EXPERIMENT 03 (a)

EXPERIMENT NAME:

DETERMINATION OF AGGREGATE IMPACT VALUE (AIV)

INTRODUCTION

- Toughness is the property of a material to resist impact.
- Due to traffic loads, the road stones are subjected to the pounding action or impact and there is possibility of stones breaking into smaller pieces.
- The road stones should therefore be tough enough to resist fracture under impact.
- A test designed to evaluate the toughness of stones i.e., the resistance of the stones to fracture under repeated impacts may be called an impact test for road stones.
- The aggregate Impact value gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slowly applied compressive load.
- With aggregate of aggregate -impact value higher than 30 the result may be anomalous.
- Also, aggregate sizes larger than 14 mm are not appropriate to the aggregate impact test.

INTRODUCTION (Contd..)

- The standard aggregate impact test shall be made on aggregate passing a 14.0 mm BS test sieve and retained on a 10.0 mm BS test sieve.
- If required, or if the standard size is not available, smaller sizes may be tested but owing to the non-homogeneity of aggregates the results are not likely to be the same as those obtained from the standard size.
- In general, the smaller sizes of aggregates will give a lower-impact value but the relationship between the values obtained with different sizes may vary from one aggregate to another.

REFERENCED DOCUMENTS

BS 812:1975 (Part 1, 2 & 3).

APPARATUS:

Impact Testing Machine:

An *impact testing machine* of the general form shown in figure 3.1 and complying with the following:

- Total mass not more than 60 kg not less than 45 kg.
- The machine shall have a circular metal base "weighing between 22 kg and 30 kg".
- With a plane lower surface of not less than 300 mm diameter, and shall be supported on a level and plane concrete or stone block or floor at least 450 mm thick.
- The machine shall be prevented from rocking either by fixing it to the block or floor or by supporting it on a level and plane metal plate cast into the surface of the block or floor.
- A cylindrical steel cup having an internal diameter of 102 mm and an internal depth of 50 mm.
-

Impact Testing Machine: (Contd..)

- The walls shall be not less than 6 mm thick and the inner surfaces shall be case hardened.
- The cup shall be rigidly fastened at the center of the base and be easily removed for emptying.
- A metal hammer weighing 13.5 kg to 14.0 kg the lower end of which shall be cylindrical in shape, 100.0 mm diameter and 50 mm long, with a 1.5 mm chamfer at the lower edge, and case hardened.
- The hammer shall slide freely between vertical guides so arranged that the lower (cylindrical) part of the hammer is above and concentric with the cup.
- Means for raising the hammer and allowing it to fall freely between the vertical guides from a height of 380 + 5 mm on to the test sample in the cup, and means for adjusting the height of fall within 5 mm.
- Means for supporting the hammer whilst fastening or removing the cup.

