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Strengthening of Pervious Concrete by using of Ceramic Tiles and Fly Ash

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ABSTRACT

Pervious concrete may be used in pavements because it allows water to permeate into the soil, recharging groundwater and lowering storm water runoff, resulting in an eco-friendly surface. Environmental change, global warming, and the management of industrial waste are the concerns of the hour. Environmental concern is becoming increasingly important in civil engineering because of the population boom, large constructions, and extensive use of industry materials such as aggregate and cement. As a result, research is being conducted around the world to develop a substitute for aggregate and cement. Because ceramic tiles and fly ash are industrial waste products, their disposal causes challenges for industries and the government, but because they have cementitious properties, their usage in the civil engineering industry can solve both issues. The experimental examination being conducted in the current study looks at the partial replacement of ceramic tiles and fly ash in pervious concrete. With variations of 0%, 10%, and 20%, respectively, aggregate is partially replaced by ceramic tiles and cement is partially replaced by fly ash. The specimens are put through tests including compaction factor and compressive strength, and the conclusions are explained in this study. We observed that ceramic tiles and fly ash can be use as a construction material in pervious concrete because of its increased strength by partially replacement of both of these materials (ceramic tiles and fly ash). It is suitable and better for applications such as parking areas, pavements, tree grates in sidewalks etc.

KEYWORDS Pervious Concrete, Coarse Aggregate, Ceramic tiles, Fly ash

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1. INTRODUCTION

Concretes are the mixtures of cement, aggregate, and water. The strength of the concrete is increased by adding coarse aggregate to cement paste (Sathyanarayanan et al., 2020). One of the primary criteria for selecting concrete materials is high durability (Petrova, Chistyakov & Makarov, 2018).Concrete is most frequently used in cities with significant levels of transportation (Cui, Long & Wang, 2019). The concrete road surface doesn't absorb water well (Putri et al., 2020). This results floods during periods of heavy rain and the drainage system is malfunctioning. Utilizing pervious concrete is the greatest option or solution in light of these factors (Guo & Liao, 2019). Pervious concrete has high water permeability and porosity (Aoki, Ravindrarajah & Khabbaz, 2012). Using cement, coarse aggregate, water, little to no sand, and chemical admixtures, pervious concrete is an innovative material that has a network of pores or gaps that enable water or air to pass through the concrete. This permits groundwater to be restored where traditional concrete does not by allowing water to drain naturally through it. Stormwater runoff is significantly decreased and groundwater restored thanks to pervious concrete. When utilised in metropolitan areas with little to no green space, this form of concrete pavementenable surface water absorption to be transported into the ground and minimising water logging. Porosity in pervious concrete ranges from 0.15 to 0.35, and its density is about 1800 kg/m^3 (Moss & Dhakal, 2020). The excellent absorption rate of pervious concrete is proportional to its porosity, but porosity may also cause deterioration in concrete quality in terms of compressive strength (Septiandini et al., 2021). Pervious concrete has a compressive strength of 5 to 10 MPa and is mostly used for parking lots, sidewalks, bus terminals, and low-traffic routes (Tennis, Leming & Akers, 2004). In the field of civil engineering, a decline in groundwater levels can result in soil sinking of several levels and the destruction of buildings, structures, and works. The usage of pervious concrete for secondary roads, parking lots, driveways, walkways, and sidewalks has steadily increased in recent decades due to its numerous environmental advantages, including:

1. The pervious concrete can recharge the ground water with the help of its filter property.
2. It keeps the soil wet due to its water and air permeability so the environment of the road surface improves.
3. The pervious concrete gives a quite and comfortable environment because it absorbs the noise of vehicles.
4. The pervious concrete contains holes that can collect the heat and prevent hot island in urban areas (Yang & Jiang, 2003; Nguyen et al., 2013).

Figure 1: Pervious concrete

The properties of pervious concrete have been studied extensively in the past, with various W/C ratios, aggregate-to-cement ratios, binder material types, aggregate sizes, and compaction energy effects being published (Neithalath, Bentz & Sumanasooriya, 2023) .In several American towns and 44 other places across the world, the use of permeable pavements (pervious concrete) increased. Pervious concrete was utilized to increase friction, reduced noise, and rain water drainage in many European countries (Schaefer et al., 2006, Cackler et al., 2006; Caestecker and Chris, 1998). In China, the sponge city design employed pervious concrete to reduce the 46-escalating problem of urban floods and overburdened drainage systems (Wang, Sun & Song, 2017). Additionally, pervious pavement has a significant capacity for dust absorption because of its many holes and substantial specific surface area, which might lower dust pollution.

