
An Alternative Approach to Comparing In-Situ Concrete Compressive Strength Using the Hammer Test Method

Agung Raharjo¹, Maraden Panjaitan² and Ari Sasmoko Adi³

Department of Civil Engineering, Faculty of Engineering, 17 Agustus 1945 University of Samarinda, 75124, East Kalimantan, Indonesia^{1,2,3}

* Correspondence: raharjoagung@gmail.com

Citations: Raharjo, Agung., Panjaitan, Maraden., & Adi, Ari Sasmoko., (2025). An Alternative Approach to Comparing In-Situ Concrete Compressive Strength Using The Hammer Test Method. *World Journal of Innovation and Technology*, 06(01), 41-45.

Academic Editor:

Received: 05 September 2025

Accepted: 28 October 2025

Published: 30 October 2025

Abstract: Concrete is a composite material consisting of fine aggregate, coarse aggregate, cement, and water, mixed in precise proportions. In construction projects—ranging from small-scale developments to large-scale infrastructure—ensuring the quality of concrete is critical to achieving the intended structural performance. One commonly used method for evaluating concrete strength without damaging the structure is the hammer test. This non-destructive testing (NDT) method offers the advantage of generating a large amount of data in a relatively short time. The hammer test works by applying an impact load to the surface of the concrete, with the rebound value directly indicating the surface hardness, which correlates with compressive strength. Results can be obtained immediately in the field, making it highly practical for on-site quality assessments. Additionally, this method can serve as a comparative tool against laboratory tests conducted on destructive samples, providing a broader understanding of concrete quality across various sections of a structure.

Keywords: Construction Materials; Concrete Testing; Hammer Test



Copyright: © 2022 by the author. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Concrete is a composite material consisting of a mixture of fine aggregates, coarse aggregates, cement, and water, mixed in precise proportions (Tjokrodinuljo, 2012). It is used in all types of construction, from small-scale projects to large-scale mega projects (Kencana & Waty, 2021). The quality of concrete as a construction material must be monitored and controlled to ensure that the structure performs according to its intended design (Lubis, 2000). Therefore, several methods are needed to control concrete quality, both during the planning phase and after construction is complete, to ensure the concrete meets the structural requirements (Deng et al., 2024).

In practice, various challenges arise during concrete testing in the field (Neville, 2006). Thus, a testing tool is needed that can provide rapid, graphical, and direct readings without damaging the constructed structure (Xiao et al., 2011). Concrete strength and mechanical properties can be examined using destructive tests (DT) and non-destructive tests (NDT) (Ali-Benyahia et al., 2023). One of the most widely used NDT methods is the hammer test. The hammer test evaluates concrete quality without damaging it and allows for the collection of a significant amount of data in a relatively short time (Gehlot et al., 2016). It works by applying an impact load to the surface of the concrete. The data obtained can be immediately observed on-site.

2. Materials and Methods

2.1. Research Location

The research was conducted at the construction site of a Guest House located on Jalan Hasan Basri, Samarinda, East Kalimantan. The structure utilizes concrete as the primary construction material for both substructure (foundation) and superstructure components

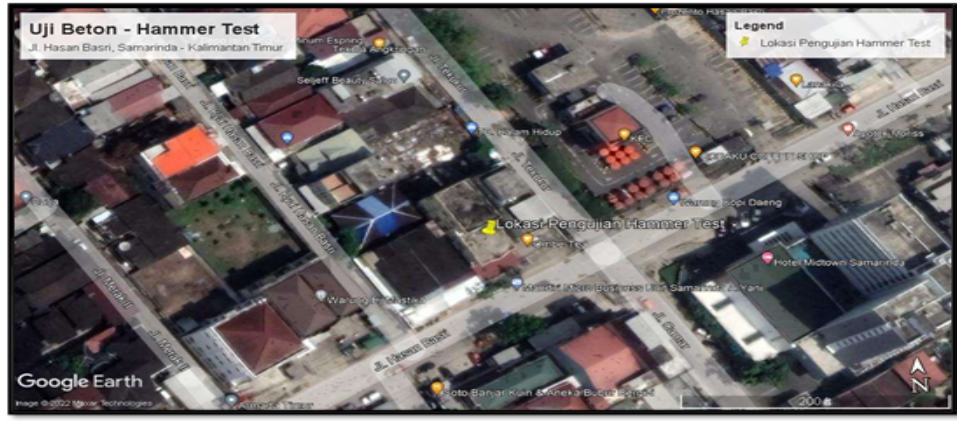


Figure 1. Research Location

2.2. Data Sources

2.2.1. Primary Data:

- Field Observation: Investigation report from 23 hammer test points on the Guest House structure.
- Semi-Structured Interviews: Conducted with the Project Manager for data validation and correction.
- Photographic Documentation: Taken from field testing data

2.2.2. Secondary Data:

- Literature Review: From academic journals discussing hammer test applications.
- Project Technical Documents: Analytical results and rebound charts from 23 hammer test points on the Guest House construction at Jalan Hasan Basri, Samarinda.

