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Experimental Analysis of Self Compacting Concrete by Replacing Sand with Stone Dust

Uzma Rashid[1], and Ashish Kumar [2]

M. Tech. Scholar, Department of Civil Engineering, RIMT University, Mandi Gobindgarh, Punjab, India
Assistant Professor, Civil Engineering Department, RIMT University, Mandi Gobindgarh,Punjab India

Correspondence should be addressed to Uzma Rashid; bhatuzma1521@gmail.com

ABSTRACT- Self-compacting concrete (SCC) is defined as concrete that can be placed normally and will flow under its own weight while maintaining its homogeneity. Full compaction and strength may therefore be achieved without the assistance of mechanical vibrations. Its development was based on the desire to improve the quality of concrete work and automate construction. It was developed in 1988.Since then, various investigations have been carried out and mainly large constructions companies have used the concrete in practical structures in Japan. Here in this report an attempt has been made to study the characteristics of self-compacting concrete and the specialties in the mix design, which had given it the self-compacting capacity.

KEYWORDS- Concrete, vibrations, strength, flow ability

I. INTRODUCTION

A. Definition

From past one decade we have seen that the one main problem that our conventional concrete has faced is poor compaction which in a way impacts the quality of our concrete, therefore SCC is an Innovative technique to help the concrete to compact itself in overcrowded reinforcement and in narrow space. As long as SCC is allowed to flow freely without segregation or bleeding, compacting it is not necessary. This impermeable concrete has the same quality and resistance as the quiver's costumed quiver. It allows for the creation of more inventive shapes and thinner components, hence enhancing design flexibility. SCC possesses enhanced qualities and improved properties due to high flow ability and elimination of compaction. Its design must strike a delicate balance between the two. Useful in areas with extensive reinforcing and where involuntary densification isn't possible, this technique is frequently employed. SCC possesses the greatest quality of compacting on its own thus easing our work and eradicating the problems arising in conventional concrete. Although this fact might not be denied that our world is way behind in building its skill in the said industry thus we should try to make further studies in this field to permanently eradicate the problems of workability.

II. BACKGROUND OF SELF-COMPACTING CONCRETE

Stability of concrete structures has been a major concern in Japan since the 1980s and 1990s. Workers with extensive experience in densification are needed in order to produce a long-lasting concrete composition. Construction employees with relevant experience have been steadily disappearing from Japan's construction workforce, leading to a major reduction in the quality of the work being produced. This type of concrete was required, as Okamura pointed out in 1986. At the University of Tokyo, Ozawa and Maekawa carried out research to aid in the development of SCC, which included a fundamental examination of concrete workability. In 1988, SCC's first prototype was developed using materials that were already available on the market. Swelling, shrinkage, and hardness characteristics were all well within the range of the prototype's capabilities. The term "High Performance Concrete" was coined after the three stages of concrete manufacture: [1]

- Fresh: self compatible
- Early stage: avoidance of initial defects
- After hardening: protection against external factors

Concrete with a low water-cement ratio that is extremely durable was coined by professor Aitcinet. Al. almost simultaneously. In the early 1990s, the term "high performance concrete" was used to denote a high-quality, long-lasting substance. This concrete has been called "Self Compacting Concrete" by Okamura.

Since its inception in Japan, the notion of SCC has spread across the globe. First European research report published at an International Union of Testing and Research Laboratories for Materials and Structures in London in 1996.SCC's early use in India was largely confined to academic circles. This was due to the fact that laying a concrete foundation was more expensive than using the previous method. Due to time constraints and difficult placement, self-compacting concrete has also gained popularity across the Indian subcontinent. "Ultra Tech Free Flow" is the first commercial supplier of M80 Self-Compacting Concrete in India "Ultra Tech Cement Limited," the largest ready-mix concrete producer in India. Numerous Indian organizations, academic institutions, and cement companies are actively pursuing the research and application of SCC in structures in order to reduce carbon emissions and deliver cost-effective construction solutions.

III. NEED OF PROJECT

SCC has not gained limelight yet as majority of countries are unaware of its advantages due to least research conducted in the said concrete and less practical work.

Introduction of SCC has become one of the milestone in the construction industry as it has came up with solutions to the problems of compaction of conventional concrete. India is still behind in implementing the practice of SCC because of two reasons:

- Least published work
- Lack of manufacturers of SCC in India.

Consequently, there is a requirement of conducting "experimental studies on SCC using local aggregates". The concept of "SCC" is to make use of locally available graded aggregates to obtain the desired strength. Fines, viscosity modifiers, and water reducers all affect the rheological qualities of self-compacting concrete, but standard codes have yet to be developed that give a complete picture of mix design. It's critical to consider all of the known variables while creating a blend.

A. The objectives are as:

- Usage of locally available graded aggregates for design of SCC.
- To analyse the strength of SCC.
- Comparison of SCC with traditional concrete.

IV. WORK PLAN

We will conduct our study in five stages as shown in figure1.

- The first phase includes a compact study of the previously published papers.
- In the second stage, the equipment was built and upgraded. SCC freshly prepared self-compactability was tested using V-funnel and L-box equipment.
- In the third phase, we designed our trial mixes of SCC in a very careful manner by adjusting the quantities of different materials required for SCC.
- The specimens were cast and cured for 28 days in the fourth phase. The specimens were examined for compressive strength after 28 days.
- The fifth phase, involved the analysis

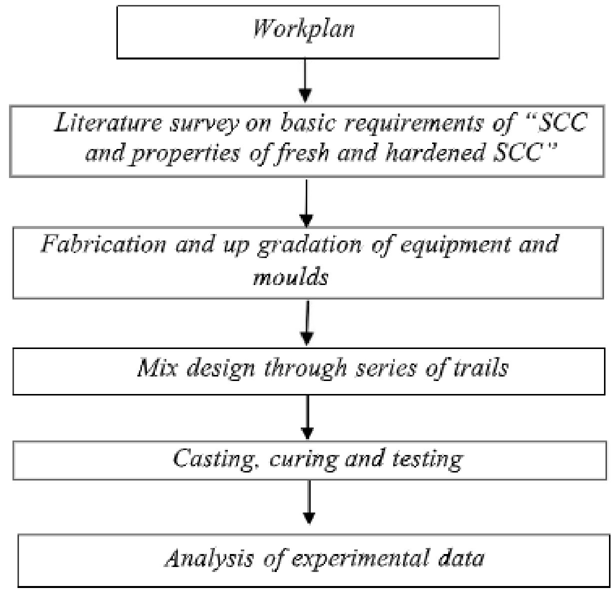

Figure.1: Phases of the Research

V. LITERATURE REVIEW

SCC was introduced in 1988 to eradicate "the problems of conventional concrete structures". "A number of experiments" were carried out to set up the mix matching the standards and self-compatibility parameters. Till 2003, logical mix design procedure and a suitable trial method at working site have both greatly been executed "by Okamura". This chapter deals with literature history of SCC. In order to achieve the workability requirements for successful SCC placement, concrete must self-compact by using closely spaced reinforcing without segregation or blockage, according to the study report by K.H. Hayat. For the sake of preventing bleeding, segregation, and surface settlement once the concrete has cured, it is essential to maintain high structural stability. As a general rule, SCC has a low yield and a medium viscosity.[2]

Depending on property of fluid medium only certain volume fraction of coarse aggregate can be carried. The carrying capacity of concrete mortar decrease with increase in aggregate content beyond a certain limit Also sometimes aggregates may block the concrete flow in pipe by forming an arch like blocking due to which concrete flow beyond that point is blocked. This blocking of concrete flow by aggregates is aggregate interlock. [3] This is a necessary component in the production of concrete paste. You don't have to increase the amount of cement in the mix if you want to increase the volume and concentration of a powder. Fly ash and stone dust, for example, can also aid. It is possible to increase the paste's holding capacity by increasing the powder concentration, however the accompanying increase in concrete mix mortar content has the reverse effect.

