2026, Volume 06, No 01, pp.131-148, p-ISSN 2807-9450 e-ISSN 2808-4284

Jurnal Pendidikan Teknik Bangunan

Journal homepage: https://ejournal.upi.edu/index.php/JPTB

Analysis of Quality Control for Ready-Mix Concrete in the BKPSDM Building Construction Project

Ega Purwanti[1], Sri Rahayu[2]*

[1,2]Building Engineering Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

[1]egapurwanti32@upi.edu, [2*]srirahayu@upi.edu

ABSTRACT

This study aims to evaluate the quality and consistency of ready-mix concrete based on compressive strength test results from the Personnel and Human Resources Development Agency (BKPSDM) Building construction project in Bandung Regency. A quantitative descriptive approach was employed using secondary data obtained from laboratory testing. A total of 28 cylindrical concrete specimens (150 mm × 300 mm) with a design strength of fc' 25 MPa (K-300) were tested at the ages of 14 and 28 days in accordance with SNI 1974. The results indicate that the average compressive strength at 28 days reached 303.89 kgf/cm², which exceeds the specified design strength. However, a significant variation in compressive strength was observed, ranging from 189.32 kgf/cm² to 424.60 kgf/cm². Statistical analysis shows a standard deviation of 67.52 kgf/cm² and a coefficient of variation (CV) of 22.23%, indicating low consistency in concrete quality. Furthermore, only 64.29% of the test specimens met the design strength requirement, suggesting that a considerable proportion of the concrete did not comply with the specified standard. Control chart analysis reveals that all data points remain within statistical control limits, indicating that the process is stable. Nevertheless, the relatively high variability suggests that the process is not yet capable of producing consistent concrete quality. These findings imply that while the average compressive strength satisfies the design requirement, the overall quality consistency has not been achieved. Therefore, improvements in quality control are necessary, particularly in transportation, casting, and curing processes, to ensure more uniform and reliable concrete performance.

ARTICLE INFO

Article History:
Submitted 26 Maret 2026
First Revised 28 Maret 2026
Accepted 29 April 2026
Available Online 30 April 2026
Publication Date 30 April 2026

Keywords:
Concrete compressive strength; Concrete compression test;Concrete quality; Quality control; Ready-mix concrete

1. INTRODUCTION

Concrete is a crucial material in building construction due to its high durability, ease of shaping, and ability to withstand structural loads. In (SNI-2847, 2019) established requirements regarding materials, planning, execution, and quality control of concrete to ensure the safety and reliability of building structures. Ready-mix concrete is a type of concrete frequently used in building construction because its quality is more assured, the construction process is faster, and it is easy to transport and pour. Consequently, this concrete has become a crucial component in structural construction. The quality of concrete expected from the use of ready-mix concrete must be consistent and meet the technical requirements established in the structural design. Concrete quality affects the strength, safety, and durability of a building. One key aspect in evaluating concrete quality is the concrete compressive strength (fc). If the concrete does not meet standards, this can reduce the structure's load- bearing capacity, increase the potential for damage, and pose a risk to the overall safety of the building. Therefore, testing concrete compressive strength is a critical part of concrete quality control in construction projects. This testing is conducted in a laboratory in accordance with current procedures and standards, and the results are used to determine whether the concrete meets the specified requirements (fc). Concrete compressive strength testing is also vital for detecting inconsistencies in concrete quality, which can be caused by various factors such as transportation duration, the casting process, and on-site curing. Concrete compressive strength test results provide an indication of the concrete quality in the project.

Previous studies have consistently shown that concrete compressive strength test results are a key parameter in assessing the quality of ready-mix concrete. According to (Mulyati, 2025), concrete compressive strength serves as the most direct indicator for ensuring that the concrete meets the project's technical specifications. This finding aligns with (Setiadi et al., 2024), who emphasize that compressive strength analysis of structural elements such as columns, beams, and slabs is a critical step in evaluating concrete quality during the construction process. Additionally, (Yusuf et al.,. 2025) note that comparing actual compressive strength test results with design specifications is a crucial step in concrete quality control. Other studies further underscore the importance of compressive strength testing in quality control. Evaluating the quality of concrete from various ready-mix sources can be effectively achieved through periodic compressive strength testing, as the consistency of compressive strength results plays a crucial role in ensuring compliance with technical standards. In addition, the quality of ready-mix concrete is influenced by various production and execution factors, making compressive strength testing essential for verifying actual concrete quality in the field (Nurokhman et al., 2021; Arman et al., 2025; Suri et al., 2024).

