RESEARCH ON

"FLY ASH BRICKS"

SIKKIM MANIPAL INSTITUTE OF TECHNOLOGY

Submitted for the partial fulfilment of the

Requirement for awarding the

Degree of Bachelor of Business Administration (BBA)

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PREFACE

Our group is committed to pursuing sustainable and eco-friendly construction materials, and as such, have undertaken a comprehensive project focused on fly ash bricks. Fly ash, a byproduct of coal combustion, has proven to be a viable alternative to traditional clay bricks, thanks to its abundance, cost-effectiveness, and environmentally-friendly characteristics. In contrast, the conventional production of clay bricks involves topsoil excavation, which contributes to soil erosion and deforestation. Fly ash bricks are manufactured using fly ash, a waste material generated by thermal power plants, thereby transforming it into a valuable resource for the construction industry. This approach not only mitigates the environmental impact of fly ash disposal but also conserves natural resources.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude towards all individuals who advocated me through the progress of this exploration.

Primarily and notable, I widen my profound thanks to my mentor and guide Dr. Ajeya Jha, for their constant counselling, precious pointers, and reinforcement at every period of this exploration. Their comprehensions exceedingly produced the guidance and complexity of this research.

I am also grateful to the faculty members of the Department of Management Studies for their academic support and for granting a fostering research atmosphere.

Special thanks to my peers and friends for their persistent incentive and consideration that intensified the capacity of this project. I also appreciate the various authors, policymakers, and industry experts whose works and reports functioned as vibrant references.

Lastly, I am profoundly comforting to my family for their staunch foundation, patience, and belief in me through this journey.

Dr. Ajeya Jha / Mr. Tathagat Sharma

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ABSTRACT

This research project investigates the viability, advantages, and public perception of fly ash bricks as a sustainable alternative to traditional clay bricks. Fly ash, a byproduct of coal combustion, has been repurposed into bricks that promise ecological and economic benefits. The study employs both primary data, gathered through surveys of 151 respondents, and secondary data from existing literature and policy documentation. It assesses fly ash bricks on parameters such as environmental friendliness, fire resistance, cost-effectiveness, and structural performance. Findings indicate widespread awareness and positive perception among consumers, supported by government regulations promoting their adoption. The project further compares the manufacturing process, cost analysis, and material properties of fly ash bricks with conventional clay bricks, reinforcing the sustainable and commercial promise of fly ash bricks in modern construction.

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INTRODUCTION

INTRODUCTION

Due to its numerous advantages over traditional clay bricks, fly ash bricks have gained immense popularity amongst builders in the construction industry. Fly ash, a fine powder produced when coal is burned in thermal power stations, is mixed with sand, lime and gypsum to create bricks. For one thing, alternative fuel vehicle buyers are especially attuned to the total cost of ownership. This is in addition to the initial purchase price, which, of course, is only part of your car's total cost, which includes fuel, maintenance, insurance, and potential resale value. Creating a detailed taxonomy that considers these costs within a variety of fuel sources (electricity, hydrogen, biofuels, etc.) and vehicle models is essential to pinpointing the highest realistically possible options for separate customer demographic groups.

Fly ash is obtained from the flue gases of power plants and is regarded as a product of the combustion process. Rather than being used as waste, fly ash can be used efficiently in the manufacture of bricks as an environmentally friendly alternative to the traditional clay bricks.

One of the key advantages of fly ash bricks is that they are eco-friendly. As they utilize fly ash, which otherwise would be disposed of in a landfill site, the bricks reduce the carbon footprint of traditional clay brick manufacture. Fly ash bricks are less water and energy intensive to manufacture than traditional clay bricks and thus more energy and water efficient.

Our project approaches fly ash brick manufacturing at large, including numerous aspects that involve almost everything from manufacturing processes to material properties, structural response, and sustainability. Our ultimate goal is to improve the quality of fly ash brick production and be as good as, or better than the industry standard. Additionally, we are aiming to analyze the economic viability of large scale fly ash bricks production on the basis of raw material, energy requirement and commercial viability. Our comprehensive study is expected to add up valuable inputs for the construction sector regarding fly ash bricks' pros and cons. Our project is our share of the eco-friendly revolution, and as a collective, we are in the business of environmentally friendly construction.

CHAPTER: 2

LITERATURE REVIEW

LITERATURE REVIEW

Green building material literature recognizes the need to replace conventional clay bricks since they possess environmental flaws, most significantly topsoil loss and excessive energy usage during the production process. Fly ash bricks, as an environmentally friendly alternative, utilize waste generated in thermal power plants, thus providing a satisfactory waste disposal solution and conserving natural resources.

Government Policies and Support: Various policies and studies reveal the growing trend of fly ash brick usage. Compulsory use in government buildings and subsidization have contributed significantly to increased usage, as stated by the Ministry of Environment and Forests (1999) and Kumar et al. (2003).

Technical Benefits: Studies by Kayali (2005) among others have enumerated that fly ash bricks possess high fire resistance, low water absorbency, strong compressive characteristics, and also better insulation capabilities. These parameters are also upheld by standardized laboratory test methods cited in IS and AS/NZS standards that provide reference tests for strength, water absorbability, and efflorescence resistance.

Market and Economic Facts: According to Sengupta (1984) and Rangwala (1991), fly ash bricks have considerable cost benefits with less fuel, labour, and raw materials needed. Not only do these benefits lower the cost of production, but they also make them commercially acceptable for mass production.

Adoption and Awareness: Journal and conference studies recognize increasing awareness on the part of consumers, architects, and builders of the environmental advantages of fly ash bricks. Increasing demand for green building techniques is an indication of movement in the industry towards green technologies.

Literature evidently substantiates technical environmental and economic advantages of fly ash bricks in tandem with findings of present study. Market trends and policy support are pointing toward a rosy future for fly ash bricks in conventional construction pretty steadily nowadays.

