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A REVIEW ON STUDY OF DEFECTS IN BUILDINGS AND THEIR REMEDIES

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Abstract - *Building defect is one of the major components of building problems that significantly needed attention. When a building fails to function as it should, we must immediately seek for the determination. Is the problem taking place as the result of the worker's failure to assemble it properly? Is it involving the nature of it? Is the proper maintenance of the structure not been performed as it should have been? The answers often depend upon a number of factors: the age of the affected construction components, the exact nature of the problem, the presence or absence of human error, or some combination of all those three. This paper will review and discuss some of the major defects happening in buildings. It contains some of the main concepts. In addition, the causes, symptoms and remedial work of defect also been discussed in this paper*

Key Words: Defects,Remedies,Symptoms

1.INTRODUCTION

Building imperfection jumps out at either the new or the old ones. Imperfection inside new structures is perhaps of resistance with Construction Code and distributed satisfactory resilience and principles. Then the more established structures, or working out of guarantee period, may not consent to these gauges but rather should be judged against the standard at the season of development or renovation. Physical foundation constitutes a high extent of the nation's speculation. It is subsequently of essential significance that these offices and road networks which incorporate open structures are kept up all together that they can serve both the engineering and aesthetical capacities for which they are manufactured. The physical appearance of structures constitutes the premise whereupon the general public makes their underlying judgment of the nature of administrations to be advertised. All components of structures decay at a more noteworthy or lesser rate subject to materials and strategies for development, ecological conditions and the utilization of the structures.

2.LITERATURE REVIEW

RW Johnson – structural survey, 2002 :He was one of the researcher who conducted structural survey and did the detailed study in structures. He gave defects on building with respect to the structural review. The defects can be classified as follows. The defect can be divided into two categories, which are:

a) Structural defect :Basic imperfection implies any deformity in an auxiliary component of a building that is owing to blemished plan, inadequate or flawed workmanship or deficient material and once in a while any blend of these. Building structure incorporates earth holding dividers, sections, bars and level sections. (Northern Territory Consolidated Regulation) According to the Engineering Encyclopedia, basic imperfection can be classified as splits in establishments (Substructure), breaks in floor or pieces (superstructure), and breaks in dividers (superstructure). These imperfections can be caused by shameful soil investigation, improper site determination, and the utilization of deficient materials. The greater part of the auxiliary issue can be stayed away from by inferring the correct and detail of the outline and arranging. Auxiliary deformities in a building can happen after some time because of crumbling, wear and tear, over-burdening, and poor support. They should be repaired to keep up the building's structure and to keep any further disappointments.

b) Non-structural defect :As per Northern Territory Consolidated Regulation, a non-basic deformity in a private building is depicted as an imperfection in a non-basic component of the working subsequently of blemished private building work. As per the Engineering Encyclopedia, non-auxiliary deformity incorporates imperfection in block work, moistness in old structures, and imperfections in mortar works.

A D Adamu – IOSR Member , 2013 :A D Admu was one of the member of IOSR. He proposed many theories based on defects on buildings on his journal which was published in 2013, he had explained about the defects in brickwork
Defects in Brickworks :

- Frost attack/damage :Frost attack/damage is a common problem that usually occurs in older bricks, and those that were underburnt during the firing process. In newer construction, failure through frost attack tends to be confined to areas of severe exposure, or where the frost resistance of the brick was incorrectly specified..
- Efflorescence and staining :In some instances the appearance of bricks is affected by the development of efflorescence or stains. These may originate from materials in the brick or mortar, from adjacent materials or from outside sources such as cleaning agents. Each has a particular chemical composition and a unique means of removal.
- Efflorescence :Efflorescence is a common sight in new brickwork. It is caused by soluble salts in solution being brought to the surface as water in

the wall dries out. It is usually a harmless, temporary problem, often occurring in spring following a wet winter. The main concern is the unsightly appearance caused by the white staining that it produces. Persistent efflorescence may indicate a design or construction fault that allows the brickwork to become, and to remain, saturated.

- Lime run-off :Lime run-off is where excess water flows through cementitious material. Water can dissolve calcium hydroxide (free lime) which is then deposited on the brick face. The calcium hydroxide is a soluble form of lime which is created as Portland cement hydrates.

Irfan che Ani And Mohd Noor were the Professors at the Putra University, Malaysia. They Studied about the Behavior of roofs defects and its analysis. Which are given below they also provided solutions or remedies to these defects.

