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Comparative Analysis of Concrete Curing Using the Water Curing Method and the Geotextile Non-Woven Membrane Curing Method and Their Effects on Concrete Compressive Strength

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Abstract: This study compares the effectiveness of conventional water curing and non-woven geotextile membrane curing on concrete compressive strength, an important issue because curing quality strongly influences early hydration and strength development while field constraints often limit continuous water-based curing. A quantitative experimental design was conducted in a controlled laboratory setting using 150 mm concrete cube specimens produced with a standardized mix design; specimens were assigned to either full water immersion or pre-moistened non-woven geotextile membrane curing. Compressive strength data were collected at 7, 14, and 28 days and analyzed descriptively by comparing average strengths and strength development trends between both curing methods. The results show that strength increased with age under both regimes, while membrane curing consistently achieved slightly higher average compressive strength than water curing, with the largest difference at 7 days (28.56 MPa vs. 26.95 MPa) and smaller gaps at 14 days (33.04 MPa vs. 32.58 MPa) and 28 days (38.61 MPa vs. 37.99 MPa). These findings suggest that non-woven geotextile membrane curing can be a practical alternative to water curing, particularly where continuous immersion or water supply is difficult to maintain, because it may provide better early-age moisture retention without compromising later-age strength. The originality of this study lies in presenting direct experimental evidence comparing immersion-based curing and an accessible non-woven geotextile membrane approach across multiple curing ages under consistent specimen production conditions

Keywords: Compressive Strength; Concrete Curing; Membrane Curing; Non-Woven Geotextile; Water Curing.

INTRODUCTION

In many construction contexts particularly in hot, windy, and low-humidity conditions curing remains a critical practical issue because accelerated moisture loss and faster hydration can increase early-age cracking risk and compromise later-age strength and durability if moisture is not adequately retained (National Ready Mixed Concrete Association (NRMCA, 2014). This challenge becomes even more relevant in Indonesia, where Portland Composite Cement (PCC) has been promoted to reduce cement production costs (reported as ~80% clinker and ~20% mineral admixture), yet such blended systems are more dependent on proper and sufficient curing to sustain pozzolanic reactions and strength development (Caronge et al., 2017). At the project level, curing decisions also affect field operations and quality documentation: ASTM distinguishes that standard-cured specimens support acceptance and quality control, whereas field-cured specimens are intended for in-place strength-related decisions (e.g., readiness for service, adequacy of curing/protection, and formwork/shoring removal) (ASTM, 2022) These field realities justify evaluating moisture-retaining alternatives such as nonwoven geotextile membrane curing against conventional water curing to identify curing approaches that remain effective and practical under variable site constraints.

Recent literature indicates that curing duration remains a key driver of compressive strength development, particularly when moisture availability varies during early hydration. Studies that explicitly vary curing time (e.g., 7–14–28 days) show that compressive strength evolves markedly with curing age and exposure history, suggesting that inadequate moist curing can shift the strength trajectory even when the target mix strength is the same (Sariman, 2023). Beyond duration alone, evidence also shows that curing conditions (e.g., air curing versus controlled moist/temperature regimes) can either accelerate early-age strength or compromise later-age performance depending on the concrete's temperature–moisture history (Wang, 2023). A recent systematic review further highlights that while conventional water curing is effective, it can be constrained by time and water demand, motivating practical alternatives and careful selection of curing duration under real project constraints (Haigh & Ameri Sianaki, 2025). However, direct, controlled comparisons between immersion water curing and nonwoven geotextile membrane curing under identical mix designs and local materials are still limited, which justifies the need for the present study.

