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BUILDING CONDITION ASSESSMENT FOR SCHOOL BUILDING

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Abstract

This research explores the multifaceted domain of Building Maintenance Management (BMM), focusing on issues, challenges, and assessment methodologies. A comprehensive review of literature spanning various academic disciplines and professional fields was conducted to synthesize existing knowledge and identify gaps in understanding. The study investigates the impact of Building Condition Assessment (BCA) methodologies on sustainable asset management practices, emphasizing the need for integrated approaches to enhance efficiency and effectiveness. Key themes explored include Facilities Management (FM), and occupant satisfaction in the context of BMM. The research highlights the importance of strategic decision-making in allocating resources and implementing maintenance strategies to optimize building performance and ensure the well-being of occupants. Drawing on insights from diverse perspectives, this study contributes to advancing knowledge in the field of BMM and provides a foundation for future research endeavors and practical applications aimed at enhancing the sustainability and resilience of built environments.

Keywords: Building Maintenance Management, Building Condition Assessment, Life Cycle Costing, Facilities Management, Occupant Satisfaction

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INTRODUCTION

Building maintenance management in Malaysia, particularly for public buildings, has become increasingly important due to the aging infrastructure and the need for better upkeep. This is evident in public sectors, where schools require regular maintenance to ensure safety and functionality. Issues such as poor facility management, delayed repairs, and insufficient maintenance budgets have often plagued public buildings.

Recent studies have emphasized the need for systematic and proactive maintenance strategies, especially as reactive maintenance approaches remain predominant in Malaysia. For instance, Dzulkifli et al. (2021) highlight that maintenance in Malaysia tends to be reactive rather than preventative, often addressing issues after they arise, leading to higher costs and inefficiencies Furthermore, the public sector has seen significant challenges, including the deterioration of school facilities due to inadequate funding and oversight, contributing to unsafe conditions (Hauashdh et al., 2020)

The Building Condition Assessment (BCA) is increasingly viewed as a valuable tool for assessing and prioritizing maintenance in public buildings like schools. BCA helps in systematically evaluating building conditions to plan for preventive maintenance, which is more cost-effective and sustainable in the long run (Dzulkifli et al., 2021)

The need for effective building condition assessments in public schools across Malaysia has become increasingly important. Numerous studies have highlighted the frequency and causes of building defects, especially in government-owned structures, including public schools. A study by Syamilah Yacob et al. (2019), examined 300 school buildings and identified a range of defects, primarily due to factors such as poor maintenance, lack of supervision, and vandalism. The study found that most schools were in average to critical condition, underscoring the need for comprehensive maintenance strategies to ensure the safety of students and staff.

The three key problems are poor school building condition assessment, absence of specific guidelines for assessing school building conditions and lack of independent school building condition assessments. Regular inspections are infrequent, leading to reliance on complaints-driven maintenance. Implementing Building Condition Assessments (BCA) could facilitate regular maintenance planning and data collection. To address these issues, the research aims to develop a Building Condition Assessment (BCA) framework tailored to school buildings, enabling systematic assessment and maintenance planning to ensure safer and more functional educational environments.

The research aims to address the pressing need for a systematic approach to assessing and managing the condition of school buildings in Terengganu, Malaysia. With recurring instances of damages and deficiencies in

maintenance management, there is a significant gap in the guidelines for assessing school building conditions. Consequently, the study endeavours to develop a comprehensive School Building Condition Assessment (BCA) system tailored specifically to the context of public-school buildings in Terengganu.

The significance of this research lies in its potential to provide school management with a practical tool for assessing building conditions, aiding in informed decision-making regarding maintenance priorities and resource allocation. By filling the existing gap in guidelines, the proposed BCA system aims to facilitate more proactive and efficient maintenance planning, ultimately contributing to the safety and well-being of students and teachers.

The study is specifically targeted at public school buildings in Terengganu, with a focus on three schools in the Bandar Al-Muktafi Billah Shah area of Dungun, during the Movement Control Order period. Thus, it provides a localized and practical approach to addressing the identified challenges in school building maintenance management.

