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A Comprehensive Study on Building Maintenance Practices for Heritage Shop Houses in Penang, Malaysia

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ARTICLE INFO	ABSTRACT
	The preservation of heritage shop houses in Penang, Malaysia, faces a critical challenge due to the absence of regular building maintenance practices. While a few conservation efforts were prompted by severe deterioration, there is a notable deficiency in implementing routine maintenance measures. The current approach primarily intervenes when buildings reach a state of severe disrepair, neglecting the imperative for continuous upkeep and adherence to maintenance regulations. This reactive strategy not only jeopardises the structural integrity of these historic structures but also destroy their long-term preservation and cultural significance. As a result, there is an urgent need to shift towards proactive maintenance practices to safeguard the architectural heritage of Penang's shop houses and ensure their sustainable conservation for future generations. This study addresses the need to enhance building maintenance practices for heritage shop houses in Penang, Malaysia, with a focus on preserving Penang's cultural heritage to maintaining their historical authenticity. The research aimed to comprehensively assess the current state of maintenance practices, analyze faced challenges and recommend effective strategies for improvement. The findings are expected to provide valuable insights into the challenges associated with maintaining these unique structures, as well as practical recommendations for improving maintenance practices, ultimately benefiting the field of heritage conservation.

1. Introduction

The George Town UNESCO World Heritage Site has a 109.38-hectare core zone and 150.04-hectare buffer zone in a total of 5,013 buildings including shop houses [1]. Heritage shop houses in Penang, Malaysia, are not just architectural valuables, but also living testaments to the region's rich cultural and historical identity. These structures provide an insight into the past, showing Penang's distinct blend of historical and cultural identities across the centuries. However, these heritage shop houses face several issues, including modernization encroachment, deterioration due to neglect and probable devaluation of their property value. Building maintenance practices must be assessed and improved to ensure the preservation of these rich historical treasures and their continuous

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contribution to the local economy and culture [2]. This study seeks to investigate the relevance, methodology and potential implications of such preservation initiatives in Penang, emphasizing the need to balance historical accuracy with practicality in the preservation of these heritage sites. Development in cities and shifting socioeconomic dynamics have created significant challenges to the maintenance of Penang's heritage shop houses in recent years. In some cases, modern buildings have replaced these historic structures, while others have been demolished, eliminating not only the actual structures but also the many decades of history they represented. Neglect and a lack of sufficient maintenance increase the risk to these buildings, potentially leading to a decrease in their property values [3]. It is imperative to preserve these heritage shop houses to preserve Penang's cultural and historical identity, not only out of sentimentality. The aim of this study was to examine the delicate balance that must be struck to preserve these structures, one that honour's the necessity of current functionality while maintaining historical authenticity, through thorough examination and improvement of building maintenance practices.

As highlighted by Au-Yong *et al.,* [4], increasing issues in this field are a major factor contributing to the difficulties associated with successful building maintenance. The rise in building maintenance issues is especially apparent in historic structures, as they may have aged and so need more maintenance. This is supported by Faqih *et al.,* [5], who highlighted that constructed buildings including heritage structures, generally have a service lifespan of about 50 years. However, this generalization does not guarantee consistent longevity, as some structures may outlast this length without revealing flaws, while others may experience problems within a few years of completion. This variety highlights the complexities of building maintenance and the necessity for comprehensive measures to meet varied issues in retaining structural integrity [6]. In 2010, the Penang State Government established George Town World Heritage Incorporated (GTWHI), a major step towards the management and preservation of George Town's newly designated historic zone. The establishment of GTWHI was aimed at supervising and organizing the preservation and administration of this historically significant and culturally diverse region. In order to preserve the exterior appearance and architectural integrity of these structures, shop houses located within the heritage zone were generally preserved by means of facade restoration. It was frequently decided that this emphasis on facade restoration was required, usually because of structural issues that had developed over time. The interior spaces were allowed to be completely refurbished and adjusted to modern needs, but the facades were meticulously maintained, guaranteeing the heritage buildings' continued functionality [7]. Two separate zones, each with special preservation concerns, were established to protect the historic zone of George Town. The Core Zone, which symbolizes the center of the World Heritage site, is inalienable because of its importance to history and culture. To provide the highest level of protection for the heritage treasures, no modifications or adjustments may be made in this zone unless they strictly follow established preservation efforts. In contrast, the historic center was surrounded by the Buffer Zone, which acts as a protective buffer. Any new development or construction within this zone must be carefully planned and supervised. The objective is to prohibit or control any actions that would jeopardize the authenticity and integrity of the Core Zone, protecting George Town's distinctive identity and historical significance [8].

