JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Experimental investigation of strength properties of concrete by introducing no fines, fly ash and coconut shells

[1]Kalyan Kumar K, [2]Sree Krishna Somu, [3]Jayarami Reddy B
[1]Assistant Professor, [2]Assistant Professor, [3]Professor
[1]Department of Civil Engineering,
[1]YSR Engineering College of Yogi Vemana University, Proddatur, Andhra Pradesh, India.
[1]Kalyan80967@gmail.com

Abstract: Flooding has become a frequent issue, particularly due to urbanization and inefficient water drainage systems. Impervious concrete, commonly used for pavements and courtyards, prevents rainwater from seeping into the ground, exacerbating drainage problems. Cities like Mumbai experience severe flooding even with moderate rainfall because of these challenges. Additionally, impervious concrete surfaces trap and emit heat, contributing to rising global temperatures. In contrast, pervious concrete, which excludes or minimizes fine aggregates, is designed to be porous, allowing water to percolate into the ground. This helps in recharging groundwater and mitigating the negative effects of urban flooding. By increasing the void space within the pervious concrete, rainwater can freely pass through, promoting better water management. Pervious concrete is composed of cement, coarse aggregates, water, and occasionally, small amounts of fine aggregates or other additives. Its porous structure enables better water infiltration compared to traditional impervious materials, which can contribute to environmental issues and health risks. One effective solution is the use of pervious concrete in pavement blocks made from locally available materials. In this research, the mix design for M25 grade concrete has been selected, and specimens are cast with different variations in composition. The specific cases considered include 0% fines, 3% fines combined with 2.5% coconut shell, and 3% fines with 5% fly ash. The percentage of fines is determined as a portion of the coarse aggregate volume and is used as a partial replacement for coarse aggregates. Similarly, the coconut shell is used as a partial replacement for coarse aggregates, and fly ash is employed as a partial replacement for cement by volume. Different shapes of specimens like cubes, cylinders, beams are carried out and having the sizes of 150×150×150 mm,150×300mm ,500×100×100 mm respectively. All specimens will be cured for a period of 7days, 14 days and 28 days before testing. Following the curing periods, compressive strength tests, flexural strength tests, and split tensile strength tests will be conducted. Based on the results, the strength characteristics of the specimens across different cases will be compared, providing a comprehensive overview of their performance.

***Index Terms* – No fines, Fly ash, Coconut shells, Compressive strength, Flexural strength.**

I. INTRODUCTION

Pervious concrete, also known as porous or permeable concrete, has been in use since the 1800s in Europe, where it was initially employed for pavement surfaces and load-bearing walls, primarily for cost efficiency due to the reduced cement content. Its use gained traction again in the 1920s for two-story homes in Scotland and England. After World War II, the scarcity of cement further promoted its adoption in Europe. In the U.S., however, pervious concrete didn't become popular until the 1970s, and in India, it gained attention around 2000. This type of concrete has high porosity, allowing water from rainfall and other sources to pass directly through, reducing runoff and supporting groundwater recharge. Pervious concrete is composed of large aggregates with little to no fine aggregates. The cement paste coats the coarse aggregates, creating a network of interconnected voids that allow water to flow through. It is commonly used for parking lots, areas with light traffic, residential streets, pedestrian walkways, and greenhouses. Pervious concrete plays a significant role in sustainable construction and is one of the techniques used to promote low-impact development, particularly for water management. Approximately 15-30% of pervious concrete's volume consists of an interconnected void structure. This unique feature not only supports environmental protection by acting as a natural drainage system but also promotes sustainable growth by recharging groundwater. The surface of pervious concrete is rough and has a honeycomb texture, which is effective for moderate surface traffic areas. A carefully controlled mix of water and cementitious materials forms a thick coating around the aggregate particles, preventing the paste from washing away during mixing and placement. By maintaining the right amount of paste, the concrete retains its interconnected void system, enabling air and water to pass through. Due to the absence of fine aggregates, pervious concrete is lighter (around 1600 to 2000 kg/m³), though the harshness of the mix can make it more challenging to handle during mixing, delivery, and placement.

Pervious concrete is a unique type of concrete made from a blend of cement, coarse aggregates, water, and occasionally admixtures or other cementitious materials. While fine aggregates are often omitted, small amounts may be added in some cases to enhance the mix, while still maintaining its porous nature. This design allows for better water permeability and can help mitigate environmental concerns. Impervious materials can pose health risks and contribute significantly to environmental degradation. A sustainable solution to this issue is the development of pervious concrete pavement blocks using locally sourced materials. These blocks, with their higher void content, allow water to flow through and seep into the ground, reducing surface runoff and recharging groundwater.

Figure 1. Pervious concrete specimens

II. LITERATURE REVIEW

This chapter provides a comprehensive review of the literature on various experimental studies conducted by researchers on pervious concrete. It covers key aspects such as mix design, properties, and the structural behavior of concrete when partially replaced with supplementary cementitious materials, including fly ash, rice husk ash, ground granulated blast furnace slag (GGBFS), silica fume, and glass powder. The potential use of coconut shells as an alternative aggregate and fly ash as a cement replacement are also discussed, highlighting relevant research findings.