"Another route available for modification of paste properties is the use of chemical admixtures"- "super plasticizers and viscosity modifying agents" [4]

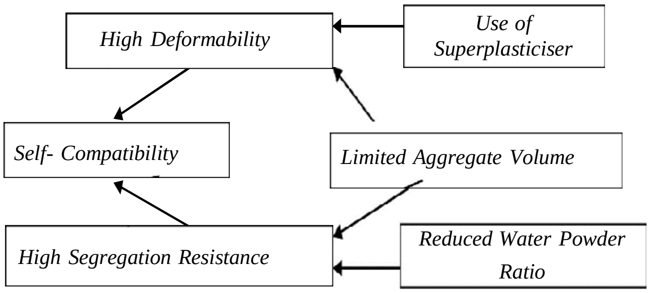

Figure 2: Basic concept of SCC

Concrete is self-compacting in nature if it follows "these basic principles,as shown in figure2

- Concrete must possess normal unrestricted flow in open
- Concrete must pass easily through pipes during pumping etc. and through large congested reinforcement.
- Concrete must be free from segregation and aggregate interlock.

In other words we can say that the concrete mix obtained satisfies the parameters of SCC if the below mentioned three parameters are satisfied

- Filling ability:
- Passing ability:
- Segregation resistance:

It is either necessary to adjust or drastically alter the constituent components of conventional concrete in order to achieve SCC's properties. Reduced friction is achieved by increasing sand volume while decreasing aggregate volume in the mixture. This results in increased concrete deformability. The proportions of air, water, and sand remain unchanged as shown in figure3.

Self-Compacting Concrete

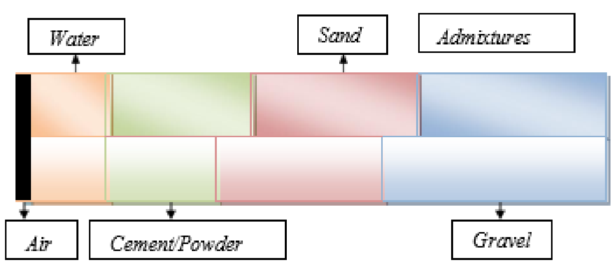

Figure 3: Conventional Concrete

A. *Constituent Materials of SCC*

1) General

The basic materials that are required to produce an well and "standard self-compacting concrete" are "similar of the normal concrete", the difference being usage of less coarser aggregates and greater fine aggregates.

2) Powder (Mixture of Portland cement and Filler)

A mixture of cement and finer aggregates, known as Powder, is used in SCC as a filler, and the use of filler enhances the workability and strength of self-compacting concrete.

3) Cement

We are selecting that type of cement which will be sufficient to provide enough strength and durability

4) Filler

Raw materials as stone dust, and other finer materials are used in manufacturing Self compacting concrete.

5) Stone Dust

Stone crushers produce crushed stone dust as a byproduct. It can be used to make sand for concrete. Financial gains are expected for concrete producers who incorporate stone dust or quarry debris into SCC.

An experiment conducted by De Silva et al. discovered that adding stone dust to concrete enhances the material's strength due of its angular and rough shape.

6) Fly ash

A fine inorganic substance with pozzalanic qualities, fly ash, can be added to Self-compacting concrete to enhance its performance. It is, nevertheless, possible that dimensional stability could be impacted. Self-compacting concrete can be improved by increasing the percentage of fly ash used in the mix. A decrease in water cement ratio resulted in an increase in compressive strength and split tensile strength. Using a water cement ratio of 0.45 and a cement to fly ash replacement of 50%, N. Bouzoubaa demonstrated the most cost-effective self-compacting concrete with a 28 day compressive strength of 35Mpa in terms of mix design. Self-compacting concrete has a similar 28-day compressive strength to control concrete, so it can be a cost-effective replacement. SCC was produced by Al-Luhybi et al utilising limestone powder in place of cement. SCC's mechanical qualities were unaffected by the use of LSP as a substitute, however when LSP was used as an additive, SCC's fluidity increased, resulting in cost savings from lower plasticizer content.[5]

7) Silica-fume

Improved rheological, mechanical, and chemical qualities can be achieved with the use of silica fume.

8) Ground granulated blast furnace slag

Fine granular predominantly latent hydraulic binding material can be utilised as a filler to improve the SCC's rheological properties. According to H.V. Pai's laboratory evaluation of self-compacting concrete formed from industrial leftovers such as silica fume and ground blast furnace slag, SCC made from GGBS has better compressive strength, split tensile strength, and flexural strength than SCC manufactured from SF.[6]

9) Aggregate

In order to make our concrete self compacting we will restrict the size of aggregates to 20mm. As much as possible, the SCC is kept as close as possible to its Coarse Aggregate Content (CAC). The sand ratio (fine aggregate volume/total aggregate volume) is a key SCC property, and the characteristics improve with increasing sand ratio.

10) Admixtures

11) Super plasticizer

That is the opinion of Professor Aijaz Ahmad Zende, Water reducers with a wide range of water reduction capabilities are essential for high flow rates at low water content. Numerous investigations have been carried out to better understand the role played by various super plasticizers in SCC. Sulphonated condensates of naphthalene formaldy des are preferred by Indians due to their lower cost. Because the gypsum present in concrete with low water content and a large dose of super plasticizer precipitates out, the slump strength of the concrete will be lowered.
[7]

The super plasticizer to be used should possess:

- Least water/powder ratio with maximum dispersion.
- The dispersion effect should last for at least 120 minutes after mixing.
- Least susceptible to thermal changes (Okamura and Ouchi, 2003).

According to a study by Rahul Dubey, the crushing strength of self-compacting concrete decreases as the dosage of super plasticizer (SP) increases. When SP was added up to 4%, the SCC mix's compressive strength increased considerably as the mixture grew older. At every age, there was a considerable increase in compressive strength when SP concentrations were more than 4 percent. Compressive strength decreased with age above an 8 percent threshold and up to a 10 percent threshold. In addition, because the SP taken was doubled, the setup time was also prolonged. Other admixtures may also be necessary.[8]

"VMA" helps in reducing laitance and therefore enhances stability of the concrete mixture. A VMA also reduce powder requirement, yet maintaining required stability.

SCC may come off as ostentatious due to the high quality of the raw materials and the ratios used in the formulation. A well-thought-out mix design is important for self-compacting concrete. According to Okamura and Ozawa (1995), an easy mix proportioning method was devised based on the regular supply of ready-mixed concrete. Self-compatibility can be easily obtained by altering the water/powder ratio and super plasticizer dosage.

The mix design procedure is as follows :

- It is set between 50% and 60% (or 28% to 35%, depending on how you look at it) of solid volume for coarse aggregate content (all particles greater than 4 mm) (or 700 to 900 kg per cubic meter).
- Typically, 40 to 50% of the mortar's volume is made up of fine aggregate (particles smaller than 0.125 mm but greater than 4 mm).
- There are a number of factors that influence the water/powder ratio, including the characteristics of the powder (i.e. cement and filler having particles smaller than 0.125 mm).
- In order to ensure self-compatibility, the final water/powder ratio and the dosage of the superplasticizer are determined by trial mixes. The desired U-flow ranges from 0 to 30 millimetres, the slump-flow ranges from 650 to 800 millimetres, and the V-funnel time spans from 6 to 12 seconds.

In conventional concrete mixes, the water cement ratio is traditionally predetermined in order to achieve the desired strength. Whereas water powder ratios must be considered when using SCC, it is necessary to consider self-compatibility. The water-to-powder ratio is usually small enough to achieve the strength you need for most projects, so you don't have to worry about determining how much water you'll need to achieve it. High viscosity and high deformability are required for the SCC process. A decreased water-to-powder ratio occurs when a super plasticizer is employed to make the material more flexible. Mortar's properties are significantly influenced by the properties of the powder and super plasticizer, thus the appropriate water/powder ratio and super plasticizer dosage cannot be determined without experimental mixing at this stage. After determining the mix proportion, it is important to conduct self-compatibility tests utilising U-box, slump flow, and funnel tests. [9]

VI. METHODOLOGY AND MATERIALS

Here, in order to execute our project we will make different trials with our material available therebyvarying quantity of ***Auramix 400***, stone dust and properly graded aggregates. we will be testing eachof our trial for the compatibility, crushing strength and at last we will select that trial which suits best to our standards.

