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Assessment Strength of Concrete by Non-Destructive Testing

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ABSTRACT: NDT Rebound hammer test is design to test structure without causing any harm to structure. It gives reasonable fair idea about the existing structure. Hence this test was selected for High School Building at Bhusawal (MS) assessment was done at site and structures as Slab, Beam, Column etc. were assessed and all procedure & precautions were followed as given in IS: 13311 (Part 2) – 1992. No. of points were taken on such structure most relevant results can be observed. It was founded that different results which is represented and reported.

KEYWORDS: Accuracy, Concrete, Compressive Strength, Non-Destructive Testing, Prediction.

I. INTRODUCTION

Non-destructive tests of concrete is a technique to get the compressive strength and other properties of concrete from the existing structures. This test provides immediate results and actual strength and properties of concrete structure. The standard method of evaluating the quality of concrete in buildings or structures is to test specimens cast simultaneously for compressive, flexural and tensile strengths. The assessment of concrete strength in existing construction is important throughout their service life for reasons of restoration, modification etc. The primarily approach to the assessment of such buildings is that the traditional strategies (coring) to estimate strength of concrete.[2] The sector of Non-Destructive Testing (NDT) involves the identification and characterization of damages or defect on the surface and interior of materials while not cutting apart. Concrete is the most widely used materials worldwide in the construction industry due to its strength, possibility to realize all desired shapes and low cost. The concrete in specimens may differ from that in the actual structure as a result of different curing and compaction conditions. Although there can be no direct measurement of the strength properties of structural concrete for the simple reason that strength determination involves destructive stresses, several non-destructive methods of assessment have been developed. These depend on the fact that certain physical properties of concrete can be related to strength and can be measured by non-destructive methods.

II. SCOPE OF NDT

Advances in sensors, development of new materials, and miniaturization of devices are all paving the way for new NDT methods. Data fusion techniques are being developed to integrate several NDT methods in the aim of enabling effective data-acquisition, processing, and interpretation of test parameters in relation to material integrity. Much research interest and industry attention have been devoted to acoustic techniques of NDT. NDT of concrete is increasingly gaining acceptance as a means of evaluating material integrity. Low awareness regarding NDT methods is hindering its uptake and is attributable to a lack of understanding construction materials and NDT methods themselves.[4]

To review most vital NDT methods for determinative the strength of concrete – Rebound hammer. This study provides useful information regarding structural health waiting for the new researchers and engineers concerned about this subject. Rebound hammer test is basically a surface hardness test to find out the compressive strength of concrete by using rebound hammer as per second part of IS 13311:(1992) with little apparent theoretical relationship between the strength of concrete and the rebound number of the hammer. Rebound hammer test the surface hardness of concrete, which cannot be converted directly to compressive strength. The Schmidt rebound hammer or rebound hammer may even be a simple and handy tool, which might be accustomed provide a convenient and quick indication of the compressive strength of concrete. It consists of a spring-controlled mass that slides on a plunger at intervals a hollow housing. The rebound hammer methodology are often used for –



1. Assessing the compressive strength of concrete with the assistance of applicable co-relations between rebound index and compressive strength.
 2. Assessing the uniformity of concrete.
 3. Assessing traditional commonplace of concrete in relevance standard wants.
 4. Assessing the standard of one element of concrete in relevance another.
- The principle that the rebound of associate degree elastic mass depends on the hardness of the surface against that mass strikes.[1]

III. CASE STUDY

3.1 General Information:

A site namely High School Building, Bhusawal has been selected for performing this case study. Now we have selected High School Campus Right side from Main Gate Entrance structures within the site. Overall physical observation of the structures was done visually. In this, the presence of cracks and crevices, etc. were observed thoroughly. Now by dividing building structures into two floors, NDT tests were performed: Rebound Hammer Test. Ultimately, the readings for both the structures were noted down separately. Readings to show the variation in the determined quality and concrete grade of the structures.