Furthermore, research conducted by (Nanda et al., 2024) at a batching plant in Surabaya demonstrated that variations in concrete quality can be identified through compressive strength analysis as part of quality monitoring. Similarly, (Skrzypczak et al., 2021) emphasized that inter-laboratory compressive strength testing is essential for maintaining

DOI : https://doi.org/10.17509/jptb.v6i1 p-ISSN 2807-9450 e-ISSN 2808-4284

the consistency of ready-mix concrete quality across different projects. In (Rahman, 2022) further highlighted that accurate structural concrete strength calculations based on SNI standards are necessary to ensure that design decisions correspond with expected field performance. In addition, (Mahardika, 2025) found that variations in water ratios and curing processes significantly affect the compressive strength of industrially produced mortar, indicating that production variables must be carefully controlled to achieve consistent material performance. Collectively, these studies demonstrate that both design accuracy and production consistency are fundamental aspects of concrete quality assurance, supporting the necessity of compressive strength testing in evaluating compliance with technical and performance standards.

Ready-mix concrete is used as the primary material in the structural work of the Personnel and Human Resources Development Agency (BKPSDM) building in Bandung Regency. The quality of the concrete is critical because it plays a direct role in supporting the building's load. In building construction projects, the main challenge in controlling the quality of ready-mix concrete is ensuring that the concrete quality meets the established specifications and remains consistent throughout the production, transportation, and on-site pouring processes. To address this issue, data from concrete compressive strength tests is required as an indicator of the concrete's quality. Therefore, this study aims to evaluate the quality of ready-mix concrete used in the construction of the BKPSDM Building in Bandung Regency. This evaluation was conducted by comparing the concrete compressive strength values obtained from laboratory test results with the design concrete strength (fc). It is anticipated that the findings of this study will provide insights into the quality of the ready-mix concrete used, serve as a reference for project implementers in improving concrete quality control, and contribute academically to studies on concrete quality management in building construction.

2. METHOD

A descriptive quantitative approach was used in this study because this approach aims to systematically describe and analyze a phenomenon through the processing of numerical data without manipulating the research variables (Sugiyono, 2019). In this study, this approach was applied to evaluate the quality control of ready-mix concrete based on the results of concrete compressive strength tests. The analysis process was conducted by comparing the concrete compressive strength values obtained from laboratory testing with the concrete quality specified in the design, namely fc' 25 MPa (K-300). In addition, descriptive statistical analysis was conducted to assess the consistency of the concrete quality used. The research object consists of ready-mix concrete applied to the BKPSDM Building Construction Project in Bandung Regency. The research population includes all concrete samples that underwent compressive strength testing during the structural construction process.

To determine the research samples, a purposive sampling method was used, specifically selecting all concrete test specimens with complete and well-documented compressive strength test results. The data utilized in this study are secondary data, sourced from reports on concrete compressive strength test results at the Construction Materials Testing Laboratory of the Bandung State Polytechnic (POLBAN), using cylindrical test specimens with a diameter of 150 mm and a height of 300 mm. The testing procedure followed SNI-1974-2023, which involves applying compressive loads in stages until the test specimen fails (BSN, 2023). The concrete compressive strength test was conducted at ages of 14 days and 28 days to assess the development of concrete strength and to what extent the concrete meets the specified strength (fc'). Concrete compressive strength is calculated by dividing the maximum load on the test specimen by the cross-sectional area of the cylinder used.

Data collection was conducted through a documentary study by gathering test reports on concrete compressive strength issued by the project team. The data obtained includes the compressive strength values of each concrete sample and the planned concrete strength (fc'). Data analysis was performed by comparing the concrete compressive strength values from the tests with the planned concrete strength (fc') to assess the extent to which the ready-mix concrete used in the project meets the standards. Additionally, descriptive statistical analysis was conducted by calculating the mean, maximum, minimum values, and the percentage of concrete samples meeting the specified strength. The results of this analysis were used to evaluate the quality of ready-mix concrete in the BKPSDM Building Construction Project in Bandung Regency. This study is limited to evaluating concrete quality based on compressive strength parameters and does not include analysis of durability, workability, or the impact of variations in the chemical composition of the concrete. **Figure 1** shows the research flowchart used in this study. The flowchart illustrates the stages ranging from the determination of the research objects and population (cylindrical test specimens), the collection of secondary data from laboratory test reports, statistical data analysis, to the assessment of concrete quality based on a comparison between the test compressive strength and the design strength fc' (K-300).

