International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

"Study of Compressive Strength of Concrete without Cement"

Prof. Satish B. Aware[1] , Sonali Dhanraj Patil[2]

[1]*Professor, Civil Engineering Department, N.B. Navale Sinhgad College of Engineering, Solapur, India.*

[2]*Student, Civil Engineering Department, N.B. Navale Sinhgad College of Engineering, Solapur, India.*

Submitted: 15-04-2021 Revised: 28-04-2021 Accepted: 30-04-2021

ABSTRACT – Cement is the binding agent in concrete and mortar and thus becomes an important construction material. Because of its important and varied use in the rapidly growing construction industry and also its consumption trends in the world makes the production of cement very high. Manufacturing of cement is an energy intensive process and releases approximately equal amount of green house gases into the atmosphere ,which affects the earth's ecosystem. More efforts are being under taken to conserve energy by mean so fusage of industrial wastes or by-products, such as fly ash, silica fume, ground granulated blast furnace slag, rice etc., containing amorphous silica in its chemical composition, as mineral admixture for partial replacement of cement. Since the cement industry is one of the prime producers of carbon dioxide ,creating upto 7% of world wide man made emissions of this gas, it is necessary to find out complete replacement of cement in construction industry. Fly ash binder is an innovative construction material and a real eco - friendly alternative to conventional cement. Fly ash binder is a combination of alumina silicate as base material in alkaline solution. The alumina silicate is available in natural minerals as well as industrial by- products. Sodium silicate and hydroxide mixture forms the alkaline solution. The use of Fly ash binder in concrete can be a great alternative to cement in the construction industry, which will result in saving of energy, environmental protection and conversation of resources. The mix proportion of Fly ash of various grade substained based on the mix proportions given in ACI code with hundred percent replacement of cement by fly ash. The compressive strength will be increased.

Keywords – Fly ash Concrete, cement Replacement, sodium silicate, sodium hydroxide, fly ash concrete Procedure.

I. INTRODUCTION-

This present world is depends on concrete for construction of various infrastructural activities. Concrete is major part of any civil engineering work. The cements and aggregate are the most important constituents used in concrete. This lead to continuous and increasing demand of natural material used for their production. This increase in demand puts a lot of pressure on civil engineer to develop cost effective as well as eco-friendly structure. Ordinary Portland is conventionally used as the primary binder to produce concrete. But the amount of carbon dioxide released during the manufacture of OPC due to calcinations material of lime stone and combustion off ossilfuel is in the order of 600kg for every ton of OPC produced. In addition the extent of energy requires to produce OPC is only next to steel and aluminum. On the other hand, the abundant availability of fly ash world wide create opportunity to utilize (by product of burning coal, regarded as a waste material) assubstitute for OPC to manufacture concrete. Binder could be produced by polymeric reaction of alkali liquids with the silicon and the aluminum in the source material such as fly ash and rice husk ash and these binder are termed as Fly ash.

Fly ash material represent an innovative technology that is generating consideration interest in the construction industry, particularly in light of the ongoing emphasis on sustainability. Since portland cement is responsible for upward of 85% of the energy and 90 percent carbon dioxide attributed to atypical ready mixed concrete, the potential energy and carbon dioxide saving through the use of Fly ash can be considerable. Consequently, there is growing interest in Fly ash application in transportation infrastructure.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

Fig.1. Material used in fly ash Concrete.

II. MATERIAL DETAILS-

I) Sodium Silicate-

The Sodium Silicate solution is commercially available in different grades. It is also known as water glass. And it is in gel form. The sodium silicate solution that we have purchased in the liquid form.

Table 1. Physical and Chemical Properties of Sodium silicate:

Chemical Formula	$Na2OxSiO_2$
Na2O	15.9%
SiO_2	31.4%
H_2O	52.7%
Appearance	Liquid(gel)
Colour	Light yellow liquid (gel)

II) Sodium Hydroxide-

The sodium hydroxide was in the pallet sorflakes forms with 97% -98% puarity. It is in solid state. And it is white in colour. The cost of the product depends on the purity. The sodium hydroxide pallets were dissolved in water to make the solution with require concentration. The mass of NaOH solids in solutions varies depending upon the concentration of the solution. It is recommended that the NaOH solution should be made 24 hours before casting and should be used within 36 hours of mixing the pallets with water as after that is converted to semi-solid state.

