Preface

The present volume comprises selected contributions from the Transactions of the Wessex Institute concerned with interactions between earthquakes and the soil through which they propagate. Soil composition and geomechanical features affect earthquake propagation and intensity while seismic shaking has a detrimental effect on soil properties and stability.

Tectonic trends are identified from various collected data such as seismicity rates, earthquake distribution, prevailing fault types; this leads to the identification of seismogenic source zones. Earthquakes originate from faults where creep deformation has been recognised as a possible cause. Instrumental monitoring allows the study of kinematics and dynamics of plate interactions. Analytical approaches whereby the laws of mechanics are combined with rigorous constitutive models lead to numerical predictions of fault behaviour; if properly validated, such modelling may provide approximate estimates of time and location of future earthquakes.

Comparison of observed consequences of the same earthquake to similar structures suggests association of seismic amplification with soil softness and compliance. This is confirmed by measurements of dynamic soil properties such as its shear wave velocity. The soil is dynamically characterised by collecting relevant data through extensive testing. Subsequent geotechnical analysis quantifies seismic amplification and indicates the potential of its catastrophic effect.

Seismic waves are modified by the presence of discontinuities, which are most commonly manifested as cracks in soil deposits. The effect of cracks is investigated analytically by adopting elastic or elasto-plastic constitutive models using boundary elements or finite differences, respectively. Material heterogeneity may also be taken into account. Another factor affecting seismic waves is damping and the issue addressed here is the difference in response predictions from hysteretic and viscous damping models. Hysteretic damping can also be included in poroelastic modelling of soil to provide the dynamic loading on man-made earth supporting structures such as retaining walls.

A substantial part of this volume is dedicated to soil liquefaction, an important consequence of seismic shaking resulting in substantial loss of soil strength and stiffness. Extensive damage due to earthquakes has been attributed to liquefaction; for this reason, criteria for assessing the liquefaction potential of a site have been proposed. Data collected from soil samples either in the laboratory or in situ are analysed to provide values for the critical parameters on which liquefaction depends leading to the assessment of seismic hazard for a particular site. "Surrogate" modelling or meta-modelling is an alternative empirical means of linking liquefaction potential to the vast amount of available soil test data. Advanced explicit modelling based on the mechanics of porous continua is also used as an analytical tool for predicting liquefaction phenomena.

Another potentially catastrophic consequence of earthquake-soil interaction is landslides. For this reason, the assessment of slope stability is of particular significance and is here achieved through a systematic geophysical and geotechnical characterisation of the soil mass followed by finite element modelling of the porous continuum. When the interest lies simply in the bearing capacity of the soil, this is directly obtained by laboratory testing of soil samples but it can also be predicted from reliable empirical relations generated by combining such test data with in situ measurements of soil dynamic properties.

The present volume provides focused insight and knowledge on the wide range of topics mentioned above; as such, it constitutes a valuable bibliographical resource on issues relating to the reliability of the soil as a foundation material in areas of high seismicity and the concomitant assessment of earthquake potential for catastrophic consequences.

Stavros Syngellakis
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