



SEISMIC FRAGILITY OF GEOTECHNICAL COMPONENTS OF ROADS AND ITS IMPACT ON THE RESILIENCE OF TRANSPORTATION INFRASTRUCTURES

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Credits: 3 CFU

Number of hours: 24 hours

Date: 10, 11, 17, 18, 23 and 24 March 2026

Objectives:

Italy is characterized by high seismic hazard. Furthermore, due to the impact of climate change, secondary hazards such as landslides and floods occur at an increasing rate of occurrence. For this reason, it is urgent to improve Italy's societal resilience and disaster risk management strategies. Within this aim, the accessibility of the transportation networks is crucial to ensure prompt actions immediately after any natural disastrous event. This course analyses the most cutting-edge analytical tools to estimate damage and functionality loss of the geotechnical components of road networks after earthquake. Such tools are then implemented into a framework that leads to the calculation of the resilience of the whole network. Such framework is triggered by an expected, predicted, or just occurred hazard scenario. This helps identifying the most critical geotechnical components compromising the functionality of the network, due to their unsatisfactory performance. During the course, this framework will also be generalized to be applicable to other disastrous events.

Course programme:

Main topics are:

- Basic concepts of seismic resilience, hazard, and fragility
- Engineering demand parameters, damage scale, and functionality loss scale for road embankments and retaining walls
- Critical acceleration and simplified dynamic analysis of embankments and retaining walls
- Evaluation of transportation network performances and approaches to quantify the network-level impacts of disruptions

Assessment methods: Discussion on a synthetic report on the exercise solved during the tutorial.

Contact for information:

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Lectures Program

N	Date	Schedule	Teacher	Topic
1	10/03/26	10:00 - 12:00	F. de Silva	<ul style="list-style-type: none"> • Definition and quantification of system functionality function and resilience index. • Definition of safety margin function.
2	10/03/26	12:00 - 14:00	F. de Silva	<ul style="list-style-type: none"> • Definition of engineering demand parameters and classification of embankments and retaining walls supporting Italian road network. • Calculation of capacity curves of embankments and retaining walls.
3	11/03/26	10:30 - 12:30	F. de Silva	<ul style="list-style-type: none"> • Simplified dynamic analysis for the calculation of seismic induced permanent displacement.
4	11/03/26	13:30 - 16:30	P. Zimmaro	<ul style="list-style-type: none"> • Calculation of site specific and regional seismic hazard and hazard-consistent seismic scenarios.
5	17/03/26	11:30 - 13:30	F. de Silva	<ul style="list-style-type: none"> • Definition of damage scale for roads. • Scalar and vectorial approaches for the computation of seismic fragility curves of embankments and retaining walls. • Examples of application. • Brief description of seismic fragility curves of tunnels.
6	17/03/26	14:30 - 17:30	L. Pariota	<ul style="list-style-type: none"> • Modelling of transportation systems components (demand, supply, demand/supply interaction)
7	18/03/26	10:00 - 13:00	F. de Silva	<ul style="list-style-type: none"> • Definition of functionality loss scale for roads. • Definition of restoration functions. • Quantification of resilience index of retaining walls and embankment.
8	23/03/26	10:00 - 13:00	L. Pariota	<ul style="list-style-type: none"> • Criteria for the evaluation of network resilience • Quantification of network resilience by means of key performance indicators
9	24/03/26	14:30 - 18:30	F. de Silva - L. Pariota	<ul style="list-style-type: none"> • Exercise on the use of a platform for the calculation of the seismic resilience of a road network.