The popularity of pervious concrete in the concrete industry is expanding daily. According to Erickson, factors including the Clean (Pure) Water Act, the Green Building movement, and developments in the asphalt industry will all contribute to its rise. In the end, he thinks, this will be the preferable flooring. According to Huffman, the Green Building movement's fastest-growing technology is pervious concrete, and he sees potential for it in the future. According to Huffman, the commercial sector as well as the federal government will have an impact on the projects supported by the government. Pervious concrete can assist a project in attaining LEED credits (“Performance and manufacturing of Pervious Concrete”, 2017).

The use of pervious concrete in practical buildings is crucial. Rapid industrial expansion leads to major issues worldwide, such as the depletion of aggregates and the production of enormous amounts of garbage from building and logging operations (Sathyanarayanam et al., 2020). But with urbanization and a quickening of population growth, particularly in a nation like India, the need for this building material is not readily supplied. India is in the top three largest producer in the world, accounting for 6% of worldwide output. There is improper consumption despite the enormous expansion in ceramic output. The annual revenue earned from the overall output will thus be between 15% to 30% (Monhun et al., 2016) In order to solve this issue, waste materials like used ceramic tiles can be used.

Cement consumption is growing daily as a result of industrial growth. According to reports, 4200 million metric tonnes of cement were produced globally in 2019 (“U.S.: cement production 2022 Statista”, 2023). Carbon dioxide (CO_2) emissions are significantly increased during cement manufacture. These gases impacts negatively on the environment. In order to lessen environmental impact, less environmentally friendly cement must be used in construction projects. This is why silica fume, fly ash, blast furnace slag, etc. can be used as a substitute material. According to Golewski et al. (2021), using pozzolanic additives in place of cement can significantly reduce CO_2 emissions (Golewski, Walker & Browning, 2021). Global researchers are very interested in looking at the prospect of using fly ash (FA) as a partial replacement for cement. However, a comprehensive analysis of using fly ash in the place of some cement to produce pervious concrete has still not been made (Khankhaje et al., 2023). There is a chance to cut world CO_2 emissions by about 22% by using waste products (Flower & Sanjayan, 2007). According to Teixeira et al. (2016), fly ash can be used as a partial replacement of cement. It can reduce the harmful effect of concrete on environment (Teixeira et al, 2016). The process of burning coal produces fly ash, or FA. The residue of coal combustion generated from a steam power plant is known as flyash (Namarak et al., 2018). Depending on the grade of the coal, the burning process produces bottom ash at a rate of around 2-3% and fly ash at a rate of about 25% –30% (Nurwidayati et al., 2019). Fly ash is a dust like particle which can easily contaminate the air, soil, and water (Ghazali et al., 2020). Fly ash is often stored in coal power stations or dumped in landfills all around the world, taking up a lot of space and causing soil pollution. Therefore, it is important to utilize fly ash completely.

In today's uncertain world, recycling ceramic tiles from construction and demolition waste shows possibility of using it as a substitute of natural aggregate. Additionally, fly ash may be utilized in construction projects as a building material to reduce pollution and make use of coal-burning waste.

In this article, compressive strength is investigated by partially replacing the materials of pervious concrete. Ceramic tiles and fly ash are used to partially substitute materials like coarse aggregate and cement respectively. This variation's percentages are 0%, 10%, and 20%. Workability and compressive strength test of pervious concrete are part of the experiments.

2. DESCRIPTION OF MATERIALS

2.1 Cement

Powdered substance called cement is combined with water to serve as a binding agent. Silica, iron ore, alumina, and calcium carbonate are the ingredients required to make cement.

Figure 2: Cement

These ingredients can be found in clay, chalk, clayey schist, or limestone rock. There are many varieties of cement on the market such as white cement, OPC, PPC etc. PPC (Portland - Pozzolana Cement) is a type of cement which is produced by consistently and closely mixing Portland cement with fine fly ash. The fly ash element must be no less than 10% and no more than 25% by mass of PPC. To prevent sudden setting during manufacturing, gypsum is also added. The homogeneity of the combination in the same consignment must be assured to within ±3%. Cement's material properties are listed in Table 1.

