

The design process for achievement of an office living laboratory with a ZEB standard

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III.: LINK Arkitektur/Veidekke

by

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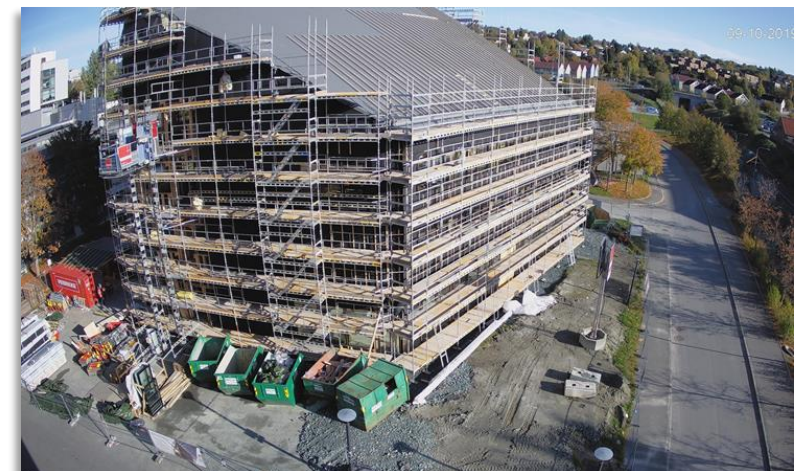
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Content

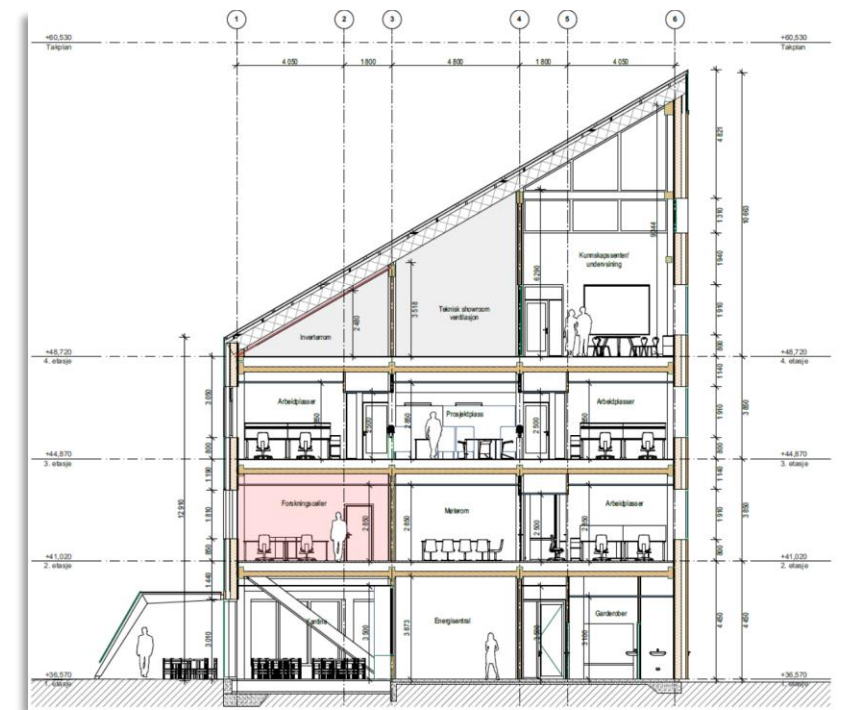
- The ZEB Laboratory
- The challenge – realising an ambition
- Designing the project delivery
- Integration of the ZEB method
- Lessons learnt



Vision of the ZEB Laboratory



is to be an arena where
innovative solutions are
developed,
investigated,
tested,
and demonstrated in
mutual interaction with
people.



