Forum Bois Construction

t-lab Holzarchitektur und Holzwerkstoffe

fatuk Fachbereich Architektur Rheinland-Pfälzische Technische Universität

RPTU Rheinland-Pfälzische Technische Universität Kaiserslautern Landau

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Paris • Grand Palais

26 → 28 février 2025

Primary structure of Educational and Research Hall for Circular Timber Construction ▪ 2023 ▪ ©Andreas Labes, Berlin

T-LAB FATUK, RPTU

→ : tlab.architektur.rptu.de

The t-lab research group at the Faculty of Architecture (fatuk) of the RPTU Kaiserslautern-Landau, Germany promotes sustainable innovation in building culture. Through interdisciplinary research and teaching, t-lab advances circular timber construction, emphasizing bio-based materials, resource efficiency, and reversibility. Since 2014, t-lab has focused on adaptable designs, reusable systems, hybrid timber structures, and sustainable renovation. The t-lab contributes to reducing greenhouse gas emissions, conserving resources, and avoiding waste. Projects like the Diemerstein research hall showcase circular, reversible designs, highlighting sustainable timber construction and reuse in existing buildings.

Cone adapter - reversible connector for timber construction▪ t-lab

Research for flexible residential, commercial and parking building structures. Exterior rendering in urban context ▪ 2022 ▪ ©Nikolai Becker

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RESEARCH AND EDUCATION

Hall for Circular Timber Construction on Campus Diemerstein

CHARACTERISTICS

Project Name	Educational and Research Hall for Circular Timber Construction
Location	Campus Diemerstein, Pfälzerwald, Rhineland-Palatinate, Germany
Delivery	2022-2023
Area	360 m²
Project Type	Industrial Hall
Total Construction Cost (Excl. VAT)	1,0 M€
Client	Foundation for the RPTU represented by Dr. Annette Mechel Managing Director, Villa Denis
Architect and Engineering	t-lab Timber Architecture and Wood-Based Materials
Project Leads	Prof. Dr.-Ing. Jürgen Graf Prof. Stephan Birk
Project Management	Marcel Balsen Viktor Poteschkin
Construction Execution	Oliver Betha with students of RPTU Kaiserslautern
Contractors	CItech GmbH & Co. KG / Deutsche Holzveredelung Schmeing GmbH & Co. KG / Annen GmbH + Co. KG
Insulation	wood fibre insulation
Wood Species	spruce CLT, Beech LVL

Funded by the European Union (LEADER), the State Government of Rhineland-Palatinate, and the Foundation of the Technical University of Kaiserslautern

Location in the Diemerstein valley and construction by the students on cite ▪ 2023 ▪ © Andreas Labes / t-lab

Klimabündnis Bauen RHEINLAND-PFALZ

Interior with view to the south ▪ 2024 ▪ ©Andreas Labes, Berlin

Exterior and disassembly diagram with reusable building elements ▪ 2023 ▪ © Andreas Labes, Berlin / t-lab

INTEGRATING RESEARCH AND PRACTICE IN CIRCULAR DESIGN

We need a construction revolution, aiming for a fully circular economy. This requires urgent changes in education, research, and building practices. At the t-lab of RPTU Kaiserslautern, we integrate student design, research, and full-scale implementation in pilot projects.

The Werk- und Forschungshalle in Diemerstein (13m wide, 28m long, 7m high) exemplifies this approach and marks the start of the planned timber campus in Diemerstein Valley. Its archetypal form blends into the landscape, driven by the principles of circular construction. All components are modular and reversibly connected, ensuring easy disassembly and reuse without loss of value.

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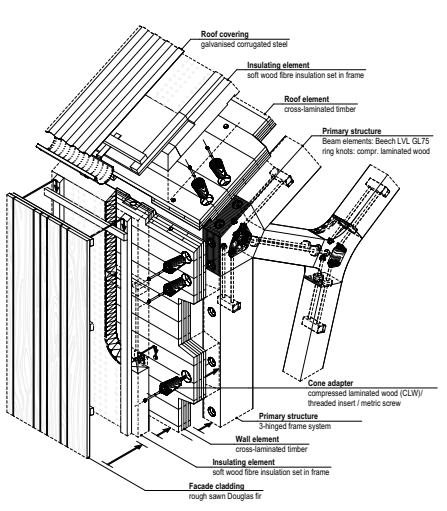
The research-design-build project embodies circular construction on a 1:1 scale. All components are designed for easy disassembly and reuse without material loss. Innovative, reversible connections ensure complete demountability, making the hall both a research facility and a pilot project for sustainable construction, showcasing practical building solutions.

