Analysis of Concrete M30 by Using Non-Destructive Testing

Ankush Dhiman[1], Saurabh Gupta[2]
[1]*M.tech Student, Department of Civil Engineering, Arni University*
[2]*Assistant Professor, Department of Civil Engineering, Arni University*

Abstract **- Reinforced cement Concrete are most adopted construction material in the world. As the growing usage, requirement of assessment of the Strength of a RCC structure without damages the existing structure needed. This could be because of various reason as importance of the structure heritage or newly build, to check the newly constructed by the contractor the actual strength proposed against the delivered as well as to assess the work of contractor whether it is satisfactory or not.. In order to meet above factors, a study was carried out to compare between Destructive Test (DT) of concrete and Non Destructive Test (NDT) of concrete of grade M30 was carried out.**

A total of 18 concrete cube (150 mm x 150 mm x 150 mm) were cast with concrete mix of grade M30. Out of which on 9 cube were tested for compressive strength with compression machine resulting into destructive testing and 9 cube were also tested non-destructively with Schmidt Rebound Hammer. Compressive strength test results at curing ages of 3, 7 and 28days were collected and analyzed.

This paper represent the study of concrete, its workability, its density, design trials of concrete, compressibility test on concrete and testing the same sample for NDT. The results show a co-relation between destructive testing (compressive strength) and Non-destructive testing at different age i.e. 3 days 7 days and 28 days of concrete of grade M30.

Index Terms **- concrete, destructive, Non-destructive testing, M30 grade.**

I.INTRODUCTION

The construction done by concrete in the present scenario has becoming already costly which is mostly done by using steel called reinforcement cement concrete so is its maintenance as well as rehabilitation. After the assembly of the building i.e. column beams walls slab etc. the strength of concrete decrease that will either be due to environmental factors, penetration of water or stagnation of the water over a specific place or may be due poor quality of material used during the construction as well as due to improper curing done for the fast construction of the structure. The problem arises during the testing of the existing structure as we have access to destructive methods like compressive testing method, flexural testing method adopted in the laboratory as well as semi destructive methods like core cutter methods. More importantly these test can be performed in laboratory and not on the existing structure so there is a need for NDT (Non-destructive Testing). The main objective of the study is to evaluate the properties of concrete mixes and comparing its result with NDT over the same samples of concrete with an aim to develop co relation for the analysis of the structure made with concrete.

II. METHODOLOGY AND MATERIALS

The various types of materials used in this study to cast the concrete include: Fine aggregate or sand, Coarse aggregate or gravel, Cement and Water.

Table 1: Number of cube Tested

Method of Testing	*Age 7*	*Age 14*	*Age 28*
Rebound Hammer (NDT)	3	3	3
CMT (Destructive)	3	3	3

III. RESULT AND DISCUSSION

1. Compressive Strength Tests Result

The compressive test results obtained under compressive test machine (CTM) with different curing ages are shown in table 2

2. Rebound Hammer Test Result

The Schmidt rebound hammer was used to get the hardness of the surface of the concrete which is actually functioning of the concrete strength. The rebound numbers gotten were converted to

compressive strength using the standard conversion graph referring to IS code provision.

Table 2: Compressive strength

Sr no	Testing After	Total Sample tested	Compressive strength			
			Destructive	Avg	Non Destructive Testing	Avg
1	3	1	10	11	9,8,10,12	9.58
		2	11		10,8,12,10	
		3	12		10,9,9,8	
2	7	1	17	17.66	15,14,16,15	15.75
		2	18		15,16,16,17	
		3	18		17,17,15,16	
3	28	1	28	29.33	25,30,29,28	28
		2	30		24,25,25,27	
		3	30		24,32,27,29	

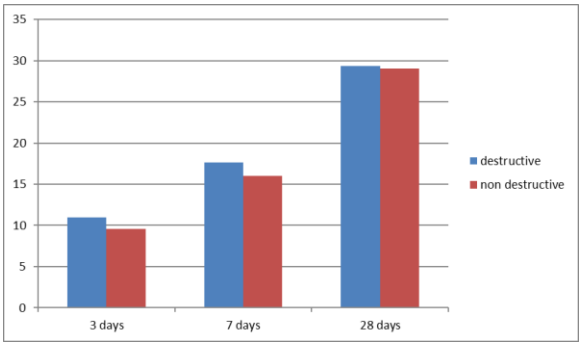

Figure 1: Comparison of average Compressive strength

IV. CONCLUSION

1. The result obtained after testing done on 3rd days over 3 samples shows that destructive as well as non-destructive testing doesn't have a large difference in the result with achieving about 40%
2. The result obtained after testing done on 7th days over 3 samples shows that destructive as well as non-destructive testing does have a large difference in the result that could be due to lack of proper curing done of the sample due to which the packing and rate of gain of strength of concrete had slow down. The sample has achieved strength of about 60%.
3. The result obtained after testing done on 28th days over 3 samples shows that destructive as well as non-destructive testing have achieved the 99% strength and gave approximately same strength.
4. The comparison study of both destructive as well as non-destructive gave a clear idea that NDT testing is reliable and can be used for existing structure for the analysis purpose.

