HOTEL BUILDING RELIABILITY TOWARDS BUILDING AGE

Syukri Indrawansyah[*], Abdullah[**], Cut Zukhrina Oktaviani[***]
[*]*Department of Civil Engineering, Syiah Kuala University, Banda Aceh, Indonesia, syukri.indrawansyah@gmail.com*
[**]*Department of Civil Engineering, Syiah Kuala University, Banda Aceh, Indonesia, abdullahmahmud@unsyiah.ac.id*
[***]*Department of Civil Engineering, Syiah Kuala University, Banda Aceh, Indonesia, cut.zukhrina@unsyiah.ac.id*

Email Correspondence: syukri.indrawansyah@gmail.com

Received : February 5, 2020 Accepted : June 12, 2020 Published : December 31, 2020

Abstract: Mahara Hotel is a tourism-supporting facility and infrastructure first established in Central Aceh District in 1999. This 3-story hotel used a reinforced concrete frame structure, and as time goes by, the service capacity of the building would decrease. This condition was suspected to affect quality and user convenience. Anticipate the older age of the building, and better maintenance management is applied so that the proper building's function can be maintained. The purpose of this study was to assess the reliability of 20 year-established hotel buildings. The method was a descriptive analysis. Data were analyzed based on the guidelines of Technical Procedures for Guidelines for Certificate of Eligibility for Functions (SLF) of Buildings Regulation of Minister of Public Works No. 25/PRT/M/2007. Based on the results, the reliability value of the Mahara Hotel building was unreliable (66.75 %), less than the SLF guidelines (at least 75 %). Some components that caused a low level of reliability to include utility and fire protection components (20.34 %) and accessibility components (3.11 %). The effective and efficient component in increasing the reliability of the building was the utility and fire protection components by not requiring major demolition.
Keywords: Assessment; Reliability; Care; Building

Abstrak: Hotel Mahara merupakan sarana dan prasarana penunjang pariwisata yang pertama kali berdiri di Kabupaten Aceh Tengah pada tahun 1999. Hotel berlantai 3 ini menggunakan struktur rangka beton bertulang dan seiring dengan berjalannya waktu, daya layan gedung akan semakin menurun. Kondisi ini ditenggarai akan mempengaruhi kualitas dan kenyamanan pengguna. Untuk mengantisipasi hal tersebut, maka semakin tua umur bangunan, seharusnya didukung dengan penerapan manajemen pemeliharaan yang baik agar kelayakan fungsi dari bangunan dapat dipertahankan. Tujuan dari penelitian ini untuk menilai keandalan bangunan hotel setelah berumur 20 tahun. Metode yang digunakan adalah analisis deskriptif. Data dianalisis berdasarkan panduan Teknis Tata Cara Pedoman Sertifikat Laik Fungsi (SLF) Bangunan Gedung Peraturan Menteri Pekerjaan Umum No. 25/PRT/M/2007. Berdasarkan hasil penelitian, nilai keandalan bangunan gedung Hotel Mahara termasuk tidak andal yaitu sebesar 66.75 %, kurang dari yang dipersyaratkan oleh pedoman SLF tersebut yaitu minimal 75 %. Beberapa komponen yang menyebabkan rendahnya tingkat keandalan anatara lain komponen utilitas dan proteksi kebakaran sebesar 20.34 % serta komponen aksesibilitas sebesar 3.11 %. Komponen yang efektif serta efisien dalam menaikkan tingkat

keandalan bangunan gedung tersebut adalah komponen utilitas dan proteksi kebakaran dengan tidak mengharuskan pembongkaran yang besar.
Kata kunci: Penilaian; Keandalan; Perawatan; Bangunan Gedung

Recommended APA Citation :
Indrawansyah, S., Abdullah, & Oktaviani, C. Z. (2020). Hotel Building Reliability Towards Building Age. *Elkawnie*, *6*(2), 201-212. https://doi.org/10.22373/ekw.v6i2.6313

Introduction

Mahara Hotel was established in 1999 with three floors using reinforced concrete frame structures. As Mahara hotel has been operating for approximately 20 years, its feasibility of the building might decrease. Therefore, it is necessary to take special care related to the feasibility of the building. Since hotel establishment, Earthquakes of magnitude 9.1 and 6.2 occurred in 2004 and 2013 in Central Aceh Regency. Although visually, Mahara Hotel buildings did not experience significant damage during the earthquakes but considering the age and the number of damaged buildings due to earthquakes. It is necessary to conduct a careful assessment, especially on structural elements.

