ASSESSMENT OF CONSTRUCTION QUALITY OF DILAPIDATED INCOMPLETE GOVERNMENT RESIDENTIAL BUILDINGS FOR CHECKING THE POSSIBILITY OF FURTHER CONSTRUCTION

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Abstract

Civil Engineering field mainly deals with the construction of the structures as roads, buildings, airports, dams to name a few. During the construction process, there are many kinds of challenges faced by the construction company resulting to either delay in the completion of the project or increase in the construction cost. At times it has been seen that due to some unavoidable reasons, the construction is left half way or abandoned for a long time before taken up for further construction. In this paper an attempt has been made to carry out the construction of an half way government school situated at Jawra in Madhya Pradesh. But before taking up the construction in such cases, it is important to measure the quality and the strength of the existing structure to check the quality performance for the new construction. Various parameters and tests are considered and conducted to assess the quality and the level of construction and the results are discussed. The testing results and the study carried out proposed that the building was of poor quality and the strength was not as desired therefore further construction was affected.

Index Terms: Non Destructive Test, Performance, Quality, Retrofitting

I. INTRODUCTION

In order to measure the resultant quality of any construction over an abandoned structure, it is important to assess the quality and the strength of the building and foundation to check for the possibility of future construction. Various tests such as Non Destructive Tests and Core Cutter Tests are performed on the existing structure to check the quality and strength to evaluate whether the building can be taken up for further construction or not. The tests results so obtained are then compared to the standards test results to measure the performance quality for future constriction on the existing building. This study deals with the structural valuation of the existing structure in the form of concrete quality and strength in Reinforced Concrete Cement (RCC). Based on the site inspection and Non-destructive test results, the condition of structural elements assessed. In order to derive the strength of existing structural members, **Non-Destructive Tests like Ultrasonic Pulse Velocity Tests, Rebound-Hammer Test and Concrete Core Tests** are done. These tests are done to check the Residual Strength of structural members, Homogeneity & find out development of cracks or presence of voids & other imperfections in order to suggest strengthening of the structure. For this purpose, the tests were carried out for the evaluation. Only selective structural elements were tested as per present structure conditions. The following methodology was adopted for determining the strength & stability of structure:

- Non Destructive Tests

- Analysis of the Tests Results
- Recommendations

II. SITE LOCATION AND SITE CONDITIONS

The site selected for carrying out the study is the staff quarters of a government model school at Jawra, Ratlam in Madhya Pradesh. The quarters were initially constructed and then the construction was left half way. The structure was of no use till recently it was again taken up for the construction to complete the structure as per the plans.

The photographs below shows the actual site conditions before performing the test for the evaluation of the strength and quality of the already constructed portion. As shown in the first photo below, lot of water clogging can be seen which will percolate in the soil increasing the moisture content of the soil in adjoining areas.

III. METHODOLOGY ADOPTED

The methodology adopted for carrying out the study is discussed in the subsequent paragraphs. In this section, the fundamentals of the tests, their purpose and the parameters will be discussed. The procedure that is followed will be also be discussed. Mainly there were three tests namely Rebound Hammer, Ultrasonic Pulse Velocity and Concrete Core rests were conducted.

REBOUND HAMMER TESTS were carried out in accordance with **I.S. 13311 (Part 2) – 1992** in order to assess the likely compressive strength of concrete, uniformity of the concrete and to assess the quality of concrete with respect to standard requirements. The impact energy required for rebound hammers for different applications is given below:

S.No.	Applications	Approx. Impact Energy Required (Nm)
1.	For testing normal weight concrete	2.25
2.	For light-weight concrete or small and impact sensitive parts of concrete	0.75
3.	For testing mass concrete i.e. roads, air fields pavements and hydraulic structures	30.00

ULTRASONIC PULSE VELOCITY TESTS were carried out in accordance with **I.S. 13311 (Part 1)** in order to determine the homogeneity of the concrete, development of crack ad presence of voids and other imperfections in concrete, changes I the structure of concrete that may occur with time and to assess the quality of concrete with respect to the standard requirements. The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation, the level of workmanship employed can be assessed using the guidelines as per the table given below which has been evolved for categorizing the quality of concrete in structures in terms of the ultrasonic pulse velocity.

