A Study of Contribution Factors to Building Failures and Defects in Construction Industry

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Abstract

Failures and defects are common phenomena in construction industry. Negative impacts may arise towards cost, duration and resources of project. Failures and defects can cause unnecessary expenditure and delays. They are also generating controversies among parties involved. Furthermore, if this situation is left unanswered and untreated, it will lead to more serious problems in the future upcoming construction projects in Malaysia. Therefore this study is aimed to identify contribution factors to building defect and failures, which frequently occur in construction project especially in Penang area in order to minimize time and cost involved. The data is collected from questionnaire from various players in construction industry. This study is succeeds in identifying the common contribution factors of structural defects and failures in construction project. Hopefully this study could improve the effectiveness of managing appraisal process of failures and defects in the future.

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Keywords: Building defects; building failures

1. Introduction

The reoccurrence incidences of defects and failures in government buildings concerning leaking pipes and ceiling collapse, including a leaking roof in the Parliament building, are an embarrassment and far too serious to be ignored. If this situation is left unanswered and untreated, it will lead to more serious problems in the future upcoming construction projects in Malaysia. Furthermore, if these problems

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continue, those who are working in the construction industry also will be facing numerous procedures and regulation before being awarded a construction project. Therefore, it is essential to identify common contribution factors of structural defects and failures in construction project especially in Penang area in order to minimize the effect to building and indirectly it will prolong the life span of the building.

2. Background

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 [1].

Building Defects ; According to Webster’s Dictionary, defect is defined as lack of something necessary for completeness; shortcoming. It is also defined as an imperfection; fault; blemish. Another term for defect is deficiency. Webster's Dictionary defines the word deficiency as a state or quality of being deficient or a shortage; deficit. As for deficient, it is defined as to be wanting, lacking in some quality necessary for completeness; defective and one that is deficient. Defect is “the nonconformity of a component with a standard of specified characteristic” [2]. A building defect may include any problem that reduces the value of a home, condominium, or building. Building defects can be the result of design error by the architect, a manufacturing flaw, defective materials, improper use or installation of materials, lack of adherence to the design by the contractor, or any combination of them. Common types of building defects include: structural defects resulting in cracks or collapse; defective or faulty electrical wiring and/or lighting; defective or faulty plumbing; inadequate or faulty drainage systems; inadequate or faulty ventilation, cooling or heating systems; inadequate insulation or sound proofing; and inadequate fire protection/suppression systems. Additionally, dry rot, wood rot, mold, fungus, or termite or vermin infestation may also be the result of a building defect. A building defect may also include damage caused by land movement or earth settlement. Proving a building defect commonly requires the hiring and testimony of a highly trained and experienced expert. An expert, such as an engineer or architect will be able to determine whether a construction problem is the result of improper design, material, or workmanship.

Building Failures ; 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]. Structural failures such as foundation failure and structural instability are the result of over-stressing, that is, the imposition of loads in excess of the capacity of the structural components. Collapse is the ultimate and most serious result of structure failures, but over-stressing is also evident at earlier stages through the development of deformation and fractures. If a structure is correctly designed and constructed in accordance with the design, over-stressing indicates some other failure, such as the use of an unsuitable material. However, still suitable materials may be inadequate in some conditions or because they have been altered in some other way.

2.1 Contribution Factors to Building Defects and Failures

Climatic Conditions ; It is important to consider the climatic conditions of Malaysia and the effect to building materials. Like many other tropical countries, Malaysia has heavy rainfall and warm sunshine all
year round. This implies that buildings in the country tend to weather rapidly, particularly in respect to external building materials which are exposed to external causes such as rain, wind, solar radiation including ultra-violet light; and atmospheric pollution. Fungal stain, harmful growth, peeling paint, erosion of mortar joints and defective plastered rendering are a few examples associated with this factor.

Location of Building; Buildings that are located near the sea or rivers tend to have common building defects. This is because the water coming from the ground causes dampness penetration and structural instability. In addition, soluble salt which comes from sea and together with the presence of a polluted atmosphere can cause damage to the exterior surface of the buildings.

Construction Materials; Most buildings use building materials which are easily available locally. Such building materials include timber, stone, brick and plaster. In the materials management of buildings, understanding the nature of the building materials and accurate diagnosis of defects is most important. This is because buildings are, like older people, vulnerable to all sorts of diseases. Therefore, in order to tackle the diseases, architects, contractors, engineers and those involved in building management should be familiar with the building materials in common use and have deeper understanding into the proper techniques of preservation of the materials and structures.

Building Type and Change in Use; Buildings that change their use and spaces should consider the effect of the new use on the existing structure. This is because some buildings were built to only hold certain loads and sometimes may not withstand additional loads. Where buildings which have been converted into either commercial or office purposes, the need to install air-conditioning systems to meet modern building requirements seems necessary. It has been found that in a few cases the air-conditioning units were placed improperly. This not only affects the appearance of the buildings but intervenes with the existing fabric, particularly when ducts are running in full view on the ceiling.

