Course Contents

Module 1: Introduction
Scope and objective; Nature and types of dynamic loading; Importance of soil dynamics

Module 2: Vibration Theory
Vibration of elementary systems; Degrees of freedom; Single degree of freedom system; Undamped and damped free and forced vibrations; Forced vibrations due to support motions; Rotating mass and constant force oscillators; Dynamic magnification factor; Phase; Non harmonic forced vibrations like step loading, impact loading, arbitrary loading etc.; Duhamel’s integral; Vibration Isolation; Vibration measuring instruments Introduction to MDOF systems.
Course Contents (contd.)

Module 3: Wave Propagation
Elastic response of continua (one, two and three dimensional wave equations); Waves in unbound media; Waves in semi-infinite media; Waves in layered media; Seismic waves; Characteristics of P-wave, S-wave, Rayleigh wave and Love wave; Estimation of epicenter of earthquake (travel time, 3-circle methods).

Module 4: Dynamic Soil Properties
Stiffness, damping and plasticity parameters of soil and their determination (laboratory testing, intrusive and non intrusive in-situ testing); Correlations of different soil parameters; Liquefaction (basics, evaluation and effects).

Module 5: Machine Foundations
Types of motion; MSD model and EHS theory; Vertical, sliding, torsional and rocking modes of oscillations; Coupled motion; Vibration control; Practical design considerations and codal provisions.

Module 6: Soil Improvement Techniques
Basic concept of soil improvement due to dynamic loading; Various methods; Mitigation of liquefaction.

Module 7: Dynamic Soil-Structure Interaction
Behaviour of shallow underground foundations due to dynamic loads; Dynamic earth pressure on retaining structures; Slope stability due to dynamic loads; Dynamic response of pile foundations; Behaviour of subgrade soil due to cyclic loads of railway, runway.
Reference Books:
Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Inc.

Additional Reading:
Various Journal papers and Conference Proceeding papers on related topics.

Course Outline:
This course "Soil Dynamics" discusses about the behaviour and properties/response of soil as a material subjected to the dynamic or cyclic time-dependent loading.

Also the design and principle for machine foundations comes along with this course to consider the dynamic properties of both soil and foundation as combined mass.

Behaviour of various geotechnical structures such as shallow and deep foundations, retaining structures, slopes, subgrade soil below railway, pavement, runway due to various types of time-dependent dynamic loading are discussed here with reference to codal provisions.
Audience/Target group for study:

This course material on soil dynamics will be very useful to undergraduate students, post-graduate students, researchers, teachers, consultants and practitioners.

Pre-requisite:

Knowledge of Basic Soil Mechanics/Fundamental Geotechnical Engineering.

Contact Details

Prof. Deepankar Choudhury
Department of Civil Engineering
Indian Institute of Technology (IIT) Bombay
Powai, Mumbai – 400076, INDIA.

Phone: +91-22-2576 7335 (O), 8335 (R)
Fax: +91-22-2576 7302

Email: dc@civil.iitb.ac.in
dchoudhury@iitb.ac.in

URL: http://www.civil.iitb.ac.in/~dc/
MODULE - 1

Introduction

Why this Course is Essential to study?

Objective of Study
Soil Liquefaction due to Earthquake

Devastating effect of earthquake by Liquefaction induced movement during Niigata 1964 earthquake.

Picture Courtesy: EERC library, UC Berkeley, USA
Devastating effect of earthquake by Liquefaction induced Bearing capacity failure during Turkey 1999 earthquake

Picture Courtesy: EERC library, UC Berkeley, USA

Devastating effect of earthquake on slope stability during Nevada 1954 earthquake

Picture Courtesy: EERC library, UC Berkeley, USA
Devastating effect of earthquake on pavement foundation during Chile 1960 earthquake

Picture Courtesy: EERC library, UC Berkeley, USA

Dynamic Loading

- What are the various types of dynamic loads?

  Dynamic loads may be of various types – e.g.
  1. Earthquake load,
  2. Wind load,
  3. Moving vehicle load,
  4. Guideway unevenness,
  5. Machine induced load,
  6. Blast load,
  7. Impact load etc.
Vibration

It is the process of continuous exchange of potential energy to kinetic energy and vice versa.

---

END of MODULE - 1

Introduction