Defects in Roofs :

- Slipped/broken slates or tiles :Individual slates or tiles can suffer breaking or cracking. This can be due to weather conditions (such as high winds or a storm), the corrosion of the nails holding the slate in place or the rotting of the wood which the slates are fixed to. You may just have to replace the individual slates that are broken, or this could be part of a larger problem that could mean re-roofing.
- Blocked roof valleys and cracked lead :A blocked valley will cause water to overflow and can cause further problems if left – but unblocking the valley is a fairly simple task and won't put you out of pocket too much. If the lead in the valley is cracked and water is leaking through, however, fixing this is a larger, but necessary task.
- Roof leaks and moisture :Leaks are a serious problem and can be identified by checking for moisture and damp in the loft. When moisture gets under the layers of the roof, this can cause mould and rot, which will lead to more extensive problems in the future if left un-repaired. This becomes a more urgent issue if the moisture has spread to the rafters as they carry the weight of the roof, and a roofing specialist should be contacted ASAP!
- Poorly installed, torn, or weathered flashing :Flashing seals the areas where there is an opening in the roof, such as sky lights, chimneys, vent pipes, and where an extension roof joins the main wall. If the flashing has been improperly installed, it can cause open seams, damaged tiles and other issues. Flashing can also become damaged over time.
- Ponding water :Water that ponds on your roof is a sign of a problem that can be caused by many things, such as debris build up or issues with draining of gutters.
- Overhanging trees :Overhanging tree limbs can rub on the roof, wearing away the protective layer of the roof. Branches can also fall in bad weather, potentially causing serious damage, and leaves can cause blockages in gutters and valleys. You should ensure that trees are trimmed back or even removed if they pose these problems.
- Inadequate ventilation : Roof and loft ventilation is an important part of ensuring a roof will last. Vents should be placed at the base of the roof and near the ridge so that warm air can leave through the top and cool air can enter through the bottom. This regulates the temperature and moisture levels in the loft – left unchecked, heat and moisture can build up, potentially causing damage to rafters and insulation, and can cause mould and damp problems.

Defects in stonework :

- Pore structure : The natural durability of stone can be affected by a number of factors; probably the most significant is pore structure. Pore structure is significant because it affects the amount of water entering and moving through the stone. Also, salts that may damage the stone can be transported by water and accumulate in the pores. The critical factor is not the total amount of space created by the pores but how they are structured.
- Incorrect bedding : Sedimentary rocks are laid down in beds. Defects can arise if a stone block is incorrectly placed in a building in relation to its bedding plane.
- Salt crystallisation : This involves salts in solution passing into the stonework and entering pores of the limestone or sandstone. There are a number of salts which can cause problems and they may come from a variety of sources. Sources may include building material such as concrete, brick or mortar, as well as soil and the air. As stone dries out, salt is deposited at the surface (efflorescence) or within the stone.
- Lime run-off : The soluble salts produced by the reaction between acid rain and the calcium carbonate in limestone can cause problems in adjacent materials. When the soluble salts are formed they may run off say, a limestone coping, onto a brick or sandstone element below. As these salts crystallise they can cause decay in materials that would otherwise not be particularly vulnerable.

- Frost attack : Frost will tend to be a problem in those areas which get both excessively wet and are subject to freezing. The vulnerable areas are described in the 'Defects in brickwork' article, but it is worth noting that frost damage is not very common in sheltered plain walls, except at below the damp proof course level. As with brickwork, pore structure is a significant factor in determining susceptibility to frost attack and the process of attack is the same with brickwork.
- Contour scaling : Contour scaling occurs in sandstone and is thought to be the result of the pores of the stone being blocked with calcium sulfate. This seems to happen even when it is not calcareous sandstone. The effect is a breaking away of a rather thick crust from the face of the stone.
- Expansion of metals and Wall tie failure : Iron and steel cramps have been used as fixing devices in stonework for many centuries. With these metal fixings, rust can expand and fracture the stone. Additionally, stone cavity walls may suffer from the cavity wall tie problems mention in the 'Wall tie failure' article.
- Extraction and dressing : Stone can be damaged in the quarry if it is extracted by the use of explosives which may cause internal fractures. Damage can also be caused by excessive tooling of the surface of the stone.
- Organic growths : Plants and lesser organic growth on stone are common. Sometimes they are seen as adding to the charm of stone; sometimes they are regarded as unsightly. The different perspective depends to some extent on context – thought of as detracting a classically designed building for example, or, in other situations, valued as part of the patina of age.

