

Building Condition Assessment at Tun Syed Nasir Residential College, UTHM

Nurul Syafiqqah Mohd¹, Rafikullah Deraman^{2*}

^{1,2}Faculty of Civil Engineering and Built Environment,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: <https://doi.org/10.30880/rtcebe.2023.04.01.017>

Received 06 January 2022; Accepted 15 January 2023; Available online 01 May 2023

Abstract: Building Condition Assessment (BCA) is a popular method for determining the physical state of an existing building. Building condition assessment (BCA) entails identifying and evaluating defects and deterioration in building elements and services, as well as determining the maintenance work required to keep the building in good condition. The Tun Syed Nasir Residential College has been in use for nearly 28 years, making it more prone to flaws due to increased wear and tear and a lack of proactive maintenance. The inadequacy of the building's facilities and its poor condition clearly have an impact on the residential college's users. As a result, the Tun Syed Nasir Residential College was used as a case study in this study to assess the building's condition using the BCA. Document review, interviews with maintenance personnel, and visual inspection using the BCA form, which follows JKR 21602-0004-131JKR, were used to obtain data. The findings show that the overall rating for the building's condition is 8, indicating good condition and implying the need for condition-based maintenance on specific components. The finding can assist Development and Maintenance Management (PPP) better plan and prioritize maintenance activities to ensure the building remains in good condition and provides comfort and safety to students and other building occupants. The BCA assessment is a useful tool for PPP maintenance staff to use in evaluating building condition performance and proposing a maintenance strategy in the future.

Keywords: Building Condition Assessment, Tun Syed Nasir Residential College, Building Defects, University.

1. Introduction

Building Condition Assessment (BCA) is growing in Malaysia's building environment [1,2]. BCA is an assessment to determine whether all the building's structural elements are rational or irrational conditions [2]. The assessment of building conditions is to evaluate the physical state of building elements and services to determine the maintenance needs of the facility [3,4]. Building conditions represent the physical conditions of the buildings and therefore their performance towards efficiency.

It is essential to check and rate the condition of the building as it could indicate the physical performance of the building from any deficiencies. Assessing the real condition of building structures is very important for building maintenance programs or building repair works. Moreover, an aging building as Tun Syed Nasir Residential College, which has been built since 1993 often has a lot of defects and deterioration which might be due to lacking proactive maintenance [5]. Defects and deterioration such as cracking, broken door or windows, peeling paint and others is a common problem which usually faces by the aging building. Thus, BCA is very important to support decision making and it is also critical to the management in achieving the service standards for maintenance [6].

University residential colleges are one of the factors to produce quality student and future leaders, captains of industry, entrepreneurs, professionals, and scientists [5]. These types of buildings require renewable and improvement to provide a quality and favorable environment for education and other activities within the institution [5,7]. It is reported that from time to time, new structures are being constructed within the various institutions to upgrade educational facilities and provide a better quality of education while the existing buildings suffer inadequate services [7]. Concerning to Tun Syed Nasir Residential College, which has been occupied for almost 28 years is more likely to appear defects as there is higher wear and tear, defective construction, and lack of proactive maintenance. A building condition assessment was performed at the residential college to identify the physical performance of the building components from any deficiencies and determine the maintenance needs to keep the residential buildings in its required condition.

The purpose of this study is to identify the defects and deficiencies in the Tun Syed Nasir Residential College building. As a result, the building's defects and deterioration were assessed using a building condition assessment (BCA) that adhered to JKR standards. Furthermore, the outcome of this BCA is to suggest the necessary maintenance work for the Tun Syed Nasir Residential College building. This research focuses on the visual inspection of the Tun Syed Nasir Residential College building using the building condition inspection for Existing Building Guidelines [3] and appropriate tools to obtain good data. In this study, the BCA's scope is limited to building components, excluding mechanical and electrical work. A BCA begins with a site inspection, information gathering from the building owner, and fieldwork measurement.

