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Project:ARCHITECTURE

Jörg Rügemer, School of Architecture, University of Utah, USA
Erin Carraher, School of Architecture, University of Utah, USA

Abstract: Project:ARCHITECTURE is about the design, development and construction of three 600ft^2 or 56m^2 gross area summer camping cabins for the Girl Scouts of Utah's Trefoil Ranch Camp near Provo, Utah, USA. The organizing team took an integrated, multidisciplinary design and development approach in which stakeholders, architecture faculty, general contractor and fabricator, engineers, the building department, Girl Scouts, and architecture students were involved. The predominantly utilized building material was Interlocking Cross-Laminated Timber (ICLT), which is a panelized wooden construction material relatively new to the US construction marketplace. This paper reports on the participatory, interdisciplinary development process of the project.

Keywords: Participatory Development Process, Design and Education, Women in Architecture, Interlocking Cross-Laminated Timber; Sustainable Design.

Preamble

Project: ARCHITECTURE is a new partnership between the Girl Scouts of Utah (GSU) and the School of Architecture (SoA) at the University of Utah, to raise awareness of careers in the built environment for women and to provide opportunities for architecture students to engage in service and creative projects. The inaugural project for this partnership was the design and construction of three cabins for the Girl Scout's Trefoil Ranch Camp near Provo, Utah. The camp is located on a wooded site at the upper end of a narrow canyon that comes off Provo Canyon, at an elevation of 6,040' or 1,840m. The area sits within the Utah Cold Climate Zone with warm and dry summers and cold winters with a heavy annual snow load. Therefore the camp's use is restricted to the summer months only, offering diverse activities during daily, weekend, or weekly camps to the GSU population, which ranges in age from 5 years (Daisies) to 18 years Ambassadors). The cabins' services are reduced to electricity only; supporting buildings such as washhouses and a common kitchen, indoor activity areas, additional sleeping opportunities, and meeting and gathering places are provided by the main lodge and the larger camp development that already exists as part of the Trefoil Ranch Camp. To conform to fire code regulations, the cabins are equipped with a fire sprinkler system.

As an important part of the participatory design process, the authors hosted a yearlong series of outreach events to expose Girl Scouts directly to women practitioners, to provide female student mentors in design-related programs, and to offer opportunities to visit architecture firms and construction sites, as well as providing the girls a first opportunity to engage with an institution of higher education. The project is based on the collective experience of the design team, the client, stakeholders and all other parties and persons involved – including the Scouts as the project's users. With this approach, it follows Reed's emphasis of a 'conscious process of learning and participation through action, reflection and dialogue' [Reed 2007] and falls into the category of regenerative design, as described by Robinson and Cole [Robinson & Cole, 2014].

Building Material

Interlocking Cross-Laminated Timber (ICLT) was the primary building and construction material used for the cabins built for the Girl Scouts of Utah (GSU) in collaboration with industry partner Euclid Timber Frame PC, a company focusing on natural building methods using no glues, binders, adhesives, or products with VOCs.

Originally developed in Europe, Cross-Laminated Timber (CLT) uses glue adhesives or mechanical fasteners to assemble solid softwood timber stock into structurally sound, cross-laminated building components and panels. Solid wood components are also available without the use of adhesives or metal fasteners – the Dowel Wood Wall System (Düberlholzwand) uses dried spruce soft wood boards, which are layered and then fixed into solid component by use of dry beech wood dowels. After pressing those into place, the dowels absorb the moisture of the soft wood and swell, thus creating a very strong, force-fit connection [Greve 2014]. ICLT is a similar, prefabricated cross-laminated solid softwood wall panel that is fabricated from several layers of alternating direction pine stock. Different to regular CLT, the wood is milled from waste or beetle-killed pine wood, using a robust, CNC-controlled process. Binding the CO_2 content of already dead wood into this long lasting, low maintenance product, ICLT has a low environmental impact over the project's life-cycle. Euclid Timber with research support from the University of Utah's Integrated Technology in Architecture Center (ITAC) has developed this innovative and highly sustainable material to incorporate locally-sourced wood damaged by pine beetle infestation prevalent in the American West.

