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REPLANNING BUILDINGS IN SURABAYA CASE STUDY OF OFFICE BUILDINGS ON JALAN BASUKI RACHMAT SURABAYA

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KEYWORDS
Structure Planning, Office buildings, SNI 1726-2019.

ABSTRACT

Infrastructure development is an important aspect in boosting the economic growth of the Indonesian people, with the stages of infrastructure development which include building facilities and infrastructure can overcome economic inequality, the opening of new jobs, per capita income will increase. Referring to Law No. 28 of 2002 concerning building buildings in article 3 states that to realize a building that is functional and in accordance with the building layout that is harmonious and in harmony with the environment, it must ensure the reliability of the building in terms of safety, health, comfort and convenience. Problems: Based on the description above in the explanation in the background, the researcher formulated the following problem: How to plan a building structure that is strong in withstanding loading according to SNI 1726-2019 and SNI 2847-2013? How to plan building structures according to annual costs. The results of the planning of the Office Building on Jln Basuki Rachmat Surabaya as stated in Chapter IV, from the planning of the floor slab to the foundation in accordance with the elements in the 8-story Building Building and require a cost of Rp. 94,965,401,000, - and the implementation time takes 35 weeks or ± 8 calendar months.

INTRODUCTION

Infrastructure development is an important aspect in boosting the economic growth of the Indonesian people, with the stages of infrastructure development which include building facilities and infrastructure can overcome economic inequality, the opening of new jobs, per capita income will increase

In order to ensure the continuity and improvement of the lives and livelihoods of its residents and realize a building that is functional, reliable, self-contained and balanced, harmonious and in harmony with the environment, it is necessary to have an arrangement that ensures the strength of the building structure.

Referring to Law No. 28 of 2002 concerning building buildings in article 3 states that to realize a building that is functional and in accordance with the building layout that is harmonious and in harmony with the environment, it must ensure the reliability of the building in terms of safety, health, comfort and convenience.

Research problems

Based on the description above in the explanation in the background, the researcher formulated the following problem:

"How to plan a Building Building with a budget of cost and time of implementation "

Research objectives

The purpose of this study is to determine the strength of the building structure and find out the implementation time and cost of structural work.

Bibliography Review

Previous researchers are intended to look for differences in research that has been made, including:

1. Nurul Dhea Andini, Haki Yusdinar, Nunu Nugraha (2019), Analysis of Earthquake Resistant Building Planning at the Al-Kamil Islamic Boarding School Building, Cianjur Regency; Special Moment Bearing Frame System SNI 1762-2012, SNI 2847-2013; Based on the results of the structural analysis and design carried out, several points of conclusion can be drawn including the following: 1. From the preliminary design results, results are obtained in accordance with sni 2847: 2013. 2. From the results of the earthquake load analysis, the building structure is included in the seismic design category D of the structure analysis program, the control of the final value of the spectrum response shown in table 4.18 is obtained. Vdynamic-X of 2471.154 kN and Vdynamic -Y of 2422.789 kN. The mass participation control shown in table 4.20 in the 4th and 5th modes has qualified at > 90%. The interstate deviation controls shown in tables 4.22 and 4.23 have qualified not to exceed 90mm. 3. Analyze the forces in the structure of the building using the auxiliary program SAP2000 v.14. by introducing the forces acting on the plates as well as vertical and horizontal loads. 4. The results of the structural analysis that has been carried out on the design of the structural modification of the Al-Kamil Islamic Boarding School building will be poured on the technical drawings in the appendix.
2. Ristyanto Adi Nugroho, Nur Hidayati, Yayan Adi Saputro, (2021); Structural Planning of 9-Storey Sky *Sea Hotel view* Jepara; Literature studies and interviews; Based on the results of the final project of compiling the planning report this time, it is interesting to draw several conclusions as follows 1. The structure of the Sky Sea View Jepara Hotel Building includes 9 lanti with structural materials using reinforced concrete including the building covering structure, upper structure to the lower structure, 2. The calculation of repeating the building structure includes columns, beams, stairs, floor plates, roof plates and pile caps manually by analyzing moments, shear forces, axillary forces with SAP200 version 11. 3. The structure of the Sky Sea View Jepara Hotel Building has an irregular building configuration with irregular shape characteristics.

Bibliography Review

SRPM stands for Moment *Resisting Frame* System. We often hear this term in discussions about earthquake-resistant building structures. SRPM is one of the options when planning an earthquake-resistant building. The characteristics of the SRPM include: Lateral loads, especially earthquakes, are transferred through a bending mechanism between the beam and the column. So, the role of beams, columns, and column beam joints here is very important. SRPM is divided into three levels, namely:

1. Ordinary Moment Bearing Frame System (SRPMB), for areas located in the earthquake area with seismic design categories (KDS) 1 and 2.
2. Medium Moment Bearing Frame System (SRPMM), for areas located in the earthquake area with seismic design categories (KDS) 3 and 4.
3. Special Moment Bearing Frame System (SRPMK), for areas located in the earthquake area with seismic design categories (KDS) 5 and 6.