S.No.	Pulse Velocity (km/sec)	Concrete Quality Grading
1.	Above 4.5	Excellent
2.	3.5-4.5	Good
3.	3.0-3.5	Medium
4.	Below 3.0	Doubtful**

The pulse velocity (V) is given by :

$$V = L / T$$

MOUNTING OF TRANSDUCERS – During the UPV Test, the direction in which the maximum energy is propagated is normally at right angles to the face of the transmitting transducer, it is also possible to detect the pulses which have traveled through the concrete in some other direction. The receiving transducer detects the arrival of component of the pulse which arrives earliest. This is generally the leading edge of the longitudinal vibration. The possible manners in which the measurement of the pulse velocity by placing two transducers is disused below:

DIRECT TRANSMISSION: This arrangement is the most perfect arrangement in which the transducers are kept directly opposite to each other on opposite faces of the concrete. The energy transfer is maximum in this arrangement.

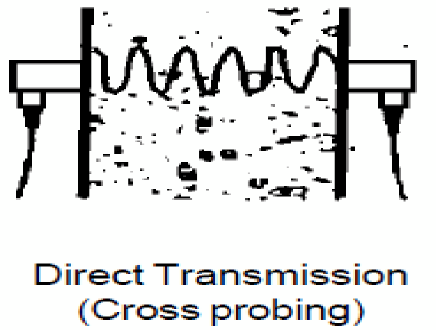

Fig1: Direct Transmission

INDIRECT OR SURFACE TRANSMISSION:

This arrangement should be used when only one face of the concrete is accessible (when the other two arrangements are not possible). It is the least sensitive of the three arrangements. For a given path length, the receiving transducer gets the signal of only about 2% or 3% of amplitude that is produced by direct transmission.

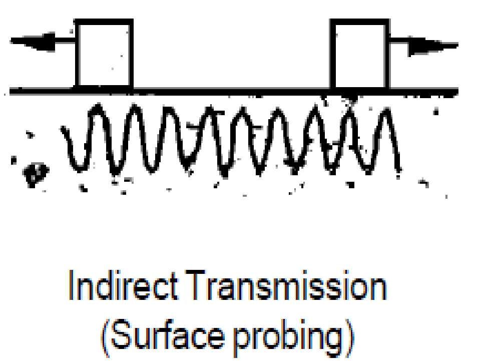

Fig2: Indirect or Surface Transmission

SEMI-DIRECT TRANSMISSION: This arrangement is used when it is not possible to have the direct transmission (May be due to limit access). It is less sensitive as compared to the direct transmission arrangement. There may be some reduction in the accuracy of the path length measurement, still it is fund to be sufficiently accurate. Otherwise this arrangement is similar to the direct transmission arrangement.

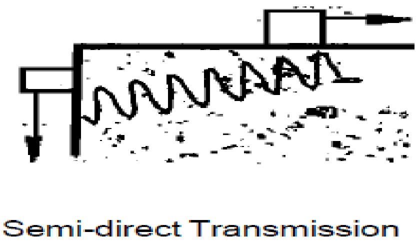

Fig3: Semi-Direct Transmission

IV. RESULTS AND DISCUSSIONS

The results as obtained after performing the Concrete Core Cube Tests are tabulated below

Table1: Concrete Core Tests Results

Sample No	Diameter (mm)	Length (mm)	Mass (gm)	Area (mm2)
1	100	200	5210	7857.14
2	100	200	5290	7857.14
3	100	200	6402	7857.14
4	100	200	6436	7857.14
5	100	200	6368	7857.14
6	100	200	6398	7857.14
7	100	200	6390	7857.14

