International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

INVESTIGATIONS ON PRECAST CEMENT CONCRETE PAVER BLOCKS USING FLY ASH AND ACCUMULATION OF POLYPROPYLENE

Vinita Sharma, Priyanka Dubey

PG Scholar, CED, Dr. APJ Abdul Kalam University Indore, M.P., India

Assistant Professor, CED, Dr. APJ Abdul Kalam University Indore, M.P., India

ABSTRACT

Concrete paver blocks came into existence in Netherland after Second World War. The paver block technology is gaining importance all around the world due to its better quality, economy, better surface efficiency, easy to lay in any bond, maximum salvage value in case of replacement. This construction technology of paver blocks started in India at IIT Kharagpur at first and growing at alarming rate due to its uses. The paver blocks are manufactured from zero slump plain concrete and is a small element used for outdoor applications and flexible road surfaces. Depending upon the traffic intensity these are fabricated with various thicknesses, dimensions and shapes to meet with the requirement of various applications. IS:15658 permits the use of 33 grade OPC minimum for manufacture of paver blocks but this type of cement has restricted use now a days in India. Keeping in view these circumstances, OPC 43 grade cement replaced by 30% fly ash has been used in the present study. Fly ash is a huge waste available at thermal power plants in the country. Large consumption of fly ash in paver blocks will help the nation to make economical paver blocks and will address challenges associated with environmental issues and disposal of waste. The present study is important for paver block manufacturers as it meets the objectives such as mix design, strength and durability requirements for Indian roads associated with utilization of waste material fly ash. Also, the study will help the nation economy for 20% level in future, along with sustainability of virgin materials.

Keywords: *Fly Ash, Concrete , Mix Design, OPC, New Technology*

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

INTRODUCTION

Precast cement concrete paver blocks are solid, unreinforced products made out of cement concrete of low water-cement ratio. These are made in varied dimensions with different grades of concrete to fulfil the need of diversified traffic environmental conditions. The paver blocks are manufactured from concrete composite comprising of cement, water, aggregates and super plasticizer, which are available locally everywhere in country. Pavers blocks are pre-fabricated in the factory using press/vibrating table system before their actual use. These are used in surface layer of pavements,urban and semi urban roads, village roads, streets, foot paths,gardens, passengers waiting sheds,petrol pumps bus stops, platforms, industry, etc.Precast paver blocks are ideal materials for pavements and footpaths along roadside where a lot of face lift is being given owing to easy laying,better look, easy to repair and ready to move after laying.Paver blocks are economical as they do not break and these have 100% salvage value in case of replacement. The term precast means that the blocks are manufactured and hardened before laying and are brought to job site.The paver blocks are manufactured in such a fashion that these interlock with each other during laying to maintain structural strength. Pavements surface using blocks are made by using individual interlocking paver blocks by installing one to another. These are laid on prepared sub grade with sand bed below bounded by edge restraints from both sides. The blocks are laid in proper bond with joints in between to have structural stability. These joints are filled with sand of suitable grading. The interlocking mechanism of concrete block pavement provides sufficient area for load spreading. Concrete block pavements have certain advantages over asphalt and concrete pavements. The general advantages are maintenance, operational, structural, aesthetics and economical. A well-constructed interlocking pavement provides better performance.

Cement concrete is strong under compressive loads at the same time it is inherently poor under tensile stresses. It is of brittle nature so it is not advisable to make paver blocks from concrete of such nature. The material for paver blocks has to be ductile. Thus to make concrete ductile,polypropylene fibres are added in small proportions during manufacturing of paver blocks to encounter the impact and flexural stresses

which are inevitable on road surface during running of traffic. The micro crack formation in concrete at early stage due to plastic shrinkage may also be addressed with the addition of polypropylene fibres.

OBJECTIVE OF THE WORK

The objectives of the present study are as under: 1. To prepare design mix for zero slump concrete composite for manufacture of paver block M30, M35 and M40 grade designation of thickness 60 mm and 80 mm by replacing OPC with 30% fly ash and adding PPF @ 0.1%, 0.2%, 0.3%, 0.4% and 0.5% in each grade. 2. To test fresh properties of various designed grades of concrete for paver blocks i.e. compaction factor for workability. 3. To test the strength properties of hardened paver blocks for various design mixes i.e. compressive strength and flexural strength at 07, 28, 56 and 90 days of age. 12 4. To test the durability properties of hardened paver blocks for various design mixes i.e. Water absorption, Freeze-thaw resistance and Abrasion resistance at 28 days of curing. 5. To establish optimum dosage of PPF addition in manufacturing of paver blocks with 30% fly ash. 6. To develop prediction models for the compressive strength and flexural strength of paver blocks using linear regression technique. 7. To study cost effectiveness of paver block with optimum dosage of polypropylene fiber.

RESULT:-

The results of mix designs, properties of fresh concrete composite mix and properties of hardened concrete composite like compressive strength, flexural strength and durability properties like water absorption, freeze-thaw resistance and abrasion resistance of paver blocks are discussed in the present chapter. The effect of replacement of OPC by 30% fly ash and addition of polypropylene fibres in varying proportions in concrete composite are discussed.