CHAPTER: 3

OBJECTIVES OF THE STUDY

OBJECTIVES OF THE STUDY

1. To assess the perception of the advantages of ash bricks over clay bricks.

2. To ascertain preference for ash bricks as being positively associated with pro environmental attitude.

To measure the perception of advantages of ash bricks over clay bricks

➢It may be difficult to quantify awareness of fly ash brick benefits compared to clay bricks since it involves carrying out surveys, research, or using available data.
➢Some observations and general trends on raising awareness and use of fly ash bricks are as follows:

Government Policies and Regulations

• Most governments have seen the advantages of fly ash bricks and have put policies and regulations in place to encourage their use. These policies tend to be in the form of incentives, subsidies, or requiring the construction sector to use fly ash bricks. The existence of these policies shows increasing awareness of the superiority of fly ash bricks over clay bricks.

Research and Publications

• Researchers and industry experts have contrasted the performance, environmental effects, and properties of clay bricks and fly ash bricks in peer-reviewed scientific journal articles, conferences, and reports, and this contributes to the information spread regarding the benefits of fly ash bricks. Having such research shows more experts and researchers who are aware of the benefits. Industry Adoption and Market Demand: • The increasing adoption of fly ash bricks by developers and construction companies points to a growing acceptance of their benefits. Increased demand for green and sustainable building materials has been one of the key reasons for the popularity of fly ash bricks. This shows that developers, contractors, and architects are increasingly looking at the benefits of fly ash bricks over normal clay bricks.

CHAPTER: 4

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

Research design frameworks that combine quantitative data with qualitative insights benefit from the mixed structure approach because it allows for complex analysis with detail.

• Nature —Descriptive, comparative, analytical.

The description extends deeply into comparative approaches in conjunction with analytical parts. The range of sentences from 5 to 24 words appears throughout the text in a scattered manner for diverse control purposes. Research methods exist in large numbers that operate comparably between different academic fields, even though they allow individual flexibility through novel approaches to measurements. Secondary data consists of information that other users have processed for unique purposes in past studies and gets its references from numerous sources.

• SAMPLE SIZE: 151 Respondents

B. The analysis of secondary data continues to enhance research background studies throughout various fields of study, with a total number of 151 respondents involved. The actual direct sources provide primary data that researchers utilize for specific research. Organizations and researchers select various well-planned methods, including surveys and interviews and experiments and observations, to acquire research data.

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PRODUCTION

PRODUCTION

•The bricks have also been called Fly ash bricks. In essence, the only heavy component of the bricks is the ash. Water is the main liquid component.

•Take other substances that are nowadays commercially protected but which are affordable, readily obtainable and, although necessary, in small quantity.

•The technology, includes the method of mixing, forming into molds, curing and firing.

•They can be easily implemented by existing clay brick factories. The technology uses less energy than in energy consumed to produce clay bricks.

•Besides that, it is less manpower-intensive and occupies less space for material processing than the manufacture of clay bricks.

Table 1. Items of difference in the production process and expected to make cost difference:

	Common Load Bearing Clay Bricks	Load Bearing FlashBricks
Factory location	On site of raw materials	Any where, preferably on site of coal power station
Factory location	Must change when material depletes	No change needed
Excavation needed	required	None
Raw materials qualities	Varies daily	consistent
Raw material needed per 1000 bricks	4-5 tonnes of clay and shale	2.75 tonnes of fly ash
Raw materials wastage per 1000 bricks	1.7-2 tonnes of clay and shale	None
Grinding of rocks	required	None to grind
Mixing dry materials	required	None
Additive (subject to provisional confidentiality)	None	Required @ 0.2L/100 kg
Drying green units	7 days	3 days
Temperature of firing the units	1000°C- 1300°C (1832 F-2372 F)	1000°C- 1300°C (1832 F-2372 F)
Length of firing time	1day-7 days	Few hours (subject to provisional confidentiality)

Summarizes the production process differences between the Fly ash bricks and the clay bricks. A very notable saving which can be voluntarily observed is that of workers. Since there is no grinding or mining involved, the workers which are conventionally used for these activities will not be required.

Added to this is the requirement of constant testing of the raw materials in the case of clay bricks. This is not required in the case of Fly ash bricks since the ash is tested again and again at the power generation plant as a mandatory practice. Therefore, the employees engaged in testing of clay materials will not be needed for Fly ash brick production. Additional market research of the products listed above is needed so that numbers can be allocated to total savings with Fly ash bricks till now, the production of Fly ash bricks has been done in the laboratory. This has been done again and again successfully, and the testing has yielded consistent results. Figure 1 depicts the moulded bricks in their fresh state.

Figure 1: cured ash bricks

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TESTING FLY ASH BRICK COMPARED TO CLAY BRICKS

TESTING FLY ASH BRICK COMPARED TO CLAY BRICKS

- Absorption Test: The absorption test is carried out to regulate the amount of water absorbed by the bricks. when emerged in water for a period of 24hrs it should not, in any case, exceed 20%of weight of dry bricks this test is carried out for all the samples of fly ash bricks and clay bricks.

1.Normal Bricks:

S.NO	Dry Weight (kg)	Wet weight (kg)	Water absorption (gm)	Water absorption (gm)
1.	3.13	3.50	370	10.57
2.	3.21	3.64	430	11.81
3.	2.78	3.21	430	13.40
				11.93

2. **Fly Ash Bricks**:

S.NO	Dry Weight (kg)	Wet weight (kg)	Water absorption (gm)	Water absorption (gm)
1.	3.17	3.47	300	8.64
2.	2.98	3.30	320	9.70
3.	3.00	3.37	320	10.97
	Average			9.77

- **Hardness test:** The brick hardness test determines if the brick possesses proper hardness. Visually inspect the brick surface with finger nails to determine its hardness properties. The conduct of the tests applies to both fly ash brick samples along with clay brick samples.

- **Efflorescence test:** Soluble salts presence in bricks can be determined through the efflorescence test by submerging bricks in water for 24 hours followed by drying them in the shade. No white or grey deposits appearing on brick surfaces indicate the deficiency of soluble salts. The presence of white deposits less than 10% results in slight efflorescence while moderate efflorescence develops when the deposits reach 50%. Efflorescence is regarded serious when grey or white depositsextend beyond 50% of the surface followed by a transformation into a powdery mass. The analysis for fourth fly ash bricks along with clay bricks is performed through this test.

- **Crushing Strength test:** The principal test used to judge brick suitability for construction purposes is the Crushing Strength test. The compression testing machine operates to execute this particular test. The compression testing machine accepts a single brick as an input. It is pressed till it breaks. The compression testing machine measures the compression strength of the brick at its final stage. The compression test follows its application to tested samples of both fly ash bricks and clay bricks.