Simple dovetail connectors join the pine stock elements, utilizing no fasteners and no adhesives within each panel. This system reduces overall capital cost for either stainless fastener purchase and install or press purchase and set up associated with glue lamination [Smith 2010, 2011]. Mechanical fasteners are used for the assemblage of the panel modules onsite, which means that capital cost can be reduced by increasing the actual size of such components to the point where size is limited by the access to the construction site, availability of equipment, and transportation restrictions. In case of the GSU summer cabins, the assembly method of choice for certain components was adjusted during the design process and through collaboration with the structural engineers: due to dead, live, and snow load requirements, the thicker horizontal floor and sloped roof panels were assembled in Brettstapel construction, in which softwood timber boards are connected in parallel with hardwood dowels. As one of the major advantages of utilization of ICLT and Brettstapel the team identified its time-savings potential: the building components were pre-manufactured in the contractor's controlled environment, utilizing a construction sequence that involved a highly-detailed computer model from which the solid wood wall components had been milled on a CNC router. The individual pieces were joined together in 'chunks' in the shop to form manageable modules that were delivered to the site where they were assembled and fastened together. In parallel, the site and foundation work was prepared and finished to allow for relatively short assembly phases on site, which on the other hand allowed constructing the cabins over the winter. Thus construction time and costs were reduced, and a higher level of quality was maintained due to the prefabrication of the components. Transportation cost and impact onto the site were also minimized as the construction process was refined, with the third cabin being erected in just a few weeks.

Figure 1: ICLT and Brettstapel Component and Panel Assembly

Sources: Authors 2013.

The ICLT system presents a new approach in construction technology, material process, and assembly methodologies; it is a low embodied energy material. The cabins provide long-lasting, very healthy, and useful buildings that conserve finite resources and fossil energy by using this extremely durable, recyclable, and renewable natural material. Utilization of this material puts the project at the forefront of sustainable construction with findings expected to influence the construction market along the Wasatch Front and beyond.

Design Philosophy

The regionally rooted typology adopted for the cabins is simple, clearly defining the project as highly sustainable from a design as well as a material standpoint. It echoes the regional, functional design of old farm and barn buildings in the canyon, and also the typology of the Scout's old wooden tent platforms, which were originally erected on simple CMU piers above the ground. The concrete piers for the new cabins minimized construction disturbances while simultaneously maximizing land use efficiency. Clad in mild steel that slowly weathers over time, the cabins already blur well into the site. In addition, the steel has been chosen for its fire resistance properties, allowing for the reduction of wall thicknesses to the structural minimum for material efficiency because the metal cladding provides the required fire protection.

Figure 2: Finished Cabins in their natural Environment

Sources: Nicholas Steffens 2014.

Each cabin has an inviting, shaded patio that is oriented towards the common gathering, activity, and fire pit area - the cabin to the north also offering additional outdoor seating on its stairs. Access to the cabins is through this common space, supporting the idea of community and communication among the group members. On the inside, the cabins offer a spacious, day lit, warm, and healthy interior that provides accommodation for up to 10 scouts. To allow for indoor activities, the bunk beds of each cabin are grouped around large tables, which were designed and digitally manufactured by students at the SoA. A small changing room completes the spatial arrangement. The tall entry door and vertical egress window oppose each other on the short cabin elevations, allowing for a direct view connection into the woods when entering a cabin. The four bay windows on the long sides echo the verticality of the trees and offer a small seating bench in each bay; the arrangement of the upper, operable windows allow for cross ventilation. Similar bays without windows, one on each side of the patio, offer sideway views when outside.

Providing a high standard of architectural quality, the regionally rooted, timeless design of the cabins is kept robust and simple, clearly defining this project as highly sustainable from a design and visual expression standpoint. As an already award-winning example of modern regionalism, the design exploits resources onsite such as sun exposure, wind protection, orientation, and preserves environmental quality with the goal to support the local ecosystem through design with nature. The cabins respond to a socially viable environment and reflect the value of the local community. They provide an outstanding case study, and thus a stimulating environment for their users, raising critical awareness of finite natural resources and a sensible use and management of an important natural resource. Within its larger context of the GSU, the project creates a space of communal significance and social value; it will inspire the Scouts' human spirit and support the bonding of their community within and the local neighborhood.

