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**Research Paper**

# Design Upper Structure of the Health Sciences Building In Malang City in Accordance With Indonesia's Code Construction Latest

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***ABSTRACT:*** *Education building is one facility used To support continuity system education With founded Health Sciences building , then planned development building education For support from system education in the Faculty Health Sciences . this building is planned be one centre of education activity. Facility education (building) According to SNI (Indonesia's Construction Code)1726-2019, mentions that building education enter in category risk 4 which is category risk the highest set and the SNI (Indonesia's Construction Code). So that design from building building education This must in be accordance with rules stipulated by SNI (Indonesia's Construction Code) and other relevant regulations ( Code ) , as well as building construction other . because _ it is necessary accompanistment technical related planning structure building stand earthquake with application rules planning building in accordance with SNI (Indonesia's Construction Code)or Applicable code . Method used in carry out activity This is form survey, coordination with various multidiciplinary, making draft design structure , making the modeling structure , analyze design and deliver recommendation form product end. .*

***KEYWORDS:*** *Education Building , Structure Building , Resisting Frame*

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## I. INTRODUCTION

This building built as building intended operation For room dean , place lectures, and spaces others used For support system lectures. Related with plan development building operational series activity start done. The activity in question is do accompaniment consultation technique related planning structure building. With objective activity For produce document technical related planning structure building. Hope from studies This is as form application analysis and design structure that refers to the latest SNI regulations moment This that is (SNI 1726-2019, 2019; SNI 2847-2019, 2019) And (SNI 1727-2020, 2020). With issuance of the latest SNI such , then building to be built must apply, and also old buildings that have awakened must be re -analyzed against the SNI . this For ensure safety existing construction. In accordance with the analysis that has been implemented by [1]. That happen enhancement style shift base earthquake and some coefficient earthquake. In matter This can result exists enhancement need element along the detailing .

## II. METHOD

- **Survey Stage**
  Activity survey condition exist For can see conditions that exist on site planning building . Survey done to form something base in planning and modeling building.

- **Discussion Stage**
  In stage, This needed coordination between field skills with party related like for example team architect and team mechanical.

- **Modelling and Structure Analysis Stage**
  Modelling analysis structure carried out in the auxiliary program based method element to ( Finite Element Method).

- **Design Element Stage**
  At this stage. is end for produce product picture design structure (define size dimensions column beam Foundation along the reinforcement). Reference used in analysis structure by following : (SNI 1726-2019, 2019; SNI 1727-2020, 2020; SNI 2847-2019, 2019; [5].

- **General Data**
  Location : Malang
  Function Building : Educational Building

- **Technical Data**
  Number of Stories : 5 Functional Levels
  Total Height : 23.3 m
  Type Building : Concrete boned
  System Structure : *One System* , SRPM
  Roof Type : Profile Steel Frame

