



A STUDY ON BUILDING FACADES DEFECTS AND
CAUSES IN GOVERNMENT BUILDINGS AT
PUTRAJAYA

BY

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ABSTRACT

The façade plays a key role as both a barrier and a filter between the comfortable 'indoors' and the uncontrolled 'outdoors'. The degree to which the façade of a building embraces maintenance considerations has a major impact on its performance. In Malaysia, new buildings are erected everyday with modern design featuring complex building façade design which has common problems often found in different types of building facades. These problems have implications in the design, constructions and maintenance of buildings. Every building facade should always be maintained to a high standard so that it will look more value in its appearance and a longer life span. The value of buildings depends on the quality of the maintenance invested in them. Maintenance management involves obtaining maximum benefit from the investment made on the maintenance activities. Maintenance in buildings in Malaysia is on the increase regardless of size, type, location, and ownership. It is necessary to rectify building facade defects and for maintenance purposes as facades is exposed to the climatic condition. The study will find out the building façade defects and other maintenance problems that are heavily attributed to design deficiencies, material limitations and lack of maintenance knowledge. To achieve this aim, three objectives have been set: to identify the types of common building façade defects, to identify its effect on maintenance and to relate the façade defects with maintenance and to recommend the appropriate solutions to improve the establishment of standard building façade maintenance in Malaysia. A study was conducted in three government buildings in Putrajaya to identify the façade defects and its effect on maintenance. The data were analyzed using Relative Index formula. The current maintenance management procedures in Malaysia are, however, condition and reactive based. The weaknesses in the current procedures are the primary problems because they do not explicitly link maintenance needs with building performance with respect to the building users. Findings show that main problems that the maintenance contractors are currently facing are caused by building design deficiencies, poor construction quality, and choice of building material which affects maintenance.

ملخص البحث

تلعب واجهة المباني دوراً مفتاحياً، حيث يتمثل في دور الحاجز من جهة، وفي دور المرشح من جهة أخرى، مابين مريح داخلياً وغير مراقب من الجهة الخارجية. إن المستوى الذي من خلاله يمكن لواجهة المباني اعتبار وجود الصيانة لها تأثير كبير على أدائه. في ماليزيا مباني عصرية حديثة تشيد كل يوم، تضم واجهات معقدة التصميم، لها مشاكل مشتركة، وغالباً ما توجد أنواع مختلفة من واجهات المباني. هذه المشاكل لها آثار في تصميم، وبناء وصيانة البنايات، وينبغي الحرص على معايير عالية لكل واجهة بناية لكي تظهر أكثر قيمة في مظهرها وتعمر طويلاً. إنه من الضروري تصحيح عيوب بناء الواجهات لأغراض صيانتها جراء تعرضها للعوامل المناخية. هذه الدراسة تكشف على عيوب بناء الواجهات وغيرها من مشاكل الصيانة التي لها تأثير على قصور في التصميم، والقيود المادية، ونقص في فنيات الصيانة. الهدف من هذه الدراسة هو الخروج بتوصيات لمواصلة إنشاء معايير صيانة واجهة البنايات في ماليزيا. لتحقيق هذا الهدف، تم تعيين ثلاثة أهداف: تحديد انواع العيوب الشائعة لواجهات المباني، تحديد تأثير تلك العيوب على الصيانة، وأخيراً ربط الواجهة مع الصيانة والتوصية بالحلول المناسبة والناجحة لتحسين صيانة الواجهة البنايات في ماليزيا. أجريت الدراسة في ثلاثة بنايات حكومية في بوترا جايا، لتحديد عيوب الواجهات وتأثيرها على الصيانة. وقد تم تحليل البيانات باستخدام مؤشر صيغة النسبية. تظهر النتائج أن المشاكل الرئيسة التي تواجه مقاول الصيانة حالياً سببها عيوب في تصميم البنايات، سوء نوعية البناء، واختيار مواد ومعدات البناء، حيث أن كل هذه العوامل تؤثر في الصيانة. وهذا من شأنه أن يؤدي إلى زيادة في الوقت المحدد للصيانة وكذا الميزانية المخصصة لذلك. إن التقدم في مجال تكنولوجيا المعلومات تزيد من فعالية وكفاءة PWD وكذا بناء نظام الصيانة.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion; it confirms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science (Building Services Engineering).



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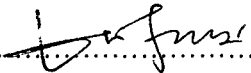


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**A STUDY ON BUILDING FACADES DEFECTS AND CAUSES IN
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*Special dedication to my entire family members and my beloved husband,
Mohd Dahari Bin Abdullah, and daughters Diyana and Farah
and sons Syafiq, Faiz, Iqbal, Naufal and Danial.
Thanks for your support*

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Building façades are exposed to extreme climatic conditions resulting in potential hazards to general public. Several cities have recorded deaths and serious injuries resulting from façade failure. Building components such as decorative trim, tiles, canopies and windows are falling down from façades to the sidewalks and street below. Cases where elements of buildings such as bricks, chunks of concrete, marble panels and metal skins falling apart are also recorded ((Nor Haniza Ishak, 2007).

