Course title: Robustness of Structures

Lecturer: Fulvio Parisi

Syllabus:

Civil engineering structures are increasingly subjected to extreme hazards, which are not usually considered in structural design and assessment. On one hand, such hazards have a very low probability of occurrence, and on the other, they are expected to produce huge consequences on people and property. Extreme events include but are not limited to natural events (e.g. landslides, floods, hurricanes), technological events (e.g. impact, fires, explosions), man-made events (e.g. malicious actions, human errors in design, construction or maintenance), deterioration phenomena (e.g. steel corrosion, concrete carbonation), and cascade events (e.g. natural-technological events). Climate change and strong urbanization in some areas have further exacerbated the occurrence of extreme hazards and their impact. This has significantly increased the awareness of governments and standardization bodies to develop guidelines for collapse prevention and provisions in national and international structural codes.

This course aims at providing fundamentals of structural robustness and large-displacement inelastic response of structures for their design and assessment under extreme hazards. Starting from forensic analysis of catastrophic failures in buildings and bridges, the course will move across several issues as follows: progressive and disproportionate collapses of structures; structural and non-structural measures for collapse risk mitigation; definitions of structural robustness; design criteria and detailing rules for structural robustness; guidelines and code provisions at both national and international levels; robustness quantification; modelling of abnormal loads due to extreme events; extreme structural behaviour during experimental tests; nonlinear structural modelling; performance limit states under extreme structural response; simplified and advanced methods for progressive collapse analysis; performance-based robustness design and assessment; scenario-based and probabilistic simulations; component-level and system-level fragility for progressive collapse risk assessment; multi-hazard design and assessment; and relationship between structural robustness and disaster resilience. Besides theoretical lectures, several case studies of structures subjected to notional local damage, specified abnormal loads or retrofitting operations will be discussed.

Assessment methods:

Oral exam with discussion of papers and design/assessment case studies.

Attendee requirements:

Fundamentals of Structural Analysis and Design; Fundamentals of Probability and Statistics.

References:

Papers and guidelines provided by the teacher.