Table 2. Chemical ingredients of sodium hydroxide :

Carbonate	2%
Chloride	0.01%

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

Sulphate	0.05%
Potassium	0.1%
Silicate	0.05%
Zinc	0.02%
Iron	0.002%

III) Fly Ash-

The quality of fly ash produced at NTPC's power stations is extremely good with respect to fineness. Fly ash is defined as finely divided residue that results from the combination of ground or powdered coal and that is transported by the flue gases from the combustion zone to the practical removal system. Fly ash is removed from the combustion gases by the dust collection system, either mechanically or by using electro static precipitators, before they are discharged to the atmosphere. Fly ash particles are typically spherical, finer than Portland cement and lime, ranging from less than 1µm to not more than 150µm. Fly ash was brought from NTPC solapur. It was brought in bulk quantity which having same physical and chemical properties. When we tested density of fly ash, it found that 980 Kg/m³.

Table 3. Chemical Composition of fly ash:

Chemical Composition	**Percentage**
CO_2	0.10%
SiO_2	55.80%
Al_2O_3	24.80%
Fe_2O_3	9.10%
K_2O	4.41%
CaO	2.46%
MgO	1.37%
Na_2O	0.21%
MNO	0.18%

IV) Water-

The water used for the proportion of all material. The water used for the preparation of the solutions was distilled water. The distillation of water was made in chemical laboratory of college and water was used only for the preparation of sodium hydroxide solution.

V) Coarse Aggregate-

Coarse aggregate are generally categorized as rock larger than a standard no. coarse aggregate are used in every construction projects which are roads, buildings etc. The coarse aggregates is used in a concrete mixture. Size of 20 mm is used for M20 grade of concreting.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

VI) Fine Aggregate (M- sand)-

M sand is the Manufacturing sand. It is nothing but artificial sand. It gives high compressive strength than natural sand. This sand is produced from hard granite stone by crushing. M sand differs from natural river sand in its physical and mineralogical properties. The size of M sand is less than 4.45 mm.