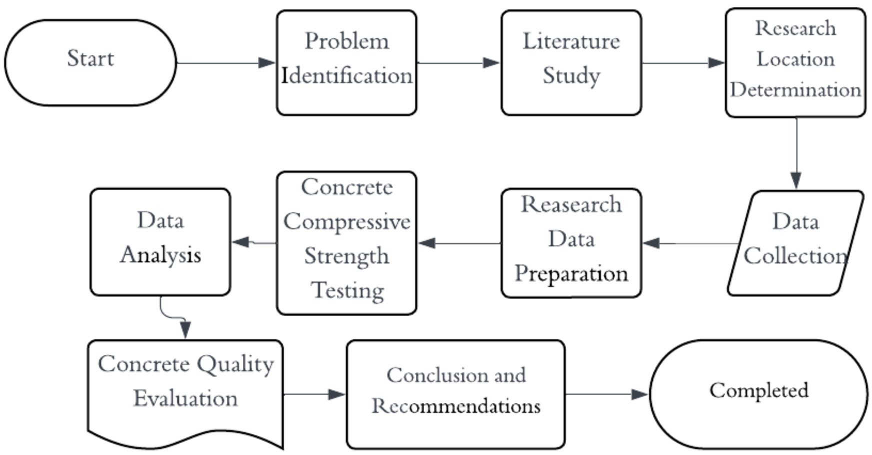

Figure 1. Research Flowchart

Based on the flowchart in **Figure 1**, this study focuses on the quantitative verification of concrete quality through compressive strength parameters and statistical analysis (mean, maximum and minimum values, standard deviation, coefficient of variation, and control limits). Thus, the research stages allow for conclusions to be drawn regarding the consistency and conformity of concrete quality in the BKPSDM project.

3. RESULT AND DISCUSSION

3.1 Concrete Work

Concrete work in the BKPSDM building construction project in Bandung Regency was planned to use fc' 25 MPa or K-300 grade concrete, which was applied to several primary structural elements as presented below.

3.1.1 Concrete Pile Cap Work

A structural element that serves to anchor the foundation as a support before columns are erected on top of it is known as a pile cap. The purpose of the pile cap is to ensure that the columns are positioned exactly at the center of the foundation, thereby preventing eccentricity that could increase the load on the foundation (Sinaga et al., 2021) In other words, the pile cap serves as a lower structural component that helps distribute the load from the columns to the foundation. The pile caps in this project consist of four types, namely (1) type 1 pile cap with dimensions of 250 x 250 cm, (2) Type 2 pile cap with dimensions of 250 x 200 cm, (3) Type 3 pile cap with dimensions of 250 x 80 cm, and (4) Type 4 pile cap with dimensions of 80 x 80 cm. This work documentation can be seen in **Figure 2.**

Figure 2. Pile Cap Concrete Work

The casting of pile caps plays a crucial role in transferring loads from columns to the foundation, ensuring that the resulting column positions are more precise and reducing the risk of load eccentricity. **Figure 2** shows the execution of pile cap work, which constitutes the initial phase of the substructure system; the quality of the concrete used must be verified to meet the specification of fc′=25 (K-300).

3.1.2 Concrete Footing Work

A footing is a structural component of a building located above the foundation; it serves to distribute the load borne by the foundation and to anchor the walls so that they do not collapse in the event of ground movement (Umar, 2016).

The footing dimensions in this project consist of two types: (1) SL 01-type footing with dimensions of 30 x 60 cm and (2) SL 02-type footing with dimensions of 25 x 45 cm. The concrete footing work can be seen in **Figure 3.**

Figure 3. Concrete Footing Work

The footing shown in **Figure 3** served to distribute the load from the superstructure to the ground and acts as a retaining element that helps maintain the building's stability against ground movement. Because footings are a structural component that bears significant loads, verifying the quality of the concrete through compressive strength testing is essential to ensure that the concrete used achieves the design strength and does not pose a risk of reduced structural performance.

3.1.3 Concrete Column Work

Columns are vertical structural components that bear loads from beams and transfer them to the underlying structure. As they serve as primary supports, failure of columns can cause floor collapse and even lead to the collapse of the entire building structure (Papulele et al., 2017). The column sizes in this project include three types: (1) Type K1 with dimensions of 60 x 60 cm, (2) Type K2 columns with dimensions of 40 x 40 cm, and (3) Type K3 columns with dimensions of 30 x 30 cm. The concrete can be seen in **Figure 4.**

Figure 4. Concrete Column Work

A column is a vertical structural element that supports loads from beams and transfers them to the elements below. Therefore, the quality of the concrete used in column construction is critical to ensuring the strength and safety of the structure. The document shown in **Figure 4** describes the construction of columns using K-300 ready-mix concrete, so that compressive strength tests at the design age can be used to verify that the concrete quality meets the specified requirements.

3.1.4 Concrete Work on Beams and Slabs

Beams are structural members that function to carry loads perpendicular to the main axis, while slabs are horizontal structural members that support dead loads and live loads, then transfer them to the vertical frame within the structural system (Nursanti et al., 2020). The beam dimensions in this project include: (1) Type B1 beams measuring 40 x 70 cm, (2) Type B2 beams measuring 35 x 65 cm, (3) Type B3 beams measuring 30 x 50 cm, (4) Type B4 beams with dimensions of 25 x 50 cm, and (5) Type B5 beams with dimensions of 15 x 60 cm. Meanwhile, the slab thickness in this project is 15 cm. The concrete beam and slab work is shown in **Figure 5**

Figure 5. Concrete Work Beams and Floor Slabs

Floor beams and slabs shown in **Figure 5** are the main components of the load-bearing system that transfer dead loads and live loads to the structural frame. The slab thickness and beam dimensions require concrete of consistent quality to ensure that the load-bearing capacity is achieved as planned. Therefore, the use of ready-mix concrete with a compressive strength of fc' 25 MPa (K-300) must be verified through compressive strength test results to ensure that the structure achieves the expected strength and complies with applicable standards. The pile caps, footings, columns, beams, and floor slabs were constructed using fc'25 (K-300) ready-mix concrete delivered from the batching plant to the project site via mixer trucks with a capacity of 6 to 7 m^3.