The ondition of earthquake area 6 in the Yogyakarta area, can be plannedusing SRPMB, taking into account the condition of the development of the earth the earthquake area can also develop so that it can also be planned in the conditions of the medium earthquake area. Reinforced concrete structures located in the area of a moderate earthquake must meet the intermediate sealing requirements. With this requirement the structure will have a behavior inelastic enough to absorb earthquake loads with a high earthquake risk. This provision applies to SRPMK and two-way plate systems without beams, excluding structural walls, which in this case are sufficiently designed with articles 3 to 20 (general requirements) and are viewed as having sufficient ductility at the level of drift that occurs in high earthquake risk areas.

From this description, SNI 03-2847-2002 emphasized that the imposition of additional protection for structures located in intermediate earthquake risk locations depends on the type of structure system used. The intermediate fixture of the sturcture wall truss system depends on how the earthquake is imposed on the frame and the sliding wall.

The bending component must comply with articles 23.3(1)) to 23.3(1(4)) (SNI 03-2847-2002) in order for its cross section to prove to perform well. Each component must be sufficiently detailed and efficiently enough to transfer moments to columns. The repeating requirements for bending components located in the intermediate earthquake region (3 and 4) are as shown in the following table.

Based on the principle of "*Capasity Design"* where the columns must be given enough strength, so that the columns do not melt first before the beam. Therefore, the columns are designed to be 20% stronger than the beams in a column beam relationship (HBK). The repeating requirements for bending and axial components located in the intermediate earthquake region (3 and 4) are as shown in the following table.

The regulatory guidelines used in this technical planning are to use the applicable SNI regulations, including:

1. Procedure for Calculating Concrete Structures for Buildings (SNI 03-2847-2002)
2. Earthquake Resistance Planning Procedures for Building and Non-Building Structures (SNI 03-1726-2012)
3. Minimum Load for Building Design and Other Structures (SNI 03-1727-2013)
4. For dead load planning using the Indonesian Loading Regulation 1983 (PPI 1983)

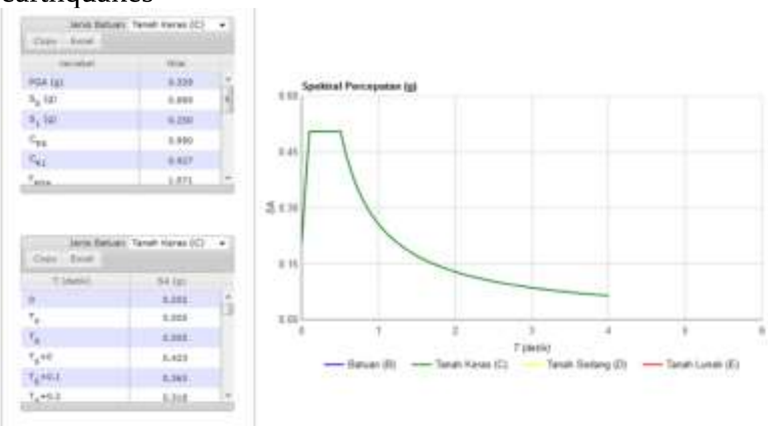
RESEARCH METHODS

Data Collection, Preliminary Design, Loading, Secondary Structure Planning, Plate Planning, Stair Planning, Child Beam Planning, Elevator Hanging Beam Planning, Structure Analysis With SAP 2000 Program, Inter-Floor Deviation Design Level and Tin Inter-Floor Deviation gkat Ijin, Primary Structure Planning (Master Beam Planning, Column Planning, Foundation).

RESULTS AND DISCUSSION

1. DATA PERENCANAAN	
- Persyaratan Beton Struktural Bangunan Gedung SNI 03-2847-2013 - Tata Cara Perencanaan Ketahanan Gempa Untuk Bangunan Gedung SNI 03-1726-2012 - Beban Minimum Untuk Perancangan Bangunan Gedung Dan Struktur Lainnya SNI 1727-2013	PERATURAN YANG DIGUNAKAN
- Tidak Ditinjau	KEMUNGKINAN PENGEMBANGAN
- Tidak Ditinjau	SYARAT-SYARAT KETAHANAN KEBAKARAN
- Beban Mati : B.S. Struktur + Finishing - Beban Hidup : Lantai 300 kg/m2 - Beban Hidup : Atap 97,89 kg/m2 - Beban Gempa : Dinamis Puskim PU	PEMBEBANAN
- Tidak Ditinjau Terhadap Beban Angin	BEBAN ANGIN
- Mutu Beton K-300 - Mutu Baja Tulangan : - Tulangan D > 10 BJTD 40, fy = 400 Mpa - Tulangan Ø < 10 BJTP 24, fy = 240 Mpa	MUTU BAHAN
- Pehitungan Struktur Dianalisa Secara Tiga Dimensi Dengan Program Struktur SAP 2000	LAIN - LAIN

Dynamic earthquakes



3.PERHITUNGAN PLAT LANTAI (*SLAB*)

PLAT LENTUR DUA ARAH (*TWO WAY SLAB*)

