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# Variational Study of NET4 Blocks and Designed Sandcrete Bricks Based on Their Characterizations

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**ABSTRACT**

NET4 blocks refer to a type of large concrete block system, commonly used for industrial and construction applications. Sandcrete bricks are made up of sand, cement, and water. This study presents an empirical investigation into the compressive strength variation between NET4 industrial blocks and designed sandcrete bricks. Both materials were evaluated over a curing period of 7, 14, 21, 28, and 35 days. The results indicate that the compressive strength of the designed sandcrete bricks significantly outperforms the NET4 blocks at all stages. NET4 blocks showed compressive strength values of 0.60 N/mm² at 7 days, increasing to 2.87 N/mm² at 35 days. In comparison, the designed sandcrete bricks recorded higher values, starting at 0.82 N/mm² at 7 days and reaching 5.23 N/mm² by day 35. The disparity in strength growth rates suggests that the composition and production methods of the sandcrete bricks provide superior structural integrity, making them a more suitable option for applications requiring higher compressive strength. These findings have implications for material selection in construction projects, particularly in environments requiring long-term durability and load-bearing capacity.

**Keywords:** Empirical, Sandcrete, Characteristic Strength, Bricks, Blocks.

## INTRODUCTION

NET4 blocks are often used for retaining walls, material storage facilities, and other structures that require substantial load-bearing capacity. They are typically engineered with interlocking features, enabling easy and stable stacking without the need for mortar, making them ideal for quick and flexible assembly in construction projects. Sandcrete bricks are lighter and less expensive than traditional concrete blocks, but their compressive strength tends to be lower. They are commonly used in masonry work. However, their compressive strength depends on the quality of materials and mix ratio, which is crucial for ensuring the durability and stability of structures built with them. Using hybrid machine learning techniques, Kashem et al. (2024) investigated the prediction of compressive strength of sustainable concrete including rice husk ash (RHA). They proved that compressive strength is considerably increased by RHA. According to the analysis, strength rises with extended curing times but falls with increasing aggregate-to-binder, RHA-to-binder, and water-to-binder ratios. Omoregie (2012) investigated the impact of vibration time on compressive strength during the manufacturing of sandcrete blocks. The study suggested quality control enhancements for Nigerian sandcrete block production and showed that longer vibration durations increase compressive strength characteristics. Jittin, et al. (2020) investigated the application of rice husk ash in cement manufacturing and found that adding it can improve the compressive strength of a range of building materials. The effects of utilizing volcanic ash as a pozzolanic material in the manufacturing of sandcrete bricks were investigated by Ogunbode, et al. (2013). The results showed that up to 30% of cement could be successfully replaced with volcanic ash, improving compressive strength and resistance to sulfate attack. Using machine learning models, Sathiparan, N. (2024) forecasted the compressive strength of rice husk ash blended sandcrete blocks, which is affected by variables including the water-to-binder ratio, curing duration, and the ratio of fine aggregate to binder. According to the analysis, strength rises with extended curing times but falls with increasing aggregate-to-binder, RHA-to-binder, and water-to-binder ratios. The R2 values for training and testing data showed that the XGB model had a significant correlation with both predicted and measured strength, at 0.89 and 0.94, respectively. In a comparative investigation of rice husk ash as a partial cement replacement in block production, Mayooran, et al. (2017) found that optimized blends improved compressive strength.They examined the viability of employing leftover high-carbon content rice husk ash from open-air rice husk burning as a secondary raw material for cement block production. For low and high-carbon RHA, cement blocks were manufactured at four distinct RHA replacement levels: 5%, 10%, 15%, and 20%. This allowed for partial cement replacement. The test's findings show that low-carbon RHA cement blocks have slightly superior workability, mechanical, and durability qualities than high-carbon RHA cement blocks. Emekwisia, et al. (2024) conducted a comparison study on the compressive strength of produced sandcrete bricks vs industrial sandcrete blocks. The alternative sandcrete bricks were colored to mimic burnt red brick product by molding sand in different amounts of 5%, 10%, 15%, 20%, and 25%. The sandcrete blocks were sold to the local building and construction sectors by local block makers. As compared to commercial sandcrete blocks, the produced sandcrete bricks had a better compressive strength, according to the results. This shows that created bricks, as opposed to industrial sandcrete blocks, are more suitable for use in load-bearing and other buildings requiring higher compressive strength. A comprehensive investigation into the durability of sandcrete bricks manufactured with slag cement was carried out by Bashar et al. (2014). According to the research, adding slag cement to sandcrete bricks can greatly increase their resistance to chloride penetration, making them more appropriate for use in marine environments.

This study therefore looked into the empirical research on the variation of NET4 block and designed sandcrete bricks according to their characteristic strength (compressive strength).

