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Optimizing Concrete Mixtures through Multi-Criteria Decision Making: A Focus on Splitting Tensile Strength in Partially Set Concrete

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ABSTRACT

The specific objectives of this experimentation is to investigate the splitting tensile strength of concrete subjected to partial setting with varying proportions of fly ash (20% and 25%) and 1% synthetic polypropylene fibers. The examination encompasses the assessment of workability, density, and splitting tensile strength, with the validation of results compared to earlier studies conducted at different time intervals (0, 45, 75, 100, and 180 minutes). The implementation of the Analytical Hierarchy Process assists in prioritizing the optimal parameters for the concrete mix. The findings reveal a reduction in workability and density as the time delay increases; however, there is a notable enhancement in splitting tensile strength, particularly when 1% synthetic polypropylene fibers are incorporated. Consistency in the study is evident, with an average correlation factor of 0.995 in comparison to previous research. The decision-making model highlights the 1% synthetic polypropylene fiber mix as the most suitable, especially at the 100-minute mark, with a weightage of 0.118. This model provides a practical solution to minimize wastage, conserve resources, and cut costs in construction projects affected by delays in casting.

1 Introduction

Concrete, a versatile building material composed of cement, fine aggregate, coarse aggregate, and water, gains strength through a chemical reaction with water. The process begins with water addition and continues until the initial setting time, after which the concrete loses its workability. Casting delays, caused by various on-site factors, compromise the strength of finished concrete.

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Partially set concrete (PSC) refers to concrete cast over time rather than immediately after mixing, influenced by factors like formwork settling, machinery failure, power supply issues, material scarcity, and transportation constraints [1]. Unforeseen delays result in reduced compressive strength, with hourly addition of water to maintain workability. A study found that compressive strength decreased hourly, and prolonged delays led to a significant decline in workability and compressive strength [2, 3]. Experimental results indicated that PSC could achieve desired strength with delays up to 120 minutes before final setting [4]. Incorporating fly ash into concrete enhances its characteristics, providing a sustainable alternative to conventional Portland Cement. Up to 25-30% replacement of cement with fly ash has been reported [5]. Fly ash in self-compacting concrete (SCC) minimizes interface bond strength loss, offering improved workability and extended setting times [6-8]. Additionally, fly ash replacement enhances resistance to sulphate attack and expansion [9-11].

Despite high compressive strength, concrete has drawbacks like low tensile strength and limited ductility. To address these issues, synthetic fibres, such as polypropylene (PP), have been used to improve tensile strength and prevent sudden crumbling [12, 13]. Unused concrete exposed to air, often considered waste, contains reactive cement. Mixing partially set concrete with freshly formed concrete, known as "selfing," can enhance strength [1]. Multi-Criteria Decision Making (MCDM) tools play a crucial role in concrete mix design, aiding decision-making for optimal results. These tools consider various inputs, including technological performance, economic factors, and environmental impact, ensuring a sustainable approach to material design in civil engineering [14]. MCDM frameworks have been applied for ranking concrete mix guidelines and improving performance-based mix design techniques [15-17].

Literature reviews emphasize the impact of partially set concrete on properties but often overlook extended time lags and the influence of fly ash on varying replacement percentages. This research addresses these gaps by experimentally analyzing the role of additives in concrete with casting delays at different setting times. Additionally, it advocates a holistic approach that aligns concrete mix parameters with sustainability objectives, aiming to optimize tensile strength, workability, and density for PSC subjected to various delays. Mathematical validation ensures result reliability, contributing valuable insights for resource conservation and eco-friendly practices in the construction industry.

2 Materials

Preliminary tests on the chosen raw material were conducted to ensure compliance with relevant Indian standard specifications before experimentation. Ordinary Portland Cement (OPC) in line with IS:12269,1987 was used, stored in a weather-tight area during experiments to prevent dampness. For Partially Set Concrete (PSC), time intervals were set based on OPC setting time characteristics as per Table 1. Fly ash, a concrete additive, was used at 20-35% of the cement content in accordance with IS456:2000, adhering to IS:3812, 2003 standards [18, 19] Table 2, and Fig. 1(a). Mono filament polypropylene fiber (PP) from KEM FIBRE 84 was used for fiber-reinforced concrete, known for widespread availability in India, with fiber properties summarized in Table 3 and illustrated in Fig. 1(b). Fine aggregates sourced from river sand conforming to IS 383:1970 standards underwent washing and screening to eliminate deleterious materials and oversized particles. Subsequent tests determined specific gravity, absorption/moisture content, and bulk density of the river sand aggregates.

Coarse aggregates, sourced from 20mm-sized crushed basalt rock in adherence to IS 383:1970 standards [19], underwent a thorough examination to ensure freedom from coatings, disintegrated pieces, alkali, vegetable matter, or other harmful substances. Special care was taken to eliminate flaky, elongated shapes, and organic impurities that could adversely affect concrete strength or durability. Detailed specifications for both fine and coarse aggregates are provided in Table 4.

