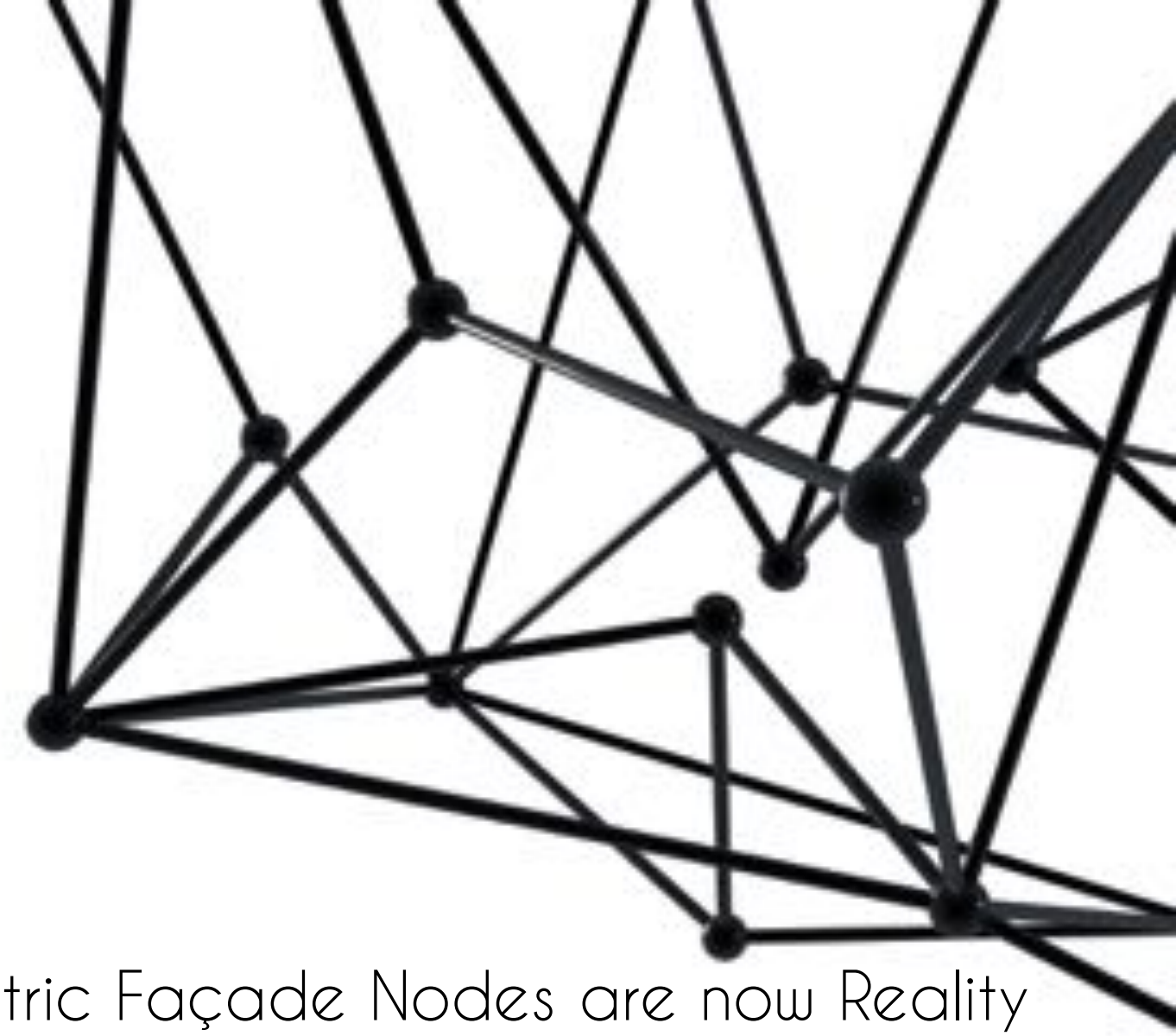
Li3

Lithium Designers GmbH



Jun. **2022**

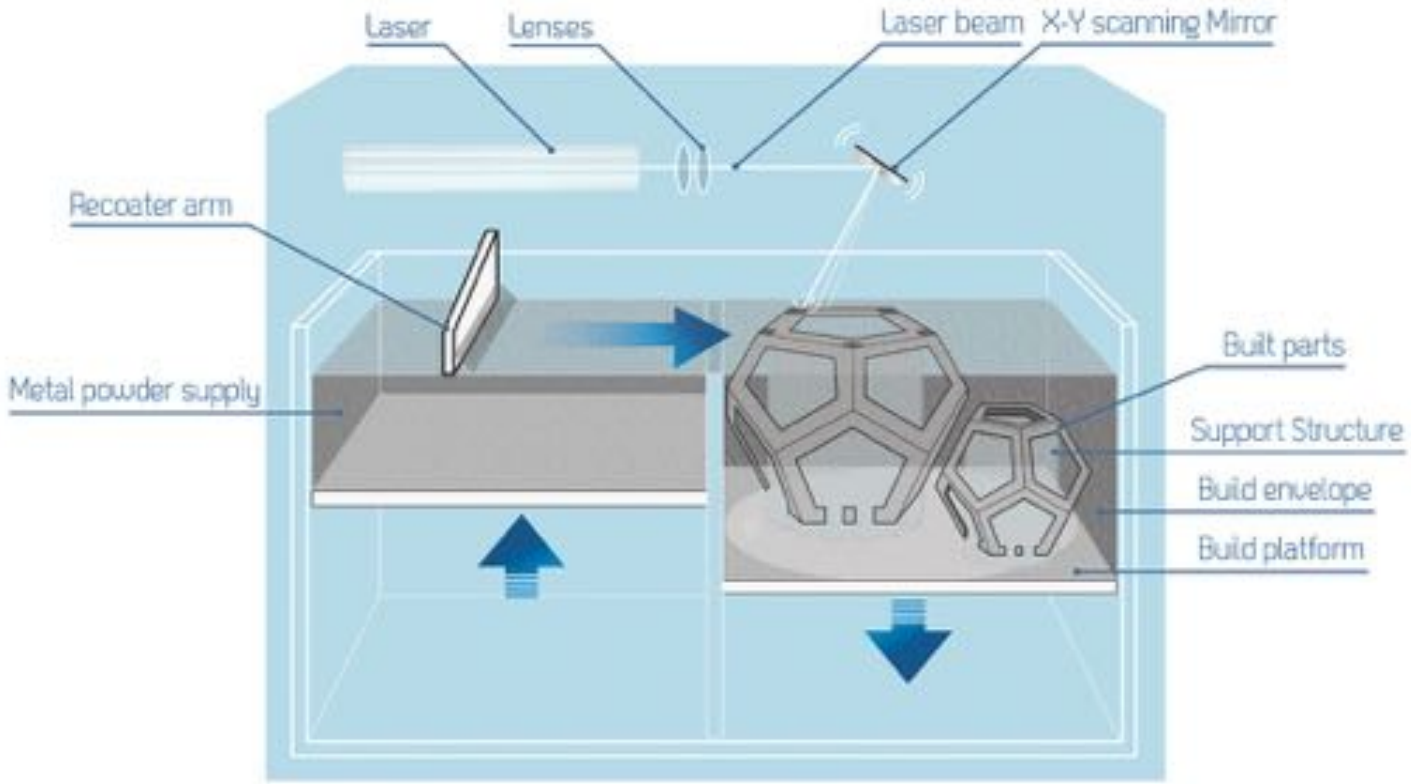
# N-AM_Li3 – 3D Printed Parametric Façade Nodes are now Reality

Presented by **Dr.-Ing Alamir Mohsen**

# State of the Art

- Additive Manufacturing of Metals (SLM).
- Direct Modelling vs. Parametric Modelling.

