BUILDING STRUCTURE DESIGN OF ENGINEERING FACULTY UNIVERSITAS MUHAMMADIYAH SURAKARTA FOUR STORIES USING INTERMEDIATE MOMENT RESISTING FRAME (IMRF)

Proposed Final Project to Meet Most Requirements
Reached the Degree of Bachelor of Engineering in Civil Study Program

Submitted by:

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Student Number: D100122006

to:

CIVIL ENGINEERING STUDY PROGRAM
FACULTY OF ENGINEERING
MUHAMMADIYAH SURAKARTA UNIVERSITY
APRIL, 2019

VALIDATION SHEET

BUILDING STRUCTURE DESIGN OF ENGINEERING FACULTY UNIVERSITAS MUHAMMADIYAH SURAKARTA FOUR STORIES USING INTERMEDIATE MOMENT RESISTING FRAME (IMRF)

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UNIVERSITAS MUHAMMADIYAH SURAKARTA FAKULTAS TEKNIK

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STATEMENT OF GENUINENESS FINAL PROJECT

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I stated in this publication sheet that no work has ever been submited to get bachelor degree at a collage and as I know there is no work or opinion ever written or published by any other person, except in writing referred to the text and mention in refference

If later provide to be unrighteous in my statement above, then I will be fully responsible

Surakarta, April 2019
Who make a statement,

Dewi Shinta D.S

FOREWORD

Assaalamu'alaikum Wa rahmatullahi Wa barakatuh.

All praise be blessed to the presence of Allah SWT over the abundance of grace, taufik and hidayah Him so that the preparation of the final project can be resolved. This Final Project is prepared to complete the requirements to complete the S-1 program at the Faculty of Engineering Department of Civil Engineering Muhammadiyah Surakarta University. Together these authors would like to thank all those who have provided support so that the authors can complete this Final Project.

Then with the completion of this Final Project the authors say many thanks to:

1. Mr. Ir.Sri Sunarjono, M.T, Ph.D., as Dean of the Engineering Faculty, Muhammadiyah Surakarta University.
2. Mr. Mochamad *Solikin*, S.T., M.T., Ph.D as Chairman of the Department of Civil Engineering Faculty of Muhammadiyah Surakarta University also my Supervisor as well as Chairman of the Board of Examiners, who has provided encouragement, direction and guidance.
3. Mr. Gurawan Djati W, S.T, M.Eng as Secretary of Department of Civil Engineering Faculty of Engineering Universitas Muhammadiyah Surakarta.
4. Mr. Budi Setiawan, S.T, M.T. and Mr. Muhammad Ujianto, S.T, M.T, as a member of the Final Task Force Board who has provided encouragement, direction and guidance and advice.
5. All of Lecturers of the Department of Civil Engineering Faculty of Engineering Universitas Muhammadiyah Surakarta thanks for the guidance and knowledge that has been given.
6. Bapak, Ibuk, Mbak Debby, Dek Anisa my lovely family who always gives me both material and spiritual encouragement. Thank you for the prayer and affection that has been given so far, may Allah Subhanahu Wa Ta'ala repay your kindness and always keep in every step and breathe.

7. My friends actually mas Ardi, mba Mya, Oma, Vicky, Mahfudz, Sakti, Mas Asso, Tamzil, Ichwan etc., who always provide moral and spiritual help.
8. All parties who have assisted in completing this Final Report.

The author realizes that the preparation of this Final Report is still far from perfect, so with all humility, constructive criticism and suggestions are highly conceived for future report improvements, and hopefully this report will benefit all of us. Amen.

Wassalamu’alaikum wa rahmatullahi wa barakatuh.

Surakarta, April 2019

Authors

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A = Sectional area of the steel profile bars, cm².

A_{an} = Wide column reinforcement between the join, mm2.

A_{cp} = Overall cross-sectional area, including a hollow cavity in cross section (see shaded area), mm².

A_g = Area of the gross cross section column, mm^2,

A_j = Wide gusset area (joint), mm2.

A_{jh} = Broad horizontal joint shear reinforcement, mm^2,

A_{jv} = Join broad vertical shear reinforcement, mm^2,

A_k = Area of special reinforcement, mm^2,

A_n = A_g-A_{st} = broad net (net) of concrete in a column section, mm2.

A_{oh} = Area bounded begel outermost line, mm^2,

A_s = Area of tensile reinforcement, mm2.

A_s' = reinforcement area compression, mm2.

$A_{s,k}$ = Area of tensile reinforcement column, mm^2,

$A_{s,k}'$ = Area of reinforcement comcompressionion column, mm^2,

$A_{s,min}$ = Area of reinforcement at least according to the requirements, mm2.

A_{st} = Total area of reinforcement, mm^2,

$A_{s,u}$ = Area of tensile reinforcement necessary, mm^2,

$A_{s,u}'$ = Area of reinforcement compression needs, mm2.

A_t = Torsion longitudinal reinforcement area, mm².