Density	Crushing Load (kN)	Correction Factor	Cylindrical strength of Core (Mpa)	Corrected Cylindrical strength of Core (Mpa)	Cube Strength (Mpa)
3.32	102.2	1.00	13.01	13.01	16.26
3.37	110.5	1.00	14.06	14.06	17.58
4.07	138.2	1.00	17.59	17.59	21.99
4.10	99.1	1.00	12.61	12.61	15.77
4.05	114.1	1.00	14.52	14.52	18.15
4.07	66.9	1.00	8.51	8.51	10.64
4.07	42.5	1.00	5.41	5.41	6.76

The comparison of the results so obtained are shown graphically. The graphs are prepared between different parameters.

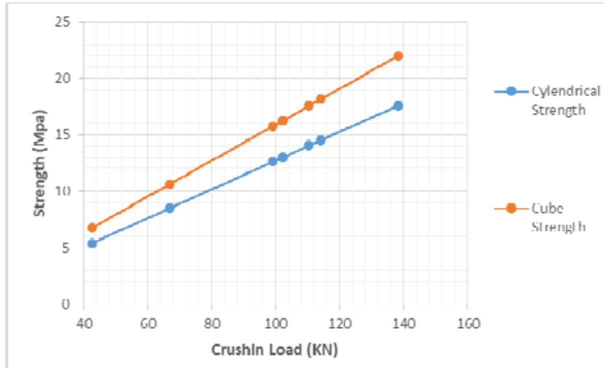

Fig4: Graph between Crushing Load and Strength for Cube and Cylinder

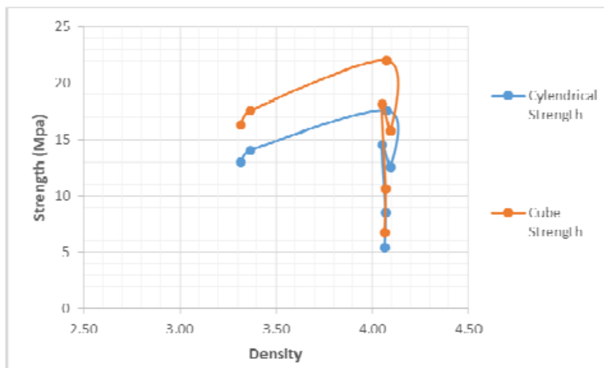

Fig5: Graph between Density and Strength for Cube and Cylinder

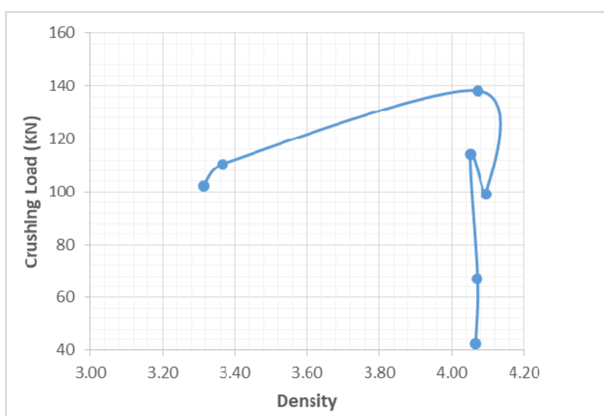

Fig6: Graph between Density and Strength

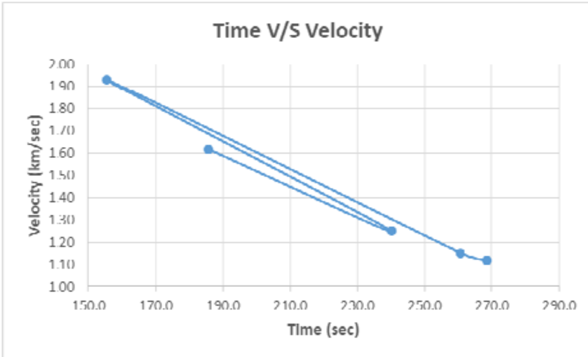

Fig7: Graph between Time and Velocity (km/sec.)

