International Journal of Civil Engineering and Technology (IJCIET)
Volume 15, Issue 4, July-Aug 2024, pp. 1-7, Article ID: IJCIET_15_04_001
Available online at https://iaeme.com/Home/issue/IJCIET?Volume=15&Issue=4
ISSN Print: 0976-6308 and ISSN Online: 0976-6316
Impact Factor (2024): 21.69 (Based on Google Scholar citation)

REPAIR AND REHABILITATION OF AN INSTITUTIONAL BUILDING: A CASE STUDY

Mayuri D. Gaikwad
Student of PG Dept. of Civil Engineering,
S.K.N. Sinhgad College of Engineering, Korati Pandharpur, Maharashtra, India

Dr. S. S. Kadam
H.O.D, Dept. of Civil Engineering,
S.K.N. Sinhgad College of Engineering, Korati Pandharpur, Maharashtra, India

ABSTRACT

In India there are infinite old structure that are at the verge damages. Every Structure having a certain service life. This life depends on different provision and factors like seepage or leakage, Chemical formation, carbon formation from the air and environment exposure condition, cracking, disjoining corrosion etc. This factor directly affected on structure and the reduced the service life of structure Also, affected the steel and concrete. Hence the very important to the inspect and maintenance condition of these structure from every time to time Purpose of this paper various test carried during structural auditing and justify the advance technic or method of repair and rehabilitation of existing structure those are deterioration due to corrosion.

Keywords: Structural Audit, Rehabilitation, Corrosion, Repairs, CFRP Laminates.

Cite this Article: Mayuri D. Gaikwad and Dr. S. S. Kadam, Repair and Rehabilitation of An Institutional Building: A Case Study, International Journal of Civil Engineering and Technology (IJCIET), 15(4), 2024, pp. 1-7.
https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_15_ISSUE_4/IJCIET_15_04_001.pdf

1.INTRODUCTION

A civil infrastructure is a model of linked, associated element that from together a system which can carry the external load on it. There are many building which have reduced their strength due to time passes, due to deterioration of concrete from structure element, Due to developed cracks replacing and developing cracks. It might threaten people and creatures. So suitable activity should be actualized to improve the exhibition of structure and re-establish the ideal capacity of structure. To control this problem a structural audit, have to do after 15 or 20 years to know the quality of building and materials used. Structural audit safeguard that the building is guarded and haven't dangerous. Structural audit consists of testing like Ultrasonic pulse velocity test, rebound hammer test, pH test, etc. from this test result come to know the quality of concrete, strength of concrete and condition of reinforcement.

According to this we can strengthening and modify structural element to regain its capacity and withstand longer. Use of structural auditing in future can help in limiting damages to structure and life as well This paper covers the study and type of tests conduct for structural Auditing of an old structure A civil infrastructure is a model of linked, associated element that from together a system which can carry the external load on it. There are many building which have reduced their strength due to time passes, due to deterioration of concrete from structure element, due to developed the crack. It might threaten people and creatures. So suitable activity should be actualized to improve the exhibition of structure and re-establish the ideal capacity of structure. To control this problem a structural audit, have to do after 15 or 20 years to know the quality of building and materials used. Structural audit safeguard that the building is guarded and haven't dangerous. Structural audit consists of testing like Ultrasonic pulse velocity test, rebound hammer test, pH test, etc. from this test result come to know the quality of concrete, strength of concrete and condition of reinforcement. According to this we can strengthening and modify structural element to regain its capacity and withstand longer. Use of structural auditing in future can help in limiting damages to structure and life as well This paper covers the study and type of tests conduct for structural Auditing of an old structure.

2.STRUCTURAL AUDIT

Structure audit is most important to perform of existing Building and to implement maintenance /repair work timely which will lead to prolonged life of the building and safety of the occupant

2.1. Need of Structural Audit

1] To increase life of property

2] To know the health of structure and its anticipated life

3] To check effective dependability of the structure.

4] In order to recommend rehabilitation methods

5] In order to point to the critical regions and repair them instantly.

6] For structural inspection certificate needed by municipality and other administrations.

2.2. Tests

Various tests are meant to determine the distress level of any existing structure or to rectify the defects in members. The strength and quality of the structural components can be determined by use of Non- Destructive tests and Destructive tests. There are various instruments available to determine at what extent the damage has been caused to the components. The evaluation and interpretation of test data is explained in detail, that helped the structural auditor to arrive at a level of concern in structure further.

2.3. Non-Destructive tests

These tests are assembly of convenient tests used to determine the strength and quality of materials used in construction without damaging the structure.

