European Commission

Horizon 2020
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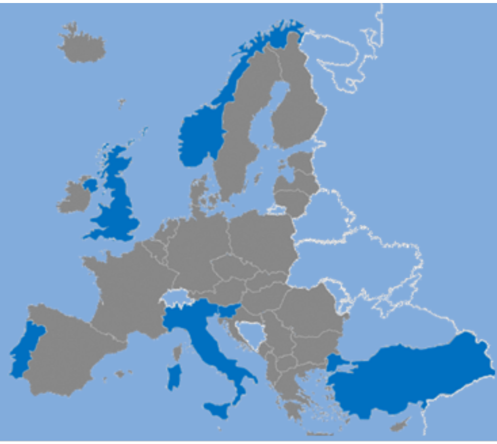
liquefACT



EARTHQUAKE INDUCED LIQUEFACTION RISK: HOLISTIC ASSESSMENT AND MITIGATION

Wednesday 20th June 2018 - 11:30-13:00

ROOM: CR2 (building M2 - Thessaloniki Concert Hall/16ECEE Conference Venue)

Liquefaction vulnerability of structures and infrastructures on liquefiable deposits

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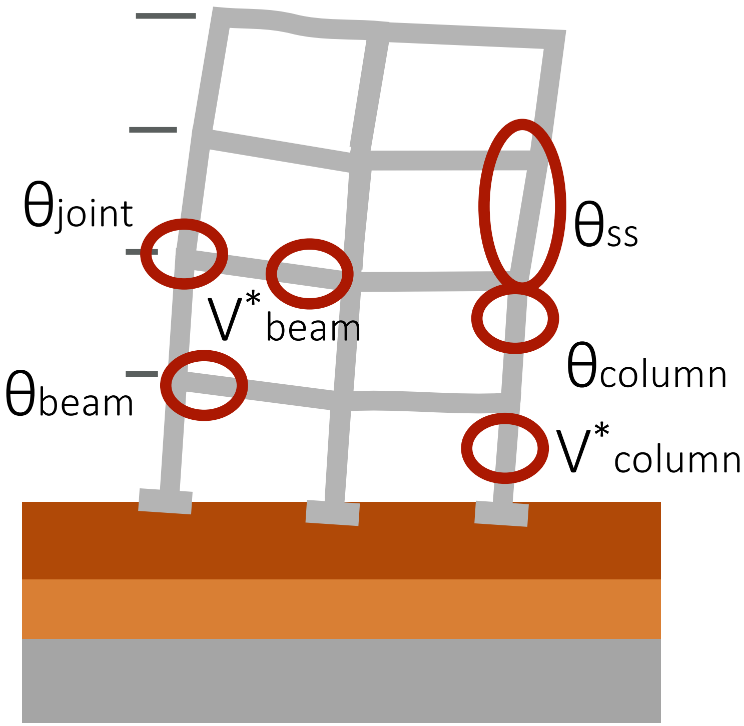
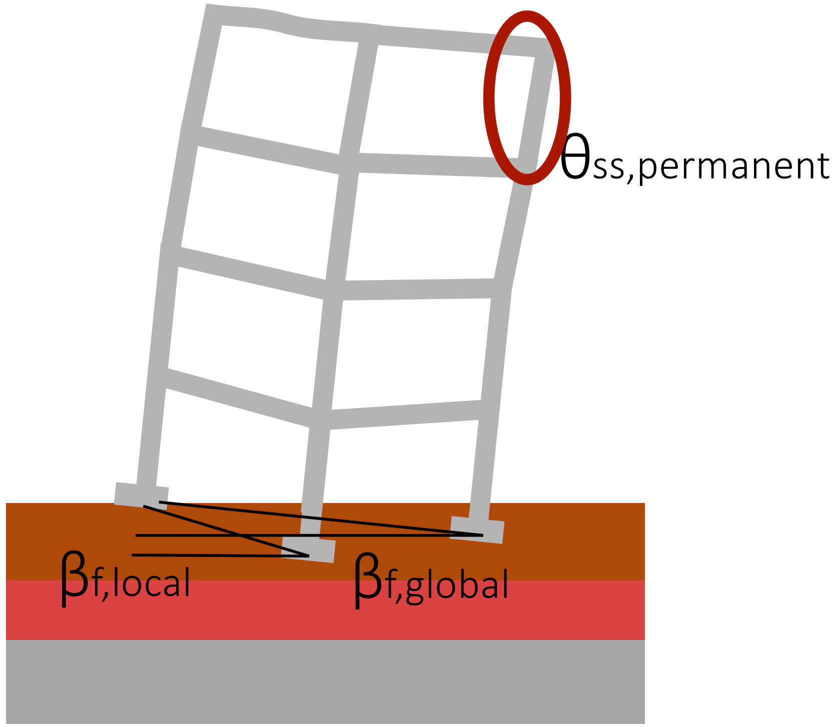
OUTLINE

