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CONTENT

TOPIC 1: STATE OF AFFAIRS AND FUTURE VISIONS

01.101 - TRANSFORMATION TAXONOMY

Maarten WILLEMS*, David GIANOTTEN

Eindhoven University of Technology
Department of the Built Environment, Unit AUDE, PO Box 513, VRT 7.34
5600 MB Eindhoven, The Netherlands, m.h.p.m.willems@tue.nl

Abstract

Provoost (1995) investigated the diversity in strategies of architects' approaches of the transformation of existing buildings through new architectural designs. She distinguishes eight so-called 'rhetorical representations' in her classification. Later Plevoets & Van Cleempoel (2011) provided an overview of literature on transformation and conservation strategies from 1989 to date. The paper will elaborate these distinct taxonomy attempts using recent thesis/ graduation research and projects as best practice examples.

From February 2016 to January 2017 fifteen Dutch and International master students at the TU Eindhoven in The Netherlands participated in the thesis/ graduation studio *Transformation – from industrial site to cultural identity* led by the authors. After a profound collective research of transformation projects worldwide, each of the students selected an existing industrial site, somewhere in the world, and implemented a cultural program relevant within the selected context; resulting in the application of a wide variety of transformation strategies in their architectural designs.

The students' designs will be used to illustrate the various strategies as distilled from literature. Observations of the results will subsequently lead to a critique on transformation taxonomy and a suggestion for an alternative approach.

Keywords

Transformation strategies, taxonomy, graduation studio, conversion, best practices.

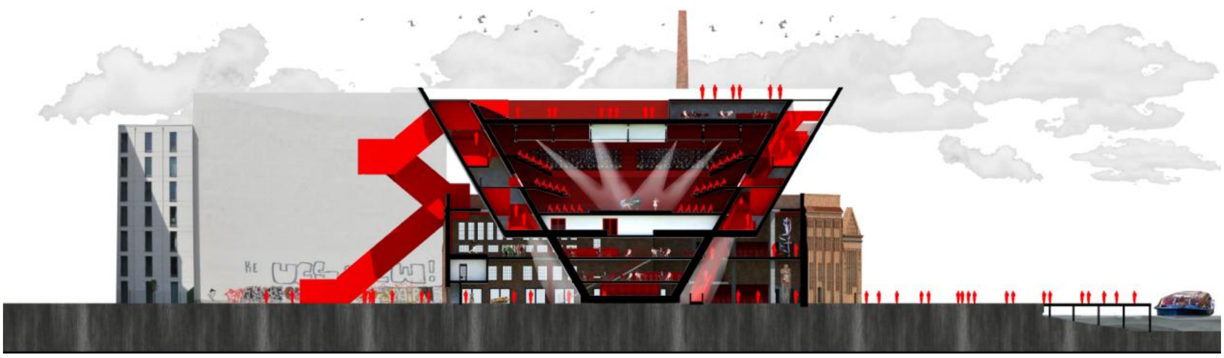


Figure 1. Transformation of the *Eisfabrik* in Berlin into a music venue by Alex van Gurp.

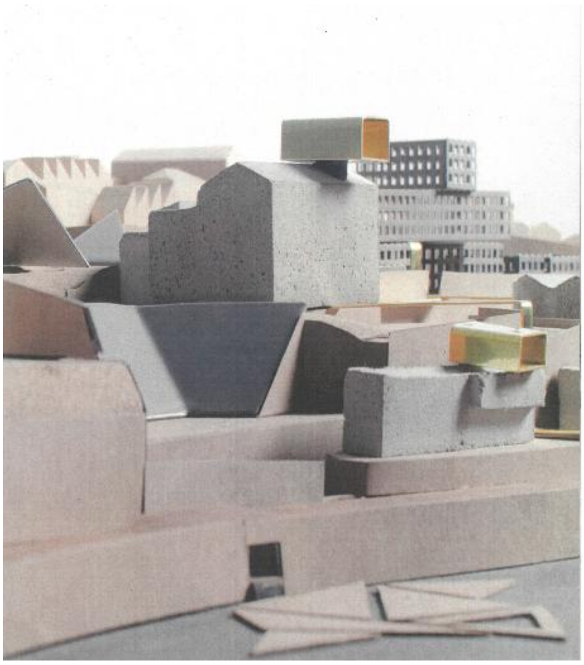
1 Introduction

From February 2016 to January 2017 the authors, together with Barbara Kuit, tutored a Masters Architecture graduation studio *Transformation – from industrial site to cultural identity* at Eindhoven University of Technology (Department of the Built Environment). The studio focused merely on the transformation of vacant or abandoned industrial buildings or complexes into new functions that would enhance the cultural identity of the city or even wider region. The eleven months duration of the graduation project was split in two parts.

The first two months were dedicated to collective research in which all fifteen students participated and which resulted in a research book. The research focussed on mapping and data collecting of both transformed and untransformed industrial sites worldwide. Over a 100 projects have been investigated and documented in photos, data, infographics and timelines.

The second part (approximately nine months) of the graduation process was an individual design assignment. Each student selected a vacant or abandoned industrial building or site to their own preference based on individually defined intended learning outcomes. Accordingly each student developed a cultural program for the building/site after transformation. Both the criteria, preferences, selected buildings and the future programs were argued by research and investigation of the context, and discussed with the tutors. This resulted in an architectural 'brief' which was the starting point for the design process.

The individual selections turned out to be surprisingly wide; in geographical location as well as typology, scale and context and were mainly based on their potential with regard to the individually intended results. (Table 1, Figure 2.)



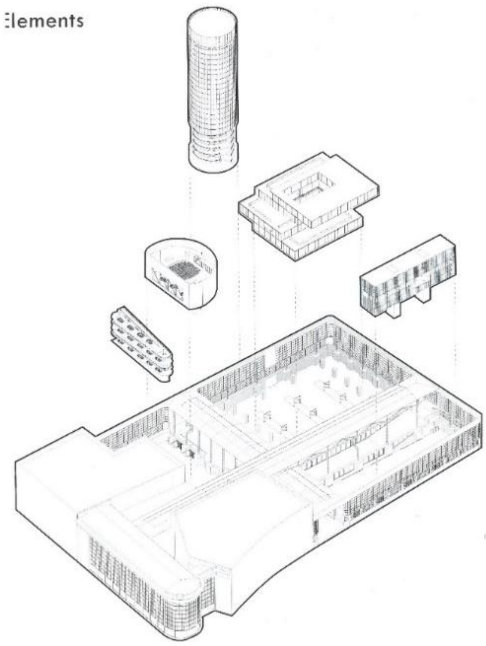


Figure 2. Two transformations of power plant sites. Left: *Central Termica do Freixo* in Porto (Portugal) into a community center by Floor van Schie. Right: transformation of the *Citroen Yser* workshop in Brussels into a future mobility center by Luuk van den Elzen, showing the inserted new elements into the existing volume.

Table 1: Studio overview showing selected locations and programs.

	Student	Site location	Previous function	Future cultural program
1	Caterina Corsi	Sao Paolo, Brazil	factory	sensorial museum/workshop
2	Marloes Dijkink	Shanghai, China	power plant	energy research
3	Luuk van den Elzen	Brussels, Belgium	car workshop	future mobility center
4	Steven Geertzen	Brooklyn, USA	grain terminal	multi-sensory experience
5	Alex van Gurp	Berlin, Germany	ice factory	music venue
6	Hratc Hovanisian	Ghent, Belgium	power plant	soccer experience
7	Marc van Kaam	Bangkok, Thailand	railway yard	cultural park
8	Lex Lagendijk	Berlin, Germany	ice factory	music campus
9	Nikki Mastenbroek	Sleaford, England	maltings	disabled sports center
10	Niels Nagtzaam	Brooklyn, USA	grain terminal	musical theatre
11	Stavriani Pournara	Bello, Colombia	train workshops	community art center
12	Magdalena Preaux	Perth, Australia	power plant	food court
13	Floor van Schie	Porto, Portugal	power plant	community center
14	Lenne van Schie	Vyborg, Russia	bakery/mill	ballet theatre / dance school
15	Erik Zonneveld	Bello, Colombia	train workshops	library

2 Transformation strategies

Back in 1995 Michelle Provoost wrote an interesting book [1] on distinctive strategic approaches architects display in architectural designs for adaptive reuse, conversion and transformation projects. It is a classification system based on the architectural relation between the existing building and the intervention. She distinguishes eight 'rhetorical representations' (Table 2); metaphors mainly that express these relations.

Table 2: The eight rhetorical representations from Provoost [1]

A	***Underground***	Underground intervention, mostly humble to the existing object.
B	***1+1=2***	Contrast juxtaposing old and new.
C	***1+1=1***	Fusion of old and new.
D	***Continuity***	Interventions based on resemblance and consistency with the existing, not on differences.
E	***Palimpsest***	Every intervention contributes to the accumulation of history but simultaneously reflects on previous interventions.
F	***Hermit crab***	Preservation of the (façade) image while hollowing out the interior for new functions.
G	***Recapitulation***	Reiteration of the original architects' design mentality without imitating.
H	***Facelift***	Reuse of the structural system of the building but altering the (façade) image.

This was one of the first comprehensive attempts trying to classify the diversity of transformation strategies. The source, Provoost [1], was not explicitly provided or brought to the attention to the studio (however some students refer to it in their thesis). All fifteen projects have been classified in retrospect by the authors. (Table 3.)

Table 3: Transformation strategies applied by students based on Table 2.

	Previous	**Applied 'rhetorical representation' from Table 2**								**Future cultural program**
		A	B	C	D	E	F	G	H	
1	factory			X		X				sensorial museum/workshop
2	power plant					X			X	energy research cent./museum
3	car workshop		X		X	X				future mobility center
4	grain terminal		X				X			multi-sensory experience
5	ice factory		X						X	music venue
6	power plant						X		X	soccer experience
7	railway yard		X							cultural park
8	ice factory	X	X				X			music campus
9	maltings					X	X	X		disabled sports center
10	grain terminal		X				X			musical theatre
11	train workshops			X					X	community art center
12	power plant						X			food court
13	power plant		X			X				community center
14	bakery/mill		X			X	X		X	ballet theatre / dance school
15	train workshops					X			X	library

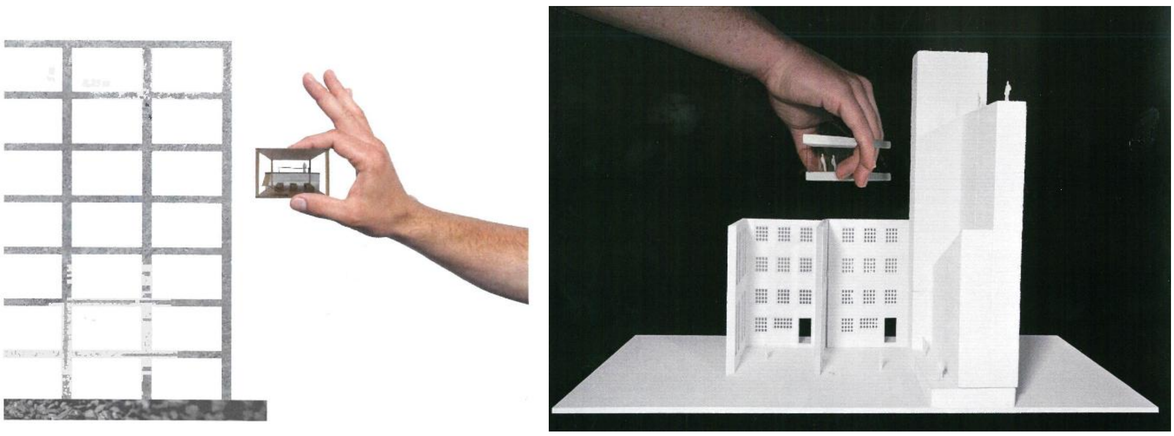


Figure 3. Transformation strategies: 'facelift' of the *Yangshupu* power plant in Shanghai by Marloes Dijkink (left) and 'hermit crab' of the *Eisfabrik* in Berlin into a music campus by Lex Lagendijk (right).

2.1 Observations

Apparently there are little conclusions to be drawn from Table 3. One reason is the fact that the population of fifteen is too small, in combination with the wide geographical scope and the liberty in selecting both previous and future programs, to draw representative conclusions. A few observations can be made though.

1. Many students don't rely on one strategy, but apply a combination or hybrid of two or more. (e.g. Figure 4)
2. The entire range of eight distinguished strategies is represented.
3. Some strategies seem less popular, relevant or appropriate.
4. There is no clear indication related to the context, the selected building or the future (cultural) program that dictates one favourable strategy.

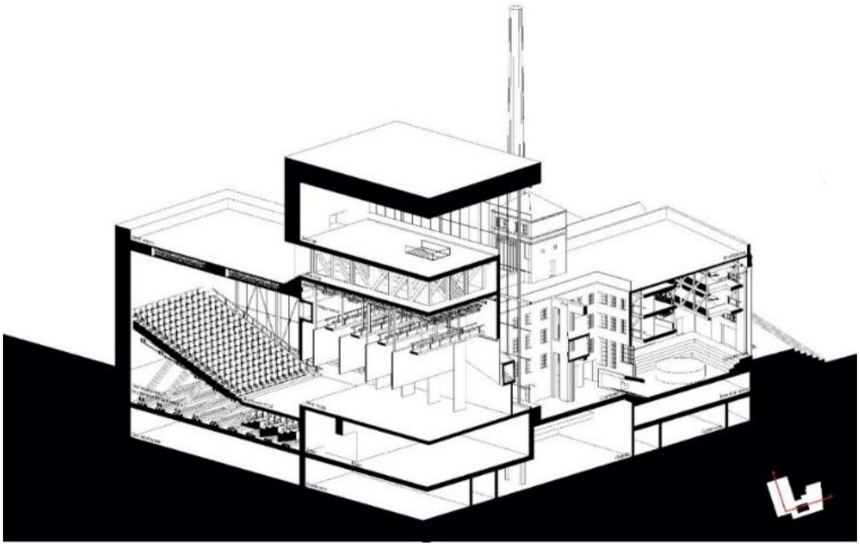


Figure 4. Left: Transformation of the *Eisfabrik* ensemble in Berlin into a music campus by Lex Lagendijk, showing a new underground part, as well as a 'hermit crab' approach (right) and a new '1+1=2' addition (middle).

Ad 1. At first sight this could probably be explained by the fact that many projects consisted of a complex of buildings rather than one singular building, where the individual buildings required a different approach. A closer look reveals however that the projects 3, 4, 10 and 12 consisted of one building but there is no significant distinction in the variety or amount of applied strategic approaches.

Ad 2. This may be due to the very wide selection of locations, previous functions and future programs. Since the variety in all these parameters is very large, an equally large variety of strategic approaches is to be expected.

Ad 3. The strategies applied most are B, E, F and H. Least applied are A, D and G. A possible explanation for this might be that students assume that their potential to express themselves originally in a spatial design differ. Building underground or continuing the existing building style or original design mentality are less attractive since they are assumed to limit the directions for creative solutions.

Ad 4. In this study, with a very limited population, there seems no apparent correlation between geographical location, previous building function or future program. The question whether it is possible to describe transformations adequately by distinct strategies seems justified.

In three cases two students selected the same building (4 and 10, 5 and 8, 11 and 15), but all adapted a different future cultural program. There are no stronger strategic similarities within those pairs than in general. The Brooklyn grain terminal is an exception as both students applied similar strategies. (Figure 5). A plausible explanation is that for this specific detached singular silo building interventions as juxtaposing (adding volumes on top and at the facades) and hollowing out are the most obvious to create usable space.

Figure 5. Two transformations of the *Red Hook* grain terminal in Brooklyn, New York: into a multi-sensory experience center by Steven Geertzen (left) and into a musical theatre by Niels Nagtzaam (right).

3 Alternative taxonomies

The size and impact of transformation projects worldwide has grown exponentially since the publication of Provoost's taxonomy attempt, so has the literature dealing with the topic of adaptive reuse. In 2011 Plevoets and Van Cleempoel published an elaborate literature overview [2]. Surprisingly enough they don't mention [1] in their list of references. Probably because it is not considered as 'international literature' (p. 157) as it was published in Dutch.

The scope of Plevoets and Van Cleempoel is wider as they do not merely consider classifications based on spatial and architectural characteristics. First of all they make a distinction between *"[…] typological, technical and architectural strategies."* ([2], p.155). For the perspective of this paper we concentrate merely on the architectural strategies. In chapter 3 of their publication, where the literature review on different approaches is provided, the word 'architectural' is, quite surprisingly and confusingly, renamed as 'strategic' in the paragraph title 3.3 (p.160).

They present a graphic overview of four main sources to show analogies as shown in Table 4.

Table 4: quoted from [2] p. 161 (References added).

Design Strategies				**Architectonic Expressions**
Robert 1989 [3]	**Brooker & Stone 2004** [4]	**Jäger 2010** [5]	**Cramer & Breitling 2007** [6]	
Building within	Insertion	Transformation	Modernisation	Correspondence
Building over		Addition	Adaptation	Unification
Building around	Intervention			
Building alongside				
Adapting to a new function		Conversion		
	Installation			Junction and delineation
Building in the style of			Replacement	
Recycling materials of vestiges			Corrective maintenance	

The interpretation of the overview is somehow ambiguous. Plevoets & van Cleempoel [2] themselves write that *"The strategies defined by the different authors in many cases overlap;[…]"* (p. 161). In fact it is very hard, if not impossible, to compare the taxonomy attempts of these four different sources as each seems to be based on a different 'taxon'; the classifying characteristic or feature.

Table 5: Table from [2] p.161 extended with the classification from [1] in the right column.

Design Strategies				**Architectonic Expressions**	
Robert 1989	**Brooker & Stone 2004**	**Jäger 2010**	**Cramer & Breitling 2007**		**Provoost 1995**
					Underground
					Hermit crab
Building within	Insertion	Transformation	Modernisation	Correspondence	Continuity
Building over		Addition	Adaptation	Unification	1+1=1
Building around	Intervention				Facelift
Building alongside					1+1=2
Adapting to a new function		Conversion			Palimpsest
	Installation			Junction and delineation	
Building in the style of			Replacement		Recapitulation
Recycling materials of vestiges			Corrective maintenanc e		

The attempt, as an exercise, to include the classification by Provoost in the table conceived by Plevoets and Van Cleempoel as shown in Table 5 is debatable, mainly because all the sources in the comparison apply their own dividing structure. The disclaimers in [2] p.161 that *"This distinction […] is not very sharp"* and that "*[…] the examples could be interpreted variously."* apply in extenso to Table 5. Also questionable is whether Provoost's 'rhetorical representations' should be considered as 'Design strategies' or 'Architectonic representations' with regard to Plevoets and Van Cleempoel's overview. Since Provoost's interest is mainly in the architectural relation between existing building and intervention, the latter option has been chosen.

4 Conclusion and recommendation

Taxonomies and classifications in general have their limitations. As a tool for comparison, communication, discussion and understanding, they can be useful though. A taxonomy for transformation, conversion or adaptive reuse of existing buildings could serve the aforementioned purposes but the authors think it is more important to look at the design process that is involved in carrying out a transformation project. Is it possible or useful to describe these complex processes with one strategy or approach? Or is a much more complex analysis that creates connections between different design decisions needed, to be able to describe the overall transformation strategy and the many different options?

It is interesting for the authors to see in which direction research related to transformation will develop. Especially as the amount of projects in this realm is growing exponentially, both in educational as well as in the professional settings, even faster than fully new construction projects. A final recommendation would be the development of an alternative way of understanding and describing the process of architectural transformations, for example the introduction of a 'matrix' that could combine strategies and design decisions.

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01.102 - ADAPTIVE REUSE OF SCHOOL BUILDINGS: THE PORTUGUESE EXPERIENCE

Teresa HEITOR

CiTUA Centre for Innovation in Territory, Urbanism and Architecture
Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 LISBON, PORTUGAL
teresa.heitor@tecnico.ulisboa.pt

Abstract

The adaptive reuse of school buildings is a complex design process that calls for non-conventional responses. It is the final result of an extensive decision-making process, which involves transposing specified educational goals and their organisational implications to existing school buildings.

The aim of this paper is to review the key themes relating to the adaptive reuse of school buildings, as opposed to taking the decision to demolish them and build new ones, by reassessing the Portuguese experiences in this area between 2007 and 2011. It seeks to explain both the design process and the strategies that were applied in adapting to the twenty-first-century educational agenda and its organisational implications, while continuing to make the most of available resources.

This paper is divided into three parts. The first part reviews the key themes involved in school building rehabilitation. The second part refers to the case study. This introduces the rationale behind the Portuguese School Building Modernisation Programme (SMP), describes the strategies applied in the design briefing process and discusses its main issues and the type of interaction and collaboration established between the principal actors during the decision-making process. Finally, a selection of five interventions in different types of school buildings is presented and assessed.

Keywords

adaptive reuse; school buildings; participative process; pilot phase; customisation.

1 INTRODUCTION: THE CHALLENGES FACING SCHOOL REHABILITATION

School building rehabilitation has been the subject of considerable attention since the end of the twentieth century. Over the last few years, in addition to the improvements noted in students' academic performance, there has been a significant increase in capital funding for school buildings, leading to the comprehensive modernisation of school facilities. This has resulted in a vast array of publications, ranging from academic papers to practical guides for construction professionals.

In addition to the potential that the rehabilitation of school buildings has demonstrated for stimulating educational excellence and competitiveness and overcoming the problems of a disruptive environment, it has also provided both direct and indirect benefits to the community as a whole, as well as to the primary investor.

Schools often have an influence on the appearance and atmosphere of the surrounding urban environment and can thus provide an anchor for social revitalisation and economic development. Besides sending out the message that education is valued, a commitment to improving school infrastructure will help to ensure a more efficient allocation of resources in the educational sector, combat the social exclusion of more vulnerable groups, and promote equal opportunities in the broadest sense (CABE, 2007).

Moreover, the adaptive reuse of school buildings will help to support healthy living, environmental awareness and social responsibility as a comprehensive, lifelong approach. The demolition and replacement of existing school buildings has a higher carbon impact, as well as increasing the material impact of the new replacement building and leading to the loss of embodied energy in the buildings that are demolished.

Despite the advantages inherent in school building rehabilitation, there are often several obstacles faced by adaptive reuse as the changes that are taking place in educational processes call into question conventional approaches to architectural design and normative construction guidance.

In many of our existing school facilities, the design approach that was adopted followed a "stationary" model. Each space or group of spaces is designed to cope with its own specific functional requirements and technical features (Blyth, A. and Worthington, J. 2010). No extra investments were made to facilitate functional or technical adaptability in the future, thus limiting the building's life expectancy. The school layout is based on a formal teacher-centred learning model, where the classroom is seen as the core unit of its spatial programming. Complementary learning spaces enabling other types of pedagogical practices and learning modes are absent and support spaces are restricted to almost the bare essentials. Such school buildings are highly resistant to adaptations designed to respond to today's educational needs, in particular their reconfiguration in order to provide the larger areas required for formal and informal learning.

Additionally, due to the age and condition of many school buildings, various building regulations and their associated legislation, as well as environmental and structural concerns, can add significant costs to a project and become a definite impediment to reuse.

Age may have led to the occurrence of building pathologies, as well as to the obsolescence or deterioration of existing building systems and materials, which need to be replaced or repaired. Building regulations and urban zoning permissions have changed since most school buildings were constructed. In particular, environmental comfort and indoor air quality standards, existing structural and mechanical systems, accessibility, fire safety regulations and means of escape frequently do not comply with current regulatory requirements. Building code compliance often involves the need to reorganise the school's internal space, install new service ducts and make changes to the circulation system or reinforce the structural system, along with other alterations.

Existing buildings and sites often have environmental issues. Structures built between the mid-1920s and the mid-1970s may contain asbestos or lead paint which must be replaced as part of the rehabilitation process. Moreover, these buildings were often designed without any goals in terms of reducing energy and maintenance costs. In order for them to be able to operate as low energy buildings, the energy performance will need to be further optimised and new systems installed, which would extend beyond the footprint of the existing buildings.

Even so, the chronological age of a school is no indicator of its construction quality. Most schools built in the first half of the twentieth century, for example, are masonry bearing structures that rely on solid walls to provide structural stability. Many were overdesigned in their load-bearing capacity by today's structural standards. Most of the older schools are easier and less costly to rehabilitate than schools built from the second half of the twentieth century onwards, when low-cost materials and less durable construction techniques were in common use.

The school building rehabilitation schedule also requires extra attention. Timelines for designing and constructing schools are often tight because the works need to be carried out in accordance with the school's activity. Apart from adopting a rigid construction-phasing model, this also implies introducing further procedures to prevent noise and other disruptions during class time and to avoid risks and hazards, which can add significant costs and increase time scales in the construction stage.

Although they may be radically different in their design, materials and systems, these schools do, however, pose similar questions and share certain common elements and responses. The challenge is how to discover their usable value and thus make an adaptive reuse project feasible. A decision is only justified when educational, technical and economic resources are jointly identified and the intended change can be carried out with the support of the school community without precipitating other conflicts. In particular, it would be pointless to rehabilitate a school building if the intervention does not take into consideration the progress that has been made in the field of education and guarantee the construction of high-quality teaching and learning environments.

2 The Portuguese experience: the context

In 2007, an increased focus on improving student outcomes, coupled with a significant increase in capital funding for school buildings, led the Portuguese government to implement a comprehensive programme for the modernisation of secondary school facilities.

In doing so, the Portuguese government was faced with three main problems in relation to the school building stock: physical deterioration; poor environmental standards; and functional inadequacy for teaching and learning. The programme was designed to optimise the use that was made of funds for improving state school facilities, bringing these up to higher standards, opening schools up to the wider community and providing for the future maintenance and conservation of the buildings thus modernised.

The programme's ultimate goal was to provide the Portuguese educational system with a new approach to the way that the community sees schools, together with academic and vocational education options and the adoption of the concept of lifelong learning. Modernisation of the physical infrastructure involved: redesigning existing facilities by reorganising their spatial layout; recovering and restoring inadequate spaces; replacing failed building systems and components; improving environmental comfort, safety, security and accessibility conditions, as well as energy efficiency and data access systems.

In 2006, Portugal adopted the European Union directives on the energy efficiency of buildings, air quality and noise certification. This programme was therefore the first major investment in the refurbishment of public buildings, which consequently had to adopt the new legislation and regulations. This included new integrated central mechanical ventilation and acclimatisation systems for classrooms, working spaces and social areas. Common guidelines were established for lighting, temperature, acoustics and mechanical equipment. All schools were equipped with wireless data access systems to enable the maximum effective use of the common space. Furthermore, new standards were developed for state-of-the-art school facilities, providing a benchmark to ensure adequacy and equity across the school system and parity within the EU.

A participative approach to planning and design was adopted, involving design professionals, educators and school users in a collaborative process of interpretation and negotiation. A comprehensive model was established to reorganise the layout of schools, which would later be customised by each design team, according to each school's educational vision and the needs of the school communities. As a result, the final solution was not a standardised one, but rather one which was discussed and approved by the school community, reflecting the educational project pursued by each school.

The programme was implemented following a phasing planning process, beginning with a pilot phase linked to four schools, each corresponding to a different school type. These pilot schemes were used to test the process for delivering the project and identifying issues with particular building types, as well as exploring innovative solutions. Interventions were made in a total of 184 schools, involving 102 teams of design professionals.

2.1 Reference situation

The school building stock under intervention is a fairly heterogeneous group in terms of building types, architectural features and quality and, as such, they mirror the changes introduced into the educational system in Portugal during the twentieth century (Heitor, T., 2008). They also express the developments that have taken place in construction technology and the technical and financial resources available to meet the requirements of the respective moment. Some date from the end of the nineteenth century but the majority were built after 1970, reflecting the period of expansion in the school network and the extension of compulsory schooling. In terms of spatial configuration, they evolved from a centralised building type with a compact configuration and a closed courtyard, to linear buildings, following a U, H, L or E shape, based on a central corridor building type. At the end of the 1960s, a standardisation strategy, based on a pavilion type, was adopted and continuously applied up to the end of the 1990s.

These schools can be grouped into three periods or phases according to when they were built: (1) from the late nineteenth century up until 1935; (2) from 1935 to 1968; (3) from 1968 onwards. The above classification makes it possible to link the respective functional programmes, architectural features and building processes, to a particular construction period, using this information to support a typified characterisation of the current condition (diagnosis) and the interventions required. In general terms, school facilities presented a picture of construction anomalies, physical deterioration and functional obsolescence, affecting their environmental comfort and conditions of use.

Fig. 1: School building types

Given the SMP's objectives, and the need for a convergence of interests and solutions, the intervention methodology focused on the development of a continuous collaborative process of interpretation and negotiation involving different key players – designers, school users and other stakeholders (e.g. local authorities, education authorities and the local community) – with a variety of skills and expertise.

2.2. The design briefing process

The interaction between the school users and the design team begins as early as the programme's development phase, thus providing exceptional conditions for the involvement of schools in defining the solutions to be put in place. Thereafter, the schools collaborate directly with the teams of designers until the Final Design is produced and approved by the school community.

The design brief was defined according to a two-stage process. The initial stage was pre-defined in accordance with the programme's rationale and sets out the general principles that should be followed in the reorganisation of all school buildings. It works as a conceptual-verbal model, called an SMP model, to be later *customised* by each design team, according to the school's particular vision, needs and features. This stage begins with a general meeting with the school boards, designed to present the SMP rationale and the school reorganisation model.

The second stage involves the use of physical analogue representations to convey design information.

2.3. The conceptual model

The key concept behind the SMP model reflects three basic principles: integration between the various functional sectors (learning and non-learning areas); guaranteed conditions for their integrated operation; and the possibility of opening up some sectors for use by the wider community during and after school times (Heitor, T., 2011).

The intention is therefore to connect the various functional areas of the school via a path ("learning street"), consisting of a succession of indoor and outdoor spaces used for different purposes and related to different formal and informal learning activities.

The SMP model includes the establishment of informal contacts between the different members of the educational community outside the classroom space and time, and the message received when walking around the school – the spatial experience – plays a key role in the learning process. It is then the role of architecture to provide new spaces that are appropriate for, and adaptable to, different situations, capable of offering users a variety of possibilities for their appropriation and exploration.

According to the SMP model, the library occupies the "core" of the school, assuming both a topological and a symbolic centrality. The message is that of a workspace providing a diversity of information sources, which is open and comfortable and where everyone is welcome, allowing for a number of uses: personal reading, multimedia access, group work. Its visibility fosters its use by the community and disseminates a new learning message by deconstructing some of the images that might still exist due to previously existing associations between the old-fashioned school library and a cathedral of knowledge. A similar logic is applied to science laboratories, art studios, ICT rooms and workshops for vocational training, all of which share a high level of visual and physical accessibility. Transparency functions here as an integrator, so that not only is the school community aware of its existence, but it may also take advantage of its presence, "see and participate in what goes on in there", thus stimulating the students' attention and interest. Visibility also becomes an important factor internally for controlling students within the school's different functional areas and externally for encouraging its use by the community and spreading the practice of learning.

The SMP model is translated into a physical analogue representation, the so-called *conceptual matrix*, designed as a *functional topology* scheme. The resulting visual representation displays a type of bubble diagram, which illustrates the "depth" of the school's layout and the relational patterns between functional sectors. Given the problem of clustering the school building's functional sectors into logical groups, the "bubbles" can be useful in creating an understandable representation of these functions and their relationships. As a complement to this, the representation of the "depth" levels specifies the spatial distance between functional sectors, thus adding the nature of the topological relations that should be present in the school's layout. In short, the matrix reflects the proper relationships and interconnections between the various elements of the programme.

The *conceptual matrix* is based on two interrelated structural rings, with five levels of depth. The first level comprises the entrance and reception areas. The second includes all the school´s management areas. Further up the segregation level is the third one, which encompasses the sports areas, social educational support areas and the adult training centre. The fourth level acts as the "core" of the school, bringing together the different informal learning spaces, such as the library, bar/students' lounge, multipurpose hall/auditorium and the staff spaces. Lastly, the fifth and most segregated level consists of the formal learning spaces, as well as the teachers' areas.

As far as the structural rings are concerned, a shallow one connects all the school spaces that are available to the community after school hours. A deeper one intertwines the teaching core with the teachers' workspaces. These two rings intersect in the informal core space.

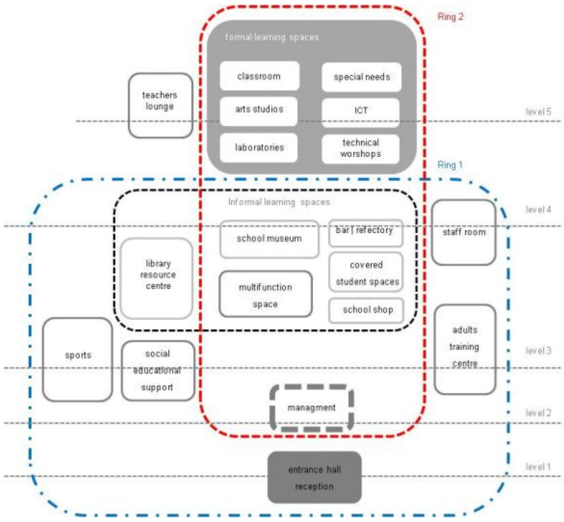

Figure 2 – The SMP's conceptual matrix

The functional hierarchy proposed by the *conceptual matrix* provides a fresh understanding of the distribution of the key functional sectors within the school universe, which are known as *Anchor Spaces*. These spaces are informal and formal learning spaces, as well as social areas, such as the library, the refectory and bar, the multipurpose hall/auditorium and the sports areas. They are organised in relation to the principal point of entry into the school, with different levels of accessibility depending on their needs for physical proximity to the exterior community.

Key spaces in the daily life of the school community, such as formal learning spaces and teachers' areas, have a deeper level of segregation, being protected against external contamination, whereas the social areas are more centrally accessible, preparing them for eventual external use by the community (Heitor, T. and J. Freire da Silva, 2009)

2.4. Customising the SMP model

The second stage of the briefing process incorporates each school's educational vision. It corresponds to the *customisation* of the SMP model.

Firstly, the school is asked to develop a strategic plan – the educational brief – prioritising the work needed to point out and tackle existing problems and to maximise the building's effectiveness over the coming years.

The "educational brief" is defined and prioritised independently of any considerations relating to physical facilities. It sets out the school's vision and educational orientation and the principles, values, goals and strategies that the school hopes to achieve. The general ideas that should be taken into account in the reorganisation of the school's spatial layout in order to accommodate the school's educational agenda and its organisational implications are also defined. Also provided are online forms to help schools make a comprehensible description of the existing facilities, identifying their limitations and disadvantages, as well as their precedence in terms of specific needs. The structure of this online document is intended to help the school to be explicit and precise about the relationships between its facilities, its organisational conditions and the requirements for the success of the rehabilitation project.

This information is further complemented by the evidence obtained both from interviews with the school's users and from walkthroughs, together with technical surveys designed to assess the facilities' physical and environmental condition and suitability.

The information from the “educational brief” is used to develop the concept design and the schedule of accommodation. The project manager then holds meetings with the school and the architects’ team so that they can begin to develop an understanding of the needs of the school for which they will be developing the design brief. Design solutions are later presented and discussed with the school community.

3 Case-studies

The following examples show the interventions planned for five schools, based on different typologies.

E1 corresponds to a school built between 1929 and 1935 in the city of Oporto, with small extensions having been added several decades ago. It is now a landmark building of recognised heritage value. This 20,000m^2 school building was opened with a basic secondary school programme and a capacity for 1,500 students aged from ten to seventeen. Some parts of the building exhibited major defects and were not operating as intended due to neglect. The science facilities and the sports and service areas were mostly obsolete. External areas were unpleasant, conveying a negative image to the community. The intervention took into account the integration of preparatory and middle-level musical education, involving the creation of a conservatory with regular educational programmes for students from the age of ten to eighteen and covering the second and third cycles of compulsory schooling, as well as post-basic secondary education. It involved a major reorganisation of the entire school’s internal space and the introduction of a number of improvements, the addition of a new block designed to house an auditorium and other specialist resource areas for the music school, as well as a covered sports ground.

E2 is another example of the adaptive reuse of a former basic secondary school in the city of Lisbon and its transformation into a mixed school combining regular education with a vocational training school geared towards the teaching of electronics. The original school opened in 1949 with a capacity for 800 students aged from ten to seventeen. The intervention involves the construction of a new wing to house science and electronics laboratories attached to the rear of the existing one, creating a new public face for the school, as well as entirely redesigning and improving the internal space, together with the addition of a covered sports ground and canteen.

E3 exemplifies the adaptive reuse of a former technical school in the city of OPorto and its transformation into a vocational secondary school geared towards artistic training and providing access to higher education. The building under refurbishment opened in 1968 as a commercial training school, preparing students aged from ten to seventeen for entry into the job market. It consists of two blocks linked by a covered passageway. The main three-storey block houses common teaching spaces in the form of isolated self-contained classrooms arranged in rows along double-loaded corridors. The canteen, as well the sports premises, are situated in the second block at the rear of the plot. In construction terms, the buildings demonstrate a high degree of robustness in spite of some deterioration of the fabric and the obsolescence of the mechanical and electrical services. Considering the curriculum of the arts school, the intervention involved the entire redesign of internal spaces and the construction of a new wing to be occupied by studios and other specialised spaces and workplaces.

E4 refers to the modernisation of a pavilion-based modular type of school in the city of Lisbon, which was opened in 1972 with a basic secondary school programme and a capacity for 1,000 students aged from twelve to seventeen. This school building type was later reproduced and/or adapted all across the country during the 1970s. The intervention will be designed for students aged from twelve to seventeen, combining vocational training with regular education. It involves the remodelling of the existing space and the construction of a new building connecting the existing pavilions, as well the remodelling of existing internal and external spaces. The new building houses the school library/ICT resource area, teachers' and students' working spaces and a multipurpose space, thus providing a new centrality in functional and physical terms.

Formal learning spaces were mostly made up of classrooms. The school library was well equipped, but physically and visually segregated. Spaces and facilities designed to support teachers' and students' work outside the classroom space and time were reduced and revealed poor conditions of use. The paths followed by teachers and students did not coincide with one another. Meetings with students and their parents or guardians were carried out in inadequate conditions. Social areas – the student common room, refectory, bar and kitchen – were placed all together in one single-storey block, which was also visually segregated within the school layout.

The existing pavilion-base layout was reorganised and converted into a compact layout by means of a new building connecting three of the existing blocks. The new building functions as the school's core. It defines the new school entrance, which is shared by all users, focuses and organises pathways, and houses the school library, the assembly hall and the teachers' work spaces and common room.

E5 corresponds to a pavilion-based modular type of construction built in the 1980s in the outskirts of the city of Lisbon and reproduced throughout the country until the 1990s. It had a capacity for about 1,000 students, aged from twelve to seventeen, combining vocational training with regular education. The school consisted of five *3x3* blocks, positioned in a disjointed manner due to the plot's uneven topography. Given this fact, two blocks were built at the ground floor level, forming segregated areas without any visual control, which were used by students to socialise during breaks. The design of each block was based on a two-storey square plan of 21.60x21.60m, within a regular grid of 7.20x7.20m, and a repeated modular partition of 50m^2, organised around a central staircase. These modular spaces were used both as learning areas – classrooms, laboratories or workshops – and non-learning areas, such as the school library, administrative sector and teachers' spaces. The existing pavilion-base layout was reorganised and converted into a compact layout by means of a new building connecting two of the existing blocks, with a canopy connecting the remaining ones. The new building also functions as the school's core and houses the school library, the administrative sector, the assembly hall and the food hall, as well as all the school spaces available to the community after school hours, except for the sports area. The canopy connects all the remaining pavilions, giving access to the learning spaces. It defines a multipurpose covered space, immediately accessible from the main entrance, sharing high levels of topological and symbolic centrality.

4 Conclusion

The programme benefited from a favourable set of circumstances, which also determined its format. The combination of the government's political determination, the availability of funding and a climate that encouraged public investment in educational facilities allowed for a significant investment to be made.

The wide range of solutions that were found and used made it possible to develop a significant body of knowledge about how these various proposals differed in their educational, economic and environmental performance. This provides us with valuable evidence about possible (successful and unsuccessful) outcomes, which will certainly contribute towards the design of innovative and high-quality school buildings in the future.

The experience also makes it possible to evaluate design and technical solutions by ranking them in order of their priority after all the relevant information has been gathered. Some useful advice can be drawn from this experience.

Firstly, school building rehabilitation calls for an effective use of resources and cost control, in other words, it demands highly efficient design solutions that follow the criteria of suitability, robustness and cost effectiveness. Deciding which solutions to apply in each case requires an assessment of their consequences, so that different options can be compared.

Secondly, a collaborative and integrative design approach based on an iterative briefing process should work simultaneously as both a planning and a learning cycle. This approach involves a systematic evaluation and feedback methodology that ensures the validation and correction of procedures and solutions focusing on all the stages of the design process. Thus, it is fundamental to implement a continuous review of the processes and the establishment of effective post-occupancy evaluation procedures that can feed back into the manuals useful information obtained from users, designers and specialist curriculum consultants, as well as the lessons obtained from completed school projects.

Thirdly, it is important to make the process of transition from the building's construction phase into its actual use as smooth and gradual as possible. Often school users are left on their own, having to manage what can be complex systems, whether these are mechanical tools or equipment, or, even more simply, being left to work out how they might rearrange the furniture in order to make best use of the spaces. Providing guidance to school occupants, as well as short-term training and workshops regarding the interaction with the building and new equipment before the move-in, is therefore important for minimising negative impacts and enhancing the efficiency and sustainability of buildings.

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01.103 - VISIONS FOR A SUSTAINABLE FUTURE METROPOLIS: A DESIGN RESEARCH LABORATORY

Dr. Rebeka Vital

SHENKAR. Design. Engineering. Arts.
12 Anna Frank str., Ramat Gan, Israel; rebekavital@gmail.com

Abstract

This paper aims present a design research laboratory that focuses on architecture, urbanity and the way of life in the future metropolis. This academic laboratory project is discussed as a pedagogical framework and presents a teaching methodology that sets up a studio-like setting, which allows students, future planners and other impactful practitioners of architecture and urban planning, to explore current environmental, urban and architectural issues as they can relate to the sustainable future of our cities. Rather than focusing on the building and the urban fabric, the studio places its focus on people and their way of life. To create visions of a utopic way of life in the future metropolis, we first have to form comprehensive approaches on how this vision can be fulfilled, with the tools of planning, the technology and the knowledge for intervention in existing environments that we have today. The studio works with the timeline of 'past future', looking to maintain life qualities of the past, while dealing with the challenges of the future, all in aim of sustainable living. Several case-studies will be presented to demonstrate the outcomes.

Keywords

Sustainability, urban planning, future metropolis

1 INTRODUCTION

Sustainability is a way of life. Often, in the architectural and urban planning discourse, when discussing sustainability, we focus on topics like the technological advancements for clean energy, on the innovative building materials, on the square meters of public areas, on the efficiency of public transportation and other. All these topics are related to creating a smart city. However, 'smart' and 'healthy' do not necessarily resonate, when it comes to our future cities. In search of a healthy way of living we need to include many other topics of sociological and psychological nature. When envisioning the way of life in a large metropolitan area in 50 years and consider the environmental challenges of today, we can be faced with quite a dystopic picture.

However, if we look at our urban environments as a conglomeration of historical layers that brought the city to its current state, we can identify the values of the past worth preserving for the future generations. The Historical Urban Landscapes approach (HUL) encourages planner to value the tangible and intangible urban heritage and take them as a factor in the planning of the future city [1]. Once values of the past are coupled with technological advances of today, they can lead to the creation of innovative environments and urban renewal.

2 Exploration of Environmental Aspects for the Future City

Having as a starting point the built urban environment in Tel Aviv - Israel, the studio sets up a platform to explore questions of how we preserve existing urban and architectural environments, while retrofitting them and adapting them to the needs of our present and future society. All students as a group analysed current environmental challenges of the ever-growing metropolis and the implication of this growth on quality of life and on the structure and interactions of local communities. In addition, the studio investigates the transformation that the digital revolution has created over the past few decades. At the same time the students were asked, based on their analysis of the past and the present, to extrapolate a vision for the future metropolis. Acting within that vision of the future, the students proposed design interventions that can lead to sustainable living.

2.1 The didactic process

The starting point of the studio was the past: the planning of the city of Tel Aviv. Students studied Patrick Geddes: an innovative thinker, town planner, sociologist and geographer, who sought to consider “primary human needs” [2]. They analysed his proposal for a master plan of Tel Aviv in 1925-1929 and examined his vision for a future sustainable living in this city, based on the condition, advancements and challenges of his industrialized society [3,4]. At the same time, major economic and political events in the area led to the development of the north part of the city and the Levantine Fair of 1934.

Looking back to the past, to the environmental and social challenges of that period and analysing the vision for their future, which is today our present, allowed the students to get into the mind set of mapping the environmental and social challenges of today [5] and creating a vision for our future. The rapid urban change and the growing role of digital technologies nowadays, sets us, designers and planners, in front of both environmental and social challenges that need to be addressed urgently.

2.2 The Historical Urban Landscape approach

The city is a dynamic entity, subject to constant change from economic and social forces, cultural and global influences, and decision making about planning that come from the level of the state to the municipality to the people. The urban condition at any given time is the outcome of these complex forces and accumulation of historical layers. The HUL approach was adopted by UNESCO in 2011 and has been a recommendation ever since as a planning attitude towards historical cities.

This approach looks beyond the preservation of the physical urban environment and gives attention to the environment and the way of life within it, identifying both tangible and intangible qualities. Aspects taken into consideration include the built environment, socio-economic composition, intangible heritage and cultural factors, local communal values and other [6]. This approach aims to avoid stagnation in the city with strict preservation rules that don’t allow growth and development, but rather to create a fertile ground for urban renewal and retrofit.

2.3 The Studio Outcomes

The impact on the current generation of students is ensuring their readiness to the ever changing and challenging world. A world of dwindling resources, population growth, global warming, economic pressures and political systems that may or may not be sympathetic to our current reality.

To address contemporary challenges of urban growth, student projects took various directions: from an urban scale to an architectural scale; some exploring how digital tools can contribute to sustainable living, while others looked at advancements in architectural and construction technologies and how these can create adaptive sustainable environments. Issues that were addressed through the projects included urban growth and development, density, maximizing public and private green spaces, re-use of materials and dynamic, adaptive architecture. Projects aimed not only for a sustainable city, defined by the life-cycle assessment [7] of its environment and activities, but for a sustainable living that focuses on the individual’s well-being.

One of the projects proposed a new conservation methodology that will allow not only to preserve the individual value of a specific structure that is identified “under preservation”, but rather its significance as part of a number of structures of the same time period and as part of the story of the city during its time, even if the rest of the urban fabric has changed beyond recognition. By applying principles of “gestalt” [8], it is possible to transmit sensory stimuli to the human consciousness, in order to create a comprehensive experience: a city that can evolve and grow and the same time contain an authentic and unique meaning that preserves its character and distinguishes its local identity and history.

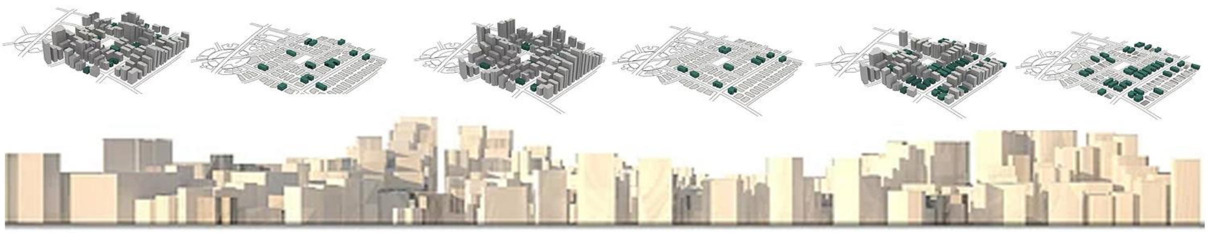

Figure 2. Parametric Urban Planning methodology that allows for resilient conservation of existing heritage structures and urban growth in Tel Aviv, Israel.

The project proposes to define the structures “under preservation” within the urban fabric by their historical, architectural, aesthetic value and by the proximity and visual connection of each structure to another one that is defined “under preservation”. That would allow the pedestrian that experiences the city to connect these ‘dots’, in our case the preserved buildings, to a broader image of the city during another time period. At the same time, the project proposes to allow growth and development of the structures that surround the preserved building but at the same time creates restrictions of height the closer the new structure is located to the preserved structure, while transferring the building rights of close-by new buildings to structures further away. Such a solution gives an economic model that will give incentives to developers to retrofit and conserve buildings under preservation.

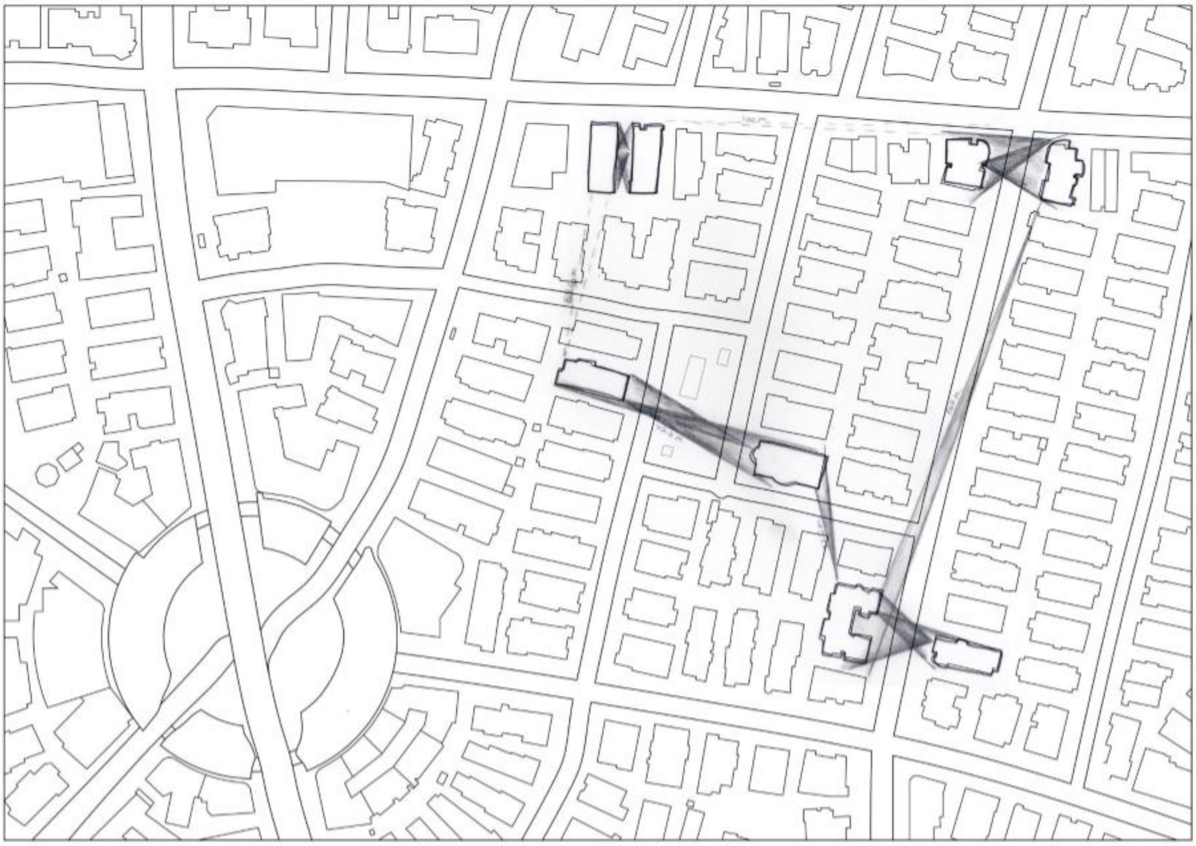

Figure 2. Selection of structures for preservation in the centre of Tel Aviv, based on their unique urban situation and their visual connection.

Another project identified that the urban lifestyle in today's megalopolis has become more isolated, introverted and competitive. It focused on addressing this issue by creating sustainable public areas that would encourage socializing and interaction. Referencing to the values presented by Patrick Geddes in his "Garden City" [4] the project proposes to utilize under-used private spaces for public areas, such as rooftops. The proposal suggests a dynamic live bamboo scaffolding construction that attaches on buildings and creates spaces for recreation, socializing and rest. The construction will be from renewable material, will integrate planting and will be run by solar energy.

Figure 3. Example of bamboo scaffolding construction on rooftop of existing building to create new public areas.

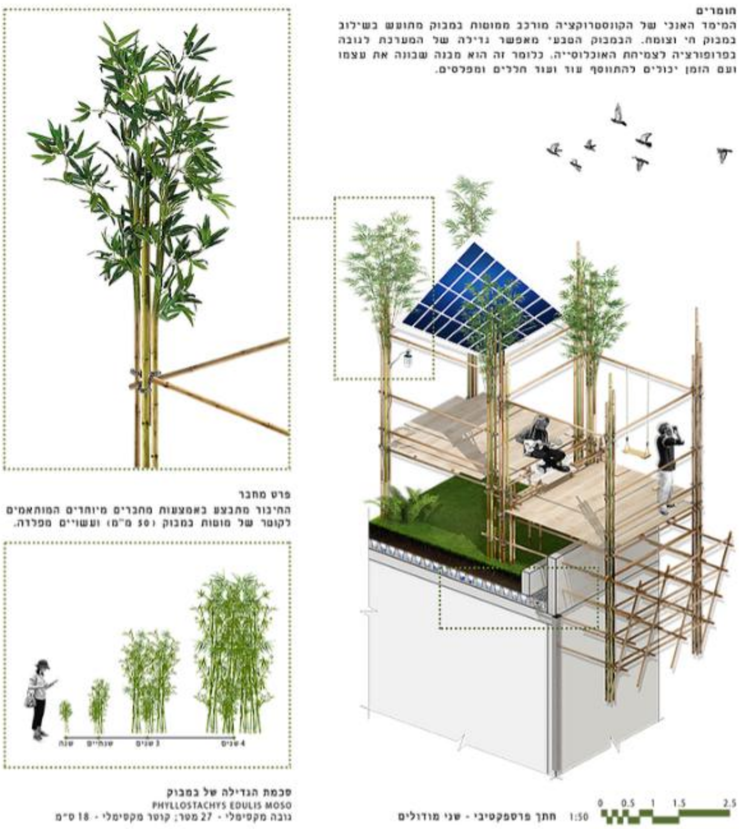

Figure 4. Renewable materials, planting and renewable energy on rooftop additions.

A similar proposal that aims to create new communal spaces for social interactions looked at how to utilize unused areas on the ground, between buildings. City planner Patrick Geddes in his urban planning proposal for the city of Tel Aviv in the 1920s [4], attributed value to the intermediate spaces between buildings that would allow 'breathing space' and green areas in what he predicted would be a dense urban fabric. However, such spaces have been neglected and deteriorated with the years, getting into a state of overgrowth and devoid of functional use. The proposal identifies such in-between spaces and recognizes them as an opportunity for urban renewal, bringing urban agriculture and common recreational areas for the residents of the buildings that surround them. The aim is dual: to create a common semi-public space and to set common aims for the neighbors through the responsibility of urban agriculture.

Figure 5. Example of in-between spaces in current state and intervention proposal.

Figure 6. Relation of built urban fabric to intervention in in-between spaces.

During the research on the topics of how the past of cities is connected to their future, some students questioned the very term of preservation and its value in today's society. When historic buildings turn into commercial stores and historic squares turn into parking lots, is preservation managing to perpetuate the values of these structures? Is the physical structure still necessary to preserve the story of the place in our collective memory?

One of the projects took one of the pavilions of the Levantine International Fair of 1934 as its case-study and examined alternatives to physical preservation that can one the one hand keep the story of the structure in our collective memory but at the same time address the ever-changing needs to today's society. Juxtaposing the terms 'preservation' and 'temporality', which initially seemed contradicting, the project manages to integrate them in with an innovative design solution: Preserving the outline of the buildings connotates the initial form and function of the structure and the relationship between neighboring structures, while the building within the envelope of the outline is a dynamic modular structure that can be changed according to the required function.

Figure 7. Belgian Pavilion in the Levantine Fair of 1934 in Tel Aviv – archival picture and framed outline of the building.

Figure 8. Permanent building frame with changeable layout within the building envelope.

3 Conclusions

Rather than building a design studio that focuses subject topics that relate to sustainable architecture, preservation and urban planning, this studio created a laboratory-like platform that allowed students to explore and test their visions of a sustainable future. Connecting values of the city's past to its future, allowed heritage to become a catalyst for urban development and growth. The proposal went beyond restoration and explored innovative ways to use past values and to bring urban renewal and social change. Sharing our approach will allow us to scale our effort and impact in the field of sustainability, preservation, conservation and urban planning. It is important that teaching methodologies are shared, scrutinized and possibly reused in other parts of the world.

Acknowledgements

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01.104 - INFO DESERTS: RECONCEPTUALIZING THE ROLE AND SPATIALIZATION OF THE PUBLIC LIBRARY

Nelson, A, Beorkrem, C. and Ellinger, J.

UNC Charlotte
School of Architecture, 9201 University City Blvd. Charlotte, NC, USA.
cbeorkrem@uncc.edu, jefferson@uncc.edu

Abstract

Meeting the needs of those who are homeless and those who have mental health issues has become increasingly more at the core of public libraries operations. With an estimated 610,042 people in the United States currently experiencing homelessness (Urban Ministry Center, 2017), public libraries across the country have been evolving their methods to offer the appropriate kind of services for this population, while still meeting the needs of typical patrons.

Meanwhile, the Internet of Things (IoT) is becoming ever more integrated into cities across the United States and access to the internet has become a vital element in sustaining one's life. "The Digital Divide" coined in 1995 just a few years after the creation of the World Wide Web, shows severe racial, economic, and location-based gaps in access to the internet. Of all American workers in 2015, 51 percent made less than $30,000 a year and 38 percent made less than $20,000 a year (OACT, 2017). At these income levels, expenses, like the internet, are often cut for healthcare or food. These low-income individuals often do not live within convenient location to a library, which is often the only place where they have access to the internet. This paper will outline how we might define zones in our cities, which are inhabited by those who cannot afford a connection and whom do not have proxemic access to a library, defined here as an *Info Desert*. This research argues for reimagining the library's role in the city to expand democratic access to information.

An Info Desert, like a Food Desert, is a region that is deprived of an essential resource, in this case it's the access to digital information instead of fresh foods. These areas are located in neighborhoods with low income levels resulting in a lack of internet access in the household, and also located more than a one-mile distance (20-minute walk) to a public library. When mapping the overlay of income levels and internet access data, the range of access to digital information becomes clearly visible. We are then able to recognize the Digital Divide in this region and outline the areas that are at the most extreme ends of the spectrum.

To respond to the propensity of Info Deserts across American Cities, and to the new-found desire for cities to invest in smart city infrastructure, this paper proposes the development of LibLabs — a multi-scale library lab with a virtual library, personal computing (PC) interface for individualized and distributed access to resources, information, and other services typically provided at public libraries.

Keywords:

Smart Cities, Homelessness, Library Design Introduction

1 INTRODUCTION

With efforts to integrate the Internet of Thing (IoT) into our urban infrastructure, Smart City concepts have the potential to create huge data sources for us to better understand how we use our cities, but can also provide a new infrastructure for those who are less fortunate. The Digital Divide, which was coined in 1995 by the Los Angeles Times and analyzed shortly after by the Department of Commerce, showed "stark racial, economic, and geographic gaps between those who could get online and those who could not" (New York Times, 2017). With a more integrated and connected system which benefits from collecting data and distributing it for an enhanced built environment and quality of life.

2 BACKGROUND

With an estimated 610,042 people in the United States currently experiencing homelessness (Urban Ministry Center, 2017), state and localized efforts have played a critical role in providing and sustaining shelters and other facilities for this population. Sadly, there are still many who are forced to wander the streets due to the different hours of operations at shelters and the lack of beds available. Some individuals also find it hard to maintain a life at shelters due to addiction problems and other mental health issues. As a result, public libraries have become a common destination "for people who have nowhere else to go" and are in search of daytime activities and shelter.

2.1 Libraries and the Homeless

Roughly 50 percent of patrons at the library are those who are experiencing homelessness (Figure 1). Meeting the needs of this population has become increasingly more integrated into the operational protocols for public libraries across the country.

Figure 1. Images displaying scenes at public libraries across the country

2.2 Services Provided by the Library

The services and support provided by libraries is continually evolving to better suit its patrons as well as it's willingness to embrace, perhaps, its most critical role — as a daytime shelter and information access point for many who are without. While efforts are in place to respond to this need, a physical reconceptualization of the role of public libraries' in the city must take place, to respond in kind. As more and more cities employ 'smart city' concepts to integrate technology and wireless internet access throughout community spaces, the public library can use this move towards more connectivity as an opportunity to expand the resources it provides. Instead of building brick and mortar libraries with an expense of often 100 million dollars (for large central libraries) or more, planners might challenge the distribution of devices to increase access in areas in the community which are often overlooked. Library interaction at many dispersed locations which don't always require a need for librarians and staff, but rather to provide a basic need to quickly access information and/or shelter in a much smaller more adaptable scale.

Figure 2. Public Library Amenities

2.3 "The Digital Divide"

"Today high-speed broadband is not a luxury, it's a necessity," said President Obama on January 14, 2015. The Obama Administration worked hard to extend broadband across the United Stated through several initiatives. They also worked with cities and broadband companies to map the income levels and percentage of households who have access to internet in neighborhoods across the United States. The maps that followed, showed clear links between income and the access to internet, which the administration titled, "Mapping the Digital Divide" (United States Government Archives, 2015). In order to better understand these factors, I mapped the Digital Divide in a local county (Figure 3).

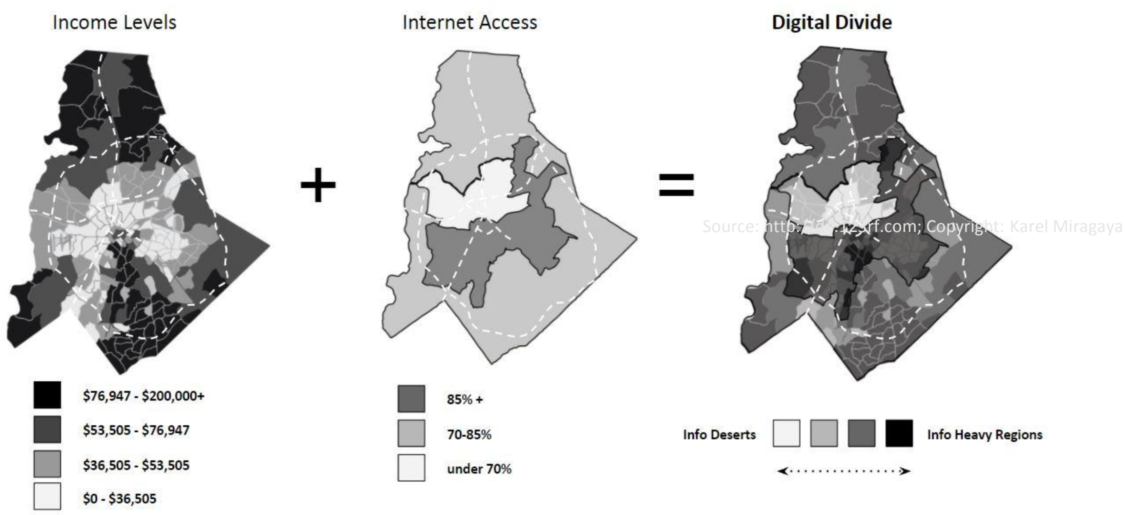

Figure 3. Mapping the Digital Divide- Light colours represent the deprived regions.

3 Research + Methods

3.1 Smart City Plan, Up Close

The county of Mecklenburg for which I mapped the Digital Divide, is developing a new "North End Smart District" to grow what they envision as an "Applied Innovation Corridor" to spur business development and growth along a new mass transit route. This same neighborhood is home to shelters, interim housing options, services, and soup kitchens for those experiencing homelessness. These county services are vital to this population, but as the city looks to create 'smart city' plans as a way to spur economic growth in the area, they risk creating only long term gentrification effects, rather than using new technologies as a way to bridge economic gaps.

3.2 Mapping "Info Deserts"

An Info Desert, like a Food Desert, is a region that is deprived of an essential resource, in this case it's the access to digital information instead of fresh foods. These areas are located in neighborhoods with low income levels resulting in a lack of internet access in the household, and also located more than a one mile distance (20 minute walk) to a public library. When mapping the overlay of income levels and internet access data in this county, the range of access to digital information becomes clearly visible. We are then able to recognize the Digital Divide in this region and outline the areas that are at the most extreme ends of the spectrum. The largest info desert in this county can be found in the North End. (Figure 4) This info desert is where the primary plans for the "North End Smart District" are established.

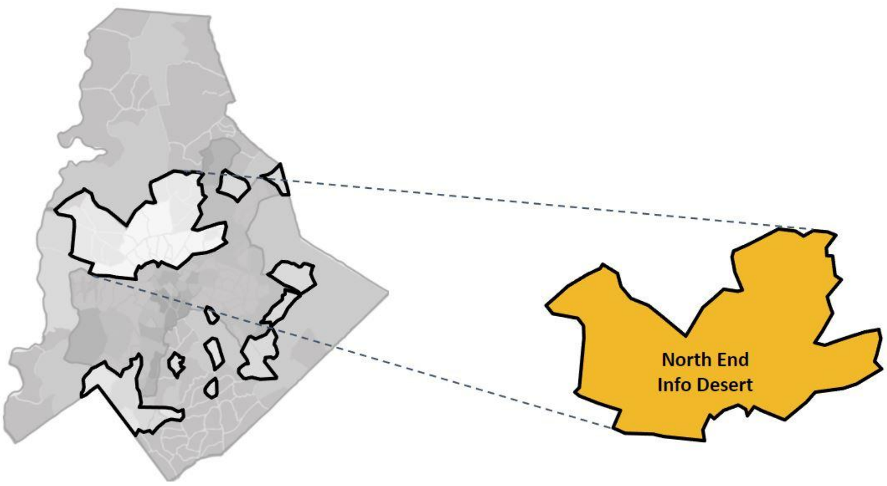

Figure 4. Locating Info Deserts

3.3 LibLabs // Your Virtual Library PC

To respond to the propensity of Info Deserts across American Cities, and to the new found desire for cities to invest in smart city infrastructure, this paper proposes the development of LibLabs — a multi-scale library lab with a virtual library, personal computing (PC) interface for individualized and distributed access to resources, information, and other services typically provided at public libraries. The LibLab Interface is a personalized virtual desktop that allows you to access digital resources directly from the Public Library as though it was your own computer traveling with you throughout the city, wherever you login. LibLabs could be integrated into existing infrastructure or newly designed and installed throughout cities. LibLabs would provide free wifi access and charging as well as interfaces in many locations, including parks, transit stops, homeless shelters, and even brick and mortar libraries to provide a more personalized experience at libraries. These LibLabs in all their forms wouldn't rely on permanent connections and could be moved in response to continual analysis of their use, adapting to changing demographics and population flows.

3.4 LibLab Interface

The LibLab interface is designed as a personalized dashboard that provides a user-focused layout to cater to the individual user. The dashboard is divided into three main areas: the two outer columns are for personalized buttons that continually update to a user needs, while the middle section is meant for a direct search through the libraries resources and content. (Figure 5)

3.5 Figure 5. LibLab Interface Design

The column on the left features a personalized tab, contact buttons, and upcoming events from your calendar. This area can display a photo and name of the user as well as a personalized welcome greeting, so the user instantly feels as though they are being connected with. There are also two contact buttons, one that allow for a user to quickly call an emergency contact and another that calls a librarian for assistance. The librarian call button prompts you to a screen which offers an option to quickly chat, Skype, or share your screen with a librarian from a nearby branch for assistance with using the LibLab interface. The calendar events shown on the interface would be ones that are specific to that day and would display information about the event, as well as how far the user currently is from the event's location. If the user clicks on a specific event, they will be sent to a screen that offers directions and transit options. (Figure 6)

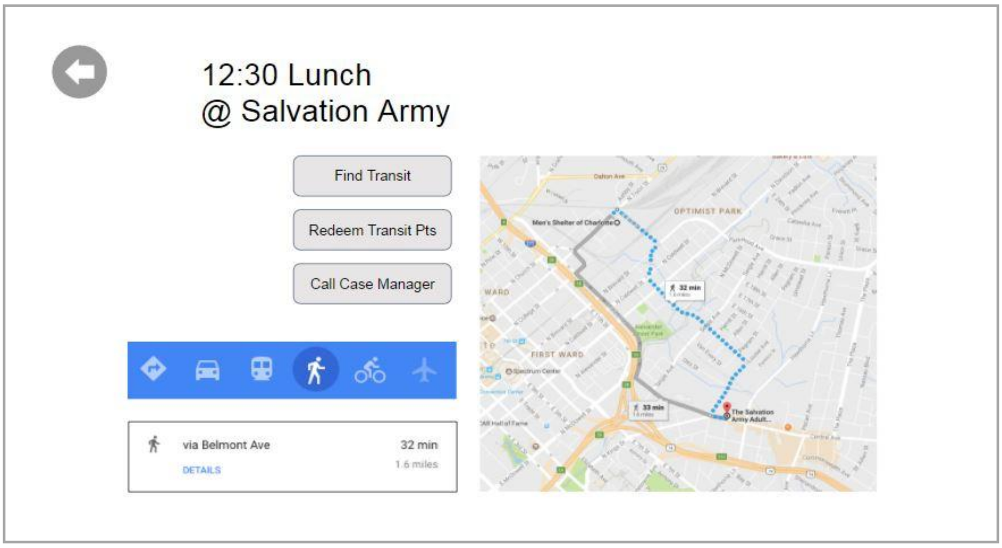

Figure 6. LibLab Interface Design

The middle section of the dashboard offers easy navigation to e-books, music, and other media from the county's public library resource database. These resources also include a simplified, but elaborate job help button that leads to local job portals and postings as well as resume templates and help information. There is also a search engine that shows everything from events to book availability at different library branches.

Lastly, the right column hosts application, icons, and a settings buttons to allow users to customize their LibLab interface. Online storage will be available here for users to keep their documents. In this same column, there are buttons that allow the user to continue with previously started projects, such as a resume or other document. Finally, there are notifications from online chats linked to a user's email address that can help keep them connected to their friends and family as well as the larger community. For those experiencing homelessness, this is a great place for the shelter to touch base with guests.

3.6 Locating LibLabs

After looking at the Digital Divide in the county and locating the "North End Info Desert", imposing a square mile grid and a map of the population density. based on this map, if there were 1,500 people per square mile one could presume from the data that 30% of people in that region have no access to internet, and that ~450 people in that zone are without access to information. In these locations, categorized as "Info Deserts", a ratio of 1 LibLab per 10 people without access, would be deployed, for this example 45 LibLabs could be deployed in that particular region. (Figure 7) Once the amount of LibLabs has been established, an overlay of the city infrastructure (parks, transit stops, and shelters) in that zone would map potential locations.

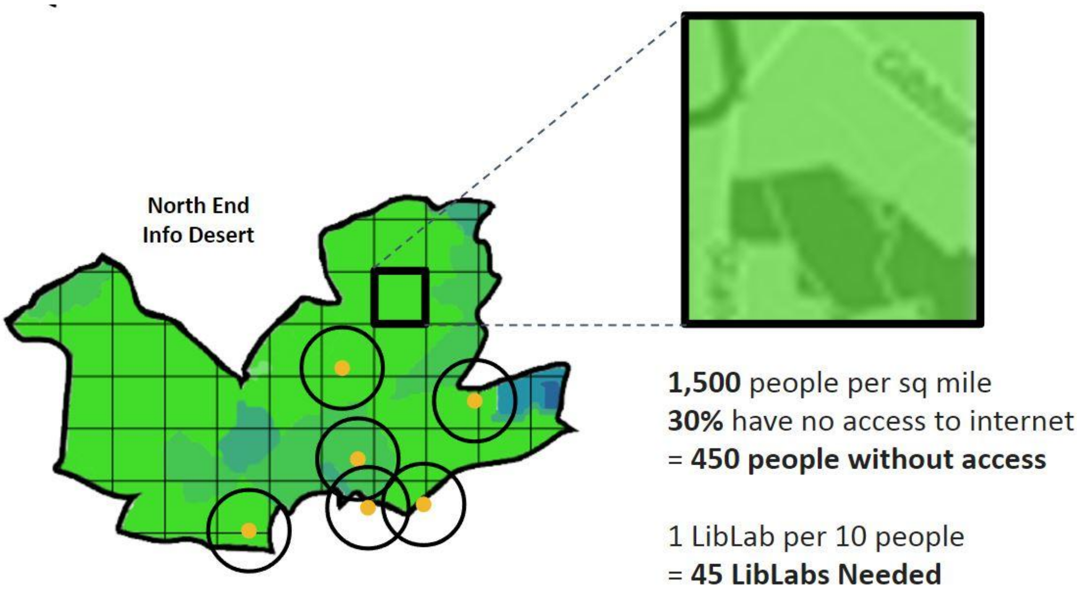

Figure 7. Mapping Population Density and Library Locations to help locate LibLab

3.7 Envisioning Multi-Scalar LibLabs

LibLabs would be deployed at three different scales to allow for flexibility in various locations and would be accessible by simply using a library card or library login number. The largest scale LibLab is the Enclosed Pod (Figure 8), which would provide shelter from the elements and offer desks for people to spend longer periods of time. The enclosed pod would best be situated into a public park, where there are likely to be other users and a quiet setting. The next scale of LibLab would be the "PC Redbox", which similar to a Redbox, allows users to rent a laptop or tablet for a period of time. (Figure 9) This would be great for users who do not own a device or simply don't have theirs with them. Lastly, an Urban Furniture LibLab could be designed as a way for users to quickly grab information they need while they are on the go. (Figure 10)

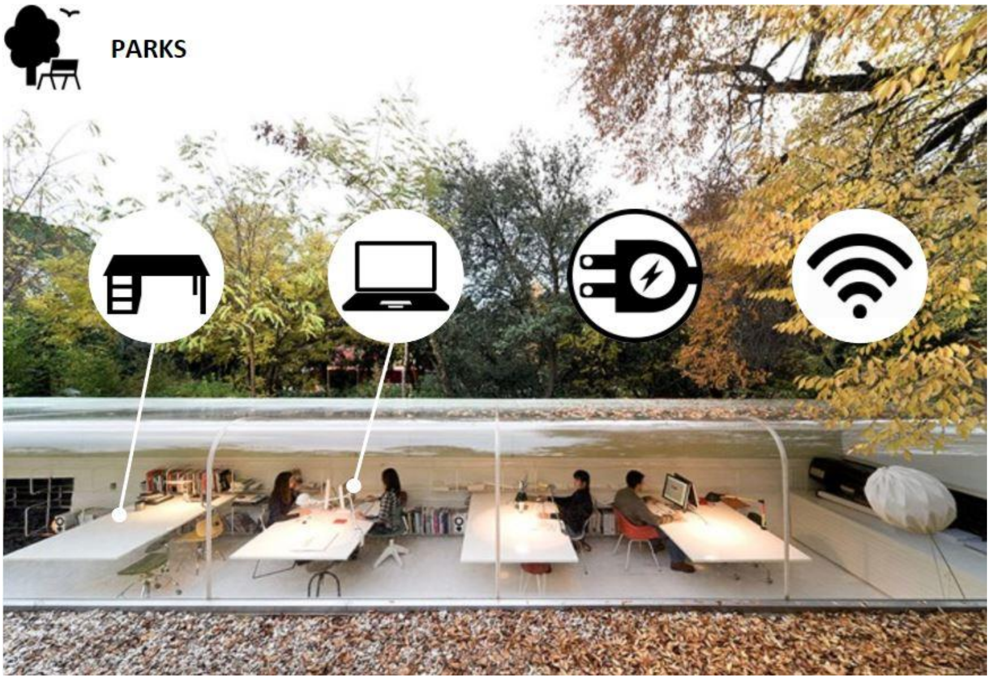

Figure 8. LibLab - Enclosed Pod

Figure 9. LibLab - PC "Redbox"

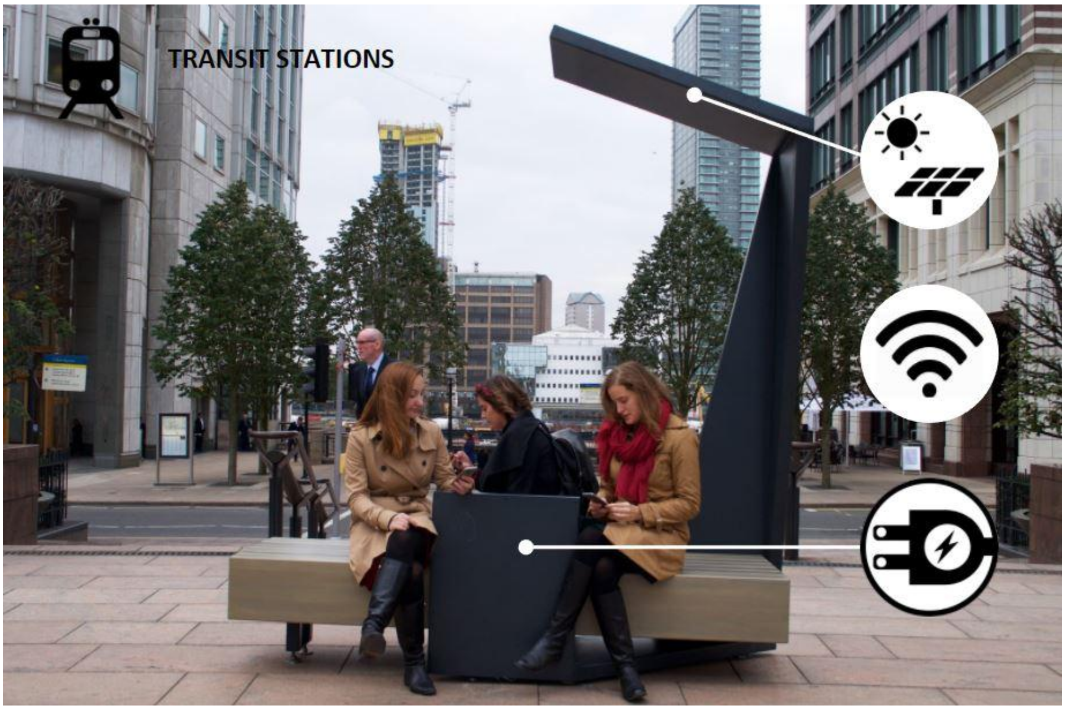

Figure 10. LibLab - Urban Furniture

4 Results

All members of local shelters will be provided with a library card and will be given an introduction and training on how to use the LibLab interface. The ease of use and access to these virtual library personal computers could have great influence on communities and could help to reimagine the role of the public library in the 21st Century.

When you consider all of the advantages of LibLabs and how low the associated costs are, the potentials of this system become very clear. In the county of Mecklenburg they are proposing to build a new public library, with an estimated cost of $93 million. 930 of the most expensive LibLabs, costing $100,000 each for the Enclosed Pods, could be integrated into the larger community for the same price as this one new library is being budgeted. (Figure 11) This forces us to question if brick and mortar libraries should always be the answer, or if in the 21st century, a new more adaptable public library can be designed to provide meaningful and accessible information resources for its less fortunate citizens.

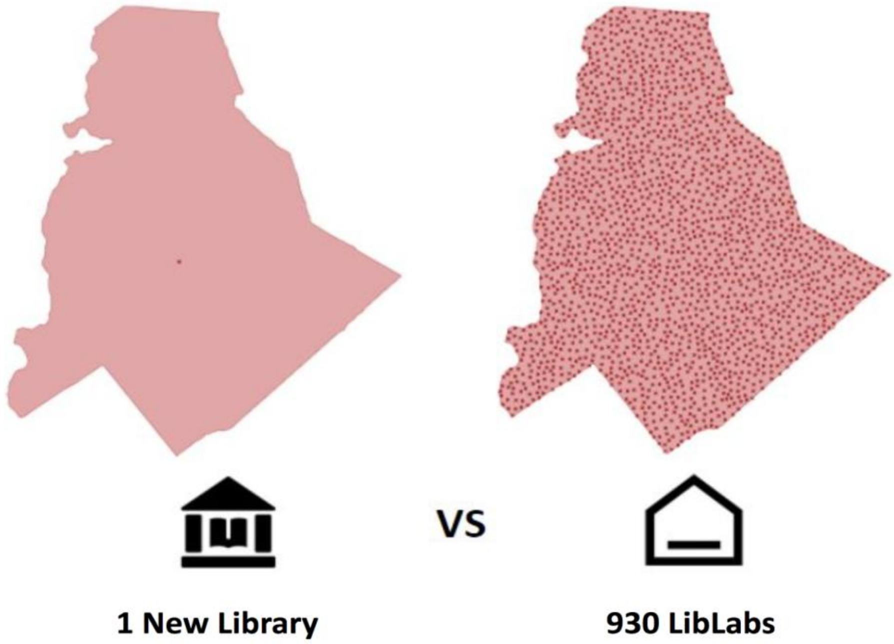

Figure 11. Comparison showing the potentials of a $93 million budget

5 Conclusion

As more and more cities take on smart city concepts to integrate technology and wireless internet access throughout community spaces, the public library must grab hold of the opportunity to extend its resources to this broader audience; and in so doing, libraries will become a leading force in the efforts to democratize the access of digital information to all. When looking at the costs associated with brick and mortar libraries, one becomes confident that extending the library beyond its walls is both critical to communities and simply practical. As this project moves forward, the design and implementation of the LibLab interface will be tested with real users in various locations to test users from multiple income levels and neighborhoods. As an interconnected lifestyle begins to change our economy, our jobs, and our social lives, we must consider how the absence of a connection creates a larger economic gap for those who remain unconnected.

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01.105 - Some Thoughts on Seat-Dip in Auditoria

Ramani Ramakrishnan*, and Romain Dumoulin

Department of Architectural Science, Ryerson University
350 Victoria Street, Toronto, ON, Canada M5B 2K3; rramakri@ryerson.ca

Abstract

In concert halls, depending on the configuration, sound can pass at grazing incidence over the audience seats. In the event, selective attenuation at low frequencies ensues, called seat dip. Seat dip was studied extensively over the past 50 years or more. Transmission response due to seat dip can have a dip of up to 10 or 20 dB in magnitude in the frequency range between about 100 and 300 Hz. Measurement results, in real halls and scale models, show dip in the propagation at a frequency where the seat backs are 1/4 wavelength high. The effect was found to be present both with and with-out the audience, and a number of geometrical parameters were found to influence measurements. The importance of the seat dip attenuation on the sound from a musical instrument was determined by measuring sound levels from a string bass. The influence of the seat dip attenuation was determined from sound-level measurements of the string bass sounds at two different heights above the floor for a central main floor seat. The average results for these two octaves show an increase of 6 dB at 125 Hz and close to 3 dB at 250 and 500 Hz. For this situation, the seat dip attenuation has a very significant effect on the overall sound levels from the musical instrument. Most of frequencies where seat dip predominates covers the principle range of cellos, violas, trombones, bassoons, and the bass and baritone voices. One of the questions to be answered deals with the impact of seat dips during performances. A newly opened concert hall in Chennai, India exhibited strong seat dips. However, two inaugural concerts were well received by the artistes and the audience, in spite of the seat dips. The measurement results and subjective responses will be presented in this paper to answer salient questions about seat dips.

Keywords

Concert hall performance, Seat dip, Low Frequency, sound level variation

1 INTRODUCTION

Sound from the stage of concert halls, depending on the configuration between the stage and the audience, can pass at grazing angles over the first few rows of seats. In such situations, sound attenuates at low frequencies over the first rows of seats. The resulting phenomenon is termed 'Seat-Dip.' Substantial research in 'Seat-Dip' phenomenon has been conducted over the past 50 years or so [1, 2, 3, 4 and 5]. Papers by Schultz and Watters [1] and Bradley [3] discuss the seat-dip events and elucidate some of the reasons for their inceptions. Ando et.al [2], Davies and Lam [4] and Davies and Cox [5] provided mechanisms to reduce the attenuations due to sea-dip. In this paper, the seat-dip phenomenon will be described first using References 1 and 2. Next, mechanisms to avoid seat-dip will be described from the research of References 2, 4 and 5. Recent measurements from three auditoria, conducted in

2018, will be presented and some thoughts of the influence of seat-dip on actual concerts will be highlighted.

2 Seat-Dip?

Schultz and Watters [1] in early 1960s attempted to answer two aspects of acoustical behaviour of seats. One of them was the attenuation of a sound wave passing at grazing incidence. The sound seemed to suffer, as it passed over an audience at near grazing incidence, more attenuation that can be attributed to spherical divergence. The suspicion by Schultz and Watters was based on early work by von Békésy in 1933 [6]. Békésy found from a set of loudness measurements and we quote, “The resulting frequency distortion was rather large and could easily be perceived. If the speaker was 50 cm above the audience, his voice seemed dull and impersonal in the back rows. But, if the listener also was elevated 50 cm above the audience, the voice for him took on a completely different timbre, became stronger, and exhibited its individual qualities. If the audience was taken away, the situation was improved still further.”

Schultz and Watters created a tone-burst measurement scheme to distinguish between the direct sound and late arriving energy in a number of concert halls and found the seat-dip attenuation to be in the 10 dB to 20 dB range in low frequencies. Some of their salient results are reproduced here in Figures 1 and 2. The seat-dip frequency for Boston Symphony Hall, as seen in Figure 1, is around 200 Hz and for Montreal’s La Grande Salle is around 150 Hz (Figure 2). Attenuation was seen to be prominent only at single frequencies. A main observation from the results of these two halls and other halls tested by Schultz and Watters was that the seat-dip becomes less severe as the seat height increases above that of the stage. In addition, the attenuation was seen to exist at many rows from the stage.

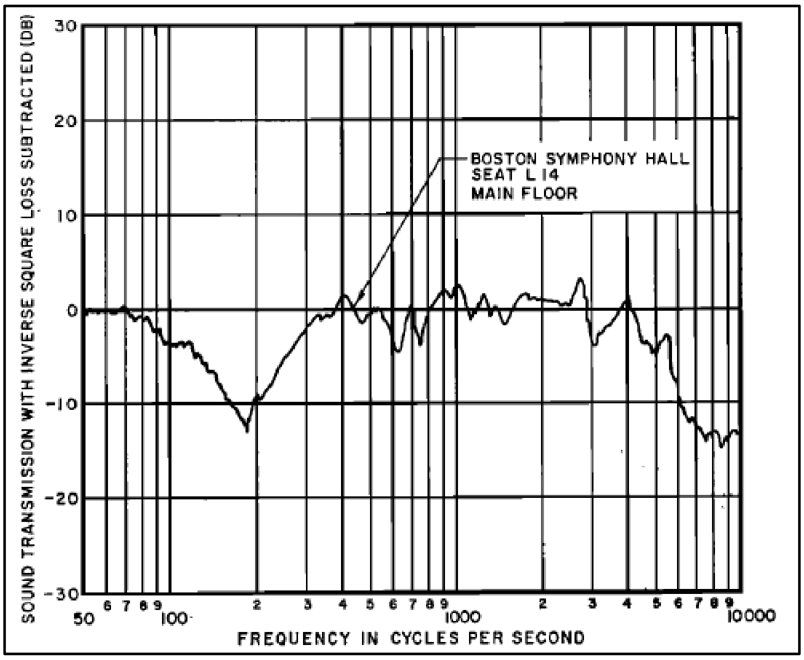
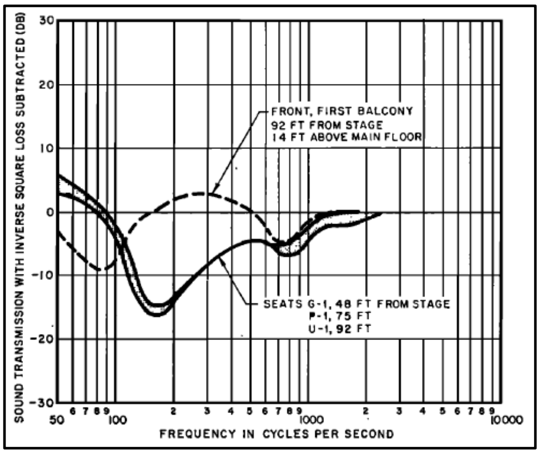
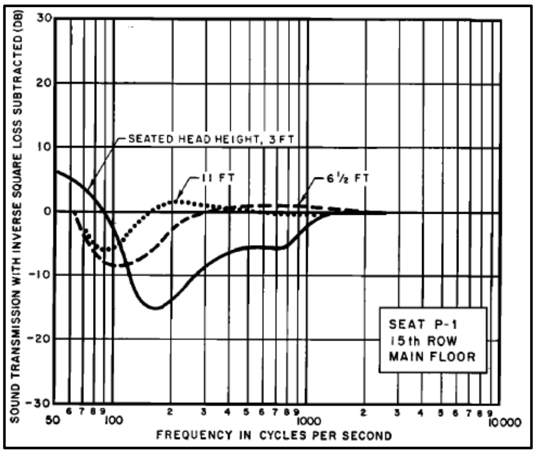


Figure 3. Seat-Dip, Boston Symphony Hall, Boston, USA [From Reference 1].



a) Function of Seat Location



b) Function of Seat Height

Figure 2. Seat-Dip, La Grande Salle, Montreal, Canada [From Reference 1].

Schultz and Watters also conducted scale model studies and theoretical modelling of the seat-dip phenomenon using wave analysis. These additional studies further corroborated their main conclusions that the seat-dip phenomenon was a low frequency event within the first 50 msec of the direct sound and raising the audience height would alleviate the negative aspects of the seat-dip event. They also included some heuristic arguments, in their final conclusions, about the late sound reflections and reverberant sound energy, which we will discuss later in this paper.

John Bradley of the National Research Council of Canada undertook an elaborate measurement program to investigate the seat-dip event [3]. His investigations included a) detailed measurements at the Opera of the National Arts Centre, Ottawa; b) scale model studies of seats in an anechoic room; and c) octave band measurements in 11 halls. He theorized that seat-dip attenuation is approximately at a frequency where the seat backs are ¼ wavelength high. His results agreed with the findings of Reference 1 and other researchers. His main conclusions were – i) the low-frequency attenuation is dependent on the grazing angle of the sound; ii) the seat-dip attenuation can be subjectively important during concerts; and iii) the attenuations can be minimized by increasing the angle of incidence of the direct sound as well as implementing techniques to increase lateral and ceiling reflections.

3 Reducing Seat-Dip

Ando et. al. [2] calculated the impact of sound transmission over theatre seats as well as provided recommendations to reduce the sound attenuation. Their major recommendations are: a) adjust the angle of incidence; and b) create a slit resonator floor surface to provide additional sound absorption. The slit resonator floor surface, however, had only minimal success, but also moved the seat-dip event to higher frequencies.

Davies and Lam [4] conducted a series of measurements in a 2500 seat concert halls as well as evaluated the impact of different floor absorber configurations. They found that the seat-dip event varies with time as well as affected other acoustic metrics such as reverberation time, clarity, centre time and strength. Even though the floor absorbers can be integrated with room ventilation systems, the absorbers seemed to reduce the attenuation marginally.

Davies and Cox [5] explored the impact of seat-dip attenuation as it directly impacts the subjective perception. By using a perception threshold, they found that very early arriving sound has the most impact. They also explored different options such as seat absorptions, floor absorbers, angle of incidence and concluded that simple solutions to reduce seat-dip were not easily available.

4 Case Studies

Many of the halls, studied by the different researchers such as Shultz [1] and Bradely [3], were seen to exhibit seat-dip attenuations. However, the investigated auditoria existed for a long time and the concerts at these venues were found to be satisfactory by the patrons. Shultz also states that adequate tonal balance on the main floor of many halls may suggest that good low-frequency of the early sound is not essential. Shultz, in addition, mentions that the listener relies upon direct and early reflected sound for source location as well as for the feeling of intimacy described by Beranek [7]. Beranek mentions that sufficient amount of lateral reflections from side walls can enhance intimacy and clarity. Bradley from his experiments conducted at Roy Thomson Hall in Toronto suggests that adequate ceiling reflection can also compensate for the lack of low-frequency early sound [3].

The one question that begs for an answer then is – Is seat-dip a real problem? To answer the question, measurements conducted in three halls will be used to describe the anecdotal response of the first author of the current investigation. The case study halls, as shown in Figures 3, 4 and 5 are: a) Roy Thomson Hall in Toronto, Canada; b) Koerner Hall in Toronto, Canada; and c) MS. Subbulakshmi Auditorium in Chennai, India whose acoustics was designed by the authors of this paper. The main characteristic of these three spaces is that the stage and artistes are at a higher elevation than a number of audience rows.

The measurements were conducted using ODEON acoustics software [9]. Different acoustic metrics such as Reverberation Time (RT_{60}), Clarity (C_{80}), and Centre Time (Ts) were evaluated from the impulse responses determined from sine-sweep signatures.

Figure 3. Roy Thomson Hall, view from the stage [From Reference 8].

Figure 4. Koerner Hall, view from the back [From Reference 8].

Figure 5. MS. Subbulakshmi Auditorium, Chennai, India, view from the stage.

It must be pointed out, before we present the results of our measurements, that the evaluated metrics include both the direct sound as well as the useful reverberant reflections that augment the subjective perceptions of the listeners. The measurements, in each auditorium, were conducted with a dodecahedron speaker as the source on the stage. A sine-sweep signal was fed through to the speaker and the resulting impulse responses were evaluated. The impulse responses were measured at two locations on the stage as well as a number of locations in the audience area. The results, to be presented later, are discussed in terms of the RT, C_{80}, and relative sound pressure level variation. In addition, the results are presented for three octave bands in 125 Hz, 250 Hz and 500 Hz, since the seat-dip event is a low frequency phenomenon. A brief definition of RT and C_{80} is given below.

Reverberance is the best known metric of subjective room acoustic aspect. When a room creates too much reverberance, speech loses intelligibility. For music, reverberance can add an attractive fullness to the sound. The reverberation time, RT_{60}, is the traditional objective measure of reverberance and is the time taken for the sound to decay by 60 dB after the source is turned off [10, 11].

Clarity describes the degree to which every detail of the performance can be perceived as opposed to everything being blurred together by late-arriving reverberant sound components. It is evaluated by giving importance to the sound that arrives within the first 80 msec (0.080 sec). The metric is represented as dB and the usual range of acceptable C_{80} values are -5 dB to +10 dB. Positive values show a strong aspect of clarity [10, 11].

4.1 Roy Thomson Hall, Toronto

The results for the empty Roy Thomson Hall are shown in Tables 1, 2 and 3. The results presented include not only the direct sound, but also early reflections and late arriving reflections. The locations include three points in the second row and three points in the middle of the auditorium.

The relative sound level reductions from the level on the stage are shown in Table 1 for three frequency bands. The results showed that there are no strong seat-dip happening in the auditorium as the results, as per the hypothesis of References 1 and 3, include both early sound and strong reflections form the late arriving sound.

Table 1: Sound Level Variation with respect to the stage location, Roy Thomson Hall, dB

Location Number	**Octave Band Centre Frequency, Hz**		
	125	250	500
L3 – Seat Number B33	12.0	10.3	11.2
L4 – Seat Number B38	11.8	11.8	13.3
L5 – Seat Number B25	8.6	7	6.3
L6 – Seat Number K36	16.5	13.1	11.8
L7 – Seat Number K43	11.7	9.9	9.5
L8 – Seat Number K27	14.7	12.3	11.2

RT and C_{80} results are presented in Tables 2 and 3. Davies and Lam's measurements showed that other acoustic metrics such RT and C_{80} can also be affected by seat-dip phenomenon [4]. However, results of Tables 2 and 3 showed no impact on RT and C_{80}. Hence, it can be concluded that even if there is seat-dip during the early part of the sound arriving at the listener's seat, the main acoustic parameters are not impacted if there are sufficient late arriving reflections.

Table 2: Reverberation Time, Roy Thomson Hall, sec

Location Number	**Octave Band Centre Frequency, Hz**		
	125	250	500
L3 – Seat Number B33	2.15	1.95	2.05
L4 – Seat Number B38	2.08	2.03	2.1
L5 – Seat Number B25	1.95	1.81	1.98
L6 – Seat Number K36	2.07	2.05	2.1
L7 – Seat Number K43	2.11	2.05	2.08
L8 – Seat Number K27	2	2.05	2.06

Table 3: Clarity, Roy Thomson Hall, C_{80}, dB

Location Number	Octave Band Centre Frequency, Hz		
	125	250	500
L3 – Seat Number B33	4.7	4.5	4.8
L4 – Seat Number B38	3.5	2.3	1.1
L5 – Seat Number B25	6.5	8	9.5
L6 – Seat Number K36	0.3	5.1	5.8
L7 – Seat Number K43	0.4	2.1	4.1
L8 – Seat Number K27	0.1	3.6	5.4

4.2 Koerner Hall, Toronto

The results for the empty Koerner Hall are shown in Tables 4, 5 and 6. The results presented include not only the direct sound, but also early reflections and late arriving reflections. The three locations include one along the third row, the second in the middle and third in the back of the auditorium. The relative sound level reductions from the level on the stage are shown in Table 4 for three frequency bands. The results showed that there are no strong seat-dip happening in the auditorium as the results, as per the hypothesis of References 1 and 3, include both early sound and strong reflections form the late arriving sound.

Table 4: Sound Level Variation with respect to the stage location, Korner Hall, dB

Location Number	Octave Band Centre Frequency, Hz		
	125	250	500
L3 – Seat Number CC14	-0.1	-0.6	-0.1
L4 – Seat Number F14	7.7	7.7	4.6
L5 – Seat Number M10	8.1	8.7	4.5

RT and C_{80} results are presented in Tables 5 and 6. Davies and Lam's measurements showed that other acoustic metrics such RT and C_{80} can also be affected by seat-dip phenomenon [4]. However, results of Tables 5 and 6 showed no impact on RT and C_{80}. Hence, it can be concluded that even if there is seat-dip during the early part of the sound arriving at the listener's seat, the main acoustic parameters are not impacted if there are sufficient late arriving reflections.

Table 5: Reverberation Time, Korner Hall, sec

Location Number	Octave Band Centre Frequency, Hz		
	125	250	500
L3 – Seat Number CC14	2.17	1.71	1.63
L4 – Seat Number F14	1.81	1.84	1.89
L5 – Seat Number M10	2.07	1.99	1.94

Table 6: Clarity, Korner Hall, C_{80}, dB

Location Number	Octave Band Centre Frequency, Hz		
	125	250	500
L3 – Seat Number CC14	5.7	7.1	7
L4 – Seat Number F14	-1.1	-5.9	-2.8
L5 – Seat Number M10	-2.2	-3.1	-1

4.3 M.S. Subbulakshmi Auditorium, Chennai, India

The results for M.S. Subbulakshmi Auditorium are shown in Tables 7, 8 and 9. The measurements were conducted when the auditorium was two-thirds full. The results presented include not only the direct sound, but also early reflections and late arriving reflections. The five locations include two in the first row, two in the fourth row and one in the seventh row. The relative sound level reductions from the level on the stage are shown in Table 7 for three frequency bands. The results showed that there are no strong seat-dip happening in the auditorium as the results, as per the hypothesis of References 1 and 3, include both early sound and strong reflections form the late arriving sound.

Table 7: Sound Level Variation with respect to the stage, M.S. Subbulakshmi Auditorium, dB

Location Number	**Octave Band Centre Frequency, Hz**		
	125	250	500
L3 – A_aisle	2	-2.3	2.1
L4 – Seat Number A16	3.6	-1.7	2.7
L5 – D_aisle	5.8	-0.1	2.7
L6 – Seat Number D16	8.2	2.9	4.8
L7 – G_aisle	6.7	2.1	6.3

RT and C_{80} results are presented in Tables 8 and 9. Davies and Lam's measurements showed that other acoustic metrics such RT and C_{80} can also be affected by seat-dip phenomenon [4]. However, results of Tables 8 and 9 showed no impact on RT and C_{80}. Hence, it can be concluded that even if there is seat-dip during the early part of the sound arriving at the listener's seat, the main acoustic parameters are not impacted if there are sufficient late arriving reflections.

Table 8: Reverberation Time, M.S. Subbulakshmi Auditorium, sec

Location Number	**Octave Band Centre Frequency, Hz**		
	125	250	500
L3 – A_aisle	1.25	0.97	1.02
L4 – Seat Number A16	1.1	0.96	1
L5 – D_aisle	1.23	1	0.96
L6 – Seat Number D16	1.23	1.03	0.97
L7 – G_aisle	1.34	0.95	0.97

Table 9: Clarity, M.S. Subbulakshmi Auditorium, C_{80}, dB

Location Number	**Octave Band Centre Frequency, Hz**		
	125	250	500
L3 – A_aisle	8.1	8.6	6.3
L4 – Seat Number A16	10	10	8
L5 – D_aisle	7.3	7.6	5.4
L6 – Seat Number D16	7.7	6.9	6
L7 – G_aisle	6.7	5.9	4.4

5 Conclusions

The phenomenon of seat-dip in auditoria was discussed in this paper. Early researchers showed that seat-dip produces strong sound attenuation of direct and early sound in the front rows of audience seats. The seat-dip is prevalent if the artistes on stage are elevated higher than the audience rows. The techniques to remove seat-dip were also studied, but showed minimal success with some of the techniques such floor slit absorbers.

On the other hand, the current investigations measured total sound, i.e., direct sound, early and late useful sound reflections in three auditoria where the stage was elevated higher than the front rows of seats. The results showed no seat-dip, perhaps due to strong reflections from the ceiling and the side walls. In addition, the reverberation time and clarity measured from impulse response in the three halls showed negative impacts, even if seat-dip existed within the first few milliseconds after the direct sound.

Subjective response from anecdotal evidence showed that the three auditoria performed satisfactorily from an acoustic perspective.

The major conclusion is that seat-dip is not major negative contributor to the overall acoustic performance of auditoria, provided sufficient reflections enabled the positive effect of the late arriving sound. In addition, early researchers suggested designing the hall such that the audience seats are elevated higher than the musicians or speakers on stage. One can conclude from the current investigation the above restriction on architects is not warranted.

Acknowledgements

The authors are thankful to the different auditoria managers for giving us permission to measure the acoustic performance of each of the auditorium.

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01.106 - THE BLOCKCHAIN-ENERGY-NEXUS

Roy R. Pachecano, AIA, MSRED

Columbia University, Urban Design Lab, Earth Institute

475 Riverside Drive, Suite 525 New York, New York 10115, U.S.A.

rrp1@columbia.edu

Abstract

The emergence of cryptocurrency and the underlining system architecture called blockchain, has a profound impact on private and public land use, and hence, the design of our governed and ungoverned spaces. To be sure, no one really knows the extent of the future impact on open and enclosed space blockchain will have on our cities, yet from understanding the fundamental aspects of blockchain operations, we can gauge and forecast long-term effects on our built environment while the [blockchain] phenomenon grows beyond its infancy phase. Blockchain's computational analytics requires an enormous infrastructure in order to maintain stable data, and thus, stability in cryptocurrency. The amount of energy consumed required to operate blockchain mining sites is expected to rise which has a direct impact on land, as well as substantial water resources needed to generate sufficient electrical power. How we respond with adequate design measures will directly drive the design of future cities, smaller townships, and everything in between. An analysis of articles and papers published with interviews of prominent thinkers, researchers, and scientists, reveals the risks posed to civilization are substantial, giving rise to the blockchain-energy-nexus.

Figure 1.0—Bitcoin energy consumption to April 2017

Keywords

Blockchain-Energy Nexus, Urban Design, Infrastructure.

Topic: T01: Future Visions, and T08: Energy

1 INTRODUCTION

Globally, the top 20 industrialized nations (so-called “G-20”) do not operate their currencies through semantically secure cryptosystem platforms. Some sovereign states with annual GPDs higher than $1 billion still do not formally acknowledge the legitimacy of cryptocurrency on existing exchanges; NYSE, NIKEI, FTSE, etc. and only a few have launched indices. (Coindesk) The digital economy is changing the dynamic by which entities will recognize its latent inefficiencies with existing financial institutions. (Perez, 2015) It is anticipated more sovereign entities will recognize cryptonic trading on secure platforms before the end of this decade.

The value of blockchain, as a disruptive technology, relies on the presumption that cryptocurrencies will continue to use proof of work and/or proof of stake algorithms to secure their transactions—whether or not efficiencies improve the kilo-watt-hour/hash rate (“kwhr/hash rate”)—so that the demand for power will continue. (de Vries, 2018) Indeed, as of this writing, some cryptocurrencies are already using other algorithms to secure their (accounting) ledgers that don't rely on proof of work as its underlying power consumption and concomitant expense, thus exposing a hidden, underlying thesis mapped along two axes: On one hand: The decoupling of computing power from blockchain and cryptocurrencies would diffuse risks to city infrastructure. On the other hand, maintaining the existing linkages between blockchain and utility grid will require a balanced flow of data and increased security measures so as maintain the stability of blockchain ledgers. The emergence of technologies such as the internet of things, artificial intelligence, machine learning, big data, and the new circumstance of deep learning bring a level of exposure to city infrastructure not conceived in the early 20th century when most of the modern grid was built. The emergence of smart energy grids serving large cities, regions, is aspirational yet fraught with risk not fully understood in the urban domain.

These questions arise:

1. In what spatial environments will we find the adequate measure of securing new decentralized computing platforms and energy markets co-habited by city infrastructure for housing, basic services, and our urban communities?
2. How can we adapt our cities to the risks associated with emerging technologies linked to the energy infrastructure?
3. Given the existing energy nexus, how will the new blockchain apparatus alter our perception of securing our critical infrastructure that serves urban ancillary spaces?

This paper explores how the impending global impact of blockchain on critical urban infrastructure and how it may alter a new spatial environments and be a harbinger of change in our current land-use paradigm and built environment.

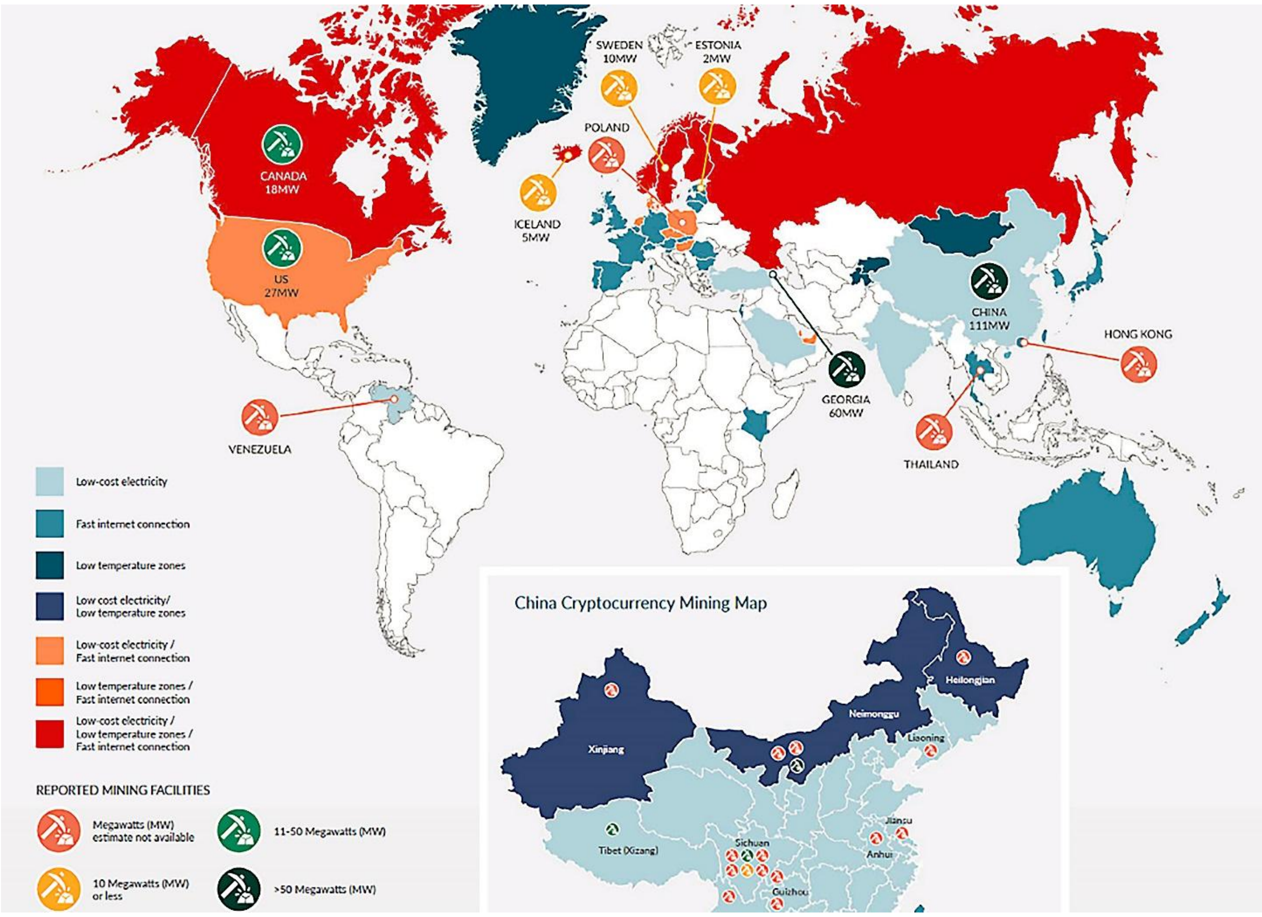

Figure 2.0—Global currency benchmarking study, 2018

2 Research Objectives

To identify, explore, and evaluate the impacts blockchain will have on urban space. Assess security threats to infrastructure serving cities, regions, and apprise attendant risks related to the rise of the sensored city. In addition, to bring about awareness of risks imposed upon urban conditions that are not yet fully understood and offer the reader a component devoted to the implications to practice. As a function of testing theoretical underpinnings of the findings, the author offers a view forward in Section VI: “Outlook and Implications for Practice.”

3 Methodology / Procedure

Qualitative research was used for this study. Accordingly, observations made within this context were used and corrobrated with multiple sources where there is more than one type of evidence or source of data. In this study, the problem was defined as a percieved risk to the urban condition, namely urban space—a metropolis and its influence upon surrounding suburban ad exurban space—where dependency upon high-transmission electrical infrastructure is critical to the success, health and vibrancy of the metropolis. This paper is written in an attempt to present the research of other scholars, as well as independent research, in the arena of a neutral context, and to source data to explain our present and future urban conditions while tracking the growth of blockchain technology. This methodology was designed to incorporate a variety of evidence, including observations, interviews, and published documents, to explore the multifaceted nature of the research problem.

4 Findings

4.1 The Roman Aerarium

Since the first numismatic minting of coins—elegantly abstract, yet physical representations of a value set—use of currencies have redefined how people, cultures, nations, civilizations interact with each other. Two thousand years ago, Roman coins such as the denarius were representations of the Roman Empire's might and control over its dominions. The mining of raw metals to smelt, forge and mint coinage into Roman currency indirectly influenced the design of the Roman city: the local treasury, or Aerarium, was where currency was held, was located next to the forum, public markets, and temples—all centrally located in the Roman genius loci of the urban fabric. (Badian, 2008)

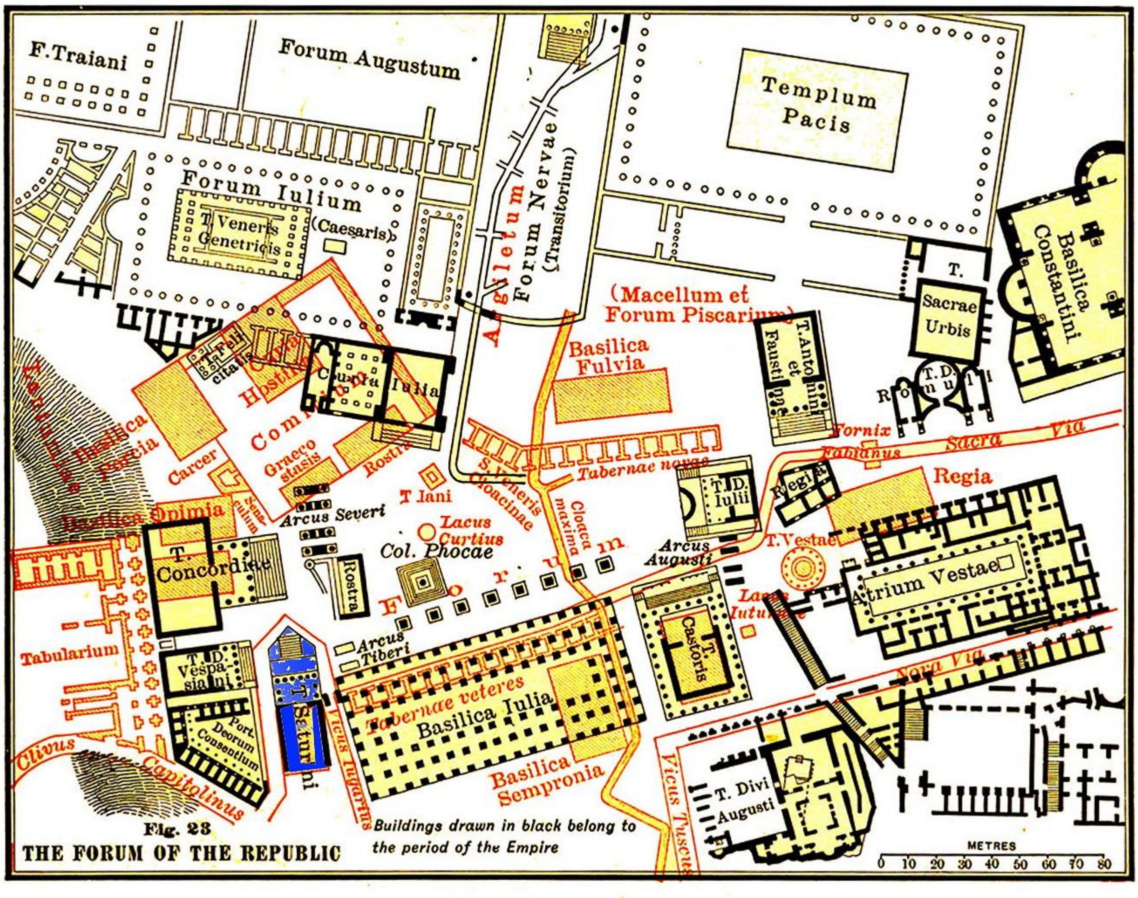

Figure 3.0—Location of Roman Aerarium in the Temple of Saturn, Rome, circa 50 AD (CE), (highlighted area in blue

At the beginning of the first century, Roman currency was in widespread use throughout its empire. At the beginning of the twenty-first century, it is estimated that 85% of the world's population will continue to transact using cash only. (Chowdhry, 2015) This underserved and untapped market is the dream of libertarian cryptocurrency enthusiasts whose belief is that money will become anonymous, and therefore, remain unregulated. This approach of implementing an electronic system based on cryptographic proof instead of trusting third parties, matches the ideal, original conception of cryptocurrency to remain far from the reach of government regulators. (Nakamoto, 2003)

What was once highly centralized, the eventual decentralization of Roman currency is perhaps analogous to blockchain's role in becoming the new Aerarium for the 21st century. As the Aerarium held a prominent (physical) place in the heart of the Roman city, so too is blockchain's link to critical infrastructure of the city of the future.

4.2 Understanding Blockchain

“If there ever was a topic for demystification, blockchain is it. Blockchain is an invention that in time may prove as momentous as the invention of printing.”—James Rickards

“The epienter of trust is about to diffuse: Blcokchain represents the decentralized trust system.”—Frank D’Souza

Some experts view the blockchain as a disruptive revolution that will transform our physical space. The Blockchain Research Insitute (BRI), for example, cites invention of blockchain is the end of the first digital wave of technology, or “digital feudalism,” where overzealous landlords once took control of lower classes. As more and more people create their own data depositories and build their online profiles, our data banks will continue to expropriated by third parties who seek to monetize our personal data streams. Blockchain technology offers users a self-sovereign position where it is possible to store all personal data in a safe, secure, black box. (BRI, 2018)

This technology represents a fundamental shift in our notion of private property—and provides a pathway to regain control of specific data-sets.

Yet, for the crypto-centric promise blockchain espouses to be, the lack of regulatory oversight has created uncertainty not just for regulatory authorities who may not understand its true potential, but for existing land use policies tied to old concepts of what constitutes private property. Blockchain is a digital medium of value. And as the technology emerges from its shadows, this new disruptive asset class is producing unconventional value structures: cryptocurrencies, protocol tokens, utility tokens, security tokens, natual asset tokens, crypto collectibles, crypto fiat currencies, and stablecoins (Fedcoin proposal)—See Section XI: “Glossary of Terms,” at the end of this paper for a brief description of each element.

Blockchain differs from the conventional operations of data collection in several important ways: (i) whereas the Internet was originally built as a “free” utility by a diverse group of stakeholders, it had more to do with security and little to do with financial incentives; (ii) blockchain provides significant financial incentive for entities who can build successful, scalable, and widely used technology through the appreciation of underlying cryptoassets; (iii) creators of mining sites build not one blockchain, but large competing, overlapping, complementary platforms—a decentralized network; and (iv) blockchain technology is dirsrupting traditional value industries such as financial, accounting, legal, and insurance services and their supply chains.

When joined with the rise of the platform as an organizational tool, blockchain technology is emerging as one of the most important economic developments of our time. Digital platforms are beginning to transform a broad range of economic and social arenas: from health care to energy, from education to government. Because the notion of the platform is scalable, it holds the power to turn business models into rapid jaugernauts. The digital connectivity and the platform model it makes possible are changing the world forever. A platform is defined as a business based on enabling value-creating interactions between external producers and consumers. (Parker, Van Alstyne, Choudary, 2016)

"The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services, or social currency, thereby enabling creation for all participants." (Parker, et.al, 2016)

Highly fragmented industries will be transformed: Market aggregation through platforms increases efficiencies and reduces search costs for businesses and individuals looking for goods and services. The newest platform technologies are disrupting diverse industries that have historically exhibited inefficiencies. The energy sector (gas, oil), as well as agriculture industries are defined by a high failure cost and are resource-intensive. (Parker, et.al, 2016) At the same time blockchain technologies create a new demand load on the energy sector, it has exposed the industry's fragmented production and costly inefficiencies. This offers a new ways to think about energy production and distribution.

4.3 The Energy Problem

The process of running pending transactions is made possible by running the secure algorithm 256 (SHA-256) to validate and solve a 'block' consumes much energy. Some in the blockchain ecosystem estimate (back-of-envelope) the bitcoin energy consumption is anywhere from the energy needed to power 700 average American homes (on the low end) to the energy needed to power the island of Cyprus (on the high end). These estimations have not beed substantiated, however, the estimate puts consumption at more than 4.409 billion kw/hrs required to cool machines operating 24/7 which stores data and secures the network and keeps the nodes honest and incorruptible.

Added to this, there is a different kind of power: processing power. In 2015, The New Republc, reported that the combined processing power of the bitcoin network was hundred times greater than the aggregate output of the world's top 5 hundred supercomputers.

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To be sure, this data is dated, yet reflects the rapid change in this technology sector and serves as a benchmark. "Processing and protecting the more than $3billion worth of bitcoins in circulation requires more than $100 million in electricity each year, generating a volume of carbon emissions to match." Nathan Schneider, author, wrote: "…all that comuting power, which could be curing cancer or exploring the stars, is locked up in machines that do nothing but process bitcoin-type transactions." (Tapscott, 2016)

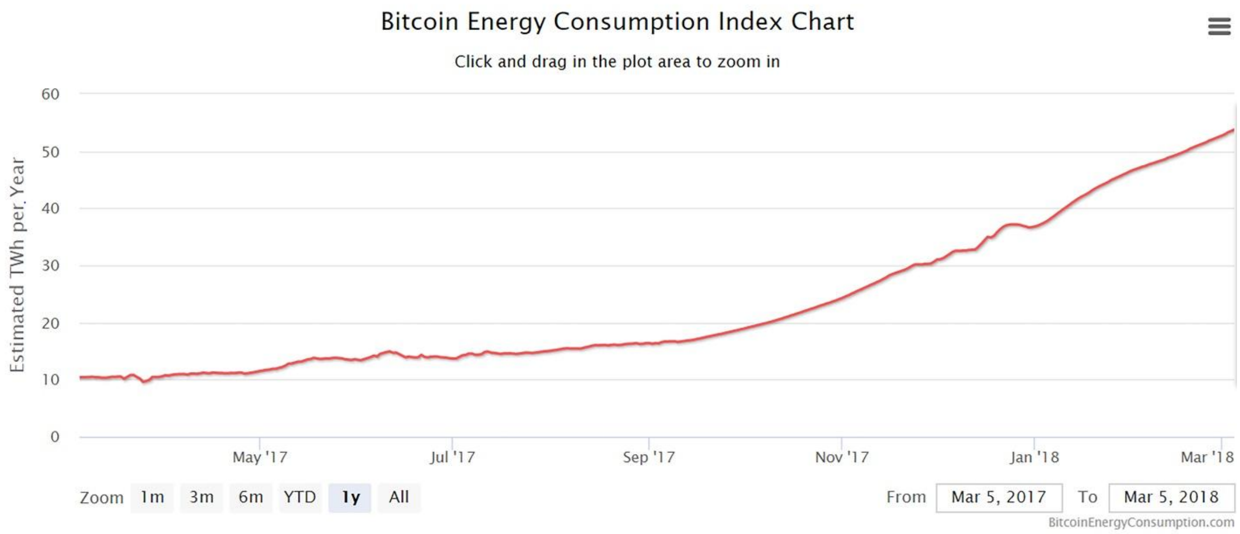

Figure 4.0—Bitcoin energy consumption Index Chart to March 2018

Source: http://de.123rf.com; Copyright: Karel Miragaya

Two main concerns arise: (1) the amount of energy used to run the machines and (2) the amount of energy used to cool them so they don't fail. The rule of thumb is for every $1 USD spent on running a computer, you need 50 cents to cool down. Recent examples in the United States of acute droughts has raised serious concerns over using precious water reserves to cool data centers and bitcoin mining operations. As the value of bitcoin increases, the competition for mining new bitcoin increases.

As more computing power is directed at mining, the computational problem that miners need to solve becomes more difficult. Thus, a new term has been devised: "hash rate." The hash rate has been increasing considerably over the last several years, rising forty-five-fold in 2017 alone. And, the trend is toward consumption of more energy, not less. Energy is a commodity that is intrinsically linked to the cost incurred in securing fiat currency.

If the formation of currency has a relationship to energy by its transformation of physical properties (minting), then the value of cyrptocurrency is derrived from its cost of completing a block of computations (mining). The cost of powering these computations, absent a central authority to arbitrate the value, becomes the true cost of the energy required to produce a proof; this approach portends a future where we have mining replacing minting.