To construct the reliability and feasibility of building construction function, technical and administrative requirements must have complied with following the function of the building itself (Rambe, 2017). Evaluation of building reliability was carried out using technical guidance parameters on procedures for checking building reliability (Regulation of the Minister of Public Works No. 25/PRT/M/2007).

Literature Review

Building

According to Law of Building in the Republic of Indonesia No. 28 of 2002, the definition of the building is a physical form of construction works which integrate with the land it stands on, partly or wholly stands over and/or underground or water, having a function as a place for people to do their activities, either for residence or place to live, religious, business, social, culture or any specific activity.

Building Technical Requirement

The technical requirements for building construction, including building layout requirements and building reliability requirements (Law of the Republic of Indonesia No. 28 of 2002 regarding Building), such as:

a. Requirements for building utilization, intensity, architecture, and condition of environmental impact management. Allotment requirements are the provision of the location concerned following the regency/city Regional Spatial Plan (RTRW), Regency Spatial Detail Plan (RDTRK), and Building and Environmental Planning (RTBL).

b. Requirements of building reliability, including safety aspect, healthy, convenience, and facility that meet technical requirements by building performance.

Building Reliability Assessment

Referring to the Regulation of the Minister of Public Works No. 25/PRT/M/2007, regarding SLF Guidelines for Buildings, there are five crucial components in observing and testing building reliability, i.e., assessment of architectural, structural, utility and fire protection, accessibility, and building layout and environmental components.

a. Architectural Component Assessment
   The actual value of the architectural conditions is a separated value based on each condition in each element of the building architecture. The condition value explains the quality and quantity of each sub-element when damage or defects occur. Components that are visually assessed and measured on each element of the building reliability architecture, including the inner and outer parts.
b. Structural Component Assessment
   The actual value of the structure is obtained based on the conditions in each element of the building structure. The visually assessed and measured components are the foundation, structural columns, structural beams, joint columns, floor plates, roof plates, stair beam plates, ceiling hangers, etc.
c. Utility and Fire Protection Components Assessment
   The utility and fire protection conditions values are obtained based on the conditions in each part of the utility element and building fire protection. There are seven components assessed, including the system of fire prevention devices, vertical transportation, plumbing, electrical devices, air conditioning devices, lightning rods, and communication devices.
d. Accessibility Component Assessment
   The evaluation of this component is more emphasized in the interests of safety, convenience, usefulness, and independence in building facilities utilization. Visually assessed and measured components including the basic parameters of space utilization, pedestrian and ramp paths, parking area, equipment, and its control, public toilets, doors, elevator accessibility, communication, and stairs.
e. Building Layout and Environmental Components Assessment
   Following the principles of arrangement, use, utilization, and management of buildings for their ideal and worthy of function, it is necessary to evaluate the building based on the established regulation. Sub-components of building spatial planning are Building Floor Coefficient (KLB), Green Base Coefficient (KDH), and Building Base Coefficient (KDB). The coefficient value of each component regulated by local regulations, namely Central Aceh Qanun No. 2 of 2016, Regarding Spatial Planning for Central Aceh Regency in 2016-2036.

DOI: 10.22373/ekw.v6i2.6313

Research methods

Data Collection Method

The process of examining and collecting data was carried out by visual inspection, measurement of the condition of existing buildings on critical components of building reliability such as structure, architecture, accessibility, fire protection utilities, building layout, and environment (Trumansyahjaya, 2012).

