International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

Paver Bricks from Foundry Waste Sand

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Abstract - The foundry industry expands to meet increasing demand for cast components. Green sand has become a critical and important environmental priority. This work demonstrates a feasible ,reusable solution by utilizing foundry waste sand into the production of eco-friendly paver bricks, using a composite mixture of 60% waste sand, 25% cement, 10% gravel, and 2% coconut fibre. By assessing the fitness of these materials for practical use, this study provides a alternative to traditional burnt clay bricks, effectively reducing the heavy dependence on landfills for sand disposal and mitigating the environmental degradation associated with conventional brick manufacturing.

Keywords: Waste foundry sand , coconut fibre , compressive strength , paver bricks

1. INTRODUCTION

The Indian economy is growing faster and has attained the fourth largest economy in the world along with rapid growth in economy and population there occurs a rapid industrialisation growth (1). The foundry industry plays a crucial role in manufacturing by supplying essential cast components for automotive, construction, agricultural, and heavy machinery sectors. A by-product of this process is foundry sand, primarily silica-based, used repeatedly in moulds for metal casting. However, after several cycles, the sand loses its bonding strength and becomes unsuitable for further use in foundries. This results in the generation of large quantities of **foundry waste sand (FWS)**, which is often disposed of in landfills, posing environmental, health, and land utilization concerns. Conventional burnt clay bricks require large amount of clay and high temperature kiln firing which result in reduction in soil fertility and high emissions of carbon . In India we have been using burnt clay bricks regularly but these bricks have disadvantages in the from of environmental pollution that is land and air pollution . Pollution happens by burning the bricks using wood and coal as a fuel for burning (2).

As industries grow, so does the volume of waste sand, with each ton of casting potentially generating up to 2.2 tons of waste material. Foundry waste sand may contain residual binders, metals, and chemical additives, making it partially hazardous if not treated or disposed of responsibly. Conventional disposal methods are increasingly unsustainable due to stricter environmental regulations, rising disposal costs, and growing awareness of sustainable industrial practices.

To address these challenges, this project explores the **regeneration of foundry waste sand** through various physical and chemical reclamation processes. The objective is to clean and restore the waste sand so it can be repurposed, particularly as a **resource in building material production**. Reusing foundry sand in construction applications not only reduces the environmental burden but also helps in conserving natural resources like river sand and promotes a **circular economy**.

OBJECTIVE

1. To find alternative to traditional burnt clay and flyash bricks.

2. to reduce landfills due to dumping of foundry waste green sand.

3. to reduce pollution caused by traditional burnt clay bricks.

2. METHODOLOGY

2.1 Materials Required

The paver bricks are engineered using a five-part composite designed for the balancing of industrial waste recycling . The specific materials used in the mixture are:

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- **Foundry Waste Green Sand (60%):** The primary fine aggregate, sourced from the moulding process after it can no longer be reused for casting. Foundry sand has high percentage of silica it is responsible for providing hardness , strength and stability to construction materials(3).
- **Cement (25%):** Acts as the hydraulic binder, reacting with water to glue the aggregates together and provide compressive strength.
- **Gravel (10%):** A coarse aggregate that provides the internal "skeleton" of the brick, enhancing its durability and volume stability.
- **Coconut Fibre (2%):** A natural reinforcement (bio-fibre) added to improve the tensile strength and prevent shrinkage cracks during the curing process.
- **Water (W):** The essential chemical activator for the cement's hydration process, ensuring the mixture is workable enough to be moulded into shape.

2.2 Brick Composition

Material	**Quantity per brick**	**Approx. Cost**	**Remarks**
Waste Foundry Sand (WFS)	60%	Minimal/Waste Material	Industrial by-product
Cement	25%	Medium	Main binder
Gravel	10%	Low	Improves strength
Coconut Fiber	1–2%	Low	Reinforcement
Water	w/c ≈ 0.45	Negligible	For hydration

3. TESTING

To test how well the eco-friendly bricks can withstand pressure, we put them through a **Compressive Strength Test** using a **Universal Testing Machine (UTM)**. This is the most critical test for any paving material because it mimics the real-world weight of foot traffic.

The Testing Process

We started by taking the cured bricks , made from the foundry waste sand and placing them right in the centre of the UTM's loading plates. Once the machine was set, it began applying a steady, vertical squeeze to the brick.

The role of the **2% coconut fibre** was very essential . While the foundry sand and cement provide the bulk of the strength, the fibres act like tiny internal skeletons. As the machine increases the pressure, these fibres help the brick "hold on" by bridging small internal cracks, preventing the specimen from just breaking instantly like a typical clay brick might.

The test continued until the brick finally reached its limit. The machine then recorded the **Ultimate Load**, which is the exact point of failure. This gave us a clear view of just how much pressure or weight the recycled brick can actually handle before they break .

