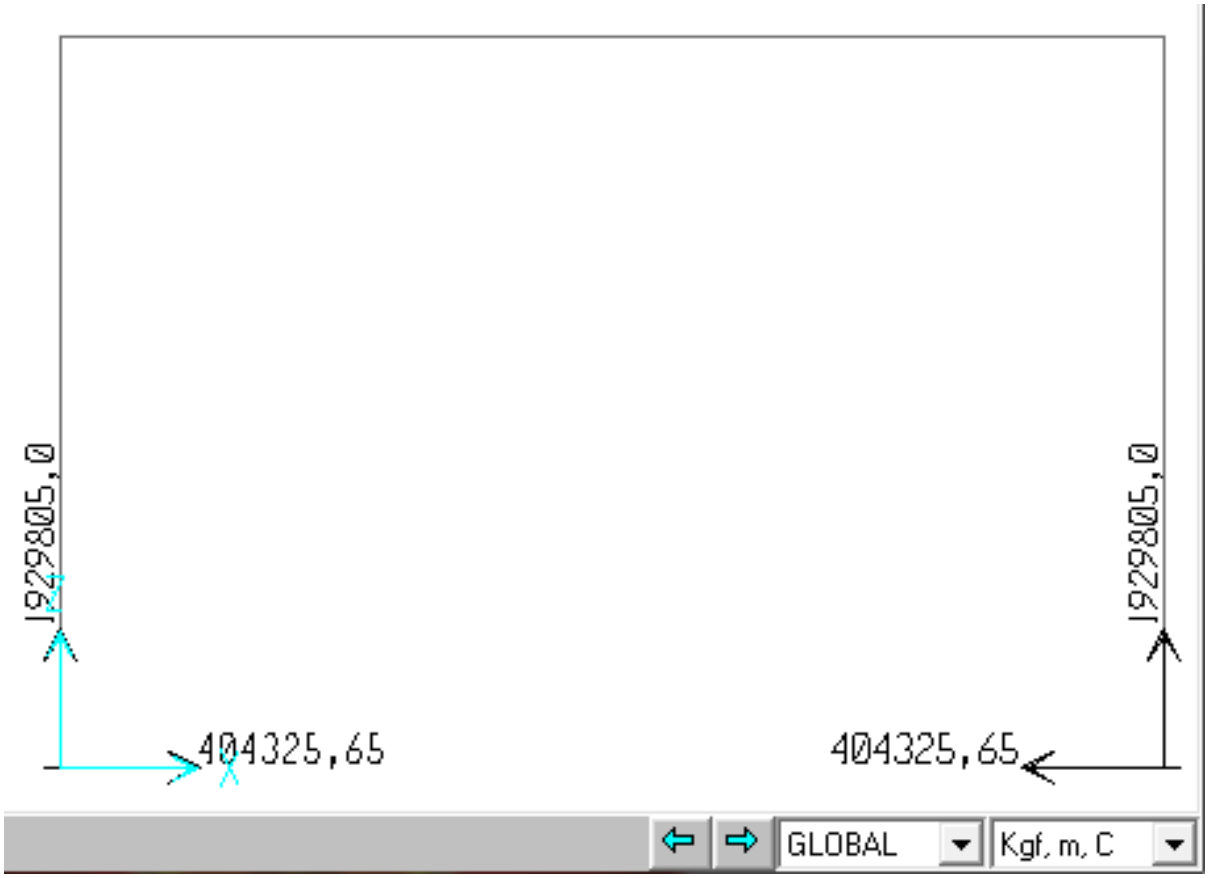
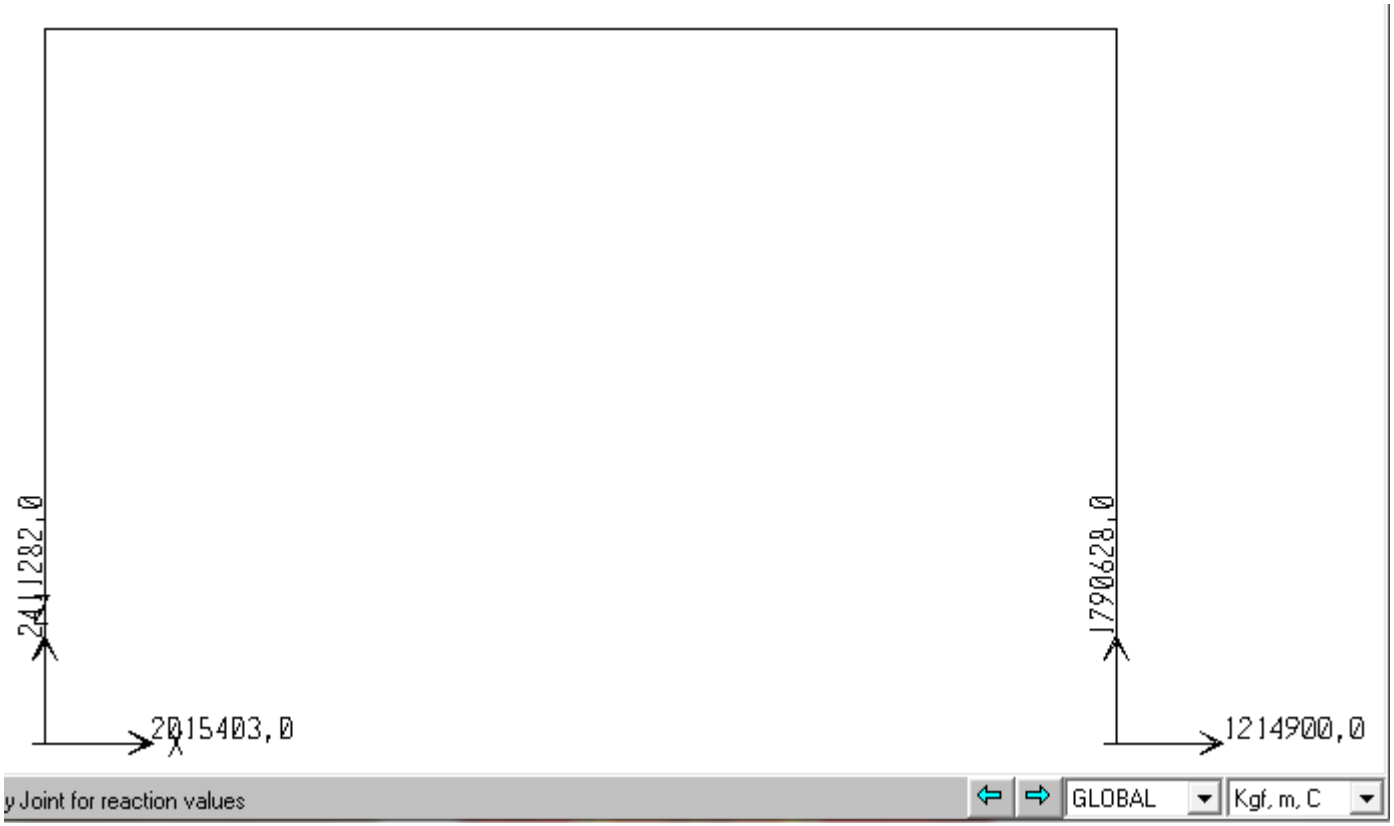
LAMPIRAN 1
REAKSI PERLETAKAN

1.) Struktur Portal dengan Tumpuan Jepit



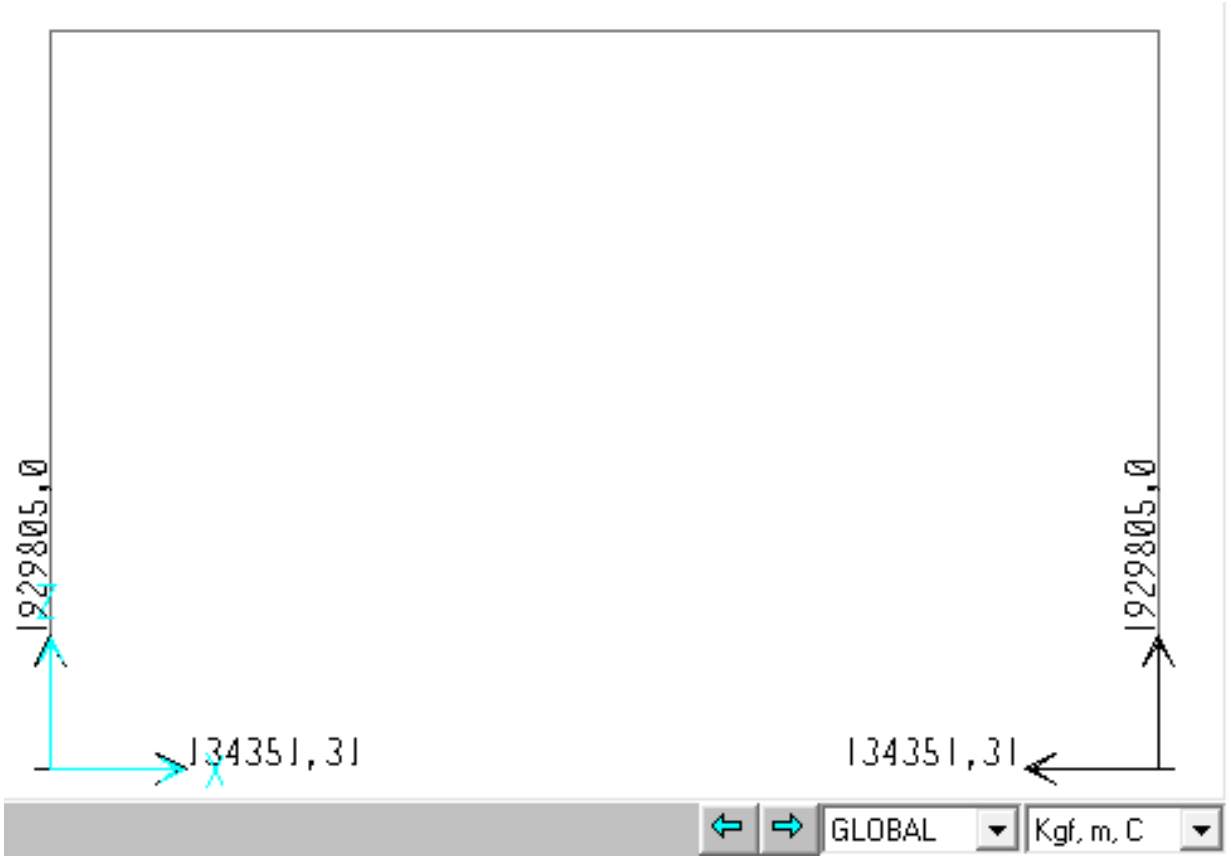
Gambar L1.1 Reaksi Perletakan Kombinasi I

