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SEISMIC DAMPERS: HOW HIGH PERFORMANCE DEVICES CHANGE THE WORLD?

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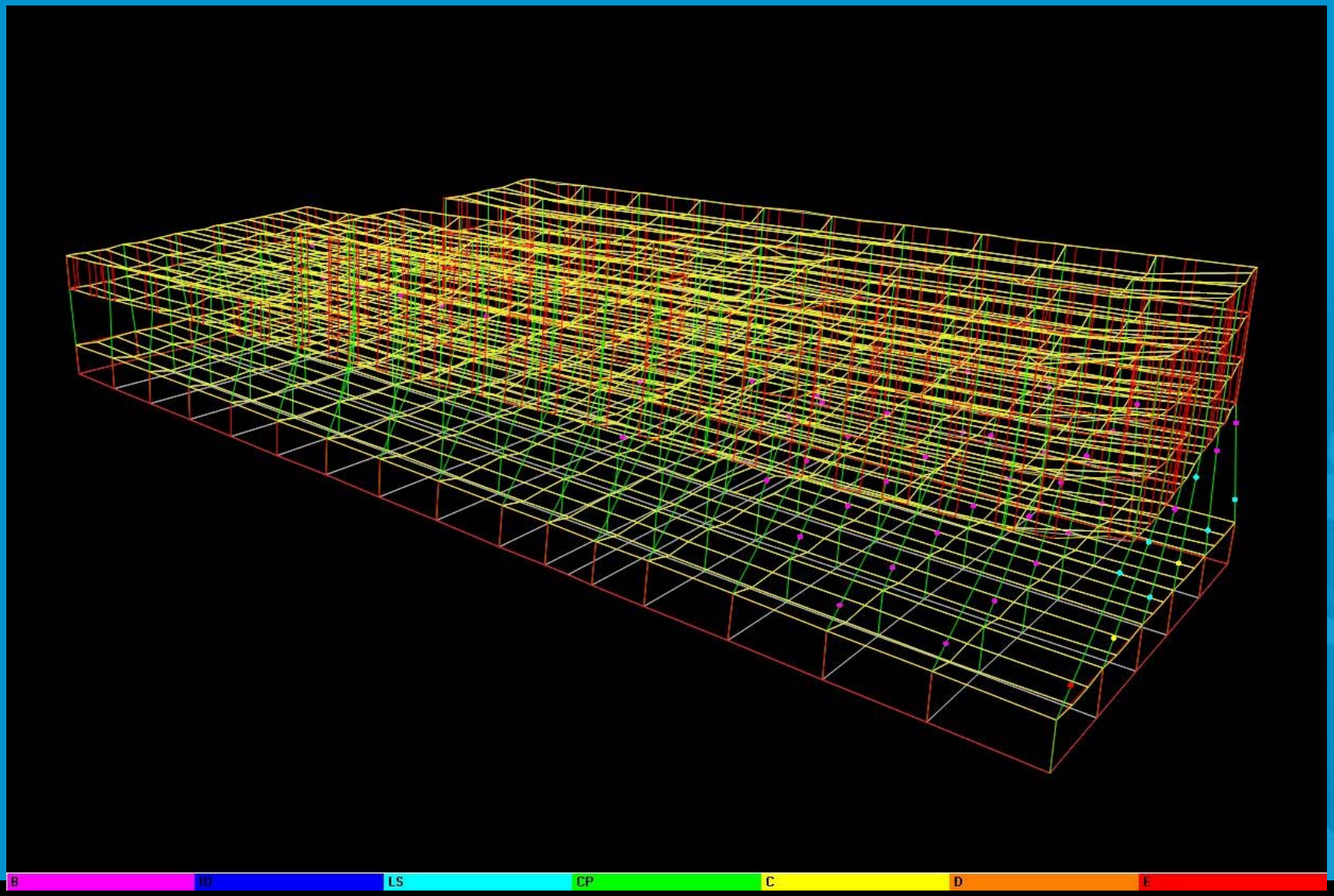
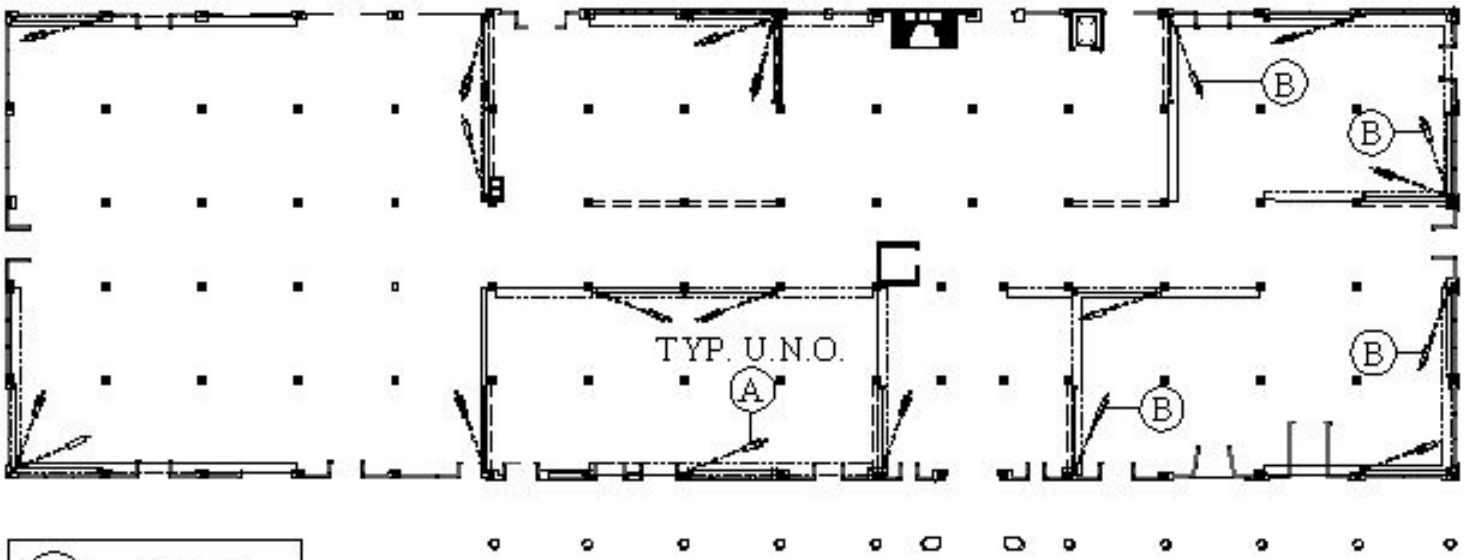