Darshna Shah et al. (2013) study evaluated the cost-effectiveness of pervious concrete compared to conventional concrete. M20 grade normal concrete was compared with pervious concrete, designed according to NRMCA guidelines. The study concluded that pervious concrete reduces stormwater runoff, improves groundwater recharge, and eliminates the need for costly stormwater management systems. Husain N Hamdulay et al. (2015) research used materials such as 53-grade cement, coarse aggregates, GGBFS, and fly ash. The study found that the compressive strength of concrete increased with GGBFS, and the grading of aggregates was critical in balancing strength and permeability. Larger aggregates reduced compressive strength but enhanced permeability. Sukamal Kanta Ghosh focused on compressive strength and permeability when using various materials as partial cement replacements. The research concluded that fly ash increased long-term compressive strength, GGBFS improved strength but reduced permeability, and silica fume increased compressive strength without affecting permeability.

Sha Shirendra Dubawnt and Dr. Esar Ahmad (2020) examined the impact of metakaolin admixtures on the compressive and tensile strengths of pervious concrete, concluding that the compressive strength exceeded 40 MPa. K.S. Elango and V. Revathi (2017) focused on pervious concrete using PPC as a binder, with coarse aggregates ranging from 6 mm to 12 mm. The study examined the compressive strength, flexural strength, and permeability, emphasizing the role of aggregate size in concrete properties. Alessandra Bonicelli et al. explored the effects of adding small percentages of sand to pervious concrete at different water-cement (W/C) ratios (0.27, 0.30, 0.35) and varying sand content (5%, 10%, 15%). The results showed improved compressive and tensile strength with sand addition, but reduced permeability.

Anurag Prabhakar Rangankar (2022) compared the strength of conventional concrete with porous concrete, finding that workability in M20 and M25 grades of no fines concrete increased by 5.6% and 5.4%, respectively. However, after 28 days of curing, compressive strength in these grades decreased by 15.36% and 16.35% compared to conventional concrete. Prof. B. A. Hase et al. (2020) investigated the effect of increasing fines content (0%-10%) on the compressive strength of pervious concrete. The study concluded that compressive strength increased with higher fines content. Prof. Avinash Shingan et al. (2022) used PPC 43-grade cement, fine aggregates, 20 mm coarse aggregates, water, and Recorn 3S fiber in 1:5 and 1:7 concrete ratios. The findings revealed that fiber-reinforced concrete had higher compressive strength and permeability than conventional concrete.

T. Ahmed and S. Hoque (2020) focused on mix design for pervious concrete pavements, using cement, coarse aggregates (9.5 mm to 19 mm), fly ash (12%-14%), and different W/C ratios (0.36, 0.32, 0.28). It examined compressive strength, infiltration rate, and permeability. Shashank Tiwari et al. (2022) used OPC, coarse aggregates, water, and Conplast SP430 admixture. The study found that no fines should be used, aggregates larger than 20 mm are unsuitable, and Conplast SP430 enhanced strength and bonding between cement and aggregates. Muniter Muresa Muda et al. (2023) investigated the strength, porosity, and permeability of porous concrete made with recycled aggregates and varying rice husk ash content (0%, 15%, 30%, 45%, 60%). It found that increasing rice husk ash content improved compressive strength and porosity. Richard Meininger (1988) focused on pervious concrete properties, including water-to-cement ratios, total cement content, compaction, and curing time. The study showed that modifying these factors significantly impacted pervious concrete's strength and permeability. Yang and Jing (2003) highlighted that smaller aggregate sizes improved the strength of pervious concrete due to stronger aggregate-paste interfaces. Traditional methods yielded low-strength concrete, but adding silica fume and superplasticizers significantly enhanced strength. Paul Klieger (2003) studied the effects of entrained air on concrete durability and strength. While he did not focus specifically on pervious concrete, his work showed that smaller aggregates and reduced cement content helped maintain strength in air-entrained concrete. Akbari et al. (2001) discussed the environmental impact of impervious pavements, noting that they increase stormwater runoff and reduce groundwater recharge, contributing to urban flooding. Ranganathan et al. (2020) found that an aggregate-to-cement ratio of 3 provided the maximum strength in M20 pervious concrete. The mix design facilitated sufficient void space for water seepage. Prof. Pallavi

Kharat et al. (2022) examined the compressive strength and permeability of pervious concrete with 5% fly ash replacing cement. Compressive strength results were 25.16 N/mm² at 7 days, 33.28 N/mm² at 14 days, and 37.51 N/mm² at 28 days.
Raj et al. (2014) tested different cement paste mixtures with coarse aggregates of 10 mm and 12.5 mm, with 10% sand and a 0.31 W/C ratio. The second trial, using 20 mm and 12.5 mm aggregates, provided higher compressive strength and permeability. Mr. V.R. Patil et al. highlighted the environmental issues caused by conventional impervious pavements, noting their negative impact on water permeability and the urban environment. S.O. Ajamu et al. (2012) analyzed how aggregate particle size and material proportions affect the strength and permeability of pervious concrete. Alireza Joshaghani (2014) focused on the effects of coarse aggregates on the density, strength, porosity, and permeability of pervious concrete, particularly in relation to storm water management.

Based on the literature survey, it is observed that many researchers have explored the effects of adding fine aggregates and fly ash to no-fines concrete. Their findings generally conclude that incorporating a certain amount of fine aggregates can significantly improve the compressive strength of no-fines concrete. This improvement is attributed to better bonding between the coarse aggregates and the cement paste, as well as the filling of voids that would otherwise reduce the strength of the concrete.

