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STRUCTURE OF EARTHQUAKE RESISTANT CONCRETE BUILDING WITH DUAL SYSTEM USING SNI 1726: 2019 (CASE STUDY: AVENUE 88 APARTMENTS SURABAYA)

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ABSTRACT

The higher a building, the greater the burden due to lateral forces. In the planning of the building structure of Apartment 88 Avenue Surabaya, a Dual system is used. This building planning is based on the Structural Concrete Requirements for Buildings (SNI 2847: 2019). And for earthquakes based on Earthquake Resilience Planning Procedures for Building and Non- Building Structures (SNI 1726: 2019). In the analysis of earthquake loads using dynamic analysis of the Response Specific Trum. The structure is planned to use reinforced concrete construction . The planning method includes the primary structure , namely the dimensioning and reinforcement of the main beam, and the column. And the secondary structure which consists of dimensioning and reinforcing plates, joists. From the results obtained structural design dimensional beam 35/70 cm (5D22; 3D22), the joist 30/55 cm (2D16; 2D16), the floor slab 14 cm thick (D10-275)

Keywords : Earthquake Dinamik , Dual System, Response Specific Trum, SNI 1726: 2019, SNI 2847: 2019

INTRODUCTION

Avenue 88 Apartment is one of the apartments in the Surabaya area which was built as a step to fulfill people's lives for residential areas . This building planning uses a Dual System (dual system structure). Planning building multilevel need to pay attention to several criteria among other criteria of strength, the behavior of the good level of earthquake plan, as well as aspects of the economy. Planning for building multi-storey lots of terms of structure requires consideration of the mature, especially the planning of the building that is resistant to earthquakes. Consideration of the structure is to be influential in determining the alternative planning, for example layout layout columns, long beams and span .

From the above background, this thesis has several formulation issues such as:

1. How to design the structure of the Avenue 88 Apartment building resistant to earthquake ?
2. How to plan beams, column, floor plates, roofing plates according to SNI 2487-201 9 regarding Structural Concrete Requirements for Buildings and Explanation and SNI 1726-2019 regarding Procedures for Designing Earthquake Resilience for Building Structures and Buildings ?

LITERATURE REVIEW

Earthquakes & their causes

Earthquake (earthquake) is the event of shaking or shaking of the earth due to the movement / shift of rock layers on the earth's crust suddenly due to the movement of tectonic plates. (Sunarjo et al, 2012 Page 26). Based on the cause of the earthquake can be grouped into

several types including: tectonic, volcanic, ruins, falling meteors, and man-made earth earthquakes. (Sunarjo et al, 2012 Page 30)

Loading Criteria

Dead load (dead load) is the weight of all components of the structural elements of the building consisting of plates, beam columns, and shear walls. (Budiono et al., 2017: 9). Live load or live load is the load caused by occupancy or use of the building from the goods or the person who can move, resulting in a change in the loading floor d an roof. (Budiono et al., 2017: 9). Earthquake loads are all equivalent static loads that work on buildings or parts of buildings that mimic the effects of ground motion due to the earthquake. (PPURG, 1987).

