Performance evaluation of M25 & M30 grade concrete with nylon fiber addition

A. Swarupa Rani[1], N.V.V.S. Madhavi[1], Bhupendra Singh Dhami[1], K. U.S.L. Sanjeev[1], Ch. Sivanarayana[2]

[1]UG Student, Dept. of Civil Engineering, Bonam Venkata Chalamayya Engineering College (Autonomous), Odalarevu, Andhra Pradesh, India, 533210

[2]Associate Professor, Dept. of Civil Engineering, Bonam Venkata Chalamayya Engineering College (Autonomous), Odalarevu, Andhra Pradesh, India, 533210

ABSTRACT: Concrete is the most widely used building material in civil engineering due to its exceptional durability and compressive strength. However, conventional concrete has low tensile strength and is prone to cracking. To overcome this limitation, fibers are incorporated into concrete to enhance its mechanical and durability properties. This study investigates the performance of M25 and M30 grade concrete with the addition of nylon fibers. Mechanical properties such as compressive strength, split tensile strength and flexural strength were evaluated. Durability properties including water absorption and acid resistance were also studied. For the acid resistance test, Hydrochloric Acid (HCl) and Sulfuric Acid (H_2SO_4) solutions were used. Nylon fibers were added in different percentages of 0%, 0.5%, 0.75%, and 1% by weight of cement. The results show that the addition of nylon fibers improves tensile strength, crack resistance, and durability characteristics of concrete.

Keywords: Nylon Fiber, Compressive strength, Split tensile strength, flexural strength, Durability, Acid Resistance, Water Absorption.

1. INTRODUCTION:

Concrete's strong compressive strength and raw material availability make it a vital component of contemporary building. Conventional concrete, however, has a relatively low tensile strength and is fragile. As a result, shrinkage, temperature fluctuations, and external stresses can produce fractures.

To get around these restrictions, Fiber Reinforced Concrete (FRC) was created. Small fibers are dispersed haphazardly throughout the concrete mix in FRC. Tensile strength, toughness, and fracture resistance are all enhanced by these fibers. Nylon fibers are synthetic fibers that offer exceptional flexibility, durability, and chemical resistance. Nylon fibers aid in reducing microcracks and enhancing concrete's overall performance.

The performance of M25 and M30 grade concrete with different amounts of nylon fibers is the main subject of this study. The goal of the study is to establish the ideal fiber fraction by analyzing both mechanical and durability aspects.

1.1 NECESSITY OF THE PROJECT

The construction industry is continuously seeking materials that enhance performance while reducing environmental impact. Conventional concrete, though strong in compression, is weak in tension and prone to cracking. This creates a need for improved materials.

The use of fiber-reinforced concrete addresses these limitations by enhancing tensile strength, crack resistance, and durability. Additionally, the disposal of waste materials such as nylon fibers creates environmental concerns. This project is necessary because it combines waste management and construction innovation, converting waste nylon into a useful construction material. It also helps in developing cost-effective and durable concrete suitable for modern infrastructure needs.

1.2 OBJECTIVES

1. Assessing the qualities of M25 and M30 concrete mixes with different nylon fiber percentages both fresh and cured.
2. Evaluating the modified M25&M30 concrete's durability, flexural strength, split tensile strength, and compressive strength.
3. To research endurance characteristics with:
   - Water absorption test.
   - An acid resistance test.
4. To evaluate how well concrete mixtures of grades M25 and M30 perform.

1.3 LITERATURE REVIEW

Kumar et al. (2026) studied nylon fiber reinforced concrete and reported improved tensile strength and crack resistance. The study also highlighted reduced permeability and enhanced durability performance. Sharma et al. (2025) investigated nylon fiber concrete and observed improvement in compressive and flexural strength. The addition of fibers increased resistance to chemical attack and improved long-term durability. Patel et al. (2024) analyzed the mechanical behaviour of nylon fiber reinforced concrete and found enhanced ductility. The study also reported reduction in micro-cracks and better load carrying capacity. Qureshi et al. (2023)

reviewed nylon fiber reinforced concrete and concluded that fibers significantly improve crack resistance. The study emphasized improvement in both strength and durability characteristics. Mohiuddin et al. (2022) examined nylon fiber concrete and reported improved ductility and flexural strength. The presence of fibers reduced shrinkage cracks and enhanced performance. Ahmad et al. (2021) studied nylon fiber reinforced self-compacting concrete and observed increased compressive strength. The results also showed reduced permeability and improved resistance to acid attack. Bheel et al. (2021) investigated nylon fiber concrete and found improvement in compressive and tensile strength. However, workability slightly decreased at higher fiber content. Singh et al. (2020) studied nylon fiber reinforced concrete and reported better crack control and durability. The study showed that fibers improved overall structural behaviour. Rao et al. (2019) analyzed nylon fiber concrete and observed improved tensile strength and ductility. The study also highlighted reduction in crack propagation. Khan et al. (2018) investigated synthetic fiber reinforced concrete and reported enhanced strength properties. Fiber addition improved toughness and resistance to cracking. Gupta et al. (2018) studied nylon fiber concrete and found improved flexural strength. The study concluded that fiber addition enhances load carrying capacity. Ali et al. (2017) examined the behaviour of nylon fiber reinforced concrete and reported improved durability. Crack resistance and tensile strength were significantly enhanced. Saeed et al. (2017) studied synthetic fiber concrete and observed reduced shrinkage cracks. The study highlighted improved performance under loading conditions. Al-Hadithi and Hilal (2016) investigated nylon fiber concrete and found improved compressive and tensile strength. Workability decreased slightly with higher fiber dosage. Mazaheripour et al. (2015) studied synthetic fiber reinforced concrete and reported improved tensile strength. The addition of fibers reduced brittleness and increased ductility. Ochi et al. (2007) examined fiber reinforced concrete and reported improved crack resistance. The study emphasized the importance of proper fiber distribution. Song et al. (2005) studied nylon fiber reinforced concrete and found enhanced toughness and impact resistance. Crack propagation was significantly reduced. Chen and Liu (2005) analyzed fiber reinforced concrete and observed improved toughness. Fiber addition enhanced structural performance and crack resistance.

Yao et al. (2003) studied hybrid fiber concrete and reported improved mechanical properties. Ductility increased while brittleness was reduced. Naaman (2003) explained fiber reinforcement mechanisms in concrete and highlighted improved post-cracking behaviour. The study showed that fibers enhance ductility and toughness.

