International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-10, Issue-2, March 2022
https://doi.org/10.55524/ijircst.2022.10.2.114
Article ID IRPV1053, Pages 606-610
www.ijircst.org

An Experimental Investigation for Comparison of Porous Concrete and Conventional Concrete in Strength

E. Mani[1], A. Narasimha Raju[2], A. Srinivasulu[3], M. Vijay[4], and K. Chiranjeevi[5]

[1,2]Assistant Professor, Department of Civil Engineering, PACE Institute of Technology & Sciences, Valluru, India
[3]M. Tech scholar, Department of Civil Engineering, PACE Institute of Technology & Sciences, Valluru, India
[4]B. Tech scholar, Department of Civil Engineering, PACE Institute of Technology & Sciences, Valluru, India
[5]Assistant Professor, Department of Mechanical Engineering, PACE Institute of Technology & Sciences, Valluru, India

Correspondence should be addressed to E. Mani; Mani_e@pace.ac.in

ABSTRACT- Previous and current concrete is defined as concrete that contains little to no fine aggregate, coarse aggregate, or cement particles. It is considered "green binding" and is used in structural applications. Pervious concrete is also known as no-fine aggregate. Compared to ordinary concrete, it uses fewer raw materials. When utilised in pavement applications, pervious concrete aids in groundwater recharging, water direct drainage, and also has greater insulating qualities when used in walls. Current or previous building uses concrete that has been specially formulated to have a higher water permeability, allowing water to move through the structure's interconnected huge pores. The findings of an investigation into the production of pervious concrete using low cement concentration and coarse aggregate are reported in this work.

KEYWORDS- Pervious Concrete, Super Plasticizer Sp430, Void Ratio, Mix Design.

I. INTRODUCTION

The 1800s saw the introduction of concrete mixture in Europe for massive amount structures and road environment. The main goal was cost effectiveness because there was less cement used. In Scotland and England, two-story dwellings once again gained popularity in 1920. After the Second World War, the lack of cement made it more and more feasible in Europe. It wasn't until 1970 that it started to gain traction in the US. It has been current or previous concrete for a long time. The Europeans recognized the insulating properties in structural buildings. As it is true with any material and construction technique, there is a science to it and a best way to conduct the construction [1-5]. Education and experience is the key to success. The coastal states have experienced pervious concrete for over 20 years. The hesitation to move into the Midwest and Northern States was mainly due to freeze/thaw concerns. Now that those concerns are no longer considered a problem, the product has moved quickly across the United States. In the 1990's the U.S[6].

A. Advances in Pervious Concrete

Numerous factors make permeable concrete advantageous. Its higher permeability than regular concrete is a major concern. In comparison to standard concrete, pervious concrete shrinks less, weighs less per unit, and has excellent heat insulation characteristics [7].

B. Super Plasticizer Conplast Sp430

The Conplast SP430 is focused on Sulphonated Naphthalene Formaldehyde and is supplied as a brown liquid instantly dispersible in water. ConplastSP430 has been specially formulated to give high water reductions up to 25% without loss of workability or to produce high quality concrete of reduced permeability. Properties:
Specific gravity: 1.24to1.26
Chloride content: Nil
Air entrainment: Approx.1%additionalairisentrained
Compatibility: With the exception of elevated cement, it can be used with all types of cement. When added individually to the mix, Conplast SP430 is compatible with different kinds of Fosroc admixtures. To optimize doses, site trials must be conducted.
Workability: can be used to create fluid concrete that doesn't need to be compacted. To achieve a productive mix without separation, a few small changes could be needed.
Cohesion: The dispersion of cement particles increases cohesion, reducing separation, and enhancing surface smoothness.
Compressive Strength: By getting the benefit on water splitting, early strength can be boosted by up to 20%. Strength often increases by up to 20% dependent on the W/C ratio and other mix variables.
Durability: Reducing the W/C ratio makes it possible to enhance density and insulative properties, improving concrete's endurance.
Dosage: Site experiments with the conventional concrete, which allow the impacts of strength and durability, training to improve, or cement reduction to be monitored, are the best way to identify the optimal dosage. Conplast SP430 site testing must always be contrasted with mixes without any admixtures. As a rule of thumb, the rate of addition falls between 0.5 and 2.0 liters per 100 kg of cement[8-10].

II. ENVIROMENTAL BENEFITS

Maintains stormwater runoff so that parking lots don't require retention ponds, allowing storm water to percolate into the ground to replenish ground water aquifers[11-13].