Table 1: Material properties of cement

S. No.	Material Properties	Value
1	Type of cement	PPC
4	Initial setting time (min.)	35
2	Fineness (%)	8.9
3	Density (kg/m^3)	1440
5	Final setting time (min.)	560

2.2 Coarse aggregate

In IS 383 and IS 2386, the standards for coarse aggregate are outlined. Aggregate comprises just those that are allowed for the different kinds indicated in this standard and the majority of which is retained on a 4.75 mm IS sieve. Coarse aggregate may be described as:

a) uncrushed gravel or stone which results from the natural disintegration of rock,
b) crushed gravel or stone when it results from the crushing of gravel or hard stone, and
c) partially crushed gravel or stone when it is a product of the blending of (a) and (b).

It may be the size of 63 mm. Table 2 lists the material characteristics of coarse aggregate which is used in our study.

Figure 3: Coarse aggregate

Examples of the coarse aggregates are crushed stone, gravel, or sand. Coarse aggregates are granular and uneven materials. The majority of the coarse aggregate may be obtained by blasting quarries or crushing them with crushers or by hand.

Table 2: Material properties of coarse aggregate

S. No.	Material Property	Value
1	Size (mm)	10-12.5
2	Density (kg/m^3)	1750
3	Fineness modulus	7.38
4	Specific gravity	2.58
5	Crushing value (%)	15
6	Water absorption (%)	5.29
7	Elongation (%)	13.57

2.3 Fly ash

FA (fly ash) and BA (fly ash) are the two varieties of coal ash. It is produced by the combustion of coal in power plants. They are among the most common and intricate man-made elements (Chindaprasirt et al., 2007). Coal ash is divided into two categories: FA (above 80%) and BA (the remaining 20%) (Mehta et al., 1996; Rafiezonooz et al., 2016). The discharge of FA and BA into the environment directly causes several environmental difficulties, such as the risk of harmful soil, air, and water contamination (Ren & Sancaktar, 2019). Nowadays, FA is usually held in coal power plants or thrown there, taking up a lot of space and polluting a lot of the soil in the process (Ahmaruzzaman, 2010). FA has been generated annually at a global rate of 600–800 million tones (Rafiezonooz, Khankhaje & Rezania, 2022). Taiwan imported more than 47 million tonnes of coal in 2018 (Lo, Lee & Lo, 2021). Utilizing imported coal, Taiwan produced more than 95% of its energy needs. On the other hand, the top five nations importing coal are Australia (59%) followed by Russia (20%), Indonesia (11%), South Africa (6%), and Canada (2.5%). It is dangerous to dispose of this FA since it can contain trace amounts of lead and arsenic. As a result, FA recycling in construction projects as building materials helps lessen environmental issues caused by FA waste.

Figure 4: Fly ash

FA can also conserve energy and save building costs when used as a cement alternative in construction projects. It may be said that utilizing FA completely is a crucial duty for that needs to be taken into account globally (Wei et al., 2020; Gimhan, Disanayaka & Nasvi, 2018). The use of fly ash in cement concrete provides a number of benefits, including lowering the amount of cement used, making the mixture easier to work with, reducing creep and hydration heat, lowering thermal expansion, and raising the concrete's impermeability (Kurda, Silvestre & Brito, 2018). The various chemical compositions of fly ash are described in Table 3 below.

Table 3: Composition of fly ash

S. No.	Chemical composition	% Composition
1	SiO_2	51.3
2	Al_2O_3	22.8
3	CaO	10.7
4	MgO	2.8
5	Fe_2O_3	6.9
6	SO_3	1.9

1.1 Ceramic tiles

When compared to other types of tile, ceramic (also known as porcelain tiles), which is made by burning at high temperatures, has the highest resilience. Additionally, ceramic is appropriate for usage in open spaces and has great durability and minimal power absorption. About 50% of the trash generated during building and demolition is made up of ceramic materials (Sathyanarayanan et al., 2020). Ceramic tiles are strong and durable. It is also unaffected by physical, chemical, and biological deterioration processes. Ceramic tiles have a smooth side and a rough side. It is lighter than traditional coarse aggregates. The categorization, characteristics, and marking of ceramic tiles are outlined in IS 13712:1993.

