Development of Ultra Strength Concrete

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Abstract. Most superior cements delivered today contain materials notwithstanding Portland cement to help accomplish the compressive strength or solidness execution. These materials include fly ash, silica fume and ground-granulated blast furnace slag used discretely or in coalescence. Concurrently, chemical admixtures such as high-range di-hydrogen monoxide-reducers are needed to ascertain that the concrete is facile to convey, place and culminate. For high-strength cements, a blend of mineral and compound admixtures is almost consistently fundamental to guarantee accomplishment of the necessary strength. The Primer investigations have been done on concrete, Fine aggregate and coarse aggregate. The Blend Extent for M200 grade concrete is determined 1: 0.313: 1.463 by following the plan methodology given by ACI Strategy. By keeping up the w/c proportion as 0.25, the multi day Compressive strength, Flexural strength and Split elasticity of cement at 3% of silica fume and 1.5% of complast have been accomplished as 163.33 N/mm², 8.4 N/mm² & 9.5 N/mm² separately. The variety of solidity of cement with the variety of silica fume is appeared in bar outline. The strength of the concrete might be as yet expanded by decreasing the w/c proportion and expanding the level of silica fume

Keywords. High strength concrete, silica fume, durability, mineral admixture, chemical admixture.

1. Introduction

In numerous nations a few sorts of design sorts of construction are fabricate which require superior materials these are submerged passages, off share stages, tall structure and pinnacles, long range extensions, streets and runway overlays and so on [1]. Recovery of concrete constructions utilizing high performance fiber built up Concrete and found that it joins proficient insurance and opposition elements of UHPFRC with customary underlying cement[2]. They have even tracked down that the restored structures have essentially improved underlying obstruction and solidness[3]. The full scale acknowledge of the idea under practical site conditions exhibit the capability of uses and that the innovation of UHPFRC is developed for cast in-situ and construction utilizing standard hardware for concrete assembling[4]. The high strength concrete which is more brittle than normal cement, utilizing constrainment support, flexibility is expanded generally[5]. At the point when repression support
dispersing is diminished to half, pliability improved twice[6]. Accordingly, by diminishing repression support dispersing, the tremor conduct of high strength cement can be improved[7]. Diminishing repression support separating has expanded the compressive strength of bound cement to a limit of 19%[4]. The Punching Shear opposition of High Strength Concrete pieces and found that the usage of high-strength concrete improves the punching shear block allowing higher forces to be travelled through the segment section [8]. Ultra High Strength Concrete under Concentrated Burden and tracked down that the customary support can be totally or mostly supplanted by fibers, which are additionally successful in the edge of the primary individuals[9]. Moreover they have tracked down that the malleable bearing capacity is uniform. Between molecule voids, a component of the coarse aggregate reviewing, is a significant boundary in the blend plan[10]. The ACI technique has no satisfactory boundary to consider this angle. This prompts higher fine aggregate substance, with ensuing expansion in the surface space of totals, when coarse aggregate of higher voids are utilized[11]. The concrete substance is resolved even before the thought of any total kind, bringing about a lower concrete/fine aggregate proportion[7]. This is the reason blends planned by the ACI strategy neglect to acquire wanted strength, when coarse aggregate of higher voids are utilized[12]. The fire execution of High Strength Concrete and tracked down that High Strength Concrete is a high-performing material and offers various advantages over Ordinary Strength Concrete[13].