3.2 Preparation and Curing of Test Specimens

The preparation of concrete test specimens for the BKPSDM Building Construction Project in Bandung Regency was conducted in accordance with SNI-03-1974. The concrete samples were cast into cylindrical specimens with a diameter of 150 mm and a height of 300 mm, which is the standard size for testing the compressive strength of structural concrete. This cylinder size was chosen because it produces a stress distribution that more accurately reflects real-world conditions during axial compression testing compared to other shapes (Sariman et al., 2023). The fresh concrete used was ready-mix concrete and was taken directly during the on-site casting process. The concrete was then poured into steel cylinder molds that had been cleaned and coated with a thin lubricant to prevent it from sticking to the mold walls. The casting process was carried out in three layers; each layer was compacted using a tamper or internal vibrator to reduce air voids and increase concrete density. Consistent compaction techniques are crucial to ensure uniform concrete density throughout the cylinder's volume and to yield accurate compressive strength values (Howes, 2019).

After the concrete is poured into the mold, the test specimen is left in a safe place, protected from vibration and bad weather, for about 24 hours to gain sufficient initial strength before the mold is removed carefully to avoid surface damage. Formwork removal must be performed after the concrete has achieved sufficient initial strength and remains protected from extreme temperatures or rain that could affect the surface and initial structure of the concrete. Curing of cylindrical test specimens is performed via a water immersion system in clean water at room temperature until the test age required for quality assessment is reached. This immersion process aims to keep the concrete moist, allowing the cement hydration reaction can proceed optimally, which directly impacts the increase in concrete compressive strength. This water-based curing method has proven more effective in enhancing concrete compressive strength compared to curing methods without humidity control, as it helps retain water within the concrete until the 28-day age, as explained in various studies on concrete (Adi, 2023). Based on test results from the POLBAN Construction Materials Testing Laboratory, test specimens were tested to determine compressive strength at 14th and 28th days, accompanied by the application of axial loads until failure occurred. The compressive strength value was obtained by dividing the maximum load withstood by the test specimen by the cross-sectional area of the concrete cylinder. The test results showed that the majority of the 28-day-old test specimens met or even exceeded the design concrete strength of fc' 25 MPa (K-300). Differences in compressive strength values at different ages are influenced by variations in curing time and concrete density due to differences in compaction techniques, consistent with findings from previous experimental studies on concrete curing (Wila et al., 2022). Therefore, since the procedures for the preparation, curing, and testing of concrete test specimens in this study complied with applicable standards, the test results obtained are valid and can be used as a basis for assessing the quality of the concrete installed in the BKPSDM Building Construction Project in Bandung Regency.

3.3 Concrete Compressive Strength Test

Cylindrical samples measuring 15 x 30 cm, taken during the mixing process of ready-mix concrete with a strength grade of fc′ 25 MPa (K- 300) for the BKPSDM Building Construction Project in Bandung Regency, were tested to assess the quality of the concrete installed and ensure that the quality of the concrete used on-site matches the planned quality. Documentation of the concrete compressive strength test can be viewed in **Figure 6.** The testing was conducted at the POLBAN Construction Materials using samples that had undergone the curing process in accordance with applicable standards. Concrete compressive strength testing is conducted in a laboratory using cylindrical test specimens that have been cured in accordance with standards. The test procedure involves applying an axial load until the test specimen fails, allowing the compressive strength to be calculated based on the maximum load recorded and the cross-sectional area of the test specimen.

Figure 6. Concrete Compressive Strength Test

The tests shown in **Figure 6** were conducted on the 14th and 28th days, and the results are presented in tabular form to serve as a reference for evaluating the quality of the concrete used. **Table 1** presents a summary of the compressive strength test results for 14-day-old concrete. This table includes data on sample numbers, the dimensions of the cylindrical test specimens, the maximum load, and the compressive strength values in kgf/cm². The purpose of presenting these results at 14 days is to observe the development of the concrete's strength toward the design compressive strength fc′.

