

Opportunities and challenges for the steel casting industry – driven by e-mobility and next generation combustion engines

Munich, 18th October 2022

Presented by Ingo Bitzer + Raphael Herzog
MAT - Schmidt Automotive + HERZOG INTERTEC

Content:

- Introduction MAT group
- Introduction HERZOG INTERTEC
- Challenges of next generation gearbox / differential cases
- Opportunities for steel and steelcasting
- Challenges of modern engines
- Example: balancing shafts
- Opportunities for steelcasting
- Summary



MFG | MARKET SECTORS

OUR CORE SPECIALISMS: A GUIDE IN NUMBERS

MAT FOUNDRY
GROUP LTD



40 MILLION
BRAKE COMPONENTS MANUFACTURED
ANNUALLY



9 MILLION
TRANSMISSION COMPONENTS
MANUFACTURED ANNUALLY



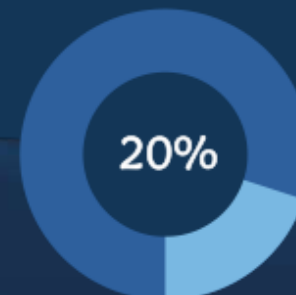
11 MILLION
COMMERCIAL VEHICLE COMPONENTS
MANUFACTURED ANNUALLY



EU BUILT CARS HAVE MFG
BRAKE PARTS



EU BUILT CARS HAVE MFG
TRANSMISSION PARTS



MARKET SHARE OF EUROPEAN FREE
AFTERMARKET ON BRAKE DISCS

MFG | CUSTOMERS

MAT FOUNDRY
GROUP LTD

WE'RE PROUD TO WORK IN PARTNERSHIP WITH ALL MAJOR AUTOMOTIVE COMPANIES

OEM CUSTOMERS:



TIER 1 CUSTOMERS:



AFTERMARKET CUSTOMERS:



A large collection of various steel casting products, including flanges, valves, pipes, and structural components, arranged in a grid-like pattern on a dark, textured background. The products are made of polished metal and vary in size and shape, showcasing the company's manufacturing capabilities.

OUR PRODUCTS

**MAT FOUNDRY
GROUP LTD**

MFG | GLOBAL PRESENCE

OUR WORLDWIDE NETWORK OF PLANTS AND TECHNOLOGY CENTRES

MAT FOUNDRY
GROUP LTD



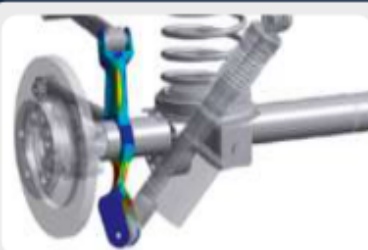
HERZOG INTERTEC GmbH

HERZOG INTERTEC is your innovative provider of engineering services - supporting you in the development of components and complete assemblies.

- We are looking for challenges and finding solutions for more than 25 years.
- We are combining established methods with an open approach to innovative technologies.
- We are focused on the solid combination improvement and sustainability.



www.herzog-intertec.de



ENGINEERING

- Concept Development
- Construction
- FE Simulation



PROTOTYPING

- Borderline Samples
- Validation Parts
- 3D Machining

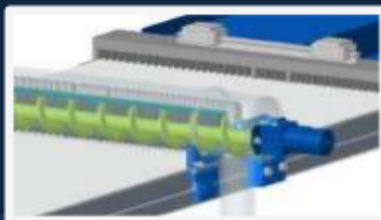


VALIDATION

- Functional Tests
- Lifetime Analyses
- Noise and Vibration



Automotive



Mechanical Engineering



Customer Goods



Renewable Energy



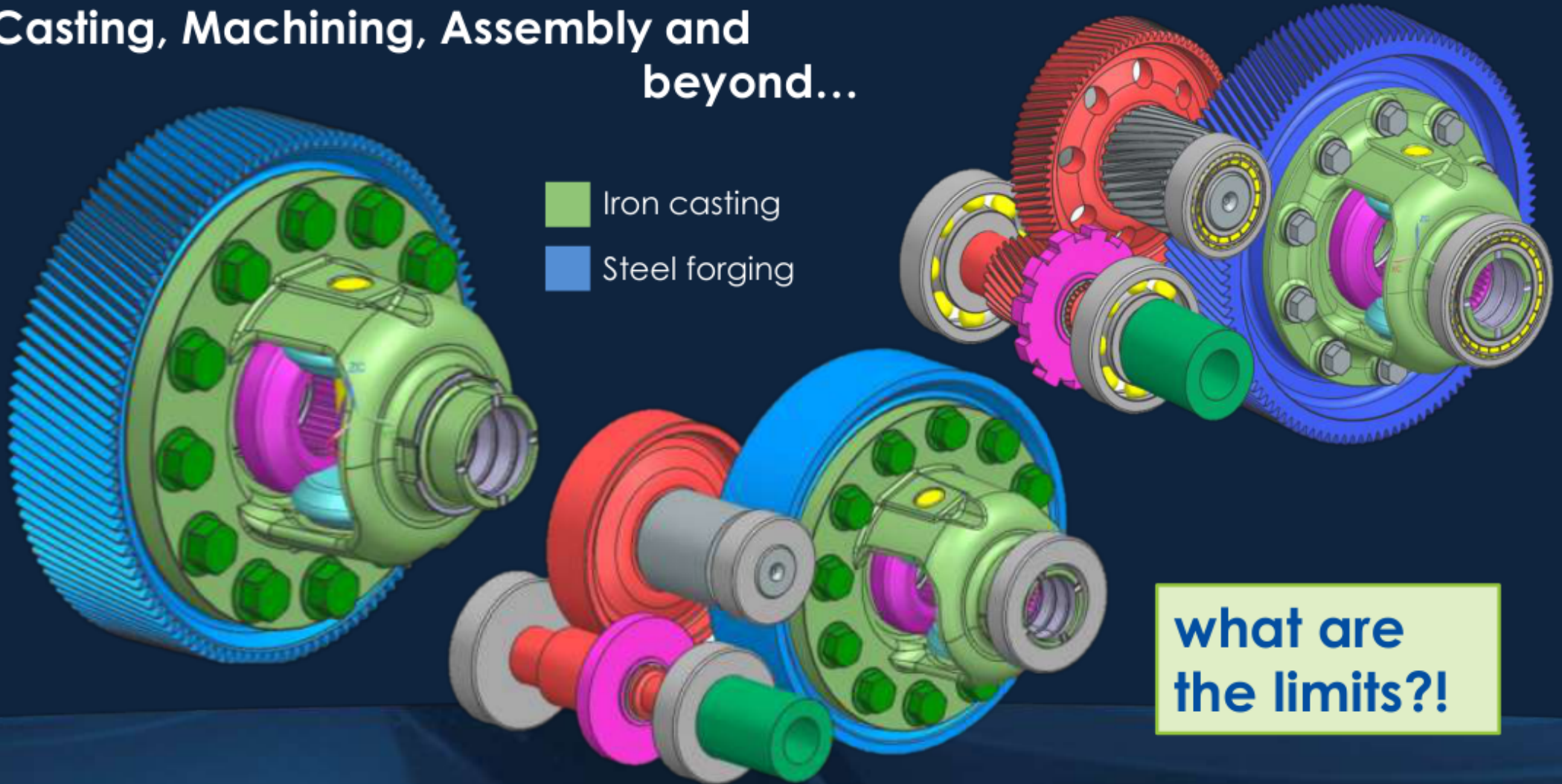
Medical Technology

Look for the woman
in the dress. If
there is no woman,
there is no dress.

Coco Chanel

Casting, Machining, Assembly and beyond...

 Iron casting
 Steel forging



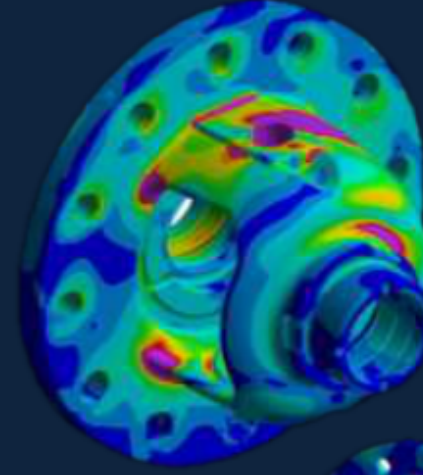
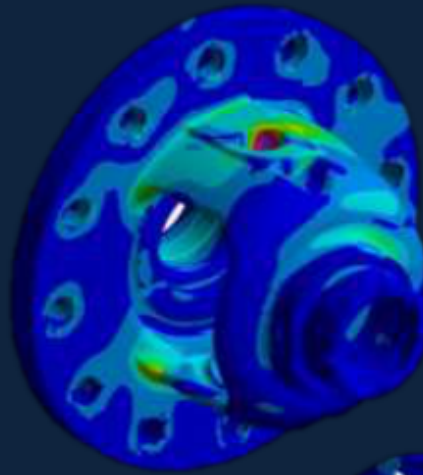
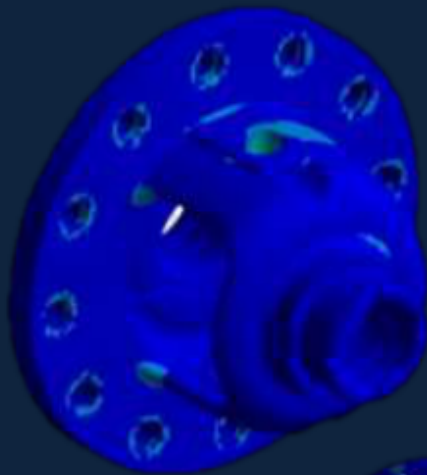
**what are
the limits?!**