# Additive Manufacturing of Metals

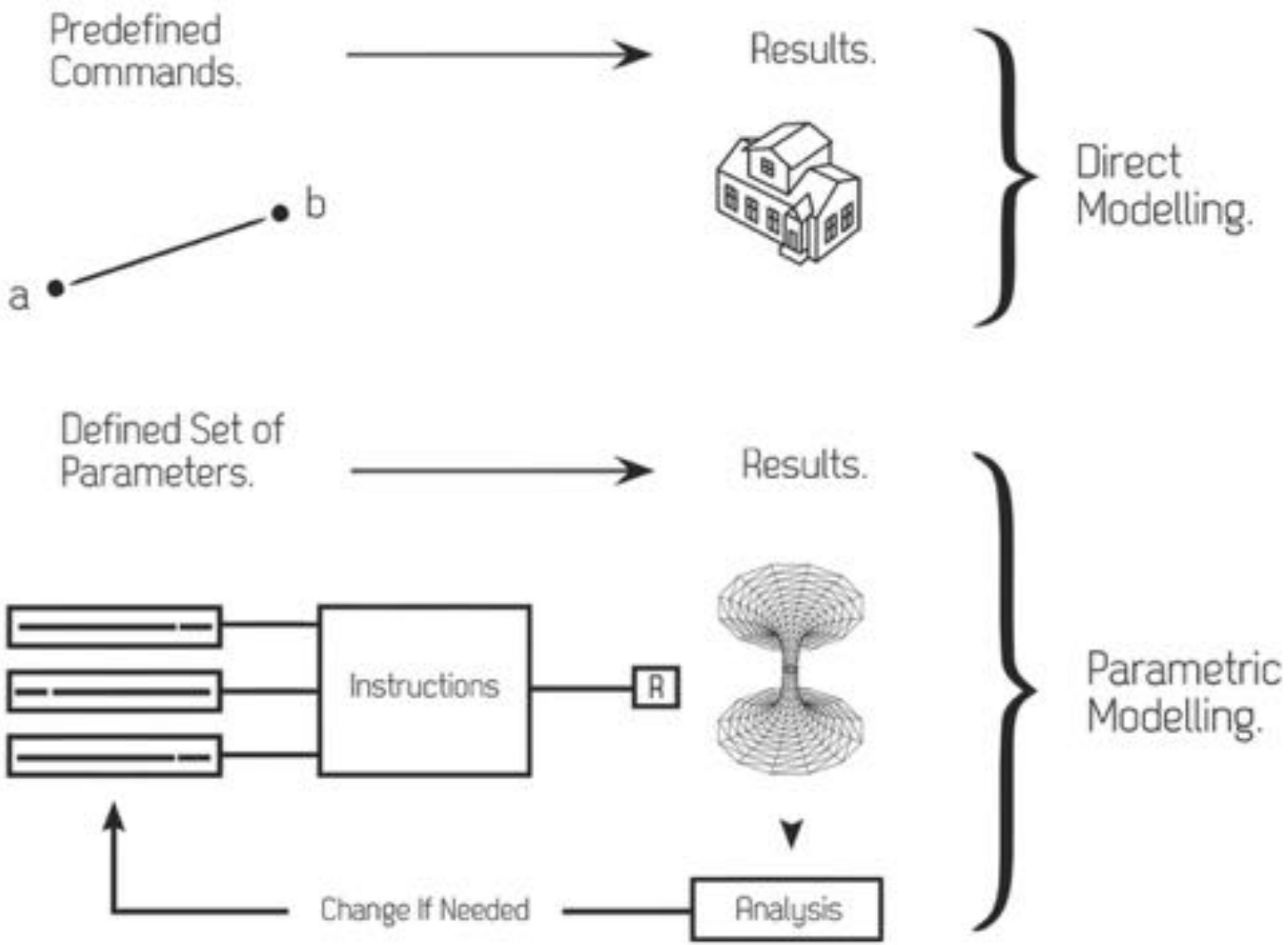



Selective Laser Melting (SLM)

# State of the Art

- Additive Manufacturing of Metals (SLM).
- Direct Modelling vs. Parametric Modelling.

## Direct- vs. Parametric-Modelling

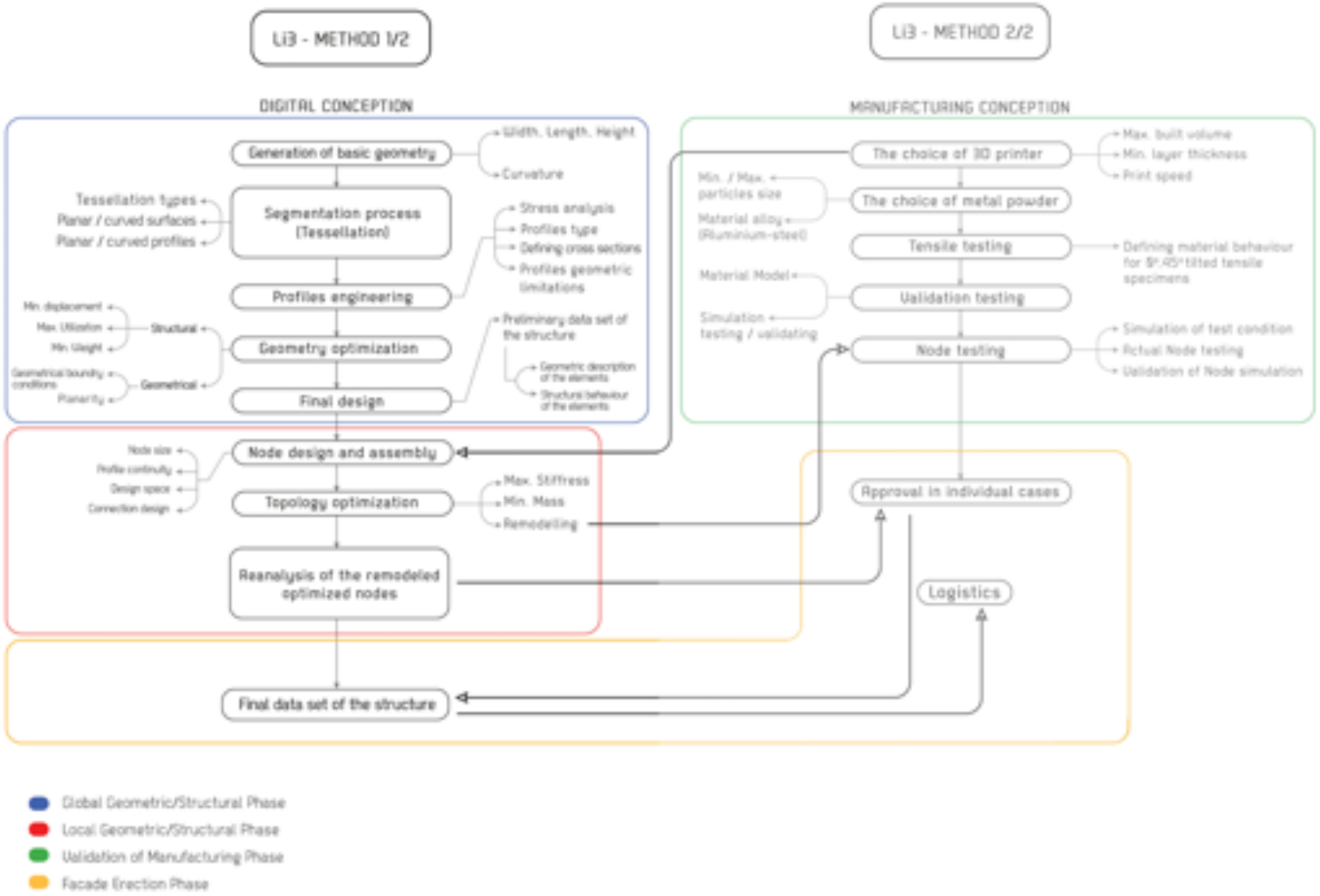


# Proof of Concept

- **Li3_Method:**

› Digital Planning concept.
› Manufacturing Planning concept.

