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Cement Concrete Hollow Blocks To Replacing Cement By Fly Ash

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Abstract - *The cement is the main ingredient used for concrete. The production of cement involves emission of large amount of carbon dioxide into the atmosphere. Therefore, the search of any other such material which can be used as an alternative to cement should lead to lowest possible environmental impact. The fly ash obtained by combustion of coal can be used as partial replacement for cement owing to its pozzolanic nature, which provides strength to cement. The huge quantity of fly ash being accumulated over the years is likely to pose a serious threat for its disposal and cause environmental problems. In this paper, an effort has been made to determine the effect on compressive strength of concrete by partial replacement of cement with 0%, 10%, 20% 30% and 40% of fly ash for M30 grade of concrete. Test results indicate that workability and durability of concrete increases with increase in fly ash content. It has also been obtained that with increase in fly ash content, there is reduction in compressive strength of concrete. The optimum replacement of cement with fly ash is 30%.*

Key Words: *fly ash, workability, durability, partial replacement, pozzolanic, compressive strength.*

1.INTRODUCTION

Cement concrete hallow blocks have an important place in modern building industry. They are cost effective and better alternative burnt clay bricks by virtue of their good durability, fire resistance, partial resistance, partial resistance to sound, thermal insulation, small dead load and high speed of construction.

Concrete hollow blocks being usually larger in size than the normal clay building bricks and less mortar is required, faster of construction is achieved. Also building construction with cement concrete hollow blocks provides facility for concealing electrical conduit, water and sewer pipes wherever so desired and requires less plastering.

In the past, fly ash was generally released into the atmosphere as it is difficult to decompose, but air pollution control standards now require that it be captured prior to release by fitting pollution control equipment. Fly ash is generally stored at coal power plants or placed in landfills. Due to the presence of pozzolanic activities, which is responsible for setting of concrete and provide concrete with more protection from wet conditions and chemical attack, fly ash can be used as a partial replacement for cement. Moreover, cement industry is the major contributor of pollution by releasing carbon dioxide. 1 ton of cement produces approximately 1 ton of carbon dioxide. So by partially replacing cement with pozzolanic material such as fly ash, the cement industry can serve both the purposes of meeting the demands of construction industry and at the same time producing green and clean environment. Fly ash is of two types class F and C. Class F fly ash is produced by burning of harder, older anthracite and bituminous coals. This fly ash is pozzolanic in nature and contains less than 7% lime (CaO). However, class C fly ash is produced by burning of younger lignite sub-bituminous coal. It possesses pozzolanic as well as self-cementing properties. In the presence of water, class C fly ash hardens and gets stronger over time. It generally contains more than 20% lime (CaO).

Now a days, Hollow Concrete Blocks (HCB) and bricks are becoming very popular. These blocks are being widely used in construction of residential buildings, factories and multi-storied buildings. These hollow blocks are commonly used in compound walls due to their low cost. These hollow blocks are more useful due to their lightweight and ease of ventilation. The blocks and bricks are made out of mixture of cement, sand and stone chips. Hollow blocks construction provides facilities for concealing electrical conduit, water and soil pipes. It saves cement in masonry work, bringing down cost of construction considerably. Economy of the structure is one of the basic aspects upon which any design is based. The stability plays an important role but the best designer is one who comes out with design which gives the stable and economics structure. The development of the construction technology is closely related to development of adequate mechanization and handling technology. Hollow concrete is an important addition to the types of masonry units available to the builders and its use for masonry is constantly increasing.

1.1 OBJECTIVE

1. To study the behaviour of the cement concrete hollow blocks by adding Fly Ash.
2. To study the compressive strength of the CC hallow blocks to replacing 'cement' by 'fly ash'.
3. Economy in design of sub-structure due to reduction of load
4. To improve the thermal and acoustic insulation properties.
5. To reducing the cost of Construction and Maintenance of the CC hollow blocks.

1.2 LITERATURE REVIEW

1. RECTIFA RIO (APRIL-2016):-

He is prepared paper name was ''comparative study on proportion of hollow concrete blocks to its compressive strength''**.** The proportion of 1:5 (cement to sand) was proven to be the minimum proportion for gaining the target compressive strength of Quality . Mud content below 5% will not guarantee the target compressive strength reach precisely. Preliminary treatment of sand should be needed as the mud content more than or equal to 5% in order to avoid the failure of target strength. Water cement ratio of 0.5 was suitably workable for mixing the hollow concrete block as well as the target compressive strength.