3 Experimental program

Concrete mix design adjusts ingredient ratios such as cement type, water-cement ratio, and aggregate proportions to meet specific performance requirements. Adding fibers enhances tensile strength, crucial for preventing structural cracking. The 28-day test results determine the characteristic strength for construction projects. Casting delays, inevitable for various reasons, are considered, and results are validated. The experiment explores the impact on the splitting tensile strength of M25 grade normal concrete (NPSC), PSC with 20% (PSC20FA) and 25% (PSC25FA) fly ash replacement, and 1% PP fibers (PSC1PPF). Experimental results are validated against existing models, and correlation factors are estimated.

3.1 Details of the mix design adopted for investigation:

The PSC splitting tensile strength study involves casting 150mm diameter, 300mm depth cylinders. The fresh mix, initially cast at $t=0$ minutes with conventional tamping, is compared to cylinders cast with delays of $t=45, 75, 120$, and 180 minutes. Mix proportioning for M25 grade concrete followed IS:10262-2009, with four concrete mixes exploring the impact of delayed casting on PSC splitting tensile strength. A total of 60 cylinder specimens, detailed in Table 5, were cast, cured, and tested. Ingredient quantities and mix proportions are outlined in Table 6.

Table 1 – Physical and chemical properties of OPC

Sr. No.	Test	Results
1	Normal consistency	34%
2	Initial setting time	60 minutes
3	Final setting time	150 minutes
4	Specific gravity	3.15 g/cc
5	Compressive strength of cement	
	on 3 days curing	25 N/mm ²
	on 7 days curing	37 N/mm ²
6	Fineness of cement	2.25%
7	Chemical Properties	
	CaO	65%
	SiO ₂	23%
	Al ₂ O ₃	5%
	Fe ₂ O ₃	3%
	MgO	5%
	SO ₃	3%
	pH	Alkaline 12

Table 2 – Physical and chemical properties of fly ash

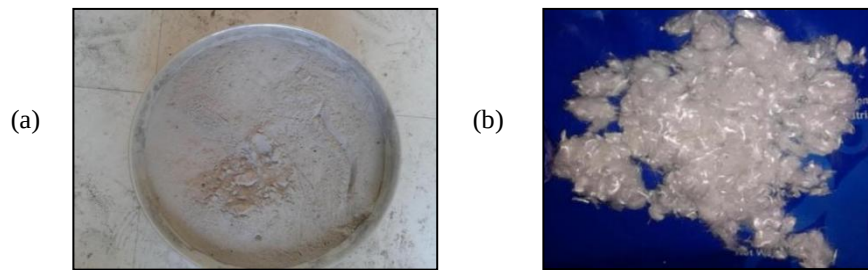
Sr.No.	Particulars	Results
A) Physical Properties		
1.	Fineness (Blaine's permeability method)	367 m ² / kg
2.	Residue oversize (Sieve No.350)	16.511 %
3.	Lime reactivity	6.42 N/mm ²
4.	Moisture Content	0.267 %
5.	Autoclave expansion	0.03%
B) Chemical Properties		
1.	SiO ₂ +Al ₂ O ₃ +Fe ₂ O ₃	92.651 %
2.	SiO ₂	59.360%
3.	MgO	1.526%
4.	SO ₃	0.837%
5.	Na ₂ O	0.506%
6.	Total chlorides	0.029%
7.	Loss on Ignition	1.1%

Table 3 – Properties of KEM fiber (polypropylene)

Sr. No.	Property	Value
1	Cut length	6 mm
2	Specific gravity	0.91
3	Tensile strength	360 N/mm ²
4	Melting point	160 °C
5	Dosage rate	909 mg / m ³
6	Aspect ratio	207

Table 4 – Properties of fine and coarse aggregates

Material	Specific gravity	Bulk density	Voids ratio	Absorption (%)
Coarse aggregate (20 mm)	2.88	1618.43	0.437	0.8
Fine aggregate	2.605	1812.72	0.336	1.0

**Fig. 1 – Blending material used for experimentation (a) Fly ash (b) polypropylene fibres****Table 5 – Type of mixtures**

Sr. No.	Description of Mixture	Designation	No. of specimens
1	Normal PSC	(NPSC)	15
2	PSC with 20% fly ash	(PSC20FA)	15
3	PSC with 25% fly ash	(PSC25FA)	15
4	PSC with 1% synthetic PP fibres	(PSC1PPF)	15

3.2 Curing conditions and specimen testing-

Curing ensures continuous hydration during the early stages of concrete, vital for high-quality results. Specimens were stored in a vibration-free water tank at approximately 27°C±20°C, fully immersed to at least 15cm above the cylinder tops, as shown in Fig. 2(a). The tank was sealed with a polythene sheet to minimize water evaporation. After 28 days of continuous curing, specimens were air-dried for 24 hours and tested the next day for split tensile strength using a 2000 kN capacity digital compression testing machine (CTM), as depicted in Fig. 2(b).