RESEARCH METHODOLOGY

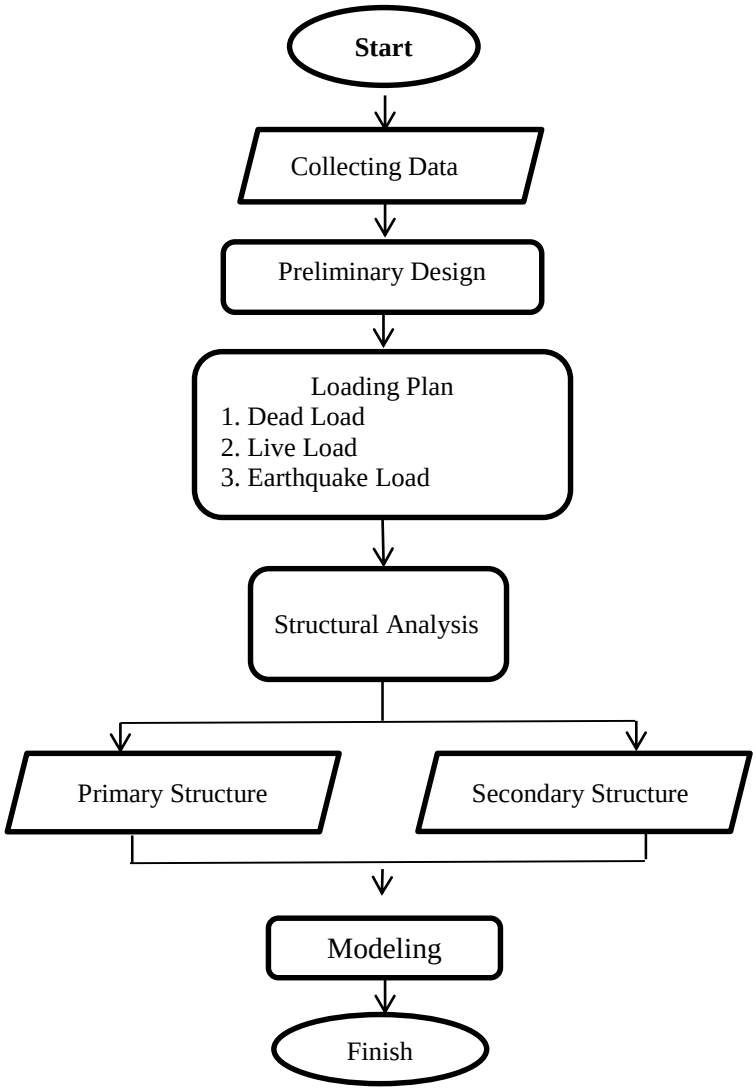

Figure 1. Flow Chart Method

RESULTS AND DISCUSSION

Collecting Data

General Data Building

Building names	: Avenue 88 Apartment
Building location	: Darmo Permai Street, Surabaya, East Java
Building functions	: Apartment
Floors	: 37 floors.

Building height : 128,2 meters.
Main structure : Renforced Concrete

Preliminary Design

- Beam

Table 1. Recapitulation dimentions of Main beam

Code	L (cm)	Hmin+15% (cm)	b (cm)	Dimension
B1	890	63,9	35	35/70
B2	826	59,4	30	30/60

Table 2. Recapitulation dimensions of joist beam

Code	L (cm)	Hmin+15% (cm)	b (cm)	Dimension
BA1	735	52,8	30	30/55
BA2	645	46,3	25	25/50

- Slab

Table 3. Recapitulation dimenstions of Slab

Code	Floor	Thick (mm)	Note
S1	1-7(interior)	140	Two way
S1	8-37	140	Two way
S2	Roof	140	Two way
S3	1-7(exterior)	140	One way

- Shear wall

From the calculation result are 14 cm, then :

$T_{rencana} = 50 > 14$ cm (OK)

- Coloumn

Table 4. Recapitulation dimenstions of Coloumn

Code	Dimention (cm)		
K1	70	x	70
K2	115	x	115
K3	145	x	145
K4	190	x	190

Control Structure Design and Modeling

In modeling the structure using the SAP ETABS 17 the rules SNI 03-1726-2019.

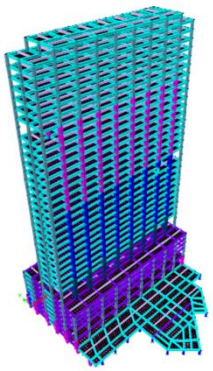

Figure 2. Structure of Building Modeling Planned

- Mass Participation Control

Control of mass participation should include sufficient amount of variance in order to get the mass participation of at least 90% of the actual mass in the horizontal direction orthogonal to the response to be reviewed.

Table 5. Ratio Mass Participation

Case	Mode	Period	SumUX	SumUY	RZ
		Sec			
MODAL	11	0.2683	0,8474	0,8741	0,004
MODAL	12	0.242	0,9172	0,9077	0,0023

- Natural Shakes Time Control Fundamentals

Table 6. Period and Frequency Building Structure

Case	Mode	Period	Frequency
		Sec	Cyc / sec
MODAL	1	6,156	0,162
MODAL	2	5,33	0,188

- Control Story Drift

Table 7. Story Drift X

		R = 7		T = 4		
Story	H (m)	Displacement (mm)	Story Drift	Ratio	Allowable	Check
		δ	Δi	Δm	Δa	
Story 39	3,4	99,034	3,245	15,9005	68	Safe
Story 38	3,4	95,789	3,305	16,1945	68	Safe
Story 37	3,4	92,484	3,323	16,2827	68	Safe
Story 36	3,4	89,161	3,329	16,3121	68	Safe
Story 35	3,4	85,832	3,328	16,3072	68	Safe
Story 34	3,4	85,504	3,322	16,2778	68	Safe
Story 33	3,4	79,182	3,326	16,2974	68	Safe
Story 32	3,4	75,856	3,298	16,1602	68	Safe
Story 31	3,4	72,558	3,286	16,1014	68	Safe
Story 30	3,4	69,272	3,24	15,876	68	Safe
Story 29	3,4	66,032	3,214	15,7486	68	Safe
Story 28	3,4	62,818	3,185	15,6065	68	Safe
Story 27	3,4	59,633	3,156	15,4644	68	Safe