2. JAY.M.PAWAR (JUNE-2015):-

He is prepared paper name was "Effect An Strength And Durability Of Fly Ash Based Hollow Concrete Blocks Having Different Configurations Using Polypropylene Fibres". Any type of waste materials which can increase the concrete that can be used to make this kind of hollow concrete blocks so that this blocks should be made eco-friendly. Here I use the fly ash as a partially replacement of cement to made these hollow concrete blocks lighter in weight.

3. PREM RANJAN KUMAR et.al :

Concluded that at 100% replacement of natural sand, compressive strength decreases when compared with the cubes prepared with only natural sand. Blast furnace slag can be used as alternative of fine aggregates in making mortar up to 60% replacement, which reduces the consumption of natural sand. When blast furnace slag was examined as replacement of natural sand for making concrete, compressive strength of cubes (decreases with increase 28 days) is comparable with that of the cubes prepared with natural sand up to 75% replacement. Beyond this, compressive strength in the replacement.

4. AMAN JATALE

He studied the effects on compressive strength when cement is partially replaced by fly ash and observed that the use of fly ash slightly retards the setting time of concrete. It was also found that the rate of strength development at various ages is related to the w/c ratio and percentages of fly ash in the concrete mix. Moreover, the modulus of elasticity of fly ash concrete also reduced with the increase in fly ash percentage for a given w/c ratio.

2. MATERIALS AND METHODOLOGY

2.1 MATERIALS

The physical properties of cement, fine aggregates, coarse aggregates, fly ash and water used for mix design of M30 grade of concrete were tested in laboratory and are mentioned below.

2.1.1 Cement

The cement used was OPC53. All properties of cement were in accordance with IS269:1976. The physical properties of the cement used are as listed in table below.

Table-1: Physical Properties of Ordinary Portland Cement

Properties	Test Values
Specific Gravity	3.023
Consistency (%)	30%
Initial Setting Time	55Min

2.1.2 Fine Aggregates

The M-sand is produced by crushing hard stone or natural gravel and passing through 4.75mm IS sieve size was used as fine aggregate. The physical properties of the fine aggregates are as listed in table below:

Table-2: Physical Properties of Fine Aggregates

Properties	Test Values
Specific Gravity	2.547
Water Absorption	1%
Fineness Modulus	3.239

2.1.3 Coarse Aggregates

The coarse aggregates with nominal maximum size of aggregates as 6mm to 10mm as per Indian standard were used. The physical properties of the coarse aggregates are as listed in table below:

Table-3: Physical Properties of Coarse Aggregates

Properties	Test Values
Specific Gravity	2.65
Water Absorption	0.5%
Fineness Modulus	5.65

2.1.4 Fly Ash

The fly ash used was of class F with specific gravity of 2.5

2.1.5 Water

The water used for experiments was potable water.

2.2 METHODOLOGY

The aim of the present study was to study the effect of fly ash on compressive strength of concrete by partial replacement of cement with 0%, 10%, 20% 30% and 40% of fly ash. The concrete mix of M30 grade was prepared as per IS10262:2009 having mix design ratio as 1:2.7:2.4 and w/c ratio of 0.4. To carry out the experimental investigation total 40 blocks of size 400mm x 100mm x 200mm were casted. 8 blocks were casted to determine the compressive strength of normal concrete with no fly ash. Similarly, each set of 8 blocks were casted to determine the compressive strength for 10%, 20% 30% and 40% replacement of cement with fly ash respectively. From these 8 blocks, 4 blocks were utilized to determine the compressive strength of concrete after 7 days of curing and rest 4 blocks were used to determine the compressive strength of concrete at 28 days. Compression Testing Machine of 2000kN capacity was used to determine the total compressive load taken by concrete at different ages. This ultimate load divided by the cross-sectional area of the blocks (400mm x 100mm) yields the compressive strength of concrete.

Figure-1: Curing of specimens

Figure-2: Specimen testing in Compression Testing Machine

Table-4: Material Quantities for Mix Design

Fly Ash (%)	No. of cubes	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)
0	8	23.6	63.72	56.64
10	8	21.2	63.72	56.64
20	8	18.8	63.72	56.64
30	8	16.4	63.72	56.64
40	8	14	63.72	56.64

3. RESULTS AND DISCUSSIONS

Each set of 4 blocks of M30 grade of concrete were tested in Compression Testing Machine with 0%, 10%, 20% 30% and 40% replacement of cement with fly ash to determine the compressive strength after 7 and 28 days of curing. Average value of these 4 readings gives the average compressive strength of concrete. The average compressive strength of hollow blocks at the age of 7 days and 28 days were found as 3.12 N/mm^2 and 5.10 N/mm^2 for normal concrete with no fly ash and it reduced to 1.90 N/mm^2 and 2.37 N/mm^2 when 40 % of cement was replaced with fly ash. The compressive strength of M30 grade of concrete for different proportions of fly ash after 7 and 28 days of curing are listed below in table 5 and 6 respectively.

