TUGAS AKHIR

PERENCANAAN ULANG STRUKTUR GEDUNG AUDIOVISUAL UNIVERSITAS KRISTEN DUTA WACANA YOGYAKARTA

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PERENCANAAN ULANG STRUKTUR GEDUNG AUDIOVISUAL

UNIVERSITAS KRISTEN DUTA WACANA YOGYAKARTA

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MOTTO

" .....Allah meninggikan orang yang beriman diantara kamu dan orang yang diberi ilmu pengetahuan beberapa derajat "

(QS. Mujadilah 11)

" ..... Katakanlah, "Apakah sama orang yang mengetahui dengan orang yang tidak mengetahui?" Sesungguhnya orang yang berakallah yang dapat menerima pelajaran!"

(QS. Az Zumar 9)

" sesungguhnya sesudah kesulitan itu ada kemudahan "

(QS. Alam Nasyrah 6)

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السلام عليكم ورحمة الله وبركاته

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Yogyakarta,November 2001

Penulis

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BAB I

PENDAHULUAN

1.1. Latar Belakang

Pembangunan Nasional yang dilaksanakan di Indonesia bertujuan mewujudkan masyarakat yang adil dan makmur. Salah satu syarat yang penting untuk mencapai tujuan tersebut ialah penguasaan ilmu dan teknologi serta profesionalisme pada bidang yang ditekuni. Penguasaan ilmu dan teknologi merupakan elemen penting yang tidak bisa ditawar-tawar lagi dalam menghadapi kompetisi di masa mendatang. Sumber daya manusia yang profesional juga menjadi penentu dan pengarah kemana bangsa ini akan dituntun.

Seiring pesatnya pembangunan konstruksi di Indonesia menuntut para lulusan sarjana agar mampu mengaplikasikan ilmunya secara maksimal di lapangan bukan hanya memiliki kemampuan secara teoritis.

Untuk mengantisipasi permasalahan ini penulis mengambil tugas akhir tentang perencanaan Gedung Audiovisual sebagai penerapan ilmu yang didapat di bangku kuliah untuk merencanakan suatu bangunan sebagai bekal untuk mempersiapkan diri dalam dunia kerja yang akan dijalani secara profesional.

1.2. Maksud dan Tujuan

Perencanaan ulang ini dimaksudkan untuk merencanakan Gedung Audiovisual Universitas Kristen Duta Wacana Yogyakarta, guna menerapkan ilmu yang didapat di bangku kuliah pada kondisi di lapangan, sehingga diperoleh gambaran dan pengetahuan tentang kegiatan perencanaan yang sebenarnya.

Adapun tujuan dari perencanaan ulang ini adalah memperoleh hasil perencanaan akhir dari data-data arsitektural dan lapangan, yang meliputi :

1. Perencanaan atap
2. Perencanaan plat lantai
3. Perencanaan balok dan kolom
4. Perencanaan pondasi

1.3. Batasan Masalah

Batasan masalah yang di gunakan di dalam perencanaan Gedung Audiovisual UK-DW Yogyakarta ini adalah :

1. Masalah dibatasi pada perencanaan Gedung Audiovisual UK-DW Yogyakarta yang berlokasi di Jl. Dr. Wahidin 5-19 Yogyakarta
2. Perencanaan struktur beton berdasarkan SK-SNI-T-15-1991-03
3. Perencanaan struktur baja menggunakan metode AISC-ASD
4. Pembebanan mengacu kepada Peraturan Pembebanan Untuk Gedung 1983
5. Analisa mekanika menggunakan SAP90 (linier-elastis)
6. Perencanaan struktur menggunakan tingkat daktilitas penuh
7. Mutu beton yang digunakan f_c'=20 Mpa
8. Mutu baja tulangan polos fy=240 Mpa dan tulangan ulir fy=390 Mpa
9. Data tanah menggunakan data tanah setempat dengan $\sigma_{ijin\ tanah}$ = 200 kn/m^2

10. Aturan gempa mengacu kepada Pedoman Perencanaan Ketahanan Gempa Untuk Rumah dan Gedung 1987

1.4. Manfaat

Manfaat yang diperoleh dari penulisan ini adalah memberikan tahapan ilmu dan wawasan baru bagi mahasiswa dalam bidang perencanaan khususnya dalam menganalisis perencanaan pada suatu proyek konstruksi bangunan gedung bertingkat.

BAB II

PERENCANAAN

2.1 Tinjauan Pustaka

Menurut Yuan-Yu Hsieh, 1985 perencanaan yang lengkap dari suatu struktur dijabarkan dalam tahap-tahap sebagai berikut:

1. *Mengembangkan tata-susun umum.* Tata susun umum melibatkan pemilihan tipe struktur, pemilihan material, perkiraan sementara biaya, pemilihan lokasi yang terbaik atau penerapan struktur pada suatu tempat yang belum ditentukan sebelumnya, estetika serta pertimbangan lainnya, termasuk aspek hukum, finansial, dan sebagainya.
2. *Penyelidikan beban.* Sebelum analisa struktural yang disempurnakan dapat dilaksanakan, adalah perlu untuk menentukan beban-beban apa saja yang akan dipakai untuk perencanaan sebuah struktur. Beban-beban tersebut antara lain beban mati *(dead load)* yaitu berat sendiri dari struktur bersama-sama dengan material yang dipasang secara permanen pada struktur. Beban hidup *(live load)* yang pada umumnya diklasifikasikan sebagai beban yang dapat dipindahkan dan beban bergerak atau beban dinamis.

3. *Analisa tegangan.* Apabila bentuk dasar dari struktur dan beban-beban eksternal telah ditetapkan, dapat dibuat suatu analisa struktural untuk menentukan gaya-gaya internal pada batang-batang struktur serta perubahan kedudukan pada beberapa titik kontrol. Jika terdapat beban-beban hidup maka adalah penting untuk mempertimbangan penentuan tegangan-tegangan maksimum yang kemungkinan timbul pada setiap batang.
4. *Pemilihan unsur-unsur.* Pemilihan terhadap ukuran-ukuran dan bentuk-bentuk yang sesuai dengan batang dan sambungan-sambungannya tergantung pada hasil-hasil analisa tegangan bersama-sama dengan ketentuan-ketentuan untuk perencanaan dari spesifikasi-spesifikasi dan peraturan-peraturan.
5. *Penggambaran dan pemerincian.* Apabila penyusunan dari setiap bagian dari struktur telah ditetapkan, maka tahap terakhir dari perencanan dapat dimulai yaitu meliputi persiapan gambar kontrak, pemerincian, spesifikasi pekerjaan dan anggaran biaya akhir yang diperlukan untuk melangsungkan bangunan.

Perencanaan gedung ini terdiri dari susunan beberapa portal baik memanjang maupun melintang. Sistem portal adalah suatu bentuk kesatuan sistem kolom dan balok induk yang merupakan sistem bangunan yang dapat menahan beban vertikal gravitasi dan lateral akibat gempa. Sistem ini memanfaatkan kekakuan balok-balok utama dan kolom. Dengan demikian, integritas antar balok utama dan kolom harus mendapat perhatian dan pendetailan tersendiri, karena disekitar daerah ini timbul gaya geser dan momen yang besar yang dapat menyebabkan retak dan patahnya penampang (L. Wahyudi, Syahril A. Rahim,1997, Struktur Beton Bertulang).

Struktur gedung ini terdiri dari bagian-bagian atap, pelat lantai, balok, kolom, dan bagian substruktur yaitu pondasi.

Atap merupakan penutup bagian atas suatu bangunan yang berfungsi melindungi dari hujan dan terik matahari, pada gedung ini rangka atapnya digunakan dari profil baja L dengan mutu baja fy=240 Mpa dan atapnya memakai genteng.

Pelat lantai dibuat dari konstruksi beton bertulang yang berfungsi sebagai pendukung beban akibat berat sendiri dan beban berguna yang ada di atasnya.

Balok adalah elemen horisontal dari sebuah portal yang menyalurkan beban dari lantai ke kolom. Balok diperhitungkan agar mampu menahan beban lantai dan berat dinding diatasnya.

Kolom merupakan elemen vertikal yang meneruskan beban dari balok ke pondasi. Dimensi kolom pada bangunan ini berbentuk segi empat dengan konstruksi beton bertulang dengan mutu beton f'c=20 Mpa dan mutu baja tulangan polos fy=240 Mpa, dan tulangan ulir fy=390 Mpa.

Pondasi merupakan bagian dari struktur yang biasanya diletakan di bawah permukaan tanah dan menyalurkan beban ke lapisan tanah atau batuan yang ada di bawahnya.

Tangga merupakan bangunan non-struktur yang berfungsi sebagai sarana penghubung antar lantai. Pada gedung ini tidak terdapat perhitungan tangga, karena alat penghubung antar lantai pada gedung tersebut menggunakan tangga pada gedung disebelahnya.

2.2 Perencanaan Konstruksi

2.2.1 Dasar-dasar perencanaan

Dasar-dasar perencanaan gedung Audiovisual UK-Duta Wacana ini adalah:

1. Tata cara perhitungan Struktur Beton untuk Bangunan Gedung (SK-SNI-T-15-1991-03)
2. Peraturan Pembebanan untuk Gedung 1987
3. Peraturan Beton Bertulang Indonesia (PBBI-1971)
4. Peraturan Perencanaan Tahan Gempa untuk Rumah dan Gedung, 1987
5. Hasil penyelidikan tanah di lapangan
6. Metode perencanaan baja AISC-ASD
7. Peraturan lain yang berkaitan dengan Perencanaan bangunan untuk gedung yang berlaku di Indonesia

2.2.2 Perencanaan pembebanan

Agar struktur dan komponen struktur memenuhi syarat kekuatan dan layak pakai terhadap bermacam-macam kombinasi beban, maka harus dipenuhi ketentuan dari faktor beban. Menurut SK-SNI T-15-1991-03 pasal 3.2 ayat 3.2.2 faktor beban ditentukan sebagai berikut:

U=1,2 D + 1,6 L dengan D = beban mati dan L= beban hidup dan bila terdapat perhitungan gempa maka faktor beban sebagai berikut:

U=0,9D±E

U=1,05(D+ϕL±E) dengan E= beban gempa dan ϕ = faktor reduksi kekuatan

dimana:

U = kuat perlu adalah kekuatan suatu komponen struktur atau penampang yang diperlukan untuk menahan beban terfaktor atau momen dan gaya dalam yang berkaitan dengan beban tersebut dalam suatu kombinasi.

Kepastian kekuatan beban terhadap pembebanan dianggap sebagai faktor reduksi kekuatan (ϕ). Menurut SK-SNI T-15-1991-03 ayat 3.2.3 faktor reduksi kekuatan ditentukan sebagai berikut:

1. Lentur, tanpa beban aksial ϕ =0,80
2. aksial tarik, dan aksial tarik dengan lentur ϕ 0,80
3. aksial tekan, dan aksial tekan dengan lentur ϕ=0,65
4. Geser dan torsi ϕ=0,60

faktor reduksi kekuatan di atas juga dipakai untuk mereduksi kekuatan beton dan baja berikut ini:

1. Untuk beton: f'c (kuat tekan beton yang disyaratkan)
2. Untuk baja : fy (tegangan leleh baja)

2.2.3 Data Hitungan Secara Garis Besar

Data keperluan perencanaan dan perhitungan gedung antara lain sebagai berikut:

1. mutu beton fc'=20 Mpa
2. mutu baja tulangan polos fy= 240 Mpa dan tulangan ulir fy=390 Mpa
3. gaya gempa termasuk wilayah III
4. perhitungan mekanika dalam perencanaan gedung ini menggunakan program komputer SAP 90
5. keadaan tanah

Hasil penyelidikan tanah menunjukan bahwa pada lokasi proyek pembangunan gedung Audiovisual, struktur dan propertis tanahnya baik. Hasil penyelidikan tanah tersebut adalah sebagai berikut :

a. dari permukaan tanah sampai kedalaman -1,25 m terdapat lapisan tanah pasir berkerikil kelanauan, coklat.
b. dari –1,25 m sampai –2,25 m terdapat lapisan tanah pasir berkerikil, coklat kelabu.
c. dari –2,25 m sampai 3,25 m terdapat lapisan tanah pasir sedang warna coklat kelabu,
d. dari –3,25 m sampai 4,25 m terdapat lapisan tanah pasir kerikil berbatu, warna kelabu,
e. muka air tanah setempat pada saat penyelidikan ada pada kedalaman –7,4 m dari elevasi ± 0.00. $\sigma_{ijin\ tanah} = 200kn/m^2$

2.3 Kriteria Perencanaan

2.3.1 Perencanaan Gedung Tahan Gempa

Perencanaan dan pelaksanaan penulangan struktur bangunan gedung bertingkat harus tahan terhadap gempa. Perencanaan beban gempa menurut Pedoman Ketahanan Gempa untuk Rumah Tinggal Gedung [3] adalah:

1. Gaya geser horisontal total akibat gempa

   $V_X = V_Y = C \cdot I \cdot K \cdot W_t$

2. Distribusi gaya geser horisontal total akibat gempa ke sepanjang tinggi gedung

a. arah x

H/A<3

$$F_{i,x} = \frac{Wi.hi}{\sum Wi.hi} . V_x$$

b. arah y

H/B<3

$$F_{i,x} = \frac{Wi.hi}{\sum Wi.hi} . V_x$$

dengan:

V_x = V_y gaya geser dasar horisontal total akibat gempa untuk arah x dan y

C = koefisien gempa dasar berdasar letak wilayah gempa (untuk Yogyakarta adalah wilayah gempa 3)

I = faktor keutamaan

K = faktor jenis struktur (K=1, untuk gedung dengan daktilitas penuh)

W_t = berat total bangunan

F_i = Gaya geser horisontal akibat gempa pada lantai ke-I

H, h_i = tinggi lantai ke-I terhadap lantai dasar

A,B = panjang sisi bangunan dalam arah x, dan y

Langkah-langkah perencanaan struktur rangka beton bertulang dengan daktilitas penuh antara lain adalah sebagai berikut:

1. Perencanaan balok portal terhadap beban lentur adalah sebagai berikut;

   $Mu,b = 1,2\ M_{D,b} + 1,6\ M_{L,bR}$

   $Mu,b = 1,05(M_{D,b} + M_{L,bR} + M_{E,b})$

   $Mu,b = 0,9\ M_{D,b} + M_{E,b}$

Dalam perencanaan kapasitas balok portal, momen tumpuan negatif akibat kombinasi beban gravitasi dan beban gempa balok boleh di redistribusikan dengan menambah atau mengurangi dengan prosentase yang tidak melebihi :

$$q \quad 30\left(1-\frac{4}{3}\frac{\rho-\rho'}{\rho b}\right)\%$$

dengan syarat apabila tulangan lentur balok portal telah direncanakan sehingga $(\rho-\rho')$ tidak melebihi $0{,}50\ \rho b$.

$M_{kap,b} = \phi_o . M_{mak,b}$

di mana:

$M_{LL,b}$ = kuat lentur balok portal

$M_{D,b}$ = momen lentur balok akibat beban mati

$M_{L,b}$ = momen lentur balok akibat beban hidup

$M_{E,b}$ = momen lentur balok akibat beban gempa

$M_{kap,b}$ = kapasitas lentur balok pada pusat pertemuan balok kolom

$M_{mak,b}$ = kuat lentur nominal balok

ϕ_o = faktor penambahan kekuatan sebesar 1,25 untuk fy<400Mpa, dan 1,40 untuk fy>400Mpa

2. Perencanaan balok portal terhadap beban geser

$V_{U,b} = 0{,}7\ \frac{Mkap + M'kap}{ln} + 1{,}05 Vg$ tetapi tidak perlu lebih besar dari

$V_{U,b} = 1{,}07[V_{D,b} + V_{L,b} + 4V_{E,b}/K]$

dimana:

M_{kap} = momen kapasitas balok berdasarkan tulangan yang sebenarnya terpasang pada salah satu ujung balok atau bidang muka kolom

M^{-}_{kap} = momen kapasitas balok berdasarkan tulangan yang sebenarnya terpasang pada ujung balok atau bidang muka kolom yang lain

n = bentang bersih balok

$V_{U,b}$ = kuat geser balok portal

$V_{D,b}$ = gaya geser balok akibat beban mati

$V_{L,b}$ = gaya geser balok akibat beban hidup

$V_{E,b}$ = gaya geser balok akibat bebangempa

3. Perencanaan kolom portal terhadap beban lentur dan aksial

$$\sum Mu,k = 0{,}7\alpha xl \sum Mkap,b$$

atau

$$\sum Mu,k = 0{,}7\alpha x l\alpha k(Mkap,ki + Mkap,ka)$$

tetapi dalam segala hal tak perlu lebih besar dari

$M_{U,k} = 1{,}05[M_{D,k} + M_{L,k} + 4M_{E,k}/K]$

Beban aksial rencana, $N_{u,k}$ yang bekerja pada kolom portal adalah sebagai berikut:

$$N_{u,k} = \frac{0{,}7\,Rn.\sum Mkap,b}{lb} + 1{,}05Ng,k$$

Tetapi dalam segala hal tidak perlu lebih besar dari

$N_{U,k} = 1{,}05[N_{g,k} + 4N_{E,k}/K]$

dengan :

Rn = faktor reduksi yang ditentukan sebesar

1,0 untuk 1<n<4

1,1-0,025n untuk 4<n<20

0,6 untuk n>20

$\alpha x l$ = faktor pembesar dinamis yang memperhitungkan pengaruh terjadinya sendi plastis pada struktur secara keseluruhan, diambil = 1,3

αk = faktor distribusi momen kolom portal yang ditinjau sesuai dengan kekakuan relatif kolom atas dan kolom bawah

n = jumlah lantai di atas kolom yang ditinjau

l_b = bentang balok dari pusat ke pusat kolom

$N_{g,k}$ = gaya aksial kolom akibat beban gravitasi

$N_{E,k}$ = gaya aksial kolom akibat beban gempa

4. Perencanaan kolom portal terhadap beban geser

untuk kolom lantai atas: $V_{U,k} = [M_{U,k\ atas} + M_{U,k\ bawah}]/h`_k$

untuk kolom lantai dasar: $V_{U,k} = [M_{U,k\ atas} + M_{U,k\ bawah}]/h`_k$

dan dalam segala hal tidak perlu lebih besar dari:

$V_{U,k} = 1.05\ (M_{D,k} + M_{L,k} + 4V_{E,k}/K)$

dengan:

$h`_k$ = tinggi bersih kolom

5. Perencanaan Panel Pertemuan Balok Kolom

Panel pertemuan balok kolom portal harus diproporsikan untuk memenuhi persyaratan kuat geser horisontal perlu $V_{u,h}$ dan kuat geser vertikal perlu $V_{u,v}$.

$V_{jh} = C_{ki} + T_{ka} - V_{koi}$

$C_k = T_{ki} = 0{,}70\ \frac{Mkap.ki}{Zki}$

$T_{ka} = C_{ka} = 0{,}70\ \frac{Mkap.ka}{Zka}$

V_{sh}

Pad

V_{sh}

Lua

diag

kura

A_{jh}

Gese

V_{jv} =

Seda

V_{sv} =

menj

V_{cv} =

denga

A_{sc} =

A_{sc} =

A_{jv} =

$$V_{kol} = \frac{0.70\left(\frac{ki}{'ki} Mkap,ki + \frac{ka}{'ka} Mkap,ka\right)}{\frac{1}{2}(hk,a + hk,b)}$$

Tegangan geser horisontal nominal dalam joint adalah

$$V_{jh} = \frac{Vjh}{bj.hc} \cdot 1,5\sqrt{fc'}$$

dengan :

b_j lebar efektif joint (mm)

h_c = tinggi total penampang kolom dalam arah geser yang ditinjau (mm)

Tegangan geser horisontal ditahan oleh dua mekanisme kuat geser inti join, yaitu V_{ch} dan V_{sh}. Besarnya V_{ch} harus diambil sama dengan nol kecuali bila:

a. tegangan tekan rata-rata minimal pada penampang bruto kolom beton di atas joint, termasuk tegangan prategang, apabila ada, melebihi nilai 0,1 fc', maka:

$$V_{ch} = \frac{2}{3}\sqrt{\left(\frac{Nu,k}{Ag}\right)} - 0,1\,fc'.bj.hc$$

b. balok diberi gaya prategang yang melewati joint, maka:

$V_{ch} = 0,7\ P_{cr}$

c. seluruh balok pada joint dirancang sehingga penampang kritis dari sendi plastis terletak pada jarak yang lebih kecil dari tingga penampang balok diukur dari muka kolom maka:

$$V_{ch} = 0,5\frac{As'}{As}Vjh\left(1 + \frac{Nu,k}{0,4.Ag.fc'}\right) \text{dimana } \frac{As'}{As} < 1$$

Besarnya V_{sh} bila $\rho c < 0,1\,fc'$ adalah:

2.3.2 Perencanaan Konstruksi

2.3.2.1 Perencanaan Atap

Perencanaan atap pada gedung ini memakai konstruksi kuda-kuda baja. Ketentuan umum perencanaan kuda-kuda baja ini adalah menggunakan rumus-rumus AISC dengan metode ASD.

Langkah-langkah perencanaan konstruksi kuda-kuda baja sebagai berikut:

1. Perencanaan Gording

   a. Pembebanan Tetap (q)

      $q\perp = q.\cos\alpha$

      $q// = q.\sin\alpha$

   b. Pembebanan angin

      angin tekan (wt) = $c_1.w.d$

      angin hisap (wh) = $c_2.w.d$

      dengan:

      c_1 = koefisien angin tekan = 0,02. α.-0,4

      c_2 = koefisien angin hisap = -0,4

      w = beban angn = 25 kg/m^2

      d = jarak gording

   c. Perhitungan Momen

      akibat beban tetap:

      $Mmaks\perp = 1/8.q\perp.L^2$, $Mmaks// = 1/32.q//.L^2$

      akibat beban angin:

      $Mmaks = 1/8.wh.L^2$

      Momen terpakai:

Mmaks = Mmaks⊥ + Mmaks angin

Mmaks = Mmaks⊥.1,25

d. pemilihan dimensi gording

e. kontrol tegangan

$$\frac{fbx}{0.6.Fy} + \frac{fby}{0.75.Fy} \leq 1 \text{, dengan:}$$

$$\text{fbx} = \frac{M\perp}{Sx} \text{, fby} \quad \frac{M//}{Sy}$$

f. kontrol lendutan

$$\delta\perp = \frac{5}{384}.\frac{q\perp.L^4}{E.Ix} \leq \frac{L}{360}$$

$$\delta// = \frac{5}{384}.\frac{q//.\left(\frac{L}{(a+1)}\right)^4}{E.Iy} \leq \frac{L}{360}$$

a = jumlah sagrod dalam satu bentang

2. Perencanaan Sagrod

pembebanan sagrod (ρ)

ρ// = ρ.sinα.Ss dengan Ss = jarak sagrod

$$A_{sagrod} = \frac{\rho//}{0,33.Fu} = \frac{1}{4}.\pi.D^2_{sagrod}, D = \sqrt{\frac{4.\rho//}{0,33.Fu.\pi}}$$

3. Perencanaan Tierod

Pembebanan tierod (T)

T = ρ//.cosα

$$A_{\text{tiered}} = \frac{T}{0{,}33.Fu} = \frac{1}{4}.\pi.D^2_{\text{tiered}}, \quad D = \sqrt{\frac{4.T}{0{,}33.Fu.\pi}}$$

4. Perencanaan Batang Tarik

a. $Ag_{\text{perlu}} = \dfrac{T}{0{,}60.Fy}$

b. $Ae_{\text{perlu}} = \dfrac{T}{0{,}50.Fu.}$

c. $An_{\text{perlu}} \rightarrow$ lihat Tabel 3.5.1 Salmon- Johnson, Luas Netto Efektif Ae (diambil dari tabel AISC - 1.14.2.2 dan 1.14.2.3)

Ag = luas brutto penampang

Ae = luas efektif

An = luas netto = Ag - $A_{\text{perlemahan baut}}$

$A_{\text{perlemahan baut}}$ = (diameter baut + $\frac{1}{8}$), dalam in

Nilai dari a,b,dan c, diambil yang terbesar

r_{min} = L / 300

Dipakai profil yang luasannya (A) lebih besar dari nilai A_{perlu} terpakai

Kontrol :

Tu = 0,60 . Fy.Ag > T

Tu = 0,50.Fu.Ae > T

L / r ≤ 300

3. Perencanaan Batang Desak

$$Kl/r \le Cc \rightarrow Fa = \frac{Fy}{Fs}\left(1 - 0{,}5\left(\frac{Kl/r}{Cc}\right)^2\right)$$

$$Cc = \sqrt{2.\pi^2 \frac{E}{Fy}} = \frac{755}{\sqrt{Fy}} \text{ ; (Fy dalam ksi)}$$

$$Cc = \frac{6400}{\sqrt{Fy}} \text{ ; (Fy dalam kg/cm}^2\text{)}$$

$$Cc = \frac{1987}{\sqrt{Fy}} \text{ ; (Fy dalam Mpa)}$$

$$Fs = \frac{5}{3} + \frac{3.\frac{kl}{r}}{8.Cc} - \frac{(\frac{kl}{r})^3}{8.Cc^3}$$

Kl/r > Cc

$$Fa = \frac{12}{23}.\frac{\pi^2.E}{(\frac{kl}{r})^2}$$

T = Fa. A

Fa tegangan ijin pada luas brutto dalam kondisi beban kerja

Kl/r angka kelangsingan kolom berujung sendi ekivalen

Fs = faktor keamanan

4. Perencanaan Sambungan

$P_{tumpuan} = tp.D_{baut}.1,2.Fu.n$

$P_{geser} = A_{baut}.0,33.Fu.2n = \frac{1}{4}.\pi.D^2_{baut}.0,33.Fu.2n$

$P_{tumpuan}$, P_{geser} untuk perhitungan 1 buah baut, dipilih nilai dari keduanya yang terkecil, sehingga:

$$n = \frac{P}{P_{geser}, P_{tumpuan}}$$

2.3.2.2 Perencanaan Pelat Lantai

Perencanaan pelat lantai sebagai berikut :

1. Mencari momen :

   $Mtx = 0{,}001.qu.Lx^2.X_{tx}$

   $Mlx = 0{,}001.qu.Lx^2.X_{lx}$

   $Mty = 0{,}001.qu.Lx^2.X_{ty}$

   $Mly = 0{,}001.qu.Lx^2.X_{ly}$

   Untuk perencanaan diambil momen terbesar dari Mtx, Mlx, Mty, Mly, dengan:

   qu = pembebanan pelat

   X = koefisien penulangan momen dari tabel Gideon seri 4

   Lx = lebar bentang plat

2. penentuan luasan tulangan lapangan dan tulangan tumpuan

   tulangan lapangan: $As = \dfrac{(Mu/\phi)_{tumpuan}}{\beta l.fy}$

   tulangan tumpuan: $As = \dfrac{(Mu/\phi)_{tumpuan}}{(Mu/\phi)_{lapangan}}$

   As min = (1,4/fy).b.d

   Cek harga As:

   a. bila $As_{perlu} < As_{min}$

      hitung harga 1,33 As_{perlu}, bila 1,33 $As_{perlu} < As_{min}$,maka As = 1,33 As_{perlu}

      Bila 1,33 $As_{perlu} > As_{min}$, maka As = As_{min}

   b. Bila $As_{perlu} > As_{min}$, dipakai As = As_{min}

3. penentuan jarak tulangan

   $x = \dfrac{A\phi.1000}{As_{pakai}}$

4. kontrol kapasitas

Kontrol harga Mn :

$$a = \frac{As.fy}{0{,}85.f'c.b}$$

Mn = As.fy (d-a/2) ≥ Mu/ϕ

2.3.2.3 Perencanaan balok

Perencanaan balok gedung audiovisual sebagai berikut:

1. Perencanaan Balok Lentur

a. Perencanaan Balok

Diketahui : Mn = Mu / ϕ ; b,h, f'c,fy ,d'

$$\rho_b = \frac{0{,}85.f'c.\beta_1}{fy}.\left(\frac{600}{600+fy}\right)$$

$\rho_{max} = 0{,}75\ \rho_b$

$\rho_{min} = 1{,}4/fy$

$$m = \frac{fy}{0{,}85.f'c} \qquad Rn = \rho.fy.(1-0{,}5.\rho.m)$$

b. perencanaan dimensi

tentukan b, hitung:

$b.d^2_{perlu} = \frac{Mu/\phi}{Rn}$, didapat d_{perlu}

dicoba ukuran b/h hitung:

$d = h\text{-}pb\text{-}\phi_{sengkang}\text{-}0{,}5.\ \phi_{tulangan\ pokok}$

chek $d > d_{perlu}$ maka dipakai perhitungan tulangan sebelah dan jika $d < d_{perlu}$ dipakai perhitungan tulangan rangkap

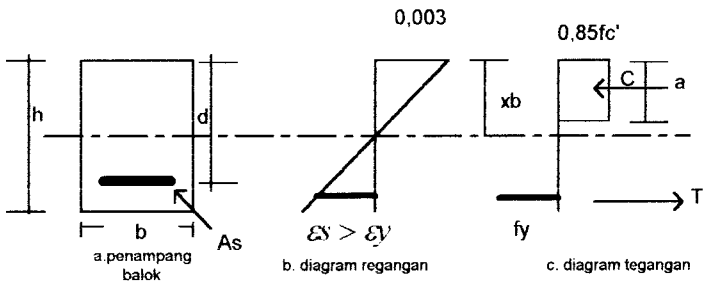
c. penulangan sebelah

$$Rn_{baru} = \frac{Mn}{b/d^2}$$

$$\rho_{perlu} = \rho_{lama} \cdot \frac{Rn_{baru}}{Rn_{lama}}$$

$As = \rho_{perlu}.b.d$

Kontrol kapasitas:



Gambar 2.1 Penampang balok dan diagram tegangan regangan

$$a = \frac{As.fy}{0{,}85.f'c.b}$$

$Mn=As.fy.(d - a/2)$

Kontrol Mn:

Bila $Mn > Mu/\phi$..... aman

d. penulangan rangkap

Menentukan Mn_1

$(\rho - \rho') = \rho_1$

$As_1 = \rho_1.B.d$

$$a = \frac{As_1.fy}{0{,}85.f'c.b}$$

$Mn_1 = As_1.fy.(d - a/2)$

Merencanakan tulangan desak

$Mn_2 = Mn - Mn_1$

$$fs' = 600 \left(1 - \frac{0{,}85.f'c.\beta_1.d'}{(\rho - \rho').fc'.b} \right) \leq fy$$

Jika fs` > fy, maka fs` = fy

fs` ≤ fy, maka dipakai fs`

$$As' = As_2 = \frac{Mn2}{fs'.(d - d')}$$

Menentukan tulangan tarik

$As = As_1 + As'$

Kontrol harga Mn:

$$\rho_1 = \frac{As - As'}{b.d}$$

$$fs' = 600. \left(1 - \frac{0{,}85.f'c.\beta_1.d'}{(\rho - \rho').fc'.b} \right) \leq fy$$

$$a = \frac{As.fy - As.fs'}{0{,}85.f'c.d}$$

$Mn_1 = (As.fy - As'fs')(d - a/2)$

$Mn_2 = As'.fs'(d - d')$

$Mn_1 + Mn_2 > Mn$

2.3.2.4 Penulangan Geser dan Torsi

Prosedur perencanaan untuk kombinasi geser dan torsi adalah sebagai berikut :

1. klasifikasikan apakah torsi yang bekerja berupa torsi keseimbangan atau torsi keserasian. Tentukan penampang kritis yang diambil pada jarak d dari

muka tumpuan dan hitung momen torsi rencana Tu. Apabila Tu lebih kecil dari $\phi\left[\left(\sqrt{f'c}/20\right)\sum x^2y\right]$, maka pengaruh torsi diabaikan.

2. Hitung tahanan torsial nominal Tc badan beton sederhana dengan persamaan $Tc=\frac{\left(1+15\sqrt{f'c}\right)\sum x^2y}{\sqrt{1+\left(\frac{0,4.Tu}{C_t.Mu}\right)^2}}$, dimana $C_t=\frac{bw.d}{\sum x^2y}$. Elemen struktur yang mengalami gaya aksial tarik yang cukup besar harus direncanakan terhadap harga Tc yang dikalikan dengan $(1+0,3.N_u/Ag)$ dimana N_u bernilai negatif untuk tarik.

   Periksa apakah Tu melebihi ϕTc. Jika Tu tidak melebihi ϕTc, efek torsi dapat diabaikan dan jika Tu melebihi ϕTc maka torsi keseimbangan:

   Ts=Tn-Tc, dengan Ts adalah momen torsi yang harus ditahan oleh tulangan.

   Torsi keserasian :

   $Ts=\frac{4}{3}\sqrt{f'c}\sum x^2y-Tc$ atau

   Ts Tn-Tc diambil nilai yang terkecil, dengan harga Tn tidak boleh lebih kecil dari Tu/ϕ.

   Jika Ts>4Tc maka penampang diperbesar.

3. Pilih sengkang tertutup sebagai tulangan melintang, dengan spasi dari sengkang tidak melebihi nilai antara $(x_1+y_1)/4$ atau 300mm. Ukuran tulangan minimum no 3 atau diameter 9mm. Apabila s=jarak konstan sengkang, hitunglah luas sengkang untuk torsi persatu lengan persatuan jarak $\frac{At}{s}=\frac{Ts}{\alpha_1 x_1 y_1 fy}$

4. Hitung penulangan geser yang diperlukan oleh Av per satuan jarak dalam penampang melintang.

$\frac{Av}{s} = \frac{Vs}{fy.d}$ dimana Vs=Vn-Vc dan $Vc = \frac{\left(1/6\sqrt{f'c}\right)bw.d}{\sqrt{1+\left(2.5.Ct.\frac{Tu}{Vu}\right)^2}}$ dengan

besarnya Vn tidak boleh lebih kecil dari Vu/ϕ.

5. Dapatkan luas total sengkang tertutup yang diperlukan untuk torsi dan geser A_{vt} dan desainlah luasan sengkang dengan memenuhi:

$$A_{vt} = \frac{2.At}{s} + \frac{Av}{s} \geq \frac{bw.S}{3.fy}$$

6. Hitung luas tulang memanjang Al yng diperlukan untuk torsi di mana:

$Al = 2.At.\frac{x_1 + y_1}{s}$ atau $Al = \left[\frac{2,8.x.s}{fy}\left[\frac{Tu}{Tu + \frac{Vu}{3.Ct}}\right] - 2.At\right]\frac{x_1 + y_1}{s}$ dipilih

yang terbesar dengan Al pada persamaan yang kedua tidak boleh lebih dari

$$Al = \left[\frac{2,8}{fu}\frac{Tu}{Tu + \frac{Vu}{3.Ct}} - \frac{bw.S}{fy}\right]\frac{x_1 + y_1}{s}$$

7. Rencanakan tulangan dengan menggunakan petunjuk di bawah ini:
   a. Jarak s dari sengkang tertutup tidak boleh melebihi $(x_1+y_1)/4$ atau 300mm.
   b. Tulangan memenjang harus berjarak sama di sekeliling sengkang tertutup. Jarak tulangan ini harus kurang dari 300mm dan paling sedikit satu tulangan memanjang harus diletakan pada masing-masing ujung sengkang tertutup.

c. Kekuatan leleh untuk desain tulangan torsi tidak boleh melebihi 400 Mpa.

d. Sengkang-sengkang yang digunakan untuk tulangan torsi harus cukup dijangkarkan ke jarak d dari tepi serat yang tertekan.

e. Tulangan torsi harus ada juga pada jarak paling sedikit (d+b) di luar titik yang secara teoritis memerlukannya dengan maksud mengatasi tegangan geser yang secara potensial dapat berlebihan.

2.3.2.5 Perencanaan Kolom

Perhitungan untuk menentukan tulangan pada kolom di mana ukuran penampang serta beban aksial dan momen yang bekerja telah diketahui, dan menggunakan grafik-grafik dari buku Grafik dan Tabel Perhitungan Beton Bertulang Gideon Kusuma.

Berikut ini diberikan langkah-langkah perencanaan kolom terhadap lentur:

1. Penentuan luas tulangan total yang diperlukan dengan bantuan tabel yang diperoleh dari:

   $Ag = b.h$

   $Ast = n\%.Ag$

   $P_{sentris} = Po = 0,85.f'c.(Ag-Ast)+Ast.fy$

   $Pno = 0,85.Po$

2. Penentuan kelangsingan kolom

   Tentukan inersia:

   $Ib = (Ib.hb^3)/12$

   $Ik = (Ik.hk^3)/12$

   menentukan kekuatan kolom:

$Ec = 4700\sqrt{f'c}$ (Mpa)

Elb = (Ec.Ib)/(5(1+βd))

Elk = (Ec.Ik)/(25(1+βd))

Tentukan kekuatan relatif

$\mu_1 = \sum(Elk_1/lk_1)/\sum(Elb_1/lb_1)$ untuk kolom atas

$\mu_2 = \sum(Elk_2/lk_1)/\sum(Elb_2/lb_2)$ untuk kolom bawah

$\mu_m = (\mu_1+\mu_2)/2$

jika $\mu_m < 2$ maka $k = (20-\mu_m)/20.\sqrt{(1+\mu_m)}$

jika $\mu_m > 2$ maka $k = 0.9.\sqrt{(1+\mu_m)}$

cara lain untuk menentukan nilai k dapat melalui nomogram berikut dengan cara memplotkan nilai μ_1 dan μ_2 kemudian tarik garis dari nilai keduanya didapat nilai k yang dicari.

Tentukan kelangsingan kolom:

r = 0,3.hk

Jika k.Lk/r < 22 (kolom tidak langsing atau kolom pendek)

Jika 22 < k.Lk/r < 100 (kolom langsing, maka ada faktor pembesaran momen) yaitu :

$M_c = \delta_b.M_{2b} + \delta_s.M_{2s}$

$$\delta_b = \frac{C_m}{1-\frac{P_u}{\phi.P_c}} \geq 1$$ dengan $C_m = 1$ untuk kolom tanpa pengekang

$$\delta_s = \frac{1}{1-\frac{\sum P_u}{\phi.\sum P_c}} \geq 1$$

$$P_c = \frac{\pi^2 . E . I}{(k . l)^2}$$

Mn = M_c/ϕ

e = Mn/Pu > (15+0,03.hk)

jika k.Lk/r > 100 (perbaiki dimensi betonnya)

3. kapasitas penampang

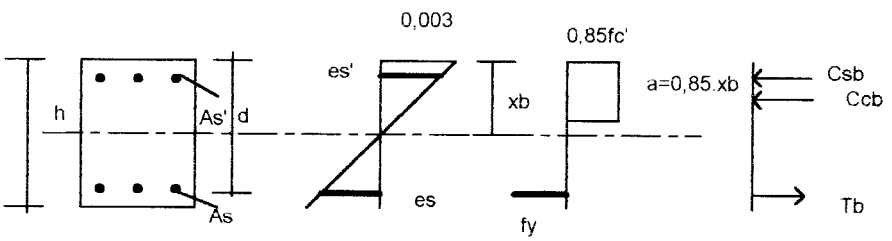
keadaan regangan seimbang:

$$x_b = \frac{600}{600 + fy} . d$$

$$fs' = \frac{x_b - d'}{x_b} . 600$$

dimana jika fs'>fy maka dipakai fs'= fy jika tidak maka dipakai fs'

kapasitas penampang:



Gambar 2.2 Penampang kolom dan diagram tegangan regangan

Ccb = 0,85.f'c.(β_1.x_b).b

Csb = As'.(fs'-0,85.f'c)

Tb = As.fy

Pnb = Ccb+Csb-Tb

$$Mnb = Ccb.\left(\bar{y} - \frac{a}{2}\right) + Csb.\left(\bar{y} - d'\right) + Tb.\left(d - \bar{y}\right)$$

$$eb = \frac{Mnb}{Pnb}$$

pilih x

jika x = xb perhitungan kapasitas penampang dengan analisa runtuh desak dengan syarat:

Pn > Pnb

e < eb

Mn < Mnb

Jika x < xb analisa runtuh tarik dengan syarat:

Pn < Pnb

e > eb

Mn < Mnb

Jika x = ~ maka Pn = 0, tulangan desak diabaikan perhitungan kapasitas penampang seperti tulangan sebelah.

2.3.2.6 Perencanaan Pondasi

Pondasi yang direncanakan dalam perhitungan gedung ini adalah pondasi telapak pada bangunan yang terdapat lantai basement, sedang untuk bangunan tanpa lantai basement digunakan pondasi sumuran.

Cara perencanaan pondasi telapak sama dengan perencanaan pelat dua arah pada umumnya, hanya pada bagian bawah dari pelat pondasi ini diberi balok sloof yang berfungsi sebagai pengikat kolom.

Langkah-langkah perencanaan pondasi telapak dan pondasi sumuran adalah sebagai berikut:

1. Pondasi Telapak

a. Diketahui beban kerja, f'c.fy, σ_{tanah}

tebal pelat kaki diasumsikan

b. Tekanan tanah

Tekanan tanah ijin efektif untuk mendukung beban total

$\sigma_{netto\ tanah} = \sigma_{netto} - q$

q = beban tanah di atas pelat pondasi dan beban pelat sendiri

Dengan menggunakan nilai awal beban kerja

$A_{perlu} = \Sigma P / \sigma_{netto\ tanah}$

Dihitung tekanan tanah terfaktor yang diakibatkan beban yang bekerja

$pu = Pu/A = (1,2\ q_D + 1,6\ q_L)/A$

c. Pemeriksaan terhadap kuat geser

Gaya geser total terfaktor yang bekerja pada penampang kritis:

$Vu = pu\ (A^2 - B^2)$

A= luas telapak pondasi empat persegi

B= lebar kolom + tinggi efektif

Kuat geser beton

$Vc = (1+(2/\beta_c)).(2\sqrt{f'c}.\ bo.\ d) \leq 4\sqrt{f'c}.bo.d$

β_c = rasio panjang/lebar kolom

bo = 4B

sehingga kuat geser maksimum adalah :

$Vc = 4\sqrt{f'c}.\ bo.\ d$

$\phi Vn = \phi Vc + Vu < \phi Vn$

d. Penulangan Momen

Diambil lebar b = 1 meter

M = (1/2).Pu.((A - a)/2)²

Jd = 0,9 d

As = (M/0,8)/(fy.jd)

ρ_{min} = 1,4/fy

$As_{min} = \rho_{min}.b.d$

Untuk langkah selanjutnya dapat dilihat pada perhitungkan pelat.

e. Periksa momen yang terjadi

As = ...

$$A = \frac{As.fy}{0,85.f'c.b}$$

Mn yang terjadi = As.fy(d-a/2) ≥ $Mn_{rencana}$

2. Pondasi Sumuran

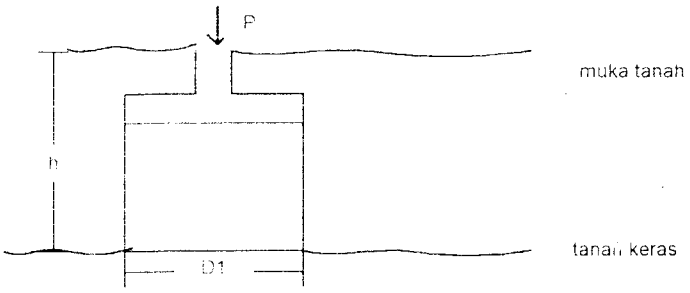
Dalam perencanaan pondasi terlebih dahulu diketahui data-data dari hasil sondir tanah yaitu:

a. daya dukung tanah qc

b. kedalaman tanah keras

Setelah diketahui data di atas maka dapat ditentukan pondasi yang akan digunakan pada bangunan tersebut. Pondasi sumuran ini digunakan pada bangunan yang tidak mempunyai basement, untuk perbaikan tanah.

Langkah-langkah perhitungan pondasi sumuran:



Gambar 2.3 Pondasi sumuran dan pondasi telapak

$$\sigma = \frac{P}{A_1} \Rightarrow A_1 = \frac{P}{\sigma}$$

$$A_1 = \frac{1}{4}.\pi.D_1^2 \Rightarrow D_1 = \sqrt{\frac{4.A_1}{\pi}}$$

Berat sendiri sumuran $= \frac{1}{4}.\pi.D_1^2.\gamma$ dengan γ = bj beton

P_{total} = Pu+berat sendiri sumuran

Selanjutnya P pondasi yang digunakan adalah P_{total}

BAB III

PERHITUNGAN KONSTRUKSI

3.1 Perhitungan Perencanaan Atap

Hasil perencanaan atap gedung Studio Audiovisual sebagai berikut:

1. Data :

   a. Gording 6.76 kg/m

   b. Eternit dan plafond = 18 kg/m^2

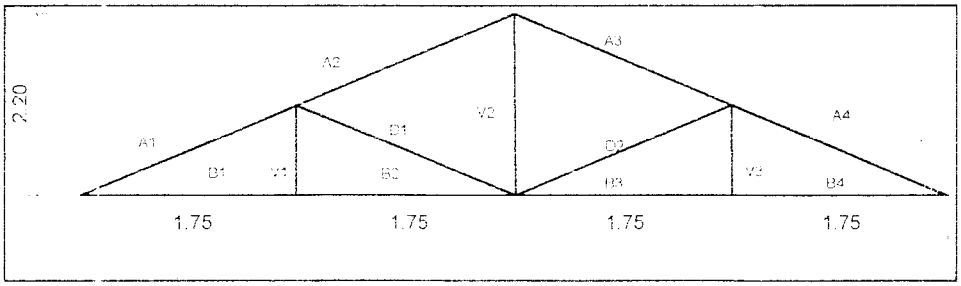
   c. Penutup atap = 50 kg/m^2

   d. Beban hidup = 20 kg/m^2

   e. fy = 2400

   f. E = 2,10x10^6

   g. Fu = 3600 kg/cm^2



Gambar 3.1 Rencana kuda-kuda

2. Hasil perhitungan perencanaan atap

Tabel 3.1 Hasil perhitungan perencanaan atap

Batang	Panjang (m)	jenis batang	Profil	n baut tiap join
A1	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
A2	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
A3	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
A4	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
B1	1,75	tarik	2L 50x50x5	2 ϕ 1/2'
B2	1,75	tarik	2L 50x50x5	2 ϕ 1/2'
B3	1,75	tarik	2L 50x50x5	2 ϕ 1/2'
B4	1,75	tarik	2L 50x50x5	2 ϕ 1/2'
D1	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
D2	2,067	tekan	2L 50x50x5	2 ϕ 1/2'
V1	1,099	tarik	2L 50x50x5	2 ϕ 1/2'
V2	2,2	tarik	2L 50x50x5	2 ϕ 1/2'
V3	1,099	tarik	2L 50x50x5	2 ϕ 1/2'

Perhitungan lengkap perencanaan atap terdapat pada lampiran.

3.2 Perencanaan Plat Lantai

Perhitungan plat lantai gedung Studio Audiovisual sebagai berikut:

1. Diketahui :
   a. tebal plat : 0,12 m
   b. tebal pasir : 0,05 m
   c. tebal spesi : 0,03 m
   d. tebal keramik : 0,01 m
   e. bj beton : 24 kn/m^3

f. bj pasir : 16 Kn/m^3

g. bj spesi : 24 Kn/m^3

h. bj keramik : 20 Kn/m^3

i. beban hidup : 2,5 Kn/m^2

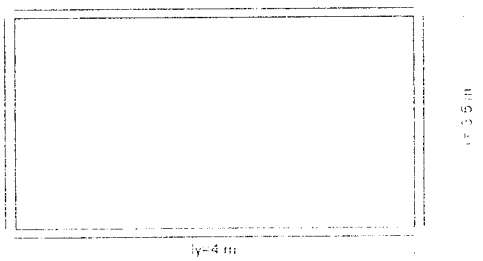
j. f'c : 20 Mpa

k. fy polos (untuk sengkang, dan pada plat lantai) : 240 Mpa

l. fy deform (tulangan pokok balok dan kolom) : 400 Mpa

m. ϕ = 0,8 (faktor reduksi kekuatan untuk pembebanan lentur tanpa aksial)

2. Perencanaan pembebanan :



Gambar 3.2 Dimensi plat lantai

a. beban mati(WD)

1) berat pelat = t pelat x bj beton = 2,88 kn/m^2

2) berat pasir = t pasir x bj pasir = 0,8 kn/m^2

3) berat spesi = t spesi x bj spesi = 0,72 kn/m^2

4) berat keramik = t keramik x bj keramik = 0,2 kn/m^2

b. beban hidup WL= 4 kn/m^2

c. qu = 1,2 $_{WD}$+1,6 $_{WL}$ = 11,92 kn/m^2

3. Perhitungan momen

Mu(lx,tx,ly,ty) (±) 0,001 . qu . l^2 . x

Hitung nilai ly/lx untuk mendapatkan faktor perhitungan momen x yang dapat dilihat pada buku *Gideon seri 4 table 14.*

a. momen lapangan arah x

$$\frac{ly}{lx} = \frac{4}{3,5} = 1,143 \text{ lihat tabel didapat } 0,001x \quad 0,034$$

maka Mlx = $\pm 0,001 \cdot qu \cdot l^2 \cdot x$

$= \pm 11,92 \quad 3,5^2 \cdot 0,034$

$= \pm 4,96$ kn-m

b. momen lapangan arah y

$$\frac{ly}{lx} = \frac{4}{3,5} = 1,143 \text{ lihat tabel didapat } 0,001x = 0,022$$

maka Mly = $\pm 0,001 \cdot qu \cdot l^2 \cdot x$

$= \pm 11,92 \cdot 3,5^2 \cdot 0,022$

$= \pm 3,212$ kn-m

c. momen tumpuan arah x

$$\frac{ly}{lx} = \frac{4}{3,5} = 1,143 \text{ lihat tabel didapat } 0,001x = 0,063$$

maka Mtx = $\pm 0,001 \cdot qu \cdot l^2 \cdot x$

$= \pm 11,92 \cdot 3,5^2 \cdot 0,063$

$= \pm 9,199$ kn-m

d. momen tumpuan arah y

$$\frac{ly}{lx} = \frac{4}{3,5} = 1,143 \text{ lihat tabel didapat } 0,001x = 0,054$$

maka Mty = $\pm 0,001 \cdot qu \cdot l^2 \cdot x$

$= \pm 11,92 \cdot 3,5^2 \cdot 0,054$

$= \pm 7,885$ kn-m

e. perencanaan tulangan

d = t pelat – p – $0,5.\phi_{tl}$

= 120 – 20 – 0,5.10

= 95 mm

jd = 0,9. d

= 85 mm

f. menghitung luasan tulangan lapangan atau tumpuan arah x dan y

untuk As lx = $\frac{Mu/\phi}{jd.fy}$

$= \frac{4,96/0,8.10^{\wedge}6}{85.5.240}$

= 302,144 mm^2

untuk As ly = $\frac{Mu/\phi}{jd.fy}$

$= \frac{3,212/0,8.10^{\wedge}6}{85.5.240}$

= 195,663 mm^2

untuk As tx = $\frac{(Mu/\phi)_{tumpuan\,x}}{(Mu/\phi)_{lapangan\,x}}.Aslx$

$= \frac{(9,199/0,8)}{(4,96/0,8)}.302,144$

= 560,38 mm^2

untuk As ty = $\frac{(Mu/\phi)_{tumpuan\,y}}{(Mu/\phi)_{lapangan\,x}}.Aslx$

$$= \frac{(7.885/0.8)}{(4.96/0.8)} .302,144$$

$$= 480,32 \text{ mm}^2$$

g. As min = $\frac{1,4}{fy} .b.d$, b = 1000 mm (tinjauan per-meter)

$$= \frac{1,4}{240} .1000.95$$

$$= 554,17 \text{ mm}^2$$

h. $1,33.As_{lx}$ = 401,85 mm^2

$1,33.As_{ly}$ = 260,23 mm^2

$1,33.Ast_x$ = 745,31 mm^2

$1,33.As_{tx}$ = 638,83 mm^2

i. chek nilai As>As min

jika As<Asmin dan 1,33As> As min ⟶ As min dipakai

jika As<As min dan 1,33 As <As min ⟶ 1,33As dipakai

As pakai lx = 401,85 mm^2

As pakai ly = 260,23 mm^2

As pakai tx = 554,17 mm^2

As pakai ty = 554,17 mm^2

j. menghitung Aϕ=1/4. π . d^2

dipakai ϕ_{tul} = 10 mm

A ϕ = 78,5 mm^2

k. menghitung jarak tulangan

$$x = \frac{A\phi.1000}{As_{pakai}}$$

$$x \text{ arah lx} = \frac{78,5.1000}{401,85}$$

$$= 195,35 \text{ mm}$$

$$x \text{ arah ly} = \frac{78,5.1000}{260,23}$$

$$= 301,65 \text{ mm}$$

$$x \text{ arah tx} = \frac{78,5.1000}{554,17}$$

$$= 141,65 \text{ mm}$$

$$x \text{ arah ty} = \frac{78,5.1000}{554,17}$$

$$= 141,65 \text{ mm}$$

I. dicoba tulangan :

arah lx : $P_{10\text{-}190}$ $As = (A\phi.1000)/x$

$= (78,5.1000)/200$

$= 392,50 \text{ mm}^2$

arah ly : $P_{10\text{-}240}$ $As = (A\phi.1000)/x$

$= (78,5.1000)/240$

$= 327,08 \text{ mm}^2$

arah tx : $P_{10\text{-}110}$ $As = (A\phi.1000)/x$

$= (78,5.1000)/110$

$= 713,64 \text{ mm}^2$

arah ty : $P_{10\text{-}130}$ $As = (A\phi.1000)/x$

$= (78,5.1000)/150$

$= 603,85 \text{ mm}^2$

m. Kontrol Mn

$$a = \frac{As.fy}{0,85.f'c.b} \qquad Mn = As.fy.(d-a/2) > Mu/\phi$$

arah lx $a = \frac{392,5.240}{0,85.20.1000} = 5,54$ mm

$Mn = 392,5.240.(95-(5,54/2)) .10^6$

$= 8,68$ kn-m $> 1,33\ Mu/\phi = 8,25$ kn-m ... aman

arah ly $a = \frac{327,08.240}{0,85.20.1000} = 4,61$ mm

$Mn = 327,08.240.(95-(4,61/2)) .10^6$

$= 7,27$ kn-m $> 1,33\ Mu/\phi\ \ 5,34$ kn-m ... aman

arah tx $a = \frac{713,64.240}{0,85.20.1000} = 10,07$ mm

$Mn = 713,64.240.(95-(10,07/2)) .10^6$

$= 15,41$ kn-m $> 1,33\ Mu/\phi = 15,29$ kn-m ... aman

arah ty $a = \frac{603,85.240}{0,85.20.1000} = 8,52$ mm

$Mn = 603,85.240.(95-(8,52/2)) .10^6$

$= 13,15$ kn-m $> 1,33\ Mu/\phi = 13,11$ kn-m ... aman

Selanjutnya hasil perhitungan plat lantai toko buku, atap dan selasar terdapat pada tabel dengan perhitungan lengkapnya terdapat pada lampiran.

Tabel 3.2 Hasil Perencanaan Plat Lantai studio

Lantai studio 4x3.5 m^2				
Perhitungan	Mlx	Mly	Mtx	Mty
Mu (Kn m)	4,96468	3,21244	9,19926	7,88508
Mu/ϕ	6,20585	4,01555	11,499075	9,85635
1,33 Mu/ϕ	8,253781	5,3406815	15,2937698	13,10895
As (mm^2)	302,43	195,69	560,38	480,33
1,33 As (mm^2)	402,23	260,27	745,31	638,84
As min (mm^2)	554,17	554,17	554,17	554,17
As maks (mm^2)	3064,17	3064,17	3064,17	3064,17
As perlu (mm^2)	402,23	260,27	554,17	554,17
jrk tulangan (mm)	195,16	301,61	141,65	141,65
Di pakai tulangan	P_{10} - 200	P_{10} – 240	P_{10} - 110	P_{10} - 130
As tersedia (mm)	392,50	327,08	713,64	603,85
A	5,54	4,62	10,07	8,52
Mn	8,688011	7,2762574	15,4081342	13,14997
Kontrol	Aman	Aman	aman	aman

Tabel 3.3 Hasil Perencanaan Plat Lantai toko buku

Lantai toko buku 4 x 3,5 m^2				
Perhitungan	Mlx	Mly	Mtx	Mty
Mu (Kn m)	4,96468	3,21244	9,19926	7,88508
Mu/ϕ	6,20585	4,01555	11,499075	9,85635
1,33. Mu/ϕ	8,253781	5,3406815	15,2937698	13,10895
As (mm^2)	302,43	195,69	560,38	480,33
1,33 As (mm^2)	402,23	260,27	745,31	638,84
As min (mm^2)	554,17	554,17	554,17	554,17
As maks (mm^2)	3064,17	3064,17	3064,17	3064,17
As perlu (mm^2)	402,23	260,27	554,17	554,17
jrk tulangan (mm)	195,16	301,61	141,65	141,65
Di pakai tulangan	P_{10} - 200	P_{10} - 240	P_{10} - 110	P_{10} - 130
As tersedia (mm)	392,50	327,08	713,64	603,85
A	5,54	4,62	10,07	8,52
Mn	8,688011	7,2762574	15,4081342	13,14997
Kontrol	aman	aman	aman	aman

Tabel 3.4 Hasil Perencanaan Plat Lantai selasar

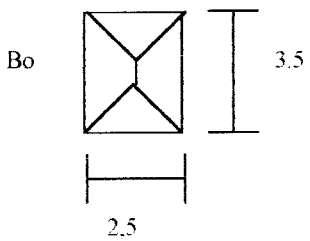
Lantai selasar 2,8 x 4 m^2				
Perhitungan	Mlx	Mly	Mtx	Mty
Mu (Kn m)	2,59736064	1,68064512	4,81275648	4,12521984
Mu/ϕ	3,2467008	2,1008064	6,0159456	5,1565248
1,33. Mu/ϕ	4,3181120	2,7940725	8,0012076	6,8581779
As (mm^2)	19,78	127,97	366,47	314,12
1.33 As (mm^2)	263,04	170,2	487,4	417,78
As min (mm^2)	443,33	443,33	443,33	443,33
As maks (mm^2)	2451,34	2451,34	2451,34	2451,34
As perlu (mm^2)	263,04	170,2	443,33	417,78
jrk tulangan (mm)	191,0	295,17	113,32	120,26
Di pakai tulangan	P_8 - 200	P_8 - 200	P_8 - 100	P_8 - 120
As tersedia (mm)	251,2	251,2	502,4	418,67
A	3,55	3,55	7,09	5,91
Mn	4,47	4,47	8,74	7,34
Kontrol	aman	aman	aman	aman

Tabel 3.5 Hasil Perencanaan Plat Lantai atap

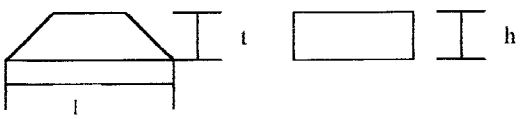
Lantai atap 2,8 x 4 m^2				
Perhitungan	Mlx	Mly	Mtx	Mty
Mu (Kn m)	1.744	1.128	3.232	2.77
Mu/ϕ	2.1804	1.4109	4.0402	3.4609
1,33. Mu/ϕ	2.9000	1.8764	5.3735	4.6059
As (mm^2)	132,83	85,95	246,12	210,96
1.33 As (mm^2)	176,66	114,31	327,34	280,57
As min (mm^2)	443,33	443,33	443,33	443,33
As maks (mm^2)	2451,34	2451,34	2451,34	2451,34
As perlu (mm^2)	176,66	114,31	327,34	280,57
jrk tulangan (mm)	284,39	439,51	153,48	179,1
Di pakai tulangan	P_8-240	P_8-240	P_8-160	P_8-180
As tersedia (mm)	209,33	209,33	314,0	279,11
a	2,96	2,96	4,43	3,94
Mn	3,74	3,74	5,56	4,96
Kontrol	aman	aman	aman	aman
Tul.susut pakai	P_8-240	P_8-240	P_8-240	P_8-240

3.3 Perencanaan Balok Anak

Perhitungan Balok Anak B_0



beban plat balok B_0:



$$h = t - \frac{4.l^3}{3.l^2}$$

Gambar 3.3 Jenis pembebanan balok anak

1. Data :

a. berat jenis beton = 24 kn/m^2

b. q pelat = 11,92 kn/m^2

c. asumsi ukuran balok = 0,25 x 0,4 m^2

d. tinggi tembok (lantai 1) = 4 m

2. Penyelesaian:

a. pembebanan

1) beban pelat = (n).h.q_{pelat}

$$= 1.(1,25-\frac{4.1,25^3}{3,3,5^2}).11,92$$

= 12,37 kn/m

2) berat balok = $b_{balok}.(h_{balok}-t_{pelat}).bj.1,2$

= 0,25.(0,4-0,12).24.1,2

2,02 kn/m

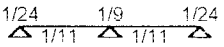
3) beban tembok = $berat_{tembok}.(t_{tembok}-h_{balok}).1,2$

= 2,5.(4-0,4).1,2

= 10,8 kn/m

b. Momen Mu

lihat faktor momen, Gideon dapatkan Mu, dan Mu ϕ, dengan ϕ 0,8



Gambar 3.4 Pembagian faktor momen

Mu = (1/24).qu.l^2

= (1/24).25,18.3,5^2

= 12,85 kn-m

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Mu/ϕ 16,07 kn-m

Mu (1/11).qu.l^2

= (1/11).25,18.3,5^2

= 28,04 kn-m

Mu/ϕ = 35,05 kn-m

Mu = (1/9).qu.l^2

= (1/9).25,18.3,5^2

= 34,28 kn-m

Mu/ϕ = 42,84 kn-m

c. penulangan balok

data:

1) f'c 20 Mpa

2) fy ulir 390 Mpa

3) ϕ tul pokok = 20 mm

4) ϕ tul sengkang, max 20 mm = 10 mm

5) β_1 =0,85 untuk f'c $\leq$ 30 Mpa

untuk f'c>30 Mpa β_1 = 0,85-0,008.(f'c30) $\geq$ 0,65

d. perhitungan:

$$\rho b = \frac{o,85.f'c.\beta_1}{fy}.\left(\frac{600}{600+fy}\right)$$

$$= \frac{o,85.20.0.85}{390}.\left(\frac{600}{600+390}\right)$$

= 0,022

ρ_{max} = 0,75 ρb

$= 0,75.0,22$

$= 0,017$

$\rho_{min} = 1,4/fy$

$= 1,4/390$

$= 0,00359$

diambil $\rho = 0,5.\ \rho_{max} = 0,0084$

$$m = \frac{fy}{0,85.f'c}$$

$$= \frac{390}{0,85.20}$$

$= 22,941$

$Rn = \rho.fy.(1-0,5.\ \rho.m)$

$= 0,0084.390.(1-0,5.0,0084.22,941)$

$= 2,9669$

$$b.d^2 = \frac{Mu/\phi}{Rn}$$

$$= \frac{42,84}{2,9669}.10^6$$

$= 14439423\ mm^3$

perkirakan d_{perlu} :

diambil b = 200 mm ; d_{perlu} = 269 mm

coba ukuran balok :

b= 200 mm ; d = 400 mm

hitung $d_{pakai} = h_{balok}\text{-}pb\text{-}\phi_{sengkang}\text{-}0.5.\ \phi_{tul.pelat}$

$= 400 - 40 - 10 - 0,5.20$

$= 340$ mm

cek $d_{pakai} > d_{perlu}$ dipakai tulangan sebelah, jika $d_{pakai} < d_{perlu}$ dipakai tulangan rangkap.

Karena $d_{pakai} > d_{perlu}$, dipakai tulangan sebelah

tulangan sebelah

$$Rn_{baru} = \frac{Mu/\phi}{b.d^2}$$

$$= \frac{42,84}{200.340^2}.10^6$$

$= 1,8529$

$$\rho_{baru} = \frac{Rn_{baru}}{Rn}.\rho$$

$$= \frac{1,8529}{2,9669}.0,0084$$

$= 0,0052591$

$As_{baru} = \rho_{baru}.b.d$

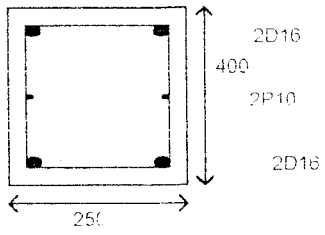
$= 0,0052591.200.340$

$= 357,619\ mm^2$

ambil jumlah ϕ_{tul} dan hitung $As_{tul} = n.A\phi \geq As$

diambil tul 2ϕ16 ; $As_{tul} = 401,92\ mm^2 > As = 357,619\ mm^2$ ... aman

periksa jarak tulangan :



Gambar 3.5 Penampang balok

x = b_{balok}-2.(jarak luar ke tulangan sengkang + $\phi_{tul\ sengkang}$)

200 2.(25 + 10)

130 mm

jarak antar tulangan:

jrk = (x-(n. ϕ_{tul}))/2, dengan n = jumlah tulangan

= (130 (2.16))/2

= 49 mm.

Periksa untuk Mu/ϕ = 35,05 kn-m

$$Rn_{baru} = \frac{Mu/\phi}{b.d^2}$$

$$Rn_{baru} = \frac{35,05.10^6}{200.340^2}$$

= 1,516

$$\rho = \frac{Mu/\phi}{Mu/\phi_{max}}.\rho$$

$$= \frac{35,05}{42,84}.0,0084 = 0,00687$$

$As_{min} = \rho_{min}.b.d$

= 0,00359.200.340

= 244,12 mm^2

$$As = \frac{Mu/\phi}{Mu/\phi_{maks}} . As$$

$$= \frac{35,05}{42,84} .357,619$$

$= 292,6 \text{ mm}^2$ > As min

Kontrol tulangan:

dipakai tulangan:2ϕ16, $As_{tul} = 401,92 \text{ mm}^2 > As_{pakai} = 292,6$ .....aman

Mu/ϕ =16,066632 kn-m

$$As = \frac{Mu/\phi}{Mu/\phi_{maks}} . As_{baru}$$

$$= \frac{16,0666}{42,84} .357,619$$

$= 134,12 < As_{min} = 244,12 \text{ mm}^2$, maka dipakai As min = 244,12 mm^2

dipakai tulangan:2ϕ16, $As_{tul} = 401,92 \text{ mm}^2 > As_{pakai} = 244,12$ .....aman

Tabel 3.6 Perencanaan balok anak

Perhitungan	Balok Ba0	Balok Ba1	Balok Ba2	Balok Ba3
Mu/ϕ (Kn/m)	67,204585	71,8	51,03	67,2
tulangan	3D16	3D16	2D16	3D16
Mu/ϕ (Kn/m)	61,1	65,27	23,39	61,1
tulangan	3D16	3D16	2D16	2D16
Mu/ϕ (Kn/m)	67,204585	71,8	51,03	67,2
tulangan	3D16	3D16	2D16	3D16
Mu/ϕ (Kn/m)	61,095077	65,27	23,39	61,1
tulangan	3D16	3D16	2D16	3D16

3.4. Perencanaan Balok Induk

1. Data :
   a. Fy = 400 mpa
   b. fc' = 20 mpa
   c. penutup beton (Pb) = 40 mm
   d. diameter tul.utama = 22 mm
   e. diameter tul.tekan = 22 mm
   f. diameter sengkang = 10 mm
   g. b = 300 mm = 0,3 m
   h. h = 500 mm = 0,5 m
   i. ϕ = 0,8
   j. Betta = 0,85
   k. d' = 40 + 10 + (22/2) = 61 mm = 0,061 m
   l. d = 500 – 61 = 439 mm = 0,439 m
   m. d'/d = 0,138952164
   n. pb = 0,021675
   o. p mak = 0,01625625
   p. p min = 0,0035
2. Perhitungan balok portal D lantai 2 elemen 21
   a. Momen Tumpuan

      Mu = 137,1 Knm

      $$Rn = \frac{Mu}{b.d^2}$$

      $$= \frac{137,1}{0,3.0,439^2}$$

= 2371,1

dari data fy, fc', Rn, d'/d lihat tabel Gideon 5.3.b didapat ρ = 0,008 > ρ min = 0,0035, maka dipakai ρ = 0,008

As = ρ.b.d

= 0,008. 300. 439

= 1053,6 mm^2

dipakai tulangan 3D22 As tul = 1139,82 mm^2

As' = 0,5.As

= 526,8 mm^2 dipakai 2D22

b. Momen Lapangan

Mu = 11,4 Knm

$$Rn = \frac{Mu}{b.d^2}$$

$$= \frac{11,4}{0,3.0,439^2}$$

= 197,9

dari data fy, fc', Rn, d'/d lihat tabel Gideon 5.3.b didapat ρ = 0,0007 < ρ min = 0,0035, maka dipakai ρ = 0,0035

As = ρ.b.d

= 0,0035. 300. 439

= 460,95 mm^2

dipakai tulangan 2D22 As tul = 759,88 mm^2

As' = 0,5.As = 230,48 mm^2 dipakai 2D22

c. Tulangan & Momen Nominal Aktual

Jumlah tulangan terpasang As = 3D22 = 1139,82 mm^2 (tulangan atas) dan

As` = 2D22 = 759,88 mm^2

$$a = \frac{(As - As').fy}{0,85.f'c.b}$$

$$\frac{(1139,82 - 759,88).400}{0,85.20.300}$$

= 29,8 mm

$$M\ nak = (0,85.f'c.a.b.(d - (a/2))) + (As'.fy.(d - d'))$$

$$=(0,85.20.10^3.29,8.10^{-3}.0,3.(0,439-(29,8.10^{-3}/2)))+(759,88.10^{-6}.400.10^3.(0,439-0,061))$$

= 179,35 Knm

MR = 0,8.M nak

= 143,48 Knm

M kap = 1,25.Mnak

= 224,19 Knm

$$fs' = 600.\left(1 - \frac{0,85.f'c.\beta_1.d'}{(\rho - \rho').fy.d}\right)$$

$$= 600.\left(1 - \frac{0,85.20.0,85.61}{((1139,82\ 300.439) - (759,88\ 300.439)).400.439}\right)$$

= 446 Mpa > fy = 400 Mpa ,maka dipakai fy = 400 Mpa

sehingga dengan cara yang sama didapat:

M nak` = 179,35 Knm

M kap = 224,18 Knm

d. Perencanaan Gaya Geser

VD = + 13,33 Kn (ujung kiri)

-13,38 Kn (ujung kanan)

VL = + 7,83 Kn (ujung kiri)

-7,85 Kn (ujung kanan)

VE_{kiri} = -75,18 Kn (ujung kiri)

-81,9 Kn (ujung kanan)

VE_{kanan} = 81,74 Kn (ujung kiri)

= 75,02 Kn (ujung kanan)

M kap,b = 224,18 Knm

M kap',b = 224,18 Knm

$$Vu1,b = 0,7.\phi_o.\left[\frac{Mkap,b + Mkap',b}{ln}\right] + 1,05.Vg \;,\; Vg = VD + VL$$

$$= 0,7.1,25.\left[\frac{224,18 + 224,18}{2,5}\right] + 1,05.(13,33 + 7,83)$$

= 179,15 Kn

$Vu_2b_{,kiri}$ = 1,05.(VD+VL+4/K.VE)

= 1,05.(13,33+7,83+4/1,-75,18)

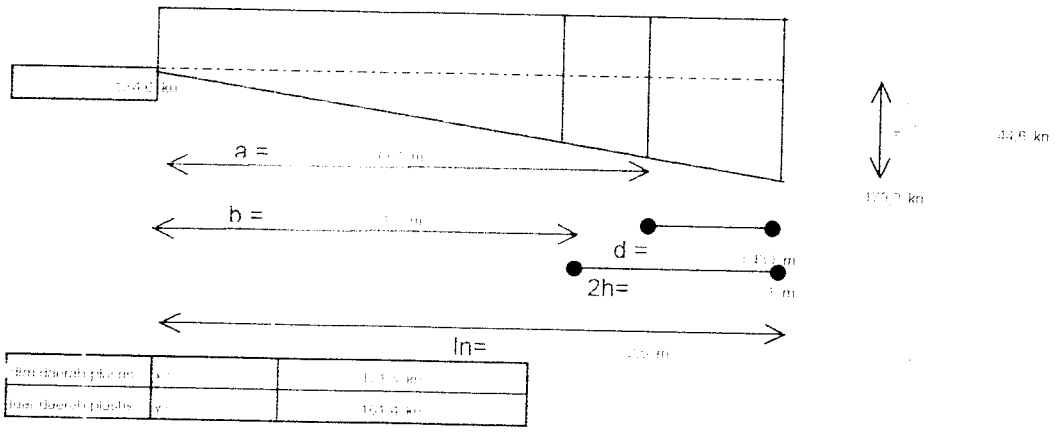
= -293,52 Kn

$Vu_2b_{,kanan}$ = 1,05.(VD+VL+4/K.VE)

1,05.(13,33+7,83+4/1,81,74)

= 365,51 Kn

Vu pilih adalah nilai terkecil negatif atau positif antara Vu1, $Vu_2b_{,kiri}$, $Vu_2b_{,kanan}$, sehingga didapat Vu pilih = 179,2 Kn. Dari hitungan diagram segitiga diperoleh Vub didaerah plastis diperoleh 171,4 Kn.



