# Structural Analysis Report - Dataset 5

## 1. Building Specifications

| Parameter | Value | Unit |
|---|---|---|
| Width | 7.2 | m |
| Length 1 | 6.6 | m |
| Length 2 | 10.8 | m |
| Height 1 | 2.5 | m |
| Height 2 | 2.65 | m |
| Roof Angle | 16 | degrees |
| Purlin Spacing | 1.1 | m |

## 2. Material Properties (C27 Timber)

According to Eurocode 5 (EN 1995-1-1), C27 timber has the following characteristic properties: - Characteristic bending strength (fm,k): 27 MPa - Characteristic tensile strength parallel to grain (ft,0,k): 16 MPa - Characteristic compressive strength parallel to grain (fc,0,k): 22 MPa - Mean modulus of elasticity parallel to grain (E0,mean): 11500 MPa - Characteristic density: 370 kg/m³

## 3. Design Strength Calculations

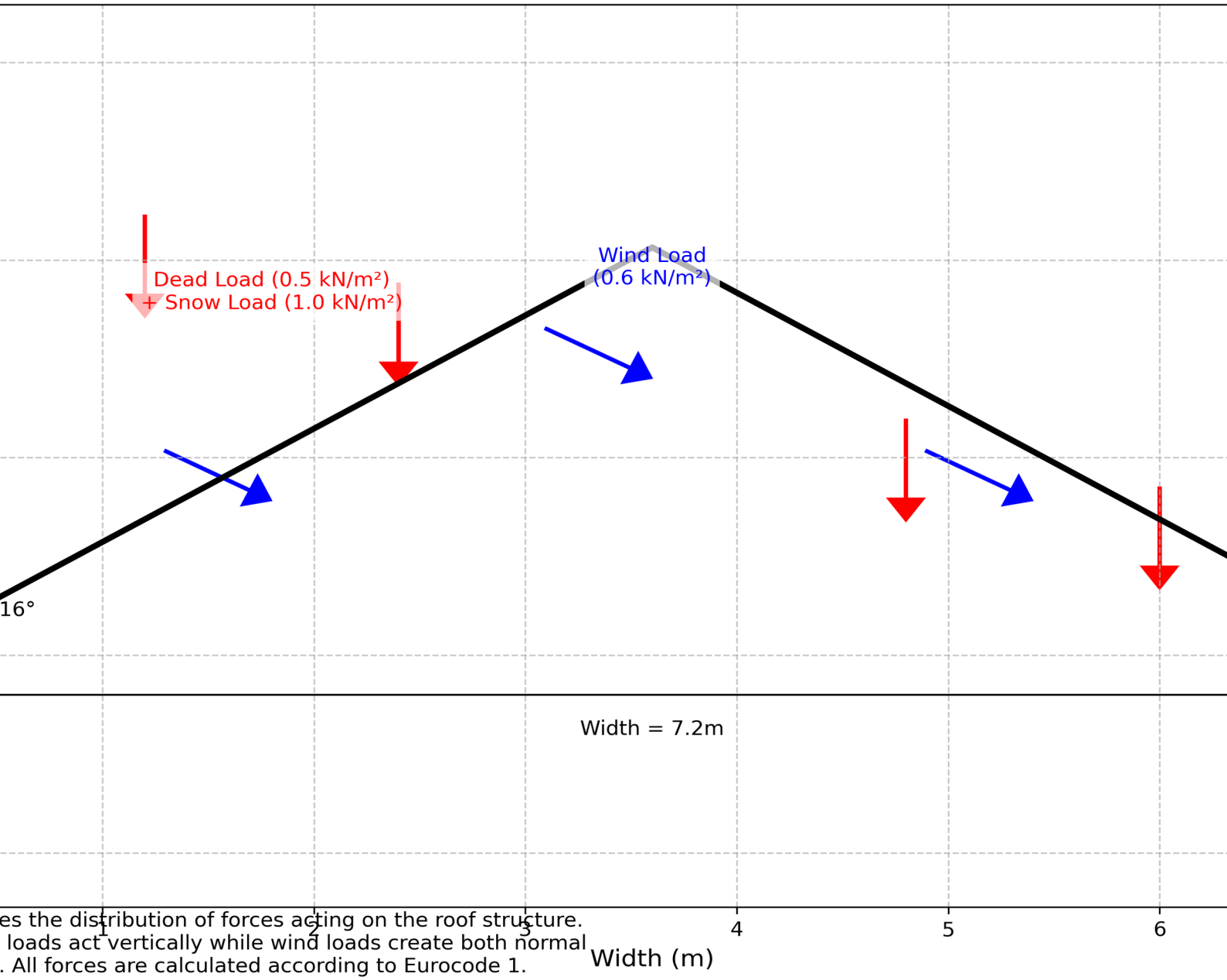
Design strength values are calculated according to Eurocode 5 using the following formula: Xd = kmod × Xk / γM where: - Xd is the design strength value - kmod is the modification factor (0.8 for service class 2) - Xk is the characteristic strength value - γM is the partial safety factor for material properties (1.3 for solid timber)