2. Methodology
2.1 Research Design

A mixed-methods approach was used, combining quantitative and qualitative research methods to provide a comprehensive understanding of building maintenance practices for heritage shop houses in Penang. The study aimed to fulfill the following objectives:

- To assess the current states of building maintenance practices for heritage shop houses in Penang, Malaysia.
- To analyze the challenges faced in building maintenance practices for heritage shop houses in Penang, Malaysia.
- To recommend the strategies for enhancing the effectiveness of building maintenance practices for heritage shop houses in Penang, Malaysia.

2.2 Research Instrument

The data collection instruments included semi-structured interviews conducted through open-ended questionnaires to gather qualitative insights into the current state of building maintenance practices among building owners in Georgetown, Penang. Additionally, survey questionnaires distributed through Google Forms facilitate the systematic collection of quantitative data on maintenance practices and associated challenges faced by heritage shop houses. Unstructured interviews were used to collect in-depth insights from professional experts in building maintenance or conservation in Penang.

2.3 Research Samples

The sample for this research study consisted of heritage shop houses in Penang, Malaysia selected to represent the target population of historic buildings subject to maintenance practices and challenges. The sample for this research study included building owners or tenants of heritage shop houses in Penang, who are responsible for the maintenance of these historical properties. Besides, the sample for this research study comprises experts in heritage conservation or building maintenance. The sample for this research study included conservators, who are experts in heritage conservation, specializing in the maintenance and preservation of historic shop houses.

2.4 Sampling Method

The sampling method used in this research was purposive sampling, chosen to select participants who possess the necessary knowledge and experience related to the research objectives. Purposive sampling allows researchers to target specific groups or individuals who can offer rich and relevant information, enhancing the quality and depth of the research findings. By purposely selecting the building owners and tenants responsible for the maintenance of heritage shop houses, this method ensures representation from individuals directly involved in the upkeep and preservation of these historical properties. Additionally, by purposely selecting individuals with expertise in building maintenance, heritage conservation and related fields, this method ensures that the participants can provide valuable insights and contribute to the study.

2.5 Data Collection Methods

This research used specific sampling techniques to achieve the aim and objectives that were set by the researchers. A set of objective questions was distributed through an online Google form in target to get 120 building owners or tenants. Besides, the interview session was conducted with the owner and professional expert in conservation and building maintenance in Penang to answer the interview questionnaire. Respondent selection was based on their willingness and interest in answering the interview questions. About one set of interview questionnaire was distributed to six

owners and one set of interview questionnaire was distributed to four experts in heritage conservation or building maintenance to answer the interview questions.

2.6 Data Analysis

Data analysis for this study employed a combination of quantitative and qualitative techniques. Survey questionnaire data was analyzed using Excel to conduct descriptive statistics, providing insights into the frequency and distribution of responses. This quantitative analysis offers a comprehensive overview of the challenges faced by heritage shop houses in Penang. Additionally, thematic analysis was conducted on qualitative data obtained from the semi-structured interviews with building owners and unstructured interviews with building maintenance experts. Thematic analysis involved identifying recurring themes, patterns and meanings within the qualitative data, allowing for a deeper understanding of the perspectives, experiences and insights shared by respondents.