Gambar 3.6 diagram segitiga tegangan geser

Vc = 0

Vs min = 1/3.b.d

= 1/3.300.439.10^{-3}

43,9

Vs = Vub/0,6

171,4/0,6

= 285,7 Kn

S = 2.Av.fy.d/Vs

= 2.0,25.π.10^{2}.240.439/285,7.10^{3}

= 59,7 < d/4 = 439/4 = 109,75. maka dipakai S = 59,7 mm

dipakai 2P10-100

periksa :

Vu,b/ϕ < Vc + Vs

171,4/0,8 < 0 + 285,7

214,25 < 285,7 .....OK

Vub di luar daerah plastis diperoleh: 161,4 Kn

$Vc = \left(\sqrt{f'c}/6\right)b.d$

$= \left(\sqrt{20}/6\right)300.439.10^{-3}$

= 240,45

Vs min = 1/3.b.d

$= 1/3.300.439.10^{-3}$

= 43,9

Vs = Vub/0,6 - Vc

= 161,4/0,6 - 240,45

= 28,5 Kn

S = 2.Av.fy.d/Vs

$= 2.0,25.\pi.10^{2}.240.439/376,8.10^{3}$

= 376,8> d/2 = 439/2 = 219,5 maka dipakai S = 219,5 mm

dipakai 2P10-100

periksa :

$Vu.b/\phi < Vc + Vs$

161,4/0,8 < 240,45 + 28,5

201,75 < 268,95.....OK

Hasil perhitungan balok induk portal terdapat pada tabel berikut :

Tabel 3.7 Hasil perencanaan balok induk portal A

Perencanaan Balok Induk Portal A							
Lantai/ elemen	Ukuran balok (mm)	tulangan tumpuan		tulangan lapangan		tulangan geser	
		n atas	n bawah	n atas	n bawah	plastis	Luar plastis
sloop/16	300/500	2D22	2D22	2D22	2D22	P10-90	P10-210
/17	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
lt. 1/18	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/19-20	300/500	3D22	2D22	2D22	2D22	P10-80	P10-210
lt. 2/21	300/500	3D22	2D22	2D22	2D22	P10-100	P10-210
/22-23	300/500	3D22	2D22	2D22	2D22	2P10-120	P10-210
lt. 3/24	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/25-26	300/500	3D22	2D22	2D22	2D22	P10-100	P10-210
Atap/27	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/28-29	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210

Tabel 3.8 Hasil perencanaan balok induk portal B

Perencanaan Balok Induk Potal B							
Lantai/ Elemen	Ukuran balok (mm)	tulangan tumpuan		tulangan lapangan		tulangan geser	
		n atas	n bawah	n atas	n bawah	plastis	Luar plastis
Sloop/16	300/500	2D22	2D22	2D22	2D22	P10-95	P10-210
/17	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
lt. 1/18	300/500	4D22	2D22	2D22	2D22	2P10-80	P10-210
/19-20	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
lt. 2/21	300/500	4D22	2D22	2D22	2D22	2P10-80	P10-210
/22-23	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
lt. 3/24	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/25-26	300/500	4D22	2D22	2D22	2D22	P10-70	P10-210
atap/27	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/28-29	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
atap/33	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/34-35	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210

Tabel 3.9 Hasil perencanaan balok induk portal D

Perencanaan Balok Induk Portal D							
Lantai/ Elemen	Ukuran balok (mm)	tulangan tumpuan		tulangan lapangan		tulangan geser	
		n atas	n bawah	n atas	n bawah	Plastis	Luar plastis
Sloop/16	300/500	2D22	2D22	2D22	2D22	P10-90	P10-210
/17	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
lt. 1/18	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/19-20	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
lt. 2/21	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/22-23	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
lt. 3/24	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/25-26	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
atap/27	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/28-29	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210

Tabel 3.10 Hasil perencanaan balok induk portal H

Perencanaan Balok Induk Portal H							
Lantai/ Elemen	Ukuran Balok (mm)	tulangan tumpuan		Tulangan lapangan		tulangan geser	
		n atas	n bawah	n atas	n bawah	Plastis	Luar plastis
sloop/16	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/17	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
Lt. 1/18	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/19-21	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
Lt. 2/22	300/500	3D22	2D22	2D22	2D22	2P10-100	P10-210
/23-24	300/500	4D22	2D22	2D22	2D22	P10-100	P10-210
Lt. 3/25	300/500	2D22	2D22	2D22	2D22	P10-90	P10-210
/26-27	300/500	3D22	2D22	2D22	2D22	P10-100	P10-210
atap/28	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210
/29-30	300/500	2D22	2D22	2D22	2D22	P10-100	P10-210

Tabel 3.13 Hasil perencanaan balok induk portal 2

Perencanaan Balok Induk Portal 2							
Lantai/ Elemen	Ukuran balok (mm)	tulangan tumpuan		tulangan lapangan		tulangan geser	
		n atas	n bawah	n atas	n bawah	plastis	nonplastis
sloop/45	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/46-49	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
lt. 1/50	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/51-57	200/350	3D19	2D19	2D19	2D19	P10-70	P10-145
lt. 2/58	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/59-65	200/350	3D19	2D19	2D19	2D19	P10-70	P10-145
lt. 3/66	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/67-73	200/350	3D19	2D19	2D19	2D19	P10-70	P10-145
atap/74	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/75	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145
/76-81	200/350	2D19	2D19	2D19	2D19	P10-70	P10-145

3.5. Perencanaan Kolom

Perencanaan kolom 2D portal D

1. Data:

   a. Ukuran kolom :

      b = 400 mm = 0,4 m

      h = 600 mm = 0,6 m

   b. Ukuran balok :

      b = 300 mm = 0,3 m

      h = 500 mm = 0,5 m

   c. r = 0,3.h = 0,18 m

   d. f'c = 20 mpa

e. fy deform = 400 mpa

f. fy polos = 240 mpa

g. Ec = Eg = 4700.√f`c = 21019,04 mpa = 21019039,0 kn/m^2

h. Ic (Inersia kolom) = 0,0072 m^4

i. Ig (Inersia balok) = 0,003125 m^4

j. tinggi kolom :

k. h pondasi = 2 m

l. panjang balok :

m. lb1 = 2,8 m

n. lb1' (bentang bersih balok) = lb1 – b kolom = 2,4m

o. lb2 = 7 m

p. lb2' = 6,6 m

q. cm = 1 (unbraced frame)

r. Ø = 0,65

s. Øo =1,25

t. d' = 50 mm

u. d = h – d' = 550 mm

2. Perencanaan kolom tengah portal D elemen 5

a. Data momen:

$M_{D\,atas}$ = -34,03 Knm

$M_{D\,bawah}$ = 24,03 Knm

$M_{L\,atas}$ = -9,17 Knm

$M_{L\,bawah}$ = 3,9 Knm

$M_{E\,atas}$ = -58,02 Knm

$M_{E\ bawah}$ = 156,87 Knm

(atas) 1,2 M_D + 1,6 M_L = 1,2.-34,03 + 1,6.-9,17

-55,51 Knm

(bawah) 1,2 M_D + 1,6 M_L = 1,2.24,03 + 1,6.3,9

= 35,08 Knm

(atas) 1,05.(M_D + $M_{L\ t}$) = 1,05.(-34,03 + -9,17.0,6)

Mb = -41,51 Knm

(bawah) 1,05.(M_D + $M_{L\ t}$) = 1,05.(24,03 + 3,9.0,6)

Mb = 27,69 Knm

(atas) 1,05 M_E = 1,05.-58,02

Ms = -60,921 Knm

(bawah) 1,05 M_E = 1,05.156,87

Ms = 164,71 Knm

(atas) Mb + Ms = -41,51 + -60,92

-102,43 Knm

(bawah) Mb + Ms = 27,69 + 164,71

= 192,4 Knm

(atas) 1,05.(M_D + M_L +(4/1).M_E) = 1,05.(-34,03 + -9,17 + 4.-58,02)

= 289,044 Knm

(bawah) 1,05.(M_D + M_L +(4/1).M_E) = 1,05.(24,03 + 3,9 + 4.156,87)

= 688,18 Knm

b. Data gaya axial:

$P_{D\ atas}$ = -305,54 Kn

$P_{D\ bawah}$ = -330,88 Kn

$P_{L\ atas}$ = -122,91 Kn

$P_{L\ bawah}$ = -122,91 Kn

$P_{E\ atas}$ = -331,22 Kn

$P_{E\ bawah}$ = -331,22 Kn

(atas) 1,2 P_D + 1,6 P_L = 1,2.-305,54 + 1,6.-122,91

= -563,31 Kn

(bawah) 1,2 P_D + 1,6 P_L = 1,2.-330,88 + 1,6.-122,91

= -593,72 Kn

(atas) 1,05.(P_D + $P_{L\ r}$) = 1,05.(-305,54 + -122,91.0,6)

Pb = -398,25 Kn

(bawah) 1,05.(P_D + $P_{L\ r}$) = 1,05.(-330,88 + -122,91.0,6)

Pb = -424,86 Kn

(atas) 1,05 P_E = 1,05.-331,22

Ps = -347,78 Kn

(bawah) 1,05 P_E = 1,05.-331,22

Ps = -347,78 Kn

(atas) Pb + Ps = -398,25 + -347,78

= -746,03 Kn

(bawah) Mb + Ms = -424,86 + -347,78

= -772,64 Kn

(atas) Pu pakai = -563,31 Kn

(bawah) Pu pakai = -593,72 Kn

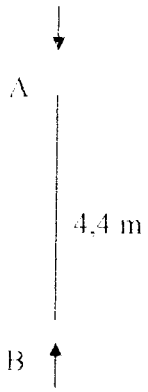
(atas) 1,05.(P_D + P_L) = 1,05.(-305,54 + -122,91)

= -449,87 Kn

(bawah) 1,05.(P_D + P_L) = 1,05.(-330,88 + -122,91)

= -476,48 Kn

c. Perhitungan Momen Rencana (Mc)



Gambar 3.7 elemen kolom

MA = -102,4 Knm

MB = 192,4 Knm

PDA = -305,54 Kn

PDB = -330,88 Kn

PuA = -746,03 Kn

PuB = -772,64 Kn

e = M/Pu

= 192,4/746,03

= 0,258 m

e_{min} = (1,5 + 0,03.h) cm

= (1,5 + 0,03.60) cm

3,3 cm

= 0,033 m < 0,342 m, maka dipakai e = 0,342 m

$$\psi_A = \psi_B = \frac{\sum\left(\frac{Ec.Ic}{Lc}\right)}{\sum\left(\frac{Eg.Ig}{Lg}\right)}$$

$$\psi_A = \frac{\sum\left(\frac{21019039.0,0072}{4,4}\right)+\left(\frac{21019039.0,0072}{4,0}\right)}{\sum\left(\frac{21019039.0,003125}{2,8}\right)+\left(\frac{21019039.0,003125}{7}\right)}$$

$= 2,20$

$$\psi_B = \frac{\sum\left(\frac{21019039.0,0072}{4,4}\right)+\left(\frac{21019039.0,0072}{2,0}\right)}{\sum\left(\frac{21019039.0,003125}{2,8}\right)+\left(\frac{21019039.0,003125}{7}\right)}$$

$= 3,35$

lihat nomogram unbranced frames, didapat k = 1,75

$$\frac{k.l}{r} = \frac{1,75.4,4}{0,18}$$

$= 42,78 > 22$ dan < 100, maka termasuk kolom panjang, dipakai konsep perbesaran momen.

$$EI = \frac{(Ec.Ig/2,5)}{(1+\beta k)}$$

$$= \frac{(21019039.0,003125/2,5)}{\left(1+\frac{305,54}{746,03}\right)}$$

$= 18639,9$

$$Pc = \frac{\pi^2.E.I}{(k.l)^2}$$

$$= \frac{\pi^2.18639,9}{(1,75.4,4)^2}$$

= 3099,71

$$\delta b = \frac{Cm}{1-\left(\frac{Pu}{\phi.Pc}\right)} \geq 1$$

$$= \frac{1}{1-\left(\frac{746,03}{0,65.3099,7}\right)} \geq 1$$

= 1,59

$$\delta s = \frac{1}{1-\left(\frac{\Sigma Pu}{\phi.\Sigma Pc}\right)} \geq 1$$

$$= \frac{1}{1-\left(\frac{506,43}{0,65.2580,29}+\frac{746,03}{0,65.3099,7}+\frac{492,18}{0,65.1056,67}\right)} \geq 1$$

= -6,25 < 1 .... diambil δs = 1

Mc = δb.Mb + δs.Ms

1,59.-41,5 + 1.-60,9

= -126,88 Knm

d. Penulangan Kolom

Kolom tengah basement elemen 5

hk = 4,4 m

hk' = 4,4 – h balok

= 4,4 – 0,5

3,9 m

Rv = 1

M $kap_{(kiri)}$ = 224,18 Knm

M $kap_{(kanan)}$ = 299,09Knm

Nu,k1 = 0,7.Rv.ϕ0.(Mkap$_{kiri}$ + Mkap$_{kanan}$)/hk + 1,05 Ng

= 0,7.1.1,25.(224,18 + 299,09)/4,4 + 1,05.449,87

= 553,93 Kn

Nu,k2 = 1,05.Ng + 1,05.P$_{ij}$.4/K

= 449,87 + 1,05.331,22.4/1

= 1841,00 Kn

dipakai Nu,k minimum, yaitu Nu,k1 = 553,93 Kn

M mak = -102,4 Knm (atas)

M mak = 192,4 Knm (bawah)

$$\alpha = \frac{M_{atas}}{M_{atas} + M_{bawah}}$$

$$\frac{102,4}{102,4 + 192,4}$$

= 0,35

ωd = 1

$$Mu,k1 = \frac{hk}{hk'}.\omega x1.0,8.\left(\frac{lki}{l'ki}.Mkap,ki + \frac{lka}{lka'}Mkap,ka\right)$$

$$= \frac{4,4}{3,9}.1.0,8.\left(\frac{2,8}{2,4}.224,18 + \frac{7}{6,6}229,09\right)$$

= 158,8 Knm

Mu,k2 = 289,04 Knm

Mu,k pakai = 158,8 Knm

e. Penulangan:

Mc = 126,8 Knm

Mu,k = 158,8 Knm

Mu terpakai = 158,8

Mu/ϕ = 158,8/0,65

244,31Knm

Nu/ϕ = 553,93/0,65

= 852,2 Kn

e = 244,31/852,2

= 0,29 m

lihat grafik Mu,Pn didapat 1%, Ast = 1 %. b.h

= 1 %. 400.600

= 2400 mm^2

As perlu = Ast/2

= 2400/2

= 1200 mm^2

dipakai 4D22 As tul = 1519,76 mm^2 > As perlu..... OK

runtuh tarik:

$$\rho = \frac{Astul}{b.d}$$

$$= \frac{1519,76}{400.550}$$

= 0,0069

$$Pn=0,85.f'c.b.d.\left[\left(\frac{(h-2.e)}{(2.d)}\right)+\sqrt{\left(\left(\frac{(h-2.e)}{2.d}\right)^2+2.\left(\frac{fy}{(0,85.f'c)}\right).\rho.\left(1-\left(\frac{d}{d'}\right)\right)\right)}\right]$$

= 2125,83 Kn > Nu/ϕ

jarak tulangan $2.pb + n/2.\phi + 2.\phi_{sengkang} + ((n/2)-1).25 < b$

$= 2.40 + 4/2.22 + 2.10 + ((4/2)-1).25 < 400$

$= 169$ mm < 400 mm..... OK

f. Penulangan Geser

$Vu = (Mu,k_{atas} + u,k_{bawah})/hk'$

$= (158,8 + 298,3)/3,9$

117,2 Kn

$0,5.\phi.Vc = (1+ (Nu/b.h)).\sqrt{fc'}/6.b.d.0,5.\phi$

$= (1+ (553,93/(400.600)).(\sqrt{20}/6).400.550).0,5.0,6$

$= 113,84 <$ Vu,k, perlu tulangan geser minimum.

Dipakai tulangan geser d =10 mm, Av =157 mm^2.

S Av.fy.3/b

$= 157.240.3/ 400$

$= 282,6$ mm

dicoba S = 250 mm

Vs = Av.fy.d/S

$= 157.240.550/250.10^{-3}$

$= 82,89$ Kn

$\sqrt{f'c}/3.b.d = \sqrt{20}/3.400.550. 10^{-3}$

$= 327,96$ Kn >Vs.....OK, maka dipakai tulangan geser ϕ10-250

Perhitungan kolom portal terdapat pada tabel berikut:

Tabel 3.13 Perhitungan kolom portal A

PORTAL A					
Posisi kolom	Lantai/ elemen	tinggi kolom (m)	ukuran kolom(mm)	Perencanaan tulangan	
				lentur	geser
tengah	base /5	4,4	400/600	11D22	Ø10-250
		4,4	400/600	11D22	
	lt. 1/8	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/11	4	400/600	6D22	Ø10-250
		4	400/600	6D22	
	lt. 3/14	5	400/600	4D22	Ø10-250
		5	400/600	4D22	
Tepi kiri	base /4	4,4	400/600	12D22	Ø10-250
		4,4	400/600	12D22	
	lt. 1/7	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/10	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/13	3,2	400/600	4D22	Ø10-250
		3,2	400/600	4D22	
tepi kanan	base /6	4,4	400/600	10D22	Ø10-250
		4,4	400/600	10D22	
	lt. 1/9	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/12	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/15	5	400/600	4D22	Ø10-250
		5	400/600	4D22	

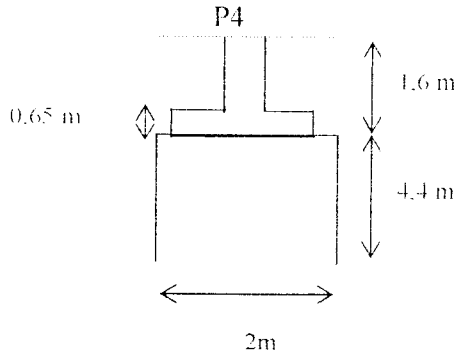
Tabel 3.14 Perhitungan kolom portal D

Posisi Kolom	Lantai/ elemen	tinggi kolom(m)	ukuran kolom(mm)	Perencanaan tulangan	
				lentur	geser
Tengah	base /5	4,4	400/600	4D22	Ø10-250
		4,4	400/600	4D22	
	lt. 1/8	4	400/600	6D22	Ø10-250
		4	400/600	8D22	
	lt. 2/11	4	400/600	8D22	Ø10-250
		4	400/600	4D22	
	lt. 3/14	5	400/600	4D22	Ø10-250
		5	400/600	4D22	
Tepi kiri	base /4	4,4	400/600	4D22	Ø10-250
		4,4	400/600	4D22	
	lt. 1/7	4	400/600	5D22	Ø10-250
		4	400/600	5D22	
	lt. 2/10	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/13	5	400/600	4D22	Ø10-250
		5	400/600	4D22	
tepi kanan	base /6	4,4	400/600	4D22	Ø10-250
		4,4	400/600	4D22	
	lt. 1/9	4	400/600	8D22	Ø10-250
		4	400/600	8D22	
	lt. 2/12	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/15	5	400/600	4D22	Ø10-250
		5	400/600	4D22	

Tabel 3.15 Perhitungan kolom portal H

Posisi Kolom	Lantai/ elemen	tinggi Kolom(m)	ukuran Kolom(mm)	Perencanaan tulangan	
				lentur	Geser
tengah	lt. 1/5	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/8	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/11	3,2	400/600	5D22	Ø10-250
		3,2	400/600	5D22	
Tepi kiri	lt. 1 /4	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/7	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/10	3,2	400/600	4D22	Ø10-250
		3,2	400/600	4D22	
tepi kanan	lt. 1/6	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 2/9	4	400/600	4D22	Ø10-250
		4	400/600	4D22	
	lt. 3/12	3,2	400/600	4D22	Ø10-250
		3,2	400/600	4D22	

3.6 Perencanaan Pondasi



Gambar 3.8 Perencanaan pondasi P4

1. Data : P4

   a. σ tanah = 200 Kn/m^2

   b. h tnh keras = 1,6 m

   c. fc' = 20 Mpa

   d. fy = 400 Mpa

   e. γ tanah = 15,9 Kn/m^3

   f. γ beton = 24 Kn/m^3

   g. P = 216,9 Kn

2. Perencanaan pondasi sumuran

   Bj beton siklop = 23 Kn/m^3

   ϕ coba = 2 m

   h pondasi sumuran = 4,4 m

   P pondasi sumuran = 0,25 π.d^2.h. γ

   = 0,25. π.2^2.4,4.23

   317,77 Kn

   P total = P + $P_{sumuran}$

   = 219,9 + 317,77

= 534,67 Kn

$$A \text{ perlu} = \frac{Pu}{\sigma_{tan\,ah}}$$

$$= \frac{534,67}{200}$$

$$= 2,67 \text{ mm}^2$$

$$\text{diameter sumuran perlu} = \sqrt{\frac{A}{0,25.\pi}}$$

$$= \sqrt{\frac{2,67}{0,25.3,14}}$$

$$= 1,84 \text{ m}$$

dipakai diameter sumuran = 2 m

σijin sumuran diambil = 700 Kn/m^2

3. Perencanaan pondasi telapak:

Asumsi tebal pondasi = 0,4 m

Ukuran kolom :

b = 400 mm

h = 600 mm

Perhitungan:

Daya dukung netto :

$q = h_1 . \gamma_1 + h_2 . \gamma_2$

$1,2.15,9 + 0,4. 24$

= 28,68 Kn/m^2

q netto = $\sigma_{sumuran} - q$

= 750 – 28,68

$= 721{,}32\ \text{Kn/m}^2$

Dimensi pondasi bujur sangkar :

$$A\ \text{perlu} = \frac{Pu}{q_{ijin}}$$

$$= \frac{534{,}67}{721{,}32}$$

$= 0{,}74\ \text{m}^2$

$b = \sqrt{A}$

$= \sqrt{0{,}74}$

$= 0{,}86\text{m}$

dicoba b = 1 m, A = 1 mm^2

$$\sigma = pu = \frac{Pu}{A}$$

$$= \frac{216{,}9/1{,}2}{1}$$

$= 260{,}3\ \text{Kn/m}^2$

Perencanaan tebal pondasi telapak (syarat kuat geser) :

asumsi tebal pondasi = 400 mm

tebal selimut beton = 70 mm

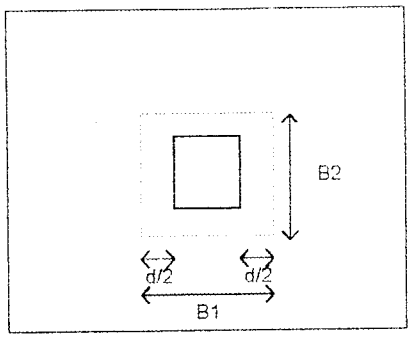
ϕ tulangan = 19 mm

d = t pondasi – t beton - ϕ tulangan

= 400 – 70 – 19

= 311 mm

Perhitungan geser beton untuk 2 arah



Gambar 3.9 Penampang kritis dan permukaan geser beton 2 arah

$B1 = b_{kolom} + d/2.2$

$= 400 + 311/2.2$

$= 711$ mm

$B2 = h_{kolom} + d/2.2$

$= 600 + 311/2.2$

$= 911$ mm

$bo = 2.B1 + 2.B2$

$= 2.711 + 2.911$

$= 3244$ mm

$Vu = pu\ (\ b_{pakai}^2 - (B1.B2))$

$= 260,3.\ (\ 1^2 - (711.911.10^{-6}))$

$= 91,69$ Kn

$\beta c = 1,5$

$$Vc = \left(1 + \frac{2}{\beta c}\right).\left(2.\sqrt{fc'}\right)bo.d$$

$$= \left(1 + \frac{2}{1,5}\right).\left(2.\sqrt{20.10^3}\right)3244.10^{-3}.311.10^{-3}$$

= 665,83 Kn

tetapi nilai tersebut tidak boleh lebih besar dari nilai:

$Vc' = (4.\sqrt{fc'}).b0.d$

$= (4.\sqrt{(20.10^3)}).3244.10^{-3}.311.10^{-3}$

= 570,71 Kn, sehingga dipakai Vc = 570,71 Kn

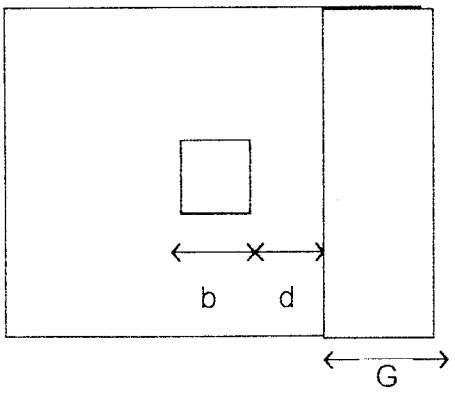
$\phi Vn = 0,6.570,71$

= 342,43 Kn

periksa : $Vu < \phi Vn$

91,69 Kn < 342,42 Kn

Perhitungan geser beton untuk 1 arah



Gambar 3.10 Penampang kritis dan permukaan geser beton satu arah

$G = b_{pakai}/2 - d - b_{kolom}$

$= 1.10^3/2 - 311 - 400$

= -11 mm

$Vu = pu.b.G$

$= 260,3 . 1.-11.10^{-3}$

= -2,86 Kn

$$Vc = \left(\frac{1}{6}\sqrt{fc'}\right) bw.d$$

$$= \left(\frac{1}{6}\sqrt{20.10^3}\right) 1.311.10^{-3}$$

= 7,33 Kn

$\phi Vc = 0,6.7,33$

= 4,39 Kn

periksa : $Vu < \phi Vc$

-2,86 < 4,39 Kn .....OK

Perencanaan tulangan untuk arah X & Y

$L = (b_{pakai} - b)/2$

$= (1 - 400.10^{-3})/2$

= 0,3 m

$Mu = 0,5.pu.L.b_{pakai}$

$= 0,5.216,9.0,3^2.1$

= 9,76 Knm

$Mu/\phi = 9,76/0,8$

= 12,2 Kn

$$As = \frac{Mu/\phi}{\gamma d.fy}$$

$$= \frac{12,2.10\text{^}6}{0,9.311.400}$$

= 108,97 mm^2

As min = $\frac{1,4}{fy}.b.d$, b = 1000 mm (tinjauan per-meter)

$\frac{1,4}{400}.1000.311$

= 1088,5 mm^2

1,33.As = 144,93 mm^2

As pakai = 144,93 mm^2

Jarak tulangan x $\frac{A\phi.1000}{As_{pakai}}$

$= \frac{0,25.3,14.19^2.1000}{144,93}$

= 1173,14 mm

di ambil jarak tulangan = 250 mm

dipakai tulangan D19-250

As tersedia = $\frac{A\phi.1000}{jaraktulangan}$

$= \frac{.0,25.3,14.19^2 1000}{250}$

= 1133,54 mm^2

$a = \frac{As.fy}{0,85.f'c.b}$

$= \frac{1133,54.400}{0,85.20.1000}$

= 26,67 mm

Mn = As.fy.(d-a/2) >1,33Mu/ϕ

= 1133,54.400.(311-26,67/2)>1,33Mu/ϕ

= 134,966 Knm > 16,2268 Knm

Tinjauan terhadap beban sementara dengan lebar pondasi 1m

M = 1,3 Knm

P = 216,9 Kn

$$e = \frac{M}{P}$$

$$= \frac{1,3}{216,9} = 0,006 \text{ m}$$

$$\sigma_{terjadi} = \frac{P}{By.(Bx - 2.e)}$$

$$= \frac{219,9}{1.(1 - 2.0,006)}$$

= 219,351 Kn/m^2 < 1,5. σ_{ijin} = 1,5.200 = 300 Kn/m^2 ....aman

Perencanaan tulangan susut:

As tul susut = 0,002.b.d

= 0,002.1000.311

= 622 mm^2

$$\text{Jarak tulangan susut} = \frac{A\phi.1000}{As_{perlu}}$$

$$= \frac{0,25.3,14.10^2.1000}{622}$$

= 126,206 mm

dipakai tulangan susut P10-120

$\sqrt{}$(A2/A1) = $\sqrt{}$((1.1000^2)/(400.600))

= 2,0412 > 2, maka dipakai 2

Kuat tumpuan pondasi = ϕ.0.85.fc'.A1.$\sqrt{}$A1/A2

$= 0,7.0,85.20.400.600.10^{-3}.2$

$= 5712$ Kn

Kuat tumpuan kolom $\phi.0,85.fc'.A1.$

$= 0,7.0,85.20.400.600.10^{-3}$

$= 2856$ Kn

periksa : Pu< kuat tumpuan pondasi < kuat tumpuan kolom

: 216,9 < 5712 < 2856 Kn .....OK

Tabel 3.16 Perencanaan pondasi:

Pondasi	dimensi	Tulangan arah X dan Y	Tulangan susut
telapak P1	1,8x1,8 m	D19-180	P10-50
telapak P2	1,8x1,8 m	D19-170	P10-50
telapak P3	1,6x1,6 m	D19-250	P10-60
telapak P4	1x1 m	D19-250	P10-120
telapak P5	1x1 m	D19-250	P10-90
telapak P6	1x1 m	D19-250	P10-120
sumuran P4	D 2m	-	-
sumuran P5	D 2m	-	-
sumuran P6	D 2m	-	-

BAB IV

PEMBAHASAN

Berdasarkan hasil perhitungan perencanaan ulang yang telah disusun, penulis memberikan pembahasan dengan membandingkan hasil perhitungan perencanaan yang ada sebagai berikut:

Tabel 4.1 Hasil analisa perencanaan

No			Perencanaan	Perencanaan Ulang
1	Kuda-kuda	profil kuda-kuda	2L 50x50x5	2L 50x50x5
			2L 60x60x6	
		profil gording	150x65x20x3,2	150x50x20x3,2
		sambungan	las	Baut
2	Plat lantai	studio : Lx	P10-200	P10-200
		: Ly	P10-200	P10-240
		: tx	P10-200	P10-110
		: ty	P10-200	P10-130
		t. buku: Lx	P10-200	P10-200
		: Ly	P10-200	P10-240
		: tx	P10-200	P10-110
		: ty	P10-200	P10-130
		selasar : Lx	P8-200	P10-200
		: Ly	P8-200	P10-240

		: tx	P8-100	P10-160
		: ty	P8-120	P10-190
		atap : Lx	P8-240	
		: Ly	P8-240	
		: tx	P8-160	
		: ty	P8-180	
3	Balok anak	Dim/tul : Ba0	250/400	250/400
			2D19	4D16
		Dim/tul : Ba1	250/400	250/400
			2D19	4D16
		Dim/tul : Ba2	250/500	250/400
			2D19	3D16
		Dim/tul : Ba3	200/350	250/400
			2D19	4D16
4	Balok induk	Dimensi P-A.lt1	300/650	300/500
		Dimensi P-A.lt2	300/650	300/500
		Dimensi P-A.lt3	300/400	300/500
		Dimensi P-D.lt1	300/650	300/500
		Dimensi P-D.lt2	300/650	300/500
		Dimensi P-D.lt3	300/600	300/500
		Dimensi P-H.lt1	-	300/500
		Dimensi P-H.lt2	300/600	300/500
		Dimensi P-H.lt3	300/650	300/500
		Dimensi P-I.lt1	-	300/500
		Dimensi P-I.lt2	300/600	300/500
		Dimensi P-I.lt3	300/450	300/500
		Dimensi P-1.lt1	250/400	200/350
		Dimensi P-1.lt2	250/400	200/350
		Dimensi P-1.lt3	250/300	200/350

		Dimensi P-2.lt1	250/400	200/350
		Dimensi P-2.lt2	250/400	200/350
		Dimensi P-2.lt3	250/300	200/350
5	Kolom	P-A.tengah.base	400/600	400/600
		P-A.tengah.lt1	400/600	11D22,11D22 400/600 4D22,4D22
		P-A.tengah.lt2	400/600	400/600 6D22,6D22
		P-A.tengah.lt3	400/400	400/600
		P-A.kiri.base	400/400	4D22,4D22 400/600
		P-A.kiri.lt1	400/400	12D22,12D22 400/600
		P-A.kiri.lt2	400/400	4D22,4D22 400/600
		P-A.kiri.lt3	400/400	4D22,4D22 400/600
		P-A.kanan.base	400/600	4D22,4D22 400/600
				10D22,10D22
		P-A.kanan.lt1	400/600	400/600 4D22,4D22
		P-A.kanan.lt2	400/600	400/600
		P-A.kanan.lt3	400/400	4D22,4D22 400/600
				4D22,4D22
		P-D.tengah.base	400/600	400/600
				4D22,4D22
		P-D.tengah.lt1	400/600	400/600 8D22,8D22

P-D.tengah.lt2	400/600	400/600 8D22,8D22
P-D.tengah.lt3	400/400	400/600
		4D22,4D22
P-D.kiri.base	400/400	400/600
		4D22,4D22
P-D.kiri.lt1	400/400	400/600
		5D22,5D22
P-D.kiri.lt2	400/400	400/600
		4D22,4D22
P-D.kiri.lt3	400/400	400/600
P-D.kanan.base	400/600	4D22,4D22 400/600
		4D22,4D22
P-D.kanan.lt1	400/600	400/600
		8D22,8D22
P-D.kanan.lt2	400/600	400/600 4D22,4D22
P-D.kanan.lt3	400/400	400/600
		4D22,4D22
P-H.tengah.base	-	400/600
		4D22,4D22
P-H.tengah.lt1	400/600	400/600
		4D22,4D22
P-H.tengah.lt2	400/600	400/600
		4D22,4D22
P-H.tengah.lt3	400/400	400/600
		5D22,5D22
P-H.kiri.base	-	400/600
P-H.kiri.lt1	400/400	400/600

		P-H.kiri.lt2	400/400	4D22,4D22 400/600
		P-H.kiri.lt3	400/400	4D22,4D22 400/600
		P-H.kanan.base	-	4D22,4D22 400/600
		P-H.kanan.lt1	400/600	4D22,4D22 400/600
		P-H.kanan.lt2	400/600	4D22,4D22 400/600
		P-H.kanan.lt3	400/400	4D22,4D22 400/600 4D22,4D22
6	Pondasi	dim. telapak P1	2x2 m	1,8x1,8 m D19-180,P10-50
		dim. telapak P2	2,7x2,7 m	1,8x1,8 m D19-170,P10-50
		dim. telapak P3	2,7x2,7 m	1,6x1,6 m D19-250,P10-60
		dim. telapak P4	0,7x0,7 m	1x1 m D19-250,P10-120
		dim. telapak P5	1,2x1,2 m	1x1 m D19-250,P10-90
		dim. telapak P6	1,2x1,2 m	1x1 m D19-250,P10-120
		Dim. Sum.P4	D 1,2m	D 2m
		Dim. Sum.P5	D 1,8m	D 2m
		Dim. Sum.P6	D 1,8m	D 2m

BAB V

KESIMPULAN

Berdasarkan hasil dari perhitungan perencanan ulang gedung Audio visual, dan berdasarkan data – data yang ada penyusun memberikan kesimpulan sebagai berikut :

1. Rangka kuda-kuda pada desain ulang disederhanakan, sehingga jumlah elemen profil yang digunakan lebih sedikit.
2. Perencanaan plat lantai didesain lebih spesifik berdasarkan momen tumpuan dan lapangannya.
3. Perencanaan balok induk juga lebih disederhanakan dengan memakai acuan momen yang dianggap besar pada daerah dimana terdapat lantai basemen dan yang tidak terdapat lantai basemen.
4. Berdasarkan data gaya aksial yang diperoleh dihasilkan dimensi pondasi yang lebih kecil namun tetap aman baik dari berat sendiri pondasi ataupun gaya geser dan momen yang terjadi.
5. Perencanaan dimensi kolom lebih besar karena dalam perencanaan ulang perhitungan disederhanakan dengan memakai acuan momen yang dianggap

5. Perencanaan dimensi kolom lebih besar karena dalam perencanaan ulang perhitungan disederhanakan dengan memakai acuan momen yang dianggap besar pada daerah dimana terdapat lantai basemen dan yang tidak terdapat lantai basemen.

Dari kesimpulan di atas terdapat profil atau dimensi struktur yang berbeda dengan profil atau dimensi struktur sebenarnya, tetapi berdasar hasil analisis yang ada, maka hasil perencanaan ulang gedung Audio visual aman digunakan.

DAFTAR NOTASI

d	= jarak sisi terluar beton desak ke pusat berat beton tulangan tarik
Mu	= momen berfaktor
Nu	= gaya aksial berfaktor
Pb	= kuat aksial nominal pada kondisi regangan seimbang
Pc	= kuat tekuk Euler
Pn	= beban kuat nominal aksial
$Pn_{(maks)}$	= kuat tekan nominal maksimum yang diijinkan, pada kolom bersengkang 0,8Po dan untuk kolom bertulangan spiral 0,85.Po
Po	= kuat nominal Pn untuk kolom berbeban aksial
Pu	= gaya aksial berfaktor
Rn	= koefisien tahanan untuk perencanaan kuat
T	= gaya tarik
Tb	= gaya tarik dalam baja untuk kondisi regangan berimbang
Tc	= kekuatan puntir nominal terpakai pada beton
Tn	= kekuatan puntir nominal
Tno	= kekuatan puntir nominal jika batang dibebani puntir saja
Ts	= kekuatan puntur nominal terpakai pada tulangan $\alpha t x1 y1 Atfy / s$
Vc	= kekuatan geser nominal yang diakibatkan oleh beton
Vn	= kekuatan geser nominal
Vs	= kekuatan geser nominal yang diakibatkan oleh tulangan
Vu	= gaya geser berfaktor
xb	= jarak sumbu netral untuk kondisi regangan berimbang

δ = faktor pembesar

δ b = faktor pembesar δ untuk suatu portal dengan pengaku batang tekan

εc = regangan pada beton

εs = regangan pada baja tarik

ε's = regangan pada baja tekan

μ = koefisien gesekan

ϕ = faktor reduksi kekuatan

ψ = faktor ujung terikat batang kolom

ρ = perbandingan tulangan As/bd,untuk tulangan tarik

ρ' = perbandingan tulangan As'/bd,untuk tulangan tekan

ρb = perbandingan tulangan untuk kondisi regangan berimbang

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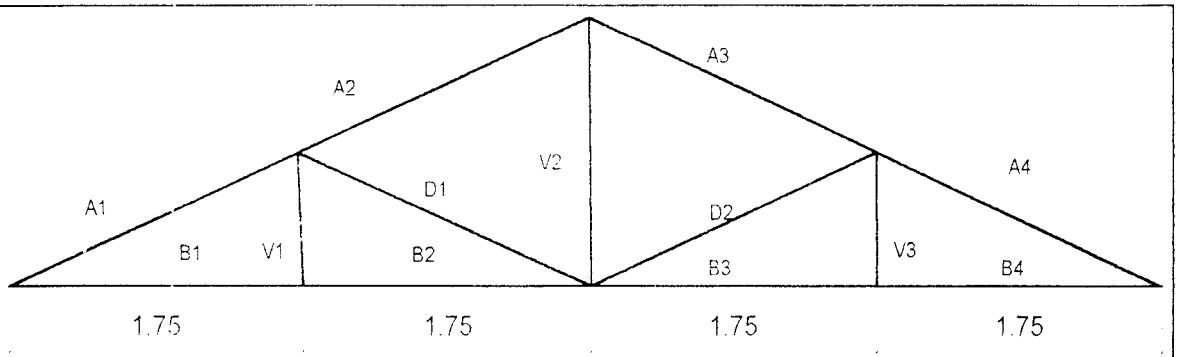
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LAMPIRAN HITUNGAN

PERENCANAAN KUDA-KUDA

RENCANAAN GORDING



Jrk. antar gording = 2.067 m
Jrk. antar kuda-kuda = 4 m
Besar sudut = 32.15

Perencanaan Gording

). Panjang Batang

njang Batang Atas

A1 s/d A4	=	2.067 m

njang Batang Bawah

B1 s/d B4	=	1.75 m

njang Batang Vertikal

V2	=	2.2 m
V1=V3	=	1.099 m

njang Batang Diagonal

D1,D2	=	2.067 m

). Pembebanan Gording

mbebanan Tetap

penutup atap	=	50 kg/m^2	x	jrk.gording	=	103.35 kg/m
nidup	=	20 kg/m^2	x	jrk.gording	=	41.34 kg/m
gording	=	8 kg/m			=	8 kg/m
				q	=	152.69 kg/m

$q_{\perp}$	=	q.cos alfa	=	113.3649589 kg/m
$q_{//}$	=	q.sin alfa	=	102.28696 kg/m

embebanan Angin

w	=	25 kg/m^2

Blok Input :

Alfa = besar sudut	=		32.15
jrk antar kuda-kuda (L)	=		4 m
Jrk.gording	=		2.067 m
Pembebanan			
b.penutup atap	=		50 kg/m^2
b.hidup	=		20 kg/m^2
b.gording	=		8 kg/m
Dicoba profil gording	⊂	(baja kanal tipis)	
Ukuran	=	C	150x50x20x3.2
	Sx	=	37.4 cm^3
	Sy	=	8.19 cm^3
	Ix	=	280 cm^4
	Iy	=	28.3 cm^4
	Fy	=	2400 kg/cm^2
	Berat	=	6.76 kg/m

ı Tekan (Wt)

C1	=	0.02 x alfa -0.4	=	0.243	
Wt	=	C1xWx jrk gording	=	12.557025	kg/m

ı Hisap (Wh)

C2	=	-0.4			
Wh	=	C2xWxjrk gording	=	-20.67	kg/m

Perhitungan Momen

ıt Beban Tetap

	:	Mmax ⊥	=	(1/8)xq ⊥ x L^2	=	226.7299178	kgm
1 sagrod	:	Mmax //	=	(1/32)xq // xL^2	=	51.14348001	kgm

ıt Beban Angin

	Mmax	=	(1/8)XWhXL^2	=	41.34	kgm

eriksaan momen maksimal tegak lurus :

ıx ⊥ = $M\,\max \perp + M\,\max angin$ = 268.0699178 kg/m

ıx ⊥ = $M\,\max \perp x1.25$ = 283.4123973 kg/m

Mmax ⊥ terpakai = 283.4124 kg/m

Dimensi Gording

ɔa profil ⊂ (baja kanal tipis)

an : C 150x50x20x3.2

Sx	=	37.4	cm^3				
Sy	=	8.19	cm^3				
Ix	=	280	cm^4				
Iy	=	28.3	cm^4				
Fy	=	2400	kg/cm^2				
Berat	=	6.76	kg/m	<	taksiran	=	8 kg/m

rol tegangan

fbx	=	$\frac{M\ \perp}{Sx}$	=	757.7871586	kg/cm^2
fby	=	$\frac{M\ //}{Sy}$	=	624.4625153	kg/cm^2

$$\frac{fbx}{0.66Fy} + \frac{fby}{0.75Fy} \le 1.0$$

0.825324604 <= 1 **aman**

rol Lendutan

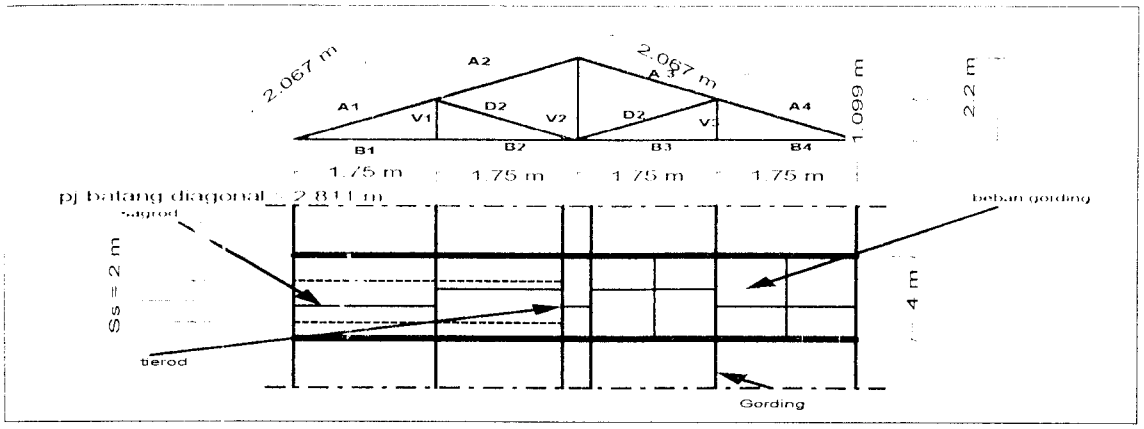
$$= \frac{5}{384} \cdot \frac{q \perp . L^4}{E.Ix} \le \frac{L}{360}$$ → 0.642658497 m <= $\frac{L}{360}$ = 1.11111 m ..... **aman**

$$= \frac{5}{384} \cdot \frac{q \left(\frac{L}{(1+n)}\right)^4}{E.Iy} \le \frac{L}{360}$$ → 0.358569466 m

n = 1

<= $\frac{L}{360}$ = 1.11111 m ..... **aman**

PERENCANAAN KUDA-KUDA



Input data kuda-kuda:				
btg atas	:	A1 - A4	=	2.067 m
btg bawah	:	B1 - B4	=	1.75 m
			=	m
btg vertikal	:	V1,V3	=	1.099 m
		V2	=	2.2 m
btg diagonal	:	D1, D2	=	2.067 m
jml gording 1 sisi	=		3 batang	
Ss	=		2 m	
jrk kuda-kuda	=		4 m	
jrk gording	=		2.067 m	
alfa(bsr sudut)	=		32.15	
bentang kuda-kuda (L)	=		7 m	

Input data beban tetap :		
Gording	=	6.76 kg/m
Eternit+plafond	=	18 kg/m^2
Penutup atap	=	50 kg/m^2
Beban hidup	=	20 kg/m^2
Taksiran berat	=	$(10 + \frac{L-12}{3}.5).jrk\,kuda-kuda$
	=	6.66666667 kg/m
fy	=	2400
E	=	2.10E+06
Fu	=	3600 kg/cm^2

Beban sagrod

Beban penutup atap x $\left(\frac{\frac{1}{2}L}{\cos\alpha}\right)$ = 235.71 kg/m

Beban hidup x $\left(\frac{\frac{1}{2}L}{\cos\alpha}\right)$ = 94.282 kg/m

jml gording 1 sisi miring x brt gord = 20.28 kg/m

P = 350.27 kg/m +

$\rho = P.\sin\alpha.Ss$ = 469.29 kg

Beban sagrod

$A_{sagrod} = \frac{\rho}{0.33Fu} \longrightarrow \frac{1}{4}\pi.D^2_{sagrod} = \frac{\rho}{0.33Fu}$

$D = \sqrt{\frac{4.\rho}{0.33Fu.\pi}}$ = 0.709 cm

D pakai = Dsagrod = 10.2 mm ≈ 12 mm

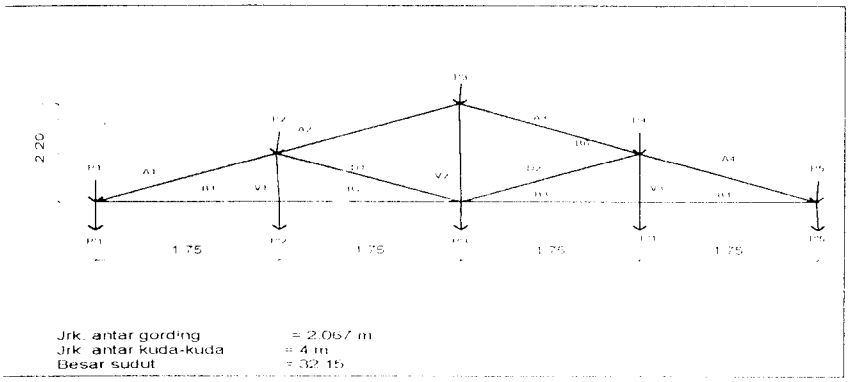
Tierod

Beban Tierod $T = P_{...}.\cos\alpha$ = 348.424022 kg

A tierod $= \frac{T}{0.33Fu} \longrightarrow$

$D_{tierod} = \sqrt{\frac{4.T}{0.33Fu.\pi}}$ = 0.61123801 cm

D pakai = D tierod = 9.112 mm ≈ 10 mm



Jrk. antar gording = 2.067 m
Jrk. antar kuda-kuda = 4 m
Besar sudut = 32.15

PEMBEBANAN

Beban pada masing masing joint

Beban sisi atas

Ujung

P1 P5	=	gording	=	6.76	x	4	=	27.04 kg	
		penutup atap	=	50	x	4 x 1.0335	=	206.7 kg	
		beban hidup	=	20	x	4 x 1.0335	=	82.68 kg	+
							P =	316.42 kg ≈	320 kg

Beban antara ujung dan puncak

P2 P4	=	gording	=	6.76	x	4	=	27.04 kg	
		penutup atap	=	50	x	4 x 2.067	=	413.4 kg	
		beban hidup	=	20	x	4 x 2.067	=	165.36 kg	+
							P =	605.8 kg ≈	610 kg

Beban Puncak

P3	=	gording	=	2	x	6.76 x 4	=	54.08 kg	
		penutup atap	=	50	x	4 x 2.067	=	413.4 kg	
		beban hidup	=	20	x	4 x 2.067	=	165.36 kg	+
							P =	632.84 kg ≈	635 kg

Beban sisi bawah

Beban ujung

P1,P5	=	eternit + plafond	=	18	x	0.875 x 4	=	63 kg	
		taksiran kuda-kuda	=	6.66666667	x	0.875	=	5.83333333 kg	+
							P =	68.8333333 kg ≈	69 kg

Beban tengah

P2,P3 P4	=	eternit + plafond	=	18	x	1.75 x 4	=	126 kg	
		taksiran kuda-kuda	=	6.66666667	x	1.75	=	11.6666667 kg	+
							P =	137.666667 kg ≈	138 kg

Analisis gaya batang

Analisis gaya batang menggunakan SAP 90

PERENCANAAN DIMENSI BATANG

a)BATANG TARIK

1).Batang Bawah (Batang 1 s/d 4)

Input :				Input profil :			
pj. Batang	=	1.75	m	Dicoba :	2L 50x50x5		
T	=	1806.525	kg	A	=	4.8	cm^2
Fy	=	2400	kg/cm^2	t	=	0.5	cm
Γ	=	3600	kg/cm^2	ix=iy	=	1.51	cm
Φ baut	=	0.5	inchi	Berat (w)	=	3.77	kg/m
Jumlah luban	=	2	buah				

Φ Lubang = diameter baut + (1/8)"

= 0.625 inchi = 1.5875 cm

A lubang = Φlubang x t profil x jml lubang

= 1.5875 cm^2

Ag1 perlu = $\frac{T}{0.6Fy}$ = 1.2545 cm^2

Ag2 perlu = $\frac{T}{0.5Fu \times U}$ + A lubang = 2.7682 cm^2

Ag pakai = 2.7682 cm^2

rmin = L/300 = 0.583

Dicoba profil : 2L 50x50x5

A	=	4.8	cm^2
t	=	0.5	cm
ix=iy	=	1.51	cm
Berat (w)	=	3.77	kg/m

A bruto = 2xA = 9.6 cm^2

A netto = A bruto-A lubi = 8.0125 cm^2

A eff = 0.85 x A nettc = 6.8106 cm^2

syarat :

A eff > Ag perlu

6.8106 > 2.7682 ..... Ok

Check :

$\frac{T}{A_{bruto}}$ = 188.179688 kg/cm^2 < 0.6Fy = 1440 kg/cm^2 ..... ok

$\frac{T}{A_{eff}}$ = 265.250987 kg/cm^2 < 0.5Fu = 1800 kg/cm^2 ..... ok

2).Batang Vertikal (batang 5,7)

Input :		
pj. Batang	=	1.099 m
T	=	137.99 kg
Fy	=	2400 kg/cm^2
Fu	=	3600 kg/cm^2
Φ baut	=	0.5 inchi
Jumlah lubar	=	2 buah

Input profil :		
Dicoba :	2L 50x50x5	
A	=	4.8 cm^2
t	=	0.5 cm
ix=iy	=	1.51 cm
Berat (w)	=	3.77 kg/m

Φ Lubang = diameter baut + (1/8)"
= 0.625 inchi = 1.5875 cm

A lubang = Φlubang x t profil x jml lubang
= 1.5875 cm^2

Ag1 perlu = $\frac{T}{0.6Fy}$ = 0.0958 cm^2

Ag2 perlu = $\frac{T}{0.5xFuxU}$ + A lubang = 1.6777 cm^2

Ag pakai = 1.6777 cm^2

rmin = L/300 = 0.583

Dicoba profil : 2L 50x50x5

A	=	4.8 cm^2
t	=	0.5 cm
ix=iy	=	1.51 cm
Berat (w)	=	3.77 kg/m

A bruto	=	2xA	= 9.6 cm^2
A netto	=	A bruto-A lubi	= 8.0125 cm^2
A eff	=	0.85 x A nettc	= 6.8106 cm^2

syarat :

A eff > Ag perlu

6.8106 > 1.6777 ..... Ok

Check :

$\frac{T}{A_{bruto}}$ = 14.3739583 kg/cm^2 < 0.6Fy = 1440 kg/cm^2 ..... ok

$\frac{T}{A_{eff}}$ = 20.2609893 kg/cm^2 < 0.5Fu = 1800 kg/cm^2 ..... ok

3).Batang Vertikal (batang 6)

Input :			
pj. Batang	=	2.2	m
T	=	887.38	kg
Fy	=	2400	kg/cm^2
Fu	=	3600	kg/cm^2
Φ baut	=	0.5	inchi
Jumlah luban	=	2	buah

Input profil :			
Dicoba :	2L 50x50x5		
A	=	4.8	cm^2
t	=	0.5	cm
ix=iy	=	1.51	cm
Berat (w)	=	3.77	kg/m

Φ Lubang = diameter baut + (1/8)"
= 0.625 inchi = 1.5875 cm

A lubang = Φlubang x t profil x jml lubang
= 1.5875 cm^2

Ag1 perlu = $\frac{T}{0.6Fy}$ = 0.6162 cm^2

Ag2 perlu = $\frac{T}{0.5xFuxU}$ + A lubang = 2.1675 cm^2

Ag pakai = 2.1675 cm^2

rmin = L/300 = 0.583

Dicoba profil : 2L 50x50x5

A	=	4.8 cm^2
t	=	0.5 cm
ix=iy	=	1.51 cm
Berat (w)	=	3.77 kg/m

A bruto	=	2xA	= 9.6 cm^2
A netto	=	A bruto-A lubi	= 8.0125 cm^2
A eff	=	0.85 x A nettc	= 6.8106 cm^2

syarat :

A eff > Ag perlu

6.8106 > 2.1675 ..... Ok

Check :

$\frac{T}{A_{bruto}}$ = 92.4354167 kg/cm^2 < 0.6Fy = 1440 kg/cm^2 ..... ok

$\frac{T}{A_{eff}}$ = 130.293475 kg/cm^2 < 0.5Fu = 1800 kg/cm^2 ..... ok

b).BATANG TEKAN

1). Batang Atas (batang 10 s/d 13)

Input :			
Pj. Batang	=	2.067	m
T mak	=	2133.219	kg
Fy	=	2400	kg/cm^2
Fu	=	3600	kg/cm^2
E	=	2.10E+06	kg/cm^2

Input Profil		
Dicoba :	2L 50x50x5	
A	=	4.8 cm^2
t	=	0.5 cm
ix=iy	=	1.51 cm
Ix=Iy	=	11 cm^4
Berat (w)	=	3.77 kg/m

$\frac{K.L}{r_{min}} \leq 200 \rightarrow r_{min} \quad \frac{K.L}{200}$ = 0.010335 m = 1.0335 cm

$Cc = \sqrt{\frac{2.\pi^2.E}{Fy}}$ = 74.1282672

Dicoba profil : 2L 50x50x5

A	=	4.8 cm^2	Ix=Iy	=	11 cm^4
t	=	0.5 cm	Berat (w)	=	3.77 kg/m
ix=iy	=	1.51 cm			

Perletakan dianggap sendi-sendi, K=1.0

$\frac{K.L}{i_{min}}$ = 136.887417 > cc = 74.1282672

jika : $\frac{K.L}{i_{min}} > Cc$, digunakan rumus : → Status : digunakan

$Fa = \frac{12}{23} \cdot \frac{\pi^2.E}{\left(\frac{K.L}{i}\right)^2}$ = 5.77E+02 kg/cm^2

jika : $\frac{K.L}{i_{min}} < Cc$, digunakan rumus : → Status : abaikan

Fs = $\frac{5}{3} + \frac{3}{8} \cdot \frac{K.L_i}{Cc} - \frac{1}{8} \cdot \frac{\left(K.L_i\right)^3}{Cc^3}$ = 2.35340235

Fa = $\left[1 - \frac{\left(K.L_i\right)^2}{2.Cc^2}\right] \cdot \frac{Fy}{Fs}$ = -1737.7792 kg/cm^2

A bruto = 2xA = 9.6 cm^2

T = P = Fa x A bruto = 5.53E+03 kg > 2133.219 kg Ok

2). Batang Diagonal (batang 8,9)

Input :		
Pj. Batang	=	2.067 m
T maks	=	704.537 kg
Fy	=	2400 kg/cm^2
Fu	=	3600 kg/cm^2
E	=	2.10E+06 kg/cm^2

Input Profil		
Dicoba :	2L 50x50x5	
A	=	4.8 cm^2
t	=	0.5 cm
ix=iy	=	1.51 cm
Ix=Iy	=	11 cm^4
Berat (w)	=	3.77 kg/m

$\frac{K.L}{r_{min}} \le 200 \rightarrow r_{min} = \frac{K.L}{200}$ = 0.010335 m = 1.0335 cm

$Cc = \sqrt{\frac{2.\pi^2.E}{Fy}}$ = 74.1282672

Dicoba profil : 2L 50x50x5

A	=	4.8 cm^2	Ix=Iy	=	11 cm^4
t	=	0.5 cm	Berat (w)	=	3.77 kg/m
ix=iy	=	1.51 cm			

Perletakan dianggap sendi-sendi, K=1.0

$\frac{K.L}{r_{min}}$ = 136.887417 > cc = 74.1282672

jika : $\frac{K.L}{r_{min}} > Cc$, digunakan rumus : → Status : digunakan

$Fa = \frac{12}{23} \cdot \frac{\pi^2.E}{\left(\frac{K.L}{i}\right)^2}$ 5.77E+02 kg/cm^2

jika : $\frac{K.L}{r_{min}} < Cc$, digunakan rumus : → Status : abaikan

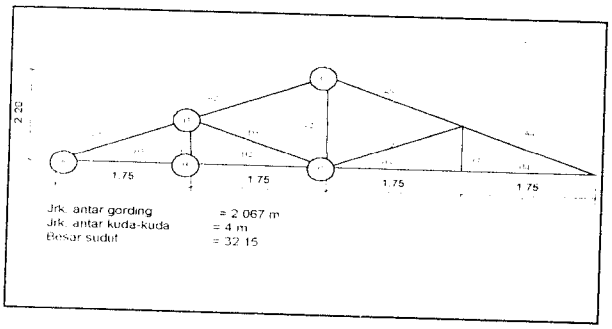
Fs = $\frac{5}{3} + \frac{3}{8} \cdot \frac{K.L_i}{Cc} - \frac{1}{8} \cdot \frac{\left(K.L_i\right)^3}{Cc^3}$ = 2.35340235

Fa = $\left[1 - \frac{\left(K.L_i\right)^2}{2.Cc^2}\right] \cdot \frac{Fy}{Fs}$ = -1737.7792 kg/cm^2

A bruto	=	2xA	=	9.6 cm^2			
T = P	=	Fa x A bruto	=	5.53E+03 kg	>	704.537 kg	Ok

PERENCANAAN SAMBUNGAN KUDA-KUDA

Perhitungan sambungan pada setengah bentang



Input data :

tp	=	1 cm
Fy	=	2400 kg/cm^2
Fu	=	3600 kg/cm^2
D baut	=	1.27 cm
	=	0.5 inchi

Output SAP 90 (file kuda1.F3F) :

Elemen	Tarik (kg)	Tekan (kg)
1	1806.525	
2	1806.524	
3	1806.524	
4	1806.525	
5	137.999	
6	887.38	
7	137.999	
8		704.537
9		704.537
10		2133.219
11		1429.416
12		1429.416
13		2133.219

Perhitungan :

p	=	1 cm		
Fa tarik	=	0.33 x Fu	=	1188 kg/cm^2
Fa tumpuan	=	0.5 x Fu	=	1800 kg/cm^2
P tumpuan	=	tp x D baut x 1.2 x Fu x n		Ket : n = 1 baut
	=	5486.4 kg		
P geser	=		3008.316564 kg	

adi dipakai P : P geser = 3008.316564 kg ket : P terkecil

Perhitungan jumlah baut untuk masing-masing joint :

) Join A

Batang A1 (tekan)

P = 2133.219 kg

$$n = \frac{P}{P_{geser}} = 0.709107221 \sim$$ 2 baut

Batang B1 (tekan)

P = 1806.525 kg

$$n = \frac{P}{P_{geser}} = 0.600510273 \sim$$ 2 baut

). Join B

atang B1 (tekan)

P = 1806.525 kg

$n = \frac{P}{P_{geser}}$ = 0.600510273 ~ 2 baut

Batang B2 (tarik)

P = 1806.524 kg

$n = \frac{P}{P_{geser}}$ = 0.60050994 ~ 2 baut

Batang V1 (tarik)

P = 137.999 kg

$n = \frac{P}{P_{geser}}$ = 0.045872499 ~ 2 baut

3). Join C

Batang B2 (tarik)

P = 1806.524 kg

$n = \frac{P}{P_{geser}}$ = 0.60050994 ~ 2 baut

Batang B3 (tarik)

P = 1806.524 kg

$n = \frac{P}{P_{geser}}$ = 0.60050994 ~ 2 baut

Batang D 1 (tekan)

P = 704.537 kg

$n = \frac{P}{P_{geser}}$ = 0.23419643 ~ 2 baut

Batang D2 (tekan)

P = 704.537 kg

$n = \frac{P}{P_{geser}}$ = 0.23419643 ~ 2 baut

Batang V2 (tarik)

P = 887.38 kg

$n = \frac{P}{P_{geser}}$ = 0.294975605 ~ 2 baut

4). Join D

Batang A1 (tekan)

P = 2133.219 kg

$n = \frac{P}{P_{geser}}$ = 0.709107221 ~ 2 baut

Batang A2 (tekan)

P = 1429.416 kg

$n = \frac{P}{P_{geser}}$ = 0.475154782 ~ 2 baut

Batang V1 (tarik)

P = 137.999 kg

$n = \frac{P}{P_{geser}}$ = 0.045872499 ~ 2 baut

Batang D1 (tarik)

P = 137.999 kg

$n = \frac{P}{P_{geser}}$ = 0.045872499 ~ 2 baut

5).Join E

Batang A2 (tekan)

P = 1429.416 kg

$n = \frac{P}{P_{geser}}$ = 0.475154782 ~ 2 baut

batang A3 (tekan)

P = 1429.416 kg

$n = \frac{P}{P_{geser}}$ = 0.475154782 ~ 2 baut

Batang V2 (tarik)

P = 887.38 kg

$n = \frac{P}{P_{geser}}$ = 0.294975605 ~ 2 baut

II.PERENCANAAN PLAT

BEBAN DAN MOMEN PLAT

1). Plat studio audiovisual

Plat lantai	tebal (m)	bj (kn/m^3)	q (kn/m^2)	faktor	qu (kn/m^2)
Plat lantai	0.12	24	2.88	1.2	3.456
pasir	0.05	16	0.8	1.2	0.96
spesi	0.03	24	0.72	1.2	0.864
keramik	0.01	20	0.2	1.2	0.24
beban hidup			4	1.6	6.4
				qu total =	11.92

Plat lantai	ly (m)	lx (m)	ly/lx	faktor	qu (kn/m^2)	M (kn-m)
Mlx	4	3.5	1.14285714	0.034	11.92	4.96468
Mly	4	3.5	1.14285714	0.022	11.92	3.21244
(-) Mtx	4	3.5	1.14285714	0.063	11.92	9.19926
(-) Mty	4	3.5	1.14285714	0.054	11.92	7.88508

2).Plat toko buku

Plat lantai	tebal (m)	bj (kn/m^3)	q (kn/m^2)	faktor	qu (kn/m^2)
Plat lantai	0.12	24	2.88	1.2	3.456
pasir	0.05	16	0.8	1.2	0.96
spesi	0.03	24	0.72	1.2	0.864
keramik	0.01	20	0.2	1.2	0.24
beban hidup			4	1.6	6.4
				qu total =	11.92

Plat lantai	ly (m)	lx (m)	ly/lx	faktor	qu (kn/m^2)	M (kn-m)
Mlx	4	3.5	1.14285714	0.034	11.92	4.96468
Mly	4	3.5	1.14285714	0.022	11.92	3.21244
(-) Mtx	4	3.5	1.14285714	0.063	11.92	9.19926
(-) Mty	4	3.5	1.14285714	0.054	11.92	7.88508

	lantai studio 4x3.5 m^2				lantai toko buku 4x3.5 m^2			
	Mlx	Mly	Mtx	Mty	Mlx	Mly	Mtx	Mty
f'c (mpa)	20	20	20	20	20	20	20	20
fy (mpa)	240	240	240	240	240	240	240	240
ф								

3). Plat Selasar

Plat lantai	tebal (m)	bj (kn/m^3)	q (kn/m^2)	faktor	qu (kn/m^2)
Plat lantai	0.1	24	2.4	1.2	2.88
pasir	0.05	16	0.8	1.2	0.96
spesi	0.03	24	0.72	1.2	0.864
keramik	0.01	20	0.2	1.2	0.24
beban hidup			3	1.6	4.8
				qu total =	9.744

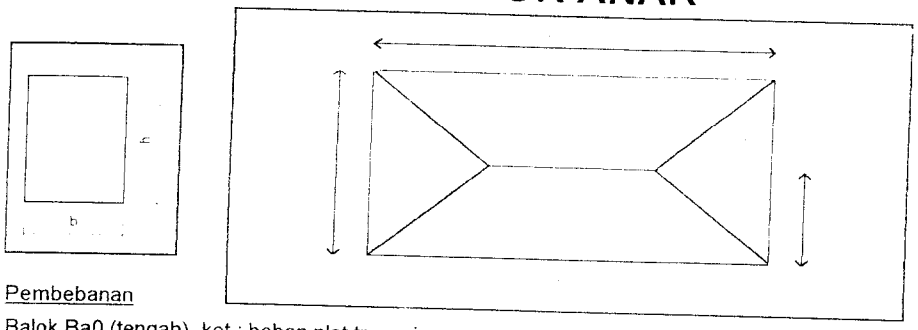
Plat lantai	ly (m)	lx (m)	ly/lx	faktor	qu (kn/m^2)	M (kn-m)
Mlx	4	2.8	1.42857143	0.034	9.744	2.597361
Mly	4	2.8	1.42857143	0.022	9.744	1.680645
(-) Mtx	4	2.8	1.42857143	0.063	9.744	4.812756
(-) Mty	4	2.8	1.42857143	0.054	9.744	4.12522

4). Plat Atap

Plat lantai	tebal (m)	bj (kn/m^3)	q (kn/m^2)	faktor	qu (kn/m^2)
Plat lantai	0.1	24	2.4	1.2	2.88
pasir	0.05	16	0.8	1.2	0.96
spesi	0.03	24	0.72	1.2	0.864
keramik	0.01	20	0.2	1.2	0.24
beban hidup			1	1.6	1.6
				qu total =	6.544

Plat lantai	ly (m)	lx (m)	ly/lx	faktor	qu (kn/m^2)	M (kn-m)
Mlx	4	2.8	1.42857143	0.034	6.544	1.744369
Mly	4	2.8	1.42857143	0.022	6.544	1.128709
(-) Mtx	4	2.8	1.42857143	0.063	6.544	3.232212
(-) Mty	4	2.8	1.42857143	0.054	6.544	2.770468

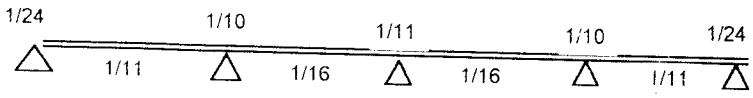
III.PERENCANAAN BALOK ANAK



Pembebanan

Balok Ba0 (tengah), ket : beban plat trapesium

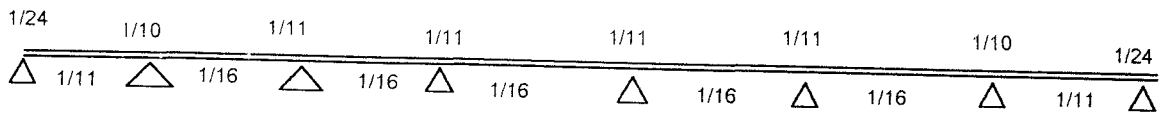
Balok Ba0	L (m)	t (m)	b (m)	h (m)	bj (kn/m^3)	faktor	q (kn/m^2)	qu (kn/m^2)
plat	4	0.12	3.5	1.30			11.92	31.07
balok			0.25	0.4	24	1.2		2.02
tembok	4	4			24	1.2	2.5	10.8
							qu =	**43.89**



Balok Ba0	faktor	qu (kn/m^2)	L (m)	Mu (knm)	Φ	Mu / Φ (knm)
(1/24)	0.04	43.89	3.5	22.40	0.8	28.00
(1/16)	0.06	43.89	3.5	33.60	0.8	42.00
(1/11)	0.09	43.89	3.5	48.88	0.8	61.10
(1/10)	0.10	43.89	3.5	53.76	0.8	67.20

Balok Ba1 (tengah), ket : beban plat trapesium

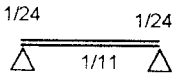
Balok Ba1	L (m)	t (m)	b (m)	h (m)	bj (kn/m^3)	faktor	q (kn/m^2)	qu (kn/m^2)
plat	4	0.12	3.5	1.30			11.92	31.07
balok			0.25	0.4	24	1.2		2.02
tembok	4	5			24	1.2	2.5	13.8
							qu =	**46.89**



Balok Ba1	faktor	qu (kn/m^2)	L (m)	Mu (knm)	Φ	Mu / Φ (knm)
(1/24)	0.04	46.89	3.5	23.93	0.8	29.92
1/16)	0.06	46.89	3.5	35.90	0.8	44.87
1/11)	0.09	46.89	3.5	52.22	0.8	65.27
1/10)	0.10	46.89	3.5	57.44	0.8	71.80

Balok Ba2 (tengah), ket : beban plat segitiga

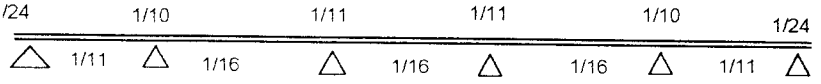
Balok Ba2	L (m)	t (m)	b (m)	h (m)	bj (kn/m^3)	faktor	q (kn/m^2)	qu (kn/m^2)
plat	3.5	0.12	3	1.50			11.92	23.84
balok			0.25	0.4	24	1.2		2.02
tembok	3.5	4			24	1.2	2.5	10.8
							qu =	**36.66**



Balok Ba2	faktor	qu (kn/m^2)	L (m)	Mu (knm)	Φ	Mu / Φ (knm)
(1/24)	0.04	36.66	3.5	18.71	0.8	23.39
(1/11)	0.09	36.66	3.5	40.82	0.8	51.03

Balok Ba3 (tengah), ket : beban plat trapesium

Balok Ba3	L (m)	t (m)	b (m)	h (m)	bj (kn/m^3)	faktor	q (kn/m^2)	qu (kn/m^2)
plat	4	0.12	3.5	1.30			11.92	31.07
balok			0.25	0.4	24	1.2		2.02
tembok	4	4			24	1.2	2.5	10.8
							qu =	**43.89**



Balok Ba3	faktor	qu (kn/m^2)	L (m)	Mu (knm)	Φ	Mu / Φ (knm)
(1/24)	0.04	43.89	3.5	22.40	0.8	28.00
(1/16)	0.06	43.89	3.5	33.60	0.8	42.00
(1/11)	0.09	43.89	3.5	48.88	0.8	61.10
(1/10)	0.10	43.89	3.5	53.76	0.8	67.20

Penulangan balok anak

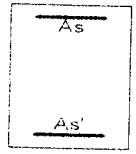
	Balok Ba0	Balok Ba1	Balok Ba2	Balok Ba3
f'c (Mpa)	20	20	20	20
fy ulir (Mpa)	390	390	390	390
Φtul_pokok (mm)	16	16	16	16
$\Phi tul_sengkang$ (mm)	10	10	10	10
$\beta 1$	0.85	0.85	0.85	0.85
ρb	0.022	0.022	0.022	0.022
ρ maks	0.017	0.017	0.017	0.017
diambil ρ	0.0084	0.0084	0.0084	0.0084
ρ min	0.00359	0.00359	0.00359	0.00359
m	22.941	22.941	22.941	22.941
Rn	2.9669	2.9669	2.9669	2.9669
Mu/ Φ maks1 (knm)	67.2	71.8	51.03	67.2
$b.d^2$	22650075.1	24200526.6	17199900.8	22650075.1
pb (mm)	40	40	40	40
dicoba 1 :				
b (mm)	200	200	200	200
d perlu (mm)	337	348	293	337
h (mm)	300	300	300	300
d pakai (mm)	242	242	242	242
jenis tul.	rangkap	rangkap	rangkap	rangkap
dicoba 2 :				
b (mm)	250	250	250	200
d perlu (mm)	301	311	262	337
h (mm)	400	400	400	400
d pakai (mm)	342	342	342	342
jenis tul.	sebelah	sebelah	sebelah	sebelah
dipakai :				
jenis tul	sebelah	sebelah	sebelah	sebelah
b (mm)	250	250	250	200
h (mm)	400	400	400	400
d (mm)	342	342	342	342
Rn baru	2.29814302	2.45545638	1.74515235	2.87267877
ρ baru	0.00652271	0.0069692	0.00495318	0.00815339
As (mm^2)	652.270878	696.920372	495.318198	652.270878
pilih tul :				
Φ(mm)	16	16	16	16
jml tul	4	4	3	4
As tulangan	803.84	803.84	602.88	803.84
Status :	aman	aman	aman	aman
x (mm)	180	180	180	130
jrk antar tul (mm)	58	58	66	33
Status :	aman	aman	aman	aman
Mu/ Φmaks2	61.1	65.27	23.39	61.1
Rn baru	1.528	1.632	0.585	1.909
ρ	0.0077	0.0077	0.0039	0.0077
As min (mm^2)	358.974359	358.974359	358.974359	287.179487
Kontrol tul :				
Mu/ Φ	67.20	71.8	51.03	67.2
pakai :				
Φ (mm)	16	16	16	16
jml tul	4	4	3	4
As tulangan (mm^2)	803.84	803.84	602.88	803.84

As (mm^2)	652.315378	696.920372	495.318198	652.270878
As pakai	652.315378	696.920372	495.318198	652.270878
Cek : As tul>As	aman	aman	aman	aman
Mu/ Φ	61.0950769	65.27	23.39	61.1
pakai :				
Φ (mm)	16	16	16	16
jml tul	3	4	2	3
As tulangan (mm^2)	602.88	803.84	401.92	602.88
As (mm^2)	593.01398	633.537503	227.032974	593.061765
As pakai	593.01398	633.537503	358.974359	593.061765
Cek : As tul>As	aman	aman	aman	aman
Mu/ Φ	42	44.87		42
pakai :				
Φ (mm)	16	16		16
jml tul	3	3		3
As tulangan (mm^2)	602.88	602.88		602.88
As (mm^2)	407.669299	435.526701		407.669299
As pakai	407.669299	435.526701		407.669299
Cek : As tul>As	aman	aman		aman
Mu/ Φ	28	29.92		28
pakai :				
Φ (mm)	16	16		16
jml tul	2	2		2
As tulangan (mm^2)	401.92	401.92		401.92
As (mm^2)	271.779532	290.415843		271.779532
As pakai	358.974359	358.974359		287.179487
Cek : As tul>As	aman	aman		aman
perencanaan sengkang :				
Φ sengkang (mm)	10	10	10	10
a) daerah plastis (2h)				
d/4 (mm)	85.5	85.5	85.5	85.5
6Φ (mm)	60	60	60	60
150 (mm)	150	150	150	150
jrk sengkang pilih (mm)	60	60	60	60
sengkang pakai daerah plastis (mm)	P10-60	P10-60	P10-60	P10-60
b).luar daerah plastis				
h/2 (mm)	200	200	200	200
12Φ (mm)	120	120	120	120
300 (mm)	300	300	300	300
jrk sengkang pilih (mm)	120	120	120	120
Sengkang pakai luar daerah plastis (mm)	P10-120	P10-120	P10-120	P10-120

IV. PERENCANAAN BALOK INDUK

PENULANGAN LENTUR BALOK-BALOK PORTAL I

Fy deform	=	400 mpa		d	=	439 mm	=	0.439 m
Fy polos	=	240 mpa		d'	=	61 mm	=	0.061 m
fc'	=	20 mpa		d'/d	=	0.138952164		
penutup beton (Pb)	=	40 mm		Φ	=	0.6		
diameter tul.utama	=	22 mm		pb	=	0.021675		
diameter tul.tekan	=	22 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	300 mm	=	0.3 m				
h	=	500 mm	=	0.5 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_0	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
Sloop 13	-4669.23	46.69	807.60	0.00	0.00	460.95	2	230.48	2
Sloop 14	-7739.08	77.39	1338.56	0.00	0.00	592.65	2	296.33	2
lt.2 -15	-9831.30	98.31	1700.44	0.01	0.01	750.69	2	375.35	2
lt.2-16.17	-11588.01	115.88	2004.28	0.01	0.01	882.39	3	441.20	2
lt.3-18	-7293.05	72.93	1261.42	0.00	0.00	553.14	2	276.57	2
lt.3-19,20	-10605.85	106.06	1834.40	0.01	0.01	803.37	3	401.69	2
atap 21	-4078.59	40.79	705.44	0.00	0.00	460.95	2	230.48	2
atap 22,23	-5841.55	58.42	1010.36	0.00	0.00	460.95	2	230.48	2

diameter =	22
n	A
1	379.94
2	759.88
3	1139.82
4	1519.76
5	1899.7
6	2279.64

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
Sloop 13	471.14	4.71	81.49	0.00	0.00	460.95	2.00	230.48	2.00
Sloop 14	3245.63	32.46	561.41	0.00	0.00	460.95	2.00	230.48	2.00
lt.2 -15	797.47	7.97	137.93	0.00	0.00	460.95	2.00	230.48	2.00
lt.2-16,17	3059.59	30.60	529.19	0.00	0.00	460.95	2.00	230.48	2.00
lt.3-18	731.60	7.32	126.54	0.00	0.00	460.95	2.00	230.48	2.00
lt.3-19,20	2527.25	25.27	437.12	0.00	0.00	460.95	2.00	230.48	2.00
atap 21	364.78	3.65	63.09	0.00	0.00	460.95	2.00	230.48	2.00
atap 22,23	1549.74	15.50	268.05	0.00	0.00	460.95	2.00	230.48	2.00

