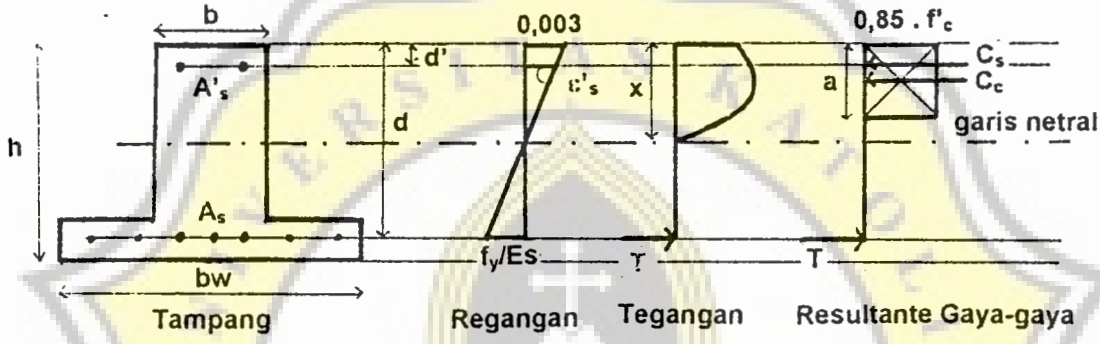
LAMPIRAN

PERHITUNGAN KAPASITAS MOMEN LENTUR

Analisa tampang balok '⊥'



Data :

Beton K-225 = f'_c = 22,5 MPa

Baja U-39 = f_y = 390 MPa

A'_s = (¼ . π . 10^2 . 2) = 157,079633 mm^2

A_s = (¼ . π . 13^2 . 2) + (¼ . π . 10^2 . 4) = 579,623845 mm^2

Peyelesaian :

$A_{s2} = A'_s = 157{,}079633\ mm^2$

$A_{s1} = A_s - A_{s2} = 422{,}546912\ mm^2$

$T_{s1} = A_{s1} \cdot f_y = 422{,}546912 \cdot 390 = 164793{,}2957\ N$

$C_c = 0{,}85 \cdot f'_c \cdot a \cdot b = 0{,}85 \cdot 22{,}5 \cdot a \cdot 200 = 3825 \cdot a\ N$

$a = 43{,}083215\ mm$

$$x = \frac{a}{0{,}85} = 50{,}686135\ mm$$

$$\varepsilon'_s = \frac{x - d'}{x} \cdot 3 \cdot 10^{-3} = \frac{50{,}686135 - 35}{50{,}686135} \cdot 3 \cdot 10^{-3} = 0{,}928428 \cdot 10^{-3}$$

$$\varepsilon_y = \frac{f_y}{E_s} = \frac{390}{2 \cdot 10^5} = 1{,}95 \cdot 10^{-3}$$

Jadi :

$\varepsilon'_s = 0{,}928428 \cdot 10^{-3} < \varepsilon_y = 1{,}95 \cdot 10^{-3}$ ⟶ belum luluh !!!

Maka :

$C_c + C_s = T_s$

$$0{,}85 \cdot f'_c \cdot a \cdot b + A'_s \left(\frac{x - d'}{x} \cdot E_y \cdot E_s - 0{,}85 \cdot f'_c \right) = A_s \cdot f_y$$

$$0{,}85 \cdot 22{,}5 \cdot a \cdot 200 + 157{,}079633 \left(\frac{a/0{,}85 - 3.5}{a/0{,}85} \cdot 3 \cdot 10^{-3} \cdot 2 \cdot 10^5 - 0{,}85 \cdot 22{,}5 \right) = 579{,}623845 \cdot 390$$

$$0{,}85 \cdot 22{,}5 \cdot a \cdot 200 + 157{,}076933 \left(\frac{a - 2{,}975}{a} \cdot 600 - 19{,}125 \right) = 226053{,}2996 \quad \text{x a}$$

$3825\ a^2 + 94247{,}7798\ a - 2803871{,}449 - 3004{,}147981\ a = 226053{,}2996\ a$

$3825\ a^2 - 134809{,}6678\ a = 2803871{,}449$

$a^2 - 35{,}244358\ a = 733{,}038287$

$a^2 - 2\ .\ (17{,}622179)\ a + (17{,}622179)^2 = 733{,}038287 + (17{,}622179)^2$

$(a - 17{,}622179)^2 = 1043{,}57948$

$a - 17{,}622179 = \sqrt{1043{,}57948}$

$a = 32{,}304481 + 17{,}622179$

$a = 49{,}92666\ mm$

$$x = \frac{a}{0{,}85} = 58{,}737247\ mm$$

$$z = d - a/2 = 365 - \frac{58{,}737247}{2} = 335{,}631377\ mm$$

$M_{n1} = A_{s1}\ .\ f_y\ .\ (d - a/2) = 422{,}546912\ .\ 390\ .\ 335{,}631377 = 55309800{,}75\ N\,mm$

$M_{n2} = A_{s2}\ .\ f_y\ .\ (d - d') = 157{,}079633\ .\ 390\ .\ (365 - 35) = 20215801{,}28\ N\,mm$

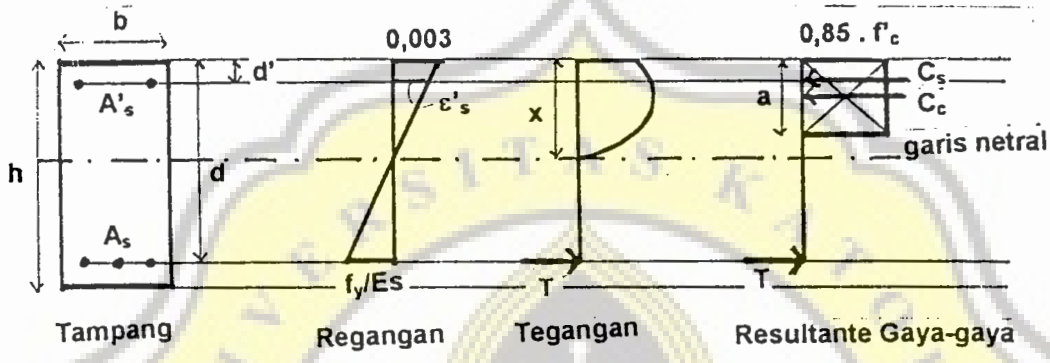
$M_{n\ total} = 75525602{,}03\ N\,mm$

$M_u = 0{,}8\ M_{n\ total}$

$M_u = 60420481{,}62\ N\,mm$

$M_u = 6{,}042\ ton\ meter$

Analisa tampang balok ' □ '



