Workshop on

Response History Analysis Validation

QuakeCoRE Annual Meeting
Wairakei, Taupo, New Zealand
4 September 2017

Overview

Over the past couple of decades, response history analysis of structural and geotechnical systems has witnessed increased adoption in earthquake engineering research and practice. This development could be attributed to a greater emphasis on performance-based design and assessment principles. The results of response history analyses are currently used as the basis for a number of important design decisions, especially for important facilities like tall buildings, bridges, dams, industrial facilities, and levee embankments. Proportionately little attention has, however, been paid to the verification and validation of commonly employed modelling techniques and numerical solution procedures. Hence, we are presently unable to provide quantitative estimates of the accuracy and precision of our simulation results. Improving confidence in the predictive capabilities of response history analysis procedures through a systematic validation exercise would require concerted efforts in the following four key thrust areas: *(i)* recording seismic response data in the laboratory and the field; *(ii)* collecting and curating recorded datasets; *(iii)* developing a methodology for analysis validation; and *(iv)* performing validation for different problem types.

An international workshop on *Response History Analysis Validation (RHAV)* will be held on 4 September 2017 at Wairakei, Taupo, in conjunction with the 2017 QuakeCoRE Annual Meeting. The objective of this workshop is to bring together researchers and practitioners in order to collate ideas, identify priorities, and foster collaborative efforts in launching a cross-Technology Platform (TP) QuakeCoRE research initiative in response history analysis validation. This objective will be achieved through a series of activities prior to, during, and after the workshop, including the development and distribution of *(i)* a workshop reader containing a list of relevant publications; *(ii)* a collection of extended abstracts submitted by the workshop participants describing their views on the identified thrust areas; and *(iii)* a QuakeCoRE report summarising the outcomes of the workshop.

Workshop topics

The discussions during the workshop will be centred around the following main topics, with the objective of exploring perspectives and identifying suitable short and long term goals.

1. **Inputs from laboratory experiments** (QuakeCoRE TP1)
    - Guidelines for loading protocols and instrumentation schemes to be used in experimental tests that are consistent with the needs for validation of local and global system response
    - Best practices for the documentation of experimental test setups, boundary conditions, results, etc. in a format that enables use in future analysis validation efforts

- Promote prospective (blind) prediction efforts prior to conducting experimental tests

2. **Inputs from field instrumentation and monitoring** (QuakeCoRE TP2)
    - Widen the network of instrumented structural and geotechnical systems in the field, in collaboration with GeoNet, with ambient vibration and strong motion recording capabilities
    - Recommendations for optimal sensor distribution so as to adequately capture required response modes with minimal instrument density
    - Collation of structural and geotechnical system characterisation information (e.g., structural drawings, site characterisation data) in conjunction with GeoNet to facilitate model creation for analysis validation
    - Work with GeoNet to enable free dissemination of system characterisation information for research
3. **Collection and curation of recorded datasets** (QuakeCoRE TP3)
    - Uniform standards for the presentation of experimental and field monitoring datasets
    - Collation of available data from previous experimental tests, blind prediction efforts (e.g., LEAP, VELACS, PEER concrete column test), and field monitoring programmes
    - Storage and dissemination of validation datasets via cyber-infrastructures like DesignSafe
    - Tools to streamline access to the compiled datasets for analysis validation studies
4. **Methodology for analysis validation and analysis of case studies** (QuakeCoRE TP4)
    - Examination of the scope and objectives of previous analysis validation efforts, and the tools and methods they adopted
    - Verification of nonlinear models and solution techniques using different analysis software
    - Development of a multi-tiered hierarchical framework for validation of structural and geotechnical models, ranging from simple SDOF models to large, complex 3D models with advanced constitutive models
    - Evaluation of various modelling and analysis techniques using the collected datasets
    - Quantification of the accuracy and precision (uncertainty) of simulation results using various modelling approaches

Structure of workshop

All workshop participants are invited to register at the workshop Eventbrite page. The objectives of the workshop will be achieved through the following series of activities:

1. **Extended abstracts**
   Workshop participants are requested to submit a 1–2 page extended abstract describing

their views on any one of the four workshop topics listed above. Participants may choose to submit a maximum of two extended abstracts, each addressing a different topic. Each submitted extended abstract should seek to address one or more of the following prompts, in relation to the chosen workshop topic:

- What is the current practice and/or state-of-the-art?
- What are they key identified challenges?
- What should the path forward be?

