ASTONJADRO: Jurnal Rekayasa Sipil

pISSN 2302-4240
eISSN 2655-2086

Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

ANALYSIS OF STRUCTURE RELIABILITY OF UTSMAN BIN AFFAN BUILDING (Case Study: Sekolah Islam Terpadu Aliya Bogor)

Muhamad Lutfi, Ayub Maulana
Program Studi Teknik Sipil, Universitas Ibn Khaldun Bogor, Indonesia
E-mail: lutfim97@gmail.com , ayub.maulana95@gmail.com

ABSTRACT

Indonesia's tectonic conditions at the meeting of the world's large plates and several small plates that cause the area associated with earthquakes, based on data from the Bogor City Disaster Mitigation, Bogor City is located in an earthquake prone area. Sekolah Islam Terpadu Aliya Bogor is located at Jalan Gardu Raya No. 03, Bubulak, Kecamatan Bogor Barat, Kota Bogor. This study evolved the structure of the school building in terms of the structure of the column and beam elements for the safety and security of its inhabitants. The buildings analyzed were Utsman Bin Affan building TK A and TK B which functioned as places for learning and teaching. The research method starts by analyzing the existing conditions, checking the quality of the concrete, then analyzing the structure using the help of the ETABS V9.7.4 program, and analyzing the column structure using the spColumn program. Structural modeling published in SNI 1727-2013 (concerning loading), SNI 2847-2013 (concerning concrete structure requirements), SNI 1726-2012 (regarding earthquake repair planning), and PPIUG-1983 (concerning Indonesian loading regulations for buildings). The results of the analysis of the Utsman Bin Affan building with 2-story building specifications column dimensions 25 x 25 cm, beams 20 x 40 cm, column concrete quality fc '= 24.74 MPa, concrete beam quality fc' = 26, 59 MPa, principal reinforcement D16 with fy = 390 MPa, shear reinforcement Ø10 Fy = 240 MPa, the results of analysis of existing columns and beams are in accordance with the requirements of SNI 2847-2013, based on that the buildings are approved, and the result of analysis beams does not exceed strength (O / S)..

Keyword: school building, discussing the upper structure, concrete.

Received:	Revised:	Accepted:	Available online:
2020-06-24	2020-07-28	2020-11-10	2020-11-18

INTRODUCTION

Indonesia's tectonic condition lies in the meeting of the world's large plates and some of the small plates that cause the area to potentially experience many earthquake events, based on data from Mitigasi Bencana Kota Bogor, Bogor city located in earthquake prone areas. Sekolah Islam Terpadu Aliya Bogor building is located at Jalan Gardu Raya No. 03, Bubulak. In designing a building structure must meet the requirements that apply in order to create a structure that is sturdy, safe and has durability. One of the requirements that must be met is that in terms of the burden stipulated in the Indonesian Burdening Regulation for Buildings issued in 1983, buildings must also have strong resistance to earthquake loads referring to SNI-1726-2012 on "Earthquake Resilience Planning System for Building Buildings, Indonesia Earthquake Hazard Resource Map 2017 and SNI 2847-2013 on "Structural Concrete Requirements for Building Buildings".

Based on this, this study analyzes the reliability of the structure over the building in terms of column structure elements, beams, and plates to ensure the safety and security of its occupants. The building that is analyzed is the building of Utsman Bin Affan which has 2 buildings namely kindergarten building and kindergarten B which is functioned as a place to study and teach.

Muhamad Lutfi & Erwin Surandi, 2019, evaluation of the structure of the shophouse building due to the addition of roof load in the form of mini tower 25M calculation method used by Sistem Rangka Pemikul Momen Biasa (SRPMB). Modeling of building structures using ETABS software this research refers to the standardization of

SNI-1726-2012, SNI-2847-2013, and PPIUG-1983.

Agung Prabowo & Muhamad Lutfi, 2020, analysis of school building structure due to the addition of new classrooms (study case at SMK Bina Putera Kota Bogor), for analysis modeling using ETABS V9.5.0 software, this research refers to the standardization of SNI 03-2847-2002, SNI 031726-2012, and SNI 1729-2015. In this analysis are made 3 stages, first the initial conditions on existing buildings, the second analysis of existing structures with additional loads of new classrooms, and the third analysis with additional load and structure strengthening.

Badaruddin, 2015, evaluation of the reliability of the structure of the Sumbawa Bupati office building. This research discusses the reliability of the structure of sumbawa Bupati office building because of its important function for the Regent's Office as a community service center and control center of Sumbawa Regency, this research refers to the standardization of SNI 03-1726-2012 and for structural analysis using SAP2000 program.

Sartika dkk, 2017, analysis of reinforced concrete building structure based on SNI 2847-2002 and SNI 2847-2013

(Case study: Gedung C Rumah Sakit Ibu Dan Anak "Rona" Pangkal pinang). This study compared the differences in analysis results between SNI 2847-2002 and SNI 2847-2013.

1) Building realiability

According to Law No. 28 of 2002, the reliability of buildings must meet the requirements of safety, health, comfort and convenience. Safety requirements namely the ability of stable and robust building structures in supporting load loads is the ability of stable and robust building structures up to maximum loading conditions in support of live load loads and dead loads, as well as for certain areas/zones the ability to support load loads arising from natural behavior.

2) Column

In a building construction, columns serve as supporting loads of beams and plates to be passed to the ground through the foundation. The load of these beams and plates is an axial press load as well as a bending moment (due to construction continuity). So that a column can be defined is a structure that supports axial load with/without bending moments (Asroni,2010).

