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MINIMIZING DEFECTS IN BUILDING CONSTRUCTION PROJECT

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Graphical abstract

Strategies	Mean	Ranking
Improve workmanship quality	4.33	1
All parties take responsibilities	4.16	2
Frequent progress meeting	4.02	3
Select the good quality of the materials	3.89	4
Use modern construction method such as IBS	3.89	5
Improve ability to read and understand drawings	3.84	6
Compliance with specifications	3.80	7
Do proper inspection	3.77	8
Improve quality control	3.70	9
Improve oversight (Inspection)	3.70	10
Corrective actions during construction process	3.69	11
Do not use of defective or damaged formwork	3.61	12
Employ the quality inspector	3.44	13
Clear information and communication channels	3.16	14
Select the qualified contractor	3.11	15
Improve communication	3.05	16
Improve site management and supervision	2.97	17
Select Suitable material	2.92	18
Employing qualified labor force	2.85	19
Quality control programs	2.85	20
Frequent coordination between the parties involved	2.79	21
Employing qualified supervisors	2.79	22
Do accurate measurement	2.72	23
Avoid changes during construction	2.64	24
Improve methods of installation	2.23	25

Abstract

Construction defects are always the key concern of the construction industry. Different constructed facilities generate different types of defects and demand different levels and types of quality, depending on the functions, system types, and materials used. Therefore, this study has been carried out to study the defect that happens in construction project and identify the strategies in minimizing the defect in building construction project. The studies were carried out using the questionnaires which were distributed to the contractors. Finally the recommendation was made based on the findings. This study helps to increase the awareness of Malaysian contractor towards managing and minimizing the defect works. By doing this, Malaysian contractor will bring up Malaysian construction industry into the next level of managing construction project.

Keywords: Construction defects, Quality

1.0 INTRODUCTION

In Malaysia, construction industry can be known as major productive sector since the construction started in the early 1990s with the development of mammoth projects [1].However, the qualities of the certain construction projects in Malaysia are not always meet satisfaction. Construction defects are always the key concern of the construction industry. Different constructed facilities generate different types of defects and demand different levels and types of quality, depending on the functions, system types, and materials used.

Defect works can be described as work which fails to comply with the express descriptions or requirements of the contract, including very importantly any drawings or specifications, together with any implied terms as to its quality, workmanship, performance or design [2]. In the context of defective buildings, the major stumbling block in majority of cases is the recovery of the costs of rectification of defects, which are discovered before physical damage occurs [3].

This loss, which is the cost of repair, lost profits or diminution in value of the building, is classified as "pure economic loss". Therefore, in those problematic circumstances, the researcher is interested to conduct a study on the type, cause and strategies of minimizing the defect in building construction project using a questionnaire survey and the data to be analyzed to meet the objectives of study.

2.0 DEFECTS

2.1 Definition of Defects

Construction defect is essentially defined by state laws and court definition and interpretation. Construction defect can be definedas a failure of a building component to be erected in the appropriate manner [4]. In addition, defects are often referred as patent defects and the latent defects [5]. Patent defects are discoverable upon examination or shortcoming in a structure that is apparent to reasonable inspection for example a roof leak or a foundation crack.

Meanwhile, latent defects are those hidden or concealed defects that would not be discovered in the course of a reasonable inspection. Normally, defects only become apparent at some later date or upon an investigation of some consequential effects caused by the defect [6].

2.2 Construction Defects

Construction 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 blueprint by the contractor, or any combination thereof [7]. Common types of construction 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 [8].

Defects in construction can typically be grouped into four which is design deficiencies, material deficiencies, construction deficiencies and geotechnical problem [9].

2.3 Causes of Defects

Defects occurs either because of poor design, low quality workmanship or because the building was not constructed according to the design or because it has been subject to factors not allowed for in the design.

Simple example of causes and effects such as poor workmanship in construction could cause penetration of dampness shown up by a damp patch on the wall, the resulting defects which are a change in appearance also due to insufficient attention to foundation design could lead to ground movement indicated by cracks in the brick walls, a change in construction; perhaps also with a sagging roof, a change in shape [10].

However, there are two aspects that are seldom taken into consideration which is the build ability of the design which determines whether good workmanship can ever be achieved if the necessary reasonable care and skill are present. Secondly, the durability of the materials which represent the life span of each materials in given environment before it deteriorates, either partially or wholly [11].

2.3.1 Defects in Material

Products made with cement such as precast, in situ concrete and concrete blocks will shrink irreversibly. To attach expanding brick slips to a shrinking concrete beam with an inflexible adhesive, for example, is to invite trouble. Materials have differing coefficients of thermal and moisture expansion and when they are used in combination it is necessary to accommodate the varying movement [12].

2.3.2 Construction Faults

Most are due to failing standards of workmanship, inadequate understanding of how non-traditional materials should be worked and installed, together with poor supervision; although genuine mistakes are sometimes deliberately hidden so as to avoid the cost and embarrassment of remedial work [13].

