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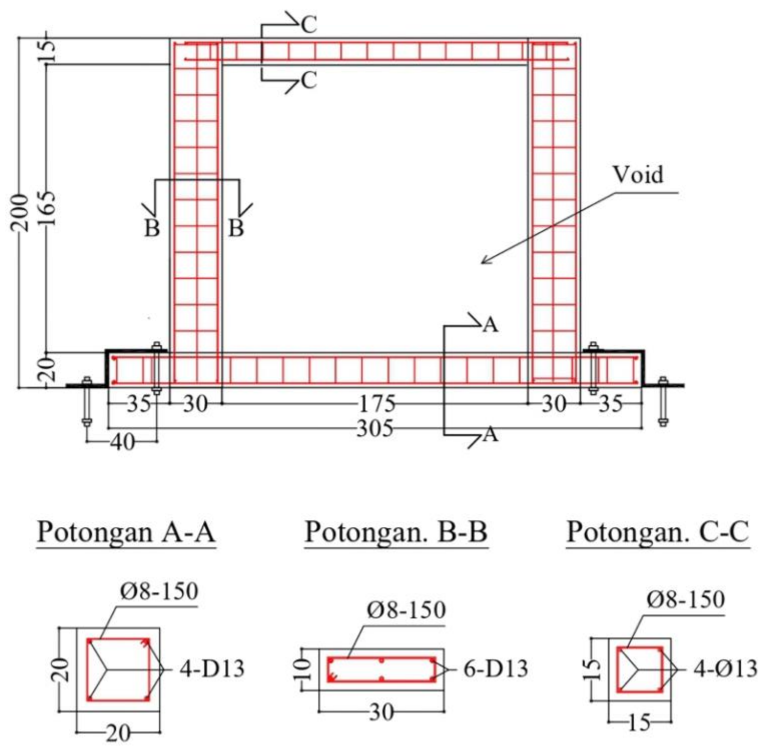
# LAMPIRAN 1

## Perencanaan Desain Struktur Portal Rangka Beton Bertulang

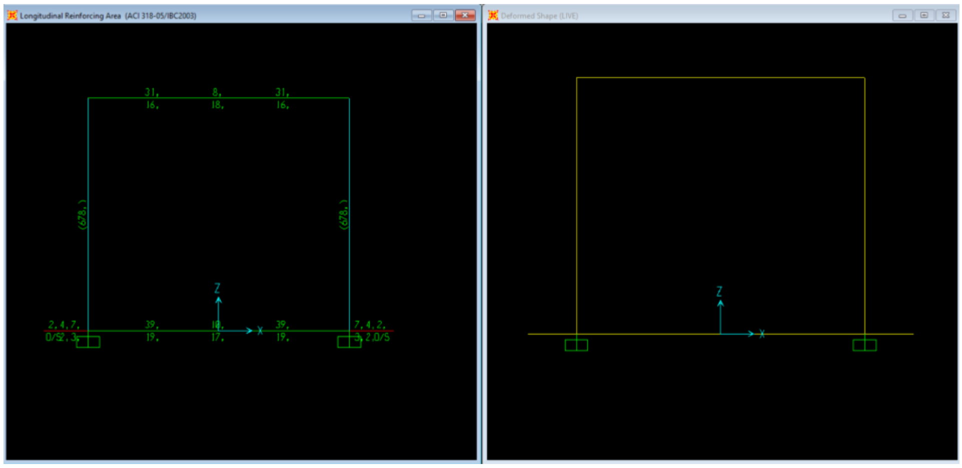
Perencanaan desain struktur portal rangka beton bertulang didasarkan kepada spesifikasi beton dan tulangan yang umum digunakan untuk konstruksi rumah 1-2 lantai. Berdasarkan dimensi penamapang elemen struktur tersebut kemudian dilakukan analisa kekuatannya dalam menahan gaya pada struktur menggunakan SAP 2000.