- Goal
- Equivalent soil profiles
- Procedure to assess performance
- Moment-rotation response
- From soil to structure (Xavier Romão to continue)

Quantifying performance of buildings on liquefiable soil

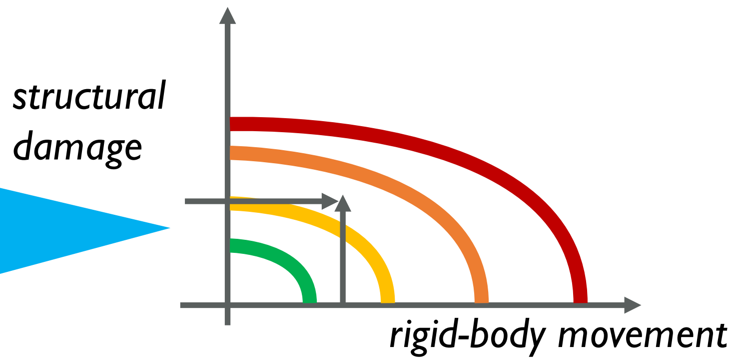


Dynamic performance



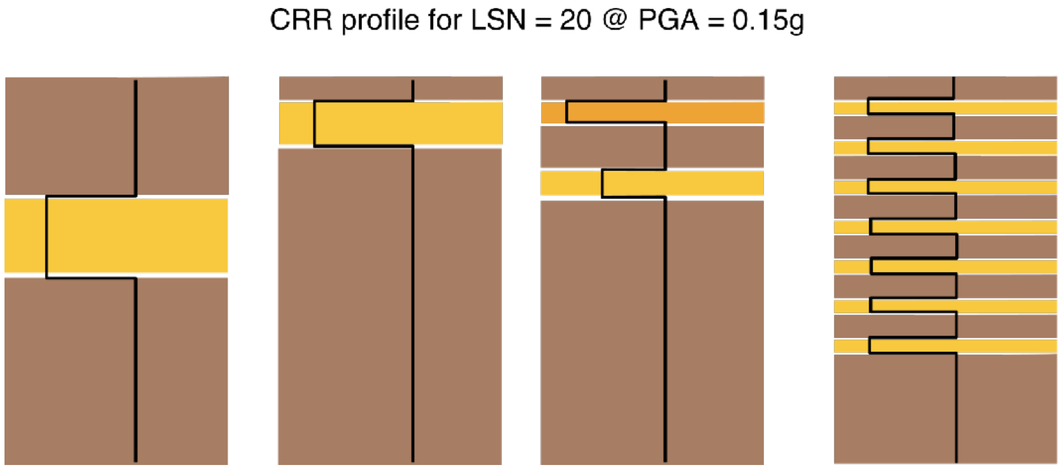
Residual performance

Combine the "damage" from structural deformation and rigid body movement



Quantifying liquefaction as a hazard

Issues with single value definitions



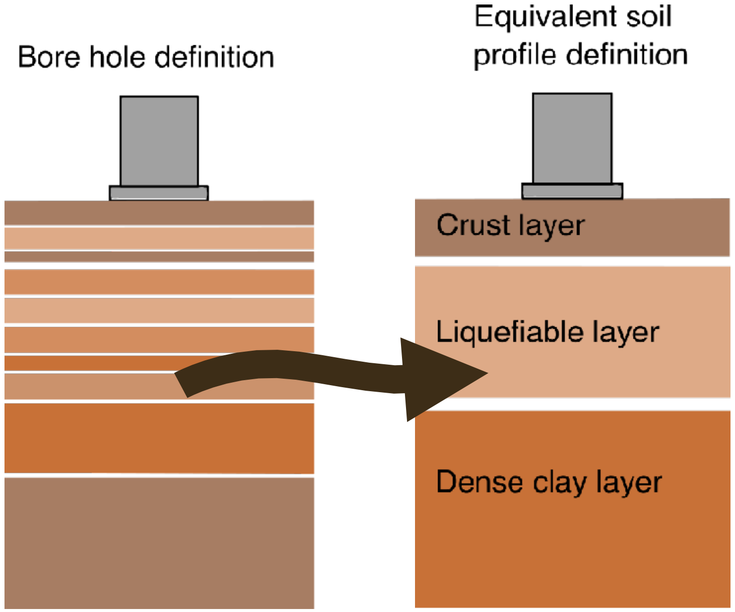
What level of differential settlement could be expected in the structure?

What level of shaking could be expected in the structure?

What level of soil-foundation stiffness could be expected?

