

## ***Lecture 4 – Design of Experimental Study***

### Introduction:

#### **Testing types**

- Qualification Studies – i.e. production damper
- Exploration studies – i.e new damper, new brace, ...

#### **Qualification Studies**

- Use predetermined protocol – test arrangement, loading, etc)
- Use predetermined monitoring requests
- Error analysis and quality control are a must

#### **Exploration Studies**

- Use best practice protocols
- Modeling and interpretation free for choice of researcher.
- Data processing focused on results recovery

## Report Organization = Planning Base

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

### **Planning an experimental study:**

2. Define scope and general presentation
3. Develop test-set-up (incl. analytical predictions)
4. Establish test procedures – protocols and expected information
5. Define and store test data – raw data
6. Process data for quality control
7. Develop analytical evaluations (before modifying analytical models)
8. Compare data tested with estimated and make recommendations

### **Planning an experimental study (in detail):**

#### **2. Scope and general presentation**

- 2.1. Define purpose and objectives of testing – general
- 2.2. Determine the prototype
- 2.3. Define the desired 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

#### **Example:**

**Test-set-up overview**

- 2.7. Design and Describe Specimen
  - 2.7.1. determine model geometry
  - 2.7.2. determine boundary conditions (UIUC)
  - 2.7.3. chose and determine materials
  - 2.7.4. determine properties of components (may be main job)
  - 2.7.5. perform initial analysis to check strength
- 2.8. Determine loading system –
  - 2.8.1. equipment type
  - 2.8.2. size of equipment - based on 3.1.5
  - 2.8.3. develop supports and fail safe system
- 2.9. Plan instrumentation set-up and measurement system
  - 2.9.1. Plan instrumentation in a drawing with all locations specified
  - 2.9.2. Select instruments for work in hand
  - 2.9.3. Check ranges of instruments with estimates – 3.1.5
  - 2.9.4. Choose and plan calibration procedures
  - 2.9.5. Connect instruments and
  - 2.9.6. Prepare connections scheme
- 2.10. Data acquisition + schematic information data flow
  - 2.10.1. Determine type, capacity and parameters (speed, accuracy)
  - 2.10.2. Prepare flow diagram and tables
  - 2.10.3. Check capture and recording
  - 2.10.4. Plan data storage and compaction.
- 2.11. Data archiving – structure, model, metadata, curation, transfer

**Example:****3. Test procedures**

- 3.1. Define test protocol (standard protocols available)
- 3.2. Define test schedule & repetitions
- 3.3. Design and develop data monitoring plan & checking during testing
- 3.4. Prepare plan and roles of test attendees
- 3.5. Plan test implementation – notes & metadata

**Example:**

**4. Test Results – raw data**

- 4.1. Data recording and repository inventory
- 4.2. Data verification & repository transfer
- 4.3. Initial test results

**Example:****5. Processing data**

- 5.1. Plan Data checking, verification & recovery
- 5.2. Plan Determination of errors & elimination of errors
- 5.3. Plan extraction of information: Identifications of structural parameters and important properties
- 5.4. Correction of test results through data processing – procedures

**Example:****6. Analytical predictions (before modifying analytical models)**

- 6.1. Plan model for calculation of model parameters using principles of engineering
- 6.2. Calculate response using simplified or sophisticated model
- 6.3. Calculate response using identified parameters
- 6.4. Comparison of response of experiment analysis with estimated and with measured parameters

Semester project:

- 1) Zipper frames
- 2) Base isolated structure
- 3) Electrical bushing