Gambar L1.2 Reaksi Perletakan Kombinasi II

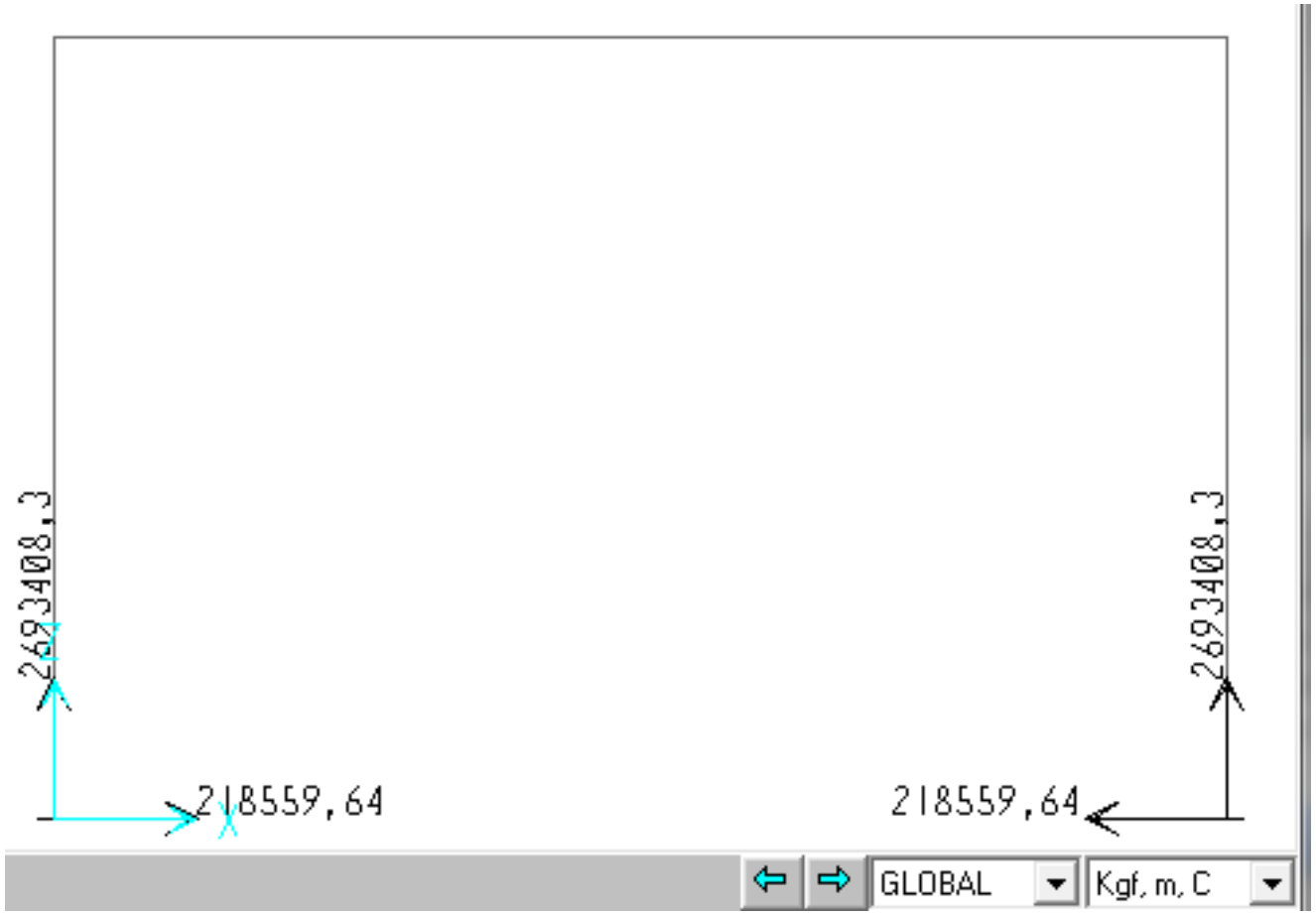


Gambar L1.2 Reaksi Perletakan Kombinasi III

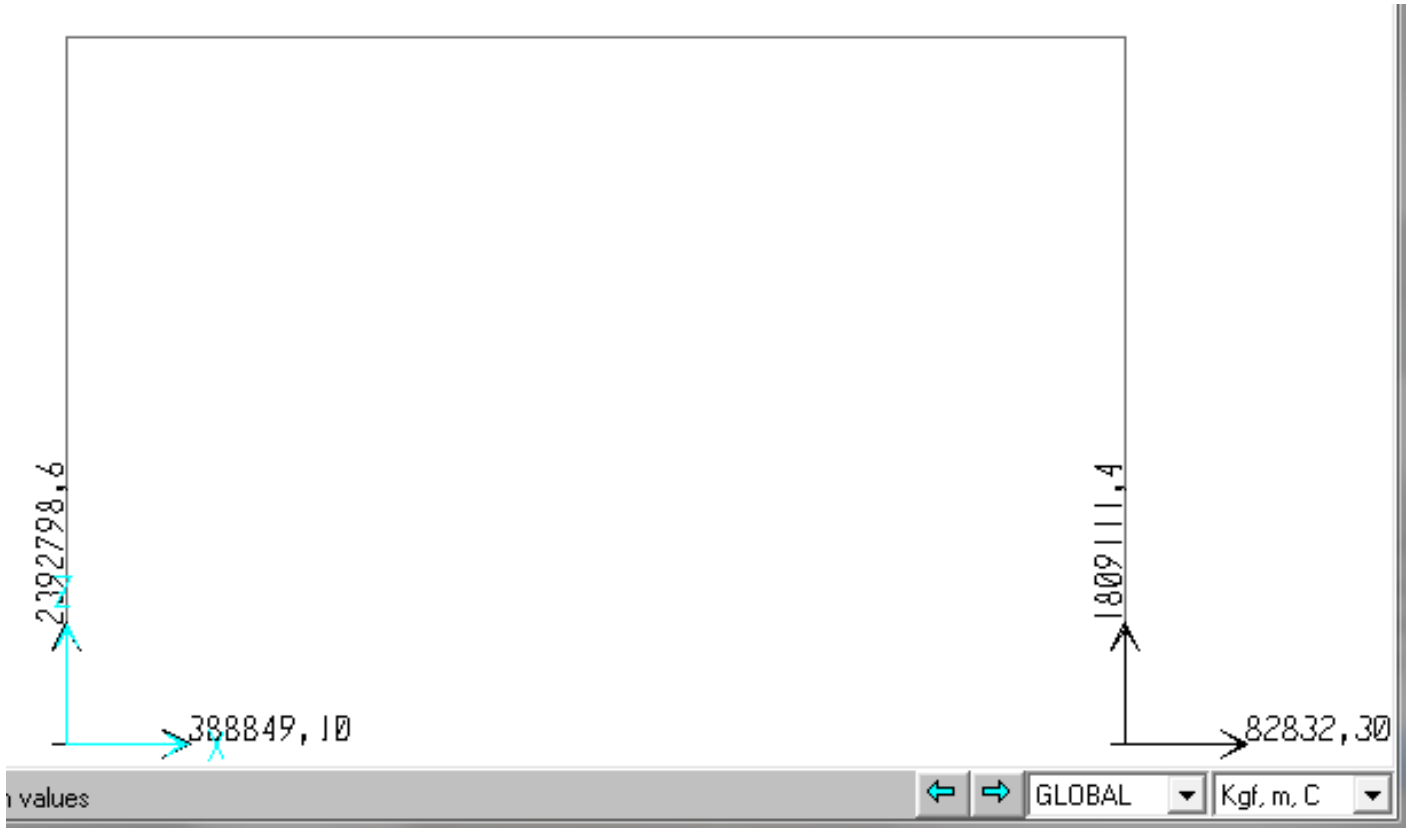
2.) Struktur Portal dengan Tumpuan Pegas



Gambar L1.4 Reaksi Perletakan Kombinasi I



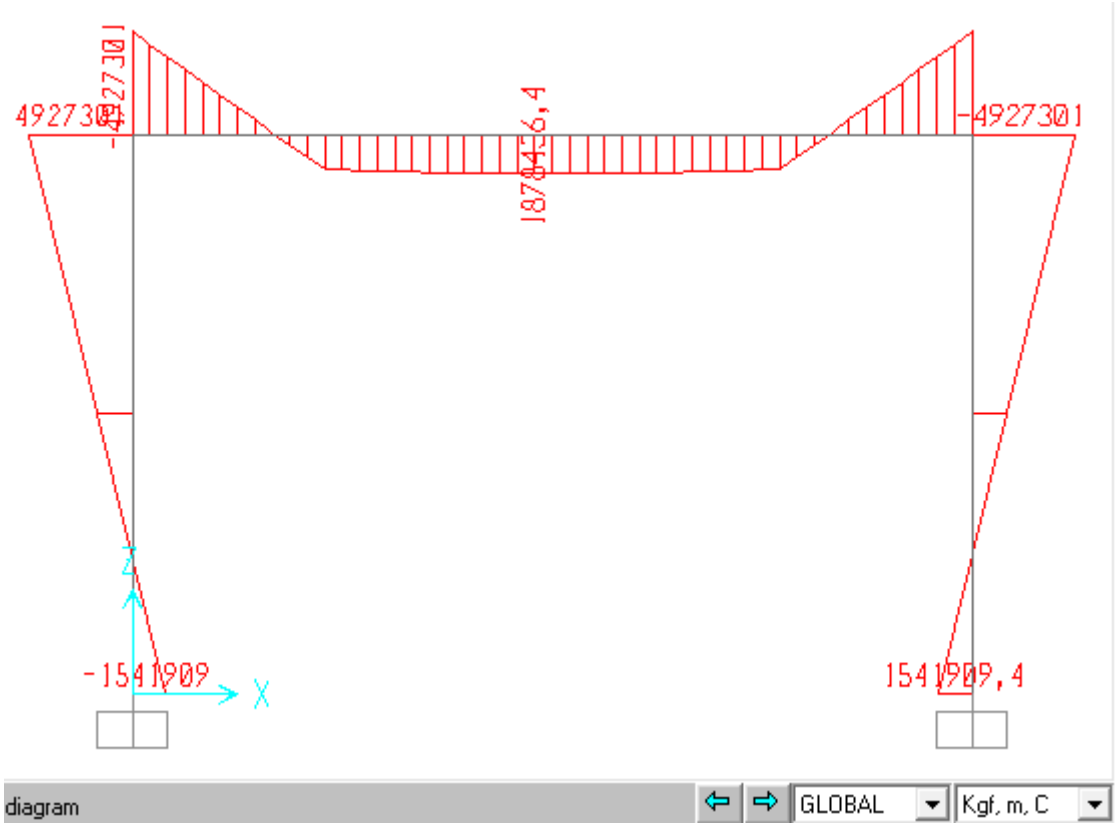
Gambar L1.5 Reaksi Perletakan Kombinasi II



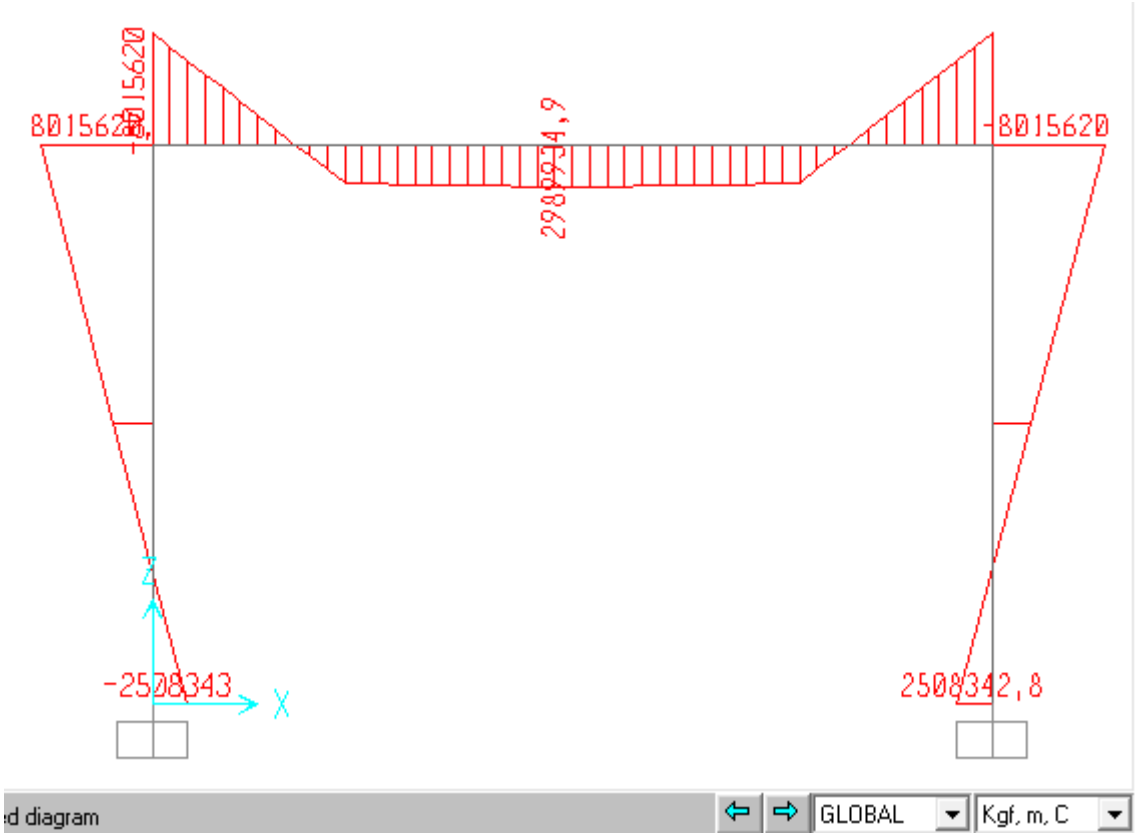
Gambar L1.6 Reaksi Perletakan Kombinasi III

Lampiran 2
GAYA DALAM

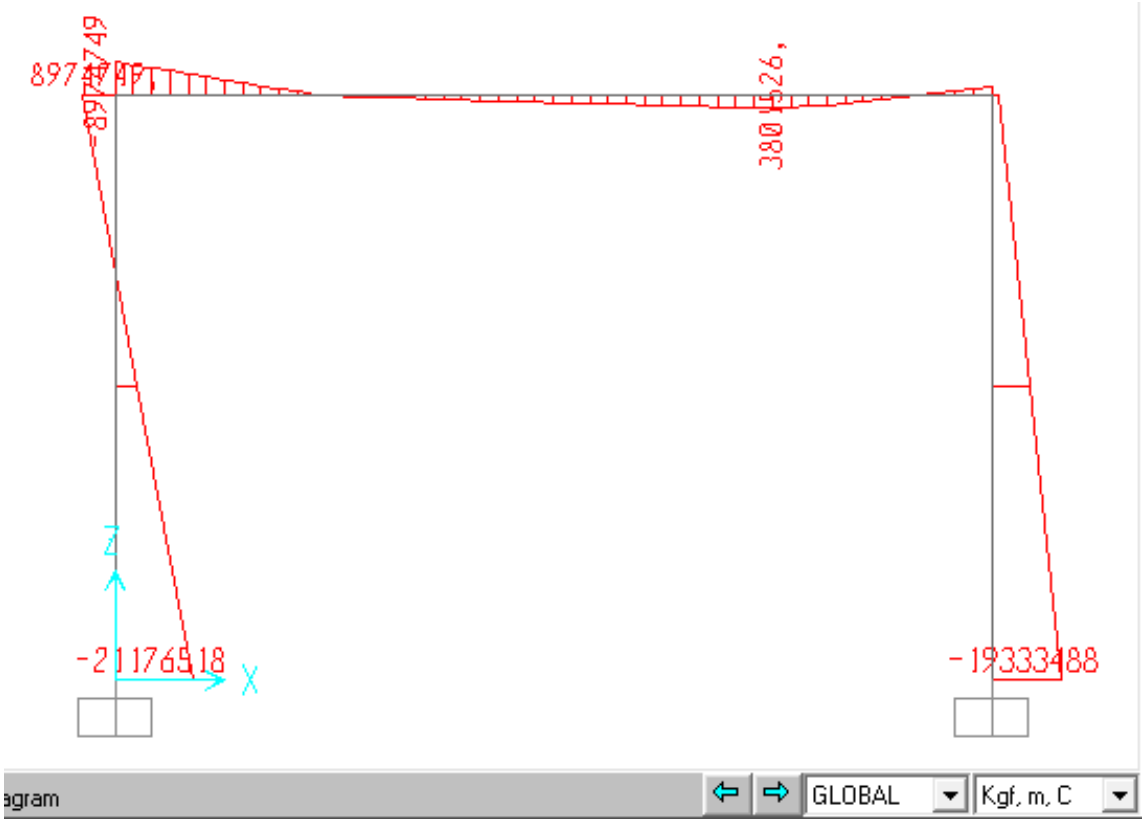
1.) Struktur Portal dengan Tumpuan Jepit



