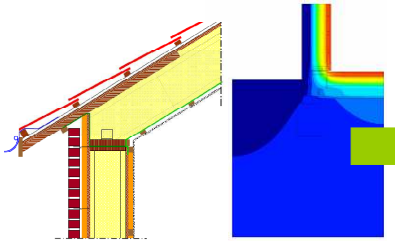
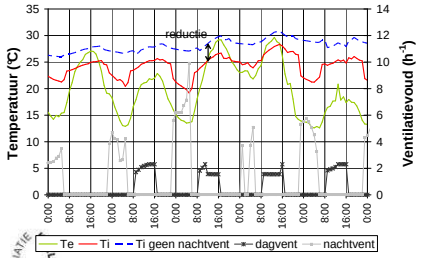
Research Group Sustainable Building

Hilde Breesch, Ralf Klein, Alexis Versele
Barbara Wauman, Katrien Biesbroeck, Jelle Langmans,

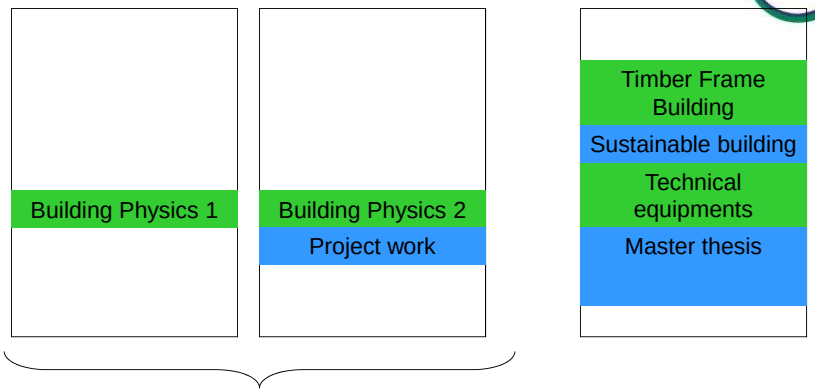
KaHo Sint-Lieven – Gent
Building Engineering
http://www.kahosl.be/site/index.php?p=/nl/page/1515/duurzaam-bouwen/

Research <> On-site experience and society related services



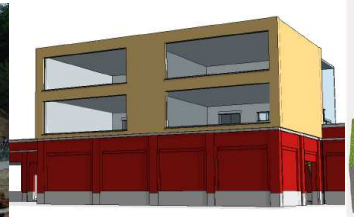


Research <> Education



Research projects

- Electrabel fund (demonstration project, 2005)
- Cost effective commissioning of low energy buildings (IEA ECBCS ANNEX 47) (international research, 2005-2009)
- Analysis and optimization of performance criteria and calculation methods for very low energy school buildings (PHD, 2009-2013)
- Active buildings (Tetra, 2008-2012)
- Net Zero Energy Solar Buildings (Nzebs) (IEA SHC TASK 40 – IEA ECBCS ANNEX 52) (international research, 2009-2013)
- Feasibility of external air tightness of timber frame buildings (PHD, 2009-2013)



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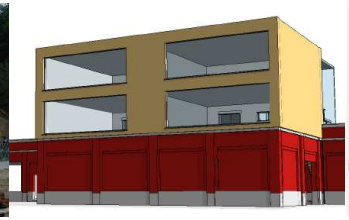



ELECTRABELHUT

Electrabel fund for environmental safety 2005

King Baudouin Foundation

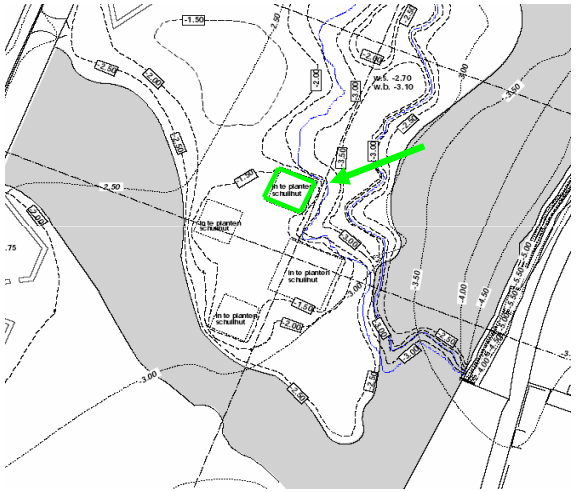
Project definition

Build and start a small documentation and educational centre realized with the passive house standard and with ecological and renewable materials

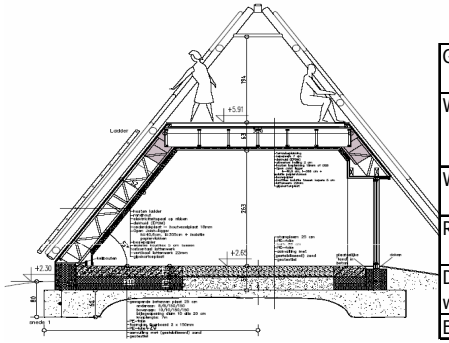
Objectives

- building "Electrabelhut" : dimensions 8m x 8m.
- integration research and education
- accessible for public

Situation



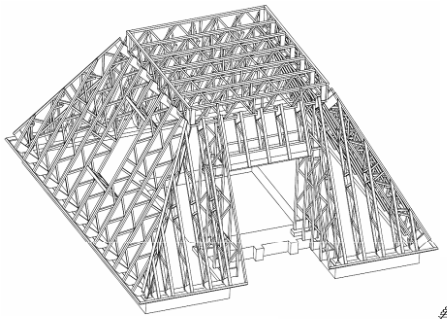
Concept & design: building enveloppe



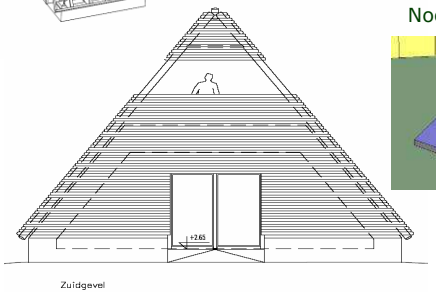
	Components	U [W/m².K]
Groundfloor	30 cm foamglas 20 cm concrete or rammed earth	0,13
Walls ad the bottom	10 cm foamglas 14 cm brick 20 cm foamglas	0,14
Walls	44 cm cellulose 2 cm earth	0,10
Roof	30 cm cellulose 2 cm earth	0,14
Double window with woor frames	Double pane (1.1) Single pane (4.2)	0,8 (g=0.6)
Entrance door	Triple pane (g=0.6)	0,8