III. METHODOLOGY-

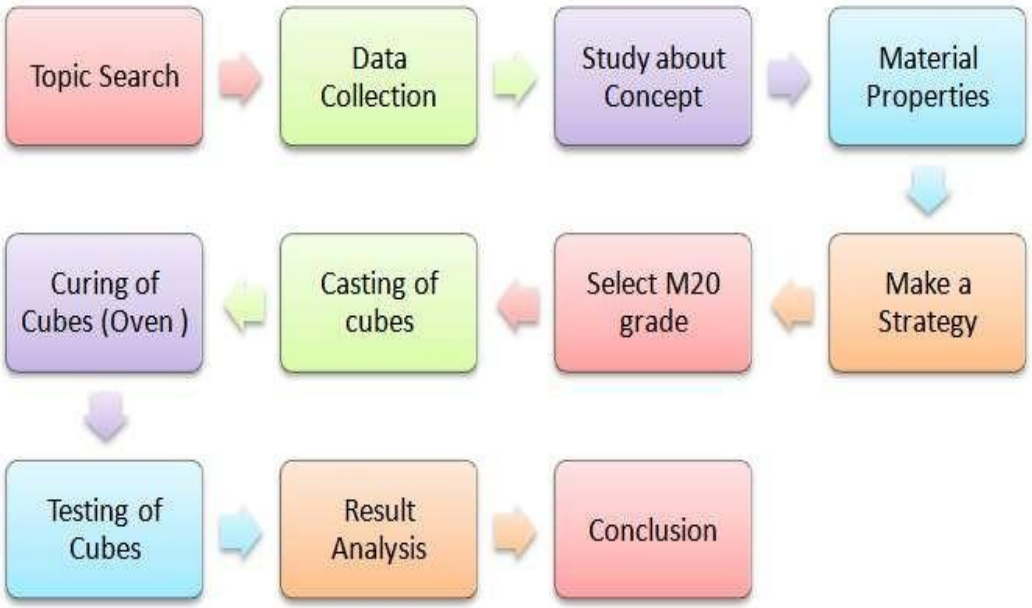


Fig.2 The complete Methodology of Research

The world of concrete is being continuously widening in major cities and also in village too. In this concrete world so many researchers have done in the name innovation. One of the main innovation is to replace in % or in total consumption for the reasons like reduce carbon emission in environment. After showing different papers, literature we decided to replace 100% cement in concrete by fly ash and chemicals namely Sodium silicate and sodium hydroxide. After showing its engineering properties. After that detailed study we've fixed to study about this concept and shows all material properties, and then make a proper strategy of work. Then we select M20 grade of concrete (1:1.5:3).and cast the four different proportion trails. And curing the all cubes in oven for 24 hrs. after that put at normal temperature for these particular curing time. (7 days , 14 days, 28 days) these all cubes tested under compression testing machine on the standard days. given by code provision. After that we discuss the result of all proportions and choose best result on that. And made conclusion.

