CAUSES OF DETERIORATION IN BUILDINGS

By

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OUTLINE

INTRODUCTION

THE SYSTEMATIC APPROACH FOR THE DIAGNOSIS OF A BUILDING DEFECT

CAUSES OF DETERIORATION IN BUILDINGS IN GENERAL

DETAILED CAUSES OF DETERIORATION IN BUILDINGS WITH EXAMPLES
INTRODUCTION

Proper building maintenance should be considered during:

* Planning
* Design
* Construction, and
* Maintenance stages

During maintenance stage, effective building maintenance requires:

The correct diagnosis of defect, and implementation of the correct remedial measures all based on sound technical knowledge, otherwise waste of capital resources have to be done again.

REPAIRS WITHOUT DIAGNOSES
### The Systematic Approach for the Diagnosis of a Building Defect

1. **Problem Definition**

2. **Field Survey and Inspection**
   a. **Visual Inspection**, includes:
      - **Taken Photos**
      - Looking for similar defect in the same area
   b. **Field Measurement**, includes:
      - **Written record about the sizes and dimensions of the defect**
      - Samples of the defected material and its adjacent area are taken

3. **Laboratory Testing of Field Samples**
   - Requires Test for:
     - **Strength**
     - Chemical and physical properties of the field samples
     - Other tests relevant to the defect condition

4. **Examine the AS-Built Design Drawings**
   - Obtain information relevant to the defect area

5. **Analysis and Discussion**
   - Compare the Lab. and field study results with the information obtained from the As-built drawings then after that,

6. **Conclusion can be withdrawn**
The primary source and causes of deterioration and decay in structures and buildings can be listed as follows:

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<th>Causes of Deterioration in Buildings in General</th>
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1. HUMAN
1. Human

- Failure to clean and carry out routine maintenance
- Ignorance of the causes of deterioration and decay
- Poor planning for proper maintenance
- Failure to promote awareness of maintenance needs by all who use the buildings.
- Adopting a negative attitude of waiting until emergency measures are required.

## CAUSES OF DETERIORATION IN BUILDINGS

2. CHEMICAL
2. Chemical

- Interaction of certain cleaning agents with materials and/or components causing disintegration, softening or discoloration.
- Promoting Corrosion
- Interaction of certain dissimilar materials in close contact with one another in a corrosion environment.

2. CHEMICAL-1-Discoloration-Concrete ages
CAUSES OF DETERIORATION IN BUILDINGS

3. ATMOSPHERIC

2. CHEMICAL 3-Alkali Aggregate Reaction
3. Atmospheric

- Reaction of the structure, external fabric, finishes and claddings 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.

3-ATMOSPHERIC 1.D-Cracking –frost cycles
3-ATMOSPHERIC 2-Climate

Scaling: Flaking of surfaces usually begins with repeated exposure to freezing and thawing. Ice first forms in low spots on a slab where water collects, especially water containing de-icers in solution. Scaling can progressively spread over the entire slab surface.

3-ATMOSPHERIC 3-Clay Brickwork – frost cycles-Salt reaction

[Image of brickwork]
CAUSES OF DETERIORATION IN BUILDINGS

4. STRUCTURAL

3-ATMOSPHERIC 4-Clay Natural Stone – frost cycles-Salt reaction-pollution
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 elements in the atmosphere
- Deterioration due to inadequate inspecting and maintenance

4. STRUCTURAL 1. Cracks Types - in brick and block work
<table>
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<tr>
<th>4. STRUCTURAL 2. Internal wall – settlement of the floor</th>
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<tbody>
<tr>
<td><img src="image1.jpg" alt="Image of internal wall settlement" /></td>
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<tr>
<th>4. STRUCTURAL 3. External wall – Diagonal Cracks-</th>
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<tbody>
<tr>
<td><img src="image2.jpg" alt="Image of diagonal cracks" /></td>
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</table>
## CAUSES OF DETERIORATION IN BUILDINGS

### 5. MOISTURE

- Penetration of the external fabric of claddings, or through 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
5. MOISTURE 1 - Dampness on Ceilings - Roof leaks -

5. MOISTURE 2 - Efflorescence - Leaks through cracks -
5. MOISTURE 3 - External Finishing - Plastering on under burnt bricks -

5. MOISTURE 4 - External Finishing - presence of moisture in between -
5. MOISTURE 5 - External Finishing - presence of moisture in between -

5. MOISTURE 6 - External Finishing - presence of moisture in between -
5. MOISTURE 7 - External Finishing - Leaks of plumbing in bathrooms -

5. MOISTURE 8 - External Finishing - Leaks of plumbing in bathrooms - Enlarged
5. MOISTURE 9-External Finishing-Irrigation

5. MOISTURE 10-External Finishing-Irrigation
CAUSES OF DETERIORATION IN BUILDINGS

6. FIRE
6. Fire

- Aftermath of a fire many possibilities may occur.
- Need for replacement of materials directly effected 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 set up deteriorating in materials not directly involved.
- The heat and the combination of heat and water can lead to the swelling, distortion, spilling and cracking of nearby materials and components.

