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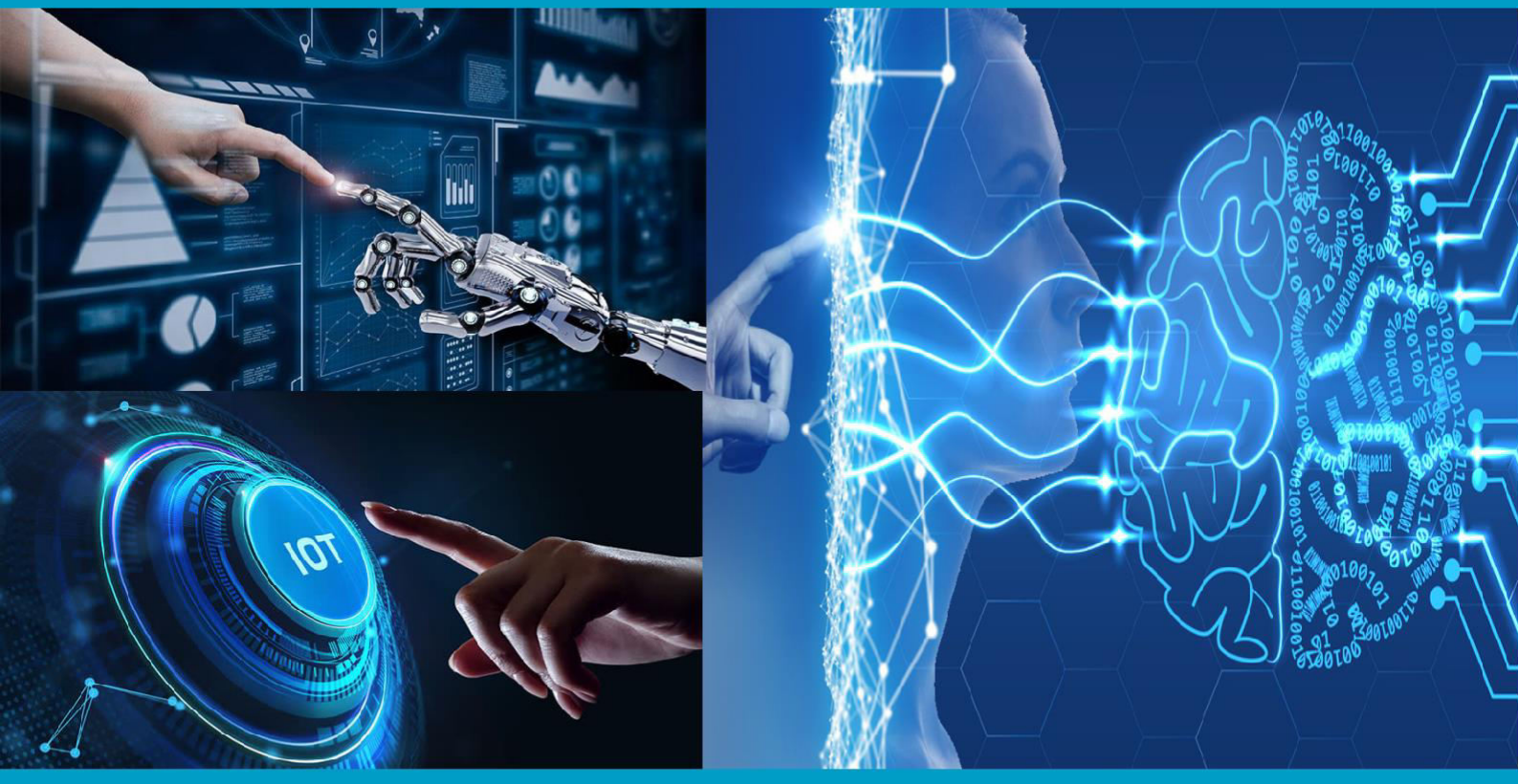


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# Production of Geopolymer Concrete Blocks

**Mr. Jangonda D.A., Mr. Ghatge S.A., Narayankar R.S, Patil S.K, Pathan T.I, Shitole P.P**

H.O.D, Department of Civil Engineering, Shree Vatavruksha Swami Maharaj Devasthan's Kai. Kalyanrao (Balasaheb) Ingale Polytechnic College, Akkalkot, India

Lecturer, Department of Civil Engineering, Shree Vatavruksha Swami Maharaj Devasthan's Kai. Kalyanrao (Balasaheb) Ingale Polytechnic College, Akkalkot, India

Diploma Student, Department of Civil Engineering, Shree Vatavruksha Swami Maharaj Devasthan's Kai. Kalyanrao (Balasaheb) Ingale Polytechnic College, Akkalkot, India

**Abstract:** Geopolymer concrete blocks are an innovative and sustainable alternative to traditional concrete blocks. They are made by combining an alkaline solution with industrial by-products like fly ash or slag, eliminating the need for cement. Geopolymer concrete blocks exhibit high strength, durability, and resistance to environmental factors and chemical attacks. They have a reduced carbon footprint, as their production emits less CO2 compared to conventional concrete. Geopolymer concrete blocks have diverse applications in construction and infrastructure projects. Ongoing research aims to optimize their properties and expand their usage.

