Experimental Investigation on Geo Polymer Concrete Cubes with Ambient and Sunlight Curing

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Abstract. Geo polymer concrete is an imaginative advanced material that also is delivered by thoroughly supplanting PC. This investigation assists with recognizing based of utilizing steel in Geo polymer concrete. The Steel slag is utilized at various rates. The basic answer for fly-ash is blended in with proportion. The projected 3D shapes were relieved in surrounding and daylight restoring. The 3D square examples were tried at 7,14, and 28 days. The compressive strong was analyzed in two unique mechanisms of restoring for various levels of expansion of steel slag in cement. The ends are drawn, and results acquired better compressive strength by the expansion of steel slag also that the daylight is restoring increments compressive strength of cement contrasted with surrounding relieving.

Keywords: geo polymer, concrete cubes, steel slag, fly ash, aggregate

1. Introduction
Concrete is the extreme comprehensively used design quantifiable in the [1], world’s next water for of its adaptable applications. The fundamental element of cement is Portland concrete (PC), which isn't viewed as harmless to the ecosystem material. The key response engaged with PC production is the breakdown of calcium oxide and carbon dioxide (CO2). The creation of PC not just uses up a [2] lot of energy yet, also produces a generous measure of CO2 and other greenhouse gases.

Geo polymer concrete is a dissolvable base begun folio passed on by a polymeric response of fundamental fluids with the silicon in addition the aluminum oxides in source things of [3] land initiation like metakaolinite or by thing materials example, fly trash alsorice’s husk debris. Their front doesn't simply help with making less CO2 than PC. Yet [4] what's more, it reuses current waste or possibly by consequences of alumina silicate synthesis to convey added regard advancement material things.

Targets and degrees:
• The discharge of CO2 gases in the climate makes more an Earth-wide temperature boost impact all together dodge [5], that impacts geopolymer concrete is utilized.
• The measure of solidarity accomplished is the same as the strength of traditional cement.
• The measure of cost is additionally less affordable when contrasted with ordinary cement.
• As geopolymer concrete is done from vegetable squanders, the [6] measure of CO2 emanation is substantially more decreased somewhat.

2. Methodology
The properties of various raw materials as shown in figure 1, utilized to be specific fly ash, coarse aggregate, fine aggregate, soluble arrangement, steel slag are considered. Strainer investigation was
accomplished for sand [7], coarse total to test their appropriateness for use in concrete as coarse and fine aggregates. The particular gravity of materials was likewise discovered [8]. The alkaline solution assumes a significant part in the blending of cement. The particular gravity and Ph estimation of soluble arrangement was discovered. The various oxides and its percentage are shown in table 1.

Table 1: Oxides and its percentage

| Oxides | Percentage |
|--------|------------|
| SiO2   | 52.0       |
| Al2O3  | 33.9       |
| Fe2O3  | 4.0        |
| CaO    | 1.2        |
| K2O    | 0.83       |
| Na2O   | 0.27       |
| MgO    | 0.81       |
| SO3    | 0.28       |
| LOI    | 6.23       |
| SiO2 / Al2O3 | 1.5 |

Figure 1: Various raw materials

Fly Ash:
There are two sorts of fly ash accessible. They are class F fly debris, and class C [9], fly ash in these investigation class F fly debris taken from Neyveli utilized in cement. The compound arrangement of fly debris was organized.

Steel Slag:
The Steel slag could regularly be gained after processors who assemble the steel slag from steel-making workplaces. Slag processors may deal with an assortment of materials, for [10] example, steel slag, scoop slag, pit slag, and utilized unmanageable material to recuperate steel metallics. These materials should be source isolated and all around characterized dealing with rehearses should be set up to stay away from tainting the steel slag total. The slag processor should likewise know about the overall total prerequisites of the end client.