2.7 Documentation

In this study, the researcher examines historical documents, building records and relevant literature to understand the evolution of heritage shop houses, past maintenance practices, any documented challenges and the strategies of building maintenance practice. Therefore, the documentary in this study focused on four main aspects: firstly, the historical development and significance of heritage shop houses; secondly, an exploration of current building maintenance practices employed in preserving these architectural culture; thirdly, an examination of the challenges faced in maintaining heritage shop houses ranging from structural deterioration to funding constraints and lastly an assessment of the effectiveness of strategies used in building maintenance practices, aiming to identify successful approaches and areas for improvement. Through this detailed analysis, the study seeks to provide valuable insights into the preservation and maintenance of heritage shop houses, informing future conservation efforts and strategies. This was then illustrated as shown in Figure 1.
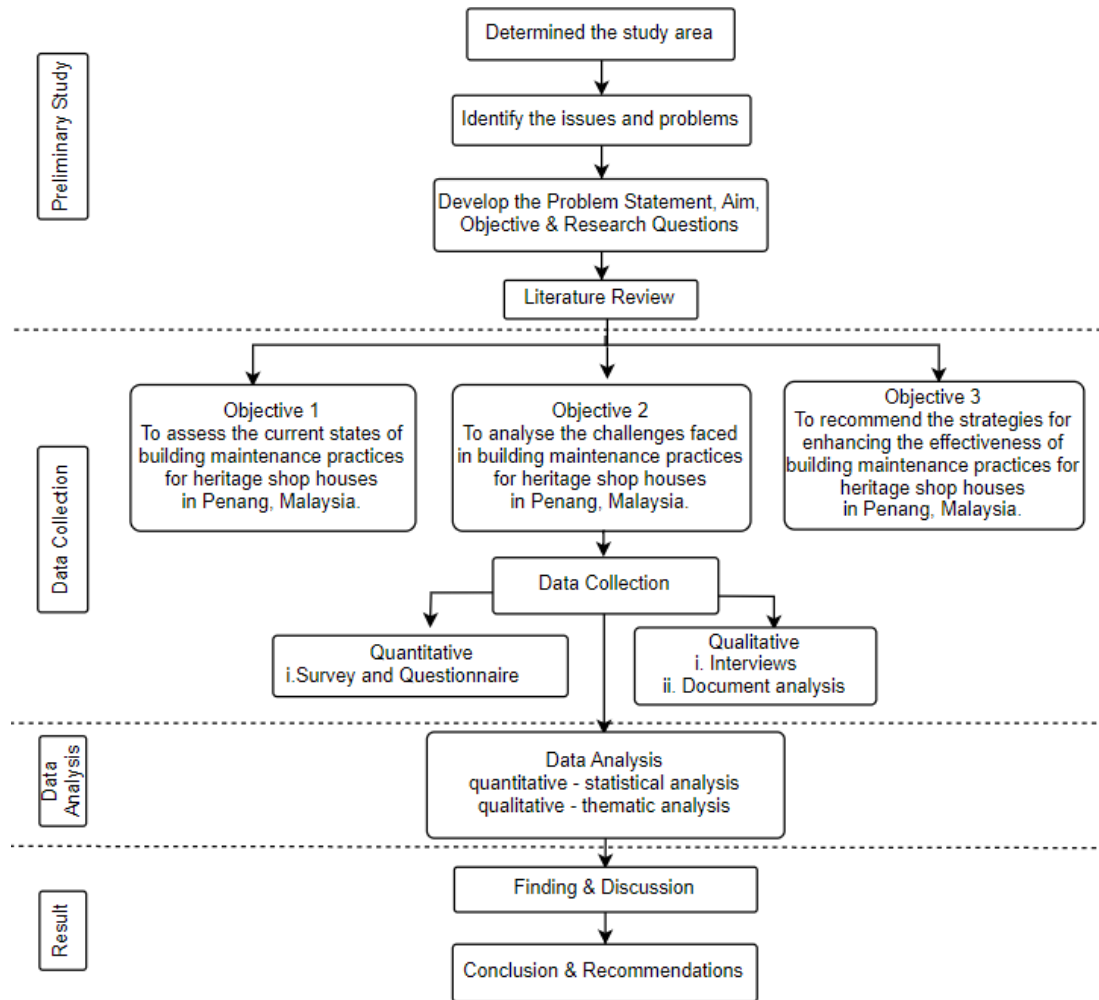
Fig. 1. Framework of research design