## I. INTRODUCTION

The name geopolymer was given by "Joseph Davidovits" in 1978. Geopolymer concrete (GPC) is an eco friendly product which uses industrial waste by-products such as fly ash (waste from thermal power plants) and ground granulated Blast Furnace Slag (waste from Iron production) as complete replacement for cement in concrete. As a result of this geopolymer concrete reduces CO2 emissions by 80%. Geopolymer is gaining importance and acceptance as it ensures sustainability. Fly ash and GGBS are rich sources of silicon and aluminium which are polymerized by alkali activating solution to form molecular chains and networks to create hardened binder

Ordinary Portland Cement, results from the calcination of limestone (calcium carbonate) at very high temperatures of about 1450-1500°C, and silico-aluminous material as given in the equation below.

$5CaCO3 + 2SiO2 \longrightarrow (3CaO,SiO2) + (2CaO,SiO2) + 5CO2$

Which means that, production of every 1 metric tonne of cement generates 1 metric tonne of CO2.With increasing consumption of cement, the world's atmosphere gets destroyed. Cement industry is one of the worst source of atmospheric pollution than any other industry. Thus the necessity for an alternative material arose and soon Geopolymer emerged as an alternative material which is eco friendly with reduced carbon dioxide emissions.

- NECESSITY OF GEOPOLYMER CONCRETE

Construction is one of the fast growing fields worldwide. As per the present world statistics, every year around 260,00,00,000 Tons of Cement is required. This quantity will be increased by 25% within a span of another 10 years. Since the Lime stone is the main source material for the ordinary Portland cement an acute shortage of limestone may come after 25 to 50 years. More over while producing one ton of cement, approximately one ton of carbon di oxide will be emitted to the atmosphere, which is a major threat for the environment. In addition to the above huge quantity of energy is also required for the production of cement

atmosphere. The Thermal Industry produces a waste called flyash which is simply dumped on the earth, occupies larges areas. The waste water from the Chemical Industries is discharged into the ground which contaminates ground water. By producing Geopolymer Concrete all the above mentioned issues shall be solved by rearranging them. Waste Fly Ash from Thermal Industry + Waste water from Chemical Refineries = Geo polymer concrete. Since Geopolymer concrete doesn't use any cement, the production of cement shall be reduced and hence the pollution of atmosphere by the emission of carbon di oxide shall also be minimized.

## II. LITERATURE SURVEY

Portland cement is universally accepted binder in concrete. The manufacturing of one ton cement liberates around one ton of CO2 to the atmosphere due to the calcinations of lime stone and combustion of fossil fuel. The production of

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cement is highly energy intensive and it consumes a substantial amount of natural resources. Geopolymer is found to be an excellent alternative construction material to the concrete produced using OPC. Davidovits (1978) proposed that binders can be produced by polymeric reaction of alkaline liquid with alumino-silicate materials such as fly ash, blast furnace slag, rice husk ash etc. Geopolymer also has the ability to form a strong chemical bond with rock based aggregates. This paper reviews the several studies on geopolymer concrete, its strength, durability and various aspects for being an environmental friendly concrete. The test results demonstrate the geopolymer concrete to be a material of choice for the future.

Alternative replacement material cement as a binder in concrete that is currently developed is the geopolymer material. Geopolymer is the result of the polymerization process material that contains silica (Si) and aluminum (Al) derived from natural materials, agricultural waste or industrial waste. Material results of agricultural wastes that can be used as precursors include rice husk ash, bagasse ash and palm oil fuel ash. Agricultural waste materials eligible to be processed into the material forming geopolymer. Chemical compounds criteria based on testing X-Ray Fluorescence (XRF) and refer to ASTM C 618 is known that industrial waste materials are feasible to be developed as a precursor. Criteria for the mechanical properties of materials such as mortar compressive strength testing also showed good results, geopolymer using 100% bagasse ash can also achieve the compressive strength of mortar at 18.34 MPa. For materials rice husk ash and palm oil fuel ash is only used by 50% and mixed with 50% fly ash, compressive strength results showed with rice husk ash of 21.50 MPa and palm oil fuel ash of 20.70 MPa.