Fine aggregate:
The degree of fine totals influences the usefulness and finish capacity of cement [11]. In the current investigation, locally accessible waterway sand was utilized. A sifter investigation of sand was given in the table 2. The weight of sample taken is 2kg. The observations from the Pycnometer test results are shown in table 3.
Table 2: Investigation of sand

| Sieve size (mm) | Weight retained (gms) | % of weight retained | Cumulative weight retained (gms) | Cumulative % retained | % of passing |
|-----------------|-----------------------|----------------------|---------------------------------|----------------------|--------------|
| 4.75            | 0                     | 0                    | 0                               | 0                    | 100          |
| 2.36            | 42.5                  | 2.13                 | 42.5                            | 2.13                 | 97.87        |
| 1.18            | 153                   | 7.65                 | 195.5                           | 9.78                 | 90.22        |
| 0.60            | 585                   | 29.25                | 780.5                           | 39.03                | 60.97        |
| 0.425           | 663.5                 | 33.18                | 1444.0                          | 72.20                | 27.80        |
| 0.30            | 0                     | 0                    | 1444.0                          | 72.20                | 27.80        |
| 0.15            | 350.5                 | 17.53                | 1794.5                          | 89.73                | 10.27        |
| 0.090           | 164.5                 | 8.23                 | 1959                            | 97.75                | 2.05         |
| 0.075           | 10                    | 0.5                  | 1969                            | 98.45                | 1.55         |
| Pan             | 8                     | 0.40                 | 1977                            | 98.85                | 1.15         |

Fineness modulus of fine aggregate = Sum of cumulative % retained /100 = 600.15 /100 = 6.00

Table 3: Explicit gravity of fine aggregate (Pycnometer test)

| Sl.No | Observations                  | Readings |
|-------|--------------------------------|----------|
| 1.    | The empty weight of the pycnometer (W1) | 629      |
| 2.    | Pycnometer + sand (W2)          | 829      |
| 3.    | Pycnometer+ sand+water(W3)      | 1779.5   |
| 4.    | Pycnometer+water (W4)           | 1660.5   |

The specific gravity of fine grains = ((W2-W1)/(W4-W1)) – ((W3-W2)) = 2.469

Coarse aggregate:
In this investigation, locally accessible coarse totals were utilized. The sifter [12] investigation results were given in the table 4, and filter examination and explicit gravity of coarse total were given in the table 5 individually.

Weight of sample taken = 2kg
Size of the coarse aggregate = 20mm

Table 4: Investigation with locally accessible coarse

| Sieve size (mm) | Weight retained(gms) | % of weight retained | The cumulative weight of retained (gms) | Cumulative % retained | % of passing |
|-----------------|----------------------|----------------------|----------------------------------------|----------------------|--------------|
| 25              | 0                    | 0                    | 0                                      | 0                    | 0            |
| 20              | 662.5                | 33.13                | 662.5                                  | 33.13                | 66.8         |
| 12.5            | 1308.5               | 65.43                | 1971                                   | 98.5                 | 1.4          |
| 10              | 28.5                 | 1.43                 | 1999.5                                 | 99.98                | 0.02         |
| 6.3             | 0                    | 0                    | 0                                      | 0                    | 0            |
| 4.75            | 0                    | 0                    | 0                                      | 0                    | 0            |
| Pan             | 0                    | 0                    | 0                                      | 0                    | 0            |

Fineness modulus of coarse aggregate = sum of cumulative % retained / 100 = 2.32
Table 5: The detailed gravity of coarse aggregate ( pycnometer test)

| Sl.no | Observations                              | Weight (gms) |
|-------|-------------------------------------------|--------------|
| 1.    | The empty weight of the pycnometer (W1)   | 700          |
| 2.    | Sand0+Pycnometer (W2)                     | 920          |
| 3.    | Water(W3)+ sand +Pycnometer              | 1540.5       |
| 4.    | Pycnometer + water (W4)                   | 1220.5       |

The specific gravity of coarse aggregate = \((W2-W1)/(W4-W1)\) = 5.345

Alkaline solution: Sodium hydroxide:
It’s a solid base, a composite that parts segregated in water to made [13], different hydroxide (OH-) particles. Right when disintegrated in sodium hydroxide, water has a high pH also feels dangerous. Everything considered sodium hydroxide is utmost dangerous when it is isolated in water. It is essential in our lives since it has no different occupations. The synthetic organization of NaOH is given underneath the table 6.

