LAB OBSERVATION FOR

TRANSPORTATION ENGINEERING LAB

(III YEAR- II SEMESTER)

UNDER GRADUATE

DEPARTMENT OF CIVIL ENGINEERING

MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

(An Autonomous Institution approved by UGC and affiliated to JNTUH, Approved by AICTE, Accredited by NAAC with 'A' Grade and NBA & Recipient of World Bank Assistance under TEQIP Phase- II S.C.1.1)

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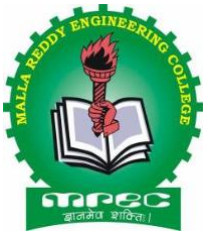


TRANSPORTATION ENGINEERING LAB

NAME OF THE CANDIDATE : _____

ROLL NUMBER : _____

YEAR / SEMESTER : _____

Signature of Faculty (1st person) **Signature of Faculty (2nd person)**

December 2018-2019

LAB CODE

1) Students should report to the labs concerned as per the timetable.
2) Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
3) After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.
4) Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the note book while performing the experiment.
5) The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
6) Not more than four students in a group are permitted to perform the experiment on a set up.
7) The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
8) The components required pertaining to the experiment should be collected from Lab- in-charge after duly filling in the requisition form.
9) When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
10) Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.
11) Students should be present in the labs for the total scheduled duration.
12) Students are expected to prepare thoroughly to perform the experiment before coming to Laboratory.
13) Procedure sheets/data sheets provided to the students' groups should be maintained neatly and are to be returned after the experiment.
14) DRESS CODE:

    Boys - Formal shirt neatly tucked in, and trousers, black / brown / tan shoes and belt, I-cards worn round neck

    Girls - Formal Sal war Kames, black / brown / tan shoes, I- cards worn round neck

LABORATORY: TRANSPORTATION ENGINEERING LAB

Course Code: 50129

LIST OF LABORATORY EXPERIMENTS

Sl. No	Name of the experiment	Page No
I ROAD AGGREGATES		
1	Aggregate crushing value	
2	Aggregate impact test	
3	Specific gravity and water absorption	
4	Attrition Test	
5	Abrasion Test	
6	Shape Tests	
II BITUMINOUS MATERIALS		
1	Penetration test	
2	Ductility test	
3	Softening point test	
4	Flash and Fire Point Tests	
5	Benkelman Beam Demo	

I. ROAD AGGREGATES

1. AGGREGATE CRUSHING VALUE TEST

OBJECTIVES

1) Determination of crushing value of the given road aggregate
2) Assessment of suitability of aggregate for use in road construction

APPARATUS

The apparatus for the test is as per IS: 2386-1963 (Part IV) and consists of the following:

1) The test mould of 152 mm diameter open-ended steel cylinder with a square base plate; Plunger having a piston of diameter 150 mm.
2) A straight metal tamping rod of circular cross section
3) A balance of capacity 5000g, readable and accurate up to 1g.
4) IS sieves of sizes 12.5 mm, 10 mm and 2.36 mm
5) A compression testing machine capable of applying load up to 400 kN at a uniform rate of 40 kN per minute

THEORY:

The strength of coarse aggregate may be assessed by aggregate crushing test. The aggregate crushing value provides a relative measure of resistance to crushing under gradually applied compressive load. To achieve a high quality of pavement aggregates possessing high resistance to crushing or low aggregate crushing value are preferred.

PROCEDURE

The aggregate sample: The material for the standard test consists of aggregates sized between 10 mm and 12.5 mm. The aggregates should be in surface dry condition.

1) About 3.25 kg of the material is sieved through 12.5 mm and retained on 10 mm IS sieves are taken for the test.
2) Empty weight of the mould with base plate is weighed (W)
3) The sieved material is filled in the mould to a depth more than $1/3^{rd}$ of the height of the cylinder and 25 gentle blows are given. Likewise, other two layers are also filled and surface is leveled by straight edge.
4) The weight of the cylindrical set-up (Cylinder + base plate) with aggregates is weighed. (W_1)
5) The plunger is placed symmetrically on the surface of aggregates in the mould and the complete set-up is placed in the compression-testing machine (CTM) for the application of load.
6) The load is applied at a rate of 40 kN/minute up to 400 kN.