Large amount of carbon-dioxide emission takes place due to the increase in the production of cement. This results into greenhouse effect. In order to overcome this problem, many researchers have done experiments to find out Solution which is known as a Geopolymer concrete. Self Compacting Geopolymer Concrete (SCGC) is a type of concreting execution and it does not require compaction. It is made by complete elimination of ordinary Portland cement content. SCGC needs more amount of fine aggregate than coarse aggregate compared to control mix. Geopolymer concrete were synthesized from fly ash, activated by combination of alkaline solution(sodium hydroxide and sodium silicate or potassium hydroxide and potassium silicate)

Concrete is the world most consumed construction material. Since it is more versatile, durable and reliable. Due to increase of infrastructure the demand of concrete has increased vastly. There are many ways to reduce environment pollution mainly carbon dioxide (CO2) which is produced by the production of portland cement. One of the best ways is to reduce the production of cement, geopolymer concrete is a kind in which cement is totally replaced by pozzolanic material that is rich in silicon and aluminium like flyash. Flyash is a by-product of coal obtained from the thermal power plant and is available in bulk quantities world wide. It is rich in silica and alumina on reacting with alkaline solution produce alumino silicate gel that act as binding material for concrete. Research is shifting from the chemistry domain to engineering applications and commercial production of geopolymer concrete. This paper briefly reviews the proportions & behaviour of Geopolymer concrete.

## III. PROBLEM DEFINITION

Geopolymer Concrete is one of the excellent materials used in the construction industry, and it is used worldwide. The main importance of geopolymer Concrete is to reuse waste materials. The concrete can be obtained from waste materials. It also gives better results than conventional concrete. The main important factor for using this type of concrete is to eliminate carbon emissions from the environment, decrease the carbon content from the environment, decrease carbon footprint, and increase structural strength and durability. Most importantly, to make the structure sustainable. It has high strength compared to conventional concrete and low creep and shrinkage.

This project evaluates the potential for manufacturing of environment friendly concrete block for SVSMD'S polytechnic college's parking area. The parking area measurement were took. By this measurement rate analysis for fixings the geo- polymer concrete block was done. Cost of material and cost of labour were also estimated.

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✓ KEY POINTS OF THE PROJECT

- Importance of geopolymer concrete and objectives & methodologies for geopolymer concrete.
- The material collection of geopolymer concrete and various tests on geopolymer concrete
- The background of geopolymer concrete and its mechanical properties.
- The alternative material for cement and also explained the importance of geopolymer concrete. The materials used for geopolymer concrete and parameters required for geopolymerization and The strength tests on geopolymer concrete.
- The problems of Co2 emissions in the environment and the reasons for using geopolymer concrete in the construction industry.

## IV. METHODOLOGY

❖ **Collection of materials:-**

The materials which we used for this project were sponsored. Choose a source material rich in silica and alumina, such as fly ash, slag, or metakaolin. These materials will serve as the primary ingredients for the geopolymer binder.

❖ **Batching of materials:**

Batching is the process in which the quantity or proportion of materials like cement, aggregates, water, etc. are measured on the basis of either weigh or volume to prepare the concrete mix. Proper Batching improves the workability of concrete by reducing the segregation or bleeding in concrete.

❖ **Mixing of materials:**

In a mixing container, combine the source material with an alkaline solution. The alkaline solution typically consists of a combination of sodium hydroxide (NaOH) and sodium silicate (Na2SiO3). The ratio of source material to alkaline solution may vary depending on the specific recipe.

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❖ **Moulding**:

Pour the geopolymer mixture into the desired moulds or formwork. Ensure that the moulds are properly prepared and cleaned beforehand.

❖ **Curing:**

Allow the geopolymer concrete blocks to cure in a controlled environment for a specific period of time. This curing process helps the geopolymer binder gain strength and durability. The curing time can vary depending on factors such as temperature and the specific geopolymer recipe used.

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❖ **Demoulding:**

Once the curing period is complete, carefully remove the moulds or formwork from the geopolymer concrete blocks. Take caution to prevent any damage to the freshly cured blocks.

❖ **Testing:**

Hence we conducted compressive strength test of the Geo polymer concrete block.

