

**Lampiran 1. Perhitungan beban tiap lantai****a. Ring Balok Lantai 13 (Top Floor)****B.1 Beban Mati**

- Balok B5 =  $0,3 \text{ m} \times 0,6 \text{ m} \times 2400 \text{ kg/m}^3 \times 1,9 \text{ m} \times 16 = 13132,8 \text{ kg}$   
=  $0,3 \text{ m} \times 0,6 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 12 = 37324,8 \text{ kg}$
- Balok B7 =  $0,25 \text{ m} \times 0,6 \text{ m} \times 2400 \text{ kg/m}^3 \times 1,9 \text{ m} \times 8 = 5472 \text{ kg}$   
=  $0,25 \text{ m} \times 0,6 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 12 = 31104 \text{ kg} +$   
 $W_1 = 87033,6 \text{ kg}$

**B.2 Beban Hidup**

- $W_2 = 0 \text{ kg}$

**B.3 Beban Total**

- $W_{TBR} = W_1 + W_2$   
=  $87033,6 + 0$   
=  $87033,6 \text{ kg}$

**b. Lantai 13****C.1 Beban Mati**

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 22 = 99792 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 6 = 18144 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 4 = 6237 \text{ kg}$
- Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 16 = 41472 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4 \text{ m} \times 2 \text{ m} = 2880 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 12 = 10692 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,4 \text{ m} \times 10 = 8640 \text{ kg}$
- Balok B4 =  $0,2 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 16,8 \text{ m} \times 4 = 19353,6 \text{ kg}$
- Balok B6 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4 = 2688 \text{ kg}$   
=  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 4 = 2079 \text{ kg}$
- Kolom K2 =  $0,8 \text{ m} \times 0,8 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,65 \text{ m} \times 18 = 128563,2 \text{ kg}$
- Kolom K5 =  $0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,65 \text{ m} \times 14 = 14061,6 \text{ kg} +$   
 $W_1 = 354602,4 \text{ kg}$

**C.2 Beban Hidup**

$$26,55 \text{ m} \times 26,55 \text{ m} = 704,9025 \text{ m}^2$$

$$(2,4 \text{ m} + 2,325 \text{ m}) \times 21,6 \text{ m} = 102,6 \text{ m}^2$$

$$3 \times 7,2 \text{ m} \times 2,325 \text{ m} = \underline{51,84 \text{ m}^2} + 859,3425 \text{ m}^2$$

- Luas lantai (A) =  $859,3425 \text{ m}^2 - (21,6 \text{ m} \times 21,6 \text{ m}) - (4 \text{ m} \times 4,8 \text{ m}) - (4 \times 3,2 \text{ m} \times 2,4 \text{ m}) - (2 \times 7,2 \text{ m} \times 2,475 \text{ m})$   
=  $307,2225 \text{ m}^2$
- $W_2 = 250 \text{ kg} / \text{m}^2 \times 307,2225 \text{ m}^2$   
=  $76805,625 \text{ kg}$

### C.3 Total Beban

$$\begin{aligned} W_{T13} &= W_1 + W_2 \\ &= 354602,4 \text{ kg} + 76805,625 \text{ kg} \\ &= 431408,025 \text{ kg} \end{aligned}$$

### c. Lantai 12

#### D.1 Beban Mati

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 7,2 \text{ m} \times 34 = 154224 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,8 \text{ m} \times 6 = 18144 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 2,475 \text{ m} \times 6 = 9355,5 \text{ kg}$
- Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 7,2 \text{ m} \times 31 = 80352 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,8 \text{ m} \times 3 = 5184 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,2 \text{ m} \times 2 = 3024 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 2,475 \text{ m} \times 4 = 3564 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 1,8 \text{ m} \times 4 = 5184 \text{ kg}$
- Balok B6 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 3,2 \text{ m} \times 4 = 2688 \text{ kg}$   
=  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 2,475 \text{ m} \times 4 = 2079 \text{ kg}$
- Kolom K2 =  $0,8 \text{ m} \times 0,8 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,5 \text{ m} \times 20 = 138240 \text{ kg}$
- Kolom K4 =  $0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,5 \text{ m} \times 6 = 18954 \text{ kg}$
- Kolom K5 =  $0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 4,5 \text{ m} \times 10 = 9720 \text{ kg} +$   
 $W_1 = 450712,5 \text{ kg}$

#### D.2 Beban Hidup

$$\begin{aligned} 31,275 \text{ m} \times 21,6 \text{ m} &= 675,54 \text{ m}^2 \\ 2 \times 2,475 \text{ m} \times 21,6 \text{ m} &= 106,92 \text{ m}^2 \\ 3 \times 7,2 \text{ m} \times 2,325 \text{ m} &= 50,22 \text{ m}^2 \\ 4 \times 1,8 \text{ m} \times 1,8 \text{ m} &= \underline{12,96 \text{ m}^2} + 845,64 \text{ m}^2 \end{aligned}$$

- Luas lantai (A) =  $845,64 \text{ m}^2 - (4\text{m} \times 4,8\text{m}) - (4 \times 3,2\text{m} \times 4,8\text{m}) - (2 \times 7,2\text{m} \times 2,475\text{m})$   
=  $729,36 \text{ m}^2$
- $W_2 = 250 \text{ kg} / \text{m}^2 \times 729,36 \text{ m}^2$   
=  $182340 \text{ kg}$

### D.3 Total Beban

$$\begin{aligned} W_{T12} &= W_1 + W_2 \\ &= 450712,5 \text{ kg} + 182340 \text{ kg} \\ &= 633052,5 \text{ kg} \end{aligned}$$

### d. Lantai 5 s/d 11

#### E.1 Beban Mati

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 34 = 154224 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 6 = 18144 \text{ kg}$   
=  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 6 = 9355,5 \text{ kg}$
- Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 31 = 80352 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 3 = 5184 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,2 \text{ m} \times 2 = 3024 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 4 = 3564 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 1,8 \text{ m} \times 4 = 5184 \text{ kg}$
- Balok B6 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4 = 2688 \text{ kg}$   
=  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 4 = 2079 \text{ kg}$
- Kolom K2 =  $0,8 \text{ m} \times 0,8 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 20 = 138240 \text{ kg}$
- Kolom K4 =  $0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 6 = 18954 \text{ kg}$
- Kolom K5 =  $0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 10 = 9720 \text{ kg} +$   
 $W_1 = 450712,5 \text{ kg}$

#### E.2 Beban Hidup

$$\begin{aligned} 31,275 \text{ m} \times 21,6 \text{ m} &= 675,54 \text{ m}^2 \\ 2 \times 2,475 \text{ m} \times 21,6 \text{ m} &= 106,92 \text{ m}^2 \\ 3 \times 7,2 \text{ m} \times 2,325 \text{ m} &= 50,22 \text{ m}^2 \\ 4 \times 1,8 \text{ m} \times 1,8 \text{ m} &= \underline{12,96 \text{ m}^2} + \\ &845,64 \text{ m}^2 \end{aligned}$$



- Luas lantai (A) =  $845,64 \text{ m}^2 - (4\text{m} \times 4,8\text{m}) - (4 \times 3,2\text{m} \times 4,8\text{m}) - (2 \times 7,2\text{m} \times 2,475\text{m})$   
=  $729,36 \text{ m}^2$
- $W_2 = 250 \text{ kg} / \text{m}^2 \times 729,36 \text{ m}^2$   
=  $182340 \text{ kg}$

### E.3 Total Beban

$$\begin{aligned} W_{T11} &= W_1 + W_2 \\ &= 450712,5 \text{ kg} + 182340 \text{ kg} \\ &= 633052,5 \text{ kg} \end{aligned}$$

### e. Lantai 4

#### F.1 Beban Mati

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 54$  =  $244944 \text{ kg}$
  - Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 46$  =  $119232 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 3$  =  $3456 \text{ kg}$   
=  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4 \text{ m} \times 2$  =  $2880 \text{ kg}$
  - Balok B3 =  $0,6 \text{ m} \times 1 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 6$  =  $62208 \text{ kg}$
  - Balok B6 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4$  =  $2688 \text{ kg}$   
=  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,475 \text{ m} \times 4$  =  $2079 \text{ kg}$
  - Kolom K2 =  $0,8 \text{ m} \times 0,8 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 20$  =  $138240 \text{ kg}$
  - Kolom K3 =  $0,6 \text{ m} \times 0,1 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 6$  =  $38880 \text{ kg}$
  - Kolom K4 =  $0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 16$  =  $50544 \text{ kg}$
  - Kolom K5 =  $0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,5 \text{ m} \times 10$  =  $9720 \text{ kg} +$
- $W_1 = 674871 \text{ kg}$

#### E.2 Beban Hidup

- Luas lantai (A) =  $(36 \text{ m} \times 36 \text{ m}) - (4 \text{ m} \times 4,8 \text{ m}) - (4 \times 3,2 \text{ m} \times 2,4 \text{ m}) - (2 \times 7,2\text{m} \times 2,4 \text{ m})$   
=  $1211,52 \text{ m}^2$
- $W_2 = 250 \text{ kg} / \text{m}^2 \times 1211,52 \text{ m}^2$   
=  $302880 \text{ kg}$

### E.3 Total Beban

$$\begin{aligned} W_{T4} &= W_1 + W_2 \\ &= 674871 \text{ kg} + 302880 \text{ kg} \\ &= 977751 \text{ kg} \end{aligned}$$

### f. Lantai 3

#### G.1 Beban Mati

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 60$  = 272160 kg
  - Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 46$  = 119232 kg
  - Balok B3 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 2$  = 3456 kg
  - Balok B4 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4 \text{ m} \times 2$  = 2880 kg
  - Balok B6 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4$  = 2688 kg
  - Balok B7 =  $0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,4 \text{ m} \times 4$  = 2016 kg
  - Kolom K1 =  $1 \text{ m} \times 1 \text{ m} \times 2400 \text{ kg/m}^3 \times 5 \text{ m} \times 20$  = 240000 kg
  - Kolom K3 =  $0,6 \text{ m} \times 0,1 \text{ m} \times 2400 \text{ kg/m}^3 \times 5 \text{ m} \times 6$  = 43200 kg
  - Kolom K4 =  $0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg/m}^3 \times 5 \text{ m} \times 10$  = 35100 kg
  - Kolom K5 =  $0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 5 \text{ m} \times 10$  = 10800 kg +
- $W_1 = 731532 \text{ kg}$

#### G.2 Beban Hidup

- Luas lantai (A) =  $(36 \text{ m} \times 36 \text{ m}) - (4 \text{ m} \times 4,8 \text{ m}) - (4 \times 3,2 \text{ m} \times 2,4 \text{ m}) - (2 \times 7,2 \text{ m} \times 2,4 \text{ m})$   
= 1211,52 m<sup>2</sup>
- $W_3 = 250 \text{ kg} / \text{m}^2 \times 1211,52 \text{ m}^2$   
= 302880 kg

#### G.3 Total Beban

$$\begin{aligned} W_{T3} &= W_1 + W_2 \\ &= 731532 \text{ kg} + 302880 \text{ kg} \\ &= 1034412 \text{ kg} \end{aligned}$$

### g. Lantai 2

#### H.1 Beban Mati

- Balok B1 =  $0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 56$  = 254016 kg
- Balok B2 =  $0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 46$  = 119232 kg

