TESTS ON AGGREGATES
3.1 DETERMINATION OF INDICES (FLAKINESS AND ELONGATION)

STANDARD


DEFINITION

- The Flakiness Index of aggregates is the percentage by weight of particles whose least dimension (thickness) is less than 0.6 times their mean dimension.
- The Elongation Index of aggregates is the percentage by weight of particles whose greatest dimension (length) is greater than 1.8 times their mean dimension.

APPARTUS

- Standard thickness gauge.
- Standard length gauge.
- IS sieves 63mm, 50mm, 40mm, 25mm, 20mm, 16mm, 12.50mm, 10mm and 6.30mm.
- Balance of capacity 15kg and sensitivity 1gram.
- Thermostatically oven controlled with capacity up to 250 °C.

PROCEDURE

- Take representative sample of aggregates from the stockpile.
- Dry the whole sample in the oven to a constant weight at a temperature of 105 to 110 °C and cool in room temperature.
- Sieve the whole sample through the sieves mentioned in the columns (1) and (2) of the Table: 3.1.1.

Fig: 3.1.1 Testing of aggregates for FI & EI.

FLAKINESS INDEX

- Take minimum of 200 pieces from each fraction and weigh (A).
- Separate flaky material from each fraction by gauging through the standard thickness gauge.
• Weigh the flaky material passing through the specified gauge from each fraction
\[c_1 + c_2 + c_3 + c_4 + c_5 + \ldots \ldots = C.\]

**CALCULATIONS**

• Flakiness index, % = \((C / A) \times 100\)

**ELONGATION INDEX**

• Take minimum of 200 pieces from each fraction and weigh (F).
• Separate the elongated material from each fraction by gauging through the standard length
gauge.
• Weigh the elongated material passing through the specified gauge from each fraction
\[e_1 + e_2 + e_3 + e_4 + e_5 + \ldots \ldots = E.\]

**CALCULATIONS**

• Elongation Index, (\%) = \((E / F) \times 100\).

**Table: 3.1.1**

<table>
<thead>
<tr>
<th>Passing through IS sieve, mm</th>
<th>Retained on IS sieve, mm</th>
<th>Thickness gauge (0.6 times mean sieve) mm</th>
<th>Length gauge (1.8 times mean sieve) mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>63.00</td>
<td>50.00</td>
<td>33.90</td>
<td>-</td>
</tr>
<tr>
<td>50.00</td>
<td>40.00</td>
<td>27.00</td>
<td>81.50</td>
</tr>
<tr>
<td>40.00</td>
<td>25.00</td>
<td>19.50</td>
<td>58.50</td>
</tr>
<tr>
<td>25.00</td>
<td>20.00</td>
<td>13.50</td>
<td>40.50</td>
</tr>
<tr>
<td>20.00</td>
<td>16.00</td>
<td>10.80</td>
<td>32.40</td>
</tr>
<tr>
<td>16.00</td>
<td>12.50</td>
<td>8.55</td>
<td>25.60</td>
</tr>
<tr>
<td>12.50</td>
<td>10.00</td>
<td>6.75</td>
<td>20.20</td>
</tr>
<tr>
<td>10.00</td>
<td>6.30</td>
<td>4.89</td>
<td>14.70</td>
</tr>
</tbody>
</table>
REPORT

- Report the result obtained to the nearest second decimal

COMBINED FLAKINESS AND ELONGATION INDEX (Requirement as per MOST)

- Take minimum of 200 pieces from each fraction and weigh (A).
- Separate flaky material from each fraction by gauging through the standard thickness gauge.
- Weigh the material retained and passed through the specified gauge from each fraction \(b_1+b_2+b_3+b_4+b_5+\ldots\) = B and \(c_1+c_2+c_3+c_4+c_5+\ldots\) = C respectively.
- Take the material retained on the thickness gauge (Non flaky material) and separate the elongated material from each fraction by gauging through the standard length gauge.
- Weigh the material retained on the length gauge from each fraction \(d_1+d_2+d_3+d_4+d_5+\ldots\) = D.