Failure of metals :

- Overload : This type of failure is caused when applied loads stress the metal beyond its ultimate strength. Failures can occur very rapidly, and are influenced by the material type, its heat treatment, and so on. Overload failures are generally categorised as: Ductile: The component stretches or bends to some degree before failure, Brittle: The component breaks with little or no distortion.
- Fatigue failure : Fatigue failure is the most common type of metal failure. The failure is easily detected by the recognisable 'beach markings' that are left on the fracture surface.
- Stress corrosion cracking (SCC) : SCC is caused when three factors are in combination: Tensile stress, A susceptible material, A corrosive chemical environment.Similar to fatigue failure, SCC initially occurs at stress levels that would not usually cause failure were there not a chemical factor present.
- Corrosion : Corrosion can occur when compressive residual stresses on the surface of metal components are induced. Laser peening is a remedial solution that can modify the surface of components and reduce the risks attached to operating in a corrosive environment imparting beneficial residual stresses in materials.
- Fretting : Fretting can occur when the surfaces of metal components slide against one another and generate abrasive compounds. As this motion continues, the abrasive components score the surface and cause a form of wear known as fretting.
- Erosion : Erosion can occur due to repeated exposure to adverse environmental and weather conditions such as wind, ice and water. Laser peening can harden surfaces to protect against erosion.
- Creep : Creep is a risk for metal components that are exposed to stresses at elevated temperatures. Deformation results from grain boundary sliding, a mechanism in which grains are displaced against each other at high temperatures.
- Hydrogen embrittlement : Hydrogen embrittlement occurs as a result of exposure to hydrogen, for example, in the manufacture or processing of high-strength steels and titanium and aluminium alloys. It reduces the ductility and load-bearing capacity of affected materials, which can cause cracking or failure at below normal yield stresses.

Flooring defects :

- Levelness : This is the most obvious thing to look out for concerning flooring.While older homes can understandably be more prone to this problem due to foundation settlement or shrinking floor joists, it's not an issue limited to old houses.
- Squeaking : Squeaking of wooden floors are commonly due to poor workmanship from fastening of the subfloor or movement in the finish. These problems can easily be fixed by a contractor.Sometimes, squeaking can occur on floors under the carpet too.Similarly, this is usually caused by inadequately glued or nailed subflooring when the work was initially done.
- Cupping or warping of hardwood floors : You'd think that if each plank is placed, positioned, and glued together nicely with adhesive by a meticulous contractor, that this would not happen.But nature has it's ways of making our life miserable. Wood is after all a material that is prone to warping and dents.Signs of this problem

can be observed when the edges of a tile bends slightly upwards.

- Damaged floor near exterior doors : This is an area of the floor that is subject to a lot of wear and tear. So it's no surprise to find defective concerns here.The damage is often caused by the constant barrage of water attack from the elements outside.Rain, snow, higher humidity from outside, poor maintenance, etc.
- Bowing at the center : This is a problem that has it's roots from the initial planning to build the house by the builder.When rooms and houses are not built with a gap installed around the perimeter, the floor will have no space to expand from the effects of heat. This means the only direction it can go is up by altering it's shape.The result is a creating of a bow at the center. Somewhat like a hump to a lesser extent.
- Sloping : You can usually feel a minor change in gravitational force when walking along sloping floors. However, just because there is a slight slope does not mean that you have a big problem on your hands.Older houses that have aged gracefully often have floors that suffer from slight sagging and sloping towards the center. This is often not an indication of a major problem.
- Floor tiles : Loose tiles are common defects of floors using ceramic tiles. They sometimes also come together with cracks along grout joints.This is caused by shoddy workmanship when the adhesive required is insufficient or applied with bad technique. Some common defects of floor tiles are: Dirty joints, Grout with uneven color, Unnatural stains like oil, adhesives, chemicals, etc.
- Loose linoleum : Linoleum is basically a canvas-like material used for floor covering.Loose or oddly worn-out linoleum near the washroom can indicate a leak, and quite possibly implies that the subflooring beneath has deteriorated from the moisture.To correct this problem, you might need to remove the floor tiles to examine what kind of party is going on below it. And rectify it accordingly.
- Bloating vinyl tiles : Slabs with moisture from below can cause vinyl tiles to bloat, lump, or "pop". Another sign of this problem to look for are stains.This can occur for linoleum and laminate flooring as well.Repairs for this issue can be extensive. Which is a reason why many homeowners and investors choose to ignore this problem altogether.So this is definitely something to get right the first time. And get the developer to fix it if the house is under warranty.
- * Asbestos : Residential construction these days don't use material that contain asbestos anymore.But older houses can still have tiles that contain it. This can be an environmental health hazard and should be taken seriously.

