A Cyberinfrastructure for the Natural Hazards Community

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What is DesignSafe?

• A web-based research platform that provides computational tools to manage, analyze, and understand critical data for natural hazards research

DesignSafe Vision

• A CI that is an integral part of research discovery
  - Support end-to-end research workflows and the full research lifecycle, including data sharing/publishing
  - Cloud-based tools that support the analysis, visualization, and integration of diverse data types
• Amplify and link the capabilities of the NHERI partners and natural hazards researchers around the globe
DesignSafe is the web-based research platform of the NHERI Network that provides the computational tools needed to manage, analyze, and understand critical data for natural hazards research.

Learn how to
Start Using DesignSafe

Browse the Data Depot's
Published Data Sets

Join the conversation in
DesignSafe's Slack Channel

Learn more about
NHERI, the NCO & DesignSafe

NHERI Five-Year Science Plan

Hurricane Michael Barreling Toward Florida Gulf Coast
Hurricane Michael will make landfall mid-day Wednesday, Oct 10 with life threatening storm surge forecasted up to 12 feet, heavy rainfall up to 12 inches and damaging winds. Researchers from the Florida Coastal Monitoring Program are heading into the field ahead of the storm to set up two 15 meter weather stations.

READ MORE IN THE NEWSROOM
DesignSafe Components

• Research Workbench
  – Data Depot
  – Discovery Workspace
  – Reconnaissance Portal

• Learning Center
  – Training resources and student engagement

• NHERI Facilities
  – Access to information about all NHERI facilities

• NHERI Community
  – News and online Slack community
Data Depot Features

• Different areas:
  – My Data (Private)
  – My Projects (Semi-Private, Collaborative)
  – Published (Publicly accessible, curated)
  – Community Data (Publicly accessible, uncurated)

• Upload files/folders via computer, cloud service providers, or bulk transfer (Globus)

• Manage, preview files within Data Depot

• Data curation and publishing
A space to share files/data/results with collaborators and to eventually publish for public use
Data Curation Philosophy

- Vision: Allow users to **easily** store, share, document, and publish data throughout the life of a project
- Flexible data models and interactive curation
  - Allows researchers to decide how to represent their research
  - Consider what is needed for data to be understandable by an outside user
  - Example: user-defined categories for experimental data

Model Config, **Sensor Info**, Event, **Analysis**, Report
Data Curation and Publication

Define Category Tree → Assign Categories to Files

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Helical Piles Under Seismic Loading

- **Model Config**: Experimental Layout and Shake Sequence Day 1
  - **Sensor**: Sensor Locations for all events
    - **Event**: Day 1, Sand Shake
- **Model Config**: Experimental Layout and Shake Sequence Day 3
  - **Sensor**: Sensor Locations for all events
    - **Event**: Day 3, Inertial Weight
- **Model Config**: Experimental Layout and Shake Sequence Day 4
  - **Sensor**: Sensor Locations for all events
    - **Event**: Day 4, Fixed Skid Group Piles
- **Model Config**: Experimental Layout and Shake Sequence Day 5
  - **Sensor**: Sensor Locations for all events
    - **Event**: Day 5, Pinned Skid Group Piles

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[Working Directory] [Publication Preview]

- **Name**
  - 10-mm Event: CPT_Dr88%_10mm
  - 4-mm Event: CPT_Dr88%_dc4mm
  - 6-mm Event: CPT_Dr88%_dc6mm
Data Curation and Publication

Define Category Tree ➔ Assign Categories to Files ➔ Publish Project and Files

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**PRJ-1617: RAPID: LARGE-SCALE SHAKE TABLE TEST TO QUANTIFY SEISMIC RESPONSE OF HELICAL PILES IN DRY SAND**

