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Evaluation of the Top Structure at PT. Sam Kyung Jaya Busana Factory Building Based on P-M-M . Ratio Capacity Value

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Abstract. Factory buildings that have been erected or built and have been used in their daily lives by many people need a thorough structural evaluation. Evaluation of the structure is important because it involves the safety of the occupants in it. Factory Building PT. Samkyung Jaya Clothing is one of the areas where the existing structure has not been analyzed, the building is composed of gording elements, rafter beams, rafter columns, sloof beams and other supporting elements. Factory Building PT. Samkyung Jaya Clothing made of steel with BJ-37 quality, the main building plan measuring 150x90 meters, with a total height of 14.45 meters, rafters using castellated beam WF. 150x175x7x11, rafter columns use 4 types of shapes, and pedestal columns and foundations also have 4 types of shapes, as well as sloof beams there are 2 types, namely 400x200 and 300x150 millimeters. The analysis uses 2 types, namely conventional calculations and computations that use the ETABS V.20.0 program. The results of the evaluation using ETABS V.20.0 there are several points in the pedestal column that experienced warnings such as columns P1 and P2, column K1 also experienced the same thing, namely Column factored axial load exceeds Euler Force and Capacity ratio exceeds limit where the ratio range is 0.5 - 1.518. The purlin cross section also experiences Capacity ratio exceeds where the ratio is more than one, namely 1.169 and 1.666. Added reinforcement is the main thing, which can use the jacketing or retrofitting method.

Keywords: Evaluation of the structure, purlin, rafter beams, rafter column, pedestal column, ETABS V20.0.

1. Introduction

Boyolali Regency is an area which, when viewed in the Seismic Design Category of SNI-1726-2019 [1], is an area that has category D, this is an area that has a high SD value, therefore it is a factor why buildings in the area must be inspected to ensure that the structure is checked. safety can be maintained. Factory Building PT. Sam Kyung Jaya Busana is one of the buildings located in Dukuh Tiris, RT. 1 / RW. 12, Candi Village, Kec. Ampel, Boyolali Regency, Central Java, the structure of the building is composed of a steel frame, and has been standing for several years, so the building will be thoroughly evaluated

(a)

(b)

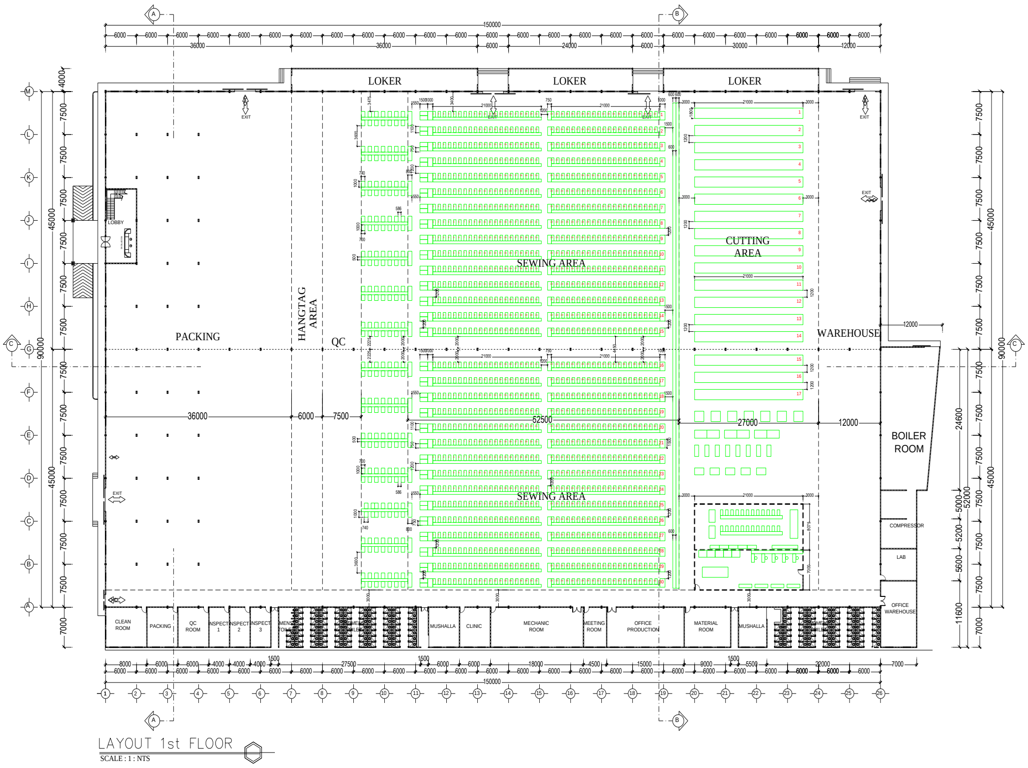
Figure 1. (a) & (b) Front view of PT. Sam Kyung Jaya Busana