Normal Bricks:

S. No.	Length (mm)	Breadth (mm)	Depth(mm)	Load KN	Crushing Strength (N/mm^2)
1.	228	110	72	220	8.70
2.	221	110	70	160	6.58
3.	220	105	69	160	6.93
4.	218	104	70	220	9.70
5.	227	104	74	200	8.47
6.	226	103	71	190	8.47

Fly Ash Bricks:

S. No.	Length (mm)	Breadth (mm)	Depth(mm)	Load KN	Crushing Strength (N/mm^2)
1.	228	114	75	387	14.89
2.	227	114	76	522	21.33
3.	228	113	74	390	15.13
4.	227	114	74	613	23.68
5.	227	114	74	453	17.50
6.	226	113	73	520	20.36
		Average		18.81	

CHAPTER: 7

MATERIALS AND MATHOD

MATERIALS AND METHOD

GENERAL:

- Material selection serves as an essential support role during product usage. A material testing program needs implementation at every busy phase of construction. There are two testing approaches: destructive methods that lead to material destruction and non-destructive procedures leaving the material usable. It becomes necessary to use sampling because testing all materials at once is not feasible to gather information about lot properties. The testing follows standard procedures that ensure uniform results for comparative use.

MATERIALS:

- The research uses mud, slag, cement and fly ash, river sand, gypsum along with lime as its various raw materials.

METHODOLOGY:

- The section explains the methodology that will be used for brick casting. A generic procedure exists for each chosen material despite their individual differences.

SITE SELECTION:

- The selection of the site makes a substantial contribution to the production of bricks. A correct choice of site ensures both raw materials remain constantly available and workers remain present at the site. Correct site selection guarantees the ability to connect the site adequately for finished product transportation.

PREPARATION OF MIX:

Proper entity between ingredients and correct water measurement determination represents an essential part of this operation. The required mix proportion determines the material weights followed by blending all components into a plastic substance through proper water addition.

CHAPTER: 8

PRICE

PRICE:

- Raw material availability determines the price of the products.
- The whole value of this business depend solely on purchasing raw material at market prices.
- The need for locality investigation comes first because you must assess your local market demand for brick types and shapes.
- The production of red bricks will become illegal entirely within the next one to two years because government initiatives prohibit their manufacturing due to environmental and soil resource requirements.

INVESTMENTS:

- LAND
- MACHINES
- RAW MATERIALS
- SHADE
- LABOUR (According to your requirement)

PROJECT COST:

- The project expense for working capital and machinery and plant amounts to Rs.30,00,000. The production output of this machinery reaches 12,000 bricks per shift. The project budget for machinery and plant and working capital amounts to Rs.30,00,000 but does not include the expense of using Diesel for power generation.

MATERIAL:

- fly ash
- lime/chuna
- sand
- cement
- main machine
- pan mixture
- conveyor belt

PROFIT:

- The business profit extends throughout this area. However, you will achieve a 1 Rs. profit per brick. By engaging in this business you can definitely obtain a profit of 1 Rupee per brick. Per brick as profit.
- The availability of raw materials, workforce and electricity determines your business profit level.

PRICE ANALYSIS OF RED BRICK AND FLY ASH BRICK

ITEM	RED CLAY BRICK	FLYASH BRICK
SHAPE AND SIZE	 (9x4x3) = 225x102x75 mm	 (9x4x3) = 225x102x75 mm
MARKET PRICE	Rs.8-Rs.10 Per Pics	Rs.4-Rs.5 Per Pics
WITH CEMENT (+10mm)	(9x4x3) = 235x112x85 mm =0.235x0.112x0.085 m =0.00952 sq. mt.	(9x4x3) = 235x112x85 mm =0.235x0.112x0.085 m =0.00952 sq. mt.
MAKING 9" WALL	0.00952 sq. mt.	0.00952 sq. mt.
NO. OF BRICK REQUIRED	11.15/0.00952 TOTAL=1,171 BRICK	11.15/0.00952 TOTAL=1,171 BRICK
COST	1,171x8=9,368/- & 1,171x10=11,710/-	1,171x4=4,684/- & 1,171x5=5,855/-

CHAPTER: 9

PROMOTION

PROMOTION:

- The communication segment between buyers and the Ash Bricks Manufacturing Industry is called promotion. Through promotion activities the Ash Bricks Industry acts to persuade potential purchasers to acquire their services and products. The marketing method serves to develop awareness of Industry products among people. The Industry gains improved public reputation through this method. Such marketing techniques create both new customer interest and establish devoted customer relationships.

Different promotional strategies adopted by Fly Ash Bricks Manufacturing Organizations:

1. Advertising
2. Direct Marketing
3. Digital marketing

ADVERTISING:

- The process of promoting businesses and products appears through television broadcasting as well as radio and internet platforms. The execution of advertising functions as a method to notify audiences regarding business products or services. The communication channels used by Fly Ash Bricks Industries consist of traditional media such as newspapers, magazines and outdoor advertisements and new media like search engine results, blogs, social media and websites and SMS platforms.

DIRECT MARKETING:

- The advertising unit known as direct marketing enables Fly Ash Bricks Industries to engage with customers through various platforms including cell phone text messages, email, websites, internet advertising, database marketing, fliers, catalog delivery, promotional letters and newspaper and magazine advertising and outdoor advertising.

DIGITAL MARKETING:

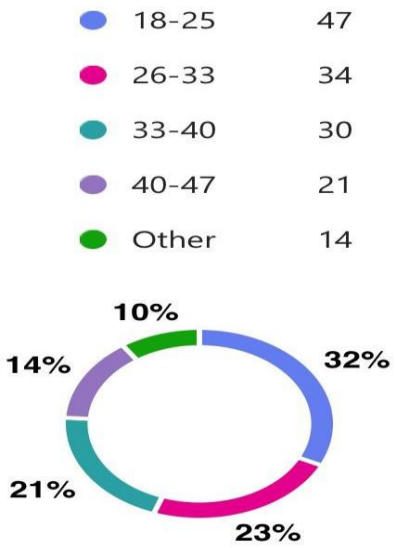
- Digital marketing refers to brand promotion through the internet and different digital communication channels which seek prospects as customers. Digital marketing includes email marketing as well as social networking and online ads together with text message and multimedia marketing as promotional tools. A marketing strategy becomes digital marketing whenever it contains any form of digital message communication.