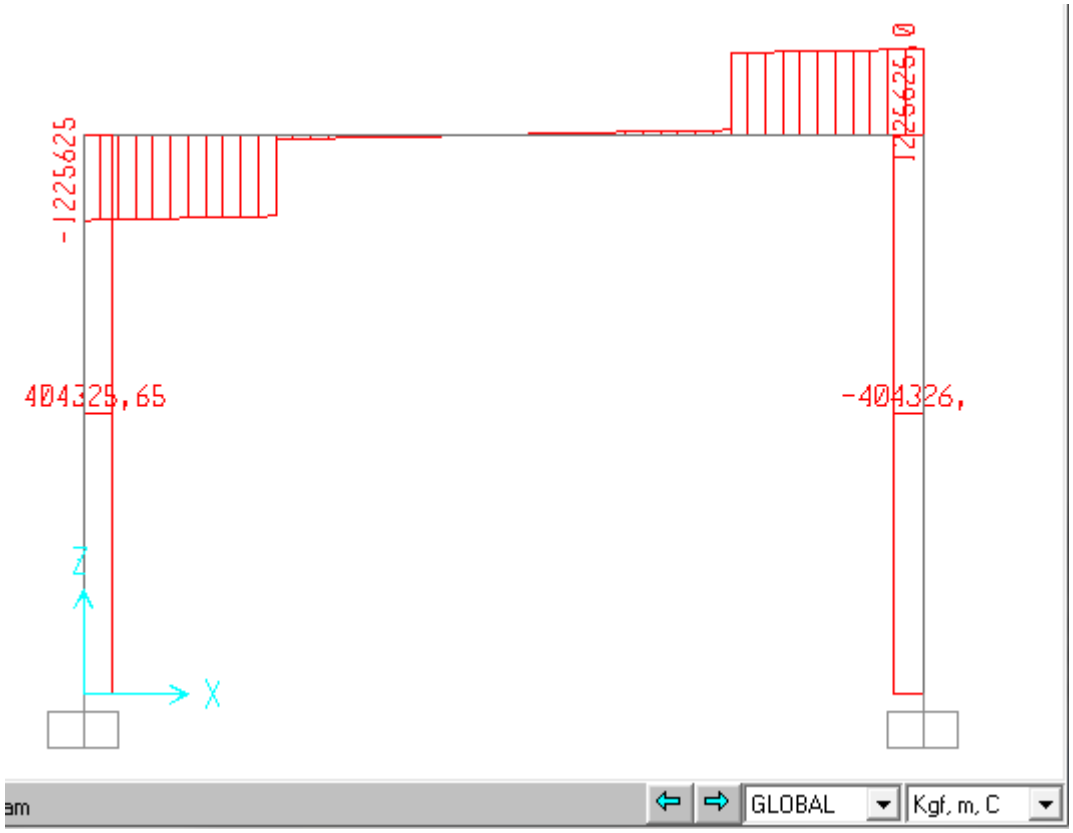
Gambar L2.1 Gaya Momen Kombinasi I



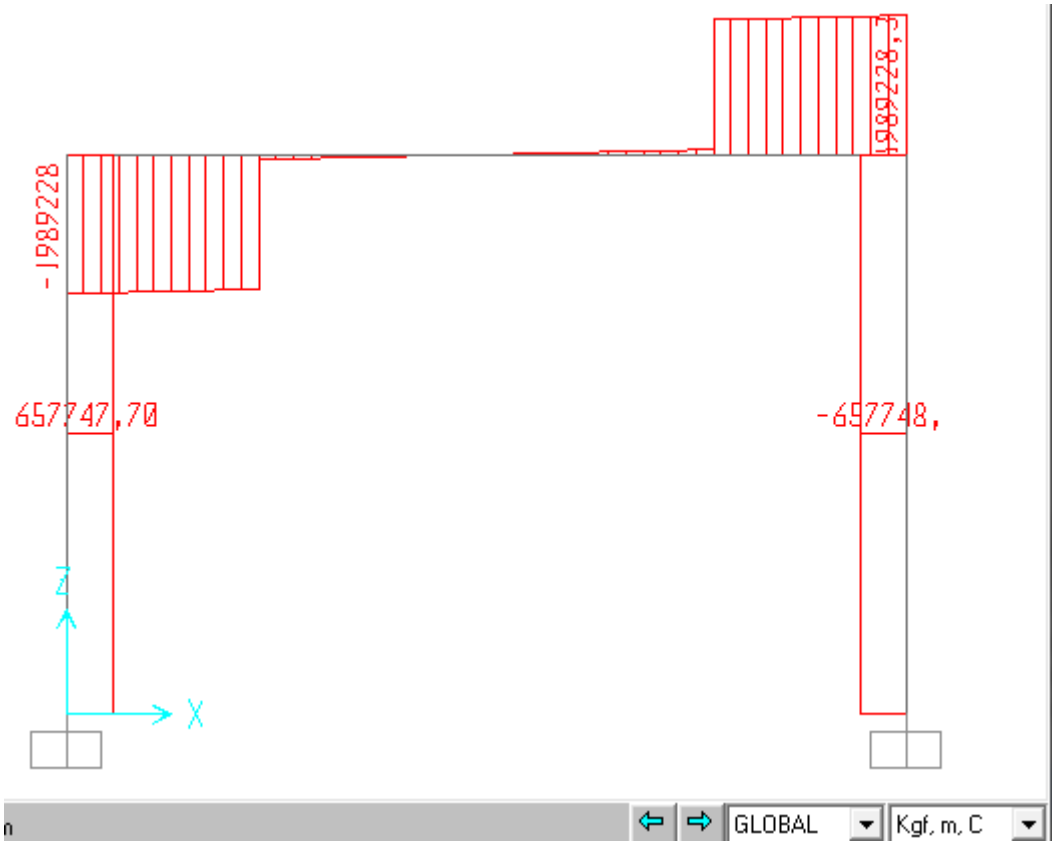
Gambar L2.2 Gaya Momen Kombinasi II



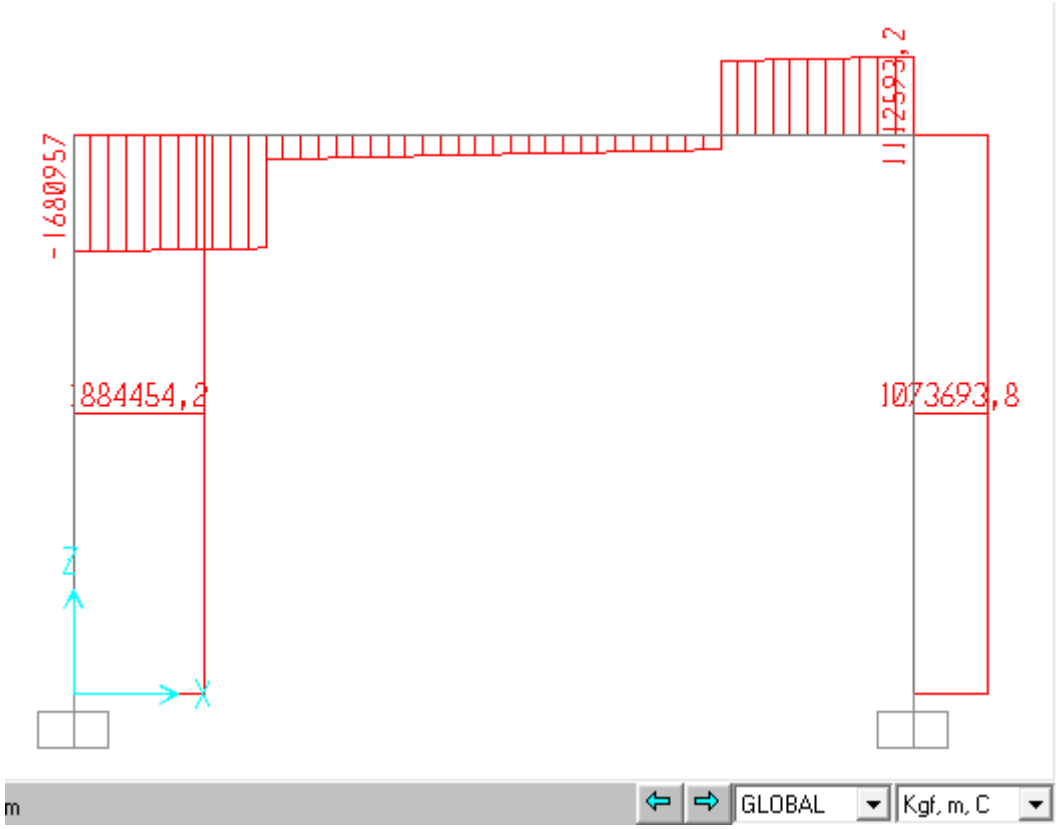
Gambar L2.3 Gaya Momen Kombinasi III



Gambar L2.4 Gaya Geser Kombinasi I

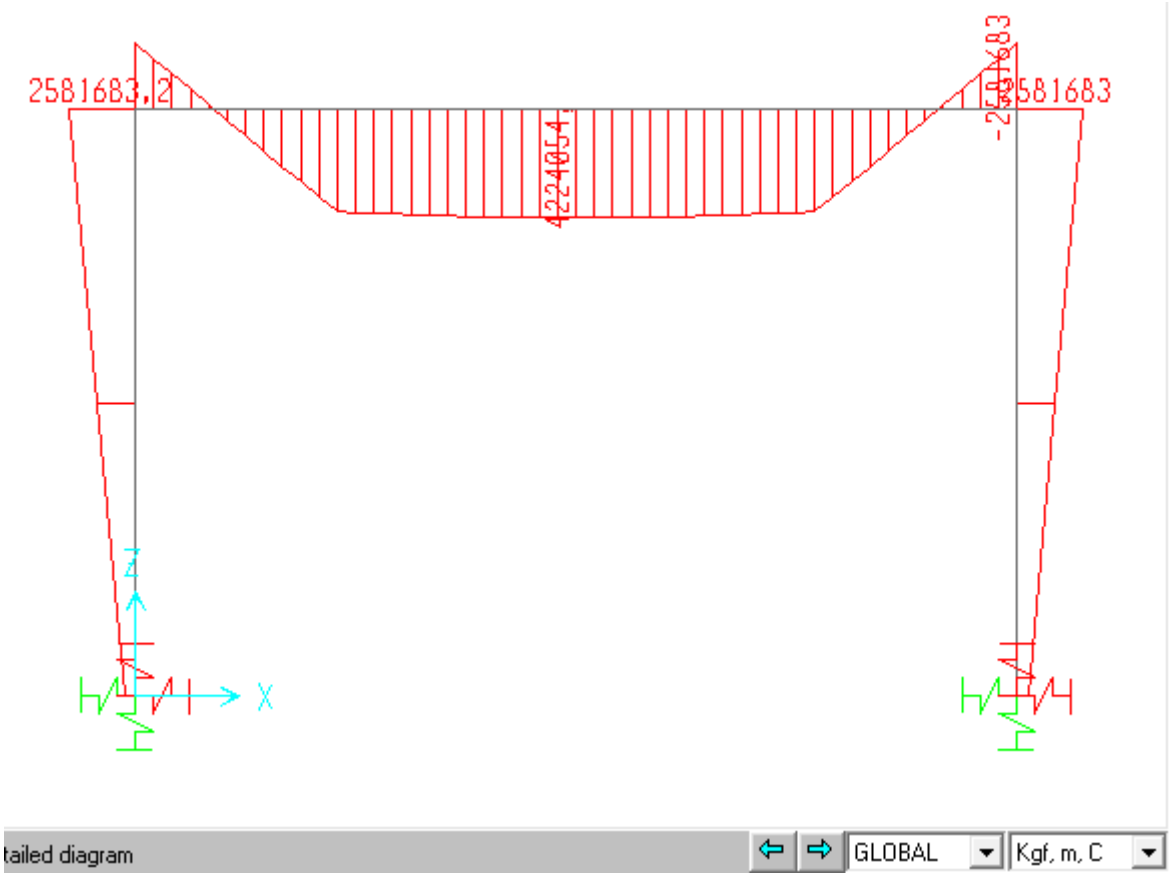


Gambar L2.5 Gaya Geser Kombinasi II

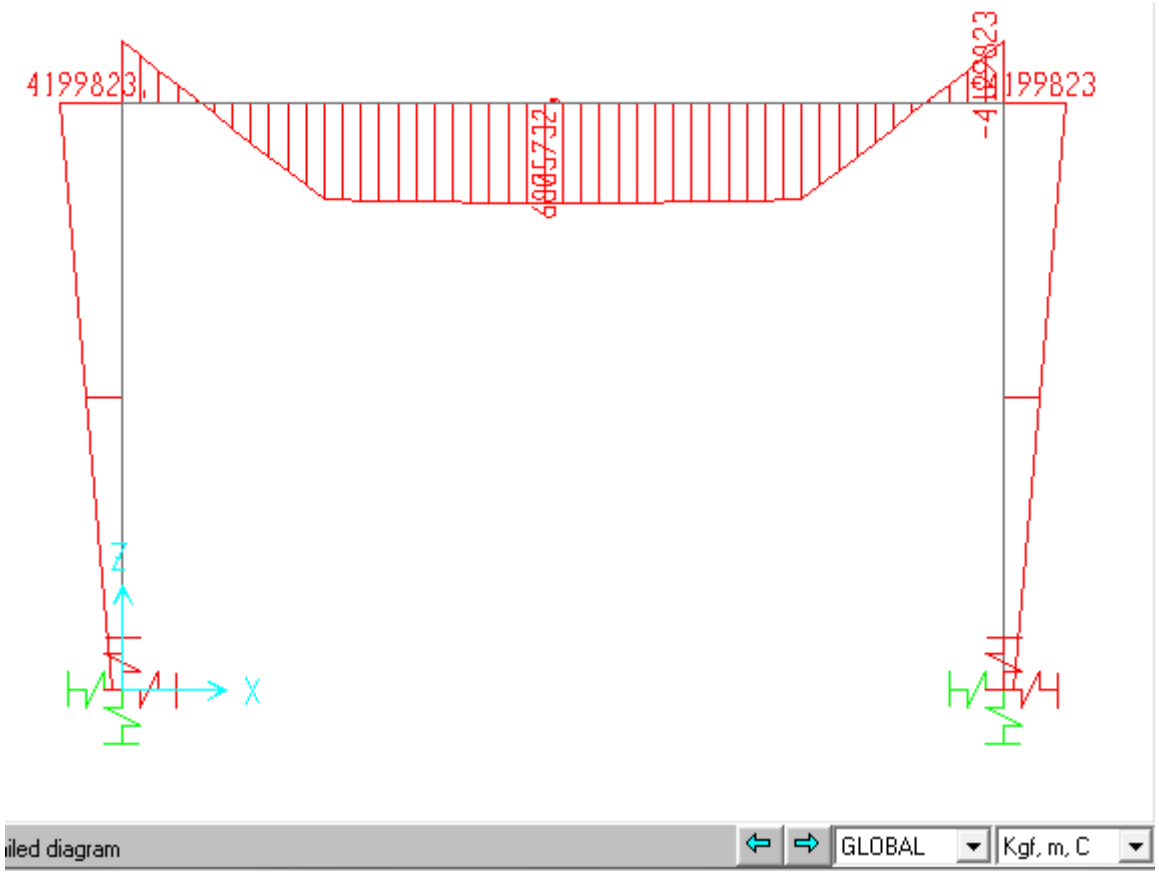


Gambar L2.6 Gaya Geser Kombinasi III

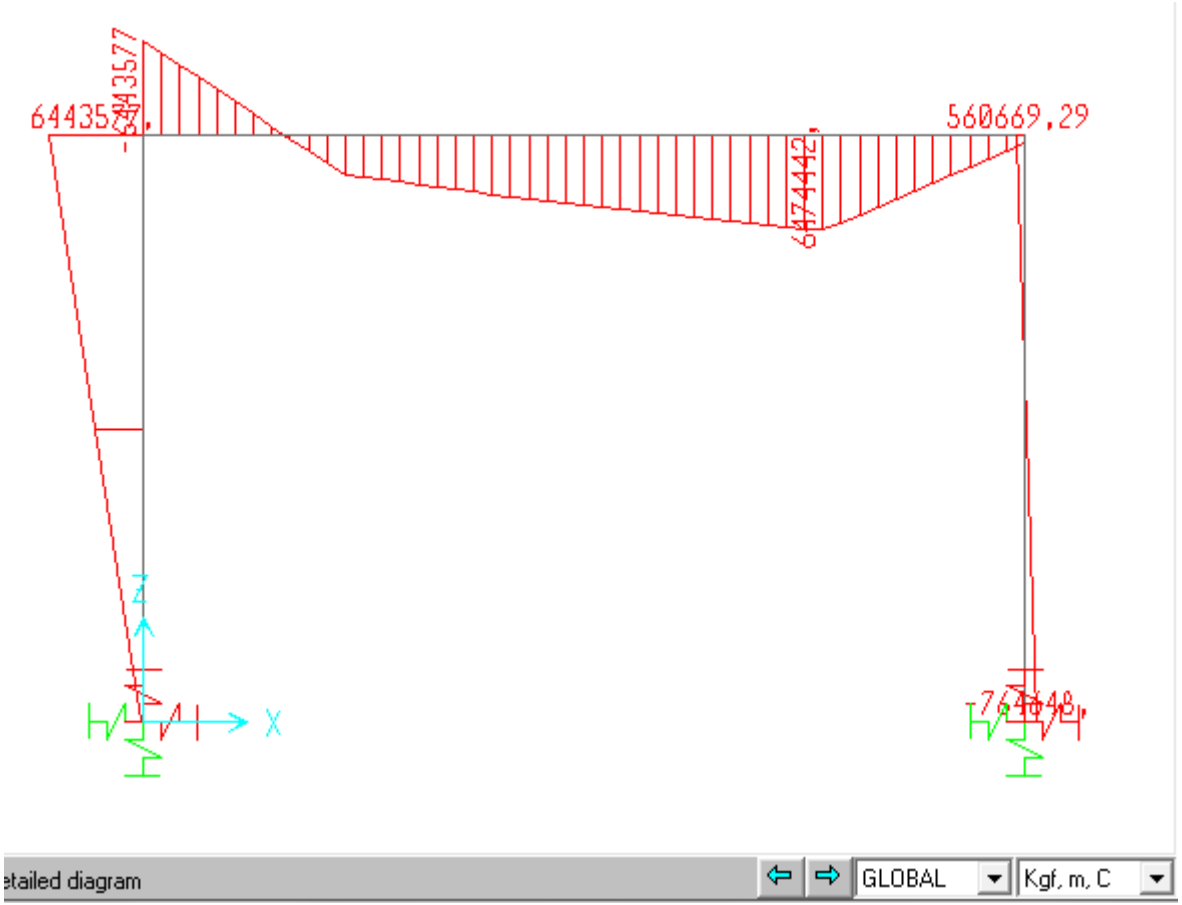
2.) Struktur Portal dengan Tumpuan Pegas



