

**( Prepared By: Ms Kajal, lecturer , CE)**



## **CHAPTER -1**

### **NEED FOR MAINTENANCE**

#### **INTRODUCTION :**

Maintenance is the process that has been done to prevent the deterioration in the building whilst also to repair the damages in happen in the building. The damages happen in the building when some part of the building cannot function well. There are many types of damages in the building such as the electric system, water supply, floor, roof, the drainage system and wall . This problem might be solving by doing the building maintenance to repair or to restore the equipment that cannot functional well. The problem occurs in the building will affect the tenant in the building, that's why the maintenance process is very important to make sure that tenants seal convince and safe to use the building.

Building maintenance usually practice in every countries and it is very important in every development to have maintenance management in general the meaning of building maintenance is the work done by someone who expertise to keep the building maintenance and to make sure that every part of the building is well improve. in order to maintain the building, it also won to keep the value of the building and to upgrade Its services and

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surrounds. The building maintenance also necessary in this country because by carried out the maintenftgr5ance in the building it will maintain the value of the building, safe for Resident who live in the building and the building can be used for extended period of time.

## MAINTENANCE :

Maintenance is an important aspect of building construction system and maintenance includes many services and their proper running for a long time.

Or

It is the work undertaken to restore improve every facility in every part of building, it's services and surroundings to currently accepted standards and to sustain utility values of the facility.

## REPAIR :



it is defined as the process of restoration of a broken, damaged, wholesale device, equipment, Part, All property to an acceptable operating or use able condition or state.

## OBJECTIVE OF MAINTENANCE :

- To preserve in good condition buildings and services.
- To extend the usual life of the buildings and prevent premature capital outlay for replacement.
- To satisfy lender/ insurer requirement to provide a safe, secure and efficient working and living environment and to avoid deterioration of physical assets.

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- To maximize the aesthetic and economic values of a building as well as increase the health and safety of the occupants.
- When deterioration occurs due to any reason it is inevitable to restore it to its original standards.
- To make improvements whenever required.
- To sustain utility value

### SOME IMPORTANT POINTS :

- Maintenance planning should start at the design stage of any building project and should continue throughout the life of that building.
- Buildings are facing weathering factors like heavy rains or drought but by insufficient/improper design during the design Stage, through bad housekeeping, inadequate maintenance and neglect during its full operation.
- Minor problem which can grow



an grow into a major one through neglect, and which can be multiplied in many buildings.

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- All new buildings, as a matter of course, should be provided with the maintenance manual.

## IS BUILDING MAINTENANCE IMPORTANT ?.....WHY?

- It was important that building continue to be properly maintained to ensure that they can function as efficiently and effectively as possible.



- The deterioration of building due to the lack of maintenance could lead to future financial burdens, pose legal and other Industrial Relation issues and affect the delivery of services.
- Identifying building problems and understanding of building materials and its mechanical and electrical systems are aspects of the process of preserving and conserving building quality and to ensure the efficiency of the facilities.

### A good maintenance team has to ensure :

1. safety
2. efficiency
3. reliability

## MAINTENANCE OPERATIONS HAVE MANY FACETS SUCH AS :

1. Condition based maintenance:

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- it is the work initiated after inspection.
- 2. **Fixed time maintenance:**
  - Activities repeated at pre-determined intervals.
- 3. **Preventive maintenance:**
  - This is intended to preserve by preventing failure and detecting incipient failure.
- 4. **Opportunity maintenance:**
  - Work done as and when possible within the limits of operational demand.
- 5. **Day-to-day maintenance:**
  - It involves maintenance that has to be performed daily.
- 6. **Shutdown maintenance:**
  - Through overhaul and maintenance after closing.



Examples of some common maintenance works in a building are as follows :

1. Maintenance survey for water supply and sanitary system:

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- In case of water supply and sanitary system, periodic surveys are necessary to observe how the system is functioning. Normally inspection should start from the top and proceeds downward. Drawings which indicate various services and lid should be obtained to facilitate survey.

## 2. Maintenance of electrical installations:

- The electrical installation is made safe by getting it installed and maintained through licence persons. It's necessary that the installation is checked periodically and a proper record of such work is maintained. Recommended periodicity of checking is as follows :  
Earthing Test - once a year  
Insulation - twice a year  
Polarity - once in 5 years

## 3. Maintenance of walls to avoid a fluorescence:

- Fluorescence is caused due to entry of moisture into the brick work and soaking in it to saturation. Once the moisture has entered it moves upward due to capillary action reasons for entry of Moistures are :
  - porous nature of structure
  - cracks in the wall
  - existing voids left due to bad workmanship
  - small trees and plants in the wall
  - non existence of damp proof course for failure of DPC



## Effects of Efflorescence :

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- Dry rot of woodwork
- Disintegration of masonry
- Damage to furniture
- Crumbling of plaster

### Steps to avoid efflorescence :

Eradication of a efflorescence is quite difficult and it is often termed as cancer of buildings. The first app to check efflorescence is to check the ingress of moisture in buildings if there is no failure of DPC efflorescence can be checked easily.

- Step 1 Ingress of water is checked
- Step 2 plaster is removed from from both inside and outside and is left to dry
- Step 3 voids in the wall are filled
- Step 4 walls are washed with tamarind water to remove stains
- Step 5 walls are replastered with cement mortar not Leaner than 1 ratio 4 and a waterproofing admixtures.

### FACTORS INFLUENCING THE REPAIR AND MAINTENANCE :

- Age of building
- Cost applied on manufacturing of building
- Availability of resources

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- Future use of structure
- Atmospheric conditions
- Social consideration

**1. Age of building :**

- It is most important to assess the age of the structure before planning the maintenance of a structure . The remaining useful useful life of building will only justify the amount of capital spent for the repair and maintenance of a building.

**2. Total cost involved :**

- Total cost involved for the repair and maintenance of a structure is a major factor which influence the decision to undertake maintenance operation.

**3. Availability of resources :**

- Maintenance of a structure can be taken up only when the availability of all the physical resources is ensured. The resources include materials, equipments and Labour.

**4. Urgency of Maintenance :**

- An urgent maintenance work may be required for repair of services or repair of settings /components. For urgent maintenance work, the cost will become of secondary importance.

**5. Future use of the structure :**

- The future use of the building must be considered before starting the maintenance operation. The extent of repair and maintaining timing of maintenance should be duly considered.

**6. Social Consideration :**

- The following factors are also considered while planning the maintenance of building :
  - the maintenance should be planned properly to minimise the nuisance .
  - The maintenance work should be undertaken without disturbing the occupants or if possible it may be carried out when the building is unoccupied
  - disturbance such as noise, dust, smell and the interruption of services should be bare minimum.



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## CHAPTER -2

### AGENCIES CAUSING DETERIORATION

#### INTRODUCTION :

A building defects can be defined as a material, component or finish which does not meet its accepted performance criterion. Technical knowledge and proficiency and an indulgent of building construction are necessary to accurately recognised as root of building defects and remedies measures essential to put the defects right.

#### DETERIORATION :

Deterioration mean the falling from higher to lower level in quality, character, or vitality. Deterioration implies generally the impairment of value or usefulness.

Or

In maintenance engineering, deterioration is defined as the gradual and continuous process of degeneration of a structure or its component which render it unusable.

#### CAUSES OF DETERIORATION IN BUILDING IN GENERAL :

The primary source and causes of deterioration and decay in structures and buildings can be listed as follows :

- Human
- Chemical
- atmospheric
- structural
- moisture
- fire
- Faulty design
- Faulty construction
- Faulty materials

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- Faulty system
- Faulty systems
- Cleaning

### 1. Human :



- Failure to clean and carry out routine maintenance.
- Ignorance of the causes of deterioration and decay.
- Poor planning for poor man proper maintenance.
- Failure to promote Awareness of maintenance needs by all who used the buildings.
- Adopting a negative attitude of waiting until emergency measures are required.
- Lack of supervision during construction.
- Use of poor construction materials.

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## 2. Chemical :



Acid Rain effect Building

Chemical Effect

Interaction of certain cleaning agents with materials and components causing disintegration or discoloration.

Promoting Corrosion

Interaction of certain dissimilar materials in close contact with one another in corrosion environment.

