

DEFECTS IN THE CONSTRUCTION INDUSTRY-THEN AND NOW

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ABSTRACT

Purpose of this paper - The purpose of this preliminary research is to determine if progress has been made in the previous decade to alleviate the problems associated with faulty construction. The aim of the research is to determine whether problems identified in a previous study are still applicable currently.

Methodology/Scope - The data collection was in the form of site visits where defects were recorded and interviews were held with relevant people in the construction environment. It was assumed that quality assurance procedures have been implemented in the industry to prevent faulty construction.

Findings - The main findings of the research were that although quality assurance procedures have been adopted, very little attention were given to the value of construction inspections.

Research limitations - The research was limited to the residential construction industry in the Cape Town Metropolitan Area.

Value - This paper highlights the importance of construction inspection and students as well as persons responsible for construction-inspections should be made more aware of the value of proper construction-inspection.

Keywords: Quality assurance, construction inspection, residential construction

INTRODUCTION

Defective building construction not only contributes to the final cost of the product but also to the cost of maintenance, which can be substantial. Defective construction includes activities such as compaction not done to specifications leading to ground subsidence and eventual early deterioration of foundations. This may lead to the complete failure of a structure.

Conditions under which building construction takes place are often far from ideal with the focus mainly being on speedy delivery. Defects resulting of inaccurate construction can be avoided by ensuring that proper inspection mechanisms are in place. The mechanism been discussed is in the form of inspection. All the activities taking place in the construction process can be clearly described and each activity can be inspected for accuracy independently. Although the inspection of accuracy forms part of the overall quality assurance techniques, little emphasis is placed on this.

The problem of defective construction is been addressed in the construction industry by introducing Quality Assurance (QA) techniques developed in other industries. These techniques are still in the process of being adapted to suit the building construction industry. This paper extends the research reported by Assaf, Al-Hammad, Al-Shihah, (1995).

Previous studies

Few studies have been conducted to determine the effect of defective construction on total construction cost and the final quality of the product in South Africa. Quality assurance is the concept adopted by most companies but recent research has found that effectively, this did not improve an organization's competitiveness and performance (Terziovski, Samson, Dow, 1997). Most of the studies that are available originated in the European countries. The Building Research Establishment in the United Kingdom (UK) conducted a survey of building failure patterns and their implications and determined the most common defects. It was found that 35% of the defects were originated from faulty construction (Assaf, Al-Hammad, Al-Shihah, 1995).

DEFECTS IN CONSTRUCTION

In order to examine the quality of construction work in progress on a number of low-rise traditional housing schemes the Building Research Establishment mounted a major research project with the National Building Agency in 1993. The results were ranked according to frequency and the 35 most frequent defects was identified and listed (Assaf, Al-Hammad, Al-Shihah, 1995). Listed below are the causes of defects that were identified:

Lack of inspection

Making use of inexperienced, unqualified inspectors

Avoiding and ignoring inspection completely

Non implementation of corrective actions during the construction process

Inaccurate measurement

Making use of defective or damaged formwork

Excavations too close to an existing building and exposing the foundations

Non-conformance with waterproofing specifications

Inability to read and understand/interpret drawings

Insufficient concrete cover

Improper construction of cold joints

Loss in adhesion between materials

Stripping formwork too early

Unacceptable soil compaction procedures

Inadequate curing procedures

Lack of communication

Non-compliance with specifications

Inability to read and understand/interpret drawings

Insufficient site supervision

Lack of communication between the owner, architect/engineer, project manager

Employing unqualified supervisors

Speedy completion of certain activities specifically where equipment is on hire

Unqualified labor force

Multinational construction experience

Defects resulting from the wrong selection of materials

Using materials unsuitable for the climatic conditions

Using cheap materials

Making use of expired materials

Inadequate storage facilities

Misuse of equipment

Equipment not performing to specification

Lack of the proper equipment

Cross referencing and detailed referencing on drawings lacking

Conflicting details on drawings
Details of sections on drawings lacking

RESEARCH METHODOLOGY

This study was done as a pilot project forming part of a PhD study. The first phase involved the determining of factors that had an influence on defects in construction work in the past. Phase two consisted of establishing to what extent these factors still play a role in defective in construction work currently. This was done by gathering data through site visits, interviews and discussions with contractors, engineers, architects and clients. The results of the data gathered was analyzed and then compared to the list of known factors leading to defective construction.

LIMITATIONS AND DELIMITATIONS

The scope of this research was limited to the Cape Town Metropolitan Area, Western Cape Province. The residential construction sector in the Cape Town Metropolitan Area, Western Cape was identified as the subject area. Samples in the construction industry, representative of the aforementioned subject area, were taken on projects under construction.