CAUSES OF DETERIORATION IN BUILDINGS

7. FAULTY DESIGN
7. Faulty Design

- Poor detailing at the design stage including:
  - Insufficient allowance for expansion or contraction
  - Absence of weathering
  - Incorrectly placed damp – proof courses
  - Poor jointing between different materials or components
  - Poor specification
  - Lack of adequate consideration of future maintenance problems
  - Inadequate provisions for access to carry out maintenance activities.

7.FAULTY DESIGN 1-Wall cracks-
Poor detailing-strong bond –vertical crack-
7. FAULTY DESIGN 2 - Wall cracks -
Poor detailing - weak bond – diagonal stepped crack

7. FAULTY DESIGN 3 - Wall cracks -
Vertical crack - cavity clay brick work - restrained by columns
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<th>7. FAULTY DESIGN 4</th>
<th>Wall cracks - Poor detailing - Parapets cracking - Extreme weather</th>
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<tr>
<th>7. FAULTY DESIGN 5</th>
<th>Wall cracks - Poor detailing - Diagonal crack - Expansion and shrinkage</th>
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</table>
7. FAULTY DESIGN 6 - Clay tiles -
Poor detailing - No allowance for E&C -

7. FAULTY DESIGN 7 - External wall -
Poor detailing - Spilling of brickwork cladding - Compression of the concrete wall
7. FAULTY DESIGN 8 - Slab with Walls - Poor detailing - Random cracks near walls -

7. FAULTY DESIGN 9 - Wall cracks - Poor detailing - Horizontal cracks - No allowance for E&C -

Random cracks. Cracks, sometimes deep or wide, occurring singly or in groups, can be caused by any of many factors, including improper jointing (causing cracks to start at columns, at wall junctions or at 10 to 20 foot intervals), or ungraded subgrade.
7. FAULTY DESIGN 10 - Plumbing design - Direct to the wall.

7. FAULTY DESIGN 11 - A/C unit on the roof - Without proper design for drainage.
7. FAULTY DESIGN 12-A/C unit on the roof-
   Without proper design for drainage-

7. FAULTY DESIGN 13-A/C unit on the roof-
   Without proper design for drainage-
### CAUSES OF DETERIORATION IN BUILDINGS

#### 8. FAULTY CONSTRUCTION

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<th>Faulty Construction</th>
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<tr>
<td>Lack of supervision during construction period</td>
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<td>Failure to understand or follow exactly the specification and/or drawings</td>
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<td>Failure to replace defective work</td>
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<td>Failure of Designer/Architect/or Engineer monitor works in progress</td>
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<td>Lack of skilled labor</td>
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<td>Over emphasis or need for quantity rather than quality</td>
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<td>Failure to fully appreciate the consequences of shady or poor and/or materials</td>
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8. FAULTY CONSTRUCTION 1 - Crazing -

A pattern of fine shallow random cracks - Spreading dry cement on concrete or wetting dry concrete for finishing.

8. FAULTY CONSTRUCTION 2 - Crazing -

Enlarged - Spreading dry cement on concrete or wetting dry concrete for finishing.
8. FAULTY CONSTRUCTION 3-Plastic Cracking-
Occurs while concrete in plastic state-rapid loss of water or settlement of aggregates

8. FAULTY CONSTRUCTION -4-Plastic Cracking-
Enlarged-rapid loss of water or settlement of aggregates
8. FAULTY CONSTRUCTION -5-Honey combing-
Improper consolidation of concrete by vibration

Honeycombing. Irregular holes, usually in walls, are caused by the failure of the mortar fraction of the concrete to fill the spaces between coarse aggregate particles. This is evident when forms are stripped. They are encountered when vibration has been carelessly done or when deficiencies within forms have been too small to permit proper vibration, particularly where reinforcement is highly concentrated.
8. FAULTY CONSTRUCTION -7-Honey combing-
Sand streak-loss of cement grout from the form