Mises Equivalent Stress

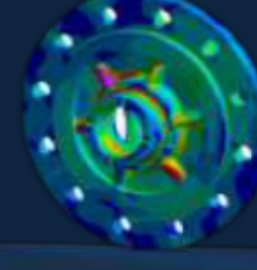
low load

standard

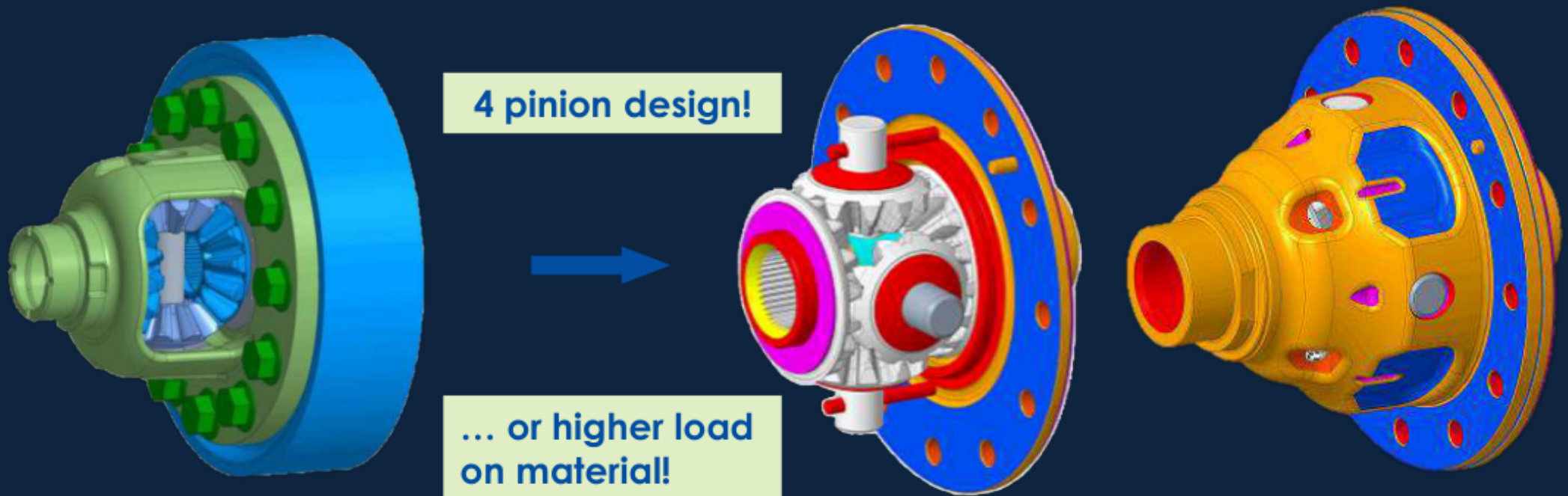
30% uphill



**Strength
limits at
pinion
shaft!**



Mises Equivalent Stress compensation by multiple pinion shaft



Weightreduction



optimized
topology!

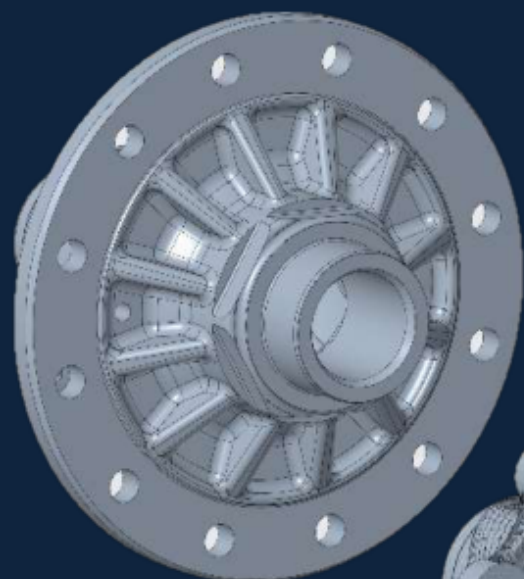


- 10 %
weight!

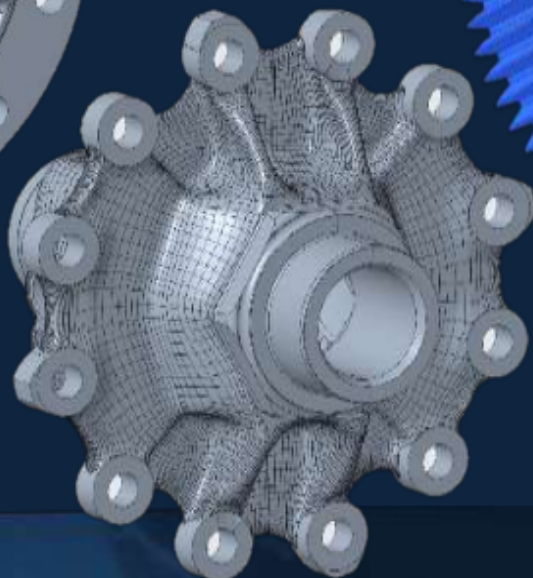
higher
demand on
material!