3. Results and Discussion

3.1 Current States of Building Maintenance Practices for Heritage Shop Houses in Penang, Malaysia

Based on the responses regarding the current state of building maintenance practices, the majority of respondents (4 out of 6) rated the maintenance as Poor (Figure 2). Two respondents rated it as Average and none rated it as Good. This indicates that the overall perception of building maintenance practices was mostly negative among the respondents.
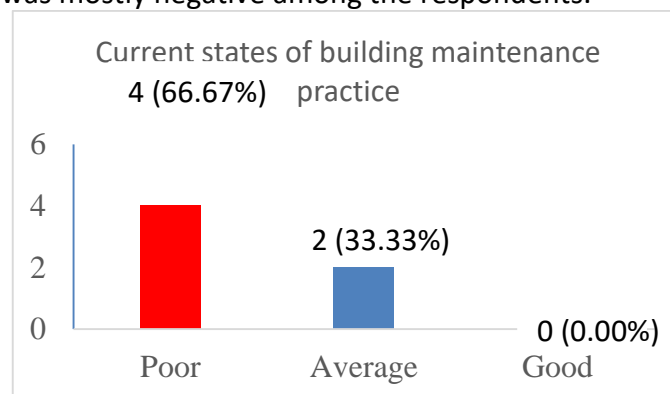

Fig. 2. Current states of building maintenance practices among respondents

According to Figure 3, the unplanned building maintenance are most using by the respondents which in total 6 of the respondents. There were only 2 respondents using the planned building maintenance. This suggests a clear preference for unplanned maintenance among the respondents.
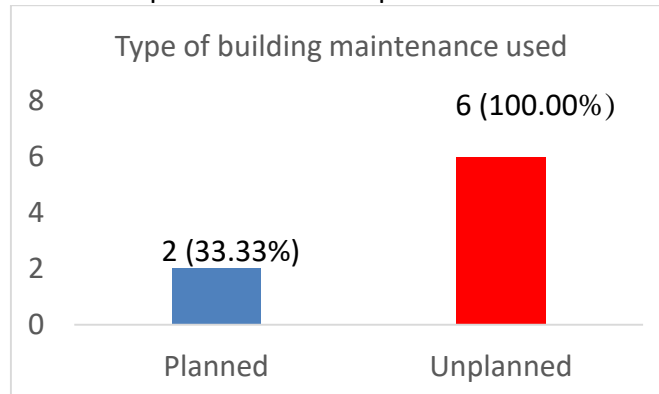

Fig. 3. Types of building maintenance used among respondents

Based on the responses, the most maintenance strategy using among the respondents was Breakdown Maintenance, as indicated by 4 respondents (Figure 4). This was followed by Proactive and Corrective Maintenance, each used by 2 respondents. Preventive Maintenance was less common, with only 1 respondent using this approach. However, Predictive Maintenance was not utilized by any of the respondents. This distribution highlights a preference for reactive maintenance strategies, where equipment was allowed to run until failure, over more scheduled or condition-based approaches.
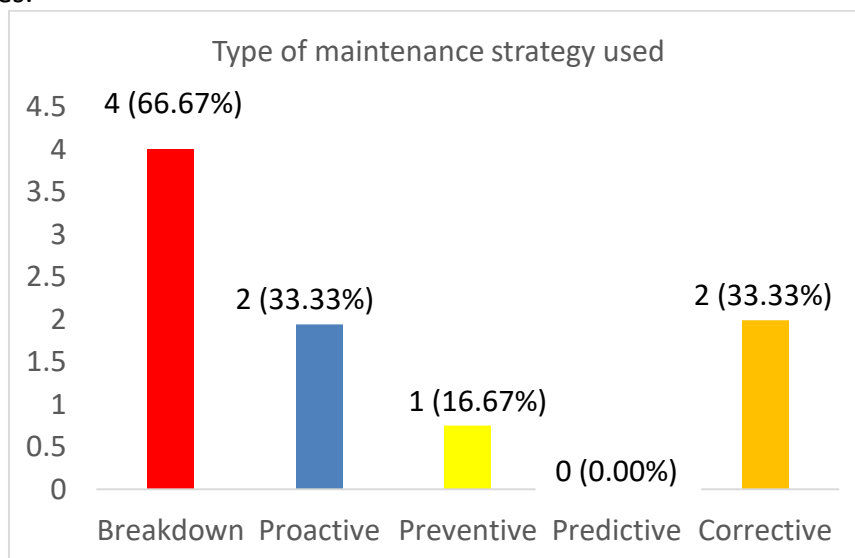

