

CE 511/Engr 699 Project

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Objectives

- Set up a standard to evaluate structural designs for CE 100.
- Obtain approximate natural frequencies and damage levels of the buildings by applying sinusoidal vibration signals.

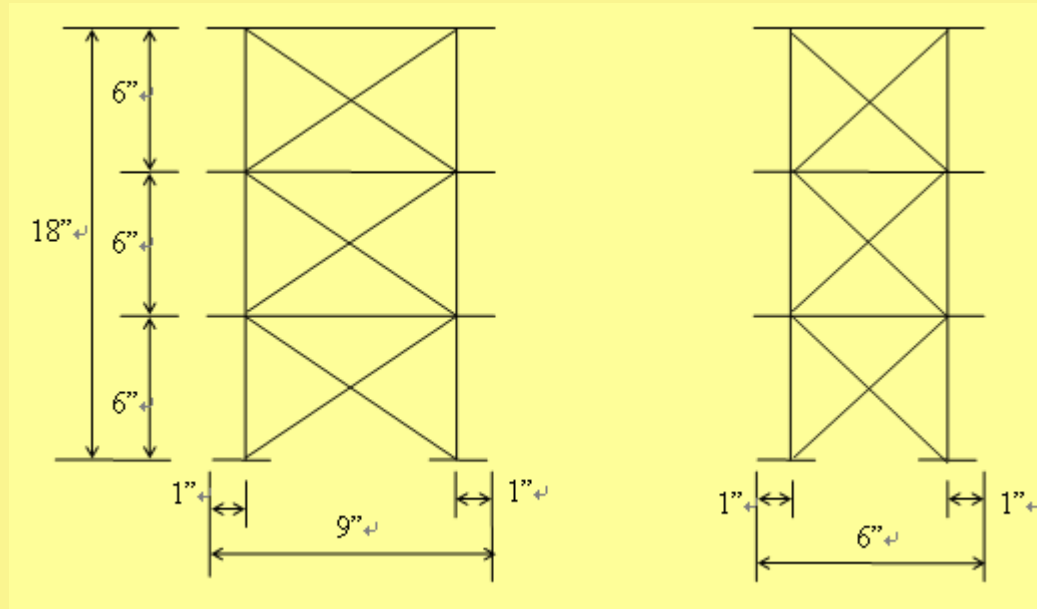
Balsa Wood

- A light and stiff material.
- Easy to make models.
- Since it is too light, which makes it different from the practical buildings, we added some weight during the test.

Procedure

1. Design a few basic structures.
2. Reinforce buildings.
3. Test the buildings on the LDS PA-2000 shake table, and apply sinusoidal vibration signals.
4. Apply different levels of acceleration and frequencies to obtain the damage levels.

Elevational Drawings (1/3)



Model 1

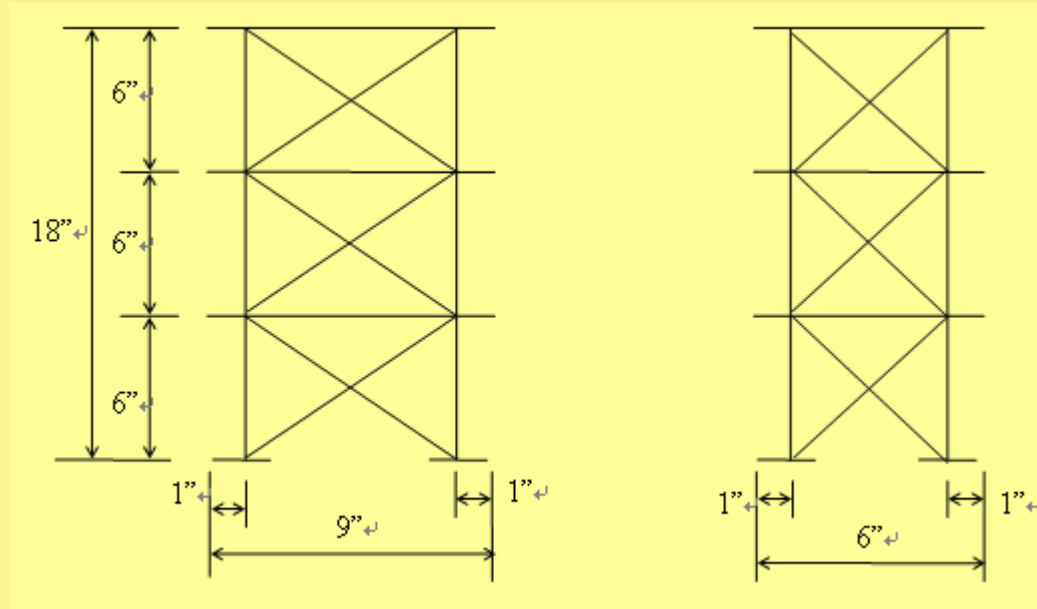
Floor: 9" X 6" X 3/32" (L X W X H)

