Circularity in architecture
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**Introduction:**
- Faculty of Architecture – University of Liège
- Laboratory of digital culture in Architecture
- Amélie Halbach

**Context:**
- Construction and demolition
- Circular economy
- BIM

**Subject:**
- BIM “as-built” as a tool for decision-making between demolition or deconstruction
- Research questions

**Survey addressed to architectural offices**
- Objectives
- 4 Parts
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Faculty of Architecture – University of Liège

- About 800 students
- 90 teachers
- 250 first-year students
- 2 sites

Botanique Site
Rue Courtois

Outremeuse Site
Boulevard de la Constitution
Main subjects

- **BIM** – European project BIM GAME – New e-learning methods in total collaboration to learn BIM through new technologies + **BIM coordinator certificate**

- **Modelling of spatial, temporal and semantic information** collected from 3D terrestrial **laserscan** (TLS) applied to Cultural Heritage. Modelling of spatiotemporal information collected from location-based networks. Development of **H-BIM** for an efficient management of built heritage information.

- **Parametric architecture** - Evolution of **methods** and the **use of digital design tools** to support design activities
Amélie Halbach

ULiège
Masters of architecture
September 2014- June 2019
Liège, Belgium

Technical University of Technology (TUT)
Erasmus exchange student
August 2017 – May 2018
Tampere, Finland

Master's thesis
Title: BIM "as-built" as a tool for decision-making between demolition or deconstruction
Supervisor: Sylvie Jancart
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Construction vs demolition

©Lionel Billiet, Rotor
Waste production per sector
Construction and demolition waste: a noteworthy opportunity

US C&D waste 2008

C&D is a significant waste stream

100% = 615 mn tonnes

C&D waste as a share of total

74

26

Discarded

20% - 30%

End-of-life treatment of C&D waste

20%

70% - 80%

Less than one-third is currently recovered

Recycled or reused

A lot of the discarded material could be recovered

100% = 112-128 mn tonnes

Potential applications

Other

Fertilizer additive

14%

10%

Gypsum board

Gravel, erosion control

Concrete/rock/brick

11%

Soil/fines

Reuse of soil after treatment

Asphalt products

Road building material

14%

Lumber

Wood flooring construction material

40%

Composition of discarded C&D waste

© Ellen MacArthur Foundation
How to avoid demolition waste?
From linear to circular

Linear economy          Recycling economy          Circular economy

©Circular Flanders
Influence of circular economy over time

©Circular Flanders
Circular economy: an industrial system that is restorative by design

© Reinterpretation of 3XN of an original owned by the Ellen MacArthur Foundation
The upcycle chart

100% good

goal

100% bad

© McDonough
Circular economy in the building sector

- Conception
- Materials
- Construction processes

Flexibility
Modularity
Normalisation
Local
Bio

Waste management
Reuse

What is waste?
What is waste?

« Waste is material without identity »
Thomas Rau

If we give an identity to a material, it is no longer waste
Reuse of building materials

Existing materials

Future materials

OPALIS

BAMB

Harvest Map

Second Use

PLANET REUSE

MADASTER
A LITTLE GAME

Is it circular?
Is it circular?  

*Using plastic bottles as bricks*
Is it circular?  Waste House by BBM
Is it circular?  

*Light as service in terminal buildings at Amsterdam Airport Schiphol*
Is it circular?

The Green House in Utrecht
Is it circular?

Quality writing paper → photocopying paper → cardboard for packaging → tissue paper/toilet paper
Is it circular? Kamikatz Public House by Hiroshi Nakamura & NAP

© Hiroshi Nakamura & NAP
Is it circular?  

*Flow by Desso*
Is it circular?

Think by Steelcase

© Herman Miller
Is it circular?

PIT lab Amsterdam by DOOR Architecten

© PIT lab
Is it circular?

...
Evolution of the way of working
Timeline: evolution of BIM versus sustainable design

© Charlotte Dautremont
BIM 7D?

1D  2D  3D  4D  5D  6D  7D

- construction
- planification
- costs
- exploitation
- end of life
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BIM “as-built” as a tool for decision-making between demolition or deconstruction
Research questions

What? How much? Where?

- Documentation
- Identification
- Maintenance
- Security

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Survey addressed to architectural offices
  – Objectives of the survey
  – Four parts
  – Selection of the offices
Objectives of the survey

- Identify the challenges for architects
- Identify the offered solutions
- Identify the wished of the architects
The survey consists of four parts

1. General informations
2. Approach to circular economy
3. Use or non-use of BIM-technologies
4. Combination of BIM and circular economy
The survey consists of four parts

1. **General informations**
   - Size of the architecture office
   - In which region they practice
   - The principal contractors of their projects
   - The average size of your design projects in 2018
   - The number of projects they have in progress in the different development phases

2. Approach to circular economy
3. Use or non-use of BIM-technologies
4. Combination of BIM and circular economy
The survey consists of four parts

1. General informations
2. **Approach to circular economy**
   - Knowledge according to circular economy
   - Knowledge of the concept "Design for Deconstruction"
   - Recovered or reused building materials in new design, construction or renovation projects
     - If yes, how they have done it
     - If not, why they haven’t done it
   - What they think could help promoting the use of recycled materials

3. Use or non-use of BIM-technologies
4. Combination of BIM and circular economy
The survey consists of four parts

1. General informations
2. Approach to circular economy
3. Use or non-use of BIM-technologies
   - Knowledge of BIM
   - The use BIM-technologies
   - Advantages and disadvantages of BIM
   - How they save and share the information
4. Combination of BIM and circular economy
The survey consists of four parts

1. General informations
2. Approach to circular economy
3. Use or non-use of BIM-technologies
4. **Combination of BIM and circular economy**

   - Integration of information about recovered materials into a BIM model
     - If yes, how they have done it
     - If not, why they haven’t done it
   - New skills and knowledge / new professions
Selection of the offices

• Applying the principles of circular economy:

  3XN Architects, Thomas Rau, William McDonough, SuperUse Studios, Epicuria Architects, Cepezed, DOOR Architecten, LIAG, Plekvoor, Samyn & Partners, Atelier 4|5, Alain Richard, V+, DDS+, ....

• Using BIM:

  Mecanoo Architecten, Cigler Marani Architecten, PLH Architecten, A-tract architecture, 8office, Jasper Eyers, B2Ai, VK Architects & Engineers, ...

• Combining the principles of circular economy and the use of BIM:

  ???
Thank you!