A. Concrete Constituents For Trial Mixes

The material that we have used in our trials

- Khyber Cement.
- Properly Graded Aggregates.
- Stone Dust as Filler.
- Aura mix 400 as an Admixture.

1) Cement

Khyber Cement is being used in our project having a specific gravity of 3.15.

Table 1: Physical properties of cement used

S.No	Physical properties	Results obtained	"IS:8112-1989 SPECIFICTIONS"
1.	Fineness	7%	10%
2.	Normal Consistency	29%	-
3.	Vicats Initial Setting time (minutes)	73	30(min)
4.	Vicats Final Setting time (minutes)	223	600(max)

2) Aggregates

Crushed stone was the primary coarse aggregate in this study's investigation. The maximum aggregate size was 20mm. The average value of specific gravity was 2.69. As a fine aggregate, we used locally sourced stone dust up to a maximum particle size of 4.75mm.

If the contact between coarse aggregates exceeds a certain limit, despite of the viscosity blockade of the mortar will occur. In the figure4 below, limit value of the C.A. is around 50% of the Solid volume.

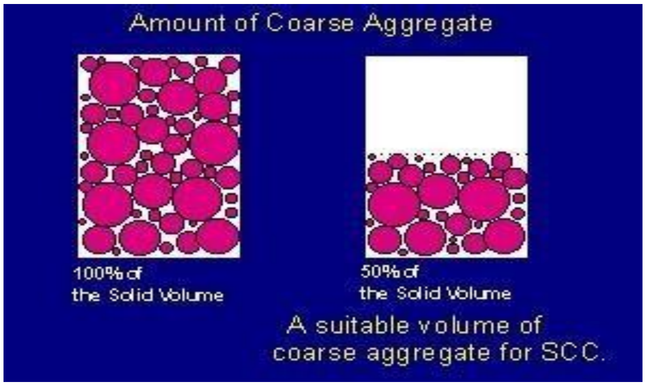

Figure 4: Schematic diagram showing amount of coarse aggregates

Similarly, if the Limit of the F.A. content exceeds a particular value, the contact between particles of sand will increase, which will eventually decrease deformability despite of the moderate viscosity of the paste. "The limit value of F.A. content" is 40 % of the mortar volume as shown in figure5

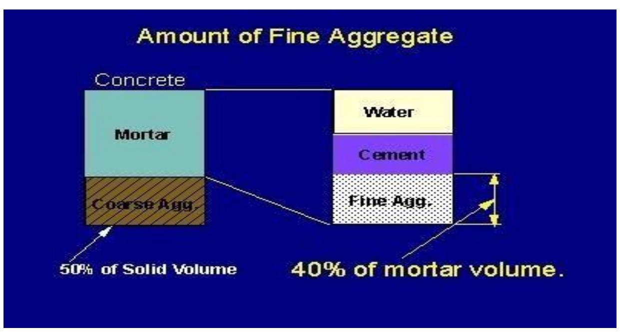

Figure 5: Schematic diagram showing amount of fine aggregates

Figure 6: Schematic diagram showing mix design system.

Therefore the mix design system can be summarized as: Self Compatibility is ensured by properly determining "the Water-powder ratio and Super Plasticizer dosage". In this study of SCC the super plasticizer (SP) used was AURAMIX 400, its comparative development of strength and thereof it's feasibility in construction industry as shown in figure6.

3) Filler

Filler used in this study is stone dust. Since more cement and Super plasticizer are used with the stone dust as filler, "this would increase the fluidity/Workability of the concrete and thus directly reduce the costs of labor".

4) Admixtures

Admixtures are the main component of the Self Compacting Concrete which provide the Flow ability to the concrete. Poly-Caboxylated Ether (PCE) being the main ingredient for widely used as the water reducing agent. Air Entraining Agents (AEA) and Viscosity Enhancing Agent (VEA) used to "improve reduction freeze-thaw resistance and reduction" from control of Self compacted concrete.

B. Role of Super Plasticizers

For achieving flow able concrete we must manipulate the Water-powder ratio which would intern alterthe flow ability of the cement paste and thus decrease the viscosity. Use of Super plasticizer may helpus achieve the self compatibility (enhanced flow abilities) while bringing in slight decrease is viscosity.Graphical representation is shown in figure7 and 8.

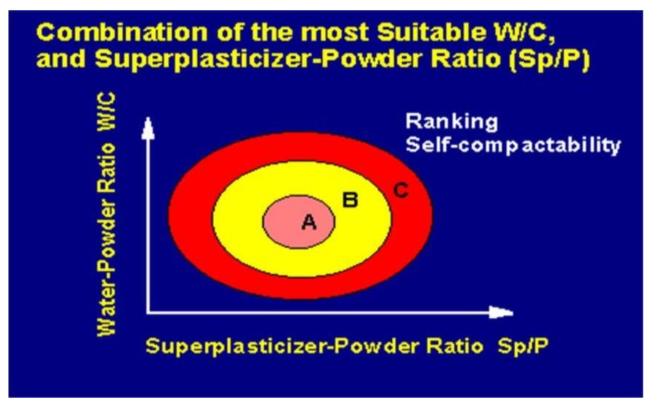

Figure 7: Showing the action of super plasticizer

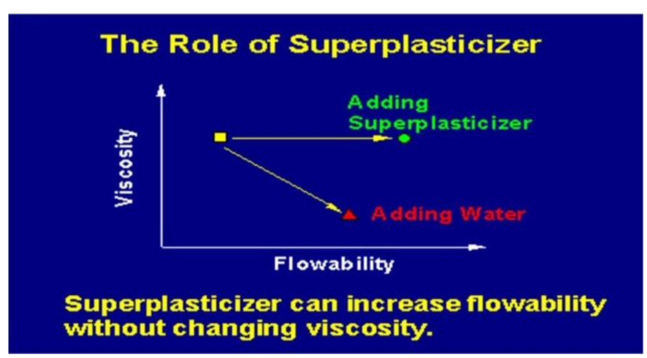

Figure 8: Showing the optimum combination of the w/c ratio and Super plasticizer powder ratio

5) Aura mix 400

- Advanced Low Viscosity
- High Performance Superplasticiser
- Based on Polycarboxylic technology

6) Advantages

- Low Viscosity Suitable for pumping of different grades of concrete to higher floors.
- Higher E modulus Improved adhesion to reinforcing and pre-stressing steel.
- Better Resistance to Carbonation.
- Lower Permeability.
- Better resistance to aggressive atmospheric conditions.
- Reduced Shrinkage and Creep.
- Increased durability.

7) Description

Auramix-400 is modern generation Super-plasticiser having distinctive amalgamation which are madefrom polymers of long lateral chains of Poly-Carboxylic Ether. This improves the diffusion of the cement particles. Main characteristics of Flow ability and fluid depletion from Auramix-400 allow us to make the high performance concrete and high workable concrete.The key properties are mentioned in Table 2.

8) Properties

Table: 2 showing properties of Auramix 400

Aspect	Light lemon shaded liquid
PH	Minimum 6.0
Volumetric mass @ 20°C	1.09 kg/liter
Chloride content	Nil to IS:456
Alkali content	Typically less than 1.5g Na2O equivalent/ liter of admixture

9) Dosage

Optimum Dosage of Auramix-400 cannot be specified as it is determined by trials using the differentconditions and materials. Although normal dosage ranges from "0.5 to 3.0 liters/100 kg" of cementationsmaterial If the dosage ranges varies outside the normal range, the design mix maybe reconsidered to meet particular Mix requirements.
Over dosage of the Admixture may alter or delay the segregation and setting time of mix.

