



Procedures for Data Sharing and Archiving in the NEES Project Warehouse

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Change History

Description and Version	Created / Updated By	Date of Change
Original Document		
Format edited to NEES Standards	Rajesh Thyagarajan	02/03/2010
Added information on data upload and resources	Stanislav Pejša	04/27/2011
Updated the Detailed NEES Project Directory Structure	Rajesh Thyagarajan	06/06/2011

1.0 Introduction

Data archiving is critical to the vision and success of NEES. The Project Warehouse found on the NEEShub (<http://nees.org>) is the repository for experimental, computational, and simulation data resulting from earthquake engineering projects funded through NEESR, NEES Shared-Use, or other agencies. This document outlines the important information related to the archiving of data via the NEEShub, and complements the information provided in the *NEES Data Sharing and Archiving Policies* and the *Equipment Site Utilization Form (ESUF)*. These documents can be found at <http://nees.org/about/policies>.

The procedures outlined here pertain to both experimental and simulation components of NEESR research. However, the procedures currently do not fully support Hybrid experiments. Hybrid experiments will be supported in the near future.

Users who need support in uploading data to the Project Warehouse should contact Standa Pejša (spejsa@purdue.edu), the NEEScomm Data Curator.

2.0 Preliminaries

2.1 Definitions

- *Project Warehouse*: The data repository found on the NEEShub
- *Project Display*: The visual display of projects within the Project Warehouse
- *Project Editor*: A tool on the NEEShub that is used to create and edit projects in the Project Warehouse
- *Data Model*: The organizational structure for storing data and relevant documentation in the Project Warehouse
- *Project Explorer for NEES (PEN)*: A tool on the NEEShub that allows for bulk upload of files into a project already existing in the Project Warehouse
- *Researcher*: A person engaged in NEES supported research

2.2 Data Categories

Based on the NSF NEES grant solicitation these categories are considered data that are required to be archived in the NEES Project Warehouse:

- Sensor measurements
- Sensor calibrations
- Observations
- Analyses
- Numerical Simulations

- Images and videos
- Commentary
- Reports (including publications and presentations)
- Logs
- Notes and electronic notebook entries

The data model provides metadata fields to collect the above information or provides appropriate folders for files that describe the required information.

3.0 Data Organization

3.1 Data Model

A data model describes the organizational structure of data for data management. The Project Warehouse incorporates two data models: one for storage (*Internal Data Model*) and one for interfacing with users (*User Data Model*). These data models are related, but not exactly the same. For example the User Data Model may allow the entered information to be in a flexible format, while the Internal Data Model chooses a canonical representation. Also, the internal data model makes room for future presentations of information (e.g., new experiment types) that may not currently be supported in the user interface. NEEShub users will interface with the User Data Model.

The NEES User Data Model is based on the hierarchy described below.

3.1.1 Project

- The Project represents the overall research project, which includes one or more experiments and/or numerical simulations. Research projects that include multiple experiments at one or more sites should be organized under a single Project. Each associated experiment should be placed within the Project.

3.1.2 Experiment

- An experiment represents a physical test of a specimen or a computational simulation performed.
- A physical experiment includes only one basic set up, but multiple trials may be imposed on the physical test.
- A simulation represents a numerical simulation, or set of numerical simulations, of an earthquake engineering problem.

3.1.3 Trial

- A trial is associated with an experiment or a simulation. Multiple trials may be applied to the same experimental or simulation set up.
- For a physical experiment, a trial represents the loading of the experiment. The results from a test correspond to a specific trial.
- For a simulation, a trial represents a run of the simulation. The input and output from a simulation correspond to a specific trial.

3.1.4 Repetition

- A repetition is associated with a trial and represents the application of the same trial *without any change* to the test set up or trial parameters.



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- Repetitions are used to collect data under the same conditions such that they can be averaged to improve data quality.
- If a trial is only applied once, only one repetition is necessary.

3.1.5 Metadata

Each hierarchical level (project, experiment, trial, repetition) has associated descriptive and contextual information (e.g., specimen drawings, documentary images, material properties), also referred to as metadata. The User Data Model defines the meaning, format, and sometimes even the values of the metadata. Metadata enable researchers to search and effectively retrieve desired data, and they document the provenance (i.e. origin) and context of data creation and processing. Thus, metadata provide researchers with the details and context necessary to understand a given project or experiment. Details of the metadata fields incorporated in the User Data Model are described in **Appendix A**.