Step of Data Collection

Data collection techniques were carried out using standard technical guidelines for checking the reliability of buildings in 1998, including:

a. Visual check, without or with the help of digital camera equipment and inspection of damage, especially in damaged parts such as cracks, porous, peeled, pitted, etc. This activity was carried out for all components of each architectural and structural elements.
b. Inspection of existing building drawings. In this study, Asbuilt drawing documents were not available. Thus, all components re-measured to be used for building reliability assessments.
c. Measurement of existing building plans, architectural and structural elements using measuring tape equipment. This measurement conducted by data collection to determine the dimensions of each architectural component and reinforced concrete structures installed in the field.

Analysis Techniques

Data analysis for determining the total reliability of hotel building components, conducted by using the guidance of The Regulation of the Minister of Public Works No. 25/PRT/M/2007 regarding the technical procedure for Certificate of Eligibility Functions (SLF) guidelines, The Regulation of the Minister of Public Works No.29/PRT/M/2006 regarding the instructions for building technical requirements, The centre for research and development of public works department in 2007 regarding evaluation procedures for vertical houses components maintenance. Collected data were analyzed with the descriptive method by determining the calculation value of each component of building construction reliability according to these guidelines. The stages of the study are presented in Figure 1.

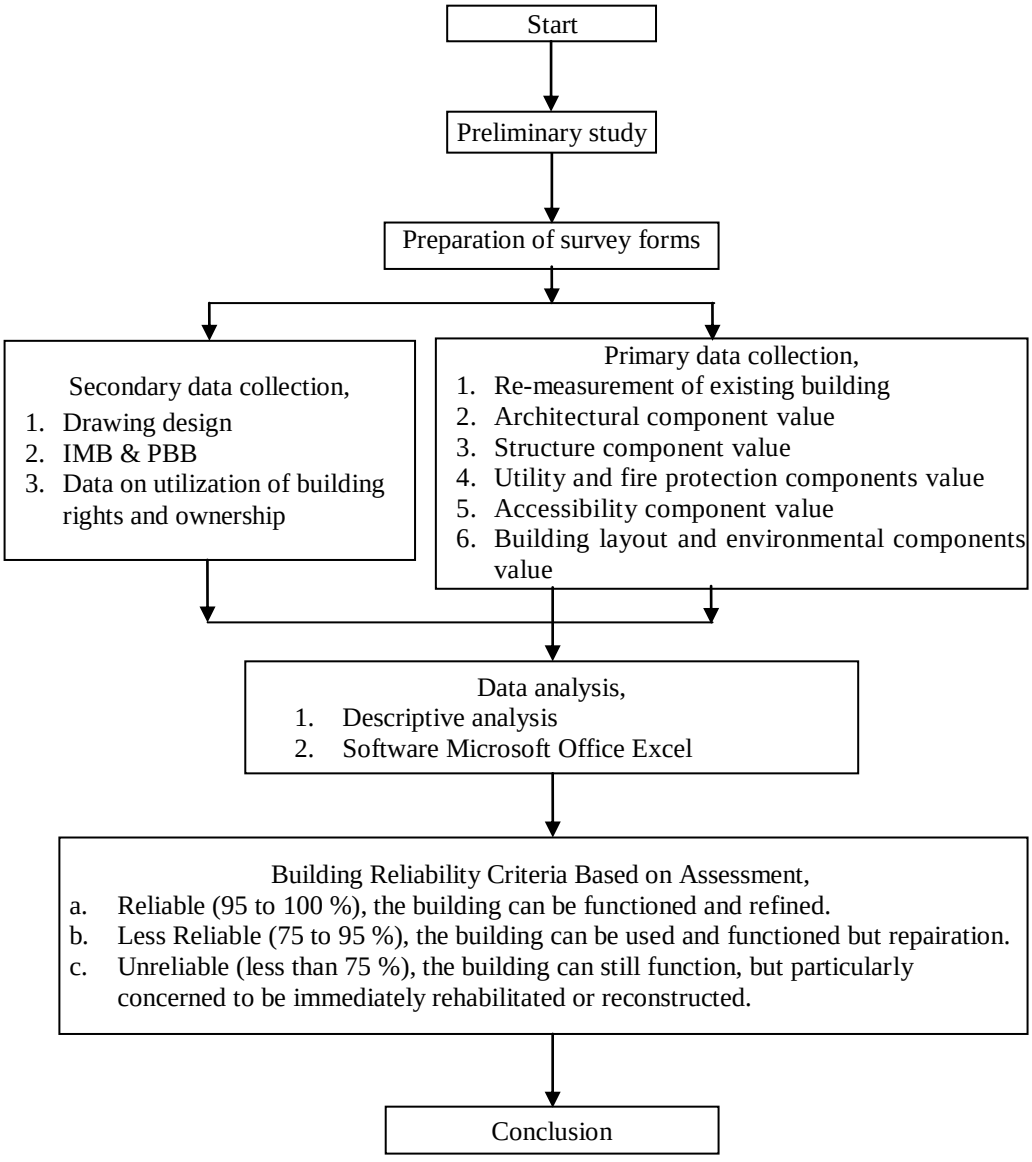

Figure 1. Scheme of research stages

Result and Discussion

Result

Data collection from the measurement of each building reliability component, then the results of data calculation were converted by assessing the ranking scale according to applicable regulations. The values from data analysis were inputted into the building reliability assessment form that is issued and socialized by the Cipta Karya Directorate General of Public Works Department.

Administrative Aspect

In terms of administration, the inspection results for Mahara Hotel building following the Minister of Public Works No. 25/PRT/M/2007 regarding SLF Guidelines for Buildings, as shown in Table 1.

Tabel 1. The administrative aspect of building

Functioning Condition Components	Status