VII. EXPERIMENTAL WORK

1) Tests on Aggregates

Test conducted on aggregates

- Sieving
- Bulk Density
- Impact Value
- Aggregate Crushing
- Silt Content

A. Determination of particle size distribution (grading of aggregate) of fine, coarse and all-in-aggregates by sieve analysis

2) Theory

Aggregates can be classified into:

- Single sized Aggregate
- Graded aggregate
- All in Aggregate

In single size aggregate, the size of particles predominantly belongs to one or two consecutive sieve-sizes only. Graded aggregate contains all sizes of particles in suitable proportions. All-in-aggregate is the combination of both coarse aggregate and fine aggregate, each type having again all sizes of particles in suitable proportions. Coarse aggregate is the aggregate retained on "*4. 75 mm*" sieve. Fine aggregate is defined as material that has a pore size smaller than 4.75 mm.
Aggregate is said to be graded when it contains different sizes of particles in suitable proportions. Smaller particles fill in the holes left by larger ones, which is why graded aggregate is so popular. It also has a significant impact on productivity. Single-size aggregate or aggregate with one particle size much larger than the other sizes makes concrete harsh and does not provide a nice surface finish when worked with a trowel.
Finer the grading, greater is the water requirement resulting in the poor quality concrete. Coarser thegrading, greater is the tendency to segregate. The most suitable grading is that give the mix necessary cohesiveness.The apparatus details are shown in Table 3

3) Apparatus

Table: 3 Shoeing sieves of different sizes

Sieves type	Sieve designation
Square hole perforated plate, 30 cm diameter	80 mm, 63 mm, 40 mm, 20mm,12mm and 10mm 16
Fine mesh, wire clothe, 20 cm diameter	10 mm, 4.75 mm, 2.36mm, 1.18mm, 600 micron, 300 micron, 150 micron, 75 micron
Balance (to weigh 10 kg)	
Brushes with fine camel hair	

4) Procedure

- The sample of aggregate taken is escorted in such a way that it is can be called an air dried sample before weighing it or the sample can be heated at room temperature of 10°C to 110°C so that it's all moisture is lost.
- The dried sample is weighed.
- The weighed sample is placed on the sieve and sieved successively on the appropriate sieves starting with the largest.
- Each sieve is trembled individually over a c tray up to not more than a vestige passes, but time of sieving in no case shall not be less than 2 minutes. The sieving is done by

rotating the sieve in all motion. Backward and anti-clockwise.

- At the end of the sieving, 150 micron and 75 micron sieves are cleaned from the bottom by light brushing with fine camel hair brush.
- After completing the sieving process, the material left on each sieve, is weighed.

Sieving should be done by giving varied motion so that each particle gets sufficient chance of passing through the sieve Opening as shown in figure 9.

Figure 9: Showing sieving of coarse aggregates

5) *Results*

The result of the the sieving done on coarse aggregates,fine aggregates and stone dust are shown in Table 4,5 and 6

Table 4: Showing result of sievie analysis of coarse aggregates

TESTING OF (20mm C.A.)			WEIGHT OF SAMPLE =10,000 GRAMS		
Sieve designation	*Weight retained*	*% retained*	*Cumulative % Retained*	*%Passing*	*%Limit*
40 mm	0	0	0	100	100
20 mm	704	7.04	7.04	92.96	85-100
10 mm	8776	87.76	94.8	5.2	0-20
4.75 mm	481	4.81	99.61	0.39	0-5
Pan	39	0.39	100		

Table 5: Showing result of sieve analysis of fine aggregates

TESTING OF (10mm C.A.)			WEIGHT OF SAMPLE =9,000 GRAMS		
Sieve designation	*Weight retained*	*% retained*	*Cumulative % Retained*	*%Passing*	*%Limit*
12.5 mm	418	4.6	4.6	95.4	100
10 mm	1028	11.42	16.02	84.04	85-100
4.75 mm	5129	56.9	72092	27.06	0-20
2.36 mm	2370	26.3	99.22	0.72	0-5
Pan	1020	11.33			

6) *Sieve analysis of stone dust*

Table 6: Showing result of sieve analysis of stone dust

Testing of FA	Weight of sample=2000grams			
Sieve designation	Wt. Retained	% retained	Cumulative % retained	% passing
10mm	5	0.25	0.25	99.75
4.75mm	16	0.8	1.05	98.95
2.36mm	64	3.2	4.25	95.75
1.18mm	828	41.4	45.65	54.35
0.60mm	629	31.45	77.1	22.9
0.30mm	174	8.7	85.8	14.2
0.15mm	83	4.15	89.95	10.5
-0.15mm	175	8.75	98.7	----------------

B. Determination Bulk Density and Voids of Aggregates

Given following types of sample:

- 20 mm graded and angular aggregate.
- 20 mm single size and angular aggregate.
- 20 mm graded and rounded aggregate.
- Fine aggregate.

It's critical to understand the differences in bulk density between the two and explain why they exist. If the *20 mm* (graded and angular) coarse aggregate and fine aggregate given in the experiment are used in the concrete proportion of *1: 3/2: by weight*, calculate the volume of coarse aggregate and fine aggregate per bag of cement.

1) *Theory*

The volume of solid material is divided by the volume of voids to arrive at this unit's volume. The aggregate weights and volume weights must be converted back and forth using these quantities when volume batching is being used. Effort, size distribution, form, and specific gravity all play a role in determining how densely packed a container may be. A higher bulk density is associated with a finer-grained aggregate. Because of its angular and flaky structure, the material has a lower bulk density. Engineers on-site can do additional tests if necessary when this bulk density test is carried out on a regular basis, as long as it is done on a regular basis. If the ingredients are measured, then the 'loose' material's bulk density should be estimated for batching purposes. Whenever grade and form changes are detected, it is vital to compare the results of the bulk density test with those obtained by the rodded bulk density test. In order to compare the outcomes of the two experiments, the aggregates that will be used must be the same size.

2) *Apparatus*

- Balance sensitive up to 0.5% of the weight to be weighted.
- Cylindrical metal measure 3, 15 and 30 liters capacity according to maximum size of the coarse aggregate as shown in Table 7
- Tamping rod 16 mm dia and 600 mm long with one end rounded.

- Container, trough, steel rule and measuring cylinder 250 ml.

Table 7: Showing Cylindrical Metal measure

Coarse aggregate	Measure
4.75 mm and less	3 liters
4.5 mm and 40 mm	15 liters
Above 40 mm	30 liters

3) Procedure

4) Rodded weight

- When bulking tests are a prerequisite, a material containing a fine quantity of moisture should be utilised instead of the more common dry material. It is essential to specify the condition when making observations.
- The aggregate is then compacted with a tamping rod with twenty five strokes .
- Exactly same amount of material is appended and a additional tamping of 25 strokes is given.
- The specimen is lastly suffused to spill and is then again tamped 25 times and the spillage solidity is measured in kg/Iitres.

5) Loose weight

- Scoop or shovel used to pour aggregate from a height not exceeding 5 centimeters above top of the specimen to suffuse it.
- “The facet of the aggregate” is then made even with a plain scale.

C. Determination of Aggregate Impact Value

1) Theory

The ability of a material to resist a certain amount of force is referred to as its toughness. Due to vehicle traffic, aggregates are broken down into smaller pieces of material. This necessitates that the aggregates be sufficient to endure the forces of impact without breaking. In order to measure this quality, the impact value test is used. Material shock resistance can be determined by estimating the aggregate impact value.

2) Aim

- To determine the impact value of the road aggregates
- To assess their suitability in road construction on the basis of impact value

Table: 8 Showing Result of Aggregate Impact value test

Aggregate impact value	Classification
< 10%	Exceptionally strong
10-20%	Strong
10-30%	Satisfactory for road surfacing
> 35%	Weak for road surfacing

3) Apparatus

- A testing machine weighing 45 to 60 kg and having a metal base with a plane lower surface of not less than 30 cm in diameter. It is supported on a level and plane concrete floor of minimum of 45 cm thickness. The machine should also have provisions for fixing its base.
- A cylindrical steel cup of internal diameter 102m, depth 50mm and minimum thickness 6.3 mm.
- A cylindrical metal measure having an internal diameter of 75mm for measuring aggregates.
- Compacting rod 5 mm in radius and 230 mm in length, rounded shape at one end.
- An offset of volume not less than 500 g, readable and accurate upto 0.1g.

4) Procedure

It comprises of aggregates with a diameter of between *10* and *12.5 millimeters*. For four hours, raise the temperature of the aggregates to a range of *100-1 10°C* before bringing it to a cool condition.

