California bearing ratio test

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California bearing ratio test

California bearing ratio test gives an indication of the shear strength of a soil. The simplicity of performing this test makes it used widely over the world. CBR is the ratio of the unit force required by a 50 mm standard circular plunger to penetrate a soil sample at 1.25 mm/min to the force required to penetrate a standard material. This ratio will be expressed as a percentage. The ratio usually determined for penetration in the soil of 2.5 mm and 5 mm. When the ratio at 5 mm is consistently higher than that at 2.5 mm, the ratio at 5 mm is used. The table no:1 shows the standard load at the penetration of 2.5mm and 5.0 mm

Table 01

Penetration of plunger (mm)	Standard Load (KN)
2.5	13.2
5.0	20

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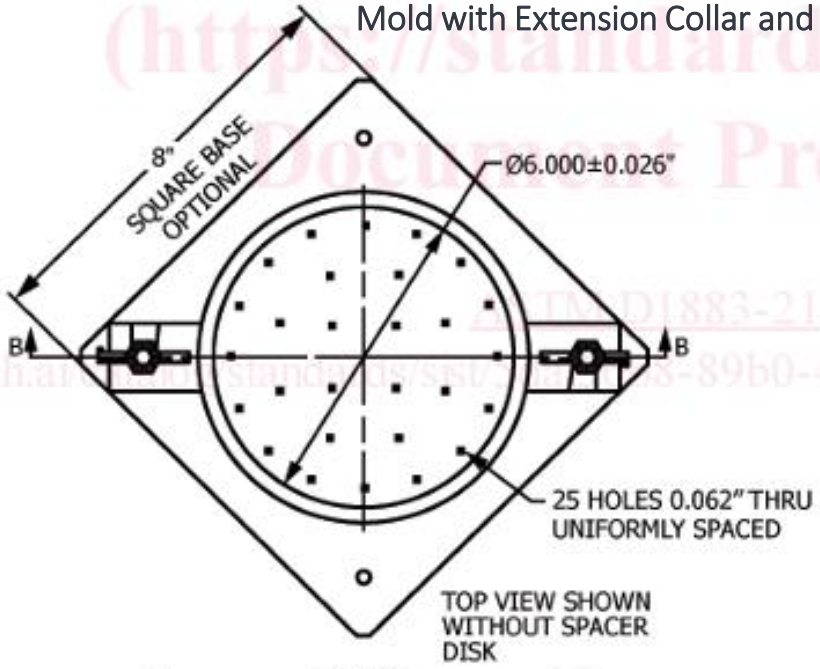
CBR test apparatus

- **Loading machine with a capacity of at least 5000 kg and equipped with a movable head or base which enables Plunger of 50 mm dia to penetrate into the specimen at a rate of 1.25 mm/ minute.**