	$= 0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4 \text{ m} \times 4$	$= 5760 \text{ kg}$
	$= 0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,6 \text{ m} \times 4$	$= 5184 \text{ kg}$
• Balok B6	$= 0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4$	$= 2688 \text{ kg}$
	$= 0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,4 \text{ m} \times 4$	$= 2016 \text{ kg}$
• Kolom K1	$= 1 \text{ m} \times 1 \text{ m} \times 2400 \text{ kg/m}^3 \times 7 \text{ m} \times 20$	$= 336000 \text{ kg}$
• Kolom K3	$= 0,6 \text{ m} \times 0,1 \text{ m} \times 2400 \text{ kg/m}^3 \times 7 \text{ m} \times 6$	$= 60480 \text{ kg}$
• Kolom K4	$= 0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg/m}^3 \times 7 \text{ m} \times 10$	$= 49140 \text{ kg}$
• Kolom K5	$= 0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 7 \text{ m} \times 10$	$= \underline{15120 \text{ kg}} +$
	$W_1$	$= 849636 \text{ kg}$

## H.2 Beban Hidup

• Luas lantai (A)	$= (36 \text{ m} \times 36 \text{ m}) - (4 \text{ m} \times 4,8 \text{ m}) - (4 \times 3,2 \text{ m} \times 2,4 \text{ m}) - (2 \times 7,2 \text{ m} \times 2,4 \text{ m}) - (7,2 \text{ m} \times 7,2) - (7,2 \text{ m} \times 3,6 \text{ m} \times 4)$	
	$= 1056 \text{ m}^2$	
• $W_2$	$= 250 \text{ kg} / \text{m}^2 \times 1056 \text{ m}^2$	
	$= 264000 \text{ kg}$	

## H.3 Total Beban

$$\begin{aligned}
 W_{T2} &= W_1 + W_2 \\
 &= 849636 \text{ kg} + 264000 \text{ kg} \\
 &= 1113636 \text{ kg}
 \end{aligned}$$

## h. Lantai 1

### I.1 Beban Mati

• Balok B1	$= 0,35 \text{ m} \times 0,75 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 60$	$= 272160 \text{ kg}$
• Balok B2	$= 0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 7,2 \text{ m} \times 46$	$= 119232 \text{ kg}$
	$= 0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4,8 \text{ m} \times 2$	$= 3456 \text{ kg}$
	$= 0,3 \text{ m} \times 0,5 \text{ m} \times 2400 \text{ kg/m}^3 \times 4 \text{ m} \times 2$	$= 2880 \text{ kg}$
• Balok B6	$= 0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,2 \text{ m} \times 4$	$= 2688 \text{ kg}$
	$= 0,25 \text{ m} \times 0,35 \text{ m} \times 2400 \text{ kg/m}^3 \times 2,4 \text{ m} \times 2$	$= 1008 \text{ kg}$
• Kolom K1	$= 1 \text{ m} \times 1 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,5 \text{ m} \times 20$	$= 168000 \text{ kg}$
• Kolom K3	$= 0,6 \text{ m} \times 0,1 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,5 \text{ m} \times 6$	$= 30240 \text{ kg}$
• Kolom K4	$= 0,45 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,5 \text{ m} \times 10$	$= 24570 \text{ kg}$
• Kolom K5	$= 0,3 \text{ m} \times 0,3 \text{ m} \times 2400 \text{ kg/m}^3 \times 3,5 \text{ m} \times 10$	$= \underline{7560 \text{ kg}} +$
	$W_1$	$= 631794 \text{ kg}$



### I.2 Beban Hidup

- Luas lantai (A) =  $(36 \text{ m} \times 36 \text{ m}) - (4 \text{ m} \times 4,8 \text{ m}) - (4 \times 3,2 \text{ m} \times 2,4 \text{ m})$   
=  $1246,08 \text{ m}^2$
- $W_2 = 250 \text{ kg} / \text{m}^2 \times 1246,08 \text{ m}^2$   
=  $311520 \text{ kg}$

### I.3 Total Beban

$$\begin{aligned} W_{T1} &= W_1 + W_2 \\ &= 631794 \text{ kg} + 311520 \text{ kg} \\ &= 943314 \text{ kg} \end{aligned}$$

### i. Basement

#### J.1 Beban Mati

- Balok A1 =  $0,4 \text{ m} \times 0,8 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 7,2 \text{ m} \times 22$  =  $121651,2 \text{ kg}$
- Balok A2 =  $0,35 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 7,2 \text{ m} \times 54$  =  $212284,8 \text{ kg}$   
=  $0,35 \text{ m} \times 0,65 \text{ m} \times 2400 \text{ kg}/\text{m}^3 \times 3,2 \text{ m} \times 12$  =  $5241,6 \text{ kg}$  +  
 $W_1$  =  $339177,6 \text{ kg}$

#### J.2 Beban Hidup

- $W_2 = 0 \text{ kg}$

#### J.3 Beban Total

- $W_{TBS} = W_1 + W_2$   
=  $339177,6 \text{ kg} + 0$   
=  $339177,6 \text{ kg}$

### Lampiran 2. Gaya geser dasar

BASE SHEAR GEMPA DINAMIK RSP SPEKTRUM X					
Story	Point	Load	FX (kg)	FY (kg)	FZ (kg)
BASE	7	RSPX	5590,5	2025,78	20526,12
BASE	8	RSPX	5174,91	2250,14	4663,7
BASE	9	RSPX	5044,43	2033,69	4661,35
BASE	10	RSPX	5477,63	2281,34	18747,1
BASE	11	RSPX	5299,52	2119,69	4888,59
BASE	12	RSPX	5303,18	2101,26	5301,54
BASE	13	RSPX	4874,59	2225,82	18769,01
BASE	14	RSPX	4727,92	1942,18	4848,59
BASE	16	RSPX	5012,45	2099,09	4825,58
BASE	17	RSPX	5296,56	1868,63	20703,68

BASE	18	RSPX	5399,58	1582,97	6135,57
BASE	19	RSPX	5361,88	1694,95	6465,95
BASE	21	RSPX	2671,11	526,85	4667,48
BASE	22	RSPX	3630,86	1087,13	4605,5
BASE	23	RSPX	4074,45	410,26	25338,03
BASE	25	RSPX	4676,39	866,61	14755,65
BASE	26	RSPX	4668,73	882,09	15199,94
BASE	27	RSPX	5537,79	1808,83	4544,35
BASE	28	RSPX	5360,06	1872,5	3844,65
BASE	29	RSPX	5777,74	1884,47	4074,12
BASE	30	RSPX	5626,35	1978,59	3662,4
BASE	31	RSPX	4162,9	318,98	25492,27
BASE	32	RSPX	6375,27	720,57	11623,39
BASE	33	RSPX	6077,71	764,23	12570,14
BASE	34	RSPX	2475,3	2506,95	38451,65
BASE	35	RSPX	3210,52	906,37	9738,71
BASE	37	RSPX	414,68	198,23	1763,23
BASE	38	RSPX	1079,74	210,67	5524,73
BASE	39	RSPX	470,61	250,92	1093,63
BASE	40	RSPX	690,19	209,56	5154,98
BASE	41	RSPX	676,32	140,33	3427,89
BASE	42	RSPX	763,24	117,11	3288,79
BASE	43	RSPX	1029,54	211,57	5570,79
BASE	44	RSPX	632,52	210,84	5300,76
BASE	45	RSPX	1148,87	214,04	1468,23
BASE	46	RSPX	1210,25	260,22	1662,67
BASE	47	RSPX	3185,98	1449,33	13592,24
BASE	48	RSPX	2412,06	923,1	11073,28
BASE	49	RSPX	2600,96	1387,53	11592,01
BASE	50	RSPX	2411,11	955,31	11001,08
BASE	51	RSPX	2598,88	1445,14	11636,5
BASE	52	RSPX	3132,48	1447,04	13154,11
BASE	53	RSPX	2988,99	950,32	8660,6
BASE	54	RSPX	2359,58	2387,04	38552,43
BASE	55	RSPX	2384,4	2531,75	38386,09
BASE	56	RSPX	2281,19	2455,56	38194,5
BASE	57	RSPX	14,91	1,26	1799,83
BASE	58	RSPX	26,81	2122,75	21227,75
BASE	59	RSPX	679,75	1,54	4278,71
BASE	60	RSPX	86,35	32,61	710,75
BASE	61	RSPX	6152,6	19,85	8748,71
BASE	62	RSPX	2401,25	25,17	7554,3
BASE	63	RSPX	92,11	39,25	553,56
BASE	64	RSPX	3,54	9,62	384,92
BASE	65	RSPX	5,82	3,37	1447,46
BASE	66	RSPX	6,44	102,84	1607,75



BASE	67	RSPX	6,98	38,51	1290,25
BASE	70	RSPX	4,2	11,63	32,58
BASE	71	RSPX	27,52	85,59	16082,93
BASE	72	RSPX	42,53	42369,1	35164,37
BASE	73	RSPX	24,83	114,3	13112,69
BASE	74	RSPX	41,97	24552	34214,85
BASE	75	RSPX	38,39	26,46	450,92
BASE	80	RSPX	3,99	6,83	50,37
BASE	81	RSPX	45,63	10970,98	30872,95
BASE	82	RSPX	42,18	10418,12	28707,35
BASE	84	RSPX	9126,8	34,13	10756,88
BASE	85	RSPX	7114,46	2,07	9164,07
BASE	86	RSPX	54,13	434571,2	71,68
BASE	87	RSPX	3197,49	34,61	7802,19
BASE	88	RSPX	9,32	42,45	46,48
BASE	89	RSPX	26,01	10,65	459,25
BASE	90	RSPX	57,02	49213,19	32921,49
BASE	93	RSPX	393,73	16,89	4881,58
BASE	94	RSPX	18611,6	65,42	6644,66
BASE	95	RSPX	10470,51	82,05	5707,06
BASE	96	RSPX	602,14	46,57	5792,82
BASE	97	RSPX	850,75	5,47	6494,26
BASE	98	RSPX	235,2	4,11	4791,58
BASE	99	RSPX	35,63	141576,6	22743,52
BASE	100	RSPX	56,88	51275,19	30670,91
BASE	101	RSPX	14,44	24,95	42,8
BASE	102	RSPX	0,27	46,84	99,07
BASE	103	RSPX	4,11	45,48	120,44
BASE	104	RSPX	32,99	9,14	632,67
BASE	105	RSPX	109,94	42,54	108,71
BASE	106	RSPX	24108,58	24,07	9482,06
BASE	107	RSPX	114,72	29,96	79,35
BASE	108	RSPX	21,84	7,13	52,12
BASE	109	RSPX	30,78	4,22	648,69
BASE	110	RSPX	33,21	25,6	1241,35
BASE	111	RSPX	26,42	1949,09	14513,37
BASE	112	RSPX	40,12	78,96	45,8
BASE	113	RSPX	15,15	7844,1	14510,12
BASE	114	RSPX	4,74	7,46	1256,24
BASE	115	RSPX	5,47	2,51	1273,78
BASE	116	RSPX	0,45	3,24	246,72
BASE	118	RSPX	3054,98	0,99	3586,42
BASE	119	RSPX	26,75	2121,23	15140,57
BASE	120	RSPX	3550,91	29,98	4601,83
BASE	122	RSPX	2,9	14,81	31,25
BASE	123	RSPX	6,31	2,29	91,57

