Experimental Study on Fly-Ash Bricks With Steel Waste

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Abstract- *Brick is one of the oldest building materials. A brick is used to make walls, pavements and other elements in masonry construction. Fly ash brick (FAB) is a building material, specifically masonry units, containing class C or class F fly ash and water. Owing to the high concentration of calcium oxide in class C fly ash, the brick is described as "Self-Cementing". The manufacturing method saves energy, reduces mercury pollution, and costs 20% less than traditional clay brick manufacturing. In this project 10% of cement,0.45 water cement ratio, Fly ash with proportion of 85% , 80%, 75% & steel waste with 5%, 10%,15% are added. The outcome of this project shall be implement for construction works.*

Keywords- Fly-ash – Steel waste – Compressive strength – Water absorption test

I. INTRODUCTION

Brick is a building material used to make walls and also to walk in the specific area . Brick was introduced in 7000 BC. Brick is a mono unit of a kneaded clay bearing soil and lime or concrete material, used in masonry construction. Brick is the most commonly used building material in the world. It is estimated that the present consumption of birck in the world is of the order of 250 billion bricks every year. The material used in the brick (50%to 60%) of sand, (20% to 60%) of clay (2% to 5%) of lime less than 7% of iron oxide less than 1% of magnesia. Fly-ash brick are stronger and lighter than ordinary bricks. The material includes fly ash, water, cement, gypsum and lime. Cao the pozzolanic reactivity of fly ash is more high calcium fly ash. The greater the pozzalanic activity leads to higher the strength of fly ash bricks as per ASTM C618 two types of fly ash are classified they are class C and class F.

Generally bricks consists of flyash, cement, water and steel waste.

Their proportion in the brick is based on strength of brick . This project is to replace the material in brick for better improvement of brick properties .The main aim for this project is to increase the strength of the brick. The characteristics of brick with use of steel waste are investigated in this study. Various other experimental studies conducted on steel waste brick showed that there is considerable increase in the compressive strength when compared to conventional brick .

In this study, steel waste is added with various percentages like 0%,5%,10%,15% and characteristics of brick like compression strength and water absorption are to be studied.

1.2 Steel waste brick

Generally steel waste brick consists of cement,fly ash, water and steel slag. Their proportion in the brick is based on the strength also. Now-a-days use of resources in the construction industry is high. The main aim of for this project is to increase the strength of the brick. The characteristics of brick with partial replacement of sand by steel lathe waste are investigated in this study. Various other experimental studies conducted on steel waste brick showed that there is considerable increase in the compressive strength when compared to conventional brick. The manufacturing method saves energy, reduces mercury pollution, and costs less than traditional clay brick manufacturing. In this project 10% of cement,0.45 water cement ratio, Fly ash with proportion of 85% , 80%, 75% & steel waste with 5%, 10%,15% are added. The outcome of this project shall be implement for construction works.

OBJECTIVE

The main objective of this project is to make strong and cost effective brick.

II. MATERIALS AND THEIR PROPERTIES

2.1 Cement

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement can also used as the binder for fly ash bricks. Cements used in construction and plays the major role.Cements used in construction are usually inorganic, often lime or calcium silicate based and can be characterised as hydraulic or non hydraulic, depending on the ability of the

cement to set in the presence of water. The various properties of cement are tabulated in table 1 given below:

Table 1: Properties of cement

S.NO	DESCRIPTION	RESULT
1	Fineness of Cement	8.2%
2	Standard Consistency	32%
3	Specific gravity	3.15
4	Initial setting time	30 mins
5	Final setting time	10 hrs

2.2 Flyash

Fly ash is a coal combustion product that is composed of particulates that are diven out of coal fired boilers together with flue gases. The minor components of fly ash is depend on specific coal be composition, it may includes one or more elements or components in trace concentrations like arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, lead etc.,.Normally the flyash was generally released into atmosphere and those ash produced is often classified as an hazardous waste. So, by the use of flyash bricks these wastes can be prevented.