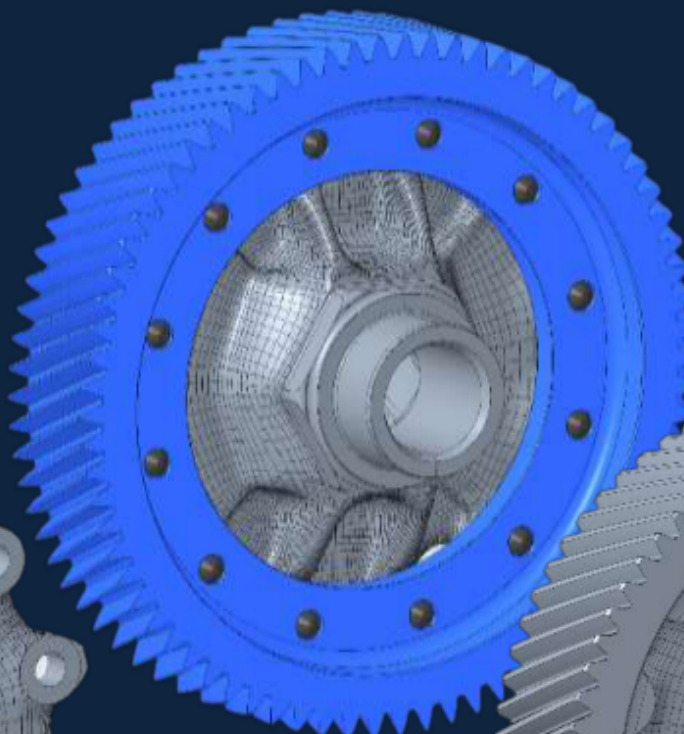
Weightreduction



**optimized
topology!**



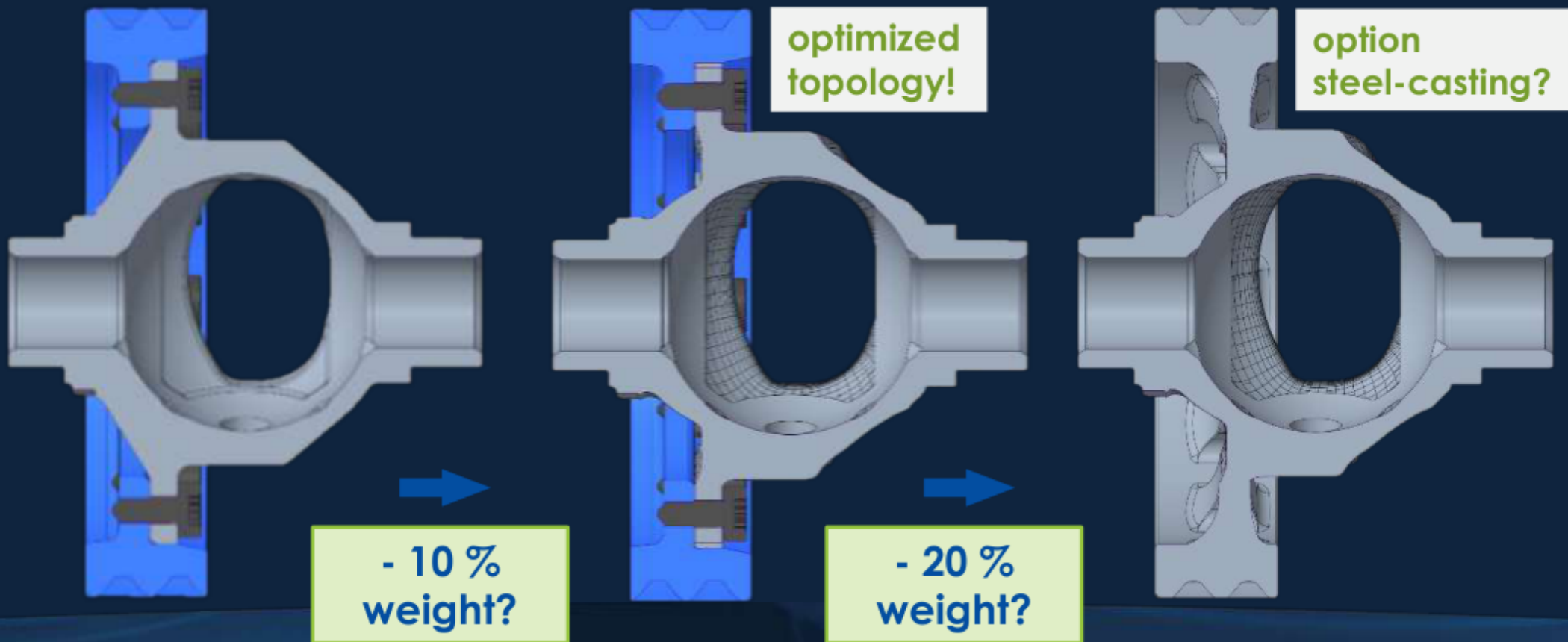
**- 10 %
weight!**



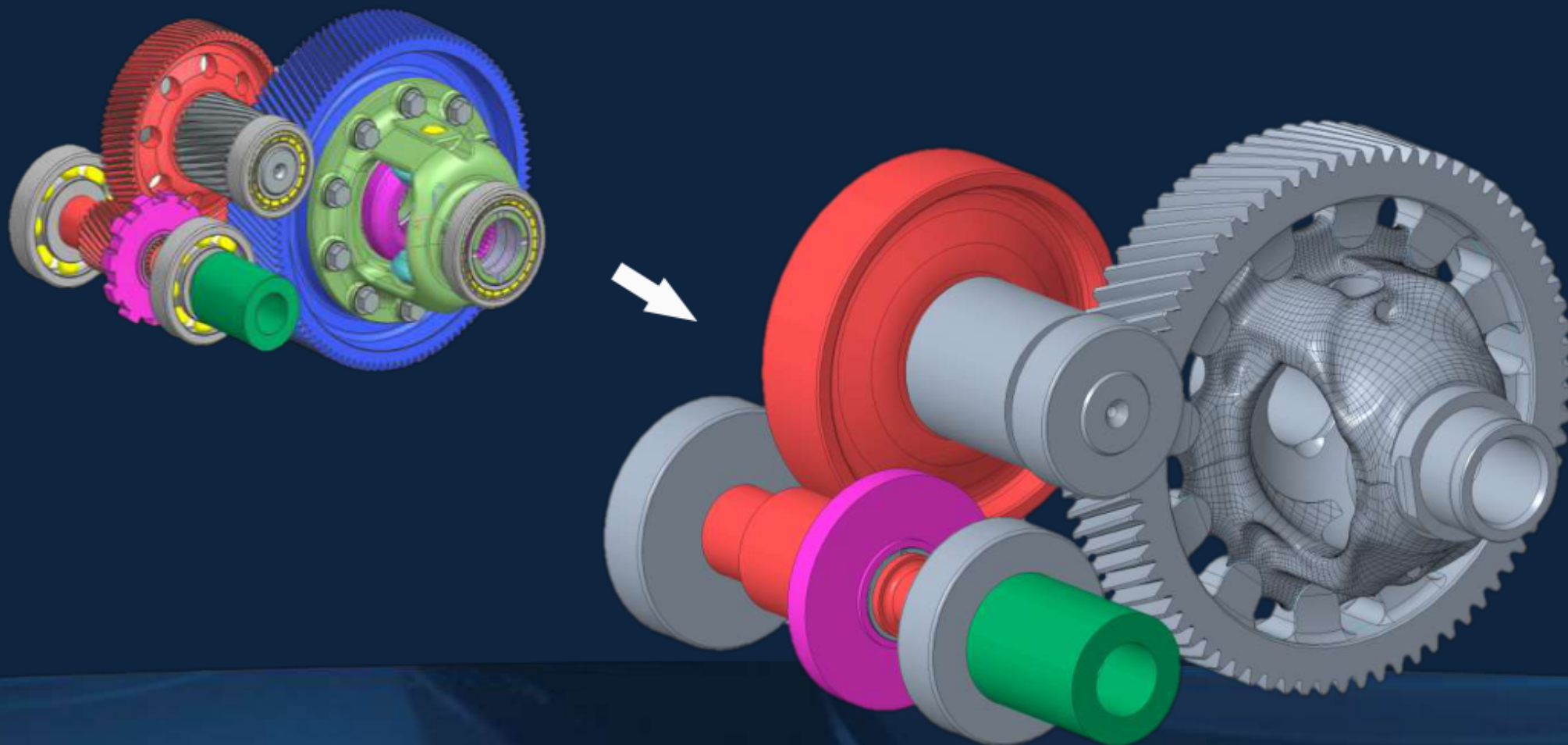
**higher
demand on
material!**



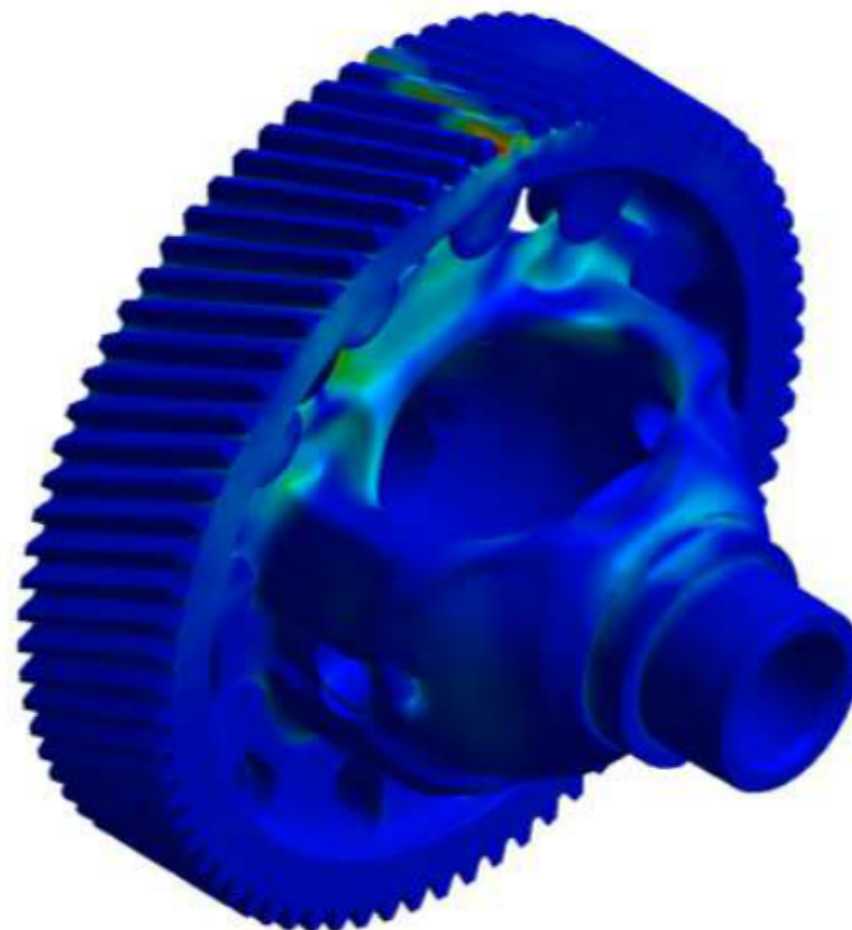
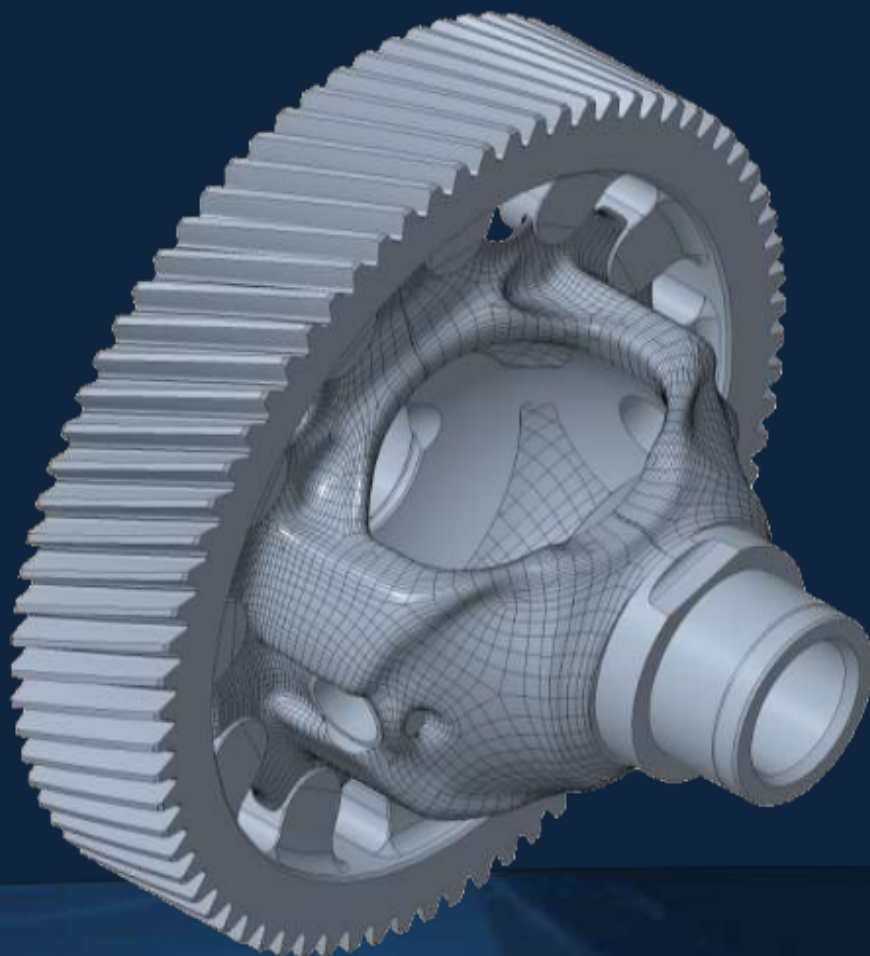
Weightreduction & Systemintegration steel casting



What strains do we have?