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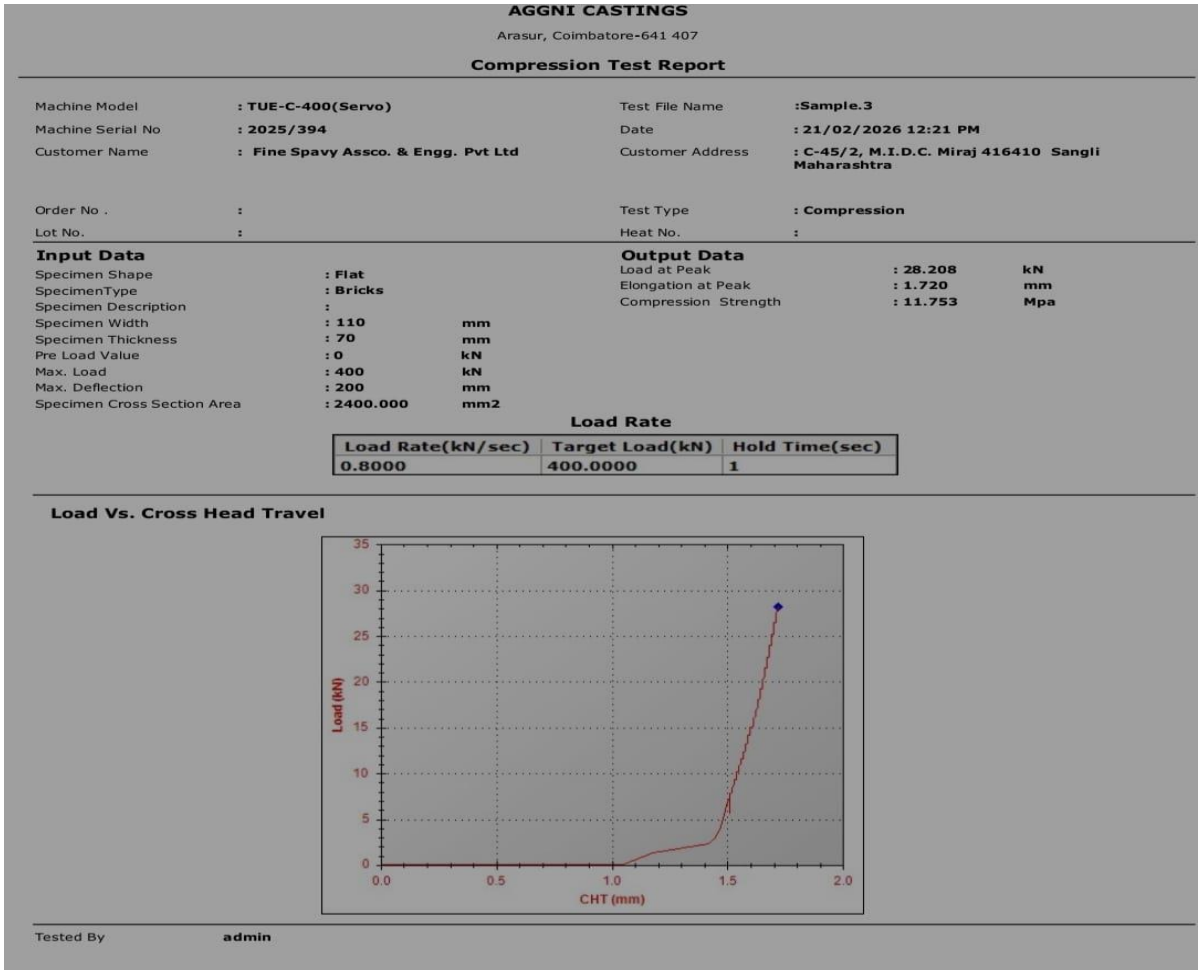


AGGNI CASTINGS

Arasur, Coimbatore-641 407

Compression Test Report

Machine Model	: TUE-C-400(Servo)	Test File Name	:Sample.3
Machine Serial No	: 2025/394	Date	: 21/02/2026 12:21 PM
Customer Name	: Fine Spavy Assco. & Engg. Pvt Ltd	Customer Address	: C-45/2, M.I.D.C. Miraj 416410 Sangli Maharashtra
Order No .	:	Test Type	: Compression
Lot No.	:	Heat No.	:

Input Data

Specimen Shape	: Flat	
SpecimenType	: Bricks	
Specimen Description	:	
Specimen Width	: 110	mm
Specimen Thickness	: 70	mm
Pre Load Value	: 0	kN
Max. Load	: 400	kN
Max. Deflection	: 200	mm
Specimen Cross Section Area	: 2400.000	mm2

Output Data

Load at Peak	: 28.208	kN
Elongation at Peak	: 1.720	mm
Compression Strength	: 11.753	Mpa

