MATERIAL AND ACTIVITY IN RESONANCE

CONNECTING MATERIAL FLOWS
IN THE FRAMEWORK OF A FORMER OFFICE BUILDING
IN RESONANCE WITH CHANGING USES
Waste
Urban Office Vacancy
Urban living
“THE MOST INTERESTING PERIOD FOR A BUILDING IS BETWEEN CREATION AND DEMOLITION — WHEN IT’S CHANGING.”

Stuart Brand (1995)
MIT OCW / Source: adapted from Bras, B., Graedel and Allenby
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Content

1. Three pillars
   1. Beyond Material Sustainability (technology)
   2. Urban Office Vacancy (context)
   3. Urban Living (program)

2. Design
   1. Designing Permanence
   2. Designing Change

3. After P4?
Beyond Material Sustainability
Zero Energy Buildings

Figure by MIT OCW (Ochsendorf, Adams, & Connor, 2006)
Zero Energy Buildings

Figure by MIT OCW (Ochsendorf, Adams, & Connor, 2006)
Waste

Construction and (mainly) Demolition Waste contributes 40% to solid waste streams in developed countries.

(UNEP Symposium on Sustainable Buildings 2010)
Pollution and Health

Pre-use: Emissions during production, construction and transportation;
Use phase: Indoor Health (VOC emissions, etc.);
End-of-life: Toxic releases in landfills;
Extracting, processing, transporting, using and recycling materials have a large impact on a material’s total footprint.
Resource Depletion

- 24% of raw material consumption by building industry.

(UNEP Symposium on Sustainable Buildings 2010)
(Zuidema, 2015)
(OVAM, 2013)
Solution?
Beyond Sustainability

From linear to circular:
Waste equals food:
Nature’s cycles as a reference
Adding value in extra step of the process;

_Cradle to Cradle: Remaking the Way We Make Things_

MICHAEL BRAUNGART AND WILLIAM McDONOUGH
effectiveness
in negative impact or positive impact

efficiency
relatively increasing or decreasing the impact

sustainability  beyond sustainability
RESEARCH QUESTION
How can a design strategy focused on the material aspect inspired by circular principles help bring a 70s office building in an urban context in its retrofit beyond material sustainability?
(1) Building perspective
(2) Material perspective
BUILDING PERSPECTIVE
Building Complexity

- Complex assembly
- Custom product
- Intransparency
- Time and its long life: change and uncertainty

(Scheuer, Keoleian, & Reppe, 2003)
“We should not try to predict what will happen, but we should try prepare for that what cannot be foreseen.”

John Habraken in ‘De dragers en de mensen’ (1961)
Future Uncertainty

**Demolition**
- Design for Disassembly
- Avoid Uncertainty

**Renovation**
- Design for Adaptability
- Anticipate Uncertainty

Project XX, Delft
Jouke Post

Solid 11, Amsterdam
Tony Fretton
Open Building / John Habraken

- Division between Structure and Infill
- Both technical and ownership
- Facilitates connecting material cycles
- The combination can be beneficial for both sides
Securing Connection of Material Cycles in Infill

- Both a potential and a challenge;
- Scaling ownership and economic responsibility;
- Infill rules;
- Infill manager;
- Infill contractor;
Shearing Layers / Stuart Brand
Building Design Guidelines

Design for Adaptability

- Different possibilities for space fragmentation;
- Diversity of spatial dimensions, accessibility, and context;
- Diversity and adaptability of services;
- Appropriate adaptability, take in account user flexibility as well;

Design for Easy Disassembly

- Dry connections / no adhesives;
- Frictionless interfaces between Shearing Layers;
- Building, product and detail simplicity – no specific troops needed;
- Prefab elements;
- Infrastructure and storage of disassembly and maintenance work
MATERIAL PERSPECTIVE
Material Perspective

![Graph showing ecological impact per layer over years with lines for structure, skin, services, space plan, and total impact.]

Table 17: Embodied impact per layer as percentage of the initial total embodied energy, between brackets the growth percentage per layer. Based on (Cole & Kernan, 1996, p. 312)
Connecting flows

1. Recycling
2. Maintenance
3. Reuse
4. Manufactured Reuse
5. Preconsumer recycling
6. Composting (or Incineration/Landfill)
7. Renewable Resources (or virgin resources)
Complexities

- Too many different sustainable variables;
- Too many types of certifications;
- Lack of transparency;
Conclusion – Task of the Architect

• Facilitate a framework that supports:
  – Disassembly;
  – Retrieving of materials with quality and purity;
  – Frictionless interfaces between shearing layers for fragmented change and improvement;
• Design for Adaptability – focus on time and match user and material change;
• Material and product selection for securing recycling and health and other benefits;
• Close collaboration with manufacturers and new business models / lease contracts;
• Close collaboration with facility management to secure the implementation of strategies and ideas;
Office Vacancy

Context
Urban Office Vacancy

• 8 million square meter office space in the Netherlands is empty
• 15% of current stock and growing
• Offices in urban contexts are especially suited for redevelopment as housing or mixed functions.
Urban Office Characteristics

• Concrete structure;
• Standard column grid of multiples of 1.8m, usually 5.4 or 7.2m;
• Non weight-bearing façade (70s and later);
• Depth between 12-20m;
• Generous ceiling height (3+ m);
• Light courts, patios or representative cores are common;
• 5000-25000 sq.m.;
• Structurally over-dimensional (extensions, but also voids are possible)

