Comparative Study Of Interlock Paver Block

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Abstract- *A Study is carried out on the strength of the pavement blocks using polypropylene fibres. The various parameters considered in this study are the compression strength, abrasion resistance strength and also the reduction in the curing time of the pavement block. Polypropylene fibres have been widely used in the pavement designing, however their use in the manufacturing of the interlocking paver blocks has been limited. We have tried to establish a relation between the quantity of polypropylene fibre used and its impact on the respective strengths of the concrete paver block. A comparative study has also been done comparing the various parameters of the natural pavement blocks and pavement blocks made with polypropylene fibre. An approximate rate analysis has also been carried out in which the rate per unit of paver block is calculated.*

Keywords- *strength of the pavement blocks using polypropylene fibres*

I. INTRODUCTION

Interlocking Concrete Block Pavement (ICBP) has been extensively used in a number of countries for quite some time as a specialized problem-solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. ICBP technology has been introduced in India in construction, a decade ago, for specific requirement viz. footpaths, parking areas etc. but now being adopted extensively in different uses where the conventional construction of pavement using hot bituminous mix or cement concrete technology is not feasible or desirable.

Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. Consequently, the pavements in which non-interlocking blocks are used are designated as Concrete Block Pavement (CBP) or non-interlocking CBP, and those in which partially, fully or multiply interlocking blocks are used are designated as ICBP.

ROLE OF FIBRES IN CONCRETE

Fibre is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fibre is often described by convenient parameter called “aspect ratio”. The aspect ratio of the fibre is ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150. Although every type of fibre has been tried in cement and concrete, not all of them can be effectively and economically used. Each type of fibre has its own characteristics properties and limitation.

Cracks play an important role as they change concrete structures into permeable elements and consequently with a high risk of corrosion. Cracks not only reduce the quality of concrete and make structure out of service If these cracks do not exceed a certain width, they are neither harmful to a structure nor to its serviceability. Therefore, it is important to reduce the crack width and this can be achieved by adding polypropylene fibres to concrete. Thus addition of fibres in cement concrete matrix bridges these cracks and restrains them from further opening. In order to achieve more deflection in the beam, additional forces and energies are required to pull out or fracture the fibres. This process, apart from preserving the integrity of concrete, improves the load-carrying capacity of structural member be- yond cracking.

II. MATERIAL AND METHODS

As a part of our investigation and field surveys for our project we came across different kinds of people as well as their factories making interlock paver blocks. We surveyed a number of manufacturers and dealers. They were all very helpful and gave us a detour of their respective factories. How they manufacture the blocks, what are the different kinds of materials that they use their equipment’s and machines were all shown to us.We however settled on to the most satisfactory manufacturer according to us. The company goes by the name of “Krushna Pavers” and they have a good experience in making paver blocks. We were very satisfied by their product and that is why we took their product as a sample prototype as a conventional paver block for our comparative study.

CONCEPT OF MIX DESIGN

It is essential to know the relationship between the aggregate and paste which essential ingredients of concrete. Workability of mass is provided by the lubricating effect of paste and is influenced by the amount and dilution of paste. The strength of concrete is limited by strength of paste. The permeability of concrete is governed by the quality and continuity of paste.
Since the properties of concrete of are governed to a considerable extent by a quality of paste, it is helpful to consider more closely the structure of the paste. The fresh paste is a suspension not solution of cement in water.

The more dilute the paste, the grater will be the spacing between the particles, and thus weaker will be the ultimate paste structure. The condition being equal, for workable mixes, the strength of concrete varies as an inverse function of the water/cement ratio. Since the quality of water required also depends upon the amount of paste, it is important that as little paste as possible of water should be used and hence importance of grading.

Two types of tests were carried on the paver blocks

- Compression test
- Abrasion test

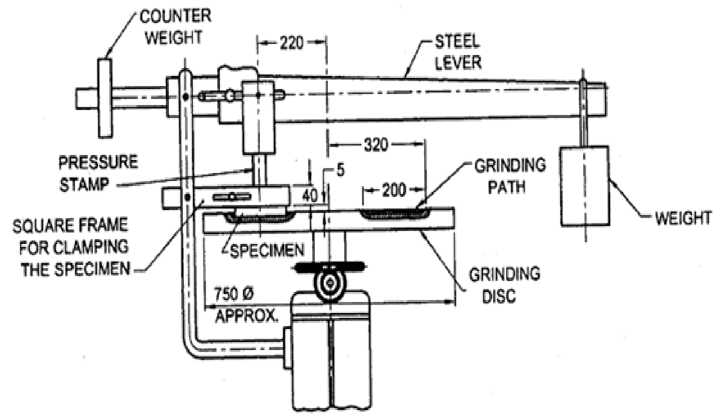
Before carrying out the tests however certain details had to be followed.

COMPRESSION TEST

The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable that the blocks have a minimum hardness of 60 (HRC) and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted. When the bearing area of the steel blocks is not sufficient to cover the bearing area of the paver block specimen, two steel bearing plates meeting the requirements of shall be placed between the steel plates fitted on the machine and the specimen.

Procedure: The dimensions and plan areas of the specimens shall be determined as described in Annex B. The blocks shall be stored for 24 (±) 4hrs in water maintained at a temperature of 20 (±) 5 degree C. The bearing plates of the testing machine shall be wiped clean. The specimens are aligned with those of the bearing plates. The load shall be applied without shock and increased continuously at a rate of 15 (±)3 N/mm²/min until no greater load can be sustained by the specimen or delamination occurs. The maximum load applied to the specimen shall be noted in N.