2.4 Classification of Defects

Classifications can be subjective and different investigators may classify the same defects as ‘minor’, ‘slight’, ‘moderate’ or even ‘very severe’[14]. Categories based solely on crack width previously formulated by others have been abandoned because such measurements will often not produce a clear evaluation of the scale of damage. Also such a limited classification is not based on cause or possible worsening of the defect [14].

Building Research Establishment recommend three broad categories of damage as a start to defining degree and suggest ‘aesthetic’, ‘serviceability’ and ‘stability. In a two-component gel, it is easy to modify the molecular structure of either of the two components.

2.5 Strategies in Minimizing Defects

There were six possible measures that suggested by researchers in order to minimise workmanship quality problem.Below is the explanation.

2.5.1 Strict Supervision

Enhance the quality by strict supervision in construction site is one of the criteria of recent practices in construction sector [15]. Daily supervision should be carried out by the contractors or subcontractors so that workmanship problem can be identified and the remedy work can be executed immediately.

Besides, when executing the supervision, contractor supervisory staff must possess the knowledge, expertise, and capabilities to administer the construction work and superintend the craft worker efficiently [16].

2.5.2 Training and Education

Many researchers agreed that appropriate training and enlarging experience is necessary in producing the quality project. Therefore, labour productivity is significant in construction because of its impact in the process of completing projects [17]. It was supported that the construction quality can be enhanced by increasing the knowledge of site labours [18].

2.5.3 Proper Communication among Parties Involved

From a research had been done, 80% of the workers in U.S. construction sector mentioned that the communication with the supervisors is vital and need to be improved [19]. Therefore, American supervisors suggested that the training in communication skills is essential to eliminate the language gap among themselves and the foreign labours. It was agreed that effective communication leads the projects complete faster [20]. Apart from the communication between supervisors and construction labours, proper communication and teamwork are also necessary between contractors and subcontractors [21]. Through a continual communication among parties involved, working relationship among the construction parties can be closer. In addition, it was found that better quality performance of Japanese construction projects can be attained attribute to steady and durable working relationship between Japanese contractors and subcontractors [22]. Therefore, proper communication is very important to improve the relationship among the construction team and consequently improve the workmanship quality in construction.

2.5.4 Proper Construction Management

Proper construction management would enhance the workmanship quality in construction. The capability of construction managers to manage, arrange and lead the work would affect the construction labour productivity [23]. If a construction manager failed to lead and control the construction project, the quality problems may arise.

Thus, a proper construction management is very crucial for every construction project.

2.5.5 Proper Manpower Management

Manpower management in term of amount and quality of skill workers is an important determinant of contractor performance and extremely prioritised by employers [24]. A construction project which has a well arrangement of manpower will produce a high quality of the project.

Besides, manpower is the sole productive resource; hence construction productivity is essentially relying on human endeavour and performance [25]. Therefore the management of manpower in every construction project should be arranged skilfully.

2.5.6 Proper Design

A better design can get rid of workmanship defects and help to avoid the defects [26]. Inadequately worded specifications and uncertain designs always cause the low construction quality.
In addition, a well-prepared designs and drawings affect the future works to become easier and the defects can be identified and rectified more effectively [24].

3.0 RESEARCH METHODOLOGY

The questionnaire was distributed to respondents within the area in Selangor that representative as majority area of construction companies in Malaysia. A total of 62 useable questionnaires were collected from the targeted respondent.

The survey questionnaires were distributed to the main targeted that involves contractors registered with CIDB Grade G7. The target personal are Project Manager, Contract Manager, Site Engineer and Quantity Surveyors. The study was carried out the data on building defect occur during Defect Liability Period in residential project.

Meanwhile, the questionnaire forms were produced by using the *Likert Scale* range from one until five developed by Rensis Likert in 1932.

4.0 RESULT AND DISCUSSION

The analysis used is SPSS software and for this paper focus on Mean Ranking and Factor Analysis. Mean Ranking most suitable in comparing various populations. The criticality of the factors is stated in the form of mean analysis, ranked in the descending orders [30]. The factor with the highest mean value is listed as first and increase as the mean value declines.
Factor analysis was used in this study to look for group among the inter-correlations of a set of variables in which the data may reduce or summarized using smaller set of factor or components [29]. The goal of running factor analysis is to reduce the dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underlie the old ones [31].
Based on the result reveal from the analysis that has been carried out shows the component matrix after rotation with value of factor loadings more than 0.5 (recommended by Kaiser and Rise, 1974).

4.1 Mean Ranking

Table 1 show the ranking for the strategies based on the mean value. The highest mean value the more

critical the items are. The first rank with highest mean value of 4.33 is improving the workmanship quality. Followed with 4.16 mean value is all parties take responsibilities and third is frequent progress meeting. The result is in line with proper manpower management in order to improve the workmanship. In addition, providing a training and educated the labor would contribute to improvement. Strict supervision required for maintaining and controlling the quality of projects by establish a frequent progress meeting.

