Geotechnical Engineering & GeoPave Research Lab

Geotechnical Engineering Laboratory at Mahindra University aims to develop the students' 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.

Ongoing 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:

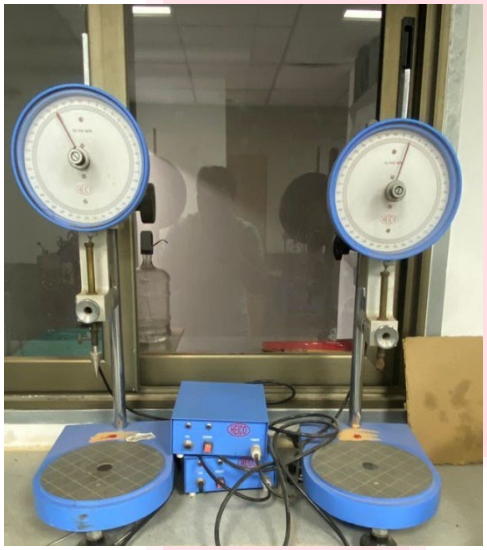
- Dr. Hariprasad Chennarapu (Hari Prasad | Mahindra University)

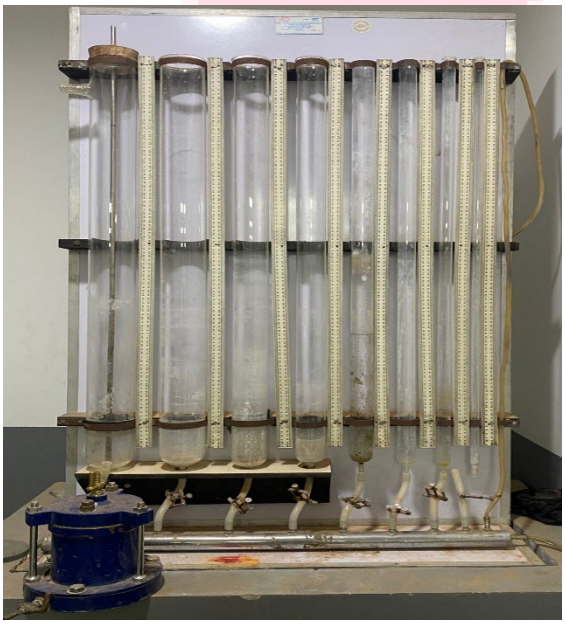
Some of the recent undergraduate project works performed in the laboratory:

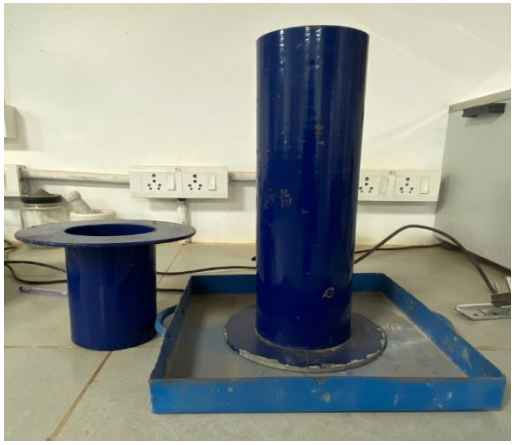
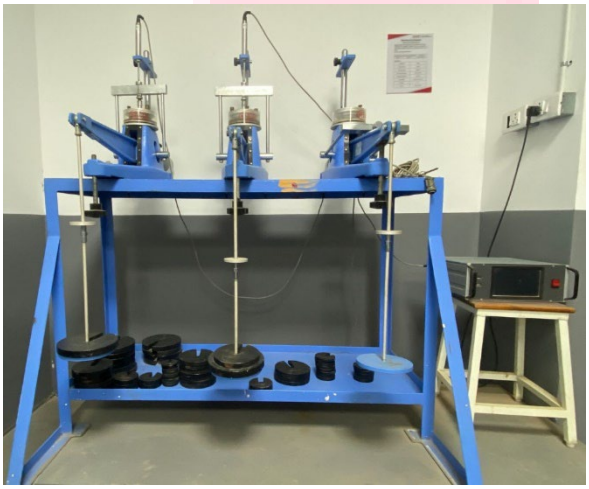
- Load settlement response of circular footing resting on reinforced layer system
- Pullout resistance factors of Geosynthetic reinforcements embedded in sand by using Numerical analysis
- Quality control of earthworks using NDT Device

