SOILS Proficiency Testing

California Bearing Ratio (CBR)

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What is CBR?

- The California Bearing Ratio (CBR) is a penetration test for evaluation of the mechanical strength of road sub grades and base courses. It was developed by the California Department of Transportation in the 1930's.

- The CBR is used for measuring the load-bearing capacity for new pathways, road and airstrips or for soils already under paved areas. The harder the surface, the higher the rating.

- E.g. CBR = 3 → tilled farmland
  CBR = 4.75 → turf or moist clay
  CBR = 10 → moist sand
  CBR = >80 → hard quality crushed rock

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What is CBR?

- CBR is a measure of resistance of material to penetration of a plunger under controlled density and moisture conditions.

- A standard piston is used to penetrate the soil at a standard rate. The pressure up to a penetration of 10mm and its ratio to the bearing value of a standard crushed rock is termed as the CBR.

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Test Procedure

Moisture content

- The soil is sieved over a 19mm sieve and the percentage of sample remaining on the sieve is calculated. This will determine the size of mould to be used in the CBR test. The material passing the 19mm sieve is split up for determining maximum dried density, optimum moisture content and CBR.

- The specimen is mixed with enough water to dampen it to achieve the required laboratory moisture ratio. It is then left to cure for as long as it takes for the water to be thoroughly mixed into and uniformly distributed.

- Soil is placed into the mould in layers. Our PT program used the modified compactive effort (5 layers). It is compacted using a rammer.

- Determine mass of mould and soil. Place in oven and dry to a constant mass, reweigh. Calculate maximum dried density and optimum moisture content.

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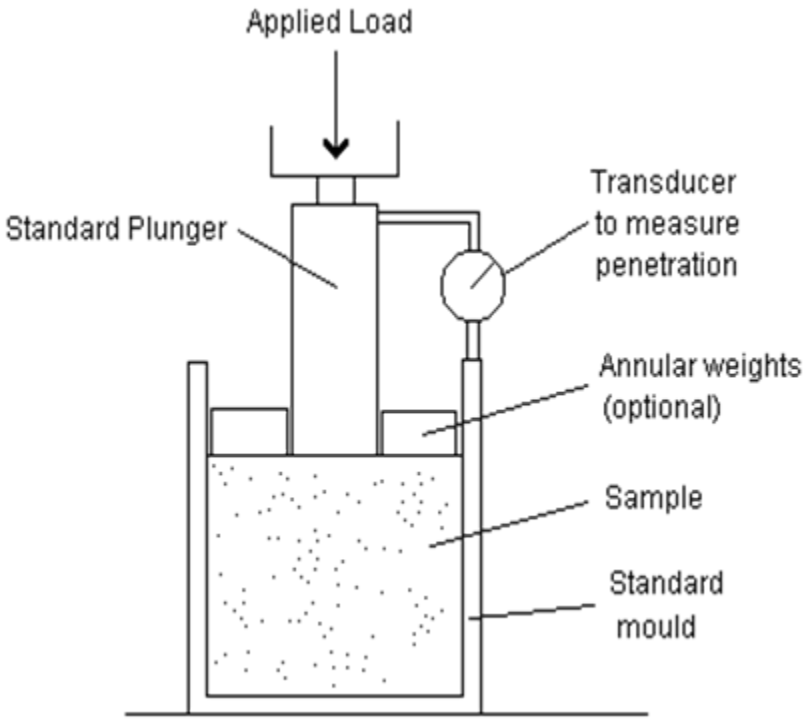
Test Procedure

CBR

- The specimen is mixed with enough water to dampen it to achieve the required laboratory moisture ratio. It is then left to cure for as long as it takes for the water to be thoroughly mixed into and uniformly distributed.

- Compact into mould using modified compaction.

- Load is applied on the sample by a standard plunger at the rate of 1 ±0.2 mm/min.



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Results

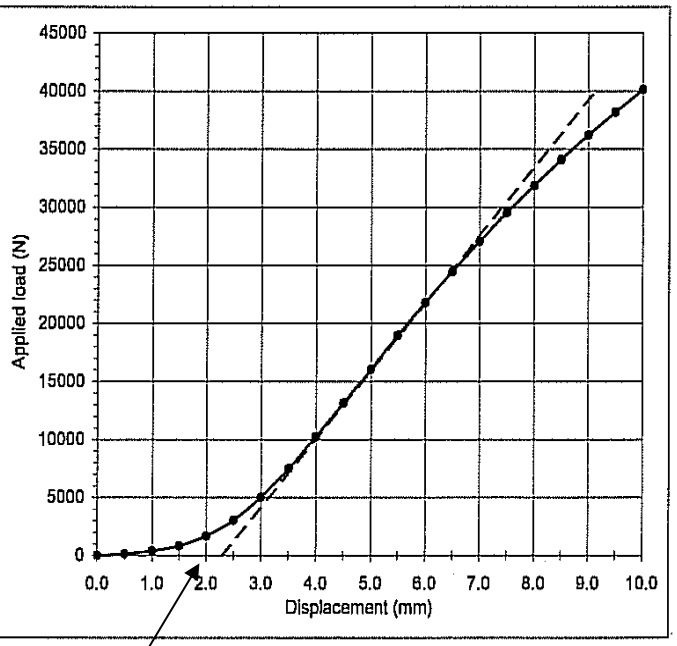
- Plot the load penetration curve.
- Read the force value in N at penetrations of 2.5mm and 5.0mm and calculate the bearing ratio for each by dividing by 13.2kN and 19.8kN respectively, then multiplying by 100.
- CBR value is expressed as a percentage of the actual load causing the penetrations of 2.5 mm or 5.0 mm to the standard loads mentioned above. Therefore,

$$CBR = \frac{\text{load carries by specimen}}{\text{load carries by standard specimen}} \times 100$$

- The greatest value calculated for penetrations at 2.5mm and 5.0mm will be recorded as the CBR.

TEST DATA

Penetration (mm)	Applied load (N)
0.0	0
0.5	145
1.0	385
1.5	839
2.0	1675
2.5	3036
3.0	5035
3.5	7492
4.0	10244
4.5	13140
5.0	16046
5.5	18959
6.0	21777
6.5	24482
7.0	27037
7.5	29537
8.0	31869
8.5	34122
9.0	36206
9.5	38190
10.0	40145



When the graph begins to concave up this is likely due to surface irregularities and so the zero point must be adjusted.

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Problems faced in Proficiency Testing

- Human error in calculations may play a small role in the problems faced in PT programs, however, with modern technology it is unlikely that calculations are performed free hand but rather through an excel spreadsheet or program.
- It seems the most common problem simply comes down to segregation and the handling of samples.
- Strength test needs a nice smooth distribution of particle sizes.
- Plunger may only contact larger particles and thus give a higher strength that is not representative of the sample.
- When performing CBR must ensure there is a good mix of the sample before compaction.

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