Data :

Beton K-225 = f'_c = 22,5 MPa

Baja U-39 = f_y = 390 MPa

A'_s = (¼ . π . 10^2 . 2) = 157,079633 mm^2

A_s = (¼ . π . 16^2 . 3) = 603,1857895 mm^2

Peyelesaian :

$A_{s2} = A'_s$ = 157,079633 mm^2

$A_{s1} = A_s - A_{s2}$ = 446,106157 mm^2

$T_{s1} = A_{s1} \cdot f_y = 446{,}106157 \cdot 390 = 173981{,}4012 \quad N$

$C_c = 0{,}85 \cdot f'_c \cdot a \cdot b = 0{,}85 \cdot 22{,}5 \cdot a \cdot 200 = 3825 \cdot a \quad N$

$a = 45{,}485334 \quad mm$

$$x = \frac{a}{0{,}85} = 53{,}512158 \quad mm$$

$$\varepsilon'_s = \frac{x - d'}{x} \cdot 3 \cdot 10^{-3} = \frac{53{,}512158 - 35}{53{,}512158} \cdot 3 \cdot 10^{-3} = 1{,}037829 \cdot 10^{-3}$$

$$\varepsilon_y = \frac{f_y}{E_s} = \frac{390}{2 \cdot 10^5} = 1{,}95 \cdot 10^{-3}$$

Jadi :

$\varepsilon'_s = 1{,}037829 \cdot 10^{-3} < \varepsilon_y = 1{,}95 \cdot 10^{-3} \longrightarrow$ belum luluh !!!

Maka :

$C_c + C_s = T_s$

$$0{,}85 \cdot f'_c \cdot a \cdot b + A'_s \left(\frac{x - d'}{x} \cdot E_y \cdot E_s - 0{,}85 \cdot f'_c \right) = A_s \cdot f_y$$

$$0{,}85 \cdot 22{,}5 \cdot a \cdot 200 + 157{,}079633 \left(\frac{a/0{,}85 - 35}{a/0{,}85} \cdot 3 \cdot 10^{-3} \cdot 2 \cdot 10^5 - 0{,}85 \cdot 22{,}5 \right) = 603{,}1857895 \cdot 390$$

$$0{,}85 \cdot 22{,}5 \cdot a \cdot 200 + 157{,}079633 \left(\frac{a - 29{,}75}{a} \cdot 600 - 19{,}125 \right) = 235242{,}4579 \quad \times a$$

$$3825\,a^2 + 94247{,}7798\,a - 2803871{,}449 - 3004{,}147981\,a = 235242{,}4579\,a$$

$$3825\,a^2 - 143998{,}8261\,a = 2803871{,}449$$

$$a^2 - 37{,}646752\,a = 733{,}038287$$

$$a^2 - 2 \cdot (18{,}823376)\,a + (18{,}823376)^2 = 733{,}038287 + (18{,}823376)^2$$

$$(a - 18{,}823376)^2 = 1087{,}357771$$

$$a^2 - 18{,}823376 = \sqrt{1087{,}357771}$$

$$a = 32{,}975108 + 18{,}823376$$

$$a = 51{,}798484 \text{ mm}$$

$$x = \frac{a}{0{,}85} = 60{,}939393 \text{ mm}$$

$$z = d - a/2 = 365 - \frac{60{,}939393}{2} = 334{,}530304 \text{ mm}$$

$M_{n1} = A_{s1} \cdot f_y \cdot (d - a/2) = 446{,}106157 \cdot 390 \cdot 334{,}530304 = 58202051{,}04$ N mm

$M_{n2} = A_{s2} \cdot f_y \cdot (d - d') = 157{,}079633 \cdot 390 \cdot (365 - 35) = 20216148{,}77$ N mm

$M_{n\,total} = 78418199{,}81$ N mm

$M_u = 0{,}8\ M_{n\,total}$

$M_u = 62734559{,}85$ N mm

$M_u = 6{,}274$ ton meter

PERHITUNGAN PENGARUH GESER AKIBAT LENTUR

Data :

Penampang ' ⊥ ', flens relatif kecil, sementara dianggap sama dengan penampang empat persegi panjang. Ukuran 20 x 40 cm.

Dengan tinjauan PBI-71

K-225

$\sigma'_{bk} = 225 \text{ kg/cm}^2$

Beban tetap ⟶ $\tau_{bu} = 0{,}65 \sqrt{\sigma'_{bk}} = 9{,}75 \text{ kg/cm}^2$

$\tau_{bm,u} = 1{,}62 \sqrt{\sigma'_{bk}} = 24{,}3 \text{ kg/cm}^2$

(dengan tulangan geser)

Beban sementara ⟶ $\tau_{bu} = 0{,}71 \sqrt{\sigma'_{bk}} = 10{,}65 \text{ kg/cm}^2$

$\tau_{bm,u} = 1{,}62 \sqrt{\sigma'_{bk}} = 24{,}3 \text{ kg/cm}^2$

Kapasitas menahan gaya geser akibat lentur

1. Tanpa memperhitungkan tulangan :

$$\tau_b = \frac{Q}{b.\,z}$$

$Q = D = \tau_b \,.\, b \,.\, z = 9{,}75 \times 20 \times 7/8 \times 36{,}5 = 6227{,}8125 \text{ kg}$

2. Kekuatan sengkang :

$\varnothing 8 \longrightarrow A_s = 2 \,.\, ¼ \,.\, 0{,}8^2 \,.\, \pi = 1{,}00 \text{ cm}^2$

