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# INTERLOCKING TILES USING PERVIOUS CONCRETE

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**Abstract -** *As the construction blooms, we see the depletion in green cover, which in turn increases surface runoff thereby reduces ground water recharge. Common Interlocking Tiles used for Pavement works causes problems in percolation of water to underground. It may lead to Flooding as infiltration decreases and droughts during summer since ground water recharge rate is low. Pervious Concrete is the concrete which passes water through its void content. So by replacing Normal concrete mix by Pervious Concrete as Interlocking Tile Mix, then it reduce Runoff and allow Ground water recharge. Generally Pervious Concrete are the Concrete in with no fine Aggregate also called No-fine concrete. The mix contains only Cementing Material, Coarse Aggregate and Water. Compared to the existing interlocking tile pervious concrete tile has lower strength due to absence of fine aggregate. Elimination of fine aggregate is necessary to make it pervious. Hence, addition of minute reinforcement material like steel fibres arises. So Lathe Scrap is added. Lathe Scrap are Industrial waste material in Lathing Industry, making tile more economical. The cementing Material used is Portland Pozzolana Cement (PPC). The present Project deals with Study and Comparison of Strength of Pervious Concrete with and without Lathe Scrap, Applications of Infiltration through different Aggregate size in Concrete mix, Comparison of Shapes of interlocking Tiles, and Comparison of different Aggregate sizes. This Project gives an overview of Design of Pervious Concrete Mix, Strength properties, Application of Pervious Interlocking Tiles, Introduction of Lathe scrap in Pervious Concrete mix.*

***Key Words***: **Pervious Concrete, Lathe Scrap, Interlocking Tiles**

## 1. INTRODUCTION

Interlocking Tiles are used for Pavement is emerged in US over last few decades. Normally, Interlocking Tiles are made using Concrete or clay. The major advantage of Interlocking Pavement Tiles than normal roads is in which can neglect cracking of Roads. Also, it can tolerate high deflection and will not affect by Thermal expansion. And Interlocking Tiles does not require curing time after paving. So directly used for traffic purpose. Due to availability, low maintenance and easy installation, Interlocking Tiles are using more and more for pavement purposes. So there is an impact that it increases surface runoff and reduce ground water recharge and later leads to flooding risks, etc. This project provides a solution to reduce the flooding and improve drainage of Interlocking Tiles. It is done by replacing normal Concrete mix by Pervious Concrete mix. By simply removing fine aggregate from the mix. So Pervious concrete is also named as No Fine concrete.

The Pervious concrete contains large number of voids and water infiltrate through these void spaces. So due Large number of Voids, its overall compressive strength is lower than normal concrete mix. The compressive Strength also depend upon the Water-cement ratio and the properties of cementing material and aggregate. So to overcome this Dis-advantage of concrete mix here we introduce an industrial waste called Lathe Scrap. The lathe scrap is act as a good fibre in the concrete. Lathe scrap can increase up to 30% of compressive Strength of concrete.

### 1.1 Properties of Pervious Concrete

Pervious concrete is a type of concrete, which is highly porous in nature and made by the mixture containing Cementing Material, Water and Coarse Aggregate. In rare cases, slight amount of Fine Aggregate is also added in Pervious Concrete Mixture. Due to the Porous nature of the mixture, the Runoff Water is simply made to pass through its voids. So runoff water can be minimized. But due to its voids, it cannot used for roofing purposes. Pervious concrete are generally light weight concrete due to the absence of Fine Aggregate.

Another main property of Pervious Concrete is the Thermal Insulation. Pervious Concretes has good Thermal Insulation Properties. And Drying Shrinkage is another Property of Pervious Concrete. This Paper follow M35 Grade for Pervious Concrete. The recommended grade of paver block is from IS 15658 (2006). And the recommended minimum Thickness of paver block is 60 mm.

## 2. MATERIALS USED AND THEIR PROPERTIES

### 2.1 Portland Pozzolana Cement

Portland Cements are the common type of cementing Material used in Concrete mix. This Paper follows Portland Pozzolana Cement, which contains 15 to 25% Fly ash Content. Pozzolana is a natural Material which contains Silica. Commonly used Pozzolanic materials are volcanic ash,

Calcined clay, Fly ash and Silica Fumes, etc. This paper follows Fly ash based Pozzolana Cement. In which Fly ashes are largely available and it is an Industrial waste too. Pozzolana Cement is also Known as blended Cement. Portland pozzolana cement obtained by mixing Clinker with Gypsum and Pozzolanic material like Fly-ash. PPC is much better than OPC and it can be used in all applications of OPC. PPC is used according to the IS code IS 1489 part 1. The cement used in this paper is Ramco Cement.