LITERATURE REVIEW

Building Condition Assessment (BCA)

Building Condition Assessment (BCA) is a crucial tool for evaluating building condition, aiding in effective maintenance planning and asset management. BCA involves assessing a building's physical condition and identifying necessary maintenance or improvement works. Definitions of BCA from various sources emphasize its role in measuring building performance and guiding future planning. Different countries utilize their own methods and components for BCA, tailored to their specific needs and standards.

BCA components typically include checklist building maintenance, defect identification, physical condition assessment, priority action assessment, and condition rating. Despite variations in components, the underlying philosophy remains consistent across countries. BCA processes are structured differently in various countries, with stages ranging from scoping services and procurement to implementation and reporting.

Condition Assessment Ranking Scales are vital in evaluating building quality, with various rating systems like three-point, four-point, five-point, and six-point scales being utilized. Each rating scale offers its own advantages and considerations, with factors like the number of rating points and the level of detail influencing their effectiveness. The choice of rating scale depends on factors such as the level of detail required and the ease of implementation.

Buidling Condition Assessment in Malaysia

Building Condition Assessment (BCA) has emerged as a crucial tool within Malaysia's built environment, particularly for managing government assets. The

country utilizes two main BCA systems: CP BS101 and JKR 21602 – 0004 – 13, both incorporating the Building Assessment Rating System (BARIS). Developed by the Royal Institution of Surveyors Malaysia (RISM) and the Public Works Department (PWD) respectively, these systems employ survey protocols for inspections and utilize BARIS to assess building conditions. The assessment process involves property description, inspection methods, and condition assessment, with detailed scales used for both condition and priority assessments. These ratings assist in prioritizing maintenance actions based on repair needs. Compared to overseas BCA systems, Malaysian BCA systems offer detailed descriptions and are more user-friendly. While they share similarities, such as using five-rating scales, variations exist in assessment processes and criteria, as shown in Table 1. Nevertheless, BCA in Malaysia plays a crucial role in asset management and maintenance planning, providing comprehensive evaluations of building conditions to guide decision-making processes effectively.

Table 1: Building Physical Condition Level used by Public Work Department

Grade	Inspection Scale	Description
1	Very Good	A new, no defect, performing as intended
2	Good	Minor defect, good condition, performing as intended
3	Fair	Major defect, moderate condition, still can functioning with supervision
4	Poor	Major or minor defect, critical, not functioning as agreed service level
5	Very Poor	Very critical, not functioning, risky to safety and health

Source: JKR (2013)

School Building in Malaysia

In Malaysia, school buildings serve as vital educational institutions for children, encompassing various facilities beyond classrooms such as administrative offices, counselling rooms, canteens, and libraries. Statistics reveal that Malaysia's school system comprises primary and secondary schools, with over 4.5 million students enrolled across approximately 10,000 schools nationwide. Primary schools alone account for 7,669 institutions, accommodating more than 2.6 million students, while secondary schools total 2,372, serving around 1.8 million students. The Ministry of Education ensures that schools meet essential infrastructure requirements outlined in the Malaysia Education Blueprint 2013-2025.

These guidelines mandate provisions like suitable physical structures, adequate classroom and toilet facilities, electricity and water supply, furniture, and technological resources. Over time, infrastructure requirements have evolved to incorporate elements such as improved internet connectivity, accessibility features, and advanced facilities to support modern educational needs. This

reflects the ongoing commitment to providing conducive learning environments for Malaysian students.

Design of School Building in Malaysia

The two main styles are identified: one-off design and standard design. One-off designs are unique, featuring distinctive layouts and façades not replicated elsewhere, while standard designs are characterized by repetitive use of façade design, layout, space planning, and materials (Norhaslin et al., 2019). Public school layouts in Malaysia typically adopt a linear spatial arrangement with single-sided corridors, featuring blocks of buildings facing each other with a courtyard in between (Farhana et al., 2022).