# Li3_Method

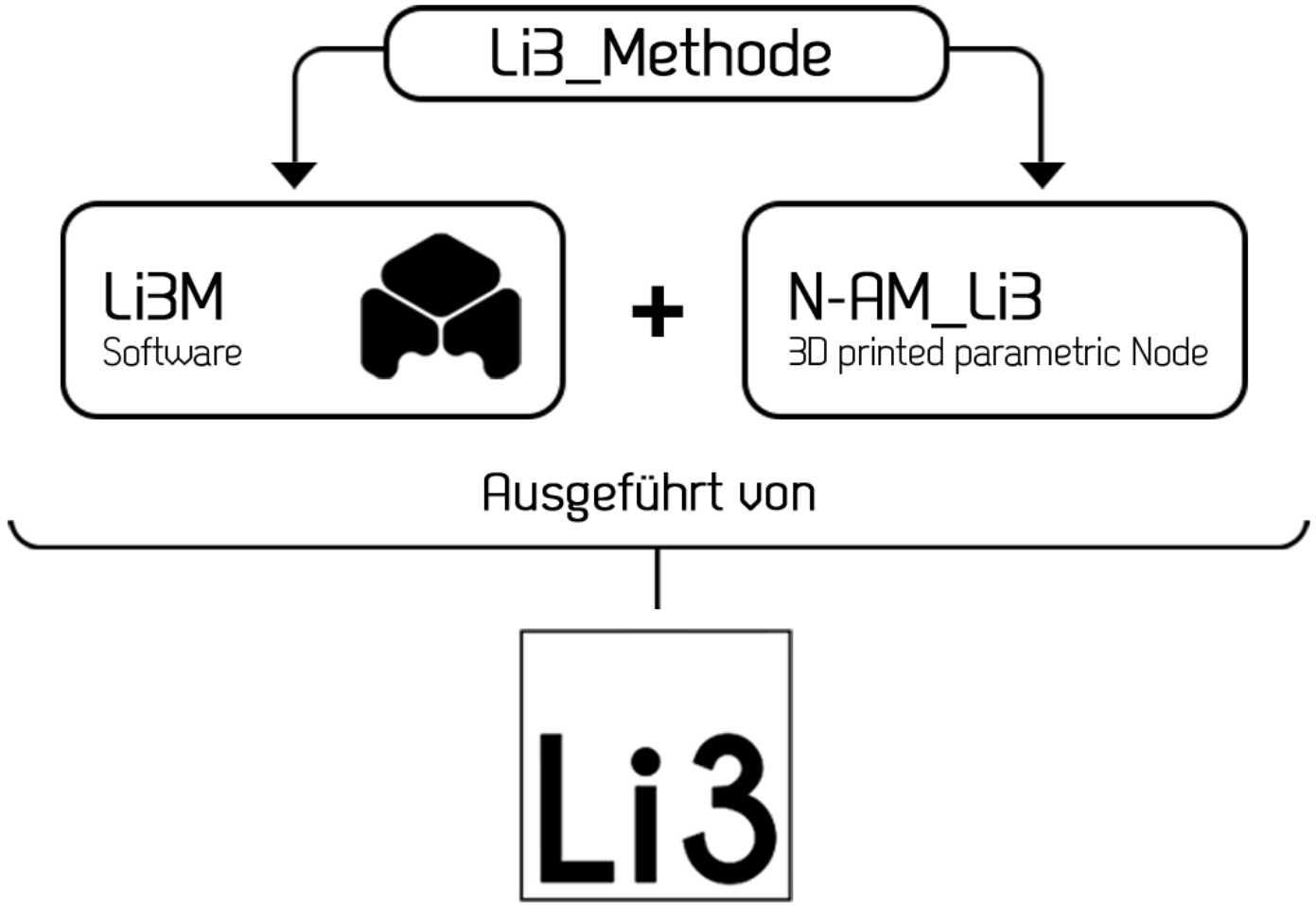


# Proof of Concept

- **Li3_Method:**

› N-AM_Li3
› Li3M Software

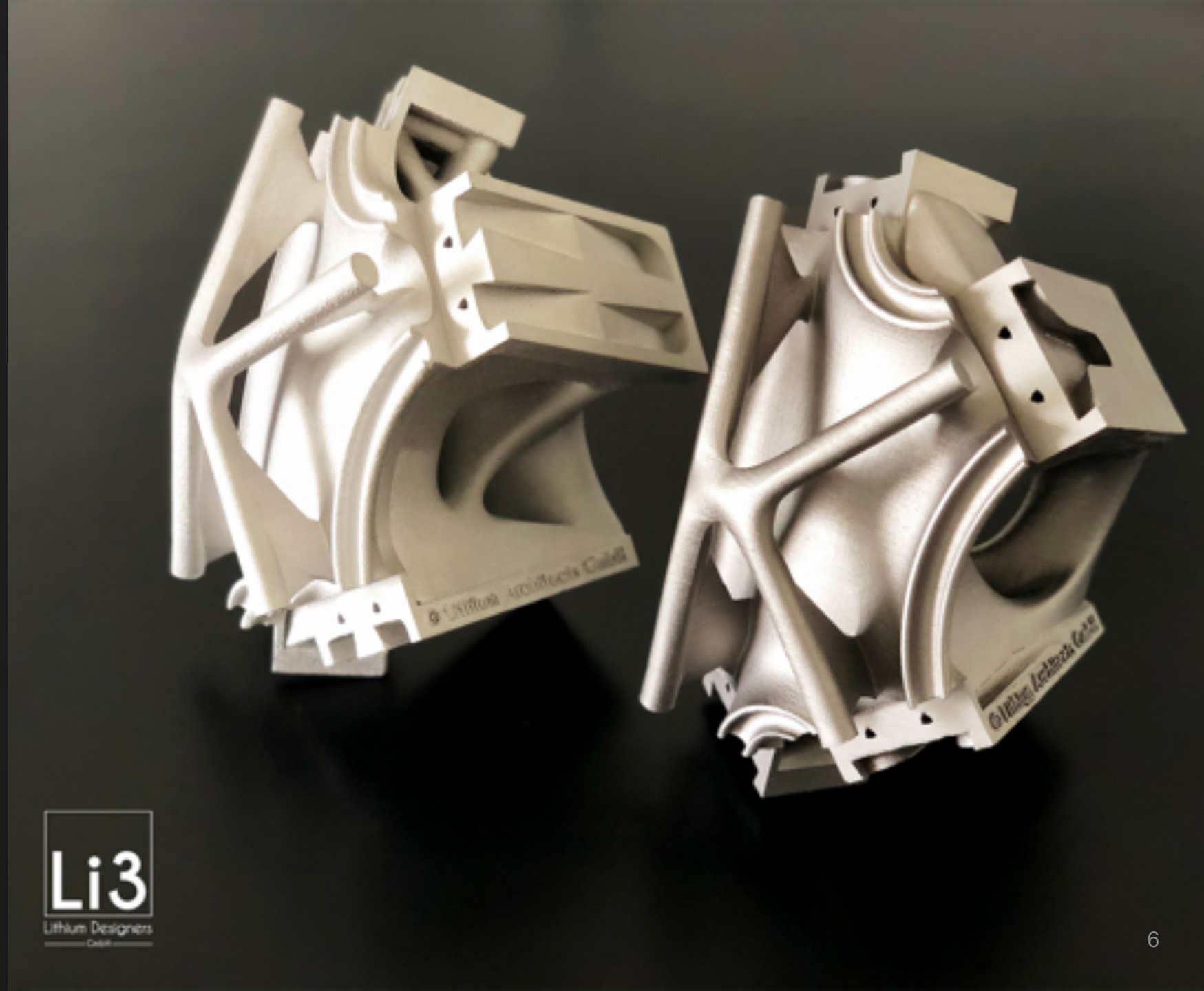
# Li3_Method



# Proof of Concept

- **Li3_Method:**

› N-AM_Li3 I
› N-AM_Li3 II



Li3
Lithium Designers

# Proof of Concept

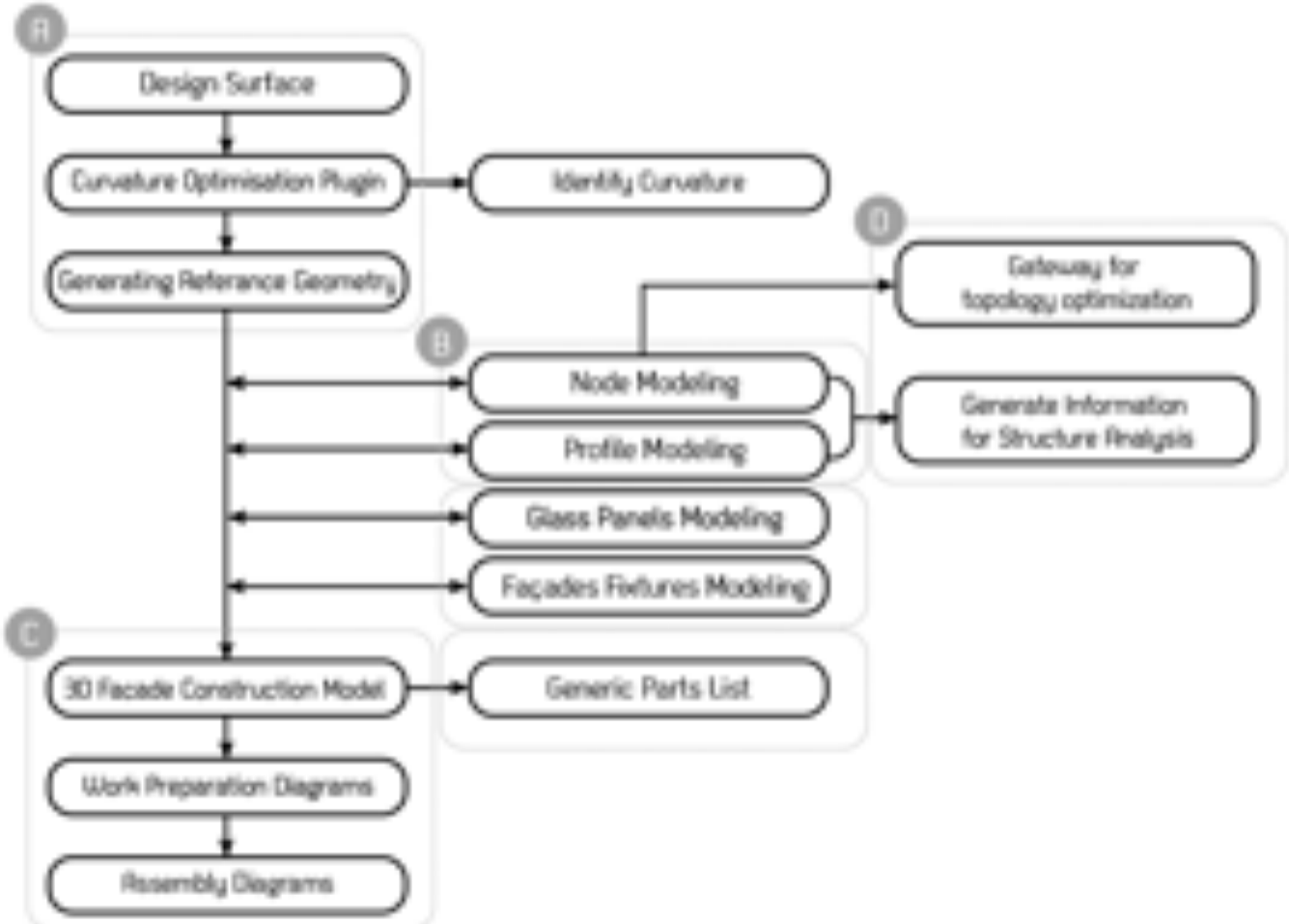
- **Li3_Method:**
  - Li3M Software

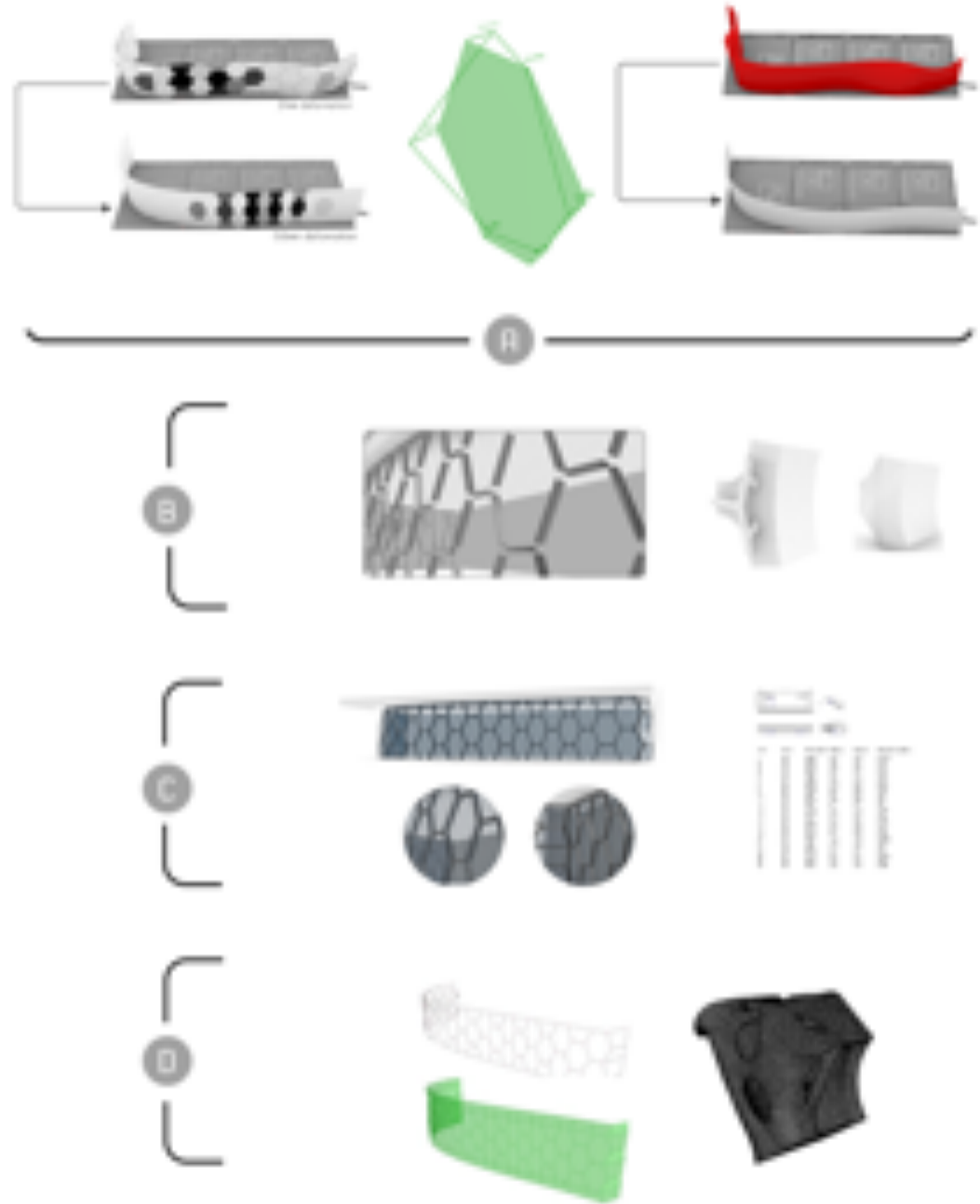
# Li3_Method

Li3M

DEVELOPED BY
LITHIUM DESIGNERS GMBH

# Li3M
## SOFTWARE MAIN FUNCTIONS



# Li3M
# SOFTWARE MAIN FUNCTIONS

## Geometric Functions

C# SQL Server Karamba 3D

## Coded Building Elements

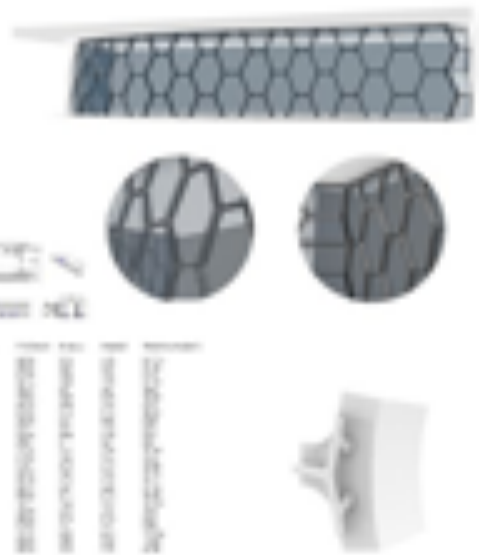
| Objects | Nodes Properties | BarElement Properties | GlassPanel Properties |
|---|---|---|---|
| Node | Vector3d NodeNormal | Cruve BarRotes | Surface> PanelSrf |
| BarElement | Point3d NodeCentre | Vector3d BarNormal | List<BarElement> BarsConnectedToPanel |
| GlassPanel | List<Vector3d> NodeBarNormals | List<Vector3d> ConnectionNormals | List<Node> NodesConnectedToPanel |
| | List<GlassPanel> ConnectedGPs | List<Surface> ConnectedSrfs | List<Curve> PanelConnectedToPanel |
| | List<Curve> ChannelCrvs | | List<Vector3d> PanelNormals |
| | | | List<Curve> JointsCurves |
| | | | List<double> ToleranceWithEachGP |

