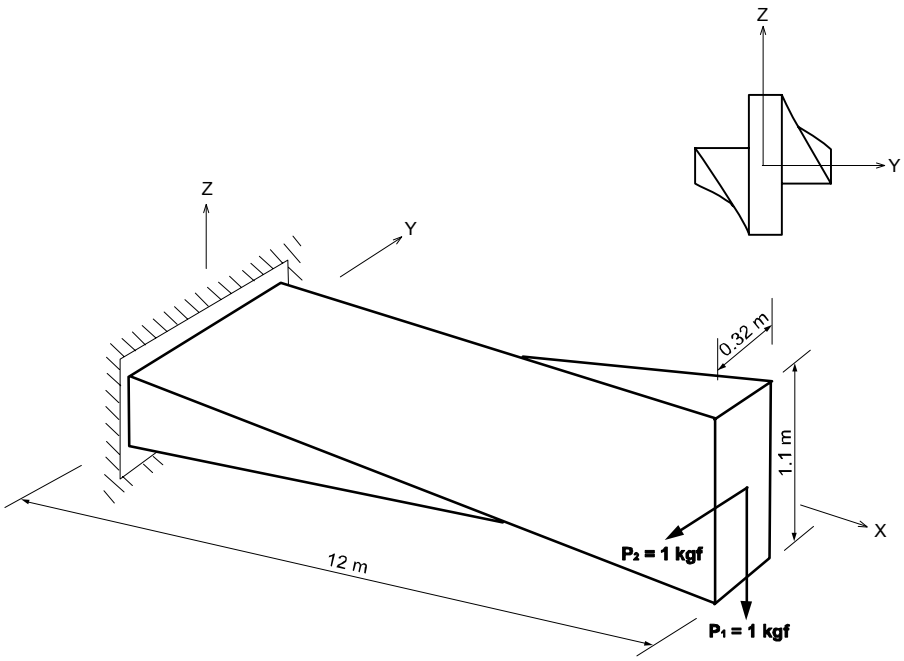
Static-37

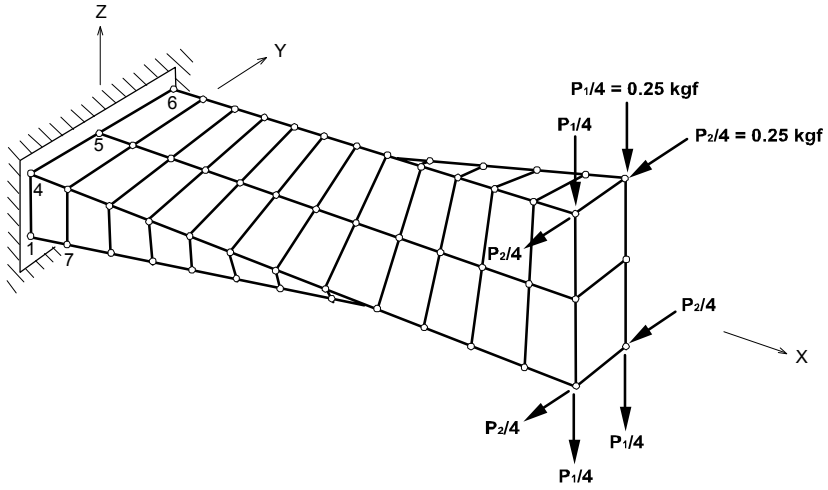
Title

Twisted solid cantilever beam subjected to in-plane and out-of-plane shear forces

Description

A twisted solid cantilever beam of rectangular cross-section is individually subjected to in-plane and out-of-plane shear forces at the free end.
Determine the displacements at the free end in the Z and Y directions.





