TOPIC 2:

AGGREGATE

(10 MARKS).....

CONTENT:

- **AGGREGATE.**
- **REQUIREMENT OF GOOD AGGREGATE.**
- **CLASSIFICATION OF AGGREGATE.**
- **PROPERTIES OF FINE AGGREGATE.**
- **TEST ON FINE AGGREGATE.**
- **QUALITY OF FINE SAND.**
- **COARSE AGGREGATE.**
- **PROPERTES OF COARSE AGGREGATE.**
- **GRADING PROPETIES.**
- **STRENGTH PARAMETERS OF COARSE AGGREGATE**

❖ **CO 2: USE OF RELEVANT AGGREGATE REQUIRED FOR CONCRETE WORK.**

❖ CIRRICULAM WEITAGE: 10 MARKS. (16-20 MARKS WITH OR)

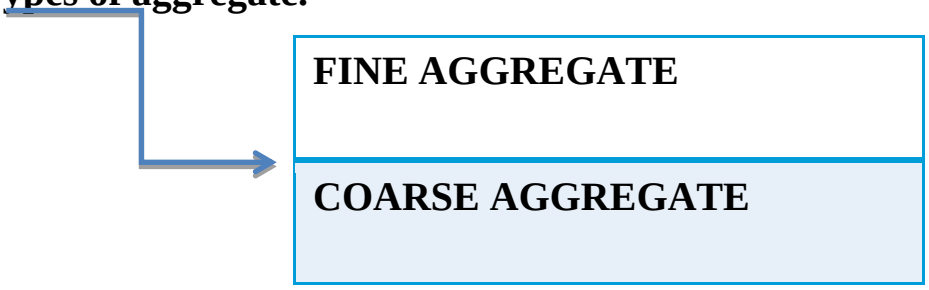
❖ NO. OF PRATICALS TO BE PERFORMED: = **04**

Determine bulk density of fine and coarse aggregate.
Determine fineness modulus of fine aggregate by sieve analysis.
Determine aggregate impact value.
Determine aggregate elongation index and flakiness index

❖ AGGREGATE.

- ❑ DEFINATION: "the material used for manufacturing / preparation of **MORTAR, CONCRETE** such as sand**, gravel** etc. are called as a aggregate."

- ❑ **Types of aggregate.**



1) **FINE AGGREGATE:** The aggregate having size **less than 4.75 mm** is called as a fine aggregate.

✓ Sand comes under the category of fine aggregate.

2) **COARSE AGGREGATE:** The aggregate having size **more than 4.75 mm** is called as a coarse aggregate.

✓ Khadi / gitti come under the category of coarse aggregate.

❖ REQUIREMENT OF GOOD AGGREGATE.

❖ The aggregate for good concrete / mortar requires following properties.

i. **It must be clean, i.e. free from dirt & dust.**

ii. **It should be strong.**

iii. **It should be hard.**

iv. **It should be durable.**

v. **It should not react with cement after mixing, i.e. it should be chemically inert.**

vi. **It should have rough surface, not smooth.**

vii. **It should not absorb water more than 5%.**

viii. **It should not be soft & porous.**

ix. **It should be spherical / cubical in shape.**

❖ CLASSIFICATION OF AGGREGATES.

1) ACCORDING TO SOURCE / NATURE OF FORMATION.

2) ACCORDING TO SIZE.

3) ACCORDING TO SHAPE.

1) ACCORDING TO SOURCE / NATURE OF FORMATION:

1) Naturally occurring aggregates.
2) Artificial / processed aggregates.

2) ACCORDING TO SIZE:

- The aggregates of **size less than 4.75mm ARE** sieve is called as **a fine aggregate. (SAND)**
- The aggregates of **size more than 4.75mm ARE sieve is called as a coarse aggregate.**

3) ACCORDING TO SHAPE:

- Rounded.
- Irregular.
- Angular.
- Flaky.

❖ PROPERTIES OF FINE AGGREGATES.

PROPERTIES OF FINE AGGREGATES

1) SIZE.
2) SHAPE.
3) SURFACE TEXTURE.
4) STRENGTH.
5) SPECIFIC GRAVITY.
6) BULK DENSITY.
7) WATER ABSORPTION.
8) SOUNDNESS.
9) SURFACE MOISTURE.
10) BULKING.
11) SPECIFIC SURFACE.
12) SURFACE INDEX.
13) IMPURITIES.
   A) ORGANIC IMPURITIES.
   B) INORGANIC IMPURITIES.
   C) PRESCENCE OF SALT.
   D) MICA

1) SIZE OF FINE AGGREGATE.

- The largest size of fine aggregate **is 4.75mm.**
- **Mixture of all sizes of fine aggregate** will gives **us desirable, economical** concrete.
- **For the masonry work, plastering work** the cement mortar is prepared with **very fine aggregate of uniform size.**

2) SHAPE OF FINE AGGREGATE.

- Fine aggregate of **irregular nodular shape** is preferred instead of completely rounded grained fine aggregate.

3) SURFACE TEXTURE OF FINE AGGREGATE.

- Generally the **rough surface aggregate** is preferred to smooth aggregate.

4) STRENGTH OF FINE AGGREGATE.

- Initially the strength of **fine aggregate is cannot ensure the strength of concrete.**

5) SPECIFIC GRAVITY OF FINE AGGREGATE:

- "The specific gravity of aggregate is defined **as a ratio of density of aggregate to density of water."**
- This is generally used in the **concrete mix design.**
- If it is not given, then take **2.7 as** the specific gravity of **aggregate is generally 2.6 to 2.8.**

6) BULK DENSITY OF FINE AGGREGATE:

- The bulk density is equals of aggregate is considered both the **fine aggregates and the voids between fine aggregates particles.**
- The bulk density of fine aggregate is in between **17-25 kN/m³.**

7) WATER ABSORPTION OF FINE AGGREGATE:

- Generally the water absorption for fine aggregate should **be kept minimum UPTO 5%**

8) SOUNDNESS OF FINE AGGREGATE:

- The soundness **means expansion / contraction of aggregate** when **subjected to temperature variation.**
- A **good aggregate should show the minimum expansion / contraction**, under changing temperature.

9) SURFACE MOISTURE OF FINE AGGREGATE:

- Many aggregate have tendency **to attract the moisture**, & absorb, gives **rise to phenomenon BULKING**.

10) BULKING OF FINE AGGREGATE:

- Due to **absorption of water/moisture the aggregate swells**, this phenomenon is known as a BULKING.
- Due to bulking of sand results, **the concrete mix design goes wrong.**

11) SPECIFIC SURFACE OF FINE AGGREGATE:

- The **surface area per unit weight of material is** called as a specific surface.

12) SURFACE INDEX OF FINE AGGREGATE:

- It is an empirical number related to specific surface.

13) IMPURITIES IN FINE AGGREGATE:

A) **ORGANIC IMPURITIES.**

- When the sand is from river bed then, it may contain decayed vegetable, clay, and decayed animal matter.
- This will affect the setting time & strength of concrete.
- This is determined by colorimetric test.

B) INORGANIC IMPURITIES:

- Inorganic impurities may occur in the salt from quarries.
- These are mainly silt & clay.

C) PRESCENCE OF SALT:

- The fine aggregate from the tidal river may contain salt which may affect the setting properties of salt.

D) MICA:

- **The presence of MICA (silicate material) reduces to some extent the durability of concrete.**

❖ TEST ON FINE AGGREGATES.

1) DETERMINATION OF FINENESS MODULUS OF SAND & GRADING OF SAND BY SIEVE ANALYSIS (IS 2386-1963 PART I)
2) SILT CONTENT IN SAND & ITS SPECIFICATION AS PER IS 383.

1) DETERMINATION OF FINENESS MODULUS OF SAND & GRADING OF SAND BY SIEVE ANALYSIS (IS 2386-1963 PART I).