Jarak 10 cm $\longrightarrow$ $\tau_s = \dfrac{1 \cdot 3000 \cdot 0{,}87}{10 \cdot 20} = 13{,}05 \text{ kg/cm}^2$

$D_{10} = 13{,}05 \cdot 20 \cdot 7/8 \cdot 36{,}5^2 = 8335 \text{ kg}$

Jarak 15 cm $\longrightarrow$ $\tau_s = \dfrac{1 \cdot 3000 \cdot 0{,}87}{15 \cdot 20} = 8{,}7 \text{ kg/cm}^2$

$D_{15} = 8{,}7 \cdot 20 \cdot 7/8 \cdot 36{,}5^2 = 5557 \text{ kg}$

Jarak 20 cm $\longrightarrow$ $\tau_s = \dfrac{1 \cdot 3000 \cdot 0{,}87}{20 \cdot 20} = 6{,}52 \text{ kg/cm}^2$

$D_{20} = 6{,}52 \cdot 20 \cdot 7/8 \cdot 36{,}5^2 = 4167 \text{ kg}$

Perbedaan tegangan geser yang terjadi antara penampang ' ⊥ ' dengan penampang empat persegi panjang.

Tampang epp $\longrightarrow$ $\tau = \dfrac{D \cdot S}{b \cdot I}$

D = gaya lintang

S = statis momen dari penampang terhadap titik berat

I = inersia

b = lebar yang ditinjau

Disimulasi dengan D = 10 ton

Dipakai epp : (20 x 40)

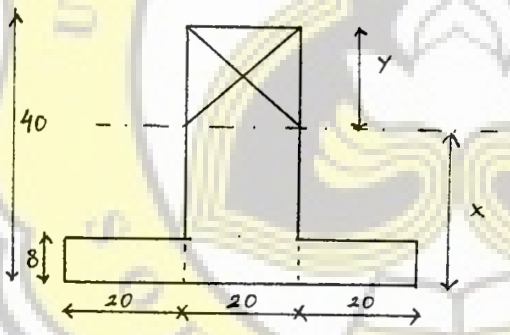
$I = 1/12 \cdot 20 \cdot 40^3 = 106666\ cm^4$

$S = 20 \times 20 \times \frac{1}{2} \times 20 = 4000\ cm^3$

$$\tau = \frac{10000 \cdot 4000}{20 \cdot 106666} = 18{,}75\ kg / cm^2$$

Tampang ' ⊥ '

D = 10 ton



Mencari x :

$$x = \frac{800 \cdot 20 + 320 \cdot 4}{1120} = 15{,}42\ cm$$

I = 166887,7

Y = 40 – 15,42 = 24,58 cm

$$\tau = \frac{10000 \,.\, (24{,}58^2 \,.\, 20 \,.1/2)}{166887{,}7 \,.\, 20} = 18{,}1 \text{ kg/cm}^2 < 18{,}75 \text{ kg/cm}^2$$

Tinjauan ACI 318-89

Sengkang Vertikal :

$$\varphi V_s = \varphi \,.\, A_v \,.\, f_y \,.\, d/s$$

dengan :

φ = 0,85

V_s = gaya lintang yang dapat dipikul gesernya oleh sengkang

A_v = luas penampang tulangan sengkang

d = tinggi efektif balok

s = jarak sengkang

$\tau_u = 2 \,.\, \sqrt{f'_c} \,.\, \varphi = 8{,}073 \text{ cm}^2$

$V_n = V_c + V_s$

dengan :

V_n = Total gaya lintang

V_c = Kekuatan beton

V_s = Kekuatan sengkang

$\varnothing$ 8 – 20 ⟶ s = 20 ⟶ V_s = 0,8 . 1 . 2610 . 36,5/20

d = 36,5 = 3810 kg

$A_v = 1\ cm^2$

$f_y = 3000 \cdot 0{,}87 = 2610\ kg/cm^2$

$\varnothing 8 - 15 \longrightarrow s = 15 \longrightarrow V_s = 0{,}8 \cdot 1 \cdot 2610 \cdot 36{,}5/15$