CHAPTER:10

ANALYSIS AND FINDINGS

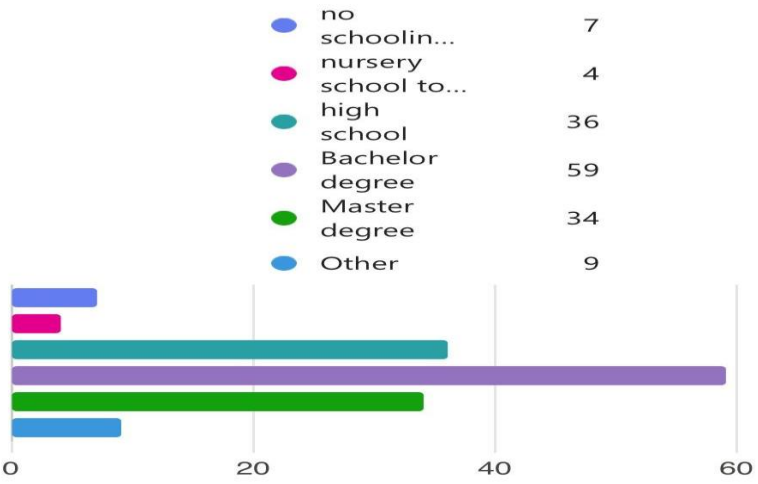
RESPONDANTS: 151

- **AGE GROUP:**



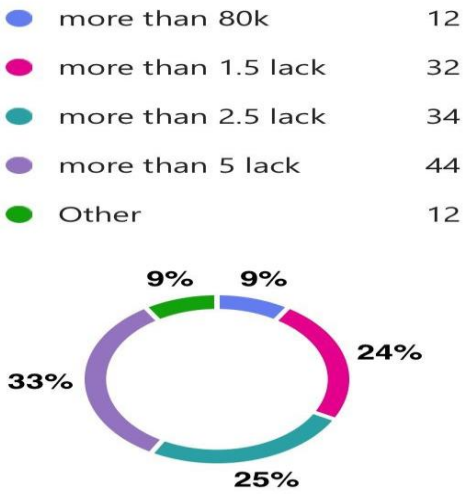
INTERPRETATION: Most respondents fall within the age of 18-25 age groups i.e. 32% and 26-33 age groups i.e. 23% and 33-40 age groups are 21%, 40-47 age groups are 14% and more than age of 47 years are 10%. Here most respondents are generally students and businessmen.

- **EDUCATION LEVEL:**



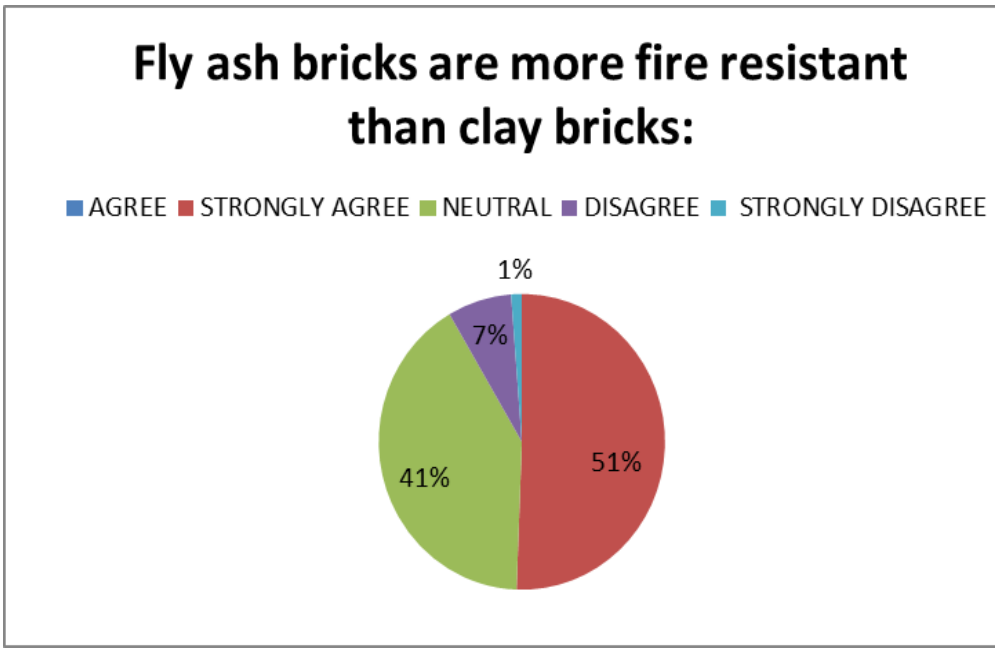
INTERPRETATION: The majority of respondents (59) possess a Bachelor's degree, indicating a high level of education. Following closely are high school (36) and Master's degree (34). Very few had no education (7) or nursery only (4). A small minority (9) fall into the "Other" category.