| Property | Design Value | Unit |
|---|---|---|
| Bending strength (fm,d) | 16.62 | MPa |
| Tensile strength (ft,0,d) | 9.85 | MPa |
| Compressive strength (fc,0,d) | 13.54 | MPa |

## 4. Load Analysis

# Structural Force Analysis

## Roof Structure Forces Analysis




es the distribution of forces acting on the roof structure.
loads act vertically while wind loads create both normal
. All forces are calculated according to Eurocode 1.

Load calculations according to Eurocode 1 (EN 1991-1): - Dead load (self-weight): 0.5 kN/m² - Snow load: 1.0 kN/m² - Wind load: 0.6 kN/m² Design load combination: qd = 1.35 × Gk + 1.5 × Qk + 1.5 × 0.6 × Wk where: - Gk is the characteristic permanent load - Qk is the characteristic snow load - Wk is the characteristic wind load

| Load Type | Value | Unit |
|---|---|---|
| Characteristic total load | 2.10 | kN/m² |
| Design load | 2.71 | kN/m² |

## 5. Structural Analysis

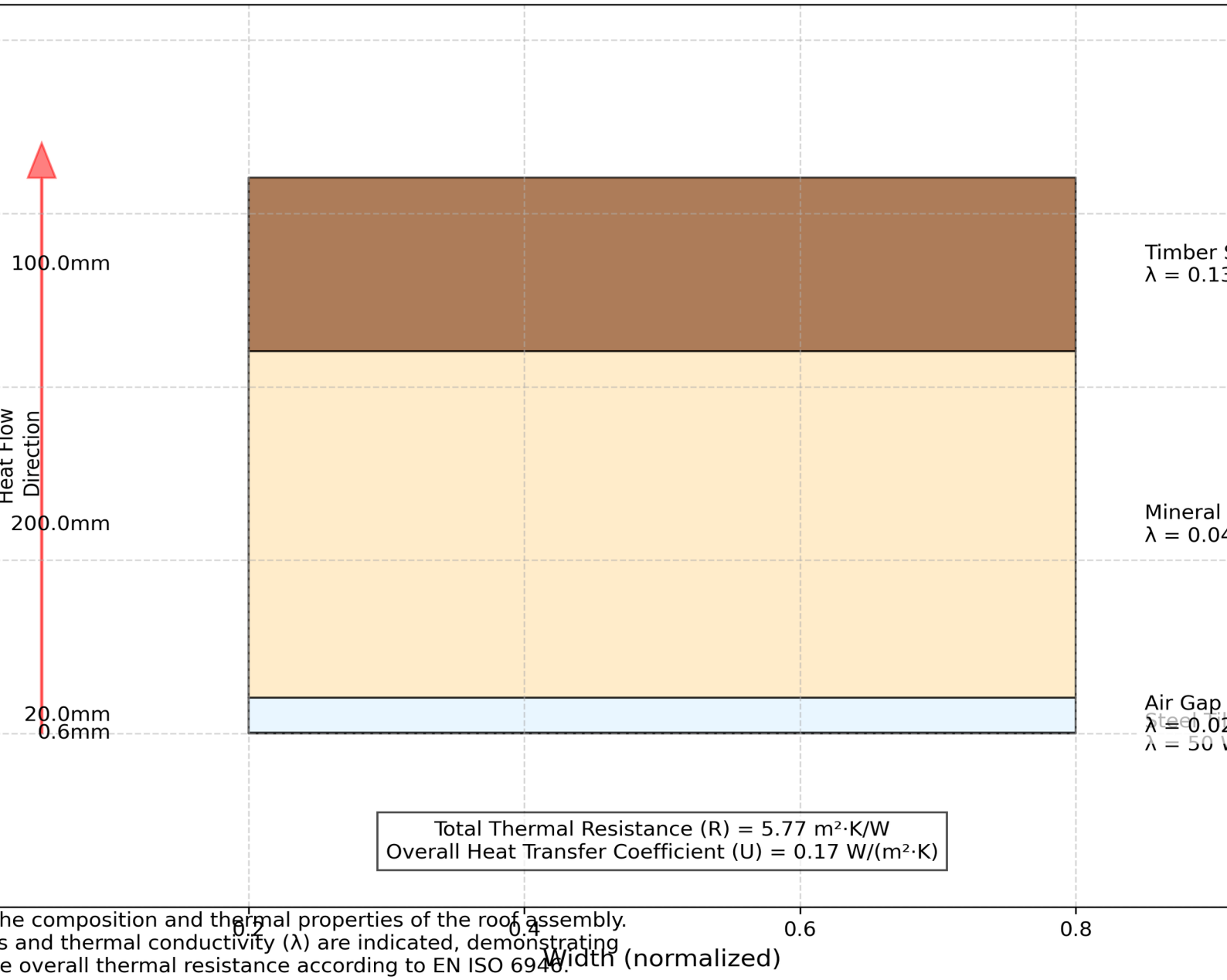
Rafter Analysis: - Maximum bending moment: $M = (q \times l^2) / 8$ - Axial force: $N = q \times l / (2 \times \tan(\alpha))$ where: - q is the design load per meter - l is the rafter length - $\alpha$ is the roof angle