7) The set-up is removed from CTM and the crushed material is removed from the mould and is sieved through 2.36 mm IS sieve. The weight of the material passed through the sieve is weighed. (W_2)
8) Steps 2 to 7 are repeated for another set of readings.
9) Aggregate crushing value in percentage of the given aggregate is calculated from the formula: $\{W_2 /[W_1\text{-}W]\} \times 100$

RECORD OF OBSERVATIONS

Sl. No	Description	Trial 1	Trial 2
1	Empty weight of mould (W) in g		
2	Weight of sample with mould and base plate with aggregate (W_1) in g		
3	Weight of sample passing through 2.36 mm IS sieve (W_2) in g		
4	Aggregate crushing value = $\{W_2 /[W_1\text{-}W]\} \times 100$ in %		
Mean value			

The mean of the two results to the nearest whole number is reported as Aggregate crushing value of the given material.

INTERPRETATION OF RESULTS

Depending on the maximum limits of aggregate crushing values given in the table below, suitability of given aggregate for road construction can be assessed.

Sl. No		Type of road construction	Aggregate crushing value Not more than
I		**Flexible Pavement**	
	1	Soling	50
	2	Water-bound macadam	40
	3	Bituminous macadam	40
	4	Bituminous surface dressing or thin mix carpet	30
	5	Dense mix carpet	30
II		**Rigid Pavement**	
	1	Other than wearing course	45
	2	Surface or wearing course	30

RESULT

Aggregate crushing value of the sample is _____

2. AGGREGATE IMPACT VALUE TEST

OBJECTIVES

1) Determination of impact value of the given road aggregate
2) Assessment of suitability of aggregate for use in road construction

APPARATUS

The apparatus for the test is as per IS: 2386-1963 (Part IV) and consists of the following:

1) A testing machine weighing 45 to 60 kg and having a metal base with a plane lower surface of not less than 300 mm diameter.
2) A cylindrical steel cup of internal diameter 102 mm, depth 50 mm and thickness 6.3 mm.
3) A metal hammer weighing 13.4 to 14 kg, the lower end is cylindrical in shape, is 50 mm long and 100 mm diameter. The free fall of the hammer should be 380 ± 5 mm.
4) A straight metal tamping rod of circular cross section
5) A balance of capacity not less than 500 g, readable and accurate up to 0.1g.
6) IS sieves of sizes 12.5 mm, 10 mm and 2.36 mm

THEORY:

A test designed to evaluate the toughness of stone or the resistance of the aggregates to fracture under repeated impacts is called impact test. The aggregate impact test is commonly carried out to impact of aggregates and has been standardized by BIS. The aggregate impact value provides a relative measure of resistance of aggregate to impact, which has a different effect than the resistance to gradually applied compressive stress.

PROCEDURE

The aggregate sample: The material for the standard test consists of aggregates sized between 10 mm and 12.5 mm. The aggregates should be in surface dry condition.

1) Required amount of the material is sieved through 12.5 mm and retained on 10 mm IS sieves are taken for the test.
2) Empty weight of the steel cup is weighed (W)
3) The sieved material is filled in the mould to a depth more than $1/3^{rd}$ of the height of the cylinder and 25 gentle blows are given. Likewise, other two layers are also filled and surface is leveled by straight edge.
4) The weight of the steel cup with aggregates is weighed. (W_1)
5) The steel cup is placed in its position of the impact tester and the hammer is allowed to fall freely on the surface of the aggregates for 15 times and the steel cup with crushed aggregate.
6) The crushed material is removed from the mould and is sieved through 2.36 mm IS sieve. The weight of the material passed through the sieve is weighed. (W_2)

7) Steps 2 to 7 are repeated for another set of readings.
8) Aggregate crushing value in percentage of the given aggregate is calculated from the formula: $\{W_2 /[W_1-W]\} \times 100$

RECORD OF OBSERVATIONS

Sl. No	Description	Trial 1	Trial 2
1	Empty weight of mould (W) in g		
2	Weight of sample with mould and base plate with aggregate (W_1) in g		
3	Weight of sample passing through 2.36 mm IS sieve (W_2) in g		
4	Aggregate crushing value = $\{W_2 /[W_1-W]\} \times 100$ in %		
Mean value			

The mean of the two results to the nearest whole number is reported as Aggregate impact value of the given material.