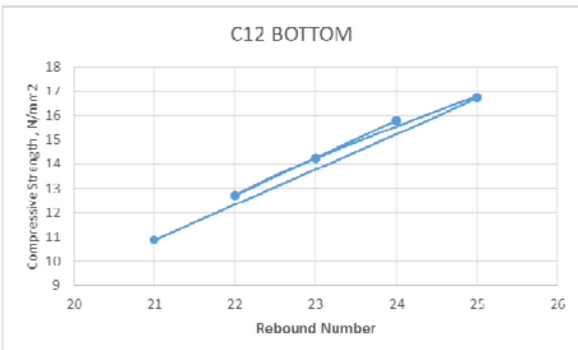

Fig8: Graph between Rebound Hammer and Compressive Strength N/mm^2 for Column12 (C12)

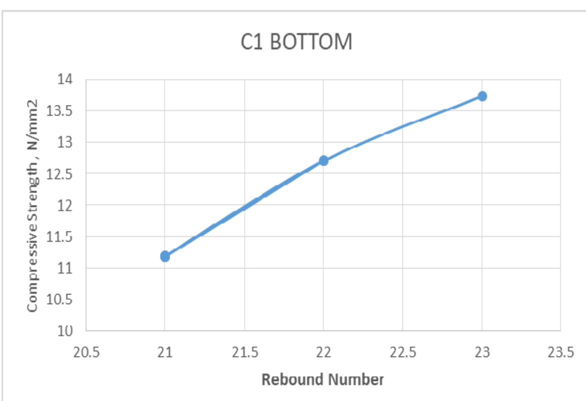

Fig9: Graph between Rebound Hammer and Compressive Strength N/mm^2 for Column1 (C1)

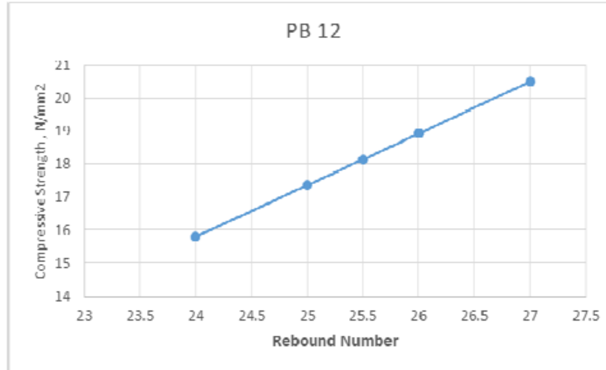

Fig10: Graph between Rebound Hammer and Compressive Strength N/mm^2 for PB 12

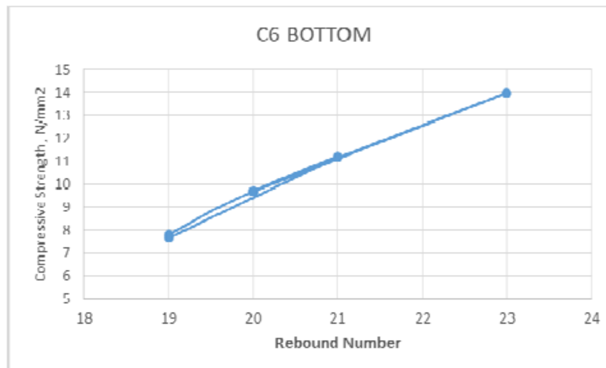

Fig11: Graph between Rebound Hammer and Compressive Strength N/mm^2 for Column6 (C6)