2. MATERIALS & PROPERTIES:

2.1 CEMENT

The following table lists the physical characteristics of locally available Ordinary Portland Cement (OPC) of grade 53.

Table-1 Properties of cement

S.NO	Properties	IS Code	Results
1	Normal consistency	IS 4031-1988(Part-4)	34%
2	Initial setting time	IS 4031-1988(Part-5)	36 min
3	Final setting time	IS 4031-1988(Part-5)	520 min
4	Fineness modulus	IS 4031-1966(Part-1)	3.6%
5	Specific gravity	IS 4031-1988(Part-11)	3.13 g/cc
6	Soundness	IS 4031-1988(Part-3)	7 mm

2.2 COARSE AGGREGATE

For the project, locally accessible 20mm-sized crushed stone aggregate is utilized. The following table lists the characteristics of coarse aggregate.

Table-2 Properties of coarse aggregate

S.NO	Properties	IS Code	Results
1	Fineness modulus	IS 383-2016	7.56
2	Specific gravity	IS 2383-1963(Part-3)	2.56
3	Water absorption	IS 2383-1963(Part-3)	0.49%
4	Abrasion resistance	IS 2383-1963(Part-4)	8.6%
5	Crushing Value	IS 2383-1963(Part-4)	24.3%
6	Impact value	IS 2383-1963(Part-4)	18.9%

2.3 FINE AGGREGATE

According to IS code standards, fine aggregate manufactured from locally accessible sand is used using a 4.75mm IS sieve. The properties are displayed in the table below.

Table-3 Properties of fine aggregate

S.NO	Properties	IS Code	Results
1	Fineness modulus	IS 383-2016	3.38
2	Specific gravity	IS 2383-1963(Part-3)	2.78
3	Moisture content	IS 2383-1963(Part-3)	2.44%

2.4 NYLON FIBER

Nylon is a synthetic polymer used as reinforcement material due to their high tensile strength and durability.

Table-4 Properties of nylon fiber

S.NO	PHYSICAL PROPERTIES	RESULT
1	Specific gravity	0.91
2	Fiber length	50mm
3	Diameter	0.35mm
4	colour	White

2.5 WATER

Clean potable water free from impurities was used for mixing and curing.

3. METHODOLOGY:

The experimental study evaluated the performance of nylon fiber reinforced concrete for M25 and M30 grades. Ordinary Portland Cement (OPC 53), crushed granite (20 mm), and river sand were used along with clean water. Nylon fibers were added at 0%, 0.5%, 0.75%, and 1% as a partial replacement of fine aggregate. The mixes were prepared as per standard design procedures, ensuring uniform fiber distribution, and specimens were cast, compacted, and cured for 7, 14, and 28 days. Tests were conducted to determine workability (slump), compressive strength, flexural strength, and split tensile strength. Durability was assessed using acid resistance and water absorption tests. The results were compared with conventional concrete to identify the optimum fiber content that improves both strength and durability.

3.1 MIX DESIGN

The amount of cement, fine aggregate, and coarse aggregate in the mix design is determined using IS: 10262-2009. The amount of ingredients needed to make one cubic meter of concrete is displayed in the table. Super Plasticizer (SP), water, nylon fiber, fine and coarse aggregate, and cement make up the concrete. The nylon fiber added to the cement weight at percentages of 0.5%, 0.75%, and 1%.

Table-7.1 mix design quantities

Materials	Quantity	
	M25	M30
Cement	371 kg	420 kg
Fine aggregate	834 kg	700 kg
Coarse aggregate	1065 kg	1062 kg
Super Plasticizer	1.1%	1.1%
Water	167 lit	205 lit

3.2 RESULT AND ANALYSIS

This section provides a thorough analysis of the experimental investigation's results. The main objective is to evaluate the concrete specimens' strength attributes, such as durability, flexural strength, split tensile strength, and compressive strength. To assess the development of strength over time, testing is done at three different intervals: 7, 14, and 28 days.

3.2.1. COMPRESSIVE STRENGTH

The capacity of a material to withstand pressing pressures is known as its compressive strength. It displays the maximum load that a material can support before crushing. When the limit is reached, brittle materials compress or shatter. Cement, aggregate, curing, water-to-cement ratio, and specimen size all play a role. The typical cube size for testing is 150 mm by 150 mm by 150 mm. Cube specimens were examined in a Compression Testing Machine in accordance with IS 516:1959 following 7, 14, and 28 days of curing.

Compressive strength = [load/area] = N/mm^2 …………(1)

The examples are placed in a curing tank following the mixing of concrete of grades M25 and M30. A compression machine was used to evaluate the specimen's compressive strength seven, fourteen, and twenty-eight days after it was stored in the curing tank. The compressive strength may be computed by dividing the specimen's maximum failure force during the test by its cross sectional area. Regular concrete and the percentage of special concrete replacements that are crushed on different days (7, 14, and 28 days) are shown in the graph data.

