Documentation of pilot project “Powerhouse Kjørbo”


Power House Kjørbo
Kjørbo, Sandvika Norway

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Disclaimer

The MaTrID project is supported by the European Commission in the Intelligent Energy for Europe Programme. The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EACI nor the European Commission is responsible for any use that may be made of the information contained therein. The MaTrID project duration is from June 19, 2012 – December 18, 2014 (Contract Number: IEE/11/989/SI2.615952).
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1 Background information

All pilot projects in WP4 have to be clearly documented. The following structure helps to keep track on IED processes in partner countries. This template emerges from work done in WP5 and WP6.

2 About this pilot project

Name/acronym of the pilot project: Powerhouse Kjørbo
Owner: Entra Eiendom
Name of contact person: Einar Børve
Function of contact person: Part of design team
Location: Kjørboveien 20, Sandvika, Norway
Type of the building: Office building
Gross floor space in m²: 5 180 m²
Investment costs in EUR: 14 mil. Euro
More information:
http://www.powerhouse.no/
http://www.futurebuilt.no/prosjektvisning?projectId=258201

3 Design goals

The candidate partner can here describe the design goals that are inspiring the design effort. For each of them, please report explicitly the target values or the acceptability conditions.
Table 1: Design goals per design phase.

<table>
<thead>
<tr>
<th>Design goal</th>
<th>Describe the goal and the set-point values if applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetics</td>
<td>Keep same outer look (original building from 1980s). The Municipality of Asker (Sandvika), had demands for the shape of the building. Now changes where allowed, except for enlarging the building footprint while the area of the increased insulation thickness. Due to restrictions, there are limitations regarding energy solutions – height of solar plants on the roof, and possibilities for placement of new larger ventilation plans (where not allowed on the roof).</td>
</tr>
<tr>
<td>Accessibility</td>
<td>The building had to fulfil new Norwegian regulations for accessibility</td>
</tr>
<tr>
<td>Cost-effectiveness</td>
<td>Build within commercial market conditions. But the building has been granted approximately with 2,000,000 Euro. A general granting for fulfilling Norwegian passive house standard ~68 Euro/m² (350.00 Euro), and granting for new technology (Solar Cells) 1,500,000 Euro.</td>
</tr>
<tr>
<td>Energy efficiency</td>
<td>Powerhouse definition: Powerhouse is a building that during its lifecycle produces more renewable energy than it consumes for production of building materials, construction, operation and demolition of the building. The demands equals ZEB-COM (Energy production on site is equal to energy consumption for Construction, Operation -without electrical appliances- , and Materials Energy-positive building with energy label A (Norwegian regulation)</td>
</tr>
<tr>
<td>Historic preservation</td>
<td>Keep historical look (original building from 1980s), see constraints from Municipality above.</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
</tr>
<tr>
<td>Secure/Safety</td>
<td></td>
</tr>
</tbody>
</table>
Design goal | Describe the goal and the set-point values if applicable
---|---
Sustainability | BREEAM Outstanding
Future Built pilot project- quality criteria are:
1. Pilot projects must be innovative and have showcase qualities.
2. Pilot projects must be of high architectural and environmental quality. They shall contribute to a healthy urban environment that ensures good living.
3. Pilot projects are localized near major transport hubs, and will reduce climate gas emissions from transport, energy and materials by at least 50%.
For more information: [http://www.futurebuilt.no/english](http://www.futurebuilt.no/english)

Other | 

### 4 Work organization

#### 4.1 Team composition

Has been the design team the same during the whole process?

Powerhouse is a collaborative project on the commercial development of energy-positive buildings. The project is carried out by a number of key actors:

- Entra Eiendom - real estate owner / developer
- Skanska – construction company
- Snøhetta - architect firm
- ZERO - environmental NGO
- Hydro - aluminum company
- Sapa - aluminum profile company
- Asplan Viak - consulting firm (Energy, environment, HVAC, acoustics, fire safety, etc)

The multidisciplinary team comprised:

- Representatives for the owner
- ID facilitator
- Head of design – management
- Architect
- Structural engineer
- Energy consultant
  - PV
  - Energy consultant
  - Contractor (Norsk Hydro with knowledge on PV)
- HVAC consultant
- SINTEF with special competences
- Acoustic consultant
- Fire consultant
All stakeholders were involved in the project from the early stages and formed a partnership. Sapa and Asplan Viak were not part of the project before the feasibility study, but joined in the design phase. Asplan Viak provided multi-disciplinary consulting in the project and also represents the user (tenant).

