Civil Engineering Project - Dataset 5
Structural and Thermal Analysis Report

Warsaw University of Technology
Environmental Engineering Department

January 19, 2025

1 Building Specifications

1.1 Geometric Parameters

- Width (b) = 7.2 m
- Length 1 (L1) = 6.6 m
- Length 2 (L2) = 10.8 m
- Height 1 (h1) = 2.5 m
- Height 2 (h2) = 2.65 m
- Roof angle (α) = 16°
- Purlin spacing (s) = 1.1 m
- Ground Level = -1.4 m.a.s.l

1.2 Materials

- Walls: MAX 220 block
- Thermal insulation: Mineral wool
- Roofing: Steel tile 0.6 mm
- Structure: C27 timber class

2 Structural Analysis

2.1 A. Rafter Analysis

2.1.1 Material Properties - C27 Timber

According to EN 338, the C27 timber class has the following characteristic properties:

6.2 Main Projections

6.2.1 Vertical Projection (1:50)

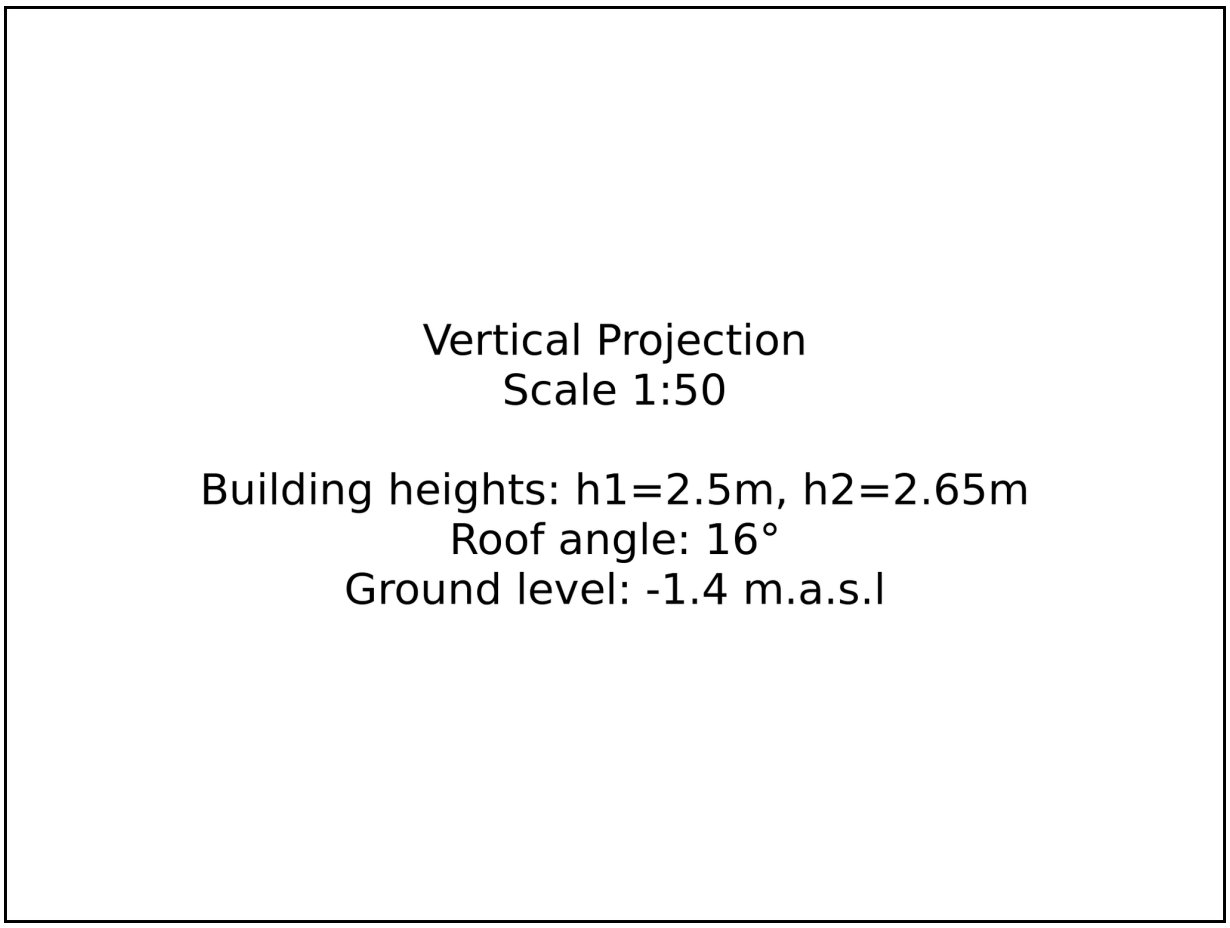

Figure 3: Vertical projection (Scale 1:50) showing building elevations and structural configuration. The drawing illustrates the primary heights (h1=2.5m, h2=2.65m), roof angle (16°), and ground level (-1.4 m.a.s.l). Wall construction utilizes MAX 220 block with mineral wool insulation for optimal thermal performance.

