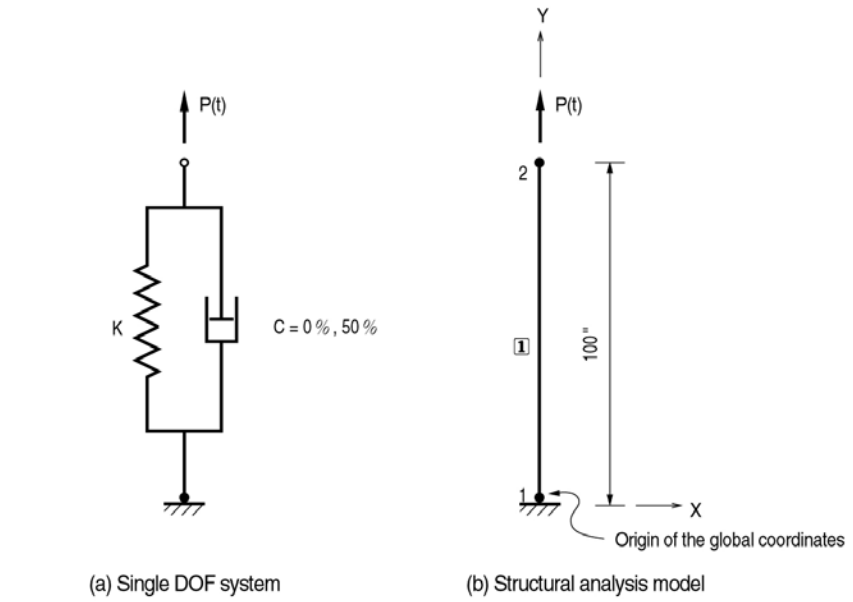
TH-1

Title

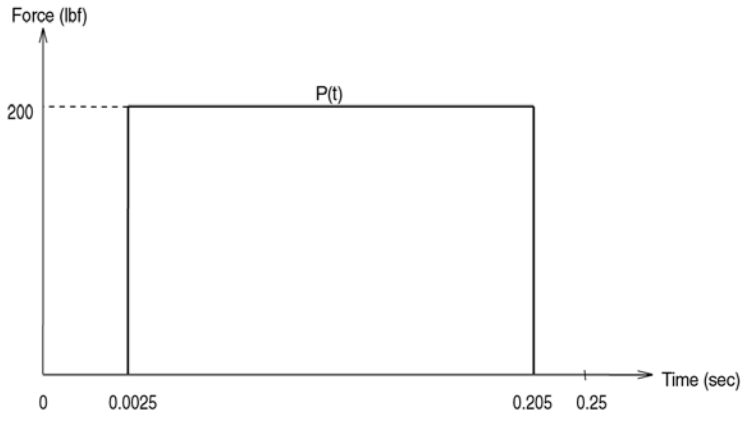
Transient response to a step excitation

Description

A spring-mass-damping system, initially at rest, is subjected to a step force.
Perform a time history analysis and compare the maximum displacements of the structure between the cases of damping and undamping.



(a) Single DOF system (b) Structural analysis model



(c) Force P(t)

Structural geometry and analysis model

Model

Analysis Type

2-D time history analysis

Unit System

in, lbf

Dimension

Length	L	= 100.0 in
Mass	M	= 0.5 lbf · sec^2/in (Y axis)
Analysis time	t	= 0.25 sec
Time step	Δt	= 0.0025 sec
Damping ratio	ξ	= 0.0 (0 %)
	ξ	= 0.5 (50 %)

Element

Truss Element

Material

Modulus of elasticity E = 20000 psi

Section Property

Area A = 1.0 in^2

Boundary Condition

Node 1 ; Constrain all DOFs.

