Geotechnical Engineering Laboratory

Geotechnical Engineering Laboratory at Mahindra University aims to develop the student's knowledge to achieve sustainable solutions to meet design standards. The laboratory is well equipped to train students to conduct various experiments to understand the properties of various types of soils.

The services offered by the laboratory are:

- Academic: Train undergraduate students as a part of their curriculum, Undergraduate and Doctoral project works
- Research: Quality control of earthworks/pavement layers with NDT methods, Sustainable materials, Ground improvement with Geosynthetics, and soil stabilization.
- Consultancy: soil testing, soil-reinforcement load bearing analysis, and numerical modeling.

On-going research projects:

- Evaluation of Quality control parameters of earthworks in lab and field by using NDT methods in Geotechnical applications
- Evaluation of geosynthetic-reinforced pavements constructed with alternative materials
- Use of geosynthetics in Pavements over soft and expansive subgrades – A sustainable solution

Research expertise available with the laboratory:

- Dr. Hariprasad Chennarapu (Hari Prasad | Mahindra University)

Some of the recent undergraduate projects works performed in the laboratory:

- Load settlement response of circular footing resting on reinforced layer system
- Pullout resistance factors of Geosynthetic reinforcements embedded in sand by using Numerical analysis
- Quality control of earthworks using NDT Device

Equipment available in the laboratory:

The laboratory is well equipped with all the necessary instruments to test the basic properties and load-bearing capacity properties of soils like grain size distribution, Atterberg limits, specific gravity, free swell index, compaction properties, cohesion, angle of internal friction, permeability (variable head and constant head), consolidation, relative density, California bearing ratio (CBR), unconfined compressive strength (UCS). etc. along with the simulation software, Plaxis – 2D (Bentley package).

List of equipments:

S.No	Equipment name	Photo
1	Liquid Limit device (Casagrande type)	
2	Shrinkage Limit	
3	Sand Pouring Cylinder	
4	Cone penetrometer	
5	Core Cutter	
6	Motorized Sieve Shaker	

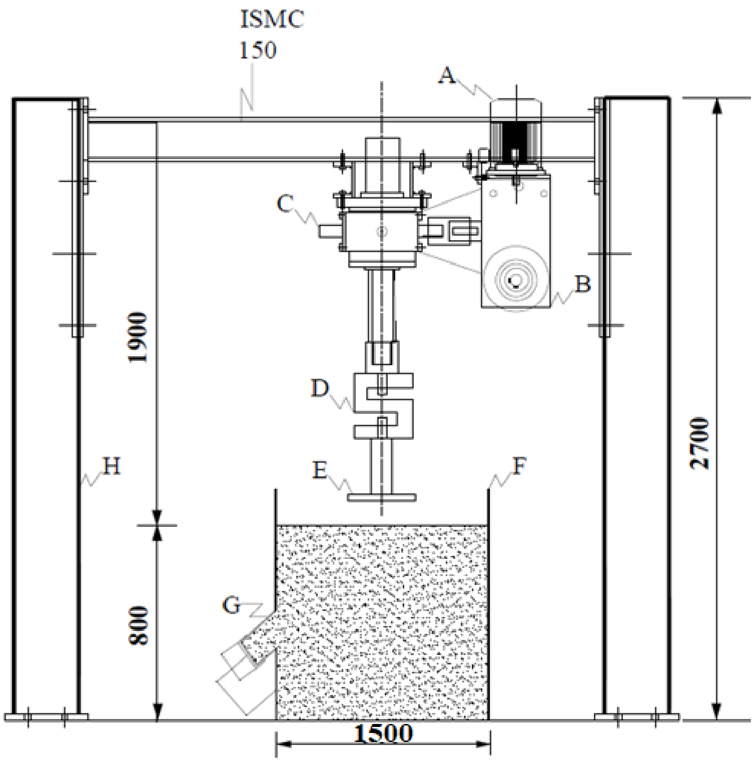
7	Hydrometer	
8	High-speed Stirrer	
9	Vane shear apparatus	
10	Hot-Air Oven	
11	Universal Permeameter	