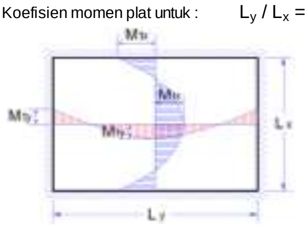
A. DATA BAHAN STRUKTUR

Kuat tekan beton,	f_c' =	25	MPa
Tegangan leleh baja untuk tulangan lentur,	f_y =	240	MPa

B. DATA PLAT LANTAI

Panjang bentang plat arah x,	L_x =	3.00	m
Panjang bentang plat arah y,	L_y =	4.00	m
Tebal plat lantai,	h =	150	mm

Koefisien momen plat untuk : L_y / L_x = 1.33 — KOEFISIEN MOMEN PLAT



Lapangan x	C_{lx} =	50	
Lapangan y	C_{ly} =	50	
Tumpuan x	C_{tx} =	38	
Tumpuan y	C_{ty} =	38	
Diameter tulangan yang digunakan,	$\varnothing$ =	8	mm
Tebal bersih selimut beton,	t_s =	20	mm

C. BEBAN PLAT LANTAI

1. BEBAN MATI (*DEAD LOAD*)

No	Jenis Beban Mati	Berat satuan	Tebal (m)	Q (kN/m^2)
1	Berat sendiri plat lantai (kN/m^3)	24.0	0.15	3.600
2	Berat *finishing* lantai (kN/m^3)	22.0	0.05	1.100
3	Berat plafon dan rangka (kN/m^2)	0.2	-	0.200
4	Berat instalasi ME (kN/m^2)	0.5	-	0.500
	Total beban mati,		Q_D =	5.400

2. BEBAN HIDUP (*LIVE LOAD*)

Beban hidup pada lantai bangunan =		300	kg/m^2
→	Q_L =	3.000	kN/m^2

3. BEBAN RENCANA TERFAKTOR

Beban rencana terfaktor,	$Q_u = 1.2 * Q_D + 1.6 * Q_L$ =	11.280	kN/m^2

4. MOMEN PLAT AKIBAT BEBAN TERFAKTOR

Momen lapangan arah x,	$M_{ulx} = C_{lx} * 0.001 * Q_u * L_x^2$ =	5.076	kNm/m
Momen lapangan arah y,	$M_{uly} = C_{ly} * 0.001 * Q_u * L_x^2$ =	5.076	kNm/m
Momen tumpuan arah x,	$M_{utx} = C_{tx} * 0.001 * Q_u * L_x^2$ =	3.858	kNm/m
Momen tumpuan arah y,	$M_{uty} = C_{ty} * 0.001 * Q_u * L_x^2$ =	3.858	kNm/m
Momen rencana (maksimum) plat,	→ M_u =	3.858	kNm/m

D. PENULANGAN PLAT

Untuk : $f_c' \le 30$ MPa,	β_1 =	0.85	
Untuk : $f_c' > 30$ MPa,	$\beta_1 = 0.85 - 0.05 * (f_c' - 30) / 7$ =	-	
Faktor bentuk distribusi tegangan beton,	→ β_1 =	0.85	
Rasio tulangan pada kondisi *balance*,	$\rho_b = \beta_1 * 0.85 * f_c' / f_y * 600 / (600 + f_y)$ =	0.0538	
Faktor tahanan momen maksimum,	$R_{max} = 0.75 * \rho_b * f_y * [1 - ½ * 0.75 * \rho_b * f_y / (0.85 * f_c')]$ =	7.4732	
Faktor reduksi kekuatan lentur,	ϕ =	0.80	
Jarak tulangan terhadap sisi luar beton,	$d_s = t_s + \varnothing / 2$ =	24.0	mm
Tebal efektif plat lantai,	$d = h - d_s$ =	126.0	mm
Ditinjau plat lantai selebar 1 m,	→ b =	1000	mm
Momen nominal rencana,	$M_n = M_u / \phi$ =	4.822	kNm
Faktor tahanan momen,	$R_n = M_n * 10^{-6} / (b * d^2)$ =	0.30374	

R_n < R_{max} → (OK)

Rasio tulangan yang diperlukan :			
	$\rho = 0.85 * f_c' / f_y * [1 - \sqrt{[1 - 2 * R_n / (0.85 * f_c')]}$ =	0.0013	
Rasio tulangan minimum,	ρ_{min} =	0.0025	
Rasio tulangan yang digunakan,	→ ρ =	0.0025	
Luas tulangan yang diperlukan,	$A_s = \rho * b * d$ =	315	mm^2
Jarak tulangan yang diperlukan,	$s = \pi / 4 * \varnothing^2 * b / A_s$ =	160	mm
Jarak tulangan maksimum,	$s_{max} = 2 * h$ =	300	mm
Jarak tulangan maksimum,	s_{max} =	200	mm
Jarak sengkang yang harus digunakan,	s =	160	mm
Diambil jarak sengkang :	→ s =	150	mm
Digunakan tulangan,	∅ 8 - 150		
Luas tulangan terpakai,	$A_s = \pi / 4 * \varnothing^2 * b / s$ =	335	mm^2