Cracks:(Gambhir, 2005)

Cracks in the building are of common occurrence in a building.Stress in a building component could be caused by externally applied forces, such as dead, live, wind or seismic loads, or foundation settlement or it could be induced internally due to thermal variations, moisture changes, chemical action, etc. Cracks could be broadly classified as Structural and Non-Structural. Structural cracks which are due to incorrect design, faulty construction or overloading and Non-structural cracks are mostly due to internally induced stresses in building materials and these generally do not directly result in structural weakening. These are due to penetration of moisture or thermal variation. Cracks may appreciably vary in width from very thin hair cracks barely visible to naked eye (about 0.01 mm in width) to gaping cracks 5 mm or more in width. A commonly known classification of cracks, based on their width is:

(a) Thin— less than 1 mm in width
(b) Medium — 1 to 2 mm in width and
(c) Wide — more than 2 mm in width.

Cracks may be of uniform width throughout or may be narrow at one end, gradually widening at the other. Cracks may be straight, toothed, stepped, map pattern or random and may be vertical, horizontal or diagonal. Cracks may be only at the surface or may extend to more than one layer of materials.

Principal causes of occurrence of cracks in buildings are as follows:

1. Moisture changes
2. Thermal variations
3. Elastic deformation
4. Creep
5. Chemical reaction
6. Foundation movement and settlement of soil and
7. Vegetation.

3.SCOPE OF WORK:

Taking the literature and various studies into consideration a case study is being done on a building in order to understand the defects as well as to suggest the latest remedial measures that can be implemented in the case study.The methodology followed the case study analysis is mentioned in this paper

4.METHODOLOGY

The following tasks will be carried out in order to achieve the study objective:

STEP-A: Select a building which will be under the study to carry out survey.

1.Carry out the investigation based on visual inspection to detect defects.

2.Identifying and measuring the defects.

STEP-B: Get knowledge about the reasons which cause defects in buildings.

1.Through the notes, select the reasons which cause defects.

This can be done through the journals and Interviews.

STEP-C: Select the best maintenance option.

1.Best maintenance method and latest remedial measures will be suggested for each defects or cracks identified.

5.REMEDIAL MEASURES: However, bigger the problem is with proper strategy and materials you can always prevent them. Discussed below are few of the remedies for defects in buildings:

1. Remedial measures for defects in floors and roof

- Qualitative testing at the beginning
- The correct time of measurement:
- Supervision of water content
- Proper implementation of Fly ash
- Aptest use of curing compounds
- Installation of an effective vapor retarder
- Strategic Selection of moisture mitigation coating
- Eliminate blotter layers
- Adaptation of General Surface repair system

2. Remedial measures for cracks

The aim of crack repair has to be established a prior and achieved by proper selection of repair material and methodology. The goal of all crack repairs is to achieve one or more objectives such as:

- Restore and increase the strength of cracked components
- Restore and increase the stiffness of cracked components
- Improve functional performance of the structural members
- Prevent liquid penetration
- Improve the appearance of the concrete surface
- Improve durability; and prevent development of a corrosive environment at the reinforcement.

Materials for nonstructural crack repair of dormant nature should be a rigid material. Cementitious, polymer modified cementitious grouts of acrylic, styrene-acrylic and styrene-butadiene should be used for wider cracks. However polyester and epoxy resins should be used for injection of dormant cracks. For live cracks flexible material of polysulphide or polyurethane should be used. Before repair of any non-structural cracks the factors have to be considered are:

- Whether the crack is dormant or live;
- The width and depth of the crack;
- Whether or not sealing against pressure is required, and, if so, from which side of the crack will the pressure be exerted and
- Whether or not appearance is a factor.

6.CONCLUSIONS

The various defects in buildings and their remedial measures have been reviewed and a case study analysis is being done on hennur sewage pump building near nagawara junction,bangalore which is a 40 year old building.

Fig.1 Hennur sewage pump

The results and observations and remedies for the defects in this building will be analysed and presented in the upcoming journal.

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