Recent studies on nonwoven geotextiles provide a scientific basis for using them as moisture-retaining coverings (i.e., membrane/wet-cover curing) because their performance is strongly governed by water retention, wicking/unsaturated flow behavior, and structural parameters (Jarjour et al., 2024, 2025). Research in civil and geotechnical contexts shows that nonwoven geotextile functionality depends on fabric structure (e.g., fiber arrangement, mass, and filtration–separation behavior), which indirectly matters for curing because it influences how effectively the fabric can hold and redistribute water over time (Bezgovšek et al., 2020). Complementary work also highlights that mechanical robustness (e.g., puncture resistance) is sensitive to manufacturing/structure, which is relevant to field curing practicality where coverings can be damaged during placement or site activity

(Dehghan-Banadaki et al., 2022). Importantly, concrete-focused innovation has emerged in the form of curing blankets incorporating superabsorbent polymers (SAPs) within layered systems that include nonwoven geotextile, designed to improve moisture availability, reduce surface cracking, and enhance concrete surface quality especially under hot-climate exposure (Kafiah et al., 2025). However, a key limitation across this body of literature is that most nonwoven geotextile studies emphasize material characterization or non-curing applications, while the SAP-blanket approach represents a specialized system rather than the common "pre-wetted geotextile wrap" practice; consequently, direct experimental comparisons between conventional immersion water curing and nonwoven geotextile membrane curing under the same concrete mix design, standardized ages (e.g., 7–14–28 days), and clearly reported fabric specifications (GSM/thickness) plus moisture-maintenance protocols remain limited. This gap motivates the present study to test nonwoven geotextile membrane curing as a practical alternative under realistic construction constraints.

Recent practice distinguishes standard-cured specimens (typically used for acceptance/quality benchmarks) from field-cured specimens, which are intended to reflect the actual temperature–moisture history experienced by concrete in the structure and therefore support decisions such as formwork removal or early-age strength estimation (ASTM International, 2025). In line with this, recent studies show that environmental variability (seasonal temperature/humidity and curing protection on site) can create a meaningful gap between laboratory cylinder strengths and in-situ structural strength, highlighting that "equivalent age" does not always mean "equivalent curing history" (Jeong & Lee, 2025). Practical research has therefore explored field-curing methods to better reproduce in-place curing conditions for strength evaluation (Solanki & Xie, 2025). In parallel, many researchers also advance alternative strength-estimation approaches including maturity-based estimation for early-age strength under challenging climates and improved NDT-to-strength conversion models (e.g., probabilistic / copula-based approaches) to reduce uncertainty in field strength prediction (Tao et al., 2025; Yan et al., 2020).

In line with the title, this study aims to conduct a comparative analysis of two curing approaches immersion water curing and geotextile non-woven membrane curing (pre-wetted nonwoven covering) and to quantify their effects on concrete compressive strength development at 7, 14, and 28 days under the same mix design and testing procedure. By providing controlled, age-based strength comparisons, the study is intended to support practical selection of curing methods, particularly where maintaining continuous water curing is difficult and moisture-retaining coverings are considered as an alternative

Based on the understanding that curing quality controls moisture availability and the continuity of cement hydration, this study hypothesizes that geotextile non-woven membrane curing (using a pre-wetted covering) will produce compressive strength that is comparable to or slightly higher than immersion water curing, particularly at early ages, because the membrane is expected to reduce surface evaporation and maintain a more stable moisture environment around the specimen. It is further expected that any strength difference between the two methods will be more pronounced at 7 days and will gradually diminish by 28 days as hydration progresses and the strength development of both curing regimes approaches a similar level.

RESEARCH METHOD

Unit of Analysis

The unit of analysis was the compressive strength of concrete measured on 150 mm × 150 mm × 150 mm cube specimens. A total of 18 cubes were produced and divided into two curing treatments water curing (WC) and nonwoven geotextile membrane curing (MC) and tested at 7, 14, and 28 days, with three specimens per curing method at each age (2 curing methods × 3 ages × 3 replicates = 18 specimens).

Research Design

This research employed a quantitative experimental laboratory design to objectively compare the effect of curing method on compressive strength under controlled conditions. A certified concrete laboratory environment was selected to ensure consistency in (i) material characterization, (ii) mix proportioning and moisture correction, (iii) specimen preparation, (iv) curing execution, and (v) compressive strength testing, thereby enabling a fair comparison between water curing and geotextile membrane curing.