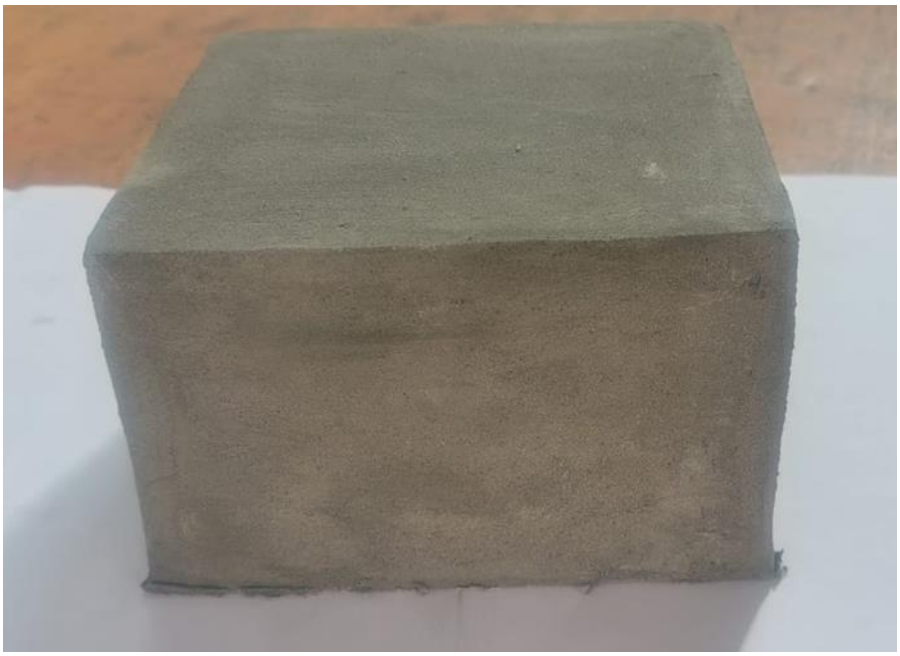
Load Rate

Load Rate(kN/sec)	Target Load(kN)	Hold Time(sec)
0.8000	400.0000	1

Load Vs. Cross Head Travel

Tested By admin

Test result



Final Brick

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RESULT AND DISCUSSION

Thus a compressive strength of 11.735 MPa has been obtained . Some of the researches have achieved an average compressive strength of 5.54 N/mm^2 (4) and others have reported a compressive strength of 5.68 N/mm^2(5).

The experimental analysis indicates that **WFS can be successfully used in brick production** when combined with adequate binder and reinforcement. Key points include:

- **Binder content directly influences strength**: Increasing cement proportion improves compressive strength.
- **Gravel and coconut fibre improve durability**: Particle packing, toughness, and crack resistance are enhanced.
- **Sustainable construction potential**: Using foundry waste sand reduces natural sand consumption and minimizes industrial waste disposal.
- **Trial-based optimization**: Systematic variation in mix ratios allowed identification of a final composition that balances **strength, workability, and environmental benefits**.

The results confirm that bricks made from WFS are **eco-friendly, resource-efficient materials**, ideal for **landscaping, pathways, and non-structural outdoor applications**, demonstrating practical reuse of industrial waste.

Cost Analysis and Weight of Brick

An approximate cost and weight analysis was carried out for the **final optimized brick composition** to demonstrate its **economic feasibility**.

Brick Weight

The **weight of a single brick** was measured after curing:

Brick Type	Approx. Weight (kg)
Final Optimized WFS Brick	2.5

Observations:

- The use of WFS significantly reduces raw material cost.
- Cement remains the primary cost driver, but optimizing its proportion ensures **strength without excessive expense**.
- The final brick weight is comparable to conventional bricks, making it suitable for **easy handling**.
- Overall, these bricks are **economical, sustainable, and practical** while achieving satisfactory compressive strength (~12 MPa).

5.CONCLUSION

Based on the carried out experiment few conclusions have been drawn

1.The brick has got a compressive strength of 11.735 MPa which is sufficient for use.

2.The brick has been made more economical by reducing the cost by 10% and the strength has been maintained to be sufficient for pathway walking of people in various area.

Thus it is understood that foundry waste sand with admixture is a viable option to make bricks a more sustainable option(6) .

The experimental results regarding the utilization of foundry sand in construction materials demonstrate promising outcomes(7).

This study supports sustainable construction and waste management practices.

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FUNDING

This research received no external funding

CONFLICTS OF INTEREST

The author declare no conflict of interest

ACKNOWLEDGEMENT

The authors would like to thank PSG Polytechnic College for technical support during the work. The authors also thank M/S. Aggni Castings , Coimbatore , Tamil Nadu , India for the material support and providing facilities for the completion of the work.

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