Building Construction Permit (IMB)	Available
Land and Building Tax (PBB)	Available
Detail Engineering Design	Available
Ownership Documents	Available
Operational Permits	Available
Environmental impact assessment	Available
Year of construction	1999

Based on calculation results, the completeness of the Mahara hotel building administration has a good level of administrative order, and it was obtained from an interview with the building owner by showing evidence of all regulatory documents. It can be concluded that the Mahara Hotel building has functional administrative requirements.

Architectural Reliability Assessment Analysis

Table 2 shows the results of the building architecture components calculations, and the values were summed to get the reliability value of the building architecture.

Tabel 2. Architectural reliability value

Components	Condition of each component	The maximum value (%) (Absolute)	Reliability value (%)
Interior 80 %	Use of Room Function	15.00	13.99
	Floor Coating	10.00	9.97
	Floor Plastering	10.00	10.00
	Wallcovering	10.00	9.94
	Wall Plastering	10.00	9.99
	Kusen Pintu dan Jendela	10.00	9.61
	Ceiling Layer	15.00	14.60
	Sub-total	**80.00**	**78.10**
Exterior 20 %	Roof cover	10.00	9.80
	Exterior Wall Surface Coating	2.00	1.04
	Exterior Wall Plastering	0.50	0.41
	Exterior Floor Coating	3.00	3.00
	Exterior Wall Plastering	2.50	2.23
	Ceiling Coating	2.00	2.00
	Sub-total	**20.00**	**18.49**
	Total	**100.00**	**96.59**

Based on the Minister of Public Works Regulation No. 29/PRT/M/2006 regarding guidelines for building technical requirements, architectural reliability plays an important role in the realization of buildings based on environmental characteristics, building design concepts, and regional culture following their environment. The priority in the calculation of architectural components, including

the functional aspects, and interior and exterior conditions become part of determining the comfort in building reliability aspect (Rosalina, 2011).

The result of Mahara Hotel building architectural reliability analysis was **96.59 %** and concluded as a **reliable** architectural category according to the specified reliability value requirements of 95 to 100 %.

A B

Figure 2. A. Overall architectural reliability condition. B. Architectural damage conditions

Utility and Fire Protection Reliability Assessment Analysis

The results of the utility and fire protection reliability of the Mahara Hotel building are listed in Table 3.