Defects on concrete façades of high rise buildings pose a significant threat to public safety and are a formidable challenge to remediate. Successful remediation requires correct diagnosis and an adequate understanding of the extent of the defects, and the appropriate repair materials and methods. Factors causing such defects are poor workmanship, inadequate design and maintenance, inappropriate use of materials and the action of environmental agents. Typical problems resulted from these factors are cracking, water penetration, misalignment, sealant failures, discolouration, staining, efflorescence, corrosion and tile de-lamination.

Maintenance is an important element in the building process. Proper maintenance with good façade design is important in order to shape the building forms and ensure building's façade will last for longer periods. The effectiveness of the building façade design will serve the required functions of accessibility for good maintenance. The lack of maintenance often results in deterioration that leads the

building to the point of collapse or to it having to be demolished (Nor Haniza Ishak, 2007).

Unfortunately, common building defects and difficulties in carrying out maintenance tasks continue to exist. One of the reasons contributing to poor maintenance of concrete buildings is local authorities lacking of manpower when being challenged to check the safety of structures (Assaf S., 1996). Furthermore, the implication of design faults on maintenance in buildings has resulted from improper material selection and poor design for access for maintenance measures (Arditi,1999b)

A major component of building maintenance costs is spent on the maintenance and repair of building façades. With maintenance budgets escalating day by day, in order to reduce the overall building maintenance expenditure, it has become necessary to minimise the total maintenance cost incurred during the lifetime of the façade while adhering to the specified performance requirements simultaneously. Another way to reduce such expenditures is to design building so as to avoid the need for unplanned maintenance at the post-occupation stage (Ramly, 2006).

More and more Malaysians are becoming aware of the need for a better management of properties. With the increased development in legislation to govern property management of buildings, there has been an increasing demand for professional property management skills. The aim of this study is to identify the main problems related to building façade maintenance, to raise awareness and to consider some approaches for better maintenance work.

1.2 PROBLEM STATEMENT

Façade today is one of the most sophisticated elements of a building project. It is unfortunate that the process of its design, procurement, installation and maintenance does not get the attention that it warrants (Arditi, 1999b). The common problems found in the different types of building façades are from the design, construction and maintenance of buildings.

In many cases, these defects are not detected or acted upon until they are severe, or until a concrete piece has fallen off a façade, or has become visibly dislodged and at risk of falling off. It has been estimated that a loose masonry falls off a building somewhere in the United States in every three weeks. This is caused by years of freezing, thawing, expansion and contraction of materials or by atmospheric pollution as well as deterioration caused by rain. In the last few years, 49 masonry building collapsed and have killed 30, injured 81 pedestrians, and damaged adjacent buildings (T.Grimms, ASTM, 2000).

Improper design and/or construction that permit water and air intrusion, failure to conduct timely inspections, and failure to perform scheduled maintenance can result in façades that pose a hazard to pedestrians. Façades that fails can cause injuries and pose potential losses to owners and insurance companies.

Building owners, facility managers and facility engineers are responsible to ensure their building's façade is free from potential hazards. If injury or damage is caused to occupants, visitors, passers-by, or adjacent property by part of the façade falling off the building, lawsuits by the injured parties are inevitable.

It is the nature of the façade materials to deteriorate over time with usage and exposure to the climate (Chew, 1999). As an external surface of building enclosure, its protective coatings are directly affected by climate. Environment is the common

factor causing deterioration of building envelope and coatings. Other factors associated with façade defects are poor construction, low quality façade materials, pollution and poor maintenance and safety concerns from falling concrete. In a survey of housing under construction reported by Quality in Traditional Housing, 1,000 different kinds of faults were identified. About half of that number was related to the external envelope, including external walls, windows and doors, and roofs (Chew, 1995).

Research has shown that 40 to 60 percent of the defects were due to bad design (Ahmad R, 2006). From the angle of maintenance work, it is difficult to maintain the façade with irregular building shapes. Few studies have been conducted in Europe to find out the faults in design that affect building maintenance. The Building Research Establishment (BRE) in England conducted a survey of building failure patterns and their implications and the most common defects. It was found that 58 per cent of the defects originated from faulty design (Seeley, 1987).

In many cases it would appear that designers do not care much about certain factors or the effects of design on the building after completion. This is because the client is not the final user of the building and sometimes has little understanding of the problems of the particular building in use (Arditi D & Nawakorawit M. 1999).

Buildings are usually not equipped with appropriate and sufficient equipment fixed permanently to the building to ensure that the façade is always clean. Any deterioration of the façade can be managed with a regular maintenance regime. The longer the problems are neglected; further deterioration will occur, which invites decay, moulds and fungus to grow out of the cracks.

Maintenance of office building based on the Government Circulars (Bil.1, 1991) is to develop a planned maintenance system to face the problem of maintenance

of office building at present which is becoming more complex. In practice, majority of building owners surrender the maintenance of property to a facilities management company which is normally run by maintenance contractors.