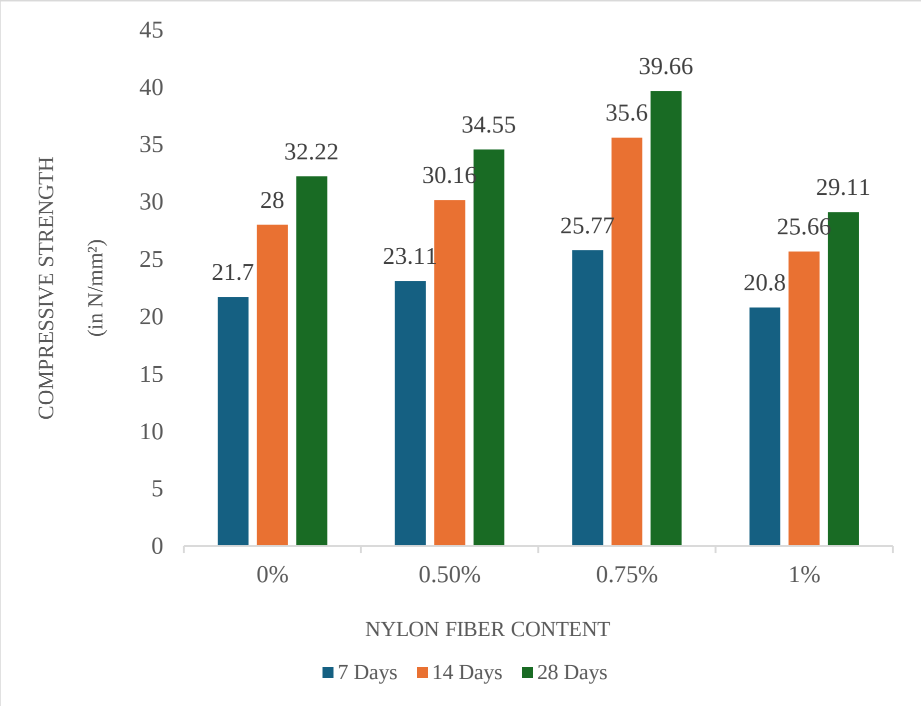


Fig-1 compressive strength for different fraction of fiber for M25

3.2.1.1. COMPRESSIVE STRENGTH-M25 RESULT & ANALYSIS:

The graphical representation of M25 compressive strength illustrates a steady increase in strength with fiber addition up to 0.75%. The control mix is positioned at the lowest point across all curing periods. The curve rises significantly at 0.5% fiber content, indicating improved performance. The peak value is observed at 0.75%, showing the maximum effectiveness of fiber reinforcement. Beyond this point, the graph shows a downward trend at 1%, indicating reduced efficiency due to poor workability. The 28-day curve shows the highest strength compared to 7 and 14 days. This pattern confirms that fiber addition improves compressive behaviour up to an optimum level.

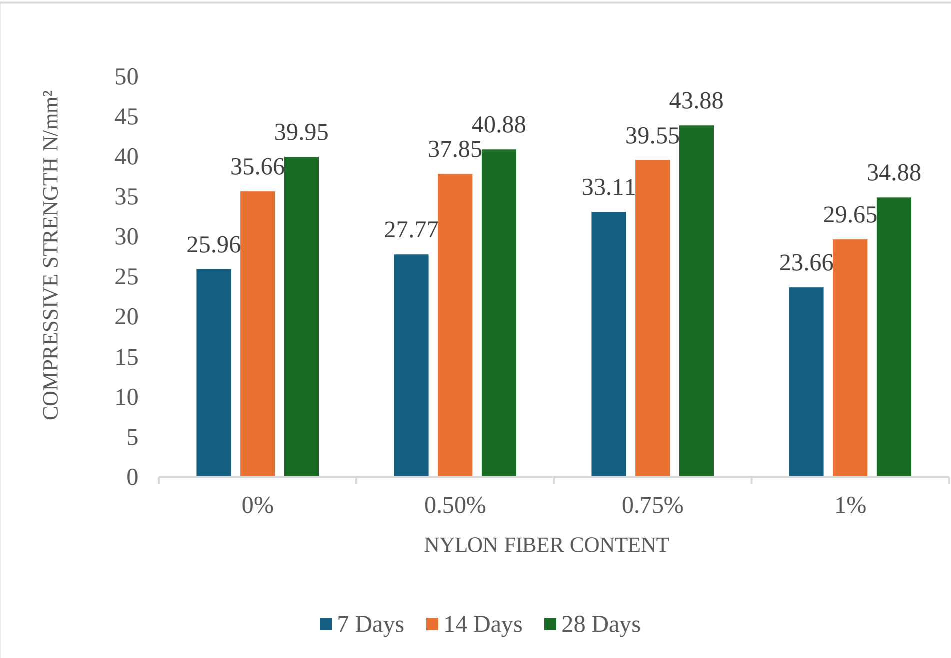


Fig -2 compressive strength for different fraction of fiber for M30

3.2.1.2. COMPRESSIVE STRENGTH-M30 RESULT & ANALYSIS:

The M30 compressive strength graph exhibits a similar trend with comparatively higher values than M25. The control mix starts at a higher baseline due to the richer mix design. The strength increases consistently with the addition of fibers up to 0.75%. The maximum peak is observed at this level across all curing periods. A slight reduction is visible at 1% fiber content, indicating the effect of reduced workability. The slope of the graph is steeper compared to M25, indicating better strength gain. The overall trend confirms improved performance with optimum fiber dosage.

3.2.1.3. COMBINED RESULT:

The combined graph comparison highlights that both M25 and M30 concretes follow a similar trend with fiber addition. M30 consistently exhibits higher compressive strength than M25 at all curing ages. Both grades achieve maximum strength at 0.75% fiber content. The decline at 1% is evident in both curves, indicating a common limitation due to excessive fiber content. The gap between the two grades is maintained throughout, reflecting the influence of mix design. The graph clearly demonstrates the importance of optimum fiber dosage. It also confirms that fiber reinforcement enhances strength in both grades.

3.2.2. SPLIT TENSILE STRENGTH

The tensile behaviour of concrete containing nylon fibers was assessed using the split tensile strength test. Concrete is prone to cracking because it typically has a high compressive strength but a low tensile strength. This study examined the impact of adding nylon fiber on the tensile capacity of concrete using cylindrical specimens. The cylindrical specimen was positioned horizontally and a force was applied throughout its length until failure occurred using a compression testing machine. The specimen split along its vertical diameter as a result of tensile stresses induced by the applied load that were perpendicular to the loading direction.

By applying a compressive force on the cylinder, one can indirectly determine the tensile strength of concrete. Conventional casting was used to create cylinders with a diameter of 150 mm and a length of 300 mm. Following a 24-hour period, the specimens were demoulded and exposed to water curing. Following 7, 14, and 28 days of curing, cylinders were removed, allowed to dry, and tested in CTM by positioning the specimens horizontally. The specimen's final loads were recorded.

