BAMB
BUILDINGS AS MATERIAL BANKS

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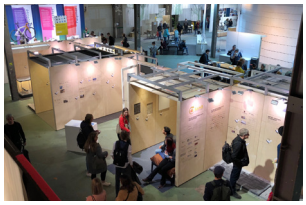
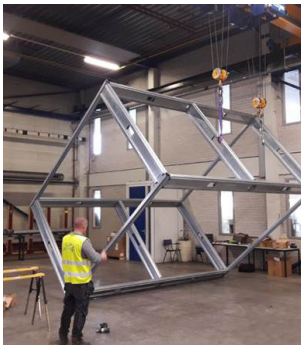
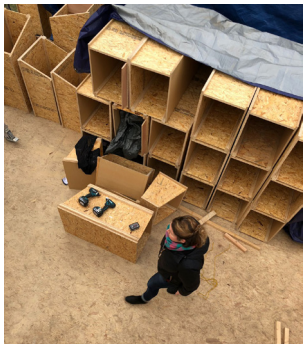
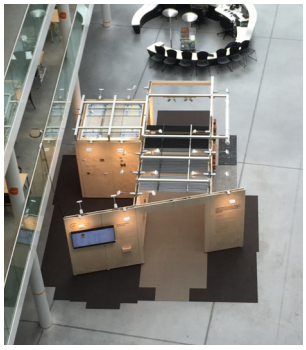
TESTING BAMB RESULTS THROUGH PROTOTYPING AND PILOT PROJECTS





THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO 642384.

BRIC

An educational transformable wooden building

Focus:
- Provide circular building knowledge and skills to the construction sector on: reversibility and transformability, sustainability, reclaimed materials, and efficient resource management with a focus on short value chain loops, and energy efficiency.
- Involve local actors by stimulating interest in circularity among building stakeholders, such as architects, contractors, manufacturers, resellers...

Type: New building,
Disassembled and assembled twice

Size: Minimum size: 70 m² (2018); maximum size: 130 m² (2019)

Function: An office building (2018), a shop (2019) and eventually an acoustic laboratory (2020)

Location: EFP, Brussels, Belgium

3.1. BUILD REVERSIBLE IN CONCEPTION (BRIC)

PILOT SUMMARY

Entirely built by young trainees, the BRIC building is a sustainable, scalable and reversible construction developed by the interdisciplinary Brussels training centre, EFP during three consecutive academic years, starting in autumn 2017. BRIC is being assembled and disassembled on a yearly basis. Each transformation is accompanied by a change in function: from an office (2018) to a shop (2019) and eventually an acoustic laboratory (2020) for training EFP students.

The first construction set-up in 2018 (BRIC 1), tested the capacity of a wooden construction to integrate reclaimed materials, applying reversible solutions that minimise the waste during transformations.

OBJECTIVES

By the end of 2018, more than 180 students had participated in the construction and disassembly of the first BRIC module. The first construction and disassembly proved the convenience and feasibility of integrating circular building techniques. The integration of the transformation phase into the design process provided a better forecast of the ability to recover materials and maintain their value.

INNOVATION

BRIC is a unique project that actively involves young people, the future construction professionals and entrepreneurs. It is an ongoing interdisciplinary laboratory of knowledge where students and experienced professionals exchange ideas and co-create the project all along its development. An open-minded approach allowed the re-assessment and redefinition of traditional stakeholder roles in the conception, construction, operation, deconstruction and re-assembly phases.

BRIC is testing a set of constructive elements in a circular configuration. Bidirectional structural columns, interchangeable insulation boxes, screwable foundations,...

ACHIEVEMENTS

Conceived as a material bank, BRIC tested the extension of the lifespan of materials. The team analysed the capacity of each constructive element to be reused several times with almost no waste production. The first technical results proved that both circularity and energy efficiency objectives can be successfully met within the same project. For example, the BlowerDoor test, which measures the airtightness of the building, generated an excellent result (v50=1,6m³/h/m²).

REPLICABILITY AND SCALABILITY

During its transformations, the project is testing the capacity of the construction to evolve in size and functionality. The ability of the project to be transformed and adapted to new functional needs makes BRIC a valuable scalable project. Making use of its reversible characteristics, such as the removable foundation, the building can be implemented in different places with a minimal ecological footprint and ease of assembly to accommodate different functions.

