

# A Prospective Study on Building Quality: Relationship between Workmanship Quality and Common Building Defects of Low-cost Construction Projects

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**Abstract.** This study focuses on the quality of workmanship in the construction of low-cost housing in Kedah and Penang State, Malaysia and its relation to defects occurring in the building. The objectives of this study are to investigate common building defects that mostly occur at low-cost housing due to poor workmanship, the factors that contribute to poor workmanship and to established possible measures to minimize these problems. From the combination of literary reviews and questionnaire surveys, this research explores all the stated objectives. For this particular study, quantitative research was conducted through questionnaire surveys involving respondents who are involved in and are experienced in working on construction projects. After analysing the data, this study found that most common defects occurring on low-cost housing are cracks on walls, settlement and peeling paint. Additionally, construction of low-cost housing commonly suffers from low quality workmanship due to poor project management and a lack of experience and competency among labourers. These significant impediments can be remedied by providing training and education to the labourers as well as implementing strict supervision during construction work.

## 1 Introduction

The construction sector contributes greatly to the economies of growing countries, including Malaysia [1]. However, the quality of certain construction projects in Malaysia does not always meet expectations [2]. The construction industry today has undergone numerous setbacks such as a decrease in standards of quality, rises in costs and delays in construction projects [3]. Poor quality work on construction projects is a common phenomenon in throughout the world. Countless disputes take place between clients, homeowners and other parties involved in construction (especially contractors), typically over cases of building defects. Defective work in construction projects could be seen as incompliance or lack of conformity with contract agreements which include: project drawings, specifications, quality of workmanship, and any other conditions not expressly stated such as “durability, aesthetics, performance or design” [4]. Particular weak points in the construction sector in Malaysia include a lack of skills or efficient training for the construction work being done and insufficient status acknowledgement of construction technologist [2].

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Housing is a major concern for people in every corner of the world as the wellbeing of a country is reflected in whether its people enjoy a certain standard of living. Residential and neighbourhood satisfaction is an important indicator of housing quality and conditions which affects an individual's quality of life. However, in recent years, there several issues have arisen involving low-cost housing. These have mainly involved quality problems and building defects of low-cost housing. Defects may be considered as a failing or shortcoming in the function, performance, statutory or user requirement of a building, and might manifest itself within the structure, fabric, services or other facilities of the affected building [5]. Defects that mostly commonly occur on low-cost housing structures are peeling paint, cracks on wall, mould growth, dampness, leakage, settlement, faulty installation of sanitary and electrical fittings, broken tiles and unevenness of floor finishes and wall plasters [6]. Along with these factors, another one seems to contribute to the problem is poor workmanship quality during construction [7]. Most defects in construction projects are due to human error. In other words, those involved in the construction of a structure are generally to blame for human error leading to poor quality work. Workmanship has been classified as one of the most frequent factors of non-conformance on construction sites and, therefore, through a review of relevant literature, eight variables related to the causes of poor quality workmanship on construction projects were found. This study's focus is on the factors that contribute to poor workmanship with a goal of establishing possible measures to overcome such problems.

## 2 Methodology

This study focused on the causes of defects that occurred on low-cost housing built in Sungai Petani, Kedah. The study began with a review of literature related to the research topic. Then, site observations were carried out to investigate commonly occurring defects involving three low-cost housing areas in Sungai Petani, namely, Bandar Puteri Jaya, Ambangan Heights Zon Mawar and Flat PPR Paya Nahu. During the site observations, pictures of defects were taken. The main source of data collection for this study was through questionnaire surveys. Due to time restrains, the survey was only carried out in Kedah and Penang with the targeted respondents being those involved in the field of construction such as building surveyors, architects, quantity surveyors, project managers, engineers, contractors and site supervisors. The data from 180 respondents were recorded and analysed. Tables and bar graphs were employed to clearly present the data, the analysis of which was carried out using mean item scores to rank the degree of importance for the factors contributing to poor workmanship and the degree of effectiveness of possible measures to overcome quality problems.

## 3. Site Observation, Questionnaire Analysis and Discussion

### 3.1 Site Observation

#### 3.1.1 Bandar Puteri Jaya



**Fig. 1:** Vertical and horizontal cracks on outer wall



**Fig. 2:** Peeling paint on external wall

### 3.1.2 Ambangan Heights Zon Mawar



**Fig. 3:** Vertical cracks on external wall



**Fig. 4:** Diagonal cracks on column area

Figures 1-6 show the existence of vertical and horizontal cracks on external walls and columns as well as peeling paint at a low-cost terrace house and a low cost flat. Cracks, whether they be vertical, horizontal or diagonal, that occur on the structural elements of a building such as walls and columns are common symptoms of structural instability. This might happen due to poor design and workmanship during construction. On the other hand, there were many causes of peeling paint. One of the causes of this is the use of unsuitable types of paint for application on external walls. External walls are the part of a building that is most vulnerable to exposure to harsh weather conditions. Therefore, it is very important to use good quality of paint for such surfaces.