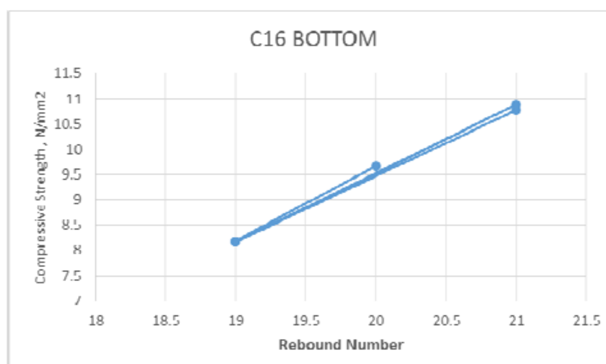

Fig12: Graph between Rebound Hammer and Compressive Strength N/mm^2 for Column16 (C16)

V. CONCLUSION

In this study various tests were conducted on the dilapidated abandoned building to check for the possibility if the future construction and the strength of the building. From the test results it can be concluded, that the rebound hammer method provides a convenient and rapid indication of the compressive strength of concrete by means of establishing a suitable correlation between the rebound index and the compressive strength of concrete. The rebound number increases as the strength increases. It is also pointed out that rebound indices are indicative of compressive strength of concrete to a limited depth from the surface. If the concrete in a particular member has internal micro cracking, flaws or heterogeneity across the cross-section, rebound hammer indices will not indicate the same. The probable accuracy of prediction of concrete strength in a structure is + 25 % (tolerance). Ultra-sonic Pulse Velocity: The test result was conducted on the structure shows are majority of location concrete are poor to doubtful. The minimum requirement of Medium to Good quality concrete is 3.0 to 3.5 km/sec and above. Almost buildings Rebound Hammer Test result indicates residual of the structure of the buildings are ranging from 6.0 N/mm2 to 14.0 N/mm2. Concrete core results are shown very much less compressive strength say 5.4 N/mm2 to 17.6 N/mm2. Reinforcement of Most of the structures are deteriorates and start corrosion on steel. Ultrasonic Pulse Velocity (UPV) and Rebound Hammer test indicate that the concrete is of poor quality in majority of the locations. Concrete Core Cubes results are also very poor.

REFERENCES

[1] Brown, A., Van der Wiele, T., & Loughton, K. (1998). Smaller enterprises experiences with ISO 9000. International Journal of Quality and Reliability Management, 15(3), 273-85.

[2] Carlsson, M., & Carlsson, D. (1996). Experience of implementing ISO 9000 in Swedish industry. International Journal of Quality and Reliability Management, 13(7), 36-47

[3] Chin-Keng, T. and Abdul-Rahman, H. (2011). Study of Quality Management in Construction Projects, Chinese Business Review. 10(7). 542-552

[4] Haupt, T. C., and Whiteman, D. E. (2004). Inhibiting factors of implementing total quality management on construction sites. The TQM Magazine, 16(3), 166-173.

[5] Jen Chi Lu et. Al.,Estimating the strength of concrete using the Surface Rebound value and design parameters of Concrete material, , Taiwan

[6] ML Gambhir, A textbook of Concrete Technology

[7] Abrahamson, N.A. and Shedlock, K.M. (1997) Overview, Seismol.res.Lett. 68,9-23

[8] Bassioni, H. A. et al. (2004). "Performance Measurement in Construction." Journal of Management in Engineering. 20(2), 42-50

[9] Davis, K. et al. (1989). "Measuring Design and Construction Quality Costs." Journal of Construction Engineering and Management. 115(3), 385-400.

[10]Cheng, E. W. L. et al. (2002). "Establishment of Critical Success Factors for Construction Partnering." Journal of Management in Engineering. 16(2), 44-52

[11]Lee, H. S. et al. (2004). "Impact of Labor Factors on Workflow." Journal of Construction Engineering and Management. 130(6), 918-923.

[12]Kubal, M. T., Engineered Quality in Construction: Partnering and TQM. McGrawHill, 1994

[13]Burati, J. L, Weed, R. M., Hughes, C. S. and. Hill, H. S. (2004). Evaluation of Procedures for Quality Assurance Specifications, FHWA-HRT-04-046, Federal Highway Administration, McLean, VA

[14]The Royal Institution of Chartered Surveyors 1996, BCIS report