E. KONTROL LENDUTAN PLAT

Modulus elastis beton,	$E_c = 4700 * \sqrt{f_c'}$ =	23500	MPa
Modulus elastis baja tulangan,	E_s =	2.00E+05	MPa
Beban merata (tak terfaktor) padaplat,	$Q = Q_D + Q_L$ =	8.400	N/mm
Panjang bentang plat,	L_x =	3000	mm
Batas lendutan maksimum yang diijinkan,	$L_x / 240$ =	12.500	mm
Momen inersia brutto penampang plat,	$I_g = 1/12 * b * h^3$ =	281250000	mm^3
Modulus keruntuhan lentur beton,	$f_r = 0.7 * \sqrt{fc'}$ =	3.5	MPa
Nilai perbandingan modulus elastis,	$n = E_s / E_c$ =	8.51	
Jarak garis netral terhadap sisi atas beton,	$c = n * A_s / b$ =	2.852	mm
Momen inersia penampang retak yang ditransformasikan ke beton dihitung sbb. :			
	$I_{cr} = 1/3 * b * c^3 + n * A_s * (d - c)^2$ =	43258703	mm^4
	$y_t = h / 2$ =	75	mm
Momen retak :	$M_{cr} = f_r * I_g / y_t$ =	13125000	Nmm
Momen maksimum akibat beban (tanpa faktor beban) :			
	$M_a = 1 / 8 * Q * L_x^2$ =	9450000	Nmm
Inersia efektif untuk perhitungan lendutan,			
	$I_e = (M_{cr} / M_a)^3 * I_g + [1 - (M_{cr} / M_a)^3] * I_{cr}$ =	680881133	mm^4
Lendutan elastis seketika akibat beban mati dan beban hidup :			
	$\delta_e = 5 / 384 * Q * L_x^4 / (E_c * I_e)$ =	0.554	mm
Rasio tulangan slab lantai :	$\rho = A_s / (b * d)$ =	0.0027	
Faktor ketergantungan waktu untuk beban mati (jangka waktu > 5 tahun), nilai :			
	ζ =	2.0	
	$\lambda = \zeta / (1 + 50 * \rho)$ =	1.7653	
Lendutan jangka panjang akibat rangkak dan susut :			
	$\delta_g = \lambda * 5 / 384 * Q * L_x^4 / (E_c * I_e)$ =	0.977	mm
Lendutan total,	$\delta_{tot} = \delta_e + \delta_g$ =	1.531	mm

Syarat :	δ_{tot}	≤	$L_x / 240$		
	1.531	<	12.500	→	**AMAN (OK)**

4. PERHITUNGAN BALOK LANTAI (*BEAM*)

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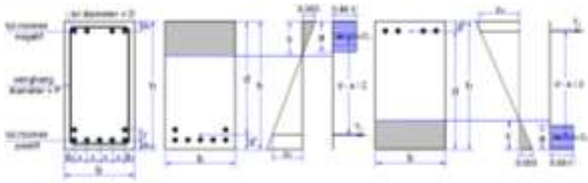


A. DATA BALOK LANTAI

BAHAN STRUKTUR			
Kuat tekan beton,	f_c' =	25	MPa
Tegangan leleh baja (deform) untuk tulangan lentur,	f_y =	400	MPa
Tegangan leleh baja (polos) untuk tulangan geser,	f_y =	240	MPa
DIMENSI BALOK			
Lebar balok	b =	400	mm
Tinggi balok	h =	700	mm
Diameter tulangan (deform) yang digunakan,	D =	22	mm
Diameter sengkang (polos) yang digunakan,	P =	10	mm
Tebal bersih selimut beton,	t_s =	60	mm
MOMEN DAN GAYA GESER RENCANA			
Momen rencana positif akibat beban terfaktor,	M_u^+ =	385.000	kNm
Momen rencana negatif akibat beban terfaktor,	M_u^- =	424.000	kNm
Gaya geser rencana akibat beban terfaktor,	V_u =	271.000	kN

B. PERHITUNGAN TULANGAN

Untuk : $f_c' \leq$ 30 MPa,	b_1 =	0.85	
Untuk : f_c' > 30 MPa,	$b_1 = 0.85 - 0.05 * (f_c' - 30) / 7$ =	-	
Faktor bentuk distribusi tegangan beton,	® b_1 =	0.85	
Rasio tulangan pada kondisi *balance* ,			
	$r_b = b_1 * 0.85 * f_c' / f_y * 600 / (600 + f_y)$ =	0.0271	
Faktor tahanan momen maksimum,			
	$R_{max} = 0.75 * r_b * f_y * [1 – ½*0.75* r_b * f_y / (0.85 * f_c')]$ =	6.5736	
Faktor reduksi kekuatan lentur,	f =	0.80	
Jarak tulangan terhadap sisi luar beton,	$d_s = t_s$ + Æ + D/2 =	81.00	mm
Jumlah tulangan dlm satu baris,	$n_s = (b - 2 * d_s) / (25 + D)$ =	5.06	
Digunakan jumlah tulangan dalam satu baris,	n_s =	5	bh
Jarak horisontal pusat ke pusat antara tulangan,			
	$x = (b - n_s * D - 2 * d_s) / (n_s - 1)$ =	32.00	mm
Jarak vertikal pusat ke pusat antara tulangan,	y = D + 25 =	47.00	mm