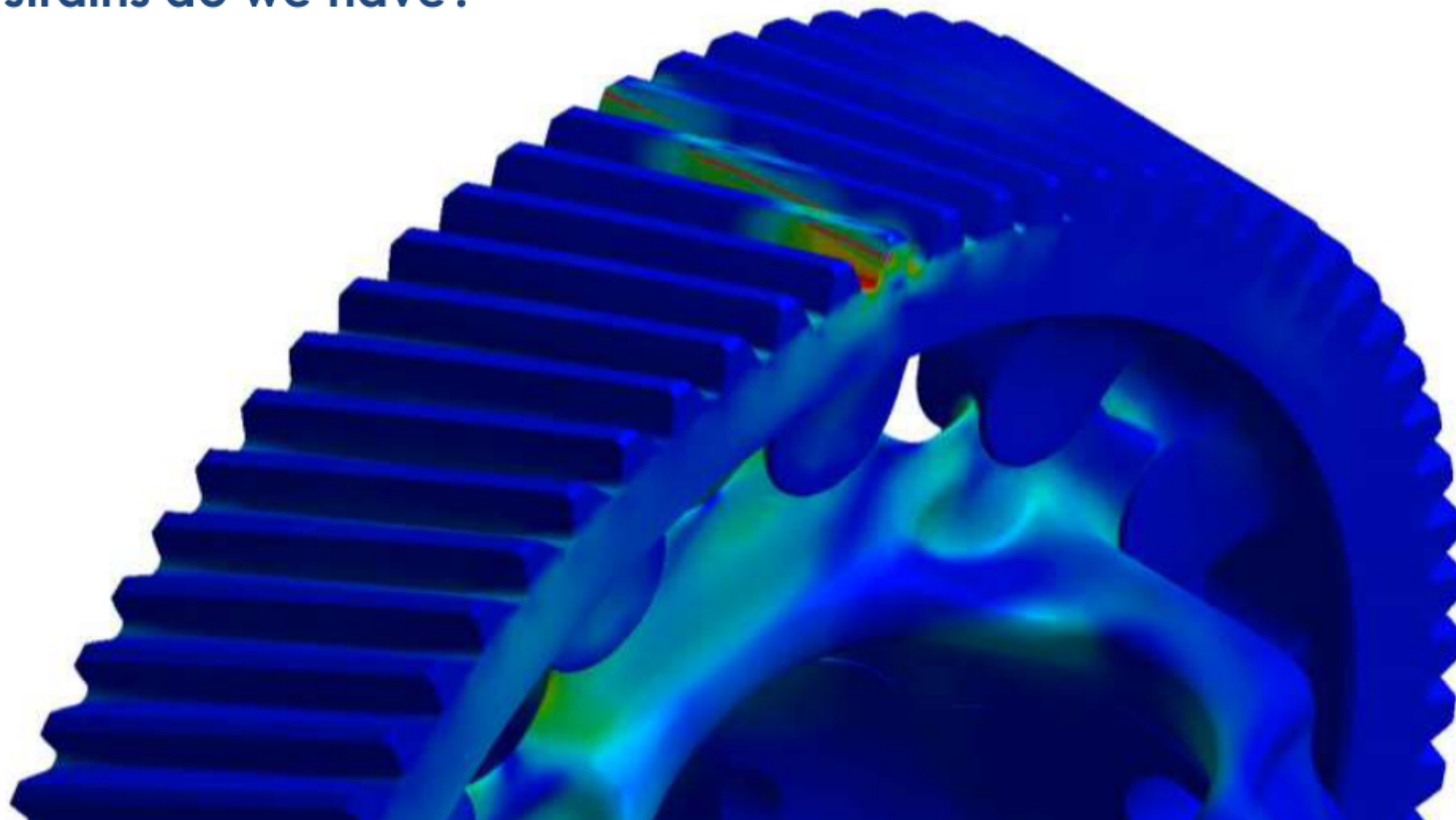


What strains do we have?

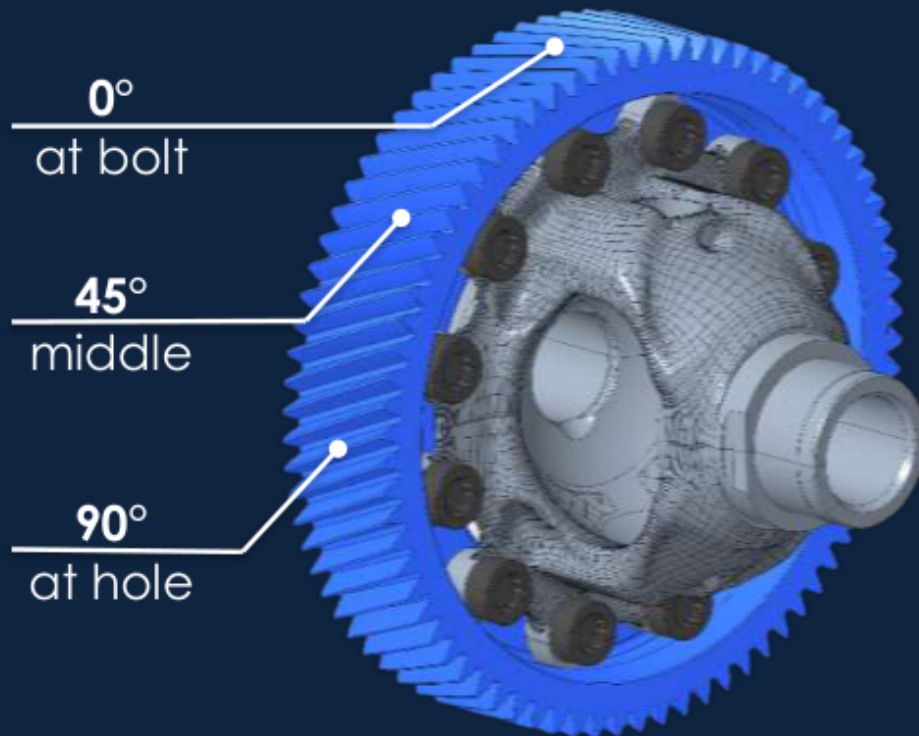




What strains do we have?



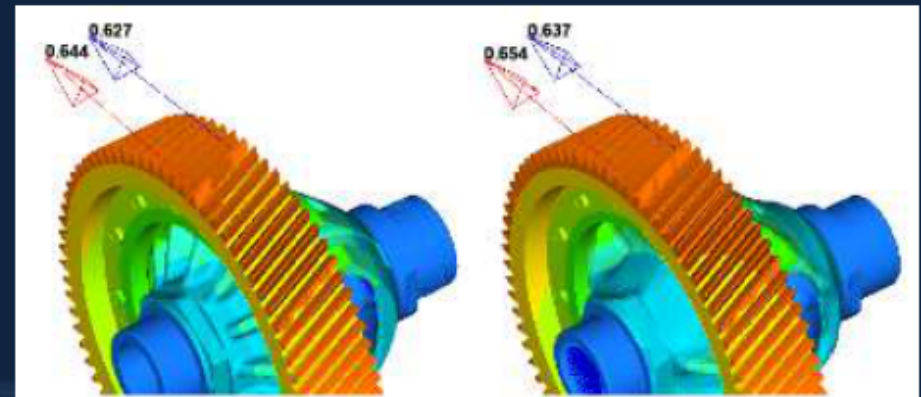
Tooth-tiffness at different positions



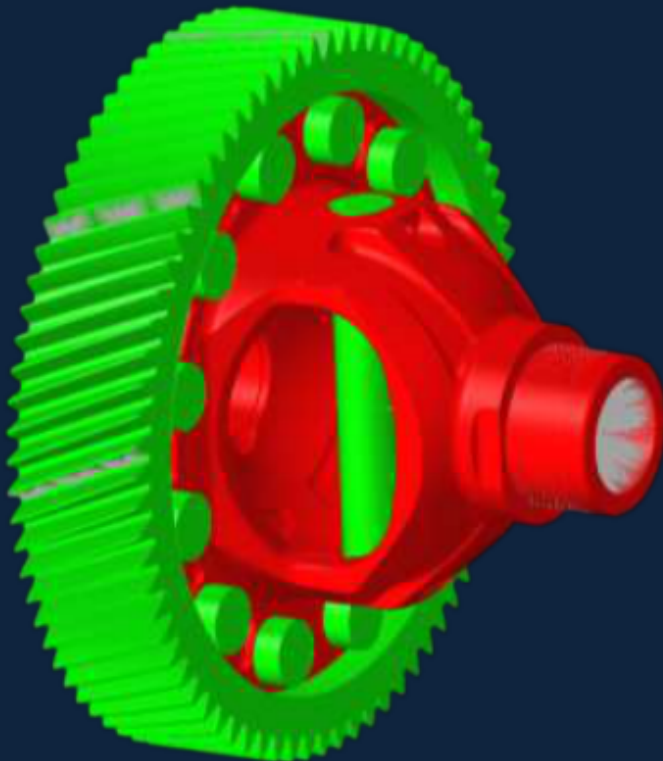
Checked and almost identical

Original design

MAT evo design



Material studies?