In light of these findings, we have chosen to experiment with two different combinations for our no-fines concrete mix design:

1. **3% fines with 5% fly ash**: Fly ash is known to enhance long-term compressive strength and durability in concrete, as it acts as a pozzolanic material, reacting with the calcium hydroxide to form additional cementitious compounds.
2. **3% fines with 2.5% coconut shell**: Coconut shell, as an alternative lightweight aggregate, contributes to improved compressive strength, permeability, and sustainability. Using coconut shell can reduce the density of concrete while maintaining its structural integrity.

III. OBJECTIVES

Key objectives include:

1. Investigating the impact of industrial waste, such as fly ash and coconut shell, on pervious concrete properties.
2. Comparing the strength differences between conventional and pervious concrete.
3. Studying the specific effects of fly ash and coconut shell on the compressive and tensile behavior of pervious concrete.
4. Analyzing the variation of compressive, split tensile, and flexural strengths with different percentages of these materials.
5. Identifying the mix design that offers maximum compressive strength for pervious concrete.

Nomenclature

- **CC**: Conventional Concrete (without any replacement).
- **F_0**: No Fines Concrete (0% sand in the mix).
- **F_3 and FA_5**:
  - **F_3**: 3% fines as a replacement of coarse aggregates in the concrete.
  - **FA_5**: 5% fly ash as a replacement for cement.
- **F_3 and $CS_{2.5}$**:
  - **F_3**: 3% fines as a replacement of coarse aggregates in the concrete.
  - **$CS_{2.5}$**: 2.5% coconut shell as a replacement for coarse aggregates.

This nomenclature will help ensure that the readers and researchers can easily identify and differentiate the various specimen types throughout your study.

IV. DETAILS OF THE SPECIMENS

In this project, a total of 144 specimens are prepared, categorized as follows:

1. **Conventional Concrete**: 36 specimens are made using both fine and coarse aggregates.
2. **No Fines Concrete**: 36 specimens are prepared without any fines, resulting in a no fines concrete mix.
3. **Concrete with Fly Ash**: 36 specimens incorporate 3% fines and 5% fly ash as a partial replacement for cement.
4. **Concrete with Coconut Shell**: 36 specimens are created using 3% fines and 2.5% coconut shell as a partial replacement for coarse aggregates.

These prepared specimens subjected to testing for compressive strength, flexural strength, and split tensile strength to assess the performance of each mix design.

Table 1: Details of different cubes specimens (7,14 and 28 days curing)

S.No	Identification	No. of specimens	Size of specimen	Mix proportion	w/c Ratio
1	CC	9	150×150×150	1:1.86:3.12	0.5
2	F_0	9	150×150×150	1:0:2.81	0.3
3	F_3 and FA_5	9	150×150×150	1:0.084:2.65	0.3
4	F_3 and $CS_{2.5}$	9	150×150×150	1:0.084:2.65	0.3

Table 2: Details of different beam specimens (7,14 and 28 days curing)

S. No	Identification	No. of specimens	Size of specimen	Mix proportion	W/C Ratio
1	CC	9	500×100×100	1:1.86:3.12	0.5
2	F_0	9	500×100×100	1:0:2.81	0.3
3	F_3 and FA_5	9	500×100×100	1:0.084:2.65	0.3
4	F_3 and $CS_{2.5}$	9	500×100×100	1:0.084:2.65	0.3

Table 3: Details of different cylindrical specimens (7,14 and 28 days curing)

S. No	Identification	No. of specimens	Size of specimen	Mix proportion	W/C Ratio
1	CC	9	150×300	1:1.86:3.12	0.5
2	F_0	9	150×300	1:0:2.81	0.3
3	F_3 and FA_5	9	150×300	1:0.084:2.65	0.3
4	F_3 and $CS_{2.5}$	9	150×300	1:0.084:2.65	0.3

V. RESEARCH METHODOLOGY

In this chapter, the materials utilized in the project are discussed in detail. The properties of each material, including cement, water, fine aggregate (sand), coarse aggregate (20 mm), coconut shell, and fly ash, are explained. These material properties are critical for designing the mix proportions of concrete in accordance with the guidelines provided in **IS 10262:2009** and **IS 456:2000**.

Table 4: Properties of cement

Properties	Values
Type of cement	OPC 53 Grade
Specific Gravity	3.12
Fineness of cement	4.5%
Normal consistency	30.5%
Initial setting time	41 minutes
Final setting time	325 minutes

Table 5: Properties of fine aggregates

Properties	Values
Fineness modulus	2.74
Specific Gravity	2.65
Bulk Density (Rodded)	1541 kg/m^3
Bulk Density (Loose)	1462 kg/m^3
Silt Content	1.22%
Zone of Sand	II

Table 6: Sieve analysis of fine aggregates

IS Sieve size, mm	Percentage of passing	Limits as per IS:383
10	100	100
4.75	99.46	90-100
2.36	87.19	75-100
1.18	69.71	55-90
0.6	45.84	35-59
0.3	18.23	8-30
0.15	2.95	0-10

Table 7: Properties of coarse aggregate

Properties	Values
Water Absorption	0.6%
Specific Gravity	2.68
Bulk Density (Rodded)	1565 kg/m^3
Bulk Density (Loose)	1472 kg/m^3
Elongation Index	13.2%
Flakiness Index	12.6%
Impact Value	14.5%
Aggregate crushing value	16.8
Abrasion value	18.4

Table 8: Sieve analysis of coarse aggregates

IS sieve size in mm	Percentage of passing	Limit as per IS:383
40	100	100
20	92.17	85-100
10	9.64	0-20
4.75	0.00	0-5

In this study, coconut shell was used as a partial replacement for coarse aggregate (crushed granite). The coconut shells were collected from a local temple, then cleaned, sun-dried, and the fibers were removed to evaluate their properties. No pre-treatment was required for the coconut shells except for addressing their high water absorption capacity. Due to this characteristic, the shells were soaked in potable water for 24 hours before use. The concrete produced using coconut shell aggregates meets the minimum requirements for concrete strength and performance.