By factoring is the cost of building processing plants (data centers) mining costs rise when you factor in the cost of building the data centers themselves, not to mention the added cost of supplying electricity to servers, and those growing costs needed for constant upgrading. Given that cryptocurrency's exchange price is wildly volatile, it creates an inverted cost-to-production ratio when its value drops. Another variable to ascertaining value of cyrptocurrency is the volatility of the cost of electricity itself, placing an usual demand cycle on local utility companies. In the western United States, for example, some utility companies have responded by freezing service to new cryptocurrency installations or charging them higher rates. While more aggressive measures have been taken by utility authorities in China to dismantle smaller, private, illegal hydroelectric projects. In all cases, whether in the US or abroad, mining sites that are being fueled by being connected to the national grid, has produced unprecedented swings in power availability. (Economist, 2018)

The miners' race, known as "proof of work," is slowly being superseded by "proof of stake." So a cryptocurrency's investors have to hold a stake in the currency for a minimum period. The value of their stake gives them a sort of voting right in how the next block is formed, as well as a return on investment for that stake. They also have to contribute computing assets, but the overall computational power required is far lower than the bitcoin approach and grows slowly over time. (Economist, 2018)

Mining facilities tend to keep their operations behind closed doors, so little is known about their Power Usage Effectiveness (PUE). In essence, it is the function of the cost to cool. Certainly not every mining operation uses this cooling technology. For example, Bitcoin's mining facility in the Inner Mongolian desert (China) makes use of an evaporative cooling system. With the exception of isolated occurrences where one of Bitcoin's mining facilities in remote Mongolia was allowed limited access by a small group of journalists, for the majority of the network no information is available at all. As of this writing, the hash rate has shown to be a critical element related to energy demand consumed in Bitcoin mining. Yet, this remains an area that requires further research and investigation to quantify the energy problem.

Experts who have calculated Bitcoin's electricity consumption across its network have published what is known. "The Bitcoin network consumes at least 2.55 GW of electricity currently, and that it could reach a consumption of 7.67 GW in the future, making it comparable with countries such as Ireland (3.1 GW) and Austria (8.2 GW)." (de Vries, 2018) A look at Bitcoin miner production estimates suggests that this figure may already have been reached at the end of 2018. With the Bitcoin network processing just 200,000 transactions per day, this means that the average electricity consumed per transaction equals at least 300 kWh, and could exceed 900 kWh per transaction by the end of 2018. The Bitcoin development community is experimenting with solutions such as the Lightning Network to improve the throughput of the network, which may alleviate the stress on the utility grid. (de Vries, 2018) For now, however, Bitcoin's network is revealing how much energy it is consuming, and the stunning amount of power required to mine virtual value and then secure that value is significant. (Fairley, 2017).

4.4 Alternate Platforms

The trend to create more efficient algorithms and thus lessen the energy demand of producing blockchains may reduce their energy-footprint. Yet, as of this writing, mining sites have added a new, and unexpected, load on our nation's infrastructure. The rise of the energy demand for mining has prompted experts to find new ways to mine with less impact to the existing grid. To underscore the magnitude of this issue, it was the specific focus of the Global Power & Energy Blockchain conference held late November 2018. "Evidence of the disruptive impact of technology on the power & utilities industry is clear and growing," according to the Energy Blockchain Consortium. (Power & Energy Blockchain Conference, 2019)

A number of other emerging platforms could challenge the bitcoin dominance such as Ethereum. Etherreum is a platform technology, designed from the outset to enable distributed applications ("D-apps," or "dapps")—an application that runs on a distributed and trust-minimized blockchain. These alternative platforms serve as candidates for a potential inversion: a point in time when an alternative blockchain displaces Bitcoin as the network with the most participants and most capital. Massive work is under way to expand Ethereum's capability and a shift to proof-of-stake. Such hyped large-scale enterprise applications are reserved for still-unreleased protocols which promise to eliminate scalability and interoperability bottlenecks and unite all blockchains into a giant, seamless, web of blockchains.

4.5 Energy Consumption in the US—(Sampling of States)

Energy in the United States is sourced from a variety of new exploration sites and new innovative extraction methods joined with an existing energy portfolio of coal and petroleum. Figures 5.0 and 6.0 below illustrates energy generation, production and diversity in the United States.

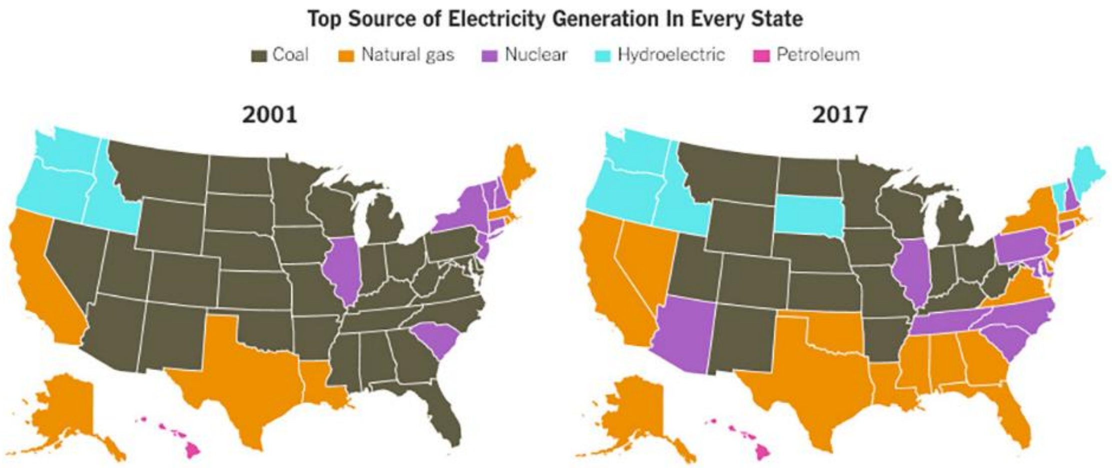

Figure 5.0 –Top Source of Electricity Generation in Every State, New York Times.

What is striking is the five major sources arrayed across the US: Coal, natural gas, nuclear, hydroelectric, and petroleum. Not shown is liquefied natural gas and a handful of renewable energy sources such as: wind, geo-thermal, bio-fuels, and solar. Considering the ten sources of energy mentioned here, the energy profile in the United States is considered a dynamic portfolio and it is this diversity which further adds complexity to inter-state delivery (transmission) of power (kwhr) to customers.

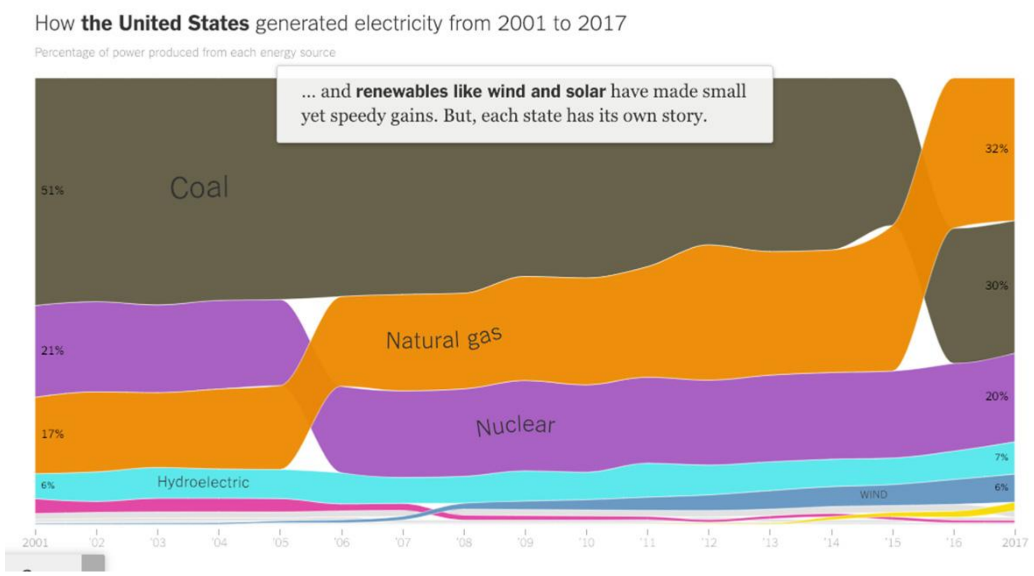

Figure 6.0 –How the United States generated electricity from 2001 to 2017, New York Times

As a result of the complexity of energy sourcing, blockchain may offer unique solutions regarding the distribution of natural resources. See Section V: “Findings, (G) Impact to Policy,” for added commentary. The potential benefit of overlaying blockchain on the utility grid can be seen in its potential to reduce costs by eliminating intermediaries (local utility companies) and usher in more efficient marketplace. By positioning the blockchain platform at the last-point-of-sale, this would allow consumers to source their power directly from low cost and low carbon resources (renewables as well as fossil fuel sources) generated from large wind farms many miles away or a neighbor’s rooftop solar array next door. (Medium, 2018)

4.6 Trading Renewable Certificates and Carbon Offsets

When a renewable-power plant generates a unit of electricity today, energy-specific data is created which becomes metered and gets logged into a shared data base. This data is then sent to a registry provider, where the data gets entered into a new system and a certificate is created. A second set of intermediaries (brokers) interacts between buyers and sellers of these certificates. When a transaction is made, another party verifies the certificates after they are purchased. (Orcutt, 2017) This basic function of trading renewable certificates through three layers of inefficiencies renders this aspect of the utility ripe for disruption via blockchain

On our utility grid carrying electricity, electrons generated from the sun, wind, or other renewable sources are indistinguishable from those generated by fossil fuels. To keep track of how much clean energy is produced, governments around the world have created systems based on tradable certificates. Managing these certificates is challenging, to say the least. Blockchain technology could remedy this problem. Advocates say the technology could be especially promising in industries where networks of peers—electricity producers and consumers, connected via the grid, for instance—depend on shared sets of data. (Orcutt, 2017)

In addition to blockchain’s usefulness in trading renewable energy certificates, the same—or similar—approach to applying carbon offsets, may offer a way for governments and private companies to trade in the marketplace. The protocol established by the CDM (Clean Development Mechanism) would interface with blockchain and offer an efficient way to improve delivery, accountability, and sustainability.

4.7 The Impact to Policy

At the same time that blockchain has made its debut, the “Smart City” movement was being formulated. In a 2018 report, McKinsey Global Institute defined smart cities as “places that put data and digital technology to work with the goal of improving the quality of life.” (McKinsey, 2018) Despite the widely circulated report, there remain mixed views on whether the future of the city is utopia or dystopia? At issue is the ongoing debate about public vs. private ownership of data. Added to this is the speed of technological change: the data sciences are leap-frogging over existing policies so much so that policy wonks openly question how many of different varieties of platforms will we create, adopt, replace, before meaningful change to policy is made. The rise of the “sensor-city” could fill security voids, yet it could also lead to an exacerbation of inequality, expansion of state and corporate surveillance, and further erosion of privacy. (Jacobs, 2019)

As reported in McKinsey Global Institute's "Smart Cities: Digital Solutions for a More Livable Future," it is logical to identify areas where city agencies can step back and make room for private-sector companies and balance this with state-owned utilities. Adding more actors to the mix is a positive, such as universities, non-profits, and other service-oriented non-governmental organizations (NGOs), as it increases adoption and is reviewed by many rather than just one or two entities. Poor municipal governments may need to enlist multiple partners to remain active, yet the 'natural' owner of the flow of data should add value and not simply be a repository. When private-sector innovations spring up organically, the role of government has often been to regulate and convene key actors. Rather than taking a master-planning approach, some cities should position themselves as creators of blockchain ecosystems, by fostering collaboration and incubators of innovation. Public-private-partnerships would bring together city agencies, institutions, NGOs, private sector, and blockchain entities to parse-out ownership.

Globally, the challenges facing the creation of blockchain policies that would impact land use and the private domain are related to how cities have built-up their respective technology base. In a future age when nations will lose influence over cities that become technology-giants, the future of land use ordinances governing blockchain driven infrastructure will be led by the powerful megapolis—See Figure 7.0.

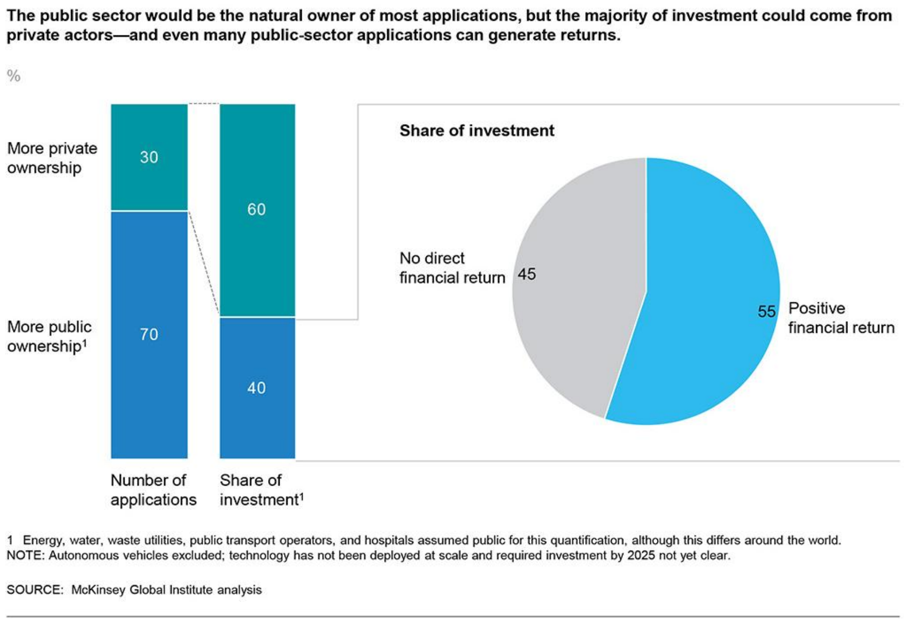

Figure 7.0—Public vs. Private Sector Ownership, McKinsey Global Institute, 2018

Notwithstanding the enormous challenge of integrating a balanced-approach to policies impacted by blockchain technology on city infrastructure, is perhaps the higher consequence of transforming an existing, centralized utility grid into an operationally effective decentralized system of many parts. In a so-called liberalized economic system, the customer typically has the right to freely choose their energy supplier. The regulatory changes made in the US during the 1980s, reflected a growing distrust of monopolized utility companies that offered no choice. If a decentralized transaction model were to be implemented on the basis of blockchain technology, it would necessitate the transformation of the existing deliver model and force all energy customers to manage their own data flows (meter reading), as all data would be recorded automatically on the blockchain. (PWC, 2016) As blockchain miners would be technically categorized as "customers," the regulatory environment remains unresolved.

The regulatory challenges posed by blockchain application in the energy sector will center on the concept of decentralizing the transaction model for energy suppliers and consumers. One major benefit of a blockchain-based transaction model is that all electricity delivered to the utility grid can be accurately attributed to customers identified in the blockchain's ledger. (PWC, 2016) The challenge is in keeping individual transactions private in the widely open-architecture of the blockchain. All customers then would have to become their own data collector and the role of the meter operators would change to merely inspect meters to ensure they are not tampered with (security of grid equipment). With this shift in responsibilities, a question arises who will be responsible for ensuring transactions are properly settled. In this scenario, the blockchain technology would step-in to confirm billions of transactions are made daily, monthly, annually.

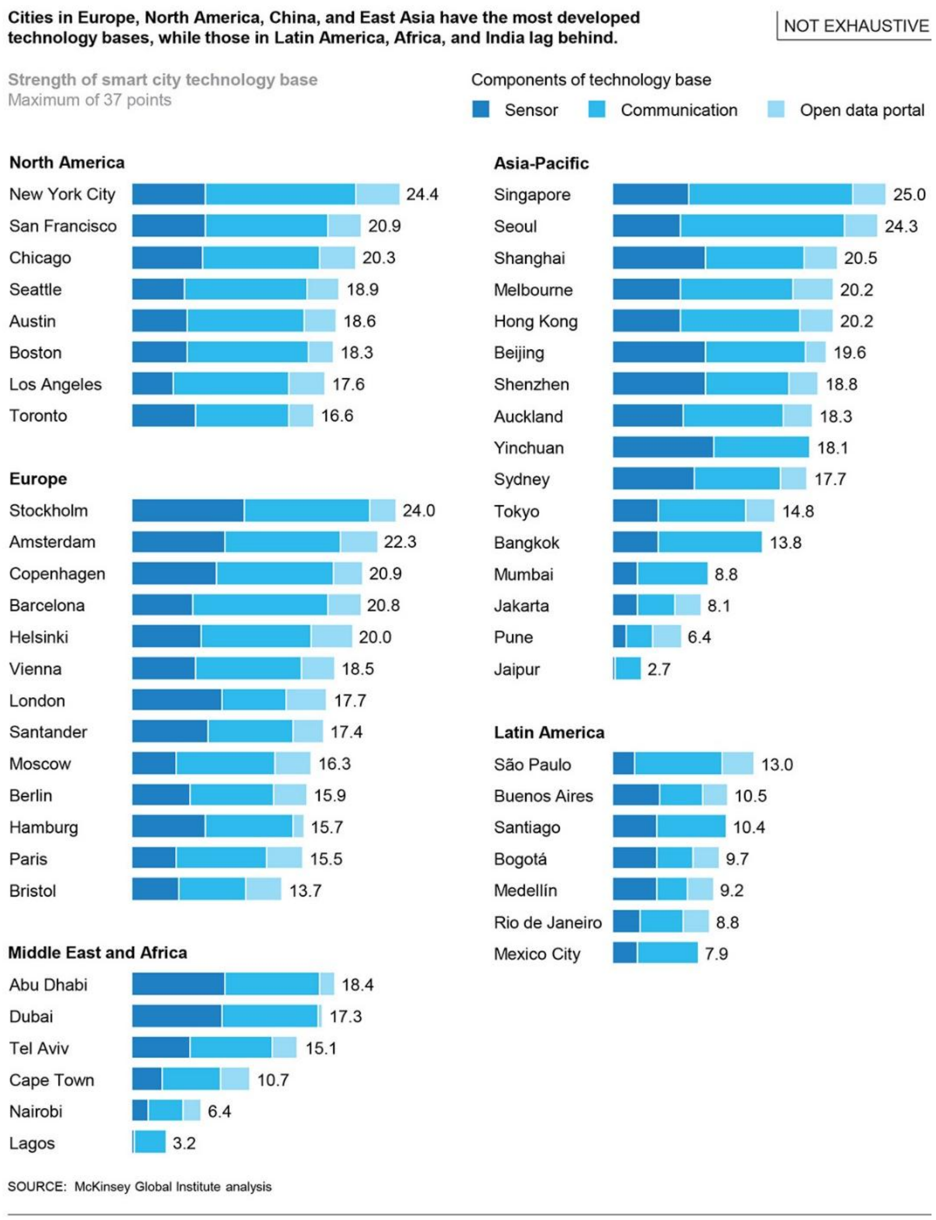

Figure 8.0—Most developed technological bases, McKinsey Global Institute, 2018

How blockchain technology will impact infrastructure policy is framed by two sides: On the positive side, customers will likely benefit from removing intermediaries and producing their own data-banks. On the negative side, the entire network will remain at risk from cyber-attacks and possibly escalate conflicts due to lack of standardization of security protocols.

On the security side, as of this reporting, negative incidents appear to have outweighed positive occurrences with the hacking of the Ethereal blockchain. Since there does not exist any wide spread adption of customer controlled data flow, it is anticipated that negative events will outpace positive ones; policy changes will follow events and play catchup to the changing. According to TNW contributor Matthew Beedham, “[t]he whole idea of blockchain is built upon decentralization, not just of technology itself, but the power it draws upon too. When a single entity can control the majority of the network’s power, it’s technological and political power is no longer decentralized.” (Beedham, 2019) To many, these types of attacks are not new. As this paper was being researched in late 2018, global mining operations began going offline as operating costs outstripped mining rewards. Despite this recent trend, the net-energy demand in the future will remain high.

5 Outlook and Implications for Practice

If blockchain reformation of the urban city is to take-up prominence in a priority of needs, it will fold in the political agenda. These operational changes require much more than a budget or election cycle—they require buying-in to a whole vision. Founder of Bits and Atoms, Anthony Townsend on this prescient view: “[t]here’s only a handful of cities around the world that actually systematically plan for their smart city strategy. And among those, it’s a small effort inside the mayor’s office that often results in more of a political document that a serious operational document.” (Townsend, 2019)

The adoption of new blockchain policies for the urban space will be critical for the 21st century city. The author identifies these main areas as future catalyst for change:

- Blockchain can protect property rights through immutable land titles, create a true sharing economy through shared, open, and distributed platforms, empower diasporas to remit funds through low-feemobile payment systems, and endow entrpreneurs with the same capabilities as large companies.
- The Internet of Things depends on a Ledger of Things to track every node, ensure its security and reliability, record its production and consumption—there are potential applications across every sector.
- Blockchain may even help reinvent government, restore legitimacy to democratic institutions, and find common ground on the Internet.
- Blockchain technology will help jounalists quash clams of “fake news” yet also provide a platform for artists and creators to receive fair compensation for cultural assets sch as songs, art.
- .Blockchain based systems could provide a platform for market participation in distributed generation, virtual power plants and demand management. One application for a decentralized transaction system, which is what a blockchain

provides, could be to support payment services for electric vehicle (EV) charging — a critical piece of infrastructure for the energy transition.

- Blockchain will prove to be a valuable depository, or data-bank, as we ebb closer to a future world where whomever controls the flow of data, controls the much of the physical and virtual domains.

As the internet-guru of our age, Yuval Noah Harari describes it: "[e]ven if you don't know how to cash in on the data today, it is worth having because it might hold the key to controlling and shaping life in the future." (Harari, 2018) Harari offers a further glimpse into this new age: "[o]rdinary humans will find it very difficult to resist this process. At present, people are happy to give away their most valuable asset—their personal data—I exchange for free email services and funny cat videos. It is a bit like African and Native American tribes who unwittingly sold entire countries to European imperialists in exchange for colorful beads and cheap trinkets. If, later on, ordinary people decide to try to block the flow of data, they might find it increasingly difficult, especially as they might come to rely on the network for all their decisions, and even for their healthcare and physical survival."

Private ownership of one's own data sounds attractive, yet it is unclear what this really means. Harari continues: "[w]e have had thousands of years of experience in regulating the ownership of land. We know how to build a fence around a field, place a guard at the gate, and control who can go in. [We] don't have much experience in regulating the ownership of data, which is inherently a far more difficult task, because unlike land and machines, data is everywhere and nowhere at the same time, it can move at the speed of light, and you can create as many copies of it as you want." (Harari, 2018)

Thus, how do we regulate the ownership of data? This may be one of the most important questions of our era. If we cannot answer this question and balance private and public property rights, this existing system might not adequately fit the blockchain future.

Regarding the subject of security: this threat will continue no matter how energy efficient the blockchain algorithms become in the future. A possible solution to this problem is the creation of micro-grids—where blockchain can simultaneously operate off a decentralized utility while maintaining security strength. According to blockchain entrepreneur, Katrin Kalden, co-creator of RHIZE, remains optimistic that the applications for blockchain technology are far numerous than just mining cryptocurrency: "[b]lockchain is being leveraged by more and more local communities for trading renewable energy locally. This shared economy innovation in the utility sector shifts energy generation away from centralized power plants into the hands of the community." Such recent examples include the micro-grid in Brooklyn called LO3 Energy. Similarly, other peer-to-peer ("p2p") communities have emerged like Drift, Pylon, Power Ledger, Greeneum, and Solarex, Grid+. These p2p developments enable residents and businesses a high decree of self-sufficiency while also being able to be producers of clean energy. This hybrid nature has given rise to a new term called "prosumer" where community members are both consumers of clean energy but also producers. Yet, with all this innovation of the in the micro-grid side, this configuration will still require robust security measures.

Blockchain technology has inarguably become the new driving force to produce, share and trade consumer green energy resources in a much more efficient way—what remains is solving the security vulnerabilities of a new micro-grid. The future of the city bound together with blockchain technology will assist in being a driving-force for re-thinking our critical infrastructure. These factors become relevant:

1. New urban design parameters—As consumers become prosumers, micro-mining sites may alter the equation for energy consumption supporting blockchain operability in urban contexts. Securitizing these decentralized parts—as opposed to a single, centralized point—offers a diverse platform of operability.
2. New land-use policies—Our current land use policies and zoning ordinances are not up-to-date in order to address the new land use of dedicated mining sites that serve distributed grids. This imposition is placed upon virtually all five major land-use ordinances that have shaped the American city: residential, commercial, industrial, manufacturing and agricultural. Transportation as a separate use-group may fall into any of the above categories that are served by movement in those land uses.
3. New cyber-security-zone tools—The creation of a new product/platform that provides for reconnaissance of micro-mining sites in urban areas and monitors vulnerabilities to urban space, both static and mobile, will be a needed tool that does not yet exist.

Further, the author of this paper seeks to use a tri-partite framework to investigate the new dimensions of urban micro-mining operations:

i. Energy. Explore the conversion of energy (excess heat-rejection) from crypto-mining sites for re-distribution to alternative fuel nodes, distributed grids, energy sharing;

ii. Land Use Distribution. Envision the impacts of current and future activities on open and enclosed space due to energy usage and mobility;

iii. Governance. Research what impacts to current land-use ordinances will trigger an update to existing regulations.

6 Conclusions

Our spatial environments will require securing new decentralized computing platforms as they interact with the energy sector which is co-habited by city infrastructure impacting a wide array of functions in urban life: public/civic and private/personal property. The adaption of blockchain technology should function as a service to our cities and not be merely another point of consumption as it currently exists. The risks associated with emerging technologies linked to the energy infrastructure must become balanced with the positive use of blockchain as a tool for enhancing the quality of life in urban areas. Given this existing energy-nexus, the new blockchain apparatus is already altering our perception of urban space in that we sense an impending need to secure our critical infrastructure that serves urban and ancillary spaces.

The creation of urbanized micro-mining sites relies on established protocols of the Internet of Things and a Ledger of Things to track every node, ensure its security and reliability, and record its production and consumption. The notion of developing and securing an urbanized micro-mining site strategy where individual buildings become mining sites themselves requires further research. The new concept of energy sharing between micro-mining sites will offer a unique opportunity to examine its efficacy and observe cyber vulnerabilities and risks. This concept could be scaled and provide a basis for examining how critical infrastructure on a national level can be observed and managed. Such reconnaissance at the present moment does not exist.

New urban design parameters must be configured in order to manage the shift of consumers becoming prosumers. Micro-mining sites will likely alter the equation for energy consumption supporting blockchain operability in urban contexts. Securitizing these decentralized parts becomes a priority to forge the resilient cities of the future.

New land-use policies that remove obsolete ordinances will be required in order to address the use of dedicated mining sites that serve distributed grids. All major land-use ordinances (residential, commercial, industrial, manufacturing and agricultural) will be affected. Transportation ordinances will also become a key in serving mobility in and to diverse land uses.

New cyber-security-zone tools will become sought-after. The creation of reconnaissance mechanisms to monitor micro-mining sites in urban areas is the next tier of cyber security. A platform that can monitor vulnerabilities to urban space, in real time, both static and mobile, will be a needed tool that does not yet exist.

Blockchain's computational analytics requires an enormous infrastructure in order to maintain stable data, and thus, stability in cryptocurrency which stresses our utility grid(s). Significant amounts of energy are currently being consumed to operate blockchain mining sites—and this new circumstance has placed a direct impact on land, as well as substantial energy-nexus resources needed to generate sufficient power. How we respond with adequate design measures will directly drive the design of future cities, smaller townships, and everything in between. This research has exposed serious security risks as well as future opportunities that may shape our future cities

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01.107 - SUSTAINABLE SOCIAL HOUSING, TECHNOLOGY, AND USERS

Jan Johansson

Copenhagen School of Design and Technology
Department of Research and Innovation
Guldbergsgade 29N, DK 2200 Copenhagen N, Denmark
jajo@kea.dk

Abstract

This paper aims to contribute with results in relation to the challenges that users encounter with regard to technologies in sustainable social housing. The results are significant and show that in modern Danish sustainable social housing consideration is not taken for the users in relation to the technologies implemented in the buildings. The consequences are that the intentions of the technologies supporting economic, environmental, and social sustainability do not work for the users when the buildings are taken into use. The paper argues that developers and architectural practice should in future use simpler technologies that give residents the opportunity to individually regulate their homes' indoor climate. At the same time, architecture and technology should reflect the consideration towards the climate in the local context and the users' fundamental living conditions. The paper argues for the development of a more user-oriented architecture, where the interaction between architecture and technology can work for the users and to a greater extent support the intentions with regard to sustainability.

Keywords

architecture, sustainability, technology, users, phenomenology

1 INTRODUCTION

If our own culture can be changed as a consequence of environmental problems, then sooner or later it will influence architectural design as a reflection of our cultural and social values (Bech-Danielsen, 2005, p. 14). Over the years, Danish architects and the social housing sector have provided different architectural answers to these complex challenges in the form of sustainable social housing in order to meet a sustainable transition.

The challenges are however that sustainable social housing is typically different in its design than ordinary construction. Sustainable architecture can be different in terms of heating, ventilation, the technologies used, etc. It implies that these homes are different with regard to the necessary knowledge and handling of the operating conditions (Jensen, Jørgensen, Elle & Lauridsen, 2012, p. 21), as well as the functionality of the building's sustainable intentions (Jensen et al., 2012, p. 99-100).

The Danish social housing sector has in general considerable expertise and better conditions for carrying out sustainability goals in the running of their buildings in relation to other forms of ownership (privately owned and privately rented). There is strong engagement in sustainable issues amongst administrators, who have experience in relation to being entrepreneurs for both many and large units. The weaknesses are that the residents' ownership of the building is often small and often has a short time frame in relation to long-term investments, which is a requirement for sustainable construction (Nielsen, Jensen & Jensen, 2012, p. 12).

Sustainable architecture should be simple, since it is so-called "ordinary people" who will live in it (Bordass & Leaman, 2013, 34:44-36:22) because they want to live as "ordinary" a life as possible without being particularly interested in the environment or showing particular interest in sustainable ways of living (Jensen et al., 2012, p. 19). The users' consumption and behaviour (Shove, 2003, p. 1-20) – and hence lacking or unintended consequences of this in relation to the intentions – must not be used as an excuse by the architects and other experts when sustainable construction does not work. The users' behaviour must be understood and influenced in a respectful way. If long-lasting sustainable solutions are to be met, then architectural practice must approach the task with a humble, respectful approach to the users (Bordass & Leaman, 2013, 34:44-36:22).

Complex requirements are placed on architectural practice, with a comprehensive understanding of all aspects of sustainability. In this regard, architectural practice must be able to professionally engage in a broad range of disciplines and specialities. At the same time, design requirements are also made in relation to the users' role (Bordass, Leaman & Willis, 1994, p. 1-8) and that the users' role gives rise to requirements for the building's operation (Leaman & Bordass, 1993, p. 4-14; 1997, p. 1-10). Architectural practice should therefore direct its focus towards the users' role and requirements for the building's operation in order to be able to achieve intentions for sustainability's so-called "triple bottom line" (Twinn, 2012, p. 128).

2 Architecture, Users, and Qualitative Evaluation

There is a need for the development of more sophisticated assessment strategies in the interaction between the human factors and buildings' physical capacity. Quantitative assessments of construction cannot stand alone but should instead be supplemented with qualitative assessments of residents' expectations, meanings, perceptions, and behaviours (Stevenson & Leaman, 2010, p. 571). This supports a need for new methods and new knowledge with a greater focus on the process as well as making the qualitative (soft) values of existing construction visible (Madsen, Beim, Reitz & Bang, 2015, p. 74-78).

More knowledge about the interaction between residents, administrative staff, and operating staff is valuable for those developing new housing as well as its subsequent operation (Leaman, Stevenson & Bordass, 2010, p. 575). We should focus on the building as it is used so that the experiences can be utilised in the design process of future constructions (Stevenson & Leaman, 2010, p. 571), where residents are often the best judges of buildings and can contribute with valuable feedback (Grierson & Moultrie, 2011, p. 632).

In this connection, this paper would like to contribute to the discussion with results as well as in relation to the challenges the users encounter with regard to technologies in sustainable housing architecture. The paper suggests challenges that could also have an impact when developers and architects develop new buildings. The contributions to the discussion are based on the results from a qualitative evaluation of sustainable housing from the author's

PhD project (Johansson, 2017) entitled: “Sustainability in Danish social housing – with a user focus”.

2.1 Research Question

The guiding research question for the PhD project is: Does the sustainability in sustainable social housing work for residents, operating staff, and administrative staff? And this also included the sub-questions: What are the users’ experiences of sustainable social housing? How can the users’ experiences be used in the development of future sustainable social housing?

2.2 Theoretical Aspects

In using a phenomenological approach, the PhD project’s study design has taken its starting point in the early Husserl’s epistemological preoccupation of investigating people’s realisation and describing their experiences of the phenomena (Zahavi, 2006, p. 12-18). The task has been to go “to the issue itself” without preconceived opinions and theories (Rendtorff, 2003, p. 279-281). There is no objective, independent research object but in contrast a subjective experience and the attribution of meaning in particular life worlds (Justesen & Mik-Meyer, 2010, p. 26; Mo, 2003, p. 57-59).

In principal, phenomenology was chosen in order to have an open and unbiased opportunity to capture people’s life worlds. At the same time, this approach has an impact on the methodological research method, where the use of the interview as a method (Kvale & Brinkmann, 2015, p. 48-55) can contribute to the issue with many spontaneous, rich, and specific answers, as well as an ideal of achieving “thick descriptions” (Geertz, 1973, p. 3-30).

2.3 Criteria for Case Selection

The study is limited to including three family-friendly and sustainable terraced social housing buildings in Denmark. The buildings are experimental constructions that have neither been renovated nor rebuilt after being taken into use. The choice of buildings that have not been renovated and/or rebuilt after being taken into use is because the aim is to capture the users’ experiences with buildings that have been taken into use over a longer period in relation to the original intentions regarding sustainability. The choice of multiple cases is made in order to strengthen the precision, validity, and stability of the results (Neergaard, 2010, p. 21-22).

The three case studies are chosen based on the criteria of maximum variation. By choosing a small number of cases with maximum variation, the data gathering and data analysis will give two kinds of result. Firstly, it provides detailed descriptions that can document unique features in the individual cases. Secondly, it can identify important common patterns across the cases, which has vital importance (significance), because they occur on the basis of heterogeneity (Neergaard, 2010, p. 21-26).

With reference to “documenting unique features” in the three cases, the following criteria are chosen: Case 1: “Økohus 99” - sustainability: low-energy construction (little) with ecological initiatives; Case 2: “Lærkehaven III” - sustainability: low-energy construction (a lot) according to the Passive House standard; Case 3: “Grøndalsvænge” - sustainability: low-energy construction (medium) sustainable building operation with increased self-management.

Figure 4. “Økohus 99”

Figure 2. “Lærkehaven III”

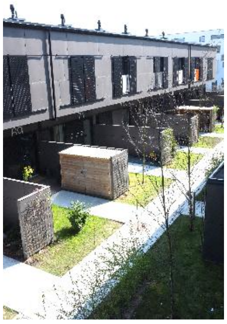

Figure 3. “Grøndalsvænge”

2.4 Methods

For each of the three case studies, the following three combinations of methods are used: semi-structured deep interviews (method 1), semi-structured focus group interviews (method 2), and structured deep interviews (method 3). In this way, the strength of validity was sought with the help of three subsequent follow-up methods as the basis for a triangulation of methods (Halkier, 2008, p. 15-18; Barbour, 2007, p. 44-47). Seventeen semi-structured deep interviews, three semi-structured focus group interviews, and six structured deep interviews were carried out.

In method 1, the residents (snowball sampling), operating staff (key people), and staff from the operating administration (key people) were interviewed individually using semi-structured deep interviews. The essences of phenomenological analysis (Tanggaard & Brinkmann, 2010, p. 51) have been used to formulate the questionnaire for method 2.

In method 2, the same users were invited to participate in semi-structured focus group interviews (Barbour, 2007, p. 38). The essences from the phenomenological analyses from method 1 and method 2 were used as the questionnaire when carrying out method 3. The coupling of identical results from method 1 and 2 contributed to a further strengthening of validity and potential generalisability in relation to typical features (Dahlberg, Dahlberg & Nyström, 2008, ch. 4; Giorgi & Giorgi, 2003, p. 243-273). The qualitative focus group interview is chosen in order to be able to see patterns and general processes, categories, and dynamics in the user groups. It is based on these elements that generalisations can be made (Halkier, 2008, p. 111-112). The criterion about communicative validation (Kvale & Brinkmann, 2015, p. 325-337) was furthermore brought into play in method 2, since parts of results from the analysis are presented to the interviewees, who have contributed to the empirical material and in that way are a part of validating the analysis’ results.

In method 3, both the developers (key people) and the architects (key people) were interviewed individually using structured deep interviews (Justesen & Mik-Meyer, 2010, p. 56) with a view to whether the users’ experiences could be used in the development of future sustainable social housing. The essences from the phenomenological analyses (methods 1 and 2) gives rise to new questions to be used in preparing the interview guide and carrying out method 3.

3 Casestudies

3.1 Case 1: "Økohus 99"

The "Økohus 99" settlement was finished in 1998, and is the result of an architecture competition for the construction of what could be called first-generation, low-energy terraced houses with ecological initiatives.

Typical sustainable characteristics are the zoned house, exploiting the passive heat from the sun in the "sun house". In addition, the buildings have ecological initiatives in the outside areas in the form of a lake collecting rainwater with a root zone system and water channels. The water channels are an integrated part of the homes' cooling system. In order for the intentions behind the architecture to work, a high degree of user involvement is required.

3.2 Case 2: "Lærkehaven III"

The "Lærkehaven III" settlement was finished in 2010, and is the result of an international project competition, with the goal of being able to display sustainable residential architecture according to the Passive House standard. The buildings have green common areas and a lake that collects rainwater, with adjoining water channels as additional environmental, sustainable initiatives. Its function is to counteract flooding and unnecessary loads on the sewer system.

Typical sustainable characteristics are the highly insulated, low-energy house and represent the first larger terraced social housing in Denmark in accordance with the principals of the Passive House standard. The requirements are that the houses, without help from renewable energy sources, are allowed to use a maximum of 15 kWh/m2 per year on heating and cooling. In addition, there is a requirement regarding the building's airtightness, which is not allowed to be greater than 0.6 m3/h/m3 (Jensen, Jensen & Gram-Hanssen, 2014, p. 76-77; Beim & Vibæk, 2013, p. 210-216). This approach to sustainable architecture is defined as the "eco-technical logic" (Guy & Farmer, 2001, p. 141-142), which is characterised by having a top-down view of environmental changes that occur with the help of integrated energy-efficient high-tech solutions in the construction.

3.3 Case 3: "Grøndalsvænge"

The "Grøndalsvænge" settlement was finished in 2012, and is the result of a concept that mainly combines reducing the cost of production with the residents' increased self-management in running the building.

Typical sustainable characteristics are the highly insulated, low-energy house built according to energy class 2020. The buildings are built with mechanical ventilation with heat recovery. In addition, the residents' "do-it-yourself" involvement in the home's flexible layout, operation, and maintenance, as well as the building's operation is a representation of social sustainability. "Grøndalsvænge" seems to represent two trends at the same time. On the one hand, the "eco-technical logic" with a focus on the construction and energy efficiency. On the other hand, the "eco-social logic" with a focus on the users' social dimension in the form of "do-it-yourself" and involvement in the operational aspects (Guy & Farmer, 2001, p. 141-146).

4 Discussion and conclusion

A pattern emerges between “Økohus 99”, “Lærkehaven III”, and “Grøndalsvænge” in relation to the implementation of complicated building-integrated technologies, whose aim is to ensure that residents have a good indoor climate and to encourage economic, environmental, and social sustainability. The results show a connection between overcomplicated technologies that have not worked for the three user groups in the operating phase in terms of environmental or social sustainability.

The reasons have been, amongst others, that residents, operating staff, and administrative staff do not know about the technologies and the functionality, that the technology has been shown to have defects, that the technologies have not been set up correctly when taken into use, and that the residents use the technologies incorrectly. The resulting effect is, amongst other things, an increased energy consumption, which can have imposed unfair additional expenses on the residents in the operating phase.

If the administrative staff have not received the necessary knowledge and information about the technologies (e.g. from the developers, advisors), then it can be said that they are not able to pass on the know-how to the operating staff. For the operating staff, this means that if they cannot get basic information about the technologies from the administrative staff, then they are dependent on getting technical information from somewhere other than the housing organisation (e.g. external service providers, calling the supplier). Finally, the residents are dependent on getting information and insight from the operating staff or the administrative staff. If the residents cannot get the necessary background information from one of these two user groups, then they are dependent on getting the technical insight from other sources (e.g. the Internet, neighbours, friends, family).

On the one hand, it can be claimed that the three user groups themselves have a responsibility to acquire sufficient basic knowledge. They could certainly be more insistent internally in the housing organisation and in relation to the building’s external partners in order to get the necessary basic knowledge required to operate and live in the sustainable terraced houses.

On the other hand, it can be claimed that the results essentially show failure with regard to the housing organisations’ efforts to ensure that the residents, operating staff, and administrative staff receive sufficient knowledge about the technologies in the sustainable buildings. This shows an underestimation of the negative impact that the users’ lack of basic knowledge has on the environmental and social sustainability. It can be argued that technology, architecture, and sustainability are dependent on each other. At the same time, this indicates that the technologies have become overcomplicated and unusable for so-called “ordinary” users.

It is possible that the developer is not aware that the users’ lack of knowledge about the technologies is a hindrance in terms of the environmental and social sustainability. Conversely, the author believes that the developer, on behalf of the three user groups, has the overall responsibility to ensure that a social housing development is well run – also with regard to the issue of technology. Therefore, it should be the developer who finds solutions to this issue. Could complaints be directed at the advisors, entrepreneurs, etc.? Should the developer not be more interested in an actual solution to the problems that are close to the users?

It has been established that there are defects in the technology and that the technologies were not set up correctly when first taken into use. In addition, the combination of a highly insulated building construction and the technology has consequences in the form of poor indoor climate (e.g. overheating, dry indoor climate causing eye irritation, the drying out of residents' mucous membranes or hands). There is furthermore a common pattern, where the residents move out of the buildings for the above-mentioned reasons.

Also, the consequences have been that the residents, because of their reluctance, have developed a behaviour that works against the technologies. The administrative staff in believe it is worth noting that when working with renting out social housing, the building should not be so complex for the residents as it is in "Økohus 99". The complexity of, for example, self-regulating heat management and ventilation should instead primarily work automatically. Otherwise, according to the administrative staff, it will not work. Bordass and Leaman suggest that it is difficult to dictate to users that they should do something in particular. They point out that it is, in general, our buildings that are dictatorial, since they consume more energy than they need just to be inhabitable.

Figure 4. "Økohus 99"

Figure 5. "Lærkehaven III"

Figure 6. "Grøndalsvænge"

On the one hand, defects and the incorrect settings on the technologies lead to additional expenses, frustration, and poor indoor climate for the residents. The defects lead to frustrations for the operating staff and administrative staff, as well as unexpected operating costs for external service providers, the changing of filters, greater operational vigilance, etc. On the other hand, defects and the incorrect settings of the technologies must be directed to the suppliers, since the developers must expect to receive the faultless technology that has been paid for. The incorrect setting up of the technologies must be directed to both the entrepreneurs and the advising engineers, since this is their area of responsibility.

Administrative staff, operating staff, and developers suggest that the technologies' lack of functionality is caused by the residents' behaviour and incorrect use. It is true that some of the residents use the technologies incorrectly. However, this is an oversimplified causal explanation. The results of the study instead paint a picture of other and different types of issue that have made it impossible for the residents to use the technologies correctly. The reasons have primarily been a lack of knowledge and information, lack of user involvement, as well as a lack of communication. And if one or more of these parts has not been present, it can lead to the residents losing their motivation in relation to the technologies, the result being incorrect behaviour and use.

At the same time, there is a worry that Danish social housing is influenced by the supplier's desire to sell their products on the pretext of "sustainability". Who says that sustainable construction has to have, for instance, mechanical ventilation with heat recovery? Who says that you have to have a technology so complicated that it makes it difficult to use in practice? When do the developers put their foot down to the suppliers, the entrepreneurs, and the advisors?

User satisfaction is increased the less complex the technology is and the less the technology requires in terms of operational vigilance. In addition, user satisfaction is increased the more context-dependent the architecture is, in combination with the users' opportunity to be able to regulate the architecture's technologies themselves, and in that way be able to adjust the home's indoor climate (Leaman & Bordass, 1997, p. 1-10). In conclusion, it is thus argued that the three cases are representative of complicated technologies, where significant results from the three user groups' show a context that has not supported the planned economic, environmental, or social sustainability of the buildings in the operating phase. The lack of interest, knowledge, and information about the technologies amongst the user groups thus shows important common patterns across the cases and can therefore be vitally important (significant), because they occur on the basis of heterogeneity.

The results indicate the importance of the residents working with routines in interaction with the climatic seasonal variations in order to get the homes' indoor climate to work appropriately for all cases. In addition, there is also a need for new methods of passing on information and knowledge to the three user groups with regard to the use of the building-integrated technologies. In order to meet a need in relation to a more resilient and sustainable architecture, one possibility could be to find inspiration in the interaction between the constructions and building-integrated technological solutions found in traditional climate-adapted architecture (Dahl, 2010).

The goal in the development of future Danish social housing could benefit from investigating and using the experiences of the users in the local context, and in that way designing simpler architectural and technological solutions with a greater opportunity for the residents to individually regulate their home's indoor climate. The point is that the shaping of sustainable housing should go "hand in hand" with user satisfaction. Here, simpler architectural and technological solutions could contribute towards a more resilient architecture and thus a more user-oriented sustainable architecture.

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01.108 - HOPE AND COMMUNITY ENGAGEMENT: THE MEDELLIN CASE

José BERNARDI, Associate Professor

Institution
ASU Herberger Institute for Design and the Arts
The Design School
PO Box 871605
Tempe, AZ 85287-1605, USA
Jose.bernardi@asu.edu

Abstract

Medellin, with a population of 2.460 million, is the second largest city in Colombia. By the early 1990s Medellin had become synonymous with the activity of drug cartels, and most of the population lived lacking any hope. When Sergio Fajardo became the mayor in 2003 until 2007 he set an ambitious political agenda determined to change this situation and transform the city. By addressing violence and poverty, the objective was to transform lives though a collaborative design process involving all stakeholders. The focus of the interventions produced ten Park Libraries. This process resulted in the design of interiors capable of accepting limitations -regulations, programs, budgets- achieving a transformation where basic decisions about the size, distribution, materials, and relations contributed to integrate and improve the quality of life of people in peripheral areas.

The innovative interiors produced during this transformation had been generally eschewed by academic circles and publications dedicated to explore interiors. The relevant narrative about the reemergence of Medellin focused mostly on the urban impact and the architectural features of some of those most iconic buildings, leaving aside an analysis of the interior spaces, where most of the daily communal and individual activities happen.

Based on interviews and conversation with some of the most significant designers involved in the design and construction process, this paper attempts to expand the critical reflection on the role of the metropolitan condition of the interiors in the city exploring the porous relations between city, politics, interior spaces and the impact they have in safety, self-relicense, healing, and hope in marginal communities in Latin America.

Keywords

Medellin. Transformation. Innovation. Re-emergence. .

1 INTRODUCTION

As part of a larger and more comprehensive urban renewal, the focus of the interventions in Medellín resulted in ten Park Libraries. [1] The innovative interiors produced during this transformation had been generally ignored by academic circles and publications dedicated to study this process. The relevant narrative about the reemergence of Medellin focused mostly on the urban impact and the architectural features of the most iconic buildings, leaving aside

an analysis and appraisal of the interior spaces, where most of the daily communal and individual activities happen.
This process resulted in the design of interiors capable of accepting limitations such as regulations, programs, budgets. The interiors were able to provide a sense of "interiority". In the middle of violence and poverty, these spaces offered to each individual the possibility to purposefully engage with their own inner self.

2 Methodology

First, the paper will analyze in larger terms the steps taken to regain public spaces in peripheral communities and bring people together into the interior realm for personal growth and community empowerment. This approach meant to plant "a seed of trust" by building schools, parks, and libraries, while placing, as Fajardo many times stated, "the most wonderful buildings in the poorest sections" of Medellín. Later, the paper will analyze the qualitative components and design strategies employed in the design of the Park Libraries to understand the larger cultural and political implications and connections between interiority and social inclusiveness.

3 Discussion

Most of the park libraries were designed by a generation of architects educated in the same school in Medellín, working in collaboration with their former instructors. All of them shared core values about how to resolve this wicked problem, advancing a cohesive local design agenda able to impact contemporary design thinking.
In collaboration with the private sector and the community, the city of Medellín created a vast collaborative enterprise involving all stakeholders. Leading the efforts of implementing the ambitious integral urban project through the EDU, the Empresa de Desarrollo Urbano was the Secretary of Public Work, Alejandro Echeverry. As a result of this collaboration and community involvement, the new park libraries were not conceived as isolated objects, but rather as part of a network of new infrastructure and buildings. All were integrated to address the specific issues affecting each community. The focus was how to provide accessibility to educational and recreational spaces, as well as equity in the distribution of resources with the objective to make the city "the most educated." Among the improvements was the implementation of a comprehensive system of transportation. A series of escalators and a cable system of "gondolas" offered the opportunity to access the neighbourhood safely, while reducing the time and cost.
There are two larger, distinctive design strategies when resolving the basic parti of the park libraries. One of those approaches is to design the library as a monumental, sculpted mass with an iconic presence in the urban fabric. An example of this approach is the celebrated Library Spain, located in the troubled Santo Domingo Savio neighbourhood, and designed by Giancalo Mazzanti and his team. A second example is the Botero Library, located in the community of San Cristobal, by G Atelier, with Orlando Garcia and Adriana Salazar as principal designers. Both buildings have a monolithic, muscular presence, and offer an identity to the area, while subtly echoing features of the neighbourhood and surrounding landscape. The bold volumes wrap interior spaces not legible from outside. The interior is understood as a place of withdrawal and refuge, disconnected from the immediate surroundings. There are random views of the distant mountains and the city below through urban perforation, clearly

creating an “inside” atmosphere different from the outside. It encourages a more introspective atmosphere.

The other approach is conceived as light containers carved in the topography, with regular, modular shapes adapting to the gently slopes of the land. These simple, similar volumes face different areas of the landscape and are interconnected by trellises, terraces, platforms, stairs and ramps. The interior volumes are visually open to vast views, and the activities and events appear more visible. The focus is on transparency that links the inside, transitional spaces and the outside. It encourages a more contemplative atmosphere.

An example of this parti is the Park Library León de Greiff in La Ladera, by The Mazzanti Team. There is also the Park Library Tomas Carrasquilla in La Quintana, by Ricardo La Rotta Caballero. Another example is the Park Library Presbítero Arroyabe Restrepo in San Javier, by Javier Vera Londoño.

One approach is a more protective and filtered environment defined by its withdrawal from the outside. The layered architectural shell involves the inside environment to recreate a peaceful, detached place. Another approach is defined by its openness to contemplate the vistas. This second strategy is structured around lean containers acting as a threshold, framing the interior as a transparent, liminal environment. Transcending the architectural boundaries, these two strategies impact differently how the interior operates, and they manifest two different understandings of the role of the interiority as a driver of community engagement, social responsibility and equity.

The Spain Library was inaugurated in 2007 with a visit by the monarchs of Spain. The building immediately received international attention, becoming the political and cultural symbol of a new Medellin.

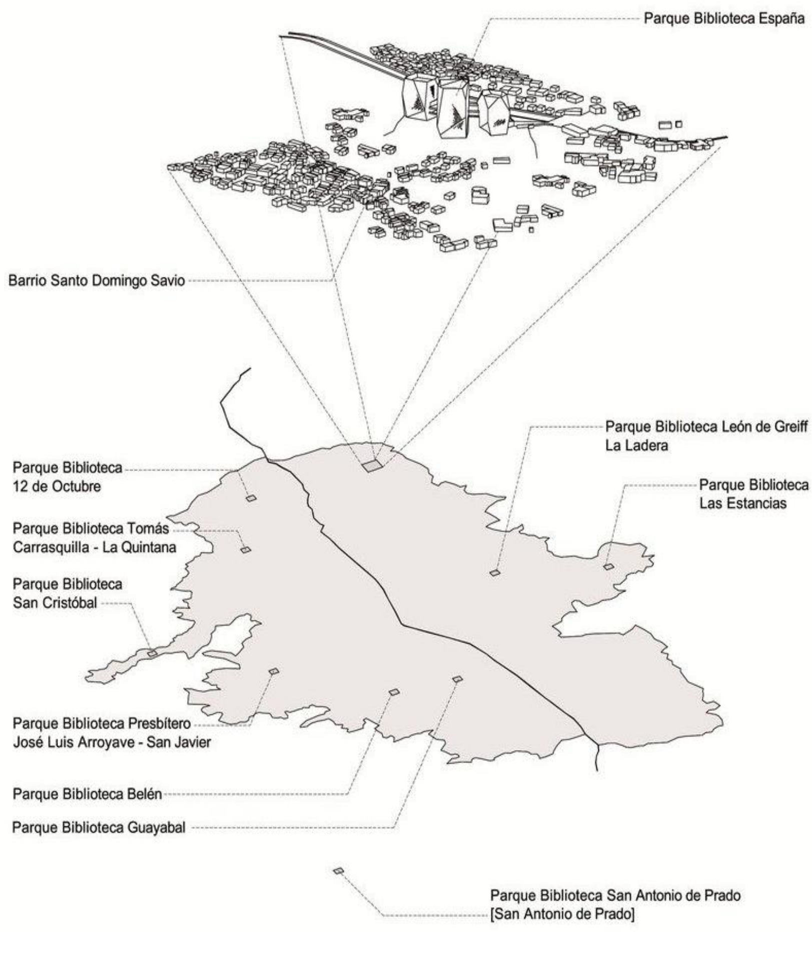

Figure 1. The system of Park Libraries in Medellín

Because of its visibility, up in the mountains, the most iconic park library is located in Santo Domingo Savio, in a fragmented and dangerous neighbourhood. The Spain Library's image became the symbol of Medellin's incredible renewal and the boundless hopes of the residents of this barrio. Giancarlo Mazzanti, reacting to the success of the project, stated "Buildings are not objects. Architects don't make iconic buildings. People make them iconic." [2]

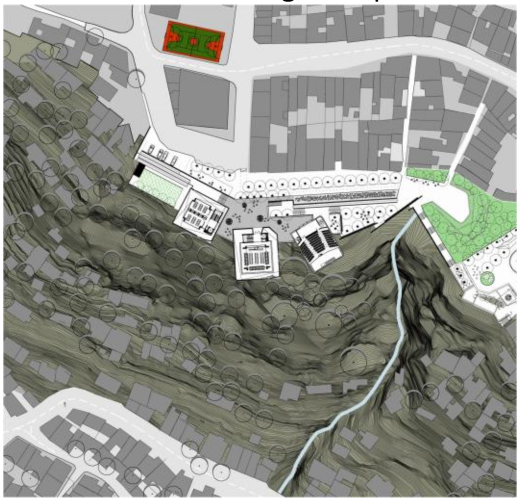

Figure 2. The boulders, Spain Library, site location

In a conversation with the author in 2014, Juliana Zambrano, member of the Mazzanti Team, reflected on their efforts to envision the library as "spaces where discussion could take place, offering a mechanism of social inclusion, and triggering new relationship and behaviors, with more public spaces, meeting points and better living conditions."

In Santo Domingo Savio, Mazzanti attempted to explore "how to develop projects that can generate social inclusion. And this is not just a matter of locating buildings in degraded areas. It also implies the capacity to create new forms of behaviour, belonging to and offering pride to the community." [3]

The site is surrounded by brick houses built by their owners without planning or regulations. As a response to limited land available and the ambitious set of activities proposed, the program was grouped in three trapezoidal "boulders" interconnected by a platform. The height of the "boulders," eight levels, is partially absorbed by the steep slope of the hill overlooking the valley. The height offers an iconic view from the city below while maintaining the façade facing the barrio at a lower scale.

A metallic frame, filled with concrete and cladded in black ionized slate, constitutes the hard exterior skin of the building. Detached and independent from this skin are the bones of the building, a concrete structure containing the interior volumes. A shell within the shell, the interior spaces offer multiple possibilities of seclusion, intimacy and study. Quiet areas are interconnected to more public, dynamic multi-use spaces, such us an auditorium, library, computer room, gym, and child care center. The spaces are also secluded from the outside. While the exterior membrane becomes part of the hill, randomly placed windows offer views of the valley and the sky from inside.

By purposely withdrawing the interior from the familiar and immediate daily context, these interiors offer the possibility to each person at the library to engage with larger, unexplored worlds through reading, conversation, and activities. Web access, new technologies, and equipment facilitate a slow process of individual learning and personal intellectual growth. The library offered new courses, encouraging communal activities and entrepreneurship, and workshops to learn different crafts. The result was a revitalization of the culture in the city. By offering the possibility to people of spaces to behave physically and mentally differently, the library is a place of regeneration and healing, transcending traditional typological and functional expectations. The interior became a healing place.

Figure 3. Interior views, Spain Library

The new facilities attracted visitors and tourism, and their presence contributed to the appearance of small business, revitalizing the community. The change brought improvements to the quality of the construction in the area. As a result of this energy there was a different and more favorable perception of the barrio combined with a renewed sense of pride.
The impact of a new facility in the community is also evident at the Botero library in San Cristóbal, a low-income community. The valley on the west side of Medellín is known for the production of flowers and vegetables. Designed by G Atelier Arquitecture, San Cristóbal's basic *parti* is an elongated volume floating over the undulating morphology of the hill containing an internal central path or street. Openings in the building, described by the designers as "urban perforations," reference the windows in the modest houses of the surroundings. The longitudinal central street connects large and small spaces on either side of the building. The interior in itself becomes a small village located in the center of the town.

Figure 4. Fernando Botero Library, and children's reading room San Cristóbal

Austere finishes in plaster create sharp contrasts of light and shade, revealing the infinite formal possibilities of the carved, protective shelter. The children's reading room synthesizes the magical possibilities of a quiet interior with interlocking cubes in pastel color framing a surreal backdrop of a luminous sky as a background. As in other cases, the new building encouraged new business and prompted improvements in the surrounding properties, proving the regenerative power of interiors in a community.

The Park Library Tomas Carrasquilla in La Quintana, by Ricardo La Rotta Caballero, is a transitional *parti*. The library, near a metro cable station, is located in the northwest central area of the valley. Because of the combination of enclosed spaces with semi-open galleries and trellises, this *parti* is a hybrid between the two extremes of closeness and openness, adapting in some cases to the slopes and views, and formally interconnecting a carved interior defined by subtraction and screened perforations.

Figure 5. The Park Library Tomas Carrasquilla in La Quintana, by Ricardo La Rotta Caballeroa

The Park Library Leon de Greiff in la Ladera, by Giancarlo Mazzanti, is characterized by openness. The structure has three modular containers interconnected by a series of terraces, ramps and stairs. The volumes appear as floating on the slope. Screens, mobile panels, vinyl floors and glassed areas with coloured resin identify the different educational activities. These spaces are furnished to create an atmosphere of dynamism and flexibility. Patios, terraces and mobile blinds control the degree of light and openness while providing crossed air circulation. Similarly, the Park Library Sacerdote José Luis Arroyave Restrepo, in San Javier, is a *parti* based on a series of aligned terraces adapted to the slope of the hill with ample roof terraces. They are simple concrete boxes containing an interior in subtle dialogue of people with the site and the geography. These interiors provide an opportunity for thoughtful contemplation and reflection.

Figure 6. The Park Library Leon de Greiff in la Ladera, by Giancarlo Mazzanti.

4 Conclusions

In 2013, landslides and winds compromised the integrity of the skin and structural concerns prompted the removal of 30 percent of the slate of Spain Library. The iconic building up the hill was closed to the public. Since then repairs had been mired by delays and lack of information. Dario Gutierrez, a member of the barrio explained to a local newspaper, “When the building was functioning, this was very good for the community”, making possible “a safe environment.” Now, with the library “left abandoned, this is a phantom.” Many shops closed, affected by the lack of tourism and visitors. This sense of abandonment is expressed also by another member of the community. “This place contributed to lift the community. Before, you could hear the construction crews working, now everything is silent.” [4] Adolfo Taborda Molina, a communal leader in the barrio reflected about how the closing saddened the community. With the furniture removed, the library is silent now, affecting the community ”socially, culturally and emotionally.” [5]
These comments reflect the incredible value a sense of “interiority” offers and its potential to contribute to good individuals and healthy communities. [6] In spite of this setback for the people of Santo Domingo Savio, the park libraries continue to provide their transformative contribution to other communities. Since its inception, the rest of the park libraries system are the physical manifestation of design as a response to the needs of marginal populations, and the ethical imperative of inclusion and equity through design. With its triumphs and setbacks, the Medellín case offers a strategic vision, incorporating interiors environments and the condition of “interiority,” at the core of the efforts to enrich the lives of individuals and change the city culturally and physically through inclusion in design.

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01.109 - HIDDEN IN PLAIN SIGHT: ALIGNING THE ACADEMY & PRACTICE

Ashlie Latiolais, AIA, NCARB

School of Architecture & Design, University of Louisiana - Lafayette
P.O. Box 43850, Lafayette, Louisiana 70504-0001 alatiolais@louisiana.edu

Jonathan Boelkins, AIA, NCARB

Fay Jones School of Architecture & Design, University of Arkansas
120 Vol Walker Hall, Fayetteville, Arkansas USA 72701 jboelki@uark.edu

Abstract

As the skills required for creating architecture continue to broaden and deepen, integrating professional experience into architectural education will be increasingly necessary. The focused and strategic combination of academic and professional experience has the potential to address this misalignment and to create graduates that are more adaptable and broadly capable than through academic experience alone. Professional Practice courses become an obvious venue for discussing and exploring new opportunities for alignment between the architectural academy and the profession. The Professional Practice courses compared and contrasted in this paper address and resist this deepening by offering focused, project-based assignments that consider areas of practice outside of production; areas of practice that are unfortunately overlooked as opportunities for advancement.

Keywords

Practice, Future, Demands, Technology, Skills, Internship

1 THE DISPARITY

Professional Practice courses are ideal for examining and investigating the broader skills required for success and advancement in architectural practice. In most curricula, only three to six credits are allocated to the development or even awareness of the vocabulary of practice. This inadequacy of professional development during architectural education is a missed opportunity when a distinct majority of students surveyed in the two Professional Practice courses in NAAB-accredited programs under consideration here wish to have their own office eventually. However, virtually none of the students have any formal training in any aspect of business – accounting, finance, human resources, strategic planning, marketing, etc. This deficiency is compounded by declining communication skills, especially regarding writing and public speaking, as exemplified in studio coursework and presentations as well.

Architects are simply not trained for the breadth of skills required in architectural practice and are especially ill-equipped to start a practice. Project-based assignments are utilized to expose other areas besides the realm of Basic Services (see Figure 1) - one through an extensive series of hypothetical assignments, the other through a quick and intense design-build exercise. These courses reveal the areas of practice that are unfortunately overlooked as opportunities for advancement and the skills they require.

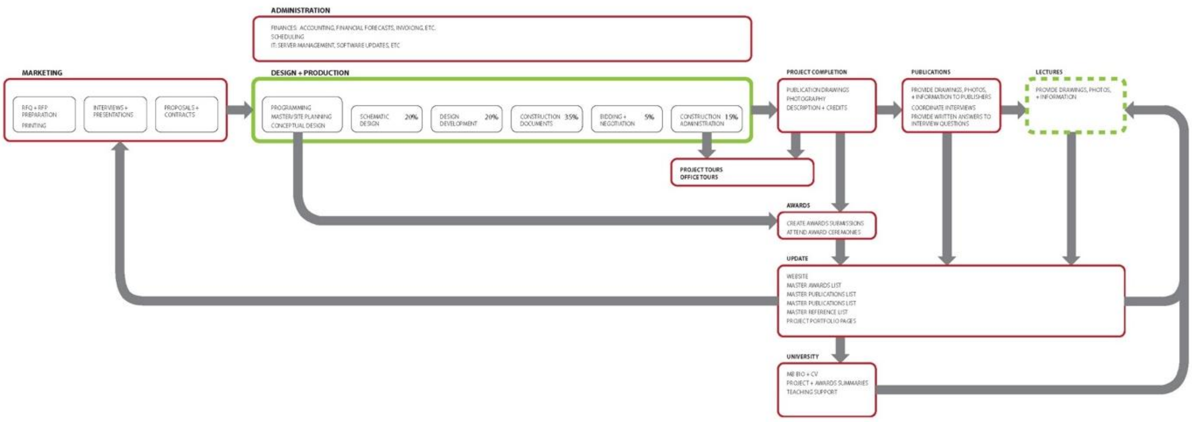


Figure 5. Firm Operations Diagram_J.Boelkins

2 Methodology

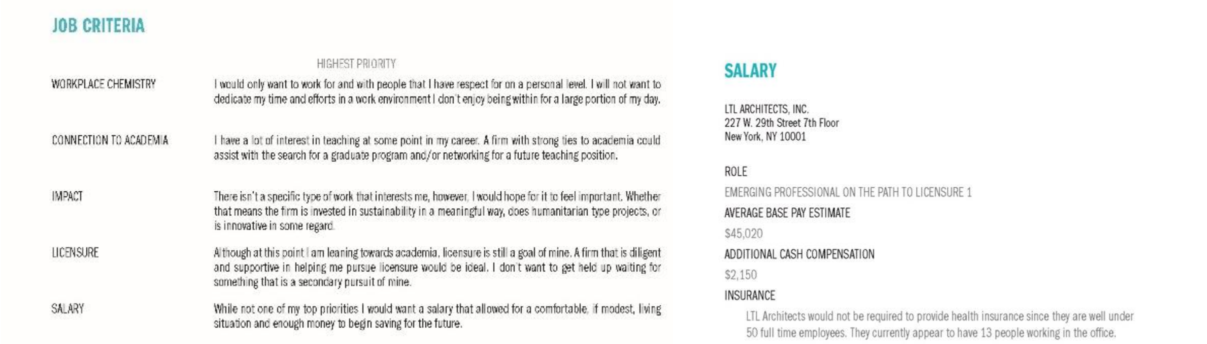
To further highlight the disparity between architectural education and skills required in practice and the importance of a pedagogical bridge between them, more than two thirds of the students surveyed in the Professional Practice courses considered here expressed interest in having their own practice. While unlikely that so many will in fact develop their own firm, the vast majority will still need the broad skill set required to advance in the profession, most of which are not directly developed in their architectural education. A focused and strategic combination of academic and professional experience has the potential to create graduates that are more adaptable and broadly capable than through academic experience alone. Professional Practice courses in particular become an obvious venue for discussing and exploring the disparity between the skills provided by the architectural academy and the skills required by the profession. Therefore, integrating professional experience and a broader comprehension of the skills required in practice into architectural education will be increasingly necessary as the skills required for creating and practicing architecture continue to broaden and deepen.

The Professional Practice courses compared and contrasted in this paper embrace the broadening and deepening of the profession described in Eric Reinholdt's thesis of 30x40 Workshop, which states "There's no longer one model of design practice; you're free to create your own. Embrace failure as an integral part of your process and as you pivot and try new things you'll find the intersections of your talents and the world's needs; that's where you'll find your business."[1] Although studio coursework is the predominant focus of architectural education, creating an interplay of engaged processes can address neglected areas of development. By offering focused, project-based assignments - one through an extensive series of hypothetical assignments, the other through a quick and intense design-build exercise – these courses consider areas of practice outside of production, areas of practice that are unfortunately overlooked as opportunities for advancement.

By developing a richer understanding of practice through these project foci, interns can gain more comprehensive experiences through exposure to the highly varied processes involved in firm operation. Rather than reinforcing a relatively narrow set of skills, professional practice coursework and structured internships thus reveal areas of deficiency which are, of course, also areas of significant prospect.

3 Case Study: Project-Based Assignment 'A'

While gathering experience and developing skill in the 'production bubble' is important and completely valid, many young architects are unaware of the opportunities for advancement that exist in other areas of firm systems. In effect, the Professional Practice course in Case Study A, endeavors to meet students where they are, as fourth year undergraduates in an accredited Bachelor of Architecture program, and fast forward their lives over the next four years. This arc takes students through the process of pursuing employment to getting hired, exposing them broadly to the complexities of architectural practice, up to the point of completing their internship requirements, becoming licensed architects and considering the possibility of opening their own offices. As a requirement to the course, students enroll in the National Council of Architecture Registration Board's (NCARB) Architectural Experience Program (AXP) and are introduced into the process of gaining and recording experience towards licensure.


JOB CRITERIA

HIGHEST PRIORITY

WORKPLACE CHEMISTRY	I would only want to work for and with people that I have respect for on a personal level. I will not want to dedicate my time and efforts in a work environment I don't enjoy being within for a large portion of my day.
CONNECTION TO ACADEMIA	I have a lot of interest in teaching at some point in my career. A firm with strong ties to academia could assist with the search for a graduate program and/or networking for a future teaching position.
IMPACT	There isn't a specific type of work that interests me, however, I would hope for it to feel important. Whether that means the firm is invested in sustainability in a meaningful way, does humanitarian type projects, or is innovative in some regard.
LICENSURE	Although at this point I am leaning towards academia, licensure is still a goal of mine. A firm that is diligent and supportive in helping me pursue licensure would be ideal. I don't want to get held up waiting for something that is a secondary pursuit of mine.
SALARY	While not one of my top priorities I would want a salary that allowed for a comfortable, if modest, living situation and enough money to begin saving for the future.

SALARY

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ROLE
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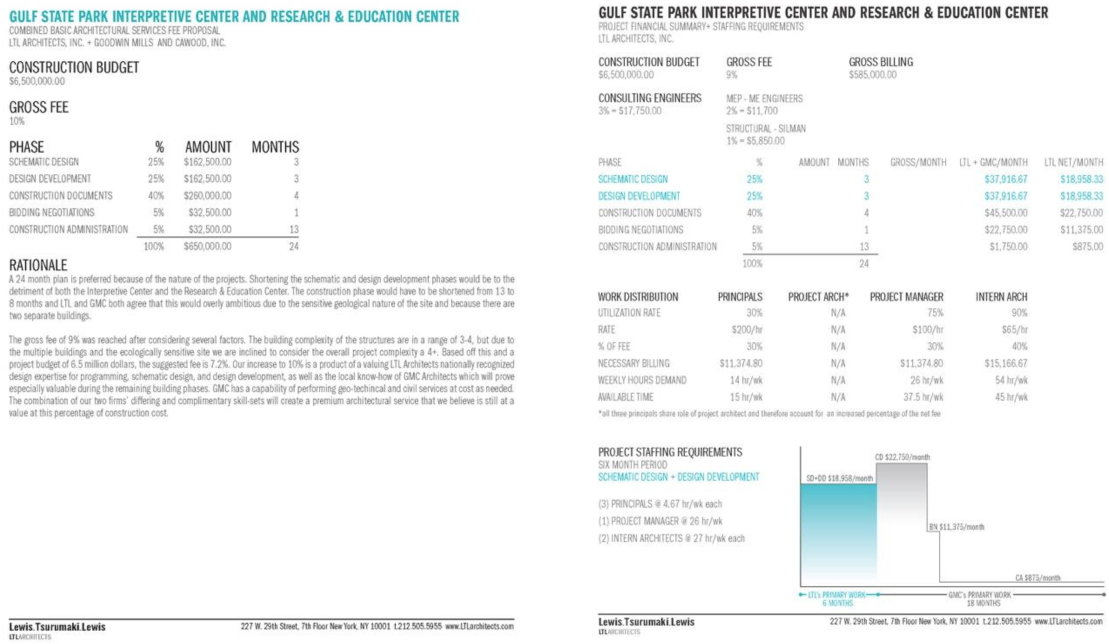
AVERAGE BASE PAY ESTIMATE
$45,020
ADDITIONAL CASH COMPENSATION
$2,150
INSURANCE
LTL Architects would not be required to provide health insurance since they are well under 50 full time employees. They currently appear to have 13 people working in the office.

Figure 6. Case Study 'A' Job Criteria & Salary Assignment.

To begin, students are asked to consider the nature of the work they wish to do and identify what is most important to them in their ideal first job (Figure 2), identify firms that actually meet their criteria and then write specific (not 'to whom it may concern') cover letters. A primer on resumes and architectural portfolios is also provided during this section of the course. The goal of this initial series of assignments is to encourage students to think carefully about their upcoming career so that they may find meaningful work, representative of the commitment they have demonstrated in completing the intensely difficult demands of architectural education. Based on the location and size of the firm under consideration, research is conducted into appropriate compensation, both in terms of salary according to the AIA salary calculator and fringe benefits such as healthcare and investments.

At the end of this initial series of assignments, students are effectively 'hired' into their firm of choice and are required to adopt the graphic identity to complete their assignments. Rather than having their first assignment in their new job be a familiar one, students are immediately asked to help craft a response on behalf of their firm to a Request for Qualifications (RFQ). The RFQ is for a real project and outlines the submission requirements, which are broken into sequential assignments but require the assembly of a sophisticated, graphically sophisticated portfolio of information and images including a cover, cover letter, firm profile, project team structure, key personnel bios, featured projects, and other relevant information such as awards and recognition. While students don't have access to the original information they would if they were actually working in the firm, most find a trove of information online and are able to develop quite professional and convincing RFQ portfolios. Students are encouraged to contact the firms they study directly, though few do, unaware and unconvinced of how readily most firms will share information and resources. Regardless, students benefit indirectly by researching the firm as it helps to prepare them to actually apply and interview successfully.



GULF STATE PARK INTERPRETIVE CENTER AND RESEARCH & EDUCATION CENTER
COMBINED BASIC ARCHITECTURAL SERVICES FEE PROPOSAL
LTL ARCHITECTS, INC. + GOODWIN MILLS AND CAWOOD, INC.

CONSTRUCTION BUDGET
$6,500,000.00

GROSS FEE
10%

PHASE	%	AMOUNT	MONTHS
SCHEMATIC DESIGN	25%	$162,500.00	3
DESIGN DEVELOPMENT	25%	$162,500.00	3
CONSTRUCTION DOCUMENTS	40%	$260,000.00	4
BIDDING NEGOTIATIONS	5%	$32,500.00	1
CONSTRUCTION ADMINISTRATION	5%	$32,500.00	13
	100%	$650,000.00	24

RATIONALE
A 24 month plan is preferred because of the nature of the projects. Shortening the schematic and design development phases would be to the detriment of both the Interpretive Center and the Research & Education Center. The construction phase would have to be shortened from 13 to 8 months and LTL and GMC both agree that this would overly ambitious due to the sensitive geological nature of the site and because there are two separate buildings.

The gross fee of 9% was reached after considering several factors. The building complexity of the structures are in a range of 3-4, but due to the multiple buildings and the ecologically sensitive site we are inclined to consider the overall project complexity a 4+. Based off this and a project budget of 6.5 million dollars, the suggested fee is 7.2%. Our increase to 10% is a product of a valuing LTL Architects nationally recognized design expertise for programming, schematic design, and design development, as well as the local know-how of GMC Architects which will prove especially valuable during the remaining building phases. GMC has a capability of performing geo-techincal and civil services at cost as needed. The combination of our two firms' differing and complimentary skill-sets will create a premium architectural service that we believe is still at a value at this percentage of construction cost.

Lewis.Tsurumaki.Lewis
LTLARCHITECTS
227 W. 29th Street, 7th Floor New York, NY 10001 t.212.505.5955 www.LTLarchitects.com

GULF STATE PARK INTERPRETIVE CENTER AND RESEARCH & EDUCATION CENTER
PROJECT FINANCIAL SUMMARY+ STAFFING REQUIREMENTS
LTL ARCHITECTS, INC.

CONSTRUCTION BUDGET
$6,500,000.00

GROSS FEE
9%

GROSS BILLING
$585,000.00

CONSULTING ENGINEERS
3% = $17,750.00

MEP - ME ENGINEERS
2% = $11,700

STRUCTURAL - SILMAN
1% = $5,850.00

PHASE	%	AMOUNT	MONTHS	GROSS/MONTH	LTL + GMC/MONTH	LTL NET/MONTH
SCHEMATIC DESIGN	25%		3		$37,916.67	$18,958.33
DESIGN DEVELOPMENT	25%		3		$37,916.67	$18,958.33
CONSTRUCTION DOCUMENTS	40%		4		$45,500.00	$22,750.00
BIDDING NEGOTIATIONS	5%		1		$22,750.00	$11,375.00
CONSTRUCTION ADMINISTRATION	5%		13		$1,750.00	$875.00
	100%		24			

WORK DISTRIBUTION	PRINCIPALS	PROJECT ARCH*	PROJECT MANAGER	INTERN ARCH
UTILIZATION RATE	30%	N/A	75%	90%
RATE	$200/hr	N/A	$100/hr	$65/hr
% OF FEE	30%	N/A	30%	40%
NECESSARY BILLING	$11,374.80	N/A	$11,374.80	$15,166.67
WEEKLY HOURS DEMAND	14 hr/wk	N/A	26 hr/wk	54 hr/wk
AVAILABLE TIME	15 hr/wk	N/A	37.5 hr/wk	45 hr/wk

*all three principals share role of project architect and therefore account for an increased percentage of the net fee

PROJECT STAFFING REQUIREMENTS
SIX MONTH PERIOD
SCHEMATIC DESIGN + DESIGN DEVELOPMENT

(3) PRINCIPALS @ 4.67 hr/wk each
(1) PROJECT MANAGER @ 26 hr/wk
(2) INTERN ARCHITECTS @ 27 hr/wk each

Lewis.Tsurumaki.Lewis
LTLARCHITECTS
227 W. 29th Street, 7th Floor New York, NY 10001 t.212.505.5955 www.LTLarchitects.com

Figure 3. Case Study 'A' RFP Assignment, student work.

Upon completion of the RFQ, a Request for Proposals (RFP) is issued for the same project, requiring the development of a fee proposal and corresponding schedule, which is in turn translated into a staffing schedule broken down by phase based on varying utilization and billing rates for various staff levels (Figure 3). Corresponding lectures are provided on a number of related financial subjects that illustrate the relationship between individual salaries, fee structures and construction budgets and schedules. To conclude the RFQ/RFP assignment, students are notified that their firm/project team has been awarded the project and this naturally leads to a discussion about contracts and related legal matters. As design work begins, the first invoice is prepared along with a corresponding billing summary that provides a financial overview. This assignment is one of the more difficult aspects of the course as virtually none of the students have any financial education. While a distinct majority of students in the course indicated they wish to have their own practice, only 5% had ever even taken accounting and none had taken finance. Despite the lack of financial education or experience, discussions of financial issues were surprisingly one of the areas of greatest interest among students. In order to address this area of deficiency, several lectures were given on financial issues in order to help students complete the assignments. At this point, students have developed a broad understanding of the process of how architects acquire work, the underlying financial structure, and the implications for staffing and scheduling.

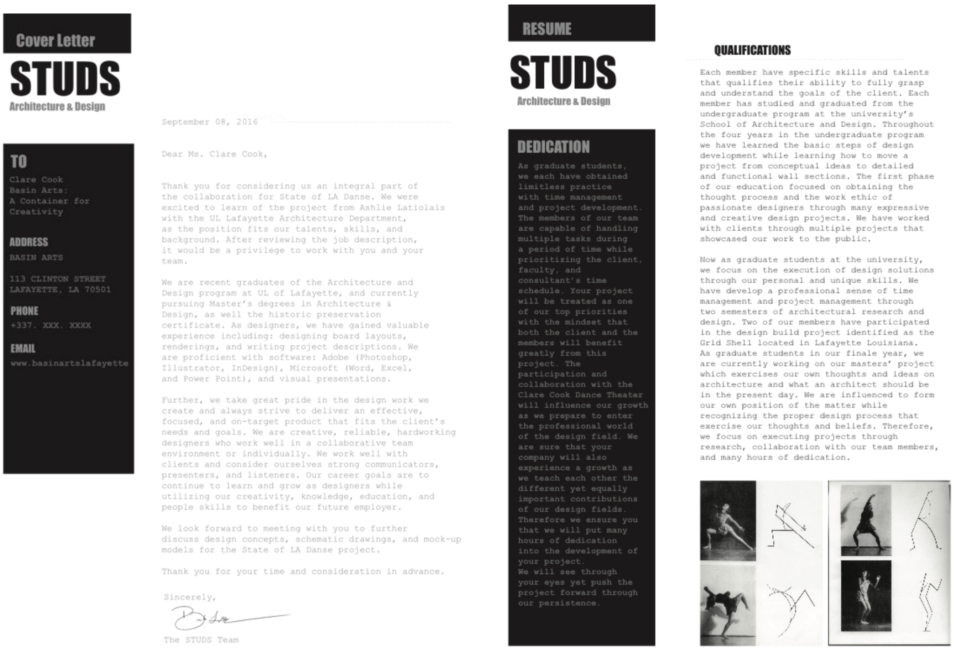
Finally, an opportunity for an independent project is presented, one that will deliberately require them to consider leaving their current job to complete as the budget and corresponding fees are known to be comparable to entry level annual salaries. The project program is translated into reasonable assumptions of overall size and cost as the basis for a fee proposal. Essentially, students are asked to thoughtfully consider their personal criteria for going out on their own in practice, much like the beginning of the course when considering the nature of the work to which they aspire. This exercise concludes the course, having accelerated students from their current status as 4th year undergraduates to begin eligible for licensure and considering independent practice, while providing an in-depth and pragmatic tour of opportunities outside the ‘production bubble.’

4 Case Study: Project-Based Assignment ‘B’

The coursework initiated in Case Study B began with discussions and considerations of what defines a 21st century architectural practice, and looks towards the futures of design practice – specifically, integrated / interdisciplinary models of interest. As stated by Ratti and Claudel, “visionary architecture for tomorrow” applies to the idea of an “open source” or “shared” knowledge of not only information, but the way in which practice is developing. [2] In 2016, the latest editions Architectural Design magazine challenges the traditional views of ownership versus authorship in “Digital Property: Open Source Architecture” and “Closing the Gap” issues. Authors Fok and Picon discuss, “even more than authorship, ownership is challenged by the rise of digital and computational methods of design and production. These challenges are simultaneously legal, ethical, and economic.”[3] Pop-up entrepreneurial companies and start-ups are increasing on the international platform causing businesses, including architecture firms, to reconsider programming and functionality needs. As the diagram at the introduction of this paper suggests, the encompassing list of items hidden in plain sight now has the potential to expand even further. Yet, with this exciting trajectory, the viewpoint of the ‘architect’ is still narrowly stereotyped into a strict conformance of only creating / designing buildings. The ‘production bubble’ can also insinuate that the act of building doesn’t fall within these early stages of Basic Services, where technology still remains in the forefront of interests and demands of the profession.

Building upon delineating current models of practice, the course maintains all lectures necessary to meet NAAB accreditation requirements in areas such as Practice Development, Managing a Practice, Project Delivery, Legal Dimensions, etc. – the leading components to running an architectural firm). The application of these subjects, outside of the typical exams and quizzes, presents an opportunity for a directed, project-based assignment. Within a three-credit course it can become difficult to expect further projects outside of classroom time. However, in this case, an intense, quick (10-weeks), design-build set design project materialized alongside the required lecture content.

The assignment began with a self-assessment exercise, allowing each student's own evaluation of strengths from a list of four skillsets: design (schematic design, design development and graphics); construction documentation (working drawings and estimating); hands-on building and making; information management (project scheduling and communication). This data was collected and organized to create group collectives where each student has a committed role which, in turn, served as an active way to increase student moral, agency, and engaged group dynamics. Each group or 'co-labs', act as sub-studios within a larger, hypothetical, design-build firm; acting as collaborative groups within the larger context of the 'firm'. The co-labs were then required to respond to a Request for Proposals (RFP) involving a set design piece for a dance performance work, entitled "Fragments" at State of La Danse. The RFP outlines the need for the project to not only be designed but also provide a full-scale, final product, construct.



Cover Letter

STUDS
Architecture & Design

TO
Clare Cook
Basin Arts:
A Container for Creativity

ADDRESS
BASIN ARTS

113 CLINTON STREET
LAFAYETTE, LA 70501

PHONE
+337. XXX. XXXX

EMAIL
www.basinartslafayette

September 08, 2016

Dear Ms. Clare Cook,

Thank you for considering us an integral part of the collaboration for State of LA Danse. We were excited to learn of the project from Ashlie Latiolais with the UL Lafayette Architecture Department, as the position fits our talents, skills, and background. After reviewing the job description, it would be a privilege to work with you and your team.

We are recent graduates of the Architecture and Design program at UL of Lafayette, and currently pursuing Master's degrees in Architecture & Design, as well the historic preservation certificate. As designers, we have gained valuable experience including: designing board layouts, renderings, and writing project descriptions. We are proficient with software: Adobe (Photoshop, Illustrator, InDesign), Microsoft (Word, Excel, and Power Point), and visual presentations.

Further, we take great pride in the design work we create and always strive to deliver an effective, focused, and on-target product that fits the client's needs and goals. We are creative, reliable, hardworking designers who work well in a collaborative team environment or individually. We work well with clients and consider ourselves strong communicators, presenters, and listeners. Our career goals are to continue to learn and grow as designers while utilizing our creativity, knowledge, education, and people skills to benefit our future employer.

We look forward to meeting with you to further discuss design concepts, schematic drawings, and mock-up models for the State of LA Danse project.

Thank you for your time and consideration in advance.

Sincerely,

The STUDS Team

RESUME

STUDS
Architecture & Design

DEDICATION
As graduate students, we each have obtained limitless practice with time management and project development. The members of our team are capable of handling multiple tasks during a period of time while prioritizing the client, faculty, and consultant's time schedule. Your project will be treated as one of our top priorities with the mindset that both the client and the members will benefit greatly from this project. The participation and collaboration with the Clare Cook Dance Theater will influence our growth as we prepare to enter the professional world of the design field. We are sure that your company will also experience a growth as we teach each other the different yet equally important contributions of our design fields. Therefore we ensure you that we will put many hours of dedication into the development of your project.
We will see through your eyes yet push the project forward through our persistence.

QUALIFICATIONS

Each member have specific skills and talents that qualifies their ability to fully grasp and understand the goals of the client. Each member has studied and graduated from the undergraduate program at the university's School of Architecture and Design. Throughout the four years in the undergraduate program we have learned the basic steps of design development while learning how to move a project from conceptual ideas to detailed and functional wall sections. The first phase of our education focused on obtaining the thought process and the work ethic of passionate designers through many expressive and creative design projects. We have worked with clients through multiple projects that showcased our work to the public.

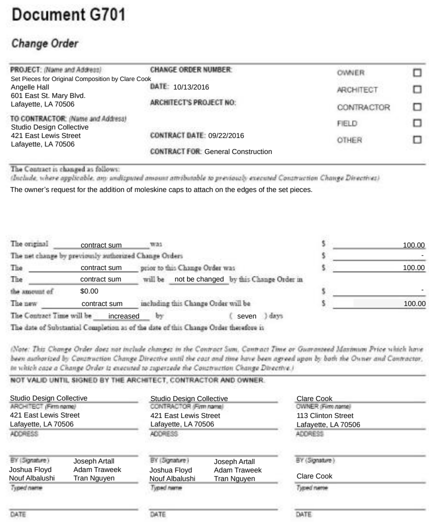
Now as graduate students at the university, we focus on the execution of design solutions through our personal and unique skills. We have develop a professional sense of time management and project management through two semesters of architectural research and design. Two of our members have participated in the design build project identified as the Grid Shell located in Lafayette Louisiana. As graduate students in our finale year, we are currently working on our masters' project which exercises our own thoughts and ideas on architecture and what an architect should be in the present day. We are influenced to form our own position of the matter while recognizing the proper design process that exercise our thoughts and beliefs. Therefore, we focus on executing projects through research, collaboration with our team members, and many hours of dedication.

Figure 4. Case Study 'B' Qualifications & Value Assignment

The first collaboration between the dance choreographer, dance students, and the co-labs initiated the discussion of intersecting the realms of dance and architecture; thinking about the field of architecture more loosely as the world of design for the human body, in motion, versus the standard 'architect as master-builder' mentality. The intention of the dance piece began as a series of questions, therefore, the set design project and choreography of the dance was a live creative process – both being created simultaneously, in real time. After initial meetings, the co-labs were asked to craft specific letters of intent (Figure 4), team biographies, team value assessments, and qualifications to the client as a response to the RFP. This assignment allowed for students to identify their strengths brought forward to a project and understand how these skills needed to secure a job are essential. Each co-lab was then 'approved' by the client, where each team initiated an AIA document A-141: Standard Form of Agreement Between an Owner and Designer-Builder, and Schematic Design commenced.

A series of exchanges between the client and co-labs (which were now integrated and paired with individual dancers) spanned from dance rehearsals, studio critiques, and full-scale test-modeling. Each meeting was required to be documented as Meeting Minutes formulating the start of a dossier of (paper) work in addition to the evolving designs. Project Managers assigned to each co-lab was responsible for conveyed the information between the client and the groups. Through this role the other co-labs members supported the framework by provided the material presented. Interactions between the client and co-labs wasn't always a seamless process, several derailing discussions occurred, especially involving internet platforms such as Pintrest and others of the like.

Each of the co-lab projects developed individually, while collaboratively, Work-Flow Budgets of each group and Material Cost-Estimates were also required. Students understanding the planning and coordination to maintain appropriate work-flow and producing follow-up paperwork required for a simple task provides not only an awareness, but also a broader skillset to bring into internship. After a series of full-scale testing, the final constructs were built and site visits to the theater space for technology rehearsals began (Figure 5).



Document G701

Change Order

PROJECT: *(Name and Address)*
Set Pieces for Original Composition by Clare Cook
Angelle Hall
601 East St. Mary Blvd.
Lafayette, LA 70506

CHANGE ORDER NUMBER:
DATE: 10/13/2016
ARCHITECT'S PROJECT NO:

OWNER ☐
ARCHITECT ☐
CONTRACTOR ☐
FIELD ☐
OTHER ☐

TO CONTRACTOR: *(Name and Address)*
Studio Design Collective
421 East Lewis Street
Lafayette, LA 70506

CONTRACT DATE: 09/22/2016
CONTRACT FOR: General Construction

The Contract is changed as follows:
(Include, where applicable, any undisputed amount attributable to previously executed Construction Change Directives)
The owner's request for the addition of moleskine caps to attach on the edges of the set pieces.

The original contract sum was	$ 100.00
The net change by previously authorized Change Orders	$ -
The contract sum prior to this Change Order was	$ 100.00
The contract sum will be not be changed by this Change Order in the amount of $0.00	$ -
The new contract sum including this Change Order will be	$ 100.00
The Contract Time will be increased by (seven) days	
The date of Substantial Completion as of the date of this Change Order therefore is	

(Note: This Change Order does not include changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.)

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

Studio Design Collective	Studio Design Collective	Clare Cook
ARCHITECT (Firm name)	CONTRACTOR (Firm name)	OWNER (Firm name)
421 East Lewis Street Lafayette, LA 70506	421 East Lewis Street Lafayette, LA 70506	113 Clinton Street Lafayette, LA 70506
ADDRESS	ADDRESS	ADDRESS
BY (Signature)	BY (Signature)	BY (Signature)
Joseph Artall, Joshua Floyd, Adam Traweek, Nouf Albalushi, Tran Nguyen	Joseph Artall, Joshua Floyd, Adam Traweek, Nouf Albalushi, Tran Nguyen	Clare Cook
Typed name	Typed name	Typed name
DATE	DATE	DATE

Figure 5. Tech Rehearsals & Change Order example

The students worked directly with lighting designers for the performance where the co-labs began to manage and coordinate between the client, users (dancers), and technical crews and consultants while Field Reports and Change Orders (Figure 5) began to initiate as minor modifications were needed to the set pieces. As the performance was well-received, the students were then asked to design a complete exhibition of this work in a public art gallery as part of the final exam for the course (Figure 6). All assignments created, two-dimensional drawings and documents, as well as, three-dimensional work was placed into the defined space. This project not only served a broader understanding to the students outside of the production bubble, but also served as a vehicle to educate the general public about the architectural design process. The exhibition "Fragments: The Creative Process" was installed for two months. The opening night reached approximately 75 people and engaged conversations reflecting on the integrated process between the disciplines.

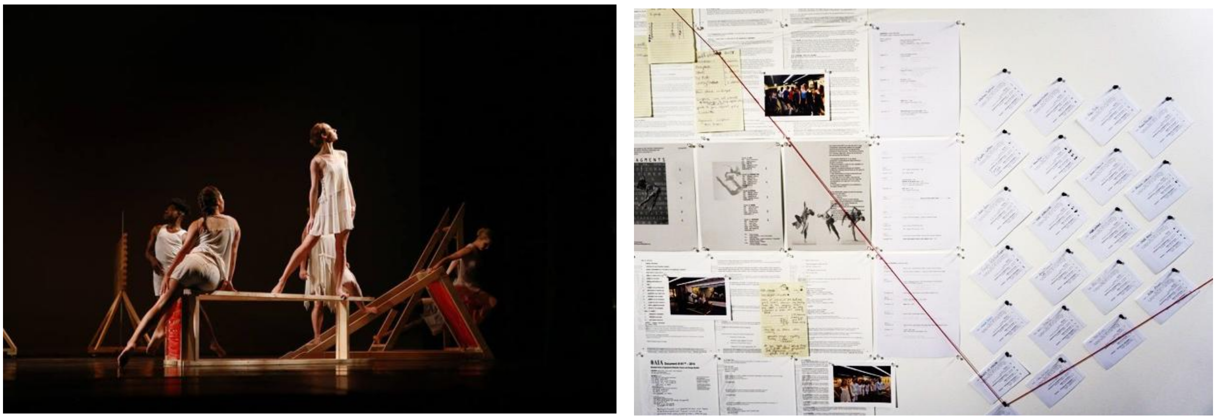


Figure 6. Final Performance Structures & Exhibition

5 Conclusions & Advancements

The skills offered in both Case Studies aimed to develop areas outside of customary architectural education training. When assessing the coursework discussed here, both attempted to engage professional practice seminars from a common perspective, immersed in focused, project-based tasks. The pragmatic components necessary for firm operation are brought to the forefront of the assignments instead of only assessing design intention and craft; reluctant to deepen the skills of basic services, and instead, develop the more pragmatic skills of practice. A balance between the technical and speculative is necessary to foster a diverse architectural education curriculum, however, revealing pragmatic opportunities hidden in plain sight develops valuable areas of expertise. Although the National Council of Architectural Registration Boards (NCARB) envision 'internship' or Architectural Experience Program (AXP), as a continuation of education, the graduates regularly find the experience of transition from their education to the workplace jarring and utterly foreign, inevitably leading to questions about existing curricula and the possibility of a more seamless alignment between the academy and practice.

The Profession craves graduates that are more capable and eager than ever, especially in regard to technical and software competency. The Academy openly recognizes this phenomenon, but only addresses the technology component. Therefore, if an apparent shift in focus becomes apparent, the items easily attainable, or in plain sight, may in fact produce more adaptable and prepared graduates entering internship. As the 'production bubble' deepens as students advance in an architectural program, the need for professional practice to be integrated into a curriculum becomes exceedingly necessary. The typical placement of professional practice is during the final semesters approaching graduation, but the appropriate time to integrate this coursework could be much earlier, embedded into second or third year curricula. The vocabulary of practice and project-based assignments linked between studios and professional practice seminars could serve as a vehicle to overcome the gap existing in the transition of internship.

Fundamentally, these courses encourage students to develop a broad understanding of not only the practice of architecture, but of their architectural education as well, seeing it not as having been completed, but only begun. This process initially improves prospects for employment and advancement, but also to helps to ensure adaptability and in turn, longevity in the profession. Phil Bernstein recognizes the importance of this pedagogical approach by saying “real-world classroom experience yields a generation of graduates who can connect their understanding of design and technology with the transforming role of the architect.”[4] But more than just a recognition of technological implications, understanding and embracing the breadth and complexity of the system of architectural practice is essential for developing architects who will advance in the profession and continue to define and redefine the nature, importance and relevance of architectural practice.

References

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01.110 - SEEDS OF ARCHITECTURE IN THE INFORMAL CITY

Francesco ROSSINI

School of Architecture, The Chinese University of Hong Kong
AIT Building, NT, Hong Kong; rossini@cuhk.edu.hk

Abstract

Top-down strategies in formal planning processes have been criticised due to their lack of community participation. In contrast, in studying informal settlements, which have lacked top-down planning from the start, the benefit of working with the community translates more immediately into an opportunity to create a more vibrant and democratic participatory process.

The more formal top-down approach and the informality that characterises such bottom-up initiatives are two complementary facets of urbanisation. The scope of this article is to describe the preliminary stage of a research project focused on the upgrading strategy of the informal community of BaSECo in Manila, the capital of the Philippines. This pilot study attempts to bridge the gap between the top-down and the bottom-up, the formal and the informal, by acting as an external mediator and facilitating the translation of bottom-up practices and knowledge into top-down processes. The direction of this approach relies on the critical role that architecture and urban design could play in addressing the challenges presented by urban informality.

Keywords

Informal Settlements, Upgrading, Urban revitalisation, Manila, Urban Prototypes.

1 INTRODUCTION

Informal settlements, slums, favelas, shacks, bidonville, shanty towns, and squatters, are all terms which connote negative characteristics and precarious living conditions such as the lack of basic services and infrastructure, high population density, unhealthy living environments, poverty and high levels of crime [1]. These organic and often illegal forms of inhabitation, which are considered parasitic compared to the areas developed according to a formal planning process, may presents similar characteristics of the vernacular architecture. According to Pietro Belluschi [2, p.132] the architecture in the past was “a communal art, not produced by a few intellectuals or specialists but by the spontaneous and continuing activity of a whole people with a common heritage, acting under a community of experience.” In his 1964 exhibition ‘Architecture without architects’, Bernard Rudofsky showed a series of examples where it is possible to appreciate the beauty of this accidental architecture and the talents and achievements of anonymous builders “…whose concepts sometimes verge on the utopian, whose aesthetics approach the sublime” [3, IV].

This type of informal or spontaneous architecture is often the result of participatory processes where the project, conceived as a determining phase for the conception of an architectural artefact, resides in the construction techniques often transmitted through a hundred generations.

In informal settlements, as remarked by Dovey [4] the constructions transgress some definitions of architecture, requiring new modes of architectural practice and ideology. (Fig.1)

Working in such dynamic context requires thinking of innovative spatial strategies where architecture and urban design could play a critical role in addressing the challenge of urban informality.

2 Manila, conflicts of a twin city.

In Metro Manila, rapid changes of the urban structure have led to an explosion of two opposite yet related phenomena: the development of high-density clusters of high-rise buildings and the formation of dispersed patterns of informal settlements.

Over the years, Manila has undergone alternate phases of crisis and economic growth, but the urbanisation of its territory has continued uninterrupted, following no specific spatial order. Rather, urban growth has been marked by highly volatile and chameleon-like configurations [5].

This urban explosion does not mean however that there has been a general improvement in citizens' living conditions; quite the contrary, it has accentuated existing inequalities. Despite the fact that the rate of urbanisation is comparable with other countries of the Asia Pacific Region, the city has not experienced the same level of development that usually follows increased urbanisation.

Large areas of the city, especially in the downtown area, are occupied by informal communities that will be affected by the city's undergoing redevelopment. The Pasig River Rehabilitation Program, a long-term plan to improve water quality and to promote urban renewal, will bring dramatic shifts in the spatial pattern of the urban structure, resulting in the relocation of large sectors occupied by informal communities. Under this program the district of BaSECo, one of the densest informal settlements in Manila, was selected as a priority area for substantial urban renewal (Fig. 1).

Although this government-lead project is aiming to resettle the residents on-site instead of relocating them outside the city, it's vital that the revitalisation strategy take into consideration the mutual, interconnected needs of both the local community and city administration, which may at times appear to be at odds.

The name BaSECo, (an acronym for Bataan Shipyard and Engineering Corporation) was established in 1964, and over the last 10 years the district, has suffered the effects of natural disasters; because of its proximity to Manila Bay it is particularly vulnerable to river flooding and storm surges.

BaSECo has also endured high levels of crime and poverty, further complicating matters for residents, and despite the support of NGOs and the local government, is still an extremely problematic area in which a number of difficulties must be solved.

Figure 7. BaSECo District in the Port Area of Manila.

There is considerable attention being paid to future of this strategic area, and both community organisations and local NGOs are quite active in negotiating with different stakeholders and facilitating the empowerment of local residents.

3 Upgrading Strategies, a Methodological Approach

In the late 1970s, the British architect John Turner promoted a new approach based on the view that self-help settlements assisted by NGOs had to be perceived as a potential solution for improving the slums. Turner's pioneering efforts led to the rethinking of urban regeneration policies in informal settlements, generating various upgrading programmes in different developing countries [6].

The on-site upgrading approach demands effective engagement and communication with different members of the community. Recent on-site schemes not only focus on improving housing conditions but also on developing open spaces and community facilities.

A participatory process focused on promoting open spaces as social integrators can have "a strong reliance on the role that public space can play in bringing people together stressing the importance of quality design and architecture" [7, p.527]. According to Jáuregui [8], planting the 'seeds of urbanism' in the heart of the community may contaminate it in a positive way, improving the physical and social dimensions of the informal district.

This alternative approach will be tested in the informal district of BaSECo with the aim to generate two main consequences: the first is to provide more open spaces in the dense and intricate urban tissue and the second is to implement the provision of infrastructure and services that are missing or deficient in the community.

Incremental interventions and on-site upgrading approaches rely on a sophisticated understanding of informal settlement forms, as well as their spatial and social structure. As Such, the process of mapping is essential in order to understand the physical context and the sociocultural environment and becomes a vital tool for discussing and planning the revitalisation of the informal community [9; 10].

The methodology of this research is structured into three interrelated phases, entitled 'Spatial Analysis', 'Participatory Process' and 'BaSECo Incremental Plan' (BIP). The preliminary stage of this study examined three areas of the district that feature different urban conditions and spatial organisation: Dubai Site (DS), Gawad Kalinga (GK), and New Site (NS) (Fig. 2).

Urban morphology, typological elements, living conditions and open spaces were analysed using quantitative and qualitative methods in order to gain a comprehensive understanding of the context, identifying tangible and intangible urban phenomena.

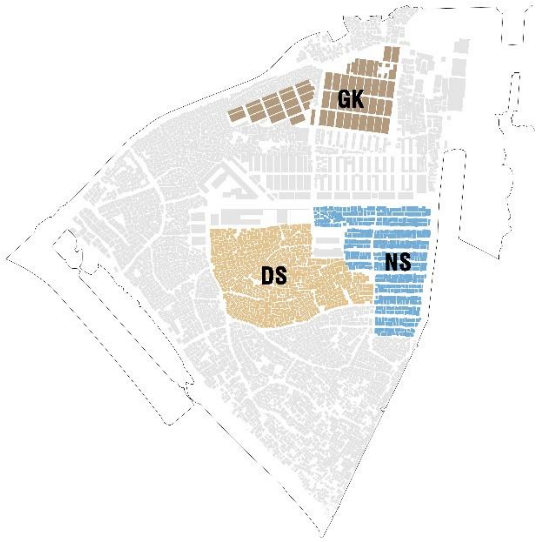

Figure 2. The areas of Dubai Site (DS), Gawad Kalinga (GK), and New Site (NS)

3.1 Preliminary Analysis

At first sight BaSECo presents all the typical characteristics of any informal community such as congestion, poor hygiene conditions, misaligned street spaces and lack of urbanity. The district covers a surface area of approximately 52 hectares; the analysis of the spatial pattern shows a complex urban form where it is possible to identify a critical mass of housing occupying more the 80% of the entire area.

The main street network, which has enough space to allow for the circulation of people and vehicles, covers approximately 100,000 m2, which corresponds to 19% of the entire surface area (Fig. 3, a). Public facilities, such as markets, schools, the evacuation centre and the church are located almost in the central area of BaSECo (Fig. 3, b). The analysis revealed that 65 % of the spatial pattern in BaSECo has an organic configuration. The areas organised in a more regular pattern are the result of a series of fires arose in the past and are located near the port shoreline and close to the main facilities of the district. (Fig. 3, c-d).

In details, the three districts analysed present substantial differences in terms of urban form, social activities and use of living and open spaces. The different spatial patterns and urban forms also influence societal relationships and the way in which open spaces are used (Fig. 5).

In GK and NS, a regular layout has fomented the development of linear communities, in that this type of organisation facilitates social interactions in the streets, thereby consolidating a sense of belonging in the residents.

By contrast, in the organic pattern of DS, neighbourhood relations are not so clearly defined, and social interaction occurs among small groups of families essentially because of proximity.

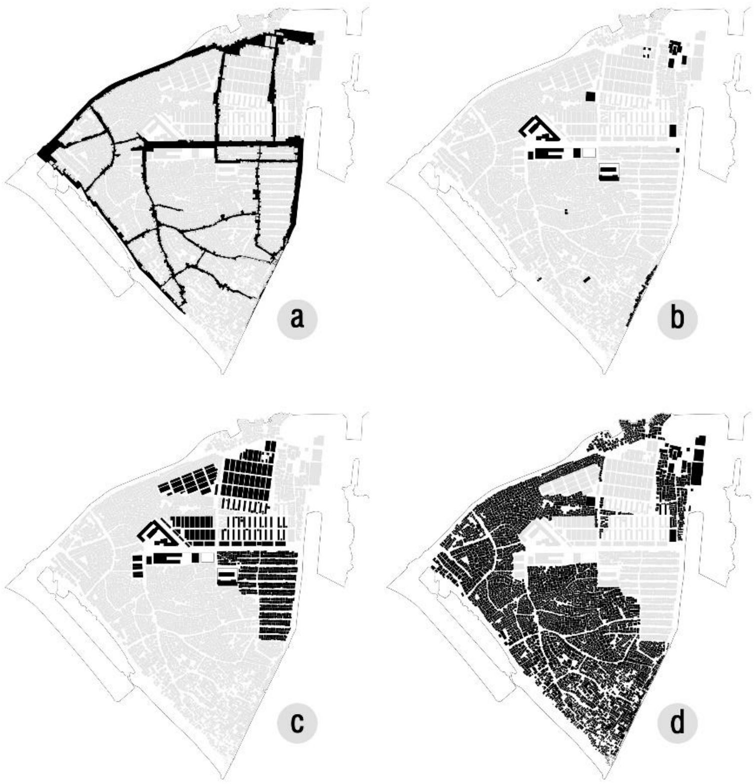

Figure 3. The graphic shows the different urban pattern in BaSECo.

In all the areas analysed, the lack of open space and community facilities is a serious issue to be addressed. In most cases, the unplanned and irregular structure, typical of informal settlements, generates dynamic spaces where distinctions between public and private are not clearly defined.

The proximity of people and open space in informal settlements generates a specific relationship, “because they are socially produced and constructed” [11, p. 5]. Such intermediate open spaces are not simply vital to the effective functioning of settlements, but rather, offer a place where social relationships and productive activities can flourish, providing what perhaps is the greatest value to informal communities.

3.2 Urban Prototypes and incremental interventions

The implementation of urban prototypes, focused on the provision of open spaces and community facilities, aims to interpret the composite DNA of the urban environment in order to celebrate the diversity and the dynamism of the informal district.

The insertion of these seeds of architecture seeks to respond to the needs of the community in order to foster a more effective and sustainable on-site upgrading strategy.

The notion of the ‘prototype’ here is primarily interesting as a process rather than the prototype itself as a product. The involvement of the local residents in all the stages of the design process will be crucial to create a sense of ownership and is a pre-condition of successful use, care and maintenance [12].

Figure 4. On the left the existing community building of Kabalikat in BaSECo.

Inserting seeds of architecture in the informal settlements means to rethink the role of the design process, moving from object-oriented models towards new understandings of complex integrations of formal and informal conditions [4].

These architectural prototypes aim to generate a strategy for incremental change, but at the same time, to make use of sustainable technologies to face the conditions of the tropical climate. The use of lightweight materials and passive cooling strategies will be adopted to limit the use of energy and to increase the thermal comfort.

Our prior pilot studies into the district helped us to engage the local community and NGOs. The implementation of the Learning and Cultural Centre, has been previously discussed during the summer workshop 'Mapping the Informality' held in BaSECo in June. This preliminary analysis and the engagement with different stakeholders gave us a significant insight on key issues and problems that this district faces, providing key background knowledge for ways to identify prototypes and determine appropriate areas and methods of intervention (Fig. 4).

The implementation of these community facilities will be comprehensively studied in order to translate the community's ideas into potential projects.

The study will offer practical recommendations to identify core components and elements of these incremental interventions such as, construction materials, project dimensions, type of structure and any other suggestions that have support from all stakeholders.

4 A Learning and Cultural Center in the Community

In Dubai Site, Kabalikat (one of the most active community organizations in BaSECo) owns a small one story construction in where the community organise various social activities and which often serves as a meeting place for the district's decision-making.

The project is going to replace the existing facility which is not in condition to be upgraded due to structural problems. The new building will have a total surface of 150m2 organised in two volumes. The taller one of 3 stories contains all the main functions of the building, the children library, a multipurpose room, a space to realize hand-craft products, and a dining area; the smaller volume of just one story contains the kitchen and a small garden for the urban farming. In the vacant space between the two volumes there is the entrance of the building where a small relationship area, with a seating bench and a flowering tree, allow a visual and physical permeability as well as the natural ventilation (Fig.5).

The BaSECo Learning and Cultural Center (BaSECo LCC) will be built using the engineered bamboo as main structural component. The use of engineering and its use to structural applications is emerging as an alternative material for construction and this building aims to demonstrate the potential applications and practical use considering also the benefits in terms of environmental sustainability [13]. The combination of recycled and new materials aims to interpret the unique DNA of the urban environment of the district. These lightweight external partitions such as mesh metal screen, corrugated metal sheets, wood panels are assembled to provide protection from the weather conditions of the tropical climate but also to create a permeable façade which allows the passage of the natural light and ventilation (Fig.6). Openings, terraces, and balconies are positioned in such a way as to generate a continuous connection between interior and exterior. Hence, the design of this skin will allow a visual integration with the rest of the district creating intermediate spaces for social relationships.

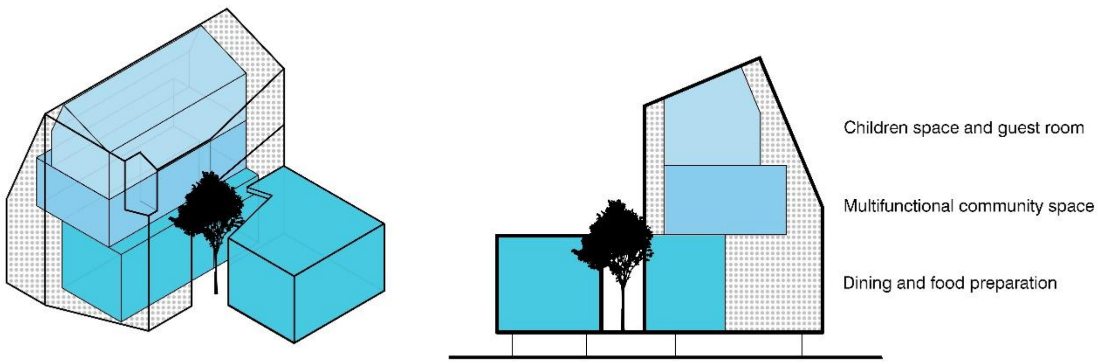

Figure 5. The conceptual scheme of the project.

The engagement of the community at every stage of the construction process is an essential task when working in the complex environments of informal settlements because it invites people to respond creatively to a given problem and develop solutions that better meet local needs. This active participation of the community will contribute to creating a building that is socially, economically and environmentally sustainable and offers a model for other informal settlements in the Philippines.

The BaSECo LCC will be an open and multi-functional space for the most vulnerable part of the community, woman, children and elderly, but at the same time a place for citizens' meetings. This strategy is based on the improvement of the social infrastructure through the insertion of seeds of culture that can grow in a building where the inhabitants can feel represented.

Figure 6. Section of BaSECo LCC with main winds and solar solstices.

The ground floor is mainly used as a dining area and for preparing meals to feed the children of the community. The second level is a multi-functional space used for community meetings, for the preparation of handicraft products, and also as a classroom to have different workshops and learning activities. The third level is mainly dedicated to children with spaces for teaching and playing. In this level there is also a small room to host people who want to visit the district. The insertion of double and triple height-spaces is crucial to allow the natural ventilation through the building as well as a continuous visual communication throughout the three levels.

The participatory design process leaves creative and unpredictable spaces for the contamination and integration of the building in a context where architecture is built on spontaneous gestures. The improvement of the social infrastructure in the form of ‘urban prototypes’ with the help of local residents aims to generate a strategy for incremental change and for consolidating a sense of community belonging.

5 Concluding remarks

As previously described, BaSECo district is affected by structural weaknesses that must be addressed with a comprehensive upgrading strategy. The need for housing as well as the extremely high population density have put incredible pressure on basic infrastructure and community services, leading to an overcrowded and unsustainable urban area. This preliminary stage of the research demonstrated the need to develop a comprehensive analysis of informal settlements to have a clear picture of the urban structure and to gain insight into residents' needs and motivations. Since conditions will differ from place to place, engagement calls for forms of practice where research takes a much more integral role in the design process, incorporating morphological and diagnostic mapping and modelling [4].

By analysing the BaSECo compound, this paper provided a general reflection on the conditions of the informal settlements in Manila. Further analysis will be conducted in this informal community in order to propose a methodological approach that will help implement long- and short-term actions and to support the decision-making processes at different stages of the revitalization process. The notion of the 'urban prototype' to be explored in this research is best understood as a process rather than a product. The implementation of urban prototypes based on open spaces and community facilities responds to the needs of local residents by providing key infrastructure and services that are missing from or deficient in the community. The BaSECo LCC will help to improve also the condition of the open spaces surrounding the buildings in order to generate a contamination process that can allow the districts to evolve into a more sustainable settlement.

The impact of this research can be measured by the improvement of the condition of excluded or disadvantaged groups. Through the upgrading strategy the aim is to create an alternative urban model of development that can be applied in the revitalisation of informal settlements and underprivileged communities. The key impact of this approach is to incrementally change the negative perceptions associated with informal settlements and reduce the physical and social segregation of these districts with the city. The lessons learned from previous experiences of slum revitalisation demonstrate that upgrading strategies are a viable, low-cost and effective way to help the urban poor solve problems in their communities.

Acknowledgements

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01.111 - DESIGNING TO LEARN AND LEARNING TO DESIGN

András CSEH*, József ÉLŐ, Szilárd KÖNINGER, András NAGY, Dávid NÉMETH, Ádám TÁTRAI

CAN Architects
Szabadsajtó utca 20, 9021 Győr, Hungary; cseh.andras@canarchitects.hu

Abstract

The design process of the new Piarist School in Mosonmagyaróvár, Hungary is a pilot project to create future learning environments for children, teachers and local communities in the 21st century. On-going paradigm shifts in pedagogy reflect the fast generational changes in recent decades. Learning is becoming increasingly important in the age of Big Data, therefore learning environments with adaptive spaces are the frontrunners of changes in architecture.

Figure 8. Modelling and discussing future learning environments with teachers in the process of designing their new school for the 21st century

The paper introduces the collaborative design process of a new school, where the fields of pedagogy, psychology, architecture and environmental design work together to develop a new process-based learning environment to enable children to deal with the challenges of the near future.

Keywords

design, learning environment, school, space

1 HERITAGE AND INNOVATION

Joseph Calasanz founded the Pious Schools at the turn of the 17th century to provide education for the poor. His life and work mark the beginning of public education. When the Hungarian

Province of the Order of the Pious Schools decided to build a new school for its community in Mosonmagyaróvár, the key question was how to merge its 400 years old teaching traditions with contemporary pedagogical models.

At CAN Architects research plays a significant role for us throughout the whole design process. We've been investigating the connection between spatial perception and creation and various learning processes for almost a decade, with special focus on experimental school architecture. The best examples we explored were always founded on a co-evolved pedagogical program and spatial structure, therefore we worked closely together with the educational board of the province and the local community of teachers to define the basic principles for both teaching and the school building itself. In the beginning we used two models of learning and education, which are widely accepted after the pedagogical paradigm shifts of recent decades.

The SCL (Student-Centered Learning) model developed from constructivist pedagogy, which suggests that humans construct knowledge and meaning from their experiences. The key elements in such learning processes are the active participation of students, communication, reflective thinking, critical acceptance of references and problem solving. [1]

The 21 CLD (21st Century Learning Design) [2] professional development program clearly describes six rubrics, each of which represents an important skill for students for develop:

- Collaboration
- Knowledge construction
- Skilled communication
- Real-world problem-solving and innovation
- Use of ICT for learning
- Self-regulation

The significance of these models is that they also provide spatial suggestions for those users, teachers and students, who develop their curricula accordingly. Based on the descriptions of learning activities an up-to-date spatial structure of a school should consist of the following spaces:

- 'Amphitheatres' for focused attention in a larger group
- 'Fire places' for guided interaction
- 'Watering places' for dynamic and self-organising team-work
- 'Caves' for personal learning and deep concentration

In parallel with contemporary guidelines the piarist educators also revealed their founder's radical approaches to redefine education. Already by the end of the 16th century Joseph Calasanz founded his schools based on the same principles that any inventive learning environment and institution uses currently:

- Reform pedagogy
- Alternative program and curricula
- Student-centred learning, love towards the children
- Personal pedagogy

- Education based on learning communities
- Co-operation in the learning process with the pupils' families
- Integration of formal and non-formal education
- Life-long learning
- Innovation and the use of cutting-edge scientific discoveries
- Practicality of knowledge and skills

The similarities in our client's pedagogical history and contemporary trends in education amplified the need for learning from the experimental architecture around the last turn of the century. While the educational board of the piarist order and the local teaching community started to create a framework for their alternative curricula, we investigated the possibilities of using our architectural research findings in the design process.

2 School Architecture and Pedagogic Research Implementation

In on our primary [3] and secondary [4] researches in learning spaces and school architecture, we concluded, that a wide range of well-defined spaces with simple flexibility are more useful in the life of a school than constantly changing multipurpose structures, which were believed to be the answer starting from the 1990's. Experience shows that the completely open-plan schools, such as the flagship of contemporary school architecture, Hellerup Skole by Arkitema Architects are slightly changing their learning landscapes by erecting new walls. Open-plan learning landscapes are amazing for lively team-work, but they become problematic when focused attention is required either in larger groups or in individual learning. Visual and audio overstimulation makes children frustrated and requires extra energy to maintain their attention-level.

Figure 2. Hellerup Skole, Gentofte, Denmark, 2002 by Arkitema Architects (photos by AA)

However, in 21st century learning strategies, dynamic teamwork plays a significant role in both producing active knowledge by the students teaching each other, and also in social skills development, which is considered to be the key element in contemporary pedagogic evaluations.

To be able to provide the necessary flexibility and appropriate spaces for a contemporary school, we approached the client, the Hungarian Province of the Order of the Pious Schools

to re-evaluate their original design program, which only included the space-range of a classical classroom-cell based infrastructure with narrow corridors and a lot of specialized rooms for each discipline that they're currently teaching. We proposed an adaptive spatial structure, where each space has a primary and secondary use, resulting in a broad range of spatial tools for the school as a whole. Our aim was to create spaces that support only few pedagogical situations themselves, yet the whole school as a complementary system provides the whole necessary spectrum.

After the first shock of the Piarist Fathers, that was caused by introducing the infinite variety of learning space design, the client trusted us to organize a so-called Visionary Team to clarify the theoretical and pedagogical background for the project. This group consisted of the educational, economist and spiritual leadership of the province, the principal team of the school itself and us, architects. The participants included ones who recently created a document called Piarist Space, which describes the attributes of a spatial structure used by Hungarian piarist communities. Based on our shared knowledge we defined the pedagogical and spatial foundations of the school to be designed:

- The school opens up with public spaces towards the city to support its connections with the whole community. Some of these public spaces remain open constantly.
- Arriving to the school happens through various in-between spaces (canopies, large roofs, courtyard, etc.).
- Both indoor and outdoor public areas (learning landscape, hall, playground, garden etc.) facilitate personal and interpersonal development for students, teachers and families as well.
- The learning space structure is a complex system, where an intensively used learning landscape connects the personalized home spaces of smaller groups.
- Classrooms need to receive natural light from at least two directions to integrate their users into their wider environment and provide sufficient lighting.
- Learning happens in indoor, in-between and outdoor spaces as well, so the appropriate spatial environment is necessary in all three situations.
- Rich versatility appears both functionally (private/intimate spaces – rather private/intimate spaces – rather community spaces – community spaces) and spatially (closed spaces - in-between spaces - open spaces) in the building, accepting everybody and acceptable to everybody.
- Rooms designed for children with special needs are not hidden, they are normal, everyday elements of the schools structure.
- The teachers' quarters are also versatile from private to public, from quiet to lively.
- The sacred and spiritual spaces are welcoming, yet ensuring the necessary intimacy.
- The building, the courtyard and the garden are complimentary elements that create the complete learning environment.

The school started to develop their own curricula accordingly and these sentences became the key guidelines for our architectural design.

3 Co-operative Design

The preparation itself already demonstrated the need for close co-operation between the client and the designing team. Therefore, we organized a co-operative design program with questionnaires, talks and workshops for all participants throughout the whole design process.

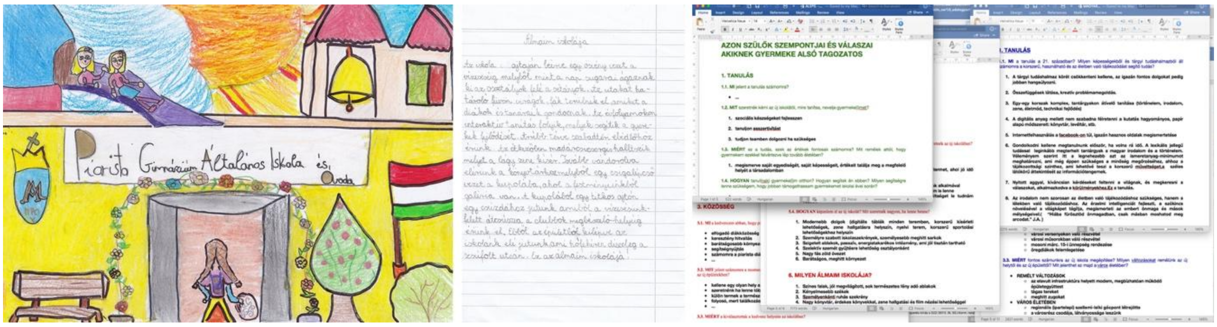

Figure 3. Various sources of information as the first steps of co-operative design

We received drawings and essays from individual students where they imagined their new school, with amazing content. We learned about their wishes for extreme situations, such as a slide over the waterfall at the entrance or three churches integrated into the school's structure, and also about their everyday problems like the lack of toilets in the current building.

More than 30 groups of users (student teams, classes, teacher groups by discipline, parents, etc.) filled out our questionnaire that targeted both their experiences and expectations. The overall picture in the end represented a general need for innovation and openness in the school, so it can help children develop creative adaptation skills to face the challenges of the constant changes in our society.

Figure 4. Learning space alternatives workshop

During the first workshop we simulated various learning scenarios to be able to figure out the appropriate scale of classrooms, labs, learning landscape open areas and private corners. We also evaluated over 200 examples of learning environments from the viewpoint and needs of the main three age groups of children (6-10, 11-14, 15-18 years old). The conclusions helped to refine the general guidelines and new aspects also arose. The role of the central courtyard as the main meeting and community space as well as the favorite location of various events became apparent in the school's operation. The main differences between the age groups also showed: while the smallest ones require a safe classroom for most of their activities, over 10 years of age the use of learning landscapes becomes an interesting choice, while in secondary school students have a more personalized learning schedule and therefore are able to personalize the use of their learning environment.