The BRIC concept is a perfect candidate for temporary occupation projects, such as seasonal shelters, which can meet the needs of niche market segments not necessarily covered by current construction industry offers.

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BRICI © EFP

GTB LAB

A transformable steel framed building module with exchangeable components.

Focus:
- Testing the transformation of the shape, size, and function of a building through the use of Reversible Building Design protocols and standards
- Investigate needs and requirements of the local stakeholders to develop new business models

Type: New Construction, assembled and transformed once

Size: Single module size: 24 m² (2019); potential subsequent up-scaling

Function: Multifunctional space for changing daily uses, potential functions: work lounge, meeting space, lecture hall and housing unit

Location: ODS Klockner, Ridderkerk, The Netherlands

3.2. GREEN TRANSFORMABLE BUILDING LAB (GTB LAB)

PILOT SUMMARY

Realised in the framework of the GTB innovation centre for circular building in Heerlen, the Green Transformable Building Lab (GTB Lab) module has been developed around a reversible multifunctional steel frame which was filled by independent, exchangeable, standardised and reversible floor, facade and roof components.

To date, a single module has been built with the newly developed components: universal steel profile, standardised reversible wooden cassette, glass heated façade. The GTBL is intended to be up scaled subsequently.

OBJECTIVES

Green Transformable Building Lab develops, tests and demonstrates reversible building design e.g. building products and elements in an operational environment.

In order to provide independence and exchangeability of building elements, the pilot focused on the reversibility of interfaces between different building components, the standardisation of connections and dimensions of exchangeable components.

INNOVATION

GTB Lab investigates the development of entirely new circular products by completely switching from the traditional construction approach. The Lab was designed as an open platform. By introducing plugins in building components, the structure was and will be able to change form and function. It can adjust its configuration to the required performance without substantial loss of value of materials while providing optimal comfort, healthy climate, and local energy production.

The joint participation of the construction industry in the development of the GTB LAB enabled the investigation of new business and operational models that makes a circular project feasible.

ACHIEVEMENTS

The module was built in Barendrecht, Netherlands. Since its construction in December 2018, the flexible and evolving structure was transformed once. In the future, the construction is intended to be scaled up, receive a specific functionality, and eventually be transformed several times.
Today, the footprint of the metal as a material for construction is assessed based on the end of life recycling scenario. The biggest achievement of the GTB Lab is to demonstrate the necessity to change these assumptions. Not only should the reuse scenario be taken into consideration, but the impact of upgradable standardised modular systems and exchangeable components should be integrated and enhanced in the calculation. Their implementation is likely to drastically reduce the material footprint and waste creation.

REPLICABILITY AND SCALABILITY

The standardisation, universal connections between different elements, and the correlation between the lifespan of materials are solutions that can be integrated in the construction industry of tomorrow.

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REMs

An indoor interactive and modular exhibition space on circular building materials.

Focus:
- Promote the benefits and the use of Materials Passports by providing direct access to the Materials Passports Platform through the different construction products displayed in the exhibition.
- Improve and test the upscaling potential of a transformable and adaptable kit-of-parts exhibition module.

Type: New Construction,
Assembled, transformed and relocated six times

Size: Minimum size: 40m²; maximum size: up to 100m²

Function: Travelling exhibition of circular materials and materials passports

Location: Brussels (BE), London (UK), Watford (UK), Amsterdam (NL), Eindhoven (NL), Westerlo (BE)

3.3. REVERSIBLE EXPERIENCE MODULES (REMS)

PILOT CONCEPT

The Reversible Experience Modules (REMs) form a traveling interactive exhibition on circular building, which displays 70 products and systems designed for reuse, recovery, and recycling in circular buildings. Each material and product inside the REMs exhibition is available on the market and labelled with a Materials Passport. Visitors of the exhibit can manipulate the products and gain direct access to the online Materials Passport data for each by scanning the product's QR code with their phone.

The structure itself was designed and built applying a reversible building design approach. The assembly, disassembly and relocation of the exhibition (six times during one year), showcased the reversibility of the whole setup and its adaptability to different configurations.

OBJECTIVES

The exhibition provides tangible means for professionals from the built environment and others interested to interact and discover the integration of the passports, healthy materials, and reversible design. By continuous interaction with the public, the team has tested the understanding of the passports as a source of valuable interchangeable data to be used within different construction phases and by different players.