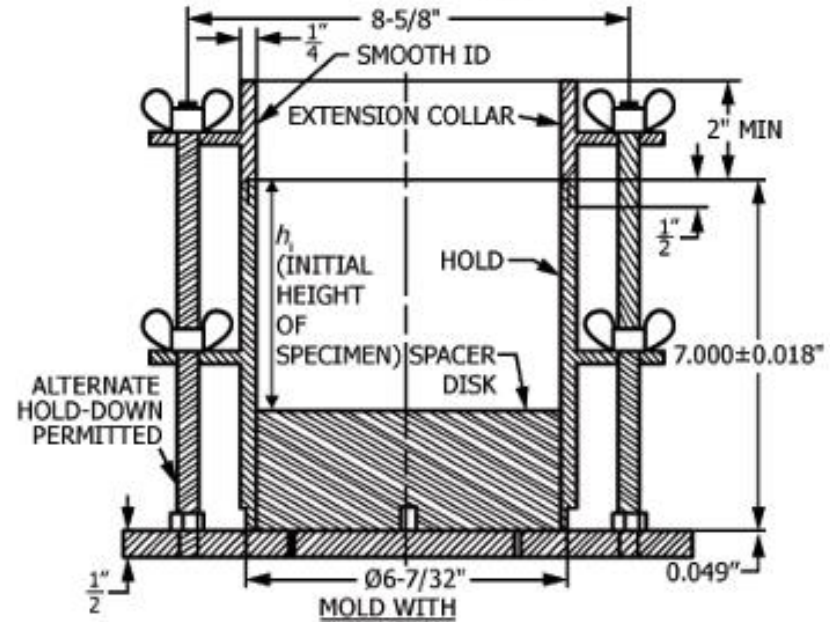
CBR test apparatus

- **Cylindrical mold: Inside dia. 150mm and height 175mm with a detachable perforated base plate of 235mm dia and10mm thickness.**
- **Collar: A detachable extension collar of 60 mm height.**
- **Spacer Disc: 148 mm in diameter and 47.7 mm in height along with the handle.**
- **Weights: One annular metal weight and several slotted weights weighing 2.5 kg each, 147 mm in diameter, with a central hole 53 mm in diameter.**

Mold with Extension Collar and Spacer Disk

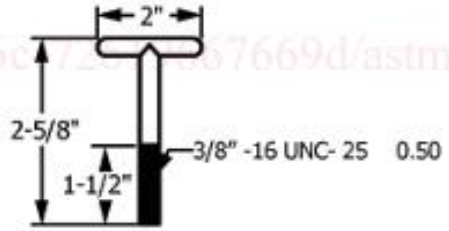


TOP VIEW SHOWN WITHOUT SPACER DISK



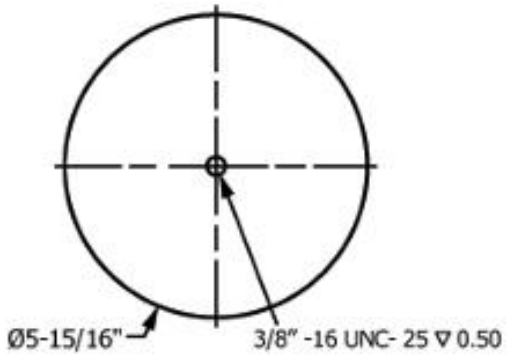
MOLD WITH EXTENSION COLLAR & SPACER DISK

