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Use of PVC Pipes in Hollow Blocks–A Study

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Abstract—*This study is basically carried to check the compatibility and use of plastic waste in hollow building blocks. Non-biodegradable plastic bottles or pipes can be used to serve the purpose of creating hollow space inside the blocks. In many under developed countries recycling plastic technology is not available or inadequate. Also, sometimes recycled plastics contain chemicals harmful for human health.PVC pipes were used in this study to create voids inside the hollow block of 100*100 mm size.*
On comparison of compressive strength of the created hollow blocks with the solid concrete block the strength was 45-50 % less than the solid blocks. This shows that appropriate cost analysis along with best mix combination can give blocks of considerable strength having low cost which can be affordable for poor population of these countries. An issue of waste management can also be kept in check. Further studies on this like heat and sound insulation, earthquake effects etc. are possible.

Keywords:-Non-Biodegradable, Reclycling Plastic, PVC Pipes, Compressive Strength, Insulation

1. INTRODUCTION

Concrete block is an important and common member in building construction. Use of plastic is increasing rapidly in India and country is facing the challenge of overflowing landfills and impacts of disposal of plastic (PVC/water bottles). This study is carried to check the possibility of using PVC pipes in the concrete blocks and do comparative testing with the nominal blocks prepared in material testing lab of PAU, Ludhiana, (Punjab, India).Its main objective was to check the compressive strength of the prepared blocks and also do the cost analysis. Hollow concrete block is gaining popularity day by day among current population as a result of which their use is being on the rise. (Ahmad et al, 2014) Hollow concrete blocks may be used, as alternatives to bricks and traditional stones in construction and buildings due to smaller weight and ease in transportation when compared with other materials. Moreover it provides an advantage of uniform quality as well as speeding in construction and the largest durability. In addition, they can be used, in different places. Such as the interior walls, exterior walls bearing, and columns, the compound walls, and retaining walls etc.

Advantages of hollow blocks:-

1. Thermal insulation
2. Sound insulation
3. Adequate strength and structural stability.
4. Highly durable.
5. Fire resistant.
6. Economy.
7. Low maintenance (No efflorescence).
8. Environmentally Eco friendly
9. Reduction in mortar consumption.
10. Fast and Easier construction system.
11. Better Architectural features.

Along with many developing and under developed countries, India is facing challenge of solid waste management. Plastic management is a major challenge and Moreover hollow concrete blocks are vastly used in building construction in countries like Oman where thermal insulation of walls was the challenge faced due to the hot dry climate. Using plastic inside hollow concrete blocks may be a solution to some of the stated challenges.

Testing of new concrete masonry units is necessary to determine if the new design meets the ASTM standards. The use of ecological aggregate has been widely used in the last two decades of research (Stahl, 2002) with two of these studies being Lightweight Concrete Masonry with Recycled Wood Aggregate by Stahl et Al. and Compressive Behavior of Concrete with Vitrified Soil Aggregate by Palmquist et Al. Use of solid pvc pipes in concrete masonry units has never been done before. It was an idea gained from the above studies. PVC pipes ables the blocks to be framed on the operation site. Hence the cost of transport, recycling plastics and energy to be used for recycling plastics was saved.

So this study was checked by testing of prepared blocks and the nominal ones and then comparing the results of the compressive strength of the both.

2. RIVIEW OF LITERATURE

2.1 Rafiq Ahmad, Mohammad Iqbal Malik, Mohammad Umar Jan, Parvez Ahmad, Himanshu Seth, Javaid Ahmad

Brick Masonry and Hollow Concrete Block Masonry – A Comparative Study :- Individual hollow concrete blocks confining to IS : 2185-1984 and class B brick units confining to IS : 1077-1986, IS : 2180-1985 and IS : 2222-1979 were tested for compression using compressive testing machine. Tests were conducted after 7, 14 and 28 days.

2.2 Sina Safinia*, Amani Alkalbani

Use of recycled plastic water bottles in concrete blocks :- The purpose of this study is to examine the possibility of using plastic bottles in concrete block. The plastic bottles were used to create voids at equal distance between them in the masonry units.

2.3 Sean M. Wonderlich

STRENGTH OF CONCRETE MASONRY UNITS WITH PLASTIC BOTTLE CORES **:-** The study utilized 500-mL plastic bottles from five different water companies placed inside masonry units of 7.87-inch wide by 8.26-inch high by 15.75-inch long (200-mm wide by 210 mm high by 400-mm long) in size and analyzed the resultant compressive strength.

2.4 C.S. Barbosa and J.B Hanai

STRENGTH & DEFORMABILITY OF HOLLOW CONCRETE BLOCKS AND THEIR CORRELATIONS WITH MECHANICAL PROPERTIES OF CONSTITUENT MATERIAL:- Hollow blocks and test samples of different types and sizes were simultaneously cast with concrete having the same plastic consistency. The influence of the platen effect was observed. It was also observed that geometry and slenderness of the tested specimens also influence the compressive strength correlation of cylindrical samples, blocks and prisms.