Some chemicals are :

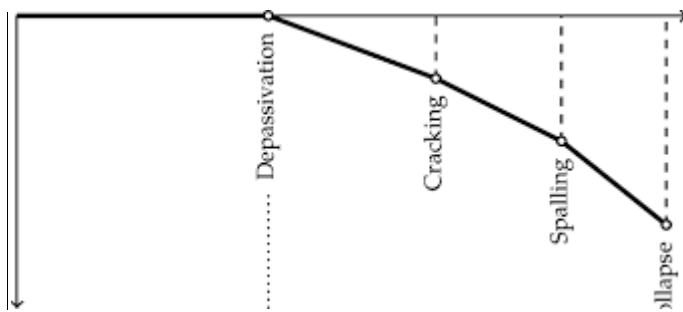
- Chloride : these may be present in the fresh mix or may penetrate from external source into the hardened concrete during the use of structures, chloride ions penetrate into the concrete from various sources, the most important of these are seawater. The chloride in water is in contact with reinforced steel and destroy the thin film on the steel.
- Sulphate : in this reaction between the physical and chemical interactions between the minerals in hard concrete and cement paste and sulphate ions from the environment. The sulphate attack on concrete mainly first in the form of expansion, cracking, loss of mass and disintegration

## 3. Atmospheric :

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- Reaction of the structure, external fabric finishes and cladding to the atmospheric elements such as :
  - Wind
  - Rain
  - Sun
  - Frost and snow for cold weather
  - Pollution in the atmosphere
  - Reaction of the building to the penetration of the above atmospheric elements.

#### 4. Structural:



- Reaction of the structural elements to settlement, moisture, shrinkage and thermal movements .
- Reaction of the structural elements to the change of loading patterns.
- Natural aging of the structural elements
- Reaction to the corrosive element in the atmosphere
- Deterioration due to inadequate inspecting and maintenance

#### 5. Moisture :

- Penetration of the external fabric of cladding, or throw ground floor Constructions giving to dampness which may create a suitable condition for fungi growth and attack.
- Excessive moisture in the internal atmosphere which may lead to excessive condensation and corrosion.
- Irrigation
- Faculty plumbing

#### 6. Fire :

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- Aftermath of a fire many possibilities may occur
- Need for replacement of materials directly affected by the fire
- Damage can be done by the fire fighters in their efforts to control the fire
- Water used during the fire fighting can not only damage but also setup deteriorating in materials not directly involved
- The heat and the combination of heat and water can lead to the swelling, distortion, flaking and tracking of nearby materials and components.

**7. Faulty Design :**

- Poor detailing at the design stage including
- insufficient allowance for expansion or contractions
- Absence of weathering in correctly placed damp
- Proof course
- Poor jointing between different materials or components
- Poor specification
- Lack of inadequate consideration of future maintenance problems
- Inadequate provisions for access to carry out maintenance activities.

**8. Faulty Construction :**

- Lack of proper supervision during construction period
- Failure to understand or follow exactly the specification and drawings
- Failure to replace defective work
- Failure of designer/ architect or engineer monitor work in progress
- Lack of skilled labour
- Over emphasis or need for quantity rather than quality
- Failure to fully appreciate the consequences of shoddy or poor work and materials.

**9. Faulty Materials :**

- Failure of client, builder, designer or architect to reject substandard materials - inadequate inspection of materials by supplier or receiver - inadequate storage facilities on site - inadequate inconsistent mixing of materials on site.

**10. Faulty Components :**

- Similar condition to those given above for faulty materials can lead to deterioration and decay of the fabrics, services or finishes of the structure of building.

**11. Faulty Systems :**

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- Inadequate knowledge on the part of the designer or architect leading to an unsatisfactory design, detail of system.
- Inability of the installer to follow the specification and drawings
- Inadequate testing of the system before commissioned
- Failure of honour to follow maintenance instructions provided by manufacture or designer
- Inability of the owner to operate the system as instructed.

#### 12. Cleaning :

- Failure to carry out routine cleaning operations
- Use of incorrect cleaning materials and techniques
- Inadequate supervision of cleaners to ensure that cleaning is thorough
- Failure of owner to tenant to provide sufficient space, enough time to know the correct equipment and materials for cleaning operations
- Failure to employ specialists for cleaning special fittings and equipments.

### EFFECTS OF VARIOUS AGENCIES OF DETERIORATION ON DIFFERENT BUILDING MATERIAL IS AS FOLLOWS :

- **Brick** : Generally bricks have good durability. The most common effects of weathering on bricks are



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7. Efflorescence (deposition of white powdery materials causing difigurement of brick).
  8. Spelling of the external surfaces.
  9. Change in appearance.
- **Timber** : The following are the effects on durability of timber :
    - Timber decays as a result of destructive action of fungi (called dry rot) growing on it.
    - Dry rot requires a moisture content of about 20% and spreads very rapidly
    - Insect infestation (i.e beetles,termites)destroys timber used in building.



- Exposure to natural weathering agents such as rain, wind and temperature contribute a lot to faster care of timber.

**The following steps are taken to avoid deterioration of timber:**



- Proper seasoning of timber (reduction of moisture content to optimum level) is done to make it last longer.



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- Preservatives are used to preserve the timber from decaying, such treatment is done to ensure a longer, trouble-free life of timber.
- **Concrete** : Concrete is a relative durable material but its durability is affected due to the following factors :



- Freezing and thawing : Water entering in the pores of concrete, freezes in cold climate .due to increase in volume of water on freezing results into disintegration of concrete. Concrete located in exposed conditions are more susceptible to such attack.
- Subsoil salt attack : the water soluble sulphate in soil when comes in contact of concrete causes its expansion spelling and disintegration. The extent of damage of concrete will depend upon the amount and type of sulphate present in the groundwater and quality of concrete.
- Alkali aggregate reaction : silica present in aggregates react with the alkalis of cement in the presence of water and causes expansion and subsequent damages of to concrete
- Corrosion of Steel : corrosion of Steel bars in RCC structures reduces the durability of concrete in contact with steel bars. Rusting of Steel bars causes spelling and cracking of concrete. Deterioration is aggravated in case the concrete is permeable or concrete cover to Steel reinforcement is inadequate.



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**Effects of deterioration of concrete can be controlled by the following steps :**

- Using optimum water cement ratio
  - Using sound and fresh cement
  - Using durables, densely graded and non reactive aggregates.
  - Using proper batching and mixing equipments and methods
  - Providing thorough and uniform compaction
  - Providing proper curing.
- 
- **Metals:** Metals used in buildings have good durability. Durability of metals is affected by corrosion. Corrosion is a complex electrochemical reaction. It is aggravated by the presence of dissolved atmospheric gaseous pollutants, salt, admixtures for stop the risk of corrosion is increased when metal are in contact with other building materials such as brick or plaster. Mild steel largely used in building construction is seldom exposed but has a protective coating of paint, bitumen or is enclosed by other materials, usually by concrete in RCC. Protective coatings reduce the rate of corrosion. In RCC members, it is the concrete cover that cracks first. Therefore, the cover to Steel in RCC structure should be according to the

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exposure of the structure to the environment. when Steel cots very much, then only we can see both broken concrete and corroded Steel.

- **Paints** : Paint are coating of coloured liquid materials applied on the surface of the finished parts of the building, which on drying, forms as an impervious court and protects the surface from the effects of atmospheric Agencies, decay or wood and corrosion of metal and also serves as a decorative surface.



FIX PAINT DETERIORATION



**The following defects are observed in painting due to various agencies of deterioration:**

- **Blistering**: this is due to tapping of water vapour behind the painted surface. This forces the paint in two little Bubbles or blisters.
- **Fading** : when the painted surface is exposed to direct sunlight, gradually shading of colour due to loss of brightness of pigment occurs.

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- Blooming : this is the development of dull patches due to the presence of moisture for chilling of surface glossy coat.
- **Plastics** : A wide range of plastics are used in buildings, polyvinyl chloride has the widest application. Plasticized plasticized PVC is extensively used as floor covering, false ceiling under pitched roofs, membrane covering in flat roofs and plastic membranes for waterproofing. Special plastics are used for large drainage chamber, plumbing drainage, fittings and wall tiles. Foamed plastic provide a cellular material used for thermal insulation  
The following defects are observed in plastics :



- short wave solar radiations degrade plastics by causing embrittlement and change in surface appearance
- moisture in general has little effect but can reduce Bond strength between glass fibre and polyester resin.
- Cracking of polyethylene in cold water systems is caused by use of oil based jointing compounds.
- plastic creep under continued loss and special precautions are needed when stresses are high.
- **Stones** : Natural stones are classified as belonging to one of the three main groups igneous, sedimentary or Metamorphic.