Story 26	3,4	56,477	3,125	15,3125	68	Safe
Story 25	3,4	53,352	3,092	15,1508	68	Safe
Story 24	3,4	50,26	3,059	14,9891	68	Safe
Story 23	3,4	47,201	3,027	14,8323	68	Safe
Story 22	3,4	44,174	2,968	14,5432	68	Safe
Story 21	3,4	41,206	2,931	14,3619	68	Safe
Story 20	3,4	38,275	2,89	14,161	68	Safe
Story 19	3,4	35,385	2,931	13,9062	68	Safe
Story 18	3,4	32,547	2,776	13,6024	68	Safe
Story 17	3,4	29,771	2,709	13,2741	68	Safe
Story 16	3,4	27,062	2,634	12,9066	68	Safe
Story 15	3,4	24,428	2,552	12,5048	68	Safe
Story 14	3,4	21,876	2,463	12,0687	68	Safe
Story 13	3,4	19,413	2,364	11,5836	68	Safe
Story 12	3,4	17,049	2,259	11,0691	68	Safe
Story 11	3	14,78	1,916	9,3884	60	Safe
Story 10	3	12,874	1,837	9,0013	60	Safe
Story 9	3	11,037	1,282	6,2818	60	Safe
Story 8	3	9,755	1,699	8,3251	60	Safe
Story 7	3	8,056	1,625	7,9625	60	Safe
Story 6	3	6,431	1,529	7,4921	60	Safe
Story 5	3	4,902	1,416	6,9384	60	Safe
Story 4	3	3,486	1,265	6,1985	60	Safe
Story 3	3	2,21	1,07	5,243	60	Safe
Story 2	3	1,151	0,738	3,6162	60	Safe
Story 1	3	0,413	0,413	2,0237	60	Safe

Table 8. Story Drift Y

		R = 7		T = 4		
Story	H (m)	Displacement (mm)	Story Drift	Ratio	Allowable	Check
		δ	Δi	Δm	Δa	
Story 39	3,4	89,783	0,866	4,2434	68	Safe
Story 38	3,4	88,917	3,014	14,7686	68	Safe
Story 37	3,4	85,903	3,023	14,8127	68	Safe
Story 36	3,4	82,88	3,013	14,7637	68	Safe
Story 35	3,4	79,867	3	14,7	68	Safe
Story 34	3,4	76,867	2,989	14,6461	68	Safe
Story 33	3,4	73,878	3,005	14,7245	68	Safe
Story 32	3,4	70,873	3,017	14,7833	68	Safe
Story 31	3,4	67,856	2,977	14,5873	68	Safe
Story 30	3,4	64,879	2,902	14,2198	68	Safe
Story 29	3,4	61,977	2,86	14,014	68	Safe
Story 28	3,4	59,117	2,83	13,867	68	Safe
Story 27	3,4	56,287	2,808	13,7592	68	Safe
Story 26	3,4	53,479	2,784	13,6416	68	Safe
Story 25	3,4	50,695	2,758	13,5142	68	Safe
Story 24	3,4	47,937	2,726	13,3574	68	Safe
Story 23	3,4	45,211	2,684	13,1516	68	Safe
Story 22	3,4	42,527	2,62	12,838	68	Safe
Story 21	3,4	39,907	2,609	12,7841	68	Safe
Story 20	3,4	37,298	2,623	12,8527	68	Safe