Concept & design: oriëntation

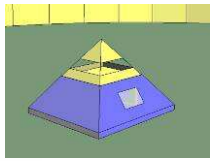


Zuid-Oost zicht



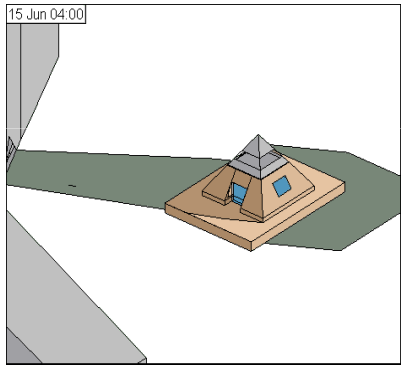
Zuidgevel

Noord-west zicht



Dynamic simulations

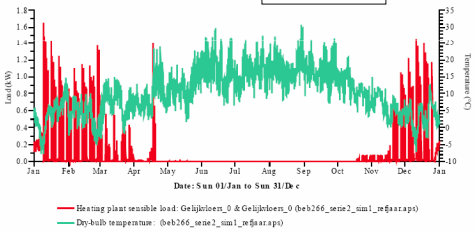
Shading



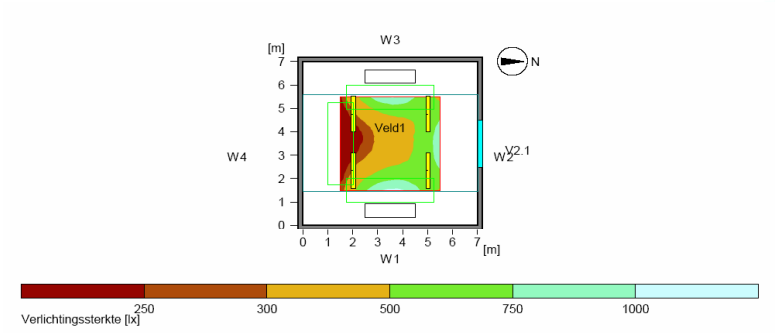
Energy demand for heating

- Jaarlijkse warmtebehoeften : 293 100 kWh/ jaar

dwz 12.7 kWh/ m².jaar



Dynamic model: daylight



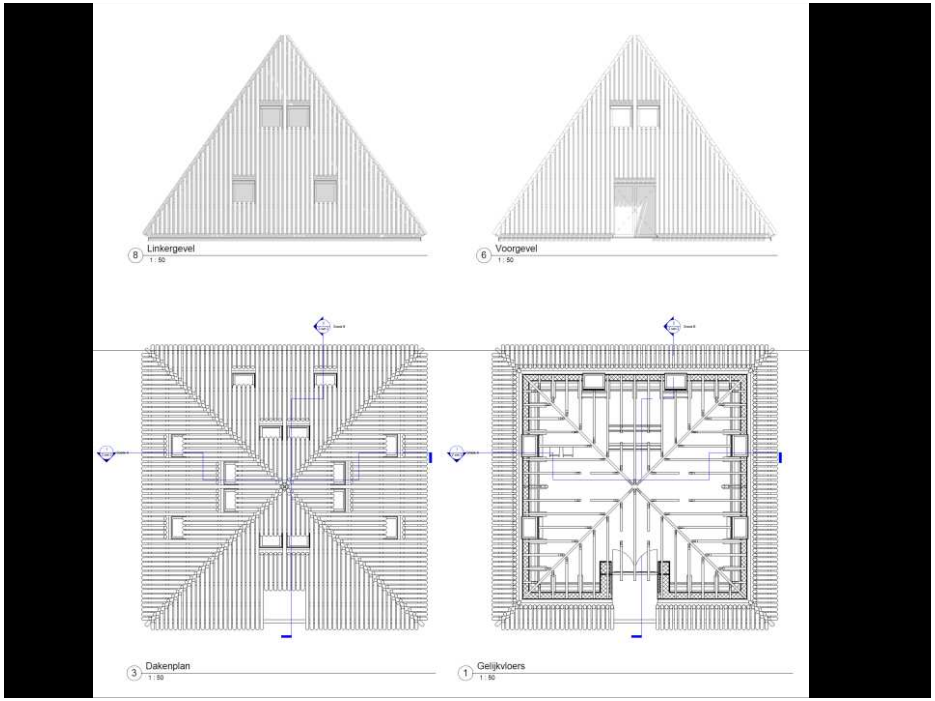
Hoogte van het referentievlak : 0.75 m
Gemiddelde verlichtingssterkte Em : 493 lx
Minimale verlichtingssterkte Emin : 181 lx
Maximale verlichtingssterkte Emax : 980 lx
Datum, tijd : 21.03. 12:00 (WOZ 11:07)

