DESIGN 10 STORY HOSPITAL BUILDING IN KLATEN WITH DIRECT DISPLACEMENT BASED DESIGN METHOD

Final Project

final project as part of

Civil Engineering Bachelor Degree requirement

Submitted by:

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For:

CIVIL ENGINEERING DEPARTMENT ENGINERING FACULTY

UNIVERSITAS MUHAMMADIYAH SURAKARTA

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APPROVAL SHEET

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I hereby certify that this final project has been composed by me and is based on my own work, unless stated otherwise. No other person's work has been used without due acknowledgement in this final project. All references and verbatim extracts have been quoted, and all sources of information, including graphs and data sets, have been specifically acknowledged. This paper was not previously presented to another examination board and has not been published.

Surakarta, August 9th 2023

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PREFACE

Assalamu'alaikum Wr. Wb.

Alhamdulillah, all praise to Allah SWT who has given blessing and mercies until this Final Project can be completed. This Final Project is to complete the requirement to achieve Bachelor of Engineering degree in Civil Engineering, Engineering Faculty, Universitas Muhammadiyah Surakarta. The author also says thank you to all parties below who has given support in completion of this Final Project:

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Surakarta, Ausgust 9th 2023

Author

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NOTATIONS

f_u	: Steel ultimate stress, MPa
f'_c	: Concrete quality, MPa
f_y	: Steel yield strength, MPa
f_{ye}	: Reinforcement effective yield strength, MPa
g	: Gravity acceleration, 9.81 m/sec^2
H_{cf}	: Height of wall contraflexure
H_e	: Effective height, m
H_{i+1}	: Height at level i+1, m
H_i	: Height at level i, m
H_n	: Structure height at the level of-i, m
L_b	: Clear length of the structure beam, m
L_p	: Plastic hinge length, m
L_{sp}	: Strain penetration length to foundation, m
L_w	: Shear wall length, m
k	: Constanta
K_e	: Lateral effective stiffness, kN/m
Ke	: System effective stiffness, kN/m
K_i	: Elastic lateral stiffness, kN/m
m_e	: Effective mass
m_i	: Story mass at the level of-i
M_{OTM}	: Total overturning moment at the structure base

$M_{OTM,F}$	: Total overturning moment at the frame
$M_{OTM,i}$	: Total overturning moment at the level of-i
$M_{w,i}$	: The unit of moment that occurs at the height of level i
$M_{,wI+1}$	: The unit of moment that occurs at the height of level i+1
n	: Number of stories
R	: Necessary elastic strength ratio due to calculated yield strength
$R\xi$	: Spectra displacement correction factor at the damping level
S_a	: Spectra acceleration, g
S_d	: Spectra displacement, m
T	: Fundamental period, second
T_e	: Effective period, second
T_0	: Characteristic period which getting from response spectrum curve
T_1	: Elastic period, second
V	: Base shear, kN
V_{Base}	: Total base shear, kN
V_F	: Frame base shear, kN
V_i	: Total shear force at the level of-i, kN
V_w	: Shear wall base shear, kN
V_y	: Base shear when the structure yield, kN
V_{Wi+1}	: The unit of shear force that occurs at the height of i + 1
W	: Structure weight, Kn
$w_{i/g}$	: Mass at the level of-i

α_1 : Modal coefficient mass at the first mode

β_{eq} : Structure viscous damping equivalent, %

β_F : Frame shear force ratio, %

β_o : Hysteretic damping which represent viscous equivalent, %

δ_T : Displacement target, m

Δ_{yi} : Yield displacement profile, m

Δ_{Di} : Displacement design profile, m

Δ_i : Drift at the level of-i, m

Δ_{roof} : Roof drift, m

Δ_{yW} : Yield drift at the shear wall when reach the effective height

ε_y : Reinforcement strain at the beam (f_{ye}/E)

θ_{cF} : Drift at the contraflexure height, H_{CF}

θ_c : Drift limit

μ_F : Ductility displacement of the frame system

μ_{Sys} : Ductility displacement of the system

μ_W : Ductility displacement of the shear wall

ξ_{eq} : Equivalent viscous damping, %

ξ_{el} : Initial elastic damping 5% ordinary value

ξ_f : Effective concrete frame damping, %

ξ_{hyst} : Hysteretic damping from the structure system, %

ξ_W : RC-Walll effective damping, %

φ_{yW} : Yield curvature, /m

φ_{il} : Mode-1 amplitude at the level of-i

ω_{θ} : Correction factor

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Abstract

Indonesia as a country located inside ring of fire made this country have prone to earthquake. It forced the structure engineer to build design as efficient as possible to resulting the adequate building design. Direct Displacement Based Design (DDBD) is a method which developed as an alternative to design the structure as efficient due to the performance of the building. This final project was designing 10 stories hospital building located in Klaten, Central Java, Indonesia. The structure using dual system structure and stand above the middle soil classification. The applied earthquake loads in the building conduct by Direct Displacement Based Design method then detailing by SNI 2847:2013 code. The design evaluated by conducting Nonlinear Static Pushover Analysis to acknowledge the performance according to FEMA 440. The result shows that the performance point of the structure is on immediate occupancy and meet the hospital design criteria. Drift result showing 0,004 for x direction and 0,005 for y direction. According to deformation limit at Table 11 – 4, ATC-40 for hospital building importance, performance target only allows on immediate occupancy level, which the maximum inelastic drift is 0,005. Due to the inelastic drift result, the structure meets the design criteria for Immediate Occupancy performance level on X and Y direction.

Keywords: DDBD, Nonlinear Static Pushover, Seismic Engineering, Engineering