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Structural Audit on RCC Water Tank Resting On Ground

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ABSTRACT

As water is very important for human life to sustain a healthy life, demand of clean water is increasing day by day. Hence storage of water becomes a crucial thing. For storing purpose the tank must be in good condition. Now days so many incidents happens like water tank bursting, cracking of walls, which is so dangerous. To avoid such tremendous loss, it should be repaired and rehabilitated. This paper represents the case study of a RCC water tank resting on ground. The paper aims on structural audit of water tank and to perform various destructive as well as non-destructive tests on tank. By performing such test the strength is calculated and suitable remedies can be suggested**.**

Keywords **–** Rebound Hammer Test, Core Test, Carbonation Test.

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I. INTRODUCTION

A water tank is used to storing the water, gases and other liquid which is used in various applications. For healthy and safe life, clean water is essential. The corrosion, cracking and deterioration of water tank makes structure weak because of that durability decreases. If the causes of cracking and deterioration of concrete are not identified in a time, there will be chances of falling of water tank or accident may be happen. Therefore repair and rehabilitation is very important. It means renewal the structure by repairing and modifying the damages. It helps to improve the stability and serviceability of structure. Rather to demolish or cast the whole structure, newly inspect the structure & suggest remedies over it which will prove to be economic and wastage of money can be avoided.

II. OBJECTIVE OF STUDY

The following are the main objective:

1. To understand the behaviour of existing water tank by visual inspection.
2. To audit the existing structure.
3. To determine the cause of deterioration of RCC water tank
4. To suggest measures for detective part of tank
5. To find the current strength of water tank by rebound hammer test.
6. To find the internal strength by using core cutter test.

III.METHODOLOGY

TANK DETAILS

The storage tank on which rehabilitation is to perform is situated near Parvati Paytha which is resting on ground of 4.5ML capacity. This tank is located on high level that's why known as high level reservoir water tank. Diameter of tank is 32m and comprises of dome shaped slab. There are 3 ring beam of size (230mmx300mm) provided on column (300mmx300m).The raft of 600mm is provided on PCC .The wall of tank is of 150mm thickness.

FIG.1 Circular Water tank resting on ground

Following are the steps which were carried out on water tank for finding the defects of water tank:-

1. Initial Visual Examination:

- Taking photographs.
- Checking of cracks and corrosion impact

2. Audit the Existing tank structure:

- Collect all original drawings.
- Collecting information about repair works.
- Find inspection report.

3. Field Testing:

- Field testing is done for checking the strength and corrosion effect. With the help of all inspection results, following common test are decided to carry out on water tank.

4. Interpretation of Result:

- By performing all necessary test interpret the result by maintaining a document.

Non-Destructive and Destructive Test

1. Rebound hammer test

Rebound hammer test is used to find out the strength of concrete. It also used to find elastic properties. This test mostly taken on hardened concrete.

With the help of rebound hammer readings (on horizontally, vertically downward position) are taken out, then strength directly taken from graph present on rebound hammer.

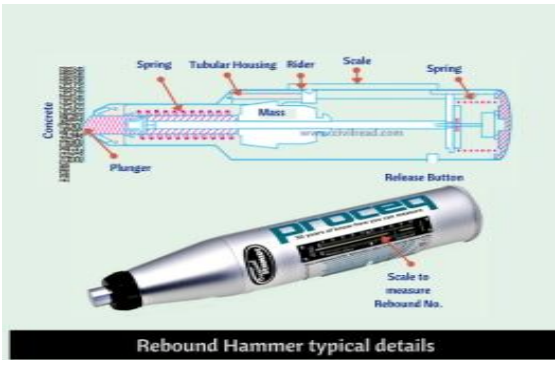


Fig.2 Detailed structure of Rebound Hammer

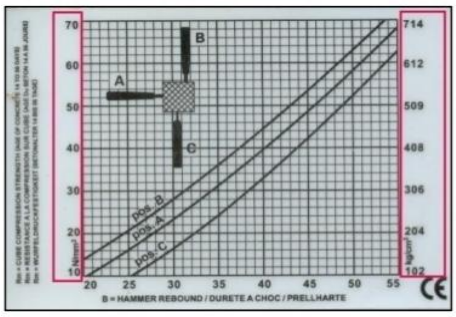


Fig.3 Correlation between Compressive Strength and Rebound Index

Fig.4 Performing Rebound Hammer Test

Fig.5 Recording readings of Rebound Hammer Test

2. Concrete Core test

Core test is also used for finding the compressive strength of concrete. It gives accurate result as compared to rebound hammer test .Take the core samples from the tank and with the help of CTM machine loads are calculated. Then compressive strength is calculated by the formula

Compressive strength = maximum load /cross-Section area

Fig.6 Core Sample

Fig.7 Core cutter machine

3. Carbonation test

When the moisture gets contact with the steel reinforcement it started corroding. To find out the rate of corrosion carbonation test is needed. It is simple and easy process which is carried out on core sample by spraying the Phenolphthalein solution on it.

Fig.8 Spraying of Phenolphthalein on core sample

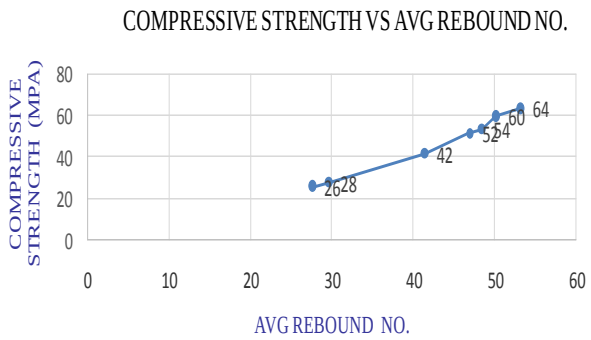
IV.RESULTS AND TABLE

As discussed in methodology, first we have to inspect the tank visually whether there is efflorescence, leaks, cracks or uneven settling but the tank in good condition from outside expects some minor changes.