12	California Bearing Ratio (CBR)	
13	Three Gang Bench Type Consolidometer (Front-loading)	
14	Unconfined Compression Machine	
15	Direct Shear Apparatus	
16	Relative Density	

Geotechnical Research Lab: Research Facilities

1. **Large-scale testing facility** for load bearing tests

A test chamber of size equal to 1.5 m x 1.5 m x 1 m will be used to study the behaviour of circular footing (to simulate the wheel load) resting on pavement layers. The reaction frame consists of four columns and two horizontal beams (Figure 1) to resist the applied loads. The diameter and thickness of the circular plate are equal to 300 mm and 20 mm, respectively. The static load tests will be conducted on the loading plate through an actuator.



A, B and C: Linear actuator with gear box set up, D: Load cell, E: Loading plate, F: Test chamber, G: Sand outlet, H: Reaction frame *(all dimensions given in the Figure are in mm)*

(a)

(b)

Fig. 1: Loading frame (a) cross sectional view and (b) photograph

The load applied on a circular plate in displacement-controlled mode with a rate of 1 mm/min. Displacement sensors linear variable displacement transducers (LVDT) are connected to measure the surface deformation. All sensors (load cell, strain gauges, and LVDT) will connect to the Data Acquisition system (DAQ) and the customized software records the data at every 30 seconds interval.

2. Lightweight Deflectometer device

LWD device is portable and used to calculate the deformation modulus of any layers of earthwork/pavement. The device consists of falling weight, loading plate, sensors, set of steel springs, etc. (as shown in Fig. 2). The falling weight is allowed to drop on a circular loading plate with a predetermined height of fall to measure the deformation modulus. In the proposed modified LWD device, three sensors are used to measure the deformation of the bearing plate. Integrated results from the three sensors use to measure the deformation modulus.

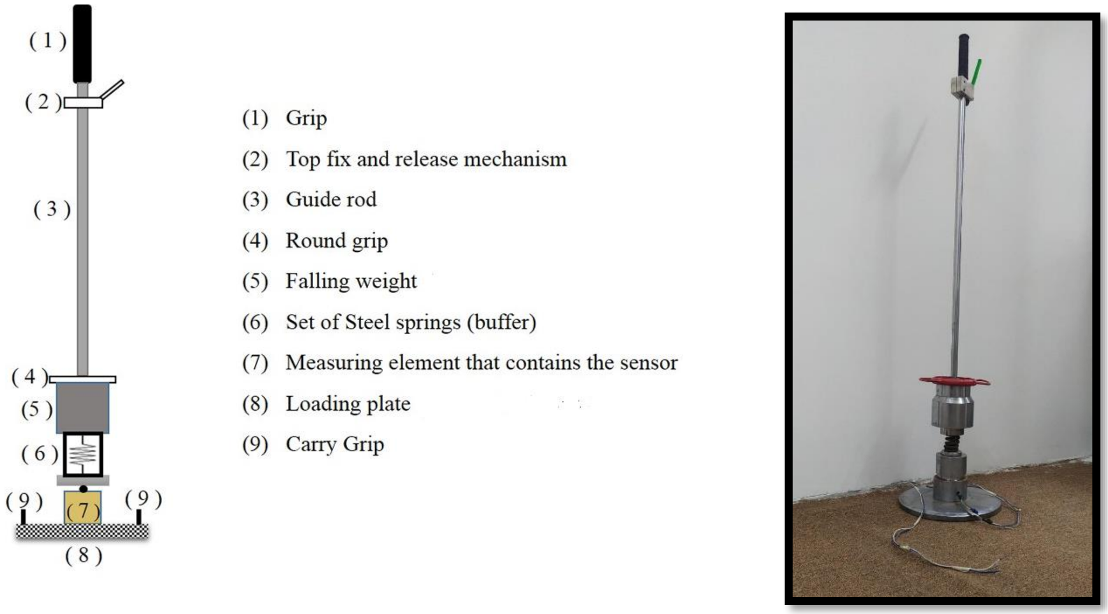


Fig. 2. Schematic diagram and photograph of LWD device

3. Large-scale direct shear apparatus

Direct shear apparatus will be used to calculate the shear strength parameters of soil, and interfacial properties of geosynthetic reinforcements. The shear box size equal to 500 mm x 500 mm x 300 mm (length x width x height), consists of two load cells, LVDTS to measure the loads and displacements respectively (refer to Fig. 3).