## MATERIALS AND METHODS

### Materials

**a) Sand:** Also known as natural sand, this kind of sand is created when rocks naturally break down. Crushed stone, which is obtained by crushing rocks or yard stones, is another source of sand. The sand utilized in this project was pure and devoid of organic matter, loam, and soil.

**b) Cement:** According to ASTM C150, ordinary Portland cement of type I, or general cement for all-purpose application, was utilized.

**c) Water:** The water was pure and devoid of substances that could hurt living things.

Steel rule, digital weighing scale, and compressive strength test apparatus are examples of additional materials.

### Methods

There were two batches involved in this experiment: A and B. The sandcrete bricks created during this operation are batch B, whereas batch A is the NET4 Blocks sampled from a local block industry at Awka, Anambra State.

### Collection of the mixtures for Batch A.

Sand, cement, and water in a pre-mixed composition were gathered at a local block industry, situated along the slaughter road in Awka, Anambra State, Nigeria. In the block industry, a mixture was made by combining four to five paint buckets (20 liters) of hard water to one bag of cement and six wheelbarrows full of sand. It became discovered that they frequently had 35–40 blocks.

### Moulding

For the purpose of the experiment, the mixed composites were manually molded by placing them inside a 75 mm by 75 mm mould, and compaction was accomplished by continuously ramming with a wooden ram. After using the wooden ram to level the surface, the blocks were carefully placed on wooden pallets with room between them.

**Curing**

After they were formed, the arranged blocks were misted with water for the first three days. This was done to lessen the blocks' brittleness and increase their ultimate achievable strength.

**Batch B:**

**Mixed proportion**

The calculation was done using the ratio of 1:6 =7

Where 1 = The proportion of cement (that is, one bag of cement), and 6 = The total mass of (that is, six wheel barrow full of sand). The measured weight of the sample (i.e. cement + sand) = 820g.

From the ratio above;

Mass of cement, C = $\frac{1}{7} \times 820$g =117.1g; Mass of sand = 820g - 177.1g= 702.9g.

For the control sample; This was done without the clay, hence the Mass of sand = 702.9g; Mass of cement = 117.lg

For 10% clay addition; Mass of clay used= $\frac{10}{100} \times 702.9$g = 70.29g; Mass of sand used = 702.9 - 70.29 = 632.6 1g

For 15% clay addition; Mass of clay used= $\frac{15}{100} \times 702.9$g =105.4g; Mass of sand used = 702.9 - 105.4 = 597.5g.

For 20% clay addition, Mass of clay used= $\frac{20}{100} \times 702.9$g = 140.58g; Mass of sand used = 702.9 - 140.58 = 562.32g.

For 25% clay addition; Mass of clay used= $\frac{25}{100} \times 702.9$ = 175.73g; Mass of sand used = 702.9 - 175.73= 527. 1 7g.

**Mixing Procedures**

Using a shovel, the materials were hand combined in the different ratios determined above, and they were continually turned until the desired color and consistency were achieved. A small amount of water was sprayed on the mixture, and it was then further mixed to ensure uniformity and high workability. (Emekwisia, et al., 2024)

**Compressive Strength Test**

To determine the strength of the designed sandcrete, a compressive strength test was conducted. As the maximum strength for the brick samples was reached on the 35th day, the samples were examined at intervals of 7, 14, 21, 28 and 35days.

The cubes' measurements were taken during the test and reported to the closest 1 mm. A computerized weighing balance was used to weigh the cubes, and the weights were noted. The compression testing machine's middle plates were precisely positioned in the middle of the metal plates that were set beneath the bed faces of the blocks to be tested. Subsequently, the load was applied axially uniformly and without shock until failure happened. It was noted what the maximum load was upon failure. (Emekwisia, et al., 2024)

**Compressive Strength Expression:**

The compressive strength was calculated using this formula:

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (N)}}{\text{Cross sectional area of block (mm}^2\text{)}}$$

## RESULT AND DISCUSSIONS

**Results**

Result of compressive strength test carried out on the blocks sampled from local block industries.

