Evaluating the Durability Properties of High Strength Self Compacting Concrete by using Mineral Admixtures

KAKUMANU CHAITANYA PAVAN KUMAR1, T. VENKATESWARA REDDY2

1PG Scholar, Dept of Civil Engineering, Nalanda Institute of Technology, Kantepudi, Guntur (Dt), AP, India.
2Assistant Professor, Dept of Civil Engineering, Nalanda Institute of Technology, Kantepudi, Guntur (Dt), AP, India.

Abstract: To assemble tall structure by lessening section sizes and expanding accessible space, to manufacture the super structure of long traverse connects and to the solidness of scaffold decks a high quality is required. High quality cement was utilized as a part of South Wacker in Chicago of 80 Mpa, Banana Tower in Abu Dhabi of 80 Map and Frankfurt Treason in Germany of 125 Map. On the off chance that high quality cement is self compacting the creation of thickly fortified building component from high quality cement with high homogeneity would be a simple work. In the present examination a judicious blend configuration is built up and self smaller capacity testing strategies have been done from the view purpose of making it a standard cement by utilizing mineral admixtures like miniaturized scale silica and fly fiery debris for giving High Strength Self Compacting Concrete. The stream properties of coming about cement is described in the crisp state by techniques utilized for, Self compacting concrete, for example, Slump-stream, V-pipe and L-box tests individually. Encourage the solidness properties are inspected for High Strength Self Compacting Concrete blend of review M100. The solidness elements are additionally considered .From these reviews we watch that 15% Micro silica and 25% Fly fiery debris will give ideal quality for M100 review at water/powder proportion of 0.22. The impact Na2So4 on these blends is nil where as HCL and H2So4 had significant effect.

Keywords: Self Compacting Concrete,Segregation Resistance, Filling Capacity, Passing Ability, Mineral Admixtures, Solidness Properties.

I. INTRODUCTION

Concrete is a vital versatile construction material, used in large choice of things. Therefore it’s vital to consider its sturdiness because it has indirect impact on economy, serviceability and maintenance. Concrete isn’t absolutely resistance to acids. Most acid solutions can slowly or speedily disintegrate concrete creme relyng upon the kind and concentration of acid. Sure acids, like ethanedioic acid and chemical element acids square measure harmless. The foremost vulnerable half of the cement hydrate is Ca (OH)2, however C-S-H gel also can be attacked. siliceous aggregates square measure a lot of resistance than calcareous aggregates. Concrete may be attacked by liquids with Concrete will attack by liquids with pH scale below vi.5, but the attacks square measure severe solely at a pH scale below five.5, below 4.5 the attack is incredibly severe. Because the attack takings, all the cement compounds square measure equally lessened and leached away, together with any carbonate mixture material. With the sulphuric acid attack, calcium sulfate shaped may be proceed to react with metallic element aluminate introduce cement to create calcium sulphaaluminate, that on crystallization will cause expansion and disruption of concrete. If acids or salt solutions are able to reach the reinforcing steel through cracks or porosity of concrete, corrosion will occur which can cause cracking.

The sulfate attack denotes a rise within the volume of cement paste in concrete or mortar owing to the natural action between the merchandise of association of cement and resolution containing sulphates. Once hardened concrete is exposed to soil or well water containing sulfate compounds, the sulphates in resolution square measure possible to react with hydrous Tricalcium compound within the hardened cement paste to create a new chemical known as Ettringite. This new compound causes expansion and disruption of the concrete. Therefore, it is necessary to limit the permeableness of the concrete to scale back the penetration of sulphates in resolution. Solid salts don't attack the concrete severely however once the chemicals square. Measure in solution, they notice their entry into porous concrete and react with the hydrous cement merchandise. Of All the sulphates, magnesium sulfate causes most harm to concrete. A characteristic whitish look is that the indication of sulfate attack. The term sulfate attack denote a rise within the volume of cement paste in concrete or mortar owing to the chemical action between the merchandise of association of cement and resolution containing sulphates. Within the hardened concrete, calcium compound hydrate (C-A-H) will react with sulfate salt from outside. The merchandise of reaction is metallic element sulpho aluminate, forming inside the framework of hydrous cement paste. Thanks to the rise in volume of the solid phase that may go up to 227 p.c, gradual
disintegration of concrete takes place. The deteriorating impact sometimes starts at the surface and corners and increasingly enters into the concrete by inflicting scaling and spalling and at last reduces the concrete a friable mass.

II. ANALYSIS SIGNIFICANCE

For a recently developing material like self compacting concrete, studies on sturdiness square measure of predominant importance for ingraining confidence among the engineers and builders. The literature indicate that whereas some studies square measure obtainable on the durability of plain self compacting concrete and fibre reinforced self compacting concrete, a comprehensive study which involves sturdiness parameters loss of weight and loss in compressive strength of specimens attributable to acid attack, sulphate attack don't seem to be obtainable for prime strength self compacting concrete (HSSCC). Hence, considering the gap in the existing literature, a shot has been created to check the durability parameters of HSSCC i.e. Loss of weight and loss in compressive strength of specimens attributable to acid attack, sulphate attack still as sturdiness factors.