Maintenance of Building; Building maintenance prepared through an accurate programme of repeated maintenance plays a major role in preventing building defects. Buildings that neglect building maintenance may fall into several defects which may lead to structural failures. Any inspections carried out by either architects or surveyors should include checking for any signs of abnormal deterioration, cleaning out gutters of leaves or harmful growth, checking lighting conductors, cleaning out all voids and spaces; and changing tap washers. To secure the general structural stability and life of a building, it is important to regularly inspect not only the main structural elements including foundations, walls and roofs; but other common building problems. It is important that buildings continue to be properly maintained to ensure that they can function as efficiently and effectively as possible in supporting the delivery of a wide range of services. At the same time, the deterioration of buildings due to the lack of maintenance could lead to future financial burdens, pose legal and other industrial relations issues and affect the delivery of services. Therefore, the maintenance of buildings is critical to the proper management of physical assets and the overall management of capital to achieve agency outputs and institutional outcomes.

Faulty Design; A common design error is often made, usually in an effort to save initial construction costs. Project cost plays an important role in designing buildings. Reducing the size of columns, the size of reinforcement bars and foundations are the common design error in construction. This situation will lead to uncertainty situation in the future where the structure cannot withstand the load and finally fails. Sometimes faulty design is also a result of misjudgment, leading to assumptions or decisions that are not consistent with the actual behavior of the structure [3]. Faulty Construction; According to the experts, faulty construction had mainly caused collapse of the buildings but legal action against the offenders through proper investigation is abandon due to various factors like reluctant mood of a section of official’s concerned and strong lobby by the vested groups. In Malaysian construction industry, faulty construction is also the main causes for building defects and failure cases. The contractors responsible to construct
manage to use lower grades materials, concrete, and method that are not according to the specification without the permission or without the client and consultant awareness.

Corruption; Corruption within the construction industry is a complex and sensitive issue. It is generally assumed that it occurs but the form and scale of corruption is by its nature difficult to establish. Corruption can occur during any phase of a construction project such as project identification, financing, designing, tendering and execution, noting that in each phase corruption may involve the project owners, funding agencies, consultants, contractors, sub-contractors, joint venture partners and agents. Corruption may lead to projects being authorized questionably because there could be bribery and fraud in the selection of contractors, project prices could be grossly inflated and the end product could thus be defective or dangerous [4].

Lack of Supervision; The quality of site supervision has a major influence on the overall performance and efficiency of construction projects. Inadequate supervision is believed to be one of the major causes of rework. Therefore, experienced and well-trained supervisors have an important role in minimizing the amount of rework due to construction defects. The quality of site supervision has a major influence on the overall performance and efficiency of construction projects. The performance of supervisors depends on skilled communication with individual workers, and planning and directing the work.

3. Research methodology

3.1 Conceptualization

Conceptualization was aimed at understanding the importance and basics of the work to be carried out. The objectives of the project would be set. The problem and the significance of this project would be stated. Then literature review would be undertaken and investigated thoroughly.

3.2 Literature review

The main aim in carrying out the literature review is to gather the information and be more understanding on the topic of this research. Relevant journals, paperwork, thesis, articles and book that related to the topic had been looking for and would help in carrying out literature review.

3.3 Questionnaire

A questionnaire was prepared and distributed to correspondences in construction industry. An interview session also had been held involving 12 contractors and 29 consultants in Pulau Pinang in order to obtain their opinions and experiences to some related study. In the distributed questionnaires, some scales are provided in order to get the highest rank answers from the respondents. The descriptions of the scales are as follows;

1. ‘Less Occurred/Less Important/Less Agree’
2. ‘Slightly Occurred/Slightly Important/Slightly Agree’
3. ‘Occurred/Important/Agree’
4. ‘Considerably Occurred/Considerably Important/Considerably Agree’
5. ‘Mostly Occurred/Very Important/Very Agree’

3.4 Data analysis
The collected data were analyzed using the Statistical for Social Science (SPSS) program version 11.0. Frequency analysis is obtained from the SPSS output and average index method is adopted for analysis from the result of frequency analysis. The frequency and the percentage will be representing in the form of table, bar chart and pie chart.

4. Result, analysis and discussion

Table 1: Rank of Relative Index for Common Types of Building Defects and Failures

