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OPTIMIZATION OF AGGREGATE GRADATION AND ITS INFLUENCE ON PROPERTIES OF M20 GRADE CONCRETE BY USING M-SAND

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Abstract: The normal concrete having as a main constituent as aggregates because it occupying 70% of total volume of concrete. The aggregates are influence the concrete characteristics of fresh and hardened concrete. We use the binding material of the concrete is cement, which is taken up to 20% in the mixing of concrete. So due to the usage of high volume of cement, increases the cost of cubic unit of concrete. So in this reason we take a challenge to decrease the cost of concrete production by using optimization technique. In this technique we use combine gradation of aggregates, it will be reduce usage of cement in the production then decrease the cost of cubic unit of concrete. The optimization technique is obtained from maximum density line or power curve, coarseness factor chart, fineness of modulus and surface area. In this experiment uses to improve the arrangement of aggregate structure i.e, reduce the gaps in the concrete structure. In this investigation, we know that it's increases the density of concrete because of good packing arrangement of aggregates and also improve the characteristics of concrete like flow of concrete, water absorption, compressive strength.

Keywords: power curve, fineness of modulus, water absorption, compressive strength, Binding material

1. INTRODUCTION

Concrete having major ingredients are aggregates, these are occupied major percentage compared to other ingredients of the concrete. This content will be given the structure for the concrete. The content i.e. aggregates are fulfilling the volume of concrete up to 70 % to 80 % of the final volume of concrete. So major content of concrete is aggregates, then it effects the characteristics of the freshly making concrete and hardened concrete. . It is effect some other characteristics of the concrete like flow or working nature of the concrete, capability of resist the atmospheric conditions , load resistance for the concrete structure. The main advantage is the cost of the aggregates is less compared to cement, so it is useful to reduce the cost of the production of the concrete. The present investigation on the study and analysis of effects the characteristics of the freshly making concrete and hardened concrete of M20 grade making with replacing of fine aggregate of sand with M-sand in different proportions aggregates (with different power factors) in the mixing of concrete. In this research we use the M-sand in the placing of fine aggregate (sand)

2. MATERIALS:

The physical properties like shape, quality , size of the materials utilize in the current experimental works are used to study on the cement , coarse aggregate , manufactures and (M-sand) are based on the standard experimental procedures are doing according to Indian standard code provisions.
The physical characteristics of the materials are calculated by using the experimental work doing on sieve analysis of aggregates , specific gravity of materials on cement , coarse aggregates , M-sand and crushing value and impact value , abrasion values of aggregates and absorption of water in coarse aggregates , fine aggregates and bulk density of aggregates , shape test like flakiness and elongation of aggregates and consistency limit test , soundness test , fineness test on cement.
The investigation of experiments on the design of concrete mix is done by using the technique of optimization of aggregates according to the code of IS10262:2009. In this we made seven concrete mixes prepare by varying of the percentages of the fine aggregates base the power factor (n) values are changed based on fineness modulus. In this mixes we use the M-sand in place of normal sand. In time of mixing of concrete, we conduct fresh properties of concrete like workability, density of concrete. After we cast the cubes with the dimensions15cmx15cmx15cm with the concrete and compacted. The cubes were removed from moulds after 24 hours time period and it placed at water tubs for curing purpose. After duration of 7 days and 28 days period of time placed in curing we are conduct the compression strength test , rebound hammer test , UPV method and durability test (water absorption test)

Figure 1: Materials

3. TESTS AND RESULTS:

According to Indian standard code provisions all characteristics of cement is tabulated below

Table 1: IS Codal Provisions of Cement

S.NO	Particulars	Test results	Is code provisions
1	Normal Consistency	28%	30 %
2	Fineness of cement	6%	5 %
3	**Setting time**		
	Initial setting time	28 minutes	30 min
	Final setting time	9 hours	10 hours
4	Specific gravity of cement	3.13	3.15
5	Soundness of cement	7mm	5-9

WORKABILITY MEASUREMENT TEST (SLUMP CONE TEST)

In test we can calculate the workability of the concrete by using the slump cone test. In this test conducted on in the fresh stage of concrete. This test conducted for all mixes in every time and note down the slump value in mm. The slump values are calculated for different power factor 'n' values and tabulated below.