## Main Core Program

Visual Studio

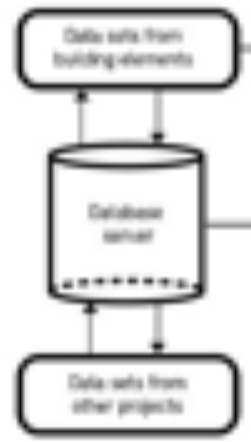
C#.Net Code

## 3D Building Elements



## Design Constraints

## DataBank Server for generic documentation



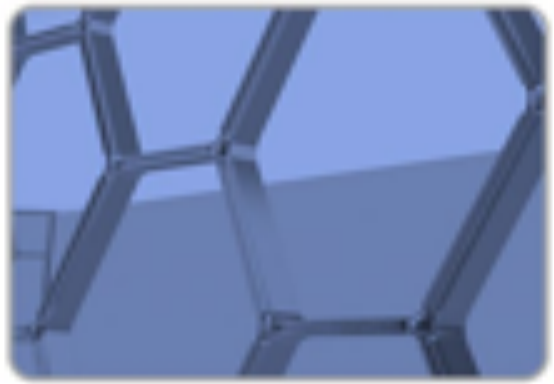

## Building Systems

Projektbeispiel

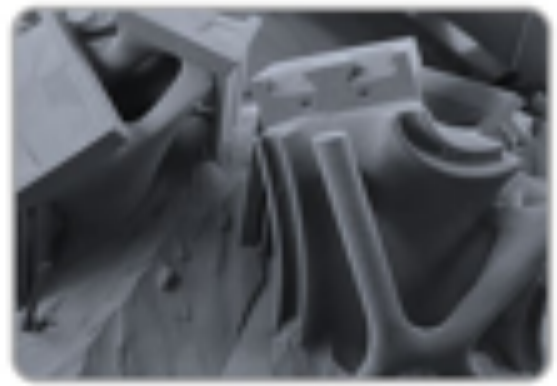
# HivE

- Surface Optimierung
- Profile| Glass Modellierung
- Automatisierte statische Berechnung
- Digitale Bauteile

**Fully Digital Planning**




**Prefab Manufacturing**



- Produktion 3D gedruckter Knoten
- Montage-Kits mit Knoten & Profile für Freiformfassaden

# Pilot Project HivE

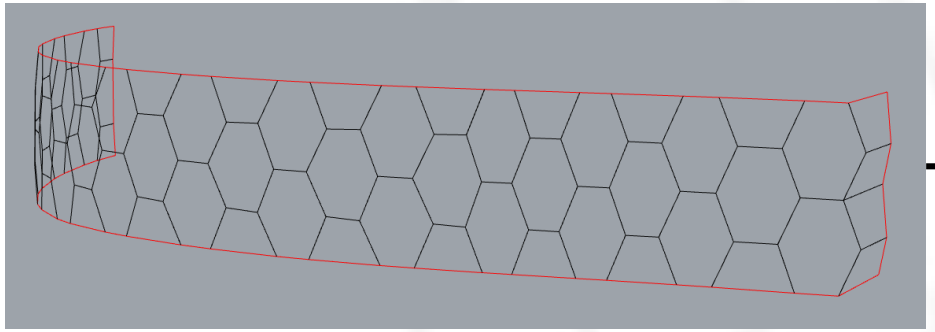
# Structural Analysis

- 134 3D Printed Nodes “N-AM_Li3”

# Structural Analysis

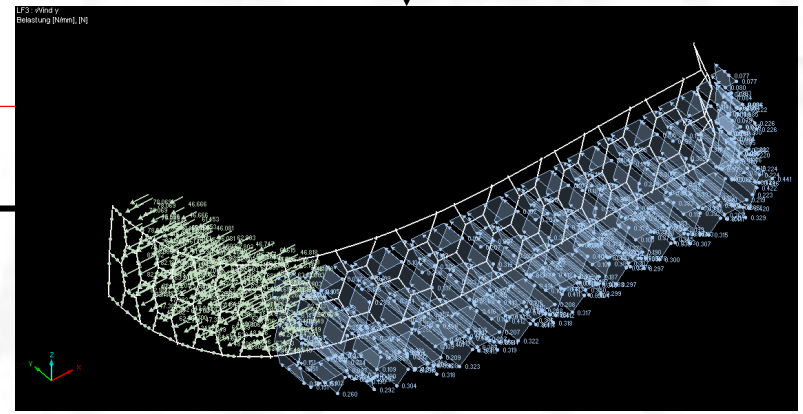
- Global Structure Analysis
  - Dead load, Wind, Temperature impact

