Workshop on the Next-Generation Liquefaction Database

September 24, 2018 – Mong Learning Center – University of California, Los Angeles

Participants (in person): Thomas Weaver, Miriam Juckett, John Stamatakos, Paolo Zimmaro, Jonathan Stewart, Steven Kramer, Yousef Bozorgnia, Scott Brandenberg, Dongyoup Kwak, K. Onder Cetin, Robb Moss, Kevin Franke, Roy Mayfield, Mahyar Sharifi-Mood, Sean Ahdi, Silas Nichols, Derek Wittwer, Robert Pike, Mike Greenfield, Albert Kottke, Massoud Hosseinali, Gizem Can, Makbule Ilgac, Chukwuebuka Nweke, Maria Giovanna Durante, Yi Tyan Tsai, Allison Lee, Honor Fisher, Tom Shantz, Steven Bartlett, Jim Gingery, Zia Zafir, Esam Abraham, Khaled Chowdhuri, Christine Beyzaei, Harold Magistrale, Marty Hudson, Jianping Hu, Craig Davis, Joseph Weber, Omar Issa, Siddhant Jain.

Via Zoom (incomplete list): Tim Ancheta, Russell Green, Joey Mukherjee, Brian Carlton, Michael Little, Ariya Balakrishnan.

Morning Session:

1. **Introduction and project overview (Yousef Bozorgnia, Jonathan Stewart)**
2. **The NGL Consortium (John Stamatakos)**
3. **Introduction to the NGL Database and activities of the Database Working Group (Scott Brandenberg)**
4. **The NGL Database: graphical interface and population status (Paolo Zimmaro)**

Discussion on the database status:

Davis – What is the future vision for database maintenance?
Brandenberg – The vision is to continue adding data and vetting them over time. We will assign a Digital Object Identifier (DOI) to each individual case history (or groups). This is possible even if the author(s) is only gathering and putting in a usable form existing data.

Hosseinali – Is it possible to download the entire database using the online graphical interface
Zimmaro – No, currently you can only download one case history at a time.

Kwak – Who is entering ground motion data?
Zimmaro – Event super-users (i.e. designated experts with access to the event section of the database) will enter ground motion data in the earthquake event section of the database (EVNT, SEGM, IM, and STAT tables). Users will enter ground motion data at the site for which observations are available (GMIM table).
Bozorgnia – The Next-Generation Attenuation (NGA) project can share additional ground motion data (not published yet) with NGL.

5. **Liquefaction legacy case histories part 1 (Onder Cetin)**

6. **Liquefaction legacy case histories part 2 (Robb Moss)**

Discussion on legacy case histories:

Zafir – How do you define a 'no liquefaction' site?
Moss – A site with lack of surface manifestation.
Cetin – There may be sites with co-located recording stations. In that case, even in the absence of liquefaction surface manifestation, a site may be classified as 'liquefaction site' if there is a clear evidence of that in the recording.
Moss – None of the CPT case histories I am working on has co-located recording stations.

Stamatakos – What about water table?
Moss – This is a challenging topic and things may change over time.
Stamatakos – Is there a benefit in classifying quality of water table measurements?
Moss – Yes. However, it is hard to capture fluctuations over time.

Gingery – How do we select critical layers?
Moss – The 2010-2011 Canterbury sequence provided useful insights into this issue. The minimum thickness for observing ground failure seems to be about 1m.

Davis – How do you define ground failure? What about cases where you have ground failure and no ejecta?
Moss – Friction ration can give you pretty good information on such issue. It is all about susceptibility (i.e. clay-like vs sand-like behavior). A great example of this is the Wufeng area during the 1999 Chi Chi earthquake in Taiwan.
Stewart – The analysis of susceptibility is one of the goals of this project.

Davis – How do you assign a ground motion intensity measure value to a specific site?
Moss – Friction ration can give you pretty good information on such issue. It is all about susceptibility (i.e. clay-like vs sand-like behavior). A great example of this is the Wufeng area during the 1999 Chi Chi earthquake in Taiwan.
Stewart – If no measurements are available at the site, we have a process to evaluate ground motion at the site. It involves a Kriging procedure on within-event residuals. This approach also accounts for spatial correlation models and level of uncertainty of the estimation.

Ancheta (via Zoom) – Do we separate between free-field and sites near buildings?
Moss – No, we have both categories in the database.

Lunch break

Afternoon Session:

7. Lateral spreading case histories (Steven Bartlett, Kevin Franke, Massoud Hosseinali)

Davis – For lateral spread features, the magnitude and the extent of the displacement area are equally important.
Franke – It is challenging to even define a lateral spread case history. We typically upload all displacement vectors available for a site. Then modelers will decide how and if to separate them into multiple case histories.
Bartlett – We usually try to define zero displacement areas, wedges, and margins of a lateral spread feature. This keeps interpretations at a minimum level. Margins and vectors are pretty objective data.

