



2. Explain the different properties of aggregate for Road aggregate.

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The different properties of aggregate for road aggregates are listed below:

Gradation:

It is the process of arranging different aggregates. Sieve analysis is done for particle size distribution. The arrangement should be done such that in the voids between the large particles of aggregates, small, fine particles should be placed.

Relative density and absorption:

The ~~mass~~ volume covered by certain mass of aggregate should be known. It is

calculated by  $RD = \frac{M}{V \times \rho_w}$  where,

RD = Relative density  $\text{KN/m}^3$

M = Mass, KN

V = Volume,  $\text{m}^3$

$\rho_w$  = Density of water =  $1 \text{ KN/m}^3$

Aggregates are porous in nature so water absorption should also be calculated. Good aggregate should not absorb much water.

Strength of crushing:

Good aggregate's crushing strength value should not exceed 30. It should be able to withstand the load by vehicle without being crushed.

Hardness:

Road aggregates resist the rubbing of the road which is also known as abrasion.

Durability:

Road aggregates also resist its wear and tear that can occur from different weather conditions.

Shape and size of aggregates:

Long, flaky aggregates are less embraced due to its weak strength that of angular shaped rough textured aggregates.

Deleterious matter:

There are the matter that makes aggregates and concrete weak such as clay lump, vegetable matters etc.

Toughness:

Road aggregates are tough enough to withstand the impact of the vehicular movement.

Affinity to bitumen:

Aggregates of road construction have great affinity and adhesion to bitumen and less affinity to water.

3.	<p>Explain the terms Bitumen, Tar, Asphalt as per British standards and American standards.</p>	10		
4.	<p>Explain the requirements of bitumen to be used as pavement surface coat mix.</p>	10		
5.	<p>Write the apparatus required, detailed procedure, figure, IS code no. and IS recommendations for the following tests.</p> <p>(a) Penetration test (b) Durability test</p> <p>(a) Penetration test:  <b>Aim:</b> To find the penetration value of bitumen</p> <p><b>Apparatus Required:</b> Container, needle, water bath, penetrometer and stop watch</p> <p><b>Brief Theory:</b> The penetration value of bituminous materials vary depending upon several factors such as constituents, temperature etc. At temperature ranging between 25 and 50 degree centigrade most of the paving bitumen grades remain in semi solid or in plastic states.</p>	10		

Asphalt:

Asphalt is a term used in America for Bitumen whereas for British standards Asphalt is formed when Bitumen is further treated with chemicals. Just like the bitumen, asphalt also possess similar properties - it is less temperature susceptible and possess less free carbon content. Asphalt exists as solid. It is also widely used in some parts of the world.

Bitumen:

Bitumen is a brown or black colored substance. American standards call Bitumen as Asphalt, whereas in British standard it is known as Bitumen itself. Bitumen is formed by the fractional distillation of petroleum. It exists as solid. It is well dissolved in carbon disulphide or carbon tetrachloride. Bitumen is less temperature susceptible. It has less free carbon content when compared to tar. It is widely in use.

Tar:

Tar is a black colored substance. It is formed by aggressive distillation of coal or wood. Tar is soluble in Toluene. It is more temperature susceptible compared to bitumen and has more free carbon content. Tar exists in the liquid form. It is known as tar in both British and American standard.

Requirements of bitumen to be used as pavement surface coat mix are:

The bitumen should have viscosity of adequate amount during the mixing and compaction.

Bitumen should be less temperature susceptible. It should not be soft during the summer season and hard during the winter season. It must be durable.

Bitumen should have more affinity to aggregates and less affinity to the water.

Bitumen should be able to be heated in high temperature without creating fire hazards.

Bitumen should be liquidified so that it can coat all the aggregates with thin coating.

Bitumen should not be too ductile or too brittle.

A good bitumen should clear all its tests like penetration test, durability test, specific gravity test, spot test, heating loss test, water content test etc.

