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STRUCTURAL STABILITY AND FEASIBILITY ANALYSIS SUBSEQUENTLY REPAIR AND RETROFITTING OF COMMON EFFLUENT TREATMENT PLANT

Dr Mahipal Burdak

[1]*Structural Consultant Engineer, Dara Construction Company Jodhpur*

Abstract- *For exploring the current hydraulic strength and hydro testing of the Common Effluent treatment Plant and structural safety the detailed visual and Non Destructive observations were made. Applications of NDT techniques in Structures become more precise since these have to assist for more reliable solutions for repairing and retrofitting study. Various visual and NDT techniques are available to achieve the task of reuse of the structures within prescribed safe limits. Being indirect in nature in depth study of these techniques is precondition for both qualitative and quantitative investigation. Visit to site at the time of Non Destructive Testing of Concrete Structures is vital for suitable extrapolations.*

Keywords- *Hydraulic Strength, Hydro Testing, Non-Destructive Testing, Rebound Hammer, Ultra sonic Pulse Velocity, Effluent Treatment Plant*

I. INTRODUCTION

1.1 Problems in structures:

Common Effluent treatment Plant-I is constructed by PX Water Pollution Control Treatment & Research Foundation in 1983. Further the plant was rehabilitated and the data regarding construction and rehabilitation is not available. At Present there are four Common Effluent treatment Plants operating under this foundation named as CETP Unit 1, 2, 3 & 4. Two plants 5 & 6 are under construction. The visit to the site was under taken on request by the concerned department, on 02.04.2017. During visit for discussion and other structural related data the concerned filed engineer and supervisor available and made the visit fruitful.

1.2 Visual observations:

Visual inspection is principally required to plan NDT assessment of the concrete structure. The various units of the structure are badly damaged. The main and secondary reinforcement are exposed at various locations and visible warning cracks are also present in the structure. Concrete cover is also chipped out at various locations as shown later on in the photographs. There could be a number of snags in plant well known to the related engineers and governing body, some of them are: Related to Foundation, Poor design/ detailing, Construction techniques, inferior material, Deterioration due to various reasons, excessive overloading, excessive chemical dowsing, natural devastations etc. Distress in plant can be seen visually at a later stage resulting in physical / chemical changes. Problems may be limited to few treatment plant elements or the plant as a whole. Useless to mention that structure has to be checked and recognized for good and bad quality of concrete, distressed locations in the structure, elementary problems in the structure, terminology of structural elements. Structural health presentation condition valuations can be made using NDT methods.

1.3 User Requirement:

Agency imminent NDT will have certain queries namely- superiority of constructed plant, difficulties in maintains the plant with their reasons, residual strength/ remaining life or the plant, possibility of repair and retrofitting/ remedial measures etc. Before visiting and start the investigation at site some important data is required to obtained from the source if possible, which may help in plan of investigation and interpolation of the results i.e. Age of the structure, reasons for its assessment, geo technical investigation report, Ambient Environment, Design and detailing of the structure, Use of the structure and its repair history etc. This provides certain status to consider appropriate NDT techniques for investigation.

1.4 Techniques Used for Assessment:

Non Destructive Testing techniques available are:

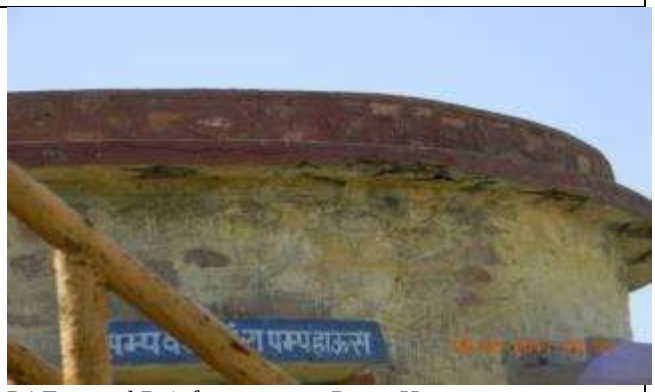
1. Visual observations.
2. Hardness based technique: Rebound hammer etc.
3. Ultra sound wave transmission: Ultra sonic Pulse Velocity.

In reply to client's demand above convinced information was desired. Except two planning drawing nothing could be provided by client for reference purposes. It was decided to inspect the site and carry out NDT with techniques deemed fit.