8. FAULTY CONSTRUCTION -8-Sticking to forms
Damage caused during stripping of formwork from concrete
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<th>8. FAULTY CONSTRUCTION - 9 - Cold joints</th>
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<td>Due to pouring concrete in different times</td>
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<th>8. FAULTY CONSTRUCTION - 10 - Floors tiles</th>
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<td>Workmanship-base concrete- grading of aggregate</td>
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<td>8. FAULTY CONSTRUCTION -11</td>
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<tr>
<td>Workmanship</td>
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<th>8. FAULTY CONSTRUCTION -12</th>
<th>Corrosion</th>
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<tr>
<td>Workmanship</td>
<td>inadequate concrete cover</td>
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<td>8. FAULTY CONSTRUCTION - 13 - Corrosion</td>
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<tr>
<td>Workmanship - inadequate concrete cover</td>
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<tr>
<th>8. FAULTY CONSTRUCTION - 14 - Corrosion</th>
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<tbody>
<tr>
<td>Workmanship - inadequate concrete cover</td>
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8. FAULTY CONSTRUCTION -15 - Corrosion
Workmanship - inadequate concrete cover

8. FAULTY CONSTRUCTION -16 - Plasterwork
Workmanship - plasterwork on dense concrete
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<th>8. FAULTY CONSTRUCTION -17- External Finishing</th>
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<td>Workmanship: Cracking of the base wall or shrinkage of the plaster</td>
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<th>8. FAULTY CONSTRUCTION -18- External Finishing</th>
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<td>Workmanship: Cracking of the base wall or shrinkage of the plaster</td>
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</table>
8. FAULTY CONSTRUCTION -19 - Internal Finishing
Workmanship - Ceramic tiles, loss of adhesion - inadequate space fixing

8. FAULTY CONSTRUCTION -20 - Roofs Blistering
occurs between layers of felts due to water vapor underneath
7/8. FAULTY DESIGN/CONSTRUCTION – 1- Floor deflection: Cracks at the wall bottom due to floor deflection.

7/8. FAULTY DESIGN/CONSTRUCTION – 3 - Internal wall finishing: Blistering due to dampness-chemical-water vapor

7/8. FAULTY DESIGN/CONSTRUCTION – 4 - Ceiling Finishing: Flaking - dampness-chemical-incompatibility of the paint with that of the ceiling
7/8. FAULTY DESIGN/CONSTRUCTION – 5- Plumbing
leaks at joints: Due to use of different metals-
expansion from hot water

CAUSES OF DETERIORATION
IN BUILDINGS

9. FAULTY MATERIALS and
10. FAULTY COMPONENTS
9. Faulty Materials

- Failure of client, builder, designer or architect to reject sub-standard materials.
- Inadequate inspection of materials by supplier or receiver
- Inadequate storage facilities on site
- Inadequate/or inconsistent mixing of materials on site

10. Faulty Components

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

9. FAULTY MATERIALS -1-Popouts

Due to expansion of soft aggregate or present of glass in the aggregate.
<table>
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<th>9. FAULTY MATERIALS - 2 - Popouts</th>
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<td>Due to expansion of soft aggregate or present of glass in the aggregate</td>
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<th>10. FAULTY COMPONENTS - 1 - Services</th>
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<td>Failure of insulation - Overheating/overload</td>
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CAUSES OF DETERIORATION IN BUILDINGS

11. FAULTY SYSTEMS

11. Faculty Systems

- 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/or drawings
- Inadequate testing of the system before commissioned
- Failure of owner to follow maintenance instructions provided by manufacturer 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/or techniques
- Inadequate supervision of cleaners to ensure that cleaning is thorough
- Failure of owner to tenant to provide sufficient space, enough time or the correct equipment and materials for cleaning operations
- Failure to employ specialists for cleaning special fittings and equipment.
12. CLEANING - Use of unsuitable detergent

13. VANDALISM
13. Vandalism

- Lack of security
- Failure to promote awareness among occupants of the consequences of vandalism
- Incorrect selection of materials and finishes in circulation areas which are prone to vandalism
- Failure to maintain or repair areas of damage by vandals thus encouraging more vandalism.

Conclusion

- It is impossible to control all the above factors during design, construction and occupations stages of buildings.
- However, considering these factors and minimizing their effect will definitely reduce the amount and need for maintenance.