### 2.2 Coarse Aggregate

Crushed Aggregates of different sizes are used. Crushed Aggregates are collected from local Crushing plants. Different Test is conducted on Coarse Aggregate to get some properties of Coarse Aggregate. The tests are conducted on Coarse Aggregate is Specific Gravity of Coarse Aggregate and Abrasion Resistance. The different size of Aggregate are 20mm, 10mm and 6mm by using Sieve.

### 2.3 Water

Water gives an important role in mixing of concrete. When water mix with cementing material a chemical reaction occurs and a paste is formed which bind Coarse Aggregate, So concrete mix can be prepared. When Excess amount of water usage leads to Segregation and Bleeding. So the amount water plays a vital role in prepare a concrete mix with good strength properties. Also, the amount of water is very less, then it should not achieve the Workability criteria. The water-cement Ratio used in this Paper is 0.27 to 0.34.

### 2.4 Lathe Scrap

Lathe Scraps are Industrial waste from Lathe industry which is cheaply available. In this paper Lathe Scrap used is Stainless Steel. By using Stainless Steel Material, corrosion can be neglected. Lathe Scrap is added to Pervious Mix to increase Strength. Lathe Scrap act as good fibre in concrete. Lathe Scrap is collected from Steel Industry.

## 3. METHODOLOGY

For pervious Concrete mix, there is no specific design methods. So the mix Design done using normal concrete mix proportion guide lines as per IS 10262: 2009. Also, the mix follows IS 12727: 1989 which is the code of practice for No Fine concrete. For concrete mix design Water cement ratio is an important thing to consider. Properties of aggregate is also important. To get good strength, water cement ratio is minimal as possible.

This project undergoes different trial mixes according to IS guide lines to determine better pervious concrete mix. By trial and error method here found that, for M35 pervious concrete mix, the better mix proportion is 1:4.5:0.30 (Cement: Coarse Aggregate: Water). The mix proportion is selected by checking Compressive strength and Infiltration of water through it.

### 3.1 Experimental Detail

It deals with various tests adopted in this project. The project undergoes Compressive Strength Test of Pervious Concrete mix, with and without Lathe Scrap.

Also, Different Shape of moulds are adopted to find which Interlocking Shape is good. The different shapes are;

1. Zig Zag Shape mould.
2. Diamond Shape mould.
3. Rectangular Shape mould.

**Fig -1**: Shapes of Interlocking Tile

Infiltration through the surface of Interlocking Tiles are the major Advantage of Pervious Concrete Mix. So the project follows different aggregate size mixes and visually checks that which sample is good in infiltration in accordance with Compressive strength.

Sample 1: Only 10 mm Aggregate.
Sample 2: Mix of 10 mm and 6 mm aggregate.
Sample 3: Mix of 20 mm and 6 mm aggregate.

**Table -1:** Number of Tiles casted

| Sample Number | Number of Samples Casted | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| Sample 1 | 6 | 6 | 6 |
| Sample 2 | 6 | 6 | 6 |
| Sample 3 | 6 | 6 | 6 |

## 4. RESULTS

### 4.1 Compressive Strength without Lathe Scrap

**Table -2:** Compressive Strength of 10 mm Aggregate mix

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 23.19 | 23.87 | 22.65 |
| 2 | 23.37 | 23.65 | 22.81 |
| 3 | 23.01 | 24.09 | 22.50 |
| Average Compressive Strength (N/$mm^2$) | 23.19 | 23.87 | 22.65 |

**Table -3:** Compressive Strength of 10mm and 6mm Aggregate

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 25.01 | 25.84 | 24.33 |
| 2 | 24.82 | 26.06 | 24.48 |
| 3 | 24.64 | 26.28 | 24.63 |
| Average Compressive Strength (N/$mm^2$) | 24.82 | 26.06 | 24.48 |

**Table -4:** Compressive Strength of 20mm and 6mm Aggregate

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 27.18 | 28.90 | 26.46 |
| 2 | 27.54 | 29.12 | 26.76 |
| 3 | 27.36 | 29.34 | 26.46 |
| Average Compressive Strength (N/$mm^2$) | 27.36 | 29.12 | 26.56 |

### 4.2 Compressive Strength with Lathe Scrap

**Table -5:** Compressive Strength of 10 mm Aggregate mix

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 30.08 | 31.75 | 29.35 |
| 2 | 30.44 | 31.97 | 29.50 |
| 3 | 30.08 | 32.19 | 29.35 |
| Average Compressive Strength (N/$mm^2$) | 30.2 | 31.97 | 29.4 |