3.2 Project Display and Project Editor

The Project Editor is an easy to use tool that does not require any installation of software. Users can access the project through the following link: <https://nees.org/warehouse/projecteditor/project/NNN>.

The instructions for using the Project Editor can be found in the Quick Start Guide which is available at https://nees.org/components/com_projecteditor/downloads/ProjectEditorQuickStartGuide.pdf

The Project Display within the Project Warehouse is the visual, navigable presentation of a Project (i.e., its experiments, data, and metadata). Projects and their associated Experiments, Trials, and Repetitions are created and edited via the Project Editor. Both the Project Editor and Project Display present project information in terms of the User Data Model (See Appendix A), which includes specific metadata fields. The Project Editor prompts the user for all components of the User Data Model.

3.3 Project Explorer for NEES (PEN)

Most of the important metadata and associated project files (e.g., drawings, data files) are input via the Project Editor. However, bulk upload of data files is best performed using the Project Explorer for NEES (PEN).

PEN is a powerful cross-platform tool for uploading and downloading data files to the NEES Data Repository. Its primary purpose is to organize files and directories for upload and download with the NEES Project Warehouse while a project is in active development. It enables easy synchronization between the files on the local machine and in the repository. PEN can be executed on NEEShub or can be downloaded to the user's local machine. PEN can be also used for transfer of data from user's home directory on the NEEShub server to the appropriate project in the repository. PEN is developed and maintained by the NEEScomm IT. Documentation and instruction are located at <http://nees.org/resources/pen>.

Uploading data files via PEN requires an understanding of the underlying directory structure within a Project. The directory structure (originally developed by NEESit) is shown in Figure 1. Analysis and Documentation folders are present at the Project, Experiment, and Trial levels. The **Analysis** folder at each hierarchical level is for results from analysis specific to that level. The **Documentation** folder is for files that provide documentation of each hierarchical level. The **Documentation** folder also contains sub-folders named Photos, Videos, and Drawings.

The Repetition level contains folders for data files. These folders are **Unprocessed Data, Converted Data, Corrected Data, and Derived Data**. The definitions of these types of data are provided in the next section.

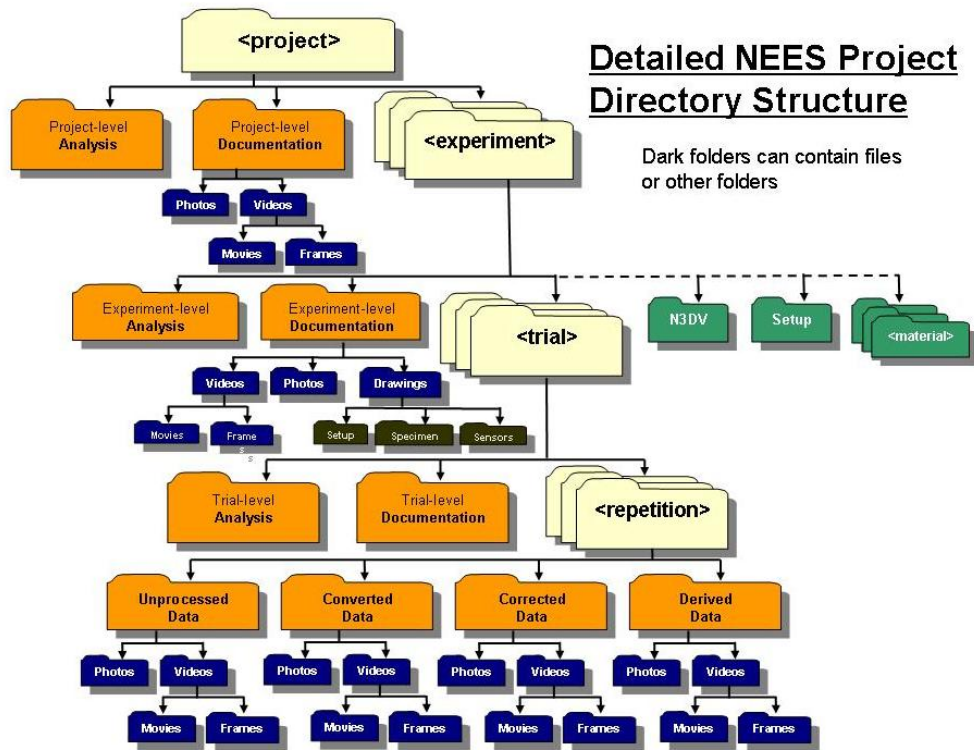


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Researchers may create sub-folders within any of the Analysis, Documentation, and Data folders shown in Figure 1, but they are discouraged from doing so.