Frame: 18" X 3/16" X 3/16"

Reinforcement: ① 9.22" X 3/32" X 3/32"

② 7.21" X 3/32" X 3/32"

Elevational Drawings (2/3)



Model 2

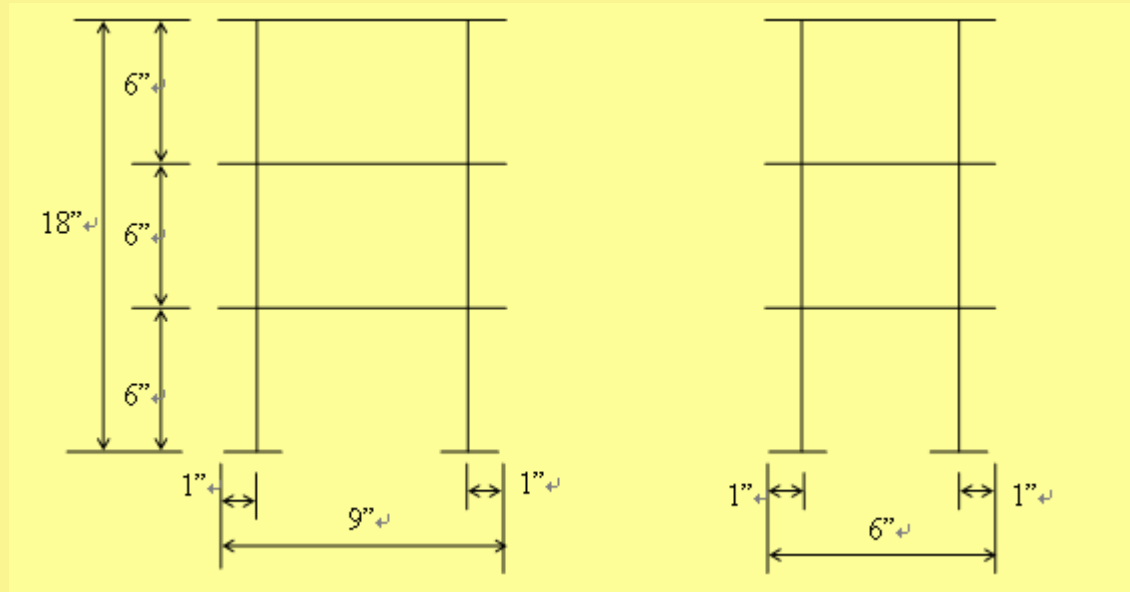
Floor: 9" X 6" X 3/32"

Frame: 18" X 1/8" X 1/8"

Reinforcement: ① 9.22" X 3/32" X 3/32"

② 7.21" X 3/32" X 3/32"

Elevational Drawings (3/3)