1. TULANGAN MOMEN POSITIF

Momen positif nominal rencana,	$M_n = M_u^+ / f$ =	481.250	kNm
Diperkirakan jarak pusat tulangan lentur ke sisi beton,	d' =	70	mm
Tinggi efektif balok,	d = h - d' =	630.00	mm
Faktor tahanan momen,	$R_n = M_n * 10^6 / (b * d^2)$ =	3.0313	
R_n < R_{max}	®	**(OK)**	
Rasio tulangan yang diperlukan :			
	$r = 0.85 * f_c' / f_y * [1 - Ö * [1 – 2 * R_n / (0.85 * f_c')]$ =	0.00821	
Rasio tulangan minimum,	$r_{min} = Ö\ f_c' / (4 * f_y)$ =	0.00313	
Rasio tulangan minimum,	$r_{min} = 1.4 / f_y$ =	0.00350	
Rasio tulangan yang digunakan,	® r =	0.00821	
Luas tulangan yang diperlukan,	$A_s = r * b * d$ =	2070	mm^2
Jumlah tulangan yang diperlukan,	$n = A_s / (p / 4 * D^2)$ =	5.445	
Digunakan tulangan,	5 D 22		
Luas tulangan terpakai,	$A_s = n * p / 4 * D^2$ =	1901	mm^2
Jumlah baris tulangan,	$n_b = n / n_s$ =	1.00	
n_b < 3	®	**(OK)**	

Baris ke	Jumlah n_i	Jarak y_i	Juml. Jarak $n_i * y_i$
1	5	81.00	405.00
2	0	0.00	0.00
3	0	0.00	0.00
n =	5	S [$n_i * y_i$] =	405

Letak titik berat tulangan,	®	d' = S [$n_i * y_i$] / n =	81.00	mm
81.00 > 70	®	perkirakan lagi d' (NG)		
Tinggi efektif balok,		d = h - d' =	619.00	mm
		a = $A_s * f_y$ / (0.85 * f_c' * b) =	89.443	mm
Momen nominal,		$M_n = A_s * f_y$ * (d - a / 2) * 10^{-6} =	436.604	kNm
Tahanan momen balok,		f * M_n =	349.283	kNm
Syarat :	f * M_n ≥ M_u^+			
	349.283 < 385.000	®	BAHAYA (NG)	

2. TULANGAN MOMEN NEGATIF

Momen negatif nominal rencana,	$M_n = M_u^-$ / f =	530.000	kNm
Diperkirakan jarak pusat tulangan lentur ke sisi beton,	d' =	50	mm
Tinggi efektif balok,	d = h - d' =	650.00	mm
Faktor tahanan momen,	$R_n = M_n * 10^6$ / (b * d^2) =	3.1361	
R_n < R_{max} ® (OK)			
Rasio tulangan yang diperlukan :			
	r = 0.85 * f_c' / f_y * [1 - Ö * [1 – 2 * R_n / (0.85 * f_c')] =	0.00852	
Rasio tulangan minimum,	r_{min} = Ö f_c' / (4 * f_y) =	0.00313	
Rasio tulangan minimum,	r_{min} = 1.4 / f_y =	0.00350	
Rasio tulangan yang digunakan,	® r =	0.00852	
Luas tulangan yang diperlukan,	A_s = r * b * d =	2216	mm^2
Jumlah tulangan yang diperlukan,	n = A_s / (p / 4 * D^2) =	5.830	
Digunakan tulangan,	5 D 22		
Luas tulangan terpakai,	A_s = n * p / 4 * D^2 =	1901	mm^2
Jumlah baris tulangan,	n_b = n / n_s =	1.00	
n_b < 3 ® (OK)			

Baris ke	Jumlah n_i	Jarak y_i	Juml. Jarak $n_i * y_i$
1	5	81.00	405.00
2	0	0.00	0.00
3	0	0.00	0.00
n =	5	S [$n_i * y_i$] =	405

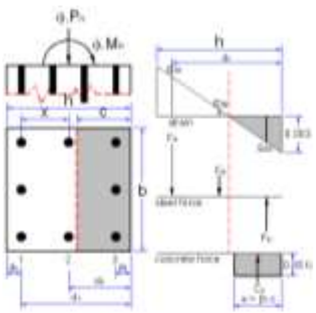
Letak titik berat tulangan,	®	d' = S [$n_i * y_i$] / n =	81.00	mm
81.00 > 50	®	perkirakan lagi d' (NG)		
Tinggi efektif balok,		d = h - d' =	619.0	mm
		a = $A_s * f_y$ / (0.85 * f_c' * b) =	89.443	mm
Momen nominal,		$M_n = A_s * f_y$ * (d - a / 2) * 10^{-6} =	436.604	kNm
Tahanan momen balok,		f * M_n =	349.283	kNm
Syarat :	f * M_n ≥ M_u^-			
	349.283 < 424.000	®	BAHAYA (NG)	