Has the multidisciplinary team increased the effectiveness of the design phase?

The multidisciplinary design team indirectly increased the effectiveness of the design phase. Early decisions in the multidisciplinary team ensure the design choices and the consolidation of strategies in order to reduce the risk of changes in following design stage. This has increased effectiveness in the project process.

Has the multidisciplinary team anticipated interferences between activities and avoided problems?

The design process was a combination of discussion in a large group, with all members present, and discussions in smaller subtask groups. The larger group included up to approximately 20 persons, and the smaller subtask group’s 3-6 persons. The themes of the subtask were:

- Thermal energy supply system
- Photo Voltaic
- Ventilations strategy
- Embodied energy
- Daylight studies
- Buildings envelope – opaque walls

The workshops were whole days meeting. During the workshop, the working method altered between discussions in a large group and discussions in the smaller subtask group. The themes for the subtask were specific technical and the theme of the group. The themes in the large group discussions were to coordinate and compromise functional needs and demands from the subtask. Additionally, the ID-facilitator discussed all proposals, and ensured that they would not violate the project objectives.
Overview Multidisciplinary design team

Do you consider useful the constitution of a multidisciplinary team from the beginning of the design activities?

Multi-disciplinary team is crucial for achievement of the project’s goal. It is very important for the ID that all stakeholders participate in the project development, design and implementation from as early stages as possible. This gives an opportunity to see the building’s development from many angles at the same time. Architects and planners contribute to optimizing the energy and environmental performance by choosing architectural design and passive solutions, while technical team and contractors facilitate choice of active systems and the building process.

4.2 ID facilitator: role and function

Describe the role of the ID facilitator during the development of the pilot project.

ID facilitator was responsible for achieving the project goals and objectives. ID facilitator was leading the large group discussions, and every time design proposals might compromise the project goals, the ID facilitator would call for alternative solutions. This process ensured that the overall design of the building was in correspondence with the project goals and objectives.

Describe within maximum one page your level of actual involvement in the respective phase:

Initial planning phase, Competition phase (if applicable in your country), concept design phase, detailed design phase, construction phase.

Table 2: Role of the ID Facilitator per design phase.
### Design phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Describe the involvement of the ID Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial planning phase</td>
<td>Not involved</td>
</tr>
<tr>
<td>Competition phase</td>
<td>Not involved</td>
</tr>
</tbody>
</table>
| Concept design phase         | Participant on workshops and work in and in-between workshop meeting I subtask:  
  - Thermal energy supply system  
  - Photo Voltaic  
  - Ventilations strategy  
  - Buildings envelope – opaque walls  |
| Detailed design phase        | Not involved                                  |
| Construction phase           | Not involved                                  |

### 4.3 ID facilitator mandate

Has the ID facilitator received a mandate from the owner?

The mandate for the ID facilitator was the goals and objectives for the project. Please, attach a copy of the mandate in the Annex X at the end of this report if possible. No paper available (Entra), the building owner and the tenant (Asplan Viak), was participant in the large multidisciplinary design team.

### 5 Communication among the team members

#### 5.1 Use of Building Information Model (BIM) tools

In case more than one BIM tool was used during the design, there were problems in sharing the numerical model among the team members?

No information available on this subject

Can you briefly report your experience in using BIM tools, basically by referring to the lessons learnt?

No information available on this subject
Do you think that the level of development of the software you used is adequate to be used in the practice?
No information available on this subject
Can you point out some lacks you found in using BIM tools?
No information available on this subject

5.2 File sharing system

How do you evaluate the efficiency of your file sharing system?
In the project the file sharing system Project Place was used. It worked well with regard to providing platform for communication and cooperation among different actors.
On the base of the experience gained during this project, would you take in consideration the adoption of more advanced systems to share files?
Probably not.

