

Eigen-1

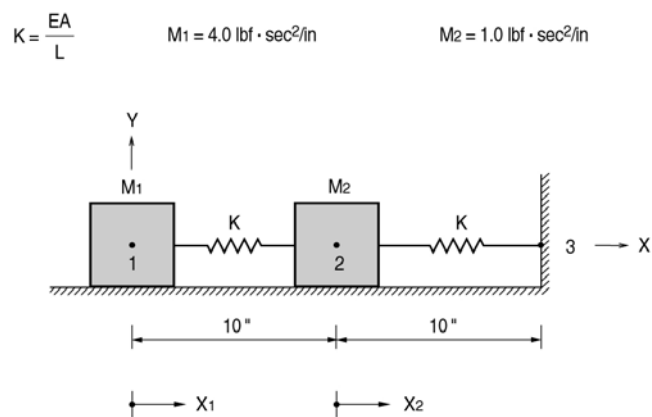
Title

Eigenvalue analysis of a two DOF system

Description

A simple frictionless two DOF system is constructed with two springs and two lumped masses.

Find the two natural frequencies and the corresponding mode shapes.



Structural geometry

MODEL

Analysis Type

2-D eigenvalue analysis (X-Y plane)

Unit System

in, lbf

Dimension

Length 20.0 in

Mass $M_1 = 4.0 \text{ lbf} \cdot \text{sec}^2 / \text{in}$

$M_2 = 1.0 \text{ lbf} \cdot \text{sec}^2 / \text{in}$

Stiffness $K = EA/L$

Element

Truss element

Material

Modulus of elasticity $E = 1.0 \times 10^5 \text{ psi}$

Section Property

Area $A = 0.1 \text{ in}^2$

Boundary Condition

Node 3 ; Constrain all DOFs

Nodes 1 and 2 ; Constrain Dy and Rz (Only Dx allowed)

Analysis Case

Masses M_1 and M_2 exist at the nodes 1 and 2 in the X direction respectively.

Number of eigenvalues to be computed = 2

Results

Eigenvalue Analysis Results

EIGENVALUE ANALYSIS													
	Mode No	Frequency				Period (sec)		Tolerance					
		(rad/sec)		(cycle/sec)									
	1	10,826716		1,723125		0,580341		1,2123e-016					
	2	46,182055		7,350102		0,136053		1,7505e-013					
MODAL PARTICIPATION MASSES(%) PRINTOUT													
	Mode No	TRAN-X		TRAN-Y		TRAN-Z		ROTN-X		ROTN-Y		ROTN-Z	
		MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM
	1	95,89	95,89	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	2	4,11	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
EIGENVECTOR													

Comparison of Results

Result			Theoretical	MSC/NASTRAN	NISA II	MIDAS/ Civil
1 st Mode	Angular velocity	$\omega_1(\text{rad/sec})$	10.83	10.83	10.83	10.83
	Eigenvalue	x_1	1.000	1.000	1.000	1.000
		x_2	0.531	0.531	0.531	0.531
2 nd Mode	Angular velocity	$\omega_2(\text{rad/sec})$	46.18	46.18	46.18	46.18
	Eigenvalue	x_1	-0.133	-0.133	-0.133	-0.133
		x_2	1.000	1.000	1.000	1.000

References

Donald T. Greenwood, “*Principles of Dynamics*”, Englewood Cliff, Prentice-Hall, Inc., 1965 . p.459, EX.9-1.

“*MSC/NASTRAN, Verification Problem Manual*”, V.64, The MacNeal-Schwendler Corporation, 1986, Problem No.V0301.

“*NISA II, Verification Manual*”, Version 91.0, Engineering Mechanics Research Corporation, 1991.