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Condition Assessement of New Building

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Abstract— *It was challenge for the Engineers to meet the demand for modern high rise buildings being constructed with modern architectural planning & R.C.C. Design technique with quality and speed. Due to this mindset, the quality of construction is compromised to large extent, where adequate technique & supervision during the construction was deficient. In this assessment, we have carried out Non Destructive Testing i.e. Ultrasonic Pulse Velocity Test and Rebound Hammer Test on the newly constructed building at Aurangabad for observing critical areas and analyze the condition of structure for saving human lives and life of building. In the present paper, the assessment results are discussed with recommended strengthening scheme. Based upon all the Non Destructive Test results it is observed that existing structure requires repair and retrofitting at few locations. As per Ultrasonic Pulse Velocity Test and Rebound Hammer Test on column it is observed that micro cracks and major honeycombing are present in column.*

Keywords—*Condition Assessment, Non Destructive Testing, Concrete, Failure of Structure*

I. Introduction

We know that, the frame structure is the heart of building. In 20th century, the whole concept of the design has to be changed from "Load Bearing Structure" to "R.C.C. Framed Structure" with modern design and construction concept, warranted by ever growing population and consequent demand for housing with enhanced speed of construction. It was challenge for the Engineers to meet the demand for modern high rise buildings are being constructed with modern architectural planning & R.C.C. design techniques with quality and speed for demanded speedy construction going up every day, the quality of construction is compromised to the large extent, where adequate technique and supervision during the construction was deficient. This resulted quality deficiencies of structure being constructed at many places.

It is interesting to observe that many of the R.C.C. Framed Structure has been observed to show high distress due to lack of quality control during construction. In India, a very large part of infrastructure is made of concrete for providing on the basis of economic and social development.

Now, the term Condition Assessment is defined as to examine the overall condition and performance checkup of the existing structure. It is an imperative tool for knowing the real health and status of the building. During the assessment we observed and investigate all the critical areas etc.

Non Destructive Test (NDT) methods are techniques which plays a virtual role to obtained internal defects, cracks in existing structural members without damaging the object. Non Destructive Test (NDT) is quality assurance management tool which can give impressive results when handle correctly. NDT requires an understanding of various methods available on their capabilities and limitations, knowledge of the relevant standard and specification for performing the test. This NDT techniques is to be used for monitoring the integrity of the structural members throughout its design life.

The main objective of present work is to adopting the Non Destructive Test for assessment of new residential building which is situated at Aurangabad (Maharashtra) with Rebound Hammer Test, Ultrasonic Pulse Velocity Test including Visual Inspection.

II. Methodology

A. Visual Inspection

Visual Inspection plays a virtual role while investigation the condition of building. In Visual inspection we have checked all the building thoroughly which damages we have observed visually. We have generally find out Excess Cover, Seepage, Bad quality of work, improper mixing, Honeycombing, Cracks etc. such as follows:

Fig I Excess Cover observed in Column

Fig ii Exposing Reinforcement & Honecombing in Column-Beam Junction

Fig iii Exposing Reinforcement in Column-Beam Junction

Fig iv Plaster Collapse at Staircase Flight

Fig v Honecombing observing in Beam

B. Rebound Hammer Test

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and therefore the rebound is taken to be related to the compressive strength of the concrete. The rebound is read off along a graduated scale and is designated as the rebound number or rebound index.

The rebound numbers are influenced by a number of factors like types of cement and aggregate, surface condition and moisture content, age of concrete and extent of carbonation of concrete. This procedure is as per IS 13311:1992 (Part-II).

TABLE I. REBOUND CRITERIA FOR QUALITY OF CONCRETE GRADING

Average Rebound	**Quality of Concrete**
>40	Very Good
30-40	Good
20-30	Fair
<20	Poor or Delaminated
0	Delaminated

Fig vi Rebound Hammer Test

C. Ultrasonic Pulse Velocity Test

Ultrasonic Pulse Velocity Test assess the homogeneity and integrity of concrete, the ultrasonic scanning was proposed to assess the following:

1. Qualitative assessemnt of strength of concrete, its gradation in different locations of structural members and plotting the same.
2. Any discontinuity in cross section like cracks, cover concrete delamination etc.

