

# LIVING PROTOTYPES

## Digital Fabrication Processes and Prototypes for Resource-Conscious Living Spaces

#digitaltools #designprocess #materials&products  
#naturalresources #housing #craftsmanship #climatechange

A Collaborative Project on digitally fabricated prototypes for residential buildings, using natural materials and developed by three teams of university research centres and industry partners across Europe

with

Forschungsinitiative Zukunft Bau (BBSR), Bonn

CITA – Centre for Information Technology and Architecture, Royal Danish Academy,  
Copenhagen

COBOD International A/S, Copenhagen  
FibR GmbH, Kernen

ITKE – Institute of Building Structures and Structural Design, University of Stuttgart

IAAC – Institute for Advanced Architecture of Catalonia, Barcelona

WASP, Massa Lombarda

## INTRODUCTION AND AIMS

Prototypes can demonstrate the kinds of building components possible with digital fabrication as well as make the underpinning processes and techniques tangible and comprehensible. *Living Prototypes* was awarded research funding under the Zukunft Bau funding programme of the Federal Institute on Building, Urban Affairs and Spatial Development (BBSR) and is a collaboration between ANCB and university research centres and industry partners in Germany, Denmark, Spain and Italy.

- Three university-industry teams will undertake the conception, design, planning and fabrication of prototypes for everyday living space, using digital fabrication techniques and natural materials.
- Online and public formats accompanying the research project will instigate a discourse around a digital building culture, the uptake of digital fabrication in the building industry, the use of resource-efficient materials and the lifecycle of building materials.
- The project will culminate with an exhibition at Aedes Architecture Forum in December 2022 presenting the fabrication process, the functionality and the physical appearance of the prototypes.

## FORMATS AND TIMELINE

27–28 Sept. 2021	Opening workshop
Sept. 2021 – March 2022	Research phase at partner universities
March 2022	Mid-term workshop
April – Nov. 2022	Prototype testing phase at partner universities with industry partners
9 Dec. 2022	Symposium and exhibition opening
10 Dec. 2022–26 Jan 2023	Exhibition at Aedes Architecture Forum
March 2023	ANCB Publication

## DOCUMENTATION

- Video diaries documenting prototype development processes
- Interviews with research teams and advisors
- Video recordings of workshops and symposium
- Scientific papers published by research teams
- Printed publication complementing ANCB Edition #4 Craftsmanship in the Digital Age. Architecture, Values and Digital Fabrication (2019)

Part of the ANCB Theme

### **RESPONSIVE CITY: Combining Local Knowledge with Digital Systems**

**The climate emergency, rapid population fluctuations and the increasing social segregation require a behaviour-changing responsiveness based on awareness and responsibility rather than on convenience. We need to reduce the impact of everyday urban life on resources, from the scale of the individual home to the global network of connectivity.**

If the use of space, services and resources are to be modified, value sets need to change. Human behaviour and knowledge need to inform digital tools to achieve an integrated approach.

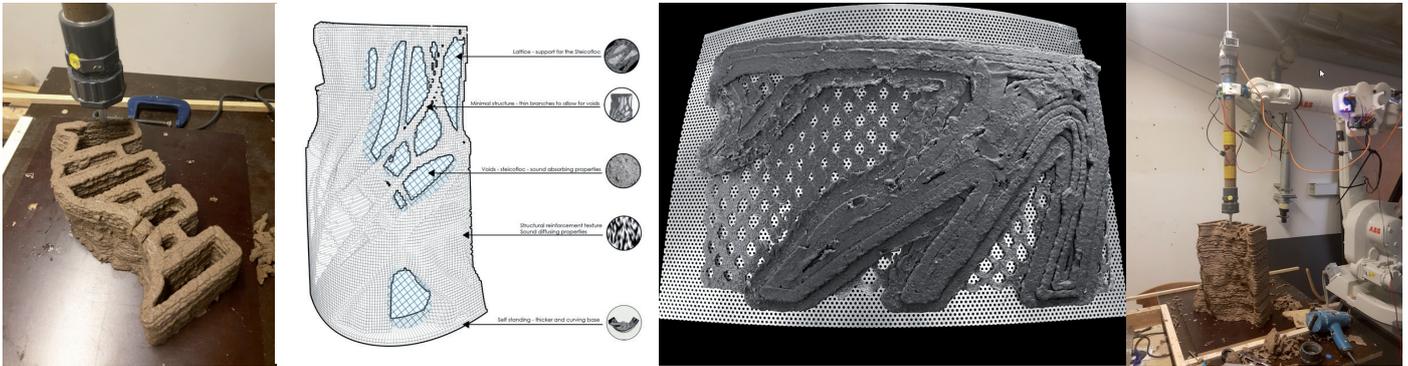
How can digital tools support the design of new living and working typologies that limit material wastage and are more affordable? What role can prototyping play in digitally fabricating efficient building components? How can traditional materials and knowledge be transformed into the digital age?