- Difficult to validate for a single building as the soil profile is not uniquely defined
- Strong dependence on ground shaking
- Liquefaction can be beneficial and detrimental to performance

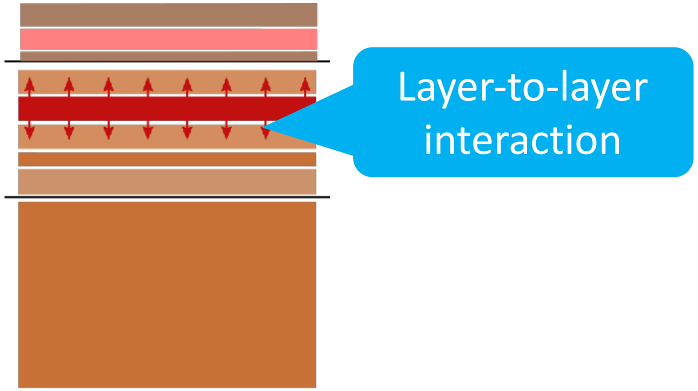
Why use an equivalent soil profile?



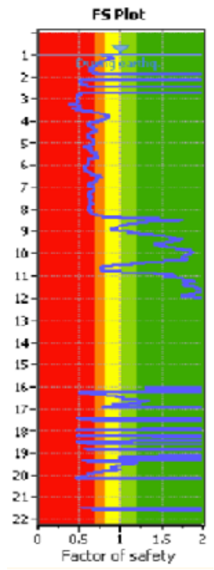
Practical reasons

- Easier to understand the mechanics
- More intuitive
- Faster (less parameters)
- Connects with existing literature
  - Dimitriadi et al. (2017)
  - Bray and Macedo (2017)
  - Karamitros et al. (2013)
- Some level of equivalent layering has to happen.

