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STUDY ON STRENGTH BEHAVIOUR OF CONCRETE BY PARTIAL REPLACEMENT OF MISCELLANEOUS COARSE AGGREGATES

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Abstract:- *This project describes the effect of type aggregate on compressive strength of high strength and normal strength concrete. High strength concrete is a type of high performance concrete generally with a compressive strength of 40 N/mm^2 or greater and normal strength concrete of 20N/mm^2 compressive strength of concrete an experimental program is carried out. In order to be useful in construction the product must meet minimum compressive and requirements which are determined through a Mechanical Test of Concrete with Aggregates mechanical test; and to check the strength of the concrete used for bridges, buildings, and other structures where the principal stresses are compressive cube samples were obtained and tested in compression testing machine. In this study, the standard specification from the Compression Testing Machine (CTM) will be used as a minimum compressive strength of 140 kg/cm^2 per minute. The different types of coarse aggregate like White Granite, Basalt, and Quartzite are used in this project. Natural sand as fine aggregate and ordinary Portland cement as binding material are used for making concrete mixer. To assess the influence of type of aggregate on compressive strength of concrete cubes of size 150mm x 150mm x 150mm are casted and tested in compression testing machine at the age of 7days,21days and 28 days.*

Introduction

1.1 Background of the Study

Aggregates are as important as cement to form a concrete that is very useful in the construction of buildings. These materials are granular material ingredients of cement and mixes. The same materials constitute about 85% of concrete mixes, by weight. With these characteristics, it is necessary for the material engineer to exercise a responsible selection of these materials to acquire a study and durable mixture. Concrete is a result of a hardened product of carefully proportioned mixture of aggregates, cement, and water.

In order to be useful in construction the product must meet minimum compressive and requirements which are determined through a Mechanical Test of Concrete with Aggregates mechanical test; and to check the strength of the concrete used for bridges, buildings, and other structures where the principal stresses are compressive cube samples were obtained and tested in compression testing machine. In this study, the standard specification from the Compression Testing Machine (CTM) will be used as a minimum compressive strength of 140 kg/cm^2 per minute.

In our project we made a cubes of different aggregates like Basalt, White Granite and Quartzite are used and we tested for 7days, 21days and 28 days in compressive testing machine. But our Chittoor district is rich in White Granite,Basalt stone and Quartzite stone and they are easily available.

1.2 Objectives of the Study:

This study generally focused on the mechanical test such as the compressive and

Strength of concrete with different aggregates which were available in our local quarry sites.

The study specifically we had the following objectives:To determine the compressive strength of concrete with different aggregates like Granite is available in CTM Road , and Basalt is available in CTM QUARY SITE, Quartzite is available in

KOTHA ROAD BIDIKI.

- To determine the compressive of concrete cubes were prepared with different source of aggregates.
- 3. To determine the compressive strength of concrete with aggregates is tested under compressive testing machine.
- 4. The results of compressive strength of concrete cube samples between the source of different aggregates after 7days, 21days, and 28 days of OPC.computational model that is inspired by the structure and/or functional aspects of biological neural networks.

Literature Review

The Conference presented four principal recommendations: (1) the influence of cement paste microstructure on long-term performance of concrete and the effects of early-age history on microstructure need to **be** understood; (2) codes and standards need to address concrete at early ages; (3) the importance of controlling the temperature rise in structures during early ages

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needs to be understood and methods for such control need to be implemented; and (4) increased efforts in education and technology transfer are required.

Determination of specific gravity of cement Object

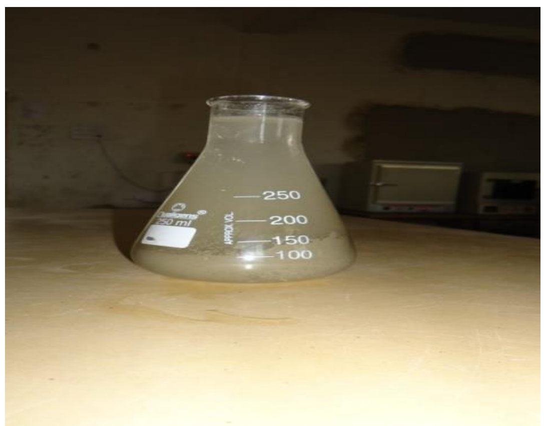
To determine the specific gravity of cement using Le Chatlier Flask or Specific Gravity Bottle.