3) Beams

The beam is one of the elements of the portal structure with a horizontal directional landscape, while the portal is the main framework of the structure of the building, especially the building. The load that works on the beam is usually a bending load, shear load or torque (twist moment), so it is necessary for the retaining steel to withstand those loads. The bone is an elongated or longitudinal bone that withstands bending loads and shear/begel bones that withstand shear load and torque (Asroni, 2010).

4) Plate

Reinforced concrete plate is a thin structure made of reinforced concrete with horizontal direction and load that works perpendicularly the field of the structure (Asroni, 2010). Based on the repeating system the plate consists of one-way plate repetition and two-way plate repetition.

5) *Hammer Test*

Quality inspection of concrete without damaging concrete is obtained by hammer test method, this method is used to test and evaluate the hardness of the concrete surface. The tool is very sensitive to the variations that exist on the concrete surface, therefore it is necessary to take several measurements around the site, the result of which is then averaged. British Standards (BS) indicates taking between 9 to 25 measurements per test area of a maximum area of 300 mm2 (Lutfi & Subtoni, 2017); (Muhamad L, Bagus NZ, 2020).

ASTONJADRO: Jurnal Rekayasa Sipil
pISSN 2302-4240
eISSN 2655-2086
Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

In the analysis of existing structure there are several parameters used according to Asroni (2010), including:

1) $Rr \geq Ru$
(1)

Strong plan Rr is the strength of the inside force (inside the structure), whereas strong need Ru is the force of the outer force (outside the structure), which works on the structure, then the Rr plan quarar must be greater than strong need Ru.

Description :

Rr : Strong plan

Ru : Strong needs

2) $Ø\ Mn \geq Mu$
(2)

Description :

Ø : Reduction Factor

Mn : Momen Nominal

Mu : Momen Ultimit

3) $Ø\ Vn \geq Vu$
(3)

Description:

Ø : Reduction Factor

Vn : Momen Nominal

Vu : Momen Ultimit

LRFD design beam prisoners according to Setiawan (2013) must meet the requirements :

$Ø\ b.Mn > Mu$
(4)

Ø b : 0,90

Mn : Nominal Moment Prisoners

Mu : Bending moments due to factored loads

RESEARCH METHODS

The research site is located at Jalan Gardu Raya No. 03, Bubulak, Kecamatan Bogor Barat Kota Bogor. The research period starts from March 2020 to June 2020. The stages carried out in this study are the first literary studies that are the first step in conducting research, references used books, thesis, thesis, journals, and research data related to the title of the study, the second the collection of primary data in the form of working images describing the condition of existing buildings and the third is the strong testing of hammer test concrete press. This research method is based on the condition of the existing structure by analyzing the reliability of the structure of the school building in terms of the structure of column elements and blocks of SIT Aliya bogor school building,

especially Utsman Bin Affan building which has two buildings including kindergarten building and kindergarten building B. The next step is to analyze the structure using the help of ETABS V9.7.4 program, depiction of construction of existing buildings using Autocad 2007 , and analyze existing column structures using the spColumn program. Structural modeling refers to the standardization of SNI 1727-2013 (on charges), SNI 2847-2013 (on concrete structure requirements), SNI 1726-2012 (on earthquake resistance planning), and PPIUG-1983 (about Indonesia's burdening regulations for building buildings).