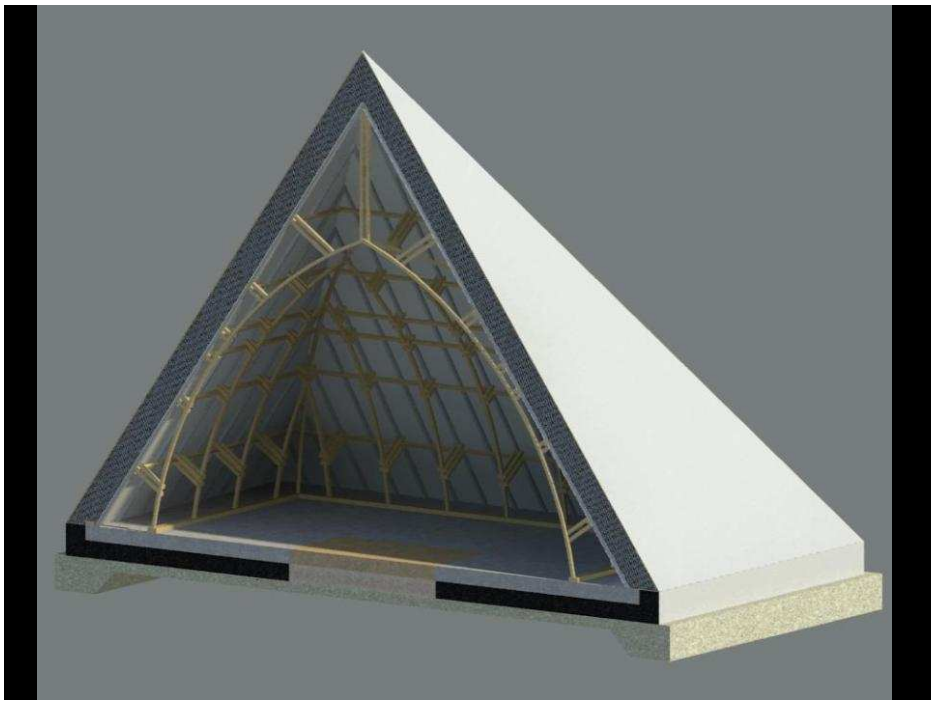
Groen Licht Vlaanderen

Building

Situering

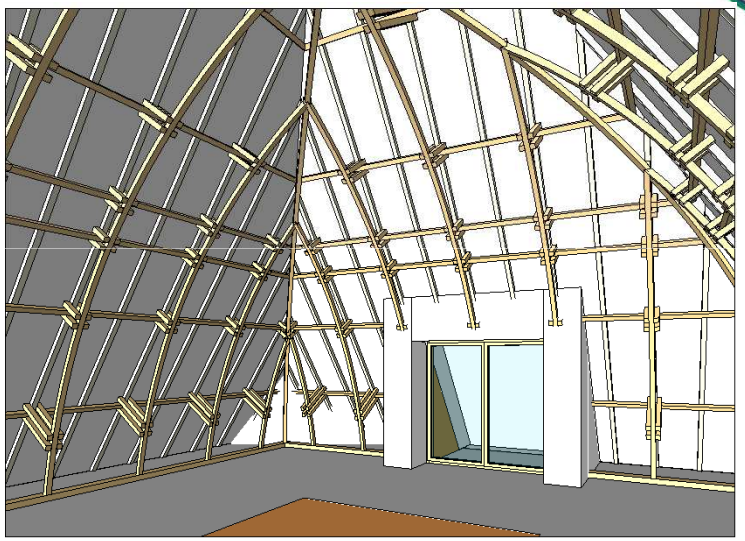
Observatiehut (8 x 8 m) - campus Aalst



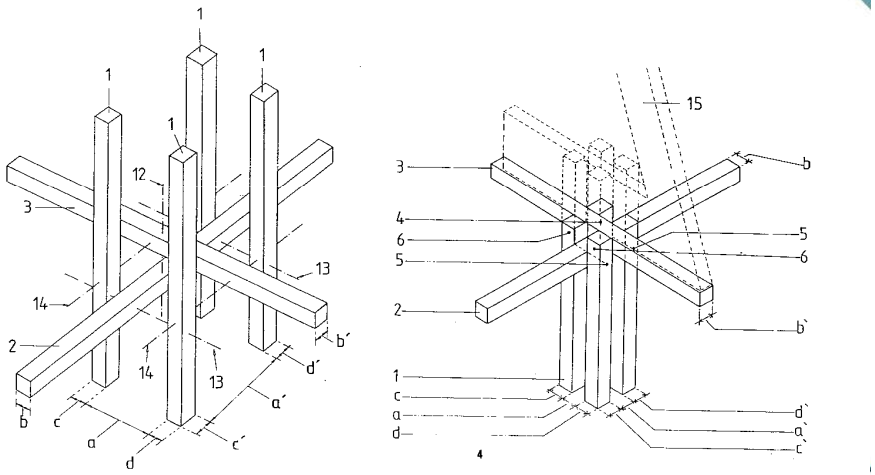


Het gebouw

Dwarsdoorsnede



Houtskeletbouwsysteem met stijve knopen



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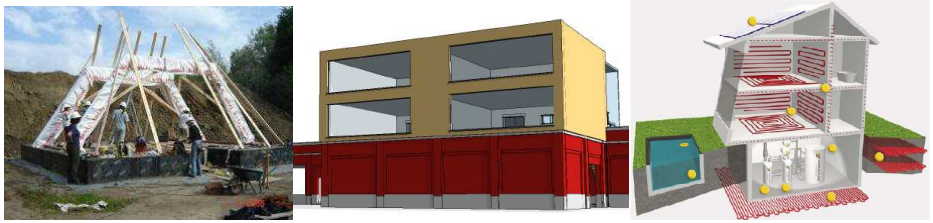
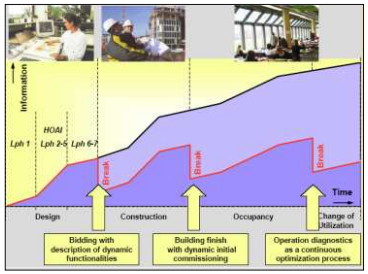
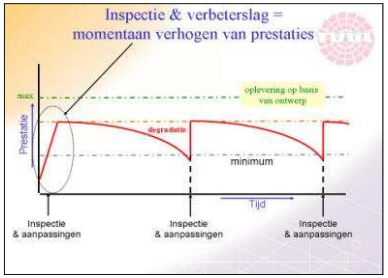


Problem statement





Problem statement

International Energy Agency

Energy Conservation in Buildings and Community Systems Programme

IEA ECBCS Annex 47

– *Cost-effective Commissioning for Existing and Low Energy Buildings*
http://www.ecbcs.org/annexes/annex47.htm

Wat is Commissioning ?