CALCULATIONS

- Flakiness index (FI), % = \((C / A) \times 100\)
- Elongation index (EI), % = \((D / B) \times 100\)
- Combined flakiness and Elongation Index = FI + EI.

REPORT

- Report the result obtained to the nearest second decimal.

PRECAUTIONS

- Take care while taking sample.
- Do not collect selected pieces.
- Collect pieces by only random sampling.
3.2 DETERMINATION OF BULK DENSITY AND VOIDS

STANDARD

OBJECTIVE
- To determine the unit weight or bulk density and voids of aggregate.

APPARATUS
- Balance sensitivity to 0.05 grams.
- Cylindrical container should be water tight, non-corrosive, provided with handles as shown in Fig: 3.2.1 and shall comply to the following requirements given in Table: 3.2.1.
- Steel tamping rod of 16mm diameter and 600mm long rounded at one end.
Table: 3.2.1 Size of containers for bulk density

<table>
<thead>
<tr>
<th>Size of largest particle in mm</th>
<th>Nominal capacity (liters)</th>
<th>Inside diameter cms</th>
<th>Inside Height cms</th>
<th>Thickness of metal in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 4.75</td>
<td>3</td>
<td>15</td>
<td>17</td>
<td>3.15</td>
</tr>
<tr>
<td>Over 4.75 to 40</td>
<td>15</td>
<td>25</td>
<td>30</td>
<td>4.00</td>
</tr>
<tr>
<td>Over 40</td>
<td>30</td>
<td>35</td>
<td>31</td>
<td>5.00</td>
</tr>
</tbody>
</table>

PROCEDURE

• Take representative sample of aggregate as required for the test according to maximum size of aggregate and the container required from Table: 3.2.1.

• Determine the empty weight ($M_1$) and the volume ($V$) of the cylinder at 27°C.

Compacted Weight

• Fill the container in three equal layers, each layer being subjected to 25 strokes with the rounded end of the tamping rod.

• Struck off the surplus aggregate using the tamping rod as a straight edge and weigh ($M_2$).

Loose Weight

• Over flow the container by pouring the material from a height of not exceeding 5cms above the top of the cylinder.

• Struck off the surplus aggregate using the tamping rod as a straight edge and weigh ($M_3$).

CALCULATIONS

\[
\frac{M_2 - M_1}{V} = \gamma_c \text{ Kg / lit or grams / cc.}
\]

\[
\frac{M_3 - M_1}{V} = \gamma_L \text{ Kg / lit or grams / cc.}
\]

\[
\frac{G_s - \gamma}{G_s} \times 100 \text{ Voids} = \gamma_c \cdot \gamma, \gamma = \text{Bulk density of aggregates.}
\]

REPORT

• Report the bulk density in Kg / lit or grams / cc to the nearest second decimal.

• Report the voids as a percentage to the nearest second decimal.
3.3 DETERMINATION OF PERCENTAGE BULKING OF SAND

STANDARD

OBJECTIVE
- To determine the percentage bulking of sand.

APPARATUS
- Containers 2nos.
- Steel scale.

PROCEDURE
- Place sufficient quantity of sand loosely in to a container until it is about two third full.
- Level the top of the sand and measure the height (h) of sand in the center with a steel scale.
- Empty the sand out of the container in to another container with out any loss.
- Fill the empty container half with the water.
- Put back about half of the sand in to the water and prod it with a steel rod about 6mm in diameter so that its volume is reduced to a minimum.
- Add the reminder of the sand and prod it in the same way as described above.
- Smooth and level the top surface of inundated sand and measure its depth (h') at the center.
CALCULATION

- Calculate the percentage bulking of sand from the equitation given below

\[
\text{Percentage of bulking} = \left( \frac{h}{h^i} - 1 \right) \times 100
\]

REPORT

- Report the percentage bulking of sand to the nearest second decimal.
3.4 DETERMINATION OF SPECIFIC GRAVITY OF AGGREGATES (LESS THAN 10MM)

STANDARD


DEFINITION

- Specific gravity is the ratio of the mass of a given volume of the substance to the mass of an equal volume of water.