- Preserves street surfaces' dryness even in humid environments like gardens.
- As soon as snow melts, it instantly drains off the surface, allowing parking lots to be ice-free in freezing climates.
- Enables both water and air to reach the tree roots in a parking space.
- Microbes that grow in the base and roads can eliminate other contaminants and decompose water containing oil that runs off the surface.
- The heat island effect is diminished by the higher light reflectance compared to asphalt surfaces.
- Can store water for irrigating and gather drip irrigation.

III. MATERIAL TEST RESULTS

A. Specific Gravity, Void Ratio and Porosity of Concrete Specimens

The test is conducted for dry concrete sample. Weight the dry sample, water fill up to initial mark of water container. Then immerse the concrete sample into the water up to 5min and then remove the excess water above initial level then weight it. The void ratio can be indicated as v, the specific gravity can be indicated as G.

Table 1: concrete type

CONCRETE TYPE	VOID RATIO	UNIT WEIGHT
Conventional concrete	0.01	2518.5 Kg/m^3
Pervious concrete	0.26	2014.8 Kg/m^3

Cement: Locally available 53 grade of Ordinary Portland Cement conforming to IS: 12269 was used in the investigations.

Table 2: Properties of cement

S.NO.	Properties	Test Results
1	Normal consistency	32%
2	Initial Setting Time	95min
3	Final Setting Time	230min
4	Specific Gravity of Cement	3.05
5	Soundness	2mm
6	Compressive Strength at 28 days	57.3N/mm^2

Fine Aggregate: The size, shape and gradation of the aggregate play an important role in achieving a proper concrete. The flaky and elongated particles will lead to blocking problems in confined zones. The coarse aggregate chosen for Pervious Concrete is typically angular in shape, is well graded, and smaller in maximum size that suited for conventional concrete; typically, conventional concrete should have a maximum aggregate size of 20mm.

Table 3: Properties of Fitness

S.NO.	Properties	Test Results
1	Fineness modulus	2.7
2	Specific gravity	2.58
3	Specific gravity a) Loose b) Rodded	1640Kg/m^3 1720Kg/m^3
4	Water absorption	0.6%

Sieve analysis of Fine Aggregate: Sample 1000gms

Table 4: weight and Loss

S. No.	I.S Sieve Size	Weight Retained (gms)	Cumulative Weight Retained (gms)	Cumulative % of weight Retained	% of passing
1	4.75mm	21	21	2.1	97.9
2	2.36mm	31	52	5.2	94.8
3	1.18mm	104	156	15.6	84.4
4	600µ	405	561	56.1	43.9
5	300µ	350	911	91.1	8.9
6	150µ	86	997	99.7	0.3
7	<150µ	3	1000	100	0
	Total	**1000**	**--**	**270**	**--**

Fineness modulus fine aggregate = 270/100 =2.7

Coarse Aggregate: As rock particles, 20mm notional size device angular rocky metal from the a local source is employed. It is devoid of contaminants like dust, mud, biological materials, etc. The different qualities of the cementitious material are also examined. We find that the coarser aggregate's specific gravity, bulk density, fineness module, and water permeability are, correspondingly, 2.76, 1760 Kg/m3, 6.85, and 1%.

Table 5: properties of Test Results

S. NO.	PROPERTIES	TEST RESULTS
1	Fineness modulus	6.85
2	Specific gravity	2.7
3	Bulk density A) Loose B) Rodded	1660Kg/m^3 1740Kg/m^3
4	Impact value	19%
5	Water absorption	0.8%

Sieve Analysis of 20mm Aggregate: Sample 5000gm

Table 6: Properties of Ls Sieve size

S. No.	I.S Sieve Size	Weight Retained (gms)	Cumulative Weight Retained (gms)	Cumulative % of weight Retained	% of passing
1	40mm	0	0	0	100
2	20mm	350	350	7	93
3	10mm	3550	3900	78	22
4	4.75mm	1100	5000	100	0
5	2.36mm	0	5000	100	0
6	1.18mm	0	5000	100	0
7	600µ	0	5000	100	0
8	300µ	0	5000	100	0
9	150µ	0	5000	100	0
	Total	**5000**		**685**	

Table 7: Mix Design

Concrete type	W/C Ratio	Cement	F.A	C.A
Conventional concrete	0.35	1	1.3	2.436
Pervious concrete	0.35	1	-	4

Table 8: Quantities of Material Require per 1m3

Concrete type	W/C Ratio	Cement (kg)	F.A (kg)	C.A (kg)	Water (lit)	Super plasticizer (ml/cement)
Conventional concrete	0.35	531	672	1133	186	-
Pervious concrete	0.35	531	-	2124	186	5310

IV. TEST AND DISCUSSION

Results of the compressive strength for 3 days, 7 days, and 28 days: The compressive strength solutions for pervious concrete and conventional concrete of 0.35W/C ratio for 3days, 7days and 28days. These solutions are observed for pervious concrete were 7MPa, 15MPa and 22MPa respectively and for conventional concrete were 28.22MPa, 39.78MPa and 46.5MPa respectively.

