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"DEVELOPMENT OF INNOVATIVE PRECAST SLAB SYSTEMFOR RESIDENTIAL AND COMMERCIAL BUILDINGS"

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ABSTRACT

Precast concrete technology is a durable and versatile technology for construction. In this technology the different elements or panels of concrete are produced under strict quality control measures in state-of-the-art factories by highly trained personnel, with virtually no wastage. There are several types of precast concrete elements that are commonly used in construction, including beams, slabs, wall panels, stairs, column setc. Precast concrete slabs are concrete slabs that are cast and cured off- site, and then transported to their final location and installed. They are typically used in the construction of buildings and other structures, and offer several benefits over cast-inplace concrete slabs, including quicker construction time, improved quality, greater design flexibility, reduced waste and greater durability etc. Different precast slabs such as prestressed hollow core, bubble, U-Boot and waffle are compared to find out the most suitable and economical slab for the construction of residential and commercial buildings. These include parameters such as strength, durability, weight, sound, material, cost, time, etc. With the help of this technology in the construction of residential and commercial buildings the durability can be increased and cost as well as time can be saved. After the selection of the best slab system conforming to the Indian standards and Indian market prestressed hollow core slab is selected taking into consideration all the advantages and benefits economically as well as technically. Following this in order to reduce the carbon emissions caused by the use of cement in construction industry material such as GGBS and Fly Ash are used as partial replacements in order to design an eco friendly and sustainable concrete mix design. By following this methodology the carbon footprint produced by the construction industry as well as the use of expensive materials can be reduced and overall there cycling of waste materials can be performed in order to construct structures and buildings which in turn will reduce the pollution. After conducting various laboratory test on concrete and finding out the required mix design in order to gain and early demolding strength for the movement of elements from casting site to the stock yardprestressed hollow core slab is casted and then transferred to the site location and installed. This slab with infused materials of GGBS and Fly ash can help reduce the environment pollution and the carbon emissions leading to a drastic decrease in global warming.

INTRODUCTION

Precast construction refers to a construction process in which concrete elements are cast and cured offsite, and then transported to the construction site to be assembled into the final structure. These elements can include walls, floors, beams, and columns, as well as more complex structural components such as stairs, balconies, and partitions. Precast construction has several benefits, including faster construction times, improved quality control, and the ability to work in a controlled environment. It is often used in the construction of multi-story buildings, bridges, and other large structures. Prestressed concrete is a type of concrete in which high-strength steel cables, strands, or bars are used to apply internal compressive stresses to the concrete structure. The purpose of prestressing is to improve the load-bearing capacity of the concrete, allowing it to support greater loads without cracking or failing. This is achieved by first casting the concrete around the prestressing tendons, which are typically made of high-strength steel. The tendons are then tensioned using hydraulic jacks or other mechanical means, imparting a compressive stress to the concrete. Once the concrete has cured, the tendons are anchored to hold the compressive stress in place. Prestressed concrete is commonly used in the construction of bridges,buildings, and other structures where high strength and low weight are desired.

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Different precast slabs are compared to find out the most suitable and economical slabfor the construction of residential and commercial buildings. These includeparameters such as strength, durability, weight, sound, material, cost, time, etc. With the help of this technology in the construction of residential and commercialbuildings the durability can be increased and cost as well as time can be saved.Hollow core slabs are efficient precast structural elements as they combine thebenefits of prestressing and light self-weight. They have high mechanical concreteproperties as they are fabricated under controlled conditions in precast plants. They - 2 - are reinforced in the longitudinal direction only using prestressed strands. Therefore,the prestressed strands serve as the primary reinforcement and are installed and pulledprior to placing the concrete. Hollow core slabs are lightweight and have high spanto-depth ratios, making them ideal for long spans and reducing construction time. Thebest choice among various precast slab options will depend on the specific projectrequirements, including factors such as span, load capacity, insulation, acoustics, andaesthetics. However, if a balance between versatility, cost-effectiveness, and structural strengthis desired, hollow core slabs may be the best option. They offer a flexible andefficient design that can adapt to various requirements and load capacities, while alsoproviding long-term durability and resistance to fire and seismic events. Ultimately,the selection of the most suitable flooring system should be based on a thoroughevaluation of the project's needs and goals, along with a consideration of the availableoptions and their benefits and drawbacks. The infusion of GGBS and Fly Ash helps to mitigate the environmental impact ofcement production. Cement production is a major source of carbon dioxide emissions,contributing to climate change. By replacing a portion of cement with GGBS and FlyAsh, the carbon footprint of concrete is significantly reduced. This substitution alsohelps in conserving natural resources, as it utilizes industrial by-products that wouldotherwise be disposed of as waste.

