

Proposal: A NHERI workshop on generation, transport, and impact of terrestrial debris and debris flows during natural hazard events

PI: Michael Motley, University of Washington

**Steering Committee: Marc Eberhard, Pedro Arduino: University of Washington;
Dan Cox, Andre Barbosa, and Pedro Lomonaco: Oregon State University**

Motivation

In the past several decades, a variety of natural hazard events have sparked a common set of research interests among the hazard engineering community. While there can be a tendency to separate wind, seismic, and coastal hazards, commonalities within these subsets of natural hazard engineering appear. During many natural hazard events, one of these common themes for engineers to consider is debris. Debris can mean many things: high-speed, low-mass projectile impacts (e.g. smaller wind-borne objects), low-speed, high-mass projectile impacts (e.g., water-borne shipping containers), small-scale debris fields (e.g., homes destroyed during storm surge or tsunami events), or flow-like debris fields (e.g., seismically-induced landslides or avalanches). While these are distinct physical phenomena, there are sufficient similarities among them, such as overlapping physical processes, probabilistic approaches and new technologies, it would be productive and timely to organize a collaborative workshop that brings together a diverse set of researchers to improve the understanding of hazard-related debris phenomena.

Objective and Goals

The research team proposes a two-day workshop at the University of Washington in Seattle, WA in late Autumn 2018 to bring together both domestic and international researchers with a focus on topics related to the generation, transport, and impact of debris and debris fields. We anticipate a series of 15-20 minute presentations combined with a set of collaborative, interdisciplinary breakout sessions. The workshop will be designed to share knowledge, take advantage of synergies and identify potential collaborations among a wide range of researchers across disciplines who work on debris issues but who would not typically communicate with each other. A tentative agenda is provided at the end of this proposal.

Specific goals of this workshop include:

- Development of a comprehensive, cross-disciplinary understanding of the current state of knowledge with respect to debris in the context of natural hazards engineering;
- Identification of critical knowledge gaps and potential synergistical research opportunities;
- Identification of the role that NHERI facilities can play in addressing key research questions; and
- Prioritization of research needs and recommendations for future research.

Scope

While there are many debris-related topics to consider related to natural hazards, the specific focus of this workshop will be on terrestrial debris and debris fields, including water-borne debris and debris fields, flow-like debris fields, and landslide/rockfall-related debris impacts on critical infrastructure. Specifically, we will consider debris generated and transported by tsunamis, storm surge, flooding, landslides, and avalanches:

- Generation: hazard assessment, initiation of debris, makeup of a debris field;
- Transport: size vs. speed, density of debris, transport of flow-like debris fields;
- Impact: forces on coastal infrastructure, effects of adjacent infrastructure across scales from subassembly, building, to community;
- Post-event debris fields: effect on response and recovery.

The workshop will focus on:

- Numerical modeling aspects of debris (both deterministic and probabilistic);
- Physical modeling of debris (e.g., debris entrainment, impact, damming);
- The role of new technology in debris hazard assessment and mitigation, including but not limited to data collection, existing modeling tools and associated needs, and concepts related to big data;
- Implications for future ASCE codes and standards related to deterministic and probabilistic assessment of existing infrastructure and methods for designing hazard resilient communities.

Because of the relative maturity of its field, wind-borne debris will not be a specific focus of this workshop. However, attendance of several experts in the field of wind-borne debris will provide valuable knowledge base related to lessons learned from wind engineers and potential implications for the less mature research topics related to terrestrial debris.

Attendees

Based on initial discussions with our colleagues, it is clear that this topic is of great interest to the tsunami, storm surge, flooding, landslide, avalanche, and wind communities. To make the workshop successful, it is important that the workshop bring together a diverse, multidisciplinary group of attendees to both synthesize similar research commonalities and to encourage future research collaborations.