From the results, it can agreed that most respondents seen the necessities in improving the defects required coordination of all parties. Besides, a good workmanship quality comes from the human oneself in conducting a works appropriately together with others.

Table 1 Tabulation of Mean-Ranking on Strategies in Minimizing the Defects

Strategies	Mean	Ranking
Improve workmanship quality	4.33	1
All parties take responsibilities	4.16	2
Frequent progress meeting	4.02	3
Select the good quality of the materials	3.89	4
Use modern construction method such as IBS	3.89	5
Improve ability to read and understand drawings	3.84	6
Compliance with specifications	3.80	7
Do proper inspection	3.77	8
Improve quality control	3.70	9
Improve oversight (Inspection)	3.70	10
Corrective actions during construction process	3.69	11
Do not use of defective or damaged formwork	3.61	12
Employ the qualify inspector	3.44	13
Clear information and communication channels	3.16	14
Select the qualified contractor	3.11	15
Improve communication	3.05	16
Improve site management and supervision	2.97	17
Select Suitable material	2.92	18
Employing qualified labor force	2.85	19
Quality control programs	2.85	20
Frequent coordination between the parties involved	2.79	21
Employing qualified supervisors	2.79	22
Do accurate measurement	2.72	23
Avoid changes during construction	2.64	24
Improve methods of installation	2.23	25

4.1 Factor Analysis

Table 2 show the Classification of the Rotated Component on the Strategies in Minimizing the Defects based on Factor Analysis. Below are the explanations for each item in each component.

- **Component 1**
  This factor consists of five items with factors loading ranging from .610 to .847. The items include all parties take responsibilities, improve workmanship quality, do accurate measurement, employing qualified supervisors, and avoid changes during construction.

- **Component 2**
  This factor consists of six items with factors loading range from .543 until .769. The items include employing qualified labor forces, improve site management and supervision, clear information and communication channels, frequent coordination between the parties involved, do not use of defective or damaged formwork and select the good quality of materials.

- **Component 3**
  This factor consists of six items with factors loading range from .514 to .784. The items include select suitable material, improve quality control, improve communication, employ quality inspector, improve oversight (Inspection) and compliance with specifications.

- **Component 4**
  This factor consists of two items with factor loading ranging .748 to .800. The items include improve ability to read and understand drawings and do proper inspection.

- **Component 5**
  This factor consists of four items along with factor loading range from .514 until .736. The items include improve methods of installation, quality control program, use modern construction method such as IBS and frequent progress meeting.

- **Component 6**
  This factor consists of one item with factor loading of .851. The items include selecting the qualified contractor.

- **Component 7**
  This factor consists of one item with factor loading of .745. The items include establish corrective actions during construction process.

Table 2 Classification of the Rotated Component on the Strategies in Minimizing the Defects in Building Construction Project

	Component						
Strategies	**1**	**2**	**3**	**4**	**5**	**6**	**7**
- All parties take responsibilities	.847						
- Improve workmanship quality	.717						
- Do accurate measurement	.655						
- Employing qualified supervisors	.622						
- Avoid changes during construction	.610						
- Employing qualified labor forces		.769					
- Improve site management and supervision		.691					
- Clear information and communication channels		.689					
- Frequent coordination between the parties involved		.685					
- Do not use of defective or damaged formwork		.593					
- Select the good quality of materials		.543					
- Select suitable material			.784				
- Improve quality control			.744				
- Improve communication			.737				
- Employ quality inspector			.637				
- Improve oversight (Inspection			.528				
- Compliance with specifications			.514				
- Improve ability to read and understand drawings				.800			
- Do proper inspection				.748			
- Improve methods of installation					.736		
- Quality control programs					.719		
- Use modern construction method such as IBS					.544		
- Frequent progress meeting					.514		
- Select the qualified contractor						.851	
- Corrective actions during the construction process							.745

4.0 CONCLUSION

Lastly, it can be concluded that there are top ten most effective strategies of minimizing the defect in building construction project are improve workmanship quality, all parties take responsibilities, frequent progress meeting, select the good quality of the materials, use modern construction method such as IBS, improve ability to read and understand drawings, compliance with specifications, do proper inspection, improve quality control and improve oversight in inspection.It is expected that by the better understanding regarding of the type, cause and strategies of minimizing defect in building construction project in Malaysia, it will be able to better predict the upcoming construction project scenario. It is hope that this research can contribute to more understanding on the construction defect issues that might be faced by contractor in Malaysia. In line with the objective, it helps to increase the awareness of Malaysian contractor towards managing and minimizing the defect works. By doing this, Malaysian contractor will bring up Malaysian construction industry into the next level of managing construction project effectively and efficiency.

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