Beyzaei – Is there a guidance document on how to conduct reconnaissance for such features?
Franke – The NGL database working group is envisioning to write a technical paper to define best practices for developing susceptibility, triggering, and lateral spread case histories.

Ahdi – What about data quality? Do you have quantitative scores to describe quality or qualitative assessments?
Bartlett – We thought about it. It is challenging. We decided to provide qualitative descriptions on data quality.
Franke – It is pretty hard to decide what data type is better.

8. Liquefaction case histories at strong motion recording sites (Mike Greenfield)

Shantz – There has been a big earthquake in Hokkaido early this month. Do we have information on liquefaction sites with co-located recording stations?
Greenfield/Stewart – We will get the data and see what we can do.
Kramer – We envision to run frequency-time Stockwell-type analysis on the whole NGA database to identify sites where liquefaction occurred and we do not know about.

Brandenberg – Are the frequency-time plots normalized?
Greenfield – Yes they are, so we can more clearly see modal changes.

Kwak – How did you evaluate the water table for stations in the NIED/PARI networks in Japan?
Greenfield – We analyzed P-wave velocity profiles.

Kwak – Were you able to identify sites where liquefaction occurred without any surface manifestation. Such sites may have experienced liquefaction at deeper layers.
Greenfield – Yes. The IBR014 site during the 2011 Tohoku earthquake may be a good candidate. There are two candidate layers that potentially liquefied. After accurate analysis, we found that the deeper layer most likely liquefied.

Davis – There are three sites with co-located recording stations that liquefied during the 1994 Northridge earthquake.
Greenfield – We will surely analyzed them.

9. Recent case histories data collection and distillation (Paolo Zimmaro)

Mayfield – We should be careful when defining priority sites. Sites with high demand and low capacity may not be consequential for triggering models, but they may be important for consequences analysis.
Cetin – It is hard to define priorities as all case histories are potentially useful.

10. NGL-DesignSafe on-the-cloud interactive tools (Allison Lee and Honor Fisher)

Moss – This Jupyter notebook tools may be used to plot data points against consensus triggering models.
Brandenberg – This is one of the uses we envisioned for such tools.

Brandenberg – The live demo of the tools has been done on the actual mirrored database hosted under DesignSafe.

Franke – Are you suggesting to interact with the data via DesignSafe or through the NGL website graphical interface?
Brandenberg – We would like to show which tools are available to interact with the data. Users and modelers will have various options.

11. Next steps for the NGL Consortium (Steven Kramer, Jonathan Stewart, John Stamatakos)

Open Discussion:

Bozorgnia – It will be good for modelers to work on the database soon, so they can identify potential issues and gaps.

Gingery – There is possible Upstate NY case history, along rail line, M5.0 event with potential Kalpha effect.

Supporting studies – important factors:

Zafir – Depth factors are critical. Also important are interlayered, intermediate soils. Ageing is also an important factor (pursued by Andrus).

Kottke – Initial shear stresses.

Franke – Minerology – non-silica sands. Kumamoto provided some useful data on this matter.

Stewart – For triggering we could have a baseline model for silica sand. Then, if you change mineralogy, you would apply a correction factor and shift the curve. This is the basic concept of what we could envision to analyze non-silica sands.

Hudson – Differential settlement of foundations and 3D effects.

Chowdhuri – Residual strength is well understood, r_d is well understood.

Shantz – I would like to see an NGL interim model. It will help to focus the research moving forward.

Moss – Spatial variability and continuity. Develop guidelines for correlation lengths. Autocorrelation of various properties.

Ancheta (via Zoom) – Ground water estimation.

Kramer – Lack of saturation in areas near the ground water table.

Davis – Volumetric strains from ejecta, impact of layering, depth, etc.

Kottke – Are there ways to get the distribution of probability of liquefaction from something other than the attributes of the data?
Kramer – As we move forward, we may be able to produce more complex probabilistic models.
Zafir – There may be some ambiguity on the merging of the lateral spread database with the NGL database.
Franke – These are separate but parallel efforts.
Stewart – When analyzing liquefaction effects, such case histories can be used as well.
Stewart – Importance of soil-structure interaction effects.
Shantz – Layering effects (Christchurch may provide useful data).
Franke – Performance of improved ground.
Moss – high profile r_d analysis.
Franke – are modelers free to use which ever IM they want?
Kramer – Yes, we do not want to constrain modeling choice.

Low M liquefaction case histories to include in the NGL database

Gingery – Upstate NY – M5.0.
Green (via Zoom) – Tailings pond in Randolph Utah.
Davis – Owens Lake
Stamatakos – Pawnee (Oklahoma)

Agency input

Weaver – Depth and age effects are important.

Shantz – Identify the lowest hanging fruit that will really be impactful.