INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Dynamic Characterisation of Soils and Seismic Analysis of Deep Foundations**

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Thesis Submitted to the Department/ Center	:	**Civil Engineering**
Date of completion of Thesis Viva-Voce Exam	:	**23rd October, 2019**
Key words for description of Thesis Work	:	**Dynamic soil properties; laboratory element tests; shear modulus; damping ratio; ground response analysis; pile foundations**

SHORT ABSTRACT

Site-specific or region-specific strain dependent dynamic soil properties and liquefaction parameters are the primary input parameters required for efficient earthquake resistant design of structures. The present study aims to investigate the dynamic behavior of soils sampled from active seismic regions of India and establish region-specific comprehensive strain dependent design stiffness curves for use in earthquake geotechnical applications. The study also was targeted to demonstrate the application of experimentally obtained dynamic soil properties in seismic ground response analysis studies and seismic analysis of pile foundations. Four soils (two cohesionless soils and two cohesive soils) from Assam state of northeastern India (most active seismic zone in the country) and two cohesionless soil samples from Haryana state (moderate to intense seismic region) of northern India have been collected. A series of laboratory tests have been conducted on the collected soil samples using four independent high quality laboratory testing techniques (bender element tests, resonant column tests, dynamic simple shear tests and cyclic triaxial tests) with varying test parameters. Results obtained from each testing technique are combined and analyzed for obtaining comprehensive dynamic soil properties over wide range of shear strains (0.0001% to 5%) and liquefaction parameters. Region-specific empirical formulations have been proposed based on the experimental results. Test results indicate that the chosen cohesionless soils are prone to severe seismic liquefaction (in their loose condition) even for mild to moderate cyclic loading. Tested cohesive soils indicate the probability of cyclic mobility phenomenon (large strain accumulation, ≥10%) for high intensity cyclic loading. Seismic ground response analyses have been performed employing the established strain dependent dynamic soil properties and liquefaction parameters for four typical sites (three from Assam and one from Haryana). The results from this study point out that the mere utilization of empirical/literature based dynamic soil properties in seismic ground response studies may often underestimate (30 to 40% as observed from the current study) the seismic demands on the structures. Amplification of seismic waves have been observed for low intensity bedrock motions while high intensity bedrock motions attenuated at the surface due to the increased damping at large strains. Furthermore, seismic analysis of pile foundations (single pile and 2×2 pile group) has been performed employing the established soil properties and results from seismic ground response studies through Winkler beam approach. Excessive lateral displacements and bending moments of pile have been witnessed in the liquefiable zones due to the additionally induced lateral stresses by the liquefied ground. A sharp response shift (displacements and bending moments) was noted at the vicinity of liquefiable and nonliquefiable stratum owing to the stiffness contrast between the layers. The response of analysed pile group (2×2) indicated lesser peak displacements and reduced bending moments in comparison with the single pile due to the absence of pile-soil-pile interaction in liquefiable deposits. The work presented in the thesis can aid as a comprehensive strategic plan for seismic analysis of deep foundation supported structures or seismic requalification studies of existing important structures.