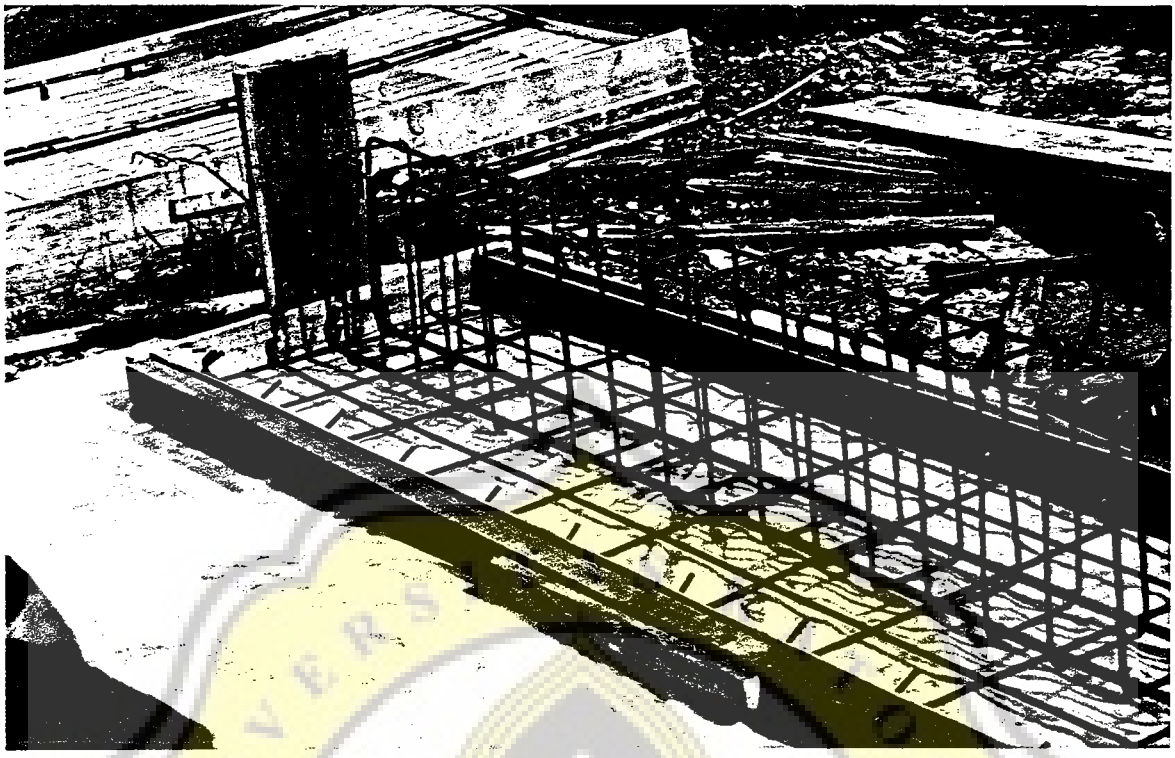
$= 5080\ kg$

$\varnothing 8 - 10 \longrightarrow s = 10 \longrightarrow V_s = 0{,}8 \cdot 1 \cdot 2610 \cdot 36{,}5/10$

$= 7621\ kg$

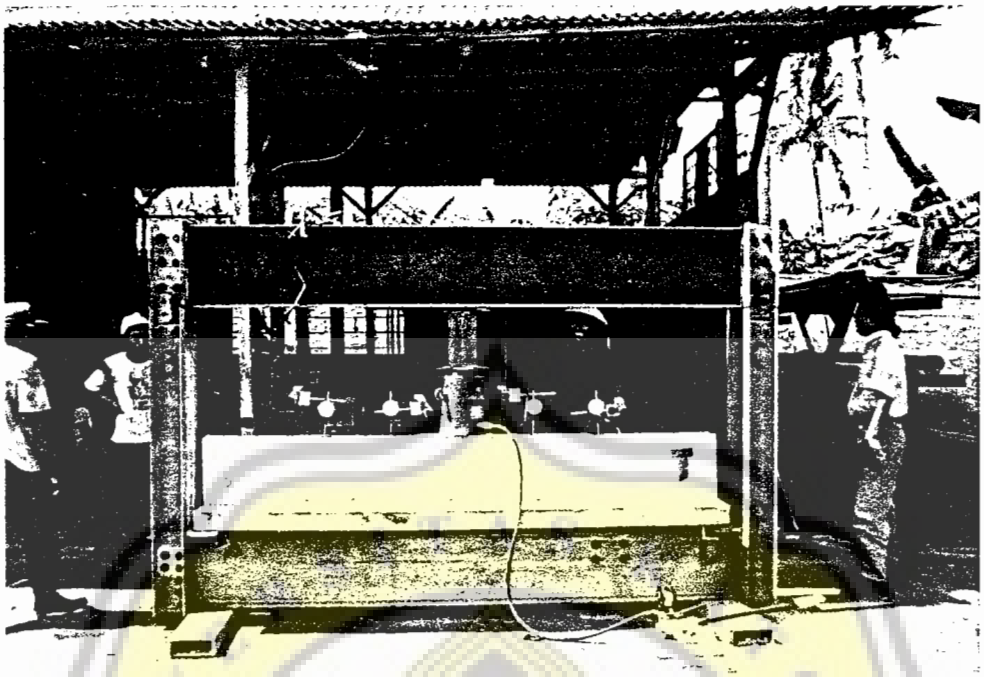
$V_c = \varphi \cdot 2 \cdot \sqrt{f'_c} \cdot b \cdot d$