Table 1: General Information about site

Location	High School Building, Bhusawal.
Type of Structure	RCC.
Year of Construction	1992-1993 (Approx).
Current Status	Existing Structure has used for School Purpose
Scope for Audit	Foundation RCC Column, Beam, Slab, Staircase units, RCC Pardi, Chajjas.
No. of Floor	G+1 (Ground Floor+ First Floor).
Length of Building	40.0m.
Width of Building	7.5m to 10.90.
Height of Building	10.0m.
Approx Built up Area	750.00 m ²

3.2 Principle of Test

When the plunger of rebound hammer is smoothed against the surface of the concrete, the spring-controlled mass rebounds and so the extent of such rebound depends upon the surface hardness of concrete. The rebound is taken to be associated with the compressive strength of the concrete. The rebound worth is browse off on a graduated scale and is chosen as a results of the rebound vary or rebound index.

The compressive strength area unit sometimes browse directly from the graph having rebound vary on the x axis and compressive strength on the y axis. The rebound scale and graph area unit graduated on the body of rebound hammer.[1]

3.3 Test Procedure

1 For testing, smooth, clean and dry surface is to be selected. If loosely adhering scale is present, this should be rubbed of with a grinding wheel or stone. Rough surfaces resulting from incomplete compaction, loss of grout, spalled or tooled surfaces do not give reliable results and should be avoided.

2 The point of impact should be at least 20 mm away from any edge or shape discontinuity.

3 For taking a measurement, the rebound hammer should be held at right angles to the surface of the concrete member. The test can be conducted horizontally on vertical surfaces or vertically upwards or downwards on horizontal surfaces. If the situation demands, the rebound hammer can be held at intermediate angles also, but in each case, the rebound number will be different for the same concrete.

Rebound hammer test is conducted around all the points of observation on all accessible faces of the structural element. Concrete surfaces are thoroughly cleaned before taking any measurement. Around each point of observation, six readings of rebound indices are taken 2nd average of these readings after deleting outliers as per IS 8900: 1978 becomes the rebound index for the point of observation. [1]