Aim and Goal :

- To select the best slab system conforming to Indian construction sector based on various factors such as cost, time, compressive strength, durability etc.
- Replacement of cement by GGBS and Fly Ash to reduce the carbon footprint and promote an eco friendly and sustainable environment
- To test variations in design mix to find out the maximum compressive strength with infusion of GGBS and Fly ash
- Casting of pre stressed hollow core slab and installation at residential and commercial building sites

LITERATURE REVIEW

P. Karthigai Priya, M. Neamitha, Jan 2018, "A REVIEW ON PRECASTCONCRETE", International Research Journal of Engineering and Technology(IRJET).

Most of the construction activities in India take place by conventional cast in situ method of construction. But still there is a huge demand for housing in India. So the construction activity has to take place in a much faster way. This cannot be achieved by conventional method of construction. It can be done possible with precast concrete of construction. Moreover there are more advantages of precast concrete when compared with conventional one. So various literature are studied and a review of those all has been given in this paper.

VPS Nihar Nanyama, Riddha Basua, June 2017, "Implementation of Precast Technology in India Opportunities and Challenges", Department of Built Environment, Liverpool John Moores University.

Rapid economic growth and limited availability of affordable land have restricted the horizontal mode of construction leading to vertical construction in most of the Indian cities. Urban India is mostly marked by tall buildings that are being built. Indian construction industry is undergoing a paradigm shift from traditional methods of construction to modern methods of construction. Precast technology is one such move - 4 - which is expected to enhance the productivity of the construction process, there by,optimizing the requirement of resources on the site, reducing waste generation and resulting in a faster delivery of the projects. While internationally precast technology is considered as a mature technology, in India, it is not widely utilized, despite the advantages.

L. A. FEITOSA, E. C. ALVES, April 2015, "Study of global stability of tallbuildings with prestressed slabs" a Centro Tecnológico, Departamento

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deEngenharia Civil, Universidade Federal do Espírito Santo.

The use of prestressed concrete flat slabs in buildings has been increasing in recentyears in the Brazilian market. Since the implementation of tall and slender buildings atrend in civil engineering and architecture fields, arises from the use of prestressedslabs a difficulty in ensuring the overall stability of a building without beams. In orderto evaluate the efficiency of the main bracing systems used in this type of building,namely pillars in formed "U" in elevator shafts and stairs, and pillars in which thelengths are significantly larger than their widths, was elaborated a computationalmodels of fictional buildings, which were processed and analyzed using the software CAD/TQS.

Richard Oduro Asamoah, John Solomon Ankrah, Kofi Offei-Nyako, Ernest OseiTutu, Oct 2016, "Cost Analysis of Precast and Cast-in-Place ConcreteConstruction for Selected Public Buildings in Ghana", Council for Scientific andIndustrial Research, Building and Road Research Institute.

The construction industry in Ghana is becoming efficient in the area of cost andachieving advance technologies. The effective management of cost enables clients,developers, and facilitators to achieve value for money. Concrete is a majorcomponent in every construction project. The use of precast concrete technology hasbeen embraced by the construction industry in Ghana. This study seeks to analyzecost estimating of the structural frame (column and slab) by considering cast-in-placeand precast concrete slabs and columns, respectively.

METHODOLOGY

As per the methodology, firstly the Survey and Site visit were conducted. We havesurveyed various precast manufacturing units and factories around the city alongwith the process involved in production of different types of elements. With majorinterest towards casting of precast slabs we have studied the slab system adoptedaccording to Indian Standards.

After comparing several factors and different types of slab system, the slab withbest commercial and structural properties have been chosen for utilization inresidential and commercial complexes. Following the selection of pre stressedhollow core slab and with our main focus towards building a more eco friendly andsustainable environment we decided to introduce materials such as GGBS and FlyAsh in the design mix for concrete.