III. LITERATURE REVIEW

Studied the deformations in additional detail, the relevancy of ancient creep and shrinkage models take a look at series as delineated, the subsequent conclusions are often formulated with increasing c/p quantitative relation, and consequently increasing cement content and decreasing w/c quantitative relation, a decrease of the creep deformations is found. The fineness of the tested fillers has virtually no influence on the deformations. Audenaert K created AN extended experimental programmed on chloride penetration of sixteen self compacting concrete mixtures and four ancient concrete mixtures were determined. Based on these tests, the conclusion is that the penetration depth in real conditions is powerfully influenced by water/cement and water/(cement +filler) ratios. Decreasing one of these ratios or each is resulting in as decreasing penetration depth. Another necessary conclusion is that the chloride penetration depth in SCC by cyclic immersion is lower than the penetration depth in TC. Gamesman N et.al studied the impact of steel fibers on the durability parameters of self-compacting concrete (SCC) such as porosity, water absorption, abrasion resistance, resistance to marine still as salt attack and all over that addition of steel fibres improved the sturdiness aspects of self compacting concrete. C. Selvamony concerned evaluating the Effectiveness of various percentages of mineral admixtures in manufacturing SCC.

Okamura’s methodology, supported EFNARC specifications, was adopted for mixed style. Dr.R.Sri ravidarajah investigated into the development of self-compacting concrete with reduced segregation potential. The fine particle content is inflated by replacing partly the fine and coarse aggregates by low calcium fly ash. S. Venkateshwar Rao aims at developing commonplace and high strength Self Compacting Concrete with totally different sizes of mixture supported Nansu’s combine style procedure. Also, ash optimization is completed in study with the stratified course mixture. Seshadri Sekhar.T (7) et.al studied on the impact of glass fibers on the sturdiness properties of fibre self compacting concrete for various grades of concretes M thirty to M65 and also mentioned concerning sturdiness factors conjointly. Seshadri Sekhar.T (8) et.al developed the high strength self compacting concrete mistreatment mineral admixtures.

IV. OBJECTIVES OF STUDY

To check the sturdiness properties like loss of weight and loss in compressive strength of specimens attributable to acid attack, salt attack, sturdiness factors of high strength self compacting concrete mistreatment mineral admixtures

V. MATERIALS USED

A. Cement

Ordinary hydraulic cement of fifty three grades having relative density was 3.02 and fineness modulus half-dozen.05 was employed in the investigation. The Cement used has been tested for varied proportions as per IS 4031-1988 and located to be confirming to various specifications of square measure 12269-1987.

Coarse Mixture: Crushed angular granite metal often millimeter size having the specific gravity of two.65 and fineness modulus half-dozen.05 was employed in the investigation.

Fine Mixture: River sand having the particular gravity of two.55 and fineness modulus 2.77 was employed in the investigation.

Viscosity Modifying Agent: A consistency changed admixture for Hemodynamic Concrete which is colorless free flowing liquid and having Specific of gravity 1.01+0.01 @ 250C and hydrogen ion concentration price as 8+1 and Chloride Content cipher was used as consistency Modifying Agent.

Admixture: The changed Poly carboxylated Ether based mostly super plasticizer which is yellow color and free flowing liquid and having Relative density one.10+0.01 at 250C, pH scale &gt;6 and Chloride particle content 0.2% was used as super plasticizer.

Fly Ash: Type-II ash confirming to I.S. 3812 – 1981of Indian Standard Specification was used as Pozzolana Admixture.

Micro silicon dioxide: The small silicon dioxide having the precise gravity a pair of.2 was employed in the present investigation.

VI. CHECK PROCEEDURE

A. Test on Salt Resistance of High Strength Self Compacting Concrete Victimization Mineral Admixtures

Sulphate resistance of concrete is decided by immersing test specimens of size one hundred X100 X one hundred metric linear unit cubes in 100% sodium salt. The deterioration of specimens area unit given in the variety of share reduction in weight and share reduction in compressive
Evaluating the Durability Properties of High Strength Self Compacting Concrete by Using Mineral Admixtures

Strength of concrete of specimens at twenty eight, 56, ninety and a hundred and eighty days.

B. Test on Acid Attack of High Strength Self Compacting
Concrete victimization mineral admixtures. Acid attack is decided by immersing check specimens of size 100 X100 X one hundred metric linear unit cubes in 100% H2So4 answer and 100% HCl answer severally. The deterioration of specimens area unit presented within the variety of share reduction in weight and percentage reduction in compressive strength concrete of specimens at twenty eight, 56, ninety and a hundred and eighty days.

