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A CASE STUDY TO FIND OUT THE POSSIBILITY OF USING RECYCLED BRICK AGGREGATE OF NATORE AREA FOR LOW STRENGTH STRUCTURE

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ABSTRACT

This paper aims to find out the possibility of using a recycled brick aggregate of Natore area fro low strength structure. To find out the efficiency of using recycled brick aggregate and compare the efficiency of recycled brick aggregate with fresh brick aggregate in this study, forty years, seventy years recycled brick aggregate and it's concrete with fresh brick aggregate and it's concrete properties have been observed. 70 years recycled brick was collected from 70 years old demolish building in Bonpara bazar, Natore and 40 years recycled brick was collected from 40 years old demolish building near Bonpara bazar, Natore. Fresh brick was collected from commercial suppliers at Doyarampur, Natore district. After collection ingredients, crushing recycles and fresh brick very carefully and do laboratory experiments. Then different experiments such as specific gravity, the compressive strength of concrete were conducted with these samples as per the requirements of the study. Results show that most of the properties of recycled brick aggregate were similar compare to fresh brick aggregate but the absorption capacity of recycled brick aggregate 7% to 12% greater than the fresh brick aggregate. but it was similar to other researcher's works. Moreover, the concrete compressive strength of recycled brick aggregates was 56% to 62% similar to fresh brick aggregate which was similar to other research works.

Keywords: *Recycled brick, Recycled aggregate, Natore area.*

1. INTRODUCTION

Brick is the main component and commonly used material for the fast-growing construction industry of Bangladesh. Brick is a prime element of concrete along with sand, water, and Portland cement. 2.5 tons per capita per year concrete expense is estimated in the world. (Equivalent to 17.5 billion tons for seven billion demography in the world) (CEMBUREAU, 2008; Mehta, 2009). About 2.62 billion tons of cement, 13.12 billion tons of aggregate, 1.75 billion tons of water are needed to make this huge volume of concrete (Torring & Lauritzen, 2002). Aggregates are culled by cutting mountains or breaking river gravels or boulders, or by breaking clay bricks. Brick is a very important material for aggregate. A huge quantity of naturalistic resources can be protected if the demolished brick is recycled for newish constructions.

Many old buildings in Bangladesh are constructed mainly from brick and brick aggregate concrete. Demolition waste from these old buildings may provide a significant generation of aggregate in the concrete industry of Bangladesh. Many works have been published recently on the recycled brick aggregate concrete use and its feasibility as coarse aggregate (Mohammed *et al*., 2015; Tam *et al*., 2018). However, extensively very few have examined permeability, shrinkage and other deformation related properties of recycled brick aggregate concrete.

Therefore, there is the scope of research in this area for a better understanding of recycled brick aggregate concrete. A correlative study of these properties between crushed clay fresh brick and recycled brick aggregate concrete will provide significant insight into the feasibility of using recycled brick as coarse aggregate. This study aims to find out the efficiency of using recycled brick and it's aggregate and compares their efficiency with fresh brick and it's aggregate.

2. METHODOLOGY

70 years old recycled bricks were collected from 70 years old demolish building in Bonpara bazar, Natore (denoted as RB70Y) and 40 years old recycled bricks were collected from 40 years old demolish building near Bonpara bazar, Natore (denoted as RB40Y). Fresh bricks were collected from commercial suppliers at Doyarampur, Natore district (denoted FB). After the collection of ingredients, crushing of recycling and fresh brick was done very carefully and carried out laboratory experiments. The 70 years old brick aggregate was denoted as RBA70Y, 40 years old brick aggregate was denoted as RBA40Y and fresh brick aggregate was denoted as FBA (Hemel *et.al.*2019). Portland Composite Cement (PCC) collected from the local market in Natore city which contains 65-79% clinker, 21-35% fly ash, slag, 0-5% limestone and gypsum was used in the experiment as a binding material. Padma river sand (brown in color) near Paksi, Pabna district was used as fine aggregate which is locally known as 'Paksi sand'. It is well-graded and having fineness modulus (F.M) 2.05. The property of water that was used in the concrete work is groundwater and being potable and also free from oil, dust, acid and other organic impurities. Then different experiments such as specific gravity, absorption capacity & compressive strength of concrete and bricks were conducted with these samples as per the standard procedure. Concrete cylinder molds were cast and cured at standard conditions in the university laboratory. Sieve analysis of sand and brick aggregates was conducted to get the gradation of aggregate. Characterizations of the strength of recycled brick aggregate concrete involving specific gravity and unit weight and compressive strength of concrete of recycled brick aggregate have been evaluated.