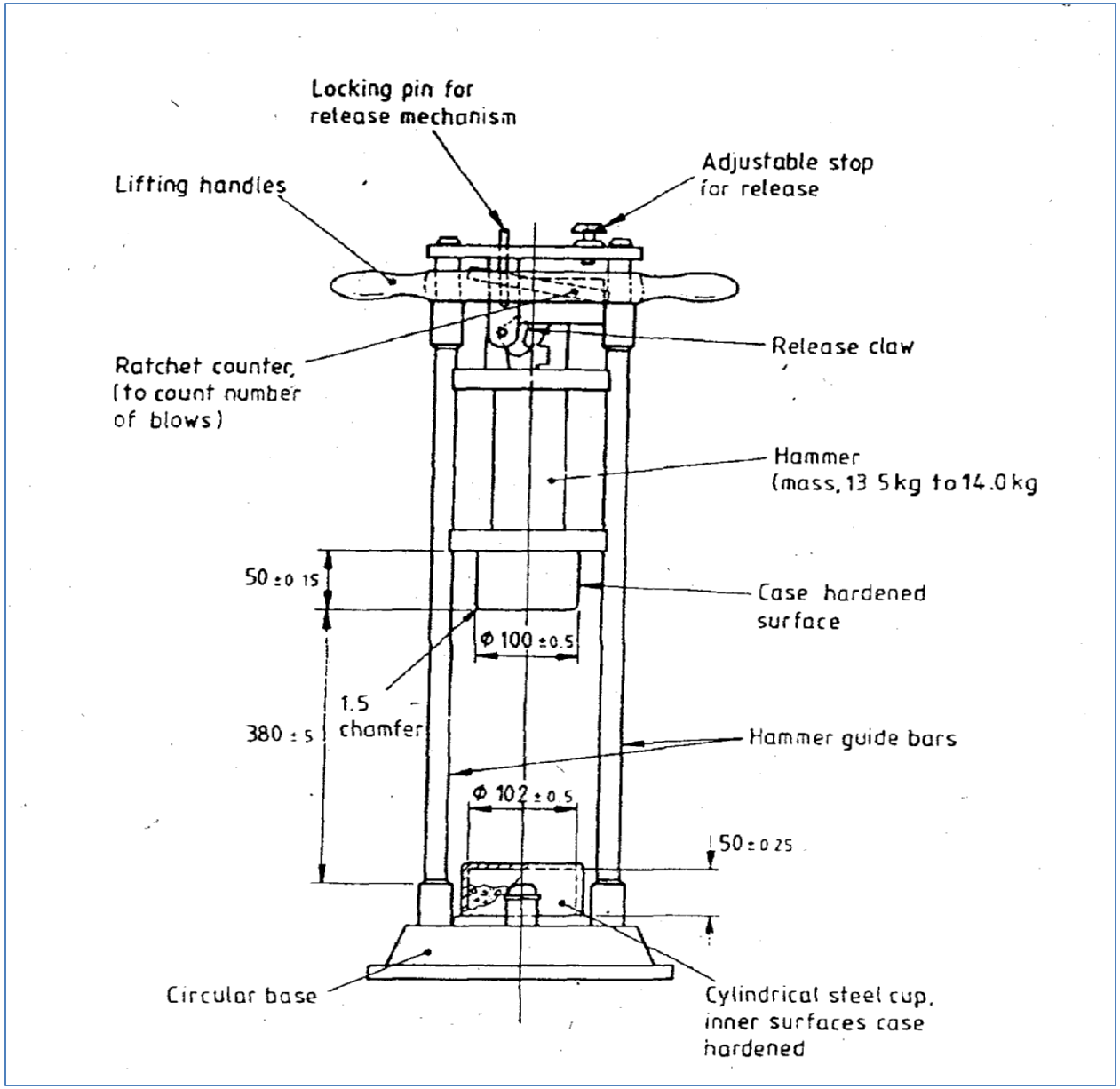


Figure 3.1 Aggregate Impact Test Machine

- **BS test sieves** of aperture size 14.0 mm, 10.0 mm and 2.36 mm, for a standard test.
- **A cylindrical metal measure** of sufficient rigidity to retain its form under rough usage and with an internal diameter of 75 ± 1 mm and an internal depth of 0.50 ± 1 mm
- **A straight metal tamping rod** of circular cross section, 10 mm diameter, 230 mm long, rounded at one end.
- **A balance** of capacity not less than 500 g, and accurate to 0.1 g.

Figure 3.2 Aggregate Impact Test Machine

PREPARATION OF THE TEST SAMPLE:

- The material for the standard test shall consist of aggregate passing a 14.0 mm BS test sieve and retained on a 10.0 mm BS test sieve and shall be thoroughly separated on these sieves before testing.
- For smaller sizes the aggregate shall be prepared in a similar manner using the appropriate sieves given in Table 1.
- The quantity of aggregate sieved out shall be sufficient for two tests.
- The aggregate shall be tested in a surface-dry condition.
- If dried by heating, the period of drying shall not exceed 4 h, the temperature shall not exceed 110°C and the samples shall be cooled to room temperature before testing.

PREPARATION OF THE TEST SAMPLE: (Contd..)

- The measure shall be filled about one third full with the aggregate by means of a scoop, the aggregate being discharged from a height not exceeding 50 mm above the top of the container.
- The aggregate shall then be tamped with 25 blows of the rounded end of the tamping rod, each blow being given by allowing the tamping rod to fall freely from a height of about 50 mm above the surface of the aggregate and the blows being evenly distributed over the surface.
- A further similar quantity of aggregate shall be added in the same manner and a further tamping of 25 times and the surplus aggregate removed by rolling the tamping rod across, and in contact with, the top of the container, any aggregate which impedes its progress being removed by hand and aggregate being added to fill any obvious depressions.
- The net mass of aggregate in the measure shall be recorded (mass A) and the same mass used for the second test.