Step Or Flow Chart Research

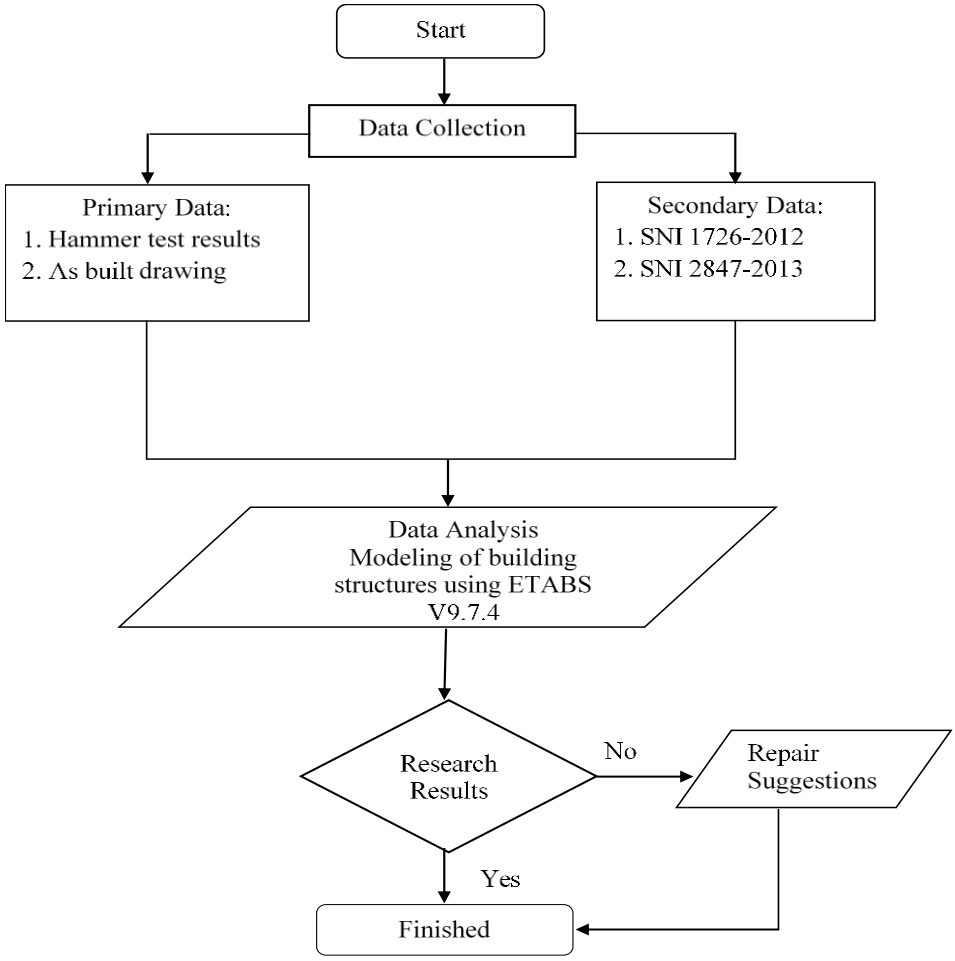

Figure 1. Research flow chart

RESULTS AND DISCUSSIONS

1) Analysis of Existing structure

The results of a direct-to-site review by collecting information about existing buildings can be seen in images 2-11, with the following data :

a) Building functions = School buildings

b) Number of floors = 2 floors

c) Number of buildings = 2 (TK A and TK B)

d) Floor notation = 1st floor given Base notation

pISSN 2302-4240
eISSN 2655-2086

Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

= 2nd floor given Story notation

e) Column dimensions = K 25 x 25 cm

f) Beam dimensions = B 20 x 40 cm

g) 2nd floor plate thickness = 12 cm

h) Quality concrete column = K-286 (fc' = 24,74 MPa)

Modulus column elasticity = 22900,14

Quality of concrete beams and plates = K-320 (fc' = 26, 59 MPa)

Modulus elasticity of beams and plates = 24235,78

The quality of concrete can be found from the test results using Hammer Test.

Mutu Steel quality = Fy 390 MPa (BJTD 400)

= Fy 240 MPa (BJTP 240)

Figure 2. Hammer test Source : Personal data

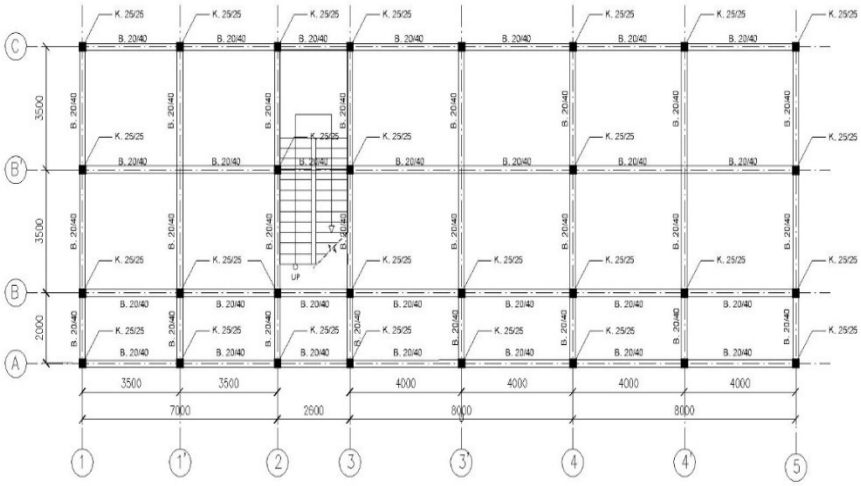

Figure 3. Floor plan of columns and building blocks TK A Source : Personal document image