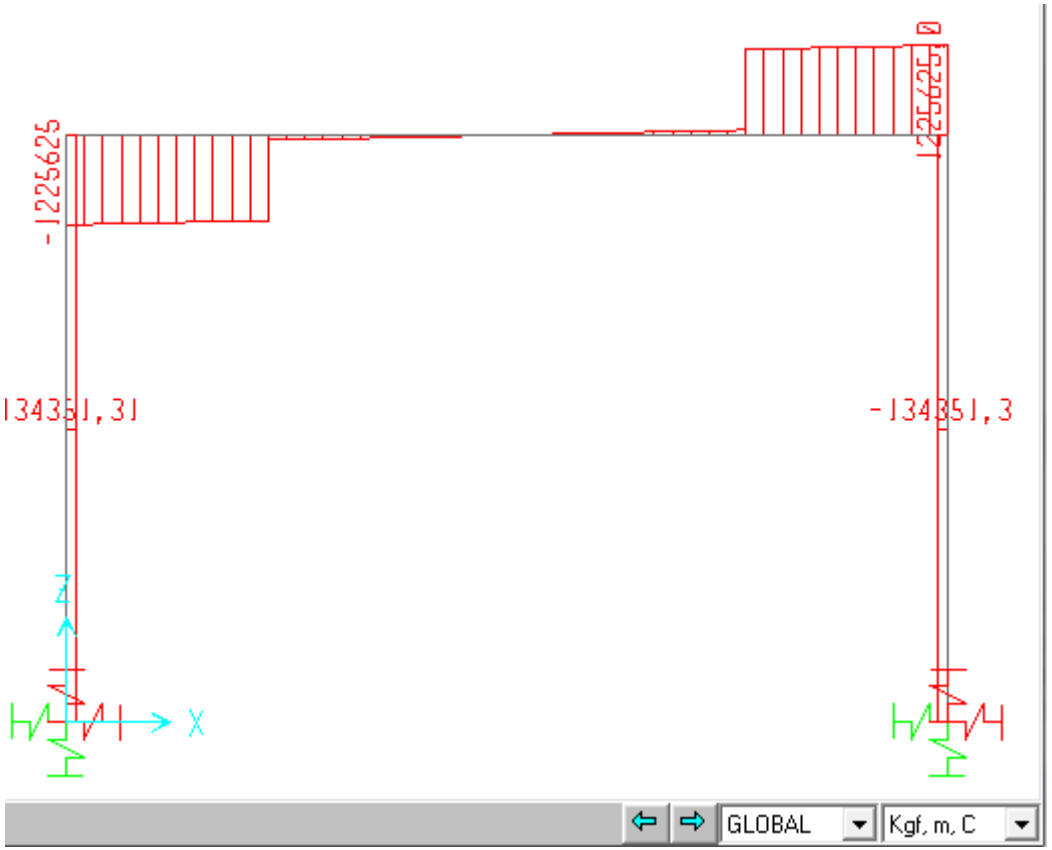
Gambar L2.7 Gaya Momen Kombinasi I



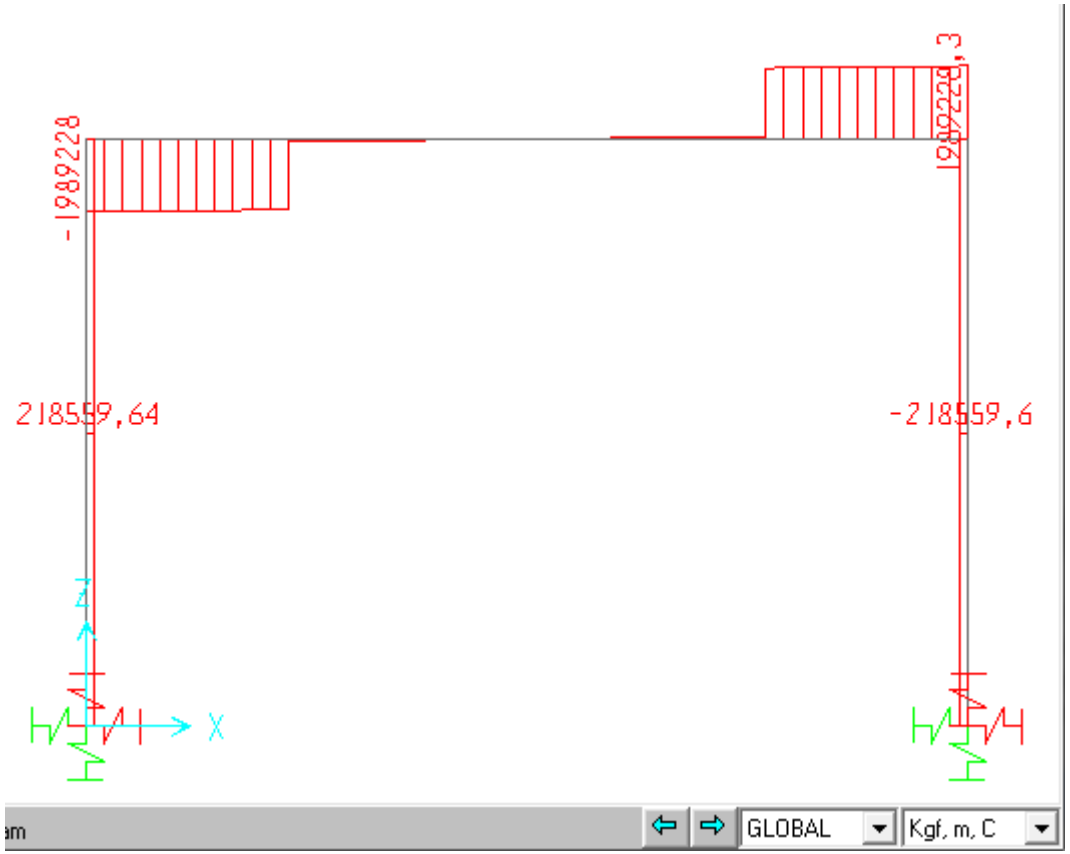
Gambar L2.8 Gaya Momen Kombinasi II



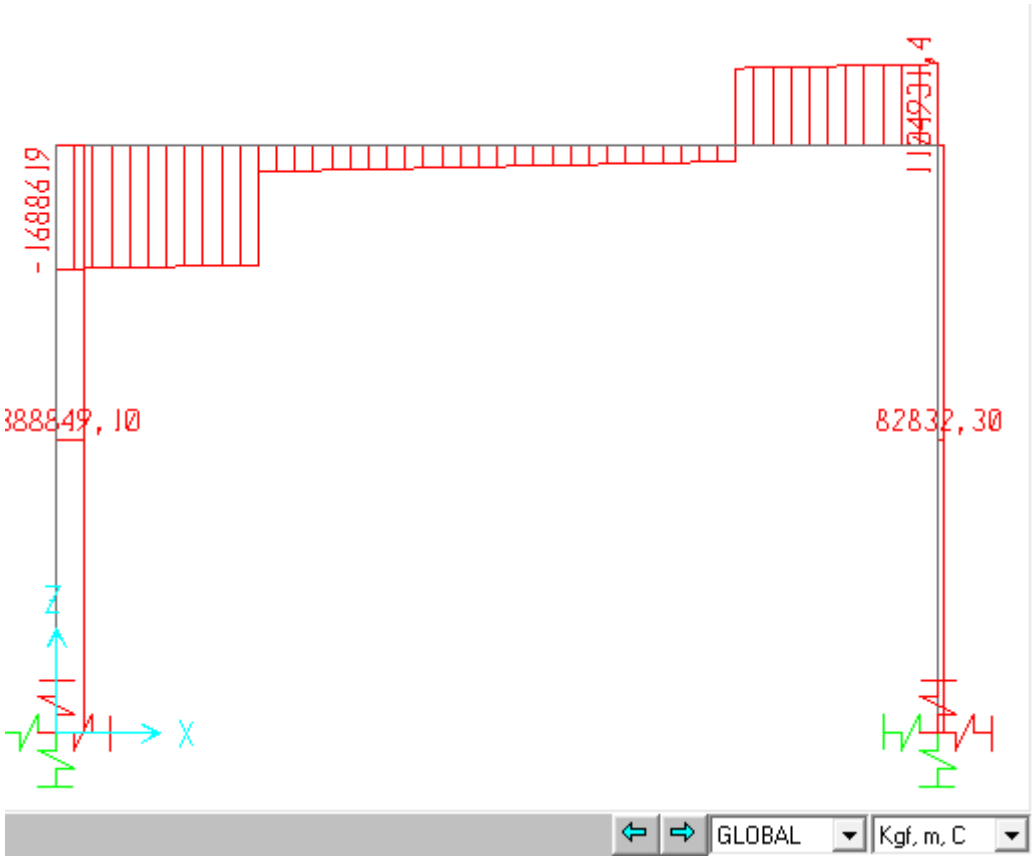
Gambar L2.9 Gaya Momen Kombinasi III



Gambar L2.10 Gaya Geser Kombinasi I

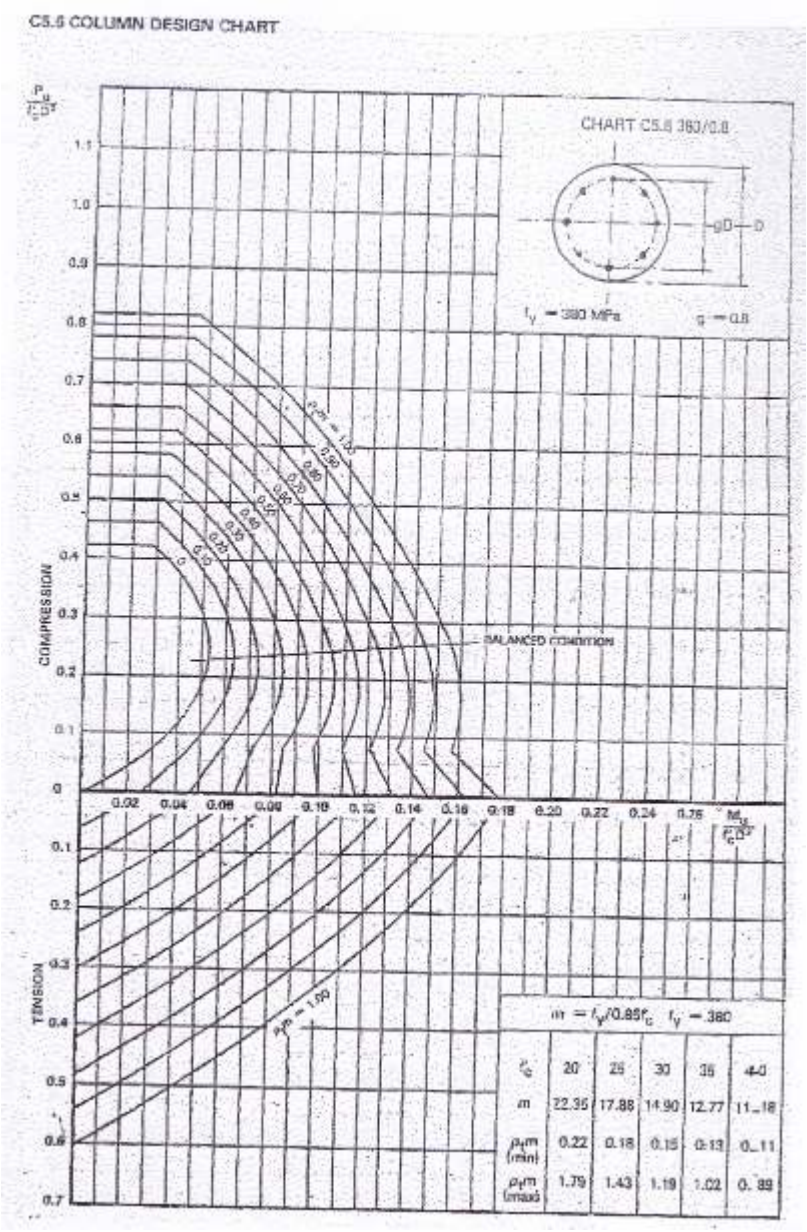


Gambar L2.11 Gaya Geser Kombinasi II