Data/Information Sources

Primary data were generated from laboratory testing and included: (1) fine and coarse aggregate properties, obtained from specific gravity and absorption tests (fine and coarse aggregates), moisture content tests, and sieve/gradation analyses, conducted in accordance with relevant SNI/ASTM provisions (e.g., SNI 1969:2016; ASTM C33; SNI 1971:2011; SNI ASTM C136:2012); (2) mix design parameters, calculated using the national mix design guideline SNI 03-2834-2000, including moisture correction for water and aggregate masses; (3) fresh concrete workability, measured using a slump test; and (4) compressive strength test outputs (maximum load at failure) recorded from a calibrated compression testing machine for each cube at each test age.

Data Collection Techniques

Material characterization was carried out first to confirm aggregate suitability and to provide inputs for mix design and moisture correction. The concrete mix proportions were determined following SNI 03-2834-2000, with theoretical requirements per 1 m^3 and then adjusted using measured moisture and absorption values to obtain corrected quantities (e.g., corrected water content and corrected aggregate masses). The final corrected mix corresponded to a water–cement ratio of approximately 0.52 (by mass relative to cement), and batching quantities were scaled to cast 18 cube specimens, with an additional 10% allowance applied to prevent material shortage during casting. Mixing was performed using a mechanical mixer until a uniform and workable mixture was achieved, followed by a slump test to verify consistency prior to casting. Fresh concrete was cast into 150 mm cube molds, compacted to expel entrapped air, and allowed to set before demolding. After demolding, specimens were assigned to curing treatments: WC specimens were fully submerged in a curing tank, while MC specimens were wrapped with pre-moistened nonwoven geotextile to retain moisture. During curing, the water level in the curing tank was maintained, and the geotextile wraps were periodically inspected and re-moistened as necessary to ensure consistent moisture retention throughout the curing period.

Data Analysis

For each specimen, compressive strength was calculated from the recorded failure load divided by the cube cross-sectional area (150 mm × 150 mm = 225 cm^2), and results were expressed in MPa. The data were tabulated by curing method and age, and the mean compressive strength was computed for each group (WC and MC at 7, 14, and 28 days). To quantify the effect of curing method, the percentage difference in average strength between MC and WC was calculated at each age. Results were presented using tables and a trend graph to compare strength development over time for both curing methods.

RESULT AND DISCUSSION

Fine and Coarse Aggregate Characterization

This subsection presents the initial evidence that the aggregates used in this study were suitable for producing concrete specimens for curing comparison. For the fine aggregate, the saturated surface-dry (SSD) specific gravity was 2.6 g/cm³, the absorption was 3.6%, and the moisture content was 4.22%. The fine aggregate gradation analysis indicated that the sand gradation falls within Zone II. For the coarse aggregate (maximum size 20 mm), the specific gravity was 2.7 g/cm³, absorption was 1.86%, moisture content was 1.83%, and the fineness modulus was 6.99.

To verify that the fine aggregate meets the targeted gradation zone, the research percentage passing values are compared with Zone I–IV limits in Table 1. This table is followed by the gradation curve in Figure 1 to provide a clearer visual confirmation.

Table 1. Fine Aggregate Gradation Test

Sieve Size (mm)	Percentage Passing (%)	Zone I	Zone II	Zone III	Zone IV	Research Results (%)
9.5	100	100	100	100	100	100
4.75	90–100	90–100	90–100	90–100	95–100	99.68
2.36	60–95	75–100	85–100	95–100	93.38	93.38
1.18	30–70	55–90	75–100	90–100	76.07	76.07
0.6	15–34	35–59	60–79	80–100	51.83	51.83
0.3	5–20	8–30	12–40	15–50	30.73	30.73
0.15	0–10	0–10	0–10	0–15	9.42	9.42

To complement the tabulated results, the gradation trend is visualized as a curve in Figure 1, which helps readers see how the distribution of particle sizes aligns with the gradation limits across the sieve range.