- Strain the aggregates past 12.5 mm and 10.0 mm IS sieves. The aggregates passing through 12.5 mm sieve and retained 10.0 mm strainers comprise the test material.
- Pour the aggregates to till about just 1/3ml depth of measuring cylinder.
- Tamp the aggregates by striking 25 strokes with the tamping rod.
- Follow the same procedure for next two layers until our specimen is suffused.
- Strike off the surplus aggregates.
- Determine the net weight of the aggregates to the nearest gram (W1).
- Bring the machine to loaf without ramming or stuffing level plate, block or floor, so that it is stiff and the hammer guide columns are upright.
- Fix the cup firmly in position on the base of machine and place whole of the test sample in it and compact by giving 25 gentle strokes with tamping rod.
- Lift the hammer till its bottom face is 380 mm over the surface of the aggregate sample in the cup and let it to fall explicitly on the aggregate sample. Give 15 such blows at an interval of not less than one second between successive falls.
- Remove the squashed aggregate from the cup and strain it past 2.36 mm. Weigh the fraction passing the sieve to an accuracy of 1 gm (W2). Also, weigh the fraction retained on the sieve.
- Note down the observations in the proforma and compute the aggregate impact value. The mean of two observations, rounded to the nearest whole number is reported as the Aggregate Impact Value as shown in Table 8.

5) Record of observations

Aggregate impact Mean value = 4.75%

6) Interpretation of results

Aggregate impact value is used to classify the stones in respect of their toughness property as indicated in Table 9

Table: 9 showing Toughness properties

	Sample I	Sample II
Total weight of dry sample taken =w1 gm	724	630
Weight of portion passing 2.36 mm sieve = w2gm	33	32
Aggregate impact value = w2 x 100/ w] per cent	4.5%	5%

D. Determination of Aggregate Crushing Value

1) Aim

1. To find out squashing value of given road aggregates.
2. To evaluate constancy of aggregates for their use in construction of different pavements.

2) Apparatus

Our Test specimen consists of a *15.2cm* diameter cylinder of steel having a base of square shaped with a plunger of diameter 15cm having a hole for the provision of rod such that rod can be placed for raising or setting down plunger in the mould. “ A cylindrical measure” having “internal diameter of *11.5cm* and height 1*8cm*”.An upright compacting rod having sectional dimension 8mm in radius and a length of *45- 60cm* having circular shape at an end. An offset of volume *5000gm* is also required A consolidating machine having ability to exert load of *4tonnes/minute.*

3) Procedure

The aggregate sample:
The material required for sample should have a size range from *10mm to 12.5mm.*The raw material should be such that no moisture is present in it, if such conditions don’t prevail

Figure 10: Showing UTM cement Block under UT

we can heat raw materials at “a temperature of *100-110 ºC*” for about “*4 hours*”. Strain the aggregates through required sieves. The material held on *10mm* and *12.mm* strains constitute our material and we will fill it in “three equal layers” such that “each layer” is compacted “*25 times*” with the help of a compacting rod. Struck off the surplus material. The volume filled in the specimen constitutes the material to be used for the test. Now we will unload the test specimen and will shift the entire measured quantity in specimen in *3 layers* the same way done before. It is important to make sure that the plunger is level before plunging horizontally on top of the aggregates The machine's pedestal can be used to place the assembled unit. Until the total weight reaches *40 tonnes*, the load should be exerted at a rate of *four tonnes per minute as shown in figure10*. Let go of the tense feelings. Remove the aggregate from the cylinder with a *2.36mm* sieve as shown in fig 11. This part should be weighed with a *0.1gm* accuracy. As a result of the crushing, a significant amount of material was lost. Analyze the recorded observations to determine aggregate crushing value. The "Aggregate Crushing Value" is calculated by averaging two measurements and rounding to the nearest whole number as shown in Table 10.

Table 10: Showing results of Aggregate Crushing value

	Sample1	Sample2
Total weight of dry sample taken (W1gm)	2897	2834
Weight of portion passing through 2.36mm sieve (W2gm)	705	950
Aggregate crushing value%=W2/W1x100	24.3%	33.5%
	Sample1	Sample2
Total weight of dry sample taken(W1gm)	2897	2834
Weight of portion passing through 2.36mm sieve(W2gm)	705	950
Aggregate crushing value%=W2/W1x100	24.3%	33.5%
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Total weight of dry sample taken(W1gm)	2897	2834
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	Sample1	Sample2
Total weight of dry sample taken(W1gm)	2897	2834
Weight of portion passing through 2.36mm sieve(W2gm)	705	950
Aggregate crushing value%=W2/W1x100	24.3%	33.5%

Average crushing strength=28.9%

Figure 11: showing crushed aggregates

4) Test with non-standard sizes of aggregates

Different grading systems can be used to conduct the test. These cases will necessitate different specifications, which should follow the format shown in the following table.

5) Precautions

- It is imperative that the plunger rest directly on the aggregates. To ensure that the entire load is transferred to the aggregates, care must be taken not to touch the walls of the cylinder.
- Tine loss is a concern during the sieving and weighing process of the aggregates through the *2.36 mm sieve*. Specimen original weight should not be exceeded by more than one gram when calculating weight differences between fractions retained and fractions passing the sieve.
- Tamping should not be done by hammering, but by gently dropping the tamping rod. Additionally, the aggregates should be tamped uniformly, with care taken to prevent the tamping rod from frequently striking the mould walls.

E. Determination of Flakiness and Elongation Index

1) Theory

Aggregates that are flaky or elongated are undesirable because they contain a higher percentage of voids, requiring more materials and water to lubricate them so that they can be worked. So that they align in one plane, the particles tend to be laminated.

- The aggregate is said to be flaky when its least dimensions is less than 3/5th of its mean dimension
- The aggregate is said to be elongated when its length is greater than 9/5th times the mean sieve size

Indicators of flakiness greater than *35% to 40%* are deemed undesirable.

2) Procedure

3) For Flakiness Index

- Take an amount of aggregate enough to dispense least of two hundred pieces of any size to be tested.
- The representative is sieved through IS sieves as specified (20mm,16mm,12.5mm,10mm and 6.3mm)
- Separate the aggregate retained on the sieves.
- Try to pass each aggregate through the corresponding slot in the thickness gauge.
- Weigh all the pieces which pass through the slot, since they are considered flaky.
- Calculate flakiness index as per formula.

4) For Elongation Index

- Sieve the aggregate through corresponding sieves.
- Separate the aggregates retained on sieves.
- Try to pass each aggregate piece through the corresponding gauge size.
- Weigh all the material retained by the length gauge.
- Calculate elongation index as per formula.

5) Flakiness and Elongation Index for 20mm Aggregates

Table: 11 Results of Flakiness and Elongation Index

Sieve Design	Weight Taken	Weight Passing (FI)	Weight Taken	Weight Passing (EI)
-25 +20	2256	355	1321	614
-20+16	2464	318	2896	286
-16+12.5	1097	188	989	154
-12.5+10	250	67	183	66
	6367	978	5389	1120

F.I + E.I = 15.36% + 11.95% = ***27.31%***

6) FOR 10mm AGGREGATE

Table 12: Result of sieve Analysis(10mm)

Sieve Design	Weight Taken	Weight Passing	Weight Taken	Weight Passing
-20+16	NIL	NIL	NIL	NIL
-16+12.5	1000	336	664	110
-12.5+10	400	98	302	56
-10+6.3	203	55	148	34
	1603	489	1114	200

F.I + E.I = 30.5% + 17.95% = ***48.45%***

F. Determination of Fine Silt in Aggregate

Given two samples of sand, determine which sample of sand is required to be washed.

