

Condition Assessment of Old Residential Police Quarters

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Abstract:-Now a days testing and quality checkup are important at several stages during life of a structure for property maintenance of the civil infrastructure. Existing structure is situated at Nagpur city which was constructed at 1978. It has multistory (G+3) RCC framed structure which is used for accommodation to the police constable of hereby area. As per detailed methodology Ultrasonic pulse velocity test was adopted for analyzing homogeneity of concrete, presence of cracks, voids and other imperfections. Rebound

I. Introduction

Now a days testing and quality checkup are important at several stages during life of a structure for property maintenance of the civil infrastructure. It is very interesting to observe that many RCC framed structures have shown high distress due to lack of quality control during construction. Now, the term condition assessment is defined as to examine overall condition and performance of existing structure. It is very essential and imperative tools to assess the structure thoroughly [2]. Existing structure shown in fig. 1 is situated at Nagpur city which was

hammer test for assessing probable compressive strength, cover meter test for locating and detecting bar location and spacing; half-cell potentiometer test for calculating corrosion level of reinforcement, carbonation test for knowing the availability of carbonation in concrete. From the entire test it is recommended that the existing structure is need to be repair immediately as per their observation and results.

Keyword: *NDT, Condition Assessment, Distress Reinforced Cement Concrete, Grouting, Jacketing*

constructed at 1978. It has multistory (G+3) RCC framed structure which is used for accommodation to the police constable of hereby area [3]. As a part of maintenance they have done tenable repair of existing structure. The main objective of the paper to adopt Ultrasonic Pulse Velocity Test, Rebound Hammer Test, Cover Meter Test, Chemical Test, Analyzing depth of the carbonation, Half Cell potentiometer including Visual [1] observation to analyse the distress in building such as RCC structure damages, Cracks, Spalling, Seepage, Vegetation, Settlement, Atmospheric reactions.



Fig.1 Existing Building

II. Methodology

A. Visual Inspection:

In Visual observation, we have check all the building thoroughly from inside and outside area to calculate the causes of the deterioration and distress of existing structure. Such as RCC structural damages, cracks, spalling, seepages, vegetation, settlement, atmospheric reactions etc. Describe in Fig. 3[5]



Fig.2 Visual Inspection

B. Rebound Hammer:

The rebound hammer In Fig.3 is one of the most popular non-destructive testing methods used to investigate concrete. It is conducted around all the points of observation on all accessible faces of structural element. Concrete surface are thoroughly cleans before taking any measurement. Around each point of observation, six reading of rebound indices are taken and average of these after deleting outliers as per IS 8900:19798 becomes the rebound index for the point of observation. The rebound numbers are influenced by a number of factors like type 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)[9].Shown in Table No. 1

Table.1: - 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. 3
Rebound Hammer

C. Ultrasonic Pulse Velocity Test:

The ultrasonic pulse velocity method is used for non-destructive testing of plain reinforced and pre-stressed concrete whether it is precast or cast in-situ. Object: The main object of ultrasonic pulse velocity method are to established

1. The homogeneity of the concrete
2. The presence of cracks, void and other imperfections.
3. Changes in the structure of concrete caused by exposure condition, corrosion, wear etc. Which may occur with time?
4. The quality of concrete in relation to the specified standard requirements.
5. The quality of one element of the concrete in relation to another.
6. The values of the dynamic elastic modulus of the concrete.

The UPV is influenced by path length, lateral dimension of specimen taste, presence of reinforcing steel, moisture content of concrete. This procedure is as per IS 13311:1992(Part -I) [8] (Details in table 2)

Table.2.Velocity criteria for quality of concrete grading

Pulse Velocity	Quality of Concrete
>4.5 Km/Sec	Excellent
3.5-4.55 Km/Sec	Good
3.0-3.55 Km/Sec	Satisfactory
<3.05 Km/Sec	Doubtful





Fig. 4
Ultrasonic Pulse Velocity Test

D. Cover Meter Test

Rebar detector is one of the NDT, which are used to locate the steel bar embedded on concrete before drilling and before take core test. It will indicate rebar location and also will give an indication of the depth of concrete cover. It has the unique real time visualization mechanism, allowing the contractor to actually see the location of rebar's beneath the concrete surface. The features data storage for automatic collection of data to make rebar detection more efficient



Fig. 5
Cover Meter

E. Half Cell Potentiometer:

Half-cell potential test is the corrosion monitoring technique to determine the probability of corrosion with the rebar in reinforced concrete structure. The instrument measures the potential and the electrical resistance between the reinforcement and the surface to evaluate the corrosion activity as well as the actual condition of the cover layer during testing.



Fig. 6
Half-cell

F. pH Carbonation test

This test allows the measurement of depth of carbonation through the surface of concrete. It will indicate the change of pH on freshly exposed concrete surface. The indicator is simply sprayed on the surface to be checked. The indicator will change to pink in uncarbonated concrete and remain colorless when sprayed on carbonated (low pH) concrete.



Fig. 7 phenolphthalein solution

III. RESULTS

A. Ultrasonic Pulse Velocity Test reading before strengthening are founds in between 2.275 km/sec to 3.13 km/sec for Column, (Refer to IS 13311(Part I):1992). So it is observed that Micro Cracks and Major Honeycombing is found in some columns so it is necessary to do strengthening.