Mutu Beton Kolom K350 (fc 29.0 MPa)

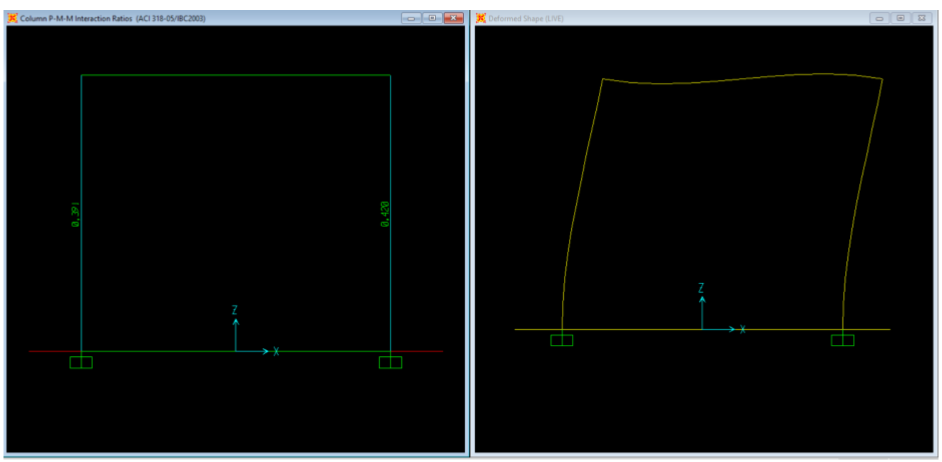
Mutu beton balok atas K350 (fc 29.0 MPa)

1. Pada Pembebanan 10 kN



Balok Atas 15x15 cm

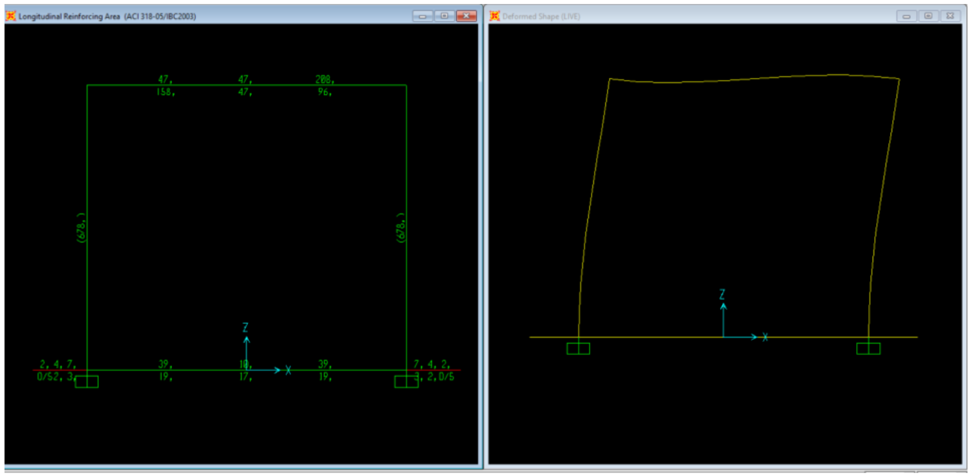
- As tulangan Lapangan perlu = 16 $mm^2$
- As tulangan Lapangan terpasang 4 $\phi$ 13 mm = 530.66 $mm^2$ (OK)



Kolom 30x10 cm (6 $\phi$ 13 mm)

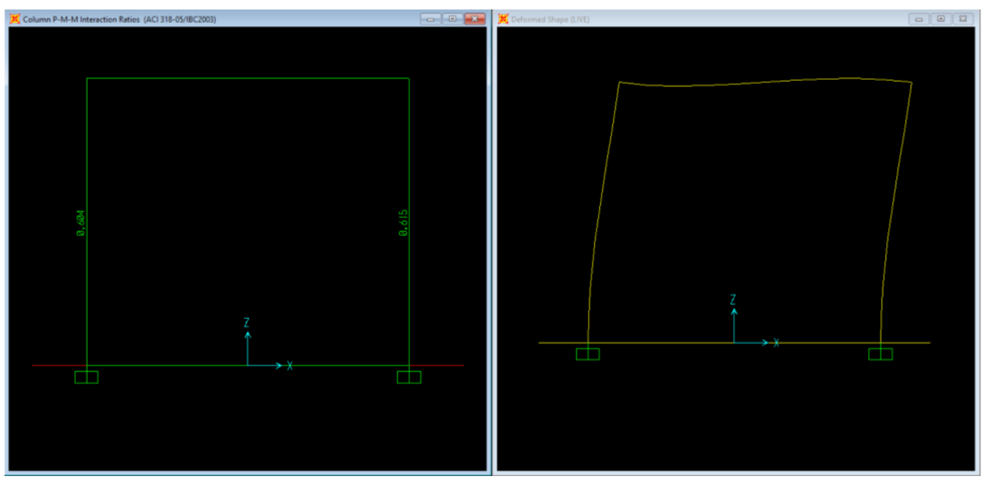
- P-M-M Ratio kolom 0.420<0.95 (OK)