Structural geometry and analysis model

MODEL

Analysis Type

3-D static analysis

Unit System

m, kgf

Dimension

Length 12 m Width 1.1 m Thickness 0.32 m

Element

Solid element

Material

Modulus of elasticity $E = 2.9\times10^7$ kgf/m^2

Poisson's ratio $\nu = 0.22$

Sectional Property

Rectangular cross-section: h = 1.1 m, t = 0.32 m

Boundary Condition

Node 1, 3, 4, 6: Constrain D_X and D_Z

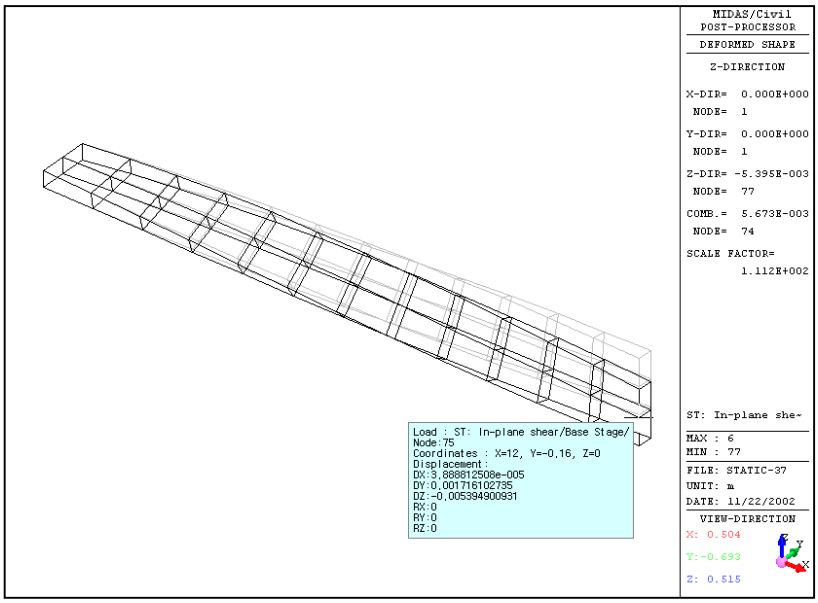
Node 2, 5: Constrain D_X, D_Y and D_Z

Load Case

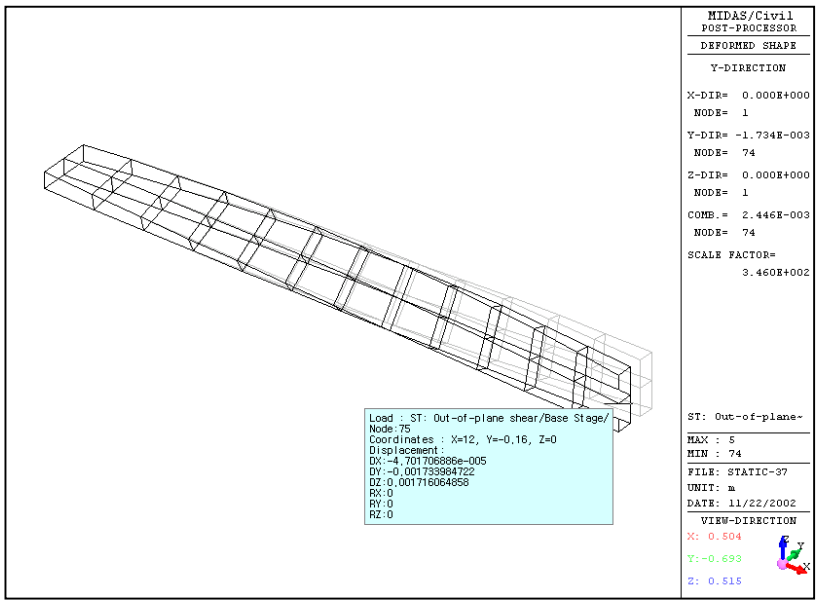
Case 1: In-plane shear force, P_1 = 1.0 kgf is applied at the free end in the -Z direction

Case 2: Out-of-plane shear force, P_2 = 1.0 kgf is applied at the free end in the -Y direction

Results



the tip displacement (δ_Z) in the load direction (Case 1)



the tip displacement (δ_Y) in the load direction (Case 2)

Comparison of Results

Unit: m

Results	Theoretical	MIDAS/Civil
In-plane displacement (δ_Z)	-0.005424	-0.005395
Out-of-plane displacement (δ_Y)	-0.001754	-0.001734

Reference

MacNeal, R. H., and Harder, R. L. (1985). "*A proposed Standard Set of Problems to Test Finite Element Accuracy*", Finite Element in Analysis and Design, 1, Elsevier Science Publishers, North-Holland, 3-20.