the Circular Retrofit Lab
a pilot project for circular construction
Circular Retrofit Lab
the result of more than fifteen years of research on design for change

The research team working on 'Transformable structures for sustainable development'
(© VUB Architectural Engineering)
Circular Retrofit Lab
renovation of the Willy Van Der Meeren student houses

The Willy Van Der Meeren student houses on the VUB campus in Etterbeek, anno 2018
(© VUB Architectural Engineering)

The Willy Van Der Meeren student houses on the VUB campus in Etterbeek, anno 1990
(© Hilde Braet, Centre for Academic and Secular Archives (CAVA), VUB, Brussels)
Circular Retrofit Lab
renovation of the Willy Van Der Meeren student houses

Relocation of one of the Variel modules, 2017 (© VUB Architectural Engineering)
Installation of the Variel modules, 1973 (© Archive Technical Service, VUB)
Circular Retrofit Lab
renovation of the Willy Van Der Meeren student houses

CRL site – original situation (© VUB Architectural Engineering)
Partial demolition, stripping of eight modules (© VUB Architectural Engineering)
Circular Retrofit Lab
high ambitions towards design for change
Circular Retrofit Lab
high ambitions towards design for change

- versatile plan lay-out
- adaptable & upgradable
- demountable and reusable building kits
- industrial partnerships
- LCA / LCC
Circular Retrofit Lab

design for change through scenarios

- Dissemination Space
- Bicycle Repair Shop
- Concert Space
- Exhibition Space
- Multifunctional Open Air Space
- Information Office
- Plug-in Offices
- Bistro / Resto
- Updated Student Housing
- Eco Guesthouse
- Sandwich Bar / Coffee shop
- ‘Kavelkamer’
Circular retrofit Lab
design for change through scenarios

+0  +1

dissemination space
public

temporary plugin offices
non-residential

eco guestrooms
residential

© VUB Architectural Engineering
Circular retrofit Lab
a collaborative project

project coordination

architecture and engineering

internal solutions

façade solutions

services
Circular Retrofit Lab
a collaborative project
Circular Retrofit Lab
experimentation & collaboration

Different workshops to test the internal wall systems in the experimentation lab (© VUB Architectural Engineering)
Circular Retrofit Lab

Different systems are fit for different types of walls:

- **TYPE 1** interchangeable wall
- **TYPE 2** technical wall
- **TYPE 3** partition wall
- **TYPE 4** “static” wall

© VUB Architectural Engineering
Circular Retrofit Lab
LCA & LCC

FIN. cost (€/m²)

300.00 €/m²
250.00 €/m²
200.00 €/m²
150.00 €/m²
100.00 €/m²
50.00 €/m²
0.00 €/m²

time (yr)

Analysis by VITO

partition wall
Circular Retrofit Lab
LCA & LCC

FIN. cost (€/m²)

<table>
<thead>
<tr>
<th>Time (yr)</th>
<th>Baseline - Gypsum Cardboard + Metal Stud</th>
<th>DfC Steel Frame + Wooden Panels</th>
<th>DfC Massive Wood</th>
<th>DfC Gypsum Fibreboard + Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>5</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>10</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>15</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>20</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>25</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>30</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>35</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>40</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>45</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>50</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>55</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
<tr>
<td>60</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
<td>0.00 €/m²</td>
</tr>
</tbody>
</table>

Analysis by VITO

partition wall
Circular Retrofit Lab
LCA & LCC

GWP (kg CO₂ eq./m²)

- DFC-Steel frame+wooden panels
- DFC-Massive wood
- Baseline-Gypsum cardboard+metal stud
- DFC gypsum fibreboard + wood

Analysis by VITO
Circular Retrofit Lab
LCA & LCC

**FIN. cost (€/m²)**

- BASELINE - Gypsum cardboard + metalstud
- DfC Steel frame + wooden panels
- DfC Massive wood

Analysis by VITO

flexible wall
Circular Retrofit Lab
LCA & LCC

GWP (kg CO₂ eq./m²)

- DFC-Steel frame+wooden panels
- DFC-Massive wood
- Baseline-Gypsum cardboard+metal stud

Climate change (kg CO₂eq./m²)

GWP (kg CO₂ eq./m²)

Flexible wall

Analysis by VITO
Circular Retrofit Lab
construction process

CRL site – original situation (© VUB Architectural Engineering)

Partial demolition, stripping of eight modules (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

CRL site – original situation (© VUB Architectural Engineering)

Partial demolition, stripping of eight modules (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

CRL site – original situation (© VUB Architectural Engineering)

Stripped and sanded structure (© VUB Architectural Engineering)
Circular Retrofit Lab  
construction process

Connections for the façades (© VUB Architectural Engineering)

Construction of curtain wall (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Prefabricated façade elements (© VUB Architectural Engineering)

Prefabricated façade elements with window frames (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installation of the façade elements (© VUB Architectural Engineering)

Installation of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installation of the façade elements (© VUB Architectural Engineering)

Installation of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installation of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installation of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installation of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Waterproofing of the envelope (© VUB Architectural Engineering)

Connections of the façade elements (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Insulation of cavities to ensure performance of envelope (© VUB Architectural Engineering)

Air-tightening (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Demountable services (© VUB Architectural Engineering)

Services integrated behind removable plinth (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installed façade elements (© VUB Architectural Engineering)

Installation of the cladding (© VUB Architectural Engineering)
Circular Retrofit Lab
construction process

Installed façade elements (© VUB Architectural Engineering)

Installation of the cladding (© VUB Architectural Engineering)
the Circular Retrofit Lab
a pilot project for circular construction