P1 Corroded Element at Site

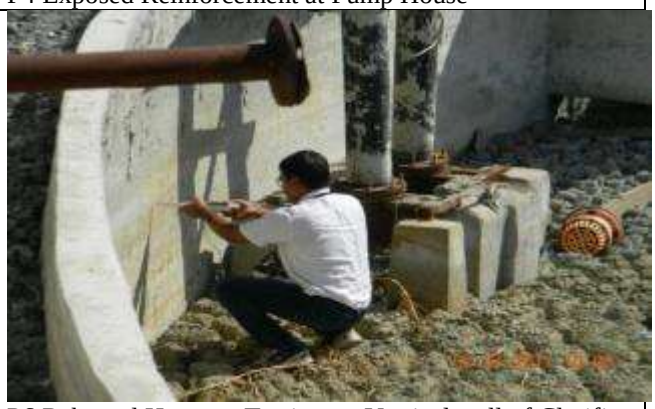
P2 Rebound Hammer at CETP

P3 Visible Crack in Structure

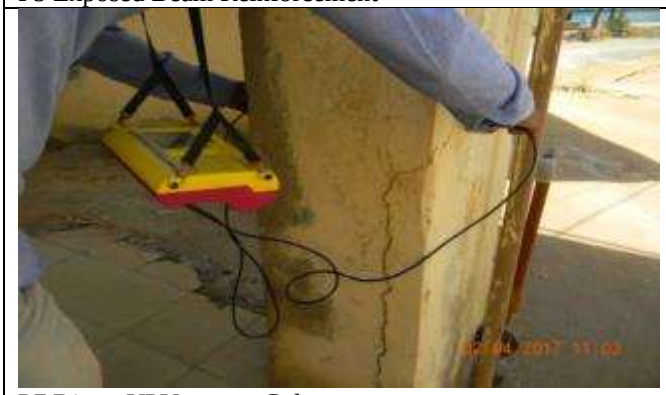


P4 Exposed Reinforcement at Pump House

P5 Exposed Beam Reinforcement



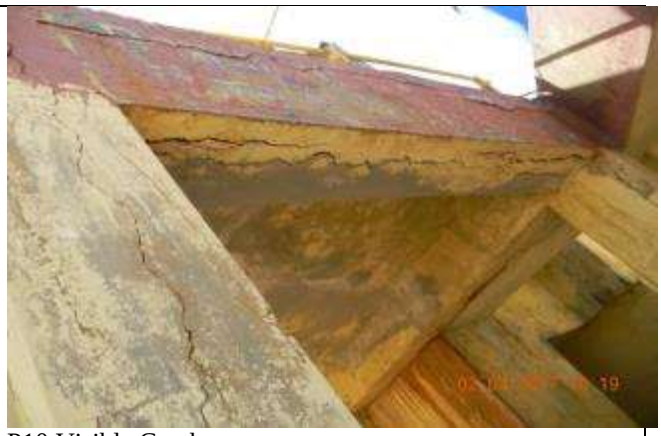
P6 Rebound Hammer Testing on Vertical wall of Clarifier