Notwithstanding, it was discovered that there is a worry on the event of spalling and lower fire perseverance of High strength Concrete (when contrasted with Typical strength Concrete)[14]. The principle boundaries that were found impacting fire execution of High Strength Concrete at material level are: concrete strength, silica fume, concrete dampness content, concrete thickness, fiber support, and kind of aggregate. At the primary level it was discovered that, tie dividing, confinement, tie setup, load levels and size of the individuals surmise a consequential part in deciding fire perseverance. Shrinkage is unaffected due to low w/c ratio, but is approximately proportional to the percentage of water by volume in concrete[15]. Shrinkage of High Strength Concrete containing high reach water reducer is not exactly that of Ordinary Strength Concrete. High Strength Concrete displays moderately higher starting pace of shrinkage. Subsequent to drying for 180 days, there is little distinction between the shrinkage of High Strength Concrete and Typical Strength Concrete made with dolomite or lime stone aggregates[16]. Decreasing the restoring time frame from 28 to 7 days causes a slight expansion in the shrinkage. The utilization of ultra concrete cements sanctions supplanting steel structures by concrete ones in tall structures. Ultra High Strength Concrete is utilized for fortified casings and for composite concrete steel outlines[17]. High modules of these concrete is especially mentioned is seismic zones to build solidness and assure solace for in habitants. The improvement of high concrete based materials enjoys other significant benefits: use of cutting edge strategies in exploration, testing and plan of materials draws a profoundly energetic staff. Ultra strength concrete is probably going to have to some degree higher beginning expense per unit volume than ordinary cement[18]. Be that as it may, its utilization is probably going to be legitimized by reserve funds coming about because of the accompanying variables like the improved functionality of USC, or the high early-age strength, can decrease development cost. The improved mechanical properties can decrease the measures of primary component and the upgraded strength will build the assistance life[19]. A portion of the upsides of silica fume concrete incorporate the capacity to acquire high early qualities and decreased wet blanket attributes. The overall downside is the increment in water interest of the substantial because of the fineness of the material[20]. A blend plan for 70MPa high strength fly ash concrete was utilized for the centre of the primary pinnacle at the Melbourne Focal venture[21]. The blend siphoned well, having an underlying droop of 50 mm and ascending to 170 mm practically speaking. Incorporation of silica fume was exceptionally powerful in accomplishing strength more than 70MPa at 28 days[3]. Folios having silica fume combined with one or the other slag or fly debris brought about cements having comparable multi day strength as the previously mentioned blend in with silica rage alone.

For the triple mix blends, an additional 25 kg/m³ of fastener was expected to accomplish the
strength execution. The triple mix blends were noted to have an altogether lower super plasticizing admixture requests for given loads of folio when contrasted with the silica fume cements alone[22]. Moreover, the later age strength gains were more noteworthy for the triple mix cements over the silica fume cements alone.

2. Materials and Proportioning

The water concrete proportion is chosen dependent on the ideal compressive strength or the normal openness conditions. The measure of blending water depends on the most extreme total size and the ideal moisture range. The total extents are chosen to accommodate a practical blend with the ideal functionality and finish-capacity attributes. An alternate kind of Portland cement permits some fitting of solidarity grain attributes or for extra protection from compound assault. An air-entrainment specialist might be utilized for protection from freezing and defrosting. Practically speaking blend extents fluctuate contingent upon the properties of the individual fixings and on the ideal properties of the substantial in assistance subtleties of some real blends utilized previously. As of now said the aggregate should not have too huge a most extreme size. The coarse aggregate should have various qualities, it should be solid, totally perfect, that is liberated from following dirt or residue, it should not contain responsive silica, with not many exemptions, and squashed total is utilized. Concerning fine aggregate it must be coarsely reviewed, ideally with a fineness modulus of 2.7 to 3. Proportioning a path combination of USC is more perplexing. The cementitious framework is typically made out of a mix of Portland concrete and different materials, like fly ash, impact heater slag. The aggregate may be painstakingly chosen to accomplish high strength or high versatile modulus. Compound admixtures are required for functionality, improved strength or control of setting measure.

53 grade Portland cement is used in the study. The cement for entire experiment was procured in a single consignment and properly stored. Locally available coarse aggregate, having 10mm & 12.5mm size are used throughout the work. River sand produced locally was used for fine aggregate. Fine aggregate passing IS 240 sieve is used, relating to zone II. Potable water used in the work for mixing concrete and also for curing.

3. Mix Design

The value of slump height is taken from the Table given in the code ACI Standard 211.298 basing on the sort of work. Allow us to think about slump height= 125mm. The ACI technique depends on the rule that the Greatest size of total ought to be the biggest accessible so long it is steady with the components of the construction. At the point when high strength concrete is wanted, best outcomes might be gotten with diminished most extreme sizes of aggregates since these produce higher qualities at a given w/c proportion. Coarse aggregate size = 20 mm and 12.5 mm and water/concrete proportion = 0.25. Table 1 gives the mix design for M200 ultra Strength concrete.

| Table 1. Mix Proportions of Concrete |
|-------------------------------------|
| Cement | W/C Ratio | Fine Aggregate | Coarse Aggregate |
| 748    | 0.25      | 234.78          | 1094.4           |
4. Tests and Results

4.1 Compressive Strength Test
Specimens are tried for compressive strength for 28 days on compressive strength testing machine. In any event three beams, ideally from various clusters, ought to be made for testing for each chosen age. Cubes are taken out from water not long before 4 to 5 hours of testing. Variation in compressive strength is shown in Table 2. Figure 1 and Figure 2 gives the performance variation and illustration of specimen at failure.

