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# STRENGTH ENHANCEMENT OF PAVER BLOCK USING RED MUD

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**Abstract -** — In this paper an attempt has been made to know the effect on strength performance of paving blocks using locally available material (red mud). A parametric experimental study was conducted in laboratory for production of paving blocks. Paving blocks using red mud with various % 10, 15, 20 were produced. Various combinations of mix proportion were used to partially replace the ingredients (fine aggregate and coarse aggregate both). Various specimens of paving blocks were casted in the laboratory by varying the material composition. The specimens were tested and their effects on compressive strength and cost of paving blocks were analyzed. Result showed that the pavement block having 10% composition of red-mud is best suited as it gives higher compressive strength as well it reduces the cost effectively.

***Key Words***: Paving block; Red mud; fine aggregate; coarse aggregate; Compressive Strength.

## 1. INTRODUCTION

Concrete blocks are mass manufactured to standard sizes. This makes them interchangeable. Typical concrete paving blocks have one smooth face and one rough, although some paving blocks so come with reversible surfaces (can be used both sides). The performance characteristics of concrete paving blocks make it suitable for the heaviest duty applications, able to support substantial loads and resist shearing and braking forces.

Pavers are a special dry mix pre-cast piece of concrete commonly used in exterior landscaping pavement applications. Interlocking paving stones are installed over a compacted stone sub-base and a leveling bed of sand. Concrete paving stones can be used for walkways, patios, pool decks and driveways and airport or docks. Many factors affect the compressive strength of paving blocks which are as follows:-Size of coarse aggregate, Water cement ratio, Curing conditions, Air entrainment, Size and shape of the specimen are some of them, Material, Composition etc.

The Paving blocks are designed based on the compressive strength, flexural strength, tensile strength and shear force, but in this study we are concerned with the compressive strength of the pavement blocks. Usually, the dimensions of the paving blocks used are as follows: 450*450*35 $mm^3$, 200*200*70 $mm^3$, 100*200*75 $mm^3$ But they can also be casted as per the site requirements. Shape of paving blocks may be hexagonal, rectangular, square, circular, pentagonal, octagonal, etc. as per requirements

Generally, the composition of the paving blocks is:- For Coloured top layer:-

| | |
|---|---|
| Chemical fusion additives | 0.05-0.15 % |
| Coloured Pigments | 0.2-0.5 % |
| Water | 10-12 % |
| Fly ash | 10-20 % |
| Portland Cement | 35-40 % |
| Fine Aggregate | 35-40 % |

These compositions may be varied according to various site conditions and their uses.

## 2. EARLIER INVESTGATION & SCOPE OF THE STUDY

There are several investigation focused on the strength development of paving block by replacement of fine aggregates.

Raman et al 2005 investigated the effect of stone dust. He partially replaced the sand with stone dust without use of fly ash. He reported reduction in compressive strength which can be compensated by inclusion of fly ash.

Reddy & Reddy 2007, reported increase in compressive strength by using rock powder /dust as a fine aggregate in place of river sand.

Hameed sekar 2009 investigated the effect of crushed stone dust as fine sand found flexural strength increases with natural sand and decreases with the increase in % of stone dust.

Tautanji investigated the long term effect of rubberized concrete paving block. He discovered that the incorporation of the rubber aggregates in concrete resulted in a reduction of compressive strength of up to 75% and a smaller reduction in flexural strength of up to 35%.

Kaloush et al. also showed that the rubberized concrete mixtures lowered the compressive strength more than the flexural strength at same mixture ratio.

Kumar and Kumar 2013 used red mud, synergistically with fly ash to develop geopolymer.

The present experimental study is therefore designed to investigate the effects of replacements of ingredients (fine and coarse aggregate both) on compressive strength and cost of paving block.

## 3. OBJECTIVE OF THE STUDY

The objective of the experimental study is:

i) To partially replace the ingredients (fine aggregate and coarse aggregate both) of paving blocks using locally available material red mud.

ii) To test the specimens of different compositions under compression.

iii) To analyzing the results to establish relation between compressive strength determined by varying materials and their compositions.

iv) To find best proportion mix to meet the requirements like aesthetic view, cost reduction, strength etc.

## 4. EXPERIMENTAL PROGRAMME

A parametric test series were conducted in the laboratory. Paving block specimen of sizes 20*20 $cm^2$ made of coarse aggregate, sand, cement were prepared. Six specimens of standard proportioned mix were casted. Six specimens of each composition of Red-mud were prepared.