2. Methods

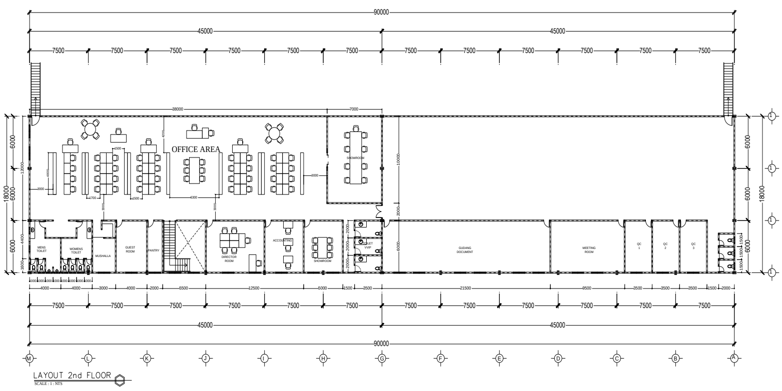
The method that will be used in this evaluation consists of several stages, namely data collection, data analysis, modeling on ETABS V.20.00, modeling analysis, evaluation and conclusions, the following will be described in full according to the stages.

2.1. Collecting of Technical Data

There is data that will be used in the evaluation, including the main building plan and the dimensions of its constituent elements, which we present in full below. The floor plan of the main building measures 150x90 meters, with a maximum building height of 14.45 meters.



(a)



(b)

Figure 2. (a) & (b) The plan of the main factory building on the first and second floors

Table 1. The constituent elements of the factory building of PT. Sam Kyung Jaya Busana

No.	Type of Element	Dimension
1.	Purlin Type-1	CNP. 100.50.20
2.	Purlin Type -2	CNP. 150.50.20
3.	Column Rafter K1	WF. 350.175.7.11
4.	Column Rafter K2	WF. 250.125.6.9
5.	Column K3	WF. 200.100.5,5.8

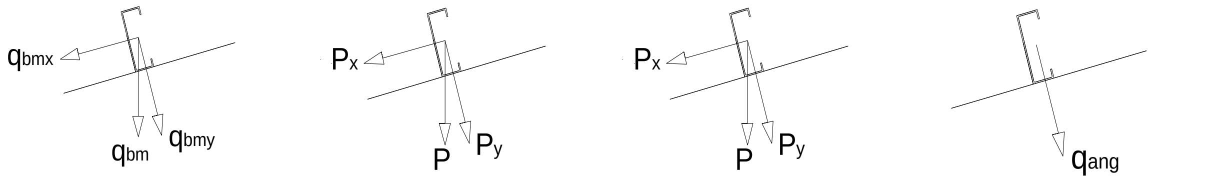
6.	Beam B1	WF. 300.150.6,5.9
7.	Beam B2	WF. 250.125.6.9
8.	Beam Rafter R1	WF. 350.175.7.11 (Castellated Beam)
9.	Beam R2	WF. 150.75.5.7
10.	Beam R3	2CNP. 125.50.20,2,3
11.	Pedestal Column P1	Rectangular 450x275
12.	Pedestal Column P2	Rectangular 350x225
13.	Pedestal Column P3	Rectangular 450x275
14.	Pedestal Column P4	Rectangular 250x175
15.	Beam Conc. Type-1	Rectangular 400x200
16.	Beam Conc. Type -2	Rectangular 300x150

2.2. Load Analysis

(a) Loading on purlin elements

The loading on the purlin elements is carried out manually and separately from the main structure, including dead load, live roof load, rain load, and other loads, which are presented as follows.