Apparatus

- Le Chatelier Flask or Specific Gravity Bottle-100ml gm.
- Balance capable of weighing accurately 0.1gm.

Procedure

(a) Weigh a clean and dry Le Chatelier Flask or Specific Gravity Bottle with its stopper (W1).
(b) Place a sample of cement up to half of the flask (about 50 gm.) and weigh with its stopper (W2).
(c) Add kerosene (polar liquid) to cement in flask till it is about half full.
(d) Mix thoroughly with glass rod to remove entrapped air. Continue stirring and add more kerosene till it is flush with the graduated mark.
(e) Dry the outside and weigh (W3). Entrapped air may be removed by vacuum pump.
(f) Clean it refills with clean kerosene flush with the graduated mark wipe dry the outside and weigh (W4).



Specific gravity and water absorption of fine aggregrates

Objective

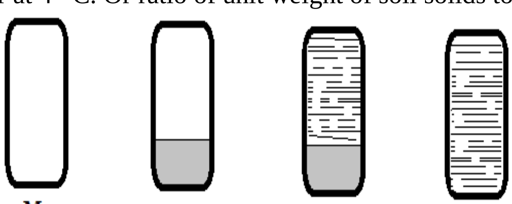
To determine the Specific Gravity of soil a particle passing through 4.75 mm IS sieve using Density bottle.

Apparatus

Density bottle of 100 mm capacity.
Desiccators.
Balance with sensitivity of 0.01 gm.

Theory

Specific Gravity is the ratio of the mass in air of given volume of dry soil solids to the mass of equal volume of distilled water at 4 ^{o}C. Or ratio of unit weight of soil solids to that of water. Let, in the figure



M1 M2 M3 M4

M1 = Mass of empty density bottle.
M_2 = Mass of density bottle + Soil grains.
M_3 = Mass of empty density bottle + Soil grains + water.
M_4 = Mass of empty density bottle + water.

$$G = \frac{(M_2 - M_1)}{(M_2 - M_1) - (M_3 - M_4)}$$

The value of specific gravity depends on the temperature hence its value is reported as standard temperature of 27 ^{o} C.

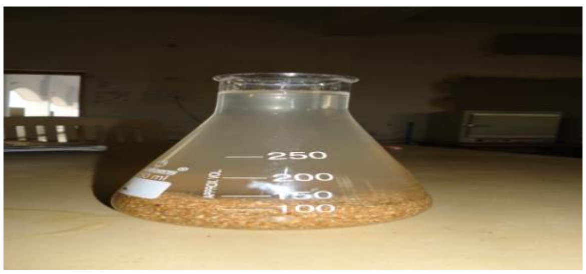
G (at 27 ^{o}C) = G (at t ^{o}C) * (SG of water at t ^{o}C / SG of water at 27 ^{o}C)

Application

Specific gravity of the soil grains is an important property and is used to determine the voids ratio, porosity, and degree of saturation if density and water content are known.Its value helps to some extent in identification and classification of solids. It gives an idea about the stability of soil as a construction material; higher value of specific gravity gives more strength for roads and foundation. It is used in comparing the soil particle size by means of hydrometer analysis. It is also used in estimation of critical hydraulic gradient in soil when sand boiling condition is being studied and in zero air void calculation in the compaction theory of solids.

Procedure

- Take the Weight of clean and dry density bottle.
- Keep about 10 – 15 gm. of oven dried cool soil in bottle and weight (M_2).
- Cover the soil with air free distilled water from the plastic wash bottle. Give some time of socking. A gentle heating may be required to dispel any air inside the soil. Gently stir the soil in the density bottle by clean glass rod. Observed the temperature of the contents (^{o} C) in the bottle and record. Insert the stopper in the density bottle, wipe and weight (M_3)
- Empty the content of bottle, rinse thoroughly, fill it with distilled water at the same temperature, insert the stopper, wipe dry from outside and weight it (M_4).
- Note the ridings as given in Table and at least three such observation and Calculate the Specific Gravity using stated equation.