RESULTS OF VOLUME LOSS FOR 80 mm THICK DIFFERENT GRADES OF PAVER BLOCKS WITH VARYING % OF PPF

- The volume loss for M30 grade reference mix without PPF was observed 4143mm 3 /5000mm 2 . Due to addition of PPF in the increment of 0.1%, it decreases from 0.1% to 0.3% and increases from 0.4% to 0.5%. The density of the specimen was increased slightly due to the effect of PPF. The minimum volume loss of 4109mm 3 /5000mm 2 was obtained at 0.3% PPF addition.

- The volume loss for M35 grade reference mix without PPF was found 4127mm3 /5000mm2 . Due to addition of PPF in the increment of 0.1%, it decreases from 0.1% to 0.3%. It increases from 0.4% to 0.5% at slow rate. The density of the specimen was increased due to addition of PPF.The minimum volume loss of 4094mm3 /5000mm 2was obtained at 0.3% PPF addition.

- The volume loss for M40 grade reference mix without PPF was 4090mm 3 /5000mm 2 . Due to addition of PPF in the increment of 0.1% it decreases between 0.1% to 0.3%. It increases from 0.4 % to 0.5% at slow rate. The density of the specimen was increased due to addition of PPF.The minimum volume loss of 4052mm3 /5000mm 2was obtained at 0.3% PPF addition.

- The volume loss observed for higher grade was 4052 mm3 and for lower grade was 4109 mm3which may be due to higher content of cement in higher grade.

- The results are well within the codal provisions of 15000mm3 /5000mm2 .

COST EFFECTIVENESS

The cost of manufacture of paver block with optimum addition of 0.3% PPF and 30% replacing OPC by fly ash has been calculated in Table

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Paver blocks with 100 % OPC	Paver blocks with OPC, fly ash, PPF composite
Manufacture of 100 pieces of paver blocks by using cement 50 kg (1 bag). Cost of 50 kg (1 bag) of OPC = Rs 300/-	Manufacture of 100 pieces of paver blocks by using (cement 35 kg + 15 kg fly ash + 0.125 kg PPF). Cost of 35 kg cement @ 300/50 kg = Rs 210/- Cost of fly ash (waste material) = Rs 0/- Cost of PPF 0.125 kg = Rs 30/- Total cost = Rs 240/-
Saving in cost = 300-240 = Rs 60/-	
Percentage saving = $(\frac{60}{300})$ x 100 = 20%	

*Rest of the other materials and labor cost will remain constant in both the cases.

Conclusion-

The objective of the present study aims at preparing mix design for fabrication of paver blocks of M30, M35 and M40 grade designation, replacing OPC with 30% F type fly ash and adding PPF @ 0.1%, 0.2%, 0.3%, 0.4% and 0.5% by weight of cementitious materials. This study was carried with the aim to evaluate compressive and flexural strength of paver blocks at the age of 07, 28, 56 and 90 days. Since the paver blocks are to be used for road surfacing for various type of traffic intensities, there have been tested for strength and durability properties. The results of the study have been validated using linear regression technique. As the Indian climate changes from hot weather to rainy season to cold season round the clock, the importance of durability properties get enhance. The aim of study is to make precast construction industry more sustainable by using the by-product like fly ash and PPF. This will not only result in saving energy which is required for cement production but also safe guard the environment from the effect of greenhouse gases released from cement industry. At the same time aggregates required for the cement industry will be conserved. On the basis of test

results of M30, M35 and M40 grade designation of paver blocks the following conclusions have been drawn from the present study

REFERENCES

1. Sharp KG, Armstrong PJ. Interlocking concrete block pavements. Australian Road Research Board.1985: 98.

2. Ghafoori N, Mathis R. Prediction of freezing and thawing durability of concrete paving blocks.J of Mat in CivEngg. 1998;10(1):45–51.

3. AndertonGL . Concrete Block Pavement for Airfields. Mississippi; 1991.

4. Rath U. Structural behavior of interlocking concrete block pavement. Rourkela: Department of Civil Engineering, National Institute of Technology; 2007. p. 1-24.

5. PurwantoP ,Arni PY. Testing of concrete paving blocks.Teknik. 2008; 29(2): 80-84.

6. IS 15658. Precast concrete blocks for paving — specification. New Delhi: Bureau of Indian Standards; 2006.

7. Ahmed MA, Singh B. Overview on structural behavior of concrete block pavement. Inter J of Sci&Engg Res. 2013; 4 (7): 782-789.

8. Bikasha CP, Ghosh A. Structural behavior of concrete block paving. J of Trans Engg ASCE. 2002; 128(2): 139-146.

9. Miura, Y ,Takaura M , Tsuda T. Structural design of concrete block pavements by cbr method and its evaluation. 2nd International Conference on Concrete Block Paving/Delft, University of Technology. 1984:152-157.

10. Shackel B. The analysis and design of concrete block paving subject to road traffic and heavy industrial loading. 2nd International Conference on Concrete Block Paving/Delft.1984:139-146.