The collective, integrated design and construction process applied by the team consistently included all stakeholders, authorities, students, Scouts, contractor, and trades. Through the efficiency of the design and the chosen materials, the cabins provide a long-term economic benefit for the users and GSU as a non-profit organization. During construction the team also focused on fulfilling high ethical standards for the construction crew and ensured through continuous visits at the site and the manufacturing plant the high quality of working and product conditions.

For the design development, in which many of the schematic decisions were further explored and finalized, groups of students and Girl Scouts were involved in the decision making process to ensure a functional architecture that would not only be rooted in the local context but would also become the most functional solution for its occupants. During those workshop-like meetings, the number and shape of the beds were discussed and defined, moving the layout from having space-consuming single beds to more efficient bunk-beds, which also allowed the team to stay within the given construction budget by reducing the overall cabin size by approximately 25% and introducing a common space for in-cabin activities. The importance of a porch for each cabin was discussed, and the need for a large table in the center of the cabin emerged. After consultation with stakeholders and the client, all of those measures were successfully implemented into the scope and design of the project.

Participatory Design and Development Process

Integrated throughout the participatory design process of the cabin project have been outreach activities benefiting both SoA students and the Girl Scouts. Utah's population of female architecture students and female practitioners is well below the national average, so recruitment was a primary goal of the project in addition to helping raise the awareness of high quality design in the community. Currently 14% of Utah's practitioners are female, which is well below the national average. The SoA also has a disproportionately low percentage of female students so the opportunity for the program to have a significant impact on the local, regional, and state community is high.

The SoA/GSU involvement in the project is two-fold: there is a Leadership Group of middle- and high-school aged girls who have followed the project through all stages by participating in workshops, site visits, design charrettes, and firm tours, and a broader audience of girls of all ages who participated in an event in April 2013 that used projects specific to the cabin design to demonstrate general principles about architecture, urban planning, landscape architecture, and design. In more detail, the participatory design and development process included participation of SoA students at the Western Mountain Regional/Northwest Pacific Region (WMR/NWPR) Leadership Institute, hosting a booth at the 2012 Girl Fest, organizing a large Cabin kickoff event at the SoA, a design charrette, several site visits and tours of Euclid Timber for scouts and students, a consultation meeting for table designs, the design and digital manufacturing of the tables themselves, the day-long educational event for 75 scouts of all ages in April 2013, and a public groundbreaking party shortly after completion of the project. Additionally, SoA students were also been involved in part of the construction administration. The authors believe that the SoA's mission and strategic goals were well-aligned with the Girl Scout's mission and 3 Keys, which are:

> **Girl Scouts**
> Girl Scouting builds girls of courage, confidence, and character, who make the world a better place - and Girl Scout definition of Leadership as described by the Three Keys - Discover, Connect and Take Action - through development of strategic partnerships and badge-related programs.

SoA Mission
The School of Architecture of the University of Utah is the leading regional center for promoting the value of architecture through education. The school's vision is to effect a transformation in attitude toward architecture.

Strategic Goals
- Inspire a culture of critical thinking, leadership, and excellence through rigor and breadth in reading, writing, scholarship, and design;
- Instill a place-based sustainable ethic in our teaching, practice, scholarship, and service that is applicable from the local to the global;
- Engage critical conversations in the campus and broader community;
- Lead the University in the practice of collaborative, integrative, and interdisciplinary education, practice, and research;
- Maximize the use of technology to contribute to our values and aid in visualizing and implementing positive change.

The authors believe the collaboration was mutually beneficial to both parties and has been successful in achieving its goals as evidenced by the final project outcome. Project:ARCHITECTURE, the first major project to be developed has created opportunities for mentoring relationships at multiple scales amongst the scouts, architecture students, and female practitioners. Mentoring is a value central to architectural practice and is closely tied to the educational components of the project. There is a strong community of women architects in Salt Lake City who are committed to mentoring the younger generation, primarily women students. This project brought these groups together multiple times to educate others about architecture.