BASE	124	RSPX	249,84	7990,19	15128,74
BASE	125	RSPX	0,34	53,9	1271,66
BASE	126	RSPX	135,66	31,47	186,32
BASE	127	RSPX	3,11	1,78	262,7
BASE	132	RSPX	36,77	8,61	148,66
BASE	144	RSPX	87,6	66,63	69,19
BASE	148	RSPX	113,01	34,51	72,06
BASE	152	RSPX	1,99	67,1	67,95
BASE	154	RSPX	1,85	27	11,7
BASE	155	RSPX	659,39	72,56	46,41
BASE	156	RSPX	21,48	9,45	46
BASE	157	RSPX	99,58	57,9	21,07
BASE	158	RSPX	3,97	19,23	137,47
BASE	164	RSPX	80,88	7,3	12,24
BASE	165	RSPX	0,79	74,09	10,88
BASE	177	RSPX	815,12	62,82	43,34
BASE	178	RSPX	509,79	47,72	219,54
BASE	187	RSPX	12,24	22,01	217,16
BASE	188	RSPX	8,69	2,3	125,48
BASE	189	RSPX	32,96	12,38	23,97
BASE	190	RSPX	59,16	18,46	127,14
BASE	191	RSPX	58,05	74,56	27,84
BASE	192	RSPX	5,08	18,21	103,3
BASE	193	RSPX	13,97	4,23	92,31
BASE	194	RSPX	1873,29	15,04	203,1
BASE	354	RSPX	1,58	2,33	0
BASE	356	RSPX	230,58	26,82	290,9
BASE	357	RSPX	250,57	14,54	0
BASE	358	RSPX	3,5	10401,16	28910,4
BASE	362	RSPX	5,21	64,95	141,35
BASE	363	RSPX	674,7	6,21	4583,55
BASE	364	RSPX	0,44	0,7	0
BASE	365	RSPX	7,94	2238,6	23091,41
BASE	366	RSPX	1,08	10929,82	31035,56
BASE	367	RSPX	18455,63	78,41	423,02
BASE	372	RSPX	312,18	45,88	0
BASE	373	RSPX	15,24	267657,6	6,47
BASE	374	RSPX	9076,79	8,93	10732,68
BASE	375	RSPX	51,8	0,07	0
BASE	376	RSPX	27,14	334023,4	27744,79
BASE	378	RSPX	1,16	1,56	0
BASE	380	RSPX	0,99	126344,5	22867,44
BASE	381	RSPX	24162,75	36,65	9561,57
BASE	382	RSPX	0,36	100644,3	27680,14
BASE	383	RSPX	9913,13	88,29	353,17
BASE	384	RSPX	15,4	24575,06	34317,39



BASE	385	RSPX	7111,34	5,14	9162,15
BASE	386	RSPX	16,09	80,94	11666,17
BASE	387	RSPX	6226,12	8,4	8751,43
BASE	388	RSPX	394,56	37,41	0
BASE	389	RSPX	18,57	51234,13	30641,58
BASE	391	RSPX	7,91	1,16	0
BASE	392	RSPX	5,51	49192,52	32903,9
BASE	394	RSPX	0,23	1,07	0
BASE	396	RSPX	26,54	87,53	16218,32
BASE	397	RSPX	2458,56	23,28	7589,65
BASE	398	RSPX	2,49	42346,05	35166,79
BASE	399	RSPX	3209,05	24,52	7843,54
BASE	400	RSPX	251,57	52,59	354,11
BASE	401	RSPX	1,53	20,61	147,6
BASE	402	RSPX	231,69	3,99	4294,66
BASE	403	RSPX	246,33	12,63	5963,88
BASE	404	RSPX	719,18	17,18	5169,48
BASE	405	RSPX	963,92	30,33	5261,98
BASE	406	RSPX	853,08	0,7	6240,6
BASE	407	RSPX	234,5	3,65	4508,78
<b>Total</b>			<b>344226</b>	<b>1868136</b>	

**BASE SHEAR GEMPA DINAMIK RSP  
SPEKTRUM Y**

Story	Point	Load	FX (kg)	FY (kg)	FZ (kg)
BASE	7	RSPY	1709,4	5740,14	21136,99
BASE	8	RSPY	1583,85	6114,7	5290,48
BASE	9	RSPY	1531,23	5238,04	4440,18
BASE	10	RSPY	1668,03	6281,41	7602,21
BASE	11	RSPY	1628,4	6959,24	13974,87
BASE	12	RSPY	1610,77	6894,63	15449,88
BASE	13	RSPY	1499,66	5349,84	5724,35
BASE	14	RSPY	1438,47	5417,79	4599,46
BASE	16	RSPY	1522,49	5818,82	6386,6
BASE	17	RSPY	1612,41	5278,71	21434,06
BASE	18	RSPY	1641,14	5136,64	5962,11
BASE	19	RSPY	1631,07	5380,11	6068,8
BASE	21	RSPY	816,03	1460,03	14018,32
BASE	22	RSPY	1107,18	2988,8	13477,77
BASE	23	RSPY	1256,01	1225,47	36510,93
BASE	25	RSPY	1444,53	2823,52	48021,55
BASE	26	RSPY	1436,03	2850,71	48919,27
BASE	27	RSPY	1680,72	5875,55	5000,83
BASE	28	RSPY	1625,69	5905,82	4085,68



BASE	29	RSPY	1752,98	6100,21	2372,67
BASE	30	RSPY	1707,36	6297,04	2723,64
BASE	31	RSPY	1275,43	879,08	36207,53
BASE	32	RSPY	1947,49	2337,44	34660,18
BASE	33	RSPY	1855,06	2449,79	34954,36
BASE	34	RSPY	757,06	5410,08	14144,82
BASE	35	RSPY	986,41	1982,48	7955,92
BASE	37	RSPY	125,78	578,31	2243,97
BASE	38	RSPY	344,92	691,21	17203,34
BASE	39	RSPY	143,42	564,42	2743,11
BASE	40	RSPY	228,1	691,52	16702,97
BASE	41	RSPY	207,49	367,74	4966,2
BASE	42	RSPY	231,45	385,33	4993,58
BASE	43	RSPY	327,71	695,13	17263,87
BASE	44	RSPY	211,36	687,71	16996,53
BASE	45	RSPY	381	601,85	2750,45
BASE	46	RSPY	401,05	600,19	2589
BASE	47	RSPY	977,71	3150,79	4484,56
BASE	48	RSPY	743,86	1976,4	8121,99
BASE	49	RSPY	790,96	2968,65	3751,92
BASE	50	RSPY	736,39	2094,75	7878,3
BASE	51	RSPY	790,99	3156,54	3683,7
BASE	52	RSPY	951,39	3227,67	4169,26
BASE	53	RSPY	909,78	2116,5	7674,6
BASE	54	RSPY	717,19	5065,8	13495,66
BASE	55	RSPY	723,8	5582,82	13777,23
BASE	56	RSPY	692,61	5398,09	13823,5
BASE	57	RSPY	4,85	0,41	555,12
BASE	58	RSPY	8,72	690,65	6457,98
BASE	59	RSPY	221,16	0,5	9652,27
BASE	60	RSPY	28,1	10,61	1961,83
BASE	61	RSPY	2001,8	6,46	28289,57
BASE	62	RSPY	781,27	8,19	24224,03
BASE	63	RSPY	29,97	12,77	1528,76
BASE	64	RSPY	1,15	3,13	498,49
BASE	65	RSPY	1,89	1,1	482,08
BASE	66	RSPY	2,09	33,46	489,16
BASE	67	RSPY	2,27	12,53	465,27
BASE	70	RSPY	1,37	3,78	33,94
BASE	71	RSPY	8,95	27,85	4949,39
BASE	72	RSPY	13,84	13785,12	10695,51
BASE	73	RSPY	8,08	37,19	4030,67
BASE	74	RSPY	13,65	7988,19	10399,25
BASE	75	RSPY	12,49	8,61	1079,59
BASE	80	RSPY	1,3	2,22	85,95
BASE	81	RSPY	14,85	3569,5	9364,3

BASE	82	RSPY	13,72	3389,62	8703,79
BASE	84	RSPY	2969,48	11,11	29521,07
BASE	85	RSPY	2314,75	0,67	29627,86
BASE	86	RSPY	17,61	141391,2	92,36
BASE	87	RSPY	1040,33	11,26	25017,41
BASE	88	RSPY	3,03	13,81	104,17
BASE	89	RSPY	8,46	3,47	1098,4
BASE	90	RSPY	18,55	16011,9	9985,46
BASE	93	RSPY	128,1	5,49	10653,15
BASE	94	RSPY	6055,43	21,29	18232,38
BASE	95	RSPY	3406,66	26,7	18450,83
BASE	96	RSPY	195,91	15,15	18579,51
BASE	97	RSPY	276,8	1,78	17703,06
BASE	98	RSPY	76,52	1,34	10585,26
BASE	99	RSPY	11,59	46063,07	6895,29
BASE	100	RSPY	18,51	16682,79	9298,68
BASE	101	RSPY	4,7	8,12	13,08
BASE	102	RSPY	0,09	15,24	69,06
BASE	103	RSPY	1,34	14,8	38,54
BASE	104	RSPY	10,73	2,97	1117,8
BASE	105	RSPY	35,77	13,84	227,7
BASE	106	RSPY	7843,91	7,83	30643,84
BASE	107	RSPY	37,33	9,75	253,35
BASE	108	RSPY	7,11	2,32	94,61
BASE	109	RSPY	10,01	1,37	1178,75
BASE	110	RSPY	10,81	8,33	377,42
BASE	111	RSPY	8,6	634,15	4408,55
BASE	112	RSPY	13,05	25,69	150,88
BASE	113	RSPY	4,93	2552,14	4422,53
BASE	114	RSPY	1,54	2,43	380,97
BASE	115	RSPY	1,78	0,82	499,34
BASE	116	RSPY	0,15	1,05	476,01
BASE	118	RSPY	993,96	0,32	9806,75
BASE	119	RSPY	8,7	690,16	4602,7
BASE	120	RSPY	1155,32	9,75	12498,34
BASE	122	RSPY	0,94	4,82	79,85
BASE	123	RSPY	2,05	0,74	302,11
BASE	124	RSPY	81,29	2599,67	4699,73
BASE	125	RSPY	0,11	17,54	444,4
BASE	126	RSPY	44,14	10,24	498,09
BASE	127	RSPY	1,01	0,58	514,94
BASE	132	RSPY	11,96	2,8	69
BASE	144	RSPY	28,5	21,68	106,77
BASE	148	RSPY	36,77	11,23	237,23
BASE	152	RSPY	0,65	21,83	140,63
BASE	154	RSPY	0,6	8,79	35,78