Table 2: Values of slump cone test

S.NO	N value	Sand (%)	Slump value (mm)
1	0.55	41.7	90
2	0.65	42	100
3	0.75	43.7	110
4	0.85	45.3	120
5	0.85	42	90
6	0.85	43.6	100
7	1.05	45.3	110

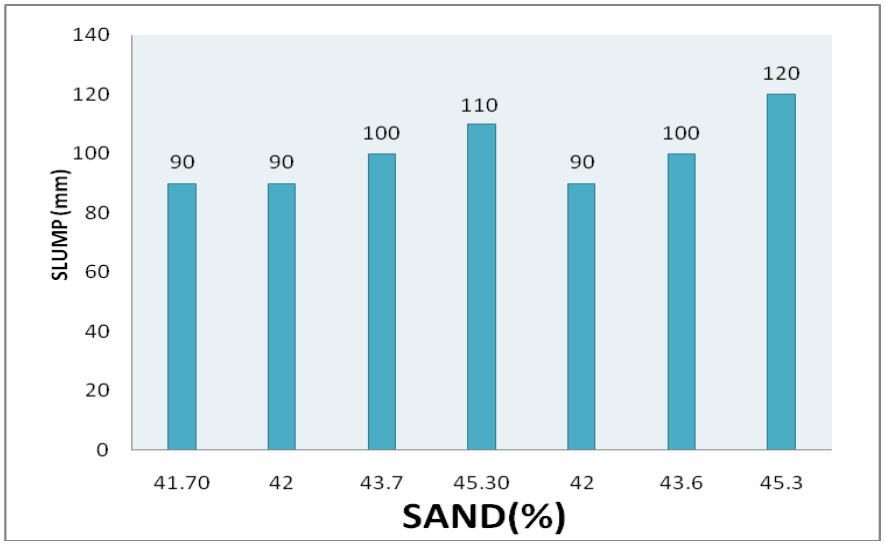


Figure 2

BULK DENSITY OF CONCRETE

It is one of the properties of the fresh concrete mix .The bulk density of the concrete means the arrangement of particles in unit volume. The density test is done by using a cylinder of the dimensions 15cm diameter and 30cm height of its volume is 5301.43 cm^3. This test is conducted on the laboratory at the time of fresh concrete . The concrete characteristic properties are depend on the bulk density .the density will be expressed in the units of Kg/m^3 or Kg/lit or KN/m^3.

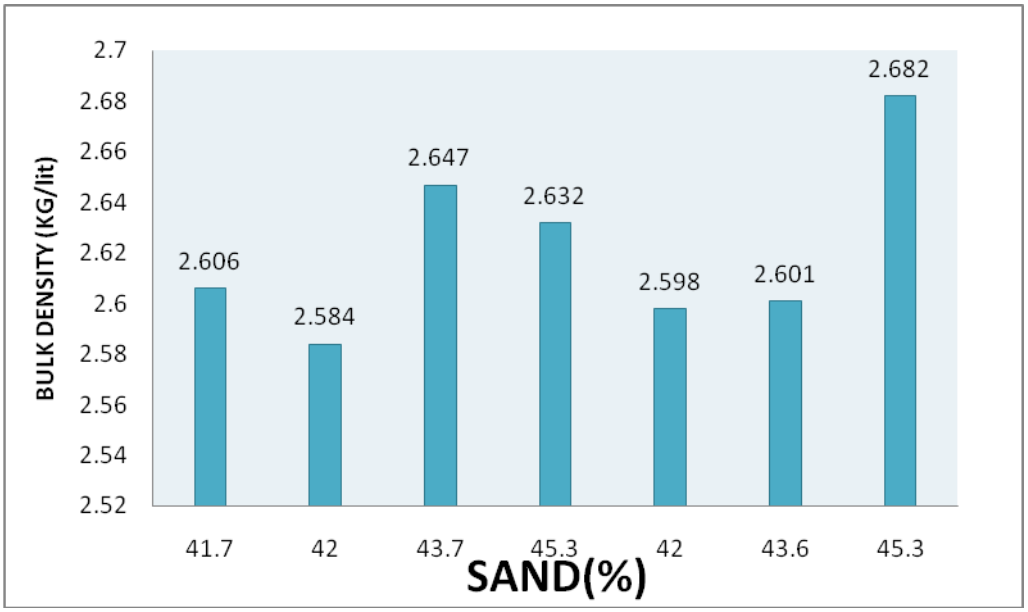
$$\text{Bulk density} = \frac{\text{weight of the concrete in cylinder}}{\text{volume of the cylinder}}$$