- **ANNUAL INCOME:**



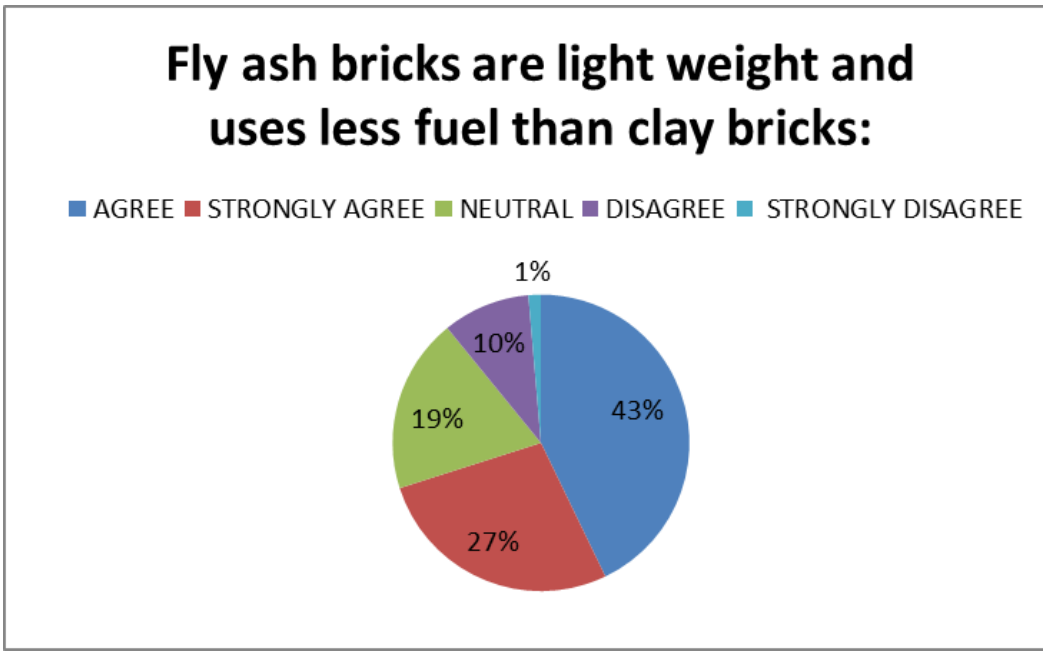
INTERPRETATION: The majority of respondents (44) have an annual income of more than 5 lakh, representing the highest segment (33%). This is trailed by 34 individuals with more than 2.5 lakh (25%) and 32 with more than 1.5 lakh (24%). Fewer (12 each) make more than 80k or are in the "Other" category (both 9%).

Question-1



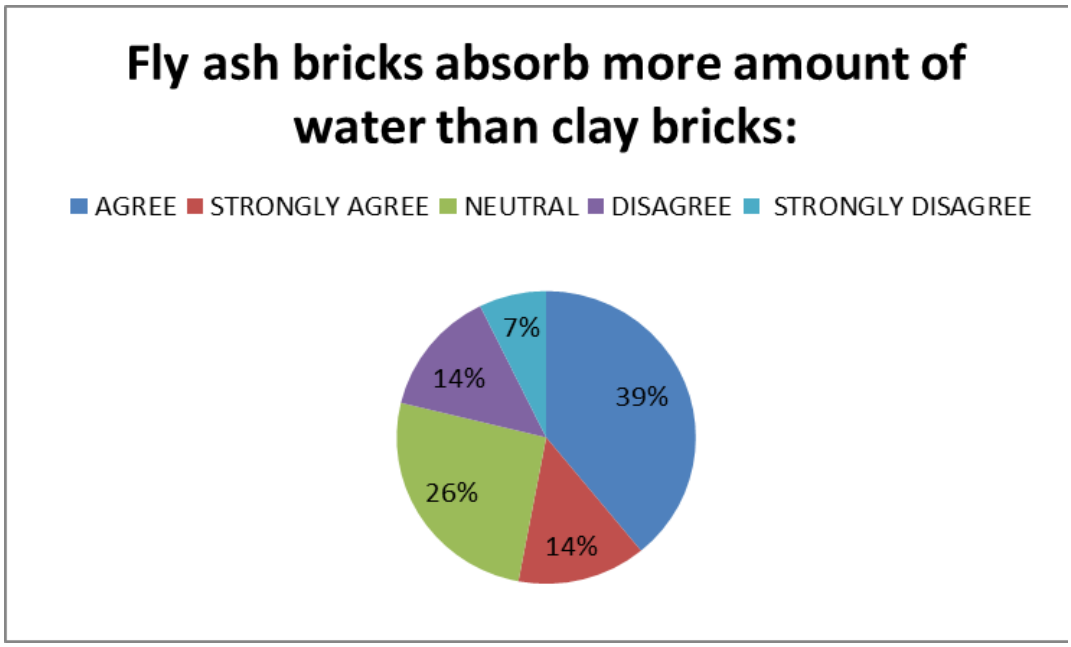
INTERPRETATION: Most of the respondents (58%) think that fly ash bricks are more resistant to fire than clay bricks, with 51% in agreement and 7% strongly agreeing. A significant proportion (41%) is neutral, suggesting they may not have information or have no strong opinion on the matter.

Question-2



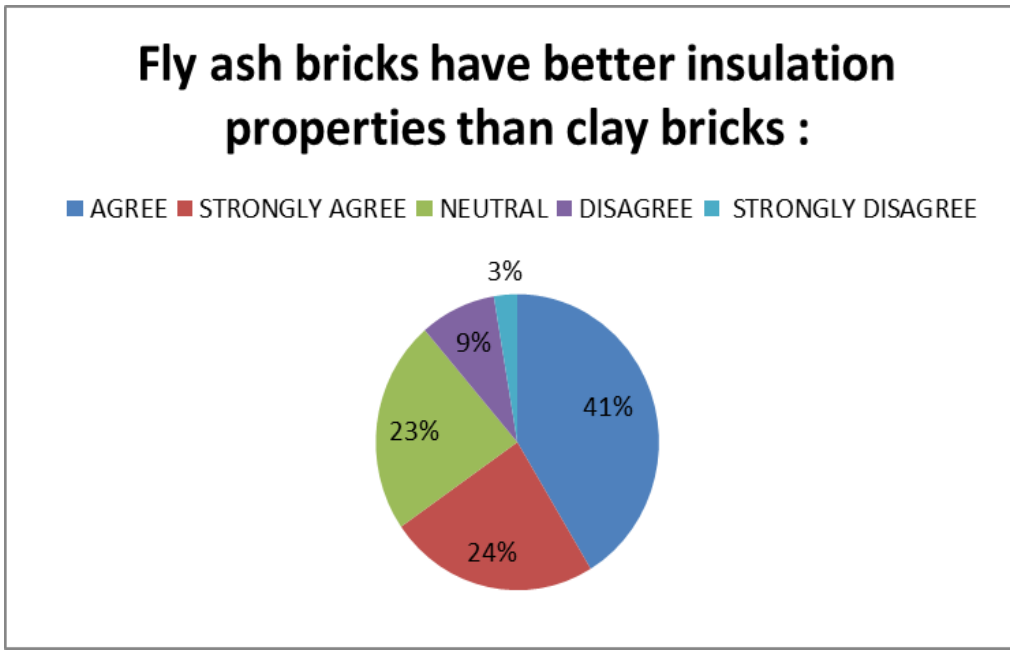
INTERPRETATION: A majority of the respondents (43%) agrees that fly ash bricks are light in weight and consume less fuel compared to clay bricks. 27% strongly agree, and 19% are neutral. 10% disagree and 1% strongly disagrees. This indicates high overall support for the statement.