Figure 2: Coconut shell (CT Lab)

Table 9: Properties of fly ash (CT lab)

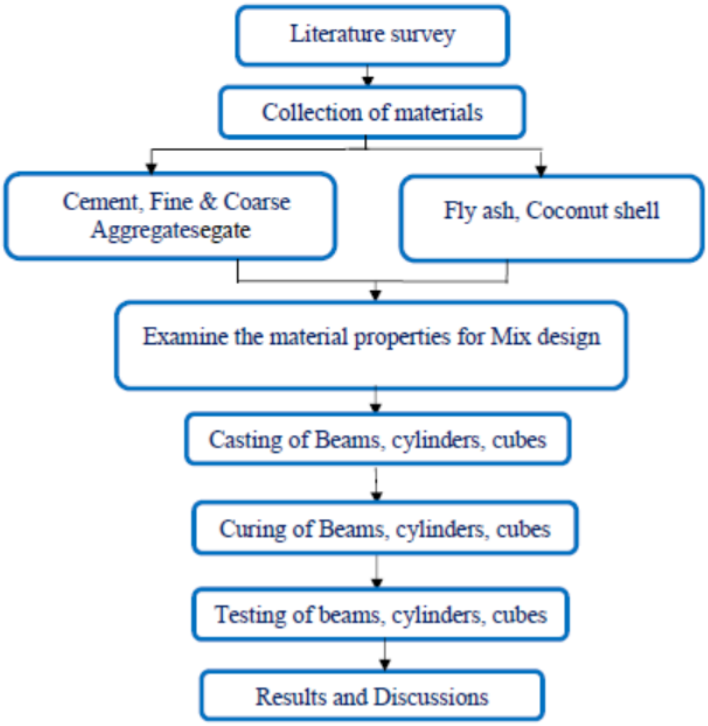
Properties	Values
Specific gravity	2.12
Fineness	291 m^2/kg
Bulk density	1100-1200 kg/m^3
Colour	Light grey

Figure 3: Fly ash (CT Lab)

Quantity of materials:

Grade of concrete	Particulars	Quantity of materials (Kgs)			
		Conventional concrete	No-fines concrete	3% fines & 5% fly ash	3% fines & 2.5% coconut shell
M25	Cement	34.66	41.85	41.91	39.82
	Fine aggregates	64.48	0	3.54	3.54
	Coarse aggregates	108.13	117.6	112.27	114.22
	Fly ash	0	0	2.09	0
	Coconut shell	0	0	0	2.94

Steps involved to producing pervious concrete



VI. RESULTS

This chapter focuses on the analysis of pervious concrete specimens tested under different conditions to study their strength characteristics and behavior. The specimens were subjected to various tests to evaluate the compressive strength, flexural strength, and split tensile strength. The analysis includes plotting graphs to compare results across different mix designs, highlighting how the inclusion of fines, fly ash, and coconut shell affects the properties of pervious concrete.

The following cases were examined:

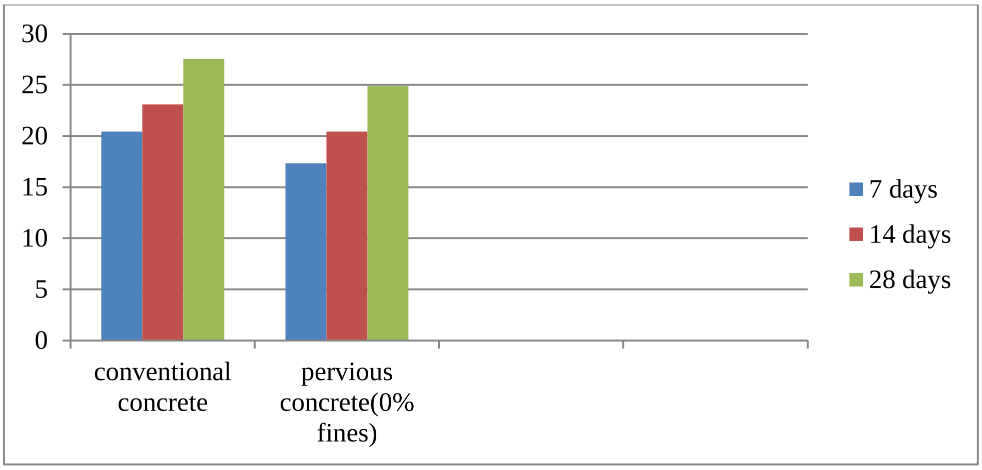
- **Case 1: 0% Fines (No Fines Concrete)**: This case serves as a baseline, where no fines were used in the concrete mix. The coarse aggregates and cement were the primary constituents, and no supplementary materials like fines, fly ash, or coconut shell were introduced.
- **Case 2: 3% Fines and 5% Fly Ash**: In this case, 3% of the volume of coarse aggregates was replaced by fines, and 5% of the volume of cement was replaced by fly ash. This mix aimed to improve the compressive strength and environmental sustainability of the pervious concrete, as fly ash is an industrial by-product that enhances long-term strength and durability.
- **Case 3: 3% Fines and 2.5% Coconut Shell**: Here, 3% fines were used by volume of coarse aggregates, and 2.5% of the volume of coarse aggregates was replaced with coconut shell. Coconut shell, being a lightweight material, was introduced to study its effects on the mechanical properties of pervious concrete, particularly its compressive strength, permeability, and overall sustainability.