Split tensile strength = $[2P/\pi dl]$ N/mm^2………… (2)

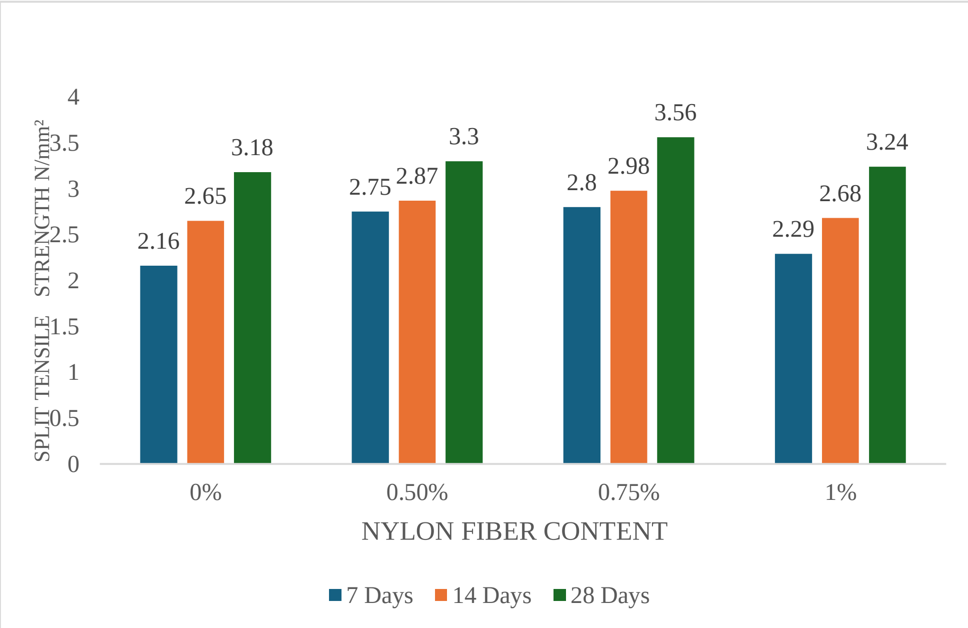


Fig -3 Split Tensile Strength of M25 Concrete with Varying Nylon Fiber Content

3.2.2.1. SPLIT TENSILE STRENGTH-M25 RESULT&EVALUATION:

The graph for M25 tensile strength shows a gradual upward trend with fiber addition. The control mix is at the lowest position across all curing periods. The curve increases steadily up to 0.75% fiber content. The peak value indicates maximum crack resistance at this level. A slight drop is observed at 1% fiber addition due to reduced workability. The 28-day curve shows the highest values compared to earlier ages. The graph clearly demonstrates improved tensile capacity with fiber inclusion.

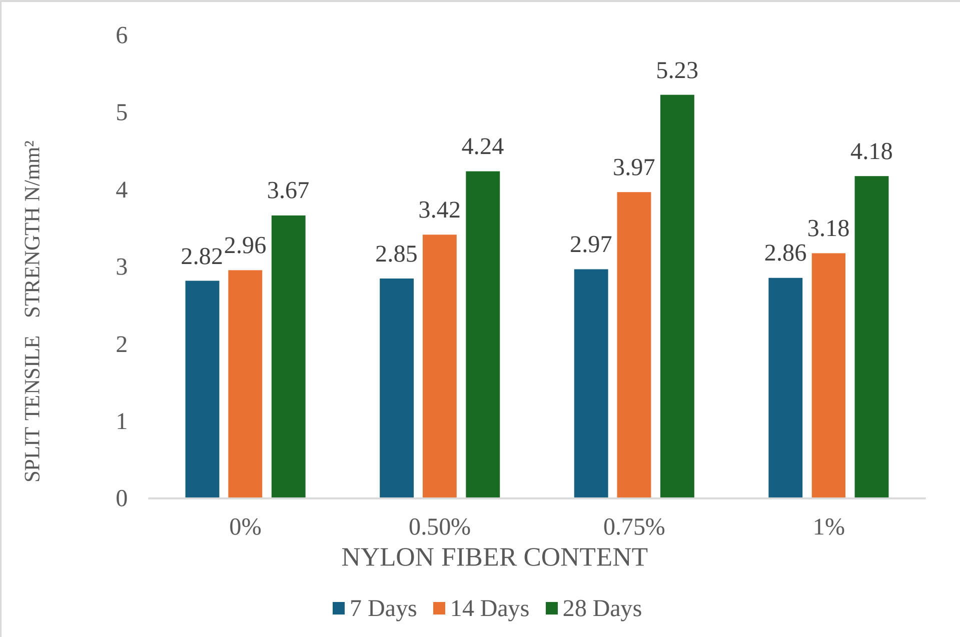


Fig - 4 Split Tensile Strength of M30 Concrete with Varying Nylon Fiber Content

3.2.2.2. SPLIT TENSILE STRENGTH-M30 OUTCOMES & EVALUATION

The M30 tensile strength graph shows higher values compared to M25. The trend remains consistent with a gradual increase up to 0.75%. The peak strength is achieved at this optimum fiber content. A minor reduction is observed at 1%, similar to M25. The curve is steeper, indicating better performance. The 28-day results dominate the graph. The behaviour confirms effective crack control by fibers.

3.2.2.3. COMBINED ANALYSIS

Both concrete classes benefitted from nylon fiber reinforcing, according to a combined evaluation of split tensile strength data. By regulating fracture development and improving stress transport within the concrete matrix, fibers were used to enhance the tensile behavior of concrete.M30 concrete has greater tensile strength values than M25 concrete, despite the fact that both classes showed comparable performance trends. This is mostly because M30 concrete has a stronger cementitious matrix, which improves the bonding between the fibers and the surrounding concrete.0.75% nylon fiber was determined to be the ideal fiber dose in both classes, offering the greatest increase in tensile strength. At this stage, fibers enhanced the concrete's ductility and successfully filled in fissures without materially compromising workability.

3.2.3. FLEXURAL STRENGTH:

The bending resistance of concrete with nylon fiber added was assessed using the flexural strength test. The capacity of concrete to withstand deformation and fracture under bending stresses is known as flexural strength. For structural components like beams, slabs, and pavements, this characteristic is very crucial. A flexural testing equipment was used in this investigation to evaluate beam specimens under two-point stress. Up to collapse, the beam specimen was supported by two supports and subjected to load at two different locations. Tensile stress was applied to the lower part of the beam throughout the test, whilst compressive stress was applied to the top part. Tensile cracking at the beam's bottom surface was typically the cause of failure.