Question-3



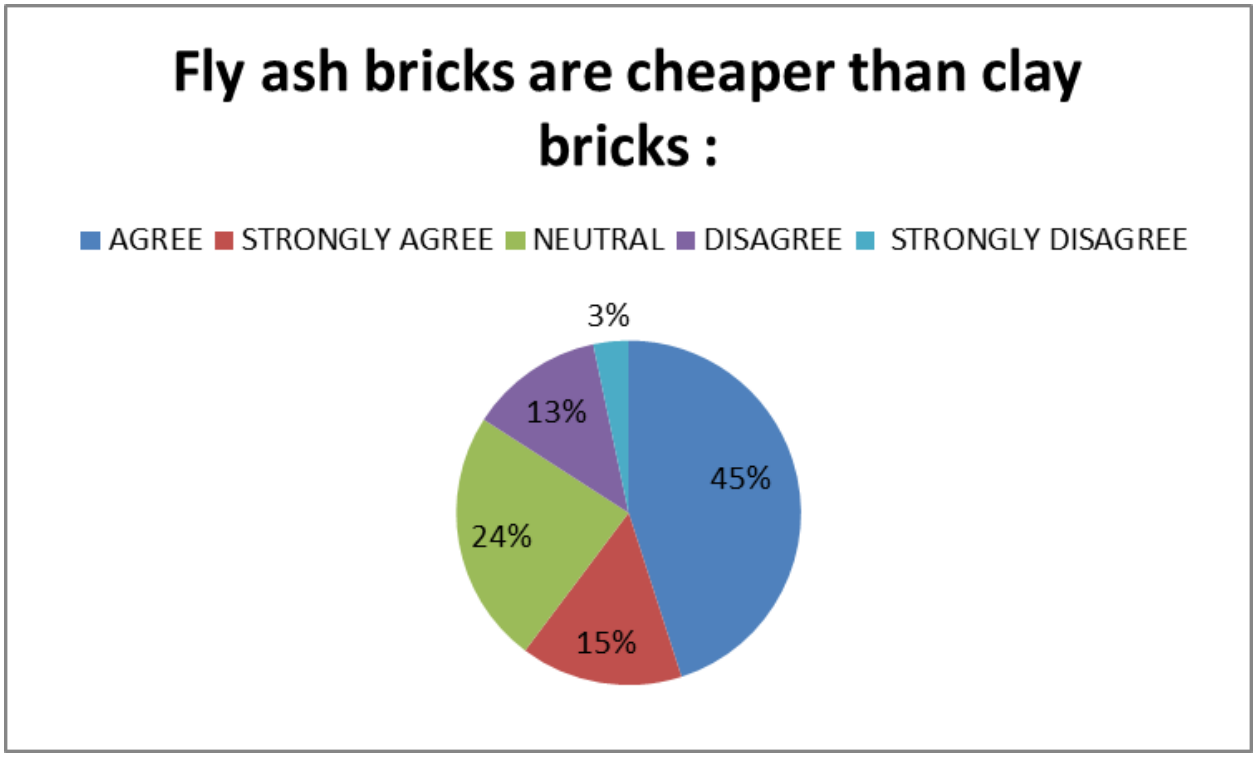
INTERPRETATION: Most (39%) of the respondents concur that fly ash bricks absorb more water compared to clay bricks. 14% strongly agree, 26% are neutral, 14% disagree, and 7% strongly disagree. This indicates that many think fly ash bricks absorb more water, but there are mixed opinions.

Question-4



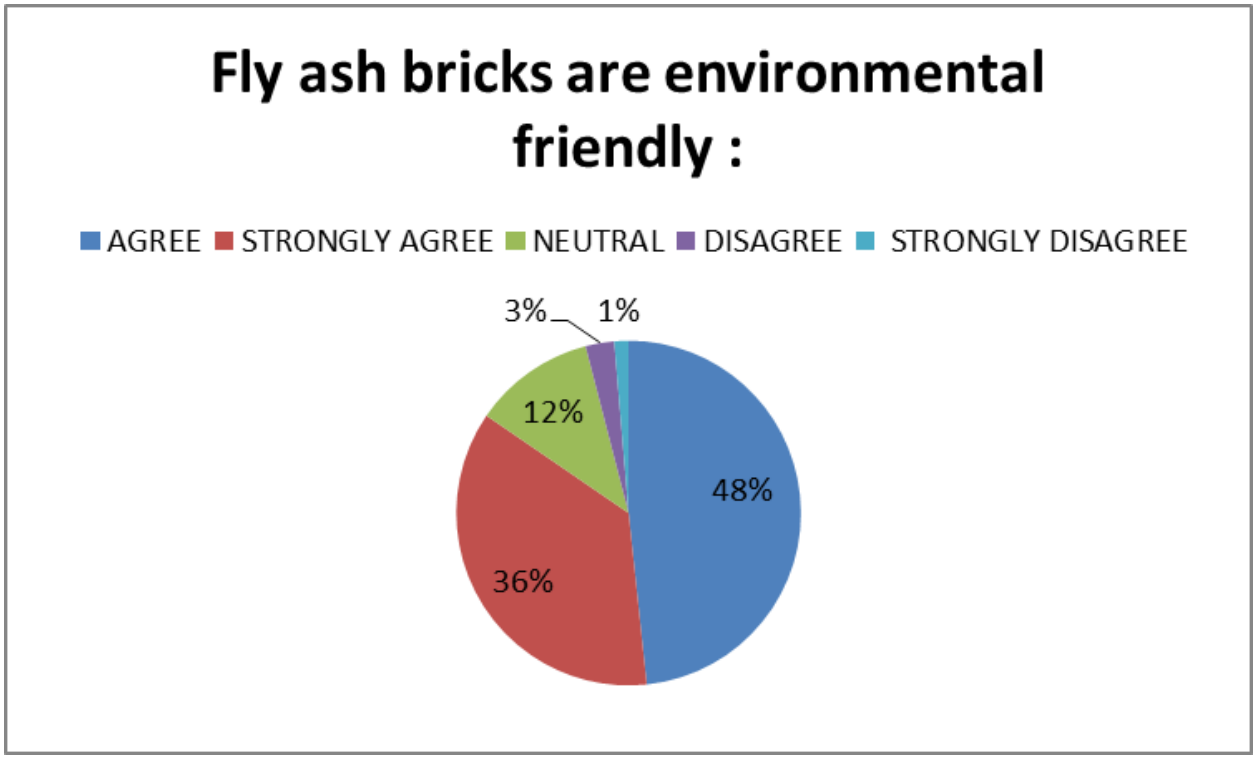
INTERPRETATION: Most respondents (41%) agrees that fly ash bricks are more insulated than clay bricks. 24% strongly agree, and 23% are neutral. Few disagree (9%) or strongly disagree (3%). This indicates overall support for the statement.