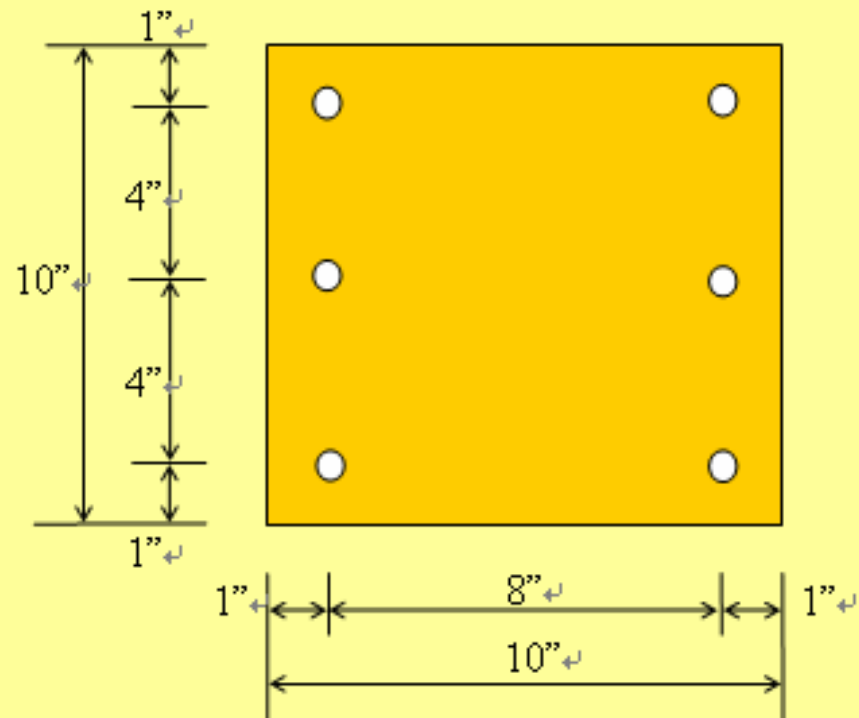
Model 3

Floor: 9" X 6" X 3/32"

Frame: 18" X 1/8" X 1/8"

No Reinforcement

Foundation



Model 1



Vibrate from strong direction
10 Hz, 1.0 G

Model 3



Static Test → Increasing Vibration → See Twisting & Bending → **BROKE**
Vibrate from weak direction
8 Hz, 0.1 G → 8 Hz, 1.0 G