1) Theory

Three types of toxic substances are commonly found in aggregates. Cement hydration is hindered by impurities in the first place. Vegetable matter decomposition produces humus, the organic matter found in natural aggregates. Cube tests are the best way to see how organic matter affects your body, and they are safe to use on any organic matter. The best way to determine if there is enough organic matter in the sample to warrant further testing is to perform the test described below. Regardless of how much organic matter is present, if the cube strength of the suspected aggregate is

Figure 12: Showing apparatus for determination for Fine silt

lower than the cube strength of another known quality aggregate, it can be rejected. The second type of coating is one that prevents the aggregate and cement paste from forming a strong bond. Clay and slits are among the items in this category, as the name suggests. Silt is between 0.002 and 0.06 millimetres in diameter, while clay is smaller than 0.002 micrometres. They can be applied as a coating or in loose form. In both cases, a high concentration of fine material is harmful due to the increased surface area that their fineness entails. Silt and fine dust require more water to work at a given level of workability. A field method can be used to figure out the volumetric percent of fine material. If the sample volume is greater than 6%, a more accurate test should be performed using the sedimentation method described in IS 2386 (Part II). All of the limits set forth by IS are applicable to this sedimentation test. A silt content greater than 6% by volume in sand necessitates washing, according to conventional wisdom. As far as silt content is concerned, only the field method has been described below.

2) Apparatus

250 ml measuring cylinder shown in

3) Procedure

- Prepare 50 ml of approximately 1% solution of common salt in water in a measuring jar.
- Add sand till the level reaches 100 ml mark as shown
- More solution is then added until the total volume of mixture in the cylinder is 150 ml shown in figure12
- Cover the cylinder with the palm of the hand and vigorously shake the contents turning it upside down.
- Allow the contents to settle down for 3 hours.
- The silt will now settle in a layer above the sand in figure1

4) Results

Since the percentage of silt exceeds/ does not exceed 6%, fine aggregate need notto be washed.

G. Determination of Consistency of Standard Cement Paste

1) Aim

- To determine the normal consistency of a given sample of cement.

2) Theory

The standard consistency of cement must be used to determine the initial setting time, the final setting time, and the soundness and strength of the cement, as well as its strength with vicats apparatus show in in figure14

Figure 13: Showing conducting of Fine silt

Table 13: Results of determination of consistency

S.No	Qt. of water added (ml)	Time of gauging (min)	Penetration from bottom of mould (mm)
1.	100	4	9
2.	110	4	9
3.	120	5	5

Apparatus

Vicats apparatus consists of a Balance, Gauging Trowel, Stop Watch, etc.

3) Procedure

- For a paste-like consistency, Vicats plungers can penetrate the mold's bottom with ease. samples of cement are taken and mixed with a known percentage of water

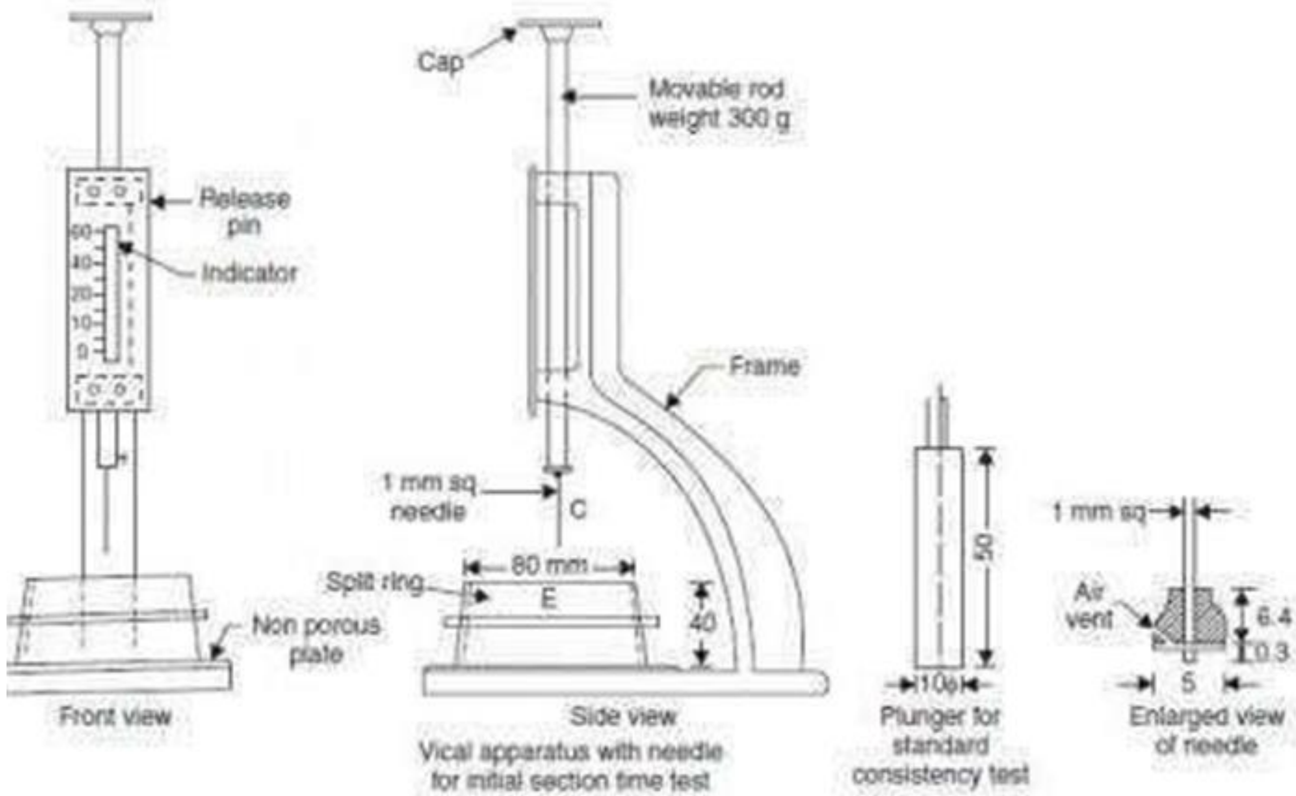

Figure 14: Showing vicat's apparatus

- by weight of cement to ensure consistency (say starting at 26 percent and then increasing by 2 percent each time until the normal consistency has been reached).
- We will make "a paste of a 300g of cement" sample with pure water taking every precautions such that the gauge is neither less than 3min nor greater than 5min.
- Now we will rest the mould on a non-porous base and after making cement paste we will fill the smooth cement paste into it and will lightly tap the mould to remove the air present in it.

4) Result

The normal consistency of a given sample of cement is *28 %.as shown in Table 13*

A. Analysis of Setting Time of Standard Cement Paste AIM": "Initial and final setting time determination"

1) Theory:

When we add water to the cement to make a cement paste,the time from that moment when the prepared cement paste begins to loose its plasticity and begins to attain

- Now we will test the mould along with the non-porous plate in such a way that the lower portion of plunger slightly touches the top of the mould surface and we will after that allow the freefall of plunger such that the plunger sinks into the cement paste in the mould. This should be done immediately after filling the mould.
- We will vary the percentage of water and quantity of cement till we get the desired results.

stiffness to overcome the applied pressure is termed as an initial setting time using vicats apparatus showin figure15

2) Apparatus

Vicat apparatus according to IS : 5513-1976, Balance, Gauging Trowel, Stop Watch, etc.

3) Procedure

Our first step would be to gauge the cement according To *0.85P*,where P corresponds to the quantity of water required to make a smooth paste. Clean water should be specifically used and necessary precautions should be taken. We will count the time with stopwatch once we will startadding water to the cement. we would be using vicat's mould for this purpose, we will add preparedcement paste into the mould till levelled off. Soon after pouring cement paste into the mould we will place our mould at place or in a room at a normal room temperature.