APPARATUS

- Standard Pycnometer of one liter capacity.
- Balance of capacity 5kg and sensitivity 0.5gram.
- Thermostatically controlled oven with capacity up to 250 °C.

PROCEDURE

- Take representative sample of aggregates approximately about 1000 grams passing 10mm IS Sieve and retained on 4.75mm or 500grams if finer than 4.75mm place in a tray and immerse in distilled water at a temperature of 22 to 32 °C.
• Soon after immersion, remove entrapped air in bubbles on the surface of the aggregate by gentle agitation with a rod.

• Allow the sample to remain immersed in water for 24±1/2 hour.

• After the specified period of soaking drain off water from the sample by decantation through a filter paper, any material retained being returned to the sample.

• Expose the aggregate including any solid matter retained on the filter paper to a gentle current of warm air to avoid surface moisture and stir at frequent intervals to ensure uniform drying until no free surface moisture can be seen and the material just attains a free running condition.

![Fig: 3.4.1 Pycnometer filled with aggregates and distilled water](image)

• Weigh (A) the saturated surface dry sample.

• Place the aggregates in the pycnometer and fill with distilled water as shown in Fig: 3.4.1.

• Remove any entrapped air by rotating the pycnometer on its side by covering the hole in the apex of the cone with the finger.

• Remove any foam from the surface by tipping up with distilled water so that the surface of the water in the hole is flat.

• Dry the pycnometer out side and weigh (B).

• Empty the contents of the pycnometer in to a tray care being taken to ensure that all the aggregate is transferred.

• Refill the pycnometer with distilled water to the same level as before, dry on the out side and weigh (C) as shown in Fig: 3.4.2.
Fig: 3.4.2 Pycnometer filled with distilled water

- Carefully drain off the water from the sample by decantation through a filter paper.
- Surface dry the sample by exposing to the atmosphere away from direct sunlight or any other source of heat for not less than 10 minutes or until it appears to be completely surface dry.
- Keep the sample in the oven in a tray maintained at a temperature of 105°C to 110°C for 24 ± 1/2 hour.
- After the specified period remove the material from the oven cool in the airtight container and weigh (D).
- Make at least two determinations for each test.

**CALCULATIONS**

- Specific gravity on oven dry basis
  \[
  \text{Specific gravity on oven dry basis} = \frac{D}{A - (B - C)}
  \]

- Specific gravity on SSD basis
  \[
  \text{Specific gravity on SSD basis} = \frac{A}{A - (B - C)}
  \]

- Apparent Specific gravity
  \[
  \text{Apparent Specific gravity} = \frac{D}{D - (B - C)}
  \]

- Water absorption, %
  \[
  \text{Water absorption, \%} = \frac{(A – D)}{D} \times 100
  \]

A = Weight of saturated surface dry sample.
B = Weight of pycnometer filled with sample and filled with distilled water.
C = Weight of pycnometer filled with distilled water.
D = Weight of oven dried sample.

**REPORT**

- Report the individual and the mean results to the nearest second decimal.

**PRECAUTION**

- The difference in temperature of the water in the pycnometer during the first and second weighing shall not exceed 2°C.
3.5 DETERMINATION OF SPECIFIC GRAVITY OF AGGREGATES (ABOVE 10MM)

STANDARD

- IS 2386 (Part 3) 1963.

DEFINITION

- Specific gravity is defined as the ratio of the mass of a given volume of the substance to the mass of an equal volume of water.