However, as pointed out by Malaysia's previous Prime Minister, Tun Abdullah Badawi, "*The weakness of government department was that they lack a building maintenance culture*". He also added that they will not see the need to inspect if they think it is a new building. (The Star, April 13, 2007). Government has given more allocation for maintenance because buildings had to be maintained to last (The Star Online, 2007).

A preliminary survey conducted on government buildings in the district of Kota Kinabalu, Sabah, found that poorly maintained buildings have become a danger to general public. There were cases where pieces of concrete fall down from canopies, ceilings, pillars and walls of unattended buildings in the Commercial business district (CDB) areas and a case where rainwater chute collapsed onto a car (Daily Express, April, 2006).

Many organizations are lacking in preventive maintenance due to insufficient budget by building owners (Stephen, 2002). However, preventive maintenance will reduce defects and prolongs the lifespan of the building façade. Out of the total maintenance cost incurred for a building, a significant proportion is spent on maintenance of façades as claimed by Chew, (1998). Therefore, the maintenance and upkeep of the façade or external finish of the building is seen as an essential component of any building maintenance programme.

Currently, there are no façade maintenance enforcements and ordinances in Malaysia. There are only drafts of guidelines and manuals that are yet to be approved. There are no standard guidelines of building façade maintenance for government

buildings. The only guidelines available are for building maintenance of government buildings in Putrajaya.

Many existing façade systems that were designed and built to standards are now found to be inadequate. Deferred maintenance can lead to materials and systems to deteriorate prematurely. Even with excellent maintenance, façade failures have been traced to poor design, or failure to install systems according to the specification. The gondolas or equipments to carry out maintenance often do not fit the design of the façades and are expensive to rent besides having many procedures and insurance to follow. Equipments to clean exterior walls are expensive and certain accessibility systems cannot be used on complex façades. Accessibility to do maintenance work on the façades is fairly limited. Maintenance of façades often involves scaffolding. The use of scaffoldings is dangerous and there are risks involving the safety of the workers, not to mention it can be disruptive to occupiers and costly to their businesses. The usage of gondolas and other equipments has to be carried out during the weekends to avoid interference with public safety. When it rains, work has to be postponed resulting in delays in carrying out the maintenance work.

Climatic condition also contributes to façade material deterioration. For a country like Malaysia which, has a hot and humid weather condition with a yearly mean temperature of between 26 degree Celsius to 27 degree Celsius, relative humidity of 70% to 90% throughout the year, and an annual average rainfall of 250-300cm, selection of proper materials for building façade is very important (Yasin, Zaidi, Hamid, 2007).

Many facilities needed major repairs because the problem had not been detected in its early stage. Things were made worse by rapid deterioration of the defects, resulting in losses amounting to billions of Ringgit due to repairs being made

when the damage had become severe. Due to this, it is vital to call on all parties to establish good asset management practices. Comprehensive records of infrastructure and their structure and conditions should be kept to enable monitoring and continuous maintenance.

In actual practice, the importance of the two links is neglected. Maintenance aspects are rarely considered in the design process and maintenance experts are seldom invited into the design teams. Common building defects and difficulties in carrying out maintenance tasks continue to exist.

Consideration of issues relating to building maintenance should ideally begin at the design stage through the adoption of an appropriate building form, choice of suitable materials, satisfactory detailing, and proper layout including the provision of access to parts of the building likely to require maintenance.

1.3 RESEARCH AIMS AND OBJECTIVES

The aim of this study is to come out with recommendations for further studies in order to establish a standard maintenance guide in Malaysia.

To achieve this aim, the following objectives have been determined for the study:

1. To identify the common types of façade defects in building.
2. To identify the factors that contributes to the causes of façade defects.
3. To recommend building façade maintenance in Malaysia.

1.4 SCOPE OF STUDY AND LIMITATIONS

The study covers three government buildings in Putrajaya due to its sub-urban location with less atmospheric pollution. The buildings selected are Block E2, E8 and E12 which are located at Parcel E, Presint 1 Putrajaya. These buildings are owned by

The Ministry of Education and Ministry of Higher Education. The three buildings are chosen because they are more than 5 storeys high, and are less than 10 years old with a high public profile. The study will focus on the building façade and the façade maintenance practises. Some limitations are due to lack of access for close-up observations on the façade defects at the exterior walls of the buildings since all three buildings are high rise buildings.

1.5 OVERVIEW OF RESEARCH METHODOLOGY

Research methodology involves two methods for collecting primary and secondary data. The primary data are the data collected from interviews with relevant parties, visual observations and inspections, and questionnaires. The secondary data are information from literature review of various medium such as books, newspapers, journals, articles, website and other references. The methodology of collecting primary data is:

- i. Semi-Structured Interview

Interviews were carried out with the building owner, the maintenance personnel, and maintenance contractors' team that are involved in the property management. The final phase of the study involves the analysis of the information collected.

- ii. Visual Inspection

Visual inspection is a procedure to carry out the building diagnostic through comment on causes of defects and recommendations from building condition reports. The photographs, written notes and sketches of façade problems at the elevations drawings are the primary data that will