Table 10: Compressive strength of pervious concrete (0% fines) (N/mm^2)

S.No	Age of concrete(days)	Compressive strength of pervious concrete (0% fines)
1	7	17.33
2	14	20.45
3	28	24.88

Table 11: Comparison of strength between conventional concrete and pervious concrete (N/mm^2)

S.No	Age of concrete(days)	Conventional concrete (M25)	Pervious concrete (0% fines)
1	7	20.44	17.33
2	14	23.11	20.45
3	28	27.56	24.88



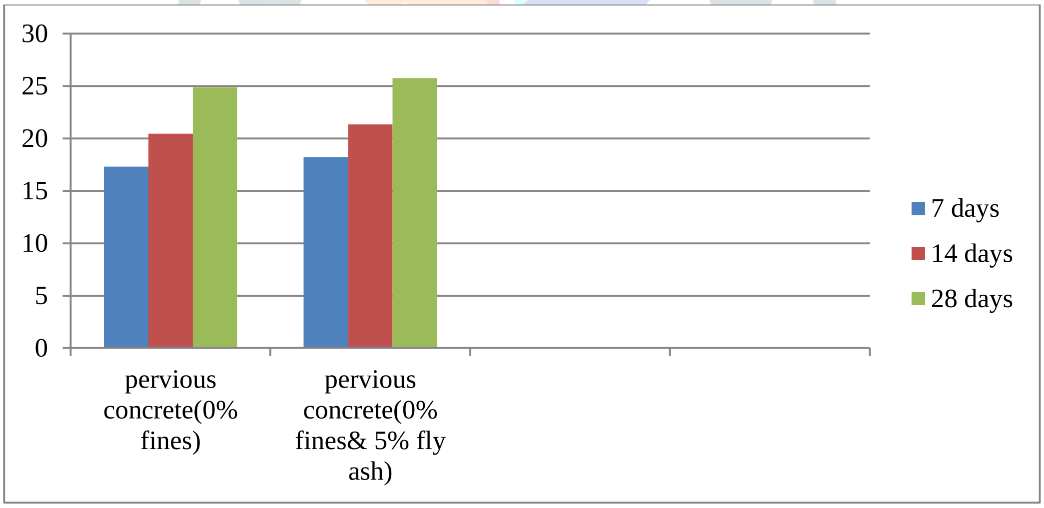
Graph 1: Graph of showing relation between compressive strength of conventional and pervious concrete (0% fines)

Table 12: Compressive strength of pervious concrete (3% fines & 5% fly ash) (N/mm^2)

S.No	Age of concrete(days)	Compressive strength of pervious concrete (3% fines and 5% fly ash)
1	7	18.22
2	14	21.33
3	28	25.77

Table 13: Comparison of strength between pervious concrete (0% fines) and pervious concrete (3% fines & 5% fly ash

S.No	Age of concrete(days)	Pervious concrete (0% fines)	Pervious concrete (3% fines and 5% fly ash)
1	7	17.33	18.22
2	14	20.45	21.33
3	28	24.88	25.77



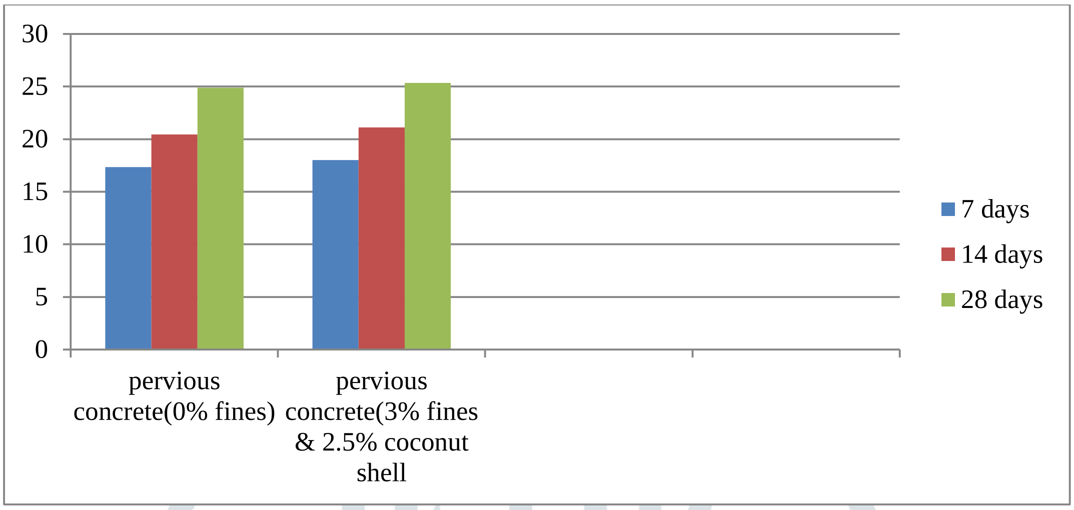
Graph 2: Graph of showing relation between compressive strength of pervious concrete (0% fines) and pervious concrete (3% fines & 5% fly ash)

Table 14: Compressive strength of pervious concrete (3% fines & 2.5% coconut shell) (N/mm^2)

S.No	Age of concrete(days)	Compressive strength of pervious concrete (3% fines & 2.5% coconut shell)
1	7	18
2	14	21.11
3	28	25.33