Additional physical structures within school buildings include halls, laboratories, workshops, canteens, and prayer rooms. The space planning of standard school designs adheres to the latest curriculum syllabus for primary and secondary schools set by the Ministry of Education. Furthermore, government school facilities in Malaysia are categorized into administration spaces, academic spaces, support facilities, laboratories, and open spaces, as per established standards and guidelines provided by the Department of Town and Country Planning (2012).

Maintenance of School Building

School building maintenance in Malaysia is crucial for ensuring a safe and conducive learning environment. However, despite its importance, the maintenance management of school buildings in Malaysia remains substandard (Hauashdh et al., 2020).

The condition of school buildings remains average, indicating a gap between theory and practice (Syamilah, 2019). The Educational Management Information System (EMIS) is an essential tool for managing school data, including infrastructure details, but challenges such as workload and competency issues among teachers hinder its effectiveness (John et al., 2022).

Furthermore, EMIS lacks specific features for building maintenance assessment, unlike formal building condition assessment (BCA) systems, such as BARS and BARIS, which are not specific to school buildings in Malaysia. The proper BCA system for schools is essential for efficient maintenance planning and cost-saving measures (Syahirah et al., 2020).

RESEARCH METHODOLOGY

The research aims to develop a School Building Condition Assessment system for schools in Terengganu, with objectives including the identification of school building components, Building Condition Assessment components, and the development of the assessment system. The research design involves both

quantitative and qualitative methods. Quantitative methods involve the analysis of numerical data using statistical techniques, while qualitative methods aim to understand and interpret social interactions. In this case, qualitative methods are employed to develop a deeper understanding of Building Condition Assessment and gather perspectives from respondents.

The research methodology chosen is qualitative, as it aligns to understand social interactions and perspectives related to Building Condition Assessment. The qualitative method allows for extensive interaction with respondents, typically involving a small group studied closely throughout the research. Case study research, characterized by investigating a contemporary phenomenon within its real-life context, addresses the research questions related to assessing school building conditions efficiently. Case studies provide comprehensive descriptions and analyses of individual cases, aiding in understanding “how" and "why" inquiries and contributing to theory development and generalization.

The research methodology involves data collection through interviews and literature review. Interviews are conducted using semi-structured approaches, with purposive sampling to select respondents with expertise in school building management. The interview questions are designed to gather insights on Building Condition Assessment (BCA) practices and building maintenance in schools. A pilot study is conducted to refine the interview questions, ensuring clarity and relevance for the respondents.

The research design incorporates grounded theory analysis to develop the BCA system for public school buildings. Grounded theory analysis involves data collection, initial coding, development of categories, theoretical sampling, and the development of core processes and relationships. The BCA system is developed based on components of school buildings identified through literature review and interviews. The components include roof, ceiling, wall, door and windows, floor, foundation, and utilities. The BCA system includes elements of the school building, condition assessment, total score, and recommended actions. Overall, the research aims to develop a comprehensive BCA system tailored for public school buildings in Terengganu, Malaysia, utilizing insights from qualitative data and grounded theory analysis.

In the analysis of interview sessions conducted for the field study, the demographic overview of respondents revealed a balanced representation in terms of gender, with an equal split between male and female participants. The age distribution across three categories—20-35 years, 36-45 years, and 46-55 years—highlighted diverse experiences. Regarding academic qualifications, respondents held a mix of diplomas and bachelor's or master's degrees, indicating a varied educational background relevant to building maintenance. Professionally, the majority were teachers, while others held roles in consultancy

or government positions related to maintenance. Most respondents had over five years of working experience, meeting the requirements for stakeholders in school maintenance.

Regarding familiarity with the Education Management Information System (EMIS), respondents exhibited varying levels of experience, with some having less than five years and others having more than 16 years. Moving to the analysis of respondents' knowledge of Building Condition Assessment (BCA), it was evident that they possessed a basic understanding, albeit with differences based on their involvement in maintenance activities versus teaching responsibilities. These findings provide valuable insights into the background and expertise of respondents, shedding light on their perceptions and experiences related to school maintenance practices in Malaysia.

