



# DESIGNSAFE-CI

A NATURAL HAZARDS  
ENGINEERING COMMUNITY



## Lessons Learned from Developing a Comprehensive CI for Natural Hazards



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DESIGNSAFE-CI   
NHERI: NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE



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TACC

RICE

Florida Tech

# What is DesignSafe?

- A web-based research platform that enables transformative research that protects human life and reduces damage during natural hazard events

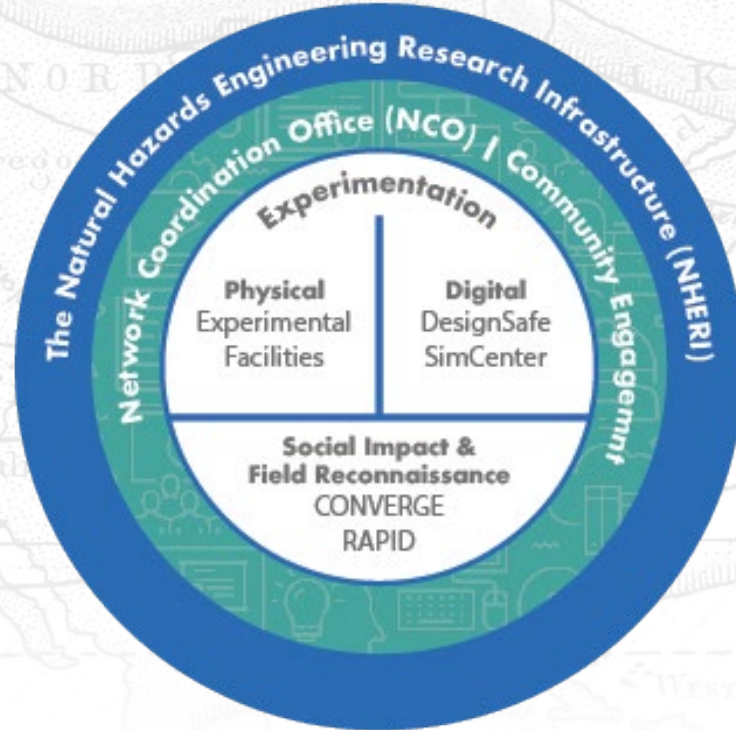
## DesignSafe Vision

- A cyberinfrastructure (CI) that is an integral part of research discovery
  - Provide a platform for data sharing/publishing
  - Enable research workflows and access to high performance computing (HPC)
  - Deliver cloud-based tools that support the analysis, visualization, and integration of diverse data types
- Amplify and link the capabilities of natural hazards researchers in the US and abroad





## Natural Hazards Engineering Research Infrastructure



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### DesignSafe Tutorials

**NEW** End to End Multi-Threat Fragility Modeling using DesignSafe  
December 3, 2019

- Watch Tutorial

Introduction to STKO  
November 18, 2019

- Watch Tutorial

Leveraging Python, Jupyter Notebooks, DesignSafe, and the SimCenter Educational Tools in the Classroom  
October 28, 2019

- Watch Tutorial

### DATA DEPOT

Find in Published Projects

**Add**

My Data  
My Projects  
Shared with Me  
Box.com  
Dropbox.com

**Publication Type**

☐ Experimental ☐ Simulation ☐ Hybrid Simulation

**Project Title**

Collaborative Research: Development, experimental validation and case studies for the next generation of landslide tsunami models for coastal hazard mitigation (Simulation)

### TOOLS & APPLICATIONS

[Learn About the Workspaces](#)

Simulation [7]	Visualization [8]	Data Processing [2]	Partner Data Apps [5]
ADCIRC	clawpack	Dakota	LS-DYNA
ADCIRC	C	D	LS-DYNA

### Recon Portal

[Learn more about contributing.](#)

Show the options

2019 Hurricane Dorian  
First landfall is at Cat S. Elbow Cay, Abaco, Bahamas  
[View Data](#)

2019 Hurricane Barry  
Louisiana Gulf Coast  
[View Data](#)

A map of the Gulf of Mexico and surrounding landmasses, with several blue location pins indicating specific points of interest.

