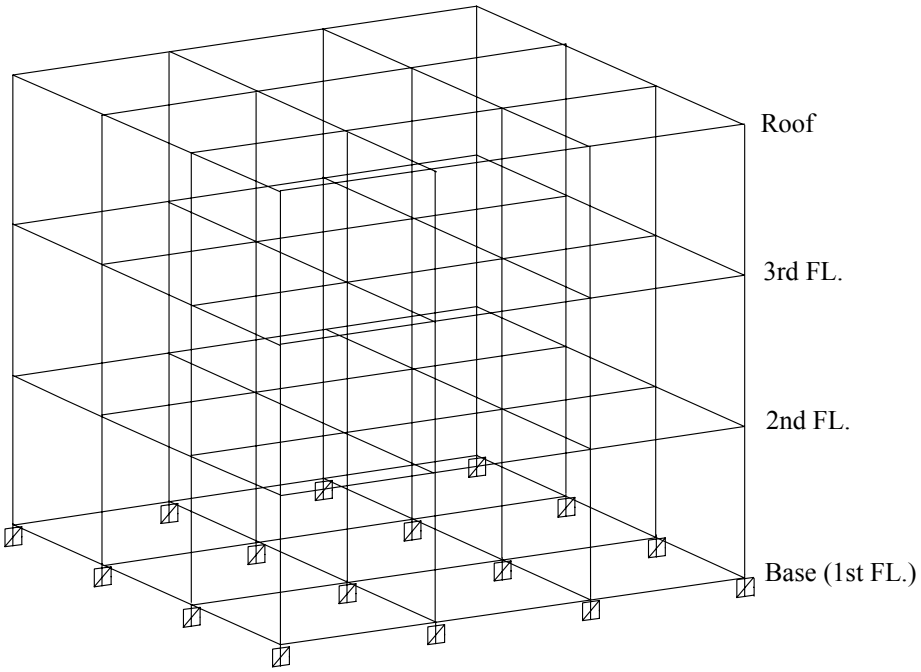
BNL-3

Title

Boundary nonlinear time history analysis

Description

Perform a boundary nonlinear time history analysis of a structure subject to lateral dynamic loads.
Determine the shear deformation, shear force and force-deformation curve for the nonlinear link No.1.



Structural analysis model

Model

Analysis Type

3-D boundary nonlinear time history analysis

Unit System

m, kN

Dimension

Length 12.0 m Width 12.0 m Height 10.5 m
Damping ratio $\xi = 0.05$
Analysis Time t = 39.98 sec
Time step $\Delta t = 0.02$ sec

Element

Beam element

Material

Modulus of elasticity $E = 2.9863 \times 10^7$ kN/m^2
Poisson's ratio $\nu = 0.25$

Section Property

Columns 97~111, 118~123, 130~144 B × H = 0.3 m × 0.3 m
Columns 112~117, 124~129 B × H = 0.3 m × 0.4 m
Beams 1~96 B × H = 0.3 m × 0.4 m

Boundary Condition

Nodes 1~16 ; Constrain all DOFs.
Nodes 1~16, 17~32 ; Nonlinear Link
Nonlinear Link Properties

Type ; Lead Rubber Bearing Isolator
Spring Properties

DOF	Effective Stiffness (kN/m)
Dx	80000
Dy	523
Dz	523

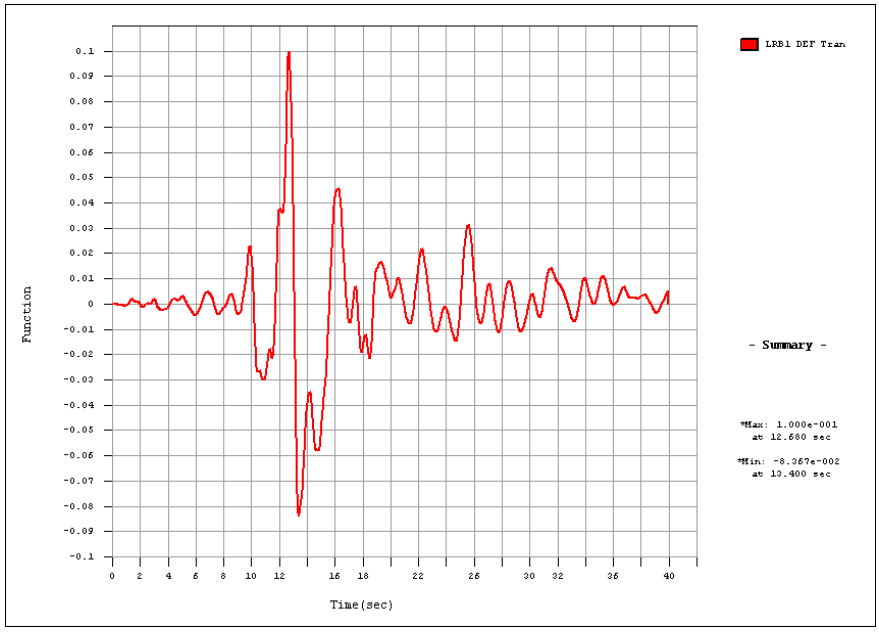
Nodes 81~84 ; Constrain Dx, Dy & Rz of all nodes at each floor to these nodes (Master nodes)

