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## PREVENTION OF SLAB LEAKAGE WITH CASE STUDY

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**Abstract-** Water leakage is one of the serious causes of common building defects. Water leakage leads to dampness, corrosion of metals, fungal growth and also affects the structural properties of concrete as well as damage the aesthetic view of the structures. It also has an adverse effect on human health by creating unpleasant condition. If water leakage is prevented, almost 80% building defects can be eliminated. In construction, a building or structure can be prevent water leakage with the use of membranes and coatings to protect contents and structural integrity. The strength parameter gets adversely affected because of water leakages. The objective of this study is to analyze the depreciation in strength caused because of water leakage. Further the study is to be focused on selecting an appropriate method to avoid the leakage. Various methods are to be critically examined and a most economical and most appropriate method is selected for repairing the leakage. Strength parameters [using Rebound Hammer method] are again checked after the remedial measures are executed comparative results before and after applying the remedial measures are to be analyzed.

**Keywords**—Waterproofing, Case study, prevention of water leakage, Rebound hammer test, Strengthening test of harden concrete, Ultrasonic Pulse velocity test, Ferro cement cover, external plate bonding, Non destructive test, External post tensioning etc.

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### I. INTRODUCTION

#### 1.1 Structural Leakage of slab:

The term water leakage in the buildings is use to mean the coming out water from components like walls and floors of the building. It is observed in building industry that 99% of water leakage problems are focused on the terrace roof and in the toilets. The water leakage of the building is common problem in all types of buildings such as residential flats, hospital, office, school buildings etc. Water leakage or water seepage is one of the major causes of common building defects. Water leakage leads to dampness, corrosion of metals, fungal growth and also affects the structural properties of concrete as well as damage the aesthetic view of the structures. It also has an adverse effect on human health by creating discomfort condition. If leakage can be prevented, almost 80% building defects can be eliminated. Thus, selecting the best method for waterproofing plays an essential role in the welfare of the structure. In construction, a building or structure can be waterproofed with the use of membranes and coatings to protect contents and structural integrity. Waterproofing can be categorized under traditional and advanced (coating) waterproofing techniques. The objective of this study is to compare the different waterproofing techniques by considering factors like cost, durability and ease of use. The discovery of this study recommends that traditional methods are simple in use; however they are uneconomical and can be easily splinter due to change in atmospheric conditions. Whereas, advance waterproofing methods like coating and laminate system gives better results but are costly and acquire a great problems while installation. Coating method needs special scrutiny during surface preparation which requires skilled workmanship.

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selected for repairing the leakage. Strength parameters [using Rebound Hammer method] are again checked after the remedial measures are executed comparative results before and after applying the remedial measures are to be analyzed.

## **1.2 Causes of Slab Leakages:**

It is necessary to prevent water leakage in the buildings so as to provide healthy and happy environment, it will also avoid damage to household articles, costly painting and short circuiting of electrical wiring. The defeats which cause water-leakages in the buildings can be grouped in the following three categories

### **1. Defects in design:-**

- i. Poor workmanship
- ii. Low quality material
- iii. Stagnation of water
- iv. Defective joints in water pipes
- v. Damaged water proofing layer
- vi. Aged pipes
- vii. Unstable Foundation

### **2. Defects in construction**

### **3. Defects due to poor maintenance**

#### **1.2.1 Defects in design:**

The defects in plumbing and design can be avoided in the preconstruction stage entrusting the work to experienced and well trained architect and engineer. Some of the measures to avoid leakage due to faulty planning are as follows

#### **1.2.2 Design of floor slab:**

It should be seem that the design and floor slab and cantering should be such that the local stagnation of water does not occur.

#### **1.2.3 Defeats in construction:**

The defeats in construction, stage includes honeycombing in concrete, use of defective material, poor workmanship etc. Remedial measures to avoid water leakage due to such defeats are as follows

#### **1.2.4 Defective concrete:**

The allocation of well-designed compacted dense concrete with proper curing can solved no. of leakage problems in a building.

#### **1.2.5 Plumbing:**

The joint in the plumbing of W.C seats and nanny traps should be charge with rich cement mortar and cured for seven days. If curing is not properly done, the rich cement mortar gets crack leads to leakage.