$$\text{Bulk density} = \frac{W2 - W1}{V}$$

The density values for n=0.55, 0.65, 0.85, 0.75, 1.05 with different sand percentages of M-SAND of fineness of modulus if 2.34 is shown in below table 3

Table 3

S.NO	N value	Sand (%)	Density (KN/m^3)
1	0.55	41.7	26.06
2	0.65	42	25.84
3	0.75	43.7	26.47
4	0.85	45.3	26.32
5	0.85	42	25.98
6	0.85	43.6	26.01
7	1.05	45.3	26.82

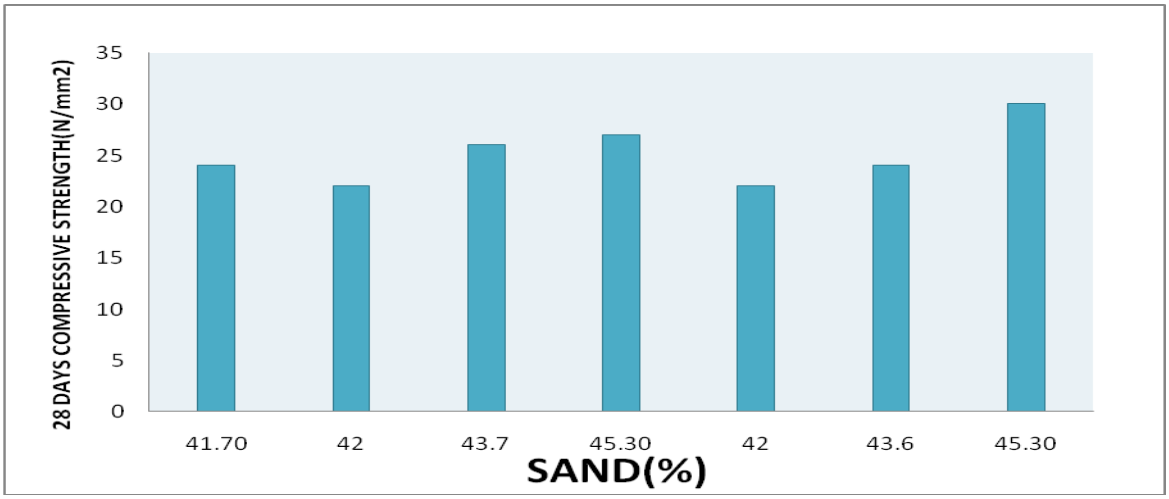


COMPRESSIVE STRENGTH TEST

Generally, the calculation of the compressive strength test is doing on a specimen of cubes are used as per Indian standard codes. The size of the cube is 15cm x15cmx15cm of on volume of 3375 cm^3. In this experiment the normal size of the aggregates not more than 20mm. This test is conducted for the calculate the compressive strength of the hardened concrete cubes with the time interval of curing is 3 days , 7 days, 14 days, 21 days and 28days. The compressive strength is related to the concrete characteristics of properties and compressive strength values for n=0.55, 0.65, 0.75, 0.85, 1.05 with different sand percentages of M-SAND of fineness of modulus if 2.34 for 28 days shown table 4

Table 4: compression strength test values

S.NO	N value	Sand (%)	Load (KN)	Compressive strength (N/mm^2)
1	0.55	41.7	520	23.52
2	0.65	42	506	22
3	0.75	43.7	596	26.88
4	0.85	45.3	665	30.12
5	0.85	42	517	22.97
6	0.85	43.6	540	24
7	1.05	45.3	683	30.85