Though pulse velocity is related with crushing strength of concrete, yet no statistical correlation can be applied. The ultrasonic pulse velocity is influenced by path length, lateral dimension of specimen tested, presence of reinforcing steel, moisture content of the concrete. This procedure is as per IS 13311:1992 (Part-I)

Fig vii Ultrasonic Pulse Velocity Test

TABLE II VELOCITY CRITERIA FOR QUALITY OF CONCRETE GRADING

Pulse Velocity	**Quality of Concrete**
>4.5 Km/Sec	Excellent
3.5 - 4.5 Km/Sec	Good
3.0 - 3.5 Km/Sec	Satisfactory
<3.0	Doubtful

III. Results

D. Ultrasonic Pulse Velocity Test

TABLE III ULTRASONIC PULSE VELOCITY TEST RESULT

Sr. No.	**Description**	**No. of Points**	**Ultrasonic Pulse Velocity (Km/Sec)**		
			Max.	**Min.**	**Average**
Basement					
1.	Column	69	2.91	0.97	1.94
2.	Beam	23	3.67	2.13	2.90
3.	Slab	24	3.62	2.96	3.29
Ground Floor					
4.	Column	43	2.75	1.80	2.28
First Floor					
5.	Column	68	3.82	2.03	2.93
6.	Beam	15	3.45	3.06	3.26
7.	Slab	08	3.00	2.63	2.82
Second Floor					
8.	Column	59	3.10	1.75	2.43
9.	Beam	16	3.53	3.16	3.35
10.	Slab	11	3.38	3.06	3.22
Third Floor					
11.	Column	79	3.74	2.53	3.14
12.	Beam	24	3.68	2.61	3.15

It is observed that the Ultrasonic Pulse Velocity Test results with semi direct, indirect and direct method indicates that maximum reading are between 1.94 Km/Sec to 3.35 Km/Sec(Refer to IS 13311(Part I):1992).

E. Rebound Hammer Test

TABLE IV. REBOUND HAMMER TEST RESULT

Sr. No.	**Description**	**No. of Points**	**Rebound Hammer Test**		
			Max.	**Min.**	**Average**
Basement					
1.	Column	126	27.77	18.88	23.33
2.	Beam	54	31.55	19.55	25.55
3.	Slab	36	47.55	35.33	41.44
Ground Floor					
4.	Column	126	23.50	15.56	19.53
First Floor					
5.	Column	126	24.89	16.89	20.89

Sr. No.	Description	No. of	Rebound Hammer Test		
6.	Beam	27	24.88	24.00	24.44
7.	Slab	09	20.00	18.00	19.00
Second Floor					
8.	Column	135	26.22	17.11	21.67
9.	Beam	27	28.66	26.44	27.55
10.	Slab	09	26.00	24.00	25.00
Third Floor					
11.	Column	135	34.00	19.56	26.78
12.	Beam	54	29.33	25.55	27.44
13.	Slab	09	26.00	20.00	23.00

It is observed that in the Rebound Hammer Test maximum readings are confirming M12 to M25 grade concrete (Refer to IS 13311(Part II):1992).

IV. Reasons Of Failure

- Failure due to improper material substandard.
- Failure due to incorrect concrete mix.
- Failure due to lac of curing to the structure while construction.
- Failure due to poor communication between the design professionals involved in conceptual design and those involved in supervision of execution of work.

V. Recommended Strengthening Scheme

As per Ultrasonic Pulse Velocity Test, Rebound Hammer Test including Visual Inspection result, it is recommended to do grouting for all the columns with Micro Fine Cement & Epoxy Resin (Non Shrink free flow low viscocity solvent free epoxy grouting required or high molecular thermo set polymer grouting) as per methodology and specification given as follows:

A. Micro Fine Cement Grout to Columns

Providing and injecting Micro Fine Cement Grout in the ratio by grouting pump at a pressure @ 3-7 Kg/Cm^2 or as instructed by Engineer-in-charge etc. complete by considering 200mm x 200mm c/c grid along honeycombing areas and 150mm x 150mm c/c grid along cracks.

B. Epoxy Resin Grout to Column

Providing and injecting low viscosity solvent free epoxy in the ratio by grouting pump at a pressure @ 3-6 Kg/Cm^2 or as instructed by Engineer-in-charge etc. complete by considering 200mm x 200mm c/c grid along honeycombing areas and 150mm x 150mm c/c grid along cracks.

C. Damaged Concrete Cracks

Open the cracks into "V" groove. Then providing and applying Epoxy + Silica Sand 1:2 mortar at the groove and finish at all heights, levels and surface etc. complete.

D. Micro Concrete

Providing and applying 50/100/150mm micro concrete as per specification or as instructed by Engineer-in-charge etc. complete.

VI. Conclusion

As per detailed systematic methodology while conducting condition assessment of new building at Aurangabad. This includes Visual Observation, Ultrasonic Pulse Velocity Test and Rebound Hammer Test on columns, beams and slabs for assessing compressive strength of concrete with correlation between rebound index and compressive strength based upon the obtained test results.

It is observed that the Ultrasonic Pulse Velocity Test results with direct, indirect and semi direct method indicates that maximum reading are between 1.94 Km/Sec to 3.35 Km/Sec(Refer to IS 13311(Part I):1992). It is

also observed that in the Rebound Hammer Test maximum readings are confirming M12 to M25 grade concrete (Refer to IS 13311(Part I):1992). Based upon all Non Destructive Test building structure required repair and retrofitting at few locations because of micro cracks and major honeycombing are present in maximum columns.

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