Question-5



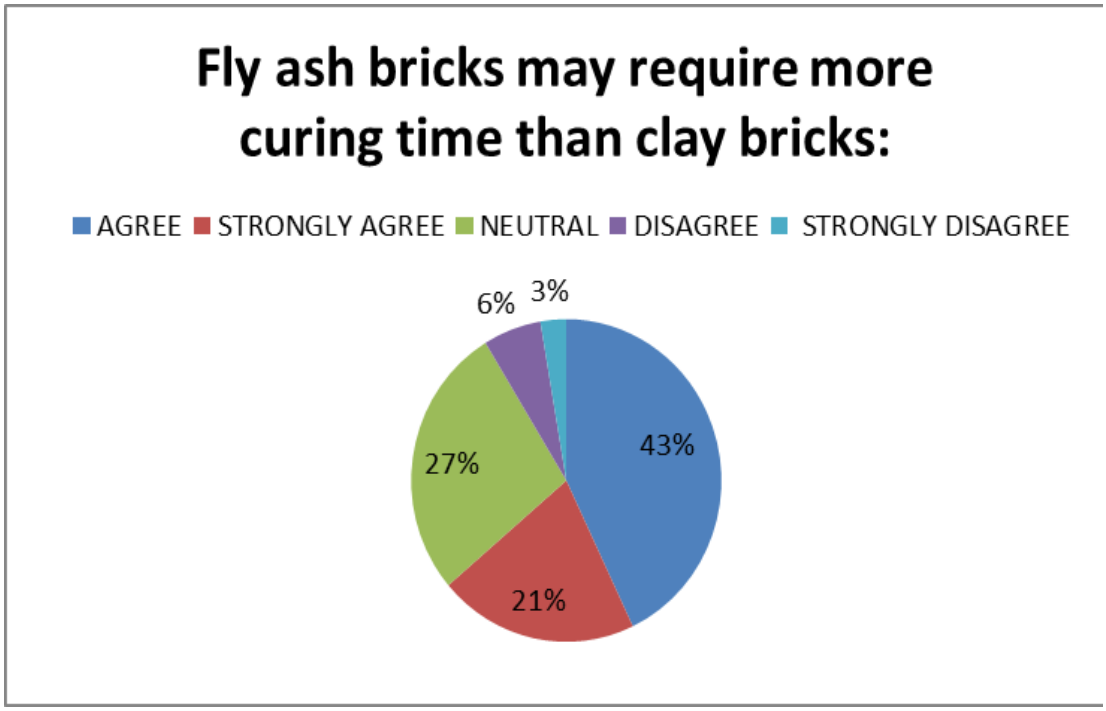
INTERPRETATION: The majority of individuals (45%) agree that fly ash bricks are more cost-effective than clay bricks. 15% strongly agree, whereas 24% neither agree nor disagree. Not many people disagree (13%) or strongly disagree (3%). The overall response is therefore generally affirmative.

Question-6



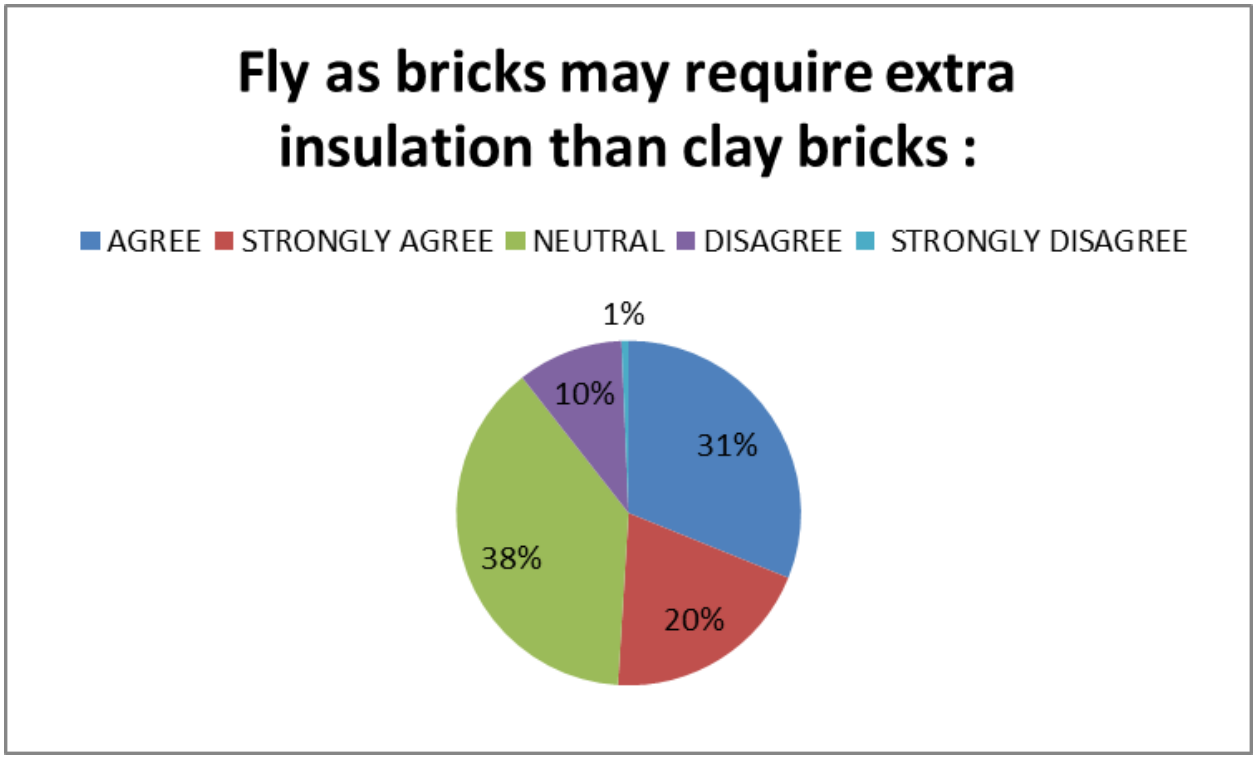
INTERPRETATION: Fly ash bricks are environmentally friendly and are agreed by most people (48%) and also by those who strongly agree (36%). 12% are neutral and 3% disagree, but 1% strongly disagree. The opinion is overall very positive.