Equipment available at the laboratory:

The geotechnical laboratory is well-equipped with all the necessary instruments to test the fundamental properties of soil and other geotechnical materials. The lab facilitates a wide range of tests, including grain size analysis, Atterberg limits, specific gravity, compaction characteristics, permeability, shear strength, unconfined compressive strength (UCS), triaxial shear, consolidation, California Bearing Ratio (CBR), swelling and shrinkage characteristics, and direct shear tests. These tests are essential for evaluating the engineering behavior of soils and ensuring the stability and safety of geotechnical structures.

S.No	Equipment name	Pictures
1	Casagrande's Liquid limit Device	
2	Cone penetrometer with Magnetic needle	
3	Shrinkage limit (SET)	

4	High speed stirrer	
5	Electro-mechanical Sieve shaker	
6	Universal Permeability Equipment	

7	Sand Replacement apparatus	
8	Relative density apparatus	
9	Consolidation apparatus	

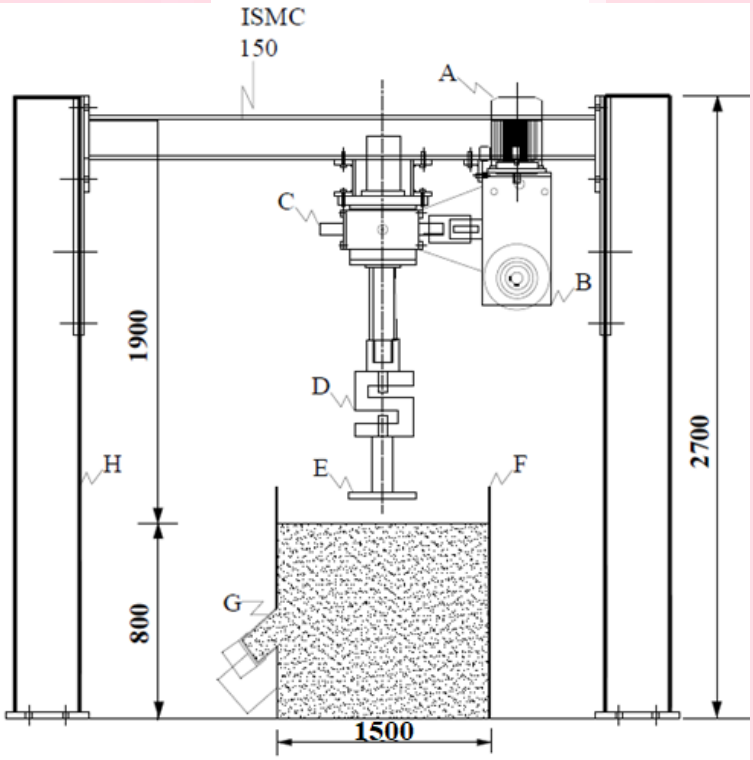
10	Unconfined compression test	 z
11	Vane shear Test	

12	California Bearing Ratio (CBR) Test	
13	Rapid moisture test	

GeoPave Research Lab

1.Large scale testing facility:

Test chamber of size equal to 0.9 m x 0.9 m x 0.9 m will be used to study the behavior of circular footing (to simulate the wheel load) resting on pavement layers. The reaction frame consists of four columns and two horizontal beam (Figure 1) to resists the applied loads. The diameter and thickness of the circular plate are equal to 150 mm and 30 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 to 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 be connected to the Data Acquisition system (DAQ) and the customized software records the data at every 30 seconds interval.

2. Modified Lightweight Deflectometer

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 are use to measure the deformation modulus.