Table 2. Loading at purlin elements [2]



$q_{bs} = 110\% \,.\, W_{gord}$ $q_{atp} = W_{atp} \,.\, d_{gord}/\cos\alpha$ $q_{bm} = q_{bs} + q_{atp}$ $q_{bmx} = q_{bm} \sin\alpha$ $q_{bmy} = q_{bm} \cos\alpha$ $M_x = 1/8\, q_{bmy}\, d_{kk}^2$ $M_y = 1/8\, q_{bmx}\, d_{sgr}^2$	$P = 100$ kg $P_x = P \sin\alpha$ $P_y = P \cos\alpha$ $M_x = 1/4\, P_y\, d_{kk}$ $M_y = 1/4\, P_x\, d_{sgrd}$	$q_{hjn} = (40\text{-}0{,}8\ \alpha).d_{gord}$ $q_{hjnx} = q_{hjn} \sin\alpha$ $q_{hjny} = q_{hjn} \cos\alpha$ $M_x = 1/8\, P_y\, d_{kk}^2$ $M_y = 1/8\, P_x\, d_{sgr}^2$	$q_{ang} = C_1.W_{ang}.d_{gord}/\cos\alpha$ $M_x = 1/8\, q_{ang}\, d_{kk}^2$ $M_y = 0$

(b) Live load

The live load is caused by the use of residential buildings, in this case it is modeled as an evenly distributed load of 2.4 kN/m2, the load is in accordance with the SNI-1727-2013 [3] reference.

(c) Live roof load

The live load of the roof is caused by the construction and use of the building, in this case it is modeled as a concentrated load of 100 kg or 0.98 kN

(d) Wind load

The wind load is applied to the building according to the 1981 PPIUG [4] as shown in the following figure

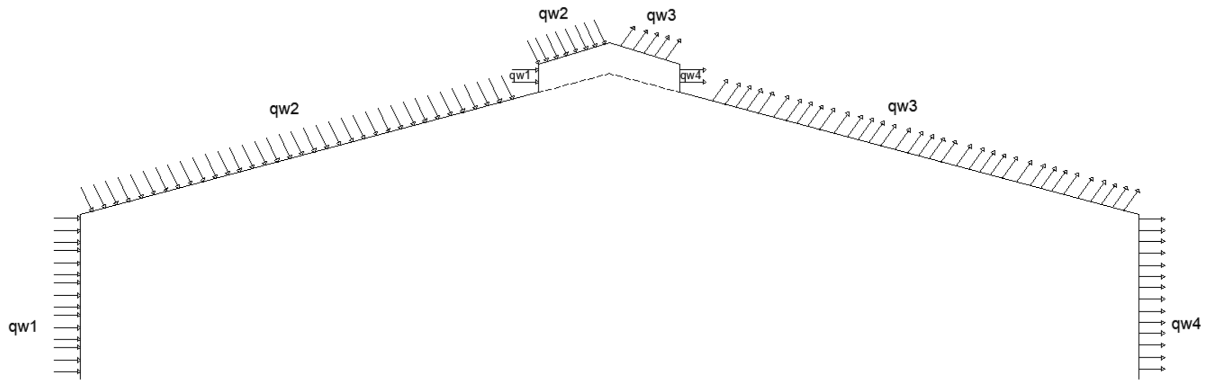


Figure 3. Wind Load Applied on The Structure

q_{w1} = 0,9 . d_r . W_{ang} = 135 kg/m = 1,32 kN/m
q_{w2} = (0,02α - 0,4) . d_r . W_{ang} = -15 kg/m = 0,15 kN/m
q_{w3} = -0,4 . d_r . W_{ang} = -60 kg/m = 0,59 kN/m
q_{w4} = -0,4 . d_r . W_{ang} = -60 kg/m = 0,59 kN/m