Figure 5. School architecture evaluation and spatial distribution workshop

The right balance between the openness and the protective level of the school seemed to will be playing a crucial part in its life. We built different models with 3 colored functional spaces (1 for mostly open, 1 for sometimes open and 1 for mostly closed to the public), deciding about the main entrance, the public functions and the protected regions of the building.

4 Human Parametric Design

In parallel with the intensive involvement of the piarist community in the design process we also included professionals not just from the usual design (interior design, landscape design, lighting design, acoustics, etc.) and technological fields (structural engineering, building services, electrical engineering, etc.), but from many others as well, who play a significant role in the current pedagogical paradigm shifts: pedagogues, psychologists, environmental psychologists, coaches, librarians, museum-pedagogues and art educators as well. Altogether our professional team consisted from over 30 disciplines from the start of the project, which resulted in enormous amounts of research- and experience-based knowledge that seemed to be impossible to start articulating spatially.

We decided to work along 4 different school concepts, all of which represented a connected spatial and pedagogical approach. The whole educational and spatial system for 800 children and 100 staff was developed in all 4 designs that served as case-studies. The participating disciplines evaluated them separately and we held a workshop, where we led discussions about each solution with the piarist students, teachers and leadership. The idea was to see all possible advantages and disadvantages of the different designs, and develop the one that was closest to fulfilling most requirements. However, this concept failed already at the workshop, where it became clear that these designs work really well as case studies, but they produce so many questions and new proposals that none of them is suitable for further development in itself. Yet, all of them presented valuable solutions to be implemented in the final scheme.

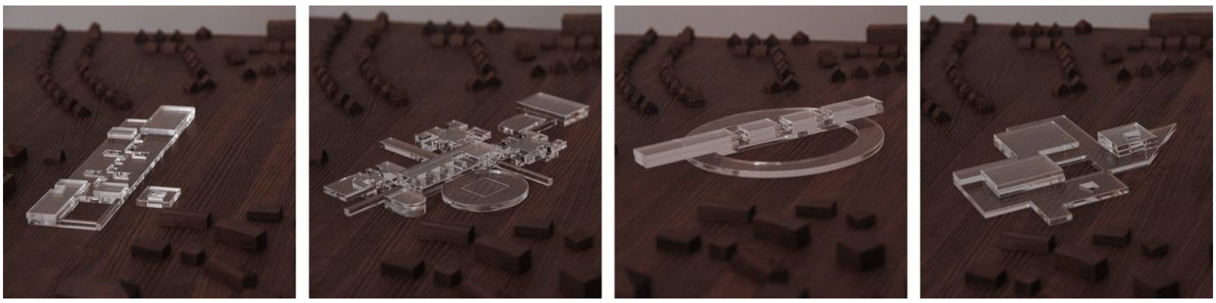

Figure 6. Case studies for discussion: The Axis, The Space Station, The Phalanstery, The Yards

The Axis was the most compact structure with a linear pedagogical program, with strong interior connections in a closed protective mass from the outside. The Space Station grew towards its environment with as many connections as possible, resulting in an organ-like structure of smaller volumes and voids. The Phalanstery differentiated between classes for smaller children in a circular ground-floor and the learning clusters of older students in a hovering rectangular structure. The Yards formed a cloister-like settlement with various outdoor spaces for different functions and ages. In addition to all previous statements, the new scheme had to develop from the core values of these solutions:

- Close and palpable connections between all spaces, inside and outside as well

- Diverse typology of classrooms and learning situations for different ages
- Fragmented volume to avoid overgrowing the city and the children
- Up-cycling of heritage to be innovative and familiar at the same time

We merged these attributes through hundreds of variations and long discussions every day for a month - at this point in a seemingly classical architectural design process. In the meanwhile we visited an important experimental school of the last decade: the Bildungscampus Sonnwendviertel by PPAG Architects, one of the best examples of learning cluster based education. Listening to the story of the design from Georg Poduschka, one of the architects, especially about the feedback of the teachers helped to clarify our main goals with the our school. Also their variation of the L-shaped classroom reinforced our intentions of further developing pedagogically approved experimental spatial solutions.

Figure 7. Bildungscampus Sonnwendviertel, Vienna, Austria, 2014 by PPAG Architects

(photos by Hertha Hurnaus)

The classrooms of children between 6 and 10 are formed according to our interpretation of the “L”-shaped classroom. The concept empowers the space and its users to inhabit it in various ways without being too extraordinary for the senses and early childhood experiences. This room consists of a square-planned larger area and an alcove for quiet retreat. However, for students over 10 years of age we invented a new classroom, based on our research in pedagogics, environmental psychology and acoustics. The plan of the new space is a cyclic quadrilateral shape with two right angles in opposite corners, one acute (75˚) and one obtuse angle (105˚); one of the right angles connects two identical sides. This formation allows changes in spatial perception. If students are facing one of the identical sides, they almost perceive the same square-shaped space that they had in their early years. This position is ideal for classical frontal teaching or presentation, where the attention of everyone in the classroom is supposed to turn to one place or person. However, if the tables are arranged in groups, so everyone has a sense of the shortest wall, the space stimulates active teamwork with its dynamic sensation. If the whole class would work or discuss something together, they should be facing the longest wall, because it provides a feeling of a much larger space than it actually is - our minds complete it into a whole rectangle. Acoustically the speech-understanding is made better, because in the absence of parallel walls voice won’t travel back and forth for long. From an architectural point of view, over the grown structure of the whole building, this is where we created a signature spatial solution for the client, which offers a strong identity for the community. Even though this formation was supported by different disciplines, we still felt hesitant to take the leap, therefore we built a model in 1:1 scale and used it for further spatial experiments. The results were reassuring, however they indicated possibilities for fine tuning, such as if the shortest and the longest wall are covered with a different material or built-in furniture, the space becomes more relaxing. The classrooms for the secondary school have the possibility for further advancements in pedagogical use: they can open up with their mobile walls towards the learning landscape to form a diverse spatial structure for the merge of two classes, so democratic school models can be implemented. [5]

Figure 8. Built experiment during the invention of a new classroom for children over 10

All data and components of the human parametric design were integrated in the design scheme. The introduction happened through a multisensory workshop, where the piarist community could play with large models, experience the two different classrooms in Virtual Reality - all this while experimenting with the spaces of MobilITy, the first learning landscape in Hungary, that was designed by our office for a robotics and programming education centre.

Figure 9. Perception and creation at the final concept introduction workshop

5 Edification

The heart of the new school is the central courtyard. With open gates outside school time it is woven into the structure of the city as the most cultured public space of the area. Even when the gates close, two public spaces with a few playground elements still remain open for children and families to meet. This notion plays a significant role in the integration of school and everyday life, and also helps the event of psychological arrival for the students and teachers. The courtyard itself bears the spatial heritage of the current building; it connects every space as a central meeting-point and also welcomes all kinds of happenings in fair weather conditions.

The courtyard is framed by the learning landscape of the school as its nervous system, connecting the organ-like clusters around. On the ground-floor the school separates into two parts: one accommodating the first four years of elementary school, the canteen and the chapel, the other incorporating the spaces for older students, the library, the event hall and the sport facilities. The two wings merge together on the first floor, making it the main circulation level in case of bad weather. The learning landscape is a shape-shifter: it opens up inside the different volumes to become an atrium, a communication yard, an open auditorium for the different age groups; its larger gestures give place to art, computing, geography and language studies; its nooks and crannies serve individual learning and small-scale teamwork.

Figure 10. Spatial structure of the school: A- Yard and learning landscape; B- Sport facilities; C- Between 11-14; D- Over 14; E - Up to 10; F- Chapel; G- Canteen, Management, Friary

Children move to a new classroom every 2 years to make their stay here interesting, yet have a sensation of home for a while. Every 4th year, when moving to another cluster, they stay on the ground-floor for the first 2 years with direct contact to the outdoor environment, then move to the 1st floor, where they have a more abstract spatial perception through skylights. The theme of the clusters reflect dwelling situations, so their users can relate to them more easily: the children are living and learning in a 'Home' (E on Figure 10.), later on they move to a "Multi-flat building" (C on Figure 10.), whereas they prepare for their lives outside school in the 'Urban tissue' (D on Figure 10.).

Every two classrooms share a terrace as an outdoor learning space. The use of these vary according to the age-range: in the beginning these connect to the indoor learning landscape as a puffer zone, later on they can be approached directly from the classrooms, in the last years even the classrooms open up completely towards the surroundings. Outdoor education starts at the threshold, but leads out deep into the garden with also a wide variety of outdoor learning places, such as the own vegetable garden of the students, the lake surrounded by the local vegetation and the sport facilities for athletics, ball-games, wall climbing and workout.

Learning starts in the new school in the autumn of 2022. In the meanwhile the teaching staff prepares the new curricula based on the various special possibilities. We're helping them by writing a book, the 'Space-Pedagogy Syllabus' to explain how the building works and which ways they can use its spaces to enhance the learning experiences. We're also planning to build a real-scale invented quadrilateral classroom in the courtyard of the current school building, so they can start discovering its possibilities while teaching outside.

Figure 11. Visualisations: View from the garden; The courtyard-heart

The creation of this multi-disciplinary design differ from most design processes, because in addition to the professionals architects usually work with, the client is also a co-designer in the progress. Therefore, developing a common language is necessary to be able to discuss all proposals and challenges. The experience of this wide-range co-operation facilitated us learning our spatial and pedagogical language based on shared words, spaces and actions.

Acknowledgements

The architects gratefully acknowledge the work, participation and co-operation of all children, students, teachers, leaders of the Piarist School of Mosonmagyaróvár, the leadership and professionals groups from the Hungarian Province of the Order of the Pious Schools and our colleagues from all design and technical disciplines throughout the design process. Their shared knowledge and co-operation became the fundament of this unique large-scale contemporary learning space development in Hungary.

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01.112 - A FEEDING STRAIT: IMAGINING A CROSS-BORDER COMMONS BETWEEN SINGAPORE AND MALAYSIA

Yann Herng YEOW, Ye ZHANG*

Department of Architecture, National University of Singapore
4 Architecture Drive, Singapore 117566; E0204871@u.nus.edu, akizy@nus.edu.sg

Abstract

The Straits of Johor, which forms the border between Singapore and Malaysia, has never ceased to be a site of power contestation, rendering the waterscape into terra nullius. In view of the fast-changing international geo-political environment, this study proposes that the border of separation can be transformed into a place for food production, a shared territory that can facilitate cooperation between Singapore and Johor, a state of Malaysia and achieve common economic growth, greater social cohesion, and higher competence of the region. This shared infrastructure is expected to contribute to tackling food security, a pressing challenge for both Singapore and Johor, and further help to address a series of bilateral issues arising from the separation, such as physical separation, territorial dispute, environmental pollution, economic imbalance, and social segregation. A phased masterplan is also proposed and discussed to show how the food production infrastructure can be planned and then turned into a catalyst for achieving the broader social objective – creating a cross-border commons.

Keywords

Food production, border, The Strait of Johor, commons, design research

1 INTRODUCTION

Lying at the southernmost end of the Asia mainland is the Straits of Johor that separates two nations which were once united – Malaysia and Singapore. In this territory of mere 1-kilometre-wide (at its shortest width) and 50-kilometre-long, half-owned by each country, numerous exchanges take place incessantly. Besides the 300,000 people and 145,000 vehicles that cross the border every day through the Causeway, what lies behind the scene are power contestations, economic competitions, and political disputes that constantly challenge the bilateral relation.

Due to political division and physical separation, the Straits of Johor is now both a cause and a host of the persisting disputes and rivalries between both sides. And the ruptured space further resulted in a spatial estrangement that intensifies the unceasing political tension between the two contiguous nation-states. Specifically, the waterscape has been rendered into terra nullius — void of life and activities. In view of these conditions, this paper attempts to explore the potentials of transforming the border of separation into a shared territory that operates as an urban commons to facilitate cooperation between Singapore and Johor towards common economic growth, greater social cohesion and subsequently higher competence of the region.

2 Border Separation and Resultant Bilateral Issues

According to C. Arbaret-Schultz, a border is "a spatial object that brings distance in proximity".[1] The ambivalent notion of border being simultaneously excluding and including[2] results in a blurred and controversial border space in many contexts across the world. In most cases, border spaces have become the venues where power being exercised, dispute being intensified, and social control being exerted. The Straits of Johor is no exception. The bilateral issues pertaining to the Strait of Johor are discussed in the following five aspects: physical, territorial, economic, environmental and social.

Inefficient and inadequate physical connections

Physical connection is seen as the fundamental element in any border-crossing dynamic. Currently, there are two existing border-crossing infrastructures across the straits. The first one is a causeway completed in 1923 and is now one of the world's busiest crossings. Often cited as a direct result of stringent border control on both sides, the bad traffic congestion during the peak hours has not yet been resolved despite being a subject of intense study and review. Worse still, travellers are prohibited from crossing the causeway by foot after the Johor Bahru Custom, Immigration and Quarantine complex (CIQ) was completed in 2008. Spanning 1.05 kilometre connecting Johor and Singapore, it was designed as a rubble causeway instead of bridge by then colonial authorities due to economic factor.[3] However, the causeway effectively cut off the passage of water carriage, eventually becomes the main source of inexorable contestations, notably in the born of the infamous 'crooked bridge' mooted by Malaysia's Prime Minister Mahathir.[4]

In 1998, the second link bridging Gelang Patah and Tuas was constructed in a bid to divert the traffic. However, it has not been used to full capacity due to its proximity to the main areas with dense population. Actions have been taken to encourage the usage especially for goods vehicle through the reduction Goods Vehicle Levy in 2018.

Apart from the road connections, the capacity of existing train service has been insufficient to cater for the need with 26 trips of 320 passengers daily which only account for 0.02% of daily commuters. This inefficiency is set to be replaced by the Rapid Transit System tentatively by 2024.[5] In 2016, another border crossing infrastructure — Kuala Lumpur-Singapore High Speed Rail (HSR) project was inked. However, it is postponed following the formation of new Malaysian government in May 2018, citing the great debt left by the previous regime. Evidently, the new Malaysian government does not see substantial reason to build the HSR, attesting to the crux of the matter — economic gain.

Continuous land reclamation and territorial dispute

Contrasting to the lacklustre efforts in addressing border-crossing issues, the two countries have been zealous in exerting respective power over the territory through land reclamation, starting from Tekong Island, Ubin Island to Forest City. However, disputes escalated when both protested to each other's land reclamation work which even involved the international arbitration.[6]

Moreover, the urban development master plan of both territories across the straits are also proven to be problematic as they are planned independently without considering the opposite side. Ironically, the incongruous developments from across the straits have been greatly affecting the opposite territory due to their proximity. The implications are not limited to visual impact, but further extends to the biodiversity, water, sound and air contamination, as seen in the example of toxic pollution from Pasir Gudang, Johor plaguing residents of Punggol, Singapore.[7] For Singapore, the northern coastal area has always been the backwater, primarily zoned as residential areas and nature reserves. For Iskandar Malaysia (development region involving Johor Bahru metropolitan area), the coastal areas along the straits are considered prime land, mostly earmarked for high revenue developments, including the existing ports, administrative zone Nusajaya, high-end residential areas and megaprojects.

Environmental pollution and degradation

The rapid developments along the coastal area especially on the Johor side following the inception of Iskandar Malaysia project have been detrimental to the water quality. Although the water pollution due to oil spills and mass fish kills are constantly reported on local news, serious actions are yet to be executed. Generally, mass fish kills are caused by the low oxygen level in the water due to plankton and algae bloom which are attributable to the massive land reclamation in the area. Besides, dead dugongs are also constantly spotted ashore.[8] The ironic fact of the strait being co-owned instead of fully owned by any sides has caused many efforts to improve the situation go futile when both do not see eye to eye.

Resource dependence and economic imbalance

Another persisting dispute arose from border separation is the disproportion of natural resource endowment, in which water supply poses the biggest threat to the land-scarce Singapore. Water security had been a contentious issue between the two sides and concerns loomed large for decades in Singapore that Malaysia would cut supplies in retaliation over bilateral differences. Under a 1962 Water Agreement, Singapore holds the exclusive right to draw up to a maximum of 250 million gallons of water per day from the Johor River until 2061. Approximately 40% of Singapore's current water needs are met by Malaysia, though the island republic has aimed to improve its domestic water supply, including the opening of desalination plant.[9] On 13th August 2018, Malaysia's Prime Minister Mahathir has revealed his intention to increase the price of water supply by tenfold to reflect the higher cost of living.[10]

Social segregation and discrimination

Socially, Malaysia and Singapore share some historical and cultural affinities, as both countries are boasting multiracial societies comprising Malays, Chinese and Indians, albeit in a different proportion. The separation of Singapore from Malaysia on 9th August 1965 was a result of communal tensions and racial riots in 1964, mainly attributed to the political and economic differences.[11] In present day, high economic interdependency and cross-border family ties of the two sides have seen a high exchange of talents, labour and capital across the strait day in day out. However, the difference in economic strength, development pace and average educational levels have elicited anti-foreigner sentiments such as discrimination against and superiority over Malaysians amongst some Singaporeans.[12] The deeply rooted prejudice and stereotype are believed to be highly related to the lack of deep understandings, communications and social interactions.

3 Alternative View of Border: one entity based on Connectography

Identifying border separation as the root of the perennial issues, a revisit on the notion of border and its state-of-the-art viewpoints is thus of paramount importance. A border is an ideological socio-cultural construct by which communities/nations define and defend the notion of their territory. As noted by Nick Vaughan-Williams,[13] borders are constitutive of political life. Border is produced, dynamic and politically charged. A look into the history reveals that border is constantly being challenged and ever-changing. This then prompts the question of what the border might be or changed to in the future.

In his seminal book ‘Connectography’, Parag Khanna posits an alternative perspective of looking at our world atlas and border, i.e. highlighting the network and connection instead of static lines as separation.[14] He also argues that functional geography is increasingly holding more significance than political geography. In Khanna’s thesis, our world is and will continue forming global network civilization through agglomeration of cities into mega city regions, while political borders are losing its relevance, in which he summarized as ‘connectivity is destiny’. In order to serve the one goal — sustainable urbanization, he teased out the two most salient points to focus on, which are infrastructure and supply chain. “We are moving into an era where cities will matter more than states and supply chains will be a more important source of power than militaries — whose main purpose will be to protect supply chains rather than borders.” To ensure continued economic openness, Khanna infers that investing more heavily in the infrastructure for enhanced connectivity should be every government’s priority in a world of super-low interest rates.

As discussed earlier, despite having active cross-border dynamics between Singapore and Malaysia, the persisting border has caused many issues that hindered the growth and collaboration of the two states. Seen from Khanna’s new perspective of borders, however, the comparative advantages reveal high potentials for the two states to collaborate – that is, while Singapore boasts a greater capital and advanced technology but facing land scarcity and ageing population issue, Iskandar Malaysia, on the other hand, is in a dire need for more capital investment albeit having more manpower and nature resource. Evidently, dissolving the border and reconceiving the region as one economy is likely to warrant a win-win situation to both based on the economic complementarities.

4 Proposal: Transforming the Strait of Johor into a commons for food production

Taking infrastructure and supply chain from ‘Connectography’ as a basic framework and tapping on the pressing challenge of food security in the region, this study hypotheses that food production potentially offers an opportunity that can create a commons, based on many complementarities between Singapore and Malaysia, in order to mitigate the abovementioned bilateral issues.

For the border to develop and evolve into a field of reconciliation and interaction, the space has to be turned into a social space for interaction, a cultural space of assimilation, as well as an ecological space of evolving nature, therefore agency has to be activated and steps have to be taken towards transformation.[15] Unlike many political borders that are imposed on the land through human agency, the Malaysia-Singapore border is defined by a natural strait which is inherently a natural commons. However, as Garrett Hardin argues, such commons of no man's lands with no rules and open access are susceptible to the tragedy of commons. The very antithesis to Hardin's argument is Elinor Ostrom's assertion that commoners would naturally communicate, negotiate and establish rules amongst each other. In other words, commons could be a social space that is defined and co-owned by a community. To that end, this study attempts to devise a plan to ease the transition from the former to the latter forms of commons.

4.1 The pressing challenge: Food Security

The fact that global food system in current world is getting more interconnected does not guarantee a more resilient food supply. Paradoxically, it is vulnerable to political, natural disaster and economic crises, where a disturbance may have snowball effect across the globe.[16] For Singapore that imports 90% of its food, the crisis is ever looming and alarming, which calls for a change in policy and consumer's behaviour to adapt to the dynamic global system.[17] As such, optimising local food production has been outlined as a core component of Singapore's Food Security Roadmap.[18] Despite being a net exporter of food, Malaysia has been ranked at 40th in 2018 Global Food Security Index, due to the low affordability and quality. In contrast, Singapore is ranked at first place for the first time in 2018, mainly attributable to the stable economic environment and high gross domestic product per capita. However, its availability of food is most susceptible to natural resource risks. Evidently, a collaboration between the two — exchange of technology and natural resources — in food production industry is beneficial to both in the event of catastrophe such as the food crisis in 2008.

4.2 Food Production as New Urban Commons

The very first prerequisites in the quest of reconciliation are the genuine intents and willingness to cooperate. Taking the alternative view of borders and its implications to the relation between Singapore and Malaysia explained above, the proposal is built upon the premise that the two governments have come together and decided to break the deadlock. With a change of mindset, the straits can be regarded as a resource commons — a shared territory which allows the governments' interventions to the no man's land.

Upon studying the existing activities and potentials, this study proposes to capitalize on the natural resources from Straits of Johor — water and marine life, to build a food supply chain network. The strait is home to plenty of marine life and a number of sea-based aquaculture fish farms. Through bilateral efforts, these natural and cultivated resources could be multiplied into a shared resource, which potentially give rise to a new typology of commons through a planned process. The governments would be the actor to initiate, curate and choreograph the subsequent communing process through policy-making and local empowerment. A productive border would then redefine the site as an urban commons, from both spatial and functional dimensions. Spatially, a cross-sectorial collaboration can be initiated to build some shared infrastructures, for both food production and connections. Functionally, the shared spaces provide the place for food production activities, i.e. aquaculture and agriculture, where the process itself would be a process of 'communing' when agreements are established and rules are negotiated. Through a collective effort to physically and programmatically enact an urban commons for food production, it is possible to leverage on the positive externalities to address the multi-faceted bilateral issues.

4.3 Food Production Engenders Other Commons

In 'Rebel Cities'[19], David Harvey urges the need on examining the other forms of commons and recognize the interaction of urban commons with other urban systems. Correspondingly, the proposed urban commons as a field of food production entails and thus engender other forms of commons (see Figure 1).

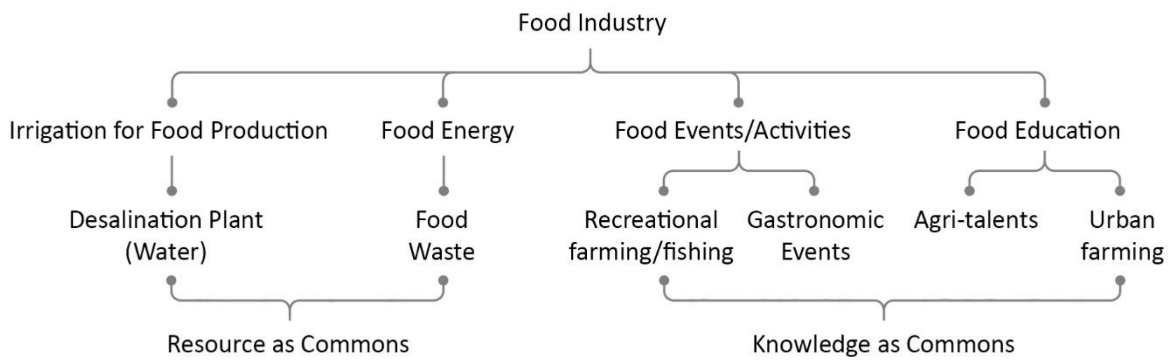

Figure 1. Food industry engenders commons

Food production need water supply for irrigation, thus also acts as a catalyst to accelerate the desalination technology. A shared desalination plant is important to build the resilience in response to the imminent climate change. The new 'water tap' become a new common resource to be shared by the two states.

In Singapore, food waste accounts for approximately 10 percent of the total waste generated. Provided the same proportion remains, more food produced also means more food wasted. Currently, 84 percent of the food waste are incinerated at waste-to-energy (WTE) plants to generate electricity. On-site food industry thus provides an opportunity to efficiently manage the food waste and contribute to a common resource — energy.

Apart from food production, food education could also probably lend to the knowledge commons. Programmes such as agri-talents by AVA and the burgeoning urban farming movement involve sharing of knowledge on how to grow our own food are a form of communing. With the desirable settings and communities in place, an array of food-related events or activities could be expected, which potentially contribute to the knowledge commons. This empowerment of the people through education of common pool knowledge is the key to the change towards food sovereignty.

5 How Commons Address the Bilateral Issues?

How then the above commons relate to the ultimate goals of the project — resolving bilateral issues? Table 1 summarizes the relationship of food industry and bilateral issues.

Table 2: Commons and Bilateral issues

Issues	How food industry intervene / improve the situation?

Physical	Inefficient and inadequate physical connections due to border control	Food production and consumption redefine border security checkpoint Inefficient and inadequate physical connections and crossing
Territory	Continuous land reclamation and territorial dispute	Create shared food source, engender one economy and interdependence - change of mindset as a whole
	Incompatible zonings and environmental impacts due to uneven development	Food production module as a gradient / mediator to bridge the gap such as algae and mussels farming
Environmental	Air and water pollution	Create needs on the water to monitor the water quality
Economic	Resource dependence and economic imbalance	A shared water desalination plant and food digester - one economy
Social	Social tension	Create social platform through farming - co-production + co-consumption
	Vanishing fishing villages as cultural heritage	Preserve fishing village and the traditional fishing culture

Physical

The project proposes to address the traffic issues through a cross-border food network by creating higher food interdependency. By reducing border control, a smoother crossing would enhance food delivery — both raw food material or cooked meals — and further enrich the current cross-border dynamic. While the main functions of the infrastructures are primarily for food production, they should also be designed to double as border-crossing facilities. Multiplying the crossing channels and expediting the process would address the insufficient and inefficient physical connections issue.

Territorial

Conceiving the straits as a shared food source and supply chain would redefine the neighbouring states as one economy, further fostering the interdependence. Apart from meeting the food demand, farming would also yield positive externalities to negotiate the incompatible zonings by alleviating the environmental pollution. Algaeculture requires carbon dioxide and nutrients from the sewage to accelerate the growth; while mussel and oyster farming are proven natural water purifiers as the bivalves take in bacteria, chemicals and pathogens in the water. To that end, well-designed architecture is required to maximize the efficiency of food production infrastructures to also serve as biofilters, especially near the areas affected by pollution such as Punggol-Pasir Gudang and Danga Bay-Sungei Buloh.

Environmental

It is the human nature to sustain our environment when/where we need them most. Human only strive to achieve the sustainability of nature when human need the natural resources to survive. Sustainability is defined as the process of maintaining change in a balanced fashion, in which the exploitation of resources is in harmony and enhance both current and future potential to meet human needs and aspirations.[20] By creating the needs on the food resources at the strait, the water quality will be constantly being monitored. This is vividly illustrated by the case “when (our) farmers along the Straits of Johor were devastated by a massive loss of fish stock in February 2014, we immediately rolled out appropriate initiatives to help them during this ordeal."[21]

Economic

Since 2005, Singapore has been investing in the desalination technology dubbed the Fourth National Tap, aiming to double the capacity by 2030 and triple it by 2060 which means more acre of lands are needed (PUB n.d.). Food production need water supply for irrigation, thus also acts as a catalyst to accelerate the desalination technology. By maximizing comparative advantages, Singapore can contribute its technology input and R&D while Johor has vast land to host the land-intensive plant. A shared desalination and waste-to-energy plant is important to build the resilience in response to the imminent climate change, which also define the region as one economy.

Social

The border space is turned into a production area that does not only yield food crop, but also doubles as a culture cauldron that aim to produce social cohesion through serendipitous encounters and interaction. As argued by Sennett, a limited sense of fraternity with others arises when people do something together rather than being together.[22] In a similar vein, the new space for production are designed to ensure colocation, copresence, and collaboration. The governments could anticipate a more efficient use of the urban and natural resources while constructing a common regional identity for collective gain. Bilateral collaboration in lieu of contestation also means that solidarity between the two nations could be built, natural surveillance could be promoted, making the border space less vulnerable to global threats.

6 Design Implications – Systems and Architecture

This section will discuss some of the possible design strategies in terms of managerial systems and its architecture. As suggested in section 4, the project would not be a one-off design but rather a long-term project that might span for decades, and this requires continuous assessment and adjustment. Therefore, it is important to take into account the fourth dimension in the design — time. Through a phased comprehensive master plan, the architecture is employed as the means and process to engender commons. In this paper, we would sequence the investigation in 4 phases to further discuss the spatial indications in each phases and scales.

Phase 1: Master plan and Infrastructure

To kickstart the project, the two governments would collaboratively come up with a joint master plan. A thorough site study is important to carefully pinpoint the specific locations of each bilateral issues as most of the issues are site-specific. Subsequently, a scientific study on the marine and ecology system would help to further inform the potential sites that are suitable for any interventions, especially fish farming which is the primary activity to initiate the system. With the preparatory works done, the planning authorities from both states can then come together to negotiate and lay out a land use plan to address the bilateral issues. This is to ensure that consensus can be reached and none of any side's interests are compromised, meanwhile effectively avoiding the current situation — conflicting land use and uneven developments. A governments-led cooperative could be formed to act as the people's representatives to convene, organize and engage the locals in the decision makings.

Phase 2: Infrastructure

When the agreement is reached, it is important to engage professional design consultants including urban planners, architects and engineers, as an innovative and unconventional urban system is required in this 'greenfield' project. To allow for future changes in programs and users, adaptable architectures do not only set the stage but instead play an active role to facilitate the transformation. A future-ready design allows evolution through varying spaces and changing occupancies in response to ever-changing realities. Through prudent provisions in the spatial design and architectural details, adaptability and flexibility could be incorporated up front. Thereafter, the governments could appoint private developers to construct the infrastructure through open tenders. A cross-sectorial collaboration does not only increase the efficiency and quality of works, but also opens up the possibility to tap on private sectors for more capital investment.

Phase 3: Food Production

Dividing the long stretch of straits into parcels or precincts would ease the management through decentralization of command and control. Each of the parcels can be superintended by a food cooperative which consists of local farmers and stakeholders. They are responsible to produce the fresh food to serve the local markets, gaining profit to sustain the system — footing the overheads cost — instead of accumulating wealth.

In terms of architecture, studies on the farming systems are done to provide some suggestions for design implications. This study suggests the employment of aquaponics system that integrates aquaculture and hydroponics farming. It is essentially a closed-loop system that involves recycling of fish waste to fertilize the vegetable farming; the hydroponics farms in return cleanse the water to complete the cycle. This helps to reduce the environmental impacts of water pollution while cyclical water consumption also reduces the loss of water. The agriculture could take the form of vertical farming towers which significantly decrease the land use. When the infrastructure stretches across the straits, it is inevitable to have travellers crossing and inhabiting the border. Hence, an innovative architecture to reimagine the border-crossing is required. The border could house food consumption spaces such as on-water eateries and food market, which redefines the security checkpoints when augmented with latest technology including radio-frequency identification (RFID), multi-biometric screening and drones. Besides, auxiliary spaces such as food waste digester and desalination plants are integral parts in the system. An open and transparent design for such infrastructure could turn them into accessible and educational spaces for the public. Multipurpose architecture allows the facilities to not only produce food, energy and water as main resource commons, but also provides a platform for knowledge and social production. In short, phase 3 would see the straits transformed into an urban commons and prepare the site to further give rise to other commons in later stage.

Phase 4: Space Conversion into Commons

Phase 4 focuses on commons as a social space to allow different forms of participation, sharing and collaboration. Everyone that comes to the sites, including residents, farmers, workers and visitors is seen as potential participant in the aforementioned events and activities who produces sharing through co-production, co-consumption and collective interaction.

In this scenario, transformability of the architecture is the key feature in producing commons. Together with the power of social media and education, transformable architecture could empower the people to re-appropriate the spaces for other usages. The process could be seen as a production and re-production of commons, which along the process slowly gravitates the focus from physical resource production to social condenser. In other words, food production in the earlier stages becomes the catalyst to multiply the spaces, which could then be transformed into social grounds. The final vision of the site is cast as an ecologically-based symbiotic social structure that creates resilient spaces and communities which are empowering and inclusive, allowing different facets of every day occurrences and needs to take place.

7 Conclusion

Despite that the design is still under investigation, the study explored the possibility of an evolving urban common as the architecture response to the manifold bilateral issues. By reimagining the border as a production site of food, the paper attempts to demonstrate how the commons can be enacted in relation to the convoluted conflicts. While the investigation only presents one of the many possibilities on this site, the approach is meant to be speculative and open-ended, wishing to evoke more conversations and inspirations for a prosperous future to the region.

Acknowledgements

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TOPIC 2: CONCEPTUAL AND METHODOLOGICAL CONCEPTS

02.101 - GENERATIVE URBAN PROGRAMMING: SOCIAL MEDIA DRIVEN SYSTEM INTELLIGENCE

Booher, C., Beorkrem, C. and Ellinger, J.

UNC Charlotte
School of Architecture, 9201 University City Blvd. Charlotte, NC, USA.
cbeorkrem@uncc.edu, jefferson@uncc.edu

Abstract

"There is no logic that can be superimposed on the city, people make it, and it is to them, not buildings that we must fit our plans (Jacobs)."

In the 21st century, the notion of 'firmness' in Architectural design is at odds with the mobility and transience of current conceptions of space (Beaumont 2015). Our realities can be temporary, virtual, and even augmented. Through social media and other interfaces, we now have access to an enormous amount of data with a wealth of information about how individuals are using and experiencing space (Calabrese + Ratti 2006). This user data reveals patterns of collective behavior that can be used to inform design interventions. The ability to access real-time data streams of collective behavior creates an opportunity to implement a socially driven, crowd sourced bottom-up approach for urban design.

By leveraging advanced computational techniques including agent-based systems and machine learning the crowd sourced information can inform new ways of deploying architectural systems. In an agent-based system (ABS) the most significant factors are the autonomy of the agent and the agents' ability to interact with the environment. A multi-agent system has the ability to simulate interactions between other agents and the environment rather than a single agent-based system in which the agent only responds to the environment. "The concept of the agent-based system has been widely used in computer science, biology and social science, such as swarm intelligence, decentralized social networks simulation, and economic growth modeling. ABS consists of interacting rule-based agents which can create real-world-like complexity (Tang, 303)." Programming the computational agents with data collected from social media can be used to simulate actual patterns of human behavior. Social media is a viable indicator of how individuals are moving through and using space while also revealing their habits and sentiments (Karduni 2017). Collective behavior patterns revealed through this localized social media data indicates opportunities for architecture to be an active agent in a collective system, at the urban scale, rather than simply a boundary condition.

Of particular interest in this research is simulating how architectural program locations can be responsively instantiated based on the collected social media data of users at a particular location. This paper presents a design tool that serves as the mediator between collected social media data and an existing site to assist the designer in visualizing and understanding localized patterns to produce bottom-up urban designs.

Keywords

Generative Design, Collective Design, Social Media, Urban Design

1 INTRODUCTION

In contemporary planning practice, specifically New Urbanist projects, architecture is often conceived as a set of rigid form-based boundaries. These boundaries often conform to surrounding traffic and pedestrian circulation patterns. Although new urbanist principles seek to build a sense of community and develop ecological practices, the success of these goals is rarely quantified. The projects are trivialized to an aesthetic that only alludes to a sense of community and environmental sustainability by capitalizing on nostalgia. This aesthetic is a false façade for a spatial hierarchy driven by economic priorities. In many instances these short term, *top-down* prescriptive environments are not socially or economically sustainable (Durack 2001). As these environments begin to collapse, rather than building new projects we can evaluate the collective behavior revealed in post-occupancy data collection to intervene on an existing site. In the context of this proposal post-occupancy data refers specifically to social media data describing the collective behavior of individuals on an existing site.

2 Swarm Intelligence

With the advent of social media and its inevitable ability to provide us with a deeper insight into our social structures, a series of terms have been derived to describe the patterns evident in the data being generated. “Horizontalism” defined by Juris describes how social media has shifted the organization of social ideas away from a single idea and towards a “leaderless” or “horizontal” organization (Juris 2005). Hardt and Negri use “swarms” to describe how these communication platforms create an intelligence that is more than just the agents singular ideas (Hardt and Negri 2005). Gerbaudo argues that it is the “collective identity” which is created and relied upon through the rapid sharing of ideas across social networks (Garbaudo 2014). Swarm intelligence is the collective behavior of decentralized, self-organized systems typically following a simple set of rules. Design can take cues from these models to understand how a decentralized system operates and may be formally synthesized (Wiesenhuetter et al. 2016). To link this user data to design, in this project, architectural elements are embedded with agency that is defined by rules stemming from the local conditions.

3 THEORY

A model of design resulting from observations of localized collective behavior is the project *Casa Familiar* by Teddy Cruz. *Casa Familiar* looks at emergent collective behavior along the Tijuana-San Ysidro border. An investigation of the local conditions revealed patterns of deviation. The residents in the local area were adapting their environments to their needs, deviating from existing zoning regulations and prescriptive residential programming. The model includes flexible spaces where program is not predetermined, resulting in spaces operating with a level of heterogeneity. As Cruz explains “…true experimental architectures can emerge from the intelligence of social networks…” (Waldorf 2009). In an equally bottom-up, yet more computational study, social media data is used to understand collective behavior (Cabrese +Ratti, 2006). This research visualizes movement patterns and attractors in the city of Rome revealed through geo-located social media data. This is significant because it indicates the correlation between urban conditions and social media data. With these bottom-up models architecture has the opportunity to become an agent reconfigured at the discretion of local collective behavior.

Another significant computational example is Ming Tang's research of Data Driven Urban Modelling. This research does not address social media but clarifies a trajectory for modelling using rule sets at an urban scale. Ting's research was specifically focused on how site data could inform the optimization urban blocks. This framework for importing and utilizing site specific data informed the development of this tool. Similarly, in the Melbourne Docklands project by Kokkugia, objects are given agency and intelligence alleviating the notion of hierarchy that is traditional in urbanist projects as mentioned earlier. This architectural agency enables "interaction without a sequential design hierarchy, instead the hierarchy of intensities at a macro scale are an emergent outcome of their self-organising operation." (Kokkugia) It is important to note that in this example the intelligence or set of rules embedded in the agents are not derivatives of local data as is the goal in this project and was true in the Cruz, Cabrese + Ratti examples. This precedent looks specifically at ideas of stigmergic growth. However we can see the connection between social intelligence and stigmergic growth in the article "*Stigmergic Epistemology, Stigmergic Cognition"* which specifically indicates how these two concepts relate to modifications of the environment (Marsh + Onuf, 2008).

Bernard Tschumi and Rem Koolhaas have based their work and written extensively about programming flexibility and creating opportunities for disjunction [BC1]. In "Some mediating agents that acts as a distancing agent between the built realm and the user's demands" In this instance Tschumi is describing the idea that program type should not be indicated by the architectural style. Tschumi is arguing for a distortion of social conceptions of architecture as a means to allow the user to define the program rather than the architecture. This is precisely what the tool is striving for, a new design typology that is spatially defined by the user but not limited to rigidity of form or program specific. Or as stated by Lewis Tsurmaki Lewis, in their manifesto, *SNAFU "Function Fucks with Form".* The function in this instance is that designated by social media users. In Koolhaas' *Delirious, New York*, each newcomer defines the programs of the compound. The design can be more complex, more heterogeneous through the use of this tool. Therefore, what is defined as "enhanced" is ultimately up to the designer, but the potential for design complexity is much higher than the limitations of the rigid contemporary planning practices.

The amalgamation of these ideas is the basis of this research: localized bottom-up data is essential to making quantitative decisions, social media can be a source of this data, embedded intelligence and rule sets stemming from data analysis, synthesized through the lens of heterogeneous space and programmatic opportunities, can create alternative methods for understanding and designing our urban environments.

4 ANALYSIS

Like many of the ideas discussed in the above precedents, this project will implement the design of a tool as means for synthesizing post-occupancy user data into responsive architecture. The tool utilizes two inputs: an as built Autodesk *Revit* model and data gathered from a variety of sources including, but not limited to data scraped from or mined outright using the application program interface (API)'s of: *Google, Yelp, Twitter* and *NextDoor*. Google's time-based search or map request relays peak hours for each commercial space. Topic modeling over geo-located tweets can create a spatial and potential emotive understanding of people's experiences. Data scraped from Nextdoor can reveal the concerns of residences linked to their relative locations and time. Data from Yelp can provide reviews as well as up-to-date pragmatic information about hours of operation. The first component of the tool creates, evaluates, and links the data collected deriving a programmatic association. This data will then be used to associate new attributes to those programs, allowing a designer to access alternative organizational strategies which are formally responsive to the data. This creates new morphologies both spatial and programmatic. Existing sites will serve as case studies to mine local data for analysis and synthesize formal responses.

Figure 1. Birkdale Village- New Urbanist Development in North Carolina, USA.

The analysis of an existing site consists of first collecting data and then determining how to use the data. The data is collected by geo-location or place mentioned posts as well as neighborhood specific apps. (There are many more applicable sources not mentioned in this study). Once the data from these sources is collected sorting techniques are identified and the data is converted into lists. The data can exist in an excel file that is specific to the site and specific to each program on the site. This excel file is referenced in a Dynamo graph and are associated with the model elements that represent each program type and name in a three-dimensional Revit model of the existing site. Each program type has an agent designation. A set of rules are developed based on the collection of social media data and the agents follow these rules in the simulation. The set of rules are specific to each data study. For example, if the Next Door app reveals that there are noise concerns during a specific time, programs (acting as agents in the system) with high acoustic levels may repel agents that represent programs in the location of the complaints. Integrating this rule set with rule sets from other data sources creates a complex system in which programs can react and (re)adjust to social cues. When these scripts are run multiple times the patterns that begin to emerge suggest new programmatic relationships that are not simplified to the limitations of Cartesian organization and anecdotal evidence.

5 CASE STUDY

The first case study for the proposed tool is Birkdale Village, an existing new urbanist project in Huntersville, NC. The project is modeled on a “Main Street America” logic in which retail shops and restaurants are clustered along one central axis culminating in a large cinema. This project exemplifies the ubiquitous form-based organizational methods that have pervaded American urban design for the last 20 years. Retail shops exist below residential units, with a storefront facing the main street and a double loaded residence corridor. (fig.2). The original plan included less retail space however, after completion of the first phase of construction investors requested more retail due to the success of the completed and active retail. In the final constructed model the percentage of retail square footage outweighed residential and all other program. This result exemplifies the deviation from the intentions set out by the new urbanism manifesto in the interest of economic priorities. There are no public institutions such as libraries, post offices, and green space is a small fraction in comparison to square footage allocated to parking. In this study, architectural elements that refer to the collected social media dataset, drive the responsive agents.

Figure 9: Simulation of program clustering in response to tweets.

We see that the programs begin to cluster and create new relationships, to each other and to existing forms (fig.3). The striped grey hatch represents programs which were geolocated or mentioned in tweets between the hours of 5pm-5am. The cross hatch represents programs that appeared in tweets from 5am-5pm. In the first example, programs which with opposing hatches are attracted to each other in the simulation. Programs with high levels of social media activity at a certain time attract those programs with opposing time of active use. Other rules are integrated into the agent's intelligence such as program size, demographics, or spatial needs. In the second drawing programs are mapped to associate with similar times of Twitter activity. The third diagram is a mix of the first two examples, where some programs are attracted to their opposites and others to their likenesses. These three simulations are overlaid on top of each other. The result reveals patterns of repetition and overlap of the alternate scenarios. In this diagram geo-located tweets are tracked by time and sentiment. The clusters of tweets at certain times and sentiments dictated the attraction or repulsion rule set for programs.

Figure 3. initial studies of program migration patterns responding to Google data.

In the next diagram Google provided data regarding the intensity of different times of use by program were embedded with rules to attract or repel one another accordingly (fig. 4). The continuous simulation of these associations began to create clusters and overlapping of programs that were typically disassociated. In this manner, the architecture began to reflect the collective behaviour inherent on the site. It becomes an agent and construct of site-specific user data. One result of the data collection is that informs when users are active in what programmatic areas. It reveals which programs are less active and what sentiment may be associated with different programs and times of use. By collecting this data and simulating how programs may react or respond the results help the designer visualize interventions which are complex, dynamic, and heterogeneous spaces because the architecture is a result of responding to the users rather than the users being limited by architectural boundaries.

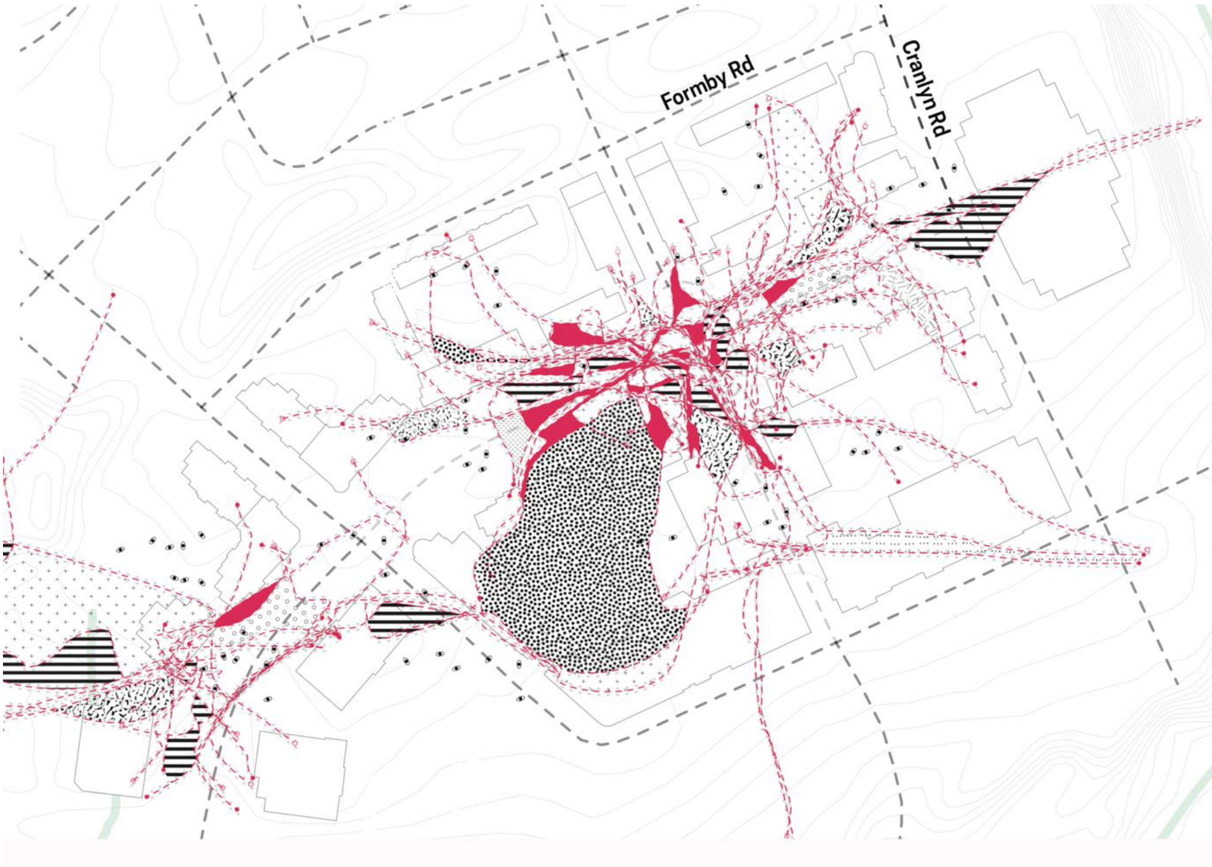

Figure 4. initial studies of program migration patterns responding to Google data.

The synthesis of the data manifested in this study as a series of interventions on the existing site that are formal and programmatic. They represent either the overlap of multiple programs or a trail of repeated paths. The interventions disrupt the flow of traffic, rearticulate circulation patterns on the site and blur the hierarchy of spaces (fig.4).

6 CONCLUSION

Although our conceptions of space continue to become more complex, rigid planning practices prevail and opportunities to reimagine existing projects are a necessity. As described, this proposal uses a multi-agent simulation where architecture is an agent responding to collective behaviour patterns as a generative tool to inform designers on how an existing project may transform over time. The result of this analysis and synthesis was a design proposition on the case study site. The intention of the proposition was to reveal the richness of programmatic relationships that resulted from an analysis of the data. The study was very simple in comparison to the amount and complexity of accessible data. Layering data could potentially create more complex results that could be used at a designer's discretion to synthesize form. The tool could also be further developed to create a typology of formal responses or design options. While the study was specific to a village site, in between a macro and micro scale, it could potentially operate at the micro-scale as well. The micro-scale would be a building or even a room. However, there are limitations to this type of data that are not as accessible. The main goal of the tool is to visualize post-occupancy data in a multi-agent simulation.

The result of the case study revealed that the visualizations indicated possibilities for programmatic interventions as a result of embedding social intelligence into those program elements. One concern with this type of study may be resident privacy but the reality is that businesses already track this type of data and more. In general, but especially in these types of highly commercialized urban spaces, user data is constantly being collected. The architect has the opportunity to have their own response to this data which in this case is intended to be based on the user's interactions in an effort to make spaces more complex and relative to the way they are used rather than increasing sales. The user will experience a city that is literally responding to the collective behaviour. The urban space comes to life and any activity can engage spatial alterations or feedback from users by adjusting. This may be in the form of temporary, say inflatable structures or scaffolding or in time become more permanent if successful. This study did not include a detailed response on type of construction for the interventions but rather seeks to imagine the potentials of collecting the data to allow the architect the freedom to be informed and curate formal or programmatic responses at their discretion.

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02.102 - ARCHITECTURE IS BRANDING

Paolo BERTOLOTTI
BBCREATIVE, LLC
NEW YORK, NY, USA
paolo@bb-creative.com

Abstract

Architecture has long been regarded as a balance between two systems; artistic ability and scientific methodology. A balance between emotion and structure. This paper seeks to introduce a fundamental and crucial third system; perception.

In business terms, perception is referred to as brand. The Dictionary of Brand specifically identifies a brand as “a person’s perception of a product, service or experience or organization” (Neumeier, 2004).

Although the value of brand has long been a powerful tool in the hands of an MBA and CEO, it has largely been ignored by architects as it seems too removed from our profession to really matter.

This paper’s quest is to bring to light the significant value of branding as a *design tool* for the architect.

Let’s not forget that the profession of Architecture is a service. A service delivers value to a client in the marketplace. As such, understanding the underlying relevance of a service in a marketplace requires basic business fundamentals. Those fundamentals teach us how to be clear and focused in identifying the value added proposition that we are striving to make. A strong brand did not happen by accident, it was carefully researched and executed, and it is that specific process that I want to explore in this paper as it relates to design.

As architects we always speak of art and science, of form and function, just think of branding as a third language that will help you design and bridge the gap with the user.

Keywords

Branding, Strategy, Design Theory, Design Thinking, Creative Process.

1 INTRODUCTION

The meaningful element of architecture is that it requires humans as participants. Architecture is alive, it needs people to fill its space, it needs to be experienced, it needs to be engaged. Describing architecture, even in a philosophical sense, “at a bare minimum, we can say that it features some connection to human use.” (Zalta, 2015)

If no one interacts with a structure, or if it does not impact anyone by its mere presence, then it really isn’t architecture per se.

Hence the dependence of human interaction and its eventual perception is what forms an architectural experience.

We have been practicing architecture for millennia and although evolving technology has markedly changed how we shape our buildings, one thing that has not changed is that humans still formalize a perception based on their own experience. From the pyramids of Giza to BIG’s latest project, and every building in between, humans (let’s call them Users, as in User

Experience) have always formalized their own perception, consciously or not. It was never up to the architects to dictate the perception, that was simply never in their control, the user decided what to think of the structure, independently of the designers dictum.
Architects, not all – but certainly many, have traditionally shunned business strategy as an unnecessary distraction. We have been indoctrinated with the thought that our work exist in an alternate level that is judged strictly in terms of 'design'. Hence our affinity for adopting the latest philosopher that utters the word "architecture" or "design', such as Heidegger. In 'Building Dwelling Thinking' Heidegger needed architecture to make his points, however, architecture does not need Heidegger to design buildings (Davies, 2017). Although a good understanding of philosophy is helpful to an architect's grounding it should not come at the high price of excluding or being in conflict with a business strategy, with branding in particular. But it often does. It is part of our pedagogy; it's how we were taught to think.
The regrettable problem with design for design sake is that it assumes that the end result is strictly a search for form. The user is merely an inconvenience in an exercise that is happening above his or her station.
Let's not forget that the true value of design is the solution it provides to the user(s).
Lastly, in talking about brand, we designers have to adopt the position that beauty is relative, that there is no such thing as absolute beauty. In like manner, the user's judgement of beauty is also relative and could very reasonably be different from yours, they have an independent perspective that could or could not coincide with your judgement.

2 Desired Result

The first thing to give shape to a design is the desired result. Design is purpose driven; it seeks to achieve a goal. Sometimes these goals can be banal, as in shelter from the elements, and other times they can be inspirational, like a monument; either way they are clearly putting a stake in the ground for what needs to be achieved.
The naturalness with which architecture and design need to speak lies at the heart of any real world design challenge; "how do we achieve the desired result?" Unless you are building a remote cabin for yourself, you will most likely want to solicit a particular response from others relative to your design. "It looks modern, it looks classical, it makes me feel …".
Hence the real definition of a brand; it's what others perceive your design to be, not what you want it to be. A brand is nothing more nor nothing less and your desired result will be judged against that perception.

2.1 Engineers build, Architects brand

The role of an architect has evolved over the years. We are no longer the "master builder" that Vitruvius described, singularly responsible for everything involved in erecting a building; engineering, design, construction, landscape, etc.

Fortunately, those roles have been separated, since it would be asking a bit much for one single person to be responsible for the elastic theory for beams, the list of regional native perennials and to provide the labor and equipment to build.

Being relieved of the all-inclusive Vitruvian responsibilities, an architect today can concentrate on realizing the user's desired result.

Meanwhile, an engineer needs to build a structure that will resist specific wind loads and allow floors to handle a precise live load capacity. It is an objective assignment, either they achieve this or they don't, and if they don't they will be looking for a new job.

Designers, however, need to design a structure that is perceived in a particular way by many (…and to do so within design constraints). If Designers do not achieve the desired perception that the desired goal requested, they too will soon be looking for a new job.

Solving problems of reality versus solving problems of perception, that's the basic difference between an engineer and an architect, and for the architect that's where the real value of design can make a big difference.).

2.2 Real World Examples

The pyramid of Giza is a great example of branding in architecture. "Immortality" was most likely the desired result demanded by the Pharaoh. The 20 years and 4,000 slaves it took to build it was solely to achieve that purpose, that desired result. To a large degree they were successful, the proof is that they still exist in a meaningful way and that we are still talking about them today. If the perception would have been any different, it would have been a total failure.

A great design challenge today would be, how can the Pharaoh achieve immortality at a fraction of that effort? I am sure that there are plenty creative designers out there that would say "Yes! And I have an idea."

Architects are designing to a desired perception. Perceived value = brand value.

Bernini, one of my favorite designers, was a master of branding. He understood that design is a perceived value better than anyone else from the Renaissance. While Michelangelo during the previous century was busy saying that 'David' was inside the rock already and he had only to carve and set it free, Bernini was busy loading the fountain in Piazza Navona with metaphors. The result is a moment of pure design genius. Next time you are in Piazza Navona, go to the Fontana dei Fiumi and stand behind the cowering Rio de la Plata figure as it faces Borromini's church and see what you perceive. I am sure that you will perceive something pretty close to what Bernini's had set as his desired result.

He did this again with the colonnade at St Peter's Square, he liked Michelangelo's dome but disliked Maderno's façade which obscured it, so he pulled the center of the piazza back in order to reveal the dome. His design was directly connected to achieving the desired perception of "what a majestic dome" for the common man strolling to or through St Peters.

A more contemporary example is Philip Stark's work, particularly the many hotels he did for Ian Schrager. The directive (desired perception) was very simple; make the guest feel like they are a walking on a stage, that they are the starring actors. That was the desired perception, and boy did he hit the out of the park. If you were lucky enough to walk through the Royalton on 44th street in Manhattan before it was ridiculously remodeled, you would have felt exactly that way and it felt wonderful.

3 Understanding a Brand

Before we go any further we have to clarifying 3 very common misconceptions about brands.

3.1 A Brand is not a logo

A brand is a reputation, a brand is a promise fulfilled, (or unfulfilled in the case of a bad brand.) A brand is an assimilation of opinions and experiences, some yours, some by others. That is why a brand can have loyalty, because it has earned it. The logo merely identifies that experience (i.e. the brand).

3.2 People tell you what your brand is, not the other way around

You don't get to tell people what your brand is, they tell you. Just imagine if you stated that you offer the most advanced green LEED certified design services in the city, yet every building you put up gets shut down by the EPA for being dangerously toxic. It would be fair to say that your claim is hogwash and indeed your reputation, your brand, would be the very opposite of what you promised. Your brand loyalty would be negative no matter what you said you stood for. Your brand is what others say your brand is, there is no escaping that reality. So lesson one, be careful with what you promise, because you will have to deliver it. Branding is a Position.

3.3 Branding is a position

And lastly, branding is not something you do to sell a product, branding is a position you take in relation to a product or service. Branding should not be confused with marketing and advertising; the latter are tools to speak about the product after the fact.

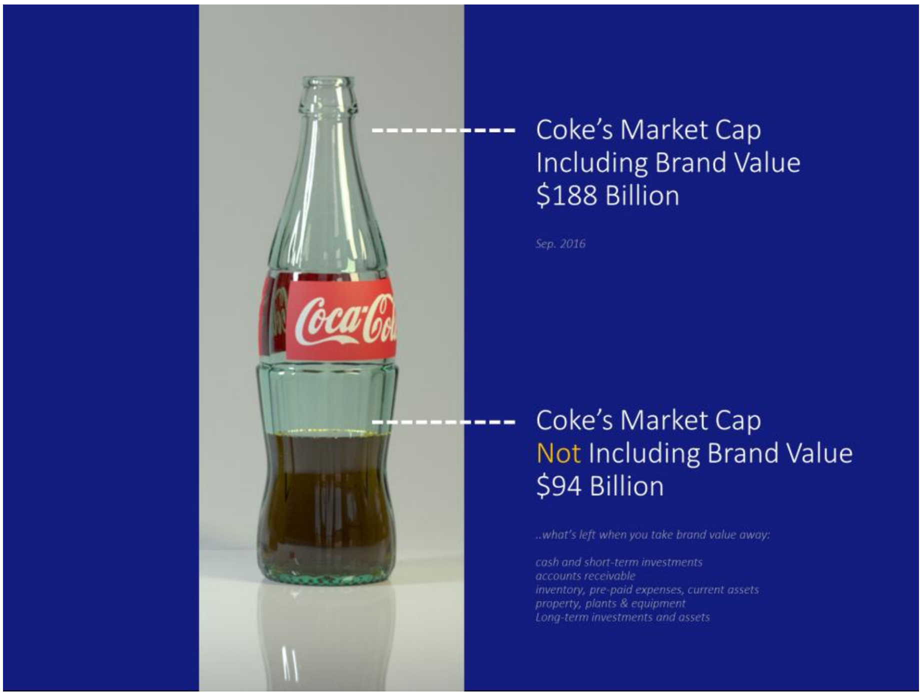


Figure 10. Coca Cola Market Cap

Nothing illustrates more clearly the impact of brand value to the overall operational value of a company as does Coca Cola

4 Basic steps to Branding

Brand agencies have a systematic approach that gets the essence, the clarity, the clear target out of a client that the client could never clearly see. Indeed, that is the very reason why branding agencies exist; To Focus.

The systematic approach varies from agency to agency, but the fundamentals do not, and they are:

4.1 Target User

Who are you creating value for? In the case of the architect this is easier to identify than other industries since it is usually identified by the program. What architects must also do, however, is the due diligence of understating the user or users in a more profound way. It's not just a question Geographic and Demographic identification, but also of needs, wants and challenges.

4.2 Offering

What customer needs are you solving? What value are you delivering? Now that you understand your user, what are you offering to them? From a design point of view what is it that you are proposing. This is more relevant in a non-design business plan, in something that has a product as the end goal, however, it's still a valid question in the design process. The answer can be as fundamental as the most economical solution or a specific inspirational feeling.

4.3 Research & Analysis

What is currently in that space and where are the opportunities? Space, in the business sense, references your competition around you. Not just physically but also in stated achievement or ambition. This helps you understand where the gaps are.

4.4 Differentiation

How are you different from the others, what makes you unique? Now that you have identified the gaps from your research, you can clearly point to where you would like to stand relative to everyone else. It goes without saying that you want to stand somewhere alone in order to be different, otherwise you are not offering anything different.

4.5 Positioning

The promise, distilled and concise, that you have formulated to convey the previous 4 steps. In branding the Positioning Statement is the holy grail, this is where you want to arrive with the full approval of your client. Branding agencies spend a lot of time to arrive at this statement, since it will be the blueprint of everything that follows and you cannot change it once you have 'launched'. A clear positioning statement will state who you are helping and the specific value promise that you are delivering. For an architect this is a tremendously useful concept, one that starts the design without having sketched one single line, and that clearly identifies the desired goal. It is a way to constantly check your design from concept to final documents; does it deliver on the positioning statement? It's your first blueprint and it's a way to keep the user involved in the design, since they will have agreed on the positioning statement as the way to proceed.

5 From Positioning Statement to Design

The real magic moment, from a design point of view, is when you are able to extract the key attributes from the very positioning statement that the users (i.e. Client) have just agreed upon.

This is easier said than done, but it's a significant head start and a very accurate compass for the remainder of the design process.

Here is a real world example taken from an old project. Years ago we branded and designed a store within a store for Verizon and RadioShack. It was a retail telecom project, essentially selling mobile phones and services. After a lengthy and careful study, which included offering, market research, competitors and strategic placement we came up with the following positioning statement that satisfied both companies:

At the Verizon Wireless Store at RadioShack, we give

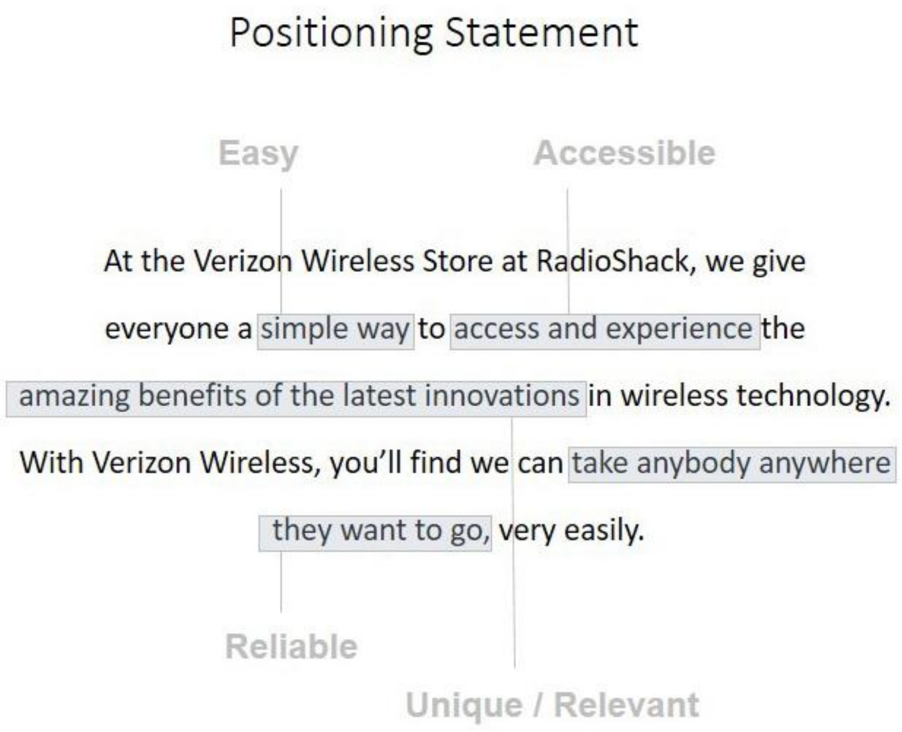
everyone a simple way to access and experience the

amazing benefits of the latest innovations in wireless technology.

With Verizon Wireless, you'll find we can take anybody anywhere

they want to go, very easily. (ODell, 2002)

Believe it or not, that's a significant statement. Architects may think its PR or just salesmanship, but the truth is that it's a blueprint for design. Once both companies signed off on that positioning statement, we were free to extract design attributes. We literally translated some of the key words into design descriptors. As shown in this diagram.



Extracting the design attributes left us with Easy, Accessible, Reliable and Unique. That was a great launching point for our design explorations. We knew exactly what points to hit and we had plenty of ideas on how to represent them. In the end we created a few concepts, but they all shared the design attributes extracted from the positioning statement. The final design was indeed an embodiment of all those attributes. The project was a success, not just by our standards, but more importantly by the perception that the end users had in relation to our design solution.

The basic definition of a brand; perceived value = brand value

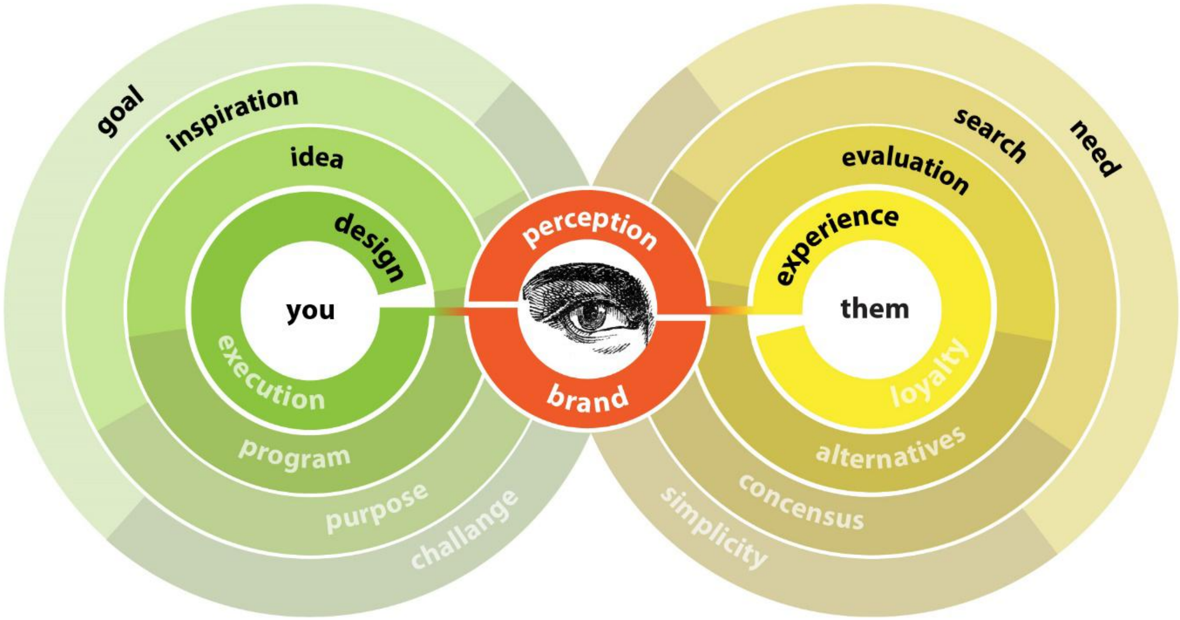


Figure 2. Design vs experience

6 Conclusions

The veneration of architecture is not good for design, we should stop building monuments to the earth, the genius loci, the Phenomenology of Architecture, the earth doesn't know, it doesn't care, however we humans do know and we care. We are the "segment" that the added value proposition of design enriches.

If we want to design things to make this a better world, we have to convince its inhabitants that it is going to make it a better world. We have to deal with us. With our perceptions.

So the challenge of design is intrinsically connected with the challenge of perception. Perception is what we believe something to be. For a designer its realizing that intangible value constitutes a greater part of overall value.

So before you pull out the sketch book, think big, think desired perception, think brand.

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02.103 - FROM LOCAL PRACTICE TO URBAN TACTIC:

Learning from Hong Kong's Vernacular Spatial Practices

Sze Ho Choi*, Peter Ferretto

The Chinese University of Hong Kong
RM201, AIT Building, CUHK, Shatin, NT, Hong Kong
Jack.choi@link.cuhk.edu.hk

ABSTRACT

In the dense urban fabric of Asian cities, anonymous colonization of public space is a common practice. Every city inherits its unique techniques and cultural habit to adapt within its own urban setting, creating an integral part of the city life experience. Anonymous architecture is a result of the tension between the scarce and expensive privately owned space and the opportunistic public space.

This paper takes Hong Kong as a study field to identify the tactical characteristics of the existing local practice in the public domain, turning leftover urban spaces into usable resource, with limited infrastructure - a unique vernacular practice of self-built urbanism.

KEYWORDS

Interobject, Urban Vernacular, Public Space, Adaptive, Tactical Urbanism
Topic: T02 - Integral Planning / Processes and Design Aspects

1. INTRODUCTION

This paper aims to provide a theoretical framework for the discussion on a series of vernacular architectural intervention that is present in every well-developed districts in Hong Kong; and to apply this framework to the observation on these commonly found typologies. These rarely discussed city elements, designated in this paper as (***interobject***), addresses the phenomenon of how architectural vernacular mediates between the assumed environment demonstrated by the designed ***context***, and the actual desired environment demanded by the ***cultural habits***. This needs to be theoretically represented amongst other well-studied local vernacular, due to its pervasive presence in the city. Previous architectural and anthropological studies focused on vernacular that is commonly acknowledged by the general public and the city of Hong Kong as local culture. Furthermore, these chaotic urban constructs (***interobjects***) are often neglected and overlooked as illegal disorder resulted from incapability of the governmental control. Nevertheless, they are created and inhabited by the majority of Hong Kong population and characterize the local urban experience. Accordingly, this paper calls for the necessity to study on this "invisible" vernacular, not only in terms of its presence closely related to our daily life activities in Hong Kong, but also from the standpoint that it may possibly profound our perception on vernacular and urbanism within today's architectural discourse.

2. EXISTING LITERATURE VS THE ACTUAL CITY

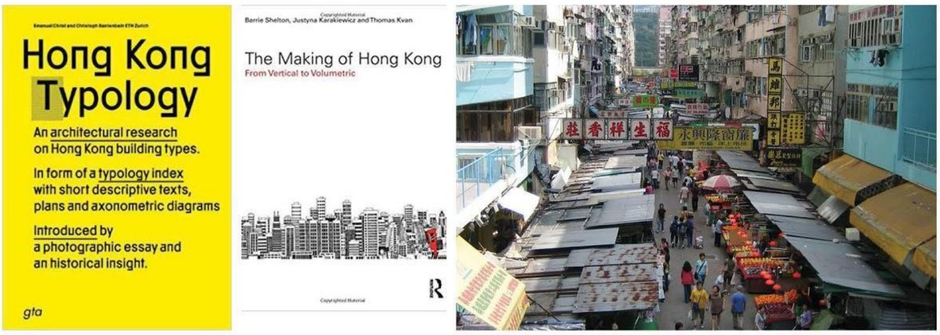

fig.1 photo of Hong Kong literature and the city

Current architecture discussions, with regard to the city of Hong Kong as an existing context, focus on the knowledge and study of the architect-designed environment, primarily of large development projects. They document buildings of different era into taxonomy of types and programs, and planning strategies, such as new towns and land reclamation, in response to historical events and natural geographical constraint, all of which are of efforts of government control (Zhang 2009; Christ and others 2010; Shelton 2011). Through such literatures, architects and planners attempt to establish a conceptual understanding and simplification of the actual city, not to mention whether or not and how such abstraction is processed into their designs of our city. Furthermore, the actuality of Asian cities, like Hong Kong, is far more complex than what can possibly be explained by the selected case studies in the above-mentioned literature. Due to the active spontaneous architectural involvement of anonymous citizens, who compose most of what we encounter, experience and interact in daily life, these literatures effectively formulate systematic catalogues of the centrally controlled city framework and sanitize the complexity and richness of the actual city. According to Yoshiharu Tsukamoto, although these overwhelming phenomena are not explained by the city of Hong Kong, they might well explain what Hong Kong is (Tsukamoto, Kaijima, and Kuroda 2001). To avoid seeing the city from insights, analogies, and stimulation from unexpected images, we look into the study of these anonymous phenomena, which may be supplementary to and help reinforce our knowledge of the “properly designed” context, and vice versa (Venturi, Brown, and Izenour 1972).

3. URBAN VERNACULAR AS REFLEXIVE INTEROBJECT

fig.2 photo of Hong Kong self-built

Anonymous architectural interventions in Asian cities are pervasive, not without a reason, for it being “a difficult activity demanding the investment of resources - economic, time, energy, effort, and so on - for a purpose”.(Rapoport 1990) Hong Kong has a long history of spontaneous urbanism contributed by anonymous citizens, an act generally termed “self-built" - most notably in last century the Kowloon walled city, Tai O water village, squatter hut settlements that also exist in numerous locations, where the users have control of their environment for what they need.(楊煒強 2012) Such local skills and tradition, that for the purpose of this paper termed "***vernacular***", have continuously evolved and emerged into a different form of contemporary urbanism within our surrounding context. The paper aims to discuss such vernacular urbanism, including those previously studied by other scholars[1], within a parallel theoretical framework and it is defined as follows: - "A physical or perceptual architectural response, conceived by the immediate inhabitants, that intervene on the government-controlled or given environment to make sense for each inhabitants' cultural and behavioral need within." For the purpose of this study, the paper will term this reappearing architectural response, ***interobject*** ; the physical government-controlled environment, ***context*** ; and the cultural activity, ***cultural habit***.

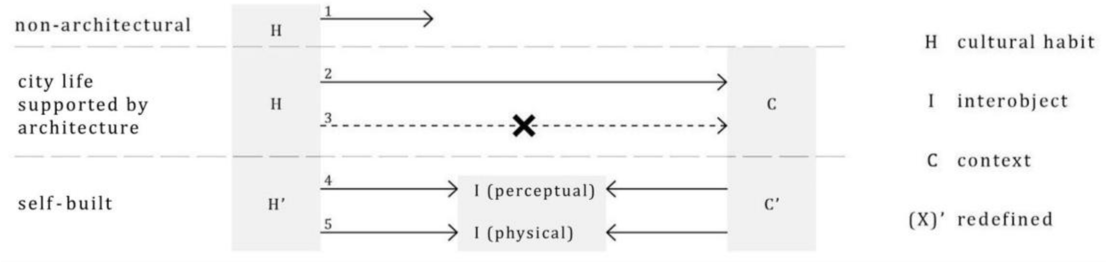

fig.3 Diagram of context/interobject/behavior

Context, due to its irrelevance to the specific ***cultural habit*** (scenario 3 in figure 3), inspires the need for ***interobject*** in two conditions. Firstly, because of its physical stability, ***context*** exists as a historical "urban artefact" that was once designed to serve the inhabitants. "In this sense a historical building …... may be disconnected from its original function, or over time take on functions different from those for which it was designed". (Rossi 1984) It remains as an infrastructure to support current ***cultural habit*** or, if otherwise fail to do so, become potential site for retro-adaptation via ***interobject***. Secondly, as a product of abstract design theory and knowledge about the city, particularly in a fast-changing environment with diverse and complex cultural identity, like Hong Kong, even newly constructed ***context*** often fails to relate to the local ***cultural habit***. It therefore encourages continuous effort and creativity on ***interobjects***. For the purpose of this study, all types of ***interobjects*** are identified by four common characteristics: -

1) <u>Currently in use</u> - All of ***interobjects***, being used and made, reflects the current architectural needs in relation to the local ***cultural habit***. Hence the observation of ***interobjects*** reveals the unique culture of the people and the unique character of the city; as opposed to the observation of ***context*** that only reflect on local history and governmental regulations. Its relevance to present allows meaningful knowledge that relates to designs in the current ***context***.

2) <u>Currently being made</u> - Different to sociological research, such as that carried out by William Whyte[2] and Jan Gehl[3], where spaces are assessed as good or bad for the citizens based on various criteria, ***interobjects*** are regarded as an experimental products that are constantly and collectively refined, and hence considered a most appropriate solution to the community, based on the current inhabitants' skills, resource and other considerations.

3) <u>Consistency</u> - ***interobjects*** exposed to particular set of situations reveal consistency in its architecture, inherent ways to solve particular problems with particular resource and skills shared within a cultural group, constantly reappearing across a cultural landscape.(Rapoport 1990) Through natural selection within the city, these patterns have evolved to be efficiently

effective to solve local problems and are shared not only amongst the anonymous citizens, but also adopted by government officials and developers. (figure 9) (Alexander 1979) It is this architectural language that allow an anthropological understanding of the place.

4) Adaptivity - Being direct responses to its immediate ***context***, ***interobject*** is inherently an architectural product of retro-design. As opposed to a building design on a green field site, it is highly adaptive and interrelated to the existing urban fabric. The typological pattern in an ***interobject*** reveals variety as well as consistency.

By observing a series of commonly found ***interobjects*** in Hong Kong, this study does not only aim to formulate an anthropological understanding of the cultural group from existing architecture, but also regards the practice of interobjects as a key part of the local architecture industry and alternative design approach in a city scale.

4. CASE STUDIES - STREET OBSERVATION

fig.4 photo of tong lau district

To build up this theoretical framework, the abstract definition of ***interobject*** will be explained by a series of 8 architectural types commonly found within ***context*** of old districts, in which *Tong Lau* (*tenement houses)*, are the most common building typology. The ownership and operational nature of tong lau and its adjacent streets makes possible the modification of the property by owners and tenants. These ***interobjects*** have not been systematically documented as an architectural discourse, especially for those nameless ***interobjects*** that are not glorified as typical Hong Kong vernacular. They are discovered primarily by walking and street observation within the neighbourhood.

4.1 Case study

Due to the emphasis of this paper, to identify common cultural ***interobjects***, it will not explore on a documentational methodology to analyse each case. The 8 identified types are simply recorded in 3 aspects within the discussed theoretical framework - brief description of the ***context*** and ***cultural habits***, a story about the making and the infrastructure of the ***interobject***.

1. Extended Eave

fig.5 photo of extended eave

context - building facades, mostly where the covered land can be optimized for usage.

cultural habits - activities are brought to outside and desired under protection from sun and rain.

interobject - retractable canopies have colonized most of the city building facade in Hong Kong. We can observe shop tenants, chain store company and cinema operator all adopted this ***interobject*** to extend their privately own space into the public domain. The semi-privatized programs are protected streetscape, covered alfresco dinner, semi-outdoor lobby and many other ambiguous spaces.

2. Urban Living Room

fig.6 photo of urban living room

context - residual spaces and public parks

cultural habits - nearby community gather together at collectively agreed desirable spots

interobject - this is created by different form of objects providing soft infrastructure for seating of different scale - sometime in form of chairs and steps. Such pattern can usually be created by abundant unwanted chairs, brought by inhabitants who are either the founder or followers of the urban living room and voluntarily and incrementally donate these infrastructures from time to time.

3. Structural Balustrade

fig.7 photo of structural balustrade

context - roadside balustrade divider from street, mainly of two types

cultural habits - flea market owner, shop tenants and others share no particular type of behavioural relationship with the balustrades.

interobject - this ***interobject*** is not characterized by its construction, technique nor its behavioural pattern; but by the constant effort and creativity on the contextual balustrade. The balustrade by the road is regarded as an infrastructure, inherited with its material and embedded footing, providing structure for diverse ideas and intervention.

4. Stadium Park

fig.8 photo of stadium park

context - public football pitch stadium, adjacent to dense urban fabric

cultural habits - different cultural groups appropriate the stadium seating as ordinary public parks. It becomes places for talking, having take-away lunch, playing chess, meeting friends and least importantly watching football.

interobject - this pattern is an example of perceptual architectural response to existing ***context***. It interprets existing seat infrastructure inherently located at an open space with long vista, serving a variety of people in the surrounding neighbourhood.

5. Novel Garden

fig.9 photo of Novel Garden

context - undetermined form of locations. Typically, adjacent to privately owned spaces.

cultural habits - spaces are made pleasant, by this ***interobject***, for non-specific ***cultural habit.***

interobject - plants in pot, planter box or other forms, are economical and effective infrastructure, placed strategically to demarcate and associate spaces to private area and fade away its association with the public realm.

6. Nomadic Filipinos

fig.10 photo of Nomadic Filipinos

context - undetermined form of locations. It is typically open to public and free of charge - such as parks, plaza, lawn (designed for only for visual pleasure), bridges, pedestrianized street, etc.

cultural habits - domestic workers' habit of cultural group gathering. Their habit can be associated with the joy of picnic that uniformly appear across a range of ***context***. They eat, dance, sing, exchange goods and practice other ***cultural habits***.

interobject - this ***interobject*** pattern is also perceptual and adaptive to different existing ***context***. It turns horizontal surface in every convenient public open spaces into picnic places. The making of the place is assisted by carpets of newspaper, fabric, cardboard or nylon canvas; and at times also by tent-like roof and partition elements.

7. Devoted Worship

fig.11 photo of devoted worship

context - undetermined form of locations. Encountered scenario includes building entrance, street, hills, seaside, house door, etc.

cultural habits - almost limited to the worshipping of Chinese religion (taoism and buddhism)

interobject - objects in relation to worship, such as the pot for incense sticks, statues, the colour of red and, sometimes, miniature temple, are arranged in particular order to make sense for the ***cultural habit***.

8. Bank-shift Retail

fig.12 photo of bank-shift retail

context - all banks in Hong Kong officially open from 9am to 5pm weekdays and 9am to 12am on Saturday. It is found as potential sites during off-hour for spontaneous commercial activities.

cultural habits - shops for daily goods (clothes, hats, nail cutter, stationery, accessories, dried fruit, shoes, etc)

interobject - the “shop” is designed in two forms - linear form along the bank shopfront or entrance hallway form utilizing entrance or ATM waiting lobby. The goods are displayed horizontally on the floor or steps; or vertically on the glass wall and roller door by various techniques.

4.2 Characteristic of Infrastructure and Program

As identified and described in the above section, these architectural phenomena share similar characters that define what this paper named ***interobject***. They have no apparent common characteristics between different ***interobjects***, due to their highly specificity to each inherent ***context*** and ***cultural habit***. This creativity, conceiving each Hong Kong ***interobject*** typology, allows the stable “patterns” (as defined by Christopher Alexander) shared amongst the cultural groups, to be modified and adjusted continuously as appropriate.

Where the city vernacular products are named “environmental units” in *Made in Tokyo*, it is in this paper named ***interobjects***, for it being “a vague structure” that is neither a part of ***cultural habit*** nor ***context***. The term was first coined by Mark Blechner, a psychologist and psychoanalyst, to describe the condensation of ideas or objects incompletely fused into a single dream element. (Blechner 2018) These elements are “vague, or merely hard to describe”, that may “set up a conceptual space or...a novel category.”(Blechner 2018) A parallel argument can be applied here to the object type or place type addressed in this paper - they can not be described as an new cultural practice, nor are they building or landscape designs. They belong to a novel category between the two - a concept of place that is rarely discussed anthropologically as a local culture, nor as an architectural product.

Furthermore, it is observed that all the common ***interobject*** typologies identified above are not constructed on privately-owned area, but colonize on unowned spaces/ public realm, because the scarce and expensive private land is limited to the wealthy minority in Hong Kong. This characterize ***interobjects*** as a vernacular product unique to Hong Kong, as opposed to those illustrated in *Made in Tokyo* and *Division and Multiplication*, where vernacular architecture is analyzed and found on private lots.(Bertram and Halik 2002; Tsukamoto, Kaijima, and Kuroda 2001)

5. CONCLUSION

Former studies on Hong Kong interpret the city as a highly organized urban fabric, as a result of engineered infrastructures and historical events. To respond anthropologically and architecturally to this overly simplified understand of the sophisticated actuality, focus had been emphasized on the obvious local vernaculars, that are appropriately recognized as architecture. Though the importance of local identity has been reinforced by these literatures, vernacular remains in the category of historical products, seemingly irrelevant to our current design practice in the city. According to the theoretical framework discussed in this paper, we no longer discuss vernacular practices by identifying architecture and urbanism in a conventional sense. As a unique local vernacular mostly found in the public realm, these current urban practices, ***interobjects***, suggests an opportunistic approach for alternative urbanism, that supplement the designed ***context*** within the actual city, into a holistic functional system.

Unlike designs in the building industry, ***interobjects*** are adaptive and sensitive to both immediate ***cultural habit*** and ***context***. It showcases skills and techniques on modifying our environment - patterns shared amongst the anonymous “architects”. Through simple observation on existing ***interobjects***, the knowledge about the city is strengthen in two aspects - demand of current ***cultural habit*** on architecture; and how the ***context*** architecturally performs.

The theoretical framework set up in the paper aims to encourage further discussions on urban vernacular. It also suggests the need to further investigate complex and "intangible" architectural phenomenon like ***interobjects***, that conventional taxonomic analysis seems inappropriate.

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02.104 - CHALLENGING DOMINANT URBAN DEVELOPMENT MODELS TO PROMOTE A MORE SUSTAINABLE COMMUNITY IN BEIRUT

Roula EL-KHOURY FAYAD *

The Lebanese American University
P.O. Box 13-5053, Beirut:1102 2801, Lebanon; roula.elkhoury@lau.edu.lb

Abstract

This paper is part of an ongoing research on affordable housing in Beirut and a specific case study conducted on 16 buildings in the city. The first part of the paper will shed light on the current building laws issued in the official newspaper in 2004. The study will demonstrate the impact of the changes of the laws on the new morphology and social fabric of the city through the creation of a favourable environment for big developers, wealthy property owners and real estate agencies and, at the expense of old city residents and low-income families. The second part of the paper will investigate the case of 16 buildings in Mar Mikhael, currently one of the most diverse, charming, and affordable neighbourhoods in Beirut. The residents and small businesses in these buildings are forced to dwell in inadequate and sub-standard living conditions and without access to basic services to survive in Beirut, *one of the most expensive cities of the world*" while waiting for their eviction as soon as the dominant model of urban development takes over the land.

This paper will argue that the promoted vertical expansion of the city weighs heavily on the environment and fails to provide a diverse mix of housing units, excluding a significant portion of the community from the city. An alternative development model challenging the current building laws will be proposed to protect both the physical and social fabric of Mar Mikhael neighbourhood and to serve as a pilot project promoting a sustainable community in Beirut.

Keywords

Affordable Housing, Sustainable Community, Building Laws, Mar Mikhael, Beirut.

1 INTRODUCTION

This paper is part of an ongoing research on affordable housing in Beirut and a specific case study conducted on 16 buildings in the city. The first part of the paper will shed light on the current building laws issued in the official newspaper in 2004. The study will demonstrate the impact of the changes of the laws on the new morphology and social fabric of the city through the creation of a favourable environment for big developers, wealthy property owners and real estate agencies and, at the expense of old city residents and low-income families. The second part of the paper will investigate the case of 16 buildings in Mar Mikhael, currently one of the most diverse, charming, and affordable neighbourhoods in Beirut. The residents and small businesses in these buildings are forced to dwell in inadequate and sub-standard living conditions and without access to basic services to survive in Beirut, *one of the most* *expensive cities of the world*" while waiting for their eviction as soon as the dominant model of urban development takes over the land.

2 The changing building laws and the transformation of the image of the city

The current Lebanese Building Laws issued in the official newspaper issue 66, on December 2004 propose some modifications of the previously legislated laws issued in 1983. The document includes 4 chapters and 29 articles. In this paper, I will only address chapter 2 tackling the technical conditions of the new building laws that will drastically affect the morphology of the city and its image.

2.1 Article 11: Natural light and ventilation requirements

In this article, the building code confirms that all rooms designed for living are required to have an opening to a street or a backyard allowing natural light in and a proper ventilation of the room. In the second paragraph of the same article, the following spaces were exempted from the previous requirements: Bathrooms, corridors or transitional spaces, storage spaces, laundry rooms, maid's rooms, and kitchens except if their size is larger than 8 sqm. What is surprising in this article is that the "maid's" room is not considered as "a space designed for living" so it is not required to have any opening and thus allows the developer to easily allocate for it any leftover space in the plan of the project. Such text is highly discriminatory and fails to respect basic human rights.

2.2 Article 12: Building set back from the street

Article 13 defines the set back of buildings from the street according to a specific classification directly related to the width of the street and the frequency of the traffic on each. However, this article does not define a maximum setback that could otherwise unify the building height and the alignment of the buildings to the street. Owners of large plots can thus set back as far they wish and build higher structures maximizing the value of the apartments and their revenues from their sales. This article constitutes a clear incentive for larger plot development and does not enforce any urban design guideline to protect or preserve the existing morphology of the street.

2.3 Article 14: Surface Exploitation ratio and total exploitation coefficient

No changes to the Surface Exploitation ratio nor to the total exploitation coefficient were dictated in this article. However other considerations defined under this article will directly affect both the coefficient and the ratio of exploitations.

Balconies defined as outdoor extensions of indoor spaces were previously allocated 20% of every floor area and excluded from the total exploitation coefficient provided that they don't exceed 25% of the total built up area and that they remain open. The new law has legislated the closure of these areas with glass panels transforming them into extra sellable indoor spaces. This new practice has gradually eradicated this typology from the city and enforced a glazed enveloped around every new building.

The external double wall area has been excluded from both the surface exploitation ratio and total exploitation coefficient because it is said to contribute to the insulation of the building, to decrease energy consumption and thus to protect the environment. This new addition amounts to approximately 10% of the built-up area and is also an extra sellable area. Note that the new law does not specify how this new norm is enforced. The developers are now automatically claiming the extra 10% without necessarily building double external walls.

The staircase and the escalator shaft have been excluded from the total exploitation coefficient as well. An area of 20 sqm have been excluded from the coefficient or added to the total built up area and 6 addition sqm in case of the incorporation of an extra elevator. In the case of high rises every development typically includes 2-3 elevators and thus benefit from 10-15% extra sellable area.

The sum of the additional square meters gained by the developer or the owner of a real estate project is equal to 40-45% of the previously allowed built up area! These additions have been legislated without any changes to the so-called exploitation “coefficient” or “ratio”.

2.4 Article 7: Building envelope

To fit the additional allowable square meters, another modification to the building envelop was necessary. The previous law set the height of the building at the edge of the plot twice as long as the width of the street which would define an external building envelop that would not fit the additional areas. The new law increased this coefficient to 2.5 allowing 3 additional floors to a building sitting on a typical street in Beirut

3 The new building laws and the city growth

For the past 15 years, Beirut has been growing in terms of its population, built up area, car traffic as well as its daily consumptions and production of waste. In the absence of any law or initiative for the provision of the necessary public amenities and spaces, green areas and playgrounds for the residents of the city, the new build laws have been an instrumental tool for the destruction of the old city fabric, the disfiguring of the architectural heritage and the displacement of the underprivileged and poor communities.

4 The new Rent Law

In addition to the new building laws, a new rent law has been legislated. Currently in Beirut, two different renting systems coexists. The first one, is a system of rent control, covering “old rent agreements” signed before 1992, which allows tenants to keep low renting housing, despite of the high increase of the rents in the past decades. The second system covers rents made as of the 23rd of July of 1992, with prices freely decided between the tenants and the property owners, where a high increase of the prices was observed. The “old rent system”, is widely seen as a problem, as it is strongly protecting the tenants, at the expense of the property owners. In 2017, a very controversial law addressed this issue. It would eventually put an end to old rent, by gradually increasing it during a period of six years. The rent value will become equal to the fair market valuation which are disconnected from the reality of wages and which will lead to the displacement of a large portion of the population.

5 Mar Mikhael: An old hidden cluster

Several institutions have attracted residents to Mar Mikhael over the years. Original property owners in Mar Mikhael narrate that they have built houses close to their work place and then built on top of it few apartments to rent for new comers due to the growing demand for housing. In 2006, the area was still predominantly residential with several trades and crafts shops along the streets defining its charming and lively character as well as the its workers and artisan's population. 10 years ago, the area has become a destination for restaurants, pubs and galleries resulting in a drastic increase of the rental prices and as a result, the displacement of a large portion of its original population. A case study of 16 plots/buildings in Mar Mikhael have been identified because of the pressing need to come up with an alternative development model that can save/protect the building fabric of this area and allow some old and poor tenants to stay in this neighbourhood.

6 Preliminaries for a de-growth city

The following section will describe a project proposed by a group of professionals including Candice Naim, Lea Helou, Fadi Mansour, Ali Assaad, Patrick Abou Kahlil and myself (the Author) as an alternative for the current dominant model of development in Beirut and specifically addressing the case of the old residential cluster in Mar Mikhael area. The proposal is a response to a call for ideas organized by the order of engineers and architects in Beirut and Public Works Studio a multipurpose research platform. The competition was also sponsored by UN-Habitat and the Public corporation for housing. Our project entitled **Protective Housing Ecologies** was awarded the first prize during a press conference at the order of Engineers and Architects in Beirut on December 18, 2018.

6.1 Manifesto and Policy Reforms

"Any project on housing stakes a claim on what and how we should live. *Housing is a place as well as an act. Housing presupposes a collective deeply embedded in the city; one which has undergone and continues to undergo an unnecessary antagonism with a city like Beirut. We propose a course of change that should be interrogative, and which must reflect deeper spatial structures concealed in Beirut's housing ecologies: a complex of nuanced traditions and routines, codes and regulations".*

"Housing must avoid commodification, and the city's maturity- not growth- should be prioritized! *In Beirut, the residential apartment has become the cornerstone of a deregulated and overinflated real estate market of exchange and speculation. The mechanisms of the market and the architect, the planner, the investor, the developer, the owner and the tenant all play their part in perpetuating and reinforcing this hyper-commodification of housing units across the city. We propose the content and material with which to update regulations, as well* *as to envisage the productive possibilities of such constraints on both the dynamics of landlord-tenant relations as well as the activities of the Public Corporation for Housing".*

"Housing must be disassociated from the real estate market's circulation of fantasy and speculation and as the beacon of what is perceived to be the indicator of economic growth. *The limits of housing should be subject to continual if not periodic reappraisal, and housing- both public and private- engaged for the transformation of the city. The reciprocal relationship between the domestic and the environment from which it arises and imposes upon has to be addressed along the spectrum of all its scales; a responsibility we reinforce upon the Public Corporation for Housing to disassociate the market value of housing from its physical being. We propose a paradigm shift which will deconstruct the perception of 'building as commodity' and installs a critical understanding of building towards a common good, attempting to substitute the growth machine that characterizes the economic culture of Beirut with a more sustainable and socially conscious model built on Equitable Resource Allocation and responsible public spending."*

Policy Reform 1: Invoking upon the state's responsibility in facilitating access to housing its citizens under Housing Law (58/1965), as well as Law (118/1977) which identifies shelter provision among the shared responsibilities of municipal authorities.

Policy Reform 2: Enforcing more rigorous controls on new large-scale developments and imposing stricter reforms on laws pertaining to merging plots by championing well-designed buildings, spaces and places, which value the existing residential ecologies and contribute towards their sustained health.
Enforcing an appropriate spectrum of Capital Gain Tax upon property sales as well as imposing reforms on laws pertaining to Heritage assessment and obtaining land rights for the purpose of demolition, which value that housing is neither produced nor distributed solely for the profit of producers and providers but also to maintain the general stability of the system (in both an economic and political sense).

Policy Reform 3: Enforcing more rigorous taxing mechanisms on vacant properties that are not placed on the rent market, should said properties exist within buildings that are occupied by other tenants, which will encourage property owners to partake in the city's revitalization by either promoting occupancy within the existing housing stock or by financial retribution towards the common good.

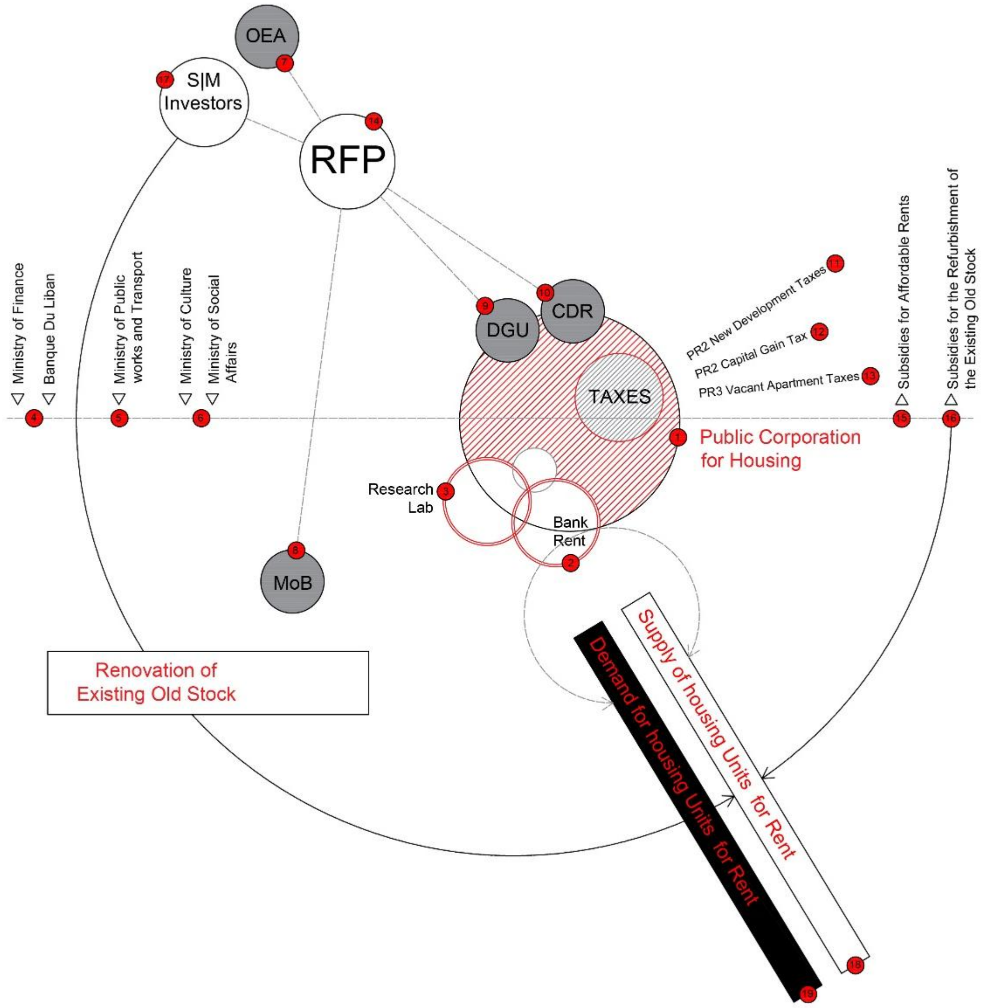

Figure 1: The Equitable Rent Program (ERP) and its operation within the geography of governmental collaboration/ and implementation within the Mar Mikhael Case Study.

The Equitable Rent Program (ERP) and the independent Housing Research Cluster (HRC), are proposed as a new forum for research and exchange which will enforce the protection of Beirut's Housing Ecologies, within a non-speculative approach to housing production, finance and ownership which seeks to:

- Create a system of balance and of continuous reappraisal between housing demand and housing supply.
- Regulate the hyper-inflated real estate sector by devising more appropriate market value assessments.
- Facilitate Affordable Housing units across the city (irrespective of location, size, and market value).
- Limit the adverse impact of profit-oriented development on lower-income and minority neighbourhoods.
- Ensure appropriate living condition standards within properties placed on the market.
- Enforce design guidelines which champion sustainable, communal and healthy living ecologies.

6.2 Implementation and Funding Mechanism

Rather than developing rigid processes that demand conformity, we propose a more flexible and inclusive socio-spatial imaginary implemented through a mechanism of social ownership (both at the community and individual level) which will function within two spheres of operation...

Intra-governmental collaboration/ Public Financing
(Public Corporation for Housing and Governmental Forums)
A major shift in public spending priorities (most notably from increased taxes on corporate and individual property gains tax) would be required to generate the initial revenues for the scheme in a progressive way. This would necessitate continued collaboration between the Public Corporation for Housing and the Ministry of Finance and Banque du Liban, but specifically in devising a mechanism which would reallocate funds generated from new tax reforms (those proposed within the Protecting Beirut's Housing Ecology strategy and which stem directly from the real estate sector).

Equitable Resource Allocation: Protecting Beirut's Housing Ecology
(Public Corporation for Housing and the inhabitants of the city of Beirut)
Landlords/ Property Owners whose properties are of inadequate living standard (which require refurbishment) or who require help to be able to rent out their properties at market value (including those currently held within old rent law agreements) register their properties within the Public Corporation for Housing as a form of Social Ownership.

The Social ownership (Individual or Community Organized Trusts) becomes a mechanism to control the speculative ownership of housing (in cases of multiple ownership) and to expand the stock of housing under public, collective, community, or resident ownership that is operated solely for resident benefit and subject to resident control.

Landlords/ Property Owners are incentivized by:
1) Funds and subsidies to renovate or refurbish their properties.
2) The mediating role the Public Corporation for Housing and Equitable Rent Program (ERP) will play in dealing with their future tenancy agreements which will guarantee a more significant return to them than their present situation.
3) Avoiding the new taxing mechanisms put into effect, which seek to protect their ownership rights without infringing upon the common good (Policy Reform 2 + 3).

Tenants and Residents, specifically but not limited to low income backgrounds (including those who are currently living under old rent law agreements that are essential to their financial stability) register for eligibility within Beirut's Housing Ecology strategy. Upon meeting specific criteria for suitability within the scheme, they are afforded a property and appropriate rent price bracket from a spectrum that ranges from subsidized affordable living values to a controlled percentage of market price values. Standard Tenants, who are registered to rent within the program but who are not eligible for affordable rent subsidies are also allowed to access the market of available units based on a continuous appraisal of demand.

Landlords/ property owners registering their units to the scheme will receive rent earnings which are at percentage of market values, regardless of whether their tenant is paying affordable value rent or market value rent. The funds generated by rents of the properties registered at market price (from standard tenants) will begin to collectively finance the value difference for affordable units, the equilibrium of which will be overseen the Equitable Rent Program (ERP) (Figure 2). It is the role of the Equitable Rent Program (ERP) to find the equilibrium in the both the demand/supply economy of the scheme, as well as the redistribution of surplus value from market value units to subsidize affordable rent properties.

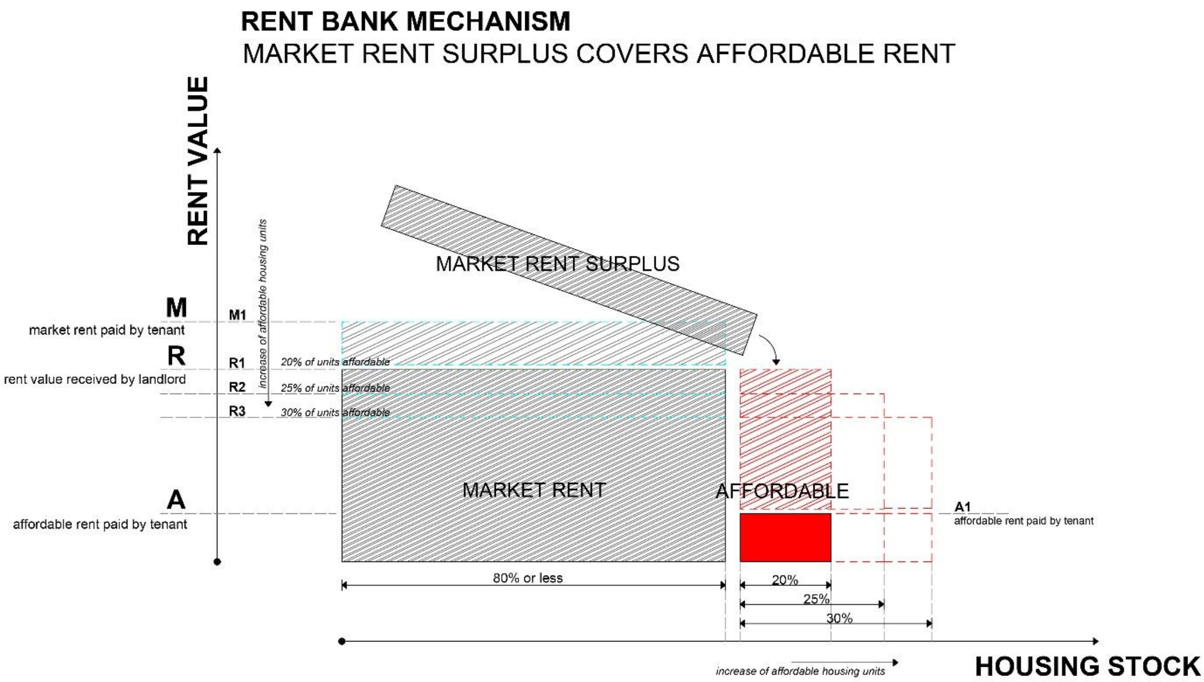

Figure 2: The circulation of value within the Equitable Rent Program (ERP) mechanism

Landlords will receive rent value **R**, which is the market price rent **M** minus a capped percentage **(M-R)**, while the market rent surplus above the value **R** is redistributed to cover the lower value A of affordable rent.

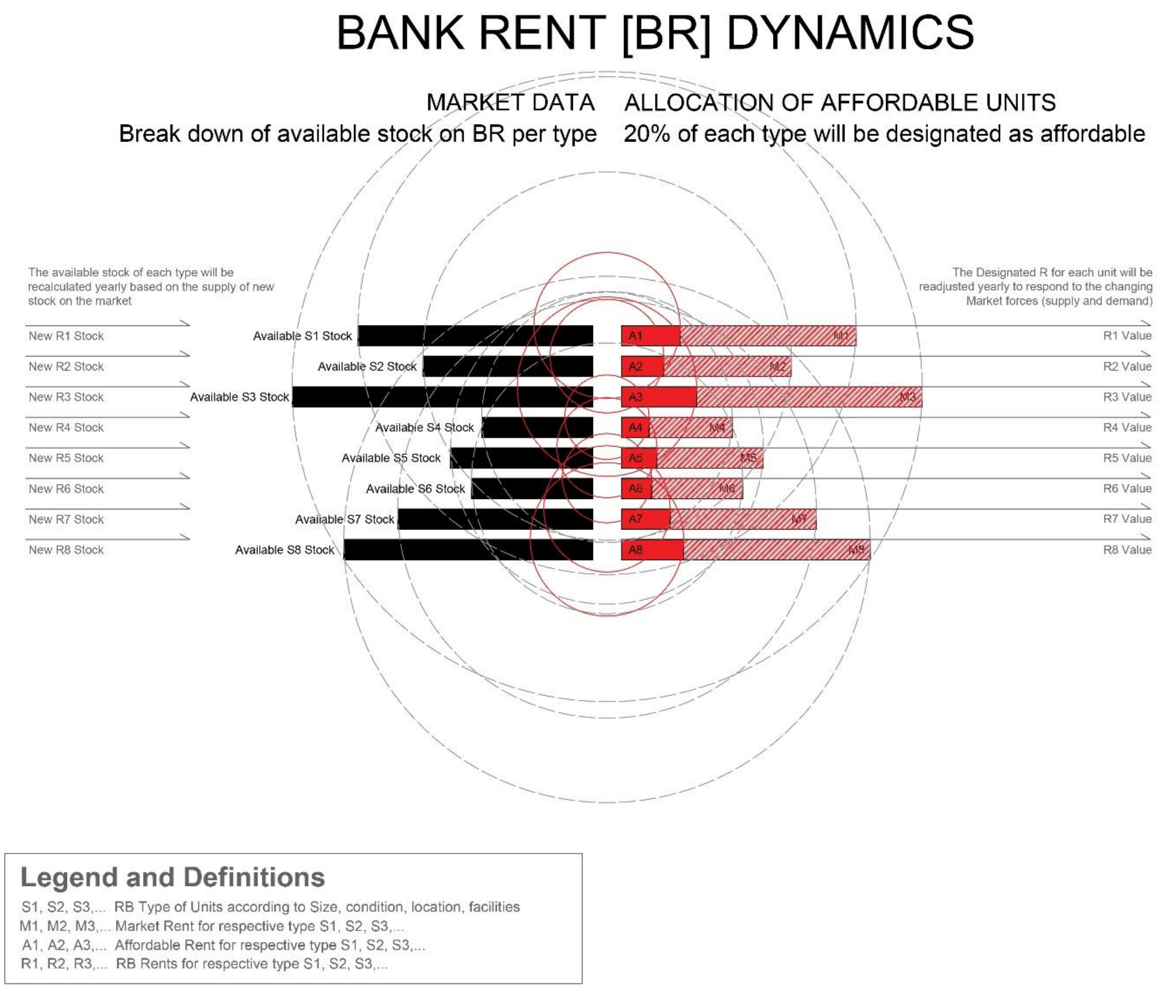

Figure 3: The circulation of units within the Equitable Rent Program (ERP) mechanism

The Equitable Rent Program (ERP) allows for a dynamic variation of the affordable housing unit stock and assigned rent value in relation to the real and specific demand for it (figure 3). As unit can become an affordable housing unit, the offer for affordability increases without the immediate requirement for new developments. Instead a certain percentage of any existing housing unit type can become affordable.

The Equitable Rent Program (ERP) is inscribed within a degrowth agenda that favours the transformation of existing housing stock which can be renovated and refurbished to meet appropriate living condition requirements and follow good design principles. The program was devised from the specificity of addressing the Mar Mikhael cluster, with its considerable percentage of vacant units and old rent law tenants but formalized as a more generalized system which could be applicable within other mixed neighbourhoods across Beirut. Protecting Beirut's Housing Ecology strategy seeks not only to facilitate the introduction of more affordable spaces across the city, but to promote an assimilation of affordable housing within the existing fabric without explicitly designating zones or buildings for it. The diagrams below illustrate a possible timeline instigated by the cancelation of the old rent law in early 2018 and the implementation of the Equitable Rent Program (ERP) in early 2019. Vacant units enter the rent market following a funded or subsidized refurbishment provided by the program, affordable units are introduced and increased in quantity over time (all the while assimilating within the existing fabric and occupants). The scheme allows a unit to alternate between being at affordable rent value and a market rent value depending on the tenant occupying the flat. As a favourable consequence in the long term, this would alleviate or eliminate any difference of living conditions, location, etc… between what is an affordable unit and a market rent unit.

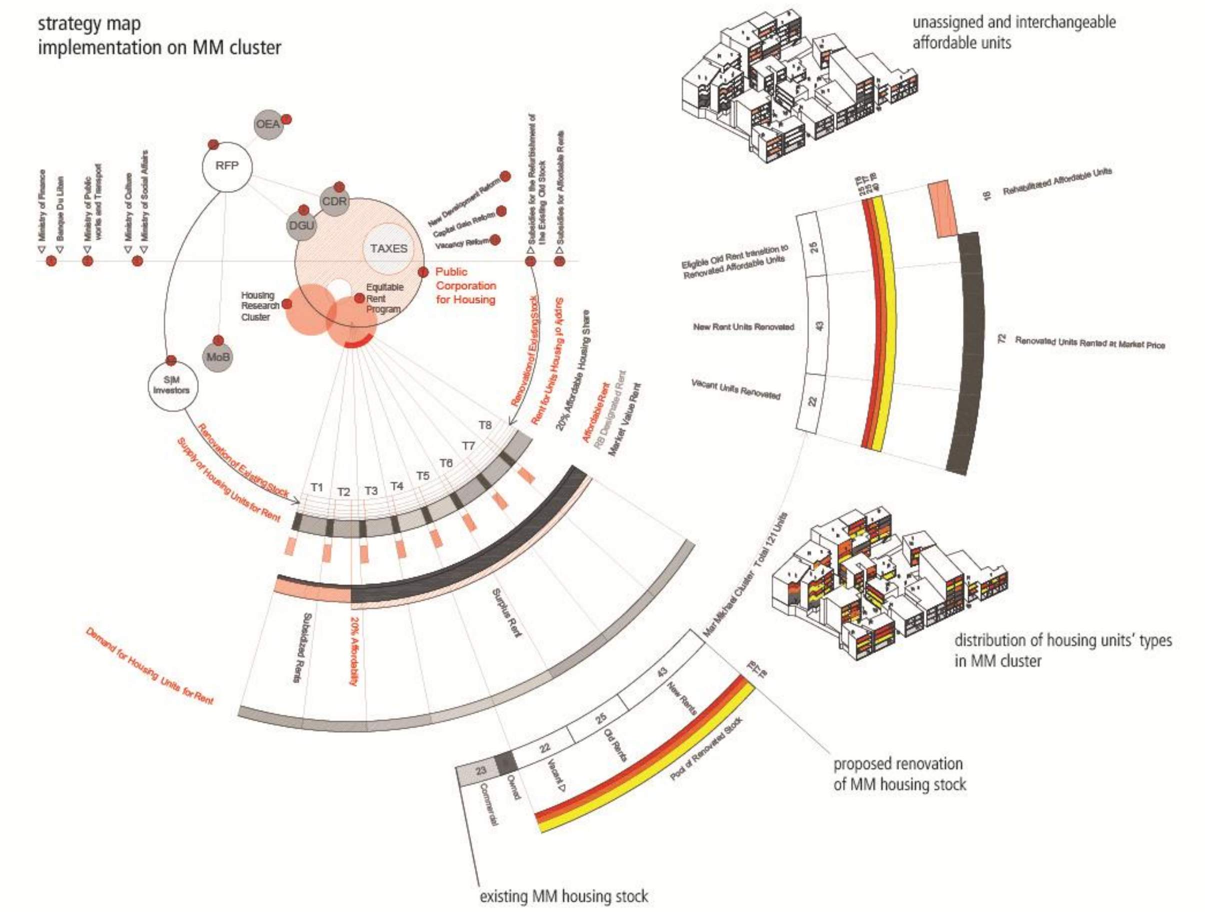

Figure 4: Strategy Map and implementation on the Mar Mikhael Cluster

Proceeding from the ideas set out within the Towards Affordable Housing and the Inclusive City report, we invoke upon existing governmental forums to support and develop the Equitable Rent Program (ERP). In addition to the pivotal responsibility assigned to the Public Corporation for Housing, especially in manifesting the ERP and Housing Research Cluster (HRC), the most essential actor in our scheme is the city of Beirut and its diverse citizenship. Rather than developing a rigid mechanism to be enforced, Equitable Rent Program (ERP) is based on the direct involvement (and social investment) of the citizens of the city- property owners and tenants alike. Figure 4 charts the new geography of our scheme as well the jurisdictive roles and participating factors of all its agents as follows:

6.3 Actors and Agents

Public and Governmental Institutions

1. Public Corporation for Housing

4. The Ministry of Finance/ Bank du Liban: (FUNDING) devising a mechanism which would reallocate funds generated from new tax reforms (those proposed within the ERP, and which stem directly from the real estate sector).
5. The Ministry of Public Works and Transport: (IMPLEMENTATION) Continuous development of infrastructure and oversight role in new developments and community projects.
6. The Ministry of Culture (PLANNING): Continued oversight in the identification and preservation of architectural heritage and the Ministry of Cultural Affairs (PLANNING): Shared Databank on participating parties within the ERP.
7. Order of Engineers and Architects (IMPLEMENTATION): Responsible for issuing the RFPs for the Investors and the supervision of the works under the ERP.
8. The Municipality of Beirut: (PLANNING) Coordinating the de-growth strategy and promotion of community projects across the city.
9. The Directorate General of Urban Planning: (PLANNING?) Examining the impact of new developments and community projects.
10. Council for Development and Reconstruction: (PLANNING?) Oversight in new developments and community projects.

New Initiatives
2. The Equitable Rent Program (ERP), a new governmental forum operating from within the Public Corporation for Housing.
3. The Housing Research Cluster (HRC), an extension of the existing practices of Research and appraisal existing within the Public Corporation for Housing which will facilitate the work of the ERP
11. Policy Reform 2: Enforcing more rigorous controls on new large-scale developments and imposing stricter reforms on laws pertaining to merging plots by championing well-designed buildings, spaces and places, which value the existing residential ecologies and contribute towards their sustained health.
12. Policy Reform 2: Enforcing an appropriate spectrum of Capital Gain Tax upon property sales.
13. Policy Reform 3: Enforcing more rigorous taxing mechanisms on vacant properties that are not placed on the rent market.
14. Request for Proposal targeting Small to Medium Scale Investors, developers will be issued to attract investors in the renovation and rehabilitation works of old existing housing stock.

Citizens/ End Users
15. Subsidies and affordable housing support will be granted based on eligibility criteria.
16. Subsidies for the refurbishment of properties that are of inadequate living standard or vacant will be granted based on the eligibility criteria.
17. Small to Medium Scale developers/ investors will refurbish and renovate the existing stock of housing units and could be afforded tax exemption incentives as they are contributing to the activation of the dormant stock of housing units and likely increase the affordable stock.
18. The supply of Housing Units consists of new or old units that have undergone renovation or refurbishment
19. The demand for Housing Units consists of applications submitted by hand or online that will be matched with more than one option in the housing stock available within the program.

6.4 Objectives and Future Developments

The proposal aims at fostering a culture of inhabiting the environment rather than setting parameters and building frameworks within which perceptions of housing are confined. By encouraging communal strategies towards the de-growth of the city and by engaging existing governmental forums to participate at the scale of its neighbourhoods, we believe that a healthy ecology of living would be made sustainable within the diverse citizenship of Beirut. With the increase in affordable housing units across the city, and an assimilation of those units within the existing fabric (as opposed to their segregation within designated zones), we would pave the road towards a socially conscious transformation aimed at engaging the city housing ecologies as a shared urban resource.
This new ecology, geared towards a more sustainable, adaptable, and inclusive ecosystem is driven by simple strategies of spatial appropriation. Building on our site observations and existing social practices, we would envisage multiple possibilities for strategic intervention and future development:

The Ground floor:
The Ground Level could become an uninterrupted expanse acting as a platform for social encounters, exchange and spontaneous events. This could be activated and enhanced through interstices spaces, the appropriation of doorways, passageways and thresholds: a complex of nuanced traditions and routines which already exists and would only be encouraged within this collective appropriation. We imagine the plausible reality that the ground level could act as an organic social landscape, integrated and inclusive: linking the buildings that will start to champion new modes of sustainable and flexible living patterns (Figure 5).

Figure 5: Proposed ground floor in Mar Mikhael Cluster

The Rooftop:
As De-growth emerged from ecological approaches, we envision our roof ecology as a platform for innovative forms of urban agricultural production, natural habitats for species

regeneration and greenhouse microcosms that help secure particular microclimates. The aim is to include the MM cluster in a sustainable production ecosystem that offers an inclusive and self-sufficient living. The rooftop also houses large collective rain water recipients to address the frequent water shortages in the neighbourhood. We imagine the plausible reality that the roof level could act as a regenerative green ecosystem, efficient and sustainable: creating new processes of production and challenging the destructive status quo of our current use of natural resources (Figure 6).

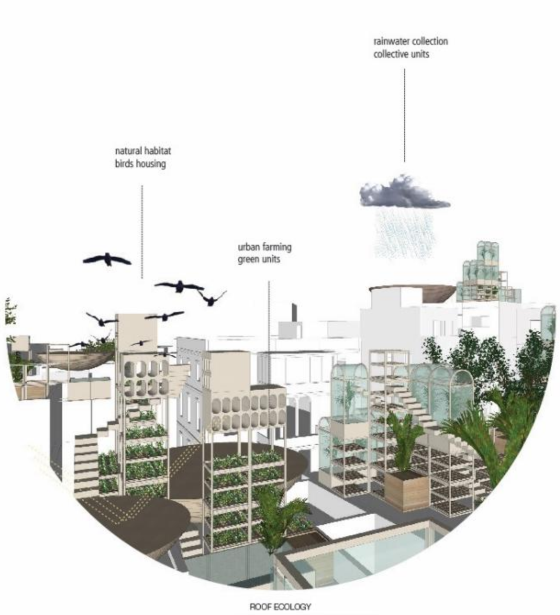

Figure 6: Proposed rooftop in Mar Mikhael Cluster

The habitable space:

The habitable space is an adaptable and inclusive platform interacting with the Ground Level and fuelled by the roof systems. It encapsulates the refuge as well as the prospect. We envisage this space as a flexible and sustainable potential that each individual or family can appropriate as an opportunity to receive and to contribute to the larger community. We call for the appropriation of habitable space rather than claiming its ownership. Tactics such as shrinking the domestic private spaces and expanding onto the public common areas help creating participatory communities. The Rehabilitation of these building will be implemented using green materials and efficient systems. We imagine the plausible reality that the habitable spaces could act as models for flexible, expandable and self-sufficient urban living: creating inclusive and self-reliant communities (Figure 7).

Figure 7: Proposed habitable space in Mar Mikhael Cluster

7 Conclusion

This paper argues that the new building and rent laws in Beirut promote a city growth through the increase of its built-up area and the encouragement of its vertical expansion and fail to provide a diverse mix of housing units, excluding a significant portion of the community from the city. The **Protective Housing Ecologies** proposal calls the government to adopt a different strategy based on de-growth principles, promoting a more inclusive city where the government and its institutions will assume a lead role in the implementation of this new vision. Through the application of this proposal on the Mar Mikhael cluster, this paper demonstrates the possibility of rehabilitating an existing residential stock and putting it again on the market as well as protecting both the physical and social fabric of this neighbourhood. The Mar Mikhael cluster as such can serve as a pilot project addressing the pressing needs of its inhabitants and property owners and promoting a more sustainable community in Beirut.

Acknowledgements

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02.105 - TOP-DOWN, BOTTOM-UP: DEVELOPING A HYBRID APPROACH TO URBAN DESIGN

Jessica YESTER, Jefferson ELLINGER, and Chris BEORKREM

UNC Charlotte
School of Architecture, 9201 University City Blvd. Charlotte, NC, USA.
jefferson@uncc.edu, cbeorkrem@uncc.edu

Abstract

The urban design discourse of the late-20th Century brought about new city planning movements such as New Urbanism. As a reaction to the internally focused aspects of these new design logics, the discipline and many practitioners returned to precedent as a way of promoting more open solutions. This return to historical examples for urban planning tended to overlook more contemporary data-driven approaches. This comfort with familiar approaches has led to a deviation from some of the well-performing ideologies that began to shape the field decades ago and has aided in the creation of an urbanism that is often falsely claimed to be primarily driven by its human occupants. In reality, designers repeatedly develop work which includes infrastructure vital to the creation of human-oriented spaces but privileges the vehicular needs in the design. This paper will introduce a computational urban design method that seeks to combine the traditional top-down approach that has become commonplace within the realm of contemporary regulated design practice with those bottom-up approaches adopted by so-called *informal settlements* throughout many parts of the world for centuries. The marriage of these two opposing traditions will allow the production of an urban environment that retains the necessary ability to be code-compliant while being characterized by a logic of spatial organization that is oriented largely toward the intended users.

Keywords

Top Down/Bottom Up, Computational Design, Scripting, Urban Design, Favela

1 INTRODUCTION

Contemporary urban design began to take shape following the highway boom in the United States during the mid-20th Century. Many of the movements and ideologies of the late-20th and early-21st Centuries are in response to vehicles holding the spotlight in previous decades. Design movements like New Urbanism have tried to place emphasis on reviving traditional planning methods in an attempt to create mixed-use spaces that are much more accommodating to the human inhabitant than their sprawling counterparts (Bahrainy and Bakhtiar 2016).