The challenge;

Going from an ambition to constructing a ZEB Laboratory

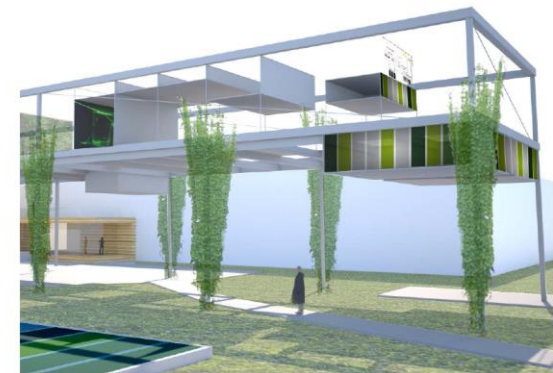
- The building should be a model project and achieve ZEB-COM level (simulated in a 60 years perspective)
- Separate control and measurement systems, one for ordinary operation and one for research
- Flexibility in design of energy and climatization systems
- Flexibility in design of working spaces
- Progressive selection of materials and enabling rebuilding parts of the facades
- Adaptation of the building to climate change

ZEB FLEXIBLE LAB

Note no. 3

Berit Time (Editor)

Ambisjoner



 SINTEF  NTNU  ZEB  KLIMA2050

Designing the project delivery*

- * incl.
- Project development
- Procurement
- Contracts

The ZEB Laboratory - a complex project

with ambitions to deliver in areas beyond time, cost and quality

Assessed project delivery models:

- Design-Bid-Built (*Utførelseskontrakt*)
- Design-Build (*Totalentreprise*)
- A collaborative form of project delivery method (*Samspillmodell*)

Developing the contract

- NTNU/SINTEF, as client, developed a method together with an expert in project delivery methods.
- A partnering contract structure was developed and asked for
- The project delivery - divided into two phases,

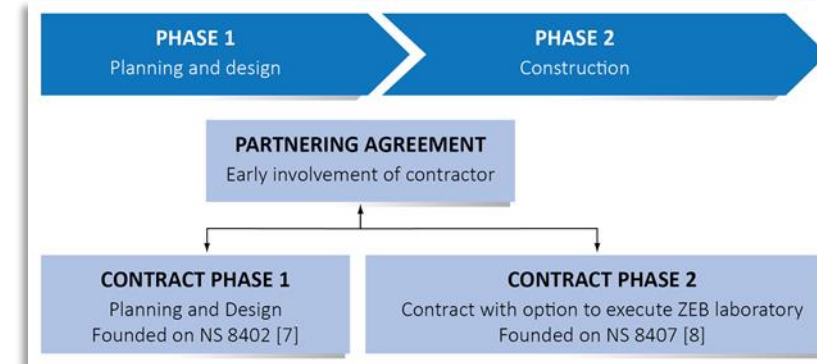
Phase 1; Planning & Design

Phase 2; Contract with an option to execute ZEB Laboratory (if target cost was accepted)

- A pre-project was developed through an integrated team approach in *Phase 1* and a target cost was established.
- In *Phase 2*, the contractor has the responsibility for the design and the construction, the client contributes.

The contractor has its expenses compensated, but carries risk when exceeding the target cost.

The client has decision making competence through change mechanisms.



The bid

Focus on

- the content of the contract
 - for planning and design (*Phase 1*) and
 - construction (*Phase 2*),
- competition rules
- the project
 - the description with the ambitions for the project were made as part of the bid
- overall requirements

Evaluation award criteria and the weighting

- tender amount 0,30
- implementation plan 0,30
- the project organization's expertise and experience 0.40

ZEB-laboratoriet

Her kommer ZEB-laboratoriet
Et laboratorium for nullutslippsbygg og en arena hvor nye og innovative løsninger utvikles, utforskes og demonstreres i samspill med menneskene i bygningen.