#### **1.2.6 Defects due to poor maintenance:**

The neglected maintenance along with wreathing and aging leads to water leakage in the existing buildings. The flowing water is dynamic and rushed through valves, traps, washer, taps and cocks situated at several places in the buildings. This thing's are subjected to constant wear and tear. They therefore require periodical maintenance as such non repairing attitude proves determinant to the safety of the structure. Following are the measure to be taken to minimize water leakage due to poor maintenance

#### **1.2.7 Improper use of toilets:**

It is necessary to educate the public for properly using toilets system. For instance, in the drainage system of public places, it is observed that the public misuse the toilet system by throwing plastics, papers etc. it ultimately leads to choking of the drainage system. Also the joint in the tiles of path and water closets are filled with white cements this joints get loose after continuous use and required periodical maintenance

### **1.2.8 Location of sanitary blocks:**

For the public buildings like hospital, schools, hotel, collages, commercial centers etc. It is a desirable to detach the sanitary block in the planning stage sole. Such a criteria will help in keeping the building utilizable even if the sanitary block ache from leakage. It will also avoid the spreading of dampness in the rest of buildings

### **1.3 Effects Due To Water Leakages:**

1. Attic and ceiling damage
2. Interior mould and mildew issues
3. Health concerns from mould
4. Fire hazard from water damage
5. Slip and fall hazard
6. Higher utility bills and wasted energy
7. Compromised structural integrity
8. Concrete strength
9. Steel corrosion & Deterioration
10. Unhygienic

#### **1.3.1 Attic and ceiling damage:**

The initial dangers of a roof leak are vandalism to the loft area and items stored there. If there is no attic, or the size of the leak is really big, it will damage the interior ceiling. Affected ceiling tint will blacken and ceiling plaster may bubble and expand. The leaking water also will damage paint and plaster on nearby walls. You can also expect damage on ceiling-mounted lights and fans.

#### **1.3.2 Interior mold and mildew issues:**

In the longer term, one of the most serious accordingly of leaking causes is fungal growth. Mold can spread throughout the home's structure, to the HVAC system and then to the repose of the house through the vents where it can conquer carpets, furniture and even clothing.

Black mold is the most common type resulting from chronic water intrusion. Toxic dark black mold growth is infrequent, but even non-toxic black mold attacks wood framing, ceiling tiles, and wall and floor coverings.

#### **1.3.3 Health concerns from mold:**

Mold and mildew can lead to momentous health issues, especially for those with high sensitivity, including adenoidal congestion, rhinitis, inflammations and asthma, according to the U.S.

#### **1.3.4 Filling of expandable material in cracks:**

Expandable material like epoxy resin plastic polymers are used for filling cracks in the slab. The expandable material is plotted in between cracks, after some duration material get expanded and filled up the cracks. Polymers and plastics need to heat up before placing in the cracks.

#### **1.3.5 Waterproofing coat:**

Waterproof coats are generally painted for prevention of water leakage as well as for an aesthetic view.

#### **1.3.6 Door framed joint near toilet:**

The joint between door frame and flooring of a bath and water closet should be made leak proof by applying epoxy mortar or cement.

#### **1.3.7 Relief valve:**

It is necessary to provide break pressure relief valves, at a suitable vertical distance in multistoried buildings to prevent seepage of water through the plumbing.

#### **1.3.8 Filling of joints:**

The joints in the drainage system should be filled with reach cement mortar due to again the strength of cement mortar deteriorates resulting in leakage through the cracked joints the remedy lies in filling such joints initially with epoxy mortar or at least at latest stage while repairing the same.

### 1.3.9 Fixing of nanny traps:

The nanny traps are required for toilets, kitchen sinks, washbasin, etc. The niche or pocket of clear size about 300mmx300mmx150mm should be provided to accommodate the nanny traps & their locations should be clearly shown in figure.

### 1.3.10 Replacement of taps:

Leaking water taps leads to colossal waste of filtered water avoidable water leakage in the building. It is therefore necessary to provide good quality of taps. By replacement washers periodically weather required or not as a preventive maintenance measure.

## II. METHODOLOGY

### 2.1 Case study:

1. History
2. Location

#### 2.1.1 History:

KJ College of Engineering and Management Research Pune, was established in the year 2009.

We admitted in the college in year 2013, since from that year we are observing the water leakage in Civil Engineering department.

#### 2.1.2 Location:

The following case study is about an issue of slab leakage in the Civil department of the K J Collage of engineering building. The slab leakage is situated at front side of head of the department (HOD) cabin. In this case, there is major possibility of leakage through the upper floor of the civil department where the drinking water supply is located.