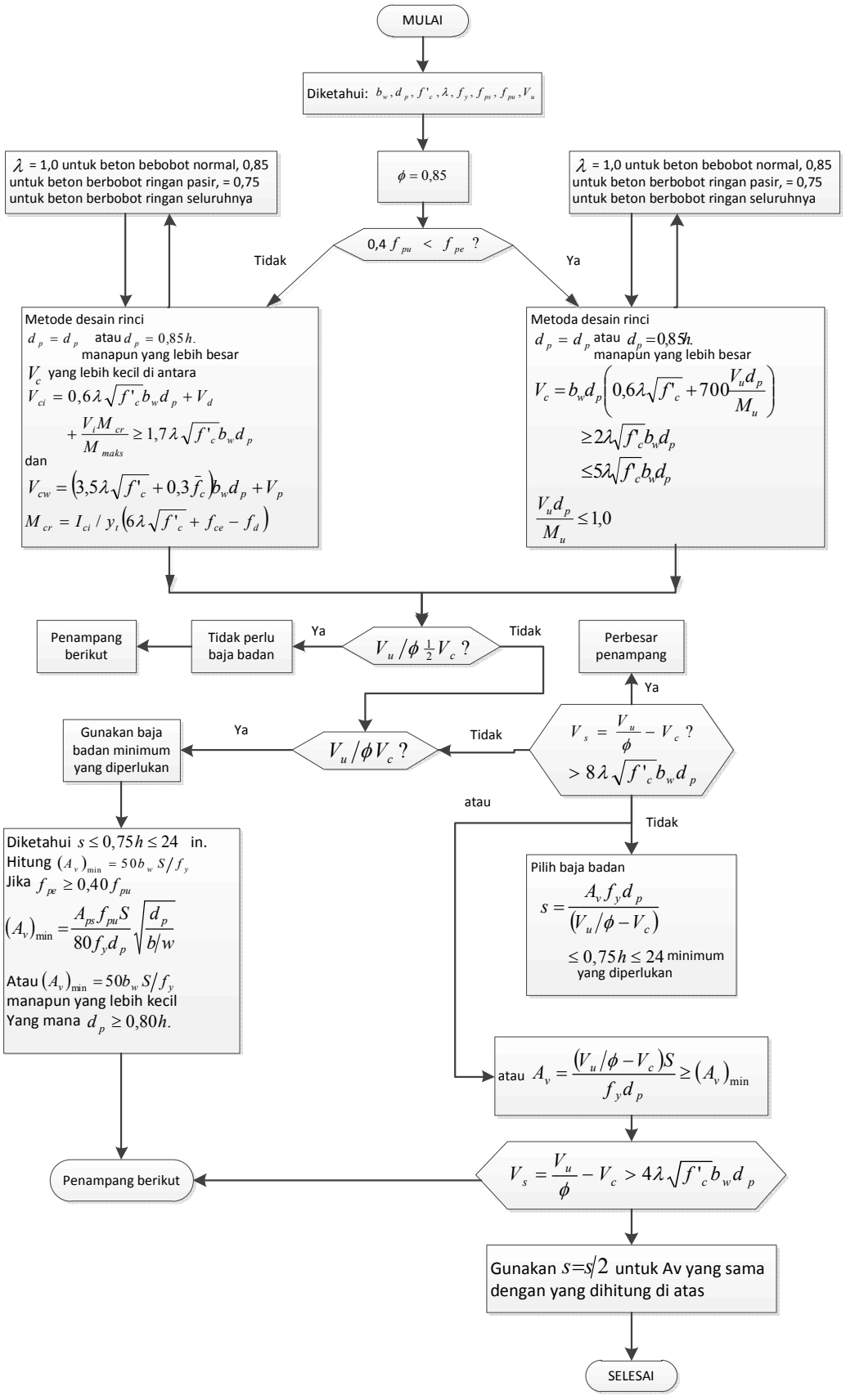


Gambar L2.12 Gaya Geser Kombinasi III

LAMPIRAN 3
Column Design Chart

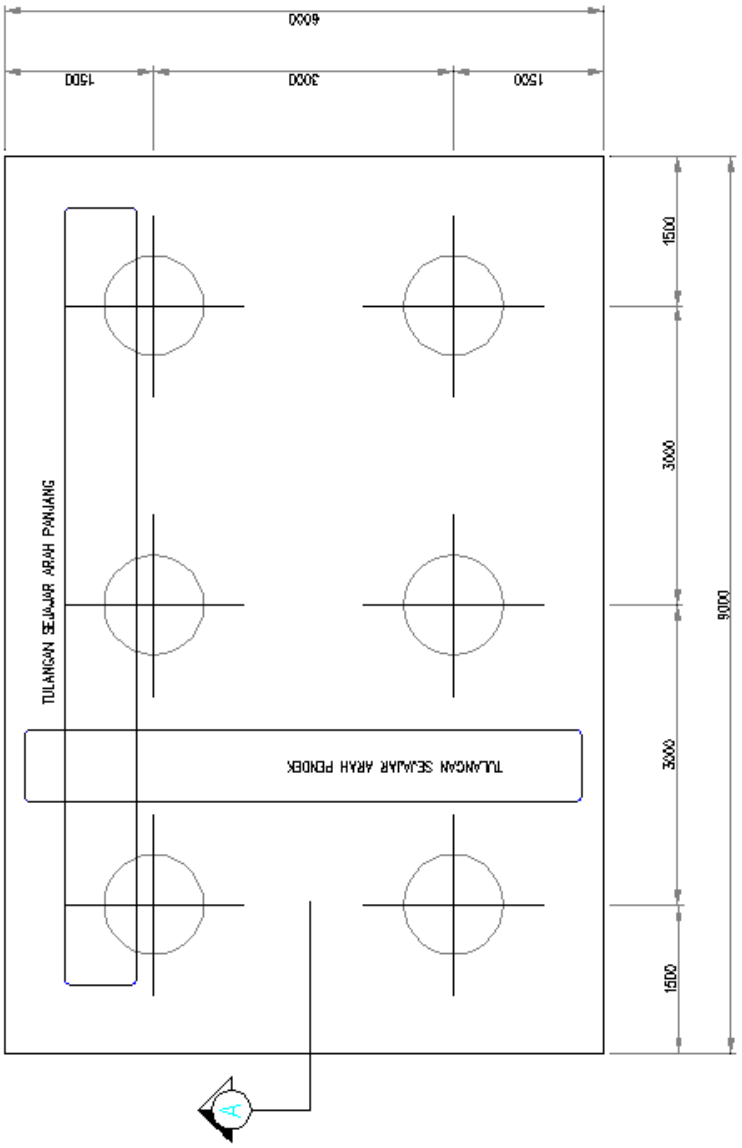


LAMPIRAN 4
Bagan Alir Penulangan Geser Balok

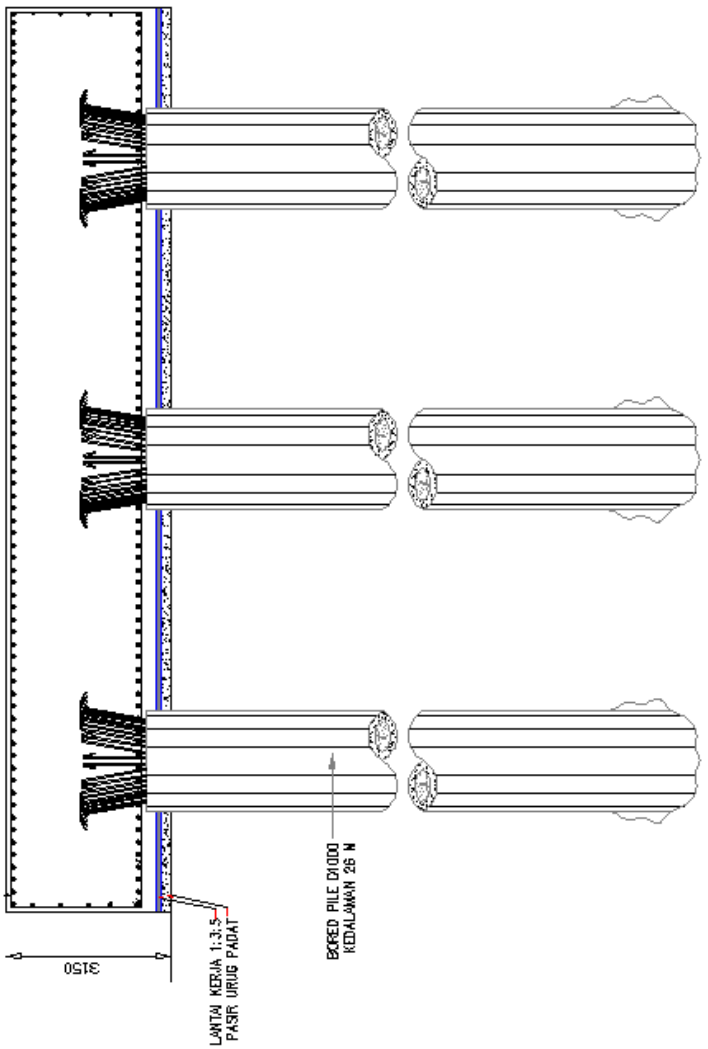


Gambar L3 *Column Design Chart*

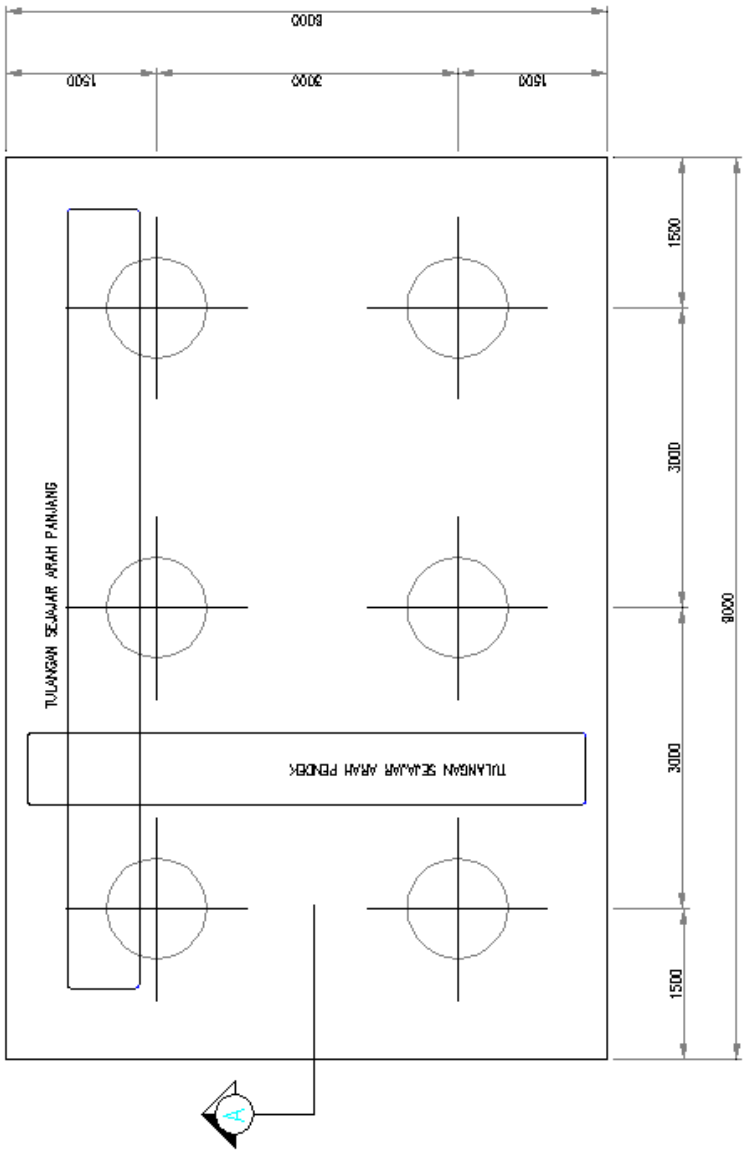
LAMPIRAN 5
Detail Penulangan *Pilecap* dan Pondasi