Fig. 3. Photograph of direct shear apparatus

4. Dynamic cone penetrometer (DCP)

DCP device will be used to assess the quality of compacted soil. DCP consists of an 8-kg hammer with a standard height of fall equal to 575mm (Fig. 4). The hammer is dropped on the anvil of the lower shaft and it consists of a cone with an apex angle of 60º. The hammer directly transfers the energy to the cone through the lower shaft. The inverted scale engraved on the lower shaft is used to measure the penetration of the cone per each blow. Initially, seating blows are given to ensure that the wider portion of the cone is flush with the compacted surface, and the depth of penetration of cone corresponding to each hammer blow is recorded. The results are expressed in terms of dynamic penetration index, DPI.

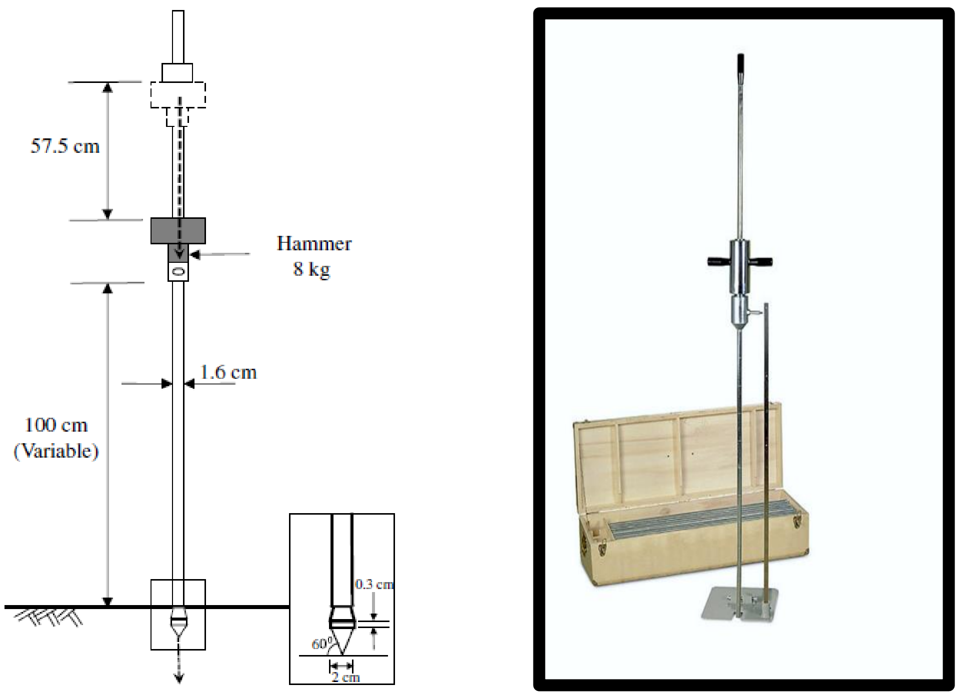


Fig. 4. Schematic view of dynamic cone penetrometer

5. Numerical modelling (Plaxis 2D)

Plaxis 2D can be used to simulate the various geotechnical and transportation-related problems.

Research Scholars in Geotechnical Engineering Laboratory:

S.no.	Name and Photograph	Area of Research	Research topic
1	**Sidhu Ram D** 	• Quality control using NDT Devices • Soil-Reinforcement interaction	Evaluation of Quality Control Parameters in Laboratory and Field using NDT Methods in Pavement Engineering Applications
2	**Vamsi Kommanamanchi** 	• Sustainable materials and stabilization • Geosynthetics	Evaluation of geosynthetic-reinforced pavements constructed with C&D waste
3	**Prabodh Kumar M** 	• stabilization	Use of Geosynthetics in pavements over soft and expansive subgrades: A sustainable solution