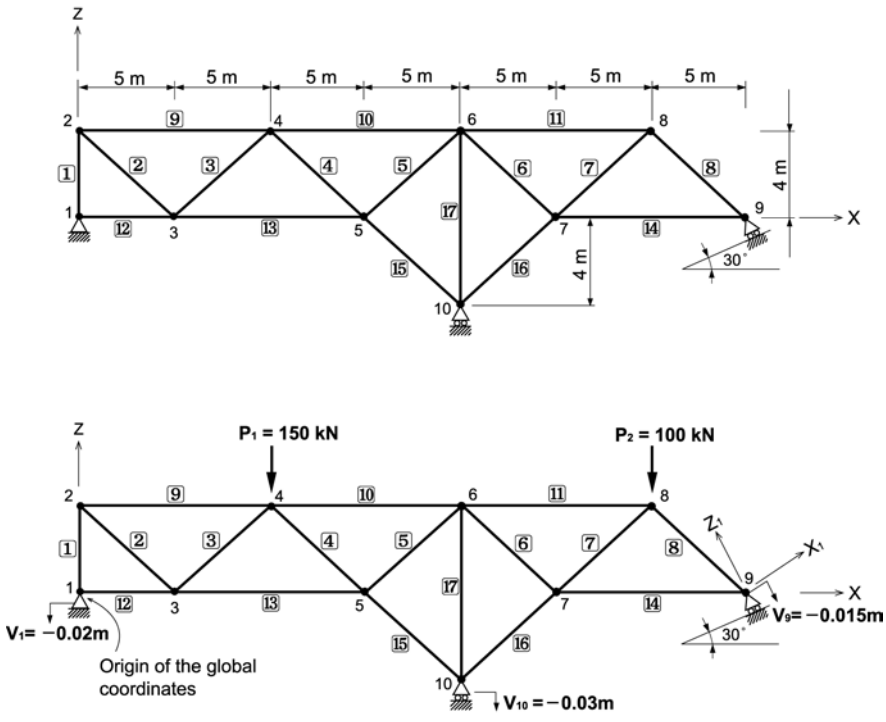
Static-27

Title

Plane truss subjected to various static loads

Description

A two-dimensional truss structure with support displacements is subjected to vertical loads and a uniform temperature change.
Determine the vertical displacement of the node 7, and the axial force in truss 16.



Structural geometry and analysis model

MODEL

Analysis Type

2-D static analysis (X-Z plane)

Unit System

m, kN

Dimension

Length 35 m Height 8 m

Element

Truss element

Material

Modulus of elasticity $E = 2.1\times10^{5}$ MPa

Coefficient of thermal expansion $\alpha = 1.0\times10^{-5}$ m/m°C

Sectional Property

Section areas

Elements 1~8: $A_1 = 1.41\times10^{-3}$ m²

Elements 9~17: $A_2 = 2.82\times10^{-3}$ m²

Boundary Condition

Node 1: Constrain D_X and D_Z

Node 10: Constrain D_Z

Node 9: Vertical support perpendicular to the plane inclined 30° counter-clockwise from the global X-axis. Constrain D_Z