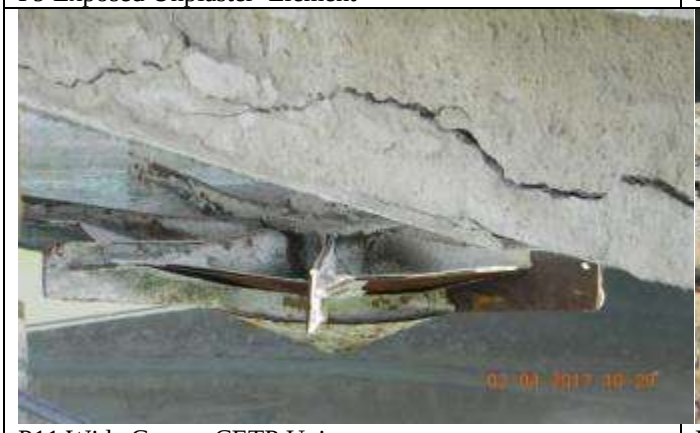


P7 Direct UPV test on Column

P8 Exposed Main & Secondary Rebar without cover

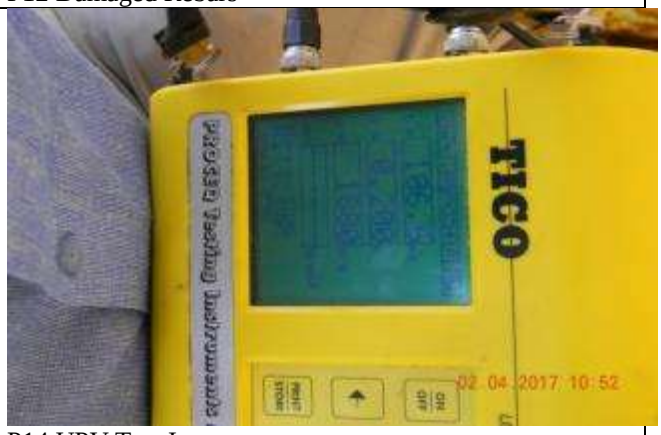

P9 Exposed Unplaster Element


P10 Visible Cracks


P11 Wide Gap at CETP Unit


P12 Damaged Rebars


P13 UPV Testing on Face



P14 UPV Test Instruments

II. PROBLEM STATEMENT

2.1 Work Strategy & Observations:

On the basis of initial site visit it was definite that NDT will be carried out using appropriate machineries available in the institution. Limitations of the study were also deliberated. Schmidt Rebound hammer readings are linked to surface hardness of the concrete and its strength is related using inbuilt calibration curve in the tool. The strength with rebound hammer number not essentially is truly indicative of its compressive strength to the extent shown, these have to be corrected for different factors but it does give comparison of surface hardness for quality of concrete, Refer IS 13311 pt II

Ultrasonic pulse velocity test indicate travel time through concrete continuous media. In Indirect method probes are kept on same side of the surface where velocity may be higher (to the tune of 1000 m/s) if experimental with semi direct or direct observations. Higher pulse velocity indicates better quality of concrete. Difference in velocities obtained by different methods should be compared with corrections as given in IS 13311 pt I.

III. NDT TEST RESULTS

3.1 Schmidt Rebound Hammer Test Results:

SN	*Average Rebound no (6 readings)*	*Maximum Reading*	*Minimum Reading*	*Standard Deviation*	*Related Compressive Strength N /sq mm*	*Remarks*
1.	21	27	2.8	24	15.7	Flat
2.	19	30	4.2	25	17.2	Flat
3.	24	36	4.4	21.6	27.7	Flat
4.	26	31	2.2	29.6	24.4	Flat
5.	33	41	3.0	36.6	36.3	Flat
6.	19	31	4.8	26.6	19.7	Tank Outer
7.	26	37	4.5	33.2	30.4	Tank Outer
8.	28	33	1.9	31.2	27.0	Tank Outer
9.	34	46	4.3	38.8	40.3	Tank Inner
10.	38	46	3.3	42.3	46.9	Tank Inner
11.	31	37	2.8	34.8	33.2	Tank Inner
12.	34	48	5.2	41.2	44.6	Tank Inner
13.	26	43	6.4	33.8	31.5	Tank Inner
14.	30	35	2.0	33.5	30.9	Tank Inner
15.	41	51	4.0	45.2	52.3	Lime Tak
16.	29	36	2.4	31.7	27.8	Pump House
17.	32	39	3.1	34.8	33.2	Pump House
18.	38	45	2.4	41.5	45.3	Pump House
19.	23	28	2.8	26.2	19.0	Clarifier-I
20.	21	32	4.0	27.8	21.6	Clarifier-I
21.	29	40	3.5	31.2	27.0	Clarifier-I
22.	21	28	2.9	26.7	19.8	Clarifier-I
23.	26	32	2.3	28.8	23.2	Clarifier-I
24.	18	33	5.0	24.5	16.5	Aeriation
25.	22	36	4.9	27.3	20.8	Aeriation
26.						
27.	26	40	5.3	33.3	30.6	Clarifier- II
28.	34	46	4.8	41.5	45.3	Clarifier- II
All Reading of RH taken in Horizontal Position only.						