2. Building Condition Assessment (BCA)

Building Condition Assessment (BCA) is a way to measure the building performance hence, its is growing in the context of the built environment in Malaysia. BCA is important which it is used to support decision-making and is critical to the management to achieve the service standard for maintenance [1]. The aging and old building usually will face more defects and damage which leads to the failure of the building. BCA has been developed to assess the physical condition of the building [8]. The objective of BCA is to make it easier to rank all of the facilities and components of the building according to its condition [1].

2.1 Building Condition Assessment (BCA) According to JKR Standard

Building condition assessment (BCA) is the process of evaluating the entire building and its infrastructure components, building frames, mechanical and electrical systems, internal structure as well as finishes [1,2]. In 2103, Jabatan Kerja Raya (JKR) has developed the standard of Guidelines for Inspection and Assessment of The Condition of Existing Buildings. This standard aims to guarantee that building inspectors will inspect the building according to the inspection guidelines hence developing a relevant and accurate rating on the defects and damage that have been identified. Based on the Building Condition Inspection for Existing Building Guidelines [3], the scope of the inspection will include all the government's properties including civil and structural (building works), mechanical systems, and electrical systems.

3. Materials and Methods

This research was carried out at UTHM's TSNR building. This residential building was chosen as a sample because of its age and location in UTHM. The building has four block with large number of students.



Figure 1: TSNR building, UTHM

3.1 Research Instruments

3.1.1 BCA Form.

The survey form is used based on the visual inspection assessment using JKR standard BCA guidelines. The evaluation is based on the physical site visit, and the inspection performed within the scope of its BCA checklist. The BCA form covers the information about the building, characterization, defects in functional elements, evaluation of the condition of defect, and maintenance action, and the information in terms of the defects' condition and priority. The defect appears must be noted on the inspection form, verified, and prioritized following the standard described in the guideline.

3.1.2 Document Reviews and Interview

Obtaining information from building owners (TSN officers/supervisors and PPP maintenance staff) and conducting document reviews can aid in identifying early-level building conditions. Furthermore, document reviews and interviews with persons in charge can aid in the process of evaluating physical defects and deterioration at the building.

3.2 Rating Scale

The rating scale used in the BCA procedure is used to determine and evaluate the building's current condition. The BCA rating system can be used to assess the condition and priority of a building [9]. The standard guideline, JKR 21602-0004-13, was chosen for this study because the rating description is comprehensive, including defects, condition, and function, and the differences between ratings are clearly addressed, making the rating procedure easier. A rating system could be utilized to accurately predict the future condition of the building. The condition indexes are used to compare the condition from different components which could be generated from numeric value or alpha values. However, the condition indexes scale and linguistic representations for the building components might differ from various nations [1]. According to JKR, a five-point grade as shown in Table 1, Table 2 and Table 3 are used to determine the level of condition of each deficiency.

Table 1: Physical Condition Levels of Building Components [3]

Grade	Inspection Scale	Description
1	Very Good	<ul style="list-style-type: none"> • No defect, • In very good condition, • Works well.
2	Good	<ul style="list-style-type: none"> • Minor defect, • In a good condition, • Works well.
3	Fair	<ul style="list-style-type: none"> • Major defect, • Moderate condition, • Still function but with supervision
4	Critical	<ul style="list-style-type: none"> • Major or minor defect, • Critical • Unable to function according to the agreed level of service.
5	Very Critical	<ul style="list-style-type: none"> • Very critical, • Unable to function, • At the risk that could lead to injury and/ or accident.

Table 2: Maintenance Action [3]

Priority	Inspection Scale	Description
Normal	1	<ul style="list-style-type: none"> • No signs of defects or damages, • Component/element well maintained, no need for repair.
Routine	2	<ul style="list-style-type: none"> • Minor defects / damages, • Need to be monitored, repaired, and replaced to prevent serious defects/damages.
Repairs	3	<ul style="list-style-type: none"> • Major defects / damages, • Needs for major repairs / replaced.
Rehabilitation	4	<ul style="list-style-type: none"> • Serious defects / damages, • Needs urgent repairs, immediately.
Replacement	5	<ul style="list-style-type: none"> • Critical defects / damages, • Needs for urgent replacement / immediate repair, • Requires a detailed examination of specialist/expert judgment.