All extended abstracts should be sent to quakecore.workshop@gmail.com by 4 August 2017 using the provided extended abstract format.

The submitted extended abstracts will be compiled into a document and distributed to the workshop participants prior to the workshop. The workshop organisers will use the extended abstracts as a basis to select additional speakers on each topic, and to finalise the workshop agenda.

2. **Bibliographies**
   Each workshop participant is also requested to submit a bibliography summarising relevant and significant prior research on response history analysis validation. This could include journal papers, conference papers, and technical reports. *The bibliography, along with PDF copies of corresponding documents, should be sent to quakecore.workshop@gmail.com by 4 August 2017.*

   A reader containing key relevant publications on the topic, selected from the submitted bibliographies, will be compiled into an unpublished document and distributed to the workshop participants. A bibliography listing the publications will also form a part of the final QuakeCoRE report, so that all researchers are aware of the current state of knowledge on the subject.

3. **Workshop**
   The tentative agenda for the workshop on 4 September 2017 is presented below. The workshop will consist of five sessions, one addressing each of the workshop topics, and a final summary session. The scope of the sessions may be modified based on the received extended abstracts. Each session will consist of presentations by invited speakers and others chosen based on the submitted extended abstracts, followed by a mediated group discussion. Speakers are requested to share their views on one of the workshop topics by responding to one or more of the prompts delineated previously.

4. **QuakeCoRE report**
   Upon conclusion of the workshop, the organisers and a few select participants who provided valuable inputs to the discussion will distil and synthesise the results of the workshop into a QuakeCoRE report, which will be made available publicly.

Key dates

Friday, 4 August 2017 : Extended abstracts and bibliographies due (send to quakecore.workshop@gmail.com)

Monday, 4 September 2017 : Workshop at Wairakei, Taupo, New Zealand (register at the workshop Eventbrite page)

Workshop agenda *(tentative)*

Date : Monday, 4 September 2017
Venue : Wairakei, Taupo, New Zealand

Session 1: Inputs from laboratory experiments
Chair: Seokho Jeong, *Recorder*: Karim Tarbali

10:00 Presentations by invited speakers
10:20 Presentations by speakers selected based on submitted extended abstracts
10:40 Discussion

Session 2: Inputs from field instrumentation and monitoring
Chair: Seokho Jeong, *Recorder*: Reagan Chandramohan

11:00 Presentations by invited speakers
11:20 Presentations by speakers selected based on submitted extended abstracts
11:40 Discussion

12:00 Lunch

Session 3: Collection and curation of recorded datasets
Chair: Brendon Bradley, *Recorder*: Chris McGann

13:00 Presentations by invited speakers
13:20 Presentations by speakers selected based on submitted extended abstracts
13:40 Discussion

Session 4: Methodology for analysis validation and analysis of case studies
Chair: Reagan Chandramohan, *Recorder*: Seokho Jeong

14:00 Presentations by invited speakers
14:20 Presentations by speakers selected based on submitted extended abstracts
14:40 Discussion

15:00 Break

Session 5: Summary and path forward
Chair: Chris McGann, *Recorder*: Brendon Bradley

15:30 Joint group discussion

16:00 Adjourn

Organising committee

Organisers: Brendon Bradley *(University of Canterbury)*, Reagan Chandramohan *(University of Canterbury)*, Seokho Jeong *(University of Canterbury)*, Chris McGann *(University of Canterbury)*

Advisers: Scott Brandenberg *(University of California - Los Angeles)*, Misko Cubrinovski *(University of Canterbury)*, Greg Deierlein *(Stanford University)*, Ken Elwood *(University of Auckland)*, Didier Pettinga *(Holmes Consulting)*, Ellen Rathje *(University of Texas at Austin)*, Liam Wotherspoon *(University of Auckland)*