TOP MIX PERMEABLE PAVEMENT SYSTEM

Supriya C.L[1],
[1] Assistant Professor, Dept of Civil engineering, Rajeev institute of technology Hassan, Karnataka, India

ABSTRACT

The idea of Permeable Pavements is a modified form of our standard concrete, lacking the finer aggregates leading to the formation of voids allowing water flow. Permeable Pavements, therefore, permit seepage of water along with the characteristic mechanical properties of concrete, including compressive strength. Therefore, instead of run-off wastage, permeable pavements allow permeation of water. Therefore, this distinctive property of permeable concrete can be utilized for increasing the infiltration.

For this study Kasak area of Bharuch city has been selected with the specific road network nearby to the Zadeshwar link joining Kasak road to Sheetal circle. The above road network has the history of the accumulation of water in the area during the monsoon season for long duration. To study the above objective the rainfall data for the area during the different day, month is collected. The volume data is the other important aspect for identifying the low volume road.

The main aim of our project is to improve the strength characteristics of pervious concrete. But it can be noted that with that increase in strength the permeability of pervious concrete will be reduced. Hence, the improvement of strength should not affect the permeability property which serves is purpose.

Keyword : - *Permeable, Pavement, Concrete roads, and Compressive strength etc….*

1. INTRODUCTION

(Pavements are an important mode of transport in India. India has a network of over 6,215,797 kilometers of roads as of 31 March 2020. This is the second-largest road network in the world, after the United States. Since the 1990s, major efforts have been underway to modernize the country's road infrastructure.

A pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favorable light reflecting characteristics, and low noise pollution. The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the sub-grade.

Permeable pavement is a storm water drainage system that allows rainwater and runoff to move through the pavements surface to a storage layer below, with the water eventually seeping into the underlying soil. It is beneficial to the environment because it can reduce storm water volume, treat storm water quality, and replenish the groundwater supply and lower air temperatures on hot days. Typically, between 15% and 25% voids are achieved in the hardened concrete, and flow rates for water through pervious concrete are typically around 480 in./hr (0.34 cm/s, which is 5 gal/ftÂ²/ min or 200 L/mÂ²/min), although they can be much higher. Due to the increased void ratio, water is conveyed through the surface and allowed to infiltrate, and evaporate, whereas conventional surfaces will not do so. A permeable pavement surface therefore becomes an active participant in the hydrological cycle: rainfall and snowmelt are conveyed back through soils into groundwater.

Top mix concrete pavement is also called porous concrete, permeable concrete, no fines concrete and thirsty concrete. Top mix concrete pavement is a special type of concrete with a high porosity used for concrete flat applications. Top mix concrete pavement is an open graded structure with interconnected voids through which rain and storm water is permitted to percolate into the aquifer. It consists of cement, coarse aggregate and water. If the

aggregate is angular,

Fig -1.1: Tarmac Concrete layer

voids in the aggregate will increase. Top mix concrete pavement is an environmental friendly building material and EPA (Environmental Protection agency) has identified it as a Best Management Practice (BMP) for storm water Management.

India is a developing country and safety of roads is still in a Pervious concrete pavement is a unique and effective means to address important environmental issues and support green, sustainable growth. By capturing storm water and allowing it to seep into the ground, porous concrete is instrumental in recharging groundwater, reducing storm water runoff. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices.

Advantages:

- Rapid water removal ensures more effective storm water management.
- There is a reduced risk of flash flooding.
- It is a low maintenance surface.
- Safer roads are created as there is less standing water and so a reduced risk of hydroplaning.
- There is reduced impact on the natural water cycle.

Applications:

- Low volume residential roads.
- Car parks.
- Pavements, bike and pedestrian pathways.
- Tennis courts.
- Pavement edge drain and gutters.
- Swimming pool decks.
- Driveways.

Fig -1.2: Top mix permeable

1.1 Objectives

1. To prepare the top mix permeable pavement for water absorption.
2. To prepare the cross sectional model of rigid pavement.
3. To study the compressive strength of top mix permeable rigid pavement

2. MATERIALS & METHODOLOGY.

MATERIALS: Cinder gravels, Cement, Coarse aggregate, Water.

