

Flagship 2: Liquefaction impacts on land and infrastructure

This flagship will develop new approaches and methodologies for quantification of impacts of soil liquefaction on infrastructure through a fundamental understanding of onset and consequences of liquefaction; and use these methods to assess liquefaction impacts throughout NZ and their potential to be mitigated. These novel methods will represent a major advance in the field, and will provide means for a robust assessment and treatment of liquefaction hazards at both site-specific and regional levels. The key thrust areas are:

1. Development and improvement of liquefaction assessment methods (Liquefaction Evaluation: Beyond Current State-of-Art- and -Practice). Utilize the exceptional databases compiled during Canterbury and Kaikoura earthquakes, and obtain additional high-quality data where needed, to develop new or improve existing liquefaction evaluation procedures (field, laboratory and analytical tools and methodologies) that will adequately address current and future society needs for performance of land and infrastructure during earthquakes.
2. Identify critical issues and ground conditions related to liquefaction impacts on infrastructure, including characterization of important but challenging NZ soils, and the development of adequate assessment procedures and cost-effective mitigation strategies.
3. Development of performance based criteria for micro systems (e.g. soil deposits; soil-foundation-building systems) and macro systems (urban areas; land use and development) and lifeline networks, integrating geotechnical engineering knowhow within cross-disciplinary tools and methodologies.

Thrust Areas	Key tasks/Deliverables	Start	Finish	Coordinated Flagship Projects (2018 – (draft – under edevelopment)
FP2.1 Liquefaction Evaluation: Beyond Current State-of-Art-and-Practice	1. Develop methodologies for assessment of liquefaction susceptibility and triggering; liquefaction-induced ground deformation	1/01/2016	31/12/2020	P1/T1: “System response of liquefiable deposits” – identification and quantification of key mechanisms and effects; incorporation in simplified liquefaction evaluation procedures (Is: MC, NN, AR, SvB)
	2. Integrate field, laboratory and computational tools to develop next-generation liquefaction methods and procedures.	1/01/2016	31/12/2020	
FP2.2 Liquefaction Vulnerability of NZ Land and Infrastructure	1. Examine, through field and laboratory investigation, typical NZ soils that are challenging for liquefaction assessment (silty soils, pumiceous soils and gravelly soils; soil composition, soil micro-structure, ground conditions, details, overall deposit characteristics)	1/01/2016	31/12/2019	P1/T2: “Liquefaction behaviour of Christchurch sands and silty soils in simple shear” (Is: MC, CC; AB)
	2. Compile, summarise and interpret historical evidence of liquefaction in NZ (paleo-liquefaction studies)	1/01/2016	31/12/2018	P1/T3: “Liquefaction characterization of gravelly fills” – CPT and Vs/Vp characterization; simplified analyses; seismic effective stress analyses; laboratory testing of gravelly soils (Is: MC, CdIT, ...)
	3. Develop liquefaction assessment procedures for challenging soils	1/01/2018	31/12/2020	
	4. Enhance observations from Canterbury and Kaikoura earthquakes with experimental and analytical studies to improve performance assessment of characteristic infrastructure	1/01/2016	31/12/2020	P2: “Dynamic Characterisation of Pumiceous Deposits” - high-quality sampling; quantify pumice contents of in-situ materials; small strain moduli (Is: RO, MS, MP, MC, SvB, VM, BA) P3: “Historical evidence of liquefaction in NZ” (Is: SvB, MC, SB, LW, masters students)
FP2.3 Liquefaction Assessment and Mitigation: Systems Approach	1. Develop assessment methodologies for micro and macro systems: Soil-foundation-building system (shallow and pile foundations); building-soil-building systems; bridge system	1/01/2017	31/12/2020	P1/T4: “Seismic effective stress analyses of soil-structure systems” – wharves, buildings on shallow and deep foundations (Is: MC, NN, CdIT, New PhD) P1/T5: “NZ Tools and Procedures for Seismic Effective Stress Analysis” (Is: MC, CM, CH, MS)
	2. Evaluate liquefaction impacts on spatially distributed systems and networks (transportation networks; pipe networks)	1/01/2019	31/12/2020	
	3. Develop a framework for performance based criteria incorporating planning, management, operational, owner and user’s perspectives in engineering evaluations of liquefaction impacts	1/01/2019	31/12/2020	

P# = Project Number; T# - Topic Number

Project 1: Advancement of Liquefaction Assessment Methodologies - Lead PI: Misko Cubrinovski

Project 2: Dynamic Characterisation of Pumiceous Deposits - Lead PI: Rolando Orense

Project 3: Historical evidence of liquefaction in NZ - Lead PI: Sjoerd van Ballegooy