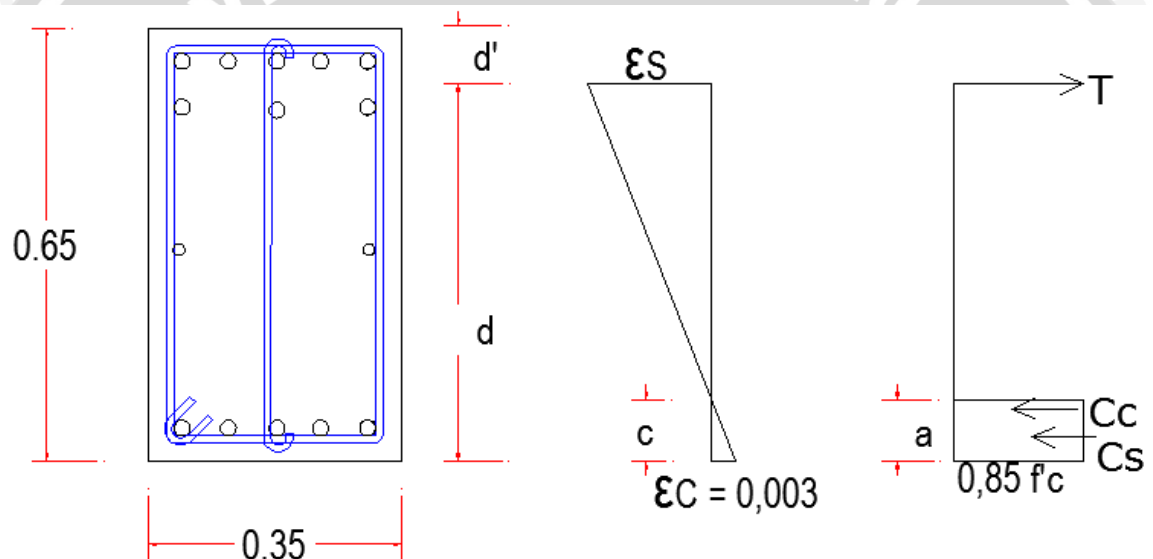
BASE	155	RSPY	214,54	23,61	142,63
BASE	156	RSPY	6,99	3,07	141,03
BASE	157	RSPY	32,4	18,84	68,26
BASE	158	RSPY	1,29	6,26	92,92
BASE	164	RSPY	26,32	2,38	33,24
BASE	165	RSPY	0,26	24,11	33,25
BASE	177	RSPY	265,2	20,44	141,11
BASE	178	RSPY	165,86	15,53	114,51
BASE	187	RSPY	3,98	7,16	117,88
BASE	188	RSPY	2,83	0,75	51,59
BASE	189	RSPY	10,73	4,03	76,9
BASE	190	RSPY	19,25	6	60,92
BASE	191	RSPY	18,89	24,26	89,94
BASE	192	RSPY	1,65	5,93	215,05
BASE	193	RSPY	4,55	1,37	206,98
BASE	194	RSPY	609,49	4,89	319,17
BASE	354	RSPY	0,51	0,76	0
BASE	356	RSPY	75,02	8,73	637,45
BASE	357	RSPY	81,53	4,73	0
BASE	358	RSPY	1,14	3384,1	8765,75
BASE	362	RSPY	1,69	21,13	46,31
BASE	363	RSPY	219,52	2,02	10070,29
BASE	364	RSPY	0,14	0,23	0
BASE	365	RSPY	2,58	728,35	7021,73
BASE	366	RSPY	0,35	3556,1	9412,46
BASE	367	RSPY	6004,68	25,51	1156,09
BASE	372	RSPY	101,57	14,93	0
BASE	373	RSPY	4,96	87084,5	2,4
BASE	374	RSPY	2953,21	2,91	29461,27
BASE	375	RSPY	16,85	0,02	0
BASE	376	RSPY	8,83	108677,1	8414,68
BASE	378	RSPY	0,38	0,51	0
BASE	380	RSPY	0,32	41107,17	6933,1
BASE	381	RSPY	7861,54	11,92	30909,3
BASE	382	RSPY	0,12	32745,42	8395,42
BASE	383	RSPY	3225,31	28,73	1141,81
BASE	384	RSPY	5,01	7995,69	10432,05
BASE	385	RSPY	2313,73	1,67	29618,58
BASE	386	RSPY	5,24	26,33	3562,31
BASE	387	RSPY	2025,72	2,73	28289,7
BASE	388	RSPY	128,37	12,17	0
BASE	389	RSPY	6,04	16669,43	9290,06
BASE	391	RSPY	2,58	0,38	0
BASE	392	RSPY	1,79	16005,18	9978,82
BASE	394	RSPY	0,07	0,35	0
BASE	396	RSPY	8,63	28,48	4950,94



BASE	397	RSPY	799,91	7,58	24335,44
BASE	398	RSPY	0,81	13777,62	10693,41
BASE	399	RSPY	1044,09	7,98	25153,29
BASE	400	RSPY	81,85	17,11	1135,93
BASE	401	RSPY	0,5	6,7	47,79
BASE	402	RSPY	75,38	1,3	9617,37
BASE	403	RSPY	80,15	4,11	16424,37
BASE	404	RSPY	233,99	5,59	16706,74
BASE	405	RSPY	313,62	9,87	16878,35
BASE	406	RSPY	277,56	0,23	17052,38
BASE	407	RSPY	76,3	1,19	10199,16
<b>Total</b>			<b>108858,8</b>	<b>747506,6</b>	

### Lampiran 3. Kapasitas penampang balok

#### a. Balok A2



$$\text{Tulangan atas (As)} = 8 - D22 = 3039,52 \text{ mm}^2$$

$$\text{Tulangan bawah (As')} = 5 - D22 = 1875,5 \text{ mm}^2$$

$$\text{Sengkang} = 3 - D10 = 100$$

$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a_1 = 5 \times 0,25 \times 3,14 \times 22^2 = 1899,7 \text{ mm}^2$$

$$a_2 = 3 \times 0,25 \times 3,14 \times 22^2 = 1139,82 \text{ mm}^2$$

$$h_1 = 25 + 10 + \left(\frac{22}{2}\right) = 46 \text{ mm}$$

$$h_2 = 46 + 40 + \left(\frac{22}{2}\right) = 97 \text{ mm}$$

$$d' = \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2}$$

$$= \frac{(1899,7 \times 46) + (1139,82 \times 97)}{46 + 97}$$

$$= 65,125 \text{ mm}$$

$$d = h - d'$$

$$= 650 \text{ mm} - 65,125 \text{ mm}$$

$$= 584,875 \text{ mm}$$

$$f'c = \frac{0,83 \times 300}{10}$$

$$= 24,9 \text{ Mpa}$$

$$f_y = 320 \text{ Mpa}$$

$$E = 4700 \times \sqrt{f'c}$$

$$= 4700 \times \sqrt{24,9} \text{ Mpa}$$

$$= 23452,95291 \text{ N/mm}^2$$

$$\epsilon_y = \frac{f_y}{E_s}$$

$$= \frac{320}{23452,95291}$$

$$= 0,013644337$$

$$a = \frac{(A_s - A_s') \times f_y}{0,85 \times f'c \times b}$$

$$= \frac{(3039,52 - 1875,5) \times 320}{0,85 \times 24,9 \times 350}$$

$$= 50,283 \text{ mm}$$

$$c = \frac{a}{\beta_1}$$

$$= \frac{50,283}{0,85}$$

$$= 59,156 \text{ mm}$$

$$\epsilon_s = 0,003 \times \frac{d - c}{c}$$

$$= 0,003 \times \frac{584,875 - 59,16}{59,16}$$

$$= 0,0266 > \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f's = f_y = 320 \text{ N/mm}^2$$

$$\epsilon's = 0,003 \times \frac{d - c}{c}$$

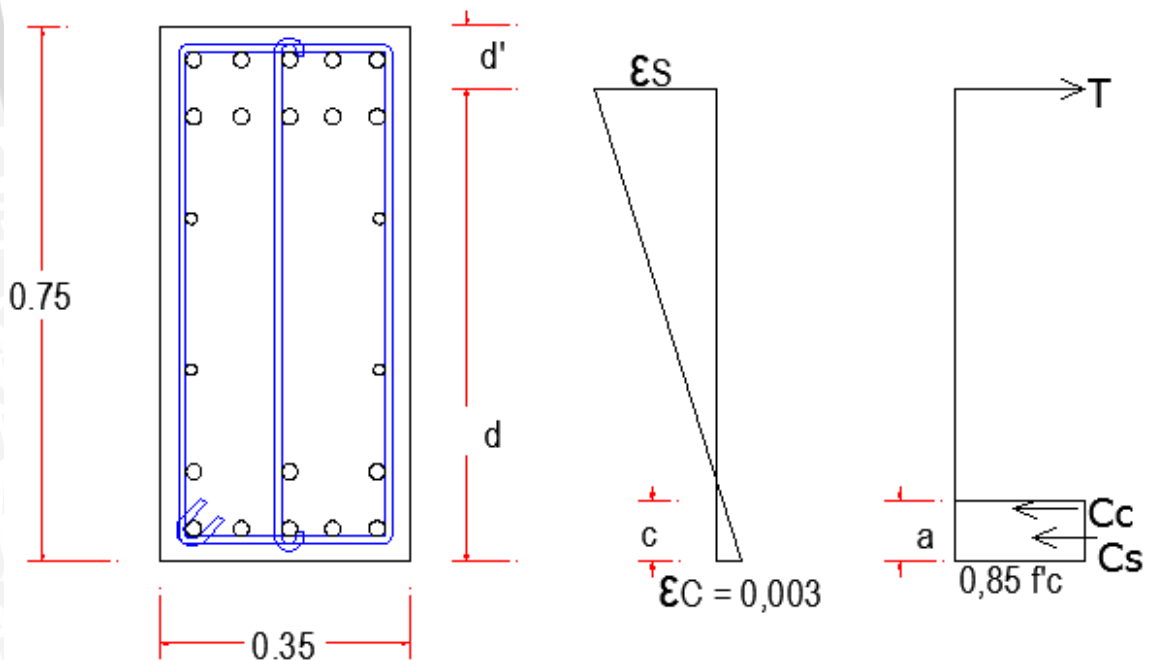
$$= 0,003 \times \frac{65,125 - 59,156}{59,156}$$

$$= 0,000302 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f's = \epsilon's \times E = 0,000302 \times 23452,95291 = 7,0982 \text{ N/mm}^2$$

$$\begin{aligned}
 C_s &= A_s' \times f_s' \\
 &= 1875,5 \times 320 \\
 &= 13312,7889 \text{ N} \\
 C_c &= 0,85 \times f_c' \times b \times a \\
 &= 0,85 \times 24,9 \times 350 \times 50,283 = 372486,4 \text{ N} \\
 T &= A_s \times f_s \\
 &= 3039,52 \text{ mm}^2 \times 320 \text{ N/mm}^2 \\
 &= 972646,4 \text{ N} \\
 M_n (+) &= T \times \left(d - \frac{a}{2}\right) \\
 &= 972646,4 \text{ N} \times \left(584,875 - \frac{50,283}{2}\right) \\
 &= 544422609,2 \text{ N.mm} \\
 &= 54442,26 \text{ kg.m} \\
 M_n (-) &= C_c \times \left(d - \frac{a}{2}\right) + C_s (d - 25) \\
 &= 372486,4 \text{ N} \times \left(584,875 - \frac{50,283}{2}\right) + 13312,7889 (584,875 - 25) \\
 &= 215946551 \text{ N.mm} = 21594,66 \text{ kg.m}
 \end{aligned}$$