4) Analysis of initial setting time

A mould will be placed on a nonporous plate from under a rod with a needle attached, and the needle will be allowed to penetrate the top surface of the mould slowly. This procedure will be repeated until the needle is unable to penetrate the mouldas shown in fig 16

5) Analysis of final setting time

After determination of initial setting time ,we will check final setting time after about 2 hours andthe cement may be considered finally set when needle fails to penetrate and the attachment isable to make impression only on the mould shown in figure17

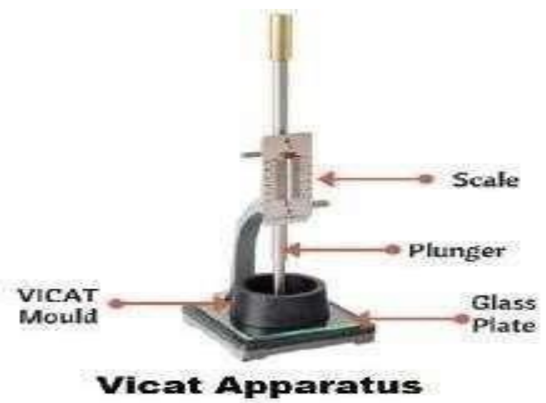

Figure 15: showing vicats apparatus with plunger

Figure 16: Determination of initial setting time

Figure 17: Determination of final setting time

- Qty. of cement is 500 gms
- Consistency of cement is 28 %
- Volume of water addend 119gm (0.85 times the water required to give a paste of standard consistency) for preparation of test block.

6) Results

- The initial setting time of the cement 45min
- The final setting time of the cement sample 137min

H. Analysis of Fineness of Cement by dry sieving

1) Objective

To analysis the normal consistency of a given sample of cement.

2) Theory

The fineness of cement is directly related to " *heat of hydration, greater the heat of hydration greater*" is "*the evolution of heat*". Greater the fineness of cement, greater is the surface area and hence greater is the development of strength.

3) Analysis of Fineness of cement

I. By Sieving

1) Apparatus

Test Sieve *90 microns*, Balance, Gauging Trowel, Brush, etc.

1) Procedure

- We will take about 100gm weight of cement accurately and sieve it on 90 micron sieve
- Break the lumps if present in sample with fingers.
- A mechanical sieve shaker or a sieve shaker that is held in both hands can be used to sieve the sample continuously. For 15 minutes, the sieving should continue.
- After 15 minutes of sieving, weigh the residue. The residual value must not go beyond the predetermined limits shown in table 14.

Table 14: Analysis of fineness of cement

		Sample 1	Sample 2	Sample 3
Weight of cement	W(g)	100	100	100
IS sieve size		90	90	90
Sieving time		15	15	15
Weight retained on Sieve		4	4	4
% weight retained on Sieve	W1(g) W1/Wx100	4%	4%	4%

2) Analysis of Soundness of Cement by Le-Chatelier method

3) Aim

To determine the soundness of a given sample of cement by *Le- Chatelier* method.

4) Theory:

Once the cement has dried, it must maintain its original volume. A few cements have been found to expand significantly after setting, causing the hardened mass to crack. Using this type of cement will put buildings at risk of structural failure. Another possible cause of cement decomposition is excessive magnesium or calcium sulphate content. Cement soundness can be tested using either the *Le-Chatelier* or the autoclave methods.

5) Apparatus

Le- Chatelier test apparatus conform to IS : 5514-1969, Balance, Gauging Trowel, Water Bath etc.

6) Procedure

- Cement paste made with 0.78P, where P is how much water is needed to make a consistent paste, should be poured into the lightly oiled mould.
- The paste shall be "gauged in the manner and under the conditions prescribed" in "experiment No.1".
- After filling the paste into the mould, we will cover the mould with a glass cover finely lubricated in a oil and to make the whole arrangement stable we will put a slight weight over the glass lid and sink the whole construction into the water at a room temperature.
- 4. To the nearest 0.5 mm, measure the distance between the indicator points. When you're done, rinse the mould in warm water and repeat the process as described above.
- The water in which we kept our whole construction as mentioned above is brought to boning point for about 3 hours, we will then take the mould assembly out from the water and will cool it down and will measure the distance between the marked points.
- The findings suggest that the cement has grown in volume. Ordinary Portland cements must not exceed 10 mm in thickness for rapid hardening and low-heat cements. If the expansion is greater than 10 mm, the cement is deemed unsound.

"The given cement is said to be sound / unsound".

7) Determination of Compressive Strength of Cement

8) Aim

To determine the compressive strength of a given sample of cement.

9) Theory

Using cement in large-scale projects necessitates extensive laboratory testing, so it's not surprising that this is the case. There are no strength tests on neat cement because of the difficulties posed by excessive shrinkage and subsequent cracking.

10)Apparatus

The standard sand to be used in the test shall conform to IS: 650-1966, Vibration

Machine, Poking Rod, Cube Mould of *70.6 mm* size conforming to IS : 10080-1982, Balance, Gauging Trowel, Stop Watch, Graduated Glass Cylinders, etc.

11)Procedure:

- Before starting the test, we should clean our test specimens thoroughly and water used should have a normal room temperature and all observations made should be done at room temperature.
- A cubic mold's filling must be prepared in a distinct way, and the quantities of cement, sand, and water are as follows: An amount of water equal to the percentage of water needed to make a consistent paste has been determined by using IS: 4031 (Part 4)-1988, which specifies the percentage of water needed to make a paste.
- Place the cement, sand on a rigid, non-absorbent plate and mix th two with the help of a shovel for about 60 seconds. After dry mixing, add water gradually and mix all the ingredients uniformly. The mixture should be mixed for about 3-4minutes neither less than this nor greater than this, otherwise the mix may not be accepted.
- Before pouring the mortar mix into the test moulds, the moulds should be thoroughly cleaned. The mould should be lubricated with light oil so that mortar mix may not adhere to it.
- Fill the mortar mix into "the mould in three layers" such that "each layer" is compacted and vibrated properly by

mounting the mould on vibrator machine as shown in figure18.

- After compaction/Vibration, Finish off the top surface with the help of a shovel to remove the surplus.
- The test specimens then should be kept in a room at normal room temperature and
- undisturbed for a period of 24-25hours.
- After 24 hrs, the moulds should be removed and the mortar cubes obtained should be submerged in a curing tank carrying fresh and clean water for curing purpose.
- After curing stage, three mortar cubes should be taken out at each stage i.e.; days, 7days and 28 days for determination of their crushing strength.

Figure18: Compaction of cement mould

12) Calculation

Don't use specimens that are clearly defective or that give strengths that differ by more than 10% from the average value of all the test specimens when determining compressive strength. The results are shown in Table 15.

Table:15 Showing result of compressive strength VIII.

Date of Casting 26-09-2018	3-day strength (N/mm2)	7-day strength (N/mm2)	28-day strength (N/mm2)
	32	39.4	55
Average	42.1		

VIII. RESULTS AND DISCUSSIONS

A. Trial Mixes

By varying the content of Super Plasticizer, Fine to coarse aggregate ratio and Stone dust content Four Trial mixes we made. For the first three trial mixes, constant water/powder ratio of 0.4 (by mass)

1) Trial A

In our First trial we designed nominal mix for reference purpose in order to compare concrete properties of nominal concrete with self compaction concrete.

2) Trial B

In this trial, we used super plasticizer according to codal recommendations but we obtained a harsh concrete, and results obtained in "V funnel test, L box test" were not "satisfactory". Compaction factor obtained was 87%

3) Trial C

In this trial, we varied super plasticizer content, coarse to fine aggregate ratio and to some extent got satisfactory results, V funnel test accomplished in 37 seconds, while L box accomplished in 3 minutes .compaction factor obtained was 96.4%

4) Trial D

Trial D was our last trial because it gave desirable results, in this trial we increased fine aggregates by 10% and varied super plasticizer content and got V funnel test accomplishedin5 seconds and L box test in 10 seconds. Compaction factor obtained was 98%.

Quantities of main ingredients used in different trials is tabulated below

Table 16: Weights of constituents in trial mixes

S.No	Trials	Dated	Quantities of main ingredients(Kg/cum)					
			w/c	Water (L)	Cement	FA	CA	Super Plasticizer
1.	A	05-oct-21	0.4	186	465	680.79	1106.63	
2.	B	09-oct-21	0.4	158.286	395.715	729.86	1186.39	3.166
3.	C	19-oct-21	0.4	165.564	406.41	835.62	1059.56	2.44
4.	D	20-oct-21	0.43	175.584	408.33	819.05	1038.55	2.654

B. Slump Flow Test

Concrete that is self-compacting can be tested using the slump flow test. Slump flow tests use the same test specimen as traditional tests as shown in figure19

Figure.19: Slump Flow test

5) *Procedure*

- Dampen the plate on which the slump cone rests.
- Level off the plate on flat base and tuck it stiffly.
- The slump cone is later filled with concrete mix without compacting it with a tamping rod.
- Struck off the surplus concrete by means of a trowel, and clean the adjacent areas of cone.
- test Shown in figure20
- The time that the sample takes to reach a diameter of 500mm (t50) is also sometimes measured

Figure 20: Results of slump flow Test

- Lift the cone upright and let the concrete flow at ease.
- On raising the cone of a slump, filled with concrete, the concrete flows. The mean diameter of the spread of sample is measured i.e., horizontal distance is measured as against vertical slump measured in the conventional shown in figure 22.

