

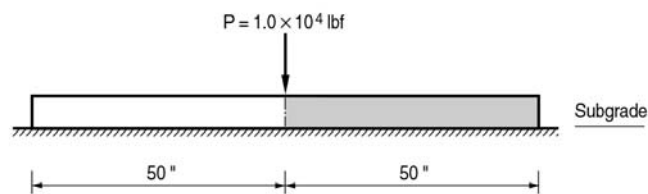
Static-9

Title

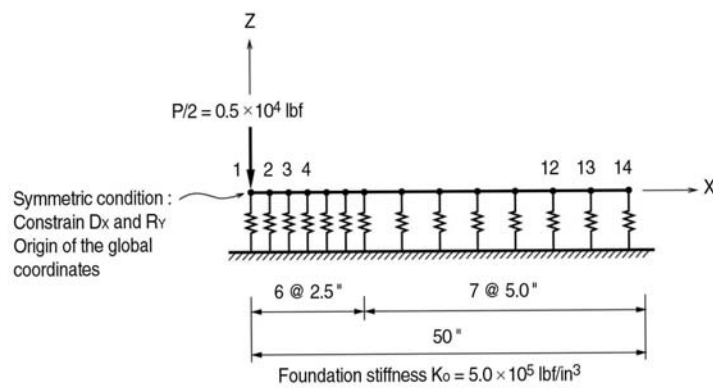
Beam on elastic foundation

Description

A beam rests on an elastic foundation and a concentrated load exerts at mid-span. Determine the vertical displacements and the bending moments of the structure. Only a half model may be analyzed due to symmetry.



(a) Beam on elastic foundation



(b) Half model

Structural geometry and analysis model

Model

Analysis Type

2-D static analysis (X-Z plane)

Unit System

in, lbf

Dimension

Length 50.0 in

Element

Beam Element

Material

Modulus of elasticity $E = 2.1 \times 10^6$ psi

Section Property

Moment of inertia $I_{yy} = 83.33333 \text{ in}^4$

Boundary Condition

Node 1 ; Constrain Dx and Ry.

Foundation stiffness ; $K_o = 5.0 \times 10^5 \text{ lbf/in}^3$

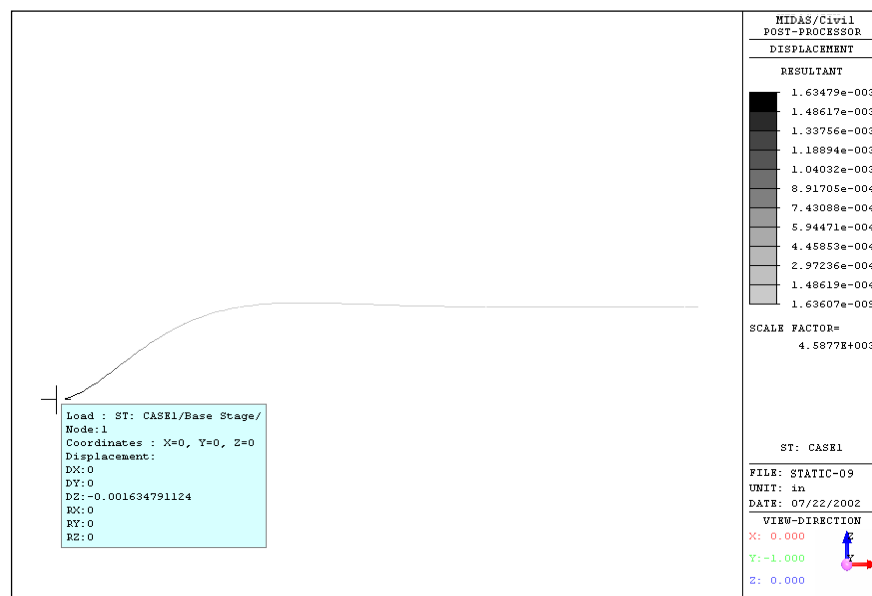
The Z directional stiffness of each node can be calculated by multiplying the tributary nodal area by the foundation stiffness.
(Width of the beam is assumed to be 1 in.)

Load Case

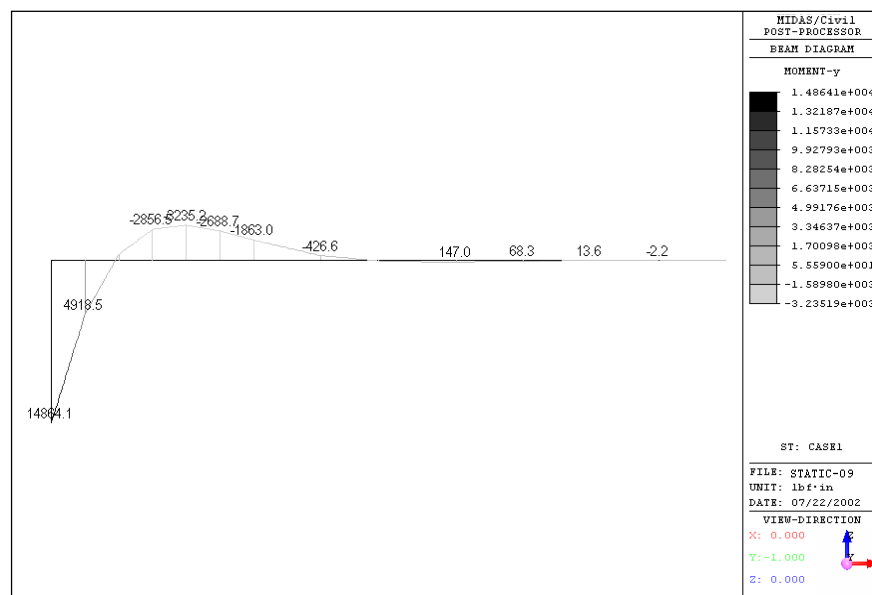
A half concentrated load P is applied in the $-Z$ direction due to symmetry.

$P/2 = 1.0 \times 10^4/2 \text{ lbf} = 0.5 \times 10^4 \text{ lbf}$

Results



Z-displacements of the structure (Node 1)



Bending moment diagram of the structure

Comparison of Results

Result (Node 1)	Theoretical	ADINA	Units : in, lbf
			MIDAS/Civil
Z-displacement(δ_z)	-1.6348×10^{-3}	-1.6348×10^{-3}	-1.6348×10^{-3}
Bending moment (M_v)	1.53×10^4	1.49×10^4	1.49×10^4

References

Timoshenko, S., “*Strength of Materials, Part II*” 3rd Edition, D. Van Nostrand Co., 1958.

“*ADINA, Verification Manual - Linear Problems*”, Version 6.1, ADINA R&D, Inc., 1992, Example A. 41.