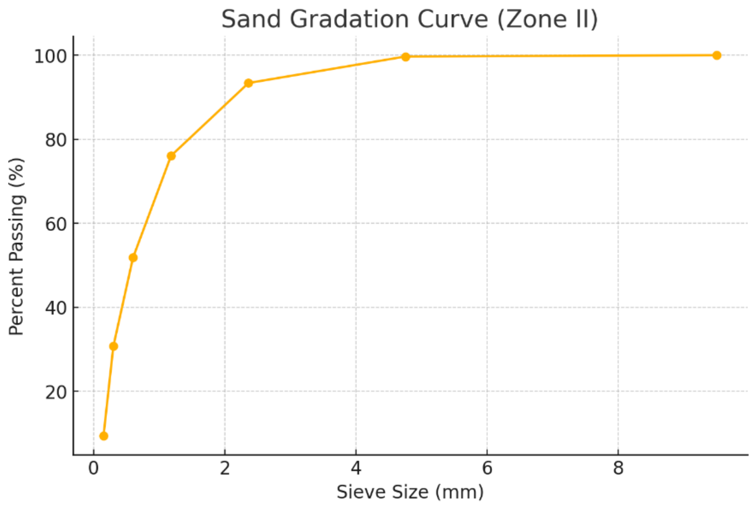

Figure 1. Sand Gradation Test Results

After reviewing Table 1 and Figure 1, the fine aggregate gradation is consistently classified as Zone II, indicating suitable particle distribution for this experiment. Overall, both fine and coarse aggregates meet the basic requirements for normal concrete: specific gravity values exceed 2.5 g/cm³ and absorption remains within acceptable limits (fine 3.6%, coarse 1.86%). A clear pattern is that the fine aggregate shows higher absorption and moisture content (4.22%) than the coarse aggregate (1.83%), which highlights the need for moisture correction to stabilize the effective water condition during batching. These results provide a reliable baseline for the curing comparison, so subsequent differences in compressive strength can be attributed more confidently to curing performance rather than to aggregate quality variability.

Mix Design, Moisture Correction, and Workability

This subsection reports evidence that the concrete was produced using a systematic and controlled mix design procedure. Based on the selected mix design method, the theoretical material requirement for 1 m³ of concrete was established as: water 205 L, cement 386.79 kg, sand 748.33 kg/m³, and gravel 1054.88 kg/m³, resulting in an estimated fresh concrete unit weight of 2395 kg/m³. Because the aggregates contained moisture and had measurable absorption, moisture correction was applied, producing corrected values of water 201.6 L, fine aggregate 749.68 kg, and coarse aggregate 1056.89 kg, while cement remained fixed at 386.79 kg.

For specimen production, each cube had a dimension of 15 cm × 15 cm × 15 cm with a volume of 0.003375 m³. A total of 18 cubes required an estimated fresh volume of 0.0607 m³. The scaled quantities were then increased by 10% to prevent material shortage during casting. Workability was evaluated using the slump test, yielding slump values of 11.6 cm and 11.4 cm, which fall within the planned slump range (8–16 cm).

Table 2. Material Data for Mix Design Correction

Notation	Weight	Unit
B1	386.79	kg
B2	205	L
B3	748.33	kg
B4	1054.88	kg
Cm	3.42	%
Ca	3.6	%
Dm	1.67	%
Da	1.86	%

Table 3. Additional Material Requirement (10% Increase)

Material	Initial Quantity	+10% Adjustment	Final Quantity
Water	13.51 L	+1.35 L	**14.86 L**
Cement	25.92 kg	+2.59 kg	**28.51 kg**
Sand	50.23 kg	+5.02 kg	**55.25 kg**
Gravel	70.81 kg	+7.08 kg	**77.89 kg**