Practically the passports are guides on how to detach or disassemble products, the reuse potential of components and the material health. They provide data that helps prevent waste, improve resource productivity, and reduce emissions. Manufacturers and end-users have discovered opportunities for new circular value propositions.

INNOVATION

Based on the experience in other industries, digitalisation is expected to drive innovative disruption in the construction industry. By exploring the relationship between physical products and the related digital data, REMs, the largest traveling exhibition on circular building materials in Europe, supports the prospect of the development of new business models, potential new players, and new market opportunities.

ACHIEVEMENTS

The pilot has been assembled and disassembled six times with almost no waste production. A small set up was presented at Brussels Environment HQ, early 2018. The first full-size construction was presented at Ecobuild, in London in March 2018. In spring 2018, it travelled to Watford, UK and Building Holland. The set up was redesigned for the Dutch Design Week in Eindhoven, just before arriving in Westerlo, Belgium.

The exhibition attracted a large number of visitors: architects, contractors, suppliers, building owners, project developers, and dismantlers. It gathered insightful feedback for the improvement of the BAMB passports ICT platform.

REPLICABILITY AND SCALABILITY

The REMs highlights cross-sectoral opportunities. Being an exhibition module, it uses reversible construction systems conceived for optimised multiple uses. The solutions developed can readily be transferred from exhibition setups to other construction sectors, e.g. partition walls for residential, commercial or health facilities, or temporary setups.

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BAMB
HOW DOES THE MATERIALS PASSPORT WORK?
STEP BY STEP, MATERIAL BY MATERIAL, BUILDING BY BUILDING, WE WILL BUILD OUR CIRCULAR FUTURE OVER AND OVER AGAIN. MATERIALS PASSPORTS ARE OUR TRAVELGUIDES.
REM © EPEA

CRL

Full renovation of prefabricated student housing modules for multiple uses

Focus:
- Reversible building design aspects, replicability, through "research by design" and "process approach" perspective.
- Foster stakeholder involvement in order to identify business models

Type: Refurbishment, integration of transformed elements

Size: 180 m²

Function: Exhibition and office space, eco guesthouse

Location: VUB Campus, Brussels, Belgium

3.4. CIRCULAR RETROFIT LAB (CRL)

PILOT SUMMARY

The pilot project tested and implemented different scenarios for the reuse and refurbishment of the VUB campus' prefabricated student housing of the 70s, without generating a large amount of waste. Strategies have been explored for internal transformations, external transformations, and the module's multiple functional reconfigurations.

Depending on their expected rate of change in the floor plan, three different types of walls were defined, analysed, constructed and transformed: walls with (1) a high rate of change, (2) a high degree of flexibility for the integration of technical infrastructure and (3) a low rate of change.

OBJECTIVES

The circular refurbishment tested dismountable, adaptable and reusable solutions for maximizing waste reduction.
The pilot developed a co-creative process all along the (re) design, (re) build, (re)use, repurpose or dismantling phases. This necessitated a close collaboration with all the value network stakeholders and future users in the early development phase.

The university organised several round tables with industry stakeholders where design solutions were debated and improved, as well as hands-on workshops with students where solutions were tested.

INNOVATION

The CRL pilot project applied a step-by-step innovation strategy based on products available on the market.
This strategy thus incrementally improves products that are already technically and commercially viable.

Selected products, such as partition walls, had a high initial potential to reach circularity objectives. Together with the manufacturers, the team sought to add new product capabilities, such as new functionality (ex. from a prefabricated service module to a fully reversible partition wall system), reversible connections, etc. and test their application in a practical retrofitting project.

ACHIEVEMENTS

The reversible solutions for internal walls and façades have been integrated in the CRL lab by January 2019. The use of modular, prefabricated and kit-of-parts design approach not only fostered flexibility in assembly and efficiency in manufacturing but allowed scaling up the implementation. In this respect, the team together with the industry partners implemented efficient operational solutions, such as the use of dry connections, robust and reversible technical systems and the use of materials able to endure multiple reuses without being damaged.

REPLICABILITY AND SCALABILITY

CRL is likely to serve as a circular renovation model for the other student housing modules located on the VUB campus. The team paid a special attention to the needs of potential users. In this respect, the project reflects on potential business models able to cope with the evolution of the users' requirements, thus enhancing the reproducibility and perpetuity of a flexible model.

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