Teaching and working with students in the hall for circular construction ▪ 2024 ▪ ©t-lab

REVERSIBLE CONNECTIONS FOR CIRCULAR CONSTRUCTION

To ensure non-destructive disassembly, innovative, user-friendly, and detachable connectors were developed and applied. The t-lab introduced nodes and cone adapters made of resin-compressed wood (KP), achieving reversibility through pre-stressing and form-fitting timber connections.

The hall's primary structure comprises pre-stressed three-hinged frames of BauBuche GL 75 with KP nodes. Stabilizing wall and ceiling modules use spruce CLT, connected to the frames via cone-shaped adapters. The reversible façade features soft fiber insulation, counter battens, and vertical Douglas fir cladding. Instead of a concrete slab, a removable CLT floor rests 300mm above the ground on steel profiles, transferring loads efficiently to micropiles.



Constructive design of the outer shell with replaceable layers ▪ 2024 ▪ © t-lab

Mounting of CLT to the frame structure with cone adapters ▪ 2023 ▪ © t-lab

Structural elements of the framework ▪ 2022 ▪ © t-lab

The primary structure of the Werk- und Forschungshalle in Diemerstein consists of pre-tensioned three-hinged frames made from BauBuche GL75, connected with innovative ring nodes made of compressed laminated wood developed at the t-lab. These components are designed for circular construction, emphasizing reversibility and resource efficiency.

Pre-tensioned frame structure with ring nodes ▪ 2023 ▪ © Andreas Labes, Berlin

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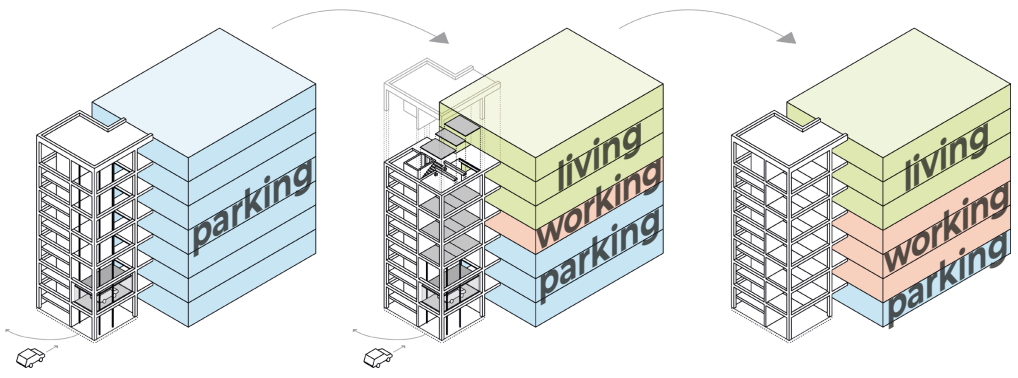
ADAPTABLE HYBRID



Access structure, differentiated primary uses, change of use | 2022 | ©t-lab

Exterior Rendering in Urban Context | 2022 | ©Nikolai Becker

RESEARCH FOR FLEXIBLE RESIDENTIAL, COMMERCIAL AND PARKING BUILDING STRUCTURES

Project Name	Wandelbarer Holzhybrid für differenzierte Ausbaustufen
Duration	01/11/2019 to 30/04/2022
Project Type	Research

Project participants in the joint project
Lead/Engineering: Graf, RPTU
Architecture: Birk, RPTU / TUM
Fastener technology: Blaß, KIT
BIM: Sadegh-Azar, RPTU
Fire/Sound protection: Winter, TUM
Building services and energetics: Auer, TUM
Life cycle assessment: Pauliuk, UNI FR

Funded by

Gefördert durch: Bundesministerium für Ernährung und Landwirtschaft, Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit aufgrund eines Beschlusses des Deutschen Bundestages
Waldklimafonds

PARKING

Vertical circulation: Vehicles, people
Building envelope: Non-thermal, impact protection for vehicles
Floor construction: CPC slab
Interior fit-out: None
Building services (TGA): Minimal, shafts provided
Regulations: MBO, M-GarVO, EAR 05

WORKING

Vertical circulation: People
Building envelope: Thermal
Floor construction: Impact sound insulation, covering
Interior fit-out: Minimal, flexible
Building services (TGA): Central shaft in use
Regulations: MBO, ASR

LIVING

Vertical circulation: People
Building envelope: Thermal
Floor construction: Impact sound insulation, covering
Interior fit-out: Flexible
Building services (TGA): All shafts in use
Regulations: MBO

FRAMEWORK FOR MULTI-USE URBAN SPACES

The chosen typology and reversible structure ensure adaptability and circularity. The building can be easily repurposed for different uses (residential, office, commercial) without altering the main structure. The use of wood as a circular material allows for further processing at the end of its life through the cascading principle. Resource efficiency is maintained, as the primary load-bearing structure remains unchanged during repurposing. This, along with the reusability of structural elements, prevents demolition and reconstruction. The project demonstrates that circular, multi-storey buildings in urban areas are achievable using timber construction, offering flexibility and sustainability.