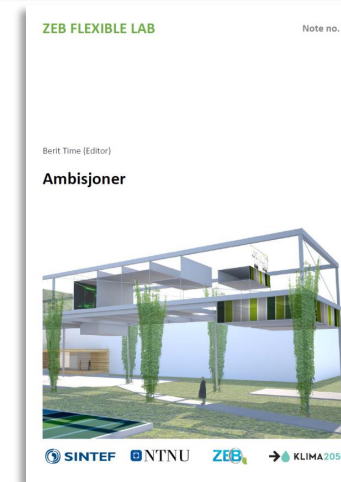
Laboratoriet er utviklet i et samspill mellom NTNU, SINTEF, Orion, Veidekke Entreprenør, Link Arkitektur, Siemens, Vintervoll, Bravida, Multiconsult, Aas Jakobsen og Brekke & Strand

Ferdig 15. oktober 2020



SINTEF NTNU Forskningsrådet

VEIDEKKE
bravida
SIEMENS
VINTERVOLL
Multiconsult
LINK ARKITEKTUR
BREKKE & STRAND
AAS-JAKOBSEN
ENOVA



The ZEB method

Integrated energy design process (IED)* was used to achieve the ZEB goal in the best possible way

1. It calls for a different approach from the very early stages of design
2. It requires a high level of general skills (energy knowledge in a broad sense) and communication within the team
3. It leads to a high level of integration and synergy of systems
4. It involves modern simulation tools where suitable

*Hestnes A and Eik-Nes N-L (Ed.) (2017) Zero Emission Buildings, Utgave 1, Fagbokforlaget.