$$\text{FLEXURAL STERNGTH} = PL/bd^2 \quad \ldots\ldots\ldots\ldots (3)$$

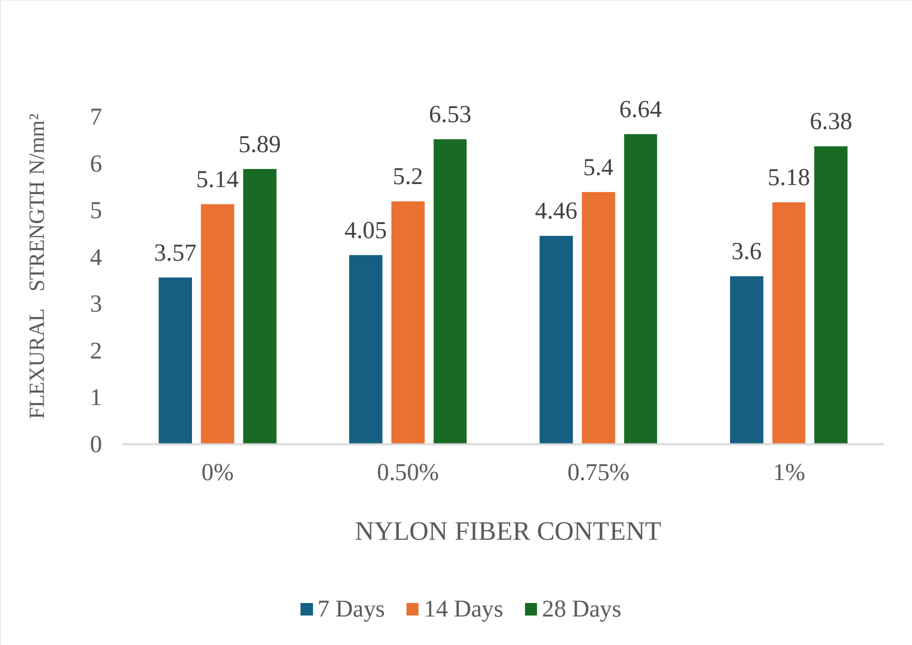
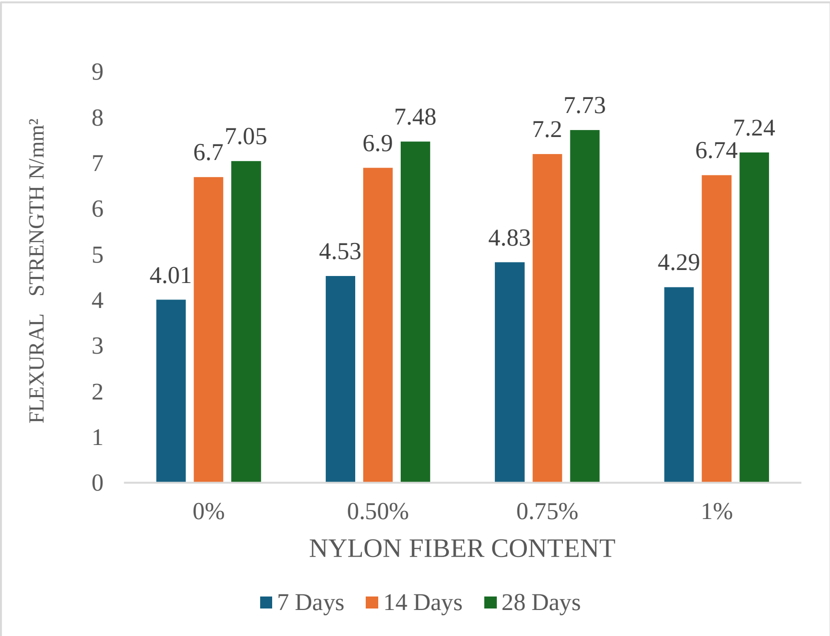


Fig – 5 Flexural Strength of M25 Concrete with Varying Nylon Fiber Content

3.2.3.1. FLEXURAL STRENGTH-M25 OUTCOMES & EVALUATION:

The graph for M25 shows a gradual increase in flexural strength with fiber addition. The control mix lies at the lowest point. The curve rises steadily and reaches a peak at 0.75%. The decline at 1% indicates reduced efficiency. The 28-day results show the highest strength. The trend confirms improved bending resistance. The graph highlights the effectiveness of fiber reinforcement.

Fig -6 Flexural Strength of M30 Concrete with Varying Nylon Fiber Content



3.2.3.2. FLEXURAL STRENGTH-M30 OUTCOME & EVALUATION:

The M30 graph shows higher strength values than M25. The trend remains similar with a peak at 0.75%. The curve is smoother and steeper. A slight decrease is observed at 1% fiber content. The 28-day curve dominates the graph. The results indicate better performance due to denser matrix. The graph confirms improved structural behaviour.

3.2.3.3. COMBINED ANALYSIS

Both M25 and M30 concrete profited from the inclusion of nylon fibers, according to a combined evaluation of flexural strength values. Because fibers primarily aid in resisting tensile loads, the gain in flexural strength was more apparent than the improvement in compressive strength.

M30 concrete outperformed M25 concrete in terms of flexural strength ratings between the two classes. This is mostly because M30 concrete has a stronger matrix structure and a larger cement concentration, which improves the bonding between the nylon fibers and the surrounding concrete. 0.75% nylon fiber was determined to be the ideal fiber dose for both classes, offering the greatest gain in flexural strength without appreciably compromising workability.

3.2.4. WATER ABSORPTION

The purpose of the water absorption test was to assess the durability and permeability properties of concrete that contained nylon fibers. Concrete's capacity to take up moisture through its pore structure is indicated by its water absorption. A denser concrete matrix and improved resistance to water penetration are often indicated by lower absorption levels. Before the test in this investigation, concrete specimens were cured for 28 and 56 days. After the specimens were dried in an oven to eliminate moisture, the original dry weight (W_2) was noted. After the specimens were submerged in water for a predetermined amount of time, the final wet weight (W_2) was determined. The following formula was used to get the percentage of water absorption:

Water absorption = {W2-W1}/{W1} x100 ………….. (4)