INTERPRETATION OF RESULTS

Depending on the maximum limits of aggregate impact values given in the table below, suitability of given aggregate for road construction can be assessed.

Aggregate impact value	**Classification**
< 10 %	Exceptionally strong
10% to 20%	Strong
20% to 35%	Satisfactory for road surfacing
> 35%	Not suitable for road surfacing

The Indian Roads Congress has recommended the following values for different types of road construction:

Sl. No	Type of pavement	Maximum AIV in %

1	Surface dressing penetration macadam, bituminous carpet concrete and cement concrete wearing course	30
2	Bitumen bound macadam, base course	35
3	WBM base course with bitumen surfacing	40
4	Cement concrete base course	45

RESULT

Aggregate Impact value of the given aggregate sample is =_____.

3. DETERMINATION OF SPECIFIC GRAVITY, DENSITY AND WATER ABSORPTION FOR COARSE AGGREGATE

OBJECTIVE

To determine the specific gravity, density and water absorption of given aggregate

APPARATUS

Wire basket, Cylinder of standard size, Tamping rod – 16 mm diameter, 60 cm long, Balance and scale.

THEORY

Specific gravity of aggregate is made use of in design calculations of concrete mixes. It is also required in calculating the compaction factor in connection with the workability measurements.

Bulk density of an aggregate gives valuable information regarding the shape and grading of the aggregate. It is used in proportioning of concrete mix. The sample that gives the maximum bulk density is taken as the right sample of aggregate for making economical mix.

Water absorption of aggregate will affect the water/cement ratio and hence the workability of concrete. It will also affect the durability of concrete when the concrete is subjected to freezing and thawing.

PROCEDURE

A. Specific gravity and water absorption

1) Take sample of aggregate not less than 2 kg and thoroughly wash it to remove the finer particles and dust adhering to the aggregate.
2) Place in a wire basket and immerse in distilled water.
3) Shake the basket and aggregate and weigh it in water. Let it be w_1 g
4) Remove the basket and aggregate from water and allow it to drain for a few minutes. Take the aggregate from the basket and place it on a dry cloth and the surface is gently dried with cloth. Transfer the aggregate to the second dry cloth and dry it further.
5) Immerse the empty basket again in water and shake 25 times and weigh it in water. Let it be w_2 g.
6) Dry the aggregates in atmosphere away from direct sunlight for 10 minutes.
7) Weigh the aggregates in air. Let it be w_3 g.

8) Keep the aggregates in oven at a temperature of 100^0 to 110^0
9) Cool the aggregates and weigh it. Let it be w_4 gm.
10) Calculate the specific gravity and water absorption using the formulae.

Specific gravity and water absorption

Weight of basket + aggregate in water, w_1	=	gm
Weight of basket in water, w_2	=	gm
Weight of saturated surface dry aggregate in air, w_3	=	gm
Weight of oven dried aggregate in air w_4	=	gm

Specific gravity = $\frac{w4}{(w4(w1-w2))}$
Water absorption = $\left(\frac{w3-w4}{w4}\right) x100$
Bulk Density of aggregate = $\frac{w4}{(w3(w1-w2))}$

B. Bulk density

1) Measure the internal diameter (d) & height (h) of the cylinder and weigh the empty cylinder. Let it be w_1 kg
2) Fill the cylinder to about one third each time with thoroughly mixed aggregate and tamp it with 25 strokes by a tamping rod.
3) Carefully strike off level using straight edge. Determine and weigh the cylinder with aggregate. Let it be w_2 kg.
4) Calculate the bulk density of the aggregate.

Volume of cylinder V = Π /4 X d^2 X h m^3
Weight of aggregate W = w_2 - w_1 kg
Bulk density of aggregate = W / V kg / m^3

RESULT

Specific gravity of aggregate = _____

Bulk density of aggregate = _____

Water absorption of aggregate = _____

4. DEVAL ATTRITION TEST

AIM: To determine the Deval attrition value.

