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Structural Design of Interlocking Concrete Paving Block

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Abstract— **Segmented interlocking concrete paving is a system of individual shaped blocks which are used to form a continuous hardwearing surface overlay. It is the one of the important load-spreading component of the pavement. However advantages of interlocking concrete pavement have not fully extended in India. This project deals with the advantage of interlock system, stone shape, thickness, compressive strength, size, and pattern and cost analysis on the overall pavement performance. To obtain a maximum load transfer in interlocking concrete pavement. Compare their interlocking properties with those of normal rectangular concrete pavers by performing compression. The superior interlock system provides the surface stability of the pavement surface. Interlocking concrete paving system has several advantages, including resist to freeze-thaw and skid resistance, It does not require any heavy construction equipment, ease of maintenance, instant opening to traffic.**

Keywords—Interlocking; Skid resistance;Stability

I. INTRODUCTION

The stone paving has been started since 4000 BC in Assyria, during that time flagstones were used to pave village streets widely, at that time also there were pavers who are made up of concrete but at that time it was new. So people did not focused on it, but over the last 100 years the usage of pavement has been increased widely for vehicular traffic and it is eco-friendly, it does not damage environment. These are not only used in commercial areas they are also used in industries and residential areas also. Over the last 20 years the concrete blocks were came into usage widely these are segmental blocks of different shapes, Due to this segmental blocks the Interlocking capacity is increased when it is subjected to heavy traffic load.

II. EASE OF USE

A. Design Consideration

The deformation and load transfer for concrete and asphalt are same as they follow the same design procedure of American Association of State Highway and transportation officials. The structural design procedure for air ports and ports follows ICPL Manuals; the required values are taken by engineers based on the attribute factors.

B. Environment

Some of the climatic factors like moisture and plays a major role in affecting pavement. The moisture content in the soil is opposite to the load bearing capacity of pavement which affects the stability, Due to this the water which is present is freezed and then material loses its stability slowly.

C. Soil Sub grade Support

The total thickness of Interlocking concrete pavement is mainly affected by soil sub grade. The Laboratory test which is conducted by California Bearing Ratio. In absence of test, resilient modulus (Mr.) can be given to each type of soil.

Table1.1. SOIL SUBGRADE CHARACTERIZATION

Quality of Drainage	<1%	1 to 5%	5 to 25%	>25%
Excellent	3	3	3	2
Good	3	3	2	2
Fair	3	2	2	1
Poor	2	2	1	1
Very poor	2	1	1	1

D. Moss

The disadvantage of pavers is moss. This assembling of moss will make the pavers very slippery and dangerous. So, we have to maintain properly for reducing the accumulation of moss to a minimum.

E. Size

Another disadvantage of brick is size; Each and every brick are of different size so test has to be done separately for each and every brick.

F. Cost

The driveway pavers is more costly when compared to concrete, it is almost twice of concrete paver.

III. OBJECTIVE OF CURRENT STUDY

It was felt necessary that the phenomenon of block interaction under applied load needed investigation. Such test could then provide insights into load-spreading ability and other structural characteristics of block pavement.

IV. SCOPE OF WORK

The present project has been taken up to study the structural design behavior of Interlocking concrete paving stone by varying the different block parameters. In this study experimental investigations have been made by taking laboratory testing values.

V. FUTURE OF CONCRETE BLOCK PAVING

At present and in future the market for paving blocks is growing one. Because it has tendency to look cities, parks and gardens beautiful. This follows a modern concrete paving product, which is quick and easy to lay, and it provide excellent performance under traffic. Figure 4.1 shows the growth in the concrete block paving market since it's commenced in the late 1950s.

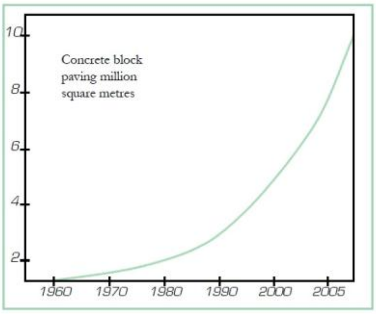

Figure 4.1: Growth in concrete block paving

VI. APPLICATIONS OF CONCRETE BLOCK PAVING

- In commercial areas it can be utilized in many different places such as bus terminals, parking lots, loading docks, zoos and airport pavements.
- These are used in road construction such as toll plazas, intersections, pedestrian crossings.
- The residential locations where the paver stones used are the patio, decking, balconies, courtyards, walkways and driveways.

VII. ADVANTAGE OF DESIGN

- Load spreading is equal in all direction.
- Failure is less than the normal pavement.
- Life of design is extended due to equal load spreading.

VIII. DISADVANTAGE OF DESIGN

- It is difficult to construct
- If it crack is determine it is difficult to replace.