Steel

- e-Module: 210.000 MPA
 - Poisson's ratio 0.3
 - Density: 7.850 kg/m³
-

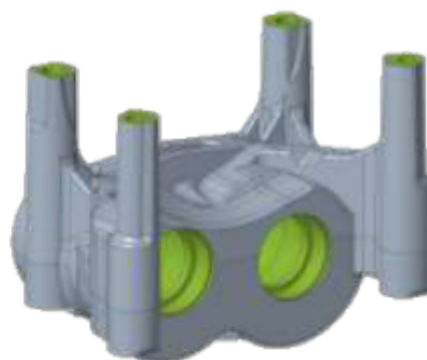
Ductile Iron (GJS 600, 700, 800, 900)

- e-Module: 175.000 MPA
- Poisson's ratio 0.28
- Density: 7.200 kg/m³

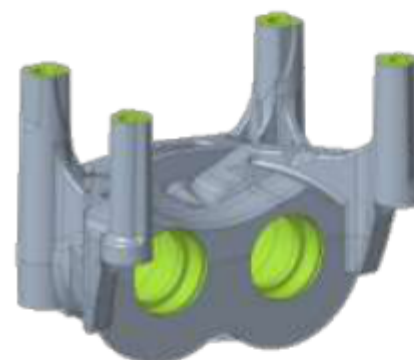
Challenges of modern engines – Lightweight