Model 3

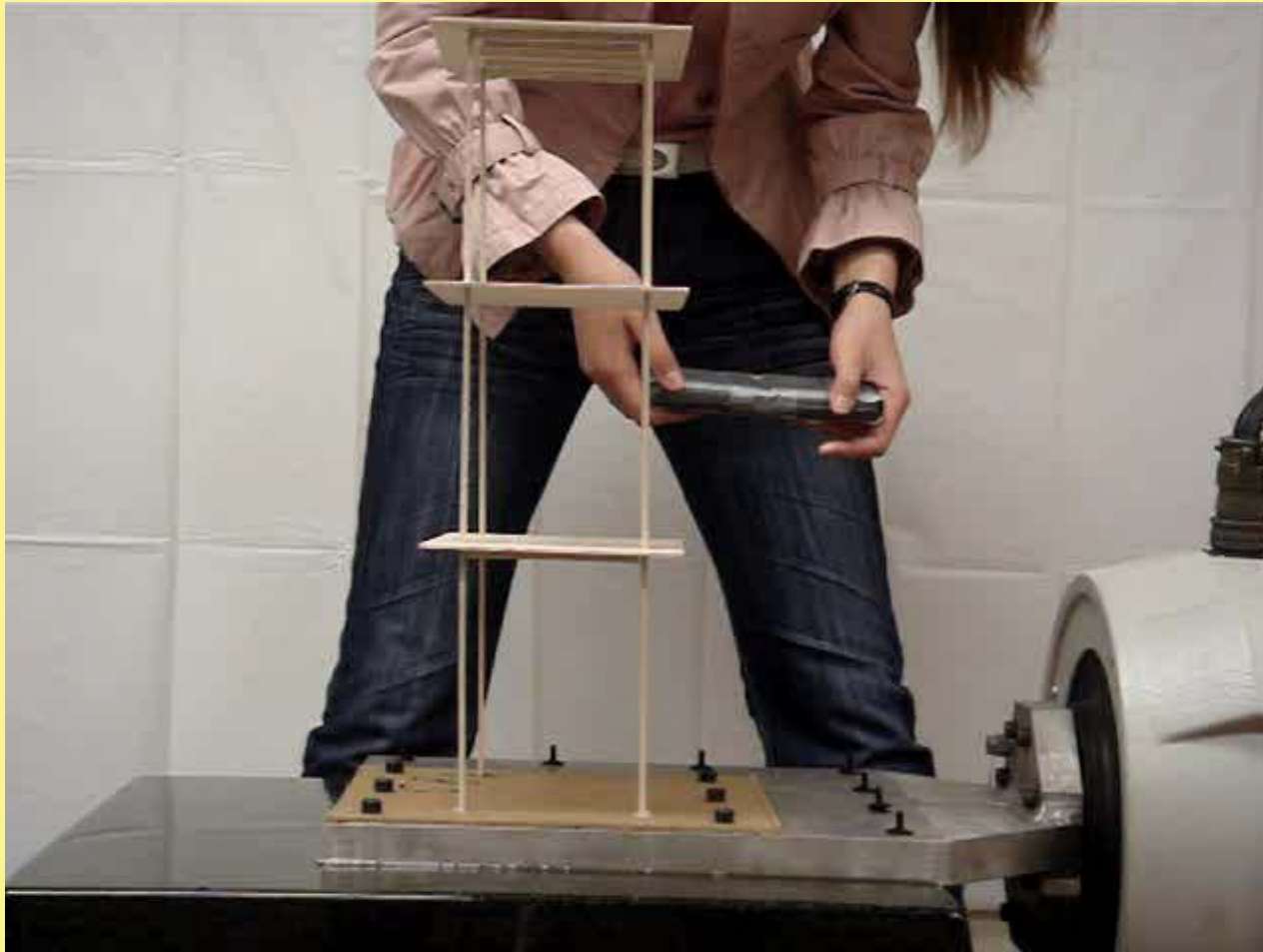


Vibrate from weak direction
9 Hz, 2.0 G → 9 Hz, 3.0 G
BROKE

Model 3



Weight on the 1st floor
Vibrate from weak direction
8 Hz, 1.25 G → 8 Hz, 2.0 G



Model 3

4 lb. weight on an unreinforced building with the reinforced floor
Vibrate from weak direction