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap'
Sloop 13	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62
Sloop 14	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62
lt.2 -15	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62
lt.2-16,17	3	1139.82	2	759.88	29.80	179.347	143.478	224.184	400	179.35	224.18
lt.3-18	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62
lt.3-19,20	3	1139.82	2	759.88	29.80	179.347	143.478	224.184	400	179.35	224.18
atap 21	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62
atap 22,23	2	759.88	2	759.88	0.00	114.894	91.915	143.617	400	114.89	143.62

c

4. Gaya Geser Rencana Balok Portal

In 13,15,18,21 = 2.5 m In 14,16,17,19,20,22,23 = 6.7 m

Gaya geser

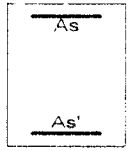
Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	ket
Sloop 13	3.16	-0.04	-20.14	23.04	143.62	143.62	103.81	-61.29	100.03	-61.29	
Sloop 13	-3.56	-0.04	-26.86	19.63	143.62	143.62	96.75	-116.57	78.86	78.86	
Sloop 14	8.39	-0.02	4.52	12.33	143.62	143.62	109.33	27.76	60.58	27.76	
Sloop 14	-8.41	-0.02	-12.28	-4.47	143.62	143.62	91.69	-60.44	-27.62	-27.62	
lt.2 -15	7.38	3.35	-51.24	57.48	143.62	143.62	111.80	-203.94	252.67	111.80	
lt.2 -15	-9.34	-4.49	-57.96	50.58	143.62	143.62	86.02	-257.94	197.90	86.02	
lt.2-16,17	-20.67	7.71	-1.06	17.95	224.18	224.18	143.32	-18.07	61.77	-18.07	
lt.2-16,17	-12.40	-1.29	-17.86	1.15	224.18	224.18	142.55	-89.40	-9.55	-9.55	
lt.3-18	8.18	3.58	-35.72	42.75	143.62	143.62	112.89	-137.65	191.89	112.89	
lt.3-18	-8.53	-4.26	-42.44	36.03	143.62	143.62	87.10	-191.66	137.88	87.10	
lt.3-19,20	-23.17	-9.67	1.52	15.30	224.18	224.18	122.45	-28.08	29.78	-28.08	
lt.3-19,20	-21.38	-8.33	-15.28	-1.50	224.18	224.18	125.73	-95.36	-37.50	-37.50	
atap 21	6.80	2.58	-18.86	25.12	143.62	143.62	110.38	-69.37	115.38	-69.37	
atap 21	-8.97	-3.30	-25.58	18.40	143.62	143.62	87.65	-120.33	64.41	64.41	
atap 22,23	-22.12	7.28	4.28	12.59	143.62	143.62	84.96	2.38	37.32	2.38	
atap 22,23	-20.27	-6.22	-12.52	-4.21	143.62	143.62	72.72	-80.41	-45.48	-45.48	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vsmin	Vs	S	cek	Digunakan	Vu.b/Ø<Vc+Vs
Sloop 13	-81.3	-70.8	0.0	43.9	118.0	140.2	109.8	P10-100	OK
	78.9								
Sloop 14	27.8	-24.0	0.0	43.9	40.0	414.1	109.8	P10-100	OK
	-27.6								
lt.2 -15	111.8	107.3	0.0	43.9	178.8	92.5	92.5	P10-90	OK
	86.0								
lt.2-16.17	-18.1	-16.6	0.0	43.9	27.7	597.9	109.8	P10-100	OK
	-9.6								
lt.3-18	112.9	108.4	0.0	43.9	180.7	91.6	91.6	P10-90	OK
	87.1								
lt.3-19,20	-28.1	-35.8	0.0	43.9	59.7	277.2	109.8	P10-100	OK
	-37.5								
atap 21	-69.4	-60.6	0.0	43.9	101.1	163.7	109.8	P10-100	OK
	64.4								
atap 22,23	2.4	-42.4	0.0	43.9	70.6	234.3	109.8	P10-100	OK
	-45.5								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu.b/Ø<Vc+Vs
Sloop 13	-81.3	-57.4	240.5	43.9	144.8	376.8	219.5	P10-210	OK
	78.9								
Sloop 14	27.8	-19.3	240.5	43.9	208.2	376.8	219.5	P10-210	OK
	-27.6								
lt.2 -15	111.8	101.5	240.5	43.9	71.3	376.8	219.5	P10-210	OK
	86.0								
lt.2-16.17	-18.1	-14.7	240.5	43.9	216.0	376.8	219.5	P10-210	OK
	-9.6								
lt.3-18	112.9	102.6	240.5	43.9	69.5	376.8	219.5	P10-210	OK
	87.1								
lt.3-19,20	-28.1	-33.7	240.5	43.9	184.3	376.8	219.5	P10-210	OK
	-37.5								
atap 21	-69.4	-49.4	240.5	43.9	158.1	376.8	219.5	P10-210	OK
	64.4								
atap 22,23	2.4	-38.4	240.5	43.9	176.5	376.8	219.5	P10-210	OK
	-45.5								

PENULANGAN LENTUR BALOK-BALOK PORTAL H

Fy deform	=	400 mpa		d	=	439 mm	=	0.439 m
Fy Polos	=	240 mpa		d'	=	61 mm	=	0.061 m
fc'	=	20 mpa		d'/d	=	0.138952164		
penutup beton (Pb)	=	40 mm		Φ	=	0.6		
diameter tul.utama	=	22 mm		pb	=	0.021675		
diameter tul.tekan	=	22 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	300 mm	=	0.3 m				
h	=	500 mm	=	0.5 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_0	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
slocp 16	-5459.2	54.6	944.2	0.0036	0.0036	474.12	2	237.06	2
slocp 17	-8318.8	83.2	1438.8	0.0048	0.0048	632.16	2	316.08	2
lt.2 -18	-12675.1	126.8	2192.3	0.0074	0.0074	974.58	3	487.29	2
lt.2 -19,20,21	-15336.3	153.4	2652.6	0.009	0.009	1185.30	4	592.65	2
lt 3-22	-11717.3	117.2	2026.6	0.0068	0.0068	895.56	3	447.78	2
lt 3-23,24	-17180.7	171.8	2971.6	0.0101	0.0101	1330.17	4	665.09	2
atap-25	-6956.4	69.6	1203.2	0.004	0.004	526.80	2	263.40	2
atap-26,27	-11071.2	110.7	1914.9	0.0064	0.0064	842.88	3	421.44	2
atap 28	-4382.6	43.8	758.0	0.0026	0.0035	460.95	2	230.48	2
atap 29,30	-6861.3	68.6	1186.7	0.004	0.004	526.80	2	263.40	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	490.1	4.9	84.8	0.0007	0.0035	460.95	2	230.48	2
sloop 17	3380.5	33.8	584.7	0.0019	0.0035	460.95	2	230.48	2
lt.2 -18	1186.5	11.9	205.2	0.0007	0.0035	460.95	2	230.48	2
lt.2 -19,20,21	-6026.2	60.3	1042.3	0.0034	0.0035	460.95	2	230.48	2
lt.3-22	1097.6	11.0	189.8	0.0007	0.0035	460.95	2	230.48	2
lt.3-23,24	4224.3	42.2	730.6	0.0025	0.0035	460.95	2	230.48	2
atap-25	714.7	7.1	123.6	0.0007	0.0035	460.95	2	230.48	2
atap-26,27	2439.2	24.4	421.9	0.0014	0.0035	460.95	2	230.48	2
atap 28	364.4	3.6	63.0	0.0007	0.0035	460.95	2	230.48	2
atap 29,30	1695.4	17.0	293.2	0.001	0.0035	460.95	2	230.475	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 16	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.893856	143.61732
sloop 17	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
lt.2 -18	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.2 -19,20,21	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.3-22	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.3-23,24	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
atap-25	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap-26,27	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
atap 28	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 29,30	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62

4. Gaya Geser Rencana Balok Portal

In 16,18 ,22,25 = 2.5 m In 17,19,20,21,23,24,26,27,29,30 = 6.7 m

Gaya geser

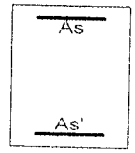
Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
slocp 16	3.74	0.03	-24.95	32.00	143.62	143.62	104.49	-100.61	138.34	-100.61281	
	-3.82	0.03	-32.51	24.44	143.62	143.62	96.56	-140.50	98.65	96.555774	
slocp 17	9.43	-0.03	4.66	24.44	143.62	143.62	110.40	29.42	112.50	29.422029	
	-9.47	-0.03	-14.24	14.29	143.62	143.62	90.56	-69.80	50.03	50.033109	
lt.2 -18	11.97	7.07	-67.05	73.46	224.18	224.18	176.92	-261.61	328.51	176.924497	
	-14.74	-8.61	-73.77	73.46	224.18	224.18	132.41	-334.34	284.00	132.412897	
lt.2 -19,20,21	36.24	16.48	-15.91	20.77	299.09	299.09	264.72	-11.48	142.57	-11.478516	
	-26.83	-8.52	-20.71	13.57	299.09	299.09	172.24	-124.12	19.85	19.853694	
lt.3-22	12.20	6.84	-60.39	66.88	224.18	224.18	176.93	-233.65	300.88	176.9261455	
	-14.51	-8.84	-67.11	60.16	224.18	224.18	132.41	-306.39	228.15	132.4145455	
lt 3-23,24	44.48	24.52	-11.28	19.73	299.09	299.09	281.81	25.05	155.30	25.0493565	
	-44.40	-24.48	-19.68	11.33	299.09	299.09	137.04	-155.00	-24.74	-24.7443735	
atap-25	8.68	3.37	-33.58	40.75	143.62	143.62	113.19	-128.36	183.82	113.185254	
	-7.09	-2.51	-40.30	34.03	143.62	143.62	90.45	-179.33	132.86	90.447294	
atap-26,27	25.91	8.23	-6.85	15.21	224.18	224.18	192.78	7.07	99.74	7.066143	
	-24.74	-7.52	-15.25	11.01	224.18	224.18	123.05	-97.94	12.38	12.379353	
atap 28	7.18	2.76	-20.71	27.37	143.62	143.62	110.97	-76.54	125.41	-76.544139	
	-8.59	-3.12	-27.43	20.65	143.62	143.62	88.23	-127.51	74.44	74.444601	
atap 29,30	26.00	8.26	-4.81	13.18	143.62	143.62	136.50	15.79	91.32	15.785784	
	-24.66	-7.49	-13.21	4.78	143.62	143.62	66.78	-89.22	-13.69	-13.689606	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	-100.8	-87.9	0	43.9	146.5	112.9	109.8	P10-100	OK
	96.6								
sloop 17	29.4	46.4	0	43.9	77.3	213.9	109.8	P10-100	OK
	50.0								
lt.2 -18	176.9	169.1	0	43.9	281.8	58.7	58.7	2P10-100	OK
	132.4								
lt.2 -19,20,21	-11.5	15.2	0	43.9	25.3	653.0	109.8	P10-100	OK
	19.9								
lt 3-22	176.9	169.1	0	43.9	281.8	58.7	58.7	2P10-100	OK
	132.4								
lt 3-23,24	25.0	-21.4	0	43.9	35.7	462.9	109.8	P10-100	OK
	-24.7								
atap-25	113.2	109.2	0	43.9	182.0	90.9	90.9	P10-90	OK
	90.4								
atap-26,27	7.1	11.5	0	43.9	19.2	863.0	109.8	P10-100	OK
	12.4								
atap 28	-76.5	-66.6	0	43.9	111.0	149.0	109.8	P10-100	OK
	74.4								
atap 29,30	15.8	13.2	0	43.9	22.0	751.9	109.8	P10-100	OK
	-13.7								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	-100.8	-71.3	240.5	43.9	121.6	376.8	219.5	P10-210	OK
	96.6								
sloop 17	29.4	41.8	240.5	43.9	170.8	376.8	219.5	P10-210	OK
	50.0								
lt.2 -18	176.9	159.1	240.5	43.9	24.7	376.8	219.5	P10-210	OK
	132.4								
lt.2 -19,20,21	-11.5	-6.8	240.5	43.9	229.1	376.8	219.5	P10-210	OK
	19.9								
lt.3-22	176.9	159.1	240.5	43.9	24.7	376.8	219.5	P10-210	OK
	132.4								
lt.3-23,24	25.0	-17.3	240.5	43.9	211.7	376.8	219.5	P10-210	OK
	-24.7								
atap-25	113.2	104.1	240.5	43.9	67.0	376.8	219.5	P10-210	OK
	90.4								
atap-26,27	7.1	10.3	240.5	43.9	223.3	376.8	219.5	P10-210	OK
	12.4								
atap 28	-76.5	-54.0	240.5	43.9	150.5	376.8	219.5	P10-210	OK
	74.4								
atap 29,30	15.8	-9.3	240.5	43.9	225.0	376.8	219.5	P10-210	OK
	-13.7								

PENULANGAN LENTUR BALOK-BALOK PORTAL D

Fy deform	=	400 mpa		d	=	439 mm	=	0.439 m
Fy polos	=	240 mpa		d'	=	61 mm	=	0.061 m
fc'	=	20 mpa		Φ	=	0.6		
penutup beton (Pb)	=	40 mm		d'/d	=	0.138952164		
diameter tul.utama	=	22 mm		pb	=	0.021675		
diameter tul.tekan	=	22 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	300 mm	=	0.3 m				
h	=	500 mm	=	0.5 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_0	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	-5459.2	54.6	944.2	0.0031	0.0035	460.95	2	230.48	2
sloop 17	-8318.8	83.2	1438.8	0.0048	0.0048	632.16	2	316.08	2
lt.1-18	-12675.1	126.8	2192.3	0.0074	0.0074	974.58	3	487.29	2
lt.1-19,20	-15336.3	153.4	2652.6	0.009	0.009	1185.30	4	592.65	2
lt.2-21	-13709.1	137.1	2371.1	0.008	0.008	1053.60	3	526.80	2
lt.2-22,23	-18189.9	181.9	3146.2	0.0107	0.0107	1409.19	4	704.60	2
lt.3-24	-10208.7	102.1	1765.7	0.0059	0.0059	777.03	3	388.52	2
lt.3-25,26	-17736.3	177.4	3067.7	0.0102	0.0102	1343.34	4	671.67	2
atap 27	-5456.4	54.6	943.7	0.0031	0.0035	460.95	2	230.48	2
atap 28.29	-9906.0	99.1	1713.4	0.0057	0.0057	750.69	2	375.35	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	490.1	4.9	84.8	0.0007	0.0035	460.95	2	230.48	2
sloop 17	3380.5	33.8	584.7	0.0019	0.0035	460.95	2	230.48	2
lt.1-18	1186.5	11.9	205.2	0.0007	0.0035	460.95	2	230.48	2
lt.1-19,20	5561.8	55.6	962.0	0.0032	0.0035	460.95	2	230.48	2
lt.2-21	1144.0	11.4	197.9	0.0007	0.0035	460.95	2	230.48	2
lt.2 22,23	4735.3	47.4	819.0	0.002	0.0035	460.95	2	230.48	2
lt.3-24	1180.6	11.8	204.2	0.0007	0.0035	460.95	2	230.48	2
lt.3-25,26	4140.6	41.4	716.2	0.0024	0.0035	460.95	2	230.48	2
atap 27	449.3	4.5	77.7	0.0007	0.0035	460.95	2	230.48	2
atap 28,29	2653.7	26.5	459.0	0.0015	0.0035	460.95	2	230.48	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 16	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.8939	143.61732
sloop 17	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
lt.1-18	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.1-19,20	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.2-21	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt 2-22,23	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.3-24	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.3-25,26	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
atap 27	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 28,29	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62

4. Gaya Geser Rencana Balok Portal

ln 16,18,21,24,27 = 2.5 m ln 17,19,20,22,23,25,26,28,29 = 6.7 m

Gaya geser

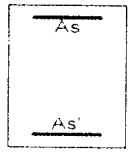
Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
sloop 16	4.16	0.42	-27.87	34.89	143.62	143.62	105.34	-112.24	151.37	105.34	
	-3.40	0.42	-35.43	27.33	143.62	143.62	97.41	-151.93	111.68	97.41	
sloop 17	9.45	-0.02	4.15	14.80	143.62	143.62	110.44	27.32	72.06	27.32	
	-9.45	-0.02	-14.75	-4.10	143.62	143.62	90.59	-71.90	-27.17	-27.17	
lt.1-18	12.17	7.13	-77.63	84.07	224.18	224.18	177.19	-305.78	373.37	177.19	
	-14.54	-8.55	-84.35	77.35	224.18	224.18	132.68	-378.52	300.63	132.68	
lt.1-19,20	44.59	24.59	-5.85	22.71	299.09	299.09	282.01	48.08	168.01	48.08	
	-44.28	-24.41	-22.65	5.91	299.09	299.09	137.24	-167.25	-47.32	-47.32	
lt.2-21	13.33	7.83	-75.18	81.74	224.18	224.18	179.15	-293.52	365.51	179.15	
	-13.38	-7.85	-81.90	75.02	224.18	224.18	134.64	-366.26	292.78	134.64	
lt.2-22,23	44.54	24.55	-5.59	22.45	299.09	299.09	281.91	49.09	166.82	49.09	
	-44.33	-24.45	-22.39	5.65	299.09	299.09	137.14	-166.24	-48.51	-48.51	
lt.3-24	14.25	8.06	-50.14	57.29	224.18	224.18	180.35	-187.15	264.02	180.35	
	-12.46	-7.62	-56.86	50.57	224.18	224.18	135.84	-259.88	191.28	135.84	
lt.3-25,26	44.53	24.55	-1.53	18.34	299.09	299.09	281.90	66.12	149.57	66.12	
	-44.34	-24.45	-18.33	1.54	299.09	299.09	137.13	-149.21	-65.76	-65.76	
atap 27	10.14	5.11	-24.03	30.02	143.62	143.62	116.55	-84.90	142.10	-84.90	
	-14.68	-6.65	-30.75	23.30	143.62	143.62	78.14	-151.54	75.46	75.46	
atap 28,29	41.93	18.54	2.78	14.14	143.62	143.62	164.02	75.17	122.89	75.17	
	-41.07	-18.21	-14.02	-2.66	143.62	143.62	38.29	-121.12	-73.40	38.29	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	105.3	103.9	0	43.9	173.2	95.5	95.5	P10-90	OK
	97.4								
sloop 17	27.3	-23.6	0	43.9	39.4	420.0	109.8	P10-100	OK
	-27.2								
lt.1-18	177.2	177.2	0	43.9	295.3	56.0	56.0	2P10-100	OK
	132.7								
lt.1-19,20	48.1	-41.1	0	43.9	68.4	241.8	109.8	P10-100	OK
	-47.3								
lt.2-21	179.2	171.4	0	43.9	285.7	57.9	57.9	2P10-100	OK
	134.6								
lt.2-22,23	49.1	-42.1	0	43.9	70.2	235.7	109.8	P10-100	OK
	-48.5								
lt.3-24	180.3	172.5	0	43.9	287.5	57.5	57.5	2P10-100	OK
	135.8								
lt.3-25,26	66.1	-57.2	0	43.9	95.3	173.6	109.8	P10-100	OK
	-65.8								
atap 27	-84.9	-74.4	0	43.9	124.0	133.4	109.8	P10-100	OK
	75.5								
atap 28,29	75.2	68.8	0	43.9	114.7	144.3	109.8	P10-100	OK
	38.3								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	105.3	102.1	240.5	43.9	70.3	376.8	219.5	P10-210	OK
	97.4								
sloop 17	27.3	-19.1	240.5	43.9	208.7	376.8	219.5	P10-210	OK
	-27.2								
lt.1-18	177.2	132.7	240.5	43.9	19.3	376.8	219.5	P10-210	OK
	132.7								
lt 1-19,20	48.1	-33.1	240.5	43.9	185.4	376.8	219.5	P10-210	OK
	-47.3								
lt 2-21	179.2	161.4	240.5	43.9	28.5	376.8	219.5	P10-210	OK
	134.6								
lt 2-22,23	49.1	-33.9	240.5	43.9	183.9	376.8	219.5	P10-210	OK
	-48.5								
lt 3-24	180.3	162.5	240.5	43.9	30.4	376.8	219.5	P10-210	OK
	135.8								
lt 3-25,26	66.1	-46.1	240.5	43.9	163.6	376.8	219.5	P10-210	OK
	-65.8								
atap 27	-84.9	-61.0	240.5	43.9	138.9	376.8	219.5	P10-210	OK
	75.5								
atap 28,29	75.2	60.5	240.5	43.9	139.6	376.8	219.5	P10-210	OK
	38.3								

PENULANGAN L. NTUR BALOK-BALOK PORTAL A

Fy deform	=	400 mpa		d	=	439 mm	=	0.439 m
Fy polos	=	240 mpa		d'	=	61 mm	=	0.061 m
fc'	=	20 Mpa		Φ	=	0.6		
penutup beton (Pb)	=	40 mm		d'/d	=	0.138952164		
diameter tul.utama	=	22 mm		pb	=	0.021675		
diameter tul.tekan	=	22 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	300 mm	=	0.3 m				
h	=	500 mm	=	0.5 m				
Φ	=	0.8						
Betta	=	0.85						
Φ	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	-5790.3	57.9	1001.5	0.0033	0.0035	460.95	2	230.48	2
sloop 17	-8864.9	88.6	1533.3	0.0052	0.0052	684.84	2	342.42	2
lt.1-18	-13033.1	130.3	2254.2	0.0076	0.0076	1000.92	3	500.46	2
lt.1-19,20	-14141.5	141.4	2445.9	0.0083	0.0083	1093.11	3	546.56	2
lt.2-21	-12311.2	123.1	2129.4	0.0072	0.0072	948.24	3	474.12	2
lt 2-22,23	-14169.9	141.7	2450.8	0.0083	0.0083	1093.11	3	546.56	2
lt.3-24	-8137.3	81.4	1407.4	0.0047	0.0047	618.99	2	309.50	2
lt.3-25,26	-11393.1	113.9	1970.6	0.0066	0.0066	869.22	3	434.61	2
atap 27	-4486.8	44.9	776.0	0.0026	0.0035	460.95	2	230.48	2
atap 28,29	-6343.8	63.4	1097.2	0.0036	0.0036	474.12	2	237.06	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	517.8	5.2	89.6	0.0007	0.0035	460.95	2	230.48	2
sloop 17	3608.3	36.1	624.1	0.0021	0.0035	460.95	2	230.48	2
lt.1-18	756.0	7.6	130.8	0.0007	0.0035	460.95	2	230.48	2
lt.1-19,20	4106.5	41.1	710.3	0.0024	0.0035	460.95	2	230.48	2
lt.2-21	766.5	7.7	132.6	0.0007	0.0035	460.95	2	230.48	2
lt.2-22,23	3995.5	40.0	691.1	0.0023	0.0035	460.95	2	230.48	2
lt.3-24	727.0	7.3	125.8	0.0007	0.0035	460.95	2	230.48	2
lt.3-25,26	2870.2	28.7	496.4	0.0016	0.0035	460.95	2	230.48	2
atap 27	360.4	3.6	62.3	0.0007	0.0035	460.95	2	230.48	2
atap 28,29	1760.9	17.8	308.0	0.001	0.0035	460.95	2	230.48	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 16	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.894	143.61732
sloop 17	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
lt.1-18	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.1-19,20	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.2-21	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.2-22,23	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.3-24	2	759.88	2	759.88	0.00	114.89	91.92	143.62	400	114.89	143.62
lt.3-25,26	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
atap 27	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 28,29	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62

4. Gaya Geser Rencana Balok Portal

In 16,18,21,24,27 = 5 m In 17,19,20,22,23,25,26,28,29 = 6.7 m

Gaya geser

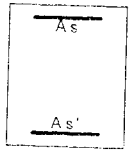
Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
sloop 16	3.77	0.21	-26.61	33.63	143.62	143.62	104.70	-107.60	145.43	104.70	
	-3.79	0.21	-34.17	26.07	143.62	143.62	96.76	-147.29	105.74	96.76	
sloop 17	7.90	-0.01	4.37	14.58	143.62	143.62	106.82	26.62	69.53	26.62	
	-6.81	-0.01	-14.53	-4.32	143.62	143.62	91.27	-70.31	-27.40	-27.40	
lt.1-18	23.78	3.56	-73.89	80.33	224.18	224.18	185.64	-281.65	366.08	185.64	
	-23.62	-4.28	-80.61	73.61	224.18	224.18	127.64	-367.87	279.85	127.64	
lt.1-19,20	23.78	12.04	-5.17	22.03	224.18	224.18	194.54	15.90	130.12	15.90	
	-23.62	-11.96	-21.97	5.23	224.18	224.18	119.57	-129.63	-15.41	-15.41	
lt.2-21	8.25	3.88	-69.67	76.16	224.18	224.18	169.66	-279.86	332.59	169.66	
	-8.47	-3.96	-76.39	69.44	224.18	224.18	143.88	-333.87	278.58	143.88	
lt.2-22,23	25.19	12.02	-4.60	21.45	224.18	224.18	193.00	19.77	129.17	19.77	
	-25.81	-11.98	-21.40	4.65	224.18	224.18	117.25	-129.54	-20.14	-20.14	
lt.3-24	8.92	4.04	-41.43	46.61	143.62	143.62	114.14	-160.38	217.76	114.14	
	-7.79	-3.80	-48.15	41.89	143.62	143.62	88.36	-214.39	163.75	88.36	
lt.3-25,26	23.72	12.01	0.07	16.72	224.18	224.18	194.45	37.79	107.73	37.79	
	-23.68	-11.99	-16.73	-0.08	224.18	224.18	119.48	-107.74	-37.80	-37.80	
atap 27	7.20	2.74	-21.26	27.65	143.62	143.62	110.97	-78.84	126.57	-78.84	
	-8.57	-3.14	-27.98	20.93	143.62	143.62	88.23	-129.80	75.61	75.61	
atap 28,29	22.38	9.04	3.38	13.45	143.62	143.62	133.52	47.17	89.48	47.17	
	-22.14	-8.96	-13.42	-3.35	143.62	143.62	67.87	-89.03	-46.73	-46.73	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	104.7	103.3	0	43.9	172.2	96.1	96.1	P10-90	OK
	96.8								
sloop 17	26.6	-23.9	0	43.9	39.8	416.0	109.8	P10-100	OK
	-27.4								
lt.1-18	185.6	175.4	0	43.9	292.3	56.6	56.6	2P10-100	OK
	127.6								
lt.1-19,20	15.9	-13.4	0	43.9	22.3	743.4	109.8	P10-100	OK
	-15.4								
lt 2-21	169.7	165.2	0	43.9	275.3	60.1	60.1	2P10-120	OK
	143.9								
lt 2-22,23	19.8	-17.5	0	43.9	29.2	567.5	109.8	P10-100	OK
	-20.1								
lt.3-24	114.1	109.6	0	43.9	182.7	90.6	90.6	P10-90	OK
	88.4								
lt.3-25,26	37.8	-32.9	0	43.9	54.8	302.1	109.8	P10-100	OK
	-37.8								
atap 27	-78.8	-68.7	0	43.9	114.5	144.5	109.8	P10-100	OK
	75.6								
atap 28,29	47.2	-40.6	0	43.9	67.6	244.8	109.8	P10-100	OK
	-46.7								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
slocp 16	104.7	101.2	240.5	43.9	71.8	376.8	219.5	P10-210	OK
	96.8								
slocp 17	26.6	-19.3	240.5	43.9	208.2	376.8	219.5	P10-210	OK
	-27.4								
lt.1-16	185.6	162.4	240.5	43.9	30.2	376.8	219.5	P10-210	OK
	127.6								
lt.1-19,20	15.9	-13.4	240.5	43.9	218.2	376.8	219.5	P10-210	OK
	-15.4								
lt.2-21	169.7	159.4	240.5	43.9	25.2	376.8	219.5	P10-210	OK
	143.9								
lt.2-22,23	19.8	-14.1	240.5	43.9	216.9	376.8	219.5	P10-210	OK
	-20.1								
lt.3-24	114.1	103.8	240.5	43.9	67.5	376.8	219.5	P10-210	OK
	88.4								
lt.3-25,26	37.8	-26.5	240.5	43.9	196.3	376.8	219.5	P10-210	OK
	-37.8								
atap 27	-78.8	-55.8	240.5	43.9	147.5	376.8	219.5	P10-210	OK
	75.6								
atap 28,29	47.2	-32.7	240.5	43.9	186.0	376.8	219.5	P10-210	OK
	-46.7								

PENULANGAN LENTUR BALOK-BALOK PORTAL B

Fy deform	=	400 mpa		d	=	439 mm	=	0.439 m
Fy polos	=	240 mpa		d'	=	61 mm	=	0.061 m
fc'	=	20 mpa		Φ	=	0.6		
penutup beton (Pb)	=	40 mm		d'/d	=	0.138952164		
diameter tul.utama	=	22 mm		pb	=	0.021675		
diameter tul.tekan	=	22 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	300 mm	=	0.3 m				
h	=	500 mm	=	0.5 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_0	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	-6525.8	65.3	1128.7	0.0038	0.0038	500.46	2	250.23	2
sloop 17	-9218.8	92.2	1594.5	0.0054	0.0054	711.18	2	355.59	2
lt.1-18	-15865.3	158.7	2744.1	0.0093	0.0093	1224.81	4	612.41	2
lt.1-19,20	-18803.9	188.0	3252.4	0.0111	0.0111	1461.87	4	730.94	2
lt.2-21	-15212.7	152.1	2631.2	0.0089	0.0089	1172.13	4	586.07	2
lt.2-22,23	-18801.0	188.0	3251.8	0.0111	0.0111	1461.87	4	730.94	2
lt.3-24	-10388.3	103.9	1796.8	0.006	0.006	790.20	3	395.10	2
lt.3-25,26	-16001.6	160.0	2767.7	0.0094	0.0094	1237.98	4	618.99	2
atap 27	-5701.4	57.0	986.1	0.0033	0.0035	460.95	2	230.48	2
atap 28,29	-9094.4	90.9	1573.0	0.0053	0.0053	698.01	2	349.01	2
atap 33	-3699.6	37.0	639.9	0.0021	0.0035	460.95	2	230.48	2
atap 34,35	-6669.2	66.7	1153.5	0.0038	0.0038	500.46	2	250.23	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 16	530.1	5.3	91.7	0.0007	0.0035	460.95	2	230.48	2
sloop 17	3598.2	36.0	622.3	0.0021	0.0035	460.95	2	230.48	2
lt.1-18	1067.9	10.7	184.7	0.0007	0.0035	460.95	2	230.48	2
lt.1-19,20	5237.1	52.4	905.8	0.003	0.0035	460.95	2	230.48	2
lt.2-21	1141.4	11.4	197.4	0.0007	0.0035	460.95	2	230.48	2
lt.2-22,23	5120.3	51.2	885.3	0.003	0.0035	460.95	2	230.48	2
lt.3-24	1045.7	10.5	180.9	0.0007	0.0035	460.95	2	230.48	2
lt.3-25,26	3915.4	39.2	677.2	0.0023	0.0035	460.95	2	230.48	2
atap 27	600.1	6.0	103.8	0.0007	0.0035	460.95	2	230.48	2
atap 28,29	2111.6	21.1	365.2	0.0012	0.0035	460.95	2	230.48	2
atap 33	358.2	3.6	62.0	0.0007	0.0035	460.95	2	230.48	2
atap 34,35	1636.9899	16.4	283.1	0.0009	0.0035	460.95	2	230.48	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 16	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.893856	143.61732
sloop 17	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
lt.1-18	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.1-19,20	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.2-21	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.2-22,23	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
lt.3-24	3	1139.82	2	759.88	29.80	179.35	143.48	224.18	400	179.35	224.18
lt.3-25,26	4	1519.76	2	759.88	59.60	239.27	191.42	299.09	400	239.27	299.09
atap 27	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 28,29	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 33	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62
atap 34,35	2	759.88	2	759.88	0	114.89	91.92	143.62	400	114.89	143.62

4. Gaya Geser Rencana Balok Portal

ln 16,18,21,24,27 = 2.5 m ln 17,19,20,22,23,25,26,28,29 = 6.7 m

Gaya geser

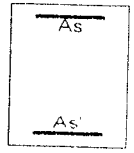
Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
stoop 16	4.14	0.41	39.23	39.23	143.62	143.62	105.31	169.54	169.54	105.31	
	-3.42	0.41	31.67	31.67	143.62	143.62	97.37	129.85	129.85	97.37	
stoop 17	9.45	-0.02	15.54	15.54	143.62	143.62	110.44	75.17	75.17	75.17	
	-9.45	-0.02	-3.36	-3.36	143.62	143.62	90.59	-24.06	-24.06	-24.06	
lt.1-18	12.15	7.08	95.24	95.24	299.09	299.09	229.56	420.21	420.21	229.56	
	-14.56	-8.60	88.52	88.52	299.09	299.09	185.05	347.48	347.48	185.05	
lt.1-19,20	43.66	24.34	24.69	24.69	299.09	299.09	260.76	175.11	175.11	175.11	
	-43.38	-24.16	7.89	7.89	299.09	299.09	138.45	-37.76	-37.76	-37.76	
lt.2-21	13.33	7.76	92.40	92.40	299.09	299.09	231.50	410.23	410.23	231.50	
	-13.38	-7.92	85.68	85.68	299.09	299.09	186.99	337.49	337.49	186.99	
lt.2-22,23	43.21	24.29	24.39	24.39	299.09	299.09	260.24	173.33	173.33	173.33	
	-43.82	-24.21	7.59	7.59	299.09	299.09	137.92	-39.54	-39.54	-39.54	
lt.3-24	13.09	7.54	60.80	60.80	224.18	224.18	178.60	277.03	277.03	178.60	
	-13.62	-8.14	54.08	54.08	224.18	224.18	134.09	204.29	204.29	134.09	
lt.3-25,26	43.52	24.26	19.06	19.06	299.09	299.09	260.53	151.23	151.23	151.23	
	-43.52	-24.24	2.26	2.26	299.09	299.09	138.21	-61.65	-61.65	-61.65	
atap 27	9.22	3.66	32.80	32.80	143.62	143.62	114.05	151.29	151.29	114.05	
	-6.56	-2.22	26.08	26.08	143.62	143.62	91.31	100.33	100.33	91.31	
atap 28,29	23.95	8.93	14.34	14.34	143.62	143.62	135.05	94.72	94.72	94.72	
	-24.17	-9.07	-2.47	-2.47	143.62	143.62	65.62	-45.26	-45.26	-45.26	
atap 33	7.65	2.97	22.27	22.27	143.62	143.62	111.68	104.68	104.68	104.68	
	-8.13	-2.91	15.55	15.55	143.62	143.62	88.94	53.72	53.72	53.72	
atap 34,35	24.91	9.14	12.81	12.81	143.62	143.62	136.29	89.55	89.55	89.55	
	24.99	-9.23	-3.99	-3.99	143.62	143.62	64.61	-52.69	-52.69	-52.69	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 16	105.3	103.9	0	43.9	173.2	95.5	95.5	P10-95	OK
	97.4								
sloop 17	75.2	-17.6	0	43.9	29.3	564.2	109.8	P10-100	NOT OK
	-24.1								
lt.1-18	229.6	221.8	0	43.9	369.7	44.7	44.7	2P10-80	OK
	185.0								
lt. I-19,20	175.1	-23.9	0	43.9	39.8	416.1	109.8	P10-100	NOT OK
	-37.8								
lt.2-21	231.5	233.7	0	43.9	389.5	42.5	42.5	2P10-80	OK
	187.0								
lt.2-22,23	173.3	-25.6	0	43.9	42.6	388.3	109.8	P10-100	NOT OK
	-39.5								
lt.3-24	178.6	170.8	0	43.9	284.7	58.1	58.1	2P10-100	OK
	134.1								
lt 3-25,26	151.2	-47.7	0	43.9	79.4	208.2	109.8	P10-100	NOT OK
	-61.6								
atap 27	114.0	95.3	0	43.9	158.8	104.1	104.1	P10-100	OK
	91.3								
atap 28,29	94.7	-36.1	0	43.9	60.2	274.7	109.8	P10-100	NOT OK
	-45.3								
atap 33	104.7	62.1	0	43.9	103.5	159.8	109.8	P10-100	NOT OK
	53.7								
atap 34,35	89.6	-43.4	0	43.9	72.3	228.8	109.8	P10-100	NOT OK
	-52.7								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu.b<Ø<Vc+Vs
sloop 16	105.3	102.1	240.5	43.9	70.3	376.8	219.5	P10-210	OK
	97.4								
sloop 17	75.2	-9.3	240.5	43.9	225.0	376.8	219.5	P10-210	OK
	-24.1								
lt.1-18	229.6	211.8	240.5	43.9	112.5	376.8	219.5	P10-210	OK
	185.0								
lt.1-19,20	175.1	-6.0	240.5	43.9	230.4	376.8	219.5	P10-210	OK
	-37.8								
lt.2-21	231.5	213.7	240.5	43.9	115.7	376.8	219.5	P10-210	OK
	187.0								
lt.2-22,23	173.3	-7.7	240.5	43.9	227.6	376.8	219.5	P10-210	OK
	-39.5								
lt.3-24	178.6	160.8	240.5	43.9	27.5	376.8	219.5	P10-210	OK
	134.1								
lt.3-25,26	151.2	-29.8	240.5	43.9	190.7	376.8	219.5	P10-210	OK
	-61.6								
atap 27	114.0	100.4	240.5	43.9	73.1	376.8	219.5	P10-210	OK
	91.3								
atap 28,29	94.7	-24.4	240.5	43.9	199.8	376.8	219.5	P10-210	OK
	-45.3								
atap 33	104.7	73.7	240.5	43.9	117.6	376.8	219.5	P10-210	OK
	53.7								
atap 34,35	89.6	-31.5	240.5	43.9	188.0	376.8	219.5	P10-210	OK
	-52.7								

PENULANGAN LENTUR BALOK-BALOK PORTAL 1

Fy deform	=	400 mpa		d	=	290.5 mm	=	0.2905 m
Fy polos	=	240 mpa		d'	=	59.5 mm	=	0.0595 m
fc'	=	20 mpa		Φ	=	0.6		
penutup beton (Pb)	=	40 mm		d'/d	=	0.204819277		
diameter tul.utama	=	19 mm		pb	=	0.021675		
diameter tul.tekan	=	19 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	200 mm	=	0.2 m				
h	=	350 mm	=	0.35 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_c	=	1.25						



1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 45	-1259.0	12.6	745.9	0.0026	0.0035	203.35	2	101.68	2
sloop 46 s/d 49	-2201.5	22.0	1304.4	0.0046	0.0046	267.26	2	133.63	2
lt.1 -50	-3054.4	30.5	1809.7	0.0064	0.0064	371.84	2	185.92	2
lt.1-51 s/d 57	-4388.7	43.9	2600.2	0.0093	0.0093	540.33	2	270.17	2
lt.2-58	-4114.7	41.1	2437.9	0.0087	0.0087	505.47	2	252.74	2
lt.2-59 s/d 65	-5411.6	54.1	3206.3	0.0115	0.0115	668.15	3	334.08	2
lt.3-66	-3909.7	39.1	2316.4	0.0083	0.0083	482.23	2	241.12	2
lt.3-67 s/d73	-5199.6	52.0	3080.7	0.0111	0.0111	644.91	3	322.46	2
atap 74	-2413.5	24.2	1432.9	0.005	0.005	290.50	2	145.25	2
atap 75	-2891.7	28.9	1713.3	0.0061	0.0061	354.41	2	177.21	2
atap76 s/d 81	-4401.2	44.0	2607.6	0.0093	0.0093	540.33	2	270.17	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 45	603.6	6.0	357.7	0.0012	0.0035	203.35	2	101.68	2
sloop 46 s/d 49	1088.5	10.9	644.9	0.0023	0.0035	203.35	2	101.68	2
lt.1 -50	1085.5	10.9	643.2	0.0023	0.0035	203.35	2	101.68	2
lt.1-51 s/d 57	2248.9	22.5	1332.4	0.0047	0.0047	273.07	2	136.54	2
lt.2-58	1088.1	10.9	644.7	0.0023	0.0035	203.35	2	101.68	2
lt 2-59 s/d 65	2236.4	22.4	1325.0	0.0046	0.0046	267.26	2	133.63	2
lt.3-66	1189.9	11.9	705.0	0.0025	0.0035	203.35	2	101.68	2
lt.3-67 s/d73	2474.8	24.7	1466.3	0.0052	0.0052	302.12	2	151.06	2
atap 74	586.0	5.9	347.2	0.0012	0.0035	203.35	2	101.68	2
atap 75	1263.1	12.6	748.3	0.0026	0.0035	203.35	2	101.68	2
atap76 s/d 81	2350.25	23.5	1392.5	0.0049	0.0049	284.69	2	142.35	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 45	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.369548	65.461935
sloop 46 s/d 49	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
lt.1 -50	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.1-51 s/d 57	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.2-58	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.2-59 s/d 65	3	850.155	2	566.77	33.34	83.41	66.73	104.26	400	83.41	104.26
lt.3-66	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.3-67 s/d73	3	850.155	2	566.77	33.34	83.41	66.73	104.26	400	83.41	104.26
atap 74	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
atap 75	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
atap76 s/d 81	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46

4. Gaya Geser Rencana Balok Portal

ln 45,50,58,66,74 = 2.8 m ln 46-49,51-57,59-65,67-73,75-81 = 3.8 m

Gaya geser

Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
sloop 45	19.43	0.08	2.91	3.34	65.46	65.46	61.40	32.71	34.51	32.71	32.705463
	-19.87	0.08	-3.39	-2.96	65.46	65.46	20.13	-35.02	-33.22	20.13	20.13397638
sloop 46 s/d 49	26.51	-0.04	4.38	4.33	65.46	65.46	68.71	46.18	45.99	45.99	46.181961
	-25.89	-0.04	-4.02	-4.07	65.46	65.46	13.69	-44.12	-44.31	13.69	13.69164038
lt.1 -50	24.18	4.36	-4.78	11.66	65.46	65.46	70.88	9.89	78.92	9.89	9.8915355
	-24.49	-4.64	-11.98	4.46	65.46	65.46	10.32	-80.91	-11.86	10.32	10.32131888
lt.1-51 s/d 57	35.01	8.06	-0.62	9.55	65.46	65.46	86.14	42.63	85.34	42.63	42.634704
	-34.67	-7.69	-9.02	-0.05	65.46	65.46	-3.57	-82.35	-44.68	-3.57	-3.566884125
lt.2-58	24.64	4.49	-11.37	18.32	65.46	65.46	71.51	-17.16	107.55	-17.16	-17.161074
	-24.03	-4.51	-18.57	11.12	65.46	65.46	10.95	-107.96	16.75	10.95	10.95023738
lt.2-59 s/d 65	34.85	7.86	-4.37	13.77	104.26	104.26	110.03	26.53	102.70	26.53	26.5329645
	-34.83	-7.87	-13.97	4.17	104.26	104.26	20.33	-103.49	-27.32	20.33	20.32917222
lt.3-66	28.85	4.54	-8.42	15.22	65.46	65.46	75.97	-0.29	98.97	-0.29	-0.285768
	-27.32	-4.46	-15.62	8.02	65.46	65.46	7.54	-98.96	0.30	7.537569375	
lt.3-67 s/d73	39.89	7.83	-2.22	12.07	104.26	104.26	115.27	40.77	100.81	40.77	40.773075
	-39.79	-7.92	-11.82	2.47	104.26	104.26	15.06	-99.75	-39.71	15.06	15.06482922
atap 74	10.67	3.63	-3.85	11.96	65.46	65.46	55.93	-1.17	65.24	-1.17	-1.168566
	-6.92	-3.12	-11.05	4.76	65.46	65.46	30.37	-56.97	9.44	9.44	30.36763538
atap 75	13.26	5.88	-0.22	9.55	65.46	65.46	61.02	19.17	60.21	19.17	19.1667735
	-14.53	-5.93	-9.82	-0.05	65.46	65.46	19.43	-62.74	-21.69	19.43	19.43369138
atap76 s/d 81	40.15	6.07	1.61	8.75	65.46	65.46	89.45	55.29	85.29	55.29	55.2944175
	-37.64	-5.74	-7.99	-0.85	65.46	65.46	-4.63	-79.11	-49.12	-4.63	-4.631426625
0	0.00	0.00	0.00	0.00	65.46	65.46	40.91	0.00	0.00	0.00	0
	0.00	0.00	0.00	0.00	65.46	65.46	40.91	0.00	0.00	0.00	0

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu b<Vc+Vs
sloop 45	32.7	30.50	0	19.36666667	50.8	215.3	72.6	P10-70	OK
	20.1								
sloop 46 s/d 49	46.0	40.3	0	19.36666667	67.2	163.0	72.6	P10-70	OK
	13.7								
lt.1 -50	9.9	10.2	0	19.36666667	17.0	643.9	72.6	P10-70	OK
	10.3								
lt.1-51 s/d 57	42.6	35.8	0	19.36666667	59.7	183.5	72.6	P10-70	OK
	-3.6								
lt.2-58	-17.2	-15.4	0	19.36666667	25.6	427.9	72.6	P10-70	OK
	11.0								
lt.2-59 s/d 65	26.5	25.4	0	19.36666667	42.3	258.6	72.6	P10-70	OK
	20.3								
lt.3-66	-0.3	-0.3	0	19.36666667	0.4	25260.1	72.6	P10-70	OK
	0.3								
lt.3-67 s/d73	40.8	36.3	0	19.36666667	60.5	180.9	72.6	P10-70	OK
	15.1								
atap 74	-1.2	8.0	0	19.36666667	13.3	821.0	72.6	P10-70	OK
	9.4								
atap 75	19.2	19.4	0	19.36666667	32.3	338.5	72.6	P10-70	OK
	19.4								
atap76 s/d 81	55.3	45.0	0	19.36666667	75.0	145.9	72.6	P10-70	OK
	-4.6								
0									

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu,b/Ø<Vc+Vs
sloop 45	32.7	27.7	106.1	19.36666667	59.9	565.2	145.3	P10-145	OK
	20.1								
sloop 46 s/d 49	46.0	33.1	106.1	19.36666667	50.9	565.2	145.3	P10-145	OK
	13.7								
lt.1 -5u	9.9	10.1	106.1	19.36666667	89.2	565.2	145.3	P10-145	OK
	10.3								
lt 1-51 s/d 57	42.6	3.3	106.1	19.36666667	100.6	565.2	145.3	P10-145	OK
	-3.6								
lt.2-58	-17.2	-13.0	106.1	19.36666667	84.4	565.2	145.3	P10-145	OK
	11.0								
lt.2-59 s/d 65	26.5	24.0	106.1	19.36666667	66.1	565.2	145.3	P10-145	OK
	20.3								
lt 3-66	-0.3	-0.2	106.1	19.36666667	105.7	565.2	145.3	P10-145	OK
	0.3								
lt.3-67 s/d73	40.8	30.5	106.1	19.36666667	55.2	565.2	145.3	P10-145	OK
	15.1								
atap 74	-1.2	0.4	106.1	19.36666667	105.4	565.2	145.3	P10-145	OK
	9.4								
atap 75	19.2	19.3	106.1	19.36666667	73.9	565.2	145.3	P10-145	OK
	19.4								
atap76 s/d 81	55.3	4.3	106.1	19.36666667	98.8	565.2	145.3	P10-145	OK
	-4.6								

PENULANGAN LENTUR BALOK-BALOK PORTAL 2

Fy deform	=	400 mpa		d	=	290.5 mm	=	0.2905 m
Fy polos	=	240 mpa		d'	=	59.5 mm	=	0.0595 m
fc'	=	20 mpa		Φ	=	0.6		
penutup beton (Pb)	=	40 mm		d'/d	=	0.204819277		
diameter tul.utama	=	19 mm		pb	=	0.021675		
diameter tul.tekan	=	19 mm		p mak	=	0.01625625		
diameter sengkang	=	10 mm		p min	=	0.0035		
b	=	200 mm	=	0.2 m				
h	=	350 mm	=	0.35 m				
Φ	=	0.8						
Betta	=	0.85						
Φ_0	=	1.25						

As

As'

1. Perencanaan Tulangan Tumpuan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 45	-509.10258	5.1	301.6	0.0011	0.0035	203.35	2	101.68	2
sloop 46 s/d 49	-804.31113	8.0	476.5	0.0017	0.0035	203.35	2	101.68	2
lt.1 -50	-3677.79825	36.8	2179.0	0.0077	0.0077	447.37	2	223.69	2
lt.1-51 s/d 57	-5864.7112	58.6	3474.8	0.0126	0.0126	732.06	3	366.03	2
lt.2-58	-4425.1389	44.3	2621.8	0.0094	0.0094	546.14	2	273.07	2
lt.2-59 s/d 65	-6517.14462	65.2	3861.3	0.014	0.014	813.40	3	406.70	2
lt.3-66	-4289.0547	42.9	2541.2	0.0091	0.0091	528.71	2	264.36	2
lt.3-67 s/d73	-6308.92227	63.1	3737.9	0.0136	0.0136	790.16	3	395.08	2
atap 74	-2796.30456	28.0	1656.8	0.0059	0.0059	342.79	2	171.40	2
atap 75	-3751.12185	37.5	2222.5	0.0079	0.0079	458.99	2	229.50	2
atap76 s/d 81	-3822.5096	38.2	2264.8	0.0081	0.0081	470.61	2	235.31	2

2. Perencanaan Tulangan Lapangan

Lantai	Mmak (kg-m)	Mu (Kn-m)	Rn (Kn/m^2)	p tabel	p pakai	As (mm^2)	n tul	As' (mm^2)	n tul
sloop 45	229.72215	2.3	136.1	0.0007	0.0035	203.35	2	101.68	2
sloop 46 s/d 49	488.78319	4.9	289.6	0.001	0.0035	203.35	2	101.68	2
lt.1 -50	1567.008	15.7	928.4	0.0032	0.0035	203.35	2	101.68	2
lt.1-51 s/d 57	3249.8564	32.5	1925.5	0.006	0.006	348.6	2	174.30	2
lt.2-58	1341.1312	13.4	794.6	0.0028	0.0035	203.35	2	101.68	2
lt.2-59 s/d 65	3307.7476	33.1	1959.8	0.007	0.007	406.7	2	203.35	2
lt.3-66	1606.0312	16.1	951.6	0.0033	0.0035	203.35	2	101.68	2
lt.3-67 s/d73	3344.0368	33.4	1981.3	0.007	0.007	406.7	2	203.35	2
atap 74	1096.0824	11.0	649.4	0.0230	0.023	1336.3	2	668.15	2
atap 75	1727.90268	17.3	1023.8	0.0036	0.0036	209.16	2	104.58	2
atap76 s/d 81	2189.858	21.9	1297.5	0.0045	0.0045	261.45	2	130.73	2

3. Momen Nominal Aktual Tumpuan

lantai	n tul. Atas	As pasang (mm^2)	n tul bawah	As' pasang (mm^2)	a (mm)	Mnak (Knm)	MR (Knm)	Mkap (Knm)	fs' mpa	Mnak' (KNm)	Mkap' (KNm)
sloop 45	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.369548	65.461935
sloop 46 s/d 49	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
lt.1 -50	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.1-51 s/d 57	3	850.155	2	566.77	33.34	83.41	66.73	104.26	400	83.41	104.26
lt.2-58	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.2-59 s/d 65	3	850.155	2	566.77	33.34	83.41	66.73	104.26	400	83.41	104.26
lt.3-66	2	566.77	2	566.77	0.00	52.37	41.90	65.46	400	52.37	65.46
lt.3-67 s/d73	3	850.155	2	566.77	33.34	83.41	66.73	104.26	400	83.41	104.26
atap 74	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
atap 75	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46
atap76 s/d 81	2	566.77	2	566.77	0	52.37	41.90	65.46	400	52.37	65.46

4. Gaya Geser Rencana Balok Portal

ln 45,50,58,66,74 = 2.8 m ln 46-49,51-57,59-65,67-73,75-81 = 3.8 m

Gaya geser

Lantai	VD (Kn)	VL (Kn)	VE kiri (Kn)	VE Kanan (Kn)	Mkap b (Knm)	Mkap' b (Knm)	Vu1 b (Kn)	Vu2 b kiri (Kn)	Vu2 b kanan (Kn)	Vu pilih (Kn)	Ket
sloop 45	4.42	0.14	2.91	3.34	65.46	65.46	45.70	17.01	18.81	17.01	
	-5.48	0.14	-3.39	-2.96	65.46	65.46	35.30	-19.85	-18.05	-18.05	
sloop 46 s/d 49	6.10	0.04	4.38	4.33	65.46	65.46	47.36	24.83	24.63	24.63	
	-5.90	0.04	-4.02	-4.07	65.46	65.46	34.76	-23.05	-23.25	-23.05	
lt.1 -50	30.42	7.63	-4.78	11.66	65.46	65.46	80.87	19.88	88.91	19.88	
	-31.60	-8.09	-11.98	4.46	65.46	65.46	-0.76	-91.99	-22.96	-0.76	
lt.1-51 s/d 57	45.70	13.65	-0.62	9.55	104.26	104.26	127.49	59.74	102.45	59.74	
	-44.79	-13.02	-9.02	-0.05	104.26	104.26	4.46	-98.57	-60.90	4.46	
lt.2-58	28.09	7.37	-11.37	18.32	65.46	65.46	78.15	-10.52	114.19	-10.52	
	-26.06	-7.35	-18.57	11.12	65.46	65.46	5.83	-113.08	11.64	5.83	
lt.2-59 s/d 65	45.08	13.35	-4.37	13.77	104.26	104.26	126.51	43.01	119.18	43.01	
	-45.02	-13.32	-13.97	4.17	104.26	104.26	3.90	-119.92	-43.75	3.90	
lt.3-66	33.32	7.97	-8.42	15.22	65.46	65.46	84.27	8.01	107.27	8.01	
	-33.20	-7.75	-15.62	8.02	65.46	65.46	-2.09	-108.58	-9.32	-2.09	
lt.3-67 s/d73	48.73	13.44	-2.22	12.07	104.26	104.26	130.44	55.95	115.99	55.95	
	-47.77	13.44	-11.82	2.47	104.26	104.26	29.12	-85.69	-25.65	-25.65	
atap 74	15.52	7.16	-3.85	11.96	65.46	65.46	64.72	7.62	74.03	7.62	
	-12.43	-6.31	-11.05	4.76	65.46	65.46	21.24	-66.10	0.30	0.30	
atap 75	21.99	11.35	-0.22	9.55	65.46	65.46	75.92	34.07	75.12	34.07	
	-22.62	-11.38	-9.82	-0.05	65.46	65.46	5.21	-76.96	-35.91	5.21	
atap76 s/d 81	22.86	11.70	1.61	8.75	65.46	65.46	77.21	43.05	73.04	43.05	
	-21.75	-11.03	-7.99	-0.85	65.46	65.46	6.50	-67.98	-37.99	6.50	
0	0.00	0.00	0.00	0.00	65.46	65.46	40.91	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	65.46	65.46	40.91	0.00	0.00	0.00	

Lantai	Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu.b/Ø<Vc+Vs
sloop 45	17.0	-15.70	0	19.36666667	26.2	418.3	72.6	P10-70	OK
	-18.0								
sloop 46 s/d 48	24.6	-20.0	0	19.36666667	33.3	328.9	72.6	P10-70	OK
	-23.1								
lt.1 -50	19.9	17.8	0	19.36666667	29.7	369.0	72.6	P10-70	OK
	-0.8								
lt.1-51 s/d 57	59.7	50.0	0	19.36666667	83.3	131.4	72.6	P10-70	OK
	4.5								
lt.2-58	-10.5	-9.4	0	19.36666667	15.7	696.5	72.6	P10-70	OK
	5.8								
lt.2-59 s/d 65	43.0	36.1	0	19.36666667	60.2	181.9	72.6	P10-70	OK
	3.9								
lt.3-66	8.0	6.1	0	19.36666667	10.2	1076.7	72.6	P10-70	OK
	-2.1								
lt.3-67 s/d73	56.0	51.2	0	19.36666667	85.3	128.3	72.6	P10-70	OK
	-25.7								
atap 74	7.6	6.3	0	19.36666667	10.5	1042.5	72.6	P10-70	OK
	0.3								
atap 75	34.1	29.0	0	19.36666667	48.3	226.5	72.6	P10-70	OK
	5.2								
atap76 s/d 81	43.0	36.6	0	19.36666667	61.0	179.4	72.6	P10-70	OK
	6.5								

Lantai	Luar Daerah Sendi Plastis								KONTROL
	Vu b	Vu b terpakai	Vc	Vs min	Vs	S	cek	Digunakan	Vu.b/Ø<Vc+Vs
sloop 45	17.0	-12.8	106.1	19.36666667	84.8	565.2	145.3	P10-145	OK
	-18.0								
sloop 46 s/d 49	24.6	-16.0	106.1	19.36666667	79.4	565.2	145.3	P10-145	OK
	-23.1								
lt 1 -50	19.9	2.3	106.1	19.36666667	102.3	565.2	145.3	P10-145	OK
	-0.8								
lt.1-51 s/d 57	59.7	37.6	106.1	19.36666667	43.4	565.2	145.3	P10-145	OK
	4.5								
lt 2-58	-10.5	-8.1	106.1	19.36666667	92.6	565.2	145.3	P10-145	OK
	5.8								
lt.2-59 s/d 65	43.0	27.4	106.1	19.36666667	60.4	565.2	145.3	P10-145	OK
	3.9								
lt.3-66	8.0	-0.6	106.1	19.36666667	105.1	565.2	145.3	P10-145	OK
	-2.1								
lt.3-67 s/d73	56.0	-13.5	106.1	19.36666667	83.6	565.2	145.3	P10-145	OK
	-25.7								
atap 74	7.6	4.7	106.1	19.36666667	98.2	565.2	145.3	P10-145	OK
	0.3								
atap 75	34.1	22.5	106.1	19.36666667	68.6	565.2	145.3	P10-145	OK
	5.2								
atap76 s/d 81	43.0	28.4	106.1	19.36666667	58.7	565.2	145.3	P10-145	OK
	6.5								

V.PERENCANAAN KOLOM

Perencanaan kolom 2D portal D

Ukuran kolom	b =	400	mm	=	0.4	m	
	h =	600	mm	=	0.6	m	
Ukuran balok	b =	300	mm	=	0.3	m	
	h =	500	mm	=	0.5	m	
r = 0.3*h	=	0.18	m				
f'c	=	20	mpa				
fy deform	=	400	mpa				
fy polos	=	240	mpa				
Ec = Eg	=	21019.04	mpa	=	21019039.3	kn/m^2	
Ic	=	0.0072	m^4				
Ig	=	0.003125	m^4				
tinggi kolom	h pondas =	2	m				
pj balok	lb1 =	2.8	m	lb1' =	2.4	m	
	lb2 =	7	m	lb2' =	6.6	m	
cm	=	1	(unbraced frame)				
Ø	=	0.65					
Øc	=	1.25					
d'	=	50	mm				
d	=	550	mm				

Tabel Momen Kolom

Element	Ujung Kolom	MD Knm	ML Knm	ME Knm	1.2*MD+1.6ML Knm	1.05(MD+ML+/-) Mb	1.05*ME Ms	Mb+Ms Knm	Muk2 1.05(MD+ML+(4/k)ME)	Posisi kolom
5	atas	-34.03	-9.47	-58.02	-55.51	-41.5	-60.9	-102.4	-289.04	tengah
	bawah	24.03	3.9	156.87	35.08	27.7	164.7	192.4	688.18	
8	atas	-40.75	-13.34	-111.91	-70.24	-51.2	-117.5	-168.7	-526.82	
	bawah	44.76	14.82	110.69	77.42	56.3	116.2	172.6	527.46	
11	atas	-46.41	-11.8	-100.7	-74.57	-56.2	-105.7	-161.9	-484.06	
	bawah	41.35	11.8	53.09	66.50	50.9	55.7	106.6	278.79	
14	atas	-42.75	-17.06	-63.13	-78.60	-55.6	-66.3	-121.9	-327.95	
	bawah	42.28	13.68	16.44	72.62	53.0	17.3	70.3	127.81	
4	atas	-5.82	-1.41	-36.2	-9.24	-7.0	-38.0	-45.0	-159.63	tepi kiri
	bawah	5.92	0.79	143.42	8.37	6.7	150.6	157.3	609.41	
7	atas	-7.42	-2.56	-83.04	-13.00	-9.4	-87.2	-96.6	-359.25	
	bawah	7.23	2.69	79.66	12.98	9.3	83.6	92.9	344.99	
10	atas	-8.51	-2.32	-79.82	-13.92	-10.4	-83.8	-94.2	-346.62	
	bawah	7.82	2.37	29.29	13.18	9.7	30.8	40.5	133.72	
13	atas	-7.78	-3.18	-40.24	-14.42	-10.2	-42.3	-52.4	-180.52	
	bawah	7.78	2.93	-2.04	14.02	10.0	-2.1	7.9	2.68	
6	atas	42.19	11.62	13.11	69.22	51.6	13.8	65.4	111.56	tepi kanan
	bawah	-27.63	-3.67	-130.78	-39.03	-31.3	-137.3	-168.6	-582.14	
9	atas	47.22	15.59	53.84	80.68	23.6	56.5	80.1	292.08	
	bawah	-52.94	-17.83	-47.51	-185.46	-148.6	-49.9	-198.4	-273.85	
12	atas	55.41	14.17	59.65	89.16	67.1	62.6	129.7	323.59	
	bawah	-48.69	-14.16	-5.62	-81.08	-60.0	-5.9	-65.9	-89.60	
15	atas	50.62	21.26	29.81	94.76	66.5	31.3	97.8	200.68	
	bawah	-49.97	-15.59	14.64	-84.91	-62.3	15.4	-46.9	-7.35	

Tabel Aksial Kolom

PD Kn	PL Kn	PE Kn	1.2*PD+1.6PL Kn	1.05(PD+PL+/-) Pb	1.05*PE Ps	Pb+Ps Kn	Pu Kn	1.05Ng Kn	Posisi kolom
-305.54	-122.91	-331.22	-563.31	-398.25	-347.78	-746.03	-746.03	-449.8724	tengah
-330.88	-122.91	-331.22	-593.72	-424.86	-347.78	-772.64	-772.64	-476.4836	
-223.36	-89.77	-228.53	-411.66	-291.08	-239.95	-531.04	-531.04	-328.7868	
-246.40	-89.77	-228.53	-439.31	-315.28	-239.95	-555.23	-555.23	-352.9788	
-142.40	-57.36	-129.18	-262.66	-185.66	-135.64	-321.30	-321.30	-209.7538	
-165.44	-57.36	-129.18	-290.31	-209.85	-135.64	-345.49	-345.49	-233.9458	
-56.60	-25.19	-47.93	-108.23	-75.30	-50.33	-125.63	-125.63	-85.88371	
-85.40	-25.19	-47.93	-142.79	-105.54	-50.33	-155.87	-155.87	-116.1237	
-124.78	-28.12	-340.67	-194.73	-148.73	-357.70	-506.43	-506.43	-160.5447	tepi kiri
-150.12	-28.12	-340.67	-225.14	-175.34	-357.70	-533.04	-533.04	-187.1559	
-89.56	-21.00	-232.40	-141.07	-107.27	-244.02	-351.29	-351.29	-116.0895	
-112.60	-21.00	-232.40	-168.72	-131.46	-244.02	-375.48	-375.48	-140.2815	
-53.19	-13.17	-127.52	-84.90	-64.15	-134.01	-198.15	-198.15	-69.67578	
-76.23	-13.17	-127.52	-112.54	-88.34	-134.01	-222.34	-222.34	-93.86778	
-10.14	-5.11	-44.42	-20.35	-13.87	-46.64	-60.51	-60.51	-16.01607	
-38.94	-5.11	-44.42	-54.91	-44.11	-46.64	-90.75	-90.75	-46.25607	
-248.91	-91.51	-164.93	-445.11	-319.00	-173.18	-492.18	-492.18	-357.4392	tepi kanan
-274.25	-91.51	-164.93	-475.52	-345.62	-173.18	-518.79	-518.79	-384.0504	
-181.58	-67.10	-118.09	-325.27	-232.94	-124.00	-356.94	-356.94	-261.1238	
-204.62	-67.10	-118.09	-352.92	-257.13	-124.00	-381.13	-381.13	-285.3158	
-114.21	-42.66	-72.57	-205.31	-146.80	-76.30	-223.10	-223.10	-164.7141	
-137.25	-42.66	-72.67	-232.96	-170.99	-76.30	-247.29	-247.29	-188.9061	
-41.07	-18.21	-28.42	-78.42	-54.59	-29.84	-84.43	-84.43	-62.21357	
-69.87	-18.21	-28.42	-112.98	-84.83	-29.84	-114.67	-114.67	-92.48357	

Perhitungan Momen rencana (Mc)

Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tengah	basemen	5	4.4	A	-102.4	-305.54	-746.03	0.258	0.033	Ok	2.20	1.75	42.78	OK	18639.9	3099.70	1.59	1	-126.8
			4.4	B	192.4	-330.88	-772.64				3.36	1.75	42.78	OK	18395.9	3059.13	1.64	1	210.0
	1	8	4	A	-168.7	-223.36	-531.04	0.325	0.033	Ok	2.30	1.61	35.78	OK	18494.7	4396.77	1.23	3.75	-503.4
			4	B	172.6	-246.40	-555.23				2.20	1.61	35.78	OK	18197.9	4326.21	1.25	4.89	639.0
	2	11	4	A	-161.9	-142.40	-321.30	0.332	0.033	Ok	2.07	1.6	35.56	OK	19205.2	4382.21	1.13	1.80	-258.2
			4	B	106.6	-165.44	-345.49				2.30	1.6	35.56	OK	17766.2	4276.56	1.14	2.02	170.6
	3	14	5	A	-121.9	-56.60	-125.63	0.559	0.033	Ok	0.92	1.48	41.11	OK	18112.8	3261.23	1.06	1.22	-139.7
			5	B	70.3	-85.40	-155.87				2.07	1.48	41.11	OK	16973.6	3056.12	1.09	1.35	80.9
Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tepi kiri	basemen	4	4.4	A	-45.0093	-124.78	-506.43	0.311	0.033	Ok	3.08	2	48.89	OK	20266.3	2580.29	1.43	1	-48.0
			4.4	B	157.3047	-150.12	-533.04				4.69	2	48.89	OK	22494.3	2863.95	1.40	1	160.0
	1	7	4	A	-96.6	-89.56	-351.29	0.265	0.033	Ok	3.23	1.85	41.11	OK	20936.1	3769.56	1.17	3.75	-337.8
			4	B	92.9292	-112.60	-375.48				3.08	1.85	41.11	OK	20212.4	3639.26	1.19	4.89	420.4
	2	10	4	A	-94.2081	-53.19	-198.15	0.204	0.033	Ok	2.90	1.82	40.44	OK	20713.5	3853.44	1.09	1.80	-161.8
			4	B	40.4586	-76.23	-222.34				3.23	1.82	40.44	OK	19565.6	3639.90	1.10	2.02	72.8
	3	13	5	A	-52.4244	-10.14	-60.51	0.130	0.033	Ok	1.29	1.62	45.00	OK	22501.4	3381.42	1.03	1.22	-61.8
			5	B	7.8729	-38.94	-90.75				2.99	1.62	45.00	OK	18384.4	2762.73	1.05	1.35	7.6
Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tepi kanan	basemen	6	4.4	A	65.4	-248.91	-492.18	0.133	0.033	Ok	7.73	2.9	70.89	OK	17449.4	1056.67	3.53	1	195.9
			4.4	B	-168.6426	-274.25	-518.79				11.73	2.9	70.89	OK	17167.8	1040.83	4.29	1	-271.7
	1	9	4	A	80.1192	-181.58	-356.94	0.224	0.033	Ok	8.06	2.81	62.44	OK	17414.5	1359.06	1.68	3.75	251.5
			4	B	-198.4374	-204.62	-381.13				7.70	2.81	62.44	OK	17095.4	1334.16	1.78	4.89	-509.2
	2	12	4	A	129.7401	-114.21	-223.10	0.582	0.033	Ok	7.26	2.8	62.22	OK	17377.6	1365.88	1.34	1.80	202.1
			4	B	-65.9463	-137.25	-247.29				8.06	2.8	62.22	OK	16896.1	1328.03	1.40	2.02	-96.1
	3	15	5	A	97.8453	-41.07	-84.43	1.159	0.033	Ok	3.23	2.2	61.11	OK	17676.3	1440.34	1.10	1.22	111.2
			5	B	-46.9182	-69.87	-114.67				7.26	2.2	61.11	OK	16326.5	1330.35	1.15	1.35	-51.0

Perencanaan Penulangan Kolom

Posisi Kolom : tengah

Kegiatan : **Penulangan Kolom Simetris**

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng kn	PE kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	5	4.4	3.9	Atas	1	-449.87	-331.22	224.18	299.09	553.93	1841.00	553.93
		4.4	3.9	Bawah	1	-476.48	-331.22	224.18	299.09	580.54	1867.61	580.54
1	8	4	3.5	Atas	1	-328.79	-228.53	224.18	299.09	443.25	1268.61	443.25
		4	3.5	Bawah	1	-352.98	-228.53	224.18	299.09	467.44	1312.80	467.44
2	11	4	3.5	Atas	1	-209.75	-129.78	224.18	299.09	324.22	752.30	324.22
		4	3.5	Bawah	1	-233.95	-129.78	224.18	299.09	348.41	776.49	348.41
3	14	5	4.5	Atas	1	-85.88	-47.93	143.62	143.62	136.15	267.19	136.15
		5	4.5	Bawah	1	-116.12	-47.93	143.62	143.62	166.39	317.43	166.39

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	M' mak = Mc+Ms knm	α	Mkap kiri knm	Mkap kanan knm	ø/d	Muk1 knm	Muk2 knm	Muk pakai knm
basement	5	4.4	3.9	Atas	-102.4	0.35	224.18	299.09	1	156.80	-283.04	156.8
		4.4	3.9	Bawah	192.4	0.65	224.18	299.09	1	298.25	-668.18	298.3
1	8	4	3.5	Atas	-168.7	0.49	224.18	299.09	1.3	297.55	-526.62	297.6
		4	3.5	Bawah	172.8	0.51	224.18	299.09	1.3	304.36	-527.46	304.4
2	11	4	3.5	Atas	-161.9	0.60	224.18	299.09	1.3	362.95	-484.06	363.0
		4	3.5	Bawah	105.6	0.40	224.18	299.09	1.3	236.97	-276.79	237.0
3	14	5	4.5	Atas	-121.9	0.63	143.62	143.62	1	157.62	-327.55	157.6
		5	4.5	Bawah	70.3	0.37	143.62	143.62	1	90.97	-127.51	91.0

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jml tul pilih D22	As tul mm^2	Astul > As perlu	periksa jenis runtuh	ρ	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
basement	5	4.4	3.9	Atas	-126.8	244.3	652.20	0.29	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	2125.83	Ok	Ok
		4.4	3.9	Bawah	210.0	458.9	893.14	0.51	1.10%	2640	1320	22	4	1519.76	ok	tarik	0.0069	1845.66	Ok	Ok
1	8	4	3.5	Atas	-503.2	774.4	681.93	1.14	1.50%	3600	1800	22	4	1519.76	ok	tarik	0.0069	1643.66	Ok	Ok
		4	3.5	Bawah	539.0	963.1	719.15	1.37	1.90%	4560	2280	22	4	1519.76	ok	tarik	0.0069	1643.66	Ok	Ok
2	11	4	3.5	Atas	-253.2	558.4	498.80	1.12	1.90%	4560	2280	22	12	4559.28	ok	tarik	0.0207	1502.75	Ok	Ok
		4	3.5	Bawah	170.6	367.6	536.02	0.69	1.00%	2400	1200	22	8	3039.52	ok	tarik	0.0138	1643.66	Ok	Ok
3	14	5	4.5	Atas	-139.7	242.8	209.46	1.16	1.00%	2400	1200	22	8	3039.52	ok	tarik	0.0138	1268.66	Ok	Ok
		5	4.5	Bawah	80.9	140.0	255.98	0.55	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	943.66	Ok	Ok
		5	4.5	Bawah	80.9	140.0	255.98	0.55	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	958.30	Ok	Ok

Kegiatan : **Penulangan geser**

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu,k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul geser (mm)	Av mm^2	S mm	S coba mm	Vs Kn	(√f'c/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
basement	5	4.4	3.9	Atas	156.8	553.93	117.20	113.64	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	298.3	580.54		119.30												
1	8	4	3.5	Atas	297.6	443.25	171.98	91.15	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	304.4	467.44		96.11												
2	11	4	3.5	Atas	362.9	324.22	171.98	66.76	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	239.0	348.41		71.71												
3	14	5	4.5	Atas	157.6	136.15	55.29	26.21	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		5	4.5	Bawah	91.0	166.39		34.41												

Posisi Kolom : tepi kiri

Kegiatan : **Penulangan Kolom Simetris**

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng (tabel) kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	4	4.4	3.9	Atas	1	-160.54	-340.67	0.00	224.18	205.13	1591.34	205.13
		4.4	3.9	Bawah	1	-187.16	-340.67	0.00	143.62	215.72	1617.95	215.72
1	7	4	3.5	Atas	1	-116.09	-232.40	0.00	224.18	165.13	1092.17	165.13
		4	3.5	Bawah	1	-140.28	-232.40	0.00	224.18	189.32	1116.37	189.32

400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jml tul pilih
basement	4	4.4	3.9	Atas	-48.0	73.9	315.58	0.23	1.00%	2400	1200	22	4
		4.4	3.9	Bawah	160.0	246.2	331.87	0.74	1.00%	2400	1200	22	4
1	7	4	3.5	Atas	-337.8	519.7	254.05	2.05	1.00%	2400	1200	22	5
		4	3.5	Bawah	420.4	646.8	291.26	2.22	1.00%	2400	1200	22	5
2	10	4	3.5	Atas	-161.8	266.1	182.64	1.46	1.00%	2400	1200	22	4
		4	3.5	Bawah	72.8	114.3	219.86	0.52	1.00%	2400	1200	22	4
3	13	5	4.5	Atas	-61.8	158.5	63.31	2.50	1.00%	2400	1200	22	4
		5	4.5	Bawah	7.6	11.8	131.52	0.09	1.00%	2400	1200	22	4

As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
1519.76	ok	tarik	0.0069	2529.40	Ok	Ok
1519.76	ok	tarik	0.0069	623.43	Ok	Ok
1899.7	ok	tarik	0.0086	215.66	Not Ok	Ok
1899.7	ok	tarik	0.0086	196.35	Not Ok	Ok
1519.76	ok	tarik	0.0069	258.42	Ok	Ok
1519.76	ok	tarik	0.0069	1028.63	Ok	Ok
1519.76	ok	tarik	0.0069	137.33	Ok	Ok
1519.76	ok	tarik	0.0069	3918.42	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul geser (mm)	Av mm^2	S mm	S coba mm
basement	4	4.4	3.9	Atas	41.8	205.13	34.69	42.35	tdk perlu tul geser m	10	157	282.6	250
		4.4	3.9	Bawah	93.5	215.72		44.52					
1	7	4	3.5	Atas	126.0	165.13	70.65	34.15	perlu tul geser min	10	157	282.6	250
		4	3.5	Bawah	121.2	189.32		39.11					
2	10	4	3.5	Atas	173.0	116.72	70.65	24.63	perlu tul geser min	10	157	282.6	250
		4	3.5	Bawah	74.3	142.91		29.59					
3	13	5	4.5	Atas	103.0	41.15	23.48	8.73	perlu tul geser min	10	157	282.6	250
		5	4.5	Bawah	2.7	85.49		17.82					