Participatory Events and Activities

August 2012, GirlFest

GirlFest is an annual event celebrating the Girl Scout Leadership Experience with activities for scouts to discover new skills and strengths, connect with other girls and their community, and take action to make their neighborhood, community, and the world a better place. School of Architecture students manned a booth at the event in August 2012 to educate girls K-12 about architecture in general and promote the upcoming Project:ARCHITECTURE activities. An activity at the booth where girls decorated laser cut wooden cabins allowed for the younger girls to engage while students shared their knowledge and discussed the program with troop leaders and parents. The event served as a recruitment tool for potential Leadership Group participants. The scouts took the cabins home as a reminder about the project.

October 2012, WMR/NWPR

SoA students and their faculty mentor participated in the Leadership Institute (LI), a two-day workshop conducted in advance of the AIA's Western Mountain Region/Northwest Pacific Region Joint Conference in Tucson, Arizona. Students arrived there with a proposal that they presented to the group of peers from architecture schools throughout the region. Over the course of two days, students participated in presentations, work sessions and lectures. The mission of the program is to provide emerging professionals the opportunity to engage with individuals from the profession regarding leadership strategies, to develop leadership skill sets, to establish a forum

that will facilitate dialog amongst future leaders, and to advance the next generation of professionals to critical roles in the design and construction of the built environment.

The intent of the LI workshop was to help emerging professionals develop leadership projects intended to transform the profession of architecture "from the top-down, the bottom-up" by addressing questions such as 'What are the roles and opportunities for architecture and architects to leverage change and position the profession so it can provide leadership for society?', 'How does the profession evolve to embrace the next generation of architecture leaders and maintain a relevancy within the design and future of the built environment?', and 'How does the next generation of leaders respond to and leverage the global influences and challenges that the profession faces?'. Students ended the workshop by presenting their work to a joint session of the AIA membership.

October 2012, Kickoff Meeting

In October 2012, the Leadership Group of scouts met with representatives from the GSU as well as the authors to discuss the project, outline the schedule and present the proposed activities for a day-long event that was planned for spring 2013. The group also reviewed the proposed involvement of the Leadership Group in the project regarding how they were to become invested in the activities that were planned to be conducted and to help lead the groups of the day. Simultaneously, the Leadership Group of girls was introduced to the basics of architectural design, sustainable use of resources and materials, and the educational as well as spatial environment of an architectural school. After touring all of the buildings facilities and talking to students working in the studios, they participated in a discussion about how to make building more sustainable and better performing. At the end of the day, they left with a high level of motivation and a suitcase full of impressions, ideas, and encouragement.

November 2012, Site and Manufacturer's Fabrication Shop Visit

As another part in the series of events, the Leadership Group of scouts, with students and faculty of the SoA visited the site and the fabrication facility to gain a better understanding of the context in which the cabins are to be erected and to understand the process of designing and manufacturing the components for the structures. On the cabin site they were able to explore and understand the specific nature of the place, the challenges of the undulating terrain, and to visit the older cabins that had been built using standard construction the year before. The latter was an important lesson to better understand the difference to how ICLT buildings are planned, manufactured, and assembled, which was the major focus when visiting Euclid Timber, the ICLT manufacturer, right after the site visit. Besides being exposed to impressive building elements on the assembly floor, all attendants took home the magic of large and heavy timber elements being moved, cut, and milled in seconds when grabbed by the automated CNC milling machines that are used to produce the final elements.

December 2012, Design Charrette

After initial code review and space allocation exercises were conducted by the authors, the GSU, troop leaders, architecture students, and Project:ARCHITECURE coordinators were invited to take part in a design charrette for the cabins. The scouts provided important information that shaped the design. This was an invaluable experience for students as well in understanding the positive impact a client can have on a design.