While many of the intentions of contemporary urban design practices are rooted in the creation of pedestrian spaces, there is a distinction to be made here between what is pedestrian-friendly and what is pedestrian-oriented; in this distinction lies a key separation between top-down and bottom-up practices. In this context, pedestrian-friendly stands to represent the top-down – elements such as wide sidewalks, public open space, and buffers to protect pedestrians from moving traffic are implemented over schemes that tend to be most directly influenced by the access of the personal vehicle. Although touted as mixed-use, this characteristic often manifests as various uses compartmentalized and separated from each other following top-down practices. What can be found between these separate compartments are generous traffic rights of way and endless parking infrastructure.

At the other end of the spectrum is the pedestrian-oriented space typically created by bottom-up approaches. These can be found in informal settlements around the world, and, while typologies, cultures, and aesthetics may differ, many of the spatial logics at the core of how these areas grow and develop persist from place to place. Qualities that lead to the successful urban nature of these environments surround the idea of what Nikos Salingaros refers to as the urban web. According to Salingaros, the urban web is shaped by complementary activity nodes and contains connections between these nodes at varying scales. This complexity of use and connectivity can be found in informal environments worldwide and serves as an influence for the organization and growth of the spaces between the nodes (Salingaros 1998).

Human mobility, without the use of vehicles, has been a fundamental element of bottom-up urbanism for centuries and has led to spaces that have well-distributed varieties of uses and are organized at the scale of the human occupant. A study of favela organization in Rio de Janeiro, Brazil revealed that the elements of integration and choice often lie at the core of how these spaces manifest. In this context, integration refers to the distribution of uses, while choice represents the variety of route options from any given origin to any given destination. This finding further emphasizes the strength of the urban web (Krenz et al. 2015).

2 Background

The research outlined in this paper was motivated at an early stage by Peter Buš's explorations of the urban environments using agent-based modelling. His work in Emergent Urban Strategies offers insight into the bottom-up nature of how the urban environment is experienced, even when implemented through highly regular, top-down methods (Buš 2013). This research is expanded upon through explorations in how studies of agent-based systems may have the ability to influence environments as they cause them to adapt and self-organize through a process of what Buš and his team call 'urban autopoiesis' (Buš 2017).

This paper describes a computational method and development of a design tool developed for use in the early stages of the urban design process to aid designers in making better-informed decisions regarding spatial organization of selected sites. Taking reference from the organizational aspect of the studies performed by Peter Buš and his team, and most directly influenced by analysing the spatial logics present within informal built environments, the tool works to develop a hybridized relationship between the seemingly-opposed top-down and bottom-up approaches to urban design solutions.

Prior to developing the tool described in later sections, a preliminary comparison of three small sites was carried out as a way to begin understanding informal spatiality through the lens of top-down urbanism. For this comparison, areas were selected from the New Urbanist developments in Seaside, Florida and Birkdale Village in Charlotte, North Carolina as well as from Vidigal, a hillside favela located in Rio de Janeiro's Zona Sul (South Zone) (Figure 1). Each study area contains roughly the same number of individual structures at the ground level, around 150. The three sites were measured in terms of area, ratio of built to open space across the entire selection, percentage of the selected area left open for public use, right of way widths, and percentage of vehicular accessibility within the overall right of way area (Table 1).

Figure 1. Selected Sites from Seaside (left), Birkdale Village (middle), and Vidigal (right).

This analysis begins to reveal some of the vast differences in how space is utilized between these top-down and bottom-up environments, with Vidigal supporting the same number of individual structures in an area two and a half times smaller than that of Birkdale Village and eight times smaller than that of Seaside. Despite this immense variance in size, however, Vidigal was found to have the most public open space of the three sites and much less allowance for vehicular access. This last fact may hint at how various land uses are distributed throughout the favela and do not necessarily require a vehicle to access them from within the site.

The findings shown in Table 1 served as a guide in selecting variable input parameters that appear to hold weight in urban design schemes. Throughout the development of the tool, variables such as density, percentage of open space, right of way width, and percentage and distribution of built-up public space were included in order to provide the user with a degree of customizability while quickly exploring possible site layouts that follow the spatial logic of bottom-up urbanism. These parameters and how they function will be described in further detail in the following paragraphs.

Table 3: Comparative Analysis

Site	Study Area (acres)	Built: Unbuilt	Public Open Space	Widest R.O.W	Narrowest R.O.W	Vehicle Accessibility
Seaside	20.8	1:3	5%	60 ft. 18.2m	24 ft. 7.3m	97% of R.O.W.
Birkdale Village	6.7	2:5	0%	50 ft. 15.2m	42’ 12.8m	121% of R.O.W.
Vidigal	2.6	100:27	13%	8 ft. 2.4m	4 ft. 1.2m	66% of R.O.W.

3 Method

As is typical in the beginning of traditional top-down design processes, the user of the tool first performs a thorough site analysis in order to determine the opportunities and constraints of his or her site. At this stage, the designer should have created a computer model of the site that contains basic information, including a topography surface generated from contour lines, represented by curves projected onto a three-dimensional surface; important natural features, represented by points and/or curves; and key site access and/or focal points, represented by points.

The next step involves generating a field of points on the topographic surface, limited by the site boundary, that will be used to create conceptual parcel and, later, block boundaries, which will hereafter be referred to as clusters. This point field is determined by finding the acreage of the site’s topographic surface and manipulating the point density until the designer’s preferred density is achieved. The point field may be distributed randomly, based on contours, or over a regular grid, depending on the goals and needs of the project; essential to this step is the designer’s determination of a preferred average individual parcel size (Figure 2).

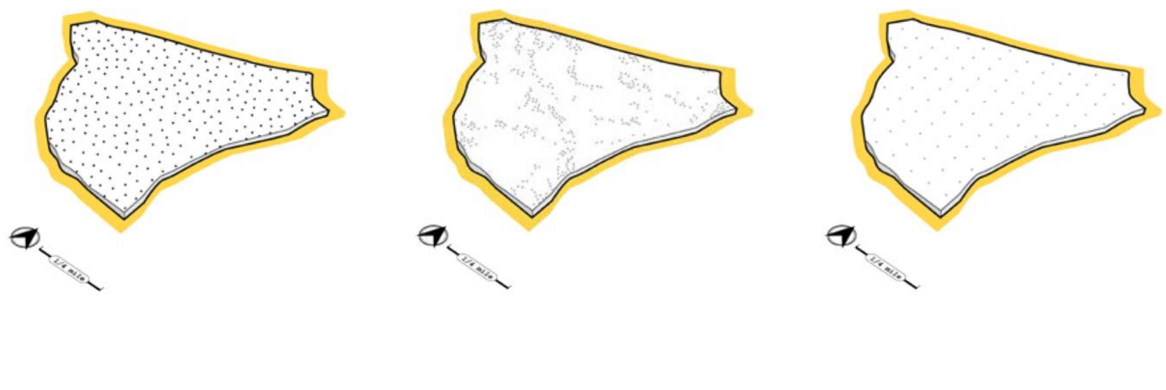

Figure 2. Possible Point Field Distribution Patterns (left: random, middle: contour-based, right: grid-based)

Following the generation of the point field, the user selects a start point that defines the likely best lot, around which others will cluster, or the main entrance to the neighbourhood; this point will be used to inform the tool's proceeding steps. The points are then reordered based upon their distance from the previous point and their z-value relative to the topographic surface. The result of this reordering is a population sequence that is based on the logic of incremental growth seen in informal urban environments as well as one that supports the move toward more sustainable approaches to urban design (Krenz et al. 2015; Lang 2005).

Each point is then used to define a boundary that represents an individual parcel. This boundary is determined through a process of distributing land in the most equitable manner, resulting in parcels of similar sizes during the schematic design phase and allowing for more malleability as the process continues. Once the points have been sequenced, their associated individual parcel boundaries become input for a script that reads the list of points and creates clusters according to the number of parcels per cluster the user wishes to set and determined by the sequencing created in the generation of the point field. Once all clusters have been formed, any parcels or parcel groupings that are isolated from others in their cluster are separated and used to create a new cluster. The outcome of this process is a range of cluster sizes across the site that is based on an average number of parcels and their associated sequencing (Figure 3).

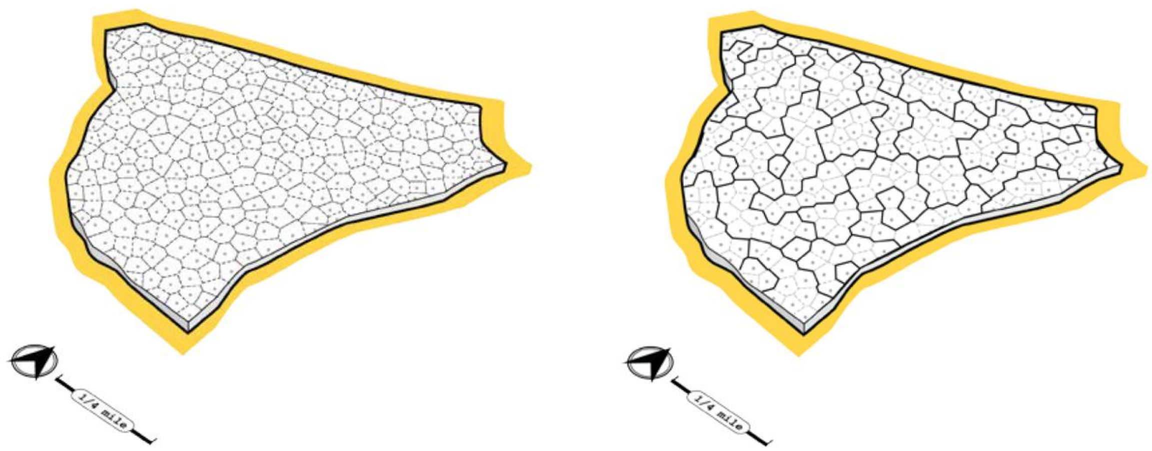

Figure 3. Generation of Clusters of Varying Size.

It is also during the clustering phase of the tool that certain individual parcels are filtered out to remain as public open space. The selection process for this is performed beginning with the cluster containing the first point in the sequence generated several steps back, which is also the user-determined start point. The tool calculates the total area of the cluster as well as each individual parcel contained within it. Gathering input from the desired overall percentage of open space, as determined by the user, the tool searches through the individual parcels contained within the cluster, beginning with the smallest area, and adds adjacent parcels to the pool until it has made a selection with a cumulative area large enough to satisfy at least the desired percentage of public open space but does not continue to search for parcels in the current cluster once this percentage has been reached. From here, the script moves on to the next cluster in the sequence, adding its area to the area of the previous cluster and, thereby, increasing the overall area. At this juncture, if the cumulative area of the individual parcels already selected to be filtered out still satisfies the desired percentage of open parcels for the new, larger overall area, the script continues to the next cluster in the sequence without filtering out more parcels. This cycle continues until all clusters have been searched and either passed or filtered out, and the cumulative area of all filtered parcels meet the user-defined percentage of the entire site's area.

After clusters have been formed, the perimeter boundary of each serves as input for determining primary circulation paths. With key access points at the edges or within the site having been predetermined by the user, these become endpoints of the lines that represent the most direct path through the site. The number of lines utilized in this step is variable depending on the needs of the individual site. Utilizing a shortest walk component that finds the fastest way across the site within the given boundaries, the tool searches through the cluster boundaries while referencing the direct path inputs created by the user in order to determine the shortest path from one endpoint to the other while staying between clusters. The use of this component preserves the nature of the sequencing pattern that has been generated and is useful in identifying areas of particular interest, which may appear at intersections between these paths. The curves created from this operation are then offset a user-determined distance on each side to create routes of primary circulation. The remaining cluster boundary edges are offset a given distance that represents secondary circulation. After all offsetting is completed, the cluster boundaries are adjusted to fit within the newly created rights of way (Figure 4).

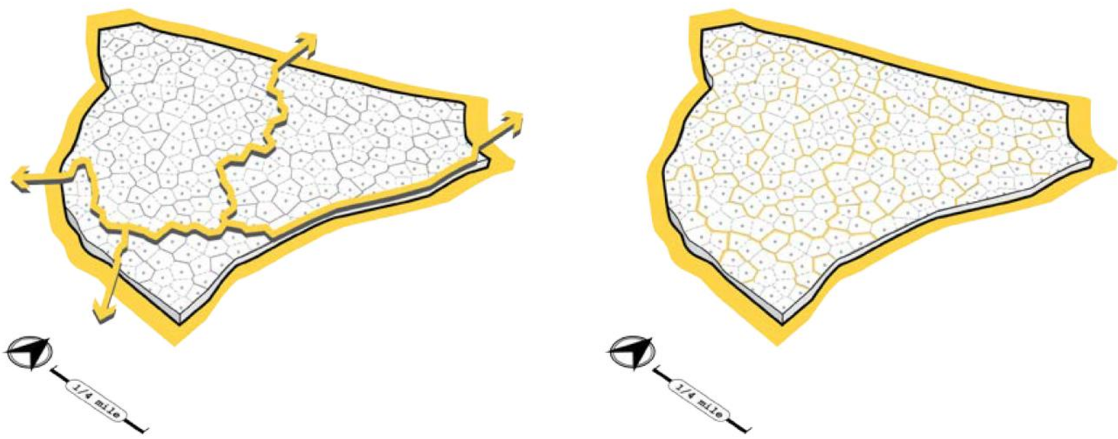

Figure 4. Manipulation of Cluster Boundaries Based on Circulation Routes.

The final set of components employed in this tool utilizes various input parameters fed into a genetic algorithm calculation to make determinations on land use distribution based on the user's desired percentage of non-residential parcels. Throughout this iterative process, the genetic algorithm attempts to find variations that minimize the distances between parcels filtered out for non-residential uses and primary circulation paths, with additional emphasis placed on nodes where multiple primary paths intersect. In addition to this, the tool attempts to maximize the distance between non-residential parcels while also minimizing the distance between non-residential and open parcels in order to encourage healthy distribution of services throughout the site and to link public uses with public open space (Figure 5).

Figure 5. Various Iterations of Non-Residential Land Distribution.

4 Results

Three sites with varying topographic conditions were chosen as test sites for the application of this tool. The sites are located in Omaha, Nebraska; Charlotte, North Carolina; and Atlanta, Georgia, which represent little, moderate, and significant topographic change, respectively. For this test, each chosen site was iterated several times, with certain variables changing for each version. The outcome of each of these explorations is a schematic land use design that can be taken from the tool and used as a base for more in-depth final design development to be completed by the user (Figures 6-11).

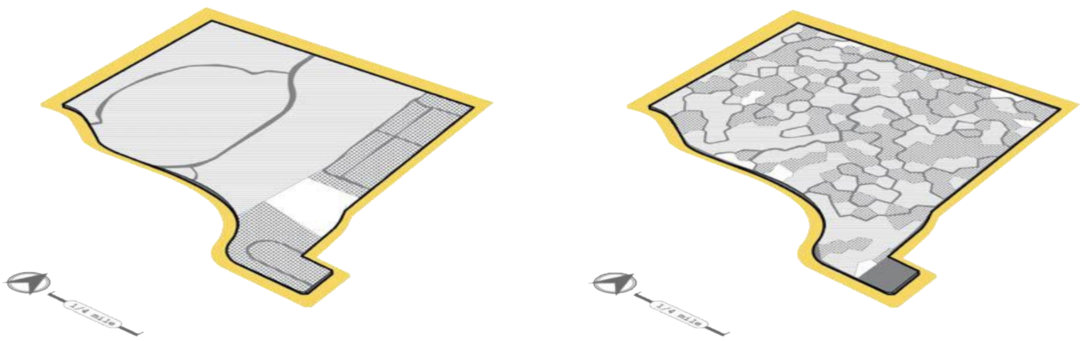

Figure 6. Existing Land Use Distribution on Omaha, NE Site on left. Redistributed existing usage using pedestrian friendly computational method on right.

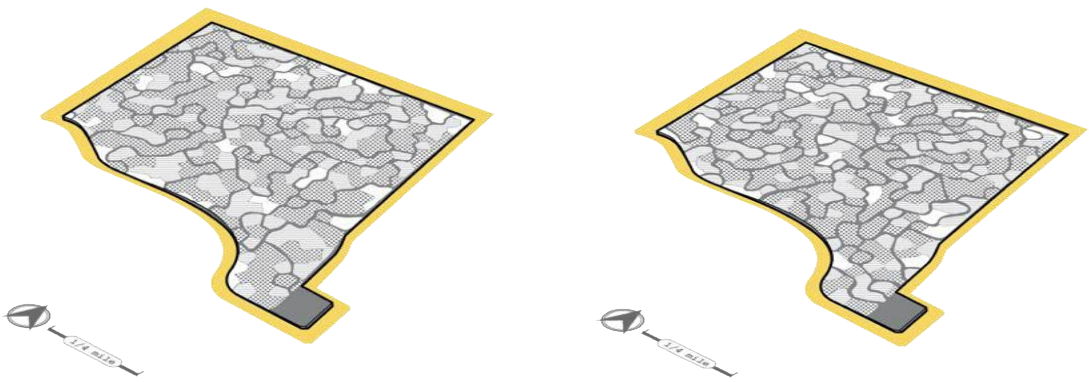

Figure 7. Land Use Distribution on Omaha, NE Site Using Reduced Percentage of Non-Residential and Moderate Cluster Size (left) and Small Cluster Size (right).

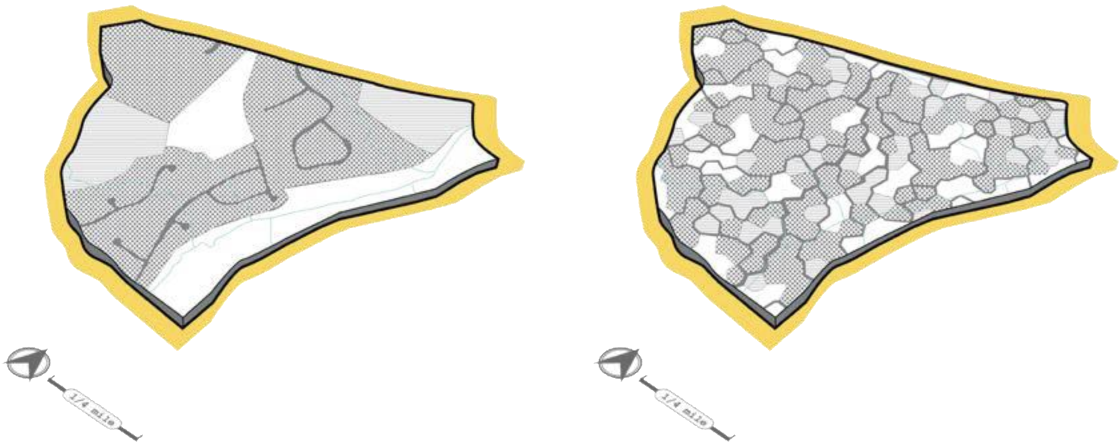

Figure 8. Existing Land Use Distribution on Charlotte, NC Site on left. Redistributed existing usage using pedestrian friendly computational method on right.

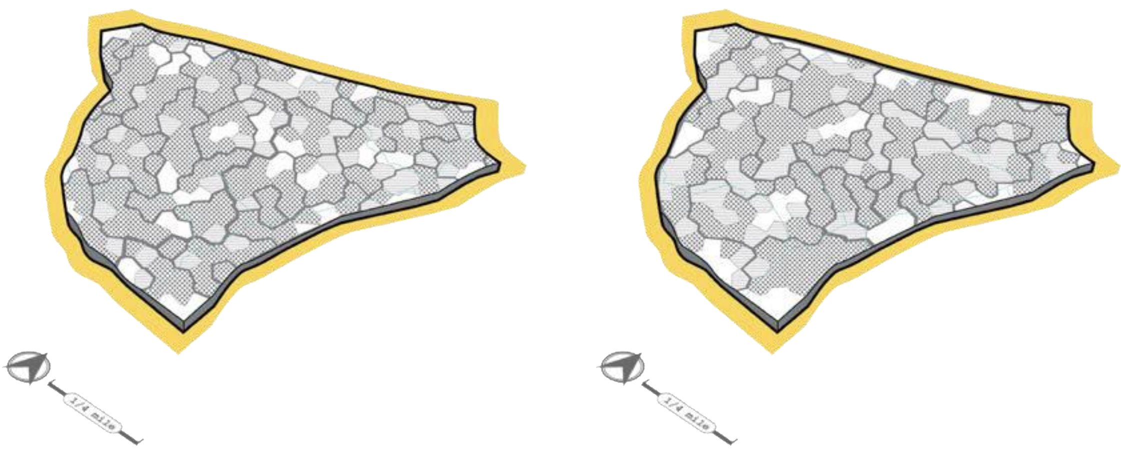

Figure 9. Land Use Distribution on Charlotte, NC Site Using Reduced Percentage of Non-Residential and Moderate Cluster Size (left) and Small Cluster Size (right).

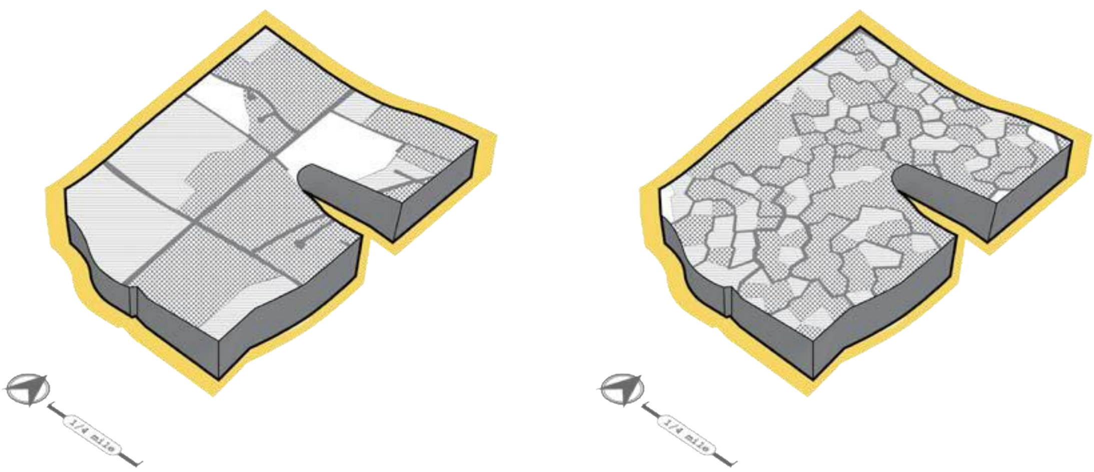

Figure 10. Existing Land Use Distribution on Atlanta, GA Site on left. Redistributed existing usage using pedestrian friendly computational method on right.

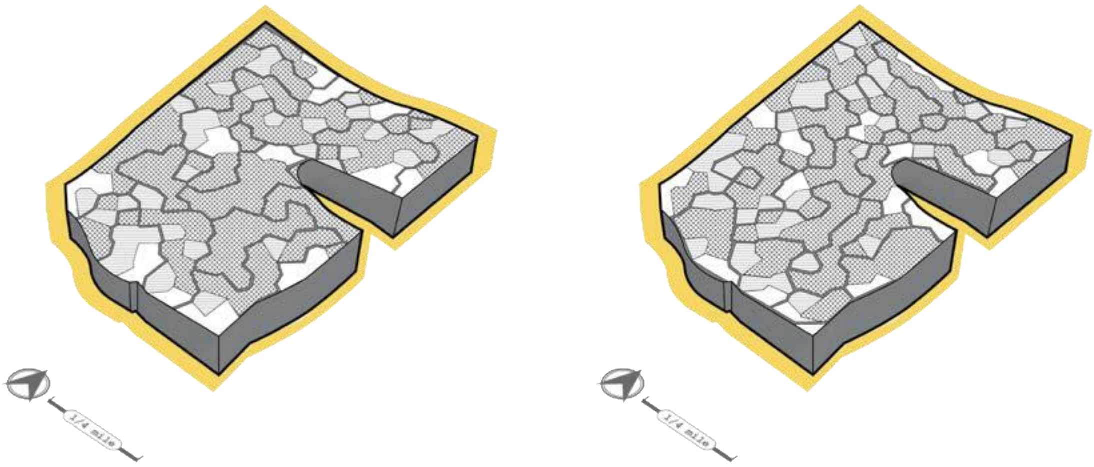

Figure 11. Land Use Distribution on Atlanta, GA Site Using Reduced Percentage of Non-Residential and Moderate Cluster Size (left) and Small Cluster Size (right).

Once a collective sampling of iterations was generated for all three sites, the success of each outcome was measured in terms of its human-orientation by analyzing land use integration. By identifying points of direct adjacency between all three land uses being considered at this stage and overlaying these points with an area representing a five-minute walking radius, the mix of uses between each iteration could be more clearly visualized (Figure 8).

This analysis found, with the exception of the iteration in Atlanta, that attempts to utilize the same land use percentages as the existing site, the use of the tool resulted in an outcome that showed a substantial increase in land use integration when compared to the existing condition. With this in mind, it can be said that the spaces generated through this test would be more walkable in nature than their existing counterparts.

5 Conclusion

In its current state the tool serves as an aid in distributing basic land uses across a site utilizing some of the spatial logics found in bottom-up urban environments. This process lays necessary groundwork for the urban design discipline to become more oriented directly to the human user and walkability rather than to the vehicle and parking.

While this is certainly a push toward a mentality surrounding design approach and distribution of uses that should be adopted within the discipline, many of the needs required to be met by top-down urban design that are not addressed at this level are unlikely to disappear entirely. This includes functions like parking and a comprehensive network of infrastructure that does not necessarily preclude vehicle access.

Future iterations of this tool may include more complex and sophisticated measures for determining size and distribution of open spaces that may also be able to satisfy needs like parking, serving a temporary purpose while remaining adaptable as those needs change over time. Additionally, circulation networks have the potential to become more fine-grain, with smaller access points integrated within clusters. This will have the effect of generating a scheme with many more nuances experienced at the scale of the human occupant.

Finally, the distribution of land uses may become more anchored to each individual site through the inclusion of easements around unbuildable areas, such as steep terrain, watersheds, or stone outcrops, to name a few. By preventing parcels that intersect with these kinds of elements from becoming populated with built uses, the outcome would result in a more realistic schematic design. This in conjunction with more sophisticated measures for manipulating the geometry of the parcels and clusters as well as including more diverse land uses will allow the designer to see a more comprehensive snapshot of what his or her site has the potential to become.

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02.106 - EXPLORING OFFICE DESIGN APPROACHES IN RELATION TO HEALTH AND WELLBEING: A SCOPING REVIEW

Melina Forooraghi*, Holger Wallbaum, Nina Ryd

Chalmers University of Technology, Department of Architecture and Civil Engineering, SE-412 96, Gothenburg, Sweden; melinaf@chalmers.se

Abstract

Aim: This article explores emerging design approaches in relation to health in the context of office building design.

Background: Design for health is an emergent theme in architectural design. Healthcare sector has long dealt with the built environment and its health outcomes. In the past decades, there has been growing interest in the potential of design approaches with a key focus on patients' health such as Co-design, Evidence-based design, Salutogenic design, User-centred design. Some of these approaches extend beyond healthcare to sectors such as schools and offices. Nevertheless, very little is currently known about how these design approaches relate to employee health and wellbeing in office building design. Therefore, new insights into the existing literature is needed to support discussions on future office design among researchers.

Methods: A scoping review of 7432 papers was conducted in 2018, in four electronic databases and five scientific journals to scan design approaches in relation to health and wellbeing in office building design resulting in the selection of 26 papers.

Result: The review, firstly, disclosed a mismatch between the research outputs and target population. Secondly, a limited understanding of health in relation to office physical environment was noted. Lastly, design approaches were found to be underdeveloped in the field of office design.

Conclusion: It was noted that Salutogenic orientation toward health is not well-recognized in work environments. Further research might be useful to conceptualize positive aspects of health in relation to physical office environment. Design for health is becoming more visible in office context, however, more research is required to expand our thinking toward the impact of the interplay of design aspects on those health and wellbeing related outcomes. This might be through firstly identifying the dimensions of office environments that can support employee well-being, and, secondly, testing and validating existing frameworks. Considering the different cultural norms for dissemination, with research agenda focusing on scholarly communication, against a far more visual language used by designers, we need to identify ways to increase visibility and readability of research outputs.

Keywords

Workplace, Office design, Health, Wellbeing, Design approach

1 INTRODUCTION

Most people spend 90% of their lives within buildings [1]. Research has shown buildings impact the physical and mental health of the people who live and work in them [2-5]. In recent years, there has been a growing interest in the potential of design approaches in healthcare building design with a key focus on patients' health, such as Co-design [28], Evidence-based design [3, 29], Salutogenic design [30], Restorative environments [31], Patient-centred design [32], and Health promoting building design [33]. Some of these approaches extend beyond healthcare to sectors such as schools and workplaces, however, they have not been widely applied.

Previous research on office buildings has mainly focused on the relationship between psychosocial work environment and employee health. 'Psychosocial' environment refers to various factors, such as social relationship at work and organizational factors, which can affect general health and sick leave [6], stress related ill health [7], depression and anxiety [8]. Conversely, only through recent years the relationship between physical work environment and employees' health and wellbeing has gained interest [9, 10] whereas healthcare building design has long dealt with the built environment and its health outcomes.

A great number of research concerning physical office environment and employee health and wellbeing has focused on ambient factors such as air quality, light and noise [11-13]. Research on architectural design of the office has studied the impact of office type on health outcomes [9, 10]. Several factors are associated with the layout of the office. For example, privacy can affect employee wellbeing and job satisfaction [14, 15]. Sense of control is also an important component of the work environment. Sense of control over physical workspace has positive effects on employees' satisfaction and wellbeing [16, 17]. The design process of office is of relevance to employee health and wellbeing as well. For example, participation in planning and design processes influences sense of control over the work environment [1] and wellbeing among employees [18].

Health and wellbeing of employees can have a significant financial implication for companies as 90% of business' operating costs is associated with staff costs such as salaries and benefits [19]. This equation has made it imperative for many organizations to understand productivity loss and negative health outcomes in relation to alternative design features.

While evidence is accumulating, the different disciplinary cultures and the variety of preferred communication methods present significant challenges in knowledge outreach. Academicians appear to disseminate research using theoretical formats while practitioners use visual aids to share knowledge. Consequently, majority of valid design research is not accessed and used by design practices. There is, therefore, a need to review how design approaches relate to health and wellbeing in the context of office design.

Background

The World Health Organization (WHO) states: 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'.

To better understand what creates health, researchers have long tried to explain the positive dimensions of health by describing terms such as Self-actualization [20], Wellness [21], Psychological wellbeing [22], Flow [23], Flourishing [24], Wellbeing [25] and Salutogenic [26]. Antonovsky developed the Salutogenic approach which focuses on the origins of health rather than determinants of disease. He argues the factor that create health are often different from those causing illness. Therefore, to move toward health only eliminating risk factors is not enough and increasing positive factors such as imagination, play, will and meaning would be necessary.

1.1 Health and wellbeing in office

A great deal of previous research into the indoor environment has tended to focus on threats, illness and negative impacts on people. A range of irritative symptoms, such as eye and nose irritation, difficulty concentrating, skin reactions, mental fatigue and headaches that occurred in employees in office buildings have been related to the Sick Building Syndrome (SBS). SBS refers to a situation when 20 per cent of buildings occupant complain of a similar medical condition, while in the building, because of an unknown cause over a period of at least 2 weeks [27]. In contrast, few research has studied the positive aspects related to work environments that could promote health and well-being [28]. Thus, only removing the harmful stimuli has been considered sufficient and the factors which generate a positive experience in the workplace has been overlooked [29]. Bluyssen (2014a) calls for a change of mindset from the current focus on single component to users and improving the quality of their lives. Positive aspects could include participation in planning and design, space personalization, building a sense of control and ability to meet changing needs and preferences [29].

WHO defines five keys to healthy workplaces as follows (WHO 2010 in Kortum and Burton 2010): A healthy workplace is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety, and well-being of all workers and the sustainability of the workplace by considering the following identified needs:
- Health and safety concerns in the physical work environment;
- Health, safety and well-being concerns in the psychosocial work environment including organization of work and workplace culture;
- Personal health resources in the workplace; and
- Ways of participating in the community to improve the health of workers.

The definition reflects a shift in perspective from a major focus on physical environment to a more holistic view on the workplace factors including psychosocial and individual health factors [30].

1.2 Health and wellbeing vs. productivity

Productivity is closely associated with wellbeing and health, yet the relationships are not symbiotic [19]. Productivity refers to more business-oriented outcomes [19] while health and wellbeing tend to be seen as individual needs. Although productivity is of relevance to office design research, this article focuses mainly on health and wellbeing aspects. Firstly, because the influence of the physical environment on humans goes beyond task performance and can contribute to functional and psychosocial outcomes [29]. Additionally, occupational and environmental risks can take weeks, months or years to produce symptoms. Therefore, productivity should not be viewed as the only indicator of health as one can be productive while being unhealthy.

1.3 Design approaches

Because of the key challenges in society such as population growth, an aging demographic and structural reorganizations, healthcare building design has been transformed to place more emphasis on the consequences of design choices in healthcare facilities. Several approaches such as Co-design, Restorative environments and Evidence-based design, have been developed to address the complex relationship between the built environment and health outcomes.

Co-design is a process-based approach which implies a central change in traditional client-designer relationship. Within this process, designers are expected to take the role as a facilitator which involves managing expectations, demands and wishes among stakeholder groups as well as providing ways for end users to engage with each other to define the final product [18]. Co-design is a well-established approach in public funded projects.

The restorative environments generally incorporate four main components including being away from everyday life, extent, fascination, and compatibility between environment and one's purposes [31]. One study showed that natural environments are seen as restorative for human beings more than urban environments [32]. It is, therefore, important to provide access to natural environments in the workplaces.

Evidence-based design is defined as 'a process for conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project' [33]. Evidence-based design reflect a fundamental change in conventional design practices by basing design decisions on credible evidence rather than designer's intuition and experience.

Although the aforementioned approaches have received significant attention in the healthcare building design, they have not been widely applied by office design practices.

2 Methods

A scoping review was conducted using the framework outlined by Arksey and O'Malley (2007); This review included the following five phases: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results.

The benefits of this approach are that firstly, it maps a wide range of literature on a subject area, while in a systematic review, the best available research on a specific question is collected. Secondly, a scoping review aims to scan and sum up a broad body of literature, whereas systematic reviews seek to collect evidence to answer a narrow research question. Lastly, scoping review does not assess the quality of different studies and aims to provide an overview of the existing literature on a topic area. Contrary, systematic reviews collect and analyse best available studies [34].

2.1 Research question

The scoping review was guided by the following question:

How do the emerging design approaches in the field of office building design relate to health?

2.2 Identifying relevant studies

The initial search was implemented on May 2018, in four electronic databases: PubMed, Scopus, Google scholar and Web of Science (Table 4). The databases were selected in consultation with Chalmers library. The search query consisted of terms considered by the authors to describe three key concepts: workplace design, design approaches, and health. The same search queries were used in all the databases except for Google Scholar in which the search query was tailored to the requirement of 32 words maximum per query. Moreover, hand searching was performed in 5 journals (Environment and Behaviour, Facilities Management, Corporate Real Estate, Health Environments Research & Design, Intelligent Buildings International).

Table 4: Overview of search keywords

Terms relating to design approaches	**Terms relating to health**	**Terms relating to office design**
Active design	Health	Office design
Co-creation	Well-being	Workplace design
Co-design	Wellness	Workspace design
Co-production	Salutogenic	Office architecture
Co-research	Health promotion	Workplace architecture workspace
Collaborative design	Quality of life	Architecture
Creative practice	Physical functioning	Office physical environment
Critical artefact	Mental functions	Workplace physical environment
Cultural probe	Mental perception	
Design probe	Spiritual dimension	
Design thinking	Social participation	
Evidence-based design		
Experience-based design		
Experience-based co-design		
Research-informed design		
Human-centred design		
Inclusive design		
Integrated design		
Interactive design		
Open design		
Participatory design		
People-centred design		
Practice-based design		
Practice-led design		
Universal design		
User-centred design		
User involvement		

Table 5: Search strategies

Terms relating to design approaches **AND** Terms relating to health outcomes **AND** terms relating to physical office environment	“active design” OR “co-creation” OR “co-design” OR “co-production” OR “co-research” OR “collaborative design” OR “creative practice” OR “critical artefact” OR “cultural probe” OR “design probe” OR “design thinking” OR “evidence-based design” OR “experience-based design” OR “experience-based co-design” OR “research-informed design” OR “human-centred design” OR “inclusive design” OR “integrated design” OR “interactive design” OR “open design” OR “participatory design” OR “people-centred design” OR “practice-based design” OR “practice-led design” OR “space syntax” OR “universal design” OR “user-centred design” OR “user involvement” **AND** "health" OR "well-being" OR "wellbeing" OR "wellness" OR “health promotion” OR "quality of life" OR "physical functioning" OR “mental

	functions" OR "mental perception" OR "spiritual dimension" OR "Social participation" OR salutogenic **AND** "office design" OR "workplace design" OR "workspace design" OR "office architecture" OR "workplace architecture" OR "workspace architecture" OR "office physical environment" OR "workplace physical environment"
Terms relating to design approaches **AND** terms relating to office design	"active design" OR "co-creation" OR "co-design" OR "co-production" OR "co-research" OR "collaborative design" OR "creative practice" OR "critical artefact" OR "cultural probe" OR "design probe" OR "design thinking" OR "evidence-based design" OR "experience-based design" OR "experience-based co-design" OR "research-informed design" OR "human-centred design" OR "inclusive design" OR "integrated design" OR "interactive design" OR "open design" OR "participatory design" OR "people-centred design" OR "practice-based design" OR "practice-led design" OR salutogenic OR "space syntax" OR "universal design" OR "user-centred design" OR "user involvement" OR "health promotion" **AND** "office design" OR "workplace design" OR "workspace design" OR "office architecture" OR "workplace architecture" OR "workspace architecture" OR "office physical environment" OR "workplace physical environment"
Terms relating to office design **AND** terms relating to health outcome	"active design" OR "co-creation" OR "co-design" OR "co-research" OR "collaborative design" OR "creative practice" OR "design thinking" OR "evidence-based design" OR "experience-based design" OR "experience-based co-design" OR "research-informed design" OR "human-centred design" OR "inclusive design" OR "integrated design" OR "interactive design" OR "open design" OR "participatory design" OR "people-centred design" OR "practice-based design" OR "practice-led design" OR "space syntax" OR "universal design" OR "user-centred design" OR "user involvement" OR "biophilic design" **AND** "health" OR "well-being" OR "wellbeing" OR "wellness" OR "health promotion" OR "quality of life" OR "physical functioning" OR "mental functions" OR "mental perception" OR "spiritual dimension" OR "Social participation" **AND** "architecture" OR "physical environment" OR "facility design" OR "building design"
Terms relating to design approaches **AND** terms relating to health outcomes	"user centred design" OR "Co-design" OR "co-creation" OR "participatory design" OR "evidence-based design" OR Design thinking" **AND** "health" OR "well-being" OR salutogenic **AND** "office design" OR "workplace design" OR "workspace design"
Google scholar	"office design" OR "workplace design" OR "workspace design"
Journals	"office" OR "workplace" OR "workspace"

2.3 Study selection

Limits on language, settings, date and content were placed on the database search (Table 6). For the first phase of screening, only the title of records was reviewed to exclude articles that did not meet the minimum inclusion criteria. Then, the abstract review resulted in 7432 records selected for review, and 47 papers were selected to be read in full text. Eventually, 26 papers were selected relating to at least two out of the three concepts; design approaches, health and office design.

Papers referring to any settings other than offices such as healthcare, school, housing, urban and industrial workplace settings were excluded. Many papers with only descriptive content were also excluded. The term descriptive refers to describing characteristics and functions while prescriptive content provides insight into a few different viable solutions and the possible impacts. The selection process was carefully documented.

Table 6: List of inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**

English;	Other settings such as schools, hospitals; and industrial sector
Refers to office design context;	Newspapers;
Published from 1988 on;	Letters to editors;
Prescriptive;	Descriptive.

2.4 Charting the data

The details of the publications included in the review were documented in a chart form which included source information (authors, year), title, and addressing health in relation to office building design.

2.5 Collating, summarizing, and reporting the results

The first author developed a framework to describe the papers, followed by an analysis by all authors. This discussion narrowed down to a core set of parameters relating to research questions; namely the research Output, Population, and Design Approach. An outline of the main and child codes is given in Figure 11.

Figure 11: List of codes

3 Results

The codes and identified themes are described and unfolded in detail using charts to provide clearer graphical representation of the commonly-researched areas as well as knowledge gaps in the literature (Figure 12).

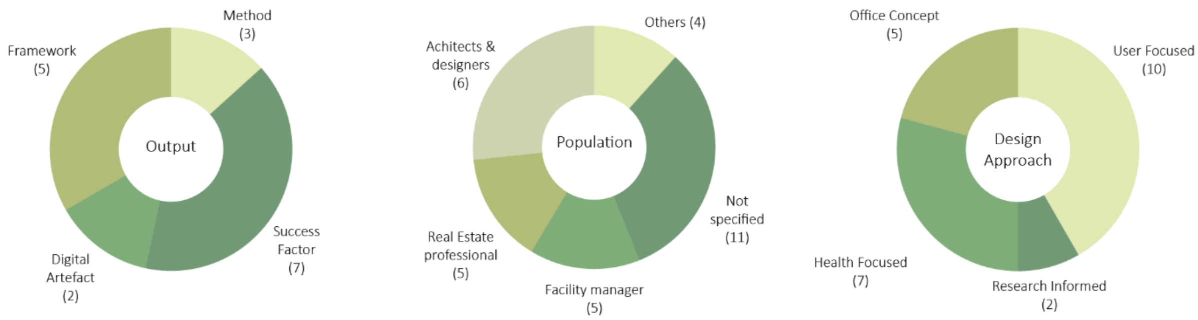

Figure 12: Instances of the codes in the included papers

3.1 Output and population

The Output code describes the diversity in research outputs that were produced by the selected papers. The child codes were applied for each type of output. For example, the code Success Factor relates to the combination of essential factors that are required to accomplish desired office-related outcomes, and it covers a range from environmental factors such as room layout, colour, windows and daylight [35-41], process related such as planning, implementation process and change management [35, 36, 41] to factors responding to psychological needs in the workplace such as privacy, sense of control and territoriality [38, 39].

The *Framework* code was applied to outputs which aim at describing the interaction between design features and organizational/and or individual outcomes. For example, Danko et al. (1990) link a range of safety, health, and wellness concerns with interior design decisions. Similarly, Wohlers and Herbel (2017) illustrate a theoretical model on the effects of activity-based flexible offices on short-term and long-term work-related consequences for individuals, teams and the organization. Ruohomäki et al. (2015), also, identify the dimensions of a workspace quality that could promote well-being.

The code *Digital artefacts* referred to tools produced by the included papers to support decision making in the design process. These include a calculation tool to determine office space dimensions [42], and a searchable online database of around 12,000 peer-reviewed articles to support evidence-based design by translating research findings into design criteria [43].

Finally, the code *Methodology* is applied to papers that do not necessarily produce a tangible output as the focus, rather they describe the methodology developed in a project [44, 45].

The *Population* code relates to the people who were addressed as the intended audience for the research output. Most information focus on architects and designers [36, 37, 40, 43, 44, 46-49] and comparatively less information targeted to facilities managers [40, 42, 43, 47, 50] and real estate developers [29, 36, 38, 40, 43]. One paper explicitly addressed occupational health professionals [29]. A few papers mentioned human resources [50], consultants [47] and researchers [51]. There were 11 papers not specifically identifying a population group as their target audience [18, 30, 35, 39, 41, 51-56].

3.2 Design approaches

The code *Design Approaches* refers to emerging approaches for form and architectural design process described in the literature. This included some aggregation of approaches into umbrella terms. Where a paper clearly mentioned the use of ‘users’ as the centre of the interest or design activity, it was coded as *User Focused Design*, such as user-centred design [45, 53, 55], participatory design [46, 47, 52], inclusive design [37], performance-oriented [50], and agile workplace design [35].

Whereas if the use of scientific methods of inquiry was stated, the approach was coded as *Research Informed* Design. For example, Sailer et al.(2009) reflected on the systematic rigour of Evidence-Based Design and called for an evidence base that is built only on firm findings of rigours studies [54]. Vischer (2009) argues that information derived from feedback collected systematically from building users is accumulating and now forms a knowledge base from which design and construction decisions are increasingly being made [57]. One article (as mentioned in output section) develops a searchable database of review papers to support practitioners with design criteria derived from peer reviewed papers [43].

The *Health Focused* code can relate to papers in which the design approach is articulated with a major focus on health and wellbeing. Only a few of included papers explicitly articulated a focus on employee health ranging from a focus on aspects of health promotion such as promoting physical activity through active design [44] and creating salutogenic work environment [29], mental wellbeing and psychological needs of employees [18, 38, 39, 56]. Similarly, one article focused on a salutogenic and user-centred, participatory approach toward workplace design [30].

4 Discussion

This review set out with the aim of exploring emergent design approaches in relation to health and wellbeing in office sector. A mismatch between target population and outputs is identified. Several papers mentioned design teams including architects and planners as their target population for the research output however, the difference between academic and practice culture in the way they prefer to communicate, might be a barrier to knowledge outreach. Firstly, because architects use an engaging and varied approaches such as drawings and physical models to codify their knowledge and transfer to their peers. While academics tend to use scholar communication and peer reviewed publications. [58]. Secondly, most of the journal articles are not accessible for non-academics, therefore, developed theoretical frameworks and methods barely reach design practices.

The result revealed that understanding of health in relation to office design is limited. Only two papers referred to the definition of health by WHO [59]. In the articles where health is mentioned, it is still unclear what aspects of health are considered. For example, Heerwagen et al. (1995) mentioned wellness promoting environments, but not explicitly defining health. Moreover, most included papers did not recognize salutogenic approach in relation to office design and were limited to pathogenic orientation. This also accords with earlier observations which showed research on health is limited to only risk factors [28]. Therefore, design implications for designers remain unclear.

Finally, Design for health in office sector seems underdeveloped. Most of the design approaches taken from healthcare building design and product design were not found in office design literature. A possible explanation for this might be that the body of research evidence in workplace environments is inconsistent and hence difficult to use [54].

5 Conclusion

This review has identified several gaps in the literature regarding health and wellbeing in office design approaches. The results disclosed a limited understanding of health in relation to office environment. Additionally, design approaches were found to be underdeveloped in the field of office research. Finally, a mismatch between the output and target population was identified.

Reflecting on the combined results, a few challenges for this field have been highlighted. It was noted that salutogenic orientation toward health is not well-recognized in work environments. Further research might be useful to conceptualize positive aspects of health in relation to physical office environment.

Design for health is becoming more visible in office context, however, more research is required to expand our thinking toward the impact of the interplay of design aspects on those health and wellbeing related outcomes. This might be through firstly identifying the dimensions of office design that can support employee well-being, and, secondly, testing and validating existing models and framework concerning office design that promotes health and well-being.

Considering the different cultural norms for dissemination, with research agenda focusing on scholarly communication and journal articles, against a far more visual language used by designers, we need to identify ways to increase visibility and readability of research outputs.

Acknowledgements

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6 Appendix

Table 1: List of included papers

Author(s), Year	Title
Danko et al. (1990)	A taxonomy of Health, safety and welfare

Wohlers and Herbel (2017)	Choosing where to work at work – towards a theoretical model of benefits and risks of activity-based flexible offices
Myerson and Ramster (2017)	Workplace health and wellbeing: can greater design participation provide a cure?
Heerwagen et al. (1995)	Environmental design, work, and wellbeing: managing occupational stress through changes in the workplace
Sailer et al. (2008)	Evidence-Based Design: Theoretical and Practical Reflections of an Emerging Approach in Office Architecture
Oseland (2009)	The impact of psychological needs on office design
Brunia et al. (2016)	Accommodating new ways of working: lessons from best practices and worst cases
Hassanain (2006)	Factors affecting the development of flexible workplace facilities
Smith and Pitt (2011)	Sustainable workplaces and building user comfort and satisfaction
Erlich and Bichard (2008)	The Welcoming Workplace: designing for ageing knowledge workers
Bell and Anderson (1999)	Workplace solutions
Davies (2010)	The psychological and physical needs of workers impacting office design
Ruohomäki et al. (2015)	Salutogenic and user-centred approach for workplace design
Vischer (2009)	Applying knowledge on building performance: From evidence to intelligence
De Bruyne and Beijer (2015)	Calculating NWoW office space with the PACT model
Vischer (2008)	Towards a user-centred theory of the built environment
Martin and Guerin (2006)	Using research to inform design solutions
Kämpf-Dern and Konkol (2017)	Performance-oriented office environments –framework for effective workspace design and the accompanying change processes
Wackernagel (2017)	Combining environmental psychology and space syntax analysis the extent of users' well-being influencing variables control, protection and privacy in an open plan office
Cawood et al. (2015)	Creating the optimal workspace for hospital staff using human centred design
Souza da Conceição (2014)	Developing through prototyping: a resource material on user involvement for workspace design
Ianeva, et al. (2015)	Learnings from workplace user-centered design: The case of a media and communication company

McGann et al. (2014)	Stationary in the office: emerging themes for active buildings
Margaritis and Marmaras (2007)	Supporting the design of office layout meeting ergonomics requirements
Lindahl (2004)	The innovative workplace: an analytical model focusing on the relationship between spatial and organisational issues
Dewulf and Meel (2002)	User participation and the role of information and communication technology

02.107 - REFURBISHMENT OF İZMIR ROMAN AGORA WEST STOA

Nağme Ebru AYDENİZ, Aslı TATLIBAŞ
Yaşar University, Turkey

Abstract

Since ancient times, the cultural heritage has been preserved for a variety of reasons, but it has started to be made by scientific methods in the nineteenth century. Different conservation principles and methods for different kinds of heritage areas have been developed in the theoretical development process up to the present. The studies on the protection of the archaeological heritage are one of these. To this date, various agreements, conferences, and charters were organized to protect the archaeological heritage and transfer it to the future.

Although some principles are recognized within the scope of the theoretical framework, the definition of general methods is avoided in order to allow a variety of approaches depending on the context. The current location, the level of conservation and the original construction date of the archaeological heritage affect the intervention approach. Therefore, in this paper, the aim is to present the diversity by analyzing multiple examples and develop a project proposal for the enhancement of the West Stoa of İzmir Agora.

Keywords

smyrna, izmir, agora, west stoa, installation.

1 INTRODUCTION

Conservation attempts, especially, urban conservation attempts, should attach particular importance to the presentation of archaeological sites and their integration with daily life. Traces and remains in urban space give information about societies that lived in different periods and has the ability to create a connection between past and present. Today, these valuable areas are not accepted as enriching factors to urban identity instead they are perceived as abandoned areas that prevent urban development. In order to avoid this, keeping the conservation and continuation of archaeological artifacts as the priority, new approaches should be developed for their presentation and adaptation to urban life.

The term " Agora" refers to a gathering space. In ancient Greek cities, besides its commercial, political and religious functions, Agora was the focal point of the city where many social events took place (International Dictionary of Historic Places: Southern Europe, 1995) The number of agoras in an ancient city depended on the size of the city.

Agora of İzmir is located in the ancient city of Smyrna. Surrounded by important public buildings of the period, this structure is the state agora of the city. Most of the remains of the Agora, which survived to the present day, are from the Roman period of the city even though it was originally built during the Hellenistic period (İzmir İl Kültür ve Turizm Müdürlüğü, retrieved in 2018).

A variety of revitalization projects are carried out by the Ministry of Culture in cooperation with the İzmir Metropolitan Municipality. Even though Agora has a significant place in the urban memory of the people and the city, in this day and time the ancient city does not take a considerable part in the city life of İzmir. The ancient city is almost stuck between modern streets and pillaged historical residences and the security problem around the site is one of the reasons for the lack of visitor income.

For this reason, a reviving installation proposal is developed for İzmir Agora by reviewing the international regulations and analyzing interventions with contemporary approaches

2 Urban Archaeology and Conservation of Archaeological Heritage

Considering that the archaeological excavation sites and their findings are related to not only a nation but also a whole history of mankind, the internationally deemed appropriate principles to be followed in these excavations have been agreed and the scientific standards to be carried out in the archaeological excavations have been accepted by UNESCO in 1956. In the process of preserving the artifacts and structures unearthed as a result of archaeological excavations and presenting them to visitors, a new frontier was defined in this area with the Venice Charter in 1964 by referring to the fact that the intervention should not make it difficult to detect the original artifact and avoiding the reconstruction processes outside of anastylosis (Venice Charter, 1964). Many countries have accepted the legal framework formed by these decisions, which has been an important step towards sorting out the integration and conservation problems of archaeological sites. The year of 1975 was named as European Architectural Heritage Year by the Council of Europe and at the end of this year, the Amsterdam Congress was convened. This Congress, composed of delegates from all countries of Europe, confirms that the European architectural heritage is an undeniable part of the world's cultural heritage. The declaration issued by Amsterdam Congress, emphasizes that the protection of architectural products should be the target in urban and city planning and in this context the survival of all urban and rural areas which have a historical and cultural value is as important as the protection of single structures. In order to provide this the education of the community about their common history and future has vital importance. As a result of the socio-economic change in many cities around the world in the 1980s and 1990s, the interest in the urban areas grew. In parallel with this change in the 1970s urban archaeology which was considered as archaeology in cities started to be considered as the archaeology of city life. This new approach has brought urban archaeology into a multidisciplinary field, and a series of meetings and conferences have been held at the head of the Council of Europe in the national and international frameworks since 1980 (Bilgin, 1996, s. 13). In 1990, International Committee for the Management of Archaeological Heritage prepared the Charter for the Protection and Management of the Archaeological Heritage where it is indicated that the protection of the archaeological heritage should be based upon influential collaboration between professions from many disciplines. Interdisciplinary cooperation is necessary in order to minimize the destruction of this fragile and non-renewable cultural resource. It is also mentioned that the reconstructions in archaeological sites should not be built directly on top of the archaeological remains in order to not to violate the original context. Between the years 2003 and 2005 European Commission funded a project called The APPEAR Project, which aimed to define manners in order to integrate archaeological sites within towns while conserving them and creating a framework for their presentation to the public. It also provides guidance about the participation of public to the conservation and presentation process, protection of remains from weather conditions, vandalism and corrosive effects of tourism. An archaeological site is considered as any place that contains remains from human activities in the past, recent or distant (Thuesen, 2008) and archaeological sites within towns have major effects on the understanding of the multi-layered cultural structure and the historical process of the city. As suggested in The ICOMOS Charter for the Interpretation and Presentation of Cultural Heritage Sites in 2007, the interpretations of these heritage sites should be considerate in terms of social and environmental sustainability. Besides that, the interpretations and presentations increasing public understanding they should also enhance the personal experience of the site (ICOMOS, 2007). With necessary interventions, these areas are able to introduce national identity in international platforms and draw touristic attention to the site (Tuna and Erdoğan, 2016).

The common point to be reached with the aforementioned documents and regulations is to create a common attitude in terms of conservation and presentation of these areas in addition to create awareness to carry these sites to the future by including them in modern life.

3 Sample Investigation

Protection and conservation of archaeological sites is a global issue. Hence many different projects and approaches exist in this manner. Following examples are chosen from various levels of intervention in order to be able to examine these differences sufficiently through their materiality, scale, reversibility, and function contribution.

3.1 Pozzuoli Cathedral, Italy, 2004, Gnosis Architettura

The The historic Pozzuoli Cathedral or Temple of Augustus with its original built name was a subject of a restoration led by Gnosis Architecture. The conservation project ensures the continuation of the original function and transmission of this historical site to the future as an archaeological site. The project proposal consists of the preservation of all the surviving historical parts of the monument, including the unfinished contemporary structural interventions so that they can all be read. Structural glass is used to fill the gaps between columns to create an indoor space while maintaining some transparency. Reintegration of the lost columns from the ancient temple was suggested as a part of the project. Opaque pattern made in serigraphy on the glass sheets is used to create the antique perimeter of the columns. (Figure 1) (Figure 2) As recommended by the Venice Charter of 1964, simplified forms and usage of the dissimilar material allow the intervention to be recognizable and modern (Campanelli, 2010). The design team was formed from a large range of specialist from various professions and disciplines in order to minimize the destruction and have the right level of interventions considering the site. The design team managed to protect the originality of the building while making the necessary additions for its conservation. Material choice ensures the visual continuity and structural support. This intervention protects the archaeological remains and adds a purpose of usage to the building in order to ensure its transmission into the future.

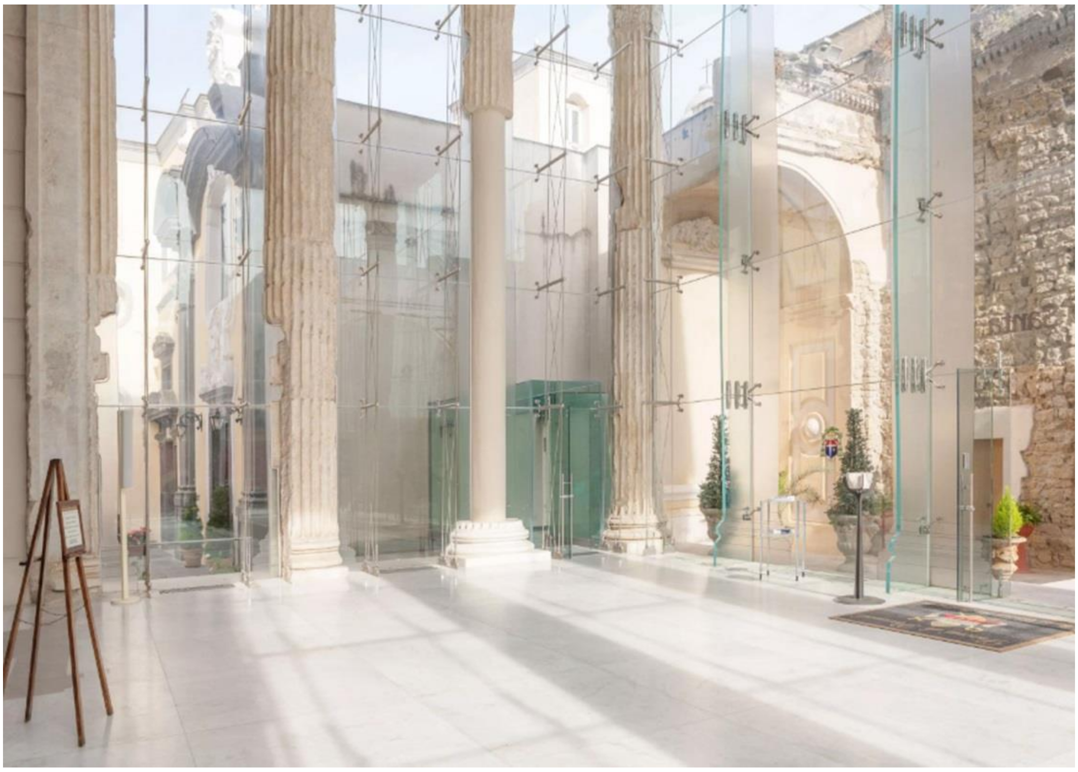

Figure 13. The building walls from inside, the column gaps are filled with structural glass

Figure 2. The new glass facade, showing the glass columns

3.2 Antiquarium Museum, Spain, 2011, Felipe Palomino Arquitectos

The archaeological remains on the site belong to Romans and Moors and they were discovered during an excavation in the area to build a car park. In 2005, the world's biggest wooden structure Metropol Parasol was built on top of the remains as a result of an urban development renovation project (Figure 3) (Lusiardi, 2017). An underground museum was designed to allow people to visit the archaeological remains. The aim was to change the feeling of being under a building and let visitors feel no limits inside the ruins by creating new spaces inside the existing spaces with transparent materials. A walking path was designed to allow things to be seen when they are approached by a person and allow visitors to have a new walking experience around the ruins. It is mostly made of glass panels with different levels of transparency, permitting an ideal control over the perception of the ruins and the level of visibility. (Figure 4) Suspended hanging walls and lighting elements are used to intervene spatially over the archaeological ruins by creating either new spaces or emphasizing the existing spaces. Communication between the ruins and the visitors was the aim in order to create a varied set of sensations on visitors. Illumination of the space is provided by artificial lighting. Hence flexible lighting elements were used in order to adapt to different strategies; general lighting and focused lighting. (Felipe Palomino Arquitectos, 2012). The new additions to the site provide accessibility and protect the archaeological remains. The transparency ensured by the selected material allows the remains to be visible. Archaeological remains are emphasized with focused artificial lighting and sense of underground is broken with general artificial lighting.

Controlling the change in urban space is defined as one of the purposes of the urban protection in Management Guidelines for World Cultural Heritage sites accepted by ICCROM. In this respect, intervening in contemporary urban centers with contemporary approaches is inevitable for sustainable development (Jokilehto 1998, 48-49). However, a balance must be established between the preservation of integrity in the historical fabric and the fulfilment of the needs of daily life.

Following this principle, the investment for the Metropol Parasol is continued with the vision of finding a balance between conservation and development. The structure was built as a need for contemporary life and in addition to this, the archaeological remains were protected to transfer them to the next generations.

Figure 3. Metropol Parasol in Plaza de la Encarnacion

Figure 4. General view of the underground museum

3.3 Garcimuñoz Castle, Spain, 2013, Izaskun Chinchilla

Garcimuñoz Castle was subjected to the refurbishment process with three main purposes; reinforcement of existing structures, the transformation of the existing spaces for the public visit and introducing new cultural and digital uses that ensure a self-sustained activity. The intervention was aimed to be dismountable and easy to reassemble elsewhere. The number of structural elements was increased in order to reduce their weight. A long period of research was necessary in order to provide new opportunities for this isolated cultural heritage. These researches mainly focused on the compatibility of micro piling with archaeological remains and on bioclimatic techniques that could be implemented in the Castle. Usage of bioclimatic techniques was proposed in order to enable new uses of old spaces without requiring big energy consumption. Open air spaces for cultural and public uses were designed with the reduction on the comfort requirements (Figure 5) (Izaskun Chinchilla, n.d). The design team aimed to revitalize the archaeological site by adding new purpose of use. As a rural site, the castle was allowed to be visited by drawing attention in multiple manners. The intervention is big in scale but with its easy detachability, it provides flexibility and reversibility. With a contemporary vision, the archaeological park is designed accordingly to minimize energy consumption and bioclimatic techniques are introduced for this purpose.

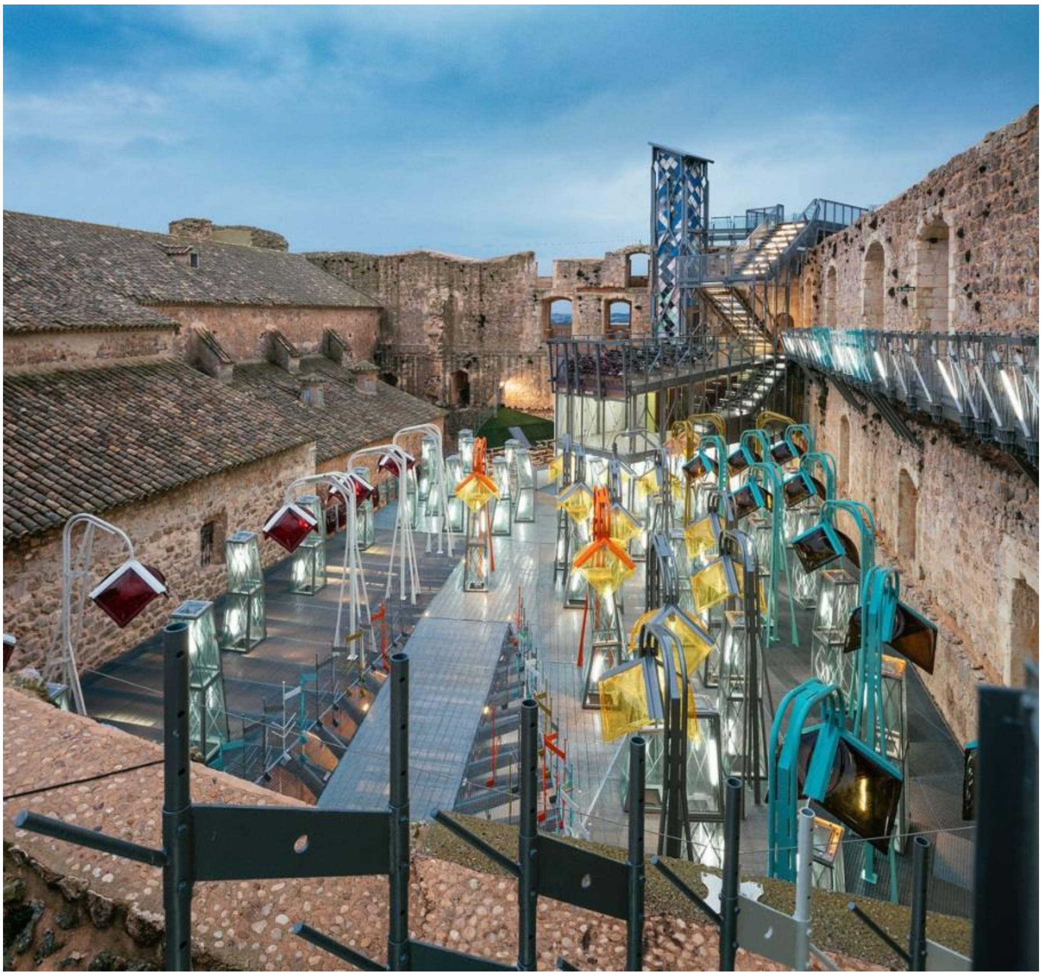

Figure 5. Castillo de Garcimuñoz

3.4 Agora West Stoa Proposal

Reference The West Portico is one of the four porticos that surround Agora of Smyrna. It is understood that the West Stoa which is only visible at the basement level today, was a two-story building during the antique period. Proposal for a project was made in order to increase the visitability of the archaeological remains and draw public attention to the site. The intervention was aimed to be a temporary installation which is easily detachable and reversible.

Designed as a walking path, the installation adopts the description made in Rereadings: Interior Architecture and the Design Principles of Remodelling Existing Buildings and uses movement as a tool to connect separate spaces with each other and provides access to different areas. Throughout the journey on the walking path, visitors are allowed to observe the portico, agora and the mosaic from different angles and heights.

Taking advantage of the buffer zone duty of the portico, new circulation axes were defined to provide multiple access points to the site. A staircase and a ramp were designed in order to allow visitors to different levels of the portico.

A light installation which enables visitors to encolour the arches and a movie screening area was proposed to expand the duration of use of the site and revitalize the archaeological site by adding new purpose of use. (Figure 6) (Figure 7)

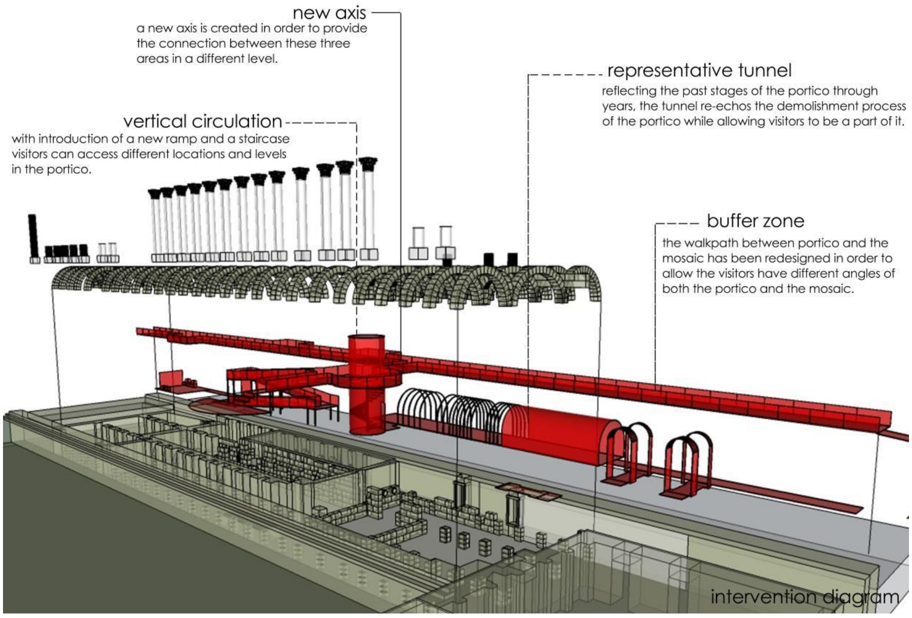

Figure 6. Intervention Diagram

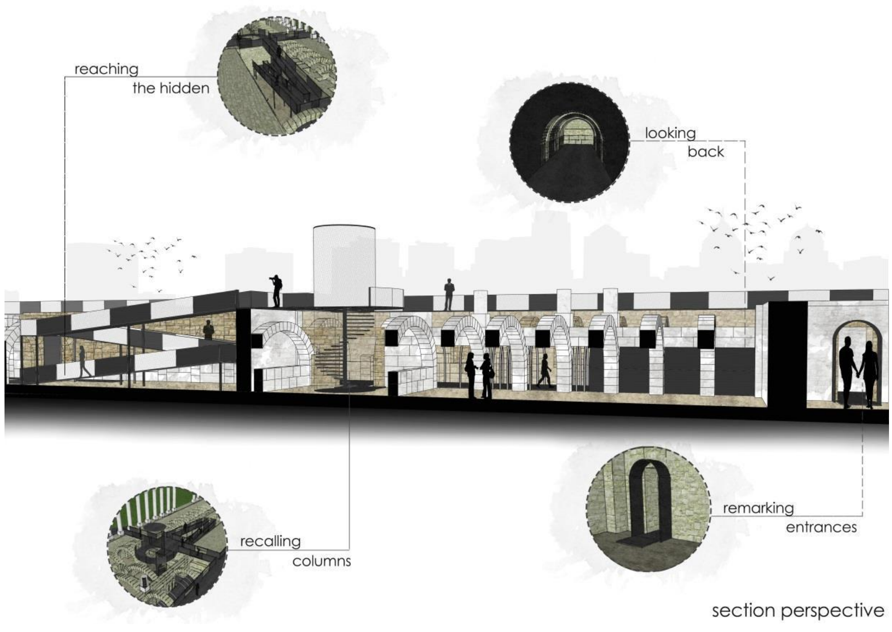

Figure 7. Section Perspective

4 Conclusion

The presentation and interpretation of archaeological heritage sites are as important as their conservation in order to ensure their transmission to the future. Urban designs for heritage sites should follow essential guidelines for the sustainability and protection of the character and identity of the area. Various regulations and charters are prepared to have a common framework in this manner.

Adapting the principle of Amsterdam Congress, the protection of cultural heritage should be targeted in urban planning, a project proposal is developed in order to draw public attention and revitalize the Agora of İzmir. The project proposal enables visitors to have a new experience of the ancient site while informing them about the cultural and historical background.

Acknowledgements

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TOPIC 3: HOLISTIC ENVIRONMENTAL PERCEPTIONS

03.101 - (NEW) NEIGHBORHOOD IN THE LIGHT OF GLOBAL INFLUENCES AND LOCAL DYNAMICS

Guliz OZORHON*, Ilker Fatih OZORHON
Ozyegin University, Faculty of Architecture and Design
Nişantepe District, Orman Street, 34794 Çekmeköy – Istanbul, TURKEY
guliz.ozorhon@ozyegin.edu.tr

Abstract

In 21. Century, new concepts and dynamics have been included to human and city life parallel to technological developments, moreover, some concepts, which have been used from past to present, have been transformed. This article was based on a hypothesis which says that searching for "neighborhood" concept might be a way to plan qualified living environments. Two parallel readings were done for the study. In the first reading, meaning of neighborhood from past to present was searched with neighborhood concept component; in the other reading, properties of current neighborhood were showed with fragments of daily Istanbul life. At the end of the article, some strategies were suggested under diversity, interaction, participation and sustainability headings based on ideas, old neighborhood for new neighborhood.

Keywords

neighborhood, diversity, interaction, participation, sustainability

1 INTRODUCTION: HUMAN, SPACE AND EXPERIENCE

Human – space relation can be defined as multi – directional and multilayered interaction. Space which human changes according to needs, changes human, surrounded by space, with experiences, its energy, meanings human attributed. This relation is constantly re-produced or differentiated with changings in both sides and both positions.

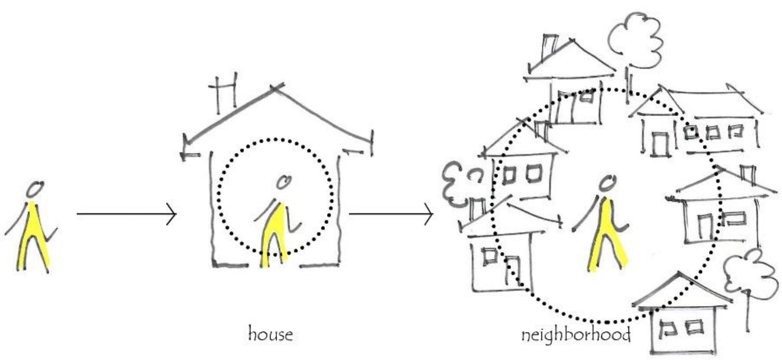

Figure 1. Human, House and Neighborhood

The first and the important ground for human-space relation is founded on housing. People mostly enjoy spatial experience of their houses in which they collected childhood memories, sharing and their friendship and hide themselves in its shelter, and also it plays an important role in the formation of their identity (Ozorhon, 2016). Human's first space perception and experience are formed with the things happening in his/her house. The next step is close environment of the house, neighboring concept. This step consists of many new situations relatively to the first step. Both contacting and facing with society for the first time happen in that place and space variety which human physically contact increases. Human meets with new ways of relationship (friendship, neighboring etc.) associated with expanding environment. These new relationship ways introduce experiencing new spatial formations and meeting with street, park and school. In other words, as human's environment enlarges the number of contacts increases; human renews with every new contact. This first environment experienced after protected and familiar environment (house) in early stages of growing, affects human's growing in many ways and probably consists of personal references created to understand environment and to communicate with environment later on his/her life.

It is probably easier for human to understand the system, to be a part of it and to form his/her own personal private space. Accumulations and stories transferred to individuals from their parents and even transferred to the parents from their parents, are still meaningful and the same language is still spoken; same tools are used and same spatial experiences are shared. Thus, it doesn't seem possible to understand next generation, to know same technology, to have same point of view, and to benefit from past experiences in the same level. Life differentiates with its global and local dynamics. Also, space where human exists continuously changes. All spaces, from room to house and from street to square, differentiate along with that changing. Some spaces belonging to the past lose its functionality, and even disappear. It can be said that, neighborhood which reflects transformation of life and city is a mirror to read cultural and social transformations. In other words, neighborhood is one of the functional – primary concepts to search for the effects changings experienced by city and citizens on space.

1.1 Method of the Study

Knowledge and accumulation connect the whole world with global network thanks to technology: this situation constantly affects life. Changings inevitably affect human and spaces where human lives. The purpose of this article is to search for changings in neighborhood scale within the perspective of human – space interaction and to determine inclusive strategies for new living environments. This searching requires to two parallel researches: the first one focuses on what neighborhood means from past to present and the second one focuses on properties of current neighborhood. For the first track of the research, neighborhood concept is examined, especially what neighborhood means in local (in Turkey), and key concepts which form a neighborhood are presented. According to the fact that Istanbul is the most suitable/richest ground for the studies about neighborhood changings, second track of the study examines current situation of neighborhood, city's main part, with fragments from Istanbul.

At the final stage, current realities, needs, opportunities, rather than past routines, and main properties of new gatherings and new living environment were researched. According to us, it will be more realistic to discuss whether functions and relations of neighborhood are still effective, rather than creating or/and looking for yesterday's neighborhood, and to improve ideas about social, searching of physical housing environment design based on the development and key concepts of this design.

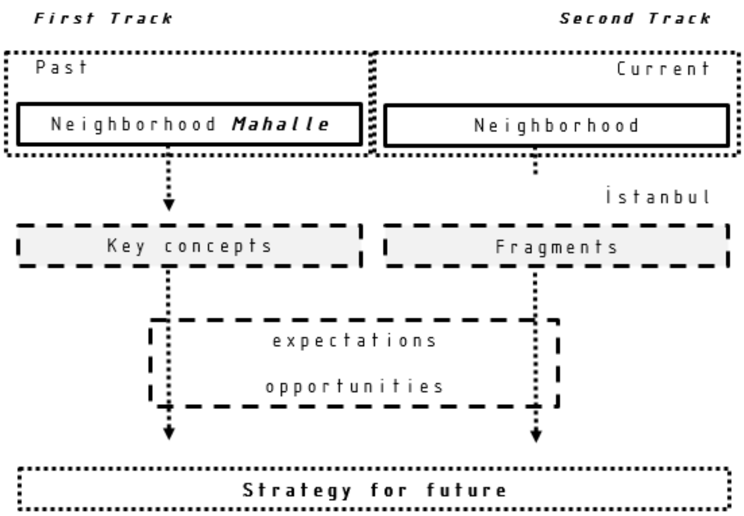

Figure 2. Research Framework

2 Neighborhood in the Past in Turkey

> *"The neighborhood for some of us; a nostalgic concept in memories, the sense of belonging and trust for some of us. A street, perhaps an impasse, where joys and sorrows are shared, eyes and ears are watching each other. The only guest in each house, …" (Hızlan, 2002)*

Keller (1968) described the neighborhood as a place with physical and social boundaries. According to Keles (1998), the neighborhood is one of the smallest parts of a city, a town, a large village which is divided in terms of administration, the smallest parts of the building districts and human communities. It is an area that has spatial boundaries and it is also the entirety of interactions developing around the neighborhood houses and resulting from the informal intimacy within this area (Topcu, 2003). On the other hand, sociologists are interested in because neighborhood has a symbolic meaning and hosts people in the center of it. The neighborhood is the foundation and essence of the city. It is the foundation of urban relations. A neighborhood is an element which stands in the center of life rather than being a place, enables social organization, and defines in itself a life style; it intertwines with concepts such as identity, culture, civilization etc. (Baday, 2011)

It is a social and cultural unit that marks a certain place. The neighborhood does not only establish places; its basis is human, so culture and social relations are the real constituents of the neighborhood. The neighborhood is a combination of layers (Alver, 2018). A healthy socialization process of a person is basically possible by transferring the norms and values of society. Person has relations with someone else in the neighborhood and develops a relationship network around certain values. The neighborhood also builds common values by combining the values of society on a common ground. The neighborhood which enables the formation of society with this function is also important in terms of creating and maintaining this existence. (Karaarslan and Karaarslan, 2013) At the same time living in the neighborhood is being part of belonging, because the neighborhood itself presents an identity and belonging (Alver, 2010).

The most visible symbolic meaning of the neighborhood is that the neighborhood primarily revives the sense of trust in the minds. In other words, the first thing that comes to mind about the neighborhood is the settlements where people live more safely than those in different settlements. In particular, the people living in the same neighborhood recognize one another and predict one another's actions, which provides an environment of trust. This symbolic meaning of the neighborhood, in most concrete sense in terms of trust, does not need the external environment to provide confidence (Baday, 2011).

The neighborhood is dominated by an advanced culture and dialogue. Moreover, this dialogue is not limited to the neighborhood; the dialogue also bounces to other neighborhoods and the neighborhood can be understood in the form of a dynamic / living part of a large network circulating in the city. This unity also allows the living of the inhabitants to develop a strong relationship of belonging with the neighborhood and the city (Ozorhon and Ozorhon, 2017).

The term signifies intimate space and extended family and is a space of collective identity, a 'we' particular to Turkish culture (Mills, 2007; Tanrıover, 2002). In Turkey, the traditional urban neighborhood is a space which extends the interior space of the family to the residential street; it is a space of belonging and collectivity. The most important practice for creating and sustaining the familiar spaces of neighborhood life is neighboring which makes home spaces open to neighbors (Mills, 2007). Another fact that comes to mind when it comes to neighborhood is solidarity. Especially in the past, the public and some private works were carried out with the collective method. Solidarity, which is shaped by the culture and historical background of the community living in the neighborhood and which gives a symbolic meaning to the neighborhood, is mainly based on trusting and knowing one another. This feeling, which evokes the solidarity and unity of the neighborhood, has created a common identity. The fact that people living in the same neighborhood are able to represent one another and to be remembered according to the structure of the neighborhood in which they live is the manifestation of the common identity. (Baday, 2011).

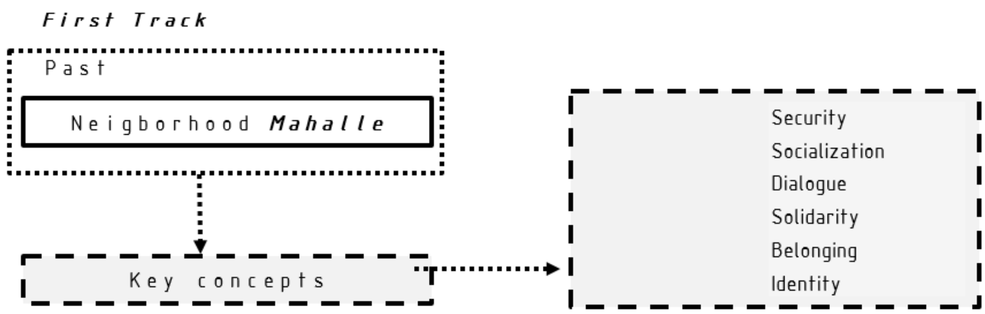

Figure 3. Key Concepts of Neighborhood

Main elements that enable the neighborhood to be what they are (key concepts): it provides sense of protection and safe living areas to people, opportunities for socialization and dialogue, identity, feeling of belonging, unity and cooperation.

3 Mutation / Metamorphosis

"Istanbul is metropolis of single family houses, closed neighborhoods, skyscraper condominiums, real and pseudo Bosphorus mansions; on the other hand, it is also metropolis of new apartments called suburbs, cannot be called slum, old housings in historical neighborhoods shaped peninsula which are getting "slum". Istanbul shelters to wide variety than it did before." (Tanyeli, 2004)

Neighborhood has been a special and important unit from past to current. It is the first step for socialization; the smallest administrative unit of the city. Thus, neighborhood can be defined as core and seed of city. Neighborhood is essential for spatial and social/humanistic structure of city (Alver, 2010). However, it is obvious that current 'neighborhood' is not the same with past 'neighborhood'. In this section of the study, metamorphosis of neighborhood is examined through Istanbul. Neighborhood has experienced some metamorphosis from past to current, as well as human and cities have. Neighborhood is close witness of all metamorphosis in social plan (Alver, 2018). In this context, life in neighborhood, metamorphosis of urban space, breakthroughs, reaction to these occasions are orientation ways of human (Arıkan, 2013).

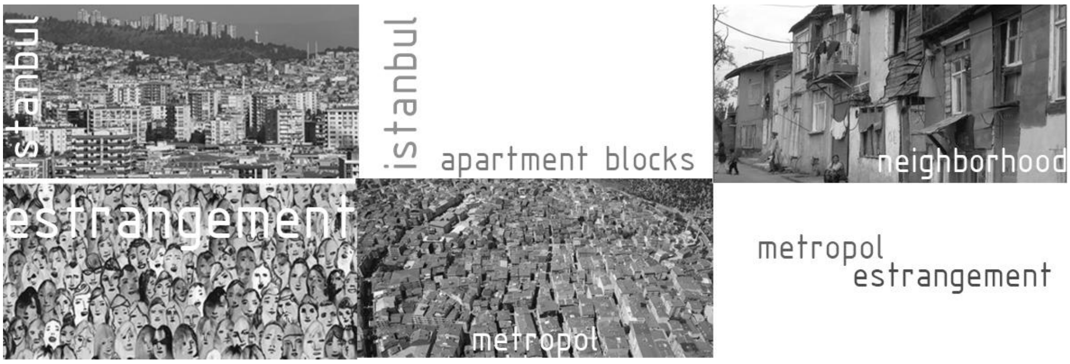

Figure 4. Collage of collapse

Neighborhood has its share of metamorphosis inevitably over time. Moreover, history of neighborhood metamorphosis that connects society with invisible web is not that new. Tanpinar stated in his book, Bes Sehir dating back end of 40's,; "Today, there is no neighborhood; there are only poor neighborhood spread around city. Today's neighborhood is not society living connected to one another; it only exists as an element of municipal organization. Anyway, neighborhood has been replaced with apartments where residents aren't aware of one another, indifferent to their deaths or lives, different melodies from radios can be heard through windows like Babel." Tanpınar criticized metamorphosis in urban structure and emphasized that apartments are wearing down neighboring relations and technology making people lonely day by day.

According to many researchers and writers, there is no neighborhood in current Istanbul; it has already dead. Behar (2003) claimed that, as Usakligil quoted, citizens in Istanbul are the most responsible for this situation. According to him, modernization idea and the idea that modernization can be established via apartments, the desire of getting rid of the old, and loyalty to the new that can almost be called religious trigger this and similar negative situations. Criticisms to industry cities and modernization process are based on increasing level of individuality and alienation in cities getting crowded and becoming metropolis, and vanishing social unity and cooperation (Altun, 2010).

Still, there are some examples which manage to survive as neighborhood. One of the examples is Kuzguncuk, settlement area around Bosporus. Although Kuzguncuk is located in the center of metropolis city, it managed to survive with its low buildings and unique properties thanks to its authenticity and its proclamation as protected area. Values Kuzguncuk have are not limited with its streets and houses. Bektas (2011) described Kuzguncuk as “Real Kuzguncuk is not structures, walls, windows, or doors. Real Kuzguncuk is a different Kuzguncuk. Kuzguncuk is a village of Bosporus, lying in the middle of the Istanbul; presents the most important knowledge of our current time. Kuzguncuk is a different settlement area with “society life” of Istanbul where the sense of fellow citizen is vanishing, environment and relations are getting similar to nomads”. Kuzguncuk is a settlement which vigorously supports diversity, solidarity, identity, and belonging concepts. On the other hand, it is hard to even add the second place next to Kuzguncuk example. Another strong element which empties the meaning of neighborhood in Istanbul is migration. The population of Istanbul is incrementally increasing after 1950’s migration. New neighborhood units have emerged in Istanbul whose process of growth is accelerating with new migrations. These neighborhoods are defined through administration rather than human relations (Usaklıgil, 2014).

Figure 5. Neighborhood – Gated Communities ?

According to some researchers, neighborhood continues to exist by transforming, differentiating, transferring some of its functions which neighborhood had in the past. According to this point of view, “safe” traditional neighborhood is being replaced by “guarded” building complexes. As Altun (2010) stated council estates, apartments, housing estates and closed building complexes have emerged as alternative to neighborhood around economic structure and social relations changing on global scale in modern city. Those which form new living environments in the city are tall buildings in city center and closed housing complexes in periphery.

Some neighborhoods become undeveloped areas and transform into unsafe place where citizens hesitate to go. Citizens become suspicious and insensitive; they discriminate one another because of urban discrimination and fear of crime accompanying to transformation of neighborhood (Sipahi, 2016). Human relations get weaker: for example, a school no longer belongs to neighborhood, which means arrangements on urban services become non-effective. This situation makes neighborhood concept negotiable (Firidin Ozgur, 2006).

Migration and rent areas grew towards periphery areas; thus, new living areas have emerged which enlarge the city continually. Problematic and abandoned lux residences have emerged in the city center. All actors in construction sector started to reconsider problematic areas of the city in social mobilization and under the name of urban transformation, which was specific to Istanbul, with pressure of Marmara earthquake in 1999. We can clearly see that many activities proceeded under the name of urban transformation cannot be solution to problems of the city. Projects started to construct enduring buildings with high living standard are criticized because people living in those areas are not included into the process.

4 Searching (new) Neighborhood

Whatever it is called (neighborhood, building complex etc.), it is the exact areas where people live and which change with people. The determinants of the place are divided into two main parts: needs (expectations), realities (restrictions). Expectations and restrictions can be considered in sub-headings related to both global effects and local dynamics. Dynamics that form past neighborhood are listed as: socialization, socializing, identity – belonging, safety, and solidarity. It seems impossible to generate past neighborhood in current cities and in Istanbul in despite of positive properties presented by this study. It is impossible to generate neighborhood, which forms by itself and through human relations, in current building complexes. For example, feeling of safety cannot exist in housing complexes in spite of technological infrastructure, security camera and security guards. Moreover, socialization and dialogue in neighborhood cannot be seen in current building complexes in spite of luxury, leisure centers and sports centers. Is it possible to revive values existed in the past and even develop them according to current living dynamics? Is it functional to match expectations and restrictions with values existed in past neighborhood to plan new living environments? This study defends that guide concepts can be found through concepts existed in past neighborhood life.

Some strategies are suggested under sub-headings, variation, interaction, participation and sustainability, based on past neighborhood for new neighborhood idea:

- **Diversity**

Variation in housing environment undoubted consists of more than physical structures and their composition. It is like to be united and to be fed from differences coming with coexisting; being a part of a whole without losing individuality. City concept is a place which many different cultures and social classes come across. Living in a city is to meet with not only similar people but also different ones, to communicate, to live together, and to respect their individuality. Thus, variation should be adopted as planning approach and designing strategy in forming living environments. Variation should be spatial in city and especially around housings environments within the perspective of holistic understanding welcoming different colors.

- **Interaction**

The most main properties which doesn't exist in past neighborhood is interaction even parks, leisure centers, sales unit, sports centers and security cameras seem to meet functions in living environments. The interaction emphasizes relations between human and neighboring relations, human and space relation which is two-sided, and settlement and city. Past neighborhood is a branch of the city. Streets of neighborhood are streets of the city. It is not possible to say the same words for housing complexes which are advertised as current modern neighborhood. Surrounded by thick walls, these settlements are enclosed and isolated from the city. Problems resulted from this situation were examined by many disciplines such as architects, sociologist, psychologist; it was observed that this attitude caused city to be divided into non-combined small pieces. Thus, involving interaction, multi-layered element in planning of living areas, into the process maintains socialization and feeling of belonging in neighborhood and city scale.

- **Participation**

Participation is one of the main necessities for living environments. Planning living environments in cities like Istanbul is formed in two ways. The first one is considering opinions and expectations of users in planning of living environments. The second one is involving all residents into restoration process. In both situations, planning the process to activate all shareholders (possible users, non-governmental organizations, local administration…) is necessary for identity and feeling of belonging. Within this point of view, Aravena's approach and designing ideas can be considered as pioneer. Quinta Monroy Housing Projects, planed with Elemantel group, founded by Aravena, became a sample project. The idea of sharing designs of the group over website with the whole world expanded the idea of participation and increased its strength.

- **Sustainability**

Designs contradictory to human nature, unnecessary space usage, sense of possessing something which isn't owned by anyone for prestige, ignored functions of spaces are indicator for consumption in architecture. Consuming supplies irresponsibly always stands against sustainability. Leaving livable environments for the future generations should be one of the most important strategies in designing new living environment. This required interiorized feeling of belonging. Human only becomes responsible when she/he feels the sense of belonging and believes her/his child or grandchild is a part of the area. This feeling will be a key for consciousness of environment – sources and sustainable living philosophy by itself.

5 Results

As it was said in the first part of the article, the basic properties which define neighborhood cannot have one spatial equivalent nowadays. Moreover, it seems debatable how past neighborhood can be functional today in terms of changing citizens and their needs. Nevertheless, it will always need for healthy and qualified housing environments with many functions for all cities. Basically, changing is observed in housing and the environment, even it is called as neighborhood, new neighborhood, building complex, housing estate or council estate. The population increase continues and the majority of the population is living in the cities or will live in big cities; innovative, alternative, inclusive solutions to the housing environment respond to the changes. To this end, it is necessary to create sustainable living environment design strategies that enable variation, present interaction opportunities and prepare for participation.

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03.102 - MAPPING APPROACHES IN SUSTAINABLE ARCHITECTURE: FROM ECO-CENTRIC TO ECO-TECHNIC

Elizabeth DONOVAN

Aarhus School of Architecture
Norreport 20, 8000, Aarhus C, Denmark; ed@aarchdk

Abstract

Sustainable architecture has developed rapidly since the environmental movements in the 1960s which has led to the current plethora of approaches. It is evident that there is an ongoing transformation within the field as new approaches emerge in response to social, environmental and technological developments. Approaches are often organized by scales based on the technological and philosophical underpinnings and it is this topic which will be the focus of this paper – mapping the commonalities and differences within a series of approaches to sustainable architecture, illuminating the complexity faced within the field. Within literature, there is an obvious captivation with the development of different approaches, however, what is often missing is what we can learn from this progression and how this diversity of approaches has affected how we practice sustainable architecture today. As Bergman [1] offers: "When we change how we ask the questions, the possibility of arriving at other answers emerges." By dissecting and framing the plurality of approaches – changing how we so to speak 'frame the question' - one can begin to imagine a more holistic sustainable architecture.

Keywords

Approaches to sustainable architecture, concepts of sustainable architecture, scales of sustainable architecture, sustainable architecture practice.

1 INTRODUCTION

The world is faced with a growing diversity of complex challenges, such as climate change, resource depletion and environmental degradation to only name a few. Architecture is in a unique position; it has the possibility to respond to and address some if not all of these challenges. New approaches to (sustainable) architecture have emerged in response to many of these challenges creating a plethora of ways to practice sustainable architecture. Subsequently, each of these diverse approaches has different focuses, different methods of practice as well as different typologies of architecture as the outcome. However, despite the variances between the approaches, there are also many commonalities, and it is these commonalities combined with differences which are of interest for this paper.

The overwhelming multiplicity within the field often leads to confusion over what sustainable architecture actually is. Within literature, there are still many debates concerning if sustainable architecture is a design approach, philosophy, movement, process or object. Furthermore, there are further debates regarding the achievability of sustainable architecture, especially since the rapid growth of certifications systems. In some cases, an additive approach (often referred to as greenwashing) or techno-centric perspective has been exacerbated by the introduction of certifications such as LEED and BREEAM in the 1990s and 2000s. Certifications presented sustainability or sustainable architecture as a 'tick-box' of strategies which if incorporated labelled the building as sustainable and something which could be achieved. In opposition to this, other authors argue that sustainable architecture is not something which can be achieved, rather it is an approach or process. For example, Williams et al. [2] argue that: "As architects and planners, we are taught to work on a project until it is done, then move on to the next one. But design, like sustainability, is a dynamic and living process. Sustainability is not a point that when reached, all is fine. Sustainability is better thought of as a continuum, as a calculus." Similarly, Guy and Farmer [3], quoting Susan Maxman, suggest that sustainable architecture is an approach or attitude, and should just be architecture [3]. There are many other perspectives on what sustainable architecture is, such as, a movement or philosophy. However, these vary compared with the above debate as they are not often discussed, but rather are just stated as nouns proceeding sustainable adjectives in the introduction to an article or book. While it is unclear precisely what effect this diverse uncertainty has on the field, it is evident that - even to a specialist in the field - this information is incredibly complicated and overwhelming. For these reasons, this paper studies a very small part of the field, attempting to map and categories multiple movements and approaches in an endeavour to add a small amount of clarity to the field.

To initiate this paper, the background and an overview of a plurality of approaches, logics and scales are introduced to provide the initial framework, following this, the development of the methodology is shortly explained elaborating on the different types of information categorised and the method employed. In section 4, the different approaches are discussed mapping the commonalities and differences and to conclude selected findings from both the information and method and outlined reiterating the plurality of approaches and the importance of a more holistic sustainable architecture.

2 A plurality of approaches to sustainable architecture

There is an inherent desire within the field's literature to categorise and order the different sustainable architecture approaches. This is often through opposing scales or the popular 'Six Competing Logics of Sustainable Architecture' by Simon Guy and Graham Farmer [4] which developed the understanding that there is a plurality of approaches. These six logics include *Eco-technic, Eco-centric, Eco-aesthetic, Eco-cultural, Eco-medical,* and *Eco-social*. The diversity of these logics was also transformative at the time of publication, as it emphasised the holistic nature of the field outside of the predominant environmental and technical debate. Guy and Farmer [4] describe different approaches which exist, depending on the technological and philosophical underpinnings [4] and, additionally, Altomonte [5], drawing on Guy and Moore, attributes the plurality of approaches to the complexity of the problem. To elaborate Guy and Farmer [3] refer to the work of Hajer [7] who reasons that logics are understood as an assembly of ideas, concepts and categorisations which are produced, reproduced and transformed through the design process giving meaning to our realities. Moreover, 'through the design process of any particular development, logics may collide, merge, or co-inhabit debate about form, design, and specification' [3]. The understanding that logics are not necessarily stand-alone categories is important; however, each of the logics will be shortly described to frame the later discussions.

The first logic – *eco-technic* - is a techno-centric approach to the built environment and environmental concerns. Within this logic, technological solutions are considered the solution to environmental issues through rational analysis and management. According to this logic, the development of technology is used to create energy-efficient architecture and high-performance buildings are examples of this approach [3]. The second logic - *eco-centric* - understands humans within a broader holistic eco-system, and rather focuses on nature as a priority and fragile entity. Within this logic, the built environment is considered against nature and it promotes a more natural approach through the reduction of ecological footprints, natural materials or the integration into nature itself [3]. *Eco-aesthetics* is the third logic, it understands sustainable architecture as metaphorical, expressing societal values through iconic forms and identifying with nature or the non-human world. Eco-aesthetics architecture may be associated with organicism, expressionism, the chaotic or the non-linear. Promoting a shift from the utilitarian to aesthetic and sensual values. The phrase: 'we sustain what we love' encapsulates this logics approach to solve environmental problems [3]. The fourth logic – *eco-cultural* – is grounded in the concept of context, both locality and place. It discourages universalism in favour of the promotion of a diversity of cultures. Eco-cultural architecture requires a different set of requirements based on where a building is situated, emphasising the uniqueness of place as well as local materials and climatic conditions. Additionally, historical, traditional and existing construction techniques, building typologies and settlement patterns are a key concern for this logic [3]. *Eco-medical* is the fifth logic which considers healthy systems connecting the built environment with nature. Within this logic, humans physical and psychological health and well-being are of main concern. Eco-medical architecture creates sustainable buildings which support healthy lifestyles through the use of tactile materials, traditional building methods, organic finishes, as well as natural light and ventilation. Often eco-medical approaches address issues such as sick building syndrome, volatile organic compounds (VOC), toxic materials and indoor environmental quality (IEQ) [3]. *Eco-social* is the last logic, it shifts beyond the individual and suggests the ecological crisis stems from broader social factors while also encompassing a political discourse. Social equality, freedom, democracy are all thrived for through the participation of people. Eco-social approaches use renewable, natural, recycled and local materials to create appropriate, flexible and participatory buildings which serve the needs of the occupants without negatively impacting the environment. The formation of these six competing logics illustrate a comprehensive understanding of sustainable architecture and as Guy and Framer [3] write, "these logics are not meant to be in any way exclusive, or frozen in time or space." This framework is unique, as it celebrates all of the approaches within each logic their strengths and focus, unlike most scales or categorisations often aim to place one approach above another concerning 'greenness' or to be more sustainable than another.

To elaborate, from these other perspectives, scales or spectrums are often used to classify different approaches to sustainable architecture; the most common being from "light to deep green" [8]. This is referring to shallow (light green) approaches at one end and in-depth and integrated (deep green) approaches at the other or as Farmer and Guy [9] phrase it "eco-centric" versus "techno-centric." Additional scales are organised by use of technology and range from "low-tech" to "high-tech." Another scale – the Regenerative Design Framework - produced and popularised by Bill Reed [10] and the Regenesis Institute. Reed [10] articulates that the scale transitions from "issue-based approaches" to "living system approaches" with conventional practice at the bottom, followed by green, with sustainable 'neutrally' in the middle and above they place restorative, followed by regenerative at the very top. As a side note, within this scale, I would position greenwashing approaches somewhere between conventional and green practices [19]. Interestingly, this scale positions broader approaches against each, organised by their influence on the living systems rather the relation to nature or technology. Often these scales are used to suggest if an approach is more sustainable than another and in support of this, Gram-Hanssen and Jensen [11] contend that despite having a constructivist view, it is possible to objectively regard if one building is more successful than another in addressing environmental challenges. While Guy [12], referencing Williamson et al. [13], further recognised that there is "no class or style of design which is unequivocally sustainable architecture and no fixed set of rules which will guarantee success if followed." It is this last opinion which frames the mapping in this paper; understanding the different 'sets of rule' which contribute to each approach.

3 Developing a methodology

To develop a method to analyse and categorise the different main approaches, Knudstrup et al.'s [14], method of mapping was used as inspiration for this project. Knudstrup et al. [14], support Guy, Farmer and Moore's position on the plurality of approaches which was a crucial factor in developing an appropriate method. They credit the plurality of approaches to the broadness of the definition; to sustainability's umbrella-like nature. Quoting William et al. [13], Knudstrup et al. [14] outline that all approaches have one of two concerns: either that "the design of buildings should fundamentally take account of their relationship with and the impact on the natural environment"; or the approach is "concerned with the concept of reducing reliance on fossil fuels to operate a building". In other words, either an eco-centric or techno-centric approach as discussed earlier. Knudstrup et al. [14], expands on this diversity by illustrating the different dominating concerns - nature, climate, culture, technology - and design principles associated with each approach (in a Danish context). Knudstrup et al.'s [14] analysis of different approaches focus mainly on those which proceed the Brundtland report, and examines the approaches broadly, including categories such as self-sufficient, ecological, green, sustainable, bioclimatic, environmental, low-energy and solar. I found that both the approaches and dominating concerns only represented some of the possible categories, therefore, a similar methodology was developed for my own mapping of different approaches (from the 60s onwards) as they appeared in the various literature.

3.1 Logics, concerns, approaches and strategies

Four columns of information were created (see figure 2) which included from left to right (abstract to specific), the six competing logics, dominating concerns, approaches, and strategies or principles. These categories were developed [19] as different information was collected and additionally, as new categories emerged they were added to the lists. The six competing logics were chosen as an abstract framework as it does not aim to highlight one approach as more sustainable than another, which was key as this method only attempts to illustrate the similarities and differences between approaches. Following this, ten dominating concerns are listed which include: the natural environment, climate, culture, technology, social, political, economic, tectonics/aesthetics, well-being/health, ethics. At the centre of the map is the list of 27 approaches sorted into 7 broader categories which include: Self-sustaining (autonomous building, earthships, bioshelters), low energy (zero/low energy building, energy plus/active house, passive house, solar architecture), ecological (arcology, biophilic, ecological design, bioclimatic), regionalism (organic architecture, critical regionalism, tropical architecture, contemporary vernacular), systems/reuse/loops (cybernetics, cradle to cradle, adaptive reuse, regenerative architecture, resilient architecture), modern technology (biomemtics/biomorphic, eco-tech, organi-tech, high-tech green) and social (co-housing, communal living, experimental living). Lastly, and most specifically, 54 design principle or strategies are sorted into 11 categories including materials, thermal, footprint, ventilation, energy, water, greenery, water, well-being, future, urban).

3.2 Mapping

Information was collected for each of the approaches and then a line drawn between the approach and its dominating concerns to the left and strategies or principles on the right. Following, these lines have linked the concerns and the six logics. This exercise involved a degree of my interpretation, as it was my understanding from the literature and information which formed the different connections. This was primarily the case when connecting each approach to the different logics. In addition to this, as part of a workshop for the teaching program – sustainability at Aarhus School of Architecture, I asked 100 students to repeat this same exercise in groups of four. One group was given one of the seven broader categories of approaches to map, and these formed three complete maps as visible in Figure 1. This exercise had many pedagogical interests but was also completed to ensure my own mapping had similar conclusions and connections, which was often the case.

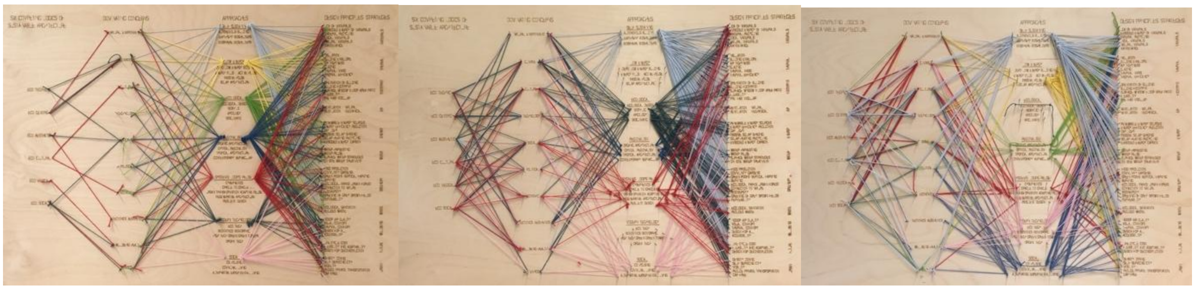

Figure 14. Three versions of student mapping of the different approaches to sustainable architecture

4 Approaches to sustainable architecture

The approaches mapped in this project specifically focus on the period after the environmental movements of the 1960s. While many of these approaches have developed from earlier periods, knowledge or technology, it is the later period which has been utilised within this method. Due to the spatial constraints of this paper, the individual approaches will be discussed within their broader categories rather than individually.

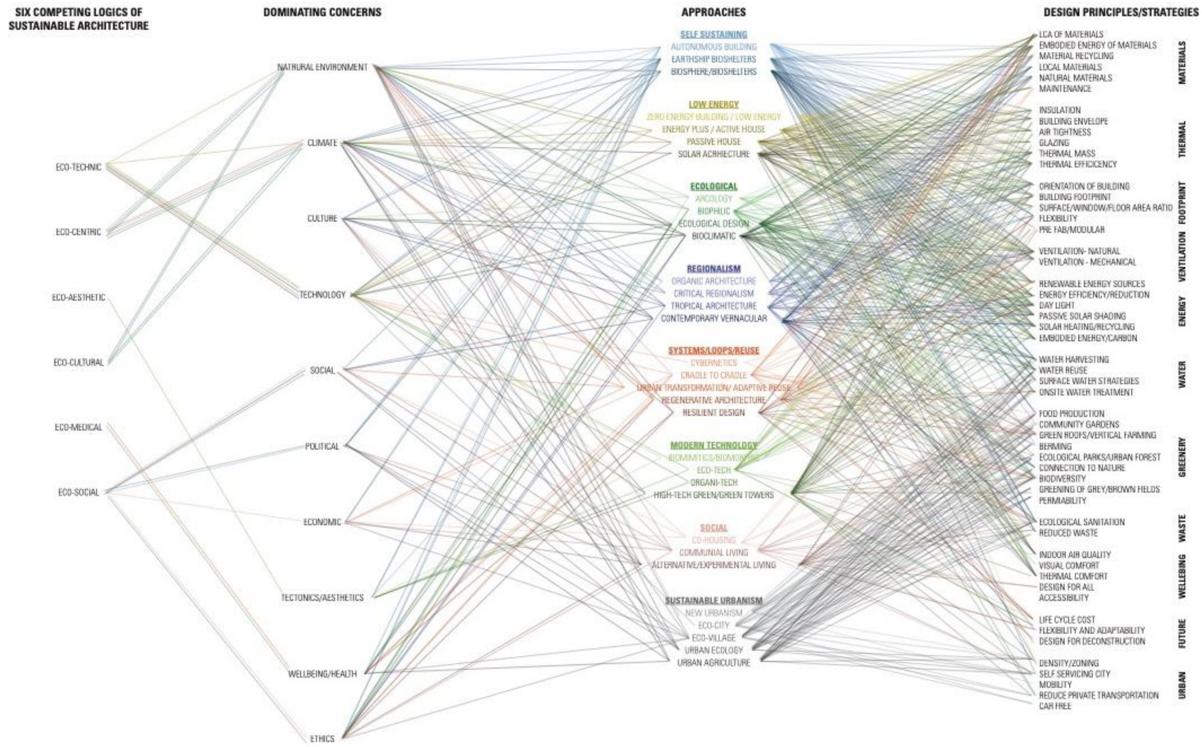

Figure 2. Mapping of the different approaches to sustainable architecture

4.1 Self-sustaining approaches

Within this *self-sustaining* category, there are three approaches - *autonomous building, earthships and bioshelters*. Autonomous or what is sometimes called off-grid architecture can be explained as buildings that operate independently from infrastructural support services such as the power or gas grid, water supply, sewage treatment, stormwater management, and communication services [15]. These approaches built on ideas developed within solar architecture and two different methods are often used to exemplify this approach – the experimental (earthships and bioshelters) and more conventional (autonomous) [19]. From the mapping, the self-sustaining approaches were considered mainly eco-technic and eco-social while also but less directly eco-centric and eco-cultural. Over the entire category, all of the concern were dominating but with slight variations for each approach, for example, autonomous and bioshelters were less concerned with social and ethical concerns. The main strategies mapped related to the desire to be off-grid, some of these include; energy production and efficiency; water harvesting and reuse; onsite waste handling; natural ventilation and daylight as well as a variety material strategies [19]. This approach is one of the more holistic approaches due to the nature of the goal to be self-sustaining.

4.2 Low-energy approaches

Four approaches make up the *low-energy* category: *zero/low energy building, energy plus/active house, passive house and solar architecture*. As the name signifies, these approaches are all concerned with the reduction of energy. This corresponds with eco-technic logic which was mapped for these approaches. The dominating concerns associated with this category are (in list order) the natural environment, climate and technology [19]. Subsequently, the strategies and principles are more specific and are concentrated within the themes of energy, thermal, materials (LCA, embodied energy, recycling and maintenance), ventilation, footprint (orientation, footprint and window to floor ratio) and well-being (indoor air quality and thermal comfort). All of the strategies are both passive and active but revolve around the core concern to reduce the reliance on energy and especially fossil fuels [19].

4.3 Ecological approaches

Ecological approaches have transformed from the early sixties; and in more recent years Sim van Der Ryn and Stuart Cowen [16] developed what they titled the "second generation of ecological design" which they explain as: "Any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" [16]. There are four approaches within the category of ecological which include: *arcology, biophilic, ecological design* and *bioclimatic*. The dominating concerns for these approaches focus more on the natural environment and ecological systems, as evident in the name. Included in the map is (in list order): the natural environment, climate, culture, technology, health and well-being, as well as ethics. It is evident from this that eco-centric and eco-cultural are main associated logics with eco-technic and eco-medical in a lesser capacity [19]. Strategies are spread out over the majority of the themes especially the passive strategies within them, this includes: energy (passive and active) materials (LCA, embodied energy, local and natural), thermal (insulation, envelope, mass and efficiency), footprint and orientation, ventilation (natural and mechanical), water (harvesting and reuse), greenery (roof, vertical, biodiversity, connection to nature) and well-being (indoor air quality, thermal and visual comfort).

4.4 Regionalism approaches

Regional approaches developed earlier in response to modernism; however, they are still very present in contemporary sustainable architecture approaches. Four approach - *organic architecture, critical regionalism, tropical architecture* and *contemporary vernacular* – are sorted within the broader theme of regionalism. Eco-cultural is the main logic with an eco-centric second. This is due to the contextual and cultural nature of these approaches [19]. This is also reflected in the dominating concerns which are (in list order): the natural environment, climate, culture, social, tectonics/aesthetics and ethics. Strategies associated with these approaches are often concerned with passive, low-tech, traditional or vernacular principles. For example, thermal (mass and efficiency), footprint (orientation, footprint and flexibility), natural ventilation, energy (daylight; embodied energy and efficiency; passive solar shading and heating), greenery (roofs, vertical, berming, connection to nature and biodiversity), waste (ecological sanitation and reduced waste) and future (life cycle cost, flexibility, adaptability and design for deconstruction).

4.5 System/ruse/loop approaches

Five approaches which are all associated with circle or systems thinking are within this category; these include *cybernetics, cradle to cradle, adaptive reuse, regenerative architecture* and *resilient architecture*. These approaches are often more recently developed, complex and elusive in concise information. This lack of published information made the mapping more difficult than other approaches. The dominating concerns are, natural environment, climate, technology, social, economic, health and well-being as well as ethics. The associated logics for this category are less clear with eco-technic, eco-centric and eco-medical all prevalent. The main principles are those which directly deal with circular thinking or have to potential to be adapted towards it [19]. For example, materials and ecological are dominating themes. To elaborate, materials (LCA, embodied, materials, natural and maintenance), footprint and flexibility, natural ventilation, energy (renewable and daylight), onsite water treatment, greenery (food production, community gardens, roofs, vertical, parks and biodiversity) and future (life-cycle cost and design for deconstruction). While all of the approaches deal with the theme of circular thinking, they subsequently focus on different topics within this which results in a different mapping for the theme as a whole [19].

4.6 Modern technology approaches

The category - modern technology contains four current approaches – biomimetics, eco-tech, organi-tech and high-tech green or green towers. From the name of this category, it is evident that there is a focus on technology in a modern manner and this is reflected in both the dominating concerns (climate, technology and tectonics/aesthetics) and logics – eco-technic and eco-aesthetics [19]. These logics are supported by the principles and strategies employed which are technologically focused, including materials (LCA and embodied energy), thermal (insulation, envelope, airtightness, glazing, thermal mass and efficiency), footprint (orientation, footprint, window to floor ratio, pre-fab and modular), mechanical ventilation, energy (both passive and active), water (harvesting and reuse), greenery (roofs, vertical, ecological parks, biodiversity and greening of brown/grey fields) and urban (density, self-servicing and reduced private transportation). The technological concern and also the iconic nature of eco-aesthetics are equally crucial for these approaches as they developed at the beginning of the 21st century when there was a desire to show the sustainability of a project visually. Within this approach, there is a belief that ecological disasters can be "avoided" through the use of technology. However, in some cases, this may have resulted in mere greenwashing rather than successful sustainable buildings. Inaki Abalo [17] describes this approach as an architecture of "good intentions." As he explains, this becomes an image of sustainability which concentrates on the development of technical solutions applied to badly conceived buildings [18]. At the time Abalo voiced this concern, in the early 2000s, the application of technology in some sectors was rife escalating greenwashing in the industry [19]. In saying this, there are also many successful projects which should be acknowledged.

4.7 Social approaches

Three similar approaches are within the social category – co-housing, communal living and alternative or experimental living. One of the first cohousing communities is Sættedammen which was built in 1972 for twenty-seven families close to Copenhagen in Denmark. This concept influenced many other alternative social living arrangements which are still growing in popularity today and can be seen in most European countries; both conventionally integrated into communities or isolated rurally in small experimental ‘eco-villages’ [19]. From the category, it is evident that eco-social is the main logic. This is supported by the dominating concerns which include: the natural environment, culture, social, political, economic and ethics. Strategies related to these approaches are associated with the social aspects (flexibility, adaptability, design for all, pre-fab and reduced waste) related to buildings as well as on-site principles (water reuse, surface water, onsite water treatment, food production, community gardens, biodiversity and ecological sanitation). Another critical factor for this logic is the method of design such as participatory processes; however, these are not included within this mapping.

To summarise based on the information collected and mapped for the 27 approaches, it is clear that many of the different approaches overlapped with multiple logics. Only two of the broader categories (low-energy and social) had one singular logic associated with it. Furthermore, eco-technic was the most common logic (self-sustaining, low-energy, systems/reuse/loops and modern technology) with eco-centric (ecological, systems/reuse/loops, regionalism and self-sustaining) followed by eco-social (social and self-sustaining), eco-cultural (self-sustaining and ecological) and eco-medical (ecological and systems/reuse/loops). Lastly, only one category was considered eco-aesthetic – modern technology. Additionally, the main dominating concerns for all approaches were the natural environment, climate and technology followed by culture, well-being, social and ethics. More specifically, the most common strategies or principles were within the themes of materials, thermal, ventilation, energy and footprint; followed by water and greenery. From this, it is evident that there are some common factors which transverse all of the different approaches when viewing from a broader perspective, compared to the diversity when analysing the information in more detail and focusing on a specific approach. Moreover, and expectedly, there is a direct connection between the dominating concerns, logics and strategies both at a detailed and general level. This finding is crucial for understanding and dissecting sustainable architecture design practices while also positioning one's self within the field.

5 Conclusion

The confusion, ambiguity and misunderstanding concerning sustainable architecture and its approaches were articulated to initiate this paper, framing why the need for clarification is so crucial. Following this, section two discusses a variety of literature, providing an overview and background to the framework used – the 'six competing logics of sustainable architecture,' which was additionally supported by short descriptions of each of the six logics. This was then contrasted with three opposing scalar frameworks – eco-centric to techno-centric, low-tech to high-tech and the regenerative design framework. The development of the methodology proceeded in section three and outlined how it developed, building on previous research methods; the selection of categories, themes and approaches; and the process of mapping. Lastly, the main body of information was provided (divided into seven categories) through both illustrations of mappings and postulated explanations, focusing on each categories associated logics, dominating concerns and strategies as well as a summary of the information as a whole.

It is evident that, despite there being many approaches and perspectives, there seems to be a consensus that there is a definite shift towards integrating sustainable architecture. As previously mentioned, celebrating the plurality of sustainable architecture debates and approaches has become an accepted position. This position was made popular by publications from Guy and Framer [4] who articulated: "Rather than argue that we need revolution or reformation, more or less technology, more pious behaviour, to embrace or abandon the city, or to develop clearer definition or standardisation, we want to explore, even celebrate, the diversity of contemporary debate about sustainable architecture." What is now important, is understanding how we can better use a holistic approach and celebrate the diversity of logics to integrate with the design process to create a complex and ethically (for both human and non-human) response architecture. Maybe, as Bergman [1] offers: “When we change how we ask the questions, the possibility of arriving at other answers emerges.” By dissecting and framing the plurality of approaches, one can begin to imagine a more holistic sustainable architecture.

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03.103 - WHAT CAN WE LEARN FROM SUSTAINABLE NORDIC ARCHITECTURE? (3 EXEMPLARY CASE STUDIES)

Sofie PELSMAKERS*, Urszula KOZMINSKA, Elizabeth DONOVAN

Aarhus School of Architecture
8000, Aarhus C, Denmark; sp@aarch.dk

Abstract

Burning fossil fuels to keep people warm in buildings in the northern hemisphere has contributed to global pollution. Decades of this excessive resource use is now causing a shift in our environment and climate. In response, European policies require ever stringent building fabric standards to curb energy use in buildings. This, in turn, has led to some architects and engineers to experiment with new materials, construction methods, energy production and supply systems. However, many of these experiments have remained in the engineering domain. Architecture has been slow to engage with or respond to this shifting world, leading to buildings that lack environmental ambition and imagination. More often than not spatial qualities and non-energy related issues are de-prioritised.
As a contrast to these prevailing scenarios, it appears that many Nordic buildings quietly respond to these new challenges [1]. In response to the harshness of the local climatic conditions and diminished daylighting during the long winters, increased performance requirements and good lighting conditions are basic criteria. In addition to this, many sustainable Nordic buildings are exemplary in terms of spatial qualities, sustainable material solutions and in response to societal challenges. Moreover, many Nordic architects integrate sustainability into their buildings in unobtrusive ways, and it is this that is exemplary for architecture throughout the world.

This paper sets out to explore the different sustainable design approaches of three Nordic case studies and to communicate the authors' evaluation and interpretation of the architects' sustainability framework and approaches. Three evaluation methods were used to frame the exemplary sustainability aspects and to map any shortcomings. In doing so, the evaluation methods are reflected upon and some key findings will be drawn out for sustainable building beyond the Nordic region.

Keywords

Nordic architecture, integrated sustainable design, contextual design, design approaches

1 INTRODUCTION

In the EU, since January 2019, all publicly funded buildings (and from 2021 all buildings) need to be designed and built according to the nZEB standard (nearly Zero Energy Buildings). This is driven by the 2010 EU Energy Performance of Buildings Directive (EPBD), who define a nearly Zero Energy Building as a *"building that has a very high energy performance… [ ]. The nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby"* [2]. Each EU country defines what the nZEB standard is within this definition. For example, in

Finland, where average winter temperatures in Helsinki are -3.9ºC, and can drop to below -25ºC for periods [3], current design standards for apartments and terraced housing are similar to PassivHaus standard [4]. Even Denmark, with average winter temperatures of about 1ºC [5], design standards for housing are also moving towards the PassivHaus standard [6]. In addition, minimum daylighting provision is also legislated for in Denmark [6]. In Norway, the nZEB standard is defined as nearly Zero Emission Buildings (ZEB) and the balance is measured in greenhouse gas equivalents (CO_{2eq}) instead of primary energy [7]. The minimum requirements for ZEB buildings are comparable with the PassivHaus standard [7]. While legislation is driving better fabric standards throughout the EU, architects in the Nordic region, in response to the harsh climatic and diminished daylighting conditions were already designing comparatively well-insulated and well-lit buildings prior to this [8, 9]. As a consequence, this has also meant that further consideration of building energy use issues, good building envelope design and detailing has been more integrated and accepted as established practices in Nordic design and construction traditions for quite some time, and many architects are now innovating beyond energy issues alone [9]. In addition, architecture within this region has been appreciated for its human scale and connection to nature, its contextual (and climatic) surroundings, its focus on regional craftsmanship, and its sense of durability and self-sufficiency [1, 8-10]. This cultural tradition has extended more recently to include an appreciation for the region's climate change engagement, social integration and architecture made through multidisciplinary collaboration (including with the users) [1, 8]. The Nordic region has also responded to more recent concerns about energy performance, material impacts and the circular economy, often pushing new methods and innovations while maintaining or improving architectural qualities and the humanist design tradition [8, 9]. It is perhaps this rich and diverse multi-layered approach, and the potentially humanist and holistic nature of these different approaches (if all present in a single project), that has contributed to the renewed international attention in Nordic architecture, and as the driver for this research.

2 Research methods: case study selection and evaluation methods

Three housing case studies in Denmark, Finland and Norway were purposively selected in order to undertake an initial evaluation of their sustainable design approaches, using three selected evaluation methods. The aim of the study was multi-fold: to understand the exemplary nature of each case, where things could be improved and what can be learned from these cases for and beyond the Nordic region. Furthermore, faced with complex examples of sustainable architecture which address both qualitative and quantitative issues, another aim of the study was to reflect how best to evaluate sustainable architecture and the use of the selected evaluation methods and their usefulness in assessing sustainable design projects.

Residential apartment buildings were chosen given the importance of everyday housing design in climate change mitigation efforts [11], but also because housing design is a large proportion of the majority of architects' work [12], and is subject to limited budgets, affecting sustainability solutions. The three residential buildings, see Figures 1 to 3, were chosen due to their similarity in typology, scale and use of low impact materials such as timber for the structure and external cladding, leading to some similarity in architectural expression.



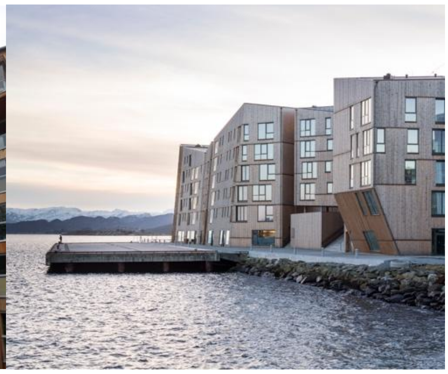

Figure 1. Housing on Lisbjerg Hill by Vandkunsten, Aarhus. Source: U. Kozminska; Figure 2. Puukuokka Housing by OOPEAA, Jyväskylä. Source: S. Pelsmakers; Figure 3. Waterfront by AART architects, Stavanger/Photographer: A.Mørk

The three case studies were evaluated with the use of three evaluation methods, specially developed for evaluating sustainable architecture: 1.) Guy and farmer's 'Six competing logics of sustainable architecture'[13], combined with a sustainable architecture strategy and principles categorisation tool developed by Donovan; 2.) the 'Wohnwert Barometer' or the 'Housing Quality Barometer', developed by the Technical University in Darmstadt [10] and 3.) Gething and Bordass' 'Rapid Assessment Checklist' [14]. The latter two evaluation methods were selected because they specifically include some qualitative architectural and spatial design aspects, unlike other assessment methods such as LEED, BREEAM and DGNB. The first method takes a different approach, and assists in placing the case study within a philosophical framework, and, together with Donovan's categorisation tool [15, 16], is useful for further discussion and interpretation of the outcome of the other two evaluation methods. Only publicly available information and data were used to describe and evaluate the case studies, and consequently, not all evaluation criteria could be assessed where there was a lack of information. Each method is briefly described in the following.

