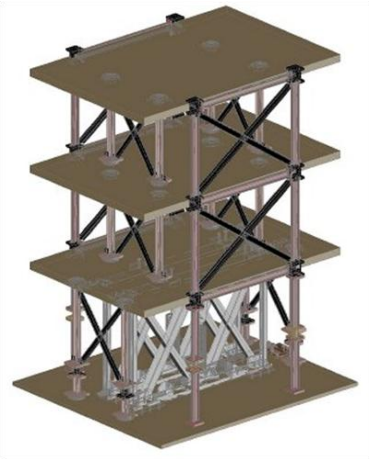
HOMEWORK PROBLEM #5

Identification of Structural Properties (Static-Dynamic) and Dynamic Response



a) Test the specimen of a 1:3 scale three stories using (i) a pull test (ii) a snap-back (release from the pull test in (i), (iii) a white noise shaking; (iv) a sine-sweep shaking and (v) table sine "impulse" motion. All tests will be done with fixed base.
   01) The information about the specimen, instrumentation, and data acquisition should be identified before the test begins, taking measurements, making sketches, and taking pictures. The specimen is made of steel A36. More details about the materials and geometry of the main frame should be obtained from . http://civil.eng.buffalo.edu/neesadapt/ >Test Plan >3 test Configuations>2 Complete Details
   02) Test protocol to be assembled during the class-experiment – prepare a log of sequences of experiments, including all loading parameters, and observations
   03) Interpret data collected in test using DADISP computer software.
   04) The raw data will be found on the repository (directions will be provided in class)

b) Prepare an assembly drawing, an instrumentation drawing, list of instruments and list of test sequences. On the list of test sequences take notes of the development of the experiment and any important information that happens during the experiment.

c) Perform the pull test at one floor of the structure and determine the displacements-force functions at each level of the frame. Determine the flexibility vector for the pullback load. Repeat the pull at other floors, to obtain the whole flexibility matrix. Derive the stiffness matrix. Develop the symmetric features, as average of "off-diagonal" terms and the associated deviations.

d) For the snap-back test, determine the transfer function at each external joint of the frame (at each level) to the excitation force. Determine the first three modal frequencies.

e) Using inverse transform for each frequency band (+/- 20% of modal frequency) determine the damping for each mode through the logarithmic decrement.

f) Using ratios of transfer functions at modal frequencies, determine the modal shapes of the frame. Orthonormalize the vectors using Schmidt procedure or equivalent, the orthonormalize them through the mass matrix.

g) Using the information generated in (d) through (f), find the stiffness and damping matrix of the structure

h) Repeat procedure from step (d) to (g) for all other methods (substitute reference force with base motion for calculation of transfer functions for the sine sweep, white noise, impulse, etc.)

i) Discuss results: compare stiffness and damping matrices

j) If the structure is a scaled model, what would be the prototype's dynamic characteristics (those that you calculated for the model). Use scaling factors to find these characteristics.

Note: Prepare report according to the standard outline

You can find the data in a repository that will be specified after the completion of the test, on the website http://civil.eng.buffalo.edu/cie616 or another location which will be provided in class or through the aforementioned website.

Report Due date: December 7, 2011

Notes:

Note 1: The structure is instrumented with numerous transducers. You should focus only on the transducers providing you the information:

1) Load cells (x 1) for the force during the pull back of structure.
2) Displacements at each floor (x 3) and at the base (x 1) of the structure in the plane of loading
3) Acceleration transducers at each floor (x 3) and base (x 1) in the plane of loading
4) Command signals in the direction of shaking (x 1) provided to the operator.

Note 2: Description of equipment is found in the SEESL Lab Manual.

Table: Sample Scaling Factors for 1:4 Scale Structure (to be modified for 1:3)

Parameter	Dimension	Scale	Conversion Factor
Linear Dimension	L	S_L	4
Gravitational Acceleration (g)	L/T^2	1	1
Time	T	$\sqrt{S_L}$	2
Displacement	L	S_L	4
Velocity	L/T	$\sqrt{S_L}$	2
Acceleration	L/T^2	1	1
Frequency	$1/T$	$1/\sqrt{S_L}$	0.5
Mass Density	FL^4T^2	*	*
Modulus of Elasticity	F/L^2	S_E	1
Stress	F/L^2	S_E	1
Strain	-----	1	1
Poisson Ratio	-----	1	1
Force	F	$S_E S_L^2$	16
Pressure	F/L^2	S_E	1
Energy	FL	$S_E S_L^3$	64
Period	T	$\sqrt{S_L}$	2

* Artificial Mass Simulation

Conversion Factor = Prototype Quantity / Model Quantity

Tentative test protocol (sequence of events)

Dynamic Identification and Seismic Evaluation of 3-Story Base Isolated IMRF							
Test No.	**Test & Data Name**	**Base Plate Condition**	**Test Direction**	**Test Description**	**Description**	**File name in Repository**	**Remarks**
1. Identification and Seismic Evaluation Testing on Fixed Base							
1	PB-EW1	Fixed		Pull - Back Test on First Floor			
2	PB-EW2	Fixed		Pull - Back Test on Second Floor			
3	PB-EW3	Fixed		Pull - Back Test on Third Floor			
4	SB-EW1	Fixed		Snap - Back Test on First Floor			
5	WN	Fixed		White Noise Test	0.1-50HZ, 0.1 g		
6	SS	Fixed		Sine Sw ep	1-16Hz-0.1g		
7	TBI	Fixed		Table ImpulseTest			Input file=All3Modes.txt-freq=256 Hz