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**The following declarations are observed in natural stones due to various weathering Agencies :**

- The atmospheric pollution causes deterioration of limestone and sandstone full stops is waiting and drying are frequent due to rainfall, the surface of the stone get slowly eroded.
- Frost may also attack some limestones.
- Marble is attacked by sulfuric gases.

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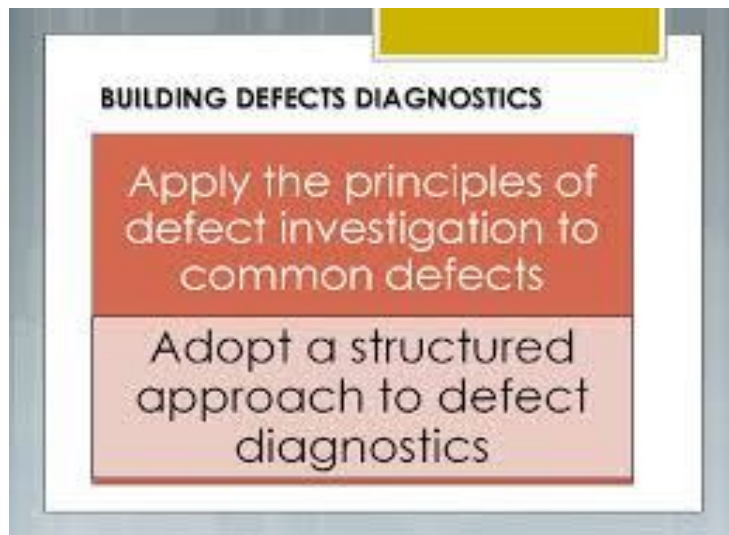
- one major cause of damage in all types of stone can be due to corrosion of embedded fixtures. Rusting of iron and steel cramps and dolls cause extensive damage to limestone and sandstones.
- Slates are used for roofing, cladding and D.P.C .Roofing slates are exposed to most severe conditions and can be affected by sulphuric gases.

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## CHAPTER - 3

### Investigation and Diagnosis of Defects :

#### INTRODUCTION :



Building components start deteriorating after certain period due to action of various natural forces like rain, sunlight, wind, it is sometimes there are may be problem in the buildings due to use of poor construction material, due to poor workmanship of faulty design etc. The deterioration, if left unchecked can cause serious defects in buildings and these defects can become the source of buildings failures. This adverse situation can be avoided for at least reduced considerable e if we are able to understand the reason of these defects. In this situation, necessary remedial measure measures can be taken in time. It is, therefore, most important that actual cause cause of defect is known by through investigation. Hence investigation of defects is the most important aspect in order to minimise the adverse effects of defects.



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## INVESTIGATION :



Investigation is the process of examining and inspecting the structure or its components to collect information on the basis of which the exact cause of defects can be known so that effective remedy strategy can be adopted accordingly.

## DIAGNOSIS :



Diagnosis is the interpretation of the results obtained from investigation. The general approach to diagnose the defects in a structure is to critically analyse all the probable cause of defects and ultimate identity that true case.

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Or

Building Diagnostics involves a process in which relevant experts investigate the existing condition of a building, carry out unnecessary test, evaluate the data collected, make recommendations professionally, and predict the future performance of the building.

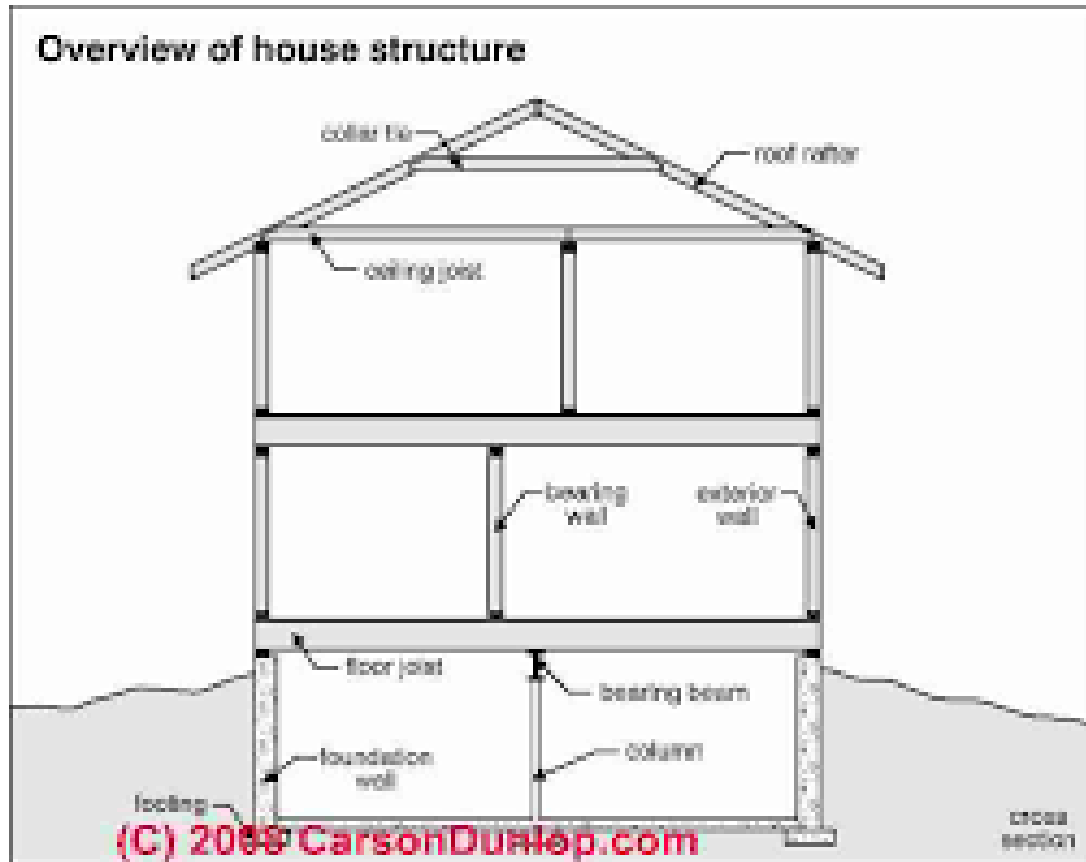
### **OBJECTIVES OF INVESTIGATION OF DEFECTS :**

- To identify the cause of defects.
- To identify the source of defects.
- To classify the damages as structural and nonstructural.
- To assess the extent of damage due to corrosion, fire earthquake or any other reasons.
- To assess the residual strength of the structure or its components.
- To assess its rehablity.
- To select and plan the effective remedy.



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- To prioritise the defective elements as per urgency for repair.



## SOME USEFUL TERMS :

4. **Scaling** : It is the breakdown of the surface mortar accompanied with the loosening of surface aggregates.
5. **Cracking** :

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Cracks are opening in the surface of concrete caused by their stresses, excessive external loads, corrosion etc.

#### 6. Spalling :



It is breaking off concrete pieces from the reinforcement surface as a result of the bar expansion due to corrosion.

7. **Leaching** : leaching is the removal of soluble matter from brickwork for concrete surface by running water.
8. **Use of Covermeter** :

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Covermetre is used for assessing cover to reinforcement, diameter of bars and locations of bars.

**9. Use of Power drill :**



Power drill is used for taking samples of plastic, bricks or concrete for inspection or moisture determination.

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## SYSTEMATIC APPROACH /PROCEDURE OF INVESTIGATION :

**A systematic investigation should fulfill the requirements :**

- It should be valid planned.
- 13. it should be thorough and timely.
- 14. It should examine all possible aspects of defects.
- 15. The scope and objective of Investigation should be clearly decided.
- 16. The investigation should have sound and for knowledge about possible aspects.
- 17. Investigation should be carried out using appropriate tools and kits.

**The following steps are involved in the systematic approach investigation :**

- Primiraly investigation about the defects in structure for stop physical inspection of the structure.
- Testing all the materials involved in the structure.
- Non destructive test.
- Detailed diagnosis of defects.
- Study all the available relevant documents.
- Estimation of actual loading.

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- Checking the design and to see if there is any error.
- Consideration of Environmental effects.
- Appropriate strengthening of members as per requirement.
- Relevant repair as per requirement.