4 Results and discussion

The concrete mix design process precisely adjusts variables like cement type, water-cement ratio, and aggregate proportions to meet specific design mix criteria. Tensile strength, crucial for evaluating concrete quality and structural behavior, prompts the exploration of fiber reinforcement. The 28-day test assesses concrete characteristic strength for construction, but casting delays, beyond site control, are factored during analysis. This study explores splitting tensile strength in various mix variations: M25 grade plain concrete (NPSC), 20% fly ash replacement (PSC20FA), 25% fly ash replacement (PSC25FA), and 1% PP synthetic fibres inclusion (PSC1PPF). Experimental results are compared to a literature-based model, deriving correlation factors.

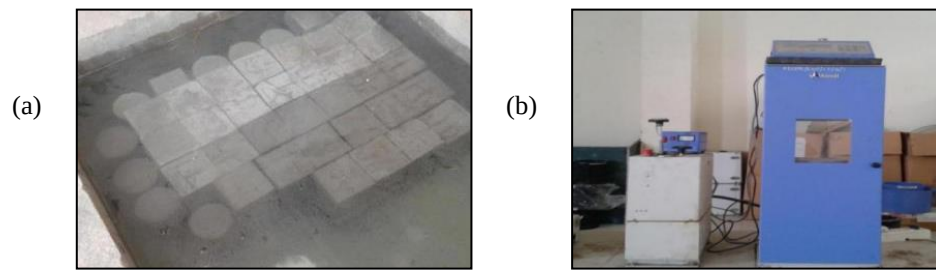


Fig. 2 – (a) Curing and (b) CTM for testing

Table 6 – Mix proportion for trial mix and design compressive strength of M25 concrete

Material	Proportion	Weight in kg/m ³	28 days Compressive strength of trial mix (MPa)	28 days average compressive strength of trial mix (MPa)
Cement	1	383.2		
Fine aggregates	1.52	582.90	33.33	
Coarse aggregates	2.98	1142.78	31.56	33.48 N/mm ²
Water	0.48	186	35.55	

4.1 Workability variation of PSC-

Concrete workability, essential for laying and finishing, was assessed using the slump cone test using IS 1199:1959 [20]. Fig. 3 depicts the impact of exposure duration on freshly prepared mixtures. Workability is inversely proportional to exposure time, with NPSC and PSC1PPF showing low workability. In contrast, PSC20FA and PSC25FA exhibit better workability, maintaining slumps even after a 100-minute lag. Slump reduction is attributed to partial setting, causing less compaction and more voids. PSC20FA and PSC25FA resist early setting, retaining notable workability. Managing exposure duration is crucial for optimal workability.

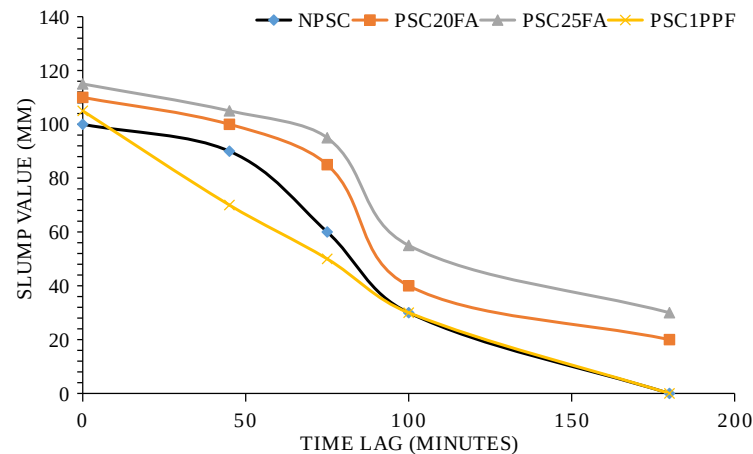


Fig. 3 – Variation in slump value for PSC

4.2 Density variation of PSC-

Fig. 4 visually illustrates changing concrete density over time. PSC25FA has the highest density at 2490 kg/m³, showcasing effective particle packing. NPSC has the lowest density at 2404 kg/m³. PSC1PPF follows closely, indicating the positive influence of polypropylene fibers on density. Density values align with strength parameters, with PSC1PPF performing well in splitting tensile strength. Extended exposure time (180 minutes) for NPSC results in the lowest density of 2370 kg/m³, aligning with prolonged exposure leading to partial setting. Overall, decreasing density in all PSC mixes over time signifies structural changes. Understanding the density-strength relationship is crucial for optimizing mix designs in

construction applications. The observed variations in workability and density over time have significant implications for concrete construction. The inverse relationship between exposure duration and workability highlights the importance of timely handling to maintain optimal workability. Variations in density reflect changes in internal structure and composition, impacting strength and durability. Understanding these relationships is crucial for optimizing mix designs and ensuring long-term structural performance.