Table 15: Comparison of strength between pervious concrete (0% fines) and pervious concrete (3% fines & 2.5%coconut shell)

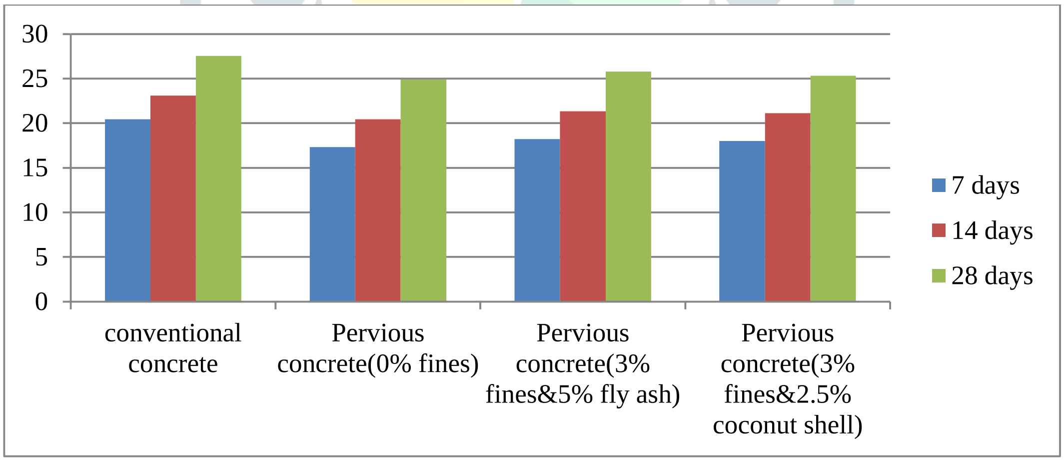
S.No	Age of concrete(days)	Pervious concrete (0% fines)	Pervious concrete (3% fines &2.5% coconut shell)
1	7	17.33	18
2	14	20.45	21.11
3	28	24.88	25.33



Graph 3: Graph of showing relation between compressive strength of pervious concrete (0% fines) and pervious concrete (3% fines 7 2.5% coconut shell)

Table 16: Compressive strength of concrete (N/mm^2)

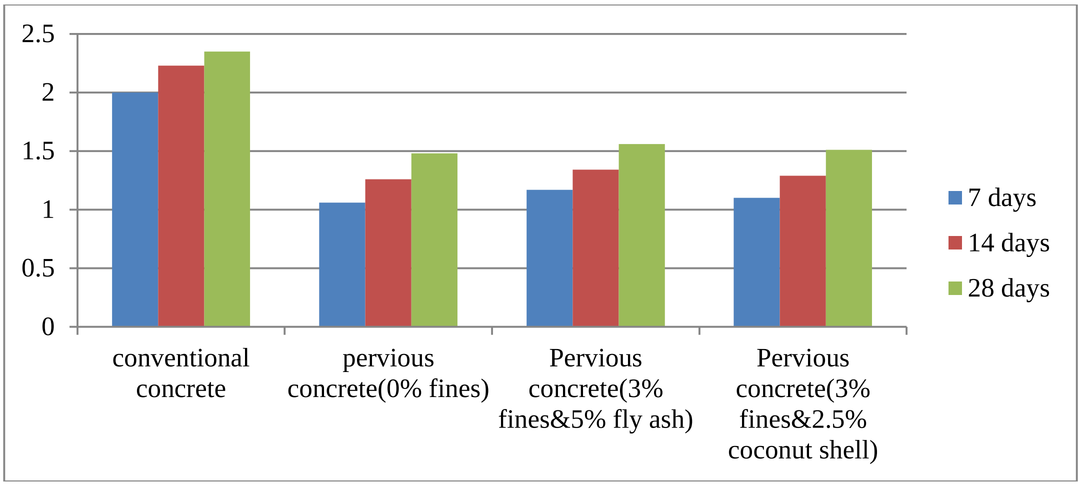
S.No	Age of concrete (days)	Conventional concrete (M25)	Pervious concrete (0% fines)	Pervious concrete (3% fines & 5% fly ash)	Pervious concrete (3% fines & 2.5% coconut shell)
1	7	20.44	17.33	18.22	18
2	14	23.11	20.45	21.33	21.11
3	28	27.56	24.88	25.77	25.33



Graph 4: Graph of showing relation between compressive strength of conventional concrete, pervious concrete (0% fines), pervious concrete (3% fines & 5% fly ash), pervious concrete (3% fines & 2.5% coconut shell)

Table 17: Split tensile strength of concrete (N/mm^2)