(RIJKSDIENST VOOR CULTUREEL ERFGOED, 2015)
Building

- 70s office building;
- 15000sqm;
- concrete structure;
- aged facade and infill;
- Grid dimension (7.2x5.4);
- Floor height (3m);
- Ground floor height (4m);
- Patios:
Opportunities

• Location: next to important route;
• Location: neighborhood in change, gentrification, a building that can facilitate this change is needed;
• Grid dimensions and possibility of fragmentation;
• Demand for housing;
• Demand for smaller office spaces and commercial activities;
• Patios that can be used as atria;
Building as a City
Urban Living

- Your home is distributed in the city: office, school, coffee shop, sports center.
- Your own house is of less importance and can be smaller;
- Target groups: young urban professionals, students, empty nesters, expats;
Program

- A multifunctional hub of living, working and leisure - a building as a small city;
- At times it can be more dominant in working spaces, or more dominant in living spaces. Depending on the market.
- The grid is used to fragment the building and create a framework of gradual change. This can be used to adopt future uncertainty.
Design

MATERIAL AND ACTIVITY IN RESONANCE
Design

- Building explanation;
- Public Permanence and Changing Content;
- Four design interventions;
- Three scenarios and materialization;
Public Permanence & Changing Content

The Public Permanence

• Extending the route between the train station and downtown;
• Will remain for 100+ years;

Changing Content

• The fragmentation within the column grid;
• Spaces for work, health, living, leisure, sleep are created
Permanence, Content and Materials

![Diagram showing changing content related to site, structure, skin, services, space plan, and stuff over time.](image)
Four strategies

1. Connecting the floors

2. Opening the volume

3. Public Spaces

4. Fragmentation
Four strategies

Old situation

New situation
(1) Connecting the floors

Closed patio to opened up atrium with routing along its facades. Accessibility and intervisibility.
Atrium Strategy
ation of atria + an infrastructure

atrium + urban infrastructure overview

back atrium even
m + main street + entry spaces

neighborhood street

main street + adjacent dwellings
ucture

core corridor
(2) Inviting entrance
(3) Public Spaces
Move into the semi-public?
(4) Fragmentation: Diversity of Spaces

- Gradual changes over time: Robustness, small changes over time are less riskier than big changes at once.
Design for Adaptability: Creating Diversity
Dimensional Diversity
Dimensional Diversity

First floor

Second floor
Service Diversity
Daylight Diversity
Accessibility Diversity
Changing Content
market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, or **1:200 Scenario Stamps** one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc. market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, one complete office wing, more extreme: one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc. market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, one complete office wing, more extreme: one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc. market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, one complete office wing, more extreme: one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc. market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, one complete office wing, more extreme: one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc. market, studio dwellings, penthouses, one bedroom apartments, mini park, shared student housing, shared kitchen facilities, sports facilities, lecture halls, mini-cinema, swimming pool, sauna/spa, exhibitions, conferences, hair saloon, dentist, one complete office wing, more extreme: one tenant for the complete building, yoga, shops, interior garden, relax, meditation, print shop, 3d print shop, elderly community room, expat community room, game room, etc.
Three Scenarios

• Dwelling
  – Wet cell
  – Balcony

• Hotel
  – Different fragmentation
  – Wet cell

• Office
  – Balanced Ventilation
  – Larger space
The Layers
The Layers
The Layers
Material Strategy

- Material strategy per shearing layer
- Depending on lifespan, complexity, etc.
- Relating to its actual function and sustainable top priority
## Material Strategy

<table>
<thead>
<tr>
<th>Layer</th>
<th>Lifespan</th>
<th>Top Sustainable Priority</th>
<th>Strategy</th>
<th>Proposed Materials</th>
<th>End-of-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>100</td>
<td>Embodied Energy</td>
<td>Manufactured Reuse</td>
<td>Concrete</td>
<td>Downcycling</td>
</tr>
<tr>
<td>Skin</td>
<td>30</td>
<td>Thermal</td>
<td>Design for disassembly, simple materials and detailing.</td>
<td>Accoya windowframe, softwood, Terra Cotta, Flax insulation;</td>
<td>Reuse, recycling, composting, incineration</td>
</tr>
<tr>
<td>Services</td>
<td>7-15</td>
<td>Energy Efficiency</td>
<td>Lease</td>
<td>Cardboard ducts</td>
<td>Takeback and recycling, composting.</td>
</tr>
<tr>
<td>Space plan</td>
<td>3-30</td>
<td>Health, Recycling</td>
<td>Diverse: infill contractor, 1:1 reuse, modular products to customfit with biosphere products.</td>
<td>Recycled gypsum board, formaldehyde free particle board, natural products.</td>
<td>Reuse, recycling, biodegradation</td>
</tr>
</tbody>
</table>
Example of Facade

-Prefab elements;
-Terra cotta facade tiles;
-Accoya wood frames;
-Damp open;
-Softwood battening;
-Wood fibre boards sheeting materials;
Example of Fragmentation Wall

- Gypsum board;
- Flax waste core;
- Modular;
Local construction facilities

- Storage in basement
- Transportation via elevators
- Service elevator and loading dock near backside
- Facility management
A Walk Through The Building