Metadata about files can be included when they are uploaded with PEN or be input via the Project Editor after the files have been uploaded.

Figure 1: Detailed NEES Project Directory Structure



4.0 Data Requirements

The sections below document the minimum requirements for sharing and archiving of research data.

4.1 Experiment Documentation

Collected data cannot be re-used without proper documentation of the experimental setup. The experimental setup is described in the metadata fields associated with each experiment, as input through the Project Editor, and this information is summarized and further expanded in a narrative summary provided in the Experimental Setup Report.

Metadata Fields: Documentation for an experiment includes populating the relevant User Data Model metadata fields (see Appendix A), as displayed in the Project Editor and Project Display.

The experimental setup metadata fields must be uploaded to the Project Warehouse within 6-months of completion of the experiment.

Responsibility: Researcher

Experimental Setup Report: The experimental setup report is a written report that includes descriptions of the geometry of the test specimen, the material properties, the sensor locations, boundary conditions, the loading

scheme, etc. in narrative form. It represents an updated and expanded version of the Equipment Site Utilization Form (ESUF) that was submitted to the equipment site before the experiment took place. The Experimental Setup Report should be placed in the **Documentation** folder under the associated Experiment.

The Experiment Setup Report must be uploaded to the Project Warehouse within 6-months of completion of the experiment.

Responsibility: Researcher

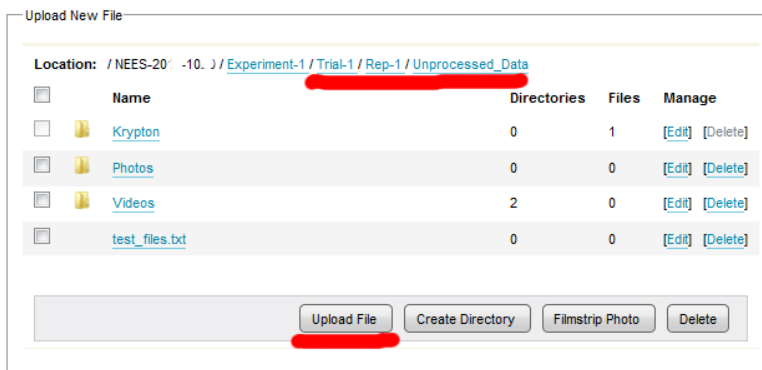
4.2 Sensor Measurement Data

Sensor measurement data are described in the User Data Model at the repetition level. Sensor measurement data also includes video or photographs that will be used to derive some measurement quantity (e.g., displacement). Video or photos that simply document the experiment should be placed in the **Documentation** folder at the Experiment level. There are four types of sensor data: Unprocessed, Converted, Corrected, and Derived. The data types do not carry any qualitative judgment, it is expected that all data uploaded to the repository are of high quality.

In addition to the sensor data, the researcher should also provide the calibration values used to process the data, the configuration files for the data acquisition (DA) system, any other file required to understand the DA process, as well as a description of the hardware and software used in the data collection process. A data log may also be included. This information can be provided in a .pdf file and should be placed in the **Documentation** folder under the **Experiment** level or the highest level appropriate (i.e., **Project, Experiment, or Trial** or).

Data need to be uploaded under the appropriate trial and repetition into **Experiment-N/Trial-N/Rep-N/Unprocessed_Data**. Even if there is only data file in the whole experiment, the path needs to be **Experiment-N/Trial-1/Rep-1/Typeofdata_Data**.

Data files taken from the data acquisition systems are typically uploaded directly under the Unprocessed_Data folder, but if applicable they can also be stored in subdirectories in order to separate them from the other data files, as it is often the case with data from the data collected from the Krypton system.



The four data types are defined below.

Unprocessed Data: Unprocessed Data are data as they come out of the data acquisition (DA) system. These data may be stored in volts, the applicable electrical unit, or engineering units.



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Some project videos or still images are also considered data. There are two possible locations where images can be uploaded.

