Summer School, nZEBRA, Assignment. Module 5
Halmstad University
Mohsen Soleimani Mohseni

nZEBRA Summer School. Assignment - Project CBL

This project aims to simulate and calculate energy use in a building using two different simulation tools. The building is a one-family detached house with a wooden structure (timber-framed), a slab-on-grade foundation, and an outdoor, air-ventilated attic, so-called cold attic.

The project contains the following parts:

- **U-value:** calculate the U-value for different parts of the building envelope and the mean U-value for the whole building.
- **Energy:** Calculate design heat power and annual energy consumption for space heating. Calculate the primary energy (PE) and primary energy number (PEN) according to BBR. Does your building meet BBR requirements? What about passive house requirements? If not, make the necessary improvements (adding more insulation, installing renewable energy systems, etc.) to fulfil passive house requirements. Analyze and discuss the results.

The assignment should be carried out by a maximum of 4 students per group.

Input data and tips:

- Nailing battens in the ceiling: unventilated; use R equal to 0.16 [(m^2·K)/W]
- Leakage at 50 Pa: 0,4–0,8 [l/s,m^2], OBS! Per m^2 envelope area towards heated indoor air (walls, ceiling, and slab on ground).
  Annual average value of leakage [l/s] = leakage air flow rate [l/s,m^2] x envelope area [m^2] / 20.
- Ventilation: 0.35 [l/s,m^2], OBS! Per m^2 floor area. After multiplying with A_{floor}, add 1.3 [l/s] due to the kitchen hood.
- cc-space roof truss 1200 [mm], cc-space wall 600 [mm].
- Thermal resistance for the roof: 0.3 [(m^2·K)/W] (with external surface resistance: 0.3 + 0.04).
- Thermal Bridge: an additional 15 % (energiberakningar.se) or feed in standard values (PHPP). Thermal bridges [W/(m·K)]: external walls: 0.03; ceiling wall: 0.02; slab: 0.251.
- Building thermal inertia: normal
- Heating system (Consider three different heating systems separately):
  - heat pump, annual mean COP = 3; NIBE F730
  - District heating
  - Direct electricity
- Vertical edge insulation for slab: d_n = 5 cm; D = 0,5 m; λ_n = 0.036 [W/(m·K)].

Calculation of energy use for Mohsen's detached house

Does Mohsen's house meet BBR's energy requirements? What about passive house requirements?

Dimension: 12.5x8x2.6 (100 m^2 floor area)
Location: Båstad

Building envelope	Size, [m^2]	U-value [W/(m^2·K)]
External wall south	25.9 (of 12.5x2.6)	
External wall North	24.8 (of 12.5x2.6)	
External wall West	19.6 (of 8x2.6)	
External wall East	20.8 (no windows)	
Windows north	4x(0.95x1.24)+1x(1.5x2)	
Windows south	2x(1.45x1.24)	
Windows west	1x(0.95x1.24)	
Door (south)	3	
Slab on ground	100	
Ceiling	100	

Construction of walls (from interior to exterior):

- Gypsum board, 13 mm thick, λ = 0.22 [W/(m·K)]
- Mineral wool, 45 mm thick, λ = 0.036 [W/(m·K)]; wooden joists 45x45, λ = 0.14 [W/(m·K)]; cc: 600 mm
- Mineral wool, 170 mm thick, λ = 0.036 [W/(m·K)]; wooden joists 45x170, λ = 0.14 [W/(m·K)]; cc: 600 mm
- 30 mm insulating wind protection, λ = 0.036 [W/(m·K)]
- Airgap+battens, 28 mm, well-ventilated
- Wooden cladding 22 mm

Ceiling and roof (from interior to exterior), 12.5x8 m:

- Gypsum board, 13 mm thick, λ = 0.22 [W/(m·K)]
- Airgap+battens, 28 mm (furring), Unventilated; R = 0.16 [(m^2·K)/W]
- 200 mm loose wool, λ = 0.042 [W/(m·K)]; wooden beams, 45X 200, λ = 0.14 [W/(m·K)]; cc: 1200 mm
- 300 mm loose wool, λ = 0.042 [W/(m·K)]
- Roof R = 0.3

Slab on the ground (from interior to exterior), 12.5x8:

- Wooden parquet 20 mm, λ = 0.14 [W/(m·K)]
- Concrete slab, 100 mm, λ = 1,7 [W/(m·K)]
- Cellular plastic, 300 mm, λ = 0.036 [W/(m·K)]
- Makadam, 200 mm, R = 0.2 [(m^2·K)/W]
- Soil: sand or gravel