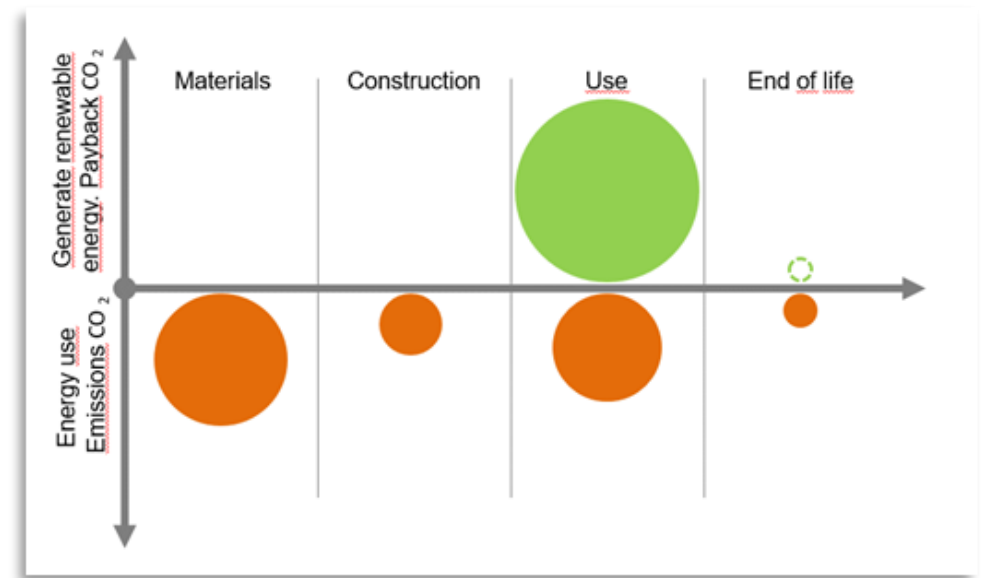
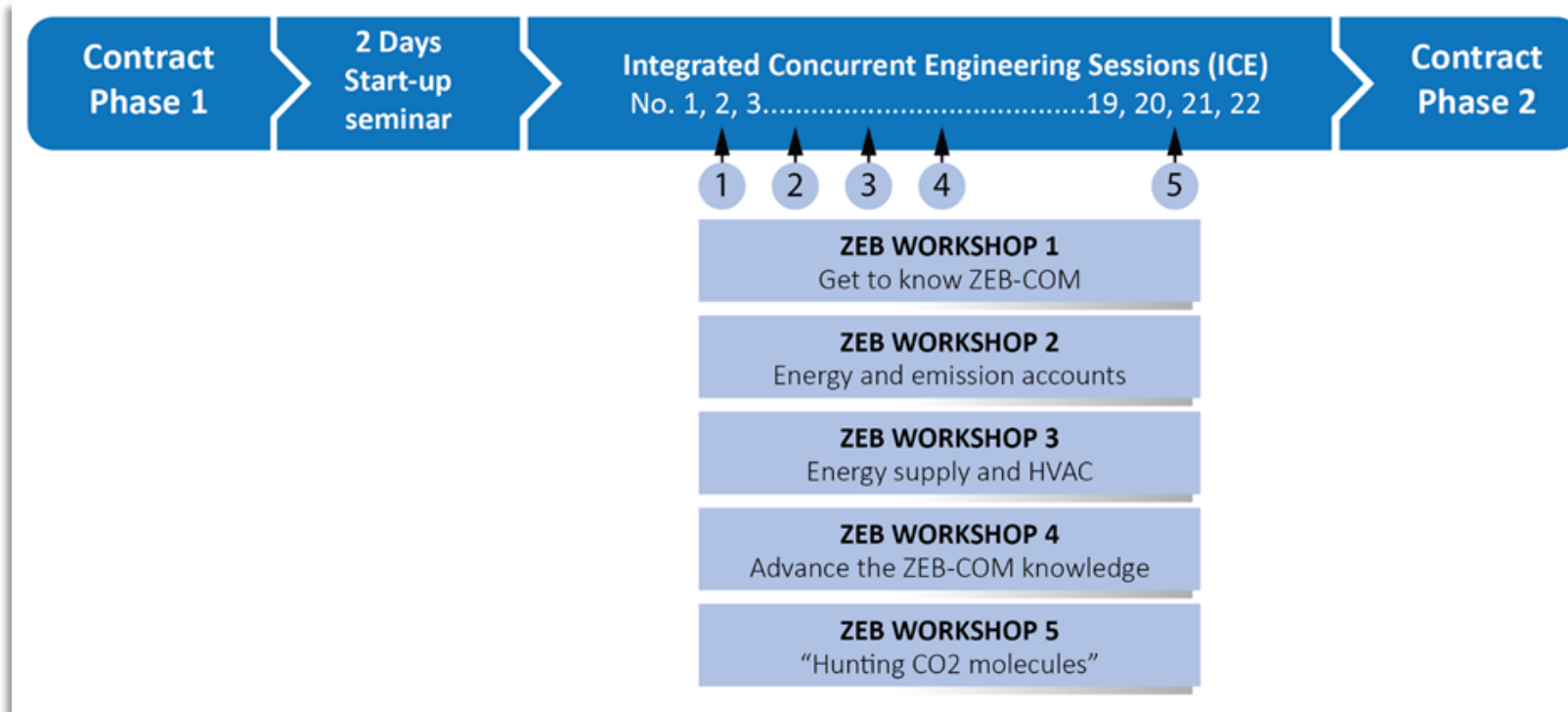