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## V. RESULTS

| Mix Designation | Compressive Strength 7 days in N/mm² | Compressive Strength 7 days in N/mm² |
|---|---|---|
| **GGBS** | 68.84 | 163.48 |
| **GGBS** | 61.96 | 157.53 |
| **Normal Concrete** | 52.63 | 142.45 |

## VI. CONCLUSION

i. Geopolymer concrete blocks use a geopolymer binder instead of traditional Portland cement, resulting in reduced carbon emissions and a more eco-friendly construction material.
ii. Geopolymer concrete blocks offer comparable or even superior strength and durability compared to traditional concrete blocks. They can withstand heavy loads and have excellent resistance to fire and chemical attacks.
iii. By utilizing industrial by-products like fly ash or slag as source materials, geopolymer concrete blocks help reduce waste and promote the efficient use of resources.
iv. The production process of geopolymer concrete blocks requires lower energy consumption compared to the production of traditional concrete blocks, further contributing to sustainability.
v. Geopolymer concrete blocks are less prone to alkali-silica reaction, a chemical reaction that can cause cracks and deterioration in traditional concrete structures.
vi. Geopolymer concrete blocks can be manufactured in various shapes and sizes, providing flexibility for different construction needs.
vii. Geopolymer concrete blocks have the potential for extended service life due to their durability and resistance to various environmental factors.

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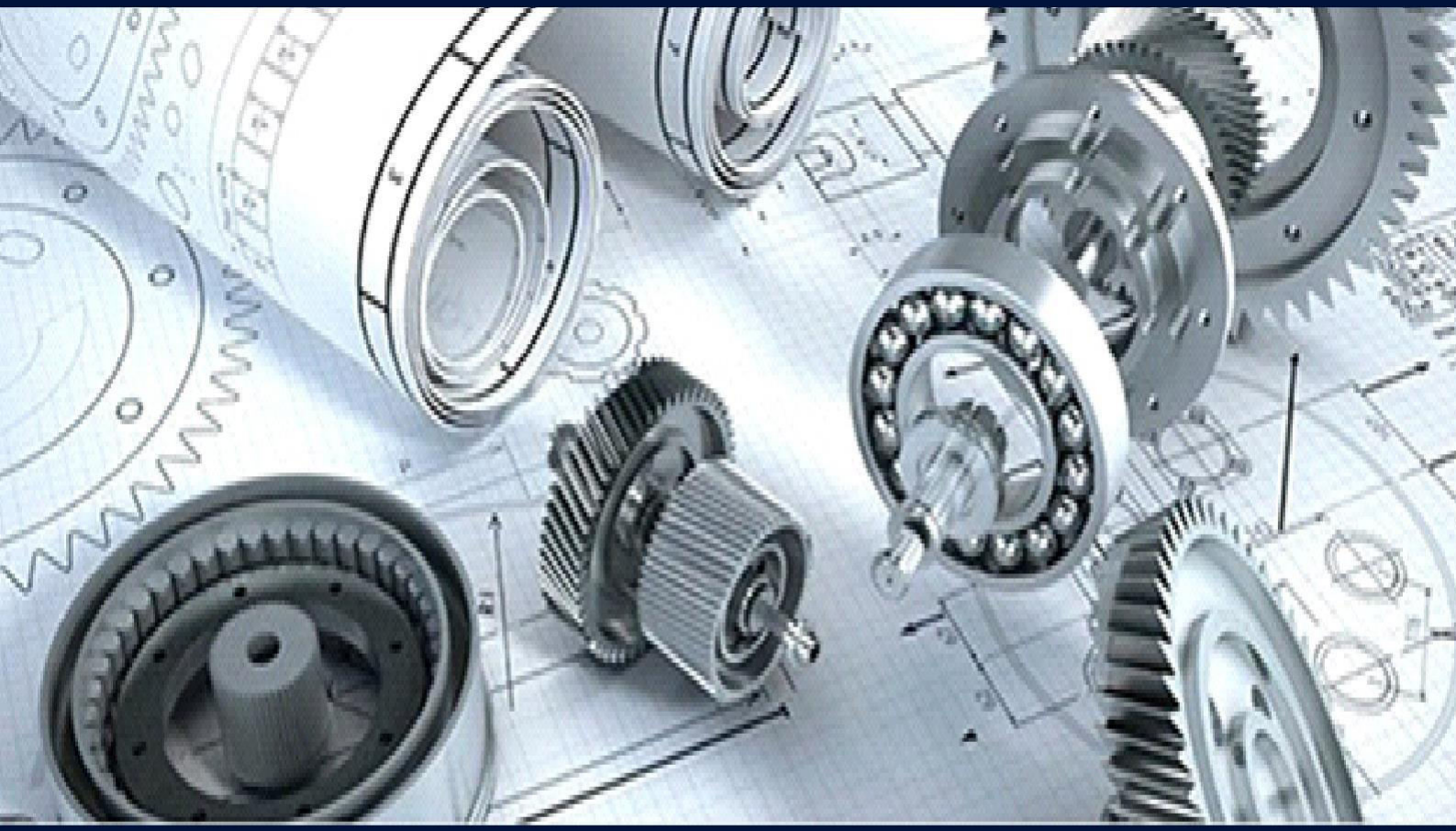

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