April 2013, Capstone Event

The capstone event to the service and outreach component of the project was an event on April 20th, 2013 that involved approximately 75 girls, including the Leadership Group. The event paired architecture students, a female practitioner, and a Leadership Group scout together to develop a series of activity sessions that exposed girls of all ages to the principles of architecture, design, and planning through hands-on activities. In addition, the day started with a panel discussion called "Archi-Chicks" where female architect-practitioners - including the dean of the College of Architecture + Planning, a senior vice president at the University, the first female fellow of the American Institute of Architects in Utah, and the principle of the AIA Utah Architecture Firm of the Year - spoke about how they became interested in architecture and what their experience has been in practice.

Activities during the day included a variety of sessions, such as

- Sleeping Bag Space Planning, where a group of young girls used sleeping bags, a masking tape cabin 'plan,' and their own bodies to understand the relationship of scale and space;
- Sun Screens - the sun and its relationship to windows, shading and protection from heat through hands-on exercises and experiments;
- Urban Design - planning principles through exploring multiple layouts for the cabins' site;
- A rainy tour of "Urban Spaces" on the campus with the dean and executive director of the AIA Utah;
- A 3D "Computational Design" workshop conducted for older girls who assisted in finalizing the bunk bed design;
- A "Sticks and Stones" session where young girls learned about structures using chopsticks, rubber bands, and bricks;
- A session on "Green Building" conducted that discussed passive sustainable principles;
- A "DIY Diorama" craft for young girls to help them think about material, color, and texture in spaces;
- A session on making "Coke Bottle Terrariums" and discussing native plant species on the cabin site;
- Archi-Chicks - the history of women in architecture presented by female faculty and practitioners;
- A workshop on "GSU Traditions" that looked at the social aspects and traditions related to camping.

Each session was run by a practitioner and one or more of the SoA students who helped coordinate the various activities. The practitioners and students worked out the details for the session together and provided any supplies and materials needed.

The event ended with a 'big reveal' of the cabin design and discussion of how the design was developed to incorporate sustainable principles and input from the GSU. After the event, the Leadership Group was invited to tour a local architecture firm and have a discussion with senior and junior members of the office on what an architect does in practice.

September 2013 to May 2014, Construction

Throughout the construction process, students and scouts were kept abreast of progress and invited to the site for tours at key points. This opportunity was highly valued especially by architecture students, as for several students it was their first exposure to seeing something they helped design under construction. Additionally, students who hadn't been involved in the project toured the site during construction and after completion for technology courses that used the

cabins as case studies, exposing them to the work of their peers and the highly sustainable qualities of the cabins.

In all, the construction process was more complex for these simple cabins than it might have been for a standard building, and the students were able to witness the process. They observed the challenges of the construction process with regard to code compliance: the jurisdiction changed fire marshals during construction, and the new marshal had a different interpretation of key aspects of the project. They were exposed to the process of utilizing a new material system (ICLT) in one of the first times in practice: the original intention for the piers was to minimally disturb the site, but due to the load of the solid wood panels and the structural engineer's caution in working with a new system, the oversized footings required significantly more excavation than originally intended. They were exposed to the process of public relations and fundraising: students observed the process of soliciting donations for materials and assemblies to help offset costs for the cabins.

July 30, 2014, Ribbon Cutting

A ribbon cutting celebration took place on July 30, 2014 in which scouts, camp staff, GSU board members, parents, architecture students, contractors, vendors, and local politicians took part in celebrating the cabins' dedication. Speakers discussed the process of constructing the cabins and scouts, students, and the authors led people on tours of the cabins, which had been in use since the beginning of the camp season. The celebration was also attended by several local and regional news outlets, which provided coverage of the cabin story, featuring the scouts' involvement and the ICLT material utilization.

In addition to the creative work and outreach components of the project, the authors have made every effort to leverage the partnership with the Girl Scouts for real-world design opportunities for architecture students. For example, faculty taught a graduate seminar in the spring of 2013 on digital fabrication where students designed and built tables that the Scouts indicated were desirable for communal activities in the cabins. The GSU served as the 'client' for the tables, and students involved in the project who were not part of the course participated in tours and critiques.