A_{vs} = Area of shear reinforcement, mm^2,

A_{vt} = Broad torque reinforcement (stirrups) per meter, in size.

$A_{v,u}$ = Area of shear reinforcement necessary, mm^2,

a = High voltage block concrete square compression equivalently, mm.

B = portal width size in the direction of loading the earthquake, m.

b = Width of beam, mm

= Width of column, mm

bo = circumference of the critical cross-section on the foundation, mm.

C_1 = Earthquake response factor value obtained from the spectrum of the earthquake response plan for a fundamental natural shakes of the building structure.

c = Distance between the edge of the concrete fiber to the neutral line, mm,

D = Deform reinforcement diameter, mm.

d = High measure of structure (Beams, columns, plates, poer), mm.

db = Diameter of main reinforcement, mm.

dp = Diameter shear reinforcement, mm.

DL = Dead load, kN

d_s = Distance between the edge of the drop concrete fiber and the central tension reinforcement weight pull, mm.

d_s' = Distance between the edge of the concrete fiber reinforcement compression and weight center tap, mm.

E = Earthquake load, kN.

= Modulus of elasticity of steel. kg / cm^2,

ed = Eccentricity plan, m.

Fi = Earthquake load the equivalent static nominal catch at the center of mass at the level of the i-th level of the floor on the building structure, kN.

f_c ' = Concrete comcompressionive strength implied, MPa.

f_y = Yield stress of reinforcing steel, MPa,

= Longitudinal reinforcement yield stress, MPa.

g = Acceleration of gravity was set at 9810 mm / sec^2

H = Height of the building, m.

= Rain Water load, not including those resulting puddles, kN.

h = High Beam, Mm.

= High-sectional structure size, mm,

= High steel profile, mm.

= Size of the column height, mm.

= Depth of cracks, m.

= High net column, m.

I = Width field of stamping (aantrede), or the width of the stairs, cm.

= Building primacy factor.

I_1 = Primacy factor to adjust the period related to adjustments earthquake probability of occurrence of the earthquake during the life of the building.

I_2 = Primacy factor to adjust the earthquake return period adjustments related to the age of the building.

i = Radius of inertia stems, cm.

K = Moment factor, MPa.

K_a = Coefficient of active earth compressionure

K_{max} = Factor to bear the maximum moment, MPa.

LL = Live load, kN.

= Distance between frames, m.

= Live Load on the roof, kN.

$M_{D, k}$ = Moment of the column due to an inanimate object, kNm.

$M_{E, k}$ = Moment of the column due to earthquake loads, kNm.

$M_{L, k}$ = Moment of the column due to living matter, kNm.

M_p = Torque, kNm.

$M_u^{(+)}$ = Moment ultimate of positive, kNm.

$M_u^{(-)}$ = Moment ultimate of negative, kNm.

$M_{u, b}$ = Moment ultimate of beams, kNm.

$M_{u, k}$ = Moment ultimate, kNm.

N = Compression on rod, kg.

$N_{u, k}$ = Normal force necessary columns, kN,

n = Number of floors of the building structure.

= Floor number topmost level.

P_a = Total active earth compressionure, kN / m.

P_o = Centric axial load or axial load on the column axis, kN.

$P_{U, k}$ = Normal force necessary columns, kN,

$P_{u, k, max}$ = Maximum column normal force necessary, kN.

R = Reduction factor which depends on factors ductility of the building.

= Reaction caused by the loads that are working, kg.

R_v = Reduction factor the number of floors above the level of the column being reviewed.

S = SPAN beam mounted stirrup torque = 1000 mm.

T = High-field ramp (optrede), or the height of the stairs, cm.

Tn = Strong nominal torque, kNm.

Tr = Torque / torque plan, kNm.

T_u = Factored torque or torque necessary, kNm.

T_1 = Time of natural shakes fundamental structure of the building, second.

t_b = Thick steel profile body, mm.

t_s = Wings Thick steel profiles, mm.

V = Load (force) base shear nominal equivalent static earthquake due to the influence of the work plan on the ground level of the building structure of irregular, kN.

V_c = Shear strength of concrete, kN.

V_u = Shear force necessary, N.

W = Wind load, kN.

W_i = Heavy-th floor level on a building structure, including the appropriate live load, kN.

W_t = Total weight of the building, including the appropriate live load, kN.

Zi = Height of the floor level of the i-th a building structure against lateral clamping level, m.

α = Reinforcement location factor.

αk = Distribution factor of the column to be reviewed moment.

β = Factors coatings

δ = Thick gusset plate, mm.

δ_{max} = Maximum deflection, cm.

δx = Deflection in the x direction, cm.

$\delta_{□}$ = Deflection in the y direction, cm.

ε'c = Strain of concrete, mm.

εs = Tensile strain of reinforcing steel, mm.

ϕ = Strength reduction factor,

γ = Heavy soil types, tons / m^3,

φ = Angle shear.

λ = Factor of lightweight aggregate concrete.

λ_d = Length distribution of tensile reinforcement, mm.