APPARATUS

- Balance of capacity 10 kg’s, sensitivity to 0.5 gram and of such a type and shape as to permit the basket containing the sample to be suspended from the beam and weighed in water.
- Oven thermostatically controlled with capacity up to 250°C.
• Wire basket of not more than 6.3mm mesh or a perforated container of convenient size preferably chromium plated and polished, with wire hangers thickness not less than 1mm.
• A stout watertight container in which the basket may be freely suspended
• Two dry soft absorbent clothes each not less than 650 cm²

**PROCEDURE**

• Take representative sample of aggregates not less than 2 kilograms.
• Wash the sample thoroughly to remove finer particles and dust.
• Remove the water and place the aggregates in the wire basket and immersed in distilled water at a temperature of 22° to 32°C with a cover of at least 5cms of water above the top of the basket.
• Immediately after immersion, remove the entrapped air from the sample by lifting the wire basket 25mm above the base of the tank and allowing to drop 25 times at a rate of about one drop per second.
• Allow the basket and aggregates completely immersed during the operation and for a period of 24 ± 1/2 hours.
• After the completion of the specified period of time remove the basket with the sample jolt 25 times and weigh (A₁) in water at a temperature of 22 to 32°C as shown in Fig: 3.5.1.
• Remove the basket and the aggregates from the water and allow to drain for a few minutes, after which gently empty the aggregate from the basket.
• Retain the empty basket to the water, jolt 25 times and weigh (A₂) in water.
• Surface dry the aggregates with the cloth, transferring it to the second dry cloth.
• Spread the sample not more than one stone deep on the cloth, and least exposed to the atmosphere away from direct sunlight or any other source of heat for not less than 10 minutes or until it appears to be completely surface dry.
• Weigh the aggregates (B) and keep in the oven maintained at a temperature of 105° to 110°C for a period of 24 ± 1/2 hours.
• After the specified period of time remove the aggregates from the oven cool in an airtight container and weigh (C).
• Make at least two determinations for each test.
CALCULATIONS

- Specific Gravity on oven dry basis
  \[ \frac{C}{B - A} \]

- Apparent Specific Gravity
  \[ \frac{C}{C - A} \]

- Specific Gravity on SSD basis
  \[ \frac{B}{B - A \ (B - C)} \]

- Water absorption
  \[ \frac{A1 - A_2}{C} \times 100 \]

REPORT

- Report the individual and the mean results to the nearest second decimal.
3.6 DETERMINATION OF AGGREGATE IMPACT VALUE

STANDARD

• IS: 2386 (Part 4) 1963.

DEFINITION
• Aggregate Impact value is the ratio between the weights of the fines passing 2.36mm IS sieve and the total sample.

APPARATUS
• Standard Impact Testing machine.
• Cylindrical steel cup 6.3mm thick and having internal diameter of 102mm and depth of 50mm.
• A straight metal tamping rod of circular cross section 10mm diameter and 230mm long, rounded at one end.
• 12.5mm, 10mm and 2.36mm IS sieves.
• Balance of capacity 500gms and sensitivity 0.1gram.
• Thermostatically controlled oven with capacity up to 250 °C.

PROCEDURE
• Take representative sample of aggregates passing 12.5mm IS sieve and retained on 10mm IS sieve.
• Keep the sample in the oven for a period of four hours till the time the weight becomes constant at a temperature of 105 to 110 °C and cool to room temperature.
• Fill the cup in three equal layers, each layer being subjected to 25 strokes with the rounded end of the tamping rod.
• Struck off the surplus aggregates using tamping rod as a straight edge.
• Determine the net weight (A) of the aggregate in the cup.
• Now transfer the material in to the cup of Impact machine, which is fixed firmly in position.
• Compact the material in the cup by a single tamping of 25 strokes with the tamping rod.
• Subject the test sample to a total of 15 blows by the hammer (weighing 13.50 Kg to 14Kg) of the Impact machine each being delivered at an interval of not less than one second and from a height of 380 ± 5 mm above the upper face of the aggregate as shown in Fig: 3.6.1.
• Remove the crushed aggregates from the cup and sieve the whole sample on the 2.36mm IS sieve till no further significant amount passes through the sieve in one minute and weigh (B) as shown in Fig: 3.6.2.
• Weigh the material that has passed through the sieve (C).
• If the total weight (B+C) is less than the original weight (A) by more than one gram, discard the result and conduct a fresh test.

CALCULATIONS
\[
\text{Aggregate Impact Value, } (%) = \frac{C}{A} \times 100
\]

A = Original weight of the oven dried sample.
C = Weight of the material passing through IS sieve 2.36mm.

