High Strength Reduced Modulus of Concrete

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ABSTRACT: High performance concrete (HPC) is defines as a concrete with higher structural capacity and superior durability as compare to that of ordinary Portland cement concrete. It is at present being utilized for relating to its physical properties and solidness attributes. The related tests which incorporate compressive strength and modulus of elasticity. The aim of this work is to appraise the impacts of coarse aggregate on the modulus of elasticity of (HPC) concrete. A sequence of laboratory tests and investigations has been carried out. Results of the experiments show that the IS recommended equation is always not been appropriate for estimating the modulus of elasticity of concrete. Depending upon the source of the aggregates relationships exist between the modulus of elasticity of the aggregate, its LA abrasion and the resulting modulus of elasticity of the concrete. In this present study investigating the effect of replacement of weathered aggregate in place of normal aggregate to reduce the young's modulus of concrete without compromising the strength compared for the grade of M_{50} concrete mix.

Keywords: High performance concrete (HPC)

1. INTRODUCTION

Concrete is a normal utilized development material for different sorts of structures because of its basic security and quality. Every material required delivering such gigantic amounts of solid originate from the earth crust. Therefore, it exhausts its assets consistently making biological strains. Then again, human exercises on the earth create strong waste in extensive amounts of larger than 2500/MT every year, including modern squanders, horticultural squanders and squanders from country and urban social orders. Late innovative advancement has established that these materials are significant as inorganic and natural assets and can deliver different valuable items. Among the strong squanders, the most conspicuous ones are fly ash debris, blustfurnce slag, rice husk, silica fume and annihilated development materials.

From the center of the twentieth century, there had been an expansion in the utilization of mineral admixtures by the bond and solid enterprises. The enlarging make for bond and cement is met by fractional concrete substitution. Significant vitality and cost reserve funds can come about when mechanical side-effects are utilized as s fractional trade for the vitality exceptional Portland bond. The utilization of by items is an ecological agreeable technique for transfer of bulking amounts of materials that that generally dirty land, water and air. A large portion of the expansion in bond request will be met by the utilization of supplementary establishing materials.

Superior Concrete (HPC) is characterized as concrete with higher quality or potentially enhanced strength as contrasted and ordinary cement. HPC is at present being utilized for connect development to shield support from erosion, to oppose synthetic and physical assault and to give enhanced auxiliary properties. The Federal Highway Administration (FHWA) created Performance Based Criteria for surveying HPC. Related with these criteria are tests identifying with physical properties and strength qualities. The related tests incorporate compressive quality, modulus of elasticity, shrinkage, crawl, solidify defrost solidness, scaling, scraped area and chloride infiltration. The modulus of elasticity of the HPC (Class E) connect decks was observed to be low and this is an issue of extraordinary concern.

1.2 OBJECTIVE

The Objective of the work is to evaluate the impacts of coarse aggregate on the modulus of elasticity of HPC utilizing Class E concrete vs Normal concrete so to reduce the stresses in concrete which form due to dynamic load

1.3 SCOPE OF WORK

This work exhibits an investigation of the impact of weathered coarse aggregate on concrete compare to normal concrete. It talks about the components influencing the modulus of elasticity of superior concrete (HPC) and techniques utilized as a part of its assurance. The test program which incorporates the testing methods and results are exhibited underneath and talks about the point's improvement of test example.

2. LITERATURE REVIEW

Superior concrete (HPC) has been characterized in various routes by many creators. In the development business, cements with higher qualities and improved execution properties, as contrasted and ordinary cement are exceptionally attractive. until 1991, notwithstanding, that quantitative esteems for execution criteria were given. Scientists of the SHRP-C-205 on HPC in 1991, characterized HPC for asphalt applications quality sturdiness characteristics and water-cementation materials proportion as takes after

2.1. HPC shall have the following strength characteristics:

a. 14 day compressive strength > 35 MPa termed as high early strength concrete (HES),

b. 28-day compressive strength > 70 MPa termed as very high early strength concrete (VHS).

c. HPC shall have a durability factor > 80% after 300 cycles of freezing and thawing

d. HPC shall have a water-cementation materials ratio < 0.4

Later in 1996, the Federal Highway Administration (FHWA) created criteria for four diverse execution levels of HPC communicated as far as its toughness qualities and quality parameters. ASTM or AASHTO benchmarks comparing to tests used to decide every parameter. Arranged by expanding nature of cement the least grade of HPC is a Grade 1 and Grade 4 is the most astounding. HPC is at present being utilized for connect development to shield fortification from consumption oppose synthetic and physical assault and to enhance the auxiliary execution of extensions. HPC is proposed to lessen the life-cycle cost of extensions, broadening the administration life of scaffolds however normally starting expense is high. In a report by Petrou and Harries on HPC utilized as a part of South Carolina for connect decks, huge shrinkage breaks were seen in a large portion of the scaffold decks. This prompted the improvement of a program to decide whether the Class E concrete s viewed as a HPC as indicated by the FHWA HPC Performance Grade. The sturdiness and quality properties are talked about quickly in the following two segments concerning HPC at present being utilized as a part of South Carolina. The HPC s alluded to as Class 6500. At the point when this investigation was started, this solid was alluded to as Class E; the Class E name is utilized all through this work.