3. RESULTS AND DISCUSSION

3.1 Physical properties

3.1.1 Size and color of the recycled bricks

In Figure 1, it was seen that the dimensions of RB70Y, RB40Y and FB were sequentially decreased. The RB70Y, RB40Y was not similar to the first-class brick size which is 240*115*70 mm (http://www.lged.gov.bd) as these bricks were prepared far before Bangladesh Standard was set. These also conclude that earlier centuries residential buildings used larger size brick than current brick. It also shows that (Figure 2) RB70Y and RB40Y were red in colour like FB, where good brick generally red in colours as per LGED (http://www.academia.edu; http://www.lged.gov.bd).

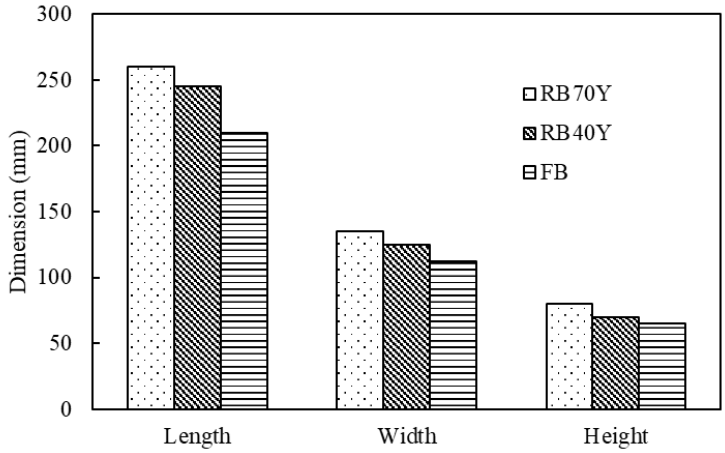

Figure 1: Dimensions of RB70Y, RB40Y and FB

(a) RB70Y (b) RB40Y (c) FB

Figure 2: Recycled and fresh brick after collection

3.1.2 Bulk specific gravity of recycled brick aggregate

It was shown in Figure 3 that, the value of bulk specific gravity of RBA70Y and RBA40Y was more than 1.5 and less than 2.0 but near to the value of FBA specific gravity (1.83). Zheng *et al.* (2018) and Reza (2013) reported that the bulk specific gravity of recycled brick aggregate was 1.7 and 1.61, respectfully which was almost similar to RBA70Y. These RBA70Y and RBA40Y couldn't be used for road pavement construction as it required specific gravity ranges from about 2.5 to 2.9 but it could be used in concrete mix design, water filtration plant design, slope stabilization project, railway bedding, sub-base road construction material, etc. (https://nptel.ac.in;https://www.in.gov).

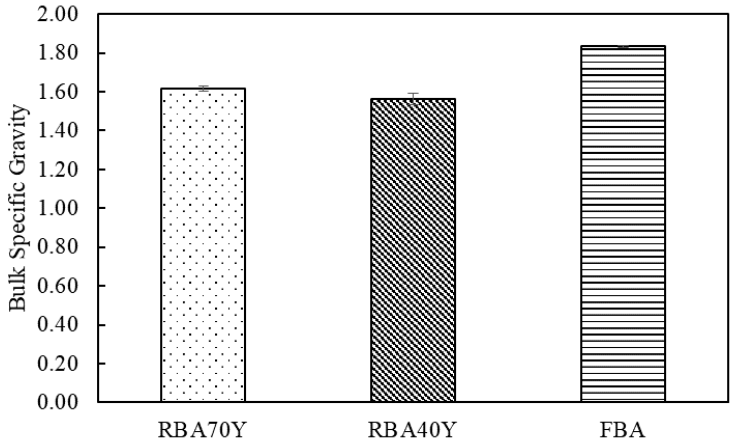

Figure 3: Bulk specific gravity of RBA70Y, RBA40Y and FBA

3.1.3 Absorption capacity of recycled brick and it's aggregate

It was shown in Figure 4 that the absorption capacity of RB70Y and RB40Y were higher than the FB absorption capacity (14.44%), but they were near the limit set by LGED which ranges from 12% to 24% by weight (http://www.lged.gov.bd). Whereas the absorption capacity of RBA70Y and RBA40Y were 7.48% and 11.91% more to the FBA absorption capacity (13.92%) as shown in Figure 5. The absorption capacity of RBA70Y was similar to Refractory brick from the demolition of an old cold storage building (19.1%), (Reza, 2013). The value of RBA70Y and RBA40Y was also similar to the recycled of 45 years brick aggregate (22.70%) (Mohammed *et al.*, 2015).