SURVEY

We have conducted a survey on mass manufacturing of precast elements in theIndian construction industry. Today, we can see that the Indian construction majorsare adopting precast concrete technology in building their latest projects. Precastconcrete technology is a durable and versatile technology for construction. Precasttechnology, also known as precast concrete construction or prefabricatedconstruction, refers to a method of construction where building elements aremanufactured in a controlled environment away from the construction site and thentransported to the

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site for assembly. In this approach, the concrete components arecast and cured in a factory or specialized precast plant using molds or form workunder strict quality control measures in factories by highly trained personnel, withvirtually no wastage. There are dedicated precast factories which serve produce formultiple construction projects as well as on-site precast factories which serve aparticular construction project. Now Indian leading companies in precast slabs.

Fig.1 Indian leading companies logos in precast slab production

The Precast Concrete Building Technology can be efficiently and effectively usedon various Affordable / Low cost Mass Housing Projects being planned by thepresent Government Policy "HAR GHAR YOJANA " OR "House for all by 2020".

Fig 2 Machines used in Mass Manufacturing Pre stressed Hollowcore Slabs

In the above images the machines do not require any manpower, the materials aredirectly added into the machine following the production of hollowcore slabs.

SITE VISIT

In order to understand the manufacturing process of precast elements we partnered upwith Preca solutions pvt ltd and visited their factory which is located at shankarpallinear Hyderabad. Along with this we were also able to visit different sites andlocations where construction was carried out using precast technology such as BirlaOpen mind schools located at Kollur and Sangareddy medical College. By visitingthese sites we were able to analyse how precast elements are erected and installed atsites as well as types of precast elements that can be casted and manufactured in theIndian construction market.

Fig 3 Govt.Medical College, Sangareddy

Fig 4 Birla Open minds Schools, Kollur

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Fig 5 PRECA Solutions India Pvt. Ltd. Factory, Shankarapally

Manufacturing Process of Precast Elements

The manufacturing process of precast elements in a factory involves several steps.Firstly, the materials such as cement, aggregates, reinforcements, and admixtures areprepared. Then, molds or form work are set up to give the desired shape anddimensions to the elements. Reinforcements are placed inside the molds, followed bythe pouring of the concrete mixture. After casting, the precast elements undergocuring to gain strength. Surface treatments and finishing are applied to achieve thedesired appearance. Strict quality control measures are implemented throughout theprocess

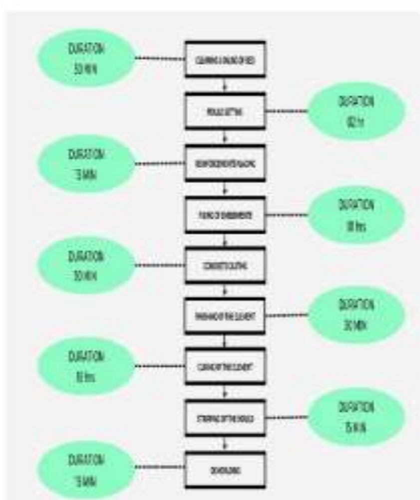

Fig 6 Manufacturing Process of Precast Elements

Table 1: Types of Precast Elements

Sr. No	Precast Components	Typical Sizes
1	Wall Panels	Sizes of panels may vary as per requirement of projects
2	Hollow Core Slabs	
3	Beams	
4	Staircase	
5	Columns	

Fig 7 Wall Panels

Fig 8 Parapet Beams

Fig 9 Staircase

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Fig 10 Hollow core slab

Fig 11 Pod Element

Selection of Slab System

The selection of a slab system in construction is a critical decision that affects the overall structural performance, functionality, and aesthetics of a building. Several factors need to be considered when choosing a slab system, such as the span and load requirements, architectural and design considerations, construction speed, cost efficiency, and long-term maintenance. Various slab systems are available in precast construction, including hollow core slabs, bubble deck slabs, U Boot slabs, waffleslabs etc. Each system has its advantages and limitations, and the selection depends on the specific project requirements and constraints depending on the Indian Standard codes. Structural engineers and architects carefully evaluate these factors to determine the most suitable slab system that can meet the project's needs while ensuring structural integrity, constructability, and desired performance.