Table 9: Compressive strength

S.NO.	No. of days	Compressive strength of Conventional Concrete (MPa)	Compressive strength of Pervious concrete (MPa)
1	3	28.22	7
2	7	39.78	15
3	28	46.5	22

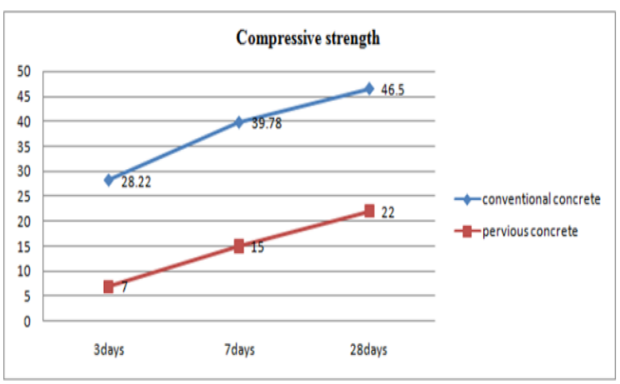

Figure 1: Delay level

On X-axis -No. of days
On Y-axis – compressive strength in MPa
Results for Split Tensile Strength at 3, 7, and 28 Days:
The tensile readings for concrete mixture and current or previous concrete at 0.35 W/C ratio after 3, 7, and 28 days. These ratios were seen to be 1.2 MPa, 1.5 MPa, and 1.8 MPa for porous concrete and 2.5 MPa, 3 MPa, and 3.25 MPa for concrete mixture, respectively.

Table 10: split material

S.NO.	No. of days	Split tensile strength ofConventional concrete (MPa)	Split tensile strength of Pervious concrete (MPa)
1	3	2.5	1.2
2	7	3	1.5
3	28	3.25	1.8

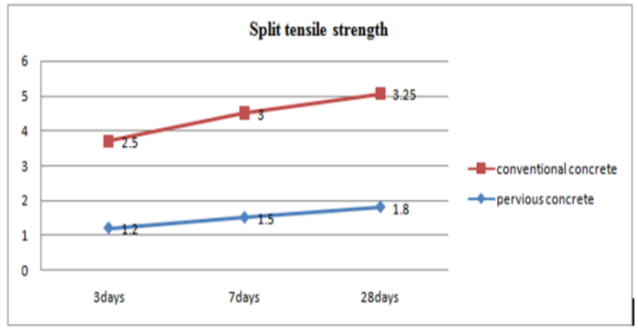

Figure 2: variation of metrial

On X – axis: No. of days
On Y- axis: Split tensile strength in MPa
Flexural strength results for 3days, 7days and 28days

Table 11: Flexural strength

No. of days	Flexural strength of Conventional concrete (MPa)	Flexural strength of Pervious concrete (MPa)
3	4	2
7	5.97	2.1
28	6.14	2.5

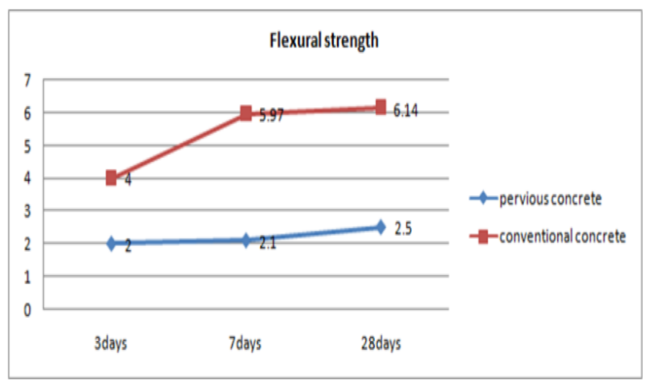

Figure 3: Variation of dela strenght

On X-axis: No. of days
On Y-axis: Flexural strength in MPa
Compressive strength of pervious concrete as a % lower than concrete mixture: The lower compressive and flexural of porous concrete as a percentage lower than normal concrete. Compressive strength for 0.35W/C ratio varied at 3 days, 7 days, and 28 days; these numbers are declining.