Story 19	3,4	34,675	2,619	12,8331	68	Safe
Story 18	3,4	32,056	2,602	12,7498	68	Safe
Story 17	3,4	29,454	2,573	12,6077	68	Safe
Story 16	3,4	26,881	2,533	12,4117	68	Safe
Story 15	3,4	24,348	2,478	12,1422	68	Safe
Story 14	3,4	21,87	2,41	11,809	68	Safe
Story 13	3,4	19,46	2,328	11,4072	68	Safe
Story 12	3,4	17,132	2,24	10,976	68	Safe
Story 11	3	14,892	1,911	9,3639	60	Safe
Story 10	3	12,981	1,845	9,0405	60	Safe
Story 9	3	11,136	1,746	8,5554	60	Safe
Story 8	3	9,39	1,63	7,987	60	Safe
Story 7	3	7,76	1,562	7,6538	60	Safe
Story 6	3	6,198	1,486	7,2814	60	Safe
Story 5	3	4,712	1,385	6,7865	60	Safe
Story 4	3	3,327	1,232	6,0368	60	Safe
Story 3	3	2,095	1,023	5,0127	60	Safe
Story 2	3	1,072	0,746	3,6554	60	Safe
Story 1	3	0,326	0,326	1,5974	60	Safe

Primary Structure Planning

- Main Beam

Calculation of reinforcement of beam B1 35/70 at joint 16 As L-N elevation +21.00. Calclation of reinforcement of the main beam is :