(e) Quake Load

The earthquake load applied to the structure uses an earthquake response spectrum load, where the loading requirements refer to SNI-1726-2019 [1]. Earthquake parameter data was taken based on the site rsa.ciptakarya.pu.go.id which is in accordance with the planning location, which is located at the PT. Samkyung Jaya Clothing, Dukuh Tiris, RT. 1 / RW. 12, Candi Village, Kec. Ampel, Boyolali Regency, Central Java

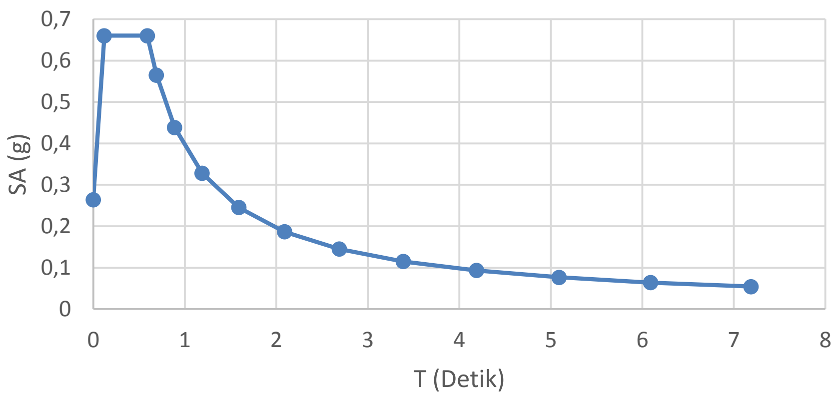


Figure 4. Spectrum Response Design at the Site

(f) Load Combinations

The load on the upper and lower structures must be designed in such a way that the design strength equals or exceeds the effect of the factored load according to the following basic combinations of SNI 1727-2013 [3].

- 1,4D
- 1,2D + 1,6L +0,5 (Lr atau S atau R)
- 1,2D + 1,6 (Lr atau S atau R) + (L atau 0,5W)
- 1,2D + 1,0W + L + 0,5 (Lr atau S atau R)
- 1,2D + 1,0E + L + 0,2S
- 0,9D + 1,0W
- 0,9D + 1,0E

2.3. 3D Building Modeling Using ETABS V.20.0

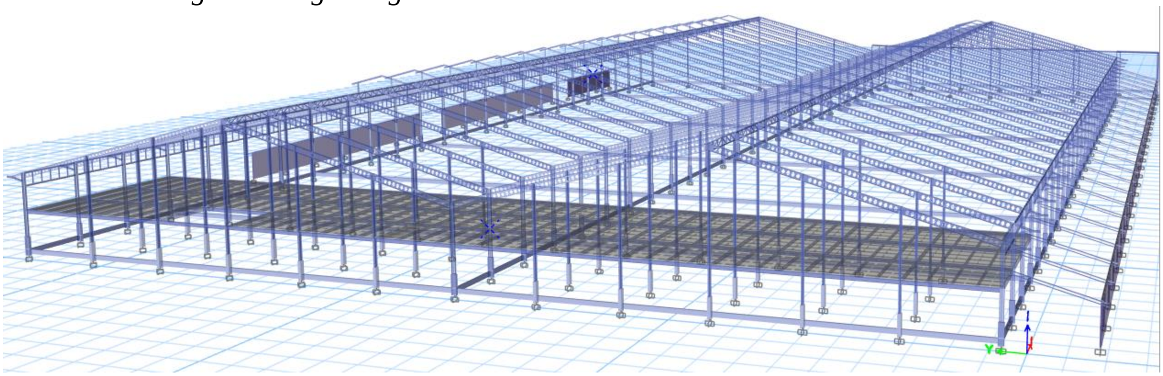


Figure 5. 3D Modeling in PT. Sam Kyung Jaya Clothing

2.4. Structure Analysis

(a) Purlin

There are two types of purlin analysed [5] in this study, namely CNP 150.50.20.2.3 and CNP.100.50.20.2.3 where all analyzes are carried out separately from the main structure and are presented in the following table.