2.5 Fatemeh Javidan, Mohammad Safarnejad and Sharif shahbeyk

SHAPE OPTIMIZATION OF HOLLOW CONCRETE BLOCKS USING THE LATTICE DISCRETE PARTICLE MODEL:- The nonlinear analysis has been done using a homemade code written based on the recently developed Lattice Discrete Particle Model (LDPM) for the meso-scale simulation of concrete. This numerical approach accounts for the different aspects of concrete's complex behavior such as tensile fracturing, cohesive and frictional shearing and also its nonlinear compressive response.

2.6 Sittati musalamah, Rectifa Rio, Ririt Aprilin Sumarsono

COMPARATIVE STUDY ON PROPORTION OF HOLLOW CONCRETE BLOCK TO ITS COMPRESSIVE STRENGTH**:-**

The proportion of cement and fine aggregate was selected to be 1:1 to 1:6 and 0.5 for water cement ratio. The result refer that the proportion or 1:5 (cement to sand) was the minimum proportion to reach the no. 1 quality compressive strength target of hollow concrete block. Meanwhile, the absorption can be handled accurately below 25 per cent for the whole comparative proportion tested until the proportion of 1:6 (cement to sand).

2.7 S.O.Osuji and B. N. Egbon

OPTIMIZING COMPRESSIVE STRENGTH CHARACTERISTICS OF HOLLOW BUILDING BLOCKS FROM BUILDING BLOCKS FROMGRANITE QUARRY DUST AND SAND GRANITE QUARRY DUST AND SAND GRANITE QUARRY DUST AND SAND:- A range of 0%, 10%, replaced with quarry dust. A range of 0%, 10%, 15%, 20% and 25% sand replacement with quarry dust 15%, 20% and 25% sand replacement with quarry dust was used in was used in the cement: the cement : sand mix ratios of 1:6 and 1:8 for molding the block sand mix ratios of 1:6 and 1:8 for molding the blocks of size 450mm x 225mm x 225mm.These blocks of size 450mm x 225mm x 225mm. It is suggested therefore, that the optimum replacement of sand with granite quarry dust as fine aggregates should be 15% of the sand fraction 15% of the sand fraction in hollow building blocks of the size and mix ratio in hollow building blocks of the size and mix ratio adopted herein.

3. METHODELOGY

RESEACH DESIGH

3.01 Advantages and properties of hollow concrete blocks

1. Good Thermal insulation
2. Good Sound insulation
3. Adequate strength and structural stability.
4. Highly durable.
5. Fire resistant.
6. Economy.
7. Low maintenance (No efflorescence).
8. Environmentally Eco friendly
9. Reduction in mortar consumption.
10. Fast and Easier construction system.
11. Better Architectural features

12. Semi skilled labor can easily handle these blocks

13. Uniform distribution of reinforcement in both vertical and horizontal direction

3.02 PVC{(C2H3CL)n} properties and advantages

PROPERTIES

1. Density is more than the normal plastics

2. Easily available and cheap

3. Have great tensile strength

4. Resist deformation due to impact load

5. Resistant to chemical and alkalis

6. Mechanically stable

7. Great processability and mouldability

8. Fire retarding

9. Prevent microbial growth

4. EXPERIMENTAL PROCEDURE

For this study M20 concrete mix was taken .A total no. of 18 test specimens were prepared of dimention 100*100 mm. Out of which 9 test specimens were having PVC pipes inside them to create hollow space and the other 9 were nominal concrete blocks. Out of 9 PVC blocks there were three groups of three types of pipes arrangements.

4.01 MATERIAL USED

FINE SAND

PORTLAND CEMENT

COARSE AGGREGATE

WATER

PVC PIPE

BLOCK MOULDS

4.02 CASTING

The mixture for block preparation was taken and mixed to be moulded. After the required curing period blocks were tested for compressive strength after 28 days period.

4.03 PROCEDURE

Blocks were tested after 28 days for comparision of compressive strength of prepared hollow blocks with the nominal concrete blocks both prepared from M20 mix. 9 blocks of each category were tested respectively. Firstly, PVC pipe concrete hollow blocks were placed one by one on the Universal Testing Machine (UTM) and all the values of compressive strength were noted. After that 9 nominal blocks were tested one by one and readings were noted. The direction of failiure was also noted for each block.

5. RESULT AND DISCUSSION

Properties and behavior of material used in his case study were already known to us as discussed in coloumn 3.0.it was observed that the compressive strength of the PVC hollow blocks came out to be 45 to 50 % lesser than the nominal ones for the M20 mix. This reduction in strength is high. Reduction in strength was least when 4 pieces PVC pipe was placed at each corners of the blocks. Blocks with 4 pieces at the centre showed the least strength. Blocks with 3 PVC pipes at the centre showed intermediate strength than the other two arrangements. The values of compressive strength are given in the table 5.1-

SR. NO.	BLOCKS	STRENGTH
1	PVC at corners	13
2	do	13.5
3	do	13.7
4	4 PVC piece at centre	12
5	do	11
6	do	12.3
7	3 PVC piece at centre	10
8	do	11
9	do	10

6. CONCLUSION AND RECOMMENDATION

Following conclusions were obtained from the above study:-

1. The value of strength came out is not sufficiently enough for the load bearing walls.

2. Walls such as partition walls can be easily and economically made from the use of this.

3. This can become a pioneer step towards plastic waste management and utilisation

4. There is a great scope for the further studies in this like with various patterns, mixes, materials, etc

5. Poor and underdeveloped countries can largely benefits from this as household construction will become economical.

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