## **PRIMIRALY INVESTIGATION :**

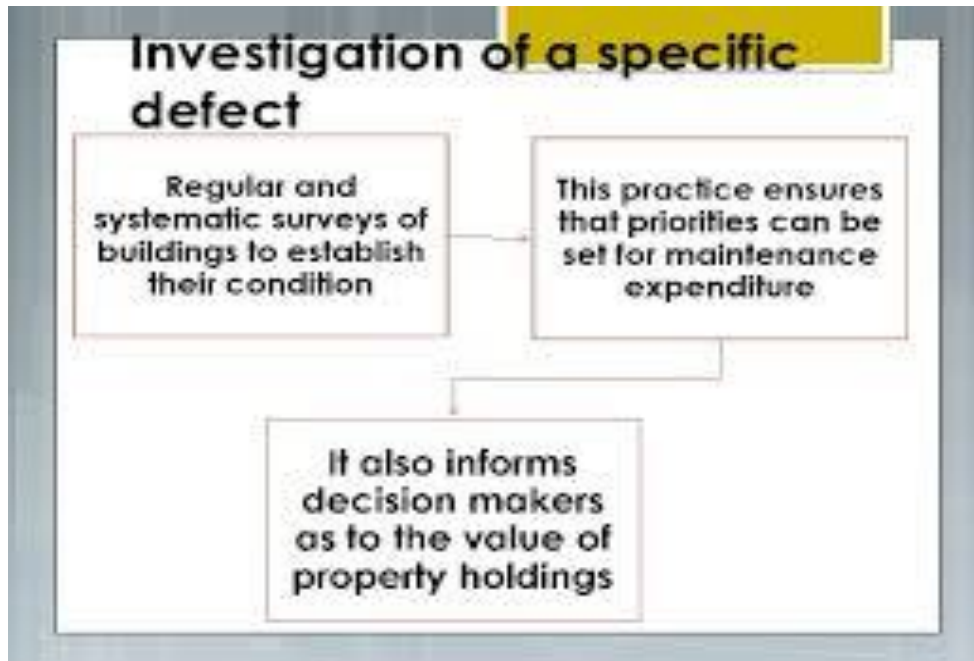
The following steps are taken in the preliminary investigation of the defects in buildings :

- The deteriorated building is kept undisturbed.
- During the first visit to the site, photographic data of the deteriorated building is collected.
- All symptoms at the site are carefully recorded for further analysis.
- All the concerned persons are interview to collect informations about the probable cause of defect.

## **SOURCES OF INFORMATION :**

7. Drawing and Specifications
8. Consultant/Architects instructions
9. Site notes, reports
10. Maintenance manuals and other records
11. Interviews
12. Inspection
13. Test and measurement

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### NON-RESTRICTIVE TEST (NDT):

- Non destructive test are used to assess the in-situ properties of the structure.
- This test are less time consuming and relative inexpensive.
- This test are used for diagnosis the defects without disturbing the performance of the structural members.
- This test can be used to assess the in situ strength, equality, location and extent of rats, whitess and honeycombs.
- These tests are useful in determination of extent of corrosion in the structure.
- Test can be used to accessorize dual strength and durability of the structure.
- This test can be helpful in confirmation of suspected deterioration of the structure.

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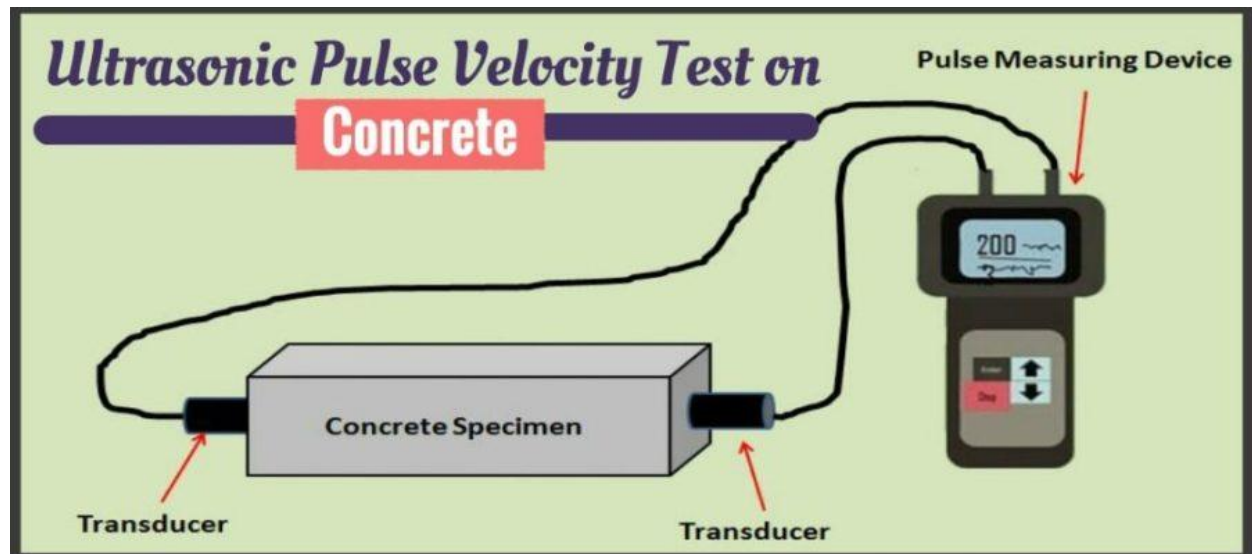
- Result of these tests are most useful when supplemented by a limited number of destructive test.
- This test are more useful in cases where Data Structure like drawings and grades of concrete used is not available.

## VARIOUS TEST USING NDT TECHNIQUES:

- Determination of concrete strength, presence of cracks, voids and honeycombing.
- Determination of depth of concrete cover, bar diameter and spacing.
- Determination of extent of corrosion of reinforcement.
- Determination of chemical attack on concrete.
- Determination of permeability.
- Determination of defects in matters and welded joints.

## SOME COMMONLY USED IMPORTANT NON DESTRUCTIVE TEST :

Ultrasonic Pulse Velocity Method :



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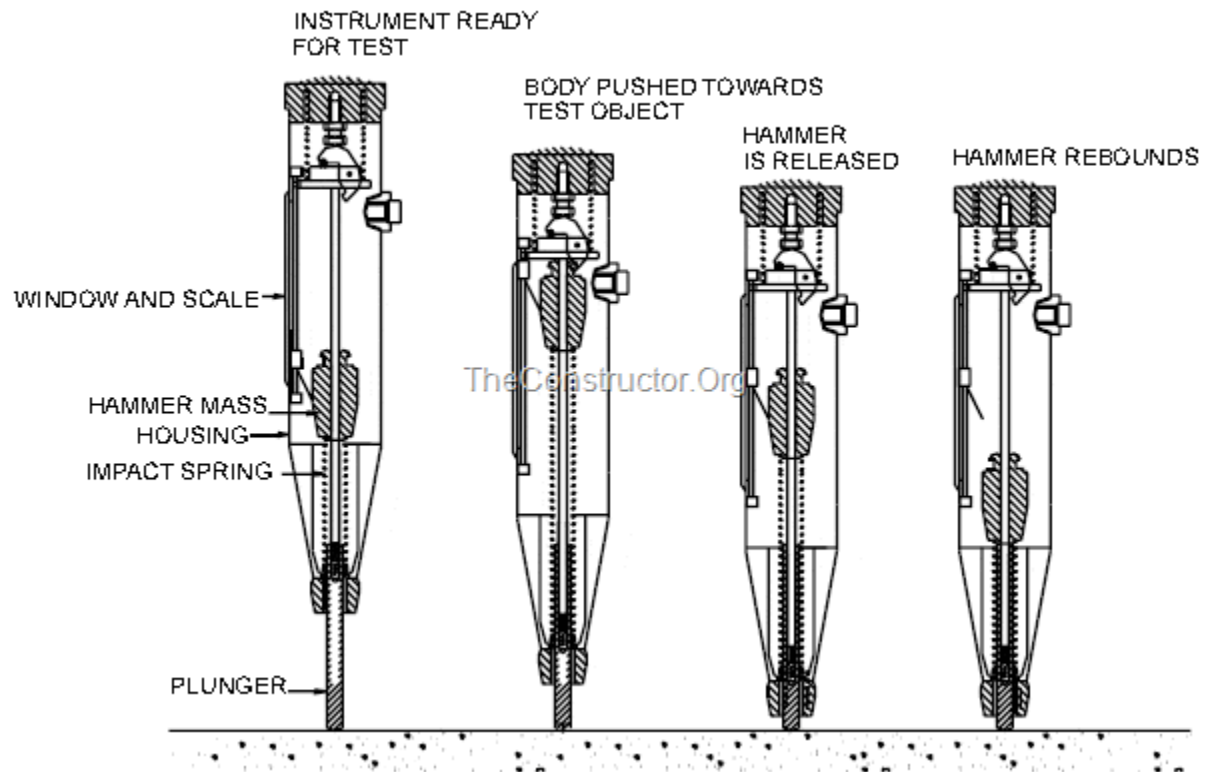


In the ultrasonic pulse velocity test, the time of travel of an ultrasonic pulse through the concrete structure is measured and the pulse velocity is determined by the relation : pulse velocity is equal to distance by time. As void and defects in the concrete prevent direct passage of ultrasonic pulse moving to the existence of concrete air interface is, the ultrasonic test can reveal internal defects of concrete such as the presence of honeycombing and the interiors. Besides, as there is positive relationship between wave velocity and elastic modulus, as well as between elastic modulus and strength, the ultrasonic velocity is able to reflect the concrete strength.