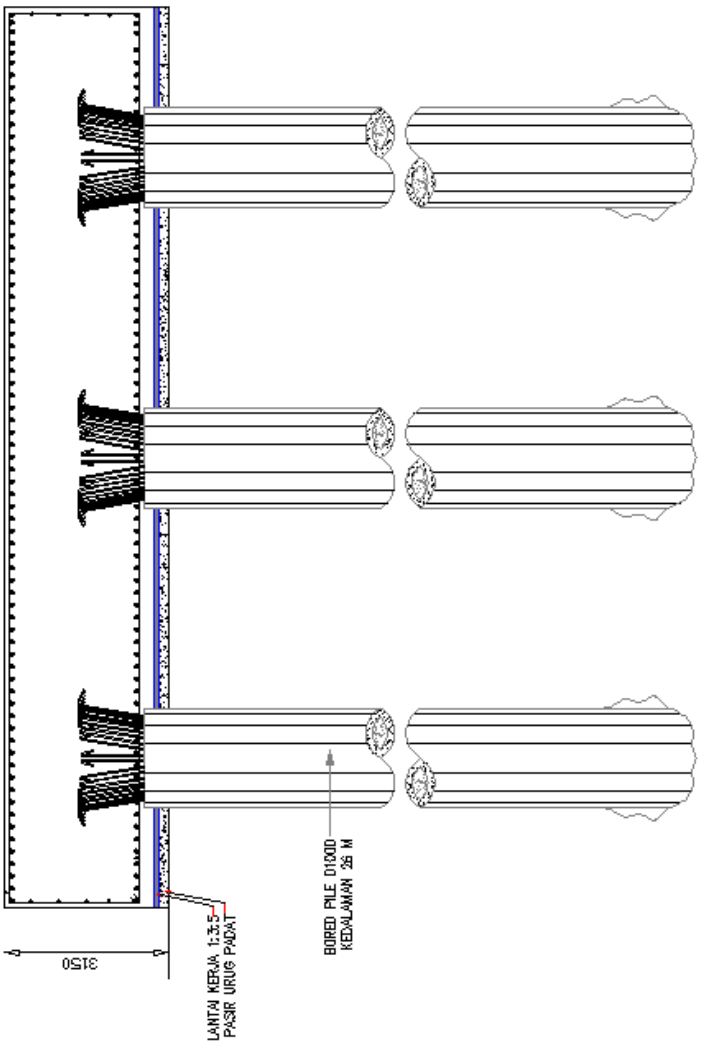
Gambar L5.1 Detail Pilecap Struktur Portal dengan Tumpuan Jepit



Gambar L5.2 Potongan A gambar L5.1



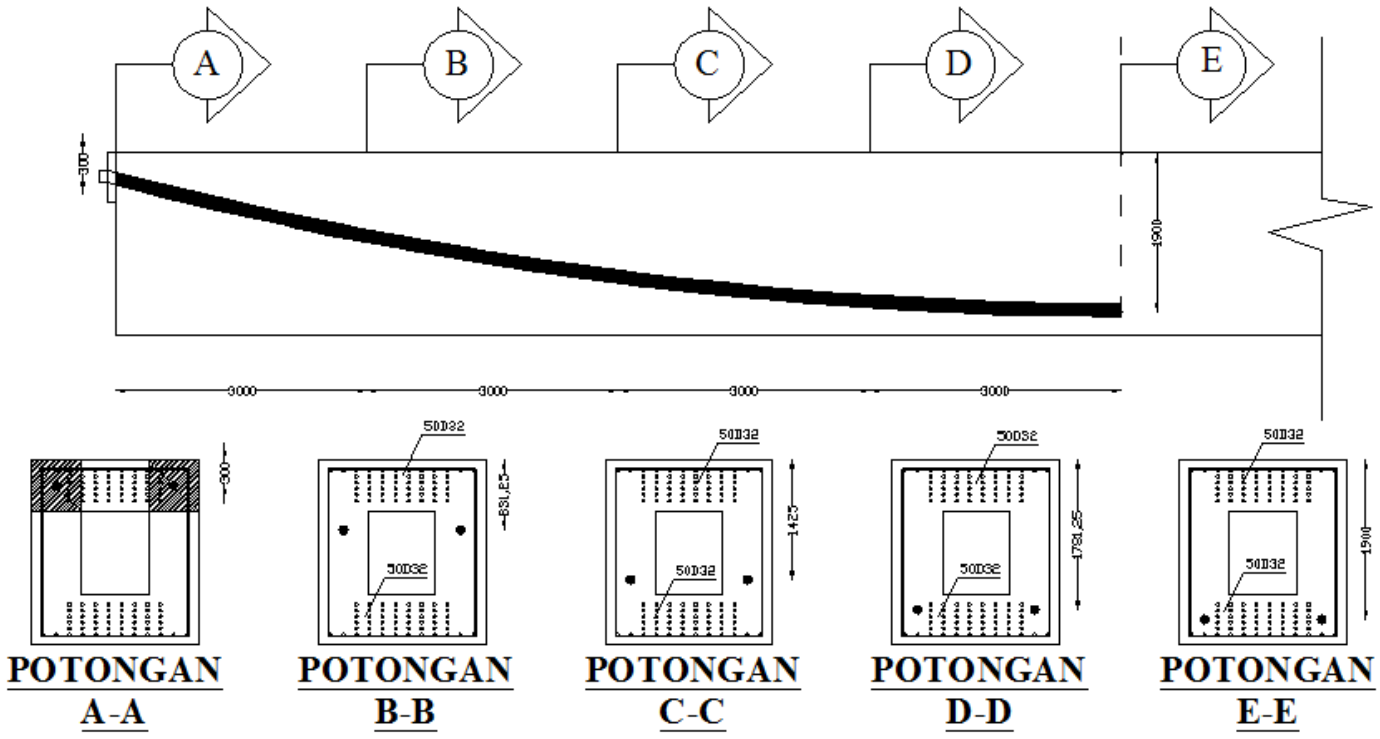
Gambar L5.3 Detail Pilecap Struktur Portal dengan Tumpuan Jepit