Where

(W1) = dry weight of specimen
(W2) = wet weight of specimen after immersion

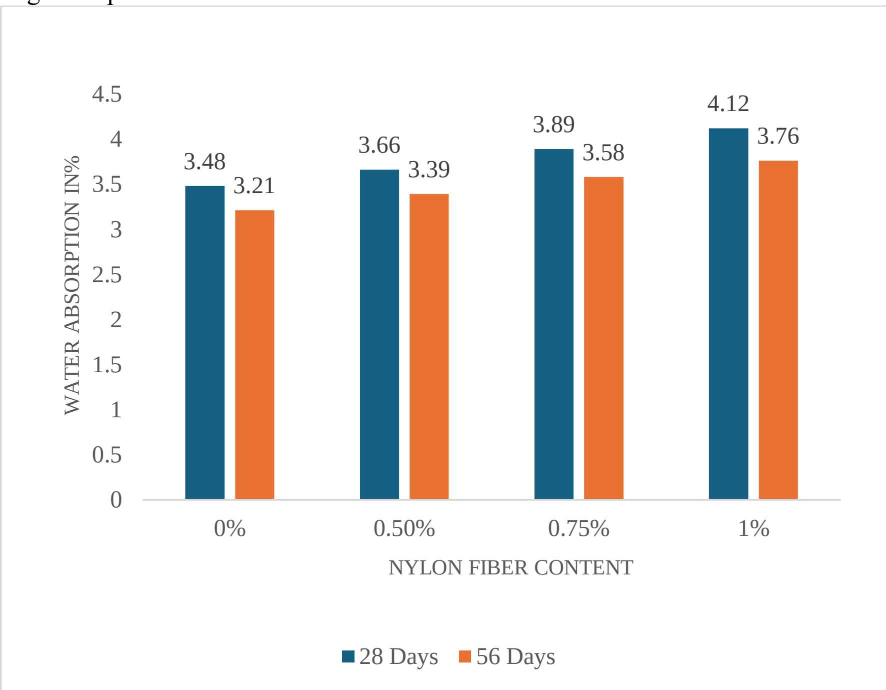


Fig - 7 Water Absorption of M25 Concrete at 28 ,56 Days with Nylon Fiber Content

The water absorption results for M25 grade concrete show a gradual increase with the addition of nylon fibers. The control mix exhibited the lowest absorption due to better workability and compaction. As the fiber content increased to 0.5% and 0.75%, a slight rise in absorption was observed. This increase can be attributed to the formation of micro-voids caused by reduced workability. At 1% fiber content, the absorption value reached its maximum, indicating less dense packing of concrete. However, all values remained within acceptable durability limits. The 56-day results were lower than 28-day values due to continuous hydration and pore refinement. Overall, the results indicate that fiber addition slightly increases water absorption but does not significantly affect durability.

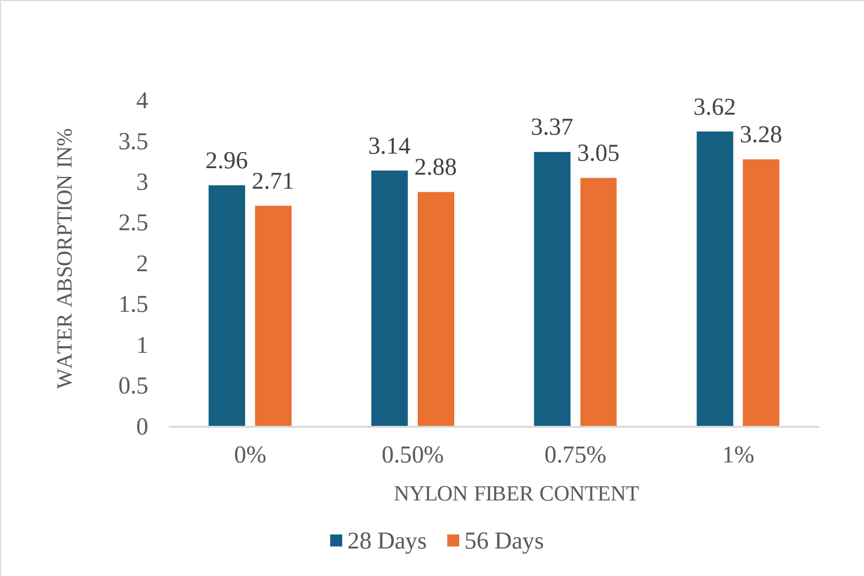


Fig - 8 Water Absorption of M30 Concrete at 28, 56 Days with Nylon Fiber Content

The water absorption behaviour of M30 grade concrete indicates lower absorption values compared to M25 grade. This is mainly due to the denser matrix and higher cement content in M30 concrete. The control mix showed the least absorption, confirming better compaction and reduced porosity. With the addition of nylon fibers, a gradual increase in water absorption was observed. The increase becomes more noticeable at higher fiber contents due to reduced workability. At 1% fiber content, the absorption values were highest but still within permissible limits. The 56-day results showed reduced absorption compared to 28 days, indicating improved hydration over time. Overall, M30 concrete maintains better resistance to water penetration even with fiber inclusion.

3.2.4.1. COMBINED ANALYSIS

The combined analysis of water absorption results for M25 and M30 grades shows a similar increasing trend with fiber addition. In both grades, the control mix recorded the lowest absorption values. As fiber content increased, a slight increase in absorption was observed due to reduced workability and formation of voids. However, the increase remained within acceptable limits for durable concrete. M30 consistently showed lower absorption than M25 due to its denser microstructure. The reduction in absorption at 56 days compared to 28 days indicates continued hydration and improved pore structure. These results suggest that proper compaction can minimize the effect of fibers on permeability. Overall, nylon fiber addition has a minor impact on water absorption and does not compromise durability significantly.

3.2.5. ACID RESISTANCE TEST

The purpose of the acid resistance test was to assess how well concrete would hold up under harsh acidic conditions. M25 and M30 grade concrete specimens with varying nylon fiber percentages (0%, 0.5%, 0.75%, and 1%) were made and allowed to cure for 28 days. The specimens were dried and their initial weights were noted following the curing time. After that, the specimens were submerged in two 5% concentrations of acidic solutions made with distilled water: hydrochloric acid (HCl) and sulfuric acid (H_2SO_4). The specimens were exposed at room temperature for 28 days after being fully immersed in the acid solutions. The acid solution was frequently checked throughout this time to keep the concentration steady. Following the exposure time, the samples were taken out of the acid solution and cleaned with fresh water to get rid of any remaining acid. Following drying, the specimens' ultimate weights were noted.

The following formula was used to compute the % weight loss in order to assess the degradation brought on by acid attack

$$\text{Weight Loss (\%)} = \{W1 - W2\}/\{W1\} X100 \quad \ldots\ldots\ldots\ldots (5)$$

Where,

(W1) = specimen initial weight (g)

(W2)=Total weight following exposure to acid (g)

Reduced weight loss is a sign of enhanced concrete durability and resistance to acid attack.