Table 2: Properties of flyash

S.NO	DESCRIPTION	RESULT
1	Specific Gravity	2.37

2.3 Water

Water is one of the important materials for fly ash bricks with steel slag by potable water with pH value 6.5-8.5 is used for mixing and curing throughout the experiment.

2.4 Steel waste

The utilization of industrial waste produced by industrial process has been the focus of waste reduction research for economic, environmental and technical reasons. Steel slag is a steel waste product from lathe industry**.**

Table 5 : Physical Properties of waste

S.NO.	DESIGNATION	PROPERTIES
1	*Colour*	*Light brown*
2	*Shape*	*Highly angular*
3	*Bulk density*	*1911.11 Kg/m³*
4	*pH (in water)*	*8*
5	*Combustibility*	*Non-combustible*
6	*Surface Texture*	*Rough*
7	*Specific Gravity*	*2.93*

III. MIX PROPORTION

The mix proportions are designed as per IS 10262-2009, tabulated in Table 6.

Table 6: Mix Proportion

CEMENT	FLY ASH	STEEL SLAG
10%	85%	5%
10%	80%	10%
10%	75%	15%

IV. CASTING OF SPECIMEN

4.1 Brick

S.NO	DESCRIPTION	RESULT
1	Specific Gravity	2.62

After 24hrs of casting the moulds were removed and the specimens were cured in water for 7days. The size of the brick is 230 x 110 x 75 mm.

Fig 4.2 Brick

V. TESTING PROCEDURE

5.1 Compressive strength

In a compression test a material experiences opposing forces that push inward upon the specimen from opposite sides

or is otherwise compressed, squashed, crushed, or flattened. The test sample is generally placed in between two plates that distribute the applied load across the entire surface area of two opposite faces of the test sample and then the plates are pushed together by a universal testing machine causing the sample to flatten. A compressed sample is usually shortened in the direction of the applied forces and expands in the direction perpendicular to the force.The compressive strength of specimen after 7 and 28 days was calculated and tabulated in table 2.

Table 7: 5% of waste added

SPECIMEN	BRICKSIZE (mm)	COMPRESSIVE STRENGTH IN 7 DAYS(N/mm^2)	AVERAGE
A	230X110X75	15	
B	230X110X75	15.23	15
C	230X110X75	14.78	

Table 8:10% of waste added

SPECIMEN	BRICKSIZE (mm)	COMPRESSIVE STRENGTH IN 7 DAYS(N/mm^2)	AVERAGE
A	230X110X75	16.2	
B	230X110X75	16.34	16.42
C	230X110X75	16.73	

Table 9:15% of waste added

SPECIMEN	BRICKSIZE (mm)	COMPRESSIVE STRENGTH IN 7 DAYS(N/mm^2)	AVERAGE
A	230X110X75	16.78	
B	230X110X75	16.23	16.96
C	230X110X75	17.78	

5.2 Water absorption test:

Water absorption are conducted to determine durability property of bricks.The specimen kept in ventilated room are weighted(W1)and immersed in water for 24 hours.After 24 hours the brick specimen is taken and weighted(W2).Percentage of water absorption =W2-W1/W1*100.In water absorption test the weight of dried brick and weight of wet brick is taken in kg and the mean value of the specimen is determined.The specimen values are taken as 0,5,10,15.The following table determines the water absorption test.

Table 10: water absorption test of brick

Specimen	Weight of dried brick (W_1) in kg			Weight of wet brick (W_2) in kg			Water absorption (W_2-W_1)/W_1x100 in%			Mean in %
	S1	S2	S3	S1	S2	S3	S1	S2	S3	
0	2.86	2.84	2.81	3.08	3.11	3.09	7.6	9.51	9.96	8.99
5	2.96	2.91	2.93	3.10	3.03	3.09	4.73	6.18	5.46	5.46
10	3.02	3.04	2.99	3.11	3.14	3.10	2.98	3.29	3.68	3.31
15	3.12	3.15	3.20	3.20	3.20	3.24	2.56	1.59	1.25	1.8

5.3 Thermal effect test

Thermal effect test involves in testing a brick at the extremes of its intended use of thermal environment for temperature and airflow and for measuring components to determine the effects in brick performance and long term reliability.The strength of the brick is affected due to increase in temperature.To find the change in strength, the brick of age 7 days were kept at 100 degree c in an oven for 24 hours.Then it is immediately tested in compression.The compressive test of specimen was calculated and tabulated in table.