$= 8{,}073 \cdot 20 \cdot 36{,}5 = 5893{,}29\ kg$



Gambar L.1. Tulangan untuk balok T

Gambar L.2. Pengecoran Beton

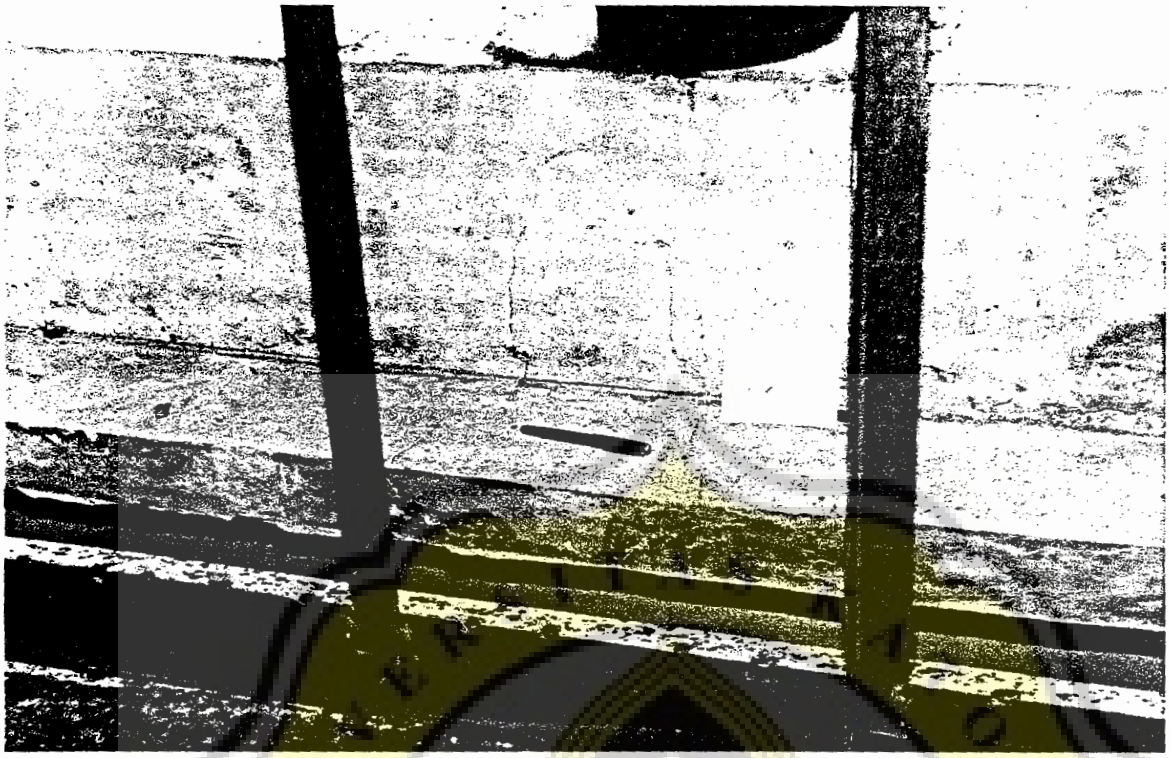


Gambar L.3. Persiapan akhir untuk pembebanan

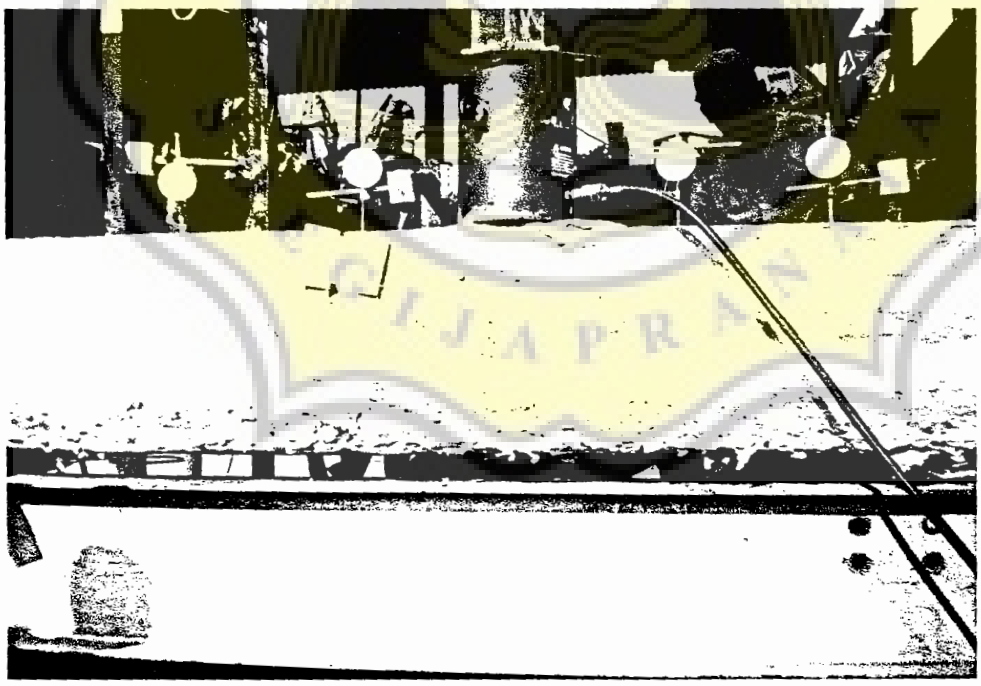
Gambar L.4. Tim peneliti bersama peninjau

Gambar L.5. Retak halus pada balok S (I), saat beban 1000 Psi

Gambar L.6. Retak halus pada balok S (II), saat beban 1000 Psi

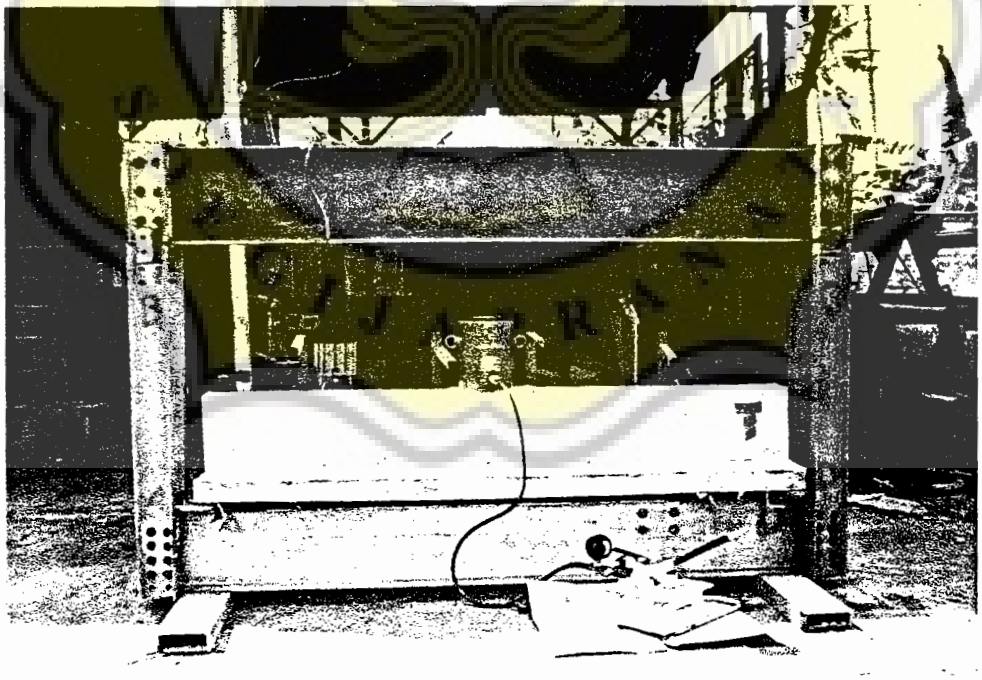


Gambar L.7. Retak halus pada balok S (I), saat beban 1100 Psi



Gambar L.8. Retak halus pada balok (IV), saat beban 1000 Psi

Gambar L.9. Retak halus pada balok (IV), saat beban 1000 Psi



Gambar L.10. Peralatan jack hidraulic yang dipakai

PERANCANGAN CAMPURAN ADUKAN BETON
(Menurut standar Pekerjaan Umum)

A. Data-data :

Beton untuk balok bangunan gedung

Kuat tekan beton yang disyaratkan f'_C = 22,5 MPa

Jenis semen = biasa

Jenis kerikil = batu pecah

Ukuran maksimum kerikil = 40 mm

Nilai slam = 100 mm

Jenis pasir = gol 2(agak kasar)

B. Perhitungan rancangan beton :

1. Kuat tekan beton yang disyaratkan, pada umur 28 hari = 22,5 MPa
2. Deviasi standart (s) = 7 MPa, karena tidak mempunyai data pengalaman sebelumnya.
3. Nilai tambah = 12 MPa, karena tidak mempunyai data.
4. Kuat tekan rata-rata yang direncanakan, f'_{Cr} = 22,5 + 12 = 34,5 Mpa
5. Jenis semen = biasa
6. Jenis Kerikil = batu pecah
7. Faktor air semen (fas) dari gambar L. 11, didapatkan fas = 0,44

8. Faktor air semen maksimum dari tabel L. 3, didapatkan fas maks = 0,60 (beton di dalam ruangan dengan keadaan keliling non korosif).