Fig 12 Prestressed Hollow Core Slabs

Fig 13 Bubble Deck Slab

Fig 14 U-Boot Beton Slab

Fig 15 Waffle Slab

Waffle Slab :

These are also known as two-way joint slabs, are a type of reinforcedconcrete slab system that consists of a grid of closely spaced beams forming awaffle-like pattern. The beams intersect to create recessed voids or "waffles" in theslab, resulting in a lightweight yet structurally efficient system.

Table 2: COMPARISON OF FACTORS FOR SLABS

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PARAMETERS	HOLLOWCORE	BUBBLEDECK	U-BOOT BETON	WAFFLE
FIRE RESISTANCE	2-4 HOURS	1-2 HOURS	1-2 HOURS	2-4 HOURS
TIME	2-4 DAYS PER FLOOR	4-7 DAYS PER FLOOR	3-5 DAYS PER FLOOR	10-14 DAYS
COST	₹4500 - 8500	₹6000 - 12,000	₹4000 - 10,000	₹5000 - 10,000
STRENGTH	3000-6000 PSI 20.6-41.4 MPA	2500-3500 PSI 17.2-24.1 MPA	2500-4500 PSI 17.2-31 MPA	3000-5000 PSI 20.6-34.5 MPA
LIFESPAN	50-100+ YEARS	70-100+ YEARS	50-100+ YEARS	50-100+ YEARS
WEIGHT	146-195 KG PER M^2	342-391 KG PER M^2	439-488 KG PER M^2	585-634 KG PER M^2
SOUND RESISTANCE	25-30 dB	53 dB	25-30 Db	25-30 dB
CONCRETE FOR 100 MM^2	9 M^3	14 M^3	10 M^3	22 M^3
STEEL FOR 100 MM^2	460 KG	700 KG	500 KG	1100 KG

From the above collected data we can analyze that among all types of slabs, hollowcore slabs produce the most economical and beneficial results. Hence moving forwardin order to design commercial and residential buildings we will be using hollow coreslabs. All necessary calculations will be calculated using designated software.

Materials Used

Cement

Ordinary Portland Cement (53 Grade) confirming to IS: 10262-2000 was usedthroughout the investigation. Different tests were performed on the cement to ensurethat it confirms to the requirements of the IS specifications. The physical properties ofthe cement were determined as per IS: 10262-2000 and are presented in below Table

Fig 16 Grade of cement

Table 3: Physical Properties of 53 Grade Cement

S.No	Characteristics	Values
1.	Standard Consistency	53
2.	Fineness of cement as retained on 90 micron sieve	3 %
3.	Initial Setting Time	30 minutes
4.	Specific Gravity	3.15
5.	7days compressive strength	37 Mpa

Table 4: Chemical Properties of Cement

S. No	Components	Weight
1.	Lime(CaO)	63%
2.	Silica(SiO_2)	22%
3.	Alumina(Al_2O_3)	6%
4.	Iron oxide(Fe_2O_3)	3%
5.	Magnesium oxide(MgO)	2.5%
6.	Sulphur trioxide(SO_3)	1.5%
7.	Alkalies	0.5%

Fly ash

Coal based thermal power plants have been a major source of power generation inIndia, where 75% of the total power obtained is from coal based thermal powerplants .The coal reserve of India is about 200 billion tones and its annual productionreaches to 250 million tones approximately .About 70% of this is used in the powersector. In India, unlike in most of the developed countries, ash content in the coalused for power generation is 30-40%

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Fig 17 Fly Ash

Table 5: Chemical composition of Fly Ash

S.no	Components	Weight (%)
1	C	23.29
2	CaO	3.10
3	SiO_2	36.10
4	Al_2O_3	25.03
5	FeO	8.66
6	MgO	1.24
7	SO_3	0.59
8	Alkalies	1.99

Table 6: Physical Properties of Fly Ash

Fineness	$200 m^2/kg$
Specific Gravity	2.2

GGBS (Ground Granulated Blast Furnace Slag)

GGBS (Ground Granulated Blast Furnace Slag) is a by-product obtained during themanufacturing process of iron in blast furnaces. It is a supplementary cementitiousmaterial used in concrete production. GGBS is produced by rapidly cooling moltenslag from a blast furnace with water or air, which leads to the formation of glassygranules. GGBS is used as a partial replacement for Portland cement as it enhancesthe properties of concrete by improving workability, reducing heat generation,increasing durability, and enhancing chemical resistance. GGBS also contributes tothe reduction of greenhouse gas emissions in the construction industry.