3. MATERIALS

The materials used in this experiment were Cement, Sand, coarse aggregate (weathered or unweathered) Admixture and water.

3.1 Cement: OPC 53 grade cement from a single batch will be used throughout the course of the project work. The properties of cement used are shown in table below.

Table 1: The properties of cement

SL NO	PHYSICAL PROPERTIES	TEST RESULTS
1.	Specific Gravity	3.10
2.	Standard Consistency	33%
3.	Initial Setting Time	33 minutes.
4.	Final Setting Time	356 minutes.
5.	Fineness of Cement	2%

3.2 Fine Aggregate:

Aggregate which are inactive materials and go about as filler material in bond and Aggregate of size less than 4.75mm are generally considered as fine aggregate.

Table 2. Physical properties of Fine Aggregate

S.No.	Property	Test Method	Value
1	Fineness modulus	Sieve analysis (IS 2386-1963 Part 2)	3.13
2	Specific gravity	Pycnometer (IS 2386-1963 Part 3)	2.6
3	Bulk density (kg/m3)	(IS 2386-1963 Part 3)	1830
4	Water absorption	(IS 2386-1963 Part 3)	1.02%

3.3 Coarse Aggregate: The coarse aggregate used in this study was crushed granite of maximum size 20 mm obtained from the local crushing plant. The physical properties of the coarse aggregate were tested in accordance with IS 2386(10).

Table 3.Physical properties of Coarse Aggregate (20mm)

S.NO	Particulars	Natural C.A	Weathered C.A
1	Sieve analysis'	6.15	6.239
2	Water absorption	0.5	2.1%
3	Specific gravity	2.6	2.51
4	Flakiness index	23.73	27.22
5	Elongation index	3.12	4.8
6	L.S abrasion test	27.39	35%
7	Attrition test	2.2	4.12%

Figure 1. Weathered Coarse Aggregate Sample

3.4 Water:

Normal portable water obtained from Municipal water supply was used for the experiment.

3.5 Admixture

CHRYSO Enviro Mix 300 is used for the study it help in inc4reasing the compressive strength in all ages with great workability (Dose: 200 to 400 ml for 50 kg bag)

PHYSICAL PROPERTIES

Form	Liquid
Color:	Brown
Specific Gravity	1.12 + 0.02
Air entrainment	<1.0 % over control mix.
Chloride Content:	Nil (As per BS:5075)
Water Reduction	15 - 20 %

4. MIX DESIGN

Mix proportions for trial number 1

Cement = 420 kg/m3

Water = 154 kg/m3

Fine aggregate = 650 kg/m3

Coarse aggregates = 1150 kg/m3

Chemical admixture = 7 kg/m3

Water cement ratio = 0.40

Test on materials

Test on Cement	
1) Fineness test	5%
2) Normal consistency of cement	32%
3) Initial setting	45min
4) Final setting	345min
5) Specific gravity	3.15
Test on coarse aggregate	
1) Fineness modulus	10.2
2) Water absorption	0.5%
3) Specific gravity	2.6
4) Flakiness index	10.5%
5) Elongation index	12.5%
6) Abrasion test(LAS Abrasion)	17.68%
Test on Fine Aggregate	

1) Bulking of sand	20%
2) Fineness modulus	3.05
3) Specific gravity 4) Water absorption	2.657 0.5%
Specific gravity of super plasticizer	1.145

Figure 2. Cylinder casing

Figure 3. Cylinder cubes after casting

Testing of concrete cylinders:

After desired curing of concrete cylinders, the sample should be tested by UTM (universal testing machine) as shown in below figure.

Figure 4.Universal testing machine

Table4. Tabular form for strength parameter

S.NO	Age of concrete	Load (KN)	Compressive Strength(N/mm2)
1	7 days	492	21.9
2	14 days	751	33.4
3	28 days	1228	54.6

Table 5. Compressive strength of cubes for 7,14& 28 day

S.NO	Age of concrete	Load (KN)	Compressive Strength (N/mm^2)
1	7 days	517	23
2	14 days	785	34.93
3	28 days	1603	71.25

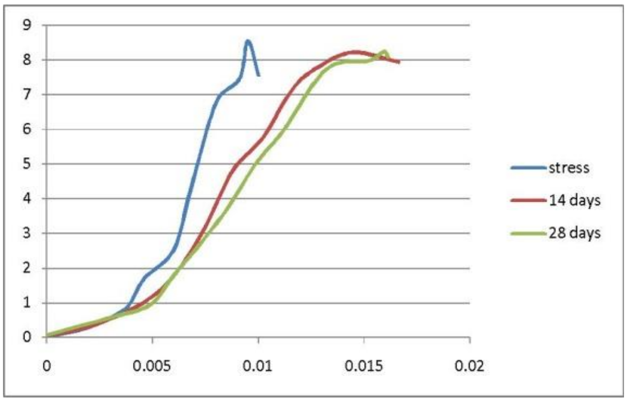

Figure5. Graphs for stresses Vs strain of special concrete

Table6. Tabular form for Modulus of elasticity parameter

S.NO	Age of concrete	Modulus of elasticity(N/mm^2)
1	7 days	1.6X10^5
2	14 days	1.85X10^5
3	28 days	2.3X10^5