Table 4. Material Ratio Relative to Cement

Material	Ratio
Water	0.52
Cement	1
Sand	1.93
Gravel	2.73

Table 5. Slump Test Results

No.	Planned Slump (cm)	Slump Value (cm)	Average (cm)
1	8–16	11.6	11.9
2	8–16	11.4	

In summary, the theoretical mix design was corrected to account for actual aggregate moisture and absorption, resulting in a slightly lower effective water content and adjusted aggregate quantities to keep the mixture consistent. The batching plan for 18 cube specimens was scaled by volume and supplemented with a 10% reserve to prevent material shortages during casting.

The slump results confirm that the fresh concrete achieved stable workability within the planned range, indicating comparable mixing and placement conditions across specimens. Taken together, these results show that batching and workability were controlled, so later differences in compressive strength can be interpreted more confidently as the effect of the curing method; the next subsection therefore reports strength development at 7, 14, and 28 days for both curing treatments.

Compressive Strength under Water Curing vs Non-woven Geotextile Membrane Curing

As presented in Tables 6–8 and summarized in Table 9 and Figure 2, the compressive strength increased with age for both curing methods from 7 to 28 days. Compressive strength testing was conducted at 7, 14, and 28 days. Each curing method used three cube specimens per testing age, and the reported cube cross-sectional area was 225 cm². For water curing (WC), the average compressive strengths were 26.95 MPa (7 days), 32.58 MPa (14 days), and 37.99 MPa (28 days). For membrane curing (MC) using pre-moistened nonwoven geotextile, the average compressive strengths were 28.56 MPa (7 days), 33.04 MPa (14 days), and 38.61 MPa (28 days).

Table 6. Compressive Strength Test Results at 7 Days

No	Specimen Code	Age (Days)	Cross-sectional Area (cm²)	Concrete Weight (kg)	Load Received (kN)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
1	BN WC 1	7	225	8.08	646	28.71	
2	BN WC 2	7	225	7.92	557	24.76	**26.95**
3	BN WC 3	7	225	8.31	616	27.38	
4	BN MC 1	7	225	8.11	676	30.04	
5	BN MC 2	7	225	8.08	628	27.91	**28.56**
6	BN MC 3	7	225	8.27	624	27.73	

Table 7. Compressive Strength Test Results at 14 Days

No	Specimen Code	Age (Days)	Cross-Sectional Area (cm²)	Concrete Weight (kg)	Load Received (kN)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
1	BN WC 1	14	225	8.22	703	31.24	
2	BN WC 2	14	225	8.15	710	31.55	**32.58**
3	BN WC 3	14	225	8.11	741	32.95	
4	BN MC 1	14	225	7.95	746	33.17	
5	BN MC 2	14	225	7.91	728	32.36	**33.04**
6	BN MC 3	14	225	8.08	744	33.58	

Table 8. Compressive Strength Test Results at 28 Days

No	Specimen Code	Age (Days)	Cross-Sectional Area (cm²)	Concret e Weight (kg)	Load Received (kN)	Compressiv e Strength (MPa)	Average Compressive Strength (MPa)
1	BN WC 1	28	225	8.37	794	35.28	
2	BN WC 2	28	225	8.34	859	38.17	**37.99**
3	BN WC 3	28	225	8.29	884	40.5	
4	BN MC 1	28	225	8.13	890	40.77	
5	BN MC 2	28	225	8.16	812	37.17	**38.61**
6	BN MC 3	28	225	8.2	862	38.54	

Table 9. Recapitulation of Compressive Strength Test Results

No	Curing Method	Age	Stress (MPa)
1	Water Curing	7 Days	26.95
2	Membrane Curing	7 Days	28.56
3	Water Curing	14 Days	32.58

4	Membrane Curing	14 Days	33.04
5	Water Curing	28 Days	37.99
6	Membrane Curing	28 Days	38.61

To emphasize the overall strength-development trend, the average values from Table 9 are plotted in Figure 2.