- Building heights: h1 = 2.5m, h2 = 2.65m
- Roof angle: $\alpha = 16°$
- Ground level: -1.4 m.a.s.l
- Wall construction: MAX 220 block with mineral wool insulation
- Column placement and foundation connections
- Structural grid and dimensions

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■ Thermal insulation: Mineral w o ol
■ Ro o ng: Steel tile 0.6 mm
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2 Structural Analysis
2.1 A. Rafter Analysis
2.1.1 Material Prop erties - C27 Tim b er
A ccording to EN 338, the C27 tim b er class has the follo wing c haracteristic prop erties:

Civil Engineering Pro ject Dataset 5 Analysis
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6.2.1 V ertical Pro jection (1:50)
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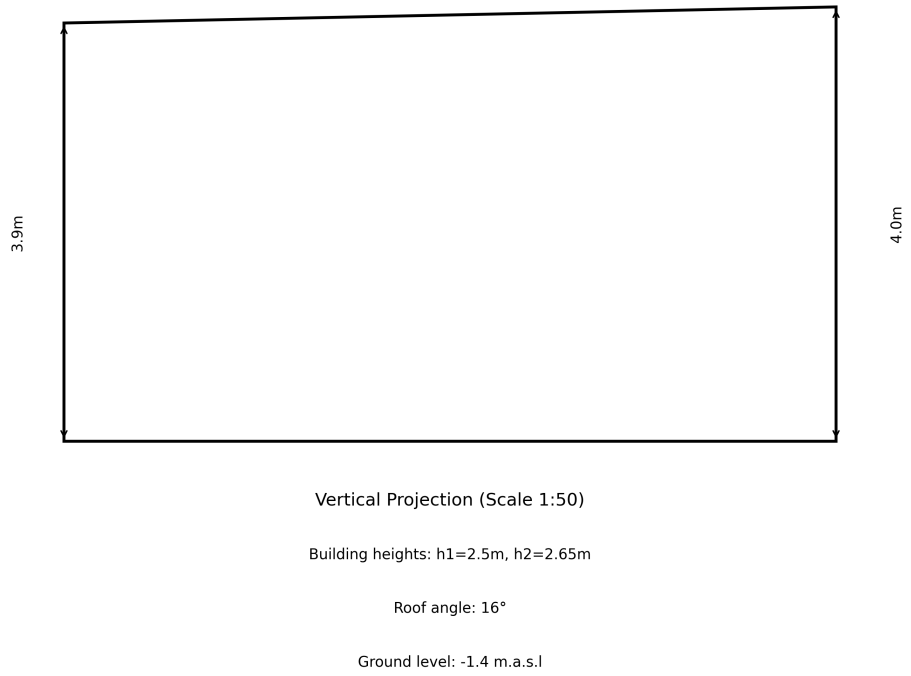

Fig.1: Momentum analysis showing bending moment distribution and maximum moments at critical points. Design values calculated per EN 1995-1-1.

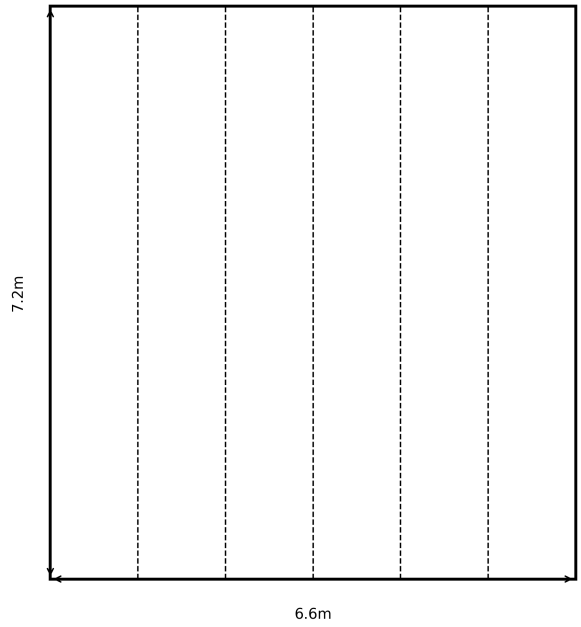

Fig.2: Stress analysis demonstrating normal and shear stress distribution in C27 timber elements. Critical sections verified against design limits.

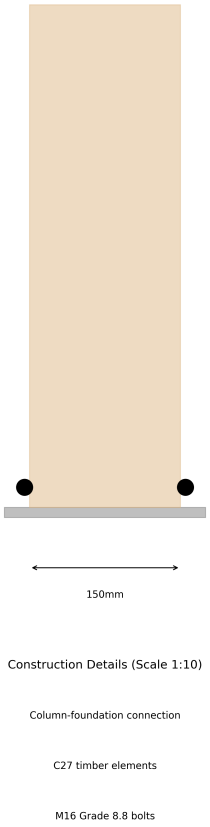

Fig.3: Vertical projection (1:50). Heights:
h1=2.5m, h2=2.65m. Angle: 16°. Ground: -1.4m.
MAX 220 block walls with mineral wool.

$$wd = qd \times s = 1.343 \times 1.1 = 1.477\ kN/m \quad (67)$$

4.2 Axial Force in Rafters:

$$NEd = wd \times l \times \sin(\alpha) / 2 \quad (68)$$

$$NEd = 1.477 \times 5.62 \times \sin(16°) / 2 = 2.34\ kN \quad (69)$$

These calculations form the basis for subsequent structural verifications and member sizing.

The analysis demonstrates compliance with Eurocode requirements for:

- Structural integrity and stability
- Load-bearing capacity verification
- Member sizing optimization
- Connection design parameters

Load Type	Value	Unit
Characteristic total load	1.24	kN/m²
Design load	1.11	kN/m²

7.1.4 Ultimate Limit State Analysis

Rafter Analysis:

Maximum bending moment:

$$M = (q \times l^2) / 8 \quad (7)$$

Axial force:

$$N = q \times l / (2 \times \tan(\alpha)) \quad (8)$$

where:

q = design load per meter

l = rafter length

α = roof angle (16°)

Parameter	Value	Unit
Rafter length	3.75	m
Maximum moment	2.60	kNm
Axial force	9.68	kN