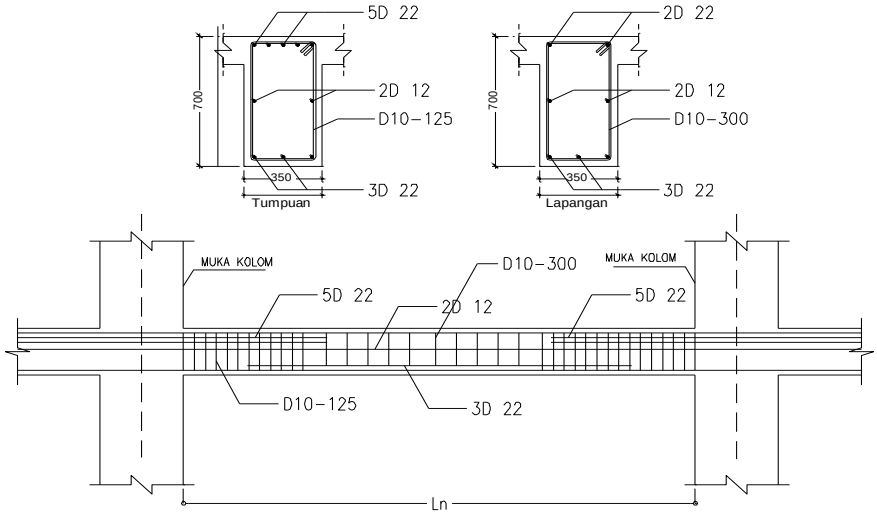

Figure 3. Reinforcement of the main beam

- Coloumn

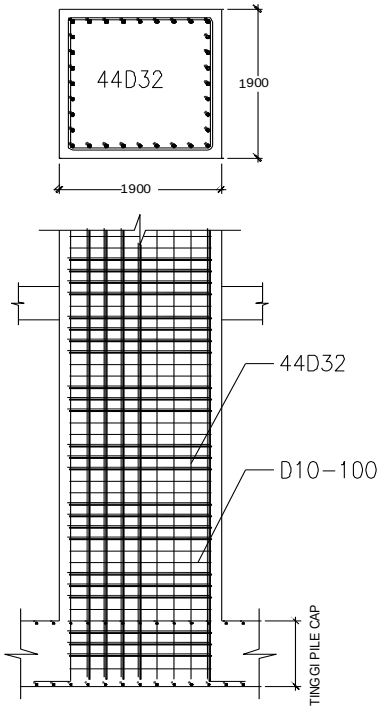

Figure 4. Reinforcement of the coloumn

Secondary Structure Planning

- Slab

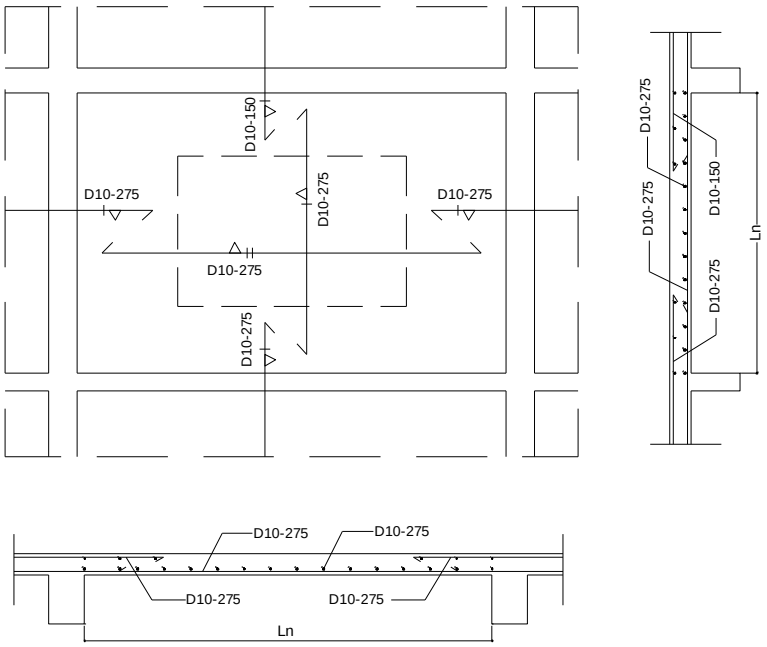

Figure 4. Reinforcement of the Slab

- Joist Beam

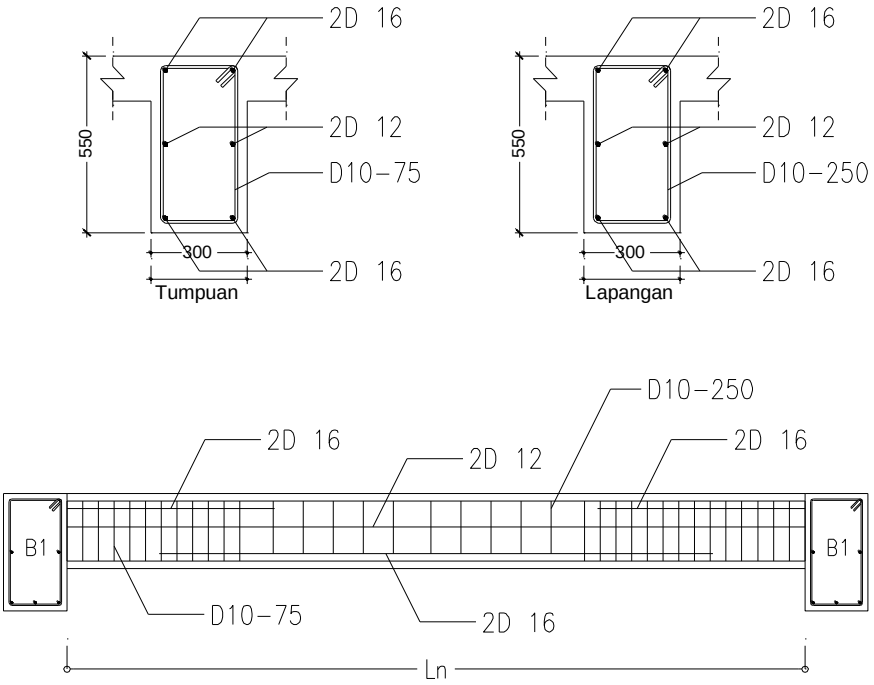

Figure 4. Reinforcement of the Joist Beam

CONCLUSIONS

Conclusion

From the structure analysis using ETABS, the following result are obtained :

1. Earthquake retaining structure is applied is system dual, and incoming seismic design category D. There is final value of the respons spectrum control V dinamic direction of 11,408 kN x and y direction at 11532,6 kN. Vibrating time (t) of 5,1474 seconds. From the calculation of the N-SPT value of 17,68, the classification of land sites is classified as medium (SD)
2. Planning Result :
   a. Beam :

- B1 = Dimention 35/70 cm, Reinforcement 5D22;3D22
- B2 = Dimention 30/60 cm, Reinforcement 4D22;2D22
- BA1 = Dimention 30/55 cm, Reinforcement 2D16 2D16
- BA2 = Dimention 25/50 cm, Reinforcement 2D16:2D16

   b. Slab :
      - S1 (Two way) = 14 cm, Reinforcement D10-275
      - S2 (Two way)= 14 cm, Reinforcement D10-275
      - S3 (One way) = 14 cm, Reinforcement D10-200
   c. Coloumn :
      - K1 = Dimention 70x70 cm (31 – 37 floors), Reinforcement 12D22
      - K2 = Dimention 115x115 cm (21-30 floors), Reinforcement 16D32
      - K3 = Dimention 145x145 cm (11-20 floors), Reinforcement 24D32
      - K4 = Dimention 190x190 cm (1-10 floors), Reinforcement 40D32

Suggestion

1. In order to do the analysis and recalculation control well for the secondary structure, Planning can use steel construction
2. Earthquake analysis can use Time History analysis.

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