Figure 5: Ceramic tiles as waste

Figure 6: Ceramic tiles as coarse aggregate

Using ceramic tiles as coarse aggregate in pervious concrete is beneficial in pollution-free construction as well as cost-effectiveness. Table 4 provides the material characteristics of ceramic tiles.

Table 4: Material properties of ceramic tiles

S. No.	Material Property	Value
1	Size (mm)	10-12.5
2	Density (kg/m^3)	2380
3	Specific gravity	2.25
4	Crushing value (%)	11.3
5	Water absorption (%)	13.5

3. METHODOLOGY

The procedure begins with collecting all necessary materials. After the gathering of the material,

a) **Mix design:** A 1:1:2 mix designs are used in the current work for M25 grade pervious concrete.
b) **Proportioning:** For the experimental investigation, weigh batching is adopted. The weighted coarse aggregate is combined with 0%, 10%, and 20% ceramic tiles, while the weighted cement is combined with 0%, 10%, and 20% fly ash. Hand mixing is used to properly combine the entire dry sample. The dried sample is mixed thoroughly with water in liters until a consistent, homogenous mixture is achieved; mixing time should not exceed 3–5 minutes. Fig. 7 showing the hand mixing process which is used in this
c) **Trial mix:** The major goal of the trial mixes was to find the ideal ratio that produces superior strength and permeability outcomes. It also aimed to find the percentage of ceramic tiles and fly ash needed to obtain adequate workability for pervious concrete.
d) **Final mix:** To determine the 28-day compressive strength and other strength parameters of the final mixture based on the results of trial or group tests, those proportions that gave a higher compressive strength with good workability are selected.
e) **Curing:** In a conventional technique, the concrete samples are removed from the molds after 24 hours of casting and left in water bath for 7, 14 and 28 days to cure.
f) **Tests:** The specimens are put to the test in accordance with Indian standard specifications for compaction factor and compressive strength.