3. TULANGAN GESER

Gaya geser ultimit rencana,	V_u =	271.000	kN
Faktor reduksi kekuatan geser,	f =	0.60	
Tegangan leleh tulangan geser,	f_y =	240	MPa
Kuat geser beton,	V_c = (√ f_c') / 6 * b * d * 10^{-3} =	210.000	kN
Tahanan geser beton,	f * V_c =	126.000	kN
® Perlu tulangan geser			
Tahanan geser sengkang,	f * V_s = V_u - f * V_c =	145.000	kN
Kuat geser sengkang,	V_s =	241.667	kN
Digunakan sengkang berpenampang :	4 P 10		
Luas tulangan geser sengkang,	$A_v = n_s$ * p / 4 * P^2 =	314.16	mm^2
Jarak sengkang yang diperlukan :	s = $A_v * f_y$ * d / (V_s * 10^3) =	196.56	mm
Jarak sengkang maksimum,	s_{max} = d / 2 =	309.50	mm
Jarak sengkang maksimum,	s_{max} =	250.00	mm
Jarak sengkang yang harus digunakan,	s =	196.56	mm
Diambil jarak sengkang : ®	s =	190	mm
Digunakan sengkang,	4 P 10	190	

5.PERHITUNGAN KOLOM
DENGAN DIAGRAM INTERAKSI

KODE KOLOM K1 70/70



INPUT DATA KOLOM			
Kuat tekan beton,	f_c' =	29	MPa
Tegangan leleh baja,	f_y =	400	MPa
Lebar kolom,	b =	700	mm
Tinggi kolom,	h =	700	mm
Tebal brutto selimut beton,	d_s =	60	mm
Jumlah tulangan,	n =	36	buah
Diameter tulangan,	D =	22	mm
PERHITUNGAN DIAGRAM INTERAKSI			
Modulus elastis baja,	E_s =	2.E+05	MPa
β_1 = 0.85	untuk $f_c' \le 30$ MPa		
β_1 = 0.85 - 0.008 (f_c' - 30)	untuk $f_c' > 30$ MPa		
Faktor distribusi tegangan,	β_1 =	0.85	
Luas tulangan total,	$A_s = n * \pi / 4 * D^2$ =	13685	mm^2
Jarak antara tulangan,	$x = (h - 2*d_s) / 2$ =	290.000	mm
Rasio tulangan,	$\rho = A_s / A_g$ =	2.79%	

Faktor reduksi kekuatan,

ϕ = 0.65 untuk $P_n \ge 0.1 * fc' * b * h$	Untuk : $0 \le P_n \le 0.1 * f_c' * b * h$
ϕ = 0.80 untuk $P_n = 0$	$\phi = 0.65 + 0.15 * (P_{no} - P_n) / P_{no}$

No	Luas masing-masing tulangan			Jarak tulangan thd. sisi beton		
1	$A_{s1} = 3/8 * A_s$ =	5132	mm^2	$d_1 = 2*x + d_s$ =	640	mm
2	$A_{s2} = 2/8 * A_s$ =	3421	mm^2	$d_2 = x + d_s$ =	350	mm
3	$A_{s3} = 3/8 * A_s$ =	5132	mm^2	$d_3 = d_s$ =	60	mm

A_s = 13685 mm^2

Pada kondisi tekan aksial sentris ($M_{no} = 0$) :

$P_{no} = 0.80*[0.85*f_c' *b*h + A_s*(f_y - 0.85*f_c')]*10^{-3}$

→ P_{no} = 13788 kN

$0.1 * f_c' * b * h *10^{-3}$ = 1423.5 kN

Pada kondisi balance :

$c = c_b = 600 / (600 + f_y) * d_1$ = 384.00 mm

Pada kondisi garis netral terletak pada jarak c dari sisi beton tekan terluar :

Regangan pada masing-masing baja tulangan : $\varepsilon_{si} = 0.003 * (c - d_i) / c$

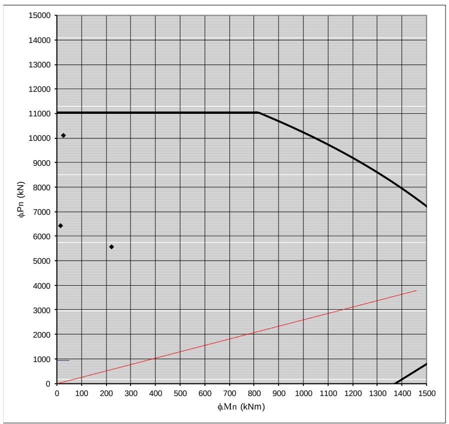
Tegangan pada masing-masing baja tulangan :

Untuk $| \varepsilon_{si} | < f_y / E_s$ maka : $f_{si} = \varepsilon_{si} * E_s$