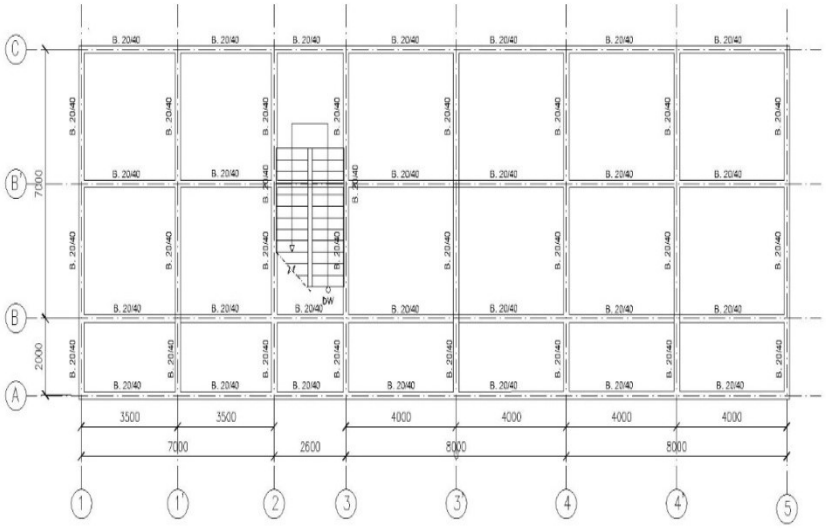

Figure 4. Building ringbalk floor plan TK A Source : Personal document image

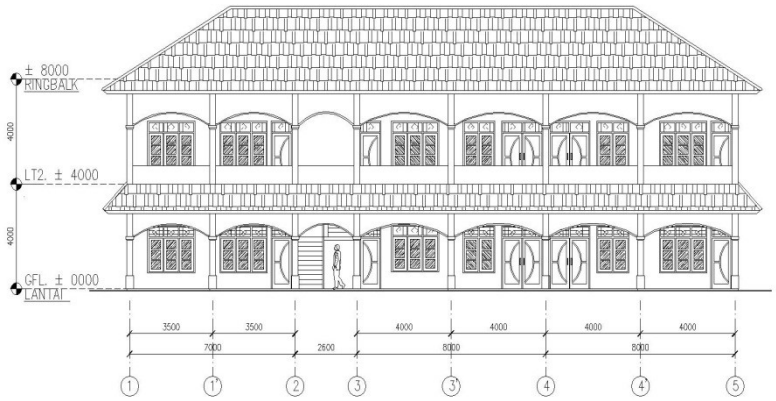

Figure 5. Front of the building TK A Source : Personal document image

ASTONJADRO: Jurnal Rekayasa Sipil

pISSN 2302-4240
eISSN 2655-2086

Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

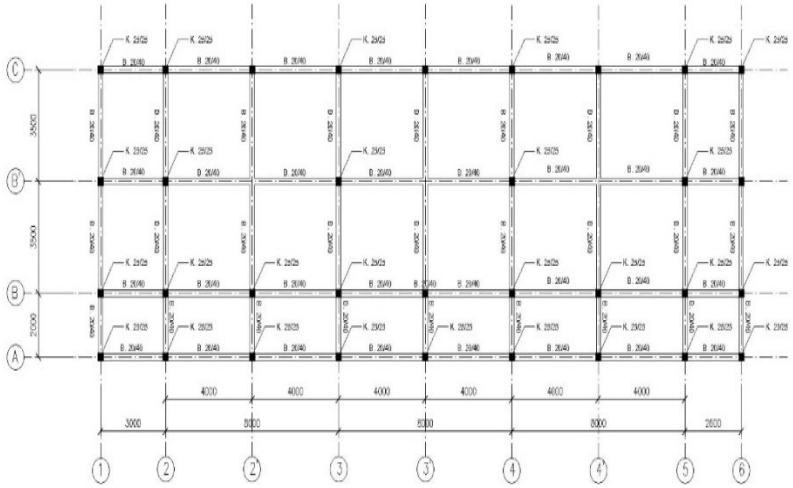

Figure 6. Floor plan of columns and building blocks TK B Source : Personal document image

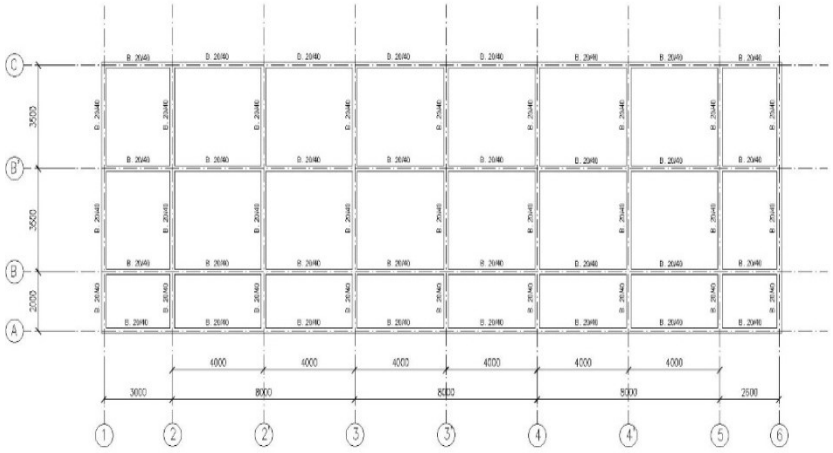

Figure 7. Building ringbalk floor plan TK B Source : Personal document image

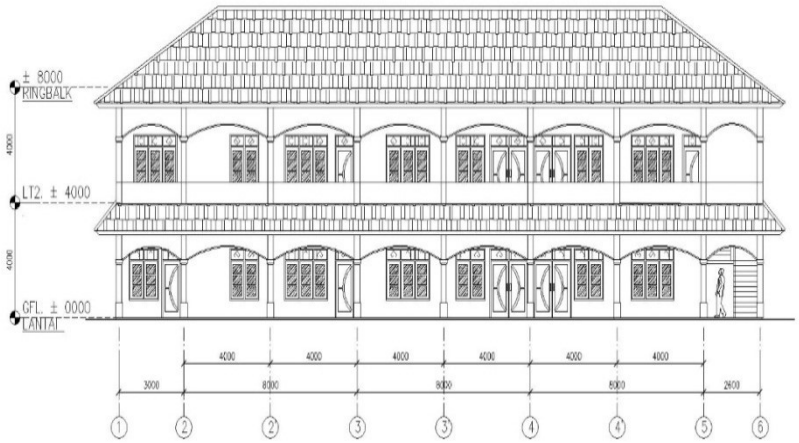

Figure 8. Front of the building TK B Source : Personal document image

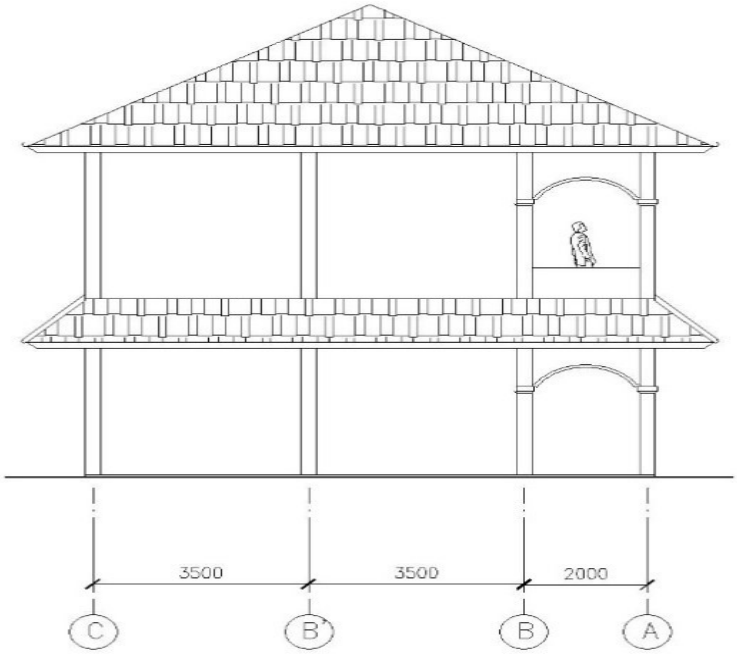

Figure 9. Side view of the building TK B Source : Personal document image

From existing data can then be modeled with Software ETABS V9.7.4, shown in figure 10 and figure 11.