BROKE

Model 3



5 N mass on the 1st floor at the corner of the building
Vibrate from weak direction
8 Hz, 2.0 G → 8 Hz, 2.5 G

Model 2



Vibrate from weak direction
11 Hz, 2.5 G

Model 2

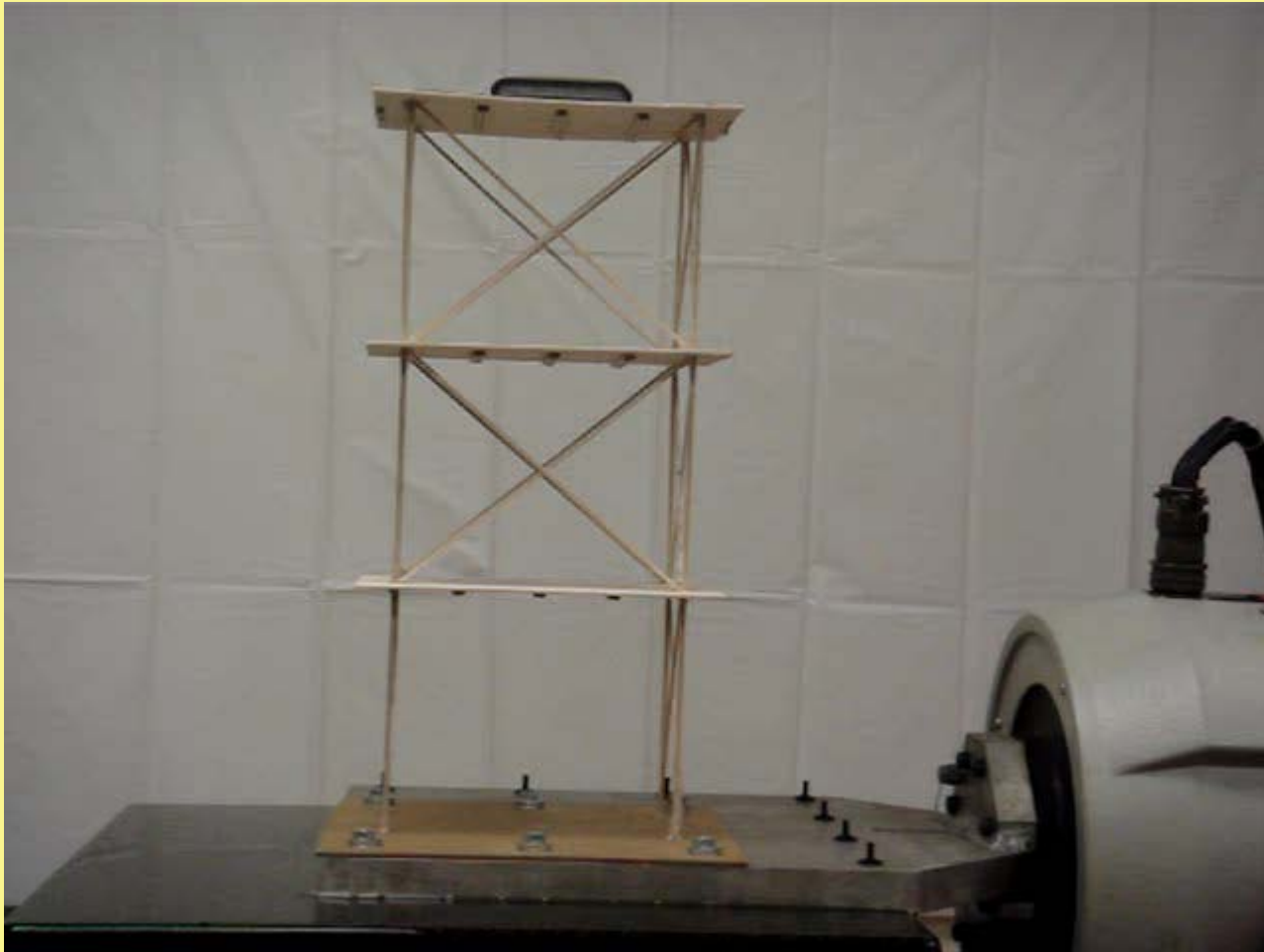


Vibrate from weak direction