Determination of Specific Gravity of fine aggregate

- Select the size of density bottle.
- Empty bottle is appearing on the screen, and note the mass (M_1).
- Select the type and mass of soil.
- Bottle with some amount of soil with close lead will appear on the screen and note the mass (M_2).
- Click arrow, some amount of water is added in the bottle and wait for some time (till the soil is completely saturated) mostly around 30 min to 2 hr.
- Then add again water in bottle till the bottle is full and give some stare for removing the air from bottle and close the lead.
- Bottle with some soil and full of water is appearing on the screen and note the mass (M_3).
- Click arrow, Empty the bottle and fill completely with distal water and note the mass (M_4).

Observation and calculation

$$G = \frac{(M_2 - M_1)}{(M_2 - M_1) - (M_3 - M_4)}$$

Empty weight of bottle (M_1) =120gm
Weight of bottle+sand (M_2) =310gm
Weight of bottle+ sand+ water (M_3) =570gm
Weight of bottle+ water (M_4) =459gm
Specific gravity (G) = (M_2-M_1)/ (M_4-M_1)-(M_3-M_2)
= (310-120)/ (459-120)-(570-310)
=190/79
=2.40
Water absorption= (M_4-M_1)-(M_2-M_1)/ (M_2-M_1) %
= (459-120)-(310-120)/ (310-120)
= 0.78%

Result: specific gravity of fine aggregate is **2.40** and water absorption is **0.78%.**

Specific gravity and water absorption test on coarse aggregrate white granite

Specific gravity of aggregates is considered to be measure of strength or quality of the material. Specific gravity test is used to easily identification of stones.Water absorption gives the an idea of strength of aggregrate,aggregrate having more absorption and having more porous in nature and are generally consider unsuitable unless they are found to be acceptable based on strength, impact and hard ness test.

AIM

To determine the specific gravity and water absorption of coarse aggregates.

Apparatus

- A wire basket of not more than 6.33mm or a perforated container of convenient size with thin wire hangers for suspending it for balance
- A thermostatically controlled to oven maintain a temperature of 100 to 110 ^C.
- A container for filling water and suspended bucket.
- An air tight container of capacity similar to that of bucket.
- A balance of weight 5kg,to the weight of accurate 0.5g and of such a type and shape as to permit weighing of sample container when suspended in air.
- A shallow tray and two dry absorbed cloths, each not less than 750X450mm.

Limits

- The specific gravity of aggregate lies between 2.5 to3.
- The water absorption of aggregate lies between 0.1 to 2%.

Sieve analysis of fine aggregates aim

To determine the fineness modulus of fine aggregate**.**

Apparatus

1. Set of sieves (4.75, 2, 1.18, 0.6, 0.3, 0.15, 0.075)mm + Pan
2. Weighing machine.
3. A brush.
4. Riffle box.
5. Shaker

Sample preparation

Samples should be obtained in the field and reduced to test size in accordance with AASHTOT 248. Samples are dried to a constant weight in an oven set at room temperature. The original sample must be reduced to a test sample size which falls within the minimum and maximum weight.Weight of the material retained on each sieve size to the nearest 0.1g. Ensure that all material entrapped within the openings of the sieve are cleaned out and included in the weight retained. This may be done using brush is to gently dislodge entrapped materials. The 8in. (203mm) or 12in. (304.8mm) round sieves need to be handled with special care due to the delicate nature of their screen sizes. As a general rule, use coarse wire brushesto clean the sieves down through the No.50 (300µm) sieve (Figure3). Any sieve with an opening ie smaller than the No.50 (300µm) should be cleaned with a softer cloth hair brush (Figure4). The final total of the weights retained on each sieve should be within 0.3% of the original weight of the sample prior to grading.

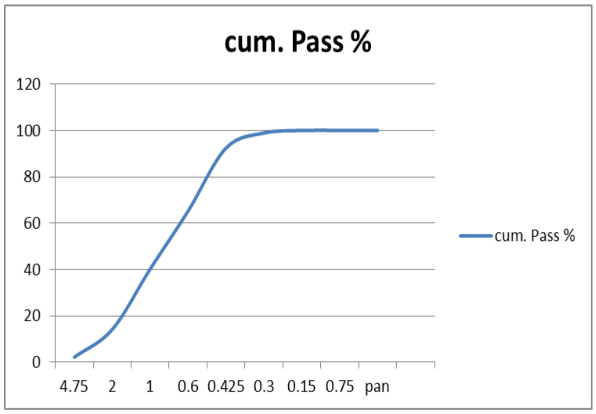
1.