## b. Balok B1



$$\text{Tulangan atas (} A_s) = 10 - D22 = 3799,4 \text{ mm}^2$$

$$\text{Tulangan bawah (} A_s') = 8 - D22 = 3000,8 \text{ mm}^2$$

$$\text{Sengkang} = 3 - D10 - 100$$



$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a_1 = 5 \times 0,25 \times 3,14 \times 22^2 = 1899,7 \text{ mm}^2$$

$$a_2 = 4 \times 0,25 \times 3,14 \times 22^2 = 1519,76 \text{ mm}^2$$

$$h_1 = 25 + 10 + \left(\frac{22}{2}\right) = 46 \text{ mm}$$

$$h_2 = 46 + 40 + \left(\frac{22}{2}\right) = 97 \text{ mm}$$

$$d' = \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2}$$

$$= \frac{(1899,7 \times 46) + (1519,76 \times 97)}{46 + 97}$$

$$= 68,6667 \text{ mm}$$

$$d = h - d'$$

$$= 750 \text{ mm} - 68,6667 \text{ mm}$$

$$= 681,333 \text{ mm}$$

$$f'_c = \frac{0,83 \times 300}{10}$$

$$= 24,9 \text{ Mpa}$$

$$f_y = 320 \text{ Mpa}$$

$$E = 4700 \times \sqrt{f'_c}$$

$$= 4700 \times \sqrt{24,9} \text{ Mpa}$$

$$= 23452,95291 \text{ N/mm}^2$$

$$\epsilon_y = \frac{f_y}{E_s}$$

$$= \frac{320}{23452,95291}$$

$$= 0,013644337$$

$$a = \frac{(A_s - A_s') \times f_y}{0,85 \times f'_c \times b}$$

$$= \frac{(3799,4 - 30000,8) \times 320}{0,85 \times 24,9 \times 350}$$

$$= 34,497 \text{ mm}$$

$$c = \frac{a}{\beta_1}$$

$$= \frac{34,497}{0,85}$$

$$= 40,587 \text{ mm}$$

$$\epsilon_s = 0,003 \times \frac{d-c}{c}$$

$$= 0,003 \times \frac{681,3333 - 40,5857}{40,5857}$$

$$= 0,0473 > \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f's = f_y = 320 \text{ N/mm}^2$$

$$\epsilon's = 0,003 \times \frac{d' - c}{c}$$

$$= 0,003 \times \frac{68,667 - 40,5858}{40,5858}$$

$$= 0,00207 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f's = \epsilon's \times E = 0,00207 \times 23452,95291 = 48,68054 \text{ N/mm}^2$$

$$C_s = A_s' \times f's$$

$$= 3799,4 \times 320$$

$$= 146080,553 \text{ N}$$

$$C_c = 0,85 \times f'c \times b \times a$$

$$= 0,85 \times 24,9 \times 350 \times 34,497$$

$$= 255552 \text{ N}$$

$$T = A_s \times f_s$$

$$= 3799,4 \text{ mm}^2 \times 320 \text{ N/mm}^2$$

$$= 1215808 \text{ N}$$

$$M_n (+) = T \times \left(d - \frac{a}{2}\right)$$

$$= 1215808 \text{ N} \times \left(681,333 - \frac{34,497}{2}\right)$$

$$= 807399091,1 \text{ N.mm}$$

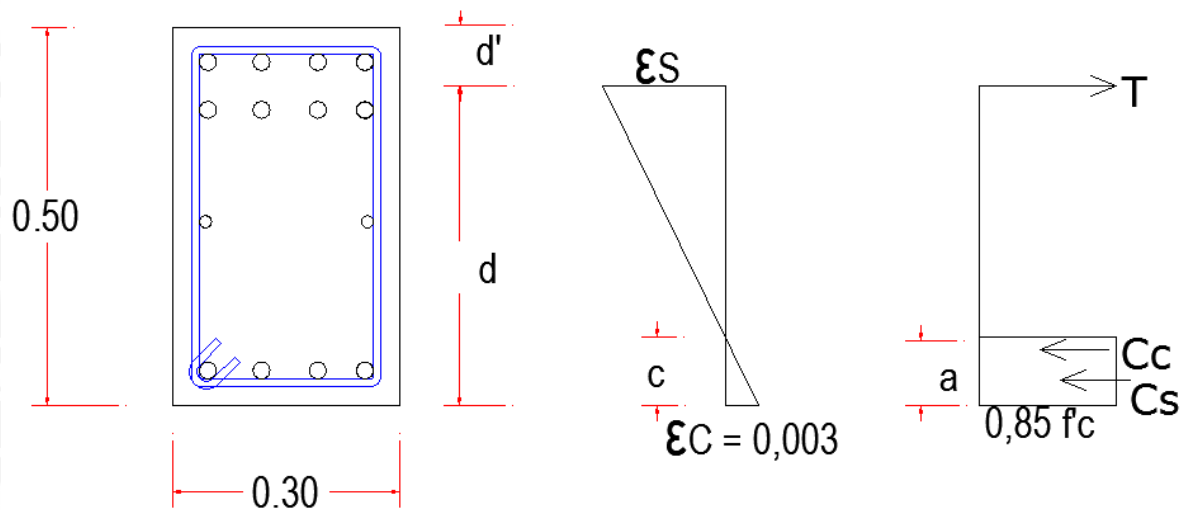
$$= 80739,91 \text{ kg.m}$$

$$M_n (-) = C_c \times \left(d - \frac{a}{2}\right) + C_s (d - 25)$$

$$= 255552 \text{ N} \times \left(681,333 - \frac{34,497}{2}\right) + 146080,553 (681,333 - 25)$$

$$= 265585625,4 \text{ N.mm} = 26558,56 \text{ kg.m}$$

## c. Balok B2



$$\text{Tulangan atas (As)} = 8 - D22 = 3039,52 \text{ mm}^2$$

$$\text{Tulangan bawah (As')} = 4 - D22 = 1500,4 \text{ mm}^2$$

$$\text{Sengkang} = 3 - D10 - 100$$

$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a_1 = 4 \times 0,25 \times 3,14 \times 22^2 = 1519,76 \text{ mm}^2$$

$$a_2 = 4 \times 0,25 \times 3,14 \times 22^2 = 1519,76 \text{ mm}^2$$

$$h_1 = 25 + 10 + \left(\frac{22}{2}\right) = 46 \text{ mm}$$

$$h_2 = 46 + 40 + \left(\frac{22}{2}\right) = 97 \text{ mm}$$

$$d' = \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2}$$

$$= \frac{(1519,76 \times 46) + (1519,76 \times 97)}{46 + 97}$$

$$= 71,5 \text{ mm}$$

$$d = h - d'$$

$$= 500 \text{ mm} - 71,5 \text{ mm}$$

$$= 428,5 \text{ mm}$$

$$f'_c = \frac{0,83 \times 300}{10}$$

$$= 24,9 \text{ Mpa}$$

$$f_y = 320 \text{ Mpa}$$

$$E = 4700 \times \sqrt{f'_c}$$

$$= 4700 \times \sqrt{24,9} \text{ Mpa}$$



$$= 23452,95291 \text{ N/mm}^2$$

$$\epsilon_y = \frac{f_y}{E_s}$$

$$= \frac{320}{23452,95291}$$

$$= 0,013644337$$

$$a = \frac{(A_s - A_s') \times f_y}{0,85 \times f'c \times b}$$

$$= \frac{(3039,52 - 1500,4) \times 320}{0,85 \times 24,9 \times 300}$$

$$= 77,568 \text{ mm}$$

$$c = \frac{a}{\beta_1}$$

$$= \frac{77,568}{0,85}$$

$$= 91,2565 \text{ mm}$$

$$\epsilon_s = 0,003 \times \frac{d-c}{c}$$

$$= 0,003 \times \frac{428,5 - 91,2565}{91,2565}$$

$$= 0,011 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f_s = \epsilon_s \times E = 0,011 \times 23452,95291 = 260,0149 \text{ N/mm}^2$$

$$\epsilon'_s = 0,003 \times \frac{c-d''}{c}$$

$$= 0,003 \times \frac{91,256 - 71,5}{91,256}$$

$$= 0,00064948 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f'_s = \epsilon'_s \times E = 0,00065 \times 23452,95291 = 15,2323 \text{ N/mm}^2$$

$$C_s = A_s' \times f'_s$$

$$= 1500,4 \times 15,2323$$

$$= 22854,5545 \text{ N}$$

$$C_c = 0,85 \times f'c \times b \times a$$

$$= 0,85 \times 24,9 \times 300 \times 77,568$$

$$= 492518,4 \text{ N}$$

$$T = A_s \times f_s$$

$$= 3039,52 \text{ mm}^2 \times 260,0149 \text{ N/mm}^2$$

$$= 790320,6307 \text{ N}$$

$$M_n (+) = T \times \left(d - \frac{a}{2}\right)$$

$$= 790320,6307 \text{ N} \times \left(428,5 - \frac{77,568}{2}\right)$$

$$= 308000571 \text{ N.mm}$$

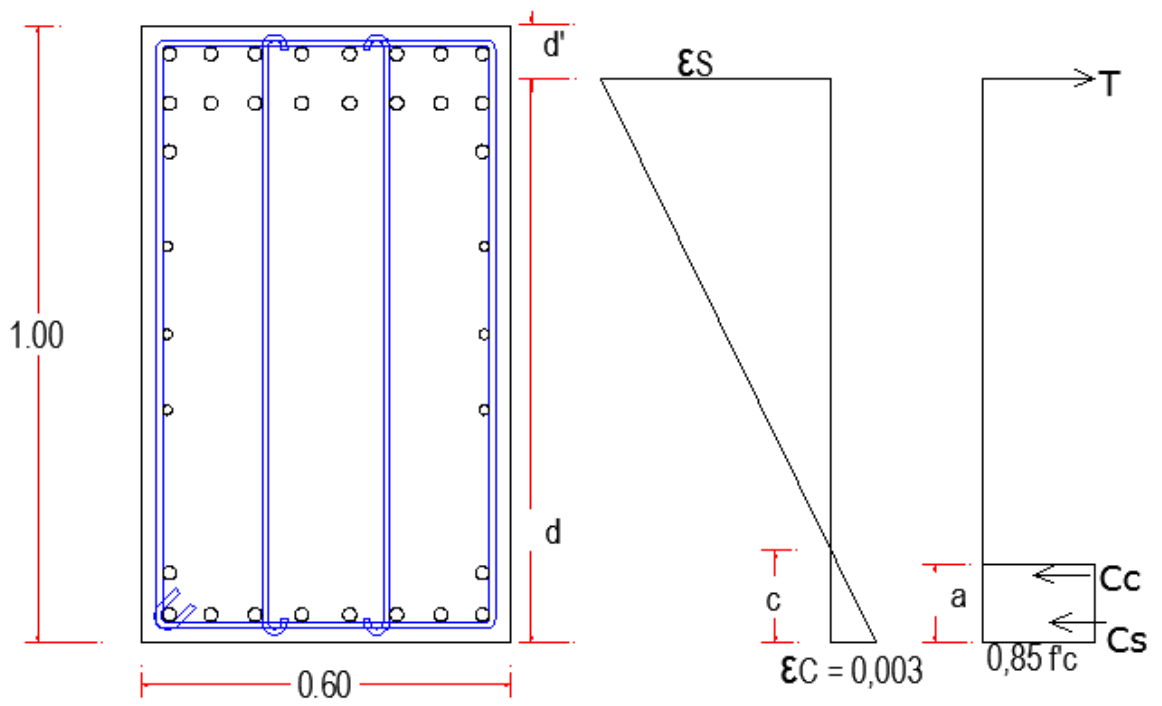
$$= 30800,06 \text{ kg.m}$$

$$M_n (-) = C_c \times (d - \frac{a}{2}) + C_s (d - 25)$$

$$= 492518,4 \text{ N} \times (428,5 - \frac{77,568}{2}) + 22854,55456 (428,5 - 25)$$

