International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

Experimental Study on Increasing Strength of Pervious Concrete

Prof. Prasad Kolekar [1], Saurabh Kulkarni[2], Yash Bhokare [3], Akash Lohar [4], Rakesh Kamble[5], Somnath Mudhe[6]

[1]Assistant Professor, Dept. of Civil Engineering, Tatyasaheb Kore Institute of Engineering and Technology, Warananagar, Dist - Kolhapur, Maharashtra, India
[2,3,4,5,6] Students, Dept. of Civil Engineering, Tatyasaheb Kore Institute of Engineering and Technology, Warananagar, Dist - Kolhapur, Maharashtra, India.

---***---

Abstract - *Due to ecological imbalances, frequency of occurrence of intensive storms has increased causing damage to life and property by flooding cityscapes. Permeable concrete offers to resolve this issue to certain extent by offering to store the stormwater and allowing it to percolate in the ground. It lacks in strength as compared to traditional concrete but with addition of flexural reinforcement and changing the proportion of concrete appreciable strength can be achieved.*

Key Words: *Pervious Concrete, Urban Flooding, Stormwater Management, Highway Stormwater, Groundwater Recharge.*

1. INTRODUCTION

In Many of The Urban Populations and Other Localities, Highway Stormwater Runoff Carries Away Dust and Other Pollutants into The Natural Water Bodies and Reservoirs. This Is Detrimental to The Native Fauna and Subtractive to The Efforts of Many Environmentalists, Municipal Corporations Trying to Preserve the Ecological Balance. Due To This It Is Encouraged to Filter The Runoff and Then Discharge It to Reservoirs. But Due to Insufficient Availability of Land for Collection and Filtration of Runoff Many of The Municipal Corporations in The World Have to Discharge the Runoff to The Water Bodies.

Permeable Pavement Offers Solution to This Problem in A Way as It Filters the Runoff Entering Ground Water and Simultaneously Recharges the Ground Water Storage and Reduces the Load On Local Authorities.

Also, During Monsoon Due to Accumulation of Rainwater on Pavements and Ponding in Nearby Areas Many of The Areas Become Inhabitable or Inaccessible. This Accumulation Further Increases Water Pressure on The Pavement and Resulting in Major Cracks and Seepage Which in Turn Creates Potholes and Renders the Pavement Unsafe to Use.

This Problem Can Be Addressed by Incorporating Permeable Pavements Which Can Store the Rainfall Excess and Prevent the Formation of Potholes to Some Extent.

1.1 Permeable Concrete

It Is a Type of No Fines Concrete in Which Aggregates with Larger Dimensions Are Used to Achieve Interconnection of Voids and Thus Improve the Permeability of Concrete. Typical Void Ratio in Permeable Concrete Varies Between 15 To 25% According to The Grade of Concrete and Proportion of Materials Used. This Type of Concrete Was in Practice During The 1800s But Became Obsolete and Regained Pace In 1970s In Us and Around 2000 In India Due to The Advantages in Can Offer Over Traditional Concrete.

1.2 Permeable Bituminous Concrete

It Is a Type of Concrete in Which Bitumen Is Used as Binder Along with Additives Which Direct the Excess Rainfall to The Ground Below. As This Type of Concrete Has Very Little Strength It Is Used for Light Duty Applications Such as Parking and Pedestrian Roads.

1.3 Permeable Pavers

This Type of Pavers Are Made Up of Porous Materials or Non-Porous Paving Blocks Placed with Larger Space In Between Them, The Gap Between Which Can Be Filled with Porous Media or Unbonded Aggregates. This Type of Paving Can Be Used for Light Duty Applications Such as Driveways, Footpaths Etc.

1.4 Impact of Highway Stormwater Runoff on Water Bodies

Many Of the Pollutants Like Dust or Gases from The Vehicles Are Resting on The Pavement Surface. The Storm Carries Atmospheric Pollutants with Itself to The Ground and The Runoff Thus Generated Is Enriched by The Surface Pollutants. Majority Of the Dangerous Pollutants Includes Heavy Metals and Sulphur.