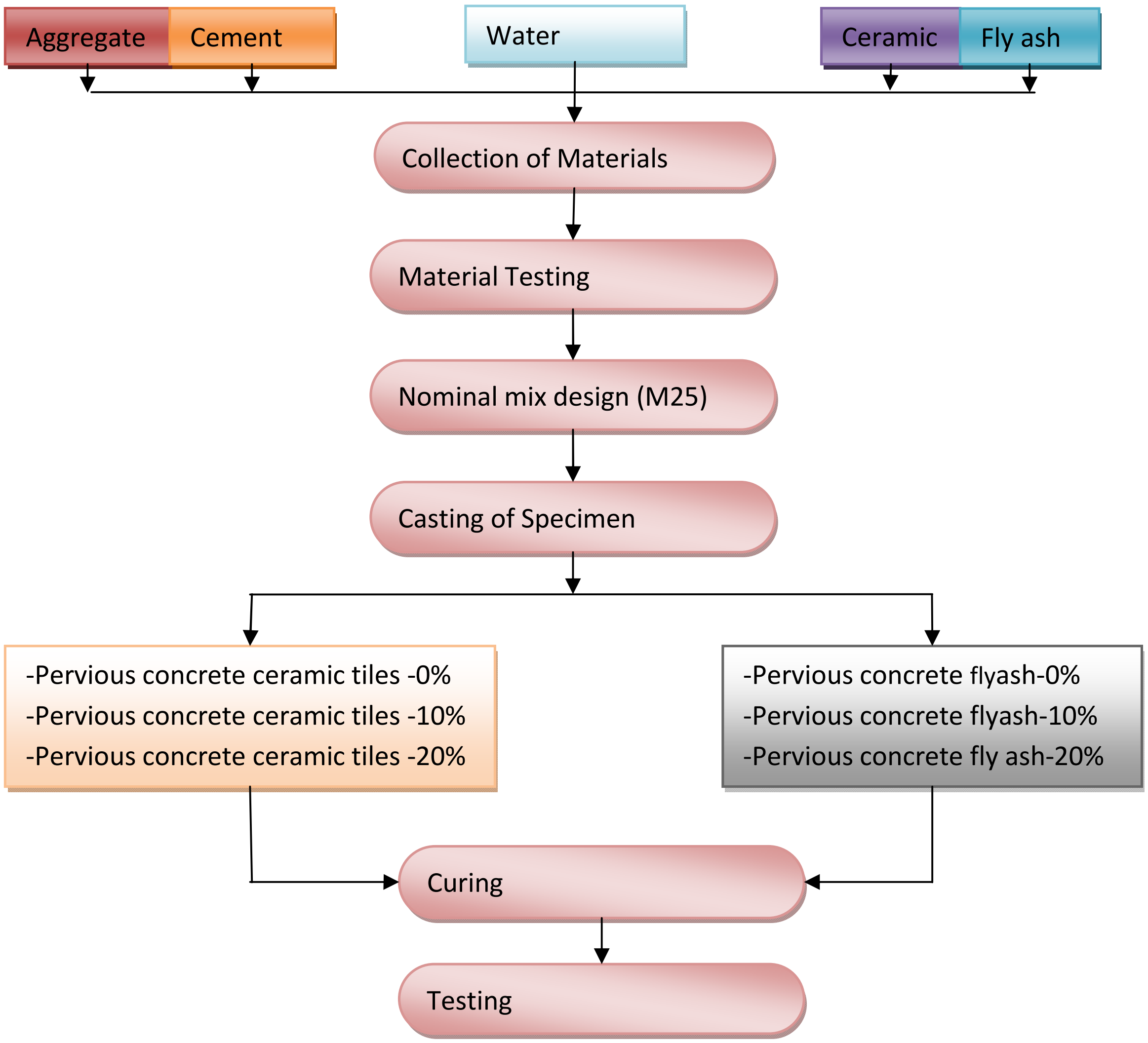

Chart 1: Flow chart of the whole testing process

2.4 Mix proportion

The process of selecting suitable concrete materials and determining their proportions to produce concrete with the required strength, durability and performance at low cost is called concrete mix design. The required performance of the concrete, in its plastic and hard state, determines the scope of use of each element. Concrete cannot be properly poured or compacted if it is not workable. The quality and quantity of cement, water, aggregates, setting and mixing, placing, compaction and curing are just a few examples of the many factors that affect concrete's compressive strength.

The mix ratio for typical pervious concrete is shown in Table 5.

Table 5: Mix proportion of Normal Pervious Concrete

S. No.	Material	Ratio
1	Cement	1
2	Coarse aggregate	3

For this report, a total of 6 samples were created. PCCT-0%, PCCT-10%, PCCT-20%, PCFA-0%, PCFA-10%, and PCFA-20% are the samples that make up this nomination. The samples are divided into groups according to how much of these components were included in the mixture.

Total 9 specimens were prepared for each type of the sample.

PCCT-0% (NPC), which stands for pervious concrete ceramic tiles with the 0% replacement of coarse aggregate, is sample-1 with 9 specimens. Table 6 shows the material-wise quantity of this sample.

Table 6: Mix proportion of PCCT-0%

S. No.	PCCT-0%	
1	No. of cubes	9
2	Amount of cement (kg)	16.84
3	Amount of coarse aggregate (kg)	61.39
4	Amount of ceramic tiles (kg)	0

PCCT-10%, which stands for pervious concrete ceramic tiles with the 10% replacement of coarse aggregate, is sample-2 with 9 specimens. Table 7 shows the material-wise quantity of this sample.

Table 7: Mix proportion of PCCT-10%

S. No.	PCCT-10%	
1	No. of cubes	9
2	Amount of cement (kg)	16.84
3	Amount of coarse aggregate (kg)	55.25
4	Amount of ceramic tiles (kg)	6.14

PCCT-20%, which stands for pervious concrete ceramic tiles with the 20% replacement of coarse aggregate, is sample-3 with 9 specimens. Table 8 shows the material-wise quantity of this sample.

Table 8: Mix proportion of PCCT-20%

S. No.	PCCT-20%	
1	No. of cubes	9
2	Amount of cement (kg)	16.84
3	Amount of coarse aggregate (kg)	49.11
4	Amount of ceramic tiles (kg)	12.28

PCFA-0% (NPC), which stands for pervious concrete fly ash with the 0% replacement of cement, is sample-4 with 9 specimens. Table 9 shows the material-wise quantity of this sample.

Table 9: Mix proportion of PCFA-0%

S. No.	PCFA-0%	
1	No. of cubes	9
2	Amount of cement (kg)	16.84
3	Amount of coarse aggregate (kg)	61.39
4	Amount of fly ash (kg)	0

PCFA-10%, which stands for pervious concrete fly ash with the 10% replacement of cement, is sample-5 with 9 specimens. Table 10 shows the material-wise quantity of this sample.