Base Geometry

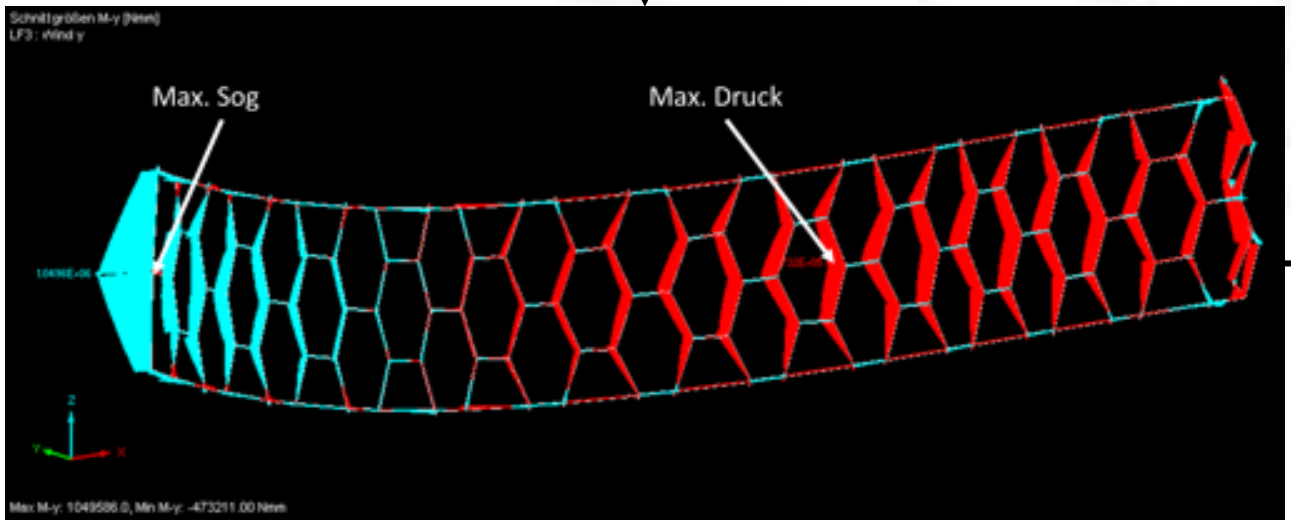


Load Implementation

Wind
Temperature
Impact Load



Stress Resultants

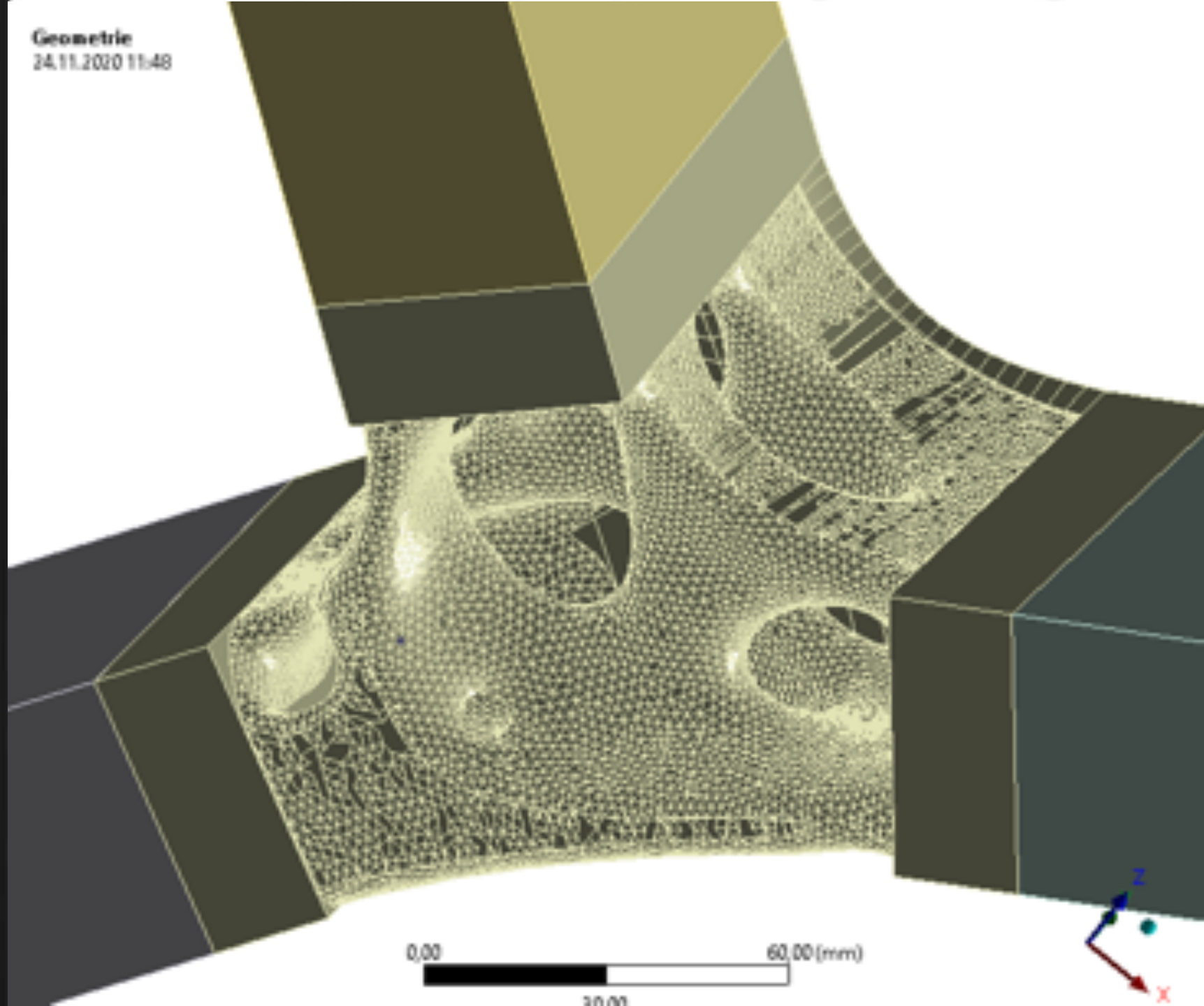



Next:

Topology Optimization

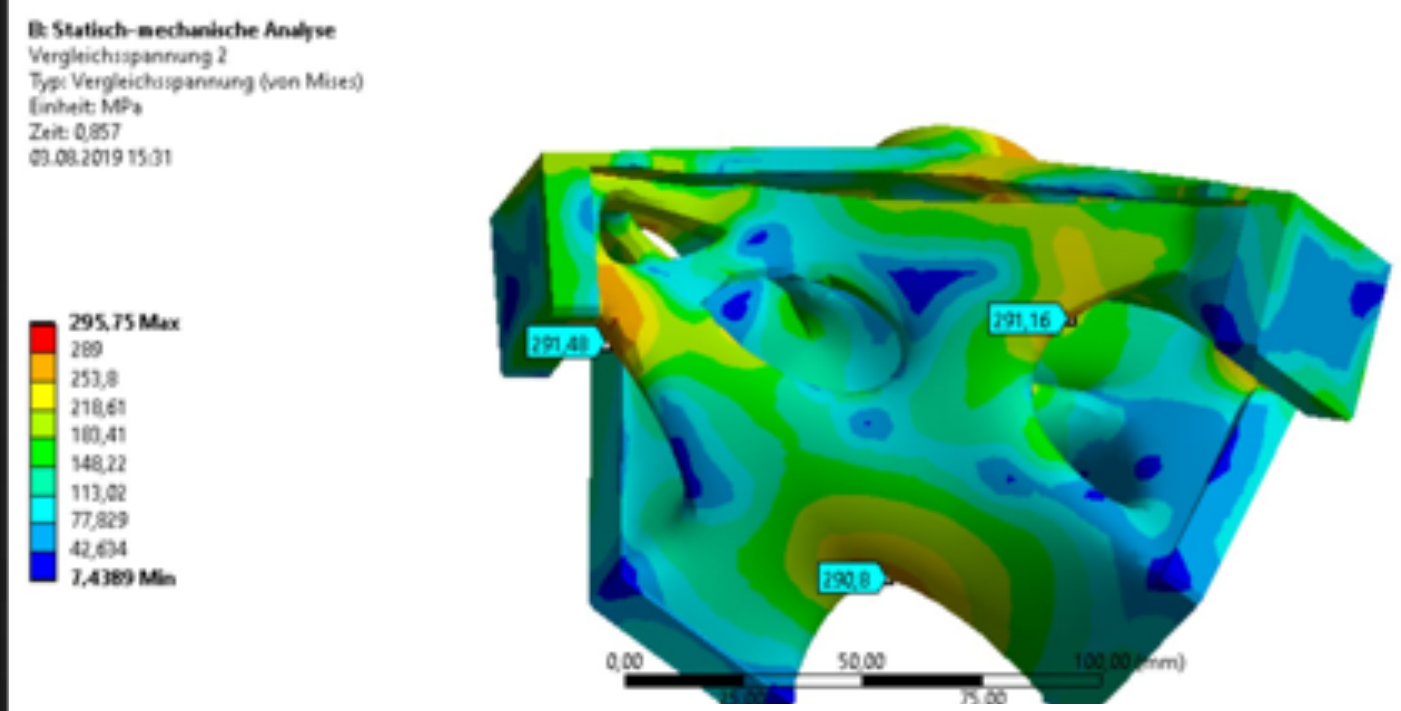
# Structural Analysis

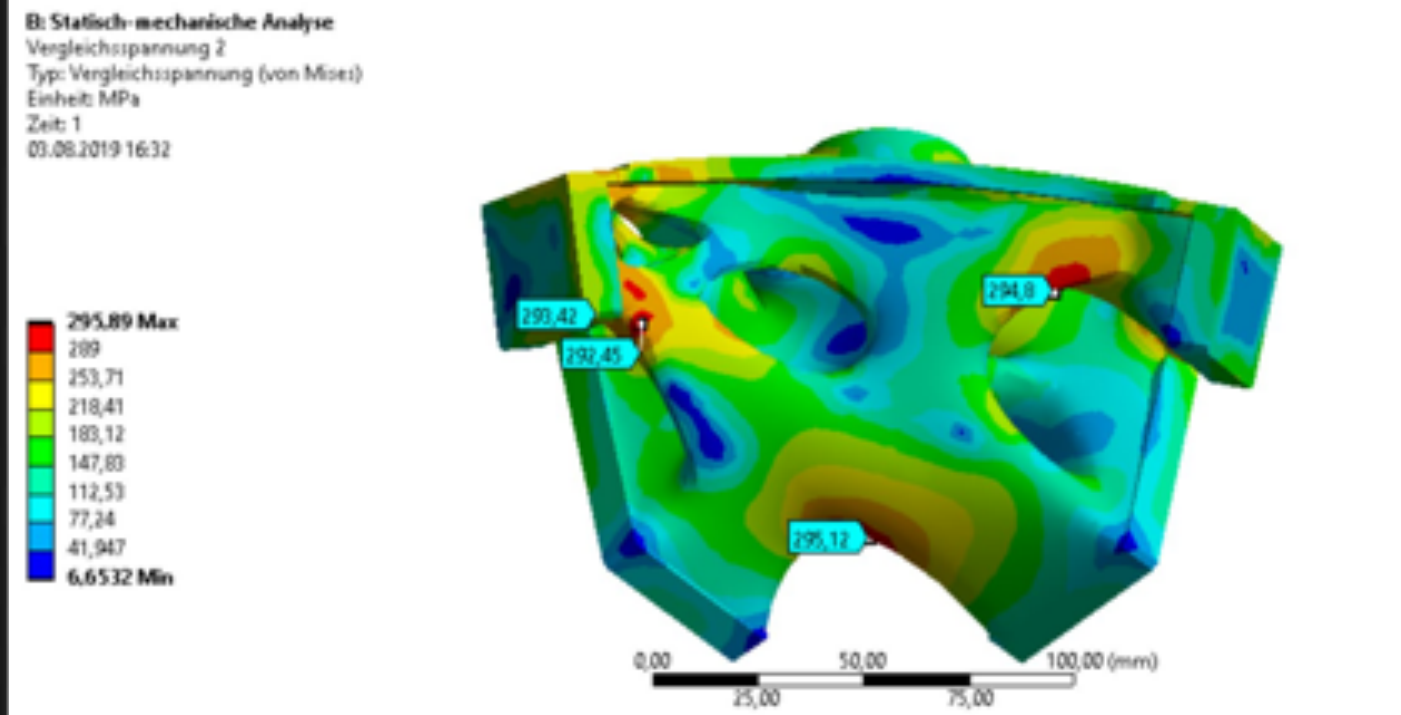
- Local Structure Analysis
  - Topology Optimization
    - Permitted Topology optimization process