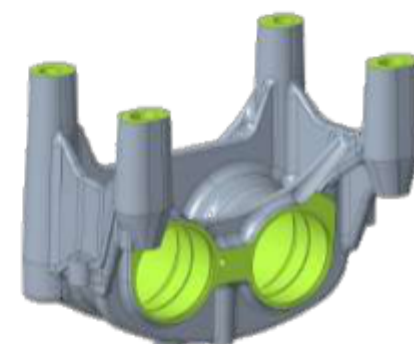
6,5 kg



5,8 kg



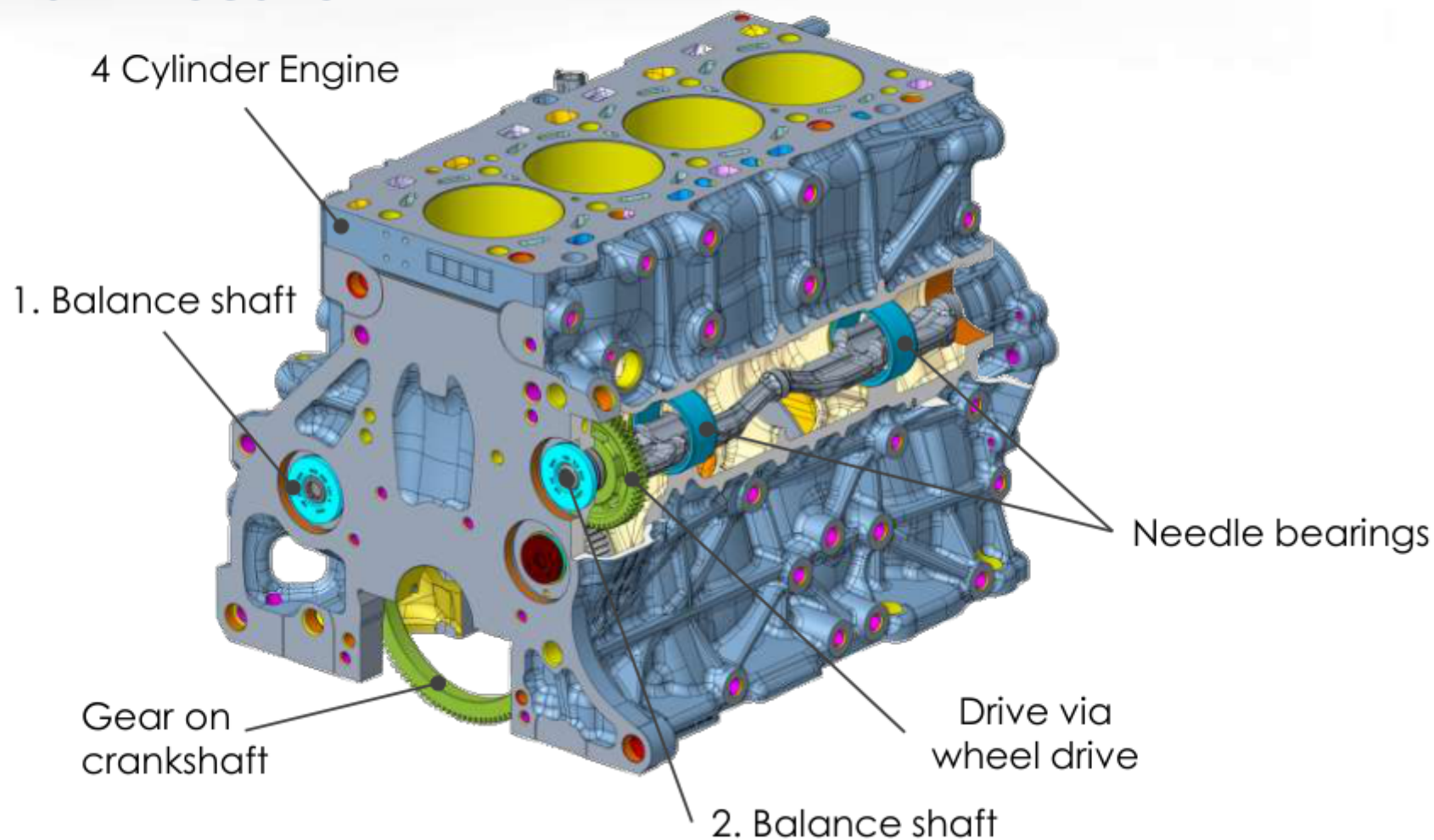
4,7 kg



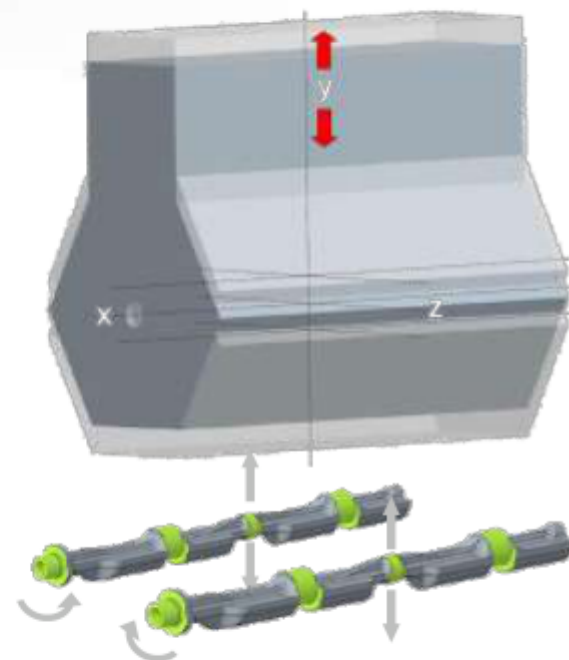
3,7 kg



Balance shaft - Location



Balance shaft - Function



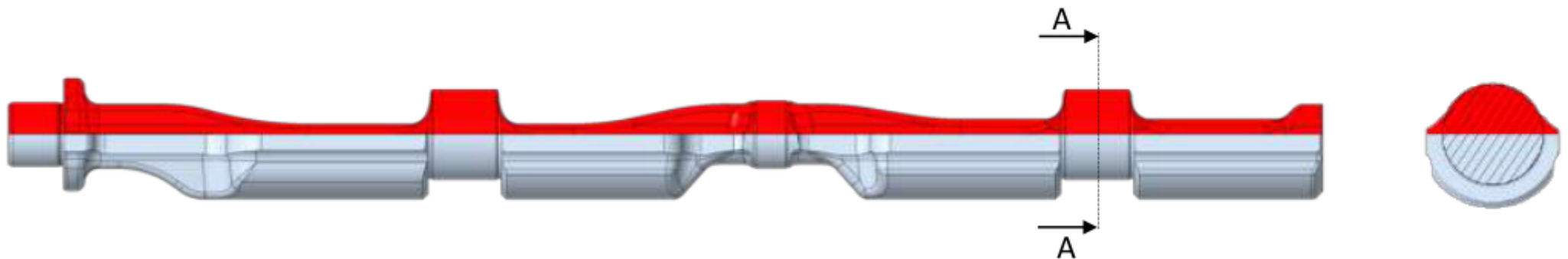
Balance shaft - Base Formula

→ **Unbalance:** Fixed requirement

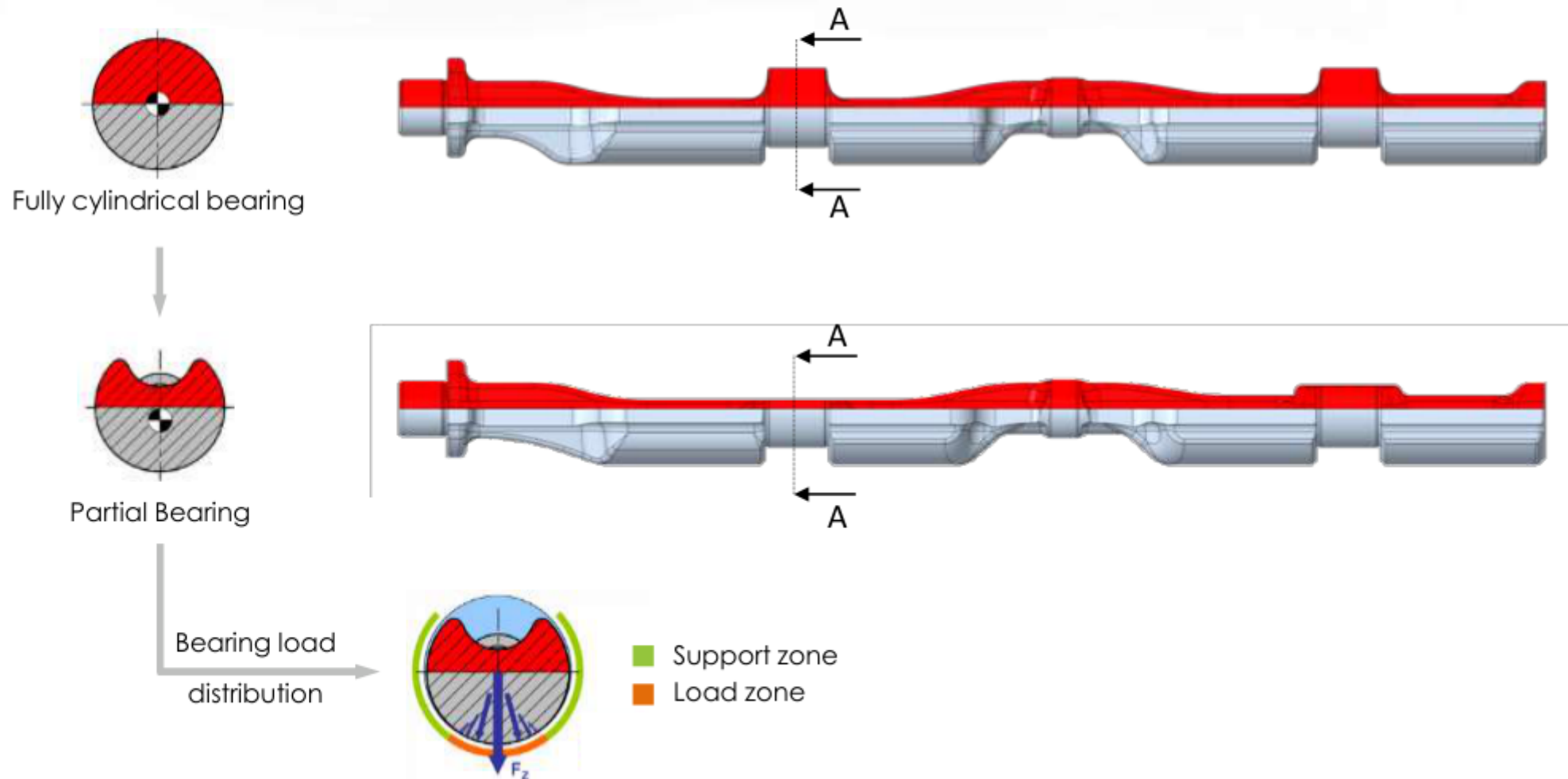
$$U = m * E$$

→ **Eccentricity:**
Must increase in proportion as the mass is reduced to meet the requirement

→ **mass:**
Should be as low as possible

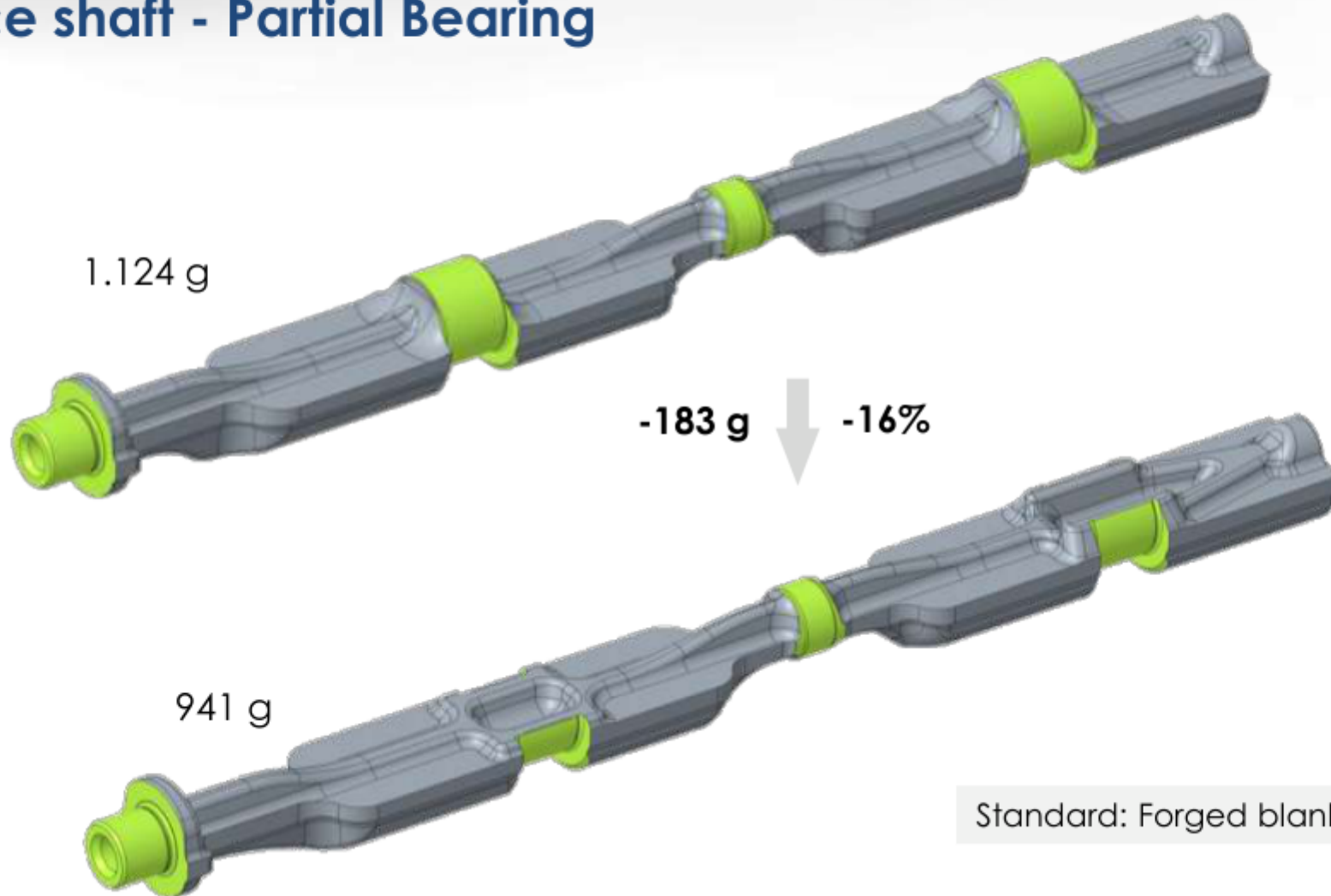


Balance shaft - Optimization Partial Bearing





Balance shaft - Partial Bearing



Balance shaft - Partial Bearing



VW - Diesel

Models: Passat, Golf, ...



Mercedes- Benz - Gasoline

Models: C- Klasse, GLC, ...



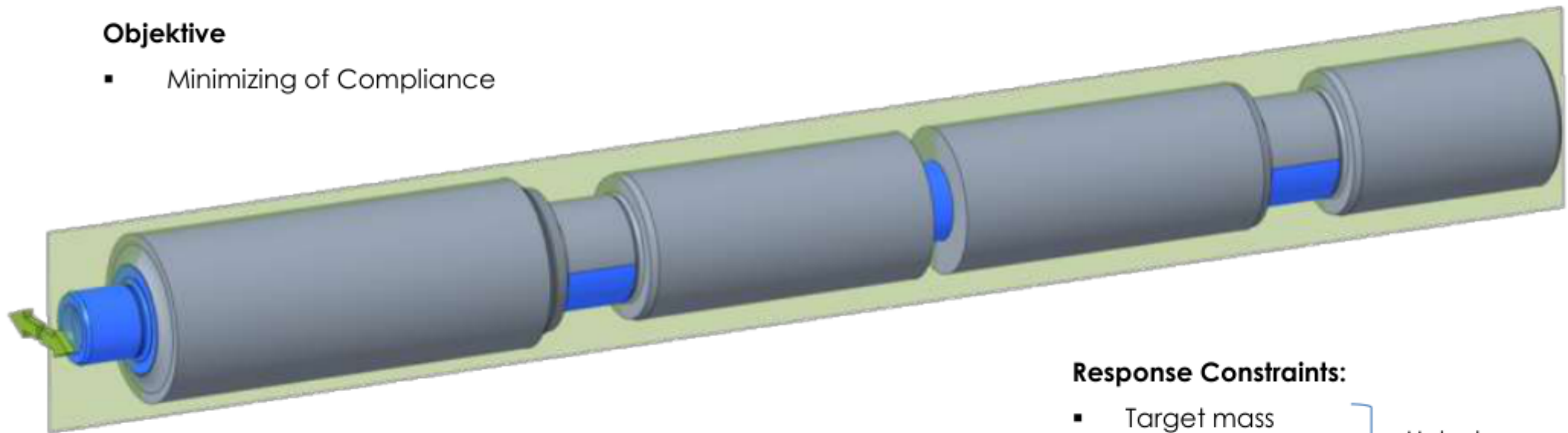
AMG - Gasoline

Models: C43, GLC43, ...