If a **series of frames** are taken by a camera and they need to be viewed in sequence in order to provide valuable information (for example, how a specimen deforms over time), then that series of frames should be stored together under ***Unprocessed_Data/Videos/Frames***. The images should be in sequence, if possible with time-stamp, so that they can be synchronized with the corresponding data. These frame images can be uploaded either tarred or zipped. A nightly job should untar and unzip these images on the server, so that they are available to the viewer in their original uncompressed format.

If a frame is taken from video, and can be viewed by itself to provide valuable information, it should be stored under Photos in the folder ***Unprocessed_data/Photos***.

The video files taken during tests that are considered data should be uploaded to the directory ***Unprocessed_data/Videos/Movies***.

Time Line: Unprocessed data must be provided to the researcher by the NEES Equipment Site within 24-hours of completion of the experiment. In some situations where it is not possible for the site to meet this schedule, this deadline can be extended with agreement of the researcher to three working days

Unprocessed data must be uploaded to the Project Warehouse within 1-month of completion of the experiment. For field experiments, unprocessed data must be uploaded within 1-month of return from the field.

If a NEES equipment site wants to use Project Warehouse to fulfill its responsibility for off-site backup, the unprocessed data must be uploaded to the Project Warehouse within 24-hours of capture and save.

***Responsibility: NEES Equipment Site (for experiments at NEES facilities)
Researchers (for experiments at non-NEES facilities)***

Converted Data: Converted Data are data in tab-delimited or comma-separated ASCII¹ format, converted from volts to engineering units and without zero offsets (if applicable). Each column within the file should provide a sensor label and the units of measure. If the DA outputs data meeting this description, the Converted Data folder can be left empty and the files placed only in the Unprocessed Data folder. For video/photo data, converted data are files in which the format has been changed.

Time Line: Converted data must be uploaded to the Project Warehouse within 6-months of completion of the experiment.

Responsibility: Researcher

Corrected data: Corrected Data are data in tab-delimited or comma-separated ASCII¹ format in engineering units (each column within the file should provide a sensor label and the units of measure) and may be corrected to exclude:

- noise
- data from sensors that malfunction during the test
- data acquired from long pauses

¹ ASCII format is preferable. Tools in the Hub have been programmed to work with ASCII format. Other formats may be accepted but may not be supported by Hub tools.



- errors due to the use of incorrect calibration constants

Video/photo data may be corrected by:

- correcting for lens distortion
- modifying brightness
- adding a title

The corrections applied to the data must be documented in a PDF file placed in the Corrected Data folder.

Time Line: Corrected data, along with documentation of the corrections performed, must be uploaded to the Project Warehouse within 6-months of completion of the experiment.

Responsibility: Researcher

Derived Data: Derived Data are files that include the corrected data plus columns of data that are functions of existing columns. This data may be re-sampled if appropriate. Each column within the file should provide a sensor label and the units of measure. Derived data typically represents the data most appropriate for re-use. The procedures used to compute the derived data must be documented in enough detail such that another researcher could re-create the derived data. The data analysis procedures should be documented in a PDF file placed in the Derived Data folder.

Time Line: Derived data, along with documentation of the data processing/analysis performed, must be uploaded to the Project Warehouse within 6-months of completion of the experiment.

Responsibility: Researcher

4.3 File Formats

Currently the Project Warehouse accepts most available data and file formats (with certain exceptions), but the recommended file formats are given below. Researchers are also advised to avoid proprietary and uncommon formats.

Type of data	Recommended formats
Sensor measurements (data)	Comma separated values (.csv) or tab-delimited (txt)
Images	png, jpg NOTE: BMP files can be uploaded, but currently they cannot be displayed
Frame captures	zip, tar, and tar.gz
Videos	Currently there are no restrictions; NOTE: avoid formats that require a specific codec, e.g. asf

4.4 Data Formats

Each column should correspond to a sensor or a physical quantity, with the first column referring to time. The first row shall include sensor labels (ideally, matching those used in sensor maps and sensor lists) and the second row shall include units.

