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Experimentation and Design Analysis

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Introduction

The objective of earthquake engineering research is to advance the state of knowledge by conducting fundamental and applied research to assist decision-makers in reducing seismic risks. All entities and organisations influencing the planning and design/construction process, such as planning or regulatory agencies, owners, investors, and insurers, as well as the engineers who protect them through earthquake-resistant design are considered decision-makers.

Earthquake engineering is a multi-phased method that includes describing earthquake origins, determining site effects and structural response, and describing seismic safety measures. It includes occurrence modelling, geophysical modelling, ground-motion modelling, stochastic and nonlinear dynamic analysis, and architecture and experimentation.

Earthquake Engineering Centre has been focusing on seismic hazard and risk analysis for over 30 years. Modelling origins, incidence, and attenuation, as well as designing probabilistic hazard analysis methodologies using Poisson and Bayesian models, were the key focus of early work. In recent years, a lot of work has gone into applying mechanistic models to the incidence and attenuation phenomenon. To reflect the fault rupture dynamics and the stress accumulation and release cycles of major earthquakes, time- and spacedependent models have been introduced. Advanced analytical tools including geographic information systems (GIS) and database management systems (DBMS) have recently been used to collect, interpret, incorporate, and view tectonic, seismological, geological, and engineering information needed in seismic hazard assessment.

Ground motion modelling

The use of simulation of ground motion models for seismic hazard analysis, stochastic-physical rupture process models for ground motion prediction, prediction of ground motion for engineering applications, and study of the nonstationary characteristics of simulated and observed ground motions for nonlinear analysis are all areas of research in earthquake engineering. For simulating strong ground motion, various geophysical models are being considered, and historical motions from recent earthquakes are being analysed for their characteristics and damage potential. Recent seismological research has focused on the understanding and characterization of heavy near-field ground motion. For simulating strong ground motion, various geophysical models are being considered, and historical motions from recent earthquakes are being analysed for their characteristics and damage potential. Recent seismological research has focused on the understanding and characterization of heavy near-field ground motion.

Through a consistent and organised methodology, research studies on seismic hazard analysis, input and response characterization, structural reliability, and design are viewed as interrelated topics. The creation of damage models for structural response, classification of ground motions based on damage potential, reliability assessment, and seismic risk analysis are all major components of this study.

Experimentation and Design

Design analysis that can be specifically applied in engineering practise is receiving a lot of attention. This study provides the following approaches for evaluating and improving the conduct of new and existing structures in extreme earthquakes:

- The development of a seismic design methodology focused on deformation.
- P-delta impact and dynamic stability considerations.
- In plan and elevation, the effects of stiffness and strength irregularities are evaluated. Modeling of cumulative injury.
- Established systems can be retrofitted.
- Exploration of new earthquake-resistant structures and structural frameworks.

A laboratory with equipment for static and dynamic testing of structural materials, parts, and device models is part of the research facilities. Current structural testing is focused on improving health-monitoring technologies and validating computational models to predict dynamic nonlinear response of structures. Shaking table experiments are used to investigate structural collapse as a result of the dynamic interactions between degrading structural response and spontaneous earthquake input motions. Testing on a shake table is also a vital part of the research to create more durable wireless powerful motion sensors. Other projects include quasi-static testing of structural components and materials in order to assess fibre-optic sensors and look into the impact of localised failure mechanisms on structural performance.

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