B
IO
LS
CP
C
D
E

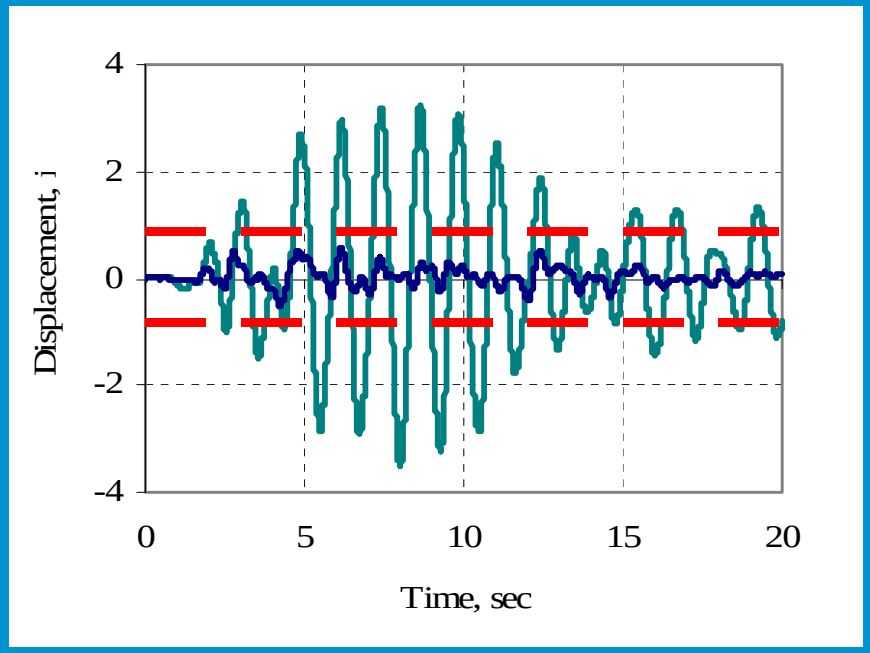


north

A = FVD

B = FVED

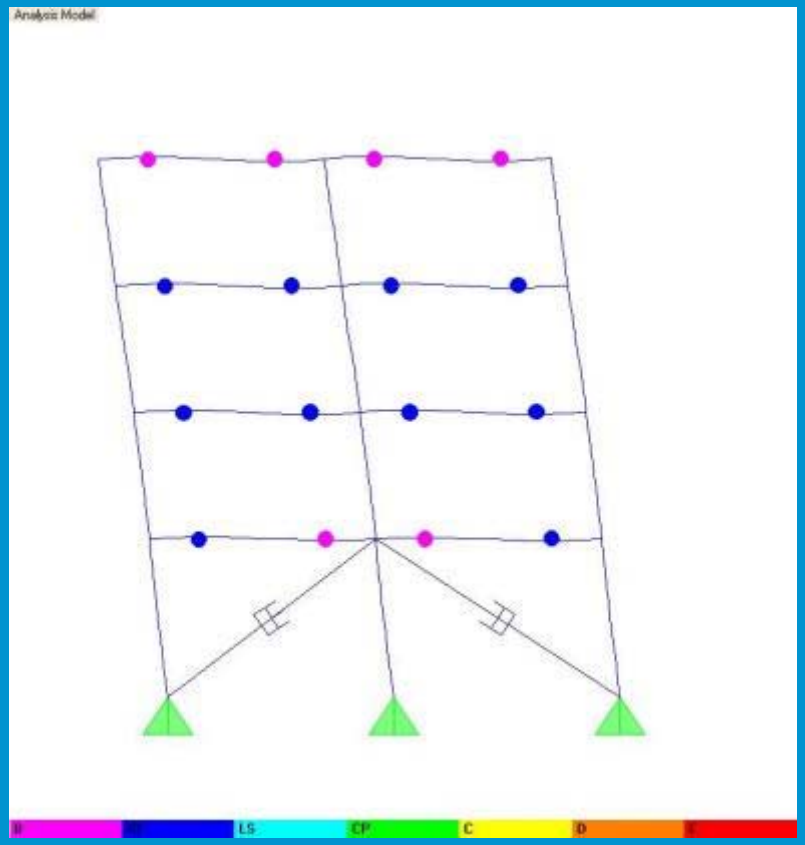
10 Dampers Each Direction



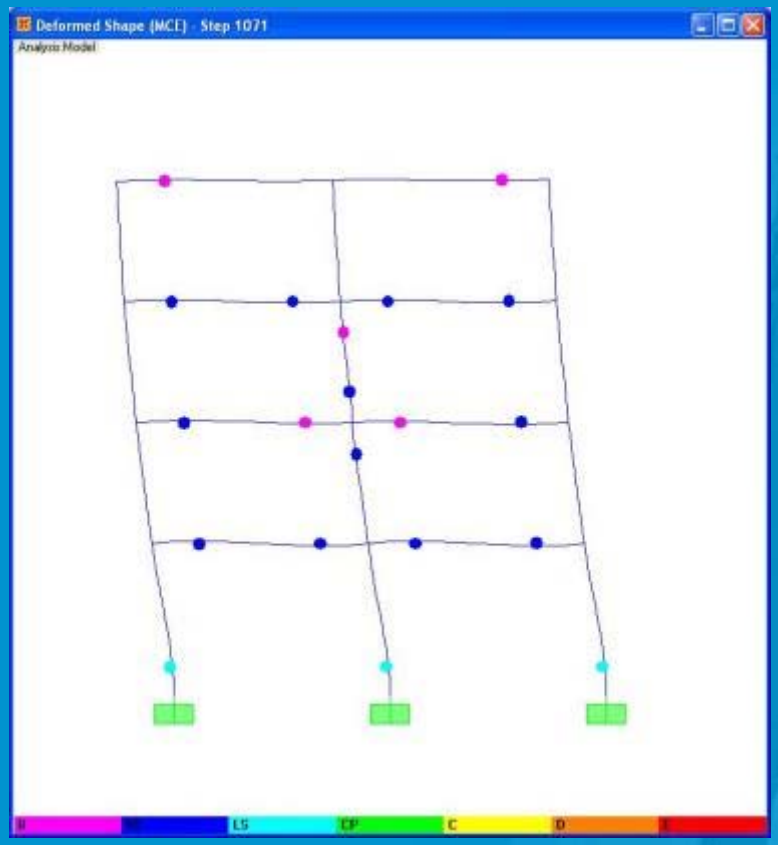
Elastic limit ----

Plastic Hinges @ MCE (level3)