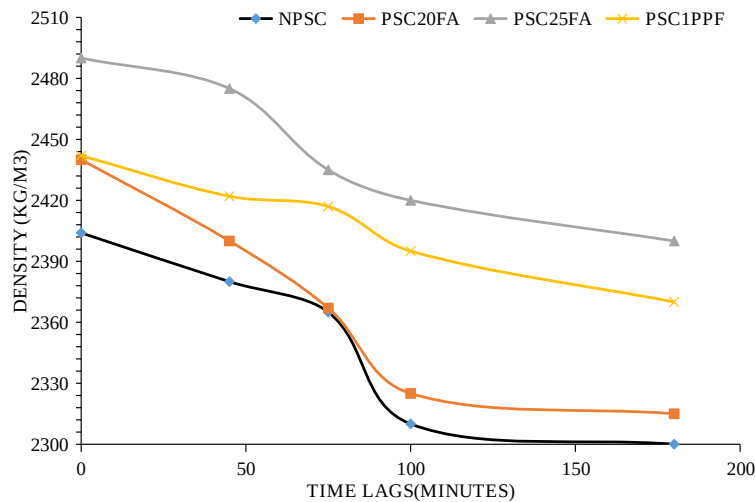


Fig. 4 – Density variation for different PSC

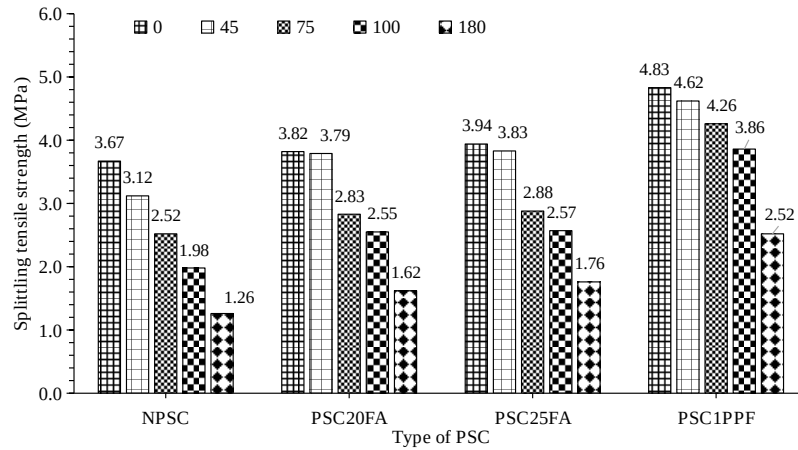
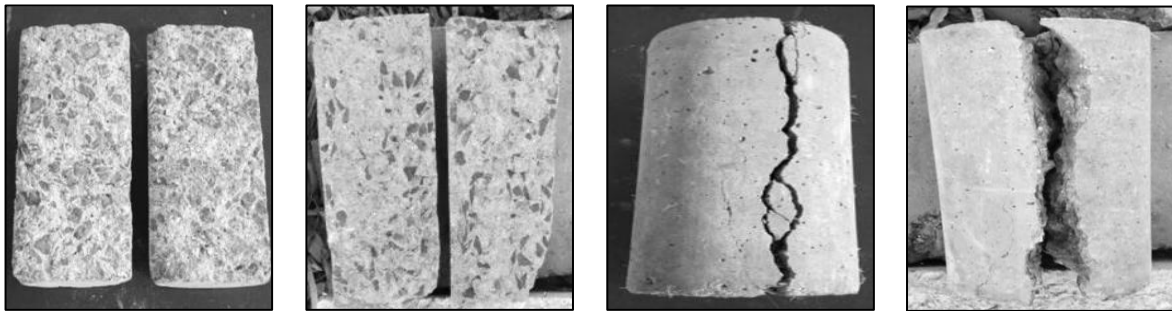
4.3 Splitting tensile strength variation of PSC

Table 7 and Figure 5 present a comprehensive assessment of split tensile strength for NPSC, PSC20FA, PSC25FA, and PSC1PPF. PSC1PPF, with 1% polypropylene fiber addition, shows a significant 4.83 MPa enhancement in tensile strength compared to other PSC mixes, approximately 31.60% higher than NPSC. This improvement underscores the positive impact of PP fibers, reducing crack width and preventing rapid failure. PSC20FA and PSC25FA demonstrate stable tensile strength, indicating fly ash role in delaying setting time while maintaining strength. Despite enhanced tensile strength, PSC1PPF, like other PSC mixes, experiences a decline over time, characteristic of concrete hydration stages. For 100-minute time lags, NPSC and PSC1PPF exhibit significant strength drops (32% to 47%), while PSC20FA and PSC25FA show remarkable resilience (at least 11%), attributed to excellent workability even when partially exposed outdoors (Fig. 3). The addition of PP fibers strengthens bonding, preventing sudden breakdown under stress. Figure 6 visually reinforces PP fiber effectiveness, with PSC1PPF showing reduced separation, unlike the brittle breaking observed in NPSC to PSC25FA.