### 3.1.3 Flat PPR Paya Nahu



**Fig. 5:** Plaster cracks on external wall



**Fig. 6:** Severely peeling paint on external wall



**Fig. 7:** Concrete spalling on beam area



**Fig. 8:** Concrete spalling underneath the floor slab



**Fig. 9:** Broken suspended ceiling



**Fig. 10:** Pipe leakage

From Fig. 7 and Fig. 8 we can see that there were exposed steel bars on beams and floor slabs on the ground floor of the building. Steel bars were exposed due to the deterioration of steel reinforcements that had been subjected to a harsh environment. The corrosion process of the steel bars was a major source of deterioration to the concrete. This may have occurred due to several factors, one of which is low quality workmanship. In Fig. 9 and Fig. 10, the photos show serious defects on a broken suspended ceiling as well as pipe leakage. The leaking pipe and the damage that occurred to the suspended ceiling may have been caused by improper installation or the ceiling rot may have been due to exposure to water leakage from above the ceiling.

### 3.2 Questionnaire Analysis

#### 3.2.1 Profession

**Table 1:** Number of respondents based on profession

Profession	No of Respondent	Percentage, % (n=180)
Architect	23	12.8
Project manager	28	15.6
Quantity surveyor	22	12.2
Building surveyor	21	11.7
Engineer	24	13.3
Contractor	26	14.4
Site supervisor	36	20
<b>Total</b>	<b>180</b>	<b>100</b>

A total of 180 questionnaires were sent to the targeted respondents with a response rate of 100% as shown in Table 1. From Table 1, it is clear that most of the respondents listed their position as Site Supervisor, Project Manager or Contractor. This is because their scope of work was directly based on the site work and they had relative experiences and expertise in the construction industry.

#### 3.2.2 Types of Defects Commonly Found in Low-Cost Housing

Fig. 5 shows the degree to which respondents agreed when asked to choose what types of defects commonly occur on low-cost housing structures and Table 2 shows the percentage of the agreement. As can be seen in Fig. 5 and Table 2, most of the respondents agreed that cracks on walls were the most frequent defects of low-cost housing, with a majority of 77.2 percent of 180 responses. Meanwhile, the least common defects found were faulty electrical fittings, only 8.3 percent out of 180 responses.

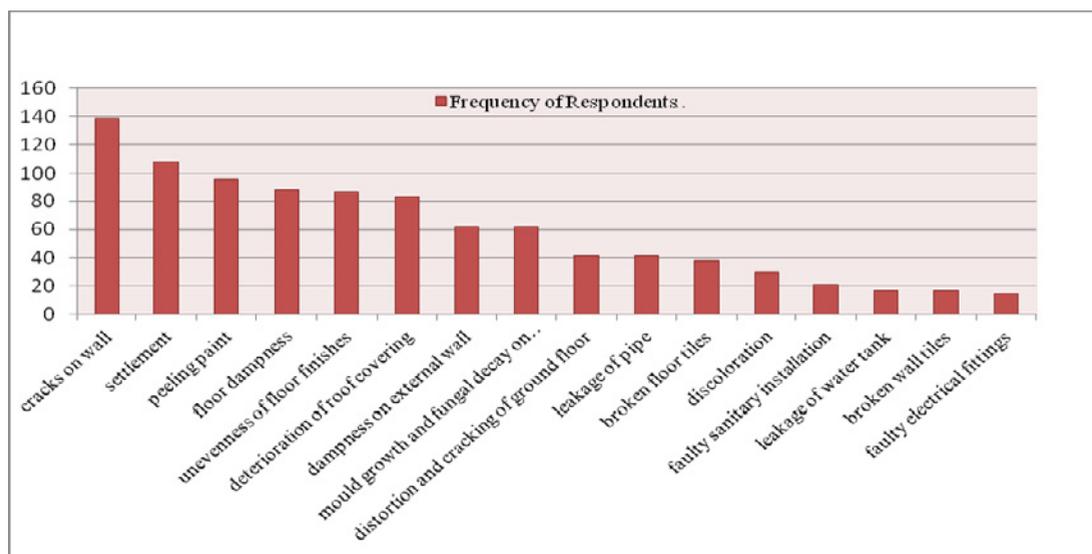


Fig. 5: Common defects on building elements

Table 2: Common defects on building elements

Types of Defects	Frequency of Respondents Agreement	Percentage (%)
Cracks on wall	139	77.2
Settlement	108	60.0
Peeling paint	96	53.3
Floor dampness	88	48.9
Unevenness of floor finishes	87	48.3
Deterioration of roof covering	83	46.1
Dampness on external wall	62	34.4
Mould growth and fungal on external wall	62	34.4
Distortion and cracking of ground floor	42	23.3
Leakage of pipe	42	23.3
Broken floor tiles	38	21.1
Discoloration	30	16.7
Faulty sanitary installation	21	11.7
Leakage of water tank	17	9.4
Broken wall tiles	17	9.4
Faulty electrical fittings	15	8.3