**Figure1:** Visualization Building Architecture

## III. RESULTS

- **Modelling Structure**

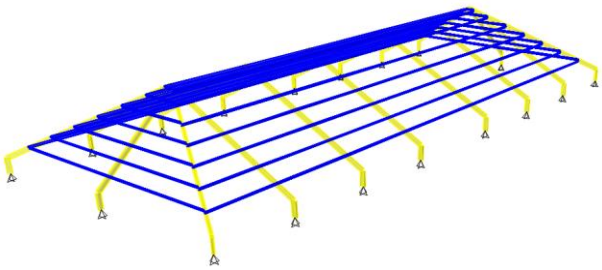

**Figure2:** 3D perspective roof structure

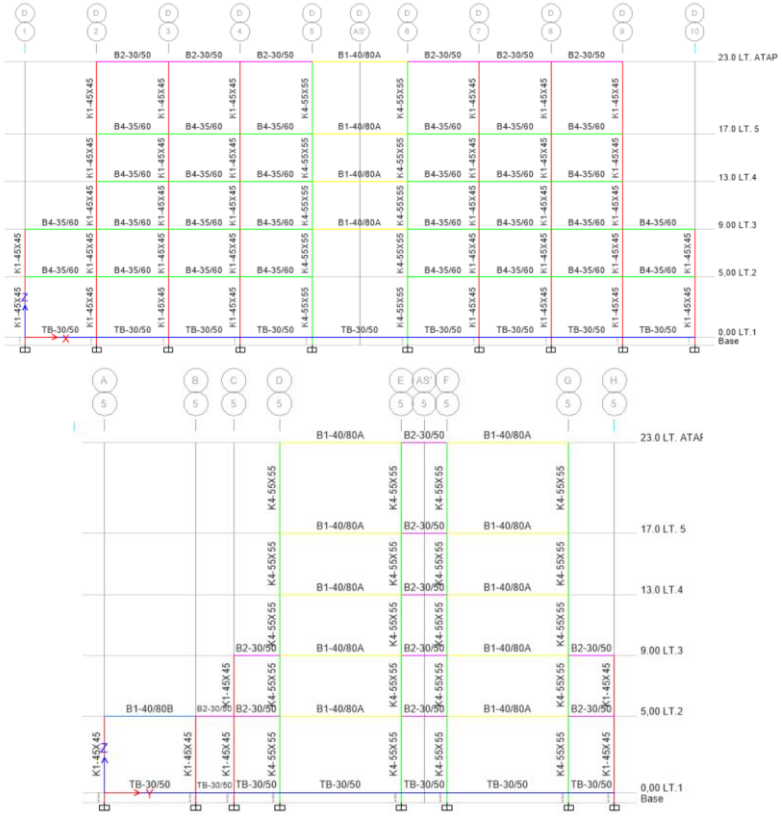

**Figure3:** Cross and Long Grid Section of Buildings Modelling

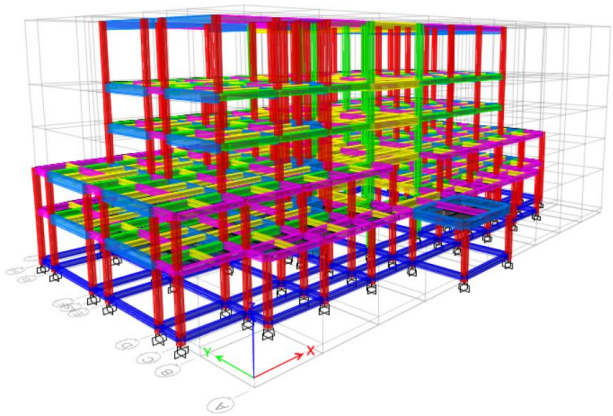

**Figure4:** 3D perspective of a building

- **Loading in Structure**
  - **Roof Loading – SelfWeight**

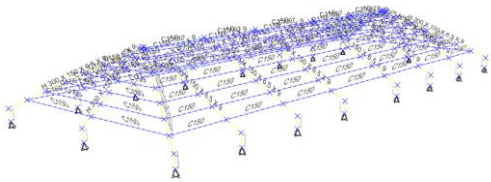

**Figure5:** Assign Load for Roofing SelfWeight

  - **Roof Loading – Super Imposed Dead Load**

Dead load addition is burden dead on the structure. However No modeled in analysis structure . In matter This is on the load-bearing roof structure dead addition in accordance in figure is

form heavy roof covering. As for the load dead extra used _ is roof covering type Zincalume ie 5.2 kg/m$^2$ ( obtained from catalogue data product ).

P = 5.2 × distance between sawhorse × distance between gording

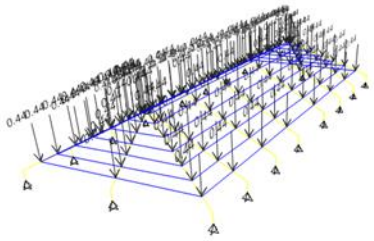

**Figure6:** Assign load dead addition ( kN )

- **Roof Loading – Live Load**

Live load is all burden characteristic No permanent at each when, but there is possibility deep condition ultimate Where occupants building in accordance function all Work in a manner full. Especially on the roof, load originating life from rainwater and loads workers in Century construction.

- Work Load = P = 100 kg
- Rainwater load used is load area on the roof with calculation as following :

P = 40 – (0.8 × α )
= 40 – (0.8 × 37 )
= 10.4 kg/m$^2$

P = 10.4 × distance between horses × distance between gording

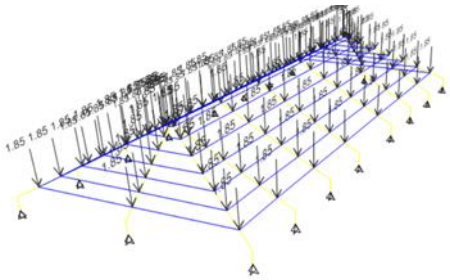

**Figure7:** Assign load Workers + Rainwater Load ( kN )

- **Roof Loading – Wind Load**

As for the load wind plan used on the structure This is 70 kg/m $^2$ . wind load Then shared to in 2 types direction that is burden wind press and wind suction .