Experimental findings indeed contribute to eco-friendly approaches in the industry. Through experiments, validation, and modeling, several uncovered and significant conclusions regarding partially set concrete (PSC) with delayed casting are studied. Notably, it is observed that prolonged casting duration correlates with reduced PSC splitting tensile strength, highlighting the critical role of timely water introduction. Moreover, the incorporation of 1% polypropylene fiber (PSC1PPF) has shown a remarkable increase in tensile strength by approximately 31.60%, indicating the effectiveness of fiber reinforcement in reducing cracks. Also noted improvements in workability and density, with fly ash enhancing slump while maintaining strength. Studied model shows high correlation factor of 0.995 further validates its reliability. Additionally, while fly ash-based cement marginally enhances tensile strength, the significant impact of fiber reinforcement is evident. This sustainable approach not only minimizes resource and energy usage but also offers a practical solution to reduce concrete wastage. Overall, research underscores the importance of adopting eco-friendly practices in concrete construction for a greener future. In summary, these results highlight the significant influence of PP fiber on split tensile strength, crack resistance, and overall structural integrity, offering valuable insights for optimized concrete formulations in construction practices.

Table 7 – Splitting tensile strength in N/mm² for PSC

Name / Time lag (Minutes)	0	45	75	100	180
NPSC	3.67	3.12	2.52	1.32	1.26
PSC20FA	3.94	3.83	2.83	2.57	1.62
PSC25FA	3.82	3.79	2.88	2.55	1.76
PSC1PPF	4.83	4.62	4.26	2.86	2.52

**Fig. 5 – Splitting tensile strength for PSC****Fig. 6 – Visuals of tested cylinder specimens for PSC**

4.4 Validation of experimental results with analytical model proposed by Bairagi N.K.,2009 [1]

The concept of selfing as derived from the analytical model is validated with the experimental results. The calculation procedure of the various stages of selfing of two partially set mixes in blending requires parameters such as: setting times, characteristic strength parameters (CSP), selfing equation and blend ratio. They are abbreviated as;

- Setting times: t_i and t_f .
- Characteristic strength parameters (CSP) : (Ar,i) and (Ar,f).

The analytical model developed for selfing equation when blend ratio $r = \infty$ indicates: Final strength at time lag is given by (Bairagi, 2009);

$$A(R', t) = \frac{(Ar,i) \times (Ar,f) \times (t_f - t_i)}{t \times (Ar,i - Ar,f) + Ar,f \times t_f - Ar,i \times t_i} \quad (1)$$

where;

$A(R', t)$ = Final strength at time lag t ; (Ar, i)= Tensile strength at initial setting time i.e. $t = t_i$.

(Ar, f)= Tensile strength at final setting time i.e. $t = t_f$; t = Time lag at which tensile strength is to be calculated; t_i = Initial setting time and t_f = Final setting time. The experimental results were used as the input values (**Table 7** for different parameters of PSC and were compared with results obtained using Equation 1 and is presented in Table 8. Following input values were considered for NPSC;

$A(\infty, 1.67)$ = Quantity to be calculated; (Ar, i)= 2.52 N/mm²; (Ar, f)= 1.26 N/mm²

$t = 1.67$ hours, $t_i = 1.33$ hours and $t_f = 3$ hours.

The predicted splitting tensile strength values for time lag 1.67 hours were estimated. The experimental results obtained are then compared to analytical values Bairagi N.K. (2009), and correlation factors are estimated accordingly. Correlation factor is estimated by taking the ratio of two quantities i.e. analytical value and experimental value as shown Equation 2.

$$cr = \frac{\text{Analytical value}}{\text{Experimental value}} \quad (2)$$

The trend for both experimental and analytical results is quite similar and shows expediency of its usage. The average correlation factor observed is 0.995 which shows the confidence in validation. Fig. 7 shows the trend of correlation among the experimental and analytical observations from Bairagi N.K. (2009).