The six competing logics of sustainable architecture was described by Simon Guy and Graham Farmer as an interpretative and qualitative framework consisting of six logics or categorisations of sustainable building approaches. These logics are: eco-technic; eco-centric; eco-aesthetic; eco-cultural; eco-medical and eco-social [13]. These general logics often combine or merge and illustrate the diversity of sustainable design approaches, helping to frame the design approach taken, influenced by specific knowledge and a vision of what a sustainable place is. Both an advantage and a limitation of this approach is that there is no 'better' or 'worse' outcome from this evaluation, but instead, the evaluation helps to understand and place the design approaches in a wider discourse about sustainable architecture, and can help clarify why some design decisions were prioritised instead of others. In addition, Donovan's categorisation tool helps to decipher a project's strategies, concerns and approaches into the six logics. Projects are marked by 53 strategies and 11 categories helping to indicate core concerns relating to the six logics [15, 16].

The Wohwert Barometer/Housing Quality Barometer was developed specifically for the evaluation of urban housing in Germany, which also included legal, social and cultural contexts [10]. It covers a total of 79 macro and micro-aspects of a residential project, including issues such as nearby facilities; accessibility; flexibility; visual, thermal and acoustic comfort, but also functional and spatial design quality and user participation. Aspects of ecological and energy-related issues are included (e.g. energy needs, energy production, costs, material resources). There are five ratings, from below average (1) to exemplary (best practice, 5).

The Rapid Assessment Checklist for sustainable buildings was developed by Bill Gething and Bill Bordass to include sustainability aspects in the evaluation of architectural projects for the RIBA design awards [14]. It has 5 overarching categories: context; design choices; outcomes; design and construction process and achieved performance. Each category is further subdivided with a total of 53 sub categories for the entire evaluation checklist. For example, the 'outcomes' category includes functionality, indoor air quality and energy and CO_2 issue, while use of materials and the use of site and building form are sub categories of the 'design choices' category. Overall a choice of 11 scores is available from 'below standard' to 'pioneering'. The inclusion of in-use performance is unique; however, a limitation is that this information is often unavailable due to lack of sharing or simply no in-use data being collected.

The evaluation of each case study with regards to their sustainability credentials allowed for a brief comparison between each project. However, the main aim of this evaluation was to transparently evaluate and present each case study and their relative merits and shortcomings, drawing on broader findings from both the cases and evaluation methods used.

3 Case studies

3.1 Housing on Lisbjerg Hill, near Aarhus, Denmark

Community housing on Lisbjerg Hill, near Aarhus, was developed by Vandkunsten Architects in 2014-2018 as a demonstration housing scheme which won the 'Non-profit housing of the future' competition. The cost of construction for the 4100-sqm residential complex was estimated at 56 million DKK (about €1500/m^2, excluding VAT) [17]. Four 3-4-storey buildings with approximately 20 dwellings each are located on a green hill 10-km from Aarhus centre. They are organised around the narrow, internal street which refers to rural housing typologies.

The aim of the project was to address diverse groups of users and to create flexible living space which would adapt to changing needs of its inhabitants. Thus, the design principles for housing on Lisbjerg Hill centre around topics such as reversible construction systems, climate adapted construction techniques and co-living. Robustness was treated as a quality, and durability as a strategy for the project development. Moreover, the design process was directed to achieve a sense of community. Therefore, multi-family houses were designed as open plan buildings with a hybrid construction system, which consists of concrete foundations and a core (a staircase and an elevator shaft), and a prefabricated, cross-laminated timber (CLT) structure reinforced with steel elements [18]. The load-bearing structure is separated from non-structural parts, and it is joined with reversible, metal joints to enable easy disassembly and the reuse of elements. The lightweight façade cassettes, made of untreated spruce wood, are protected from rain with large eaves. Untreated wood also dominates in the interiors.

The co-living principle was addressed in shared functions and the zoning of space. There is a communal house with a shared laundry room, a living room, and a recycling centre. The public street and an outdoor garden are accessible for everyone. Semi-private terraces with pergolas and workshops lead to private living spaces. Moreover, the low-cost of apartments and flexibility of buildings aims at a great diversity of users. Open plan, flexible section, the easily modifiable system of partition walls, decentralised ventilation system, adequate heating and electricity solutions enable users to self-design their flats. Furthermore, the buildings are designed to enable increased density within existing structures or their extension in case of an expected growing number of future users.

Results from the evaluation

The analysis of the housing on Lisbjerg Hill according to the characteristics of competing logics of sustainable architecture (see [13]) situates the project between an eco-technic and eco-social approach, which focuses on technology, social and economic aspects. In Donovan's accompanying categorisation, the project scores high on materials - for their LCA, embodied energy, recycling, and maintenance (design for disassembly). It is positively evaluated for the use of natural and healthy materials (predominantly wood) as well as for flexibility (diversity of sizes and types of apartments, open plan and section) and prefabrication/modularity (prefabricated structural elements, partition walls as modules, façade cassettes). It also rates high on adaptability (open module, floor plan, building, the composition of buildings), design for deconstruction (modular design, a hierarchy of building layers, reversible joints) and reduced waste during construction and further life-cycle (prefabrication). Moreover, buildings achieve positive assessment for thermal efficiency (rated as 2015 low energy standard, and the use of PV panels fulfils the requirements for 2020), water harvesting (filtered rainwater from roofs to the basin and terrain), well-being, accessibility (ramps, elevators, 2-storey flats accessible from the kitchen and bathroom level) and inclusivity (low-cost of apartments, open access to public space).

The more detailed assessment (Wohnwerter Barometer, see [10]) confirms the high score of the project on flexibility, a variety of use, choice of apartments and furnishability. Similarly, this evaluation shows very good results in aspects concerning resource demands of the building, for example, spatial efficiency, sustainable building materials, durability and dismantling, primary energy for mobility and construction (prefabrication, limited use of machinery). It also validates the previous positive assessment of the buildings' accessibility and quality of space, especially the provision of free communal spaces and zoning within apartments. It attests such project qualities as systemic planning (design for disassembly), addressing the user's needs, personalisation (unique dwellings, diverse typologies and sizes), and user participation (self-management, self-design of apartments, co-financing of common space). Furthermore, the project scores high on location near the elementary school (proximity to Lisbjergskolen), playgrounds, parks, open spaces, recreational areas (surrounded by nature) and on car accessibility and the proximity of public transport (fast connection to Aarhus by light rail), footpaths and bicycle paths (bike racks and paths connecting to the Aarhus cycling system). This evaluation also highlights comfort (open plan, depot rooms, shield entrances, high ceilings, common utility rooms), lighting conditions (daylight), security (co-living, dwellings clustered in groups ensure safety) and favourable economic aspects (low-cost of construction, property, and maintenance).

The Rapid Assessment Checklist [see 14] situates housing on Lisbjerg Hill between good (14 aspects) and best practice (12). Some solutions were evaluated as standard (12 aspects). The selection of materials for low environmental impact and the project's potential for reuse and recycling were assessed as innovative (2 aspects). The best practice rating includes such indicators concerning the design and construction process as the environmental impact of transport to site, sourcing of materials, waste minimisation during construction and fit-out (high flexibility). Moreover, a similar score was achieved in categories related to the outcome e.g., durability, provision for maintenance and waste management. Design choices are also assessed highly, especially adaptability potential and the use of materials for low environmental impact, their potential for reuse and recycling, low toxicity, embodied energy and pollution. Furthermore, the project scores high on energy efficiency and emissions to the atmosphere (GWP emissions reduced by 50% according to conducted LCA). The proximity to public transport, indoor environment (daylight, acoustic insulation), water management, and on-site renewable energy (1500sqm of roofs designed for future PV panels) are rated as a good practice. In overall analysis, housing on Lisbjerg Hill rates high in systemic planning, pro-environmental technical solutions, resource conservation, usage comfort, and social and economic aspects. The project is also pre-certified for Gold in DGNB certification.

3.2 Puukuokka housing in Jyväskylä, Finland

At eight storeys high, the Puukuokka multi-family housing block was the tallest timber tower in Finland when it was completed in 2015 [19, 20]. It consists of three separate blocks of eight to six storeys, with a total of 184 apartments in a diversity of sizes, all completed in 2018. The design was a pilot project in the application of locally pre-fabricated volumetric modules constructed out of solid spruce CLT. Two different modules typically make up an apartment: a room module for the living spaces, bedroom and balcony and a wet module for the kitchen, bathroom and hallway [19, 20]. Depending on apartment size, these modules differ in length, for example, to accommodate an additional bedroom. The modules are fully finished, and have some exposed CLT finishes; services for water, heating, electricity and ventilation are all integrated into the wall system facing the communal hallway, hence enabling easy access for maintenance. In addition to the prefabricated wooden volumes, the façade cladding was also pre-fabricated out of spruce or larch wood [20]. The larch timber cladding is untreated on the more private courtyard area [19]. The extent of pre-fabrication lead to better quality construction due to the reduced on-site construction time and exposure to adverse weather conditions [19, 20], not unimportant in a cold climate. The architects' aim was to *"find a solution that makes the best possible use of the technical and aesthetic qualities of CLT and to create a wooden building in large scale with a distinct architectonic expression of its own*" [20], and intends to create a focal point for the sub-urban neighbourhood. The main focus are the ecological concepts related to the fabrication and construction of the building, though some social aspects are also present, such as a range of differently sized apartments, and an innovative 'rent to own' finance strategy in support of a diverse community. Some shared spaces are provided, though are mainly expressed through generous, well daylit and semi-warm atria and common hallways to support neighbourly interactions. However, several units are single-aspect, and others have some windows facing onto the black treated spruce of the other surrounding blocks, absorbing instead of reflecting daylight back into spaces. Enclosed balconies, either set back or as pop-outs, create a diversity of plan and in elevation; the pop-outs are especially successful in giving human scale to the courtyard area, but are missing on the roadside. The project is mainly built out of locally available timber and much of the existing bedrock has been left untouched, though the basement foundation (becoming a ground floor barrier on the busy road), is in-situ concrete and accommodates car parking. The project has received (or was shortlisted) for several awards.

Results from the evaluation

According to the characteristics of competing logics of sustainable architecture (see [13]), the Puukuokka housing evaluation firmly situates the project in the eco-technic approach, focusing on technology and innovation. But there are also elements of the eco-aesthetic and

-cultural approach, focusing on architectural form and use of new materials, as well as on the use of local materials and climatic responses. In Donovan's accompanying categorisation, the project scores high on the use of innovate materials and construction methods, and local sourcing and local manufacturing, as well as its pre-fabricated nature (volumetric modules, façade elements, pop-out balconies, finishes) and the associated reduction in on-site waste. While no specific thermal envelope information was available, it is expected that the housing project will also be evaluated positively given the high fabric performance standards of the Finnish building regulations, and the excellent thermal performance of CLT as well as the high-quality construction achieved through pre-fabrication, reducing exposure to adverse weather conditions while constructed on-site. The use of CLT timber could give good scores for LCA and embodied energy, and for the use of natural materials. However, the CLT gluing process is unknown, affecting these scores, and that of indoor air quality. The project is positively evaluated for some well-being aspects (thermal and visual comfort), and inclusivity (low-cost financing options, shared open spaces). However, it rates less high on user adaptability and flexibility: while there is a diversity in unit sizes, it is unclear whether (and if so, how), partitions can be moved or adapted, or units can be combined. In addition, considerations of renewable energy, water (harvesting, re-use, treatment), and greenery (food production, permeable paving, biodiversity, etc.) seem de-prioritised.

The above aspects were confirmed by the more detailed Wohnwerter Barometer evaluation (see [10), drawing out some additional issues, such as the housing project's good location for local facilities (i.e. near medical centres, doctors, schools, parks, cycle and footpaths etc.), though it also highlighted the problematic public transport connections, and while accessibility of the site itself is above standard, its connections are much less so. In addition, the Barometer highlighted the lack of user participation in the design process, and further confirmed the previous evaluation that the building and the units are of limited flexibility once built.

Finally, the Rapid Assessment Checklist (see [14]) situates Puukuokka housing between standard (13 aspects) and good practice (9 aspects), with some solutions such as the use of materials in the best practice to innovative category. What this evaluation method also highlights is that several aspects of the 'Design and Construction Process' could not be evaluated due to lack of information (e.g. briefing and design reviews, considerate contractor's scheme, the environmental impact of operations on site, fitout, commissioning issues, incorporating post-occupancy evaluation issues etc.).

In overall analysis, Puukuokka housing rates high in pro-environmental technical solutions, resource conservation and innovation.

3.3 Waterfront housing in Stavanger, Norway

This 19,500 m^2 waterfront housing in Stavanger by AART Architects (in cooperation with Kraftverk) was developed as a result of an international architecture competition in 2007, with the building construction completed in 2014. The 128 apartments, which vary in size (from 44 to 225 m^2) and shape (some split over two floors) are distributed across several 5-6 storey buildings which form a broken 's' shape winding along the former industrial harbour with public amenities on the ground floor. The irregular layout of the different apartment blocks reference the local historical residential buildings with a spectrum of social meeting points and passageways which offer glimpses to the sea, a diversity of routes and connections to the promenade that in the future will link with the historic city centre roughly 2 km away. The development has a social ambition, aiming to promote a diversity of life styles and social interactions through different apartment typologies, public outdoor spaces (a community square, playground and amenities) and common spaces for the residents, such as a communal room on the first floor. The form and materiality of this development take influence and inspiration from Norway’s mountainous landscape and the regions strong timber building culture. The apartments are clearly influenced by, and connect to nature with the architects describing them as a *“clear-cut cluster of wooden mountains, rising on the periphery between the city and the surrounding landscape”* [21].

This development was designed using Integrated Energy Design (IED). From the start of the design process, the design premise and goals were identified as well as key concerns for the form, local context, orientation and use of materials. Focusing on passive and active strategies, the volumes are shaped towards the local climate - sun and wind - while also creating views for all of the apartments. Considerations such as being lit from both sides, large windows in the living areas, orientation (for daylight and natural ventilation) and sunrooms aid in reducing energy use, improving daylight while also strengthening the visual comfort and connection to nature. Lastly, this project is boasted as one of Europe’s largest wooden residential developments [21], using local building methods (timber framing) as the main structural idea. In addition, the façade and roof are clad with eco-labelled Moelven ThermoWood which is heat treated wood from Scandinavian forests. To increase the durability of the wooden poles, they are carbonised in a similar technique used by the Vikings. The use of regional untreated wood, without toxic surface coating, reduces negative environmental factors as well as CO_2 emissions from material transportation.

Results from the evaluation

The Stavanger Waterfront housing was analysed according to the six competing logics of sustainable architecture (see [13]), it situates the project between an eco-aesthetic and eco-technic approach. In this way, the sustainable approach of this project is metaphorical, expressing societal values while also focusing on technological aspects. The project scores high on passive strategies such as the use of materials (local wood); specifically relating to the wood’s natural and healthy properties, LCA, embodied energy and locally sourced - reducing CO_2 emissions. Additional passive strategies which increased this project’s score relate to thermal strategies (insulation, envelope, air tightness and glazing), footprint (orientation, footprint size and window to floor ratios), energy (daylight, embodied and efficient energy) as well as natural ventilation. While there is little public data regarding the thermal strategies of this project, it is acknowledged that the Norwegian building standards are higher than other European countries, which consequently increases the score for these aspects for this building. Moreover, this building was recognised for its connection to nature, context and visual comfort, which as stated earlier were all goals from the outset of the project. The connection to nature was expressed in the physical form, mimicking the local landscape as well as in the physical public connection to the sea and visual connection from each of the apartments. All of these factors combined resonate with the eco-aesthetic categorisation.

The more detailed Wohnwerter Barometer (see [10]), confirms the high scores for quality of space and design, specifically integration into the environment (physical placement, historic and local references) and visual reference to outdoor spaces through openings on both sides of the apartment and the overall form of the building which allows for views. Similarly, this evaluation shows very good results in aspects concerning the location of the development. The industrial redevelopment has close connections to the city (via developing walking/biking routes and public transport), small parks and public spaces (developed with the project including mixed-use on the ground floor), however, other public amenities are further away but one could foresee that these will increase as the area develops further. It also validates the previous positive assessment of the buildings for its appropriate and building tradition, quality of building system (timber frame influenced by local building traditions), healthy and sustainable use of materials (local wood for structure and cladding of the walls and roof) and comfort (open plan, shielded entrances, high ceilings and common spaces) - specifically for a high quality of natural light from careful orientations, window placement and ceiling heights. Additionally, it gained points for flexibility and variety due to the diversity of apartment sizes and shapes in support of a diverse range of occupants from different generations and family constellations [21], however, with the high cost/m^2 for the apartments, it is not envisioned that these would be considered 'affordable' housing. Similarly, this project also ranked low for spatial efficiency due to the irregular shaped apartments resulting in many odd angles, especially in the eastern blocks.

Finally, the Rapid Assessment Checklist (see [14]) situates the Stavanger Waterfront project between standard (18 aspects), good (9 aspects) and best practice (2 aspects). The majority of the factors were ranked standard practice; however, this is in relation to a Nordic context and these may actually be considered good practice when compared to other countries within Europe and especially the USA. This project was ranked best practice for community integration (mixed-use and the integration of public and communal spaces) and the selection of materials for low environmental impact (locally sources untreated wood). Additionally, the choice of material was ranked good practice for thermal qualities (insulation and airtightness), low embodied energy (nature of wood combined with reduced transportation) and low toxicity (traditional charring and heat treatment instead of surface treatments). Similarly, the evaluation shows good results for good practice; including the context (refurbishment of a brownfield), design choices (land use and infrastructure), building form (location of the building protecting from harsh prevailing sea winds while maintaining views), indoor environment and energy efficiency (both with daylight and thermal comfort from high levels of insulation, glazing and orientation).

Overall, Stavanger Waterfront rates well for the overall design; integration of the local context, climatic conditions and cultural history, as well as, the connection to nature. Many of the passive and active strategies are integrated into the project with very little 'bolted-on' technology.

4 Discussion and conclusion

The three cases studied highlight both the different sustainability approaches and philosophical frameworks, as well as some of their similarities. None of the cases studied had one single sustainability approach, though all cases expressed a sensitivity for low impact materials and were clearly approached from an eco-technic approach. The prevalence of the eco-technic approaches in all three cases might be explained by the climatic and environmental context of the Nordic region, influencing the design of high-performing fabric standards. The cases also had integrated other aspects of sustainability, emphasising both a diversity in approaches and that merging different approaches is necessary to achieve holistic sustainable architecture; this is an important reflection for the practice of sustainable architecture elsewhere. The need for holistic sustainable design approaches became clear from the other more extensive evaluation methods, and several aspects were often not met by all cases. For example, the cases in Finland and Norway clearly also had an eco-aesthetic approach, while the case study in Denmark took an eco-social approach. The former cases would have benefitted from more ambitious approaches in other sustainable design aspects to deliver overall a more holistic sustainable design. Equally, what became clear from the more extensive evaluation criteria, is that the evaluation of architectural aesthetics was missing entirely. Yet, it could be argued that the inclusion of aesthetics in sustainability criteria is important, because it is based on the premise that what we love, will last [22-25]. For instance, the case study in Denmark, which was most exemplary for its eco-technic and eco-social approach, and scored highest in the extensive sustainability checklists, might be the least aesthetically considered design. Equally, the case study in Norway, while scoring lower on the sustainability checklists, might perhaps last longer due to its iconic and artistic approach. Clearly, aesthetics is not mutually exclusive from sustainable design, but rather integral to it.

Generally, the use of different evaluation criteria assisted in a deeper understanding and a more robust comparison of different cases and their relative sustainability merits and shortcomings and the way in which they are valued. The use of evaluation criteria have associated limitations, such as a requiring a fair amount of information to undertake the evaluation, and inability to assess due to missing information. While missing criteria were excluded for evaluation, this is not ideal: lack of data could also mean that the criteria were not fulfilled and would hence score low. There can also be a lack of a clear, or up-to-date description of the evaluation criteria, leaving them open to interpretation; another limitation is the assessor's subjectivity due to their own preference, background or interpretation of the criteria. However, these biases were minimised in this study, by undertaking the evaluation of the case studies jointly to ensure each case was evaluated based on the same interpretation. Nevertheless, the inherent nature of including qualitative aspects in evaluation checklists introduces an element of subjectivity and interpretation; transparency in assessment and in reporting is needed to allow for meaningful and robust assessment.

Moreover, the inclusion of in-use performance criteria in the Rapid Assessment Checklist, which evaluates user information (e.g. about the achieved performance of the housing in-use, and how satisfied occupants are with the space, fit-out, management, and if energy use matches expectations) could not be evaluated for any of the cases in this study as none of this information was publicly available. While many architects do not yet undertake performance feedback practices, the importance of doing so is acknowledged as integral to sustainable architecture practices world-wide [26].

Finally, while the evaluation methods used are sufficiently generic for relevance elsewhere, they are now at least 10 years old and need updating. For example, aspects of health and well-being and issues of social diversity are not explicitly included, yet are also considered integral to holistic sustainable design.

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03.104 - UNDERSTANDING YOUR DESIGN: WHAT *OTHERS* WANT AND THINK ABOUT IT?

Sofie PELSMAKERS*, Thomas HILBERTH

Aarhus School of Architecture
8000, Aarhus C, Denmark; sp@aarch.dk

Abstract

Buildings are not fixed, or 'static' over time: they weather and evolve to meet changing user's needs, maintenance requirements also a changing climate. Many buildings do not 'perform' as the design team intended at the design stage. For example, performance evaluations and user surveys show that the energy use might be higher than expected, and people might not be as satisfied with the visual, thermal or auditory comfort that the spaces are expected to provide. This is problematic, as occupants' health and well-being can be adversely affected, and energy use and associated CO_2 emission targets are missed. Most often, this underperformance remains invisible because most architects do not collect 'feedback' from the building and its users. When issues do arise, frequently building users are held responsible by the design team for not using the building and its spaces or systems as 'intended'. While users may affect the building's performance through their behaviour, clearly spaces also affect users through the design-decisions architects make. Yet users are often excluded from the design and building processes and decision-making phases: without knowing what others want, how can architects understand what to design, and try to achieve their design ambitions in the actual spaces they create?

This paper summarises the key issues related to different underperformances and their causes and impacts, and illustrates the importance and value of working with people, not only once the building is used, but at early design stages to understand (and respond to) users' needs and expectations. Exemplary participation and feedback practices are explored through two case study interviews, exploring both POE (Post Occupancy Evaluation) and BPE (Building Performance Evaluation), and different ways of collecting feedback. This paper highlights the value of user participation and in obtaining feedback, and that in doing so, it enables the design team to learn, reflect and improve while also expanding the role and value of the architect.

Keywords

performance, feedback, POE, BPE, user expectations

1 INTRODUCTION

There is an increasing emphasis placed on 'feedback' practices, i.e. for architects and clients to collect information about how the buildings they designed and built, work in reality [1, 2]. This information collection includes the gathering of data on the performance of the building such as energy use, air quality and fabric performance, but also gathering knowledge about the satisfaction and user experience of the people using the building and spaces. This is often referred to as Building Performance Evaluation (BPE) and Post Occupancy Evaluation (POE) respectively, though often these terms are used interchangeably. Generally, POE is a major part of BPE and takes part from the beginning of the project at concept and design stage through to construction, pre-occupancy and then at post-occupancy stage [3]. The purpose of collecting feedback is manifold and is based around gaining an understanding of whether what was intended at design stage, is met in reality, and if not, why this is the case. This allows the following up and fixing of any issues to reduce the gap between actual performance and expectations. Building performance evaluation and user experience feedback allows the client and the design team to learn lessons for future projects, and where shared publicly, the wider profession and industry can also benefit from this knowledge for their design and building processes [2]. In Europe, the increased recent focus on building performance monitoring follows on from improved building regulations limiting building energy use and associated CO_2 emissions in view of climate change mitigation policies. The monitoring of technical building data became easier and cheaper thanks to digital and wireless technological advancements, and many buildings are now monitored for their energy and technical performance [1]. The actual monitoring of buildings often highlight a gap between predicted energy use and carbon emissions versus actual energy use and emissions, which is often much higher [1, 2]. This is a result of several factors such as lack of accounting for all energy use; ill-suited energy use modelling software, building inaccuracies and commissioning and maintenance issues [1]. In addition to technical issues, research has also unfolded the link between user behaviour and perception and the impact on building energy use and carbon emissions, as well as the link between building design and occupant health and well-being [1, 2]. However ’feedback practices’ are not only about output and evaluation at the end of the project (i.e. at post-completion). For it to be useful, stakeholder participation and feedback is needed at the start, and throughout, the design process as an input. Given that design affects the living environment of users and their health and well-being, early user involvement can inform design decisions, and lead to better design, improved inclusivity, and support by the local community as well as greater user satisfaction [4]. Because user involvement aids understanding of the users’ expectations and their local ‘expert’ knowledge, this can lead to new ideas and perspectives and ways of working for designers [4]. The process of involving users is also referred to as co-design, people-centred design or participatory design (among other terms), which evolved from the aim to make more humane working environments in 1960s Scandinavia [5]. It is based around the principles of democracy (i.e. those affected are involved in influencing the outcome), and mutual learning (i.e. designers learning from users, and users learning about design aspects and their implications) [5]. In architecture, participatory processes have often been used as part of local community engagement, often a planning requirement in the UK or for instance as required by social housing landlords [4]. However, depending on the motives, and how participatory design is conducted (e.g. if it is steered towards a certain outcome) and how, and if, it is incorporated in later designs, not all involvement leads to democratically designed architecture. Instead it can be used as a symbol of social responsibility without meaningful intended community involvement, or it can be used to retain existing hierarchies and privileges [5].

Despite the importance of gathering building performance and user expectation and experience feedback, its take-up has been low in the architecture profession [6]: only around 10% of RIBA practices in the UK offer BPE/POE as a service [2], with only 3% of UK architects reportedly undertaking feedback processes regularly [6]. Gathering feedback has been more common for some commercial and educational buildings, but it is lacking on residential buildings. Furthermore, some architects might undertake some aspects of POE, but might not frame it as POE [6]. In the UK, building evaluations are now required on all centrally publicly funded projects via the UK Government ‘Soft Landings policy’, which is a building delivery process from the early stages of a project until after completion with a focus on meeting client and user expectations and intended building operation performance [7].

This paper set out to explore different feedback practices, and the drivers and challenges experienced by architects. This was undertaken through a small industry survey of 23 participants, and two case study interviews with leading European architects. In this paper, the term ‘feedback’ is used to include both user engagement and building performance monitoring; where one or the other is specifically referred to, this is separately identified.

2 Research methods

The authors undertook qualitative research in the autumn-winter of 2018, consisting of a brief online industry survey and two in-depth purposive interviews with architects undertaking feedback practices. The survey was distributed in the authors' network via email, LinkedIn and Twitter; this might lead to a sample bias. However, the survey and the interview sample were not intended to be representative of the wider industry. Instead the aim was for a deeper understanding of the motivations and the current issues faced by those already undertaking feedback practices, especially by those in sustainable architecture practice. Two leading architects, Anders Tyrrestrup at AART Architects in Denmark and Mark Lumley at Architype Architects in the UK were identified and invited for in-depth interviews based on their leadership reputation and different approaches to building evaluation and user engagement practices. Both semi-structured interviews lasted between 60-90 minutes; the interview approach and structure was based on prior work by academics Hay et al (see [6]) and by architecture practice Skidmore, Owings and Merrill (see [8]). The semi-structured nature of the interviews allowed for a structured beginning, and tracking of the progress of the interview according to its purpose. It also allowed an extent of freedom in responses by the interviewees and for the researchers to pose follow-up questions for further probing and clarification. The interview in Denmark was undertaken face-face while via Skype with the UK; both were voice recorded with permission and oral informed consent was obtained. The interviews were analysed through selective coding and the authors' interpretation and use of quotes was validated by subsequent interviewee review.

3 Industry survey

Twenty-three anonymous participants took part in a short seven-question online survey for one month in the winter of 2018, though not all questions were answered by all participants; where this is the case this will be identified when discussing findings. The majority of participants (39%) were from the UK, with four participants practicing in other European countries (17%); another four in New Zealand and Australia, and three in North America (USA & Canada). Two participants were located and practiced in Chile and one in India. The questions asked were to understand the extent of the participants’ engagement with feedback practices and of what kind, (questions 1 and 2); when feedback is undertaken during the design and building process (question 3), and what the value and challenges of doing so are (questions 4 and 5). The remaining two questions were related to the participants' geographic location and the estimated proportion of sustainable design projects in the practice.

As previously discussed, regular gathering of feedback from building users and building performance has been low in the architecture profession [7]. However, 19 participants (83%) claim that they work with users at different stages, though just 56% reported undertaking building performance monitoring (13 respondents). This suggests that for the study respondents, user engagement is more embedded and common than building performance monitoring. About half (12 of the 23) respondents claim that they undertake both building monitoring and user engagement. However, ten respondents say that they do not get involved in any building monitoring at all, while four of 23 (17%) do not undertake any user engagement at all. All but one of the respondents who undertake building performance monitoring, also engage with users. Only three respondents do not undertake any feedback of any kind. It is unknown in how many projects these feedback practices were undertaken, and this might explain the discrepancy with other reported studies such as [7]. Some participants expressed that they would like to do more. Another explanation for such high engagement with feedback practices in this small sample could be that a higher number of sustainable architects were included in the sample, reflected by sharing of the survey in the authors' professional network, which stretches mainly in the sustainable construction field. For example, 16 of 18 respondents who answered the final question about the proportion of sustainable projects, claim that 75-100% of their projects were sustainable design projects. Only one practice who say they have 100% sustainable projects in the UK, did not undertake any feedback of any kind, while 14 respondents that undertake feedback practices of any kind, claim that 75-100% of their practice work consists of sustainable design projects. Only two of the three respondents that do no feedback at all estimated that 25-60% of their practice projects has a focus on sustainability. These initial results, based on a small sample, might suggest that there is an association between sustainable practice and embedding of feedback processes, indicating a potential greater awareness and commitment to the practice of feedback as part of sustainable architecture.

Of those undertaking feedback practices, the majority of engagement was done at the early stages of the design process (80%); though also at other stages during the design process (73%) and about five do it less than six months post completion, while six undertake feedback more than six months after building completion. Six of the respondents stated that they undertake evaluation more than once on the same project. Nine of 10 respondents undertake feedback practices "in-house", while three of the respondents hire other experts to undertake feedback practices, though two of whom also combine it with "in-house" approaches. Note that only 15 of 23 respondents provided answers in this section, and only 10 responses were received related to who undertakes the feedback. Of the 12 responses about barriers, nine respondents (75%) stated that a main barrier to undertaking user satisfaction and building performance evaluation was because the client was not willing to pay for it (not included in the fees). Those not undertaking feedback practices of any kind, stated this as the reason.

One respondent stated lack of expertise and a respondent from Chile specifically mentioned that feedback practices are not usual in their country and they lacked expertise. A respondent from North America, stated that the main barrier in post-occupancy evalution because *"clients keep energy engineers retained but not architects re net zero carbon behavior".*

Table 7: Value of feedback practices (16 survey responses)

What is the value of feedback (user engagement and/or building performance monitoring) to your practice?		**Learning for future projects**	**Understanding how building works/what people think**	**Ensuring the building works**	**Understanding user/client expectations/ influencing design decisions**	**Supports sustainable design**
R1	Learning process for future projects, giving the user a voice	x	x			
R2	Critical to a successful outcome			x		
R3	To know what will work - and if		x			
R4	Possible to deliver outstanding performance in use; problems get fixed during defects liability period; client engagement lessons learned for practice and designers	x	x	x		
R5	Greater understanding of real-world performance of fabric and services performance - informs future design work.	x	x			
R6	Very important to know from users how your design finally worked.		x			
R11	Future project use, future learnings	x				
R12	Learning as designers, uncovering problems the client didn't know they had, discovering opportunities for the design, collecting data we need (and don't think the client can give us on their own)	x	x			
R13	Ensuring a dialogue and better alignment with client expectations. We always talk about doing robust post-occupancy evaluation but often it is less formal than we want it to be at the end of the warranty period. We need to do better on this.				x	
R14	User feedback allows us to establish how well we responded to the brief given to us and how comprehensive that brief was.				x	
R15	We get to understand user expectations, user demand and the level of which we have to give information back. Also we sometimes get to know key users that can follow the project more in detail and get back informations on a more detailed user level than otherwise planned.		x		x	
R17	To learn from successes, to correct weaknesses.	x		x		
R18	We undertake POE with monitors installed in our buildings for a year after occupation. We also undertake user surveys and collect feedback. This data has helped us develop and refine our approach to design and detailing. We have now adopted the a Passivhaus approach as standard and have adapted our details over a number of	x				x

	years by responding to POE feedback to the point where we feel we can offer a guarantee on our buildings performance!					
R19	We see sustainability as a cornerstone of architecture. Communicating with the client often increases the number of sustainable practices they are willing to include (and pay for) in a project.					x
R20	Informs design decisions				x	
R22	Helps us bring down the rate of error in simulations for all later projects.. some projects give useful insight into occupant behavioural aspects which cannot be simulated				x	

The value of undertaking feedback practices was shared by 16 respondents (see Table 1) and based on the responses, the authors divided the responses in five main categories: learning for future projects; understanding how the building works/what people think; ensuring the building works; understanding user/client expectations/influencing design decisions (early on), and supporting sustainable design practices.

The responses highlight the value of feedback practices for learning for future projects, and what users think and how the building works (both received seven mentions). Early on in the design process, the value of user engagement is understanding both what users and the client expect and it influencing design decisions (five mentions). However, ensuring the building works is only explicitly mentioned by three respondents, yet is a primary driver and benefit for undertaking feedback practices post-occupancy: the obtained feedback and the resulting understanding of what users think and how the building works, should be used to fine tune the building and ensure expectations are met [9]. Collecting feedback for use in future projects is clearly insufficient if that feedback is not used to fix issues in the current building. Finally, in some cases feedback collection was in support of better sustainable design practices, such as a respondent (R19) mentioning that *“Communicating with the client often increases the number of sustainable practices they are willing to include (and pay for) in a project*.” Another respondent (R18) stated that feedback has supported design processes and knowledge and they have since adopted *“Passivhaus approach as standard and have adapted our details over a number of years by responding to POE feedback to the point where we feel we can offer a guarantee on our buildings performance!”*

3 Architect interviews

The semi-structured interviews were structured broadly along the following themes based on previous work (see [6] and [8]), and analysed and discussed in accordance with: current practice; feedback processes; barriers/challenges; practice motivations; value of feedback; and embedding feedback in practice. Additionally, the architects shared feedback evaluation reports with the authors, which has been drawn on for illustrative purposes, with the architects’ permission.

3.1 Architype Architects – UK

Current practice, feedback processes and barriers/challenges

In the interview, Mark Lumley at Architype Architects focused mainly on the value, process and barriers to building performance monitoring post-completion (i.e. once the building is in use). Their feedback practices focus both on user satisfaction evaluations as well as data collection of fabric and system performance and for example indoor environmental quality: *"Doing basic CO_2 monitoring, temperature monitoring and humidity monitoring is good, combined with questionnaires, and being there and getting feedback".* The main motivation for undertaking post-completion monitoring is about the architects feeling a responsibility about 'how the building works' and making sure they 'get it right', fixing any issues, and how this feeds back into future projects. The initial interest in feedback practices came about from an extensive study revealing some issues with underperformance and indoor environmental quality issues on an eco-school, despite the architects designing to best practice sustainable architecture principles. This made them realise the importance to understand actual performance better in order to achieve truly sustainable design.

While the focus of the interview was very much on post-completion feedback processes, this did not mean early user input is not undertaken. This is illustrated by the architect reflecting that *"we involve everybody really, sometimes we get M&E people involved, controls people involved, local authority team that was supporting the operation of the school, the school, the care takers and duty managers, the head teacher often, consultants…".* When a full Soft Landings programme is undertaken, it gets fully embedded in the design process, but in other projects there might be no direct contact with the client so they try to lobby with the contractor to get access to undertake feedback practices. Where there is an opportunity and a relationship with the client, the architects encourage feedback possibilities to be undertaken internally in the practice. Post-completion feedback is then undertaken in-house as an investment by the architects and more limited in scope if no additional funding exists. The architects also work with university researchers and have obtained government funding and have established KTPs (Knowledge Transfer Partnerships). In these better resourced cases the feedback processes are more systematic, structured, comparable, holistic and more extensive, and follow a prescribed process and template, unlike the own in-house engagements and evaluations which are adapted for each project. More extensive monitoring includes, in addition to indoor environmental quality aspects, sub-metering, BMS (Building Management System) monitoring, and fabric monitoring. At present the architecture practice sponsors a PhD student in this area.

Barriers mentioned included time, cost and insurance liability as well as *"the risk that you identify things that you cannot fix or might not want to face up to it in terms of accountability. But I think we are prepared to take that risk because most of the time we will try and fix things or will improve them next time."* Regarding insurance liability, the architect said it could be seen as a risk *"…going there and identifying things that do not work. But we take the view that because we are pro-active and we are highly conscientious, our buildings are working pretty well, compared to a lot of our competitors."* The architects seem to put building performance and satisfaction as equal to the design of beautiful spaces, suggesting that the latter means little if it does not also work in reality: "*We take it for granted that we are going to be designing delightful spaces,…, appropriately daylit,…, relationships to nature and landscape are really important for schools as well, having good access to the outside, so* *all these things are in balance. But you have kids sitting in a beautiful classroom, but if they are overheating or the air quality is bad, it is not very clever really… or the air quality through what is in there is bad. We get comments from our schools, …, and kids would say that it smells nice, they feel nice, it almost becomes quite tactile."*

Practice motivations and value of feedback

Interestingly for Architype Architects the main motivation for feedback practices is about "*Accountability, and wanting to really engage with how our buildings perform and really understand it and learning from mistakes and not repeating mistakes (…)".* It is about 'getting it right' for the client and users, with the co-benefit of being able to show evidence to new clients about the performance of their designs and that they can deliver what is promised: "*within industry, failure is endemic, lack of engagement is endemic and lack of responsibility is endemic and we believe in what we are trying to do is to provide better quality environments for people to live in or learn in. Obviously good design is primary, but the environmental issues how occupants experience the spaces are critical, as well as the bigger environmental issues in terms of energy use. It is a no-brainer,…".*

The practice also thinks it will start to become an consultancy opportunity as they are now so experienced and there could be more work coming through this way.

Embedding feedback in practice

The practice is medium-sized (50-60 people) and its architects are generally interested in feedback practices; shared lunchtime CPD talks (Continuing Professional Development) are held to share knowledge and lessons learned, as well as in hiring practices of committed individuals to create a feedback culture in day-day design practice. Beyond this, Architype rely on unstructured forms of sharing and embedding feedback and lessons learned in design projects. However, given the small nature of the practice, this seems to have been no barrier to embedding previous feedback in follow-on projects.

Figure 1. Wilkinson Primary School, Designed by Architype. Photo: ©DennisGilbert/VIEW

This is illustrated by Wilkinson Primary School in England (Figure 1), built to PassivHaus standard. The design of the school was influenced by previous feedback on similar school designs. For example manually operated window openings were designed and only relying on BMS for top windows. Similarly some construction and system details were revised and simplified from previous specifications for ease of construction and better energy efficiency, based on previous building performance monitoring [10]. On this school, initially the architects undertook a less extensive in-house post-occupancy evaluation, though external funding has since enabled more extensive data collection and academic research collaborations. Wilkinson school performed the best in terms of thermal energy use and measured thermal comfort variables, and CO_2 concentrations, compared to its four previous school designs[10], due to building on lessons learned from the previous design, user and performance feedback. However, the evaluation also revealed that while space heating was the lowest, and below the predicted PassivHaus standard, the total primary energy use, while still low, was nevertheless about 20% higher than expected (and than the PassivHaus standard) [10]. While only in-situ monitoring of actual energy use could reveal this issue, the real value of the feedback is that it enables the design team to understand and fix the cause, and to bring the actual performance of the building and its environmental impact closer to the design values and intent.

3.2. Aart Architects – Denmark

Current practice, feedback processes and barriers/challenges

Similarly to the interview with Architype, most of the discussion with Anders Tyrrestrup at AART Architects in Denmark was focused on feedback processes post-completion. However, the focus with was mainly on human aspects in the design process, i.e. stakeholder inclusion at the beginning of the design to have *"an idea of who we are designing the building for"*, and after realisation, to *"investigate the impact of the project on the users"*. The architect refers to this as the "soft values"; this is to understand user needs, and then once the building is in-use, to understand how the building is perceived, used and whether it meets expectations. This is not yet done on each project, but has been thoroughly done on eight to 10 projects, in the past decade, that are mainly the most visionary projects and those that push new design solutions and boundaries. These evaluations also influence other projects:*"we use those learnings and the knowledge we gain from these experiences and evaluations in other projects. So you can kind of say that these really influence other projects and processes".* Quantitative data collection of the building's environmental qualities and fabric and system performance is at present not yet embedded nor the main focus in the practice. However they expressed they would like to include this in the future, and get a more holistic perspective and look at energy issues in certain projects because they realise that architects *"can make a difference*" and that *"architecture influences a lot",* referring to one of their projects where illness was reduced among children and employees by 50% compared to before. They are keen to "*make our measuring more specific and also more structured somehow, so that we maybe have 4 or 5 parameters that we measure every time and get it a little more systematized. But … all the way… we have to continue developing it and change it, and tune it into each project"* and *"we now have to do it at a much higher level".* Uniquely, they have been working with external anthropologists who undertake the building in-use occupant surveys, though they have just had an anthropologist join them full-time at the head office to reflect their increased commitment and wish to embed stakeholder engagement in an increasing number of projects.

They see a real benefit in experts undertaking in-use surveys, due to the appreciation that this requires specialist skills. At present the practice finds the existing evaluation methods too rigid. Hence each in-use survey is adjusted and unique for each project to enable the architects to understand specific design aspects related to new solutions and innovations, specifically mapped against the brief and the ambition as a starting point for the feedback. The practice aims to continue working with external specialists, while the new in-house anthropologist will support the integration of evaluation in the design processes and practice culture as well as a more systematic approach. This is because experts have this *"scientific or anthropologist method that they use for testing or experiencing our building works. And they do it instead of we do it ourselves so that is kind of a way to make it more valid".* External consultants also bring the added benefit of independency in data collection and interpretation and *"they see it with other eyes".* It usually involves the anthropologist spending some time observing and interviewing clients and users and then writing up a summary report. This is usually done one year after realisation, and is followed-up if adjustments are needed. This process can be illustrated by Musholm sports centre for disabled users (Figure 2), where at the competition stage, the architects worked with potential users to understand their needs, and to challenge the single-storey building design brief. With the users, the architects tested the idea of a long circular ramp in a two-storey building to make the most use of amazing views, not attainable by a single storey building. Post-completion, anthropologists then observed internal and external building use and informally interviewed 20 children users, and some parents and employees over a few days. The user responses ended up highlighting the positive impact of the building design on its young users [11]. The knowledge from this project directly influenced other projects, based on a better understanding of more vulnerable users and their use of space. One of the main barriers to feedback practices is the overhead expense, especially given it is outsourced, but it is 3 days external involvement, so the expense has been limited to 30,000 to 50,000 DKK (approximately €4000 to €6700) and not done on each project.

Figure 2. Musholm sports centre and holiday homes for people with disabilities in Denmark, by AART Architects. Photographer: Jens Markus Lindhe

Practice motivations and value of feedback

The architects regard user and stakeholder engagement as of such high value that they invest in the process themselves – it was only once that the Client part-paid for the process. The main driver and value of working with stakeholders appeared to be three-fold for AART architects: 1. understanding user needs and suitability of potential design solutions and shaping early design decisions; 2. how the architecture they created has affected its users and whether they are satisfied, and 3. being able to demonstrate the value of the architecture they created to (current and future) clients and users. It is important that also the findings are shared with the Client: *"the negative feedback is always very important for us but also to communicate it but also validates that we are not only looking for the good story".* The main value for AART architects of user participation and feedback is specifically evidencing the value of their innovative design solutions where they push the boundaries, as this gives them a unique edge in competitions and new project discussions. Interestingly, this was not a focus for the survey respondents, and for Architype this was a co-benefit of feedback processes. A secondary benefit for AART architects is understanding how their buildings work, adjusting where things do not work so well (as illustrated by Bikuben Kollegiet – see further below), and being able to learn from this for future projects. This was identified as of prime value when undertaking feedback practices by Architype and some survey respondents.

Additionally, hearing from end-users can be a highlight in the design process: *"They make a small report,…, and that is some of the most fantastic days when they come back with these reports and they tell us about what works and what does not work and what are the reactions and they have these quotations [sic]… from the children and their mother that are fantastic to hear because you get it very directly from the end users that is very touching somehow to hear that".* For example a parent stated (translated quote [11]):"*This is a really nice place - the architecture itself. When you have children with disabilities, the architecture often becomes a clumsy and awkward compromise. We can't get anywhere. This is not the case here. This is cozy and friendly - it accommodates us."* Another user stated: *"That was what I dreamed of in my wildest imagination"* and *"That architecture can be identical to freedom, we have never encountered before… "[11]*. The architects now use some of these quotes in their marketing material to highlight the value and human impact of their architecture. Other feedback further illustrates the human impact of the design, such as how much all users love using the spaces, how both parents and children equate the architecture with freedom (from worry and disability respectively) due to the spatial integration of accessibility aspects. Some improvements noted by users include for example that they wish some spaces were larger, better temperature controls and automatic door sensors. Another example is that on Bikuben student housing project; the practice found that some of the common spaces were under-used and this feedback allowed the Client to re-arrange the building in favour of additional student rooms and more dynamically and intense used common spaces, again indicating the value of feedback on functional building use and allowing space optimisation. Specialist and external input and analysis validate the soft learnings as part of evidence of the building use but also the value of the design, though according to the architect,*"the most interesting and important is to actually combine some of them (quotes) with some of the quantitative measurements we can make because that makes it extremely valid and extremely understandable for most people and also for decision makers and politicians when we maybe want to push things and argue why we should make more schools or better schools, or… choose us as architects…. And that is the very difficult part, is to make actual fact based investigations and to connect them".*

Embedding feedback in practice

AART architects are a large practice (over 100 employees), and the embedding of the knowledge gained from these practices and feedback is undertaken by the head of research and the design directors who then further share this knowledge to others in the smaller design teams in the practice, as well as CPD sessions in the practice. They are however interested in formalising the integration of this feedback knowledge further in the practice, and the new in-house anthropologist's role will help with communication and sharing and embedding different levels of knowledge internally.

4 Discussion and conclusion

Many architects are interested (and starting) to get involved in user involvement at different stages of the design and building process, as well as in data collection of how the building performs once built. Feedback and user engagement practices are considered to be in support of evidence-based design, and socially and ecologically sustainable building procurement. Based on a small survey and two leading European architects' interviews, this paper highlighted the value of feedback practices to the architects. The benefits are multifold and different architects highlight a diversity of benefits and motivations for undertaking feedback practices. The main themes are: learning lessons to incorporate in future designs, understanding how the building works in reality, ensuring it works as intended and feedback provides evidence of the value (and uniqueness) of the architects' design services in support of winning future work. Practices often undertake feedback in-house, though some also through expert consultants such as anthropologists, which has the benefit of independence and a more methodical approach. It seems that there is also a desire from architects to undertake more feedback practices and to do it better, but are hampered by the main barrier, which centers around the lack of financial resources to collect feedback, identified from the survey and interviews. Despite Clients not paying for feedback practices, both interviewed architects seem to think that feedback practices pay for themselves, due to the added value they gain from collecting feedback. The research also highlighted that those undertaking feedback practices could improve processes: i.e. to be more systematic and to ensure feedback obtained is shared, embedded and correctly interpreted for future projects by all teams. Designers also need to ensure that knowledge gained from feedback is used to fix things in the current building (and not just learning for the future) and to get better at publicly sharing of findings so that others in the industry can learn and we can move forward together – both of these aspects were not a focus in the small sample of respondents in this study. Given the increasing interest in feedback practices and user involvement, the research also illuminated that even where a full user or performance evaluation is not possible, collecting less extensive feedback, whether in-house or by specialists, is still of value. This can be focused on specific issues that the design team want to understand, e.g. how the impact of their intervention has worked in reality and to learn from for future projects. However, given the recent increased focus on post-completion processes, user engagement early on and throughout the design process should not be neglected in favour of post-completion feedback only. Similarly, the human aspect should not be de-priortised in favour of quantitative building monitoring evaluations. Clearly, both are closely connected and influence each other, and finding out about what users think about our designs post-completion is more likely to meet their expectations, if we asked people what they wanted, and involved them at the beginning of the design process in the first place.

Overall, placing user-centric and evidence-based design at the heart of design processes will require a culture change in most architectural practices and schools. At present, feedback principles and skills are generally not included in architectural education, but could be integrated in architectural design courses by placing people and feedback processes central in the design process, through for example live projects (actual built or planned projects involving the local community). However, what is needed is more than equipping students with knowledge and practical feedback skills, but also a critical and intellectual position about our future role and value as architects in the creation of holistic sustainable buildings and communities now and in the future.

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03.105 - THE TEN-BEL APARTMENT ENSEMBLES

JUAN ANTONIO GONZÁLEZ PÉREZ

Escuela de Arquitectura, Universidad de Las Palmas de Gran Canaria ULPGC, Campus de Tafira s/n, 35017 Las Palmas de Gran Canaria, Spain; juanantonio.gonzalez@ulpgc.es

Figure 1. Díaz-Llanos/Saavedra: *Ten-Bel*. Agrupación *Frontera*. Photograph: ©Jordi Bernadó

Abstract

Through the study of the various apartment Ensembles (Agrupaciones) making up the Ten-Bel tourist complex, this article reveals the innovative project mechanisms and architectural concepts employed in Southern Tenerife in the 1960s, taking into consideration typological and program aspects as well as the building techniques employed, in the context of contemporary architectural production. This article attempts to demonstrate how taking a suitable approach to the surrounding territory at both the project and architectural level can lead to urban transformation that integrates landscape and architecture, using the example of the Costa del Silencio, a region of special environmental and landscape value.

This research concludes with the finding that the uniqueness and relevance of the Ten-Bel apartment Ensembles lie in the fact that they define complex residential units that reproduce in their interior the hierarchy of the open spaces common to all cities, but which here form part of the architecture itself. The Ensembles are a means of interspersing architecture and urbanism; they construct an integral space for tourism that unfolds in the territory as a function of the landscape. All this is achieved while paying attention to density, occupation limits and height considerations; systematically creating architecture that is half-open to the landscape; and protecting endemic plant species and lava flows.

The aim of Ten-Bel, which it achieves through its Ensembles, is to forge a singular identity through the synthesis and empathetic integration of art, architecture and landscape, thereby constructing a unique space for tourism that preserves and promotes, through the project, the idiosyncrasies of the landscapes of Southern Tenerife.

Keywords

Tourism, Landscape, Canary Islands, Architecture, Ensembles.

1 THE *TEN-BEL* TOURIST COMPLEX

In the 1960s, tourism in the Canary Islands began to expand from its initial roots in the traditional tourist centres around the cities of Puerto de la Cruz and Las Palmas de Gran Canaria. The 1970s, for their part, marked the start of a rush to colonize and develop the untouched landscapes along the southern coasts of the islands, through the construction of villages dedicated exclusively to mass tourism.

In this context, Ten-Bel was the first tourist village developed in the south of Tenerife. It was built on land falling under the tourism zoning arrangements of the 1963 Costa del Silencio Development Plan (Plan Parcial de Ordenación Turística de la Costa del Silencio de 1963) and was designed by Javier Díaz-Llanos and Vicente Saavedra together with the architect Luis Cabrera Sánchez Real. The land in question consisted of a largely flat platform untouched by farming, with a natural cover of local vegetation, areas covered by lava beds, and a steep sea cliff along one side.

Given this situation, one of the main objectives of the project would be to protect and exploit to maximum effect the natural landscape in the area to be developed. But it was not enough to merely limit the density and height of the buildings to ensure that nature would maintain a central role in the development. The buildings also had to be grouped strategically into highly concentrated, yet sufficiently separated complexes, so as to create areas of intense development interspersed with open spaces where nature could be preserved in its pristine state.

The Ten-Bel tourist complex would ultimately be defined by its apartment ensembles. These self-sufficient units, none of which would exceed two stories, offered an alternative to the traditional hotel format.

The access route to the tourist village takes the form of a large ring road that circles back on itself. From this main ring road, small side roads lead to the hotels and apartment ensembles. Superimposed on this solution for vehicle traffic, there is a separate network of footpaths built around the village’s open, public landscaped areas. This system of footpaths links all the residential complexes with the long park bordering the gully, and with the boardwalk and lookout point that run along the coastal cliff all the way to the pool and swimming area. The roads, which measure 7 m across, are all adapted to the lay of the land to avoid any unnecessary, disfiguring earth movements.

Designing the tourist complex on the basis of independent ensembles allowed for a phase-by-phase approach to implementation, such that the estate would appear complete at the end of every phase but could adapt as necessary to future demands. The zoning arrangements in the Costa del Silencio Development Plan also stipulated that each complex had to be different from the last, with a view to strengthening each complex’s internal unity and ensuring their autonomy.

The Ten-Bel tourist complex is made up of the Bellavista bungalow park, the Carabela, Drago, Eureka, Frontera and Géminis apartment ensembles, the Alborada and Maravilla aparthotels, and the Hotel los Guanches, which was designed but never built. The estate also has a pool at

Ballena Beach, a public swimming area, a park with sports and leisure facilities, and an office/shopping centre.

Apartments ranged from more basic studio-type residences, with a living-sleeping area, kitchen, bath and terrace arranged in different configurations, to the roomier one- and two-bedroom apartments, created by adding extra modules. This flexible system of adding modules [1] allowed for a broad range of solutions to be implemented while allowing for the serial production of the building elements.

Each apartment ensemble has its own internal logic built around the basic apartment types used and the form in which the units are interlinked, giving rise to widely varied, increasingly complex configurations and uses of space.

The disjointed, broken profile found in most complexes – the result of the irregular aggregation of the small modules comprising the apartment types – is also a reference to the architectural style common to this part of the island and is employed as a strategy for making the various complexes appear smaller than they really are.

Ten-Bel was an atypical case, in that a single entity, Ten-Bel S.A., developed, constructed and ran all of the facilities in the tourist village and was involved in all scales and phases of the development. This lent coherence to the project, beyond the sum of its different residential ensembles, giving the village a strong spatial identity.

Further, the landscape was given an active role in Ten-Bel and has been completely integrated into the tourist village’s leisure infrastructure.

The territory, its topography, the nature of its materials, its plant life – all these determine the shape of the structure, which submits to the existing values of the landscape.

The ensembles that structure the whole are complex residential units, collective tourist infrastructures built at the scale of the landscape, which derive meaning in and by the landscape.

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2 The Santa Ana Ensemble

The Santa Ana apartment ensemble was the first tourist installation built in the Costa del Silencio. It is made up of 92 apartments built around private interior patios in each residential unit. Each apartment is distributed over two levels connected by a spiral staircase leading from the main living room to an upper room with an adjoining, private sun terrace. The different standard living units are grouped into blocks, with side entrances off footpaths that criss-cross to form small plazas. The public space opens out into a large main plaza that holds the swimming pools, surrounded by other leisure facilities and general services. Vehicle traffic is restricted to the parking strip that extends straight into the complex’s inner ring without cutting off the footpaths.

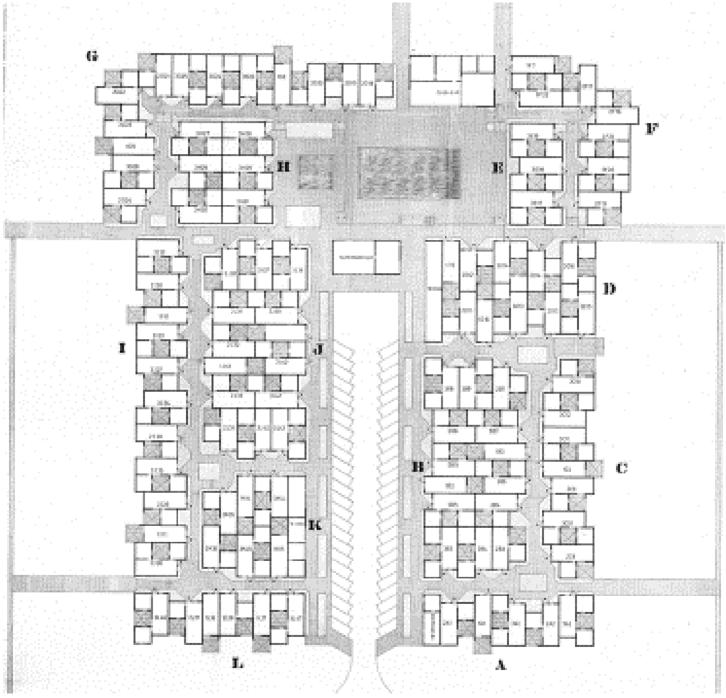

Figure 2. The Santa Ana apartment ensemble_General layout. Ground floor

Figure 3. Díaz-Llanos/Saavedra & Cabrera: The Santa Ana apartment ensemble. Photograph: ©L. Cebrián

Figure 4. The Santa Ana apartment ensemble_Standard types

Built in a U-shape with a north-south orientation, the Santa Ana is like a jigsaw of houses and patios interlocking over a modular square mesh that form the complex's base. The different heights of the building components – the entrance halls and baths, bedrooms, living rooms, upper rooms with sun terrace, walls and overhangs – together with the staggered façades, give rise to a play of volumes that makes the complex seem smaller than it is, and adds variety to the view from the main footpaths.

The apartments in this inward-looking complex manage to combine privacy with exposure to the landscape, as the private patios and roof terraces act as outdoor spaces for enjoying vistas over the surrounding area.

The Santa Ana complex offers a range of urban solutions that ensure high-density occupation of the plot while respecting private space. This model will be further developed in later complexes to adapt to the new needs of mass tourism and a newfound respect for the untouched landscapes of the island's south.

3 The DRAGO Ensemble

Drago was the fourth apartment ensemble to be built in the Ten-Bel tourist complex. It was designed as a self-sufficient complex with 261 apartments as well as common rooms, a bar, a restaurant and shops.

This ensemble is built along a continuous interior corridor – a covered footpath that opens at regular intervals into a series of inner courtyards leading to the residential units. On the upper floor, each of these separate inner courtyards is isolated by the apartments surrounding it. The building complex is bordered by a perimeter garden along which run the apartments' pergola-covered terraces – shaded areas topped by trellises that act as a filter and create a buffer between the inside and outside.

A modular mesh forms the ensemble's base and helps facilitate serial production and a degree of prefabrication of the building elements. The different apartment types are created by adding one or two additional bedroom modules to the smallest, two-module base type. The terraces are staggered by setting back the units on the upper floor, ensuring the same amount of sunlight reaches both floors.

The different units are strung together in a loop that links the various inner courtyards. This long line curves to form a U-shape around the main pool and parking areas, which are separated from the common buildings by a series of pergolas.

The play of light and shade achieved through the staggering of the volumes on the two floors, the shadows thrown by the terrace pergolas, and the alternation of well-lit and shady areas found along the covered corridors and open courtyards on the footpath, are all forms of expression that lend this complex its personal touch.

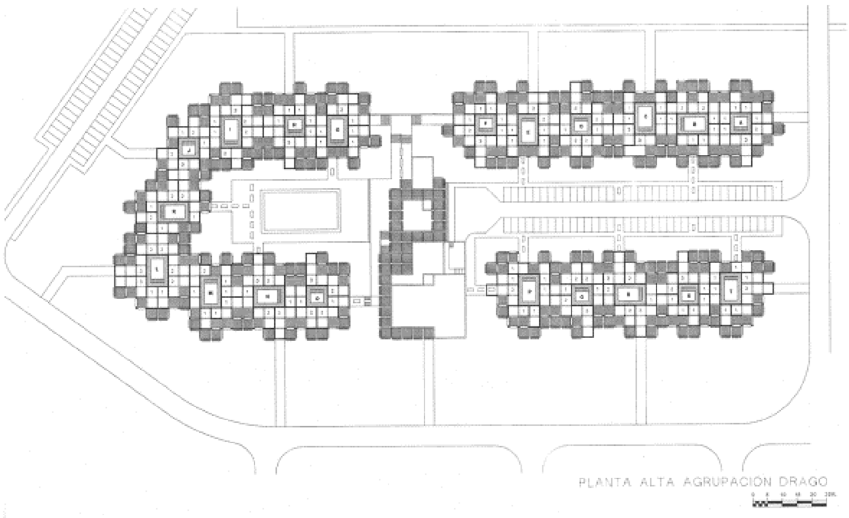

Figure 5. The *Drago* apartment ensemble_General layout. Top floor

Figure 6. Díaz-Llanos/Saavedra & Cabrera: The Drago apartment ensemble.
Photograph: ©E. Pintos

Figure 7. The Drago apartment ensemble_Standard types

4 The FRONTERA Ensemble

Figure 8. The *Frontera* apartment ensemble_General layout. Top floor

Figure 9. Díaz-Llanos/Saavedra: The *Frontera* apartment ensemble. Photograph: ©Jordi Bernadó

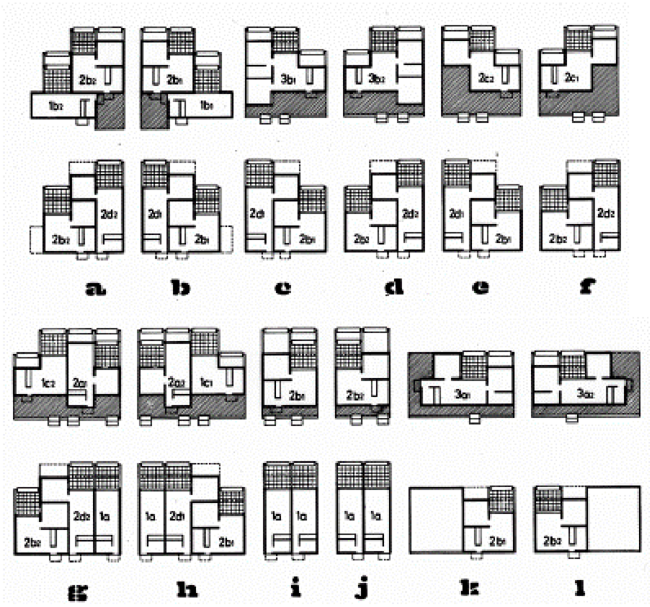

Figure 10. The Frontera apartment ensemble_Standard types

Frontera was the sixth apartment ensemble designed for Ten-Bel, and with 467 apartments is the largest complex in the village.

As in the other apartment ensembles, the different apartment types used in the Frontera were created by adding one- or two-bedroom modules to a basic, studio-type model. These base types were then arranged and stacked to create a series of linear bodies distributed along a continuous double strip. This opposing double strip defines the ensemble's public space, with its interior passageway that meanders through the open air to the different apartments.

The staggered structure, which is created by setting back the upper floors, helps to unfold the central passageway into raised corridors, a "street-in-the-air". The apartments open through semi-covered terraces onto the subtropical oasis that runs along the ensemble's perimeter, home to a grove of Phoenix Canariensis palms, landscaped areas, and fragments of "badlands" of thistle and spurge left in their natural state.

Using the U-shape of the Santa Ana and Drago ensembles as its basis, the Frontera adopts a more complex configuration, meandering freely through the plot and adapting to the slight unevenness of the land while skirting the sections of badlands left in their natural state. The pool area is still placed at the centre, but the parking strips are distributed along the edge of the plot, leaving the footpaths undisturbed.

In this ensemble, the focus is on the open spaces, with particular attention paid to the borders between the newly-landscaped gardens and the existing lava beds, which had to be carefully protected during construction due to their extremely fragile nature.

5 The *TEN-BEL* Tourist Complex as a Laboratory

The *Ten-Bel* tourist complex would be the first intervention exclusively aimed at building a "landscape of leisure" to serve mass tourism in Tenerife. This project, commissioned by the Belgian Company Ten-Bel S.A., took over twenty years to complete and included the planning of the entire tourist village as well as a large number of individual tourist installations, facilities and hotel complexes.

To make the most of the opportunities offered by such a long-term, comprehensive project, the architects took a flexible approach to planning, allowing the experiences garnered in the early phases of development to be incorporated into later planning stages. This strategy allowed the architects to try out new approaches, explore different solutions, and see how they worked out at each stage of the project. This more empirical, pragmatic approach was in line with the critical position taken by Team X as compared to the more universalist positions of the CIAM.

The possibility of being able to develop each apartment ensemble in succession converted this ongoing exploration into a form of laboratory, with the various interactions reminiscent of the dual strategy of “dissection” and “reconnection” [2] developed by Candilis, Josic y Woods in their proposals for a new leisure architecture. This emerging project-based culture found its reference in Spain in Rafael Leoz’s "HELE Module" and spatial network system [3].

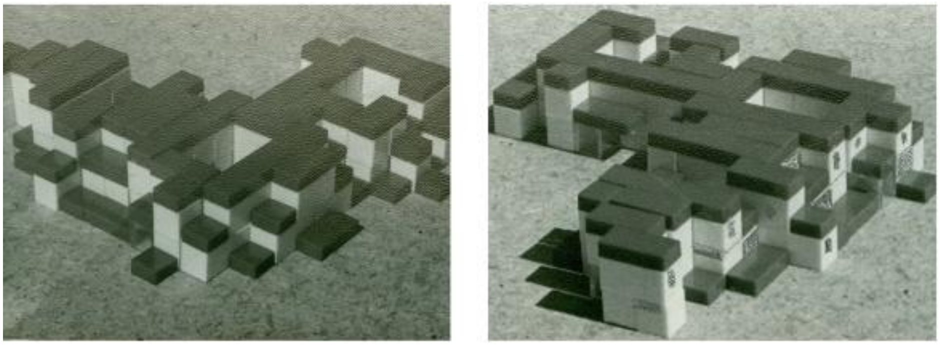

Figure 11. The Drago apartment ensemble_Models

In *Ten-Bel*, Javier Díaz-Llanos and Vicente Saavedra, together with Luis Cabrera, experimented with all scales of intervention: from the overall zoning decisions that determined the tourist village’s design at a territorial level, to the intermediate level of the residential complexes, right down to the finest detail. Through all this, they defined new building processes adapted to the isolated conditions and low level of technological development found in southern Tenerife.

As they developed the various *Ten-Bel* apartment ensembles, Cabrera, Díaz-Llanos and Saavedra sought out, through a process of successive approximations, new methods, systems and procedures for generating forms of spatial organisation that would permit greater densities (so necessary for the development of mass tourism) while maintaining a large degree of privacy compatible with an intensification of the individual and collective experiences of the landscape.

Their research into new urban fabrics was thus based on this need to strike a balance between two diametrically opposed facets of mass leisure: “the democratic intention to give everybody individual access to natural resources (snow, sea) on the one hand, and the need to prevent the disappearance of those natural resources on the other” [4].

The *Ten-Bel* estate’s layout places special importance on open, shared landscaped areas and is based on the radical separation of pedestrian and vehicle traffic. The densely built-up ensembles define the structure of this new tourist complex and are to be seen as concentrations of the footpaths running along the continuous strip of subtropical gardens.

6 The Apartment Ensembles - Passageways Between the Landscapes

The concentrated built-up fragments of the apartment ensembles are configured as a space for transit, as a "passageway" between the landscapes.

These passageways are the places where things happen, the new forms of community, places of interrelation, spaces that foster movement and change.

Alongside the landscape, the ensembles became the focal point of the construction of the Ten-Bel tourist complex. These apartment ensembles comprise "complex residential units" [5], whose interiors reproduce the hierarchy of the open spaces typical of a city, but which here are conceived as part of the whole. The complex syntheses between the built-over and open spaces in the Ten-Bel ensembles are both architecture and city at the same time

Figure 12. Díaz-Llanos/Saavedra: The Frontera apartment ensemble. Photograph: ©Jordi Bernadó

The interrelation between the architectural typology and urban morphology, between architectural typology and landscape, was taking as the starting point for conceiving new urban forms.

Apartment ensembles such as the *Santa Ana*, the *Drago* or the *Frontera* reflect how the tourist model evolved over the period in question: there was a progressive transformation from types of spatial organization and buildings with clear urban references to new, more open forms directly linked to the surrounding nature and landscape.

From the *Santa Ana* to the *Frontera*, we witness a unique transformation of the “block” as an element for configuring urban space. The concave body of the Santa Ana is progressively transformed into a convex form.

The “block” as morphological unit mutates through a mechanism of syntactic inversion to the point where it unfolds into two parallel strips that unfurl along the relief lines of the landscape.

In the interior of the *Frontera's* strips we have the mirrored double corridor with its "street-in-the-air"; on the exterior, there are fragments of unspoilt nature.

The *Frontera*, the last complex to be designed, is a system, a building of buildings that best embodies the serial development to be found in the *Ten-Bel* tourist complex; it expresses, through its infinite articulations of a limited number of simple parts, a spatial multiplicity that is perceived over time.

The aggregate modular system used in the configuration of the various ensembles built in *Ten-Bel* weaves a spatial "network" or fabric that sketches out new ways of using space in tourist installations. This fabric links the individual with the universal, uniting uniformity and diversity, repetition and change, allowing for the creation of building types that respond to the new demands of mass tourism while adapting to unique local features.

7 The Island Project – Place as Identity

Ten-Bel develops the idea of the "place as identity", of the place as a basis of an "island project"[6], which is linked with reflections on geography first articulated by the island's avant-gardists [7].

In his "Third Rationalist Manifesto" (Tercer Manifiesto Racionalista), published in the art revue Gaceta de Arte in 1932, entitled "The function of plants in the landscape" (Función de la planta en el paisaje)[8], Eduardo Westerdahl outlined how to work with the shapes of the island, and how to highlight the images of our island landscape through urban rationalism, functional architecture and the use of indigenous plants. With Westerdahl's guidance in mind, work began in the *Costa del Silencio* on the construction of southern Tenerife's tourist landscape: attention was paid to density, limits were placed on occupation levels and building height, and there was a wide-scale adoption of the approach of "half-opening" buildings up to the surrounding landscapes and protecting natural lava beds and indigenous plants.

Sartoris noted the need to "use the air, the light, the greenery, the natural and invented landscapes as one's own true, unprecedented building materials"[9], making the most of individual traits and appreciating geographical differences and local features.

Given the unique context of its arid, volcanic surroundings, Ten-Bel seeks to define its own identity through the empathetic integration of architecture and landscape, thereby constructing a different sort of tourist destination, one that eschews anonymity by preserving and highlighting the unique features of its surroundings.

Ten-Bel approaches the construction of the tourist space from an architectural standpoint, as a complex, non-linear process. Using the ensemble (agrupación) as a "device", *Ten-Bel* defines the new city of leisure by means of a unifying model in which architecture unfolds "as a function of the landscape".

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[1] FULLAONDO, Juan Daniel. "Agonía, Utopía, Renacimiento". *Nueva Forma*, n.28, May 1968. p.39. Fullaondo defines the "additive line" [línea aditiva] as the <<line of structures in constant potential growth>> ("own translation"), in reference to the thinking of Rafael Leoz.

[2] AVERMAETE, Tom. *ANOTHER MODERN. The post-war architecture and urbanism of Candilis-Josic-Woods.* Rotterdam: NAi Publishers, 2005. p. 354. Avermaete claims that tourism projects of this era were forms of investigation aimed at an emergent urban culture that would transform the city’s production mechanisms. The strategy to give form to this new urban culture relied on a double move of 'dissection' and 'reconnection'. <<In the first dissecting move, the tourism project was unravelled into its smallest composing entities; be it the simple dwelling cell or even only parts of it. In a second instance these different parts were combined, juxtaposed and superimposed and thus reconnected as a new urban figure>>.

[3] The "HELE Module" was developed in the late 1950s by Rafael Leoz and Joaquín Ruiz Hervás. It consisted of four cubes arranged in an L shape that, thanks to its multiple possible combinations, allowed for an astonishing degree of spatial variety. The "HELE Module" is one example of the general theory of “spatial networks” formulated by Leoz. In: LEOZ, Rafael. *Redes y Ritmos espaciales*. Madrid, Editorial Blume, 1956.

[4] AVERMAETE, Tom. *Op. cit.,* p. 354.

[5] MONESTIROLI, Antonio. *La arquitectura de la realidad*. Barcelona, 1993. p. 74 (Tipo edificatorio y agregaciones complejas).

[6] <<…artists on the Canary Islands in this period were able to speak, paint and write from, in and about a territory in particular>> (“own translation”). This landscape (and geographical) reformulation of the island’s vision forms the basis for what Sánchez Robayna has called the “island project” ["proyecto insular"]. SÁNCHEZ ROBAYNA, Andrés (ed.). *Canarias, las vanguardias históricas.* Tenerife: CAAM / Gobierno de Canarias. Viceconsejería de Cultura y Deportes, 1992. p. 16.

[7] <<Tourism led to a reflection on the Canarian identity (...) on identity as a cultural trait>> (“own translation”). For more on tourism and identity, nature and island landscapes, see: NAVARRO SEGURA, Maria Isabel. "Eduardo Westerdahl y la construcción de Canarias como identidad espacial." In: AAVV*. gaceta de arte y su época. 1932-1936*. Las Palmas de Gran Canaria, 1997, CAAM, Centro Atlántico de Arte Moderno. pp. 29-31.

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TOPIC 4: INTERACTIVE STRUCTURES

04.101 - REFUSE AND TIME DEMACRATION AS FILTERS OF TIME AND SPACE

A. Tarik Orgen. (Professor emeritus)

Institution

Auburn University, College of Architecture,

Planning and Landscape Architecture, 104 Dudley Hall, Auburn, Alabama 36849

e-mail: orgenat@auburn.edu

1 INTRODUCTION

“Our instrument of work will be imagination. It is necessary to relearn the art of building, to invent entirely new myths capable of begetting the new atmosphere that we need in order to breathe. We will be done with amusing ourselves by grotesquely gathering up in a butterfly net our weakest sighs, with continually dancing in a circle, stirring up around our bodies the phosphorescent mist of our closely held impressions. We will be finished when we have placed before us a solid new world. Then our most alert work will be climbing and exploring it, to hew heavy blocks of stone and put them one on top of the other to erect solid buildings, changing ceaselessly the crust of the conquered world.”

Bontempelli 1926

2 The Problem(s)

2.1 Too much waste

Americans produced 88.1 million tons of solid waste in 1960’s. That amount jumped to a horrific 262.4 million tons in 2015 only. That means each person in the United States produced 4.7 lbs. of waste a day. All of this solid waste goes to the thousands of solid waste landfills around the country. There are roughly twenty three hundred landfills in America. The total number of landfills though reduced from 6326 in 1960 to 1956 in the year2014 most of which are located in the western United States.

2.2 Too many prisoners

United States locks up more people per capita than any other nation. In 2002 6.7 million people were on probation, jail or in prison. Last year alone there were 2.3 million prisoners in the United States. That translates into roughly 1 in 32 adults or a rough total of 1719 State, 102 Federal prisons (or more than 35.7/state). Presently most states in the country find themselves facing very serious problems that are the unavoidable result of prison overcrowding.

2.3 Lack of suitable sites

At the present most states in the country are having a very difficult time procuring suitable sites to utilize as additional solid waste landfill and prisoner holding facility sites. Nobody in the United States is willing to have either a solid waste landfill or a prisoner holding facility built at or near their communities. This in turn drives the price of suitable or permitted lands to astronomical levels. In Princeton New Jersey for example, one site with landfill permit was sold for $500,000.00/acre. Without the permit the same site would have sold for only $20,000.00.

2.4 Statement of purpose

With this paper I am going to make an attempt to explore the issues of refuse disposal and time demarcation within the American Society. It is not only important to explore these issues but also to highlight the necessary correlation between them.

2.5 Vehicles

The possible vehicles for exploring these issues of an outcast genre within the American Society are a typical solid waste disposal facility/site, time as an entity and a prisoner holding facility

2.6 History of elements. Solid waste disposal.

Waste disposal facilities are almost as old as public waste management itself. Athens, Greece had the first municipal waste disposal site around 500 B.C. The Council in Athens issued laws prohibiting waste disposal within one mile of the city walls. American Society had similar disposal areas to the ones in Greece. Only about thirty years ago were these dump areas replaced with regulated sanitary waste disposal landfill areas. Modern landfill areas are constructed under close surveillance and are required to have liners, leachate collection facilities and naturally produced landfill gas monitoring systems.

Nowadays the landfill areas are typically divided into smaller units called cells. By way of isolating limited working areas of the dump site they are able to control exposure to weather, thus controlling leaks, vermin and odor.

As for content, most data suggests that about 40 percent of materials entering the landfill are paper products, 20 percent is yard waste,9 percent metals,9 percent food, 8 percent glass and 7 percent plastic. All these different waste materials decompose at different rates and eventually produce landfill gas which consists of 60 percent methane. The rest is mostly carbon dioxide with varying amounts of nitrogen, oxygen and some assorted contaminants. Some of these landfill gases eventually escape from the landfill site and leak into neighboring sites. Eighty-three percent of the landfill sites in United States had methane leaks reported. The general popular options for dealing with landfill gas are flaring, boilers (makes heat), internal combustion engine and gas turbines/ fuel cells.(makes electricity). Of these options boilers and fuel cells are the cleanest ones in converting the landfill gas to usable energy resource

2.7 Prisoner holding facility

The earliest prisons were just temporary holding facilities. They were described as strong cages, within a fortress, castle or subterranean portions of public buildings. These early facilities were usually a prelude to execution, banishment or other forms of punishment and were not considered as punishment themselves. The first prison as we define it was a Mammertime prison built around 640 B.C. by Ancus Maritus as a vast system of dungeons constructed under the Cloaca Maxima-the main sewer in Rome. Most of the medieval prisons such as the Tower of London, the Bastille, were not built as prisons but as storerooms for provisions.

During the Medieval period, the Christian Church became more involved with the prison because of the concept of prison as a substitute for death or mutilation of the body was derived from a custom of early church of granting asylum to fugitives or criminals. Mont San Michel in France is a typical example of this kind of ecclesiastical, civil and military prison.

The early 1800’s were the first time when prisons were erected for the sake of prisons, so there had to be an aesthetic which was becoming of such an institution. The main development in prison design history has been the telephone pole layout which allows for multiple functions as well as increased movement within the prison.

Prison designers had been admonished to pay particular attention to the needs of the future rather than the present because of the difficulty of obtaining funds for frequent replacement of the facilities. It may be fairly easy for a community to obtain funds for an old and decrepit school or a hospital, but in the case of prisons the tendency has always been to expand and/or overcrowd the existing facilities rather than building new ones

2.8 Time

In traditional western thought, time is as an important resource as space. Architects and designers are usually casual but competent space and place makers. There is however, a single profession yet to be fashioned as competent time-world designers. Time is usually identified with space and the movement through it. However it is not time itself that is of general concern to scholars and designers but the very important exchange between any given person and his/her manmade or natural environment. I believe only through an understanding of time can the designer appreciate the dynamic nature of the built form. In her famous quote Loren Eisley states “The Darwinian Revolution…is based on the concept of life is a process unfolding over vast spans of time. To formulate laws based on a static concept of time, such as balance of nature”, is to misconstrue the essence of the process. Natural selection-the force that shapes man and other existing forms of life-involves a dynamic change in which malleable organisms interact with a shifting environment…”

Time thus is an inseparable ingredient of the environmental experience. We perceive things and predicaments in a time frame However, our general design education usually overemphasizes both the studies of the precedents and the future. We work rather with the structures of the history or the structures of the utopia.

A serious evaluation of what surrounds us now with all its beauty as well as its problems should and will provide meritorious experience for future structures

2.9 Relationship

The relationship between these three entities is an important and symbiotic one. The typical landfill keeps the refused product of the society in general (waste) which is stored in a specific confined area over a period of time.

In turn a typical prisoner holding facility keeps the refused product of the society in general (the prisoner) which is stored in a specific confined area over a period of time. Time is described as a period during which an action, process or condition exists or continues. Both prisoner holding facility and solid waste disposal are processes that mark time as well as continue over a period of time. Therefore it is fair to say that prisoner holding facility, solid waste disposal and time are related and therefore should mutually coexist within this study as well as in reality

2.10 Proposal

This mutual coexistence can be achieved by creating a solid waste landfill situation (recording of time through waste), which will actually become a site for prisoner holding facility(halting of time). This solution, only partial it may be, to the above-mentioned problems of lack of suitable sites, too much solid waste and overcrowded prisoner holding facilities, is achieved by merging the two thus making them interdependent and efficient

2.11 Project

At the initial phase of this project a perimeter wall is erected on a given site. Small concrete waste storage cubicles are erected, within which controlled amounts and varieties of waste is dumped.

Once the cubicles are filled then the prisoner holding facility is built on top utilizing the walls of the units as foundation. A main frame structure is erected and the cell blocks are then individually hung to this frame. All cell units face south thus giving the prisoner a clear understanding of the passage of time through created shadows. The prisoners spend their incarceration working at the landfill from which their holding facility is born. They take turns working at bailing, sorting, banding etc. This way the "waste" of will be working literally with the waste the society produced, thus paying their debt to the system.

The landfill gas that normally becomes a hazard and a problem in itself is now utilized to heat and cool as well as provide electricity to the prisoner holding facility through the use of boilers and fuel cells respectively. Thus the facility gets its birth, its beginning as well as its maintenance from the landfill site that it is built upon.

Both owners and managers of these facilities have difficulties in procuring a suitable site location. As mentioned above, nobody wants either one of these facilities in their community. I further propose a solution by placing them at the edge of the community as a boundary.

The German philosopher Heidegger defines boundary as not that at which something stops but, As the Greeks also recognized, that from which something begins its presentcing.

Thus we place them both at the specific niche at which the society does not just stop but also the nature begins its presentcing. By doing this I believe we will create an entity that will also become an efficient filtering threshold between nature and society in general.

Furthermore the idea of prisoner holding facility and a solid waste landfill existing is in a sense the making of a filter. This filter transforms to become the purifier of man, waste and time.

If it is a filter then it automatically implies a passage, a movement through a process or an entity that cleanses. This process then becomes the basis for replenishment of man and his environment within time. In the process of filtering and cleansing the entities going through normally slow down. This reduction in speed allows for the individual units of an organism or an entity to be cleansed. If we accept the fact that the filter slows down the entities during cleansing, then the filter itself is further transformed into a threshold or a barrier. Thresholds are places where a change of realm occurs.

The threshold (boundary) is then utilized to another realm that begins its presentcing. The two realms in our discussion are the man and the nature. The prisoner holding facility over a solid waste landfill then becomes a threshold, a definer if you will, to reduce the ever present tension between what man creates(the urban realm) and what nature creates(the realm of the forest).

I will end my paper with a quote from Mevlana Celaleddin Rumi regarding the threshold.

“Threshold is a place where ego dissolves and a resonance with universal soul comes in”.

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04.102 - DEPLOYABLE TENSEGRITY STRUCTURES USING PNEUMATIC COMPRESSION MEMBERS

Authors (Personal Name & FAMILY NAME) – if more separate with commas

Institution
Full postal, ZIP Code & City, Country; e-mail address
(the Corresponding Author has to be labelled with * in Authors list)

Institution
Full postal, ZIP Code & City, Country; e-mail address
(the Corresponding Author has to be labelled with * in Authors list)

Abstract

A hybridized structure system is introduced, which extends the principles of active-deployed tensegrity structures through a series of prototypes that use pneumatic compression struts. Resulting in a minimum weight deployable structure with maximal global volume change. The design and construction of the prototypes, analytical strategies for the performance of such air-struts under compression, and speculation on material possibilities, and the applications of pneumatic tensegrity structures will be discussed.

Keywords

Tensegrity Structures, Pneumatic Structures, Deployable Structures, Inflatable Tensegrity.

1 INTRODUCTION

Tensegrity structures are considered to be optimal because they maintain their stability with the fewest possible number of structural members carrying purely axial forces [1]. Since their introduction to mid-twentieth century, artists, architects, and engineers have imagined the range of applications for tensegrity structures and several innovative variations to the system have been proposed. This paper presents advancements in a hybridized structure system that extends the principles of active-deployed tensegrity structures through a series of physical prototypes that use pneumatic compression struts. Replacing rigid compression struts traditionally found in tensegrity structures with pneumatic members presents an opportunity to maximize the global volume change of the structure before and after it is deployed, and minimize its overall weight. Though proven to be theoretically possible, no large-scale physical prototypes have been developed. The research presented in this paper is focused on developing preliminary construction strategies for architectural-scale deployable tensegrity structures that use low-pressure air-struts. Due to the unique combination of two historic structural systems, this paper will first review the origins, historical context, and applications of pneumatic and tensegrity structures in architecture and give an overview of previous proposals of inflatable tensegrity systems in other fields. Next, theoretical, analytical and design strategies for this hybrid structure system will be described, followed by a discussion of a series of physical inflatable tensegrity prototypes at increasing scale and technological resolution. Finally, this paper will specify next steps in development of large-scale inflatable tensegrity structures, and speculate on the range of material possibilities and applications such structures may have.

2 Historical Overview of Pneumatic and Tensegrity Systems

This section provides a historical context for the system being proposed whereby aspects of two historic systems are being combined. Though distinct in their material strategies, pneumatic and tensegrity systems were not only developed simultaneously in the mid-twentieth century, but also were considered to be conceptually similar because they both isolate matter in a state of compression immersed in matter in a state of tension [2].

2.1 Pneumatic Structures in Architecture

The application of pneumatic, or air-supported structures in engineering and other technical fields far precede their application in architecture. An early example of pneumatic structures being applied to building construction involved spraying concrete onto rubber balloons as formwork [3], was pioneered by American engineer Wallace Neff in the early 1940's and refined several decades later by systems such as *Domecrete* by Haim Heifetz and later, *Binishells* by Dante Bini [4]. Frei Otto's first volume of *Tensile Structures,* first published in in 1962, contained a chapter on pneumatic structures [5], and helped establish an analytical basis for pneumatic structures as field of building construction. By the end of the 1960's art and design groups such as Archigram, Haus-Rucker-Co, Coop Himmelb(l)au, and Ant Farm each proposed and promoted the use of rapidly deployable and materially economic environments [6], culminating with the 1970 Expo in Osaka, which featured several pneumatic pavilions . Following the exhibition manuals and handbooks including the Inflato-cookbook [7], a technical handbook by Herzog [3], and a recommendations book by the IASS [8] were published**.** These initiatives to explore and disseminate knowledge of inflatable structures has helped them become a ubiquitous building technology. Advances in materials, design, and fabrication have facilitated their widespread use for many applications and building types. Recent innovations such as the "tensairity" concept [9] use cable-tensioning to give inflatable structures them increased stiffness, bending, or buckling resistance. Like tensegrity systems, the advantage of cable-reinforced inflatables is that states of compression and tension are isolated.

2.2 Tensegrity Structures in Architecture

The history of tensegrity structures is highly controversial as several people have been credited for their invention [2]; all describing identical structural modules comprising of three compression struts and nine tension cables. The name and concept of tensegrity are credited to Buckminster Fuller, whose "tensional integrity" concept dates as far back as the mid 1940's. Kenneth Snelson's 1948 X-Column sculpture is considered to be the first built tensegrity structure [2]. In architecture, 'true' tensegrity structures have scarcely been achieved as the super-structures of buildings due to the difficulty to construct them at building scale. They have most commonly been used for experimental pavilions and sculptures. The now-demolished Georgia Dome, built in 1992 in Atlanta, Georgia [10] was perhaps the most famous example of a permanent long-span structure that used the concept of tensegrity structures. Although tensegrity-domes are not considered to be 'true' [1] the success in Atlanta helped cultivate fresh enthusiasm for tensegrity research and experimentation. The first building to use a ‘real’ tensegrity super-structure was built in 2001 at an experimental facility for the University of Tokyo in Chiba, Japan [11]. A current research tread of tensegrity structure research is interested in facilitating their inherent deployment.

Several deployable tensegrity systems have been proposed over the last two decades. One variety of these systems use rigid compression members and use external actuating elements [12; 13]. Another variety builds actuating (prestress) capacity into the tension members [14; 15]. A third variety of deployable tensegrity structures integrate pneumatic actuation directly into the compression members. Such proposals have been made for applications in aerospace engineering, but have only been demonstrated with small-scale models [16; 17]. Others have developed analytical and numerical deployment simulation models for such systems and proved it was possible at large scales, but not physically tested [18; 19]. Recently, Georgia Tech Professor Glaucio Paulino used 3D-printed shape-memory polymers that self-deploy small-scale tensegrity structures by activating and stiffening strut members through changes in water temperature [20]. Paulino’s work in producing such impressive shape-changing tensegrity structures has served as inspiration for the research being presented in this paper.

3 Theoretical, Analytical, and Design Considerations

This section describes theoretical, analytical, and design strategies used to develop an ultra-light variety of deployable tensegrity structures that combine the advantages of tensegrity and pneumatic structures. The structural and analytical development of the project are described, followed by a discussion of several built prototypes that expand the field of active-deployed tensegrity structures through their use of pneumatic compression struts.

3.1 Motivation and Theoretical Basis

Tensegrity structures are known to be one of the most efficient forms of construction in terms of span/weight ratio [1] but are only stable under certain combinations of topology, material stiffness, and prestressing. Deployable tensegrity structures such as those demonstrated by Glaucio Paulino [20] can achieve a minimum weight structure with significant global volume change. Replacing rigid struts traditionally found in tensegrity structures with pneumatic compression members presents the opportunity to build an even more optimal structure. Though similar proposals such structures have been made, none have seriously considered their construction at large scale in detail. This project seeks to expand on the concept of self-deploying inflatable tensegrity structures by physically demonstrating the concept at increasing scale and technological resolution. The analytical and design challenges posed by this concept include:

- Achieving a combination of topology and prestress which result in a stable structure.
- Creating a pneumatic compression strut of minimum weight that has both the strength and buckling resistance to sustain imposed loads.
- Selecting materials and components which can be packed into a minimum volume, shipped, assembled, and inflated on site as part of a self-erecting process.

3.1.1 Topology and Prestress

A basic criterion for this research is achieving stable tensegrity structures through an essential combination of precise topology and sufficient prestress in the compression members. In order to demonstrate our concept of large-scale inflatable tensegrity structures, we have chosen to only consider simple and commonly known three and four-strut tensegrity geometries. Testing the proposed concept with a more complex configuration would add unnecessary complications. One advantage to using pneumatic struts is we assume their magnitude of prestress is correlated to the magnitude of air pressure in those members.

3.1.2 Pneumatic Compression Struts

Our research has been focused on developing new material schemas for high-performance, low pressure air-struts. These ultra-lightweight struts are stiffened via air pressure and must have the capacity to be folded or packed into a much smaller volume when deflated. The struts must be air-tight so the structure can be freestanding without the need for continuous air feeds. The struts must be sufficiently strong to handle axial loads imposed on the structure even with low air pressures. Lastly, as the tensegrity structure is loaded, the struts also tend to deform and buckle, so buckling resistance must be accounted for in struts design.

3.1.3 Materials and Components

The prototypes described in this paper were developed using readily available such as polymeric sheeting and tubing. In order maintain their air pressure, the struts require end-caps that permit a certain degree of adjustability, to fine-tune the overall length of the strut. The caps should contain air-intake couplings and any other devices to monitor or enhance the performance of the strut, be lightweight, and made of materials that are compatible with the membrane material. For the tension elements of the tensegrity structure, we assume the use of thin steel cables. The amount of stress in these cables is quite low and dependent on the amount of prestress achieved in the compression strut.

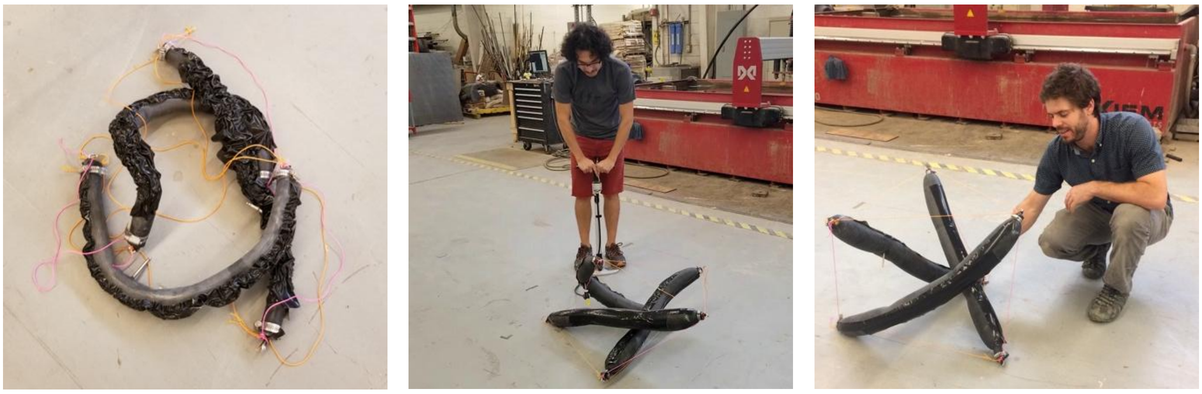

Figure 1: A proof-of-concept prototype for deployable inflatable tensegrity structure.

3.2 Preliminary Physical Prototype

As a proof-of-concept, our investigation started by building a physical model [Figure 1] using basic geometric and intuitive design guidelines [1,2]. This simple three-strut model used inflatable struts made from bicycle innertubes. The tubes were cut to length, capped with wooden dowels at each end, and held in place with epoxy and metal hose clamps. The end-caps were fitted with metal hardware to connect tension members made from braided nylon strings. The rubber tubes satisfied a critical requirement of maintaining inner air pressure, but as they were pumped with air, the synthetic rubber membranes tended to lengthen, expand, deform, and bulge unpredictable ways. As we observed behavior, tape was added to give the membranes additional stiffness. Despite its tactical use of materials and intuitive design concepts, the preliminary prototype proved our basic design criteria could be met; it validates intuitive concepts, and exhibits significant global volume change.

3.3 Structural Analysis

The structural analysis of tensegrity structures is complex. Only certain combinations of topology and prestress are feasible - often resulting in a trial and error analysis process. Additionally, the structure is geometrically non-linear, which necessitates recursive analysis procedures. Finally, the model must incorporate the non-linear hybrid properties of the air-polymer-steel compression struts.

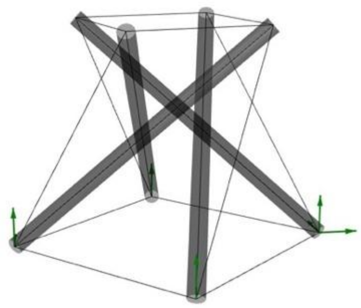

Figure 2. Basic of 4-strut Tensegrity

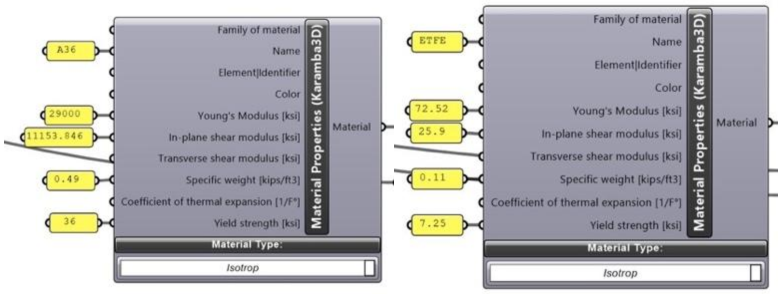

Figure 3. Input parameters for cables and struts.

The four-strut model geometry [Figure 2] was derived from a combination of engineering intuition and analogy to known stable four strut tensegrity topologies [1]. In order to facilitate the design and analysis process, a parametric model was developed using Rhinoceros/Grasshopper [21] linked to Karamba3D [22], which allowed for the viewing of real-time analysis results as input parameters were modified. Input parameters included topology (e.g. number of struts, overall dimensions, angle of rotation, etc.) as well as level of prestress, superimposed loading, and strut/tie properties [Figure 3]. Analysis results [Tables 1 and 2] were based upon incremental loading to capture geometric non-linearity and were reported for two stages: a prestress stage followed by a superimposed loading stage, visualized in Figures 4 and 5 respectively. The final configuration from the computational form-finding and analysis tool was validated using the SAP computer program [23], which confirmed the strength and stability of the proposed configuration and prestress levels.

Table 8: Member Forces.

	After Applying Initial Prestress (Lbf)	**After Applying Superimposed Loads on the Structure (Lbf)**
Struts	-18.08 (Compression)	-158.16
Top Cables	8.47	74.57
Bottom Cables	5.57	60.38
Ties	13.9	76.16

Table 2: Displacement of an upper compression node.

	After Applying Initial Prestress (in)	**After Applying Superimposed Loads on the Structure (in)**

dX	4.42	0.76
dY	-3.00	-0.45
dZ	3.07	0.54

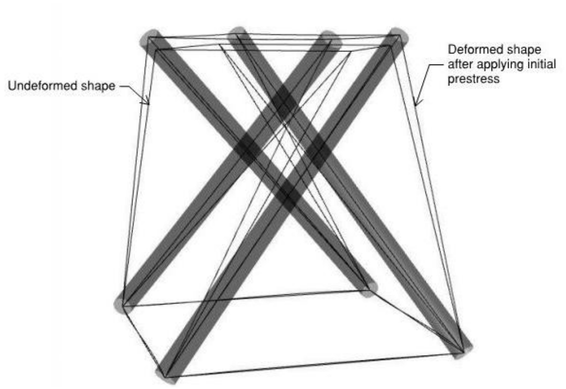

Figure 4. Deformed Shape After Prestress

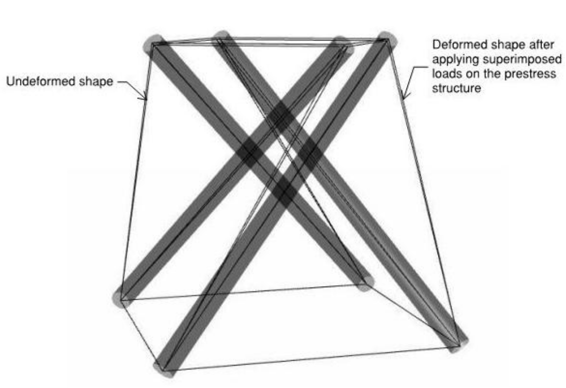

Figure 5. Deformed Shape After Superimposed Loading

4 Inflatable Tensegrity Prototypes

Following the preliminary prototype, two more prototypes were built to test our scaler limits and as a validation of the computational structural analysis methods described above. In this section two physical prototypes of deployable tensegrity structures are presented. Their common design details will be described, followed by brief discussions of each structure.

4.1 Design Details and Materials

The preliminary prototype revealed several important design considerations that were addressed in these next prototypes. The rubber membrane material lacked stiffness and was highly prone to deformations and deflections. Seeking to maintain our criterion of using commonly available materials, the two prototypes used high-density polyethylene (HDPE) tubing. Somewhat stiffer than rubber, our assumption was HDPE would provide a stiffer membrane that could handle higher air pressures and would tend to buckle less. This was proved to be particularly true when several layers of plastic tubing were used together to make a thicker membrane. The development of new endcaps to correspond with the new membrane material was another important area of focus. The caps **[Figure 6]** are made from polyvinyl (PVC) plumbing ends with steel hose clamps and synthetic-rubber casketing to provide an airtight seal in the HDPE membrane. Affixed at the center of each cap, a threaded rod around which the braided steel tension cables of the were looped around. Pairs of hex nuts were used to fix the cables to the cap and by moving them up or down the treaded rod, offered a small degree of adjustability to the length of each strut. Installed in one of every two PVC caps were brass pneumatic air couplings and valves that make it possible to inflate the assembly and let the struts maintain their air pressure.

Figure 6. End-cap and valve detail with tension cables. Shown with 2 layers of HDPE tubing.

4.2 Three-Strut Inflatable Tensegrity Prototype

The three-strut prototype [Figure 7] sought to deploy the most basic tensegrity unit at maximal scale. The geometry was intended to be a scaled-up iteration of the preliminary prototype and thus, still based on intuitive design concepts. The inflatable struts neared three meters in length and 10 centimeters in diameter. They were designed with two-layers of HDPE membranes, which provided a higher capacity for internal air pressure and were far stiffer than the synthetic rubber tubes. Despite monumental improvements compared to the preliminary prototype, the three-strut prototype did not fully satisfy our structural design criteria. The overall topology of the structure was not accurate enough, causing to struts to nearly touch. More significantly, the construction and detailing of the struts were improved, but for the strut length attempted in this second prototype, the membranes neither had enough stiffness to counter buckling tendencies, nor could they hand air-pressure need to supply enough prestress to the structure.

4.3 Four-Strut Inflatable Tensegrity Prototype

The four-strut prototype [Figure 8] attempted to test the geometry that was described and analysed in section 3.3. This prototype used the same end-caps from the three-strut prototype but made some measured adjustments. Once again, the membranes consisted two layers of 10 cm diameter HDPE tubing. Thanks to the integrated computational form-finding and structural analysis tools, the overall geometry of this third prototype was far more precise. The struts were a stiffer than before, likely due to the fact that they were shorter (close to two meters in length) and had less of a tendency to buckle due to prestress. When any part of the structure was externally loaded, the struts would buckle nearly immediately. Numerous modifications are needed to address several aspects of the pneumatic struts. Though we initially had a desire to use cheap, “off the shelf” materials, the HDPE membranes are ultimately too weak on their own for a large-scale application such as this. With a higher-performance plastic membrane such as PVC, the inflated portion would be stiff enough to resist higher internal pressures.

Figure 7. Three-Strut Prototype.

Figure 8. Four-strut Prototype.

5 Toward Buckling-Resistant Compression Air-Struts

The tensegrity prototypes described above indicated compression strut stability issues. Although inflation pressures were theoretically adequate to maintain structural integrity, premature buckling caused by weak membrane materials was an issue. As the tensegrity prototype was loaded, the struts tended to deform and buckle, which in turn caused the HDPE membrane to permanently yield into a deformed shape. This shifted the focus of our investigation toward developing new material schemas for low-pressure, buckling-resistant compression air-struts - a process that is ongoing. Our initial strategy involves using a steel cable reinforcing system in a manner similar to the “tensairity” concept [10], which offer increased stiffness to low-pressure pneumatic tubes through cable-reinforcement. Though tensairity has been proven to provide buckling stiffness to inflated members in bending, very little work has been done to develop reinforcing strategies for an air-strut in compression.

Conceptually, the inflatable tube serves mainly to provide prestressing to steel cables of sufficient strength and stiffness to sustain imposed loads. This is analogous to the effect of tendons in prestressed concrete construction. A computer model of a hybrid strut consisting of a polymer tube reinforced with steel cables was developed. Simultaneously to these computational studies, a new strut prototype was built [Figure 9], which began addressing several of the problems identified before. Through our experience working with these polymer-membrane struts, we found that the strut tended to shorten slightly as it gained more internal pressure. The caps were modified to include several points of adjustability to adjust the length of each cable. An added advantage to this was the ability to ‘true’ or straighten the compression strut. A delicate balance had to be observed: while the steel cables (along with the plastic hoops) have the potential to increase buckling resistance in the strut, one could also imagine causing premature buckling in the membrane, simply by tightening the tension cables too much. This would be analogous to putting too much post-tensioning in a concrete beam and exploding the concrete in compression.

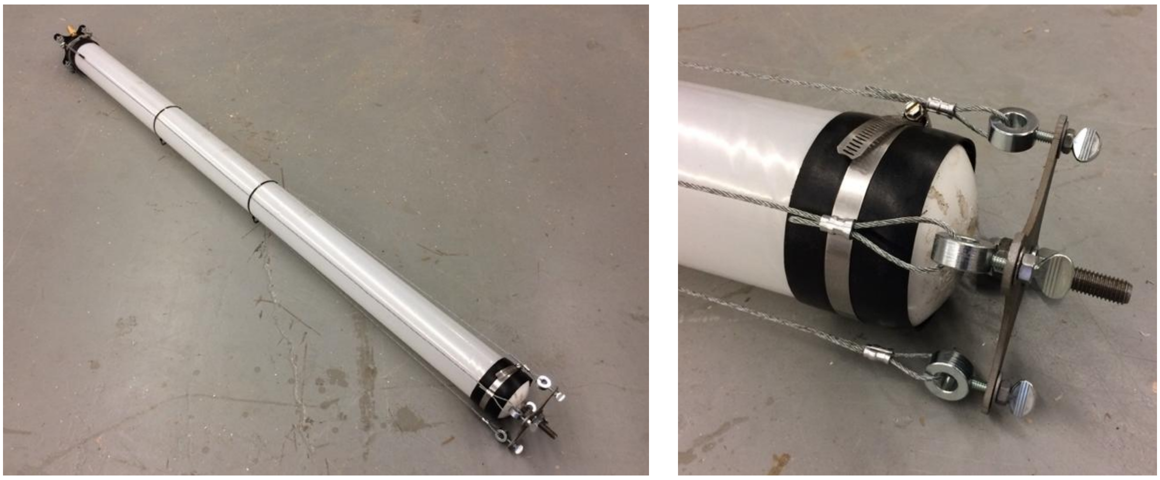

Figure 9. Cable Reinforced Air-Strut Prototype.`

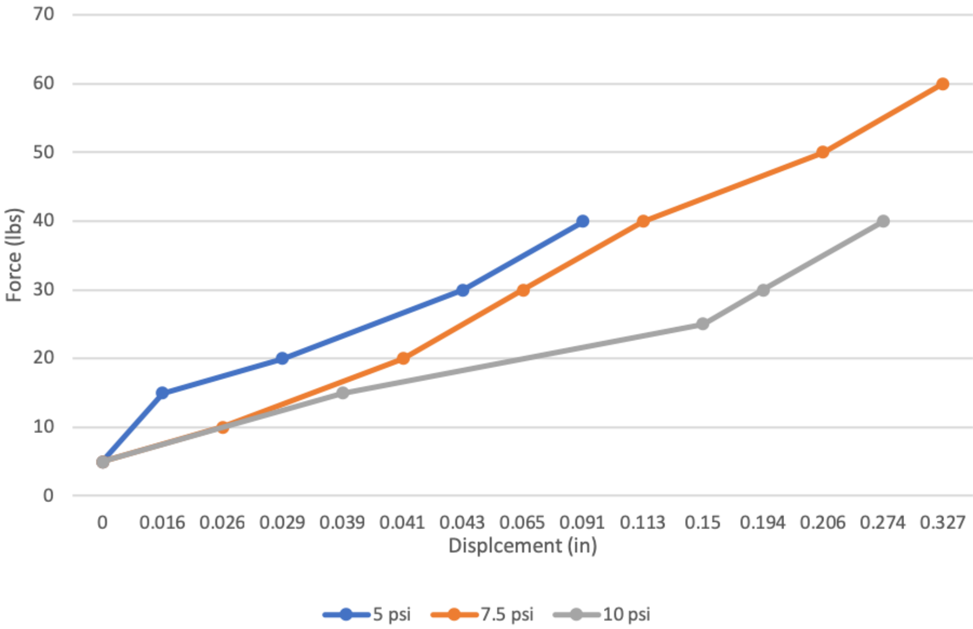

Figure 10. Force-Displacement -strut Prototype.

To confirm our analytical results, the new strut was load tested at different air-pressures. These initial tests resulted in strut capacities far lower than those indicated by the analysis. The graph [Figure 10] shows the highest loading did not correlate with highest internal pressure. Significantly, the tests revealed that as the strut was loaded externally, the diameter of the membrane increased, in turn causing the length of the strut to shorten – which we attribute to a Poisson's ratio effect caused by insufficient hoop stress capacity in the plastic. The shortened strut caused the cables to lose their tension in turn caused the strut to buckle prematurely. Using a stiffer membrane material and reconfigured tension cable scheme would help reduce this effect. Our team is currently improving the design for retesting.

6 Conclusion

The research presented in this paper has focused on developing preliminary construction strategies for architectural-scale deployable tensegrity structures that use low-pressure air-struts. Replacing rigid compression struts traditionally found in tensegrity structures with pneumatic members presents an opportunity to maximize the global volume change of the structure, and minimize its overall weight. Though proven to be theoretically possible at large scale, previous inflatable tensegrity systems have only been physically developed at small scale. This paper has presented advancements in the concept of active-deployed tensegrity structures through a series of physical prototypes that use pneumatic compression struts. The prototypes demonstrate that inflatable tensegrity structures are possible at large scale - particularly if high performance materials were to be used. With continued development of buckling resistance strategies, there is even greater potential for expanding the material and performative schemata for the struts. This is significant because it expands the potential for this technology to be applied in several contexts and scales. As performative and aesthetic concerns are considered, a wide range of design possibilities arise. At architectural scale, such deployable structures could be designed to be self-supporting or work as a part of a larger superstructure. Depending on the application, the design of the compression air-struts and the materials used could differ drastically.

Acknowledgements

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TOPIC 5: BUILT ENVIRONMENT

SPATIAL FORM ANALYSIS OF INDUSTRIAL BUILDING HERITAGE RENOVATION BASED ON SPACE SYNTAX

Wu Yanming, Zhou Qi*

School of Architecture, Southeast University
2 Sipailou, 210096 & Nanjing, China; 791367448@qq.com

Abstract

As urban development is deepening and evolving and urban functional structure is constantly adjusted, many old industrial buildings have been abandoned or idle. The protection and renewal of current industrial architectural heritage is not only a continuation of its own value, but also of great significance to urban construction and transformation. Domestic research on the protection of industrial building heritage started relatively late, and concerned practices confront the problems of single function and lack of creativity. What is more, research on reform focuses more on a theoretical level than on quantitative analysis. In this paper, taking the situation into consideration, the theory of spatial syntax is introduced into the transformation of modern industrial building heritage, and the spatial model of Hutchison Factory in Nanjing is established by convex space method. The space permeability, convenience and distribution are measured by connecting value, depth value and integration degree. Its spatial form is analyzed quantitatively and the influence of spatial arrangement on function realization is explored so as to analyze the scientific nature of the transformation scheme and put forward transformation strategies.

Keywords

Space Syntax, Industrial Architectural Heritage, Spatial Form.

1 INTRODUCTION

In recent years, with the successful implementation of industrial building renovation projects such as Beijing 798 Art Center and Zhongshan Yongjiang Park, people are paying more and more attention to the transformation of industrial building heritage and gradually abandoning the traditional practice of demolition and reconstruction. In the 1980s, China began to explore and practice in related fields. After the transformation of many industrial building heritages, its economic value has significantly improved. More than 30 years of practice have proved that the transformation and reuse of industrial building heritage have good value in Ecological, social, cultural and economic fields [1], which is in line with the current values of sustainable development in China. However, due to the short practice time and little experience in China, there are still many shortcomings in actual operation.

An important part of the transformation of industrial building heritage is spatial transformation, and domestic scholars have done a lot of research. Wang Jianguo and other scholars proposed that the method of space renovation is mainly to reconstruct and expand the original building space (including horizontal expansion and vertical expansion)[2]; for the spatial characteristics of the old industrial buildings, Li Jiani started from the space transformation design and summarized 5 ways to recreate the space, that is “plant, separate, connect, intersect and integrate”[3]; Some scholars represented by Shi Kehui proposed several major strategies for reshaping the internal space of old industrial buildings from the perspective of structural aesthetics, such as dividing space, merging space, nesting space, Extended space, connected space[4]. However, due to the current research on the spatial transformation of industrial building heritage, the research mainly focuses on the spatial transformation methods and methods, but lacks the rationality and scientific quantitative evaluation of spatial transformation. This paper focuses on the quantitative research of industrial building heritage space, and analyzes the existing typical examples. It discusses the impact of spatial layout on the functional realization of industrial building heritage space reconstruction, and analyze the science in the transformation plan to propose a transformation strategy base on its functional positioning.

Nanjing Hutchison Factory is the largest industrial heritage buildings in modern China. It is located at No. 168 West Street in Baota Bridge, Xiaguan District. It was founded in 1912 and is the first foreign-invested food processing factory in Nanjing. As one of the modern factories built by its British investor William Vestey Edmund Vestey brothers in the UK, Hutchison is a model of Western modern technology and production technology combined with local technology and craftsmanship, as well as architectural style and a sample of technical things fusion. Therefore, it is of great significance to select such an industrial building heritage as the research object of this paper. In September 2015, the demolition of Hutchison’s original site was basically completed, and there were more than ten historical and architectural buildings built in the 1920s and 1930s retained, including office buildings, laboratory buildings, workshops, slaughterhouses, and cold storage. The total construction area was about 70 thousand square meters. I was fortunate to be one of the assistants of the project leader in the autumn of 2017 to participate in the renovation design of Hutchison, and to consider and summarize the experience of the research on the spatial form of industrial building heritage renovation during the process of the entire reconstruction project.

2 Research theoretical perspective: spatial syntax

2.1 Concept and application

Space syntax theory originating from 1970 and was proposed by Bill Hillier and Julienne Hanson of the University of London's Bartlett College. Spatial syntax is a theory and method for studying the relationship between spatial organization and human society through quantitative description of the spatial structure of human settlements including buildings, settlements, cities and landscapes [5]. Different from many spatial theories, spatial syntax studies space as an independent element. And based on this, the relationship with architecture, society and cognition has been further analyzed [6]. The spatial syntactic theory does not emphasize the concepts of distance and shape in Euclidean geometry, but focuses on the structural system composed of the connection between nodes [7]. It describes a relationship represented by topological relations, focusing on the accessibility and relevance of space.

The emergence of spatial syntactic theory has laid a theoretical foundation for spatial analysis, and also brought the application of spatial morphology analysis in urban planning and architectural design to a new height. Nowadays, space syntax theory has been widely used in spatial analysis of urban planning and architectural design, such as urban form analysis, urban function analysis, urban space protection and restoration, residential space, museum (art museum) space, work space and other buildings. Spatial analysis[8]. This paper uses spatial syntax as a methodology to conduct a preliminary exploration of the architectural space form.

2.2 Choice of spatial abstraction

The premise of spatial syntactic analysis is to transform the spatial system into an expression system that can be identified by the analysis software. Spatial syntax theory usually uses several basic methods to abstract space: axis or line segment, visible field of view, convex space, and pixel points (Figure 1). When the building or building group in the urban system is dense, the axis method is generally adopted; when the urban free space presents a nonlinear layout, the convex space method or the view field segmentation method is adopted[9]. The axis method is usually adopted in the analysis of urban planning related issues. But if we try to analysis the problems related to architectural design, the convex space method and the visual field method are usually adopted, and the line segment method and the pixel point method are less used.

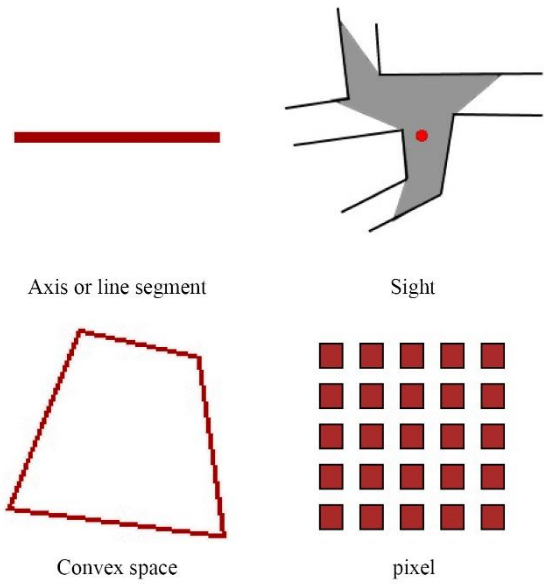

Figure 15 Basic methods of Spatial abstract representation (Source: Self-painted)

The interior space of industrial buildings is large, so it is plastic. A common method for transformation is to re-segment the internal space and then functionally partition the divided small space. For a single industrial building with a relatively small space size, it is also necessary to redefine the functions of the original space bearing in order to adapt to the overall functional transformation. The geometric form of industrial buildings is usually designed regular enough to meet the needs of industrial production and reduce design and construction costs. Therefore, whether it is to re-segment the large-scale factory building or to transform the function based on the original small-scale space, the spatial forms involved are relatively regular. This spatial morphological feature provides great convenience for using the convex space method. Most of the space itself is a convex space that satisfies the analysis requirements, reducing the workload of converting space into two-dimensional graphics.

Considering the above-mentioned spatial characteristics of industrial building heritage transformation, this paper uses the convex space method to describe the spatial form of Nanjing Iron and Steel (Group) Co., Ltd. (hereinafter referred to as "Hutchison Factory"). In the convex polygon area, the line between any two points cannot intersect with the boundary, which means that any two people in the polygon area can look at each other.

2.3 Selection of spatial morphological variables

Space syntax simplifies space into two-dimensional geometric elements such as points, lines, and surfaces, abstracts the interrelationship between spaces into a connected graph, and then performs topology on the spatial accessibility of axes or feature points according to the basic principles of graph theory. Analysis, and finally derive a series of morphological analysis variables: connection value, control value, depth value, integration degree and intelligent value[10]. These morphological variables quantitatively describe the characteristics of the entire spatial structure and the permeability, accessibility, and agglomeration of a single space or node.

This paper mainly selects three spatial morphological variables to analyze the spatial shape of the reconstruction plan of the Hutchison Factory area: connection value, depth value and integration degree.

1) Connection value: It indicates the sum of the number of other nodes connected to a node in the system[11]. In a real space system, the higher the connection value of the space, the better the spatial permeability.

2) Depth value: Depth represents the shortest topological distance between two nodes in the system, while the depth value represents the minimum number of topologies required for a node to reach all other nodes in the system, which is usually used to express the convenience of the node.

3) Integration degree: it indicates the degree of distribution of a node in the system. It is usually used to express the degree of distribution of people and traffic in the space. In the analysis process, the integration degree can be divided into two types: global value and local value. The overall integration degree indicates the closeness of the connection between the node and all nodes in the whole system. It is mostly used to describe the degree of distribution of traffic flow. The local integration degree indicates the closeness of the connection between a node and the nodes in several steps nearby, and describes the degree of distribution of the flow. Local integration is usually taken as three topological units called "radius-3 integration". The degree of integration eliminates the interference of the number of system nodes and can compare the degree of distribution of spatial systems of different scales.

3 Spatial Syntax Analysis of Hutchison Area

In this paper, the convex space method is used to analyze the position of the commercial complex in the space of the whole Hutchison area, and the rationality of the spatial arrangement of the entire Hutchison area. When examining the spatial configuration of the entire new commercial complex, the focus is the spatial relationship between the new commercial buildings and the surrounding cultural relics. Therefore, when the abstract part is irregular, it will be approximately treated as a convex space. The entire spatial analysis is done by Depthmap software, which uses color to represent the value. The color of the high value segment is reddish and the color of the low value segment is bluish.

The transformation of the entire Hutchison area is focused on the expansion, which accounts for a large proportion of the area and is the core area of the Hutchison area. This part has to bear the important role of attracting people. It can be said that the transformation effect of the newly-built commercial complex directly determines the economic benefits of the reconstruction of the Hutchison area. (Figure 2)

Figure 2 The plan of the renovation design of Hutchison Factory’s area (Source: Zhou Qi Studio design)

3.1 Local Integration analysis

The degree of local integration examines the closeness of a convex space in the system to all convex spaces within 3 steps. The 3 steps here refer to the topological distance. It can be seen from Fig. 3 that the highest integration level is the inner street of the southwest commercial area, that is, the red part in Fig. 3, which is 3.75. The road connects the new buildings and cultural relics on both sides, and the links are closer. The two axis roads in the central and northeast sides of the commercial complex have an integration degree of 2.75 and 2.16 respectively. In Figure 3, the industrial museum, commercial complex and the scenery along the river have been established near the Riverside Square. The three can gather together and share the flow of people. Relatively speaking, the local integration of the southeast side of the commercial complex is relatively low, only 1.73, indicating that it lacks good connection with the surrounding space.

Figure 3 Local Integration Analysis of Convex Space in Hutchison’s Area (Source: Self-painted)

3.2 Connection value analysis

By analyzing the connection value of the apartment and commercial complex on the east side, it is found that the connection value of this part is only 3, indicating that the east side apartment and the surrounding space lack communication, and there is no good permeability. This limits the interaction between the area and the surrounding space to a certain extent. The connection values of the surrounding streets and roads are 5 and 10, indicating that the spatial permeability of the axis road is good, which plays an important role in the connection of the entire space system (see Figure 4).

Figure 4 Analysis of Convex Space Values in Hutchison's Area (Source: Self-painted)

3.3 Depth value analysis

Depth values are critical to measuring spatial accessibility. The lower the depth value, the lower the topological distance that needs to be reached to reach the space, which is relatively convenient. The overall depth value refers to the sum of the topological distances from each space to a certain space in the space system, and describes the convenience to reach a certain space from various positions of the space.

The overall depth of the industrial museums and office buildings is 180, and the overall depth values of the two main roads adjacent to them are 121 and 129, respectively. The overall depth value of this part is at a lower level throughout the space system. As shown in Fig. 5, the minimum part of the overall depth value is a blue area, which is basically in the range of 40 to 60, indicating that the number of spaces that need to pass to reach the part of the area is small, and has good accessibility. This part of the plan is commercial, which reduces the difficulty for consumers to explore the consumption of the space, and has certain benefits for the operation of the commercial part.

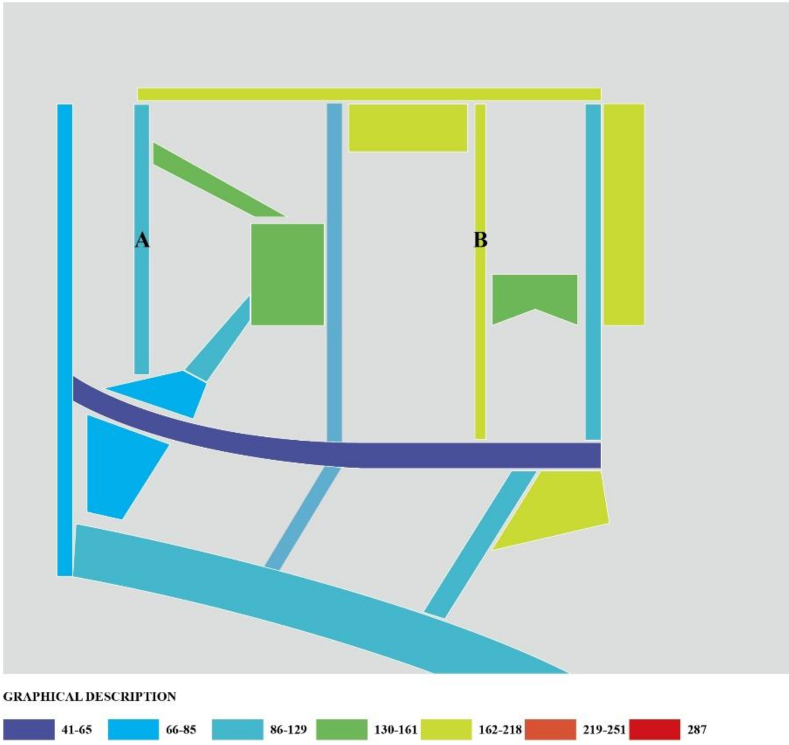

Figure 5 Analysis of the Whole Depth Value of Convex Space in Hutchison's Area (Source: Self-painted)

3.4 Analysis of spatial attributes of outdoor plaza

The connection values of the entrance plaza and the central plaza are 8 and 6, respectively, and the local integration degrees are 3.75 and 3, respectively, and the overall depth values are 82 and 130, respectively. As public spaces, their various spatial morphological variables are higher than other public spaces, and their spatial accessibility, permeability and agglomeration are better, which is convenient for realizing the function of their public activity space.