2. Pada Pembebanan 15 kN




Balok Atas 15x15 cm

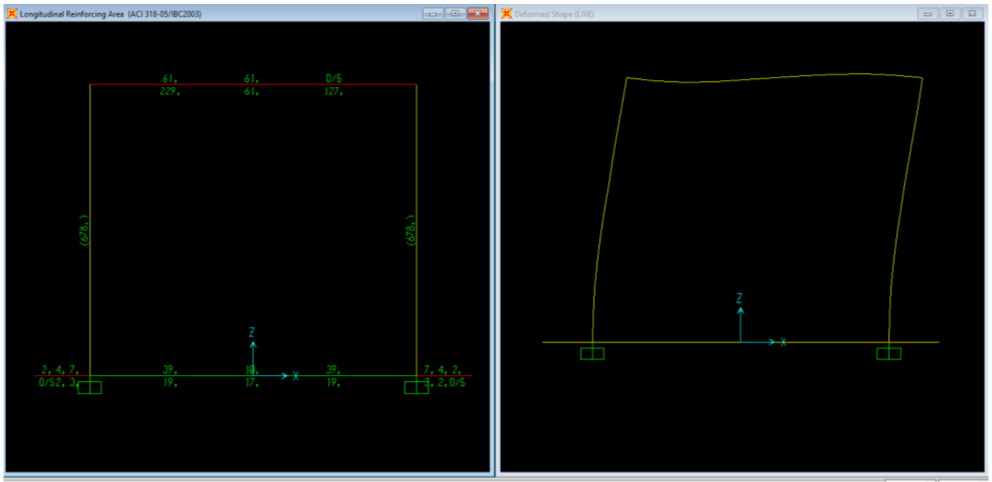
- As tulangan Lapangan perlu = 158 $mm^2$
- As tulangan Lapangan terpasang 4 $\phi$ 13 mm = 530.66 $mm^2$ (OK)




Kolom 30x10 cm (6 $\phi$ 13 mm)

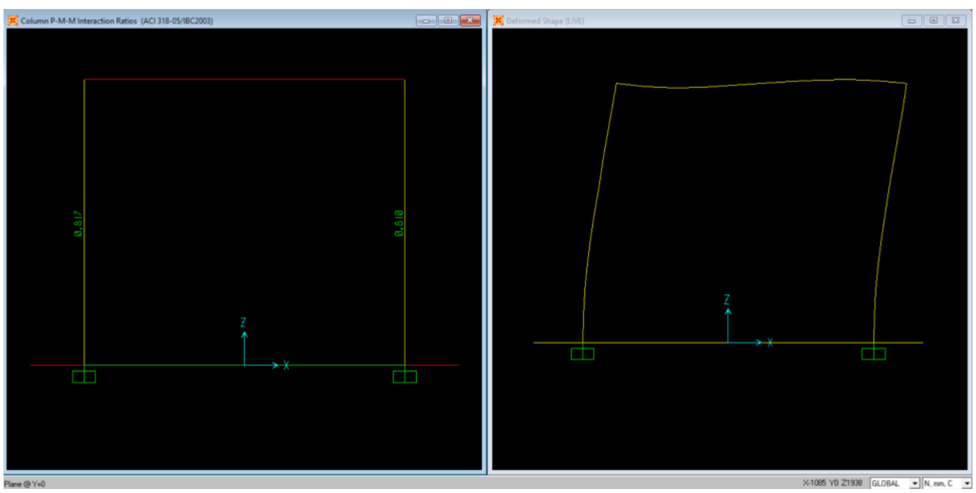
- P-M-M Ratio kolom 0.615<0.95 (OK)