Fig 18 Ground Granulated Blast Furnace Slag (GGBS)

LABORATORY TESTS ON MATERIALS

Procedure :

1. Keep the vicat apparatus on a level base (when using vicat apparatus withdashpot, keep the bearing movable rod to its highest position and pin it.)Unscrew the top of the dashpot. Half fill the dashpot with any suitable oil ofviscosity and screw the top. Work the plunger a number of times.

2. Attach the plunger for determining standard consistency to the movable rod.Work the plunger a number of times.

3. Take 400 gm of cement in a pan and a weighed quantity of water in a beaker.

4. Prepare a paste with the water added to cement. Start a stopwatch at the timeof adding water to cement.

5. Keep the vicat mould on a non porous plate and fill the cement paste in it.

Fig 19 Testing for Consistency of Cement

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Table 7: Determination of Standard Consistency of Cement IS:4031, Part-4,1996

Sr.no	Weight of Cement taken (gms)	% of Water added	Vol. Of water added (cc)	Time taken for adding water to cement (min)	Vicat Apparatus Reading (mm)	Temperature (Degree Celcius)
1	300	28	84	5 min	23 mm	28.4'c
2	300	28.5	85.5	5 min	18 mm	
3	300	29	87	5 min	12 mm	
4	300	30	90	5 min	6 mm	

Determination of Fineness of Cement

Procedure :

1. Get a sample of the cement, and then work it in between your fingers. The samplethat is being tested for fineness should be completely lump-free.

2. Take a sample of cement weighing one hundred grams and record it as the W1weight.

3. Place one hundred grams of cement in a sieve with a mesh size of ninety micronsand cover it with the lid.

4. Now, using your hands and moving the sieve in circular and linear motions forfifteen minutes, shake the sieve to remove any debris.

5. After that, W2 is equal to the weight of the cement that passes through the sievewith a particle size of 90 microns. The formula to calculate the fineness of cementis presented in the following: Fineness = (W2/W1) * 100

Fig 20 Testing for Fineness of Cement

Table 8 Fineness of cement (IS:4031, Part 1-1996)

S.no	Determination no.	1	2
1	Weight of cement taken	100	100
2	Weight of cement retained on 90 micron IS sieve	3	3.8
3	% weight of residue (2/1x100)	3%	3.8%
4	average	3.4%	

CONCRETE MIX DESIGN

The mix design procedure adopted to obtain a M-40 grade concrete is in accordancewith IS 10262- 2009. As the minimum grade of concrete to be used in prestressedconcrete is M40. The design stipulations are as follows.

RECOMMENDED GUIDELINES FOR CONCRETE MIXDESIGN AS PER IS:10262-2019

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10.1 STIPULATION FOR PROPROTIONING

a)	Grade designation	: M40 Mix
b)	Type of cement	: OPC 53 grade conforming IS 1226
c)	Maximum nominal size of aggregate:	20 mm
d)	Minimum cement content	: 300
e)	Maximum water-cement ratio	: 0.34
f)	Workability	: 100 mm (slump) +/- 20mm
g)	Exposure condition	: MILD (for Reinforced Concrete)
h)	Method of concrete placing	: Precasting
i)	Degree of supervision	: Good
j)	Type of aggregate	: Crushed angular Aggregete
k)	Maximum cement content	: 450 kg /m^3
l)	Chemical admixture type	: Forsroc Aurocast-102

STEP 1 : TEST DATA FOR MATERIALS

a)	Cement used	: OPC 53 grade conforming IS 122
b)	Brand of cement	: Birla Shakti
c)	Specific gravity of cement	: 3.15
d)	Chemical admixture	: Superplasticizer conforming to IS 9103
	Chemical admixture	: Fosroc Aurocast-102
	Type of chemical admixture	: Superplasticizer
e)	Specific gravity of	
1)	Coarse aggregate	: 2.64
2)	Fine aggregate	: 2.59
f)	Water absorption	
1)	Coarse aggregate	:0.3
2)	Fine aggregate	
	R.Sand	: 1.4
	C.S.Sand	: 2.4
g)	Free (surface moisture)	
1)	Coarse aggregate	: Nil
2)	Fine aggregate	: Nil