Fig.1 Rebound Hammer Graph



Fig.2 Chajja at Ground Floor



Fig.3 Column at Ground Floor



Fig.4 Slab of Class Room at Ground Floor



Fig.5 Beam in Room No. 06 at Ground Floor

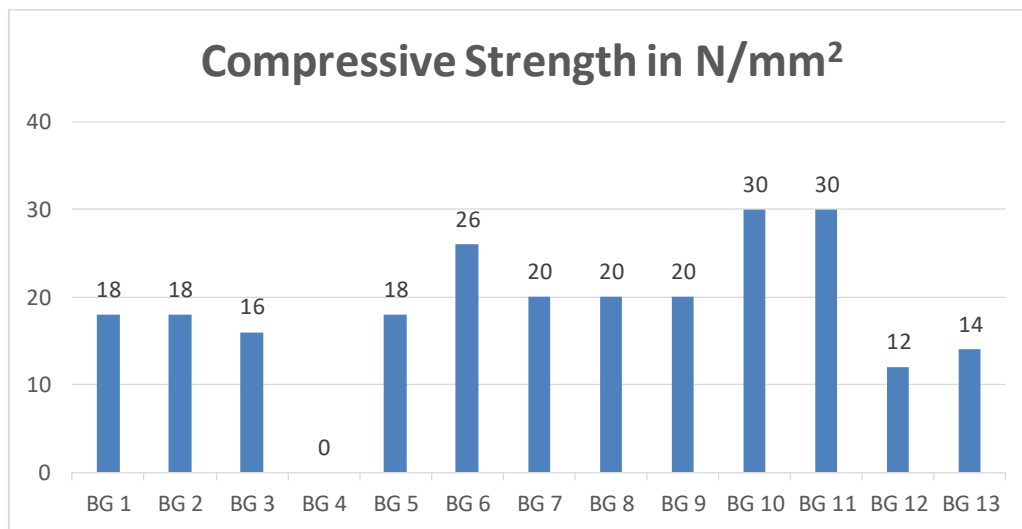
3.3 RESULTS

Table 2: Results of Ground Floor of Building

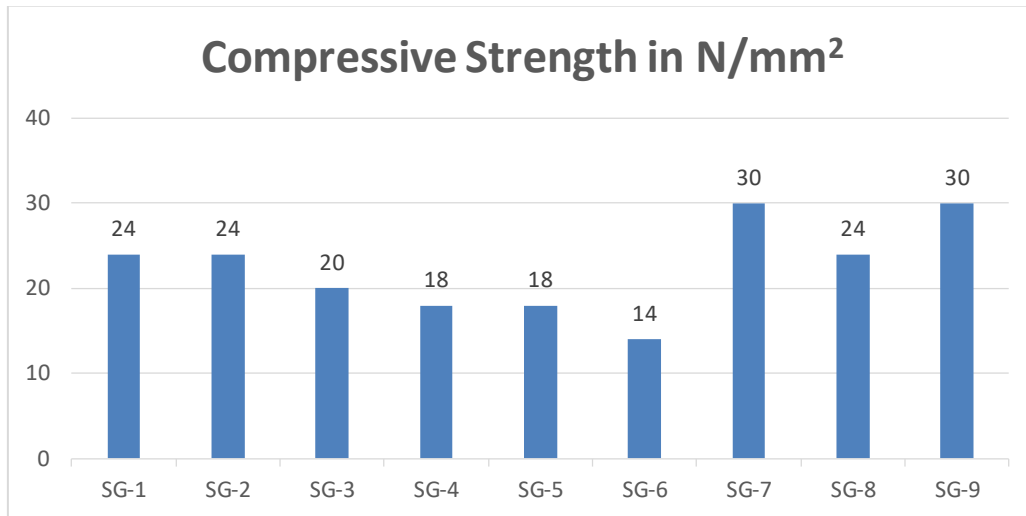
Ground Floor of Building					
Beam					
Sr. No.	Structural Member	Rebound No.	Compressive Strength(N/mm ²)	Location	Remark
1	BG 1	30	18	Room No.2	-
2	BG 2	30	18		-
3	BG 3	24	16		-
4	BG 4	20	0	Room No.3 Projector Room	No Strength
5	BG 5	30	18		-
6	BG 6	30	26	Passage	-
7	BG 7	32	20		-
8	BG 8	32	20		-
9	BG 9	32	20	Passage Beam	-
10	BG 10	38	30		-
11	BG 11	38	30		-
12	BG 12	26	12		-
13	BG 13	28	14		-
Slab					
Sr. No.	Structural Member	Rebound No.	Compressive Strength(N/mm ²)	Location	Remark
1	SG-1	34	24	Room No.2	At various location.
2	SG-2	34	24		
3	SG-3	32	20		



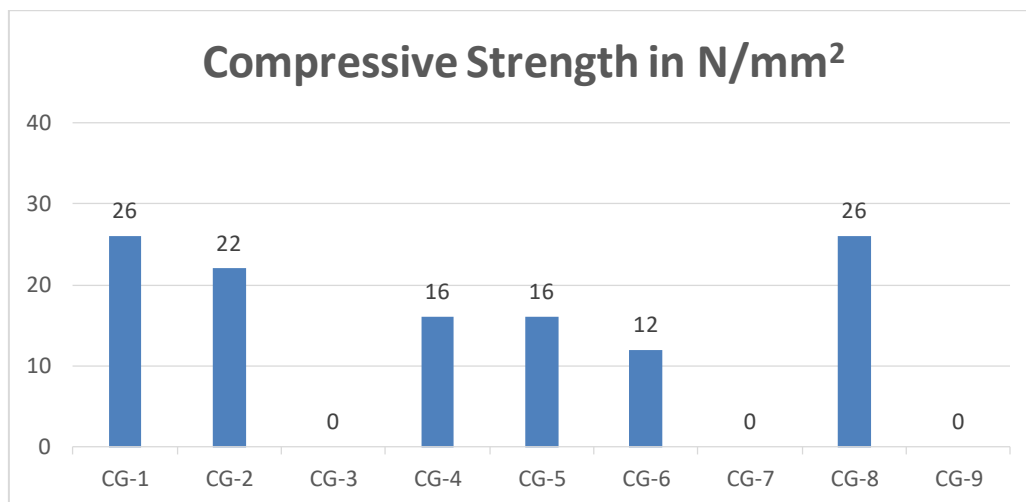
4	SG-4	30	18	Room No.3 Projector Room	At various location.
5	SG-5	30	18		
6	SG-6	28	14		
7	SG-7	38	30		
8	SG-8	34	24		
9	SG-9	38	30		
Column					
Sr. No.	Structural Member	Rebound No.	Compressive Strength(N/mm ²)	Location	Remark
1	CG-1	30	26	Passage Col. 1	-
2	CG-2	28	22	Room No. 2	-
3	CG-3	0	0	Passage Col. 3	No Strength
4	CG-4	24	16	Passage Col. 4	-
5	CG-5	24	16	Room No. 3	-
6	CG-6	22	12	Passage Col. 6	-
7	CG-7	0	0	Passage Col. 7	No Strength
8	CG-8	30	26	Room No. 6	-
9	CG-9	18	0	Passage Col. 9	No Strength