3. Pada pembeban 20 kN



Balok Atas 15x15 cm

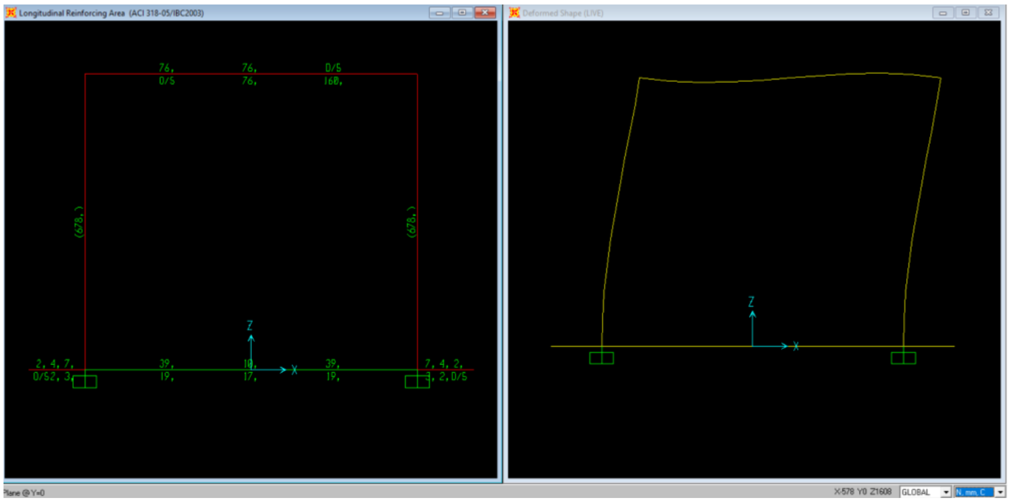
- As tulangan Lapangan perlu = 229 $mm^2$
- As tulangan Lapangan terpasang 4 $\phi$ 13 mm = 530.66 $mm^2$ (OK)



Kolom 30x10 cm (6 $\phi$ 13 mm)

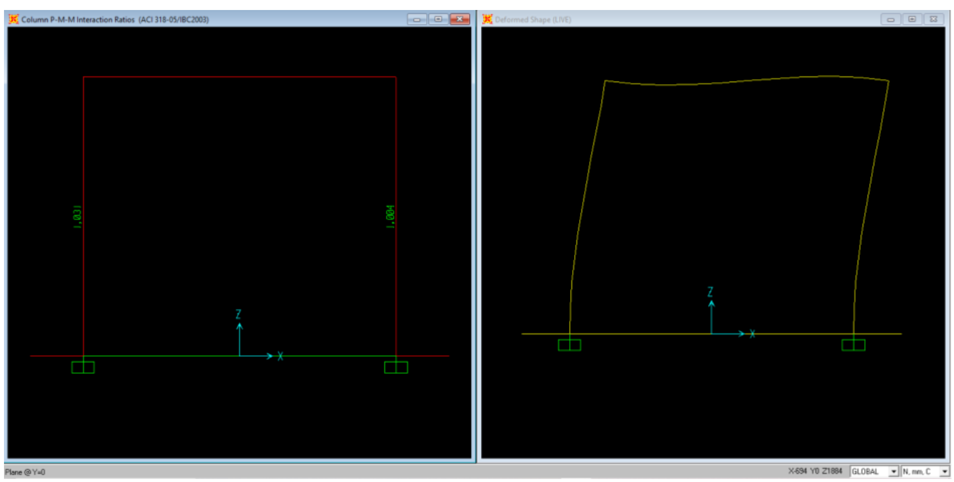
- P-M-M Ratio kolom 0.817<0.95 (OK)

4. Pada pembebanan 25 kN




Balok Atas 15x15 cm

- As tulangan Lapangan perlu = 160 $mm^2$
- As tulangan Lapangan terpasang 4 $\phi$ 13 mm = 530.66 $mm^2$ (OK)