Table 3. Moment Combinations of Purlin Type CNP 150.50.20.2.3

Moment	Load			Load Combinations						
	Dead (D)	Live (L)	Wind (W)	I	II	III (a)	III (b)	IV	V (a)	V (b)
M_x	45,594	144,889	-0,450	63,832	127,158	286,175	286,895	242,844	40,450	41,620
M_y	1,357	38,823	-0,050	1,900	21,040	63,706	63,786	52,074	1,157	1,287

Check of Structure Capacity :

$\lambda = \frac{b}{t} = 10{,}870$; $\lambda_p = \frac{170}{\sqrt{Fy}} = 10{,}973$; $\lambda_r = \frac{370}{\sqrt{Fy-fr}} = 28{,}378$ ($\lambda < \lambda_p$) "Compact"

Ratio = $\frac{Mux}{\emptyset b.Mnx} + \frac{Muy}{\frac{1}{2}.\emptyset b.Mny} \leq 1{,}0$

Ratio = $\frac{2868954{,}914}{0{,}9\,.7112516} + \frac{637855{,}022}{\frac{1}{2}.0{,}9.1966978{,}7} \leq 1{,}0$

Ratio = 1,169 > 1,0 (*Not OK*)

Check of Structure Deflection :

$\delta y = \frac{5.q_{bmy}.L^4}{384.E.Ix} + \frac{Py.L^3}{48.E.Ix} = 16{,}731$ mm ; $\delta_{max} < L/240$

16,73 mm < 25 mm (*OK*)

Table 4. Moment Combinations of Purlin Type CNP 100.50.20.2,3

Moment	Load			Load Combinations						
	Dead (D)	Live (L)	Wind (W)	I	II	III (a)	III (b)	IV	V (a)	V (b)
Mx	41,291	144,889	-0,450	57,808	121,994	281,012	281,732	237,680	36,577	37,747
My	1,229	38,823	-0,050	1,721	20,887	63,552	63,632	51,920	1,041	1,171

Check of Structure Capacity:

$\lambda = \frac{b}{t} = 10{,}870$; $\lambda_p = \frac{170}{\sqrt{Fy}} = 10{,}973$; $\lambda_r = \frac{370}{\sqrt{Fy-fr}} = 28{,}378$ ($\lambda < \lambda p$) "Compact"

$$\text{Ratio} = \frac{Mux}{\emptyset b.Mnx} + \frac{Muy}{\frac{1}{2}.\emptyset b.Mny} = \frac{2817316{,}519}{0{,}9\,.4135016} + \frac{636317{,}637}{\frac{1}{2}.0{,}9.1556409{,}7} \leq 1{,}0$$

Ratio = 1,666 > 1,0 (*Not OK*)

Check of Structure Deflection:

$$\delta y = \frac{5.q_{bmy}.L^4}{384.E.Ix} + \frac{Py.L^3}{48.E.Ix} = 36{,}525 \text{ mm} ; \delta_{max} < L/240$$

36,525 mm > 25 mm (*Not OK*)

(b) Pedestal Column

Presented in tabular form for the analysis of the pedestal column P1 to P4 with the largest capacity ratio selected from all elements, see the following table.

Table 5. Axial Force and Biaxial Moment Case Column Check for P_u , M_{u2} , M_{u3}

Element	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar % %	Capacity Ratio Unitless
P4	24,8761	-0,7021	16,4995	0,5097	0,5657	1,82	0,715
P3	416,9056	-24,2218	18,5388	9,7931	11,9819	1,07	0,344
P2	269,6937	-5,9306	-41,4315	5,9306	6,9419	1,69(O/S #52)	0,51(O/S #52)
P2	254,5326	-5,5972	0	5,5972	6,5517	1,69(O/S #5)	0,213(O/S #5)
P1 Int.	45,6489	-1,0723	-33,2128	1,0723	1,3119	1,07	0,377
P1 Ext.	42,7153	-0,1019	108,4345	1,0034	1,2276	1,07(O/S #35)	1,518(O/S #35)

(c) Beam

Presented in tabular form for analysis of beams B1, B2, R1, R2, and beams 2CNP 125.50.20.2,3 by selecting the largest demand/capacity ratio of all elements, see the following table.