[www.designsafe-ci.org](http://www.designsafe-ci.org)



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# Data Depot

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Published

Published (NEES)

Community Data

Help ▾

Find in My Projects



Project ID	Project Title	Project PI	Last Modified
PRJ-2752	CEC Project geohazards group	Paolo Zimmaro	9/15/20 2:31 AM
PRJ-2889	Earthquake Time Series from Events in Texas, Oklahoma, and Kansas	Ellen Rathje	9/11/20 2:02 PM
PRJ-2662	Displacement and subsurface characteristics of select lateral spread locations from the 2011 Christchurch, New Zealand earthquake	Ellen Rathje	9/1/20 9:52 AM
PRJ-1822	Hybrid Simulation Test Project	Keith Strmiska	8/24/20 5:01 PM
PRJ-2859	NEES, The George E. Brown, Jr. Network for Earthquake Engineering Simulation, 2004-2014 A DECADE OF EARTHQUAKE ENGINEERING RESEARCH	Julio Ramirez	8/14/20 12:13 PM
PRJ-2157	Simulations of Seismic Displacement of a Clay Slope using LS-Dyna	Ellen Rathje	8/11/20 2:24 PM
PRJ-2331	RAPID Data for DesignSafe Site Visit	Jeffrey Berman	8/3/20 3:54 PM
PRJ-1716	Bidirectional Testing of Drywall Partition Walls with Novel Details, Integrated into a Rocking Wall Subassembly	Keri Ryan	7/29/20 11:26 PM
PRJ-2824	Numerical modeling of lateral spread displacements at free-face sites using	Michael Little	7/13/20 4:48 PM



# DATA DEPOT

+

 Add

My Data
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Box.com
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Published (NEES)
Community Data

Help

🔍

✎

 Rename

➡

 Move

📄

 Copy

👁

 Preview

🖼

 Preview Images

⬇

 Download

🗑

 Move to Trash

## PRJ-2363 | Soil-Foundation-Structure Interaction Effects on the Cyclic Failure Potential of Silts and Clays

Download Dataset

PI

CoPIs

Project Type

DOI(s) in Dataset

Keywords

Brandenberg, Scott

Stewart, Jonathan

Experimental

10.17603/ds2-e7s5-b025

10.17603/ds2-jpwh-nq72

Cyclic Screening, Fine-Grained Soil, Soil-Foundation-Stru

Earthquake-induced ground failure has resulted in billions of dollars of damage during exhibiting either "sand-like" or "clay-like" behavior with respect to strength loss during soils, which are less well understood than "sand-like" soils. Cyclic failure of fine-grained and not in the free-field soils away from the structures, indicating that soil-foundation-centrifuge model testing to study cyclic failure of fine-grained soils beneath structures containing all of the experimental measurements and metadata required for users to

View Data Diagram

Experiment | Centrifuge Test on Bentonite Clay - Test UCLA JZB01

Experiment Type

Author(s)

Experimental Facility

Equipment Type

Date of Experiment

Date of Publication

DOI

License(s)

Centrifuge

Buenker, Jason; Brandenberg, Scott; Eslami, M Jonathan

Center for Geotechnical Modeling, UC Davis

9m Radius Dynamic Geotechnical Centrifuge

08-21-2017 — 08-26-2018

08-25-2020

10.17603/ds2-e7s5-b025

Open Data Commons Attribution

Report | Data Processing

Report | Digital Data Report (JZB02)

Model Configuration | Centrifuge Model (JZB02)

Sensor Information | Centrifuge (JZB02)

Event | CPT (JZB02)

Event | Fast Data from Spin

Data collected at 5000 Hz

01162019@082639@

01162019@082639@

01162019@082639@

01162019@082639@

01162019@082639@122026@77.0rpm.bin

01162019@082639@125704@77.0rpm.bin

Citation

Buenker, J. Brandenberg, S. Eslami, M. Abundis, D. Buckreis, T. Stewart, J. (2020) "Centrifuge Test on Bentonite Clay - Test UCLA JZB01", in *Soil-Foundation-Structure Interaction Effects on the Cyclic Failure Potential of Silts and Clays*. DesignSafe-CI. <https://doi.org/10.17603/ds2-e7s5-b025>.






