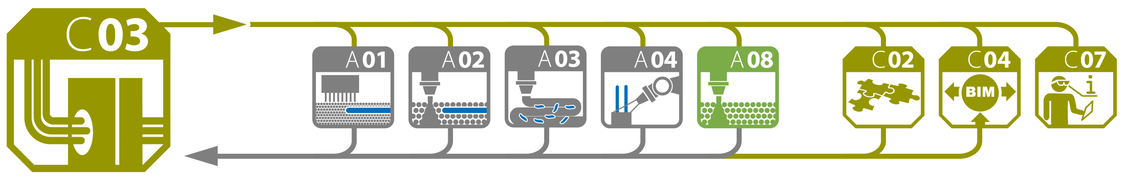
C03

Integration of Passive and Active Functions in Additively Manufactured Construction Elements

Prof. Dipl.-Ing. Thomas Auer | Chair of Building Technology and Climate Responsive Design, TUM

Summary



This research project aims to develop and test additively manufactured building components that integrate multiple passive and active functions to improve building operation and environmental quality. It explores the potential of AM of building components to incorporate different performative features. The components are developed and optimised through a simulation-based parametric design process for integrated performative functions. This research introduces methods for a robust performance using AM building components due to the integration of passive and active functions in their design, fabrication and construction process.

Research Question

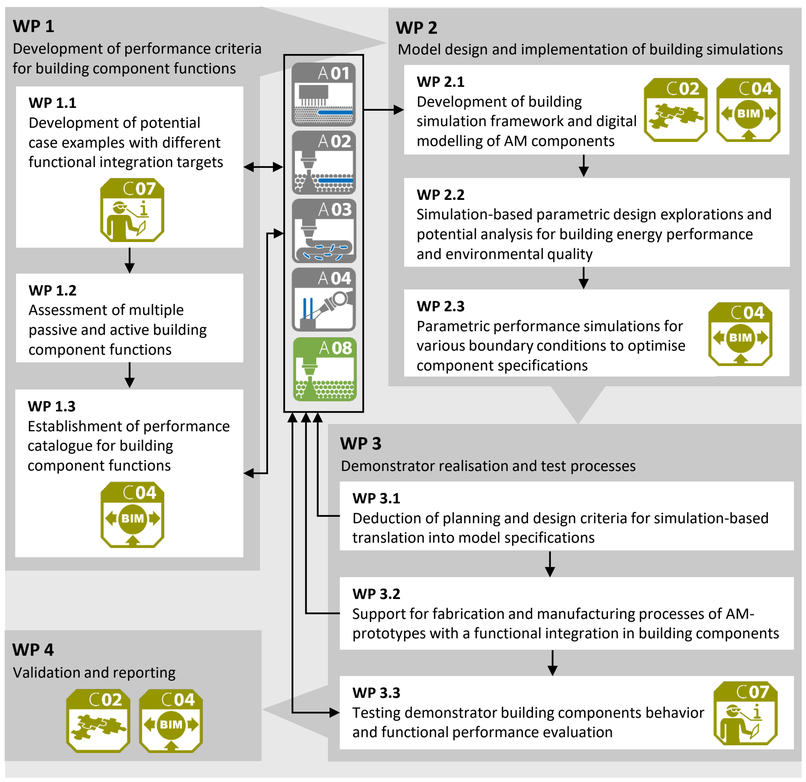
Which performative passive and active functions can be integrated in AM building components in different geometries and functional scenarios - considering different materials - and can their suitability be verified?

Expected outcomes:

- Analytic process to explore how complex AM component geometries can achieve both, a minimised use of material and performance optimised intrinsic characteristics.
- Methods to optimise functions, integrated in AM building components through a simulation-based process.
- Additively manufactured building components with multiple integrated passive and active functions.