A} Half- Cell Potential Test

This test is used to determine the possibility of corrosion arising in the member. This NDT test is used for measuring the potential of corrosion. The probability of the corrosion occurring or not in the steel embedded in concrete can be determined from the corrosion potentials. Half-cell test includes determining the potential of a steel bar in concrete with the reference of half-cell such as copper sulphate electrode.

Table -1: Relationship between the potential values andprobability of corrosion

Measured Potential (mV CSE)	Probability of steel corrosion
>-200	Lesser than 10%(Initial Phase)
-200 to -350	10% to 90% (Transit Phase)
<-350	Greater than 90%(Final Phase)

Figure 1: Half-cell measurement test

Table -2: Observations of Ultrasonic Pulse Velocity Test

Sr. No.	Description	Potential Value (mV)	Remark
1	Beam - 01	-310	Transit Phase
2	Beam - 02	-225	Transit Phase

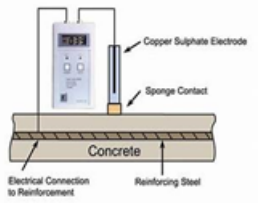

Figure 2: Half-Cell test

B}. Ultrasonic Pulse Velocity Test

This method is based on the transmitting the pulsein the material or components. This method is based on the utilization of tools consisting of transducers. It provides information about the corrosion prone locations or occurrence of

Porosity in the material. UPV test comprises of measuring time of travel of a pulse ranging between 25 kHz to 60 kHz, ASTM C876 provides a guideline on measurement of potential values.

$V = L/T$

Where,

V = Pulse Velocity in longitudinal direction

L = Path Length (mm)

T = Time taken to travel the length

Table -3: Observations of Ultrasonic Pulse Velocity Test

Beam No.	Method of transmis -sion	Path length [mm]	T (μs)	Pulse Velocity (kmps)	Concrete Quality
Beam01	Direct	240	71	3.38	Satisfactory
Beam02	Direct	250	75	3.33	Satisfactory

C} Rebound Hammer Test

This test is used to determine the surface hardness of the concrete. The test procedure should be carried according to guidelines provided in IS 13311:1992 (Part II). This test is carried out with the help of rebound hammer. It is a tool used to evaluate the relative compressive strength of concrete based on the hardness of the exposed surface.

Figure 3: Rebound Hammer Test

Table 4: Observations of Rebound Hammer Test

Sr. No.	Description	Strength (MPa)
1.	Beam 01	19.66
2.	Beam 02	24

3. PARTIALLY DESTRUCTIVE TESTS

A) Carbonation Depth Test

Carbonation is the process of transformation of calcium hydroxide in the concrete into calcium carbonate due to reaction with CO2 present in the atmosphere. Through the exposed surface of the concrete, carbonates get penetrated. This process of carbonation in concrete is also termed as de passivation of concrete.

Procedure:

The phenolphthalein method is used to detect concrete carbonation. This test is a simple, economical and widely used method. The only constraint is the minor amount of damage is cause to concrete by drilling a core.

Figure 4.: Carbonation test sample of Beam 01

Table 5: Observations of Carbonation Depth test

Sr. No.	Description	Carbonation Depth (mm)
1.	Beam 01	06
2.	Beam 02	07

B} Concrete Core test

This destructive test gives the direct quality of concrete. Concrete core test is, therefore most trustworthy and decisive. This test must be carried out while carrying .out vital works such as repairing, retrofitting, etc. as it gives clear idea about the condition of the concrete. The observations of core test are shown in Table 6

Figure 5: Core test sample of Beam 01

Table 6: Observations of Core test

Sr. No.	Description	Equivalent cube strength (MPa)
1.	Beam 01	18
2.	Beam 02	16.55

4. OUTCOMES OF STRUCTURAL AUDIT

Repair and rehabilitation of structures is necessary to avoid abrupt failure. Timely maintenance of structures should be worked out in order to maintain the safety and structural integrity of old buildings. Repairs are costly and thus repairs and rehabilitation should be done with identifying the root cause of the damage. In the case study, various tests on damaged beam have been presented to determine the quality of the material.

5. REHABILITATION OF STRUCTURE

Procedure adopted for repair and rehabilitation is as follows:

1. Cover concrete was removed up to reinforcement.

2. Rust remover, SP Rustcleen was applied to the corroded steel to remove the corroded portions of the steel and to stop the further process of corrosion.

3. Potholes and spalled areas were filled with repair mortar, SP Durocon 49. SP Durocon 49 has strength up to 40 N/ mm2 at 28 days of curing.