Vs Kn	(√f'c/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
82.896	327.95664	Ok	275	250	Ø10-250	
82.896	327.95664	Ok	275	250	Ø10-250	
82.896	327.95664	Ok	275	250	Ø10-250	
82.896	327.95664	Ok	275	250	Ø10-250	

Posisi Kolom tepi kanan

Kegiatan Penulangan Kolom Simetris

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng (tabel) kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	6	4.4	3.9	Atas	1	-357.44	-164.93	299.09	0.00	416.92	1050.16	416.92
		4.4	3.9	Bawah	1	-384.05	-164.93	143.62	0.00	412.61	1076.77	412.61
1	9	4	3.5	Atas	1	-261.12	-118.09	299.09	0.00	326.55	757.11	326.55
		4	3.5	Bawah	1	-285.32	-118.09	299.09	0.00	350.74	781.30	350.74
2	12	4	3.5	Atas	1	-164.71	-72.67	299.09	0.00	230.14	469.91	230.14
		4	3.5	Bawah	1	-188.91	-72.67	299.09	0.00	254.33	494.11	254.33
3	15	5	4.5	Atas	1	-62.24	-28.42	143.62	0.00	87.38	181.60	87.38
		5	4.5	Bawah	1	-92.48	-28.42	299.09	0.00	144.82	211.84	144.82

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mb+Ms knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 (tabel) knm	Muk pakai knm
basement	6	4.4	3.9	Atas	65.4	0.28	299.09	0.00	1	76.99	111.56	77.0
		4.4	3.9	Bawah	-168.6	0.72	143.62	0.00	1	95.35	-582.14	95.4
1	9	4	3.5	Atas	80.1	0.29	299.09	0.00	1.3	104.38	282.06	104.4

LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mb+Ms knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 (tabel) knm	Muk pakai knm
basement	4	4.4	3.9	Atas	-45.0	0.22	0.00	224.18	1	41.76	-159.63	41.8
		4.4	3.9	Bawah	157.3	0.78	0.00	143.62	1	93.53	609.41	93.5
1	7	4	3.5	Atas	-96.6	0.51	0.00	224.18	1.3	126.03	-359.25	126.0
		4	3.5	Bawah	92.9	0.49	0.00	224.18	1.3	121.25	344.99	121.2
2	10	4	3.5	Atas	-94.2	0.70	0.00	224.18	1.3	172.99	-346.62	173.0
		4	3.5	Bawah	45.3	0.30	0.00	224.13	1.3	74.29	135.72	74.3
3	13	5	4.5	Atas	-52.4	0.67	0.00	143.62	1	103.00	-180.52	103.0
		5	4.5	Bawah	7.9	0.13	0.00	224.18	1	24.15	2.68	2.7

400	600	50	550	20	240	400	40			4	3.5	Bawah	-198.4	0.71	299.09	0.00	1.3	258.52	-273.85	258.5
400	600	50	550	20	240	400	40	2	12	4	3.5	Atas	129.7	0.66	299.09	0.00	1.3	240.60	323.59	240.6
400	600	50	550	20	240	400	40			4	3.5	Bawah	-65.9	0.34	299.09	0.00	1.3	122.30	-89.60	89.6
400	600	50	550	20	240	400	40	3	15	5	4.5	Atas	97.8	0.68	143.62	0.00	1	88.08	200.68	88.1
										5	4.5	Bawah	-46.9	0.32	299.09	0.00	1	87.96	-7.35	7.4

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul.utama mm^2	Jml tul pilih	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
basement	6	4.4	3.9	Atas	195.9	301.4	641.41	0.47	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1183.15	Ok	Ok
		4.4	3.9	Bawah	-271.7	417.9	634.79	0.66	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	736.73	Ok	Ok
1	9	4	3.5	Atas	251.5	386.9	502.38	0.77	1.00%	2400	1200	22	8	3039.52	ok	tarik	0.0138	1102.75	Ok	Ok
		4	3.5	Bawah	-509.2	783.3	539.60	1.45	1.90%	4560	2280	22	8	3039.52	ok	tarik	0.0138	511.14	Not Ok	Ok
2	12	4	3.5	Atas	202.1	370.2	354.06	1.00	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	392.54	Ok	Ok
		4	3.5	Bawah	-96.1	147.8	391.28	0.38	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1572.21	Ok	Ok
3	15	5	4.5	Atas	111.2	171.0	134.43	1.27	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	305.54	Ok	Ok
		5	4.5	Bawah	-51.0	78.5	222.81	0.35	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1709.42	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul.geser (mm)	Av mm^2	S mm	S coba mm	Vs Kn	(√fc/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
basement	6	4.4	3.9	Atas	77.0	416.92	44.19	65.76	tdk perlu tul.geser m	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	95.4	412.61		84.67												
1	9	4	3.5	Atas	104.4	326.55	103.68	67.23	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	258.5	350.74		72.19												
2	12	4	3.5	Atas	240.6	230.14	94.34	47.47	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	89.6	254.33		52.43												
3	15	5	4.5	Atas	88.1	87.38	21.21	18.21	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		5	4.5	Bawah	7.4	144.82		29.99												

Perencanaan kolom 2D portal A

Ukuran kolom	b	=	400 mm	=	0.4 m		
	h	=	600 mm	=	0.6 m		
Ukuran balok	b	=	300 mm	=	0.3 m		
	h	=	500 mm	=	0.5 m		
r	= 0,3*h	=	0.18 m				
f'c		=	20 mpa				
fy deform		=	400 mpa				
fy polos		=	240 mpa				
Ec = Eg		=	21019.04 mpa	=	21019039.0 kn/m^2		
Ic		=	0.0072 m^4				
Ig		=	0.003125 m^4				
tinggi kolom	h pondasi	=	2 m				
pj balok :	lb1	=	2.8 m	lb1'	=	2.4 m	
	lb2	=	7 m	lb2'	=	6.6 m	
cm		=	1 (unbraced frame)				
Ø		=	0.65				
Øo		=	1.25				
d'		=	50 mm				
d		=	550 mm				

Tabel Momen Kolom

Element	Ujung Kolom	MD Knm	ML Knm	ME Knm	1.2*MD+1.6ML Knm	1.05(MD+ML.r) Mb	1.05*ME Ms	Mb+Ms Knm	Muk2 MD+ML+(4/5)ME	Posisi kolom
5	atas	-24.26	-4.48	-56.65	-36.23	-28.3	-59.5	-87.8	-268.08	tengah
	bawah	19.95	1.89	150.47	26.97	22.1	158.0	180.1	654.90	
8	atas	-31.15	-6.62	-109.97	-47.96	-36.9	-115.5	-152.3	-501.54	
	bawah	31.27	7.23	104.55	49.10	37.4	109.8	147.2	479.55	
11	atas	-26.11	-5.27	-97.06	-39.76	-30.7	-101.9	-132.6	-440.58	
	bawah	27.80	5.58	43.60	42.28	32.7	46.0	78.7	218.99	
14	atas	-22.25	-8.71	-58.33	-40.64	-28.9	-61.2	-90.1	-277.48	
	bawah	24.32	7.19	7.94	40.69	30.1	8.3	38.4	66.46	
4	atas	-4.95	-0.72	-35.80	-7.10	-5.7	-37.6	-43.2	-156.32	tepi kiri
	bawah	5.39	0.39	137.54	7.10	5.9	144.4	150.3	583.74	
7	atas	-5.97	-1.27	-82.06	-9.20	-7.1	-86.2	-93.2	-352.25	
	bawah	5.60	1.32	74.77	8.84	6.7	78.5	85.2	321.29	
10	atas	-5.94	-1.21	-80.46	-9.06	-7.0	-84.5	-91.5	-345.42	
	bawah	5.32	1.15	22.45	8.22	6.3	23.6	29.9	101.08	
13	atas	-5.28	-1.70	-36.43	-9.06	-6.6	-38.3	-44.9	-160.33	
	bawah	4.61	1.40	18.27	7.77	5.7	19.2	24.9	83.05	
6	atas	30.59	5.66	13.87	45.77	35.7	14.6	50.3	96.31	tapi kanan
	bawah	-23.96	-1.80	-125.57	-31.62	-26.3	-131.9	-158.1	-554.45	
9	atas	36.75	7.69	54.37	28.95	19.4	57.1	76.5	275.03	
	bawah	-37.24	-8.75	-44.33	-164.69	-137.4	-46.6	-183.9	-234.49	
12	atas	-2.16	-0.27	-33.13	-3.02	-2.4	-34.8	-37.2	-141.70	
	bawah	-26.11	-5.27	-97.06	-39.76	-30.7	-101.9	-132.6	-440.58	
15	atas	26.41	10.69	26.57	48.80	34.5	27.9	62.4	150.56	
	bawah	-30.05	-8.31	-36.70	-49.36	-36.8	-40.6	-77.4	-202.83	

Tabel Aksial Kolom

PD Kn	PL Kn	PE Kn	1.2*PD+1.6PL Kn	1.05(PD+PL.r) Pb	1.05*PE Ps	Pb+Ps Kn	Pu Kn	1.05Ng Kn	Posisi kolom
-193.23	-60.29	-303.99	-328.34	-240.87	-319.19	-560.06	-328.34	-266.1959	tengah
-218.57	-60.29	-303.99	-358.75	-267.48	-319.19	-586.67	-358.75	-292.8071	
-137.60	-43.97	-204.35	-235.47	-172.18	-325.42	-497.60	-235.47	-190.6477	
-160.64	-43.97	-204.35	-263.12	-196.37	-214.57	-410.94	-263.12	-214.8397	
-80.89643	-27.99	-109.52	-141.86	-102.57	-115.00	-217.57	-141.86	-114.3307	
-103.94	-27.99	-109.52	-169.51	-126.77	-115.00	-241.76	-169.51	-138.5227	
-30.95	-12.18	-40.57	-56.63	-40.17	-42.60	-82.77	-56.63	-45.28541	
-49.38	-12.18	-40.57	-78.74	-59.52	-42.60	-102.12	-78.74	-64.63901	
-96.79	-14.23	-309.92	-138.91	-110.59	-325.42	-436.01	-138.91	-116.5642	tepi kiri
-122.13	-14.23	-309.92	-169.32	-137.20	-325.42	-462.62	-169.32	-143.1754	
-65.84	-10.66	-205.40	-96.07	-75.85	-215.67	-291.53	-96.07	-80.32994	
-88.88	-10.66	-205.40	-123.72	-100.04	-215.67	-315.72	-123.72	-104.5219	
-34.56	-6.78	-106.21	-52.32	-40.56	-111.52	-152.07	-52.32	-43.40585	
-57.60	-6.78	-106.21	-79.97	-64.75	-111.52	-176.27	-79.97	-67.59785	
-7.20	-2.74	-36.87	-13.03	-9.29	-38.71	-48.00	-13.03	-10.43987	
-25.63	-2.74	-36.87	-35.15	-28.64	-38.71	-67.35	-35.15	-29.79347	
-159.77	-44.88	-150.71	-263.53	-196.03	-158.24	-354.27	-263.53	-214.878	tapi kanan
-185.11	-44.88	-150.71	-293.94	-222.64	-158.24	-380.88	-293.94	-241.4892	
-113.10	-32.92	-104.55	-188.41	-139.50	-109.77	-249.27	-188.41	-153.3307	
-136.14	-32.92	-104.55	-216.05	-163.69	-109.77	-273.47	-216.05	-177.5227	
-64.25	-20.95	-60.11	-110.62	-80.66	-63.12	-143.78	-110.62	-89.46201	
-87.29	-20.95	-60.11	-138.27	-104.86	-63.12	-167.97	-138.27	-113.654	
-22.14	-6.96	-22.64	-40.91	-26.90	-23.77	-52.67	-40.91	-32.65869	
-40.57	-6.96	-22.64	-63.03	-48.25	-23.77	-72.02	-63.03	-52.01229	

Perhitungan Momen rencana (Mc)

Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tengah	basement	5	4.4	A	-87.8	-193.23	-328.34	0.549	0.033	Ok	2.20	1.75	42.78	OK	16540.1	2750.52	1.22	3.12	-220.1
			4.4	B	180.1	-218.57	-358.75				3.35	1.75	42.78	OK	16326.7	2715.04	1.26	3.82	630.6
	1	8	4	A	-152.3	-137.60	-235.47	0.625	0.033	Ok	2.30	1.6	35.56	OK	16583.4	3991.84	1.10	1.51	-214.7
			4	B	147.2	-160.64	-263.12				2.20	1.6	35.56	OK	16314.0	3926.99	1.11	1.66	224.2
	2	11	4	A	-132.6	-80.90	-141.86	0.555	0.033	Ok	2.59	1.7	37.78	OK	16732.2	3567.74	1.07	1.26	-160.9
			4	B	78.7	-103.94	-169.51				2.30	1.7	37.78	OK	16287.1	3472.84	1.08	1.37	98.2
	3	14	3.2	A	-90.1	-30.95	-56.63	0.678	0.033	Ok	1.44	1.6	28.44	OK	16988.2	6389.50	1.01	1.04	-93.1
			3.2	B	36.4	-49.38	-79.74				2.59	1.6	28.44	OK	16147.3	6073.22	1.02	1.07	39.6
Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tepi kiri	basement	4	4.4	A	-43.2	-96.79	-138.91	1.082	0.033	Ok	3.08	1.95	47.67	OK	13981.2	1872.53	1.13	4.26	-166.6
			4.4	B	150.3	-122.13	-169.32				4.69	1.95	47.67	OK	18917.5	2533.66	1.11	3.82	557.6
	1	7	4	A	-93.2	-65.84	-96.07	0.887	0.033	Ok	3.23	1.85	41.11	OK	15589.5	2806.90	1.06	1.51	-137.4
			4	B	85.2	-86.88	-123.72				3.08	1.85	41.11	OK	15289.5	2752.89	1.07	1.66	137.7
	2	10	4	A	-91.5	-34.56	-52.32	0.571	0.033	Ok	3.63	1.8	40.00	OK	15822.7	3009.37	1.03	1.26	-113.4
			4	B	29.9	-57.60	-79.97				3.23	1.8	40.00	OK	15273.1	2904.84	1.04	1.37	36.8
	3	13	3.2	A	-44.9	-7.20	-13.03	1.912	0.033	Ok	2.02	1.75	31.11	OK	16920.5	5319.83	1.00	1.04	-46.5
			3.2	B	24.9	-25.63	-35.15				3.63	1.75	31.11	OK	15193.0	4776.68	1.01	1.07	26.4
Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	cek : e > e min	ψ	k (tabel)	k.l/r	konsep pemb.Momen	EI	Pc	δb	δs	Mc Knm
tepi kanan	basement	6	4.4	A	50.3	-159.77	-263.53	0.191	0.033	Ok	7.70	2.5	68.44	OK	16357.2	1062.54	1.62	4.26	119.6
			4.4	B	-158.1	-185.11	-293.94				11.73	2.5	68.44	OK	16121.3	1047.22	1.76	3.82	-549.4
	1	9	4	A	76.5	-113.10	-188.41	0.406	0.033	Ok	8.06	2.6	57.78	OK	16417.8	1496.61	1.24	1.51	110.2
			4	B	-183.9	-136.14	-216.05				7.70	2.6	57.78	OK	16117.5	1469.23	1.29	1.66	-254.9
	2	12	4	A	-37.2	-64.25	-110.62	0.337	0.033	Ok	9.07	2.65	58.89	OK	16620.2	1456.42	1.13	1.26	-46.5
			4	B	-132.6	-87.29	-138.27				8.06	2.65	58.89	OK	16105.8	1413.28	1.18	1.37	-175.4
	3	15	3.2	A	62.4	-22.14	-40.91	1.525	0.033	Ok	5.04	2.45	43.56	OK	17046.8	2734.46	1.02	1.04	64.4
			3.2	B	-77.4	-40.57	-63.03				9.07	2.45	43.56	OK	15983.9	2563.95	1.04	1.07	-81.9

Perencanaan Penulangan Kolom

Posisi Kolom : tengah

Kegiatan : Penulangan Kolom Simetris

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng kn	PE kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	5	4.4	3.9	Atas		-266.20	-303.99	224.18	224.18	355.36	1542.94	355.36
		4.4	3.9	Bawah	1	-292.81	-303.99	143.62	143.62	349.93	1569.55	349.93
1	8	4	3.5	Atas	1	-190.65	-204.35	224.18	224.18	288.73	1048.92	288.73
		4	3.5	Bawah	1	-214.84	-204.35	224.18	224.18	312.92	1073.11	312.92
2	11	4	3.5	Atas	1	-114.33	-109.52	143.62	224.18	194.79	574.31	194.79
		4	3.5	Bawah	1	-138.52	-109.52	224.18	224.18	236.60	598.50	236.60
3	14	3.2	2.7	Atas	1	-45.29	-40.57	143.62	143.62	123.83	215.68	123.83
		3.2	2.7	Bawah	1	-64.64	-40.57	143.62	224.18	165.21	235.04	165.21

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mc+Ms knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 knm	Muk pakai knm
basement	5	4.4	3.9	Atas	-283.1	0.29	224.18	224.18	1	114.53	-268.08	114.5
		4.4	3.9	Bawah	654.9	0.71	143.62	143.62	1	179.25	654.90	179.2
1	8	4	3.5	Atas	-501.5	0.51	224.18	224.18	1.3	265.47	-501.54	265.5
		4	3.5	Bawah	479.5	0.49	224.18	224.18	1.3	253.82	479.55	253.8
2	11	4	3.5	Atas	-440.6	0.67	143.62	224.18	1.3	281.58	-440.58	281.6
		4	3.5	Bawah	218.9	0.33	224.18	224.18	1.3	172.41	218.99	172.4
3	14	3.2	2.7	Atas	-277.5	0.81	143.62	143.62	1	214.10	-277.48	214.1
		3.2	2.7	Bawah	66.5	0.19	143.62	224.18	1	64.97	66.46	65.0

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jml tul p/ h D22	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk. Tul
basement	5	4.4	3.9	Atas	-220.1	338.7	546.71	0.62	1.00%	2400	1200	22	4	4179.34	ok	tarik	0.0190	1838.43	Ok	Ok
		4.4	3.9	Bawah	630.6	970.2	538.35	1.80	3.10%	7440	3720	22	11	4179.34	ok	tarik	0.0190	542.06	Ok	Ok
1	8	4	3.5	Atas	-214.7	408.4	444.20	0.92	1.01%	2424	1212	22	4	1519.76	ok	tarik	0.0069	465.02	Ok	Ok
		4	3.5	Bawah	224.2	390.5	481.42	0.81	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	550.98	Ok	Ok
2	11	4	3.5	Atas	-160.9	433.2	299.67	1.45	1.50%	3600	1800	22	6	2279.64	ok	tarik	0.0104	388.31	Ok	Ok
		4	3.5	Bawah	98.2	265.2	364.00	0.73	1.00%	2400	1200	22	6	2279.64	ok	tarik	0.0104	918.74	Ok	Ok
3	14	5	4.5	Atas	-93.1	329.4	190.50	1.73	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	210.42	Ok	Ok
		5	4.5	Bawah	39.6	100.0	254.17	0.39	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1495.49	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul.geser (mm)	Av mm^2	S mm	S coba mm	Vs Kn	(√fc/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul.geser pakai	keterangan
basement	5	4.4	3.9	Atas	114.5	355.36	75.33	73.14	perlu tul.geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	179.2	349.93		72.03												
1	8	4	3.5	Atas	265.5	288.73	148.37	59.48	perlu tul.geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	253.8	312.92		64.44												
2	11	4	3.5	Atas	281.6	194.79	129.71	40.23	perlu tul.geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	172.4	236.60		48.80												
3	14	5	4.5	Atas	214.1	123.83	62.02	25.68	perlu tul.geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		5	4.5	Bawah	65.0	165.21		34.16												

Posisi Kolom : **tepi kiri**

Kegiatan : **Penulangan Kolom Simetris**

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng (tabel) kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	4	4.4	3.9	Atas	1	-116.56	-309.92	0.00	224.18	161.15	1418.23	161.15
		4.4	3.9	Bawah	1	-143.18	-309.92	0.00	143.62	171.74	1444.85	171.74
1	7	4	3.5	Atas	1	-80.33	-205.45	0.00	224.18	129.37	943.02	129.37
		4	3.5	Bawah	1	-104.52	-205.45	0.00	224.18	153.56	967.22	153.56
2	10	4	3.5	Atas	1	-43.41	-106.27	0.00	143.62	74.82	489.48	74.82
		4	3.5	Bawah	1	-67.60	-106.27	0.00	224.18	116.64	513.67	116.64
3	13	3.2	2.7	Atas	1	-10.44	-36.67	0.00	143.62	49.71	165.27	49.71
		3.2	2.7	Bawah	1	-29.79	-36.67	0.00	143.62	69.06	184.63	69.06

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mu mak = Mb+Ms knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 (tabel) knm	Muk pakai knm
basement	4	4.4	3.9	Atas	-43.2	0.22	0.00	224.18	1	41.95	-156.32	42.0
		4.4	3.9	Bawah	150.3	0.78	0.00	143.62	1	93.42	583.74	93.4
1	7	4	3.5	Atas	-93.2	0.52	0.00	224.18	1.3	129.19	-352.25	129.2
		4	3.5	Bawah	85.2	0.48	0.00	224.18	1.3	118.09	321.29	118.1
2	10	4	3.5	Atas	-91.5	0.75	0.00	143.62	1.3	119.41	-345.42	119.4
		4	3.5	Bawah	29.9	0.25	0.00	224.18	1.3	60.89	101.08	60.9
3	13	3.2	2.7	Atas	-44.9	0.64	0.00	143.62	1	61.26	-160.33	61.3
		3.2	2.7	Bawah	24.9	0.36	0.00	143.62	1	45.11	83.05	45.1

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jmi tul pilih	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk. Tul
basement	4	4.4	3.9	Atas	-166.6	256.4	247.92	1.03	1.00%	2400	1200	22	12	4559.28	ok	tarik	0.0207	1117.10	Ok	Ok
		4.4	3.9	Bawah	557.6	857.9	264.21	3.25	3.50%	8400	4200	22	12	4559.28	ok	tarik	0.0207	307.06	Ok	Ok
1	7	4	3.5	Atas	-137.4	211.4	199.03	1.06	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	384.46	Ok	Ok
		4	3.5	Bawah	137.7	211.9	236.25	0.90	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	480.80	Ok	Ok
2	10	4	3.5	Atas	-113.4	183.7	115.11	1.60	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	231.51	Ok	Ok
		4	3.5	Bawah	38.8	93.7	179.44	0.52	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1022.61	Ok	Ok
3	13	3.2	2.7	Atas	-46.5	125.0	76.48	1.63	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	224.94	Ok	Ok
		3.2	2.7	Bawah	26.4	69.4	106.25	0.65	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	745.13	Ok	Ok

Kegiatan : **Penulangan geser**

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul.geser (mm)	Av mm^2	S mm	S coba mm	Vs Kn	(√f'c/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul.geser pakai	keterangan
basement	4	4.4	3.9	Atas	42.0	161.15	34.71	33.33	perlu tul geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	93.4	171.74		35.50												
1	7	4	3.5	Atas	129.2	129.37	70.65	26.82	perlu tul geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	118.1	153.56		31.78												
2	10	4	3.5	Atas	119.4	74.82	51.51	15.64	perlu tul geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	60.9	116.64		24.21												
3	13	3.2	2.7	Atas	81.3	49.71	46.80	10.49	perlu tul geser n	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		3.2	2.7	Bawah	45.1	69.06		14.46												

Posisi Kolom : **tepi kanan**

Kegiatan : **Penulangan Kolom Simetris**

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng (tabel) kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
basement	6	4.4	3.9	Atas	1	-214.88	-150.77	224.18	0.00	259.46	847.85	259.46
		4.4	3.9	Bawah	1	-241.49	-150.77	143.62	0.00	270.05	874.46	270.05
1	9	4	3.5	Atas	1	-153.33	-104.55	224.18	0.00	202.37	592.42	202.37
		4	3.5	Bawah	1	-177.52	-104.55	224.18	0.00	226.56	616.61	226.56

400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa)	pb (mm)
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40
400	600	50	550	20	240	400	40

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn
basement	6	4.4	3.9	Atas	119.8	184.3	399.17
		4.4	3.9	Bawah	-549.4	845.2	415.46
1	9	4	3.5	Atas	110.2	169.5	311.34
		4	3.5	Bawah	-254.9	392.2	348.56
2	12	4	3.5	Atas	-46.5	91.7	213.08
		4	3.5	Bawah	-175.4	326.8	250.30
3	15	5	4.5	Atas	64.4	99.0	110.66
		5	4.5	Bawah	-81.9	184.9	174.33

e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jml tul pilih	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk. Tul
0.46	1.00%	2400	1200	22	12	3799.4	ok	tarik	0.0173	2298.07	Ok	Ok
2.03	3.00%	7200	3600	22	12	3799.4	ok	tarik	0.0173	430.30	Ok	Ok
0.54	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	963.83	Ok	Ok
1.13	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	357.01	Ok	Ok
0.43	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1331.42	Ok	Ok
1.31	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	295.88	Ok	Ok
0.89	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	462.31	Ok	Ok
1.06	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	365.27	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul geser (mm)	Av mm^2	S mm	S coba mm	Vs Kn	(1/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
basement	6	4.4	3.9	Atas	49.8	259.46	38.52	53.48	tdk perlu tul ges	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	100.4	270.05		55.65												
1	9	4	3.5	Atas	79.9	202.37	77.72	41.78	perlu tul geser m	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	192.1	226.56		46.74												
2	12	4	3.5	Atas	59.6	138.50	77.72	28.69	perlu tul geser m	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	212.4	162.69		33.65												
3	15	5	4.5	Atas	62.0	71.93	40.49	15.04	perlu tul geser m	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		5	4.5	Bawah	120.2	113.31		23.53												

								2	12	4	3.5	Atas		-89.46	-60.11	224.18	0.00	136.50	341.92	136.50
										4	3.5	Bawah	1	-113.65	-60.11	224.18	0.00	162.69	366.11	162.69
								3	15	3.2	2.7	Atas	1	-32.66	-22.64	143.62	0.00	71.93	127.74	71.93
										3.2	2.7	Bawah	1	-52.01	-22.64	224.18	0.00	113.31	147.10	113.31

LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = ... ts knm	α	Mkap kiri knm	Mkap kanan knm	twd	Muk1 knm	Muk2 (tabel knm	Muk pakai knm
basement	6	4.4	3.9	Atas	80.3	0.24	224.18	0.00	1	49.81	96.31	49.8
		4.4	3.9	Bawah	-155.1	0.76	143.62	0.00	1	100.42	-554.45	100.4
1	9	4	3.5	Atas	76.5	0.29	224.18	0.00	1.3	79.90	275.03	79.9
		4	3.5	Bawah	-183.9	0.71	224.18	0.00	1.3	192.11	-234.49	192.1
2	12	4	3.5	Atas	-57.2	0.22	224.18	0.00	1.3	59.61	-141.70	59.6
		4	3.5	Bawah	-132.6	0.78	224.18	0.00	1.3	212.40	-440.58	212.4
3	15	5	4.5	Atas	62.4	0.45	143.62	0.00	1	62.02	150.56	62.0
		5	4.5	Bawah	-77.4	0.55	224.18	0.00	1	120.18	-202.83	120.2

Perencanaan kolom 2D portal H

Ukuran kolom	b =	400	mm	=	0.4	m	
	h =	600	mm	=	0.6	m	
Ukuran balok	b =	300	mm	=	0.3	m	
	h =	500	mm	=	0.5	m	
r = 0,3*h	=	0.18	m				
f'c	=	20	mpa				
fy deform	=	400	mpa				
fy polos	=	240	mpa				
Ec = Eg	=	21019.04	mpa	=	21019039.0	kn/m^2	
Ic	=	0.0072	m^4				
Ig	=	0.003125	m^4				
tinggi kolom	h pondasi	=	2	m			
pj balok	lb1	=	2.8	m	lb1'	=	2.4 m
	lb2	=	7	m	lb2'	=	6.6 m
cm	=	1	(unbraced frame)				
Ø	=	0.65					
Øc	=	1.25					
d'	=	50	mm				
d	=	550	mm				

Tabel Momen Kolom

Element	Ujung Kolom	MD Knm	ML Knm	ME Knm	1.2*MD+1.6ML Knm	1.05(MD+ML+(1/R)ME) Mb	1.05*ME Ms	Mb+Ms Knm	Muk2 1.05(MD+ML+(4/k)ME)	Posisi kolom
5	atas	-23.1993	-1.3839	-60.6086	-30.05	-25.2	-63.6	-88.9	-280.37	tengah
	bawah	18.1623	-0.1983	122.925	21.48	18.9	129.1	148.0	535.15	
8	atas	-24.1525	-2.7198	-81.8555	-33.33	-27.1	-85.9	-113.0	-372.01	
	bawah	26.1124	2.7461	54.879	35.73	29.1	57.6	86.8	260.79	
11	atas	-21.8898	-6.0195	-51.9275	-35.90	-26.8	-54.5	-81.3	-247.40	
	bawah	24.869	5.6137	5.6994	38.82	29.6	6.0	35.6	55.94	
4	atas	-4.6513	-0.5893	-42.7933	-6.52	-5.3	-44.9	-50.2	-185.23	tepi kiri
	bawah	4.1982	-0.4901	111.8453	4.25	4.1	117.4	121.5	473.64	
7	atas	-4.4157	-0.3971	-67.307	-5.93	-4.9	-70.7	-75.6	-287.74	
	bawah	4.7649	0.9574	35.4881	7.25	5.6	37.3	42.9	155.06	
10	atas	-4.4621	-1.3795	-32.8007	-7.56	-5.6	-34.4	-40.0	-143.90	
	bawah	4.781	1.5302	13.3524	8.19	6.0	14.0	20.0	62.71	
6	atas	27.2189	0.4482	26.569	33.38	28.9	27.9	56.8	140.64	tapi kanan
	bawah	-22.9922	-0.8366	-103.1119	-28.93	-24.7	-108.3	-132.9	-458.09	
9	atas	29.6946	4.4959	53.8115	39.08	30.7	56.5	87.2	261.91	
	bawah	-29.75	-2.32	-16.96	-127.45	-109.7	-17.8	-127.5	-104.90	
12	atas	26.0357	8.0378	24.4047	44.10	32.4	25.6	58.0	138.28	
	bawah	-29.9662	-6.5052	-32.6811	-46.37	-35.6	-34.3	-69.9	-175.56	

Tabel Aksial Kolom

PD Kn	PL Kn	PE Kn	1.2*PD+1.6PL Kn	1.05(PD+PL+(1/R)E) Pb	1.05*PE Ps	Pb+Ps Kn	Pu Kn	1.05Ng Kn	Posisi kolom
-134.27	-36.71	-183.71	-219.86	-164.11	-192.89	-357.00	-219.86	-179.531	tengah
-157.31	-36.71	-183.71	-247.51	-188.31	-192.89	-381.20	-247.51	-203.723	
-81.22	-24.51	-103.77	-136.69	-100.73	-108.96	-209.68	-136.69	-111.022	
-104.26	-24.51	-103.77	-164.33	-124.92	-108.96	-233.88	-164.33	-135.214	
-31.09	-10.58	-39.07	-54.24	-39.31	-41.03	-80.34	-54.24	-43.7576	
-49.52	-10.58	-39.07	-76.36	-58.67	-41.03	-99.69	-76.36	-63.1112	
-63.84	-9.52	-178.34	-91.83	-73.02	-187.26	-260.28	-91.83	-77.0219	tepi kiri
-86.88	-9.52	-178.34	-119.48	-97.22	-187.26	-284.47	-119.48	-101.214	
-33.42	-6.16	-97.83	-49.96	-38.97	-102.72	-141.69	-49.96	-41.5592	
-56.46	-6.16	-97.83	-77.61	-63.16	-102.72	-165.88	-77.61	-65.7512	
-6.80	-2.58	-34.34	-12.29	-8.77	-36.06	-44.83	-12.29	-9.85217	
-25.23	-2.58	-34.34	-34.41	-28.12	-36.06	-64.18	-34.41	-29.2058	
-95.53	-15.83	-98.66	-139.97	-110.28	-103.59	-213.87	-139.97	-116.93	tapi kanan
-118.57	-15.83	-98.66	-167.61	-134.47	-103.59	-238.06	-167.61	-141.122	
-60.09	-14.54	-57.7528	-95.38	-72.26	-60.64	-132.90	-95.38	-78.3634	
-83.13	-14.54	-57.75	-123.02	-95.45	-60.64	-157.09	-123.02	-102.555	
-20.27	-6.22	-21.74	-34.27	-25.20	-22.83	-48.03	-34.27	-27.8126	
-38.70	-6.22	-21.74	-56.39	-44.56	-22.83	-67.38	-56.39	-47.1662	

Perhitungan Momen rencana (Mc)

Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	ek : e > e m	ψ	k (tabel)	k.l/r	konsep pemb Momen	EI	Pc	δb	δs	Mc Knm
tengah	1	5	4	A	-88.9	-134.27	-219.86	0.673	0.033	Ok	2.30	1.8	10.00	OK	16311.9	3102.41	1.12	1.59	-129.6
			4	B	148.0	-157.31	-247.51				3.46	1.8	40.00	OK	16063.9	3055.24	1.14	1.72	244.0
	2	8	4	A	-113.0	-81.22	-136.69	0.635	0.033	Ok	2.59	1.7	37.78	OK	16480.6	3514.09	1.06	1.27	-138.0
			4	B	86.8	-104.26	-164.33				2.30	1.7	37.78	OK	16074.9	3427.61	1.08	1.40	112.0
	3	11	3.2	A	-81.3	-31.09	-54.24	0.657	0.033	Ok	1.44	1.58	28.09	OK	16700.7	6441.38	1.01	1.03	-83.4
			3.2	B	35.6	-49.52	-76.36				2.59	1.58	28.09	OK	15937.4	6146.99	1.02	1.06	36.6

Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	ek : e > e m	ψ	k (tabel)	k.l/r	konsep pemb Momen	EI	Pc	δb	δs	Mc Knm
tepi kiri	1	4	4	A	-50.188089	-63.84	-91.83	1.323	0.033	Ok	3.23	2	44.44	OK	13501.3	2079.97	1.07	1.74	-83.8
			4	B	121.536912	-86.88	-119.48				4.84	2	44.44	OK	20531.6	3163.03	1.06	1.72	206.6
	2	7	4	A	-75.6	-33.42	-49.96	0.858	0.033	Ok	3.63	1.9	42.22	OK	15743.9	2687.48	1.03	1.27	-94.6
			4	B	42.868812	-56.46	-77.61				3.23	1.9	42.22	OK	15209.8	2596.30	1.05	1.40	58.0
	3	10	3.2	A	-39.995025	-6.60	-12.29	1.627	0.033	Ok	1.44	1.7	30.22	OK	16915.4	5635.66	1.00	1.03	-41.1
			3.2	B	20.004096	-25.23	-34.41				3.63	1.7	30.22	OK	15158.4	5050.29	1.01	1.06	20.9

Posisi Kolom	Lantai	elemen	hk m	Ujung Kolom	M=Mb+Ms KNm	PD tabel KN	Pu tabel KN	e m	e min m	ek : e > e m	ψ	k (tabel)	k.l/r	konsep pemb Momen	EI	Pc	δb	δs	Mc Knm
tepi kanan	1	6	4	A	56.8	-95.53	-139.97	0.406	0.033	Ok	8.06	2.95	65.56	OK	15615.7	1105.75	1.24	1.74	84.4
			4	B	-132.936363	-118.57	-167.61				12.10	2.95	65.56	OK	15398.2	1089.64	1.31	1.72	-218.8
	2	9	4	A	87.231942	-60.09	-95.38	0.915	0.033	Ok	9.07	2.9	64.44	OK	16118.8	1181.07	1.14	1.27	106.9
			4	B	-127.536465	-83.13	-123.02				8.06	2.9	64.44	OK	15679.2	1148.86	1.20	1.40	-156.3
	3	12	3.2	A	58.026234	-20.27	-34.27	1.693	0.033	Ok	1.44	2.1	37.33	OK	16506.8	3604.42	1.01	1.03	59.3
			3.2	B	-69.877941	-38.70	-56.39				9.07	2.1	37.33	OK	15580.2	3401.68	1.03	1.06	-72.6

Perencanaan Penulangan Kolom

Posisi Kolom : tengah

Kegiatan : **Penulangan Kolom Simetris**

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng kn	PE kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
400	600	50	550	20	240	400	40	1	5	4	3.5	Atas	1	-179.53	-183.71	143.62	224.18	259.99	951.09	259.99
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-203.72	-183.71	143.62	143.62	266.56	975.29	266.56
400	600	50	550	20	240	400	40	2	8	4	3.5	Atas	1	-111.02	-103.77	143.62	224.18	191.48	546.85	191.48
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-135.21	-103.77	143.62	224.18	215.67	571.04	215.67
400	600	50	550	20	240	400	40	3	11	3.2	2.7	Atas	1	-43.76	-39.07	143.62	143.62	122.30	207.87	122.30
										3.2	2.7	Bawah	1	-63.11	-39.07	143.62	224.18	163.68	227.22	163.68

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mb+M knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 knm	Muk pakai knm
400	600	50	550	20	240	400	40	1	5	4	3.5	Atas	-88.9	0.38	143.62	224.18	1	121.65	-280.37	121.6
400	600	50	550	20	240	400	40			4	3.5	Bawah	146.0	0.62	143.62	143.62	1	159.90	535.15	159.9
400	600	50	550	20	240	400	40	2	8	4	3.5	Atas	-115.0	0.57	143.62	224.18	1.3	238.46	-372.01	238.5
400	600	50	550	20	240	400	40			4	3.5	Bawah	86.8	0.43	143.62	224.18	1.3	183.08	260.79	183.1
400	600	50	550	20	240	400	40	3	11	3.2	2.7	Atas	-81.3	0.70	143.62	143.62	1.3	239.86	-247.40	239.9
										3.2	2.7	Bawah	35.6	0.30	143.62	224.18	1.3	133.21	55.94	55.9

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul.utama mm^2	Jmi tul pilih D22	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
1	5	4	3.5	Atas	[illegible]29.6	199.4	399.98	0.50	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	1090.62	Ok	Ok
		4	3.5	Bawah	244.0	375.3	410.09	0.92	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	467.91	Ok	Ok
2	8	4	3.5	Atas	[illegible]38.0	366.9	294.58	1.25	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	313.85	Ok	Ok
		4	3.5	Bawah	[illegible]2.0	281.7	331.80	0.85	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	517.85	Ok	Ok
3	11	3.2	2.7	Atas	83.4	369.0	188.15	1.96	1.00%	2400	1200	22	5	1899.7	ok	tarik	0.0086	226.43	Ok	Ok
		3.2	2.7	Bawah	36.6	86.1	251.82	0.34	1.00%	2400	1200	22	5	1899.7	ok	tarik	0.0086	2006.68	Ok	Ok

Kegiatan : **Penulangan geser**

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul.geser (mm	Av mm^2	S mm	S coba mm	Vs Kn	(√fc/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
1	5	4	3.5	Atas	121.6	259.99	80.44	53.59	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	159.9	266.56		54.94												
2	8	4	3.5	Atas	238.5	191.48	120.44	39.55	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	183.1	215.67		44.51												
3	11	3.2	2.7	Atas	239.9	122.30	109.56	25.37	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		3.2	2.7	Bawah	55.9	163.68		33.85												

Posisi Kolom : tepi kiri

Kegiatan : **Penulangan Kolom Simetris**

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	f'c (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	Rv	1.05Ng (tabel) kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
400	600	50	550	20	240	400	40	1	4	4	3.5	Atas	1	-77.02	-178.34	0.00	143.62	108.44	826.04	108.44
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-101.21	-178.34	0.00	143.62	132.63	850.23	132.63
400	600	50	550	20	240	400	40	2	7	4	3.5	Atas	1	-41.56	-97.83	0.00	143.62	72.98	452.42	72.98
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-65.75	-97.83	0.00	143.62	97.17	476.62	97.17

400	600	50	550	20	240	400	40	3	10	3.2	2.7	Atas	1	-9.85	-34.34	0.00	143.62	49.12	154.08	49.12				
400	600	50	550	20	240	400	40			3.2	2.7	Bawah	1	-29.21	-34.34	0.00	143.62	68.48	173.44	68.48				

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mb+M knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 (tab knm	Muk pakai knm
400	600	50	550	20	240	400	40	1	4	4	3.5	Atas	-50.2	0.29	0.00	143.62	1	35.61	-185.23	35.61
400	600	50	550	20	240	400	40			4	3.5	Bawah	121.5	0.71	0.00	143.62	1	86.24	473.64	86.2
400	600	50	550	20	240	400	40	2	7	4	3.5	Atas	-75.6	0.64	0.00	143.62	1.3	101.07	-287.74	101.1
400	600	50	550	20	240	400	40			4	3.5	Bawah	22.9	0.36	0.00	143.62	1.3	57.34	155.06	57.3
400	600	50	550	20	240	400	40	3	10	3.2	2.7	Atas	-40.0	0.67	0.00	143.62	1.3	109.51	-143.90	109.5
										3.2	2.7	Bawah	25.0	0.33	0.00	143.62	1.3	54.77	62.71	54.8

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pilih/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul.utama mm^2	Jml tul pilih	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
1	4	4	3.5	Atas	-83.8	129.0	166.83	0.77	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	588.74	Ok	Ok
		4	3.5	Bawah	206.6	317.9	204.05	1.56	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	238.32	Ok	Ok
2	7	4	3.5	Atas	-94.8	155.5	112.27	1.39	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	275.01	Ok	Ok
		4	3.5	Bawah	58.0	89.2	149.49	0.60	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	847.27	Ok	Ok
3	10	3.2	2.7	Atas	-41.1	168.5	75.57	2.23	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	156.61	Ok	Ok
		3.2	2.7	Bawah	20.9	84.3	105.35	0.80	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0069	561.65	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu, k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asums: Ø tul geser (mm	Av mm^2	S mm	S coba mm	Vs Kn	(√fc/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul.geser pakai	keterangan
1	4	4	3.5	Atas	35.6	108.44	34.82	22.53	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	86.2	132.63		27.49												
2	7	4	3.5	Atas	101.1	72.98	45.26	15.26	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	57.3	97.17		20.22												
3	10	3.2	2.7	Atas	109.5	49.12	60.84	10.37	perlu tul geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		3.2	2.7	Bawah	54.8	68.48		14.34												

Posisi Kolom tepi kanan

Kegiatan **Penulangan Kolom Simetris**

DATA KOLOM

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	Pn	1.05Ng (tabel kn	PE (tabel) kn	Mkap kiri knm	Mkap kanan knm	Nu,k1 kn	Nu,k2 kn	Nu,k pakai kn
400	600	50	550	20	240	400	40	1	6	4	3.5	Atas	1	-116.93	-98.66	224.18	0.00	165.97	531.28	165.97
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-141.12	-98.66	143.62	0.00	172.54	555.47	172.54
400	600	50	550	20	240	400	40	2	9	4	3.5	Atas	1	-78.36	-57.75	224.18	0.00	127.40	320.93	127.40
400	600	50	550	20	240	400	40			4	3.5	Bawah	1	-102.56	-57.75	224.18	0.00	151.60	345.12	151.60
400	600	50	550	20	240	400	40	3	12	3.2	2.7	Atas	1	-27.81	-21.74	143.62	0.00	67.08	119.12	67.08
										3.2	2.7	Bawah	1	-47.17	-21.74	224.18	0.00	108.47	138.48	108.47

Kolom

b (mm)	h (mm)	d' (mm)	d (mm)	fc (mpa)	fy polos (mpa)	fy deform (mpa	pb (mm)	LANTAI	elemen	hk m	hk' m	Ujung Kolom	M mak = Mb+M knm	α	Mkap kiri knm	Mkap kanan knm	ωd	Muk1 knm	Muk2 (tab knm	Muk pakai knm
400	600	50	550	20	240	400	40	1	6	4	3.5	Atas	56.8	0.30	224.18	0.00	1	62.61	140.64	62.6
400	600	50	550	20	240	400	40			4	3.5	Bawah	-132.9	0.70	143.62	0.00	1	93.94	-458.09	93.9
400	600	50	550	20	240	400	40	2	9	4	3.5	Atas	87.2	0.41	224.18	0.00	1.3	110.48	261.91	110.5

400	600	50	550	20	240	0	40				4	3.5	Bawah	-127.5	0.59	224.18	0.00	1.3	161.53	-104.90	104.9
400	600	50	550	20	240	400	40	3	12	3.2	2.7	Atas	56.0	0.45	143.62	0.00	1.3	81.98	138.28	82.0
400	600	50	550	20	240	400	40			3.2	2.7	Bawah	-69.9	0.55	224.18	0.00	1.3	154.11	-175.56	154.1

LANTAI	elemen	hk m	hk' m	Ujung Kolom	Mc Knm	Mu pakai/Ø knm	Nu,k pakai/Ø kn	e m	% dari grafik	Ast grafik mm^2	As perlu mm^2	Ø tul utama mm^2	Jml tul pilih	As tul mm^2	Astul > As perlu	periksa jenis runtuh	p	Pn Kn	periksa Pn > Nu/Ø	Periksa jrk Tul
1	6	4.4	3.9	Atas	84.4	129.8	255.34	0.51	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0059	1061.10	Ok	Ok
		4.4	3.9	Bawah	-278.8	336.6	265.44	1.27	1.10%	2640	1320	22	4	1519.76	ok	tarik	0.0059	306.82	Ok	Ok
2	9	4	3.5	Atas	106.9	170.0	196.01	0.87	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0059	503.09	Ok	Ok
		4	3.5	Bawah	-156.3	240.4	233.22	1.03	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0059	399.85	Ok	Ok
3	12	4	3.5	Atas	59.3	126.1	103.20	1.22	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0059	321.39	Ok	Ok
		4	3.5	Bawah	-72.8	237.1	166.87	1.42	1.00%	2400	1200	22	4	1519.76	ok	tarik	0.0059	266.53	Ok	Ok

Kegiatan : Penulangan geser

Lantai	elemen	hk m	hk' m	ujung	Muk pakai Knm	Nu k pakai Kn	Vu,k Kn	0.5*Ø*Vc Kn	periksa	asumsi Ø tul.geser (mm	Av mm^2	S mm	S coba mm	Vs Kn	√fc/3)*bw*d Kn	Kontrol	d/2 mm	S pilih	tul geser pakai	keterangan
1	6	4.4	3.9	Atas	62.6	155.97	40.14	34.32	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4.4	3.9	Bawah	93.9	172.54		35.67												
2	9	4	3.5	Atas	116.5	127.40	61.54	26.41	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	104.9	151.60		31.37												
3	12	4	3.5	Atas	82.0	67.08	67.46	14.05	perlu tul.geser min	10	157	282.6	250	82.896	327.95664	Ok	275	250	Ø10-250	
		4	3.5	Bawah	154.1	108.47		22.53												

Grafik Mn,Pn Kolom:

Diketahui

b	=	400 mm	=	0.4 m
h	=	600 mm	=	0.6 m
d	=	50 mm		
f'c	=	20 mpa		
fy deform	=	400 mpa		
fy polos	=	240 mpa		

Ukuran Kolom : 400/ 600

tabel 1%

	seimbang	Patah Desak x>xb			Patah tarik x<xb			Pn=0
d (mm)	550	550	550	550	550	550	550	
Ag (mm^2)	240000	240000	240000	240000	240000	240000	240000	
Ast (mm^2)	2400	2400	2400	2400	2400	2400	2400	
As' = As (m	1200	1200	1200	1200	1200	1200	1200	
Po (kn)	4999.2							
Xb (mm)	330	396	495	660	132	198	264	
f's (mpa)	400.00	400.00	400.00	400.00	372.73	400.00	400.00	
Ccb (kn)	1907.4	2288.88	2861.1	3814.8	762.96	1144.44	1525.92	
Csb (kn)	459.6	459.6	459.6	459.6	426.8727	459.6	459.6	
T (kn)	480	480	480	480	480	480	480	
Pn (kn)	1887	2268.48	2840.7	3794.4	709.8327	1124.04	1505.52	
ȳ (mm)	300	300	300	300	300	300	300	
a (mm)	280.5	336.6	420.75	561	112.2	168.3	224.4	70.58824
Mnb (knm)	539.6072	536.3455	491.3261	309.2886	412.8041	481.9274	521.4678	247.0568
eb (m)	0.28596	0.236434	0.17296	0.081512	0.581551	0.428746	0.346371	
cek Pn		Ok	Ok	Ok	Ok	Ok	Ok	
cek e		ok	ok	ok	ok	ok	ok	

tabel 2%

	seimbang	Patah Desak x>xb			Patah tarik x<xb			Pn=0
d (mm)	550	550	550	550	550	550	550	
Ag (mm^2)	240000	240000	240000	240000	240000	240000	240000	
Ast (mm^2)	4800	4800	4800	4800	4800	4800	4800	
As' = As (m	2400	2400	2400	2400	2400	2400	2400	
Po (kn)	5918.4							
Xb (mm)	330	396	495	660	132	198	264	
f's (mpa)	400.00	400.00	400.00	400.00	372.73	400.00	400.00	
Ccb (kn)	1907.4	2288.88	2861.1	3814.8	762.96	1144.44	1525.92	
Csb (kn)	919.2	919.2	919.2	919.2	853.7455	919.2	919.2	
T (kn)	960	960	960	960	960	960	960	
Pn (kn)	1866.6	2248.08	2820.3	3774	656.7055	1103.64	1485.12	
ȳ (mm)	300	300	300	300	300	300	300	
a (mm)	280.5	336.6	420.75	561	112.2	168.3	224.4	141.1765
Mnb (knm)	774.5072	771.2455	726.2261	544.1886	639.5223	716.8274	756.3678	460.2353
eb (m)	0.414929	0.343069	0.2575	0.144194	0.973834	0.649512	0.509297	
cek Pn		Ok	Ok	Ok	Ok	Ok	Ok	
cek e		ok	ok	ok	ok	ok	ok	

tabel 3%

	seimbang	Patah Desak x>xb			Patah tarik x<xb			Pn=0
d (mm)	550	550	550	550	550	550	550	
Ag (mm^2)	240000	240000	240000	240000	240000	240000	240000	
Ast (mm^2)	7200	7200	7200	7200	7200	7200	7200	
As' = As (m	3600	3600	3600	3600	3600	3600	3600	
Po (kn)	6837.6							
Xb (mm)	330	396	495	660	132	198	264	
f's (mpa)	400.00	400.00	400.00	400.00	372.73	400.00	400.00	
Ccb (kn)	1907.4	2288.88	2861.1	3814.8	762.96	1144.44	1525.92	
Csb (kn)	1378.8	1378.8	1378.8	1378.8	1280.618	1378.8	1378.8	
T (kn)	1440	1440	1440	1440	1440	1440	1440	
Pn (kn)	1846.2	2227.68	2799.9	3753.6	603.5782	1063.24	1464.72	
ȳ (mm)	300	300	300	300	300	300	300	
a (mm)	280.5	336.6	420.75	561	112.2	168.3	224.4	211.7647
Mnb (knm)	1009.407	1006.145	961.1261	779.0885	866.2405	951.7274	991.2578	639.5294
eb (m)	0.546749	0.451656	0.343272	0.207558	1.435175	0.878593	0.676763	
cek Pn		Ok	Ok	Ok	Ok	Ok	Ok	
cek e		ok	ok	ok	ok	ok	ok	

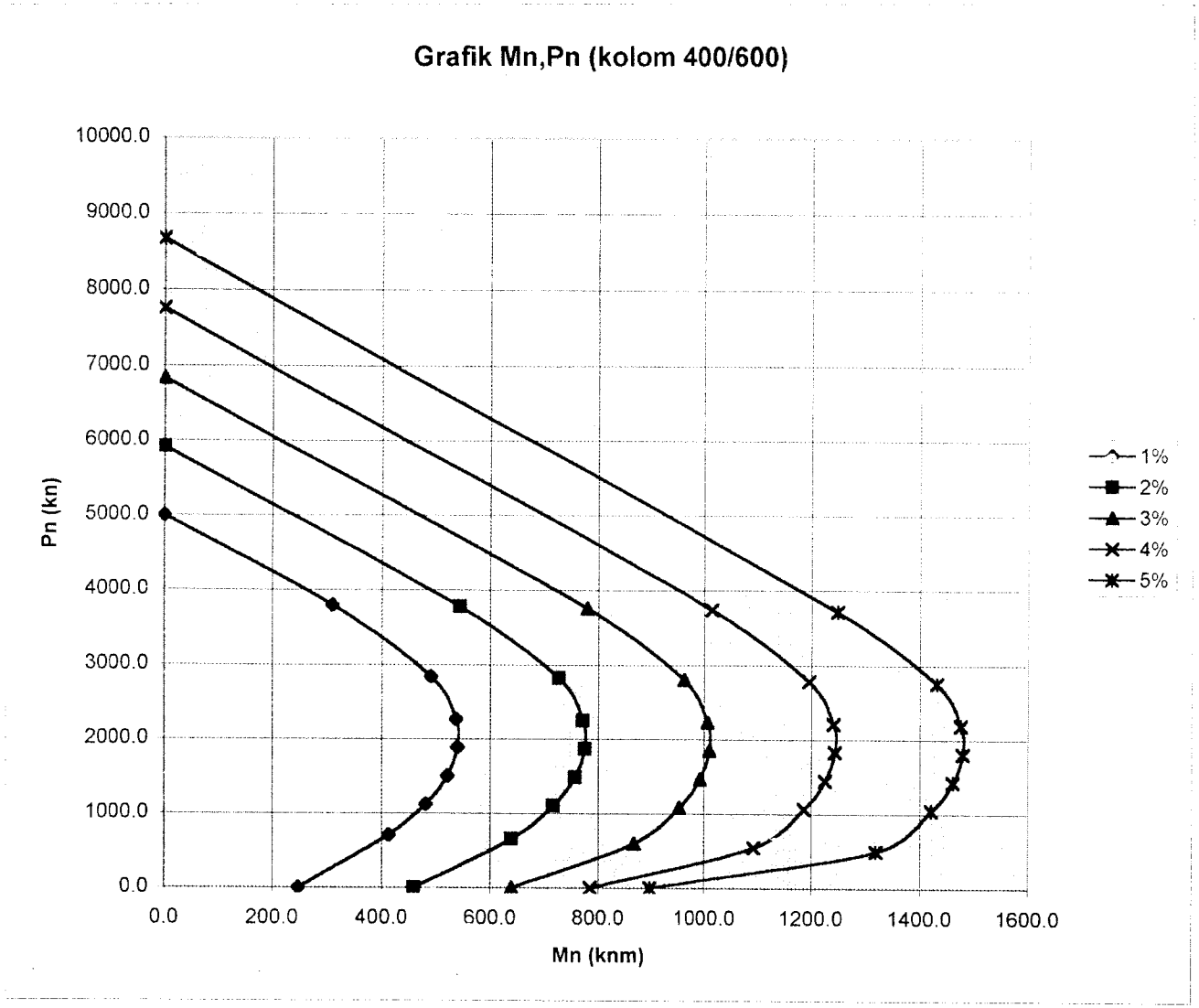
tabel	4%							
	seimbang	Patah Desak x>xb			Patah tarik x<xb			Pn=0
d (mm)	550	550	550	550	550	550	550	
Ag (mm^2)	240000	240000	240000	240000	240000	240000	240000	
Ast (mm^2)	9600	9600	9600	9600	9600	9600	9600	
As' = As (m	4800	4800	4800	4800	4800	4800	4800	
Po (kn)	7756.8							
Xb (mm)	330	396	495	660	132	198	264	
f's (mpa)	400.00	400.00	400.00	400.00	372.73	400.00	400.00	
Ccb (kn)	1907.4	2288.88	2861.1	3814.8	762.96	1144.44	1525.92	
Csb (kn)	1838.4	1838.4	1838.4	1838.4	1707.491	1838.4	1838.4	
T (kn)	1920	1920	1920	1920	1920	1920	1920	
Pn (kn)	1825.6	2207.28	2779.5	3733.2	550.4509	1062.84	1444.32	
ȳ (mm)	300	300	300	300	300	300	300	
a (mm)	280.5	336.6	420.75	561	112.2	168.3	224.4	282.3529
Mnb (knm)	1244.307	1241.045	1196.026	1013.989	1092.959	1186.627	1226.168	784.9412
eb (m)	0.681513	0.562251	0.430303	0.271614	1.98557	1.116468	0.848959	
cek Pn		Ok	Ok	Ok	Ok	Ok	Ok	
cek e		ok	ok	ok	ok	ok	ok	

tabel	5%							
	seimbang	Patah Desak x>xb			Patah tarik x<xb			Pn=0
d (mm)	550	550	550	550	550	550	550	
Ag (mm^2)	240000	240000	240000	240000	240000	240000	240000	
Ast (mm^2)	12000	12000	12000	12000	12000	12000	12000	
As' = As (m	6000	6000	6000	6000	6000	6000	6000	
Po (kn)	8676							
Xb (mm)	330	396	495	660	132	198	264	
f's (mpa)	400.00	400.00	400.00	400.00	372.73	400.00	400.00	
Ccb (kn)	1907.4	2288.88	2861.1	3814.8	762.96	1144.44	1525.92	
Csb (kn)	2298	2298	2298	2298	2134.364	2298	2298	
T (kn)	2400	2400	2400	2400	2400	2400	2400	
Pn (kn)	1805.4	2186.88	2759.1	3712.8	497.3236	1042.44	1423.92	
ȳ (mm)	300	300	300	300	300	300	300	
a (mm)	280.5	336.6	420.75	561	112.2	168.3	224.4	352.9412
Mnb (knm)	1479.207	1475.945	1430.926	1246.889	1319.677	1421.527	1461.068	896.4706
eb (m)	0.819324	0.674909	0.518621	0.336374	2.653557	1.363654	1.026088	
cek Pn		Ok	Ok	Ok	Ok	Ok	Ok	
cek e		ok	ok	ok	ok	ok	ok	

DATA GRAFIK										
	1%		2%		3%		4%		5%	
	Mn	Pn	Mn	Pn	Mn	Pn	Mn	Pn	Mn	Pn
Pn=0	247.1	0.0	460.2	0.0	639.5	0.0	784.9	0.0	896.5	0.0
tarik	412.6	709.8	639.5	656.7	866.2	603.6	1093.0	550.5	1319.7	497.3
	481.9	1124.0	716.8	1103.6	951.7	1053.2	1186.6	1062.8	1421.5	1042.4
	521.5	1505.5	756.4	1485.1	991.3	1464.7	1226.2	1444.3	1461.1	1423.9
setimbang	539.6	1887.0	774.5	1866.6	1009.4	1846.2	1244.3	1825.8	1479.2	1805.4
desak	536.3	2268.5	771.2	2248.1	1006.1	2227.7	1241.0	2207.3	1475.9	2186.9
	491.3	2840.7	726.2	2820.3	961.1	2799.9	1196.0	2779.5	1430.9	2759.1
	309.3	3794.4	544.2	3774.0	779.1	3753.6	1014.0	3733.2	1245.9	3712.8
Mn=0	0.0	4999.2	0.0	5918.4	0.0	6837.6	0.0	7756.8	0.0	8676.0

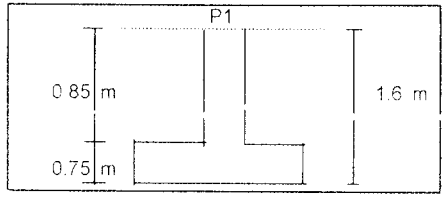
VI. PERTEMUAN BALOK-KOLOM

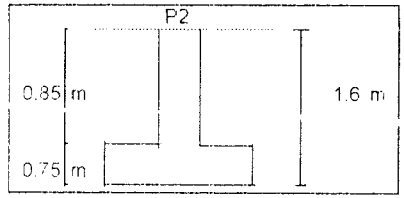
NAMA TABEL	Penulangan pertemuan balok kolom		
Jenis pertemuan	luar	luar	dalam
Posisi	kolom D 1 lantai 3	kolom D 1 lantai 3	kolom D 2 lantai 3
f'c (Mpa)	20	20	20
fy (Mpa)	400	400	400
Ukuran Kolom			
b (mm)	400	400	400
h (mm)	600	600	600
d' (mm)	50	50	50
d (mm)	550	550	550
Z (mm)	500	500	500
pb (mm)	40	40	40
Ukuran Balok kiri = kanan			
b (mm)	300	300	300
h (mm)	500	500	500
pb (mm)	40	40	40
d' (mm)	61	61	61
d (mm)	439	439	439
Z (mm)	378	378	378
Data tulangan			
Ø tulangan (mm)	22	22	22
Ø sengkang (mm)	10	10	10
faktor			
Øo	1.25	1.25	1.25
Perhit. Gaya dalam :			
l ki (m)	0	7	7
ln ki (m)	-0.4	6.6	6.6
l ka (m)	2.8	0	2.8
ln ka (m)	2.4	-0.4	2.4
hk a (m)	5	5	5
hk b (m)	4	4	4
Mnak.ki (knm)	0	239.27	179.35
Mnak.ka (knm)	179.35	0.00	239.27
Mkap.ki (knm)	0	299.089066	224.1836715
Mkap.ka (knm)	224.18	0.00	299.09
V kol (kn)	40.69	49.34	91.27
C (kn)	0.00	0.00	415.15
T (kn)	415.15	553.87	553.87
Vj.h (kn)	374.47	504.52	877.76
Vj.v (kn)	343.26	462.48	804.61
Kontrol teg.geser minimal :			
1.5f'c (Mpa)	30	30	30
hc (mm)	600	600	600
bj 1 (mm)	400	400	400
bj 2 (mm)	600	600	600
bj pilih (mm)	400	400	400
Vj.h (n/mm^2)	1.73	2.31	2.31
check Vj.h<1.5f'c	Ok	Ok	Ok
Penulangan geser Horizontal :			
0.1f'c (mpa)	2	2	2
Nu k (kn)	85.49	144.82	166.39
Nu k/Ag (mpa)	0.356200885	0.603433984	0.693290719
Vc.h (kn)	0	0	0
Vs.h (kn)	343.26	462.48	804.61
Aj.h (mm^2)	856.1596721	1156.200788	2011.528568
digunaka sengkang rangkap Ø (mm	10	10	10
A tersedia (mm^2)	314	314	314
jumlah lapis sengkang	2.732993223	3.682168113	6.406142001
jml lapis sengkang pakai	3	4	7
Penulangan geser vertikal :			
Vc.v (kn)	231.3511805	317.9367338	557.081829
Vs.v (kn)	111.91	144.54	247.53
Aj.v (mm^2)	279.7819209	361.3589531	618.824016
n tul	4	6	8
check : As pasang > Aj.v	Ok	Ok	Ok
Kontrol jarak tul.Vertikal :			
2 s (mm)	378	378	378
jarak tulangan (mm)	189	189	189

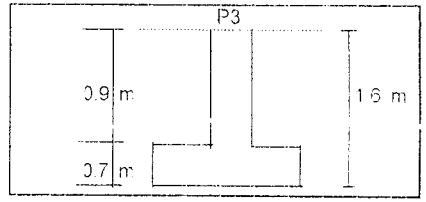

Grafik Mn,Pn (kolom 400/600)
Pn (kn)
10000.0
9000.0
8000.0
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
1600.0
Mn (knm)
1%
2%
3%
4%
5%

VII. PERENCANAAN PONDASI

Perencanaan Pondasi Telapak







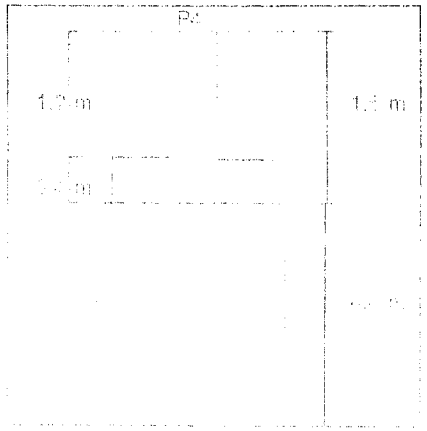
Data :	P1	P2	P3
σ tanah (kn/m^2)	200	200	200
h tnh keras (m)	1.6	1.6	1.6
fc (mpa)	20	20	20
fy (mpa)	400	400	400
Bj tnh (kn/m^3)	15.9	15.9	15.9
Bj btn (kn/m^3)	24	24	24
asumsi tebal pondasi (m)	0.75	0.75	0.7
PU (kn)	497.18	512.33	411.50
Ukuran kolom			
b (mm)	400.00	400.00	400.00
h (mm)	600.00	600.00	600.00
Daya dukung netto :			
q (kn/m^2)	31.515	31.515	31.515
q netto (kn/m^2)	168.485	168.485	168.485
Dimensi pondasi bjr.sangkar :			
A perlu (m^2)	2.95	3.04	2.44
b (m)	1.72	1.74	1.56
b pakai (m)	1.8	1.8	1.6
A pakai (mm^2)	3.24	3.24	2.56
σ = pu (kn/m^2)	184.14213	189.7531	192.8906
Perenc tbl pond telapak (syarat kuat geser) :			
asumsi tebal pondasi (mm)	750	750	700
tebal selimut beton (mm)	70	70	70
Φ tul (mm)	19	19	19
Φ tul susut (mm)	10	10	10
d (mm)	661	661	611
1. Perhitungan geser Beton untuk 2 arah			
B1 (mm)	1061	1061	1011
B2 (mm)	1261	1261	1211
bo (mm)	4644	4644	4444

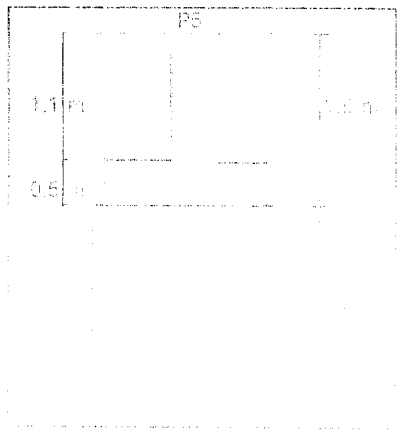
PERHITUNGAN Pu PONDASI

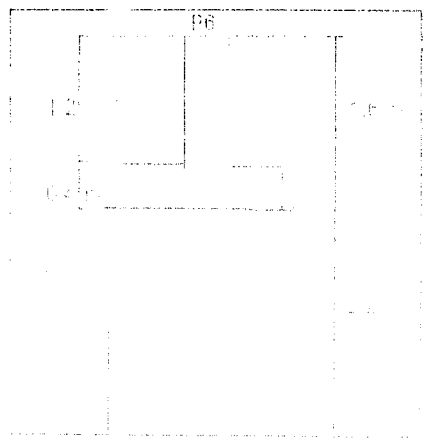
posisi	PD	PL	PE	1.2*PD+1.6PL	1.05(PD+PL,r)	1.05*PE	Pb+Ps	Pu
					Pb	Ps		
P1	-160	-28.5	-391.11	237.6	185.955	410.6655	596.621	596.62
P2	-349	-122.5	58.02	614.8	443.625	60.921	504.546	614.8
P3	-289.5	-91.5	-96.76	493.8	361.62	101.598	463.218	493.8
Cat : satuan dalam Kn								

Vu (kn)	350.25	360.93	257.64
β_c	1.5	1.5	1.5
Vc (kn)	2025.89	2025.89	1792.00
Vc' (kn)	1736.48	1736.48	1536.00
Vc pakai (kn)	1736.48	1736.48	1536.00
Φ Vn (kn)	1041.8853	1041.885	921.598
check : Vu < Φ Vn	Ok	Ok	Ok
2. Perhitungan geser beton untuk 1 arah			
G (mm)	39	39	-11
Vu (kn)	12.926778	13.32067	-3.39488
Vc (kn)	28.043855	28.04385	23.04225
ΦVc (kn)	16.826313	16.82631	13.82535
check : Vu < Φ Vc	Ok	Ok	Ok
Perenc.Tulangan Utk Arah X & Y			
l (m)	0.7	0.7	0.6
Mu (knm)	219.26	225.94	118.51
Mu/ Φ (knm)	274.07	282.42	148.14
As (mm^2)	1151.76	1186.85	673.49
Asmin (mm^2)	2313.50	2313.50	2138.50
1.33 As (mm^2)	1531.84	1578.52	895.74
As pakai (mm^2)	1531.84	1578.52	895.74
Jarak tulangan (mm)	185.00	179.53	250.00
diambil jrk tul (mm)	180	170	250
dipakai tul	D19-180	D19-170	D19-250
As tersedia (mm^2)	1574.3611	1666.971	1133.54
a (mm)	37.04	39.22	26.67
Mn (knm)	404.59702	427.6704	270.9905
1.33 Mu/Φ (knm)	364.51648	375.6236	197.0262
cek : Mn>1.33 Mu/Φ (knm)	Ok	Ok	Ok
M (Kn)	1.49	7.48	4.57
e (m)	0.0029969	0.0146	0.011106
σ = P/A	153.96446	160.735	163.005
1,5 . σ ijin	300	300	300
cek : σ<1,5 . σ ijin	ok	ok	ok
Perenc. Tulangan Susut			
As tulangan susut	1322	1322	1222
Jrk tulangan susut	59.379728	59.37973	64.23895
dipakai tulangan susut	P10-50	P10-50	P10-60
√(A2/A1)	3.6742346	3.674235	3.265986
Kuat tumpuan pondasi (Kn)	5712	5712	5712
Kuat tumpuan kolom (kn)	2856	2856	2856
check : Pu< kuat tumpuan pondasi	Ok	Ok	Ok
check : Pu< kuat tumpuan kolom	Ok	Ok	Ok

Perencanaan Pondasi Telapak Sumuran







	P4	P5	P6
	0.4	0.4	0.4
	1.6	1.6	1.6
	2	2	2
	40	40	40
	15.6	15.6	15.6
	24	24	24
	216.90	297.50	178.23
PONDASI SUMURAN :			
	25	25	25
	1	1	1
	4.4	4.4	4.4
	317.77	317.77	317.77
	534.67	615.27	496.00
	3.67	3.08	3.43
	1.845406	1.97963	1.77741
	2	2	1.3
σ	750	750	750
PONDASI TELAPAK :			
	0.4	0.5	0.4
	400.00	400.00	400.00
	600.00	600.00	600.00

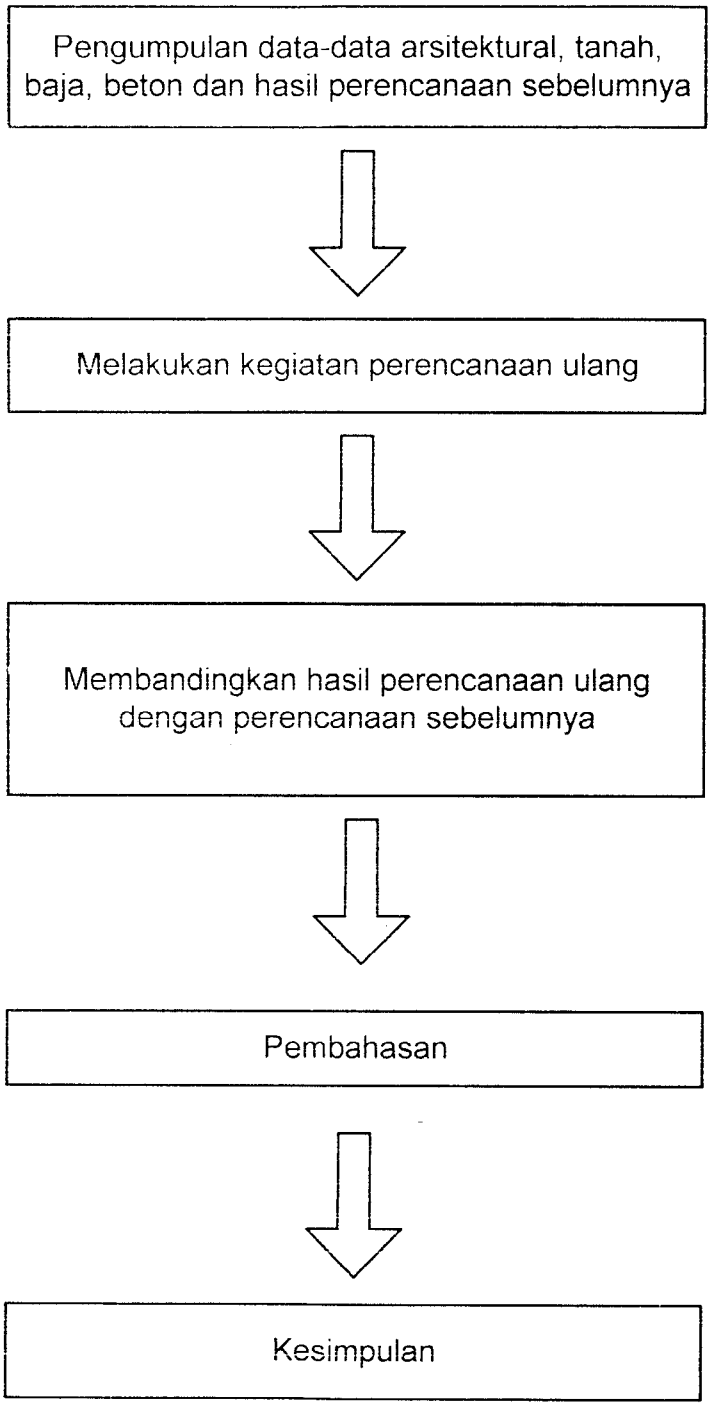
P4	-83.88	34	-39.51								
P5	-113.	27.28	-30.715								
P6	-95.63	30.32	-36.8.11								

Catatan satuan dalam kN

Daya dukung [illegible] to :			
q (t/m^2)	[illegible]68	29.49	29.49
q netto (t/m^2)	72[illegible]	720.51	720.51
Dimensi pondasi [illegible] :			
[illegible]	0.74	0.85	0.69
[illegible]	[illegible]	0.92	0.83
[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	[illegible]	1
σ [illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	40[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
σ [illegible]	[illegible]	[illegible]	[illegible]
σ [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	711
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
β [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	576.71
[illegible]	[illegible]	[illegible]	576.71
Φ [illegible]	[illegible]	[illegible]	[illegible]
[illegible] Φ [illegible]	Ok	Ok	Ok
[illegible]			
[illegible]	[illegible]	-61	-11
[illegible]	[illegible]	-19.7975	-2.352555
[illegible]	[illegible]	10.6561	7.33034
[illegible]	4.398204	6.39366	4.398204
[illegible]	Ok	Ok	Ok
Perenc Tulangan Utk Arah X & Y			
[illegible]	[illegible]	0.35	0.3
Mu (tm)	[illegible]76	20.04	8.02
Mu / Φ (tm)	1[illegible]20	25.06	10.03
As [illegible]	10[illegible].9[illegible]	169.34	89.54
As [illegible] (mm^2)	1088.50	1438.50	1088.50
1[illegible] (mm^2)	144.93	225.22	119.09
As pakai (mm^2)	144.93	225.22	119.09
Jarak tulangan (mm)	250.00	250.00	250.00
diambil [illegible] (mm)	250	250	250
dipakai [illegible]	D19-250	D19-250	D19-250
As tersedia (mm^2)	1133.54	1133.54	1133.54

	26.67	26.67	26.67
	134.9657	180.307	134.9657
	16.28577	33.3236	13.3333
	Ok	Ok	Ok
	1.3	5.55	4.8
	0.009	0.01086	0.02736
	219.3	254.609	188.548
	300	300	30
	ok	ok	ok