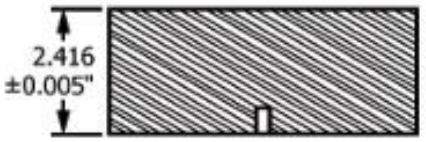
MATERIAL- STEEL



HANDLE FOR SPACER DISK

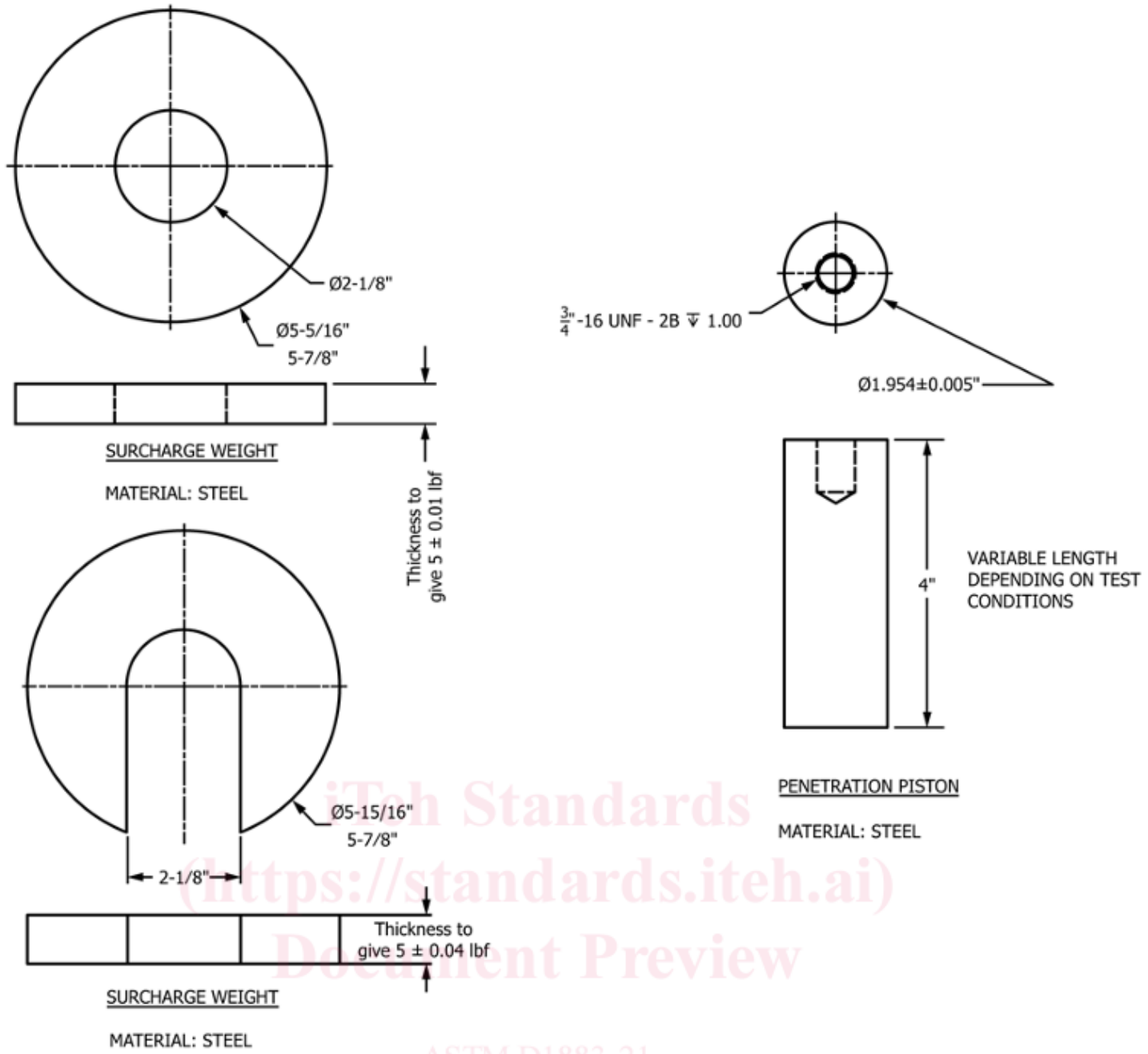
MATERIAL- METAL





SPACER DISK

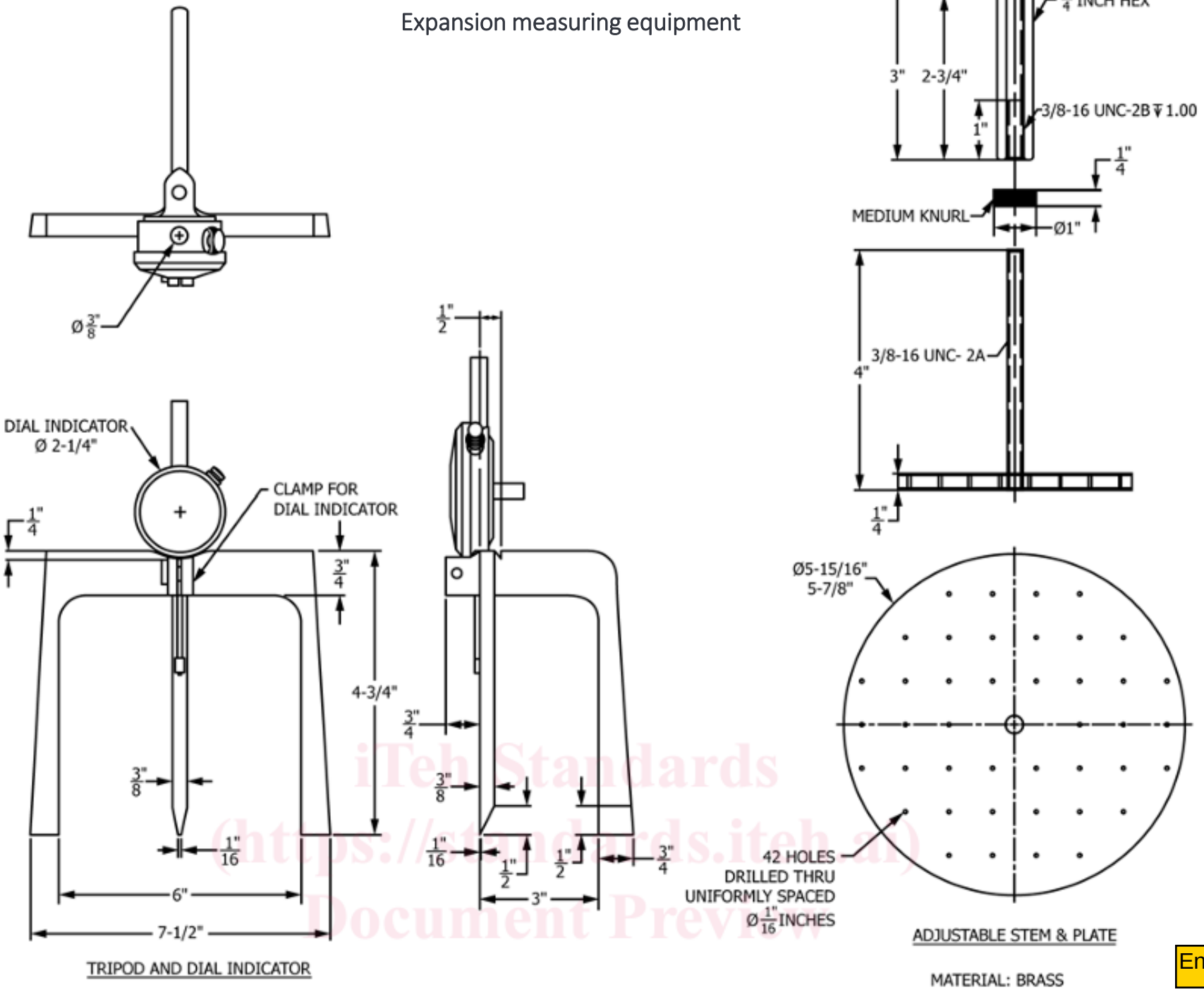
MATERIAL-STEEL



NOTE 1—See Table 1 for SI equivalents.

FIG. 3 Surcharge Weights and Penetration Piston

Expansion measuring equipment



CBR test apparatus

- **Compaction Rammer: Weight - 4.89 kg with a drop of 450 mm.**

CBR test Procedure

1. **Preparation of test specimen:**

- The soil sample shall be collected from the material required for testing.
- Dynamic compaction: a representative sample of the material to be tested shall be compacted. The weight shall be 4.5 kg for fine-grained material and 5.5 kg for granular materials. If it is required to compact the material to maximum dry density. The sample of material should be weighted, and the water should be added to the sample. The amount of water added should be equal to the determined optimum water content for this material.
- Fix the extension collar and the base plate to the mold. Insert the spacer disc over the base. Place the filter paper on the top of the spacer disc.
- Place the soil inside the mold and compact the mix soil in the mold using heavy compaction. Compact the soil in 5 layers with 56 blows to each layer by the 4.89 kg rammer.

Sample compaction

CBR test Procedure

Procedure:

1. **Preparation of test specimen:**

- Remove the extension collar and level the material to the top of mold by a straight edge. Remove the perforated plate, filter paper, and the spacer disc and record the weight of mold and compacted soil.
- Place a filter paper over the specimen and place the perforated plate on the compacted soil specimen in the mold. Put annular weights to produce a surcharge equal to the weight of base material and pavement to the nearest 2.5 kg.