REPORT
• Report the individual and the mean results to the nearest second decimal.

PRECAUTION
• Care shall be taken that the Impact machine shall rest without wedging or packing upon the level plate, block or floor, so that it is rigid and the hammer guide collars are vertical.
3.7 DETERMINATION OF SOUNDNESS OF AGGREGATES
STANDARD

OBJECTIVE
- To determine the soundness of aggregates.

APPARATUS
- Sieves of size 80mm, 63mm, 50mm, 40mm, 31.50mm, 25mm, 20mm, 16mm, 12.50mm, 10mm, 8mm, 4.75mm, 4mm, 2.36mm, 1.18mm, 600microns, 300microns and 150microns with square openings conforming to IS: 460-1962.
- Containers for immersing the samples shall be perforated so as to permit free access of the solution from the sample and drainage of the solution from the sample with out loss of aggregate.
- Arrangements shall also be available to ensure that the volume of the solution in which samples are to be immersed shall be at least five times the volume of the sample immersed at any one time.
- Balance of capacity 500gm sensitivity to 0.01gm
- Balance of capacity 10kg sensitivity to 1gm.
- Thermostatically controlled oven capable of being maintained at 105°C to 110°C.
- The rate of evaporation, at this range of temperature shall be at least 25gm/hour for four hours during which period the doors of the oven kept closed.

Reagents
Sodium Sulphate Solution
- Prepare saturated solution of sodium sulphate technical grade, conforming to IS: 255 - 1950 or an equivalent grade of the salt of either the anhydrous (Na₂SO₄) or the crystalline (Na₂SO₄·10H₂O) form in water at temperature of 25 to 30°C.
- For making of the solution, 420gms of anhydrous salt or 1300gms of decahydrate salt per liter of water are sufficient for saturation at 28°C.
- The mixer shall be thoroughly stirred during the addition of salt and the solution shall be stirred at frequent intervals until used.
- The solution shall be cooled to a temperature of 27 ± 2°C and maintained at that temperature for at least 48 hours before use.
- Salt cakes if any shall be broken and specific gravity of the solution shall be determined.
- When used, the solution shall have specific gravity of 1.151 to 1.174.
- Discoloured solution shall be discarded, or filtered and checked again for specific gravity.

Magnesium Sulphate Solution
• Prepare saturated solution of magnesium sulphate technical grade, conforming to IS: 257 - 1950 or an equivalent grade of the salt of either the anhydrous (Mg SO\(_4\)) or the crystalline (Mg SO\(_4\) 7 H\(_2\)O)(Epsom salt) form in water at a temperature of 25 to 30\(^\circ\)C.

• For making of the solution, 400gms of anhydrous salt or 1400gms of heptahydrate salt per liter of water are sufficient for saturation at 28\(^\circ\)C.

• The mixer shall be thoroughly stirred during the addition of salt and the solution shall be stirred at frequent intervals until used.

• The solution shall be cooled to a temperature of 27 ± 1\(^\circ\)C and maintained at that temperature for at least 48 hours before use.

• Salt cakes if any shall be broken and specific gravity of the solution shall be determined.

• When used, the solution shall have specific gravity of 1.295 to 1.308.

• Discoloured solution shall be discarded, or filtered and checked again for specific gravity.

**Fine Aggregates**

• Aggregates passing 4.75mm IS Sieve shall be considered as fine aggregates.

• Sample shall be of such size that it will yield not less than 100gms of each of the sizes shown in Table: 3.7.1.

**Table: 3.7.1**

<table>
<thead>
<tr>
<th>Passing IS sieve</th>
<th>Retained on IS sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>600microns</td>
<td>300microns</td>
</tr>
<tr>
<td>1.18mm</td>
<td>600microns</td>
</tr>
<tr>
<td>2.36mm</td>
<td>1.18mm</td>
</tr>
<tr>
<td>4.75mm</td>
<td>2.36mm</td>
</tr>
</tbody>
</table>
**Coarse Aggregates**

- Aggregates of size more than 4.75mm shall be considered as coarse aggregates.
- Sample shall be of such size that it will yield not less than following amounts of different sizes, mentioned in Table: 3.7.2 which shall be available in amounts of 5% or more.