Table 6. Demand/Capacity (D/C) Ratio of Beam Eqn.(H1-1b)

Element	D/C Ratio =	$(P_r /2P_c) + (M_{r33} /M_{c33}) + (M_{r22} /M_{c22})$
B1	1,885 =	0,001 + 1,884 + 4,69E-05
B2	1,114 =	1,367E-04 + 1,114 + 4,289E-05

R2	0,45 =	0,006 + 0,442 + 0,002
2 CNP 125.50.20.2,3	0,79 =	0,025 + 0,754 + 0,011
R1	7,931 =	4,031 + 3,897 + 0,003

(d) Column

Presented in tabular form for column K1 analysis with the largest demand/capacity ratio selected from all elements, see the following table.

Table 7. Demand/Capacity (D/C) Ratio of Column Eqn.(H1-1b)

Element	D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
K1	1,231 =	0,064 + 1,165 + 0,002

3. Results and Discussion

Through the results of the analysis in section 2.4, it can be seen that there are several elements whose value of the capacity ratio or demand/capacity ratio exceeds the safe limit of 1.00. It can be seen in Table 5. In the P2 Pedestal Column element there are two types of warnings, namely the ratio 0.51(O/S #52) and the ratio 0.213(O/S #5), based on the warning it can be seen that Warning #52 Deltans exceeds 1.4 (ACI 318-14 6.2.6, 6.6.4.5.1) and O/S #5 is Column factored axial load exceeds Euler Force. When the factor exceeds the limit, it is necessary to increase the cross-section to anticipate the presence of large axial compression forces or can be reinforced on the outside of the element such as jacketing or retrofitting methods on the element. The P1 Pedestal column on the outer side also experienced a warning, namely O/S #35 Capacity ratio exceeds limit, this indicates that the load that occurs exceeds the capacity of the cross section, so it is necessary to add nominal strength by using the jacketing or retrofitting method there are elements that exceed the capacity the. Not all of the elements reviewed have failed such as exceeding the safe limit, only a few elements have experienced it, so it is necessary to clearly and precisely mark it so that it is right on target in its repair.

Elements of Column K1 based on the results of the analysis there are also several elements whose ratio exceeds the requirement limit, where the highest D/C ratio is 1.231. This incident also has the same solution as the previous pedestal beam and column elements, which must be given additional reinforcement by jackeing or retrofitting methods.

4. Conclusion

The conclusions that can be drawn from this study are as follows.

(a) Boyolali Regency is included in the seismic design category “D”.

(b) It is necessary to enlarge the purlin on the two existing types of curtains or also with the addition of a flange brace or the addition of a sagrod so that the capacity ratio can meet the requirements.

(c) Dynamic earthquake loading using a response spectrum analysis with an orthogonal combination scheme applied to the building causes a large moment so that there are several elements that need additional reinforcement.

(d) Elements on the pedestal columns P1 and P2, as well as Column K1 which exceed the safe limit need to be reinforced using the jacketing or retrofitting method.

(e) In the implementation of additional reinforcement, the elements ensure that the locations or points of elements that do not meet the standard have been marked or labeled.

(f) A more detailed modeling approach is needed, such as combining the gording analysis with the main building frame.

(g) Analysis carried out after the building is built will result in double work, where there is additional work to provide reinforcement, structural analysis should be carried out before the building is made.

References

[1] Standar Nasional Indonesia, "*Tata Cara Perencanan Ketahanan gempa untuk Struktur Bangunan Gedung dan Non Gedung*," SNI-1726, 2019.

[2] Abdul Rochim, "*Modul Perancangan Atap*," in *Muhamadiyah University of Surakarta*, 2018.

[3] Standar Nasional Indonesia, "*Beban Minimum untuk Perancangan Bangunan Gedung dan Struktur lain*," SNI-1727, 2013.

[4] Direktorat Penyeledikan Masalah Bangunan, "*Peraturan Pembebanan Indonesia untuk Gedung*," PPIUG, 1981

[5] Standar Nasional Indonesia, "*Spesifikasi untuk Bangunan Gedung Baja Struktural*," SNI-1729, 2020.

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