Observations and calculations

Sieve Size (mm)	Weight of sieve (grams)	Weight of sieve+sand(gra	Weight of Sand (grams)	Cumulative Weight retaind (grams)	%retain Weight On sieve	% passing Weight on sieve
75	280	0.280	0	920	100	-
Pan	280	0.280	0	920	100	-
Total =				5640		

Fineness =5640/1000 =5.64

SAMPLE	WEIGHT OF CEMENT TAKEN (gm)	WEIGHT OF RESUDE FORME (gm)	FINENESS OF CEMENT
1	300	30	10
2	300	20	6.67
3	300	30	10



Seive size

A graph for sieve size and cum. % of passing.

Result
Fineness Modulus of fine aggregate is **5.64%**

Bulking of fine aggregates Aim
To determine the percentage of bulking of fine aggregate.

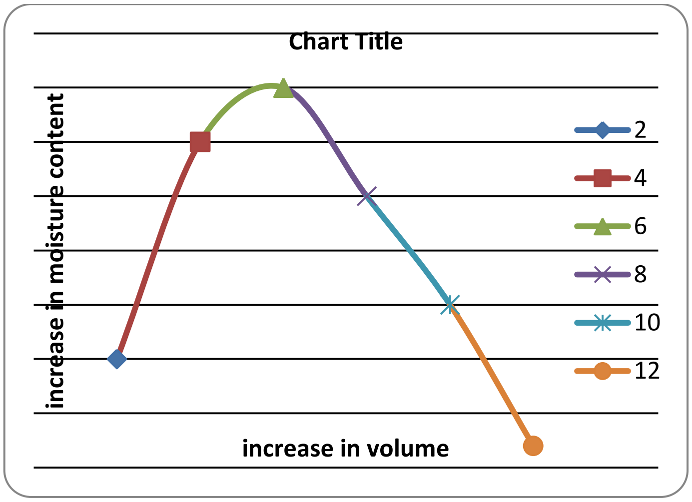
Apparatus

1. Container
2. Steel rule
3. Steel rod 5 mm diameter
4. Measuring cylinder
5. Measuring jar
6. Fine aggregate

Calculation
Initial reading h=18.3cm

S no	% of Water added to Wt. of Sand	Height of moist sand in cm (h')	% of bulking of sand $(\frac{h'-h}{h}) * 100$
1.	2	20.5	12.02
2.	4	22.5	22.9
3.	6	23	25.6
4.	8	22	20.2
5.	10	21	14.75
6.	12	19.7	7.65

Graph:



Result:

Bulking of fine aggregate is **25.6%**

Is specification for fineness of cement

As per IS: 12269 the residue of cement sample on the 90µm IS sieve after sieving, it Should not exceed following percentage by weight for different types of cement.

I) Ordinary Portland cement = 10%
II) Rapid hardening cement = 5%
III) Low heat cement = 5%

Observation and Calculations

Fineness of cement = W1+W2+W3/avg X100
= weight retain on sieve/total weight
= (10+6.67+10)/3
=8.89%

Result

The finesse of cement is **8.89%**

Limits

the value of fineness of cement does not exceed 10%

Test set up and testing

Moulds

Metal moulds, preferably steel or caste iron, thick enough to prevent distortion are required. They are made in such a manner as to facilitate the removal of the molded specimen without damage and are so machined that, when it is assembled ready for use, the dimensions and internal faces are required to be accurate with in the following limits

The height of the mound and the distance between the opposite faces are of the specified size $\pm$0.2 mm.the angle between adjacent internal faces and between internal faces and top and bottom places of the molds is required to be $90^{0} \pm 0.5^{0}$ .the mold having the dimensions like 150mmX150mmX150mm.

Process of Testing

The cube specimen of size 15*15*15cm.if the largest nominal size of aggregate does not exceed 20mm, 10cm size cubes may also be used as an alternative. Cylindrical test specimens have a length equal to twice diameter. They are 15cm in diameter and 30cm long. Smaller test specimen may be3 used but a ratio of diameter of specimen to maximum size of aggregate, not less than 3 to 1 is maintained.