APPARATUS: The apparatus as per IS: 2386(PartIV)–1963consistsof:

1) Deval machine
2) Sieve: 1.70, 4.75, 10, 12.5, 20, 25,40mm IS Sieves.
3) Balance of capacity5kg or10kg
4) Drying oven

THEORY

The Deval attrition testing machine shall consist of one or more hollow cast-iron cylinders closed at one end and furnished with a tightly fitting iron cover at the other. The inside diameter of the cylinders shall be 20cm and depth34cm.The cylinder shall be mounted on a shaft at an angle of 30degrees with axis of rotation of the shaft.

PROCEDURE:

The test sample consists of clean aggregates dried in oven at 105°-110°C.The sample should conform to any of the grading shown in table1.

1) Select the grading to be used in the test such that it conforms to the grading to be used in construction, to the maximum extent possible.
2) Place the aggregates on the cylinders and fix the cover.
3) Rotate the machine at a speed of 30-33 revolutions per minute. The number of revolutions is 10000.The machines should be balanced and driven such that there is uniform peripheral speed.
4) The machine is stopped after the desired number of revolutions and materials discharge to a tray.
5) The entire stone dust is sieved on1.70mmISsieve.
6) The material coarser than1.7mm size is weighed correct to one gram.

TABLE 4.1

Grading	Passing IS Sieve (mm)	Retained on IS sieve (mm)	Percentage of Sample
A	20	12.5	25
	25	20	25
	40	25	25
	50	40	25
B	20	12.5	25
	25	20	25
	40	25	50
C	20	12.5	50
	25	20	50
D	12.5	4.75	50
	20	12.5	50
E	10	4.75	50
	12.5	10	50

The weight of the test sample shall depend upon its average specific gravity and shall be as follows:

Range in specific Gravity	Weight of Sample(g)
Over2.8	5500
2.4to2.8	5000
2.2to2.39	4500
Lessthan2.2	4000

OBSERVATIONS:

Original weight of aggregate sample (W_1) =

Weight of aggregate sample sample retained (w2) =

Weight passing 1.7mm IS sieve (W_1 -W_2) =

$$\text{Attrition value} = \frac{W1 - W2}{W1} * 100$$

RESULT:

Deval attrition value = _____

5. LOS ANGELES ABRASION TEST

OBJECTIVE

To determine the Los Angeles abrasion value of coarse aggregate

THEORY

The principle of Los Angeles abrasion test is to find the percentage wear due to the relative rubbing action between the aggregates and steel balls used as abrasive charge; pounding action of these balls also exist while conducting the test. This test is believed to be more dependable as rubbing and pounding action simulate the field conditions where both abrasion and impact occur.

APPARATUS

Los Angeles abrasion testing machine, Test sieves

PROCEDURE

1) Take 5 kg of aggregate for grades A, B, C, D and 10 kg for E, F, G grades of aggregates. (see table below for gradation of aggregates)
2 Select the no. of steel balls to be used as abrasive charge from the same gradation table and place them in the cylinder of the machine.
3 Rotate the cylinder for 500 revolutions for grading A, B, C, D and 1000 revolutions for E, F, G at a speed of 30 to 33 revolutions per minute.
4 Stop the machine and take out all the material including stone dust carefully.
5 Sieve the material using 1.70 mm IS sieve and weigh the portion of material retained on the sieve accurately.
6

CALCULATION

Let original weight of aggregate = W_1 g

Weight of aggregate retained on 1.70 mm IS sieve after the test = W_2 g

Loss in weight due to wear = $(W_1 - W_{2)}$ g

Los Ángeles abrasión valué = $(W_1 - W_{2)} / W_1$ X 100

Specifications for Los Angeles Test

Grading	Weight in grams oí each test sample in the size range mm (Passing and retained on square holes)										Abrasive charge	
	80-63	63-50	50-40	40-25	25-20	20-12.5	12.5-10	10-6.3	6.3-4.75	4.75-2.36	Number of spheres	Weightof charge
A	-			1250	1250	1250	1250				12	5000
B	-					2500	2500				11	4584
C	-							2500	2500		8	3380
D	-									5000	6	2500
E	2500	2500	5000								12	5000
F	-		5000	5000							12	5000
G	-			5000	5000						12	5000

RESULT

Los Ángeles abrasión valué of given sample = _____

6. SHAPE TESTS

(FLAKINESS AND ELONGATION INDEX OF ROAD AGGREGATE)

OBJECTIVE

Determination of flakiness and elongation index of coarse aggregate

APPARATUS

Weighing balance, Set of IS sieves, Thickness gauge, Length gauge

THEORY

The flakiness index of aggregate is the percentage by weight of particles in it whose least dimension (thickness) is less than 0.6 times that of mean dimension. Elongation index of aggregate is the percentage by weight of particles in it whose greatest dimension (length) is greater than 1.8 times their mean dimension. Both these tests are not applicable to aggregates of sizes smaller than 6.3 mm.