Load Case

Support displacements in the Z direction

Node 1: -0.02 m

Node 10: -0.03 m

Node 9: -0.015 m

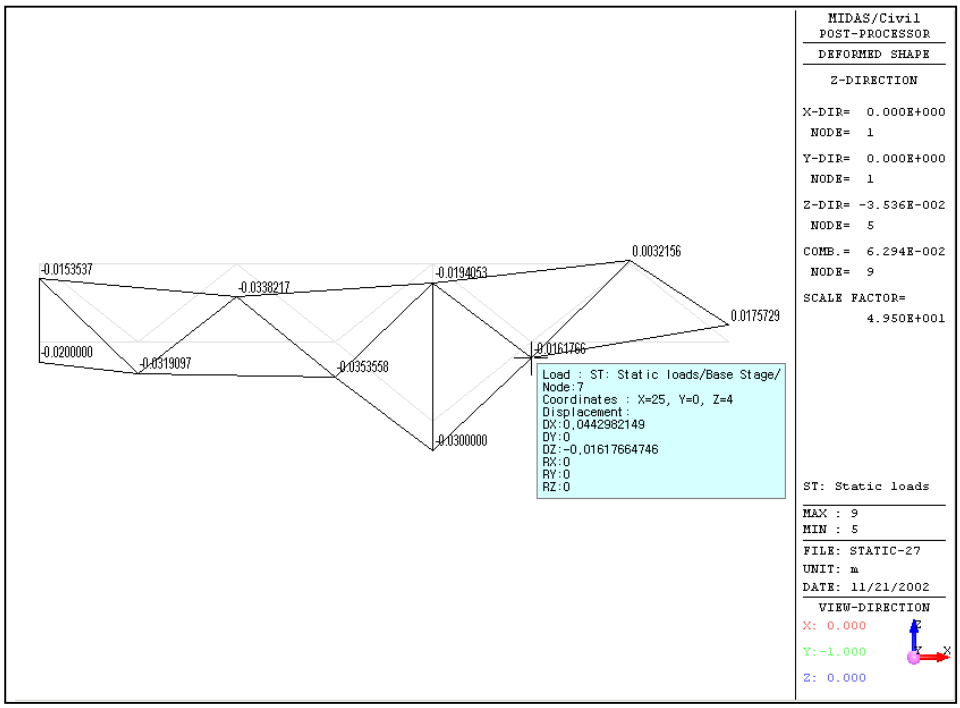
Vertical loads in the Z direction

Node 4: -150 kN

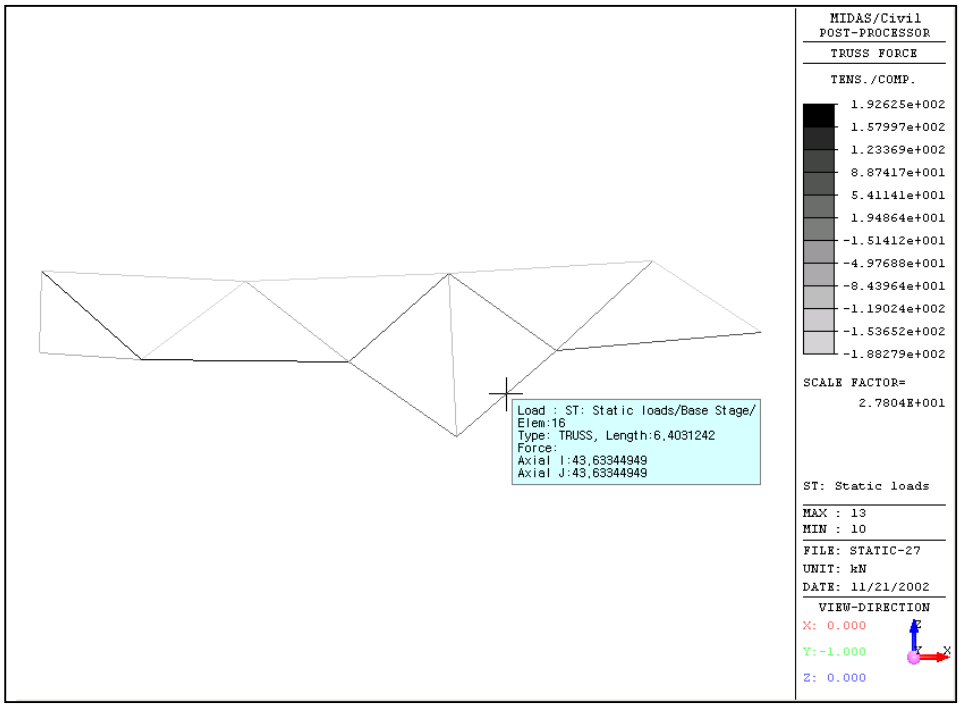
Node 8: -100 kN

Entire structure is subjected to a uniform temperature change $\Delta T = 150^{\circ}$

Results



Displacements of the structure



Axial forces in members

Comparison of Results

Unit: m, kN

Results	Theoretical	MIDAS/Civil
Vertical displacement of node 7	-0.01618	-0.01618
Axial force in element 16	43.633	43.633

Reference

"*Guide de Validation des Progiciels de Calcul de Structures*", SFM, Afnor Technique, France, 1990.