LANGKAH KERJA TUGAS AKHIR PERENCANAAN ULANG GEDUNG AUDIOVISUAL UK-DW YOGYAKARTA :



```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL 1 UNIT:KG-M
C PERENCANA: DEDDY & RANI

SYSTEM
L=3

JOINTS
1 X=0 Y=0 Z=0
2 X=3
6 X=19 G=2,6,1
7 X=0 Y=1
8 X=3
12 X=19 G=8,12,1
13 X=23 Y=4.4
15 X=31 G=13,15,1
16 X=0 Y=5.4
17 X=3
24 X=31.0001 G=17,24
25 X=0 Y=9.4
26 X=3
33 X=31.0001 G=26,33,1
34 X=0 Y=13.4
35 X=3
42 X=31.0001 G=35,42,1
43 X=0 Y=16.6
44 X=3
45 X=27
46 X=31.0001
47 X=3 Y=18.4
53 X=27 G=47,53,1

RESTRAINTS
1 53 1 R=0,0,1,1,0
1 6 1 R=1,1,1,1,1,1
13 15 1 R=1,1,1,1,1,1

FRAME
NM=3 NL=17   NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6  W=0.4*0.6*2400  M=0.4*0.6*2400/9.81      : KOLOM
3 SH=R T=0.25,0.35 W=0.25*0.35*2400 M=0.25*0.35*2400/9.81 :SLOOF S1
C SPAN LOADS
C DEAD LOADS, 1ST FLOOR
1 TRAP=0,0,0,1.5,-765,0,3,0,0                              : T.BUKU
2 TRAP=0,0,0,1.75,-892.5,0,2.25,-892.5,0,4,0,0
C LIVE LOADS, 1ST FLOOR
3 TRAP=0,0,0,1.5,-600,0,3,0,0
4 TRAP=0,0,0,1.75,-700,0,2.25,-700,0,4,0,0
C DEAD LOADS, 2ND & 3TH FLOOR
5 TRAP=0,0,0,1.5,-765,0,3,0,0                              : STUDIO AUDIOVISUAL
6 TRAP=0,0,0,1.75,-892.5,0,2.25,-892.5,0,4,0,0
7 TRAP=0,0,0,1,-510,0,3,-510,0,4,0,0
C LIVE LOADS, 2ND & 3TH FLOOR
8 TRAP=0,0,0,1.5,-600,0,3,0
9 TRAP=0,0,0,1.75,-700,0,2.25,-700,0,4,0,0
10 TRAP=0,0,0,1,-400,0,3,-400,0,4,0,0
```

```
C DEAD LOADS, ROOF
11 TRAP=0,0,0,1.5,-693,0,3,0,0
12 TRAP=0,0,0,1.75,-808.5,0,2.25,-808.5,0,4,0,0
C LIVE LOADS, ROOF
13 TRAP=0,0,0,1.5,-450,0,3,0,0
14 TRAP=0,0,0,1.75,-525,0,2.25,-525,0,4,0,0
C WALL
15 WL 0,-1100,0          : BASEMENT
16 WL 0,-1000,0          : 1ST,2F
17 WL=0, 1250,0          : 3F3
C COLUMN ELEMENT
1 1 7 NM=2 LP=1,0 G=5,1,1,1
7 7 16 G=5,1,1,1
13 13 22 G=2,1,1,1
16 16 25 G=8,1,1,1
25 25 34 G=8,1,1,1
34 34 43 G=1,1,1,1
36 41 45 G=1,1,1,1
38 36 48 G=4,1,1,1
43 44 47 G=1,1,1,6
C BEAM ELEMENT
45 7 8 NSL=0,0,15 NM=3 LP=1 G=4,1,1,1
50 16 17 NSL=1,3,16 NM=1
51 17 19 NSL=2,4,16 G=3,1,1,1
55 21 22 NSL=0,0,16 NM=3 G=2,1,1,1
58 25 26 NSL=5,8,16 NM=1
59 26 27 NSL=6,9,16 G=4,1,1,1
64 31 32 NSL=7,10,16
65 32 33 NSL=0,0,16 NM=3
66 34 35 NSL=5,8,17 NM=1
67 35 36 NSL=6,9,17 G=6,1,1,1
74 43 44 NSL=11,13
75 45 46 NSL=12,14
76 47 48 NSL 12,14,17 G 5,1,1,1

COMBO
1 G=1,0,1 : MATT
2 G=0,1,0 : HILDUP
```

```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL 2 UNIT:KG-M
C PERENCANA: DEDDY & FANI

SYSTEM
G=6

JOINTS
1  X=0 Y=0 Z=0
2 X=3
6 X=19 G=2.6,1
7 X=0 Y=1
8 X=3
12 X=19 G=8,12,1
13 X=23 Y=4.4
15 X=31 G=13,15,1
16 X=0 Y=5.4
17 X=3
24 X=31 G=17,24
25 X=0 Y=9.4
26 X=3
33 X=31.0001 G=26,33,1
34 X=0 Y=13.4
35 X=3
42 X=31.0001 G=35,42,1
43 X=0 Y=16.6
44 X=3
45 X=27
46 X=31
47 X=3 Y=18.4
53 X=27 G=47,53,1

RESTRAINTS
1 53 1 R=0,0,1,1,0
1 6 1 R=1,1,1,1,1,1
13 15 1 R=1,1,1,1,1,1

FRAME
NM=3 NL=28  NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6  W=0.4*0.6*2400  M=0.4*0.6*2400/9.81      : KOLOM
3 SH=R T=0.25,0.35 W=0.25*0.35*2400 M=0.25*0.35*2400/9.81 : SLOOF S1
C SPAN LOADS
1 TRAP=0,0,0,1.5,-765,0,3,0,0                              : WD,1ST,BOOK STORE,1
2 TRAP=0,0,0,1.75,-892.5,0,2.25,-892.5,0,4,0,0             : WD,1ST,2,3,4,5
3 TRAP=0,0,0,1.5,-600,0,3,0,0                              : WL,1ST,1
4 TRAP=0,0,0,1.75,-700,0,2.25,-700,0,4,0,0                 : WL,1ST,2,3,4,5
5 TRAP=0,0,0,1,-510,0,2,-150,0,3,0,0                       : WD,STUDIO,2ND ONLY,1
6 TRAP=0,0,0,1.75,-892.5,0,2.25,-892.5,0,4,0,0             : WD,2ND,3TH,2,3,4,5,6,7,8
7 TRAP=0,0,0,1.5,-765,0,2.5,-765,0,4,0,0                   : WD,2ND ONLY,9
8 TRAP=0,0,0,1.5,-765,0,3,0,0                              : WD,3TH ONLY,1
9 TRAP=0,0,0,1,-400,0,2,-400,0,3,0,0                       : WL,2ND ONLY,1
10 TRAP=0,0,0,1.75,-700,0,2.25,-700,0,4,0,0                : WL,2ND,3TH,2,3,4,5,6,7,8
11 TRAP=0,0,0,1.5,-600,0,2.5,-600,0,4,0,0                  : WL,2ND ONLY,9
12 TRAP=0,0,0,1.5,-600,0,3,0,0                             : WL,3TH ONLY,1
13 TRAP=0,0,0,1.5,-693,0,3,0,0                             : WD,ROOF,1B
14 TRAP=0,0,0,1.4,-646.8,0,1.6,-646.8,0,3,0,0              : WD,ROOF,1A
```

```
15 TRAP=0,0,0,1.75,-808.5,0,2.25,-808.5,0,4,0,0 : WD,ROOF,2,3,4,5,6,7,8B
16 TRAP=0,0,0,1.4,-646.8,0,2.6,-646.8,0,4,0,0   : WD,ROOF,2,3,4,5,6,7,8,A
17 TRAP=0,0,0,1.5,-450,0,3,0,0                  : WL,ROOF,1B
18 TRAP=0,0,0,1.4,-420,0,1.6,-420,0,3,0,0       : WL,ROOF,1A
19 TRAP=0,0,0,1.75,-505,0,2.25,-505,0,4,0,0     : WL,ROOF,2,3,4,5,6,7,8B
20 TRAP=0,0,0,1.4,-420,0,3.6,-420,0,4,0,0       : WL,ROOF,2,3,4,5,6,7,8A
21 TRAP=0,0,0,1.4,-646.8,0,1.6,-646.8,0,3,0,0   : WD,ALLEY,1ST,2ND,3TH,1
22 TRAP=0,0,0,1.4,-646.8,0,3.6,-646.8,0,4,0,0   : 1ST,2,3,4,2ND,3TH,5,6,7,8
23 TRAP=0,0,0,1.4,-420,0,1.6,-420,0,3,0,0       : WL,ALLEY,1ST,2ND,3TH,1
24 TRAP=0,0,0,1.4,-420,0,3.6,-420,0,4,0,0       : 1ST,2,3,4,2ND,3TH,5,6,7,8
25 PLD=0,-360,0
26 WL=0,-1100,0                                 : WALL,BASEMENT
27 WL=0,-1000,0                                 : WALL,1ST,2ND
28 WL=0,-1250,0                                 : WALL,3TH
C COLUMN ELEMENT
1 1 7 NM=2 LP=1,0 G=5,1,1,1
7 7 13 G=5,1,1,1
13 13 22 G=2,1,1,1
16 16 25 G=8,1,1,1
25 25 34 G=8,1,1,1
34 34 43 G=1,1,1,1
36 41 45 G=1,1,1,1
38 36 48 G=4,1,1,1
43 44 47 G=1,1,1,6
C BEAM ELEMENT
45 7 8 NSL=0,0,0,0.0,25 NM=3 LP=1 G=4,1,1,1
50 16 17 NSL=-1,3,21,23,0,26 NM=1
51 17 19 NSL=2,4,22,24,0,26 G=3,1,1,1
55 21 22 NSL=0,0,0,0,0,26 NM=3 G=2,1,1,1
58 25 26 NSL=5,9,21,23,0,27 NM=1
59 26 27 NSL=6,10,22,24,0,27 G=4,1,1,1
64 31 32 NSL=6,10,22,24,25,27
65 32 33 NSL=7,11,23,24,0,27
66 34 35 NSL=8,12,21,23,0,28
67 35 36 NSL=6,10,22,24,0,28 G=6,1,1,1
74 43 44 NSL=13,17,14,18
75 45 46 NSL=15,19,16,20
76 47 48 NSL=15,19,16,20 G=5,1,1,1

COMBO
1 C=1,0,1,0,1,1    : DEAD
2 C=0,1,0,1,0      : LIVE
```

```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL I SATUAN:KG-M
C ENGINEER : DEDDY & RANI

SYSTEM
I,=3

JOINTS
1 X=0 Y=0 Z=0
2 X=2.8
3 X=9.8
4 X=0 Y=1
5 X=2.8
6 X=9.8
7 X=0 Y=5
8 X=2.8
9 X=6.3
10 X=9.8
11 X=0 Y=9
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=12.2
16 X=2.8
17 X=9.8
18 X=6.3

RESTRAINTS
1 17 1 R=0,0,1,1,1,0
1 3 1 R=1,1,1,1,1,1

FRAME
NM=3 NL=8 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81        : KOLOM
3 SH=R T=0.25,0.45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81 : SLOOF S2
C SPAN LOADS
1 TRAP=0,0,0,1.4,-714,0,2.8,0,0          : WD,2ND&3THF,1
2 TRAP=0,0,0,1.5,-765,0,3,0,0            : WD,2NDF,2,3THF,2,3
3 TRAP=0,0,0,1.4,-560,0,2.8,0,0          : WL,2ND&3THF,1
4 TRAP=0,0,0,1.5,-600,0,3,0,0            : WL,2NDF,2,3TH,2,3
5 TRAP=0,0,0,1.4,-646.8,0,2.8,0,0        : WD,ROOF,1
6 TRAP=0,0,0,1.5,-693,0,3,0,0            : WD,ROOF,2,3
7 TRAP=0,0,0,1.4,-420,0,2.8,0,0          : WL,ROOF,1
8 TRAP=0,0,0,1.5,-450,0,3,0,0            : WL,ROOF,2,3
C ELEMENTS
C COLUMN IDENTITY
1 1 4 NM=2 NSL=0,0,0 EP=1,0 G=0,1,1,1
4 4 7 G=0,1,1,1
6 6 10
7 7 11 G=1,1,1,1
9 10 14
10 11 15 G=1,1,1,1
12 14 17
C BEAM IDENTITY
13 4 5 NM=1 NSL=0,0,0
14 5 6
```

```
15  7  8 NM=1 NSL=1,3,0
16  8  9 NSL=2,4
17  9 10 NSL=0,0,0
18 11 12 NSL=1,3,0
19 12 13 NSL=2,4,0
20 13 14 NSL=2,4,0
21 15 16 NSL=5,7,0
22 16 17 NSL=6,8,0
23 18 17 NSL=6,8,0

LOADS
9 L=3 F=0,-480,0
13 F=0,-480,0
18 F=0,-480,0

COMBO
1 C=1,0,1          : DEAD
2 C=0,1,0          : LIVE
```

```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL H SATUAN:KG-M
C ENGINEER : DEDDY & RANI

SYSTEM
L=5

JOINTS
1  X=0 Y=0 Z=0
2  X=2.8
3  X=9.8
4  X=0 Y=1
5  X=2.8
6  X=9.8
7  X=0 Y=5
8  X=2.8
9  X=5.8
23 X=7.8
10 X=9.8
11 X=0 Y=9
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=12.2
16 X=2.8
17 X=6.3
18 X=9.8
19 X=0 Y=14
20 X=2.8
21 X=6.3
22 X=9.8


RESTRAINTS
1 23 1 R=0,0,1,1,1,0
1 3 1  R=1,1,1,1,1,1

FRAME
NM=3 NL=14 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81        : KOLOM
3 SH=R T=0.25,0.45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81  : SLOOF S2
C SPAN LOADS
1 TRAP=0,0,0,1.4,-714,0,2.8,0,0                            : WD,R&L,2ND&3THF,1
2 TRAP=0,0,0,1.5,-765,0,3,0,0                              : WD,R,2NDF,2
3 TRAP=0,0,0,1,-510,0,2,-510,0,3,0,0                       : WD,L,2NDF,2
4 TRAP=0,0,0,1,-510,0,2,0,0                                : WD,L,2NDF,3,4
5 TRAP=0,0,0,1.75,-892.5,0,3.5,0,0                         : WD,R&L,3THF,2,3
6 TRAP=0,0,0,1.4,-560,0,2.8,0,0                            : WL,R&L,2ND&3THF,1
7 TRAP=0,0,0,1.5,-600,0,3,0,0                              : WL,R,2NDF,2
8 TRAP=0,0,0,1,-400,0,2,-400,0,3,0,0                       : WL,L,2NDF,2
9 TRAP=0,0,0,1,-400,0,2,0,0                                : WL,L,2NDF,3,4
10 TRAP=0,0,0,1.75,-700,0,3.5,0,0                          : WL,R&L,3THF,2,3
11 TRAP=0,0,0,1.4,-646.8,0,2.8,0,0                         : WD,ROOF,1
12 TRAP=0,0,0,1.75,-808.5,0,3,0,0                          : WD,ROOF,2,3
13 TRAP=0,0,0,1.4,-420,0,2.8,0,0                           : WL,ROOF,1
14 TRAP=0,0,0,1.75,-525,0,3,0,0                            : WL,ROOF,2,3
```

```
C ELEMENT
C BEAM IDENTITY
16 4 5 NSL=0,0,0,0,0 NM=3 LP=1,0 G=1,1,1,1
18 7 8 NSL=1,1,6,6,0 NM=1
19 8 9 NSL=2,3,7,8,0
20 9 23 NSL 4,0,9,0,0
21 23 10 NSL=4,0,9,0,0
22 11 12 NSL 1,1,6,6,0
23 12 13 NSL=5,5,10,10,0 G=1,1,1,1
25 15 16 NSL=0,11,0,13,0
26 16 17 NSL=0,12,0,14,0 G 1,1,1,1
28 19 20 NSL=0,11,0,13,0
29 20 21 NSL=0,12,0,14,0 G 1,1,1,1
C COLUMN IDENTITY
1 1 4 NM=2 LP=1,0 G=2,1,1,1
4 4 7 G=1,1,1,1
6 6 10
7 7 11 G=1,1,1,1
9 10 14
10 11 15 G=1,1,1,1
12 14 18
13 15 19 G=1,1,1,1
15 18 22

LOADS
9 L=5 F=0,-960,0
23 L=5 F=0,-480,0
13 21 4 L=5 F=0,-960,0

COMBO
1 C=1,1,0,0,1    : DEAD
2 C=0,0,1,1,0    : LIVE
```

```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL D SATUAN:KG-M
C ENGINEER : DEDDY & RANI

SYSTEM
L=3

JOINTS
1 X=0 Y=0 Z=0
2 X=2.8
3 X=9.8
4 X=0 Y=1
5 X=2.8
6 X=9.8
7 X=0 Y=5.4
8 X=2.8
9 X=6.3
10 X=9.8
11 X=0 Y=9.4
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=13.4
16 X=2.8
17 X=6.3
18 X=9.8
19 X=0 Y=18.4
20 X=2.8
21 X=6.3
22 X=9.8

RESTRAINTS
1 22 1 R=0,0,1,1,1,0
1 3 1 R=1,1,1,1,1,1

FRAME
NM=3 NJ=9 NSEC=3 Y -1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BEAM
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81        : COLUMN
3 SH=R T=0.25,0.45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81 : SLOOF S2
C SPAN LOADS
1 TRAP=0,0,0,1.4,-1428,0,2.8,0,0                    : WD,1ST&2ND&3THF,1
2 TRAP=0,0,0,1.75,-1785,0,3.5,0,0                   : WD,1ST&2ND&3THF,2,3
3 TRAP=0,0,0,1.4,-1120,0,2.8,0,0                    : WL,1ST&2ND&3THF,1
4 TRAP=0,0,0,1.75,-1400,0,3.5,0,0                   : WL,1ST&2ND&3THF,2,3
5 TRAP=0,0,0,1.4,-1293,0,2.8,0,0                    : WD,ROOF,1
6 TRAP=0,0,0,1.75,-1617,0,3.5,0,0                   : WD,ROOF,2,3
7 TRAP=0,0,0,1.4,-840,0,2.8,0,0                     : WL,ROOF,1
8 TRAP=0,0,0,1.75,-1050,0,3.5,0,0                   : WL,ROOF,2,3
C ELEMENT
C BEAM ID NTITY
16 4 5 NM=3 NSL=0,0,0 LP=1,0 G=1,1,1,1
18 7 8 NM=1 NSL=1,3,0 G=2,3,4,4
19 8 9 NSL=2,4,0 G=2,3,4,4
20 9 10 NSL=2,4,0 G=2,3,4,4
27 19 20 NSL=5,7,0
28 20 21 NSL=6,8,0 G=1,1,1,1
```

```
C COLUMN IDENTITY
1  1  4  NM=2 NSL=0,0,0 G=2,1,1,1 LP=1,0
4  4  7  G=1,1,1,1
6  6  10
7  7  11 G=2,3,4,4
8  8  12 G=2,3,1,4
9  10 14 G=2,3,4,4

LOADS
9  21 4  L=3 F=0,-960,0

COMBO
1 C=1,0,1          : DEAD
2 C=0,1,0          : LIVE
```

```
C ANALISA MOMEN AKIBAT BEBAN GRAVITASI PORTAL A SATUAN:KG-M
C ENGINEER: DEDDY : RANI

SYSTEM
L=3

JOINTS
1 X=0 Y=0
2 X=2.8
3 X=9.8
4 X=0 Y=1
5 X=2.8
6 X=9.8
7 X=0 Y=5.4
8 X=2.8
9 X=6.3
10 X=9.8
11 X=0 Y=9.4
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=13.4
16 X=2.8
17 X=6.3
18 X=9.8
19 X=0 Y=16.6
20 X=2.8
21 X=6.3
22 X=9.8

RESTRAINTS
1 22 1 R=0,0,1,1,1,0
1 3 1 R=1,1,1,1,1,1

FRAME
NM=3 NL=9 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81      : BEAM
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81         : COLUMN
3 SH=R T=0.25,0.45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81   : SLOOF S2
C SPAN LOADS
1 TRAP=0,0,0,1.4,-714,0,2.8,0,0                             : WD,1ST&2ND&3THF,1
2 TRAP=0,0,0,1.5,-765,0,2,-765,0,3.5,0,0                    : WD,1ST&2ND&3TH,2,3
3 TRAP=0,0,0,1.4,-646.8,0,2.8,0,0                           : WD,ROOF,1
4 TRAP=0,0,0,1.5,-693,0,2,-693,0,3.5,0,0                    : WD,ROOF,2,3
5 TRAP=0,0,0,1.4,-560,0,2.8,0,0                             : WL,1ST&2ND&3TH,1
6 TRAP=0,0,0,1.5,-600,0,2,-600,0,3.5,0,0                    : WL,1ST&2ND&3TH,2,3
7 TRAP=0,0,0,1.4,-420,0,2.8,0,0                             : WL,ROOF,1
8 TRAP=0,0,0,1.5,-450,0,2,-450,0,3.5,0,0                    : WL,ROOF,2,3
9 PLD=0.5,-360,0
C ELEMENT
C BEAM IDENTITY
16 4 5 NM=3 NSL=0,0,0 LP=1,0 G=1,1,1,1
18 7 8 NM=1 NSL=1,5,0 G=2,3,4,4
19 8 9 NSL=2,6,0 G=2,3,4,4
20 9 10 NSL=2,6,0
23 13 14 NSL=2,6,9
```

```
26 17 18 NSL=2,6,0
27 19 20 NSL=3,7,0
28 20 21 NSL=4,8,0 G=1,1,1,1
C COLUMN IDENTITY
1 1 4 NM=2 LP=1,0 NSL=0,0,0 G=1,1,1,1
4 4 7 G=1,1,1,1
6 6 10
7 7 11 G=2,3,4,4
8 8 12 G=2,3,4,4
9 10 14 G=2,3,4,4

COMBO
1 C=1,0,          :DEAD
2 C=0,1,0         :LIVE
```

```
C ANALISA MOMEN AKIBAT BEBAN GEMPA KIRI PORTAL X UNIT:KG-M
C PERENCANA: DEDDY & RANI

SYSTEM
L=1

JOINTS
1 X=0 Y=0 Z=0
2 X=3
6 X=19 G=2,6,1
7 X=0 Y=1
8 X=3
12 X=19 G=8,12,1
13 X=23 Y=4.
15 X=31 G=13,15,1
16 X=0 Y=5.4
17 X=3
24 X=31.0001 G=17,24
25 X=0 Y=9.4
26 X=3
33 X=31.0001 G=26,33,1
34 X=0 Y=13.4
35 X=3
42 X=31.0001 G=35,42,1
43 X=0 Y=16.6
44 X=3
45 X=27
46 X=31.0001
47 X=3 Y=18.4
53 X=27 G=47,53,1

RESTRAINTS
1 53 1 R=0,0,1,1,0
1 6 1 R=1,1,1,1,1,1
13 15 1 R=1,1,1,1,1,1

FRAME
NM=3 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6  W=0.4*0.6*2400  M=0.4*0.6*2400/9.81      : KOLOM
3 SH=R T=0.25,0.35 W=0.25*0.35*2400 M=0.25*0.35*2400/9.81 :SLOOF S1
C COLUMN ELEMENT
1 1 7 NM=2 LP=1,0 G=5,1,1,1
7 7 16 G=5,1,1,1
13 13 22 G=2,1,1,1
16 16 25 G=8,1,1,1
25 25 34 G=8,1,1,1
34 34 43 G=1,1,1,1
36 41 45 G=1,1,1,1
38 36 48 G=4,1,1,1
43 44 47 G=1,1,1,6
C BEAM ELEMENT
45 7 8  NM=3 LP=1 G=4,1,1,1
50 16 17  NM=1
51 17 18 G=3,1,1,1
55 21 22 NM=3 G=2,1,1,1
```

```
58 25 26 NM=1
59 26 27 G=4,1,1,1
64 31 32
65 32 33 NM=3
66 34 35 NM=1
67 35 36 G=6,1,1,1
74 43 44
75 45 46
76 47 48 G=5,1,1,1

LOADS
16 F=69.1,0,0
25 F=3527,0,0
34 F=5150,0,0
43 F=1471,0,0
47 F=1849,0,0

COMBO
1 C=1
```

```
C ANALISA MOMEN AKIBAT BEBAN GEMPA KANAN PORTAL X UNIT:KG-M
C PERENCANA: DEDDY & RANI

SYSTEM
L=1

JOINTS
1 X=0 Y=0 Z=0
2 X=3
6 X=19 G=2,6,1
7 X=0 Y=1
8 X=3
12 X=19 G=8,12,1
13 X=23 Y=4.4
15 X=31 G=13,15,1
16 X=0 Y=5.4
17 X=3
24 X=31.0001 G=17,24
25 X=0 Y=9.4
26 X=3
33 X=31.0001 G=26,33,1
34 X=0 Y=13.4
35 X=3
42 X=31.0001 G=35,42,1
43 X=0 Y=16.6
44 X=3
45 X=27
46 X=31.0001
47 X=3 Y=18.4
53 X=27 G=47,53,1

RESTRAINTS
1 53 1 R=0,0,1,1,0
1 6 1 R=1,1,1,1,1,1
13 15 1 R=1,1,1,1,1,1

FRAME
NM=3 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81     : BALOK
2 SH=R T=0.4,0.6  W=0.4*0.6*2400  M=0.4*0.6*2400/9.81      : KOLOM
3 SH=R T=0.25,0.35 W=0.25*0.35*2400 M=0.25*0.35*2400/9.81 :SLOOF S1
C COLUMN ELEMENT
1 1 7 NM=2 LP=1,0 G=5,1,1,1
7 7 16 G=5,1,1,1
13 13 22 G=2,1,1,1
16 16 25 G=8,1,1,1
25 25 34 G=8,1,1,1
34 34 43 G=1,1,1,1
36 41 45 G=1,1,1,1
38 36 48 G=4,1,1,1
43 44 47 G=1,1,1,6
C BEAM ELEMENT
45 7 8  NM=3 LP=1 G=4,1,1,1
50 16 17  NM=1
51 17 18 G=3,1,1,1
55 21 22 NM=3 G=2,1,1,1
```

```
58 25 26 NM=1
59 26 27 G=4,1,1,1
64 31 32
65 32 33 NM=3
66 34 35 NM=1
67 35 36 G=6,1,1,1
74 43 44
75 45 46
76 47 48 G=5,1,1,1

LOADS
24 F=-69.1,0,0
33 F=-3527,0,0
42 F=-5152,0,0
46 F=-1471,0,0
53 F=-1849,0,0

COMBO
1 C=1
```

```
C ANALISA MOMEN AKIBAT BEBAN GEMPA KIRI PORTAL B SATUAN:KG-M
C ENGINEER: DEDDY & RANI

SYSTEM
L=1

JOINTS
1 X=0 Y=0
2 X=2.8
3 X=9.8
4 X=0 Y=1
5 X=2.8
6 X=9.8
7 X=0 Y=5.4
8 X=2.8
9 X=6.3
10 X=9.8
11 X=0 Y=9.4
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=13.4
16 X=2.8
17 X=6.3
18 X=9.8
19 X=0 Y=16.6
20 X=2.8
21 X=6.3
22 X=9.8
23 X=0 Y=19.4
24 X= 2.8
25 X=6.3
26 X=9.8

RESTRAINTS
1 26 1 R=0,0,1,1,1,0
1 3 1 R=1,1,1,1,1,1

FRAME
NM=3 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81      : BEAM
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81         : COLUMN
3 SH=R T=0.25,0.45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81   : SLOOF S2
C ELEMENT
C BEAM IDENTITY
16 4 5 NM=3 LP=1,0 G=1,1,1,1
18 7 8 NM=1 G=2,3,4,4
19 8 9 G=2,3,4,4
20 9 10
23 13 14
26 17 18
27 19 20
28 20 21 G=1,1,1,1
33 23 24
34 24 25 G=1,1,1,1
C COLUMN IDENTITY
```

```
 1  1  4  NM=2  LP=1,0  G=2,1,1,1
 4  4  7  G=1,1,1,1
 6  6  10
 7  7  11  G=2,3,4,4
 9  8  12  G=2,3,4,4
 9  10  14  G=2,3,4,4
 30  19  23     G=1,1,1,1
 32  22  26

LOADS
 7  F=115.1,0,0
 11  F=3919.5,0,0
 15  F=5724.31,0,0
 19  F=1635,0,0
 23  F=2055.31,0,0

COMBO
 1  C=1
```

```
C ANALISA MOMEN AKIBAT BEBAN GEMPA KANAN PORTAL B SATUAN:KG-M
C ENGINEER: DEDDY & RANI

SYSTEM
L=1

JOINTS
1 X=0 Y=0
2 X=2.8
3 X=9.8
4 X=0 Y=1
5 X=2.8
6 X=9.8
7 X=0 Y=5.4
8 X=2.8
9 X=6.3
10 X=9.8
11 X=0 Y=9.4
12 X=2.8
13 X=6.3
14 X=9.8
15 X=0 Y=13.4
16 X=2.8
17 X=6.3
18 X=9.8
19 X=0 Y=16.6
20 X=2.8
21 X=6.3
22 X=9.8
23 X=0 Y=18.4
24 X= 2.8
25 X=6.3
26 X=9.8

RESTRAINTS
1 26 1 R=0,0,1,1,1,0
1 3 1 R=1,1,1,1,1,1

FRAME
NM=3 NSEC=3 Y=-1
C MATERIAL PROPERTIES
1 SH=R T=0.25,0.4 W=0.25*0.4*2400 M=0.25*0.4*2400/9.81        : BEAM
2 SH=R T=0.4,0.6 W=0.4*0.6*2400 M=0.4*0.6*2400/9.81           : COLUMN
3 SH=R T=0.25,0 45 W=0.25*0.45*2400 M=0.25*0.45*2400/9.81     : SLOOF S2
C ELEMENT
C BEAM IDENTITY
16 4 5 NM=3 LP=1,0 G=1,1,1,1
18 7 8 NM=1 G=2,3,4,4
19 8 9 G=2,3,4,4
20 9 10
23 13 14
26 17 18
27 19 20
28 20 21 G=1,1,1,1
33 23 24
34 24 25 G=1,1,1,1
C COLUMN IDENTITY
```

```
  1  4  NM=2  LP=1,0  G=2,1,1,1
  4  7  G=1,1,1,1
  6  10
  7  11  G=2,3,4,4
  8  12  G=2,3,4,4
  10  14  G=2,3,4,4
0  19  23     G=1,1,1,1
2  22  26

OADS
 F=1,5.1,0,0
1  F=3919.5,0,0
5  F=5724.31,0,0
3  F=1635,0,0
3  F=2055.31,0.0

OMBO
 C=1
```

OUTPUT SAP90

Momen Rencana Portal 1

Elemen	Section m	MD kg-m	ML kg-m	ME,ki kg-m	ME,ka kg-m	1,2.MD+1,6.ML	1,05 (MD+ML,r+ME)	1,05 (MD+ML,r-ME)	0,9 (MD+ME)	0,9 (MD-ME)	Keterangan
1	0	-17.908	37.382	10.666	-4.2	38.3216	15.94656	-6.45204	-6.5178	-25.7166	klm pond 1
1	0.5	-235.084	30.686	-165.792	99.355	-233.0032	-401.58762	-53.42442	-360.7884	-62.3628	klm pond 1
1	1	-452.26	23.989	-342.249	202.911	-504.3296	-819.12138	-100.39848	-715.0581	-99.0099	klm pond 1
2	0	-9.763	29.148	32.046	-24.134	34.9212	41.76039	-25.53621	20.0547	-37.6281	klm pond 1
2	0.5	-161.594	30.728	-178.319	129.05	-144.748	-337.55001	36.91989	-305.9217	15.0525	klm pond 1
2	1	-313.426	32.307	-388.683	282.235	-324.42	-716.86104	99.37326	-631.8981	67.7313	klm pond 1
3	0	-17.736	16.165	69.778	-69.595	4.5808	64.82805	-81.70575	46.8378	-78.7626	klm pond 1
3	0.5	9.064	6.418	-98.435	102.084	21.1456	120.74874	-93.62766	100.0332	-83.718	klm pond 1
3	1	35.865	-3.329	-266.648	273.762	37.7116	323.01108	-251.88912	278.6643	-214.1073	klm pond 1
4	0	80.433	-4.368	160.975	-132.387	89.5308	250.72656	-87.32094	217.2672	-72.4878	klm pond 1
4	0.5	33.818	0.485	-26.187	35.481	41.3576	73.0695	-1.4406	62.3691	-1.4967	klm pond 1
4	1	-12.797	5.337	-213.348	203.349	-6.8172	-234.08994	213.94086	-203.5305	180.4959	klm pond 1
5	0	223.77	-31.838	270.915	-195.78	217.5832	499.36131	-69.56019	445.2165	-42.4305	klm pond 1
5	0.5	65.951	-5.483	69.11	-51.849	70.3684	138.35976	-6.77124	121.5549	-2.8431	klm pond 1
5	1	-91.867	20.873	-132.695	92.082	-76.8436	-222.64011	56.01939	-202.1058	36.7452	klm pond 1
6	0	101.178	-44.154	295.432	-259.973	50.7672	388.62348	-231.78372	356.949	-174.8286	klm pond 1
6	0.5	552.657	-61.366	270.509	-87.031	565.0028	825.66372	257.59482	740.8494	253.9332	klm pond 1
6	1	1004.136	-78.578	245.586	85.911	1079.2384	1262.70396	746.97336	1124.7498	682.695	klm pond 1
7	0	493.588	36.117	-220.219	387.332	650.0928	947.71971	134.32251	792.828	95.6304	klm basement
7	2.2	-52.578	-34.395	-952.341	892.044	-118.1256	-1076.8338	923.0823	-904.4271	809.7867	klm basement
7	4.4	-598.744	-104.907	-1684.462	1396.755	-886.344	-2463.45771	1073.91249	-2054.8854	977.1462	klm basement
8	0	404.129	50.169	-335.812	461.556	565.2252	940.57572	-28.69188	779.1165	-51.6843	klm basement
8	2.2	-61.323	-42.069	-863.416	814.229	-140.898	-997.47942	815.69418	-832.2651	721.8837	klm basement
8	4.4	-526.775	-134.308	-1391.02	1166.903	-847.0228	-2098.29879	822.84321	-1726.0155	777.8205	klm basement
9	0	34.641	1.59	-309.672	315.843	44.1132	369.01305	-204.26355	315.4383	-253.0845	klm basement
9	2.2	2.837	-0.49	-877.528	857.093	2.6204	-918.73425	924.07455	-787.2219	792.3285	klm basement
9	4.4	-28.976	-2.571	-1445.393	1398.331	-38.8848	-1549.70718	1485.61812	-1326.9321	1274.7753	klm basement
10	0	1.938	5.527	-222.807	216.917	11.1688	-228.43044	239.46426	-198.7821	202.2705	klm basement
10	2.2	-5.119	0.762	-888.995	875.502	-4.9236	-938.33964	928.54986	-804.7026	795.4884	klm basement

10	4.4	12.195	-4.002	-1555.202	1534.07	-21.0372	-1648.28811	1617.63609	-1410.6573	1388.7063	klm basement
11	0	-35.021	14.498	-96.511	73.451	-18.8284	-128.97486	73.69824	-118.3788	55.341	klm basement
11	2.2	-17.882	-0.242	-906.033	900.186	-21.8456	-970.26321	932.40609	-831.5235	799.3359	klm basement
11	4.4	-0.77	-14.981	-1715.582	1726.893	-24.8936	1802.99112	-1823.48418	1553.5107	-1554.8967	klm basement
12	0	-662.728	-88.199	8.187	-210.394	-936.392	-972.34347	-530.51607	-785.8098	-407.1006	klm basement
12	2.2	-45.348	92.716	-950.85	924.497	93.928	-987.59682	1009.18818	-896.5782	814.9518	klm basement
12	4.4	571.997	273.631	-1909.922	2059.352	1124.206	2935.30398	-1389.33522	2368.2141	-1338.6195	klm basement
13	0	186.18	-13.939	-8258.185	8382.927	201.0896	8988.75978	-8615.38692	7712.1783	-7377.0903	klm pond 2
13	0.5	75.385	-17.214	-4829.999	4939.602	62.9196	5254.89153	-5118.27267	4513.4883	-4377.7953	klm pond 2
13	1	-35.402	-20.489	-1401.824	1496.267	-75.2636	1521.00123	-1621.15947	1314.7794	-1378.5012	klm pond 2
14	0	220.234	-17.697	-6350.379	6570.665	235.9656	7119.29484	-6679.10166	6111.8091	-5715.3879	klm pond 2
14	0.5	19.157	-35.638	-4242.283	4401.965	-34.0324	4619.72616	-4624.40034	3979.0098	-3944.5272	klm pond 2
14	1	-181.933	-53.578	-2134.2	2233.254	-304.0444	2120.13291	-2569.70049	1846.1889	-2173.6683	klm pond 2
15	0	85.122	-19.243	-5564.841	5772.707	35.3576	6107.09736	-6015.58734	5245.0461	-5145.8265	klm pond 2
15	0.5	465.615	3.202	-4096.679	4438.75	563.8612	5151.60051	-4169.77449	4413.9285	-3575.8215	klm pond 2
15	1	876.094	25.647	-2628.532	3104.778	1092.348	4196.07321	-2323.96059	3582.7848	-2005.8156	klm pond 2
16	0	684.937	156.47	-2781.968	2802.019	1048.2764	3738.8799	-2145.36	3120.2604	-1923.3738	klm lt-1
16	2	1.152	4.08	-857.516	825.141	7.9104	-896.6118	904.1718	-770.7276	772.8012	klm lt-1
16	4	-682.632	-148.31	1066.936	-1151.737	-1032.4544	-1998.52275	420.12495	-1632.9321	440.1945	klm lt-1
17	0	613.132	196.374	-3451.394	3416.712	1049.9556	-2856.46053	4391.46687	-2554.4367	3658.0725	klm lt-1
17	2	3.299	9.955	-760.392	766.984	19.8868	815.0688	-795.5976	693.2547	-687.3165	klm lt-1
17	4	-606.533	-176.465	1930.611	-1882.745	-1010.1836	1279.10895	-2775.17415	1191.6702	-2283.4296	klm lt-1
18	0	-26.074	-7.529	-3361.338	3265.569	-43.3352	-3561.52587	3497.28393	-3048.6708	3001.7376	klm lt-1
18	2	-2.505	-1.545	-820.06	795.349	-5.478	-864.6666	857.4594	-740.3085	735.7995	klm lt-1
18	4	21.065	4.439	1721.217	-1674.871	32.3804	1832.19267	-1782.36303	1568.0538	-1530.1368	klm lt-1
19	0	-8.257	-3.018	-3455.033	3410.284	-14.7372	-3638.35584	3617.21346	-3116.961	3102.0984	klm lt-1
19	2	-1.174	-1.26	-828.172	821.634	-3.4248	-871.6071	867.5541	-746.4114	744.2982	klm lt-1
19	4	5.91	0.497	1798.689	-1767.016	7.8872	1895.14206	-1882.10484	1624.1391	-1613.5011	klm lt-1
20	0	16.49	7.377	-3607.577	3615.614	31.5912	3818.35671	-3774.43269	3268.8936	-3239.2116	klm lt-1
20	2	6.577	3.417	-849.93	855.821	13.3596	907.67061	-889.55349	776.1582	-764.3196	klm lt-1
20	4	-3.335	-0.543	1907.718	-1903.972	-4.8708	1999.26006	-2006.94774	1713.9447	-1719.9477	klm lt-1
21	0	-318.003	-297.464	-3825.644	3839.379	-857.546	3510.04248	-4552.65342	3169.2384	-3741.6438	klm lt-1
21	2	-94.107	-103.773	-876.153	893.046	-278.9652	773.50896	-1101.88764	719.0451	-888.4377	klm lt-1
21	4	129.789	89.917	2073.339	-2053.288	299.614	2369.93211	-1984.07979	1982.8152	-1749.195	klm lt-1
22	0	-110.044	-20.603	-3376.057	3436.022	-165.0176	3479.29701	-3736.34919	2993.3802	-3191.4594	klm lt-1
22	2	14.243	27.721	-642.398	675.783	61.4452	741.99153	-677.15277	621.0234	-595.386	klm lt-1

22	4	138.531	76.045	2091.261	-2084.455	287.9092	2389.18995	7002.45815	2006.8128	-1757.457	klm lt-1
23	0	-151.693	-66.602	-3956.127	4127.512	-288.5948	4132.65069	-4535.12451	3578.2371	-3851.2845	klm lt-1
23	2	77.011	64.42	-871.475	880.002	195.4852	1045.44825	-802.55595	861.3117	-722.6919	klm lt-1
23	4	305.715	195.442	2213.177	-2367.507	679.5652	-2041.75314	2930.01156	-1855.6128	2405.8998	klm lt-1
24	0	-680.337	22.223	-3783.58	3755.086	-780.8476	-4673.11236	3272.40564	-4017.5253	2792.9187	klm lt-1
24	2	-4.349	-15.786	-1094.623	1156.437	-30.4764	1199.74722	-1228.77048	1036.8792	-1044.7074	klm lt-1
24	4	671.639	-53.794	1594.334	-1442.212	719.8964	2345.38143	-1002.71997	2039.3757	-830.4255	klm lt-1
25	0	669.68	132.538	-1040.273	1266.216	1015.6768	2116.18974	-542.86086	1742.3064	-536.8824	klm lt-2
25	2	23.301	10.091	392.624	-349.83	44.1068	443.07858	-381.43182	374.3325	-332.3907	klm lt-2
25	4	-623.078	-112.356	1825.521	-1965.876	-927.4632	-2789.18598	1339.15362	-2330.0586	1208.5182	klm lt-2
26	0	622.72	195.395	-1853.812	2109.629	1043.896	2985.7653	-1444.4556	2459.1141	-1338.2181	klm lt-2
26	2	10.495	-11.324	259.788	-372.543	-5.5244	-387.28452	395.05578	-325.8432	344.7342	klm lt-2
26	4	-601.73	-208.044	2373.388	-2854.715	-1054.9464	-3760.33497	2234.56653	-3110.8005	2027.6865	klm lt-2
27	0	39.548	3.425	-1764.52	1732.653	52.9376	-1809.06285	1896.42915	-1552.4748	1623.6612	klm lt-2
27	2	-19.696	-2.301	418.539	-360.486	-27.3168	417.33552	-461.59638	358.9587	-394.4115	klm lt-2
27	4	-78.941	-8.028	2601.599	-2453.625	-107.574	2643.73326	-2819.62464	2270.3922	-2412.486	klm lt-2
28	0	9.305	0.359	-1703.633	1697.336	11.7404	-1778.81823	1798.81107	-1524.8952	1541.6442	klm lt-2
28	2	-5.683	-1.336	416.679	-396.025	-8.9572	430.70412	-444.32178	369.8964	-380.1258	klm lt-2
28	4	-20.671	-3.03	2536.991	-2489.385	-29.6532	2640.2271	-2687.454	2264.688	-2301.8958	klm lt-2
29	0	-8.615	-7.408	-1625.92	1636.899	-22.1908	1705.03116	-1732.45674	1465.4556	-1480.9626	klm lt-2
29	2	-6.5	-3.584	436.152	-435.77	-13.5344	448.87668	-467.04252	386.6868	-398.3868	klm lt-2
29	4	-4.386	0.241	2498.225	-2508.439	-4.8776	-2638.31442	2629.40748	-2261.5425	2253.6477	klm lt-2
30	0	-9.79	53.159	-1542.787	1532.672	73.3064	-1596.71568	1643.13702	-1397.3193	1379.6973	klm lt-2
30	2	17.286	22.249	469.391	-490.8	56.3416	-483.17283	547.50717	-426.1626	457.2774	klm lt-2
30	4	44.363	-8.66	2481.57	-2514.272	39.3796	-2598.86025	2681.11095	-2222.9181	2302.7715	klm lt-2
31	0	-174.535	-83.237	-1552.768	1571.55	-342.6212	1414.42644	-1885.82856	1257.3135	-1571.4765	klm lt-2
31	2	-16.985	-26.594	455.502	-514.534	-62.9324	-574.84917	505.67223	-478.3671	447.7941	klm lt-2
31	4	140.565	30.049	2463.772	-2600.619	216.7564	-2564.12583	2897.17407	-2214.0486	2467.0656	klm lt-2
32	0	-259.061	-219.517	-1349.715	1215.498	-662.1004	-1827.51051	1006.89099	-1447.8984	981.5886	klm lt-2
32	2	-125.509	-50.575	586.811	-464.972	-231.5308	452.50485	-779.79825	415.1718	-641.088	klm lt-2
32	4	8.043	118.368	2523.336	-2145.443	199.0404	2732.51979	-2566.48581	2278.2411	-2263.7637	klm lt-2
33	0	-899.338	-53.655	-423.374	93.792	-1165.0536	-1422.65025	-533.56485	-1190.4408	-428.3676	klm lt-2
33	2	113.206	74.432	651.71	-702.795	254.9384	-572.17629	903.69321	-530.6301	734.4009	klm lt-2
33	4	1125.749	202.52	1726.794	-1499.382	1674.9308	3122.75775	-503.50965	2567.2887	-540.9405	klm lt-2
34	0	967.926	179.704	190.46	-8.617	1449.0376	1329.51882	929.55282	1042.5474	699.7194	klm lt-3
34	1.6	98.586	-27.388	583.735	-700.272	74.4824	-649.02474	821.54646	-541.5174	718.9722	klm lt-3

34	3.2	-770.753	-234.481	977.01	-1391.926	-1300.0732	-2418.53598	504.50862	-1946.4111	559.0557	klm lt-3
35	0	854.442	149.821	-697.279	315.132	1265.044	259.40838	1723.69428	141.4467	1396.5489	klm lt-3
35	1.6	188.918	86.511	734.568	-261.338	365.1192	1024.16223	-518.43057	831.1374	-491.085	klm lt-3
35	3.2	-476.605	23.201	2166.416	-837.809	-534.8044	1788.91818	-2760.55542	1520.8299	-2378.7189	klm lt-3
36	0	-74.713	126.773	-131.75	725.846	113.1812	763.55664	-760.71996	586.0197	-720.5031	klm lt-3
36	1.6	-68.957	-81.301	267.099	-778.953	-236.83	-962.52513	673.27617	-781.119	620.9964	klm lt-3
36	3.2	-103.161	-289.374	665.988	2283.712	-586.7916	2107.27293	-2688.52227	1962.4959	-2148.1857	klm lt-3
37	0	-1641.637	-424.095	26.71	-356.9	-2048.5164	-2365.6437	-1616.1537	-1798.6833	-1156.2633	klm lt-3
37	1.6	-232.357	24.336	660.041	-514.511	-239.8908	464.39988	-921.68622	384.9156	-803.1582	klm lt-3
37	3.2	1176.923	472.767	1293.372	-672.121	2168.7348	2891.65296	175.57176	2223.2655	-104.8041	klm lt-3
38	0	-69.68	-13.993	-130.083	246.872	-106.0048	177.23601	-341.19519	159.4728	-284.8968	klm lt-3
38	2.5	23.348	2.764	580.067	-581.59	32.44	-584.41278	636.92622	-502.4178	544.4442	klm lt-3
38	5	116.386	19.521	1290.227	1410.042	170.8968	1615.04763	-1346.04057	1373.7852	-1164.2904	klm lt-3
39	0	-33.288	-6.841	-154.569	209.618	-50.8912	180.83667	-259.36113	158.697	-218.6154	klm lt-3
39	2.5	-7.99	-1.181	575.465	-561.842	-11.4776	595.10472	-613.37178	510.7275	-525.1095	klm lt-3
39	5	17.329	4.48	1305.519	-1333.281	27.9628	-1378.9272	1420.9629	-1184.3568	1215.549	klm lt-3
40	0	-14.732	-4.613	-189.53	186.533	-25.0592	-217.38129	180.63171	-183.8358	157.3182	klm lt-3
40	2.5	-1.839	0.509	565.893	-569.183	-1.3924	-599.25243	596.03187	-513.9198	510.6096	klm lt-3
40	5	11.085	5.63	1321.347	-1324.868	22.31	-1375.92525	1406.29755	-1182.4047	1202.3577	klm lt-3
41	0	-79.702	-26.245	-243.867	134.82	-137.6344	-356.2818	155.8389	-291.2121	147.7485	klm lt-3
41	2.5	14.131	-2.738	560.149	-569.402	12.5764	-584.75949	610.98471	-499.7439	525.1797	klm lt-3
41	5	108.004	20.769	1364.206	-1273.582	162.8352	1558.90497	-1305.92763	1324.989	-1130.5818	klm lt-3
42	0	-8.712	6.622	-255.24	86.742	0.1408	-272.97774	263.02626	-237.5568	221.8752	klm lt-3
42	2.5	-16.858	2.315	580.053	-575.009	-16.5256	592.8132	-625.2981	506.8755	-537.2199	klm lt-3
42	5	-24.951	-1.992	1415.397	-1236.709	-33.1284	1458.71334	-1513.62036	1251.4014	-1296.3132	klm lt-3
43	0	-685.002	-135.05	907.374	277.496	-1038.0824	148.4091	-1757.0763	200.1348	-1433.1384	klm atap 1
43	0.9	-1548.362	-287.151	610.106	-435.824	-2317.476	-1166.07393	-2447.29653	-844.4304	-1942.6212	klm atap 1
43	1.8	-2411.723	-439.252	312.837	-1149.144	-3596.8708	-4015.63911	-1602.43671	-3204.7803	-1136.3211	klm atap 1
44	0	820.993	173.939	-50.013	-1055.982	1263.494	-137.15688	2080.40532	-211.4901	1689.2775	klm atap 1
44	0.9	1605.882	309.168	530.666	-667.102	2421.7272	1180.49484	2581.40904	844.902	2045.6856	klm atap 1
44	1.8	2390.771	444.397	1111.346	-278.222	3579.9604	3957.19296	1623.36636	3151.9053	1151.4825	klm atap 1
45	0	-945.848	-12.128	-122.03	-184.421	-1154.4224	-1194.42309	-807.13899	-1017.2421	685.2843	sloop 1
45	1.5	494.739	0.002	78.155	80.16	593.69	603.64521	435.30921	517.4091	373.1211	sloop 1
45	3	-1012.174	12.132	-194.16	-127.76	-1195.1976	-1259.00754	-851.27154	-1085.7006	-736.2126	sloop 1
46	0	-1729.73	-5.73	-247.031	-307.081	-2084.844	-2142.26145	-1497.39135	-1833.1299	-1280.3841	sloop 1
46	2	879.409	-0.866	142.844	159.04	1053.9052	1072.82007	772.84767	920.0277	662.9085	sloop 1

46	4	-1751.452	3.999	-307.281	-254.84	-2095.344	-2159.15028	-1513.86018	-1852.8597	-1299.7539	sloop 1
47	0	-1750.227	-0.92	-264.258	-296.923	-2101.7444	-2150.0871	-1526.5488	-1842.435	-1307.9736	sloop 1
47	2	874.215	-0.211	142.572	137.629	1048.7204	1067.49342	768.09222	915.1083	658.4787	sloop 1
47	4	-1741.343	0.498	-290.598	-267.819	-2088.8148	-2133.22431	-1522.96851	-1828.7469	-1305.6705	sloop 1
48	0	-1756.078	0.309	-281.139	-281.386	-2106.7992	-2139.14253	-1548.23193	-1833.7176	-1327.2228	sloop 1
48	2	874.477	-0.212	143.393	136.891	1049.0332	1068.62994	767.50464	916.083	657.9756	sloop 1
48	4	-1734.967	-0.734	-272.075	-284.832	-2083.1348	-2121.25137	-1523.10417	-1817.8191	-1305.1215	sloop 1
49	0	-1791.912	5.641	-308.259	-266.2	-2141.1488	-2201.52072	-1554.17682	-1890.0639	-1335.1977	sloop 1
49	2	890.662	-1.99	147.171	138.747	1065.6104	1088.47095	779.41185	934.0497	669.1419	sloop 1
49	4	-1666.864	-9.62	-237.399	-296.305	-2015.6288	-2067.38805	-1445.14755	-1766.8521	-1233.5031	sloop 1
50	0	-1263.68	-261.377	1097.506	-1405.264	-1934.6192	-2967.05871	-16.00431	-2402.0496	127.4256	blk lt-1
50	1.5	682.056	166.92	110.548	73.036	1085.5392	937.3938	705.243	713.3436	514.3572	blk lt-1
50	4	-1309.708	-304.782	-1416.41	1011.335	-2059.3008	-3054.43656	-79.97556	-2453.5062	96.0318	blk lt-1
51	0	-2449.614	-635.464	643.964	-1238.474	-3956.2792	-4272.83472	-1672.03932	-3319.2792	-1090.026	blk lt-1
51	2	1341.455	394.966	160.725	166.578	2240.4916	1831.21323	1481.39943	1356.3297	1056.4893	blk lt-1
51	4	-2488.432	-660.031	-1282.521	611.623	-4042.168	-4375.32018	-1682.02608	-3393.8577	-1085.3199	blk lt-1
52	0	-2491.334	-655.074	633.424	-1265.615	-4037.7192	-4346.99307	-1710.20157	-3372.2541	-1112.1471	blk lt-1
52	2	1321.607	388.494	160.888	160.587	2207.5188	1801.37097	1463.50617	1334.2455	1044.6471	blk lt-1
52	4	-2484.408	-653.366	-1271.655	616.782	-4026.6752	-4355.48673	-1685.01123	-3380.4567	-1091.4777	blk lt-1
53	0	-2484.408	-654.349	628.176	-1259.432	-4028.248	-4343.27187	-1698.46467	-3369.456	-1102.4784	blk lt-1
53	2	1321.047	388.089	160.828	160.867	2206.1988	1800.50577	1462.68507	1333.7226	1044.162	blk lt-1
53	4	-2488.517	-654.901	-1266.526	621.158	-4034.062	-4355.38278	-1695.67818	-3379.5387	-1099.7919	blk lt-1
54	0	-2505.777	-677.26	625.469	-1267.563	-4090.5484	-4388.6808	-1726.7985	-3396.006	-1114.3926	blk lt-1
54	2	1336.911	402.88	160.172	162.922	2248.9012	1828.63905	1486.50285	1349.8497	1056.5901	blk lt-1
54	4	-2439.357	-602.408	-1265.132	633.4	-3891.0812	-4269.23049	-1612.45329	-3334.0401	-1056.8025	blk lt-1
55	0	-1549.357	-31.313	650.59	1146.627	-1909.3292	-442.59369	-2850.51039	-362.457	-2426.3856	sloop 2
55	2	796.785	-12.953	107.361	174.14	935.4172	1011.31086	645.61686	873.8325	560.3805	sloop 2
55	4	-1697.109	5.408	-1275.873	654.902	-2027.878	-3118.22406	-438.89076	-2675.6838	-379.1124	sloop 2
56	0	-1622.466	5.522	698.361	-1284.854	-1938.124	-3049.20714	-351.01374	-2616.588	-303.8508	sloop 2
56	2	804.67	-0.656	160.926	120.859	964.5544	1013.46252	675.51792	869.0364	579.3696	sloop 2
56	4	-1608.228	-6.834	-1216.515	686.566	-1940.808	-2970.28557	-415.60407	-2542.2687	-352.5417	sloop 2
57	0	-1638.468	6.19	605.412	-1207.692	-1956.2576	-2984.5683	-448.4151	-2561.544	-387.6984	sloop 2
57	2	822.568	1.383	145.185	141.311	989.2944	1017.01194	712.12344	870.9777	609.6447	sloop 2
57	4	-1556.431	-3.424	-1155.048	650.308	-1873.1956	-2849.21007	-423.60927	-2440.3311	-361.2447	sloop 2
58	0	-1332.312	-280.849	2107.209	-2417.953	-2048.1328	-4114.71312	962.98818	-3375.2385	977.0769	blk lt-2
58	1.5	682.522	168.195	131.625	60.415	1088.1384	960.8172	684.4047	732.7323	495.8073	blk lt-2

58	3	-1240.145	-282.761	-2383.958	1998.782	-1940.5916	-3983.44758	1022.86422	-3261.6927	1029.4317	blk lt-2
59	0	-2469.398	-644.621	1400.465	-1993.591	-3994.6712	-5092.24968	-905.70858	-4016.6901	-428.2263	blk lt-2
59	2	1339.511	393.095	151.013	171.194	2236.3652	1833.8901	1474.3827	1359.6345	1051.4853	blk lt-2
59	4	-2470.537	-654.618	-2058.445	1375.973	-4012.0332	-5167.84044	-845.10594	-4076.0838	-370.8828	blk lt-2
60	0	-2489.02	-653.604	1427.292	-2031.551	-4032.5904	-5158.37007	-892.11297	-4068.5139	-411.7221	blk lt-2
60	2	1321.824	388.541	159.567	164.865	2207.8544	1805.80428	1459.58778	1338.0201	1041.2631	blk lt-2
60	4	-2486.288	-654.742	-2068.164	1401.274	-4031.1328	-5194.66206	-851.51766	-4099.0068	-376.3116	blk lt-2
61	0	-2489.683	-654.604	1434.157	-2063.078	-4034.986	-5192.79957	-860.33577	-4097.4849	-383.9445	blk lt-2
61	2	1322.309	388.85	157.287	166.431	2208.9308	1808.1525	1458.6474	1339.866	1040.2902	blk lt-2
61	4	-2484.656	-653.123	-2079.59	1435.933	-4026.584	-5203.92579	-836.78679	-4107.8214	-364.5594	blk lt-2
62	0	-2479.376	-646.258	1454.048	-2104.938	-4009.264	-5220.67224	-800.30244	-4125.8826	-336.9942	blk lt-2
62	2	1320.524	385.434	155.904	168.981	2201.3232	1806.80367	1451.94357	1340.5545	1036.3887	blk lt-2
62	4	-2498.533	-668.302	-2102.247	1482.892	-4067.5228	-5251.84926	-837.13056	-4140.702	-356.6574	blk lt-2
63	0	-2358.954	-631.544	1513.879	-2103.068	-3841.2152	-5082.99582	-666.55302	-4015.8198	-230.2974	blk lt-2
63	2	1328.359	395.11	160.745	163.656	2226.2068	1815.53505	1471.85745	1342.8135	1048.2327	blk lt-2
63	4	-2603.283	-663.663	-2152.396	1470.373	-4185.8004	-5411.57064	-891.53904	-4280.1111	-405.7983	blk lt-2
64	0	-2290.218	-504.381	1491.633	-2185.633	-3555.2712	-5017.40358	-427.57428	-4028.2659	-94.1265	blk lt-2
64	2	1163.978	263.558	146.631	171.363	1818.4664	1568.14959	1208.28729	1201.8069	893.3535	blk lt-2
64	4	-2211.873	-435.177	-2158.379	1568.353	-3350.5308	-4862.92611	-330.33021	-3933.2268	-48.1446	blk lt-2
65	0	-1647.096	-20.218	1404.514	-2014.652	-2008.864	-3857.57274	373.19646	-3295.5732	330.8004	blk lt-2
65	2	810.981	-10.04	113.405	180.679	957.1132	1034.9178	655.4919	892.494	567.2718	blk lt-2
65	4	-1570.977	0.139	-2017.709	1536.004	-1884.95	-3768.03273	469.15617	-3229.8174	402.0588	blk lt-2
66	0	-1591.003	-292.06	1635.061	-1957.258	-2376.4996	-3909.67185	200.56995	-3193.4349	329.6295	blk lt-3
66	1.5	773.493	163.548	102.798	55.486	1189.8684	1023.14079	807.26499	788.6619	603.6255	blk lt-3
66	3	-1362.012	-280.844	-1969.465	1528.229	-2083.7648	-3674.98257	460.89393	-2998.3293	546.7077	blk lt-3
67	0	-2818.184	-638.709	1101.203	-1641.617	-4403.7552	-5085.17772	-1637.78202	-4013.8209	-1058.9103	blk lt-3
67	2	1501.265	394.563	176.851	173.157	2432.8188	2010.59649	1639.20939	1510.3044	1191.9726	blk lt-3
67	4	-2798.25	-657.592	-1707.507	1027.924	-4410.0472	-5145.32781	-1559.56311	-4055.1813	-981.6687	blk lt-3
68	0	-2807.511	-651.628	1024.175	-1672.573	-4411.618	-5114.61384	-1602.21054	-4032.0756	-1021.4442	blk lt-3
68	2	1490.772	388.698	159.265	159.081	2410.8432	1977.41859	1642.96209	1485.0333	1198.3563	blk lt-3
68	4	-2829.907	-656.404	-1665.653	1030.727	-4446.1348	-5133.87252	-1636.00122	-4046.004	-1047.8286	blk lt-3
69	0	-2817.29	-652.594	1025.907	-1668.276	-4424.8984	-5120.97852	-1617.59892	-4037.0094	-1034.1126	blk lt-3
69	2	1488.843	388.484	160.456	159.962	2408.186	1976.50887	1639.55127	1484.3691	1195.5483	blk lt-3
69	4	-2823.987	-655.866	-1665.001	1028.193	-4438.17	-5126.63298	-1630.13088	-4040.0892	-1043.0874	blk lt-3
70	0	-2813.641	-651.012	1022.754	-1666.779	-4417.9884	-5114.57856	-1614.34266	-4032.378	-1032.1758	blk lt-3
70	2	1491.063	389.639	161.314	160.024	2412.698	1980.46842	1641.70902	1487.1393	1196.7741	blk lt-3

70	4	-2823.196	-655.139	-1660.133	1026.82	-4436.0576	-5120.23[illegible]02	-1633.95372	-4034.9961	-1046.7567	blk lt-3
71	0	-2699.131	-637.554	1065.304	-1622.272	-4259.0436	-4939.13217	-1532.36097	-3889.2627	-969.1731	blk lt-3
71	2	1489.449	387.161	158.484	159.793	2406.7964	1975.61553	1640.05023	1484.3178	1196.6904	blk lt-3
71	4	-2940.933	-673.552	-1708.342	981.851	-4606.8028	-5306.[illegible]651	-1718.55831	-4184.3475	-1109.3319	blk lt-3
72	0	-2791.656	-650.125	1010.669	-1705.51	-4390.1872	-5131.60305	-1550.03205	-4047.4494	-977.5314	blk lt-3
72	2	1478.957	389.632	168.003	179.43	2398.4796	1986.90051	1610.09751	1492.5483	1169.5743	blk lt-3
72	4	-2869.392	-655.64	-1634.671	1104.364	-4492.2944	-5142.31935	-1709.51025	-4053.6567	-1111.2489	blk lt-3
73	0	-2786.637	-664.045	1020.416	-1766.925	-4406.4364	-5199.38845	-1489.04595	-4098.2058	-917.7408	blk lt-3
73	2	1532.47	397.384	140.169	167.782	2474.7784	2035.61652	1683.27432	1530.2268	1228.2192	blk lt-3
73	4	-2767.387	-626.615	-1700.084	1142.483	-4323.4484	-5085.612[illegible]	-1515.4356	-4020.7239	-960.5727	blk lt-3
74	0	-770.753	-234.481	977.01	-1391.926	-1300.0732	-2418.53598	504.50862	-1946.4111	559.0557	blk atap-1
74	1.5	300.175	141.134	128.984	131.689	586.0244	542.37162	265.82472	388.6776	151.6374	blk atap-1
74	3	-208.397	-158.251	-1259.042	1115.305	-503.278	-1640.50908	1003.47912	-1320.6951	945.5805	blk atap-1
75	0	-924.155	-463.313	716.001	-1227.73	-1850.2868	-2551.36644	26.86656	-1936.6965	273.2175	blk atap-1
75	2	633.859	314.021	191.339	202.22	1263.0644	1075.71618	651.05418	752.4711	388.4751	blk atap-1
75	4	-1176.923	-472.767	-1293.372	672.121	-2168.7348	-2891.65296	-175.57176	-2223.2655	104.8041	blk atap-1
76	0	-2411.723	-439.252	312.837	-1149.144	-3596.8708	-4015.63911	-1602.43671	-3204.7803	-1136.3211	blk atap-2
76	2	1548.191	307.763	154.533	120.781	2350.25	1981.75089	1657.23159	1532.4516	1254.2922	blk atap-2
76	4	-2860.552	-509.284	-963.77	430.706	-4247.5168	-4336.38702	-2312.47002	-3441.8898	-1707.1038	blk atap-2
77	0	-2744.166	-489.762	326.457	-979.336	-4076.6184	-4218.22716	-2161.62156	-3351.1518	-1588.347	blk atap-2
77	2	1437.766	290.766	158.327	163.098	2190.5448	1864.08978	1521.58398	1440.7776	1147.2012	blk atap-2
77	4	-2748.958	-492.769	-969.802	345.531	-4087.18	-4215.14247	-2178.55827	-3346.884	-1601.2404	blk atap-2
78	0	-2731.629	-488.289	335.717	-987.75	-4059.2172	-4212.97002	-2138.69502	-3347.4411	-1569.4911	blk atap-2
78	2	1443.464	291.698	158.508	158.468	2198.8736	1865.84034	1532.97354	1441.7748	1156.4604	blk atap-2
78	4	-2750.099	492.377	-978.7	344.685	-2512.3156	-3605.04144	-1549.77144	-3355.9191	-1594.2591	blk atap-2
79	0	-2739.014	-486.747	342.647	-980.183	-4065.612	-4211.80746	-2153.42316	-3347.2773	-1582.9479	blk atap-2
79	2	1447.681	291.848	160.145	159.979	2204.174	1872.08154	1535.77704	1447.0434	1158.7824	blk atap-2
79	4	-2734.279	-493.619	-982.357	340.141	-4070.9252	-4213.44777	-2150.49807	-3344.9724	-1576.7298	blk atap-2
80	0	-2626.275	-472.849	381.849	-933.441	-3908.0884	-4035.59667	-2075.37057	-3203.7444	-1523.5506	blk atap-2
80	2	1436.514	291.059	162.533	158.651	2189.5112	1862.36652	1521.04722	1439.1423	1146.5829	blk atap-2
80	4	-2869.353	-509.095	-1016.783	290.744	-4257.7756	-4401.17265	-2265.92835	-3497.5224	-1667.313	blk atap-2
81	0	-2894.305	-511.087	398.614	-945.966	-4290.9052	-4[illegible]54.26936	-2367.74076	-3456.2439	-1753.5051	blk atap-2
81	2	1541.79	304.289	123.621	146.128	2337.0104	1964.01597	1657.14717	1519.1262	1256.0958	blk atap-2
81	4	-2390.771	-444.397	-1111.346	278.222	-3579.9604	-3957.19296	-1623.36636	-3151.9053	-1151.4825	blk atap-2

Momen Rencana Portal 2

Elemen	Section m	MD kg-m	ML kg-m	ME,ki kg-m	ME,ka kg-m	1,2.MD+1,6.ML	1.05 (MD+ML,r+ME)	1,05 (MD+ML,r-ME)	0,9 (MD+ME)	0,9 (MD-ME)	Keterangan
1	0	176.994	64.857	10.666	-4.2	316.164	237.90291	215.50431	168.894	149.6952	klm pond 1
1	0.5	101.13	34.928	-165.792	99.355	209.2408	-33.29046	314.87274	-58.1958	240.2298	klm pond 1
1	1	25.267	44.999	-342.249	202.911	102.3188	-304.48173	414.24117	-285.2838	330.7644	klm pond 1
2	0	144.631	51.474	32.046	-24.134	255.9156	217.93947	150.64287	159.0093	101.3265	klm pond 1
2	0.5	100.352	51.767	-178.319	129.05	203.2496	-49.25214	325.21776	-70.1703	250.8039	klm pond 1
2	1	56.073	52.06	-388.683	282.235	150.5836	-316.4427	499.7916	-299.349	400.2804	klm pond 1
3	0	92.987	28.659	69.778	-69.595	157.4388	188.95842	42.42462	146.4885	20.8881	klm pond 1
3	0.5	43.769	12.303	-98.435	102.084	72.2076	160.89654	-53.47986	131.2677	-52.4835	klm pond 1
3	1	-5.449	-4.053	-266.648	273.762	-13.0236	279.17526	-295.72494	241.4817	-251.2899	klm pond 1
4	0	49.891	-5.742	160.975	-132.387	50.682	217.79184	-120.25566	189.7794	-99.9756	klm pond 1
4	0.5	30.65	2.202	-26.187	35.481	40.3032	70.82481	-3.68529	59.5179	-4.3479	klm pond 1
4	1	11.409	10.147	-213.348	203.349	29.926	-205.64334	242.38746	-181.7451	202.2813	klm pond 1
5	0	18.738	-51.874	270.915	-195.78	-60.5128	271.45503	-297.46647	260.6877	-226.9593	klm pond 1
5	0.5	21.599	-7.862	69.11	-31.849	13.3396	90.29139	-54.83961	81.6381	-42.7599	klm pond 1
5	1	24.46	36.15	-132.695	92.082	87.192	-90.87225	187.78725	-97.4115	141.4395	klm pond 1
6	0	-44.22	-72.592	295.432	-259.973	-169.2112	218.03964	-402.36756	226.0908	-305.6868	klm pond 1
6	0.5	31.115	-101.592	270.509	-87.031	-125.2092	252.70224	-315.36666	271.4616	-215.4546	klm pond 1
6	1	106.451	-130.593	245.586	85.911	-81.2076	287.36526	-228.36534	316.8333	-125.2215	klm pond 1
7	0	312.979	66.21	-220.219	387.332	481.5108	777.03885	-36.35835	630.2799	-66.9177	klm basement
7	2.2	-186.88	-60.384	-952.341	892.044	-320.8704	-1234.22397	765.69213	-1025.2989	688.9149	klm basement
7	4.4	-686.738	-186.979	-1684.462	1396.755	-1123.252	-2607.55677	929.81343	-2134.08	897.9516	klm basement
8	0	270.035	82.758	-335.812	461.556	456.4548	820.30809	-148.95951	658.4319	-172.3689	klm basement
8	2.2	-165.648	-67.23	-863.416	814.229	-306.3456	-1122.8721	690.3015	-926.1576	627.9912	klm basement
8	4.4	-601.331	-217.218	-1391.02	1166.903	-1069.146	-2228.81589	692.32611	-1793.1159	710.7201	klm basement
9	0	20.095	4.777	-309.672	315.846	31.7572	355.74756	-307.52904	302.3469	-266.1759	klm basement
9	2.2	-0.847	-0.269	-877.528	857.093	-1.4468	-922.46322	920.34558	-790.5375	789.0129	klm basement
9	4.4	-21.788	-5.316	-1445.393	1398.331	-34.6512	-1543.88913	1491.43617	-1320.4629	1281.2445	klm basement
10	0	24.583	11.053	-222.807	216.917	47.1844	-201.17181	266.72289	-178 4016	222.651	klm basement
10	2.2	0.099	2.068	-888.995	875.502	3.4276	-932.03796	934.85154	-800.0064	800.1846	klm basement
10	4.4	-24.385	-6.917	-1555.202	1534.07	-40.3292	-1662.92406	1603.00014	-1421.6283	1377.7353	klm basement
11	0	32.942	26.012	-96.511	73.451	81.1496	-50.35989	152.31321	-57.2121	116.5077	klm basement
11	2.2	-4.132	0.422	-906.033	900.186	-4.2832	-955.40739	947.26191	-819.1485	811.7109	klm basement

11	4.4	-41.206	-25.167	-1715.582	1726.893	-89.7144	1754.1[illegible]614	-1872.35916	1517.1183	-1591.2891	klm basement
12	0	-349.604	-146.461	8.187	-210.394	-653.8624	-680.26833	-238.44093	-503.9982	-125.289	klm basement
12	2.2	182.652	156.388	-950.85	924.497	469.4032	-708.08346	1288.70154	-691.3782	1020.1518	klm basement
12	4.4	714.908	459.236	-1909.922	2059.352	1592.6672	320[illegible]29168	-1122.34752	2496.834	-1209.9996	klm basement
13	0	233.637	12.145	-8258.185	8382.927	299.7964	9055.04355	-8549.10315	7754.9076	-7334.361	klm pond 2
13	0.5	108.634	2.374	-4829.999	4939.602	134.1592	5302.14342	-5071.02078	4543.4124	-4347.8712	klm pond 2
13	1	-16.369	-7.397	-1401.824	1496.267	-31.478	1549.23279	-1592.92791	1331.9082	-1361.3724	klm pond 2
14	0	211.487	39.868	-6350.379	6570.665	189.9056	7095.14276	-6702.25374	6103.9368	-5723.2602	klm pond 2
14	0.5	63.713	-2.902	-4242.283	4401.965	71.8124	4687.13364	-4556.99286	4019.1102	-3904.4268	klm pond 2
14	1	-84.061	34.064	-2134.2	2233.254	-46.3708	2278.11297	-2411.72043	1934.2737	-2085.5835	klm pond 2
15	0	4.722	-63.224	-5564.841	5772.707	-95.492	6026.46933	-6096.21537	5199.6861	-5191.1865	klm pond 2
15	0.5	387.905	-87.384	-4096.679	4438.75	325.6716	5012.93583	-4308.43917	4343.9895	-3645.7605	klm pond 2
15	1	771.088	-111.544	-2628.532	3104.778	746.8352	3999.38658	-2520.64722	3488.2794	-2100.321	klm pond 2
16	0	906.559	271.774	-2781.968	2802.019	1522.7092	4065.22452	-1819.01538	3337.7202	-1705.914	klm lt-1
16	2	64.68	13.268	-857.516	825.141	98.8448	-824.11896	976.66464	-713.5524	829.9764	klm lt-1
16	4	-777.198	-245.239	1066.936	-1151.737	-1325.02	-2179.88232	238.76538	-1736.0415	337.0851	klm lt-1
17	0	864.471	328.309	-3451.394	3416.712	1562.6596	-2509.43448	4738.49292	-2328.2307	3884.2785	klm lt-1
17	2	20.208	10.875	-760.392	766.984	41.6496	833.40285	-777.26355	708.4728	-672.0984	klm lt-1
17	4	-824.055	-306.558	1930.611	-1882.745	-1479.3588	968.75226	-3085.53084	995.9004	-2479.1994	klm lt-1
18	0	-31.885	-10.581	-3361.338	3265.569	-55.1916	-3569.55018	3489.25962	-3053.9007	2996.5077	klm lt-1
18	2	-10.305	-1.579	-820.06	795.349	-14.8924	-872.87802	849.24798	-747.3285	728.7795	klm lt-1
18	4	11.268	7.424	1721.217	-1674.871	25.4	1823.78637	-1790.76933	1559.2365	-1538.9541	klm lt-1
19	0	-11.198	-3.009	-3455.033	3410.284	-18.252	-3641.43822	3614.13108	-3119.6079	3099.4515	klm lt-1
19	2	-5.86	-1.69	-828.172	821.634	-9.736	-876.7983	862.3629	-750.6288	740.0808	klm lt-1
19	4	-0.538	-0.371	1798.689	-1767.016	-1.2392	1887.82482	-1889.42208	1618.3359	-1619.3043	klm lt-1
20	0	19.286	14.657	-3607.577	3615.614	46.5944	3825.87891	-3766.91049	3271.41	-3236.6952	klm lt-1
20	2	7.197	6.031	-849.93	855.821	18.286	909.96843	-887.25567	776.7162	-763.7616	klm lt-1
20	4	-4.917	-2.595	1907.718	-1903.972	-10.0524	1996.3062	-2009.9016	1712.5209	-1721.3715	klm lt-1
21	0	-718.87	236.406	-3825.644	3839.379	-484.3944	3425.47023	-4637.22567	2808.4581	-4102.4241	klm lt-1
21	2	-231.729	-172.509	-876.153	893.046	-554.0892	585.70218	-1289.69442	595.1853	-1012.2975	klm lt-1
21	4	255.38	154.155	2073.339	-2053.288	553.104	2542.2726	-1811.7393	2095.8471	-1636.1631	klm lt-1
22	0	-45.095	5.622	-3376.057	3436.022	-45.1188	3564.01521	-3651.63099	3051.8343	-3133.0053	klm lt-1
22	2	-28.659	7.068	-642.398	675.783	-23.082	683.93304	-735.21126	582.4116	-633.9978	klm lt-1
22	4	-12.265	8.515	2091.261	-2084.455	-1.094	2188.31025	-2203.33785	1871.0964	-1893.1734	klm lt-1
23	0	-42.365	24.527	-3956.127	4127.512	-11.5948	4304.85636	-4362.91884	3676.6323	-3752.8893	klm lt-1
23	2	-0.569	-0.254	-871.475	880.002	-1.0892	923.24463	-924.75957	791.4897	-792.5139	klm lt-1