Table 12: Compressive strength of pervious concrete

S. No.	No. of days	Conventional Concrete Compressive Strength(Mpa)	Pervious concrete Compressive Strength(Mpa)	% Decrease
1	3	28.22	7	75
2	7	39.78	15	62.5
3	28	46.5	22	52.68

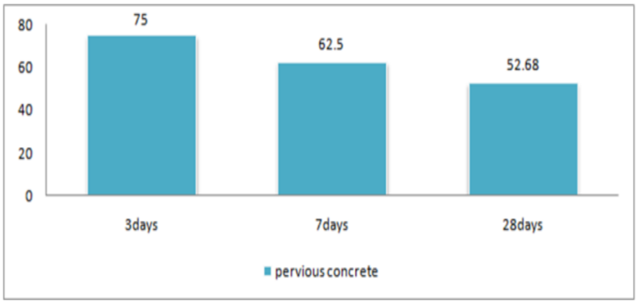

Figure 4: Compressive strength

On X-axis: no. of days
On Y-axis: percentage
Decrease in Split Tensile as a Fraction Comparing the durability of normal concrete to permeable concrete:the difference between porous concrete and regular concrete in terms of the split tensile strength. At 3 days, 7 days, and 28 days, the split tensile strength for 0.35W/C ratio varied; these values are declining.

Table 13: Conventional split

S. No	No. of days	Conventional concrete Split Tensile Strength in MPa	Pervious concrete Split Tensile Strength in MPa	% Decrease
1	3	2.5	1.2	52
2	7	3	1.5	50
3	28	3.25	1.8	44.6

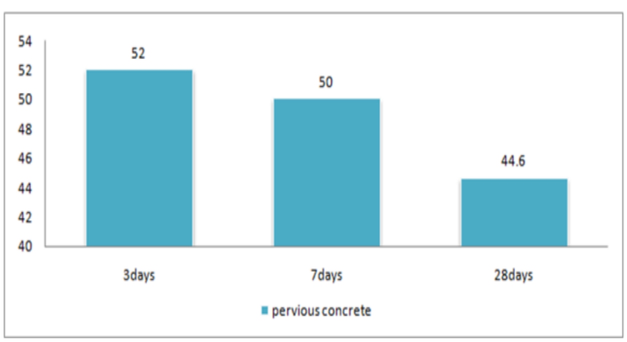

Figure 5: reduce the flexural strength

F On X-axis: No. of days
On Y-axis: percentage
Reduced Flexural Strength by % Comparing the strength of normal concrete to permeable concrete: the 0.35 W/C ratio flexural strength values for concrete mixtures and current or previous concrete after 3, 7, and 28 days. These figures were 2 MPa, 2.1 MPa, and 2.5 MPa for porous concrete, and 4 MPa, 5.97 MPa, and 6.14 MPa for normal concrete, respectively.

Table 14: Difference between conventional concrete variations.

S. No	No. of days	Conventional concrete Flexural Strength in MPa	Pervious concrete Flexural Strength in MPa	% Decrease
1	3	4	2	50
2	7	5.97	2.1	64.8
3	28	6.14	2.5	59.3

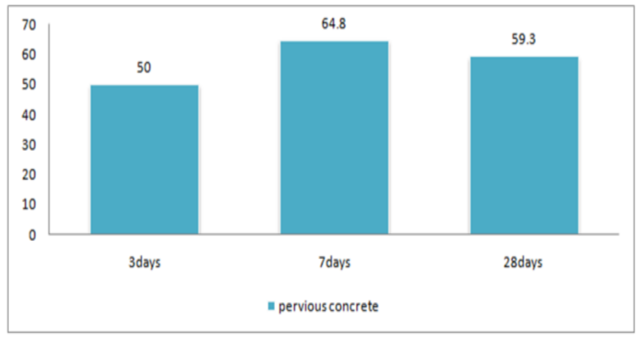

Figure 6: On X-axis: no. of days On Y-axis: percentage

V. CONCLUSIONS

The following Conclusions are made from the Experimental investigation in present thesis:

- The percentage decrease in compressive strength in pervious concrete is 50 to 75% compared with conventional concrete.
- The percentage decrease in split tensile strength in pervious concrete is 45 to 50% compared with conventional concrete.
- The percentage of void ratio is increased to 4% in pervious concrete as compared with conventional concrete. So that the permeability also high.
- Density is 30% decreases in pervious concrete compared with conventional concrete.
- By observing all parameters comparing between pervious concrete and conventional concrete both are quite different.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Malhotra, V.M., No-Fines Concrete- Its properties and applications, ACI Journal, November 1976, Vol. 73, Issue 11, pp 628-644.
[2] Meininger, Rechard C., No-Fines Pervious Concrete for paving, Concrete International, August 1988, Vol. 10, No. 8, pp 20-27.
[3] Ghafoori, Nader, Pavement Thickness Design for No-fines

Concrete Parking Lots, Journal of Transportation Engineering, November 1995, Vol. 121, No. 6, pp 476-484.

[4] Kliger, Paul, Further Studies on the Effect of Entrained Air on Strength and Durability of Concrete with Various Sizes of Aggregate, Concrete International, November 2003, Vol. 25, No. 11, pp 26-45.

[5] Marty Wanielista, Manoj Chopra, Performance Assessment of Portland Cement Pervious Pavement, Storm water Management Academy, University of Central Florida, Orlando, FL 32816, June 2007

[6] A. M. Made, S. Rogge, Development of High Quality Pervious Concrete Specifications for Maryland Conditions, The University ofMaryland, February 2013.

[7] G. N. Gopu and S. A. Joseph, “Corrosion Behavior of Fiber-Reinforced Concrete—A Review,” Fibers 2022, Vol. 10, Page 38, vol. 10, no. 5, p. 38, Apr. 2022, doi: 10.3390/FIB10050038.

[8] G. Ganesh Naidu, M. Sri Durga Vara Prasad, and A. Venkata Sai Pavani, “Impact of chloride attack on basalt fibre reinforced concrete,” Int. J. Innov. Technol. Explor. Eng., vol. 8, no. 12, 2019, doi: 10.35940/ijitee.L3502.1081219.

[9] G. Ganesh Naidu, M. Sri Durga Vara Prasad, and K. Anil Kumar, “Strengthening of reinforced concrete continuous beams using GFRP,” Int. J. Eng. Adv. Technol., vol. 9, no. 1, 2019, doi: 10.35940/ijeat.A1504.109119.

[10] A. Sofi and G. Naidu Gopu, “Influence of steel fibre, electrical waste copper wire fibre and electrical waste glass fibre on mechanical properties of concrete,” IOP Conf. Ser. Mater. Sci. Eng., vol. 513, no. 1, 2019, doi: 10.1088/1757-899X/513/1/012023.

[11] G. Ganesh Naidu, M. Sri Durga Vara Prasad, and E. Mani, “Mechanical behavior of fibre reinforced concrete using shape memory alloys,” Int. J. Innov. Technol. Explor. Eng., vol. 9, no. 1, 2019, doi: 10.35940/ijitee.A3998.119119.

[12] G. Ganesh Naidu, M. Sri Durga Vara Prasad, N. Venkata Kishore, and R. Hari Prasad, “Influence of pet waste on mechanical properties of concrete,” Int. J. Eng. Adv. Technol., vol. 9, no. 1, 2019, doi: 10.35940/ijeat.A9849.109119.

[13] G. Ganesh Naidu, M. Sri Durga Vara Prasad, U. Upendra Varma, and S. Sandhya, “Effect of R.O. wastewater on properties of concrete,” Int. J. Recent Technol. Eng., vol. 8, no. 3, 2019, doi: 10.35940/ijrte.C5201.098319.

[14] G. N. Gopu and A. Sofi, “Electrical Waste Fibers Impact on Mechanical and Durability Properties of Concrete,” Civ. Eng. Archit., vol. 9, no. 6, pp. 1854–1868, 2021, doi: 10.13189/cea.2021.090618.

[15] G. Ganesh Naidu, K. Anusha, M. S. D. Vara Prasad, and P. Ravi Kumar, “Structural health monitoring of beam retrofitted with SMA using piezoelectric transducers,” Int. J. Sci. Technol. Res., vol. 9, no. 3, pp. 5935–5937, 2020

List of referred Indian Standard (IS) code books:

- I.S. 12269-1989 : Specifications for 53 grade ordinary Portland Cement
- I.S. 383-1970: Specification for Coarse and Fine Aggregate from Natural sour for concrete
- I.S. 456-2000:Indian Standard Plain Reinforced Concrete-code of Practice
- I.S. 10262-1982: Recommended concrete Mix Design.