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### Rebound Hammer Test :



Average Rebound Number	Quality of Concrete
>40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
< 20	Poor concrete
0	Delaminated

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Rebound hammer test, or Schmidt Hammer Test, is a simple method to estimate the in situ concrete strength. The hammer measures the rebound of a spring loaded mass impacting against the surface of the concrete. The rebound hammer has an arbitrary scale ranging from 10 to 100. Empirical correlation was established between concrete strength and the rebound number. It should be noted that the surface for testing should be grinded flat and smooth. When conducting test, the Hammer should be held at right angles to the surface, because the rebound reading can be affected by the orientation of the hammer. When used on the underside of a suspended slab, gravity will increase the rebound distance of mass. The rebound hammer should be calibrated before use. The major drawback of rebound hammer test is the Limited accuracy. Even for calibrated Hammers, the error of test could be about 15% there as for uncalibrated hammers, the accuracy is much worse and error can reach 30%.

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**Concrete core test :**



this is the direct way of measuring actual strength of concrete. concrete cores are cut by means of a Rotary cutting tools with diamond bits. in this manner, a cylindrical specimen is obtained. The core is then soaked in waters, capped with molten sulphur to make its ends plane and parallel. The core is then tested in compression. In this way, we get the compressive strength of the concrete used in the structure which gives the idea about the quality of concrete.

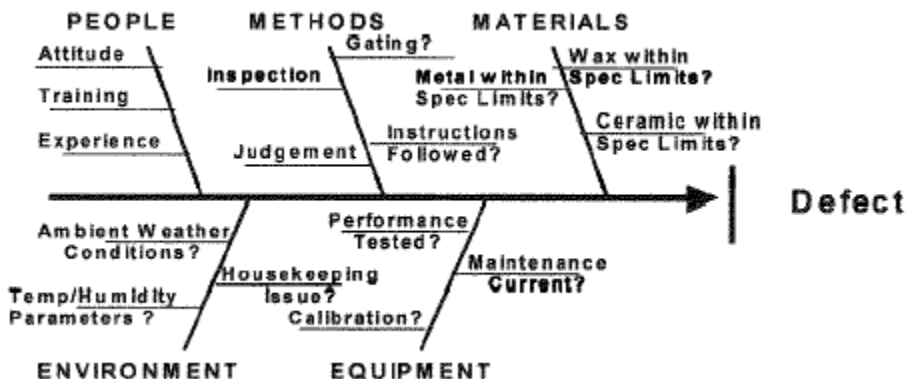
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## CHAPTER - 4

### DEFECTS AND THEIR ROOT CAUSES :

#### INTRODUCTION :

An ideal structure is the net result of the combination of so many ideal conditions such design, materials, workmanship, super vision, environmental conditions etc. But in actual practice, all these ideal conditions very rarely exist. Any slight variation in any of these parameters causes defects in the structure. Hence defects are invertible in civil engineering structures. Some defects are the natural consequences of ageing and normal use. But many premature defects can be attributed to lack of proper scale and care during construction and maintenance.



#### DEFECTS IN BUILDING :

Defects in buildings may be defined as any fault, deficiency or Imperfection in a building components which adversely affects its functional performance and appearance.

Or

A defect is a building flaw or design mistakes that reduces the value of the building, and causes a dangerous condition for stop a construction defect can arise due to many factors such as poor workmanship for the use of inferior materials

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## MAIN CAUSES OF DEFECTS IN BUILDINGS :

- Dampness
- Relative movement of members of buildings due to various forces
- Lack of proper design
- Lack of proper construction practices
- Lack of suitable Maintenance practices

18. **Dampness** : Dampness in buildings may occur due to bad design, faulty construction and use of poor quality of materials. Dampness not only affects the life of the building but also create unhygienic condition of the important items of work in the construction of a building. Following defects in the building are due to dampness in any part of the building:

- Stains on different surfaces of buildings.
- Fluorescence or white patches on the wall of concrete surface of the buildings.
- Falling of paint films, wallpapers, plaster etc.
- Weakening and disintegration of building materials of the buildings.
- Corrosion of Steel reinforcement or other Metals used in the buildings.
- Decay of timber used in the joinery or furniture in the building.

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- Occurrences of bad smell in building.

**Causes of Dampness /Sources of Dampness in buildings :**

**14. Rain penetration**

- rising of groundwater by capillary action through Foundation
- leakage from water supply and sanitary pipes
- Condensation of water from atmosphere
- Entrapped water during construction process
- hygroscopic salt
- Climate condition
- Defective construction i.e joints
- Drain ability of Soil

**Methods of preventing dampness :**

- By providing DPC (damp proof course)
- By surface treatment that is by providing them to paint
- By integral waterproofing methods
- By special devices that is by providing chajjas and by providing cavity walls etc.

**19. Relative movement of members of building due to various forces:** Defects in buildings are also caused due to movement of one member of the building relative to another member. Movement in the building components may be due to anyone or a combination of some factors out of the following:

- Applied forces(dead load, live load, wind load)
- Temperature stresses(expansion or contraction of members)
- Change in moisture content (shrinkage or swelling in members)
- Physical Changes (creep, fatigue, settlement)
- Vibrations (due to earthquake, impact load, machines etc)

**20. Effect of Environmental factors :** The following environmental factors also affect the building components and materials which causes defects in buildings.

- Solar radiations



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- Temperature Changes
- Humidity
- Air pollutants (solids, liquid and gaseous)
- Ground salts
- Biological agencies

21. **Lack of Proper design** : Defects in buildings may also occur due to lack n the proper design. It may be due to wrong consideration of design loss in appropriate provision of sections, reinforcement, choice of wrong construction materials etc.

22. **Lack of proper construction practices** : Defects in buildings may be due to non observance of standard concentration specifications, poor workmanship, inadequate supervision and inspection is also.

23. **Lack of suitable Maintenance practices**: In the old buildings defects may develop due to lack of maintenance and deterioration of materials with Agencies. Hence to avoid defects in buildings, proper and timely maintenance is required.

## MAIN DEFECTS AND THEIR CAUSES IN VARIOUS ELEMENTS (COMPONENTS)OF BUILDING :

- Foundation
- Basement
- D.P.C
- Walls
- Columns
- Beams
- Roofs and Terraces
- Joinery work
- Decoration and protective finishes
- Services

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**Foundation :**

Defects	Causes
a.) Excessive settlement or Differential settlement of foundation	<ul style="list-style-type: none"><li>• Low bearing capacity of soil</li><li>• Overloading of soil</li><li>• inadequate depth or bits of foundation</li><li>• construction of additional storage without strength meaning of existing foundations</li><li>• excavation of deep foundations for construction of basement on the adjoining land</li></ul>
b.) Cracks in foundation	<ul style="list-style-type: none"><li>10. Load bearing capacity of soil</li><li>11. differential settlement of foundation</li><li>12. overloading</li><li>13. quicksand phenomena construction activities on the adjoining land</li><li>14. non provision of Expansion joints before below DPC level</li><li>15. due to earthquake</li></ul>



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	<p>16. vegetative growth and thrust exerted by the roots of trees on the nearby land</p> <p>17. Location variation is soil conditions under Foundation.</p> <p>IX. Vibrations due to heavy machinery , traffic</p> <p>etc.</p>
c.) Disintegration of foundation	<ul style="list-style-type: none"><li>• Freezing and thawing</li><li>• Chemical reaction such as sulphate attack on cement concrete.</li></ul>

### Basement :

Defects	Causes
a.) Inward bulging (swelling outward) of walls of basement	<ul style="list-style-type: none"><li>• Inadequate design</li><li>• Poor workmanship</li><li>• Excessive lateral loads due to active earth pressure and water pressure</li><li>• Excessive rainfall</li><li>• Plugging of drains</li></ul>
b.) Cracks in raft slab	<ul style="list-style-type: none"><li>• Inadequate design</li><li>• Construction joints not treated</li></ul>
c.) Cracks in raft walls	<ul style="list-style-type: none"><li>• Differential settlement of foundation</li></ul>