4. Beams were applied with Carbon Fiber Reinforced Polymer (CFRP) laminates to increase the flexural strength and stiffness of the member.

5.For proper anchoring of the laminates, U shape CFRP wraps were provided.

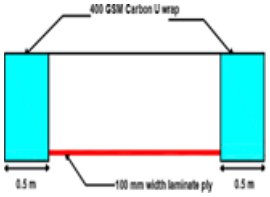

Fig -6: Side view of strengthening diagram

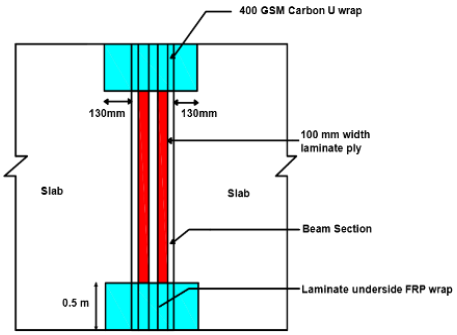

Fig -7: Bottom view of strengthening diagram

Fig -8: After strengthening

6. CONCLUSIONS

Repair and Rehabilitation of structure is very important to avoid the abrupt failure so time to time maintenance necessary of structure should be worked out and maintain the life and safety of structure. Repairs are costly and thus repairs and rehabilitation should be done with identifying the root cause of the damage. This case study adopted various test and proved the deterioration of concrete and corrosion of steel was confirmed the potential value of beam died in250 mv to 350mv this value 95% probability value indicated, method described above can be utilized.

REFERENCES

[1] IS 13311:1992 (Part I) Non-Destructive Testing of Concrete - Methods of Test -Ultrasonic Pulse Velocity.

[2] IS 516:1959 Methods of Tests for Strength of Concrete.

[3] IS 13311:1992 (Part II) Non-Destructive Testing of Concrete - Methods of Test – Rebound Hammer.

[4] Handbook on Repair and Rehabilitation of RCC Buildings.

[5] Rishabh Karnavat and Vivek Singh (2017), “Assessment of Structural Efficiency of an Existing Building Structure by Performing Non-Destructive Tests: A Case Study,” International of Journal Research in Engineering and Technology (IJRET), volume 06, Issue 07|

[6] ISSN: 2278-0181 Structural Audit of a Residential Building Vol 11 {01 April 2022}

[7] e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 14, Issue 3 Ver. VI Rehabilitation of Damaged Reinforced Concrete Beams (May - June 2017),

[8] Van Gemert, D. and Maess Chalk, R., 1983, "Structural Repair of a Reinforced Concrete Plate by Epoxy Bounded External Composites and Lightweight Concrete, Vol. 5, No. 4, Nov. pp. 247-255.

[9] Mays, and Calder, 1989, "External Plates extend reinforcement reach", Concrete Journal. Vol 23, No. 1. ACI Publication SP.61, 1979, "Ferrocement–Materials and application", pp 1-195.

[10] Meier, U., Rehabilitation and Retrofitting of Existing Structures Through External Bonding of Thin Carbon Fibre Sheets.

[11] RILEM Materials and Structures, Vol. 28, No.176, pp. 105-106, March 1995.

[12] Garden, H.N., L.C. Hollaway, and A.M. Thorne, The Strengthening and Deformation Behaviour of Reinforced Concrete Beams Upgraded Using Prestressed Composites. RILEM Materials and Structures, Vol. 3 1, pp. 247-258, 1998.

[13] C. E. Chalioris, C. N. Pourzitidis, C. P. Papadopoulos, and D. Fotis, "Flexural rehabilitation of RC beams using self compacting concrete jacketing," Proceedings of the 2nd International Conference on Civil Engineering and Building Materials, Hong Kong, 2012, Paper ID 257.

[14] Raafat El-Hacha, and Mohamed Gaafar, (2011), "Flexural strengthening of reinforced concrete beams using prestressed, near-surface-mounted CFRP bars" PCI Journal, Fall 2011, 134-157 pp.

Citation: Mayuri D. Gaikwad and Dr. S. S. Kadam, Repair and Rehabilitation of An Institutional Building: A Case Study, International Journal of Civil Engineering and Technology (IJCIET), 15(4), 2024, pp. 1-7.

Abstract Link: https://iaeme.com/Home/article_id/IJCIET_15_04_001

Article Link:
https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_15_ISSUE_4/IJCIET_15_04_001.pdf

✉ **editor@iaeme.com**