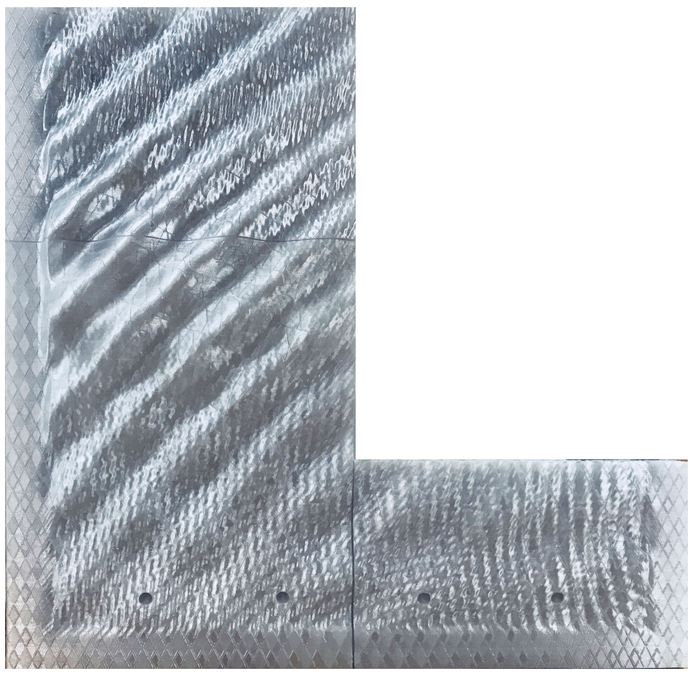
Methods

- Integration and verification of multiple building technologies within the framework of a distinct construction method - Additive Manufacturing (AM).
- Methodology based on prediction of specific indoor comfort performance metrics that will be simulated considering location, function and climatic conditions according to the components' material properties.
- Focus on the assessment of multiple requirements for passive and active building component functions.
- Simulation-based parametric design process to explore, predict and quantify the benefits from an energy and comfort related point of view for the multiple functions.
- Based on performance and potential analysis, variants are turned into physical mock-ups (A-Projects).
- Identify which prototypes, including its functional integrated building components, are tested under real conditions in the research and experimental laboratory or at the solar station.
- Manufactured prototypes are tested, using different testing protocols in order to verify and validate the various simulation models.

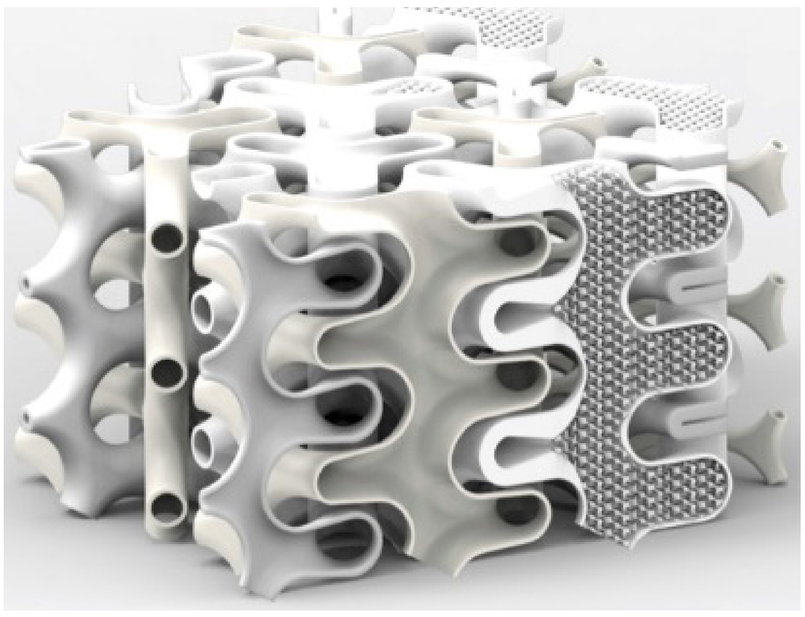


Preliminary Work

- Thomas Auer has more than 25 years of experience in the building industry and developed concepts for projects around the world noted for their innovative design and energy performance.
- In collaboration with the University of Wisconsin, Madison and other companies and institutions Thomas Auer`s company 'Transsolar' develops the established dynamic thermal simulation package 'Trnsys'.
- Thomas Auer's research shows a continuation of his thorough understanding of environmental quality as well as energy performance.
- The desire and need to simplify and standardize building construction has been studied in several research projects.



Additively manufactured façade element considering performative aspects such as solar control and natural ventilation



Additively manufactured and functionally integrated wall or ceiling component, functional-geometry of 'Hyperbolic Chanel-System' for different media (air and fluids) with high structural properties