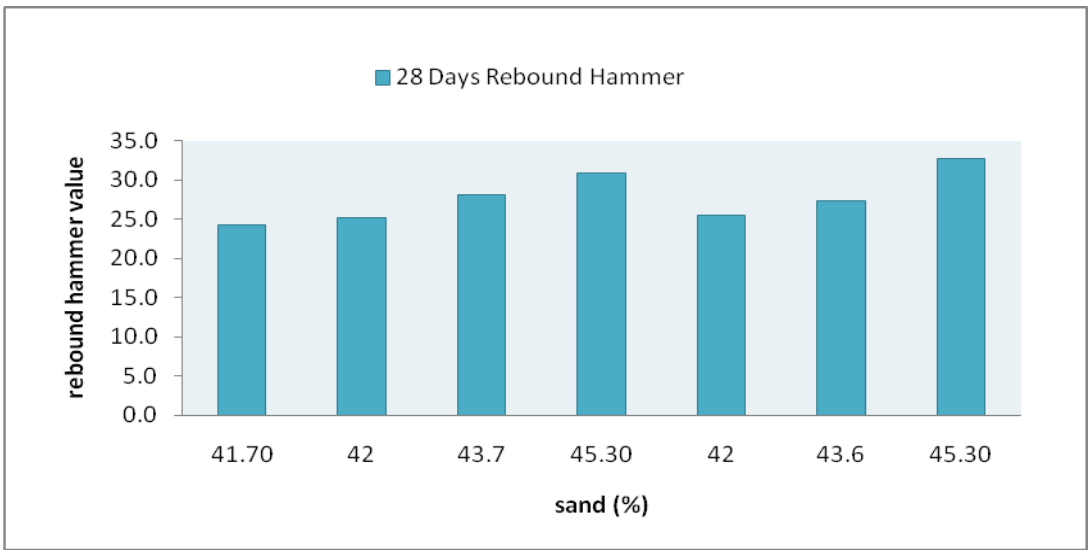


REBOUND HAMMERTEST:

In this research on the concrete, rebound hammer is conducted horizontally to the applied perpendicular to the surface of the cube of concrete. The experiment on cube we take reading in three levels to get 9 readings and the final result is the average of the above 9 values. it is decided with help of above calculation we conclude the stress resistance against to the applied load of the cube In this test conducted on cubes at the time interval of 7 days and 28 days respectfully. The rebound hammer for n=0.55, 0.65, 0.85, 0.75, 1.05 with different sand percentages of M-SAND of fineness of modulus if 2.34 shown in table 5

Table 5: Rebound hammers test values

S.NO	n value	Sand (%)	Rebound hammer value
1	0.55	41.7	24.33
2	0.65	42	25.14
3	0.75	43.7	28.25
4	0.85	45.3	30.78
5	0.85	42	25.42
6	0.85	43.6	27.33
7	1.05	45.3	32.68

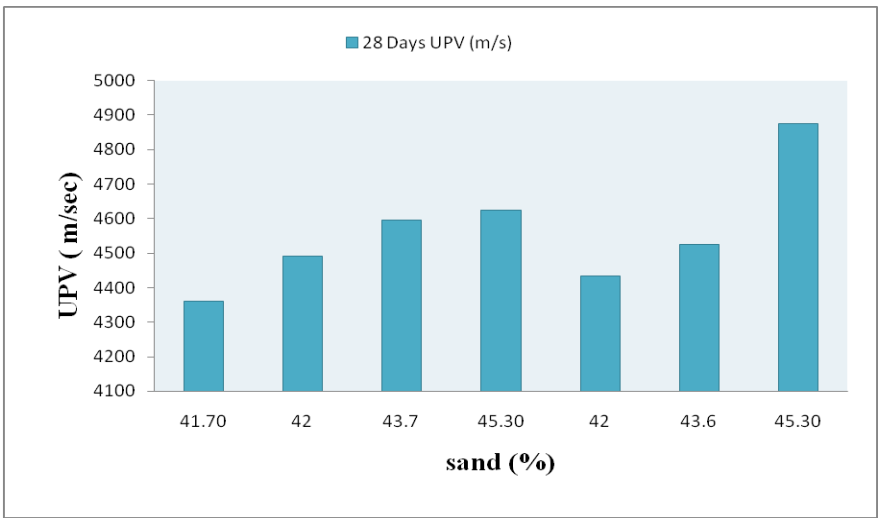


ULTRA PULSE VELOCITY TEST:

In this testing method is calculated the time of travelling the ultrasonic pulse passing through the concrete cubes. The machine having two wires connected main operating system. They are one is transfer the ultrasonic pulses and another one is receive the signals of ultrasonic pulse .The reading will be displayed on screen of system. It is gives the velocity of pulse passing through the cube and time taken for passing. The velocity and time taken is recorded .if the higher velocity of the cube indicates that cube having low voids due to this the strengthen of the concrete is higher. The lower velocity denotes that the cube having more voids and gives less strength. Based on the results of the test we concluded the strengthen parameters of the concrete. The pulse velocity of concrete cube are recorded for 7days and 28 days and the results are noted below table and the results are shown in graphs in below in table 6

Table 6: Ultrasonic pulse velocity test

S.NO	N VALUE	SAND (%)	PULSE VELOCITY	TIME TAKEN
1	0.55	41.7	4360	36.2
2	0.65	42	4491	35.8
3	0.75	43.7	4596	34.4
4	0.85	45.3	4625	32.8
5	0.85	42	4435	34.1
6	0.85	43.6	4525	33.8
7	1.05	45.3	4875	31.2



IV. CONCLUSIONS

Based on the experimental work carried out on red soil, the following conclusions are shown below:-

1. The sand content of 45% will be given the good workability i.e easiness of working with this concrete for power factor values n= 0.85, n= 1.05 respectually.
2. The bulk density of concrete for 45.3% sand content for power factor values n= 0.85, n= 1.05 respectually.
3. The compressive strength of concrete mixes with the n vales 0.55, 0.65 , 0.75, 1.05 with the sand contents 41.7% , 42% , 43.7% , 45.3% are 23.52 N/m^2, 22N/m^2, 26.8N/m^2 , 30.85N/m^2 respectually .
4. The compressive strength of concrete mixes with the n vales 0.85with the sand contents 42%, 43.7%, 45.3% are 22.97N/m^2, 24N/m^2, and 30.12N/m^2respectually.
5. The ultrasonic pulse velocity of concrete mixes with the n vales 0.55, 0.65 , 0.75, 1.05 with the sand contents 41.7% , 42% , 43.7% , 45.3% are 4360 m/sec , 4491 m/sec , 4596 m/sec , 4875 m/sec respectually .
6. The ultrasonic pulse velocity of concrete mixes with the n vales 0.85with the sand contents 42% , 43.7% , 45.3% are 4435 m/sec , 4525 m/sec , 4625 m/sec respectually .
7. The rebound hammer values of concrete mixes with the n vales 0.55, 0.65 , 0.75, 1.05 with the sand contents 41.7% , 42% , 43.7% , 45.3% are 24.33 , 25.14 , 28.25 , 32.68 respectually.
8. The rebound hammer values of concrete mixes with the n vales 0.85with the sand contents 42% , 43.7% , 45.3% are 25.42 , 27.33 , 30.78 respectually .
9. The water absorption values of concrete mixes with the n vales 0.55, 0.65 , 0.75, 1.05 with the sand contents 41.7%, 42% , 43.7% , 45.3% are 1.37 , 1.41 ,1.27 . 1.17 Respectually.
10. The water absorption values of concrete mixes with the n vales 0.85with the sand contents 42% , 43.7% , 45.3% are 11.44, 1.31 , 1.19 respectually .
11. The good workability , bulk density , compressive strength , rebound hammer number , ultrasonic pulse velocity and water absorption values is given by the concrete mix with sand content of 45.3% for n= 0.85 , 1.05 values respectually .

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