IX. MIX DESIGN

A. *General*

Design of concrete mixes involves in step by step process firstly determination of the proportions of the given constituents namely, cement, water, coarse aggregate and fine aggregate with admixtures if any. Workability is the important property of concrete in the fresh state. For hardened state compressive strength and durability is considered.

The mix design methods are being followed in different countries it is mostly based on empirical relationships, charts and graphs developed from experimental investigations. Following methods are in practice

1. ACI Mix design method
2. British Mix design method
3. USBR Mix design method
4. Mix design method according to Indian standard

M-15 CONCRETE MIX DESIGN		
As per IS 10262-2009		
A-1	Stipulations for Proportioning	
1	Grade Designation	M15
2	Type of Cement	OPC 53 grade
3	Maximum Nominal Aggregate Size	20 mm
4	Minimum Cement Content	250 kg/m^3
5	Maximum Water Cement Ratio	0.5
6	Workability	25 mm (Slump)
7	Exposure Condition	Normal
8	Degree of Supervision	Good
9	Type of Aggregate	Crushed Angular Aggregate
10	Maximum Cement Content	540 kg/m^3
A-2	Test Data for Materials	
1	Cement Used	Coromandal OPC 53 grade
2	Sp. Gravity of Cement	3.00
3	Sp. Gravity of Water	1.00
4	Chemical Admixture	Not Used
5	Sp. Gravity of 10 mm Aggregate	2.878
6	Sp. Gravity of Sand	2.605
7	Water Absorption of 10 mm Aggregate	0.83%
8	Water Absorption of Sand	1.23%
9	Free (Surface) Moisture of 10 mm Aggregate	Nil
10	Free (Surface) Moisture of Sand	Nil

B. *Cement Mortar*

- For preparing mortar, firstly a mixture of cement and sand is mixed thoroughly and then it should be kept in dry condition. Water is added gradually and mixed with shovels. The cement to sand proportion recommended for various works is as shown is Table

C. *Properties of Cement Mortar*

The following are the important properties of cement mortar:
1. When water is added to the cement and sand mixture, hydration of cement starts and it binds sand particles along with the surrounding surfaces of masonry and concrete.
2. A mix higher than 1:3 is prone to shrinkage.
3. Proper mix alone closes the voids in sand and hence the plastered surface is porous.
4. Well mixed and proportioned mortar provides impervious surface
5. The strength of mortar mainly depends upon the proportion of cement and sand.

S. No	Works	Cement: Sand
1	Masonry works	1:6 to 1:8
2.	Plastering masonry	1:3 to 1:4
3.	Plastering concrete	1:3
4.	Pointing	1:2 to 1:3

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A. EXPERIMENT PROCEDURE

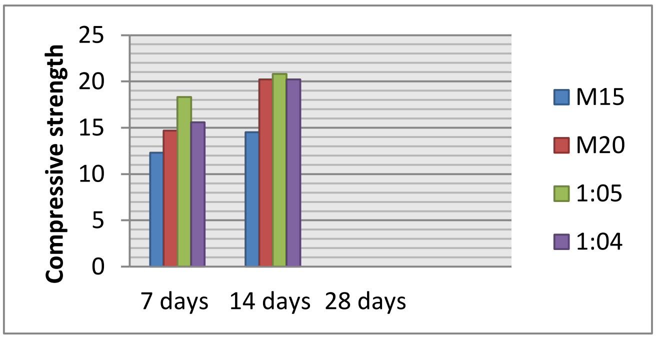
The experimental procedure in preparation of mould (wooden) in desired size is as follows. Steps involve in experimental procedure

- Preparation of concrete
- setting of mould
- preparation of stone
- Curing process
- Testing of stone

7 days test result				
Size (mm)	Ratio	Weight (Kg)	Failure load (KN)	Crushing streng (Mpa)
200x200x80	1:2:4	10.55	560	12.3
200x200x80	1:1.5:3	10.43	680	14.7
200x200x80	1:5	10.46	842	18.3
200x200x80	1:4	10.32	725	15.6

14 days test result				
Size (mm)	Ratio	Weight (kg)	Failure load (kN)	Crushing strength (Mpa)
200x200x80	1:2:4	10.26	670	14.5
200x200x80	1:1.5:3	10.64	930	20.2
200x200x80	1:5	10.21	960	20.8
200x200x80	1:4	10.79	930	20.2

Compressive strength result



B. CONCLUSION

1. A simple laboratory-scale test setup can be utilized to assess the behavior of concrete blocks with respect to their shape, thickness and laying pattern, etc.
2. The effectiveness of load transfer depends on the vertical surface area of individual blocks.
3. Shaped blocks perform better than rectangular and different blocks of similar thickness installed in same laying pattern.
4. Blocks with larger size produce lower deflection.
5. Strength of blocks has no significant influence on deflection.
6. Block pavements stiffen more progressively with an increase in load repetition, but gain full elastic property after some repetitions.

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