We expect to invite a diverse set of U.S. and international researchers across a variety of disciplines. A sample attendee list is provided below to illustrate the types of people who might be invited to the workshop. The final list of workshop attendees will be depend on the interests and availability of the invitees, as well as the need to maintain a diversity of research interests and capabilities. For interested participants who are unable to attend in person, access for remote participation will be provided.

The workshop will not be limited to invited participants; we plan to allow members of the research community to apply through submission of a brief abstract. A final list of presenters and moderators will be selected such that we are able to provide a diverse, comprehensive set of presentations covering the topics listed above.

Potential United States Collaborators:

- Pat Lynett (USC) – Modeling of boats as water-borne debris in harbors areas
- Jaime Padgett (Rice) – Hurricane/storm surge debris forces on above ground storage tanks
- Clint Dawson (Texas) – Large debris field transport during storm surge events
- Jen Irish (Virginia Tech) – Coastal engineering
- Joe Wartman (UW) – Landslide modeling
- Clay Naito (Lehigh) – Large debris impact
- Ronald Riggs (Hawaii) – Debris impact forces

Potential International Collaborators.

- Ioan Nistor (Ottawa) – Tsunami related debris experiments
- Nozmu Yoneyama (Kyoto U.) – Numerical modeling of debris fields
- Nils Goseberg (Hannover) – Coastal Debris
- PARI, UW-Tohoku

The PI and the steering committee have also had preliminary discussions with key members of the NHERI community. The workshop team has already discussed this workshop with the NHERI NCO (Julio Ramirez), SimCenter (Laura Lowes), DesignSafe (Tim Cockeril), and RAPID (Jeff Berman, Joseph Wartman) sites, who have critical roles in supporting this research. The co-location of the workshop and the RAPID would provide attendees with the opportunity to observe first-hand the RAPID capabilities. All of these facilities are interested in participating. There are also natural research opportunities associated with debris and debris fields at the NHERI Wave Research Lab (Dan Cox), and the team has had initial discussions with the PIs of the NHERI Wind Facilities (Forrest Masters and Arindam Chowdhury) who have expressed interest in participating as well.

Budget

We request a total budget of \$50,000 for this workshop to cover expenses related to attendee travel and fees related to facilities and meals. We anticipate this will provide sufficient funding to hold a workshop of approximately 30-35 people.

Workshop Deliverables

At the conclusion of the workshop, a half-day will be set aside for the steering team to combine the information presented during the workshop with the ideas from the breakout sessions into a final report to be publicly distributed on the DesignSafe website. This report can serve as valuable input into the NHERI Science Plan.

We also plan to develop a summary presentation from the workshop as an outreach tool that will be presented in a NHERI, post-workshop webinar. This summary can be incorporated into the site workshops and summer institutes.

Tentative Agenda

Day 1:

8:00-8:30: Check-in

8:30-9:00: Welcome, workshop goals and objectives (Motley)

9:00-10:40: Plenary session of motivational presentations, ~20 minutes per presentation + 5 minutes for discussion

- Field studies of tsunami/storm surge/landslide related debris
- Overview of windborne debris

10:40-11:00: Break

11:00-12:00: Plenary session of experimental research presentations, ~20 minutes per presentation + 5 minutes for discussion

12:00-1:00: Lunch

1:00-2:40: Plenary session of numerical modeling research presentations, ~20 minutes per presentation + 5 minutes for discussion

2:40-3:00: Break

3:00-4:30: Plenary session of presentations from NHERI Experimental/RAPID Facilities

4:30-5:00: General discussion and summary of Day 1

Day 2:

8:30-9:30: Plenary session of presentations from NHERI SimCenter and DesignSafe personnel

9:30-10:45: Breakout sessions for group discussions

10:45-11:00: Break

11:00-12:00: Discussion from breakout sessions

12:00-1:00: Lunch

1:00-2:00: Discussions Future research needs and collaborative NHERI efforts, Workshop wrap-up

2:00-5:00: Steering committee meeting to summarize the workshop and kick start workshop deliverables