

Failures in Construction; Types and Causes and Its Assessment.

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Abstract : Failures produce economic and temporal deviations in construction industry. Failures in buildings are the defects, reduced serviceability or an unachieved goal. This research looks at the failure modes that caused latent defects and immediate defects. Defects are categorized according to their causes. It analyses the areas and elements in which defects were detected. Studies confirm that there are three major categories in which defects can be classified i.e. Controllable failures, uncontrollable failures and design failures. Honeycombing of columns, beams, cracks in walls, water leakage are common failures. Waterlogging, visible sunk slab, under reinforcement are design failures. Defects in brickwork, structure, tiles, plumbing, painting add to the failures in building. Weather impact, load impact, corruption, lack of supervision, deficient materials, unskilled manpower are major sources or causes of failures. This paper confirms the need to look at defects in another way and establish more effective methods to reduce latent as well as immediate defects.

Keywords- Defects, failures, deficiencies, maintenance.

I. Introduction

The field of engineering mainly comprises of investigating the solutions for avoiding the failures which the mankind comes across. In it we identify the principle causes for the failure along with the other causes which complement the principle causes along with their respective remedial measures and precautions to be taken prior the failure. There is now a need to understand the various situations or conditions whose existence gave rise to such failures. This job is very important to be done in order to reduce the consequences caused by such failures. In this research the various failures were studied along with live case studies to determine their causes for different types of failure. Failure can be broadly

defined under three types which would be failure during construction, failure due to failure of services and failure, due to improper maintenance, and design failure. Construction failures would include all those failures caused to the assets at the time of construction or defects occurred in it over a period of time. The main reason behind this is that information related to failures and their causes are kept confidential from the fear of embarrassment and legal issues. The best way to tackle these failures is to fight it by facing them gravely identifying the causes for this and to determine the preventive measures to prevent those failures from occurring in future. The management of construction projects requires knowledge of modern management as well as understanding of the design and the construction process. Construction projects have a specific set of objectives and constraints such as a required time frame for completion. Also they are a costly undertaking so many people, in an effort to reduce the cost, become penny wise and pound-foolish. Change is inherent in construction work. The majority of the projects fail to meet deadlines, cost and quality targets. This is not too surprising considering that there are not known perfect engineers, anymore than there are perfect designs or that the forces of nature behave in a perfectly predictable way. Change cannot be eliminated, but by applying the principles of risk management, engineers are able to improve the effective management of this change. In construction projects, each of the three primary targets of Cost, Time and Performance are likely to be subject to risk and uncertainty. Many people, in order to make change in the project with minimum cost, get the project into trouble. The lack of risk management, even an insufficient risk analysis, can put construction projects in jeopardy.

1.1 Definition of 'failure'

Failure of Civil Engineering Structures could mean several Things It could be a catastrophic failure or collapse, It could be a loss in functionality or it

could mean a degradation in the serviceability of the building to a level that would be uneconomic to maintain.

The Technical Council on Forensic Engineering of the American Society of Civil Engineers has defined a construction failure as —an unacceptable difference between expected and observed performance. Thus construction failures would include all those failures caused to the assets at the time of construction or which have collapsed post construction prior to the end of their design life.

According to dictionary by Farlex, failure is defined as the condition or fact of not achieving the desired end or ends. Failure is “an unacceptable difference between expected and observed performance; also the termination of the ability of an item or system to perform an intended or required function”. Failure mechanism is “an identifiable phenomenon that describe the process or defects by which an item or system suffers a particular type of failure” Failure mode is “a description of the general type of failure experienced by a system”.

1.2 Types of Failure

- a. Failure during construction
- b. Failure due to failure of services
- c. Failure due to improper maintenance

2 Background

The purpose of this research is to reveal why the construction projects fail, due to inadequate risk management and what are the best practices for the recovery, in addition, our goal is to define pre-signals of failure of project. the main function of a building is to protect the occupants and contents from the weather, mainly rain, wind and extremes of temperature. It is most important to provide the basic needs which will achieve all of these functions. Features such as windows, pipe, air conditioning system and finishes are only additional. Obviously a building must be structurally safe in order to survive, and the floors must be capable of resisting any normal imposed loads. Projects by their nature are unique and many of the more interesting ones are complex they frequently take place over an extended period of time and demand the engagement of wide range of resources, including people, finance, facilities, materials and intellectual property. In most circumstances, projects have defined objectives or an end state that provides those involved in them with a clear vision and specification of their goals. Although attitudes of construction organizations towards risks are generally known, little

information is available concerning the use of risk management as a tool within the organization. To evaluate attitude and skills in risk management, a comprehensive multiple choice questionnaire survey was adopted for this survey. It is obvious that it needs documentarily updates. Risk management is brought on a higher level of importance for the project as compared classical methods of risk management as it becomes a common tool for both project team and project organization , it becomes an organization philosophy and strategy.

3 Research objectives and methodology

The aim of this research is to detect the causes of failure and its types to suggest remedial measures and how to assess it. It also aims to suggest guidelines for defect free construction and develop a checklist for defects in near future. The field of engineering mainly comprises of investigating the solutions for avoiding the failures which the mankind comes across. In it we identify the principle causes for the failure along with the other causes which complement the principle causes along with their respective remedial measures and precautions to be taken prior the failure. Study and detection of following factors is to be done.

1. Causes of failures
2. Types of failures
3. Types of defects
4. Impact of failure on building

The first step was to identify the data to be tracked. Data were to classify different types and causes of failures Study of relevant literature is done on the failure of a building, several defects were found out. Categorization of defects and failures is done. Second step was a research carried out by doing case studies of building in which emphasis is given on defects. a classification of defects is carried out by conclusions of previous studies and by conducting interview with the contractors and person involved in construction. A review of defects is done and data is collected on defects and failures. classification on the bases of causes is done so as to give a clear opinion about its types and causes.