C. Durability Factors of High Strength Self Compacting Concrete Victimization Mineral Admixtures
After casting, the specimens area unit immersed in water for twenty eight days. Then they're immersed in 100% H2So4, 100% HCl and 10% Na2So4 answer unceasingly. Then six specimens area unit removed from every cluster brushed with a soft nylon brush and rinsed in H2O. This method removes loose surface material from the specimen. The specimen’s area unit tested at twenty eight days, 56 days, ninety days and a hundred and eighty days for the compressive strength. The durability issue is calculated as follows.

\[ \text{Durability issue (D F)} = \frac{(\text{Sr. N})}{M} \]

\( S_r \) = Relative strength at N days or perhaps weeks 
\( N \)= variety of days at that sturdiness issue is required 
\( M \)= variety of days at that the exposure is to be terminated.

The acid attack check is terminated at a hundred and eighty days. Therefore M is a hundred and eighty in this case.

VII. DISCUSSION OF RESULTS
Quantities of materials needed per one seed of high strength self compacting concrete mixes Table one offers the quantities of fabric needed for M100 grade of high strength self compacting concrete victimization mineral mixes. To make high rise building by reducing column sizes and increasing accessible area, to design the super structure of long span bridges and to the sturdiness a high strength is required. Therefore we've got tried for M100 grade mixes as terribly restricted work is accessible victimization mineral admixtures.

A. Fresh State Properties of High Strength Self Compacting Concrete Mixes
Table a pair of provides a outline of the recent state properties of high strength self compacting concrete combines for mix one hundred. As it is evident, the essential necessities of high flow ability and segregation resistance as such that by pointers by EFNARC is happy.

B. Percentage Loss of Weight of Specimens When Immersing In Ten the Concerns HCL
From table three the share loss of weight is determined to be 1.68 looking forward to twenty eight days, 3.74 looking forward to fifty six days, 4.25 looking forward to ninety days and 5.92 looking forward to a hundred and eighty days severally. The share weight loss is determined to be increasing in correspondence with time. The behavior is given in fig.1.

C. Percentage Loss of Weight of Specimens When Immersing in 10% Na2So4
From table three the share loss of weight is determined to be Nil. This shows that top strength self compacting concrete mixes have the resistance against Na2So4 SOLUTION. The behavior is given in fig.2.

D. Percentage Loss of Weight of Specimens When Immersing In Ten the Concerns H2So4
From table three the share loss of weight is determined to be 8.12 looking forward to twenty eight days, 14.78 looking forward to fifty six days, 23.38 looking forward to ninety days and 27.98 looking forward to a hundred and eighty days severally. The share weight loss is determined to be increasing in correspondence with time. The behavior is given in fig.3.

E. Loss of Compressive Strength of Specimens Once Immersing In Ten The Troubles HCL Solution
From table four the share loss of compressive strength is observed to be four.74 anticipating twenty eight days, 6.28 anticipating fifty six days, 9.38 % for ninety days and twelve.78 anticipating one hundred eighty days severally. The percentage loss is discovered to be increasing in correspondence with time. Because the attack income, all the cement compounds are equally countermanded and leached away, in conjunction with carbonate mixture material.

F. Percentage Loss of Compressive Strength Of Specimens Once Immersing In Ten The Troubles Na2So4 Solution
From table for the share loss of compressive strength is observed to be nothing. Incorporation of Pozzolana material reduces the sulfate attack. Admixing of pozzolana converts the leachable slaked lime into insoluble non leachable cementitious product. This pozzolana action is accountable for impermeability of concrete. This shows that Na2So4 resolution indirectly serving to in natural action the specimens.

G. Percentage Loss of Compressive Strength Of Specimens Once Immersing In Ten The Troubles H2So4 Solution
From table five the sturdiness factors are discovered to be twenty two.21 anticipating twenty eight days, 29.42 anticipating fifty six days, 38.40 anticipating ninety days and forty eight.45 anticipating one hundred eighty days severally. With the acid attack, calcium sulfate shaped will be proceed to react with metal aluminate introduce cement to form metal sulphoaluminate, that on crystallization will cause enlargement and disruption of concrete.

H. Durability Factors of Specimens Once Immersing in Ten % HCL Solution
From table five the sturdiness factors are discovered to be fourteen.81% for twenty eight days, 29.15 % for fifty six
days, 45.31 anticipating ninety days and 87.22 anticipating one hundred eighty days severally.

I. Durability Factors of Specimens Once Immersing in Ten % Na2So4 Solution
From table five the sturdiness factors are discovered to be fifteen.11% for twenty eight days, 31.11 % for fifty six days, 50.00 anticipating ninety days and 100.00 anticipating one hundred eighty days severally.