2	4	41.178	-25.036	2213.177	-2367.507	9.356	-2458.41813	2513.34657	-2093.6961	2167.8165	klm lt-1
24	0	-927.142	-126.76	-3783.58	3755.086	-1315.3864	-5026.1169	2919.4011	-4239.6498	2570.7942	klm lt-1
24	2	204.121	145.482	-1094.623	1156.437	477.7164	1520.23956	-908.27814	1224.5022	-857.0844	klm lt-1
24	4	1335.325	417.725	1594.334	-1442.212	2270.75	3339.3087	-8.7927	2636.6931	-233.1081	klm lt-1
25	0	744.158	213.277	-1040.273	1266.216	1234.2328	2245.25721	-413.79639	1809.3366	-469.8522	klm lt-2
25	2	-40.59	14.885	392.624	-349.83	-24.892	379.01325	-445.49715	316.8306	-389.8926	klm lt-2
25	4	-825.338	-183.507	1825.521	-1965.876	-1284.0168	-3046.38411	1081.95549	-2512.0926	1026.4842	klm lt-2
26	0	904.372	323.46	-1853.812	2109.629	1603.3824	3369.00585	-1061.21505	2713.0509	-1094.2313	klm lt-2
26	2	-64.538	-13.419	259.788	-372.543	-98.916	-467.38902	314.95128	-393.3729	277.2045	klm lt-2
26	4	1033.948	-350.299	2373.388	-2854.715	680.2592	-2132.49372	3862.40778	-1638.6903	3499.7967	klm lt-2
27	0	6.297	8.561	-1764.52	1732.653	21.254	-1840.74072	1864.75128	-1582.4007	1593.7353	klm lt-2
27	2	-5.922	-6.399	418.539	-360.486	-17.3448	429.21648	-449.71542	371.3553	-382.0149	klm lt-2
27	4	-18.142	-21.358	2601.599	-2453.625	-55.9432	2699.17431	-2764.18359	2325.1113	-2357.7669	klm lt-2
28	0	3.808	2.608	-1703.633	1697.336	8.7424	-1783.17321	1794.45609	-1529.8425	1536.6969	klm lt-2
28	2	-5.979	-3.72	416.679	-396.025	-13.1268	428.8914	-446.1345	369.63	-380.3922	klm lt-2
28	4	-15.765	-10.049	2536.991	-2489.385	-34.9964	2640.95643	-2686.72467	2269.1034	-2297.4804	klm lt-2
29	0	-11.684	-10.788	-1625.92	1636.899	-31.2816	1699.67931	-1737.80859	1462.6935	-1483.7247	klm lt-2
29	2	-10.719	-7.391	436.152	-435.77	-24.6884	442.04832	-473.87088	382.8897	-402.1839	klm lt-2
29	4	-9.753	-3.993	2498.225	-2508.439	-18.0924	-2646.61719	2621.10471	-2266.3728	2248.8174	klm lt-2
30	0	79.909	86.484	-1542.787	1532.672	234.2652	-1481.53698	1758.31572	-1316.5902	1460.4264	klm lt-2
30	2	41.882	33.924	469.391	-490.8	104.5368	-449.99178	580.68822	-404.0262	479.4138	klm lt-2
30	4	3.856	-18.636	2481.57	-2514.272	-25.1904	-2647.67748	2632.29372	-2259.3744	2266.3152	klm lt-2
31	0	24.641	-22.742	-1552.768	1571.55	-6.818	1661.67309	-1638.58191	1436.5719	-1392.2181	klm lt-2
31	2	19.048	-5.833	455.502	-514.534	13.5248	-523.93509	556.58631	-445.9374	480.2238	klm lt-2
31	4	13.455	11.075	2463.772	-2600.619	33.866	-2709.54495	2751.75495	-2328.4476	2352.6666	klm lt-2
32	0	-124.783	-37.262	-1349.715	1215.498	-209.3588	-1571.69796	1262.70354	-1327.0482	1102.4388	klm lt-2
32	2	60.7	32.966	586.811	-464.972	125.5856	700.65513	-531.64797	582.7599	-473.4999	klm lt-2
32	4	246.183	103.194	2523.336	-2145.443	460.53	2973.00717	-2325.99843	2492.5671	-2049.4377	klm lt-2
33	0	1646.851	-582.184	-423.374	93.792	1044.7268	917.87493	1806.96033	1101.1293	1863.2025	klm lt-2
33	2	-13.516	-63.598	651.71	-702.795	-117.976	-792.19329	683.67621	-644.6799	620.3511	klm lt-2
33	4	1619.819	454.988	1726.794	-1499.382	2671.7636	3800.58609	174.31869	3011.9517	-96.2775	klm lt-2
34	0	992.89	332.038	190.46	-8.617	1722.7288	1451.70144	1051.73544	1065.015	722.187	klm lt-3
34	1.6	-2.204	-62.25	583.735	-700.272	-102.2448	-776.8173	693.7539	-632.2284	628.2612	klm lt-3
34	3.2	-997.299	-456.537	977.01	-1391.926	-1927.218	-2796.30456	126.74004	-2150.3025	355.1643	klm lt-3
35	0	590.874	243.835	-697.279	315.132	1099.1848	41.8908	1506.1767	-95.7645	1159.3377	klm lt-3
35	1.6	412.381	146.476	734.568	-261.338	729.2188	1296.57633	-246.01647	1032.2541	-289.9683	klm lt-3

35	3.2	233.888	49.117	2166.416	-837.809	359.2528	2551.26291	-1998.21069	2160.2736	-1739.2752	klm lt-3
36	0	360.787	140.12	-131.75	725.846	657.1364	1229.24025	-295.03635	977.9697	-328.5531	klm lt-3
36	1.6	-385.958	-190.915	267.099	-778.953	-768.6136	-1343.433	292.3683	-1048.4199	353.6955	klm lt-3
36	3.2	1132.665	-521.95	665.988	2283.712	524.078	3258.36735	-1537.42785	3074.7393	-1035.9423	klm lt-3
37	0	1758.084	-620.297	26.71	-356.9	1117.2256	1080.45609	1829.94609	1261.0656	1903.4856	klm lt-3
37	1.6	-7.404	136.354	660.041	-514.511	209.2816	771.17187	-614.91423	587.3733	-600.7005	klm lt-3
37	3.2	1743.322	893.005	1293.372	-672.121	3520.7944	3751.12185	1035.04065	2733.0246	404.955	klm lt-3
38	0	-45.039	-30.397	-130.083	246.872	-102.682	192.77454	-325.65666	181.6497	-262.7199	klm lt-3
38	2.5	2.866	5.404	580.067	-581.59	12.0856	-604.25568	617.08332	-520.8516	526.0104	klm lt-3
38	5	50.781	41.206	1290.227	1410.042	126.8668	1559.82393	-1401.26427	1314.7407	-1223.3349	klm lt-3
39	0	-24.662	-16.409	-154.569	209.618	-55.8488	183.86613	-256.33167	166.4604	-210.852	klm lt-3
39	2.5	-4.373	-3.313	575.465	-561.842	-10.5484	597.55941	-610.91709	513.9828	-521.8542	klm lt-3
39	5	15.936	9.783	1305.519	-1333.281	34.776	-1377.04896	1422.84114	-1185.6105	1214.2953	klm lt-3
40	0	-19.257	-12.148	-189.53	186.533	-42.5452	-226.87959	171.13341	-187.9083	153.2457	klm lt-3
40	2.5	-2.415	-0.23	565.893	-569.183	-3.266	-600.3228	594.9615	-514.4382	510.0912	klm lt-3
40	5	14.458	11.689	1321.347	-1324.868	36.052	-1368.56643	1413.65637	-1179.369	1205.3934	klm lt-3
41	0	-114.28	-46.527	-243.867	134.82	-211.5792	-405.36636	106.75434	-322.3323	116.6283	klm lt-3
41	2.5	2.307	-4.465	560.149	-569.402	-4.3756	-598.2627	597.4815	-510.3855	514.5381	klm lt-3
41	5	118.934	37.596	1364.206	-1273.582	202.8744	1580.98248	-1283.85012	1334.826	-1120.7448	klm lt-3
42	0	-72.09	-6.351	-255.24	86.742	-96.6696	-347.69763	188.30637	-294.597	164.835	klm lt-3
42	2.5	-10.08	-6.539	580.053	-575.009	-22.5584	594.35208	-623.75922	512.9757	-531.1197	klm lt-3
42	5	51.982	-6.726	1415.397	-1236.709	51.6168	1536.51057	-1435.82313	1320.6411	-1227.0735	klm lt-3
43	0	-300.416	-280.308	907.374	277.496	-808.992	460.71186	-1444.77354	546.2622	-1087.011	klm atap 1
43	0.9	-960.559	-556.859	610.106	-435.824	-2043.6452	-718.79682	-2000.01942	-315.4077	-1413.5985	klm atap 1
43	1.8	-1620.702	-833.411	312.837	-1149.144	-3278.3	-3433.38723	-1020.18483	-2492.8614	-424.4022	klm atap 1
44	0	483.952	365.605	-50.013	-1055.982	1165.7104	-370.30035	1847.26185	-514.827	1385.9406	klm atap 1
44	0.9	1048.931	605.1	530.666	-667.102	2226.8772	782.13345	2183.04765	343.6461	1544.4297	klm atap 1
44	1.8	1613.91	844.595	1111.346	-278.222	3288.044	3393.61365	1059.78705	2452.7304	452.3076	klm atap 1
45	0	-287.712	-21.211	-122.03	-184.421	-379.192	-509.10258	-121.81848	-424.9197	-92.9619	sloop 1
45	1.5	138.713	-0.15	78.155	80.16	166.2156	229.72215	61.38615	196.9857	52.6977	sloop 1
45	3	-267.362	20.911	-194.16	-127.76	-287.3768	-471.42417	-63.68817	-415.3698	-65.8818	sloop 1
46	0	-481.324	-9.786	-247.031	-307.081	-593.2464	-833.99043	-189.12033	-709.5645	-156.8187	sloop 1
46	2	317.985	-1.405	142.844	139.04	379.334	482.9853	183.0129	414.7461	157.6269	sloop 1
46	4	-442.705	6.976	-307.281	-254.84	392.7436	-783.09042	-137.80032	-674.9874	-121.8816	sloop 1
47	0	-468.249	-1.854	-264.258	-296.923	-534.2124	-804.59862	-181.06032	-688.6548	-154.1934	sloop 1
47	2	319.533	-0.36	142.572	137.629	382.8636	484.98345	185.58225	415.8945	159.2649	sloop 1

47	4	-452.685	1.135	-290.598	-267.819	-541.406	-779.7321	-169.4763	-668.9547	-145.8783	sloop 1
48	0	-465.859	0.228	-281.139	-281.386	-558.666	-784.46361	-193.55301	-672.5205	-166.0257	sloop 1
48	2	319.678	-0.358	143.393	136.891	383.0408	485.99901	184.87371	416.7639	158.6565	sloop 1
48	4	-454.786	-0.945	-272.075	-284.832	-547.2552	-777.19425	-179.04705	-665.6562	-152.9586	sloop 1
49	0	-463.268	9.194	-308.259	-266.2	-541.2112	-804.31113	-156.96723	-694.3743	-139.5081	sloop 1
49	2	320.339	-3.337	147.171	138.747	379.0676	488.78319	179.72409	420.759	155.8512	sloop 1
49	4	-456.054	-15.868	-237.399	-296.305	-572.6536	-799.97379	-177.73329	-677.1231	-143.7741	sloop 1
50	0	-1593.297	-458.753	1097.506	-1405.264	-2645.9612	-3437.50344	-486.44904	-2698.7049	-169.2297	blk lt-1
50	1.5	915.932	292.431	110.548	73.036	1567.008	1262.03553	1029.88473	923.832	724.8456	blk lt-1
50	3	-1770.064	-526.985	-1416.41	1011.335	-2967.2528	-3677.79825	-703.33725	-2867.8266	-318.2886	blk lt-1
51	0	-3235.866	-1072.512	643.964	-1238.474	-5599.0584	-5373.73956	-2772.94416	-4026.906	-1797.6528	blk lt-1
51	2	1810.11	654.882	160.725	166.578	3219.9432	2488.09806	2138.28426	1779.0192	1479.1788	blk lt-1
51	4	-3327.444	-1118.741	-1282.521	611.623	-5766.9184	-5538.97008	-2845.67598	-4148.9685	-1840.4307	blk lt-1
52	0	-3317.346	-1103.475	633.424	-1255.615	-5746.3752	-5496.7983	-2860.0068	-4115.6649	-1855.5579	blk lt-1
52	2	1782.543	644.507	160.888	160.587	3170.2628	2446.64196	2108.77716	1749.0879	1459.4895	blk lt-1
52	4	-3301.099	-1098.529	-1271.655	626.782	-5718.9652	-5493.46497	-2822.98947	-4115.4786	-1826.4996	blk lt-1
53	0	-3314.285	-1102.436	628.176	-1259.432	-5741.0396	-5496.93753	-2852.13033	-4116.3453	-1849.3677	blk lt-1
53	2	1781.781	643.795	160.828	160.867	3168.2092	2445.37125	2107.55055	1748.3832	1458.8226	blk lt-1
53	4	-3305.682	-1100.99	-1266.526	621.158	-5728.4024	-5494.4421	-2834.7375	-4114.9872	-1835.2404	blk lt-1
54	0	-3366.174	-1140.814	625.469	-1267.563	-5864.7112	-5584.13667	-2922.25437	-4170.3633	-1888.7499	blk lt-1
54	2	1816.735	668.609	160.172	162.922	3249.8564	2499.86352	2157.72732	1781.6913	1488.4317	blk lt-1
54	4	-3183.885	-1012.985	-1265.132	633.4	-5441.438	-5309.6484	-2652.8712	-4004.1153	-1726.8777	blk lt-1
55	0	-1750.107	-54.574	650.59	1146.627	-2187.4468	-668.03562	-3075.95232	-543.132	-2607.0606	sloop 2
55	2	847.48	-20.798	107.361	174.14	983.6992	1059.59826	693.90426	919.458	606.006	sloop 2
55	4	-1794.934	12.979	-1275.873	654.902	-2133.1544	-3216.17058	-536.83728	-2763.7263	-467.1549	sloop 2
56	0	-1766.209	-0.04	698.361	-1284.854	-2119.5148	-3203.64135	-505.44795	-2745.9567	-433.2195	sloop 2
56	2	871.734	-0.188	160.926	120.859	1045.78	1084.17456	746.22996	929.394	639.7272	sloop 2
56	4	-1730.323	-0.336	-1216.515	686.566	-2076.9252	-3094.39158	-539.71008	-2652.1542	-462.4272	sloop 2
57	0	-1772.019	9.201	605.412	-1207.692	-2111.7012	-3122.89992	-586.74672	-2681.7399	-507.8943	sloop 2
57	2	884.876	-3.008	145.185	141.311	1057.0384	1079.66901	774.78051	927.0549	665.7219	sloop 2
57	4	-1698.229	-15.216	-1155.048	650.308	-2062.2204	-3005.52693	-579.92613	-2567.9493	-488.8629	sloop 2
58	0	-1521.356	-458.515	2107.209	-2417.953	-2559.2512	-4425.1389	652.5624	-3545.3781	806.9373	blk lt-2
58	1.5	768.208	262.051	131.625	60.415	1341.1312	1109.91678	833.50428	809.8497	572.9247	blk lt-2
58	3	-1397.453	-454.65	-2383.958	1998.782	-2404.3836	-4256.91105	749.40075	-3403.2699	887.8545	blk lt-2
59	0	-3126.379	-1084.669	1400.465	-1993.591	-5487.1252	-6059.30997	-1872.76887	-4607.973	-1019.5092	blk lt-2
59	2	1738.488	652.859	151.013	171.194	3130.76	2416.46727	2056.95987	1718.7138	1410.5646	blk lt-2

59	4	-3180.237	-1100.65	-2058.145	1375.973	-5577.3244	-6194.0256	-1871.2911	-4714.8138	-1009.6128	blk lt-2
60	0	-3175.266	-1101.787	1427.292	-2031.551	-5573.1784	-6161.28366	-1895.02656	-4686.1353	-1029.3435	blk lt-2
60	2	1716.61	644.492	159.567	164.865	3091.1192	2381.57871	2035.36221	1693.3275	1396.5705	blk lt-2
60	4	-3175.105	-1100.264	-2068.164	1401.274	-5570.5414	-6198.59877	-1855.45437	-4718.9421	-996.2469	blk lt-2
61	0	-3179.45	-1103.242	1434.157	-2063.078	-5580.5272	-6199.69686	-1867.23306	-4718.2752	-1004.7348	blk lt-2
61	2	1717.251	645.056	157.287	166.431	3092.7908	2384.25138	2034.74628	1695.3138	1395.738	blk lt-2
61	4	-3169.64	-1097.682	-2079.59	1435.933	-5559.8592	-6203.23116	-1836.09216	-4724.307	-981.045	blk lt-2
62	0	-3162.873	-1089.489	1454.048	-2104.938	-5538.63	-6217.57962	-1797.20982	-4741.0299	-952.1415	blk lt-2
62	2	1711.192	639.553	155.904	168.981	3076.7152	2377.10004	2022.23994	1692.1557	1387.9899	blk lt-2
62	4	-3198.335	-1122.44	-2102.247	1482.892	-5633.906	-6272.7483	-1858.0296	-4770.5238	-986.4792	blk lt-2
63	0	-3022.865	-1054.769	1513.879	-2103.068	-5315.0684	-6046.73412	-1630.29132	-4613.3397	-827.8173	blk lt-2
63	2	1719.756	649.962	160.745	163.656	3103.6464	2387.05866	2043.38106	1695.0708	1400.49	blk lt-2
63	4	-3321.215	-1136.341	-2152.396	1470.373	-5803.6036	-6463.18638	-1943.15478	-4926.2499	-1051.9371	blk lt-2
64	0	-3358.121	-1105.084	1491.633	-2185.633	-5797.8796	-6517.14462	-1927.31532	-4989.3786	-1055.2392	blk lt-2
64	2	1898.995	643.096	146.631	171.363	3307.7476	2579.02638	2219.16408	1863.3222	1554.8688	blk lt-2
64	4	-3347.481	-1099.758	-2158.379	1568.353	-5776.59	-6474.00054	-1941.40464	-4955.274	-1070.1918	blk lt-2
65	0	-3181.519	-1087.532	1404.514	-2014.652	-5557.874	-6141.12471	-1910.35551	-4676.5539	-1050.1803	blk lt-2
65	2	1723.62	634.089	113.405	180.679	3082.8864	2398.99002	2019.56412	1713.8691	1388.6469	blk lt-2
65	4	-2982.176	-999.908	-2017.709	1536.004	-5178.464	-5879.82129	-1642.63239	-4499.8965	-868.0203	blk lt-2
66	0	-1818.229	-515.545	1635.061	-1957.258	-3006.7468	-4289.0547	-178.8129	-3397.9383	125.1261	blk lt-3
66	1.5	957.334	285.769	102.798	55.486	1606.0312	1293.17307	1077.29727	954.1188	769.0824	blk lt-3
66	3	-1799.828	-483.516	-1969.465	1528.229	-2933.4192	-4262.37273	-126.49623	-3392.3637	152.6733	blk lt-3
67	0	-3424.65	-1077.65	1101.203	-1641.617	-5833.82	-5998.49985	-2551.10415	-4559.6403	-1604.7297	blk lt-3
67	2	1914.696	654.001	176.851	173.157	3344.0368	2608.14498	2236.75788	1882.3923	1564.0605	blk lt-3
67	4	-3529.556	-1105.383	-1707.507	1027.924	-6004.08	-6195.30744	-2609.54274	-4713.3567	-1639.8441	blk lt-3
68	0	-3502.659	-1096.344	1024.175	-1672.573	-5957.3412	-6124.69032	-2612.28702	-4657.7088	-1647.0774	blk lt-3
68	2	1883.269	644.928	159.265	159.081	3291.8076	2550.96534	2216.50884	1838.2806	1551.6036	blk lt-3
68	4	-3514.402	-1104.835	-1665.653	1030.727	-5985.0184	-6135.1038	-2637.2325	-4662.0495	-1663.8741	blk lt-3
69	0	-3505.505	-1098.475	1025.907	-1668.276	-5964.166	-6124.5093	-2621.1297	-4656.4029	-1653.5061	blk lt-3
69	2	1883.147	644.458	160.456	159.962	3290.9092	2551.79169	2214.83409	1839.2427	1550.4219	blk lt-3
69	4	-3511.8	-1103.645	-1665.001	1028.193	-5979.992	-6130.9374	-2634.4353	-4659.1209	-1662.1191	blk lt-3
70	0	-3502.296	-1095.489	1022.754	-1666.779	-5955.5376	-6117.68682	-2617.45092	-4652.1675	-1651.9653	blk lt-3
70	2	1886.421	646.278	161.314	160.024	3297.75	2557.27689	2218.51749	1842.9615	1552.5963	blk lt-3
70	4	-3508.46	-1102.991	-1660.133	1026.82	-5974.9376	-6121.90698	-2635.62768	-4651.7337	-1663.4943	blk lt-3
71	0	-3390.325	-1075.101	1065.304	-1622.272	-5788.5516	-5940.54048	-2533.76928	-4511.3373	-1591.2477	blk lt-3
71	2	1882.707	643.492	158.484	159.793	3288.8356	2550.02496	2214.45966	1838.25	1550.6226	blk lt-3

71	4	-3627.86	-1128.952	-1708.342	981.851	-6159.7552	-6314.25186	-2726.73366	-4802.5818	-1727.5662	blk lt-3
72	0	-3542.315	-1111.525	1010.669	-1705.51	-6029.218	-6210.477	-2628.906	-4723.0425	-1653.1245	blk lt-3
72	2	1892.443	649.411	168.003	179.43	3309.9892	2584.59558	2207.79258	1864.6857	1541.7117	blk lt-3
72	4	-3456.399	-1080.688	-1634.671	1104.364	-5876.7796	-6026.45694	-2593.64784	-4581.963	-1639.5552	blk lt-3
73	0	-3571.004	-1117.614	1020.416	-1766.925	-6073.3872	-6308.92227	-2598.37977	-4804.1361	-1623.6711	blk lt-3
73	2	1917.347	649.069	140.169	167.782	3339.3268	2598.29892	2245.95672	1876.6161	1574.6085	blk lt-3
73	4	-3377.902	-1075.284	-1700.084	1142.483	-5773.9368	-6009.31422	-2439.13782	-4570.1874	-1510.0362	blk lt-3
74	0	-997.299	-456.337	977.01	-1391.926	-1927.218	2796.30456	126.74004	-2150.3025	355.1643	blk atap-1
74	1.5	540.31	279.819	128.984	131.689	1096.0824	881.88492	605.33802	604.7991	367.7589	blk atap-1
74	3	-534.304	-329.425	-1259.042	1115.305	-1168.2448	-2090.55105	553.43715	-1614.0114	652.2642	blk atap-1
75	0	-1616.617	-887.556	716.001	-1227.73	-3360.03	-3545.72463	-967.49163	-2559.9123	-349.9983	blk atap-1
75	2	1086.671	594.551	191.339	202.22	2255.2868	1727.90268	1303.24068	1160.0019	796.0059	blk atap-1
75	4	-1743.322	-893.005	-1293.372	672.121	-3520.7944	-3751.12185	-1035.04065	-2733.0246	-404.955	blk atap-1
76	0	-1620.702	-833.411	312.837	-1149.144	-3278.3	-3433.38723	-1020.18483	-2492.8614	-424.4022	blk atap-2
76	2	1051.971	579.683	154.533	120.781	2189.858	1632.02949	1307.51019	1085.8536	807.6942	blk atap-2
76	4	-1808.636	-976.886	-963.77	430.706	-3733.3808	-3526.46448	-1502.54748	-2495.1654	-760.3794	blk atap-2
77	0	-1757.855	-935.68	326.457	-979.336	-3606.514	-3463.52895	-1406.92335	-2463.4719	-700.6671	blk atap-2
77	2	1001.83	546.024	158.327	163.098	2075.8344	1567.16952	1224.66372	1048.4352	754.8588	blk atap-2
77	4	-1771.766	-941.935	-969.802	345.531	-3633.2152	-3472.06545	-1435.48125	-2467.4112	-721.7676	blk atap-2
78	0	-1755.83	-932.153	335.717	-987.75	-3598.4408	-3468.01539	-1393.74039	-2469.222	-691.272	blk atap-2
78	2	1003.579	547.954	158.508	158.468	2081.0212	1565.40237	1232.53557	1045.8783	760.5639	blk atap-2
78	4	-1770.292	-941.601	-978.7	344.685	-3630.912	-3479.65023	-1424.38023	-2474.0928	-712.4328	blk atap-2
79	0	-1755.834	-929.912	342.647	-980.183	-3594.86	-3458.66241	-1400.27811	-2462.4153	-698.0859	blk atap-2
79	2	1007.415	548.285	160.145	159.979	2086.154	1571.35755	1235.05305	1050.804	762.543	blk atap-2
79	4	-1762.615	-943.181	-982.357	340.141	-3624.2276	-3476.42463	-1413.47493	-2470.4748	-702.2322	blk atap-2
80	0	-1643.681	-905.585	381.849	-933.441	-3421.3532	-3276.49665	-1316.27055	-2319.4098	-639.216	blk atap-2
80	2	1000.221	545.939	162.533	158.651	2073.7676	1564.83327	1223.51397	1046.4786	753.9192	blk atap-2
80	4	-1889.158	-972.2	-1016.783	290.744	-3822.5096	-3663.72405	-1528.47975	-2615.3469	-785.1375	blk atap-2
81	0	-1837.176	-978.926	398.614	-945.966	-3770.8928	-3539.02248	-1552.49388	-2504.8278	-802.089	blk atap-2
81	2	1041.097	573.071	123.634	146.128	2166.23	1607.62098	1300.75218	1068.5025	805.4721	blk atap-2
81	4	-1613.91	-844.595	-1111.346	278.222	-3288.044	-3393.61365	-1059.78705	-2452.7304	-452.3076	blk atap-2

MOMEN RENCANA BALOK PORTAL A

Elemen	section m	MD kg-m	ML kg-m	ME,ki kg-m	ME,ka kg-m	1,2MD+1,6ML	1.05 (MD+ML,R+ME)	1.05 (MD+ML,r-ME)	0.9 (MD+ME)	0.9 (MD-ME)	Keterangan
1	0	-92.52	45.32	-13307.08	13248.65	-38.512	-14041.0284	13903.8396	-12059.64	11893.104	kl. Pondas
1	0.5	-167.27	29.51	-11386.23	11310.47	-153.508	-12112.5837	11798.4990	-10358.15	10097.064	kl. Pondasi
1	1	-242.01	13.70	-9465.38	9372.29	-268.492	-10184.1285	9693.1695	-8736.651	8301.033	kl. Pondasi
2	0	632.36	-.57	-13377.51	13626.21	757.92	14971.1394	-13643.9016	12832.713	-11694.465	kl. Pondasi
2	0.5	-918.64	77.35	-11314.79	10913.2	-978.608	-12796.371	10964.688	-11010.087	9356.535	kl. Pondasi
2	1	-2469.63	155.27	-9252.08	8200.19	-2715.124	-12209.9754	7219.3926	-10549.539	6104.205	kl. Pondasi
3	0	-155.76	-47.50	-13100.11	13053.23	-262.912	-13948.5885	13561.6425	-11930.283	11649.915	kl. Pondasi
3	0.5	1469.99	-109.61	-11386.67	12007.43	1588.612	14082.2367	-11133.3663	12129.678	-9483.696	kl. Pondasi
3	1	3095.73	-171.72	-9673.23	10961.62	3440.124	14652.0339	-8367.3681	12651.615	-7079.301	kl. Pondasi
4	0	539.11	39.35	-13548.34	13754.03	709.892	15032.5875	-13850.8755	12863.826	-11893.428	kl. Lantai 1
4	2.2	21.92	-16.52	-5089.15	5087.06	-0.128	-5330.9991	5356.2159	-4560.507	4599.963	kl. Lantai 1
4	4.4	-495.27	-72.40	3370.03	-3579.9	-710.164	-4324.5405	3193.2495	-3667.653	2776.167	kl. Lantai 1
5	0	1995.07	189.09	-14353.80	15046.8	2696.628	18013.0902	-13585.1898	15337.683	-11746.557	kl. Lantai 1
5	2.2	-215.29	-128.	-4718.15	4690.81	-463.148	-5260.752	4647.363	-4440.096	4052.574	kl. Lantai 1
5	4.4	-2425.64	-445.08	4917.5	-5665.18	-3622.896	-8775.7614	3121.1166	-7281.738	2915.586	kl. Lantai 1
6	0	-2395.65	-179.58	-12557.3	11683.5	-3162.108	-15813.7329	10556.5971	-13457.655	9145.485	kl. Lantai 1
6	2.2	331.9	193.38	-5585.34	5639.66	707.688	6391.9674	-5451.3186	5374.404	-4776.984	kl. Lantai 1
6	4.4	3059.45	566.34	1386.63	-404.18	4577.484	5025.1782	2113.2552	4001.472	1505.538	kl. Lantai 1
7	0	560.25	132.22	-7387.88	7476.59	883.852	8521.9806	-7178.8584	7233.156	-6224.706	kl. Lantai2
7	2	-18.24	2.5	339.62	-364.67	-17.888	-400.4805	365.3265	-344.619	311.787	kl. Lantai 2
7	4	-596.73	-127.23	8067.13	-8205.93	-919.644	-9322.9479	7909.5051	-7922.394	6848.28	kl. Lantai 2
8	0	3126.87	723.48	-9635.13	10455.24	4909.812	14717.0079	-7238.9961	12223.899	-6595.533	kl. Lantai2
8	2	6.14	30.83	260.08	-271.08	56.696	-256.7641	310.5039	-238.446	249.498	kl. Lantai 2
8	4	-3114.6	-661.82	10155.29	-10997.4	-4796.432	-15234.5466	7859.9934	-12700.8	7094.52	kl. Lantai 2
9	0	-3723.7	-875.30	-4433.36	3507.26	-5868.92	-9116.352	193.704	-7341.354	638.694	kl. Lantai2
9	2	-24.47	-52.92	501.92	-483.16	-114.036	467.9829	-586.0491	429.705	-473.751	kl. Lantai 2
9	4	3674.76	769.46	5437.20	-4473.58	5640.848	10052.3178	-1365.8022	8200.764	-1586.196	kl. Lantai 2
10	0	531.89	115.08	-2080.22	2245.03	822.395	2988.2664	-1726.2966	2499.228	-1541.826	kl. Lantai3
10	2	-30.97	-2.75	2945.15	-2900.34	-41.564	3058.1565	-3126.6585	2622.762	-2678.508	kl. Lantai 3
10	4	-593.84	-120.58	7970.51	-8045.72	-905.536	-9147.5034	7748.5086	-7775.604	6706.692	kl. Lantai 3

11	0	2779.55	558.08	-3645.06	4379.53	4228.388	7868.6244	-1328.3886	6443.172	-1439.982	kl. Lantai3
11	2	84.51	15.37	2727.94	-2663.0	126.004	2962.7556	-2765.9184	2531.205	-2379.087	kl. Lantai 3
11	4	-2610.52	-527.35	9100.93	-9705.53	-3976.384	-13264.083	7117.53	-11084.445	6385.509	kl. Lantai 3
12	0	-3474.04	-687.27	-159.09	-783.06	-5268.48	-4902.9351	-3258.5091	-3831.39	-2421.882	kl. Lantai3
12	2	-216.14	-26.72	3160.55	-3313.16	-302.12	-3722.5986	3235.0374	-3176.37	2787.318	kl. Lantai 3
12	4	3041.76	633.82	6480.19	-5843.26	4664.224	10397.3541	-3211.0449	8569.755	-3094.587	kl. Lantai 3
13	0	460.99	139.85	1827.07	-1507.03	776.948	2490.5685	-1346.2785	2059.251	-1229.472	kl. Lantai3
13	1.6	-33.64	-15.04	2572.53	-2574.97	-64.432	-2748.5157	2658.9213	-2347.749	2287.197	kl. Lantai 3
13	3.2	-528.28	-169.94	3318.0	-3642.92	-905.84	-4486.8222	3163.3098	-3754.08	2803.176	kl. Lantai 3
14	0	2432.06	719.12	794.49	272.94	4069.064	3840.9231	2172.4941	2903.895	1473.813	kl. Lantai3
14	1.6	103.34	-75.96	2563.37	-2779.84	2.472	-2858.1798	2979.4842	-2408.85	2594.862	kl. Lantai 3
14	3.2	-2225.38	-871.05	4332.2	-5832.61	-4064.136	-9009.651	3238.83	-7252.191	3246.507	kl. Lantai 3
15	0	-3005.29	-830.73	2555.38	-3870.24	-4935.516	-7742.6664	384.8376	-6187.977	778.455	kl. Lantai3
15	1.6	-181.93	119.26	2657.04	-2365.52	-27.5	2673.9993	-2905.7847	2227.599	-2555.073	kl. Lantai 3
15	3.2	2641.42	1069.24	2657.04	-860.8	4880.488	6237.0042	657.2202	4768.614	-14.058	kl. Lantai 3
16	0	-781.12	-25.65	4082.95	-4381.75	-978.384	-5437.173	3764.502	-4646.583	3240.567	sloop
16	1.4	398.4	3.13	92.87	62.22	483.088	517.8054	322.7784	442.143	274.977	sloop
16	2.8	-1107.28	31.91	-4426.41	3976.99	-1277.68	-5790.2712	3505.1898	-4980.321	2987.217	sloop
17	0	-5571.99	-1.92	675.31	-2869.63	-6689.46	-8864.9106	-2838.6876	-7597.458	-2432.124	sloop
17	3.5	2859.56	-4.89	549.37	579.87	3423.648	3608.3208	2390.5938	3095.487	2051.721	sloop
17	7	-5491.38	-7.86	-2884.07	721.88	-6602.232	-8799.1743	-2742.6273	-7537.905	-2346.579	sloop
18	0	-1055.52	-204.62	10757.91	-11056.49	-1594.016	-12846.5211	10372.1079	-10900.809	9000.873	balok 1
18	1.4	475.65	111.47	177.44	-46.04	749.132	755.9706	383.3466	587.781	268.389	balok 1
18	2.8	-1356.53	-304.17	-10873.43	10494.01	-2114.508	-13033.0851	9801.1179	-11006.964	8565.21	balok 1
19	0	-6909.05	-1472.73	3679.21	-5626.41	-10647.228	-14090.0529	-2274.5919	-11281.914	-1154.376	balok 1
19	1.8	1041.96	278.79	2406.91	-2139.45	1696.416	3796.9512	-1257.5598	3103.983	-1228.455	balok 1
19	3.5	3426.4	642.82	399.61	612.52	5140.192	4645.8426	3359.5506	3635.028	2532.492	balok 1
20	0	3426.4	642.82	399.61	612.52	5140.192	4645.8426	3359.5506	3635.028	2532.492	balok 1
20	1.8	1104.91	294.34	-2342.69	2629.48	1796.836	4106.5437	-1415.3643	3360.951	-1372.113	balok 1
20	3.5	-6783.15	-1441.63	-5819.99	3911.44	-10446.388	-14141.5239	-1919.5449	-11342.826	-866.844	balok 1
21	0	-1128.63	-242.31	10147.35	-10450.96	-1742.052	-12311.2248	9635.7912	-10421.631	8390.097	balok 2
21	1.4	481.32	118.06	158.95	-24.28	766.48	746.6613	412.8663	576.243	290.133	balok 2
21	2.8	-1272.09	-253.31	-10299.85	9932.0	-1931.804	-12310.1223	9319.5627	-10414.746	8124.984	balok 2
22	0	-7166.24	-1473.21	3500.5	-5444.93	-10956.624	-14169.8508	-2735.4978	-11350.053	-1549.179	balok 2
22	1.8	1027.65	274.66	2328.8	-2058.57	1672.636	3697.3083	-1193.1717	3020.805	-1171.035	balok 2

22	3.5	3654.98	635.03	422.1	592.79	5402.024	4860.2274	3615.3684	3822.993	2755.971	balok 2
23	0	3654.98	635.03	422.10	592.79	5402.024	4860.2274	3615.3684	3822.993	2755.971	balok 2
23	1.8	1126.37	282.9	-2219.6	2509.15	1804.264	3995.523	-1273.692	3271.968	-1244.502	balok 2
23	3.5	-7148.8	-1456.73	-5596.3	3690.52	-10909.328	-14300.0949	-2547.8649	-11470.59	-1397.25	balok 2
24	0	-1054.83	-260.43	6143.44	-6538.68	-1682.484	-8137.2564	5593.9716	-6834.159	4935.465	balok 3
24	1.4	442.84	122.27	108.44	30.91	727.04	655.8741	428.1501	496.152	300.96	balok 3
24	2.8	-1030.85	-226.76	-5396.95	6130.09	-1599.936	-7942.0483	5491.5462	-6685.02	4829.49	balok 3
25	0	-6073.44	-1473.23	1909.49	-3848.38	-9645.296	-11346.0459	-3264.4479	-8929.638	-2002.554	balok 3
25	1.8	933.94	272.69	1553.41	-1290.53	1557.032	2783.5122	-478.6488	2238.615	-557.523	balok 3
25	3.5	2987.26	631.11	462.34	532.32	4594.488	4093.1583	2975.2863	3167.622	2209.446	balok 3
26	0	2987.26	631.11	462.34	532.32	4594.488	4093.1583	2975.2863	3167.622	2209.446	balok 3
26	1.8	947.14	277.03	-1363.74	1620.17	1579.816	2870.2044	-532.1526	2310.579	-605.727	balok 3
26	3.5	-6047.05	-1464.55	-3924.81	1973.02	-9599.74	-11393.1195	-3151.0185	-8974.674	-1910.016	balok 3
27	0	-528.28	-169.94	3318.0	-3642.92	-905.84	-4486.8222	3163.3098	-3754.08	2803.176	balok atap
27	1.4	190.52	76.64	106.74	-7.2	351.248	360.4062	136.2522	267.534	75.402	balok atap
27	2.8	-406.23	-225.58	-3574.92	3158.11	-848.404	-4322.3229	3185.0091	-3583.035	2851.821	balok atap
28	0	-2631.61	-1096.63	757.32	-2674.5	-4912.54	-6262.2924	-645.8424	-4775.499	38.601	balok atap
28	1.8	482.47	218.03	960.82	-688.18	927.812	1673.8134	-385.9086	1316.961	-448.515	balok atap
28	3.5	1258.98	492.07	469.31	563.15	2298.088	2223.2406	1040.6256	1639.917	626.247	balok atap
29	0	1258.98	492.07	469.31	563.15	2298.088	2223.2406	1040.6256	1639.917	626.247	balok atap
29	1.8	477.56	231.73	-777.2	1079.48	943.84	1780.8819	-486.0261	1401.336	-541.728	balok atap
29	3.5	-2641.42	-1069.24	-2758.71	860.80	-4880.488	-6343.7577	-550.4667	-4860.117	105.561	balok atap

MOMEN RENCANA BALOK PORTAL B

Elemen	section	MD	ML	ME,ki	ME,ka	1,2MD+1,6ML	1.05	1.05	0.9	0.9	Keterangan
	m	kg-m	kg-m	kg-m	kg-m		(MD+ML,R+ME)	(MD+ML,r-ME)	(MD+ME)	(MD-ME)	
1	0	-13.75	91.61	15787.09	15723.79	130.076	16619.7213	-16533.1677	14196.006	-14220.756	kl. Pondasi
1	0.5	-128.68	58.46	-13517.96	13436.42	-60.88	-14292.1422	14095.5738	-12281.976	12050.352	kl. Pondasi
1	1	-243.6	25.30	-11248.82	11149.05	-251.84	-12051.102	11571.42	-10343.178	9904.698	kl. Pondasi
2	0	620.25	-2.35	-15898.69	16141.76	740.54	17598.63	-16299.066	15085.809	-13969.359	kl. Pondasi
2	0.5	-773.46	157.47	-13404.13	12998.18	-676.2	-14787.2634	13361.4096	-12759.831	11367.603	kl. Pondasi
2	1	-2167.17	317.29	-10909.56	9854.59	-2092.94	-13530.6738	9379.4022	-11769.057	7868.151	kl. Pondasi
3	0	-250.34	-97.41	-15542.15	15489.46	-456.264	-16643.4828	15995.0322	-14213.241	13762.629	kl. Pondasi

3	0.5	1258.29	-224.07	-13581.24	14195.8	1151.436	16085.6304	-13725.5496	13908.681	-11643.759	kl. Pondasi
3	1	2766.93	-350.73	-11620.33	12902.15	2759.148	16231.5741	-10862.9409	14102.172	-9121.698	kl. Pondasi
4	0	583.49	76.73	-16117.20	16317.04	822.956	17793.8964	-16471.8876	15210.477	-14160.195	kl. Basement
4	2.2	-1.38	-33.56	-6116.76	6109.54	-55.352	-6445.1898	6400.0062	-5506.326	5503.842	kl. Basement
4	4.4	-586.26	-143.85	3883.68	-4097.95	-933.672	-5009.046	3596.649	-4215.789	3160.521	kl. Basement
5	0	2360.78	385.57	-17124.65	17814.64	3449.848	21427.1001	-15983.6439	18157.878	-13908.474	kl. Basement
5	2.2	-480.61	-253.76	-5670.0	5634.99	-998.748	-6624.3093	5282.6907	-5535.549	4670.451	kl. Basement
5	4.4	-3322.01	-913.09	5784.65	-6544.67	-5447.356	-10935.2607	2808.5463	-8880.012	2900.394	kl. Basement
6	0	-2739.8	-366.79	-14843.39	13961.98	-3874.624	-18693.4272	12477.6918	-15824.871	10893.231	kl. Basement
6	2.2	686.47	392.83	-6710.2	6760.84	1452.292	8067.1584	-6130.6056	6702.579	-5466.933	kl. Basement
6	4.4	4112.74	1152.45	1422.99	-440.30	6779.208	6538.56	3550.281	4982.157	2420.775	kl. Basement
7	0	717.55	260.89	-8981.86	9069.13	1278.484	10440.3747	-8604.7983	8808.012	-7516.422	kl. Lantai 1
7	2	-39.98	-.67	165.42	-201.24	-49.048	-253.7031	163.9009	-217.098	145.134	kl. Lantai 1
7	4	-797.52	-262.23	9312.70	-9471.61	-1376.592	-10947.7914	8942.5896	-9242.217	7806.681	kl. Lantai 1
8	0	4418.96	1447.21	-11750.61	12554.77	7618.288	18734.1588	-7630.8582	15276.357	-7322.229	kl. Lantai 1
8	2	121.41	75.79	72.38	-78.8	266.956	92.4882	257.9682	38.349	180.189	kl. Lantai 1
8	4	-4176.13	-1295.63	11895.37	-12712.37	-7084.364	-18549.1719	8146.8051	-15199.65	7682.616	kl. Lantai 1
9	0	-5267.64	-1762.87	-5355.95	4425.42	-9141.76	-12265.3776	-1017.8826	-9561.231	79.479	kl. Lantai 1
9	2	-212.55	-129.89	342.02	-338.88	-462.884	54.1128	-664.1292	116.523	-499.113	kl. Lantai 1
9	4	4842.53	1503.09	6039.99	-5103.17	8215.98	12373.5927	-310.3863	9794.268	-1077.714	kl. Lantai 1
10	0	661.08	218.56	-3119.51	3269.58	1142.992	4264.8858	-2601.2322	3537.594	-2347.65	kl. Lantai 2
10	2	-52.35	-21.55	3298.73	-3252.83	-97.3	3395.1225	-3532.2105	2921.742	-3015.972	kl. Lantai 2
10	4	-765.78	-261.67	9716.98	-9775.23	-1337.608	-11232.9126	9295.0704	-9486.909	8108.505	kl. Lantai2
11	0	3742.54	1178.16	-5173.88	5937.60	6376.104	10906.3878	-1562.5722	8712.126	-1975.554	kl. Lantai 2
11	2	-61.32	-61.17	3093.25	-3090.22	-171.456	3144.9894	-3350.8356	2728.737	-2839.113	kl. Lantai 2
11	4	-3865.17	-1300.50	11360.38	-12118.04	-6719.004	-17601.6855	7846.1985	-14384.889	7427.583	kl. Lantai2
12	0	-4639.26	-1448.63	-612.87	-366.35	-7884.92	-6427.3734	-5140.3464	-4726.917	-3623.751	kl. Lantai 2
12	2	-121.97	30.81	3530.99	-3645.37	-97.068	-3936.2967	3718.9803	-3390.606	3171.06	kl. Lantai 2
12	4	4395.31	1510.25	7674.86	-6924.39	7690.772	13625.136	-2492.07	10863.153	-2951.595	kl. Lantai2
13	0	572.51	198.89	1822.12	-1496.23	1005.236	2639.6622	-1186.7898	2155.167	-1124.649	kl. Lantai 3
13	1.6	-48.37	.63	3699.07	-3725.74	-57.036	-3962.4186	3861.6354	-3396.699	3309.633	kl. Lantai 3
13	3.2	-669.25	-197.63	5576.02	-5955.25	-1119.308	-7080.2319	5425.7931	-5962.05	4757.4	kl. Lantai 3
14	0	3374.07	1116.26	525.42	330.77	5834.9	4797.7083	3694.3263	3509.541	2563.785	kl. Lantai 3
14	1.6	504.37	243.51	3471.47	-3406.44	994.86	4328.0433	-2962.0437	3578.256	-2670.39	kl. Lantai 3
14	3.2	-2365.34	-629.23	6417.51	-7143.65	-3845.176	-10380.8544	4620.8106	-8558.091	4300.479	kl. Lantai 3

15	0	-4293.55	-1442.74	2895.93	-4105.41	-7460.644	-9727.8342	-1106.4732	-7559.064	-169.326	kl. Lantai 3
15	1.6	-802.97	-371.73	3977.43	-4043.19	-1558.032	-5322.6579	3168.0411	-4361.544	2916.198	kl. Lantai 3
15	3.2	2687.61	699.27	5058.93	-3980.96	4343.964	8574.4071	-2049.3459	6971.886	-2134.188	kl. Lantai 3
16	0	-827.10	-51.43	4868.38	-5167.99	-1074.808	-6327.2454	4525.5336	-5395.581	3906.801	sloop
16	1.4	405.37	6.48	95.64	59.54	496.812	530.1429	329.2989	450.909	278.757	sloop
16	2.8	-1047.37	64.38	-5206.29	4757.88	-1153.836	-6525.7836	4407.4254	-5628.294	3743.028	sloop
17	0	-5575.31	-3.90	1008.80	-3202.17	-6696.612	-9218.811	-2494.254	-7899.732	-2135.826	sloop
17	3.5	2850.23	-9.98	546.62	582.58	3404.308	3598.1631	2374.7451	3089.529	2040.885	sloop
17	7	-5506.73	-16.06	-3223.06	1059.83	-6633.772	-9176.3973	-2407.9713	-7856.811	-2055.303	sloop
18	0	-1303.81	-404.74	12865.55	-13167.08	-2212.156	-15449.4207	12201.4473	-13023.801	10676.943	bl. Lantai 1
18	1.4	594.87	221.28	199.28	-68.45	1067.892	973.2639	554.7759	714.735	356.031	bl. Lantai 1
18	2.8	-1802.76	-616.18	-12937.38	12559.78	-3149.2	-15865.3404	11303.1576	-13266.126	10021.158	bl. Lantai 1
19	0	-9543.73	-2976.48	4597.87	-6539.66	-16214.844	-18762.7419	-5029.4559	-14475.051	-2703.663	bl. Lantai 1
19	1.8	1429.38	569.02	2856.17	-2585.81	2625.688	4858.3101	-1139.6469	3856.995	-1284.111	bl. Lantai 1
19	3.5	5013.73	1297.85	379.46	633.03	8093.036	6746.7435	5417.3805	5082.084	3942.63	bl. Lantai 1
20	0	5013.73	1297.85	379.46	633.03	8093.036	6746.7435	5417.3805	5082.084	3942.63	bl. Lantai 1
20	1.8	1511.05	599.6	-2832.24	3116.87	2772.62	5237.064	-1308.363	4165.128	-1445.238	bl. Lantai 1
20	3.5	-9380.38	-2915.32	-6778.94	4865.71	-15920.968	-18803.9376	-4568.1636	-14543.388	-2341.296	bl. Lantai 1
21	0	-1458.60	-480.79	12432.22	-12741.19	-2519.584	-15212.6772	11543.8218	-12779.811	10154.331	bl. Lantai 2
21	1.4	632.4	239.06	177.65	-39.98	1141.376	1001.1603	628.0953	729.045	409.275	bl. Lantai 2
21	2.8	-1572.91	-504.56	-12547.32	12190.83	-2694.788	-15144.1143	11205.2577	-12708.207	9876.969	bl. Lantai 2
22	0	-9491.58	-2978.34	4521.94	-6459.14	-16155.24	-18624.6102	-5060.4162	-14355.648	-2729.196	bl. Lantai 2
22	1.8	1398.13	558.52	2830.74	-2557.65	2571.388	4792.1811	-1152.3729	3805.983	-1289.349	bl. Lantai 2
22	3.5	4899.10	1278.72	404.54	608.84	7924.872	6588.9306	5310.3666	4957.146	3861.234	bl. Lantai 2
23	0	4899.1	1278.72	404.54	608.84	7924.872	6588.9306	5310.3666	4957.146	3861.234	bl. Lantai 2
23	1.8	1493.03	571.83	-2756.66	3040.33	2706.564	5120.2809	-1264.4121	4080.024	-1392.57	bl. Lantai 2
23	3.5	-9481.78	-2951.72	-6652.86	4736.82	-16100.888	-18800.9556	-4829.9496	-14521.176	-2546.028	bl. Lantai 2
24	0	-1338.29	-460.56	7894.86	-8279.00	-2342.844	-10388.3073	6997.5927	-8655.561	6246.639	bl. Lantai 3
24	1.4	564.98	229.85	129.87	-2.17	1045.736	874.398	601.671	625.365	391.599	bl. Lantai 3
24	2.8	-1436.07	-543.22	-8105.52	7804.25	-2592.436	-10360.8981	6660.6939	-8587.431	6002.505	bl. Lantai 3
25	0	-8675.31	-2959.97	2729.43	-4644.55	-15146.324	-15850.6341	-6097.0791	-11987.874	-3627.684	bl. Lantai 3
25	1.8	1334.82	571.99	1954.84	-1676.17	2516.968	3814.4967	-290.6673	2960.694	-558.018	bl. Lantai 3
25	3.5	4568.69	1287.27	445.25	557.21	7542.06	6193.1751	5023.0341	4613.31	3610.332	bl. Lantai 3
26	0	4568.69	1287.27	445.25	557.21	7542.06	6193.1751	5023.0341	4613.31	3610.332	bl. Lantai 3
26	1.8	1328.04	575.48	-1799.34	2055.59	2514.416	3915.3639	-401.3751	3045.267	-654.795	bl. Lantai 3

26	3.5	-8688.87	-2952.98	-4778.93	2818.97	-15151.412	-16001.5674	-5965.8144	-12121.02	-3518.946	bl. Lantai 3
27	0	-967.17	-271.08	3895.00	-4300.11	-1594.332	-5701.4244	3328.8066	-4740.552	2999.646	bl. Atap 1
27	1.4	362.07	103.52	87.53	57.22	600.116	537.2976	353.4846	404.64	247.086	bl. Atap 1
27	2.8	-506.24	-70.67	-4190.33	3944.15	-720.56	-4975.9206	3823.7724	-4226.913	3315.681	bl. Atap1
28	0	-4741.05	-1086.91	1113.85	-3037.43	-7428.316	-8852.1573	-2473.5543	-7000.632	-1533.258	bl. Atap 1
28	1.8	720.28	208.19	1165.88	-896.3	1197.44	2111.6277	-336.7203	1697.544	-401.04	bl. Atap 1
28	3.5	2465.92	462.66	482.90	509.83	3699.36	3416.0133	2345.3703	2678.175	1760.481	bl. Atap1
29	0	2465.92	462.66	482.90	509.83	3699.36	3416.0133	2345.3703	2678.175	1760.481	bl. Atap 1
29	1.8	645.49	182.76	-935.08	1180.96	1067.004	2032.9113	-447.1047	1643.805	-481.923	bl. Atap 1
29	3.5	-4890.62	-1137.76	-3088.05	1117.10	-7689.16	-9094.3923	-2609.4873	-7180.803	-1622.313	bl. Atap1
30	0	297.92	73.44	1681.02	-1655.15	475.008	2124.1542	-1405.9878	1781.046	-1244.79	kl. Atap
30	0.9	-126.54	-61.25	2119.79	-2255.	-249.848	-2539.2045	2196.2955	-2143.386	1915.614	kl. Atap
30	1.8	-551.00	-195.95	2558.56	-2854.85	-974.72	-3699.591	2295.594	-3065.265	2073.465	kl. Atap
31	0	1869.47	387.01	1113.33	-162.07	2862.58	3375.7563	1037.7633	2684.52	680.526	kl. Atap
31	0.9	-382.14	-260.92	2246.56	-2535.94	-876.04	-3228.3636	2097.1104	-2626.272	1938.42	kl. Atap
31	1.8	-2633.76	-908.85	3379.79	-4909.80	-4614.672	-8493.3135	1817.2665	-6789.204	2048.436	kl. Atap
32	0	-2203.01	-438.49	1970.88	-2863.87	-3345.196	-5596.4727	417.6543	-4560.192	594.774	kl. Atap
32	0.9	473.06	344.13	2248.66	-1739.93	1118.28	3074.6079	-1647.5781	2449.548	-1598.04	kl. Atap
32	1.8	3149.14	1126.75	2526.45	-615.99	5581.768	6669.222	1363.677	5108.031	560.421	kl. Atap
33	0	-551.0	-195.95	2558.56	-2854.85	-974.72	-3699.591	2295.594	-3065.265	2073.465	bl. Atap 2
33	1.4	188.33	82.63	100.80	27.82	358.204	355.6434	143.9634	260.217	78.777	bl. Atap 2
33	2.8	-387.9	-187.59	-2827.37	2440.10	-765.624	-3494.2152	2443.2618	-2893.743	2195.523	bl. Atap 2
34	0	-3021.65	-1096.44	552.42	-2469.70	-5380.284	-6456.6747	-1270.3047	-4942.215	-496.755	bl. Atap 2
34	1.8	532.34	235.83	885.2	-595.78	1016.136	1636.9899	-221.9301	1275.786	-317.574	bl. Atap 2
34	3.5	1700.64	496.22	482.99	543.15	2834.72	2668.5981	1527.9831	2019.411	1041.741	bl. Atap 2
35	0	1700.64	496.22	482.99	543.15	2834.72	2668.5981	1527.9831	2019.411	1041.741	bl. Atap 2
35	1.8	468.59	220.67	-654.23	947.07	915.38	1625.4651	-363.3819	1274.094	-430.632	bl. Atap 2
35	3.5	-3149.14	-1126.75	-2526.45	615.99	-5581.768	-6669.222	-1363.677	-5108.031	-560.421	bl. Atap 2

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Elemen	section m	MD kg-m	ML kg-m	ME,ki kg-m	ME,ka kg-m	1,2MD+1,6ML	1.05 (MD+ML,R+ME)	1.05 (MD+ML,r-ME)	0.9 (MD+ME)	0.9 (MD-ME)	Keterangan
1	0	-.24	93.82	-13862.06	13804.48	149.824	-14496.3084	14614.0176	-12476.07	12475.638	sloof

1	0.5	-119.97	60.35	-11869.13	11794.1	-47.404	-12550.5345	12374.6385	-10790.19	10574.244	sloof
1	1	-239.69	26.87	-9876.19	9783.72	-244.636	-10604.7459	10135.2531	-9104.292	8672.85	sloof
2	0	625.07	-.75	-13940.59	14189.89	748.884	15555.2355	-14243.5335	13333.464	-12208.338	sloof
2	0.5	-753.42	160.11	-11790.04	11389.43	-647.928	-13069.7637	11689.3203	-11289.114	9932.958	sloof
2	1	-2131.9	320.97	-9639.48	8588.96	-2044.728	-12157.7379	8085.1701	-10594.242	6756.822	sloof
3	0	-252.82	-96.46	-13644.78	13598.2	-457.72	-14653.2498	14000.7882	-12507.84	12052.764	sloof
3	0.5	1245.38	-223.85	-11881.26	12502.04	1136.296	14293.7655	11960.5185	12372.579	-10130.994	sloof
3	1	2743.59	-351.24	-10117.74	11405.89	2730.324	14635.6728	-9316.6962	12734.532	-7796.07	sloof
4	0	592.49	79.67	-14135.78	14342.56	838.46	15731.9946	-14387.3814	13441.545	-12375.063	kl. Basement
4	2.2	4.81	-31.12	-5362.46	5361.05	-44.02	-5645.1381	5616.0279	-4821.885	4830.543	kl. Basement
4	4.4	-582.87	-141.91	3410.86	-3620.46	-926.5	-4502.8998	3100.0662	-3782.997	2733.831	kl. Basement
5	0	2403.98	390.96	-14992.55	15687.51	3510.312	19242.3693	-13701.4017	16282.341	-11955.177	kl. Basement
5	2.2	-499.94	-263.12	-4969.99	4942.72	-1020.92	-5909.1921	4527.7869	-4922.937	4023.045	kl. Basement
5	4.4	-3403.86	-917.19	5052.56	-5802.07	-5552.136	-10244.0562	1940.2908	-8285.337	2158.389	kl. Basement
6	0	-2763.49	-367.18	-13078.53	12204.52	-3903.676	-16865.4444	10599.4686	-14257.818	9283.536	kl. Basement
6	2.2	728.11	397.69	-5883.61	5940.02	1510.036	7252.0812	-5221.9608	6001.317	-4690.719	kl. Basement
6	4.4	4219.71	1162.55	1311.32	-324.48	6923.732	6539.988	3786.216	4977.927	2617.551	kl. Basement
7	0	723.44	269.00	-7875.92	7966.62	1298.528	9294.033	-7435.869	7821.054	-6518.862	kolom lt1
7	2	-9.50	6.09	148.24	-169.12	-1.656	-183.7143	171.4377	-160.758	143.658	kolom lt1
7	4	-742.44	-256.81	8172.4	-8304.85	-1301.824	-9661.4448	7778.7402	-8142.561	6806.169	kolom lt1
8	0	4476.24	1482.51	-10249.31	11069.48	7743.504	17256.9873	-5988.9207	13991.148	-5933.916	kolom lt1
8	2	200.55	73.83	56.82	-61.01	358.788	193.0299	321.1509	125.586	235.404	kolom lt1
8	4	-4075.14	-1334.84	10362.95	-11191.51	-7025.912	-16870.9317	6631.2393	-13739.985	6404.733	kolom lt1
9	0	-5294.93	-1783.51	-4751.31	3830.43	-9207.532	-11672.1633	-1694.4123	-9041.616	-489.258	kolom lt1
9	2	-286.3	-111.94	316.4	-301.34	-522.664	-38.9172	-703.3572	27.09	-542.43	kolom lt1
9	4	4722.33	1559.64	5384.11	-4433.11	8162.22	11594.3352	287.7042	9095.796	-595.602	kolom lt1
10	0	782.5	237.32	-2749.69	2929.99	1318.712	4047.6261	-2105.3529	3341.241	-1932.741	kolom lt2
10	2	-34.38	2.41	2565.53	-2526.31	-37.4	2659.2258	-2728.3872	2278.035	-2339.919	kolom lt2
10	4	-851.25	-232.50	7880.74	-7982.61	-1393.5	-9422.028	7341.453	-7950.474	6418.224	kolom lt2
11	0	4135.0	1183.88	-4548.85	5309.19	6856.208	10662.2439	-487.0551	8499.771	-1056.771	kolom lt2
11	2	-253.41	1.58	2430.13	-2380.58	-301.564	2286.5514	-2816.7216	1959.048	-2415.186	kolom lt2
11	4	-4641.82	-1180.72	9409.11	-10070.36	-7459.336	-16191.6426	4956.1134	-13240.962	4885.686	kolom lt2
12	0	-4869.15	-1416.70	-562.35	-391.79	-8109.7	-6595.596	-5414.661	-4888.35	-3876.12	kolom lt2
12	2	336.14	.51	2701.46	-2803.71	404.184	-2590.6272	3297.1638	-2220.813	2825.865	kolom lt2
12	4	5541.43	1417.71	5965.26	-5215.64	8918.052	12975.1818	448.1358	10356.021	-381.447	kolom lt2

13	0	778.05	293.18	495.93	-204.78	1402.748	1522.3824	480.9294	1146.582	253.908	kolom lt3
13	2.5	-.3	-12.64	2114.62	-2114.69	-20.584	-2228.7027	2212.1463	-1903.491	1902.951	kolom lt3
13	5	-778.65	-318.47	3733.31	-4024.61	-1443.932	-5244.0591	3207.6219	-4322.934	2921.364	kolom lt3
14	0	4226.34	1368.29	-633.47	1644.17	7263.272	7028.1582	3575.4012	5285.259	2325.753	kolom lt3
14	2.5	-23.67	-169.1	2126.69	-2334.73	-298.964	-2582.353	2320.08	-2122.56	2079.954	kolom lt3
14	5	-4275.67	-1706.48	4886.84	-6313.63	-7861.172	-12193.8474	1064.7756	-9530.37	1834.164	kolom lt3
15	0	-4997.86	-1559.70	1464.19	-2649.95	-8492.952	-9012.8115	-3447.9165	-6883.029	-2113.119	kolom lt3
15	2.5	32.5	283.51	2222.84	-1898.64	492.616	2546.7183	-2121.2457	2029.806	-1971.306	kolom lt3
15	5	5062.86	2126.72	2981.49	-1147.32	9478.184	9786.4011	3525.2721	7239.915	1873.233	kolom lt3
16	0	-832.18	-52.80	4259.59	-4558.85	-1083.096	-5693.8455	3879.7395	-4851.927	3354.003	bl. basemen
16	1.4	406.11	6.52	93.37	61.74	497.764	528.5616	332.4846	449.532	281.466	bl. basemen
16	2.8	-1040.8	65.85	-4602.04	4153.12	-1143.6	-5883.4965	3780.7875	-5078.556	3205.116	bl. basemen
17	0	-5576.68	-4.14	751.02	-2945.43	-6698.64	-8950.8237	-2765.4207	-7669.899	-2368.125	bl. basemen
17	3.5	2849.37	-10.04	548.86	580.35	3403.18	3594.8808	2376.1458	3086.748	2042.118	bl. basemen
17	7	-5507.08	-15.95	-2960.79	798.64	-6634.016	-8901.312	-2683.653	-7621.083	-2291.661	bl. basemen
18	0	-1306.31	-410.91	11286.78	-11587.08	-2225.028	-13796.9328	10535.9352	-11604.051	9252.693	balok lt 1
18	1.4	589.01	220.86	183.38	-52.12	1060.188	950.1513	565.0533	695.151	365.067	balok lt 1
18	2.8	-1811.99	-610.84	-11390.42	11012.44	-3151.732	-14247.3597	9672.5223	-11882.169	8620.587	balok lt 1
19	0	-9692.1	-3010.54	3911.45	-5859.11	-16447.384	-18225.4107	-5921.2797	-13996.089	-3449.691	balok lt 1
19	1.8	1443.99	578.5	2520.43	-2253.1	2658.388	4527.096	-765.807	3567.978	-968.796	balok lt 1
19	3.5	5138.19	1309.20	394.41	617.9	8260.548	6868.6905	5571.1005	5180.481	4068.261	balok lt 1
20	0	5138.19	1309.20	394.41	617.90	8260.548	6868.6905	5571.1005	5180.481	4068.261	balok lt 1
20	1.8	1532.71	610.73	-2466.61	2753.9	2816.42	4885.7004	-897.4896	3857.949	-1099.071	balok lt 1
20	3.5	-9514.64	-2946.07	-6062.63	4154.91	-16131.28	-18212.1576	-5480.6346	-14019.543	-3106.809	balok lt 1
21	0	-1524.94	-494.13	10922.09	-11234.84	-2620.536	-13709.0709	9884.0931	-11483.802	8738.91	balok lt 2
21	1.4	637.85	236.61	162.12	-26.98	1143.996	989.0328	648.5808	719.973	428.157	balok lt 2
21	2.8	-1495.68	-496.11	-11068.25	10710.48	-2588.592	-13504.6758	9738.6492	-11307.537	8615.313	balok lt 2
22	0	-9705.82	-3014.83	3843.56	-5790.22	-16470.712	-18170.1849	-6010.7229	-13946.436	-3524.04	balok lt 2
22	1.8	1414.48	567.71	2498.56	-2229.84	2605.712	4466.3493	-780.6267	3521.736	-975.672	balok lt 2
22	3.5	5092.91	1291.92	418.55	595.55	8178.564	6786.7926	5536.1376	5119.614	4047.624	balok lt 2
23	0	5092.91	1291.92	418.55	595.55	8178.564	6786.7926	5536.1376	5119.614	4047.624	balok lt 2
23	1.8	1471.66	586.96	-2396.45	2685.93	2705.128	4735.2543	-905.1987	3741.831	-1092.843	balok lt 2
23	3.5	-9591.48	-2976.33	-5946.45	4041.32	-16271.904	-18189.9144	-5702.3694	-13984.137	-3280.527	balok lt 2
24	0	-1629.31	-525.68	7384.81	-7777.83	-2796.26	-10208.6754	6124.7676	-8466.426	5533.668	balok lt 3
24	1.4	668.59	236.42	130.64	6.9	1180.58	988.1361	713.7921	719.307	484.155	balok lt 3

24	2.8	-1819.84	-464.94	-7593.93	7321.23	-2927.712	-10177.3707	5769.8823	-8472.393	5196.681	balok lt 3
25	0	-10690.01	-3013.95	2448.65	-4393.3	-17650.332	-17736.264	-8510.334	-13574.979	-5667.039	balok lt 3
25	1.8	1587.83	568.1	1813.72	-1551.05	2814.356	3929.5305	120.7185	3061.395	-203.301	balok lt 3
25	3.5	5658.16	1291.82	443.79	556.19	8856.704	7338.9141	6170.9151	5592.915	4591.773	balok lt 3
26	0	5658.16	1291.82	443.79	556.19	8856.704	7338.9141	6170.9151	5592.915	4591.773	balok lt 3
26	1.8	1663.19	586.37	-1661.14	1928.44	2934.02	4140.6246	90.9006	3232.467	-236.725	balok lt 3
26	3.5	-10539.29	-2977.41	-4501.07	2565.59	-17411.004	-17668.1463	-8215.8993	-13536.324	-5434.398	balok lt 3
27	0	-778.65	-318.47	3733.31	-4024.61	-1443.932	-5244.0591	3207.6219	-4322.934	2921.364	balok atap
27	1.4	220.39	122.35	134.15	-57.05	460.228	449.3475	167.6325	319.086	77.616	balok atap
27	2.8	-940.49	-534.43	-3935.41	3440.1	-1983.676	-5456.3859	2807.9751	-4388.31	2695.428	balok atap
28	0	-5216.17	-2240.91	951.43	-2873.53	-9844.86	-9905.9583	-3871.5453	-7280.73	-2108.376	balok atap
28	1.8	891.38	467.33	1070.70	-765.82	1817.384	2354.6019	106.1319	1765.872	-161.388	balok atap
28	3.5	2962.55	1031.81	454.97	606.89	5205.956	4397.9523	3123.4833	3212.496	2120.094	balok atap
29	0	2962.55	1031.81	454.97	606.89	5205.956	4397.9523	3123.4833	3212.496	2120.094	balok atap
29	1.8	968.03	524.42	-895.76	1244.61	2000.708	2653.6566	39.9756	1991.376	-248.922	balok atap
29	3.5	-5062.86	-2126.72	-2981.49	1147.32	-9478.184	-9786.4011	-3525.2721	-7239.915	-1873.233	balok atap

MOMEN RENCANA PORTAL H

Elemen	section	MD	ML	ME,ki	ME,ka	1,2MD+1,6ML	1.05	1.05	0.9	0.9	Keterangan
	m	kg-m	kg-m	kg-m	kg-m		(MD+ML,R+ME)	(MD+ML,r-ME)	(MD+ME)	(MD-ME)	
1	0	-79.50	-21.92	-12672.64	12625.30	-130.472	-13403.5566	13208.9874	-11476.926	11333.826	sloop
1	0.5	-183.72	-28.28	-10745.51	10675.12	-265.712	-11493.5079	11072.0631	-9836.307	9505.611	sloop
1	1	-287.93	-34.64	-8818.38	8724.95	-400.94	-9583.4487	8935.1493	-8195.679	7677.405	sloop
2	0	529.16	-49.89	-12728.51	12978.12	555.168	14151.2133	-13102.8387	12156.552	-11204.064	sloop
2	0.5	-806.06	-4.41	-10693.21	10307.03	-974.328	-12077.0118	10378.7292	-10349.343	8898.435	sloop
2	1	-2141.28	41.07	-8657.91	7635.95	-2503.824	-11313.2754	6868.3356	-9719.271	5864.967	sloop
3	0	-294.38	-84.40	-12449.75	12383.00	-488.296	-13434.5085	12709.9665	-11469.717	10939.833	sloop
3	0.5	1145.06	-123.52	-10715.18	11307.27	1176.44	12997.1289	-10748.1381	11207.097	-9145.989	sloop
3	1	2584.49	-162.64	-8980.61	10231.53	2841.164	13354.3578	-8131.8552	11534.418	-6882.336	sloop
4	0	444.59	-31.44	-12667.09	12875.66	483.204	13966.4553	-13072.4307	11988.225	-11187.963	kolom lt1
4	2	-62.23	-82.48	-4980.65	4976.73	-206.644	-5346.9864	5112.3786	-4538.592	4426.578	kolom lt1
4	4	-569.05	-133.51	2705.79	-2922.20	-896.476	-3749.9238	2386.6962	-3142.125	2117.835	kolom lt1
5	0	2008.23	39.54	-13427.63	14155.23	2473.14	16996.5432	-12729.4398	14547.114	-10932.3	kolom lt1

5	2	-407.44	-138.82	-4619.94	4588.55	-711.04	-5366.2056	4335.6684	-4524.642	3791.25	kolom lt1
5	4	-2823.12	-317.17	4187.76	-4978.13	-3895.216	-8391.1296	2062.9434	-7021.125	1939.509	kolom lt1
6	0	-2527.25	-176.72	-11761.82	10848.37	-3315.452	-15114.8571	9584.9649	-12860.163	8311.113	kolom lt1
6	2	395.25	52.67	-5467.95	5525.98	558.572	6250.4736	-5354.0844	5329.107	-4617.657	kolom lt1
6	4	3317.74	282.07	825.92	203.59	4432.6	4526.5471	2794.1151	3729.294	2242.638	kolom lt1
7	0	651.55	228.38	-7081.53	7159.68	1147.268	8345.6709	-6689.6571	7030.107	-5857.317	kolom lt2
7	2	21.10	39.61	613.16	-640.87	88.696	-625.8042	720.0228	-557.793	595.773	kolom lt2
7	4	-609.35	-149.16	8307.84	-8441.42	-969.876	-9597.2793	8129.7027	-8145.693	7048.863	kolom lt2
8	0	3745.02	842.89	-8989.79	9764.15	5842.648	14715.6492	-5789.0658	12158.253	-5417.217	kolom lt2
8	2	-74.17	-127.94	516.03	-520.24	-293.708	-704.7327	387.7713	-534.969	401.463	kolom lt2
8	4	-3893.36	-1098.78	10021.85	-10804.63	-6430.08	-16125.1209	6564.6021	-13228.191	6220.143	kolom lt2
9	0	-4252.93	-868.85	-4543.30	3661.78	-6493.676	-9783.417	-242.487	-7916.607	261.333	kolom lt2
9	2	196.72	290.76	814.19	-811.28	701.28	1244.6343	-465.1647	909.819	-555.723	kolom lt2
9	4	4646.36	1450.36	6171.69	-5284.34	7896.208	12272.6793	-687.8697	9736.245	-1372.797	kolom lt2
10	0	701.53	219.13	-525.14	691.39	1192.444	1600.6179	148.6989	1253.628	9.126	kolom lt3
10	1.6	-13.38	32.0	3532.85	-3469.54	35.144	3715.6035	-3703.3815	3167.523	-3191.607	kolom lt3
10	3.2	-728.28	-155.13	7590.84	-7630.47	-1122.144	-8874.4194	7149.5676	-7522.875	6211.971	kolom lt3
11	0	4018.98	1242.92	-1914.01	2709.0	6811.448	7847.4186	2158.5186	6055.182	1178.982	kolom lt3
11	1.6	497.62	319.59	3241.42	-3157.23	1108.488	4127.3337	-2679.6483	3365.136	-2469.42	kolom lt3
11	3.2	-3023.74	-603.73	8396.86	-9023.47	-4594.456	-13029.9204	5919.3666	-10842.489	5399.757	kolom lt3
12	0	-4949.07	-1526.21	1190.47	-2215.96	-8380.82	-8484.7938	-3831.2778	-6448.527	-2459.799	kolom lt3
12	1.6	-712.8	-415.76	3751.44	-3963.2	-1520.576	-5171.7288	3150.9912	-4208.4	2925.36	kolom lt3
12	3.2	3523.47	694.69	6312.42	-5710.43	5339.668	10765.3392	-2490.7428	8852.301	-2510.055	kolom lt3
13	0	342.08	73.57	2566.54	-2212.95	528.208	3100.4001	-2289.3339	2617.758	-2002.014	kolom lt4
13	0.9	-79.24	-45.13	2896.81	-2894.02	-167.296	2930.0166	-3153.2844	2535.813	-2678.445	kolom lt4
13	1.8	-500.57	-163.82	3227.09	-3575.09	-862.796	-4382.6496	3125.0394	-3668.094	2767.068	kolom lt4
14	0	2623.60	269.61	1674.28	-629.39	3579.696	4682.6283	1166.6403	3868.092	854.388	kolom lt4
14	0.9	-109.0	-242.23	2934.82	-3189.19	-518.368	-3615.7044	3081.5946	-2968.371	2772.171	kolom lt4
14	1.8	-2841.61	-754.06	4195.36	-5748.98	-4616.428	-9495.1773	2577.6807	-7731.531	2616.633	kolom lt4
15	0	-3031.04	-300.56	2920.10	-4282.43	-4118.144	-7868.4963	1124.6067	-6582.123	1126.251	kolom lt4
15	0.9	122.89	329.98	2800.79	-2513.07	675.436	3277.7514	-2603.9076	2631.312	-2410.11	kolom lt4
15	1.8	3276.82	960.51	2681.48	-743.7	5469	6861.3363	1230.2283	5362.47	535.806	kolom lt4
16	0	-732.52	-3.20	3848.71	-4150.71	-884.144	-5129.4075	3587.0835	-4394.907	3076.371	balok lt1
16	1.4	374.17	1.56	91.62	64.13	451.5	490.0623	297.6603	419.211	254.295	balok lt1
16	2.8	-1008.34	6.32	-4194.67	3749.77	-1199.896	-5459.1789	3349.6281	-4682.709	2867.697	balok lt1

