Optimization of Compressive Strength for Fly Ash Building Bricks

Aditya Punia[1], Parasram Pandit[1]

[1]National Institute of Technical Teachers Training & Research, Chandigarh, India

(Corresponding Author- Aditya Punia, email- punia1794@gmail.com)

Abstract Fly ash bricks are comparable to burnt clay bricks in that they may be utilised in all types of building construction. Fly ash bricks are lighter in weight and more durable than traditional clay bricks. Because fly ash is accumulating as a waste material in large quantities near thermal power plants, causing serious environmental pollution issues, its use as a primary raw material in the production of bricks will not only provide ample opportunities for its proper and useful disposal, but will also aid in environmental pollution control to a greater extent in the power plant's surrounding areas. In addition, the brick industry consumes 180 billion tonnes of common burnt clay bricks each year, equivalent to about 340 billion tonnes of clay—roughly 5000 acres of top layer soil dug out for bricks manufacture, soil erosion, and emissions from coal burning or firewood, all of which contribute to deforestation. The use of fly ash bricks can help to alleviate these issues. The best optimum mix proportion for the samples tested in this study has been observed to be 50% Fly Ash, 10% Cement and 40% sand at 21 days curing time.

Keywords Fly ash, bricks, sustainable construction, water absorption, compressive strength.

1. Introduction

Burnt clay brick production necessitates the use of coal, resulting in greenhouse gas emissions. The major raw material for bricks is soil, which is frequently taken from prime agricultural land, resulting in environmental deterioration as well as economic losses owing to agricultural land diversion. The use of traditional brick-firing technology causes substantial local air pollution. In India, the burned clay brick business generates around 180 billion clay bricks every year, causing significant land erosion and unprocessed emissions. At the same time, India's thermal power plants continue to create large amounts of fly ash, which poses enormous issues for power plants to dispose off.

The use of fly ash in the production of construction materials, notably bricks, is seen as one of the answers to the country's growing fly ash disposal problem. Although there are various processes for creating fly ash bricks, the FaL-G technique is gaining favour [1].

Fly ash bricks are comparable to burnt clay bricks in that they may be utilised in all types of building construction. Fly ash bricks are lighter in weight and more durable than traditional clay bricks. Because fly ash is accumulating as a waste material in large quantities near thermal power plants, posing serious environmental pollution problems, its use as a primary raw material in the production of bricks will not only provide ample opportunities for its proper and useful disposal, but will also aid in the reduction of pollution in the areas surrounding power plants. The demand for Fly Ash Bricks has increased as a result of its excellent quality, eco-friendly nature, and government assistance. The fly ash bricks have some advantages over conventional burnt clay bricks, some of which are:

- There is no breakage during transit and usage due to the high strength.
- Because the bricks are of the same size, the amount of mortar needed for seams and plastering is cut by half [2].
- Water seepage through brickwork is significantly decreased due to lesser water penetration.
- Fly ash brick houses are cool in the summer and warm in the winter. Superior insulating properties combined with low embodied energy greatly cut building energy consumption by as much as 40-50 percent [3].
- Fly ash bricks absorb sound and prevent it from escaping, making the interiors very comfortable and quiet.

- Fly ash bricks are resistant to salt and other sulphates, guaranteeing that the construction is free of efflorescence.

2. Research Methodology

The research methodology adopted in this study is as follows:

1. Material selection for fly ash brick.
2. Prepare different mixing proportion for fly ash bricks.
3. Determination of hardened properties of fly ash bricks.
4. Comparison of results with standard burnt clay bricks.

2.1 Material selection for fly ash bricks

2.1.1 Fly ash

Pulverized fuel ash, often known as fly ash, must meet the requirements of IS 3812 Grade 1 or Grade 2. Depending on the quality of the raw materials, the quantity of fly ash ranges between 50 to 60 percent in this research study.

2.1.2 Sand/ Stone dust

It enhances the volume of concrete and provides dimensional stability. It is sourced from a granite quarry. River sand is expensive due to the enormous volume of shipment from natural sources. The percentage of sand used in this research study ranges from 30 to 45 percent.