Damped



Conventional

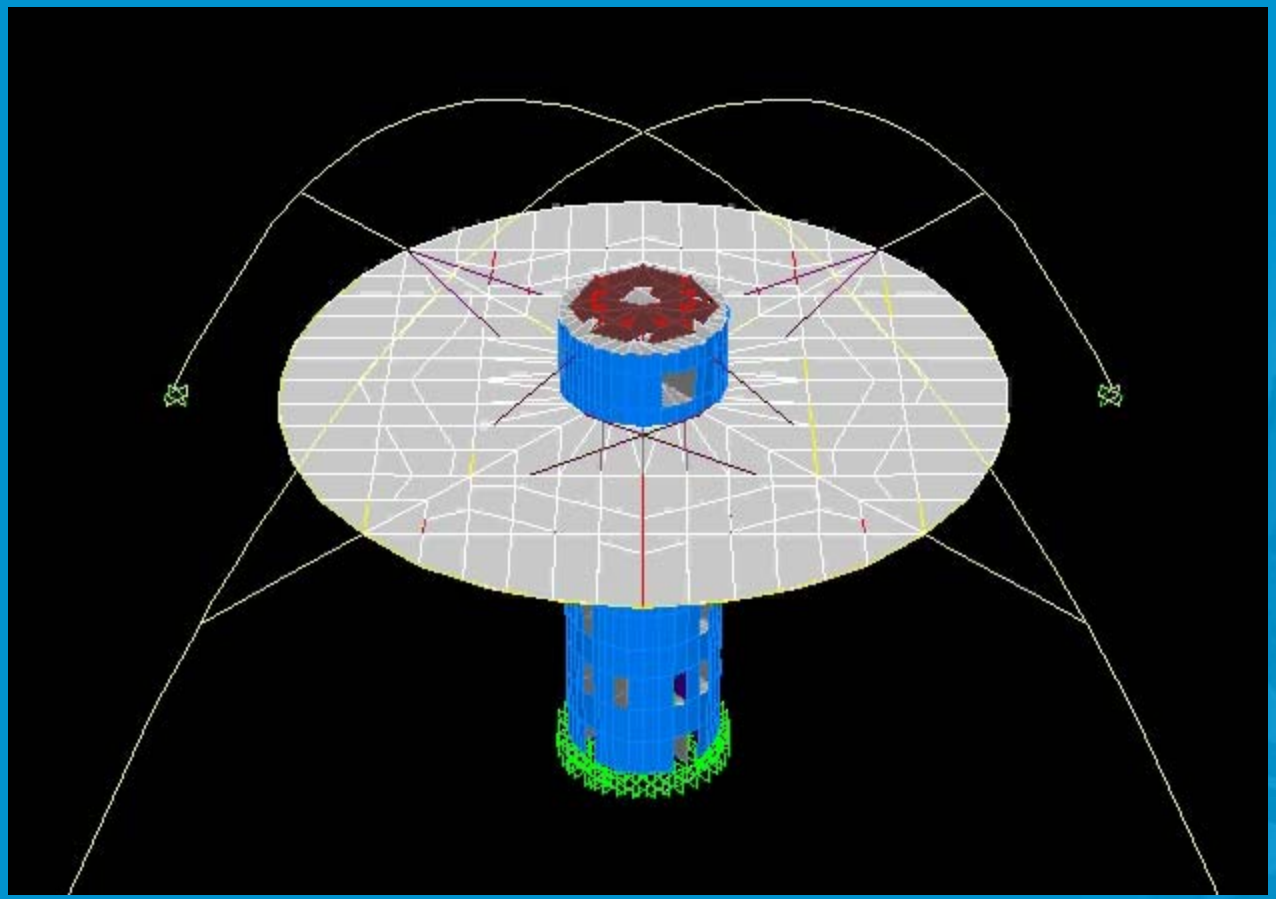


Response	Damped	Conventional	Level
Drift Ratio (%)	1.4	1.4	DBE
Base Shear Coefficient (g)	0.5	0.9	DBE
Roof Accretion (g)	1.7	2.7	DBE
Beam PH Rotation (% Radians)	1.3	1.7	MCE
Column PH Rotation (% Radians)	0	2.6	MCE