➢ TERMS USED IN FINENESS MODULUS:

1) WELL GRADED SAND:

- If the aggregate of **all the sizes are present in appreciable / EQUAL percentage** the aggregate is termed as a **WELL GRADED AGGREGATE.**
- **4.75 mm, 2.36mm, 1.18mm, 600µ, 300µ, 150µ, 75µ.**
- **All sizes fine aggregate are present in equal/ appreciable %**

2) POORLY GRADED:

If the aggregate of **all are of the same sizes then the** aggregate is termed as a **POORLY GRADED AGGREGATE.**

3) GAP GRADED:

If the aggregate **having the total absence of a particular size of aggregate**, then it is called as **a GAP GRADED AGGREGATE.**

DEFINATION:

FINENESS MODULUS = $\frac{\sum CUMMULATIVE\ \%\ RETAINED\ ON\ SIEVE}{100}$

The resulting value is FINENESS MODULUS.

FINE SAND = 2.2 – 2.6.

MEDIUM SAND = 2.6 – 2.9.

COARSE SAND = 2.9 – 3.2.

The sand having FINENESS MODULUS less than 2.2 or more than 3.2 is not suitable for the use in concrete.

❑ PROCEDURE TO BRING FM IN THE LIMIT:

- To bring the FINENESS MODULUS in limit **the cumulative % of retained sand is increased** by adding **sand particles which have lesser % in the calculation.**

❑ IMPORTANCE OF FINENESS MODULUS:

- Fineness modulus of **sand 2.2 to 2.6 is helpful for minimizing voids ratio & increasing the density of concrete mass.**
- **Well graded sand** is also **useful for good bonding of particles & strength.**

❖ NUMERICALS ON FINENESS MODULUS

Calculate fineness modulus and classify the sand from this Weight of sample = 500 gm.

Sieve Size	2.36 mm	1.18 mm	600 micron	300 micron	150 micron	75 micron
Weight in g.	10	105	137	175	63	10

SIEVE SIZE	WEIGHT IN GM.	% RETAINED	CUMMULATIVE RETAINED
2.36mm	10	$\frac{10}{500}$x100= **02**	**02**
1.18mm	105	$\frac{105}{500}$x100= **21**	**23**
600µ	137	$\frac{137}{500}$x100= **27.4**	**50.4**
300µ	175	$\frac{175}{500}$x100= **35**	**85.4**
150µ	63	$\frac{63}{500}$x100= **12.6**	**98**
75µ	10	$\frac{10}{500}$x100= **02**	**100**
	500	**TOTAL**	**358.8**

FINENESS MODULUS =

$$\frac{\sum cummulative\ retained}{100} = \frac{358.8}{100} = 3.588$$

This sand is not used in the concrete

Sieve analysis was conducted on sand with 500 gm of sample and observations are as below. Determine F.M. of sand.

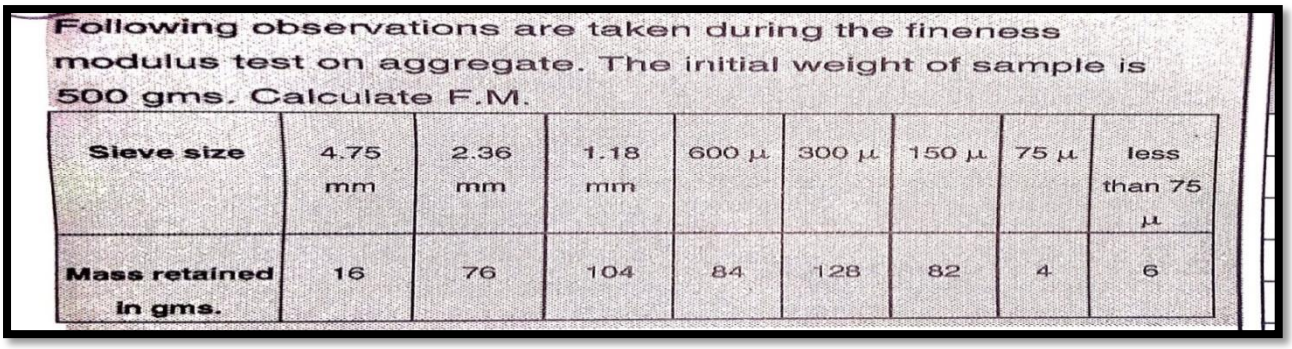
sieve size(mm)	10	4.75	2.36	1.18	600 µ	300 µ	150 µ
Weight retained (gm)	0	10	50	50	95	185	110

SIEVE SIZE	WEIGHT IN GM.	% RETAINED	CUMMULATIVE RETAINED
4.75mm	10	$\frac{10}{500}$x100= **02**	**02**
2.36mm	50	$\frac{50}{500}$x100= **10**	**12**
1.18mm	50	$\frac{50}{500}$x100= **10**	**22**
600µ	95	$\frac{95}{500}$x100= **19**	**41**
300µ	185	$\frac{185}{500}$x100= **37**	**78**
150µ	110	$\frac{110}{500}$x100= **22**	**100**
	500	**TOTAL**	**255**

FINENESS MODULUS =

$$\frac{\sum CUMMULATIVE\ RETAINED}{100} = \frac{255}{100} = 2.55$$

This sand is used in the concrete.



Following observations are taken during the fineness modulus test on aggregate. The initial weight of sample is 500 gms. Calculate F.M.

Sieve size	4.75 mm	2.36 mm	1.18 mm	600 µ	300 µ	150 µ	75 µ	less than 75 µ
Mass retained in gms.	16	76	104	84	128	82	4	6

SIEVE SIZE	WEIGHT IN GM.	% RETAINED	CUMMULATIVE RETAINED
4.75mm	16	$\frac{16}{500}$x100= **3.2**	**3.2**
2.36mm	76	$\frac{76}{500}$x100= **15.2**	**18.4**
1.18mm	104	$\frac{104}{500}$x100= **20.8**	**39.4**
600µ	84	$\frac{84}{500}$x100= **16.8**	**56**
300µ	128	$\frac{128}{500}$x100= **25.6**	**81.6**
150µ	82	$\frac{82}{500}$x100= **16.4**	**98**
75µ	4	$\frac{4}{500}$x100= **0.8**	**98.8**
Less than75µ	6	$\frac{6}{500}$x100= **1.2**	**100**
	500	**TOTAL**	**495.4**

FINENESS MODULUS =

$$\frac{\sum cummulative\ retained}{100} = \frac{495.4}{100} = 4.954$$

This sand is not used in the concrete

SUMMER -2019

Calculate the fineness modulus of a sample using following data. Total weight of sample is 1kg.

Sieve	4.75	2.36	1.18	600	300	150	Pan
Size	mm	mm	mm	µ	µ	µ	--
Weight retained (gm)	100	150	300	200	120	90	40

Sieve	Size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative weight retained (%)
4.75	mm	100	100	10
2.36	mm	150	250	25
1.18	mm	300	550	55
600	µ	200	750	75
300	µ	120	870	87
150	µ	90	960	96
Pan	--	40	1000	
∑ % cumulative wt. retained upto 150µ IS sieve				**348**

3

F. M.=∑ % cumulative wt. retained upto 150µ IS sieve / 100
F.M. = 348/100
F.M. = 3.48

1

WINTER -2019

Calculate fineness modulus for the given data of fine aggregate. Total weight of C.A. = 1000 gm.