The study did not aim to identify new causes leading to defective construction, but rather to determine what progress have been made over the last decade to prevent these factors.

DISCUSSION OF THE FINDINGS

- Lack of inspection. It is known that when construction inspection increases, quality increases. Residential contractors largely ignore this to save in expenditure. The opposite applies in that the lack of inspection leads to defective construction.
- Making use of inexperienced and unqualified inspectors. The level of qualification and experience of building inspectors at local council level as well as inspectors currently employed by the National Home Builders Registration Council is lacking. Contractors proceed with construction often as a result of time constraints. Condemnation of work is rarely found. This then result in poor construction quality.
- Avoiding and ignoring inspection completely. Owners avoid inspection deliberately for various reasons. The result is that the contractor performs the construction on his own and is not concerned as to the quality of the final product. Owners also avoid inspection in order to have construction done to their specifications, which does not comply with building regulations.
- Non implementation of corrective actions during the construction process. Owners insist being part of the communication channel between the inspector and the contractor which may cause delays. The owners should rather ensure that corrective actions, as required by inspectors, are immediately implemented.
- Inaccurate measurement. This occurs where the contractor under-measure or over-measure the sizes of building elements. An example of this is excessive joints in face-brickwork to accommodate inaccurate surveying. Varying plaster thicknesses to accommodate inaccurate brickwork or the combination of different elements not compatible is often the result of inaccurate measurement during the design stage. Inaccurate measurement also happens when material is to be mixed. The contractor can add more water to the concrete mix or to little cement with the result that the product does not achieve the required strength
- Making use of defective or damaged formwork. Damaged and defective formwork affects quality by producing honeycombing or surface cracks which allow for moisture penetration and eventual corrosion to the reinforcing

- Excavations too close to an existing building and exposing the foundations. Contractors do not take the necessary precautions and in the process create unsafe conditions. This is often found where additions are done to residential structures. Vibration created during the backfilling and compaction process can cause continuous cracking along walls.
- Applying paintwork in unsuitable conditions. Generally paint is the final product applied to surfaces and can become a major activity if for example paintwork is performed under very wet conditions commonly found in the Western Cape region. This might lead to paint peeling and hence remedial work will need to be done. Existing paint will need to be removed and this might lead to further remedial work when painted surfaces are damaged.
- Non-conformance with waterproofing specifications. Waterproofing and the provision of adequate drainage are two areas where most contractors lack experience. In general contractors do not ensure that waterproofing membranes are suitably protected. The result is that the membranes are damaged and seepage occurs into the structure.
- Insufficient concrete cover. Contractors in general ensure that reinforcing is covered with the concrete but the specified thickness of the cover is not adhered to. The importance of 25mm or 40mm concrete cover to reinforcing steel is not really understood by contractors.
- Improper construction of cold joints. Cold joints are formed when new work is joined with old work. Examples in construction work are concrete joints formed when fresh concrete is placed next to concrete previously cast in structural members without ensuring a proper bond. The same applies where fresh plasterwork needs to tie in with existing plasterwork and no provision is made for proper bonding.
- Loss in adhesion between materials. Contractors allow employees to use glues without providing instructions regarding usage. The result may be tiles coming loose or materials been damaged by using non-compatible chemicals in the bonding agent.
- Stripping formwork too early. This can result in deflection of structural components. Cracking because of excessive moisture loss may occur and affect the strength of structural components.
- Unacceptable soil compaction procedures followed by contractors. In order to save on costs, contractors do not backfill and compact the soil according to specifications. Rather than backfilling and compacting in layers, it is often only the top layer that is properly compacted. The result is that excessive settlement takes place at a later stage.
- Inadequate curing procedures. Contractors are not willing to spend the time and money to ensure correct curing procedures of concrete components. They do not realize the importance of correct curing and are pressed for time to deliver the final product.
- Lack of communication. A number of different nationalities are commonly found working together on construction projects. Each one communicates in his or her home language. The English language is mostly used in the construction industry. Difficulties arise when everyone is not fluent in English. These cause communication barriers between members of the project team.
- Non-compliance with specifications because of miss-reading it. Contractors think that they understand exactly what needs to be done but there might be a special specification which is not common and which is miss-read. The result is that time and effort spent during the design stage is wasted.
- Inability to read and understand/interpret drawings. Most people are able to easily interpret two-dimensional drawings. Three-dimensional interpretations are not so easy and some people interpret them correctly. If the printed language used on the drawings is very technical, and inexperienced people have to gather information from it, mistakes can easily be made.
- Insufficient site supervision. Having to deal with different nationalities obviously necessitates accommodating various cultures. This may lead to serious problems for the project manager coordinating the employees.
- Lack of communication between the owner, architect/engineer and project manager. This often results in a frustrated contractor waiting for information and then relying on his own initiative to

resolve problems. At worst the contractor may use his own experience to ensure production is kept up. The result may be that the final product does not comply with the specification which may lead to re-work and construction defects.