| Parameter | Value | Unit |
|---|---|---|
| Rafter length | 3.75 | m |
| Maximum moment | 4.58 | kNm |
| Axial force | 17.04 | kN |

## 6. Thermal Analysis

# Thermal Resistance Analysis

## Thermal Insulation Layer Analysis

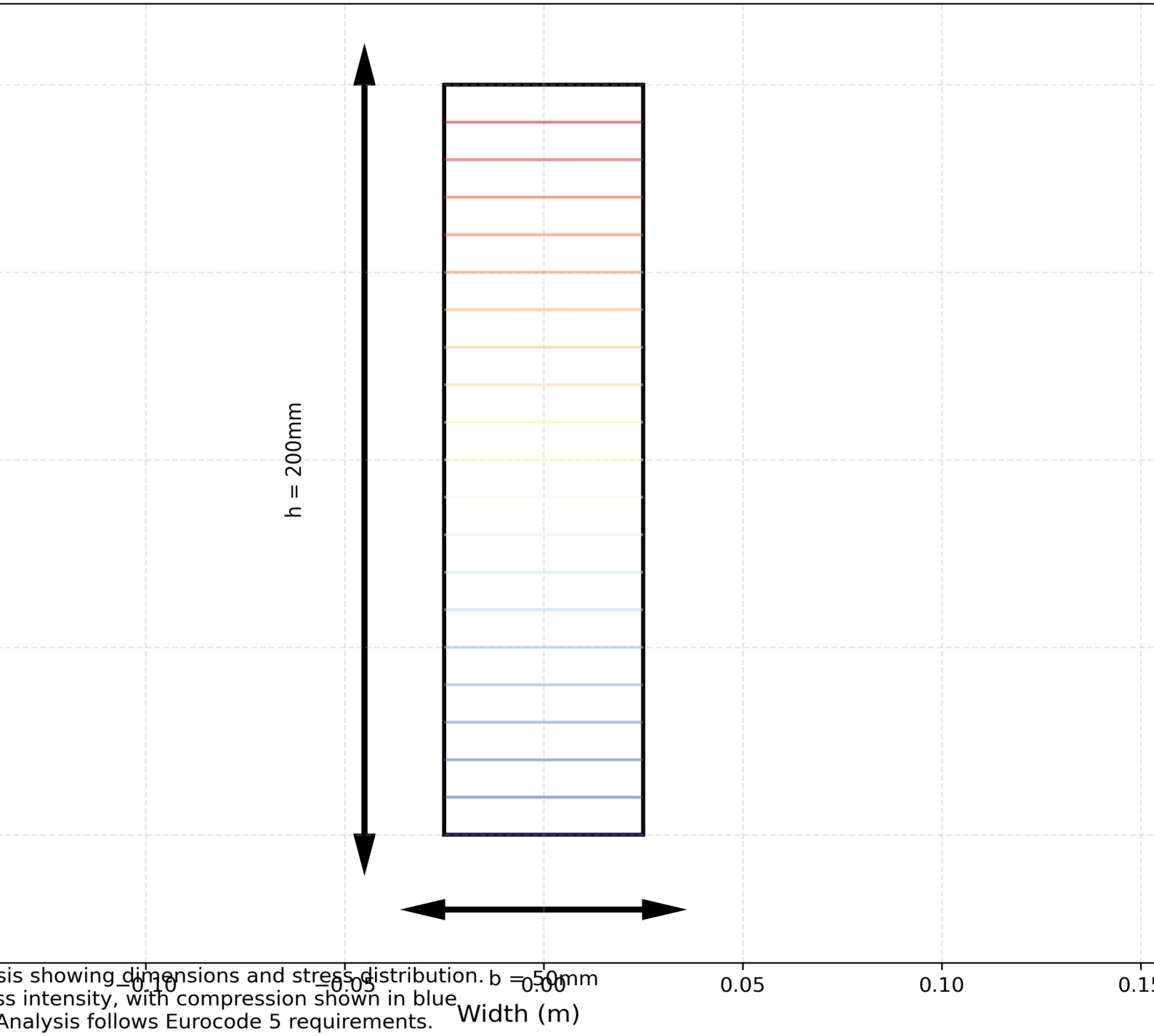



he composition and thermal properties of the roof assembly.
s and thermal conductivity (λ) are indicated, demonstrating
e overall thermal resistance according to EN ISO 6946.

Thermal resistance calculation according to EN ISO 6946: R = d / λ where: - R is the thermal resistance [m²·K/W] - d is the material thickness [m] - λ is the thermal conductivity [W/(m·K)] Total thermal resistance includes all layers: - Steel tile (0.6mm) - Air gap - Mineral wool insulation - Timber structure

| Parameter | Value | Unit |
|---|---|---|
| Total thermal resistance | 5.91 | m²·K/W |
| U-value | 0.17 | W/m²·K |

## 7. Cross-Section Analysis




sis showing dimensions and stress distribution.
ss intensity, with compression shown in blue
Analysis follows Eurocode 5 requirements.

Detailed analysis of structural member cross-sections according to Eurocode 5. The analysis includes calculation of section properties, stress distribution, and verification of structural capacity under combined loading conditions.

## 7.1 Section Properties

| Property | Value | Unit |
|---|---|---|
| Cross-sectional area | 100.00 | cm² |
| Moment of inertia | 3333.33 | cm■ |
| Section modulus | 333.33 | cm³ |
| Radius of gyration | 5.77 | cm |