   → dipakai fas yang rendah = 0,44

9. Nilai slam tabel L. 4. didapatkan = 100 mm
10. Ukuran maksimum butiran kerikil = 40 mm
11. Kebutuhan air dari tabel L. 7, didapatkan = 205 liter
12. Kebutuhan semen = 204 / 0,44 = 466 kg
13. Kebutuhan semen minimum, tabel L. 8, didapatkan = 275 kg
14. -→ Dipakai semen (diambil yang besar) = 466 kg
15. Golongan pasir telah diketahui gol 2
16. Persentase pasir terhadap campuran (gb L. 12) = 37
17. Berat jenis campuran pasir dan kerikil (karena tidak ada data) maka diambil sebesar = 2,60
18. Berat beton (gb. L. 13) = 2350 kg
19. Kebutuhan berat pasir dan kerikil dihitung dengan rumus :

$$W_{psr} + W_{krk} = W_{btn} - A - S$$

$$= 2350 - 205 - 466$$

$$= 1679 \text{ kg}$$

20. Kebutuhan pasir dihitung dengan rumus :

$$W_{psr} = (P/100) \cdot W_{psr+krk}$$

= (37/100) . 1679

= 621 kg

21.Kebutuhan kerikil dihitung dengan rumus :

$W_{krk} = W_{psr+krk} - W_{psr}$

= 1679 - 621

= 1058 kg

Kesimpulan :

Untuk 1m^3 beton (berat betonnya =2350 kg) dibutuhkan :

a. Air = 205 liter

b. Semen = 466 kg (11,65 kantong)

c. Pasir = 621 kg

d. Kerikil = 1058 kg

Untuk 1 adukan (misalnya 1 kantong semen) maka dibutuhkan :

a. Air = (1/11,65) x 205 = 17,596 liter

b. Semen = 1 kantong semen = 40 kg

c. Pasir = (1/11,65) x 621 = 53,304 kg

d. Kerikil = (1/11,65) x 1058 = 90,815 kg

Berat satu adukan = 201,679 kg

Volume Pekerjaan		Mutu pelaksanaan		
	m3	baik sekali	baik	cukup
kecil	< 1000	45 < s <=55	55 < s <= 65	65 < s <= 85
sedang	1000 - 3000	35 < s =45	45 < s <= 55	55 < s <= 75
besar	> 3000	25 < s <=35	35 < s <= 45	45 < s <= 65

Tabel L. 1. Nilai deviasi standar (kg/cm^2)

Faktor air-semen	Perkiraan kuat tekan rata-rata (MPa)
0,35	42
0,44	35
0,53	28
0,62	22,4
0,71	17,5
0,80	14

Tabel L. 2. Hubungan faktor air semen dan kuat tekan rata-rata beton pada umur 28 hari

Beton di dalam ruang bangunan :	
a. Keadaan keliling non-korosif	0,60
b. Keadaan keliling korosif, disebabkan oleh kondensasi atau uap korosif	0,52
Beton di luar ruang bangunan :	
a. Tidak terlindung dari hujan dan terik matahari langsung	0,60
b. Terlindung dari hujan dan terik matahari langsung	0,60
Beton yang masuk ke dalam tanah :	
a. Mengalami keadaan basah dan kering berganti-ganti	0,55
b. Mendapat pengaruh sulfat alkali dari tanah atau air tanah	0,52
Beton yang kontinu berhubungan dengan air :	
a. air tawar	0,57
b. air laut	0,52

Tabel L. 3. Faktor air semen maksimum

Pemakaian beton	Maks	Min
Dinding, plat fondasi dan fondasi telapak bertulang	12,5	5,0
Fondasi telapak tidak bertulang, kaison, dan struktur di bawah tanah	9,0	2,5
Pelat, balok, kolom dan dinding	15,0	7,5
Pengerasan jalan	7,5	5,0
Pembetonan masal	7,5	2,5

Tabel L. 4. Nilai slam (cm)

Slam, mm	Ukuran maksimum agregat, mm		
	10	20	40
25 - 50	206	182	162
75 - 100	226	203	177
150 - 175	240	212	188
Udara terperangkap	3%	2%	1%

Tabel L. 5. Perkiraan kebutuhan air berdasarkan nilai slam dan ukuran maksimum agregrat (liter)

Ukuran maksimum agregat,mm	Modulus halus butir pasir			
	2,4	2,6	2,8	3,0
10	0,46	0,44	0,42	0,40
20	0,65	0,63	0,61	0,59
40	0,76	0,74	0,72	0,70
80	0,84	0,82	0,80	0,78
150	0,90	0,88	0,86	0,84

