A case-based study on the use of life cycle assessment and life cycle costing in the building industry

Session: Education & Economy 2: LCC - Economic Challenges

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WHO AM I...

Christine Collin

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2019  Senior Sustainability consultant, Buildings, Rambøll
2018  DGNB consultant
2017  Sustainability consultant, Buildings, Rambøll
2016  Structural Engineer, JPM ApS

Education
2016  M.Sc. Architectural Engineering - DTU and TU Wien
2014  B.Sc. Civil Engineering - DTU and TU München

WHAT I DO...

- Sustainable Building Design, DGNB, LEED, BREEAM
- Life Cycle Assessments (LCA)
- Life Cycle Cost (LCC)
- Research & Development e.g. ‘GreenBIM’

References
- WGBCs ‘Bringing embodied carbon upfront’ report, which will be published 23rd of September 2019
- EEA – Quantification Methodology for, and analysis of, the decarbonisation benefits of sectoral circular economy actions
- LCE from the perspective of an engineering consultancy, 2018
A STRONG HERITAGE

- Founded in 1945 in Copenhagen, Denmark
- Founders: Professors Johan G. Hannemann and Børge J. Rambøll
- Talented engineering combined with social visionary aspects
- Strong principles and philosophy
Today

15,000 experts

Close to 300 offices in 35 countries
INTEND - INDUSTRY PERSPECTIVE

Only 4% of all building projects in 2018 in Denmark were considered sustainable\(^1\) including:

- Certified buildings
- Low energy buildings
- Additional sustainability measures

In Ramboll Denmark approximately 6.5% of the building projects are described as sustainable

Question: How are we going to change the current practice?

\(^1\) Danish Construction Association
CASE STUDIES – ASSESSMENT OF DIFFERENT DESIGN TOOLS

1. Life Cycle Engineering Screening
2. Building element LCA and LCC
3. Whole building LCA and LCC
LIFE CYCLE ENGINEERING SCREENING

Tool to compare different products on their sustainability throughout the building life cycle, to enable informed design decision

Can be used with both generic and specific product data

<table>
<thead>
<tr>
<th>Life cycle stages</th>
<th>Production</th>
<th>Construction</th>
<th>Use</th>
<th>End of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustainability parameters</strong></td>
<td>Social</td>
<td>Economic</td>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td><strong>Comparison of functional equivalent products</strong></td>
<td></td>
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</tr>
<tr>
<td>Acoustic ceiling panels</td>
<td>Environmental Impact [kg CO2 eq/m²]</td>
<td>Lifetime [years]</td>
<td>Price [kr/m²]</td>
<td>Maintenance friendly</td>
</tr>
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<td>-------------------------</td>
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<td>----------------------</td>
</tr>
<tr>
<td>Ceiling Panel 1</td>
<td>0,43 kg CO2 eq/m²</td>
<td>50 years</td>
<td>130 kr/m²</td>
<td>Yes</td>
</tr>
<tr>
<td>Ceiling Panel 2</td>
<td>1,87 kg CO2 eq/m²</td>
<td>30 years</td>
<td>296 kr/m²</td>
<td>Yes</td>
</tr>
<tr>
<td>Ceiling Panel 3</td>
<td>1,20 kg CO2 eq/m²</td>
<td>50 years</td>
<td>225 kr/m²</td>
<td>Yes</td>
</tr>
</tbody>
</table>
POTENTIALS AND BARRIERS

• Can be tailored for the specific need
• Enable informed decision-making, not only focusing on functionality and aesthetics
• If demand arise the manufacturers will start competing on more parameters than just price
• Clients like the simplicity and the visual comparison

• Data gathering can be time consuming
• No regulation of manufacturers to disclose the needed information
• Risk of neglecting important parameters, if comparing too few indicators
• It may be necessary to introduce weighting of the parameters if some products receive equal ‘score’
LCA/LCC can be used to compare comparable building elements or for optimization.

Building element A
Fx External wall w. woodwool

Building element B
Fx External wall w. PUR insulation

Building element C
Fx External wall w. stone wool

Concept Design
Fx External wall 100%

1. Optimization
Fx of load bearing structure 80%

2. Optimization
Fx of facade 70%
Solar shading systems in a life cycle perspective

- Solution A
- Solution B
POTENTIALS AND BARRIERS

- Enable informed decision-making, not only focusing on functionality and aesthetics
- Operator developers are more likely to see the benefit of these assessments
- Calls for an integrated design process and early stakeholder inclusion

- Design phases are limited in time
- Conservative construction industry with a “business as usual” approach
- Often different companies need to be involved as well as facility managers and contractors, which often are not included in the early design stages
<table>
<thead>
<tr>
<th>Current/Old process</th>
<th>Ideal process</th>
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CASE – BUILDING LCA DURING CONCEPTUAL DESIGN

ENVIRONMENTAL IMPACT SCENARIO 1, GWP [KG CO2-EQ]
POTENTIALS AND BARRIERS

• Shows the building elements with the largest emissions or related cost
• Enable informed decision-making
• Useful for certification purposes, both DGNB, LEED and BREEAM
• Is best perceived by client if results are converted into certification points (needs to be simple)

• Lack of integration between BIM and LCA/LCC tools
• Lack of standardized 3D models makes it time consuming to retrieve and check data
• Lack of detailed data in models e.g. rebar or timber studs
INDUSTRY PERSPECTIVE - THE NORDIC COUNTRIES

Increase in Sustainable Building Projects Globally in Ramboll from 2008-2018

- Sustainability
- DGNB (DK, DE, SE, NO)
- BREEAM (NO, SE, FI, DK)
- LEED (NO, SE, FI, DK)
- Miljöbyggnad (SE)
THANK YOU

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