**Result For Batch A**

**Table 1:** Result of compressive strength test of NET4 blocks.

| Test Duration (Days) | Dimension ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|
| 7 | 75 x 75 | 0.60 |
| 14 | 75 x 75 | 1.00 |
| 21 | 75 x 75 | 1.79 |
| 28 | 75 x 75 | 2.08 |
| 35 | 75 x 75 | 2.87 |

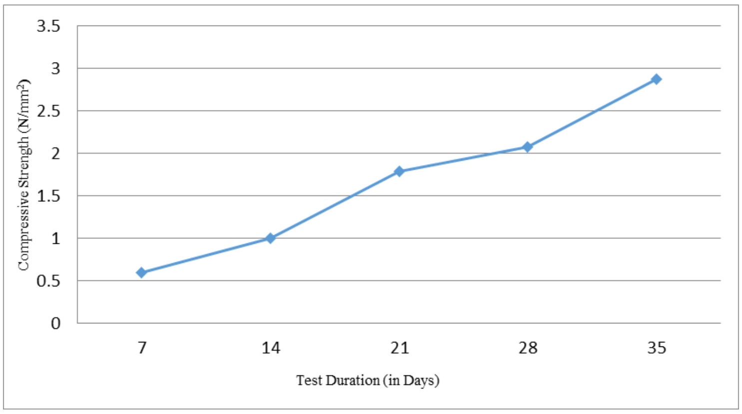


*Figure 1: Graph of compressive strength test of NET4 blocks.*

**Result For Batch B**

**Table 2:** Result of compressive strength test of the designed sandcrete bricks at 35% maximum clay addition.

| Duration in Days | Dimension ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|
| 7 | 75 x 75 | 0.82 |
| 14 | 75 x 75 | 1.59 |
| 21 | 75 x 75 | 3.88 |
| 28 | 75 x 75 | 4.57 |
| 35 | 75 x 75 | 5.23 |

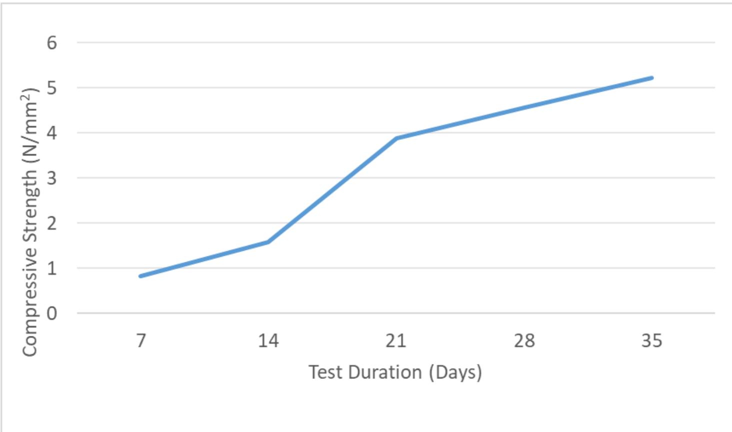


*Figure 2: Graph of compressive strength test of the designed sandcrete bricks at 35% maximum clay addition.*

The results above indicates a clear difference in the compressive strength between NET4 blocks and designed sandcrete bricks over time. The data showed that while both materials experience an increase in compressive strength as curing time progresses, designed sandcrete bricks significantly outperformed NET4 blocks at every stage of the curing process. At 7days period, the NET4 blocks have a compressive strength of 0.60 N/mm², whereas the sandcrete bricks record a higher value of 0.82 N/mm². This difference of 0.22 N/mm² may be attributed to the composition of sandcrete, which typically contains a higher cement-to-sand ratio, allowing it to achieve higher initial strength. By the 14th day, the gap widened, with sandcrete bricks reaching 1.59 N/mm² compared to 1.00 N/mm² for NET4 blocks. This suggests that the hydration process in sandcrete is more efficient early on, likely due to better cement dispersion. At the middle stage strength (21 to 28 days), the difference becomes even more pronounced. The designed sandcrete bricks achieve a compressive strength of 3.88 N/mm², compared to 1.79 N/mm² for NET4 blocks. This nearly double increase indicates that sandcrete benefits from better material bonding and more optimal water-cement ratios, promoting a more significant strength gain during this period. By 28 days, sandcrete reaches 4.57 N/mm², while NET4 blocks achieve 2.08 N/mm². At this point, the designed sandcrete bricks are over twice as strong as NET4 blocks. At the final stage strength (35 days), the designed sandcrete continues to lead, with a compressive strength of 5.23 N/mm², while NET4 blocks reach 2.87 N/mm². The steady increase in both materials is typical of concrete products, which continue to gain strength as hydration and curing progress. However, the superior strength of sandcrete bricks at this point suggests better material quality and curing conditions, making them a more durable option for structural applications.

## CONCLUSION

The compressive strength variation observed between NET4 blocks and designed sandcrete bricks emphasizes the differences in their material compositions. While NET4 blocks may be suitable for non-load-bearing or light-duty applications, designed sandcrete bricks demonstrate much higher compressive strength, making them better suited for load-bearing walls or structures requiring greater strength. The differences in performance can be attributed to the higher cement content, more efficient hydration, and better particle bonding in the sandcrete mix compared to the NET4 blocks, which may have different or lower quality materials. This result is critical for builders and engineers in selecting appropriate materials for construction projects, particularly where strength and durability are key concerns.

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