TEST PROCEDURE:

- Rest the Impact machine, without wedging or packing, upon the level plate, block or floor, so that it is rigid and the hammer guide columns are vertical.
- Fix the cup firmly in position on the base of the machine and place the whole of the test sample in it and compact by a single tamping of 25 strokes of the tamping rod as above.
- Adjust the height of the hammer so that its lower face is 380 ± 5 mm above the upper surface of the aggregate in the cup and then allow it to fall freely on to the aggregates.
- Subject the test sample to a total of 15 such blows, each being delivered at an interval of not less than 1 sec.
- No adjustment for hammer height is required after the first blow.
- Then remove the crushed aggregate by holding the cup over a clean tray and hammering on the outside with a suitable rubber mallet until the sample particles are sufficiently disturbed to enable the mass of the sample to fall freely on to the tray.

TEST PROCEDURE: (contd..)

- Transfer fine particles adhering to the inside of the cup and the underside of the hammer to the tray by means of a stiff bristle brush.
- Sieve the whole of the sample in the tray, for the standard test, on the 2.36 mm BS test sieve until no further significant amount passes in 1 mm.
- When testing sizes smaller than the standard separate the fines on the appropriate sieve given in the 'for separating fines' column in Table 1.1.
- Weigh the fractions passing and retained on the sieve to an accuracy of 0.1 g (mass B and mass C respectively) and if the total mass B+C is less than the initial mass (mass A) by more than 1 g, discard the result and make a fresh test.
- Repeat the whole procedure starting from the beginning using a second sample of the same mass as the first sample.

Table 3.1 Particulars of BS test sieves for testing standard and non-standard sizes of aggregates

Sample size	Nominal aperture sizes of BS test sieves complying with the requirements of BS 410 (full tolerance)		
	For sample preparation		For separating fines
	Passing	Retained	
Non – standard	28.0 mm	20.0 mm	5.00 mm
	20.0 mm	14.0 mm	3.35 mm
Standard	14.0 mm	10.0 mm	2.36 mm
Non – standard	10.0 mm	6.30 mm	1.70 mm
	6.30 mm	5.00 mm	1.18 mm
	5.00 mm	3.35 mm	0.85 mm
	3.35 mm	2.36 mm	0.60 mm

NOTE: Aggregate sizes larger than 14.0 mm are not appropriate to the aggregate impact test.

CALCULATIONS

- The ratio of the mass of fines formed to the total sample mass in each test shall be expressed as a percentage, the result being recorded to the first decimal place.

$$Aggregate\ Impact\ Value\ (AIV) = \frac{B}{A} \times 100$$

Where,

- A is the mass of surface-dry sample (g);
- B is the mass of fraction passing the sieve (2.36 mm) for separating the fines (g)

REPORTING OF RESULTS

- The mean of the two results shall be reported to the nearest whole number as the aggregate impact value.

QUESTIONS??

- What is Aggregate Impact Value?
- Why Aggregate Impact Value of road stones is important?
- What are the applications of Aggregate Impact Value?
- Aggregate impact value material A is 15 and that of B is 20. Which one is better for surface course? Why?

EXPERIMENT 03 (a)
Aggregate Impact Value Test
Data Sheet

- **Type of Material:** *Brick Chips / Stone Chips / Gravels /Boulder / Rock Sample*
- **Sample Size:***14 mm to 10 mm* **Test Method:***BS 812 (Part 3) 1975*

Observation No.	1	2
Wt. of Sample, (Surface dry) ***A***, gm		
Wt. of material retained on 2.36 mm sieve, ***C***, gm		
Wt. of material passing 2.36 mm sieve, B=(A-C), gm		
Aggregate Impact Value (AIV), *=(B/A) x 100%* (to the first decimal place)		

Average Aggregate Impact Value (AIV) =
(To the nearest whole number)

Student No. :
Group :
Date :

Signature of Course Teacher

EXPERIMENT 03 (b)

EXPERIMENT NAME:

DETERMINATION OF AGGREGATE CRUSHING VALUE (ACV)

INTRODUCTION

- The principal mechanical properties required in road stones are i) satisfactory resistance to crushing under the roller during construction and ii) adequate resistance to surface abrasion under traffic.
- Aggregates used in road construction, should be strong enough to resist crushing under traffic wheel loads.
- If the aggregates are weak, the stability of the pavement structure is likely to be adversely affected.
- The strength of coarse aggregates is assessed by aggregates crushing test.
- The aggregate crushing value provides a relative measure of resistance to crushing under a gradually applied compressive load.
- To achieve a high quality of pavement, aggregate possessing low aggregate crushing value should be preferred.

INTRODUCTION (Contd..)