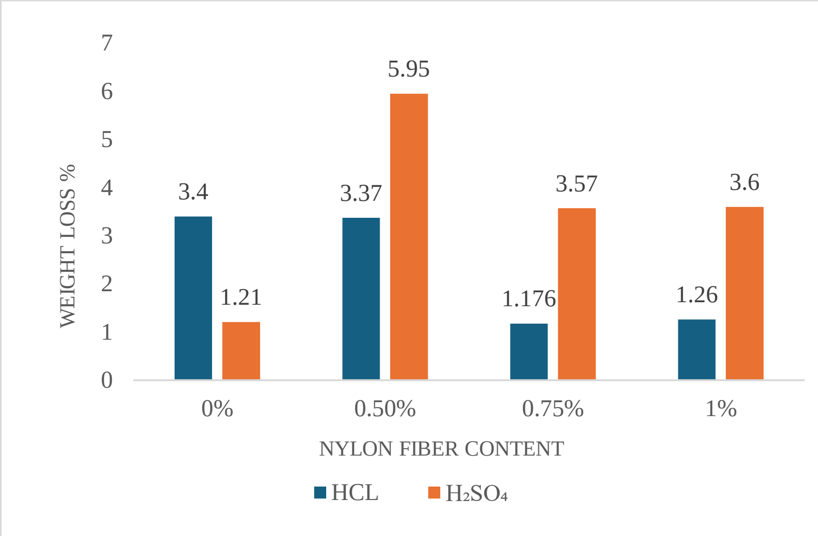


Fig - 9 Acid Resistance of M25 Concrete in HCl, H_2SO_4 Solutions

The acid resistance test results for M25 grade concrete indicate a noticeable reduction in weight loss with fiber addition. The control mix showed the highest weight loss when exposed to both hydrochloric acid and sulfuric acid. This is mainly due to higher permeability and lack of crack resistance. With the addition of nylon fibers, the weight loss gradually decreased up to 0.75% fiber content. This improvement is due to the crack-bridging ability of fibers, which reduces acid penetration. At 1% fiber content, a slight increase in weight loss was observed due to reduced workability and possible void formation. Sulfuric acid caused more severe damage compared to hydrochloric acid due to its aggressive chemical reaction. Overall, fiber reinforcement improved the durability of M25 concrete under acidic conditions.

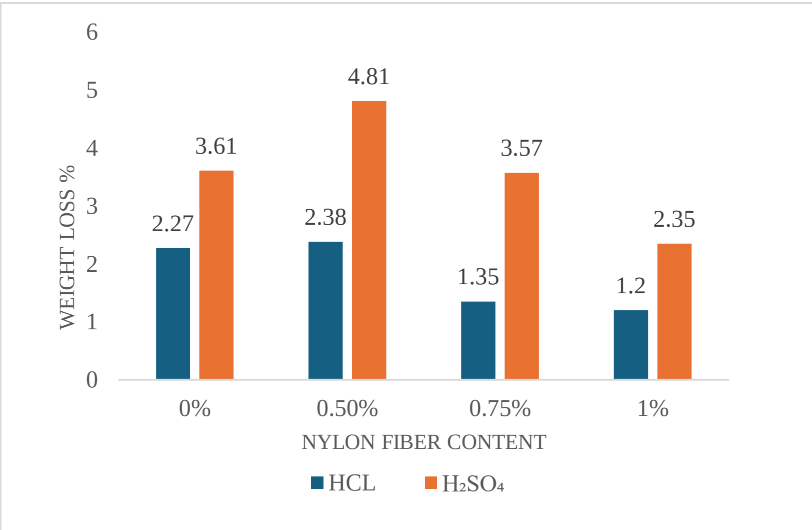
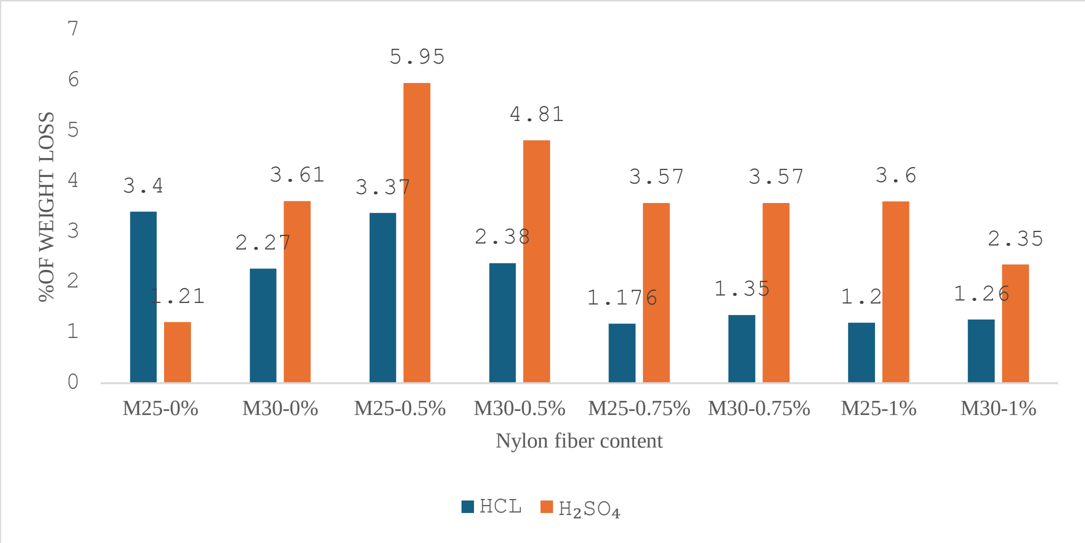


Fig – 10 Acid Resistance of M30 Concrete in HCl, H_2SO_4 Solutions



The acid resistance performance of M30 grade concrete was better compared to M25 grade due to its denser and stronger matrix. The control mix exhibited lower weight loss than M25 but still showed significant degradation under acid exposure. With fiber addition, weight loss reduced steadily up to 0.75% fiber content. This indicates improved resistance to acid attack due to reduced crack formation and permeability. At 1% fiber content, a slight variation in weight loss was observed, which may be due to fiber clustering and reduced compaction. Sulfuric acid caused more damage than hydrochloric acid, similar to M25 results. However, the overall resistance of M30 remained higher. These results confirm that fiber addition enhances durability in higher-grade concrete.