Table 8 – Comparison of experimental results with Bairagi [1] model

Parameter Type	NPSC	PSC20FA	PSC25FA	PSC1PPF
(Ar,i)	2.52	2.83	2.88	4.26
(Ar,f)	1.26	1.62	1.76	2.52
t_i	1.3	1.3	1.3	1.3
t_f	3	3	3	3
t	1.7	1.7	1.7	1.7
$Ari \times Arf \times (t_f - t_i)$	5.303	7.656	8.465	17.928
$t \times (Ari - Arf)$	2.104	2.021	1.87	2.906
$(Arf \times t_f)$	3.78	4.86	5.28	7.56
$(Ari \times t_i)$	3.352	3.764	3.83	5.666
$(t \times (Ari - Arf) + (Arf \times t_f) - (Ari \times t_i))$	2.533	3.117	3.32	4.8
Bragi N.K.(2009) ($t=1.67$)	2.094	2.456	2.55	3.735
Experimental Value ($t=1.67$)	1.98	2.55	2.57	3.86
cr	1.057	0.963	0.992	0.968
Average cr factor	0.995			

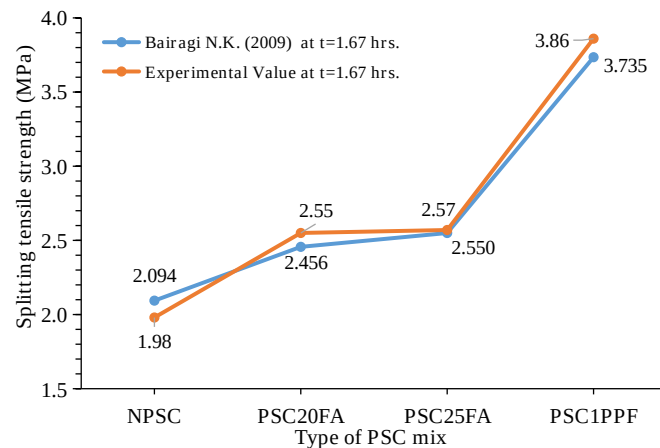


Fig. 7 – Correlation of experimental and analytical observations

5 Analytical hierarchy process for selection of concrete mix parameter for PSC

AHP plays a crucial role in selecting the optimal concrete mix parameter for PSC. Fig. 8 illustrates the AHP analysis hierarchy, facilitating prioritization and decision-making. This tool assists in determining priorities among various options, adhering to a hierarchical structure with the goal at the top, followed by criteria and alternatives.

AHP, a widely used mathematical model for complex decision-making, prioritizes alternatives effectively. The process involves pairwise comparisons, normalization, and weight determination. Key steps include:

1. Pairwise comparison using experimental data for attributes ‘i’ and ‘j’ (**Table 7**), through normalization with matrix size $M=10$.
2. Geometric mean calculation and normalization for relative weights (**Table 9** and **Table 10**) using equation 3 and equation 4.

$$\text{Geometric mean (GM}_j) = [\prod_{i=1}^M b_{ij}]^{1/M} \quad (3)$$

$$\text{Weight of each attribute} = W_j = [GM_j / \sum_{j=1}^M GM_j] \quad (4)$$

3. Testing five time-lag alternatives for PSC tensile strength, with optimal times observed.
4. **Fig. 9** indicates that NPSC normalized weight of 0.112 is retained up to a 100-minute time lag for PSC1PPF, achieving the target strength with increased tensile strength and resistance to cracking after drying, despite outdoor exposure.

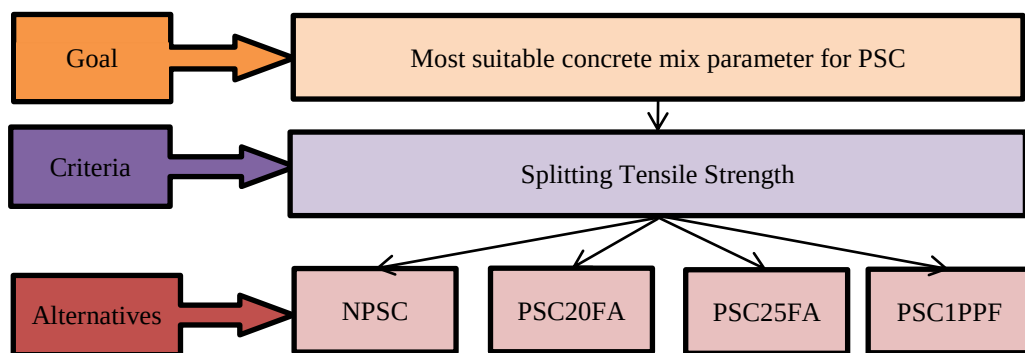


Fig. 8 – Schematic diagram showing hierarchy of AHP

5. **Fig. 10** reveals minimal variations in tensile strength among NPSC, PSC20FA, and PSC25FA, emphasizing marginal changes in concrete containing fly ash. Notably, NPSC's normalized weight (0.087) matches PSC25FA weight (0.091) up to a 45-minute lag, highlighting the negligible impact of fly ash on tensile strength. Despite alterations in concrete flow with fly ash addition, tensile strength enhancement remains consistent for both PSC20FA and PSC25FA, diminishing with prolonged time lag.
6. **Fig. 11** ranks the best mix parameter among all combinations. PSC1PPF stands out with the highest normalized weight (0.118) at a 100-minute time lag. Using controlled NPSC concrete weight (0.112) as the baseline, PSC1PPF surpasses all other weights, solidifying its status as the top-performing.