Node 2 ; Constrain Dx and Ry

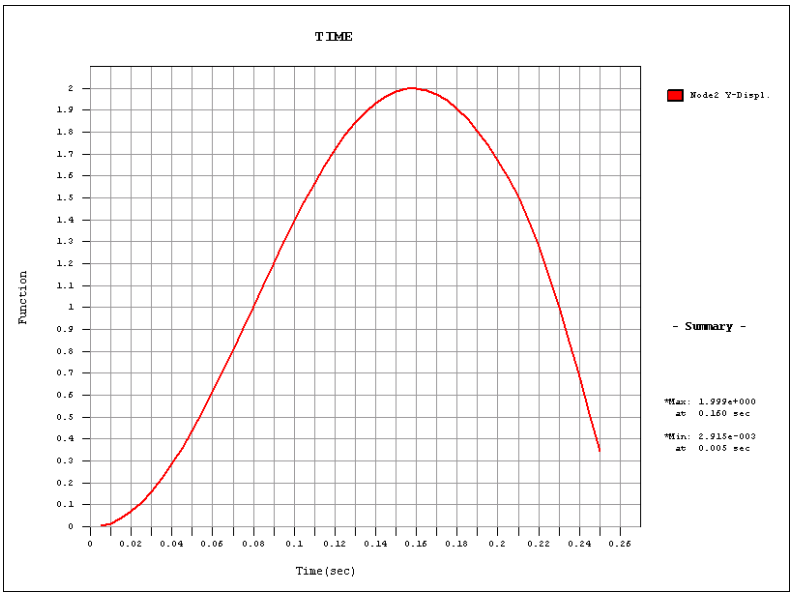
Analysis Case

Step force acts in the Y direction.

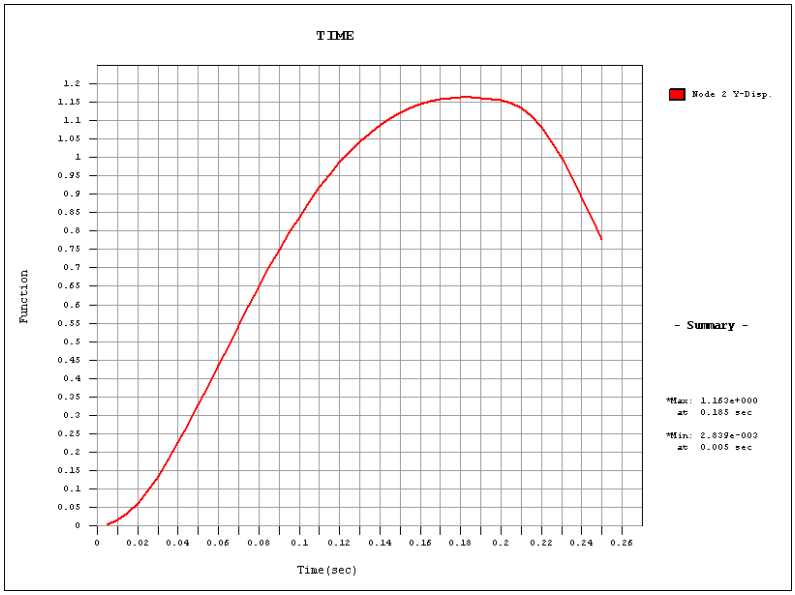
The time step force data are as follows ;

Time (sec)	Force (lbf)
0.0025	200
0.2050	200

Results



Displacements at the nodes 2 (Damping ratio is 0.0)



In the case of damping ratio is 0.5

Comparison of Results

Unit : in

Result		Theoretical	MIDAS/Civil
Maximum displacement	Damping ratio=0.0	2.000	2.000
Displacement (t = 0.2 sec)	Damping ratio=0.0	1.654	1.672
	Damping ratio=0.5	1.1531	1.1543

References

Thomson, W. T., "*Vibration Theory and Applications*", Prentice-Hall, Inc., Englewood Cliffs, N. Y., 2nd Printing, 1965, p. 102, Article 4.3.

.

Step force data