The Factors Affecting the Extent of Impact of Highway Stormwater on Receiving Waters Are Potential for Dispersion of The Pollutants, Size of Catchment, Type of Pollutants and Biological Diversity of Receiving Waters.

The First Flush or The Discharge During First Few Minutes of Storm Flushes All the Impurities on The

Pavements and Thus Overloading the Filtration System. The Major Constituent Pollutants Are Cadmium, Zinc, Lead, and Iron.

1.5 Impact of Highway Construction on Ground Water

In Urban Areas Roads Account for Around 18% Area of The City. This Impermeable Surface Cuts Off the Flow of Water into The Ground. Due To the Compaction and Damming Effect of Road Fill There Is Rerouting of Ground Water Which in Turn Results in Loss of Head in Surrounding Areas.

After Analysis of Various Literature on Permeable Pavement Systems We Could Find Shortcomings in The Permeable Pavements As

1 – Lesser Compressive and Flexural Strength

2 – Higher Cost of Construction

3 – No Definite Article on The Proportion

Here In This Research, We Have Tried to Stress on The Strength and To Find Out Definite Proportion of Constituents of Concrete.

2. MATERIALS USED

1 – Cement

Ordinary Portland cement conforming to is 456-2000 53 grade was used.

The properties of cement as tested in lab were

1. Fineness – 3%
2. Standard consistency – 34%
3. Initial setting time – 30 min
4. Final setting time – 300 min

2 – Aggregates

Two types of aggregates were used in the project

1. Aggregates passing through 22 mm sieve and retained on 19 mm sieve
2. Thread aggregates having mean size 9.52 mm
   Properties of aggregates used
   1. Specific gravity – 2.46
   2. Water absorption – 2%

3- WATER

Common tap water from municipal supply line was used.

LABORATORY PROCEDURE

1. Mix Design

Nominal Mix for M20 Grade as Given by Is 456: 2000 Gives the Percentage of Cement in The Concrete As 18.18%.

Here For the Specific Gravities of Concrete and Cement the Ratio for Weight Batching Was Found to Be 1: 7.64.

Water Cement Ratio Of 0.35 Was Selected on The Criteria of Workability and To Avoid the Cement Slurry from Occupying the Voids Generated.

2. Preparation of Moulds

Standard Moulds of Size 15cm X 15 Cm X 15cm Were Assembled Using Nuts and Bolts and Then Oil Was Applied on Inside Surface.

3. Casting of Cubes

Keeping The Proportion of Cement Constant and Varying the Proportion Of 9.52 Mm Aggregates And 19.05 Mm Aggregates a Total Of 11 Different Proportion Were Created and for 1 Batch of Cubes Aluminum Mesh Was Used to Improve Flexural Strength of Concrete.

4. Curing

The Moulds Were Cured in A Tub of Potable Water For 6 Days and Then Tested for Compressive Strength.

5. Testing

Compressive Testing Machine Was Used to Check the Compressive Strength Attained by Concrete Cubes in The Interval Of 7 Days. The Results Thus Attained Were Interpreted to Find Out Exact Proportion.

3. RESULTS

Compressive Strength After 7 days:

SR. NO.	PROPORTION OF CONCRETE (BY VOLUME)	NO. OF DAYS	COMP. STRENGTH			AVERAGE COMP. STRENGTH
1	1:1.5:3	7	1.666	2.222	3.533	2.474
2	1:2.25:2.25	7	1.644	2.488	2.77	2.301
3	1:1.8:2.7	7	4.377	3.755	3.400	3.844
4	1:2.7:1.8	7	2.866	3.288	3.488	3.214
5	1:0.9:3.6	7	7.666	3.755	5.177	5.533
6	1:3.6:0.9	7	3.777	4.222	2.844	3.614
7	1:4.05:0.45	7	1.577	3.355	4.000	2.977
8	1:0.45:4.05	7	3.688	4.266	3.466	3.801
9	1:3.15:1.35	7	4.711	4.578	4.044	4.444
10	1:2.25:2.25 (USING ALUMINIUM MESH)	7	10.400	10.177	7.956	9.511
11	1:4.5	7	1.911	1.633	2.611	2.052