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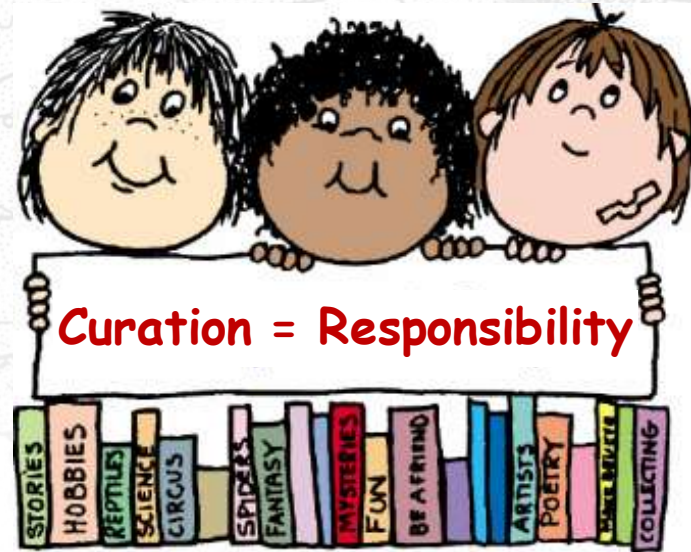


# DATA









Structured, yet **flexible**, data models for different types of research

-  **Experimental Project**  
For physical work, typically done at an experimental facility or in the field.
-  **Simulation Project**  
For numerical and/or analytical work, done with software.
-  **Hybrid Simulation Project**  
For work using both physical and numerical components.
-  **Field Research Project**  
For work done by observation in areas affected by a natural hazard.
-  **Other Project**  
For work other than the project types above.



# Tools and Applications

Simulation [8]	Visualization [9]	Data Processing [2]	Partner Data Apps [5]	Utilities [2]	My Apps [8]
FigureGen <b>F</b>	HazMapper 	Kalpana <b>K</b>	Paraview 	Potree Converter <b>P</b>	Potree Viewer <b>P</b>
QGIS Desktop 3.8.1 	STKO <b>S</b>	Visit 	Jupyter 	MATLAB 	

- Simulation codes on high performance computing (HPC) resources
  - OpenSees, LS-Dyna, ADCIRC + SWAN, OpenFOAM
- Cloud-based tools for data analysis and visualization



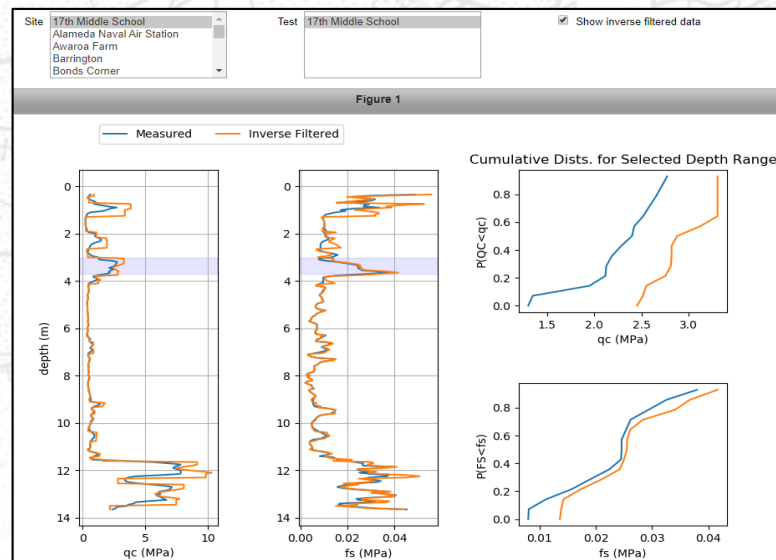


# Jupyter Notebooks



- Electronic notebooks in Python or R
- JupyterHub in DesignSafe
  - Access to Data Depot files
- Interactive data viewer
- Can write scripts for data processing, AI or machine learning
- Publish for use by others
- Accelerates data reuse, adoption of approaches into practice