The Jiangbian Square is located at a relatively marginal location and is not closely related to the entire Hutchison's space system. Its own concentration is not high, it is difficult to absorb the flow of people. Lack of contact with the surrounding space makes it impossible to improve the internal links of the entire space system.

3.5 Review

The commercial area after the renovation of the entire Hutchison area has better spatial agglomeration and permeability, while the commercial part of the southwest has better spatial accessibility. However, the spatial separation of the commercial area on the southeast side and the commercial area on the southwest side has made it difficult to exert a commercial agglomeration effect. And the southeast side of the business is in the corner of the entire Hutchison area, the accessibility and agglomeration are not ideal, and the operational effect is not optimistic. The two main axes in the commercial complex, namely the A-axis and the B-axis, are the most balanced in terms of spatial agglomeration, permeability and accessibility, and are located in the core area of the entire Hutchison area. Due to the limitation of location and road connection, the outdoor plaza on the north side is more difficult to play the role of public space. Although the industrial museum is more important to the whole region, it is far from the core position level in terms of spatial accessibility, permeability and agglomeration due to the spatial layout. The spatial status in the Hutchison area needs to be improved.

4 Conclusions

The overall renovation plan of Hutchison Factory's area fully utilizes the original resources and carries out protective transformation of Hutchison's line on the premise of preserving the original building's appearance. Ingeniously planned two intersecting and distinctive spatial axes to achieve a harmonious coexistence between the cultural industry and the commercial atmosphere. However, the spatial configuration analysis of Hutchison's transformation plan through spatial syntax shows that the spatial layout of the transformation plan still needs to be improved.

In order to make the overall spatial layout of the Hutchison area more scientific and reasonable, and to make the spatial attributes and function definitions more matching, the spatial layout can be adjusted as follows: the functions of the southeast commercial and industrial museums are interchanged, so that the industrial museum area Relatively independent, from the interference of the surrounding commercial noisy environment, the two parts of the business can be aggregated, resulting in cluster effect. In addition, such changes allow the commercial segment to occupy the highest position of agglomeration and permeability, maximizing space advantages and value. After the adjustment, the commercial complex and the riverside scenery zone are separated by only one street, and the two can share the flow of people and build together their popularity. The commercial complex should strengthen the connection with the two surrounding roads, increase the entrance and exit of the street, and take advantage of the spatial location of the roads on both sides to enhance the agglomeration, permeability and accessibility of its own space. The Yangtze River Plaza should strengthen the transportation links with the surrounding space, and guide the dispersed people to enter, in order to bear the rest function.

Acknowledgements

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This paper was completed under the guidance of the instructor Professor Zhou Qi, including the topic selection, the reading of the literature, and the final revision. I would like to thank Teacher Zhou Qi for helping me to help me find the right direction, again and again. After the revision, the final draft of the paper was finally completed. During the writing of the paper, I also encountered a lot of difficulties, including the development of the paper, and my own health, I think all this is the process of honing me.

Finally, I sincerely thank all the experts and professors who reviewed this article. Thank you for reviewing and correcting my papers during your busy schedule.

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TOPIC 6: URBAN ECOLOGY AND CLIMATE

06.101 - COMMUNITY GARDENING AS COMMUNITY REGENERATION APPROACH IN THE CITY - A CASE STUDY IN ZHIYIN WEST IN WUHAN, CHINA

Shunyuan ZHANG, Hao HONG, Yuan WANG*

Huazhong University of Science and Technology
430074, Wuhan, China; 609790231@qq.com

Abstract

Self-constructed community gardening as informal urban gardening has been become common phenomenon in old community. Taking Zhiyin West Community as an example. This paper is based on the current physical environment condition and residents' everyday activities through observation, whilst holding semi-structured in-depth interviews with local residents. It aims to find out the challenges that Zhiyin West Community are facing with: lacking of living space, demands of private green space, poor living condition. Moreover, this paper has explored and demonstrated what impacts has occurred to people due to these challenges, understanding people's behavior and perception from the role of existing self-constructed community gardening and public space.

All the findings of this paper presented by qualitative analysis to provide supports for people to understand a better community gardening. Also, the community gardening as informal space extension in Zhiyin West, the improvement of community esteem and social cohesion through community gardening can create high-quality public space for residents' uses whilst to meet their requirements on living condition, educational uses and leisure time.

The authors expect it could be helpful for strengthening old community esteem and social cohesion in urban space and the provided design proposal could be worked as instructive advice for old community regeneration, revitalization and a guide for future urban living and better urban ecology.

Keywords

Community gardening, public space, community regeneration, community participation

1 INTRODUCTION

Community is fundamental to society development. There are numbers of problems came out in old community under the rapid urbanization. In recent years, there has been an increasing interests and a considerable literature has grown up in around the theme of old community regeneration in Chinese context. Some of the greatest challenges are lacking of living space, demands of private green space, poor living condition. In this case, the issue of community gardening has received considerable critical attention. This paper attempts to show that, an old community (Zhiyin West) in heart of Wuhan, which has experienced a special period of time in terms of social, economic and political transformation, it left some characteristics of works' village and mixed with updated urban issues. The purpose of this study is to determine community gardening has great important role in activate community regeneration. And discovers the impacts have occurred to people, understanding people's behaviour and perception from the role of existing self-constructed community gardening and public space. This paper begins by a fundamental understanding of the image of urban old community draw on Chinese context and community gardening can physically and socially effects on residents' everyday life. It will then go on to the brief overview on development of old community in Wuhan. The methodological approach taken in this study is mixed based on observation, interviews and questionnaires. The next section presents the findings of the research, focusing on the three key themes that high community attachment, middle community satisfaction and low community trust. Finally, A small urban design proposal- "Ring of Conviviality" is provided at the end.

2 Theoretical Conceptualization

2.1 Image of urban old community

Urban regeneration is identified as a best approach to solve the rising complex urban issues from rapid development of social modernization. The urban old community is taking critical role of urban regeneration, and it is regards as special product of social transformation particularly. Also, urban old community is different from modern community (new commercial housing community). It is mainly the workers' village funded by the government and company before the market-oriented reform [1]. These special community (workers' village) became the basic unit of China's urban social and economic development for a long time. Moreover, the workers' village has become a unique urban spatial cell within Chinese characteristics and occupied most of the urban space. As a result of the social and enterprise transformation, and the change of housing property marketization. The workers' village has been transformed from a socialist ideal paradise into an urban old community with retired workers and urban non-household income groups [1][2].

At present, most works' village have been converted into pure residential areas [3]. Most of these areas are located in the heart of old city, densely populated, property ownership is complex, there are a lot of problems left over from history. Also, the old community was constructed during the 1980s without good planning, public facilities are extremely far behind today. Especially, with the rapid urbanization undergoing, public facilities and physical environment cannot catch up and adapt to fit residents' living demands. There are some obvious issues such as, illegal self-construction, less green space, damaged housing and pipeline system, no public lighting, less safety control, less parking area, environmental pollution and so on. These issues become common among urban old community in China [1].

To date, preview studies have highlighted the demolition of old community as main stream. However, demolition ignored the benefit and profit inside works' village. Works' village as a representative of a particular time, still has special historical symbolic significance today. Modern community has been constantly developed while old community has been destroyed. Thus, works' village works as a legacy seems more precious [4].

2.2 Relationship between community gardening and residents' everyday living in old community

Urban gardening is identified such as urban green space, abandoned space with planting fruit, vegetables, herbs, flowers and plants. Providing urban people gardening space, beautifying the environment and undertaking urban agricultural production… [5][6]. Community gardening is based on urban gardening, as the expression of urban gardening inside community, is an integration of planting, horticultural activities, public space and residents' lifestyle. Although Community gardening comes from Europe, it advocates urban idyllic life is rooted in Chinese ideal and poetic life in the traditional farming culture [6].

Research into community gardening has a long history, it has been demonstrated that community gardening has transformed from the edible function that satisfy basic living demands into a space carrier for community empowerment. Liu yuelai [6] draws his attention to community gardening through a series case study in Shanghai. Community participation and co-sharing are the main concepts in community gardening. It creates a new connection between people and nature with an indigenous native habitat, and helping people realize their community in a welcomed co- sharing way.

Otherwise, several lines of evidence suggest that horticultural therapy plays a positive role in service people' social contact, cognition, psychological mood, spiritual vitality, daily life ability and other aspects [7][8]. The combination of horticultural therapy and landscape design can create more vivid places, improve residents' involvement and regulate people's emotions [7]. Thus, horticultural therapy can be used in community gardening while combining planting and managing garden together. However, there are very a few community gardening residents spontaneously organized and managed currently in China. Only some planned public space and public facilities are shared by residents.

The theoretical conceptualization of present study is illustrated below (Figure 1). Since works' village has transformed from a socialist ideal paradise into an urban old community, which cannot adapt to fit residents' living demands, which has great physically and socially effects on residents' everyday life. Community gardening is regarded as an action: physically, improving physical environment and integrate public space within multi-function; psychically, boosingt community cohesion and residents' esteem living in the old community through co-sharing and community participation. Thus, *community attachment*, *community satisfaction* and *community trust* can reflect residents' esteem, which can be improved by community gardening, and strengthening the old community social cohesion.

Figure 1. Theoretical Conceptualization

3 Literature Review :Development of old community in Wuhan

Wuhan is highly urbanized mega city, located in the central part of China. it is a national historical and cultural city. Also an important industrial, scientific and educational base and transportation hub in China.

Only in the past ten years have a few studies of urban regeneration directly addressed how old community regenerated in Wuhan [9] [10] [11]. It is only since the work of Deng Lei [9] that the research fieldwork methods have gained the beginning on old community regeneration. All previous findings into old community regeneration have been deal with from the perspective of community management, development and landscape beautification. The literature on old community only focused on identifying common issues, such as, disordered green and road system, old pipes system and backward community management [11]. Papers introduced design project and planning strategy were drew on the common findings. Also, fieldwork research methods were based on observation, qualitative analysis is rarely involved, such as in-depth interview and participant observation. There is no any findings and analysis on what impacts has occurred to people due to these common issues, and how to understand people's behavior and perception from the role of existing self-constructed community gardening and public space.

4 Case Study of Community Zhiyin West

Zhiyin West is one of the typical old communities of Wuhan, located in heat of Hanyang center (Figure 2). Historically, it has been characterized by workers' accommodation which refer to workers' village. It has been experienced the market-oriented reform that gave a great impact on residents living environment. Nowadays, rural-urban migrates takes a great proportion in community population. Population composition becomes complex. Its current population is approximately 9,514 (nearly 3000 families), with 70 to 80 families that having basic living allowances and 100 disabled families. Most people are more than 70 years.

63 buildings in Zhiyin West totally, over 50 buildings in were constructed in 1980s, the physical construction and basic service are under very poor condition. There are one middle school and one primary school in community. Due to the household registration system, plenty people rent and live in Zhiyin West so that their children can go to those two school. Moreover, a basketball court inside central square but nearby communities don't have.

While government begins to take community regeneration rather than demolishing and rebuilding into action, Zhiyin West has moved a giant step forward. Between 2017 and 2018, Zhiyin West had done a sponge city pilot project and 11 buildings' outsider wall was renovated. As a model community, Zhiyin West could get governmental assistance to create more public fitness equipment and better sanitation condition. But these still couldn't match the challenges that Zhiyin West truly facing: Only improvement physically but not psychically.

Comparing with other community around, Zhiyin West has a better physical environment, infrastructure, public spaces and high coverage green space. Residents have kind attitude and willingness to talk with others. All of these qualities above explained Zhiyin West has community improvement possibility in many ways though there are plenty informal self-constructed gardens in bad conditions. They are dispersed in places in community.

Figure 2. Satellite Map of Zhiyin West

Figure 3. Self-constructed Garden

5 Methodology

As this research seeks to discover the impacts has occurred to people due to these challenges, understanding people's behaviour and perception from the role of existing self-constructed community gardening and public space. It is concerned with the multiple forms of evidence available. Also, it is believed that qualitative research is more appropriate and it will give a better social understanding to see the world from residents' standpoint [12]. Interview works as primary research and it seems the most naturalistic, the most 'real' approach to finding out what people do and think in a particular setting [12].

This study begins with filed-work observation in Zhiyin West to understand physical environment, resident' everyday life and activities, and how people use public spaces day and night. Including a specific architectural typology study on community gardening, cognitive map and space annotated. An analysis for people's behaviour and perception based on 10 semi-structured in-depth interviews of Zhiyin West residents and 39 questionnaire survey. The interviews are conducted in Chinese, and each lasts about 20 mins, the interviewees are aged from 15 to 80 and are from urban backgrounds, most of them are tenements only a few are local residents have lived there for long time. 6 interviewees being 30-55 years old, one old lady is 80 and one teenager is 16. The gender split was 3 males and 7 females. They were voice recorded and transcribed. The questionnaire survey is conducted in Chinese, the age of the participants ranged from 20 to 70, with the most participants being 30-55 years old, 15 males and 24 females.

The interview questions and questionnaire survey aims to identify the residents' level of community attachment, community satisfaction and community trust based on physical environment and everyday activities. The community attachment concept was understood through observation about current physical environment and maintenance, and questions about how people's feel being living in Zhiyin West, why people liked or disliked the community and would they intended to attend community improvement. The community satisfaction concept was understood through questions about residents' everyday activities demands and public facilities demands. The community trust concept was understood through questions about mutual help between neighbours, neighbour relations and community security perceptions.

6 Findings and Discussions

The findings below reveal a High community attachment, middle community satisfaction and Low community trust among Zhiyin West residents. A discussion in relation to everyday activities and residents' living demands is followed to each theme. Interviewees' opinions have been summarized in the text to support points for the most part.

6.1 High Community Attachment

Although they complaint many issues in terms of physical space and maintenance, they still have to live in this community. What is surprisingly is that high attachment. People would like to live here, because of the great location of Zhiyin West. Providing people short commuting distance, education and basic facilities and convenient living environment. A group of aged retired people feel desperate for living in Zhiyin West. It may be that these participants, they are familiar and feel love for, the place they have been living in since they moved in in late 1980s, but they lost the enthusiasm towards life.

Meanwhile, residents' response towards community maintenance and cleanness is very frustrated. It is often argued that in old community there is a common attitude of people not respecting the tidiness of public space, a general attitude of incivility towards the physical environment. Most residents are rural-urban migrates, they say some places are dirty but don't willing to keep public space tidy individually though trash everywhere. However, they complaint community staff haven't take responsibility to keep community clean.

6.2 Middle Community Satisfaction

Since a high community attachment exists in between residents and Zhiyin West. A middle level of community satisfaction has been come out. Residents dissatisfied with the quality of physical space: peeled wall, broken roads and pipes system, over-split trash bin……. Also, they feel upset that many places lack of safety. Most parents say they worried about children playing on the central square and nearby, especially at night. An obvious reason is lacking of lighting and CCTV; many places cannot be lit very well. Additionally, lack of provision of green areas: bush hasn't got trimmed and trash on the top; trees are too thick to block out lights go through and the road is under-lit; there are several forgotten public green space without maintenance but beautiful private gardens built by residents. Hence, it could conceivably be assumed that people don’t get the sense of ‘publicness’ and ‘co-sharing’, that has rooted in human nature.

As an open community. Zhiyin West has no planned parking space when it was completely built in late 1980s. A direct impact on this issue reflected on Zhiyin West becomes a big temporary parking space, many private cars from city park inside community. Otherwise, street vendors occupied the road lead to the originally narrow road easily turned more crowded. Surprisingly, interviewees don’t care much about the availability of public space. But rich and diverse activities, informal self-construction rely on their living demands give expression to a high community vitality. Aged people do exercise in early morning, people spontaneously gather together on the central square. Teenagers play basketball and aged people play mahjong and cards during day time, and dancing after dinner. Community center is just next to the central square, regularly holds singing and dancing courses.

Another important finding is, many residents plant vegetables and fruits in boxes on the ground. It can be explained as human born with the pursuit for green space or courtyard. People use a piece of “private area” in front of door, build a small garden. Garden owner planted flowers and grass, and some painted on the wall. This is significant as it indicates any small urban design projects do have ability to support residents’ everyday life.

6.3 Low Community Trust

A low level of community trust is related to a middle level of community satisfaction. Basically, residents have a fixed social networks, a stable group of loyal friends, although they have large engagement in whole community sometimes. It can be explained as a complex population composition, many rural- urban migrations rent apartments in Zhiyin West and work nearby Those fluent population care less about Zhiyin West than old residents. Also, local people and migrates have social and communicational problems, they are not engaged very much. However, they are cautious about meeting strangers. The problems of community safety and community integration between local residents and migrants become more significant and obvious. As for community improvement, interviews present many households are willing to participate in community improvement action with local authorities and universities. But, they prefer working with their own private a piece of land in front of door. In fact, public space belongs to everyone live in this community, due to lack of the perception and conceptualization towards public space, few people pay attention to public space in Zhiyin West.

Insecurity is another major problem for residents, the improper lighting strategy and lack of lamps are the causes. Some areas are turn into dangerous after dark, burglaries happen frequently, many dark corners in Zhiyin West cannot be lit up. It can be regarded as public space transform into private space. Similarly, residents live in ground floor would like to enclose their front door space into a private garden. Positively, those gardens provide a relaxing meeting space for residents and beautifying the physical environment. Negatively, gardens occupy some space originally for traffic use. This finding may be indicate that a realistic conflict between old community and planning regulations—the informal self-construction. But, self-construction is an action representing democratic rights.

According to these findings above, local residents feel powerless and desperate to continue living in Zhiyin West because of the low level of community trust. Some residents regard government intervention is a kind of temporary pacify. Obviously, majority residents don't think they have responsibility and ability to maintain and improve physical environment. However, they expressed a strong willing and interests in maintaining and improving community from the questionnaires and interviews.

7 Small Community Gardening Proposal

7.1 Site Selection and proposal intention

The site was chosen for a further flexible development, though its current physical environment is unsatisfactory. Then central square was split into 3 parts. From north to south are activities' area, basketball court and public green space, from vivid area to isolated area. The activities' area is in front of community service centre, with cement floor, alone with 4 arbour trees. It is common to see people divided into small groups, they are playing cards or simply watching others' playing. The basketball court is quite important to youth those live in or nearby Zhiyin West, because they can only play here or very far away. The public green space is in bad condition as benches are broken, weeds springing up everywhere, no lighting and trash bin.

Based on concepts and benefits of community gardening mentioned before, the design concept will focus on the public green space. Try to improve its physical environment through simple elements, transform it to a better public space that bring a co-sharing idea to residents. This central square would be more united and balanced via spatial sequential reforming. It is believed that changing into a shared community garden from current public square could guide residents to strengthen their consciousness of community while they are facing own demands and built the garden together. Within high community attachment, more co-sharing workings will boost community trust. Once residents have realized they can truly do something for both themselves and others, or feel proud of what they have done for their living environment, a higher community satisfaction will be arising.

7.2 "Ring of Conviviality"

In line with site conditions, the idea is to keep those positive aspects: thick green lawns, cement pathway and site openness. Spatial forms will be lightly transformed by adding landscape elements within multi- functions. The Ring brings a sharing place for residents, and an in-depth regenerate possibility into community. lighting, trash bin, fitness facilities and plants will be alone with the base ring. This Ring has no specific function, residents can explore and paly with the Ring with moulded components to fulfil their demands. Therefore, with the components changing. the centre green space will be easily transformed into community playground, exhibition field, mini theatre and so on. In addition, there is a long table for people meeting and sharing home-made dishes, educational nursery of planting and farming for children, community notice board aside the entrance and main walking path. All these small design offer all aged people opportunities to meet and boot social cohesion in Zhiyin West.

Figure 4. Community garden proposal

8 Conclusion

The purpose of the current study was to determine community gardening has ability to regenerate old community. From an understanding of people's attitude and perception in terms of everyday activities and the role of existing self-constructed urban gardening and in Zhiyin West, an old community in Wuhan. This study has identified residents would like to live in a clean and safe place, with updated infrastructure and good quality living environment. Most people would like to have a piece of green space, that represented a longing for nature. High community attachment, middle community satisfaction and low community trust emerged as reliable results due to lack of aspects stated above. Taken together, these findings suggest a role for community gardening in promoting community participation and co- sharing way, try to boost community esteem and social cohesion. The major limitation of this study is lacking of empirical practice, a large amount of research work have been gained and a series of gardening activities has been planned. However, municipal institution blocked the work to proceed in Zhiyin West. Notwithstanding this limitation, this is the first study to investigate the effect of how self-constructed community gardening occurred to people's life in old community in Wuhan. Therefore, the authors expect a further study could assess the long-term effects of community gardening in one old community, to see how this activity enrich the urban green space with in-depth co-sharing community work.

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06.102 - THE INFORMAL CITY. PATTERNS OF APPROPRIATION OF PUBLIC SPACES

Manuel C. Teixeira
CIAUD - Cento de Investigação em Arquitectura, Urbanismo e Design
Faculty of Architecture University of Lisbon
Rua Sá Nogueira, Polo Universitário da Ajuda, 1349-063 Lisboa, Portugal
manuelteixeirafa @gmail.com

Abstract

Informal social-economic dynamics have a deep impact on urban spaces, both regarding the setting of informal activities in the city and the housing of the populations involved.

Although such informal social-economic dynamics are a crucial component of the city's image and vibration, they are often disregarded and its urban imprint repressed. When repression is not an option, given their importance for urban life and no formal alternative is available, informality gains an aura of invisibility. Homeless people, street vendors and all kinds of informal appropriations of public spaces, although they are all around us, are kept out of our psychological awareness whenever we don't need them or choose not to be disturbed.

And yet, a city only acquires an urban feeling when such unplanned and informal activities make their appearance and their urban imprint is a fundamental part of the urban flavour. Despite their fleetingness, they tell us more about city life of a certain period than the buildings and urban layouts, permanent across decades and centuries.

The study will focus on Lisbon, Portugal, and will look into these issues from two different perspectives. First, from an historical perspective, we will look into old prints and photographs, where such activities are prominent. Second, we will look into the contemporary scenery, in order to understand the way such informal activities, often contrary to planning directives, are shapers of urban life and urban form.

Informal social-economic dynamics gain a foothold on the formal city by means of an acute sense of location, of accessibility patterns, of social, economic and functional patterns of organization of urban life, as well as by means of informal townscape as well as actual design strategies the architects would gain to learn from.

Keywords

Informal city, public spaces, informal townscape, design strategies

1.

Informal social-economic dynamics have a deep impact on urban spaces. Two instances in which this impact is most visible are the setting of informal activities and the patterns of location of illegal settlements in the city.

Although such informal social-economic dynamics are a crucial component of the city's processes of development, as well as of its image and vibration, they are often disregarded and its urban imprint repressed. When repression is not an option, given their importance for urban life, either they are integrated in the formal city or, when no formal alternatives are available, informality gains an aura of invisibility. Homeless people, street vendors and all kinds of informal appropriations of public spaces, although they are all around us, are kept out of our psychological awareness whenever we don't need them or choose not to be disturbed by them. And yet, a city only acquires an urban feeling when such unplanned and informal activities make their appearance, and their urban imprint is a fundamental part of the urban flavour. Although some of them are transient, they tell us more about city life of a certain period than the buildings and urban layouts, which are permanent across decades and centuries.

2.

The city one inhabits is the synthesis of multiple layers accumulated over time. These different layers are present simultaneously in the street layouts, the buildings, the uses, with rhythms of change different from each other. The uses change rapidly, the buildings may change in decades, the urban layouts may change in centuries, if at all. These different layers that make up the city are the result of a variety of processes, some of them planned and carried out under the control of public powers, many others the result of multiple actions carried out by individuals in a piecemeal way over time, some complying to existing regulations, others against or oblivious to them.

In any case, the city is a work of man, the result of man's actions. Although one accepts the idea that the city is the result of larger social and economic processes, these processes are always mediated by people and implemented through individual actions. The study of the city is therefore essentially a study of human actions [1], no matter what the actual processes are. The consequences of such actions are, on the one hand, the built up spaces of the city, its physical reality; on the other hand, the uses of such spaces, the way people inhabit, live and use the city.

The city is both the material result of people's actions and the unfolding of those same actions in everyday life. In other words, the city is composed of spaces and of the life that goes on within them. Many of these actions are rational, even if such actions are not always clear to the actors themselves. Their interests are not integrated into a coherent system and are not free of contradictions. Furthermore, men also have other ways of behaving, not wholly rational, characterized by affective and emotional conducts. Their actions on the city embody not only rational behaviours, based on rational interpretations of reality, but they also embody non-rational and non-logical motives, objectives and behaviours. As Alfred Schutz said, "men's thought is just spread over subject matters located within different and differently relevant levels, and they are not aware of the modifications they would have to make in passing from one level to the other" [2].

It is in this complex and often contradictory context that one must understand the development and the construction of the city, which is into a large extent the result of bottom up processes, usually classified as illegal, informal, organic or some other imprecise designation. In fact, in many cases, urban entities are neither fully planned nor the result of unplanned activities, and Portuguese cities are an example of that. They are hybrid configurations negating the exact distinction between planned and non-planned.

Unplanned actions, meaning by that the actions that are not subject to a centralized control, but instead carried out by myriads of individuals going about their daily lives, play an important role in the way the city is organized and evolves over time. Some of these actions have large scale consequences, like the shanty towns or illegal settlements built completely outside municipal or state regulations and which become an important part of the city. Others are more modest, but equally with a significant impact in the way the city is organized and inhabited.

Some instances in which informal activities influence the organization of city life have a local impact. For example, in the definition of paths crossing a green or a square. Sometimes, the paths defined by the planner or the architect in their designs are actively contradicted by the more sensible tracks treaded on by the users of those same spaces, leading in the end to the change of pathways, zebra crossings, traffic lights and so on.

In many cases, buildings with specific functions or the location of certain activities may be explained only by their origin as the sites where informal activities once took place and eventually took root. Commercial activities seem to be an active shaper of urban form. For example, a street seller of refreshments [3] with his selling point, although informal, established in a particular place, may have attracted other vendors and today that same spot has become a fashionable location of terraces and coffee shops.

Figure 1. A street vendor of refreshments in Terreiro do Paço, Lisbon, 1908

Figure 2. Terrace of a coffee-shop in Terreiro do Paço, Lisbon, 2019

A similar example concerns the place where street vendors of fruit, vegetables or other merchandises sold their wares [4], which in time became a proper market building. The same with other types of activities, which became associated with specific locations in such a way that sometimes, even contradicting municipal plans, they came to define the nature of a place and determine its development. That occurred, for example, in Oporto with the informal Mercado do Anjo, established in the Cordoaria Garden for more than a century [5], which today became an upmarket mall.

Figure 3. Street seller of fruit, Lisbon, 1962

Figure 4. Market, Lisbon, 2019

Figure 5. Mercado do Anjo, Oporto, n.d.

Figure 6. Commercial mal in the same location of Mercado do Anjo, Oporto, 2016

Other activities did not have a direct impact on the city form, but on the way urban spaces are lived. That is the case of the popular parades organized in June by different neighbourhoods of Lisbon, [6]. These parades, which started as small scale genuine manifestations of popular culture, became touristic attractions that command the city centre a few days a year.

Figure 7. Alfama, Lisbon, 1963 Figure 8. June parade, Lisbon, 2017

Many other activities did not leave any imprint on the city. Street life, or at least a particular type of street life characterized by its popular nature, was in previous times much richer than today. For example, the street theatre, the puppet shows or the street entertainers [7] who, still active until the 1960's, disappeared altogether. Many such popular street activities vanished, others were taken indoors or were refashioned and commercialized, appealing to more prosperous segments of the population.

Figure 9. Puppet show, Lisbon, 1966 Figure 10. Street entertainers, Lisbon, 1957

There are other instances in which social-economic informal dynamics became deeply imprinted in the form of the city. That is the case of the informal settlements, which grew within or in the periphery of cities and became an important part of the urban fabric and of the city's townscape. In Lisbon, this process took two forms: the shanty towns and the illegal settlements in the outskirts.

The poorest settlements, which began to be built in the first decades of the twentieth century, were the shanty towns, or *bairros de barracas*, insalubrious settlements made up of small shacks built with poor materials. These shanty towns typically occupied empty areas of the city that in a few decades would become central. The shantytowns of Lisbon began to be demolished in the 1970's, by which time those areas had become valuable. However, contrary to expectations, the population was not evicted to the periphery.

In the political context of Portugal at the time – after the revolution of 1974 that overthrew Salazar's regime – the inhabitants of these shanty towns developed strong popular movements, in consequence of which they were lodged in housing blocks in urban areas close to their previous locations. These were prime locations, destined to other more profitable purposes, and this change of land uses was in stark contradiction to the directives of the city's master plan, which had to be changed in a significant way to accommodate the new reality.

Figure 11. Shanty town in Lisbon, 1960's

Figure 12. Housing blocks for the rehousing of shanty town's inhabitants, 1980's

Another form of informal production of housing were the illegal settlements, the *clandestinos*, built on the periphery of Lisbon mainly from the 1960's, which also contravened local master plans. Although illegal, lacking basic services and infrastructures and with building deficiencies, this was a better type of housing. They consisted of individual or multi-storey houses made up of bricks and mortar. After 1974, and in the same political context, most of these settlements were not demolished, but given infrastructures, rehabilitated and legalized. This new situation had a deep impact on accessibility patterns, road infrastructures, public transport routes, altered priorities regarding other public services and implied the reformulation of many local and regional master plans.

Thus, in two different ways, the informal socio-economic dynamics that originated the shanty towns and the illegal settlements had in the end a durable impact on the city structure and image. Both at the small scale, regarding the location of specific activities in the city, or at the large scale, concerning the city's land uses, such informal dynamics gained a foothold on the formal city by means of an acute sense of location, of accessibility patterns, and an understanding of social, economic and functional patterns of organization of urban life on the part of those involved. That was a necessary condition to make such endeavours successful.

3.

In order to understand these informal dynamics, one may resort to existing documentation, both written and visual. But very often, given their informal nature that is not enough, either because that documentation is insufficient or simply does not exist. If one wants to understand the city, the processes that gave origin to it and its development, in addition to this research based on documentary sources, one must also engage in a kind of archaeology. Not an archaeology of buried things, but an archaeology of physical traits – layouts, streets, architecture, details – which, beyond all the changes they underwent over time, remain inscribed in the built up spaces of the city and constitute a forest of indices ready to be decoded.

One inhabits a city of different eras, whose remains are present simultaneously in the reality that surrounds us. Walking around the city is an exercise in deciphering what is hidden behind each one of its elements. The main source for this reading of indices is the city itself, a repository of all physical strata built through time, which is usefully complemented by the study of historical cartography and iconography. These two sources of visual information illustrate the continuous additions, corrections, deletions that make up the life of the city. Thus, to the search for indices that is focused on a living reality – the city around us - one may add an archaeology of past urban structures and patterns of land use, to which one of the most important tools is the study of historical cartography.

Cartography is a privileged narrative for the description and knowledge of cities and their processes of development. However, one should bear in mind that cartographic representations are always made on the cartographer's perspective, who describes and values the different urban elements according to his own criteria, or his patron's criteria, and the cultural frame of reference at the time. Cartographic representations are always the result of a process of selection of that which may or should be represented, according to the objectives of such representation and the multiple filters that consciously or unconsciously are interposed between the reality, the gaze of the cartographer, and what is registered. Cartography is description and inventory, but also expression of selection and discrimination. The mental framework of the cartographer is revealed in the way regular urban structures were represented in an irregular way when there was not the perception of regularity that, later on, would be given by flat projections. In the same way irregular urban structures were represented as regular when principles of geometrical rationality ruled the way the city was conceived and, a result of that, the way the city was represented.

In the same manner, informal spaces that were not inscribed in the dominant order did not exist in cartographic representations. That was the case with informal settlements built within the urban fabric or on the outskirts of cities. Because these settlements were often socially invisible, unrecognized and not talked about, their social non-existence was translated into their invisibility in terms of cartographic representation.

In Lisbon, for example, the shanty towns that dotted the city until the 1990's were not represented in the city's cartography. Because they were never mapped and they were eventually demolished, it is, as far as cartography is concerned, as if they had never existed. Apart from a few surviving photographs, one cannot reconstitute the way large areas of the city, for most of the twentieth century, looked like. Similarly, the illegal settlements that surrounded Lisbon only appeared in the official cartography when they were legalized. Until then, like the shantytowns, it was as if they did not exist. In city maps of the 1970's and 1980's the built up spaces that corresponded to these illegal settlements, where thousands of people lived, were represented as large blank areas.

That was not new. At all times, all illegal or informal urban spaces were left out of the official cartography. In Oporto, the working-class houses, the *ilhas*, which were built inside the urban blocks throughout the second half of the nineteenth century, were not represented in contemporary cartography. Although up to one third of the city's population lived in such houses, in rather poor conditions, they were not talked about either in Council meetings or in the press [8] for most of the century. For all purposes they were not *acknowledged*, despite their existence for decades. Only towards the end of the century, when serious epidemics broke out in these housing clusters and spilled into the formal city, they were recognized, began to be talked about, the first measures were taken toward their eradication, and they finally appeared in the cartography of the 1890's.

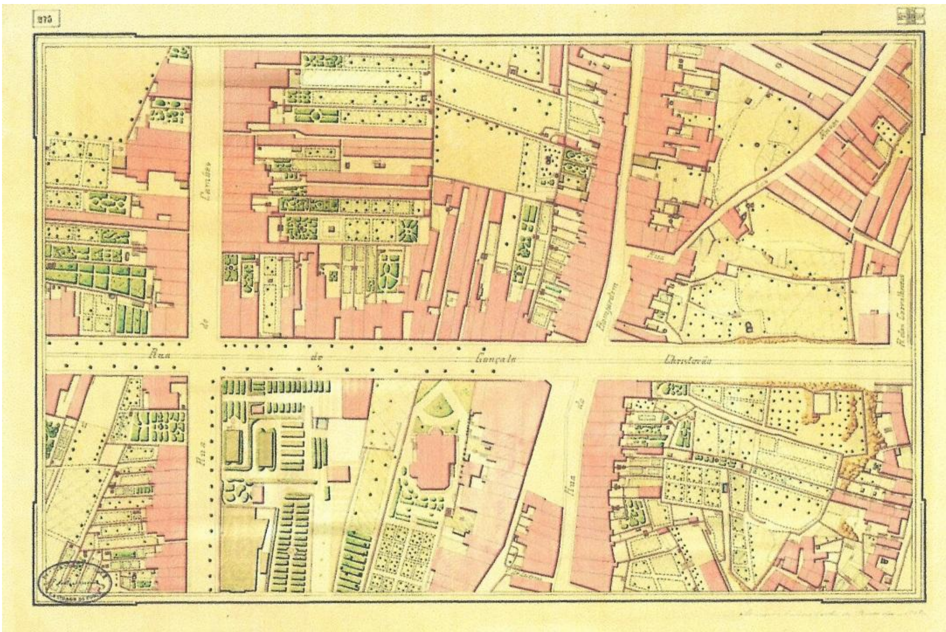

Figure1. Teles Ferreira, Planta Topográfica da Cidade do Porto, 1892. Sheeet 275.
Working-class housing first represented in the city plan of 1892

4.

In the end, and in most cases, reality imposes itself. Even if certain types of activities and forms of city growth are refuted at the beginning, they end up being accepted, either because they make sense or because of their sheer force, they impose themselves and change existing patterns of organization of the city. In any case, they are important for the generation of the layered complexity and seeming chaos of urban life. People in their daily lives have a finer understanding of the actual reality they live in, the challenges they are faced with, the objectives they want to fulfil, and the way the city must answer these needs and aspirations, rather than planning professionals in their offices often away from that same reality.

Cities are living beings and ecosystems, as Jane Jacobs emphasized [9]. The desired diversity, density and dynamism of city life may only be achieved by means of a larger share of initiative being given to such informal activities, and bottom-up planning given more credit and a larger role in the planning of our cities.

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06.103 - MUNICH_RE

Gerd WETZEL

Institution
STUDIOWETZEL, Germany
Schaffhausenstrasse 111, 72072 Tuebingen, Germany; gerdwetzel@gerdwetzel.com

Abstract

MUNICH_RE is a strategic design proposal dealing with the massive growth of Munich, Germany´s 3rd largest city. Munich is currently a city seemingly in denial with a massive lack of optimism regarding the future of the city in terms of urban identity. But there is much potential that should be activated, especially through communication and visualization of possible scenarios.

Keywords

Munich, Growth, Strategy, Vision, Proposal.

1 INTRODUCTION

Despite the huge economic success and the accompanying growth in population within the last decades, there is a massive lack of optimism regarding the future of the urban shape of Munich.

In order to shed a light on the reasons for this pessimism and to open up ways to overcome it, it is necessary to put it in a wider historical context

2 Chapter 1. Past and Present

Munich and Growth

Munich is more than 850 years old, but Munich's ascend to become one of Germany's major cities only began around 1800. All its major steps of growth happened since then. And almost all these steps left their readable traces within the urban fabric of the city.

Growth, Bigness and Copies

During these times of growth, major urban development took place. Axes like the Ludwigsstrasse (built 1816), the Maximiliansstrasse (1850), the Prinzregentenstrasse (1891), plazas like the Koenigsplatz (from 1854 onwards) reached out and connected into new territory. The English Garden, a park bigger than Central Park in New York and still one of the biggest urban parks worldwide, was opened when Munich only had 40.000 inhabitants in 1789. When they were built they were vast compared to the surrounding city.

Most of these extensions have a few things in common: in the time when they were built, they had a massive impact on the city. Many of them were axial developments. Most of them used adapted architectural styles from all around, whole buildings and architectural ensembles were copied. Few of them were uniquely new like the Olympic Park for the summer games in 1972. But all of them became the pride and joy of Munich. They became vernacular.

Figure 16. Urbanized Areas in 1860 with main axes (left) and English Garden (right, southern part only) in comparison to today´s city limits

Growth and Pessimism

Today the situation has changed. Most new urban developments in Munich don´t seem to be welcome any more. There are huge discussions about shape and size of new developments, which leads to a somewhat timid planning approach. Rather than aiming for big urban visions, developments are scaled down to make them seem less of a change. And in the end everybody is disappointed about the results. A vicious circle. Definitely, size seems to matter.

Intermediate Conclusion 1:

Munich's urban constitution is marked by big urban developments which were absorbed both by the urban fabric and became part of the collective urban memory. In many times size was not an issue and the mix of styles was eclectic. Hence it might be possible to originate a fresh approach towards growth and the new developments in Munich. But in order to get the right perspective on the current situation, it is important to get the numbers right.

3 Chapter 2. Scaleplays – Communicating Numbers

Scaleplay Part 1: How Big Is the Growth?

In the last decade, Munich grew at an average rate of almost 22.000 new inhabitants per year. In average today an inhabitant of Munich occupies approximately 40m² of housing per person. This means each year of housing is needed. Compared to the Munich´s surface within the city limits of 310.710.000m², this would be a recognizable area.

Of course, the 880.000m² new housing per year is somewhat abstract. A common option to visualize growth would be a comparison to familiar structures, thus gaining some kind of a feeling for the numbers: The growth would translate into 18 Barcelona blocks or 6 New York blocks.

Figure 2. Munich city limits today and new m² needed per year (in black)

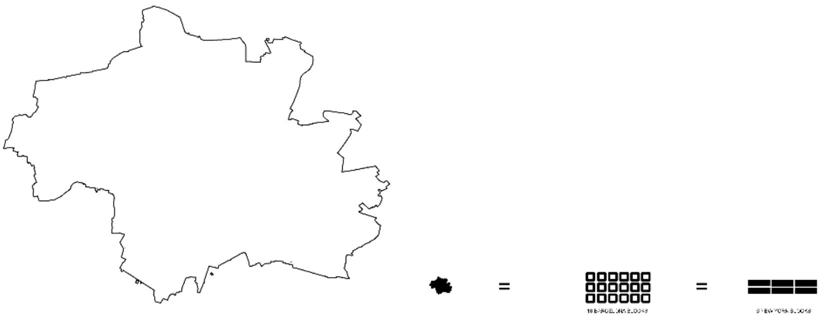

Figure 3. Growth per year translated into Barcelona and New York Grid

Scaleplay Part 3: Positive Translation / Comparing Ratios

But rather than showing relatively abstract shapes and translations, it is obvious to choose a comparison that everybody in Munich can relate to: The English Garden. When it was built in 1789 Munich had only 40.000 inhabitants. If one was to build the English Garden today and would use the same inhabitant/park ratio as in 1789, an English Garden with gargantuan proportions would be the result: a new English Garden XXL. Not timid at all

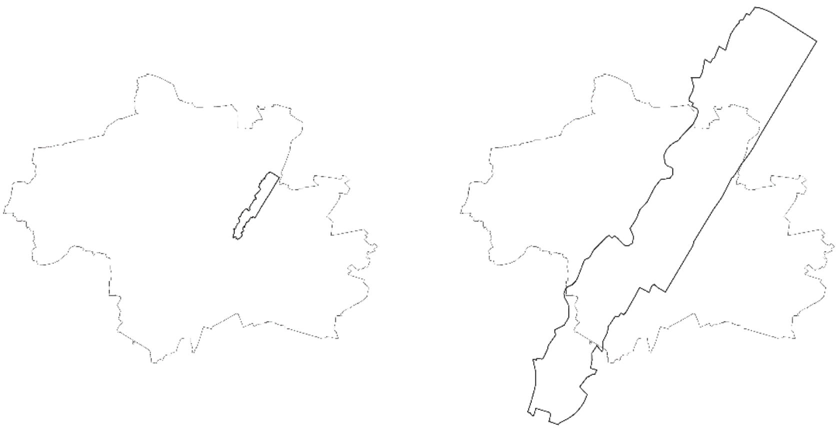

Figure 4. English Garden original size (left) and English Garden XXL (right) compared to Munich´s current city limits

Scaleplay Part 4: Multiplied Structures

As shown before, the right comparison can lead to surprising and eventually positive results. So let´s go one step further and imagine what would happen if Munich's new inhabitants would be accommodated in existing buildings and urban structures. How many of these would be needed each year, every ten years? Some of Munich's most remarkable structures function as guinea-pigs:

- The Munich "Residenz", the former royal palace, construction started in the 14th century

- The "Gaertner-Square", a popular neighborhood from the 1860s, situated in the center of Munich

- The "Neuperlach Wohnring", a prototype example of „Wohnlandschaft" from the 1970s

The following figures show the number of structures that would be needed to house the growth of Munich:

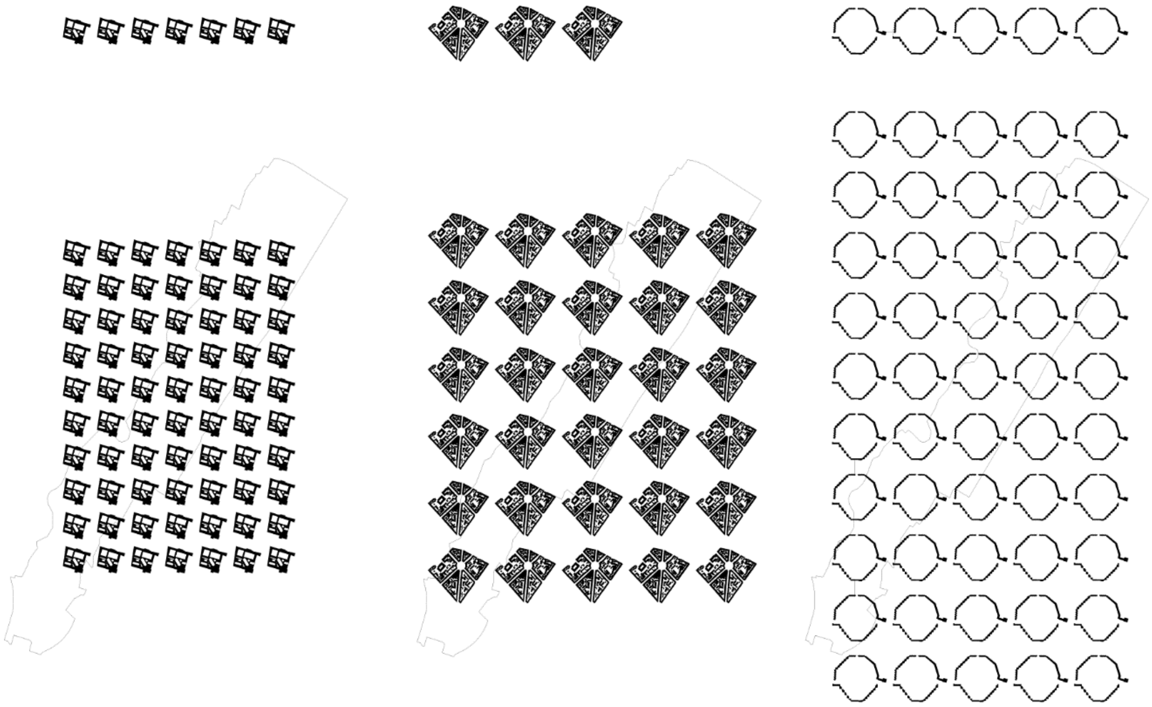

Figure 5. Growth per year/ten years converted into the Munich "Residenz" (left), the "Gaertner-Square “(center) and the "Neuperlach Wohnring" (right).

Intermediate Conclusion 2

The current growth of Munich allows massive developments. Why not use this chance to do something that everybody can agree upon: to build more Munich!

3.1 More Munich

Since the idea of copying buildings, structures, and axes was already successfully used as a tool in past centuries, it seems obvious to re-introduce this strategy. This could establish urban structures that would become vernacular again. Already existing structures should be quantified and converted into patterns. This manipulation allows reinterpretation and to weave the urban fabric further. Interference and superimpositions with already existing structures should be sought. They could link between copied past, past and presence, generating identity. By pairing the copy paste approach with existing large-scale landmarks and structures, recognizable anchors and rooms can be created. These can be filled with functions and be read anew. They could create the anticipation of the known.

Existing landmarks, buildings, and axes, need to be identified and activated. This allows re-using already existing sense of place, to rearrange it, to collage it. The already existing collage patterns then can be re-collaged and thus turned into originals in their own right. Rather than a fixed rigid city with predetermined buildings, these collages should then be used as a framework, providing the space for further urban development.

So this copying act could be much more than just copytecture, many different topics could be addressed: image, identity, context.

3.2 Adapting existing Strategies

Much of the above was already addressed in urban strategies, in different times, different places and in different contexts. Many were already executed in Munich. So let's try a few of these strategies:

Testing Strategy 1.): Playing with Scale:

„As Koolhaas said, if it has a certain scale, that has value in itself, regardless of what it looks like. A high tower becomes special, as soon as it exceeds a critical height., even if it's terribly ugly "(1)

As illustrated before, the growth of inhabitants in Munich could generate 880.000m² of new buildings which could be translated into 7 Munich „Residenz "buildings.

This again would make the growths more understandable, it would add scale and dimension. Obviously this would raise questions, but it would as well offer some options too. These options could be varied in order to generate options that could easily be adapted and communicated. It could be used as a head start for the planning of new developments.

Figure 6. 7 x The Munich Residenz

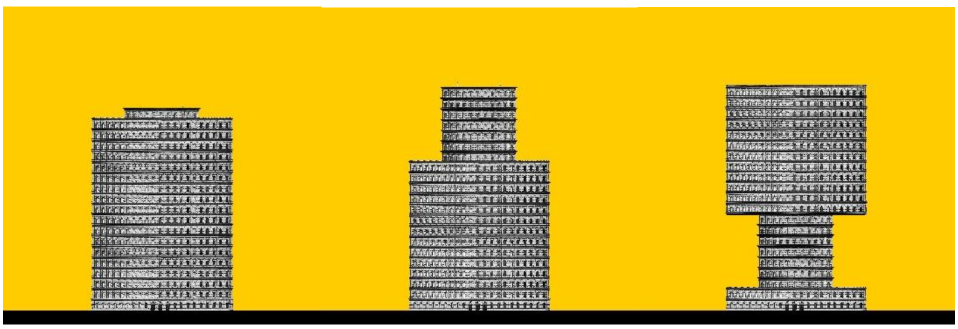

Fig. 7: The Munich Residenz (Main Facade) scaled up and multiplied to accommodate the average need for housing each year. 3 Variations.

Testing Strategy 2.): The Beginning Middle and End of Buildings

"(...) sometimes a building wants to be the base for another building" (2)

Buildings need a connection to their surroundings. They can achieve this best with articulating a connection to the ground or the street level, which is the most important part of any building for pedestrians, and thus for the live in cities.

The other end of a building needs to be articulated as well since it relates a building to the sky. Of course, there should be a well configured middle section as well, but let`s stick to the beginning and the end for the time being.

As already said, the beginning or the ground level of a building is the most important part. It should be accessible and interact with its surroundings. Public functions, shops or other accessible functions could be situated here.

On the other end of the building, other functions could be situated in order to add expression and identifiability to the building. Especially in Munich, where space is scarce, these areas are essential for the benefit of the city. Towers and articulated roofscapes, traditionally the articulation of roofscapes with dormers, small etc. was well established in Munich. Artists' Studios, Kindergartens, and sports facilities could be accommodated here and would not only contribute to the roofscape in a functional manner but would as well work on a visual level making the buildings more recognizable.

Obviously this approach is nothing new. One of the most livable quarters of Munich, Schwabing, was densified that way after it became a part of Munich at the end of the 19th century. Shops and Stores were situated in the ground floor, artists studios and ateliers were situated in the roof, contributing to Schwabing´s and Munich´s fame for being an artistic center at the turn from the 19th to 20th century.

„Enough original genius! Let us repeat ourselves endlessly" (3)

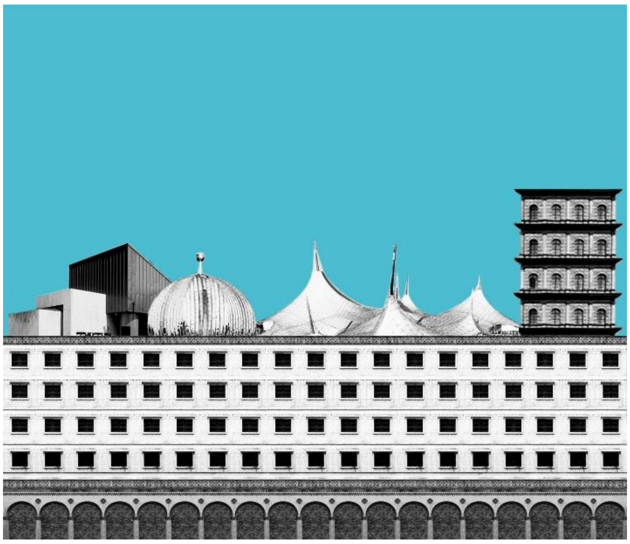

Fig. 8: Collage New Schwabing House

Testing Strategy 3.): Themed neighbourhoods

The approach explained before could be as well neatly be packed in urban clusters, as they have been earlier: Schwabing used to build a reputation as the artists quarter(especially writers and painters)now different themes could be addressed: a musicians quarter with studios and proberäumen to fight the extreme lack of these spaces in Munich, a gallery quarter (with obligatory and subsidized small galleries in the ground floor and artists studios on the north sides in the top floor) or themes like global warming could be addressed and Munich could demonstrate its leading role in research and industry by building the greenest new housing areas ever (Munich wants to be climate neutral by the year 2040) So even problems and already set goals by the city government could be addressed, formulated and thus used for the branding of new areas.

Luckily some of the issues mentioned earlier are now being installed (e.g. more public functions in the groundfloors), but a wider view on these possibilities should be embraced openly and investigated by municipal planners.

Testing Strategy 4.): The adapted Haverleij approach

„the architect should be a scientist that is able to use existing knowledge on technology, and who knows the complete repertoire of previous architectural samples in order to use them anew "(4)

Haverleij is a settlement for roundabout 1000 inhabitants as a part of the Vinex-Program. The Vinex is a housing program established in the Netherlands in 1990. To overcome the monotony often criticized at of the Vinex program, in Haverleij new housing complexes were built as dense, fortress-like structures that offer clear identification for their inhabitants. The landscape and surroundings were not to be influenced by the designs of the structures, only the interior areas of the structures were designed by the architects responsible. In order to make this strategy usable for Munich, two points have to be clarified: since there are actually no big castles in Munich that could be used and adapted to work as a castle structure?

How could this approach be tested? As guinea-pigs for the castle structures obviously an iconic building should be used: The Neuperlach Wohnring which was mentioned earlier. As the site the so-called planning area "Städtebauliche Entwicklungsmaßnahme München Nordost" (Urban Development Scheme North-East) could be used, where new housing developments are planned. The interiors of these new castles could then be filled with various themes, the surrounding landscape could be structured with golf courses and farmlands, probably both themes Munich's inhabitants could identify with.

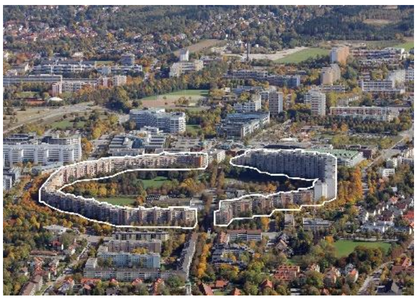

Fig. 9: The Neuperlach Wohnring

Fig. 10: Site (left) Site and Golfcourse (Middle), Golf Course and Wohnring-Castles (Right)

Testing Strategy 5.): The reused Relic

A relic is something people can relate to. In Munich, there are several large relics that await revitalization, for example, the Paketposthalle (a former post and package logistics center which is after heavy debates about its future now on the course of being re-awakened by private investors following a masterplan from Herzog & De Meuron).

Another relic that's actually an urban gem lying in plain sight is the Regattastrecke in Oberschleissheim in the northern edge of Munich, which used to be the rowing course for the 1972 Olympics. The latter is now part of a discussion about listing and so forth and new uses are sought for this massive 2km long seminatural swimming pool.

But why could this relic be so interesting for urban development? If we compare it to the main axes shown before being used during the extensions in the 19th century, the potential becomes evident:

In terms of scale, it would just fit neatly into the line, in terms of use it could add something completely new for Munich: a feeling of being at a harbour, at a long seminatural linear structure that offers relaxation, sports activities, and marvellous sunsets.

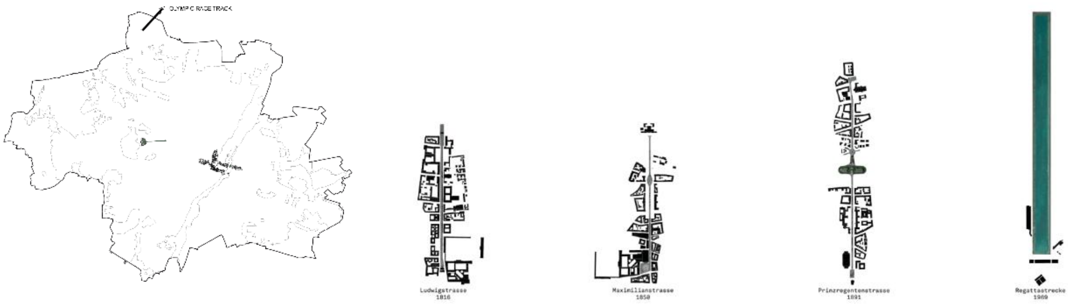

Fig. 11: Historic Main Axes within Munich and the Olympic Rowing Track in Comparison

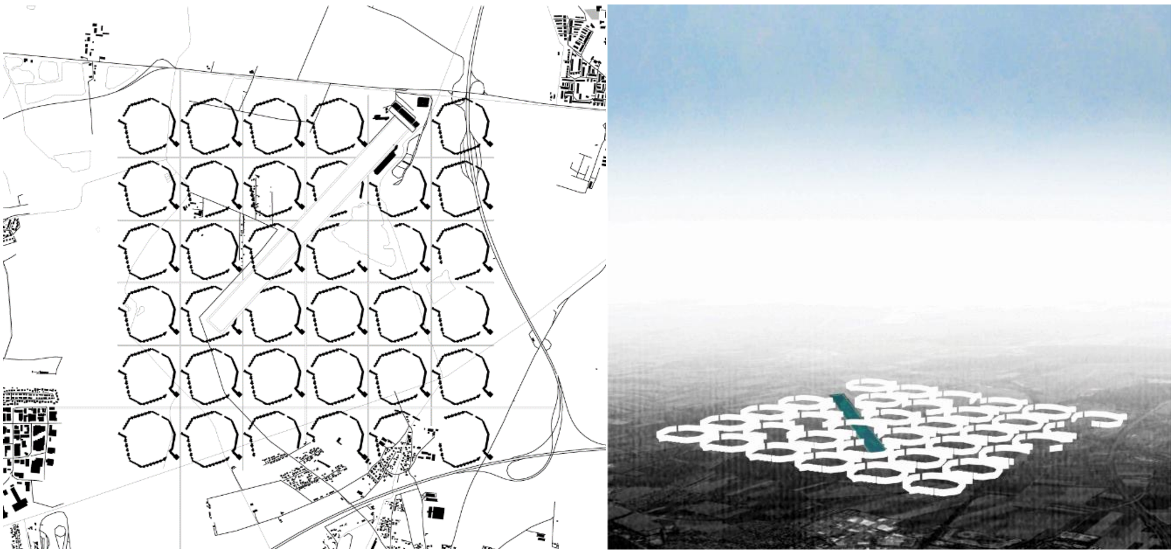

Fig 12: "Wohnring" around the Olympic race track, urban plan (left), and aerial view (right)

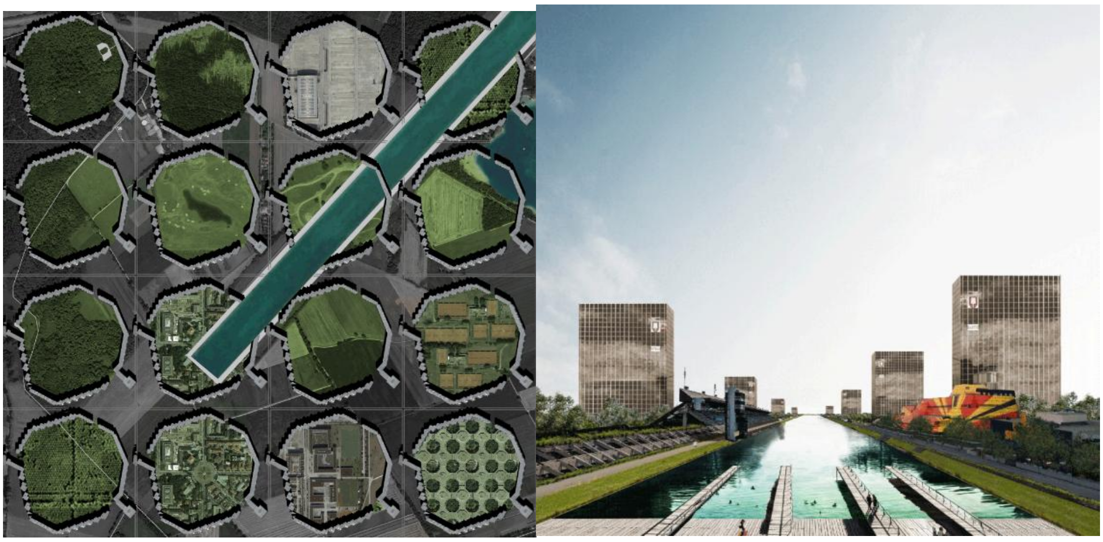

Fig 13: New urban courtyards (left), the race track reinterpreted as new axis (right)

4 Conclusion

This paper does not aim at drawing a final conclusion. It is an ongoing design research and collection of possible approaches to enrich the somewhat timid discussion about urban planning in Munich. Munich is regarding itself as leading in many fields. It is regarding itself often in the top ten of the most liveable cities worldwide. But in comparison to the competitors in these lists (as personal-taste driven as they often are), Munich is falling behind, although it has sometimes more assets and more economic power than its competitors. If a conclusion has to be drawn, it is that Munich should identify its needs and plan accordingly to its full potential. In the end, this would lead to more Munich, which would make anybody happy.

Acknowledgements

The organizer gratefully acknowledges the work done by Programme Committee and Lecturers of the International Conferences S.Arch-2019 for efforts done for the success of this event.

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06.104 - THE PLAY OF THE MIRROR IN THE URBAN SPACE

Constanze SIXT

Universidad Europea de Canarias / The Bartlett School of Architecture, UCL

Calle Inocencia García 1, 38300 La Orotava, Tenerife, Spain;
Constanze.sixt@universidadeuropea.es

Abstract

This study investigates the performative quality of reflecting and mirrored surfaces in spatial experience and behaviour, in buildings and art installations, with a particular focus on the public realm.

It shows how reflecting surfaces appeal to, interact with and manipulate our senses, our notion of space and consequently our behaviour.

The mirror creates a depth that amplifies space and defies reality. It is activated by its manipulation and in turn activates its surroundings. It becomes a medium, as it acts as a transformer of space and augments reality.

This investigation examines the externalisation of the mirror and its evolution from body accessory towards a performing interface in the public sphere.

It analyses the mirror's capacity to both produce and, at the same time, question reality, the role it plays in the sensitisation and socialisation of the subject, and its resulting effect on social life.

By introducing an irritating, intriguing or disturbing aspect, and by questioning the existent reality, mirrors can play an important role in the appropriation of public space.

Through mirrors and their interactive, performative qualities, the scenic space recovers its position outside of the codified building: the stage re-conquers the public realm.

This research shows how the interweaving of the illusionary, imaginary and interpretative play and the construction of reality through the mirror can be considered an act of urban proposition.

In-/outside - Amalienburg, Schloss Nymphenburg, Munich. Photograph: Constanze Sixt.

Keywords

Mirror, Perception, Performance, Installation, Urban Space
Topic: T06. Urban Ecology and Climate. Urban Space

1 INTRODUCTION

The use of mirrors in architecture is experiencing an upturn. Having developed from a luxury good to a mainstream product thanks to the Industrial Revolution, the use of mirrored glass reached its apex during the 1980s, usually in monolithic corporate office buildings in the form of fully-glazed one-way mirrored façades that occluded the view from the outside, indistinctly reflecting their immediate surroundings. Today's use of the mirror in architecture works with perceptual shifts between transparency and opacity of building skins that consciously manipulate the viewer's gaze and behaviour and play with their setting.

2 Relevance

In contemporary architecture, there appears to be a quest for a mediator, for an element that is capable of interacting between the built object, its user and the environment. This mediator or catalyst is meant to adapt the building to its changing circumstances and to relate it to a world in constant change.

The following text investigates, with examples from architecture and art, the potential of mirrored (glass) surfaces, beyond being a mere building material, to fulfil an interactive, performative function in society.

3 Historic Background

The widespread use of mirrors in architecture began with the introduction of flat glass techniques around the 17th century, which allowed for the production of large-scale glass elements. The creation of manufactories like those of Murano, Vauxhall and St. Gobain allowed for the far-reaching distribution of mirrors throughout Europe. Mirror cabinets, often introduced as special spaces in palaces or adjoining pavilions, showed their mimetic qualities, multiplying the appearance of the mainly porcelain exhibited objects.
Over the years however, mirror cabinets came to exhibit themselves, displaying their own reflection. This shift manifests a popular appreciation of the reflective quality of the mirror's surface.
Since the Baroque Age there has been a gradual externalisation of the mirror, which evolved from body accessory to a performing interface in the public sphere and experienced a major breakthrough in the last few centuries:
"In keeping with a new visionary order, mural surfaces are progressively broken and spaces become part of the world of illusion […]"[i]. Mirror cabinets ceased to be the most intimate spaces of the nobility's remote palaces and, being common elements in playful garden pavilions, from the 19th century onwards, became populist fairground attractions within cities.
Starting in the 19th century, the use of mirrored glass experienced an even greater transformation, away from an element of interior decoration towards a constitutive element of the exterior building membrane. This transformation was further supported by the industrial production of float glass in the second half of the 20th century and the development of smart coatings.

4 The mirror as an activator in the urban space


Figure 1: Rjukan, Norway, 2013. Photograph: Krister Sørbø
Figure 2: Lowline Lab. New York, 2015-17. Image Source: www.thelowline.org

Mirrors offer possibilities for activating spaces in architecture and urban design through the concentration and visualization of light energy. As light-reflecting devices, they help to illuminate spaces, not only within buildings, but also in the public realm. In Viganella, Italy, and Rjukan, Norway (Fig.1), huge heliostats—rotating mirrors normally used to generate energy—concentrate light and bring it, with a reflection percentage of up to 95% (Viganella), into the towns' shadowy valleys during the winter months.

Interestingly, in both cases it is the main public square that was selected to be the first spot to be illuminated.
In Rattenberg, Austria, a (not yet) realised project by the Bartenbach Light Laboratory has even considered that the mirror lighting effect could help reactivate the city's main industry, (glass) tourism, during the dark winter.
Another project that uses orientable mirrors aims to create green spaces while enhancing tourism: the Lowline in New York (Fig.2), a subterranean reflection of the Highline, has been conceived as a public underground park that would reactivate a historic trolley terminal on Manhattan's Lower East Side. Its test laboratory, the Lowline Lab, was used for two years to test the mirrored light tunnels planned to bring sunlight into the underground park, and drew local residents, who gathered there for workshops and cultural activities.
The mirror in these cases is clearly meant to play both an activating and a socializing role. The mirror "augments the energetic reality", creating a "transoptical reality" [ii]. It helps to create community.

5 The mirror as intermediary between the building and the city

The CCCB Centro de Cultura Contemporánea de Barcelona, by the architects Viaplana-Piñón (Fig.3), is an interesting architectural example that uses the mirrored façade of a new, built volume added to a historical complex not as a demonstration of corporate power, but as an alienating element in its central patio. The mirrored façade reflects the original building and augments the visual space of the patio and the activities that take place in it. In addition, it acts as a large window towards the city: its inclined crest reflects the building's roof and brings the city into the patio.
The entire project plays with visual division and augmentation by emphasizing the patio's mirrored halves, which are strictly divided by the different colours and brightnesses of the pavement and the façades' glass; the crest, when viewed from the front, appears to have the same height as the façade, becoming its mirrored half.

Figure 3. Viaplana-Piñón: CCCB. Barcelona, 1994. Source: www.cccb.org

All these optical manipulations constitute a performance setting, where the new building volume becomes the stage and fly tower and the patio is converted into both orchestra pit and auditorium.

Yet mirrored surfaces, rather than acting as mere visual intermediaries of (distant) spaces, have come to be applied directly as activators of public space in public venues, such as the Marseille Vieux Port building, by Foster & Partners (Fig.4), or the Mercat dels Encants in Barcelona, by B720 (Fig.5).
In these constructions, specular surfaces are used mainly on the ceilings, in the form of polished metal sheets. However, in contrast to the CCCB, these surfaces do not form part of a prism that brings the city as an exterior into an enclosed, yet open interior; rather, they are applied as a device that displays the new activity to the city, reflecting the urban scenes underneath.

Figure 4. Foster + Partners: Marseille Vieux Port. Marseille, 2013. Photograph: Nigel Young

Whereas in the Vieux Port building, the reflection on the roof acts as a sign of revival of the city's formerly abandoned historic port, displaying a visual balance in the coexistence of urban surroundings and human movement in the reflected image, the Mercat dels Encants goes one step further: here, the manipulation of the play of the mirror is complete. The reflective roof, with its various foldings and cuts, acts as a kaleidoscopic screen, revealing to the city the spectacle of buzzing human activity around the Plaça de les Catalanes, a place that once was a no man's land underneath a notorious motorway roundabout.

Figure 5 (left). B720: Mercat dels Encants. Barcelona, 2013. Photograph: Rafael Vargas
Figure 6 (right). Hiroshi Nakamura: Tokyu Omotesando Plaza. Tokyo, 2012. Photograph: Jeremy Sutton-Hibbert

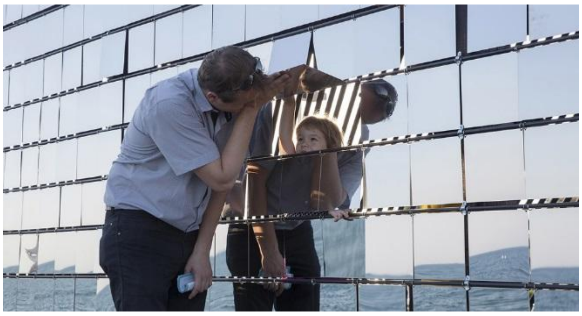
This kaleidoscopic fragmentation and multiplication is even more extreme in Hiroshi Nakamura & NAP's Tokyu Omotesando Plaza (Fig.6), where the mirrored entranceway is converted into a diaphragm that draws the city into the building and at the same time becomes a kaleidoscope that mixes its images with those of the shoppers dropping in and out. Fraction and distortion of mirrored surfaces are a current trend. "And now, in the twenty-first century, it is difficult to pin down our "mirror stage": We are provided with an extensive choice of mirrors and reflective distortions, in an endless variety of materials and forms." [iii]
In contrast to the mirrored corporate buildings of the 1980s, façades nowadays reflect not so much the separation of the citizen from the corporate world, but the impossibility of a clear image of the corporate concept itself. In Barkow Leibinger's Trutec building in Seoul (Fig.7), the mirrored façade generates incomplete images, as it multiplicatively reflects its cut self in a heterogeneous context. "In a metonymic operation the mirror building becomes the city. […] the building is made of elements of the city – other buildings, ornaments, lights, cars, sidewalks, etc. - and becomes the city itself […]" [iv]


Figure 7 (left). Barkow Leibinger: Trutec Building. Seoul, 2006. Photograph : Corinne Rose
Figure 8 (right). Pattersons Associated: Len Lye Centre. New Plymouth, 2015. Photograph: Patrick Reynolds

In Pattersons' Len Lye Centre (Fig.8) the context is completely incomprehensible due to the building's many-folded steel façade, described by the architects as a "theatre curtain" [v]. It is a magic skin that hides or almost negates the building behind. By adopting a three-dimensional depth, the building envelope asserts itself as the actual built volume that stands for itself, more closely related to the outer world than to a questionable interior. The façade forms part of the stage set of an urban play. It is the backdrop that is activated by the city.

6 The mirror as a window towards the scenery

The (playful) activation or interaction of building façades with their surroundings is markedly evident in the increasing number of small-scale follies. NAS' Breath Box in La Grande Motte (Fig.9+10), for example, is a pavilion placed on a sea promenade on the French Riviera that invites passers-by to interact with the separate, movable mirror sheds that form its skin. In contrast to the Len Lye Centre, it does not hide an invisible interior, but rather, as an open canopy, lets its non-existent interior shine through. Looking inside it means looking through it at the same time. It seems almost as if the landscape that is reflected in the mirrored curtain is a *mirage*, with the real landscape concealed behind.



Figures 9+10. NAS: Breath Box. La Grande Motte, 2014. Photographs: Paul Kozlowski

Often, these pavilion-like constructions are ultimately completed by the reflective mirror play of natural elements, or they camouflage themselves within the reflection. Reflection becomes a method of integration or dissolution of the building in its surroundings, or vice versa. The—mostly rudimentary—architecture becomes “secondary to the image” [vi] as “the figurative level of the building is increased through the images, but at the same time the architectural specificity is reduced or negated.”[vii]

As a formal counterpart to the previously observed “superarticulated volumetric architecture”, here we often have simple glass boxes, with the mirror being “pure image applied to the box” [viii].

Bandesign’s roadside café in Gifu (Fig.11), for example, is a simple house cut into two mirrored halves. They face each other, reflecting themselves and completing their sparse garden by multiplying the borrowed reflections of the cherry trees alongside the street.

“The mirror building becomes a cutout of reality and through its unifying reflection creates the illusion of coherence where in fact there is only a set of fragmentary relationships.” [ix]

Buildings like DepA’s ‘floating’ pavilion in the Serralves museum park (Fig.12), on the other hand, camouflage themselves completely into a seemingly pristine natural environment by virtue of their apparently immaterial mirrored skin. The building could be considered “object and context at the same time” [x]; it seems as if it aims to disappear within nature.

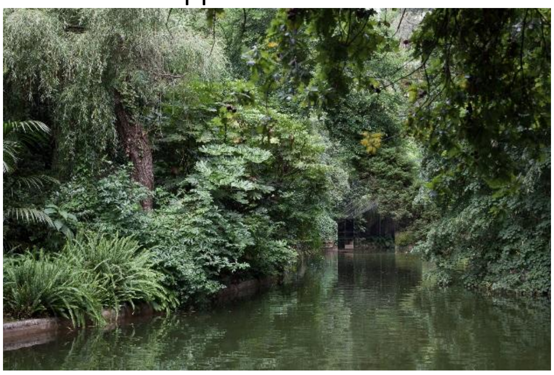



Figure 11.Bandesign: Roadside Café. Gifu, 2014. Photograph: Shigetomo Mizuno
Figure 12. DepA Architects: Serralves Pavilion. Oporto, 2017. Photogra`h: José Campos

Interestingly, we usually find such formally simpler buildings in suburban or non-urban contexts, with their reflections replacing the built surroundings with landscape scenery.

It could be argued that the next logical step of disappearance of the built volume would be its apparent de-materialization in an environment of other mirrored structures, a *Total Reflective Abstraction*:

"As a culture, we seem obsessed by the idea of mirroring and self-reflexivity; this can be observed throughout our physical environment, in the use of reflective surfaces as an emblem of modernity. Total Reflective Abstraction is a possible term of classification for the ways in which this preoccupation is expressed in the worlds of art and design." [xi]

7 The public mirror: (De)Construction of Reality

Whereas in the former examples mirrored constructions establish a dialogue with the surroundings that almost excludes any human interaction, it is possible to identify another trend of intertwining the uttermost intimate and private experiences of mirror self-consciousness within the public realm.
When a spectator is involved in interaction with a mirror in the public sphere, the private connotation suddenly adopts a public nature: the spectator physically sojourns in the public space while observing his reflection or a reflection of the public space (Fig.13). The viewer's private experience becomes public, and an interior notion that the mirror may insinuate is turned into an exterior.


Figure 13: Maria Nordman: Markt Stommeln. Pulheim-Stommeln, 1996. Photograph: Jürgen Hillie
Figure 14: Christian Wagstaff, Keith Courtney: House of Mirrors, 2017. Source: www.thedenizen.co.nz

A mirrored object appearing in an open space still has a very intimate and personal connotation. This implies a certain feeling of alienation, of something that feels strange in a public place, even more so if it plays with disorientation (Fig.14), questioning our concepts of interior and exterior, void and matter, above and below. "Please note: Mirrors may cause disorientation. You should also prepare yourself for getting lost". [xii]

8 The social mirror: freedom and control inside-out

Dan Graham alerts that "Within the art context it is often only the aesthetic effects of glass and mirror which are noticed; whereas, outside the exhibition frame, these same materials are employed to control a person or a group's social reality." [xiii]

Graham's pavilion installations, which repeatedly work with multiple layers of two-way mirrored glass (Fig.15), could be seen as experiments or models re-introducing this socially controlling aspect of mirrored surfaces of the built environment into the art context, while undermining it at the same time. As Graham states in an interview: "I think people are familiar with the materials but they're not familiar with the psychological or social interaction within these architectures. In my pavilions, people can observe and be observed at the same time." [xiv]

Public Space/Two Audiences (Fig.16), an installation for the Venice Biennale, for example, where visitors see themselves in adjacent rooms separated by a glass wall, represents three layers or degrees of mirroring as a form of social control: each group as a mirror of the other, the view of both groups reflected in one space's background mirror, and the group's overlaying reflections in the glass that divides them.

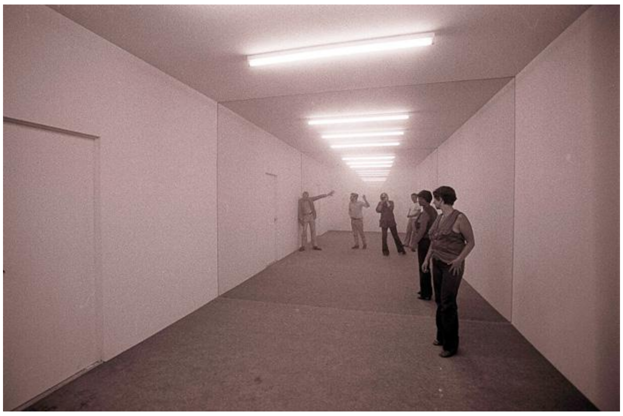



Figure 15. Dan Graham: Half Square/Half Crazy. Como, 2004. Photograph: Paolo Brambilla
Figure 16. Dan Graham: Public Space/Two Audiences. Venice, 1976. Photograph: **Eustachy Kossakowski**

The experimental setting of the installation produces an intertwining of viewing directions and superimpositions of reflected images. Triggered by the reflected elements and projected onto them, the spectator is at the same time subject and object, a *reciprocal spectator*[xv].
"The observer is made to become psychologically self-conscious, conscious of himself as a body which is a perceiving subject; just as, socially, he is made to become aware of himself in relation to his group."[xvi]
Complexity and Contradiction, concepts of Robert Venturi's homonymous book [xvii], are important aspects of Graham's publicly accessible open-air pavilions, where spectators are submerged into an interior-exterior space, dissolve themselves in a whole-body experience, and convert themselves into actors that form an essential part in the mirror play.
The connotations of interior and exterior are questioned. The pavilion seems to be a fragile interior, exposed to the exterior, or, more positively, an interior space that invites the exterior in, as much as vice versa. By questioning the limits, this type of installation also questions socially accepted "differences, limits and codes" [xviii].

9 Mirror – no mirror

The dazzle of mirror installations in the public space is potentiated when specular surfaces are interrupted and 'reality' comes into play. For example, in Dan Graham's *Pavilion/Sculpture for Argonne* (Fig.17), an open steel framework, there is a continuous visual ambiguity caused by the confusion between the parts filled by mirrors and those opening onto the landscape, interior and exterior, and their respective reflections. Time plays an important role, as the visual impact changes with time and the visitor's movement. The pavilion is "subject to continual variation" [xix].

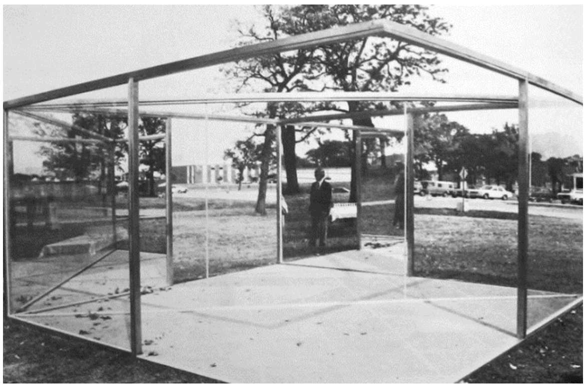



Figure 17. Dan Graham: Pavilion/Sculpture for Argonne, 1982.
Figure 18. Alicja Kwade: Weltenlinie. Hayward Gallery, 2018. Photograph: Mark Blower

Alicja Kwade's *Weltenlinie* installations (Fig.18) potentiate the ambiguous effect caused by a series of steel-frame chambers and seemingly randomly-placed mirrors that create a puzzling maze. Although situated in a controlled interior museum space, natural elements such as stones or tree trunks are introduced and reflected either visually or physically by placing an (artificial) counterpart on the other side of the frame, maintaining the form, but switching the material. Objects are reflected twice, as reflections of natural elements in other materials and as 'real' reflections. The spectator is invited into the installation, but as one passes through, intrigued by the different types of reflection, a disconcerting feeling of insecurity arises and grows, even though, when one observes the arrangement analytically, it is evident where the 'real' mirrors are placed and where the structure is hollow. Finally, a subliminal, but constant sense of disbelief crops up, "destabilising our assumptions about reality" [xx].

10 (Re)Construction of Reality

Not only can mirrors disrupt our notion of unity and reality, they can also help us build a new (trans)reality through their representations. In the example of Leandro Erlich's Dalton House (Fig.19), installed in an area of London bombed during World War II, people discover the reflection of a house that may have been destroyed and now recovers its presence as a specular image in a gigantic mirror wall. The image completes what only existed in memory, and creates a surreal side effect of people occupying the house 'downside-up'. This theatrical representation on a public stage helps us recover the memory of the past and integrate it into our presence. [xxi]

Figure 19: Leandro Erlich: Dalston House. London, 2013. Photograph: Gar Powell-Evans

As the selected examples of this text show, mirrors have complex and contradictory implications. Although they may produce confusion and uncertainty, by doing so they increase our awareness of and sensibilities about our surroundings and the role we play in it

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[xix] ibid., p.163

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[xxi] Andrea Ciunta calls Erlich’s installation a “ludic memorial”: “Beyond what visitors may bring from the past, those who play in his works act principally as inventors of forms, fictions, dialogues, and photographs that can become realities. Present and past images are activated by different contexts.” Ciunta, Andrea: “A Gap in the Limits of the Possible”. In: Giasson, Patrice and Posner, Helaine (ed.): *Leandro Erlich. Port of Reflections*. Neuberger Museum of Art, 2017. P.41

06.105 - URBAN METABOLISM AND METROPOLITAN REGIONS

Giovanni Santamaria

New York Institute of Technology- School of Architecture and Design

1855 Broadway New York, NY 10023, USA

1 INTRODUCTION

"Territory is our condition of existence, the positive product of the collaboration between man and nature, and also our irreplaceable patrimony. In the territory is the inner meaning of man and civilization, their relationship with the natural world ..." (Muratori, S. Civilta' e Territorio, 1967)

2 THE BACKSTAGE: Global geographies as result of systems of actions/reactions

The flow of people, resources, material and immaterial goods, and at the same time of powers, and strategies of control, have always shaped/reshaped our geographies and processes of urbanization. Therefore, built and inbuilt landscapes have been characterized by gradual or dramatic changes, leading to new architectural typologies and urban morphologies corresponding to the transformation of means of production, distribution, circulation, consumption and to the shift of political, economic and ideological realms. The effects of these processes on structure and quality of space and life could be described as part of a complex Urban Metabolism [1] which looks at the city and its territory as a complex organism. This dynamic landscape has reached a high level of complexity where natural environments (geology, hydrology, topography) and cultural environments (productive lands, urban settlements, infrastructural networks) need to be synergistically understood as part of an articulated ecological system, with both micro and macro implications. It is the synthesis of geographic-historical contents (collective values), aesthetic-perceptual contents (individual values), and ecological-natural contents (biological values) [2], and influenced more and more by natural and man-made disasters following urgent issues concerning climate change and several typologies of conflicts.

Since the city as a definable entity and result of predetermined models has become obsolete, we are now called to work with a sort of collage of fragments, heterogeneous and dynamic, often in conflict and unpredictable, subjected to the balance of variable forces, with their own order and rules, and their own ways of evolving, which we have to understand and manage [3]. This determines the need for new tools and methods to observe, record and analyse urban phenomena towards more sensitive interventions.

3 THE STAGE: Shifting theoretical approaches and decoding paradigms

A shift from the utopia of canonical forms to heterotopic processes and performable methodologies has derived from that, modifying our way of understanding and approaching urban contexts, overcoming the emphasis towards towns and cities, building and form, to focus on the process of growth-shrinking of these subjects within their landscapes. We need to re-think these in a systematic way and accordingly to the ecological, infrastructural, technical, social, and political challenging processes that they generate and derive from, and the relevance of their effects on metropolitan areas.

For these reasons design interventions need to proactively operate across greater extents of time and dimensional scales from the geography of entire regions, to the engineering and new techniques concerning building and environmental components, capable of dealing with critical problems such as water, waste and energy management, reuse, recycling and reclaiming of building and land, consumption of resources, pollution and environmental risks. At the same time, these interventions have to deeply understand the collective historic memory of the landscapes in which they operate, their anthropological genetic processes, to be capable of responsibly and coherently re-think and project them towards a more sustainable future.

This approach more than on solid objects, focuses on the several levels of interactions within open fields as coordinated ecosystems. It requires reimagining instruments, expertise, roles, and responsibilities that today are still often rigidly separated, operating through hyper-bureaucratic structures which do not take into consideration the cross-relationships between the several fields and scales involved into the transformation processes of spaces. This calls for a sort of multidimensional and multidisciplinary approach, which should be able to cross simultaneously: Scales -from the global one of networked political, economic logistics and natural strategies, to the local ones of micro-oriented intervention related to the needs of specific communities and to the local natural life cycles; Fields –from the strictly urban and infrastructural ones, and the different gradients of human manipulation of productive lands, to the natural ones related to flora and fauna, soil, water, and air; Time/Space –from the status quo and the understanding of its past as a complex process of actions and reactions, to its future projections and their implications on a global scale of issues concerning shrinking and fast growing processes of metropolitan areas and their uncontrolled consumption of space.

Here the dominance of corridors of technological, financial and productive powers over settlements, become strategies for physical and social exclusion and isolation, generating conflicts and inequalities. While unifying and overcoming differences related to geographical and political boundaries at a large scale, infrastructure can act then as a divider and generator of social disengagement at the local one, making the connection to and between urban and ecological patterns more abstract.

This panorama has generated a sort of post-industrial Meta-Urbanism, as programmatic layering: textures and flows where new design experiments are capable of injecting the territorial scale into the fields enclosed within the consolidated city, but also of operating in the blurred zones between suburbs, terrain vague, producing areas, natural sensitive sites and metropolitan deserts. These interstitial zones of frictions and exchange produce the complex ecology of our current landscapes, which overcoming the deterministic paradigm, open to diversity and indetermination, where the understanding of organizational and working processes of ecology helps to generate more adaptable and resilient urban structure operating through redundancy as way to avoid the collapsing of systems and guarantee the overall balance.

In the crucial role assigned to understanding topography and reinterpreting its values through the design proposals, it is still possible to find some common ground between Architecture, Landscape and Urban Design, their peculiarities but also their similarities, not only in terms of formal and spatial expressions, like the experiments of Land Art for example, but also as contents and meanings, introducing the temporal processes of acceleration- deceleration as a component of the design proposal, to understand its life cycle within the context.

If we consider our landscapes as the pluralistic and active expression of our society, of the ideological and metaphysical values shaping it, then it becomes the 'active cultural agent' defined by J. Corner in his book *Landscape Imagination* [4], that proactively and critically synthesize our way of being and adapting to the context we operate in and express through, continuously reactivating and rethinking it, towards the production of new meanings. Within this landscape we find the final and perhaps purest concept of democracy, since everyone is equally but differently called to take care of it, to equally and individually belong to it, and critically operate in it within a community.

Being a synthesis of variously man and ecological-made structures and functions -not only their image- our landscapes become a fundamental lens to decode contemporary metropolitan regions and to understand their values and performability, as we perceive them and at the same time, as we act redefining them even while we describe them. We then become part of the same story, witnesses and actors recalling and generating memories without which a future 'prophecy' would be impossible, so any 'hope' would be impossible. C. Rowe, *Collage City* [5].

This evolving process deals with and creates values of differentiation and of persistence or memory, which are relevant in the way an environment changes and survives, critically redefining the *Urban Ecologies* [6] we live in and move thorough, characterized by heterogeneity and complexity: cross interactions between infrastructures, concentrated or dispersed urban structures, productive land, and residual or neglected areas with their potentialities. This substantiates new urban systems open and strategically integrated into their landscapes, defining processes of change that involve the overall regional metabolism.

Consistently with this metabolic approach, and considering both built and unbuilt environments, we operate and organize the change by means of Maintenance, Transformation, and Substitution as different but coordinated degrees of regeneration. While Maintenance is a way of preserving/improving the status quo, especially in historically consolidated urban, productive, and natural contexts, which have often also symbolic values in relation to the identity of the place; Transformation involves a structural change of the system and its functioning/program, operating on crucial parts of it and its connectivity; and then Substitution as action that implies the total rethinking of structure and form of a specific part or of the entire system, replacing the old with a radically new one, thus changing the qualities of its context as well.

This Metabolic Intervention concerns several dimensional scales, space and time frames as well, from the extra specific related to the object and its parts, to the regional/territorial ones beyond political and administrative boundaries, to the global one regarding synergic decisions. It requires thinking of new coordinated and creative strategies, tools and codes to plan, design and manage the scale of the landscape, to envision it and invest in it. Therefore, it is crucial to consider the entire and networked life cycle of the system environment, its formation, growth, consumption and its eventual destruction and recycling, similarly to the physical metabolism of individuals, which manages the biological, chemical, and energetic transformation processes within a human body and its livelihood. This also enables professional operators into the field of architecture and planning to re-think their roles, tasks and objectives in designing buildings, cities and landscapes, considered as adaptable and flexible processes, an integrated and interactive part of a more complex territorial and environmental dimension, still in need to find new physical and spatial possibilities of expression, to define a place, becoming applied knowledge open to new strategies of management and decision making.

At the territorial scale, we have to envision a new paradigm of a networked city, formed by differentiated but connected epicenters that identify strategic locations for new design interventions as densifying points, dynamic and open to shift their functionality. It is a sort of capillary system that gradually evolves, balancing the effects of the change of its parts in synergy to the overall, to localize and direct modalities and dimensions of the transformation. This specialized but also flexible and hierarchized polycentric network of existing and new integrated nodes makes the overall system sustainable and adaptable, always proactively able to create new alternative paths and synopses, avoiding the collapse of the structure because of the change of contextual conditions. In this context, the crisis becomes an opportunity for the development of new strategies, redefining connectivity based on a sustainable balance of growth and available resources, in a competitive framework.

The new cores that characterize a project at the scale of the landscape, unlike the previous centralized paradigms operating at the scale of the consolidated city, constitute a sort of episodic but integrated model which creates new territorial and urban structures. Here the old nodes can gain new symbolic meaning, sort of 'mediators' actively integrated with the new ones and capable of orienting the existing communities within the new networked environment, making it recognizable and attractive, accordingly to Donadieu [7].

This system of heterogeneous epicenters within the landscape is territorially linked and locally specialized accordingly to the other close nodes and to the environment in which they operate.

At the microscale these epicenters, as a point of accumulation of territorial forces, work like permeable clusters of localized exchanges, and are open to opportunities for Landscape Architecture. This finds place in problematic 'between spaces,' where elements with different nature collide: where infrastructures cross city, landscape, and productive land; where the city meets and merges with its surroundings, creating thresholds where informal, spontaneous, uncontrolled and incredibly fast strategies of growth or shrinking are in progress. Charles Waldheim, *Landscape Urbanism Reader* [8].

Through these performative design interventions, we can give form to a rhizomatous and diverse process of transformation of our urban landscapes which we aim to be resilient, so capable of absorbing more than of resisting to the changes of the environmental conditions and of retaining most of its structure and functions once it returns to the original state.

This is represented through proactive strategies and design experimentations geared towards potential futuristic visions openly framed within a landscape urbanism approach, since if we cannot control the volatile tides of change, we can learn to build better boats. We can design and redesign organization, institutions, and systems to better absorb disruption, operate under a wider variety of conditions, and shift more fluidly between several circumstances. To do that we need to understand the concept of as continuous and rhizomatous process of transformation/ adaptation [9].

4 THE ACTION; Converting criticalities in opportunities for proactive strategies

This background describes the complexity of the scene within which operate some of the current examples of design strategies that are noted below, underlining the great potential of our post-industrial environments. These express different ways to approach the design of urban space transformations, often driven and promoted by local communities, rather than the result of the intervention of a centralized institution. These are also focused on design strategies- more than models- operating systemically at multiple levels, not only on formal/aesthetic ones, but regarding issues of pollution, ecological risks, social imbalance, sustainable production, and recognition of values of 'ordinary heritage.'

This is the case of Detroit for example, which among several other American cities, has been deeply affected by the crisis in the decline of automobile production. The shrinking process has involved mostly the downtown of the city, its closer surrounding and the infrastructural system, meanwhile several gated communities have been growing within the metropolitan area. This produced no-man lands and incredibly suggestive 'urban deserts', which replaced the traditional American sprawl of single family houses just outside the downtown area. In turn, it has led to a new fragmented landscape and renewed modalities of the use and share of it by the ones left, introducing an unprecedented re-combination of the units of the lot and of the block. Plenty of literature and studies have been produced about this post-industrial urban phenomenon and its several dramatic effects on the physical and social environment. In the last 15-20 years this has also given to the city the opportunity to re-think itself, opening to experimental strategies of adaptation that have redirected the transformation in creative and proactive ways.

Several art and now agriculturally-based initiatives have been introduced to retrofit the cityscape, its structure and also its social setting. Informal and less institutionalized projects are reactivating bottom up selected areas of the city, attracting new dynamic and proactive local strategies which are readapting its public realm. Not far away from the well-known cultural institution DIA museum with its Matisse, Degas and the murals by Rivera celebrating the mechanistic society of production, the MOCAD and the Red Bull House of Art today represent the new face of the art scene in Detroit. Meanwhile, since 1986 the Heidelberg Art Project by the artist Tyree Guyton in the McDougall-Hunt Neighborhood, has been creatively and progressively transforming the empty houses and lots of the area in a colourful and eclectic open air museum, a land art piece that celebrates crisis and decay of the city, and of the ideology that created that urban- social model.

In the Eastern Market district, the Adopt a Lot program has introduced new strategies of productive adaptation of the several empty lots, transforming them in opportunities for self-managed and free urban farming. Similarly, in the North End Neighborhood, the Agri-Hood project by Tyson Geresh introduces us to new possibilities for a more sensitive and adaptable urban planning. Two acres of urban farming are located here as part of the non-profit Michigan Farming Initiative (MUFI) where 50,000 pounds of fresh vegetables have been produced per year, and mostly by and for the surrounding low-income community. This project is unique, having at the center of the housing planning proposal, the working farm as the social and spatial incubator that operates also at political and administrative levels, directing the future process of transformation/gentrification on a more sustainable path, using low-cost building systems like shipping containers and recycled construction materials from the local industrial archeology.

In New York, where the process of de-industrialization has been slower and less dramatic because of the more heterogeneous production system and due to the presence of a stronger and more diverse metropolitan economy, the transformation process that has involved all the urban waterfronts, has been the key in changing its dynamics and morphology, often through an aggressive gentrification, barely balanced by its green components. Piers, highways and

factories along the water have been in fact demolished, replaced, transformed, densified, embellished during the last 30-40 years, starting from the island of Manhattan (Battery Park and Hudson River) and then Queens (Long Island City), Brooklyn (Dumbo and Brooklyn Bridge Park) and Staten Island (Fresh Kills Park) with progressively more attention to the design of spaces for leisure and public services, and in the more recent projects, also to ecological and environmental issues such as rising currents, pollution and waste, more than pure real estate speculation, still the main engine of these transformation processes.
Along with the shoreline, more recent projects in the city have been operating with some of the dismissed fragments of infrastructure within its core neighborhoods, as is the case of the well-known 1.45 miles-long project of the High Line by Field Operation with Diller Scofidio + Renfro across the Meatpacking District and Chelsea on the West side of Manhattan.
This elevated green promenade has been opening in phases from 2006 until 2017, experimenting a new approach in the US towards the reuse of infrastructural archeology metabolically reintroduced into the public realm of the city. At the same time this has also boosted a strong process of gentrification of the entire area through mostly small acupunctural interventions except for the last of these at its end. In fact, the 28 acres of the Hudson Yards are located here on the site of the West Side Rail Yard by Kohn Pedersen Fox Associates, which is dramatically changing the skyline of the city and the balance of its dynamics. Several are the local activities and residents that have been leaving these areas due to the effects of gentrification that transformed the previous manufacturing nature of it, into a product for global tourism who now enjoys the roof scape of the city. Far from the inconveniences of the street level, it has created a sort of “elegant living room” for reach investors (often foreign) who can afford the bird’s-eye view of the Hudson River sunset, beyond the gated and controlled ‘front yard’ represented by the High Line Park.
On the opposite side of the island, and also of the surface of the ground, are the three blocks from Essex to Clinton Street on the Lower East Side, of the former Williamsburg Bridge Trolley Terminal adjacent to the Essex Street subway station active until 1948. The so-called “Lowline” or Delancey Underground, now legally part of the 1,650,000 sq. ft. Seward Park Urban Renewal Area, is open to new creative possibilities to rethink and reuse the extended underground network of spaces in the city. This first underground park, co-founded by James Ramsey and Dan Barasch with Arup, opened in 2012 thanks to a Kickstarter campaign. This allowed the installation called Imagining the Lowline, of a 30 feet solar canopy capable of directing sunlight into unlit spaces through a “remote skylight” designed by RAAD studio. This optical system is made of parabolic reflectors- a sun collector dish and a sun distribution dish- connected by an “heliotube” containing optical fiber cables that channel the light into a live cultivated underground area, creating a park that brings new possibilities of life and programs in these forgotten infrastructural spaces. The great resonance of the project within the community, and the strong support received by politicians, public administration and media, led to an extension of the closing date of the installation which opened in 2015 by executive producer Robyn Shapiro and industrial designer Ed Jacobs, to March 2017. This introduced a sort of reverse code in approaching the spaces of the city redefining their values, which become more experiential than commercial, more collective than individual, more integrative and performative than isolative and constative.
Through these new typologies of synergic and contextually-aware projects we are then called to manage, adapt and reorganize the active and flexible set of spatial systems within our environments, critically identifying sensitive locations which could work as opportunities for the creation of a remapping process and of an original design vocabulary of strategies and

methodologies which will generate renewed '*po(i)etic*' [10] effects on a wider scale, resolving or positively converting the limiting issues in proactive potentialities.

Acknowledgements

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References

[1] Urban Metabolism is mostly related to the scale of an Urban Region which supports its own sustainable growth in terms of spatial, social, energetic, and economic balance through internal and external exchange processes improving systems of production and reproduction and its power of attraction. A. Wolman in his book entitled A Typical American City (1965) defines urban metabolism as 'all commodities needed to sustain a city's inhabitants at home, at work, and at play,' but his approach was mostly focused on the physical aspects of the balance of production and exchange of energy and natural resources, more than on their effects on the quality of space and life. An evolution and extension of the same concept is included in C. Kennedy's book Changing Metabolism of Cities (2007), where he defined it as a 'totality of the technical and socio economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste.' His point of view is more focused on the way the overall system of the lifecycle of an urban environment works and has interesting references to P. Geddes' (1885) studies about the city as a 'living machine' with its own metabolism and related social effects.

[2] This concept is explored philosophically by Assunto, R. 1973. Il Paesaggio e l'Estetica. Napoli, Guerini

[3] References to this concept by Neuteling, W.J., are described in GUST (AA.VV.) 1999. The Urban Condition: Space, Community, and Self in the Contemporary Metropolis. Rotterdam, 010 Publisher, pp.36-39.

[4] Corner, J. & Bick Hirsch, A. 2014. The Landscape Imagination. New York, Princeton Architectural Press, p.111

[5] Rowe, C. & Koetter F. 1978. Collage City. Cambridge Mass, MIT Press, p. 124

[6] This concept has been explored and consolidate in a book titled Ecological Urbanism by Mostafavi, M. & Doherty, G. 2010. Boston, Harvard University.

[7] Waldheim, C. 2006. The Landscape Urbanism Reader. New York, Princeton Architectural Press, pp. 64-67

[8] Waldheim, C. 2006. The Landscape Urbanism Reader. New York, Princeton Architectural Press, pp. 64-67

[9] Zolli, A. & Healy, A.M. 2012. Resilience. Why things bounce back. London, Headline Publishing Group, p. 28

[10] The Greek etymology of the word ‘poetic’ from ποιεω, means ‘to do,’ ‘to operate’ and so to be active through conscious actions which also have immaterial values or effects, and are aesthetically balanced. This is also related to the way M. Heidegger used the same word ‘poetic’ as the only way for humans to inhabit a space, actively transforming it into a ‘specific’ place.

06.106 UNDERSTANDING THE CITY "AS IT IS": PHYSICAL FORM, STRUCTURE, AND ISLAMIC IDENTITY AND SOCIO-CULTURAL VALUES IN TRADITIONAL AND MODERN CITIES IN SAUDI ARABIA

Oumr Adnan OSRA, *Paul JONES
Sydney School of Architecture, Design and Planning, University of Sydney, Wilkinson Building, 2006, Sydney, Australia, oosr3429@uni.sydney.edu.au

Abstract

Considering socio-cultural values and Islamic principles has traditionally been fundamental in the planning and design of cities in Saudi Arabia. In the transition from traditional to modern cities, there is a changing mix and nature of stakeholders and their views regarding on the planning and design of modern cities. This paper reviews the role of stakeholders in shaping traditional and modern cities in Saudi Arabia and assesses their views, aspirations and attitudes at the macro and micro levels of the city. This paper focuses on the views of stakeholders on the role of socio-cultural values and Islamic principles in shaping the physical form and structure in King Abdullah Economic City (KAEC), a new major planned city in Saudi Arabia. Stakeholders interviewed included academic staff, architects, planners from the government and private sector, and residents of the city. Two types of interviews were used. Firstly, in-depth interviews were conducted with academic staff, architects and planners who have been involved in the planning and design of KAEC. Secondly, structured interviews using a questionnaire were used to interview residents who live in KAEC. The in-depth interviews provided important information to clarify the nexus between urban transformation, socio-cultural change, Islamic identity and socio-cultural values as seen and practised by policy-makers including the varying roles and attitudes of the stakeholders in creating differing urban development and housing projects in KAEC and, to a lesser degree, in Jeddah. The perspective of residents assisted in understanding residential neighbourhood patterns, housing typologies and the 'logic' of the form and shape of the built environment in the new modern masterplan for KAEC. The paper concludes there are a mix of views from stakeholders about how Islamic principles and socio-cultural values are considered and expressed in the planning and design of the physical forms and structures in KAEC. The city has different stakeholders and different views, but not all stakeholders are equal in the decision-making processes which consider Islamic principles and socio-cultural values and their place in the city.

Keywords

Traditional, transitional, contemporary, patterns, modern.

1 Introduction

King Abdullah Economic City (KAEC) in Saudi Arabia was planned and built to address several aims at a national and international level [1]. The construction work started in 2005, now most of the infrastructure has been completed. The population number in 2108 was 10000 people, however, the target of Emaar Economic city (the main developer) is two million people by 2035 [2]. At the local level, the city was developed to meet the increasing demand for housing generated by the steady population increase in the surrounding areas, as well as to provide job opportunities for younger Saudi Arabians [3]. The design of KAEC also aimed to appeal to international investors. To achieve these goals, investment plans were formulated to attract residents and investors during the early stages of the project. However, continual changes in economic, planning and development policies rendered the original plans ineffective. Emaar, a real estate company located in the UAE that has been appointed by the Saudi govt to develop the economic cities in Saudi Arabia, responded to these issues by promoting KAEC investment opportunities to foreign embassies in Saudi Arabia to encourage collaboration with international companies. Emaar has also given presentations at various local and global commercial events to enhance the economic reputation of KAEC [4].

There are a variety of stakeholders involved in developing the masterplan of King Abdullah Economic City (KAEC): the residents who live in the city, and academic staff from local universities, Saudi Arabia General Investment Authority (SAGIA), Economic Cities Authority (ECA), Emaar, the Economic City Company (EEC). These stakeholders have different views, attitudes and aspirations about the relationship between socio-cultural values, Islamic principles and the physical forms and structures in KAEC. This paper provides information about the major stakeholders and the views of four types of stakeholders – academic staff, architects, planners and residents of KAEC – on the role of socio-cultural values and Islamic principles in shaping the physical forms and structures in KAEC.

2 Context of the city

KAEC is located on the Red Sea shore close to other competitive cities in Saudi Arabia such as Jazan Economic, Neom and Al-Faisaliah cities [5]. The Saudi government has also launched the Red Sea Project, located close to KAEC, which aims to develop around fifty of the uninhabited islands in the Red Sea to become global tourist destinations [6].

KAEC is approximately 181 km² in area and has six main zones: King Abdullah Seaport, Industrial Valley, Financial Island (Central Business Zone), Educational Zone, Watersides Resort, and Residential zone [4]. This research focuses on the residential zone in the three main districts of Bay La Sun, Al-Waha and Al-Shroog. KAEC has a total of 13,454 dwellings [5]. Bay La Sun district is fully developed at 96,000 m² [5]. Two other districts have been developed for middle-income earning residents. Al-Waha district of 243,000 m² is 82% complete while Al-Shroog district of 150,000 m² is fully developed [5].

3 The key government and private stakeholders

There are five main types of stakeholders involved in the urban development of KAEC: residents who live in KAEC, academic staff from local universities, the Saudi Arabia General Investment Authority, the Economic Cities Authority, and Emaar, The Economic City. The three organisations are responsible for making planning decisions, and monitoring the site works and construction stages in the economic cities in Saudi Arabia.

3.1 KAEC residents

The population of KAEC increased from approximately 7,000 in 2017 to nearly 10,000 in 2018. Residents have a diverse range of socio-cultural backgrounds. Over half (53%) of the residents in KAEC are Saudi Arabians, while the remaining 47% are non-Saudis from a wide range of nationalities such as American, European, African, Asian, Middle Eastern and Australian. Based on the latest EEC statistics in December 2017, about 2,000 residents live in the three main districts of Al-Waha, Al-Shroog and Bay La Sun, with 1,375 Saudis and 568 non-Saudis. Of the Saudis living in these districts, 1,290 own housing units while 382 are tenants (Figure 1). Of the 568 non-Saudis, 96 own housing units and 472 are tenants (Figure 1). Details of nationalities in the residential districts are not available due to the EEC's privacy policy.

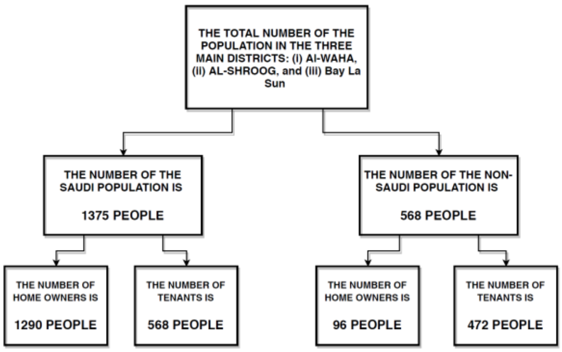

Figure 1: Residents in KAEC based on nationality and tenure

The residents of KAEC were not involved in the development of the masterplan for the city. Anticipated future needs of the population were based on assumptions made by the EEC. The planning process for the main features of the residential districts failed to include residents' input. Since development has continued, the EEC has focused on improving social interaction between the residents by organising social activities in the residential districts, usually held at community centres and local parks. Larger festivals and events take place at the city centre at the Bay La Sun district where the EEC headquarters is located.

Structured interviews with (209) from the Saudi residents in KAEC show they were satisfied with these social activities because they enhance the social ties between residents of shared and different socio-cultural backgrounds. Social activities contribute significantly to increasing socio-cultural homogenisation and harmony between residents. For example, in the public spaces in the city and during prayer time, groups of Muslims that include Saudis and non-Saudis pray together close to the beach, while concurrently another group of non-Muslim residents have dinner. However, Saudi residents argue that local architectural features, such as mashrabiyah and roshan[1], are lacking in appropriate physical forms and structures of KAEC. They feel that Islamic identity has been lost in the city, though it is present in Saudi social practices residents praying in public spaces and women wearing a hijab outside their homes to meet Islamic principles and to maintain socio-cultural values.

[1] Mashrabiyah and Roshan are wooden screens which ensured safe visual connection with surrounding semi-public and public spaces, ventilation, and light in the traditional houses.

3.2 Academic staff of local universities

The 26 state universities in Saudi Arabia are directed and monitored by the Ministry of Education and academic staff are often sent abroad to study specific disciplines and educational practices to meet the future needs of the country [7]. The Ministry of Education encourages academic staff at state universities to participate in national scientific research activities, conferences and related projects [7]. As part of these initiatives, the Emaar Economic City has hired academic staff from state universities to help develop the masterplan of KAEC. As discussed further in this paper, academic staff had varied views on the role of socio-cultural values and Islamic principles in shaping the physical forms and structures in KAEC.

3.3 Saudi Arabia General Investment Authority (SAGIA)

The Saudi Arabia General Investment Authority, established in 2000, regulates and issues the investment licences of non-Saudis in the country. In 2005, SAGIA launched a ten-year program "('10*10)" which aimed to rank Saudi Arabia in the top ten for competitive investment destinations for global investors by 2010 [8]. To achieve this aim, SAGIA launched the National Competitiveness Center to compare the local investment opportunities in Saudi Arabia against other global competitiveness indicators.

By 2009, due to the successful development of local investment opportunities, Saudi Arabia's global investment ranking had risen considerably from 67 in 2005 to 16 in 2009 [9]. Between 2005 and 2009, the NCC conducted a worldwide survey on economic free zones to identify the most successful zones in the world and developed a database on those nations ranked in the top sixty [10]. This information paved the way for the planning and development of the economic cities in Saudi Arabia. By 2009, the creation of the economic cities program and other advisory services which have been provided by SAGIA for investors led to Saudi Arabia being ranked 8th in the global ranking for the highest Foreign Direct Investment (FDI) recipients [9].

3.4 Economic Cities Authority (ECA)

The Economic Cities Authority (ECA), established in 2010, is responsible for regulating the development plans of the economic cities with the developers, as well as supervising the performance of these cities (Figure 2). The regulation framework of the ECA also includes the national policy which specifies consideration of socio-cultural values and Islamic principles. To facilitate developing the economic cities while ensuring the quality of the projects, the ECA focuses on two main aspects. Firstly, it strives to avoid complex bureaucratic rules in daily tasks in the government sector that may obstruct the flow of works in the cities. Secondly, strategic plans are created to provide an ideal investment environment for global and local investors which ensures consistency for growth of the economic cities, and the Saudi economy in general. The latter provides flexible regulations for foreign investors such as in land and building rights in KAEC. Flexibility is also visible in the development regulations of the seaport and the bonded zone, and in issuing local business permits.

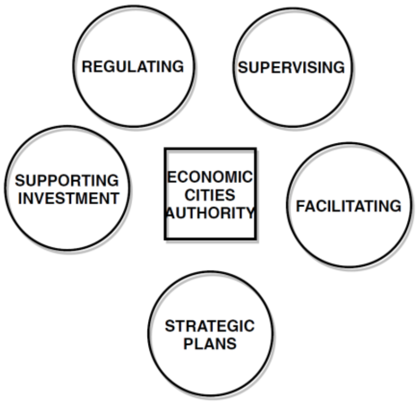

Figure 1: The roles of the ECA in relation to Economic Cities

3.5 EMAAR, The Economic City Company (EEC)

The EEC was established in July 2006 as a public Saudi joint-stock company specialising in real estate development of the nation's economic zones. As of 2018, the EEC's current activity is exclusively focused on developing KAEC [10]. Its tasks include marketing land parcels owned by the EEC, and developing residential communities including designing, building, developing and marketing housing units. The EEC is also involved in modernising existing residential buildings, public facilities and infrastructure. The EEC is directed by the Emaar Properties PJSC in Dubai and a number of Saudi investors [10].

Since the development of KAEC is one of largest economic projects in the Middle East managed by a private organisation, the EEC has made significant effort to work with the ECA to achieve the national aims for economic cities which include attracting global investors and following the objectives of the Saudi Vision 2030 [11]. There are three main pillars of Saudi Vision 2030: considering the religious status of the country as a centre of the Islamic world in future development; targeting the global economy market by attracting global investor powerhouses to invest in Saudi Arabia; and transforming the country to a global hub to connect Asia, Africa and Europe [12].

The headquarters of EEC is located in the Business Centre of the Bay La Sun district in KAEC and has 200-500 employees including architects, planners, economists, developers and other specialists. The EEC has also hired academic staff from local universities to participate in the early stages of developing the masterplan for KAEC.

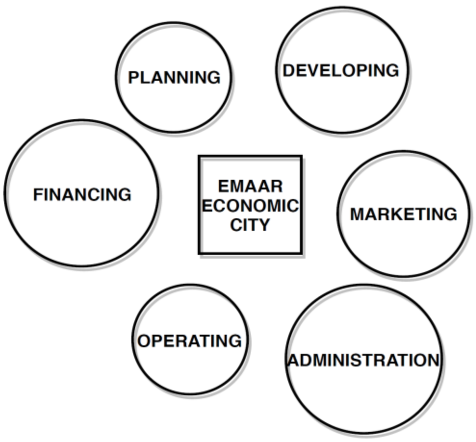

Figure 2: The different roles of the EEC in KAEC

4 Method

4.1 Data collection

This study contributes to a wider context of research in examining how Islamic principles and socio-cultural values have been expressed in King Abdullah Economic City (KAEC). Understanding the view of stakeholders in KAEC is case study research. The interview method is a significant source of evidence for case study research because most case study research discusses either social matters or behavioural events [13]. While there are several types of interviews within case study design, this research uses two types: in-depth interviews and structured interviews [13]. In-depth interviews were conducted with academic staff, architects, and planners from government and the private sector who have been involved in the planning and design of KAEC. Secondly, structured interviews using a questionnaire were used to interview Saudi residents of KAEC. The in-depth interviews provided important information to clarify the nexus between urban transformation, socio-cultural change and Islamic identity and socio-cultural values as seen and practised by policy-makers. This includes understanding the varying roles and attitudes of the stakeholders (their 'visions' and why) in creating differing urban development and housing projects for Saudi residents in KAEC and, to a lesser degree, Jeddah. The structured interviews with Saudi residents assisted in examining the role of Islamic principles and socio-cultural values in shaping residential neighbourhood patterns, housing typologies and the 'logic' of the form and shape of the built environment in the new modern masterplan for KAEC.

4.2 Data analysis

The qualitative and quantitative data were analysed separately. In this respect, 12 people have been interviewed in the qualitative part while 209 people have been surveyed. Qualitative data was categorised into two major themes: physical forms and structures, and stakeholders [14]. Each theme discusses specific topics. The first theme examines three main categories: (i) the role of Islamic principles and socio-cultural values in shaping the physical forms and structures mainly in KAEC, and to a lesser degree in Jeddah, (ii) planning regulations, and (iii) patterns and styles. The second theme examines issues about views, attitudes, roles and aspirations of stakeholders by focusing on four main parameters: (i) modernity and globalisation, (ii) views and aspiration, (iii) roles and participation, and (iv) relationships. The quantitative data was analysed separately to support the outcomes of the qualitative data and provides significant information on Islamic principles such as the privacy and neighbour's rights, socio-cultural values such as modesty and equanimity, physical forms and stakeholder views. Emaar has developed a variety of urban projects in the Gulf area. However, some argue that Emaar tries to brand itself through these projects without considering local circumstances and contexts such as architecture, socio-cultural values and Islamic principles [15].

Emaar has used similar urban and architectural approaches for planning developments in Dubai to those it now applied with the masterplan for KAEC. Emaar experienced setbacks initially when developing KAEC and faced financial difficulties during the planning and the construction phases leading to "a 1.3 billion USD bailout by the Saudi Government in 2010 (KAEC 2012)" [16]. This financial help led to an economic revival in the city, thus Emaar built a wide range of housing units and started to market these units by using social media, local exhibitions, and advertisements in the local newspaper.

Although building a global brand for KAEC is progressing slowly, at the local level Emaar has been attracting local investors to build mega infrastructure in the industrial zone. By using different forms of social media, Emaar heavily encouraged Saudis to buy houses in residential communities in KAEC. It is apparent that Emaar has a clear view on developing the city and, given the diversity of residents in the city, it is also significant to identify the views and aspirations of the other major stakeholders in the project.

5 Results

The variety of stakeholders interviewed had diverse views, attitudes and aspirations about how socio-cultural values and Islamic identity have been expressed in the physical forms and structures in KAEC. Stakeholders discussed several matters which have been categorised into two main themes: (i) physical forms and structures, and (ii) stakeholders. The views of academic staff, architects, planners and residents on the first two themes are presented.

5.1 Physical forms and structures

This theme examines issues about expressing Islamic identity and considering socio-cultural values in developing KAEC from the perspective of the private and government sectors, as well as the residents. Academic staff, architects, planners and residents were interviewed to express their views from a socio-cultural perspective. Three main categories emerged from the in-depth interviews analysis: (i) Islamic identity and socio-cultural context, (ii) planning regulations, and (iii) patterns and styles.

5.1.1 Islamic identity and socio-cultural context

The first category in this theme discusses the identity and socio-cultural context with regard to the physical forms and structures in KAEC. One of the academics interviewed argued that Emaar exclusively expresses its own brand by using specific physical forms and structures to attract buyers belonging to a middle and high-income demographic.

> *“Emaar is based on branding, they are not doing any projects that address socio-cultural values and Islamic principles. Because they are targeting specific people such as famous clothing brands companies they give minor things more attention than other essential aspects of planning cities. So, you pay a huge amount of money to get a house that does not match your desires but to join the club of Emaar residents and own a house that has been designed by Emaar.” (AS 2017)*

In following the nation’s state religion of Islam, Saudi Arabia remains strongly connected to Islamic principles and socio-cultural values. Any discussions of these values and national identity are therefore inextricably linked with Islamic religious practices. In this context, another academic criticised the architectural style of the residential towers in Bay La Sun district in KAEC because they failed to reflect local identity and consideration of common social practices and values.

> *"The facades of the residential towers are very simple and do not reflect any identity. Also, this type of architectural style does not match the socio-cultural values of Saudis. For example, windows do not provide any privacy for the residents. Second, the distance between the towers is very short, which is also affecting the privacy of the inhabitants." (AZ 2017)*

This academic argued that physical forms and structures should represent the socio-cultural values of the residents to express the 'civilisation of the nation', describing the identity as a part of 'civilisation'.

> *"Identity is a part of civilisation, and civilisation is a product of the socio-cultural mechanism between the people and the surrounding circumstances. Thus, architecture and urban fabric are derived from the culture of the society." (AZ 2017)*

On the use of culturally-specific architectural elements like the mashrabiya or roshan in some housing in KAEC, respondent AS argued that these were not accurately representing Islamic identity in the built environment. A visual representation of Islamic identity in traditional cities can be seen in the area planning framework and overall designs, all of which demonstrate consideration of Islamic principles and values. For example, in the traditional districts of Jeddah, the spatial organisation accommodated tiers of privacy by demarcating private, semi-public and public spaces as defined by Islam throughout the cityscape (Figure 4, Figure 5) [16]. The urban patterns and house designs have been divided into three degrees of privacy: public, semi-public and private [17].

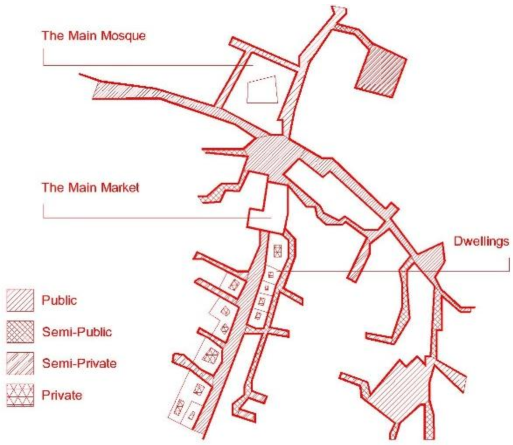

Figure 4: The hierarchy of urban spaces in the traditional districts of Jeddah [18]

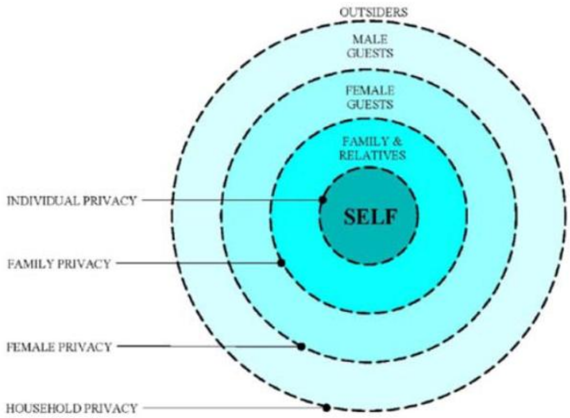

Figure 5: The hierarchy of the spaces inside traditional houses in Jeddah to maintain privacy [19]

The inclusion and development of various architectural elements should therefore be a reflection of Islamic principles and the socio-cultural values of the residents.

> *"Islamic identity is not about using some architectural elements such as roshan, but it is about addressing the socio-cultural needs of the inhabitants, which are derived from Islam. Thus, the urban pattern of Islamic cities around the world has a general framework which is almost the same, however at the local level they are slightly different based on the local socio-cultural values of the residents." (AS 2017)*

The architects and planners interviewed also affirmed that Islamic principles and socio-cultural values have combined to develop the physical forms and structures of traditional cities and to express Islamic identity. HM pointed out examples of Islamic principles and socio-cultural values which have been considered in developing the urban pattern and the design of houses in traditional cities, such as Jeddah, which express Islamic identity.

> *"Islam has provided rough guidelines of planning cities for Muslims, such as the size of the neighbourhood, the dimension of the roads, and the land use. Islam was very flexible in terms of shaping the built environment thus most of the traditional cities offered diversity, functionality, public and private interface, unique geometries and considered the human scale. There was a social framework which derived from the Islamic teachings. This framework has shaped the daily life of Muslims that includes planning cities and the design of houses. For example, privacy has been considered at the local scale in developing the urban pattern and the design of houses in the traditional cities to avoid social tensions and express Islamic identity."* (HM 2017)

However, with regards to the masterplan for KAEC, KS argued that Islamic principles have been partially considered in developing the urban pattern and the design of the houses. However, they failed to demonstrate a deeper understanding of the link to Islam and socio-cultural values.

> *"If we want to know whether KAEC has expressed the Islamic Identity or not, we should know what the Islamic identity is and how it can be expressed in the scale of the city as well as the local scale. Thus, we should*

identify a set of Islamic identity elements, and then test them at the different scales in KAEC. However, based on what I see in KAEC it has not achieved that. Because the neighbourhood pattern and dwelling design applied some features of Islamic principles without deep understanding of the purpose of using them in the traditional cities." (KS 2017)

Over half (53%, n=110) of the residents surveyed in KAEC strongly agreed on the significance of considering Islamic principles and socio-cultural values in planning residential neighbourhoods in KAEC (Figure 6).

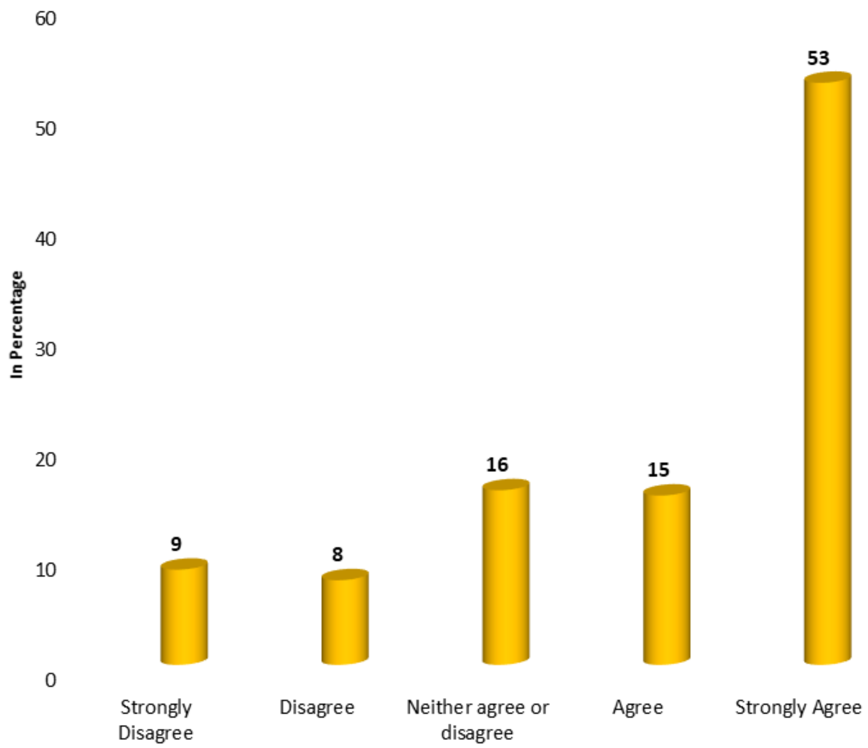

Figure 6: Responses to interview question (#3.3): 'Islamic principles and local socio-cultural values should be considered in planning residential neighbourhoods and housing design in King Abdullah Economic City.' (Source: The Researcher 2018.)