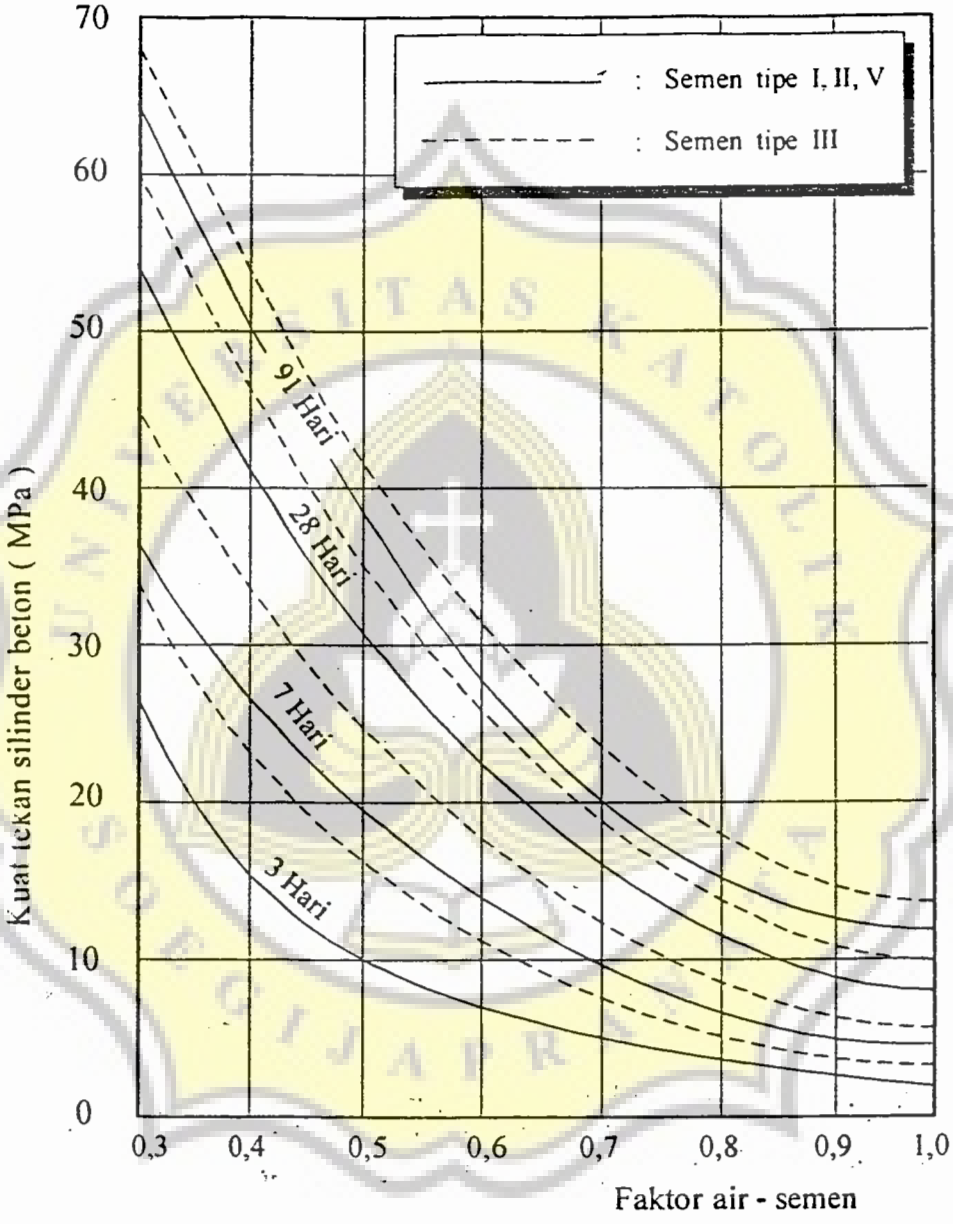
Tabel L. 6. Perkiraan kebutuhan agregrat kasar permeter kubik beton berdasarkan ukuran maksimum agregrat dan modulus halus pasir (m^3)

Besar ukuran maks. kerikil (mm)	Jenis batuan	Slam (mm)			
		0 - 10	10 - 30	30 - 60	60 - 180
10	Alami	150	180	205	225
	Batu pecah	180	205	230	250
20	Alami	135	160	180	195
	Batu pecah	170	190	210	225
40	Alami	115	140	160	175
	Batu pecah	155	175	190	205

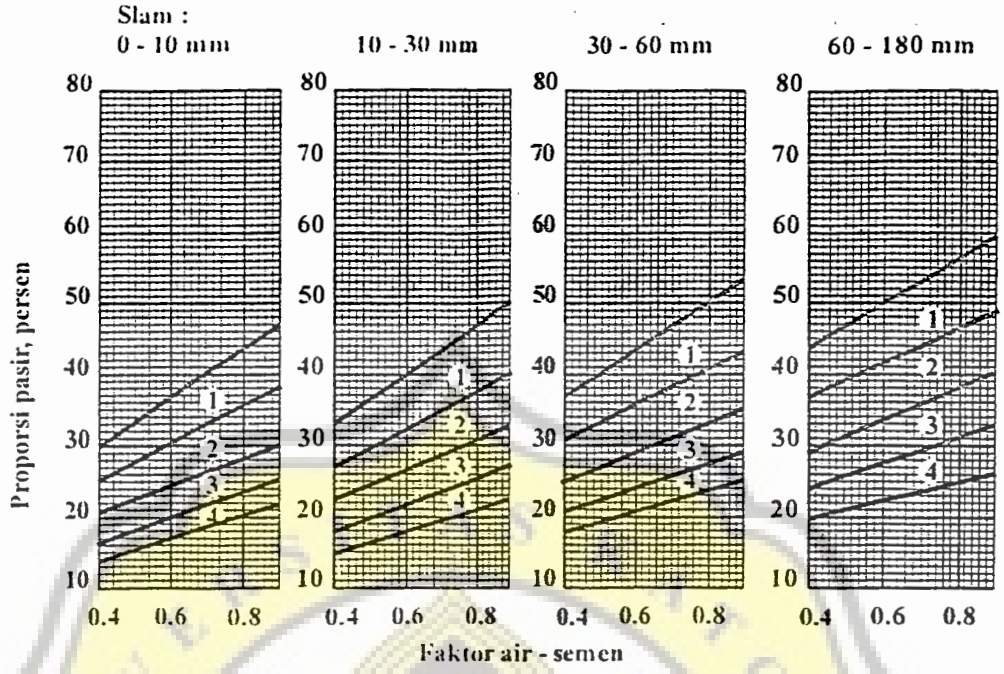
Tabel L. 7. Perkiraan kebutuhan air permeter kubik beton (liter)

Jenis pembetonan	Semen minimum (kg/m^3 beton)
Beton di dalam ruang bangunan :	
a. keadaan keliling non-korosif	275
b. keadaan keliling korosif, disebabkan oleh kondensasi atau uap korosif	325
Beton di luar ruang bangunan :	
a. tidak terlindung dari hujandan terik matahari lansung	325
b. terlindung dari hujan dan terik matahari langsung	275
Beton yang masuk ke dalam tanah :	
a. mengalami keadaan basah dan kering berganti-ganti	325
b. mendapat pengaruh sulfat dan alkali dari tanah	lihat tabel 7.15.a.
Beton yang selalu berhubungan dengan air tawar / payau / laut	lihat tabel 7.15.b.