**Table -6:** Compressive Strength of 10mm and 6mm Aggregate

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 32.26 | 34.6 | 31.93 |
| 2 | 32.07 | 34.82 | 31.63 |
| 3 | 32.62 | 35.04 | 31.93 |
| Average Compressive Strength (N/$mm^2$) | 32.31 | 34.82 | 31.83 |

**Table -7:** Compressive Strength of 20mm and 6mm Aggregate

| SL. NO. | Compressive Strength (N/$mm^2$) | | |
|---|---|---|---|
| | Zig Zag | Diamond | Rectangular |
| 1 | 36.60 | 37.80 | 34.97 |
| 2 | 36.97 | 38.10 | 34.67 |
| 3 | 37.33 | 38.32 | 34.37 |
| Average Compressive Strength (N/$mm^2$) | 36.96 | 38.07 | 34.67 |

### 4.3 Comparison of Compressive Strength with and without Lathe Scrap

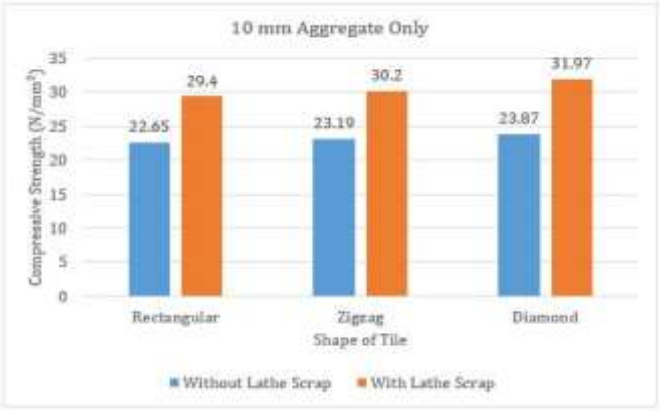


**Chart -1**: 10 mm Aggregate Only

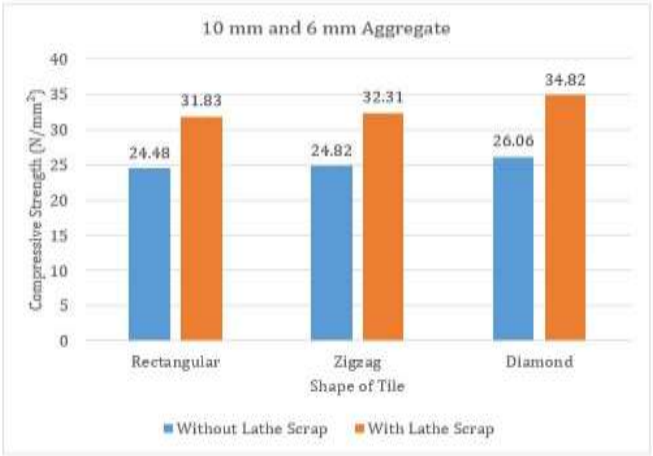


**Chart -2**: 10 mm and 6 mm Aggregate

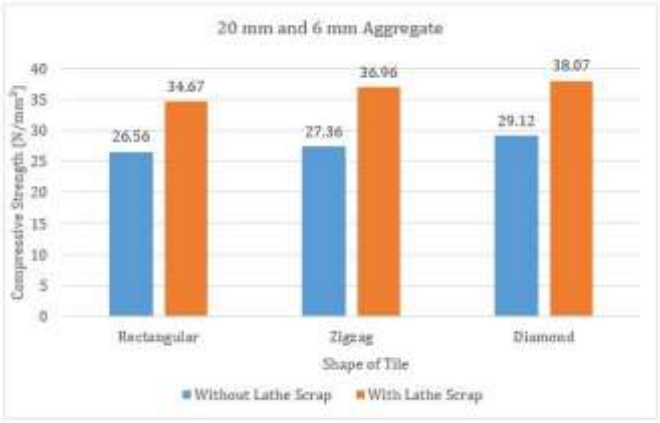


**Chart -3**: 20 mm and 6 mm Aggregate

### 4.4 Comparison of Compressive Strength Based on Aggregate Proportion

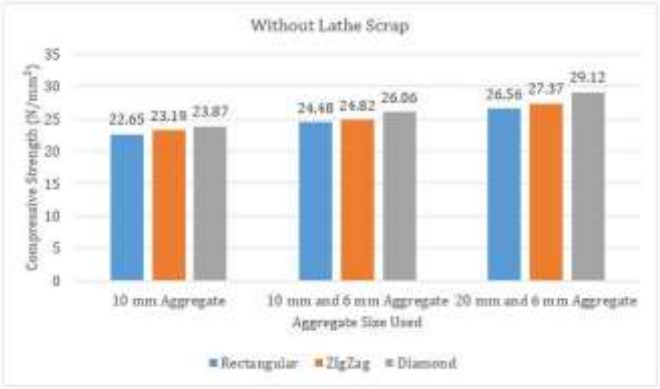


**Chart -4**: Without Lathe Scrap

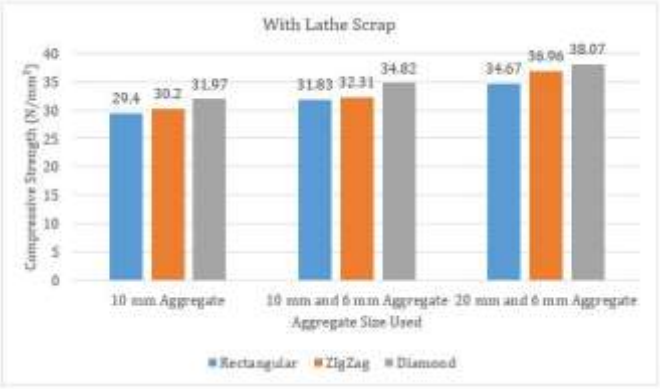


**Chart -5**: With Lathe Scrap

## 5. DISCUSSIONS

All the samples are undergoing 28 days curing in water. After curing all the samples are tested for Compressive Strength. Experimental observations establish an increase in the compressive strength, With Lathe Scrap of 10 mm

Aggregate size for rectangular, zigzag and diamond shapes are 29.8%, 30.22% and 33.93% respectively. And With Lathe Scrap of 10 mm and 6 mm Aggregate size for rectangular, zigzag and diamond shapes are 30.02%, 30.17% and 33.61% respectively. And With Lathe Scrap of 20 mm and 6 mm Aggregate size for rectangular, zigzag and diamond shapes are 30.53%, 35.08% and 30.73% respectively.

Compressive Strength Test of Pervious Concrete mix Without Lathe Scrap for 10 mm Aggregate size, an increase Strength of 2.3% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 5.38% for Diamond Shape compared to Rectangular Shape. And for 10 mm and 6 mm Aggregate size, an increase Strength of 1.38% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 6.45% for Diamond Shape compared to Rectangular Shape. And for 20 mm and 6 mm Aggregate size, an increase Strength of 3.04% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 9.63% for Diamond Shape compared to Rectangular Shape.

Compressive Strength Test of Pervious Concrete mix With Lathe Scrap for 10 mm Aggregate size, an increase Strength of 2.72% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 8.74% for Diamond Shape compared to Rectangular Shape. And for 10 mm and 6 mm Aggregate size, an increase Strength of 1.5% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 9.39% for Diamond Shape compared to Rectangular Shape. And for 20 mm and 6 mm Aggregate size, an increase Strength of 6.60% for Zigzag Shape compared to Rectangular Shape and an increase Strength of 9.80% for Diamond Shape compared to Rectangular Shape.