Sieve size in mm	4.75	2.36	1.18	600µ	300 µ	150 µ	Pan
Wt. retained in gm	20	75	210	274	305	106	10

Sieve size (mm)	Weight retained (gm)	Cumulative weight retained (gm)	% Cumulative weight retained (%)
4.75	20	20	2
2.36	75	95	9.5
1.18	210	305	30.5
600 µ	274	579	57.9
300 µ	305	884	88.4
150 µ	106	990	99
Pan	10	--	--
∑ % cumulative wt. retained upto 150µ IS sieve			**287.3**

2

F. M.= ∑ % cumulative wt. retained upto 150µ IS sieve / 100
F.M. = 287.3/100
F.M. = 2.873

1

1

❖ SILT CONTENT IN SAND & ITS SPECIFICATION AS PER IS 383

- SILT (गाळ) is the very fine particles of **size less than 75 microns.**
- The excessive silt contain in fine aggregate makes it **more permeable, increases shrinkage reduction in the strength.**
- **DEFINITION:-**
- The quantity of silt, fine silt, clay & very fine dust is determined by **SEDIMENTION METHOD/PROCESS**.
- In this aggregate sample is **mixed with water** in the **measuring jar** & the aggregates are **nicely rodded to remove the particles of clay & silt, which are stuck to aggregates.**
- **PROCEDURE:-**

1) First of all fill the **jar up to 50 mm.** With water with **1% of common salt.**
2) After this **add the FINE AGGREGATE in the jar till it reaches <u>100 ml</u> mark in jar.**
3) After the adding the water & fine aggregates into the jar, **shake it well** & keep in the **undisturbed condition at least for 3 hrs.**
4) After this the silt & clean fine aggregates are settled, **respective readings are taken.**

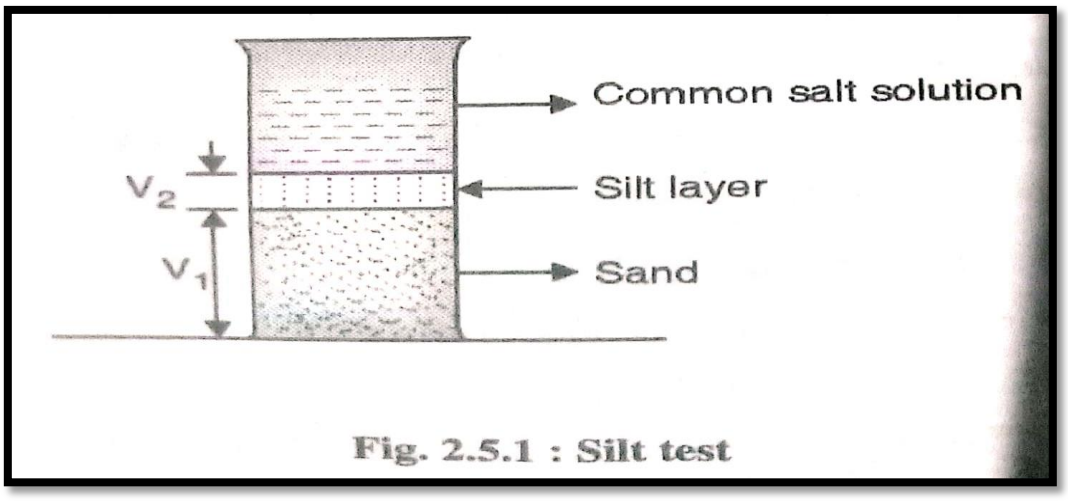


Fig. 2.5.1 : Silt test

5) **% of silt =** $\frac{\textbf{volume of silt after 3 HR}}{\textbf{volume of sample}}$ **× 100** **% silt =** $\frac{V2}{V1}$ **× 100.**

V1= Volume of sample.

V2= Volume of silt after 3 hr.

- The impurities should **not exceed 5%** according **to IS -383.**

❖ QUALITY OF FINE AGGREGATE / SAND:-

1. It should be clean, free from salt, silt, dirt, dust etc.
2. It should be well graded.
3. It should be strong, hard, & durable.
4. It should be chemically inert / inactive.
5. It should have less bulking phenomenon.

❖ BULKING OF FINE AGGREGATE / SAND:-

- **DEF:-**

"The **free moisture** content in fine aggregate results in **increasing volume of sand** is called as a **bulking / swelling of fine aggregates / sand."**

- **This happens especially in rainy seasons**

❖ PHENOMENON OF BULKING:-

❖ Bulking is due to **absorption of moisture on individual sand grains in the form of a thin film.**

❖ Due to this the **sand swells** & **its volume increases more than the it's actual volume.** This will increase the **bulking to certain limit.**

❖ After this limit, more moisture **causes the breakage of this moisture film. (SATURATION POINT).**

❖ This will cause the **sand particles lose the film & sinks into the water.**

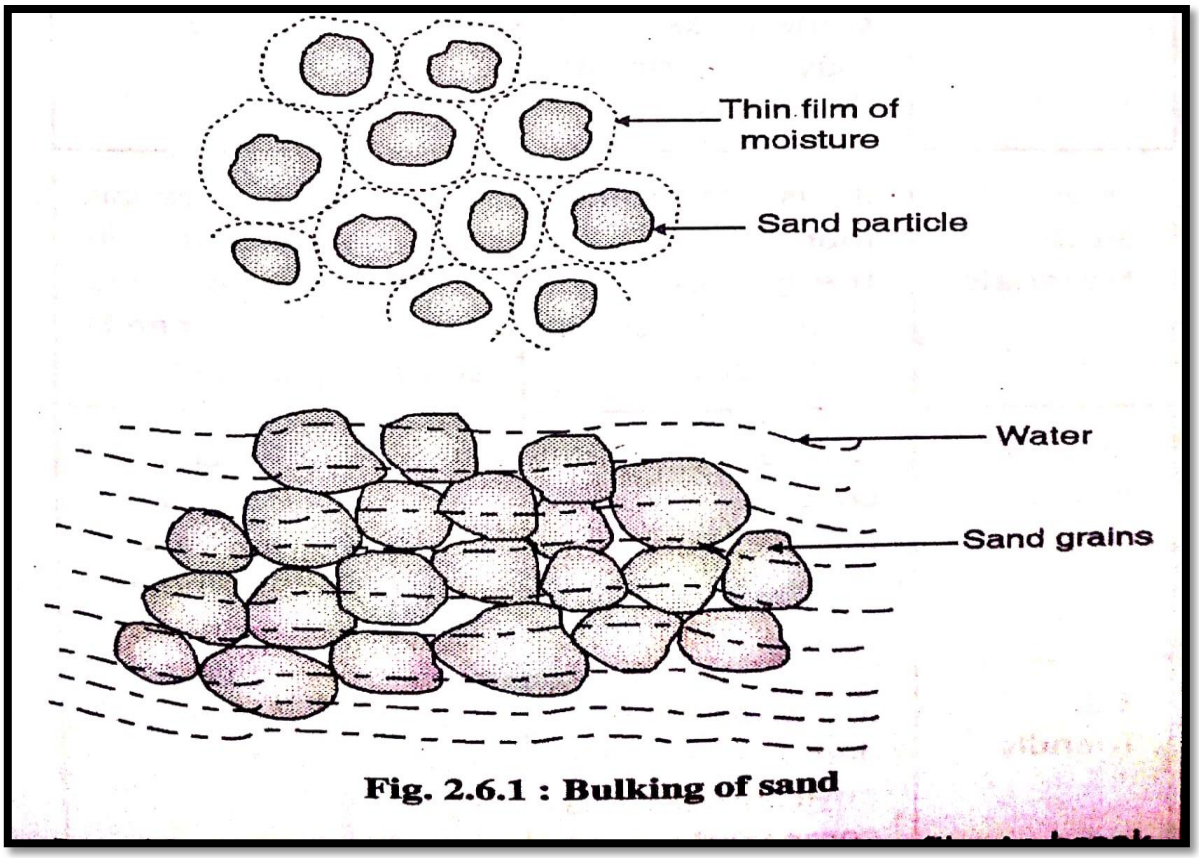


Fig. 2.6.1 : Bulking of sand

- **PROCEDURE:-**

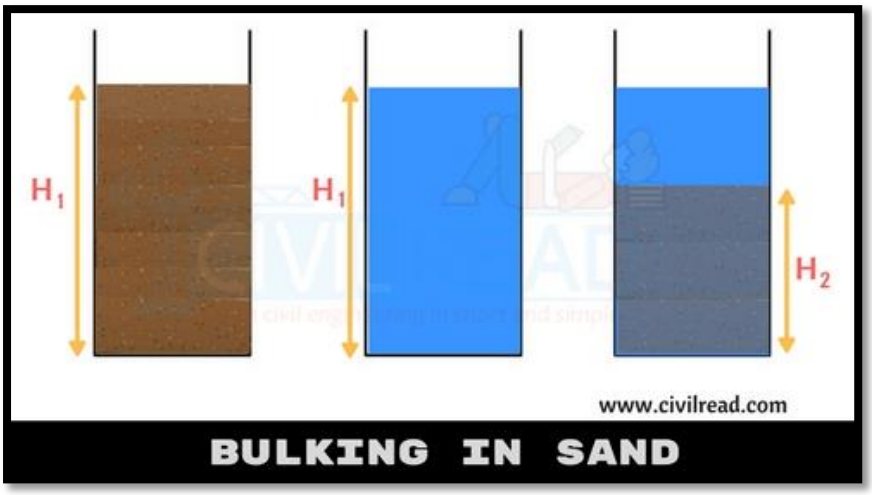
1. Take a simple container and **add 2/3 part of sand in it.**