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	<ul style="list-style-type: none"><li>• Excessive thermal stresses</li><li>• Drying shrinkage</li></ul>
d.) Efflorescence	<ul style="list-style-type: none"><li>• Use of poor quality</li><li>• Use of salty water during construction</li><li>• Continuous dampness</li><li>• Alternate wetting and drying</li></ul>

### D.P.C

Defects	Causes
a.) Cracks	<ul style="list-style-type: none"><li>• Improper design</li><li>• Improper construction and expansion joints</li><li>• Excessive loading</li><li>• Differential loading</li><li>• Shrinkage</li></ul>
b.) Rising dampness	<ul style="list-style-type: none"><li>• Poor construction practices</li><li>• Poor quality materials used D.P.C</li><li>• Non provision of damp proof membrane</li><li>• Damage caused in D.P.C while providing services pipes etc.</li><li>• D.P.C not wide enough to cover full width of wall</li></ul>

**Walls :**

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Load bearing walls :	
Defects	Causes
a.) Outward bulging of walls	10. Overloading of walls 11. High Slenderness ratio that is thickness of wall insufficient in relation to height 12. vibrations due to heavy traffic aur up
b.) Horizontal, Vertical or Diagonal cracks	<ul style="list-style-type: none"><li>• Non provision of Expansion joints in long walls</li><li>• Foundation laid on shrinkable clay</li><li>• sulphate attack on jointed motor</li><li>• differential settlement of foundation</li><li>• vegetative growth in walls corrosion of metal ties if used in wall masonry for strengthening.</li></ul>
c.) Efflorescence	<ul style="list-style-type: none"><li>• Presence of soluble salts for building material</li><li>• alternate wetting and drying</li></ul>
d.) Movement of wall at D.P.C.level	Expansion due to absorption of moisture in new clay bricks  Lack of mechanical bond at D.P.C.
Non load bearing walls :	
a.) Cracks at head and side	<ul style="list-style-type: none"><li>• inadequate support at base</li><li>• differential moment between partition and surroundings load bearing structure</li><li>• deflection of upper floor joints</li></ul>

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Parapet walls :	
a.) Cracks	<ul style="list-style-type: none"><li>• Deflection and tilt due to wind/ earthquake</li><li>• sulphate attack</li><li>• Rusting of reinforcement</li></ul>
Boundary walls :	
a.) Cracks	<ul style="list-style-type: none"><li>• Moisture movement in walls</li><li>• vegetative growth in foundation and walls</li></ul>
b.) Collapse of boundary wall	<ul style="list-style-type: none"><li>• Inadequate Foundation</li><li>• scoring of foundation soil</li><li>• poor bonding large height/ thickness ratio</li><li>• natural calamity that is floods, earthquakes</li></ul>

### Columns:

Defects	Causes
a.) Cracks	<ul style="list-style-type: none"><li>i. Excessive loading</li><li>ii. Eccentric loading</li><li>iii. corrosion of reinforcement</li><li>iv. Shrinkage</li><li>v. Temperature stresses</li></ul>
b.) Buckling	<ul style="list-style-type: none"><li>• Inadequate design</li><li>• excessive slenderness ratio</li></ul>

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	<ul style="list-style-type: none"><li>• excessive bending</li><li>• eccentric loading</li></ul>
c.) Crushing of Columns	<ul style="list-style-type: none"><li>• Excessive loading on compressive strength of concrete</li></ul>
d.) Spalling	<ul style="list-style-type: none"><li>• Corrosion of reinforcement</li><li>• Insufficient cover to reinforcement</li><li>• Carbonation or chloride attack</li><li>• Physical damage</li></ul>

### Beams :

Defects	Causes
a ) Excessive deflection, lateral bulging	<ul style="list-style-type: none"><li>• Excessive span/ effective depth ratio</li><li>• Excessive loading</li><li>• Inadequate design</li><li>• Construction failures</li><li>• Poor workmanship</li><li>• Excessive lateral loading</li><li>• Excessive vibration</li><li>• Corrosion of Reinforcement</li></ul>

### Roofs and Terraces :

Defects	Causes
---------	--------

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a.) Deflection	<ul style="list-style-type: none"><li>• Inadequate design</li><li>• Poor workmanship</li><li>• Poor formwork</li><li>• High span/depth ratio</li></ul>
b.) Cracking	<ul style="list-style-type: none"><li>• Improper mixing</li><li>• Improper placement reinforcement</li><li>• Shrinkage in concrete</li><li>• Improper support condition</li></ul>
c.) Spalling	<ul style="list-style-type: none"><li>i. Corrosion of reinforcement</li><li>ii. Freezing and thawing</li><li>iii. Sulphur attack</li><li>iv. Insufficient cover to Reinforcement</li></ul>

### Decorative and Protective Finishes (paint films) :

Defects	Causes
a.) Blistering	Entrapped moisture forces of paint in two little Bubbles or blisters
b.) Moulds	Damp conditions
c.) Blooming	Development of dull patches due to presence of moisture or chilling surface glossy coat.
d.) Grining	This is the clear reflection of the background due to lack of opposite of final coat  surface not cleaned properly

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	paint partially applied
e.) Flaking/Peeling	Lifting up and peeling away of the pain due to loss of addition  in complete application of printing course in complete preparation of substrate.



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## CHAPTER - 5

### MATERIALS FOR REPAIR , MAINTENANCE AND PROTECTION

#### INTRODUCTION :

Though concrete is relative durable construction material it may suffer damage or distress during its life period due to number of reasons for stop deterioration of concrete structure is the natural phenomena of the gradual degradation of constituent materials that about physical ,chemical and mechanical processes. A basic understanding of underlying causes of concrete deficiencies is essential to performing meaningful evaluations and successful repair for stocks if the cause is understood it is much more likely that an appropriate repair system will be selected and the repair will be successful and maximum life of repair will be obtained.

#### ESSENTIAL PARAMETERS FOR REPAIR MATERIALS

- Low shrinkage properties
- required setting/ hardening properties
- workability
- good Bond strength with existing substrate
- coefficient of thermal expansion
- compatible Mechanical properties and strength to that of the substrate
- Minimal or no curing requirement
- alkaline character
- low air and water permeability
- aesthetic to match with surroundings
- cost
- durable ,non degradable and non biodegradable
- non hazardous / non polluting

**Low Shrinkage :** it is well known that the cementitious repair materials shrink with the passage of time. Most of the shrinkage generally takes place in the initial period from the time of casting to 21 days. Therefore, cementitious repair material in its original form, if used for repair to

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concrete / mortar, is likely to get either delaminated due to de-bonding or develop shrinkage cracks on its surface due to shrink strains and stresses. Shrinkage cracks so developed in the repair patch would allow the easy access of atmospheric air and water, which would be harmful for concrete and reinforcement. It is therefore, essential that the low shrinkage properties of repair materials shall be looked for while selecting a material for concrete repair. Cementitious material needs additional shrinkage compound so as to be effective in achieving the desired property. Using low cement content and low water cement ratio will also reduce the drying shrinkage.

**Workability** : the property designed by the field workers is good workability. optimum workability is to be achieved without sacrificing the other desirable properties by use of suitable additives admixtures .

**Bond with the Substrate** : the bond strength of repair patch with the substrate is essential to have a successful repair system for structure if it is felt that the bond strength of the repair materials with the base material is inadequate on left and the strength of the base material, then some other suitable means could be explored to improve Bond strength between repair material and substrate. This could be used of :

- 24. adhesive
- 25. surface interlocking system and
- 26. mechanical bonding

**Alkalinity** : In case of RCC, it is important to maintain the alkalinity of concrete around reinforcement with its pH above 11.5 from corrosion protection point of view. In this context, it is necessary for the repair material to have Chemical characteristics such that it does not adversely affect the alkalinity of the base concrete at a later date.

**Low air & water permeability** : permeable material allows easy formation of environmental Chemicals including carbon dioxide, water, oxygen, industrial gases etc. It is essential that repair materials should have a very low air and water permeability to provide protection to the reinforced concrete against Ingress of harmful environmental chemicals.

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**Aesthetic** : it is desirable that colour and texture of the repair material should match with the structure and give aesthetically pleasing and appearance. If need be ,this could be achieved through appropriate finishes.