Different test series conducted in the laboratory are tabulated in following table1.

**Table -1. Test Series under parametric study**

| Material Composition | Block Designation & Composition % | | | Properties to be Examined |
|---|---|---|---|---|
| **1. Standard Block** | **SB-I** | | | Compressive strength at 7 days and 28 days |
| Coarse Aggregate | 50 | | | |
| Fine Aggregate | 25 | | | |
| Cement | 15 | | | |
| Water | 10 | | | |
| **2. Red Mud Block** | **RB-I** | **RB-II** | **RB-III** | Compressive strength at 7 days and 28 days |
| Coarse Aggregate | 45 | 45 | 45 | |
| Fine Aggregate | 20 | 15 | 10 | |
| Red Mud | 10 | 15 | 20 | |
| Cement | 15 | 15 | 15 | |
| Water | 10 | 10 | 10 | |

SB: Standard Block

RB: Red Mud Block

## 5. MATERIAL USED

Ordinary Portland Cement (OPC) 43 grade confirming to IS: 8112-1989 was used. For partial replacement of fine aggregate and coarse aggregate red mud as a locally available material in various % like 10, 15 and 20 were used in the experimentation.

## 6. TESTING OF PAVING BLOCKS

Six specimens of each category were prepared in the lab. In this manner total 24 (6 standard block + 18 red mud block) specimens were prepared. Each specimen is then kept for curing for 7 and 28 days. Their compressive strength at the age of 7 and 28 days were determined under compression (table 2 and table 3).

**Table -2: Compressive strength at the age of 7 days**

| S. No. | Block Designation and % | | Average compressive strength at 7 days (MPa) |
|---|---|---|---|
| **1.** | **Standard Block** | SB-I | 13.33 |
| **2.** | **Red Mud Block** | RB-I 10)% | 34.33 |
| | | RB-II (15% | 32.73 |
| | | RB-III (20%) | 13.09 |

**Table -3: Compressive strength at the age of 28 days.**

| S. No. | Block Designation and % | | Average compressive strength at 7 days (MPa) |
|---|---|---|---|
| **1.** | **Standard Block** | SB-I | 22.21 |
| **2.** | **Red Mud Block** | RB-I (10)% | 42.22 |
| | | RB-II (15%) | 36.22 |
| | | RB-III (20%) | 21.08 |

## 7. RESULTS AND DISCUSSION

In the present work an experimental study has been conducted to understand effect of red mud on the compressive strength of paving block. The parameters of the study include: partial replacement of fine aggregate and

coarse aggregate both by red mud in various % like 10, 15 and 20. These parameters were presented in detail in Table 1. For better understanding of role of ingredients on compressive strength, typical graphs have been drawn.

### 7.1 Standard Block

Compressive strength of paving blocks was determined using compression testing machine in the laboratory. Compressive strength of standard paving blocks is shown in the figure 1. It was found that first crack appears at 3.11 MPa. Compressive strength of standard paving blocks at the age of 7 and 28-days was found 13.33 MPa and 22.21MPa respectively.

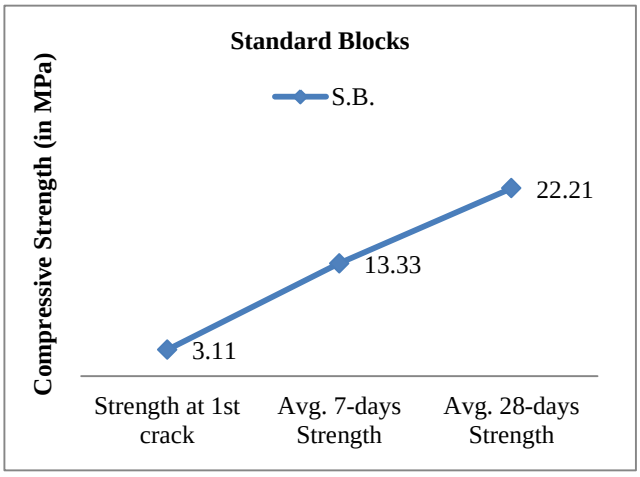


**Figure 1. Comprssive strength of standard paving block at 7 and 28 days**

### 7.2 Red Mud Block

Figure 2 shows compressive strength of red mud paving blocks (MB) at 10 %, 15% and 20%. Figure shows decrease in compressive strength as the % of red mud increases in the overall composition. It can be interpreted that as the percentage composition of the red-mud increases beyond 10%, the compressive strength of the pavement blocks decreases. It was practically observed that red mud block had good bonding properties. Beside this a change in water demand was also observed practically. It can be clearly said that partial replacement of fine aggregate and coarse aggregate by red mud results in good bonding properties and increase in compressive strength. But the water content of the particular proportion mix also increases.