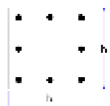
Untuk $| \varepsilon_{si} | \ge f_y / E_s$ maka : $f_{si} = | \varepsilon_{si} | / \varepsilon_{si} * f_y$

Jumlah interval jarak grs netral = 125 → Δc = 5.6000

URAIAN PERHITUNGAN	PERSAMAAN	UNIT
Gaya-gaya internal pada masing-masing baja tulangan :	$F_{si} = A_{si} * f_{si} * 10^{-3}$	kN
Resultan gaya internal baja tulangan :	$C_s = [\Sigma F_{si}]*10^{-3}$	kN
Momen akibat gaya internal masing-masing baja tulangan :	$M_{si} = F_{si}*(h/2 - d_i)$	kNmm
Momen total akibat gaya internal baja tulangan :	$M_s = \Sigma M_{si}$	kNmm
Tinggi blok tegangan tekan beton,	$a = \beta_1 * c$	mm
Gaya internal pada beton tekan :	$C_c = 0.85 * f_c' * b * a * 10^{-3}$	kN
Momen akibat gaya internal tekan beton :	$M_c = C_c * (h - a) / 2$	kNmm
Gaya aksial nominal :	$P_n = C_s + C_c$	kN
Momen nominal :	$M_n = (M_c + M_s)*10^{-3}$	kNm
Gaya aksial rencana :	$P_u = \phi * P_n$	kN
Momen rencana :	$M_u = \phi * M_n$	kNm



ANALISIS KOLOM DENGAN DIAGRAM INTERAKSI



	b =	700	mm
	h =	700	mm
Tul. :	36	D	22
	f_c' =	29	MPa
	f_y =	400	MPa
	P_u (kN)	M_u (kNm)	
	10,110.00	26.70	
	6,427.00	15.83	
	5,576.00	223.00	

6.PERHITUNGAN SLOOF

A. Data Sloof

Penampang balok (b x h)	=	30 cm x 70 cm
Mutu beton (f'c)	=	25 MPa
Mutu baja (f'y) (ulir)	=	400 MPa
Mutu baja (f'y) (polos)	=	240 MPa
Berat jenis beton	=	2400 kg/m³
Modulus Elastisitas (E)	=	23500 MPa
Tebal selimut beton	=	4 cm
Ø tulangan utama	=	D22 mm
Ø sengkang	=	Ø10 mm
Tinggi efektif (d)	=	639.00mm
Penurunan yang diijinkan (δ)	=	5 cm

B. Perhitungan Tulangan

Menghitung nilai Mu

- $Mu = \frac{E \times I \times \delta}{12 \times L^2}$

$= \frac{23500000 \times 0.008575 \times 0.05}{12 \times 8.00^2}$

$= 13.12$

Tulangan utama lapangan

- $Mn = \frac{Mu}{Ø} = \frac{13.12}{0.8} = 16.40$ KNm

- $Rn = \frac{Mn}{bd^2} = \frac{16399129 \text{ Nmm}}{(300 \times 639.0^2)} = 0.13$ N/mm²

- $m = \frac{fy}{0.85 \; f'c} = \frac{400}{0.85 \quad 25} = 18.824$

- $\rho_b = \frac{0.85 \; \beta_1 \; f'c}{fy} \left[\frac{600}{600 + fy} \right]$

$= \frac{0.85 \quad 0.85 \quad 25}{400} \left[\frac{600}{600 + 400} \right]$

$= 0.0271$

- $\rho_{max} = 0.75 \; \rho_b$

$= 0.75 \quad 0.0271$

$= 0.0203$

- $\rho_{min} = \frac{1.4}{fy} = \frac{1.4}{400} = 0.0035$

- $\rho_{perlu} = \frac{1}{m} \left\{ 1 - \sqrt{1 - \frac{2 \; m \; Rn}{fy}} \right\}$

$= \frac{1}{18.824} \left\{ 1 - \sqrt{1 - \frac{2 \times 18.824 \times 0.13}{400}} \right\}$

$= 0.00034$ → ρ min > ρ < ρ maks

Karena nilai ρ < ρ min, maka digunakan ρ min

- Luas tulangan utama (As) = ρmin x b x d

= 0.00350 x 300 x 639

= 670.95 mm²

Maka tul. atas digunakan	2	D22	(760.27 mm²)	
Maka tul. bawah digunakan	3	D22	(1140.40 mm²)	Ok!

