

# Miguel Bravo-Haro

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## EDUCATION

### Imperial College London, UK 2014–2019

- Postdoc Researcher in earthquake engineering, Department of Civil and Environmental Engineering  
Development of a multi-purpose open-source and low-cost seismic sensing.  
Research on earthquake-duration effects in the seismic response of structural systems.  
Development of open software for the Earthquake Engineering research community.
- PhD in earthquake engineering, Department of Civil and Environmental Engineering  
Thesis: *Seismic drift demands in steel moment resisting frames*  
Supervisor: Professor Ahmed Elghazouli, Head of the Structures Section

### University of Chile, Chile 2004–2012

- MSc in seismic engineering  
Thesis: *Experimental and analytical behaviour of welded T-shapes under cyclic loading*
- Diploma in civil engineering
- B.Sc in applied science

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## PUBLICATIONS

### Peer-reviewed journals

- Bravo-Haro M, Liapopoulou M, and Elghazouli AY. *Collapse capacity assessment incorporating duration and stability effects*. Submitted and under review. 2019.
- Bravo-Haro M and Elghazouli AY. *Influence of earthquake duration on the response of steel moment frames*. Soil Dynamics and Earthquake Engineering. Elsevier. DOI: [10.1016/j.soildyn.2018.08.027](https://doi.org/10.1016/j.soildyn.2018.08.027). 2018.
- Bravo-Haro M and Elghazouli AY. *Permanent seismic drifts in steel moment frames*. Journal of Constructional Steel Research. Elsevier. DOI: [10.1016/j.jcsr.2018.06.006](https://doi.org/10.1016/j.jcsr.2018.06.006). 2018.
- Bravo-Haro M and Elghazouli AY. *Drift and rotation demands in steel frames incorporating degradation effects*. Bulletin of Earthquake Engineering. Springer. DOI: [10.1007/s10518-018-0389-6](https://doi.org/10.1007/s10518-018-0389-6). 2018.
- Tsitos A, Bravo-Haro M and Elghazouli AY. *Influence of deterioration modelling on the seismic response of steel moment frames designed to Eurocode 8*. Earthquake Engineering & Structural Dynamics. DOI: [10.1002/eqe.2954](https://doi.org/10.1002/eqe.2954). 2017.
- Bravo-Haro M and Herrera R. *Performance under cyclic load of built-up t-stub for double T moment connections*. Journal of Constructional steel research. Elsevier. DOI: [10.1016/j.jcsr.2014.08.005](https://doi.org/10.1016/j.jcsr.2014.08.005). 2014.
- Herrera R, Bravo-Haro M, Gómez G and Aedo G. *Performance of built-up T-stubs for Double T moment connections*. Journal of Constructional Steel Research. Elsevier. DOI: [10.1016/j.jcsr.2013.05.022](https://doi.org/10.1016/j.jcsr.2013.05.022). 2013.

## Conferences

- Elghazouli AY. and Bravo-Haro M. *Towards improved seismic design procedures for steel structures*. Society for Earthquake and Civil Engineering Dynamics Conference, SECED. Keynote Presentation. London, UK. 2019.
- Bravo-Haro M and Elghazouli AY. *Open-source low-cost sensor for vibration monitoring*. Society for Earthquake and Civil Engineering Dynamics Conference, SECED. London, UK. 2019.
- Liapopoulou M, Bravo-Haro M and Elghazouli AY. *Ultimate seismic performance of degrading structures*. Society for Earthquake and Civil Engineering Dynamics Conference, SECED. London. 2019.
- Liapopoulou M, Bravo-Haro M and Elghazouli AY. *Incorporating duration effects in design collapse capacity spectra of ductile systems*. Society for Earthquake and Civil Engineering Dynamics Conference, SECED. London. 2019.
- Sahin B, Bravo-Haro M and Elghazouli AY. *Finite element based deterioration modelling of composite beams for european steel profiles*. Society for Earthquake and Civil Engineering Dynamics Conference, SECED. London. 2019.
- Bravo-Haro M and Elghazouli AY. *Influence of ground motion duration on the seismic response of steel moment frames*. 16th European Conference on Earthquake Engineering. Thessaloniki, Greece. 2018.
- Bravo-Haro M, Tsitos A, and Elghazouli AY. *Influence of deterioration modelling on local deformation demands in steel moment frames*. 8th European Conference on Steel and Composite Structures. Copenhagen, Denmark. 2017.
- Bravo-Haro M, Tsitos A, and Elghazouli AY. *Influence of cyclic degradation on inelastic seismic demands in steel moment frames*. 16th World Conference on Earthquake Engineering. Santiago, Chile. 2017.
- Bravo-Haro M, Muñoz A, Rojas E and Sarrazin M. *Evaluation of kinetic energy on rocks ejected during rock bursting through image processing of compression tests. "El Teniente" mine case*. 9th International Symposium on Rockbursts and Seismicity in Mines. Santiago, Chile. 2018.
- Bravo-Haro M and Herrera R. *Cyclic behavior of welded T-shapes for Double Welded T-connections*. Behaviour of Steel Structures in Seismic Areas, STESSA. Santiago, Chile. 2012.

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## TEACHING AND SUPERVISION

### Teaching Assistant

- University of Chile  
Structural steel design (Fall, 2010), Dynamic of structures (Fall, 2011), General geophysics (Fall 2011), Dynamic of structures (Spring, 2012), Structural Analysis (Spring 2010), Seismic design of structures (Spring, 2010), Structural steel design (Fall, 2011), Advanced dynamic of structures (Fall, 2011).
- Imperial College London  
Dynamic of structures (Spring, 2016), Dynamic of structures (Spring, 2017).
- Rose School, Pavia, Italy  
Seismic design of steel structures (May-June, 2017).