**All in Aggregates**

- Separate all in aggregates in to two major fractions such as smaller than 4.75 and coarser than 4.75.
- The former shall be dealt as fine aggregates and the latter as coarse aggregates.

**Preparation of Test Sample**

**Fine Aggregates**

- Thoroughly, wash fine aggregates on 300micron IS sieve and dry to constant weight at 105° to 110°C and separate in to different sizes through the sieves mention in Table: 3.7.1.

**Coarse Aggregates**

- Thoroughly wash and dry aggregates to a constant weight in an oven at a temperature of 105° to 110°C.
- Separate in to desired fraction by sieving through the sieves mention in Table: 3.7.2.
- Weigh the required size of fraction and place in to separate containers.
- In the case of fraction coarser than 20mm the number of particles shall also be counted

**Table: 3.7.2**

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Required Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm to 4.75mm</td>
<td>300gms</td>
</tr>
<tr>
<td>20mm to 10mm</td>
<td>1000gms</td>
</tr>
<tr>
<td>12.5 to 10mm</td>
<td>33%</td>
</tr>
<tr>
<td>20 to 12.5mm</td>
<td>67%</td>
</tr>
<tr>
<td>40mm to 20mm</td>
<td>1500gms</td>
</tr>
<tr>
<td>25mm to 20mm</td>
<td>33%</td>
</tr>
<tr>
<td>40 to 25mm</td>
<td>67%</td>
</tr>
<tr>
<td>63mm to 40mm</td>
<td>3000gms</td>
</tr>
<tr>
<td>50mm to 40mm</td>
<td>50%</td>
</tr>
<tr>
<td>63 to 50</td>
<td>50%</td>
</tr>
</tbody>
</table>
PROCEDURE

Storage of Sample in Solution

- Immerse the samples in the prepared solution of sodium sulphate for not less than 16 hours nor more than 18 hours in such a manner that the solution covers the sample to a depth of at least 15 mm.
- Cover the containers to reduce the evaporation and to prevent accidental condition of extraneous substances.
- The temperature in the solution shall be maintained within 27 ± 1°C throughout the immersion period.
- After the immersion period remove the aggregates from the solution and permit to drain for 15 ± 5 minutes and place in the oven at a temperature of 105 to 110°C until it attains a constant weight.
- During this period remove the aggregates from the oven cool to room temperature and weigh at intervals not less than 4 hours nor more than 18 hours.
- Constant weight may be considered to have been achieved when two successive weights for any one sample shall not differ by more than 0.1 gram for fine aggregates and 1 gram for coarse aggregates.
- After the constant weight has been achieved remove the aggregates from the oven and cool to room temperature.
- Again immerse the aggregates in solution for next cycle and repeat the same procedure as described above.
- The number of cycles to be conducted shall be as per specifications.
- After the completion of the final cycle cool the sample and wash the sample free from sulphate.
- This may be determined when there is no more reaction of the washed water with barium chloride. (When there is no white precipitation when barium chloride is added to washed water, it can be said that there is no sulphate with washed water)
- Dry each fraction of sample in an oven at a temperature of 105 to 110°C to constant weight and weigh.
- Sieve the fine aggregates over the same sieve on which it was retained before the test. Sieve the coarse aggregates over the sieves of sizes shown in Table: 3.7.3 for appropriate size of particle.

Table: 3.7.3
<table>
<thead>
<tr>
<th>Size of aggregates</th>
<th>Sieve Size used to determine loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>63 to 40mm</td>
<td>31.50mm</td>
</tr>
<tr>
<td>40 to 20mm</td>
<td>16mm</td>
</tr>
<tr>
<td>20 to 10mm</td>
<td>8mm</td>
</tr>
<tr>
<td>10 to 4.75mm</td>
<td>4mm</td>
</tr>
</tbody>
</table>

- Examine visually each size of aggregates to see if there is any evidence of excessive splitting, crumbling or disintegration of the grains.
- Conduct a combined sieve analysis of all the material subject to the above test to note the variation from the original grain size analysis of the sample.