Construction Cost

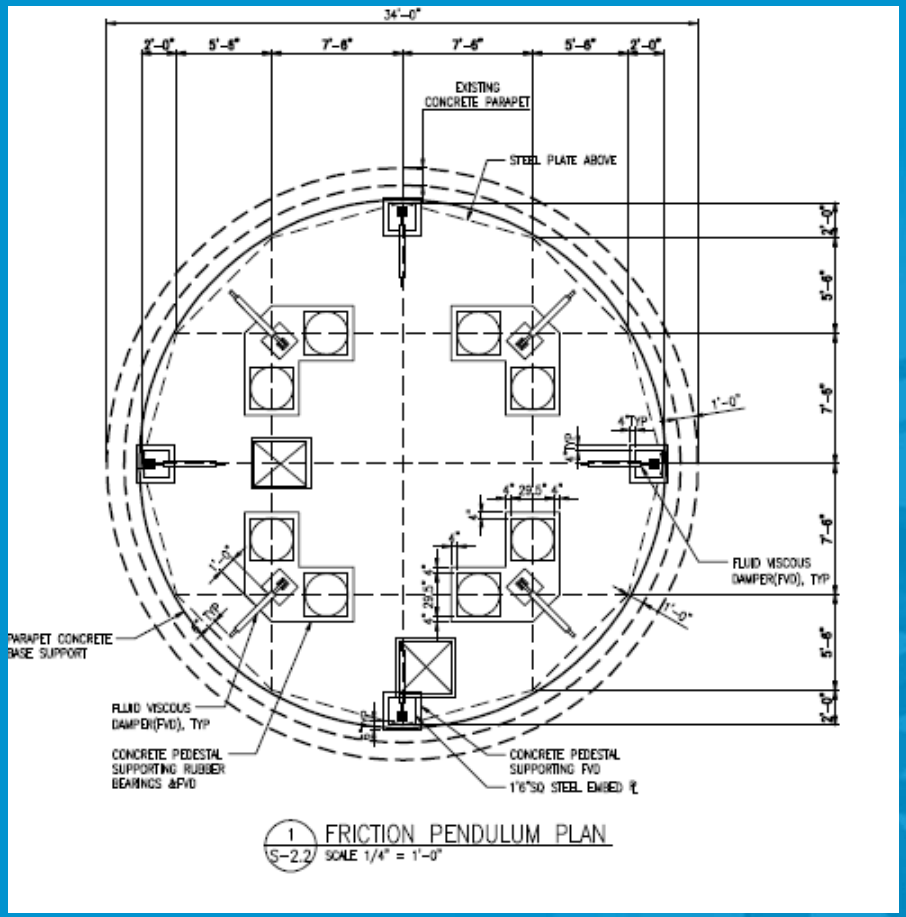
Item	Conventional	Damped	Differential Cost
Moment Frames	274 ton	223 ton	- $150,000
Foundation	RC Grade Beams, Excavation & Backfill	No Grade Beams	- $200,000
Dampers	--	$200,000	+ $200,000
Net			**-$150,000**