5.2 Planning regulations

The second category of this theme discusses the planning regulations and principles for the physical forms and structures in KAEC. One academic argued that the urban regulations and principles used to develop the major cities of Saudi Arabia led to several issues, specifically loss of local identity and social resistance because of the lack of consideration of socio-cultural values when the planning regulations were developed. The academic added that Emaar should work on modifying the planning regulations and principles to consider the socio-cultural values and other local circumstances.

"The absence of having successful planning regulations that treat the local socio-cultural values and Islamic principles has resulted in changing local identity, social conflicts, and social resistance which led to modifying the

physical forms and structures by the residents without getting official permission from the local authority. For example, the municipalities have adopted building and planning regulations which have been designed based on the needs of other societies, so it failed to consider the Islamic principles and local socio-cultural values. In KAEC, Emaar should re-develop the existing planning regulations and principles, to introduce a city that respects the surrounding circumstances." (TH 2017)

Other academics clearly stated that the planning principles and building regulations in KAEC adhered to similar principles applied in planning in other major cities in Saudi Arabia and ignored the local circumstances.

"Planning principles and building regulations of major cities in Saudi Arabia are not considering the socio-cultural values and the surrounding circumstances." (AS 2017)

"There is no reference to the local architecture and traditional planning regulations and principles." (AF 2017)

AF added that:

"Emaar should be aware of what I mentioned earlier with regards to understanding the socio-cultural values of the society to develop physical forms and structures which carefully consider the socio-cultural context in the country." (AF 2017)

5.3 Patterns and styles

Interviewees discussed the urban patterns of the residential districts as well as the architectural styles in KAEC and mentioned both advantages and disadvantages. Respondent TH argued that the architectural styles used have been applied without consideration of local context, thus there is no local nuanced relationship between housing styles and the urban patterns in KAEC. Their suggestion was to use the same components of the residential neighbourhoods that include urban pattern, houses styles, shops and public facilities as appeared in the design-origin countries to enhance the harmony and create unique identities for each district.

"In KAEC, I do not criticise the proposed housing prototypes because they are not local but because they were not applied as they appeared in Spain for example. If Emaar decided to apply Spanish style to the housing units the urban pattern, shops, and other facilities should express the Spanish identity to having different identities and landmarks for each district in the city." (TH 2017)

However, another academic NS has a different view and highlighted that the city plan contains several features of contemporary cities, citing examples of major infrastructure and residential communities. NS compared the integrated urban pattern in KAEC to the gridiron pattern applied in other major cities in Saudi Arabia and affirmed that the proposed urban pattern in KAEC is successful in considering the surrounding circumstances. This view contradicts what TH said about heterogeneity between urban pattern and houses styles in KAEC.

> *"But when we talk about KAEC, it has been built from scratch to avoid any obstacles. KAEC has all the features of the contemporary city such as seaport, industrial valley, residential areas, and other land uses. Also, KAEC has been surrounded by a large zone on three sides to protect the city from informal growth and to use for future expansion. The modern urban pattern of Jeddah is boring because they applied the gridiron style. While in KAEC you can find what I call the integrated or closed district, which is better in terms of dealing with the surrounding circumstances".* (NS 2017)

NS was highly critical of the housing styles of KAEC for their lack of consideration of the socio-cultural values in shaping residential spaces. NS raised the issue of the design of the houses in KAEC possibly either forcing a change to the lifestyle of the residents or otherwise needing modifications to the housing units to address socio-cultural concerns.

> *"The design of the residential unit is not appropriate for the lifestyle of Saudi families. They have used open plan style, the kitchen is open, living and guest rooms are open and directly connected to each other, besides other aspects which are not acceptable in our society."* (NS 2017)

The views of architects and planners on the urban pattern and housing styles in KAEC varied. Socio-cultural values and Islamic principles such as modesty, equanimity and neighbours' rights have strongly shaped spaces and places in traditional cities, resulting in similar urban patterns and architectural styles across the built environment. KAEC is a contrast by having a variety of urban patterns and architectural styles, in part because the interrelated relationships between physical forms and structures and local circumstances have not been considered.

"Emaar might try to apply a mix of socio-cultural and Islamic principles of the traditional cities. However, I do not think that the forms, structures, and patterns have been built on a deep understanding of the mentioned values and principles. Also, planners and designers do not correctly apply the idea of having defensive space in the residential neighbourhood. This space appeared in the traditional neighbourhoods and it was surrounded by dwellings, while in KAEC you can only see the parking area surrounded by dwellings, which is an incorrect application of the defensive space, and not safe for the pedestrians." (AZ 2017)

> *"At first glance, it is a Western urban pattern"* (AF 2017)

> *"Privacy is very important, however it also important to enhance the social ties between residents. Modesty and equanimity have been introduced in the traditional cities. For example, the houses from outside were almost the same but people know who owns each home in the neighbourhood because there were strong social ties between the residents. In contrary, in KAEC mass production was more important than other essential aspects. For example, it is not correct to have different architectural styles at the same place. If that is the aim, then they should accurately apply the principles of each style at the local scale that includes the neighbourhood planning principles as well as the key determinants of housing designs, because that will improve the social interaction between the residents and support the relationships between the neighbours. Our Prophet … has recommended that the seventh neighbour, even if he is Jewish, still has civil rights and should be maintained. Thus, unity is also important. Neighbours*

should have a general socio-cultural framework that regulates their daily life. Simply, if the urban pattern, as well as housing designs, supports specific socio-cultural values such as privacy, all inhabitants will start to adopt that smoothly.” (AF 2017)

“Emaar has applied elements on the building facades only; however, the design of the residential units for the city is still the same in all styles. As I said earlier, architecture, as well as the urban pattern, should express the lifestyle of the inhabitants. Muslims cannot be 100% happy in KAEC.” (AF 2017)

The structured interviews with residents supported the views of other stakeholders on the significance of having a socio-cultural framework that regulates the daily practices of residents in KAEC, including shaping spaces and places. Approximately 61% of the residents strongly agreed that socio-cultural values reinforced by Islam have greatly contributed to shaping the daily life of Muslims, especially Saudis (Figure 5).

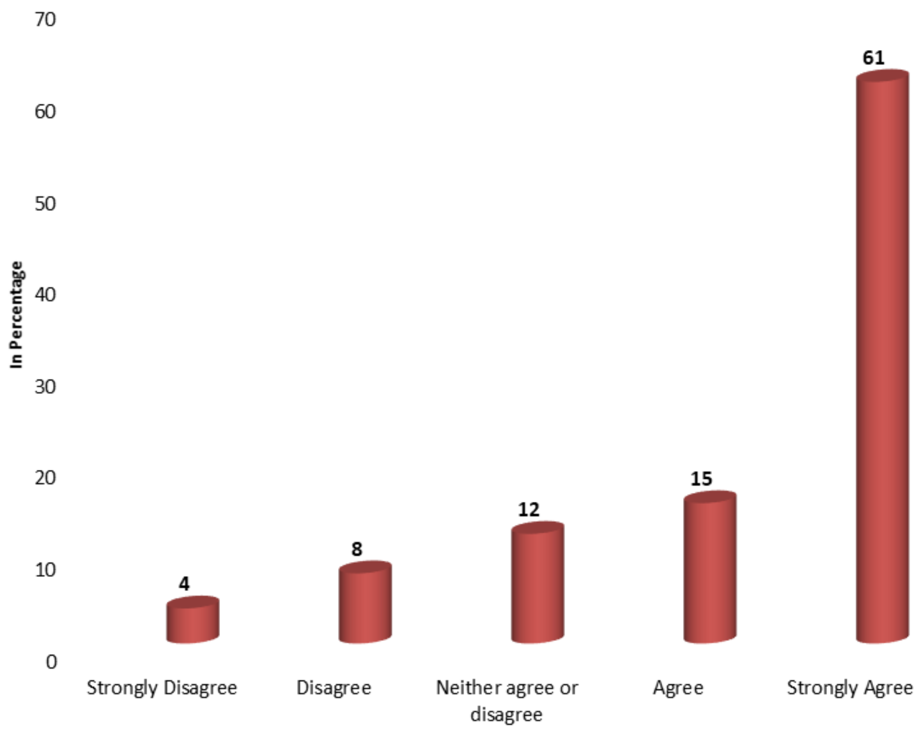

Figure 3: Responses to interview question (#3.1): *'There are a variety of socio-cultural values which have been reinforced by Islam and greatly contributed in shaping the daily life of Muslims, especially Saudis*'. (Source: The Researcher 2018.)

Some interviewed architects and planners affirmed that there was a balance between using modern and local styles in planning the residential neighbourhoods and the design of the houses in KAEC. MA noted that Emaar has applied a modern Western style to design the office towers, while the Andalusian style template was used when designing the residential towers in Bay La Sun district; noting however Andalusian is not considered a local style.

"So we decided when planning KAEC to make it a modern city but at the same time, we applied some of the local characteristics at the residential neighbourhoods. So, you find the Arabian and the Andalusian architectural

> *styles in some of the residential districts. The Andalusian architectural style was also used to design the residential towers at Bay La Sun and Marina districts, while we used the modern style to design office buildings such as Dubai. To be honest, the built environment in KAEC is very similar to Dubai."* (MA 2017)

On the styles of the houses in KAEC, respondents MA and MI clearly stated that Saudis will not approve of them due to socio-cultural concerns. Saudis have been described as conservative because they designate separate sections for men and women in their homes. MA argued that nothing in the Islamic principles define the details of designing interiors of houses and supported this view by citing the prophet Mohammed's own home as not having gender segregation in the space.

> *"Saudis are so conservative due to social customs and values, not the Islamic teachings. For example, most Saudi families prefer two parts in their home: (i) for the family, (i) for the guests to protect the privacy of women inside the house. This kind of separation never happened in the prophet era peace be upon him, and he was sitting with his companions and their families in the same room. Most of the Saudis today when they invite friends to their homes, they send their wife to stay at her parents' home even if they have a different part for guests in their house due to privacy concerns. So, I do not think they will like the open plan in some of the housing units in KAEC." (MA 2017)*

> *"In the housing units, Emaar claims using different architectural styles in the residential districts in KAEC, which is not correct. They only applied architectural elements to the housing facades, which cannot be described as an architectural style. Because the style is not only about the external features but they should consider the internal layout of the house as well as the neighbourhood pattern. However, these different styles are not designed based on the local socio-cultural values of the residents. For example, here in the residential units in the Al-Waha district, there is only one living room on the ground floor which can be used also for hospitality, which is incorrect. Privacy is very important for Saudis; thus they will not accept this kind of design and they will start modifying them immediately."* (MI 2017)

One in five (21%, n=44) of the residents surveyed in KAEC strongly disagreed that the urban pattern in KAEC maintains the Islamic principles of planning in the residential neighbourhood. This view supports the arguments raised by the stakeholders' in-depth interviews in terms of overlooking Islamic principles and local socio-cultural values when determining the physical forms and structures in KAEC in favour of importing Western urban and architectural styles (see Figure 6).

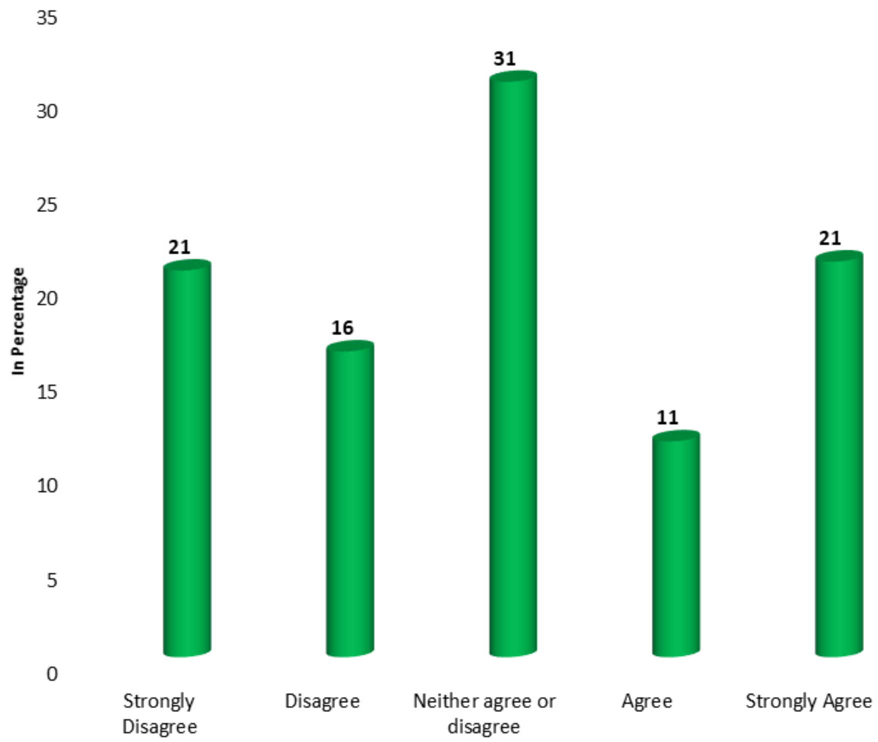

Figure 4: Responses to interview question (#3.6): '*The urban pattern in King Abdullah Economic City maintains Islamic principles of planning residential neighbourhoods*.' (Source: Researcher 2018)

6 Stakeholders

This theme examines issues regarding views, attitudes, roles and aspirations of stakeholders in terms of physical forms and structures in KAEC from the perspective of the private and government sectors, as well as the general population. Academic staff, architects, planners and residents were interviewed to provide their views on this theme from a socio-cultural perspective. Four main categories emerged from the in-depth interviews analysis: (i) modernity and globalisation, (ii) views and aspiration, (iii) roles and participation, and (iv) relationships.

6.1 Modernity and globalisation

The first category in this theme examines the issues raised by academics about modernity and globalisation, and the role of socio-cultural values and Islamic principles in shaping spaces and places in KAEC. The role of Islamic principles and socio-cultural values in developing cities in Saudi Arabia has dwindled due to several reasons. A significant factor is the application of modern urban patterns and architectural styles following the economic boom in the early 1970s. The gradual adoption of a modern Western lifestyle by architects, planners and the general Saudi population also led to minor changes in the wider socio-cultural context of Saudi Arabia. Among the academic respondents, AM highlighted that:

> *"Yes, there are various reasons; however, the most important reason is that planners and architects are not careful when treating socio-cultural values*

while planning the new districts. During the economic boom and the industrial revolution, most of the people and stakeholders did not appreciate local forms, structures, patterns, and even socio-cultural values. Thus, these daily issues we are facing in existing neighbourhoods in KAEC are a result of ignoring the local contexts and impressing with Western products." (AM 2017)

"Globalisation has been imposed on the developing countries to adopt the Western model, Western ethics, and Western foundations to develop their economic capabilities." (AS 2017)

6.2 Views and aspiration

The second category in this theme discusses the views of academics, architects and planners on the views and aspirations of the stakeholders. Residents were identified by most of the interviewees as being a significant factor for consideration in urban projects in KAEC. Academic respondent AS criticised planners, architects and academics in general as being responsible for ignoring the needs of residents when developing planning policies for new cities such as KAEC.

"Stakeholders should come down from the stage of divinity because they should know that planning decisions should interpret people's needs such as socio-cultural, religious, environmental needs." (AS 2017)

Interviewed architects and planners generally shared the belief that it was valuable to the city masterplan process to conduct a survey of targeted residents prior to its development. This would provide data on the socio-cultural values and economic status of potential residents, all of which should be considered when developing the physical forms and structures of the city.

"Emaar should conduct surveys with the targeted locals prior to designing the dwellings to identify what they actually need and what kind of socio-cultural values should be addressed at the local scale in KAEC. Simple questions could be helpful such as, do you need privacy in your new dwelling, is that required for indoor and outdoor spaces? The economic status of the possible owners is also important in terms of defining the level of the dwelling." (AZ 2017)

"Emaar has applied elements on the building facades only; however, the design of the residential units for the city is still the same in all styles. As I said earlier, architecture, as well as the urban pattern, should express the lifestyle of the inhabitants. Muslims cannot be 100% happy in KAEC." (AF 2017)

About half (49%, n=102) of the residents interviewed strongly agreed that the views of stakeholders (i.e. residents, academics, architects, planners) differed on how to achieve Islamic identity and to maintain socio-cultural values when planning residential neighbourhoods and designing housing in KAEC (see Figure 7).

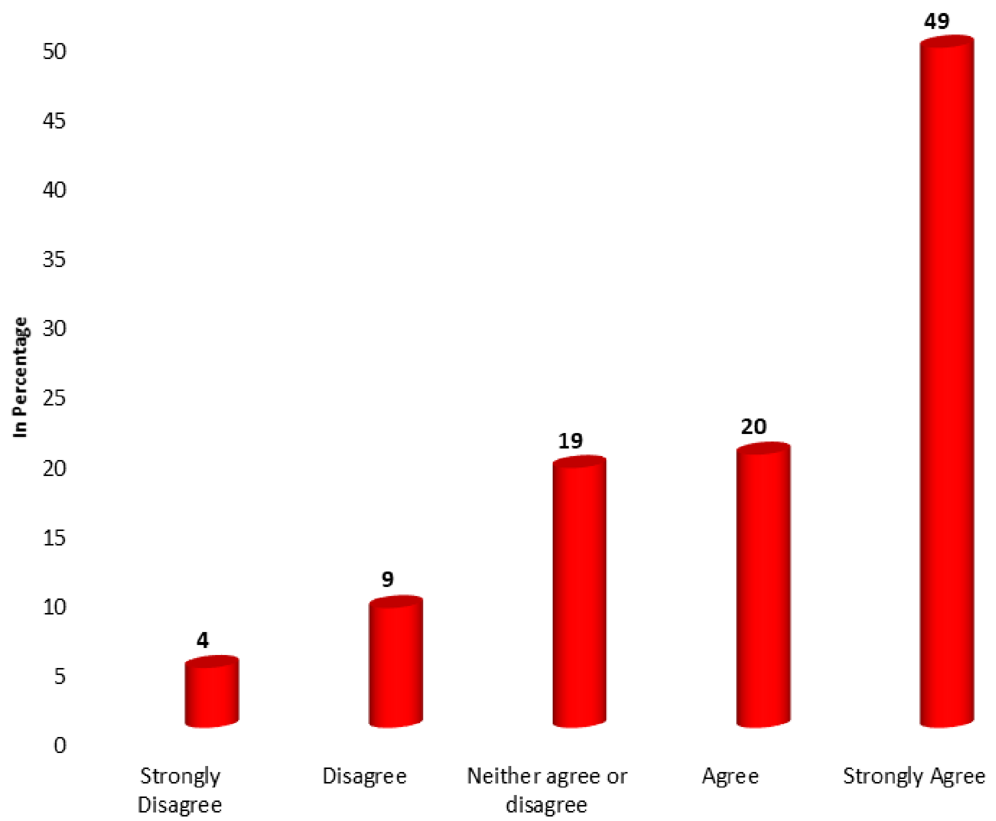

Figure 7: Responses to interview question (#3.4): 'The views of stakeholders (residents, engineers, architects, planners) differ on how to achieve Islamic identity and to take care of social and cultural values when planning residential neighbourhoods and designing housing in KAEC.' (Source: Researcher 2018)

Two questions in the structured interviews had an open-ended option to clarify the views of residents in KAEC from a socio-cultural perspective. The comments were categorised into three categories: positive, negative and neutral comments. For the question on considering the Islamic principles and socio-cultural values in planning residential neighborhoods and housing design in King Abdullah Economic City, Table 1 shows 56% (n=116) of comments were positive, and only 12% (n=25) were negative, indicating the majority of the participants argued that Islamic principles and local socio-cultural values should be considered in the planning of residential neighbourhoods and housing design in KAEC.

Table 9: Views of the residents in KAEC on considering Islamic principles and socio-cultural values during city planning and housing design

Particulars	N	%	Brief Description of Comments
Positive Comments	116	56	The city is designed for all and that must be taken into account by stakeholders, but it can be clarified what is acceptable and unacceptable to Saudi society to avoid social tension. The most important is not to turn the city into a traditional one.
			The importance of integrating traditional and contemporary architecture is important, finding new ways of expressing Islamic identity in the architectural elements.
			Islamic principles of planning cities are flexible and suit all other socio-cultural backgrounds.
			To achieve happiness, comfort, and quietness I think yes they should consider that.
Negative Comments	25	12	The existing stream in the country is to make Saudis widely accept people from other religions, and treat them like Saudis, so applying Islamic principles in planning KAEC is not useful during this era.
			No, because we have to build up modern cities like other leading countries because we have the same capabilities, however, applying Islamic principles in planning the cities could not give it an international reputation.
Neutral Comments	68	32	

Table 2 shows the question on participants' perceptions on whether the urban pattern in KAEC fails to maintain Islamic principles of planning in residential neighbourhoods received 24% (n=51) positive comments, 31% (n=65) negative comments, and 45% (n=93) neutral comments.

Table 10: Views of residents on maintaining Islamic identity in KAEC

Particulars	N	%	Brief Description of Comments
Positive Comments	51	24	There is still a need for greater privacy as a Muslim community, where family size is large and need more places and privacy to meet needs of extended family.
			The relationship between the mosque, houses and the neighbourhood centre is good which is an important part of the planning of the traditional neighbourhood.
			One of the aspects that has been observed in the neighbourhood is considering the walking distance from the houses to the mosque. Also, preserve the rights of the neighbour when using the public spaces while providing areas of social communication without ignoring the religious aspects that are important to Muslims.

Negative Comments	65	31	International styles have been greatly applied by Emaar in planning the city. They do not pay attention to our local lifestyle which formed the local neighbourhood in other traditional cities. For example, some of the neighbourhoods do not have local mosques, which is unacceptable for Muslim communities. There is something missing here, I cannot have the same feeling of locality like when I was in Jeddah, building features and neighbourhood pattern are strange. Inhabitants usually sit at home and rarely go outside, streets are empty, it is not like any Islamic city. The design of the city does not express either Islamic identity or local socio-cultural values.
Neutral Comments	93	45	

6.3 Roles and participation

The third category in this theme examines the roles and participation of stakeholders in shaping physical forms and structures of the cities in Saudi Arabia. The one-sided, vertical approach of the stakeholders when designing Saudi Arabian urban projects diminished the role of architects and planners in expressing the Islamic principles and socio-cultural values in the new projects. This was in part due to the application of rigid planning policies and building regulations developed by private organisations that received support from the government.

> *"Some of the practitioners were mostly trying to develop neighbourhoods and houses based on the local socio-cultural values, however, some of the building regulations are rigid and do not encourage the practitioners to show their aims. So, they mostly design projects that represent planning principles and building regulations even if they do not like it, to avoid having the project rejected by a government or private organisations. I think government and private bodies should support the practitioners to develop creative Islamic patterns for the neighbourhoods and dwellings based on the surrounding circumstances such as the local socio-cultural values, Islamic principles, economic and environmental aspects, and so forth."* (MH 2017)

The participation of architects, planners and other stakeholders in the planning process of new cities is significant in representing the diversity of stakeholders and views in the city. In this context, understanding views, needs, attitudes and aspirations of stakeholders during the formative processes of the project is vital in avoiding long-term issues after completing the project. Residents should participate in the planning process of new cities in the early phases of the project to ensure the resulting built environment sufficiently addresses their needs and aspirations.

> *"Thus, the urban development projects should be planned based on the needs of the stakeholders, especially the inhabitants. Their participation at*

> *the early stage of planning the urban projects is really important to understand their needs and avoid issues in the long term."* (AZ 2017)

The masterplan of KAEC has been widely criticised for not having specific ideologies to enhance the social ties between the residents. For example, some residential districts do not have basic public infrastructure like district centres or a local mosque, both of which play significant roles in enhancing social ties in traditional cities. In response to these issues, residents were gathering to find solutions for the missing infrastructure in their residential neighbourhoods. However, the participation of the residents in the formal urban planning process has continued to diminish in KAEC.

> *"For example, here in KAEC, I can only see the parks and the community centres which could enhance the communication between the residents. The mosques in most of the neighbourhoods are temporary buildings. There is something missing between the dwellings and the urban spaces which could be the defensive space in between. In Europe, stakeholders started to develop special ideologies to encourage the neighbours to communicate with each other such as neighbourhood councils. These councils started arranging socio-cultural activities to attract society members. Thus, neighbours started to communicate more than before to discuss daily matters and do other activities. Thus, stakeholders should work as a group to develop the residential neighbourhood. This kind of collaboration is very important and unfortunately, it has not happened in KAEC or any other cities in Saudi Arabia."* (AZ 2017)

Academics also play a significant role in adopting Western urban approaches and architectural styles in developing the major cities in Saudi Arabia. Similarly, some architects and planners who have studied abroad also contributed to applying foreign approaches, an effect which has extended to include planning new cities such as KAEC. Such professional practices have occurred in Saudi Arabia for a number of reasons. Returning local professionals in urban planning face difficulties in understanding the role of socio-cultural values and Islamic principles in shaping the physical forms and structures in modern and new cities. Building and planning regulations in Saudi Arabia are more compatible with modern urban planning regulations of the US rather than the existing local socio-cultural needs.

> *"Academic staff, due to completing postgraduate studies overseas, adopted international patterns in teaching architecture and the planning principles. Thus, young architects and planners find difficulties in understanding Islamic principles and socio-cultural values to consider them correctly in planning districts and designing houses."* (TH 2017)

> *"Architects and planners who have learned overseas in Western universities have adopted the Western style, thus applied it widely in the country. Also, those practitioners have lost the sense of connecting the Islamic principles as well as socio-cultural values with architecture and planning cities."* (AS 2017)

> *"Most of the stakeholders who participate in the planning projects in the country such as planners, architects, and academic staff have widely adopted the classic Western style for planning cities. The principles of these Western styles are still applied in Saudi Arabia."* (AS 2017)

6.4 Relationships

This final category demonstrates the necessity of communication between various stakeholders at different levels of the planning process to ensure that all aims are addressed. This interconnected relationship between the stakeholders has decreased with the emergence of contemporary cities in Saudi Arabia. For example, in KAEC, Emaar (the main developer) has individually developed the urban pattern and the design of the houses based on the view of the company and its assumptions about the possible residents.

> *"However, this compatible relationship between stakeholders in the traditional cities started to change gradually due to having different aims for the stakeholders. For example, the municipalities have developed building and planning regulations to shape the major cities in Saudi Arabia. These regulations have been designed by expatriates based on the needs of other societies, so they failed to consider the Islamic principles and local socio-cultural values of Saudis. The situation in KAEC is similar to the other major cities in the country because Emaar has dominated the drawing of the planning policies and regulations of the city. Thus, it shaped the city based on its assumptions. It is important to collect accurate data about future residents prior to developing the masterplan of the city."* (TH 2017)

7 Conclusion

The stakeholders who are involved in planning traditional and modern cities in Saudi Arabia have different views, attitudes and aspirations. In traditional cities, the participation of the stakeholders in the planning process occurred in both a fluid and standard manner due to a socio-cultural framework which is derived from Islamic principles. Residents and master builders applied these values and principles in planning the residential neighbourhoods and the design of the houses in traditional cities.

In contrast, in the modern city of KAEC the role of Islamic principles and socio-cultural values in shaping the local physical forms and structures was significantly diminished. In-depth interviews were used to identify the views of the three main types of stakeholders – planners, architects and academics – on two main themes from a socio-cultural perspective. The first theme of physical forms and structures has three main categories: (i) Islamic identity and socio-cultural context, (ii) planning regulations, and (iii) patterns and styles. Following this, the second theme of stakeholders has four main categories: (i) modernity and globalisation, (ii) views and aspirations, (iii) roles and participation, and (iv) relationships. The outcomes of structured interviews with residents of KAEC have been used to support the results of the in-depth interviews with the other stakeholders.

The first theme examines views of stakeholders on Islamic identity and local socio-cultural context. Interviewed academics highlighted that a failure to consider Islamic principles and socio-cultural values in planning KAEC is a continuation of Emaar's approach when developing new cities, as evidenced in previous projects undertaken in Dubai. The standard approach of Emaar is identifiable by the use of specific physical forms and structures that express the company brand rather than reflecting the local socio-cultural values and Islamic practices. KAEC's urban forms and structures were criticised by academics, architects and planners for not adequately representing the Islamic identity of the local area. Academics argued that

Islamic identity is not defined by implementing some traditional architectural elements such as roshan, but rather in developing forms and structures that represent the Islamic principles and socio-cultural values of the residents. Over half (53%) the Saudi residents surveyed in KAEC agreed with the views of academics, architects and planners by strongly highlighting the significance of considering Islamic principles and socio-cultural values when planning residential neighbourhoods in KAEC.

The second category discusses planning regulations. Academics reviewed the defects of planning regulations in major cities like Jeddah, which were partially responsible for losing the Islamic identity of the traditional city. Inhabitants started to resist the modern planning and building regulations by changing the outline of the neighbourhoods and the design of the houses in some Jeddah districts. In response to Jeddah's example, academics, architects and planners have suggested adjusting planning regulations in KAEC to consider socio-cultural values and Islamic principles to avoid similar issues, ensuring the development of physical forms and structures that represent prevailing socio-cultural values and Islamic principles.

The third category examines the urban patterns and architectural styles in KAEC. Views of academics varied. Some criticised the existing urban patterns because they were not adequately adapted to reflect the local KAEC context. Other respondents argued that the urban pattern in KAEC is superior to those of other Saudi Arabian major cities because it applied an integrated approach to developing residential districts. However, academics, architects and planners argued that the architectural styles and housing designs did not demonstrate socio-cultural values, Islamic principles, and surrounding local environment. Most posited that Saudis would dislike these housing designs, and it was likely residents would make modifications to meet their needs. The structured interviews with the residents supported the views of other stakeholders on the significance of having a socio-cultural framework that regulates the daily practices of residents in KAEC, including shaping spaces and places. Around 61% of the residents strongly agreed that socio-cultural values reinforced by Islam greatly contribute to shaping the daily life of Muslims, particularly Saudis.

Some architects and planners supported the current architectural styles in KAEC, argue that Islamic teachings do not provide specific details on housing design. For example, it was cited that the prophet Mohammed did not designate separate rooms for men and women in his house. Due to socio-cultural changes, Saudis became more conservative and changed the design of their houses to reflect their values. One in five (21%) of the surveyed residents in KAEC strongly disagreed that the urban pattern in KAEC maintains the Islamic principles of planning residential neighbourhoods. This view supports the arguments raised by stakeholders in the in-depth interviews on how Islamic principles and socio-cultural values were overlooked when shaping the physical forms and structures in KAEC in favour of importing Western urban and architectural styles.

The second theme examines issues about the views, attitudes, roles and aspirations of stakeholders on physical forms and structures in KAEC in four main categories: (i) modernity and globalisation, (ii) views and aspirations, (iii) roles and participation, and (iv) relationships.

Academic interviewees highlighted the role of Islamic principles and socio-cultural values in shaping spaces and places in KAEC. In part, modernity and globalisation is responsible for the diminishing influence of existing Islamic principles and socio-cultural values in developing cities in Saudi Arabia. Modern urban patterns and architectural styles have been applied to Saudi cities since the economic boom in the early 1970s. The adoption of a modern lifestyle by Saudis led to minor socio-cultural changes in Saudi Arabia. Most respondents agreed that the adoption of a Western approach in urban planning was partially responsible for decreasing the presence of local socio-cultural values and Islamic principles in the KAEC masterplan.

The views and aspirations of academics, architects, planners and residents varied on the development of the masterplan for KAEC. Interviewed academics, architects and planners affirmed the significance of addressing the needs and views of residents in planning new cities. They criticised Emaar for not researching beyond its own assumptions on the needs of future residents prior to developing the masterplan and housing designs. Interviewees also expressed concerns that residents will not be satisfied with KAEC housing because they did not address their needs About half (49%) of the residents expressed that the views of stakeholders (residents, academics, architects, planners) differed on how to achieve Islamic identity and maintain socio-cultural values when planning residential neighbourhoods and designing houses in KAEC. This demonstrates the importance of considering the views of all stakeholders when shaping new cities, however this did not occur during KAEC's development.

The majority of participants argued that Islamic principles and local socio-cultural values should be considered in planning residential neighbourhood and housing design in KAEC. Responses demonstrated the residents' perception that physical forms and structures in KAEC fail to express Islamic identity. Interviews data shows some of the views of the residents on KAEC's urban landscape design were ignored.

The vertical approach of the stakeholders in the urban projects in Saudi Arabia reduced the role of architects and planners in expressing the socio-cultural values and Islamic principles in new projects. Rigid planning policies and building regulations were developed by private organisations receiving government backing. These policies severely limited flexibility in architectural design. Thus, the views and participation of residents during the planning process were not considered during new city developments. Places and spaces in KAEC were criticised for failing to encourage social ties between residents, and for not completing infrastructure in the residential districts that could increase social integration. Local academics have also played a major role by adopting Western urban approaches and architectural styles, attributed to their lack of understanding of the role of Islamic principles and socio-cultural values in shaping Saudi cities; and because building and planning regulations in the country adhere to Western approaches.

Finally, there are the relationships between stakeholders. The compatible relationship between the stakeholders has reduced with the emergence of modern and contemporary cities in Saudi Arabia. For example, in KAEC, Emaar has dominated the development of the urban pattern and the housing design based on its own views, which have been criticised by other stakeholders. This is in direct contrast to the planning of traditional Saudi Arabian cities, which incorporated prevailing Islamic principles and socio-cultural values, among other rules. Inhabitants, master-builders and other stakeholders were responsible for planning the districts and the design of houses at the micro level of the traditional cities, with rulers and other government members responsible for macro city management. As a result, there was a compatible relationship between the stakeholders in traditional cities such as Jeddah, which is not seen in the modern city KAEC.

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06.107 AN AFFORDABLE CO-LIVING COMMUNITY FOR MIGRANT PEOPLE IN BEIJING

Yanhan Liu
211 Lafayette RD, APT 306, Syracuse, NY, The US, 13205, yliu224@syr.edu

Abstract

The sprawl of cities never stops. Brick walls crumble, the squares where the kids played vanish, dilapidated houses are slowly dismantled. Skyscrapers, mansions, and transportation are spring up like mushrooms. Beijing as the capital of China attracts urban migrants because it promises future and hopes. Meanwhile, urban migrants in Beijing have to face so many social and economic issues, and migrant communities grow in an opposite direction to urban development [1]. They provide affordable housing for migrant people, but they have become synonymous with dirty and messy environments, and narrow and inconvenient spaces. However, under the support of the sharing economy, unparalleled forms of exchange are happening worldwide. As crucial parts of the sharing economy, co-living is profoundly affecting people's residential options. So what other major housing difficulties do urban migrants face? What are the existing understandings of the current urban migrant population in Beijing? How can we popularize co-living lifestyle in migrant communities to match their living space to their life style?

Employing mappings, interviews, and surveys, this study seeks to analyse and improve different types of migrant people's communities, using a detailed case study of the urban village- Shuimo community in Beijing. Analysing the existing pattern of affordable housing and considering opportunities to develop and combine it with a co-living lifestyle can optimize the affordable housing environment to meet different migrant people's needs. By analysing five groups of users of different identities in the community, and exploring the various spatial needs for the users, the project will propose a strategy for reorganizing the space for people who have the same spatial needs and creating a new model of migrant housing and dealing with the paradox between migrant people and urbanization. Therefore, through this research, we can improve living conditions of migrant people, and coordinate the contradiction between market trading and citizen life.

Keywords

Urban migrant, Affordable housing, Sharing economy, Co-living, Migrant community.

5 Introduction

The phenomenon of human migration, defined as the "movement by people from one place to another with the intention of setting temporarily or permanently in the new location" [2], has been soaring steadily in the last century. According to the 2011 census, internal migrants in China reached a count of 220 million.

With more than 50% of the world's population living in cities, the trends of migration are set to rise exponentially. With it arise the problems of high-density inadequate living. Estimates show that one out of every three people in cities of the developing world lives in deprived and unexpected squatter settlements. According to the UN Habitat's report "State of the World's Cities 2008/2009", the rate of growth of these unplanned parts of a city is way higher than the visible, planned parts.

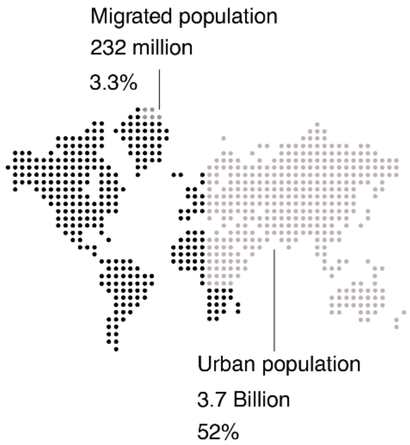


Figure 17. Global Migration Trends

(Source: Survey by the United Nations, DESA)

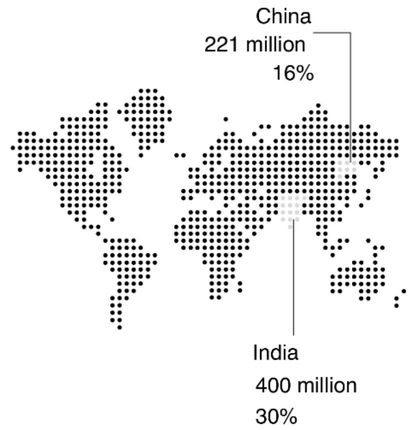


Figure 2. Internal Migration Trends

(Source: Survey by the United Nations, DESA)

This project asks how urban migrants deal with housing difficulties they faced. It seeks out latent potentials in spatial choices for diverse users, situating itself with a hybrid of user needs and alternative strategies. Through analyzing different users, the project attempts to coherently synthesize new housing types to satisfy different users' needs. The goal was to create a new mode of affordable migrant communities, coordinating the paradox between the housing market and urban migrant life.

6 Urban Migrant Community: Past and Present

Urban morphology is an approach to studying and designing urban forms which consider both the physical and spatial components of the urban structure [3]. It is the study of the way of human settlements and their process of formation and transformation.

By looking at the space changes from 1989 to 2018 for four different cities (Fig.3), one can see the process of urbanization is very fast. Meanwhile, the formation of migrant communities is obviously followed by the process of urbanization.

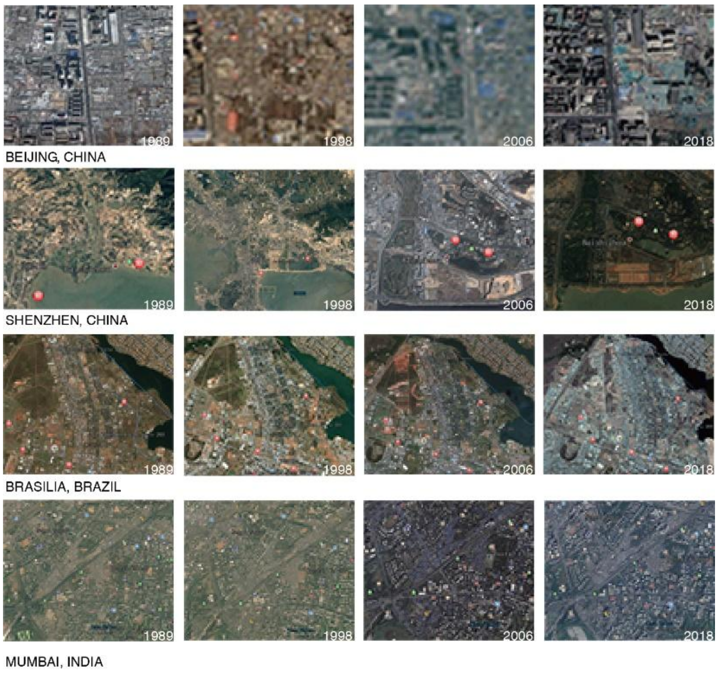


Figure 3. Urban Morphology

(Source: Google Earth Pro)

6.1 Space Change in Beijing

China is a country with rapid economic development and expansion, which is most visible in a megacity like Beijing [4]. The development of Beijing is more like the diffusion of the point. That means, Beijing's urbanization process is spread by points area. Like in 1975, Beijing Only develops as a small circle, but in 2016, it spread to more than other rural areas. Especially, for the housing (Fig.4), it is gradually developed by urban's infrastructure. After the development of housing, urban migrant communities continuously pop up from the edge of Beijing (Fig.4).

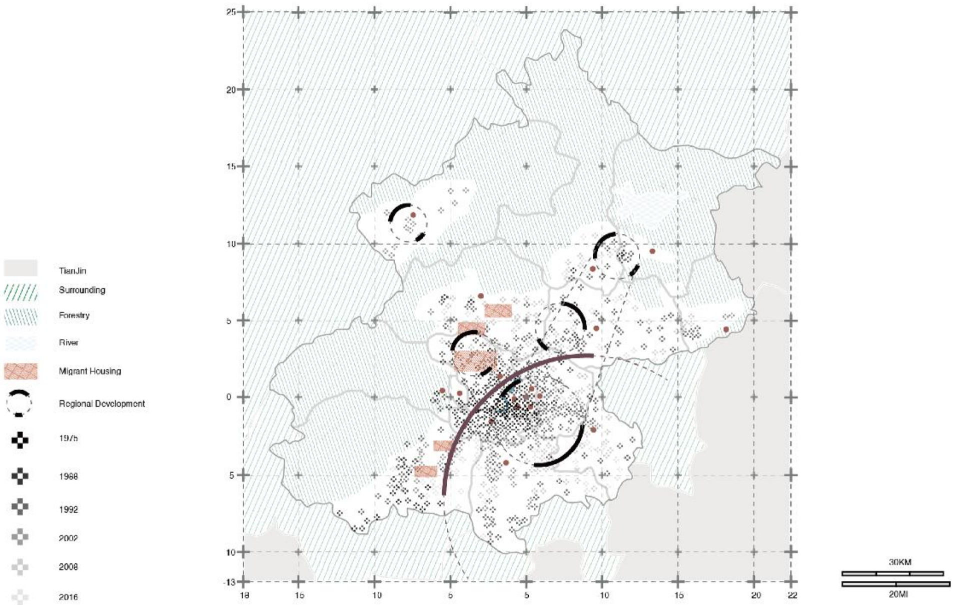


Figure 4. Housing changes in Beijing

(Source: Mapping by author)

6.2 Migrant Communities in Beijing

Zooming in the migrant communities, nowadays, it has become synonymous with dirty and messy environments, and narrow and inconvenient spaces. For the most migrant people, there is impossible that affordable and comfortable are coexisting. They have to decide between finance and life environment. So, based on these issues that migrant people faced, how can popularize co-living lifestyle in migrant communities to match their living space to their lifestyle?

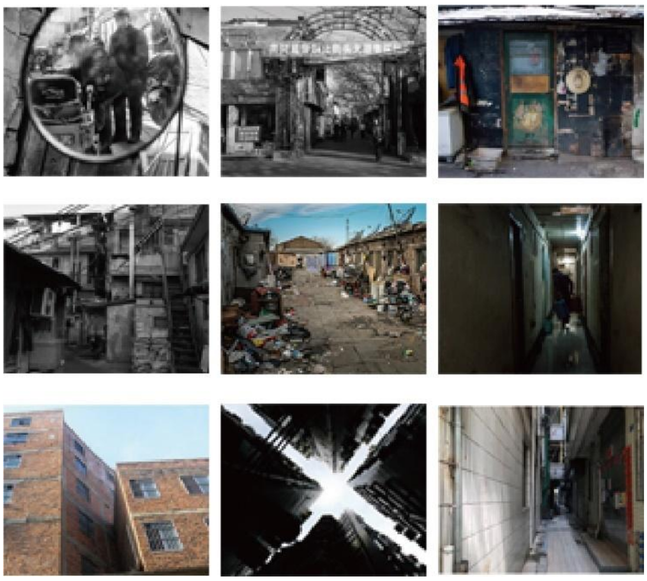


Figure 5. Neighbourhood of migrant communities

(Source:http://www.360doc.com/content/17/0113/22/9061014622303443.shtml)

After doing some research on the six major migrant communities (Fig.6), area, the population structure, and how many people share one apartment are clear. However, compare to other communities, the area of Shuimo community is kind of smaller, but around 320 units, 11,000 people live in here.

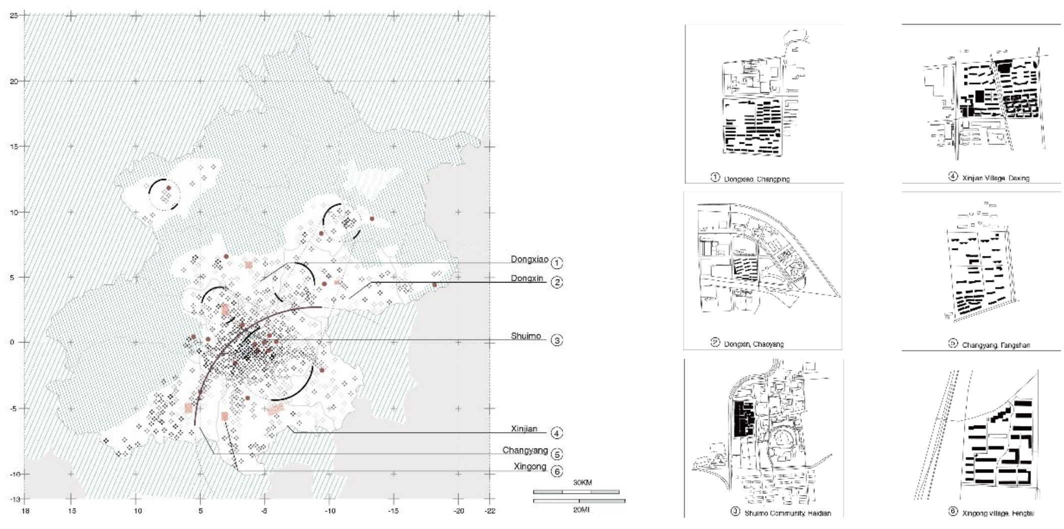


Figure 6. Migrant communities in Beijing

(Source: Mapping by author)

6.3 Shuimo Community

Shuimo community is nearby the Peking University and Tsinghua University. It is also very nearby the Zhongguancun which area contains lots of high technology people. And in this area, there are more than 90% people are migrants. Also, because of the location, there is no doubt that it has lots of job opportunities. There are some daily scenarios in Shuimo community (Fig.7). There are lots of students and entrepreneur living in here. Simultaneously, some old structures still reserved here, like the stair. In some way, people who live in Shuimo community are willing to talk to their neighborhood in the stair. Sometimes, the stair means a kind of social networking. The most active group in the Shuimo community are people living in this land, only a small group of people go shopping or strolling from other areas to this place.

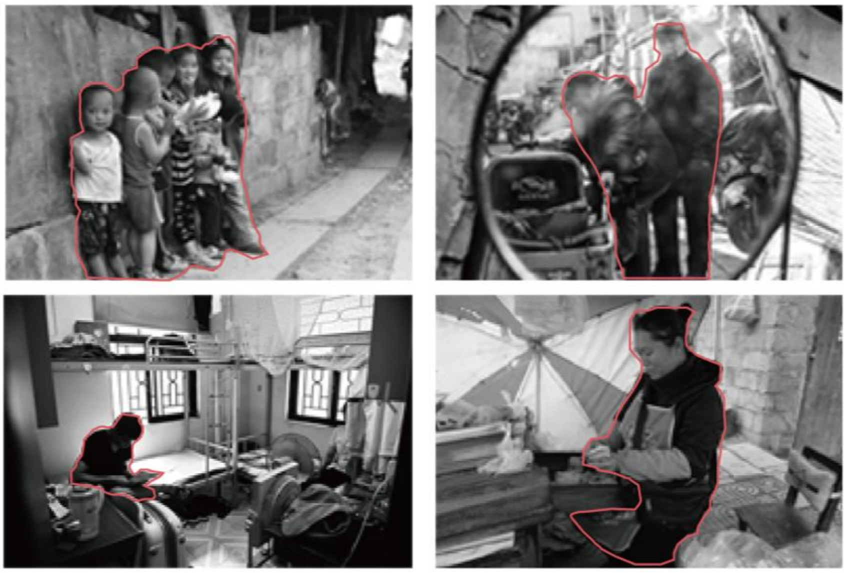


Figure 7. Life senarios in Shuimo community

(Source:http://www.360doc.com/content/17/0113/22/9061014622303443.shtml)

6.4 User Anslysis

According to the site analysis, there are five different kinds of people could be researched— students, office workers, low-income people, entrepreneur, and seniors. Some research questions could be proposed, like how many people are willing to share an apartment, how many roommates they have, and what kind of space they need and so on. There are lots of space needs overlapped by different users. That means, there are some opportunities to make them live together and improve their living condition. So, the strategy here is that according to different people's activities, people could choose their own space needs and choose the one who has same space need to live together. For example, the graduated students are looking for a job, so they need a workspace same as office workers' needs. And they might not willing to cook at home, so they do not need a cooking space. Then they could live together.

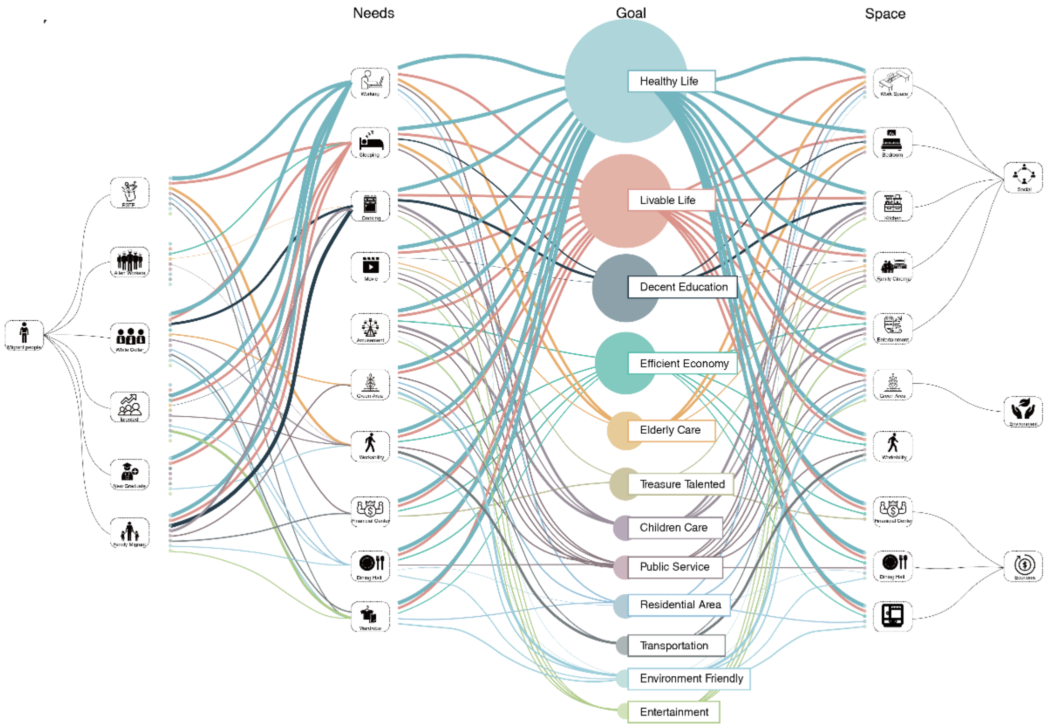


Figure 8. Strategy

(Source: Drawing by author)

7 Sharing Culture: Co-living in Migrant Community

If we look at music or transportation industries now, we can see that the idea of sharing culture has penetrated deep into the sectors. From these industries, we know that the consumer experience can range far greater when things are shared. The pool of resources is much greater than if it were to be individually funded. However, this idea of sharing is not only a recent trend. The idea of the gym, where all the gym equipment are shared, has been around for decades and we understand and accept the logic. However, if owning a personal gym at your home sounds like an extravagance, why holding a living room that you only use a very small percentage of your time? [5]

Needless to say, the idea of sharing has re-emerged into the housing as well. According to an article on NPR, called "Bay Area's Steep Housing Costs Spark Return to Communal Housing," young generations are voluntarily deciding to live together in a large household to reduce the cost of living in cities. So, if you can reform your house and choose your roommate according to the same needs, will the affordable and comfortable coexisting?

7.1 Key Factor

Based on the strategy proposed before, different types of people could base on their own spatial needs to choose their housing type (Fig. 9). The people who have the same spatial needs can negotiate to live together. On the one hand, it could make their living condition more affordable; on the other hand, it could optimize the spatial usedness.

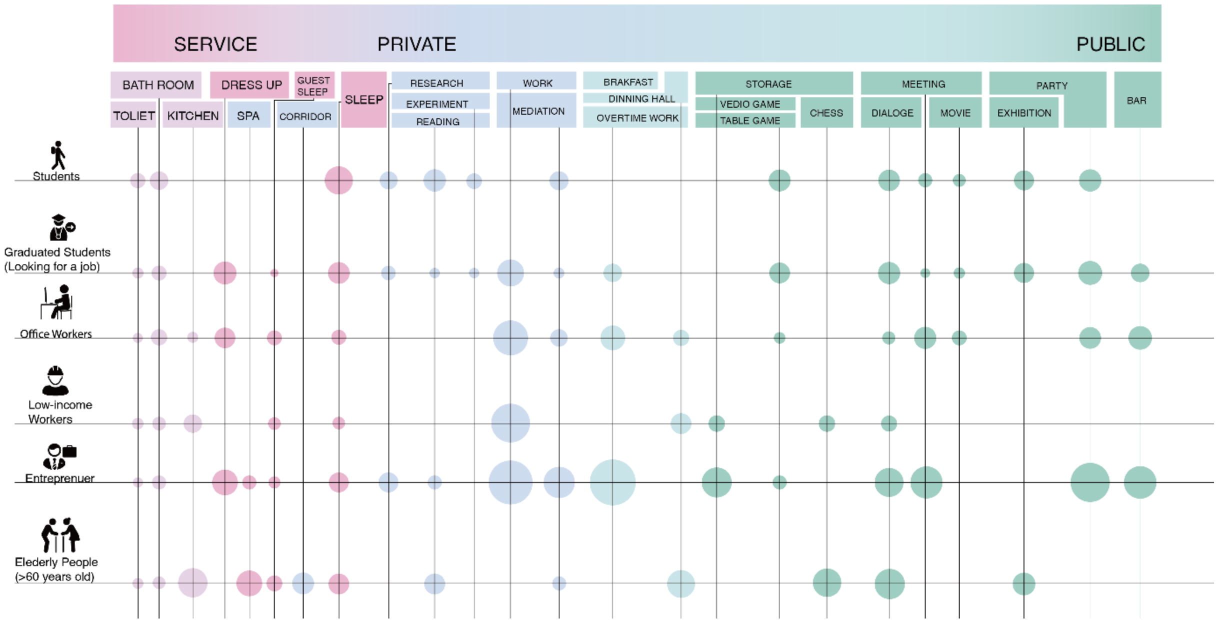


Figure 9. Key factor

(Source: Surveyed by author)

8 Community Strategy

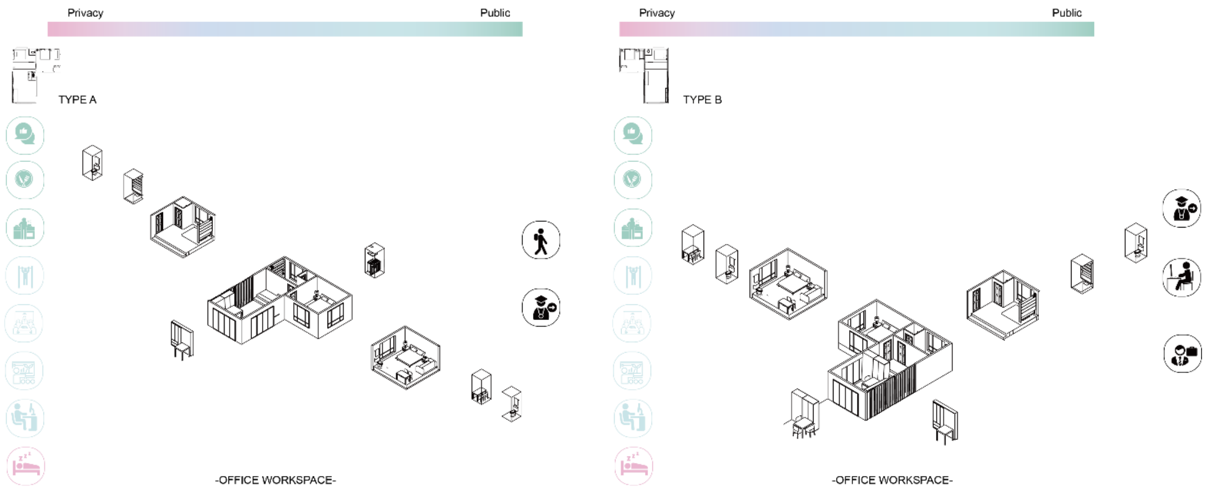
Hence, to improve the living conditions of Shuimo community, the strategy mainly through four categories to start—housing type, community facility, and community operation.

Figure 10. Strategy

(Source: Drawing by author)

8.1 Strategy: Housing Type

For housing type, the start point is 1 by 1 modular unit, like the rest space or toilets, through the privacy to the public, space could be used separately. Then, for the multiple space, it could be used for different uses in different times. Such as the closet and eating table, you can use it depends on whatever you want. Based on the modular units, it could be combined in one housing type. Take type A and type B as an example. The type A, for students and graduate students, the public space is mainly for work, they could use these public spaces in different time for different uses. For example, during the 8:00 pm, the students or graduated students could use their workspace, and during the dinner time, the two type could be connected and share one cooking and eating space. And, like during the working day, like 8:30 am-5:30 pm, the public space could be rent to some company for meeting space or working space. And during the night, it will be separate for private sleep.



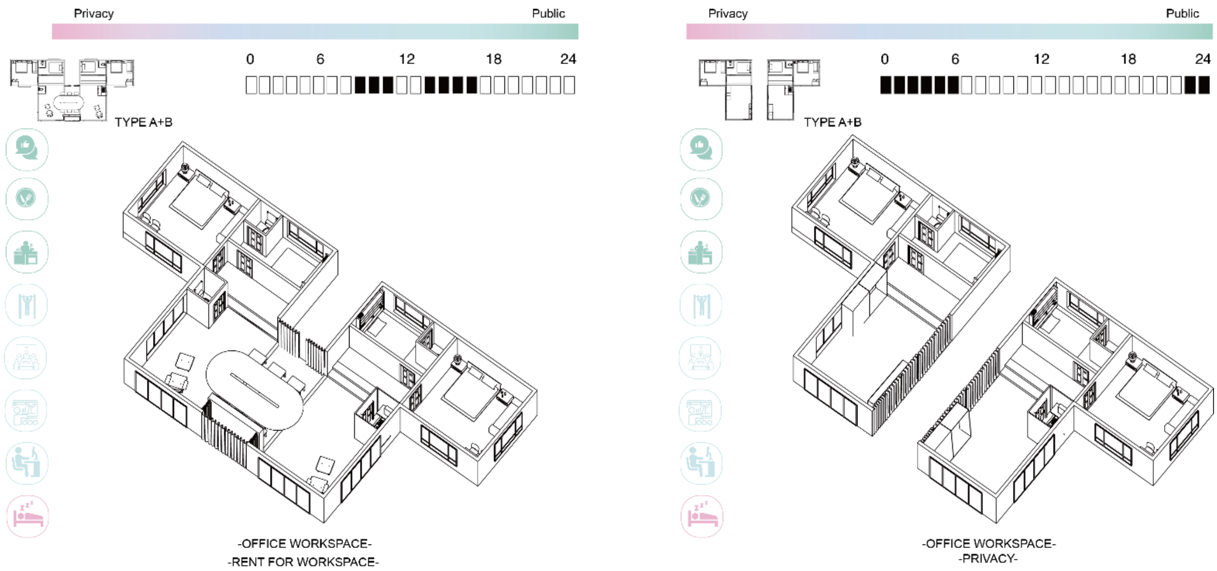


Figure 11. Housing type

Figure 12. Housing type

(Source: Drawing by author)

8.2 Strategy: Community Facility

For the community facility, the start point is module structure, based on these modular structures. It could be multiple public spaces for what people's needs, like library café or even some workspace over here, people could use all of these space together.

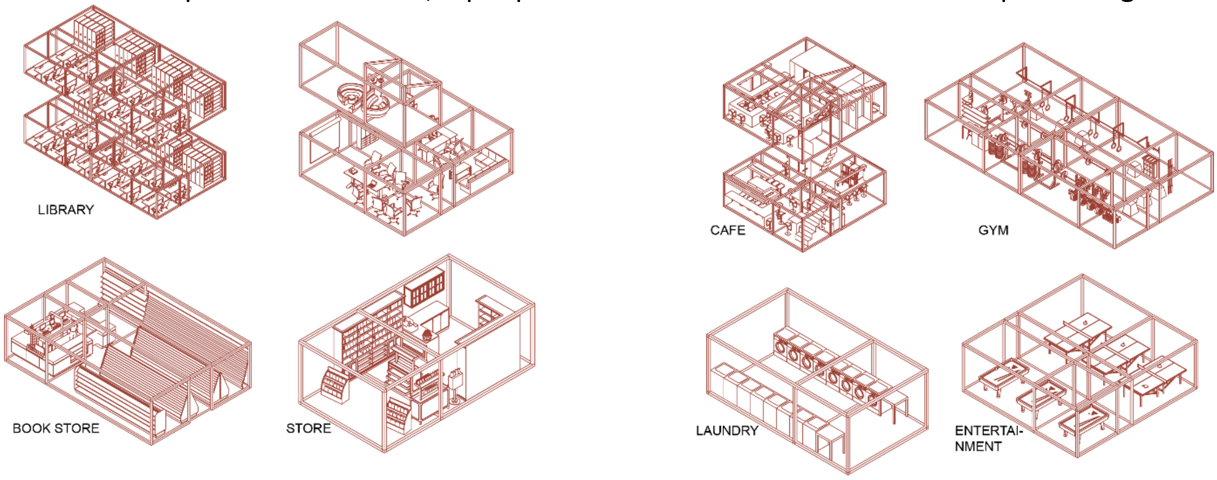


Figure 13. Community facility

(Source: Drawing by author)

8.3 Strategy: Community Planning

For the community planning, we can reorganize the commercial area, vertical transportation, and so on. For the stair, as mentioned before, it becomes a kind of new social networking for migrant people living here. Retaining it and reusing it could be maintaining the necessary communication in Shuimo community. It is an original element for the migrant community also is a kind of lifestyle for the people who live in here.

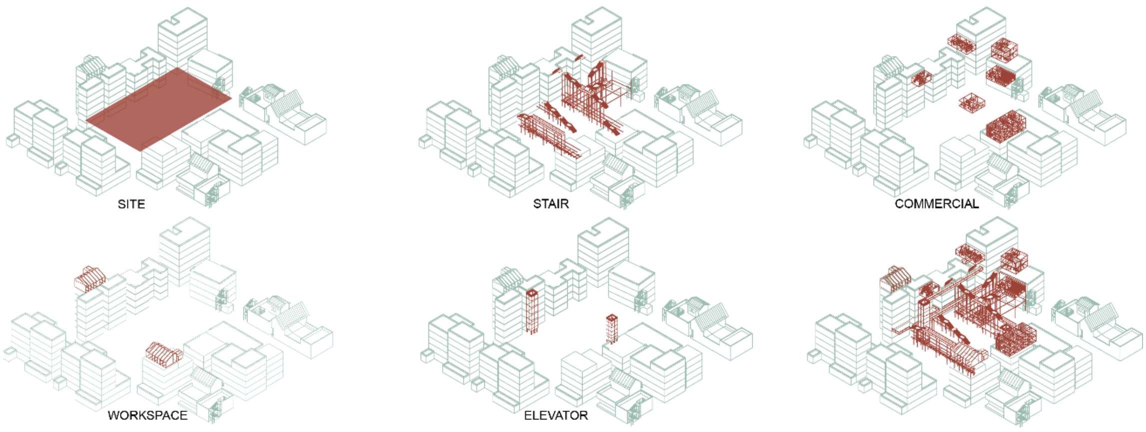


Figure 14. Community planning

(Source: Drawing by author)

8.4 Strategy: Community Operation

For the operation, there is a concept here is zero useless space, it is changeable according to different people's needs and time. When the migrant people do not need this space, we can make full use of the space for commercial use.

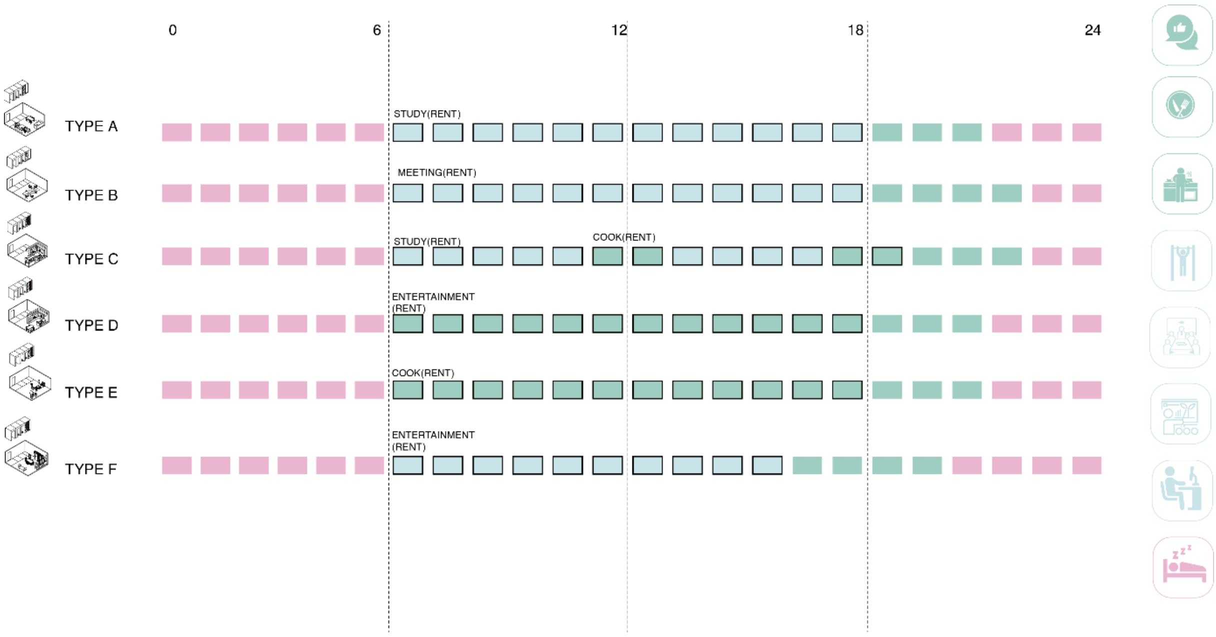


Figure 15. Community operation

(Source: Drawing by author)

Conclusion

The common language to link different people and needs is space, and people are always the key to start the events. For the urban migrant, they still have the right to optimize their lifestyle. They still have the right to enjoy an affordable and comfortable life. Why not inspire people to use their own resources to move into the future?

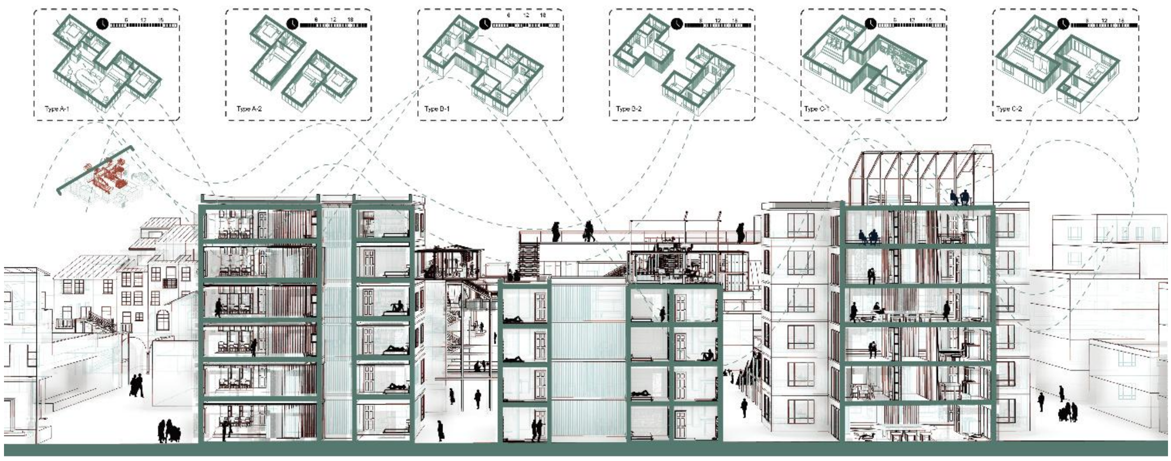


Figure 15. Living scenario

(Source: Drawing by author)

Acknowledgements

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06.108 INDUSTRY TO CO-INDUSTRY: A NEW BREAKTHROUGH WITH COMPLETELY INNOVATIVE SPACE UTILIZATION APPROACHES

Chun Yen Ku

Syracuse University, School of Architecture, NY
241 Lafayette road, Apt 304, Syracuse, NY 13205, USA; E-mail: cku101@syr.edu

Abstract

The shrinking of the industry has led to the decline of the city's economic center of gravity, and the subsequent weakening of the city's economic strength, coupled with the long-standing suburbanized lifestyle, has created a vicious circle. This proposal is trying to develop the new typology based on the current trend, therefore applying the spatial typology to Kodak Business Park as an example. In the future, it can be applied to various industrial parks in Rust Belt, and helping to smoothly transform vacant and no longer flourish space. Focusing on urban development, flipping the shrinking city into a city that is in line with the trend of the new era and attractive, in order to restart the virtuous circle.

Keywords

Smart Decline, Shrinking cities, Transformation, Rust Belt, Technology sharing

1 RESEARCH BACKGROUND

The most urbanized places on planet Earth are the most economically developed, with North America, Europe, and Oceania all displaying high percentages of urbanization and all starting with high levels after 1950. However, these areas have all continued to urbanize. (Figure 1)

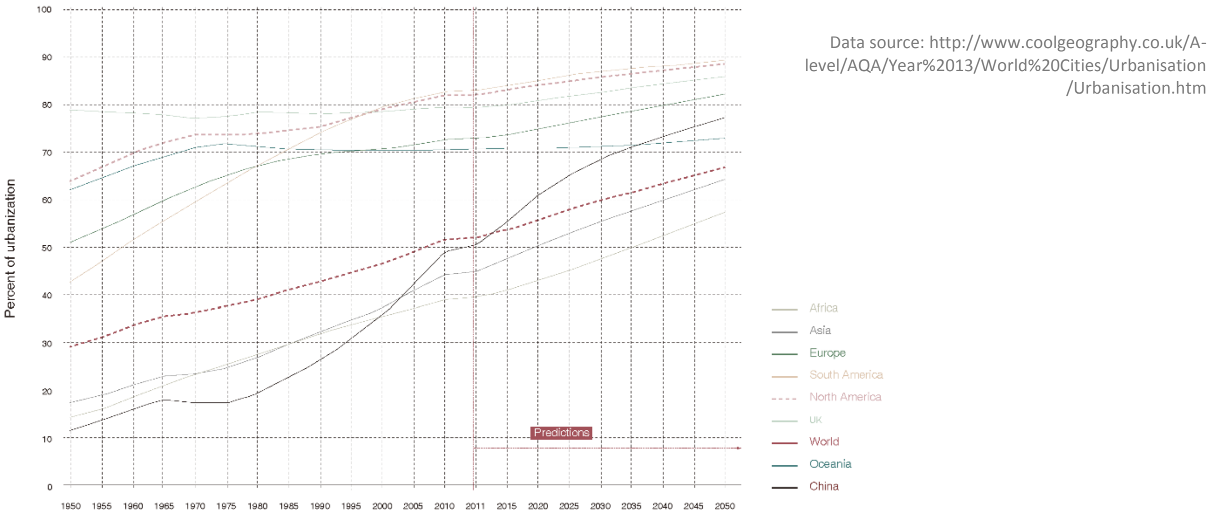


Figure 1. A graph to show world urbanization for different world areas from 1950 to 2050

About 40 out of every 100 people in the US population live in the top 20 metropolitan areas. [1] Where do these populations of urbanization come from? Starting from economic and social issues, we will expand to the scale of cities and even the world. The root of the problem is more than just a cause. From a macro perspective, we will explore the rapid flow of population between cities, and the fact that people who cannot stay.

1.1 Narrative

Even if urbanization is a fact, the proportion of population movement never decrease, and the specific thrust and pull are obvious. Study highly developed countries such as the United States to understand the background of population movements and changes between cities. At present, the proportion of urban population in the United States to the total population has exceeded 80%, and this proportion will reach 90% in 2050. (Figure 2)

Data source: http://hugaiguancha.blog.caixin.com/archives/183522

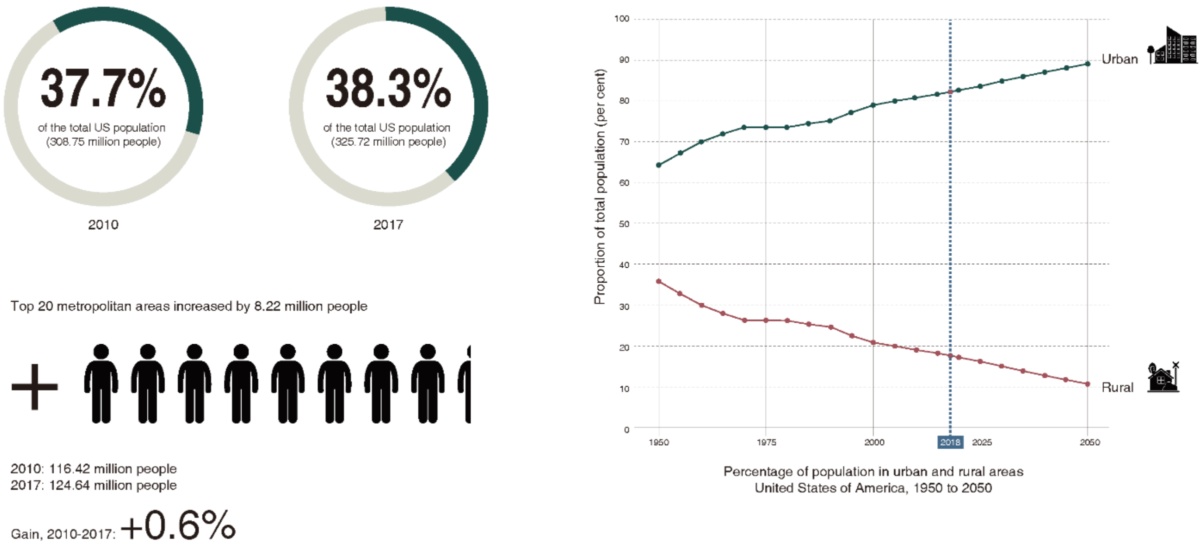


Figure 2. Top 20 metropolitan areas in the united states

1.2 Research Question

Under the urbanization issue, it is further discovered that a large number of Americans have already flowed into specific areas. However, I want to more explore the source of people. In areas where have lost a lot of people, we will definitely find clues. In the simplest way, look for huge thrust and cause from the other side of the attraction.

The statistics of population changes in 383 metropolitan areas in the United States, most of the metropolitan areas with reduced population are located in the Northeast industrial zones with developed specific industries. (Figure 3) Made into a chart, you can see a group of obvious lines falling in a similar time, the US Rust Belt.

Data source: https://en.wikipedia.org/wiki/List_of_most_populous_cities_in_the_United_States_by_decade#/media/File:Largest_US_cities_graph.png

Data source: http://www.city-data.com/forum/city-vs-city/1460826-top-10-rust-belt-cities-making-2.html

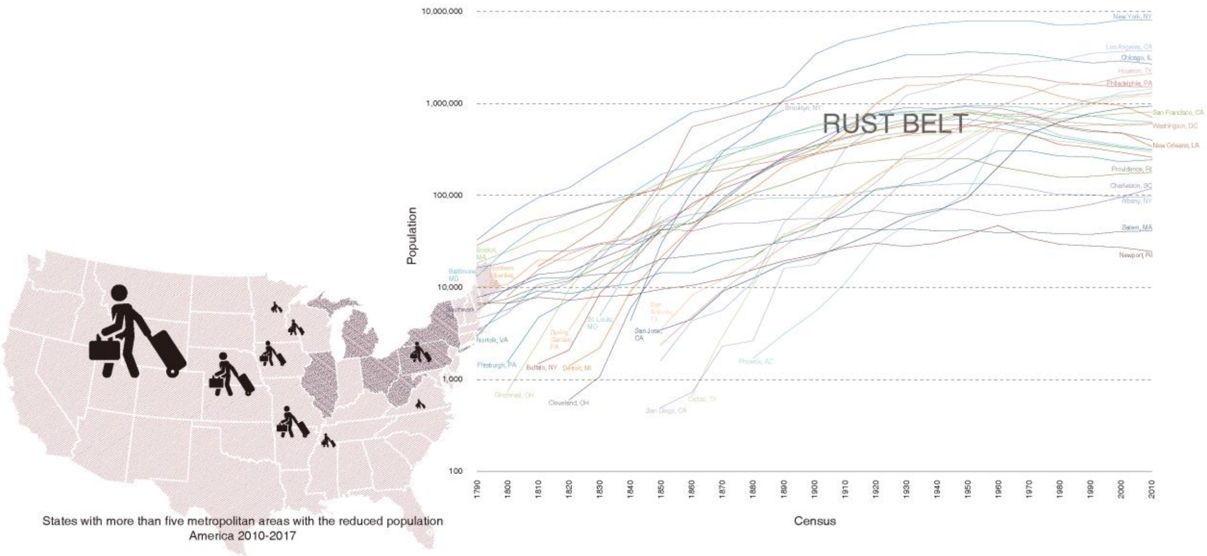


Figure 3. Migrant population source & Populations of the largest cities by decade

The Rust Belt is a region in the US where economic decline, population loss, and urban decay have left the once booming area desolate of industry. Before this decline in the 20th Century, it was the focus of American industrial development, and was called the Manufacturing Belt or Factory Belt. The term "Rust Belt" is meant to refer to the now abandoned factories in the area. [2]

2 Problem Statement

Cities with a population loss have common pains and problems, and the failure of industrial transformation is the main reason. The cities that once flourished in these areas are not spared. In addition to the industry's recession, the negative effects also appeared due to the rapid expansion ever happened. (Figure 4)

Data source: http://www.coolgeography.co.uk/A-level/AQA/Year%2013/World%20Cities/Decline/Urban_Decline.htm

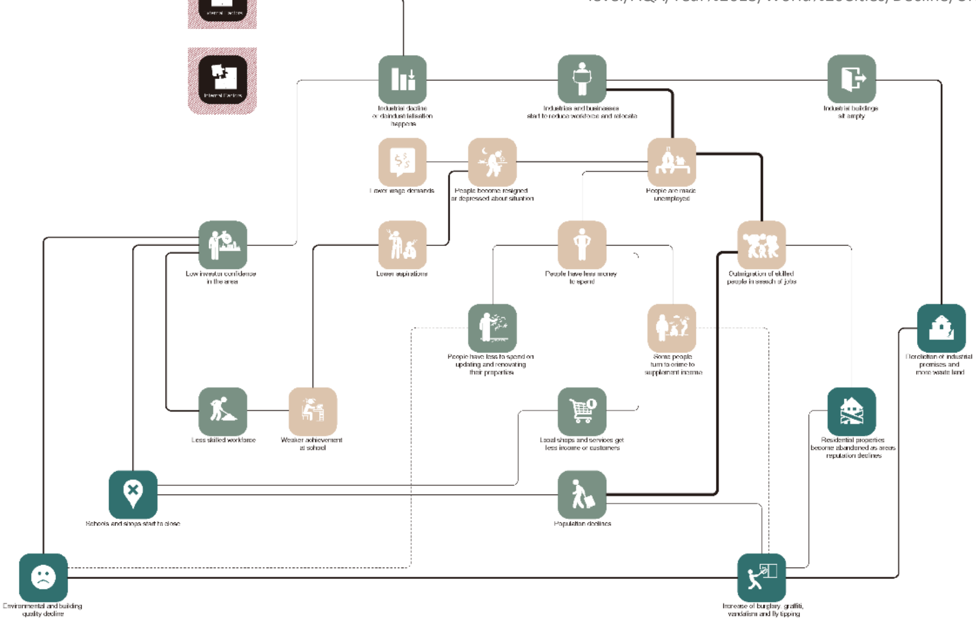


Figure 4. Cycle of urban decline following deindustrialization

2.1 The Decline

This decline has never eased, and it is clear that all of the cities are no longer dependent on the previous industry. The vicious circle caused by the continued decline makes the problem roll like a snowball. (Figure 5)

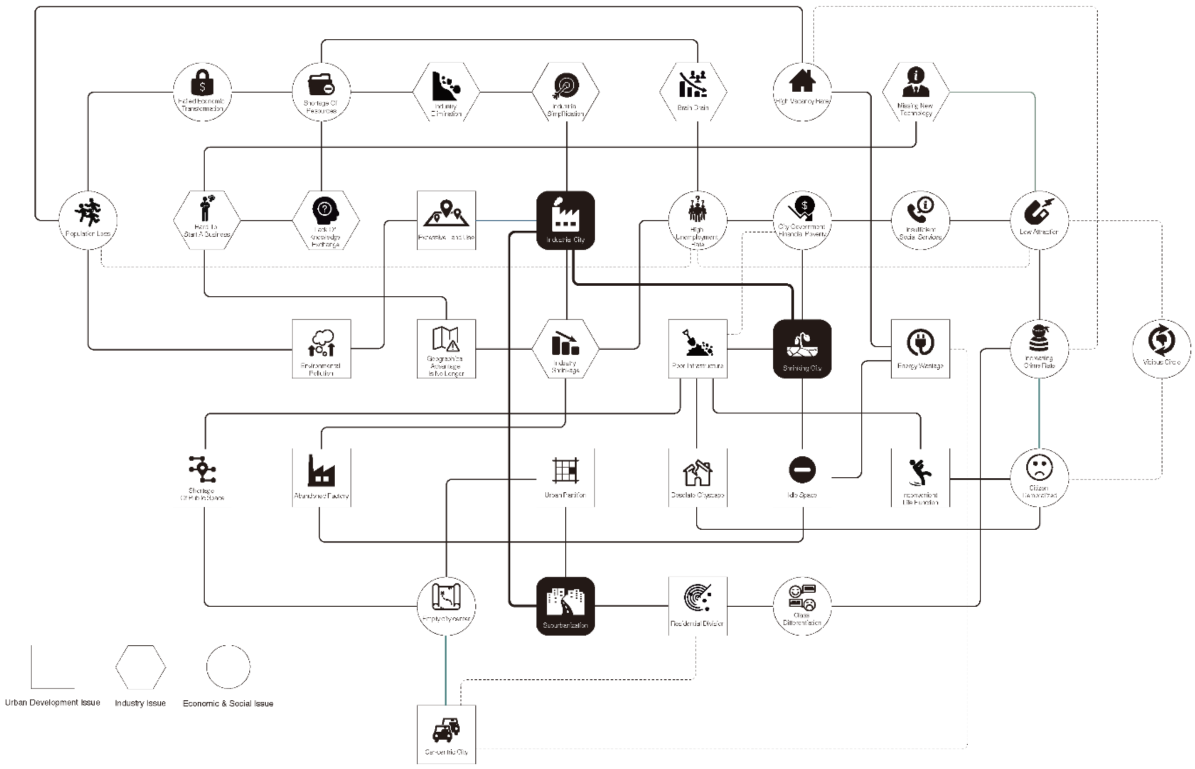


Figure 5. Issue framework

The services sector forms about 80% major part of the U.S. economy whereas in China it is just 40%. Since the majority of the U.S. manufacturing was off-shored to developing countries, this sector accounts for just 19% of the U.S. economy. [3]

Knowing the reason for that these cities have experienced the decline is the decline of the industry. Is there a chance to regenerate? Can they still rely on the same industry again? Unfortunately, according to the data above, the manufacturing industry proportion in the United States is lower when compared to other countries, which means it must be better to found other ways to change this misery. At this time, the factory construction and campus was still there, and the idling situation just a waste of energy. The countermeasures must be taken against the problems.

Although Major changes in the industrial structure have brought problems and declines, we could have also found a glimmer of hope for rebirth. (Figure 6)

Data source: http://www.63alfred.com/whomakesit/

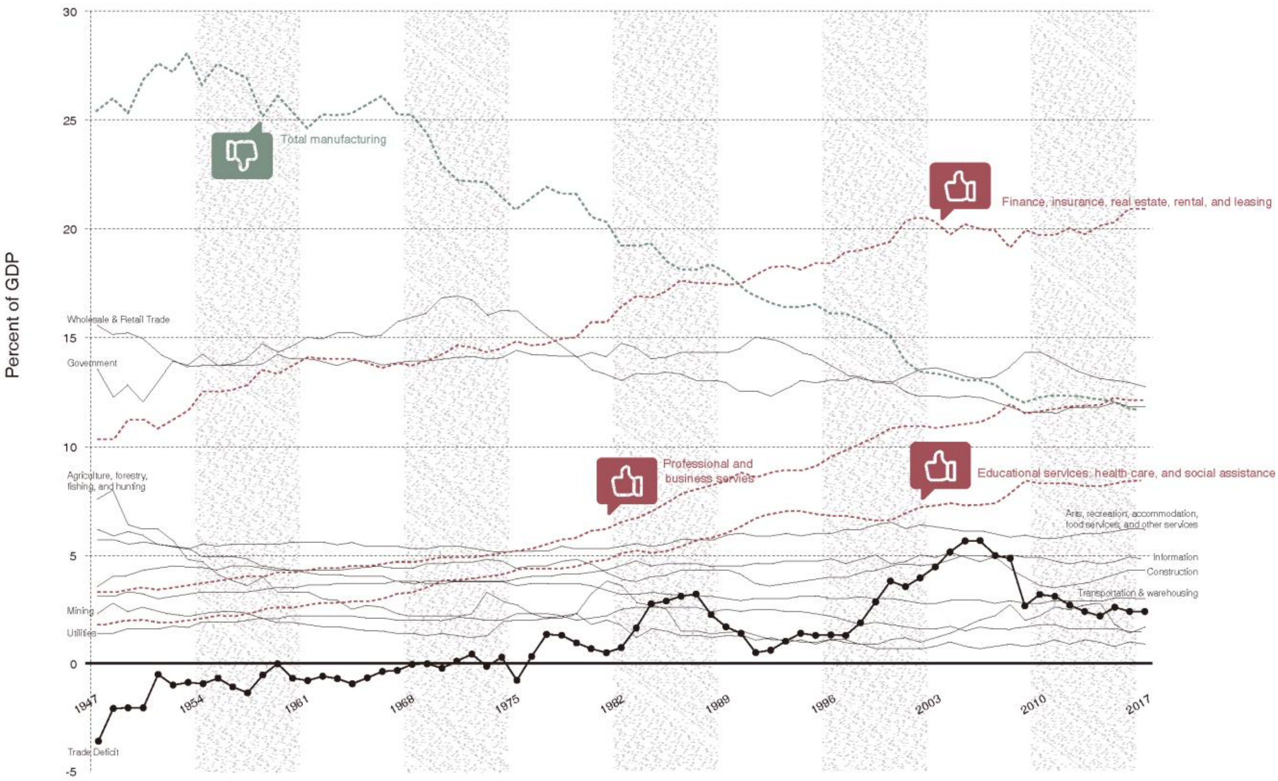
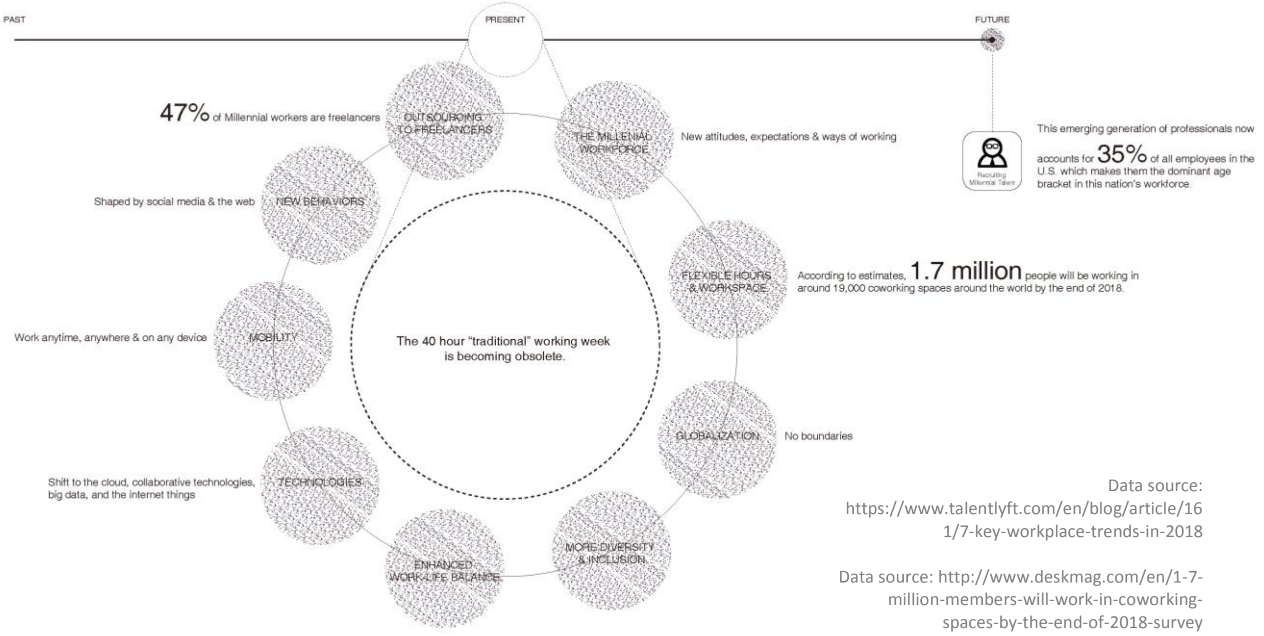


Figure 6. Sectors of US economy

3 Proposal

My proposal is to breathe new vitality into the city through working space, by flipping up the image of this city. Furthermore, according to the result of the research, I would conduct to produce a prototype. The prototype will be applied to the base space of Kodak. Adaptive reuse the land area of the declining industry park, in that way we can save energy and create conference opportunities for the young generation. (Figure 7)



Data source: https://www.talentlyft.com/en/blog/article/161/7-key-workplace-trends-in-2018

Data source: http://www.deskmag.com/en/1-7-million-members-will-work-in-coworking-spaces-by-the-end-of-2018-survey

Figure 7. Issue framework

3.1 Prototype

Find the core of the problem and start the right script. New development does not mean that the traces of the past must be erased, but how to develop new programs ingeniously for new trends and develop appropriate prototypes is the main topic. In that way, the production of porotype can be applied to homogenous sites, and use the soft way to insert new programs from a whole new direction. The eventual target of this proposal will be fully connected to all the managers, employers and employees to organize the system. (Figure 8)

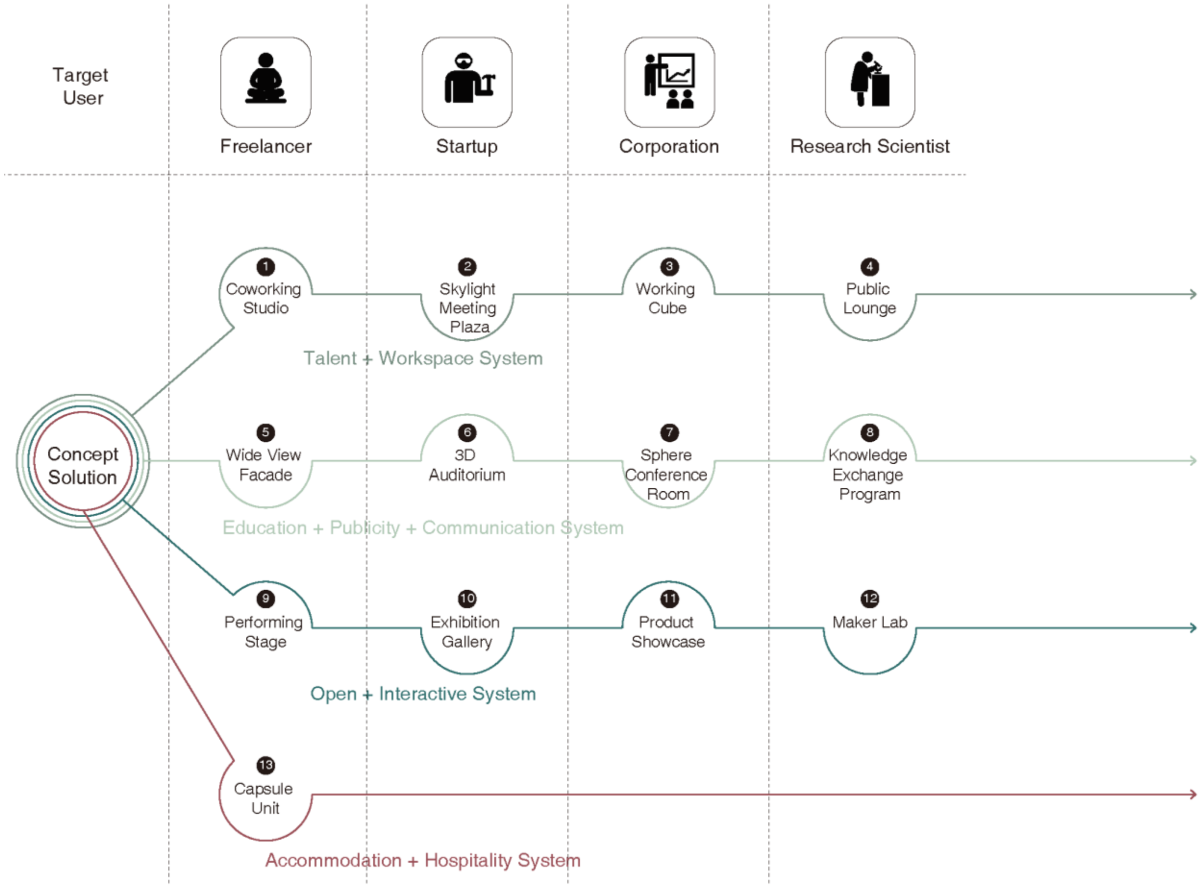


Figure 8. New ways of working

3.2 Site Selection

Rochester, industrial city, seat of Monroe County and the third most populous city in New York state, U.S. This area is important in the field of photographic processing and imaging, and it has been the birthplace to Kodak, home to a number of Fortune 1000 and international businesses, as well as several national and regional companies. Given the high prevalence of imaging and optical science among the industry and the universities, Rochester is known as the world capital of imaging. However, with digital technology gaining in popularity, since the 2000s, as established companies in Rochester downsized, the University of Rochester became the Rochester area's largest employer, surpassing the Eastman Kodak Company. [4] (Figure 9)

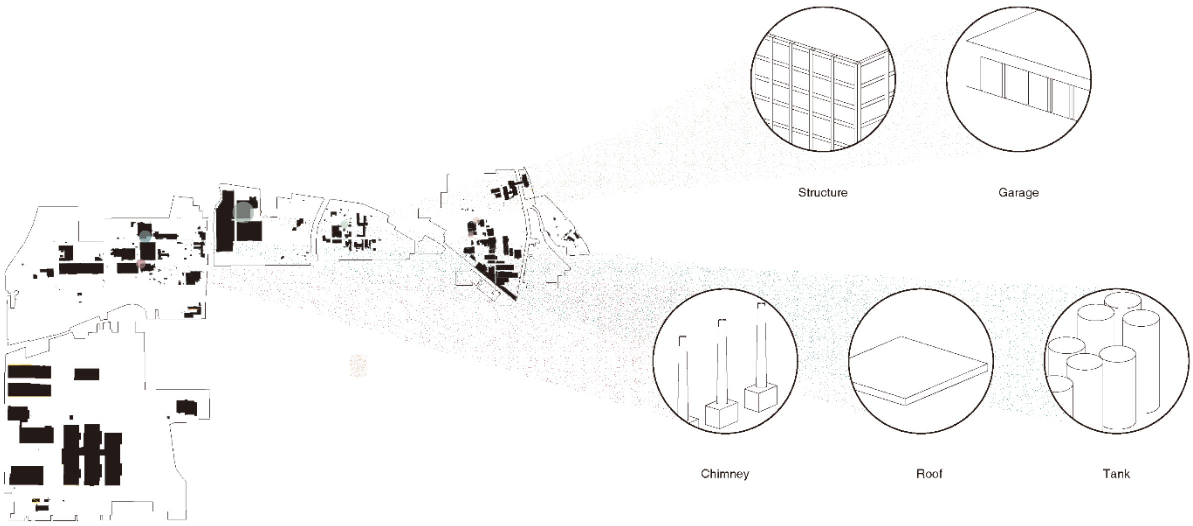


Figure 9. Eastman business park & Intervention typology

I boldly proposed that strategy is to address the problem and use trends to develop a prototype. These prototypes can be used in industrial parks that are no longer prosperous. Usually, their area is very large. If you can join the function of the service era while retaining the historical texture, it will be able to drive the talents back. Revival city, not idling. The strategies are the following:

a. Interleaved space usage in different time periods can guarantee the maximum frequency of use of space.

b. Create a new space type for start-ups with the focus on entrepreneurial preferences.

c. Use the new generation of preferences to create a work operation model.

d. Breaking the pattern of renting office space, using it flexibly. Instead of renting a specific single space in a period of time, renting the whole space in a time range can become more flexible.

e. Add new space based on the principle of preserving existing plants or buildings without destroying historical textures.

4 Design Implementation

A desolate scene has been shown on this picture of the economic locomotive- Kodak Business Park, as well as the city. In the meantime, the lifestyles that the current young generation has changed completely compared to the past. Newer generation has more free will in which they are willing to share working spaces with other individuals. Nevertheless, according to my observation and daily life experience of the site, I discovered that the city of Rochester has no space to co-working with each other, and the downtown has less capacity which pushes young people away from the ground. However, the design applications will be able to flip scenes on the site.

4.1 Scenarios

Put the prototype developed for the current situation into the site. The series of scenarios shows the success of the strategy. The attraction for the return of the crowd will be the main point to design. In the past, industrial park buildings were always closed and it was difficult to provide other industries use. The first priority is to open up and cater to new trends and industries.

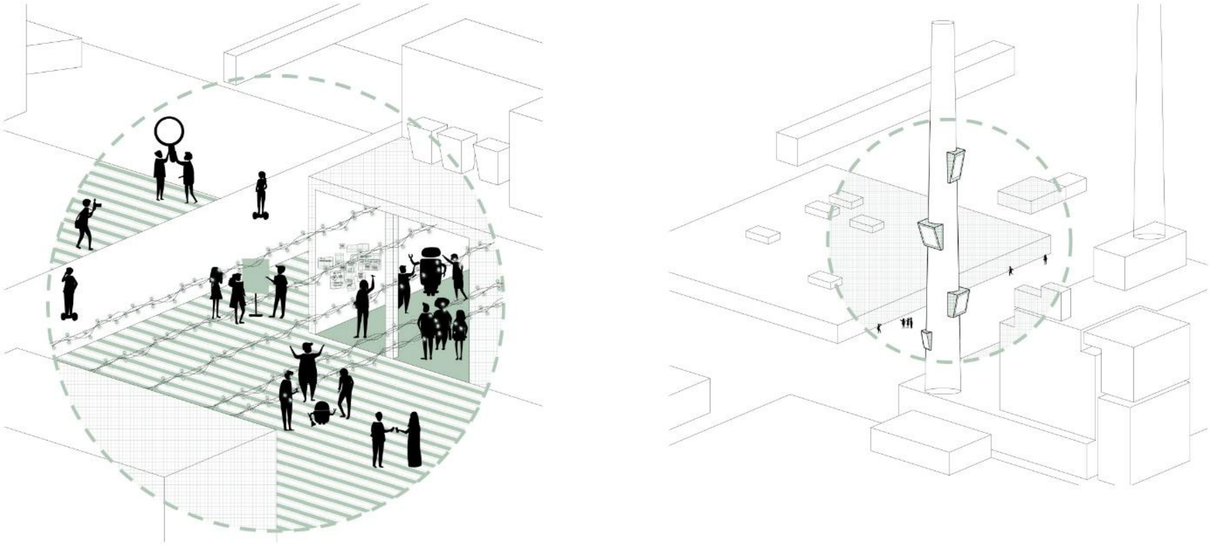


Figure 10. Innovation Incubator & Vertical Exhibition

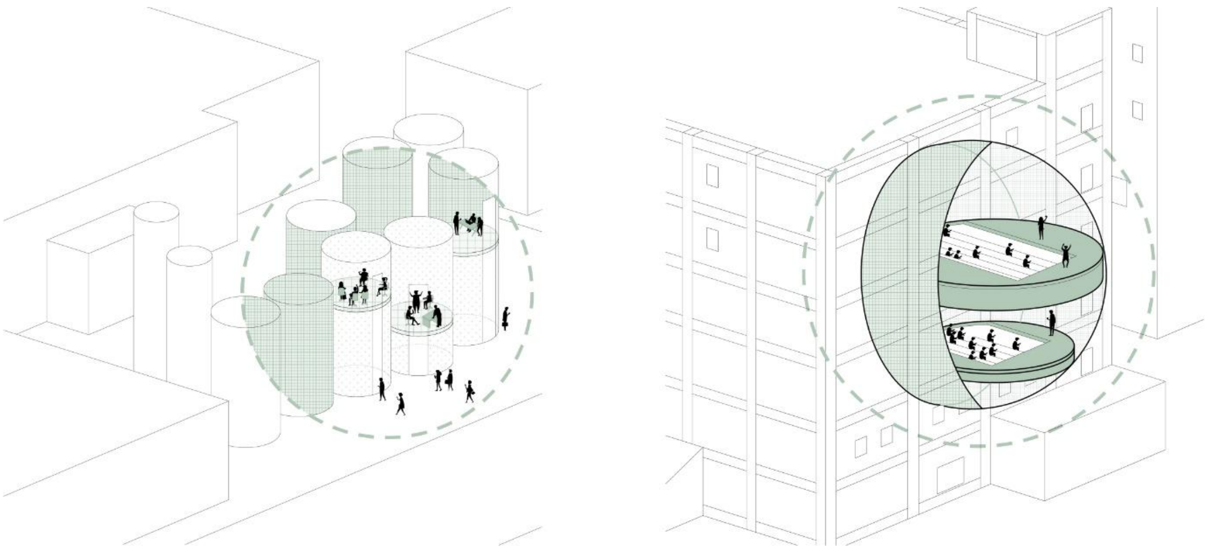


Figure 11. Small Group Meeting Unit & Natural Light Auditorium

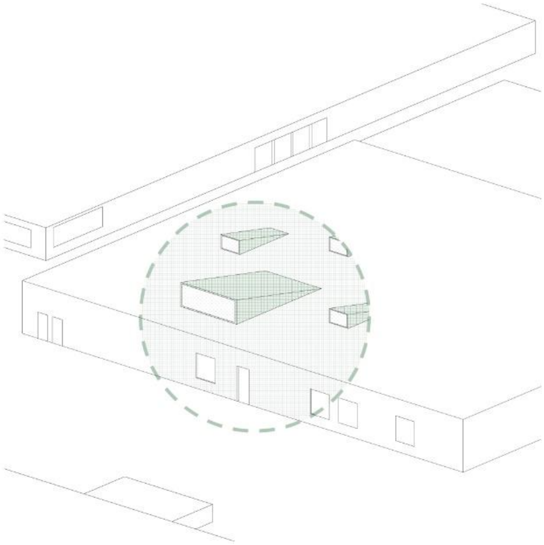



Figure 12. Outdoor Display Stage & Good Lighting Studio

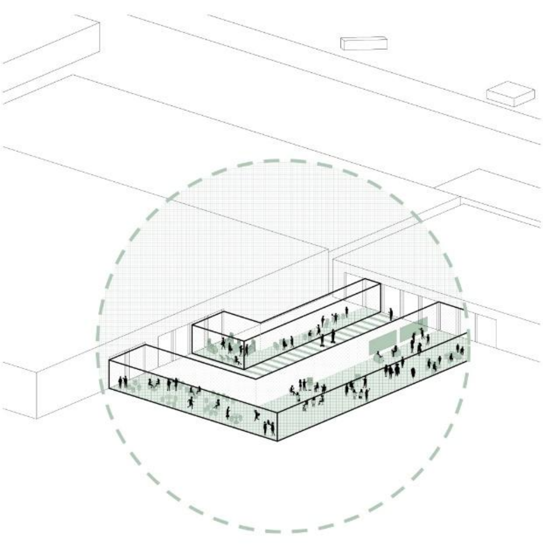
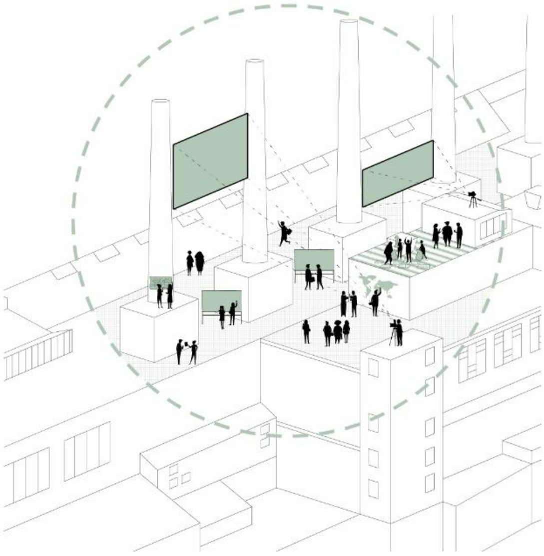



Figure 13. Working Bridge & Outdoor Projection Platform

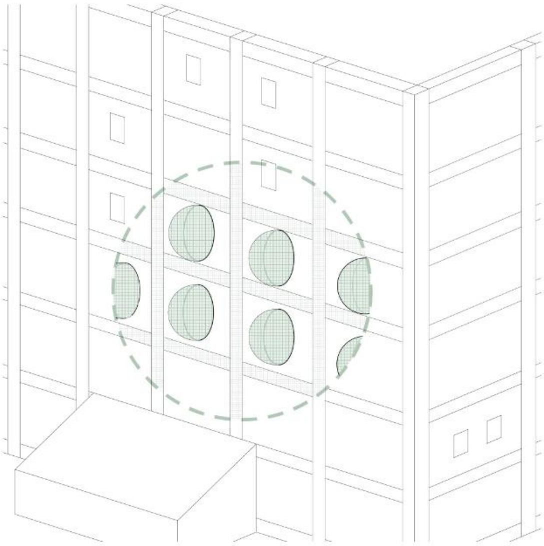
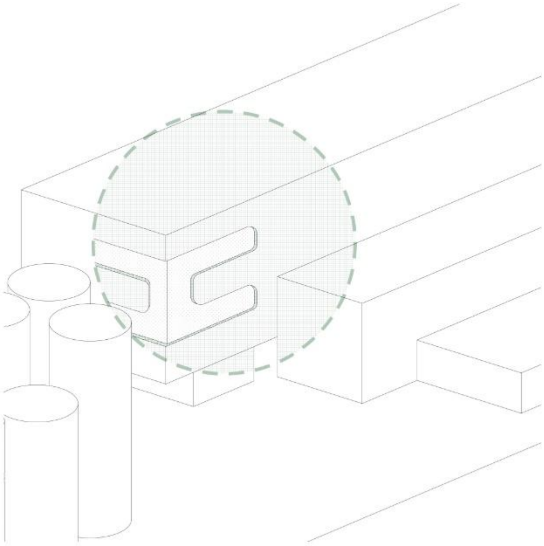



Figure 14. Capsule Residence & Interactive Publish Pavilion

5 Conclusion

The mission of an architect is to constantly look for problems and propose solutions. Although it is not immediately possible to solve the problems of the world in an instant, it can at least lead to a better future and create sustainable development.

Even the once prosperous industrial city has declined, but the splendid construction still exists in place, and reuse can avoid the consumption of resources, especially the energy waste of idle buildings. In addition, it will be possible to avoid wasting more resources to build new buildings if using the small-scale transformation.

This is just the beginning, and the goal of the short-range is to lay out for the long-term goal.

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06.109 RESEARCH ON ALLOCATION OF MEDICAL RESOURCES IN MEGACITIES IN CHINA FROM THE PERSPECTIVE OF BIG DATA: A CASE STUDY OF SHENYANG

Zhu Jinghai[1], Zhan Mingsong[2], He Miao[1], Yuan Yujing[2], hexiang[2]

Institution
[1]China Medical University Shenyang 110001, China ; [2]Shenyang Jianzhu University, Shenyang 110168, China

Abstract

With the strengthening of China's aging population, in order to promote healthy living, optimize health services and improve the health protection system. CPC Central Committee and State Council Issued and implemented "Healthy China 2030" Planning Outline and proposed a planning target of creating a "fifteen-minutes health care servicing circle" medical and health service system called "fifteen-minutes health care servicing circle" system. The study selected Shenyang, a mega city in Northeast China, as the research object, relying on Baidu big data as a data source, using nuclear density analysis and path cost module in ArcGIS software and combining the strategic allocation strategy of medical resources in Shenyang, to calculate the scope of medical resources services in Shenyang City. The results show that top medical institutions gather in the downtown area and suburban county medical and medical institutions have a severely lacking; The coverage of "fifteen-minutes health care servicing circle" medical and health service system in Shenyang is only 38.17%, and the number of medical resources at all levels needs to be improved; Relying on provincial town system planning, e.g. "Construction of the Great Shenyang Economic Zone", "Integration of Shenyang, Fushun and Benxi" and " Economic Corridor Construction of Western Liaoning Province", to develop a "mutual understanding network +" medical resource optimization configuration strategy, which coordinating the linkage of cities and regions. Supported by city big data, the research starts from the supply gap of medical service infrastructure in China's megacities, in the way of zoning the scope of service for medical facilities, accurate and reasonable determination of the location and scope of new medical service facilities to provide scientific and effective basis for strategy formulation.

Keywords

Chinese Megacities; Medical resources; Points of interest; Scope of service; Optimization strategy.

1 INTRODUCTION

Medical service institutions are basic public service resources for regional social and economic development. Their functions directly reflect the health of the public. Rational distribution of medical resources and improvement of different types of medical service functions are the guarantee of citizens 'health [1-2]. They are also important indicators for evaluating the level of urban development [3]. Under the requirement of the "supply-side reform" put forward by The

Central Committee of the Communist of China (CPC), new requirements have been put forward for the supply of medical services, and public health services covering the whole people have been strengthened so that residents of different strata and regions can enjoy relatively balanced services of medical institutions. The primary task of planning is to gradually improve the scientific allocation of medical service institutions on the basis of integrating existing medical resources. Domestic research on medical resource allocation is mainly about service evaluation and planning application of medical institutions [5] Liu Ze, Yang Hongzhi, Zheng Chaohong, Zhong Shaoying, Yang Xin, etc., used the improved two-step mobile search method, improved potential model and network analysis of multimodal network data sets to analyze the accessibility of medical service institutions. Song Zhengna and Chen Wen analyzed the spatial accessibility of medical institutions in the study, and formulated the allocation standard of medical resources based on population, travel resistance and service capacity of medical institutions.In terms of the application of planning strategies, Tao Yinhua and Shenyue studied the difference of medical accessibility between registered population and floating population and its influencing mechanism, put forward the optimization strategy of spatial allocation of medical resources in Shanghai [10], Hu Huiqin and Liu Nan improved the community medical services from the architectural layout and functional planning according to the results of field survey and questionnaire feedback. To sum up, there are three main problems in the current research on the allocation of medical service resources: firstly, the research objects are concentrated in large medical service institutions such as Third-level grade-A hospital, general hospitals and specialized hospitals, lacking the integration of grassroots resources such as health centers and clinics, and inadequate measurement of the supply of medical resources; Secondly, the original research data sources are mainly static data, which are combined with survey questionnaires and interview to carry out data statistics. For the medical resources census in the city, there are many difficulties, such as heavy workload, long cycle and low efficiency, and it is difficult to reflect the relation between institutions. Thirdly, the research object is too simple, only from the perspective of spatial layout and resource evaluation of medical service institutions, the lack of research is the correlation with urban factors such as urban population distribution and road system.

In recent years, the state has greatly promoted the development of large-scale healthy industries. Shenyang has actively implemented relevant national policies, formulated and promulgated a series of development outlines such as the <Shenyang Health Industry Development Plan (2017-2025)> and the <"Healthy Shenyang 2030" Action Plan>, and promoted the construction of new medical systems such as hierarchical medical system, multi-site practices and shared medical care. It is planned to basically build a 15-minute basic medical and health service circle in Shenyang by 2030.In 2017, Shenyang's elderly population reached 17,891,000. With the increasing of the urban elderly population, the public's demand for basic-level medical services is increasing day by day. The new trend appears in Shenyang's medical service space. Under the background of the revitalization of the old industrial base in Northeast China, the integration of medical service resources in Shenyang will become the basis for the development of regional health industry. Therefore, objectively and accurately combing the spatial characteristics of medical service resources and exploring the fitting relationship between them and the spatial distribution of population have better practical significance for optimizing regional medical service resources and better meeting the public's demand for medical services.

In recent years, breakthroughs in big data analysis technology have provided new research perspectives and methods for urban geography. POI data has the characteristics of simple acquisition, strong timeliness, comprehensive classification and wide coverage. The innovative application of new technologies represents the continuous improvement of geospatial data. Points of interest (POI) can be used to describe the functional layout of cities, to express the correlation with other elements, and to evaluate the fairness of urban life by POI. Domestic interest points as data support, studies urban space such as urban spatial depth [15], spatial structure [16], urban spatial correlation [17], research focuses on urban commercial space [18-20], and less research on medical resources integration and service space delimitation. Moreover, POI data includes basic information such as sample name, address, longitude and latitude, which can effectively link up with urban traffic system, land use planning, population density and other information. At the same time, the traditional data acquisition and statistics have the difficulties of large workload, high difficulty and low accuracy. The POI data published through Baidu, Gaode, Metro and other network platforms can effectively solve the problems existing in the traditional data. Therefore, extracting, classifying and utilizing the data of interest points can be used as data support for the study, and exploring the time cost and coverage of medical resources of public access to medical institutions have practical significance for the construction of Shenyang's "15-minute basic medical and health service circle".

2 Data and methods

2.1 Data from processing

Medical and health services reflect the main manifestation of urban economic and social development and are closely related to the production and life of residents. The size and distribution of medical and health services institutions are clearly defined in the normative guidelines such as 《Measures for the Management of General Land Use Planning》 and 《Specification for compilation of regulatory detailed planning》 DB23T744-2016. This paper chooses Shenyang municipal medical institutions as the research object. According to the 《Classification of National Economic Industries》 (GB/T 4754-2017) as the basis of classification, Extracting Open and Accessible Data of Baidu Interest Points (POI). Incorporate the Third-level grade-A hospital, general hospitals, health centers and clinics into the sample data sources of medical resources. Because the sales of specialized hospitals and medical care institutions are highly targeted, they are not in the scope of this study. The data of Baidu Interest Point (POI) obtained on February 15, 2018 in Shenyang were checked with the data of Shenyang Health and Family Planning Commission and Shenyang Statistical Bureau. There were 31 Third-level grade-A hospital, 446 general hospitals (Primary, Secondary, Tertiary except the Third-level grade-A hospital), 426 health centers and 2482 clinics in Shenyang. The data of urban traffic system comes from Baidu Map in 2018, including road information data of Shenyang expressway, national highway, provincial highway, Urban road, Urban secondary road, sidewalk, County Road and rural road. The population data is the data of the sixth census with an accuracy of 1 kmx1 km. Travel speed is comprehensively considered in 《Technical Standards of Highway Engineering of the People's Republic of China》 (JTG B01-2014) and "Didi company: Urban Transportation Travel Report in 2017". The regional scope of Shenyang comes from the geographic information data of county (district) administrative divisions boundary in Shenyang in 2018. Land use map comes from 《Urban Master Plan of Shenyang City (2011-2020)》. All POI data and geographic information system spatial data are pre-processed by projection transformation and format conversion.

2.2 Research methods. Nearest Neighbor Index Method

The nearest neighbor distance is calculated by calculating the average distance between the nearest point and the nearest point in the random distribution model. The nearest neighbor index (NI) is the ratio between the average distance of the nearest neighbor and the average distance in the random distribution model. The average nearest distance index is a reflection of the degree of point aggregation.

$$NI = \frac{d(NN)}{d(RN)} = \frac{\sum_{i=1}^{n} \frac{\min(d_{ij})}{n}}{0.5\sqrt{\frac{A}{\mathrm{n}}}} \qquad \text{(Eq.1)}$$

$$ZNN = \frac{d(nn) - d(ran)}{\sqrt{\frac{(4-\pi)A}{4\pi n^2}}} \qquad \text{(Eq.2)}$$

In formula: NI represents the nearest neighbor index; d (NN) represents the nearest neighbor distance; d (RN) represents the random distribution distance in the study area; d_{ij} represents the nearest distance between sample point i and sample point j; n represents the number of sample points; A represents the administrative scope of the study area (Shenyang).

2.3 Research methods. Nuclear Density Estimation Method

The POI data of medical resources in Shenyang were analyzed by nuclear density estimation method [22], and the characteristics of location and spatial distribution of medical resources were described. The nuclear density estimation method was first proposed by Rosenblatt and Emanuel Parzen. The basic principle is to calculate the density contribution of each sample point to the center point of each grid cell in the specified radius range (circle with bandwidth h as radius) by using the kernel function with I (x, y) as the center.The closer the center point of grid element in search radius is to the sample point, the greater the density contribution of the sample point is [23-24]. It mainly reflects the concentration degree of the sample point in space. The concentration degree of spatial elements distribution is estimated by using the sample point. The expression equation is as follows:

$$\mathrm{f(s)} = \sum_{i=1}^{n} \frac{1}{h^2} k\left(\frac{s - c_i}{h}\right) \qquad \text{(Eq.3)}$$

In the formula, f (s) is the calculation function of nuclear density at position s, K is the spatial weight function, h is the distance attenuation threshold, and N is the number of elements whose distance from position s is less than or equal to H. Considering the average influence range of commercial sample points, 1 km was chosen as the distance analysis threshold to reflect the thermal and spatial characteristics of sample points in medical institutions.

2.4 Research methods. Consumption Path Time Cost

Consumption path time cost (the following is called "time cost") is the ratio of path distance to travel speed between residents and medical institutions at all points in the city (Form Eq4), which is different from the displacement distance between residents and medical institutions. The path distance depends on the urban road traffic system and can more accurately reflect the path of resident's medical activities. According to the 《Technical Standards of Highway Engineering of the People's Republic of China》 (JTG B01-2014) and "Didi company: Urban Transportation Travel Report in 2017", the speed of highways in the city is assigned (Table 1).

$$T = \sum_{n=1}^{n} \frac{l_{ij}}{v_{ij}} \qquad \text{(Eq.4)}$$

Formula: T represents the time cost to the point of interest; L_{ij} represents the distance from point i to the nearest intersection j; V_{ij} represents the speed of movement from point i to the nearest intersection j; and N represents the number of medical paths for residents.

Table 1 Road Form Velocity Assignment

Road level	Expressway	National Highway	Provincial Highway	County Highway	Urban road	Urban secondary road	Sidewalk
V km/h	120	80	60	40	40	30	5

3 Results and analysis

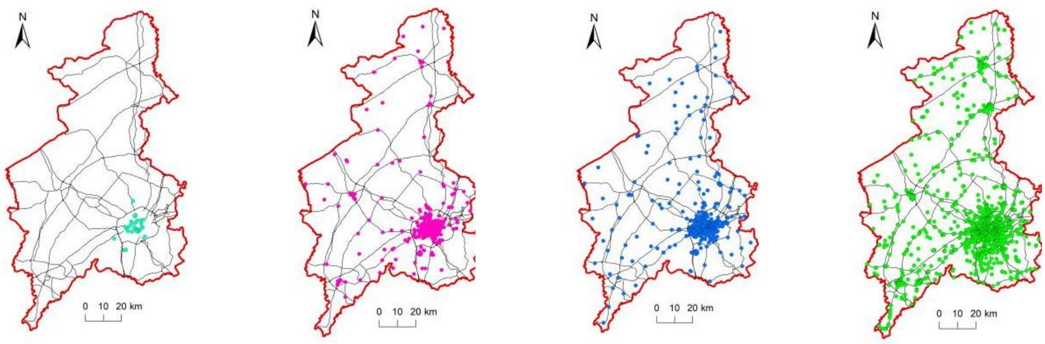
3.1 Distribution Characteristics of Medical Resources

As can be seen from Figure 1, medical service institutions are mainly concentrated in the central urban areas, that is, Shenhe District, Heping District, Huanggu District, Tiexi District and Dadong District, etc., while the distribution of medical service institutions in the surrounding suburbs (counties) is only sporadic. According to formula 1, the average nearest neighbor index of the spatial distribution of medical service institutions is calculated. The results are shown in Table 2. Referring to the threshold value of the average nearest neighbor index, only the NNI value of general hospitals is 0.67, which is greater than the threshold value 0.5. That is to say, the general hospitals are clustered and distributed randomly in the city area, and that of other medical institutions is less than the threshold value 0.5. That is to say, the Third-level grade-A hospital, health centers and clinics are clustered and distributed in the city area (Table 2). According to the calculation results of the confidence level of formula 2 to events, we can see that the ZNNs of Shenyang medical institutions are less than - 2.58, that is to say, they are all spatial patterns of clustering distribution, and the confidence level of above 99% is not caused by random events.

Table 2Mean distance index of medical facilities distribution

Types of medical institutions	NNI	d（nn）	d（ran）	ZNN
Third-level grade-A hospital	0.15	1529	9575.72	-9.51
general hospital	0.67	1815.94	2747.96	-12.89
Health center	0.47	1200.64	2685.5	-24.83
Clinic	0.28	434.23	1537.34	-92.42

According to Table 2 and Figure 1, the agglomeration degree of various medical institutions is different. Among them, the NNI of the Third-level grade-A hospital is 0.15, with the highest degree of agglomeration. Third-level grade-A hospitals are mainly concentrated in Shenhe District, Heping District and Huanggu District. The higher degree of agglomeration is that medical institutions are clinics, and their NNI value is 0.28., mainly concentrated in the central city, new town and central town, scattered along highways, national highways and provincial roads. The lower degree of agglomeration is that the medical service institution is the hospital, and its NNI is 0.47., mainly concentrated in the central urban area and scattered in the population gathering area. The general hospitals include the Primary, Secondary, Tertiary except the Third-level grade-A hospital, mainly concentrated in the central urban area, the central town and the transportation hub area, and other areas are randomly distributed according to the population distribution.