PROCEDURE

A. FLAKINESS INDEX

1) Take sufficient quantity of aggregates such that a minimum number of 280 pieces of any fraction can be tested.
2) Sieve the aggregates first in IS sieve 63 mm and collect the aggregates passing through this sieve and retained on Is sieve 50 mm. Let it be w_1 g.
3) Pass the above aggregates though the 33.90 mm slot of thickness gauge.
4) Collect the aggregates which are passing in the gauge in a separate tray.
5) Repeat the same procedure for the remaining sample of aggregate according to the table given below.
6) Weigh the aggregate passing through the various slots of the thickness gauge and let it be W.

7) Calculate the flakiness index which is taken as the total weight of material passing the various slots of the thickness gauge expressed as a percentage of the total weight of sample taken.

Tabulation for Flakiness Index

According to IS: 2386 (part I) – 1963.

S. No	Aggregate Passing IS Sieve size (mm)	Aggregate Retained on IS Sieve size (mm)	Slot size of thickness gauge (mm)	Weight of aggregate in this size range (g)	Weight of Aggregate Passing the Slot of thickness gauge	Flakiness Index (percent)
1	63	50	33.9			
2	50	40	27			
3	40	31.5	19.5			
4	31.5	25	16.95			
5	25	20	13.5			
6	20	16	10.8			
7	16	12.5	8.55			
8	12.5	10	6.75			
9	10	6.3	4.89			

B. ELONGATION INDEX

1) Take sufficient quantity of aggregate such that a minimum number of 200 pieces of any fraction can be tested.
2) Sieve the aggregates through 80 mm IS sieve and collect the sample passing 890 mm and retained on 40 mm and weigh them accurately. Let it be w_1 g.
3) Pass each and every piece of aggregate from the above sample through the 81.0 mm slot of the length gauge.
4) Collect the aggregates that are retained in a separate tray.
5) Repeat the same procedure for the remaining aggregate according to the table given below.

6) Calculate the elongation index that is taken as the total weight of material retained on the various slots of the length gauge expressed as a percentage of total weight of material sample taken.

Tabulation for Elongation Index

According to IS: 2386 (part I) – 1963.

S. No	Aggregate Passing IS Sieve size (mm)	Aggregate Retained on IS Sieve size (mm)	Slot size of thickness gauge (mm)	Weight of aggregate in this size range (g)	Weight of Aggregate Passing the Slot of thickness gauge	Elongation Index (percent)
1	80	40	81			
2	40	25	58.5			
3	25	20	40.5			
4	20	16	32.4			
5	16	12.5	25.6			
6	12.5	10	20.2			
7	10	6.3	14.7			

RESULT

1) Flakiness Index of given sample of aggregate =

2) Elongation Index of given sample of aggregate =

II. BITUMINOUS MATERIALS

1. DETERMINATION OF PENETRATION VALUE OF BITUMEN

OBJECTIVES

1) Determination of consistency of the given bituminous material
2) Assessment of suitability of bitumen aggregate for its use under different climatic condition and type of construction

APPARATUS

1) Container: a flat-bottomed cylindrical metallic dish 55 mm in depth is required.
2) Needle: Straight, highly polished cylindrical hard steel rod
3) Water bath: A water bath maintained at 25 ºC containing not less than 10 litres of water. The sample is to be immersed in not less than 100 mm from the top and supported on a perforated shelf, 50 mm from the bottom.
4) Transfer dish or tray
5) Penetration apparatus
6) Thermometer: Range 0 to 44 ºC
7) Time measuring device

THEORY

The penetration test determines the hardness or softness of bitumen by measuring the depth in tenths of a millimeter to which a standard loaded needle will penetrate vertically in five seconds. The sample is maintained at a temperature of 25ºC and BIS have standardized the test. The bitumen grade is specified in terms of penetration value. 80-100 or 80/100 grade bitumen means that the penetration value of the bitumen in the range of 80 to 100 at standard test conditions. The penetration test is exclusively used to bitumen. The penetration value of various types of bitumen used in pavement construction in our country range between 20 and 225.

