

## Homework #1

### LAB #1: SIMILITUDE AND MODELING

Having two three-story models and measuring the frequencies of the models; make the necessary adjustments (length, or weight) to obtain:

- (a) Scaling of all frequencies for the first three modes in ratio to the geometric scale. ( $\lambda_f = \lambda_1^{-1}$ )  
where  $\lambda = \text{prototype property/model property}$ .
- (b) Scaling all frequencies for the first three modes identical in prototype and model.

Measure the period of the structure (the fundamental period only) for each case

#### **Required:**

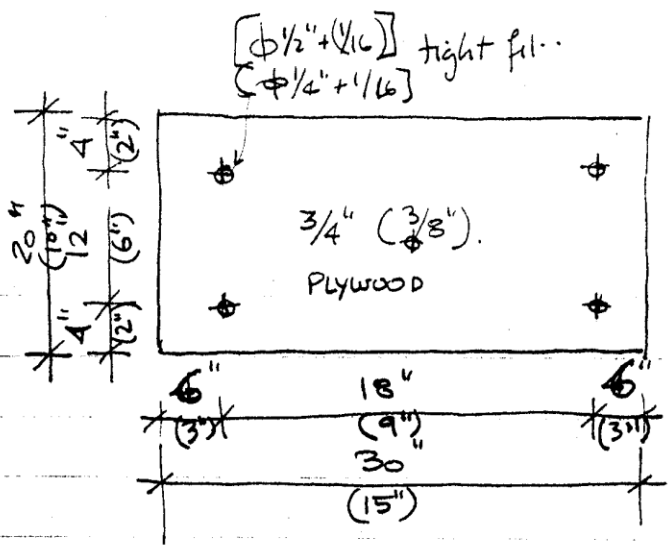
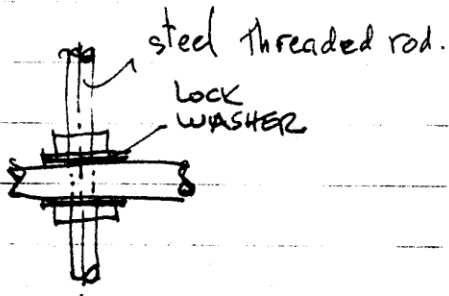
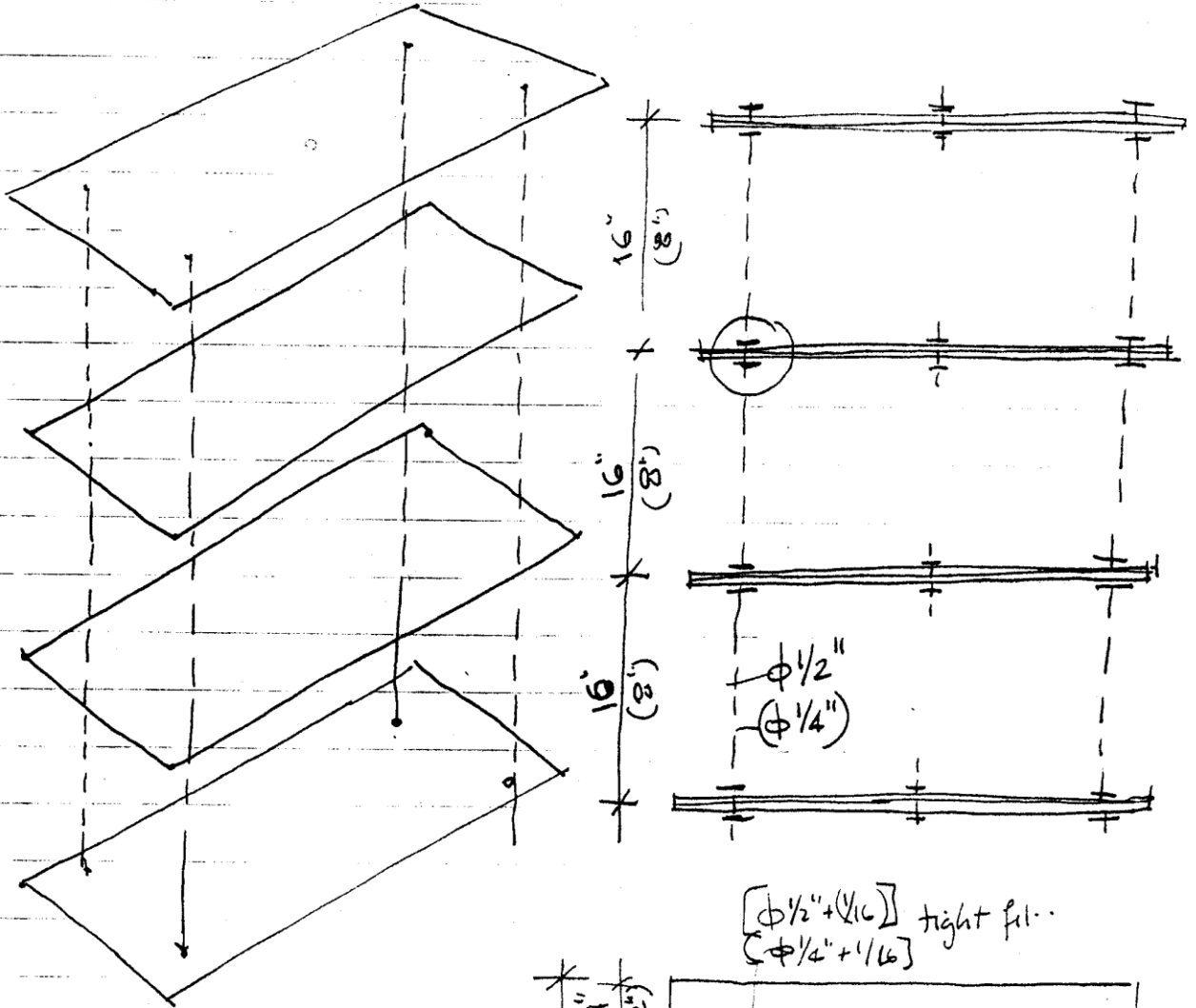
- (1) Measure the geometry and make necessary adjustments to have geometric similitude. Measure all quantities, which contribute to scaling.
  - (2) Measure the frequencies of each model using a frequency analyzer.
  - (3) Add weights until the scaling requirements are fulfilled for (a) and for (b).
  - (4) Measure for each the time/period of first mode.
  - (5) Calculate using similitude rules the required tributary mass for all cases.
  - (6) Prepare a report, which presents the experiment, estimated conditions, observed conditions and suggested reasons for differences.
- (Note: You may return to the lab and repeat the experiment, if necessary.)
- (7) Solve the problem in the last page and report the solution (report also all assumptions, etc.).