STEP 2: TARGET STRENGTH FOR MIX PROPERTIONING

$f'_{ck} = f_{ck} + 1.65 \times S$

where

f'_{ck} = target average compressive strength at 28 days

f_{ck} = characteristic compressive strength at 28 days, and s = standard deviation

From table 1, standard deviation, s = 5 N/mm^2 . Therefore, target strength = 40 + 1.65 x 5 = 48.25 N/mm^2

STEP 3: SELECTION OF WATER-CEMENT RATIO

From table 5 of IS 456, maximum water-cement ratio = 0.55 Based on experience, adopt water-cement ratio as 0.34

0.34 < 0.55, hence O.K.

STEP 4: SELECTION OF WATER CONTENT

From table 2, maximum water content = 186 litre (for 75to 120 mm slump range) for 20 mm aggregate

Estimated water content for 100 mm slump = 186 + 6 / 100 x 186= 197 litre

As superplasticizer is used, the water content can be reduced up to 20 % and above. Based on trials with superplasticizer water content reduction of 17 % has been achived.Hence , the arrived water content = 197 x 0.83 = 164 litre

A-6 CALCULATION OF CEMENT

Water - cement ratio Cement content = 0.34

= 164/0.34= 482kg/m3, Adopt 482kgs

From table 5 of IS 456, minimum cement

Mild' exposure condition = 300 kg/m3 482 kg/m3 > 300 kg/m3, hence, O.K.

STEP 5: PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

From Table 3, volume of coarse aggregate corresponding to 20mm size aggregete and fine aggregate (Zone ii) for water-cement ~~ratio~~ of 0.50 = 0.62

In the present case water-cement ratio is 0.407. Therefore, volume of coarse aggregate is required to be incresed to decrese the fine aggregate content. As the water-content ratio is lower by 0.10, the proportion of volume of coarse aggregate is increased by 0.02 (at the rate of -/+ 0.01 for every +/- 0.05 change in water -cement ratio) , Therefore, corrected propertion of volume of coarse aggregate for the water-cement of 0.34=0.62+.014=0.634,

Note - In case the coarse aggregate is not angular one, then also volume of coarse aggregate may be required to be incresed suitable, based on experience .

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TABLE 9: DESIGN MIX FOR M40 GRADE CONCRETE WITH PARTIALREPLACEMENT OF FLY ASH AND GGBS SEPERATELY

Sample	Cement Percentage	Material Replaced	Material Percentage	Coarse Aggregate	Fine aggregate	Water
Mix 1	95 % 522.5 kg	Fly ash	5% 27.5 kg	996 kg	738 kg	164 kg
		GGBS	5% 27.5 kg	996 kg	738 kg	164 kg
Mix 2	90 % 495 kg	Fly ash	10% 55 kg	996 kg	738 kg	164 kg
		GGBS	10% 55 kg	996 kg	738 kg	164 kg
Mix 3	80 % 440 kg	Fly ash	20% 110 kg	996 kg	738 kg	164 kg
		GGBS	20% 110 kg	996 kg	738 kg	164 kg

TABLE 10: DESIGN MIX FOR M40 GRADE CONCRETE WITH PARTIALREPLACEMENT OF FLY ASH AND GGBS COMBINED

S.no	Mix Design	Fly ash Percentage	GGBS Percentage	Cement Percentage	Total weight of cement
1.	F0-G0-C100	0%	0%	100%	550 kg
2.	F10-G10-C80	10% 55kg	10% 55kg	80% 440kg	
3.	F10-G20-C70	10% 55kg	20% 110kg	70% 385kg	
4.	F10-G30-C60	10% 55kg	30% 165kg	60% 330kg	
5.	F10-G40-C50	10% 55kg	40% 220kg	50% 275kg	
6.	F10-G50-C40	10% 55kg	50% 275kg	40% 220kg	

Respresentation : F = Fly Ash, G = GGBS,C = Cement, Numbers denote the % of materials

Casting of Specimen mould

Sample preparation of specimen mould

1.Determine proportions of materials including cement, sand, aggregate and water.