Damper Cost Offset by Reductions in Materials

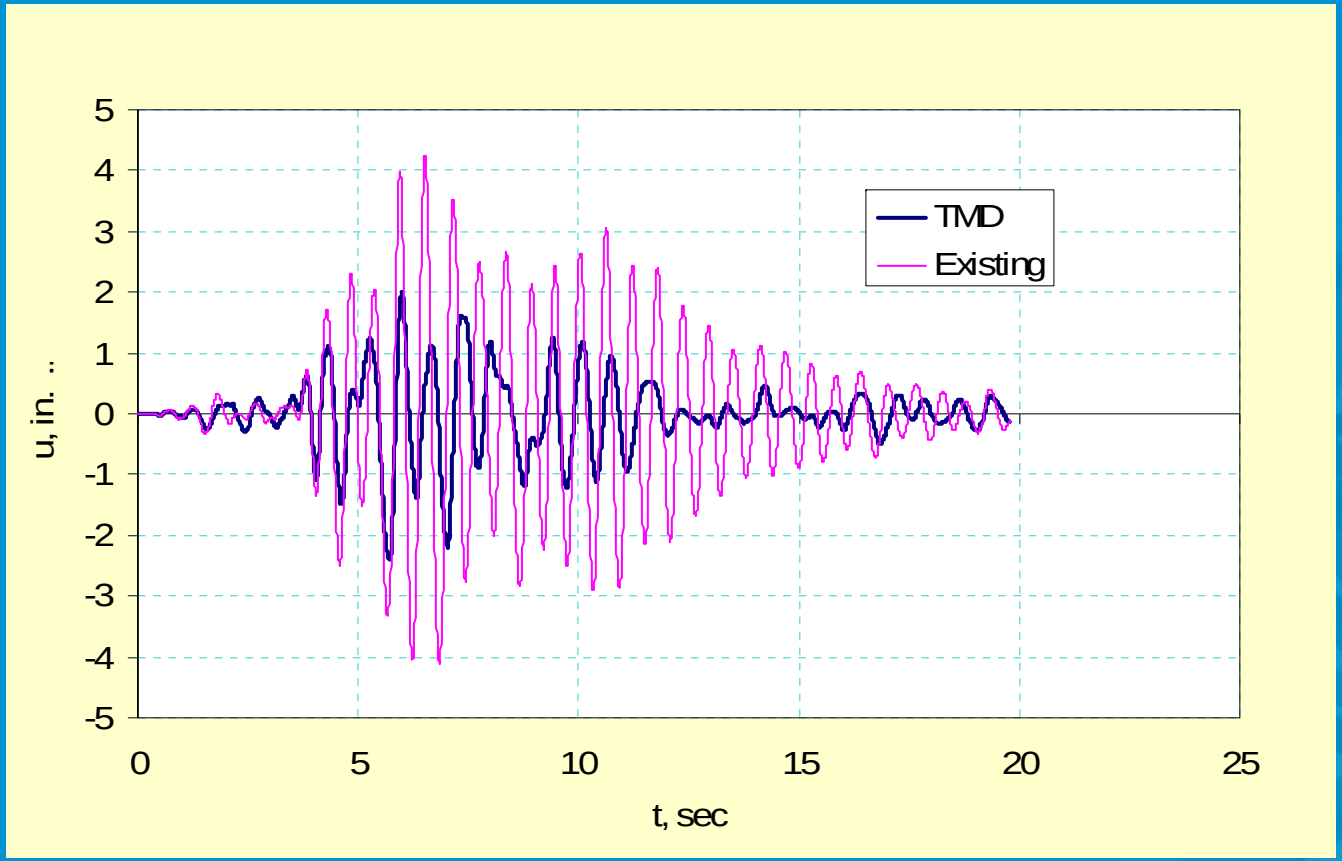


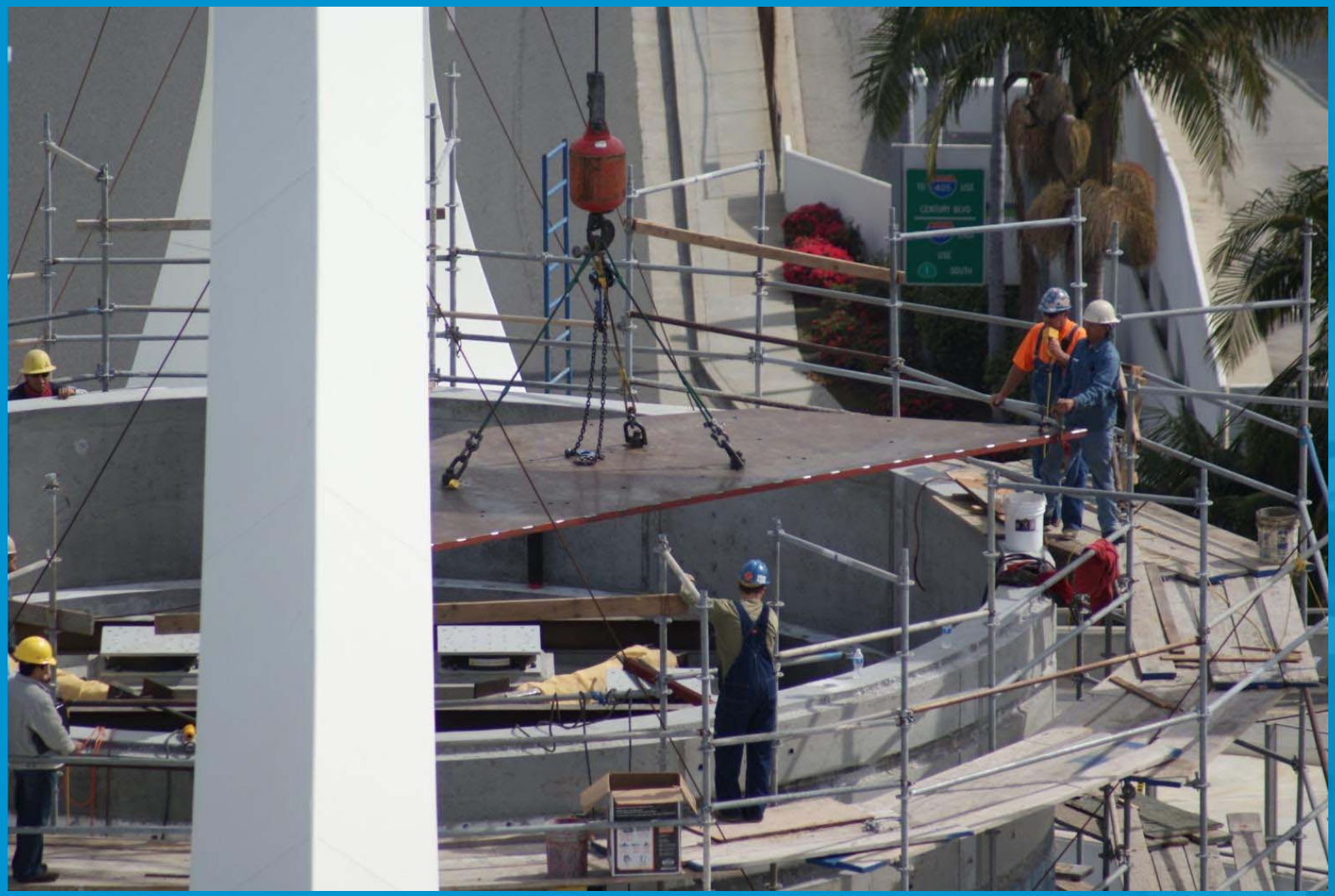
Mass Damper

- 25% Mass of Structure (2-747s)
- Viscous Damper and Rubber Isolator
- 15% damping