Table 3: Matrix Analysis – Physical State Level of Building Components and Maintenance Action Priority Level [3]

Scale		Maintenance action priority level				
		5	4	3	2	1
The physical state building component	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1

Table 4: Building Rating Classification [3]

Rating	Condition	Action Matrix	Score
A	Very Good	Scheduled Maintenance	1 to 5
B	Good	Condition-Based Maintenance	6 to 10
C	Fair	Repairs	11 to 15
D	Critical	Rehabilitation	16 to 20
E	Very Critical	Replacement	21 to 25

The matrix analysis will be calculated based on the formula below.

$$\text{Matrix Analysis, } c = a \times b \tag{Eq. 1}$$

Where, a is the physical state level of building components, b is the priority level of maintenance action.

After scoring each defect, the overall building rating, which summarizes the building’s condition, was calculated using the following formula.

$$\text{Building classification rating} = \frac{d}{e}$$

$$\text{Total marks (d)} = \sum \text{ of } c$$

$$\text{Number of defects or damages (e)} \tag{Eq. 2}$$

Where c is the matrix analysis, e is the number of defects.



Based on the Table 4, the score of 1 to 5 indicates the building is in very good condition which requires scheduled maintenance. As for 6 to 10, the building is in a good condition but requires condition-based maintenance. However, for the rating score 11 to 15, the building shows in fair condition which requires a repair action. Meanwhile, the building will be rated as a rehabilitation state which is a critical condition when scores are 16 to 20. The building which obtains a score of 21 to 25 is a very critical condition that needs replacement work.

4. Results and Discussion

The data analysis of the building condition assessment (BCA) at Tun Syed Nasir Residential College based on the survey inspection and document reviews is presented in the results and discussion section. The JKR standard Building Condition Assessment Guidelines were used to evaluate all survey inspection data. In addition, the results of the interviews with building owners are presented in this section. 4.1 Results Analysis from Survey Inspection

The building inspection at the Tun Syed Nasir Residential College has been done following the JKR standard guidelines. In this section, the defects and deterioration have been analyzed and summarized in Table 5.

Table 5: Types of Defects Found at TSNR building

No.	Types of Defects	Descriptions
1		<p style="text-align: center;">Fungus</p> <p>Fungus in the building can be apparent or concealed. It could be caused by the leaks rising damp. This defect is found at the first level wall (external) and can be seen clearly. In addition, is not hazardous but could create toxins that might be harmful to human health.</p>
2		<p style="text-align: center;">Apron Cracks</p> <p>This defect has been found at the apron of the building. This defect is not stated as major as it is not related to the structural of the building.</p>

3



Roof Leakage

The roof leakage is currently occurred at the ceiling in the room from level 3. This could be a major defect because it leaks when it is raining. The students must be not conformable with the situation, so action must be taken for the maintenance works.

4



Dampness

The defect can be found quite a lot at every toilet in TSN building, but only can be found in the toilets. However, dampness is a significant issue which could lead to old building to deterioration.

5



Peeling Paint

Peeling paint is a very typical defect occurs at the building. This is due to insufficient the moisture or poor adhesion. Poor adhesion portrayed the peeling paint which makes the paint separates from the previous layer.

6



Finishing Cracks

This kind of cracks were found at the stair's steps on the first level. This kind of defect is not major and not dangerous because it is only from its finishing.

From the analysis, there are several defects found at TSNR building. Some of them were part of the structural defects, which is major and could lead to structural failure. After all, these defects was evaluated by using Building Condition Assessment Rating System in order to determine the level of rating for the building condition.

4.1.1 Building Condition Assessment Rating System

Building condition assessment is critical in supporting decision-making and assisting management in meeting service requirements for maintenance works. The physical state of the structure, as well as its performance, are represented by building condition [1]. Table 6 shows a summary of the BCA rating.