Conclusion

The participatory and integrated design, development and construction process applied by the author team consistently included all stakeholders – building authorities, students, scouts, contractors, and trades – to efficiently provide a long-term economic benefit for the users and non-profit GSU. According to du Plessis' [2012] 'philosophical departure points', it can be argued that the cabin design and development process was a generative design and development process because:

1. The human system of the Scouts and their education became an integral part of the ecosystem at the site;
2. The human activities incorporated in the process contributed positively to the ecosystem function and evolution;
3. The human endeavors were informed by context-specific aspiration;
4. Ongoing participatory and reflective processes were and still are applied in the design and development of the GSU cabins as a regenerative place.

Already during and shortly after completion, the project received 5 important design, collaboration, and diversity achievement awards. The success of it was extensively covered in the regional media. The authors are confident in stating that the project overall has been a tremendous success in its intention to serve as an outreach, teaching, and research initiative that links faculty and students in architecture, Girl Scouts of Utah, and female practitioners with industry to create learning opportunities about architecture through sustainable building design and construction projects.

The authors also believe that the project has had a significant impact on the community, which includes the general public in the form of GSU, parents, and troop leaders; the academic community of students and faculty who volunteered for the project; and the professional community who engaged in mentoring the GSU and architecture students by sharing their expertise. This impact includes both a sustainable focus as it relates to the ICLT material utilized for the cabin design as well as a social focus as it relates to female architects. There are plans to continue this partnership in the 2014/15 academic year through the development of an "Architecture Badge" in collaboration with the GS of Utah, which will formalize a series of events and activities related to architecture that will impact an even broader audience. Furthermore, the authors discussed with the GSU leadership future projects on other campsites in northern Utah.

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Project Team
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Architects: Jörg Rügemer, Erin Carraher

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ABOUT THE AUTHORS

Jörg Rügemer: Graduated with an M.Arch. from the Southern California Institute of Architecture in Los Angeles and a Diplom-Ingenieur Architekt from the University of Applied Sciences in Cologne, Germany. He has worked internationally for Frank O. Gehry, Los Angeles, Anshen & Allen, San Fransico, and Bothe Richter Teherani, Hamburg. Mr. Ruegemer is a licensed architect in Germany, eligible to practice in all countries of the European Union, and an Associate Member of the American Institute of Architects. Between 2004 and 2008, he was professionally active in China, where he maintained an office in Shanghai with partners from Berlin. He has taught at Karlsruhe and Cottbus University of Technology in Germany, where he led the Department for Architectural Design and CAD, at the School of Architecture at Florida International University in Miami, Florida, where he served as the Director for Digital Design, and at the School of Architecture, University of Utah, where he teaches sustainable architecture and urban design and co-directs the Integrated Technology in Architecture Center. Rügemer has received numerous international scholarships and architectural awards, including 16 placements in international architectural and urban competitions, a variety of completed projects, many scholarly publications, and numerous international lectures on sustainable architectural and urban design, passive and design strategies, and virtual design. His research in highly energy-efficient and cost-effective buildings, design strategies, systems, and Post-Occupancy building monitoring is funded through grants from the Department of Energy Building America Program, the Boston Society of Architects BSA, the AIA Upjohn Award program, the University of Utah, and Rio Tinto Kennecott Copper Utah. Supported by a fellowship of the German Academic Exchange Service and the German Federal Ministry of Education and Research, he spends a one-year sabbatical at the Karlsruhe Institute of Technology in southern Germany, which is the University of the State of Baden-Württemberg and National Research Center of the Helmholtz Association, where he focuses on Net-Zero and Energy+ design strategies.

Erin Carraher: is a licensed architect and an Assistant Professor at the University of Utah's School of Architecture where she is the coordinator for the first-year and pre-major architecture studios. She also teaches graduate and undergraduate courses on communication and digital technologies. As a senior researcher at ITAC, the Integrated Technology in Architecture Center, Erin studies emerging modes of practice and collaborative project delivery models and is working on ways to translate these topics into the classroom in applied ways. Previously, Erin practiced in New York City for BKSK Architects where she worked primarily on public library and education projects before moving full-time into education. After two years teaching foundation design and technology courses at Virginia Tech's School of Architecture + Design

where she received university recognition for the innovative integration of technology into the design studio, she joined the faculty at the University of Utah in 2011.