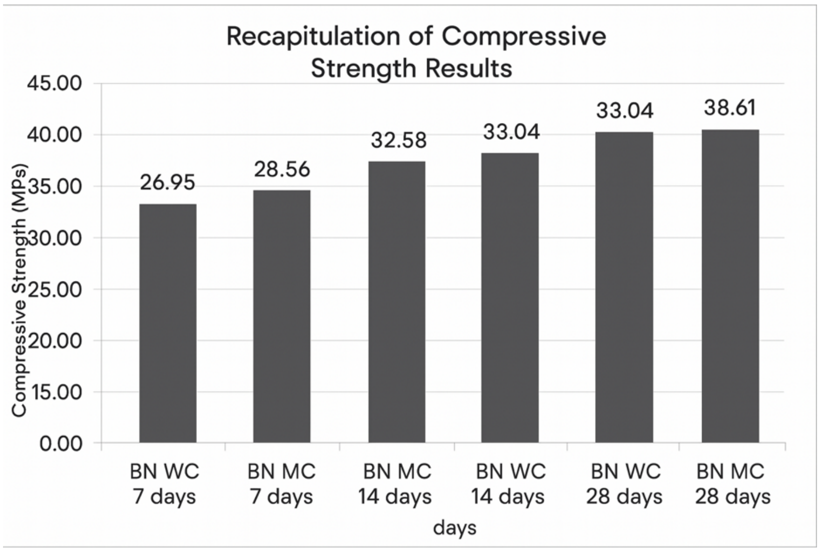

Figure 2. Recapitulation of Average Compressive Strength Results

Overall, both curing methods produced the expected pattern of increasing compressive strength as concrete age progressed from 7 to 14 and 28 days. However, at each testing age, the average compressive strength for specimens treated with nonwoven geotextile membrane curing remained slightly higher than that of specimens under water curing. The difference was most apparent at 7 days, where membrane curing achieved 28.56 MPa compared with 26.95 MPa for water curing. At 14 and 28 days, membrane curing continued to show higher values (33.04 MPa and 38.61 MPa), while the gap between the two methods became smaller as the concrete matured.

Three notable tendencies can be observed from the strength results. First, both curing regimes supported continuous strength development across the three ages, indicating ongoing hydration and normal strength gain behavior. Second, membrane curing maintained a consistent advantage over water curing at each age, suggesting that the method did not hinder hydration and may provide a slightly more favorable moisture condition. Third, the strength difference between methods decreased over time, implying that curing conditions may have a stronger influence during early hydration, while later-age strength becomes increasingly governed by overall hydration maturity.

The consistent strength advantage observed under membrane curing indicates that pre-moistened nonwoven geotextile can maintain surface moisture effectively enough to support hydration and compressive strength development at least as well as immersion-based water curing, and slightly better in this dataset. The larger difference at 7 days suggests that moisture retention and reduced evaporation may be particularly beneficial during early-age strength development when concrete is most sensitive to drying. As the concrete approaches 28 days, the smaller difference implies that both curing methods ultimately support comparable long-term hydration progress. Practically, this result suggests that nonwoven geotextile membrane curing can serve as a viable alternative method, especially where continuous water immersion is difficult to maintain.

In summary, the Results section demonstrates that the materials and fresh mix conditions were controlled, and that membrane curing produced slightly higher compressive strength at each age. The Discussion section will further examine why this pattern may occur, how it aligns with prior findings, and what practical implications it provides for curing selection under field constraints.

Discussion

This study examined how water curing (immersion) and non-woven geotextile membrane curing affect concrete compressive strength **at** 7, 14, and 28 days. The results show a normal strength-gain pattern for both methods as the concrete matured, but the membrane-cured specimens consistently achieved slightly higher average strengths at every age. The difference was most noticeable at 7 days (about 1.61 MPa higher), then became smaller at 14 days (about 0.46 MPa) and 28 days (about 0.62 MPa), indicating that the influence of curing was strongest during early-age strength development.

