Design for Change
towards a circular economy in construction (handout)

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What is design and why does it matter?
Design is the way we shape our buildings. It determines for what they can and can’t be used.

Design is also the way we apply our materials. It determines how easily they can be recovered.

Alterations to this glued, external wall insulation and rendering is only possible by replacing it (2016/12/12).
Because we design our buildings as durable solutions for temporary problems, the invested resources are wasted too early.

Conventionally we design our buildings as durable solution for temporary problems. But because user requirements and standards change increasingly faster, our buildings reach the end of their functional and economic service life at a moment they are not yet outdated.
Buildings have a vast share in our environmental impact, including pollution, resource depletion and land use.

As a result of our durable design choices, buildings have a vast environmental impact.

According to the European Environment Agency, construction and demolition result in almost 40% of all waste. Construction and maintenance initiate 50% of all material flows. And as a result of our inefficient building use more than 20% of Belgium is built-up land.

Because most of earth’s resources are finite, the only option is to reuse them wisely.

Construction and demolition result in almost 40% of all waste. Construction and maintenance initiate 50% of all material flows. More than 20% of Belgium is built-up land, 30% in Flanders.

As a first alternative, we can design buildings so they could be adapted more easily.

If a building is adaptable, its functional and economic service life can be extended to house new functions and answer to changing needs of users or to increasingly stringent standards.

And if the building’s service life is extended, the utility of the invested resources increases.
If we make building components reusable their value can be maintained.

But to maintain the value of the components a building is made of, they should be reused.

If at the end of building’s functional or economic service life its components can be recovered, they could be reused in the same or another building.

This recovery requires however new business models and different design choices.
Design for Change is making buildings adaptable and their components reusable.

But how?
How buildings can be made adaptable, and how materials can be reused is the focus of the TRANSFORM research team since more than ten years.

The researchers of the team are engaged in diverse aspects such as the technical and structural performance of transformable structures, in their environmental and financial impact as well as in their practical implementation.

Based on qualitative surveys, quantitative assessments, consultancy and prototyping the team maintains a holistic view on Design for Change.

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design and circularity
design and adaptability
design and reuse
If we want to find out what design means in a circular system, we have to reframe it.

Since design choices are crucial for the subsequent life cycle stages of a building and its components, it is necessary to question the role of design in a system that is no longer linear.

After all, although extending service lives is necessary, recycling materials alone does not close all the loops. More life cycle stages have to be reconnected before the consumption of virgin materials and the production of waste will be omitted.
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In a circular system, buildings are not designed from scratch but redesigned from an existing situation.

Neither are buildings built. They are refurbished or rebuilt with the use of existing components and structures.

It is therefore expected that a building that is easily adaptable, because of choices made earlier, can also be redesigned easily.
A combination of architectural qualities facilitates the redesign and adaptation of buildings.

Three architectural design choices can be discerned that make future redesign more easy. They include strategic choices, for example about where to (re)erect buildings, but also spatial and practical choices about the polyvalence of the building and about the construction method.

- **Location**: Belle-vue brewery, Brussels
- **Polyvalence**: Grundbau & Siedler, Hamburg
- **Pace layering**: Vleeshuis, Gent
Well-situated buildings remain attractive as they are easily accessible, can be densified and provide qualitative spaces.

Location

The reconversion of the former Belle-vue brewery in Brussels into a hotel complex and a training centre illustrates the importance of a building’s location.

The project was not only feasible because the site allowed expanding the building. Also the view over and the promenade along the canal determined the existing building’s value.
Polyvalent spaces facilitate the fulfilment of various and changing user requirements.

**Generality**

In addition to their location, buildings are easily adaptable if they are very generic.

A building with polyvalent spaces, generous daylighting and a high load bearing capacity can fulfill various and changing user requirements on a day-by-day basis as well as on the long term.

These principles were already the core of Le Corbusier’s Dom-ino concept dating back to WWI.

The concept of generality was also exploited in the design of this villa by Office KGDVS. Its floorplan exists of a grid of nine identically dimensioned and connected spaces.

Because the shape of each room is independent from its function, it is possible to reorganize the building’s use without actual alterations. Only the furniture should be moved.
Pace layering respects the different rates of change within a building, preserving the building’s integrity during alterations.

**Pace layering**

And also pace layering is not new. In reconversion projects new interventions are regularly decoupled from the existing structure, both conceptually and physically.

Because it should be possible to recover the valuable existing structure when a more recent intervention has become irrelevant, it is usual to decouple both.
Life cycle assessments of the transformation of the VUB student residences confirmed the feasibility and environmental advantage of redesign.

To demonstrate the financial feasibility of building redesign, life cycle cost assessments have been conducted for the student residences built in the early ‘70 at the VUB campus.