Question-7



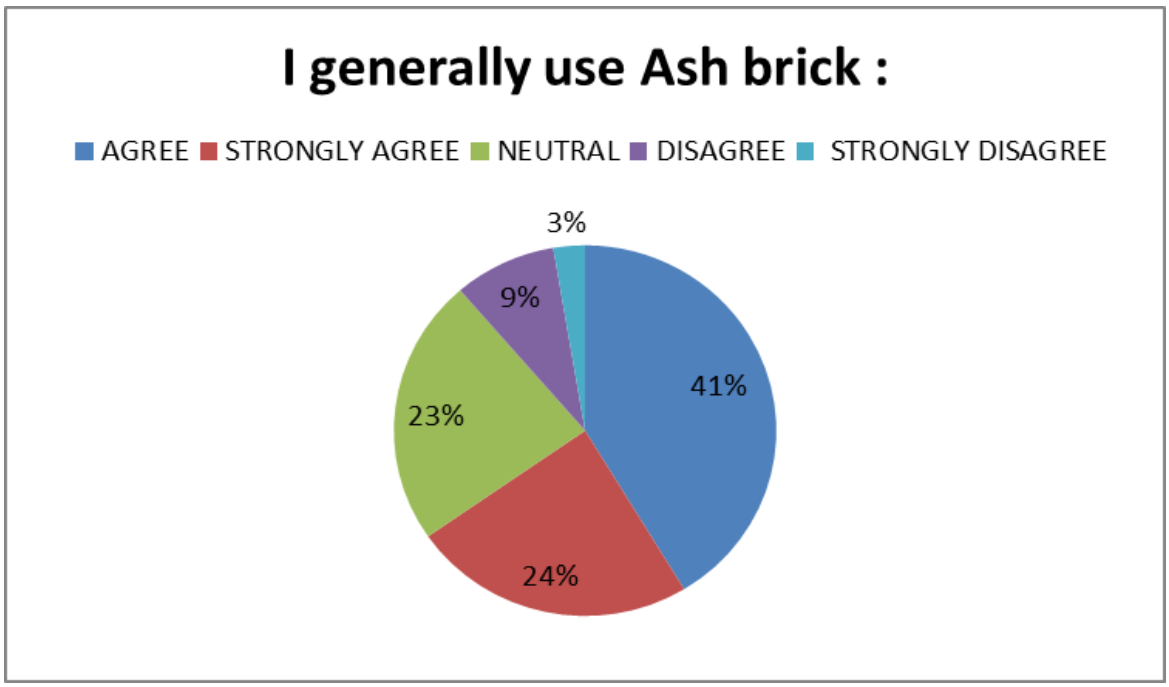
INTERPRETATION: Most people (43%) agree that fly ash bricks may take more time to cure than clay bricks, and 21% strongly agree. About 27% are neutral, while only a few disagree (6%) or strongly disagree (3%).

Question-8



INTERPRETATION: Most people agree or don't know whether fly ash bricks require added insulation as compared to clay bricks. A fair percentage of respondents agree, and probably about one-third do, some definitely agree, but there are a lot of people who are in between, don't know enough. Not many disagree. Therefore, overall it appears that people think fly ash bricks need more insulation but there is some uncertainty.

Question-9



INTERPRETATION: Most people say they usually use ash bricks, with 65% either agreeing or strongly agreeing. A smaller group is unsure, and only a few say they don't use them. So overall, ash bricks seem to be commonly used.

FINDINGS:

1. **The understanding of Fly Ash Bricks and Clay Bricks:**

- **Fire Resistance:** 58% of the participants believed fly ash bricks to be fire-resistant compared to clay bricks, while the minority did not share this belief.
- **Light in Weight and Fuel Saving:** 70% (agree and strongly agree) believed that fly ash bricks are light in weight and use less fuel.
- **Water Absorption:** 53% (agree and strongly agree) opined that fly ash bricks absorb more water, though there was a divided opinion.
- **Insulation Properties:** 65% (agree and strongly agree) reported that fly ash bricks were more insulated compared to clay bricks.
- **Cost-Effectiveness:** 60% (agree and strongly agree) regarded fly ash bricks as cost-effective.

2. **Environmental Benefits:**

- An overwhelming 84% of the participants who agreed or strongly agreed taking into account the fact that fly ash bricks are eco-friendly, thereby indicating to have a predominantly positive attitude.

3. **Insulation requirements and curing time:**

- 64% (agree and strongly agree) agreed that fly ash bricks are slow to set.
- There was skepticism regarding whether fly ash bricks require extra insulation, and they were overall neutral.

4. **Fly Ash Brick Applications:**

- 65% (agree and strongly agree) marked the usage of fly ash bricks, and they demonstrated the day-to-day use of the respondents.

CONCLUSION:

- Fly ash bricks are also a more sustainable and eco-friendly forms of bricks than clay bricks.
- And they use industrial waste so as to cut down on environmental pollution and guard natural resources.
- However, fire resistance, lightweight structure, better insulation and cost effectiveness are some benefits.
- No clay excavation needed to eliminate topsoil erosion. They require less fuel to produce thus they are energy efficient.
- It incorporates higher water absorption, longer curing times, sometimes there is a need for insulation.
- In general, they enjoy wide preference for their overall advantages and good market perception.
- Regular improvements will help them take sustainable construction further.

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