Channel	LVD001	LOA001	LVD002	LOA002
Measurement_Type	displacement	force	displacement	force
Sensor_Unit	mm	kN	mm	kN
Sensor_Time				
0	-0.20239	-1.1565	0.20158	2.9917
0	-0.50597	-2.5798	0.050396	5.8954

4.5 Data Visualization

Visualization of data within the Project Warehouse significantly improved the usefulness of the data. Currently, the data viewer inDEED (<http://nees.org/topics/inDEED>) is the only visualization tool that allows for viewing of data without download, which greatly improves data accessibility to users searching the Project Warehouse for data relevant to their research. Thus, the presence of an inDEED file enhances the project. Enhanced projects are listed separately within the Project Warehouse (in addition to their inclusion in the searchable section of the Project Warehouse). An experiment is considered enhanced if it includes at least one visualization file of the data. Researchers are encouraged to enhance their projects.

4.6 Time Table for Uploading Experiment Documentation and Data

An experiment is considered complete and ready for curation when it is fully documented and the acquired data have been uploaded to the Project Warehouse. For an experiment to be fully documented the metadata fields in the Project Editor must be populated and an Experimental Setup Report must be uploaded. The required data for upload is Unprocessed, Converted, Corrected, and Derived Data.

The time table for submission of experiment documentation and data is summarized in Table 1. The table also specifies the parties responsible for uploading each type of data. Note that for experiments performed at NEES Sites, the Researcher is responsible for uploading most of the documentation and data, except for the Unprocessed Data. For experiments performed at non-NEES sites, the Researcher is also responsible for uploading Unprocessed Data.

Table 1: Time Table for Uploading Experimental Documentation and Data

Documentation	Responsible Party	Deadline
Experimental Setup Report	Researcher	6-months after completion of experiment
User Data Model fields	Researcher	6-months after completion of experiment
Data	Responsible Party	Deadline
Unprocessed Data	NEES Equipment Site Researcher*	1-week after data capture and save
Converted Data	Researcher	6-months after completion of experiment
Corrected Data	Researcher	6-months after completion of experiment
Derived Data	Researcher	6-months after completion of experiment

* For experiments performed at non-NEES sites, the Researcher is responsible for uploading Unprocessed Data

4.7 Data management Tips

Large files (over 600MB)

If large files need to be broken up into smaller files, so that they can be more easily uploaded, then they should have the same filename to which should be added a hyphen following by leading zero and digit rather than letter.

Example: 20110328-ch004_2Hz_020g-001.txt
 20110328-ch004_2Hz_020g-002.txt

Filenames

- Avoid special characters in filenames and directories
 Examples: |,;!@%#\$()<>\/\''~{}[]+=&^*?
- Use file extensions consistently – do not mix JPG and jpg (lower case is preferred)
- Do not start filenames with a period "."
- Avoid whitespace in filenames and directories; use underscore (_) or hyphen (-) instead



5.0 Intellectual Property

The framework for intellectual property for resources stored in NEES repository is driven by two policies. One of them is the [NEES Site User Agreement](#). This document basically states that all findings and inventions based on NEES research are the intellectual property of the researcher. However, NEES claims the rights to data collected during NEES research. The schedule of data collection is detailed in the Data Sharing and Archival Policy Guidelines.

The other policy is the "[Intellectual Property Considerations](#)". According to this policy NEES endorses the Creative Commons licenses, and users are encouraged to adopt them for their online presentations, teaching materials, animations, and other materials.

Finally, all data made public in the NEEShub are made public under the Open Data Commons Attribution License.

6.0 Other Resources

- [NEES Wiki](#), especially chapters *NEES Curation and Data Documentation*
- [NEEScomm Data Sharing and Archiving Procedures](#)
- [Project Editor - Quick Start Guide](#)
- [Documentation and instruction for PEN](#)



APPENDIX A - USER DATA MODEL (v. 1.0.3)