Table-5: Compressive Strength of M30 grade of concrete for different proportions of Fly Ash at the age of 7 days

Mix	Load (kg)	Average Load (kg)	Compressive Strength (N/mm2)
0% fly ash	12500 13000 12500 12700	12670	3.12
10% fly ash	11500 10500 11500 10700	11050	2.70
20% fly ash	8500 9000 8000 8500	8500	2.09
30% fly ash	7000 7600 6800 6500	6975	1.71
40% fly ash	5800 5200 4800 5000	5200	1.27

Table-6: Compressive Strength of M30 grade of concrete for different proportions of Fly Ash at the age of 28 days

Mix	Load (kg)	Average Load (kg)	Compressive Strength (N/mm2)
0% fly ash	21000 20000 21500 20200	20675	5.10
10% fly ash	17500 16800 17900 18000	17550	4.30
20% fly ash	14200 15000 14800 14500	14625	3.59
30% fly ash	11000 12500 12000 12600	12025	2.95
40% fly ash	10500 9300 10000 9000	9700	2.37

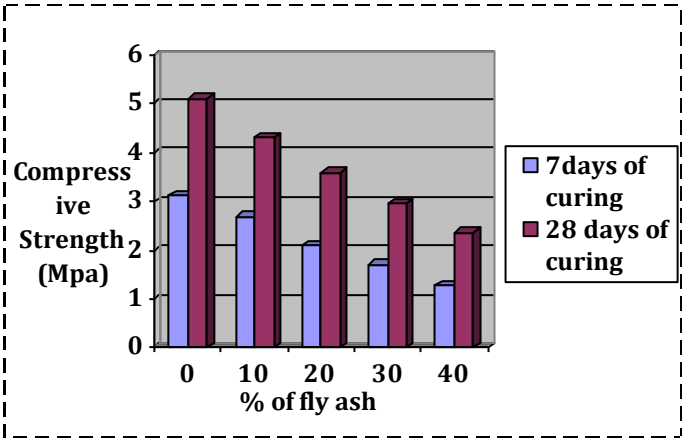

Chart-1: Compressive Strength (MPa) for different proportions of fly ash after 7 and 28 days of curing

4. CONCLUSIONS

From the experimental work carried out for M30 grade of concrete by partial replacement of cement with 10%, 20% 30% and 40% of fly ash, the following conclusions were drawn.

1. The compressive strength of concrete decreases with increase in fly ash content. The reduction in compressive strength of concrete at the age of 28 days was found to be 15.68% 29.60%,42.15% and 53.53% for 10%, 20% 30% and 40% replacement of cement with fly ash.

2. As the cement was replaced with fly ash, the reduction in compressive strength of concrete was higher at the age of 7 days as compared to 28 days. This occurs as the secondary hydration due to pozzolanic action is slower at initial stages for fly ash concrete.

3. The workability of concrete improves with the increase in fly ash content.

4. The consistency of cement increases with increase in fly ash content. This happens because the consistency of cement depends upon its fineness, and the fly ash molecules are finer than cement.

5. Not more than 30% of cement should be replaced with fly ash; otherwise it may lead to significant reduction in the compressive strength of concrete.

5. REFERENCES

[1]. ACI Committee 531, "Building code Requirements for Concrete Masonry Structures", ACI Journal, Proceedings V.75, No.8, p. 384-403, Aug. 1978.

[2]. ACI Committee 531, "Commentary on Building Code Requirements for Concrete Masonry Structures", ACI Journal, Proceedings V.75, No.8, p. 460-498, Sept. 1978.

[3]. Boult, B. F., "Concrete Masonry prism testing", ACI Journal, Vol.76, p. 1145, Oct. 1979.

[4]. Curtin, W. G., Shaw, G. and Beck, J. K. "Design of reinforced and prestressed masonry", Granada publishing limited, London, 1988.

[5]. Curtin, W. G., Shaw, G., Beck, J. K. and Parkinson, G. I., "Structural Masonry Detailing", Granada Publishing Limited, London, 1989.

[6]. Curtin, W. G., Shaw, G., Beck, J. K. and Bray, W. A., "Structural Masonry Designers Manual", Granada Publishing Limited, London, 1982.

[7]. CP: 111-1964, "Structural recommendations for load bearing walls", British Standard Institution.

[8]. Journal on use of soil cement hollow concrete and others precast cement concrete component and

[9]. Neville A.M., Properties of concrete, pitman publishing, 1973.

[10]. Orchard D.F., Concrete Technology volume-I, applied science publishers limited, Third Editiossn, 1973