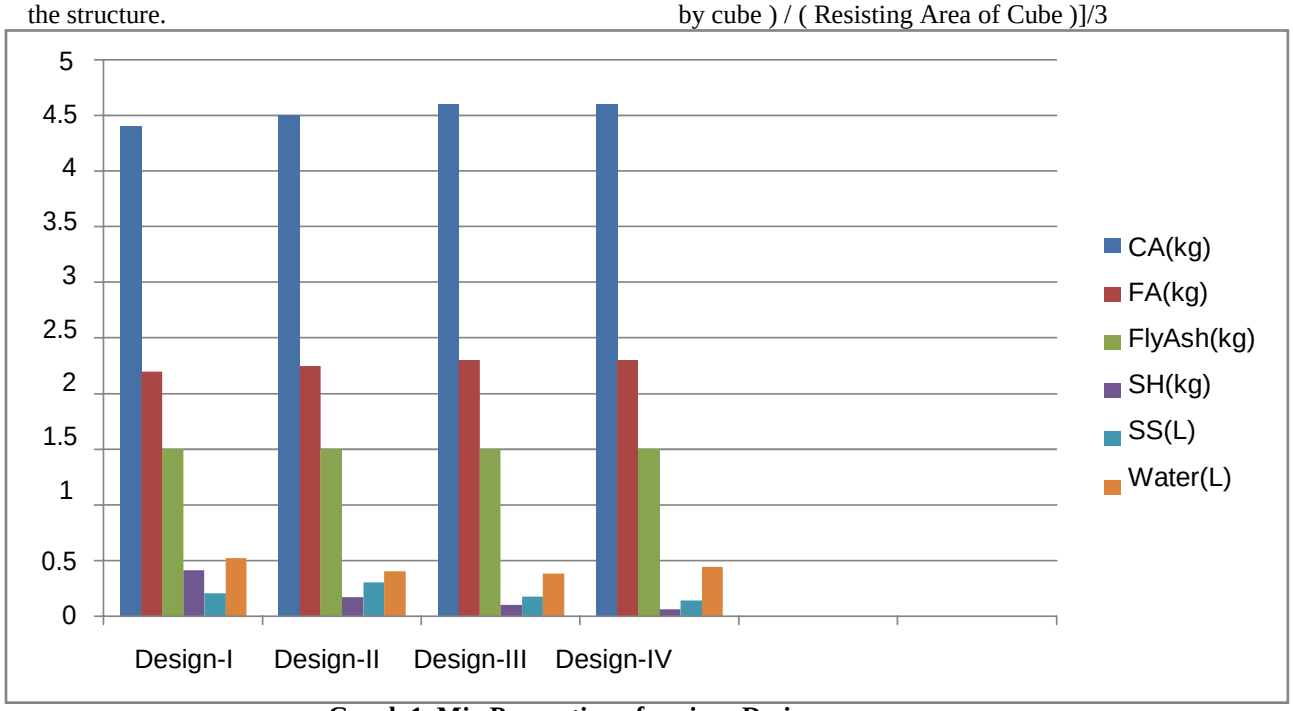
IV. PROCEDURE-

- Take 1st mix proportion of sample. And mixed it in Concrete mixer.
- Take cube size is (150mm X 150mm X 150mm) the volume of cube concrete is 0.003375 m^3.
- Pour concrete in the mould in 3 layers. Compact each layer 35 no. of strokes with the help of Tamping rod.
- After Compaction of last layer finishing the top surface of mould by using trowel.
- Put the mould in oven for 24 hours, with 90°C temperature. The remove the Specimen from the mould.
- While removing the cube from mould, take care to avoid breaking of edges.
- Code the cube with marker. It should be self record.
- Make a cube clean and wrapping thin metal sheet (Foil paper) and put it on Normal Temperature until the time of testing.
- Test the 3 cubes for 7 days, 3 cubes for 14 days and 3 cubes for 28 days.
- On the day of testing firstly weight of cube and Record the weight.
- Put the cube in testing machine and observed the failure and note the maximum load applied on cube.
- Take the average compressive strength of 3 cubes for each standard days. This represents

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

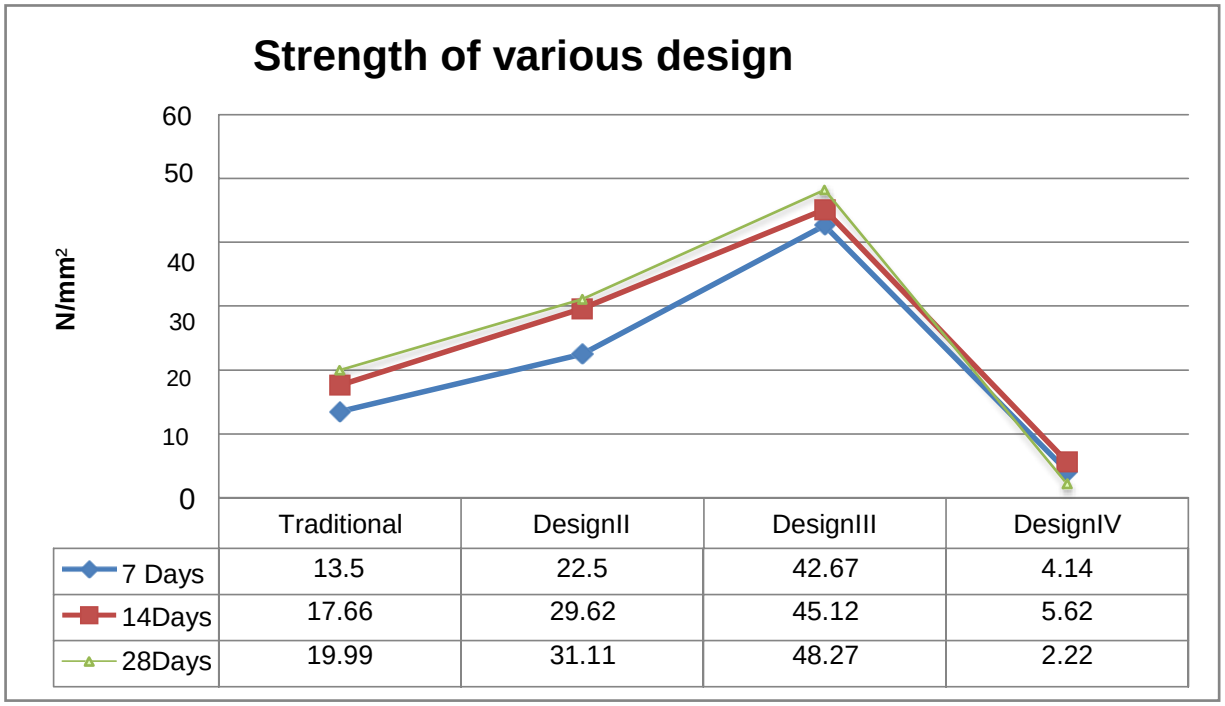
the strength of concrete of particular portion of the structure.

- Compressive Strength =[(Failure load taken by cube) / (Resisting Area of Cube)]/3



Graph 1. Mix Proportion of various Designs.

V. RESULT ANALYSIS-



	Traditional	DesignII	DesignIII	DesignIV
7 Days	13.5	22.5	42.67	4.14
14Days	17.66	29.62	45.12	5.62
28Days	19.99	31.11	48.27	2.22

Graph 2. Result representation.

Table No.4 . Compressive Strength shown by various Designs.