Table 3. Utility and fire protection reliability value

	Components	Function			Kmax Reliability (%)	Depreciation Factor ϕ (%)	Reliability value	
		Good	Fair	Poor			Real	K Utility
A	**INSTALLATION OF FIRE PREVENTION SYSTEMS**							
	Fire Alarm System	-	-	-	20.00	0.00	0.00	
	Automatic Sprinkler	-	-	-	20.00	0.00	0.00	
	Extinguisher Gas	-	-	-	20.00	0.00	0.00	
	Hydrant	-	-	-	20.00	0.00	0.00	
	Fife extinguisher	√			20.00	20.00	2.86	
				Total		**20.00**		**3.33**
B	**VERTICAL TRANSPORT**							
	Elevator / Lift : ~~Availabe~~/Not Available	-	-	-	25.00	0.00	0.00	
	Escalator : : ~~Availabe~~/Not Available	-	-	-	25.00	0.00	0.00	
	Stairs; Condition	√			50.00	50.00	7.14	
				Total	**100.00**	**50.00**		**7.14**
C	**PLUMBING**							
	Clean water	√			50.00	37.00	5.29	
	Dirty water	√			50.00	41.40	5.91	
				Total	**100.00**	**78.40**		**11.20**
D	**ELECTRICAL DEVICES**							
	Resources from the National Electric Company (PLN)	√			50.00	43.00	7.14	
	Resources from Generators / Generators	√			50.00	33.00	4.71	
				Total	**100.00**	**76.00**		**11.86**
E	**AIR MANAGEMENT DEVICES**							
	Direct Cooling System	-	-	-	50.00	0.00	0.00	
	Indirect Cooling System	-	-	-	50.00	0.00	0.00	

DOI: 10.22373/ekw.v6i2.6313

	Components	Function			Kmax Reliability (%)	Depreciation Factor ϕ (%)	Reliability value	
		Good	Fair	Poor			Real	K Utility
				Total	**100.00**	**0.00**		**0.00**
F	**LIGHTNING LIFTER DEVICE**							
	Main Installation of Lightning Protection	-	-	-	50.00	0.00	0.00	
	Lightning Protection Installation	-	-	-	50.00	0.00	0.00	
				Total	**100.00**			**0.00**
G	**COMMUNICATION DEVICES**							
	Telephone & Internet	√			50.00	50.00	7.14	
	Sound system (Speaker)	-	-	-	50.00	0.00	0.00	
				Total	**100.00**	**50.00**		**7.14**
	Total Utility and Fire Protection Reliability:							**40.68**

The resulting utility and fire protection components reliability calculation of the Mahara Hotel building was **40.68 %,** concluded as an **unreliable** category since the value was less than 85 % according to the specified reliability value requirements.

A B

Figure 3. Condition of utility and fire protection. A. Lack of lightning protection facilities. B. Lack of fire-fighting sprinkle facilities

Analysis of Structural Reliability Assessment

Table 4 shows the results of building structure reliability components calculation, and these values were summed to get the total value of building structure reliability based on predetermined coefficients.

Table 4. Structural reliability value

	The functioning of Structural Components Condition	Kmax (%)	Realization of Structural Reliability Value
I	**Structure of Main Building Elements**		
	Concrete Foundation Structure	25.00	25.00
	Concrete Structure Column Pole	20.00	17.96
	Concrete Beam Structure	15.00	14.59
	Joint Column - Concrete Beam Structure	15.00	14.03
	Concrete Floor Plates	4.50	4.50
	Concrete Roof Plates	0.50	0.00

DOI: 10.22373/ekw.v6i2.6313

	The functioning of Structural Components Condition	Kmax (%)	Realization of Structural Reliability Value
	Ceiling hanger	5.00	5.00
	Total	**85.00**	**81.08**
II	**Buildings Complementary Element Structure**		
	Plates/Beam of Stairs	6.00	6.00
	Secondary Beam	5.00	4.38
	Óther elements	4.00	4.00
	Total	**15.00**	**14.38**
	Total	**100.00**	**95.45**

The results of Mahara Hotel building structural reliability analysis was **95.45 %**, concluded in a **reliabl**e category according to the specified architectural reliability values of 95 to 100 %.