Definition: *Commissioning*

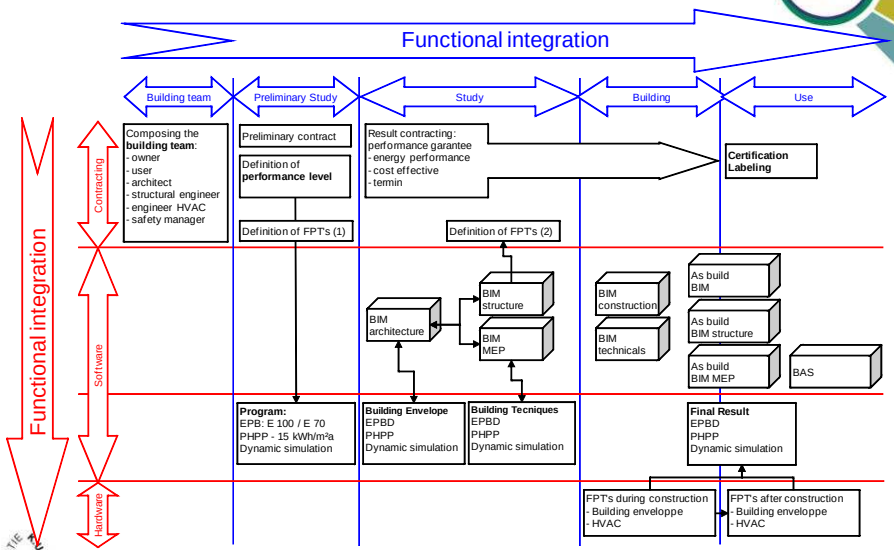
A quality assurance process for new construction (design phase through operation) to ensure the building operates as intended
and
building staff are prepared to operate and maintain its systems and equipment

IEA International Energy Agency - Annex 47

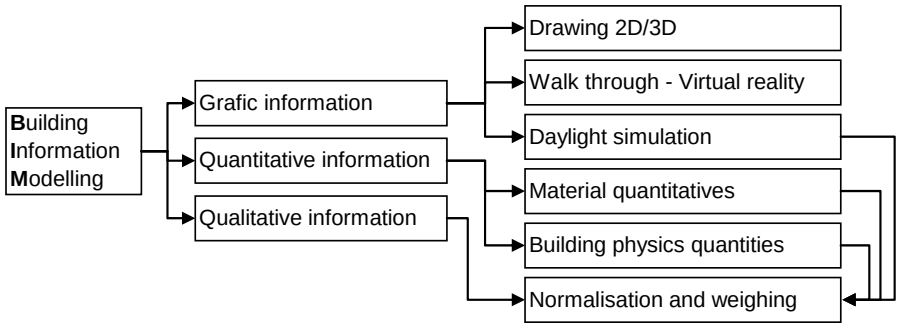
- Commissioning
  - Process for quality control
  - Project teams
  - Complete lifecycle
- Our contribution

Cost-effective Commissioning for Existing and Low Energy Buildings

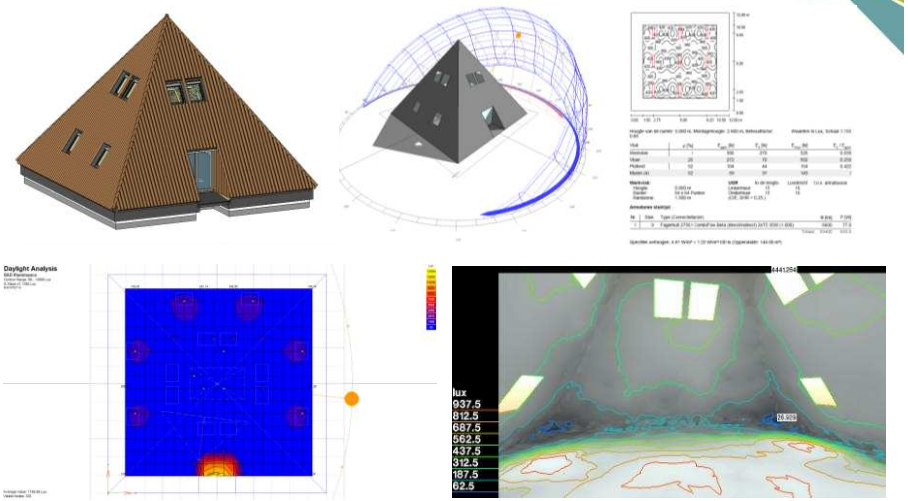
- Tool for linking Flemish EPBD with Building Information Modelling
- Contracting for Building Teams and Passive House certification
- The use of Benchmarking in Contracting Building Cx
- Flow Charts and Data Models for Initial Commissioning of Advanced and Low Energy Building Systems
- Retro-commissioning to improve building energy efficiency for social-profit organization.
- Analysis of the optimal economical energy performance level for a retrofitted dwelling



Building Information Modeling



BIM for lighting analyses



Introduction

Objectives

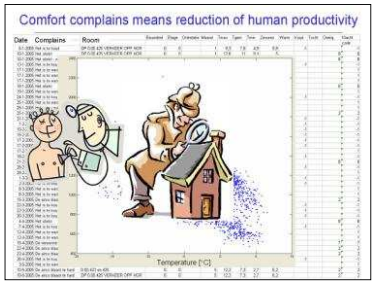
- This study researches 2 new building methods:
  - Integrated project delivery from the USA

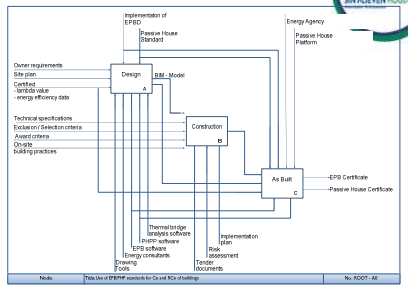
AIA National | AIA California Council
The American Institute of Architects

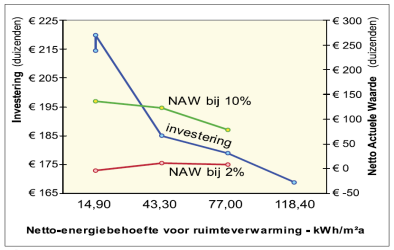
  - Working in project team in Belgium

Bouwdata PB®

Commissioning







Figuur 4: *kosten-batenanalyse van de renovatie voor de verschillende maatregelpakketten (KaHo-SL)*

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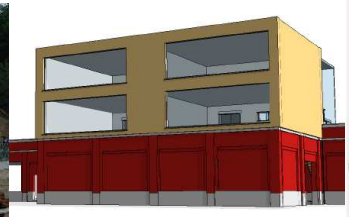
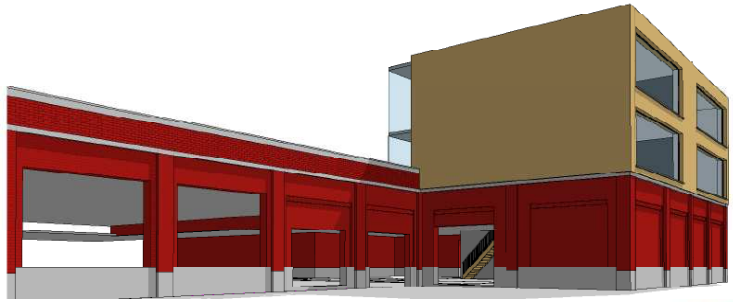