Graph 4: Compressive Strength of Ground Floor Building (Beam)



Graph 5: Compressive Strength of Ground Floor Building (Slab)



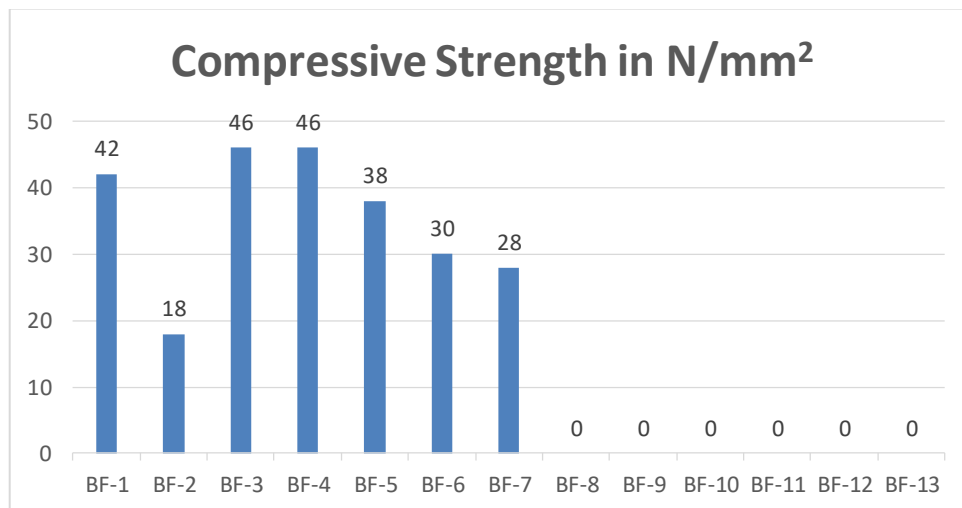
Graph 6: Compressive Strength of Ground Floor Building (Column)

Table 3: Results of First Floor Building

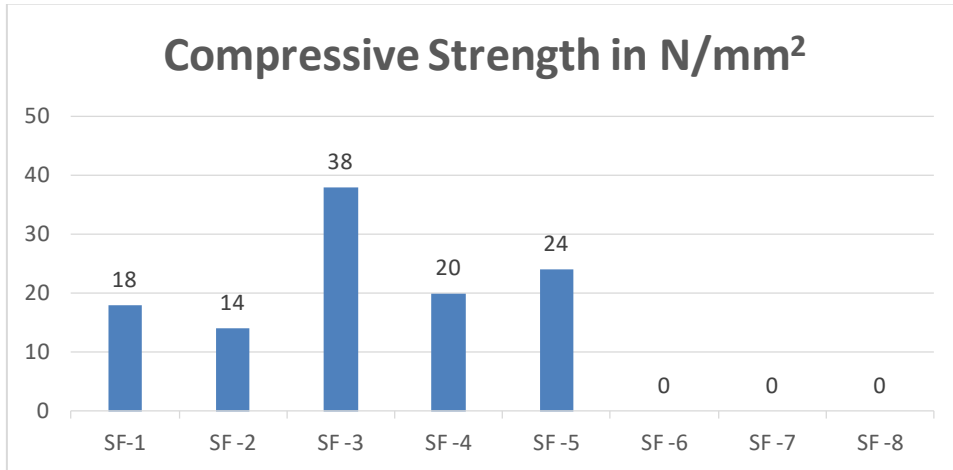
First Floor of Building					
Beam					
Sr. No.	Structural Member	Rebound No.	Strength	Location	Remark
1	BF-1	44	42	Class Room 12 Beam 1	-
2	BF-2	30	18	Class Room 12 Beam 2	-
3	BF-3	46	46	Class Room 11 Beam 1	-
4	BF-4	46	46		
5	BF-5	42	38	Class Room 11 Beam 2	-
6	BF-6	38	30	Class Room 10	One Beam & 2 span of Slab
7	BF-7	36	28		
8	BF-8	20	0	Beam Internal @	No Strength