Load Case

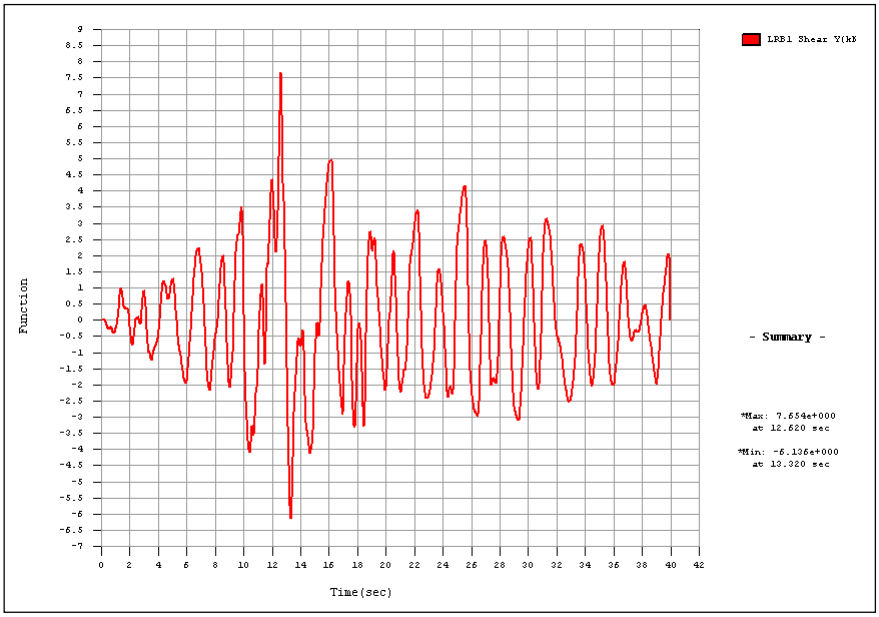
Loma Prieta Earthquake in 270 Deg and 0 Deg (Oakland Outer Wharf, 1989) are applied in the X & Y directions respectively.

Results

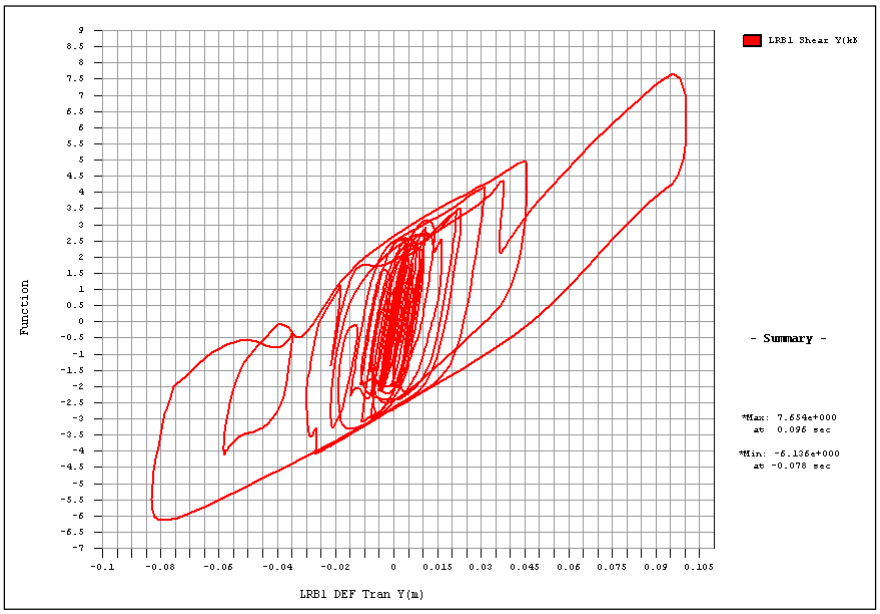
Time History Analysis Results



Shear Deformation in local y direction of nonlinear link No.1 from 0 sec. to 39.98 sec.



Shear Force in local y direction of nonlinear link No.1 from 0 sec. to 39.98 sec.



Force-Deformation curve in local y direction of nonlinear link No.1 from 0 sec. to 39.98 sec.

Comparison of Results

Maximum Inter-story Drifts

Unit : m

Result	D_X		D_Y	
	3-D Basis-Tabs	MIDAS/Civil	3-D Basis-Tabs	MIDAS/Civil
Roof	0.0007	0.0008	0.0008	0.0007
3rd FL.	0.0012	0.0012	0.0013	0.0011
2nd FL.	0.0012	0.0012	0.0013	0.0013
Base (1st FL.)	0.1192	0.1190	0.1007	0.1000

Maximum Top Floor Acceleration

Unit : m/sec^2

Result	A_X		A_Y	
	3-D Basis-Tabs	MIDAS/Civil	3-D Basis-Tabs	MIDAS/Civil
Roof	0.5116	0.5847	0.4928	0.4815

Reference

Reinhorn, A. M., Nagarajaiah, S., et al., "*3-D Basis-Tabs:Version 2.0, Computer Program for Nonlinaer Dynamic Analysis of Three Dimensional Base Isolated Structures*", Technical Report NCEER-94-0018, Nat. Ctr. for Earthquake Engrg. Res., State University of New York, Buffalo, N.Y., 1994.