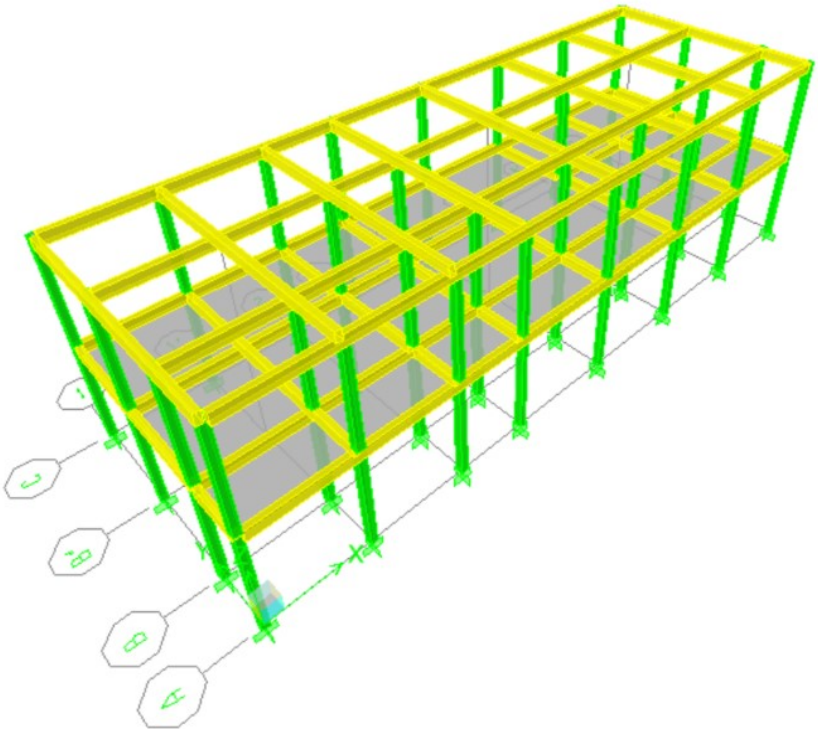

Figure 10. Modeling of existing structures of buildings TK A Source: ETABS V9.7.4

ASTONJADRO: Jurnal Rekayasa Sipil
pISSN 2302-4240
eISSN 2655-2086
Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

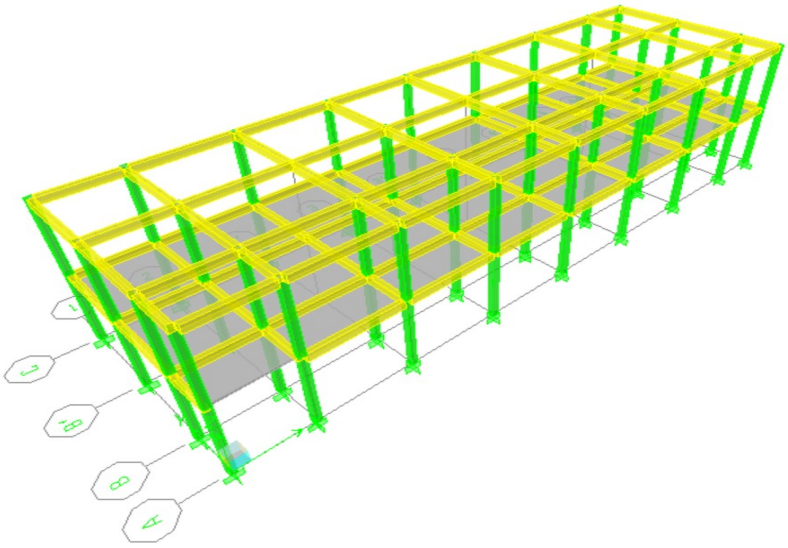

Figure 11. Modeling of existing structures of buildings TK B Source: ETABS V9.7.4

Dead Load and Life Burden

The analysis is carried out by entering the load data, i.e. the dead load and the life burden that works on the structure of the building can be seen from Table 1 below.

Table 1. Dead loads and life burdens

No	Dead loads	
1	- Flooe 2	
	Ceramic weight	= 24 kg/m^2
	Weight of stirring	= 2 x 21 kg/m^2
		= 42 kg/m^2
	Red brick walls	= h = 4 m
		= 900 kg/m^2
	Red brick walls	= h = 0,7 m
	(selasar Lt.2)	= 175 kg/m^2
2	- Roof	
	Floor School, Spaces Lecture	= 250 kg/m^2
	Life Burden	
3	- Floor 2	
	Floor School	= 250 kg/m2

Earthquake Load

The magnitude of the earthquake load is determined by the acceleration of the earthquake plan and the total mass of the structure. The total mass of the structure consists of its own weight of structural elements, dead load and life load multiplied by a reduction factor of 0.8. The acceleration of the earthquake taken from the map of the earthquake area (SNI 03-1726-2012) is shown in Figure 12, the curve of the earthquake spectrum plan taken according to the research site shown in Figure 13.

