Mansoura College Academy

Civil Engineering Department

The GUIDE 2022





Highway Engineering Lab

v 1.0

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Marshall Testing Machine

Fig (1): Marshall Testing Machine

Device Description:

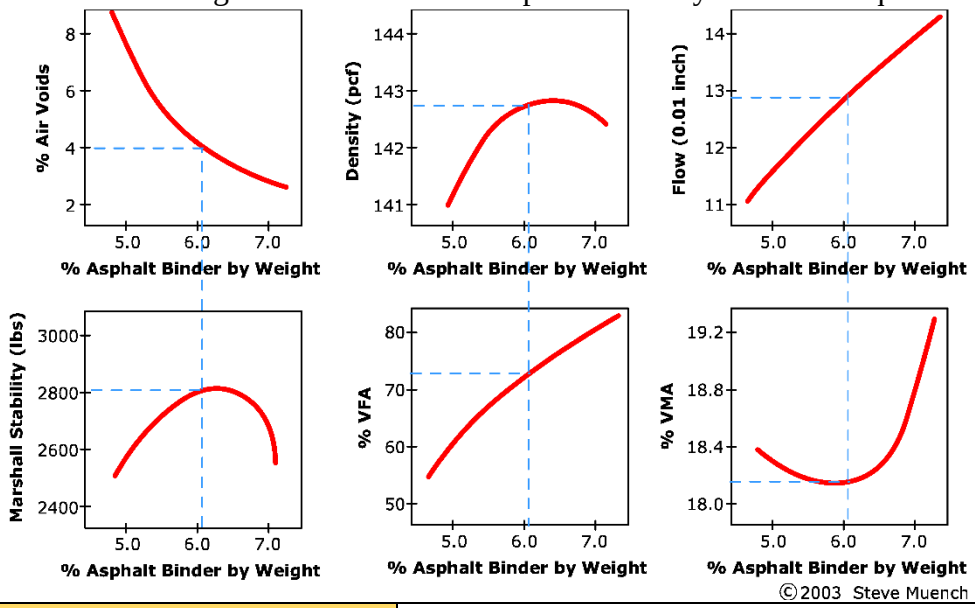
Dimensions (l x w x h) = 550 x 400 x 870 mm
Rated power = 373 W
Platen speed = 50.8 mm per minute
Weight = 65 kg

Objectives:

-Sufficient asphalt to ensure a durable pavement .
-Sufficient mixture stability to satisfy the demands of traffic without distortion or displacement .
-Sufficient voids in the total compacted mixture to allow for a slight amount of additional compaction under traffic loading without flushing, bleeding, and loss of stability, yet low enough to keep out harmful air and moisture .
-Sufficient workability to permit efficient placement of the mixture without segregation.

Basic Procedure:

1- Aggregate with suitable gradation is selected and blended.
2- Asphalt binder is selected with suitable grade.
3- Prepare a series of initial samples, each at a different asphalt binder content. For instance, two to three samples each might be made at 4.5, 5.0, 5.5, 6.0 and 6.5 percent asphalt by dry weight for a total of 10 to 15 samples. There should be at least two samples above and two below the estimated optimum asphalt content.
4- Compact these trial mixes using Marshall drop hammer.
5- Test the samples in the Marshall testing machine for stability and flow. Determine the density and other volumetric properties of the samples.
6- Select the optimum asphalt binder content. The asphalt binder content corresponding to 4 percent air voids is selected as long as this binder content passes stability and flow requirements



Test Specifications	AASHTO T-245, ASTM D-1559, BS 598

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C.B.R. Testing Machine (Mechanical)

Fig (2): C.B.R. Testing Machine

Device Description:

The test is performed by measuring the pressure required to penetrate a soil sample with a plunger of standard area. The measured pressure is then divided by the pressure required to achieve an equal penetration on a standard crushed rock material.

Objectives:

Penetration test for evaluation of the mechanical strength of road subgrades and base courses. It was developed by the California Department of Transportation

Basic Procedure:

The basic CBR test involves applying load to a small penetration piston at a rate of 1.3 mm (0.05″) per minute and recording the total load at penetrations ranging from 0.64 mm (0.025 in.) up to 7.62 mm (0.300 in.).

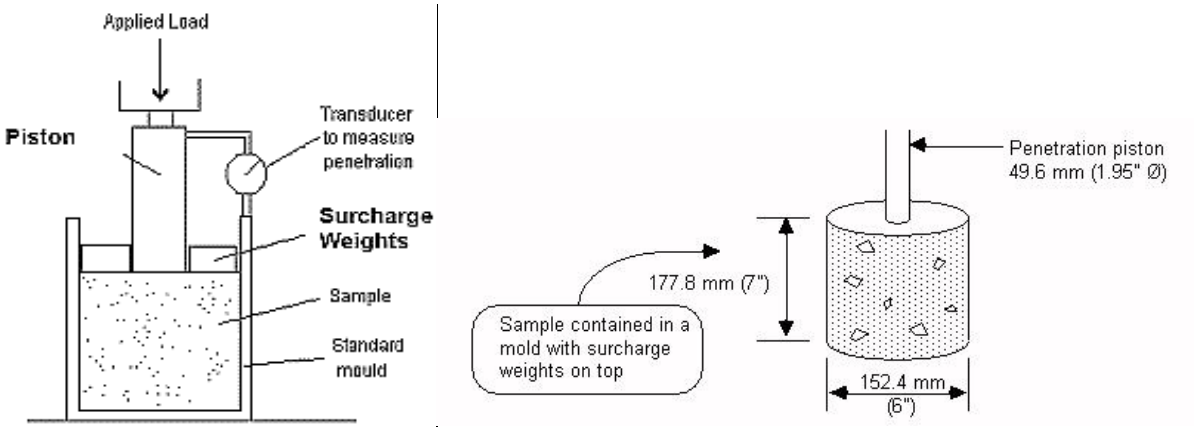


Fig (3-2): C.B.R. Sample Loading

$$\text{CBR} = \frac{100 \times \text{Load of Material}}{3000 \text{ for } 1" \text{ or } 4500 \text{ for } 2"}$$