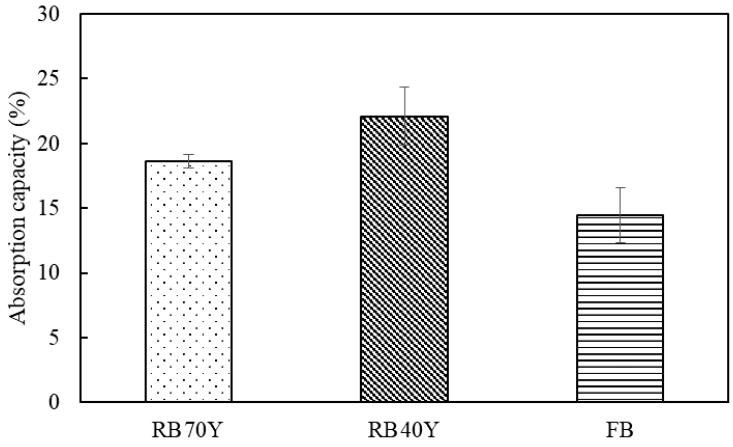

Figure 4: Absorption capacity of recycled bricks

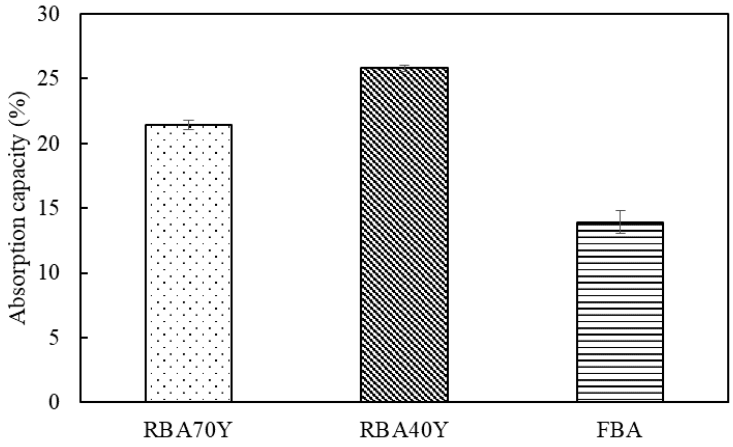

Figure 5: Absorption capacity of recycled bricks aggregate

3.2 Mechanical properties

3.2.1 Compressive strength of recycled brick

The compressive strength of RB70Y was similar to the 20% of the FB strength and was almost 50% of the FB strength in the case of RB40Y (Figure 6) where the RHD standard was 6.64 MPa which was similar to FB (www.rhd.gov.bd). The reason for being low strength may be caused by the aging of the recycled bricks and composition of the bricks. RB40Y can be used in footpaths, cycle-tracks and very unimportant road construction (village roads, etc).