## Students Co-supervision

IMPERIAL COLLEGE LONDON

PhD Students

- Maria Liapopoulou, Phd Thesis. Imperial College London, commenced on 2018.
- Burak Sahin, Phd Thesis. Imperial College London, commenced on 2018.

MSc Students

- Xiapeng Ding, MSc dissertation. Calibration of an open-source low-cost sensor for measurement of vibrations. Ongoing, 2019.
- Jorge Cisneros, MSc dissertation. Inelastic drift demand on steel structures. Ongoing, 2019.
- Roberto Virreira, MSc dissertation. Inelastic displacement ratios for non-structural components in steel moment resisting frames. Ongoing, 2019.
- Maria Liapopoulou, MSc dissertation. Seismic collapse capacity assessment incorporating duration effects. Imperial College London, Summer term 2018.
- Xinzhi "Annie" Tang, MSc dissertation. Influence of the magnitude of tributary area on the capacity of the steel structure. Imperial College London, Summer term 2018.
- Demetris Demetriadis, MSc dissertation. Examination of deterioration parameters for equivalent single degree of freedom systems. Imperial College London, Summer term 2018.
- Fotios Andris, MSc dissertation. Seismic performance of composite moment-resisting frames including degradation. Imperial College London, Summer term 2018.
- Carlos Moscoso, MSc dissertation. Optimisation of relative stiffness storey ratio ( $\beta$ ) incorporating cyclic degradation and ground motion frequency content. Imperial College London, Summer term 2017.
- Thomas Greenleaf, MSc dissertation. Influence of strong motion duration on inelastic displacement demands of cyclically degrading steel structures. Imperial College London, Summer term 2017.
- Cai Chen, MSc dissertation. Structural assessment and rehabilitation of steel structures codes comparison. Imperial College London, Summer term 2016.
- Giorgos Haralambous, MSc dissertation. Seismic assessment of existing steel moment resisting frames and local deformation demands. Imperial College London, Summer term 2016.

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### EDUCATIONAL AND RESEARCH TOOLS AND PROJECTS

## Selected Projects and Tools

- Open-Source Web-App for the processing of earthquake strong motion recording information. Currently under development, this tool aims to contribute to the understanding of some cornerstone concepts in Earthquake Engineering, such as Elastic and Inelastic Response Spectrum. Besides, offers the possibility of visualising and processing strong-motion data on the fly. The processing involves baseline corrections, filtering techniques, among others; that are indispensable for several methods in Earthquake Engineering practice and research. More tools to be set upon the current building blocks are coming soon, as the computation of rotated spectrum, correction and filtering of several records at once, ground motion selection records based on seismic hazard, among others. You can already play with it here:  
[Processing of Strong-Motion Data](#)

- Open-Source Seismic Hazard Curves Web-App for the computation of seismic hazard based on novel intensity measures (IMs). The merits of the spectral acceleration of the fundamental period,  $S_a(T_1)$ , are incontestable. However, for collapse risk assessment, novel IMs have been shown to perform better (i.e., efficiency and sufficiency). As is the case of the spectral acceleration averaged over a period range,  $S_{a_{avg}}$ . However, the development of probabilistic seismic hazard information in terms of these novel IMs is needed, and this endeavour is on that direction. This is an ongoing project in collaboration with Professor Eduardo Miranda and PhD Student Pablo Heresi from Stanford University. More information in the following links:  
[Hazard Curves and Uniform Hazard Spectra \(UHS\)](#)  
[Hazard Maps](#)
- Construction, calibration and documentation of a small low-cost and open-source shaking table. More Information here: [Shaking Table](#)
- Construction and calibration of a large reaction frame for cyclic loading test. More Information here: [Experimental Campaign](#)
- Web-app for supporting teaching of complex concepts through interactive coding and visualizations. More Information: [MDOF Web-App](#), [SDOF Web-App](#)

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## SKILLS AND EXPERIENCES

### Structural Engineering

- Finite elements, large-scale numerical models, parallel computing, design and assessment of structures, Pushover, Nonlinear time-history, Incremental dynamic analysis, Fragility curves, nonlinear regressions, Statistical analysis.

### Computer Science and Probabilistic methods

- Machine learning, neural networks, optimization, numerical sampling methods, statistical inference, image processing.

### Hardware and Control System

- Arduino boards, Raspberry Pi, Simulink, and LabVIEW

### Engineering Software

- OpenSEES, SAP200, ETABS, Ansys, Abaqus, and AutoCAD.

### Programming Languages

- Matlab, Python, Fortran, Tcl, Java, Javascript, C, C++, Processing IDE, Arduino IDE, TensorFlow (library), CSS, and HTML.

### Spoken Languages

- Spanish (native), English (advanced), German (elementary).

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## WORKING EXPERIENCE

- Civil Engineering practitioner in [S y S Engineers](#), a firm established nearly 40 years ago in Chile, by Rodolfo Saragoni and Mauricio Sarrarín, both professors in the Civil and Environmental Department of the University of Chile. I took part on more than a dozen of projects ranging from seismic design and assessment of industrial and civil structures to complex research projects

to shed some light on physical phenomena, as the rock bursting in public subterranean copper mines.

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#### **FUNDING AND AWARDS**

- EEFIT Research Grant. The Institution of Structural Engineers, United Kingdom. 2018.
- MEEES Scholarship, ROSE School, Pavia, Italy. 2017.
- OC Trust PG, Imperial College London. 2017.
- PhD Scholarship, National Council of Science and Technology, Chile (CONICYT). 2014 - 2018.
- Ismael Valdés Valdés Award. Best three graduated students per university at national level. National Institute of Engineers, Chile. 2013.