Differentiated primary uses | 2022 | ©t-lab

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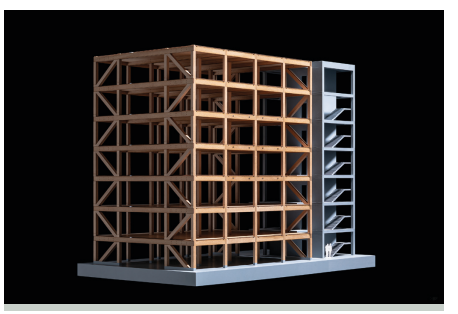
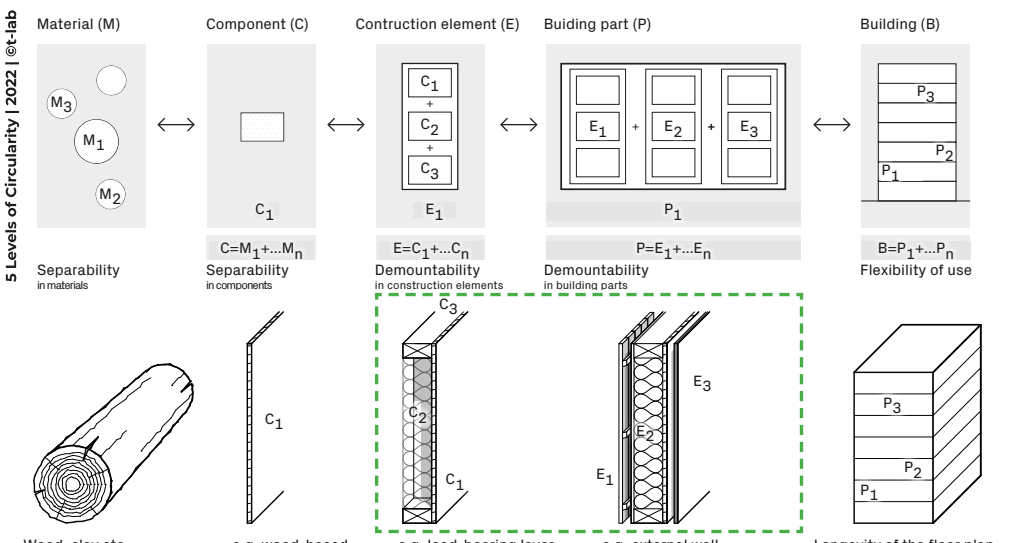
The project involves inner-city construction with potential for expansion. It falls under Building Class 5 (GK 5) and features individual units with a maximum size of 400 m². The building is designed to accommodate three primary uses: parking, working, and living. The design adheres to real-world planning conditions in Germany and aims for maximum circularity.



Space Frame Made of Beech LVL with Maximum Usage Flexibility | 2022 | ©B.Friese

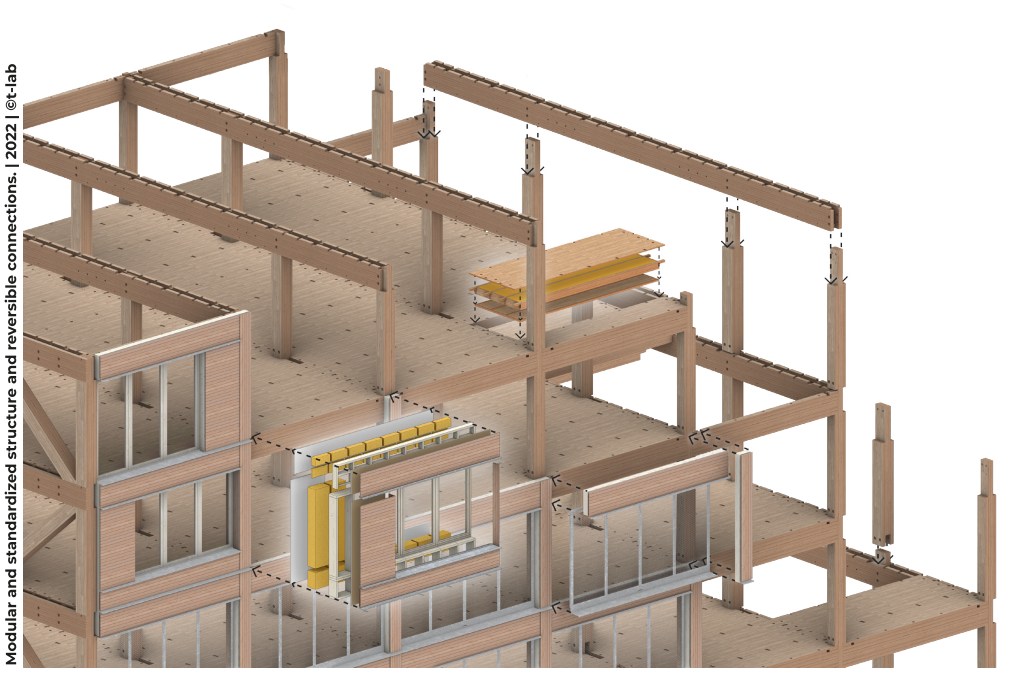
REVERSIBLE DESIGN: TIMBER, FLEXIBILITY, AND REUSE