- With aggregate of an aggregate crushing value higher than 30 the result may be anomalous, and in such cases the ten per cent fines value (clause 8) should be determined instead.
- The standard aggregate crushing test shall be made as described in 2.3 to 2.7 on aggregate passing a 14.0 mm BS test sieve and retained on a 10.0 mm BS test sieve.
- If required, or if the standard size of aggregate is not available, the test shall be made according to 2.8.

REFERENCED DOCUMENTS

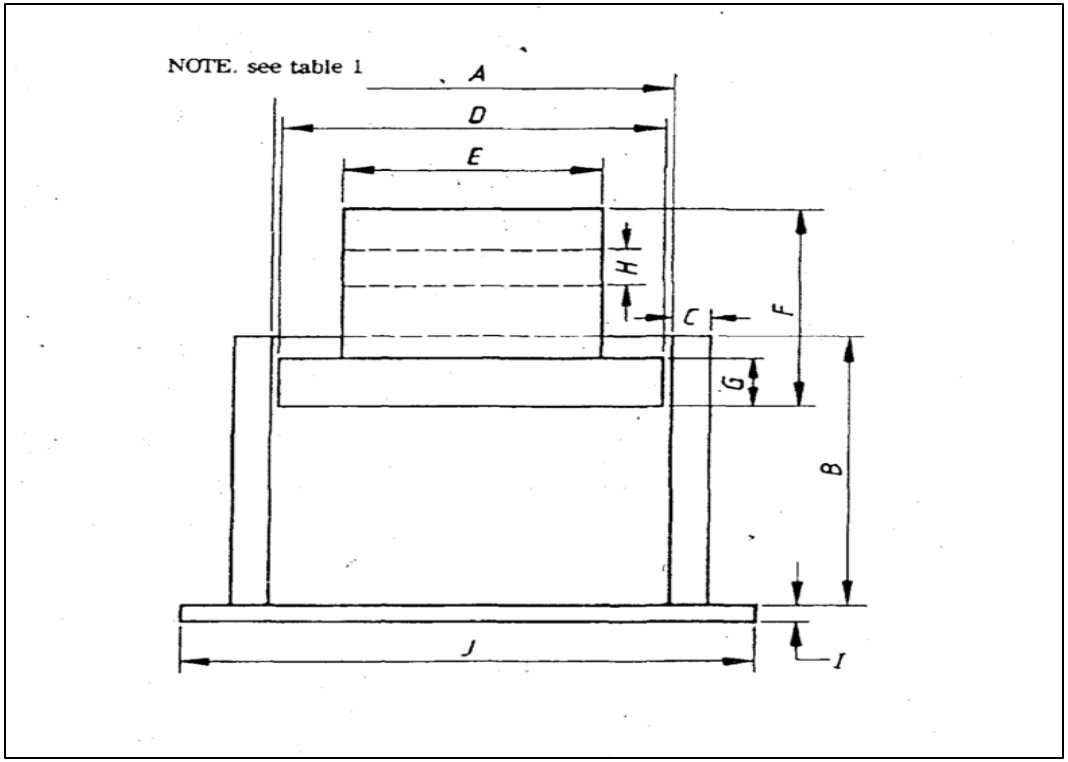
BS 812:1975 (Part 1, 2 & 3).

APPARATUS:

- ***An open ended steel cylinder*** of nominal 150 mm internal diameter with plunger and base-plate, of the general form and dimensions shown in Fig. 2.1. The surfaces in contact with the aggregate shall be machined and case hardened, or otherwise treated, so as to have a hardness value of not less than 650HV, in accordance with BS427, and shall be maintained in a smooth condition.
- ***A straight metal tamping rod*** of circular cross section, 16 mm diameter and 450 mm to 600 mm long. One end shall be rounded.
- ***A balance*** of at least 3 Kg capacity and accurate to 1 g.
- ***BS test sieves*** of sizes 14.0 mm, 10.0 mm and 2.36 mm.

APPARATUS(Contd..)

- ***A compression testing machine*** capable of applying a force of 400 kN and which can be operated to give a uniform rate of loading so that this force is reached in 10 mm. The machine shall comply with the requirements of BS 1610 for a grade A or a grade B machine. The machine may be used with or without a spherical seating.
- ***A cylindrical metal measure*** (optional) for measuring the sample, of sufficient rigidity to retain its form under rough usage and having an internal diameter of 115 mm and an internal depth of 180 mm.