Removing extension
and leveling the surface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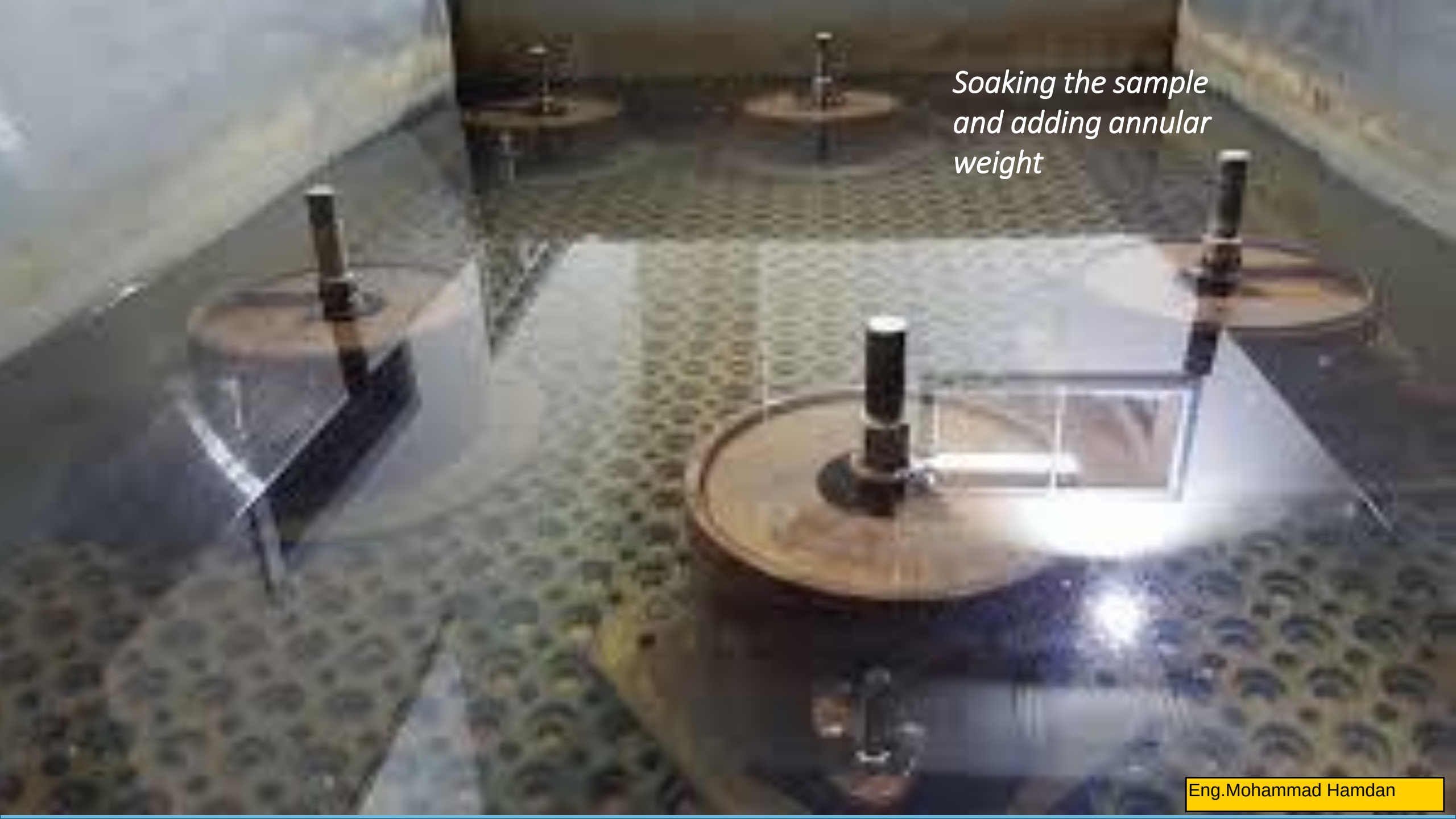
CBR test Procedure

Procedure:

1. **Preparation of test specimen:**

- Immerse the mold assembly and weights in a tank of water and soak it for 96 hours. Mount the tripod for expansion measuring device on the edge of the mold and record initial dial gauge reading. Note down the readings every day against the time of reading. A constant water level shall be maintained in the tank throughout the period.
- At the end of the soaking period, note down the final reading of the dial gauge and take the mold out of the water tank.
- Remove the free water collected in the mold and allow the specimen to drain for 15 minutes. Remove the perforated plate and the top filter paper. Weigh the soaked soil sample and record the weight.



Soaking the sample and adding annular weight

Soaking the sample in water and mearing extension by gauge

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CBR test Procedure

Procedure:
2. Procedure for the penetration test

- Place the mold assembly with the test specimen on the lower plate of the penetration testing machine. To prevent the upheaval of soil into the hole of the surcharge weights, 2.5 kg annular weight shall be placed on the soil surface prior to seating the penetration plunger, after which the remainder of the surcharge weights shall be placed.