Comparing the initial cost of the residences’ refurbishment to that of their replacement shows that reusing the durable concrete portal frames results in a cost reduction of almost 20%.

In addition of the durability of the concrete, the refurbishment would profit from the generality and the central location of these residences.

Life cycle assessments of the transformation of the VUB student residences confirmed the feasibility and environmental advantage of redesign.

The difference between the reuse and replacement of the existing structure is even more significant if expressed in environmental terms. For the floor, the difference in the initial environmental impact is larger than 50%.

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Although adapting buildings and extending the functional service life their most durable components is advantageous, materials should be recovered when aiming for a circular economy.

Only if components are recovered without damage, their value is maintained and the production of waste is avoided. This recovery forms the back-end of closed material loops.

When adapting buildings in a circular system, those buildings’ materials need to be recovered.
A combination of technical qualities facilitates the recovery of materials.

Different technical design choices make material recovery more easy. Three are crucial. They include value choices, for example about the durability of materials, but also constructive choices about their compatibility and reuse potential as well as about the reversibility of component’s connections.

**Durability**
Rotor Deconstruction, Brussels

**Reversibility**
Corium bricks by Wienerberger

**compatibility**
Open structures
The recovery of materials is only possible if they remain intact during use and disassembly. Therefore, they have to withstand the wear and tear typical of frequent recovery and reuse.

Moreover, durable materials, that are hardwearing or age beautifully keep their value or could even increase in value. Therefore however, the right material has to be selected from the initial design.

Materials should be durable and withstand the wear and tear typical of frequent recovery and reuse.

**Durability**

But durability is not only a matter of materials. The value of a building component is also determined by its aesthetic and historical aspects.

For example, these doors, designed by the renowned Belgian architect Jules Wabbes for a bank’s headquarters are sought after frequently.
Dry and reversible connection enable the disassembly of building components without damage.

Reversibility

It is however only possible and financially feasible to recover durable materials if they are connected in a reversible way to the building elements that surround them.

Therefore, dry and mechanic connections such as bolts and screws are preferred over wet and chemical connections such as cement mortar and glue.

In addition to the recovery of materials, it is expected that reversibility also facilitates maintenance and repair.

That completely reversible buildings can be realized was already demonstrated by various designers and engineers. For example in this Dutch office building by Bierman Henket architecten.

Amongst other elements its façade can be disassembled as it is mounted by bolts, clamps and hooks. To guarantee its water tightness, it was however necessary to double the skin allowing at the same time natural cooling.
Compatible building components can be reconfigured, recombined and reused time and again.

**Compatibility**

Compatibility is something we already know from our kitchens. They are based on a grid of 60cm and their components could be easily swapped and thus reused.

This idea was further exploited by Thomas Lommée and his Open Structures collaborative that designs interiors only with the use of kit-of-parts of compatible elements.
Because of its technical requirements, Design for Change results in a different kind of architecture.

As a result of the required durability, reversibility and compatibility, Design for Change results in a kind of buildings that is different from the ones we are used to today.

For example the Loblolly house in the US is actually a kit-of-parts with visible joints and seams. Nevertheless, the spaces it creates and comfort it offers are outstanding.

Project Loblolly house, Taylors Island by Kieran Timberlake architects
Image Kieran Timberlake architects
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Because of its technical requirements, Design for Change results in a different kind of architecture.

Therefore, new construction materials and products are necessary. Although it is not the task of researchers to develop new products, it is our mission to demonstrate the feasibility of doing so to manufacturers.

For example the demountable Dynamic Wall our team developed was extensively tested and approved during subsequent assembly and reuse for its acoustic and structural performance.

**Project** Dynamic Wall, Brussels Retrofit XL supported by Innoviris  
**Image** Anne Paduart
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Also expressed in environmental terms, a small additional initial investment is necessary. On the long term the environmental advantage of the possibility to reuse building elements is however significant.

Moreover, the environmental life cycle impact of the transformable renovation strategy is less dependent on the number of future transformations than the impact of the conventional one.

But the circle is not closed as long as we don’t reuse building components. Reuse should therefore become the second nature of the design choices architects, engineers and contractors make.

Only if components are reused, their value is valorized and the consumption of raw, virgin materials is avoided. This reuse forms the front-end of the circular economy we aim for.

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To wrap up, building alterations conventionally lead to resource depletion. Because most resources are finite, we should *re*use them wisely.
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Moreover, buildings are never in an end state, but part of a process. Making them adaptable and reusable is therefore vital.
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Architectural, technical and material qualities facilitate the recovery of resources. But only by reuse, material loops are closed.
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Reference to this document:  

More information:  
vub.be/arch/transform  
ovam.be/veranderingsgerichtbouwen