2.Mix the materials using either by hand or using suitable mixing machine in batches with size of 10 percent greater than molding test specimen.

3.Measure the slump of each concrete batch after blending.

4. Place molds on horizontal surface and lubricate inside surface with proper lubricant material and excessive lubrication should be prevented.

5. Pour fresh concrete into the molds in three layers.

6.Compact each layer with 16mm rode and apply 25 strokes for each layer or fillthe mold completely and compact concrete using vibration table.

7.Remove excess concrete from the top of the mold and smoothen it without imposing pressure on it.

8.Cover top of specimens in the molds and store them in a temperature room for24 hours.

9.Remove the molds and moist cure specimens at 23+/-2 o C till the time of testing.

The age of the test is 3 days,7days and 28 days and three specimens for each test should be prepared (according to Indian Code, the specimen is stored in water at 24-30oC for 48hours and then tested)

Fig 21 Casting of Specimen mould

Fig 22 Casted Cubes

Curing of specimen

After 24 hours of moulding, the specimens were demoulded and were sun dried for one day. After this, the samples were kept for curing by wet covering method, usingjute bags.

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Fig 23 Curing of Specimen

Compression Test

Procedure

1.Take three cube moulds for each mix. Assemble the mould with base plate so that it is rigidly held together.

2.Clean the inside of the mould and see that joints (at the edges) are perfectly tight.

3. Pour properly mixed concrete for the given mix to the cube moulds.

4.Compaction by needle vibrator will be preferred. If vibrator is not available, hand compaction is to be done by placing concrete in three layers each layer becompacted with the help of standard tamping rod by means of 25 blows.

5.Level the concrete at the top of the mould by means of trowel and give proper identification mark of the specimen.

Fig 24 Compression Testing Machine (CTM)

Fig 25 Compression Test on Moulds

CASTING OF PRESTRESSED HOLLOWCORE SLAB

13.1 Cleaning and Oiling of bed:

Fig 26 Oiling of Bed

Cleaning and oiling the bed in prestressed hollow core slab production is an essential step in ensuring the quality and durability of the finished product. The bed should becleaned regularly to remove any debris or residue that may accumulate during the production process.

ANALYSIS & RESULTS

The minimum grade of concrete required for pre stressing of hollow core slab isM40. A design mix with addition of GGBS and Fly ash has to be prepared conforming to IS 10262 : 2009

After comparing the properties of various slab system available in the Indian market we found out that pre

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stressed hollow core slabs produce the best and economical results

After mixing different variations of materials in concrete design we have finally found that GGBS and Fly Ash do not produce the required result when added separately as the process of demoulding has to be carried out within 7 days for laying of new batch

In order to gain early demoulding strength a mix of GGBS and Fly ash were combined together in different proportions maintaining the percentage of Fly Ash at10 and the mix with the proportion F10-G30-C60 gave the best results in 7 days following the process of demoulding and curing

The cured pre stressed hollow core slab is then transported to the site for erection and grouting.

CONCLUSION

Pre stressed hollow core slabs can be used extensively in the construction of residential and commercial buildings as they cab be manufactured with ease on a large scale boosting the construction speed considerably and reducing the requirement of labour overall lowering the expenses involved when compared with conventional construction

With the replacement of cement we can reduce the cost of slab without hindering the strength promoting the same in precast industries

With addition of industry by-product materials such as GGBS and Fly Ash the concentration of cement in concrete mix can be reduced promoting eco friendly and sustainable environment and reducing the overall emission of carbon dioxide and carbon footprint of the construction sector.

The casting process of hollow core slabs requires skilled labour and experienced engineers. The casting process can be carried out in monitored and well maintained factories and manufacturing units.

Precast manufacturing of slabs is a much faster method of construction compared to conventional method and follows a precise manufacturing process avoiding any flaws

By the implementation of hollow core slabs in Indian construction sector, there is a major decrease in the amount of concrete and steel required when compared to conventional slabs leading to saving of materials and promoting sustainability

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