<table>
<thead>
<tr>
<th>No</th>
<th>Defects/Failures</th>
<th>Relative Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blemishes (Scaling, Honeycomb)</td>
<td>0.909</td>
</tr>
<tr>
<td>2</td>
<td>Corrosion of Reinforced Steel</td>
<td>0.827</td>
</tr>
<tr>
<td>3</td>
<td>Damage of Exterior Surface</td>
<td>0.813</td>
</tr>
<tr>
<td>4</td>
<td>Dampness</td>
<td>0.807</td>
</tr>
<tr>
<td>5</td>
<td>Peeling Paint</td>
<td>0.789</td>
</tr>
<tr>
<td>6</td>
<td>Roof Defects</td>
<td>0.722</td>
</tr>
<tr>
<td>7</td>
<td>Cracking (floor, beam, etc)</td>
<td>0.716</td>
</tr>
<tr>
<td>8</td>
<td>Spalling or Chipping</td>
<td>0.700</td>
</tr>
<tr>
<td>9</td>
<td>Foundation Failure</td>
<td>0.614</td>
</tr>
<tr>
<td>10</td>
<td>Structure Instability</td>
<td>0.476</td>
</tr>
</tbody>
</table>
From the result shown in Table 1, the most common types of building defects and failures occurred is blemished with the highest value of 0.909. The types of blemishes in concrete are scaling, honeycomb, air pockets and bolt holes. There are many kinds of activities that lead to this problem. One of the factor is the usage of unskilled workers in handling the concrete works can result in blemishes on the surface due to lack of knowledge of the worker on how to handle and repair concrete. Other than that, less monitoring and inspection by the supervisor also may lead to the problem. When the supervisor did not monitor or check the work regularly, the workers tend to speed their works without considering the quality of the outcome of his work. Blemishes are an output from human errors itself where the concrete that is not properly prepared. Attempting to speed up the construction also will result in many kinds of blemishes as the concrete are not even hardened or reach the desired strength in 28 days. Meanwhile the least occurred is structure instability with the value of 0.47. Generally, structure instability is related to the instability of the foundation of the structure itself. Foundation instability can be caused by the characteristic of the soil or the bearing capacity of the soil is low, high water table that originated from the sea water seeps through the soil under the structure resulted in the decreasing of the soil strength. Sometimes structure instability also related with the surrounding factors that contribute to the problem such as near construction site that was doing piling works, will have an impact on the buildings around it. Although less cases of structure instability present in Penang area, this factor cannot be ignored especially due to the recent incidents of earthquakes in Indonesia that has an impact on the west coast of Malaysia.

Table 2: Rank of Relative Index for Common Contribution Factors to Building Defects and Failures

<table>
<thead>
<tr>
<th>No</th>
<th>Governing Factors</th>
<th>Relative Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Construction Materials</td>
<td>0.982</td>
</tr>
<tr>
<td>2</td>
<td>Faulty During Construction</td>
<td>0.923</td>
</tr>
<tr>
<td>3</td>
<td>Corruption</td>
<td>0.827</td>
</tr>
<tr>
<td>4</td>
<td>Lack of Supervision</td>
<td>0.808</td>
</tr>
<tr>
<td>5</td>
<td>Faulty Design</td>
<td>0.805</td>
</tr>
<tr>
<td>6</td>
<td>Climatic Condition</td>
<td>0.789</td>
</tr>
<tr>
<td>7</td>
<td>Lack of Maintenance</td>
<td>0.782</td>
</tr>
<tr>
<td>8</td>
<td>Building Type and Change in Use</td>
<td>0.745</td>
</tr>
<tr>
<td>9</td>
<td>Location of Building</td>
<td>0.700</td>
</tr>
</tbody>
</table>

For contribution factors to building defects and failures, the highest rated factor is construction materials with the highest value 0.982. Construction material is an important because the materials being used in construction will determine the behavior of the structure and resulted in any types of failures or defects in the future. Maybe the effects of using low quality materials do not take place in a year or two, but in many years to come the effects will slowly began to spread like a cancer in the concrete. Sometimes the usage of materials that are not according to specification is the consequence from irresponsible parties who intentionally reduce the quality in order to reduce the cost. Reducing the quality of materials and also the cost seem to have a hidden agenda among the parties involved. The second most important factor is faulty during construction. Faulty during construction or better known as poor workmanship is one of the popular factor that lead to building defects and failures problems. Usually residential buildings are the one which experienced most of the defects or failures problems due to poor workmanship. Poor workmanship
problems are closely related to the developer and also the contractor that construct the buildings. In Malaysia construction, these problems always been a highlight in the media especially through television and newspapers reported that newly constructed residential experienced defects due to poor workmanship by the developer. Quality Assessment System in Construction (QLASSIC) is a system or method to measure and evaluate the quality of workmanship of a construction work based on the relevant approved standard. QLASSIC is a QA/QC programme introduces by CIDB is a proof of government and the responsible authority has taken actions to solve these problems that have been a stigma in Malaysian construction industry. The third ranking of factor that governs building defects and failures is corruption. Corruption problems can be solved through law enforcement and through the project management that is more exposed and reliable from the tendering phase until the completion of the project. But until present, corruptions are continuously being practice by those irresponsible parties using their power and status in construction industry. The lowest ranking factor that governs building defects and failures cases is building type and change in use. Majorly Pulau Pinang area consists of residential and commercial buildings. This type of buildings rarely being change into other types of building such as goods storage or building that holds greater load than it is supposed to handle. Moreover, it is rarely seen that building is being change for other usage other than what it is designed for.

5. Conclusion

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 defects and failures at northern region, particularly in Penang area. 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.

6. References