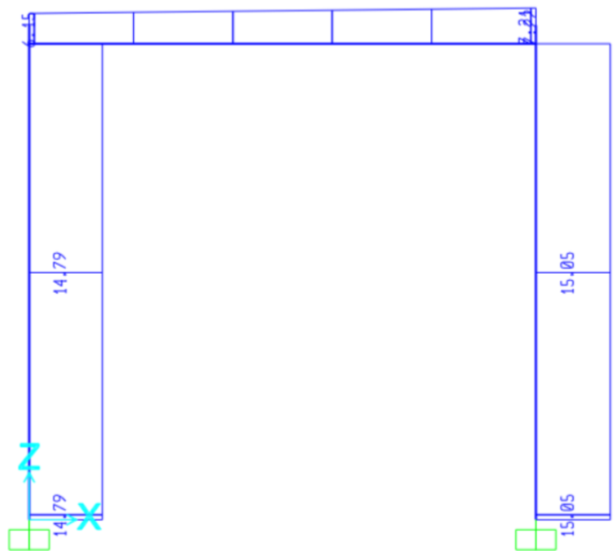

Kolom 30x10 cm (6 $\phi$ 13 mmm)

- P-M-M Ratio kolom 1.031> 0.95 (Over Stressed)

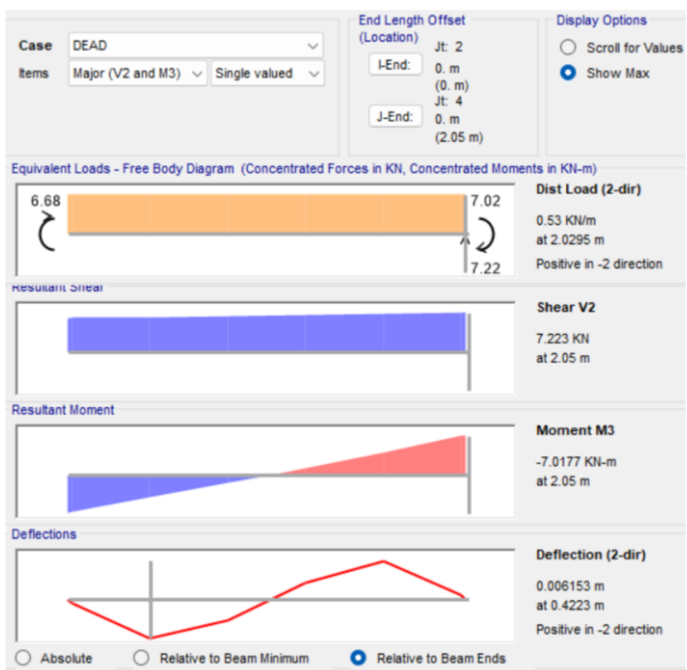
## LAMPIRAN 2

### Gaya-gaya dalam Benda Uji

### 1. Gaya Dalam Benda Uji WT1 (Portal Rangka Beton Bertulang)

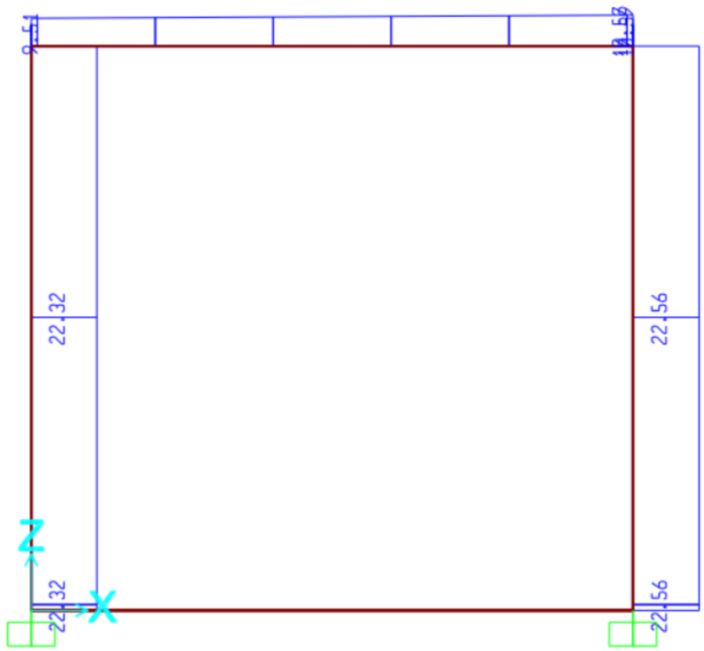



**Gambar** Diagram geser benda uji WT1

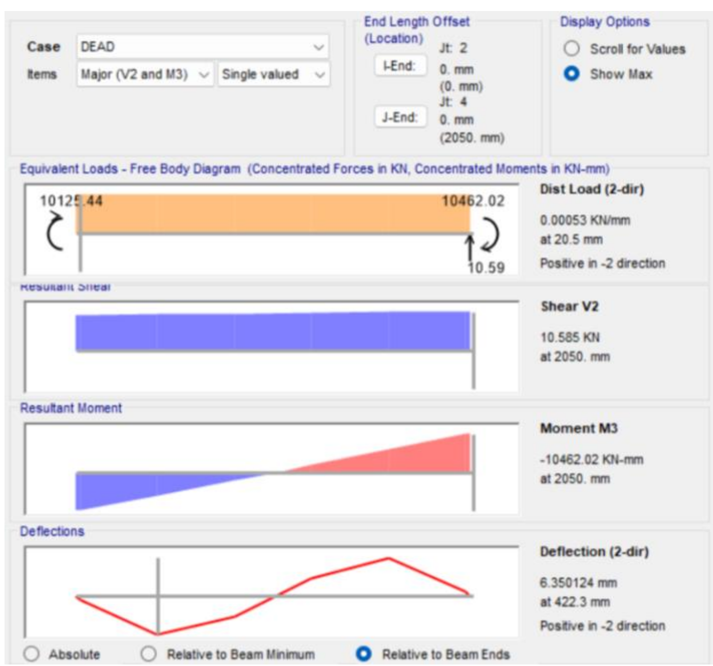