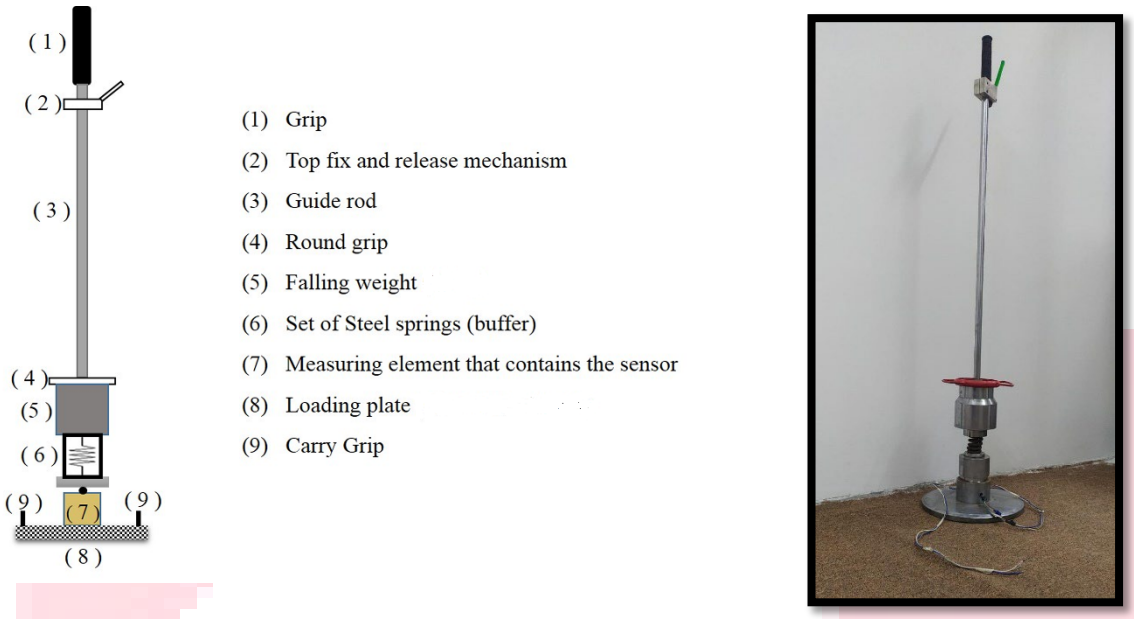


Fig. 2. Schematic diagram and photograph of LWD device

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).