Days	Traditional (N/mm2)	Fly Ash Concrete (N/mm2)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 4 Apr. 2021, pp: 295-301 www.ijaem.net ISSN: 2395-5252

		Design 1	Design 2	Design 3	Design 4
7 Days	**13.20**	**Fail**	**22.5**	**42.67**	**4.14**
14 Days	**17.34**	**Fail**	**29.62**	**45.12**	**5.62**
28 Days	**19.99**	**Fail**	**31.11**	**48.27**	**2.22**

Fig.3. Compressive Strength reading of Design III

VI. CONCLUSION-

After Carrying out the study, test and by comparing its results following conclusion can be made.

- ✓ The Compressive strength of fly ash concrete is more than conventional Concrete.
- ✓ The compressive strength of fly ash concrete is directly Proportional to curing temperature up to certain limit. The 90° C there will be effective result in increasing strength of concrete.
- ✓ It is also found economical than that of Conventional Concrete in aspects of material price.
- ✓ By using Chemicals, it is found that there is increase in strength with increasing curing period as compared to ordinary Portland cement.

REFERANCES :

[1]. J. K. Dattatreya [2011] Geopolymer Chemistry and Applications. Institute Géopolymère, Saint-Quentin, France.

[2]. Rangan ,B.V.."Low-Calcium, Fly-Ash-Based Geopolymer Concrete." Concrete Construction Engineering Hand book.

[3]. Aslani (2015); Thermal Performance Modeling of this Concrete, Journal of Materials in Civil Engineering

[4]. Shankar H Sanni (2012); Performance of Geopolymer Concreteunder severe environmental conditions, International Journal on Civil and Structural Engineering

[5]. Ramujee et al (2014), Development of Low Calcium Fly Ash Based Geopolymer Concrete, IACSIT International Journal of Engineering and Technology, Volume 6.

[6]. Sumajouw, M. D. J. & Rangan, B.V., "Low-Calcium Fly Ash-Based Geopolymer Concrete"

[7]. M. Mustafa Al. Bakri, Review on fly ash based geopolymer concrete without cement, Journal of Engineering and Technology Research, Vol. 3(1), pp. 1-4, January 2011

[8]. B. Singh, Geopolymer concrete: A review of some recent developments, Construction and Building Materials 85, 78–90, 2015 B. Jindal, Geopolymer Concrete – A review, April 2015
[9]. Y. Nagvekar, D. Aarekar, P. Dalal and V. Kudke, Comparative study of conventional and green concrete, Volume 5 Issue V, May 2017
[10]. M. I. Abdul, P. Arumairaj, Geopolymer Concrete – A review, User-friendly geopolymer concrete can be used under conditions International Journal of Engineering Sciences & Emerging Technologies, Feb 2012
[11]. S. Marathe, Mithanthaya, N. Bhavani, A Review on Strength and Durability Studies on Geopolymer Concrete, Vol. 5, Special Issue 9, May 2016
[12]. Bakharev T, "Thermal behavior of geopolymers prepared using class F fly ash and elevated temperature curing". Cement Concrete Res., 36: 1134-1147, 2006.
[13]. Bakharev T, Resistance of geopolymer materials to acid attack. Cement Concrete Res. 35: 658-670 2005
[14]. Chanh NV, Trung BD, Tuan DV, Recent research geopolymer concrete. The 3rd ACF International Conference –ACF/VCA 2008.
[15]. Kong DLY, Sanjayan JG, Damage behavior of geopolymer composites exposed to elevated temperature. Cement Concrete Compos. 30: 986-991, 2008.
[16]. Chindaprasirt P, Chareerat T, Siricicatnanon V (2007). Workability and strength of coarse high calcium fly ash geopolymer. Cement Concrete Composites. 29: 224-229.
[17]. Rangan B.V., "On the Development of Fly Ash Based Geopolymer Concrete", ACI Materials Journal, 2004
[18]. Rangan B.V., "Studies on Fly Ash-Based Geopolymer Concrete, Malaysian Construction Research Journal, Vol. 3, 2008
[19]. Davidovits J., "Geopolymer Chemistry and Applications", Institute Geopolymer, Saint-Quentin, France, 2008
[20]. Rangan, B. V., "Low-Calcium, Fly-Ash-Based Geopolymer Concrete", Concrete Construction Engineering Handbook.Taylor and Francis group, Boca Raton, FL,2008.