**Gambar** Nilai maksimum (momen, geser dan defleksi) benda uji WT1

2. **Gaya Dalam Benda Uji WT2 (Portal Rangka Beton Bertulang Menggunakan Bahan Pengisi Panel Pracetak Beton Busa)**

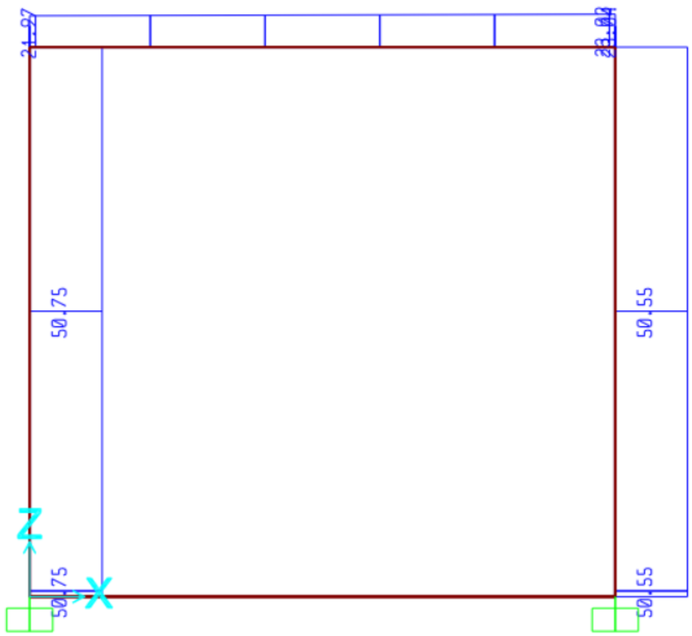



Gambar Diagram geser benda uji WT2

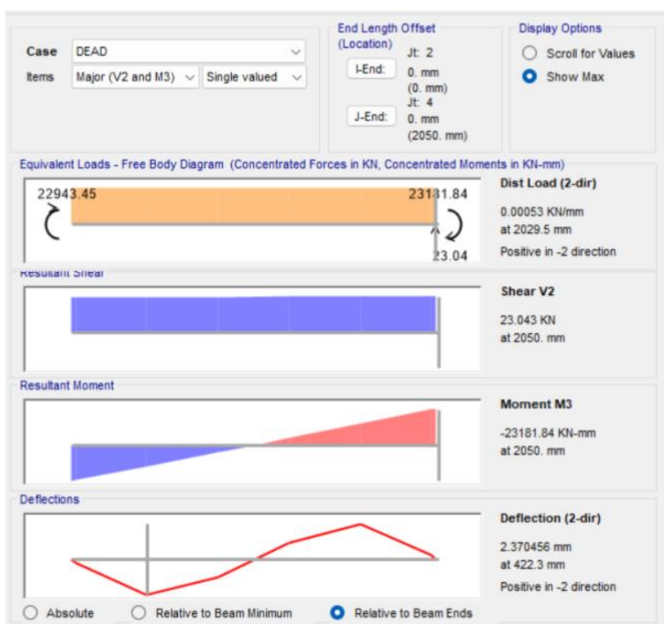



Gambar Nilai maksimum (momen, geser dan defleksi) benda uji WT2

3. **Gaya Dalam Benda Uji WT3 (Portal Rangka Beton Bertulang Menggunakan Bahan Pengisi Panel Pracetak Beton Busa Diperkuat dengan CFRP dengan Lebar 0,10D)**