A B

Figure 4. Structural reliability condition A and B. Damage is in the beam components located in the hotel conference room (deflection and cracking).

Accessibility Reliability Assessment Analysis

Table 5 shows the results of building accessibility components calculations, and these values were summed to get the value of building accessibility reliability.

Tabel 5. Reliability assessment value

Accessibility Components	The maximum value (%)	Factorized Reliability Value (%)
Room size	20.00	20.00
Pedestrian area dan ramp	20.00	0.00
Parking area	20.00	10.40
Tools and equipment	5.00	2.50
Toilet	20.00	16.60
Door	15.00	12.75
Elevator accessibility	0.00	0.00
Telephone	0.00	0.00
Escalator	0.00	0.00
Total	**100.00**	
The total accessibility reliability value		**62.25**

DOI: 10.22373/ekw.v6i2.6313

The result of Mahara Hotel building accessibility reliability analysis was **62.25 %,** concluded as **unreliable** since the value was less than 75 % according to the specified reliability value requirements.

Building Layout and Environmental Reliability Assessments Analysis

The calculation of building layout and environmental reliability assessments analysis adapted to Qanun of Central Aceh District No. 2 of 2016, regarding the Central Aceh Regional Spatial Planning 2016-2036. Based on the qanun or regional regulation, the value of each component is 40 % for the Building Base Coefficient (KDB), 0 – 60 % for the Building Floor Coefficient (KLB), and a minimum of 30 % for the Green Base Coefficient (KDH). The results of the data analysis shown in table 6.

Table 6. Building layout and environmental reliability value

Components	Available	Not available	Maximum Value (Absolute)	Reliability	Reliability value
Compliance with urban planning administration					
Building Base Coefficient (KDB)	√		2.00	2.00	100
Building Floor Coefficient (KLB)	√		2.00	2.00	100
Green Base Coefficient (KDH)	√		1.00	1.00	100
Total value					**100.00**

The result of building layout and environmental reliability analysis of Mahara Hotel building was 100 %, concluded as a **reliable** category according to the reliability value requirements that had been set at 95-100 %.

Total Reliability Value of Building

Table 7 shows the overall results of the Mahara Hotel building reliability components assessment.

Table 7. Recapitulation of total reliability value

Aspect/Component	Criteria of Reliability (Absolute)						Percentage (%)	Total Reliability Value (%)
	Reliable	K-value	Less Reliable	K-value	Not Reliable	K-value		
Architecture	95 - 100	96.59	75 - < 95		< 75		10.00	9.66
Structure	95 - 100	94.13	85 - < 95		< 85		30.00	28.64
Utility, fire protection	95 - 100		75 - < 95		< 95	40.68	50.00	20.34
Accessibility	95 - 100		75 - < 95		< 75	62.25	5.00	3.11
Building layout and environment	95 - 100	100.00	75 - < 95		< 75		5.00	5.00

DOI: 10.22373/ekw.v6i2.6313

Aspect/Component	Criteria of Reliability (Absolute)						Percentage (%)	Total Reliability Value (%)
	Reliable	K-value	Less Reliable	K-value	Not Reliable	K-value		
Total							**100.00**	**66.75**
Building Reliability Value							**Unreliable**	

Mahara Hotel building total reliability analysis was 66.75 %, concluded as an **unreliable** category since the minimum value required in the total building reliability is 75 %. However, buildings can still be used and function because architecture, structure, building layout, and environment were categorized as **reliable,** and the security, safety, and comfort of the building remain in proper condition.