Table 10: Mix proportion of PCFA-10%

S. No.	PCFA-10%	
1	No. of cubes	9
2	Amount of cement (kg)	16.84
3	Amount of coarse aggregate (kg)	61.39
4	Amount of fly ash (kg)	1.69

PCFA-20%, which stands for pervious concrete fly ash with the 20% replacement of cement, is sample-6 with 9 specimens. Table 11 shows the material-wise quantity of this sample.

Table11: Mix proportion of PCFA-20%

S. No.	PCFA-20%	
1	No. of cubes	9
2	Amount of cement (kg)	13.47
3	Amount of coarse aggregate (kg)	61.39
4	Amount of fly ash (kg)	3.37

4. RESULTS AND DISCUSSION

This study aims to test the physical and mechanical properties of different pervious concrete mixes. Compaction Factor test and Compressive strength test are some common test results that have been obtained in this study.

2.5 Compaction factor

The compaction factor is used to determine how workable the concrete mixture is. Different proportions of ceramic tiles and fly ash have an effect on how workable pervious concrete is. A common technique for evaluating the workability of concrete, particularly for mixes with ceramic tiles and fly ash is the compaction factor test. This test aids in determining the concrete's workability by determining how quickly it can be compacted and moulded. Cement, aggregates, and water should be thoroughly combined using a concrete mixing method. Hand mixing is done for this study. After preparing concrete mix, set up the compaction factor apparatus, which usually consists of an upper hopper and a lower hopper with a trapdoor, a cylinder, a tamping rod, and other related items.

2.6 Compressive strength

Concrete's primary mechanical attribute is its compressive strength. To determine how the addition of ceramic tiles by the partial replacement of coarse aggregate and fly ash by the partial replacement of cement affects the strength of the pervious concrete, it is likely that the compressive strength of each sample was examined. Usually, the compressive strength decreases as the porosity rises. Testing samples were casted of 150×150×150 mm sizes of iron mould (IS 456-2000). After 24 hours, all specimen were demoulded from the iron mould. After demoulding, specimens were placed in a curing tank for 7, 14, and 28 days respectively. By partially replacing coarse aggregate and cement with various amounts of ceramic tiles and fly ash respectively, 9 cubes were casted for each type and an average of them were taken for compressive strength.

2.7 Observation

Table 12 shows the value of the compaction factor and compressive strength of the M25 grade of pervious concrete with the partially replacement of coarse aggregate by ceramic tiles for 7, 14, and 28 days of time period.

Table 12: Test result of M25 grade of pervious concrete with replacement of coarse aggregate by ceramic tiles for 7, 14, and 28 days

S. No.	Replacement of coarse aggregate with ceramic tiles	Compaction factor value	Compressive strength		
			7th day (N/mm^2)	14th day (N/mm^2)	28th day (N/mm^2)
1	PCCT-0% (0% replacement of coarse aggregate by ceramic tiles)	0.85	4.54	4.93	5.76
2	PCCT-10% (10% replacement of coarse aggregate by ceramic tiles)	0.83	4.46	6.95	8.62
3	PCCT-20% (20% replacement of coarse aggregate by ceramic tiles)	0.79	8.53	9.58	11.91

After analyzing Table 12, the observation is discussed in further section.

2.7.1 Compaction Factor of PCCT:

The compaction factor indicates the workability of concrete. A lower value suggests better compaction and, consequently, better workability. The results show that as the rate of ceramic tile replacement increments, the compaction factor decreases. This proposes that joining ceramic tiles as a replacement for coarse aggregate reduces the workability of the concrete blend. This can be likely due to the relatively higher surface roughness of the ceramic tiles compared to conventional coarse aggregates.

2.7.2 Compressive Strength of PCCT:

- **7th day:** For the 7th-day compressive strength, 0% replacement had the lowest value. Both the 10% and 20% replacement samples showed higher compressive strength values than the 0% replacement. This might be due to the pozzolanic reaction between ceramic particles and cement, contributing to early strength gain.
- **14th day:** On the 14th day, the 10% replacement sample shows a significant growth in compressive strength as compared to the 0% replacement and the 20% replacement. This might indicate an optimal range of ceramic tile replacement that enhances early strength.
- **28th day:** Similar to the 14th day, the 0% replacement and the 10% replacement continued to exhibit the highest compressive strength. However, it's interesting to note that the 20% replacement caught up significantly, indicating potential long-term strength development with higher ceramic tile content (Chart 2).