λ_{dh} = Length distribution hooks, mm.

λ_{hb} = Length of the base distribution, mm.

λo = Distance from the face of the column plastic hinge, m.

μ = Ductility factor of the building structure can be selected according to need.

θ = Crack angle = 45^o for non prestressed.

ρ = Reinforcement ratio,%.

ρ_{max} = Maximum reinforcement ratio,%.

ρ_{min} = Minimum reinforcement ratio,%.

ρt = Exist reinforcement ratio,%.

$\overline{\sigma}$ = Voltage steel base, kg / cm^2,

σd = voltage urges bolt, kg / cm2.

$\overline{\sigma}_{kip}$ = Voltage kip, kg / cm^2,

σl = Voltage of melting steel, kg / cm^2,

$\overline{\sigma}_t$ = Tensile steel permits, kg / cm^2,

$\overline{\tau}_{bolt}$ = Shear bolts permit, kg / cm2.

$\overline{\tau}_{bh}$ = Gusset plate shear stress permits, kg / cm2.

ω = Buckling factor that depends on slimness (λ) And the kinds of steel.

ζ (Zeta) = Coefficient multiplier of the number of levels that limit the building structure T_1 depending on the region of the earthquake.

BUILDING STRUCTURE DESIGN OF ENGINEERING FACULTY UNIVERSITAS MUHAMMADIYAH SURAKARTA FOUR STORIES USING INTERMEDIATE MOMENT RESISTING FRAME (IMRF)

ABSTRACT

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The number of UMS engineering student is increased year by year, due to limited space so that UMS have to enlarge the area of building faculty. Therefore, to resolve that problem, it will be designed engineering faculty building four floors using intermediate moment resisting frame (IMRF). This design of building structure refers to the latest published SNI-1726:2012 (*Tata Cara Perencanaan Ketahanan Gempa Untuk Struktur Bangunan Gedung Dan Non Gedung*) and SNI-2847:2013 (*Persyaratan Beton Struktural Untuk Bangunan Gedung*). The design of this building includes roof structure, slab structure (floor slab, stairs), and main structure (upper and under structure). This building is located in Surakarta with the value of seismic importance factor (Ie) is 1.5 (for building school), seismic factor (R) is 5 using dynamic method. Using concrete quality (f'_c) 25 MPa, and main reinforcement quality (f_y) 400 MPa and shear reinforcement (f_y) 240 MPa. The main structure designed with two types of column dimension and beam dimension. Column dimension are 800/800 mm and 700/700 mm, while beam dimension are 400/600 mm and 600/800 mm. The bottom structure designed using a pile foundation diameter 400 mm with depth 18 m, poer dimension 3200x3200x1250 mm for 4 piles, and sloof dimension 450/250.

Keyword: Building structure design, intermediate moment resisting frame (IMRF), dynamic method

DESAIN STRUKTUR GEDUNG FAKULTAS TEKNIK UNIVERSITAS MUHAMMADIYAH SURAKARTA EMPAT LANTAI MENGGUNAKAN SISTEM RANGKA PEMIKUL MOMEN MENENGAH (SRPMM)

ABSTRAK

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Jumlah mahasiswa teknik UMS meningkat dari tahun ke tahun, karena terbatasnya lahan maka UMS harus memperluas lahan gedung fakultas teknik. Oleh sebab itu, untuk menyelesaikan permasalahan tersebut direncanakan gedung fakultas teknik empat lantai menggunakan Sistem Rangka Pemikul Momen Menengah (SRPMM). Perencanaan struktur gedung mengacu pada peraturan terbaru yaitu SNI-1726:2012 (Tata Cara Perencanaan Ketahanan Gempa Untuk Struktur Bangunan Gedung Dan Non Gedung) dan SNI-2847:2013 (Persyaratan Beton Struktural Untuk Bangunan Gedung). Perencaan gedung ini meliputi struktur atap, struktur plat (plat atap, plat lantai, tangga), dan struktur gedung utama (struktur atas dan struktur bawah). Gedung ini berlokasi di Surakarta dengan nilai faktor keutamaan gempa (Ie) adalah 1.5 (untuk gedung sekolah), faktor gempa (R) adalah 5 menggunakan metode dinamik. Menggunakan kualitas beton (f'_c) 25 MPa, dan kualitas tulangan utama (f_y) 400 MPa dan tulangan geser (f_y) 240 MPa. Struktiur utama direncanakan dengan dua tipe dimensi kolom dan balok. Ukuran kolom yaitu 800/800 mm dan 700/700 mm, sedangkan ukuran balok yaitu 400/600 mm dan 600/800 mm. Struktur bawah menggunakan pondasi tiang pancang dengan diameter 400 mm dan dalam 18 m, ukuran poer 3200x3200x1250 mm untuk 4 tiang, dan ukuran sloof adalah 450/250.

Kata Kunci: Perencanaan struktur gedung, Sistem Rangka Pemikul Momen Menengah (SRPMM), metode dinamik