### 3.2.3 Contributing Factors to Poor Workmanship

Table 3: Ranking of factors leading to poor workmanship quality

Factors Contribute to Poor Workmanship	Mean	Rank
Poor project management	4.03	1
Complex role of subcontractor	3.41	5
Lack of skill and experience/issue of labours competency	3.89	2
Lack of communication/language barrier to communicate	2.41	8
Inappropriate construction equipment	2.33	9
Poor weather condition	2.73	6
Inadequate time	2.56	7
Restricted budget	3.70	3
Unsuitable materials used	3.54	4

Table 3 above indicates the ranking of each factor's priority based on mean readings of the contributing factors of poor workmanship. A calculation of the primary trend using the mean was carried out in order to rank all nine variables. From this data, it was found that poor project management was the most important factor contributing to poor workmanship. The problem in management may be due to insufficient supervision on site [8]. In fact, poor supervision contributes to poor workmanship and it can be seen in many instances on such jobsites [9]. In addition, the ability of management on a construction site is the primary cause that affects labourers' daily productivity [8]. Lack of skills and experience, as well as the issue of labourers' own competency, ranked second highest. Naturally, labourers cannot perform their work well if they do not have any experience or expertise in a certain field [10]. However, inappropriate construction management was rated as the factor having the least effect on poor workmanship [11].

### 3.2.4 Possible Measures to Minimize the Problem

**Table 4:** Ranking of possible measures to overcome poor quality workmanship

Effective Measure to Overcome Poor Quality Workmanship	Mean	Rank
Strict supervision	4.43	1
Training and education of labours	4.16	2
Proper communication among parties involved	3.4	5
Suitable construction management	3.88	3
Appropriate manpower management	3.69	4
Accurate and proper design	3.28	6

There were several possible measures that can be implemented in order to overcome the issue of poor quality workmanship in the construction of low-cost housing. Six possible measures are proposed in Table 4 along with their priority rankings. The highest ranking measure that can be used to overcome poor workmanship is strict supervision [12]. Daily supervision should be carried out by the contractors or subcontractors so that workmanship problems can be identified and a remedy can be executed immediately [13]. When actively supervising construction, contractor supervisory staff (site supervisor) must have the knowledge, expertise and capability to monitor and superintend the construction work efficiently. In contrast, accurate and proper design received the lowest ranking of the possible measures [14]. Training and education of labourers was ranked the second highest. Many respondents agreed that appropriate training and sufficient experience is necessary to increase the capability of construction site workers [15]. By doing so, quality construction will result in a quality end product [16]. Other possible measures that can be implemented are suitable construction management, appropriate manpower management and assuring proper communication among parties involved in construction.

## 4 Conclusion and Recommendations

Based on reviews of previous research and analysis of the results, the objectives of this study were achieved. The types of defects which commonly occur on low-cost housing due to poor workmanship were identified, with cracks on walls ranking as the most common defect. Furthermore, there were nine factors listed which contribute to poor workmanship. These factors include poor project management, the complex role of the subcontractor, lack of skills and experience including the issue of labourers' competency, language as a barrier to communication along with lack of communication, unsuitable construction equipment, poor weather conditions, limited time frames, limited costs and unsuitable materials used. From the data collected through the questionnaire surveys, poor project management was ranked as the most significant factor contributing to poor workmanship. In order to overcome this problem, several measures were suggested based on reviews of past research, in which strict supervision was ranked as the most effective measure based on the

respondents' responses. Apart from that, some recommendations were given by the respondents to minimize the problems of building defects due to poor workmanship. These include monitoring the supply of construction materials to ensure they are up to specifications, using detailed drawings, preventing damages through periodical checking on construction work (by stages), conducting a defects assessment upon completion of building, appropriate budget allocation from the government as to be welfare concept of government to citizen/poor/bottom billion, and, last but not least, selecting procurement and use of quality assessment on building construction work (QLASSIC) developed by CIDB. As a conclusion, this study revealed the factors contributing to poor workmanship and proposed suitable measures that can be implemented by contractors and other parties in the field of construction, especially those involved in low-cost construction in Malaysia to help improve overall performance at every level of management.

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