- Acceptable range for SCC is from 650 to 800 mm (EFNARC, 2002), shown in Table 17.

Table 17: Result of slump flow Test

S. No.	Trial mix	Slump flow(mm)	Acceptable ranges of values (mm)	T50 slump flow (sec)	Acceptable range of values (sec)
1.	Mix A	650	650-800	4.5	2-5
2.	Mix B	690		3	
3.	Mix C	720		2	
4.	Mix D	710		2	

A. C.V-FUNNEL TEST

The test is valid for the raw material having "a maximum size of 20mm only". The equipment consists of V- shaped funnel with top width of 490mm and bottom width of 65mm.the overall depth of funnel is 575mm (EFNARC 2002) as shown in figure21 .If concrete take longer time pass to through the V-Funnel, it may indicate that there may be some obstruction present in the funnel.The results of v-funnel are shown in Table 18.

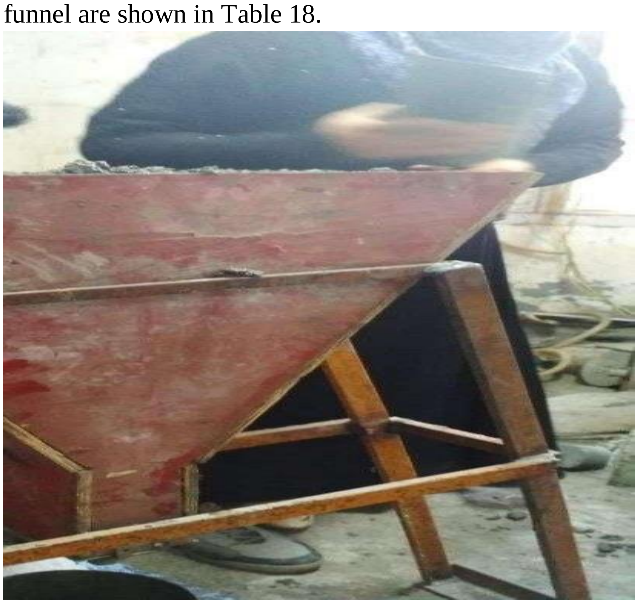

Figure 21: Locally fabricated V-Funnel utilized to evaluate the segregation resistance of SCC

"The results of V-funnel test" is given in table 18 below:

A. D.L-BOX

1) Procedure

- Now, we will fill the upright section of the box with the prepared mix and struck it off with trowel.
  - "Wait for 60 seconds and open the shutter and allow the concrete to flow" from vertical section to horizontal section.
- Now, we will measure the depth of concrete in horizontal section and fall of concrete in vertical section.
- Our final observation would be the time taken by concrete to flow from vertical section to horizontal section.the results are shown in table 19.

Figure 22: Performing L-box test

Table 19: Results of L-box test

S. No.	Trial mix	L-BOX (sec)
1.	Mix A	Didn't pass
2.	Mix B	Didn't pass
3.	Mix C	180
4.	Mix D	10

E. Compaction Factor Test for Concrete Workability

Concrete's workability can be determined using the compaction factor test in the laboratory. The compaction factor is the weight difference between partially compacted and fully compacted concrete. Research at the UK's Road Research Laboratory led to its creation and current application in concrete sturdiness testing It is preferable to use the compaction factor test rather than the slump test for concrete with low workability. Trowels, hand scoops, and a steel or other suitable material rod make up the compaction factor apparatus (1.6 cm diameter, 61.5 cm long).
Calculation of Compaction Factor Value :

Compaction Factor Value= (W1-W) / (W2-W1)

"The compaction factor ranges from 0.7 to 0.95"

1) Purpose

Because of the special admixtures and mineral filler or fines in self-compacting concrete, it flows easily and doesn't segregate. Concrete does not need to be compacted with vibrators because it will do so naturally. There is no segregation when they are placed from a height of up to *5 metres* because they lack separating properties. As they can pass through highlyreinforced areas, these type of concrete are quite handy for congested reinforcement and also they have slightly higher strength then traditionally vibrated concrete.
Generally we compact the concrete with the help of needle vibrators, plate vibrators or vibrators attached to formwork. Now imagine a foundation having large area and very dense reinforcement.In this case we cannot use formwork vibrator since the area is large. Also because of dense reinforcement, the needle of needle vibrator cannot penetrate through the reinforcement cage intoconcrete.
So here comes our savior self compacting concrete. No external source is required to compact thisconcrete. The name itself suggests it can compact itself.

Table 20: Showing results for compaction factor

TRIAL	COMPACTION FACTOR
A	----------------------------------

B	87%
C	96.4%
D	98%

F. Compressive Strength of Trial Mixes

The results of compressive strength tests are shown in the Table 2,22,23 and 24 for trials A,B,C and D respectively and shown in figure23
Result of Compressive strength tests conducted on Trail mix A shown in Table 21.

Table 21: Result of compressive strength for Trial A

S. No.	7 Days		28 Days	
	Load (kN)	Strength (N/mm^2)	Load (kN)	Strength (N/mm^2)
1.	710	31.55	990	44
2.	670	29.78	900	40
3.	610	27.11	910	40.4
Average	663.3	29.48	933.3	41.4

Result of Compressive Strength tests conducted on Trail mix B shown in Table 22.

Table 22: Showing Results of compressive strength for Trial B

S. No.	7 Days		28 Days	
	Load (kN)	Strength (N/mm^2)	Load (kN)	Strength(N/mm^2)
1.	900	40	1060	47.1
2.	790	35.1	1100	48.8
3.	850	37.7	1450	64.4
Average	846.6	37.76	1203.3	53.4

Result of Compressive strength test for Trial mix C shown in Table 23

Table 23: Showing Results of compressive strength for Trial C

S. No.	7 Days		28 Days	
	Load (kN)	Strength(N/mm^2)	Load (kN)	Strength(N/mm^2)
1.	1100	48.8	1380	61.3
2.	1100	48.8	1350	60
3.	1170	52	1300	57.7
Average	1123.3	49.8	1343.3	59.7

Result of compressive strength tests conducted on Trail mix D shown in table 24.

Table 24: Showing Results of compressive strength for

	7 Days		28 Days	
	Load (kN)	Strength(N/mm^2)	Load (kN)	Strength(N/mm^2)
1.	720	32	800	35.5
2.	700	31.1	970	43.1
3.	600	26.6	970	43.1
Average	673.3	29.9	913.3	40.5

Figure 23: Showing Results of compressive strength

IX. CONCLUSION

Vibration is not an issue with self-compacting concrete, which makes the construction site more environmentally friendly and reduces the exposure of workers to vibration. SCC's advantages have made it a popular choice around the world. A number of review papers have been written about the use of industrial waste products in self-compacting concrete. It is also understood that different super-plasticizers can impart different properties and different characteristics to the Self Compacting Concrete. We used Auromix 400 (Poly- Carboxylated Ether) in our project and replaced conventional sand by stone dust of appropriate grade which enhanced itsstrength and came to conclude its optimum dosage at which the required strength, compaction and flow-ability can be achieved. Apart from this, the super-plasticizer used is readily available in the market at affordable prices. Also the stone dust used is available in abundance particularly in Kashmir. It can prove to be economical as well and also the stone dust coming from stone quarries, which otherwise goes waste, can also be used judiciously and profitably. As such the usage of the discussed concrete is expected to do wonders in the world of concrete.

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