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Replacement of Waste Rubber for COA RSE Aggregate in LEGO (Interlocking Blocks)

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Abstract: *This invention relates to the development of sustainable LEGO-type interlocking construction blocks inspired by toy LEGO bricks. These blocks are designed to provide fast, modular, and eco-friendly construction. In this study, crumb rubber obtained from waste tyres is used as a partial replacement for coarse aggregates to promote sustainability and reduce environmental pollution. The blocks are produced using cement, sand, aggregates, and crumb rubber in suitable proportions. Compressive strength and water absorption tests are conducted to compare the performance of rubber-modified blocks with conventional blocks. The results show that although strength slightly decreases, flexibility, impact resistance, and lightweight properties significantly improve. Thus LEGO-type interlocking blocks containing crumb rubber are ideal for non-load-bearing, temporary, or modular structures and contribute to eco-friendly construction.*

Keywords: Lego, Crumb rubber, Sustainable construction

I. INTRODUCTION

LEGO BLOCKS IN CONSTRUCTION

LEGO bricks are small interlocking plastic blocks mostly used as toys, but their simple and strong locking system has inspired new ideas in the construction industry.

In real construction, engineers use LEGO-like interlocking blocks made of concrete or recycled materials. These blocks fit into each other without the need for heavy machinery or skilled labour.

This method is especially useful for temporary shelters, low-cost houses, boundary walls, disaster-relief structures, site offices, and modular buildings. The blocks are easy to assemble and dismantle, which makes construction faster, cleaner, and more reusable.

By using interlocking blocks, construction becomes eco-friendly, reduces cement usage, cuts labour costs, and allows buildings to be completed in a shorter time. This LEGO concept shows how a simple toy idea can improve modern engineering in a practical and sustainable way.

II. OBJECTIVE

1. To develop strong and durable interlocking blocks for construction.
2. To reduce construction time and labour through easy assembly.
3. To promote sustainability by using recycled materials.
4. To provide a cost-effective alternative to conventional building materials.
5. To create reusable and versatile blocks for various structures.

III. SCOPE

- The project focuses on designing and developing interlocking construction blocks inspired by LEGO concepts.
- It includes testing the strength, durability, and stability of the blocks.
- The study covers the use of recycled or alternative materials to improve sustainability.
- The scope involves comparing the blocks with traditional building materials in terms of cost, time, and labour.

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• It also includes examining the suitability of these blocks for small houses, temporary structures, and modular buildings.
• Maintenance, reusability, and ease of transportation of the blocks are also considered within the scope

IV. NEED FOR LEGO INTERLOCKING BLOCKS

• To build houses faster and with less labour.
• To reduce construction cost and material usage.
• To use recycled waste and promote sustainability.
• To create easy-to-assemble and reusable structures.
• To provide affordable housing in developing and disaster-affected areas.

V. IMPORTANCE OF LEGO INTERLOCKING BLOCKS

1. Faster Construction
2. Less Skilled Labour Required
3. Cost-Effective
4. Reusable and Modular
5. High Strength and Stability
6. Eco-Friendly Option
7. Reduced Construction Waste
8. Light weight and Easy to Handle
9. Good Aesthetic Appeal
10. Suitable for Modular Building

VI. MATERIALS

6.1 DESCRIPTION OF CEMENT

Cement is a fine, grey powder that acts as a binding material in construction. When mixed with water, it forms a paste that hardens and gains strength due to a chemical reaction called hydration. Cement binds the aggregates together in concrete and provides strength, durability, and stability to structures. Its quality depends on properties like fineness, setting time, soundness, and compressive strength.

6.2 DESCRIPTION OF FINE AGGREGATE

Fine aggregate consists of small particles of sand, usually less than 4.75 mm in size. It fills the gaps between coarse aggregates and improves the workability of concrete and mortar. Good fine aggregate should be clean, well-graded, and free from silt, clay, and impurities. It contributes to the smooth finish and strength of the concrete mix.

6.3 DESCRIPTION OF COARSE AGGREGATE

Coarse aggregate includes larger particles such as crushed stone or gravel, typically above 4.75 mm in size. It forms the main skeleton of concrete and provides bulk, stability, and load-bearing capacity. High-quality coarse aggregates should be strong, durable, and free from dust or organic matter. Their shape, size, and hardness directly affect the strength and performance of concrete.