A reasonable explanation for this trend is tied to moisture retention and early hydration stability. Early-age concrete is highly sensitive to moisture loss; rapid evaporation can reduce the availability of water for hydration and may promote microcracking at the surface zone, which can suppress early compressive strength. A pre-moistened nonwoven geotextile wrap functions as a localized moisture reservoir and reduces evaporation, helping maintain a more uniform near-surface humidity condition. This more stable moisture environment can support hydration continuity and produce a denser microstructure sooner, which is consistent with the general principle that curing primarily protects hydration by controlling moisture and temperature exposure (Neville, 2011).

When compared with previous studies, the present findings align with research reporting that curing regimes meaningfully affect strength development, and that membrane-based approaches can be effective if they successfully limit moisture loss. For instance, work comparing water curing and membrane curing has also reported measurable differences in compressive strength, emphasizing the importance of curing effectiveness rather than the label of the method itself (Fernando et al., 2023). In addition, studies on curing duration and hydration continuity highlight that adequate moist conditions are essential to sustain cement reactions and strength development, particularly when cement systems require continued hydration over time (Caronge et al., 2017). The novelty of this study lies in providing a direct, age-by-age comparison between immersion curing and nonwoven geotextile membrane curing using the same mix design, specimen geometry, and controlled laboratory procedures, allowing the observed strength differences to be interpreted more specifically as curing effects.

Beyond technical performance, the findings carry practical implications for construction environments where curing must be feasible and resource-efficient. In many field situations, continuous immersion curing is difficult due to limited water access, labor constraints, and logistical challenges. Demonstrating that nonwoven geotextile membrane curing can deliver comparable and slightly improved strength development suggests a viable pathway to maintain concrete quality while potentially reducing water demand. In that sense, this study contributes to broader understanding of curing selection as not only a laboratory variable, but also a site-management decision with implications for productivity, resource use, and construction reliability (Patah et al., 2022).

A balanced reflection is necessary. The functional advantage of membrane curing is its practicality: it can be implemented where water curing is hard to sustain and may better protect the surface from evaporation-driven early-age disturbance. However, its disfunction risk is execution sensitivity if the geotextile is not kept adequately moist, if coverage is uneven, or if exposure conditions (heat/wind) are not controlled, the intended moisture-retention benefit may decline and results could become inconsistent. In contrast, immersion curing is typically robust in maintaining moisture but may be less realistic in many project settings. These considerations suggest that the “best” curing method depends on both performance and field controllability.

Based on the results, a clear action plan is recommended for practice and specification. Projects considering nonwoven geotextile membrane curing should adopt a simple standard procedure: pre-wet the geotextile to a saturated condition, ensure full contact coverage, maintain a defined inspection and re-wetting schedule, and use protective outer covering (e.g., plastic sheeting) under hot or windy conditions to reduce evaporation. For policy at the project level, curing requirements should be written explicitly in method statements and quality plans, including documentation of curing maintenance checks. For further improvement, future work should validate these findings under field exposure (varying temperature, wind, and sunlight) and evaluate durability indicators (e.g., sorptivity or surface cracking) so that curing selection can be supported not only by compressive strength but also by long-term

CONCLUSION

This study confirms that curing method plays a critical role in concrete compressive strength development, and both curing regimes produced the expected trend of increasing strength from 7 to 14 and 28 days. However, at every testing age, concrete treated with non-woven geotextile membrane curing achieved a slightly higher average compressive strength than concrete under water curing, with the most noticeable difference occurring at the early age (7 days) and a smaller gap at 14 and 28 days. The main takeaway is that moisture control during the early curing period can be particularly influential for early strength gain, whereas later-age strength tends to converge as hydration progresses.