# RESEARCH PROJECTS

## BIO-BASED LIFECYCLE MATERIALS – Cellulose Enclosures

CITA – Centre for Information Technology and Architecture, Copenhagen and COBOD International A/S, Copenhagen

In contrast to the petroleum-based plastics used for 3D-printing, cellulose-based bioplastics are renewable, inexpensive, biodegradable and chemically diverse. Digital data analysis technologies, such as machine learning, make it possible to predict and control the behaviour of these materials during and after the printing process. CITA and COBOD will explore components for interior spaces made possible by this adaptive manufacturing process, and with the perspective of material lifecycles and circularity in building.



## NATURAL FIBRE WINDING – Composite Installation in Existing Buildings

ITKE – Institute of Building Structures and Structural Design (ITKE), University of Stuttgart and FibR GmbH, Kernen

The fabrication technique of robotic fibre winding produces material-efficient architectural components, as no formwork is required and no cut-offs are produced. The amount of fibre used corresponds exactly to what is needed for structural performance. ITKE and FibR investigate winding with flax-based materials, rather than the fossil-based materials used to date. By developing composite prototypes that engage with the existing materials and geometries of the Aedes exhibition space, adaptability in living spaces will be explored.



## LOCAL MATERIALS – 3D-Printed Earth-Based Buildings

IAAC – Institute for Advanced Architecture of Catalonia, Barcelona and WASP, Massa Lombarda

Earth is a traditional and inexpensive building material, for which extensive technical knowledge exists locally. IAAC and WASP employ 3D-printing and computational design to improve the structural and climate-regulation performance of earth construction, advance its aesthetic capacity and make the construction process more efficient and feasible for infill and other forms of built environment densification. Material local to the Berlin area will be combined with bespoke additives for the robotic fabrication of a prototype for an internal building component.



## RESEARCH TEAMS

### **BIO-BASED LIFECYCLE MATERIALS – Cellulose Enclosures**

CITA – Centre for Information Technology and Architecture, Copenhagen and COBOD International A/S, Copenhagen

- Mette Ramsgaard Thomsen (CITA)
- Martin Tamke (CITA)
- Paul Nicholas (CITA)
- Gabriella Rossi (CITA)
- Alma Bangsgaard Svendsen (COBOD)

### **NATURAL FIBRE WINDING – Composite Installation in Existing Buildings**

ITKE – Institute of Building Structures and Structural Design (ITKE), University of Stuttgart and FibR GmbH, Kernen

- Jan Knippers (ITKE)
- Marta Gil Pérez Design (ITKE)
- Moritz Dörstelmann (FibR)
- Christo van der Hoven (FibR)

### **LOCAL MATERIALS – 3D-Printed Earth-Based Buildings**

IAAC – Institute for Advanced Architecture of Catalonia, Barcelona and WASP, Massa Lombarda

- Alexandre Dubor (IAAC)
- Francesca Morretti (WASP)
- Lapo Naldoni (WASP)

### **PROJECT COORDINATION**

ANCB The Aedes Metropolitan Laboratory, Berlin

- Dunya Bouchi
- Áine Ryan

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