DOI : https://doi.org/10.17509/jptb.v6i1 P-ISSN 2807-9450 E-ISSN 2808-4284

Table 1. Compressive Strength Test Results for 14-Day-Old

No	14-Day Age (14 Sample)					
	Sample Age	**Diameter (cm)**	**Height (cm)**	**Max. Load (kN)**	**Max. Load (kgf)**	**Cylinder Compressive Strength (kgf/cm²)**
1	14	15	30	5.07	517.4	292.94
2	14	15	30	4.56	464.9	263.21
3	14	14.89	30.04	4.16	424.1	243.67
4	14	14.9	30.3	5.01	511.3	293.38
5	14	14.77	30	4.15	423.3	251.87
6	14	14.76	30	4.14	422.6	251.76
7	14	14.82	30	4.55	464	274.20
8	14	14.81	30	4.78	487.6	288.68
9	14	15.15	30	4.44	453.1	251.25
10	14	14.77	30	4.65	474	276.72
11	14	14.82	30	4.58	466.9	275.93
12	14	15.02	30	4.32	440.4	253.40
13	14	15	30	4.70	479.3	271.12
14	14	15	30	4.42	450.6	254.89
Total						**3743.01**

Based on **Table 1**, it can be seen that the compressive strength values at 14 days show variation among samples. Although the concrete generally exhibits an increase in strength as the hydration process progresses, not all samples have met the quality criterion of fc′ = 25 MPa (equivalent to approximately 255 kgf/cm²). This variation indicates that the production, transportation, casting, and/or curing processes can affect the consistency of concrete quality. **Table 2** presents a summary of the concrete compressive strength test results at 28 days, which is the design age for assessing concrete quality. At this stage, the concrete's strength is expected to have reached a more stable value, making it more appropriate to compare it with the design strength standard of fc′ = 25 MPa (K-300).

Table 2. Compressive Strength Test Results for 28-Day-Old

No	28-Day Age (14 Sample)					
	Sample Age	**Diameter (cm)**	**Height (cm)**	**Max. Load (kN)**	**Max. Load (kgf)**	**Cylinder Compressive Strength (kgf/cm²)**
1	28	14.61	30.01	5.09	519.4	309.98
2	28	14.89	30.35	3.23	329.5	189.32
3	28	14.91	30	3.68	375.5	219.34
4	28	14.87	30	7.09	723.4	424.60
5	28	14.87	30	7.10	724.1	416.79

DOI : https://doi.org/10.17509/jptb.v6i1 p-ISSN 2807-9450 e-ISSN 2808-4284

No	28-Day Age (14 Sample)					
	Sample Age	Diameter (cm)	Height (cm)	Max. Load (kN)	Max. Load (kgf)	Cylinder Compressive Strength (kgf/cm²)
6	28	14.93	30	5.27	537.8	307.28
7	28	14.87	30	5.45	555.3	325.90
8	28	14.86	30	5.27	537.8	316.31
9	28	15.06	30	4.81	490.5	275.25
10	28	15.06	30	4.44	452.5	253.92
11	28	15.1	30	6.20	631.8	352.66
12	28	15.08	30	5.86	597.8	334.57
13	28	15	30	4.92	501.6	283.73
14	28	15	30	4.25	432.9	244.87
Total						**4254.52**

The results in **Table 2** show differences in concrete compressive strength values among samples, indicating variations in quality that still fall within the tolerance range for structural concrete. Although most samples meet the planned quality standards, these variations underscore the importance of continuous quality control, particularly during the production and transportation of ready-mix concrete, to reduce the risk of concrete quality degradation on-site. Based on the results of concrete compressive strength tests at two ages, the average compressive strength of the concrete at 28 days met the planned compressive strength standard of fc'25 MPa. The maximum and minimum compressive strength values showed variations that remained within the quality tolerance limits for structural concrete. The percentage of concrete samples meeting the standard was 64.29%, indicating that the production, transportation, and casting processes for ready-mix concrete in this project proceeded smoothly.

3.4 Statistical Analysis and Calculation of Cylinder Concrete Compressive Stength Test

Statistical analysis of the concrete compressive strength test results is a crucial component in evaluating the data characteristics of the concrete cylinder compressive strength tests and assessing the consistency of the ready-mix concrete quality used in the BKPSDM Building Construction Project in Bandung Regency. The analyzed data is derived from laboratory test results at 14-day and 28-day concrete ages. The statistical analysis includes calculations of the mean value, maximum value, minimum value, and the percentage of samples meeting the concrete quality standard of fc' 25 MPa (K-300). The mean value is used to generally describe the quality of the concrete, while the maximum and minimum values aim to determine the variation in quality among samples. The percentage of concrete quality compliance is calculated to assess the extent to which the installed concrete meets applicable technical criteria.

DOI : https://doi.org/10.17509/jptb.v6i1 P-ISSN 2807-9450 E-ISSN 2808-4284

The calculation of the concrete compressive strength is performed using formula **(1)**, while the average is determined based on formula **(2)**.