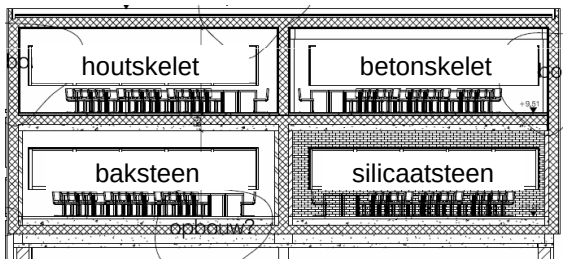

Analysis and optimization of performance criteria and calculation methods for very low energy school buildings

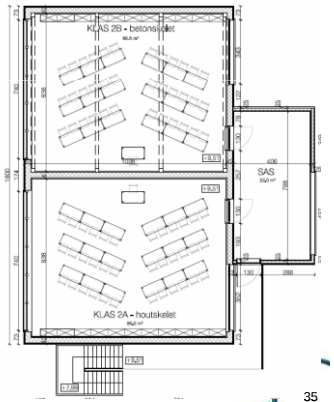
- Objectives
  - Design and Build four very low energy testing teaching rooms KaHo
  - PHD 1: Analysis and optimization
    - performance criteria
    - calculation methods
  - PHD 2: Modelling and controlling HVAC systems



Analysis and optimization of performance criteria and calculation methods for very low energy school buildings

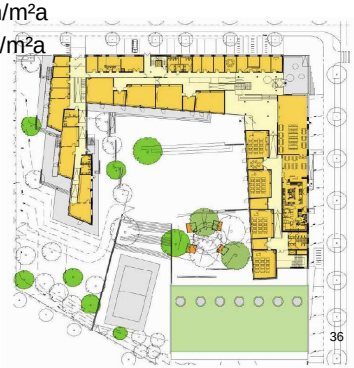
- Very low energy testing teaching rooms
  - Example
  - 4 different building systems
  - comprehensive monitoring en follow up





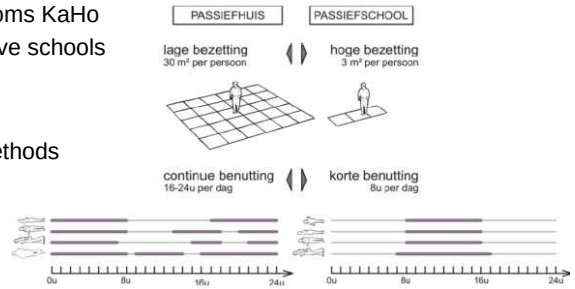
Analysis and optimization of performance criteria and calculation methods for very low energy school buildings

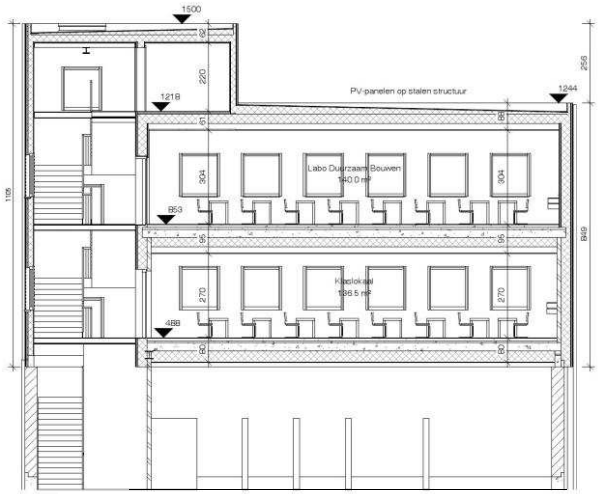
- PHD: analysis
  - Passive school buildings
    - Germany: Frankfurt Riedberg, Biberach
    - Flanders: pilote projects AGIOn
  - Criteria: *Flemish decree energieperformance in school buildings dd.07/12/2007*
    - Net energy demand for heating ≤ 15 kWh/m²a
    - Net energy demand for cooling ≤ 15 kWh/m²a
    - Air tightness $n_{50} \leq 0{,}6h^{-1}$
    - E-level ≤ E55
  - Existing calculating methods:
    - Static monthly: PHPP, EPB
    - Dynamic building simulations (TRNSYS, Energy+)



Analysis and optimization of performance criteria and calculation methods for very low energy school buildings

- PHD: optimisation
  - Modelling
    - Definition of limiting conditions: ex. Use patterns of the building
    - Type model different education departments
  - Monitoring
    - 4 test classrooms KaHo
    - Existing passive schools
  - Optimisation
    - criteria
    - calculation methods





1 Section EE
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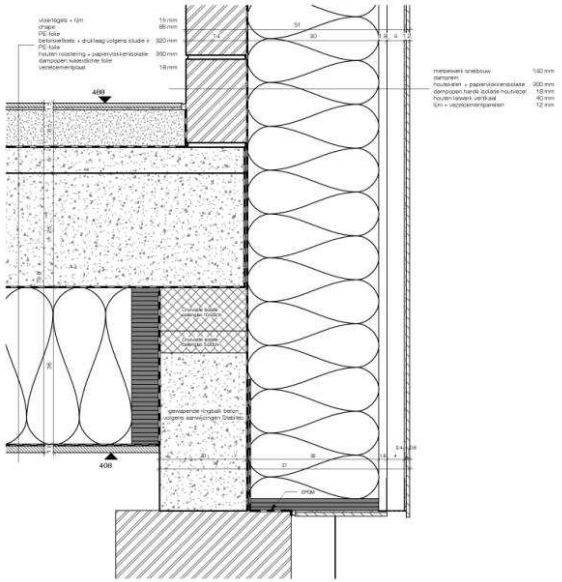

1 Detail 3
1 : 5

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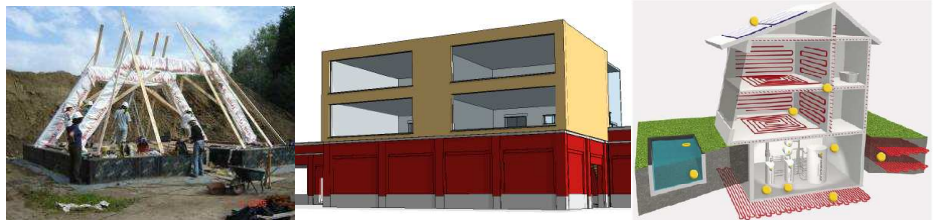