**REPORT**

- Report the following particulars in the test result
  i. Type of solution used.
  ii. Weight of each fraction of sample before test.
  iii. Material from each fraction of the sample finer than the sieve on which the fraction was retained before test, expressed as a percentage by weight of fraction.
3.8 DETERMINATION OF AGGREGATE IMPACT VALUE OF SOFT COARSE AGGREGATES

STANDARD
• IS: 5640 –1970.

DEFINITION
• Aggregate Impact Value is the ratio between the weights of the fines passing 2.36mm IS sieve and the total sample.

APPARATUS
• Standard Impact Testing Machine.
• Cylindrical steel cup 6.3mm thick and having internal diameter of 102mm and depth of 50mm.
• A straight metal tamping rod of circular cross section 10mm diameter and 230mm long, rounded at one end.
• IS sieves of sizes 12.5mm, 10mm and 2.36mm.
• Balance of capacity 500gms and sensitivity 0.1grams.
• Thermostatically controlled oven with capacity up to 250 °C
PROCEDURE

• Take representative sample of aggregates passing 12.5mm IS sieve and retained on 10mm IS sieve.
• Dry the whole sample in the oven for a period of four hours or till the time the weight of aggregates become constant at a temperature of 105 to 110°C and cool to room temperature.
• Fill the cup in three equal layers, each layer being subjected to 25 strokes of the rounded end of the tamping rod.
• Struck off the surplus aggregates using tamping rod as a straight edge.
• Determine the net weight of the aggregates in the cup (A).
• Soak the oven-dried sample in water for three days.
• After the specified period remove the material from water and surface dry with a suitable cloth.
• Immediately transfer the material in to the cup of Impact machine, which is fixed firmly in position.
• Compact the material in the cup by a single tamping of 25 strokes with the rounded end of the tamping rod.
• Subject the test sample to a total of 15 blows by the hammer of the Impact machine each being delivered at an interval of not less than one second and from a height of 380 ± 5 mm above the upper face of the aggregates.
• Remove the crushed aggregates from the cup and sieve the whole material on the 2.36mm IS sieve and wash with water till no further significant amount passes through the sieve in one minute.
• Dry the fraction retained on the sieve in the oven to the constant weight at 105 to 110°C, cool in the airtight container and weigh (B).
• Weigh the material that has passed through the sieve (C).
• If the total weight (B+C) is less than the original weight (A) by more than one gram, discard the result and conduct a fresh test.

CALCULATIONS

\[
\text{Aggregate impact value, (\%)} = \frac{C}{A} \times 100
\]

A = Original weight of the oven dried sample
C = Weight of the material passing through 2.36mm IS sieve

REPORT

• Report the individual and the mean results to the nearest second decimal
PRECAUTIONS

• Care shall be taken that the Impact machine shall rest without wedging or packing upon the level plate or floor, so that it is rigid and the hammer guide collars are vertical.

3.9 DETERMINATION OF TEN PERCENT FINES VALUE

STANDARD

• BS: 812 (Part 3) 1990.

DEFINITION

• Ten percent fines value is defined as the load taken by the soaked sample at ten percent of fines.

APPARATUS

• Standard Compression Testing Machine.
• A cylindrical metal measure having an internal diameter of 57 ± 1 mm and an internal depth of 90 ± 1 mm as shown in Fig: 3.9.1.
• Steel cylinder open ended with plunger and base plate with a normal internal diameter of 75 mm as shown in Fig: 3.9.1.
Fig: 3.9.1 Apparatus for determining ten percent fines value

- Straight steel rod of circular cross section 8mm diameter and 300mm long, one end shall be rounded.
- Balance of capacity 15Kg and sensitivity 1gram.
- 14mm, 10mm and 2.36mm IS test sieves.
- Thermostatically controlled oven with capacity up to 250 °C.