(1) $fc' = \frac{P}{A}$ (Sayfullah & Musrifin, 2020)

(2) $Xrt = \frac{\Sigma Xi}{n}$ (Ningrum et al., 2024)

Notes:

fc' = compressive strength (Kgf/cm^2)

P = maximum load (N)

A = cross-sectional area (mm^2)

ΣXi = total compressive strength values (Kgf/cm^2)

Xrt = average compressive strength (Kgf/cm^2)

n = number of specimens

3.4.1 Calculation of Concrete Compressive Strength

Example The presented before a comprehensive statistical analysis is performed against the test data. This calculation aims to clearly and systematically explain the method used to calculate the compressive strength of concrete cylinders in this study. This example serves as basis or reference for calculating the compressive strength of concrete in all samples, thereby making the data analysis process more consistent and accountable. For example, the calculation of the compressive strength of the first sample at 14 days is performed as follows:

Given:

P = 517,4 KN = 5174000 N

D = 15 cm = 150 mm

Question: What is the compressive strength of the concrete?

Solution:

$$fc' = \frac{P}{A}$$

$$fc' = \frac{P}{\frac{1}{4} \times \pi \times d^2}$$

$$fc' = \frac{5174000}{\frac{1}{4} \times 3{,}14 \times 150^2}$$

$$fc' = 292{,}94\ Kgf/cm^2$$

Thus, the compressive strength of the first concrete sample at 14 days was determined to be 292,94 Kgf/cm^2.

3.4.2 Average Compressive Strength of Concrete

The analysis of the average concrete compressive strength was performed by calculating the average of the compressive strength test results for the concrete cylinders at each testing stage. This calculation aims to evaluate the growth of concrete compressive strength as the concrete ages, as well as the concrete's ability

DOI : https://doi.org/10.17509/jptb.v6i1 p-ISSN 2807-9450 e-ISSN 2808-4284

to meet the fc'25 quality standard MPa as planned. Here are the calculations:

Given:

1. $\Sigma fc'$ at 14 days = 3743,01 Kgf/cm^2; n=14 samples
2. $\Sigma fc'$ at 28 days = 4254,52 Kgf/cm^2; n=14 samples

Question: what is of compressive of the concrete?

Solution:

Average age of 14 days:

$$fcr' = \frac{\sum fc'}{n}$$

$$fcr' = \frac{3743,01}{14}$$

$$fcr' = 267,36\ Kgf/cm^2$$

Average 28-day age:

$$fcr' = \frac{\sum fc'}{n}$$

$$fcr' = \frac{4254,52}{14}$$

$$fcr' = 303,89\ Kgf/cm^2$$

Data analysis indicates that the average compressive strength of the concrete at 14 days of age is 267.36 kgf/cm², while at 28 days of age it reaches 303.89 kgf/cm². The highest average value occurred at 28 days, indicating that the concrete had reached its optimal compressive strength in accordance with the planned age and met the fc'25 MPa quality standard.

3.4.3 Statistical Analysis of Concrete Compressive Stre

An analysis of the lowest and highest concrete compressive strength values was conducted by determining the smallest and largest compressive strength results from all test data. This calculation aims to demonstrate the variation in concrete compressive strength as well as the level of consistency in the quality of the concrete produced. The results showed that the highest compressive strength value reached 424.60 kgf/cm², while the lowest value was 189.32 kgf/cm². The analysis results show that the strongest concrete compressive strength value reached 424.60 kgf/cm² and the weakest value was 189.32 kgf/cm², which Both occurred in 28-day-old concrete. These differences in values indicate variations in compressive strength among the samples; however, overall, they remain within the normal range of variation for structural concrete. To obtain a more comprehensive evaluation of the consistency and stability of concrete quality, an extended statistical analysis was conducted on the compressive strength test results. In addition to the descriptive parameters such as maximum value, minimum value, standard deviation, and coefficient of variation, control limits were also determined as part of Statistical Quality Control

(SQC). **Table 3** presents comprehensive statistical data for the simultaneous analysis of variance and stability.

Table 3. Statistical Analysis of Concrete Compressive Strength Values

Parameter	14 Days	28 Days
Number of Samples (n)	14	14
Mean ($\bar{x}$)	267,36 kgf/cm²	303,89 kgf/cm²
Minimum Value	243,67 kgf/cm²	189,32 kgf/cm²
Maximum Value	293,38 kgf/cm²	424,60 kgf/cm²
Range	49,71 kgf/cm²	235,28 kgf/cm²
Standard Deviation (SD)	16,82 kgf/cm²	67,26 kgf/cm²
Coefficient of Variation (KV)	6,29%	22,13%
Upper Control Limit (UCL = $\bar{x}$+3σ)	317,83 kgf/cm²	505,67 kgf/cm²
Lower Control Limit (LCL = $\bar{x}$−3σ)	216,89 kgf/cm²	102,12 kgf/cm²
Samples Outside Control Limits	0	0
Pass≥ K-300	0/14 (0%)	8/14 (57,14%)

Based on **Table 3**, no samples fell outside the control limits (UCL and LCL), indicating that the production/implementation process remains statistically stable. However, the relatively high SD and KV values at 28 days suggest that, although the process is still "under control," quality consistency is not yet fully satisfactory due to a fairly wide distribution of compressive strength.