Letter Symbol	Dimensions for	Nominal 150 mm internal diameter of cylinder	Nominal 75 mm internal diameter of cylinder
	Cylinder	mm	mm
A	Internal diameter	154±0.5	78±0.5
B	Internal depth	125 to 140	70 to 85
C	Wall thickness	≮16	≮8
	Plunger		
D	Diameter of piston	152±0.5	76±0.5
E	Diameter of stem	95 to 155	45 to 80
F	Overall length of piston plus stem	100 to 115	60 to 80
G	Depth of piston	≮25	≮19
H	Diameter (nominal) of hole	20	10
	Baseplate		
I	Thickness (nominal)	6	6
J	Length of each side of square	200 to 230	110 to 115

Figure 3.3 Outline forms of cylinder and plunger apparatus for the aggregate crushing value

Figure 3.4 Cylinder and Plunger for ACV Test

PREPARATION OF TEST SAMPLE

- The material for the standard test shall consist of aggregate passing the 14.0 mm BS test sieve and retained on the 10.0 mm BS test sieve and shall be thoroughly separated on these sieves before testing.
- The quantity of aggregate sieved out shall be cooled to room temperature before testing.
- The aggregate shall be tested in a surface dry condition.
- If dried by heating the period of drying shall not exceed 4 h, the temperature shall not exceed 110°C and the aggregate shall be- cooled to room temperature before testing.
- The quantity of aggregate for one test shall be such that the depth of the material in the cylinder shall be 100mm after tamping as described earlier.

PREPARATION OF TEST SAMPLE (Contd..)

- The appropriate quantity may be found conveniently by filling the cylindrical measure in three layers of approximately equal depth, each layer being tamped 25 times from a height of approximately 50 mm above the surface of the aggregate with the rounded end of the tamping rod and finally leveled off using the tamping rod as a straight edge.
- The mass of materiel comprising the test sample shall be determined (mass **A**).

TEST PROCEDURE

- Put the cylinder of the test apparatus in position on the base plate, and add the test sample in thirds, each third being subjected to 25 strokes from the tamping rod distributed evenly over the surface of the layer and dropping from a height approximately 50 mm above the surface of the aggregate.
- Carefully level the surface of the aggregate and insert the plunger so that it rests horizontally on this surface, taking care to ensure that the plunger does not jam in the cylinder.
- Place the apparatus, with the test sample and plunger in position, between the platens of the testing machine and load it at as uniform a rate as possible so that the required force is reached in 10 mm. The required force shall be 400 kN.

TEST PROCEDURE (Contd..)

- Release the load and remove the crushed material by holding the cylinder over a clean tray and hammering on the outside with a suitable rubber mallet until the sample particles are sufficiently disturbed to enable the mass of the sample to fall freely on to the tray.
- Transfer fine particles adhering to the Inside of the cylinder, to the base plate and the underside of the plunger-to the tray by means of a stiff bristle brush.
- Sieve the whole of the sample on the tray on the 2.36 mm BS test sieve until no further significant amount passes in 1 mm.
- Weigh the fraction passing the sieve (mass **B**).
- Take care in all of these operations to avoid loss of the fines.
- Repeat the whole procedure, starting from the beginning of 2.5, using a second sample of the same mass as the first sample.

CALCULATION

- The ratio of the mass of fines formed to the total mass of the sample in each test shall be expressed as a percentage, the result being recorded to the first decimal place.

$$Aggregate\ Crushing\ Value\ (ACV) = \frac{B}{A} \times 100$$

Where,

- *A is the mass of surface-dry sample (g);*
- *B is the mass of the fraction passing the 2.36 mm BS test sieve (g)*

REPORTING OF RESULTS

- The mean of the two results shall be reported to the nearest whole number as the aggregate crushing value.

QUESTIONS??

- What is Aggregate Crushing Value?
- Why Aggregate Crushing Value of road stones is important?
- What are the applications of Aggregate Crushing Value?

EXPERIMENT 03 (b)
Aggregate Crushing Value Test
Data Sheet

- **Type of Material:** *Brick Chips / Stone Chips / Gravels /Boulder / Rock Sample*
- **Sample Size:***14 mm to 10 mm* **Test Method:***BS 812 (Part 3) 1975*

Observation No.	1	2
Wt. of Sample, (Surface dry) A, gm		
Wt. of material retained on 2.36 mm sieve, C, gm		
Wt. of material passing 2.36 mm sieve, B = (A-C), gm		
Aggregate Crushing Value (ACV) = (B/A)x 100% (to the first decimal place)		

Average Aggregate Crushing Value (ACV) =
(To the nearest whole number)

Student No. :
Group :
Date :

Signature of Course Teacher