



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

Name of the Student : Shiv Shankar Kumar

Roll Number : 126104027

Programme of Study : Ph.D.

Thesis Title: **Evaluation of dynamic response of soils subjected to regular and irregular excitations using cyclic triaxial tests**

Name of Thesis Supervisor(s) : Dr. A. Murali Krishna and Dr. Arindam Dey

Thesis Submitted to the Department/ Center : Civil Engineering

Date of completion of Thesis Viva-Voce Exam : 16/3/2018

Key words for description of Thesis Work : Dynamic response, Dynamic soil properties, liquefaction, Regular and irregular loading, Cyclic triaxial tests

---

**SHORT ABSTRACT**

Most of the damages during the seismic incidences are greatly influenced by the response of soils, which is governed by the dynamic properties of the soils and the pore-pressure variations. Assam (India), located in the North-eastern region of India, is one of the most seismically active regions in the world, has experienced several devastating earthquakes of different magnitudes in the past. In view of the above, the present study is focused to investigate the dynamic behaviour of cohesionless soil (Brahmaputra Sand, BS) and cohesive soil (Red Soil, RS) available in the Guwahati region, Assam. To evaluate the dynamic properties and liquefaction potential of the soils, strain-controlled as well as stress-controlled cyclic triaxial tests, with regular and irregular excitations, were conducted at different shear strain amplitudes ( $\gamma$ ), relative density ( $D_r$ ) and confining stress ( $\sigma'_c$ ). On-sample LVDTs were also used to measure the elemental response of soil during monotonic and cyclic loading. Both strain-controlled and stress-controlled tests on BS and RS revealed that the hysteresis loops obtained at high  $\gamma$  exhibited noticeable asymmetric nature. A modified methodology for the evaluation of dynamic properties has been proposed considering asymmetric hysteresis loops. Application of on-sample LVDTs during the cyclic tests aided in the determination of the shear modulus and damping ratio over a wide strain range, encompassing both low ( $\sim 3 \times 10^{-3}$  %) as well as high strains ( $\sim 5$  %). Based on the strain- and stress-controlled regular as well as irregular excitations, BS specimens are observed to liquefy under the following optimum conditions: peak ground acceleration (PGA)  $\geq 0.36g$ , cyclic stress ratio (CSR)  $\geq 0.3$  and  $\gamma_{max} > 0.5\%$  for  $D_r = 30-90\%$  and  $\sigma'_c = 50-150$  kPa. Therefore, the limiting value of  $\gamma = 0.5\%$  can be suitably adopted for the liquefaction potential evaluation studies for loose BS soil of North-eastern region of India. The results of the investigations, i.e. the strain dependent dynamic properties of BS and RS, were further used for the ground response analysis (GRA) of Guwahati city to manifest the importance and necessity of the experimentally determined dynamic properties of the regional soils.