$$= 201164098,6 \text{ N.mm} = 20116,41 \text{ kg.m}$$

d. Balok B3



$$\text{Tulangan atas (As)} = 18 - D22 = 6838,92 \text{ mm}^2$$

$$\text{Tulangan bawah (As')} = 10 - D22 = 3751 \text{ mm}^2$$

$$\text{Sengkang} = 4 - D10 - 100$$

$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a_1 = 9 \times 0,25 \times 3,14 \times 22^2 = 3419,46 \text{ mm}^2$$

$$a_2 = 9 \times 0,25 \times 3,14 \times 22^2 = 3419,46 \text{ mm}^2$$

$$h_1 = 25 + 10 + (\frac{22}{2}) = 46 \text{ mm}$$

$$h_2 = 46 + 40 + (\frac{22}{2}) = 97 \text{ mm}$$

$$d' = \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2}$$

$$= \frac{(3419,46 \times 46) + (3419,46 \times 97)}{46 + 97}$$

$$= 71,5 \text{ mm}$$

$$\begin{aligned}d &= h - d' \\ &= 1000 \text{ mm} - 71,5 \text{ mm} \\ &= 928,5 \text{ mm}\end{aligned}$$

$$\begin{aligned}f'c &= \frac{0,83 \times 300}{10} \\ &= 24,9 \text{ Mpa}\end{aligned}$$

$$f_y = 320 \text{ Mpa}$$

$$\begin{aligned}E &= 4700 \times \sqrt{f'c} \\ &= 4700 \times \sqrt{24,9} \text{ Mpa} \\ &= 23452,95291 \text{ N/mm}^2\end{aligned}$$

$$\begin{aligned}\epsilon_y &= \frac{f_y}{E_s} \\ &= \frac{320}{23452,95291} \\ &= 0,013644337\end{aligned}$$

$$\begin{aligned}a &= \frac{(A_s - A_s') \times f_y}{0,85 \times f'c \times b} \\ &= \frac{(6838,92 - 3751) \times 320}{0,85 \times 24,9 \times 600} \\ &= 77,8119 \text{ mm}\end{aligned}$$

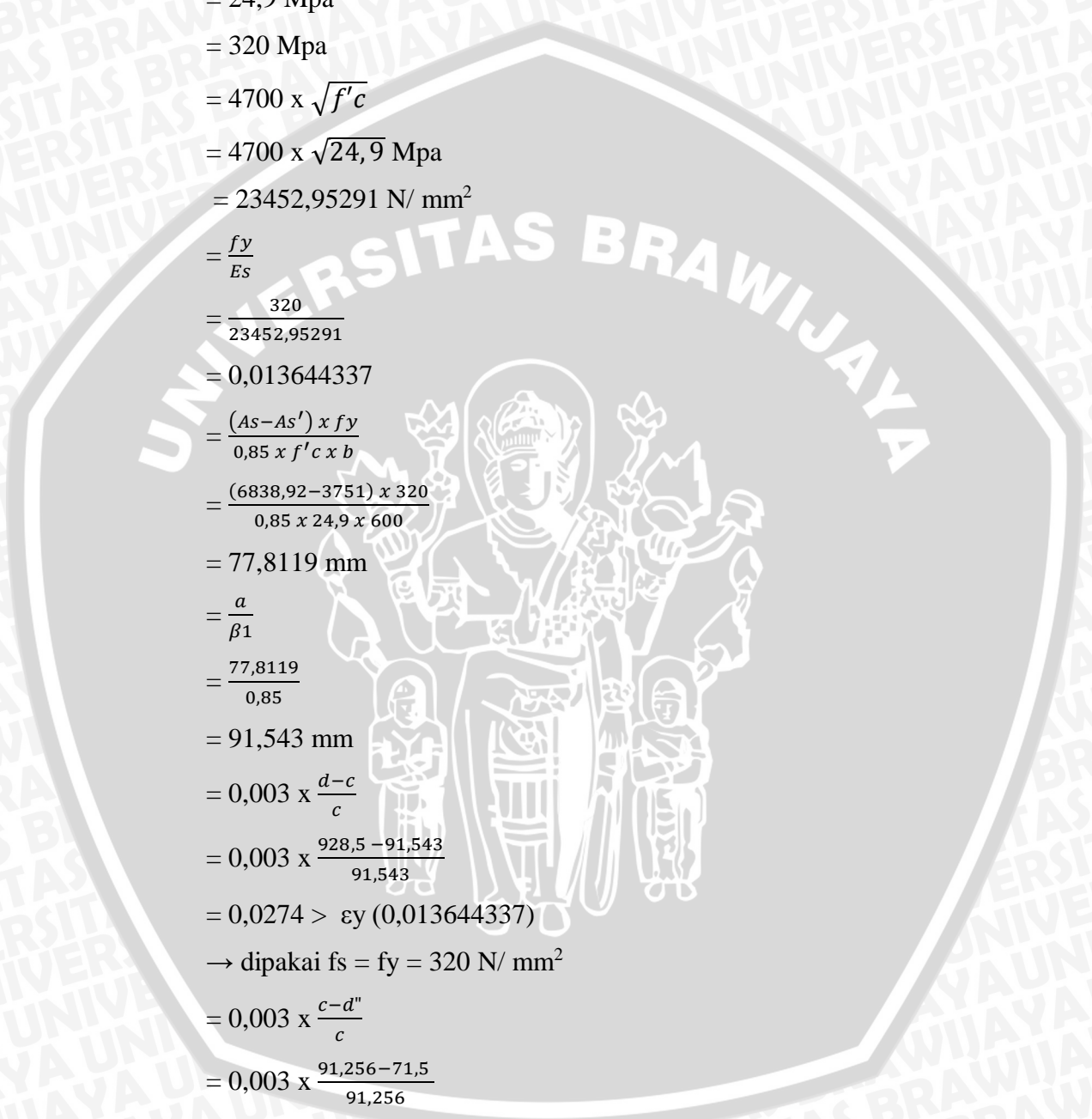
$$\begin{aligned}c &= \frac{a}{\beta_1} \\ &= \frac{77,8119}{0,85} \\ &= 91,543 \text{ mm}\end{aligned}$$

$$\begin{aligned}\epsilon_s &= 0,003 \times \frac{d-c}{c} \\ &= 0,003 \times \frac{928,5 - 91,543}{91,543} \\ &= 0,0274 > \epsilon_y (0,013644337) \\ &\rightarrow \text{dipakai } f_s = f_y = 320 \text{ N/mm}^2\end{aligned}$$

$$\begin{aligned}\epsilon's &= 0,003 \times \frac{c-d''}{c} \\ &= 0,003 \times \frac{91,256 - 71,5}{91,256} \\ &= 0,000656 < \epsilon_y (0,013644337)\end{aligned}$$

$$\rightarrow \text{dipakai } f's = \epsilon's \times E = 0,000656 \times 23452,95291 = 15,405 \text{ N/mm}^2$$

$$\begin{aligned}C_s &= A_s' \times f's \\ &= 3751 \times 15,405 \\ &= 57784,598 \text{ N}\end{aligned}$$





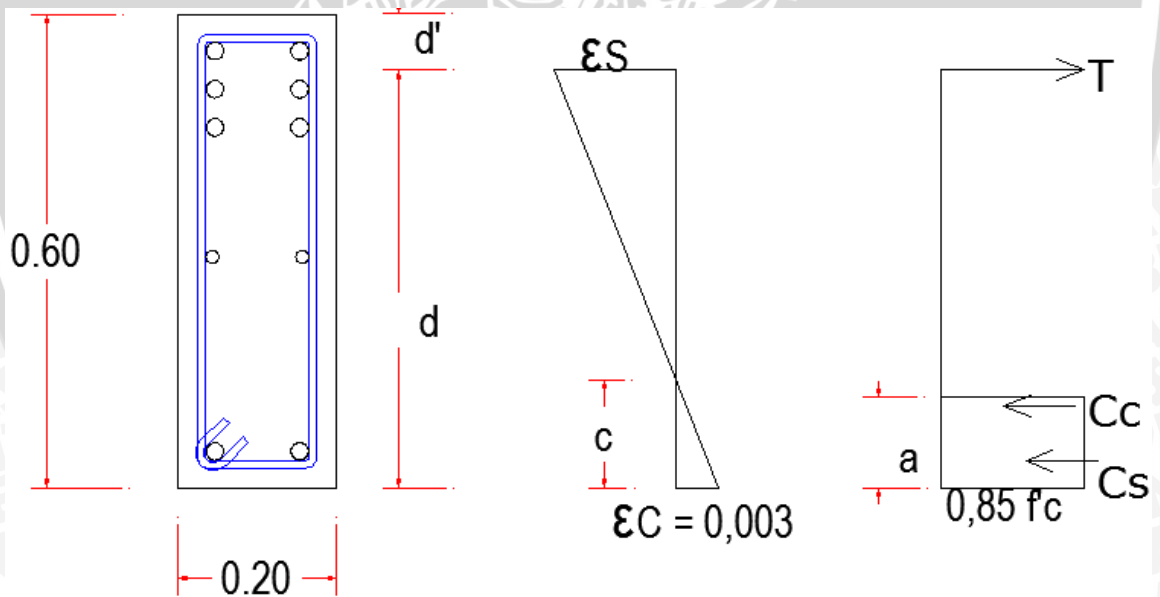
$$\begin{aligned}
 C_c &= 0,85 \times f'_c \times b \times a \\
 &= 0,85 \times 24,9 \times 600 \times 77,811 \\
 &= 988134,4 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 T &= A_s \times f_s \\
 &= 6838,92 \text{ mm}^2 \times 320 \text{ N/mm}^2 \\
 &= 2188454,4 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 M_n (+) &= T \times \left( d - \frac{a}{2} \right) \\
 &= 2188454,4 \text{ N} \times \left( 928,5 - \frac{77,811}{2} \right) \\
 &= 1946835920 \text{ N.mm} \\
 &= 194683,6 \text{ kg.m}
 \end{aligned}$$

$$\begin{aligned}
 M_n (-) &= C_c \times \left( d - \frac{a}{2} \right) + C_s (d - 25) \\
 &= 988134,4 \text{ N} \times \left( 928,5 - \frac{77,811}{2} \right) + 57784,59861 (428,5 - 25) \\
 &= 931246825,6 \text{ N.mm} = 93124,68 \text{ kg.m}
 \end{aligned}$$

e. Balok B4



$$\text{Tulangan atas (As)} = 4 - D22 = 6838,92 \text{ mm}^2$$

$$\text{Tulangan bawah (As')} = 2 - D22 = 3751 \text{ mm}^2$$

$$\text{Senggang} = 2 - D10 - 100$$

$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a1 = 2 \times 0,25 \times 3,14 \times 22^2 = 759,88 \text{ mm}^2$$

$$a2 = 2 \times 0,25 \times 3,14 \times 22^2 = 759,88 \text{ mm}^2$$

$$h1 = 25 + 10 + \left(\frac{22}{2}\right) = 46 \text{ mm}$$

$$h2 = 46 + 40 + \left(\frac{22}{2}\right) = 97 \text{ mm}$$

$$\begin{aligned} d' &= \frac{(a1 \times h1) + (a2 \times h2)}{a1 + a2} \\ &= \frac{(759,88 \times 46) + (759,88 \times 97)}{46 + 97} \\ &= 71,5 \text{ mm} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 600 \text{ mm} - 71,5 \text{ mm} \\ &= 528,5 \text{ mm} \end{aligned}$$