Table 6: Various constituents and its percentage

| Constituents | Percentage |
|--------------|------------|
| Na2CO3       | 2          |
| Cl           | 0.01       |
| SO4          | 0.05       |
| Pb           | 0.001      |
| Fe           | 0.001      |
| K            | 0.1        |
| SiO2         | 0.05       |
| Zn           | 0.02       |

3. Sodium silicate:
The most part is known as water glass, or liquid is outstanding a direct result of complete business and mechanical application. The unadulterated plans are dull or white. Until now [14], business tests are regularly greenish otherwise blue inferable from the presence of iron comprising defilements. It is, for the most part, made by utilizing a response in the fluid stage or the strong stage. The manufactured synthesis of sodium silicate plan given by the creator is according to the accompanying: 14.7% of Na2O,29.4% OF SiO2 too 55.9% of water by mass.- (W3-W2). Table 6 shows the mix proportions.

Table 6: Mix proportions

| Mix id | Fly ash (kg) | Fine aggregate (kg) | Coarse aggregate (kg) | Alkaline solution (kg) | Steel slag (kg) |
|--------|--------------|---------------------|-----------------------|------------------------|----------------|
| GPC1   | 408          | 530.4               | 1142.5                | 163                    | 0              |
| GPC2   | 408          | 530.4               | 1142.5                | 163                    | 2.04           |
| GPC3   | 408          | 530.4               | 1142.5                | 163                    | 3.06           |
| GPC4   | 408          | 530.4               | 1142.5                | 163                    | 4.08           |
| GPC5   | 408          | 530.4               | 1142.5                | 163                    | 5.12           |

Where,
GPC1- Geopolymer concrete by 2 % steel slag
GPC2- Geopolymer concrete by 2.5 % steel slag
GPC3 – Geopolymer concrete by 3 % steel slag
GPC4 – Geopolymer concrete by 3.5 % steel slag
GPC5 – Geopolymer concrete by 4 % steel slag
4. Experimental Program
There are two experimental programs conducted on this project which are explained in figure 2 and figure 3. They are [15] plain geopolymer concrete and geopolymer concrete with steel slag.

![Figure 2: Experimental program 1 (plain geopolymer concrete)](image1)

![Figure 3: Experimental program 2 (Geopolymer concrete with steel slag)](image2)

In the present study, a slump test was performed for the experimental investigation of the new concrete's workability. In the hardened concrete, the compressive strength of concrete was investigated to find out the fly ash in concrete instead of cement and the outcome of steel slag in geopolymer concrete.

5. Discussion
New Geopolymer concrete blends were discovered to be profoundly gooey and durable with low to high droop. The usefulness of the geopolymer solid reductions with increment in the evaluation of cement. The proportion of soluble arrangement builds the droop estee in any evaluation of GPC. Furthermore, this is because there will be more measure of sodium silicate arrangement, and the water present in the fly debris will be delivered into the combination during the blending. An expansion in sodium silicate fixation in this way decreases the progression of GPC.
6. Summary
In the current examination, coal burning of fly debris in cement has satisfied the greater part of the targets of the exploration works. The underneath is the end dependent on the examination. The Steel is utilized as a break arrester in cement. Breaking of cement is an irregular cycle, profoundly factor and affected in numerous components. Be that as it may, one cycle is protected. The more extended the break, the higher the pressure concentrations actuated by it. Because of a break in construction, the design’s strength will diminish dynamically with the expansion of the break size. As a outcome, the design will be dependent upon disappointment when its strength turns out to be low to the point that break happens under ordinary stacking. Therefore, breaks in solid constructions ought not to be underestimated, however, on the contrary. They should be forestalled, which can be satisfied by the steel.

7. Conclusion
In light of the exploratory examination did, the accompanying ends are drawn.
• There is an expansion in the solid functionality with an increment in a basic answer for fly debris proportion. It tends to be seen that the level of functionality is medium for the proportion of 0.4 medium. It is reasonable for ordinary fortified put with vibrations.
• Geopolymer cubes improve the strength of customary cement. So fly debris can be utilized rather than concrete in cement.
• By looking at the expense of geopolymer concrete with customary concrete, there is no huge contrast since the cost of fly debris is extremely less.
• The dissolvable arrangement contains sodium hydroxide. What's more, sodium silicate which updates the polymerization in the geopolymer concrete.
• Geopolymer solid gins around 75% of the compressive strength.
• An expansion in the solid's strength expanded particularly at 0.5% of steel slag later that it was diminished.
• The compressive strong of the solid square block shapes in daylight relieving is high compared to surrounding restoring. Daylight relieving is essentially conceivable. So there is no issue with daylight relief.

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