Table 6: Building Condition Assessment Rating System for Tun Syed Nasir Residential College Building Condition Schedule

No	Elemental/Component	Part	Defect	Score		
				Condition Assessment (a)	Priority level (b)	Matrix analysis a x b = (c)
1	Ground Floor	Wall	Fungus	3	3	9
2			Peeling Paint	2	2	4
3		Slab	Fungus	2	2	4
4		Soffit Slab	Dampness	3	3	9
5			Crack	4	4	16
6		Ceiling	Waterproofing	3	3	9
7		Toilet	Dampness	3	4	12
8		Perimeter	Crack	3	3	9
9		Apron	Slab Cracks	2	2	4
10	First Floor	Wall (rainwater downpipe)	Fungus	3	4	12
11			Dampness	2	2	4
12		Soffit Slab	Dampness	3	3	9
13		Stairs	Finishing	2	1	2
14		Toilet	Dampness	3	4	12
15		Stairs	Finishing	2	1	2
16			Fungus	1	2	2
17	Second Floor	Wall	Peeling Paint	2	2	4

18		Ceiling (3)	Peeling Paint	2 x 3	2 x 3	18
19		Toilet	Dampness	3	3	9
20	Third Floor	Roof	Leakage	4	4	16
21		Stairs	Cement Render	2	2	4
22		Toilet	Dampness	3	3	9
Total Mark (d) ($\sum c$)						179
No. of Defect (e)						22
Total Score (d/e)						8
Overall Building Rating						Good

Table 6 shows the results of the BCA rating system. According to the Building Rating Classification [3,] the overall building rating for the TSNR building is B, with a score between 6 and 10. Based on the total score of 8, the building is in good condition and thus requires condition-based maintenance.

4.2 Results from Document Reviews and Interviews

Three interviewees were conducted, including the TSNR building supervisor, Mdm. Yazilah Mohd Yazir, and the Development and Maintenance Office, UTHM (PPP), Mr. Mohammad Zaki Lokeman and Mr. Fadzlee Nizam Jaafar. The interview questions focused on the recommendation of maintenance works based on the results of the BCA rating system.

According to the inspection, the most common defects found at the TSNR building are dampness, peeling paint, roof leakage, and others. However, respondents agreed that roof leakage is a common problem at the TSNR building. The roof is a critical component of a building structure because it protects the interior from elements such as rain, sunlight, and wind [11]. The roof used at TSNR building is a pitched roof. It is known as a roof which slopes downwards, from one edge to another. However, pitched roof could lead to the penetration of rainwater into the roof structures if there are no suitable connections between the roof tiles [12].

The interviewees responded that the best solution is in terms of corrective maintenance. Maintenance is very important thing if there is any defect occurs at the building. This is because, it is important for the authorities to adopt a corrective maintenance to repair the degrading process of its facilities, maintain the environment, and leave it safe for the students. However, they also agreed if preventive maintenance used in TSNR building but, it will need a higher cost. Preventive maintenance is performed in order to preserve the equipment and facilities in a good operational condition.

In addition, for TSNR building, the maintenance is basically will run according to the complaint received. If the defect is in minor, then the suitable maintenance would be corrective maintenance. However, preventive maintenance also will be done for the periodically inspection works. As for example, TSNR building will be having inspection at the end of every semester by PPP, the contractors, and maintenance team form TSN. Mr. Zaki concluded that preventive maintenance needed more time compared to corrective maintenance.

As indicates in Table 5, the suitable maintenance works for the defects also have been identified. For example, the defect peeling paint. Mr. Zaki and Mr. Fadzlee said that the very best approach is by removing and scrape off all the loose paint in the affected area. If there is any damage after the paint is removed, it is advisable if it gets fixed before the wall is painted again. Besides, as for the cracks, it is known as a major defect and cannot be done in a limited time, said Mr. Zaki. However, if the cracks

are not relatable to the structure of building, then it is not a major defect. For cracks in structural part, it is recommended if it get repaired because it will lead to structural failure in the future. Lastly, dampness may be occurring because of the failed waterproofing. In order to get rid this defect, the solution may be by fixing the leaking pipes. Hence, roof leakage also relatable to dampness. This is because, when the roof leaks, the water will be seeping through the wall. So, in order to avoid dampness, the roof leakage also need to be recovered.