HOGESCHOOL VOOR WETENSCHAP & KUNST

DE NAYER INSTITUUT | sint-lucas departement architectuur

VITO

Active buildings:
Houses as energy producing systems

(IWT TETRA project 080152)

Ralf Klein,
Onderzoeksgroep Duurzaam Bouwen,
KaHo Sint-Lieven, Gent

Introduction

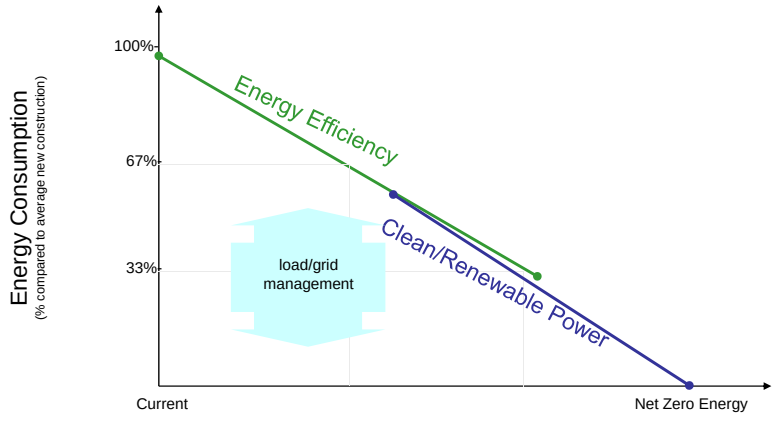
- Active dwellings, **N**et **Z**ero **E**nergie **B**uildings, …

Solar Settlement Freiburg, Germany
Architecture and Concept: Rolf Disch

11,000 m² area with 59 terrace houses,
3,150 m² roof integrated PV,
district heating network

Introduction

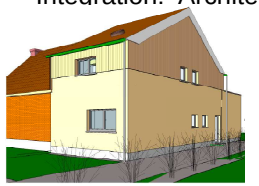
- First “passive” than “active”

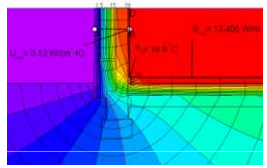


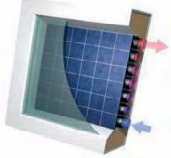
bron: Mark Riley, Annex 52 presentatie juni 2008

Project : design process and exchange of information

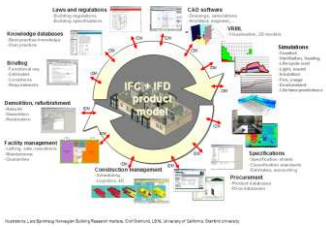
- Integrated Designproces
  - Integration: Architecture– Civil engineering - HVAC





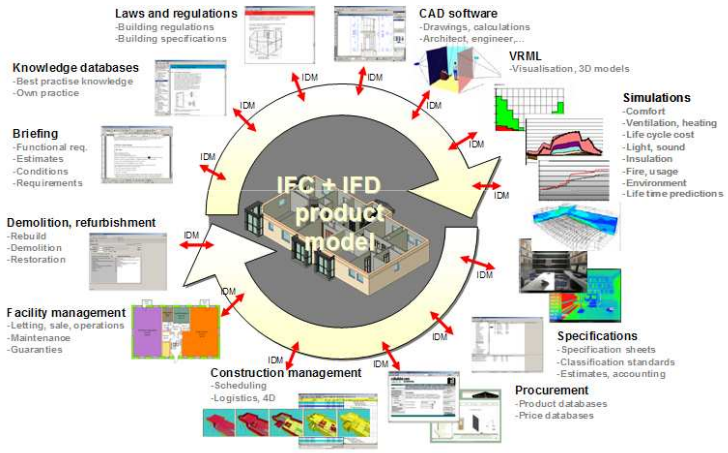


- Building Information Modelling (BIM)



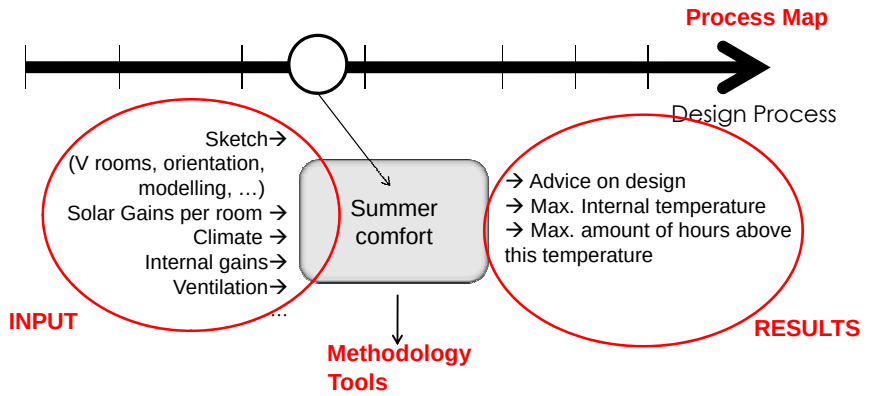
→ Describe designproces
→ Choice of softwaretools
→ BIM-stategy for active dwellings

- 3D building as key model



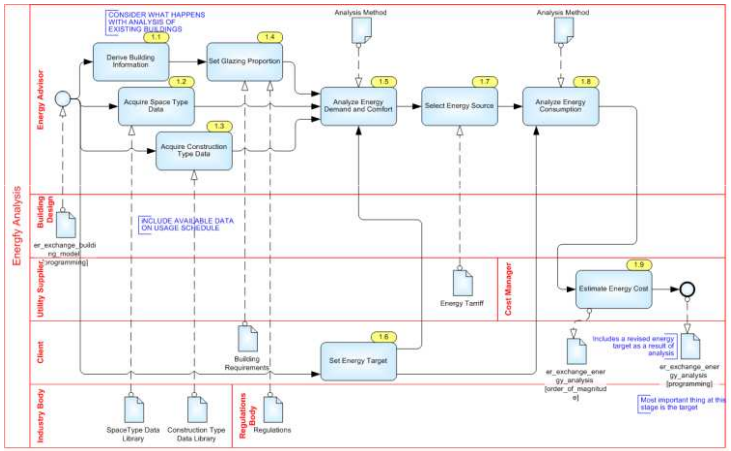
Illustrations: Lars Bjerkhaug Norwegian Building Research Institute, Olof Granlund, LBNL University of California, Stanford University