Gambar L5.4 Potongan A gambar L5.1

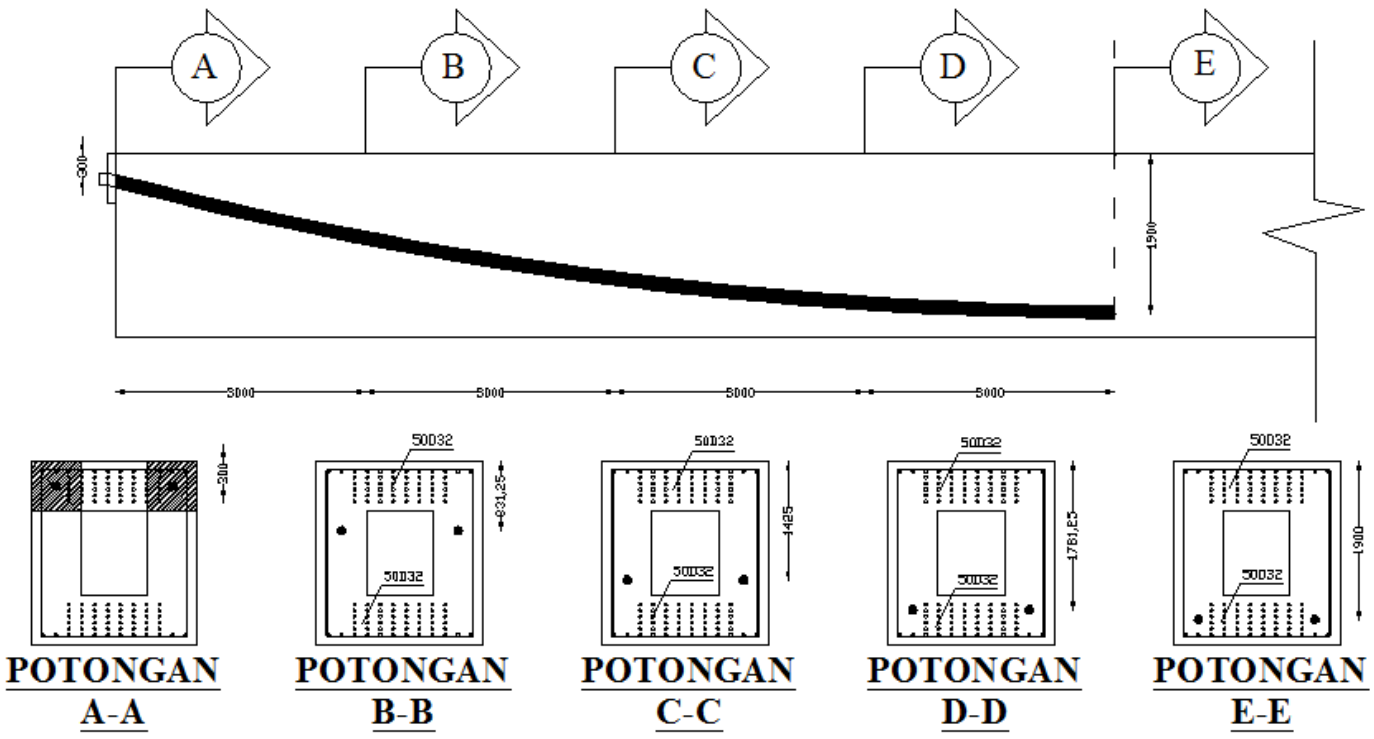
LAMPIRAN 6
Detail Penulangan Balok

1.) Penulangan Balok pada Struktur Portal dengan Tumpuan Jepit



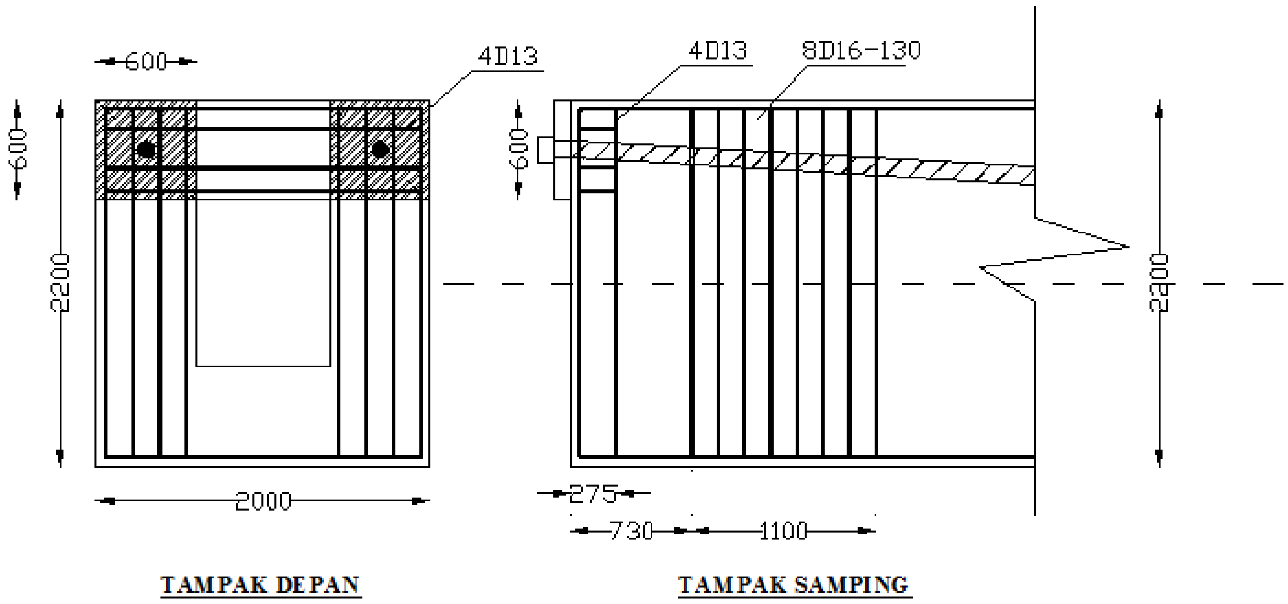
Gambar L6.1 Detail Penulangan Balok

2.) Penulangan Balok pada Struktur Portal dengan Tumpuan Pegas



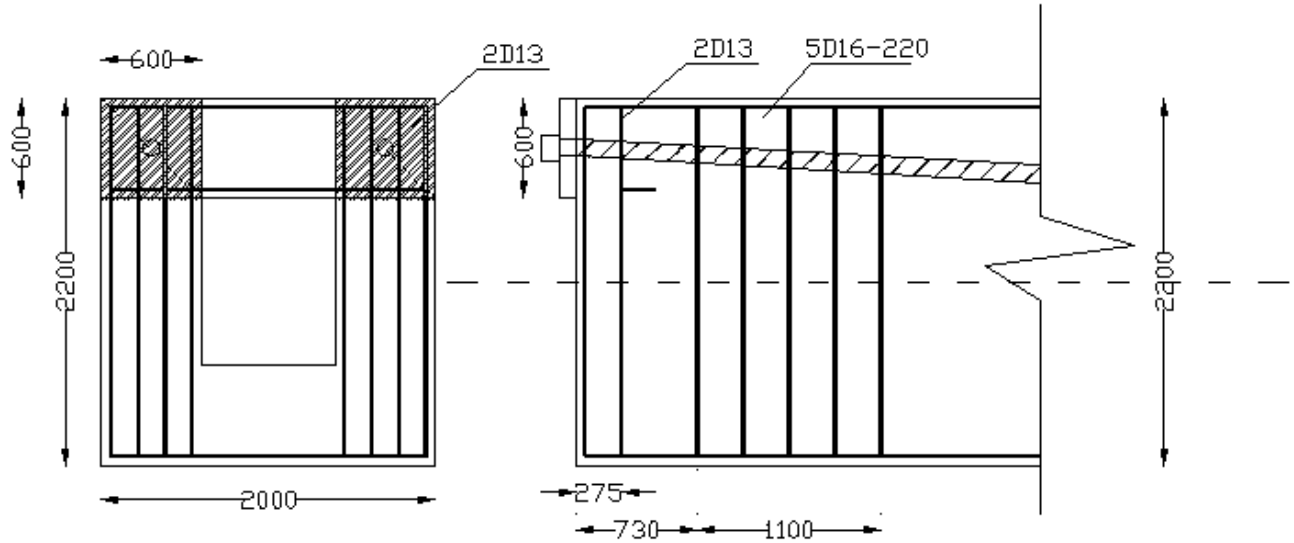
Gambar L6.2 Detail Penulangan Balok

3.) Pengangkuran Balok pada Struktur Portal dengan Tumpuan Jepit



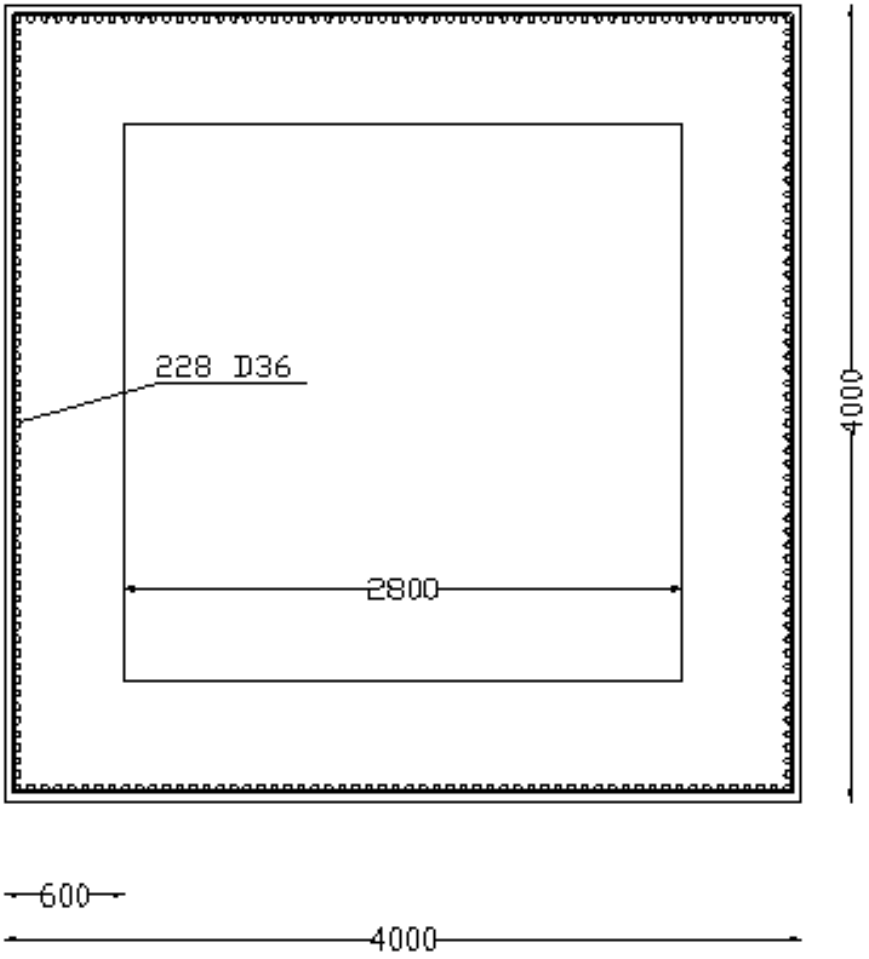
Gambar L6.3 Detail Pengangkuran Balok dengan Tumpuan Jepit

4.) Pengangkuran Balok pada Struktur Portal dengan Tumpuan Pegas

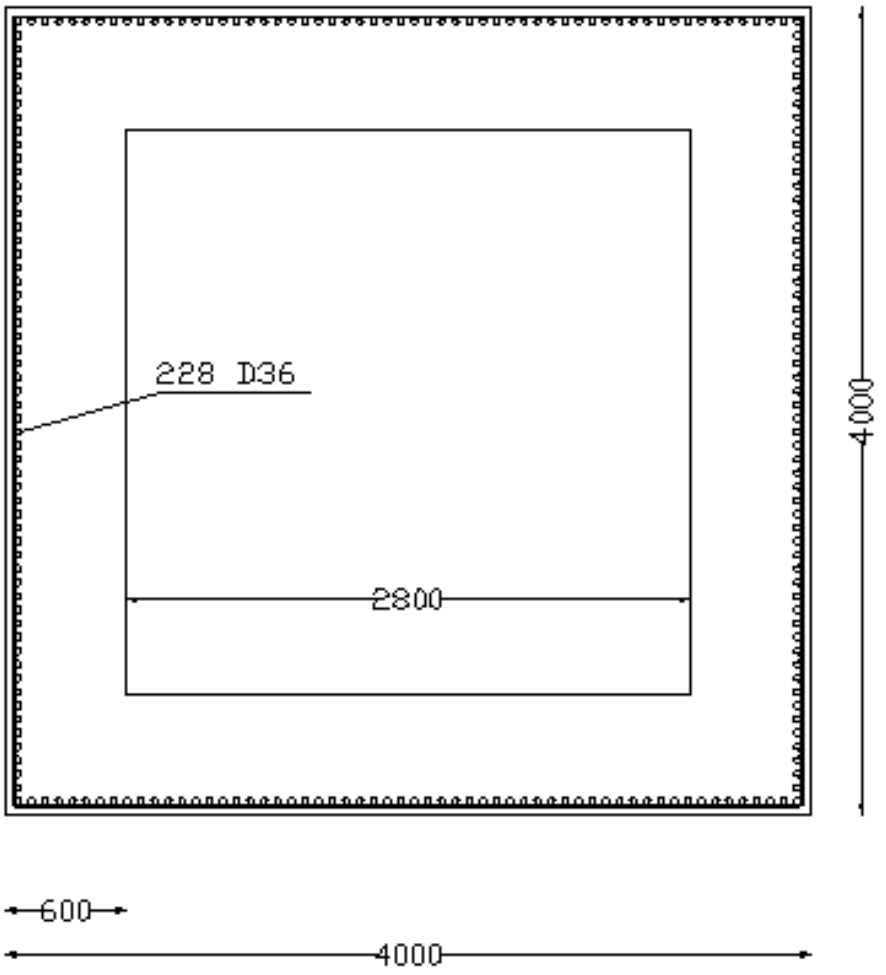


Gambar L6.4 Detail Pengangkuran Balok dengan Tumpuan Pegas

LAMPIRAN 7
Detail Penulangan Kolom

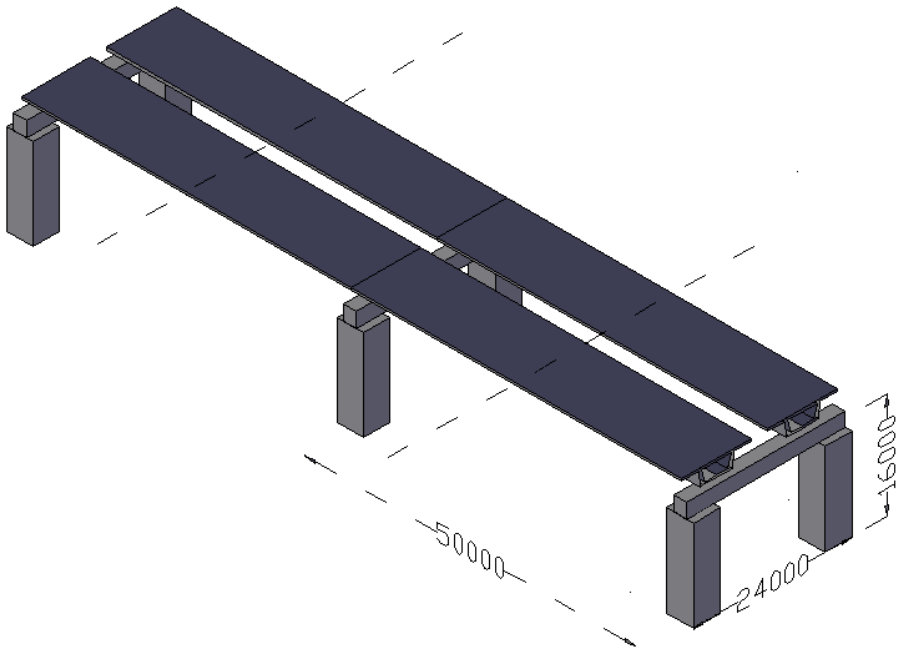


Gambar L.7.1 Detail Penulangan Kolom pada Struktur dengan Tumpuan Jepit

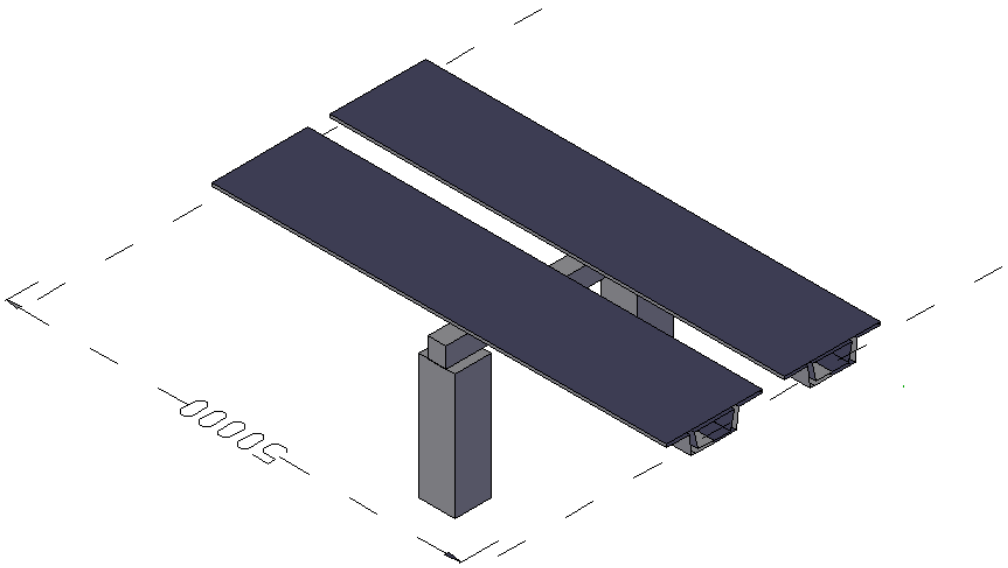


Gambar L7.2 Detail Penulangan Kolom pada Struktur dengan Tumpuan Pegas

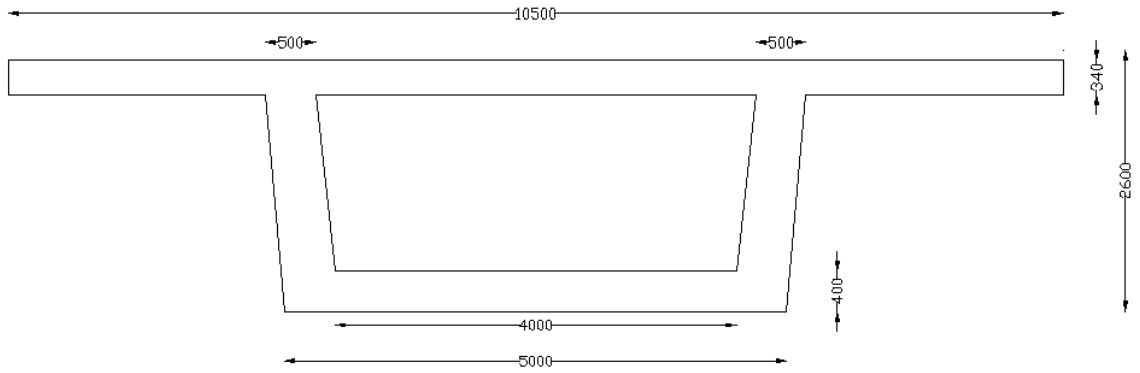
LAMPIRAN 8
Data Beban



Gambar L8.1 Struktur Jembatan 3D



Gambar L8.2 Potongan Struktur Jembatan



Gambar L8.3 Deck Jembatan

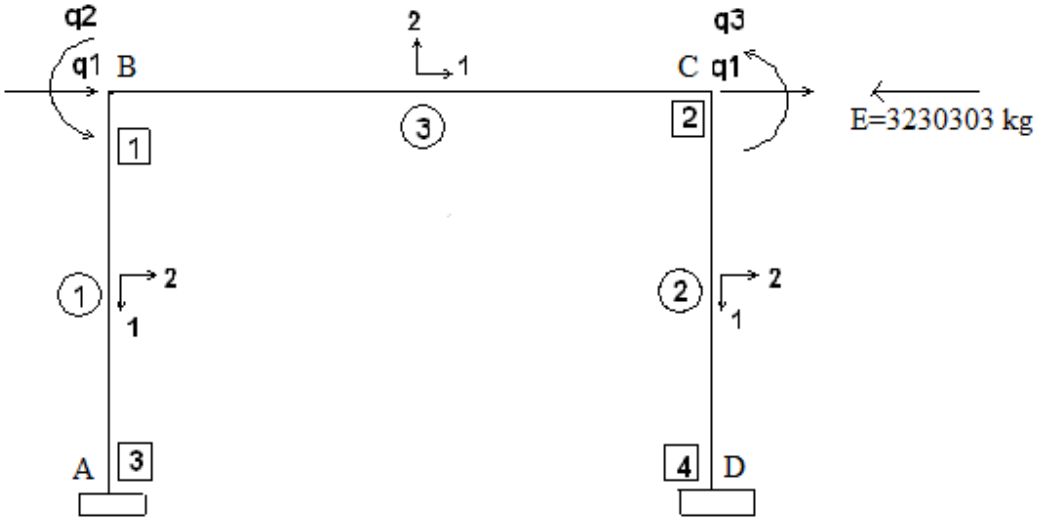
Luas penampang *deck* (A_{deck}) = 7,307 m^2
Berat jenis beton (γ) = 2400 kg/m^3
Jarak antar portal (L) = 50 m