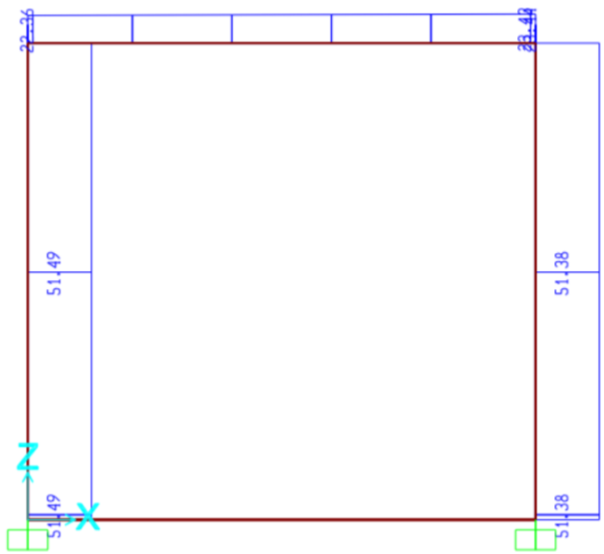



Gambar Diagram geser benda uji WT3

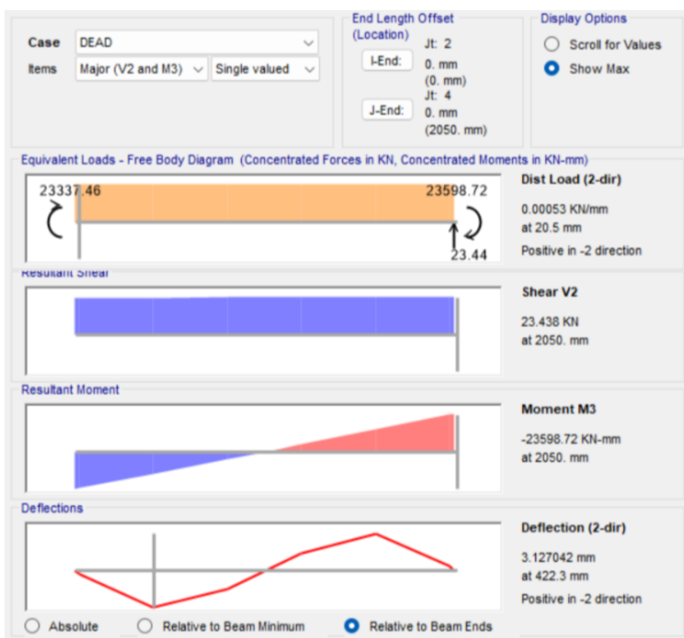



Gambar Nilai maksimum (momen, geser dan defleksi) benda uji WT

**4. Gaya Dalam Benda Uji WT4 (Portal Rangka Beton Bertulang Menggunakan Bahan Pengisi Panel Pracetak Beton Busa Diperkuat dengan CFRP dengan Lebar 0,15D)**




**Gambar 71**. Diagram geser benda uji WT4




Gambar Nilai maksimum (momen, geser dan defleksi) benda uji WT4

# LAMPIRAN 3

## Perhitungan Gaya Lateral

### I. Tegangan Lateral PORTAL

| | | | |
|---|---|---|---|
| b balok | = | 150 | mm |
| h balok | = | 150 | mm |
| A Balokgros | = | 22500 | $mm^2$ |
| Jumlah Tulangan | = | 4 | buah |
| Diameter besi | = | 13 | mm |
| As 13 | = | 132,67 | |
| As Besi 13 | = | 530,66 | $mm^2$ |
| fy balok | = | 473,74 | MPa |
| f'c balok | = | 30,25 | Mpa |
| P balok | = | (As gros balok - As besi) f'c + As Fy | |
| | = | 915970 | N |
| | = | 915,97 | kN |
| d kolom | = | 150 | mm |
| besi kolom | = | 6 | |
| diameter | = | 13 | mm |
| As besi kolom | = | 132,67 | mm2 |
| As total | = | 795,99 | mm2 |
| fy | = | 390 | |
| a | = | 80,489 | mm |
| h kolom | = | 1825 | mm |
| Momen bahan | = | 3E+07 | N,mm |
| P | = | 18670 | N |
| P (2 kolom) | = | **37.339** | |