# Structural Analysis

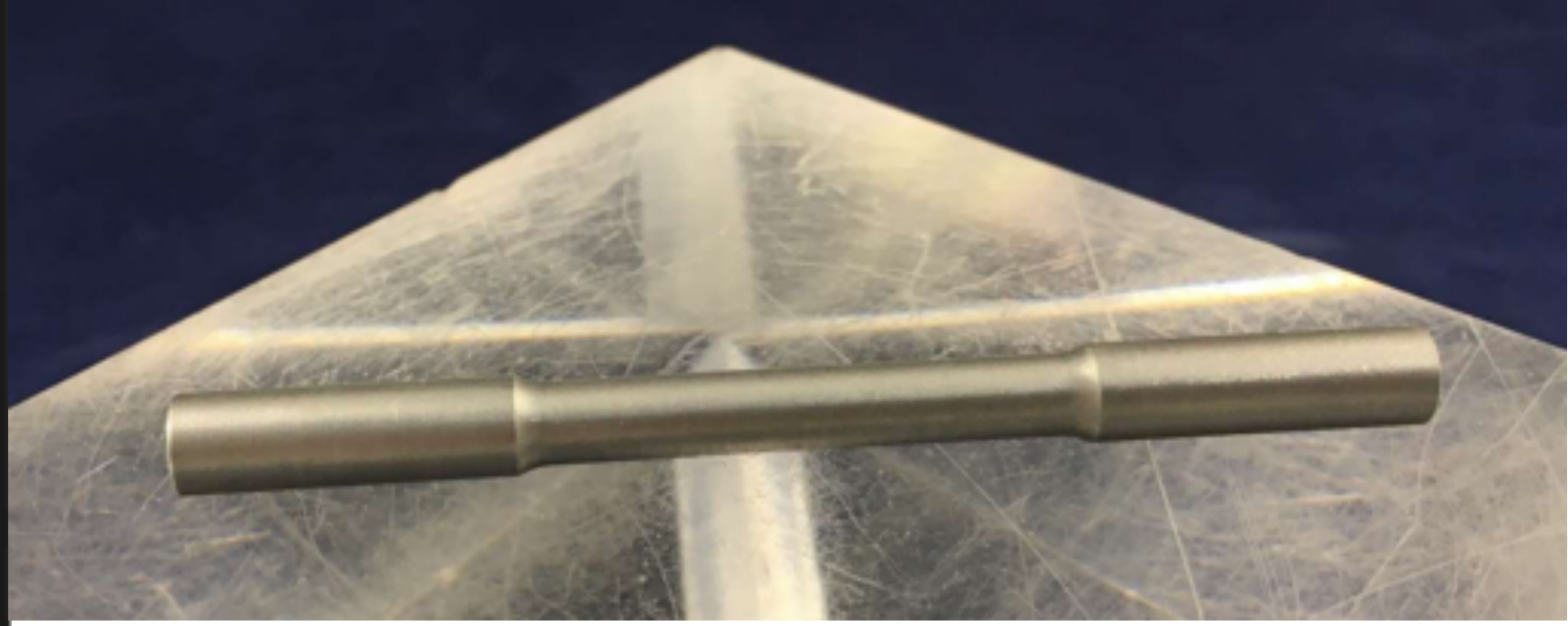
- Local Structure Analysis
  - Topology Optimization
    - Permitted Topology optimization process

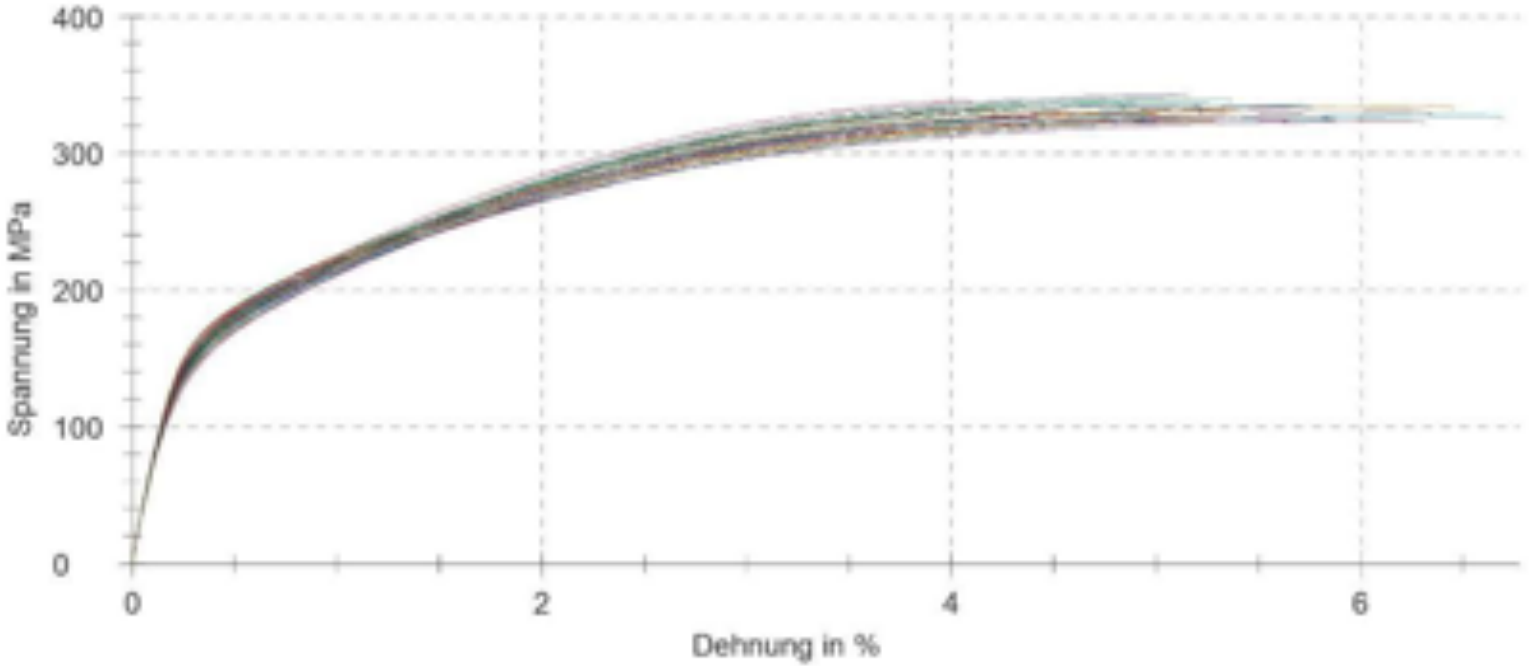


# Structural Analysis

- Local Structure Analysis
  - Topology Optimization
  - Material properties tests
    - Audited Material properties