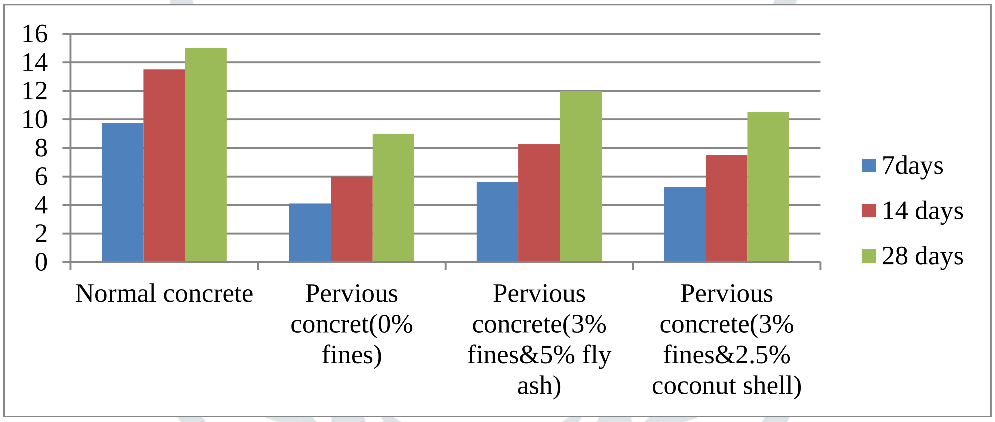
S.No	Age of concrete (days)	Conventional concrete (M25)	Pervious concrete (0% fines)	Pervious concrete (3% fines & 5% fly ash)	Pervious concrete (3% fines & 2.5% coconut shell)
1	7	2	1.06	1.17	1.10
2	14	2.23	1.26	1.34	1.29
3	28	2.35	1.48	1.56	1.51



Graph 5: Graph of showing relation between split tensile strength of conventional concrete, pervious concrete (0% fines), pervious concrete (3% fines & 5% fly ash), pervious concrete (3% fines & 2.5% coconut shell).

Table 18: Flexural strength of concrete (N/mm^2)

S.No	Age of concrete (days)	Conventional concrete (M25)	Pervious concrete (0% fines)	Pervious concrete (3% fines & 5% fly ash)	Pervious concrete (3% fines & 2.5% coconut shell)
1	7	9.75	4.12	5.62	5.25
2	14	13.5	6.0	8.25	7.5
3	28	15	9.0	12	10.5



Graph 6: Graph of showing relation between flexural strength of conventional concrete, pervious concrete (0% fines), pervious concrete (3% fines & 5% fly ash), pervious concrete (3% fines & 2.5% coconut shell)

VII. CONCLUSION

The study provides insights into the structural and strength behavior of pervious concrete under different configurations involving fines, coconut shell, and fly ash. The investigation focuses on analyzing the compressive strength, flexural strength, split tensile strength, and slump value of concrete, with varying amounts of supplementary cementitious materials. Each of these properties is evaluated across different percentages of fines, coconut shell, and fly ash to understand the impact of these materials on pervious concrete performance.

- The size of coarse aggregates, water to cement ratio and aggregates to cement ratio plays a crucial role in strength of pervious concrete.
- The void ratio and unit weight are two important parameters of pervious concrete in the context of mix design.
- The compressive strength of pervious concrete is inversely proportional permeability.
- From the results of compressive strength, we observed that by adding of 3% fines & 5% fly ash in pervious concrete then the compressive strength of pervious concrete tends to be increased.
- The maximum value of compressive strength for 28 days attains at 0% fines is 24.88 N/mm^2. The maximum value of compressive strength attains at 3% fines & 5% fly ash is 25.77N/mm^2.
- From the results of compressive strength, we observed that by adding of 3% fines & 2.5% coconut shell in pervious concrete then the compressive strength of pervious concrete tends to be increased.
- The maximum value of compressive strength for 28 days attains at 0% fines is 24.88 N/mm^2. The maximum value of compressive strength attains at 3% fines & 2.5% coconut shell is 25.33N/mm^2.
- From the results of split tensile strength, we observed that by adding of 3% fines & 5% fly ash in pervious concrete then the split tensile strength of pervious concrete tends to be increased.
- The maximum value of split tensile strength for 28 days attains at 0% fines is 1.48N/mm^2. The maximum value of split tensile strength attains at 3% fines & 5% fly ash is 1.56 N/mm^2.
- From the results of split tensile strength, we observed that by adding of 3% fines & 2.5% coconut shell in pervious concrete then the split tensile strength of pervious concrete tends to be increased.

- The maximum value of split tensile strength for 28 days attains at 0% fines is 1.48N/mm². The maximum value of split tensile strength attains at 3% fines & 2.5% coconut shell is 1.51N/mm².
- From the results of flexural strength, we observed that by adding of 3% fines & 5% fly ash in pervious concrete then the flexural strength of pervious concrete tends to be increased.
- The maximum value of flexural strength for 28 days attains at 0% fines is 9N/mm². The maximum value of flexural strength attains at 3% fines & 5% fly ash is 12 N/mm².
- From the results of flexural strength, we observed that by adding of 3% fines & 2.5% coconut shell in pervious concrete then the flexural strength of pervious concrete tends to be increased.
- The maximum value of flexural strength for 28 days attains at 0% fines is 9 N/mm². The maximum value of flexural strength attains at 3% fines & 2.5% coconut shell is 10.5N/mm².
- From the results, we observed that when no fines were introduced, the 28 days compressive strength of no fines concrete, 9.72% of compressive strength were decreased on comparing with conventional concrete.
- From the results, we observed that when 3% fines & 5% fly ash were introduced, the 28days compressive strength of 3% fines & 5% fly ash concrete, 3.58% of compressive strength were increased on comparing with 0% fines concrete
- From the results, we observed that when 3% fines & 2.5% coconut shell were introduced, the 28days compressive strength of 3% fines & 2.5% coconut shell concrete, 1.80% of compressive strength were increased on comparing with 0% fines concrete.
- From the results, we observed that when no fines were introduced, the 28days split tensile strength of no fines concrete, 37% of split tensile strength were decreased on comparing with conventional concrete.
- From the results, we observed that when 3% fines & 5% fly ash were introduced, the 28days split tensile strength of 3% fines & 5% fly ash concrete, 5.4% of split tensile strength were increased on comparing with 0% fines concrete.
- From the results, we observed that when 3% fines & 2.5% coconut shell were introduced, the 28days split tensile strength of 3% fines & 2.5% coconut shell concrete, 2.07% of split tensile strength was increased on comparing with 0% fines concrete.
- From the results, we observed that when 3% fines & 5% fly ash were introduced, the 28days flexural strength of 3% fines & 5% fly ash concrete, 33.33% of flexural strength were increased on comparing with 0% fines concrete.
- We conclude that fly ash with fines gives more strength compared to coconut shell with fines.