3.4.4 Percentage of Compressive Strength Compliance

The percentage of concrete compressive strength compliance was determined by comparing the number of samples with compressive strength values equal to or greater than the planned strength of fc′ 25 MPa (approximately 255 kgf/cm²)to the total number of tested samples. Samples with compressive strength values ≥ 255 kgf/cm² were classified as meeting the quality standard, whereas samples with values < 255 kgf/cm² were categorized as not meeting the required standard. The evaluation results indicate that, for 14-day-old concrete, 8 out of 14 samples met the required quality standard, resulting in a compliance percentage of 57.14%, while the remaining 6 samples did not satisfy the specified compressive strength criteria. In the 28-day-old concrete specimens, 10 out of 14 samples met the quality standard, producing a compliance percentage of 71.43%, whereas 4 samples remained below the required strength. Overall, from a total of 28 tested concrete samples, 18 samples met the planned quality standard of fc′ 25 MPa, resulting in an overall compliance percentage of 64.29%, while 10 samples did not achieve the specified compressive strength requirement. The higher compliance percentage observed in the 28-day-old concrete indicates that the concrete achieved a more optimal compressive strength performance at the planned curing age.

3.4.5 Summary of Concrete Compressive Strength Compliance

Table 4 summarizes the compliance rates of concrete quality with fc′=25 MPa (K-300). This table shows the number of samples that met the requirement (fc′≥25 MPa) and those that did not, for both 14-day and 28-day ages, and presents the corresponding percentages to allow for quantitative comparison.

Table 4. Summary of Concrete Compressive Strength Compliance

Concrete Age (Days)	Number of Samples	Compliant (fc' ≥ 25 MPa)	Does Not Meet (fc' < 25 MPa)	Percentage Met (%)
14	14	8	6	57.14
28	14	10	4	71.43
Total	**28**	**18**	**10**	**64.29**

The summary results in **Table 4** show that the percentage of quality compliance at 28 days is higher than at 14 days. However, there are still samples that do not meet the specified quality standards; therefore, an evaluation and improvement of quality control during the concrete placement phase-after the concrete arrives at the site-are necessary to minimize quality variations and ensure that more samples meet the fc′ criteria.

The results of the statistical evaluation reveal a clear contrast in the level of consistency between concrete tested at 14 days and at 28 days. At the earlier age, the variation was relatively small, as indicated by a standard deviation of 16.82 kgf/cm² and a coefficient of variation (CV) of 6.29%, which falls within the excellent category. However, at 28 days, the variability increased markedly, with a standard deviation of 67.26 kgf/cm² and a CV of 22.13%, indicating poor consistency. This pattern suggests that the source of variation is unlikely to originate from the batching plant, but rather from processes occurring after delivery. The considerable spread in compressive strength values at 28 days, ranging from 189.32 to 424.60 kgf/cm², reflects the influence of several external factors. These include transportation time, which may lead to reduced workability, as well as inconsistencies in curing practices and compaction methods during casting. Such factors can significantly affect the final strength of concrete. Similar observations have been reported in previous studies, which emphasize that variations in ready-mix concrete quality are often associated with on-site practices rather than production processes. The presence of large discrepancies among specimens within the same batch further indicates insufficient quality control. Consequently, a more structured quality monitoring approach, such as the application of Statistical Quality Control (SQC) with control charts, is necessary to improve consistency.

4. CONCLUSION

The results of this study indicate that the average compressive strength of the ready-mix concrete exceeds the specified design strength of fc’ 25 MPa, demonstrating that the concrete has the capacity to achieve the required strength level. However, the statistical analysis reveals significant variability, with a coefficient of variation of 22.23%, indicating poor consistency in concrete quality. Furthermore, only 64.29% of the test specimens meet the design strength requirement, which suggests that a considerable portion of the concrete does not comply with the specified standard. Although the control chart analysis shows that the process remains within statistical control limits, the high variability indicates that the process is not yet capable of producing uniform concrete quality. Therefore, it cannot be concluded that the concrete fully meets the required quality standards. Instead, the results indicate that the quality control process is moderately adequate but still requires significant improvement. Enhancing quality control measures, particularly in transportation, casting, and curing processes, is essential to achieve more consistent concrete performance.

REFERENCES

Adi, T. P. (2023). Pengaruh perawatan beton (curing) terhadap kuat tekan beton normal. *JITSi : Jurnal Ilmiah Teknik Sipil, 3*(2), 61–66.

Arman, U. D., Sari, A., & Chairi, M. (2025). Prosedur pengendalian mutu struktur beton teknologi precast pembangunan rumah susun Sumatera Barat. *Jurnal Rivet, 4*(02), 66–72.

BSN. (2023). Metode uji untuk kekuatan tekan beton spesimen silinder (ASTM C39-20, IDT) SNI 1974:2023.

Howes, R., Hadi, M. N., & South, W. (2019). Concrete strength reduction due to over compaction. *Construction and Building Materials*, *197*, 725-733.