Figure 1. Specimen behaviour before and after the failure in compressive strength testing

| Cubes No | Silica Fume (%) | Complast (%) | 28 Days Compressive Strength (N/mm²) | Average Compressive Strength |
|----------|-----------------|--------------|--------------------------------------|----------------------------|
| 1        | 3               | 1.5          | 165                                  | 163.33                     |
| 2        | 3               |              | 160                                  |                            |
| 3        | 3               |              | 165                                  |                            |
| 4        | 5               | 2            | 145                                  | 141.67                     |
| 5        | 5               |              | 140                                  |                            |
| 6        | 5               |              | 140                                  |                            |
| 7        | 7               | 3            | 140                                  | 136.6                      |
| 8        | 7               |              | 135                                  |                            |
| 9        | 7               |              | 135                                  |                            |
| 10       | 9               | 4            | 120                                  | 118.3                      |
| 11       | 9               |              | 115                                  |                            |
| 12       | 9               |              | 120                                  |                            |
Figure 2. Variation of Compressive strength for different proportions of Silica and Conplast

4.2 Split Tensile Strength

Cylinders are tried for elasticity for 28 days on split tensile testing machine. Specimens, ideally from various groups, ought to be made for testing for each chose age. Cylinders are taken out from water before 4 to 5 hours of testing. On account of chambers the specimen ought to be set in the machine in such a way that the heap is applied on the outside of the chamber, (for beam along the length of the chamber) consistently load is applied at the pace of around 140Kg/cm2/min. until the opposition of the specimen to the expanding load separates and no more prominent burden can be maintained.

Figure 3. Specimen behaviour before and after the failure in Split Tensile Test

The deliberate split tensile strength of the cylinder is determined by isolating the multiple times of the heap during the test by the surface region, determined from the mean elements of the part.
| Cube No | Silica Fume (%) | Conplast (%) | 28 Days Split Tensile Strength (N/mm²) | Average Split Tensile Strength |
|---------|----------------|-------------|--------------------------------------|------------------------------|
| 1       | 3              | 1.5         | 9.5                                  | 9.5                          |
| 2       | 5              | 2           | 8.5                                  | 8.55                         |
| 3       | 7              | 3           | 8                                    | 8                            |
| 4       | 9              | 4           | 6                                    | 6                            |

**Figure 4.** Variation of Split Tensile Strength for different proportions of Silica and Conplast

### 4.3 Flexural Strength Test

The bearing surfaces of the supporting and stacking rollers will be cleared off, and any free sand or other material are killed from the surfaces of the Beam Specimen, where they are to interface with the rollers, the Beam Specimen will then be placed in the machine so that the load will be applied to the most noteworthy surface as cast in the shape, along two lines isolated 20.0 or 13.3cm isolated. The rotate of the Beam Specimen will be carefully agreed with the centre point of the stacking contraption. No squeezing will be used between the bearing surfaces of the Beam Specimen and the rollers. The store will be applied without paralyze and extending incessantly at a rate so much that the cut-off fiber stress increases at around 7Kg/cm2/min, that is, at a speed of stacking of 400Kg/min for the 15.0cm pillars and at a speed of 180Kg/min for the 10.0cm shafts. The pile will be extended until the shaft misses the mark, and the best weight applied to the bar during the test will be recorded.
Figure 5. Variation of Flexural Strength for different proportions of Silica and Conplast

Table 4. Variation of flexural strength for 28days duration

| Beam No | Silica Fume (%) | Super Plasticizer | 28 Days Flexural Strength |
|---------|----------------|-------------------|--------------------------|
| 1       | 3              | 1.5               | 8.4                      |
| 2       | 5              | 2                 | 7.5                      |
| 3       | 7              | 3                 | 6.9                      |
| 4       | 9              | 4                 | 5.7                      |

Figure 6. Specimen behaviour before and after the failure in flexure
5. Conclusions

- By keeping up the w/c proportion as 0.25, the 28 day strength of the concrete is accomplished as 150.9 N/mm^2 at 8% of silica fume and 3% of conplast.
- A notable increase in strength of the concrete can be achieved by reducing the w/c ratio & increasing the proportion of silica fume.
- By keeping up the w/c proportion as 0.25, the 28 day Compressive strength, flexural strength and elasticity of cement at 3% of silica fume and 1.5% of conplast have been accomplished as 163.33 N/mm^2, 8.4 N/mm^2& 9.5 N/mm^2 separately.

The current age of concrete based materials gives a conservative choice to supplant a few elective materials as of now being used. Albeit a few activities have been done to show the handiness of these materials, research is as yet expected to refresh ebb and flow code prerequisites, quality confirmation strategies and configuration cycles to securely use these new materials to their definitive potential. We are making a point that the setting time ought to be expanded for Ultra Strength Concrete than that for Common cement to have a Sound look and more Strength.

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