Table 11: Thermal effect test of brick

Specimen	Weight of dried brick (W_1) in kg			Weight of wet brick (W_2) in kg			Water absorption (W_2-W_1)/W_1 x100 in%			Mean in %
	S1	S2	S3	S1	S2	S3	S1	S2	S3	
0	2.86	2.84	2.81	3.08	3.11	3.09	7.6	9.51	9.96	8.99
5	2.96	2.91	2.93	3.10	3.03	3.09	4.73	6.18	5.46	5.46
10	3.02	3.04	2.99	3.11	3.14	3.10	2.98	3.29	3.68	3.31
15	3.12	3.15	3.20	3.20	3.20	3.24	2.56	1.59	1.25	1.8

5.4 Thermo shock effect test

The thermo shock test for the bricks involves by determining the young's modulus for sonic test in bricks.The process which the thermal stress and strain of an large magnitude the component temperature change abruptly.The strength of bricks also et affected when the brick is exposed to high temperature like fire and then due to sudden cooling.To find the change in strength,the brick of age 7days were kept at 100 degrees on oven for 24 hours and then immersed in water for few minutes and then tested in compression testing machine.The compressive strength of specimen was calcilated and presented in table.

Table 12:Thermo shock effect test

Specimen	Load (kN)			Compressive strength after 7 days (N/mm²)			Mean (N/mm²)
	S1	S2	S3	S1	S2	S3	
0	210	209	221	8.3	8.26	9.40	8.65
5	270	260	250	10.67	10.28	9.88	10.28
10	290	320	318	11.46	12.65	12.57	12.23
15	340	322	331	13.44	12.73	13.08	13.08

VI. RESULT AND DISCUSSION

6.1 Compressive Strength Test

From the Table 6.1 and 6.2, it is observed that the compressive strength is in increasing order when admixtures are used. It is also observed that the compressive strength of fly ash brick with steel slag and durability is greater than that of a normal brick. The variation in compressive strength is presented in fig.6.1.

Fig 6.1 Compressive strength of Concrete in 7 daysand 28 days

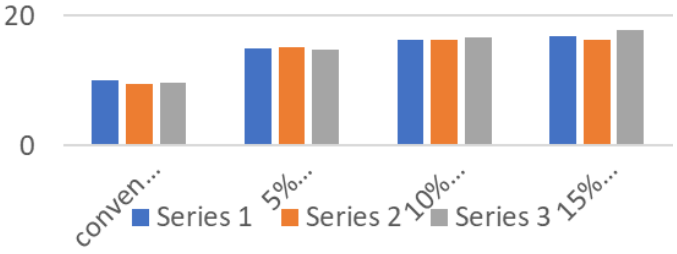


Fig 6.1 Compression strength test of brick.

6.2 Water absorption Test

From the Table 5, it is observed that the water absorption test is in increasing order when admixtures are used. It is also observed that the water absorption test of brick with cement and steel slag is greater than that of a ordinary brick. The variation in water absorption test is presented in fig.6.2.