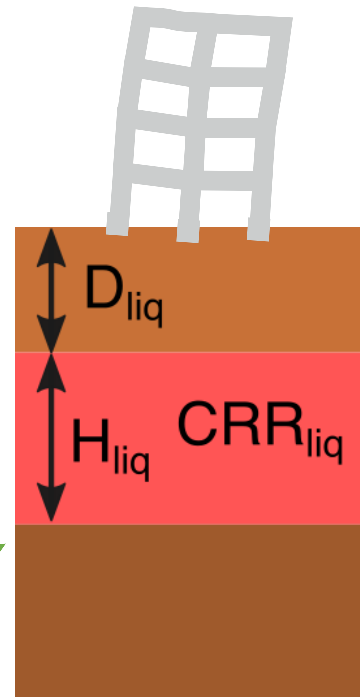
Physical basis

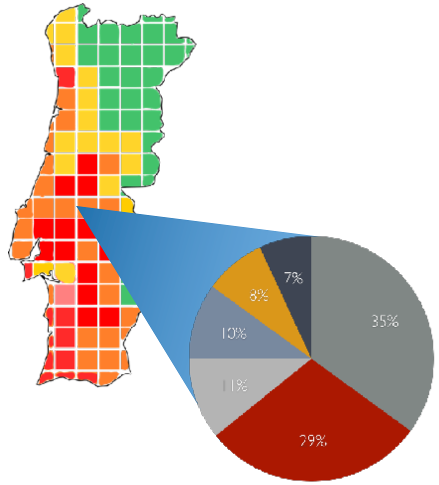


Connects to wider liquefaction research

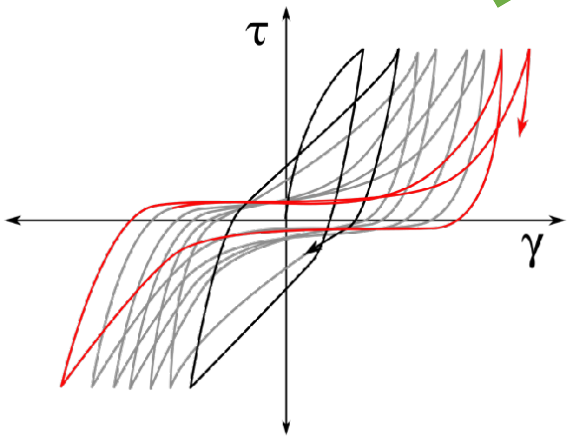


From CPT

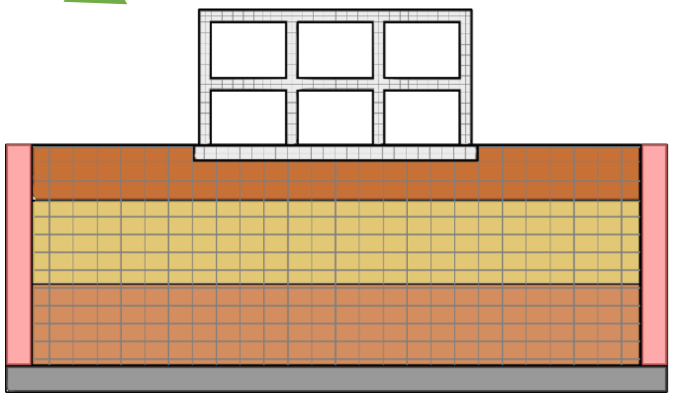




To and from macro-zonation



From lab tests



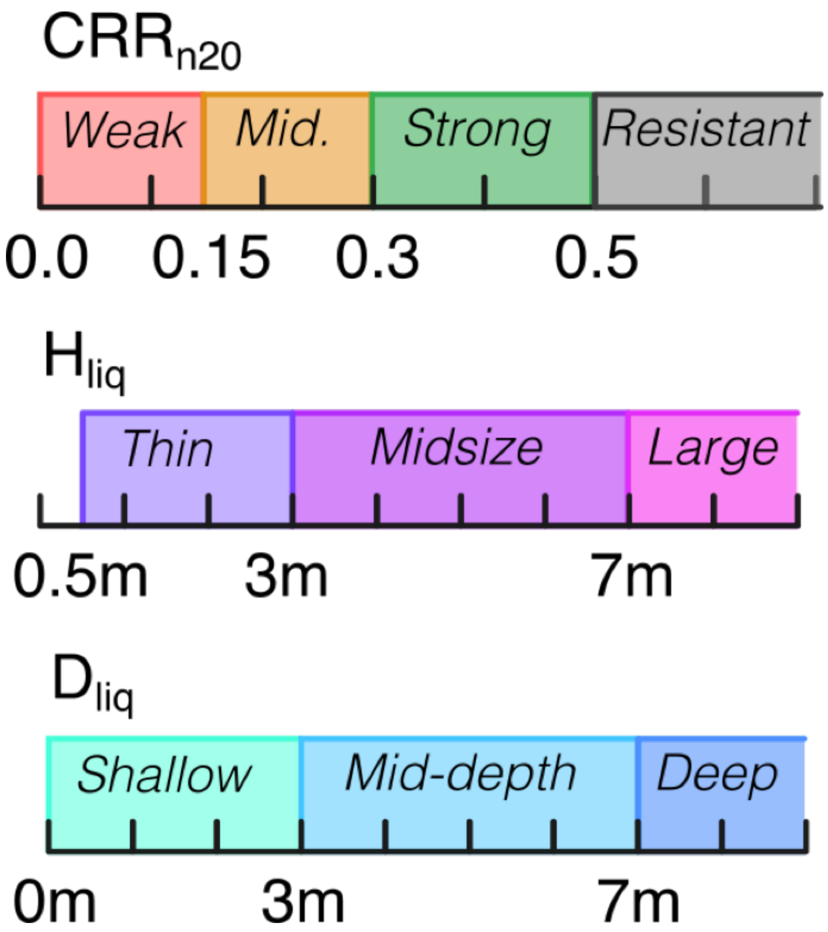
To and from numerical models

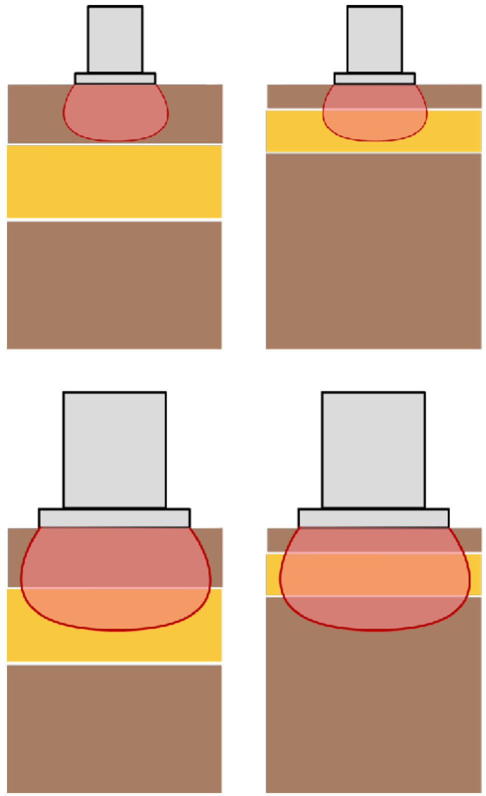
Soil profile classification for liquefaction

Proxy for time to liquefaction based on shaking hazard

Proxy for change in ground motion characteristics and bearing capacity/settlement

Proxy for change in ground motion characteristics and bearing capacity/settlement