$$\begin{aligned} f'c &= \frac{0,83 \times 300}{10} \\ &= 24,9 \text{ Mpa} \end{aligned}$$

$$fy = 320 \text{ Mpa}$$

$$\begin{aligned} E &= 4700 \times \sqrt{f'c} \\ &= 4700 \times \sqrt{24,9} \text{ Mpa} \\ &= 23452,95291 \text{ N/mm}^2 \end{aligned}$$

$$\begin{aligned} \epsilon y &= \frac{fy}{Es} \\ &= \frac{320}{23452,95291} \\ &= 0,013644337 \end{aligned}$$

$$\begin{aligned} a &= \frac{(As - As') \times fy}{0,85 \times f'c \times b} \\ &= \frac{(2279,64 - 750,2) \times 320}{0,85 \times 24,9 \times 200} \\ &= 115,620 \text{ mm} \end{aligned}$$

$$\begin{aligned} c &= \frac{a}{\beta1} \\ &= \frac{115,620}{0,85} \\ &= 136,024 \text{ mm} \end{aligned}$$

$$\begin{aligned} \epsilon s &= 0,003 \times \frac{d-c}{c} \\ &= 0,003 \times \frac{528,5 - 136,024}{136,024} \\ &= 0,00865 < \epsilon y (0,013644337) \end{aligned}$$

$$\rightarrow \text{dipakai } fs = \epsilon s \times E = 0,00865 \times 23452,95291 = 203,0097 \text{ N/mm}^2$$

$$\begin{aligned}
 \epsilon's &= 0,003 \times \frac{c-d''}{c} \\
 &= 0,003 \times \frac{136,024 - 71,5}{136,024} \\
 &= 0,001423 < \epsilon_y (0,013644337) \\
 &\rightarrow \text{dipakai } f's = \epsilon's \times E = 0,001423 \times 23452,95291 = 33,37522 \text{ N/}
 \end{aligned}$$

mm<sup>2</sup>

$$\begin{aligned}
 C_s &= A_s' \times f's \\
 &= 750,2 \times 33,37522 \\
 &= 25038,09249 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 C_c &= 0,85 \times f'c \times b \times a \\
 &= 0,85 \times 24,9 \times 200 \times 115,6203 \\
 &= 489420,8 \text{ N}
 \end{aligned}$$

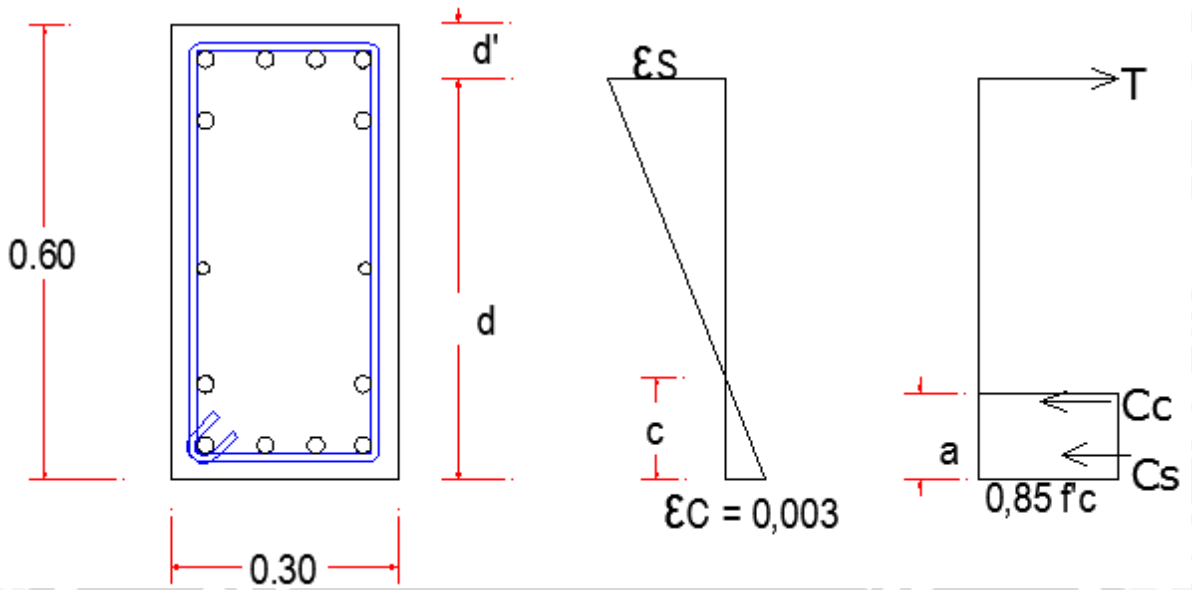
$$\begin{aligned}
 T &= A_s \times f_s \\
 &= 2279,64 \text{ mm}^2 \times 203,0097 \text{ N/mm}^2 \\
 &= 462789,013 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 M_n (+) &= T \times \left(d - \frac{a}{2}\right) \\
 &= 462789,013 \text{ N} \times \left(528,5 - \frac{115,6203}{2}\right) \\
 &= 217830087,3 \text{ N.mm} \\
 &= 21783,01 \text{ kg.m}
 \end{aligned}$$

$$\begin{aligned}
 M_n (-) &= C_c \times \left(d - \frac{a}{2}\right) + C_s (d - 25) \\
 &= 489420,8 \text{ N} \times \left(528,5 - \frac{115,6203}{2}\right) + 25038,09249 (528,5 - 25) \\
 &= 242972078,5 \text{ N.mm} = 24297,21 \text{ kg.m}
 \end{aligned}$$



f. Balok B5



Tulangan atas ( $A_s$ ) = 6 – D22 = 6838,92 mm<sup>2</sup>

Tulangan bawah ( $A_s'$ ) = 2 – D22 = 3751 mm<sup>2</sup>

Senggang = 2 – D10 – 100

Selimit beton = 25 mm

Jarak bersih tulangan = 40 mm

$\beta_1$  = 0,85

$a_1$  = 4 x 0,25 x 3,14 x 22<sup>2</sup> = 1139,82 mm<sup>2</sup>

$a_2$  = 2 x 0,25 x 3,14 x 22<sup>2</sup> = 759,88 mm<sup>2</sup>

$h_1$  = 25 + 10 + ( $\frac{22}{2}$ ) = 46 mm

$h_2$  = 46 + 40 + ( $\frac{22}{2}$ ) = 97 mm

$$d' = \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2}$$

$$= \frac{(1139,82 \times 46) + (759,88 \times 97)}{46 + 97}$$

$$= 66,4 \text{ mm}$$

$$d = h - d'$$

$$= 600 \text{ mm} - 66,4 \text{ mm}$$

$$= 533,6 \text{ mm}$$

$$f_c = \frac{0,83 \times 300}{10}$$

$$= 24,9 \text{ Mpa}$$

$$f_y = 320 \text{ Mpa}$$

$$E = 4700 \times \sqrt{f_c}$$



$$= 4700 \times \sqrt{24,9} \text{ Mpa}$$

$$= 23452,95291 \text{ N/ mm}^2$$

$$\epsilon_y = \frac{f_y}{E_s}$$

$$= \frac{320}{23452,95291}$$

$$= 0,013644337$$

$$a = \frac{(A_s - A_s') \times f_y}{0,85 \times f'c \times b}$$

$$= \frac{(2279,64 - 1500,4) \times 320}{0,85 \times 24,9 \times 300}$$

$$= 39,2718 \text{ mm}$$

$$c = \frac{a}{\beta_1}$$

$$= \frac{39,2718}{0,85}$$

$$= 46,2022 \text{ mm}$$

$$\epsilon_s = 0,003 \times \frac{d-c}{c}$$

$$= 0,003 \times \frac{533,6 - 46,2022}{46,2022}$$

$$= 0,03164 > \epsilon_y (0,013644337)$$

→ dipakai  $f_s = f_y = 320 \text{ N/ mm}^2$

$$\epsilon's = 0,003 \times \frac{d'' - c}{c}$$

$$= 0,003 \times \frac{66,4 - 46,202}{46,202}$$

$$= 0,00131 < \epsilon_y (0,013644337)$$

→ dipakai  $f's = \epsilon's \times E = 0,00131 \times 23452,95291 = 30,758 \text{ N/ mm}^2$

$$C_s = A_s' \times f's$$

$$= 1500,4 \times 30,758$$

$$= 46149,489 \text{ N}$$

$$C_c = 0,85 \times f'c \times b \times a$$

$$= 0,85 \times 24,9 \times 300 \times 39,271$$

$$= 249356,8 \text{ N}$$

$$T = A_s \times f_s$$

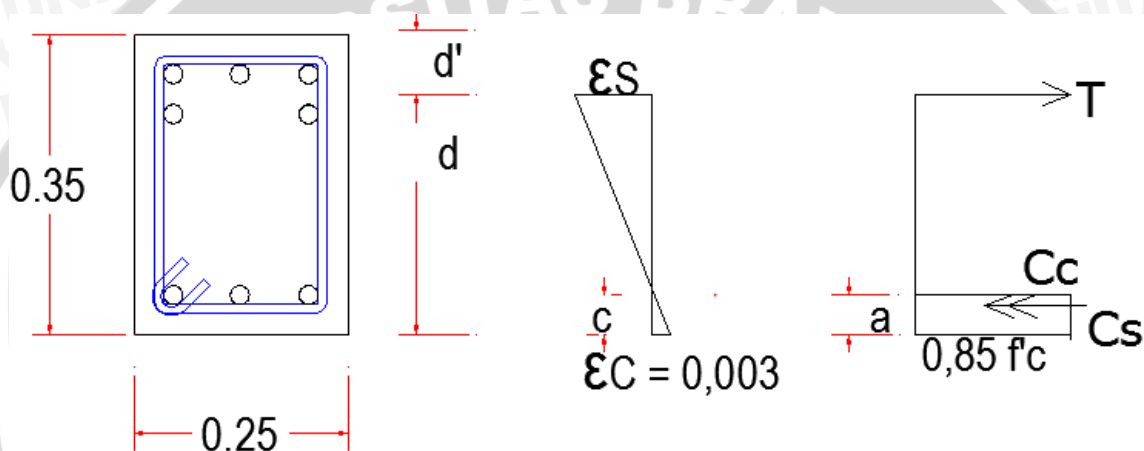
$$= 2279,64 \text{ mm}^2 \times 320 \text{ N/ mm}^2$$

$$= 729484,8 \text{ N}$$

$$\begin{aligned}
 M_n (+) &= T \times \left(d - \frac{a}{2}\right) \\
 &= 729484,8 \text{ N} \times \left(533,6 - \frac{39,271}{2}\right) \\
 &= 374928969,6 \text{ N.mm} \\
 &= 37492,9 \text{ kg.m}
 \end{aligned}$$

$$\begin{aligned}
 M_n (-) &= C_c \times \left(d - \frac{a}{2}\right) + C_s (d - 25) \\
 &= 249356,8 \text{ N} \times \left(533,6 - \frac{39,271}{2}\right) + 46149,489 (533,6 - 25) \\
 &= 151632063,7 \text{ N.mm} = 15163,21 \text{ kg.m}
 \end{aligned}$$

