Integrated design covers the complete life cycle of a building. In the earliest design stages, where the impact of a design change on costs is low and the impact on performance is high, clear goals should be set by a multidisciplinary design team, preferably including the contractor and future tenant.

Integrated design also includes knowledge transfer and evaluation, for example by monitoring real energy use and providing feedback to improve future projects. A committed and competent client is necessary to keep all project members on track towards the design goal.

Three detailed cases

Three projects are analysed in detail. For each project 6 to 7 involved actors are interviewed including the client and owner, tenant, architect and sustainability engineer.

The three detailed case studies show a development in time of sustainability goals. Lysaker Park, realized in 2009, was the first renovation project to achieve Norwegian energy label B, while FS4 obtained the passive house standard. Powerhouse Kjerbo takes the next step and offsets operational energy use and embodied energy with the generation of renewable energy. In all three projects the owner also acted as client.

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Size</th>
<th>Sustainability goal</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysaker Park (Chapter 6)</td>
<td>Lysaker</td>
<td>38,000 m²</td>
<td>quality program (incl. energy label B)</td>
<td>December 2009</td>
</tr>
<tr>
<td>Fredrik Selmers vei 4 (Chapter 7)</td>
<td>Oslo</td>
<td>36,000 m²</td>
<td>passive house and BREEAM-NOR very good</td>
<td>October 2013</td>
</tr>
<tr>
<td>Powerhouse Kjerbo (Chapter 8)</td>
<td>Sandvika</td>
<td>5,200 m²</td>
<td>net zero energy and BREEAM-NOR outstanding</td>
<td>February 2014</td>
</tr>
</tbody>
</table>

Two pilot cases

Two pilot cases are used as a reference. The cases provide evidence of a shift in investment direction, as well as a shift in minimum requirements. The Norwegian low energy standard is experienced as a minimum standard nowadays.

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Size</th>
<th>Sustainability goal</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Monarch (Section 5.4)</td>
<td>The Hague</td>
<td>19,500 m²</td>
<td>BREEAM-NL excellent</td>
<td>February 2012</td>
</tr>
<tr>
<td>Nesøyveien 4-6 (Section 5.5)</td>
<td>Asker</td>
<td>15,000 m²</td>
<td>energy label B</td>
<td>2015</td>
</tr>
</tbody>
</table>

Introduction

Sustainability is a hot topic, both in the construction industry and on the global agenda. Sustainability in buildings requires to optimise contradictory parameters, such as daylight and operational energy use. Therefore, an integrated design process is needed.

Integrated design

Integrated design covers the complete life cycle of a building. In the earliest design stages, where the impact of a design change on costs is low and the impact on performance is high, clear goals should be set by a multidisciplinary design team, preferably including the contractor and future tenant.

Integrated design also includes knowledge transfer and evaluation, for example by monitoring real energy use and providing feedback to improve future projects. A committed and competent client is necessary to keep all project members on track towards the design goal.

More information

The guidelines in this booklet are the result of a master thesis project at Delft University of Technology performed in 2013. 25 actors with decision-making power in office renovation projects are interviewed to research the best way to organize a design process to involve sustainability.

The complete master thesis, including detailed descriptions of the case studies can be found online:

- Go to http://repository.tudelft.nl, and search on “Daan Boonstra” or “sustainable office renovation”
- Contact the author via daan.boonstra@gmail.com
INTEGRATED DESIGN PROCESS (IDP)
Holistic non linear design optimization from a systems perspective

Goal setting & quality assurance

Early actor involvement
Knowledge transfer & evaluation

idea end-of-life solutions

1. START OF PROJECT
2. DETERMINE WISHES AND GOALS
3. SET UP A MULTIDISCIPLINARY DESIGN TEAM
4. BUILDING ASSESSMENT
5. CLEAR GOAL SETTING
6. FINALIZE REFRURBISHMENT STRATEGY
7. IMPORTANCE OF TENANT
8. RECALL STRATEGY
9. DEVELOP A MEASUREMENT AND VERIFICATION PLAN
10. TEST (INNOVATIVE) SOLUTIONS
11. EDUCATE WORKERS THAT WILL WORK ON-SITE
12. FOLLOW UP CONSTRUCTION
13. EDUCATE OPERATION PERSONAL
14. COMPARE DESIGN AND REALITY
15. EVALUATE FOR FUTURE PROJECTS

START OF PROJECT

DETERMINE WISHES AND GOALS
SET UP A MULTIDISCIPLINARY DESIGN TEAM
BUILDING ASSESSMENT
CLEAR GOAL SETTING
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