The scientific contribution of this research lies in providing direct comparative evidence between conventional water curing and a non-woven geotextile membrane curing approach across multiple ages, under consistent specimen production and compressive testing procedures. The results add empirical support that non-woven geotextile membrane curing can function as a practical alternative to immersion-based curing, especially when the goal is to maintain surface moisture effectively without requiring continuous water immersion. This evidence may also serve as a preliminary reference for selecting curing methods under site constraints such as limited water availability or operational limitations.

This study is limited by its scope, which includes a single mix design, one specimen geometry, a relatively small number of specimens, and performance evaluation focused primarily on compressive strength at 7–28 days. It also does not yet represent broader field variability (e.g., hot weather, wind, direct sunlight) or durability-related indicators such as surface cracking, sorptivity, permeability, or long-term strength. Future research should expand mixture variations and environmental conditions, increase sample size, and include durability parameters so that curing recommendations are supported not only by compressive strength outcomes but also by long-term performance considerations.

REFERENCES

(NRMCA), N. R. M. C. A. (2014). *Fundamentals of quality concrete*. NRMCA.

ASTM. (2022). *ASTM standards on concrete testing and curing*. ASTM International.

Bezgovšek, Š. et al. (2020). Influence of structural parameters of nonwoven geotextiles on separation and filtration in road construction. *Autex Research Journal*, *20*(4), 449–460. https://doi.org/10.2478/aut-2019-0038

Caronge, M. A. et al. (2017). Effect of water curing duration on strength behaviour of Portland composite cement (PCC) mortar. *IOP Conference Series: Materials Science and Engineering*, *271*(1), 12018. https://doi.org/10.1088/1757-899X/271/1/012018

Dehghan-Banadaki, Z. et al. (2022). Dynamic puncture behavior of the calendered geotextile compound fabrics: optimization using the Taguchi design of experiment. *Journal of the Textile Institute*, *113*(3), 388–395. https://doi.org/10.1080/00405000.2021.1883234

Haigh, R., & Ameri Sianaki, A. (2025). Traditional and advanced curing strategies for concrete. *Applied Sciences*, *15*(20), 11055. https://doi.org/10.3390/app152011055

Jarjour, J. et al. (2024). Water retention characterization of non-woven geotextiles: An application for wicking materials. *E3S Web of Conferences*, *569*. https://doi.org/10.1051/e3sconf/202456912003

Jarjour, J. et al. (2025). Experimental and numerical investigation of the unsaturated behavior of conventional and wicking non-woven geotextiles. *Geotextiles and Geomembranes*, *53*(6), 1544–1557. https://doi.org/10.1016/j.geotexmem.2025.08.001

Jeong, M.-G., & Lee, H.-S. (2025). Experimental Study on the Estimation of Structural Strength Correction for Concrete Using Ordinary Portland Cement. *Buildings*, *15*(20). https://doi.org/10.3390/buildings15203642

Kafiah, F. et al. (2025). Design and Application of Concrete Curing Blankets with Infused Water Super Absorbent Polymers (SAPs). *World Congress on Civil, Structural, and Environmental Engineering*. https://doi.org/10.11159/icsect25.135

Sariman, S. (2023). Parameters of compressive strength of PCC concrete. *Jurnal Penelitian Fisika Dan Aplikasinya*.

Solanki, P., & Xie, H. (2025). Field-Curing Methods for Evaluating the Strength of Concrete Test Specimens. *Transportation Research Record*, *2679*(7), 124–139. https://doi.org/10.1177/03611981251324192

Tao, J. et al. (2025). Copula-based full probability conversion model for estimating concrete compressive strength. *Construction and Building Materials*, *504*. https://doi.org/10.1016/j.conbuildmat.2025.144555

Wang, L. (2023). Effect of curing regime on mechanical properties and durability of concrete. *Buildings*, *13*(7), 1697. https://doi.org/10.3390/buildings13071697

Yan, J. et al. (2020). Comparison of evaluation tests for compressive strength of structural concrete. *Periodica Polytechnica Civil Engineering*, *64*(2), 387–395. https://doi.org/10.3311/PPci.12545