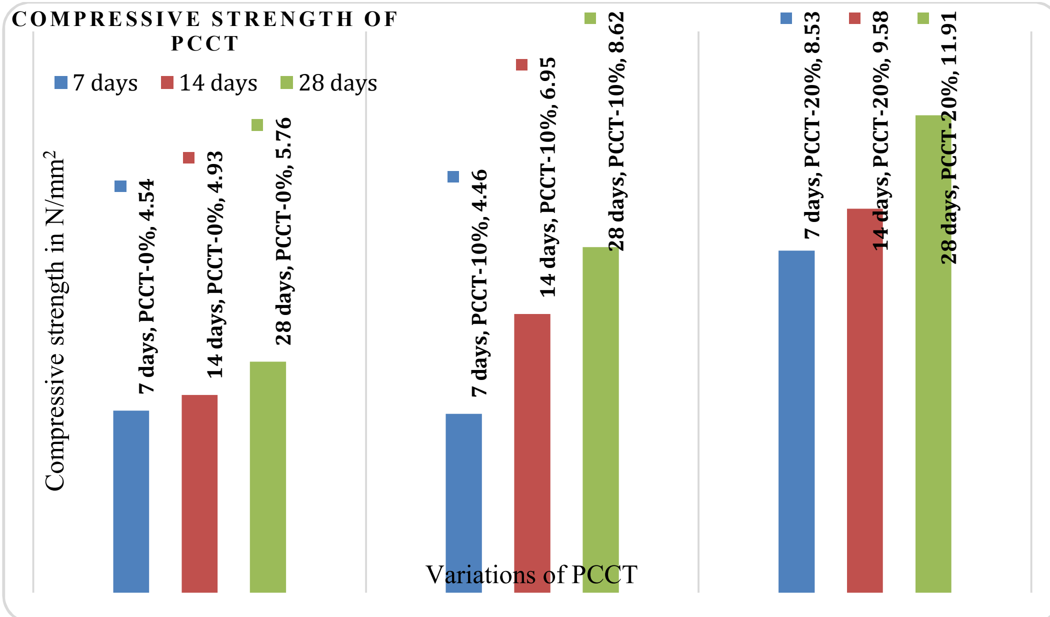

Chart 2: Comparison between the variations of PCCT

In table 13 shows the value of the compaction factor and compressive strength of the M25 grade of pervious concrete with the partially replacement of cement by fly ash for 7, 14, and 28 days of time period.

Table 13: Test result of M25 grade of pervious concrete with replacement of cement by fly ash for 7, 14, and 28 days

S. No.	Replacement of cement with fly ash	Compaction factor value	Compressive strength		
			7th day (N/mm²)	14th day (N/mm²)	28th day (N/mm²)
1	PCFA-0% (0% replacement of cement by fly ash)	0.85	4.54	4.933	5.76
2	PCFA-10% (10% replacement of cement by fly ash)	0.85	7.63	10.90	13.29
3	PCFA-20% (20% replacement of cement by fly ash)	0.87	7.34	9.89	11.85

After analyzing table 13, the observation is discussed in further section.

2.7.3 Compaction factor of PCFA:

The compaction factor provides insights into the workability of the concrete mix. Higher values indicate better workability. In this experiment, the compaction factor values are relatively consistent across the replacement percentages. This suggests that the partial replacement of cement with fly ash does not significantly affect the workability of the concrete mixes.

2.7.4 Compressive strength of PCFA:

- **7th day:** For the 7th-day compressive strength, the 0% replacement had the lowest value. Both the 10% and 20% replacement samples showed higher compressive strength values than the 0% replacement. This indicates that fly ash incorporation positively influences early strength development, which could be attributed to the pozzolanic reactions between fly ash and cement.