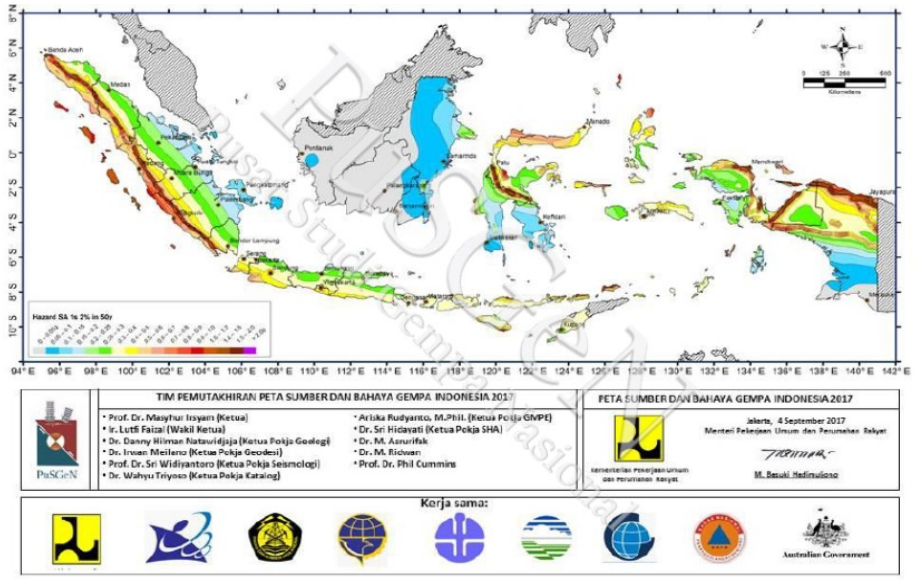

Figure 12. Earthquake zoning map Source: Pusat studi gempa nasional, (2017)

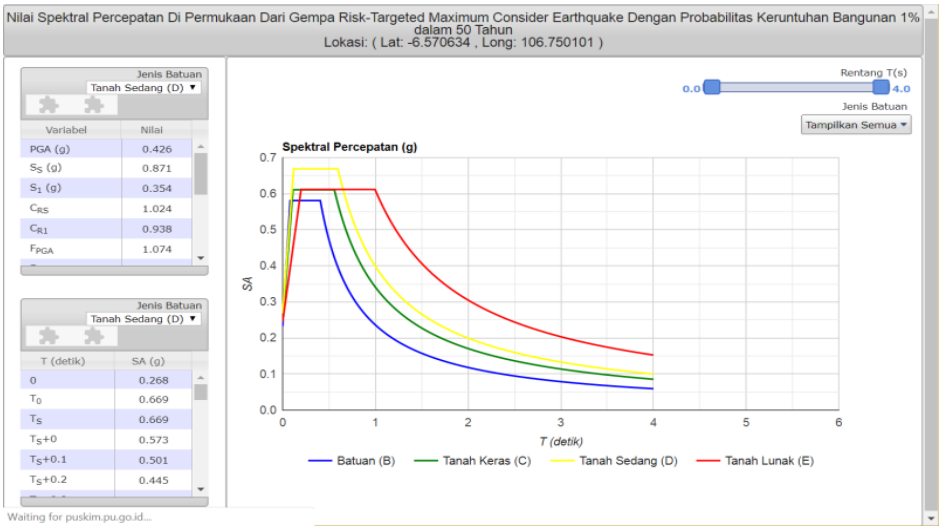

Figure 13. Curve spectrum earthquake plan Source: Pusat studi gempa nasional, (2017)

The result of the analysis of the existing structure of Utsman Bin Affan building (TK A and TK B) based on the calculation of the repetition of columns and beams with the combination of the burdeninputed in the program ETABS V9.7.4. The analysis of building TK A is shown in figure 14 and building TK B figure 15.

ASTONJADRO: Jurnal Rekayasa Sipil
pISSN 2302-4240
eISSN 2655-2086
Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

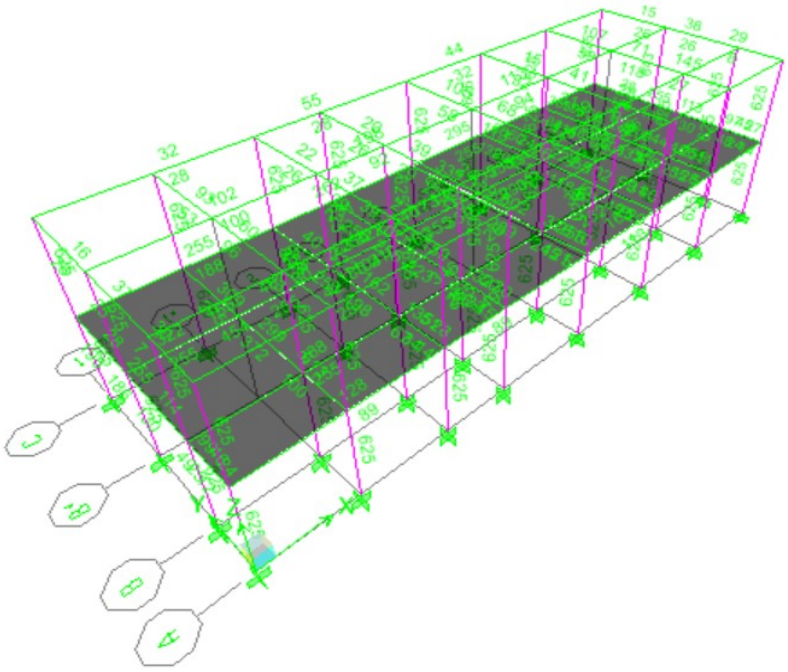

Figure 14. Results of analysis of building structure elements TK A Source: ETABS V9.7.4