2.1.3 Cement

Cement is an essential binding substance. In nature, it is mostly found as a mixture of Calcium Oxide (CaO) and magnesium oxide (MgO). Cement combines with fly ash at room temperature to generate a product having cementation characteristics or properties. The percentage of cement in this research study ranges from 8% to 10%.

2.2 Preparing mix proportions

The mixing proportion for various samples of fly ash bricks has been taken as presented in Table 1.

Table 1 Mixing proportion of fly ash bricks

Specimen No..	Cement	Fly ash	Sand
1	8%	50%	42%
2	8%	55%	37%
3	8%	60%	32%
4	9%	50%	41%
5	9%	55%	36%
6	9%	60%	31%
7	10%	50%	40%
8	10%	55%	35%
9	10%	60%	30%

3. Results

3.1 Compressive strength test

The results of 7 days, 14 days and 21 days curing time compressive strength test of fly ash bricks are presented in Table 2.

Table 2 Compressive strength of fly ash bricks

Specimen No.	7 days (N/mm2)	14 days (N/mm2)	21 days(N/mm2)
1.	4.5	7	9.2
2.	4	6	7.8
3.	2.5	5	7.5
4.	2.8	5.3	8
5.	3	5.7	8.5
6.	3.5	6.5	9

7.	5	7.5	10
8.	4.3	7.2	9.5
9.	3.8	6.2	8.7

3.2 Water absorption test

The results of water absorption test on various specimens of fly ash bricks are shown in Table 3.

Table 3 Water absorption of fly ash brick

Specimen No.	W1(kg)	W2(kg)	W2-W1	(W2-W1)/W1	(W2-W1)/W1X100%
1	2.252	2.450	0.198	0.127	12.8
2	2.182	2.440	0.258	0.144	14.5
3	2.336	2.695	0.359	0.153	15.4
4	2.246	2.495	0.249	0.127	12.8
5	2.346	2.660	0.314	0.133	13.4
6	2.012	2.310	0.298	0.148	14.9
7	2.164	2.425	0.261	0.1201	12
8	2.262	2.535	0.273	0.1206	12.1
9	2.258	2.580	0.322	0.147	14.8

4. Conclusion

Based on the results for the experiments done on different samples of fly ash bricks, the optimum results of compressive strength and water absorption obtained are following:

Compressive strength = 10 N/mm2

% Water absorption = 12 %

The best optimum mix percentage for fly ash brick samples is 50% Fly Ash, 10% Cement and 40% sand at 21 days curing time 21.

Further it can be concluded that fly ash bricks have many advantages like –

- Light weight
- Environment friendly
- Economical
- Saving of fertile land
- Higher compressive strength
- Usage of waste as raw material.

It can be concluded that the use of fly ash in the brick production business is techno-economically viable if it is implemented using the best available technology with appropriate degrees of automation and capacity

creation. The manufacture of fly ash bricks is one potential application where large-scale use of fly ash is conceivable.

References

1. Hivasheesh Kaushik, Nimisha Raj, Parvez Alam , Sabaz Ali , Naveen Chandra Palariya. Optimization of Compressive Strength for Fly Ash Building Bricks Using Taguchi Method., international Journal on Emerging Technologies.
2. Pravin P. Gadling, M.B. Varma. A Review of Ecofriendly Bricks by Using Fly Ash., Volume 7, Issue 2, Journal of Construction Engineering, Technology and Management.
3. P.P. Gadling, Dr. M.B. Varma, Comparative Study on Fly Ash Bricks and Normal Clay Bricks Vol. 4, Issue 09, 2016 international Journal for Scientific Research & Development.
4. IS 12894:2002 – Pulverized Fuel Ash-Lime Bricks – Specification
5. IS 3115:1992 – Specification for lime-based blocks
6. IS 10049: 1981 (Reaffirmed 2009) – Code of Practice for Manufacture of Lime Based Blocks
7. IS 2541:1991 – Code of practice for preparation and use of lime concrete
8. IS 3495:1992 (Part-1)– Compressive Strength of Brick
9. IS 3495:1992 (Part -2)– Water absorption of fly ash brick
10. IS 3495:1992 (part-3)– Efflorescence test of fly ash brick