Table 3. Ultrasonic pulse velocity test results

Sr. No.	Description	No. of Points	Ultrasonic Pulse Velocity (Km/Sec)		
			Max.	Min	Average
Ground Floor					
1.	Column	13	2.14	3.31	2.275
First Floor					
2.	Column	9	2.47	4.13	3.3
Second Floor					
3.	Column	12	3.05	3.46	3.2
Third Floor					
4.	Column	12	2.86	3.4	3.13

B. Rebound Hammer Test reading before strengthening at maximum location it is indicate that the Compressive Strength are found between M10 to M15 (Refer to IS 13311(Part II):1992). So it is observed that some columns are weak on the basis of obtained compressive strength with the help of Rebound Hammer Test

Table 4. Rebound hammer test results

Sr. No.	Description	No. of Points	Rebound Hammer Test			Probable Compressive Strength (N/mm ²)
			Max	Min	Average	
Ground Floor						
1.	Column	18	32	20	25	13
First Floor						
2.	Column	18	26	18	22	10
Second Floor						
3.	Column	18	32	20	26	15
Third Floor						
4.	Column	18	26	18	22	10

C. The cover meter test readings are in acceptable limits (Reading in table 5)

Table 5. Cover meter test results

Sr. No.	Description	Cover to the Reinforcement in (MM)
1.	Column A4	25,28,23,24,,16,21
2.	Column A2	25,40,41,35,22,19
3.	Column A6	17,21,27,52,20,22
4.	Column A8	26,24,30,34,20,22

D. As per pH of concrete and carbonation of concrete, the pH of cover concrete is reduced and active corrosion of reinforcement observed at maximum locations.

Table 6. pH carbonation test results

Sr. No.	Description	Potentiometer MV		pH
		40mm	80mm	
1.	Column A6	-121	-142	8.25 to 10.75
2.	Column A4	-139	-149	9.38 to 11.37
3.	Column B5	-127	-139	10.97 to 11.99
4.	Column A7	-97	-112	8.70 to 11.51
5.	Column B3	-107	-139	9.11 to 10.77

E. As per Hall Cell potentiometer test on reinforcement it is observed that all the readings are range from -197 MV to -401MV.

Table 7. Half cell potentiometer

Sr.No.	Particulars	Half Cell Potentiometer
1.	Column A4	-291
		-306
		-255
		-359
		-351
		-401
		-321
2.	Beam	-332
		-197
		-309
		-217
		-223
		-255
		-321
		-358
		-321

IV. Observation

1. Improper material substandard used while construction.
2. Building has done tenable repairs without analyzing the behavior of structure.
3. High corrosion in column , beam and slab at maximum locations.

4. High seepage observed at kitchen , toilet and bathroom walls.
5. High vegetation at the back side of building.
6. The building has many construction deficiencies.
7. Slab leakage (Terrace).

V. Recommendation

- 1) Terrace-Acrylic polymer modified cement based waterproofing with fiber glass mesh.
- 2) External Plaster- a. Patches repair with modified cement plaster.
b. Provide rough cast cement plaster in two coats 12mm to 15mm thick with base coat
- 3) Structural Repairs-
a. Column -125mm thick M25 conventional and 60mm thick Mirco-Concrete to the column. After grouting both cement based and epoxy based.[5]
b. Beam-Anti corrosion treatment, epoxy based grouting , modified polymer plaster, repair.
c. Slab-Anti corrosive treatment , patch repair with modified polymer plaster.
d. Plumbing-New plumbing installation recommended.
e. Chajja -repair with micro-concrete or polymer modified plaster or recasted as per requirement.
f. Bathroom and Toilet-Brick bat coba waterproofing grouting, waterproof bedding 25mm thick

VI. Conclusion

As per detailed methodology, we adopted Ultrasonic pulse velocity test for analyzing homogeneity of concrete ,presence of cracks , voids and other imperfections ,rebound hammer test for assessing probable compressive strength, cover meter test for locating end detecting bar location and spacing; half-cell potentiometer test

for calculating corrosion level of reinforcement , carbonation test for knowing the availability of carbonation in concrete.

It is observed that the Ultrasonic pulse velocity results with direct and indirect method indicates that the readings are between 2.275 km/sec to 3.13 km/sec (refer to IS 13311(Part 1):1992).The quality of concrete is Medium and doubtful at maximum locations.

As per the rebound hammer test ref.IS 13311(Part 2):1992 "all the readings are confirming M10-M15 grade of concrete. As per pH of concrete and carbonation of concrete, the pH of cover concrete is reduced and the passive layer over the reinforcement is not intact and active corrosion of reinforcement observed at maximum locations, Carbonation depth has reached upto to the reinforcement level. As per Hall Cell potentiometer test on reinforcement it is observed that all the readings are range from -197 MV to -401MV.This indicated corrosion has started in the reinforcement and exceeds the acceptable limits.

From all the test it is recommended that the existing structure is need to be repair immediately as per their observation and results.

Acknowledgement

I would like to express my special thanks of Gratitude to Shri. Dipak Sontakke, Superintending Engineer, Nagpur Regional Office ,Maharashtra State Police Housing and Corporation Ltd. Shri Amol Dhepe Deputy Engineer, Maharashtra State Police Housing and corporation Ltd. Dr.Dilip P. Mase, Director, P.T. Mase and Associates, Nagpur and Ashish Ganjude, Project Engineer , ,P.T.Mase and Associates, Nagpur who gave me the golden opportunity to do this work which also helped me in doing a lot of research and I came to know about so many techniques and things. I am really Thankful to them.

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