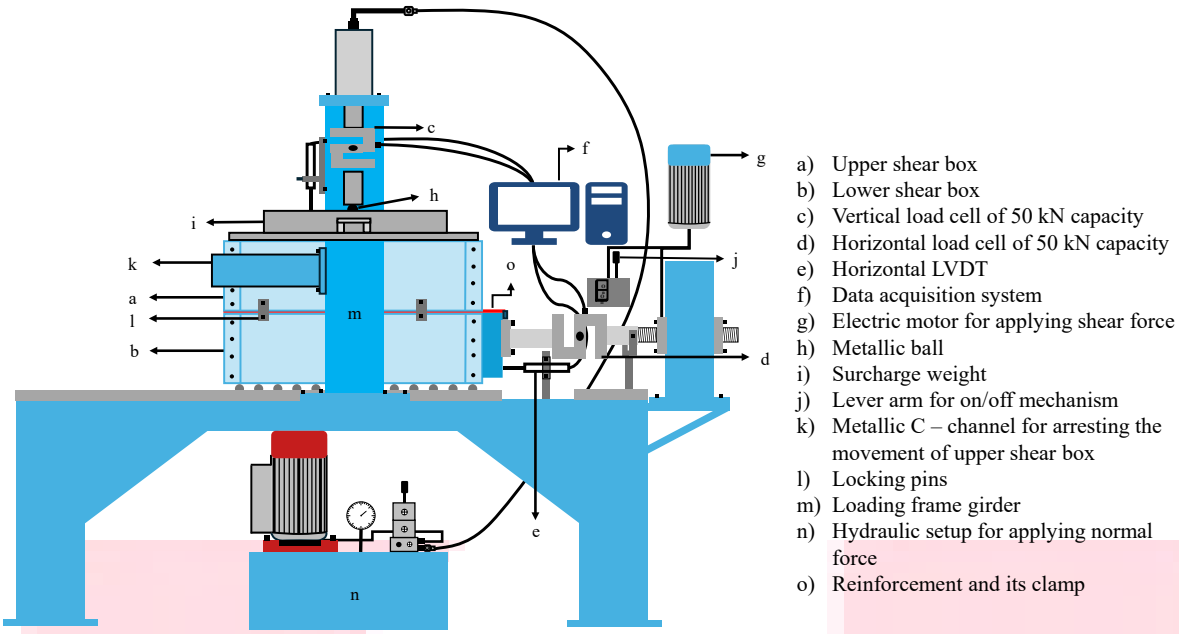


Fig. 3. Photograph of direct shear apparatus

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 consisting 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 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.

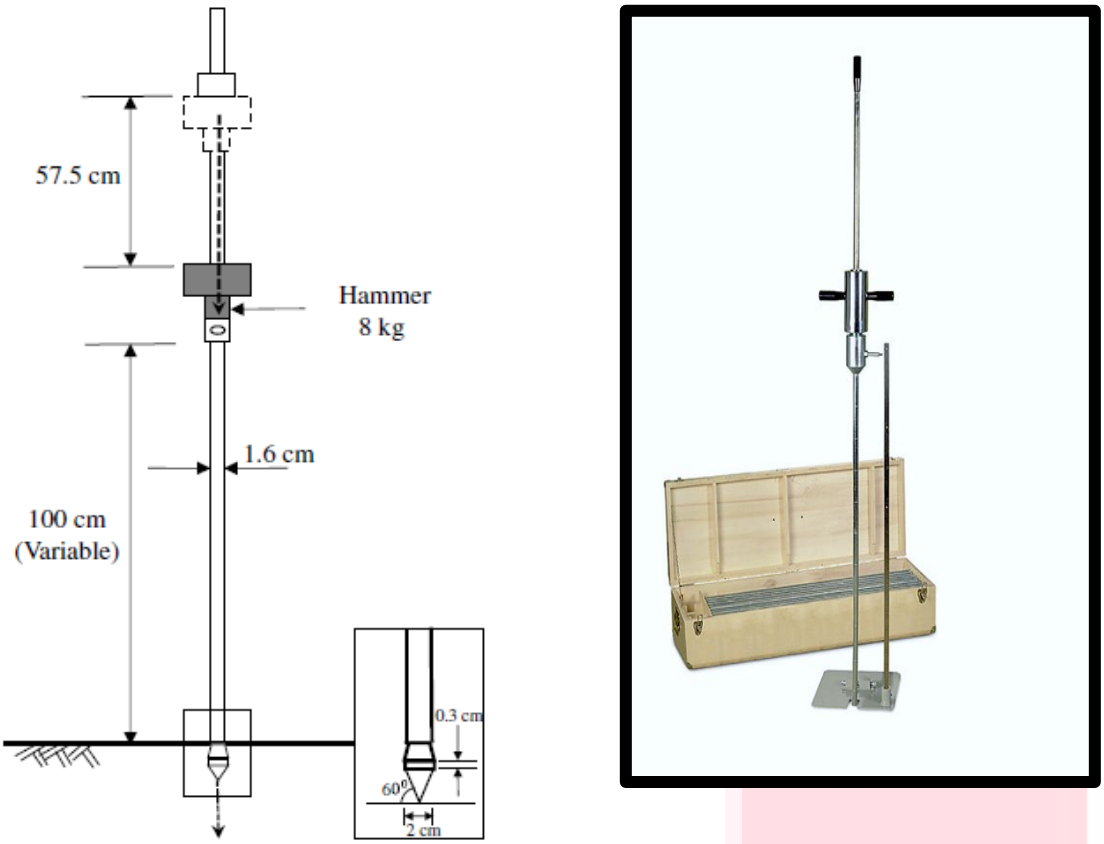


Fig. 4. Schematic view of dynamic cone penetrometer

5. Numerical modelling (Plaxis 2D)

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

.