1- Process



Exchange Requirements

- Process Map (PM) / Exchange Requirements (ER)



- BIM model of sample dwelling
  - One familiar, open building
  - Basis/Test for design process
  - Monitoring

- **IEA SHC TASK 40 – IEA ECBCS ANNEX 52**

afbeelding:

- Subtask D (dissemination and valorisation)
- Website: `http://www.iea-shc.org/task40/index.html`
  - Examples (Database)
  - Manuals and Guidebooks
  - Publications
  - Education

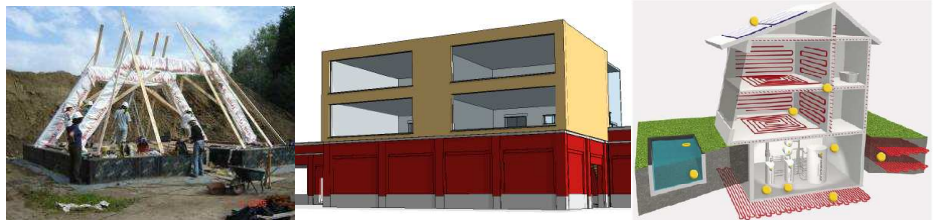
MONDO (social profit organisation)
• Demonstrative project ‘Solar 2002’
• Renovation project: 25 years old
• Main goal: Without fossil resources

Monitoring
50 measurement points:

- Solar radiance
- Solar collector’s efficiency
- Temperature of storage tank
- Heat meters on heat pumps and solar energy collectors
- Etc.

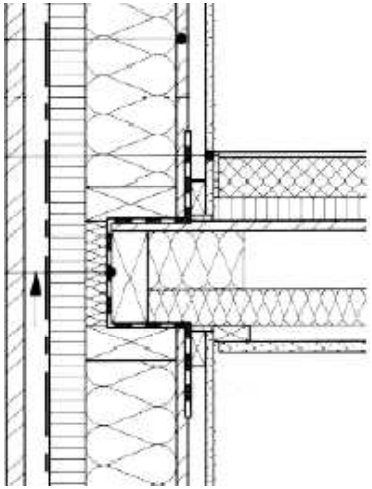
Research projects

- Electrabel fund (demonstration project, 2005)
- Cost effective commissioning of low energy buildings (IEA ECBCS ANNEX 47) (international research, 2005-2009)
- Analysis and optimization of performance criteria and calculation methods for very low energy school buildings (PHD, 2009-2013)
- Active buildings (Tetra, 2008-2012)
- Net Zero Energy Solar Buildings (Nzebs) (IEA SHC TASK 40 – IEA ECBCS ANNEX 52) (international research, 2009-2013)
- Feasibility of external air tightness of timber frame buildings (PHD, 2009-2013)



PHD: IWT-scholarship

"*Feasibility of external air tightness of timber frame buildings*"



Feasibility of external air tightness of timber frame buildings

- Problems with air tigtness from the inside
  - Labour-intensive
  - Need to place connecting foils
  - Risks of air penetration – technical devises

Feasibility of external air tightness of timber frame buildings

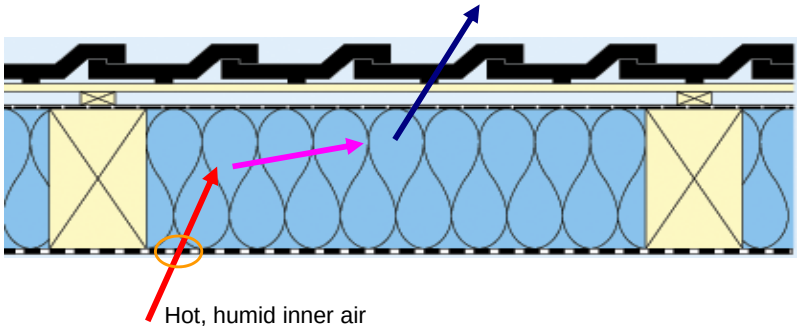
- Air tightness from the outside
  - Origin: Windshields in Scandinavië

Tyvek: n_{50}=1,5 1/h Sarket: n_{50}=2 1/h

- Is air tightness from the outside still necessary ???

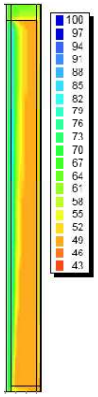
Feasibility of external air tightness of timber frame buildings

- Risks: internal condensation
  - Convection ⟷ Diffusion
  - Air pressure ⟷ Vapour pression



Feasibility of external air tightness of timber frame buildings

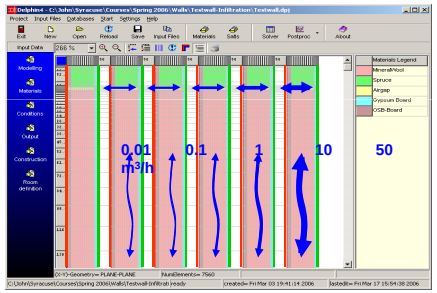
- Simulations:
  - Heat, moisture, air
- Tests
  - Lab
  - Buildings + External climatic conditions