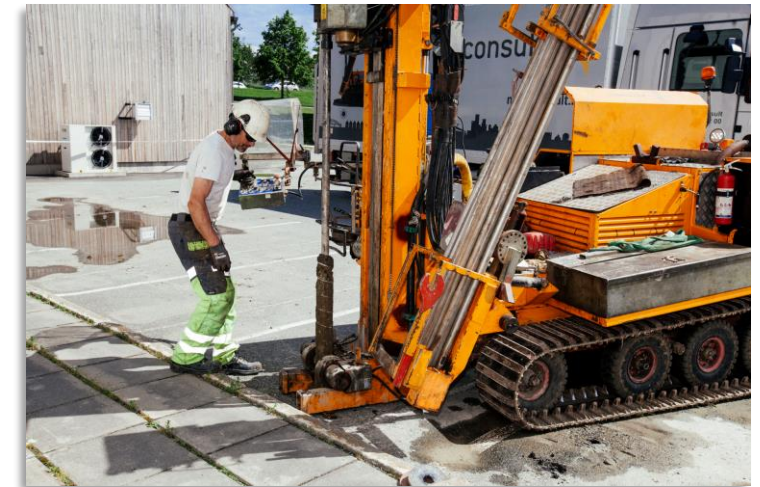
Illustration: FME ZEB

Implementation of measures to perform the ZEB methodology



Lessons learnt

- Bring all the actors together early and create professional and social competent teams with little replacement of people
- Anchor the ZEB ambition and common goals initially – the ZEB workshops were a success
- Focus on improvements – use a system for evaluation of the process and mutual evaluation between the parties
- Continuously measure process and progress and keep team members accountable



For more information about the ZEB Laboratory

- Visit the poster presentation
- See www.zeblab.no
- Join conference excursion on the 8th of November

ZEB Laboratory – Research Possibilities
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Abstract
The ZEB Laboratory is a facility located in NTNU Glisshaugen campus in Trondheim. The building is designed as a 4-storey high and 1800 m² area office space and should achieve the ZEB-COM emission level over 60 years.
The laboratory will contribute to build knowledge for zero-emission buildings. It will be an arena for experimental investigation of user-building interaction, and a laboratory to test new technologies on a large scale. Innovative ventilation and energy technologies are included.
At the first floor, two identical rooms are equipped as test cells with dedicated HVAC systems, a larger number of sensors and with a higher flexibility for control.

The Ambitions

- Be a model project and achieve ZEB-COM level (simulated over a 60 years perspective) [3]
- Separate control and measurement systems
- Flexible design and use of energy and climatization
- Improvements in design of working space
- Adaptation to climate change [4]

Development of ZEB-COM
The ambition goal of the ZEB Laboratory was set to ZEB-COM [3]. This means that the renewable energy should compensate for the emissions due to:

- Energy use for operation and equipment
- Embodied material emissions
- Construction process

Indoor Positioning System
The IP3 delivery by Siemens detects the occupants' position and establishes a communication network that interacts the occupants' smart phones. User position is sent in real time to a cloud solution.
The data can be used to provide services and information; locate colleagues, equipment, be guided to meeting rooms or exits, etc.
The building is equipped with a common platform including a Building Energy Management System (BEMS) and a time series database system provided by Siemens.

Energy Balance
ZEB Laboratory integrates BIPV solar panels and a heat pump that can use different heat sources (i.e. heat recovery from service and outside air). This allows to investigate possible combinations between available local renewable energy and centralized electric grid to reach the zero emission building requirements.
A PCM heat storage will be installed used to recover thermal energy from the BIPV roof and as a thermal buffer to ensure more efficient use of the heat pumps. The PCM infrastructure is made flexible for grid integration and development of such systems.
Future research and development of such systems experiments on the interface between buildings (BEBs) and grids, especially smart power grids and district heating and cooling, thus enabling to study the performance of optimal predictive control strategies, load shifting and energy storage.

Research Possibilities

- New methods for user centered design of zero emission building technologies
- User interfaces of building technologies in general (end users)
- Synergy effects of user interaction and building response
- User interfaces of building energy management systems (building operators)
- The building as an ecosystem - systemic interfaces
- Impact of lighting systems on user health and well-being
- User perception of different natural and mechanical ventilation and advanced use of natural and mechanical systems (building operators) and user data
- Thermal energy storage efficiency in relation with external parameters (smart grid, weather data and forecast)
- Use of AI to interpret connections between indoor positioning data and indoor climate data
- Peak loads and load shifting strategies for building design

Further Reading
https://www.sintef.no/book/index/3232/zeo_laboratory_research_possibilities

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