- **14th day:** At the 14th day, the 10% replacement sample exhibited the highest compressive strength, surpassing both the 0% replacement and the 20% replacement. This suggests an optimal replacement percentage for enhanced early-age strength.
- **28th day:** The trend continued at the 28th day, with the 10% replacement sample maintaining the highest compressive strength. But the 0% replacement and the 20% replacement samples exhibited lower strength values at this point (Chart 3)

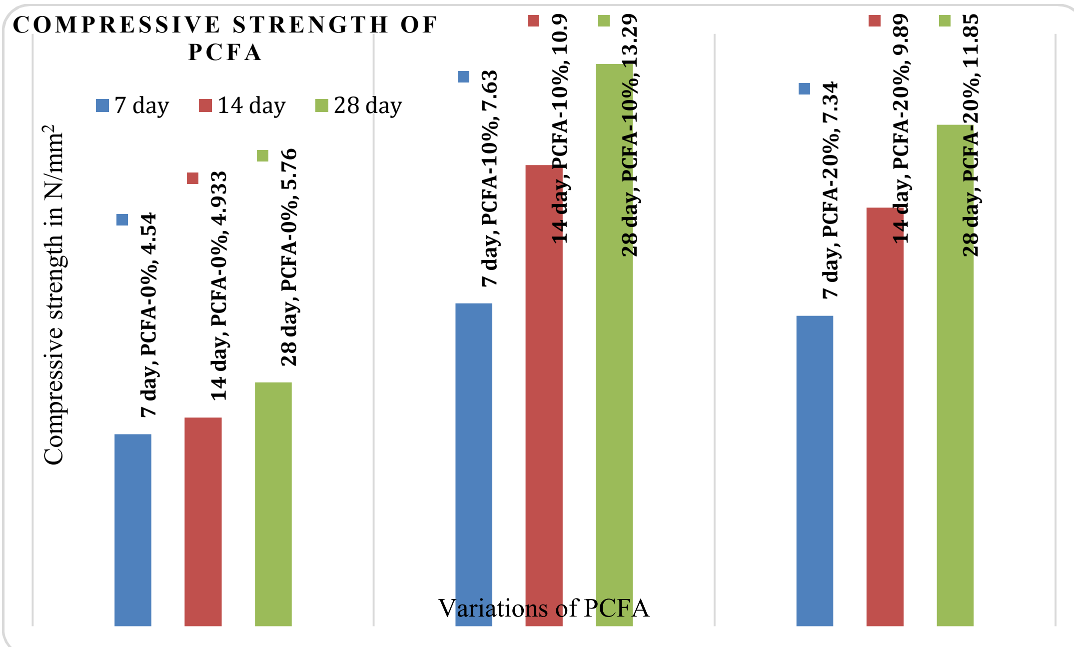

Chart 3: Comparison between the variations of PCFA

3. CONCLUSION

Experiments show that the addition of ceramic tiles to partially replace coarse aggregate has several effects. The workability of the concrete mixture decreases as the concentration of ceramic tiles increases. The early-age compressive strength tends to improve with ceramic tile replacement, particularly around 10% replacement, indicating the presence of beneficial pozzolanic reactions. Longer-term strength development is promising, especially for the sample with 20% ceramic tile replacement. Further studies and analyses would be necessary to understand the specific mechanisms behind these trends, including the role of pozzolanic reactions and the influence of different curing conditions. Additionally, aspects like durability, cost-effectiveness, and environmental impact would need to be considered before considering large-scale application of ceramic tile-replaced concrete.

Partial replacement of cement with fly ash also has several effects. Workability, as measured by the compaction factor, is relatively consistent between replacement percentages, suggesting that the addition of fly ash does not significantly affect the ease of placement and compaction of the pervious concrete. The 10% replacement of cement with fly ash appears to provide the highest compressive strength at early and later curing durations, suggesting an optimal replacement percentage. While the 20% replacement still provides improved strength compared to the 0% replacement, its performance is slightly lower than the10% replacement in terms of both early and long-term strength development. Further investigations could be done for the study of the specific contributions of fly ash to the hydration process, long-term durability effects, and the economic and environmental implications of using fly ash as a cement replacement material. These findings could guide the selection of suitable replacement percentages for practical applications.

Pervious concrete is made by partially replacing traditional materials. Coarse aggregate (10 mm - 12.5 mm) is partially replaced by ceramic tiles of the same size obtained by crushing the tiles. Cement is partially replaced by fly ash.. We conclude that, this proposed strategy is beneficial in the management of industrial waste and can be applied to the various applications where the pervious concrete is particularly used. It is suitable for applications such as parking areas, pavements, tree grates in sidewalks etc.

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