- Seat the penetration piston at the center of the specimen with the smallest possible load, but in no case above 4 kg, so that full contact of the piston on the sample is established.

CBR test Procedure

Procedure:
2. Procedure for the penetration test

- Set the load and deformation gauges to read zero. Apply the load on the piston so that the penetration rate is about 1.25 mm/min.
- Record the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 4.0, 5.0, 7.5, 10 and 12.5 mm.
- Raise the plunger and detach the mold from the loading equipment. Take about 20 to 50 g of soil from the top 30 mm layer and determine the moisture content.

Seating the piston for measuring pressure

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CBR test Procedure

Procedure:
2. Calculation

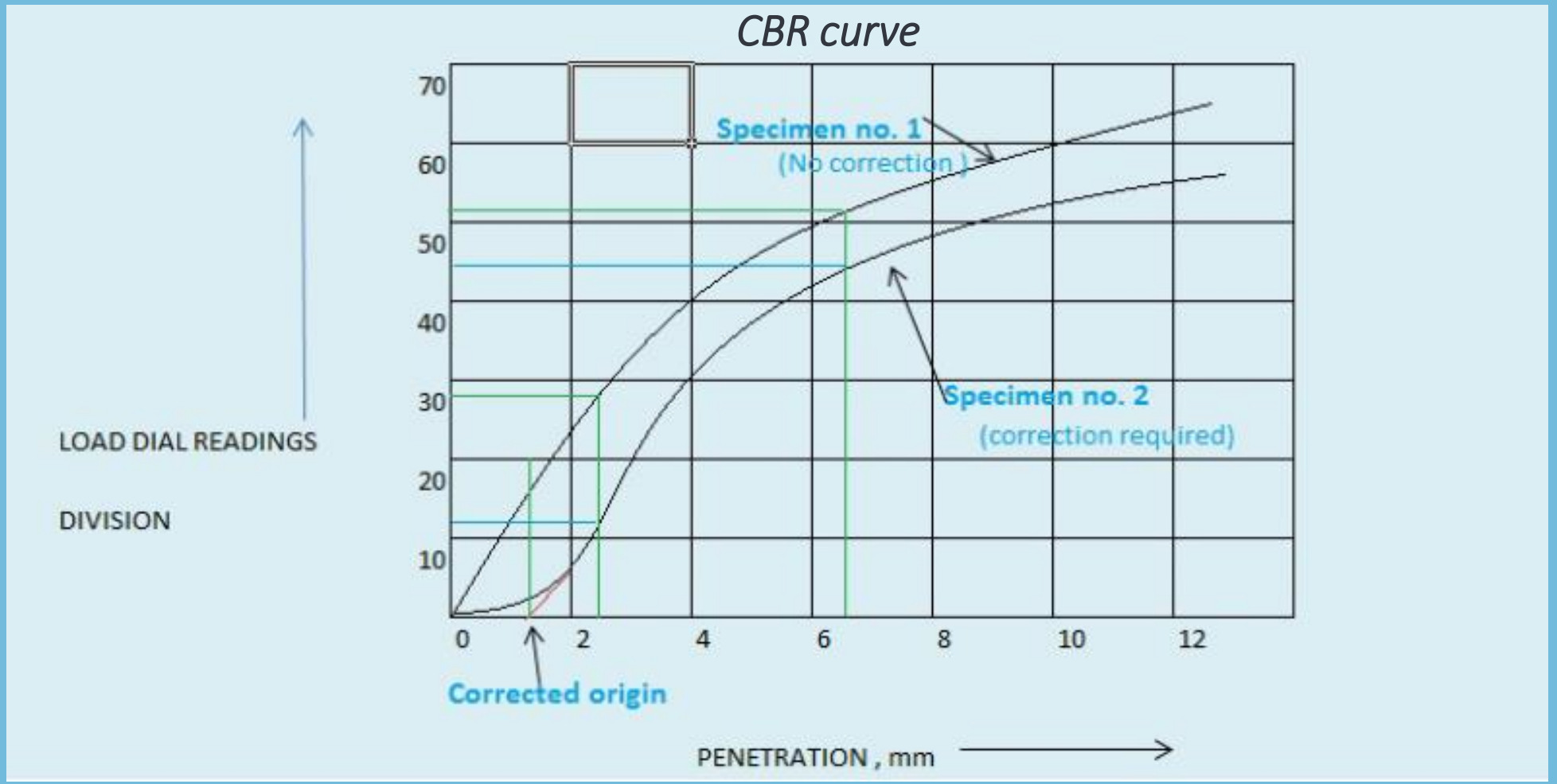
- 1. after the completion of the test draw the penetration vs the load curve. Then, If the initial portion of the curve is concave upwards, apply correction by drawing a tangent to the curve at the point of the highest slope and shift the origin.