Wind Pressure

Koef . wind pressure = (0.02 × roof angle ) – 0.4

W $_1$ = Coef . wind press × load wind
= 0.34 × 30
= 10.2 kg/m $^2$

P = 10.2 × distance between horses × distance between gording

- **Frame Loading – SelfWeight**

Heavy itself on the structure on is form heavy on the elements beams , columns and slabs floor . In accordance with modeling in figure 11.

Concrete = 2400 kg/m $^3$ = 23.536 kN /m$^3$
Steel = 7850 kg/m $^3$ = 76.982 kN /m$^3$

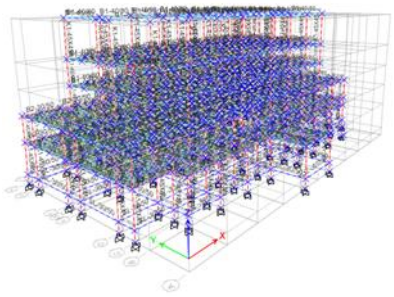

**Figure8:** Assign burden selfweight 3D portal structure Building

- **Frame Loading – Super Imposed Dead Load**

As for the load dead additions applied to the structure is form heavy wall ( *line frame load* ) or heavy *finishing* work floor ( *surface loading* ).

***finishing* load**

As for the load dead plate used for all type plate in structure This is as following :

| | | |
|---|---|---|
| Mixture (2 cm) | = 2 × 0.21 kN /m2 | = 0.442 kN /m $^2$ |
| Ceramic (1 cm) | = 1 × 0.24 kN /m2 | = 0.24 kN /m $^2$ |
| Sanitation + Plumbing | | = 0.16 kN /m $^2$ |
| Installation Mechanical and Electrical | | = 0.25 kN /m $^2$ |
| Ceiling and Suspension | | = 0.18 kN /m $^2$ |
| *Total* | | *= 1.226 kN /m $^2$* |

As for the load dead plate used _ For all type plate in structure This is as following :

**Table 1**Wall load

| Q | BJ Dinding (kN/m$^3$) | Tinggi Dinding (m) | Tebal Dinding (m) | Efektif Luas Dinding (%) | Q (kN/m) |
|---|---|---|---|---|---|
| LT.1 | | | | | |
| | 6,50 | 5 | 0,15 | 80% | 3,90 |
| | 6,50 | 5 | 0,15 | 50% | 2,4375 |
| LT.2 – LT4 | | | | | |
| | 6,50 | 4 | 0,15 | 80% | 3,12 |
| | 6,50 | 4 | 0,15 | 50% | 1,95 |
| LT.5 | | | | | |
| | 6,50 | 6 | 0,15 | 80% | 4,68 |
| | 6,50 | 6 | 0,15 | 50% | 2,925 |

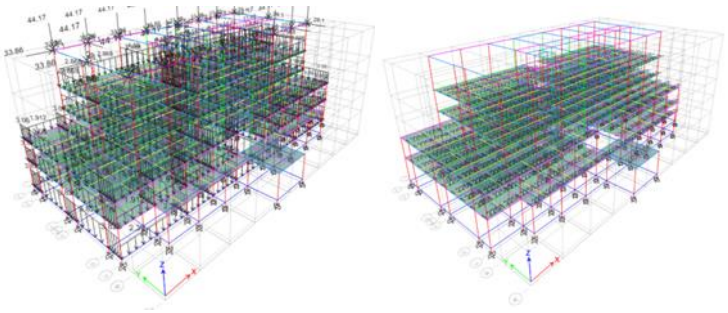

**Figure9:** Assign Superimposed Dead Load

- **Frame Loading – Live Load**

Live load is all occurring load _ consequence occupants or user something building, incl burdens possible structure move. As for the load service used from building This is burden equally floor with magnitude as following in accordance table below :

**Table 2**. Live load Used

| Function | Live Load kN /m$^2$ |
|---|---|
| Office | 2,4 |
| Auditorium | 4.79 |
| Archive Room | 4.79 |
| Friend Room , Chair Still | 4.79 |
| Podium floor | 7,18 |
| Corridor Floor First | 4.79 |
| Corridor above _ Floor First | 3.83 |
| Classroom _ | 1.92 |
| Ladder Permanent | 4.79 |
| Flat Dak Roof | 0.96 |
| Warehouse | 4.79 |
| Praying room | 4.79 |
| Library | 2.87 |
| Storage Room Library | 7,18 |
| Balcony and Deck | 3.83 |

**Figure10:** Assign live on the 5th floor of the building (example)

- **Frame Loading – Earthquake Load**

Before analysing an earthquake, the parameters of the earthquake must be calculated is determine the type of land in accordance with the condition building to be built. this _ later will affect on style the earthquake that occurred in the structure, because different type of land will produce mark acceleration in different earthquake.