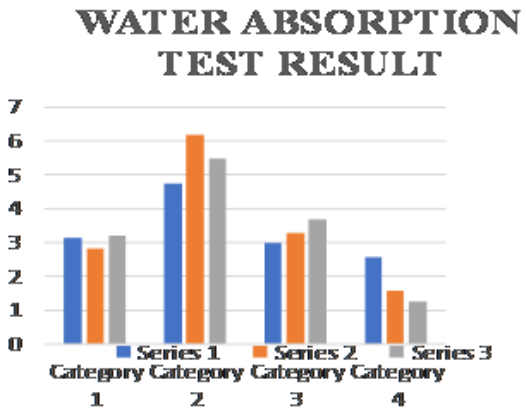
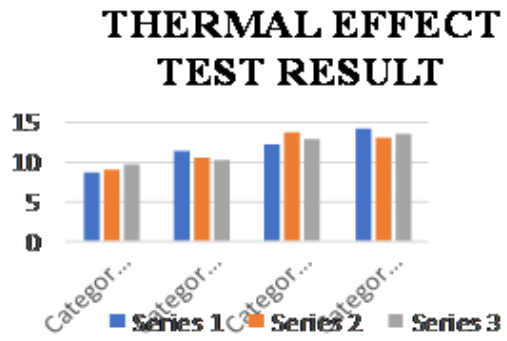


Fig 6.2 Water absorption test of bricks

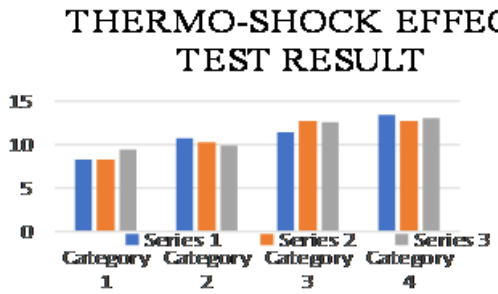
6.3 Thermal effect Test

From the Table 6, it is observed that the thermal effect test is in increasing order when admixtures are used. It is also observed that the thermal effect test of a brick with cement and steel fibre is greater than that of a normal brick. The variation in thermal effect test is presented in fig.6.3.



6.4 Thermo shock effect test

From the Table 6, it is observed that the thermo shock effect test is in increasing order when admixtures are used. It is also observed that the thermo shock test of a brick with cement and steel fibre is greater than that of a normal brick. The variation in thermo shock effect test is presented in fig.6.4.



VII. CONCLUSION

From the test results, the following conclusions were made

- The compressive strength of fly ash brick is increased when compared to normal brick, when the steel waste is added to the brick at a percentage of 5%, 10% and 15% .
- By compression test, water absorption test, thermal effect test and thermoshock effect we observed that brick gets stronger while compared to normal bricks.
- The prospects of fly ash are still being underused even today. Thus keeping in mind about environmental concerns and its indispensability as mineral adm lathe scrap with steel fibre IRJOSER, Vol 6, issue 4, April 2018.

REFERENCES

[1] Nutan C. Patel, Prof.Jayeshkumar Pitroda "Fly ash brick" is the innovative concept for getting higher strength bricks" in International journal of innovative research in science, Engineering and Technology.

[2] Tutunlu and U. Atalay, "Utilization of fly ash in manufacturing of building bricks," in International Ash Utilization Symposium, Center for Applied Energy Research", 2001.

[3] Ozdemir, B. Erhan, and M. S. Celik, "Separation of pozzolanic material from lignitic fly ash of Tuncbilek power station," in International Ash Utilization Symposium, Center for Applied Energy Research, 2001.

[4] AS standard, ASTM C 618, "Fly ash for use as mineral admixture in Manufacture of bricks".

[5] Ashik Kumar Parashar, Rinko Parashar, "Bricks with Total Replacement of FlyAsh Mixed with Different Materials", International Journal of Scientific and Research, July 2012.

[6] M.Narmatha R. ArunaM. Saraswathi,,Strengthening of Fly Ash Bricks" by Ironite IOSR Journal of Mechanical and Civil Engineering 2014.

[7] Edward Allen, Robert Hallon. Fundamental of residential construction (3rd edition), 672 pages. John Wiley & Sons, San Francisco, 2011.

[8] Jeorge J. Venta, P.Eng. "Life cycle analysis of brick and mortar products", The ATHENATM Sustainable Material Institute, Canada, Ottawa, 1998.