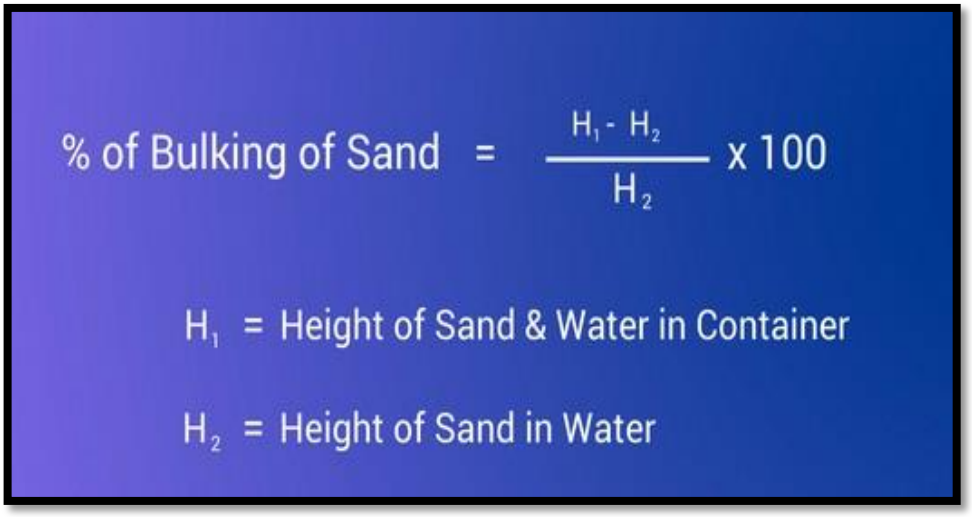
2. Measure the exact height of sand using the scale .and notes it down. **(Height:-H1)**

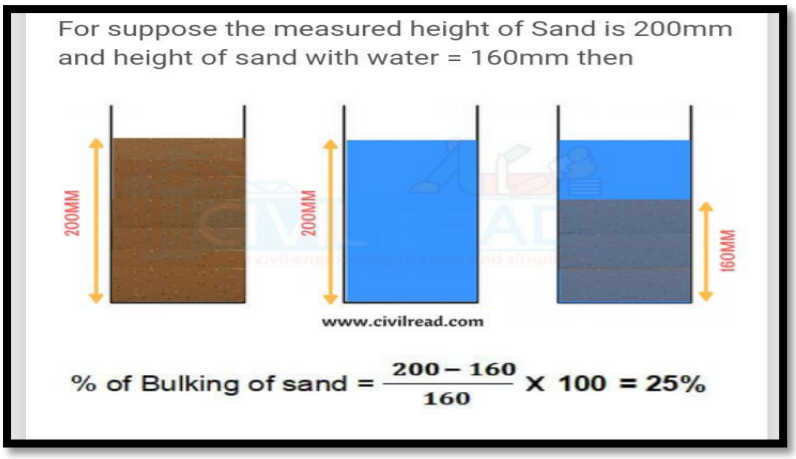
3. Now fill the container **up to 2/3 part with water. (Same height of Sand)**

4. Now add the measured sand to the container and wait for some time to settle down.

5. Now calculate the **height of Sand in water. (Height:-H2)**





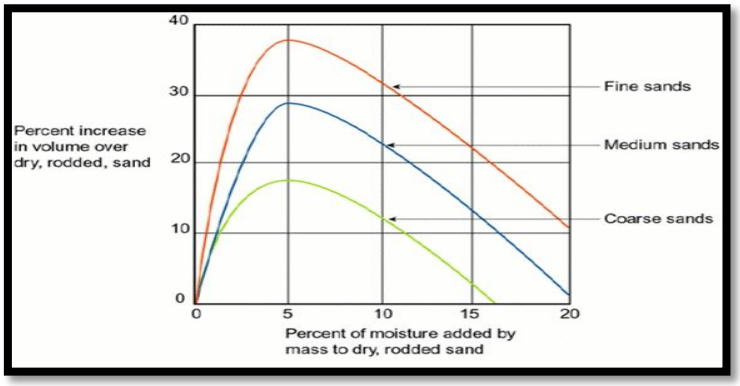


% of Moisture content	Percentage of Bulking with respect to volume
2%	15%
3%	20%
4%	25%
5%	30%

❖ EFFECTS OF BULKING ON CONCRETE MIX PROPORTION:-

1. It affects the **properties of concrete.**
2. This will leads to **harsh concrete with less workability.**
3. It will also **decrease the productivity of concrete per bag of cement.**
4. It will affect the **quality of concrete.**

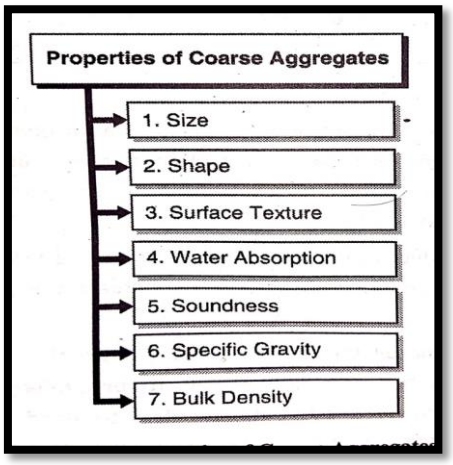
❖ CURVE REPRESENTS THE EFFECT OF MOISTURE CONTENT ON THE BULKING OF SAND:-



❖ COARSE AGGREGATE.

- The Aggregate **obtained from stone quarries & stone crusher.**
- **The size between 4.75 mm to 80 mm is termed as coarse aggregates.**

❖ PROPERTIES OF COARSE AGGREGATES.



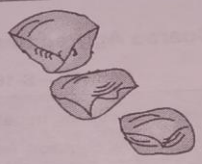
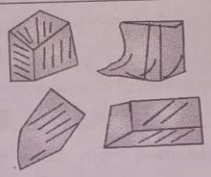
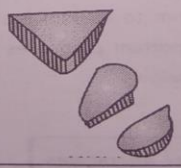
1) SIZE OF COARSE AGGREGATE.

- For the **mass concreting works** without complicated reinforcement, **lager aggregates of 80mm, 40mm, 20 mm size is used.**
- For ordinary construction of **residential / other buildings 20 mm is the maximum size is used.**
-

2) SHAPE OF COARSE AGGREGATE.

- The shape of coarse aggregates is an important factor which **affects the workability & strength of concrete.**
- The **angular aggregates are preferred instead of rounded & smooth aggregates.**

Table 2.7.1 : Classification of aggregate according to shape

Sr. No.	Classification	Description	Figure	Example
1.	Rounded	Fully water-worn or shaped by attrition. Not very suitable for concrete.		River or seashore gravel, desert, seashore and wind blown sands.
2.	Irregular or partly rounded	Naturally irregular or partly rounded by natural attrition and having rounded edges. Medium quality concrete.		Pit sand and gravel flints, cuboid rock.
3.	Angular	Possessing well defined edges, roughly plane faces. Best for concreting.		Crushed rock from stone quarry or crusher site.
4.	Flaky	Angular, having small thickness as compared to width or length. Suitable for only lower grade of concrete.		Aggregate obtained from laminated or sedimentary rocks.

3) SURFACE TEXTURE OF COARSE AGGREGATE.