Balance shaft - Topology Optimization

Objektive

- Minimizing of Compliance



Designspace



Non - Designspace

Response Constraints:

- Target mass
 - Center of gravity
- } Unbalance

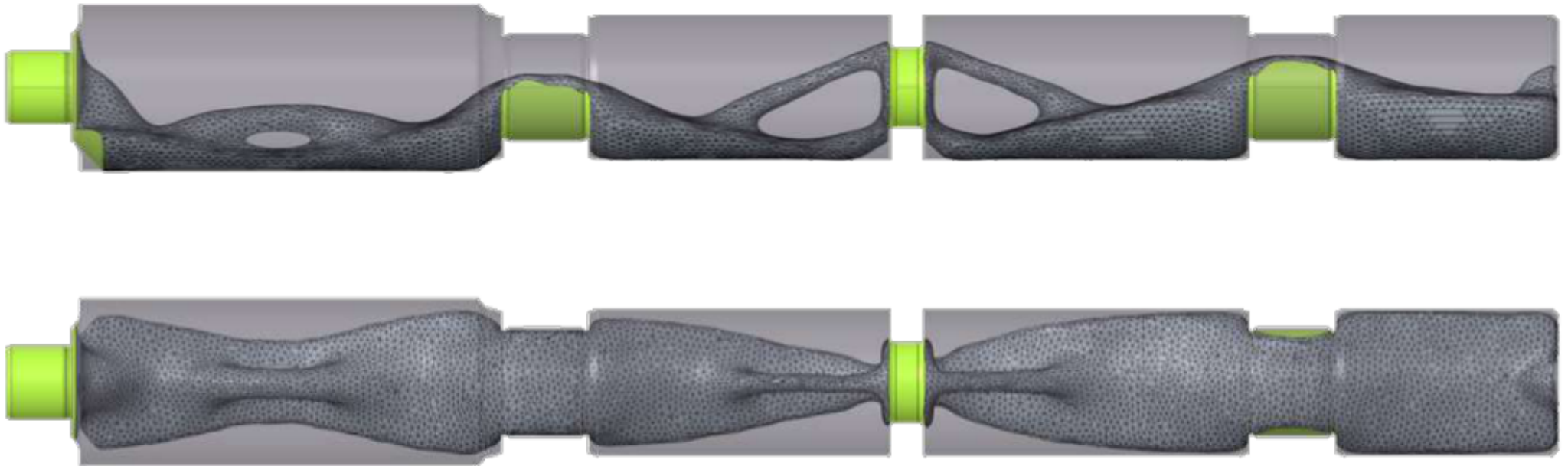
Manufacturing Constraints:

- Demolding level (green plane)
- Minimum wall thickness

Balance shaft - Topology Optimization

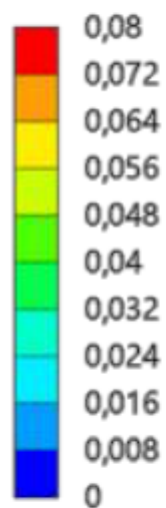


Balance shaft - Topology Optimization Results

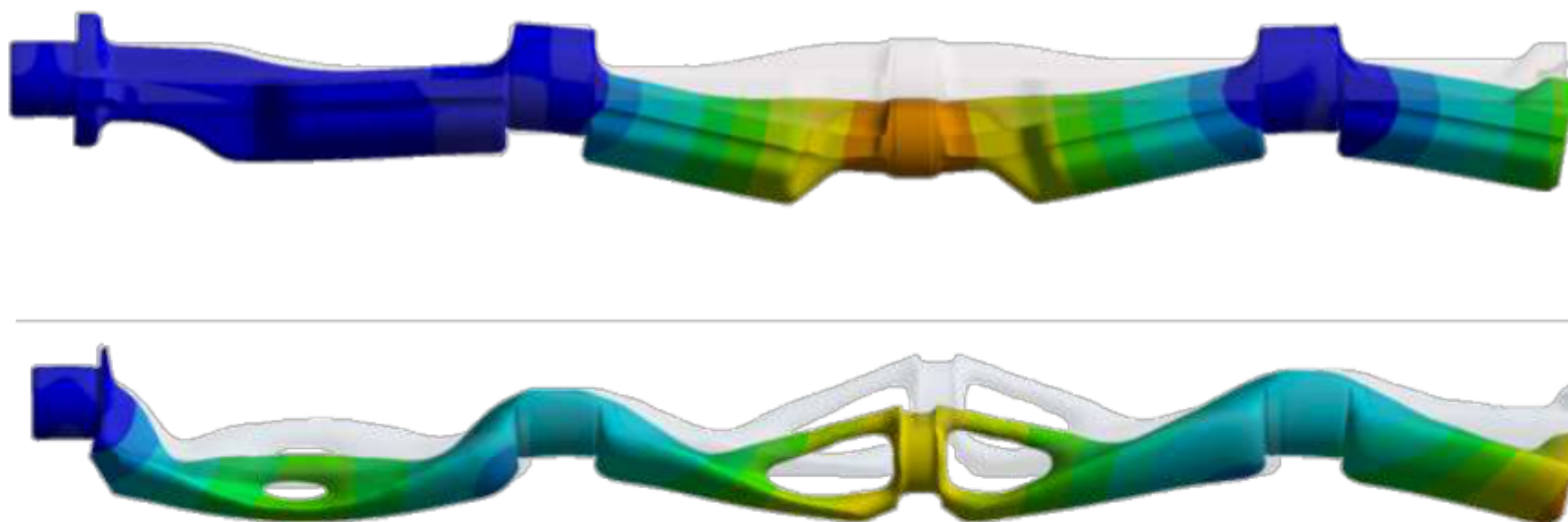


Balance shaft - Topology Optimization Results

Overall deformation at 14.000 rpm
Unit: mm

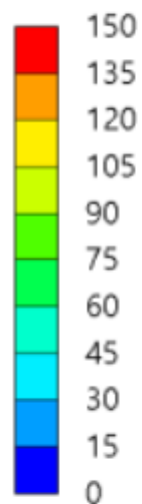


200 - times exaggerated display

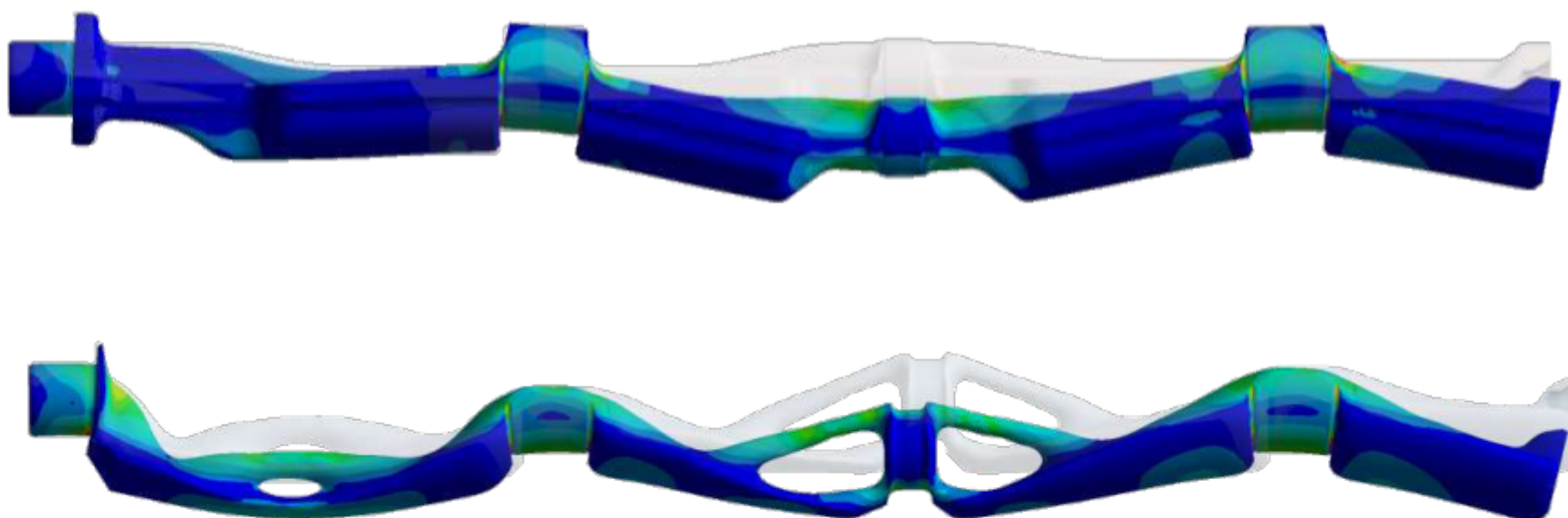


Balance shaft - Topology Optimization Results

Mises Equivalent Stress at 14.000 rpm
Unit: MPa



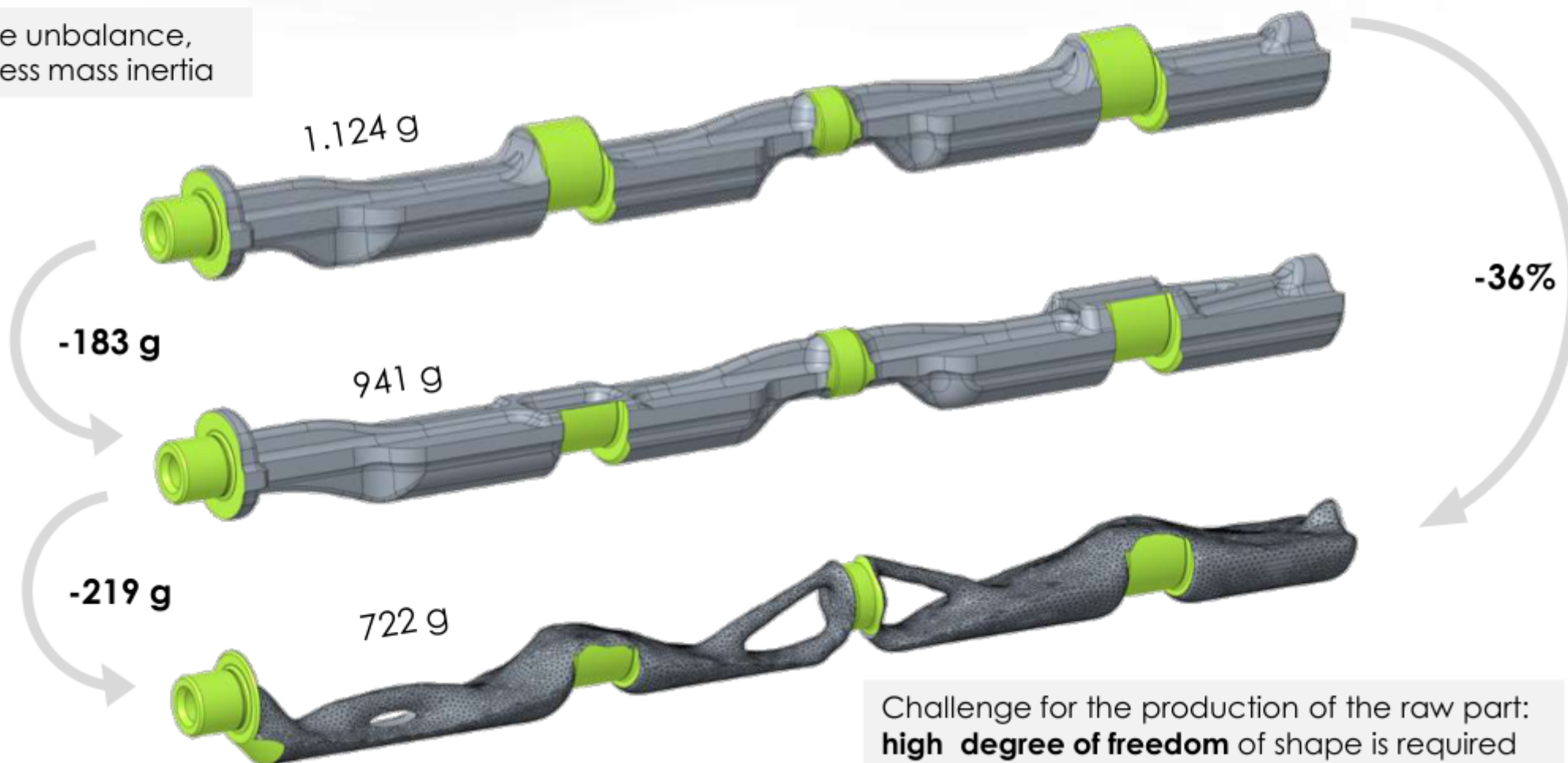
200 - times exaggerated display



There are no critical stresses on any shaft

Balance shaft - Topology Optimization Results

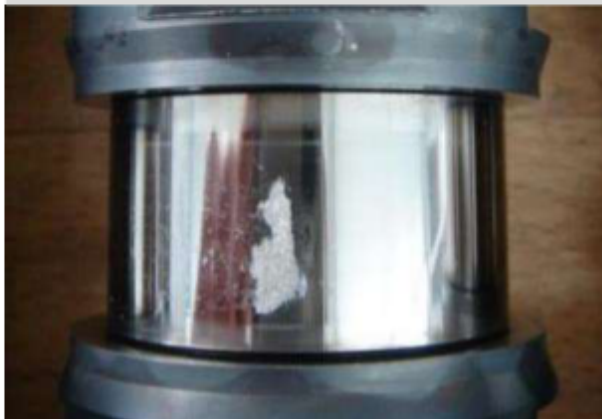
Same unbalance,
but less mass inertia



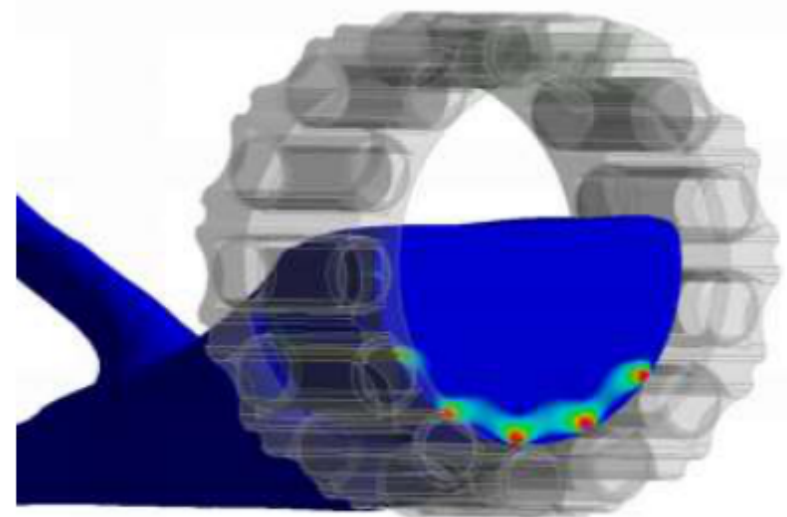
Balance shaft - Blank Material

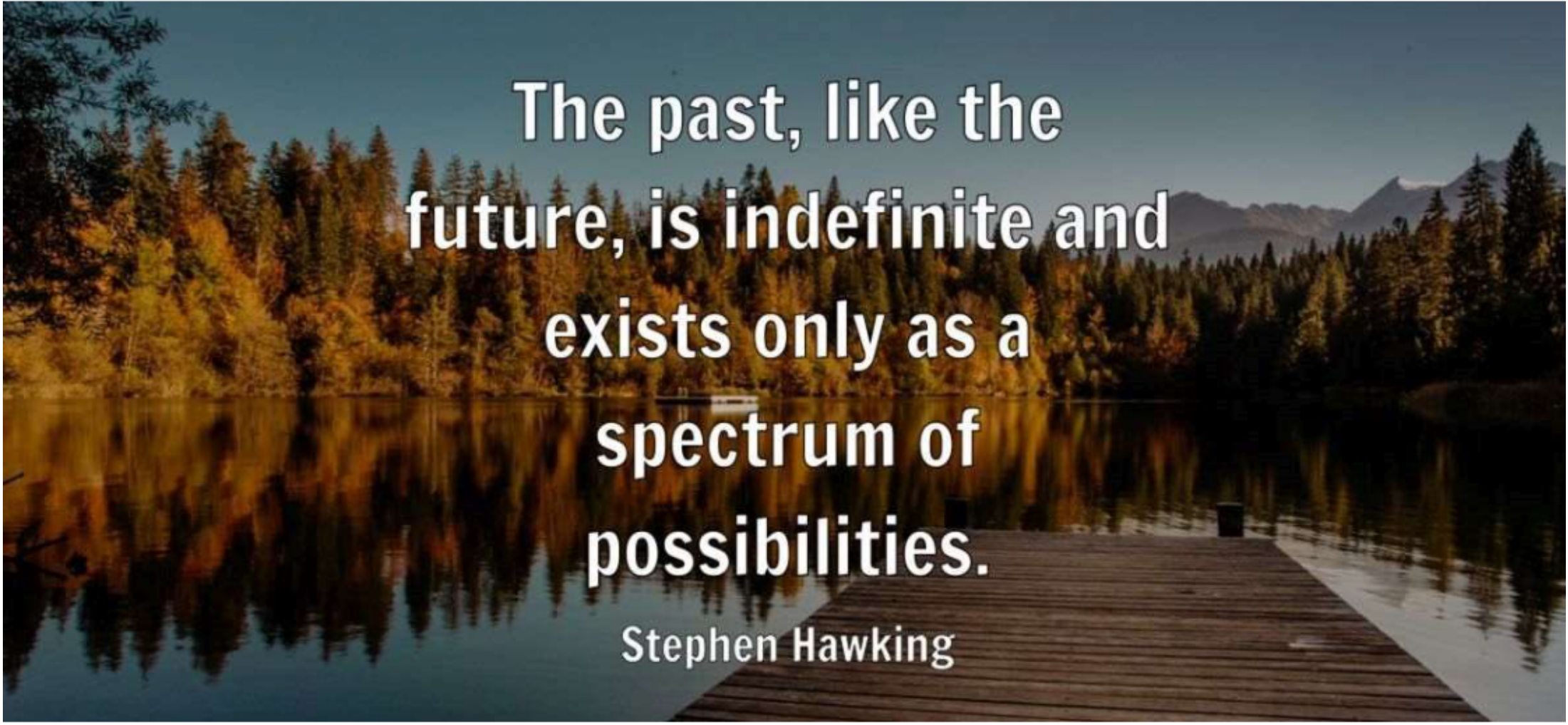


Cast Iron → Pitting



Due to high
Hertzian pressures





The past, like the
future, is indefinite and
exists only as a
spectrum of
possibilities.

Stephen Hawking



Thanks for your attention, Questions?