ABRASION TEST



PROCEDURE : The density of the specimen, shall be determined nearest to 0.1 g. The weight of the specimen 1 shall be noted to nearest 0.1 g both prior to the abrasion test and after every four cycles. In the case of two-layer specimens, the density of specimens taken separately from the wearing layer shall be determined. The grinding path of the disc of the abrasion testing machine shall be evenly strewn with 20 g of the standard abrasive powder. The specimen shall be fixed in the holding device such that the testing surface faces the grinding disc. The specimen shall be centrally loaded with 294+-3 N. The grinding disc shall be run at a speed of 30 rpm. The disc shall be stopped after one cycle of 22 revolutions. The disc and contact face of the specimen shall be cleaned of abrasive powder and debris. The specimen shall be turned 90° in the clockwise direction and 20 g of abrasive powder shall be evenly strewn on the testing track before starting the next cycle. When testing wet/saturated specimens, prior to each cycle, the track shall be wiped with a lightly damp artificial sponge and moistened before being strewn with the abrasive powder. From the start of the test, arrangement shall be made for drip-wetting of the central portion of the track, about 30 mm from the specimen (opposite to the direction of motion of the disc), by supplying water drops at the rate of 180 to200drops (13ml) per minute. During this test, it should be ensured that the abrasive powder continuously returns to the effective area of the track. The test cycle shall be repeated 16 times, the specimen being turned 90° in the clockwise direction and spreading of 20 g of abrasive powder on the testing track after each cycle.

III. Experimental Investigation:

- Target strength =fck+1.65S
  = 25+1.65 × 5
  = 33.35 N/mm^2
- Water cement ratio = 0.30
- Water content (considering maximum size of aggregate 20mm) = 186 litres
- 20 % reduction =197 litres
- Plasticizer = 71 %
- Total water content = 197X0.71= 140 litres
- Area of block = 0.029266 m^2
- Thickness = 0.08 m
- Volume = 0.029266 × 0.08 = 0.00234128 m^3
- Cement content = 140/ 0.30 = 466.66 kg/m^3
- IS 456 specifies minimum cement content = 320 kg/m^3
- Since 466.66 > 320 therefore cement content calculated is safe
- Now assuming corrected proportion of volume of coarse aggregate = 0.64
- Proportion of aggregate = 0.64 × 0.9 = 0.576
- Volume of fine aggregate = 1- 0.576 = 0.424

IV. Result & Discussion:

Sl No.	Paver Block Thickness mm	Correction Factor for Plain Block	Correction Factor for Arrised/Chamfered Block
(1)	(2)	(3)	(4)
i)	50	0.96	1.03
ii)	60	1.00	1.06
iii)	80	1.12	1.18
iv)	100	1.18	1.24
v)	120	1.28	1.34

Fig. 1 Correction factors for thickness of paver blocks in calculation compressive stress

Table2 : for other thickness of paver blocks between 50 mm and 120 mm

SR NO.	Paver block thickness (mm)	Correction factor for plain blocks	Correction factor for chamfered blocks
1	50	0.96	1.03
2	60	1.00	1.06
3	80	1.12	1.18
4	100	1.18	1.24
5	120	1.28	1.34

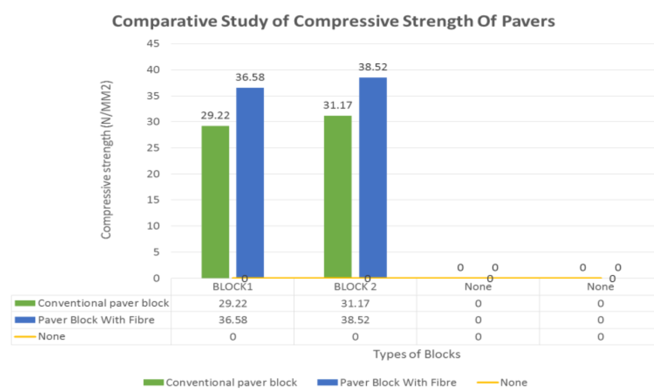


Fig 2. COMPARATIVE STUDY OF COMPRESSION STRENGTH

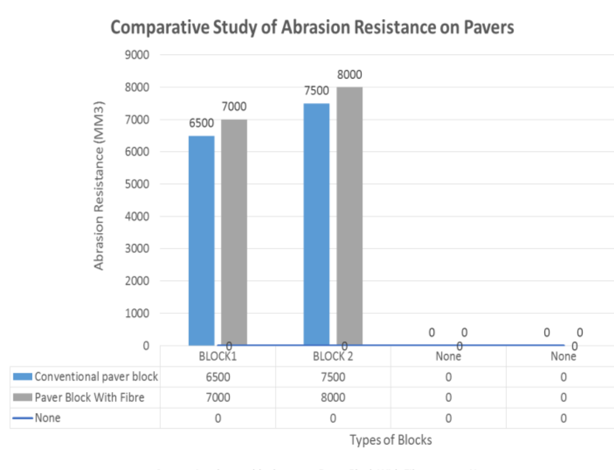


Fig3 : COMPARTIVE STUDY OF ABRASION STRENGTH

V. CONCLUSION

We have successfully studied about the effect of polypropylene fiber on the interlock paver blocks and a comparative study has also been done between conventional blocks and polypropylene reinforced pavement blocks. We have reached to a conclusion that the blocks made with the conventional fiber have a compressive strength of 29 N/mm^2 whereas blocks made with the polypropylene fiber have a compressive strength of 37.24 N/mm^2. It was also seen that the average value for abrasion in conventional paver blocks was 7000 mm^2 whereas the abrasion value for the block made with polypropylene fiber was 7500mm^2. Thus the whole basis on which our project was based has been achieved successfully.

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