Fig. 4. Type of maintenance strategies used among respondents

3.2 Challenges Faced in Building Maintenance Practices for Heritage Shop Houses in Penang, Malaysia

The demographic profile of the respondents shows a relatively balanced gender distribution as shown in Table 1, with 48.30 % male and 51.70 % female respondents. Regarding the age, the majority of respondents fall within the 41-50 years category (45.00 %), followed by 51-60 years (32.50 %), while a smaller percentage are aged 30-40 years (14.20 %) or over 60 years (8.30 %). In terms of the duration of occupancy, the respondents chosen is more than 20 years, the largest proportion of respondents have occupied their spaces for 20-30 years (57.50 %), followed by 31-40 years (35.00

%), and a smaller percentage for over 40 years (7.50 %). Lastly, in terms of ownership, a slightly higher percentage of respondents are renters (57.50 %) compared to property owners (42.50 %). These demographic insights provide context for understanding the perspectives and experiences of the respondents, which can be valuable for interpreting the findings of the survey.

Table 1
Demographic information of the respondents

Demographic information	Frequency	Percent (%)
Respondent's gender		
Male	58	48.30
Female	62	51.70
Respondent's age		
< 30 years	0	0.00
30–40 years	17	14.20
41–50 years	54	45.00
51–60 years	39	32.50
> 60 years	10	8.30
Respondent's Year of Occupancy		
< 20 years	0	0.00
20-30 years	69	57.50
31-40 years	42	35.00
> 40 years	9	7.50
Respondent's Type of ownership		
Owned	51	42.50
Rental	69	57.50

An analysis of the challenges faced in building maintenance practices was conducted using a ranking analysis methodology. Respondents were asked to rate their agreement with various factors contributing to maintenance challenges on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Mean scores were then utilized to indicate the degree of agreement for each item. This approach enabled a comprehensive understanding of the Identified the obstacles hindering effective building maintenance. Table 2 shows the result of the mean, standard deviation and ranking of the Challenges faced in building maintenance practices for heritage shop houses in Penang, Malaysia. The overall result shows that the top three challenges are "Aging and deterioration of heritage shop houses" followed by "Lack of funds in proper maintenance on heritage shop houses" and "Loss of authenticity of heritage shop houses." "Aging and deterioration of heritage shop houses" achieved the highest mean score of 4.71. This finding aligns with the observations made by [9] where they pointed out that as buildings age, they become increasingly susceptible to physical wear and tear, resulting in functional and external obsolescence that compromises their overall functionality. This deterioration is exacerbated by the lack of proactive maintenance, which is significant for sustaining a building's longevity over its life cycle. "Lack of funds in proper maintenance on heritage shop houses" secured the second highest mean score of 4.53, indicating its impact on building maintenance practices. This is highlighted by [10], demonstrating how the lack of funding leads to the neglect of the routine and regular maintenance practices. Budget constraints often force owners to postpone necessary maintenance tasks, finally hindering the optimal functioning of maintenance operations.

Table 2 also shows the overall mean for "Loss of authenticity of heritage shop houses" to be 4.49. This result is supported by Barbara Wood [11]. Improper conservation could cause these buildings to lose some of their authenticity. Several buildings are conserved without following the regulations, which causes the building's historical relevance and authenticity to be lost.