5.3 Information sharing

How do you evaluate the efficiency of sharing information during this project?
During the design and development period there has been held 4. workshops with the representatives of the key stakeholders. The goal of the workshops was to facilitate communication and information sharing for the purpose of planning and cooperation among various parties in the project. Workshop included updated information and presentation on latest design and decisions. This process ensure available updated information on design team members.
On the base of the experience gained during this project, would you take in consideration the adoption of more advanced systems to share information?
No

5.4 Transfer of knowledge

Transfer of knowledge is about how the ID process increases understanding and knowledge of all specialists work conditions. The aim of transferring this knowledge is that by increasing awareness and knowledge during all stages of the planning process it should provide even better ID processes in the future.
Describe how transfer of knowledge took place among architects, engineers and developer.
One of the key partners in the project is environmental organisation Zero. One of their roles include creating public interest and political follow-up, providing and disseminating information and raising awareness about the project among all interested groups.

During the project development and implementation stages representatives of the ID team travelled around the country and presented the concept and progress of the project. Such presentations were held for the relevant companies and organisations in the building industry and technical branches, as well as academia, including NTNU (Technical University of Norway in Trondheim) and various design schools.

6 ID Strategy – Workflow

6.1 Quality assurance plan & Quality control plan

A Quality Assurance Program describes the overall goals for the building. The values have to be described both as goals and demands. It may also be useful to weight the goals or rank them. It is important that the Quality Assurance Program is deeply rooted in the decision makers of the project and it should be given the same status as the budget and time schedule for the project.

The Quality Assurance Program has to be followed up by a Quality Control Plan. This plan is a tool for the project team and a document that makes it possible for the building owner to control and follow up the goals. The quality control plan defines goals and related sub goals, defines milestones through the planning and construction phases, and specifies who is responsible for each task.

6.2 Setting responsible, milestones and highlighting critical points per each design phase

The responsible in charge for a given design phase helps the ID facilitator in managing the whole process. He/she has the responsibility for the correct implementation of the tasks planned in a specified phase and for the on-time execution of the activities.

A milestone is a formal checkpoint defined by the whole design team during the initial planning phase. It can be a formal approval by the owner or the delivery of one or a set of documents. The approval of a milestone allows access to a subsequent phase.

A critical point is an unexpected situation that has occurred during a given design phase. Please report the solution discussed within and proposed by the design team.
Table 3: Responsibilities, milestones, critical points and outcomes per design phase.

<table>
<thead>
<tr>
<th>Design phase</th>
<th>Responsible(s) in charge for the phase</th>
<th>Milestone(s)</th>
<th>Critical point(s)</th>
<th>Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial planning phase</td>
<td>No documentation</td>
<td>No documentation</td>
<td>No documentation</td>
<td>No documentation</td>
</tr>
<tr>
<td>Competition phase</td>
<td>No documentation</td>
<td>No documentation</td>
<td>No documentation</td>
<td>No documentation</td>
</tr>
<tr>
<td>Concept design phase</td>
<td>ID Facilitator</td>
<td>Overall goals and objectives for the project – see section above</td>
<td>Documentation report – documentation on design proposal and documentation on the fulfilling on project goals</td>
<td></td>
</tr>
<tr>
<td>Detailed design phase</td>
<td>ID Facilitator</td>
<td>Overall goals and objectives for the project – see section above</td>
<td></td>
<td>Drawing and technical specification</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BREEAM Outstanding design certificate</td>
</tr>
</tbody>
</table>
| Construction phase      | ID Facilitator, Leader on the building site | Overall goals and objectives for the project – see section above | BREEAM demands Airtightness                                                      | BREEAM Outstanding certificate
|                         |                                        |                                                   |                                                                                  | Energy label A
|                         |                                        |                                                   |                                                                                  | Passive house standard                                                                         |
7 Innovation and Demonstration

7.1 Please report which are the most innovative features of your intervention. Why is this project innovative?

Powerhouse Kjørbo is the first rehabilitated energy-positive office building in the world. Powerhouse is defined as a building that during its lifecycle produces more renewable energy than it consumes for the production of building materials, construction, operation and demolition of the building.