## *Next Generation Liquefaction*



From Scott Brandenburg (UCLA)





- Easy access to images and point cloud data
- Location and preview exposed
- Link to Potree viewer provided

**HazMapper**

Maps: Map\_1

Assets

Point Clouds

Layers

Filters

322531

Download

**Metadata**

Assessment_type	"Single Family Residence"
Building_address_admin_area	"Texas"
Building_address_country	"United States"
Building_address_full	"2011 South Kossuth St., Rockport, Texas 78382"
Building_address_locality	"Rockport"
Building_address_postal_code	78382

View

96972

**Metadata**

Geometry: Polygon

Area (m<sup>2</sup>) 161731.9877286004 1

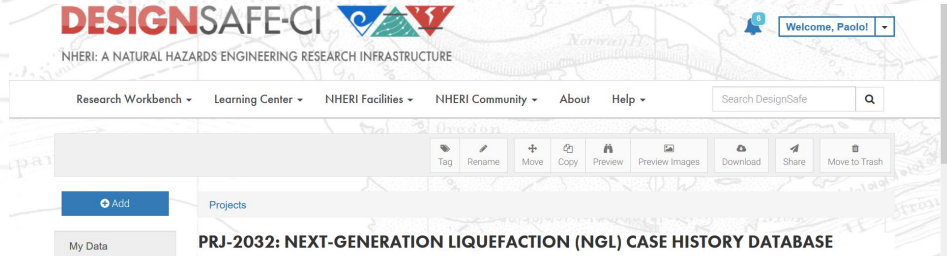
**Bounding Box**

	Latitude	Longitude
Min	47.6501437109597	-122.308231325997
Max	47.6535931484506	-122.302614622767



# Support for Structured Databases

- NGL: Community database of liquefaction case histories
- Data housed in SQL database with its own schema
- Database replicated to DesignSafe daily
- Jupyter notebooks to access data available in DesignSafe



From P. Zimmaro,  
UCLA



# A Little History...

- NEES (for earthquakes) was the predecessor of NHERI
  - 2000-2004: NEES facility and CI development (CI-1)
  - 2004-2009: NEES Operations (CI-2)
  - 2009-2014: NEES Operations recompleted (CI-3)
  - 2015-2020: NHERI-DesignSafe (CI-4)
  - 2020-2025: NHERI-DesignSafe renewal (CI-4)





# Lessons Learned: leadership

- Partnership between domain scientists and CI specialists
  - DesignSafe PIs are researchers in natural hazards
  - Leadership team includes PIs and TACC Director/Staff
  - Working with TACC allows us to leverage expertise as needed
- Develop a cyberinfrastructure that can evolve and grow
  - Top down (CI staff → domain) AND bottom up (domain → CI)
  - Don't be afraid to modify your plan (e.g., Jupyter)
  - Being a part of TACC allows us to maintain state-of-the-art CI



# Lessons Learned: user needs

- Data publishing and sharing
  - Make data publishing easy (“give me tools not rules”)
  - Data publishing as a goal rather than a technical requirement
  - Educate the community about citing data to properly credit others
  - Younger researchers are the most open to sharing (open source generation)
- Broader vision in terms of the goals of the CI
  - Enable research workflows, provide access to HPC, deliver cloud-based tools for analysis, visualization, etc. – what do users want/need?
  - Meet the needs of a diverse user base from novice to power users



# Lessons Learned: usage

- Promoting adoption of CI
  - Highlight real research examples that utilize the CI
  - Advanced user support for early adopters
  - Training webinars and online resources

Metric	Year 2	Year 3	Year 4	Year 5+
Registered Users	500	1,942	3,523	5,709
User Data	16.5 TB	45 TB	110 TB	487 TB
Published Datasets	1	41	131	336
Views of training / yr	2,699	15,795	49,724	53,519
Citations of DS	1	8	25	98