Table 1: Project-Level Data and Metadata for Physical Experiments

Mark	Project Level	Format	Notes
1A	Title	Text	Title from NSF (or other funding agency).
1B	Short Title	Text	Title for short descriptions
1C	Principal Investigator(s)	Text	List of the project PI/Co-PIs. Order is significant.
1D	Team Members	Text	List of Project personnel and NEEShub roles
1E	Sponsor and Award Number	Text	Name of award agency or agencies and award number(s).
1F	Start and End Dates	Date	Start and end date of the project.
1G	Project Description	Text	Brief description of the project. Similar to an NSF abstract (limited to 300 words).
1H	Executive Summary	PDF document	Focused summary of the project results and impact. Should be written after significant results are available, include key figures and plots, and directed toward practitioners and researchers looking for specific data. Max. 2 pages.
1I	Research Organizations	Text	PI/Co-PI Institutions. (Testing facilities are entered under Experiments)
1J	Keywords	Text	Keywords similar to those used (or to be used) in journal publications to describe the entire project.
1K	Project Photographs	File ^a	Key project photograph and caption (selected from project photo library)
1L		File folder with one level of subfolders	Other project photos. Can use subfolders to organize photos and photo sequences ¹ .
1M	Publications	List of citation (Text, Endnote, Bibtext) plus PDF file where available	All publications resulting from the project (journal articles, technical reports, dissertations, master's theses, etc.).
1N	Documentation	File folder with subfolders ^a	Contains manuals, NSF reports, interim reports, lab notes, interim papers, presentations
1O	Analysis	File folder with subfolders	Results from project-level statistical analyses and numerical simulations (input files, documentation, drawings, etc.)
1P	Web Links	URL and Short Title	Links to any relevant websites, for example a project website.
1Q	NEES Status	(NEES, non-NEES)	Project funded by NEES or external.
1R	Access Settings	(public/protected/private)	Initially private. Will become public automatically after a time set by the Data Sharing Policy.
1S	Curation Status	One of several curation states	Set by Curator

Table 2: Specimen/Experiment-Level Data and Metadata for Physical Experiments

Mark	Experiment Level	Format	Notes
2A	Experiment Title	Text	Experiment title or specimen ID (limited to 50 characters). (Experiment is one setup with one loading)
2B	Type of test	Select from a menu	(Centrifuge, shaketable, field, large scale, ...)
2C	Experiment Description	Text	1-paragraph description of the experiment
2D	Testing Facilities	Text	Usually one facility. Can be multiple.
2E	Equipment ^b	Selection from a list of equipment available in testing facility	List of main equipment used in tests (i.e. centrifuge, actuators, multi-axial sub-assembly testing (MAST) system, shake table, Thumper, uni-axial mobile shaker, etc.).
2F	Start and End Date	Date	Start and end date of the experiment.
2G	Specimen(s) ^b	Text	Brief description of the specimen(s) (limited to 150 words).
2H		Form or Table (with text entries)	Specimen(s) type(s) (column, beam, wall, slab, joint, 2D frame, 2D dual system, 3D frame, 3D dual system, other;) and material (s) (steel, wood, soil, reinforced concrete, composite, water, fluid, other)
2I	Experiment Photographs	File ^a	Key experiment photograph.
2J		File(s)	Best photos to describe overall experiment (filmstrip – no subfolders)
2K	Drawings ^d	File/String	3D model of the test. (optional)
2L		File/String	Detailed drawings of the specimen. Indicate in drawings N-S, Up-Down directions. If applicable, show coordinate system.
2M		File/String	Detailed drawings of the setup (this field shall provide the option to refer to the same setup used in another specimen/experiment). If applicable, show coordinate system.
2N		File/String	Detailed drawings showing locations of sensors and cameras. All sensors are to be labeled with the IDs used in 2D. If applicable, show coordinate system.
2O	Sensors ^e	Form or Table (with text entries)	List of sensors and cameras used in the experiment. Fields: ID (from 2D), units, orientation (azimuth or up-down), xyz coordinates (optional), label of drawing or 3D model showing location of sensor, calibration factor, units of cal. factor, zero offset, units of zero offset.
2P	Keywords	Text	Keywords similar to those used (or to be used) in journal publications to describe the experiment.
2Q	Documentation	File folder with subfolders ^a	Contains manuals, NSF reports, interim reports, lab notes, interim papers, and presentations specific to the experiment.
2A	Analysis	File folder with subfolders ^a	Results from experiment-level statistical analyses and numerical simulations (input files, documentation, drawings, etc.)
2R	Access Settings	(public,protected,private),	Initially private. Will become public automatically after a time set by the Data Sharing Policy.
2S	Curation status	One of several curation states	Set by curator

