Outcomes of a Student Research Project on Circular Building Systems
Focus on the Educational Aspect

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Introduction

Context

**The Situation**
Under a business as usual scenario, the global temperature by 2100 will be more than 4°C above pre-industrial levels.

**The End Goal**
To limit temperature rise to 1.5°C, we need to cut greenhouse gas emissions from 65 to 33 billion tonnes CO₂e per annum by 2030.

**The Solution**
Current national commitments achieve about half of the required emissions cuts. Circular economy may fill about half of the remaining gap.

- **National commitments**
  - Renewable energy
  - Energy efficiency
  - Reduced deforestation

- **Circular Economy**
  - Recovery and reuse
  - Lifetime extension
  - Sharing and service models
  - Circular design
  - Digital platforms

- **Other measures**
  - Further scale up of renewables and energy efficiency
  - Reforestation
  - Climate-smart agriculture

Not an objective but a means as part of managing a sustainable development.

Circularity in the building sector is high on public & corporate agendas.
Introduction

Problem statement

Producers of building materials and construction systems are rapidly taking the first steps and develop or redevelop products in view of the requirements for circular building.

- The risk is high that in the rush to quickly develop products, claims of circularity are made too easily.

- As circular building will become key in the professional field, it is necessary that architecture students are being prepared.

Flemish policy action:
Green deal – Circular building
Introduction

Objective

➢ study the potential for circular building of specific building systems
➢ by master students in architecture of the Faculty of Architecture and Arts of Hasselt University.

Aims

✓ Educational: trigger and train students
  • to become architect-designers with a strong focus on circularity
  • to conduct research in a collaborative and critical way
✓ Research methodological
  • exploring possibilities for actively involving architecture students in research on building-technical aspects (nexus education – research)
✓ Innovation & development
  • building-technical niche development with a societal relevance, in this case building systems that enable circular building and enhance a circular economy model

Aim paper/presentation
✓ present and discuss the concept of the student research
✓ present tentative and illustrative outcomes of selected circular building systems
Concept of the research

Description of the assignment

Positioning within the curriculum / Fac-Ark

Education
- Research Seminar ‘Building Concept’
- Mastersthesis
- Design & Build -studio

Societal service
- Design & Build LAB

‘nexus’ & interaction

Research
- Arck Sustainability Research Team

2 years of the seminar form a complementary journey

Every year combines design, hands-on activity and research

Year 1, the concept of circularity is explored through EXPERIMENT

Year 2, focus is on a REALITY CHECK
Concept of the research

Description of the assignment

The assignment as such

“in-situ testing and improving circular building systems for cavity walls”

• by the act of building
• backed by an assessment with an existing framework of evaluation criteria for design for change

The assignment evolves from hands-on explorations, over analysis and assessment by desk-top research, to the formulation of improvements by design & build research.
Selected systems, composed cavity wall ensembles and set-up building experiment

System 1: Construclick
http://www.facadeclick.be

System 2: Facadeclick
http://www.facadeclick.be

System 3: Systimber
https://www.systimber.com

System 4: Clickbrick
http://www.daasbaksteen.com

System 5: Steko
https://www.steko.ch

System 6: Facatile
https://www.wienerberger.be
Results and discussion

Educational aspects

Students’ perspective  (Based on a self and peer assessment, including a personal reflection on the assignment)

✓ Added value for the curriculum:

□ The **in-depth focus** on materials and construction methods, and having the **time and space to experiment** with details of/for new ways of building with a strong societal relevance.

□ The set-up of the seminar, with its structure and **balance between theory and practice**, enabled to gain good insights in circular building.

□ Development of **critical thinking skills**, inter alia by including an assessment tool.

This assessment tool appeared to be both a blessing and a curse, as it was found to be time consuming.
Results and discussion

Educational aspects

Tutors’ perspective

✓ Labour intensive preparation (collaborations, hands-on activities, ...)
✓ Hands-on approach was evaluated positive

✓ Needs improvement:
  ▪ Aspect of working in a group
  ▪ Aspect of assessing in an objective way
  ▪ Aspect of encouraging/stimulating/feeding innovation by students

Research methodological aspects in view of the nexus education – research

✓ The nexus ‘research & education’ worked well
  ▪ Topic with a strong societal relevance
  ▪ Tangible research method (hands-on)
  ▪ Exposed outcomes (visibility)
  ▪ Use of an assessment tool so outcomes can be validated (quantitative method is preferred)
Results and discussion

Niche development aspects

Systems 1 & 2 – composition A
a) a mounting lath for a circular connection with the foundation
b) a connecting block to fix the watertight slab between foundation and inner wall
c) an alternative cavity anchor; with c1 the existing cavity anchor, and c2 an alternative cavity anchor

Systems 3 & 4 – composition B
a) wider grip surfaces of the spacer (with a1 the existing grip)
b) (b1 + b2) two anchoring solutions for cavity anchors
c) metal plate for a circular connection with the foundation
d) a screw head of the cavity anchors
Conclusion

- Based on reflections of both students and tutors, it can be concluded that the concept of the nexus education-research was successful and only needs minor revisions.

- Perspectives for future editions of similar student research:
  - complementing the assignment with a real-life full design/build project
  - including a team building activity in order to improve the aspect of working in a group
  - using tailored pedagogical methods to encourage/stimulate/feed innovation during the development of improvements by the students
  - from a research point of view, selecting a quantitative assessment method which avoids subjective assessments, and which is easy and quick to use by students.
Conclusion

- Concerning the circular building systems/

  ✓ all systems as such work, are easy to use and fast to assemble and disassemble
  ✓ small-scale incremental improvements on the individual system level are required.

  ✓ fundamental improvements and research regarding following aspects (non-exhaustive) are believed to be crucial for a full and successful application of the idea of circular building:

    - circular connections between circular building systems and other building components (e.g. foundation, windows, roofs)
    - compatibility (e.g. dimensions, connections) with other circular building systems,
    - watertight and vapor tight sealing of both surfaces and joints
    - diversity of products within circular building systems (e.g. tailored lintels, corner solutions)
    - broad building type (in view of needed performances) and project type application range (e.g. renovation)
    - prefabrication potential
    - lowering the environmental impact (e.g. especially of connecting components) of existing circular building systems, and more broadly development of new circular building systems based on renewable and regenerative resources
Thank you.

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