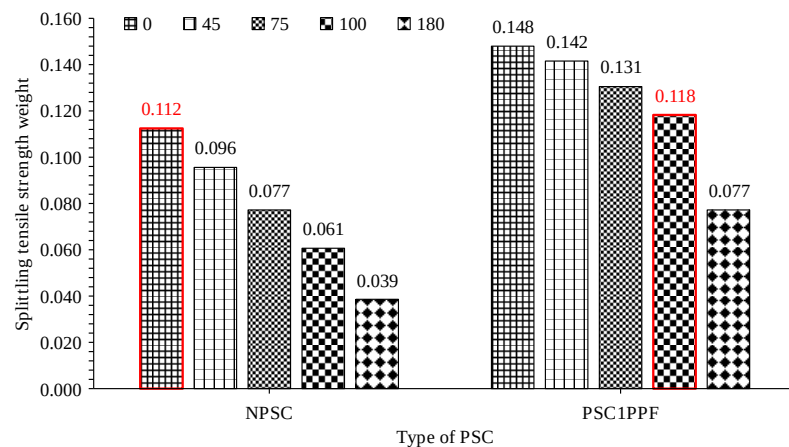


Fig. 9 – Maximum weight of alternatives for NPSC and PSC1PPF

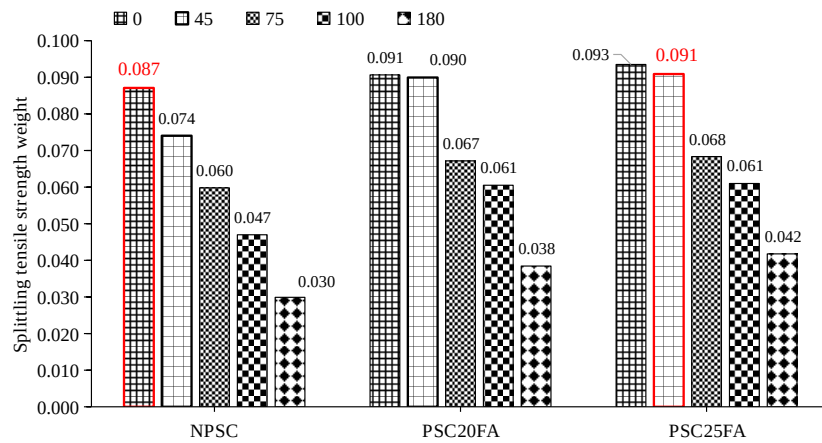


Fig. 10 – Maximum weight of alternatives for NPSC PSC20FA and PSC25FA

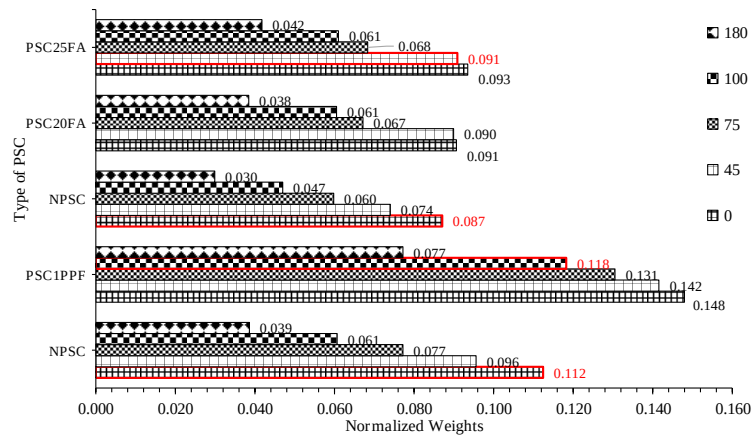


Fig. 11 – Ranking of most suitable alternative for NPSC to PSC1PP

6 Conclusions

Based on experiments, validation, and modeling, several key conclusions emerge regarding PSC with delayed casting. Firstly, it's evident that extended casting duration leads to a reduction in PSC splitting tensile strength, a trend that varies with composition, underscoring the importance of timely water introduction. Secondly, the incorporation of 1% polypropylene fiber (PSC1PPF) enhances tensile strength by approximately 31.60%, effectively reducing cracks and demonstrating the potential of fiber reinforcement. Additionally, notable changes in workability and density are observed, with fly ash improving slump without compromising strength. The validation of our model yields a high correlation factor of 0.995, affirming its reliability. Furthermore, while fly ash-based cement marginally improves tensile strength, it is evident that fiber reinforcement plays a more significant role in enhancing overall strength. This sustainable approach not only minimizes resource and energy usage in construction practices but also offers a viable solution to reducing concrete wastage through the use of partially set concrete.