2.3. Research Method

This test method involves applying an impact load to the concrete surface using a mass activated with a specific amount of energy. The rebound distance of the mass after impact with the test surface indicates the hardness of the material, which can be calibrated. This tool is useful for assessing the uniformity of concrete within a structure. Due to its simplicity, testing can be done quickly and cover a large area in a short time. However, it is sensitive to surface conditions such as the presence of large aggregates near the surface. Therefore, multiple measurements around the test area are required, and the results are averaged.

$$FC' = \frac{P}{A} \quad (1)$$

Where :

- FC' = Compressive Strength (MPa)
- P = Load applied (Newton)
- A = Cross-sectional area (mm²)

2.4. Hammer Test Field Testing

British Standards (BS) recommend taking between 9 to 25 readings, or at least 10 impact points on a test surface, with a minimum spacing of 25 mm between each point (SNI 03-4430-1997 / ASTM C805-85 (1989) / BS 4408 pt.4).

In general, the hammer test tool can be used for:

1. Checking the uniformity of concrete quality within a structure;

2. Obtaining an estimated compressive strength of the concrete.

Therefore, field testing using this method allows direct assessment of the consistency of concrete strength, and with the help of rebound graphs, one can make informed decisions regarding the estimated compressive strength of the structure.

3. Results

3.1. Planned and Actual Progress

Testing was conducted at 23 points on the Guest House structure. The results are as follows:

Table 1. Planned Location

No	Hammer Test Point	MPa	Kg/cm ²
1	HT Column. 1	30.360	309.59
2	HT Column. 2	21.072	214.87
3	HT. 3 Top Beam	46.547	474.64
4	HT. 4 Top Beam	40.385	411.81
5	HT Column. 5	25.788	262.96
6	HT. 6 Top Beam	36.056	367.66
7	HT. 7 Top Beam	24.935	254.27
8	HT Column. 8	28.164	287.19
9	HT Column. 9	37.882	386.28
10	HT Column. 10	25.304	258.03
11	HT Column. 11	42.489	433.26
12	HT Column. 12	28.734	293.00
13	HT Column. 13	40.733	415.36
14	HT Column. 14	28.161	287.15
15	HT. 15 Top Beam	40.699	415.00
16	HT Column. 16	27.433	279.73
17	HT Column. 17	21.960	223.93
18	HT. 18th Floor	32.986	336.36
19	HT. 19th Floor	38.592	393.52
20	HT. 20th Floor	40.688	414.89
21	HT. 21th Floor	27.567	281.10
22	HT. 22th Floor	21.810	222.39
23	HT. 23th Floor	31.461	320.81

3.2 Analysis Results

From the test results, the lowest strength was recorded at HT Column. 2 (21.072 MPa), while the highest was at Beam HT.3 (46.547 MPa). To assess uniformity, it is recommended to consider the average or median value of all test points rather than focusing on the extremes.

3.3. Interview and Field Observation Results

Discussions with the Project Manager indicated that the low value at HT Column. 2 may have resulted from extreme weather conditions, such as rain, that affected the concrete curing process after pouring.

3.4 Data Visualization

The hammer tests were conducted using various impact angles ($\alpha 0^\circ$, $\alpha 90^\circ$, $\alpha -90^\circ$) and visualized in the following charts:

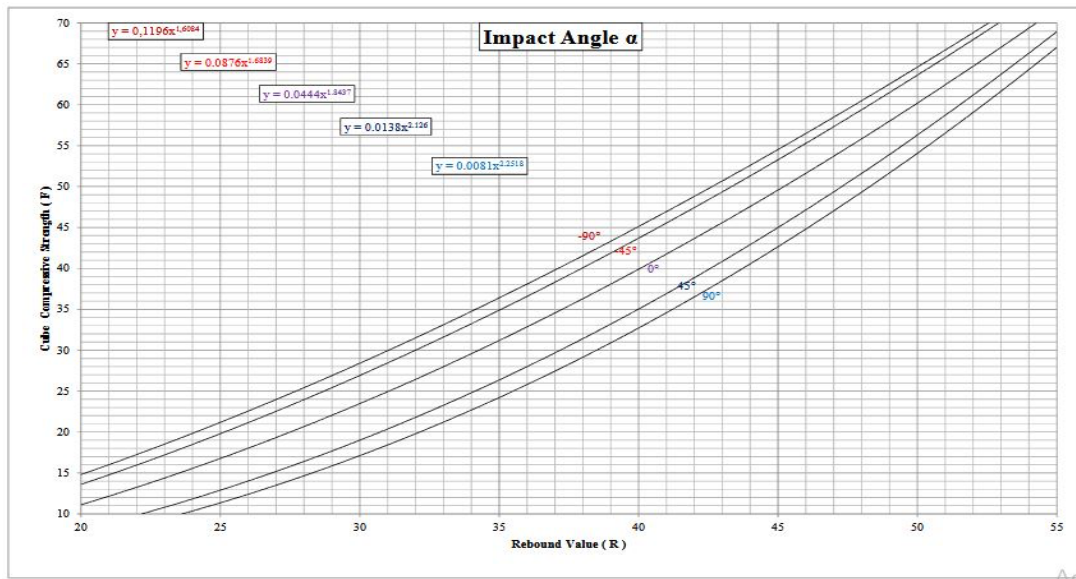


Chart 1. Results Planned

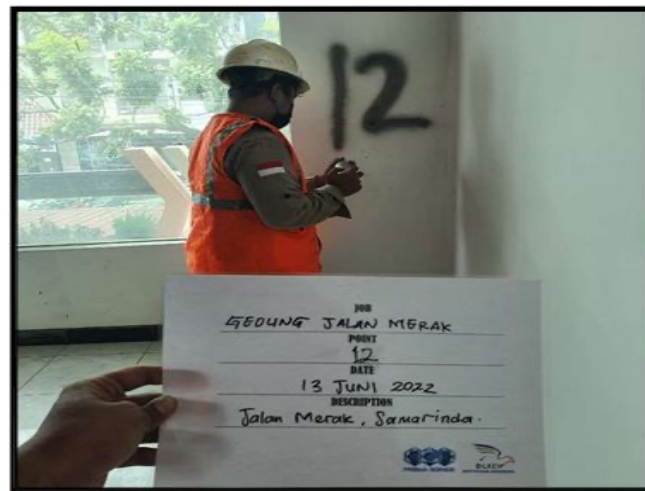


Figure 1. Results Planned

4. Discussion

The findings of this research are consistent with previous studies conducted by Balsala et al., (2018), Sumajouw et al., (2018) which explore alternative methods for evaluating concrete strength.

5. Conclusions

The hammer test is a reliable alternative method for assessing concrete quality. The more samples taken and tested by professionals, the more detailed and accurate the results. It is recommended to complement non-destructive tests with destructive methods to better understand material composition, mix homogeneity, and porosity within the concrete.

References

- Ali-Benyahia, K., Kenai, S., Ghrici, M., Sbartaï, Z.-M., & Elachachi, S.-M. (2023). Analysis of The Accuracy of In-Situ Concrete Characteristic Compressive Strength Assessment in Real Structures using Destructive and non-Destructive Testing Methods. *Construction and Building Materials*, 366(130161). <https://doi.org/10.1016/j.conbuildmat.2022.130161>
- Balsala, O. S., Manalip, H., & Ointu, B. M. M. (2018). Pengujian Tekan dan Tarik belah Beton dengan Agregat dari Kepulauan Aru. *Jurnal Sipil Statik*, 6(9).

-
- Deng, F., Mehdipour, A., & Soltani, A. (2024). Construction Quality Control of Concrete Structure in Architectural Engineering: A Case in Shanghai, China. *Urban Resilience and Sustainability*, 2(3), 256–271. <https://doi.org/10.3934/urs.2024013>
- Gehlot, T., Sankhla, S. S., & Gupta, A. (2016). Study of Concrete Quality Assessment of Structural Elements Using Rebound Hammer Test. *American Journal of Engineering Research (AJER)*, 5(8), 192–198.
- Kencana, J. A., & Waty, M. (2021). Penerapan Metode Value Engineering Dalam Pemilihan Jenis Beton Pada Proyek Konstruksi Perumahan. *JMTS: Jurnal Mitra Teknik Sipil*, 4(1). <https://doi.org/10.24912/jmts.v0i0.10408>
- Lubis, M. (2000). *Pengujian Struktur Beton dengan Metode Hammer Test dan Metode Uji Pembebanan (Load Test)*. FT UGM.
- Neville, A. (2006). *Concrete: Neville's Insight and Issues*. Thomas Telford.
- Sumajouw, A. J., Pandaleke, R., & Wallah, S. E. (2018). Perbandingan Kuat Tekan Menggunakan Hammer Test Pada Benda Uji Portal Beton Bertulang dan Menggunakan Mesin Uji Kuat Tekan Pada Benda Uji Kubus. *Jurnal Sipil Statik*, 6(11), 941–948.
- SNI 03-2491-2002; *Metode Pengujian Pengujian Kuat Tarik Belah Beton*, Badan Standarisasi Nasional, Jakarta.
- Tjokrodimuljo, K. (2012). *Teknologi Beton*. Biro Penerbit Teknik Sipil dan Lingkungan.
- Xiao, X., Xie, T., Tillmann, N., & Halleux, J. de. (2011). Precise Identification of Problems for Structural Test Generation. *ICSE '11: Proceedings of the 33rd International Conference on Software Engineering*, 1258. <https://doi.org/10.1145/1985793.1985876>