The adaptability and circular potential are guaranteed through strategic typology, positioning of access points, and a reversible structural framework. These design choices allow individual areas or entire floors to be repurposed for various uses, such as residential, commercial, or office spaces, without altering the building's primary structure.
The reversible framework also supports the reuse and repurposing of components at both element and material levels. Timber, as a core material, offers circular capabilities: it can be repurposed, cascaded through successive applications, and eventually utilized for energy recovery at the end of its lifecycle. Additionally, this resource-efficient design eliminates the need for structural changes during transitions between uses, reducing environmental impact. Key measures, including the use of hardwood, flexibility in usage, and reusability of components, contribute to a climate-friendly building with a long-lasting and sustainable foundation.

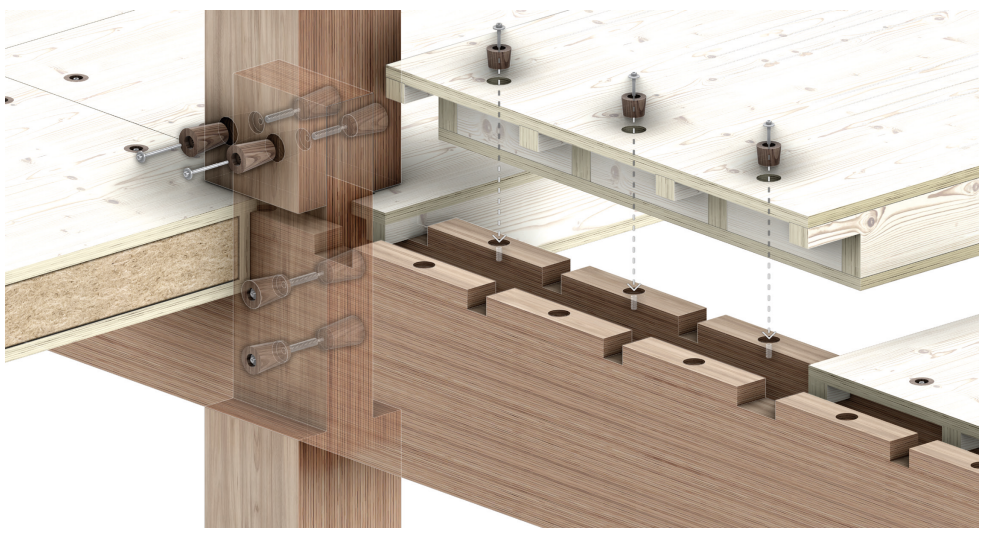


Dismountable and separable building envelope | 2022 | ©B. Friese

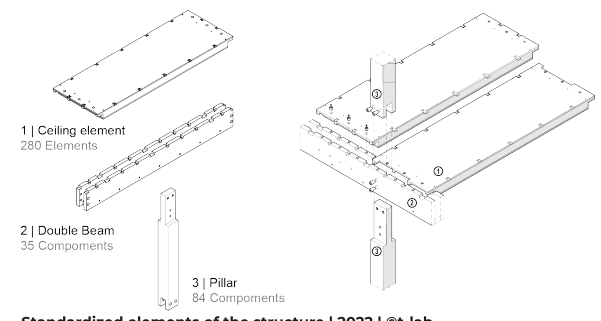
The three functions (living, working and parking) can be accommodated within the same structural framework, allowing for an easy transition between uses, thus contributing to the building's longevity. The change of use is achieved by modifying the façade components and interior finishes.



Modular and standardized structure and reversible connections. | 2022 | ©t-lab



Reversible Component Connections | 2022 | ©t-lab



Standardized elements of the structure | 2022 | ©t-lab

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