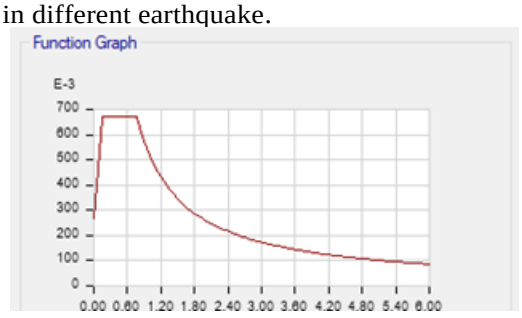


**Figure11:** Acceleration and period earthquake land while Malang City Region

*Scales* factor = g. I/R

g = 9.81

I = 1.5 ( Factor Priority earthquake ,with Risk Category IV)

R = 8.0 ( Coefficient modification response )

# IV. DISCUSSION

- **Center of Mass and Center of Rigidity**

**Table 3**. Coordinate of CoM & CoR

| TABLE: Centers of Mass and Rigidity | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Story | Diaphragm | Mass X | Mass Y | XCM | YCM | Cumulative X | Cumulative Y | XCCM | YCCM | XCR | YCR | Eksentrisitas | | Eksentrisitas | |
| | | kgf-s²/m | kgf-s²/m | m | m | kgf-s²/m | kgf-s²/m | m | m | m | m | x (m) | y(m) | x (%) | y (%) |
| 5,00 LT.2 | D1 | 77971,2 | 77971,2 | 28,0 | 19,9 | 77971,2 | 77971,2 | 28,0 | 19,9 | 27,4 | 19,0 | 0,6 | 0,9 | 2,89% | 3,43% |
| 9.00 LT.3 | D2 | 68339,6 | 68339,6 | 28,0 | 21,1 | 68339,6 | 68339,6 | 28,0 | 21,1 | 27,3 | 19,7 | 0,7 | 1,5 | 3,13% | 5,43% |
| 13.0 LT.4 | D3 | 47011,0 | 47011,0 | 28,0 | 21,0 | 47011,0 | 47011,0 | 28,0 | 21,0 | 27,2 | 20,1 | 0,8 | 0,9 | 3,95% | 3,21% |
| 17.0 LT. 5 | D4 | 50780,5 | 50780,5 | 28,6 | 21,0 | 50780,5 | 50780,5 | 28,6 | 21,0 | 27,1 | 20,3 | 1,6 | 0,7 | 7,44% | 2,52% |

- **Participating Mass Ratio**

**Table 4**. Participating Mass Ratio

| Case | Mode | Period | UX | UY | UZ | Sum UX | Sum UY | Sum UZ | RX | RY | RZ | Sum RX | Sum RY | Sum RZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | sec | | | | | | | | | | | | |
| Modal | 1 | 0,927 | 0,7433 | 0,0327 | 0 | 74% | 3% | 0% | 0,0089 | 0,1701 | 0,0366 | 1% | 17% | 4% |
| Modal | 2 | 0,895 | 0,0468 | 0,7285 | 0 | 79% | 76% | 0% | 0,1818 | 0,0107 | 0,0207 | 19% | 18% | 6% |
| Modal | 3 | 0,796 | 0,0195 | 0,0402 | 0 | 81% | 80% | 0% | 0,0066 | 0,0062 | 0,6731 | 20% | 19% | 73% |
| Modal | 4 | 0,407 | 0,0021 | 0,0123 | 0 | 81% | 81% | 0% | 0,0595 | 0,0249 | 0,1177 | 26% | 21% | 85% |
| Modal | 5 | 0,381 | 0,0741 | 0,0023 | 0 | 89% | 82% | 0% | 0,0136 | 0,4351 | 0,0064 | 27% | 65% | 85% |
| Modal | 6 | 0,374 | 0,001 | 0,0762 | 0 | 89% | 89% | 0% | 0,4204 | 0,0035 | 0,0171 | 69% | 65% | 87% |
| Modal | 7 | 0,332 | 0,0094 | 0,0000 | 0 | 90% | 89% | 0% | 0,00003072 | 0,0571 | 0,0002 | 69% | 71% | 87% |
| Modal | 8 | 0,288 | 0,0001 | 0,0021 | 0 | 90% | 89% | 0% | 0,0081 | 0,0002 | 0,0003 | 70% | 71% | 87% |
| Modal | 9 | 0,273 | 0,0001 | 0,0037 | 0 | 90% | 90% | 0% | 0,0106 | 0,0005 | 0,0002 | 71% | 71% | 87% |
| Modal | 10 | 0,256 | 0,0003 | 0,0006 | 0 | 90% | 90% | 0% | 0,0003 | 0,0007 | 0,0105 | 71% | 71% | 88% |
| Modal | 11 | 0,246 | 0,0104 | 0,0003 | 0 | 91% | 90% | 0% | 0,0007 | 0,0186 | 0,0019 | 71% | 73% | 88% |
| Modal | 12 | 0,243 | 0,0008 | 0,0012 | 0 | 91% | 90% | 0% | 0,0025 | 0,001 | 0,0007 | 71% | 73% | 89% |

