Civil Engineering Project Documentation - Dataset 5

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Contents

1 Civil Engineering Project Documentation - Dataset 5

1.1 1. Project Overview

1.1.1 1.1 Building Specifications

1.1.1.1 1.1.1 Dimensions

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

1.1.1.2 1.1.2 Materials

- Walls: Max 220 block
- Insulation: Mineral wool
- Roofing: Steel tile 0.6mm
- Structure: C27 timber class

1.1.2 1.2 Drawing Set

1.1.2.1 1.2.1 Main Views (Scale 1:50)

- Vertical projection (front elevation)
  - Shows building heights, wall sections, and roof angle
  - Includes ground level reference (-1.4 m.a.s.l)
  - Details column placements and structural connections
- Horizontal projection (top view)
  - Displays building dimensions (b, L1, L2)
  - Shows purlin layout with 1.1m spacing
  - Indicates wall thickness and insulation layers

1.1.2.2 1.2.2 Detail Drawings (Scale 1:10)

1. Foundation-column connection
   - Shows 150×150mm column section
   - Details 400mm foundation depth
   - Includes connection specifications
2. Roof-column connection
   - Details C27 timber joint design
   - Shows load transfer mechanisms
   - Includes fastener specifications
3. Wall-roof junction
   - Shows insulation continuity
   - Details vapor barrier placement
   - Includes flashing details
4. Insulation installation
   - Shows mineral wool placement
   - Details thermal bridge prevention
   - Includes air barrier specifications

1.2 2. Structural Analysis

1.2.1 2.1 Material Properties

1.2.1.1 2.1.1 C27 Timber (EN 338)

- Characteristic bending strength (fm,k) = 27 N/mm²
- Characteristic compression parallel to grain (fc,0,k) = 22 N/mm²
- Mean modulus of elasticity (E0,mean) = 11.5 kN/mm²
- Characteristic density (k) = 370 kg/m³
- Partial safety factor (γ_M) = 1.3
- Modification factor (k_{mod}) = 0.8 (Service Class 2)

1.2.2 2.2 Load Calculations

1.2.2.1 2.2.1 Dead Loads

1. Steel tile roofing (0.6mm): 0.047 kN/m²
2. Timber structure:
   - Rafters: 0.15 kN/m²
   - Purlins: 0.10 kN/m² Total dead load (gk) = 0.297 kN/m²

1.2.2.2 2.2.2 Snow Load (EN 1991-1-3) For Warsaw, Poland: - Ground snow load (sk) = 0.7 kN/m² - Roof shape coefficient (μ_1) = 0.8 ($\alpha = 16°$) - Exposure coefficient (Ce) = 1.0 - Thermal coefficient (Ct) = 1.0

Snow load on roof: s = 1 × Ce × Ct × sk = 0.8 × 1.0 × 1.0 × 0.7 = 0.56 kN/m²

1.2.2.3 2.2.3 Wind Load (EN 1991-1-4)

Basic parameters for Warsaw: - Basic wind velocity (vb,0) = 22 m/s - Terrain category III - Reference height (ze) = 2.65 m

Wind pressure calculation: qp(z) = ce(z) × qb where: - ce(z) = 1.6 (exposure factor) - $q_b = 0.5 \cdot \rho \cdot v_{b,0}^2 = 0.302$ kN/m²

Peak velocity pressure: $q_p(z) = 1.6 \cdot 0.302 = 0.483$ kN/m²

1.2.3 2.3 Structural Design

1.2.3.1 2.3.1 Purlin Design

Load transfer: - Design load (Ed) = 1.401 kN/m² - Purlin spacing = 1.1 m - Load per purlin = 1.541 kN/m

Section properties (80mm × 160mm): - Maximum span = 1.8m - Design moment = 0.623 kNm - Section modulus = 341,333 mm³ - Design stress = 1.83 N/mm² < 16.62 N/mm² ✓

1.2.3.2 2.3.2 Rafter Design

Load combination (ULS): $E_d = 1.35 \cdot g_k + 1.5 \cdot q_k + 1.5 \cdot \psi_0 \cdot q_w = 1.401$ kN/m²

Section properties (100mm × 200mm): - Maximum span = 5.62m - Design moment = 6.12 kNm - Section modulus = 666,667 mm³ - Design stress = 9.18 N/mm² < 16.62 N/mm² ✓

1.2.3.3 2.3.3 Column Design

Load calculation: - Tributary area = 5.94 m² - Design load (Ned) = 8.32 kN

Section properties (150mm × 150mm): - Area = 22,500 mm² - Compressive stress = 0.37 N/mm² - Design strength = 13.54 N/mm²

1.3 3. Thermal Analysis

1.3.1 3.1 Wall Assembly

1.3.1.1 3.1.1 Components

1. Max 220 block:
   - Thickness = 220 mm
   - $\lambda = 0.33$ W/(m · K)
   - $R_1 = 0.667$ m²K/W
2. Mineral wool:
   - Thickness = 150 mm
   - $\lambda = 0.035$ W/(m · K)
   - R2 = 4.286 m²K/W
3. Surface resistances (EN ISO 6946):
   - Rsi = 0.13 m²K/W (internal)
   - Rse = 0.04 m²K/W (external)

Total thermal resistance: RT = 5.123 m²K/W U-value = 0.195 W/(m²K) < 0.20 W/(m²K)

1.3.2 3.2 Roof Assembly

1.3.2.1 3.2.1 Components

1. Steel tile:
   - Thickness = 0.6 mm

- $\lambda = 50$ W/(m · K)
- $R_1 = 0.000012$ m²K/W

2. Air gap:
   - R2 = 0.16 m²K/W (ventilated)
3. Mineral wool:
   - Thickness = 200 mm
   - $\lambda = 0.035$ W/(m · K)
   - R3 = 5.714 m²K/W
4. Surface resistances:
   - Rsi = 0.10 m²K/W
   - Rse = 0.04 m²K/W

Total thermal resistance: RT = 6.014 m²K/W U-value = 0.166 W/(m²K) < 0.18 W/(m²K)

1.4 4. References

1. EN 338:2016 - Structural timber - Strength classes
2. EN 1990:2002 - Basis of structural design
3. EN 1991-1-3:2003 - Snow loads
4. EN 1991-1-4:2005 - Wind actions
5. EN 1995-1-1:2004 - Design of timber structures
6. EN ISO 6946:2017 - Thermal resistance calculation