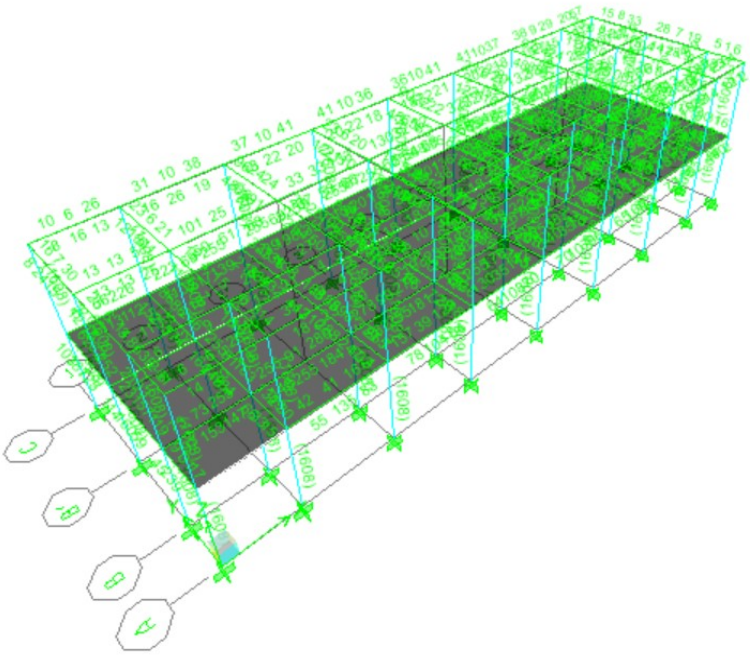

Figure 15. Results of analysis of building structure elements TK B Source: ETABS V9.7.4

Then the calculation is done with ms. Excel application formula to get the maximum load value and moment. The calculation of load and maximum moments in Ms. Excel is shown in table 2.

Table 2. Maximum column load moment 25 x 25 cm

Max Axial				
Maximum Axial Force	=	-26431,57 kg	=	278,83 kN
My	=	-865,23 kg.m	=	8,49 kN.m
Mz	=	44,62 kg.m	=	0,44 kN.m
M	=	866,38 kg.m	=	8,50 kN.m
Max Moment				
Axial Force	=	-17140,19 kg	=	168,09 kN
Maximum Mz	=	-1899,34 kg.m	=	18,63 kN.m
My	=	199,34 kg.m	=	1,95 kN.m
Axial Force	=	-19302,94 kg.m	=	189,30 kN.m
Mz	=	-39,08 kg.m	=	0,38 kN.m
Maximum My	=	-2297,32 kg.m	=	22,53 kN.m

To find the value of the column interaction chart used by the spColumn application, by entering the calculation result value based on Table 2. By looking at the results of the interaction chart in Figure 16 shows an existing 25x25 cm column capable of withstanding axial and momental styles and being declared safe because your and Pu's maximum values are in the strong plan.

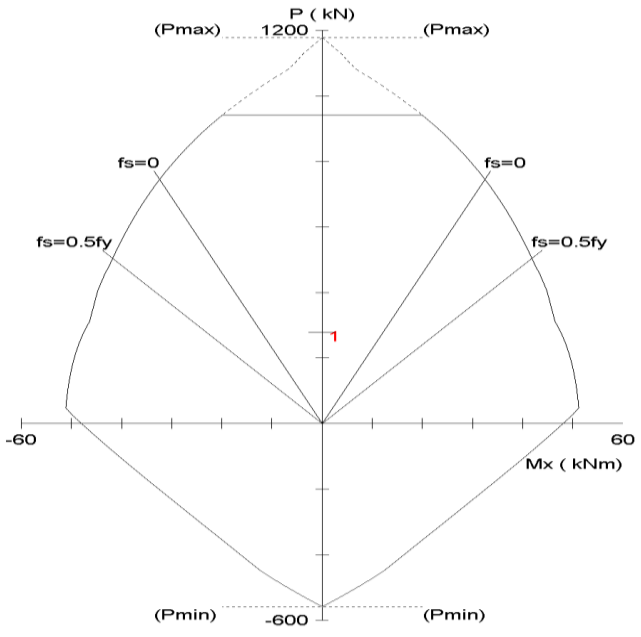

Figure 16. 25 x 25 cm column interaction diagram Source : Results of personal analysis

ASTONJADRO: Jurnal Rekayasa Sipil
pISSN 2302-4240
eISSN 2655-2086
Volume 9, No. 2, Desember 2020, Halaman 93-106
DOI: 10.32832/astonjadro.v9i2.3111

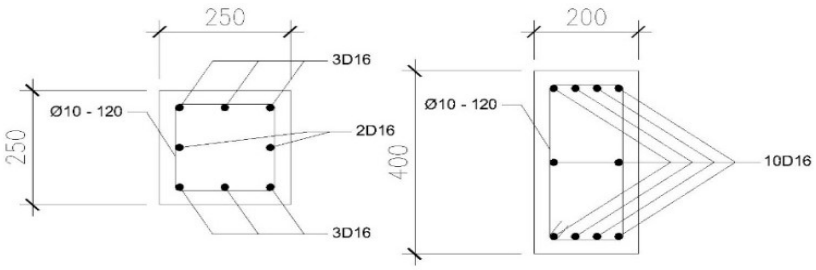

Figure 17. Details of repetition of existing columns and beams Source : Results of personal analysis