The building is certified BREEAM Outstanding in the design phase.

Powerhouse Kjørbo features low ratio of embodied energy in materials used in construction and technical installations, and high ratio of reused materials in the construction phase.

The building has obtained energy label A, and has energy properties better than a passive house. Reduction in the energy need is achieved by employing energy efficient solutions and a well insulated building structure. Specific energy consumption (excluding user’s equipment) is calculated at 20,4 kWh/m² yearly.

The building has the following properties:

- u-value roof: 0.08 W/m²K,
- u-value walls: 0,15 W/m²K,
- u-value windows: 0,8 W/m²K
- Airtightness: < 0,6 h-1 (measured 0,2 h-1)

Powerhouse employs renewable energy systems for energy production/recycling:

- Two heat pumps running at different temperatures (COP heating = 3.5, COP cooling = 15)
- Local production of PV electricity
- Recycling of heat from data servers

Solar energy (PV) installation at Powerhouse Kjørbo is Norway’s largest. Its area is 1550 m², located on the roof of the two blocks and partly on the garage. Calculated energy production for such a system is 210 000 kWh/year (40 kWh/m²).

Technical systems in Powerhouse Kjørbo include:

1. Heating: Air heating delivered from ventilation system combined with radiators in the wave wall in the center of the building.
2. Cooling: central air cooling – mechanical and displacement ventilation
3. Hot water: energy wells, heat pump and district heating as back-up.
4. Lighting: energy efficient and demand-controlled, LENI number ~9 kWh/m² year.
5. Ventilation: displacement ventilation. Efficient heat recovery (85%), with reduced duct lengths and low SFP. The stairs are also used as ventilation ducts.
7.2 What lessons have you learned during the ID process?

1. Work in a multi-disciplinary team is a complex activity. Communication is something as perceived an easy task, but it’s a much more difficult pursuit in practice. Challenges related to multi-disciplinary communication can be solved through good planning and setting aside enough time for meetings/workshops and clarification process.

2. Quality and degree of precision in the initial concept stage (feasibility study) is invaluable. Good quality of feasibility study can contribute to a more cost-efficient process at the later stages.

3. All design team members should take part of most discussions because they have to know how hard the process is to find the best solution. If they haven’t been a part, they tend to be less flexible in finding holistic solutions. It’s important to be a part of the process to be motivated to change attitude. And it might end up being most cost efficient.

4. The initial phase should be longer – and the stage model has to be challenged. It’s important to give time to the process; the client developer has to accept/acknowledged this. But from a developer perspective it is crucial: Milestones represent designs that are well documented in order to secure confidence in decisions made (reducing economical risk).

7.3 What kind of problems did occur during the ID process and how did you solve it?

One of the challenges that the project had faced during its ID process was the conflict between environmental goals and aesthetic objectives. For example, preservation of the wooden façade of the building and its aesthetics was weighted against the possibility for increased utilization of solar energy, by using the parts of façade for photovoltaic cells. As a result of discussion, a compromise solution had been reached: the solar cells were eventually placed on the roof of a nearby garage instead of the building’s facades, thus keeping the aesthetic expression of the building and increasing capacity for energy production by using off-site areas.

7.4 What would you do differently during the next ID process?

Total contracting in a complex project like Powerhouse Kjørbo sometimes resulted in most of the decision-making power concentrated with the developer. This can feel for other involved parties like losing control over the project. Developers tend to speed up the decision-making process, setting short-term deadlines and restricting the amount of time available for discussion of key design concepts. As a result some of the technical solutions in the project could have been more optimal.

7.5 What kind of awareness rising

There has been an outstanding interest in the building in the operation phase, with visits from politicians, authorities and professionals. The building has been opened in an official ceremony with participation of Minister of Commerce of Norway. There are regular visits and guided tours around the building for all interested, with a possibility to book such tours online. Energy consumption and production data is available through implementation of the energy dashboard, where one can present historical and technical data, internally as well as publicly online.