Cinder gravels: A cinder is a pyroclastic material. Cinders are extrusive igneous rocks; they are fragments of solidified lava. Cinders are typically brown, black, or red depending on chemical composition and weathering. Cinders have been used on track surfaces and roads to provide additional traction in winter conditions. Cinders are also employed as inorganic mulch in xeriscaping, because of excellent drainage properties and erosion resistance.

Table -1: Test on Cinder gravels.

Materialproperty	Results obtained
Specific gravity	1.9
Density	783.46 kg/m^3

Fig -2.1: Cinder

Cement : A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and aggregate together. Cement mixed with fine aggregate

produces mortar for masonry, or with sand and gravel, produces concrete. Concrete is the most widely used material in existence and is behind only water as the planet's most-consumed resource.

Table -2: Test on Cement

Material property	Results obtained
Specific gravity	3.089
Fineness	4%
Normal consistency	33%
Initial setting time	40 minutes

Fig -2.2: Cement

Coarse aggregate: Coarse aggregates are a construction component made of rock quarried from ground deposits. Coarse aggregates are defined as any material greater than 4.75 mm. Aggregates make up 60-80% of the volume of concrete and 70-85% of the mass of concrete. Aggregate is also very important for strength, thermal and elastic properties of concrete, dimensional stability and volume stability. The aggregates were tested as Indian standard Specifications IS:383- 1970.

Table -3: Test on Coarse aggregate.

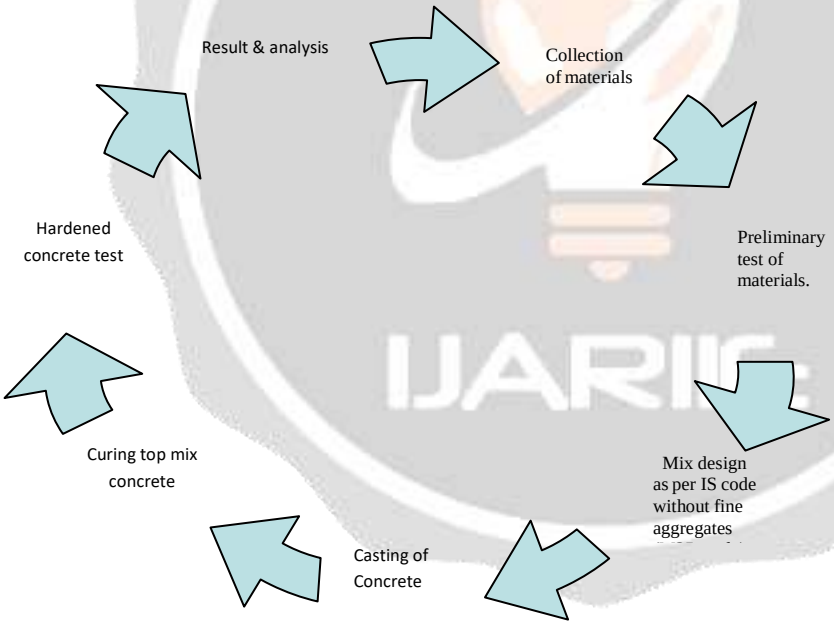
Characteristics	Test Result
Specific gravity	2.73
Water absorption (%)	0.5
Bulk Density(kg/m³)	1515.25

Fig -2.4: Coarse aggregate

Water: Water is one of the most important elements in construction and is required for the preparation of mortar, mixing of cement concrete and for curing work etc. The quality of water used has a direct impact on the strength of the motor and cement concrete in the construction work. The water used for curing and mixing must be free from high quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth, etc that might be deleterious to bricks, concrete or iron.

Fig-2.5: Water

3. Methodology



3.1 Mix proportion

Table -4: Mix proportion for M-35 Grade Concrete

Grade of concrete	Cement	Coarse aggregate	W/C
M 35	1	3	0.5

3.2 Mixing & Casting of Specimens

Cement and coarse aggregate were taken in mix proportion 1:3 which correspond to M35 grade of concrete. Coarse aggregates are replaced by cinders aggregates in different percentages, such as 0%, 10%, 20%, 30%, 40%. All the ingredients were dry mixed homogeneously. To this dry mix, add required quantity of water (W/C= 0.50) and the entire mix is again homogeneously mixed. This wet concrete is poured into the moulds which is compacted by hand, in three layers and then kept on the vibrator for compaction. After the compaction, the specimens are given smooth finish.