J. Durability Factors of Specimens Once Immersing In Ten % H2So4 Solution
From table five the sturdiness factors are discovered to be twelve.80% for twenty eight days, 21.96 anticipating fifty six days, 19.20 anticipating ninety days and 51.55 anticipating one hundred eighty days severally.

Fig.1. Test Specimens of High Strength SCC mix of M100 grade immersed in HCL solution.

Fig 2. Test Specimens of High Strength SCC mix of M100 grade immersed in Na2SO4 solution.

Fig 3 Test Specimens of High Strength SCC mix of M100 grade immersed in H2SO4 solution.

VIII. CONCLUSIONS
- High strength self compacting concrete mixes with addition of V-day small silicon oxide and 27 % fly ash can give optimum strength for M100 grade.
- Water powder quantitative relation of 0.25 is employed to in developing High Strength self compacting concrete.
- The share weight loss of high strength self compacting concrete mixes once immersing in ten the troubles HCL resolution will increase reminiscent of the time.
- The share weight loss of high strength self compacting concrete mixes once immersing in ten the troubles Na2So4 is discovered to be nothing for any amount of

TABLE I: Quantities Of Materials For 1m3 Of High Strength Self Compacting Concrete Mixes

<table>
<thead>
<tr>
<th>Mix</th>
<th>Cement (kg/m3)</th>
<th>Fly ash (kg/m3)</th>
<th>Micro Silica (kg/m3)</th>
<th>Water (kg/m3)</th>
<th>Coarse Aggregate (kg/m3)</th>
<th>Fine Aggregate (kg/m3)</th>
<th>SP (kg/m3)</th>
<th>VMA (kg/m3)</th>
<th>Water/</th>
<th>Powder</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix 60</td>
<td>520</td>
<td>135</td>
<td>85</td>
<td>164</td>
<td>784.985</td>
<td>786.195</td>
<td>13.2</td>
<td>0.45</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE II: Fresh Concrete Properties of High Strength Self Compacting Concrete Mix M 100

<table>
<thead>
<tr>
<th>Test Specimens</th>
<th>10% HCl Solution</th>
<th>10% Na2So4 solution</th>
<th>10% H2So4 solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-Box</td>
<td>10 sec</td>
<td>8 sec</td>
<td>10 sec</td>
</tr>
<tr>
<td>Abrams slump flow</td>
<td>685 mm</td>
<td>600 mm</td>
<td>820 mm</td>
</tr>
<tr>
<td>T 50cm slump flow</td>
<td>5.5 sec</td>
<td>3 sec</td>
<td>6 sec</td>
</tr>
<tr>
<td>L-Box</td>
<td>0.10</td>
<td>0.92</td>
<td>1.5</td>
</tr>
<tr>
<td>T 20</td>
<td>2 sec</td>
<td>3 sec</td>
<td>3 sec</td>
</tr>
<tr>
<td>T 40</td>
<td>3 sec</td>
<td>3 sec</td>
<td>4 sec</td>
</tr>
<tr>
<td>V-Box at T 5 min</td>
<td>15 sec</td>
<td>12 sec</td>
<td>16 sec</td>
</tr>
</tbody>
</table>

TABLE III: Percentage Loss of Weight of High Strength Self Compacting Mixes

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>10% HCl solution</th>
<th>10% Na2So4 solution</th>
<th>10% H2So4 solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 days</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>56 days</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>90 days</td>
<td>0.48</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>180 days</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
</tr>
</tbody>
</table>

TABLE IV: Percentage Loss Of Compressive Strength Of High Strength Self Compacting Mixes

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>10% HCl solution</th>
<th>10% Na2So4 solution</th>
<th>10% H2So4 solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

TABLE V: Durability Factors Of High Strength Self Compacting Mixes

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>10% HCl solution</th>
<th>10% Na2So4 solution</th>
<th>10% H2So4 solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Relative strength</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Durability Factor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Evaluating the Durability Properties of High Strength Self Compacting Concrete by Using Mineral Admixtures

your time. This shows that prime strength self compacting concrete mixes have the resistance against Na2So4 solution.

- The share weight loss of high strength self compacting concrete mixes once immersing in ten the troubles H2So4 resolution will increase reminiscent of the time.
- The share loss of compressive strength of high strength self compacting concrete mixes once immersing in 100 % HCL resolution will increase corresponding to the time.
- The share loss in compressive strength of high strength self compacting concrete mixes once immersing in ten the troubles Na2So4 resolution is nothing. This shows that Na2So4 resolution indirectly serving to in curing the specimens.
- The share loss of compressive strength of high strength self compacting concrete mixes once immersing in ten the troubles H2So4 resolution will increase corresponding to the time.
- Higher the Durability factor higher is the resistance to the acid and sulfate attacks.

VIII. REFERENCES

[2] Zongjin Li; Advanced concrete technology; 2011