Foundation calculation

Carrying capacity

DATA BORLOG

Panjang (m)	No BH	Ni	Φ	A	C	SF	Pijin (Ton)	
33.00	BH1	40	0.80	0.5024	40.00	2.50		321.54
33.00	BH 2	32	0.80	0.5024	40.00	2.50		257.23
33.00	BH 3	45	0.80	0.5024	40.00	2.50		361.73

Drill posts in groups

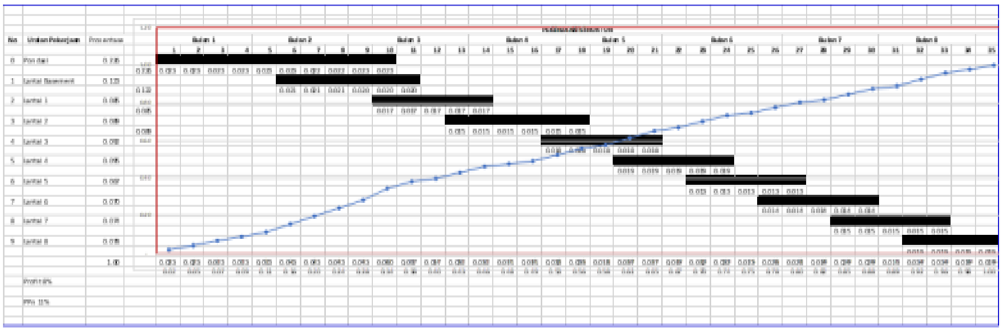
No	Nama Kolom	Reaksi Kolom				Pondasi	Pijin	Pgroup	Ket
		Nu(Ton)	Mu (Ton meter)	Mu (Ton meter)	Vu (Ton)				
1	K1	1031	3.18	2.72	3.14	**Type PC-4**	326	**1304**	**OK**
2	K7	874.99	1.54	0.06	0.95	**Type PC-3**	326	**978**	**OK**
2	K6	407	12.19	0.3	0.31	**Type PC-2**	257	**514**	**OK**

Cost budget plan

No	Uraian Pekerjaan	Harga
0	Pondasi	17,900,513,625.00
1	Lantai Basement	9,779,028,750.00
2	Lantai 1	6,767,410,000.00
3	Lantai 2	7,027,695,000.00
4	Lantai 3	7,287,980,000.00
5	Lantai 4	7,548,265,000.00
6	Lantai 5	5,314,500,000.00

7	Lantai 6	5,580,225,000.00
8	Lantai 7	5,859,236,250.00
9	Lantai 8	6,152,198,062.50
	SUB TOTAL	**79,217,051,687.50**
	Profit 8%	6,337,364,135.00
	PPn 11%	9,410,985,740.48
	TOTAL	**94,965,401,562.98**

Implementation schedule



CONCLUSION

Based on the problems in chapter 1, in this study, it can be concluded as follows: The results of the planning of the Office Building on Jln Basuki Rachmat Surabaya as stated in the discussion, from the planning of the floor slab to the foundation in accordance with the elements in the 8-story Building Building and require a cost of Rp. 94,965,401,000, - and the implementation time takes 35 weeks or ± 8 calendar months.

REFERENCES

National Standardization Agency, 2015, Procedures for Planning Steel Structures for Building Buildings (SNI 03-1729-2015), National Standardization Agency, Jakarta

National Standardization Agency, 2012, Earthquake Resistance Planning Procedures for Building Buildings (SNI 03-1726-2012), National Standardization Agency, Jakarta

Fauzi, A. 2009, Planning Modification Using a Special Concentric Bresing Frame System in Metropolis Apartment Building, Sepuluh Nopember Institute of Technology, Surabaya

Hamdany, Sarwiasih, Han, Himawan. 2014, Study of SRPMK Steel Portal (Daktail) Based on SNI 03-1726-2012 and SNI 03-1729-2002, Diponegoro University, Semarang

Khafis, M. 2009, Steel Structure Planning in a Seven-Story Building as a Hotel, Sebelas Maret University, Surakarta

Moestopo, M. 2007, Some New Provisions Regarding the Design of Earthquake-Resistant Steel Structures, HAKI Seminar and Exhibition, Jakarta

Moestopo, M. 2012, Earthquake Resistant Steel Building Structure, HAKI Seminar and Exhibition, Jakarta

Pujianto, A. 2010, Composite Structure with LRFD, Yogyakarta State University, Yogyakarta

Sarkawi, K. 2002, Structural Planning of Krampung Cotton Building No. 39 Surabaya from Composite Construction Based on SNI 03-1729-2002, Wijaya Kusuma University, Surabaya

Sampakang, JJ. 2013, Planning of a Special Moment Bearing Frame System on Beam-Column Components and Steel Structure Joints of BPJN XI Building, Sam Ratulangi University, Manado

Schodek, Daniel L. 1992, Structure Edition 2, Translation by Bambang Suryoatmono, Erlangga, Jakarta

Setiawan, A. 2008, Steel Structure Planning With LRFD Method (In Accordance with SNI 03-1729-2002), Erlangga, Jakarta

Wijaya, RA. 2012, Effect of Double "X" Bracing Layout on Lateral Displacement in Multi-Storey Room Steel Portal, Universitas Brawijaya, Malang

Widodo. 2010, Validation of Soil Acceleration Parameters and Earthquake Frequency Effect on Multi-Storey Building Structure Response, UII Press Jogjakarta, Yogyakarta

Zulfiana, A. 2012, Study of Semi Rigid Connection and Rigid Connection Type Connection Behavior in Steel Frame Structures That Are Resistant To Earthquake Loads Using Abaqus 6.7, Sepuluh November Institute of Technology, Surabaya.