*Figure 1. Location of the leakage*

### 2.2 Causes of Slab Leakage:

1. Defects in design
2. Defects in construction
3. Defects due to poor maintenance
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#### 2.2.1 Defects in design:

The defects in plumbing and design can be avoided in the preconstruction stage entrusting the work to experienced and well trained architect and engineer. Some of the measures to avoid leakage due to faulty planning are as follows

### **2.2.2 Defects in construction:**

The defects in construction, stage includes honeycombing in concrete, use of defective material, poor workmanship etc. Remedial measures to avoid water leakage due to such defects are as follows.

### **2.2.3 Defects due to poor maintenance:**

The neglected maintenance along with weathering and aging leads to water leakage in the existing buildings. The flowing water is dynamic and rushed through valves, traps, washer, taps and cocks situated at several places in the buildings. These things are subjected to constant wear and tear. They therefore require periodical maintenance as such non repairing attitude proves determinant to the safety of the structure.

## **III. TEST CARRIES TO FIND LEAKAGE**

It is divided into two types shows as follows.

1. Strength
2. Leakage

### **3.1 Strength:**

There are several tests to find strength of the concrete

1. Rebound hammer test
2. Ultrasonic pulse velocity test

#### **3.1.1 Rebound Hammer Test:**

In general, the rebound number increases as the strength increases and is also affected by a number of parameters i.e. type of cement, type of aggregate, surface condition and moisture content of the concrete, curing and age of concrete, carbonation of concrete surface etc. Moreover the rebound index is indicative of compressive strength of concrete up to a limited depth from the surface. The internal cracks, flaws etc. or heterogeneity across the cross section will not be indicated by rebound numbers. As such the estimation of strength of concrete by rebound hammer method cannot be held to be very accurate and probable accuracy of prediction of concrete strength in a structure is  $\pm 25$  percent. If the relationship between rebound index and compressive strength can be found by tests on core samples obtained from the structure or standard specimens made with the same concrete materials and mix proportion, then the accuracy of results and confidence thereon gets greatly increased.

#### **3.1.2 Ultrasonic Pulse Velocity Test:**

This test indicates the quality of workmanship and to find the cracks and defects in concrete. Quality of concrete in terms of strength, homogeneity, trapped air, internal flaws, cracks, segregation, honeycombing, compaction, workmanship, and durability can be concluded from this test. The test can also be used to evaluate the effectiveness of crack repair. Ultrasonic testing is an indicative and other tests such as destructive testing must be conducted to find the structural and mechanical properties of the material.

### **3.2 Leakage:**

1. Visual Test
2. Colour Test

#### **3.2.1 Visual Test:**

It is very simple test which can be carried out by direct observation.

#### **3.2.2 Colour Test:**

Colour test is tracking and tracing the flow of water from different water leakage spots. For this test Dye or Colour is used.

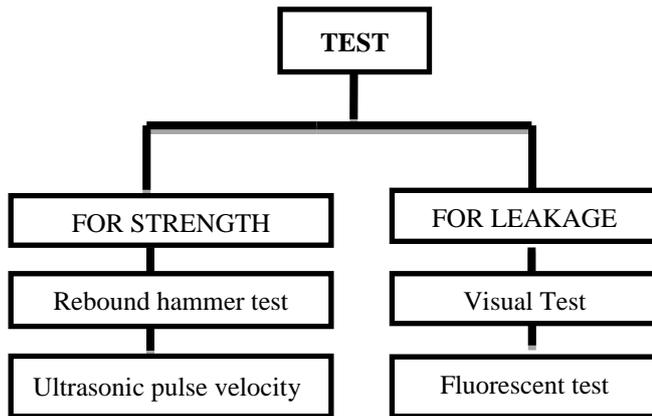


Figure 2:-Flow Chart of Test

### 3.3 Recommendation of the test:

Rebound hammer test is an economical as well as efficient test for the determination of strength of concrete slab. Hence rebound hammer is applicable to the current case. Rebound Hammer test is implemented as per recommendation.

## IV. PREVENTIVE MEASURES

### 4.1 Grouting:

Grout is a particularly fluid form of concrete used to fill gaps. It is used in construction to embed rebar in masonry walls, connect sections of pre-cast concrete, fill voids, and seal joints such as those between tiles. Grout is generally a mixture of water, cement, sand, often colour tint, and sometimes fine gravel (if it is being used to fill large spaces such as the cores of concrete blocks). Unlike other structural pastes such as plaster or joint compound, correctly-mixed and -applied grout forms a waterproof seal.