Discussion

The value of each component reliability of Mahara Hotel building can be used as an indicator of whether Mahara Hotel building management needs to be followed up to improve aspects of each component, which does not meet the requirement of building reliability. This case especially in the elements of utility and fire protection and accessibility. Although the results of Mahara Hotel building, structural reliability assessment were categorized as **reliable (94.13 %)**, however, it is necessary to maintain and repair some parts of the structure. Based on crack data that occurs in several parts of the beam structure of the 2nd-floor meeting room, repairation should be done immediately. Several repairation methods, i.e., crack epoxy injection and Carbon Fiber Reinforcement Polymer (CFRP), can be utilized as an alternative (Antonius et al., 2009; Budio et al.). However, this type of improvement is only for restoring the initial conditions, not for changing or increasing the strength of the structure itself.

Conclusion

Based on the results of Mahara Hotel building reliability analysis, it can be concluded that the reliability of building administrative aspects is following the provisions, but the building technical factors reliability only **66.75 %,** which categorized as **unreliable** since the value was below specified reliability requirements of <75 %. Although the total reliability value was classified as unreliable, the operational of the Mahara Hotel building can still be used and functioned because the reliability value of architecture, structure, building layout and environment were included in the reliable category. The improvement of utility and accessibility components can be conducted for improving the building reliability.

Reference

Antonius, P. H., & Hadin, M. (2009). Studi Kelayakan Struktur, Lingkungan, dan Mekanikal Elektrikal Pada Bangunan Publik Di Semarang [Laporan Penelitian Berorientasi Publik]. Semarang. Universitas Islam Sultan Agung.

Budio, S. P., Anggraini, R., Zacoeb, A., & Wahyuni, E. (2015). Analisis Kapasitas dan Keandalan Bangunan, Studi Kasus : SMA 1 Madiun. *Jurnal Rekayasa Sipil*. *9*(1). 1978-5658.

Kementerian Pekerjaan Umum. (2005). Peraturan Pelaksanaan Undang-Undang Nomor 28 Tahun 2002. Jakarta: Penulis. Accessed from http://ciptakarya.pu.go.id/dok/hukum/pp/pp_36_2005.pdf.

Kementerian Perkerjaan Umum. (2005). Tentang Pelaksanaan Pemeriksaan Bangunan Gedung Nomor 36 Tahun 2005. Jakarta: Penulis. Diakses dari https://www.scribd.com/doc/221850291/Pemeriksaan-Keandalan-Bangunan-Gedung.

Kementerian Pekerjaan Umum. (2007). Panduan Teknis Tata Cara Pedoman Sertifikat Laik Fungsi Bangunan Gedung Nomor : 25 Tahun 2007. Jakarta: Penulis. Accessed from https://greenbuilding.jakarta.go.id/files/regulations/permenpu-25-2007-slf.pdf.

Kementerian Pekerjaan Umum. (2006). Pedoman Persyaratan Teknik Bangunan Gedung Nomor 29 Tahun 2006. Jakarta: Penulis. Accessed from http://pustaka.pu.go.id/biblio/peraturan-menteri-pekerjaan-umum-nomor-29prtm2006-tentang-pedoman-persyaratan-teknis-bangunan-gedung /547DL.

Mulyandari, Hestin, Saputra, A., & Rully, (2010). Pemeliharaan Bangunan: Basic Skill Facility Management. Yogyakarta. Penerbit Andi.

Rambe, Y. F. S. (2017). Analisa Keandalan Fisik Bangunan Gedung (Studi Kasus: Gedung Departemen Teknik Sipil Fakultas Teknik Universitas Sumatera Utara [Skripsi]. Medan. Universitas Sumatera Utara.

Rosalina. (2011). Sistem Pemeliharaan Gedung Ditinjau Dari Keandalan Bangunan Gedung (Studi Kasus: Gedung Rumah Susun Sederhana Sewa Di Kabupaten Cilacap) [Tesis]. Surakarta. Universitas Sebelas Maret.

Trumansyahjaya, K. (2012). Pemeriksaan Keandalan Bangunan Gedung Di Universitas Negeri Gorontalo [Tesis].Gorontalo. Universitas Gorontalo.