The following procedure is adopted to cast the specimens

Place the moulds on the vibrating table and pour the wet concrete mix inside the moulds in three layers. Vibrate the concrete both through table vibrator and by hand compaction using tamping rod.After filling the moulds with wet concrete, level the surface and give the designation to each specimen.Demould the specimen after 24 hours.

Fig -2.5: Model of C/s View of pavement

4. Results & Discussion

4.1 Compressive strength test results: Following table gives the overall results of compressive strength of concrete, when coarse aggregates are replaced by cinders aggregates in different percentages and then subjecting them to curing.

Table -5: Compressive strength test result

Percentage replacement of coarse aggregate by cinders aggregates	7 days Compressive strength of concrete (MPa)	14 days Compressive strength of concrete (MPa)	28 days Compressive strength of Concrete(MPa)
0%	24.57	35.67	46.28
10%	20.29	27.53	33.85
20%	20.43	30.96	41.16
30%	22.66	34.06	44.98
40%	20.59	26.43	31.73

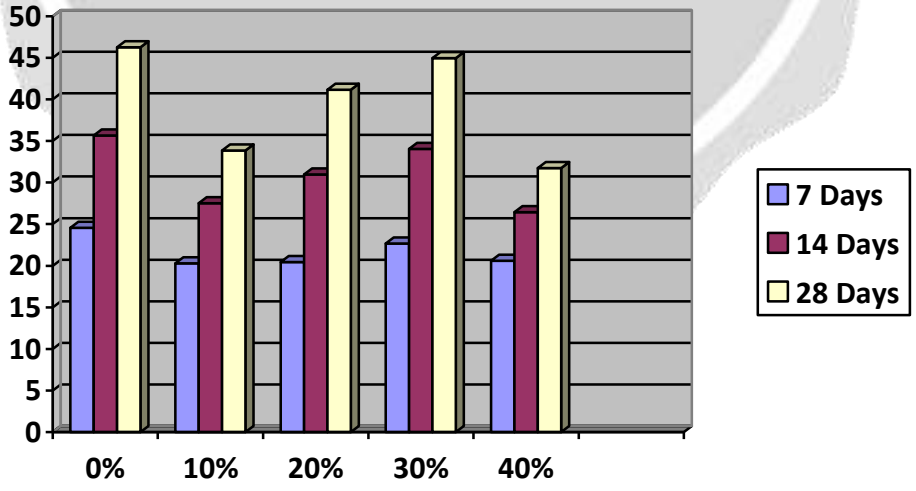


Chart -1.: Compressive strength test results

4. CONCLUSIONS

The following conclusions can be drawn based on the experimental studies conducted.

- The proper mix design is necessary for the preparation of top mix permeable pavement layer.
- The workability of concrete goes on increasing as the percentage replacement of coarse aggregates by water saturated cinders aggregates goes on increasing.
- The concrete produced with 30% replacement of coarse aggregates by water saturated cinders aggregates will yield higher compressive strength
- Thus it can be concluded that the top mix concrete needs a proper mix design. In this project an attempt is made for assessment of compressive strength of cinders cement concrete. Concrete mixes M35, is designed as per Indian standard code (IS-10262-2019) by adding normal mix design, 10%, 20%, 30%, 40% of cinders. From the strength studies it is also concluded that the optimum replacement of aggregates by cinder aggregate is 30% where the strength is almost equal to the strength obtained by conventional concrete.

In conclusion, facing the viable wastage of water and receding water levels, the idea of permeable pavement systems is a feasible, economical, efficient, and ethical option. Permeable pavement and hence water drinking concrete is the sustainable option to replenish our groundwater levels.

5. REFERENCES

[1]. M S Shetty – Concrete Technology

[2]. IRC 58-2002 code book for rigid pavement.

[3]. IS 10262:2019 code for mix design