So from table above can be concluded that participation mass has been achieved where in mode 9 only ( already exceeds 90%) and has capable fulfil condition participation mass according to seismic SNI.

- **Interstory Drift**

**Table 5**. Interstory Drift X- Direction

| Story | Load Case/Combo | Direction | Maximum mm | Tinggi Lantai | Deformasi Lantai (mm) | Deformasi Ijin (mm) 0,015 x hsx | Keterangan |
|---|---|---|---|---|---|---|---|
| LT.5 +17 | RSPX Max | X | 29,54 | 4000 | 29,54 | 60,00 | Memenuhi |
| LT.4 +13 | RSPX Max | X | 24,92 | 4000 | 24,92 | 60,00 | Memenuhi |
| LT.3 +9,00 | RSPX Max | X | 18,85 | 4000 | 18,85 | 60,00 | Memenuhi |
| LT.2 +5,00 | RSPX Max | X | 12,2 | 5000 | 12,2 | 75,00 | Memenuhi |

**Table 6**. Interstory Drift Y- Direction

| Story | Load Case/Combo | Direction | Maximum mm | Tinggi Lantai | Deformasi Lantai (mm) | Deformasi Ijin (mm) 0,015 x hsx | Keterangan |
|---|---|---|---|---|---|---|---|
| LT.5 +17 | RSPY Max | Y | 32,46 | 4000 | 32,46 | 60,00 | Memenuhi |
| LT.4 +13 | RSPY Max | Y | 26,51 | 4000 | 26,51 | 60,00 | Memenuhi |
| LT.3 +9,00 | RSPY Max | Y | 19,27 | 4000 | 19,27 | 60,00 | Memenuhi |
| LT.2 +5,00 | RSPY Max | Y | 12,13 | 5000 | 12,13 | 75,00 | Memenuhi |

From table above show that drift/deformation structure occurring in the building has fulfilled condition deformation regulated by SNI.

- **Concrete Design**

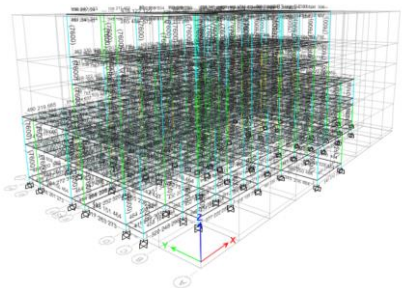

**Figure12:** Concrete Design

Based on the figure above, shows that concrete 3D portal boned fulfil / strong. However, will still validate with use manual calculation.

## V. CONCLUSION

This Report Is Handle In Planning Construction Of Education Building, Malang City in Indonesia . With Arranged This Report Is Expected Building Physique Awakened In Accordance With Planned Recommendations, So That Building Can Reach Performance Good Performance Structure Inside Accept Working Load according Latest Code in Indonesia.

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3. UB Malang Faculty of Health Building Planning Team.
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## REFERENCES

[1]. Indra Surya Pratama , A., & Jonbi . (2022). Analysis Structure Based on Application Sni 1726-2019 and Sni 2847-2019 in the Female Apartment Building of the Indonesian International Islamic University . Journal Artesian , 2 (1), 1–12. https://journal.univpancasila.ac.id/index.php/ARTESIS/article/download/3754/1910

[2]. SNI 1726-2019. (2019). SNI 1726-2019 Planning Procedures resilience Earthquake For Structures Building and Non Building .

[3]. SNI 1727-2020. (2020). SNI 1727-2020 Specifications for Structural Steel Buildings . www.bsn.go.id

[4]. SNI 2847-2019. (2019). SNI 2847-2019 Requirements Concrete Structural for Buildings and Explanations . In 2019 . www.bsn.go.id

[5]. Tavio , & Usman Wijaya. (2020). Structural Design Manual Concrete Basic Bones : Vol. Vol. 1 . deeppublish .