**PI:** Conato, Amy

**Date of Publication:** Jan 31, 2018

**Doi:** 10.17603/DS2ND6F

**Project Type:** Experimental

**Keywords:** helical pile, helical pier, single helix, double helix, push pile, group effects, rocking foundations

**Description:**

This Rapid Response Research (RAPID) project investigated the seismic behavior of helical piles by means of shake table tests on full-scale piles in the UC San Diego laminar soil box. Helical piles are deep foundation elements that look like, and are installed like, a large steel soil screw - they have a slender steel shaft with any number of round plates welded to the central shaft at the tip to provide support to the structure they hold. Helical piles are spun into the ground with a large torque motor and provide support through soil bearing on the plates and along the shaft. They come in many lengths and are often the foundation of choice for retrofiting existing buildings or new, urban construction, due to their small footprint and ability to create minimal disturbance to surrounding structures. Even though it is known from anecdotal studies (e.g. New Zealand and Japan) that piles with comparatively small cross-section and high anchoring capacity, such as helical piles, are beneficial for seismic resistance seemingly due to their slenderness, higher damping ratios, ductility, and resistance to tip uplift, building codes and current state of practice have not been adequately developed for this pile type because no quantitative data exist. Research of seismic behavior of helical pile supported structures is therefore imperative to generate necessary data that will help ensure that helical piles are being correctly applied in seismic areas and establish quantifiable benefits and/or limitations of helical pile use in seismic areas. This project will benefit people living in seismic zones by educating engineers with full-scale helical pile experimental data so that they better understand how to design a building system that is safer, more resilient and sustainable for individuals and the community.
Data Curation and Publication

Define Category Tree → Assign Categories to Files → Publish Project and Files
Data Curation and Publication

- Data Models
  - Experimental
  - Simulation
  - Other
    - Hybrid Simulation (coming in June)
    - Field Reconnaissance (working with RAPID)
- Virtual Office Hours with Data Curator
  - Tues/Thurs Zoom meetings with Maria Esteva
Make your data count!

- **Formally publish** data sets in stable data repositories
  - Include data processing scripts, visualizations, etc.
- Data needs a permanent, **digital location (DOI)** not just a URL
  - List curated data sets on your CV
- Formally cite data in your reference list of your papers using DOI, citation language as indicated in DesignSafe
Reconnaissance Portal

Identifying Archived Datasets from Recon Events
Reconnaissance Portal

Identifying Archived Datasets from Recon Events

2017 Hurricane Irma
Florida, USA
2017-09-10

Available datasets:
- Hurricane Irma Preliminary Reports and Information
- GEER Hurricane Irma - Cape Coral to Key West (Initial Data Collection)
Recon Portal → Data Depot

PRJ-1900: GEER HURRICANE IRMA - CAPE CORAL TO KEY WEST (INITIAL DATA COLLECTION)

PI: Stark, Nina
Date of Publication: Apr/19/2018
Project Type: Other

PI: Stark, Nina
Date of Publication: Apr/19/2018
Project Type: Other

Description:
Hurricane Irma was a category 5 hurricane on the Saffir-Simpson hurricane wind scale. Irma developed from a tropical wave around the Cape Verde Islands. The National Hurricane Center started monitoring it on August 25, and it was classified as a tropical storm named Irma on August 30. Moving across the Atlantic Ocean, Irma increased in strength. On September 5, Irma was classified as a category 5 hurricane with wind speeds up to 175 mph (280 km/h). Irma made landfall in the U.S. on Cudjoe Key (near Big Pine and Summerland Keys) in the morning of September 10, still being a category 4 hurricane, and made a second landfall on Marco Island, south of Naples, on the same day as a category 3 hurricane. In preparation for Hurricane Irma, more than 6.5 million people were ordered to evacuate (http://www.pbs.org), 134 fatalities were associated to the storm, and damages were recorded of more than $50 billion (http://www.bbc.com/news/business-41231323, https://en.wikipedia.org/wiki/Hurricane_irma). Two teams from the Geotechnical Extreme Events Reconnaissance (GEER) Association, supported by the National Science Foundation, were deployed to investigate geotechnical impacts of flooding, storm surge and wave forcing in Florida in response to Hurricane Irma in September of 2017. The teams worked collaboratively with federal, state, and local organizations in Florida. This initial data collection presents the field observations of the GEER team made during the field reconnaissance from September 24 to 28, 2017. The survey region extended along the coastal zone from Cape Coral to Key West.