3.1 Broad Classification of Causes of Failure

The broad classification of causes for failure can be done in two type's i.e. controllable and uncontrollable causes. Controllable causes are the causes which can be controlled by taking proper preventive measures and through inspection during the construction of the structure. Uncontrollable causes are those which are out of control of human beings. The best example is failure caused due to

earthquake, tsunamis, etc which are termed as unpredictable causes of failure.

3.2 Controllable Causes of construction failures are as follows

I. Error in Design

Design error can be easily determined as the design data and all the evidence are all included in the contract documents, i.e. the drawings and specifications. Thus any error committed by the designer or architect can readily is established.

II. Improper Detailing and drafting

The job of proper detailing and drafting acts as an important link between the planning and engineering processes in any of the construction project. Many of the structures which have been properly designed and executed have failed due to poor detailing work. In some of the cases the shop drawings are prepared by persons having non technical background thus important engineering decisions are taken by non professionals.

III. Improper selection of Materials In construction industry many types of materials are used from man-made to naturally available materials such as timber, steel, plastic, brick, mortar, glass, etc. most of the times these materials are used without any test or checks to determine whether this material is fulfilling the standard specifications or not.

IV. Poor Workmanship

Workmanship is a manual aspect of skill. This skill would develop more with more practice and experience. In past, the quality of workmanship was excellent and it used to determine the quality of construction. There are no written standards for measuring this skill of workmanship. In recent years we are lacking in good quality workmanship.

V. Lack of proper Inspection

The proper execution of the contract as per the requirements and design depends on continuous monitoring the construction process. There are various types of inspection been done such as periodical inspection, spot inspection, progress inspection and full time inspection.

VI. Formwork failure

Such type of failure is caused due to improper fixing of formwork or lack of providing proper bracing during erection of form work. The collapse of Sawantwadi fish market slab is an example of formwork failure.

VII. Geotechnical failure

The failure caused due to lack of proper soil investigation done prior to construction of structure, wrong type of foundation provided can result into settlement of structure, when deep excavations are made near the existing foundation the possibility for settlement is high etc.

VIII. Technical failure

Many times structural members are cut down or altered without any technical knowhow, the capacity is crane is limited but it is used to lift loads higher that the capacity is also a technical failure. The failure caused in building which collapsed in Mazgaon dock area is an example of technical failure.

IX. Failure Due To Errors

Errors are also committed during the course of the project which are caused unintentionally leading to deviations from correct and acceptable practice and thus can be avoided. There are three basic types of human errors:

- i. Errors of knowledge (ignorance)
- ii. Errors of performance (carelessness and negligence)
- iii. Errors of intent (greed)

X. Maintenance failure

Building maintenance can be defined as: work done in order to keep an existing building in, or restore it to, a condition where it can perform its functions as per plan. It can be divided into:

- Preventive maintenance -carried out to a predetermined plan to reduce the risk of failure. This can be achieved by:
- Scheduled maintenance, preventive maintenance done at regular intervals.
- Condition-based maintenance, preventive maintenance done when deemed necessary through regular inspections of the building.

Fig.1 Major causes of failures

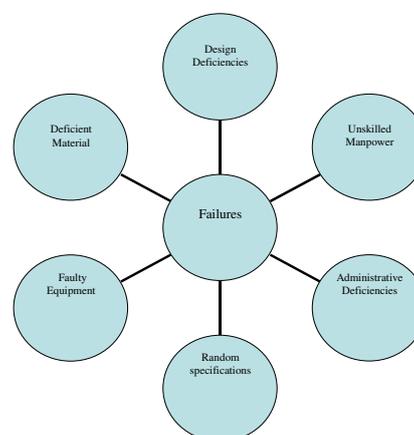


Table 1: Causes of Common Types of Building Defects and Failures

No	Defects/ Failures	Causes
1	Blemishes(Scaling, Honeycomb)	Improper mix design
2	Corrosion of Reinforced Steel	Material Deficiency
3	Damage of Exterior Surface	Weather impact
4	Dampness	Plumbing defects
5	Peeling Paint	Material Deficiency
6	Roof Defects	Unskilled manpower
7	Cracking(floor, beam, etc)	Under reinforcement /over reinforcement
8	Spalling or Chipping	Improper mix design
9	Foundation Failure	Design deficiency
10	Structure Instability	Faulty Steel design
11	water seepage	capillary in concrete
12	Delaminated/disc olored tiles	Weather impact/ architectural deficiency
13	Exposed rebar	Chipping of concrete
14	Hollowness below tiles	Poor workmanship
15	Cracks in wall	Over curing/under curing
16	Visible sunk slab beams	Design deficiency

Conclusions

It should be pointed out that, entire buildings are subjected to the various forms of defects, failures, deterioration and variation. The literature has explored a number of building defects and its contribution factors which can be associated to the major theme of this paper. It is significant to appraise each defect and failure in every part of building and find out the primary causes of each individual defect and failure. Then, remedy them correctly. The contribution factors to these defects and failures must be investigated intensely. Once founding out the possible causes of the defects and failures, it is imperative to distinguish how to keep away from it in the future and reduce the effect to the minimum. Based on the result of the data analysis for building defects and failures, it was found that the low quality of construction material is most common factors that lead building defect. Therefore, it is important to ensure parties in construction using good and acceptable materials throughout the project in order to produce high end product that satisfy end users. Furthermore, it is recommended to all parties to promote and practice ethical conducts in their project to minimize other contribution factors to building defects and failures.

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