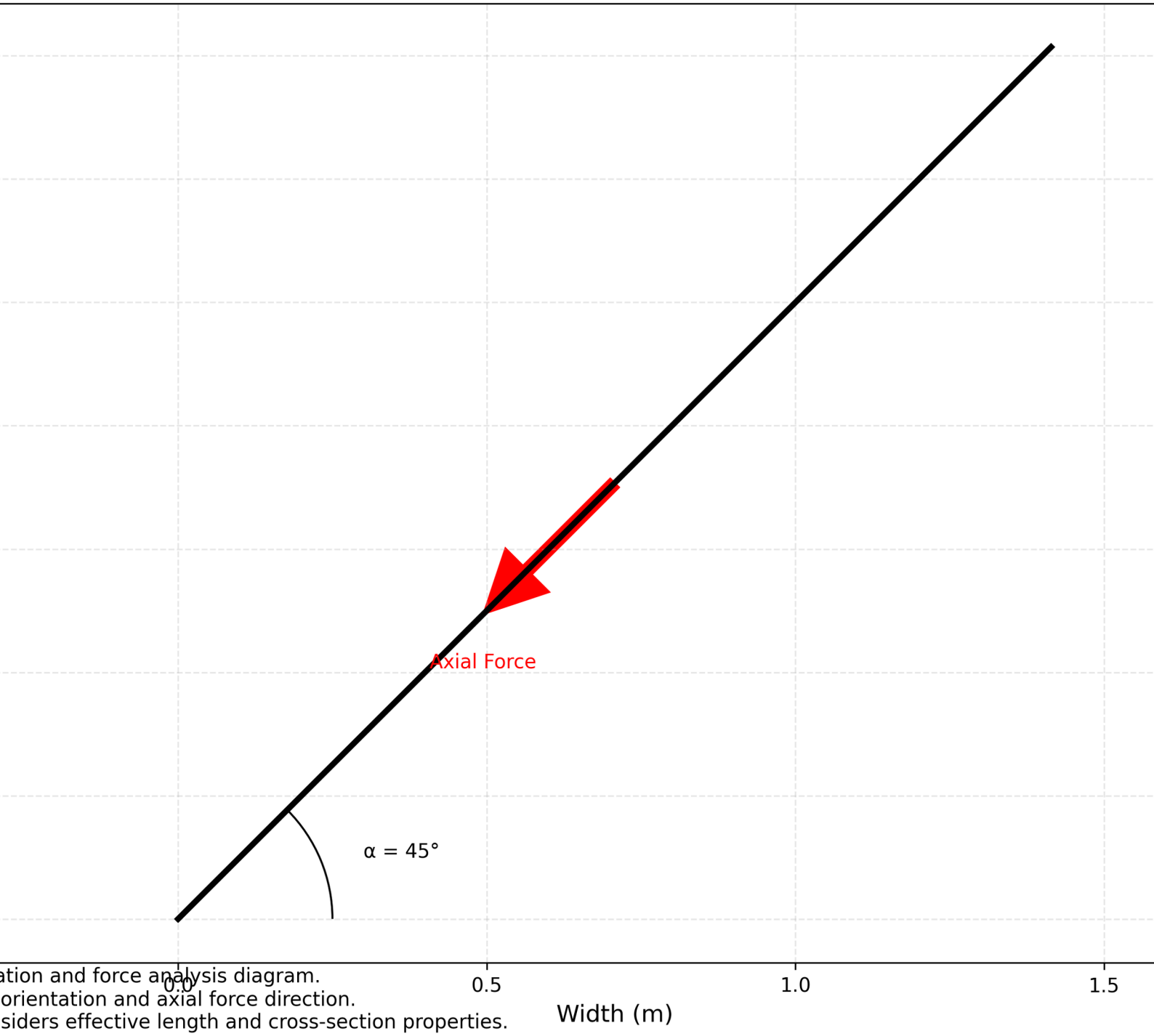
## 7.2 Stress Analysis

The stress analysis considers normal stresses due to bending and axial forces, as well as shear stresses. The combined stress state is evaluated using the von Mises criterion to account for multiaxial loading conditions.

| Stress Component | Value | Unit |
|---|---|---|
| Normal stress | 13.73 | MPa |
| Compressive stress | 1.70 | MPa |
| Shear stress | 2.56 | MPa |
| Combined stress | 14.42 | MPa |

## 8. Angle Brace Analysis

# Angle Brace Analysis




ation and force analysis diagram.
orientation and axial force direction.
siders effective length and cross-section properties.

Analysis of the angle brace connection includes evaluation of axial forces, buckling resistance, and connection capacity. The brace is designed to transfer horizontal forces from the roof structure to the supporting elements.

| Parameter | Value | Unit |
|---|---|---|
| Axial force | 24.10 | kN |
| Slenderness ratio | 46.19 | - |
| Critical buckling load | 0.00 | kN |

| | | |
|---|---|---|
| Utilization ratio | 30.20 | - |