VII. MIX PROPORTIONS

Conventional Block 2.106:2.714:6.017:0
25%replacement- 2.106:2.714:4.513:0.267
50%replacement- 2.106:2.714:3.0085:0.534
75%replacement- 2.106:2.714:1.504:0.8022
100%replacement- 2.106:2.714:0: 1.069

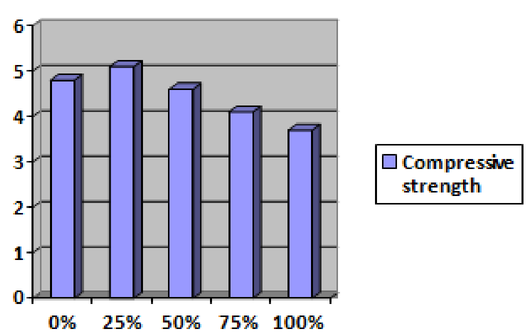
Unit	Water	cement	Fineaggregate	Coarseaggregate
By weight (kg)	3	2.106	2.714	6.017
Byvolume	0.2	0.669	1.024	2.229

VIII. RESULTS

Compressive Strength Test

The compressive strength test is used to find out how much load a concrete block, brick, or cube can resist when pressure is applied. The specimen is placed in a Compression Testing Machine (CTM), and load is applied gradually until it cracks or fails. The maximum load taken by the specimen is used to calculate its compressive strength. This test helps determine whether the material is strong enough for construction work.

REPLACEMENT LEVEL	COMPRESSIVE STRENGTH
0%(Conventional Block)	4.8MPa
25%Replacement	5.1MPa
50%Replacement	4.6MPa
75%Replacement	4.1MPa
100%Replacement	3.7MPa



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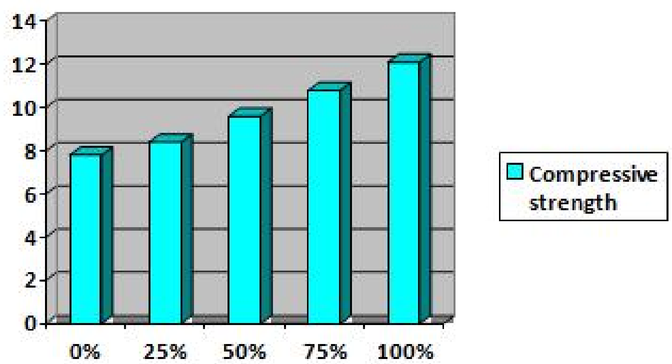
Water Absorption Test

The water absorption test determines how much water a material can soak in. First, the specimen is weighed in a dry condition, then soaked in water for a specific period (usually24 hours), and weighed again when wet. The increase in weight shows the amount of water absorbed. This test helps in understanding the porosity, durability, and weather resistance of the material. High water absorption means lower strength and durability.

REPLACEMENT LEVEL	WATER ABSORPTION(%)
0%(ConventionalBlock)	7.8%
25%Replacement	8.4%
50%Replacement	9.6%
75%Replacement	10.8%
100%Replacement	12.1%



IX. CONCLUSION

The study on LEGO interlocking blocks using rubber as a partial and full replacement for coarse aggregate demonstrated the potential of producing lightweight, sustainable, and economical construction units. When rubber was added in different proportions (25%, 50%, 75%, and 100%), noticeable changes were observed in the block properties.

At25%replacement, the blocks showed good strength with reduced weight, making them suitable for non–load-bearing walls.

At 50%replacement, the weight decreased further, and the blocks maintained moderate strength, making them ideal for partitions and modular structures.

At75%replacement, the blocks became significantly lighter but showed a reduction in compressive strength; however, they remained usable for temporary and low-strength applications.

At100%replacement, the blocks were the lightest and most sustainable but had the lowest strength, making them suitable only for decorative or non-structural purposes.

Overall, the results indicate that rubber can effectively replace coarse aggregate upto 50% without major loss of performance. This makes LEGO interlocking blocks a practical and eco-friendly alternative, supporting waste utilization, faster construction, and reduced environmental impact. The system proves to be a promising solution for affordable housing, temporary shelters, and sustainable construction practices.

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