PROCEDURE

1) Preparation of test specimen: The material is softened to a temperature of 60ºC for tars and 90ºC for bitumen and stirred till air bubbles and water are freed. It is poured into transfer dish and it is allowed to cool for one hour. Then it is kept in water both along with Transfer dish 1 to 1½ hour.

2) The transfer dish is then taken out from water bath and it is placed on the stand of penetrometer device.
3) The needle in the penetrometer is cleaned with benzene and the needle is adjusted in such a way that, the tip of needle is in contact with the surface of the bituminous material.
4) The pointer of the dial is made to zero and initial reading noted.
5) Then the needle is released exactly for 5 seconds.
6) The penetrometer is adjusted to measure the depth penetrated.
7) At least three readings are to be taken at different points on the surface, which are not less than 10 mm from each other.

RECORD OF OBSERVATIONS

Test temperature:

Description	**Trial Number**		
Penetrometer dial reading	1	2	3
Initial			
Final			
Penetration value			
Mean value			

INTERPRETATION OF RESULTS

IRC suggests bitumen grades of 30/40, 60/70 and 80/100 for bituminous macadam and penetration macadam. In warmer regions lower penetration grades are preferred, where as in colder regions higher penetration grades like 180/200 are used so that excessive brittleness will not occur. Highest penetration grades are used in spray application works.

RESULT

Consistency of the given bituminous material is = _____

2. DUCTILITY TEST ON BITUMEN

OBJECTIVES

Determination of ductility value the given bituminous material

APPARATUS

1) Briquette mould
2) Square end trowel
3) Ductility testing machine

THEORY

In the flexible pavement constructions where bitumen binders are used, it is important that the binders form ductile thin films around the aggregates. This serves as a satisfactory binder in improving the physical interlocking of the aggregate bitumen mixes. Under traffic loads the bituminous pavement layer is subjected to repeated deformation and recoveries. The binder material, which does not possess sufficient ductility, would crack and thus provide pervious pavement surface. Ductility test is carried out to test this property of the binder. The test is believed to measure the adhesive property of bitumen and its ability to stretch. The bitumen may satisfy the penetration value, but may fail to satisfy the ductility requirements. Penetration and ductility tests cannot in any case replace each other. The ductility is expressed as the distance to which a standard briquette of bitumen can be stretched before the thread breaks. The ductility values may vary from 5 cm to 100 cm. The BIS have specified a minimum ductility value of 75 cm.

PROCEDURE

1) Preparation of test specimen: The material is softened to a temperature of 75 ºC to 100ºC for bitumen and stirred till air bubbles and water are freed.
2) It is poured in the mould assembly and placed o brass plate after a solution glycerin and dextrin is applied to all surfaces of mould assembly.
3) It is air cooled for 30 to 40 minutes, then it is kept in water bath for 80 to 90 minutes and excess bitumen is removed and leveled off.
4) The sides of the mould are removed and the clips are carefully hooked without any hook strain. The reading is set to zero.
5) The machine is started and the two clips are thus pulled apart horizontally
6) The distance at which the bitumen thread breaks is recorded to report as ductility value.