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Discovery Workspace

- Cloud-based tools for use in research
- Access to files in the Data Depot

**WORKSPACE**

Select an application from the tray above.

The *Workspace* allows users to perform simulations and analyze data using popular simulation codes including OpenSees, ADCIRC, and OpenFOAM, as well as data analysis and visualization tools including Jupyter, MATLAB, Paraview and VisIt.
DesignSafe Discovery Workspace

• Data analysis in the cloud
  − Matlab: data analysis and plots
  − Jupyter: electronic notebook that supports Python and R

• Computational simulation codes
  − OpenSees: finite element code for structures and soil
  − ADCIRC: storm surge modeling
  − OpenFOAM: computational fluid dynamics
  − LS-DYNA: available via Bring Your Own License

• Visualization in the cloud
  − Potree: View and analyze point cloud data
  − QGIS: geospatial data analysis
Data Report: Centrifuge Testing of a Circular and a Rectangular Embedded Structure During Base Shaking

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1 Introduction

Seismic response of underground structures is a complex soil-structure interaction (SSI) problem in which two fundamental mechanisms are at play: kinematic SSI is concerned with the motion of the structure in the presence of spatially variable ground motions and the interface pressures that develop as a result of different structural and free-field motions. Inertial SSI captures the soil reactions that develop to resist inertial forces associated with the acceleration of the structure. The kinematic component is generally considered to be more significant for buried structures, due to their modest mass and their confinement with the surrounding soil.
Application of Probabilistic Framework for Flexible Sliding Displacements

Vector (PGA, PGV) Approximation

Site Location: W -121.99 and N 37.18, Santa Clara County, California

Deaggregation Source: [https://earthquake.usgs.gov/hazards/interactive/](https://earthquake.usgs.gov/hazards/interactive/) - Vs30 = 760 m/s

Mean and standard deviations of ground motions (ie. PGA and PGV) Source: NGA_Models_Version2.4.xls

MRE for PGA obtained from deaggregation Correlation coefficient between PGA and PGV, rho PGA PGV = 0.6 Correlation coefficient between kmax and k max, rho kmax k max = 0.6 Logic tree consists of 27 branches, 9 for T s and k y (correlated) and 3 for T m


Site Location
DesignSafe Workflow Example

What addresses will be inundated on Galveston Island by storm surge from the impending hurricane?

- Compute storm surge water levels with ADCIRC
- Convert output to shapefile format
- Import results into a GIS along with elevation and property data
- Identify addresses that are inundated by simulated water levels
Kalpana python script used to convert ADCIRC output files to shapefiles. Executed within a Jupyter notebook in DesignSafe.
HPC Allocation Policy

- **Base allocation:** 8000 SUs and 50GB of storage. Automatically given to each user.
- **Startup allocation:** 50,000 SUs and 1TB of storage. Requires fast track internal review.
- **Research allocation:** up to 2,000,000 SUs and 100TB of storage. Requires a proposal.
- Allocations last for one year, then you can request a renewal or extension.
- www.designsafe-ci.org/rw/support/allocations-policy
Other Components

- **Learning Center**: Access to webinars, information on REU, CODE@TACC DesignSafe for high school students, Summer Institute, FAQ
- **NHERI Facilities**: Web pages for NCO, EFs, SimCenter, and Facility Scheduler
- **NHERI Community**: News, access to Slack online collaboration
Slack Online Collaboration

- Online collaborative communication tool
- DesignSafe Slack Team (https://designsafe-ci.slack.com/) accessible via web browser or downloadable Slack app
  - 43+ topical channels
  - Active use with 27k+ posts
DesignSafe: Open for Business

www.designsafe-ci.org

• Capabilities available to the global natural hazards research community—account registration is free

• Training webinars
  – Overview webinars, as well as detailed training on Jupyter, etc.
  – Archived training webinars available at https://www.designsafe-ci.org/learning-center

Please share your feedback, ideas, experiences!

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