BROKE

Model 2

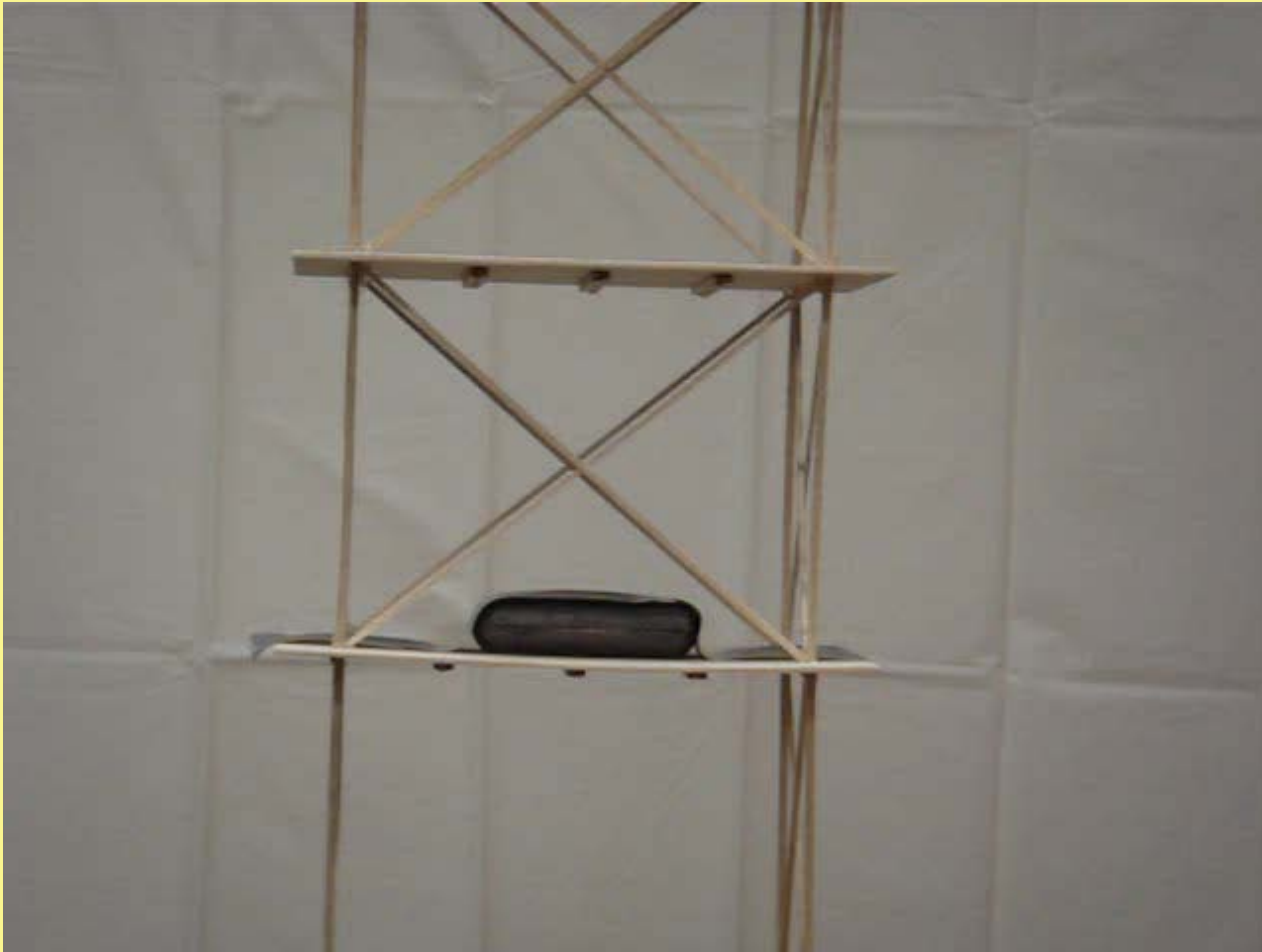


Vibrate from strong direction
13 Hz, 2.25 G → 12 Hz, 2.25 G



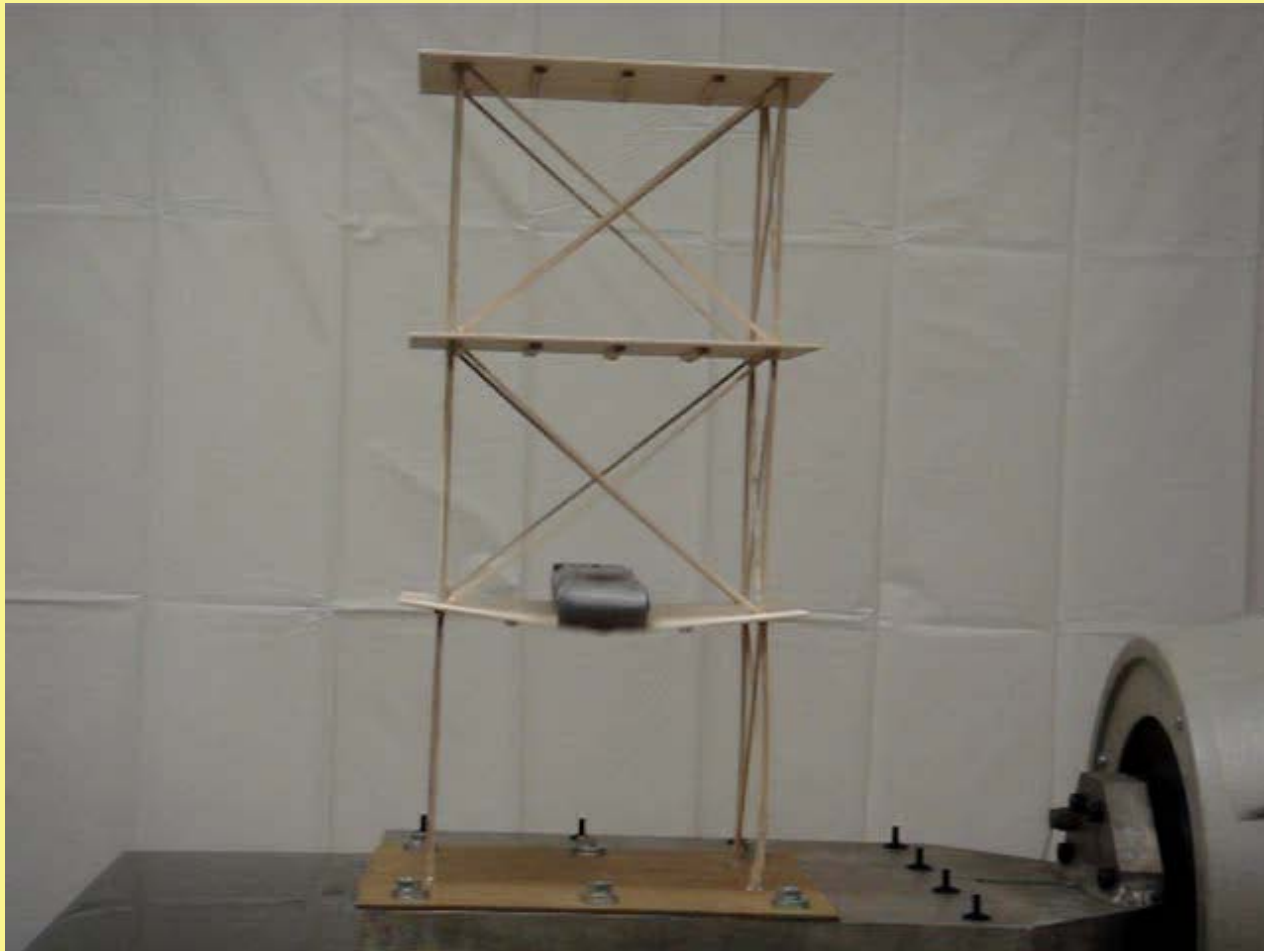
2 lb. weight on the top floor
Vibrate from strong direction
12 Hz, 2.25 G