POROSITY OF SPECIMENS AFTER 7 DAYS:

Sr. No	Proportion	Porosity			Avg.
1	1:1.5:3	0.228	0.246	0.27	0.248
2	1:2.25:2.25	0.249	0.284	0.323	0.285
3	1:1.8:2.7	0.166	0.206	0.225	0.199
4	1:2.7:1.8	0.222	0.269	0.296	0.262
5	1:0.9:3.6	0.163	0.199	0.219	0.194
6	1:3.6:0.9	0.210	0.264	0.323	0.266
7	1:4.05:0.45	0.151	0.202	0.207	0.187
8	1:0.45:4.05	0.237	0.293	0.299	0.276
9	1:3.15:1.35	0.148	0.196	0.207	0.184
10	1:4.5	7	1.911	1.633	2.611
11	1:2.25:2.25 (USING ALUMINIUM MESH)	0.145	0.181	0.187	0.171

WEIGHT, DENSITY AND STRENGTH TO WEIGHT RATIO

Sr No.	Proportion	Weight	Density	S/W Ratio
1	1:1.5:3	6.1	1.81	1.37
2	1:2.25:2.25	6.92	2.05	1.12
3	1:1.8:2.7	6.65	1.97	1.95
4	1:2.7:1.8	6.6	1.96	1.64
5	1:0.9:3.6	6.78	2.01	2.75
6	1:3.6:0.9	6.42	1.90	1.9
7	1:4.05:0.45	7.33	2.17	1.37
8	1:0.45:4.05	6.4	1.89	2.01
9	1:3.15:1.35	7.1	2.10	2.12
10	1:2.25:2.25 (USING ALUMINIUM MESH)	6.93	2.03	4.69
11	1:4.5	6.39	1.89	1.09

Advantages

1. Lightweight

2. Can Reduce the Size of Sewers

3. Rough Texture Provides Resistance Against Skidding

4. Can Increase the Groundwater Storage

5. Can Prevent Water Clogging

6. Filtration of Stormwater

Disadvantages

1. Less Strength to Weight Ratio

2. Rough Texture Can Increase Wear and Tear of Tyres

3. CONCLUSION

1. Increasing the Proportion of Threads After Certain Limit Reduces the Strength of Concrete.

2. Changes in Proportion of Thread And ¾ Inch Aggregate Can Greatly Influence the Compressive Strength.

3. Addition of Flexural Reinforcement Such as Chimney Mesh Can Improve the Compressive Strength.

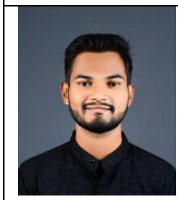
4. 7:3 Proportion of Thread And ¾ Aggregates Yielded the Maximum Compressive Strength.

REFERENCES

1. Mukul Nama, Akshaya Galva, Amit Sharma, Jitendra Singh, Kapil Astoria Department of Civil Engineering Poornima Group of Institutions Report 13-14

2. Koller Hemanth Kumar, Review Paper on Permeable Pavement Systems

BIOGRAPHIES

	Name - Prasad Kolekar Designation - Assistant Professor Department - Civil Engineering College - T.K.I.E.T. Warananagar
	Name – Saurabh Kulkarni Designation - Student (B. Tech) Department - Civil Engineering College - T.K.I.E.T. Warananagar
	Name – Yash Bhokare Designation - Student (B. Tech) Department - Civil Engineering College - T.K.I.E.T. Warananagar
	Name – Akash Lohar Designation - Student (B. Tech) Department - Civil Engineering College - T.K.I.E.T. Warananagar
	Name – Rakesh Kamble Designation - Student (B. Tech) Department - Civil Engineering College - T.K.I.E.T. Warananagar
	Name – Somnath Mudhe Designation - Student (B. Tech) Department - Civil Engineering College - T.K.I.E.T. Warananagar