Feasibility of external air tightness of timber frame buildings

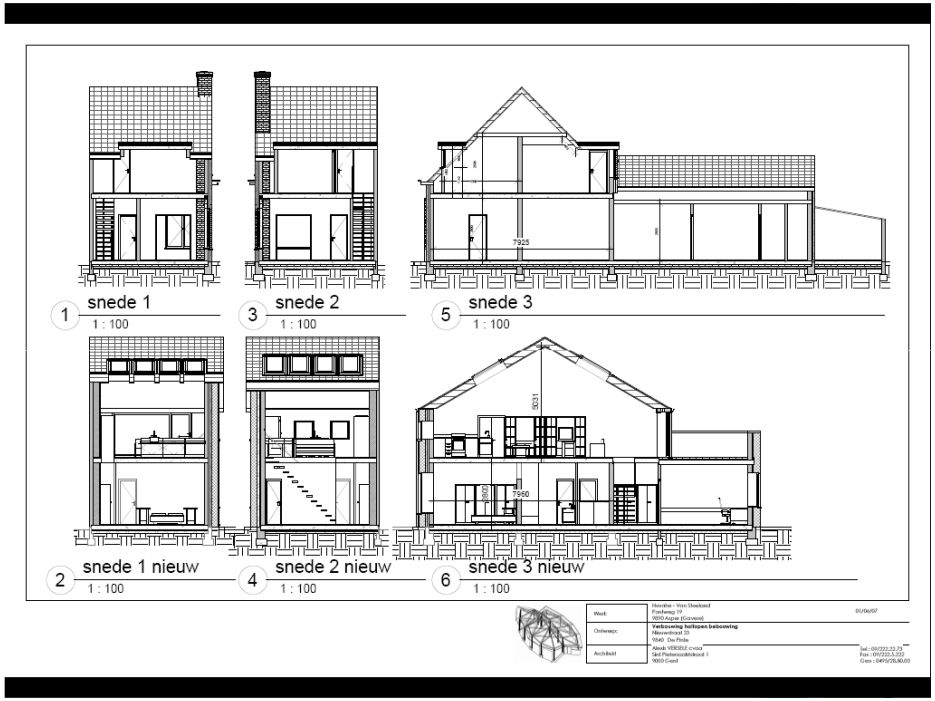
- Risk analysis
  - Parameter study

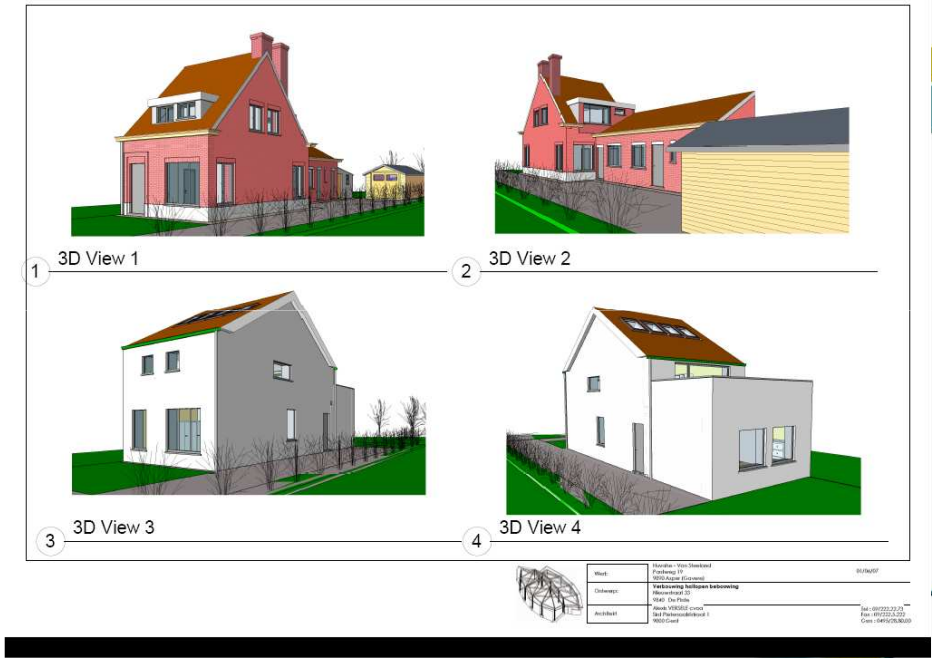
Optimisation of joins
- Detail level
- Building level



Society related services

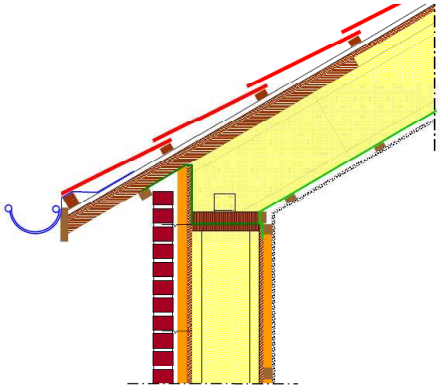
- Definition of limiting conditions for school buildings according to passive house standaard – Agion (study assignment, 2009)
- Examen des primes passif / basse energie du logement collectief & du secteur tertiare – IBGE – BIM (steering committee 2009 - 2010)
- Integration of van sustainable HVAC-systems – Bouwunie - (steering committee 2009 - 2010)
- Advice simulations natural night cooling –engineering office Boydens (expert 2009)
- Low Energy Housing Retrofit
  LEHR - TAP2 (2006-2010)
- Building Details for passive house standard - Presti 5

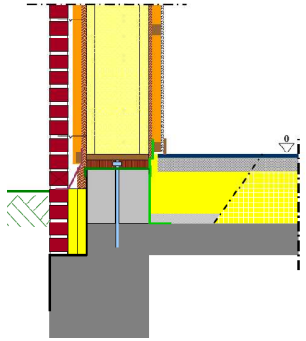




PRESTI 5: Bouwdetails in de passiefhuisstandaard

- PRESTI 5: “Vermijden van afval en emissies”
  - Passiefhuis: zeer laag energieverbruik (minder emissies)
  - Duurzaam gebouw: minder afval, minder gevaarlijk afval





ERASMUS Intensive Programme

- Low Energy Building Research:
  sustainable building, a European wide approach

1. Energy performance – Mechanical and Building	KaHo	Alexis Versele	Energy performance of builings in a European context
2. Commissioning – Monitoring	VGTU	Natalija Lepkova	ENERGY SECTOR IN LITHUANIA: ENERGY CONSUMPTION, SAVING AND MANAGEMENT
3. Comfort: air quality and thermal – principles, concepts and systems	TTK	Anti Hamburg	Indoor climate measuring in third insulated department buildings and also these building energy usage (1,30 h)
4. Construction detailing – Archicad, Autocad, Revit,	Metro	Eric Pollock	Multi-storey dwellings
5. Process Modeling	HTW	Dieter Bunte	Introduction in the process modelling - investment analysis of energy saving measures

- Questions ???