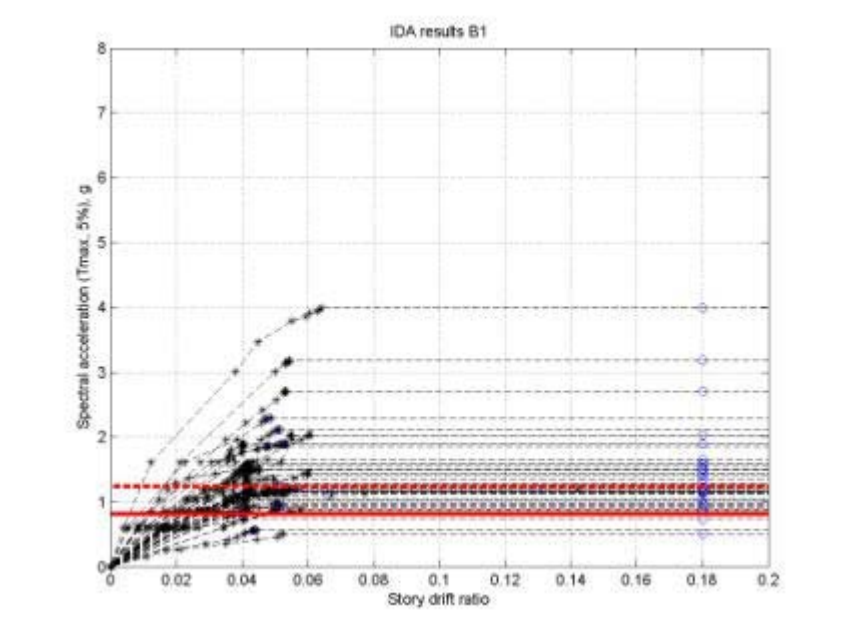
Roof Displacement



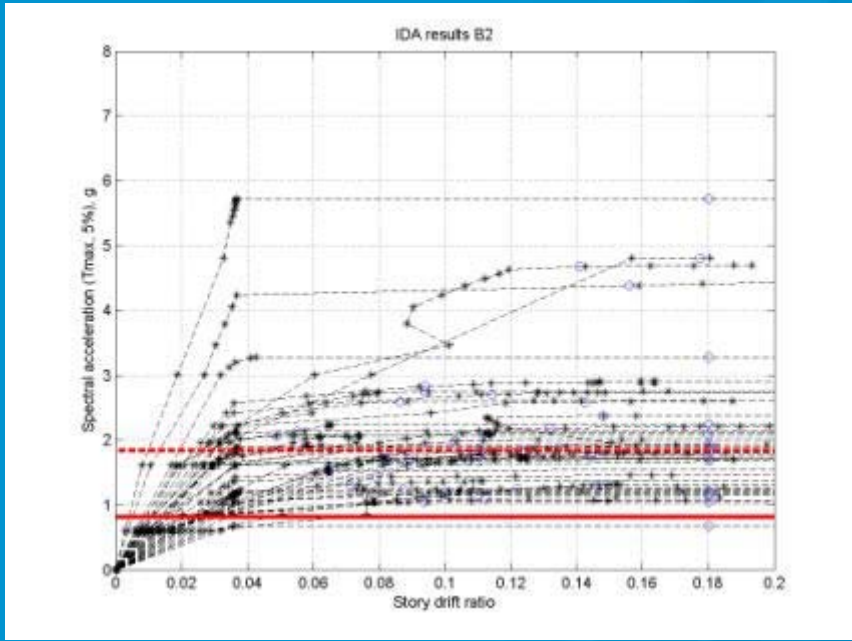


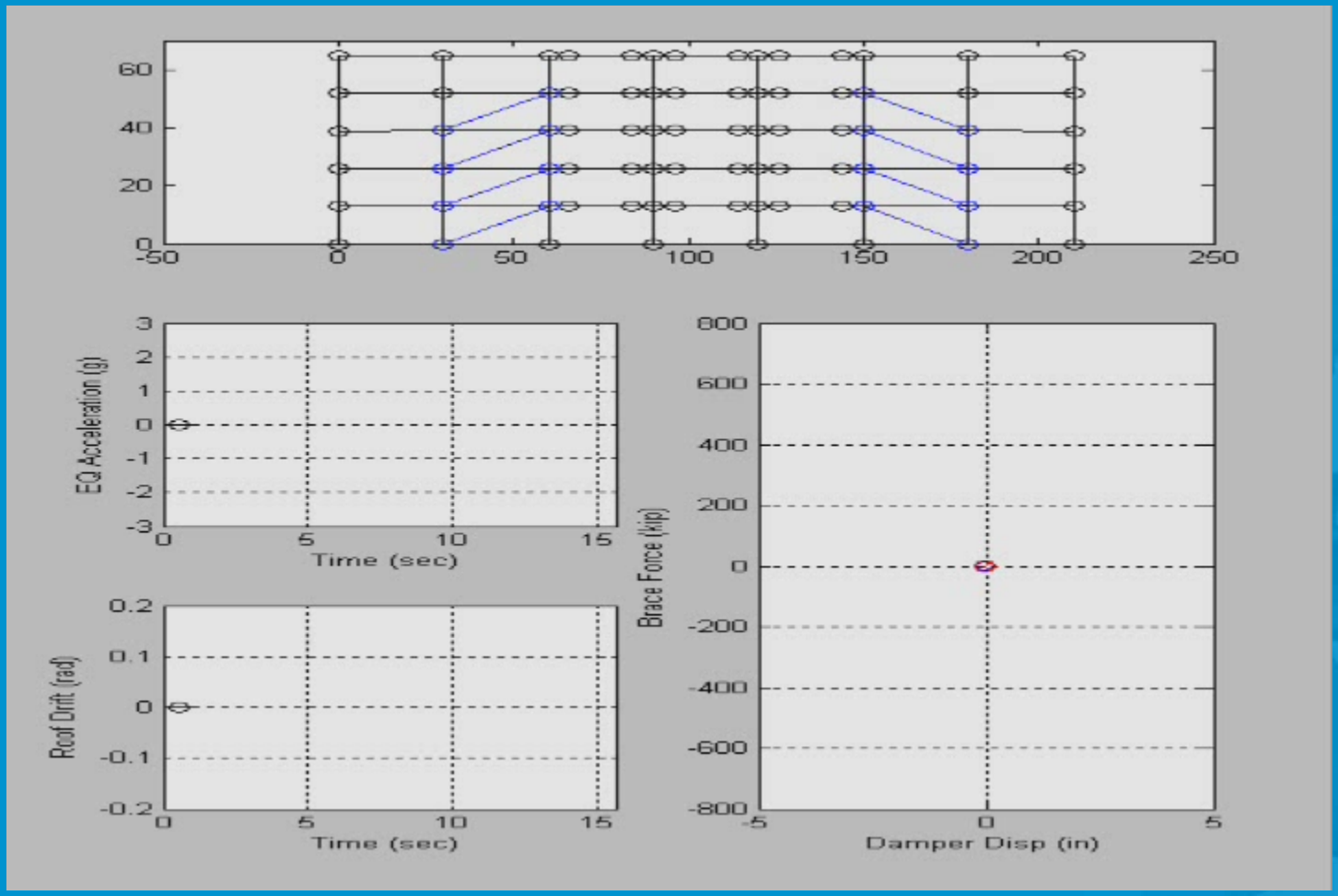
Incremental Dynamic Analysis

B1: S_{CT} = 1.2 g S_{MT} = 0.82g



B2: S_{CT} = 1.8 g S_{MT} = 0.82g




60
40
20
0
-50
0
50
100
150
200
250
EQ Acceleration (g)
3
2
1
0
-1
-2
-3
0
5
10
15
Time (sec)
Roof Drift (rad)
0.2
0.1
0
-0.1
-0.2
0
5
10
15
Time (sec)
Brace Force (kip)
800
600
400
200
0
-200
-400
-600
-800
-5
0
5
Damper Disp (in)

- Damped structure per current practice is safe : 5.6% probability of collapse at MCE
- Increase damper SF to 1.3 MCE force:

  1.8 % probability of collapse at MCE

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