Table 2
Challenges faced in building maintenance practices

Challenges faced in building maintenance practices	Mean	Standard Deviation	Ranking
Aging and deterioration of heritage shop houses	4.7083	0.4545	1
Lack of funds in proper maintenance on heritage shop houses	4.5333	0.5617	2
Loss of authenticity of heritage shop houses	4.4917	0.6191	3
Lack of experts on heritage shop houses maintenance	4.4167	0.6656	4
Lack of spare parts and materials to replace for original components	4.3917	0.6096	5
Effects of urbanization on heritage shop houses	4.3833	0.7209	6
Lack of legislation and regulation heritage preservation	4.3333	0.7226	7
Lack of occupants' awareness on heritage shop houses	4.3333	0.7341	8

3.3 Effective Strategies for Enhancing Building Maintenance Practices of Heritage Shop in Penang, Malaysia

This section discusses the findings from the interview questions posed for objective 3. It seeks to determine respondents' views on effective strategies for enhancing building maintenance practices at heritage shop. Data was obtained using suitable methodologies, and interviews have been identified as the most appropriate way to achieve the research aim. Table 3 shows the effective strategies for enhancing building maintenance practices of heritage shop in Penang, Malaysia, detailing research findings in a tabular format presenting various strategies relevant to respondents' opinions regarding building maintenance practices.

Table 3
Effective strategies for enhancing building maintenance practices

Summative of interview		Percentage of strongly agree (%)
Q1	manage the costs of maintaining heritage shophouses	100
Q2	hire qualification of expert with heritage conservation	100
Q3	effective preservation techniques for heritage shop houses	100
Q4	regular maintenance and inspection	50
	practices for ongoing condition monitoring	50
Q5	educated owner the proper maintenance practices	75
	ensure compliance with local conservation standards and guidelines	25
Q6	raise public awareness of the cultural of heritage shophouses	100
Q7	Implementing a proactive maintenance strategy	25
	Implementing a preventive maintenance strategy	50
	Implementing a predictive maintenance strategy	25

3.3.1 Implementing efficient budget planning

Efficient budget planning is enabled by the strategic implementation of planned maintenance, leading to cost reduction as unplanned maintenance is more expensive. Building owners can optimize resource allocation and minimize the increased costs associated with emergency repairs by proactively organizing maintenance practice. Furthermore, efficient budget planning includes addressing maintenance needs as soon as possible to avoid the development of major harm caused by deferred maintenance [12].

3.3.2 Improved expertise and professional

According to Ali Hauashdh *et. al.*, [13], providing training to maintenance staff is significant for improving their competence and ensuring they satisfy the necessary work standards. As a result, qualified maintenance staff is capable of not only saving time and money but also improving overall maintenance quality [14]. A qualified and knowledgeable maintenance personnel was required for professional building maintenance practices. Such competency is especially important in addressing and resolving difficult tasks that frequently accompany maintenance work, emphasizing the significance of investing in the continual growth and training of maintenance professionals for optimal results in the care and preservation of structures.

3.3.3 Comprehensive standards and guidelines

The current standards and guidelines for World Heritage Site (WHS) cities are general and require more specific translations to properly meet particular conditions. Authorities must aggressively enforce and execute a proper framework for evaluating the heritage effect of any new developments as stewards of these WHS cities. Limits on allowable alterations must be established, particularly in transition zones between conservation areas (core and buffer zones) and new development districts. This method ensures that modern development is balanced while the cultural and historical value of heritage shop houses is preserved [15].

3.3.4 Education and awareness initiatives owners

Engaging with heritage conservation professionals, participating in education and awareness initiatives, seeking hands-on learning experiences and networking within the preservation community all play crucial roles in equipping owners with the knowledge and resources necessary for effective maintenance practices. By embracing these opportunities for learning and collaboration, owners demonstrate a commitment to preserving the cultural and historical significance of their shop houses. Ultimately, this concerted effort not only ensures the longevity and integrity of these cherished heritage buildings but also fosters a sense of stewardship and community within the broader preservation community [16].

3.3.5 Regular inspections

Regular inspections serve as an essential preventative step to spot possible problems early on and fix them before they become bigger ones. Due to their frequent use and inherent everyday wear and tear, these buildings are vulnerable to a variety of damages. Over time, elements including weather, pollutants in the environment and poor care techniques may all aggravate their state of deterioration. Maintaining the shop houses structural integrity requires a systematic approach in order to provide focused and attentive focus. This strategy is essential for preventing long-term damage in addition to helping to resolve current issues [17].

