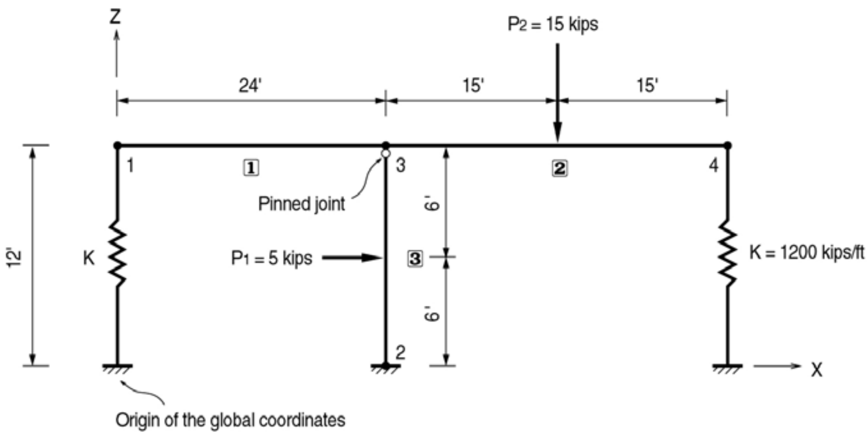
Static-7

Title

Beam with elastic supports and an internal hinge

Description

Determine the displacements of a structure subjected to two concentrated loads.



Structural geometry and analysis model

Model

Analysis Type

2-D static analysis (X-Z plane)

Unit System

ft, kip

Dimension

Length 54 ft Height 12 ft

Element

Beam element

Material

Modulus of elasticity $E = 4.32 \times 10^6$ ksf

Section Property

Elements 1 and 2	-	Area	$A = 0.125\ ft^2$
		Moment of inertia	$I_{yy} = 0.263\ ft^4$
Element 3	-	Area	$A = 0.175\ ft^2$
		Moment of inertia	$I_{yy} = 0.193\ ft^4$

Boundary Condition

Node 2 ; Constrain all DOFs.

Nodes 1 and 4 ; Spring constant (Z direction), K = 1200 kips/ft
Release Ry of the node 3 of the element 3 in the element local coordinates.

Load Cases

A concentrated load, P_1= 5 kips is applied to the mid-point of the element 3 in the X direction.

A concentrated load, P_2= 15 kips is applied to the mid-point of the element 2 in the -Z direction.

Results

Displacements

	Node	Load	DX (ft)	DY (ft)	DZ (ft)	RX ([rad])	RY ([rad])	RZ ([rad])
▶	1	CASE1	0.001079	0.000000	0.001787	0.000000	-0.000099	0.000000
	2	CASE1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	3	CASE1	0.001079	0.000000	-0.000180	0.000000	0.000444	0.000000
	4	CASE1	0.001079	0.000000	-0.004820	0.000000	-0.000361	0.000000

Comparison of Results

Unit : ft, rad

Node	X-displacement, $\delta_X(\times 10^{-3})$		Z-displacement, $\delta_Z(\times 10^{-3})$		Y-rotational, $\theta_Y(\times 10^{-3})$	
	Theoretical	MIDAS/Civil	Theoretical	MIDAS/ Civil	Theoretical	MIDAS/ Civil
1	1.079	1.079	1.787	1.787	-0.099	-0.099
3	1.079	1.079	-0.180	-0.180	0.444	0.444
4	1.079	1.079	-4.820	-4.820	-0.362	-0.361

Reference

Beaufait F. W.,et al., “*Computer Methods of Structural Analysis*”, Prentice-Hall, Inc.,New Jersey, 1970, pp. 197～210.