Model 2



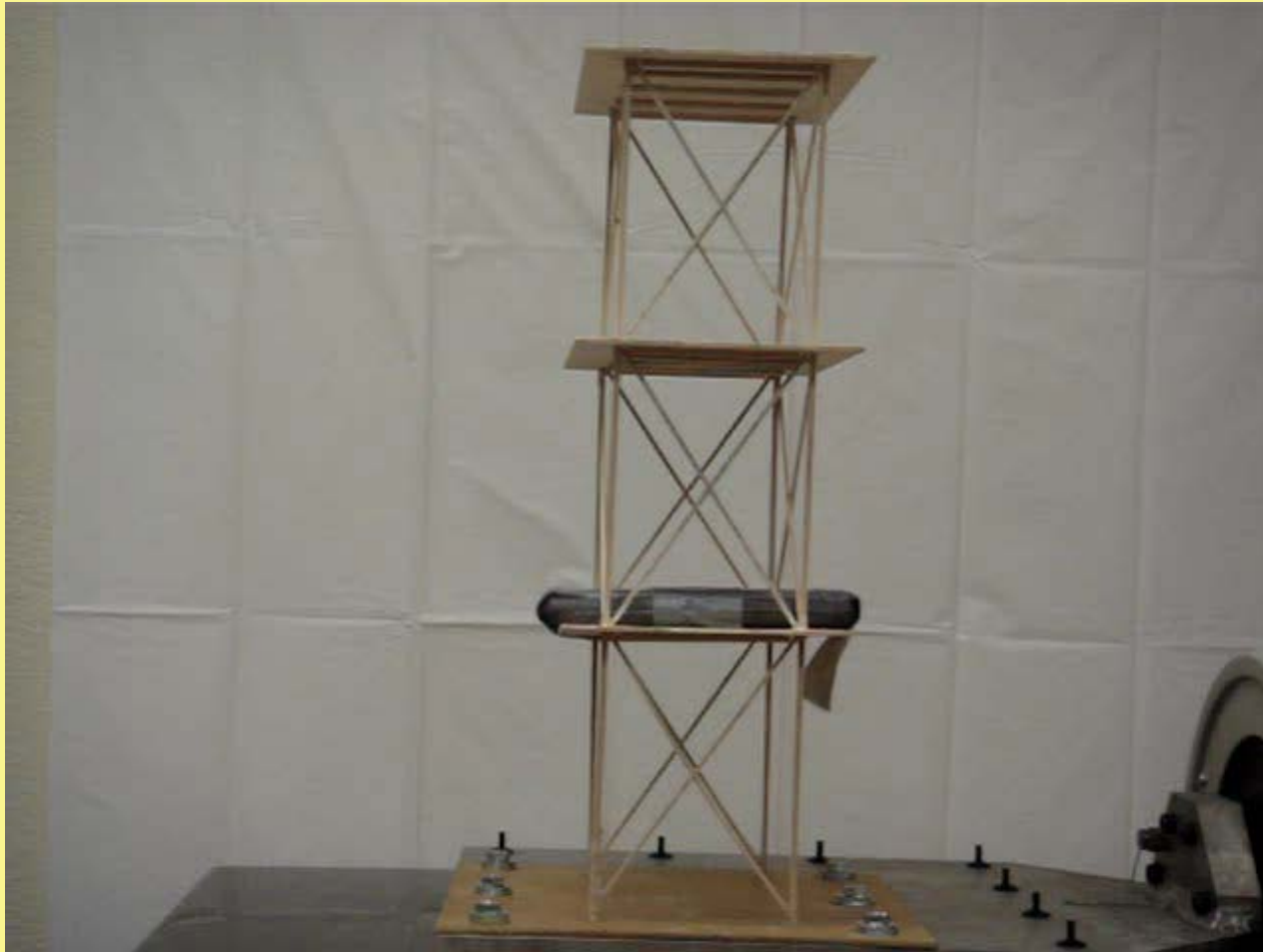
2 lb. weight on the 1st floor
Vibrate from strong direction
7.5 Hz, 1.0 G