**PROCEDURE**

- Take approximately 15kg of sample passing through 14mm and retained on 10mm sieves.
- Place the test specimen in the wire basket and immerse it in the water with a cover of at least 50mm of water above the top of basket.
- Immediately after immersion remove the entrapped air from the sample by lifting the basket 25mm above the base of container and allowing it to drop 25 times at the rate of one drop per second.
- Keep the basket and aggregates completely immersed in water for a subsequent period of 24 ± 2 hours and the temperature of water maintained at 20 ± 5 °C.
- Remove the specimen of aggregates from the basket after the specified period of soaking and blot the free water from the surface of the material with the absorbent cloths.
- Immediately place the test specimen in to the cylinder in three layers each layer being subjected to 25 blows from the tamping rod distributed evenly over the surface of the layer and dropped from a height of 50mm above the surface of aggregates.
- Carefully level the surface of the aggregates and insert the plunger so that it rests horizontally on the surface.
- Place the apparatus with the test specimen and plunger in position between the platens of the testing machine.
- Apply load at a uniform rate to cause a total penetration of the plunger in 10 min ± 30 seconds and record the maximum load applied to produce the required penetration.
- Replace the load and remove the crushed material by holding the cylinder over a clean tray.
- Dry it in the oven at a temperature of 105 ± 5 °C either to constant mass or for a period of
24 ± 1/2 hours.

- After specified period of time remove the aggregates from the oven and allow the material to cool, weigh and record the mass of the aggregates ($m_1$).
- Sieve the whole of the specimen in the tray on the 2.36mm sieve until no further significant amount passes during a further period of 1min.
- Weigh and record the masses of the fraction passing ($m_2$) and retained ($m_3$) on the sieve to the nearest gram.
- The total mass ($m_2 + m_3$) should not differ from the initial mass ($m_1$) by more than 10 grams otherwise discard the test and start a fresh test.
- Repeat the complete test procedure for another three or more samples with the same of the aggregates at different loads that gives a percentage fines value within the range of 7.50% to 12.50%.

**CALCULATIONS**

\[
\text{Percentage of material passing, } P = \frac{m_2}{m_1} \times 100
\]

**REPORT**

- Plot the graph representing load on Y-axis and percentage of fines on X-axis.
- Draw an average line through the plotted points.
- Record the load at ten percent fines from the graph.

**PRECAUTION**

- Care shall be taken to ensure that the plunger does not jam in cylinder while applying load.
3.10 DETERMINATION OF STRIPPING VALUE OF AGGREGATES

STANDARD

DEFINITION
- The stripping value of aggregates is determined as the ratio of the uncovered area observed visually to the total area of aggregates, expressed as a percentage.

APPARATUS
- Heat resistant glass beaker of 500 ml capacity.
• 20mm and 12.5mm IS sieves.
• Mixer.
• Balance of capacity 10Kg and sensitivity 1 gram.
• Water bath preferably with a thermostat.

PROCEDURE
• Take 200 grams of dry and clean aggregates passing 20mm and retained on 12.5mm sieves and heat up to 150°C.
• Take five percent by weight of bitumen binder and heat up to 160°C.
• Mix the aggregates and the binder till they are completely coated and transfer the mixture into a 500ml beaker and allow to cool at room temperature for about 2 hours.
• Add distilled water to immerse the coated aggregates.
• Cover the beaker and keep in a water bath maintained at 40°C taking care that the level of water in the water bath is at least half the height of the beaker.

Fig: 3.10.1 Bitumen coated aggregates kept in distilled water
Fig: 3.10.2 Aggregates kept out side for observation of stripping of bitumen coating.
• After 24 hours take the beaker out, cool at room temperature and estimate the extent of stripping visually while the specimen is still under the water.

REPORT
• Express the stripping value as the ratio of the uncovered area observed visually to the total area of aggregates in each test.
• Report the mean of three results as stripping value of the tested aggregates to the nearest whole number.

PRECAUTION
• Care shall be taken while mixing aggregates with bitumen.