7 Scope for future study

In addition to the insights gained from this study, there are several avenues for future research that warrant exploration. Further investigations could focus on assessing the long-term durability and performance of concrete mixes with varying compositions under different environmental conditions. Additionally, exploring alternative additives and reinforcement materials to enhance the properties of partially set concrete could offer valuable insights into sustainable construction practices. Moreover, conducting field studies of PSC and validate the findings of laboratory experiments would provide practical contribution to the real-world applicability of the research findings. By addressing these areas, future

research endeavors can advance understanding of concrete mix design and construction practices, ultimately contributing to more sustainable and resilient infrastructure development.

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Data Availability Statement: The authors confirm that the data supporting the findings of this study are available within the article.

Table 9 – Pair-wise matrix for NPSC and PSC1PPF

Type of Concrete mix	Time Lag	0	45	75	100	180	0	45	75	100	180	Product of row	Weight
NPSC	0	1	1.18	1.46	1.85	2.91	0.76	0.79	0.86	0.95	1.46	1.209	0.112
	45	0.85	1	1.24	1.58	2.48	0.65	0.68	0.73	0.81	1.24	1.028	0.096
	75	0.69	0.81	1	1.27	2.00	0.52	0.55	0.59	0.65	1.00	0.830	0.077
	100	0.54	0.63	0.79	1	1.57	0.41	0.43	0.46	0.51	0.79	0.652	0.061
	180	0.34	0.40	0.50	0.64	1	0.26	0.27	0.30	0.33	0.50	0.415	0.039
PSC1PPF	0	1.32	1.55	1.92	2.44	3.83	1	1.05	1.13	1.25	1.92	1.591	0.148
	45	1.26	1.48	1.83	2.33	3.67	0.96	1	1.08	1.20	1.83	1.522	0.142
	75	1.16	1.37	1.69	2.15	3.38	0.88	0.92	1	1.10	1.69	1.403	0.131
	100	1.05	1.24	1.53	1.95	3.06	0.80	0.84	0.91	1	1.53	1.271	0.118
	180	0.69	0.81	1.00	1.27	2.00	0.52	0.55	0.59	0.65	1	0.830	0.077

Table 10 – Pair-wise matrix for NPSC, PSC20FA and PSC25FA

Type of Concrete mix	Time Lag	0	45	75	100	180	0	45	75	100	180	0	45	75	100	180	Product of row	Weight
NPSC	0	1	1.18	1.46	1.85	2.91	0.96	0.97	1.30	1.44	2.27	0.93	0.96	1.27	1.43	2.09	1.378	0.087
	45	0.85	1	1.24	1.58	2.48	0.82	0.82	1.10	1.22	1.93	0.79	0.81	1.08	1.21	1.77	1.172	0.074
	75	0.69	0.81	1	1.27	2.00	0.66	0.66	0.89	0.99	1.56	0.64	0.66	0.88	0.98	1.43	0.946	0.060
	100	0.54	0.63	0.79	1	1.57	0.52	0.52	0.70	0.78	1.22	0.50	0.52	0.69	0.77	1.13	0.744	0.047
	180	0.34	0.40	0.50	0.64	1	0.33	0.33	0.45	0.49	0.78	0.32	0.33	0.44	0.49	0.72	0.473	0.030
PSC20FA	0	1.04	1.22	1.52	1.93	3.03	1	1.01	1.35	1.50	2.36	0.97	1.00	1.33	1.49	2.17	1.435	0.091
	45	1.03	1.21	1.50	1.91	3.01	0.99	1	1.34	1.49	2.34	0.96	0.99	1.32	1.47	2.15	1.423	0.090
	75	0.77	0.91	1.12	1.43	2.25	0.74	0.75	1	1.11	1.75	0.72	0.74	0.98	1.10	1.61	1.063	0.067
	100	0.69	0.82	1.01	1.29	2.02	0.67	0.67	0.90	1	1.57	0.65	0.67	0.89	0.99	1.45	0.958	0.061
	180	0.44	0.52	0.64	0.82	1.29	0.42	0.43	0.57	0.64	1	0.41	0.42	0.56	0.63	0.92	0.608	0.038
PSC25FA	0	1.07	1.26	1.56	1.99	3.13	1.03	1.04	1.39	1.55	2.43	1	1.03	1.37	1.53	2.24	1.480	0.093
	45	1.04	1.23	1.52	1.93	3.04	1.00	1.01	1.35	1.50	2.36	0.97	1	1.33	1.49	2.18	1.438	0.091
	75	0.78	0.92	1.14	1.45	2.29	0.75	0.76	1.02	1.13	1.78	0.73	0.75	1	1.12	1.64	1.082	0.068
	100	0.70	0.82	1.02	1.30	2.04	0.67	0.68	0.91	1.01	1.59	0.65	0.67	0.89	1	1.46	0.965	0.061
	180	0.48	0.56	0.70	0.89	1.40	0.46	0.46	0.62	0.69	1.09	0.45	0.46	0.61	0.68	1	0.661	0.042

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