Berat sendiri *Deck* (P_{SDL}) = $A_{deck} \times L \times \gamma$
= $7{,}306 \times 2400 \times 50$
= 876,82 ton
Beban *Crane* (P_{CR}) = 250 Ton
Beban Pejalan Kaki (P_{PLL}) = 40 ton
Beban Hidup (P_{LL}) = 302,3 ton

LAMPIRAN 9
Verifikasi Program dan Manual

Dalam Tugas Akhir ini akan dilakuakan verivikasi antara hasil perhitungan struktur dengan menggunakan Program SAP2000 dan perhitungan struktur dengan menggunakan Analisis Struktur Metoda Matriks. Dalam verivikasi ini digunakan struktur portal dengan tumpuan jepit dan hanya menerima beban gempa (E) sebesar 3230303 kg.

- Analisis Struktur Metoda Matriks



L_{AB} = 16 m I_{AB} = 16,2112 m^4 AAB = 8,16 m^2

L_{BC} = 24 m I_{BC} = 1,708 m^4 ABC = 3,6 m^2

L_{CD} = 16 m I_{CD} = 16,2112 m^4 ACD = 8,16 m^2

E $= 4700\sqrt{f_c'} = 4700\sqrt{25} = 23500\ {}^{N}/_{mm^2}$

$= 2396000000$ kg/ m^2

$$M_{code} = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 0 & 0 \\ 2 & 3 & 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

Elemen 1 (AB)

$$\alpha 1 = \frac{E.I_{AB}}{L_{AB}^{\ 3}} = 9{,}48291875 \times 10^{6}$$

$$\beta 1 = \frac{A_{AB}.L_{AB}^{\ 2}}{I_{AB}} = 128{,}85906040268456376$$

$$c11 = \frac{0}{L_{AB}} = 0$$

$$c12 = \frac{-L_{AB}}{L_{AB}} = -1$$

$$g11 = \alpha 1\left(\beta 1.c11^2 + 12.c12^2\right)$$
$$g12 = \alpha 1.c11.c12.\left(\beta 1 - 12\right)$$
$$g13 = \alpha 1\left(\beta 1.c12^2 + 12.c11^2\right)$$
$$g14 = -\alpha 1.6.L_{AB}.c12$$
$$g15 = \alpha 1.6.L_{AB}.c11$$
$$g16 = \alpha 1.4.L_{AB}^{\ 2}$$
$$g17 = \alpha 1.2.L_{AB}^{\ 2}$$

$$K1o = \begin{pmatrix} g11 & g12 & g14 & -g11 & -g12 & g14 \\ g12 & g13 & g15 & -g12 & -g13 & g15 \\ g14 & g15 & g16 & -g14 & -g15 & g17 \\ -g11 & -g12 & -g14 & g11 & g12 & -g14 \\ g12 & g13 & g15 & g12 & g13 & g15 \\ g14 & g15 & g17 & -g14 & -g15 & g16 \end{pmatrix} \begin{matrix} 1 \\ 0 \\ 2 \\ 0 \\ 0 \\ 0 \end{matrix}$$

$$k1 = \begin{pmatrix} g11 & 0 & g14 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ g14 & 0 & g16 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \begin{matrix} 1 \\ 0 \\ 2 \\ 0 \\ 0 \\ 0 \end{matrix} \quad \rightarrow \quad K1 = \begin{pmatrix} 1{,}138 \times 10^{8} & 9{,}104 \times 10^{8} & 0 \\ 9{,}104 \times 10^{8} & 9{,}711 \times 10^{9} & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Elemen 2 (CD)

$$\alpha 2 = \frac{E.I_{CD}}{L_{CD}^{\ 3}} = 9{,}48291875 \times 10^{6}$$

$$\beta 2 = \frac{A_{CD}.L_{CD}^{\ 2}}{I_{CD}} = 128{,}85906040268456376$$

$$c21 = \frac{0}{L_{CD}} = 0$$

$$c22 = \frac{-L_{CD}}{L_{CD}} = -1$$

$$g21 = \alpha 2\left(\beta 2.c21^{2} + 12.c22^{2}\right)$$

$$g22 = \alpha 2.c21.c22.\left(\beta 2 - 12\right)$$

$$g23 = \alpha 2\left(\beta 2.c22^{2} + 12.c21^{2}\right)$$

$$g24 = -\alpha 2.6.L_{CD}.c22$$

$$g25 = \alpha 2.6.L_{CD}.c21$$

$$g26 = \alpha 2.4.L_{CD}^{\ 2}$$

$$g27 = \alpha 2.2.L_{CD}^{\ 2}$$

$$K2o = \begin{pmatrix} g21 & g22 & g24 & -g21 & -g22 & g24 \\ g22 & g23 & g25 & -g22 & -g23 & g25 \\ g24 & g25 & g26 & -g24 & -g25 & g27 \\ -g21 & -g22 & -g24 & g21 & g22 & -g24 \\ -g22 & -g23 & -g25 & g22 & g23 & -g25 \\ g24 & g25 & g27 & -g24 & -g25 & g26 \end{pmatrix} \begin{matrix} 1 \\ 0 \\ 3 \\ 0 \\ 0 \\ 0 \end{matrix}$$

$$k2 = \begin{pmatrix} g21 & 0 & g24 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ g24 & 0 & g26 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \begin{matrix} 1 \\ 0 \\ 3 \\ 0 \\ 0 \\ 0 \end{matrix} \quad \rightarrow \quad K2 = \begin{pmatrix} 1{,}138 \times 10^{8} & 0 & 9{,}104 \times 10^{8} \\ 0 & 0 & 0 \\ 9{,}104 \times 10^{8} & 0 & 9{,}711 \times 10^{9} \end{pmatrix}$$

Elemen 3 (BC)

$$\alpha 3 = \frac{E.I_{BC}}{L_{BC}^{\ 3}} = 296033{,}564814814814$$

$$\beta 3 = \frac{A_{BC}.L_{BC}^{\ 2}}{I_{BC}} = 1214{,}0515222482435597$$

$$c31 = \frac{L_{BC}}{L_{BC}} = 1$$

$$c32 = \frac{0}{L_{BC}} = 0$$

$$g31 = \alpha 3\left(\beta 3.c31^2 + 12.c32^2\right)$$

$$g32 = \alpha 3.c31.c32.\left(\beta 3 - 12\right)$$

$$g33 = \alpha 3\left(\beta 3.c32^2 + 12.c31^2\right)$$

$$g34 = -\alpha 3.6.L_{BC}.c32$$

$$g35 = \alpha 3.6.L_{BC}.c21$$

$$g36 = \alpha 3.4.L_{BC}{}^2$$

$$g37 = \alpha 3.2.L_{BC}{}^2$$

$$K3o = \begin{pmatrix} g31 & g32 & g34 & -g31 & -g32 & g34 \\ g32 & g33 & g35 & -g32 & -g33 & g35 \\ g34 & g35 & g36 & -g34 & -g35 & g37 \\ -g31 & -g32 & -g34 & g31 & g32 & -g34 \\ -g32 & -g33 & -g35 & g32 & g33 & -g35 \\ g34 & g35 & g37 & -g34 & -g35 & g36 \end{pmatrix} \begin{matrix} 0 \\ 0 \\ 2 \\ 0 \\ 0 \\ 3 \end{matrix}$$

$$k3 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & g36 & 0 & 0 & g37 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & g37 & 0 & 0 & g36 \end{pmatrix} \begin{matrix} 0 \\ 0 \\ 2 \\ 0 \\ 0 \\ 3 \end{matrix} \quad \rightarrow \quad K3 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 6{,}821 \times 10^8 & 3{,}41 \times 10^8 \\ 0 & 3{,}41 \times 10^8 & 6{,}281 \times 10^9 \end{pmatrix}$$

$$K = \begin{pmatrix} 227590050 & 910360200 & 910360200 \\ 910360200 & 10392570133.333 & 341030666.667 \\ 910360200 & 341030666.667 & 10392570133.333 \end{pmatrix}$$

$$\hat{Q} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \qquad \overline{Q} = \begin{pmatrix} -3230303 \\ 0 \\ 0 \end{pmatrix}$$

$$Q = \overline{Q} - \hat{Q} = \begin{pmatrix} -3230303 \\ 0 \\ 0 \end{pmatrix}$$

$$K.q = Q \rightarrow q = K^{-1}.Q$$

$$q = \begin{pmatrix} -0.044149501916110566458 \\ 0.0037444982483651524011 \\ 0.0037444982483651524011 \end{pmatrix}$$

$$D1 = \begin{pmatrix} -0.044149501916110566458 \\ 0 \\ 0.0037444982483651524011 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad D2 = \begin{pmatrix} -0.044149501916110566458 \\ 0 \\ 0.0037444982483651524011 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

$$D3 = \begin{pmatrix} 0 \\ 0 \\ 0.0037444982483651524011 \\ 0 \\ 0 \\ 0.0037444982483651524011 \end{pmatrix}$$

Gaya-gaya pada Elemen

$$f1 = K1o.D1$$

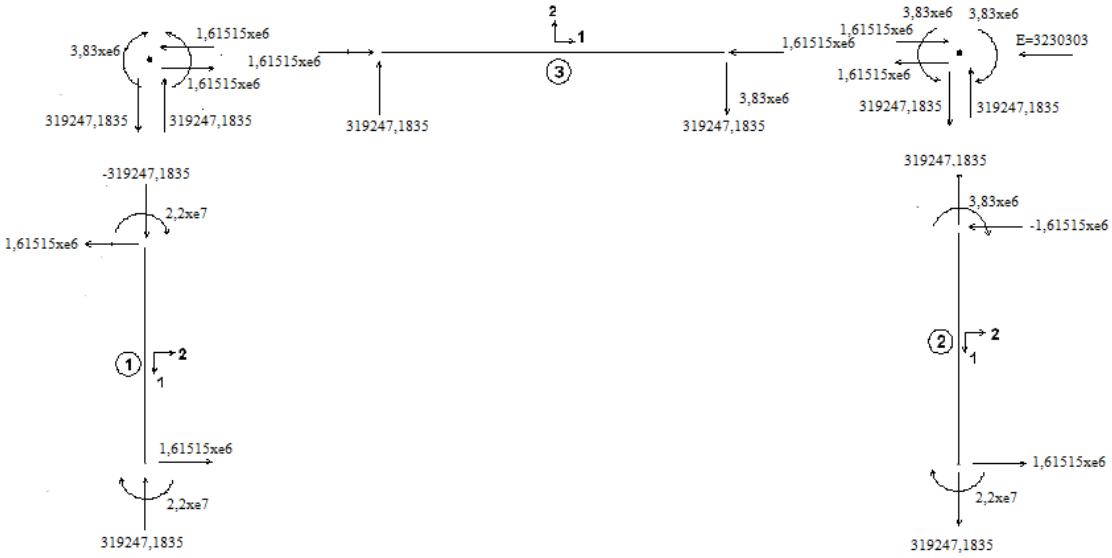
$$f1 = \begin{pmatrix} -1.6151514999999999999561 \times 10^{6} \\ 0 \\ -3.8309662019164004985973 \times 10^{6} \\ 1.6151514999999999999561 \times 10^{6} \\ 0 \\ -2.2011457798083599500709 \times 10^{7} \end{pmatrix}$$

$$f2 = K2o.D2$$

$$f2 = \begin{pmatrix} -1.6151514999999999999561 \times 10^{6} \\ 0 \\ -3.8309662019164004985973 \times 10^{6} \\ 1.6151514999999999999561 \times 10^{6} \\ 0 \\ -2.2011457798083599500709 \times 10^{7} \end{pmatrix}$$

$$f3 = K3o.D3$$

$$f3 = \begin{pmatrix} 0 \\ 319247.18349303337502635 \\ 3.8309662019164005002713 \times 10^{6} \\ 0 \\ -319247.18349303337502635 \\ 3.8309662019164005002713 \times 10^{6} \end{pmatrix}$$



	Vertikal (kg)	Horisontal (kg)	Momen (kg.m)
ASMM	319247,1835	1615151,5	22011457,8
SAP2000	310327	1676026,4	23032511,5
% beda	2,79%	3,63%	4,43%