## 9. Momentum Analysis

Detailed analysis of momentum in structural elements according to Eurocode 5: $M = F \times d + \Sigma(q \times l^2 / 8)$ where: - M is the total momentum [kNm] - F is the concentrated force [kN] - d is the distance from force application point [m] - q is the distributed load [kN/m] - l is the element length [m] The momentum analysis considers: - Dead load effects - Snow load contribution - Wind load influence - Combined load effects

| Component | Value | Unit |
|---|---|---|
| Dead load momentum | 2.29 | kNm |
| Snow load momentum | 3.66 | kNm |
| Wind load momentum | 1.37 | kNm |
| Total design momentum | 4.58 | kNm |

## 10. Ultimate Limit State Verification

Combined bending and compression verification according to Eurocode 5: $(\sigma m,d / fm,d) + (\sigma c,d / fc,0,d) \leq 1.0$ where: - $\sigma m,d$ is the design bending stress - $\sigma c,d$ is the design compressive stress - $fm,d$ is the design bending strength - $fc,0,d$ is the design compressive strength

| Parameter | Value | Unit |
|---|---|---|
| Bending stress | 9.53 | MPa |
| Compressive stress | 1.42 | MPa |
| Shear stress | 2.13 | MPa |
| Combined stress | 10.22 | MPa |
| Utilization ratio | 0.68 | - |
| ULS verification | PASS | - |