Although both are applied as a thick emulsion and harden over time, grout is distinguished from its close relative mortar by its viscosity; grout is thin so it flows readily into gaps, while mortar is thick enough to support not only its own weight, but also that of masonry placed on top of it.

### 4.2 Filling of expandable material in cracks:

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### **V. STRENGTHENING TECHNIQUE OF HARDEN CONCRETE**

#### **5.1 Cement grout:**

In the grout pouring technique the existing cracks from the slabs, resulting from the excessive loading, are enlarged in width and in depth until the existing reinforcement is exposed. Before the cement grout is streamed into the enlarged extends the exposed reinforcement and concrete surfaces must be cleaned using a steel brush, compressed air and water jet.

#### **5.2 Ferro cement cover:**

The Ferro cement was used, in general, to replace the damaged concrete and reinforcement (if also damaged). The experiment's results shown that the strengthen beams presented improved cracking resistance, flexural stiffness and the ultimate loads compared to the original beams. It is intended for use in Drainage, Water Supply Line, Water Harvesting, Cabling etc.

#### **5.3 Section enlargement:**

Section enlargement is method used in retrofitting concrete members. The Enlargement consists of the placement of reinforced concrete jacket around the existing structural member to achieve desired section properties as well as performance. The main disadvantages of such system are the increase in the Concrete member size obtained after the jacket is constructed and the need to construct an alternate formwork. With section enlargement slabs can be enlarged to increase their load-carrying capacity or stiffness. A typical enlargement is approximately 5 to 8 cm for slabs.

The strengthening by section enlargement can be performed in two ways,

- a) Strengthening by adding the new reinforcement and new concrete layer to the bottom of the structural element.
- b) Strengthening by adding the current reinforcement and concrete layer to the top face of the RC member  
Increase stiffness or reduce crack widths at service levels. Consisting of additional concrete added to an existing structural member, they may also incorporate additional reinforcement.

#### **5.4 External plate bonding:**

This method was first used more than 30 years ago in France, in the mid 1960s and it is considered by some publications to be a "classic" method. It consists in bonding steel plates or steel flat bars to the structural elements and it is widely is strengthening of bridge structures.

- a. Reduces deflection, hence limit cracking.
- b. Increases load carrying capacity.
- c. Increases flexural strength.
- d. Improve resistance to shear in certain instance.

#### **5.5 External post-tensioning:**

This strengthening method is considered to be an authoritative method that has been used since the 1950s.

It is very effective in increasing the flexural and shear capacity of concrete members. It can be appeal to reinforced and pre-stressed concrete members. The technique is petition to RC slabs to correct the excessive deflections and cracking. The repair system adjunct minimal additional load to the structure thus being a productive economical strengthening technique.

## VI. CONNCLUSION

Hence as we have many strengthening techniques for hardening concrete yet we are going to use the cement grouting technique because it is economical and gives internal and external strength in existing structure.

## REFERENCES

- [1] Al-Hammad, A.-M., Assaf, S., & Al-Shihah, M. (1997). *The Effect of Faulty Design on Building Maintenance. Journal of Quality in Maintenance*, 3(1), 29-39.
- [2] Bari N.A.A, Abdullah N.A., Yusuff R., Ismail N., Jaapar A. (2012). *Environmental Awareness and Benefits of Industrilized building Systems (IBS). Procedia Social and Behavioral Sciences*, 50 (2012) 392-404.
- [3] Chew, M. Y. L. (2005). *Defect Analysis in Wet Areas of Buildings. Construction & Building Materials*, 19(2005), 165-173.
- [4] EPA. (2013). *Moisture Control Guidance for Building Design, Construction and Maintenance. from U.S. Environmental Protection Agency:*
- [5] H.M. Jonkers, R. Mors, *Full scale application of bacteria-based self-healing concrete for repair purposes. In Concrete Repair, Rehabilitation and Retrofitting III; Alexander,*
- [6] M. G.; Beushausen, H.-D.; Dehn, F.; Moyo, P., Eds.; Taylor & Francis Group: London, 2012; Vol. 3, pp 967-971.
- [7] Vokey, D., *et al*, (2006, summer). *A Building Envelope Moisture Detection System Using Contiguous Zone Monitoring. OBEC*, 25-27.
- [8] IS 13311 (Part 2) : 1992