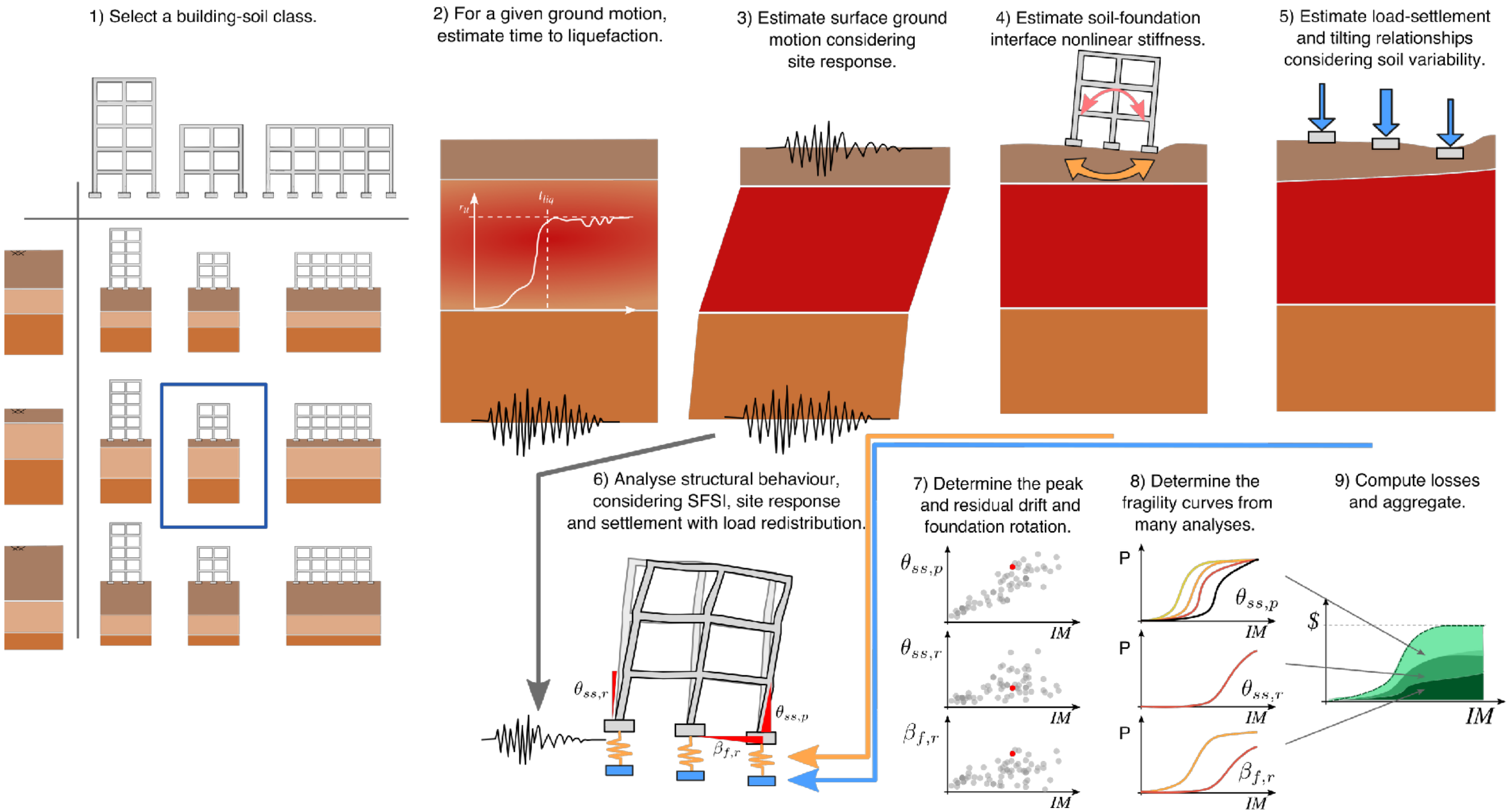




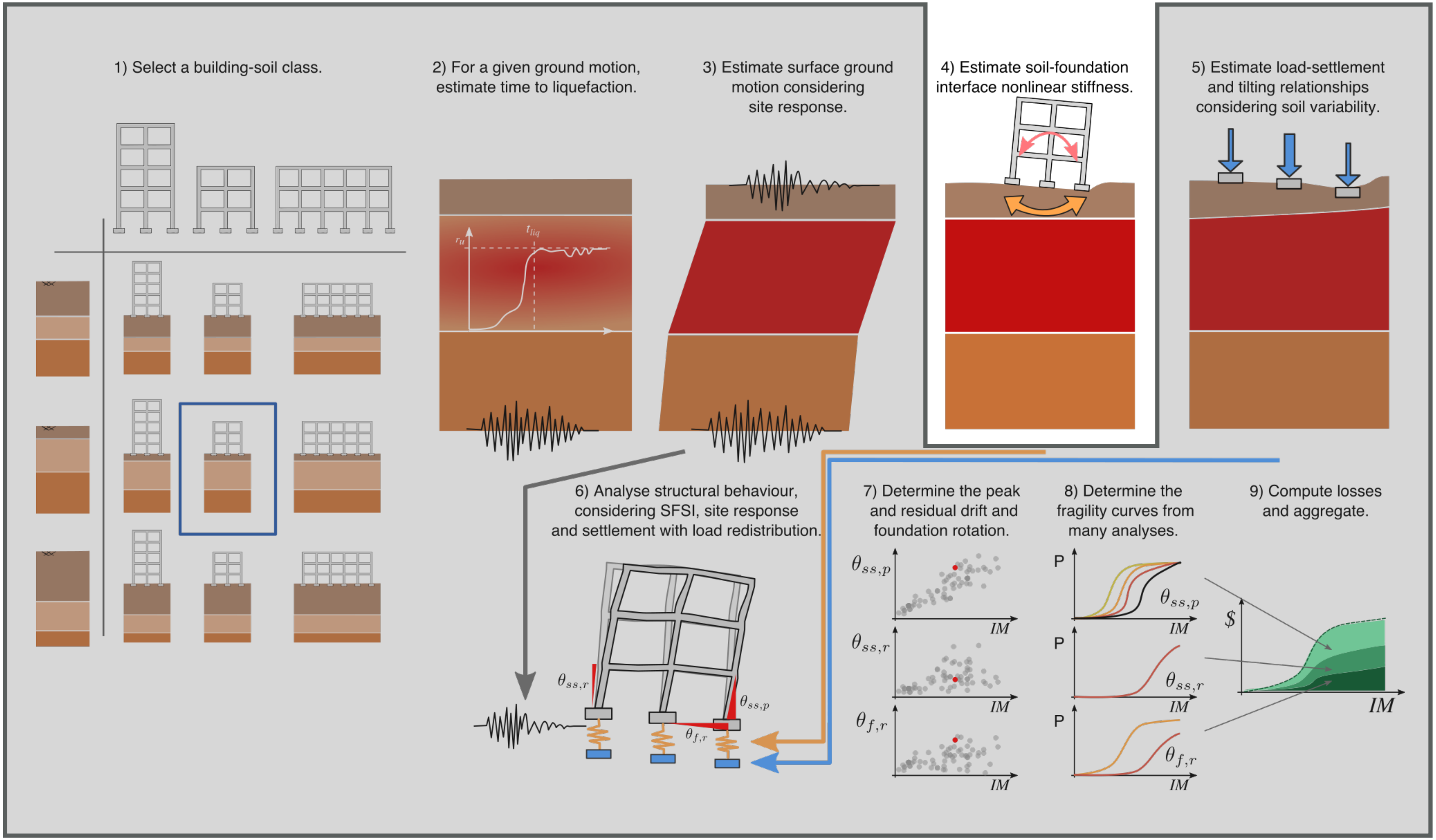
Strength - Size - Position

		Weak	Mid.	Strong	Resist
	Shallow	WLS	MLS		
Large	Mid.	WLM	MLM	SLX	
	Deep	WLD	MLD		
	Shallow	WMS	MMS		
Midsize	Mid.	WMM	MMM	SMX	RXX
	Deep	WMD	MMD		
	Shallow	WTS	MTS		
Thin	Mid.	WTM	MTM	STX	
	Deep	WTD	MTD		