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Penetration test is commonly adopted test on bitumen to grade the material in terms of hardness. Depending upon the climatic conditions and type of construction, bitumen of different penetration grades are used.

**Procedure:**

1. The bitumen is softened to a pouring consistency between 75 and 100<sup>0</sup>C above the atmospheric temperature at which bitumen softens.
2. The weight of the needle, shaft and additional weights are checked. The total weight of the assembly should be 100 gm.
3. The needle assembly is lowered and the tip of the needle is made to touch the top surface of the sample.
4. The initial reading of the penetrometer dial is either adjusted to zero or the initial reading is taken before releasing the needle.
5. The needle is released exactly for a period of 5 seconds by pressing and final reading is taken on the dial.
6. The difference between the reading gives the penetration value of bitumen

**Observations:**

Reading	Test 1	Test 2	Test 3
Initial (mm)			
Final (mm)			
Penetration value (mm)			

**Result:** The mean penetration value of bitumen = .....

**IS Specification:**

IRC suggests bitumen grades 30/40, 60/70, & 80/100. In warmer region lower penetration grades is used are preferred and in colder region bitumen with higher penetration are used.

**Technical Discussion:**

- The penetration test is used as a measure of consistency. Higher values of penetration indicate softer consistency.
- The test is widely used all over the world for classifying bituminous materials into different grades.
- Depending upon the climatic conditions and type of construction, bitumen of different penetration grade are used. Commonly used grades are 30/40, 60/70 and 80/100.
- In warmer regions, lower penetration grades are preferred and in colder regions bitumen with higher penetration values are used.
- The test is not intended to estimate consistency of softer materials like cut back which are usually graded by viscosity test.

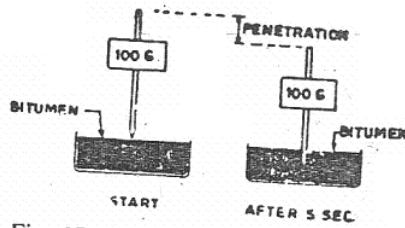
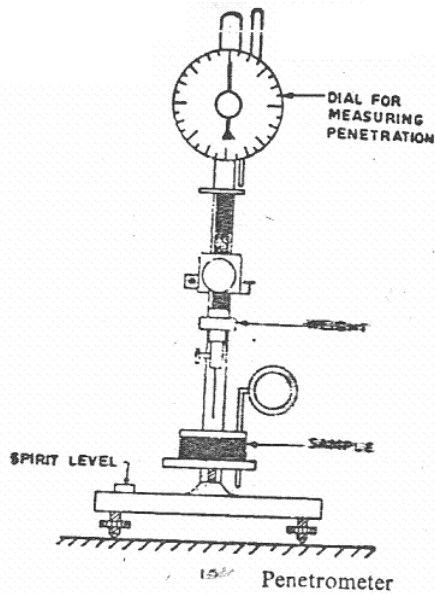
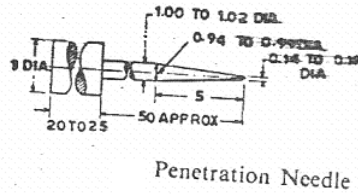


Fig. 17.1 Penetration Test Concept



Penetration Needle

b) Durability test: test is intended to study the resistance of aggregates to weathering action, by conducting accelerated weathering test cycles. The Porous aggregates subjected to freezing and thawing is likely to disintegrate prematurely. To ascertain the durability of such aggregates, they are subjected to an accelerated durability test as specified in IS:2386 part-V. Aggregates of specified size are subjected to cycles of alternate wetting in a saturated solution of either sodium sulphate or magnesium sulphate for 16 - 18 hours and then dried in oven to a constant weight. After five cycles, the loss in weight of aggregates is determined by sieving out all undersized particles and weighing. And the loss in weight should not exceed 12 percent when tested with sodium sulphate and 18 percent with magnesium sulphate solution.