RECORD OF OBSERVATIONS

Grade of Bitumen :

Pouring temperature, ºC :

Test temperature, ºC :

Periods of cooling in air :

In water bath :

Test Property	Briquette Number			Mean Value
	1	2	3	
Ductility value (cm)				

RESULT

The Ductility value of the given bitumen material is = _____

3. DETERMINATION OF SOFTENING POINT OF BITUMINOUS MATERIAL

OBJECTIVES

Determination of softening point of the given bituminous material

APPARATUS

1) Ring and ball apparatus consists of the following:

   Steel balls: 2 No's each of 9.5 mm diameter and weighing 3.5 g

   Brass rings: 2 No's each having depth of 6.4 mm, inside diameter at bottom and top of 15.9 mm and 17.5 mm respectively

   Ball guides: To guide the movement of balls centrally

   Support: To hold the rings in position and allow for suspension of a thermometer
2) Thermometer that can read up to 100ºC
3) Bath: A heat resistant glass beaker not less than 85 mm in diameter and 1220 mm in depth.
4) Stirrer

THEORY

The softening point is the temperature at which substance attains a particular degree of softening under specified condition of test. The softening point of bitumen is usually determined by Ring and Ball test. The softening point of various bitumen grades used in paving jobs vary between 35ºC to 70ºC.

PROCEDURE

1) Preparation of test sample: The material is softened to a temperature of 75 ºC to 100ºC and stirred it till air bubbles and water are freed. If necessary filter ot through I.S.sevie 30
2) The rings are placed on a metal plate, previously heated to a temperature approximating to that of molten material and the molten material is poured into rings. It is air-cooled and excess material is removed with a Sharpe edged knife.
3) The apparatus is assembled with rings, thermometer and ball guides in position.
4) Bath is filled with distilled water to a height of 50 mm above the top of the upper surface of the rings. The starting temperature is 5ºC

5) The heat is applied at a rate of 5ºC per minute and with increase in temperature, the bituminous material starts to melt and ball sinks through the ring and carries a portion of material with it.
6) The temperatures are noted down, when the first and second ball touches the bottom plate separately and average of the two values reported as softening point.

RECORD OF OBSERVATIONS

Description	1st ball	2nd ball	Mean value
Temperature when the ball touches the bottom, ºC			

INTERPRETATION OF RESULTS

Softening point has particular significance for materials that are to be used as joint and crack fillers. In general, higher the softening point, lower the temperature susceptibility. Bitumen with higher softening point will be preferred in warmer places.

RESULT

Softening point of the given bituminous material is =_____

4. FLASH AND FIRE POINT TEST

THEORY AND SCOPE:

Flash and Fire point test is as a safety test conducted on a bituminous material so that it gives an indication of the critical temperature at and above where precautions should be taken to eliminate fire hazards during its applications. Bituminous materials leave out volatiles at high temperature depending up on their grade.

These volatile vapour catch fire causing a flash. This condition is very hazardous and it is therefore essential to qualify this temperature for each bitumen grade, so that the paving engineers may restrict the mixing or application temperature well within the limits. Flash and Fire point test is conducted as per IS: 1209.

As per IS: 1209 the definitions of flash and fire point are:

Flashpoint: "The flash point of materials the lowest temperature at which the vapour of substance momentarily takes fire in the form of a flash under specified conditions of test".

Fire Point: "The fire point is the lowest temperature at which the material gets ignited and burns under specified condition of test".

AIM:

To determine the flash and fire point of a given bituminous material.

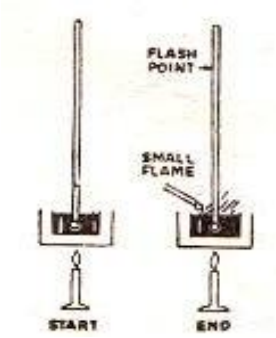
APPARATUS:

Pen sky-Martens closed cup tester, thermometer, heating source, flame exposure.

PROCEDURE:

1) All parts of the cup are cleaned and dried thoroughly before the test is started.
2) The material is filled in the cup up to a mark. The lid is placed to close the cup in a closed system. All accessories including thermo meter of the specified range are suitably fixed.
3) The bitumen sample is then heated. The test flame is lit and adjusted in such a way that the size of a bed is of 4mm diameter. The heating of sample is done at a rate of

5ºto6ºC per minute. During heating the sample the stirring is done at are at of approximately 60 revolutions per minute. The test flame is applied at intervals depending up on the expected flash and fire points and corresponding temperatures at which the material shows the sign of flash and fire are noted.



Flash and Fire Point Test Concept

OBSERVATION AND CALCULATION:

Test	Trails			Mean Value
	1	2	3	
Flash point				
Fire point				

RESULT:

The temperature at which the flame application that causes a bright flash _____

The temperature at which the sample catches fire _____.