3.3.6 Proactive maintenance plan (PMP)

Taking a proactive stance toward maintaining structures included various important elements, such as careful preservation planning, preventive maintenance measures and comprehensive documentation of the historical context and architectural features of each building. The Project

Management Plan devised for each historic structure is to satisfy its distinct requirements and challenges, taking into account factors such as structural soundness, historical importance and intended usage. This adaptability is significant due to the variety of historic buildings, each possessing its own distinct characteristics and preservation demands [18]. Proactive maintenance aims to identify and address issues at their earliest stages, preventing failures from developing further. Its main goal is to maximize the lifespan of components by implementing thorough and precise maintenance practices while ensuring operational efficiency remains complete.

3.3.7 Preventive maintenance

Ensuring the long-term performance of buildings by minimizing their degradation relies on making informed decisions regarding various preventive maintenance tasks. Scheduled preventive maintenance involves performing maintenance tasks on specific items or components at predetermined intervals, either based on usage or time. In contrast, condition-based preventive maintenance relies on real-time monitoring and assessment of the actual condition of the item or part, allowing for maintenance activities to be carried out as needed based on the observed condition [19]. By implementing a combination of scheduled and condition-based preventive maintenance strategies, building owners and maintenance professionals can effectively preserve the integrity and performance of buildings while minimizing the risk of deterioration and costly repairs.

3.3.8 Predictive maintenance

Predictive maintenance (PdM) employs advanced data analysis techniques to detect irregularities in equipment operation and forecast potential defects, allowing for timely repairs before the occurrence of failures. By proactively addressing issues, PdM aims to prevent unexpected interruptions and minimize the need for unnecessary preventive maintenance, thereby reducing maintenance frequency and optimizing maintenance costs. In the context of heritage buildings, predictive maintenance involves utilizing data-driven approaches to anticipate and address maintenance needs, ensuring the preservation of these historical structures while minimizing disruptions and expenses [20].

4. Conclusions

The research study aimed to assess the current state of building maintenance practices for heritage shop houses in Penang, Malaysia. The findings indicate that a considerable number of respondents primarily rely on breakdown or reactive maintenance. This reactive approach can lead to increased costs, potential delays and disruptions, exacerbating existing problems due to the neglect of preventative measures. Moreover, most of the respondents do not follow specific regulations, guidelines or standards in their maintenance practices. Many owners rely on practicality, personal experience and common sense rather than adhering to formal conservation regulations. This independent approach, while practical, may overlook the specialized expertise required for the proper preservation of heritage buildings. The absence of adherence to established guidelines can result in maintenance practices that are not aligned with best practices for heritage conservation, potentially leading to improper repairs and further deterioration of these cultural landmarks.

Next, the research findings indicate the challenges of facing the maintenance practices for heritage shop houses in Penang, Malaysia. The top-ranked challenge, aging and deterioration of these heritage shop houses highlighted the pressing need to address physical degradation to

preserve their cultural significance. This challenge is closely followed by the lack of funds for proper maintenance, highlighting the critical importance of increased financial support to sustain heritage preservation efforts. Additionally, the loss of authenticity ranks third, emphasizing the significance of preserving the original architectural and cultural integrity of these heritage buildings.

Lastly, to identify the most effective preservation techniques for maintaining the historical integrity of iconic heritage shop houses. Effective strategies for enhancing building maintenance practices of heritage shops in Penang, Malaysia include managing maintenance costs through proactive, preventive and predictive maintenance strategies. This involves hiring experts with qualifications in heritage conservation to ensure specialized knowledge and skills are applied. Utilizing effective preservation techniques, regular maintenance and ongoing condition monitoring are essential for preserving heritage shop houses. Educating owners on proper maintenance practices and ensuring compliance with local conservation standards and guidelines are crucial steps. Additionally, raising public awareness of the cultural significance of heritage shop houses can garner support for their preservation efforts. In conclusion, implementing a comprehensive maintenance approach tailored to the unique needs of heritage shop houses is essential for their long-term preservation and sustainability.

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