C.B.R. = (PT/PS) X 100

Where:

- PT = Corrected test load corresponding to the chosen penetration from the load penetration curve.
- PS = Standard load for the same penetration taken from the table below.
- The C.B.R. values are usually calculated for penetration of 2.5 mm and 5 mm. Generally, the C.B.R. value at 2.5 mm will be greater than at 5 mm, and in such a case the CBR value for 2.5 mm shall be taken as C.B.R. but If C.B.R. for 5 mm exceeds that for 2.5 mm, the test should be repeated.

Penetration of plunger (mm)	Standard Load (KN)
2.5	13.2
5.0	20

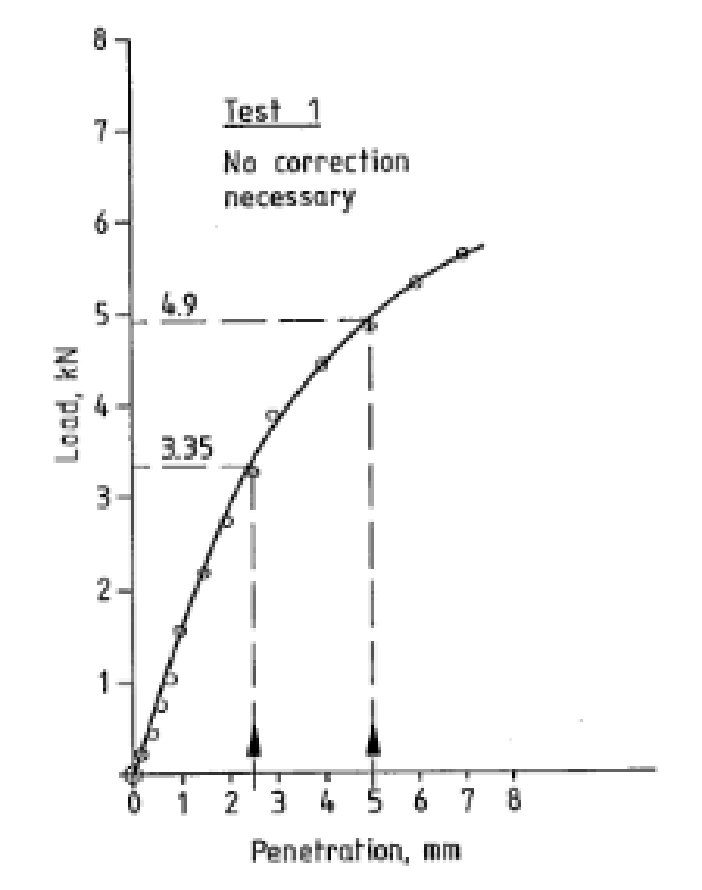

CBR curve
LOAD DIAL READINGS
DIVISION
70
60
50
40
30
20
10
0
2
4
6
8
10
12
Specimen no. 1
(No correction)
Specimen no. 2
(correction required)
Corrected origin
PENETRATION , mm

Example: determine CBR value for the following curve obtained during test of soil sample?

1. C.B.R @2.50mm = (PT/PS) X 100
   C.B.R. = (3.35/13.2) X 100=25.50%

2. C.B.R @5.0mm = (PT/PS) X 100
   C.B.R. = (4.9/20) X 100=24.5%

So CBR=25.50%



Example: determine CBR value for the following curve obtained during test of soil sample?