**Cost** : Economics is important while considering various options for repair materials but cheaper repair Metro should not be selected at the cost of performance characteristics.

**Durability & Bio non - degradability** : the repair material selected should be durable under its exposure conditions during the service life against chemical attack, resistant to any form of energy like ultraviolet rays, infrared rays, heat acceptor and should be bio non degradable.

**Non - Hazardous / Non-polluting** : the repair material should not be hazardous to field workers. However adequate safety measures are required to be taken for repair materials, which are hazardous to workers involved with their applications, etc should also be environment friendly.

**ANTI CORROSION COATINGS** : Anti corrosion refers to the protection of metal surface from corroding in high-risk environment



When metallic materials are put into positive environment ,they tend to have chemical reactions with air and water. The effects of corrosion become evident on the surface of these materials. for example after putting a piece of iron into the atmosphere for an extended period, it start rusting due to oxygen interaction with water on the surface of the fees of iron.

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Metal equipments lacking any preventive measures may become registered both inside and out depending upon atmospheric condition and how much of that equipment is exposed to the year. Be there are a number of methods for preventing corrosion, is special in Marine applications of anti corrosion measures are of particular importance in our environment there high humidity, mist and start are factors.

**Protection from corrosion :**

- Anti corrosion materials
  - Stainless steel
  - Electrogalvanized cold rolled steel
  - Barrier coatings provide a consistent and film that Forms of chemical resistant barrier and blocks external factors from causing harm.
- 15. Surface treatments : formation by chemical reaction of a protective layer on the surface such as nitriding or nitrocarburizing surface treatments.
- 16. Surface plating : deposition of a corrosion resistant layer, usually nikala Chrome by various plating processes such as electroplating aur electroless plating.
- 17. Painting treatment on the surfaces : another way to protect metal housing from corrosion is by using anti corrosive paint or powder on the metallic surface will stop the function of this coating is to act as a barrier that inhibits contact between chemical compounds for corrosive materials with the metal housing.

**ADHESIVE AIDS :** It is generally used for attaching drywall,tile, molding and fixtures to walls, ceilings and floors. It is most most commonly available in tubes in timetable for use with a caulking gun.

**Composition :** common ingredients include clay, cement, acrylic resin, polyethylene monomer, styrene-butadiene rubber,hexane and other non-polar solvents, and various initiators and functional additives.

**Different types of adhesive are:**

- White craft glue
- Yellow wood glue

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- Super glue
- Hot glue
- Spray adhesive
- Fabric adhesive
- Epoxy
- Polyurethane

**REPAIR MORTARS** : Repair mortars are used to provide new strength to damaged concrete and, in most cases, offer a permanent repair that is tough enough to stand up to the most heavy use.



Types of Repair mortars are :

- Cementitious concrete repair Mortars
- Epoxy concrete repair mortars
- Concrete repair mortars

**CURING COMPOUND** : Curing is essential for the hydration of cement in concrete making. So, to maintain required moisture content, some precautions are applied. Concrete curing compound is a compound which helps to prevent loss of moisture content from the

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concrete. So, concrete is properly secured with letters the full development of strength of



concrete.

Types of Concrete Curing Compounds :

- Synthetic resin compound
- Acrylic compounds
- Wax compound
- Chlorinated rubber compound

**Synthetic resin concrete curing compound** : synthetic resins will seal the concrete by forming a membrane. Full stops if we want to provide plastering, the membrane can be removed by washing it with hot water.

**Acrylic concrete curing compound** : Acrylic is made of polymers of acrylic acid. It also seals the concrete in good manner. It is having property of addition to the subsequent plaster. No need to wash the surface of acrylic with hot water if we want to provide plastering.

**Wax Concrete Curing Compound**: Wax compound having similar properties like rising compound. The wax membrane will lose its efficiency with time increment.

**Chlorinated rubber curing compound** : chlorinated rubber type curing compound will form a thick layer when we applied. It seals the concrete tightly and also fills the minute pores

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present in the concrete .but the film cannot stay for longer period. It is near about in the long run.

Properties of curing compound

- Water retention
- Reflectance
- Drying period
- Long term setting
- Non-Volatile matter

**JOINTS SEALANTS** : joint ceiling is the installation of materials into the joints of building, concrete slab for balconies, car parks and commercial structures. Created a waterproof feel with joint feeling is used to intercept movement within the surface or at the point of intersection between various building elements.



Types of sealants used for joints in building :

- Silicone based sealants
- Urethane based sealants
- Arcylic based sealants



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- Polysulphide based sealants

**WATER PROOFING SYSTEMS FOR ROOFS** : Many types of water proof membrane systems are available , including felt paper or tar paper with asphalt or tar to make a built - up roof, other bituminous waterproofing, ethylene propylene monomer EPDM rubber, polyvinyl chloride, liquid roofing and more



**Here are some easy ways to waterproof your roof and ensure that your home is safe :**

- Remove all dead leaves and branches.
- Trim trees close to the roof.
- Replace missing, curling or damage shingles
- Cover seams with seam tape
- Add a water repellent layer
- Add heat tape to gutters and more

**Which waterproofing is best?**

Silicone sealant is one of the materials that are effective for waterproofing . silicone sealant can be effectively used to protect concrete and make it waterproof. Silicon are functions as the crack filler and sealant, which can be applied to crack up to a quarter inch or 0.6 thin.

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**Cementitious waterproofing** : cementitious waterproofing coating are breathable, seamless coatings used to provide positive and negative side waterproofing protection on concrete and masonry surfaces. They prevent damage from water infiltration and register mould and mildew.



**Protective coating** : attack to prevent corrosion of Steel by providing a barrier against moisture, Oxygen and other contaminants and by providing Galvanic action. Paint is the most common protective coating applied.

It is a layer of material applied to the surface of another materials with the intent of inhibiting or preventing corrosion. A protective coating maybe metallic or nonmetallic.....

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commonly used materials in non metallic protective coatings include Polymer foxes and polyethanes.

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## CHAPTER - 6

### REMEDIAL MEASURES FOR BUILDING DEFECTS :

#### INTRODUCTION :

In this we will study about the remedies so that we can provide the longer life to our structure.

We will deal all types of remedies and their uses.

#### PREVENTIVE MAINTENANCE CONSIDERATION :

It is conducted to keep equipment working and extend the life of the equipment.

#### SURFACE PREPARATION TECHNIQUE FOR REPAIR :

Coating performance is directly affected by surface preparation.

##### Methods :

- Chemical Cleaning
- Acid Etching
- Mechanical preparation
- Abrasive preparation
- Rotomilling
- Needle scaling

#### CRACK REPAIR METHOD :

**Epoxy injection** : Epoxy injection method is used for crack has narrow as 0.002 inch. The technique generally consists of establishing entry at closed interval along the cracks, sealing the

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crack on exposed surfaces, and injecting the expose under pressure.



Epoxy injection is an economical method of preparing non moving cracks in concrete walls, slabs, columns and pure and is capable of restoring the concrete to its free cracked strength.

Epoxy resins are used in the manufacture of adhesive, plastics, Paints, coatings, primers and sealers, flooring and other products are materials that are used in building and construction applications.

**Epoxy injection procedure :**

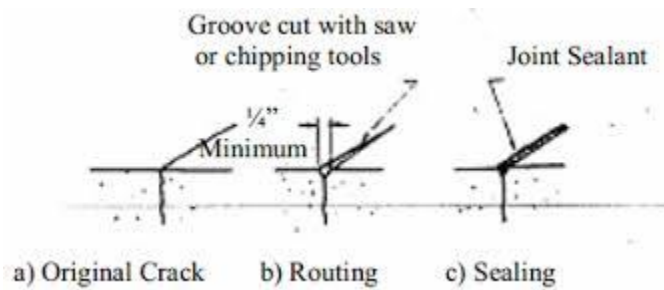
27. Clean the cracks
28. Seal the surfaces
29. Install the entry
30. Mix the epoxy
31. Inject the epoxy
32. Remove the surface seal

**Is Epoxy waterproof :** epoxy is incredible waterproof, a detailed that didn't escape the attention of the pioneers of these materials, and epoxy resins are used to broadly as coatings Andaz waterproofing in man Industries, including home construction.

**Is Epoxy eco-friendly :** epoxy coating is one of the most environmental friendly method of protective coatings because it comes from organic plant sources, it is manufactured in a wave that release no biohazards to the environment, and when applied as protective coating, it has no contaminants that could endanger the safety of women

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**Grooving and Sealing :** grooving and sealing is used to treat both fine pattern cracks and larger, isolated cracks. And effective use is for waterproofing by ceiling cracks on the concrete surface Where water stands, or where hydrostatic pressure is applied . this statement reduces the ability of moisture to reach the reinforcing steel or passed the concrete, causing surface stains or other problems.