g. Balok B5



$$\begin{aligned}
 \text{Tulangan atas (As)} &= 5 - D22 &= 1899,7 \text{ mm}^2 \\
 \text{Tulangan bawah (As')} &= 3 - D22 &= 1125,3 \text{ mm}^2 \\
 \text{Sengkang} &= 2 - D10 - 100 \\
 \text{Selimut beton} &= 25 \text{ mm} \\
 \text{Jarak bersih tulangan} &= 40 \text{ mm} \\
 \beta_1 &= 0,85 \\
 a_1 &= 3 \times 0,25 \times 3,14 \times 22^2 &= 1139,82 \text{ mm}^2 \\
 a_2 &= 2 \times 0,25 \times 3,14 \times 22^2 &= 759,88 \text{ mm}^2 \\
 h_1 &= 25 + 10 + \left(\frac{22}{2}\right) &= 46 \text{ mm} \\
 h_2 &= 46 + 40 + \left(\frac{22}{2}\right) &= 97 \text{ mm} \\
 d' &= \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2} \\
 &= \frac{(1139,82 \times 46) + (759,88 \times 97)}{46 + 97} \\
 &= 66,4 \text{ mm} \\
 d &= h - d'
 \end{aligned}$$



$$= 350 \text{ mm} - 66,4 \text{ mm}$$

$$= 283,6 \text{ mm}$$

$$f_c = \frac{0,83 \times 300}{10}$$

$$= 24,9 \text{ Mpa}$$

$$f_y = 320 \text{ Mpa}$$

$$E = 4700 \times \sqrt{f'_c}$$

$$= 4700 \times \sqrt{24,9} \text{ Mpa}$$

$$= 23452,95291 \text{ N/mm}^2$$

$$\epsilon_y = \frac{f_y}{E_s}$$

$$= \frac{320}{23452,95291}$$

$$= 0,013644337$$

$$a = \frac{(A_s - A_s') \times f_y}{0,85 \times f'_c \times b}$$

$$= \frac{(1899,7 - 1125,3) \times 320}{0,85 \times 24,9 \times 250}$$

$$= 46,8333 \text{ mm}$$

$$c = \frac{a}{\beta_1}$$

$$= \frac{46,8333}{0,85}$$

$$= 55,0982 \text{ mm}$$

$$\epsilon_s = 0,003 \times \frac{d - c}{c}$$

$$= 0,003 \times \frac{283,6 - 55,098}{55,098}$$

$$= 0,01244 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f_s = \epsilon_s \times E = 0,01244 \times 23452,95291 = 291,7898 \text{ N/mm}^2$$

$$\epsilon'_s = 0,003 \times \frac{d'' - c}{c}$$

$$= 0,003 \times \frac{66,4 - 55,098}{55,098}$$

$$= 0,000615357 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f'_s = \epsilon'_s \times E = 0,000615357 \times 23452,95291 = 14,431 \text{ N/}$$

mm<sup>2</sup>

$$C_s = A_s' \times f'_s$$

$$= 1125,3 \times 14,431$$

$$= 16240,26733 \text{ N}$$

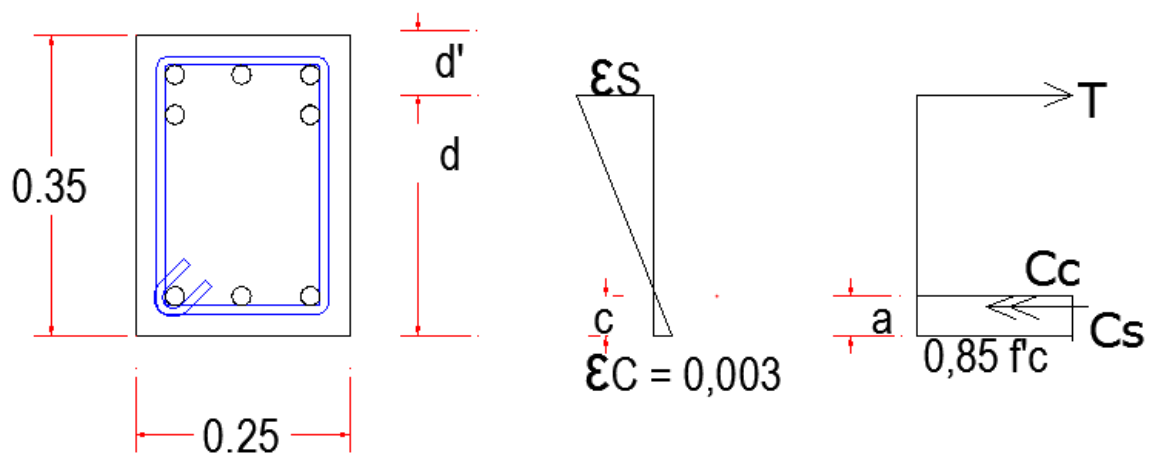
$$\begin{aligned}
 C_c &= 0,85 \times f'_c \times b \times a \\
 &= 0,85 \times 24,9 \times 250 \times 46,833 \\
 &= 247808 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 T &= A_s \times f_s \\
 &= 1899,7 \text{ mm}^2 \times 291,7898 \text{ N/mm}^2 \\
 &= 554313,1088 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 M_n (+) &= T \times \left(d - \frac{a}{2}\right) \\
 &= 554313,1088 \text{ N} \times \left(283,6 - \frac{46,833}{2}\right) \\
 &= 14422973,4 \text{ N.mm} \\
 &= 14422,3 \text{ kg.m}
 \end{aligned}$$

$$\begin{aligned}
 M_n (-) &= C_c \times \left(d - \frac{a}{2}\right) + C_s (d - 25) \\
 &= 247808 \text{ N} \times \left(283,6 - \frac{46,833}{2}\right) + 16240,26733 (283,6 - 25) \\
 &= 68675218,25 \text{ N.mm} = 6867,522 \text{ kg.m}
 \end{aligned}$$

#### h. Balok B5



$$\text{Tulangan atas (As)} = 5 - D22 = 1899,7 \text{ mm}^2$$

$$\text{Tulangan bawah (As')} = 3 - D22 = 1125,3 \text{ mm}^2$$

$$\text{Sengkang} = 2 - D10 = 100$$

$$\text{Selimut beton} = 25 \text{ mm}$$

$$\text{Jarak bersih tulangan} = 40 \text{ mm}$$

$$\beta_1 = 0,85$$

$$a_1 = 3 \times 0,25 \times 3,14 \times 22^2 = 1139,82 \text{ mm}^2$$

$$a_2 = 2 \times 0,25 \times 3,14 \times 22^2 = 759,88 \text{ mm}^2$$

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$$h_1 = 25 + 10 + \left(\frac{22}{2}\right) = 46 \text{ mm}$$

$$h_2 = 46 + 40 + \left(\frac{22}{2}\right) = 97 \text{ mm}$$

$$\begin{aligned} d' &= \frac{(a_1 \times h_1) + (a_2 \times h_2)}{a_1 + a_2} \\ &= \frac{(1139,82 \times 46) + (759,88 \times 97)}{46 + 97} \\ &= 66,4 \text{ mm} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 350 \text{ mm} - 66,4 \text{ mm} \\ &= 283,6 \text{ mm} \end{aligned}$$

$$\begin{aligned} f'c &= \frac{0,83 \times 300}{10} \\ &= 24,9 \text{ Mpa} \end{aligned}$$

$$f_y = 320 \text{ Mpa}$$

$$\begin{aligned} E &= 4700 \times \sqrt{f'c} \\ &= 4700 \times \sqrt{24,9} \text{ Mpa} \\ &= 23452,95291 \text{ N/mm}^2 \end{aligned}$$

$$\begin{aligned} \epsilon_y &= \frac{f_y}{E_s} \\ &= \frac{320}{23452,95291} \\ &= 0,013644337 \end{aligned}$$

$$\begin{aligned} a &= \frac{(A_s - A_s') \times f_y}{0,85 \times f'c \times b} \\ &= \frac{(1899,7 - 1125,3) \times 320}{0,85 \times 24,9 \times 250} \\ &= 46,8333 \text{ mm} \end{aligned}$$

$$\begin{aligned} c &= \frac{a}{\beta_1} \\ &= \frac{46,8333}{0,85} \\ &= 55,0982 \text{ mm} \end{aligned}$$

$$\begin{aligned} \epsilon_s &= 0,003 \times \frac{d-c}{c} \\ &= 0,003 \times \frac{283,6 - 55,098}{55,098} \\ &= 0,01244 < \epsilon_y (0,013644337) \end{aligned}$$

$$\rightarrow \text{dipakai } f_s = \epsilon_s \times E = 0,01244 \times 23452,95291 = 291,7898 \text{ N/mm}^2$$

$$\epsilon'_s = 0,003 \times \frac{d'' - c}{c}$$



$$= 0,003 \times \frac{66,4 - 55,098}{55,098}$$

$$= 0,000615357 < \epsilon_y (0,013644337)$$

$$\rightarrow \text{dipakai } f's = \epsilon's \times E = 0,000615 \times 23452,95291 = 14,431 \text{ N/mm}^2$$

Cs

$$= A_s \times f's$$

$$= 1125,3 \times 14,431$$

$$= 16240,26733 \text{ N}$$

Cc

$$= 0,85 \times f'c \times b \times a$$

$$= 0,85 \times 24,9 \times 250 \times 46,833$$

$$= 247808 \text{ N}$$

T

$$= A_s \times f_s$$

$$= 1899,7 \text{ mm}^2 \times 291,7898 \text{ N/mm}^2$$

$$= 554313,1088 \text{ N}$$

Mn (+)

$$= T \times \left(d - \frac{a}{2}\right)$$

$$= 554313,1088 \text{ N} \times \left(283,6 - \frac{46,833}{2}\right)$$

$$= 14422973,4 \text{ N.mm}$$

$$= 14422,3 \text{ kg.m}$$

Mn (-)

$$= Cc \times \left(d - \frac{a}{2}\right) + Cs (d - 25)$$

$$= 247808 \text{ N} \times \left(283,6 - \frac{46,833}{2}\right) + 16240,26733 (283,6 - 25)$$

$$= 68675218,25 \text{ N.mm} = 6867,522 \text{ kg.m}$$

**Lampiran 4.** Tabel Respon Spektrum Format ADRS

T	Sa (m/s <sup>2</sup> )	Sd (m)
0	0,226	0
0,114	0,564	0,000186
0,571	0,564	0,004663
0,671	0,48	0,00548
0,771	0,418	0,0063
0,871	0,37	0,007117
0,971	0,332	0,007937
1,071	0,301	0,008754
1,171	0,275	0,009562
1,271	0,254	0,010404
1,371	0,235	0,0112
1,471	0,219	0,012016
1,571	0,205	0,012829
1,671	0,193	0,013664

1,771	0,182	0,014474
1,871	0,172	0,015267
1,971	0,163	0,016056
2,071	0,156	0,016965
2,171	0,148	0,017687
2,271	0,142	0,01857
2,371	0,136	0,019386
2,471	0,13	0,020127
2,571	0,125	0,020951
2,671	0,121	0,021888
2,771	0,116	0,022585
2,871	0,112	0,023408
2,971	0,108	0,024172
3,071	0,105	0,025109
3,171	0,102	0,026006
3,271	0,099	0,026858
3,371	0,096	0,027661
3,471	0,093	0,02841
3,571	0,09	0,029101
3,671	0,088	0,03007
3,771	0,085	0,030649
3,871	0,083	0,031536
3,971	0,081	0,032387
4	0,081	0,032861
-	-	-