Area of cube = 150x150mm = 22500mm²
Volume of cube = 150x150x150mm = $3.375x10^6$ mm³
Stress = Load / Area N/mm^2

Results and discussion

Compressive Strength of Concrete at 7 days for M20:

S.NO	TYPEOF AGGREGATE USED	SAMPlE-1	SAMPLE-2	AVG FORCE	COMPRESSIVE STRENGTH
1	White Granite	420	435	427.5	19
2	Bassalt	380	395	387.5	17.22
3	Quartzite	320	315	317.5	14.12

Compressive Strength of Concrete at 7 days for M40:

S. NO	TYPE OF AGGREGATE USED	SAMPLE-1	SAMPLE-2	AVG FORCE	COMPRESSIVE STRENGTH
1	White Granite	658	670	664	29.52
2	Bassalt	510	510	510	22.67
3	Quartzite	485	495	490	21.78

Compressive Strength of Concrete at 21 days for M20:

S. NO	TYPE OF AGGREGATE USED	SAMPLE-1	SAMPLE-2	AVERAGE FORCE	COMPRESSIVE STRENGTH
1	White Granite	640	625	632.5	28.11
2	Bassalt	640	620	630	28
3	Quartzite	580	560	570	25.33

Compressive Strength of Concrete at 21 days for M40:

S. NO	TYPE OF AGGREGATE USED	SAMPLE-1	SAMPLE-2	AVERAGE FORCE	COMPRESSIVE STRENGTH
1	White Granite	810	860	835	37.11
2	Bassalt	810	600	710	31.55
3	Quartzite	730	680	705	31.33

Compressive Strength of Concrete at 28 days for M20:

S. NO	TYPE OF AGGREGATE USED	SAMPLE-1	SAMPLE-2	AVERAGE FORCE	COMPRESSIVE STRENGTH
1.	White Granite	860	900	880	39.44
2.	Bassalt	850	810	830	36.89
3.	Quartzite	850	780	815	36.22

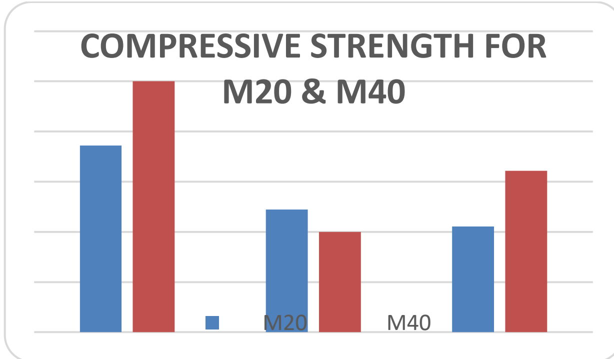
Compressive Strength of Concrete at 28 days for M40:

S. NO	TYPE OF AGGREGATE USED	SAMPLE-1	SAMPLE-2	AVERAGE FORCE	COMPRESSIVE STRENGTH
1	White Granite	1010	880	945	42
2	Bassalt	720	900	810	36
3	Quartzite	800	930	865	38.44

Final compressive strength for m20 & m40:

S.no	TYPE OF AGGREGATE USED	m20	m40
1.	White granite	39.44	42
2.	Bassalt	36.89	36
3	Quartzite	36.22	38.44

From the above results we got the highest strength both for M20 and M40 concretes is “White Granite”. But in the case of Bassalt and Quartzite, they have less strength when compared to the White Granite.



Conclusion

Aggregate type has effect on the compressive strength of concrete. Highest compressive strength was achieved from concrete containing crushed granite, followed by the concrete containing crushed basalt. Concrete containing crushed quartzite shows the least strength developed at all stages of ages. Linear polynomial model as a function of age at curing is adequate to account for the variability in the compressive strength data. It is suggested that crushed granite may be employed for concrete work in places where concrete partitions have variety of choices available.

- the aggregate like white granite can be used in high rise buildings, skyscrapers.
- Basalt can be used as a building material in construction of resedentional buildings and road material.
- Quartzite can be used in foundation and also in flooring purpose.

Scope of further study

The following aspects can be taken up for further investigation.

Similar studies can be carried out on other concrete like metakoline,rice husk etc. to access and analyze the effect of chemical admixture substances on the compressive strength, split tensile, flexural strength with a special attention on the durability.

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Details

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