- Employing unqualified supervisors. Employers do not have the benefit of validating the experience or qualifications of new employees that apply for positions. Applicants are more inclined to submit inflated information regarding their background than reverting to the reality. They are employed, based on the information provided by them, and the true level of their competency is only later established.
- Speedy completion of certain activities specifically where equipment is on hire. Contractors tend to focus more those activities in order to return the equipment as soon as possible.
- Unqualified labor force. There is a lack of experience and in the level of qualification of the general labor force. Contractors do not have the time or the resources to train the general workforce. The result is work been done of a low standard and quality.
- Multi-national construction experience. Different nationalities gain different construction experience in their respective countries of origin. When a project is undertaken, making use of multi-nationals, the work is performed according to past experiences.
- Defects can result because of the wrong selection of materials. Different materials have different characteristics. Because of this the thermal expansion characteristics for example, will differ which may lead to the separation of materials that were actually meant to bond.
- Making use of materials that are unsuitable for the climatic conditions. Contractors mistakenly use materials designed for external use, internally. Materials that are designed to withstand outdoor conditions, fail when exposed to very humid conditions such as in bathrooms.
- Usage of cheap materials should not be encouraged. In general cheap materials are not durable and would last a limited period where-after it needs to be replaced. This leads to defects and higher maintenance cost.
- Making use of expired materials. Contractors often use material left over from previous projects without taking notice of the expiry dates. This may cause problems because of not conforming to specifications.
- Inadequate storage facilities. Material that may not be exposed to excessive heat is being left unprotected in the sun. Discoloration is often a result of this. Some materials become brittle and their characteristics changes when exposed to the sun.
- Misuse of equipment. Employees regularly use the wrong tool for the action required. This result in the wrong quality being achieved. An example is the high usage of angle grinders for work the grinder is not been designed for.
- Equipment not performing to specification. Equipment is often been neglected or not properly maintained resulting in failure in operation
- Unavailability of proper equipment. The unavailability of proper equipment may have the effect of causing delays on the program. It may also have the effect of work been done with equipment not suitable for the activity for example compaction been done with lightweight equipment resulting in compaction not achieving the desired density.
- Cross referencing and detailed referencing lacking. The speed required to prepare the drawings disallows time for proper referencing. This often is accommodated with “site instructions”.
- Conflicting details on drawings are very problematic. Mechanical drawings often show details only understood by the mechanical engineer. Conflicting details can also arise where as example the civil engineer and the electrical engineer do not consult or coordinate their respective drawings. The result is that the contractor has to resolve these discrepancies which take up time and leads to the slowing down of the construction process.
- Details of sections of structural sections, joints, plumbing, drainage and electrical connections are lacking, leaving it to the judgment of the contractor to resolve.

CONCLUSIONS

It was found that construction inspection is the factor that, not only ensures accurate building construction but also have an effect on the major portion of the listed causes leading to defects.

Construction inspection relating to accuracy has a positive effect on the final quality of the product ensuring minimum defective work.

More than 90% of contractors in the Cape Town Metropolitan area, have not allowed for construction inspection as an independent activity in the building program (Zietsman, R. 2004)

Architects, Engineers and Contractors ranked construction inspection very high. The neglect of construction inspection was ranked the highest as reason for construction defects. Accuracy of work in process is ranked as highly important. The very nature of the construction process requires that inspection, of work in process, is essential in order to ensure the smooth flow of the construction program.

The neglect of construction inspection is still currently the highest rated reason given for defects in building construction. Considering the results of the study published in 1995, one would assume that procedures would have been implemented to ensure construction inspection attracting high priority. It was however determined that very little attention have been given to ensure that proper construction inspection is done on construction projects in the residential market. The importance of construction inspection is still largely ignored.

All the factors listed are currently contributing to construction defects and although new controlling regulations have been promulgated by Government, very little is evident in practice.

According to P.E.D. Love and H. Li, (2000) inspection carries a cost. They identified two costs namely cost of control and cost of failure. Feigenbaum (1991) divided the cost of control between prevention costs and appraisal costs. Cost of failure is divided between internal failure cost and external failure cost.

RECOMMENDATIONS

The cost related to construction inspection can be measured and budgeted for in all building construction projects. In order to measure the effectiveness thereof, savings on rework can be determined and the final quality of the product can be recorded. This should be done on every project to enable project managers the opportunity to identify areas which may require more intensive- or less construction inspection.

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