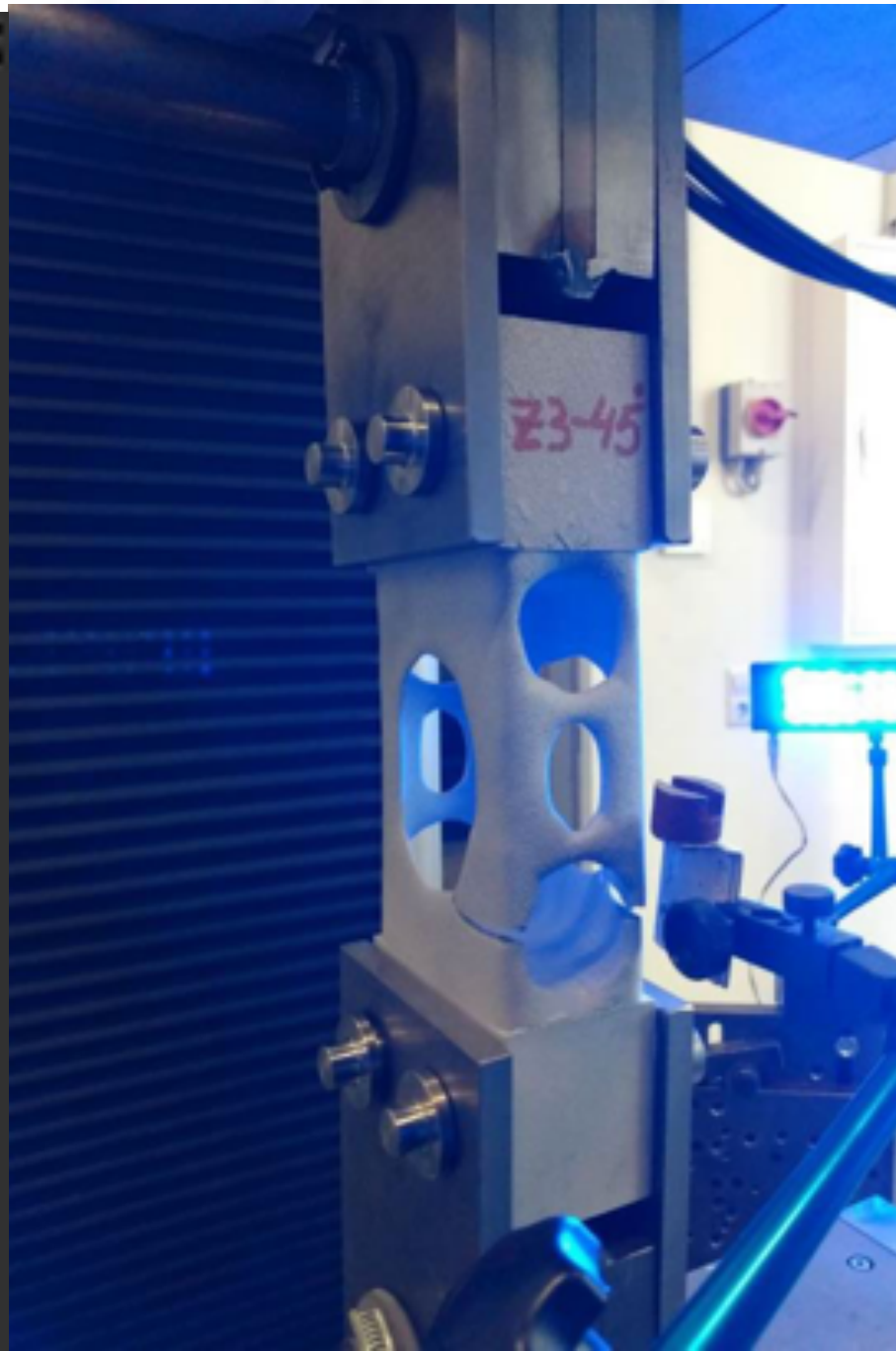


# Structural Analysis

- Local Structure Analysis
  - Topology Optimization
  - Material properties tests
  - Validation of the Topology optimization tests

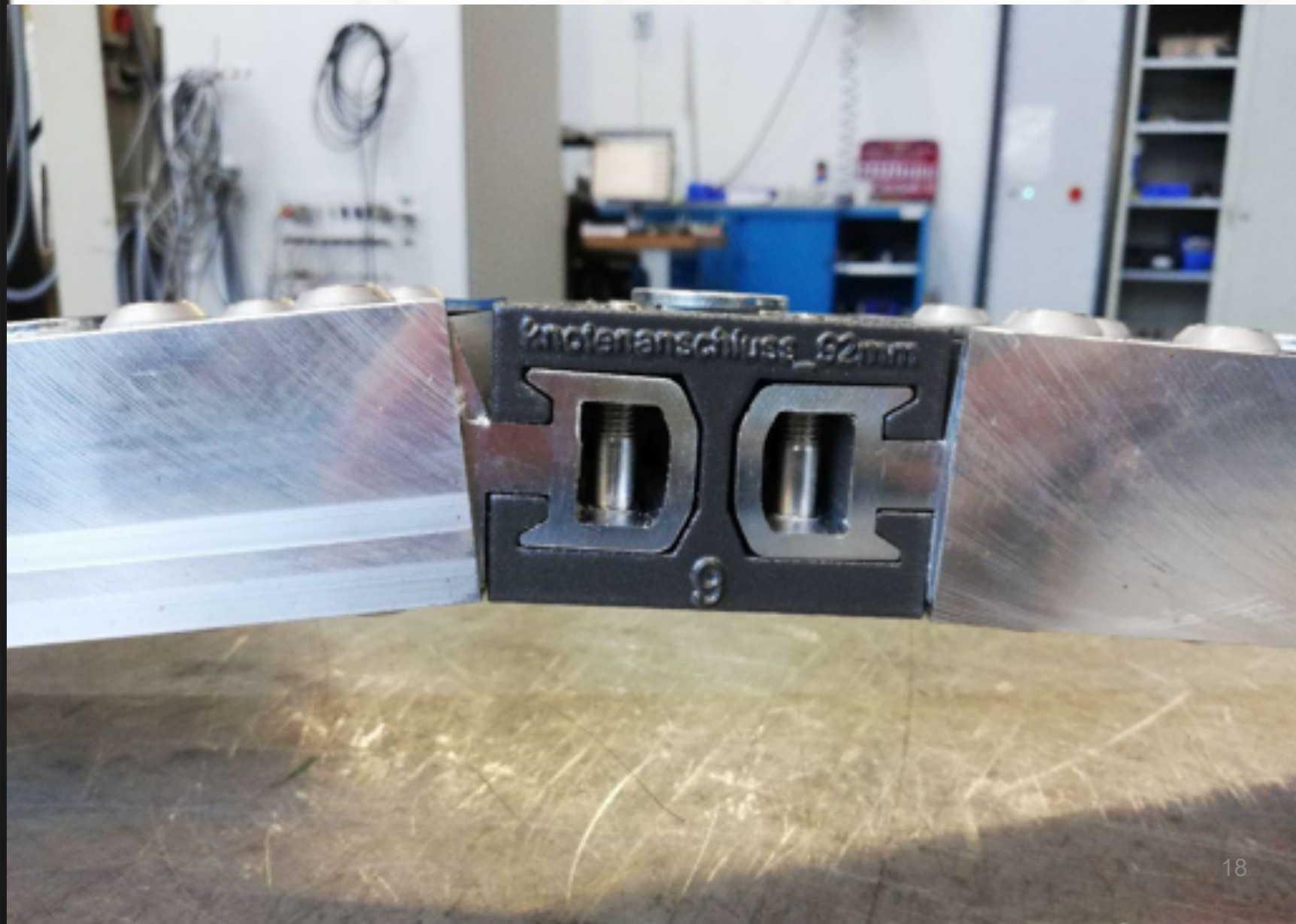
3D Scan

Experiments on topology optimized structures



# Structural Analysis

- Local Structure Analysis
  - Topology Optimization
  - Material properties tests
  - Validation of the Topology optimization tests
  - Validation of the connection Node-Profile tests



# THANK YOU