ANALYSIS AND DISCUSSION

In discussing the research findings, the focus revolves around addressing the research questions concerning the components of school buildings, Building Condition Assessment (BCA), and efficient methods for assessing the condition of school buildings. Firstly, regarding the components of school buildings, the study confirms the importance of all elements listed, as respondents largely agreed on their significance for developing BCA systems. These components encompass various aspects such as architectural, structural, electrical, and utility components, all essential for the overall maintenance of school infrastructure. Consequently, the research successfully identifies these components, which are crucial for further investigation.

Secondly, the discussion delves into the components of Building Condition Assessment (BCA), emphasizing its importance in developing BCA systems. Respondents with backgrounds in building maintenance demonstrate an understanding of BCA components, which remain consistent despite variations across countries. The components include checklist building maintenance, defect identification, physical condition assessment, priority action assessment, and condition rating. This understanding lays the groundwork for the subsequent development of BCA systems tailored to school environments.

Additionally, the Ministry of Education's utilization of the Education Management Information System (EMIS) is a significant finding. The EMIS online system, managed by the Ministry, provides detailed information about school profiles, management, and facilities. While comprehensive, EMIS lacks the functionality to assess priority actions and rate conditions for damages or non-functional items, highlighting a gap that BCA systems could potentially address.

Lastly, the discussion touches upon the methodology for condition assessment in school buildings, with a five-point ranking scale identified as the standard approach. This standardized scale, supported by international

comparisons, facilitates consistent and efficient assessments, aligning with best practices in building maintenance evaluation. As a result, the study contributes valuable insights into the components of school buildings, the development of BCA systems, the role of EMIS in educational infrastructure management, and effective condition assessment methodologies.

Based on the data analysis and findings, a Building Condition Assessment (BCA) system tailored for school buildings is developed, utilizing a user-friendly format in Microsoft Excel for ease of use. This system comprises five key components, as depicted in Figure 1, which shows the components of BCA for school building, Sub-components of school building, Condition of school building, Score rating, and Action to be taken.

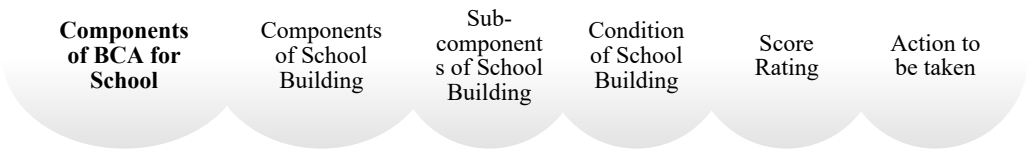

Figure 1: Component of BCA for school

Further examination of the Components of the School Building reveals two distinct sub-components: architectural components and structural components, respectively. These components are then categorized into Parts, including Components of school building, School facilities, and Sport facilities

Moving forward, each part is subdivided into specific Elements, representing essential aspects of school infrastructure maintenance. These Elements are identified through a comprehensive review of data analysis and literature, ensuring the inclusion of crucial factors for Building Condition Assessment for School systems. Table 2 outlines the Components and their corresponding Elements, covering critical areas such as Roof, Ceiling, Wall, Door and Windows, Floor, Utilities, School facilities, and Sport facilities. Each Element is meticulously defined to encompass various components of school buildings, facilitating a comprehensive assessment process.

Table 2: Components and Elements of School Building

No	Parts	Components	Elements
1	Components of School Building	Roof	Roof Cover Roof Truss Lisplank and Gutter
2		Ceiling	Ceiling frame Cover and ceiling trim Paint

No	Parts	Components	Elements
3		Wall	Column and Ring beam Brick/Filler Wall Paint
4		Door and windows	Frame Doors Windows
5		Floor	Lower structure Floor Cover
6	School Facilities	All school facilities	
7	Sport Facilities	All sport facilities	

Developing the Building Condition Assessment (BCA) system for school buildings incorporates a standardized approach to condition assessment using a five-point rating scale. This scale, selected for its simplicity and effectiveness, allows for an easy description of the building's condition without requiring complex formulas or equations. The decision to employ a five-point scale with color-coded indicators stems from its suitability for providing detailed assessments based on physical observations, as evidenced by literature findings.