- **As** far as possible the coarse aggregates should have **rough surface texture**.
- **A** rough surface **provides more area for bonding with cement paste & gives more strength.**
- Smooth textured aggregates can be used for **unimportant work.**

4) WATER ABSORPTION OF COARSE AGGREGATE

- The water absorption of coarse aggregates is measured by **per cent increase in weight of an oven dry sample after immersion in water for 24 hrs.**
- More the absorption **will affect the both workability & durability of the concrete.**

6) SOUNDNESS OF COARSE AGGREGATE.

- Soundness is the **resistance offered by the Aggregates, to any volume changes.**
- The average loss of weight **should not exceed 12% if tasted with sodium sulphate & 18% if tasted with magnesium sulphate.**

7) SPECIFIC GRAVITY OF COARSE AGGREGATE.

- It is the ratio of **dry weight of aggregates to the weight of equal volume of water.**

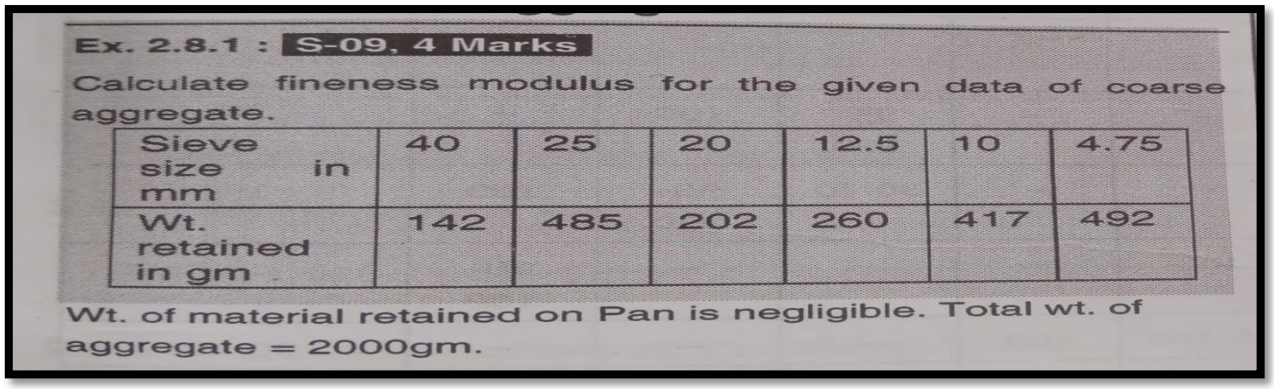
8) BULK DENSITY OF COARSE AGGREGATE.

- The ratio of **net weight of Aggregate to the volume of Aggregate.**

GRADING PROPERTIES:-

- **Determination of FM of coarse Aggregates by sieve analysis:-**
- **This** test is similar to sieve analysis of fine Aggregate.
- In this the aggregates are sieved through a **series of sieve 80 mm, 40mm, 20mm, 10mm, 4.75mm & the weight retained on each sieve is measured.**
- Form this **percentage & respective cumulative percentage for each sieve is calculated.**
- Thus,
- **FINENESS MODULUS =**

$$\frac{\sum CUMMULATIVE\ \%\ RETAINED\ ON\ SIEVE}{100}$$



Ex. 2.8.1 : S-09, 4 Marks

Calculate fineness modulus for the given data of coarse aggregate.

Sieve size in mm	40	25	20	12.5	10	4.75
Wt. retained in gm	142	485	202	260	417	492

Wt. of material retained on Pan is negligible. Total wt. of aggregate = 2000gm.

SIEVE SIZE	WEIGHT IN GM.	% RETAINED	CUMMULATIVE RETAINED
40mm	142	$\frac{142}{2000}$x100 =7.1	7.1
25mm	485	$\frac{485}{2000}$x100=24.2	31.35
20mm	202	$\frac{202}{2000}$x100=10.1	41.45
12.5mm	260	$\frac{260}{2000}$x100 =13	54.45
10mm	417	$\frac{417}{2000}$x100=20.8	75.3
4.75mm	492	$\frac{492}{2000}$x100=24.6	99.9
	2000	TOTAL	309.55

FINENESS MODULUS =

$$\frac{\sum cummulative\ retained}{100} = \frac{309.55}{100} = 3.0955$$

Ex. 2.8.2 **W-12, 4 Marks**

Calculate finencess modulus for given data.

Sieve size in (mm)	150	100	80	63	40	20	12.5	10	4.75	Pan
Mass retained in (gm)	154	134	87	392	416	160	202	385	105	18

Soln. :

Sieve Size	Weight retained	% retained = $\frac{\text{Weight retained}}{\text{Total weight}} \times 100$	Cumulative % retained
150	154	$\frac{154}{2053} \times 100 = 7.5$	7.5
100	134	$\frac{134}{2053} \times 100 = 6.5$	14
80	87	$\frac{87}{2053} \times 100 = 4.2$	18.2
63	392	$\frac{392}{2053} \times 100 = 19.09$	37.29
40	416	$\frac{416}{2053} \times 100 = 20.26$	57.55
20	160	$\frac{160}{2053} \times 100 = 7.79$	65.34
12.5	202	$\frac{202}{2053} \times 100 = 9.83$	75.17
10	385	$\frac{385}{2053} \times 100 = 18.75$	93.92
4.75	105	$\frac{105}{2053} \times 100 = 5.11$	99.03
Pan	18	$\frac{18}{2053} \times 100 = 0.87$	99.9
	$\Sigma = 2053$	Cumulative % retained	$\Sigma = 567.9$

❖ STRENGTH PARAMETERS OF COARSE AGGREGATE

Various tests to be conducted on coarse aggregate.

- **DETEMINATION OF CRUSHING VALUE**

  (IS 2386 part IV-1963)

- **DETEMINATION OF IMPACT VALUE**

  (IS 2386 part IV-1963)

- **DETEMINATION OF ABRASION VALUE**

  (IS 2386 part IV-1963)

- **FLAKINESS INDEX OF COARSE AGGREGATE**

  (IS 2386 part I-1963)

- **ELONGATION INDEX OF COARSE AGGREGATE**

  (IS 2386 part I-1963)

1) DETEMINATION OF CRUSHING VALUE (IS 2386 part IV-1963)

- DEF: Crushing value of aggregates a relative **measure of resistance of an aggregate to crushing under gradually applied crushing load**.

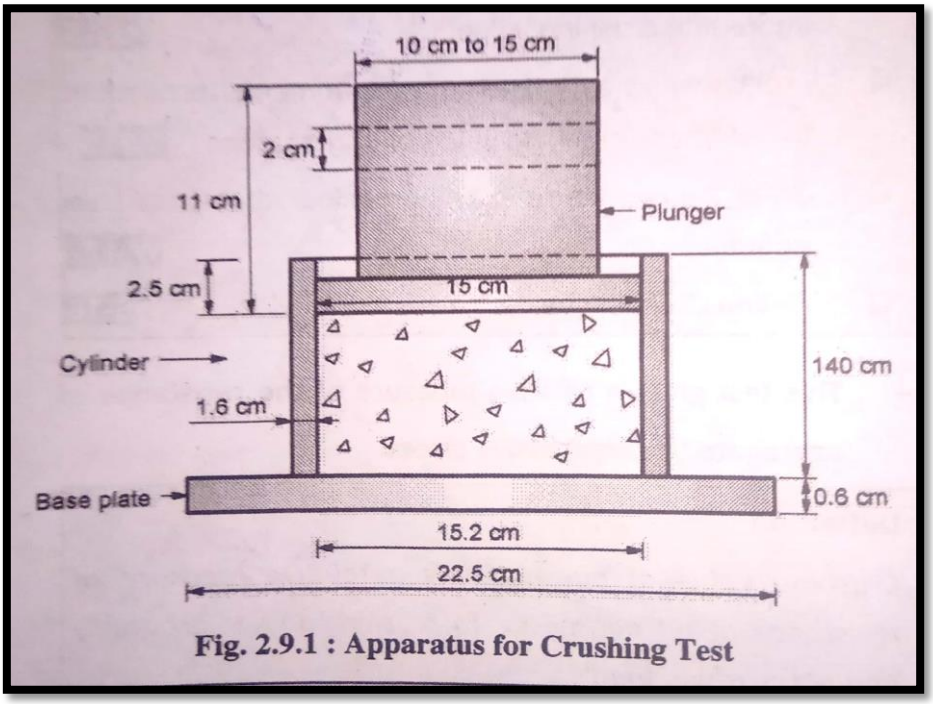


Fig. 2.9.1 : Apparatus for Crushing Test

PREOCEDURE:

- The aggregates **passing through 12.5mm sieve & retained on 10mm sieve is collected.**
- **About 6.5kg dry aggregates are filed in standard cylinder in 3 layers.**
- **Taming is done with tamping rod for each layer for 25 times& finally levelled at top surface.**
- **For this the weight is found (weight A).**
- **The whole assembly is then kept under compression testing machine & total weight of 40 tonnes is applied uniformly for 10 minutes.**
- The load is released, the aggregates is taken out & **sieved on 2.36mm sieve**. The fraction passing through t**his 2.36mm sieve is weighted (weight B).**
- **The aggregates crushing value is given by,**

- **THE AGGREGATES CRUSHING VALUE =** $\frac{B}{A}$ **X 100 %.**

- **The aggregates crushing value should not be more than 45% for ordinary concrete.**

- **The crushing value should not be more than 30% for concrete used for wearing surface such as a runways, roads & pavements.**

- **https://youtu.be/JbAf1DKMxwE YOUTUBE LINK.**

NUMERICAL 01:- Crushing value test was conducted on coarse aggregates in the lab. & the observations are recorded as given below. Find the average crushing value of coarse aggregate & state its suitability.

SR. NO.	SAMPLE NO	I	II	III
01	WEIGHT OF OVEN DRIED SAMPLE (W1) IN GMS.	2150	3085	3212
02	WEIGHT OF FRACTIONS PASSING THROUGH 2.36mm (W2) SIEVE IN GMS.	570	582	602

ANS:-

- **Aggregate crushing value for sample I**

$$= \frac{weight\ of\ fraction\ pasiing\ through\ 2.36mm\ (B)}{weight\ of\ oven\ dried\ sample} \text{ x100.}$$

$$= \frac{570}{2150} X\ 100 = 18.09\%$$

- **Aggregate crushing value for sample II**

$$= \frac{weight\ of\ fraction\ pasiing\ through\ 2.36mm\ (B)}{weight\ of\ oven\ dried\ sample} \text{ x100.}$$

$$= \frac{582}{3085} X\ 100 = 18.86\%$$

- **Aggregate crushing value for sample III**

$$= \frac{weight\ of\ fraction\ pasiing\ through\ 2.36mm\ (B)}{weight\ of\ oven\ dried\ sample} \text{ x100.}$$

$$= \frac{602}{3212} X\ 100 = 18.74\%$$

$$\text{Average crushing value} = \frac{18.09+18.66+18.74}{3} = 18.56$$

These samples are suitable for wearing as well as non-wearing surface.

2) DETEMINATION OF IMPACT VALUE (IS 2386 part IV-1963)

DEF: This test gives **relative measure of resistance of Aggregates to Suddenly applied load / impact load.**

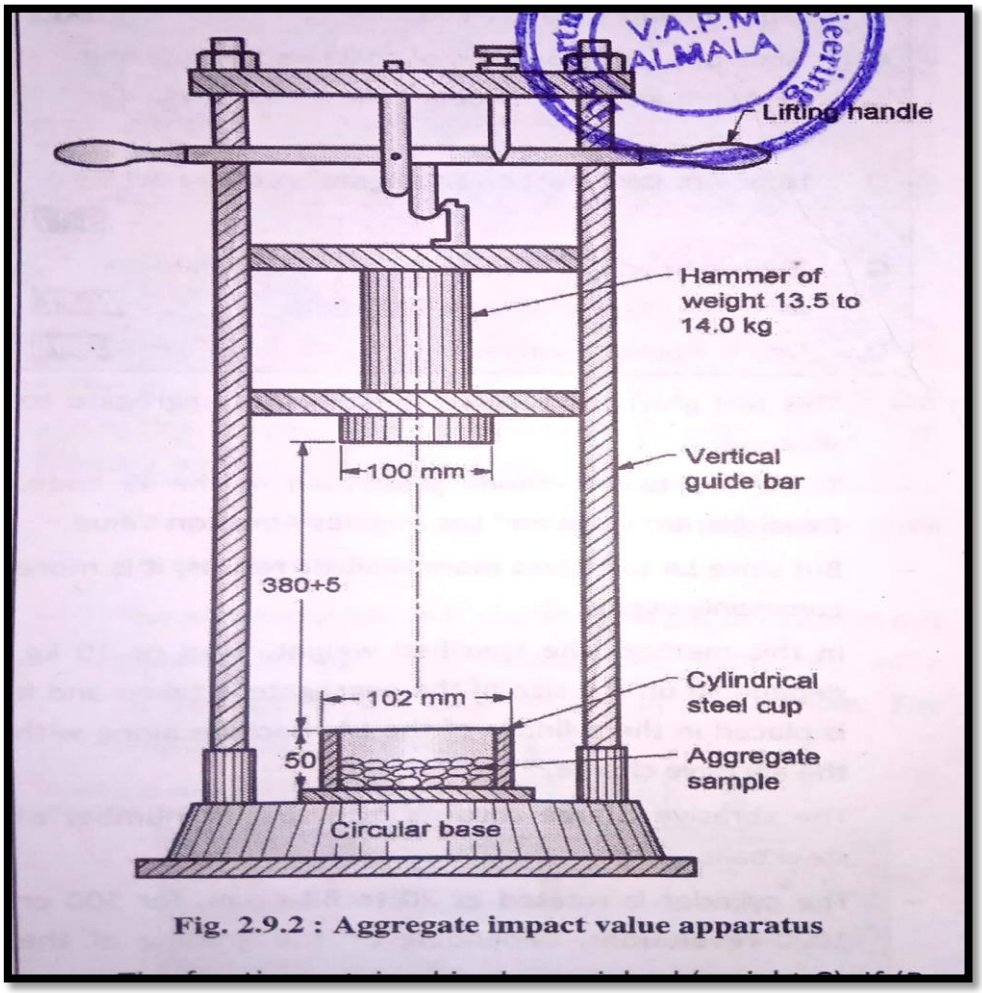


Fig. 2.9.2 : Aggregate impact value apparatus

PREOCEDURE:

- The aggregates **passing through 12.5mm sieve & retained on 10mm sieve is collected. The aggregates are oven dried at 110°C for 4 hrs.**
- The aggregates are filled in the cup **(WEIGHT-A)**
- By lifting the handle, **the hammer is allowed to fall freely on the aggregates in the cup.**
- **Such 15 blows are given to the cup.** & Aggregates are taken out of the cup & **sieved on the 2.36mm sieve.**
- **The fraction passing through sieve is weighed (WEIGHT-B)**
- The fraction retained on sieve is also weighed **(WEIGHT-C**)
- **If (B+C) is less than A by more than 1 gram, then test is discarded & fresh test is made.**
- **The Aggregate impact value is given by,**

- **THE AGGREGATES IMPACT VALUE =** $\frac{B}{A}$ **X 100 %.**

- **The aggregates impact value should not be more than 45% for ordinary concrete.**

- **The impact value should not be more than 30% for concrete used for wearing surface such as a runways, roads & pavements.**

- **https://youtu.be/x4ekpMEERxI YOUTUBE LINK**

3) DETEMINATION OF ABRASION VALUE (IS 2386 part IV-1963)

- **DEF:** This test gives relative measure **of resistance of Aggregates to wearing.**

