

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