Test Specifications	ASTM D-1833, AASHTO T-193, UNI 10009

Websites

Proctor Compaction Machine

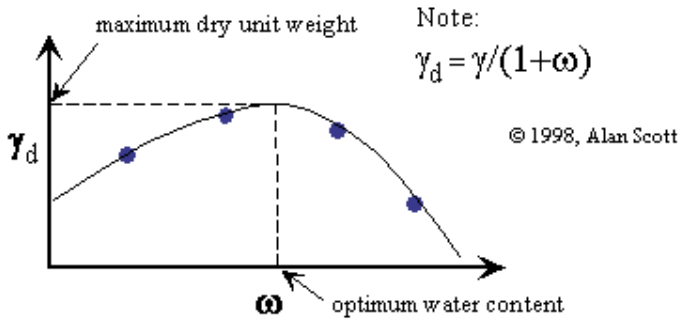
Fig (3): Soil Test Proctor Compactor

Device Description:

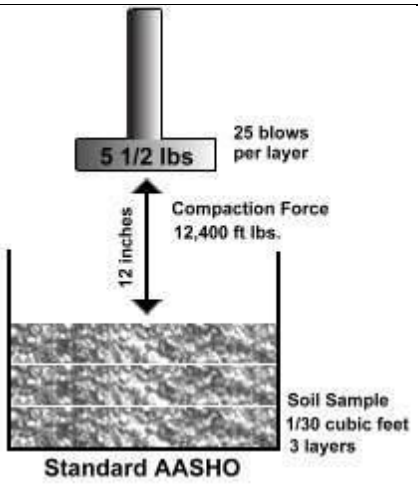
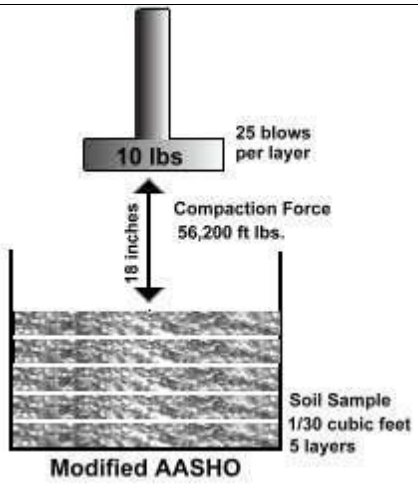
laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

Objectives:

Determining OMC



Basic Procedure:

Test	Standard Proctor	Modified Proctor
Rammer Weight (lbs)	5.5	10
Rammer Height (in)	12	18
Number of Layers	3	5
Blows/Layer	25	25
Mold Volume (ft^3)	1/30 ft^3 = 944 cm^3	1/30 ft^3 = 944 cm^3
Compaction Force (ft.lbs)	12400	56200
Compaction Energy (kJ/m^3)	593	2695
Graph.		

Test Specifications	ASTM D1557 and AASHTO T180

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Los Angeles Abrasion Machine

Fig (4): Los Angeles Abrasion Machine

Device Description:

Sample of aggregate retained on the No. 12 (1.70 mm) sieve is placed inside a rotating steel drum containing a specified number of steel spheres or "charge".

Objectives:

The L.A. abrasion test measures the degradation of a coarse aggregate sample that is placed in a rotating drum with steel spheres. As the drum rotates the aggregate degrades by abrasion and impact with other aggregate particles and the steel spheres. Once the test is complete, the calculated mass of aggregate that has broken apart to smaller sizes is expressed as a percentage of the total mass of aggregate.

Basic Procedure:

1- Obtain the aggregate sample to be tested.
2- Record the total sample mass. The total sample mass should be about 5000 gm.
3- Place the sample and the specified number of steel spheres into the cylindrical drum.
4- Rotate for 500 revolutions at 30 to 33 rpm.
5- Discharge the material and sieve the aggregate over 1.70-mm (No. 12) sieve.
6- Weight aggregate passing 1.70-mm (No. 12) sieve.

$$\text{L. A. Abrasion loss (\%)} = \frac{\text{original sample mass}}{\text{final sample mass}} \times 100$$

Test Specifications	AASHTO T 96 or ASTM C 131

Mechanical Sieve Shaker for Sieve Analysis Test

Fig (5): Mechanical Sieve Shaker

Device Description:

The Standard grain size analysis test determines the relative proportions of different grain sizes as they are distributed among certain size ranges.

Objectives:

The grain size analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc. Information obtained from grain size analysis can be used to predict soil water movement although permeability tests are more generally used

Basic Procedure:

1- Put a soil sample in a Container.
2- Record the Weight of Container and Soil.
3- Make sure that all the sieves are clean using the a brush
4- Put the Pan on a clean surface and assemble the sieves on it starting with sieve # 200 at the bottom and descending.
5- Carefully pour the soil sample into the top sieve and place the cap over on it.
6- Place the sieve stack on the mechanical shaker, place the top holding part and shake for 10 minutes.
7- Remove the stack from the shaker and carefully weigh and record the weight of each sieve with its retained soil including the bottom pan with its retained fine soil.
8- Make a semi-logarithmic plot of grain size vs. percent finer.

Test Specifications	ASTM C136 - 06