**Lab Report due Date and Time [two weeks after the lab date](#)**

**Work should be done in groups of three students**

**Report should include all the information required in the outline presented in the first class (see attached):**

Lab #1 : Similitude and frequency analysis and testing.



Prototype dimensions w/o parentheses.  
 Model dimensions in parentheses.

## ***LAB REPORT ORGANIZATION\_***

1. Summary (executive summary)
  - + Information about authors, sponsor, and other participants
2. Scope and general presentation
  - 2.1. Purpose and objectives of testing - general
  - 2.2. Prototype description
  - 2.3. Scope of testing
  - 2.4. Prototype design information – size etc where applicable
  - 2.5. Scaling and model development – similitude information
  - 2.6. Materials and constraints
3. Test-set-up overview
  - 3.1. Specimen / model description – including materials and component properties
  - 3.2. Loading system – description
  - 3.3. Instrumentation set-up and measurement system + calibration procedures
  - 3.4. Data acquisition + schematic information data flow
  - 3.5. Data archiving – structure, model, metadata, curation, transfer
4. Test procedures
  - 4.1. Test schedule & repetitions
  - 4.2. Data monitoring & checking during testing
  - 4.3. Test implementation – notes & metadata
5. Test Results – raw data
  - 5.1. Data recording and repository inventory
  - 5.2. Data verification & repository transfer
  - 5.3. Initial test results
6. Data processing
  - 6.1. Data checking, verification & recovery
  - 6.2. Determination of errors & elimination of errors
  - 6.3. Identifications of structural parameters and important properties
  - 6.4. Correction of test results through data processing – procedures
7. Analytical predictions (before modifying analytical models)
  - 7.1. Calculated model parameters using principles of engineering
  - 7.2. Calculated response using simplified or sophisticated model
  - 7.3. Calculated response using identified parameters
  - 7.4. Comparison of response of experiment analysis with estimated and with measured parameters
8. Discussions and recommendations
  - 8.1. Discussion of information as obtained from tests
  - 8.2. Recommendation to reduce gap between computed and tested

*The headings and subheadings may be further subdivided as needed by specific projects*

### HOMEWORK PROBLEM #1

A tall TV tower (400 meters), weighing 250,000 mtons, made of concrete materials, has to be tested on one of the shaking table at SEESL.

Several limitations apply:

- (a) The height above the table is less than 10.00 m.
- (b) The shaking table can support less than 50 mtons.

The suggested material for the model is Plexiglas ( $E = 3.1\text{GPa}$  ( $4.5 \times 10^5$  psi);  $f_u = 69$  MPa (10ksi);  $\rho = 1.2$  t/m<sup>3</sup>). Determine the scale parameters ( $\lambda$ ) for all properties and quantities, including mass simulation, if necessary. You may make assumptions for the basic scales.

**Homework problem and report due [two weeks after](#) the lab date**

**You must submit an [electronic version \(pdf\)](#) and a printed copy by email.**

**Mark names (participants only) and group #**