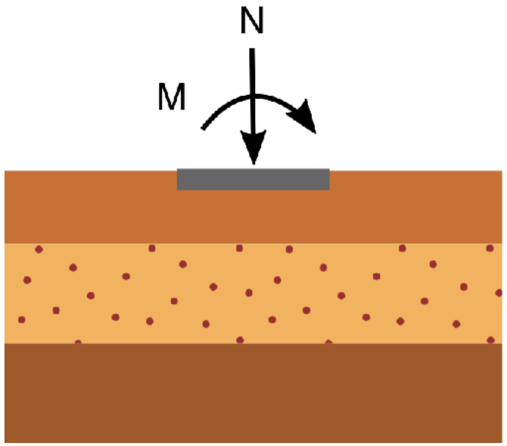
Procedure to assess loss

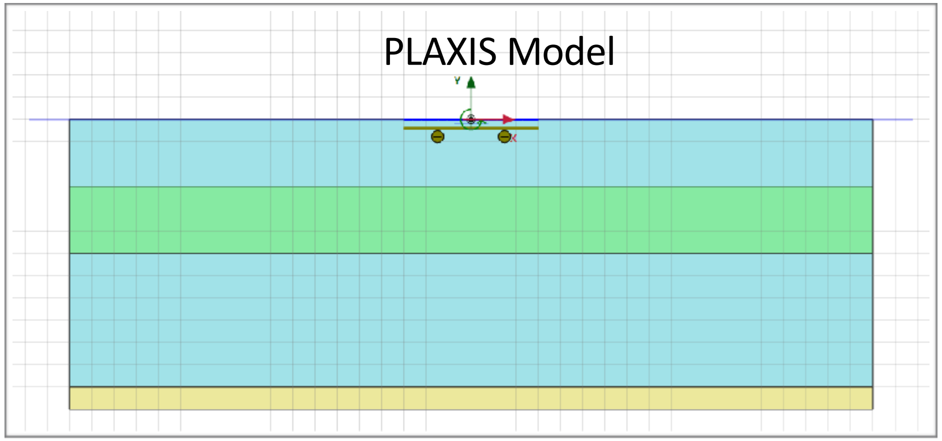


Individual study of each aspect

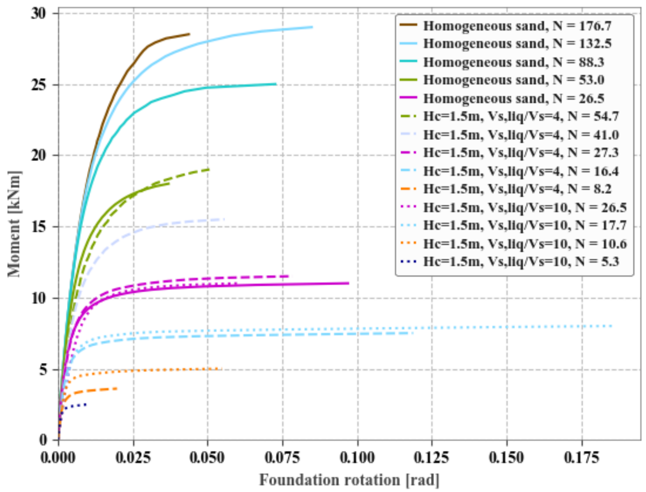


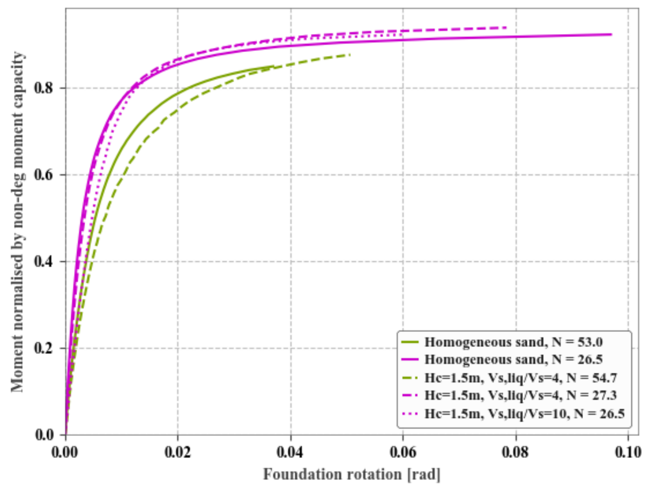
Extended study:Influence of liquefaction on non-linear foundation rotation



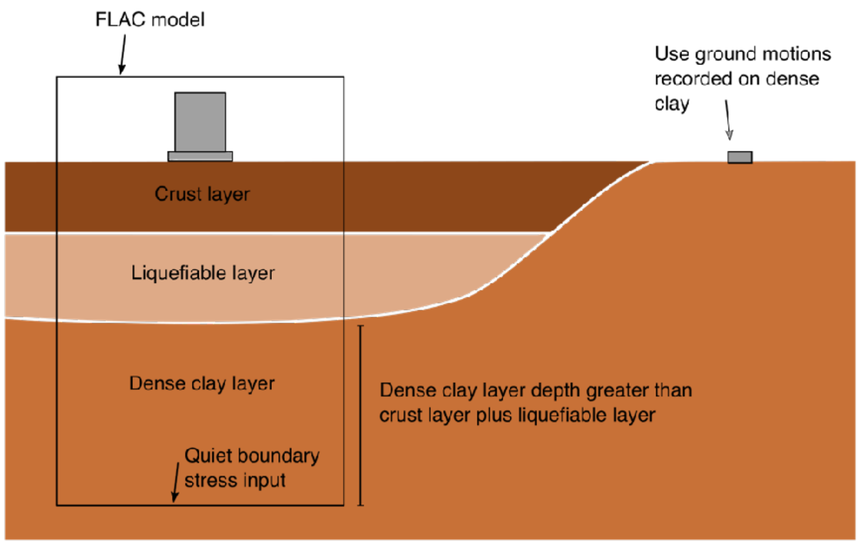


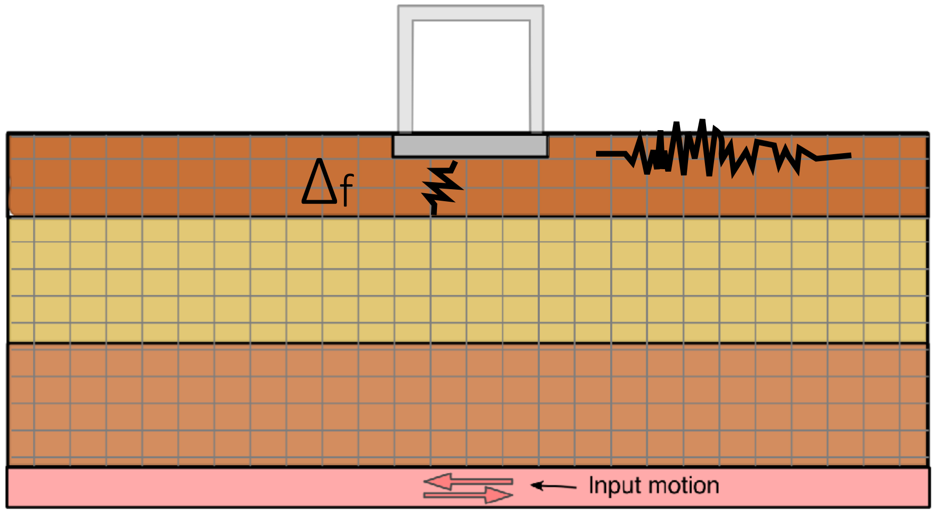
In many cases moment capacity is largely unaffected by liquefaction, but stiffness changes