This curve need correction because it is concave upwards. The new curve origin will be as shown in this figure

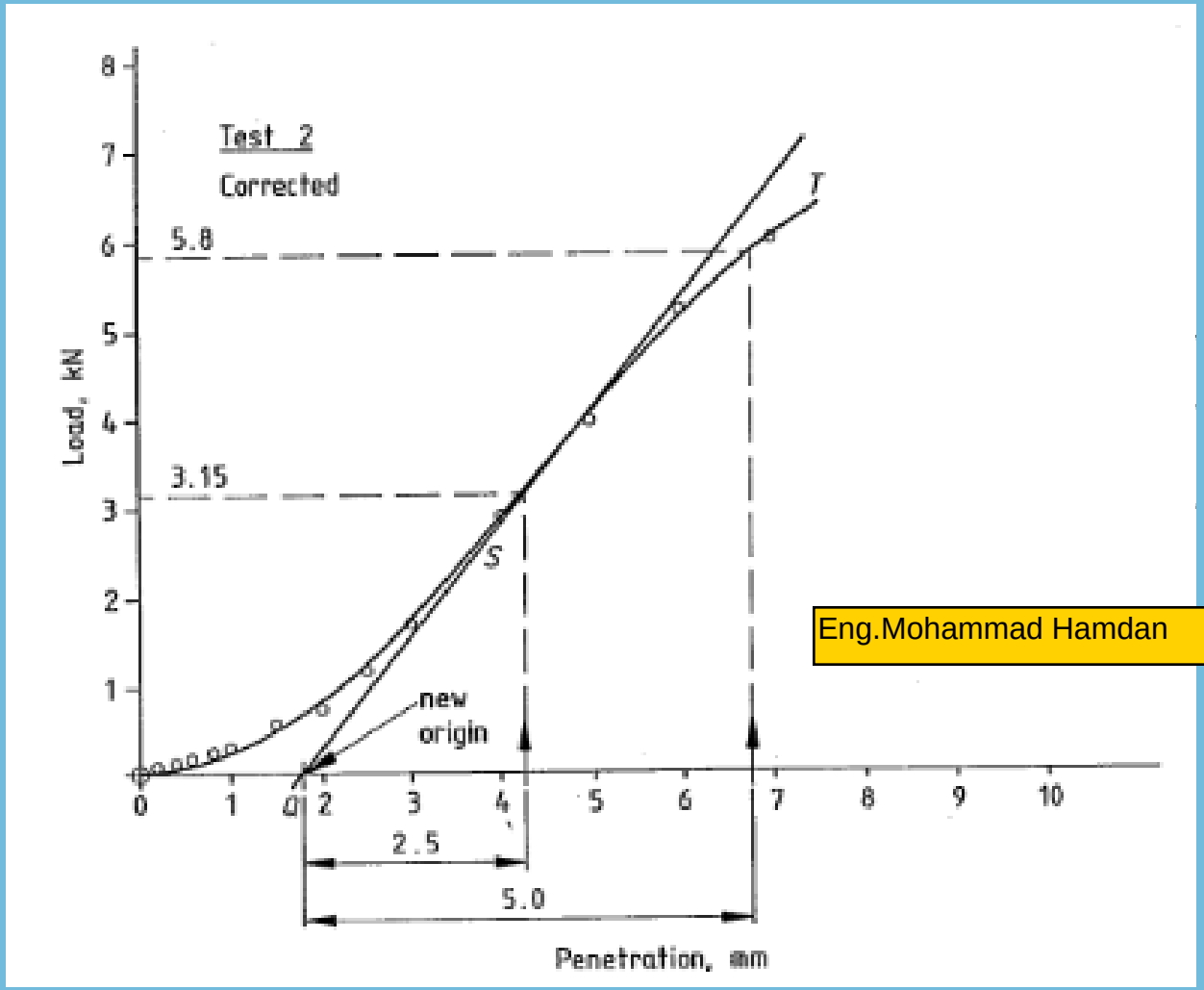
1. C.B.R @2.50mm = (PT/PS) X 100

C.B.R. = (3.15/13.2) X 100=23.80%

2. C.B.R @5.0mm = (PT/PS) X 100

C.B.R. = (5.80/20) X 100=29.00%

So CBR=29.00%



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