The procedure consist of preparing a group at the surface ranging in depth, typically, from 1 by 4 to 1 inch. A concrete saw,hand tools for pneumatic tools may be used.The group is then cleaned by air blasting, sandblasting or water blasting and dried.

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A sealant is placed into the dry group and allowed to cure. A bond breaker may be provided at the bottom of the group to allow the sealant to change shape, without a concentration of stress on the bottom. The bond breaker may be of a polyethylene or tape which will not bond to the sealant. Careful attention should be applied when detailing the joint so that its width to depth aspect ratio will accommodate anticipated movement.

**Concrete crack repair by Stitching** : stitching in walls drilling holes on both sides of the crack and grounding in u shaped metal units with short legs that span the crack .stitching may be used when tensile strength must be established across major cracks. The stitching procedure consists of drilling holes on both sides of the crack cleaning the holes and anchoring the ends of the staples in the holes, with either a known shrink grout or an epoxy resin based bonding system.



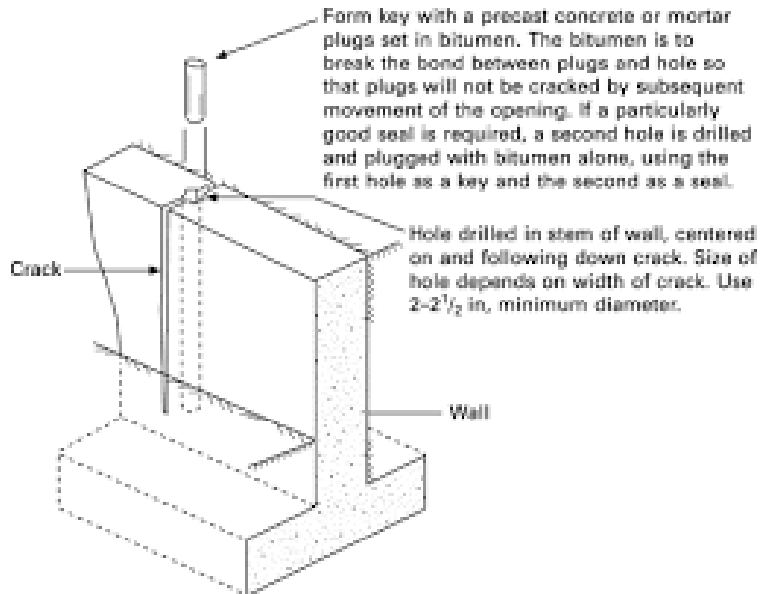
### **Additional reinforcement and grouting for crack repair :**

#### **Drilling and plugging method :**

Drilling and plugging a crack consists of drilling down the length of the crack and grounding it to form a key. This technique is only applicable when cracks are in reasonable straight lines and are accessible at one end. This method is most often used to repair vertical cracks in retaining walls. A hole should be drilled, standard on and following the crack.



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### Prestressing the steel :

post tensioning is open the desirable solution when a major portion of a member must be strengthened or when the cracks that have formed must be closed .this technique uses prestressing stands or bars to apply compressive forces.Adequate anchorage must be provided for the prestressing steel, and care is needed so that the problem will not merely migrate to another part of the structure.

### Portlanl cement grouting :

White cracks, particularly in gravity dams and thick concrete walls, may be repaired by filling with Portland cement ground. This method is effective in stopping water leaks, but it will not structurally Bond cracked section.

## REPAIR OF SURFACE DEFECTS OF CONCRETE :

**Bug holes** : Bug holes are surface voids in concrete defined as small regular or irregular cavities that usually do not exceed 15 mm in diameter. They are the result of the Entrapment of air Bubbles in the surface of formed concrete during placement and consolidation.

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- Careful preparation and mathematical practices can eliminate even the worst of surface voids.
- Removal and replacement of deteriorated concrete

**Form tie holes:** Three main contribute to this condition , improper vibration practice, non permeable formwork and mix design.

**Honey comb and larger voids :** honeycombing is a structural defect of RCC structure, areas of the concrete surface where the coarse aggregate are prominently visible are called honeycombed surface, giving a look of honey bees nest.

If not treated Honey comb from the surface, the RCC structure will not perform adequately as per its design, will also allow Ingress of harmful agents like contaminated water and air so the created voids affecting durability of structure substantially.

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**How to prevent Honeycomb in concrete :**

- All concrete batches to be cohesive
- Concrete workability should match the placement requirement
- Ensure proper compaction of placed concrete
- Concrete should be thoroughly compacted and fully work around the reinforcement
- Concrete fall should be kept minimum.

**REPAIR OF CORROSION IN R.C.C. ELEMENTS :**

- Remove all loose concrete
- Remove rust over the bars
- Paint the steel with anti corrosion paint
- Apply bonding agent on concrete

**Prevention of corrosion in reinforcement :there are few methods is :**

- Cathodic protection

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- Corrosion inhibitor admixture
- Anti corrosion coatings
- Rebar coating: This coating has strong adhesive force to steel.
- Fly ash : using of fly ash concrete with very low permeability, which will delay the arrival of carbonation and chloride at the level of the Steel reinforcement.
- Epoxy coated bars

## REPAIR OF DPC AGAINST RISING DAMPNESS :



### Physical method:

- Keep on top of outdoor home Maintenance
- Keep the home warm
- Make sure your home is well ventilated
- Avoid producing lots of moisture
- Take care when cooking
- Remove excess moisture
- Choose moisture resistant Paint and wallpaper
- Leave room to breathe.

### Electrical method :

There are two Electro Osmosis method :

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- **Passive system** : The passive system relies on earthing of copper tape inserted at approximately half metre intervals into two third of the thickness of the Wall. The Earth rod, or the series of earth rod, short out the electrical potential, does stopping for the uses rising damp.
- **Active system** : The active system uses a low DC current from a main Transformer, directly two wires linking up to the anodes in the wall, providing an electric charge repairing the charged water molecules rising from the ground.  
Electro Osmosis DPC is usually used for stone buildings.

### Chemical method :

The most effective and economical way to treat rising damp is with a damp proofing injection cream. you can choose between complete kids or individual cottages of cream from leading brands such as Kiesol C and Aida. The cream is injected or handpump into specially positioned holes in the motor cost . Once inserted that damp proofing cream reverts into a liquid. this allows it to penetrate the brakes and achieve complete absorption. As it crosses, it creates a powerful water repellent barriers and a new chemical DPC that stops water from rising up the wall.

### REPAIR OF WALLS :

**Repair of mortar joints against leakage** : Be assure the mortar joints between the brakes are in great shape, and repair as necessary. Once you have the motor in great shape, apply as silane /siloxane water repellent to the entire brick wall. Play close attention to the return instructions with respect to hear temperature and the amount of water supplied to apply.

**Remove of efflorescence** : If you have not waterproof pure basement, now is the time to prevent acceleration from our appearing. When you your walls are protected, water will not be able to enter and stay for crystals to form. However, if you do not is an acceleration problem forcibly starting to form this may mean you have a leak. At this point we suggest basement waterproofing to come and professional assess the situation.

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Some preventing efflorescence are :

- **Hydrophobic Sealant** : Apply and connecting hydrophobic sealant to a building material surface can prevent the absorption of water. The sealant also will stop water from travelling within a building material.
- **Capillary breaks** : Installing capillary breaks such as polythene sheeting between a building material and soil can minimise the risk of salt and bring the materials.
- **Quality masonry construction** : Implementing overhanging coatings, eaves and flashings will minimise the risk of water from entering a wall.
- **Installing Grout with mechanical vibrations** : Consolidating route with mechanical vibration with limit the chance of voids in the ground.
- **Pressurised water** : Applying pressurized water may dissolve efflorescence quickly. If you use water, dry of the water from the building material after application. If you fail to remove the water, crystal may remain that can cause efflorescence to reappear.
- **Brushing** : With the strong brush, you can remove efflorescence with ease.

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- **Diluted vinegar** : If you are in a pinch, using household diluted white vinegar can be used on efflorescence ,so it's less harmful than industrial Chemicals and you most likely already have vinegar in your kitchen.

THE END



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**E-NOTES , Subject : Repair and Maintenance of Buildings , Subject Code: 6.6.2 , Course: Diploma,  
Branch: CIVIL Engineering , Sem-6<sup>th</sup>**

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