Table 3: Trial-Level Data/Metadata for Physical Experiments

Mark	Trial Level	Format	Notes
3A	Trial Title	Text	Trial title (limited to 50 characters). A trial refers to the test of a specimen. Because the same specimen may be subjected to different tests, several trials may be associated with a specimen.
3B	Start/end dates	Date	
3C	Trial Objective	Text	Describe the purpose of this trial
3D	Trial Description	Text	Brief description of the trial (limited to 150 words), including loading protocol
3E	Repetitions	Rep-1 through n, Start/End dates	Repetition of the same trial. Sensor data, photos, and videos are associated with a Repetition.
3F	Data	File/String	Unprocessed data
			Converted data
3G		File/String	Corrected data
			Derived data
3H	Links to tools for analysis or visualization	Tool-specific	Reference information allowing tools to display data (e.g., inDEED file/reference)
3I	Damage Maps ^b (not yet supported)	File/String	Drawings showing crack/damage maps. Each map shall have a time stamp (optional if adequate photographs are available).
3J	Trial Photographs ^h	File(s)	Best photos to describe overall trial (filmstrip – no subfolders)
3J		File folder with one level of subfolders	General trial photos
3K	Video ⁱ	File folder with subfolders	Video clips specific to this trial and repetition

Notes:

a – All files (sensor data, photos, videos, etc.) and (sub) folders have a title and description. Where the folder title and description is informative enough, the contained files may not need to have separate titles/descriptions. (e.g., photo sequences)

b – Each NEES facility will have a corresponding equipment list that details all of the equipment available at that lab. Users will select their equipment from these predefined lists. Fields for each piece of equipment will include the Item Name, ID, and, Output Units. Additional (optional) fields may include Manufacturer, Model, Calibration Constant, Accuracy, and Date of Calibration. The option to input unique pieces of equipment that are not already listed will also be available.

Suggested naming format for sensors:

Accelerometer	ACC000
Piezoelectric Sensor	PIE000
Camera (Still Image)	CAS000
Camera (Video)	CAV000
Electrical Strain Gage	ESG000
Inclinometer	INC000
Linear Variable Differential Transformer	LVD000
Load Cell	LOA000
Pressure Gage	PRE000
Potentiometer	POT000
Standard Penetration Test Equipment	SPT000
Wave Gage	WAV000
Other Transducers	TRA000

c – Right now, the specimen description will be set up to collect a general description (2C), specimen type (2D), and a brief description of the specimen material (2E). Eventually a table or form will be created for each type of

specimen and the user will be given the option to provide dimensions, properties, or key measurements. For instance, for reinforced concrete columns the user will be given the option to provide the following quantities:

- concrete strength
- axial load
- height
- width
- depth
- effective depth
- diameter of longitudinal bars
- number of longitudinal bars
- yield stress of longitudinal bars
- diameter of hoop bars
- spacing of hoops
- transverse reinforcement ratio
- yield stress of hoops
- peak moment
- peak shear force
- maximum displacement reached before failure
- type of failure

d – The user will have the option of uploading a 3D model and drawings describing the specimen, setup, and sensor configurations in detail. Each file should also include a one-liner explaining the drawing or model. (3D Google SketchUp models will be preferred over 2D pdf or similar drawings. SketchUp models for each NEES site will be available on the NEEShub, with each model having built-in components representing all available equipment.) It will be suggested that each drawing have a format that identifies the cardinal directions, along with up and down.

e – The suggested data file format will be the comma-separated-values (CSV) format. It will also be suggested that each column shall correspond to a sensor or physical quantity, with the first column referring to time. The first row shall include sensor labels (matching those used in sensor maps and sensor lists) and the second row shall include units. Each file shall be labeled using the ID of the specimen it refers to and trial number. Each file should also include a one-liner explaining the type of data collected.

f – The suggested data file format will be the comma-separated-values (CSV) format. It will also be suggested that each column shall correspond to a sensor or physical quantity, with the first column referring to time. The first row shall include sensor labels (matching those used in sensor maps and sensor lists) and the second row shall include units. Each file shall be labeled using the ID of the specimen it refers to and trial number. Each file should also include a one-liner explaining the type of data collected.

g – Crack/damage maps are photographs or drawings that show the results for each trial. Each drawing or photo should also include a one-liner explaining the drawing or photo.

h – The suggested labeling convention for photograph and video files will include the camera ID, specimen ID, and trial number. It will also be suggested that each file have a time stamp (synchronized with sensor data).



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i – The suggested labeling convention for photograph and video files will include the camera ID, specimen ID, and trial number. It will also be suggested that each file have a time stamp (synchronized with sensor data).