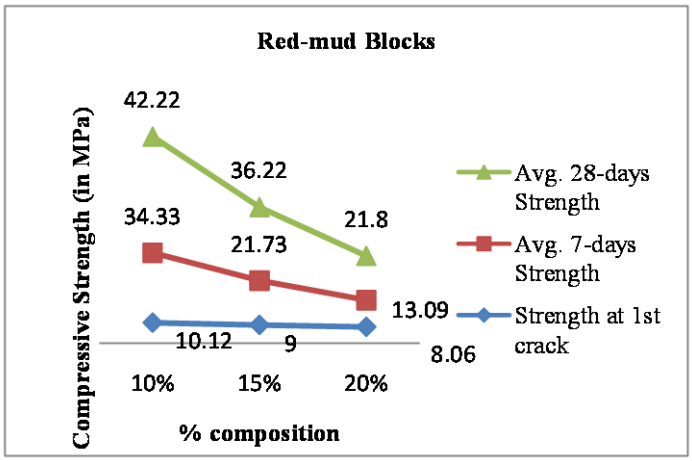


**Figure 2. Compressive strength of red mud block at 7 and 28 days**

Hence, the pavement block having 10% composition of red-mud is best suited as it gives highest compressive strength.

Therfore, it can be said that the pavement block having 10% composition of red-mud is best mix proportion. It should also be noted the red mud block increases water content (observed practically) also.

### 7.3 Effect on cost

It can be clearly said that partial replacement of fine aggregate and coarse aggregate by red mud results in significance decrease in the cost. Red mud shows better performance as it gives higher compressive strength as well it reduces the cost effectively.

## 3. SUMMARY AND CONCLUSIONS

In the present study an experimental program has been conducted to evaluate the performance of paving block using locally available waste. Paving block in various proportion mixes was prepared in the laboratory. Based on results obtained from the present investigation, the following conclusions can be made on the strength development of paving block using red mud:

1. Partial replacement of fine aggregate and coarse aggregate by red mud results increase in compressive strength.
2. Red mud blocks results in good bonding properties and increase in compressive strength. But the water content of the particular proportion mix also increases.
3. The pavement block having 10% composition of red-mud is best suited as it gives highest compressive strength as well it reduces the cost effectively.

**REFERENCES**

[1] Anuj Kumar and Sanjay Kumar., 2013, " Devlopment of paving blocks from synergistic use of red mud and fly ash using geopolymerzation.", Costruction and building material ., January pp 865-871.

[2] Radhikesh P. Nanda, Amiya K. Das and Moharana N. C., 2010, "Stone crusher dust as a fine aggregate in concrete for paving blocks", International Journal of Civil and Structural Engineering, Vol 3 No.10.

[3] Hameed M. S. and Sekar A. S. S., 2009., " Properties of green concrete containing quarry rock dust and marble sludge powder as a fine aggregate," ARPN Journal of Engineering and Applied Science Vol 4 (4), pp 83-89.

[4] Ilangovana R., Mahendrana N. and Nagmanib K., 2008, "Strength and durability properties of concrete containing Quarry rock dust as a fine aggragates."ARPN Journal of Engineering and Applied Science Vol 3 (5), pp 20-26.

[5] Reddy M. V and Reddy C. N. V. S.,2007 " An experimental study of rock flour and insulator ceramic scrap in concrete" Journal of Institute of Engineers (India), Vol 88 august , pp 47-50.

[6] Raman S. N. M. Zain., F. M. Mahmood H. B.& Tan K. S., 2005, " Influence of Quarry dust and fly ash on the concrete compressive strength development"., Proc. AEESEAP International. Conference., Kuala Lumpur Malaysiya 7-8 june 2005.

[7] T. C. Ling*, H. M. Nor, M. R. Hainin, S. K. Lim Long term strength of rubberized concrete paving blocks.

[8] M L Gambhir (2008), Concrete Technology, Tata Mc Graw Hill Pvt. Ltd., New Delhi .

[9] M S Shetty (2007) Concrete Technology, S. Chand & Company Ltd.,New Delhi.

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