The above report clearly explain both the testing is reliable and can be adopted for the testing purpose as non-destructive has many benefit.

REFERENCES

[1] Hamidian, Mohammadreza, Mahdi Shariati, M. M. K. Arabnejad, and Hamid Sinaei. "Assessment of high strength and light weight aggregate concrete properties using ultrasonic pulse velocity technique." *International Journal of Physical Sciences* 6, no. 22 (2011): 5261-5266.

[2] Hamidian, Mohammadreza, Ali Shariati, MM Arabnejad Khanouki, Hamid Sinaei, Ali Toghroli, and Karim Nouri. "Application of Schmidt rebound hammer and ultrasonic pulse velocity techniques for structural health monitoring." *Scientific Research and Essays* 7, no. 21 (2012): 1997-2001.

[3] Subaşı, Serkan, Ahmet Beycioğlu, Emre Sancak, and İbrahim Şahin. "Rule-based Mamdani type fuzzy logic model for the prediction of compressive strength of silica fume included concrete using non-destructive test results." *Neural Computing and Applications* 22, no. 6 (2013): 1133-1139.

[4] Shih, Yi-Fan, Yu-Ren Wang, Kuo-Liang Lin, and Chin-Wen Chen. "Improving non-destructive concrete strength tests using support vector machines." *Materials* 8, no. 10 (2015): 7169-7178.

[5] Kim, Min Wook, Hongseob Oh, and Kwang Chin Oh. "Estimating the Compressive strength of high-strength concrete using surface rebound value and ultrasonic velocity." *Journal of the Korea institute for structural maintenance and inspection* 20, no. 2 (2016): 1-9.

[6] Sourav, Shah Nur Alam, Salam Al-Sabah, and Ciaran McNally. "Strength assessment of in-situ concrete for the evaluation of structural capacity: State of the art." In *Civil Engineering Research in Ireland Conference (CERI 2016), Galway, Ireland, 29-30 August 2016*. Civil Engineering Research Association of Ireland, 2016.

[7] Sreenivasulu, C., J. Guru Jawahar, and C. Sashidhar. "Predicting compressive strength of geopolymer concrete using NDT techniques." *Asian Journal of Civil Engineering* 19, no. 4 (2018): 513-525.

[8] Safa, M., M. Shariati, Z. Ibrahim, A. Toghroli, Shahrizan Bin Baharom, Norazman M. Nor, and Dalibor Petkovic. "Potential of adaptive neuro fuzzy inference system for evaluating the factors

affecting steel-concrete composite beam's shear strength." *Steel Compos Struct* 21, no. 3 (2016): 679-688.

[9] IS: 10262-1982 (Reaffirmed 2004): Recommended guidelines for concrete mix design, Bureau of Indian Standard, New Delhi-2004.

[10] IS: 13311-1992 (Reaffirmed 2004): Non destructive testing of concrete – methods of testing, Bureau of Indian Standard, New Delhi-2004.

[11] Anterrieu, O., Giroux, B., Gloaguen, E. and Carde, C., 2019. Non-destructive data assimilation as a tool to diagnose corrosion rate in reinforced concrete structures. *Journal of Building Engineering*, *23*, pp.193-206.

[12] Tosti, F. and Ferrante, C., 2019. Using ground penetrating radar methods to investigate reinforced concrete structures. *Surveys in Geophysics*, pp.1-46.

[13] Wahab, A., Aziz, M.M.A., Sam, A.R.M., You, K.Y., Bhatti, A.Q. and Kassim, K.A., 2019. Review on microwave nondestructive testing techniques and its applications in concrete technology. *Construction and Building Materials*, *209*, pp.135-146.

[14] Poorarbabi, A., Ghasemi, M. and Moghaddam, M.A., 2020. Concrete compressive strength prediction using non-destructive tests through response surface methodology. *Ain Shams Engineering Journal*, *11*(4), pp.939-949.

[15] El Masri, Y. and Rakha, T., 2020. A scoping review of non-destructive testing (NDT) techniques in building performance diagnostic inspections. *Construction and Building Materials*, *265*, p.120542