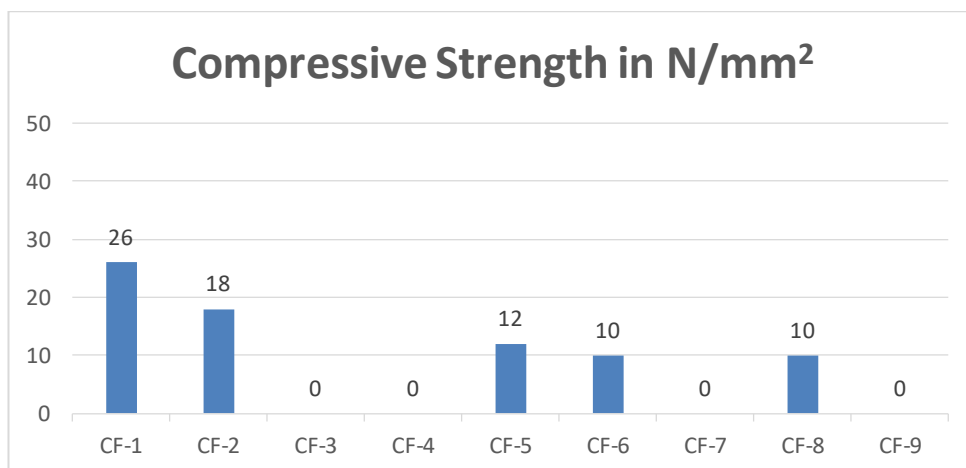
9	BF-9	12	0	Passage	No Strength
10	BF-10	26	0		No Strength
11	BF-11	22	0	Beam Corroded & Reinforcement	No Strength
12	BF-12	20	0		No Strength
13	BF-13	18	0		No Strength
Slab					
Sr. No.	Structural Member	Rebound No.	Strength	Location	Remark
1	SF-1	30	18	Class Room 12	At various location
2	SF -2	28	14		-
3	SF -3	42	38	Class Room 11	-
4	SF -4	32	20		-
5	SF -5	34	24	Class Room 8	-
6	SF -6	0	0		No Strength
7	SF -7	0	0		No Strength
8	SF -8	0	0		No Strength
Column					
Sr. No.	Structural Member	Rebound No.	Strength	Location	Remark
1	CF-1	30	26	Class Room 12	-
2	CF-2	26	18	Passage Col. 2	-
3	CF-3	10	0	Class Room 11	No Strength
4	CF-4	12	0	Passage Col. 4	No Strength
5	CF-5	22	12	Passage Col. 5	-
6	CF-6	20	10	Class Room 10	-
7	CF-7	10	0	Class Room 10	No Strength
8	CF-8	20	10	Passage Col. 8	-
9	CF-9	18	0	Passage Col. 9	No Strength



Graph 1: Compressive Strength of First Floor Building (Beam)



Graph 2: Compressive Strength of First Floor Building (Slab)



Graph 3: Compressive Strength of First Floor Building (Column)

IV. DISCUSSION

1. Low strength if found in any section is as reported in remark column.
2. Foundation of Existing Building Showing Minimum Strength.
3. Slab Beam of Ground Floor Strength Variation 0 to 32 N/mm² Maximum observed during testing.
4. RCC Slab of Ground Floor Strength Variation 0, at Room No. 6 Maximum is 34 N/mm².
5. Chajja of First Floor Cracks observed.
6. RCC Column of First Floor in Passage Showing zero Strength Many Places.
7. Slab Reinforcement Rusted in Main area Reinforcement & Distribution Reinforcement Strength is zero observed.
8. Top Slab Damaged due to Heavy Seepages of Water Concrete Section Weak Spalling Concrete of Bottom Section.

V. CONCLUSION

Present strength of structure is determined easily, without harming integrity of structure. It assess different materials used for different structure is caused to usage of structure during testing. It is for the, major structure as high school building having strength between 0 to 34 N/mm². Major loss of structure was founded RCC Structure have columns need jacking. While slab need to be made waterproofing for deterioration of structure. It's been recognized that NDT



plays a crucial role in condition assessment of existing structures, associate degree there has been an pressing want for developing standards for acting NDT ways and for interpretation of NDT results. NDT provides helpful info by revealing hidden or unknown defects, and repair or replacement of RCC structures are often planned in keeping with NDT results.

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