CALIFORNIA BEARING RATIO TEST

AIM:

To determine California Baring Ratio (C.B.R.) value of a given soil sample.

NEED AND SCOPE

The california bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers. This is the most widely used method for the design of flexible pavement.

This instruction sheet covers the laboratory method for the determination of C.B.R. of undisturbed and remoulded /compacted soil specimens, both in soaked as well as unsoaked state.

DEFINITION OF C.B.R.

It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material.

C.B.R. = (Test load/Standard load) X 100

APPARATUS:

1. Cylindrical mould with inside dia 150 mm and height 175 mm, provided with a detachable extension collar 50 mm height and a detachable perforated base plate 10 mm thick.

2. Spacer disc 148 mm in dia and 47.7 mm in height along with handle.

3. Metal rammers. Weight 2.6 kg with a drop of 310 mm (or) weight 4.89 kg a drop 450 mm.

4. Weights. One annular metal weight and several slotted weights weighing 2.5 kg each, 147 mm in dia, with a central hole 53 mm in diameter.

5. Loading machine. With a capacity of atleast 5000 kg and equipped with a movable head or base that travels at an uniform rate of 1.25 mm/min. Complete with load indicating device.

6. Metal penetration piston 50 mm dia and minimum of 100 mm in length.

7. Two dial gauges reading to 0.01 mm.

8. Sieves. 4.75 mm and 20 mm I.S. Sieves.

9. Miscellaneous apparatus, such as a mixing bowl, straight edge, scales soaking tank or pan, drying oven, filter paper and containers.

The following table

(I) gives the standard loads adopted for different penetrations for the standard material with a C.B.R. value of 100%

Penetration, mm	Standard Load, kg	Unit Standard Load, kg/cm2
2.5	1370	70
5.0	2055	105
7.5	2630	134
10.0	3180	162
12.5	3600	183

The test may be performed on undisturbed specimens and on remoulded specimens which may be compacted either statically or dynamically.

PREPARATION OF TEST SPECIMEN

Undisturbed specimen

Attach the cutting edge to the mould and push it gently into the ground. Remove the soil from the outside of the mould which is pushed in . When the mould is full of soil, remove it from weighing the soil with the mould or by any field method near the spot.

Determine the density

Remoulded specimen

Prepare the remoulded specimen at Proctors maximum dry density or any other density at which C.B.R> is required. Maintain the specimen at optimum moisture content or the field moisture as required. The material used should pass 20 mm I.S. sieve but it should be retained on 4.75 mm I.S. sieve. Prepare the specimen either by dynamic compaction or by static compaction.

Dynamic Compaction

Take about 4.5 to 5.5 kg of soil and mix thoroughly with the required water.

Fix the extension collar and the base plate to the mould. Insert the spacer disc over the base, Place the filter paper on the top of the spacer disc.

Compact the mix soil in the mould using either light compaction or heavy compaction. For light compaction, compact the soil in 3 equal layers, each layer being given 55 blows by the 2.6 kg rammer. For heavy compaction compact the soil in 5 layers, 56 blows to each layer by the 4.89 kg rammer.

Remove the collar and trim off soil.

Turn the mould upside down and remove the base plate and the displacer disc.

Weigh the mould with compacted soil and determine the bulk density and dry density.

Put filter paper on the top of the compacted soil (collar side) and clamp the perforated base plate on to it.

Static compaction

Calculate the weight of the wet soil at the required water content to give the desired density when occupying the standard specimen volume in the mould from the expression.

$$W = \text{desired dry density} * (1+w)\, V$$

Where W = Weight of the wet soil

w = desired water content

V = volume of the specimen in the mould = 2250 cm^3 (as per the mould available in laboratory)

Take the weight W (calculated as above) of the mix soil and place it in the mould.

Place a filter paper and the displacer disc on the top of soil.

Keep the mould assembly in static loading frame and compact by pressing the displacer disc till the level of disc reaches the top of the mould.

Keep the load for some time and then release the load. Remove the displacer disc.

The test may be conducted for both soaked as well as unsoaked conditions.

If the sample is to be soaked, in both cases of compaction, put a filter paper on the top of the soil and place the adjustable stem and perforated plate on the top of filter paper.

Put annular weights to produce a surcharge equal to weight of base material and pavement expected in actual construction. Each 2.5 kg weight is equivalent to 7 cm construction. A minimum of two weights should be put.

Immerse the mould assembly and weights in a tank of water and soak it for 96 hours. Remove the mould from tank.

Note the consolidation of the specimen.

PROCEDURE FOR PENETRATION TEST

I. Place the mould assembly with the surcharge weights on the penetration test machine.

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

III. Set the stress and strain dial gauge to read zero. Apply the load on the piston so that the penetration rate is about 1.25 mm/min.

IV. Record the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10 and 12.5 mm. Note the maximum load and corresponding penetration if it occurs for a penetration less than 12.5 mm.

V. Detach the mould from the loading equipment. Take about 20 to 50 g of soil from the top 3 cm layer and determine the moisture content.

OBSERVATION AND RECORDING

For Dynamic Compaction

Optimum water content (%)

Weight of mould + compacted specimen g

Weight of empty mould g

Weight of compacted specimen g

Volume of specimen cm^3

Bulk density g/cc

Dry density g/cc

For static compaction

Dry density g/cc

Moulding water content %

Wet weight of the compacted soil, (W)g

Period of soaking 96 hrs. (4days).

For penetration Test

Calibration factor of the proving ring 1 Div. = 1.176 kg

Surcharge weight used (kg) 2.0 kg per 6 cm construction

Water content after penetration test %

Least count of penetration dial 1 Div. = 0.01 mm

If the initial portion of the curve is concave upwards, apply correction by drawing a tangent to the curve at the point of greatest slope and shift the origin. Find and record the correct load reading corresponding to each penetration.

$$C.B.R. = (P_T/P_S)\ 100$$

Where P_T = Corrected test load corresponding to the chosen penetration from the load penetration curve.

P_S = Standard load for the same penetration taken from the table I.

Penetration Dial		Load Dial		Corrected Load
Readings	Penetration (mm)	proving ring reading	Load (kg)	

INTERPRETATION AND RECORDING

C.B.R. of specimen at 2.5 mm penetration

C.B.R. of specimen at 5.0 mm penetration

C.B.R. of specimen at 2.5 mm penetration

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 that at 5 mm and in such a case/the former shall be taken as C.B.R. for design purpose. If C.B.R. for 5 mm exceeds that for 2.5 mm, the test should be repeated. If identical results follow, the C.B.R. corresponding to 5 mm penetration should be taken for design.

VIDEO URL:- https://www.youtube.com/watch?v=fCmMW73rP64