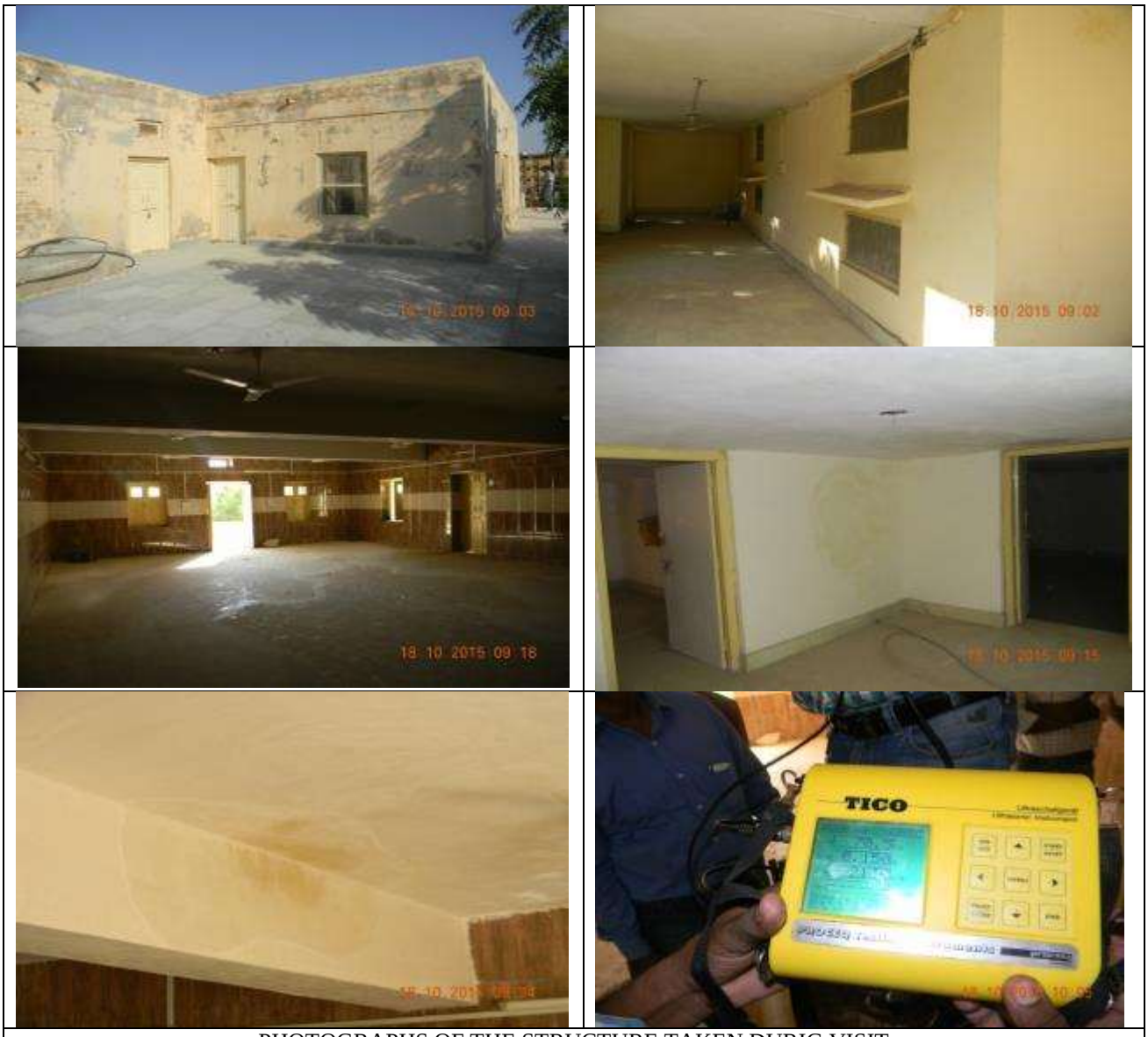
3.2 Ultrasonic Pulse Velocity Test Results:

S N	*Column/Beam No.*	*Path length mm*	*Travel time µ sec*	*Velocity m/sec*	*Remarks/ Method*
1.	200	106.3	1760	-	31.6
2.	200	102.7	1950	-	33.2
3.	200	107.4	1810	-	38.8
4.	200	80.1	2470	-	41.2
5.	350	623.0	560	-	31.7
6.	330	104.7	3150	-	41.5
7.	200	81.8	2450	-	26.2
8.	200	106.6	1880	-	33.3

D- Direct, SD-Semi Direct & ID- Indirect Transmission of Ultra Sonic Pulse Wave

IV. RECOMMENDATIONS/CONCLUSION

It was observed that the plant has lived its active service life. The present status will be uneconomical for repair to suggest, hence the structure may be discontinued to use. It will be in the interest of the trust to build new one. As decided by the governing body and looking the new structure by government in very near future the trust decided to repair the same. After repair with chipped out plaster and exposed rebars the visual inspection is again carried out and the same is presented here in form of photos. There is no meaning to re-conduct the NDT tests after repair as there is no change in the structural integrity of the plant.



PHOTOGRAPHS OF THE STRUCTURE TAKEN DURIG VISIT

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