Compressive Strength of different Aggregate size, Without Lathe Scrap for Rectangular shape, there is an increase in strength of 8% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 17.20% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix. And for Zigzag shape, there is an increase in strength of 7.02% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 18.02% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix. And for Diamond shape, there is an increase in strength of 9.17% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 21.99% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix.

Compressive Strength of different Aggregate size, With Lathe Scrap for Rectangular shape, there is an increase in strength of 8.26% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 17.90% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix. And for Zigzag shape, there is an increase in strength of 6.98% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 22.38% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix. And for Diamond shape, there is an increase in strength of 8.91% for 10 mm and 6 mm aggregate mix compared to 10 mm aggregate mix and an increase of 19.08% for 20 mm and 6 mm aggregate mix compared to 10 mm aggregate mix.

## 6. CONCLUSIONS

Pervious Concrete mix is an Environmental friendly concrete mix. The Interlocking Tiles made with Pervious Concrete is less weight and Cost effective in nature. Pervious Concretes are no-fine Concrete. So, no Fine aggregate required for the preparation of mix. Pervious Concrete interlocking Tiles are very good in Storm water Runoff through it Surface.

From the results, it is conformed that Compressive Strength taken by Interlocking Tile with Lathe Scrap is good enough than Interlocking Tiles without Lathe Scrap. Lathe Scraps are industrial waste. So this method is cost-effective. Better to use Stainless Steel material as Lathe Scrap to avoid Corrosion. The project analyses three different Interlocking Shapes. Among that Diamond Shape can withstand more Compressive Strength than other two. Even though, compressive strength is low, it can be used in light traffic roads. The project compares three different Aggregate sizes. From the result, concluding that Aggregate with mix of 20 mm and 6 mm sizes can take more Compressive Strength that others. So, aggregate with mix of 20 mm and 6 mm are preferable for Pervious Concrete mix.

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