17	0	-5157.85	7.85	575.06	-2769.51	-6176.86	-8318.7825	-2502.8115	-7134.624	-2149.506	balok lt1
17	3.5	2643.95	-3.12	550.68	577.41	3167.748	3380.4624	2167.9014	2899.224	1859.886	balok lt1
17	7	-5111.74	-14.08	-2781.21	616.84	-6156.616	-8296.4679	-2455.9269	-7103.655	-2097.477	balok lt1
18	0	-1220.6	-361.89	9787.31	-10081.88	-2043.744	-12095.5947	9076.3533	-10172.232	7975.152	balok lt2
18	1.4	638 48	262.69	165.31	-33.25	1186.48	1009.4742	662.3232	723.411	425.853	balok lt2
18	2.8	-1798 75	-576.20	-9927.09	9544.98	-3080.42	-12675.138	8171.751	-10553.256	7315.506	balok lt2
19	0	-8366.9	-1736.27	3250.46	-5197.30	-12818.312	-15336.2601	-4421.9301	-12207.78	-2852.64	balok lt2
19	1.5	375 87	293.93	2393.38	-2352.56	921.332	3092.8884	-1933.2096	2492.325	-1815.759	balok lt2
19	3	4203 63	657.46	996 31	-47.81	6096 292	5874.1368	3781 8858	4679.946	2886.588	balok lt2
20	0	4203 63	657.46	996.31	-47.81	6096 292	5874.1368	3781.8858	4679.946	2886.588	balok lt2
20	1	3785 06	538 7	-235.07	1188.69	5403.992	5561.8185	3065.5695	4476.375	2336.733	balok lt2
20	2	1786 48	153.27	-1706.45	2185.19	2389.008	4266.8136	-322.0854	3574.503	-358.839	balok lt2
21	0	1786 48	153.27	-1706.45	2185.19	2389.008	4266.8136	-322.0854	3574.503	-358.839	balok lt2
21	1	-2102 09	-365.49	-3417.84	2941.69	-3107.292	-6026.1852	1151.2788	-4967.937	1184.175	balok lt2
21	2	-7570 67	-1150.92	-5369.22	3458.19	-10926.276	-14311.9641	-3036.6021	-11645.901	-1981.305	balok lt2
22	0	-1310 88	-368.29	8832.99	-9132.81	-2162.32	-11197.8972	7981.0038	-9399.321	7039.737	balok lt3
22	1.4	616 33	223.73	142.73	-5.21	1097.564	937.9629	638.2299	683.15	426.24	balok lt3
22	2.8	-1752 77	-647.72	-9017.94	8651.99	-3139.676	-11717.3091	7220.3649	-9693.639	6538.653	balok lt3
23	0	-9665 11	-2989.42	2917.92	-4861.63	-16381.204	-17136.4116	-6926.9886	-13074.066	-4323.132	balok lt3
23	1.8	1444 03	586.71	2045.64	-1776.63	2671.572	4033.7808	-262.0632	3140.703	-541.449	balok lt3
23	3.5	5111 30	1304.50	438.35	573.37	8220.76	6790.7385	5586.6615	5116.203	4084.137	balok lt3
24	0	5111 30	1304.50	438.35	573.37	8220.76	6790.7385	5586.6615	5116.203	4084.137	balok lt3
24	1.8	1478 87	593.13	-1903.94	2188.38	2723.652	4224.2844	-371.3136	3300.525	-638.559	balok lt3
24	3.5	-9595 43	-2976.58	-4981.22	3068.38	-16277.044	-17180.7279	-6720.1659	-13118.985	-4152.789	balok lt3
25	0	-1070 36	-228.70	5024.30	-5417.52	-1650.352	-6956.355	4420.437	-5839.092	3912.444	balok atap
25	1.4	454 66	105.72	88.52	52.89	714.744	636.9426	451.0506	488.862	329.526	balok atap
25	2.8	-903 87	-108.66	-5317.67	5052.89	-1258.5	-6601.0728	4566.0342	-5599.386	3972.42	balok atap
26	0	-6551 22	-982.00	1404.91	-3341.19	-9432.664	-11005.6905	-3989.1915	-8903.169	-2889.027	balok atap
26	1.8	876 16	190.47	1308.10	-1046.39	1356.144	2413.4691	-333.5409	1965.834	-388.746	balok atap
26	3.5	3619 45	389.50	476.30	513.41	4966.54	4584.888	3506.727	3719.574	2795.436	balok atap
27	0	3619 45	389.50	476.30	513.41	4966.54	4584.888	3506.727	3719.574	2795.436	balok atap
27	1.8	874 52	183.85	-1090.51	1338.20	1343.584	2439.1815	-371.0385	1991.448	-417.312	balok atap
27	3.5	-6554 51	-995.25	-3392.31	1428.00	-9457.812	-11071.1685	-3947.3175	-8952.138	-2845.98	balok atap
28	0	-500 57	-163.82	3227.09	-3575.09	-862.796	-4382.6496	3125.0394	-3668.094	2767.068	balok atap
28	1.4	190 21	85.10	92.49	22.0	364.412	350.448	156.219	254.43	87.948	balok atap

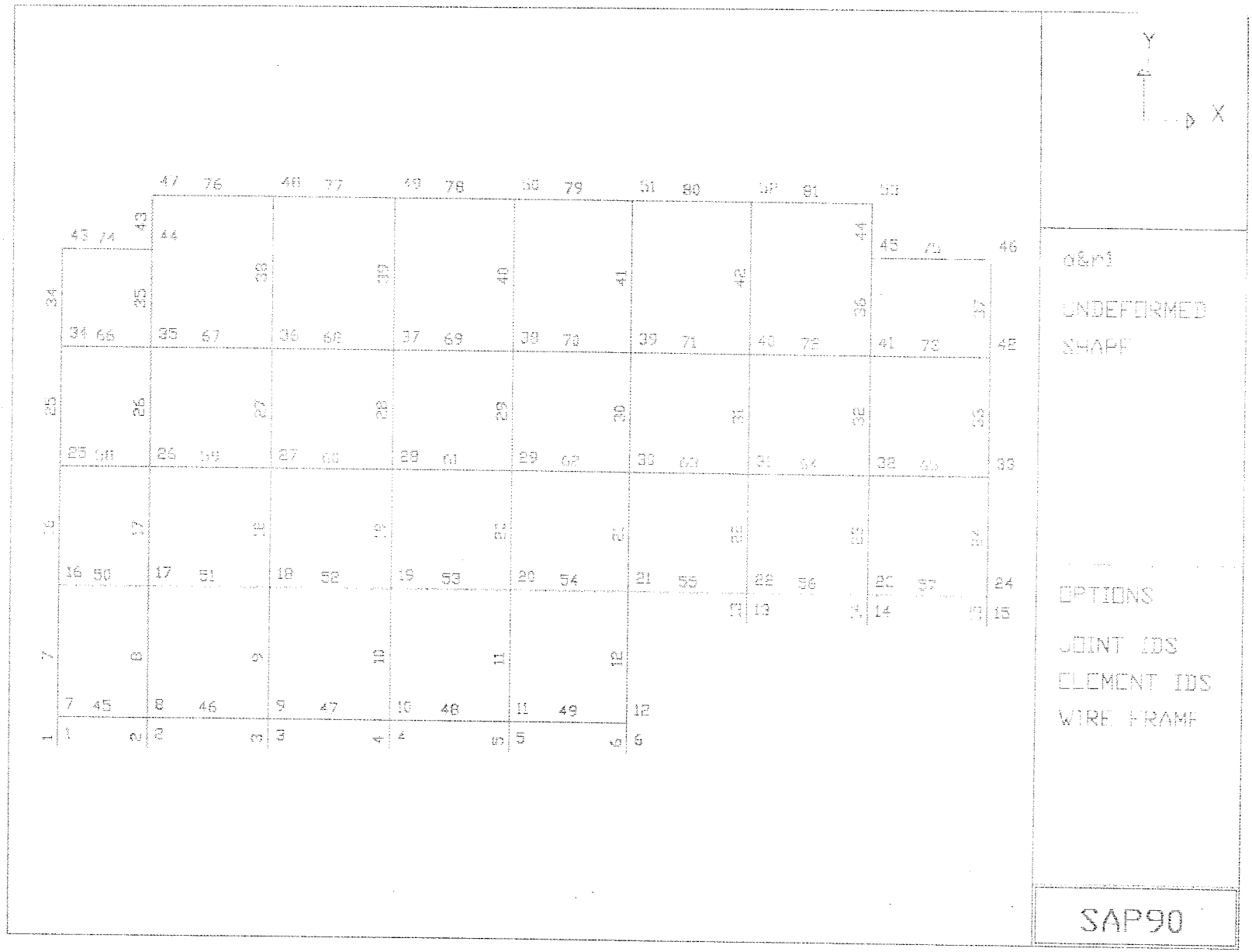
28	2.8	-434.56	-214.77	-3512.5	3148.69	-865.104	-4279.7181	3096.5319	-3552.354	2770.146	balok atap
29	0	-3276.16	-968.84	682.85	-2600.29	-5481.536	-6780.6417	-1320.0327	-5288.805	-608.283	balok atap
29	1.8	476.87	209.03	944.27	-661.79	906.692	1623.8859	-359.0811	1279.026	-420.66	balok atap
29	3.5	1995.82	413.45	470.69	541.70	3056.504	2924.8695	1787.2995	2283.768	1308.708	balok atap
30	0	1995.82	413.45	470.69	541.70	3056.504	2924.8695	1787.2995	2283.768	1308.708	balok atap
30	1.8	476.55	213.19	-737.89	1010.2	912.964	1695.3972	-426.0228	1338.075	-480.285	balok atap
30	3.5	-3276.82	-960.51	-2681.48	743.7	-5469	-6861.3363	-1230.2283	-5362.47	-535.806	balok atap

MOMEN RENCANA PORTAL I

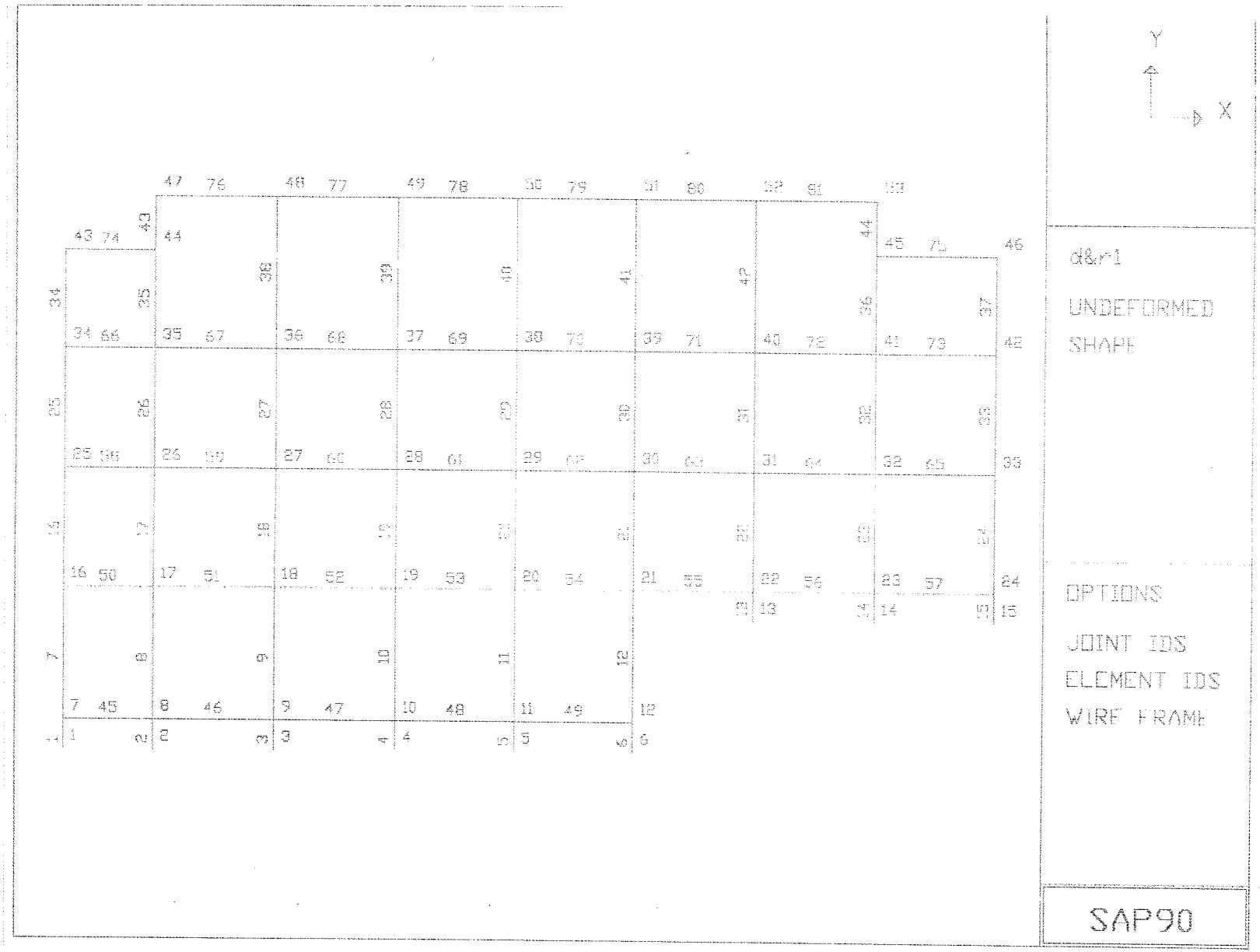
Elemen	section	MD	ML	ME,ki	ME,ka	1,2MD+1,6ML	1.05	1.05	0.9	0.9	Keterangan
	m	kg-m	kg-m	kg-m	kg-m		(MD+ML,R+ME)	(MD+ML,r-ME)	(MD+ME)	(MD-ME)	
1	0	-131.72	-32.32	-11716.78	11668.44	-209.776	-12461.2866	12143.9514	-10663.65	10426.554	sloop
1	0.5	-204.08	-37.21	-9829.15	9727.00	-304.432	-10558.3338	10082.8812	-9029.907	8662.563	sloop
1	1	-276.43	-42.11	-7941.53	7785.55	-399.092	-8655.3873	8021.8257	-7396.164	6898.59	sloop
2	0	499.17	-41.78	-11756.50	11965.82	532.156	13061.9181	-12066.3039	11218.491	-10319.985	sloop
2	0.5	-861.71	-25.14	-9776.83	9436.0	-1074.276	-11186.3052	9345.0378	-9574.686	8023.608	sloop
2	1	-2222.59	-8.49	-7797.16	6906.19	-2680.692	-10526.0862	5847.9498	-9017.775	5017.113	sloop
3	0	-176.82	-52.49	-11517.24	11503.38	-296.168	-12311.8317	11874.3723	-10524.654	10206.378	sloop
3	0.5	1256.42	-64.24	-9745.04	10335.14	1404.92	12130.6668	-9573.1272	10432.404	-8170.848	sloop
3	1	2689.65	-75.99	-7972.83	9166.89	3105.996	12401.4933	-6848.9757	10670.886	-5829.516	sloop
4	0	419.82	-49.01	-11077.13	11184.53	425.368	12153.6912	-11333.8218	10443.915	-9688.239	kolom 1
4	2	-22.65	-53.97	-3456.01	3452.6	-113.532	-3686.5941	3571.0269	-3130.794	3090.024	kolom 1
4	4	-465.13	-58.93	4165.10	-4279.33	-652.444	-5018.8089	3967.7841	-4270.014	3432.78	kolom 1
5	0	1816.23	-19.83	-11620.12	12292.50	2147.748	14801.6736	-11012.5764	12697.857	-9428.643	kolom 1
5	2	-251.85	-79.11	-3167.28	3115.82	-30348.576	-29819.7333	-23168.4453	-25517.052	-19815.948	kolom 1
5	4	-2319.93	-138.39	5285.57	-6060.86	-3005.34	-8887.0152	3840.7908	-7542.711	3366.837	kolom 1
6	0	-2299.22	-83.66	-10311.19	9583.46	-2892.92	-13293.6363	8359.8627	-11349.369	7210.773	kolom 1
6	2	211.34	-19.42	-3827.14	3934.08	222.536	4340.4564	-3921.1116	3730.878	-3350.466	kolom 1
6	4	2721.89	44.82	2656.90	-1715.31	3337.98	5675.9661	96.4761	4840.911	58.491	kolom 1
7	0	476.49	95.74	-3392.23	3548.81	724.972	4286.8812	-3165.6198	3622.77	-2765.088	kolom 2
7	2	17.46	28.02	1639.32	-1590.95	65.784	1757.2716	-1685.3004	1491.102	-1459.674	kolom 2
7	4	-441.57	-39.71	6670.88	-6730.70	-593.42	-7555.9008	6578.5692	-6455.043	5660.217	kolom 2
8	0	2611.24	274.61	-4716.32	5487.90	3572.864	8677.1013	-2847.4887	7289.226	-2588.994	kolom 2

8	2	97.99	1.31	1431.72	-1348.83	119.684	1607.0208	-1399.5912	1376.739	-1200.357	kolom lt 2
8	4	-2415.25	-271.98	7579.75	-8185.55	-3333.468	-11302.1874	5887.4676	-9540.72	5193.27	kolom lt 2
9	0	-2975.09	-232.45	-1695.67	743.38	-3942.028	-5050.7415	-1489.8345	-4203.684	-1151.478	kolom lt 2
9	2	-2.82	108.57	1842.74	-1998.14	170.328	-2032.6089	2163.4851	-1800.864	1795.788	kolom lt 2
9	4	2969.46	449.59	5381.15	-4739.66	4282.696	9051.3822	-2249.0328	7515.549	-2170.521	kolom lt 2
10	0	478.10	153.02	1335.24	-1020.92	818.552	2000.4096	-803.5944	1632.006	-771.426	kolom lt3
10	1.6	15.94	7.54	2153.79	-2150.49	31.192	2282.9667	-2239.9923	1952.757	-1924.065	kolom lt3
10	3.2	-446.21	-137.95	2972.33	-3280.07	-756.172	-3999.5025	2888.6445	-3353.652	2550.474	kolom lt3
11	0	2486.90	561.37	569.94	491.09	3882.472	3563.3451	2366.4711	2751.156	1725.264	kolom lt3
11	1.6	148.96	-20.29	2133.14	-2350.83	146.288	-2324.7462	2611.9968	-1981.683	2249.811	kolom lt3
11	3.2	-2188.98	-601.95	3696.33	-5192.75	-3589.896	-8130.045	2774.73	-6643.557	2703.393	kolom lt3
12	0	-2996.62	-650.52	1971.95	-3268.11	-4636.776	-6987.7941	-124.7631	-5638.257	244.341	kolom lt3
12	1.6	-196.52	76.63	2206.21	-1912.61	-113.216	2158.4514	-2474.5896	1808.721	-2162.457	kolom lt3
12	3.2	2603.57	803.78	2440.47	-557.11	4410.332	5802.6234	677.6364	4539.636	146.79	kolom lt3
13	0	-696.25	6.89	3135.60	-3398.98	-824.476	-4295.6508	2842.2072	-3685.707	2432.457	balok lt1
13	1.4	366.84	.70	81.44	61.48	441.328	471.135	300.111	403.452	256.86	balok lt1
13	2.8	-1000.47	-5.49	-3443.12	3051.55	-1209.348	-4669.2282	2561.3238	-3999.231	2198.385	balok lt1
14	0	-5039.30	5.85	379.84	-2334.76	-6037.8	-7739.0775	-2836.0815	-6636.654	-2434.086	balok lt1
14	3.5	2580.92	-.91	490.74	510.91	3095.648	3245.8482	2172.9372	2782.647	1863.009	balok lt1
14	7	-4988.87	-7.67	-2338.36	416.57	-5998.916	-7698.4236	-2787.8676	-6594.507	-2385.459	balok lt1
15	0	-941.62	-154.67	7557.33	-7828.14	-1377.416	-9305.6901	7133.4039	-7892.784	6197.868	balok lt2
15	1.4	488.48	132.06	148.58	-16.82	797.472	752.1108	440.0928	573.354	305.91	balok lt2
15	2.8	-1444.79	-312.95	-7730.58	7324.09	-2234.468	-9831.297	6402.921	-8257.833	5657.211	balok lt2
16	0	-6375.96	-725.95	2271.30	-4224.67	-8812.672	-11588.01	-2716.203	-9540.567	-1936.161	balok lt2
16	1.75	1034.96	268.51	1717.83	-1451.33	1671.568	3059.5908	-547.8522	2477.511	-614.583	balok lt2
16	3.5	3259.15	173.39	429.37	587.01	4188.404	4147.7037	2914.9827	3461.544	2404.926	balok lt2
17	0	3259.15	173.39	429.37	587.01	4188.404	4147.7037	2914.9827	3461.544	2404.926	balok lt2
17	1.75	679.83	-51.94	-1594.10	1890.35	732.692	2665.9668	-1303.7682	2313.162	-1089.468	balok lt2
17	3.5	-5696.99	-277.27	-4352.57	2458.69	-7280.02	-10726.7181	-1586.3211	-9044.604	-1209.978	balok lt2
18	0	-919.67	-192.73	5335.64	-5709.79	-1411.972	-7082.3529	4908.2061	-5966.514	4311.108	balok lt3
18	1.4	441.87	125.85	100.31	39.47	731.604	648.5745	437.9235	487.962	307.404	balok lt3
18	2.8	-1167.95	-287.31	-5605.43	5318.33	-1861.236	-7293.0543	4478.3487	-6096.042	3993.732	balok lt3
19	0	-6070.10	-1120.66	1404.39	-3358.31	-9077.176	-10605.8463	-3553.3953	-8485.569	-2440.611	balok lt3
19	1.75	852.08	216.77	1303.49	-1048.35	1369.328	2399.9136	-337.4154	1940.013	-406.269	balok lt3
19	3.5	3200.04	464.62	467.60	526.62	4583.44	4205.7036	3099.8016	3353.994	2406.078	balok lt3

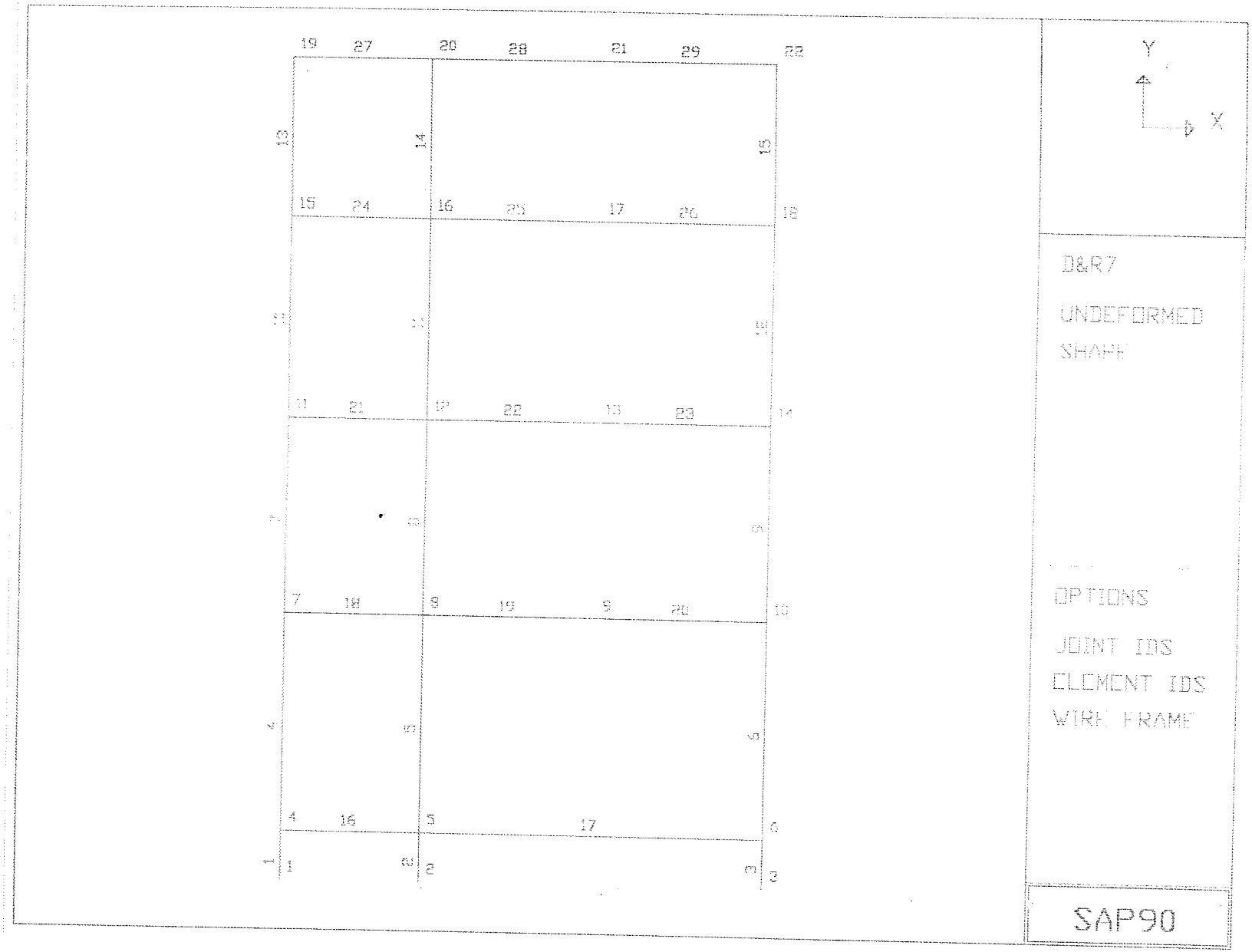
20	0	3200.04	464.62	467.60	526.62	4583.44	4205.7036	3099.8016	3353.994	2406.078	balok lt3
20	1.8	904.09	227.05	-1103.3	1366.58	1448.188	2527.245	-342.573	2043.603	-416.241	balok lt3
20	3.5	-5966.07	-1100.10	-3409.2	1471.55	-8919.444	-10537.0965	-3377.7765	-8437.743	-2301.183	balok lt3
21	0	-446.21	-137.95	2972.33	-3280.07	-756.172	-3999.5025	2888.6445	-3353.652	2550.474	balok atap
21	1.4	188.82	86.37	96.46	2.21	364.776	353.9571	151.3911	256.752	83.124	balok atap
21	2.8	-491.71	-238.11	-3249.8	2814.09	-.71.028	-4078.5948	2745.9852	-3367.359	2482.281	balok atap
22	0	-2680.68	-840.07	446.53	-2378.66	-4560.928	-5841.5511	-846.3651	-4553.406	-271.818	balok atap
22	1.8	399.89	168.22	827.28	-542.22	749.02	1394.5071	-342.7809	1104.453	-384.651	balok atap
22	3.5	1487.00	359.33	473.03	559.23	2359.328	2374.9194	1200.5364	1841.607	834.993	balok atap
23	0	1487.00	359.33	473.03	559.23	2359.328	2374.9194	1200.5364	1841.607	834.993	balok atap
23	1.8	438.45	186.37	-616.22	925.67	824.332	1549.7391	-394.1679	1227.708	-438.498	balok atap
23	3.5	-2603.57	-803.78	-2440.47	557.11	-4410.332	-5802.6234	-677.6364	-4539.636	-146.79	balok atap


Y
X
08#1
UNDEFORMED
SHAPE
OPTIONS
JOINT IDS
ELEMENT IDS
WIRE FRAME
SAP90

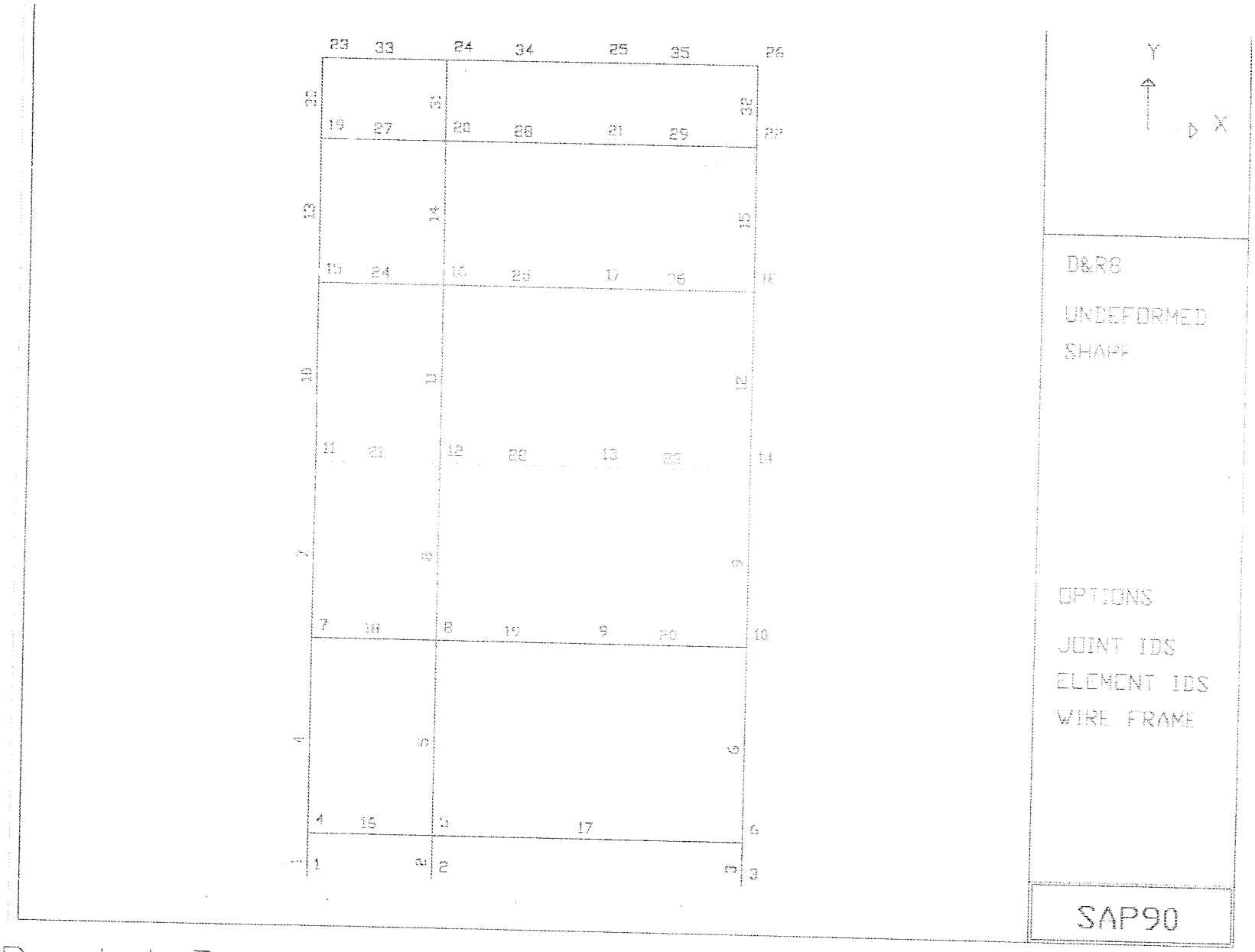
Portal 1


Y
X
d&r1
UNDEFORMED
SHAPE
OPTIONS
JOINT IDS
ELEMENT IDS
WIRE FRAME
SAP90

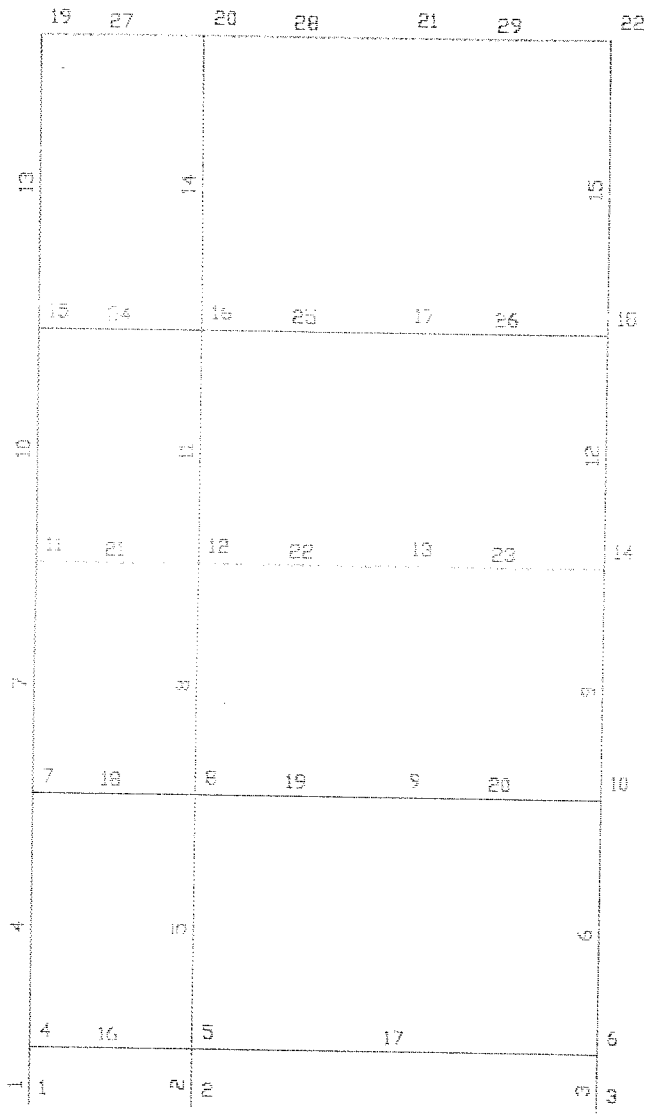
Portal 2


Y
X
D&R7
UNDEFORMED SHAPE
OPTIONS
JOINT IDS
ELEMENT IDS
WIRE FRAME
SAP90

Portal A


Y
X
D&RB
UNDEFORMED
SHAPE
OPTIONS
JOINT IDS
ELEMENT IDS
WIRE FRAME
SAP90

Portal B



Y

X

d&r6

UNDEFORMED SHAPE

OPTIONS

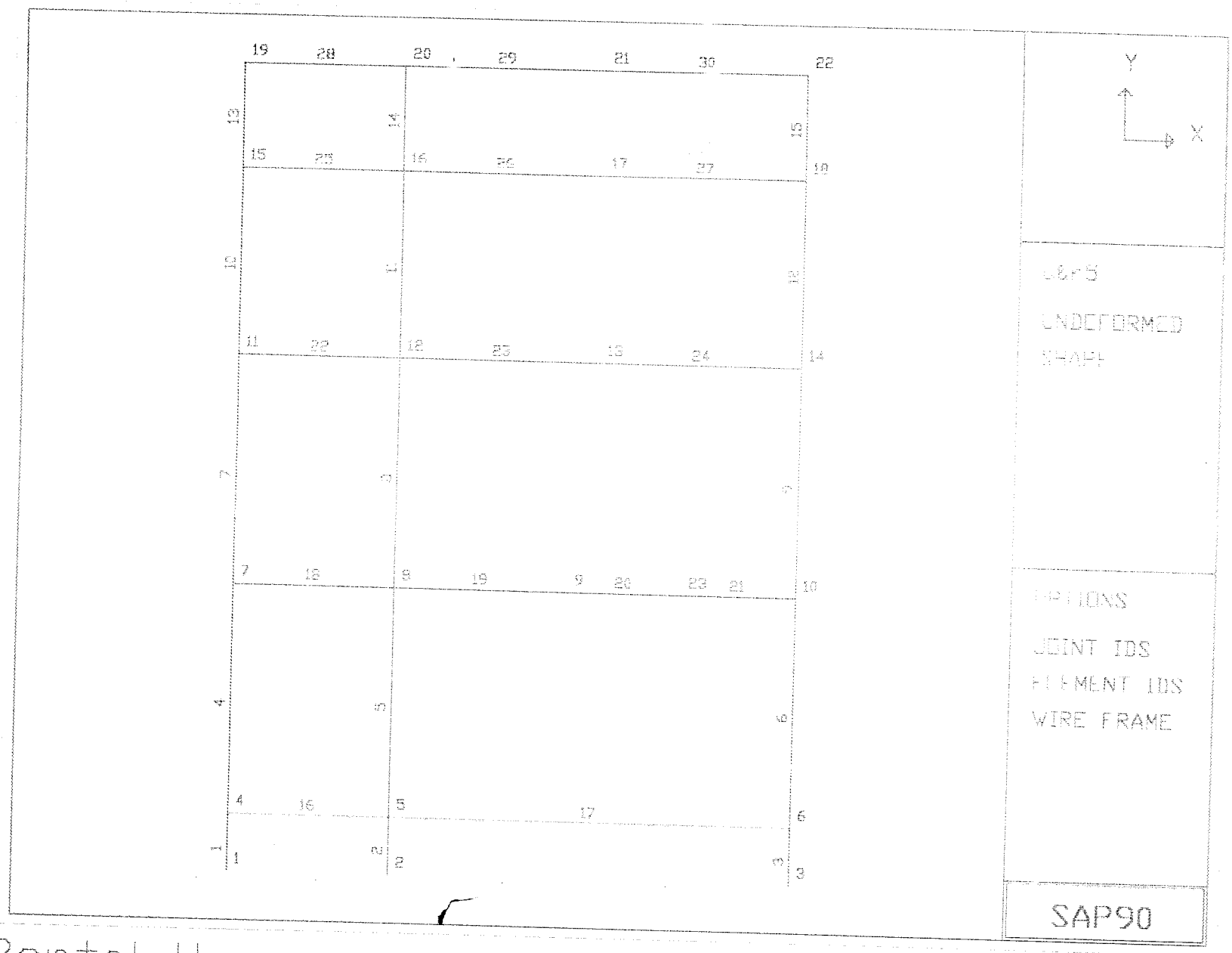
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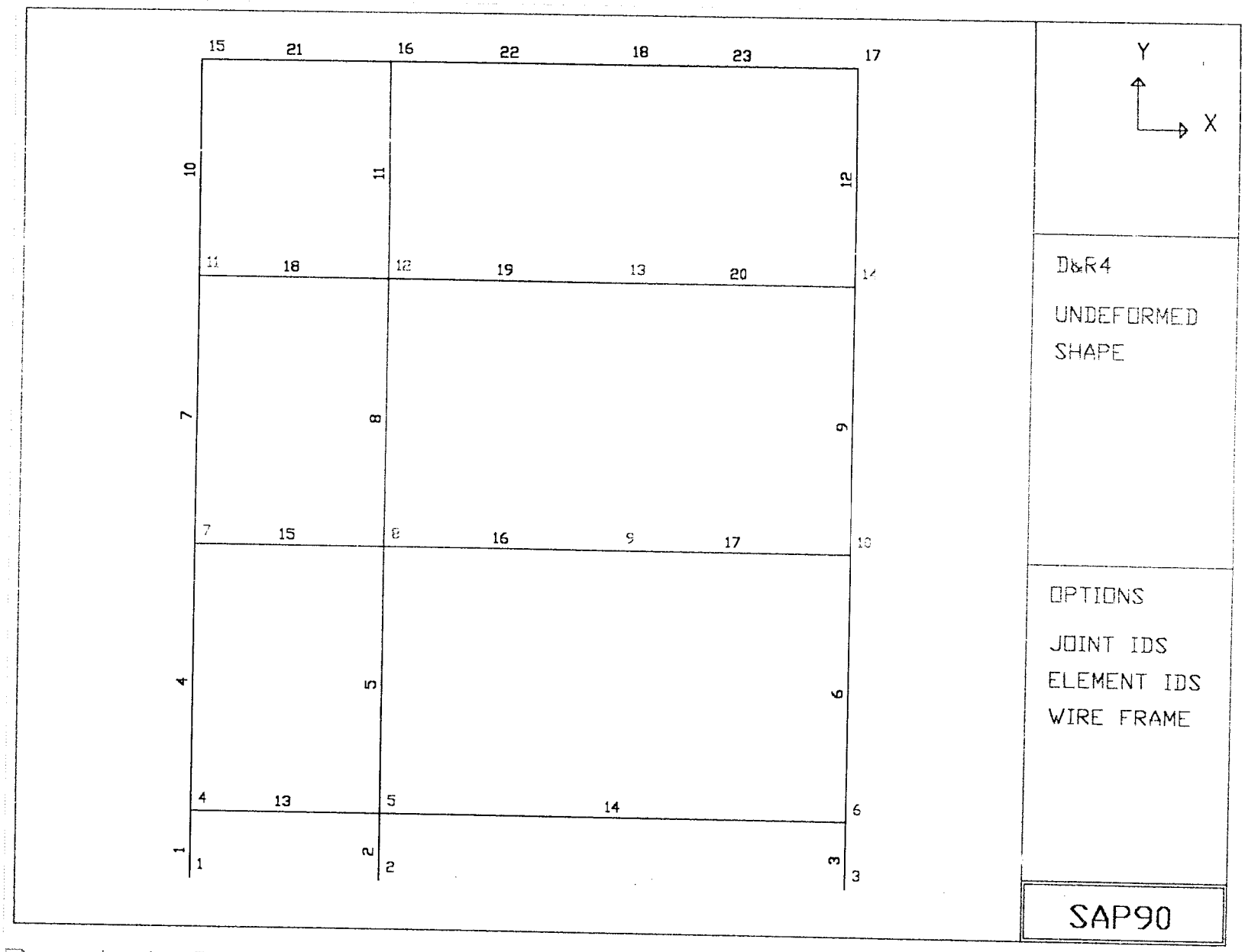
WIRE FRAME

SAP90

Portal D


Y
X
U&R5
UNDEFORMED
SHAPE
OPTIONS
JOINT IDS
ELEMENT IDS
WIRE FRAME
SAP90

Portal H


15
21
16
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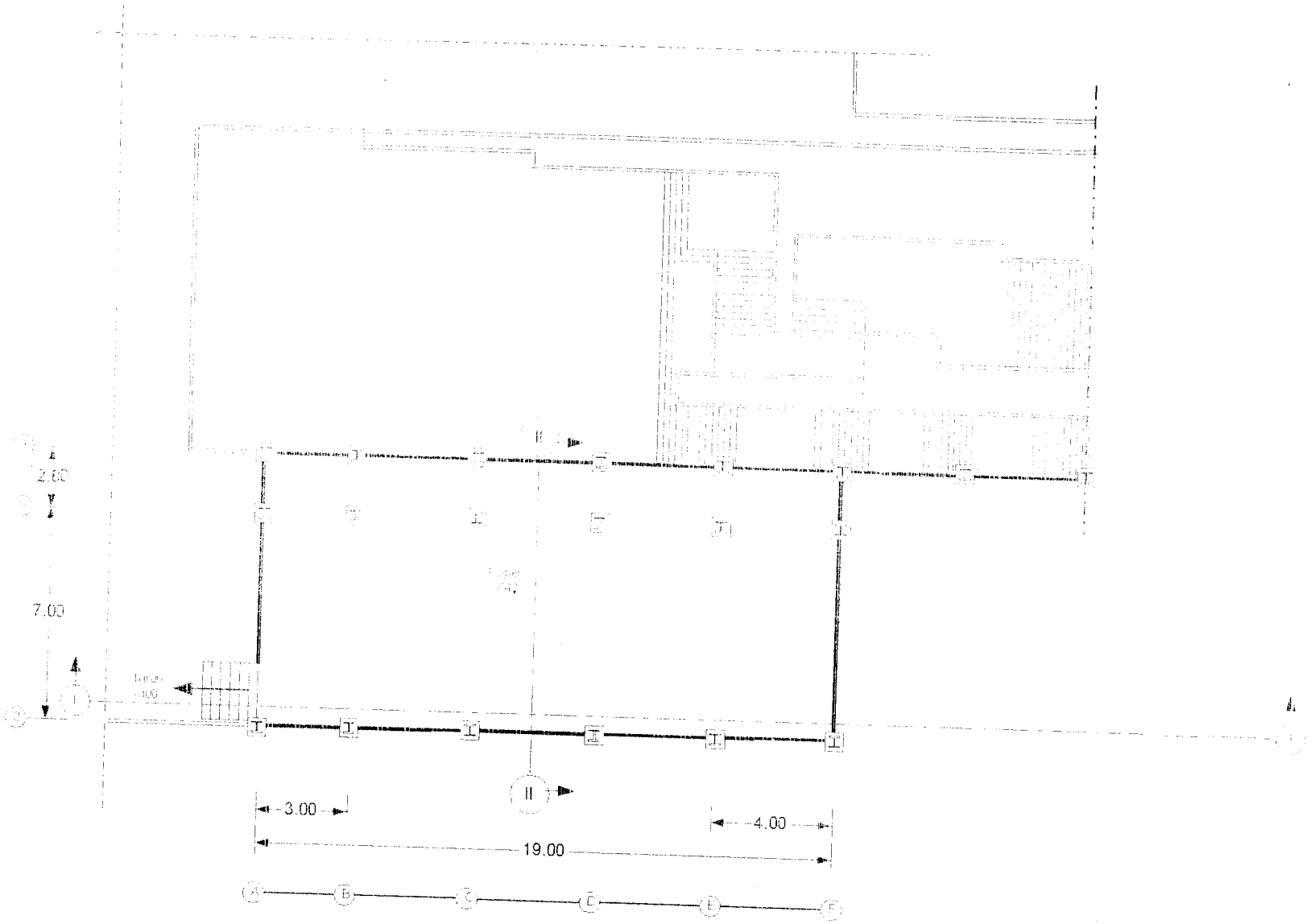
Portal I

RAB Kolom Lantai 1 (K1.1,K2.1,K3.1) Gedung Audiovisual UK-DW Yogyakarta :

Jenis Pekerjaan	koefisien	Satuan	Jenis Bahan	Harga sat Bahan (Rp)	Jml harga bahan (Rp)	Upah Mengerjakan					Jumlah Upah +Bahan (RP)
						koefisien	Jenis tenaga	Satuan (Rp)	Jumlah (Rp)	Diambil (Rp)	
Beton 1Pc:2Ps:3Kr	10.175	zak	Pc (50 kg)	22000	223850	0.1	Kep.Tk.batu	20000	2000		
per m^3	0.49	m^3	Pasir	30000	14700	1	Tk.Batu	15000	15000		
	0.81	m^3	Kerikil (split)	75000	60750	6	Pekerja	10000	60000		
						0.3	Mandor	20000	6000		
					299300				83000	[illegible]	379300
Besi Tulangan	110	kg	Besi Tulangan	3800	418000	2.25	Kep.Tk.Besi	6500	14625		
per 100 kg besi	2	kg	Kawat bendrat	6250	12500	6.75	Tk.Besi	5500	37125		
						6.75	Pekerja	3500	23625		
					430500				75375	[illegible]	505500
Bekisting Kolom	8.5	m^2	Multiplek 9 mm	28250	240125	0.5	Kep.Tk.Kayu	6500	3250		
per m^3 beton	4	kg	Paku reng	6250	25000	5	Tk.Kayu	5500	27500		
	16.8	m	kayu usuk	5500	92400	2	Pekerja	3500	7000		
	1	ls	Scafolding	50000	50000	0.1	Mandor	7000	700		
						4	Tk.Bk.Cetakan	3500	14000		
					407525				52450	[illegible]	457525
Kolom Lantai 1	1	m^3	Beton	379300	379300						
Per m^3	0.4	-	Bekist.Kolom	457525	183010						
	2.94	-	Besi tulangan	505500	1486170						
					2048480						2048480

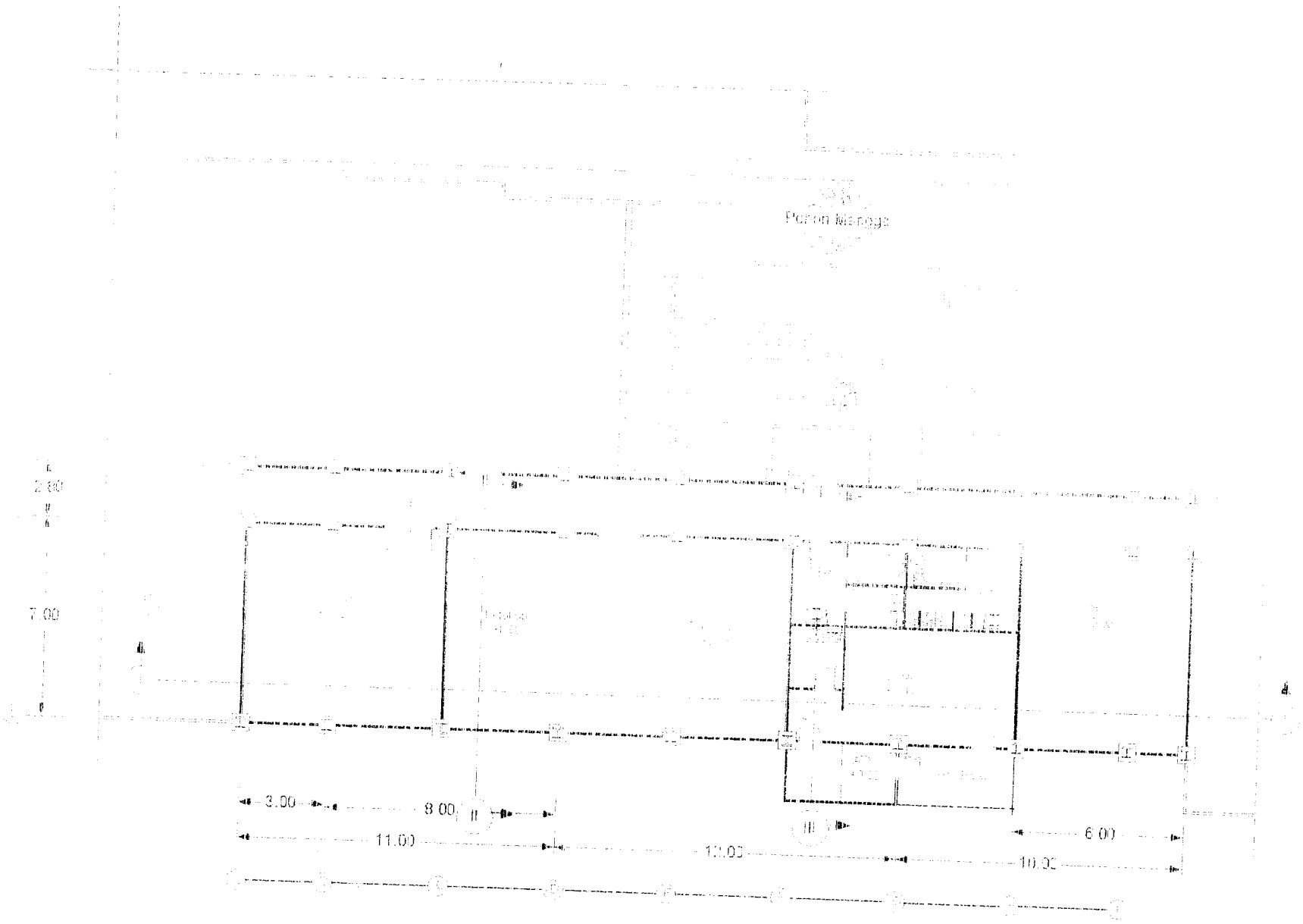
Kebutuhan Total Kolom Lt.1 = Rp.38.628.480,00

LAMPIRAN GAMBAR



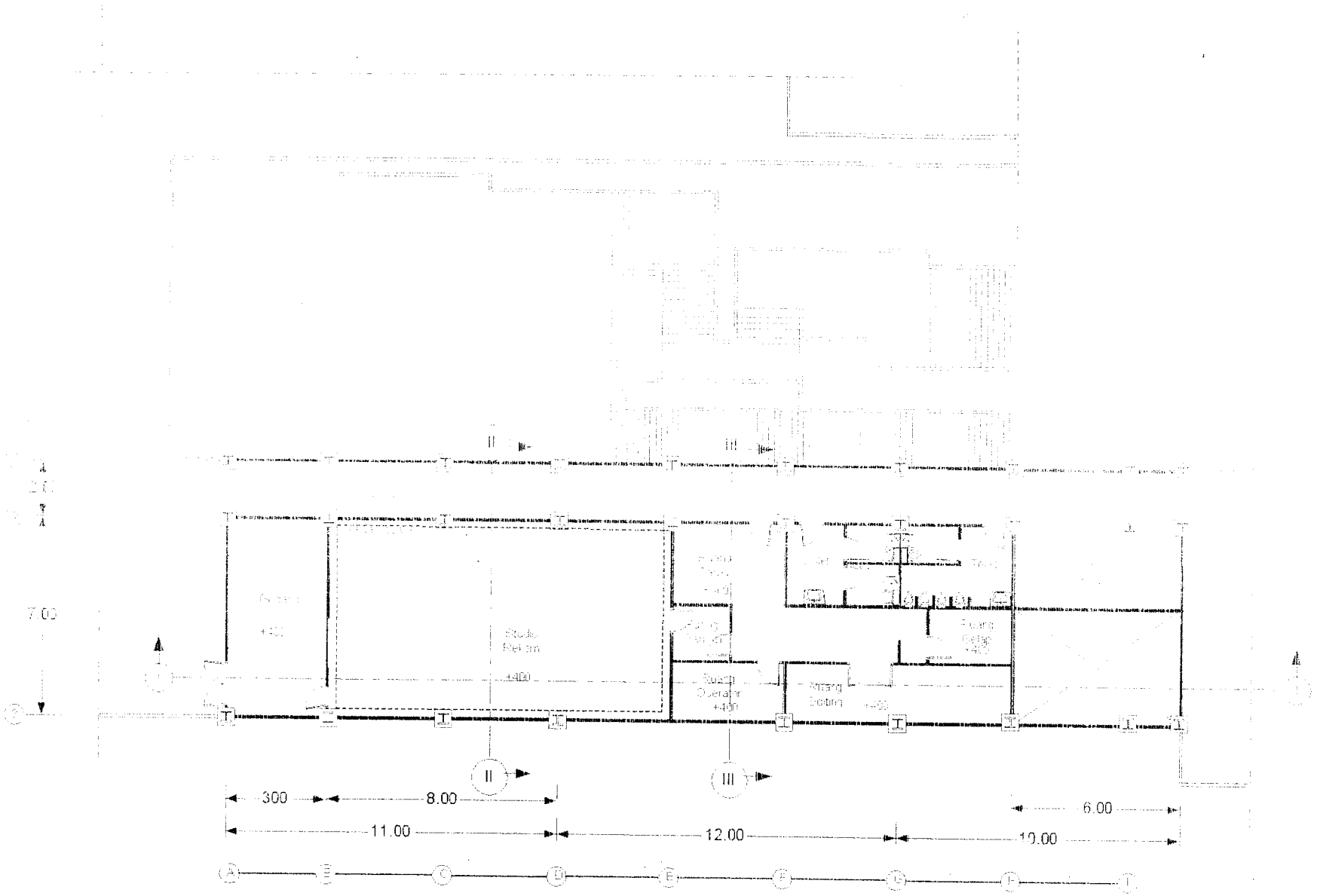
Denah Basement

Scale: 1/200 : 1



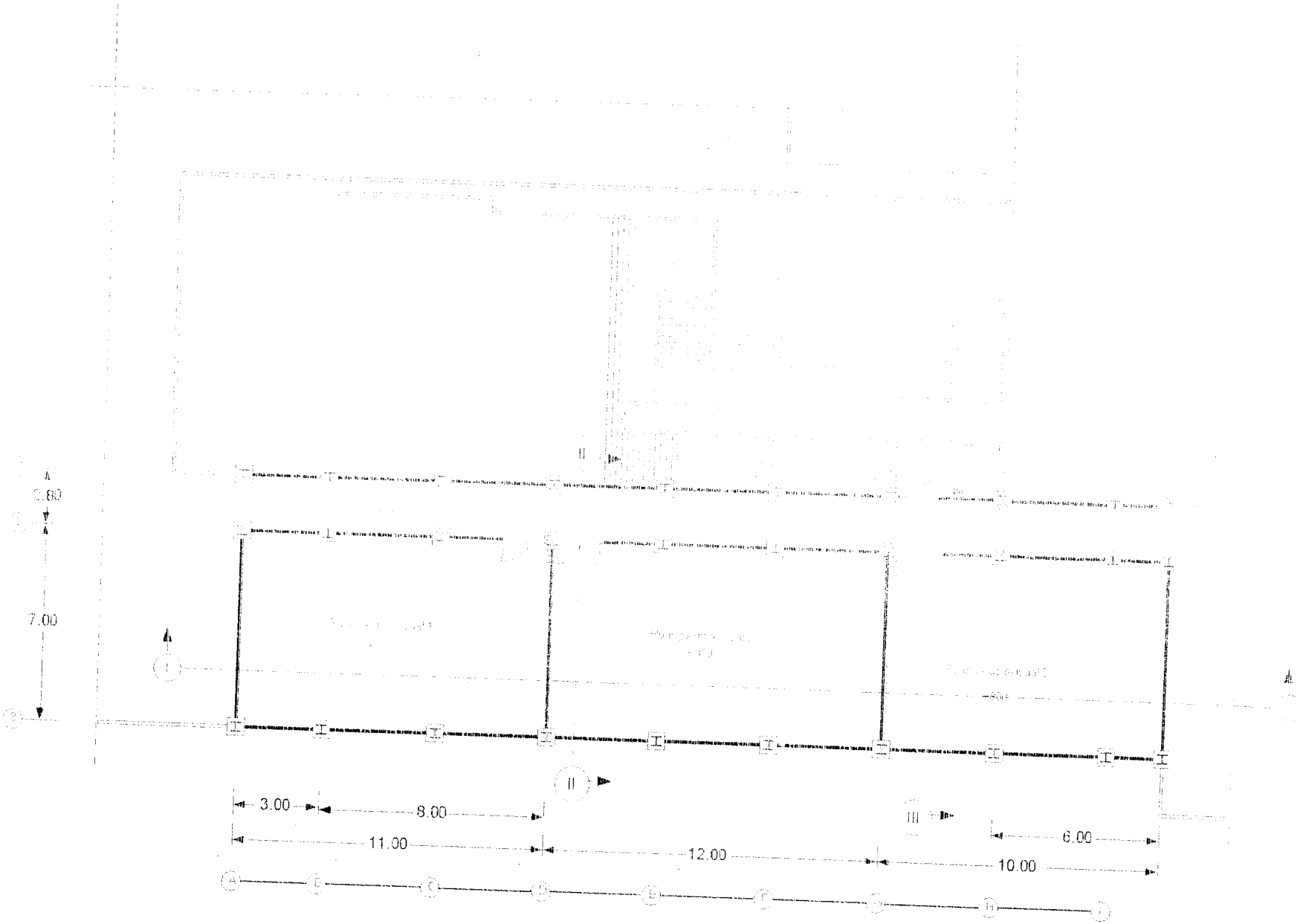
Denah Lantai 1

Scale: 1/200



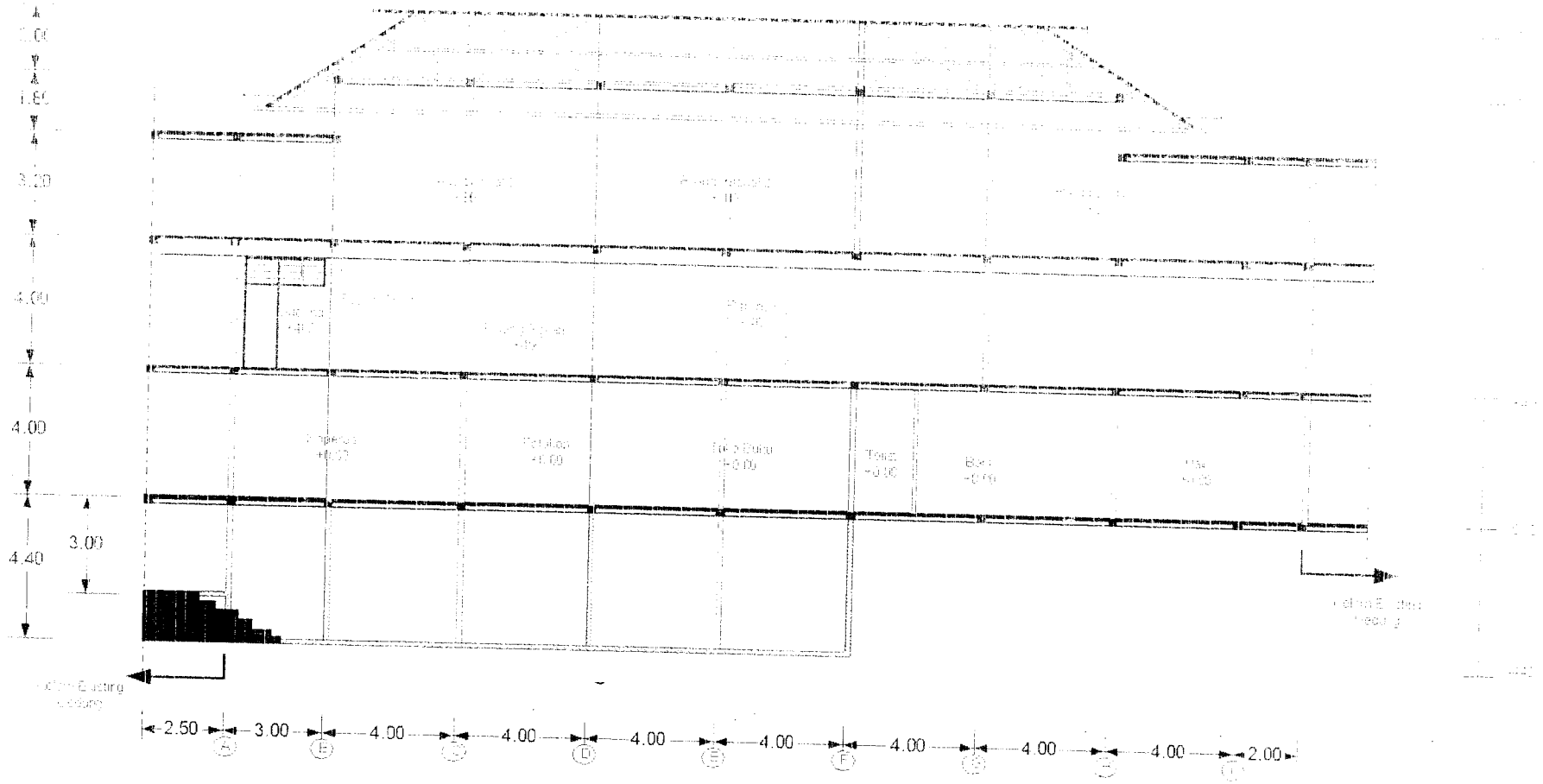
Denah Lantai 2

Scale: 1/200 : 1



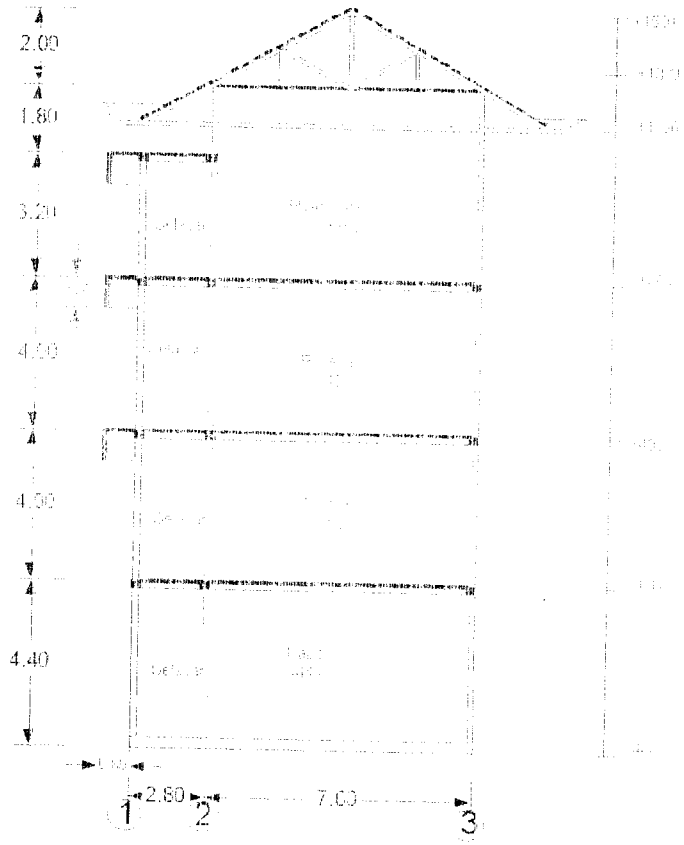
Denah Lantai 3

Scale: 1/200 : 1

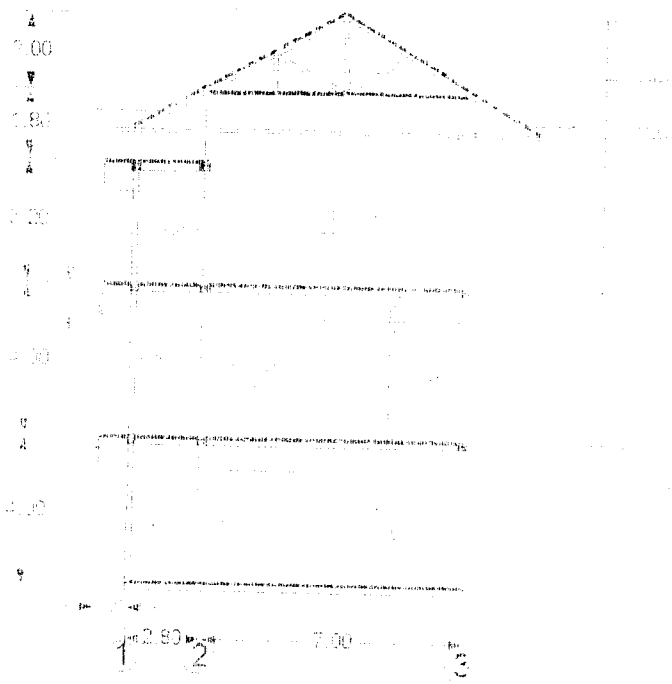


Potongan I-I

Scale: 1/200 : 1

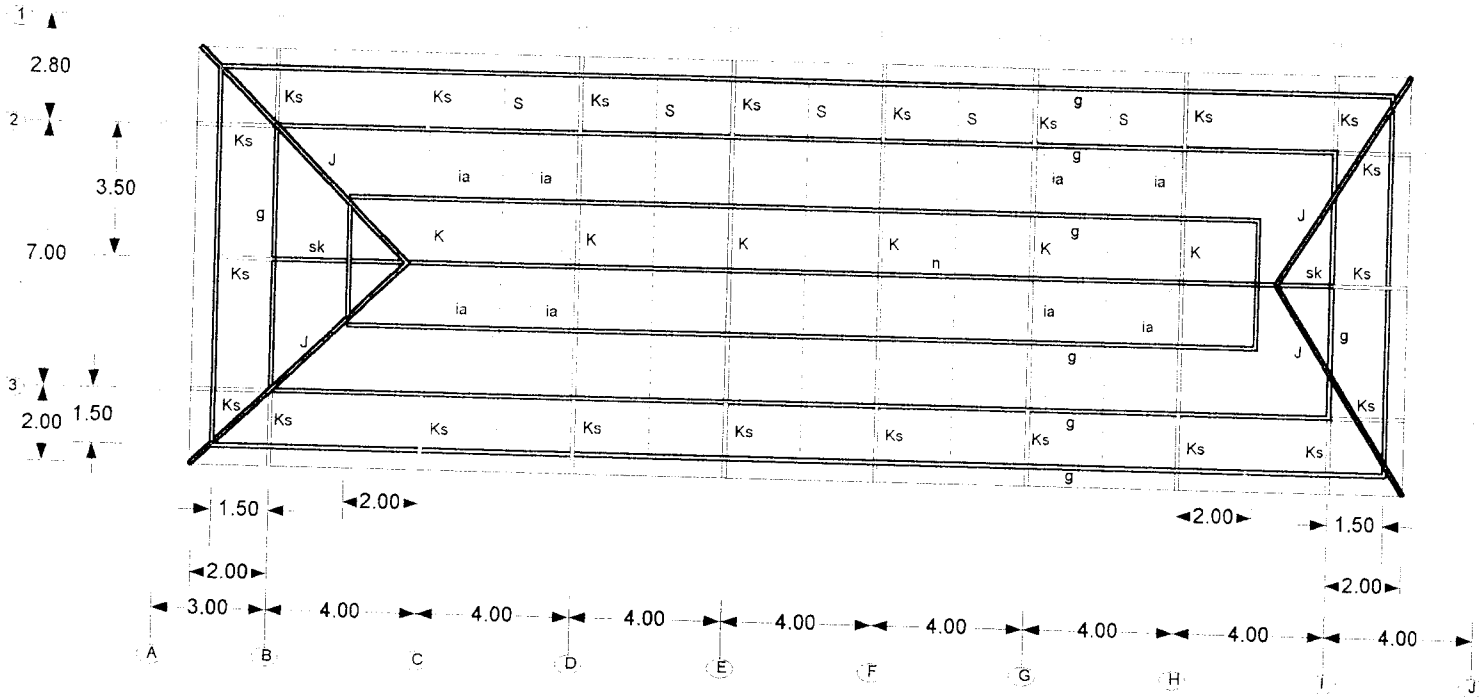


Potongan II-II



Potongan III-III

Scale: 1/200 : 1

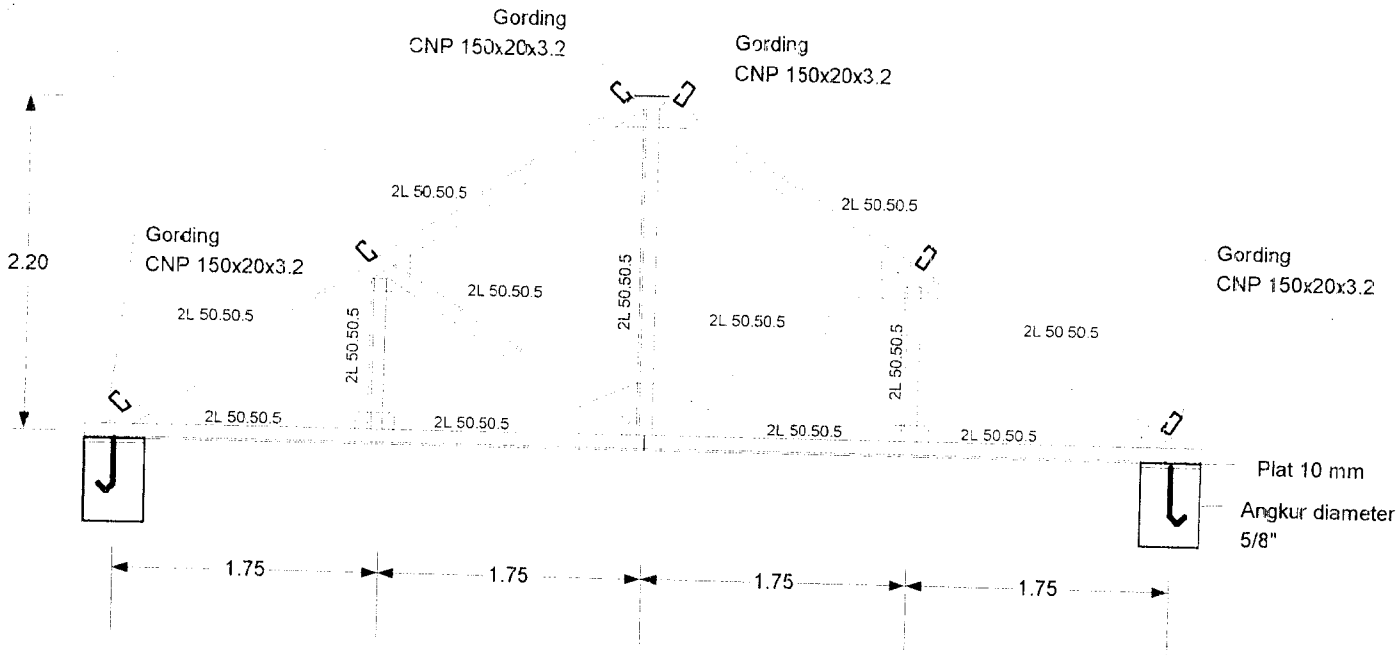


Rencana Kuda-Kuda

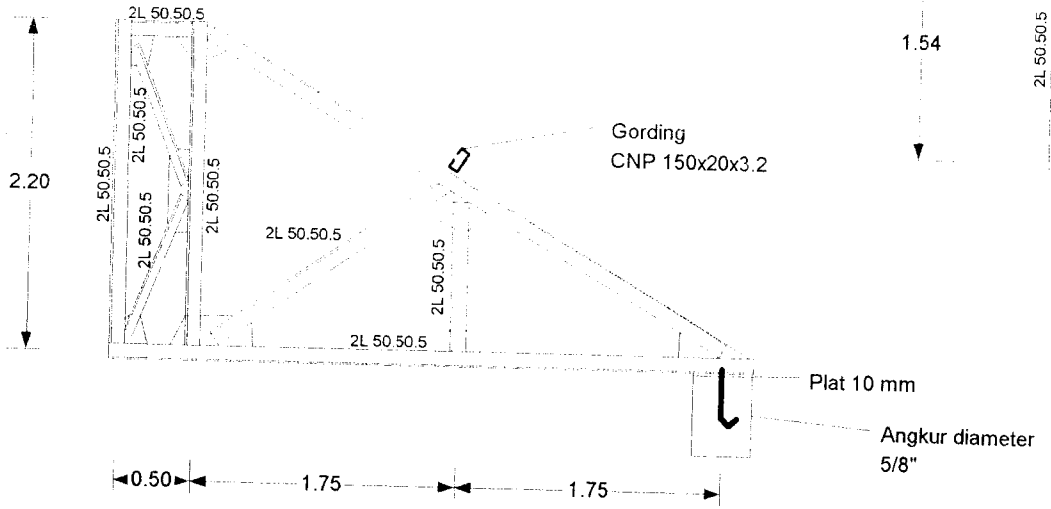
Keterangan :
K = kuda-kuda
g = gording CNP 150x20x3.2
n = nok
J = jurai CNP 150x20x3.2
S = sagrod diameter 10 mm
ia = ikatan angin diameter 12 mm
Ks = konsol
Sk = setengah kuda-kuda