Each component and element of the school building, as outlined in Table 2, is evaluated using this five-point scale, ensuring a comprehensive assessment process. The description and general condition overview further clarify the significance of each rating level, ranging from "Very Good" to "Critical," based on the extent of repairs or replacements required.

Subsequently, the score rating is determined based on the total score derived from the condition ratings of individual elements, as demonstrated in Table 3. This matrix system identifies the seriousness of each element and guides subsequent actions. Priority assessment, outlined in Table 4, further categorizes maintenance actions based on the total score, distinguishing between dilapidated, fair, and good conditions. This classification simplifies decision-making regarding the urgency and extent of repairs or replacements needed, streamlining the maintenance process for school buildings.

Table 3: Score for element

Score	5	4	3	2	1	
Cement Floor	**Very Good**	**Good**	**Fair**	**Poor**	**Critical**	**Total**
Ground Floor		4				4
1st Floor			3			3
2nd Floor				2		2
3rd Floor					1	1

Score	**5**	**4**	**3**	**2**	**1**	**Total**
Cement Floor	**Very Good**	**Good**	**Fair**	**Poor**	**Critical**	
Total	0	4	3	2	1	
Score	10					

Table 4: Priority Assessment

Priority Assessment	**Total Score**	**Description**
Dilapidated	4 – 8	The element of the building needs major repair or replace with new.
Fair	9 – 11	Only certain parts of the elements need to repair or replace.
Good	12 – 16	No maintenance action should be taken as the building is still in good condition

In the comprehensive Building Condition Assessment (BCA) process, each school building component undergoes a detailed condition assessment using a standardized five-point scale rating. This assessment is essential for accurately evaluating the state of the building and determining necessary maintenance actions. The assessment is then broken down further according to specific components, with detailed observations recorded for each element.

Starting with the Roof assessment, observations focus on physical indicators such as leaks or visible damage, with the overall condition graded based on a scoring system. Similarly, the Ceiling assessment involves inspecting ceiling frames, covers, trims, and paint quality to determine the condition of internal ceilings.

The Wall assessment entails observing the facade of the building, including columns, ring beams, brick or filler walls, and wall painting, to evaluate the condition of external wall elements. For Doors and Windows, assessments are made regarding door leaf, frame, knob, hinges, louvers, and frames, with attention to any signs of damage or deterioration.

Floor assessments cover timber, cement, and tile floors, with observations on their overall condition and any visible defects. Utilities such as rainwater downpipes are inspected to determine their functional state and any maintenance requirements.

Additionally, assessments extend to School Facilities and Sports Facilities, encompassing various amenities and infrastructure within the school premises. Each element undergoes thorough observation and evaluation to determine its condition and any necessary maintenance actions.

Through this meticulous assessment process, the BCA provides a comprehensive overview of the condition of each component and element of the school building. This information enables informed decision-making regarding maintenance priorities and actions to ensure the school infrastructure's safety, functionality, and longevity.

CONCLUSION

In conclusion, this research has culminated in developing a comprehensive School Building Condition Assessment (BCA) system specifically tailored for Malaysian school buildings. Through a systematic approach, the study has successfully addressed its aim and objectives, contributing valuable insights to the field of educational infrastructure management. Looking ahead, future research endeavours could focus on validating the developed BCA system through real-world implementation and assessing its effectiveness in improving building maintenance practices and enhancing educational outcomes. Additionally, exploring opportunities for technological enhancements, such as integrating building management software and IoT sensors, could further optimize the efficiency and effectiveness of the BCA process. By continuing to innovate and refine infrastructure management practices, stakeholders can ensure the long-term sustainability and resilience of Malaysia's educational facilities, ultimately benefiting students, educators, and communities alike.

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