INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	JOY KUMAR MONDAL
Roll Number	:	176104112
Programme of Study	:	Ph.D.

Thesis Title: A Frequency Domain based Inverse Ground Response Analysis Framework for the Determination of Dynamic Soil Properties

Name of Thesis Supervisor(s)	:	Dr. Abhishek Kumar
Thesis Submitted to the Department/ Center	:	Civil engineering
Date of completion of Thesis Viva-Voce Exam	:	27.07.2023
Key words for description of Thesis Work	:	Local site effects, ground response analysis, inverse ground response analysis, modulus degradation curve, damping ratio curve

SHORT ABSTRACT

Effect of local soil in amplifying bedrock motion during earthquakes (EQs) is an important phenomenon, and is observed globally. As a result, the bedrock motion at times increases manifold while reaching the surface. Such amplification in ground motions due to local soil is termed as local site effect (LSE), and can numerically be quantified by performing ground response analysis (GRA). Understanding the effect of local soil requires information about subsoil type as well as shear strain dependent behaviour of each subsoil layer (known as dynamic soil properties curves or DSPCs). Literature suggests that DSPCs of local soil are not readily available at regional level. Due to this reason, while attempting to estimate LSE, majority of site-specific studies consider DSPCs developed for other region's soils. DSPCs, though can be determined using existing inverse GRA methodologies, critical review done in this work highlighted that most of the frequency domain studies target to determine change in shear modulus (G) with shear strain (γ) but no to very limited studies target to determine damping ratio (β) variation with γ (or β curve). Additionally, these methodologies are limited to finding out soil properties for the surficial layer only. During an EQ excitation however, each of such soil layers will behave distinctively.

In the light of above shortcomings in existing methodologies, the present thesis proposes frequency domain methodology employing seismic downhole arrays focusing on determining β curve for the surficial layer in particular. Later, the methodology is further modified to determine DSPCs (G/Gmax curve and β curve) for both the surficial layer and the layer below it. Further, a generalized methodology is developed that can be applied to multiple soil layer system to determine DSPCs of each layer involved. At each stage, the determination for DSPCs for Lotung downhole array site has been done.

For major infrastructure development in India, accurate assessment of LSE is must. However, since site-specific DSPCs are not available for most of the sites to do so. Hence, depending upon selected DSPC, different outcomes can be obtained from different set of DSPCs. Eliminating necessity for site-specific DSPCs for every site of interest, attempts are also made in this thesis work to develop four empirical correlations for Guwahati city, which when used with LGRA results, estimate results similar to ELGRA without selecting a particular DSPC and complete input motion.