Fig - 11 Comparison of Acid Resistance between M25 and M30 Concrete

The combined analysis of acid resistance results shows that nylon fiber addition significantly improves the durability of concrete. In both M25 and M30 grades, the control mix exhibited higher weight loss due to greater permeability. With increasing fiber content, weight loss decreased up to an optimum level of 0.75%. This is due to the ability of fibers to restrict crack propagation and reduce acid ingress. Beyond this level, a slight increase in weight loss was observed due to reduced workability and uneven fiber distribution. Sulfuric acid caused more severe deterioration compared to hydrochloric acid due to its reaction with cement hydration products. M30 concrete consistently showed better resistance than M25 due to its dense structure. Overall, 0.75% fiber content is optimal for achieving maximum resistance to acid attack.

4.CONCLUSION:

This study investigated the effect of nylon fiber on the mechanical and durability properties of M25 and M30 grade concrete. Fibers were added in different proportions to evaluate their influence on strength, workability, and long-term performance. The results demonstrated that controlled addition of nylon fibers enhances both mechanical properties and durability characteristics when compared to conventional concrete.

The following findings may be made in light of the experimental study conducted on M25 and M30 grade concrete with nylon fiber addition:

1. The addition of nylon fibers improved the overall mechanical performance of concrete compared to conventional mixes.
2. Compressive strength increased with fiber content up to 0.75%, after which a slight reduction occurred due to reduced workability and compaction issues.
3. Split tensile strength showed significant improvement due to better crack control and enhanced tensile resistance provided by the fibers.
4. Flexural strength increased, indicating improved ductility and resistance to bending stresses in concrete members.
5. Water absorption values decreased slightly, suggesting a denser and less permeable concrete structure.
6. Acid resistance improved, as fiber reinforced concrete exhibited lower weight loss compared to normal concrete.
7. The optimum fiber content was found to be 0.75%, providing the best balance between strength and durability.
8. Nylon fibers can be effectively used as secondary reinforcement to enhance crack resistance, durability, and overall structural performance.

The study of fiber-reinforced concrete has wide scope for future research and practical applications. Further investigations can be carried out by using different types of fibers such as steel, glass, and natural fibers to compare performance. Advanced studies can focus on long-term durability, including resistance to extreme environmental conditions like marine exposure and industrial chemicals. The use of hybrid fibers (combination of two or more fibers) can also be explored to achieve better results. Moreover, implementation in large-scale construction projects such as pavements, bridges, and industrial floors can be studied. The development of eco-friendly and sustainable concrete materials using recycled fibers will continue to be an important research direction.

REFERENCES:

1. Sharma, K., Gupta, N., and Mehta, R. (2025). Study on durability properties of nylon fiber reinforced concrete. Construction and Building Materials, 350, 129567.
2. Patel, H., Desai, M., and Joshi, T. (2024). Behavior of nylon fiber reinforced concrete under loading conditions. Materials Today: Proceedings, 68, pp. 245–250.
3. Qureshi, H.J., Ahmad, J., Aljabr, A., and Garcia-Troncoso, N. (2023). Review on characteristics of nylon fiber reinforced concrete. Journal of Engineered Fibers and Fabrics, 18, 1–12.
4. Mohiuddin, M., Nath, A., Ulfat, M., and Chowdhury, S.R. (2022). Mechanical behavior of nylon fiber reinforced concrete. Malaysian Journal of Civil Engineering, 34(3), pp. 45–56.
5. Ahmad, J., Zaid, O., Aslam, F., and Alabduljabbar, H. (2021). Mechanical and durability properties of nylon fiber reinforced concrete. Journal of Engineered Fibers and Fabrics, 16, 1–10.
6. Bheel, N., Tafsirojjaman, T., Liu, Y., and Awoyera, P.O. (2021). Engineering properties of concrete with nylon fibers. Buildings, 11(10), 454.
7. Singh, S., Kumar, R., and Singh, B. (2020). Experimental study on nylon fiber reinforced concrete. International Journal of Civil Engineering and Technology, 11(5), pp. 50–58.
8. Rao, P., Reddy, K., and Kumar, S. (2019). Strength characteristics of fiber reinforced concrete. Journal of Construction Materials, 33(4), pp. 220–228.
9. Khan, M., Ali, M., and Ahmad, S. (2018). Performance of synthetic fiber reinforced concrete. Cement and Concrete Research, 108, pp. 10–18.
10. Gupta, V., Sharma, R., and Singh, D. (2018). Flexural behavior of fiber reinforced concrete. Materials Today: Proceedings, 5(9), pp. 19020–19027.
11. Ali, A., Khan, M., and Raza, S. (2017). Durability of nylon fiber reinforced concrete. Construction and Building Materials, 150, pp. 670–676.
12. Saeed, T., Ahmed, S., and Khan, R. (2017). Shrinkage behavior of fiber reinforced concrete. Engineering Structures, 140, pp. 1–8.
13. Al-Hadithi, A.I., and Hilal, N.N. (2016). Effect of nylon fibers on strength of concrete. Engineering and Technology Journal, 34(3), pp. 123–130.
14. Mazaheripour, H., Ghanbarpour, S., Mirmoradi, S.H., and Hosseinpour, I. (2015). The effect of synthetic fibers on mechanical properties of concrete. Construction and Building Materials, 95, pp. 21–27.
15. Ochi, T., Okubo, S., and Fukui, K. (2007). Development of recycled fiber reinforced concrete. Cement and Concrete Composites, 29(6), pp. 448–455.
16. Song, P.S., Hwang, S., and Sheu, B.C. (2005). Strength properties of nylon fiber reinforced concrete. Cement and Concrete Research, 35(8), pp. 1546–1550.
17. Chen, B., and Liu, J. (2005). Contribution of fibers to mechanical properties of concrete. Construction and Building Materials, 19(7), pp. 532–536.
18. Yao, W., Li, J., and Wu, K. (2003). Mechanical properties of hybrid fiber reinforced concrete. Cement and Concrete Research, 33(10), pp. 1591–1595.
19. Naaman, A.E. (2003). Engineered steel fibers with optimal properties for reinforcement. Journal of Advanced Concrete Technology, 1(3), pp. 241–252.