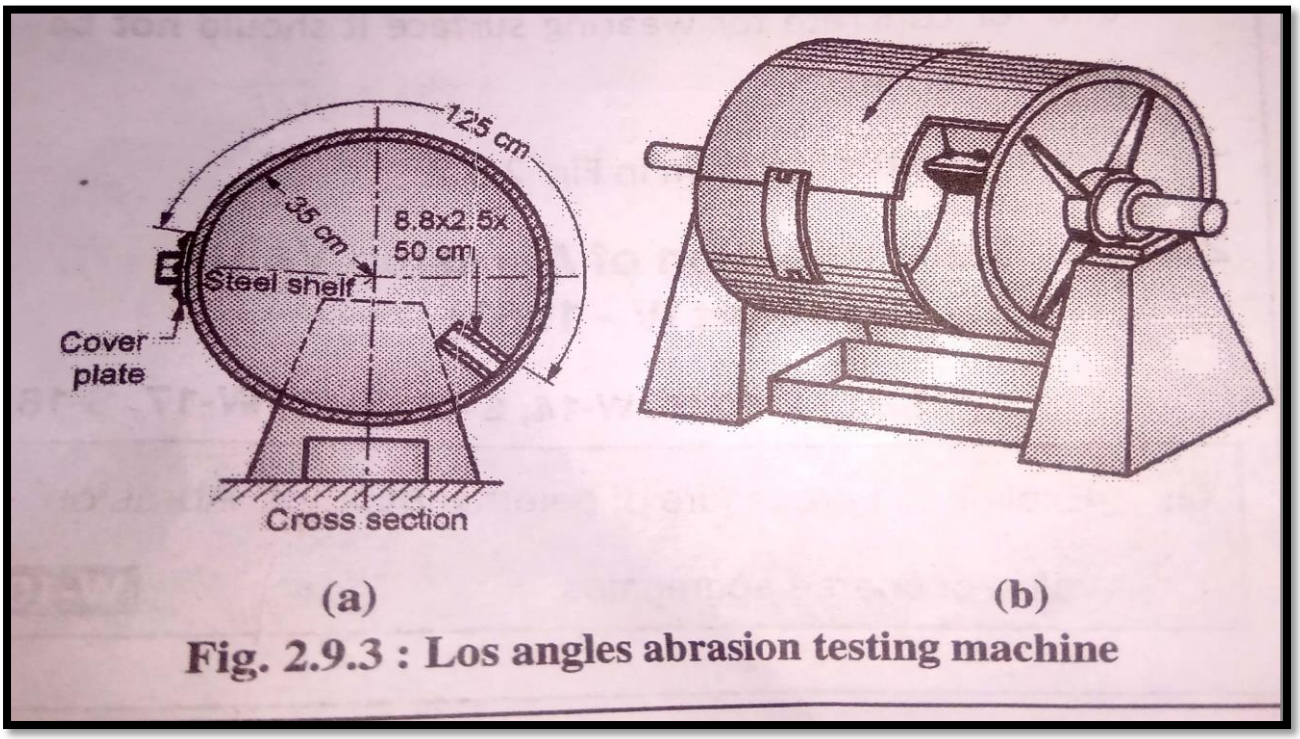


Fig. 2.9.3 : Los angles abrasion testing machine

PREOCEDURE:

- There are 2 methods as per IS code:
  i. **DEVALATTRITION TEST.**
  ii. **LOS ANGELES ABRASION VALUE.**

- **But LA test gives more realistic results, it is commonly used.**

- **LOS ANGELES ABRASION VALUE:-**
  In this method, specific weight of 5kg / 10kg of aggregate is taken & this aggregate is placed in the cylinder along with abrasive charges.
- The abrasive charges are specific no of steel balls.

- **The cylinder is rotated at 22 to 33 r.p.m. for 500 /1000 revolutions.**
- The aggregate is **removed from cylinder & sieved on 1.7 mm IS sieve.**

- **The fraction passing through 1.7mm sieve is expressed as a percentage of original weight gives the aggregate abrasion value.**

- **ABRASION VALUE** $= \frac{\text{FRACTION PASSING THROUGH 1.7MM IS SIEVE}}{\text{TOTAL ORIGINAL WEIGHT OF AGGREGATE}(\frac{5}{10}\text{KG})} * 100 = \%$

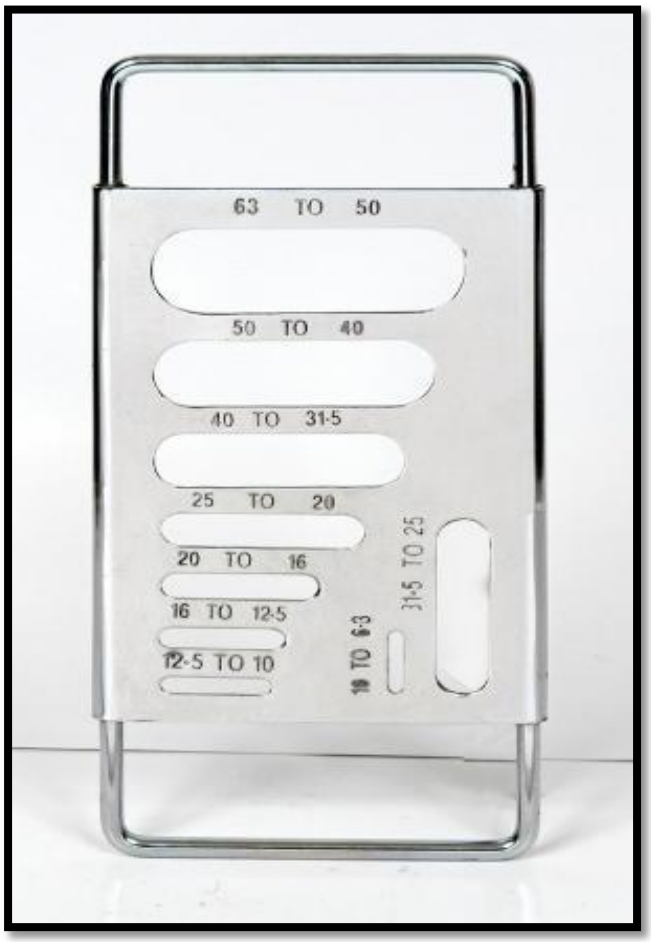
- The aggregates abrasion value should not be more than 45% for ordinary concrete.

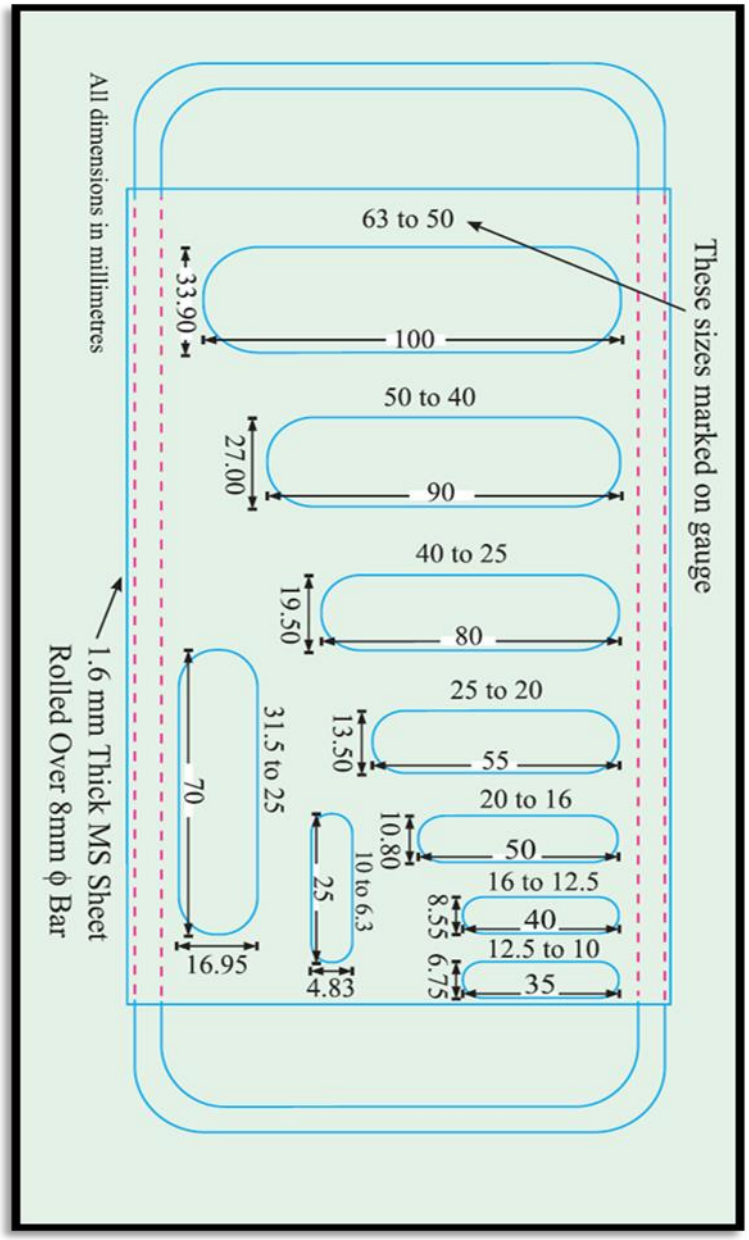
- The abrasion value should not be more than 30% for concrete used for wearing surface such as a runways, roads & pavements.