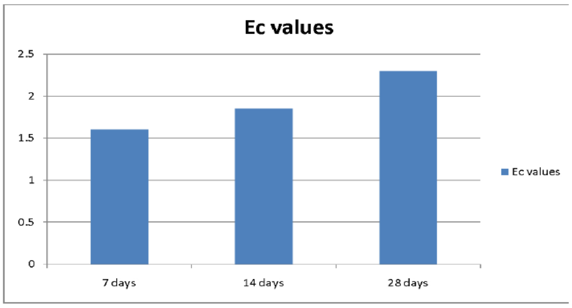

Figure6. Test result of modulus of elasticity of concrete

Special Concrete

a)Preparation Of special Concrete Mix:

1. Prepare a mix of 1:1.5:2.74 of special concrete - 2.
2. -Take the materials with respect to desired proportions i.e. 1kg of cement, 1.5 kg of fine aggregates and 2.74kg of weathered coarse aggregate.
3. Take w/c of 0.4 with respect to mix design.
4. Add 275 ml (per 50kg of cement bag) of admixture.
5. Thoroughly mix all the materials together to form a uniform mix.

b) Placing The Fresh Concrete In Moulds

1. After mixing the concrete thoroughly, place the mix of concrete into the desired cylinders (150x300) as shown in below figure.
2. Place the concrete in molds in three steps, each step is tamped by 25 blows with the help of tamping rod.
3. After filling the mould with concrete in three layers finish the top surface smoothly.

c) curing:

After 24 hours of casting, the concrete cylinders should be removed from moulds.
The concrete cylinders will be placed for curing of 7, 14 and 28days and maintaining constant temperature.

Table 7. Test result of modulus of elasticity of concrete

S.NO	Age of concrete	Modulus of elasticity(N/mm^2)
1	7 days	1.545X10^5
2	14 days	1.725X10^5
3	28 days	2.16X10^5

Figure 7. Failure patron of traditional concrete

Figure 8. Failure patron of special concrete

COMPARISON OF TRADITIONAL AND WEATHERED CONCRETE

Table 8.Comparison on Strength Parameter

S.NO	Age of Concrete	Traditional (N/mm²)	Weathered (N/mm²)
1	7 days	23	21.9
2	14 days	34.93	33.4
3	28 days	71.25	54.6

Table 9.Comparison on Modulus of Elasticity parameter

S.NO	Age of Concrete	Traditional (N/mm²)	Weathered (N/mm²)
1	7 days	$1.8X10^5$	$1.3X10^5$
2	14 days	$2.5X10^5$	$1.65X10^5$
3	28 days	$3.2X10^5$	$2.0X10^5$

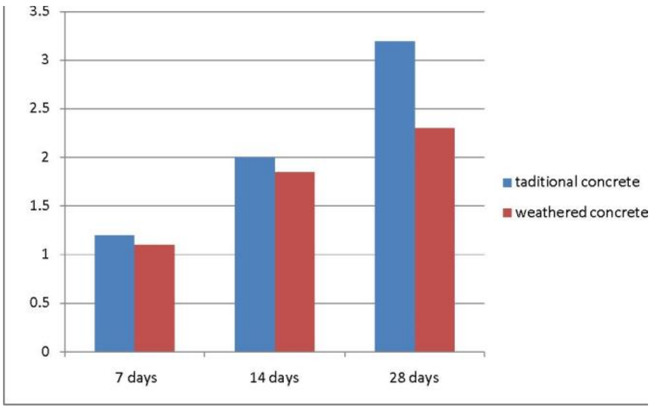

Figure 9. Graph of weathered vs traditional concrete result

CONCLUSIONS

- Finally observed that as per test result Modulus of Elasticity of Concrete can be decreased by using weathered coarse aggregate in place of natural coarse aggregate
- The test result shows that the strength of weathered aggregate concrete is good when compare to traditional concrete
- Based on the test result observed that the weathered coarse aggregate can reduces the stresses and modulus of elasticity of concrete
- The optimum dosage of admixture is 275 ml per 50 kg bag of cement
- Two weathered aggregate quarry concretes were investigated and its potential in terms of young's modulus and compressive strength at different ages were investigated and compared to traditional vs weathered aggregate concrete.

- For the weathered aggregate concrete modulus of elasticity becomes very less and observed increased ductility representing the concrete flexible. Moreover the weathered aggregate concrete has got enough strength with traditional concrete.
- The percentage of weathered aggregate concrete is becoming flexible and we can observe very less young's modulus of concrete. Hence can be used in concrete sleepers to reduce stresses.
- The weathered aggregate concretes are characterized by trans-granular type of fracture with passing through the aggregates and cement mortar.
- The unweathered aggregate concretes are characterized by fracture mainly through the cement mortar and not necessarily through the aggregates.
- It weathered aggregate from perecharla (Granite-Cmeiss) is better than weathered rock aggregate from Venkateswara quarry near Yedlapadu (Granite).

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