CONCLUSION

Based on analysis and language, by modeling using ETABS V9.7.4 program on the building of Sekolah Islam Terpadu Aliya Bogor, especially Utsman Bin Affan building (TK A and TK B) located at Jalan Gardu Raya No. 03, Bubulak, Kecamatan Bogor Barat Kota Bogor, with building specifications 2 floors column dimensions 25 x 25 cm, beam dimensions 20 x 40 cm, concrete quality column K-286 (fc' = 24.74 MPa) , the quality of concrete beams and plates K-320 (fc' = 26, 59 MPa), the main reinforcing D16 with fy=390 Mpa, shearing hear Ø10 Fy = 240 MPa, obtained the following conclusions, the elements of the column and beam structure on the 1st and 2nd floors of the Utsman Bin Affan building (TK A and TK B) are strong and safe against earthquake loads and gravitational loads are characterized by column structure elements, and none of the analysis beams are over strength (O/S)). Utsman Bin Affan building is declared reliable in terms of column and beam structure elements.

REFERENCES

Asroni, Ali. 2010. Kolom, Fondasi dan Balok “T” Beton Bertulang. Graha Ilmu. Yogyakarta. (Indonesian).

Asroni, Ali. 2010. Balok dan Plat Beton Bertulang.Graha Ilmu. Yogyakarta. (Indonesian).

Asroni, Ali. 2017. Teori dan Desain Balok Plat Beton Bertulang Berdasarkan SNI 2847-2013. Surakarta. (Indonesian).

Badaruddin. 2015, Evaluasi Keandalan Struktur Gedung Kantor Bupati Sumbawa, (Unsa progress Vol.72 No. 22 April 2015). (Indonesian).

Lutfi, Muhamad dan Erwin Rusandi 2019, Evaluasi Struktur Bangunan Ruko Akibat Penambahan Beban Atap Berupa Mini Tower, Astonjadro: Jurnal Sipil, vol 8, no. 2, hh. 87-96. (Indonesian).

Lutfi, Muhamad dan Subtoni 2017, Kajian Struktur Bangunan Akibat Penurunan Mutu Beton Pada Kolom Terpasang (Studi Kasus: SDN 01 Cikaret Kabupaten Bogor), Astonjadro: Jurnal Rekayasa Sipil, vol. 6, no. 2, hh.115-129. (Indonesian).

Lutfi, M, H. Arien, M. Hendrawati, P. J. Ramadhansyah, dan N. I. Ramli. 2020. Assessment of Safety Performance Level on Simple Urban Residential Building : Case Study at Bogor City Indonesia. Jurnal IOP Conference Series: Materials Science and Engineering **712** (2020) 012004, Hal 1-7.

Mujihutami, S, A. dan Lutfi, M. 2020, Evaluasi Struktur Tondon Air di Kelurahan Sukaresmi Kecamatan Tanah Sereal Kota Bogor, Jurnal Manajemen Aset Infrastruktur & Fasilitas – Vol. 4, No.2, April 2020. (Indonesian).

Prabowo, A. dan Lutfi, M. 2020, Analisis Struktur Bangunan Gedung Sekolah akibat Penambahan Ruang Kelas Baru (studi Kasus di SMK Bina Putera Kota bogor), Jurnal Manajemen Aset Infrastruktur & Fasilitas – Vol. 4, No.2, April 2020. (Indonesian).

Sartika dkk, 2017, Analisis Struktur Gedung Beton Bertulang Berdasarkan SNI 2847-2002 dan SNI 2847-2013, Jurnal Fropil, Vol 5 Nomor 1 Jan-Jun 2017. (Indonesian).

Setiawan, A. 2016, Perancangan Struktur Beton Bertulang (Berdasarkan SNI 2847:2013, Erlangga, Jakarta. (Indonesian).

SNI 2847-2013, Persyaratan Beton Struktural untuk Bangunan Gedung, Badan Standarisasi Nasional, Indonesia. (Indonesian).

SNI 1727-2013, 2013, Beban Minimum untuk Perancangan Bangunan Gedung dan Struktur Lain, Badan Standarisasi Nasional, Indonesia. (Indonesian).

SNI 1726-2012, 2012, Tata Cara Perencanaan Ketahanan Gempa untuk Struktur Bangunan Gedung dan Non Gedung, Badan Standarisasi Nasional, Indonesia. (Indonesian).

SNI 03-4430-1997, 1997, Metode Pengujian Elemen Struktur Beton dengan Alat Palu Beton Tipe N dan NR, Badan Standarisasi Nasional, Indonesia. (Indonesian).

Tim Pusat Studi Gempa Nasional 2017, Peta Sumber Gempa dan Bahaya Gempa Indonesia Tahun 2017, Pusat Penelitian dan Pengembangan Perumahan dan Permukiman Badan Penelitian dan Pengembangan Kementerian Pekerjaan Umum dan Perumahan Rakyat, Bandung. (Indonesian).

UU 28/02. Undang-Undang Nomor 28 Tahun 2002 tentang Bangunan Gedung. (Indonesian).

Wuryanti, Wahyu 2013, Penilaian Keandalan Struktur Bangunan Gedung eksisting: Peraturan dan Implementasinya, Konferensi Nasional Teknik Sipil 7 (koNTekS 7), Surakarta.(Indonesian).

Muhamad Lutfi, Bagus Nurzein Syaifullah. 2020. ANALISIS KELAYAKAN BANGUNAN GEDUNG PASAR SUKASARI BOGOR MELALUI PENDEKATAN LAIK FUNGSI BANGUNAN, ASTONJADRO: Jurnal Rekayasa Sipil, Vol. 9, No. 1, hal. 14-23. (Indonesian). http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO/article/view/2726/1797