Model 2



4 lb. weight on the 1st floor
Vibrate from strong direction
8 Hz, 2.25 G → 8 Hz, 2.5 G

Model 2

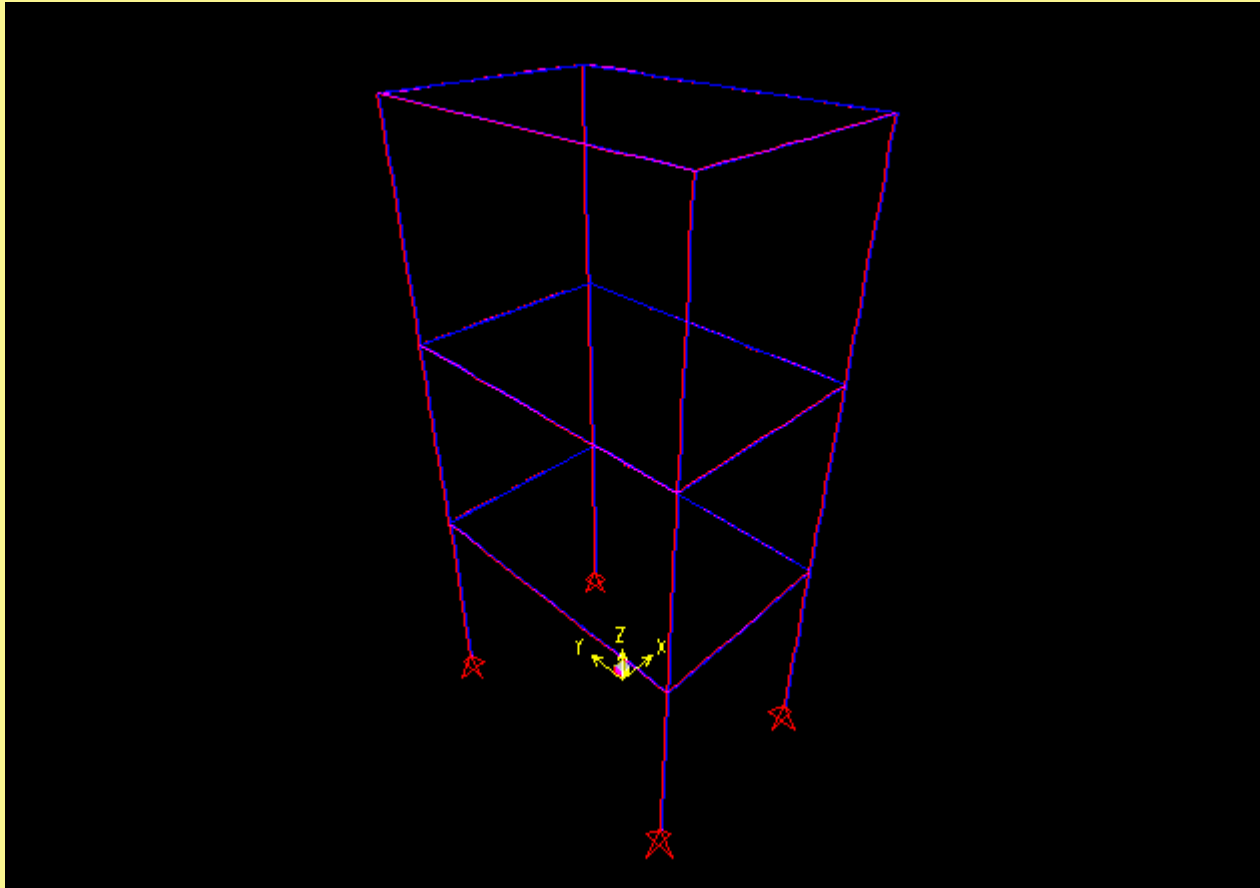


4 lb. weight on the 1st floor

Vibrate from weak direction

10 Hz, 0.5 G → 8 Hz, 1.0 G → 8 Hz, 1.5 G → something broke

SAP2000 Animations



Mode Shapes

Thank You