Mahardika, T. Analysis of the stability of retaining walls using fem and lem on the dumai duri kandis road. *Jurnal Pendidikan Teknik Bangunan, 5*(1), 47-62.

Mulyati, E. (2025). Pengawasan kualitas beton pada proyek dinding penahan tanah kejaksaan tinggi sumatera selatan. *STORAGE: Jurnal Ilmiah Teknik dan Ilmu Komputer*, *4*(3), 194-201.

Nanda, R. D., Milo, F., Nalindri, I. R., Anjasari, G. W., & Safitri, D. A. (2024). Peninjauan mutu beton ready mix pada baching plant-surabaya. *Jurnal Kendali Teknik dan Sains, 2*(2), 24–33.

Ningrum, N. P. A., Pranowo, D. D., Wari, W. N., Utanaka, A., & Khomari, M. G. (2024). Pengaruh penambahan silica fune terhadap campuran beton memadat sendiri (self

DOI : https://doi.org/10.17509/jptb.v6i1 p-ISSN 2807-9450 e-ISSN 2808-4284

compacting concrete) mutu tinggi. *Jurnal Teknik Sipil dan Arsitektur, 29*(2), 73–80.

Nurokhman, N., Suharyanto, I., & Rochmawati, U. (2021). Evaluasi mutu beton dari berbagai ready mix pada gedung parkir yogyakarta international airport. *CivETech, 3*(2), 55–65.

Nursanti, A., Rivai, I., & Rahmat, T. (2020). Analisis kapasitas balok dan pelat lantai pada proyek gedung pusat pembelajaran ARTNZ-GEISE tahap II Parahyangan Universitas Parahyangan—Bandung. *Jurnal Teknik Sipil-Arsitektur, 19*(2).

Papulele, F. W. G., Wallah, S. E., & Pandaleke, R. (2017). Perbandingan nilai kapasitas beban maksimum beton bertulang kolom utuh dengan kolom yang diperkuat menggunakan chemical anchor. *Jurnal Sipil Statik, 5*(8), 519.

Rahman, S. B. A. (2022). Pengembangan modul prosedur perhitungan kekuatan struktur beton bangunan gedung sederhana menurut SNI 2847:2019. *Jurnal Pendidikan Teknik Bangunan, 2*(1), 43–58.

Sariman, S., Setiawan, A., & Ridwan, R. (2023). Analisis waktu curing dan bentuk specimen terhadap kuat tekan beton PCC. *Jurnal Ilmiah Ecosystem, 23*(1), 102–110.

Sayfullah S, Muh., & Musrifin, M. (2020). Uji kuat tekan beton dengan menggunakan pasir kali desa rongi kec. Sampolawa kab. Buton Selatan. *Sang Pencerah: Jurnal Ilmiah Universitas Muhammadiyah Buton, 6*(1), 26–34.

Setiadi, M. S., Usman, K., Sebayang, S., & Kustiani, I. (2024). Analisis pengendalian mutu beton pada proyek rumah susun PIK pulo gadung dengan metode statistical quality control. *Journal of Sustainable Construction, 3*(2), 1–15.

Sinaga, J. G., Sari Siallagan, N. A., & Suhairiani, S. (2021). Teknik pelaksanaan pekerjaan pile cap pada pondasi gedung rumah sakit grand mitra medika di jalan S.Parman Medan. *Indonesian Journal Of Civil Engineering Education, 6*(1), 27.

Skrzypczak, I., Leśniak, A., Ochab, P., Górka, M., Kokoszka, W., & Sikora, A. (2021). Interlaboratory comparative tests in ready-mixed concrete quality assessment. *Materials, 14(*13), 3475.

SNI-2847. (2019). Persyaratan beton struktural untuk bangunan gedung. *Badan Standardisasi Nasional*.

Sugiyono. (2019). Metode penelitian kuantitaf, kualitatif, dan R&D.

Suri, Y. A. P., Noorhidana, V. A., Helmi, M., Isneini, M., & Wahono, E. P. (2024). Analisis faktor-faktor yang mempengaruhi mutu beton ready mix. *Teras Jurnal : Jurnal Teknik Sipil, 14*(1), 171–186.

Umar, M. Z. (2016). Sloof dan indentifikasi kearifan lokal dikalangan pekerja bangunan. *Jurnal Vokasi Indonesia, 4*(1), 9.

Wila, A. T. M., Hunggurami, E., & Nasjono, J. K. (2022). Pengaruh perawatan water-curing dengan variasi lama perawatan dan tinggi perendaman terhadap kuat tekan beton. *Jurnal Teknik Sipil, 11*(2), 183-188.

Yusuf, S. A. A., Putra, I. N. D. P., & Widowati, E. D. (2025). Analisis mutu dan faktor-faktor yang mempengaruhi mutu beton kolom menggunakan metode SPC dan RII. *Jurnal Civil Engineering Study, 5*(2), 112-123.