5. Conclusion

In conclusion, building condition assessment is the first step in the process of building maintenance. Building inspection necessitates primarily on the inspection of defects and evaluation of each defect, which results in an overall assessment of the building condition. The number of defects, priority level, and overall building rating were identified as a result of the analysis for this research. Tun Syed Nasir Residential College building needs to be repaired but in condition-based maintenance. The findings of this study have raised awareness of the significance of building condition evaluation on residential buildings, as well as the significant technique required to score the building condition. Hence, method used for this study may assist the contractors or authorities in taking future action on defect that occur, ensuring that TSNR building will have a longer lifespan.

Acknowledgement

The authors would like to thank the Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia for its support.

References

- [1] S. Yacob, A. S. Ali, and A. Y. C. Peng, "Building Condition Assessment: Lesson Learnt from Pilot Projects," *MATEC Web Conf.*, vol. 66, 2016, doi: 10.1051/mateconf/20166600072.
- [2] A. Wafiy, N. Abdul, M. Ashraf, and A. Rahman, "Building Condition Assessment in School Using JKR Standard," vol. 1, no. 1, pp. 39–47, 2020.
- [3] Public Work Department. *Garis Panduan Pemeriksaan dan Penilaian Keadaan Bangunan Sedia Ada*. Kuala Lumpur, Malaysia, JKR 21602-0004-13, 2013.
- [4] A. I. C. Ani, A. Sairi, S. Johar, M. Z. A. Razak, and N. M. Tawil, "The practice of building inspection in Malaysian total asset management," *J. Teknol.*, vol. 78, no. 1, pp. 1–11, 2016, doi: 10.11113/jt.v2023.04.01.01778.3715.
- [5] M. M. Abdullah and R. Z. A. Al-Shameri, "Evaluation of Current Services and it's Satisfaction for Student's Residential Colleges in Uthm Campus Evaluation of Current Services and it's Satisfaction for Student's Residential Colleges in Uthm Campus Department of Business Management, Unive" no. January, pp. 0–14, 2020, doi: 10.1145/2818048.2820555.
- [6] S. Mohd Noor, C. Shing Mei, I. Syahrizal Ibrahim, N. Nabilah Sarbini, M. Hanim Osman, and N. Azeyah Khiyon, "Heritage building condition assessment: A case study from Johor Bahru, Malaysia," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 220, no. 1, 2019, doi: 10.1088/1755-1315/220/1/012024.
- [7] O. A. Lateef, M. F. Khamidi, and A. Idrus, "Building Maintenance Management in a Malaysian University Campus: A Case Study," *Constr. Econ. Build.*, vol. 10, no. 1–2, pp. 76–89, 1970, doi: 10.5130/ajceb.v10i1-2.1593.

- [8] Yacob, Syamilah, A. A. Shah, and C. P. A. Y., "The Practice of Building Condition Assessment in Public Sector Facility Management," *J. Build. Perform.*, vol. 9, no. 2, pp. 1–3, 2018.
- [9] N. A. Awang, S. J. L. Chua, and A. S. Ali, "Building condition assessment focusing on persons with disabilities' facilities at hospital buildings," *J. Des. Built Environ.*, vol. 17, pp. 73–84, 2017, doi: 10.22452/jdbe.sp2017no1.7.
- [10] G. R. Abbott and M. Duling, "Building condition assessment: A performance evaluation tool towards sustainable asset management."
- [11] M. A. Othuman Mydin, N. A. Agus Salim, S. W. Tan, N. M. Tawil, and N. M. Ulang, "Assessment of Significant Causes to School Building Defects," *E3S Web Conf.*, vol. 3, pp. 1–7, 2014, doi: 10.1051/e3sconf/20140301002.
- [12] A. S. Ali, K. C. Keong, N. Zakaria, U. Zolkafli, and F. Akashah, "The effect of design on maintenance for school buildings in Penang, Malaysia," *Struct. Surv.*, vol. 31, no. 3, pp. 194–201, 2013, doi: 10.1108/SS-10-2012-0030.