## II. Tegangan Lateral DINDING PENGISI

| | | |
|---|---|---|
| Unit | | mm |
| E me | = | 7112,4 |
| G | | 1,1 |
| E fe | = | 25850,0 |
| T inf | = | 80 |
| b | = | 300 |
| h | = | 150 |
| I col | = | 8E+07 |
| panjang bawah | = | 1750 |
| h inf | = | 1650 |
| h col | = | 1825 |
| sudut sin2a | = | 0,9983 |
| sudut cosa | = | 0,728 |
| r inf | = | 2405,20 |
| a1 | = | 0,0025 |
| a | = | 229,12 |
| Vc | = | **15.270 N** |

## III. Perhitungan Tegangan Lateral pada CFRP

A. Spesimen WT3

Data berdasarkan hasil uji di laboratorium

| | | | |
|---|---|---|---|
| 1 | Jumlah lembar CFRP (n) | 4 | pcs |
| 2 | Lebar lembar CFRP ($W_{CFRP}$) | 240,0 | mm |
| 3 | Tebal lembar CFRP ($t_{CFRP}$) | 1,00 | mm |
| 4 | Regangan CFRP($\varepsilon_{CFRP}$) | 0,005 | mm |
| 5 | Beban pada CFRP ($P_{CFRP}$) | 101300 | N |
| 6 | Cos | 0,728 | |
| 7 | Mod. Elas. CFRP ($E_{CFRP}$) $=\sigma_{CFRP}/\varepsilon_{CFRP}$ | 13.627 | N/mm2 |
| 8 | Cal_Kapasitas Kekuatan Lateral CFRP ($V_{cal}$) | | |
| | n x ($\varepsilon_{CFRP}$ x $E_{CFRP}$ x $W_{CFRP}$ x $t_{CFRP}$) | 69.635 | N |
| | X Cos | 50.665 | N |

B. Spesimen WT4

Data berdasarkan hasil uji di laboratorium

| | | | |
|---|---|---|---|
| 1 | Jumlah lembar CFRP (n) | 4 | pcs |
| 2 | Lebar lembar CFRP ($W_{CFRP}$) | 240,00 | mm |
| 3 | Tebal lembar CFRP ($t_{CFRP}$) | 1,00 | mm |
| 4 | Regangan CFRP($\varepsilon_{CFRP}$) | 0,006 | mm |
| 5 | Beban pada CFRP ($P_{CFRP}$) | 102870 | N |
| 6 | Cos | 0,728 | |
| 7 | Mod. Elas. CFRP ($E_{CFRP}$) = $\sigma_{CFRP}/\varepsilon_{CFRP}$ | 13.627 | N/mm2 |
| 8 | Cal_Kapasitas Kekuatan Lateral CFRP ($V_{cal}$) | | |
| | n x ($\varepsilon_{CFRP}$ x $E_{CFRP}$ x $W_{CFRP}$ x $t_{CFRP}$) | 83.186 | N |
| | X Cos | 60.525 | N |

## IV. Total Perhitungan Tegangan Lateral Benda Uji

| No | Kode BU | $V_{ANALISIS}$ (kN) | | | |
|---|---|---|---|---|---|
| | | $V_{FRAME}$ | $V_{INFILL}$ | $V_{CFRP}$ | $V_{TOTAL}$ |
| 1 | WT1 | 37.339 | 0 | 0 | 37.339 |
| 2 | WT2 | 37.339 | 15.270 | 0 | 52.610 |
| 3 | WT3 | 37.339 | 15.270 | 50.665 | 103.275 |
| 4 | WT4 | 37.339 | 15.270 | 60.525 | 113.135 |