- **https://youtu.be/kyxn8sLfPuY YOUTUBE LINK**

4) FLAKINESS INDEX OF COARSE AGGREGATE (IS 2386 part I-1963)

- **DEF:** The flakiness index is the **percentage by weight of particle whose least dimension (thickness) is less than 3/5th of their mean dimension.**
- **This test is generally applicable to aggregates larger than 6.3mm size.**





PROCEDURE:-

1) Take W1 quantity of coarse aggregate which **should possess at least 200 pieces of any fractions.**
2) **Sieve** this sample through the IS sieve.
3) **Now** the aggregate **retained on the different sieve should be separated.**
4) Then each sizes **dry aggregate should pass through the corresponding slot of the thickness gauge.**

   Ex. The aggregate passing through 50mm size & retained on 40 mm size sieve should pass only through

   $\left(\frac{50+40}{2} X \frac{3}{5}\right)$ = **27.00mm**

5) i.e. through 50-40mm slot **& if it is passes through it is called as FLAKY.**

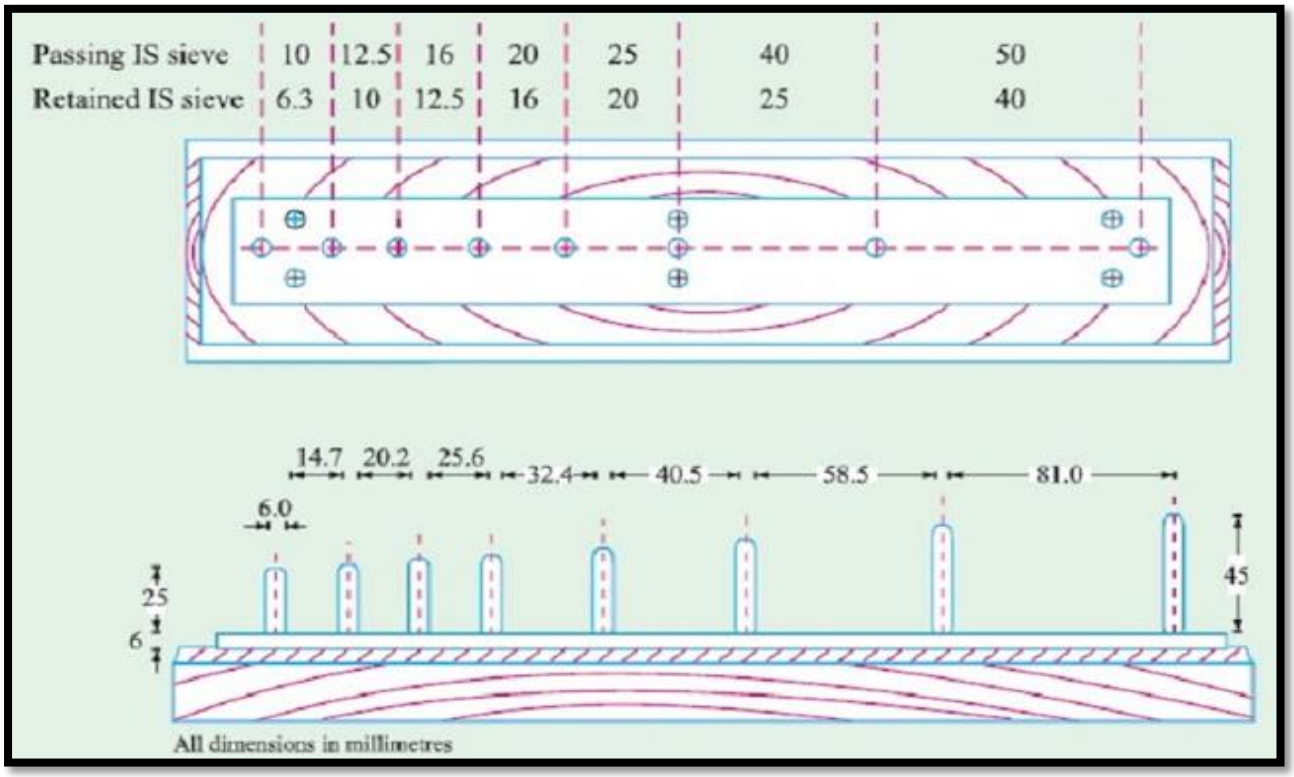
6) Now weigh the all the pieces which passes through respective slot i.e. FLAKY (W2)

NOW FLAKINESS INDEX = $\frac{W2}{W1} X 100 = \%$

https://youtu.be/2ds0DhrnrtI **YOUTUBE LINK**

5) ELONGATION INDEX OF COARSE AGGREGATE (IS 2386 part I-1963)

- DEF: The elongation index is the **percentage by weight of particle whose greatest dimension (length) is less than 1.8 times of their mean dimension.**
- **This test is generally applicable to aggregates larger than 6.3mm size.**
- **This test is performed at the same time with flakiness test.**
- The elongation index is the total weight of material not passing through the various slots, which is expressed as a percentage of the total weight of the sample.



PROCEDURE:-

1) **Sieve the aggregate passing through IS sieve.**
2) **Pass each aggregate piece through the corresponding a lot of the gauge/ sieve.**
3) **Weight the all material retained by length gauge say W3.**
4) **Now**

ELONGATION INDEX = $(\frac{W3}{W1} X100) = \%$

This test gives us suitability of coarse aggregate w.r.t shape & size.

https://youtu.be/5Rks5je9Yuk YOUTUBE LINK

❖ NECESSITY OF GRADING OF AGGREGATE &DALETERIOUS MATERIAL IN THE AGGREGATE

❑ NECESSITY OF GRADING OF AGGREGATE :

i. To make structure dense.
ii. To prevent honey combing.
iii. To achieve proper workability.
iv. To achieve proper finishing.

❑ DALETERIOUS MATERIAL IN THE AGGREGATE :

The various deleterious material materials in aggregates are

Coal, clay, lumps, shale, soft fragment, silt, mica etc.

i. It prevents normal hydration of cement.
ii. Reduces strength & durability of concrete.
iii. Prevent good bonding between aggregates & cement.
iv. Causes efflorescence's.

QUESTION BANK.

2 MARKS QUESTION.

01) Define fineness modulus of aggregate.

02) Enlist four shapes of aggregates.

03) Define bulking of sand.

04) What is aggregate impact value?

05) Define Aggregate crushing value.

06) What is abrasion value of course aggregate?

07) Define flakiness index.

08) Define elongation index.

09) State the four properties of fine aggregate and coarse aggregate

04 MARKS QUESTION.

01) What are the requirements of good aggregate in good concrete?

02) How is bulking of sand is determined.

03) What is mean by grading of aggregate?

Well graded

Gap graded and

Poor graded

04) State the properties of fine aggregate and coarse aggregate.

05) Describe the procedure for aggregate impact value test.

06) Describe the Los Angeles abrasion test.

07) How is silt content is determined?

08) Define Aggregate abrasion value and explain with procedure.

09) Explain the procedure of elongation index and flakiness index.