Tebal plat simpul 8 mm
Tebal las 4 mm

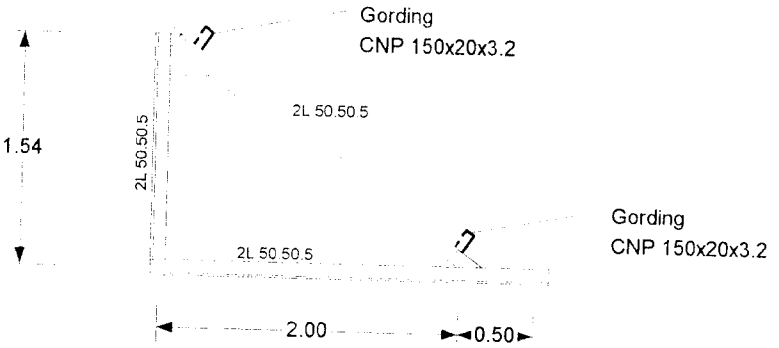
Scale: 1/200 : 1



Detail Kuda-Kuda



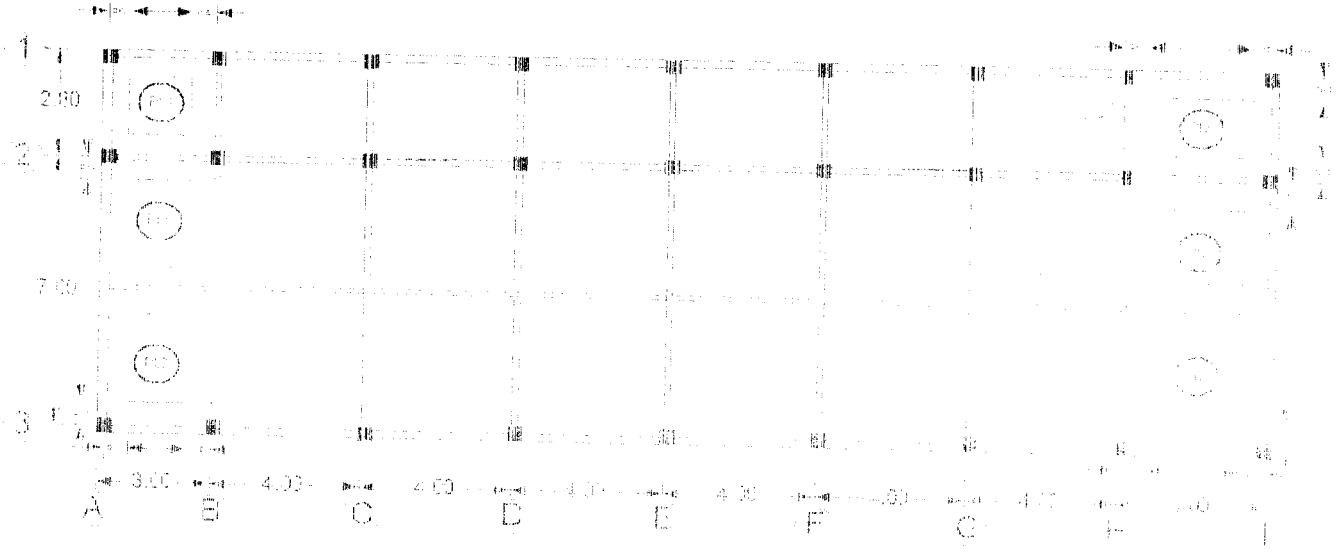
Jurai



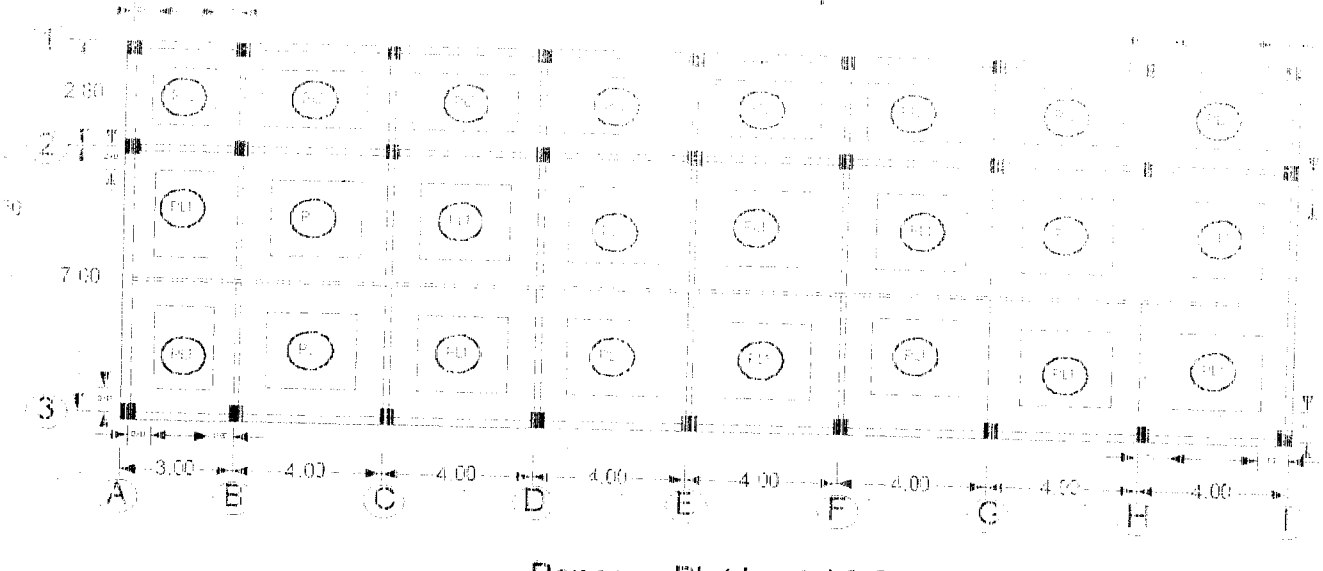
Konsol

Scale: 1/50 : 1

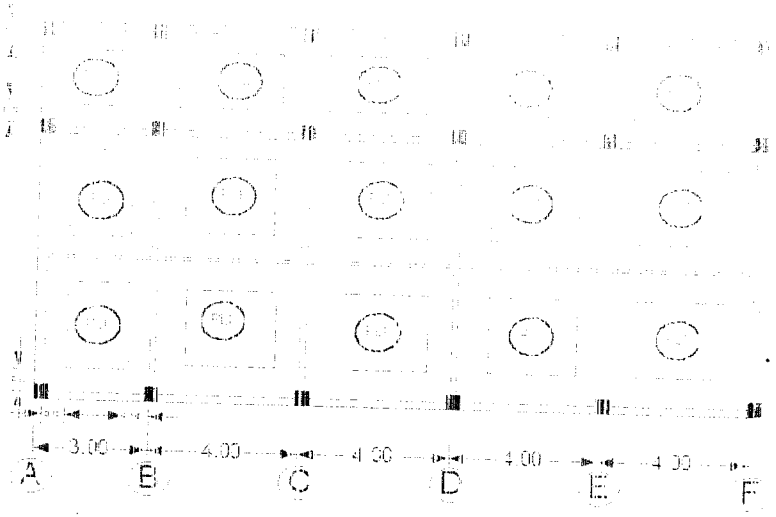
RENCANA PLAT LANTAI & ATAP :



Rencana Plat Atap

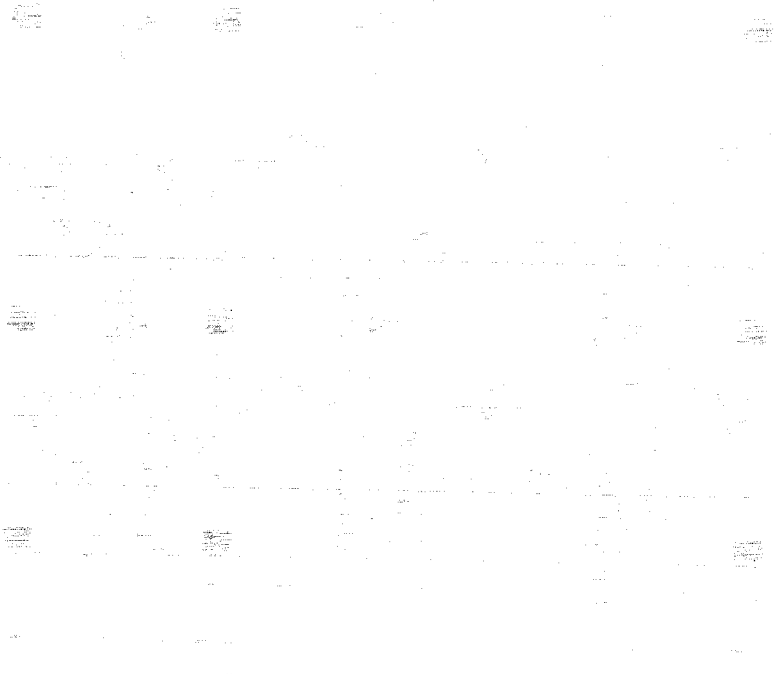


Rencana Plat Lantai 2 & Lantai 3

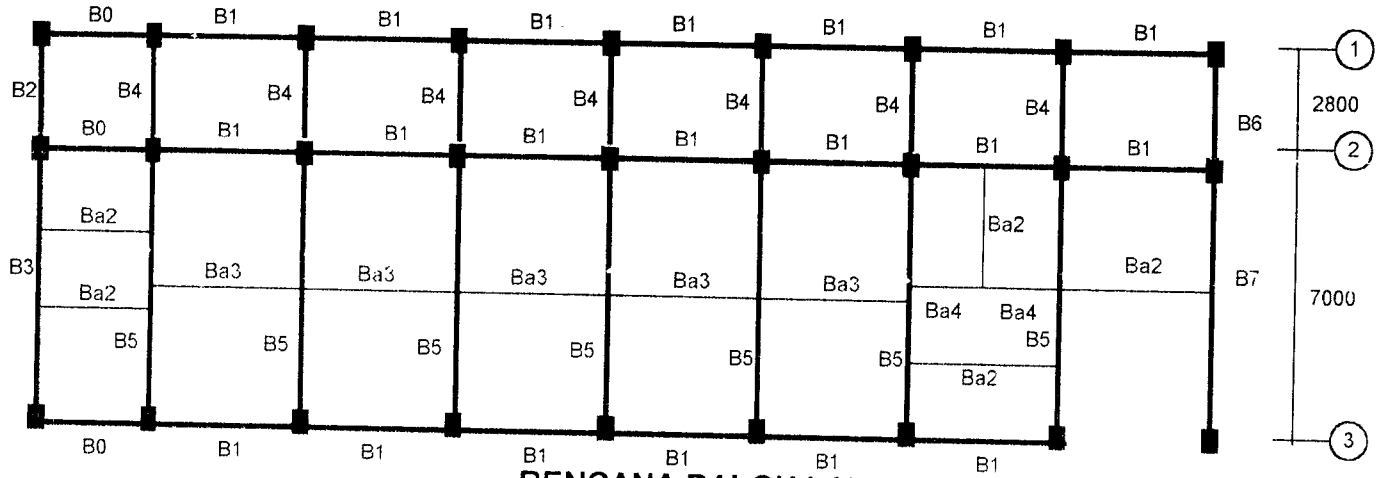


Rencana Plat Lantai 1

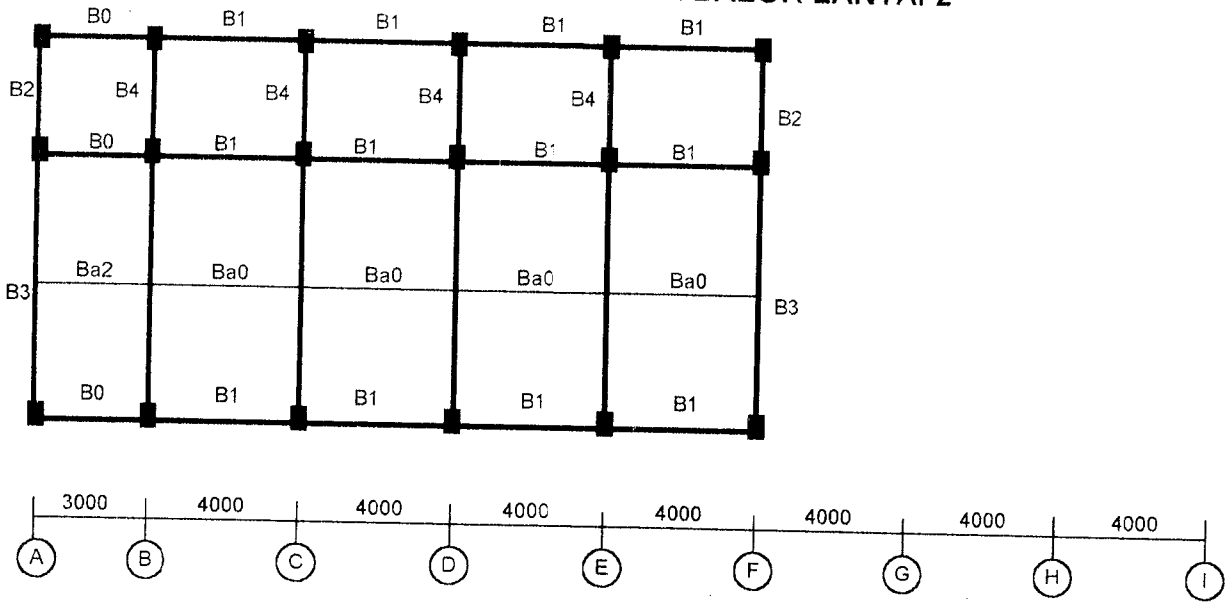
Scale: 1/200





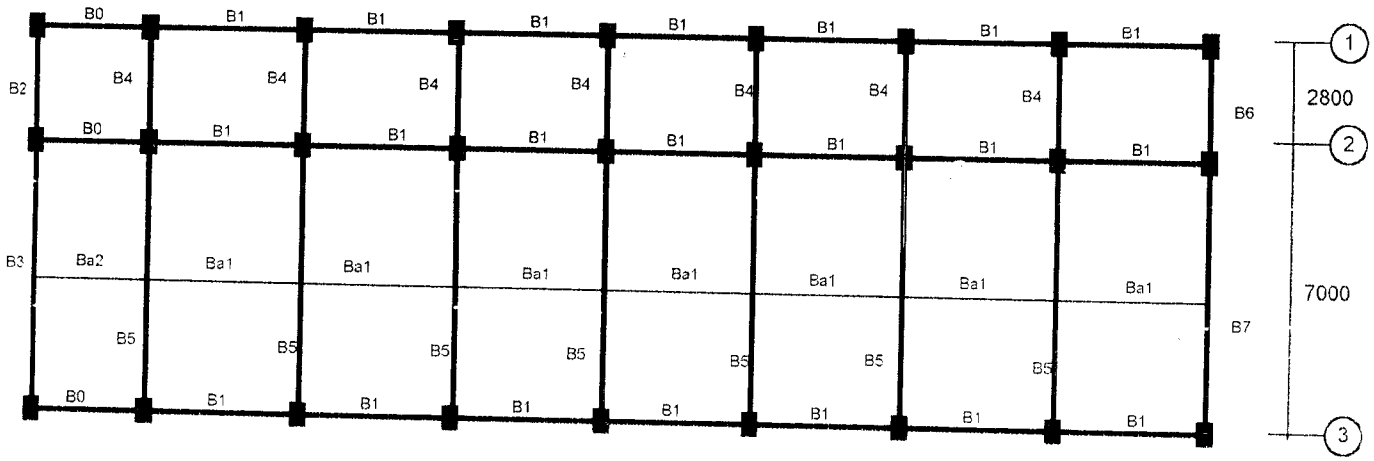


RENCANA BALOK LANTAI 2

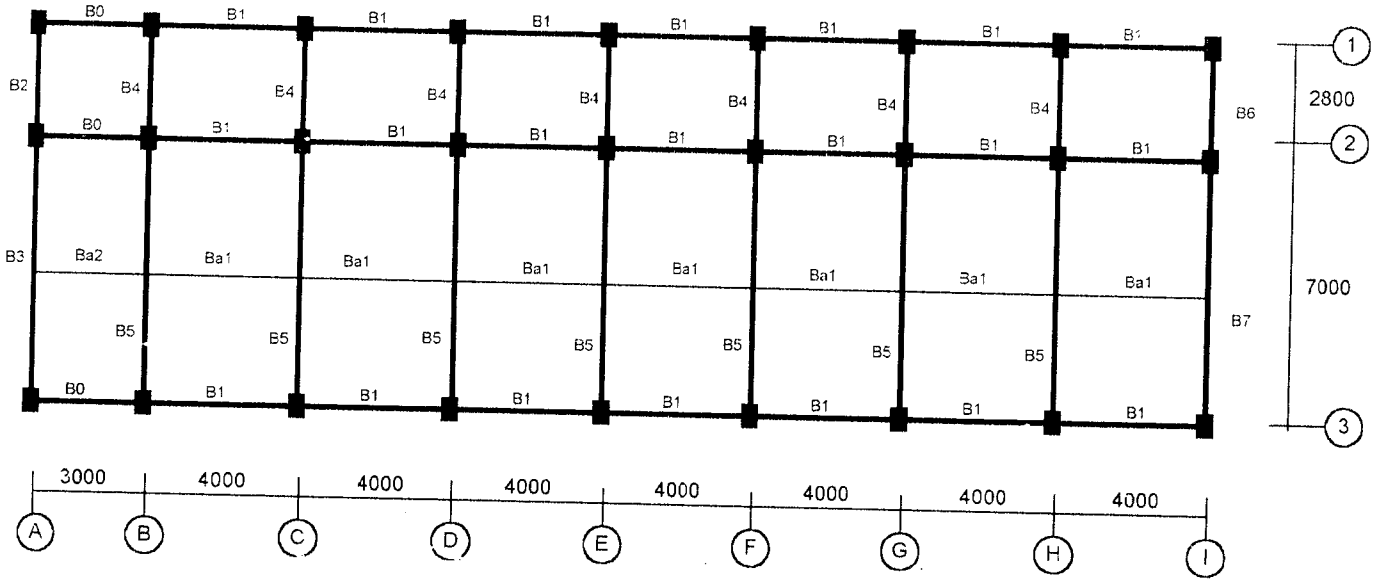


RENCANA BALOK LANTAI 1

Scale: 1/1000 : 1

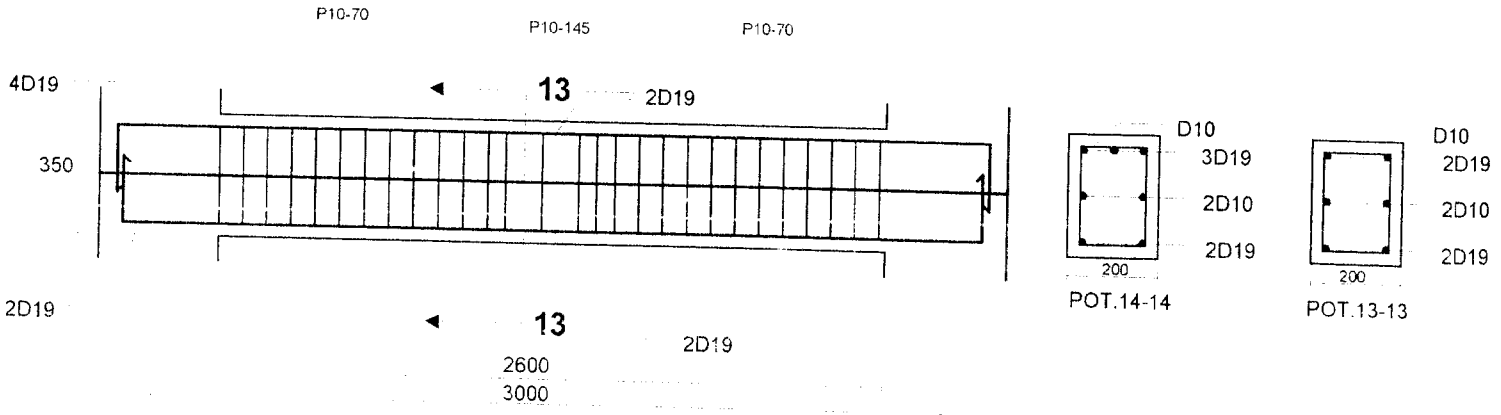


RENCANA BALOK ATAP

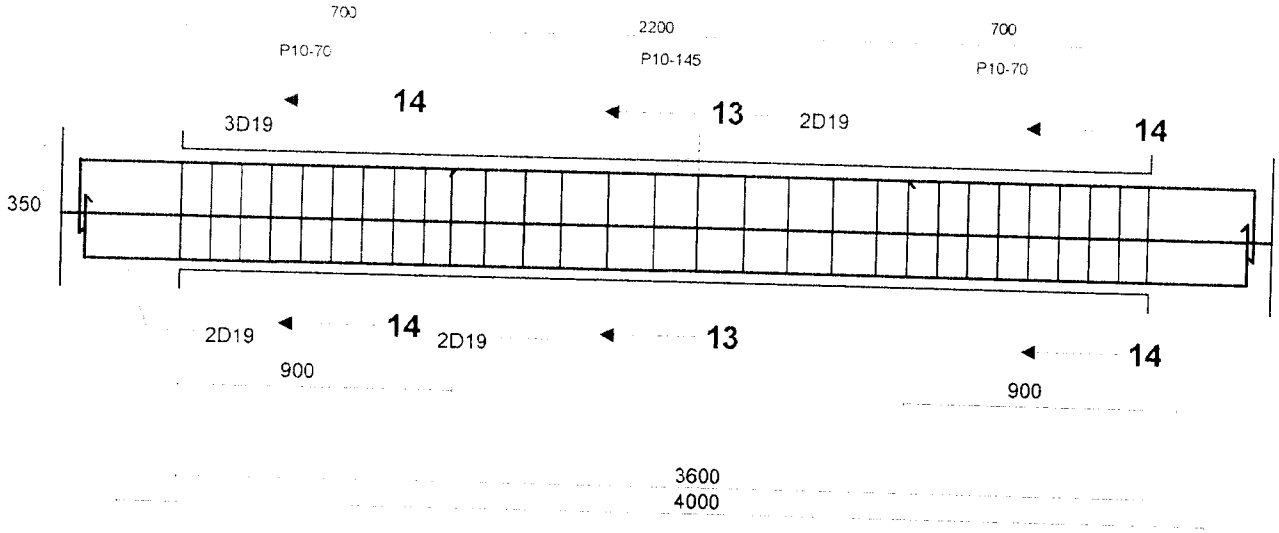


RENCANA BALOK LANTAI 3

Scale: 1/1000 : 1

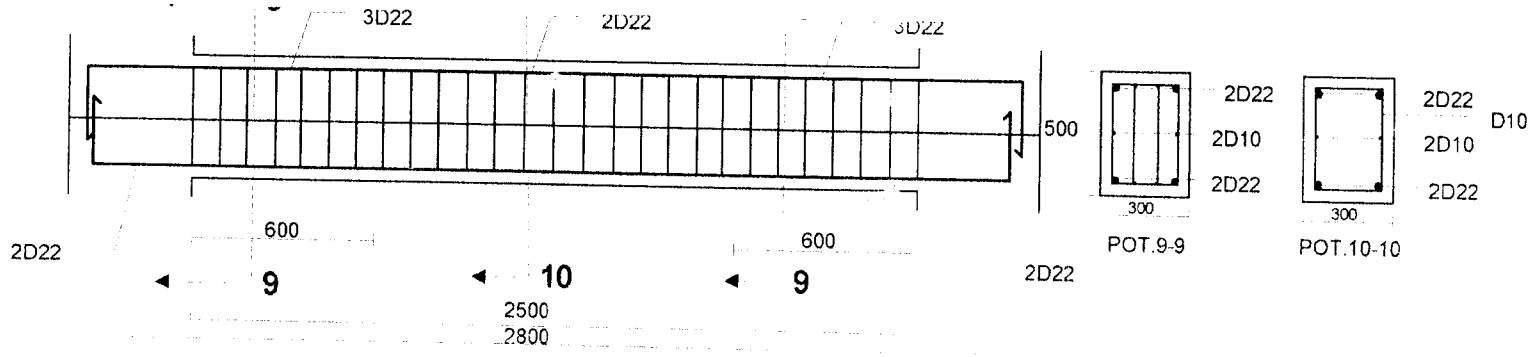


BALOK B0

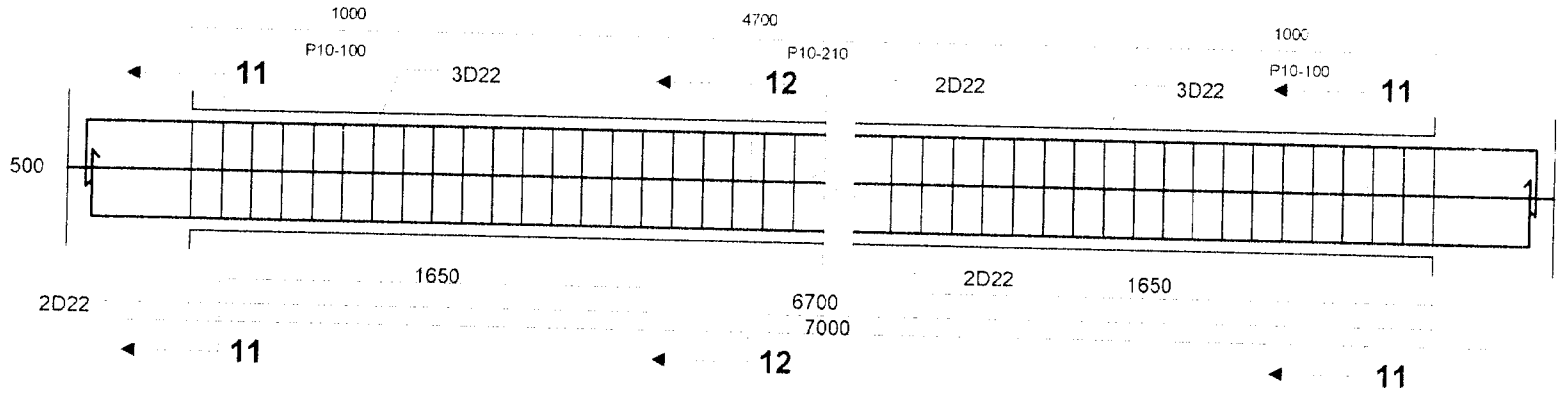


BALOK B1

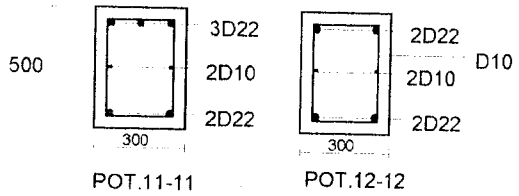
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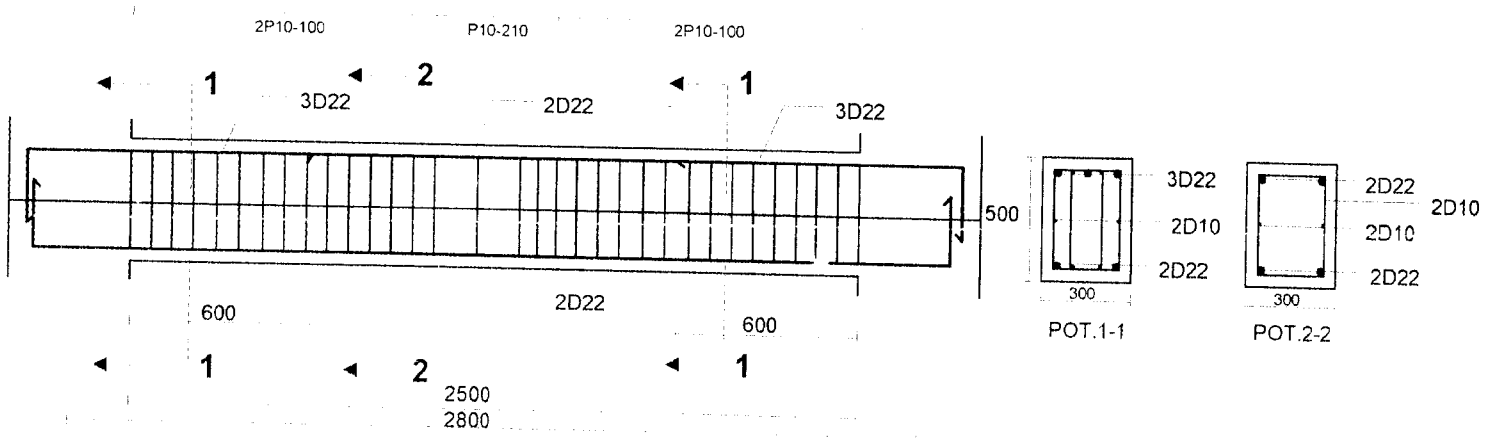
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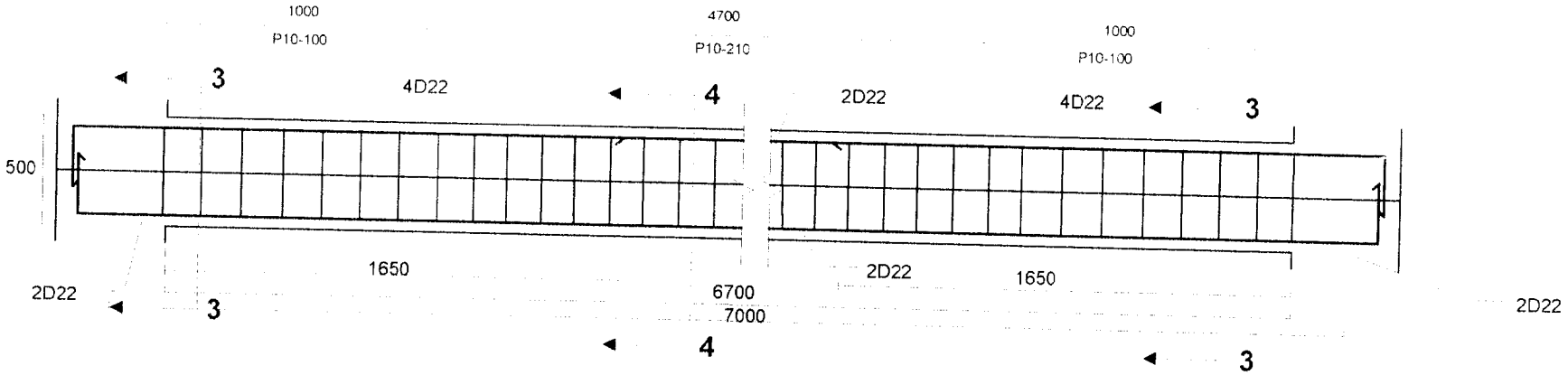
BALOK B3



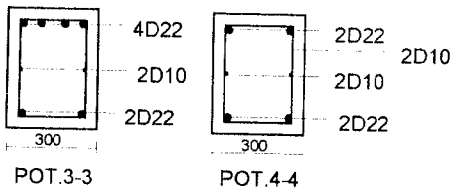
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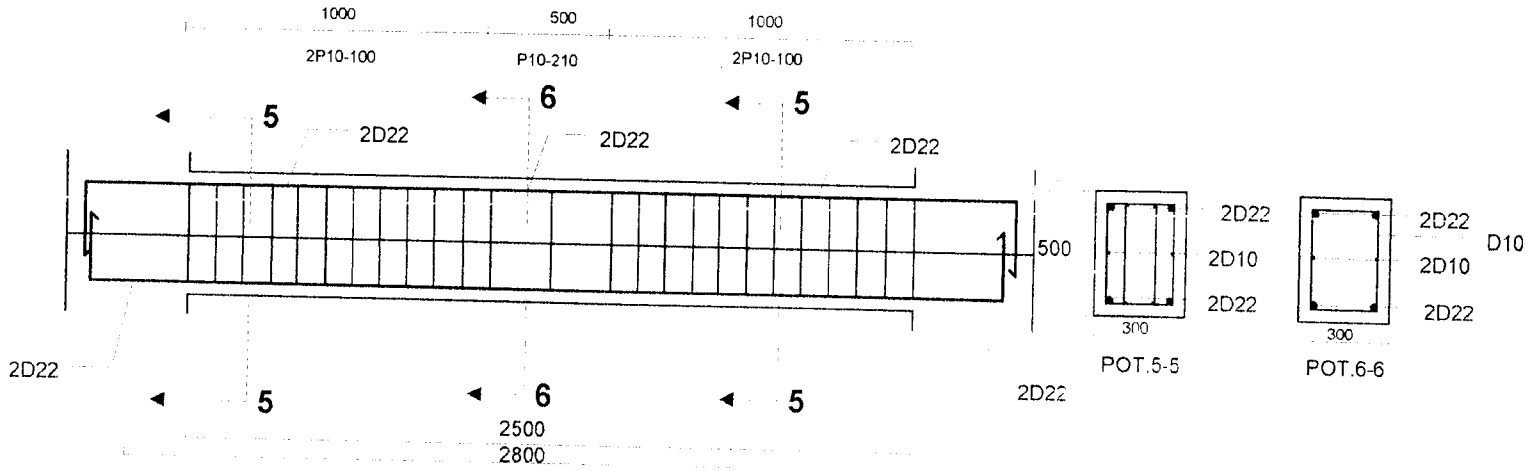
BALOK B4



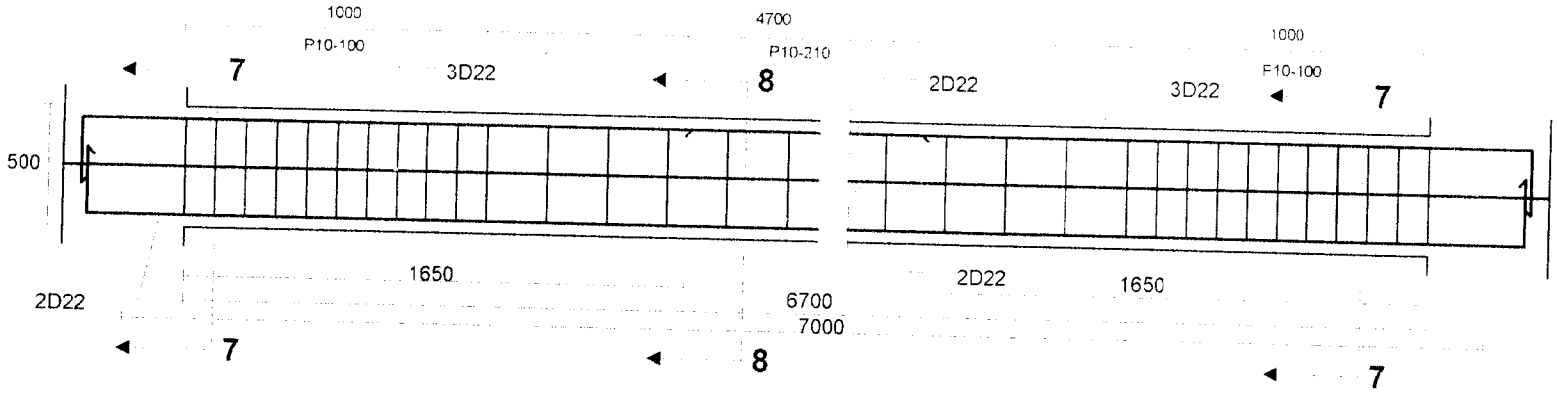
BALOK B5



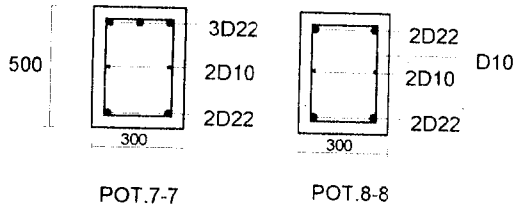
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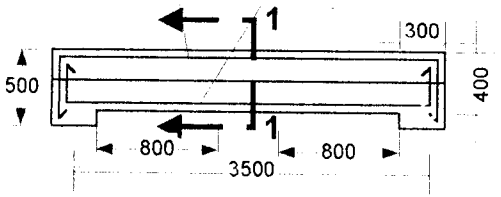
BALOK B6



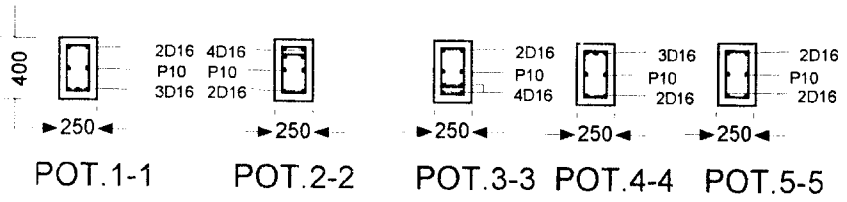
BALOK B7



Scale: 1/25 : 1

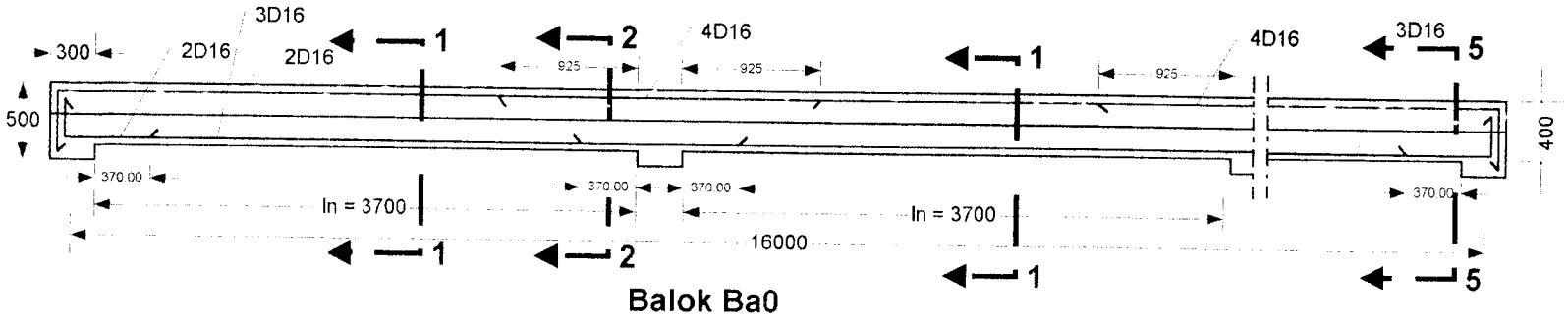


Balok Ba2

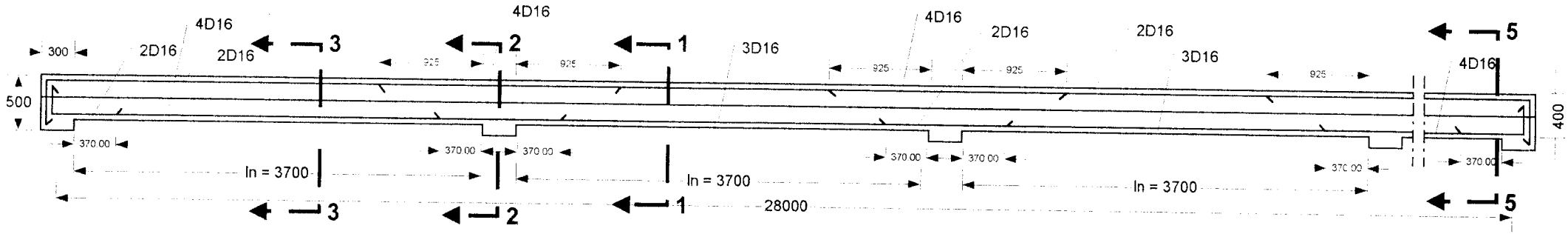


POT.1-1 POT.2-2 POT.3-3 POT.4-4 POT.5-5

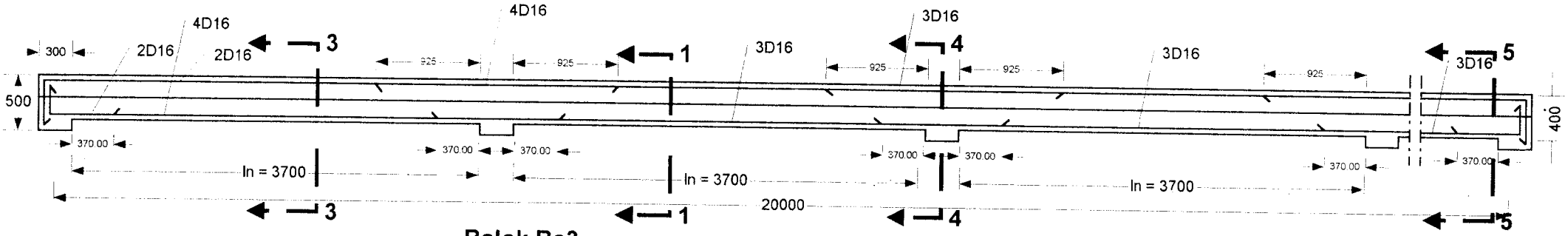
Catatan :
Sengkang daerah plastis : P10-60
Sengkang luar daerah plastis : P10-120



Balok Ba0



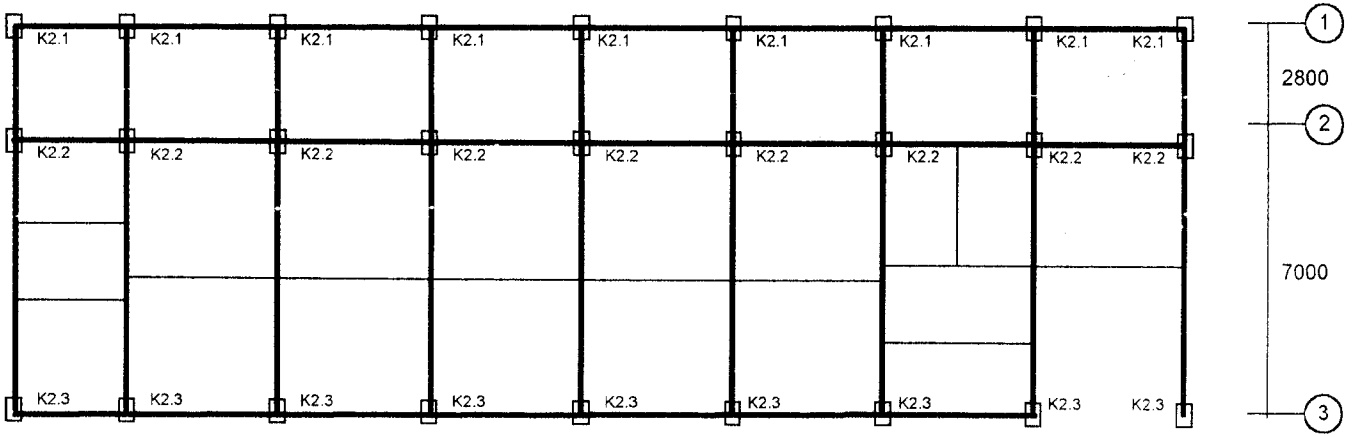
Balok Ba1



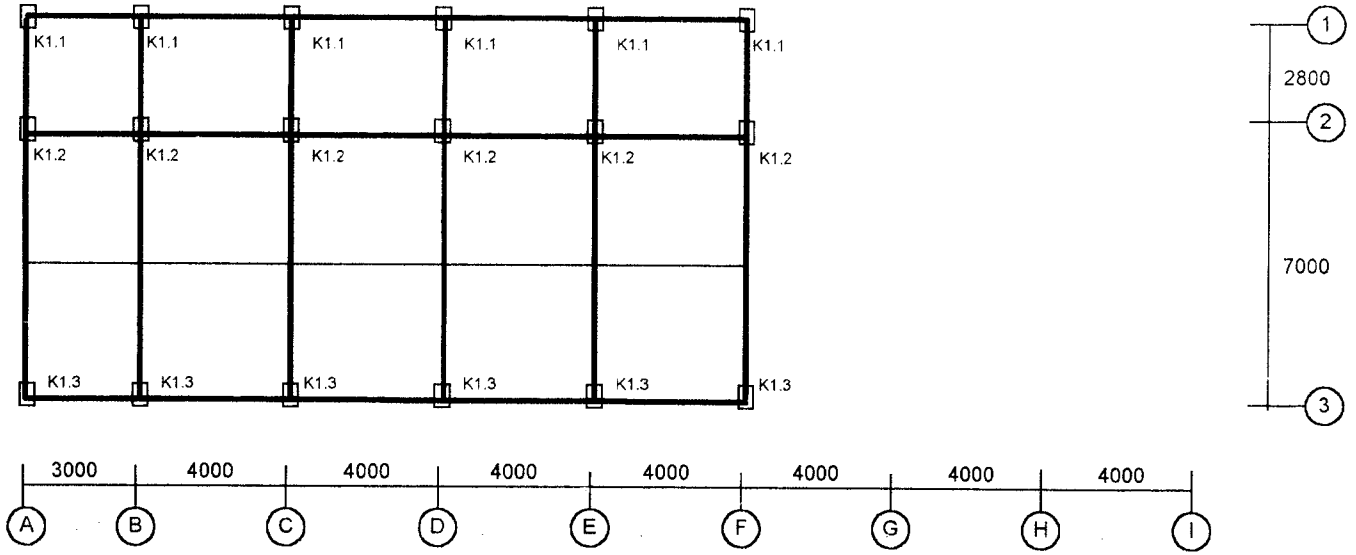
Balok Ba3

Scale: 1/50 : 1

RENCANA KOLOM :

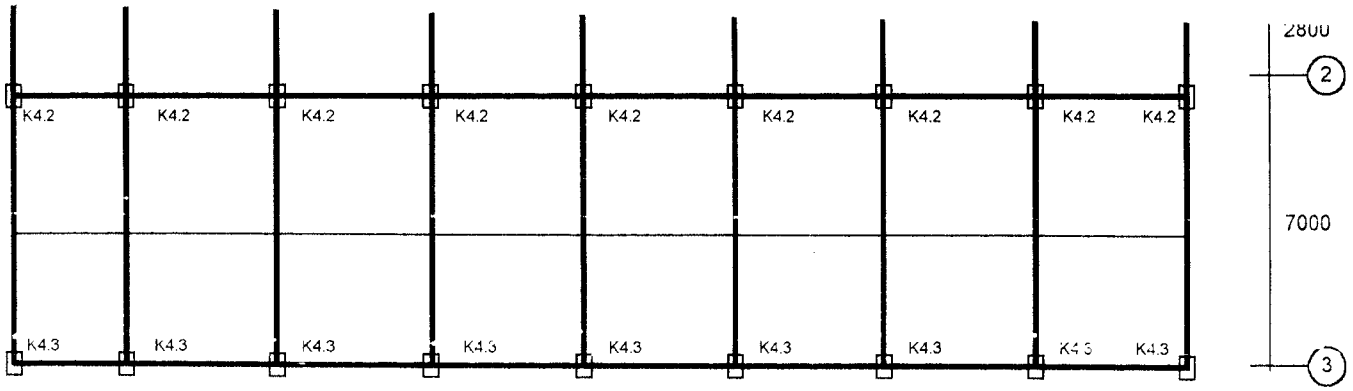


RENCANA KOLOM LANTAI 2

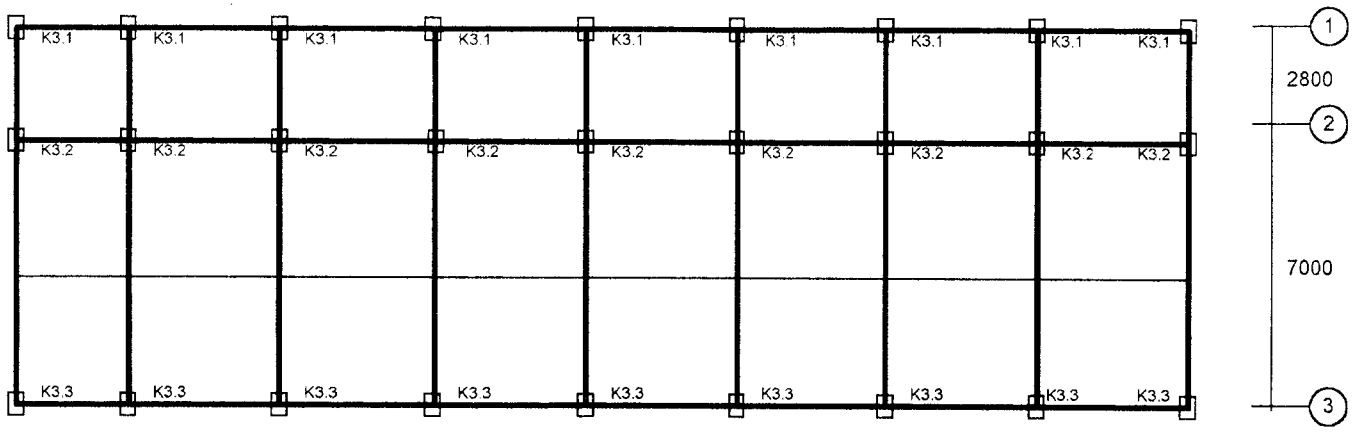


RENCANA KOLOM LANTAI 1

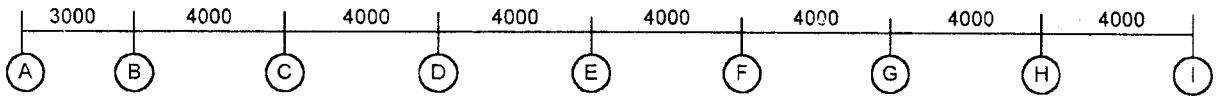
Scale: 1/1000 : 1



RENCANA KOLOM ATAP

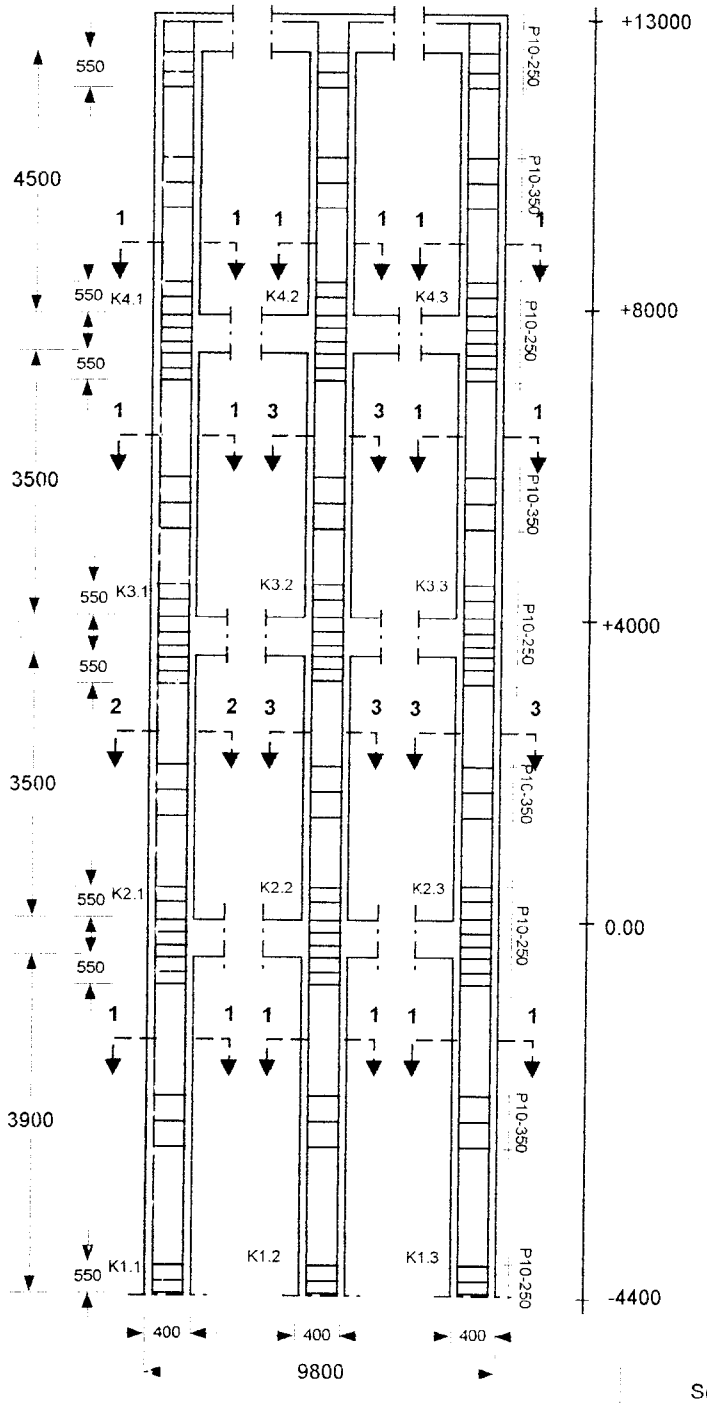


RENCANA KOLOM LANTAI 3

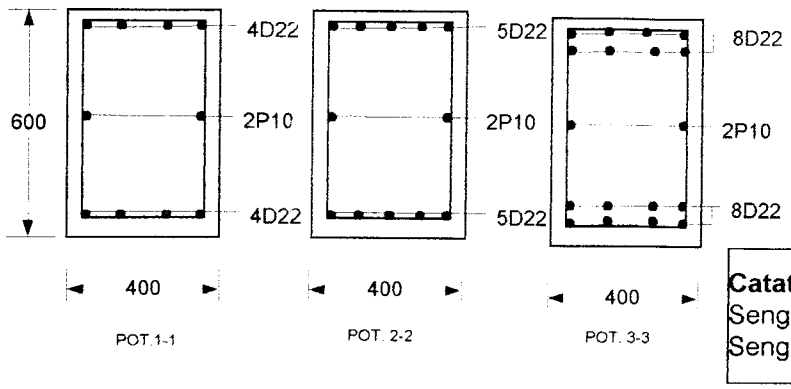


Scale: 1/1000 : 1

ENDETAILAN KOLOM :

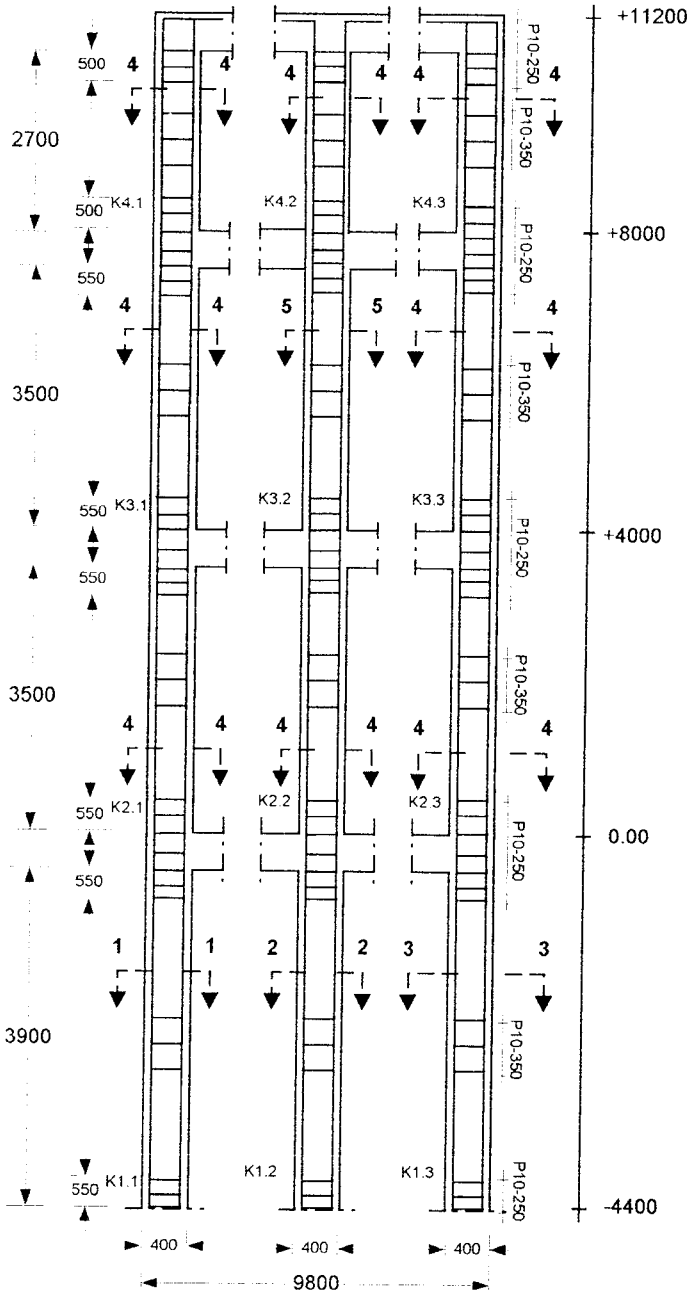


Scale: 1/100 : 1

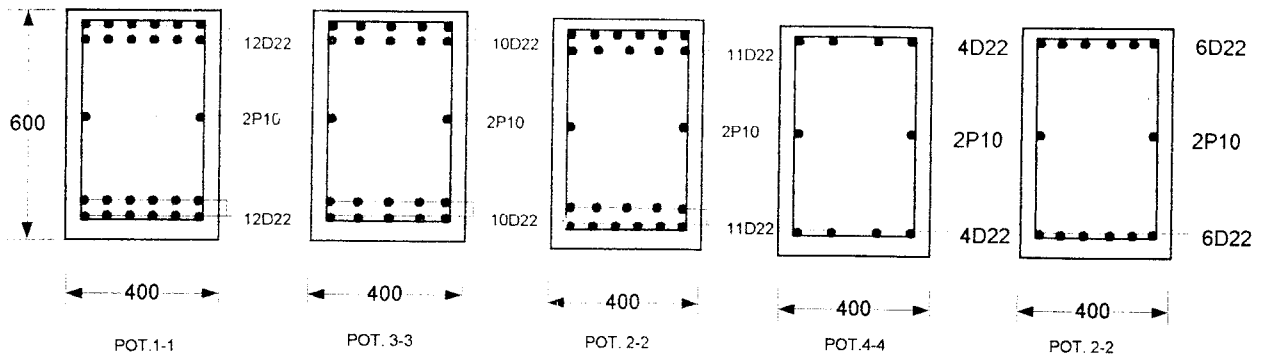


Catatan :
Sengkang daerah plastis : P10-250
Sengkang luar daerah plastis : P10-350

PORTAL B,C,D,E,F

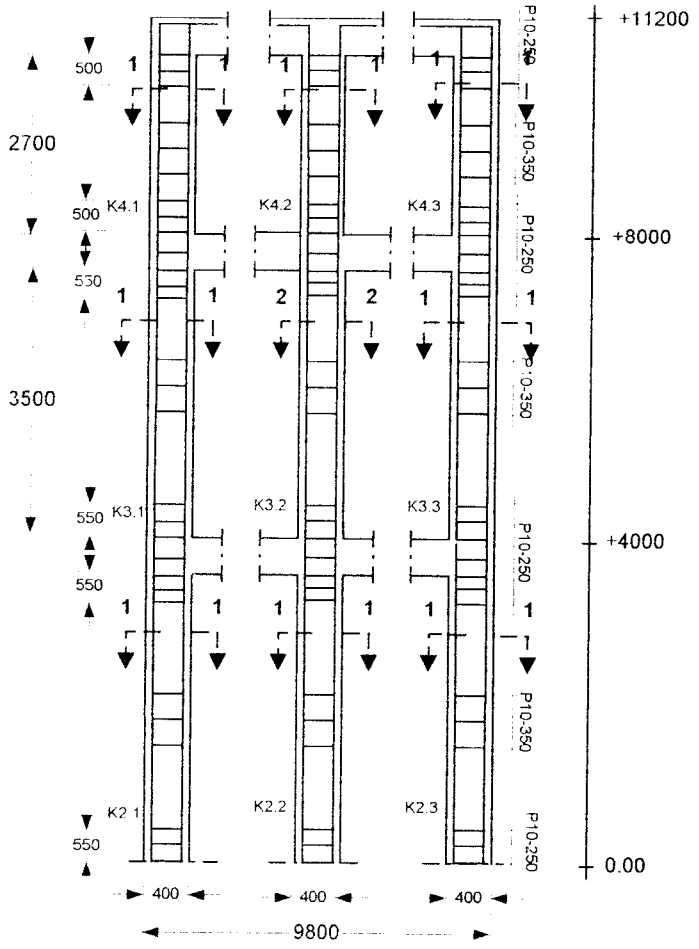


Scale: 1/100 : 1

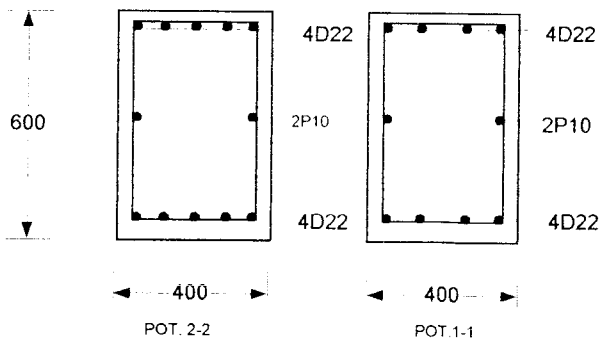


Catatan :
Sengkang daerah plastis : P10-250
Sengkang luar daerah plastis : P10-350

PORTAL A



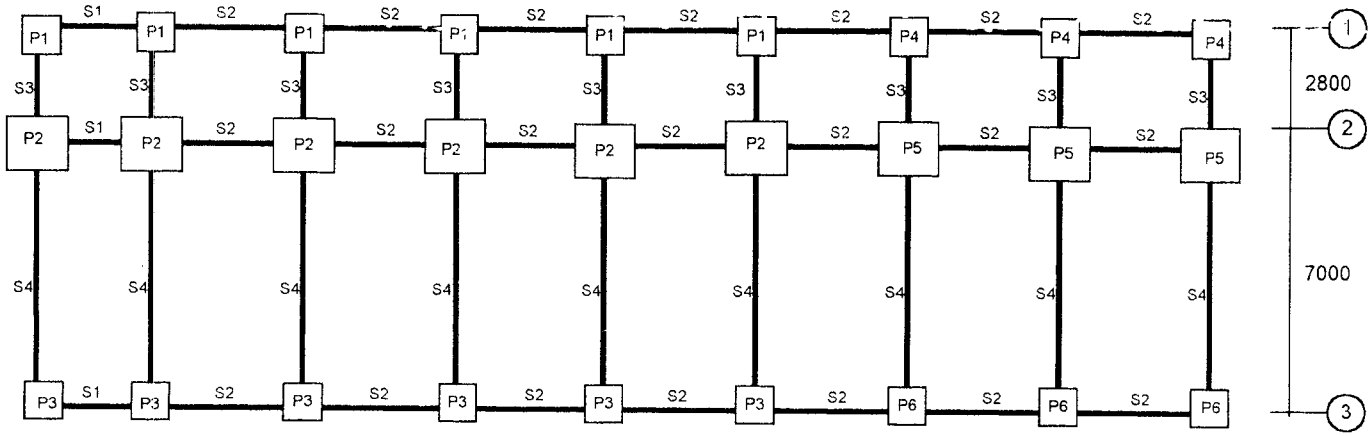
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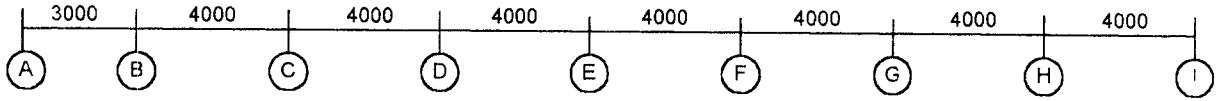
Catatan :
Sengkang daerah plastis : P10-250
Sengkang luar daerah plastis : P10-350

PORTAL H,I,G

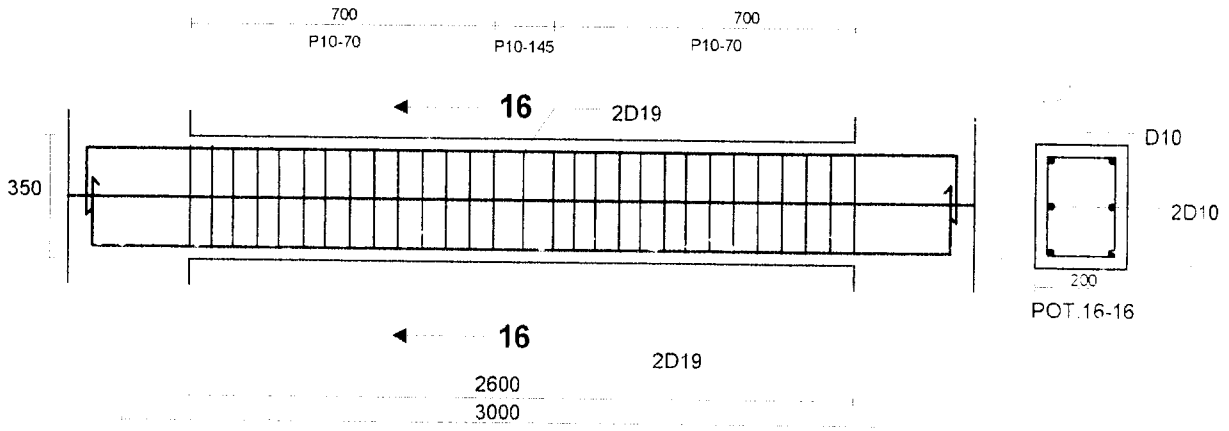
RENCANA SLOOP DAN PONDASI :



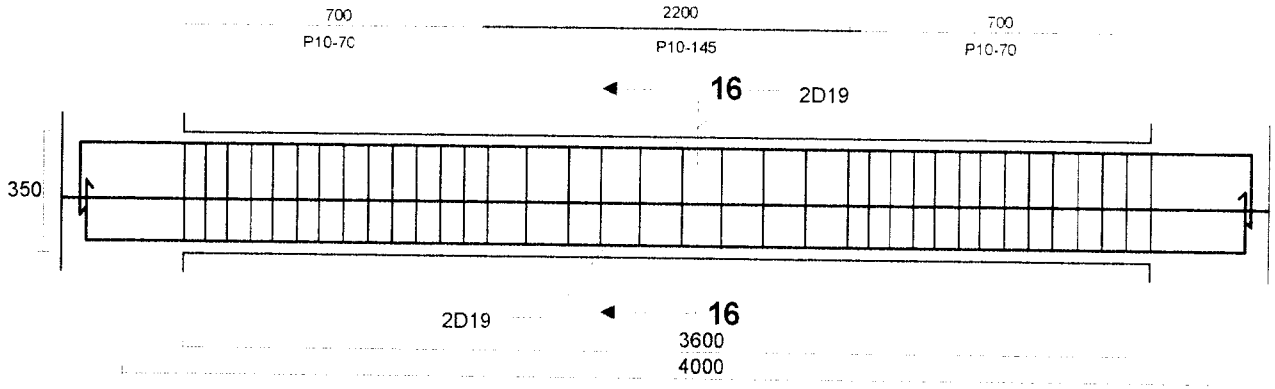
RENCANA SLOOP DAN PONDASI



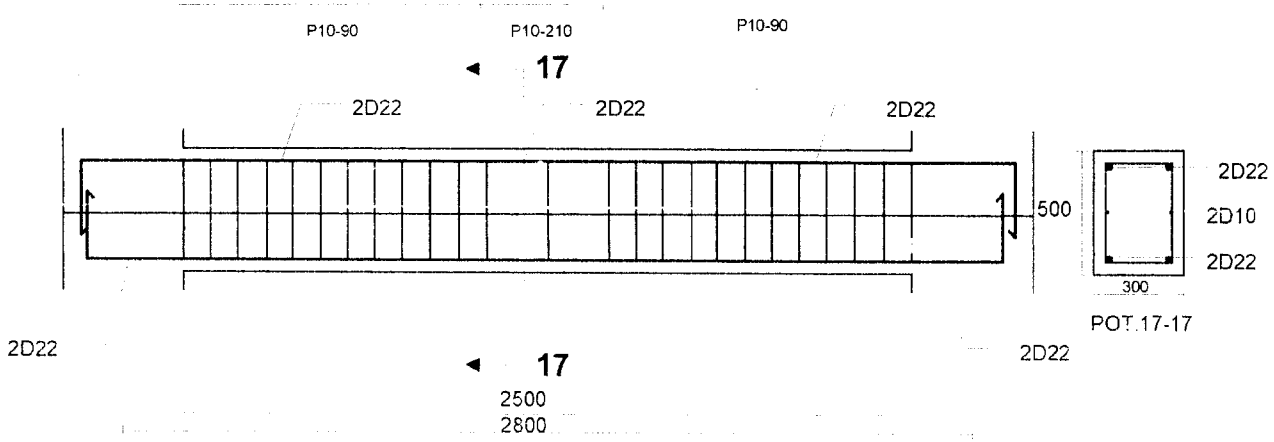
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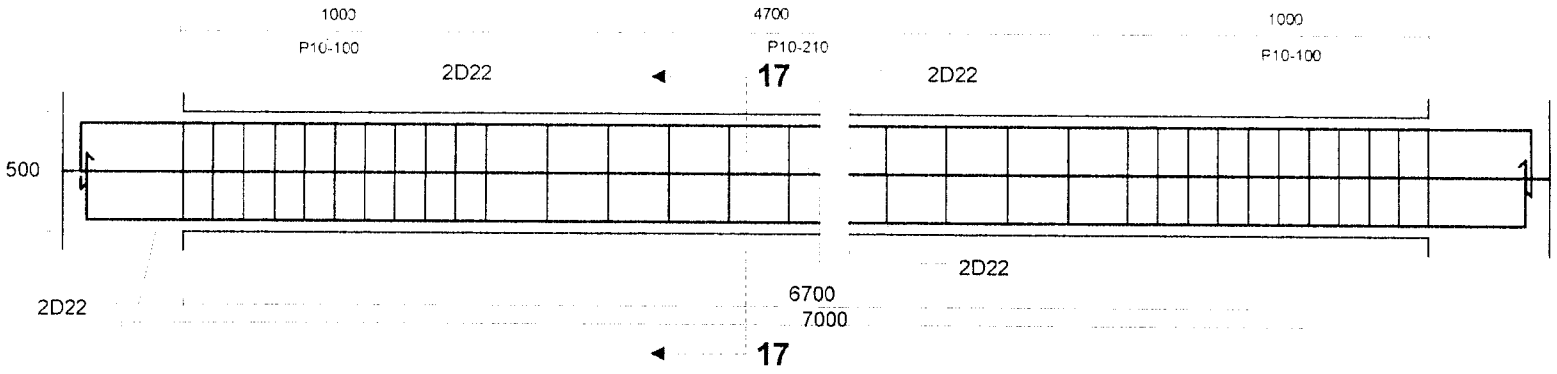
BALOK S1



BALOK S2



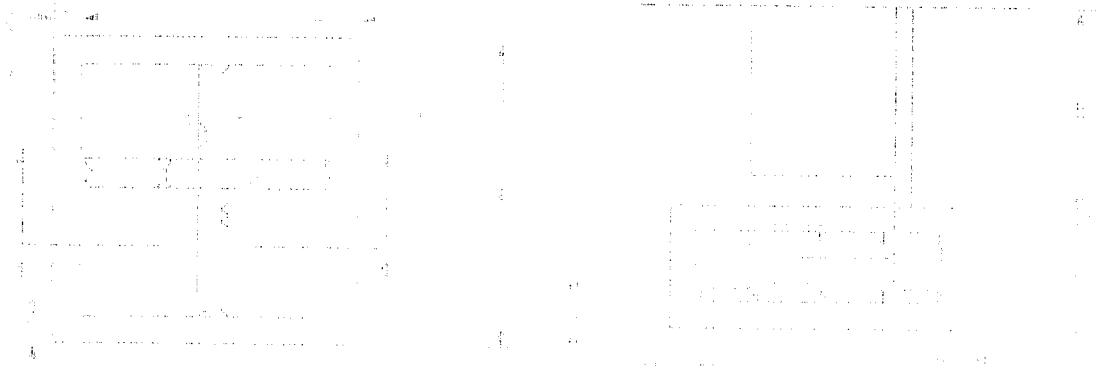
BALOK S3



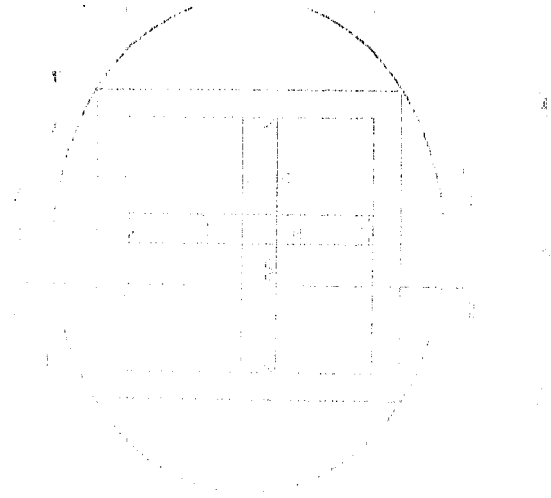
BALOK S4

Scale: 1/25 : 1

PENDETAILAN PONDASI :

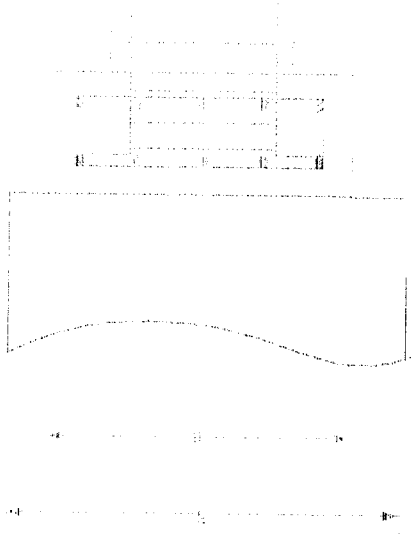


DENAH PONDASI TELAPAK



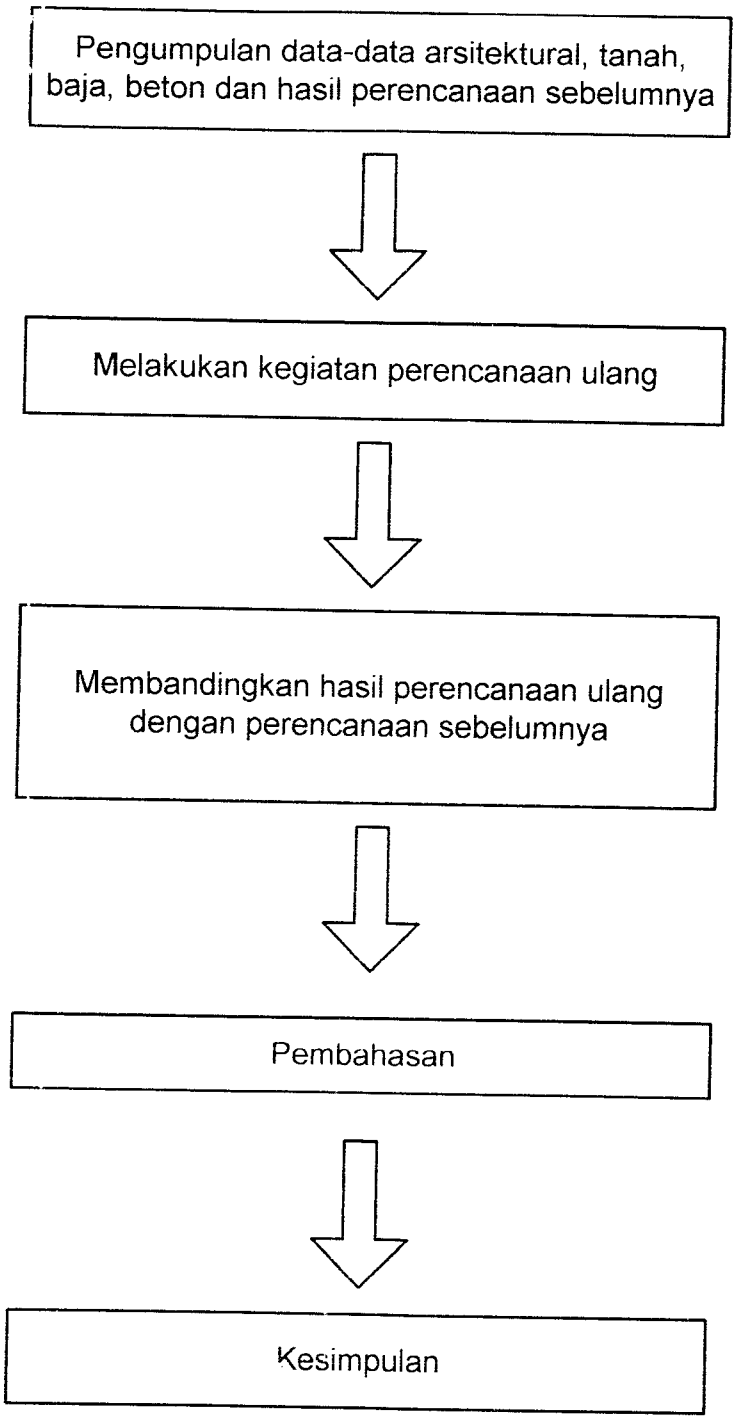
POTONGAN PONDASI TELAPAK

Type (Satu)								
P1		1050	850	S1	1400-150			1400-150
P2		1350	850	S2	1400-150			1400-150
P3		1650	900	S3	1400-250			1400-250
Type Sumuran								
P1		1000	1200	S1	1400-250	1000	2800	1400-250
P2		1000	1200	S2	1400-250	1000	2800	1400-250
P3		1000	1200	S3	1400-250	1000	2800	1400-250



Potongan 2-2

LANGKAH KERJA TUGAS AKHIR PERENCANAAN ULANG GEDUNG AUDIOVISUAL UK-DW YOGYAKARTA :







CATATAN KONSULTASI TUGAS AKHIR

NO.	TANGGAL	CATATAN KONSULTASI	TANDA TANGA
	2/3/01	- Acc proposal, Konsultasi Bab 2	
	08/03	Lanjutkan	
	23/03/01	Lanjutkan Bab	
	27/3/01	Lanjutkan Bab	
	23/10-01	Acc. Lengkapi dampak	
	27/10/01	Perbaiki Bab	
	29/10/01	Acc Bab Siapkan Sidang.	