Time history based approach



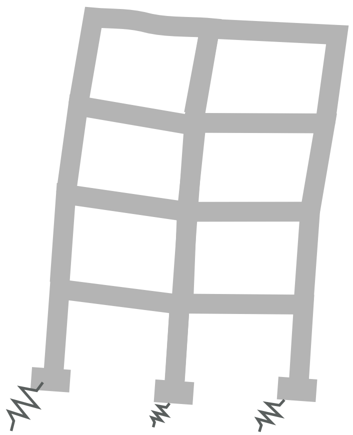


Problem definition

Model the soil system with a simple structure

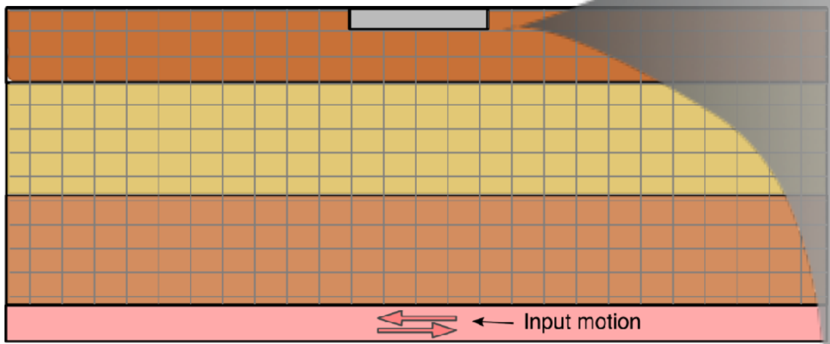
Extract time series of:

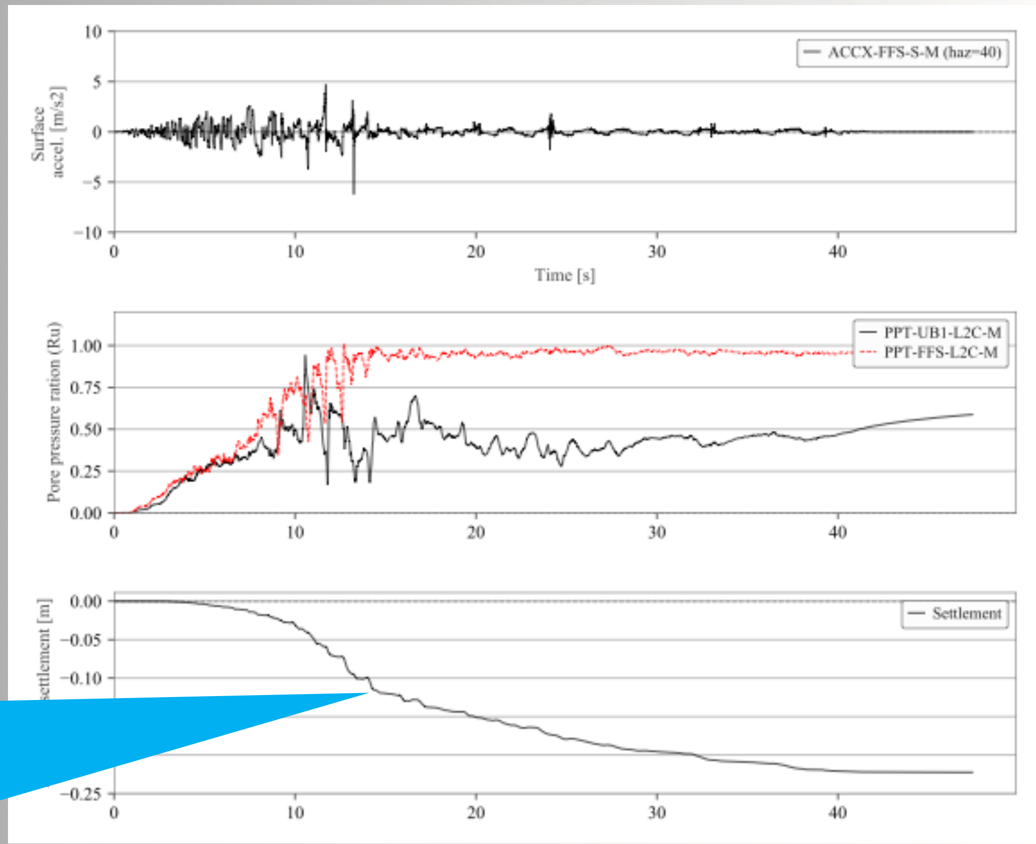
- Settlement
- Stiffness
- Surface shaking



Model the structural system

Outputs from FLAC to Opensees





Relationship with N, to account for load redistribution