REFERENCES

[1].Prof. Pallavi Kharat ,Prashant Nagawade , Omkar Jadhav, Sumit ubale , Vaibhav Chavan,” Porous pavements block for rain water harvesting”, journal of emerging technologies and innovative research (JETIR) volume 9, may 2022.

[2].Anurag Prabhakar Rangankar, Dr.S.G.Makarande, Prof.R.S.Kedar,”Making green porous concrete for rain water harvesting and urban pavements”,International journal of advanced research in science,communication and technology(IJARSCT) volume 2,issue 4, may 2022.

[3].S.Arifin, O.Setyandito, E.Prahara, Y.Wijayanti ,”Investigating properties of pervious concrete containing coconut shell flake and ash”, International conference on biospheric harmony advanced research 2020.

[4].T,Ahmed and S.hoque,”study on pervious concrete pavement mix designs”,2nd international conference on civil & environmental engineering.

[5].Prof.Avinash Shingan , Mr.Saurabh Sawant, Mr.Darshan Deokule, Mr.Yogiraj Maske, Mr.Rahul Mhaske.”Mix design of green porous concrete for urban pavements”, International journal of creative research thoughts (IJCRT) volume 10 issue 6, June 2022.

[6].S.N. Abhishek and Pritam DESHMUKH, “Mix proportion of materials in pervious concrete”,International research journal of engineering and technology (IRJET) volume 6 issue 2 feb 2019.

[7]. Pervious Concrete Pavements, http://www.perviouspavement.org, maintained by National Ready Mixed Concrete Association (NRMCA), (accessed July 15, 2010)

[8]. Meiningen, R.C, No-nonspurious concrete for paving, Concrete International, August 1988, Vol. 10, No. 8, pp. 20- 27.

[9]. Storm water technology fact sheet porous pavement, United States Environmental Protection Agency, EPA 832- F-99-023, September 1999. www.epa.gov/npdes

[10]. NRMCA, “What, Why, and How? Pervious Concrete,” Con series, CIP 38, Silver Spring, Maryland, May 2004b.

[11]. Tennis, P., Leming. M.L., and Akers, D.J., Pervious Conc EB 302, Portland Cement Association (PCA), Skokie, Illino Leming, M.L., Malcolm, H.R., and Tennis, P.D., “Hydro Pervious Concrete,” EB 303, Skokie, Illinois, 2007.

[12]. Pervious Concrete: Hydrological Design and Resources, C PCA, Skokie, IL, 2007. Stormwater Phase II Final Rule Fact Sheet Series, United State Protection Agency, http://cfpub.epa.gov/npdes/storm cfm.

[13]. Leadership in Energy and Environmental Design (LEED) Rating System, US Green Building Council, National Ready Mixed Concrete Association, Winter.

[14]. Ash Pervious Concrete to Achieve LEED™ Points “, Concrete info V. 8, No. 5, pp. 81-84, http://www.nrmca.org/research/CI 08%20Perv%20Conc%20LEED.pdf, (accessed July 15, 2010 ACI Committee 522, Specification for Pervious Concrete Pav American Concrete Institute, Farmington Hills, MI, USA. Wanielista, M., Chopra, M., Spence, J., and Ballock.

[15]. Performance Assessment of Pervious Concrete Pavements Management Credit,” Storm water Management Academic Central Florida, 81 pp.

[16]. NRMCA, “Pervious Concrete: Guideline to Mixture Pro Research Report,” 2PE002, Version 1.0, Silver Spring, Mar 2009, 32 pp. The Chicago Green Alley Handbook, http://egov.city web portal/COC Web Portal/COC_EDITORIAL/Green Alle (accessed July 19, 2010

[17]. Sourabh rahandale, shobhit maran sumit lakhmanli , mayuresh gidde vol.04 experimental study on pervious concrete. 06 June 2017

[18]. Saurabh mehata , viraj surti , rahul shah , yesh shah vol 05. Experimental study on compressive strength and permeability of pervious concrete 04 April 2016 .

[19]. Karthik h. obla s. Indian concrete journal on pervious concrete august 2010 pervious concrete pavements, southeast association.
[20]. B.V.R.murthy , g. rajeswari, vol. 07. Study on strength improvement of pervious concrete 03 march 2018 .
[21]. S.o.ajamu,a.a. jimoh,j.r.oluremi. International journal of engineering and technology . 05 may 2012 . .
[22]. Wan C N C, Jaya R P and Hamzah M O 2012 Adv. Mater. Res. 486 378-383
[23]. Zachary Bean E, Frederick Hunt W and Alan Bidelspach D 2007 J. Irrig. Drain. Eng. 133 583- 592
[24]. Hassani A, Mohammad S and Ghoddusi P 2010 P. I. Civil. Eng-Transp, 163 183-190
[25]. Chindaprasirt P, Hatanaka S, Chareerat T, Mishima N and Yuasa Y 2008 Constr. Build. Mater. 22 894- 901