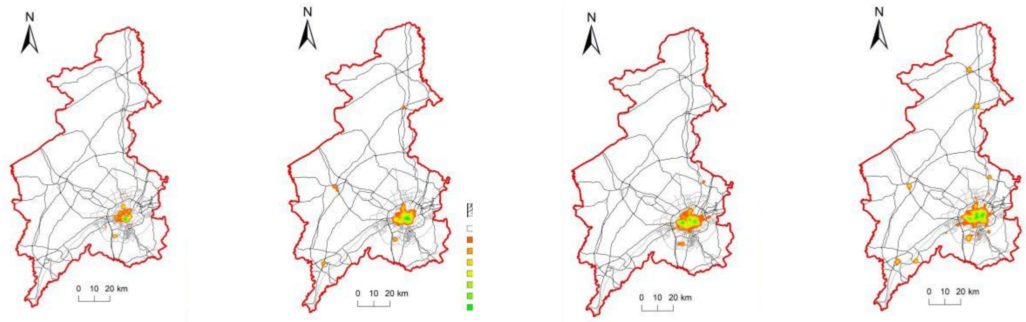


a.Third-level grade-A hospitalPOI   b.general hospitalPOI   c.Health centerPOI   d.ClinicPOI

Figure 1. POI distribution of interest points of medical institutions in Shenyang

3.2 Spatial Agglomeration Pattern of Medical Resources

Using the nuclear density analysis module of ArcGIS 10.2 software and based on POI data of various medical institutions in Shenyang, the nuclear density of various medical institutions in the study area was analysed (Figure 2).



a.Nuclear density map of Third-level grade-A hospital

d.Nuclear density map of general hospital

b.Nuclear density map of Health center

c.Nuclear density map of Clinic

Figure 2. Estimation of nuclear density of medical institutions in Shenyang

Shenyang Third-level grade-A hospitals are mainly concentrated in the central urban areas within the Second Ring Road, with 28 hospitals and 3 hospitals in Sujiatun District. It mainly distributes along Nanjing - Nanjing North Street and Nanwu Road - Culture Road, of which 6 hospitals are affiliated hospitals of China Medical University. There are 7 districts (counties) in Dadong District and Huanggu District, which are the two most concentrated districts of Third-level grade-A hospital in Shenyang. There is only one Third-level grade-A hospital in YuHong District. Figure 2 (a) shows that the maximum nuclear density of the Third-level grade-A hospital is 0.744. The location of the hospital is basically in line with the location of public transport hub and transfer station, which are located in the area where the motor vehicle traffic is more convenient. It shows that the people who take the Third-level grade-A hospital as the destination mainly use motor vehicles as the main tools of travel, and mainly take on the diagnosis and treatment needs of residents with major diseases in the area.

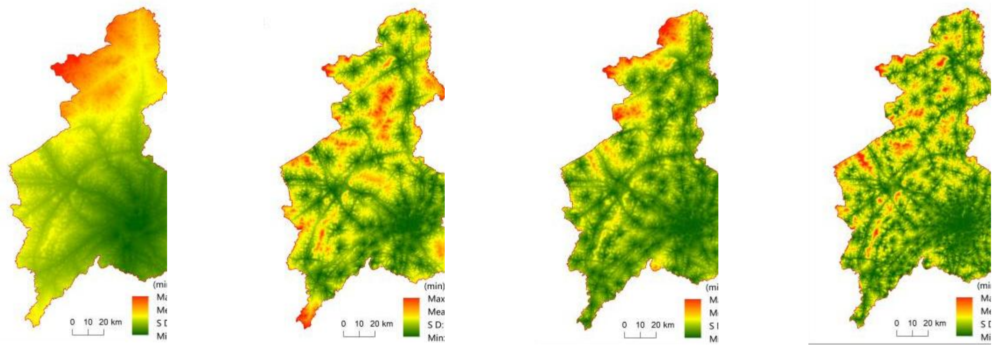
Shenyang General Hospital is also mainly concentrated in the central city and suburban (county) centers within the Second Ring Road, that is, the single-center spatial structure of "one main and four auxiliary". The outward nuclear density gradually decreases from the center of the city and suburban (county) centers, with the highest nuclear density of 3.99. The number of general hospitals in various administrative districts is arranged from more to less, which is Shenhe District (70), Dadong District (61), Heping District (51), Huanggu District/Tiexi District (48), Yuhong District (33), Xinmin City (31), Sujiatun District (24), Liaozhong County (21), Shenbei New District/Hunnan District (18), Kangping County/Faku County (11). The general hospitals in the central urban area are mainly along Nanjing - Nanjing North Street, Nanwu Road - Culture Road, Yellow River North Street, East-West Expressway and Northeast Da Road, as well as around Fangcheng. The suburban (county) general hospital gathering center is close to the business office center and business center. Figure 2 (b) shows that the location of the general hospital is basically in line with the location of the high population density, which is close to the center of the residential land, indicating that the general hospital mainly undertakes the general practice needs of the residents nearby.

Four health centers have been formed in the downtown area of Shenyang, which are patchy distribution around the city center. They are located in the surrounding areas of Shenyang Station, Beiling Park, Longzhimeng Shopping Center and Wuai Market. The maximum nuclear density is 2.94. The nuclear density of the health centers in the downtown area is lower than the four areas. Beyond the central urban area, the agglomeration centers of health centers have been formed in the university towns of Shenbei New Area, Hunnan University Town, Zhang Shi Development Zone and Sujiatun District. As a result of the population agglomeration brought about by higher education and industrial production, high-density population agglomeration areas have been formed. In order to meet the general medical needs of residents in the area, the market has formed the agglomeration of health centers according to the self-organizing development law. Compared with the single-center spatial structure of Figure 2 (a) and Figure 2 (b), the center of the hospital agglomeration area has more discrete effect, which is determined by its own site size, diagnosis and treatment technology and the number of beds. Its service function mainly bears the general needs of residents in the neighbourhood.

Three clinic agglomeration patches have been formed in the downtown area of Shenyang, which are located along the Jinlang Silver Belt, Tiexi Business Circle and Dadong Square. The highest nuclear density is 12.08. The nuclear density of clinics in Fangjialan-Changqing Street area is slightly lower than the above three patches, but higher than other areas in the downtown area. It has the potential to form the fourth clinic agglomeration patches in the downtown area. Among them, the nuclear density of clinics in suburbs (counties) such as Sujiatun District, Shenbei New District and Xinmin City is higher. Figure 2 (d) shows that the suburbs (counties) outside the Second Ring Road in Shenyang have formed clinic agglomeration patches in areas with high population concentration. As the number of clinics ranks first at 5.57, according to Tyson polygon algorithm, the service scope of clinics is far lower than that of hospitals. Compared with Figure 2 (a-c), clinics are medical service institutions serving the general medical needs of residents in surrounding suburbs (counties), which can be regarded as primary medical service institutions.

3.3 Medical resource service coverage

The service coverage of medical institutions can be expressed by the time and cost from any point in the region to the nearest medical institutions, quantified by formula 4, vector operation in ArcGIS 10.2 software, and the service coverage of various medical institutions in Shenyang can be obtained (Figure 3).



a.Third-level grade-A hospital b.general hospital c.Health center d.Clinic

Figure 3. Intensity of medical facilities in Shenyang

Statistics were made on the proportion of service coverage of various medical service institutions in the area of the city (Table 3). Table 3 shows that the coverage of general hospitals, clinics and Health center decreases with the increase of medical time cost. However, there are obvious differences in the trend of the coverage of medical services in the Third-level grade-A hospital, (0-15min) only covers 9.02% of the city area, while (15min-75min) covers similar coverage in different time periods. It can be seen that the time cost of medical treatment in the Third-level grade-A hospital is relatively balanced, and the coverage reaches its peak in (45min-60min). It can be seen that the time cost of public medical treatment is relatively high. Within the coverage of medical services in general hospitals and Health center, the time cost consumed by public medical needs is in the range of (0-30 minutes). When the time cost of medical treatment is in the range of (0-15 minutes), the coverage of medical services in Health center is higher than that in general hospitals. The coverage of medical services in Health center reaches 63.24%, and the coverage of medical services in general hospitals reaches 50.25%. When the time cost of medical treatment is (15 minutes, 30 minutes), the coverage of medical services in general hospitals is the highest, the coverage of medical services in general hospitals can reach 42.04%, the coverage of medical services in Health center is 30.19%, and the coverage of medical services in Third-level grade-A hospital is the smallest 13.75%. In conclusion, general hospitals and health centers cover more than 93% of the city area within the range of (0-30 minutes), which can be used as the main component of the supply of diagnosis and treatment. Within the scope of the clinic's medical service, the time cost consumed by the public's medical needs is within the range of (0-15 minutes). It can be seen that the number and spatial distribution of clinics have approached the requirement of "Healthy Shenyang 2030 Action Plan" to build a 15-minute basic medical and health service circle.

Table 3 Time cost of medical treatment

Time / Institution	0-15min	15-30min	30-45min	45-60min	60-75min	75min及以上
Third-level grade-A hospital	9.02%	13.75%	16.33%	18.08%	14.77%	28.06%
general hospitals	50.25%	42.04%	7.36%	0.35%	0.01%	0.00%
Health center	63.24%	30.19%	5.19%	1.25%	0.12%	0.00%
Clinic	82.30%	17.13%	0.56%	0.02%	0.00%	0.00%

According to the spatial pattern and coverage of medical resources, we weighted the cost data of the Third-level grade-A hospital, general hospitals, health centers and clinics, which were 0.1, 0.4, 0.3 and 0.2, respectively. The comprehensive coverage of medical resources in Shenyang was obtained by weighting the figure 3 with ArcGIS software. That is, the time cost of medical treatment (Figure 4, Table 4), which represents the coordinated allocation of four kinds of medical services in urban space. From Figure 4, it can be seen that the time cost of medical treatment in Shenyang's central urban area is less, the time cost of medical treatment in the surrounding suburbs (counties) is lower than that in other areas, the time cost of medical treatment along the highway is lower than that far away from other areas, and the time cost of medical treatment in Faku, Liaozhong and Xinmin is higher, the maximum time consumed is about 79.46 minutes. Table 4 shows that 52.23% of Shenyang's total medical treatment time cost is within the range of (15 minutes, 30 minutes) and 38.17% of Shenyang's total medical treatment time cost is within the range of (0-15 minutes). The medical service system composed of medical institutions at all levels can cover 99.64% of the city area. When the travel time cost of residents is 45 minutes, it can basically reach the nearest medical service institutions in Shenyang.

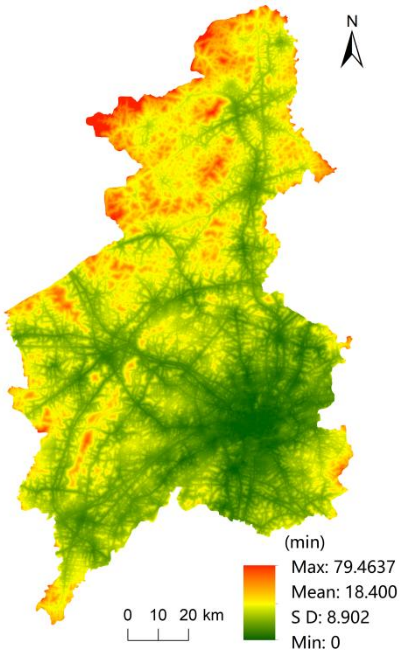


Figure 4. Comprehensive coverage of medical resources

Table 4 Time cost of comprehensive medical treatment

Time cost	0-15min	15-30min	30-45min	45-60min	60-75min	75min and above
Comprehensive cost	38.17%	52.23%	8.96%	0.57%	0.07%	0.00%

4 Conclusion

Based on Baidu big data and ArcGIS software, this study analyzed the spatial pattern characteristics of four types of medical service institutions in Shenyang, such as Third-level grade-A hospital, General Hospital, Health Hospital and Clinic, analyzed the intensity of medical service in different types of medical institutions and the whole city, and divided the coverage area of medical service according to the time-cost interval, and drew the following conclusions:

(1) Neighborhood Distance Analysis of Four Kinds of Medical Institutions

Medical institutions such as Third-level grade-A hospital, health centers and clinics in Shenyang are clustered all over the city. General hospitals are also clustered, but there is a certain trend of random distribution. The clustering degree of the four types of medical institutions is from strong to if ranked as Sanjia, clinics, health centers and general hospitals. In the same kind of medical institutions, the average proximity of general hospitals is the farthest, the average proximity of clinics is the closest, the random proximity of tertiary hospitals is the farthest, and the random proximity of clinics is the closest.

(2) Analysis of Spatial Distribution Patterns of Four Types of Medical Institutions

Shenyang Third-level grade-A hospital, General Hospital, Health Hospital and Clinic and other medical institutions are concentrated in the central urban area. Within the scope of the city, Third-level grade-A hospital and general hospitals present a single-center spatial pattern. With the increasing distance from the center, the density of medical facilities gradually decreases. The distribution of patches in hospitals and clinics is patchy. Four patches formed by nuclear density of hospitals are located in the east, west, north and south of central and western urban areas. Three patches formed by nuclear density of clinics are located in the east, central and west of central and western urban areas. The fourth patch of Shenyang clinics is being formed in Jialan area. Only medical institutions such as clinics form spatial agglomeration in suburbs (counties). There is a positive correlation between the spatial distribution of medical facilities and population density.

(3) Analysis results of service intensity of medical resources

The time cost of medical treatment in Shenyang Third-level grade-A hospital is relatively balanced. The time cost of medical treatment in general hospitals, health centers and clinics decreases with the increase of path distance. In the (0-15 min) medical cost range, the coverage of clinics is the largest, and in the (15-30 min) medical treatment range, the coverage of medical services in general hospitals is the largest. The time cost of receiving medical resources services in the city is mainly in the (15-30 min) range. The time cost of medical treatment in the central city and along the highway is the lowest, and the maximum time cost appears in the remote areas of Kangping and Faku counties. The time cost consumed by clinics is negatively correlated with land use classification and road capacity.

5 Epilogue

Based on POI, the spatial pattern of medical resources in Shenyang was studied by ArcGIS software according to the nearest neighbor index method and nuclear density method. The coverage scope of medical institutions in different time intervals was delineated according to the time cost consumed, and the coverage weight of medical institutions was set based on the spatial pattern of medical resources. Obtain the time cost of comprehensive medical treatment of medical resources. Compared with other related studies, this study quantifies the space resistance and the speed of different road systems, obtains the time cost of public medical treatment, and defines the coverage of medical resources based on time cost. The research data sources are based on timeliness and authenticity, and enriches the research methods of the cost of public medical treatment path. The research results provide data support for the construction of 15-minute basic medical and health service circle in the "Health Shenyang 2030 Action Plan", and provide new ideas and methods for the demarcation of service radius of different medical institutions. It is hoped that this study can provide valuable reference for future researchers.

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TOPIC 7: BIOCLIMATIC AND CULTURAL SENSITIVITY

07.101 Morphological Characteristics of Ling-Nan Architecture and BE Design

Beisi Jia*, Yan Jin

Associate Professor, Department of Architecture, The University of Hong Kong;
bjiaa@hku.hk
Associate Professor, Department of Enviornmental Desgin ,Beijing Institute of Fashion Industry

Abstract

The theoretical and methodological systems underpinning urban morphological analysis on Guangzhou and Ling-Nan (岭南) Architectural is significant to understand the cultural of identity in built environment. However, research on Architecture and urban scape is still scattered and unmethodical. In this paper, Guangzhou is selected as case examples, and the morphological characteristics of traditional residential districts are defined on four spatial levels. This not only casts light on the motivation to transform traditional residential districts to adapt to commercial development, but also promotes inspiration and assistance in the new projects. Two new projects designed by BE Architects Shenzhen are introduced as examples of selective implementation of Ling-Nan Architectural characters. The paper concluded that the traditions can be inherited in the new buildings not as comprehensive morphological system, but as transforming process.

Keywords

Urban Morphology, Patterns, Levels, Identity

6 Introduction

Although Ling-nan architecture is not a new understanding, it is not well understood systematically. According to Q. Wang (2017), Chinese architect and researcher divided the new architecture styles of China into "Jing Pai" (京派) from Beijing, "Hai Pai" (海派) from Shanghai and "Guang Pai" (广派) from Guangzhou, which later known as Ling-nan School (岭南学派). Ling-nan School refers to the mainstream of contemporary architecture in Pearl River Delta area, and from time dimension point of view refers to the development and maturity of new architecture since middle of nineteenth century (Ai, 1989).
Some attempts to characterize it haf firstly began with concept of modernism which consider the adaptability of local weather in an economic way as the very character of Ling-nan. For instance, Chen Boqi (1963) concluded five principles for better reducing temperature in traditional housing: small outer wall area directly exposed in sunlight, narrow street and lane, appropriate enclosure spatial strategy, courtyard strategy and compact plan arrangement. Some developed a facade strategy mainly aimed for lowering the indoor temperature through

enhancing shading, ventilation and thermal insulation performance. This strategy can ensure a highly efficient environmental impact and low-cost investment. Some refer to flexible spatial organization and wall system. Some others attempt for strengthening the connection of local cultural features especially the gardens. It is believed that Ling-nan architecture should be designed with light morphological impression, spatial permeability and small volume for better adapting local context. Its decoration can be combined with local feature and other cultures, the major identities are dainty and exquisite, and their themes are related to nature and daily lives. Wang (2017) summarized the characteristic and principles Ling-nan architecture as:

1. Adaptable for local subtropical weather.
2. Functional rationality and flexibility.
3. Spatial permeability and morphological simplicity
4. Well integration of courtyard, gardens and architecture.
5. Compatible for local traditional architecture and other cultures.
6. Compatible for new material and technology.

Wang (2017) also pointed out that most researchers of Ling-nan School didn't pay enough attentions to the urban scale as well as the space in between building and public space, although the spatial permeability is a strong identity of their practices, most are inside an enclosure like the garden and courtyard.

This paper intends to build up systematic understanding on the urban scape and architecture with case studies in residential buildings in Guangzhou. Based on the morphological concepts and methods given by Conzen, Caniggia and Kropf, the study of urban scape is carried out in hierarchical structure with the division of different scaled levels (Kropf, 1996). The morphological characteristics of different levels can reflect the specific political, economic and cultural driving factors of form formation and evolution. This king of hierarchical analysis can enhance the continuity of urban research, embodying the deep inherent philosophical thinking. The existing urban morphological research focus European cities. In recent years, some morphological study with comparison among different cities has appeared. However, urban morphological research on Southeast Asian cities is still very weak and scarce. The spatial reorganization and redevelopment of these city ushers in an opportunity. Therefore, it is necessary to draw lessons from the development experiences of traditional port cities in different countries or regions.

Guangzhou is located in southeast Guangdong Province in the northern part of the Pearl River Delta, bordering the South China Sea, adjacent to Hong Kong and Macao. It is a regional central city and a political, economic, and cultural center of Lingnan region, a sub-tropical area with almost year round high humidity and high temperatures. A remoteness from the political and cultural focus of China in the centre and north of the country contributes to the Lingnan region's distinct cultural identity, characterized by a mixture of local Nanyue culture, the influence of Confucianism from central China, and Western influence (Lu, 2008).

The city underwent significant expansion after the mid-nineteenth century but the majority of development between the mid-nineteenth century and the mid-twentieth century was characterized by the continued construction of traditional types of buildings and streets (Whitehand, Gu, Whitehand & Zhang, 2010) Although traditional building methods and styles continued, Western influences began to play an important role in the city's transformation (Yang and Cai, 2003). Developments in Guangzhou, as in other treaty ports, such as Shanghai, Tianjin and Wuhan, were precursors of change in other Chinese cities (Gu and Whitehand, 2008). With the introduction of Western technology, concrete was widely used in housing. The traditional Zhutongwu grchanged in the structure and physical form, from single to multi-storey, to accommodate more people on the limited land. Versions of Zhutongwu with two or more stories were the major residential building type built in Guangzhou between the late-nineteenth and mid-twentieth centuries (Gu and Whitehand, 2008).

7 Research Method

Using typo-morphological study, it is important to find the element of each level. This study focuses on the fabric and typical building level. The internal arrangements of components at the typical fabric level within plots, internal streets, and open spaces are examined. Moreover, the physical structure of typical buildings, including rooms, and the significant element - the courtyard - bridging traditional housing and Chinese early urban mass-housing, are investigated.

Urban fabric: This includes an overview of cities and the geographical, topographical, social and economic background. In most examples, a clear boundary separates the fabric from the city. However, the boundaries are in different forms. It is necessary to discern the relationship between the fabric and the city. In this study, a two-dimensional outline of the ground plan, revealing the location, shape, and size of fabric, is examined. Some photos are also included to indicate the character of the boundary. Arrangement is described in terms of the type of component parts, the number of parts, and their relative position. In turn, the types of component parts are distinguished by their position, outline, and further internal arrangement (Kropf, 1996). As discussed, the fabric can be described as an arrangement of plots, houses (including open space), and internal streets.

Building level: The internal arrangement of rooms is investigated using the layout plan and more volumetric characteristics with section. The layout relates to the organization of different rooms in the plan. Section is a good way to show the internal relationship between each component in a spatial way. Chinese early urban mass-housing involves the inward complex of families and the formation of buildings has unique characteristics. The relationship between rooms indicates a symmetrical pattern in all directions around the longitudinal and horizontal axes; the space of the courtyard is a complete pattern in itself; the connectors between rooms, such as corridors under eaves, winding corridors in corners, walls, and decorative gates, form a pattern. Complete urban mass-housing, whether large or small, is in a strict and clear layout.

Circulation and courtyard: Different possibilities for arranging floor plans within the house are primarily determined by the stairways within the house. The positioning and type of stairway defines different houses. There are internal stairways or external stairways in the different examples. Mass-housing is economical and adapts to compact needs. The efficient stairway connecting the different floors influences different houses and meets the different needs of the occupants. The formation of residential fabric follows a hierarchical structure of access, from major streets, to small lanes, to courtyard, that extends in a systematic way (Wu, 1999). The courtyard still persisted in early urban mass-housings and can solve many of the problems of the housing in that historical period. Courtyard involved three sided buildings and quadrangles, the inward complex of families with courtyards, as the public centres, and the formation of the building in a strict and foursquare pattern. This provided daylight and ventilation. Including more than one courtyard allowed for varied courtyards: recreational courtyards with green areas, light wells that solely provide daylight and ventilation, and access yards; each affording different degrees of openness. Courtyard housing is the dominant type of Chinese traditional housing, and the courtyard bridges traditional courtyard houses and early urban housing. Courtyards are analysed in terms of *size, position, outline, and relationship with the surrounding environment.*

Structure and material: The character of a building is most vividly expressed through these elements: the form of the roof and its materials, the walls, the arrangement of windows, the window frames and shutters, the doors, the finish of the walls and the colors. The characteristics of streets and therefore the character of the whole settlement is informed by the combined effect of all the buildings which line the streets (Kropf, 1993). This study focuses on the roofs, walls, windows and entrances. However, many have been destroyed and have lost their original features. These will be presented with photos and will not be examined in depth.

3. Analysis on the Morphological Characters of Lingnan Architecture

3.1 Urban Fabrics

Before the investigation, some should be clarified. As discussed earlier, in the twentieth century, no new types of houses were built on a large scale in the urban center of Guangzhou.(Whitehand, et.al, 2010) There comes some problem in choosing the typical mass-housing fabric in Guangzhou from 1900 to 1937. Based on the idea that mass-housing being the type of housing that accommodates most people in the twentieth century in the colonial cities, Baoren Fang fabric was chosen for the further investigation. It represents the typical residential fabric of Guangzhou in the twentieth century and still accommodates and meets the needs of most city people at that time, although it might be formed before 1900.

Figure 1 Position of Baoren Fang (Source: Zhou, 2005; Google Earth, 2010)

Baoren Fang is located between Changshou West Road and Wenchang North Road, one corner of the urban block. There are about 100 buildings in this district. The buildings along the city streets are shop houses, with commercial ground floors and upper floor residences. The Changshou West Road and Wenchang North Road were broadened in the 1930s (Chang, 2008). This may be the reason why the depth of buildings along the streets is reduced. There are five main entrances from different directions, making it more open.

The spatial layout is a comb-like system. The lanes are organic with the growth of the buildings. There are limited lanes which are used with high efficiency. The lanes are arranged in a functional way. Along the other two sides not adjacent to city streets, there are lanes which connect Baoren Fang with other groups. There is one long lane in the group, running east-west from the Wenchang North Road to Baohua Street. The other short south-north lane runs from Changshou West Road and does not go through the whole group, ending at the intersection with the long main lane. They are about three meters wide and look narrow with the buildings on both sides. There are also some irregular footpaths which lead to buildings inserted in the group.

Figure 2 Lanes and people in Baoren Fang

In Baoren Fang,buildings were built side by side and back to back to save land. The narrow and long rectangular building plans also make efficient use of the land. There is no unified planning and the buildings are in different forms. The buildings are mainly south-north direction but they are in high density with no consideration of the sunlight. However, almost all buildings are fronted to streets or lanes with narrow frontages, so that the ground floors adjacent to streets are used commercially or for workshops.

3.2 Building Levels

Zhutongwu with three or more stories were built as land prices increased. In some cases, more efficient use of the land was achieved by constructing multi-story Zhutongwus with shared staircases and light wells (Gu and Whitehand, 2008).

This is a multi-family house with two families on each floor. The elongated plan of this house type is very efficient. The width of the house basically depends on the numbers of families per floor, and for each family there is only one room oriented towards the front. Depth is significant compared to width and can extend as needed. An entrance niche provides access without the need for further transition zones. A shared staircase leads to upper floor rooms. There is a living room near each family entrance. A long, narrow corridor connects the bedrooms and surplus rooms at the back. The windows of kitchens and washrooms are open to the shared light well, thus daylight and ventilation are available through the enclosed light well.

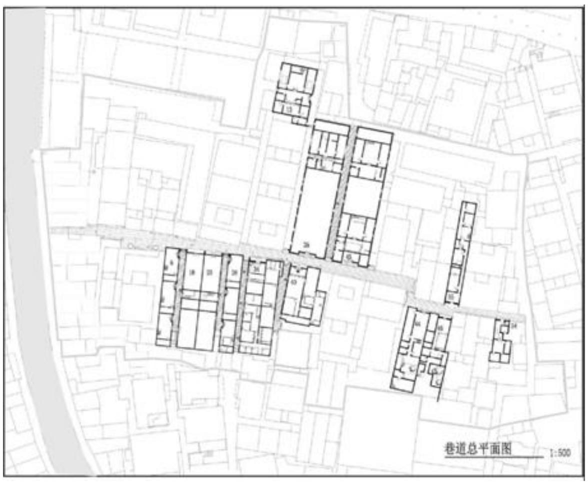

Figure 3 Typical multi-storey Zhutongwu house with a shared staircase and lightwell,

3.3 Circulation and courtyard

There is one access for each family. The shared staircase, compact to save space, is along the party walls between the families on each floor. Since the house is narrow with small width, the staircase is with single-flight form. It starts from the street directly and leads to the upper directly. This staircase usually serving a maximum of three stories, is limited by the depth of the floor plan, but creates a spatial continuum across several floors. The independent corridors inside the rooms can help to subdivide rooms and provide good ventilation due to their long and narrow form (Lu, 2008).

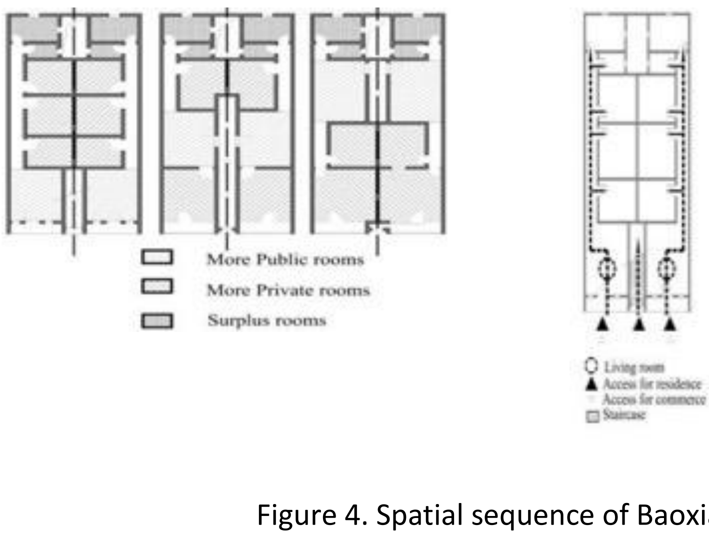

Figure 4. Spatial sequence of Baoxian Road 29

3.4 Structure and material

Concrete was used in the structure of the building. Concrete–frames, brick wall partitions, and wooden staircases characterize this house. The shared lightwell is located in the middle of the two families on each floor. It provides sufficient sunlight and ventilation for the kitchens and washrooms.

Figure 1 Position of lightwell in typical multi-storey Zhutongwu house

In 1933, there were about 22,178 qilou houses in Guangzhou, with about 50 people per qilou house on average (L. Lin, 2006). The qilou was developed with high density and wide distribution, reflecting the commercial character of Guangzhou.
Qilou always have an arcade supported by stone or brick columns erected on the pavement, providing cover for pedestrian underneath. This linear Qilou with an overall length of about 25 meters and 8.6 meters in width is exemplary for the effectiveness of making use of the land. The ground floor spaces adjacent to the city street, and have a certain degree of publicity, are the best places for shops or workshops. The qilou can be attached to neighboring buildings on three sides; one side provides access. Therefore, this house is a suitable housing development module, meeting economical requirements. There is no clear division of rooms; usually the living, dining and bedrooms can be separated according to the varying needs of families. All personal rooms can be easily furnished.

Figure 6 Typical Qilou, redrawn based on Liu, 1997

The house is accessed from the front. Shops can be accessed directly from streets while a single-flight staircase leads from the shops on the ground floor to residence on the upper

floors. When it extends to the first floor, it turns into two-flights. With a width of around 8.6 meters, it is possible to arrange a straight stairway in a crosswise fashion. Therefore, multiple variations can be realized compared to the smaller width type with a lengthwise staircase. The 14 meters long corridor inside is independent from the rooms, providing possible sub-division of rooms and also good ventilation (Lu, 2008). The qilou facades generally have a Western appearance, frequently classical revival or art deco in style. Concrete was frequently used in their construction (L. Lin, 2006).
Since the plan is extremely long with small width, the light wells play an important role in ventilation in the house of Guangzhou, where is always highly humid. The light well is flexibly located according to the requirements. However, there is usually one light well providing light and ventilation for adjacent kitchens and washrooms. Internally, the elongated spatial arrangement combined with small and shared light wells and daylight from above creates an exciting spatial continuum.

4. Two Projects designed by BEA Hong Kong Ltd.

The Engineering school under construction and Futian Culture Center, a competition final entry projects were selected as reference to compare with morphology Lin-nan architecture. Both were designed by BE Architects of Hong Kong, which always address the issues of context in broader sense, not particularly on the Lin-nan architecture. Situated in Shenzhen, a rapid developing city in the fringe of Lin-nan culture, a dialogue between new architecture and the culture of the context may reveal the fact and possibility of interlocking and overlapping in the advancing of new architecture towards a new future.

Urban fabric

Engineering School follows the overall concept structure of the campus, integrated in pedestrian flow and the topography. As the landmark of the northwest campus, the massing emphasizes the architecture integrity. The engineering school has 2 U-shaped courtyards, which have openings towards 2 hills at the southwest with landscape successfully utilized. Overall, the sloping roof, which is lower at east/south and higher at west/north, fully reflects the consideration of terrain and the respect to context.

Located in the dense urban area with high rise buildings around, there would have little open and public space left after the Futian Culture Center to be build – the plot ratio of the Center is 7.8. Stressing with need of open public spaces, this scheme introduced the idea of “vertical city”. By pressing the programs under the ground and up in the highrise building, the scheme opens up multiple ground levels for the public use.

Figure 7. The Engineering School (left) and Futian Culture Centre (Right) in different context.

Building Levels

The Engineering School fully reflects the dignity, simple and economic features of the university architecture. However, there are nine departments in the faculty. Each of them had an intension to accommodate the research lab, administration, and professor number with assistant ratio based on their own chose. However, at design stage none of them could actually a concrete program. On the technical aspects, the research labs are very different from one department to another. The project adopted a neutral based building system, efficient floor plan, sufficient service cores for research labs, but open for varieties of layout.

A flexibility and mix use of program were introduced both in the podium, basement and the tower by providing multiple level of accesses, neutral and simplicity of the building form. “Vertical City” concept also invites elements such as lanes, plazas and pocket parks as those in horizontal urban tissue, as well as the flexibility and hierarchies of privacy and publicity.

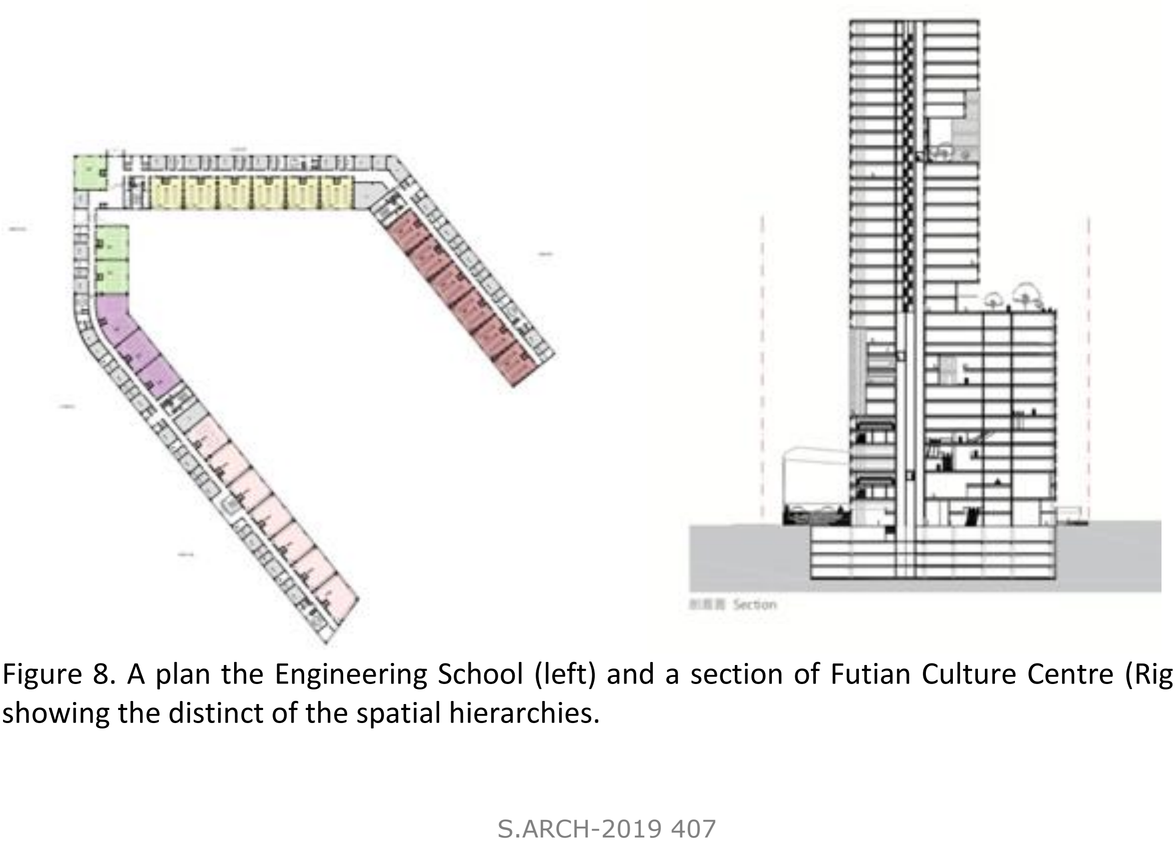

Figure 8. A plan the Engineering School (left) and a section of Futian Culture Centre (Right) showing the distinct of the spatial hierarchies.

Circulation and courtyard
To accommodate the large amount of students, two large open spaces however shaded by trees and covered walk ways. These elements are similar as those in Lin-nan Architecture and gardens, however the dimension is bigger generated the needs of public gathering and sharing. The comparative example is Lin-nan ancestral hall. Through careful design of every detail, the project not only fulfils a highly diversified research labs, and constant changes of the faculties, but also considers the humanity design principles by the well elaborated indoor and outdoor space and green architecture strategies.

The shaded, naturally ventilated semi private spaces in the high rise building in the Centre are connected by open staircases. The pedestrian network in the tower support the multiple use of the building, reduce the needs of elevators. It also suggests a new typology of high rise building.

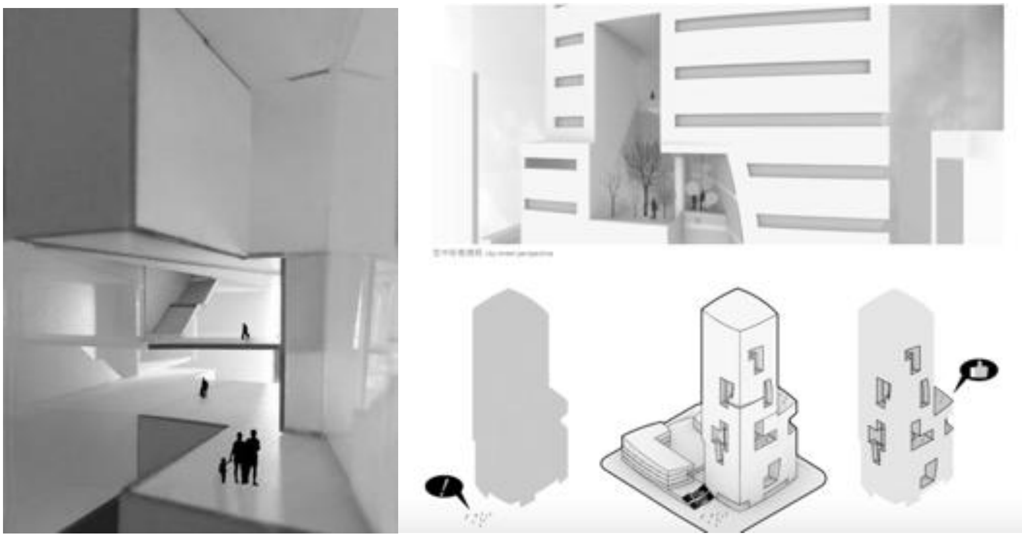

Figure 9. Elevated public spaces in Futian Culture Centre

Structure and material
During the design process, the constant changes of requests raised by departments of the Engineering School could easily integrated and accommodated. The façade is made of stone cladding. Together with simple geometric form and lower ratio of window/wall, is saving energy. Among the four projects carried out at the same time, the Engineering Faculty run most smoothly. Actually, final built up will be exactly the same as initial competition project at the very early stage. Thanks for the strategically laid-out base building.

Simple structure also supports the dynamic spaces and composition of façade in the Cultural Center. The compact form and solid façade not only response the low energy for air cooling in the summer and most of time of the years, but also make the high rise building a cultural identity, distinct from commercial and residential buildings.

5. Concluding Remarks

Architectural research with morphological approach builds up scientific understanding towards built environment including characteristics of a regional architecture. Lin-nan architecture is reviewed on four spatial levels in this paper: urban fabrics, building level, circulations and courtyards, and structure/material. A comparative study on the two new projects by BE Architects in Hong Kong on the four levels, justify both departure from tradition and continuity of tradition towards future.

In urban fabric level, a hierarchy of small and liner open spaces are found both traditional context and new high-rise projects.

In the building level, open and flexible space can accommodate multiple use and changes of functions also in both traditional courtyard houses and new institutional projects.

In terms circulations and courtyard spaces, traditional buildings represent strong potential of diversity with horizontal composition. However, an overlapping of shaded and protected semi open spaces also provides new prototype for high rise buildings.

Simple and neutral structure system provides possibility of multiple use of space and characteristic building forms. It is found provocative in both Lin-nan architecture and the two new projects.

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TOPIC 8: ENERGY SAVING

08.101 Passive House Design for an Infill Site

Ramani Ramakrishnan*, Stephen Chun, Clive Fernandes, Jacqueline Galang, Palma Gatti, Romina Kaveh, Pearl Mu, Liam Van Steekelenburg, and Freedom Stone

Department of Architectural Science, Ryerson University
350 Victoria Street, Toronto, ON, Canada M5B 2K3; rramakri@ryerson.ca

Abstract

The focus of the current investigation was the design of a 185 sq. m. residential dwelling as an in-fill development that satisfied passive house requirements. The house was designed strategically to utilize the maximum potential for shading and daylighting, as well as to minimize the impact of the site. The challenge for daylighting was the two trees in front of the south facade. Setbacks were imposed on the southern facade to allow for deeper solar penetrations into the interior, to maximize the amount of solar gain during the winter. The majority of the glazing was placed on the east wall to maximize solar gains. The space heating demand criteria was managed by applying an advanced envelope, utilizing a TJI stud wall assembly, with the insulation level of RSI 8.8. Foundation walls of the envelope achieved RSI 7.9 using a Quad-Lock Insulated Concrete Formwork (ICF) wall. The roof was designed using conventional practices to achieve an RSI-Value of 10.6. Additionally, passive house certified components for windows and doors ensured no thermal bridging. ENERGY STAR® rated appliances were utilized for the house, to ensure minimal water and electricity usage. An energy recovery ventilator was implemented to reduce energy loss throughout the mechanical system. In addition, a photovoltaic array was added on the roof facing south to supply energy for domestic hot water. The overall design achieved the alternative criteria for space heating with a value of 9.2 W/m², an airtightness of 0.4 ACH @ 50 Pa/hr, and a primary energy demand of 55 kWh/m²/year. The details of the design with Passive House results will be presented in the paper.

Keywords

Passive House standards, Infill site, Solar panel, Day lighting, Energy use

1 INTRODUCTION

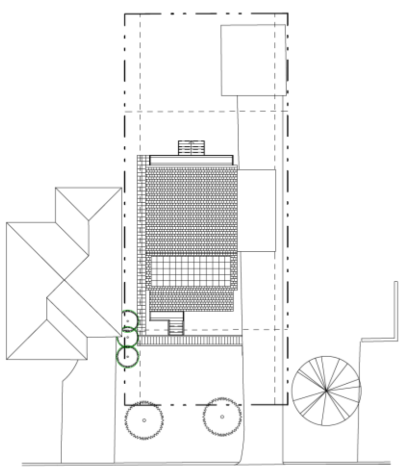
A group of eight 4th year students, as part of the design studio in the Building Science option, designed a residential dwelling in an infill site in the City of Toronto. The project called for a two storey + basement residential house design, facing south and ranging from 140 to 185 square metres and required to fulfil Passive House requirements. The specification for the project was to design and build a 360 square metres home with 3 bedrooms and 2 bathrooms, with a decent amount of glazing facing the backyard. The infill site is located in Toronto, Canada, with a moderate density consisting of near adjacent detached houses and trees fronting the lot.

Zoning by-laws were also taken into consideration during the design process. Two of the students were given 'Beta' training in passive house design techniques by Passive House Canada.

The implementation of passive house standards for an infill site renovations required new sustainable methods and systems in the design of residential homes. The design process involved the following steps: a) resolving the site issues and building massing; b) design of the envelope; c) application of renewable energy sources; and d) evaluation of energy demand. An EXCEL spread sheet developed by Passive House Canada was applied to create an efficient design [1]. Details of the passive house design techniques will be described in the following sections.

2 Site Conditions and Building Massing

The most important features on the site are the trees, as shown in Figure 1. The challenge for daylighting was the two trees in front of the south facade. A basic shading study was conducted to determine the total amount of sun light potential. There are two coniferous trees directly to the south and one deciduous tree to the south east of the site. It is important to note that the coniferous trees will retain the majority of their pines all year round and will provide consistent shading. The deciduous tree will lose its leaves in the fall, which means it will have a minimal effect in the cold winter months when solar radiation is required the most.



a) Site Plan

b) Exterior Rendering

Figure 18. Existing House

2.1 Sun Study

A sun study was conducted to determine the availability of light for the site and house, as tall mature trees in close proximity to the existing building footprint, and neighbouring houses to the West and East lots lead to the major design decision to set back the southern elevation. Results of the sun study are presented in Figure 2 below.

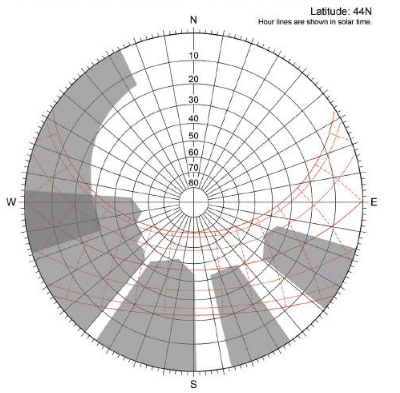
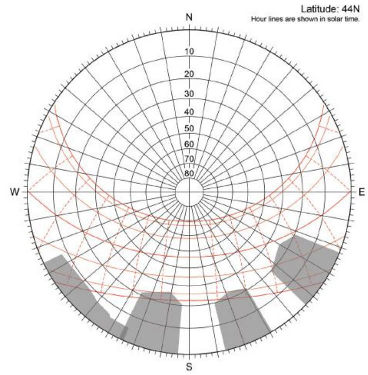
	
a) South Façade – First Floor	b) South Façade – Second Floor

Figure 2. Results of Sun Path Diagrams.

The sun study results show ideal location for window placements. The sun study revealed windows to be placed extensively on the South and East facades, the West façade left blank due to zoning by-law regulations, and minimal glazing placed on the North façade. The sun path diagrams also indicated that the glazing should be placed at higher elevations. Setbacks were imposed on the southern facade to allow for deeper solar penetrations into the interior, to maximize the amount of solar gain during the winter. It can be seen that pushing the second storey facade back (north) reduces the shading on those second storey glazing units.

2.2 Building Massing

The building massing was the next factor considered in the design, as it has a significant effect on the passive heating potential and the successful application of the photovoltaic system. In the massing design process, it was important to orientate the building to respond to the sun path, and to develop a form that would allow optimal window placement as well as good roof areas for photovoltaic array design.

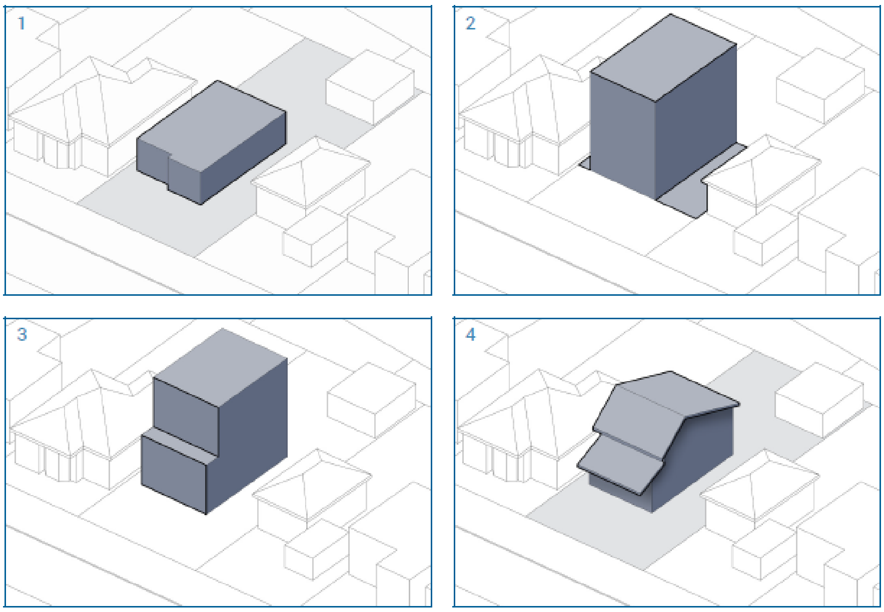


Figure 3. Evolution of Building Massing.

Two main gestures were made in order to fulfill these requirements. As seen in Figure 3 above, the south facade of the second story was pushed closer to the centre of the building such that solar radiation could heat up a thermal mass that is the circulation core of the residence such that energy can radiate in all directions and energy loss through the envelope is reduced.

The evolution of the building massing folowed four stages as shown in Figure 3. The first stage was to ensure that the building was situated within the original house foot print. Next the massing was constrained to meet the reqirements of the local by-laws as well as the driveway adjacent to the house. After satisfying the local bylaws, the southern façade was pushed further into the house to allow for deeper solar penetration into the living space. Finally, the form of the roof is created to allow for shading on the southern and eastern facades.

The design of the house consisted of an open volume on the main floor, combining the kitchen, dining room, and living room spaces. A separate zone was created solely for plumbing and mechanical systems to minimize pipes and ductwork. The basement was left open for recreational purposes, fulfilling the intentions of the client.

2.3 Envelope Details

The next step after deciding on the building massing is the selection of building materials for walls, roof and foundation. Design of the building envelope featured advanced techniques and materials that opposed conventional practices. The materials and components were chosen based on its environmental performance and embodied energy, and the assembly was determined by its ability to mitigate thermal bridging within the key junctions. The choice for each of these envelope is described below.

The structure of the wall is composed of TJI vertical joists, with an additional (50 by 100 mm) stud wall. The advantage in using TJI joists for the stud wall was its fast assembly due to its balloon framing capability and has the ability to maintain a continuous insulation level. Spray foam insulation was applied within the cavity of the joists, and within the cavity of the floor joists. This ensured a tighter air barrier in and out of the wall assembly and provided an additional thermal and moisture barrier. Additionally, the spray foam assisted in mitigating potential thermal bridging that would occur within the junctions.

The blown-in cellulose required less labour due to the use of a compressor rather than manual installation of the batt or board insulation and contributed to the overall air tightness of the envelope. In addition, cellulose was chosen for its environmental benefits, as dense pack cellulose has a lower embodied energy and carbon footprint, and its ability to be recycled to meet future needs. The additional stud wall assisted in installing conduits for electrical appliances and plumbing, without having to disturb the TJI joist cavity. The total insulation level was estimated to have a value of RSI 8.8.

To continue the high efficiency of thermal insulation below grade, a Quad-Lock Insulated Concrete Formwork (ICF) was used to maintain the consistency of the building envelope. This system was chosen because of its ease of assembly, as well as its long lifespan and structural durability. Additionally, insulated concrete formwork does not require any structural framing, as it only relies on minimal use of concrete and rigid EPS boards. Together, the composition of materials provides a continuous insulated and airtight barrier. The ICF system utilizes two layers of extruded polystyrene (EPS) on the warm side, each measuring 100 mm thick with a U-Value of 0.036 w/m^{2}k. The dimensions of the concrete fill will be 7” thick, and an additional 100 mm thick EPS layer placed on the cold side of the foundation. To equal the overall U-Value of the foundation wall assembly, a 50 by 100 mm stud wall was placed facing the interior, filled with 100 mm of Rockwool batt insulation, producing an overall U-Value of 0.098 W/m^{2}K.

For the foundation floor, an ISOQUICK raft foundation was used for the house. The decision was based on its popularity in other passive house projects, and because of its low embodied energy. The raft foundation uses less concrete than conventional homes, by relying on EPS rigid insulation to distribute load, therefore using less concrete, and replacing concrete footings. In addition, any wall system can be connected to the foundation, which was convenient for this project in particular, as there is a continuous thermal barrier surrounding the entire concrete structure.

The roof assembly utilized a 900 mm raised heel truss with blown-in cellulose. The use of a heel truss allowed for a continuous blanket of insulation within the eaves of the roof, maintaining a constant RSI Value of 15.9. The southern face of the roof was designed to be inclined at 40 degrees to implement solar photovoltaic panels. A slight overhang was created to provide shading during the summer season.

Schematic details of the wall-roof-foundation systems are shown in Figures 4 and 5 below.

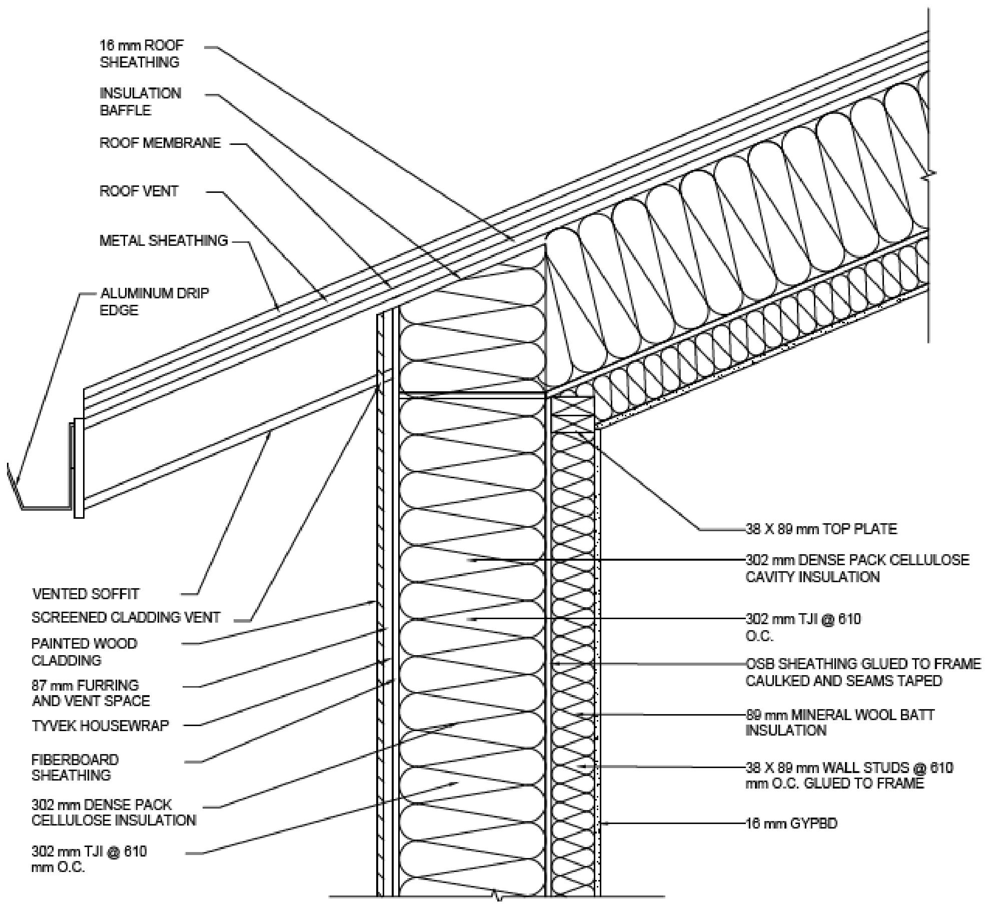


Figure 4. Above Grade Wall and Roof Details.

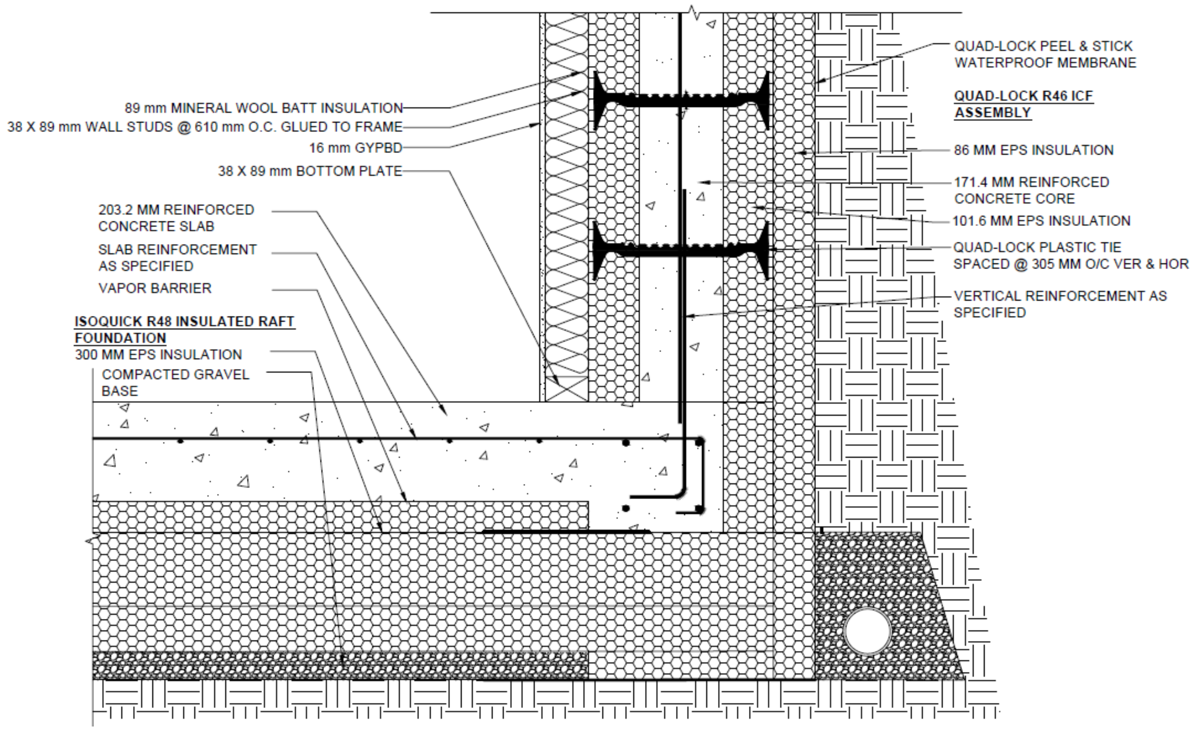


Figure 5. Below Grade Wall and Foundation Details.

2.4 Building Components and Systems

The systems and components used for the design are selected based on its environmental performance and energy efficiency. Windows and doors were selected from manufacturers listed in the Passive House Components database. Standard kitchen and washroom appliances were to be ENERGYSTAR® rated and ensured no penetrations within the thermal envelope when installing ductwork or pipes. For domestic hot water, an electric water heater was used. Electric water heaters were selected for the house because they were typically more efficient than other fuel sourced water heaters, and doesn't require a pilot light, meaning less energy consumption and supervision.

A mini-split ductless heat pump was chosen for heating the house. The heat pump contains an inverter and a variable-speed compressor, designed to maximize comfort in times of extreme weather. A heat pump was chosen as the most environmentally friendly option, as heat pumps reduce carbon emissions compared to oil, gas, LPG, or biomass, and produce almost little carbon emissions when powered by electricity. Additionally, the masonry wall in the living room not only provides for structure to the 2nd floor, but also provides for passive heating by absorbing natural light through the mass of the brick during the winter season, to reduce energy consumption for heating.

Solar photovoltaic panels were implemented on the southern slope of the roof. The selected panels were suitable for a residential, grid-connected house of a small scale. The panels, being manufactured in Canada, presents a low embodied energy, and provides renewable energy that could offset the initial energy usage. The lifespan of this system is 25 years, and the material/workmanship of the panels has a lifespan of 10 years. The panels are composed of mono-crystalline cells, which uses high transmission glass and absorbs diffused light, and deliver more current in all weather conditions. Additionally, the solar PV can be connected to the domestic hot water to reduce energy consumption.

Finally, ventilation was provided by a Passive House certified HRV (Heat Recovery Ventilator). The HRV circulates the incoming and outgoing air throughout the house. It recovers the heat from the outgoing air to reheat the incoming air. The particular HRV was chosen due to a) its lowest sound output; b) its 92% heat recovery rate; c) its frost protection at low temperatures; and d) low energy consumption from the direct current motors. The only disadvantage of the unit is its maintenance issue.

2.5 Thermal Bridging

THERM software was utilized to understand the heat-transfer effects in the proposed design's building components, specifically where thermal bridges were of concern [2]. Possible locations for thermal bridging are highlighted in Figure 6 below.

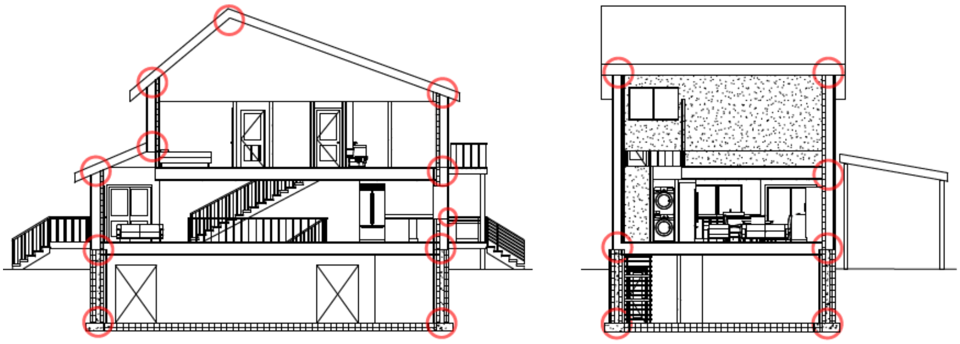


Figure 6. Locations of Potential Thermal Bridging.

THERM's heat-transfer analysis examines a material's energy efficiency and local temperature patterns, which may relate directly to problems with condensation, moisture damage, and structural integrity. THERM helped compare the impacts of different choices of materials and its thermal performance. Other residences from the literature were used as a precedent for the design of the details to mitigate thermal bridging. An example of the analysis is shown in Figure 7.

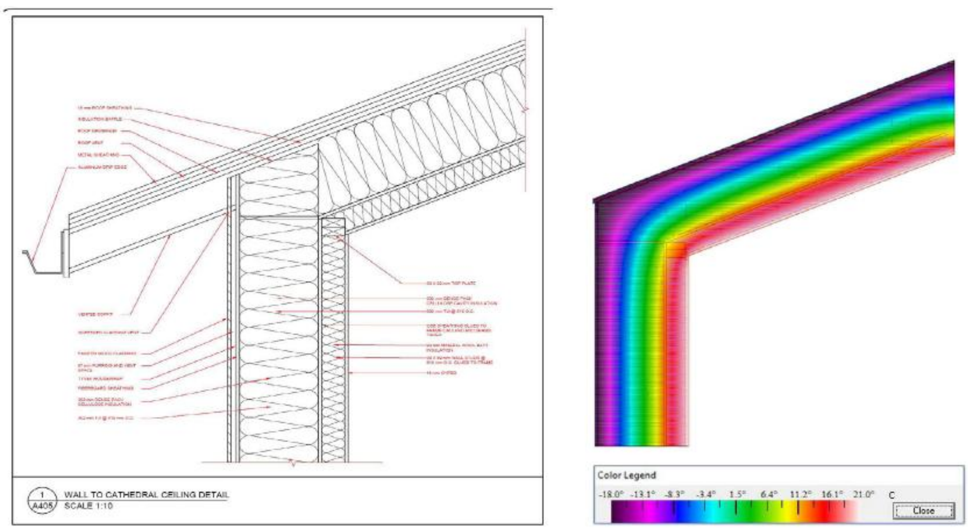


Figure 7. Results of Therm Analysis.

Results of Figure 7 clearly show that there is no bridging in the corner between the roof and the wall. The temperature variation is very smooth.

2.6 Energy Demands of the House

The energy modelling of the house was conducted using the PHPP (Passive House Planning Package) developed by the Passive House Institute [3]. The results are described in Table 1 below.

Table 11: Energy Modelling Results

Description	Requirement	Calculated	Requirement Met?
Space Heating Demand	15 kWh/m^{2}a	16.2 kWH/m^{2}a	NO
Space Heating Load (Alternative to Space Heating Demand)	10 W/m^2	9.2 W/m^2	YES
Frequency of Overheating (Above 25° c)	≤ 10%	9.7%	YES
Frequency of Excessive Humidity (Above 12g/kgda)	≤ 20%	0.3%	YES
Airtightness @50Pa/1Hr	0.6 ACH @50Pa/1Hr	0.4 ACH @50Pa/1Hr	YES
Primary Energy Demand	120 kWh/m^2/year	55 kWh/m^2/Year	YES
Primary Renewable Energy	NA	24 kWh/m^2/Year	NA

The model was calculated using selected products and equipment for the house. It is important to note that while the PHPP model reveals that the house does not meet the initial space heating demand of 15 [kWh/(m^{2}a)], but meets the alternative criteria of the space heating load, which is 9.2 W/m^2.

2.7 Final Design

In conclusion, the final rendering of the Passive House design is shown in Figure 8 below.

a) Interior Rendering
b) Exterior Rendering

Figure 8. Interior and Exterior View of the Passive House

3 Conclusions

The infill house design was unique in a way that presented an opportunity to experiment with advanced construction techniques, sustainable technology, and passive design strategies. The design challenged the students to collectively think outside the box and face the challenge of providing a greener and healthier method of achieving comfort. The introduction of energy efficient systems and sustainable techniques simultaneously aims to combat climate change and energy conservation, and potentially address the issue of affordable housing and lower rent costs. The final design showed that most of passive house standards were satisfactorily complied with.

Acknowledgements

The authors gratefully acknowledge the help provided by Mr. Andrew Peel of Passive House Canada during the evolution of the infill project

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TOPIC 9: MATERIALITY

09.101 THE AESTHETICS OF SUSTAINABLE ARCHITECTURE: REUSED MATERIALS

Urszula Kozminska, PhD Eng.Arch.*

Aarhus School of Architecture
Norreport 20, 8000 Aarhus C, Denmark; *uk@aarch.dk

Abstract

The aesthetics of reused materials, their imperfect textures, unpredictable properties, and patina parts with the modernist understanding of the term beauty. The aesthetics of waste should be discussed trespassing the visual perception. It is necessary to include the Hegelian concept of beauty of the idea and the context or to incorporate the ancient category of appropriateness. In the case of reused materials, the beauty lies in the idea of choosing sustainable solutions and in the adequacy of reusing practices in the times of shrinking natural resources. The deterioration of the environment directs the aesthetic perception of architecture towards such concepts as environmental aesthetics, aesthetics of engagement or environmental ethics, which highlight the importance of contextual, knowledge- and value-based analysis of buildings' appearance.

Successful examples of the reuse of building materials in architecture are developed as negotiations between materials' quality, durability, adequacy, their environmental impacts, ethics of using and aesthetics. The case studies from Denmark, Germany, and the Netherlands, presented in this paper, show that the use of construction waste adds authenticity and enriches sensual perception of created space. Moreover, reusing practices influence new, creative design processes which result in high-quality, sustainable architecture.

Keywords

reuse, reused materials, aesthetics of sustainability, sustainable architecture, adequacy of sustainable materials

1 INTRODUCTION

The aesthetics of reused materials, their imperfect textures, unpredictable properties, and patina parts with the modernist understanding of the term beauty. The aesthetics of waste should be discussed trespassing the visual perception. However, as an ongoing discussion on the aesthetics of sustainable architecture shows the often-depreciated category of beauty is crucial to develop accepted, pro-environmental and long-lasting buildings. Successful applications of reused materials in architecture are developed as negotiations between materials' properties, performance, functionality, adequacy, their environmental impacts, social perception, ethics, and aesthetics.

In this paper, the issue of reused materials is related to the general discussion on the aesthetic of sustainable architecture. Firstly, the overview of ongoing philosophical discussion and related research is examined to understand the current context. Then the focus is put on the specificities of the appearance of waste. The aesthetics of reused materials is analysed in theory and on selected case studies from Germany, the Netherlands, and Denmark. The paper concludes with general recommendations for developing high-quality, sustainable architecture.

2 Aesthetics of sustainable architecture - background

The discussion on aesthetics has been present in the philosophical discourse since ancient times. The concept of beauty, treated as an ultimate value, was discussed in regard to the issue of objectivity. Until XVIII century beauty was regarded as an objective and transcendent value. Then, narration often focused on subjective perception, personal experience, and taste. The duality of the issue is visible in Kant's differentiation between dependent and absolute beauty. Absolute, free beauty is considered as disinterested judgment and can be found in the form or design (Kant) or in the arrangement of lines and colours (Bell). In contemporary philosophy, beauty is not attributed solely to the subject nor the object [1]. It is often seen as a relation between the two in the context that they belong to [2].

Historically beauty was defined as perfect proportions (the Classical Conception), adequacy (Socrates), usefulness (Berkeley), moral good (Kant), idea (Hegel), love and longing (Burke), pleasure (Muratori), discovery (Baroque aesthetics), distance (Bollough), expertise (institutional aesthetics) and invitation for further exploration (Nehamas) [1], [3]. The complexity of the term, its 'objectivity-subjectivity' duality and different, often juxtaposing definitions provoked that the issue of aesthetics is often considered in relation to ethics. Socratic, Kantian or Hegelian understanding of beauty shifts the discussion on aesthetics towards morality.

In case of sustainable architecture, beauty – analysed in the context of morality - lies in the idea and the adequacy of choosing pro-environmental solutions and design practices in the times of shrinking natural resources. The deterioration of the environment directs the aesthetic perception of architecture towards such concepts as environmental aesthetics, which sees aesthetic assessment through knowledge-based environmental analysis, or to the aesthetics of engagement which promotes contextual analysis of buildings' appearance. Environmental problems turn the discussion on aesthetics to environmental ethics, which accentuates the necessity of responsible and pro-environmental actions [4].

Over the years, the approach to sustainable architecture has frequently been changing [5]. In the 1960-1970s, the architects designing pro-environmental buildings were more focused on their performance than aesthetics. As a result, the design quality of such projects was not competitive with mainstream architecture [6]. Moreover, *'the principles of sustainability in design have remained largely restricted to the ad hoc assembly of various mechanical devices'* [7:99]. Later, pro-environmental design expressed variously. Such aesthetic manifestations of sustainability were observed as: baroque suprematism (the aesthetics of excess linked to the growth and self-generation), bio-mimeticism (the aesthetics of artificial naturalism), analytic (the aesthetics of processes), hyper-technologic (the aesthetics of high-tech), regulatory (the aesthetics of rules) and eclectic style [8]. But in the majority of these developments *'the concept of sustainability becomes the content and paradigm of the project, and the concept of aesthetics is diminished and suffocated'* [8:46]. The notion of aesthetics is replaced by the notion of ethics [9]. Pro-environmental, often certified buildings lack lasting aesthetics, which is a consequence of disconnection between aesthetics and sustainability [10]. Moreover, there is a danger that the policies of the European Union may negatively influence the aesthetic quality of future green buildings as they focus on specialised mechanical components and leave the design to the engineers which can cause that such *'terms as architecture and aesthetics may be nothing more than the quaint adages of an anachronistic practice'* [10:113]. Finally, in the times of consumerist culture, image-driven media and predominant visual technologies, the rejection of the appearance seems to deny the cultural needs of current societies [11].

Thus, there is a demand for the integration of aesthetics and sustainability in the projects but also in the core of the discipline. Ethics and aesthetics should not be considered separately because *'no generic antagonism exists between the form of consciousness aimed at action, which is morality and the nourishment of consciousness, which is aesthetic experience'* [12:235]. Those categories are inseparable [13] because beauty in architecture is not only appreciated through intellectual contemplation [14]. In contemporary sustainable architecture, the ethical is an irreplaceable value, but the rigidness of rules, norms, and codes negatively influences its aesthetics [8]. The focus in pro-environmental projects is put on the problem-solving aspect of sustainability and it often results in dull and unattractive architecture. Along with the resource efficiency and the respect for natural and cultural context, aesthetic attraction should be considered as an environmental imperative [9]. There is a need for enticement, and sustainable architecture is a perfect space for a negotiation between the reason and seduction [8], [15].

3 Aesthetics of waste and reused materials

The reuse of building materials in architecture requires unconventional approach to the design process, in which the focus is put on materials, their properties, structure, optimal ways of using and aesthetics. Reused materials have irregular shapes and uneven texture with scratches, chips, cracks, and decrements caused by time and previous usage. They undergo processes of abrasion, deposition, fatigue, deformation, unrevealing. Their naturally-aged and covered with patina look is a consequence of alternations through repeated use [16]. Thus, the appearance of such materials differs from standard, new and industrially produced, architectural solutions. Waste can be sourced from historical buildings or the common construction and demolition debris. Reused materials are being adapted for the new functions using traditional construction techniques and high technologies. Those methods and tools should be adjusted to untypical properties of materials. Moreover, the building's form and details should be shaped respecting their unique history and appearance as all those aspects affect its aesthetics.

3.1 Aesthetics vs. ethics

It is easy to link the aesthetics of reused materials to the ethical approach to the understanding of beauty. The aesthetics of waste is often discussed trespassing the visual perception and includes the Hegelian concept of beauty of the idea and the context [17]. In a current situation of shrinking natural resources, the choice of pro-environmental and waste-reducing solutions may be considered as beautiful. Moreover, the use of locally sourced materials and techniques adds to the contextual argument. The aesthetics of reused materials remains in relation to the romantic concept of beauty, which centred around non-obvious solutions. The beauty of using waste also incorporates the ancient but currently valid category of appropriateness, understood as functionality or adequacy [17]. The reuse of construction waste adequately addresses the needs of the contemporary world, so it is beautiful. Furthermore, the deterioration of the environment directs the aesthetic perception of architecture towards such concepts as environmental aesthetics, aesthetics of engagement or environmental ethics, which highlight the importance of contextual, knowledge- and value-based analysis of buildings' appearance [4]. This kind of aesthetic analysis enables a complete appreciation of buildings made out of waste materials. Trespassing modernist understanding of beauty as an ideal, clean and hygienic form [18] unfolds the potential of working with waste, which can be seen as an enabler of the new creative processes. Additionally, the skilful use of the reused substance may enrich sensual perception of architecture [19]. Uneven textures, traces of time and artisanal solutions emphasize the local character of buildings and add to their authenticity [20]. The reuse of building materials supports the concept of haptic aesthetics and design practice which focuses on texture, density and weight of material, and on the precision of the detail (e.g. F.L.Wright, C.Scarpa, A.Alto). It helps creating the buildings which activate diverse sensory experience.

The ethical approach to beauty, sensual perception of buildings and its understanding in the context of holistic processes of nature enables thorough aesthetic analysis of architecture created with waste. Trespassing visual perception of buildings uncovers their environmental, cultural, and historical meaning. The understanding of spoglia construction method in Klostergarten Lehel in Munich (designed by Hild und K Architekten in 2009), where historical window details were incorporated in new walls of the contemporary residential building, shows a value of its contextual location. The reuse of rough and irregular bricks, sourced from the old cloister, on the facades of the Art Museum in Ravensburg (designed by LRO Architekten in 2012) blended the building in the historical urban tissue of the old town. A similar application of reused bricks and local rubble added aesthetic patina to the elevations of the Gallery Am Kupfergraben (designed by D.Chipperfield in 2007) located in the historic centre of Berlin. The use of aluminium prefabs, extracted from the GDR department store, in a new library in Magdeburg (designed by Karo Architekten in 2009) emphasized the legitimacy of urban renewal of degraded space in Eastern Germany. The reuse of locally sourced construction and industrial waste in Villa Welpeloo in Enschede (designed by Superuse Studios in 2009) or in the recycling centre Kringloop Zuid in Maastricht (designed by Superuse Studios in 2014) shows the adequacy of architectural application of such materials and proves that it can be done precisely, aesthetically, and environmentally friendly. The understanding of the structure and the use of advanced technologies in 3D-Printed Canal House in Amsterdam (designed by Dus Arkitekten in 2016) or material innovation in the Nærgenbrugstation and

Resource Row Housing in Copenhagen (designed by Lendagar Group in 2018) directs the attention towards the beauty of inventive solutions and processes.

Figure 19. Klostergarten Lehel, Munich; Gallery Am Kupfergraben, Berlin; recycling centre Kringloop Zuid, Maastricht; 3d Printed Canal House, Amsterdam; Nærgenbrugstation, Copenhagen.

The ethical approach to the aesthetic assessment results in a holistic understanding of sustainable architecture but it should not diminish the aesthetic value of its appearance. On the contrary, it is important to create beautiful buildings with reused materials in architecture as there are multiple troubling issues embedded in such solutions. First of all, the contemporary consumerist culture abandons old objects and discarded materials. *'The constant devaluation of the old in the flux of the aesthetic is the engine of aesthetically grounded consumption'* [6:35]. It accelerates the consumption of resources and it constructs the aesthetics of obsolescence [6]. Another challenge for the application of reused materials is people's environmental awareness and social perception [21], [22]. Waste often is perceived negatively – in some cultures reusing practices are seen as a stigma [23], [24] and in consequence reused materials are socially depreciated. Sometimes their aesthetics reveals the unwanted truth about human living conditions [6]. Moreover, the reuse of reclaimed materials is often blocked by their poor quality, worse properties, lower performance, and doubtful aesthetics. At times the reuse practices are considered a burden as it happened in the case of Vandkunsten Architects' project of a housing complex of Albertslund Syd in Denmark. The architects teamed up with the researchers from TU-Delft to sustainably reuse existing wooden flooring for wall-cladding in new apartments. This concept was rejected by the future tenants and the administration as the *'inhabitants preferred the new and conventional material solutions over the reused solutions'* [25:12]. Common preconception is *'that what looks like an old building also functions like one'* [15:45]. And even if the patina of historical substance is appreciated, it is more likely to be accepted when it is clean and controlled [26]. Thus, it is important to design high-quality buildings with precise detail. Not all pro-environmental design principles work with every material. For example, the avoidance of finishings may result in the uncompleted or prematurely aged look of a newly designed building as it happens in case of uncoated concrete prefabs in the Plattenpalast in Berlin (designed by Wiewiorra Hopp Architekten in 2009). Sometimes the use of common reuse solutions worsen the functionality of designed details, e.g. a gabion as a bench in front of Brunnerstrasse 9, Berlin (designed by A.Brandlhuber in 2010). Moreover, waste, used in do-it-yourself developments, often creates playful but chaotic spaces (e.g., NDSM Art District in Amsterdam has been developed by local artists since 1990) or alternative aesthetics (e.g. Earthship in Zwolle designed by Superuse Studios in 2009). Thus, it is important to consider the choice of materials and construction methods concerning the future function of buildings as it justifies their appearance. DIY solutions which work perfectly in an alternative art centre will seem random and deceptive in a corporate office building. On the contrary sleek and polished surfaces of high-tech, recycled materials would deprive the alternative architecture of its organic character and the connection with nature.

Figure 20. Plattenpalast, Berlin; Brunnestrasse 9, Berlin; NDSM, Amsterdam; Earthship, Zwolle

3.2 Aesthetics – a need for beauty

But the understanding of the aesthetics of reused materials should not be considered only through the lens of ethics. There is a great potential in this kind of architectural solutions as discarded materials embed such positive values as the experience of continuity, the beauty of passing time, the evidence of history, the emanation of cultural heritage or the authenticity of space. Moreover, they may act as a creative force for new processes and aesthetic solutions in architecture. Foremost, the reuse of existing substance adds to the experience of a continuum of designed space. It creates the connection to its cultural and environmental context which, along with the conservation of resources and attraction, is one of the principles of successful, sustainable architecture [9]. This relation is visible in such a/m projects as Klostergarten Lehel in Munich or Open-Air Library in Magdeburg. In the first one, the spoglia of historic window details connects the new building to the previous function of location. It refers to the typology of existing cloisters but it results in appealing, modern architecture. In the latter, the reuse of prefabricated façade panels from GDR times creates a link to the challenging history of the neglected space adding to its identity.

Secondly, the use of discarded materials in architecture shows the beauty of passing time in the built environment. Patina, scratches, and cracks refer to the romantic 'age value' of buildings [27], natural attrition of materials and to their long-lasting qualities [26]. For example, old bricks, which construct the vaults in the Art Museum in Ravensburg, break the sterile atmosphere of its exhibition rooms. The juxtaposition of historical and new elements in Neues Museum in Berlin (renovated by D.Chipperfield in 2009) shows the beauty of patina. Moreover, the mature building substance reused in new projects is evidence of history in architecture. It also refers to the cultural heritage of the location. The historical value *'accures by virtue of a monument's significance with respect to a specific historical moment to which it is linked and bears witness'* [27:71]. Uncovered concrete panels and golden-glazed windows of Plattenpalast in Berlin are sourced from, demolished Palast der Republik which served as the seat of the GDR parliament. Thus, the small gallery is now the only remnant of the controversial but popular building. Sometimes reused materials show more day-to-day history as it can be seen in the case of the Aquartis Housing in Amsterdam (designed by Zeinstra van der Pol in 2001) where bricks, wooden and steel details of the building, located in the Eastern docks area, refer to the harbour identity of this district, to its authenticity. The issues of originality or uniqueness, already discussed by such philosophers as W.Benjamin, gain momentum. In the times of globalisation, mass-production and easily copied solutions, this aesthetic category, also named as 'character and liveliness' [28], becomes critical. The architectural applications of reused materials may become a way to create more contextual, relatable and in consequence unique buildings. It is visible in case of Gallery Am Kupfergraben in Berlin where the quality of reclaimed building rubble and customized construction methods used for façade cladding fittingly set the building in the historic surroundings simultaneously distinguishing it from the existing substance. Similarly, reused bricks which form the elevation of Byhusene Islands Brygge Housing in Copenhagen (designed by Vandkunsten in 2016) add an aesthetic quality to the modern residential complex and differentiate it from the sameness of surrounding, currently developed housings. The multidimensionality and unrepeatability of used components result in textural uniqueness of buildings. Thus, it becomes referable. *'Authenticity refers to the look and feel of a place as well as the social connectedness that place inspires'* [20:220].

Figure 21. Art Museum, Ravensburg; Villa Welpeloo, Enschede; Byhusene Islands Housing, Copenhagen; Upcycle Studios, Copenhagen.

Moreover, the use of such non-standard materials as waste in the architectural design process leads to interesting aesthetic solutions [29]. Because of diverse and often unpredictable properties of reused materials, the design process is extended. It is necessary to secure time for additional investigations, tests, consultations, materials' sourcing, processing and storing [30]. This leaves space for innovation and new aesthetic solutions as it happened in the case of Villa Welpeloo in Enschede, where the experiments with locally sourced waste and new processing methods were used to create aesthetic and designed for disassembly wooden cladding of the building's façades. Similarly, the studies on processing reused shipping containers, windows, upcycled concrete, and wooden offcuts served to define new housing and working environments in Upcycle Studios in Copenhagen (designed by Lendager Group in 2015-2018). In this project, discarded materials were processed to optimise the sustainability goals and to achieve beautiful architecture. Thus, reusing practices may act as a creative force in the design process which leads to innovative material solutions and which defines a new image of waste. An example, which illustrates this thesis, is another residential project in Copenhagen – Resource Rows Housing where reused bricks are cut out from existing walls, reinforced with steel frames and transformed into easily mountable, prefabricated façade panels. This procedure facilitates the often-troubling extraction process of bricks and creates a system of fast-in-construction but unique building elements of high-quality. In future, the use of waste in 3d-printing may lead to creative, sustainable, architectural solutions as it happened with bioplastics in the 3D-Printed Canal House in Amsterdam. The use of novel tools may create a new aesthetic language of reused materials applications in architecture and it has the potential to change the perception of waste.

4 Conclusions – aesthetics as the effect of negotiations

Successful examples of the reuse of building materials in architecture are developed as negotiations between materials' quality, durability, adequacy, their environmental impacts, ethics of using and aesthetics. Such solutions analyse technical properties of materials but also their cultural and environmental context. They are the results of negotiations between the ethics and aesthetics, between pragmatic approach and seduction. They create sensual architecture. Sometimes they touch upon the historical context. Often, they address social conditions and transgress environmental challenges. Long-lasting and high-quality sustainable architecture fulfils programmatic needs, environmental goals, and creates beautiful forms. According to the Resource Preservation Hierarchy presented by Vandkunsten Architects the cultural, functional, technical and chemical strategies for noteworthy architectural solutions must include such criteria as appreciation, robustness, reversibility, and decomposability [31]. Thus, sustainability and beauty need to be balanced (Hosey, 2012).

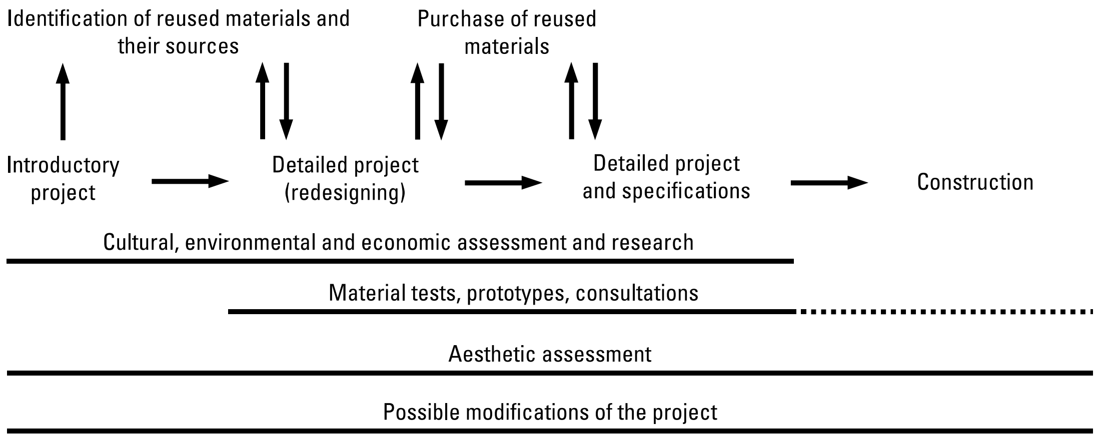

Figure 22. The aesthetics and design process with reused materials.

But to make it happen, it is necessary to alternate the standard design process for projects aiming to reuse building materials. It is observed that *'(…) most architects start their design with an image in mind either in reference to a type or a model, or else to a form with particular aesthetic connotations. This latter appropriation of image (…) subdues materiality'* [32:59]. The reuse of materials requires that material investigations are embedded on an early stage of the design process. It is crucial to include aesthetic assessment of chosen materials and solutions on every stage of the design and construction process starting from the moment of identification of reused materials and an introductory project, through the purchase of materials, to adjustments of detailed project and construction (Fig.4). It is helpful to work with real materials, to conduct material tests, to prototype 1:1 mock-ups and to consult designed solutions with experts. These tests should not only examine materials' technical properties and environmental impacts but also their appearance and details. It is advantageous to investigate different processing and construction methods and to assess their economic efficiency. Moreover, it may be valuable to research cultural and social context. Finally, it is necessary to leave the design process, project and specifications open to necessary modifications which can occur on every stage of the design and construction process.

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TOPIC 10: INVESTMENTS AND CONSTRUCTIONS

STATE-OF-THE-ART IN CIVIL ENGINEERING – A GAP TO SCIENCE?

Klaus HOLSCHEMACHER, Ulrike QUAPP*

HTWK Leipzig University of Applied Sciences
Karl-Liebknecht-Str. 132, 04277, Leipzig, Germany, ulrike.quapp@htwk-leipzig.de

Abstract

Respecting State-of-the-Art in design and construction is an indicator for building quality. However, worldwide the term is used in different ways and with different definitions. State-of-the-Art mostly means to be very modern and to use the most recent ideas and methods. In Germany, State-of-the-Art is a general term for building quality that must be divided in three levels: Generally Accepted Engineering Standards, Best Available Techniques and the Newest State of Knowledge in Science and Technology.

These three requirement levels can be found in many different German regulations such as in Private Building Law, Public Building Law, Environmental Law and even Criminal Law. But, most of the building requirements demand to meet the Generally Accepted Engineering Standards as the lowest level for building quality.

Universities nearly each day present innovations in engineering sciences and technology, especially to improve safety and resource efficiency in construction. But, it needs a long time until these research results find their way into codes and practice. Thus, it is to state that there is a gap between the newest research results of scientists and the codes used in building practice. Why, nevertheless, it makes sense to have this gap and to define different requirements for building quality, the authors will present in their conference submission.

The paper provides definitions of the general term "State-of-the-Art" and shows its importance for German legal and building practice. It defines the three levels of building quality requirements and explains their usage. Furthermore, the authors will inform about the development of State-of-the-Art in Germany over the years and will examine the way of selected building materials and construction methods, such as self-compacting concrete and timber-concrete composite, to become Generally Accepted Engineering Standards. The paper closes with a summary.

Keywords

State-of-the-Art, quality requirements, newest technology, standards.

1 INTRODUCTION

Construction processes in Germany are dominated by numerous rules and regulations, including legally binding acts and ordinances set by the legislator as well as recommended technical codes and standards given by authorities or standardization committees.

Acts and ordinances in German Building Law contain the requirement to design, to construct, to maintain and to alter in a way that public safety and order, especially life, health and natural living resources will not be in danger [1]. Furthermore, the contractor must offer a design or construction work free of defects or deficiencies. These requirements are met if the construction is in compliance with State-of-the-Art.

State-of-the-Art is an umbrella term that includes three levels. The requested level is stated in the respective acts and ordinances of the German Building Law or neighboring fields of law. The State-of-the-Art levels are so called “undetermined legal terminology” that must be defined and substantiated.

The legislator uses undetermined legal terminology because it is not able to formulate all safety requirements for construction and maintenance of facilities in detail in acts and ordinances. This is caused by the fact that technical and scientific development never will be finally completed and the problems of technical matters and methods are complex. Otherwise, the legislative bodies would be forced to update legislation permanently to the newest development. To avoid that, the legislator uses undetermined legal terminology and thereby transfers the problems of continuing adoption of scientific and technical innovations to the administrative level (e.g. to building authorities) [2], to standardization committees or – in case of litigation – to the judiciary authorities.

This paper will show the different State-of-the-Art levels used in legal regulations and their relevance in practice. At two examples the authors will explain, how time-consuming and difficult it may be to apply findings and development in science and technology with legal certainty. Further, it will be discussed, why it is often not possible and advantageous to enable the newest technical and scientific solutions immediate access into building practice.

2 Levels of State-of-the-Art in Germany

2.1 Basic Information

State-of-the-Art requirements can be found in many different fields of German law, such as in Public Law, Civil Law and even Criminal Law. There are three State-of-the-Art levels:

- Generally Accepted Engineering Standards,
- Best Available Techniques and
- Newest State of Knowledge in Science and Technology.

These three terms, substantiated in the “Kalkar Decision” of the German Federal Constitutional Court [2], refer at the development of science and technology in different intensity.

2.2 Generally Accepted Engineering Standards

Legal requirements for the majority of construction projects in Germany result from the German Building Law with its two specializations: Public Building Law and Private Building Law. Even if the acts and ordinances have different regulatory objectives, on the one side the protection of public safety and order, life, health as well as natural living resources, and on the other side a work free of defects or deficiencies, they both require to meet Generally Accepted Engineering Standards while design and construction.

The difficulty for the professionals lies in the missing legal definition what Generally Accepted Engineering Standards are and how they can be substantiated. Resulting from jurisdiction, Generally Accepted Engineering Standards, also known as Accepted Engineering Standards, are the predominant opinion of the technical experts [3]. That means they have to be acknowledged as theoretically right in the scientific community (general scientific acceptance) and already tested and used in the field of practice (proof in the field of practice) [4]. For these two requirements, the opinion of the majority of the technical experts is decisive (see Figure 1).

Figure 23. Requirements for Generally Accepted Engineering Standards

To identify what is generally accepted among the experts and proofed in practice to be Generally Accepted Engineering Standards, non-legally binding technical codes and standards such as DIN-Codes, Eurocodes or Guidelines of the Association of German Engineers should be used [4]. These normally contain requirements consisting of data, limits and/or processing methods that have a very high level of detail. It is not necessary that a technical rule must be written down. In special cases, passed down orally knowledge of craftsmen, such as carpenters, can be Generally Accepted Engineering Standards as well [4].

In the field of Private Building Law, e.g. for construction contracts, Generally Accepted Engineering Standards help the contractors to define the target quality at which a deviation of the work quality is measured (Article 13 (1) sentence 2 of the German Construction Tendering and Contract Regulations Part B [VOB/B]). A work free of defects or deficiencies normally is proofed if the construction is in compliance with Generally Accepted Engineering Standards. Nevertheless, it must be mentioned that building in compliance with technical codes and standards not always will secure a compliance with the Generally Accepted Engineering Standards. If DIN-Codes or other codes and standards will have been stayed unchanged for a longer time and no longer will be the commonly used method in practice, they will lose the qualification as Generally Accepted Engineering Standards [4]. For example the formerly German code DIN 4109 [5] – regulating sound insulation in buildings – remained unchanged from 1989 until 2016 and was no more a Generally Accepted Engineering Standard in the second part of this period.

For the purpose of hazard prevention, in Public Building Law building materials and construction methods only should be used if they are in compliance with building authorities' ordinances, such as the List of Technical Building Regulations of Germanys' Federal States, and Generally Accepted Engineering Standards. If they are not, official certificates of usability are required, such as a General German or European Technical Approval, a General Construction Supervision Test Report or an Approval in the Individual Case given by the highest building authority [1].

To meet the legal requirements in most of the construction projects, designers and constructors have to investigate the predominant opinion of the experts that normally will be represented by technical codes and standards. The disadvantage of the requirement to work in compliance with the Generally Accepted Engineering Standards is their low scientific depth. Furthermore, because of their need to be generally accepted among the majority of professionals, they will be renewed and adopted to technical innovations quite late.

2.3 Best Available Techniques

To work in compliance with the Best Available Techniques is required mainly in fields related to environmental and technological law, e.g. in the Federal Immission Control Act (BImSchG), the Federal Water Act (WHG) and the Federal Energy Saving Act (EnEG). There, Best Available Techniques are defined as the state of development of advanced methods, facilities or operating modes, which is deemed to indicate the practical suitability of a particular technique to reach a high protection level for the environment [6].

As far as compliance with the Best Available Techniques is compulsory, the legal standard of what is forbidden and what is allowed will not be substantiated by non-legally binding codes and standards but mainly by administrative technical ordinances and thus transferred to the field of the technological development [7]. For the characterization of a technical innovation as a Best Available Technique, general scientific acceptance and proof in the field of practice is not decisive.

In contrast to Generally Accepted Engineering Standards, the requirement to act in compliance with the Best Available Techniques has the advantage, that the time between development of a technical innovation and obligation to apply it in practice, can be considerably reduced.

2.4 Newest State of Knowledge in Science and Technology

The Newest State of Knowledge in Science and Technology means the latest technical and scientific findings that will not be limited by the presently technically feasible [2]. Only in a few acts and ordinances, this high safety level will be required, for example on the field of nuclear power. Thus, e.g. the license for erecting, operation and holding a nuclear power plant may only be granted if it is proofed that the necessary precautions have been taken in the light of the Newest State of Knowledge in Science and Technology to prevent damage resulting from the erection and operation of the installation [8].

This highest innovative level is the hardest to determine because in individual cases the scientific and technological state of knowledge must be clarified normally by using research papers and experts' reports. If there are diverging opinions of the experts, nevertheless a decision of what is forbidden and what is allowed must be found in the individual case and by this also in the scientific dispute.

Due to the aforementioned requirements, building industry is limited in using innovative building materials and methods. In the following, the authors will show the long way from development of materials and methods to be one of the State-of-the-Arts levels in Germany.

3 Examples for Building Materials and Building Methods on their Way into Construction Practice

The way of modern and innovative building materials and building methods into construction practice often is very complex and takes more time as desirable. For one building material (self-compacting concrete) and one building method (timber-concrete composite) the situation in Germany is explained in this context. It is described that successful introduction of innovations into construction practice and needed time for this process may differ strongly.

3.1 Self-Compacting Concrete (SCC)

Self-compacting concrete (SCC) has been developed in the late eighties by Japanese researchers when they tried to improve concrete's durability [9]. Very soon, information about SCC became worldwide known in the researchers' community and first trials for its application in construction practice started at the end of the nineties.

SCC is a high-performance building material with outstanding fresh concrete properties. Because of its high flowability there is no need for vibration of the fresh concrete. SCC compacts only under its own-weight and removes almost all air bubbles while flowing in the formwork. SCC is able to fill all recesses, reinforcement spacings and voids even in heavily reinforced concrete members and has self-levelling properties [10], [11]. Because of its superior almost pore-free surface SCC is particularly suitable for architectural concrete. Hence, among first applications of SCC were façade elements with high demands for surface quality. Preferred other applications were members with difficult casting conditions and/or big amount of reinforcement, e.g. tunnel walls.

The first generation of SCC was characterized by a concrete composition with high mortar content and intensive usage of specialized superplasticizers (Figure 2), so-called powder-type SCC. Because of its special concrete composition, primary the high amount of fine ingredients with a grain size below 0.125 mm, SCC was not covered by the general codes for production and classification of concrete, e.g. EN 206-1 [12]. Another problem in early application of SCC was the lack of regulations for classification and quality control of fresh concrete properties. Furthermore, it was apparent very soon that the differences in the concrete composition of SCC and traditional concrete could influence the hardened concrete properties in a not negligible magnitude. In Figure 3 this effect is shown for the example of modulus of elasticity. It is easy to recognize that the modulus of elasticity for powder-type SCC is slightly lower than for normal concrete of comparable strength leading to higher deflections of bending members. In the years around 2000 it was not clear if this effect could cause damages. It was obvious that a successful and wide application of SCC in practice needs a normative basis answering the open questions.

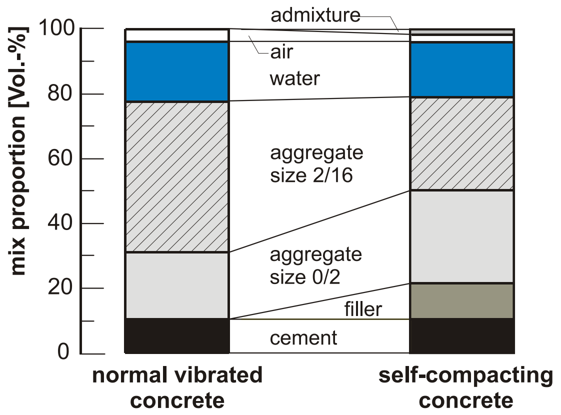

Figure 24. Tyipcal mix composition of normal vibrated concrete and powder-type SCC [11]

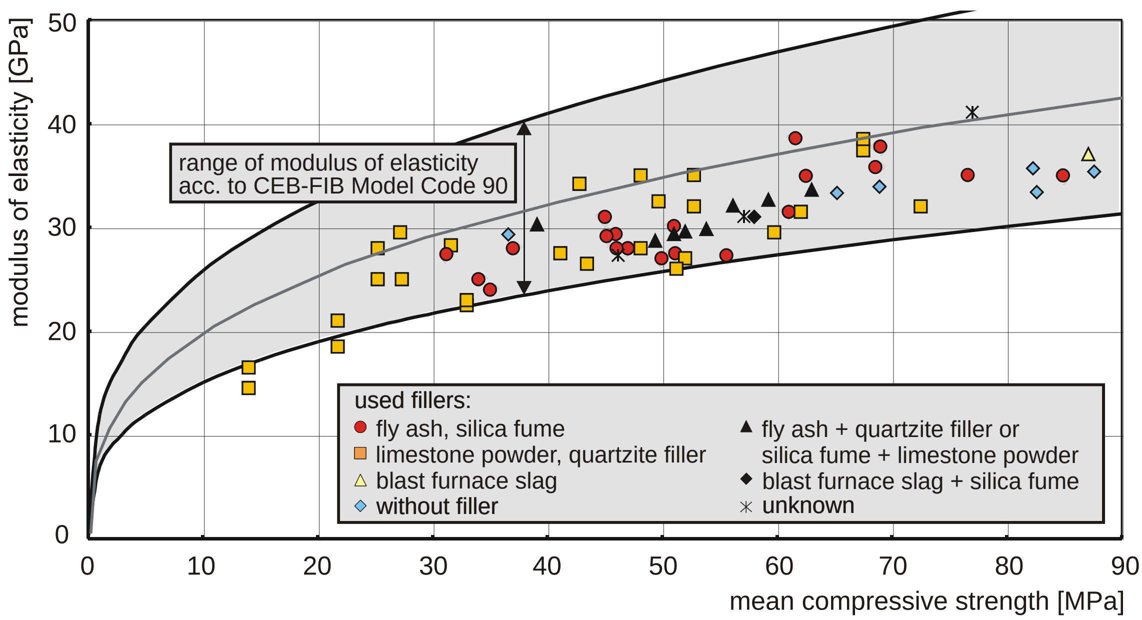

Figure 25. Data base of the modulus of elasticity of SCC with reference to the corresponding compressive strength in comparison with the regulations of Model Code 90 [11]

Before such a norm was available all structural applications of SCC were just executable on the basis of an Approval in the Individual Case, an often time-consuming task, or on the basis of a General Technical Approval with the disadvantage of limitation on one building product. Nevertheless, there was a huge interest of building industry to apply SCC in suitable construction projects. A lot of remarkable structures have been erected in the early years of SCC. Otherwise, a lot of research projects resulted in interesting findings opening the door for formulation of a technical standard about SCC.

The first German SCC-guideline has been published by the German Committee for Reinforced Concrete (DAfStb) already in 2003 [13]. In this guideline needed information additionally to the existing basic codes dealing with normal concrete (e.g. EN 206-1 [12], EN 1992-1 [14]) were given to enable a purposeful usage of SCC in practice. The main new information was about shear behavior in the interface between old and new concrete, concrete composition, quality control and test methods for fresh concrete properties. The previous discussed problems in modulus of elasticity did not find entrance in SCC-guideline because of the fact that modulus of SCC is lower than those of normal concrete in average but still inside the typical variance. Furthermore, the typical SCC composition had changed with time away from powder-type to stabilizer- and combination-type where the amount of filler materials was reduced.

In the year 2005, the SCC-guideline was introduced via building acts in the List of Technical Building Regulations of Germanys' Federal States. By this, the SCC-guideline achieved the standing of Generally Accepted Engineering Standards resulting in easy applicability of this innovative material in construction practice. A revised release of the SCC-guideline from 2012 [15] was necessary to conform to meanwhile arisen changes in the basic codes.

It is to state that the period of time between first international investigation on SCC and introduction of normative rules for this material in Germany took around 15 years. In the light of safety demands connected with the introduction of new building materials it was a quite fast process. Today, SCC is a recognized and established building material especially in precast concrete industry and for architectural concrete.

3.2 Timber-Concrete Composite (TCC)

Timber and concrete are building materials with quite different properties. Timber is a sustainable and renewable resource and has similar strength under compression and tension. Concrete offers high compression strength for reasonable price, good durability and high fire resistance. The application of both materials together in TCC to combine their benefits and compensate their disadvantages can provide many benefits. For this reason already for around 100 years TCC-constructions have been developed mainly in the context of strengthening of existing timber beam ceilings [16], [17].

A typical section of a TCC-ceiling is shown in Figure 4. TCC-ceilings consist of a plain or reinforced concrete slab, timber beams and connectors responsible for the shear transfer between the timber and the concrete parts of the section. When strengthening an existing timber beam ceiling just the shear connectors have to be mounted at the top of the timber beams and after it the concrete is cast. In many cases there is no need to remove the fill and the boarding resulting in a cost and time efficient procedure [18], [19].

The type of shear connectors essentially influences the structural behavior of TCC members. Usually, the shear connectors cause a flexible, but not a rigid bond between the timber beams and the concrete slab, see Figure 5. Nevertheless, TCC enables bending members of high stiffness and load-bearing capacity and improve essentially the fire resistance in comparison to timber beam ceilings [19], [20].

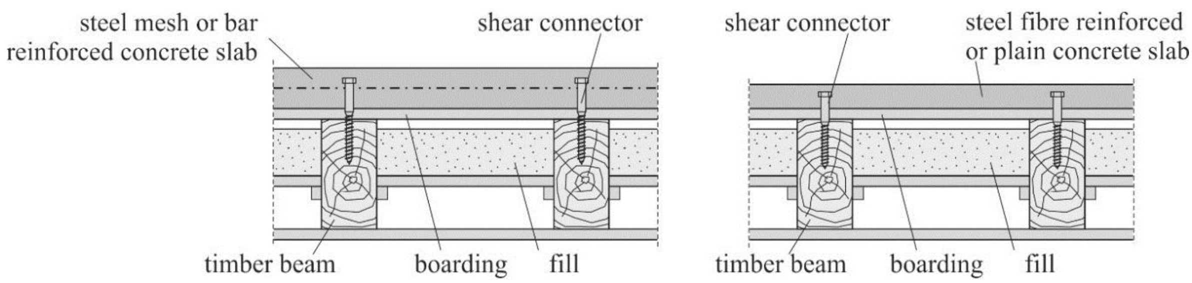

Figure 26. Strengthening of existing timber beam ceilings with TCC [18], [21]

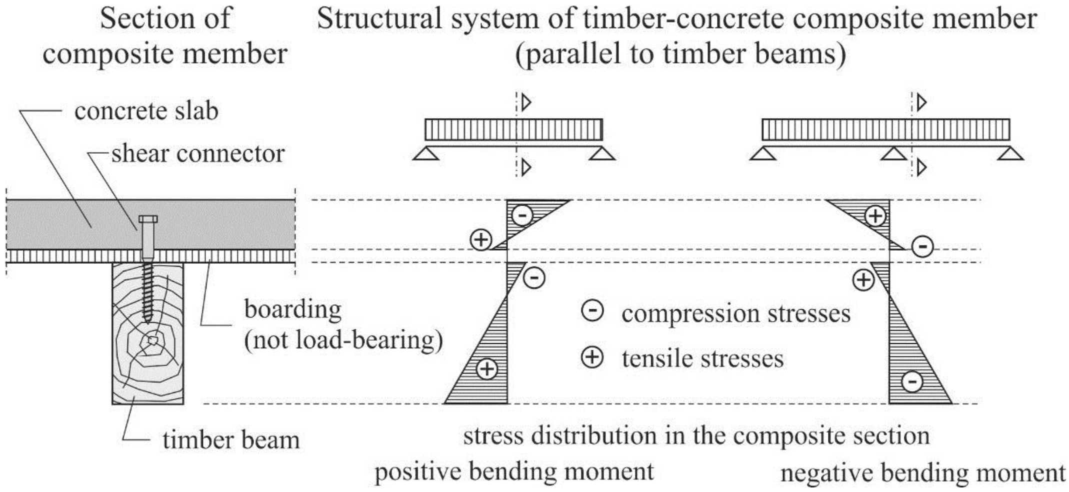

Figure 27. Strengthening of existing timber beam ceilings with TCC [18]

In spite of the mentioned advantages of TCC this construction method is only marginally applied in construction practice today. The main problem is the absence of a design code for TCC. With EN 1992-1-1 [14] and EN 1995-1 [22] only design codes for concrete and timber structures are available, and in EN 1995-1, Chapter 9.1.3 and Annex B, a procedure for calculation of multi-component sections is framed evenly. However, there are no regulations for shear connectors available in any code. Without secured information about their mechanical properties (ultimate load, stiffness, time-dependent behavior) the design of TCC members is impossible. Therefore, at time application of TCC is just possible on the basis of a General Technical Approval or an Approval in the Individual Case where characteristic values for mechanical properties of connectors are specified.

At is to state that TCC is in accordance with the Generally Accepted Engineering Standards but the lack of normative regulations and the limited number of available General Technical Approvals for shear connectors has led to inadequate competiveness of this construction method in comparison to other possibilities like traditional reinforced concrete. At time, just few new buildings are erected or revaluated in Germany using TCC. It is to expect that situation will change with future part of Eurocode 5 where special information for design TCC will be provided.

4 Summary

Scientists at universities are doing research for the benefit of society and nature. They investigate to improve building safety, quality, energy efficiency and costs. Nevertheless, it needs a long time until research results will become Generally Accepted Engineering Standards, which means a gap between the newest scientific findings and the mainly required State-of-the-Art level. But, there is a good reason for it.

Only if building products and methods are scientifically accepted and practically proved, it will improve the building quality and reduce the danger of death, injury, property loss and environmental damages in construction processes. It is for the good of all people and the society. Furthermore, the reference of legal building requirements to the Generally Accepted Engineering Standards contributes to legal certainty because designer, constructors, authorities and judges do not have to decide academic disputes.

The modalities and needed time for recognition of new building materials or methods in one of the State-of-the-Art levels is very different as the examples of SCC and TCC show. There is a clear disadvantage if a building method like TCC is accepted as State-of-The-Art but not specified in technical regulations and codes. Though, application of TCC in practice is possible with an approval of the authorities and in agreement with the contractors the missing TCC-code is a barrier for the further development of this building method and their wide usage in construction industry.

Finally, it is to state that there is a gap between the newest findings in science and technology and the dominant State-of-the-Arts level in design and construction in Germany, but for good reason.

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10.101 A STUDY OF THE FINNISH MULTI-STORY TIMBER FRAME APARTMENT BUILDINGS 1995 – 2018

Markku KARJALAINEN

Tampere University, School of Architecture
P.O. Box. 600, FIN-33014 Tampere University (TAU), Tampere, Finland;
markku.karjalainen@tuni.fi

Abstract

In all, 65 over-two-story timber residential apartment buildings comprising 1673 apartments have been constructed in Finland as of October 2018. Tampere University's (TAU) School of Architecture has conducted a "Competitiveness of Multi-Story Timber Apartment Buildings" study investigating the frame design of all the multi-story timber residential apartment buildings constructed in Finland as well as the form of ownership of the apartments in each building. The frame designs used in Finnish multi-story timber apartment buildings are platform-frames (62 %), volume modular element designs based on CLT (Cross Laminated Timber) technology (21 %), veneer pillar-beam-ribbed slab frames (12 %) and CLT based slab elements (5 %). Based on the study, CLT and LVL (Laminated Veneer Lumber) based volume modular elements are becoming the most common designs in new multi-story timber apartment buildings. Timber-concrete composite slab structures are most commonly used in the intermediate floors due to their good sound insulation. The timber apartment buildings constructed in Finland contain rental (43 %), privately owned (38 %), right-of-residence (17 %), and semi-privately owned (2 %) apartments.

Keywords

Timber construction, timber multi-story apartment building, modular element, CLT, LVL

1 BACKGROUND

1.1 Timber construction as a part of the forest industry

The forestry sector is a very important part of Finland's national economy. Finland's forests grow nearly 110 million m^3 of stem wood per year, of which about 60–65 % has been utilized in recent years. Sustainable use of wood could be increased significantly (by approx. 20 mill. m^3/year), e.g. as a source of bioenergy and in construction, the wood product industry, and various processed bioproducts. Approximately four-fifths of Finland's sawn timber is used in construction, where housing construction plays a major role: about 65 % of Finland's building stock is comprised of residential buildings. The greatest growth potential in Finland's timber construction lies in apartment buildings, public buildings, hall-type buildings, bridges, yard and milieu structures, as well as energy renovations of suburban apartment building façades, construction of additional floors, and infill construction.

1.2 Timber construction as a part of preventing climate change

Timber construction is ecological. While growing, one cubic meter of wood binds one ton of carbon dioxide from the air and simultaneously releases 700 kg of oxygen into the atmosphere through photosynthesis. Half of wood's dry weight consists of carbon. Growing forests are carbon sinks and timber wood products are carbon stores. Ever greater possibilities are opening for timber construction, as the significance of worldwide climate, environmental, and natural resource issues grow. Ecological, low-carbon, renewable resources and raw materials should be increasingly promoted globally. Timber construction is an important part of the bio economy and one of the forerunning projects of Finland´s Prime Minister Juha Sipilä's government (2015 – 2019). The forest sector accounts for over half of the value of Finland's bio economy. The goal of Finland's Ministry of the Environment is to take the carbon footprint of buildings into consideration in building regulations by the mid-2020s. It is apparent that in this respect wood—a domestic, local, renewable, and environmentally friendly energy source and construction material—will become an increasingly desirable raw material.

2 Timber apartment building construction in Finland

2.1 Development cycle and market potential of timber multi-story apartment buildings

Timber multi-story apartment building construction was started in Finland with a brief experimental construction phase in the mid-1990s. After three pilot timber apartment buildings (Ylöjärvi, Helsinki, Oulu), Finland's fire code (RakMK E1) was revised 1.9.1997 to allow residential and workplace buildings with wood frames and façades up to four stories high (= multi-story timber apartment buildings). Finland's fire code was revised again 15.4.2011, after which the tabular specifications of the fire code allowed construction of timber apartment buildings up to eight stories high. The fire code was revised again 1.1.2018 (Ministry of the Environment statute 848/2017 concerning building fire safety). Thereafter is has been possible to design and build residential and workplace buildings as well as lodging and institutional buildings with wood frames and façades up to eight stories high. It is also possible to build timber apartment buildings over eight stories high based on analysis of functional fire design. [1]

In Europe, Finland is second only to Spain in the proportion of apartment buildings; around 46 % of Finland's housing units are in apartment buildings. Still today, of all new housing units built annually (approx. 30,000–40,000 units / year), over half are in apartment buildings. [2] To date, 65 timber apartment buildings over two stories high have been built in Finland, comprising 1673 apartments. New timber apartment buildings containing about 1350 apartments will be built in the next few years. In addition, plans for new timber residential apartment buildings containing around 9000 apartments are on the table all over Finland.

2.2 Frame systems of multi-story timber apartment buildings

There are several different types of frame systems available for timber apartment building construction, for which there is a sufficient amount of wood element production plants and manufacturing capacity in Finland. Most of Finland’s earliest residential apartment buildings were built using the American platform-frame system. This construction method is based on floor-by-floor stud frame construction. In this method the frame is usually made from precut timber either by building one floor at a time on-site or by utilizing prefabricated elements in different stages of completion (small or large elements). Today large elements are very commonly used in timber apartment buildings. Laminated wood is also used in stud frames. Various types of mixed frame systems are also possible. Typically, the load-bearing structures in all timber apartment building systems have rather short spans (4.5–8 meters). Finnish timber apartment buildings generally have wood façades, but other façade designs are also possible.

In recent years CLT (Cross Laminated Timber) technology, in particular, has become very common in Finnish timber apartment building construction; the building’s vertical and horizontal elements are formed from massive timber sheets made of crossed layers of boards that are glued together. The CLT system in Finland was originally robustly developed by StoraEnso, which also started its own LVL (Laminated Veneer Lumber) massive timber sheet production in Varkaus in 2016. LVL sheets can be used similarly to CLT sheets in a building’s frame construction. Due to their simple joint technique, airtightness, and frame rigidity and minimal settling, CLT and LVL are competitive especially as large elements in tall timber apartment buildings. Domestic CLT production began at the CrossLam plant in Kuhmo in December 2014. CLT production is also running in Alajärvi (CLT Finland Oy, Hoisko) and a CLT-Plant is starting up in Kauhajoki.

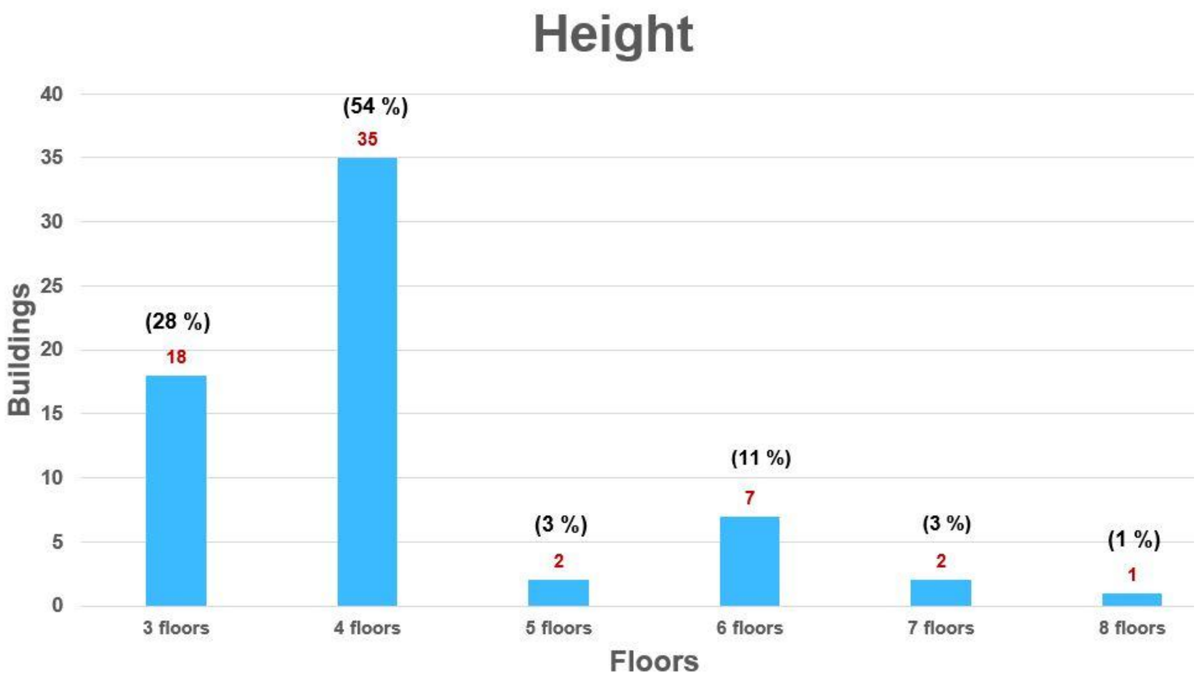
Figure 28. Finland´s first CLT-factory (Oy CrossLam Kuhmo Ltd) started in 1st December 2014.

Volume modular element technology based on CLT and LVL frames has very rapidly become common in Finnish timber apartment building construction. Modular element construction using dry, lightweight, largely prefabricated elements is a rapid construction method that shortens construction time at the building site and thereby lowers overall costs. Due to the limitations of road transport, the most common modular element sizes are: 4.5 (width) x 3.0 (height) x 13.5 (length). Swedish Lindsbäck Bygg is also entering the Finnish modular element construction market; it's timber apartment building production is based on stud frame modular elements [3]. A few timber apartment buildings with a pillar-beam-ribbed slab system based on LVL technology has also been constructed in Finland. The system concept is quite advanced and its most competitive area is in 3–4-story timber residential apartment buildings and office buildings. Laminated wood is also suitable for beam-pillar frames.

3 Competitiveness of Timber Multi-Story Apartment Buildings Study 2018; Results

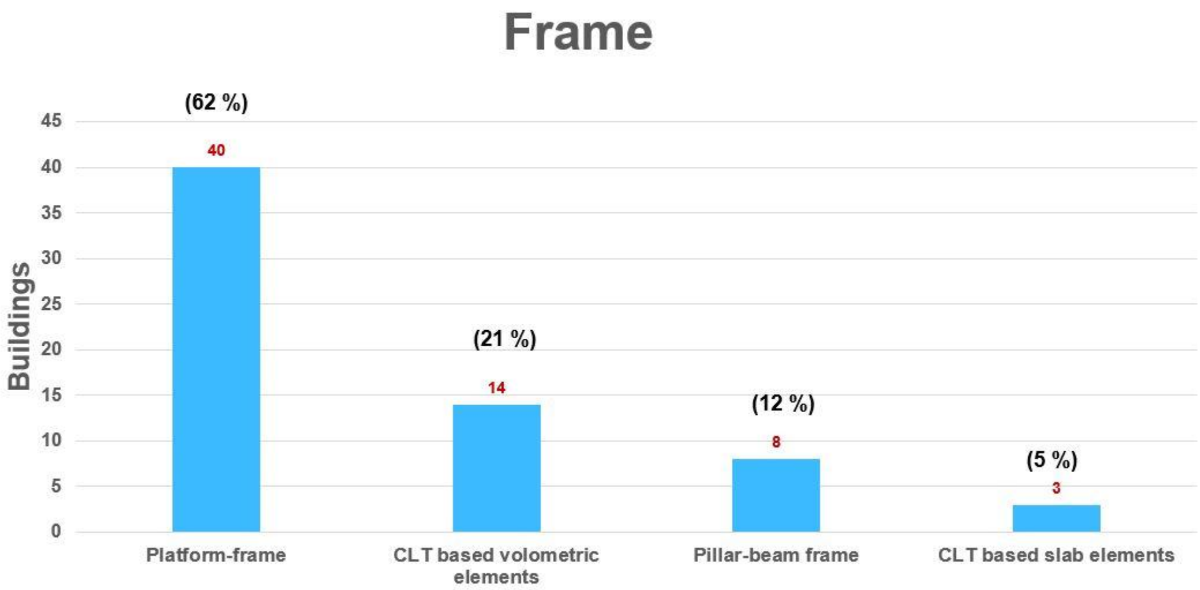
Tampere University's (TAU) School of Architecture conducted a "Competitiveness of Timber Apartment Buildings" study that investigated the number of floors, size, frame design, and form of ownership of the apartments in the timber apartment buildings constructed in Finland as of October 2018. This information has been compiled as a statistical summary and comparison in tables 1 – 3. The timber apartment buildings constructed in Finland so far contain an average of 26 apartments (= 1673 / 65). The most common height is 3–4 stories (28 % + 54 % = 82 %).

Table 12: Height of Finnish multi-story timber apartment buildings.



The frame designs used are platform frames (62 %), volume modular element designs based on CLT technology (21 %), veneer pillar-beam-ribbed slab frames (12 %), and CLT based slab elements (5 %).

Table 2: Frame of Finnish multi-story timber apartment buildings.



Based on the study, CLT and LVL modular elements are becoming the most common designs in new timber apartment buildings. Since the beginning of 2018 Finland's fire code has allowed freer use of wood as the visible facing material of indoor surfaces. This appears to favor CLT designs, where massive wood surfaces can be left visible on indoor surfaces. Timber-concrete composite slab structures are most commonly used in the intermediate floors due to their good sound insulation. The timber apartment buildings constructed in Finland contain rental (43 %), privately owned (38 %), right-of-residence (17 %), and semi-privately owned (2 %) apartments.

Table 3: Form of ownership of Finnish multi-story timber apartment buildings.

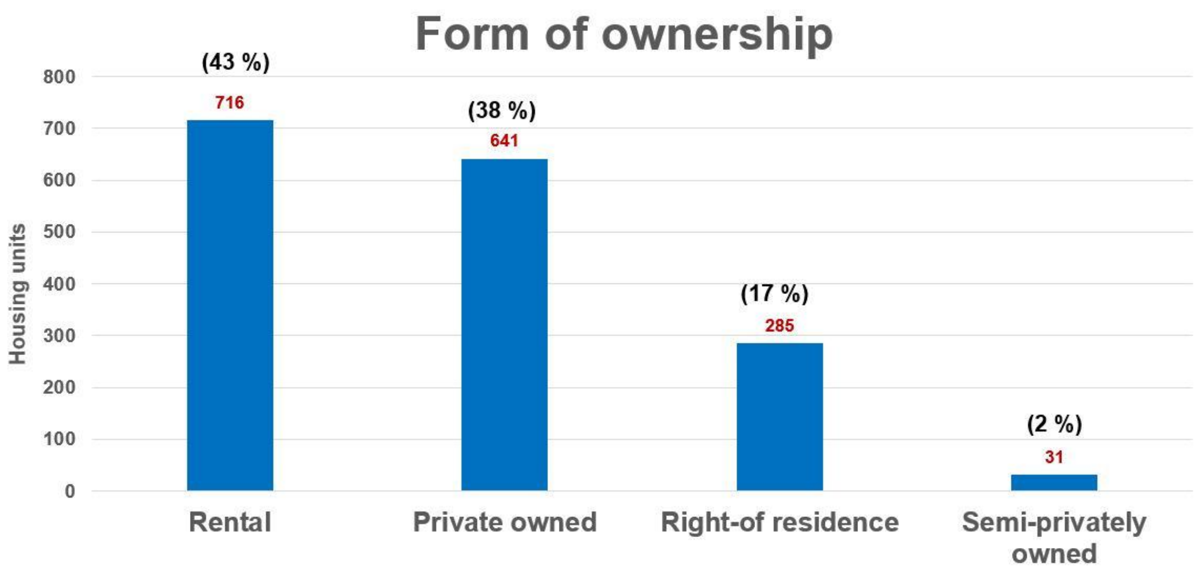


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Figure 2. Puukuokka 1 – 3, Jyväskylä; one of the most prized multi-story timber apartment buildings in Finland; Architect Anssi Lassila, OOPEAA – Office for Peripheral Architecture.

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