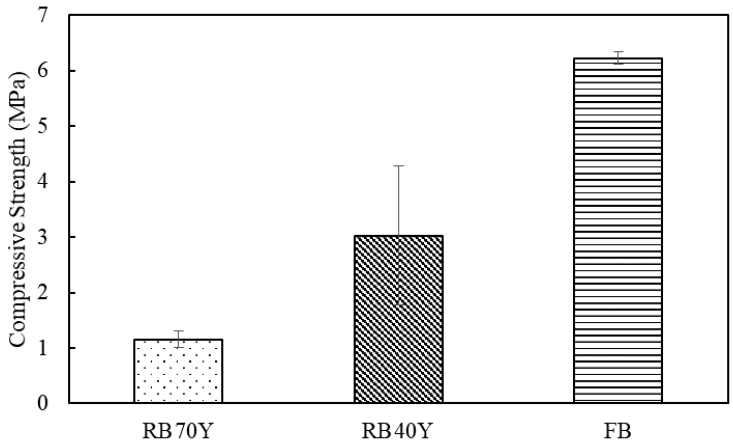

Figure 6: Compressive strength of recycled bricks

3.2.2 Compressive strength of recycled brick aggregate made concrete

The compressive strength of RBA70Y, RBA40Y and FBA for 7, 14 and 28 days were shown in Figure 7. As expected, the compressive strength of the specimen increased with curing age for recycled and fresh brick aggregates. It also is shown that the compressive strength of RBA70Y, RBA40Y and FBA were nearly similar at 7 days; but FBA had a high percentage increase in strength compared to RBA70Y, RBA40Y in 14 days (43%, 38% respectively) and in 28 days (44%, 38% respectively). However, the strength gaining characteristics of RBA70Y and RBA40Y shows that the strength of 28days within the range of 1.3 to 1.7 times of the strength of 7days (Aziz, 1995) which confirmed that the 14 and 28 days compressive strength of RBA70Y and RBA40Y are nearly similar. The compressive strength of RBA70Y and RBA40Y were similar to recycled brick aggregate made (Mohammed *et al*. 2015). This concludes that the RBA70Y and RBA40Y get compatible strength within 7 days although the strength is lower than FBA.

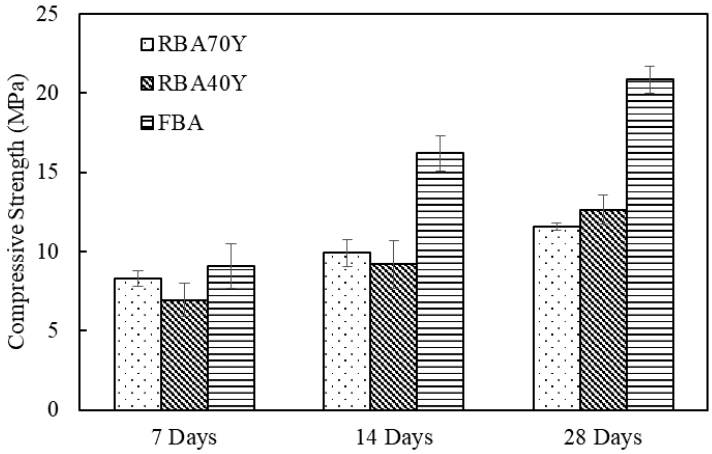

Figure 7: Compressive strength of recycled brick made concrete

Although the present study showed that by using RBA70Y and RBA40Y, around 12 MPa strength concrete can be prepared but it is reported that by changing cement content, W/C ratio, fine to coarse aggregate ratio, etc. and using 100% recycling brick aggregate, it is possible to make 20.7 MPa to 27.6 MPa strength of concrete (Mohammed *et al*, 2015).

4. CONCLUSIONS

In this study, it was found that the recycled brick and its aggregate had the potential to use in different construction works. The findings are listed below:

- Comparing the brick colour and size it was seen that the colour of the recycled brick (RB70Y and RB40Y) were similar to FB and meet the LGED standard whereas the size of recycled brick was larger than the FB. The absorption capacity of recycled brick was in the limit of the LGED standard. The compressive strength of the RB70Y seems very poor whereas RB40Y possess 50% strength of the FB. So, it may be not used in heavy construction but it could be used in footpaths, cycle-tracks and very unimportant road construction (village roads, etc).

- Comparing the physical properties of the recycled brick aggregate (RBA70Y and RBA40Y) and fresh brick aggregate (FBA) it was seen that the bulk specific gravity of recycled brick aggregate was similar to FBA. But the results of the bulk specific gravity of recycled brick aggregate showed similar to other researchers' work on recycled brick aggregate (Zheng et al.,2018; Reza, 2013). The absorption capacity of the recycled brick seems higher than FBA but it was similar to other researcher's works (Reza et al. 2013, Mohammed *et al*. 2015).

- In case of compressive strength of recycled brick aggregate (RBA70Y and RBA40Y) and fresh brick aggregate (FBA), it was seen that the strength gaining capacity at 7days is similar for both recycled brick aggregate and FBA whereas low for recycled brick aggregate compared to FBA at 14days and 28 days. But the compressive strength of recycled brickwork is similar to Mohammed *et al*. (2015) works.

- Finally, it could be concluded that the recycled brick aggregate (RBAY70Y and RBAY40Y) may be used in water filtration plant design, slope stabilization project, railway bedding, sub-base road construction material, etc. which are low strength structure as the strength of recycled brick aggregate was found low (10 ~ 12 MPa). The absorption capacity of recycled brick aggregate could be reduced by using a plasticizer admixture or by using a pre-saturation method or by adding water-reducing chemical admixture (Kesegić *et al*. 2008; Mohammed *et a*l. 2015). The recycled brick aggregate (RBAY70Y and RBAY40Y) also could be used for small to medium loads as like last floor slabs as lightweight concrete (Bashandy *et al*. 2017).

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