From inside of tank Columns and Slab Reinforcement is exposed due to presence of chlorine in water we have observed.

Fig. 9 Column and Slab reinforcement is exposed due to Chlorine attack

Graph1. Compressive Strength Vs Average Rebound Index /Rebound Number



Tables 1: Parvati HLR-3 Tank Rebound Hammer Test

	RAFT	WALL					
AVG REBOUND NO.	27.6	29.6	41.4	47	48.4	50.2	53.2
COMPRESSIVE STRENGTH(MPA)	26	28	42	52	54	60	64
AVG COMPRESSIVE STRENGTH(MPA)	27	54.6					

Graph1 indicates the final output of Rebound Hammer Test. The graph plotted is a Compressive Strength Vs Average Rebound Number. The same is reflected in the tabular form .As Rebound Index increases, Compressive Strength also increases.

Table 1 show that Average Compressive Strength and Average Rebound Number for wall and raft. From Renould Number we can predict that the Concrete quality of Raft is fair and for wall it is very

good. The average strength for raft comes out to be 27 MPa and that of wall is 54.6MPa. The test cannot be held very accuracy of prediction of concrete strength in structure is 25%.

This graph signifies that the compressive strength of raft as well as wall is good enough and quality of concrete was also good.

Graph 2: Parvati HLR 3 Core Cutting Test

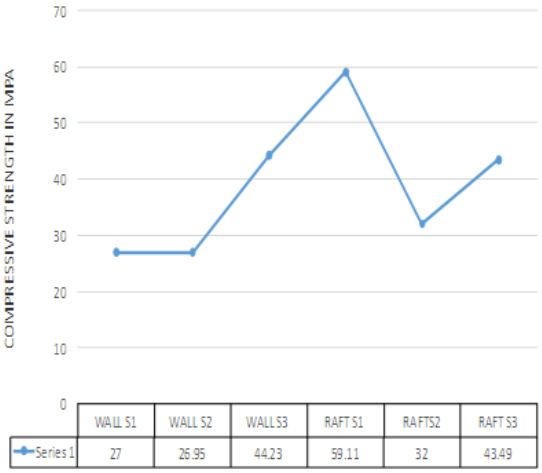


TABLE 2: Parvati HLR-3 Core Cutting Test

ID MARK	W 1	W 2	W3	R 1	R2	R 3
AVG COMPRESSIVE STRENGTH (MPA)	27	26.95	44.23	59.1	32	43.49

Table 2 Where W means wall and R means raft. This table shows that samples of wall and raft which gives average compressive strength. This test gives very accurate result. The average Compressive Strength of Raft was considered as 44.87 MPA and for Wall is considered as 32.73MPA. Hence the Compressive Strength was good enough.

Graph 2 showing the compressive strength of concrete core

TABLE 3: Parvati HLR-3 Carbonation Test

ID MARK	GRADE OF CONCRETE	UNIT	TEST RESULT
WALL S1	20	QUALITATIVE	NO CARBONATION
WALL S2	20	QUALITATIVE	NO CARBONATION
WALL S3	20	QUALITATIVE	NO CARBONATION
RAFT S1	20	QUALITATIVE	NO CARBONATION
RAFT S2	20	QUALITATIVE	NO CARBONATION
RAFT S3	20	QUALITATIVE	NO CARBONATION

Table 3 shows that samples of wall and Raft. No carbonation was seen in core samples; hence the reinforcement was safe from corrosion.

TABLE 4: Parvathi HLR-3Tank RHT and Core Cutting Testing

SAMPLE DESCRIPTION	AVG STENGTH	
	CORE CUTTING	REBUOND HAMMER
RAFT	44.87 N/MM^2	27 N/MM^2
WALL	32.73 N/MM^2	54.66 N/MM^2

This is the final result of Core Cutting and Rebound Hammer Test. The Core Test was more reliable. The average Compressive Strength of Raft was considered as 44.87 N/mm^2 and for Wall is considered as 32.73 N/mm^ 2. Hence the Compressive Strength was good enough. All samples appear Purple so there was no Carbonation hence the reinforcement was safe from corrosion and concrete was well alkaline.

III. CONCLUSION

RCC water tank or structures are damages because of various attacks. Therefore, damaged tank structures are required to repaired and rehabilitated to increase their serviceability. If the structure affected by cracking, corrosion then a proper treatment is needed for restoring the strength. The test which was performed on water tank helped to find out compressive strength of the concrete.

From above result, we conclude that there is no need of demolition of whole structure. As water tank is in well condition only demolition of Column and Slab are necessary. As raft of old

structure is strong enough it can be used as base foundation and re-rafting can be done on that. RCC walls of tank are good enough in strength but to bind the reinforcement of slab with wall reinforcement, the walls should be cut to open the reinforcement up to lap length i.e. about 0.6m.Rather to demolish the whole structure .Rehabilitation of tank would be cost worthy and can attain the desired strength and durability. So the for "Repair and Rehabilitation of water tanks" result into a fruitful outcome.

Fig.9 Group photo with an Engineer.

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