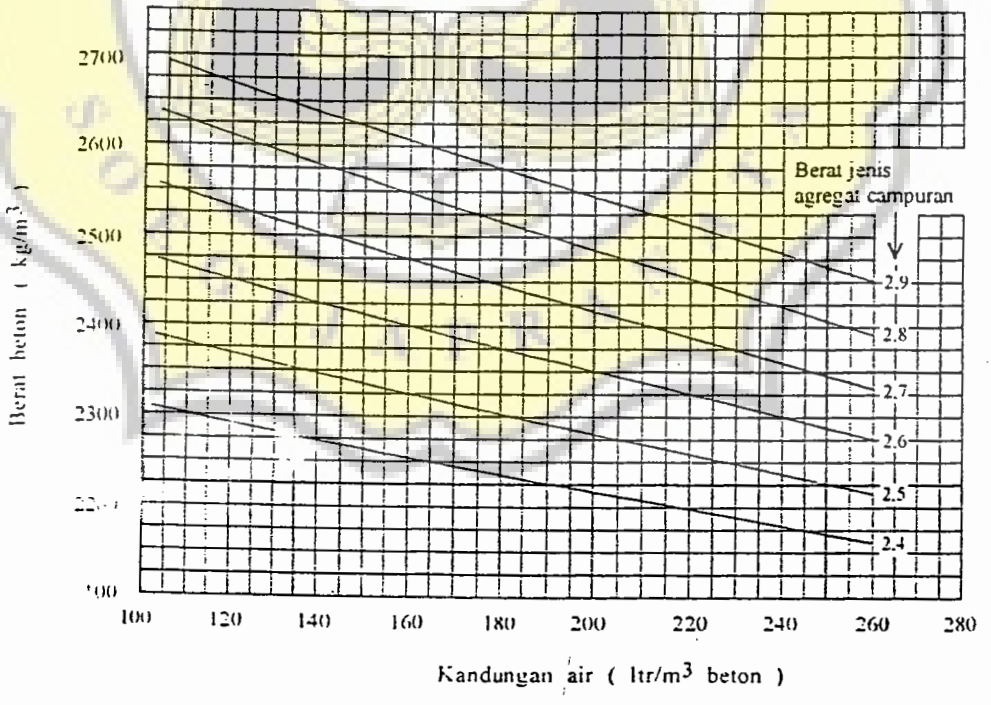
Tabel L. 8. Kebutuhan semen minimum untuk berbagai pembetonan dan lingkungan khusus



Gambar L.11. Hubungan faktor air semen dan kuat tekan rata-rata beton (sebagai perkiraan nilai fas)



Gambar L.12. Grafik Persentase agregrat halus terhadap agregrat keseluruhan untuk ukuran butir maksimum 40 mm



Gambar L.13. Grafik hubungan kandungan air, berat jenis agregrat campuran dan berat beton

ENERPAC

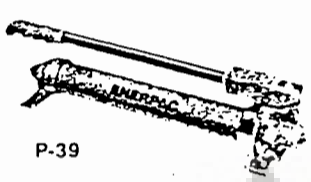
Hydraulic Hand Pumps

10,000 PSI

Applications

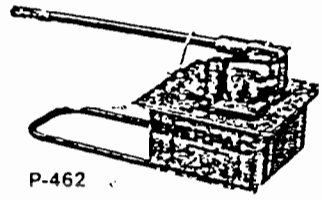
For fabrication, maintenance, construction, and industrial use, these 10,000 psi hand pumps are proven performers. The P-39 is a versatile mid-size pump. The P-80 has two-speed operation to get the job done faster. The P-462 has a large 2 gallon reservoir for use with high tonnage cylinders. Both the P-80 and P-462 are available in 4-way valve versions (P-84 and P-464) for use with double-acting cylinders.

FOR SINGLE ACTING CYLINDER



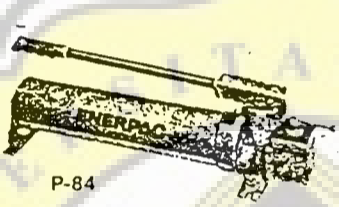
P-39

P-80

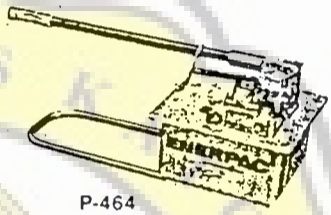


P-462

FOR DOUBLE ACTING CYLINDER



P-84



P-464

Features

- 5 models.
- External load release valve.
- Internal pressure relief valve.
- Two-speed operation (except P-39).
- 4-way valving (P-84 and P-464).
- 43 cu. in. to 462 cu. in. reservoir capacities.
- 10,000 psi operation.

Ordering Information

Refer to the selection chart below for available models. PC-10 Kit converts P-39 to foot power. Outlet ports are $^{3}/_{8}$ NPTF for hose connection.

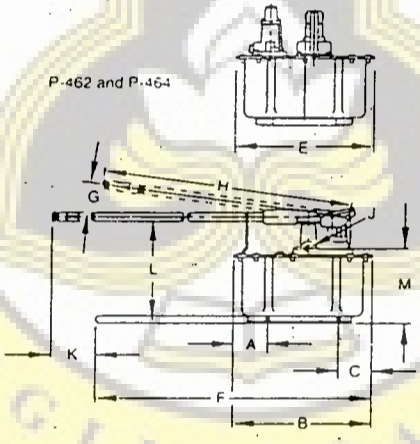
Accessories

Foot Pump Conversion Kit

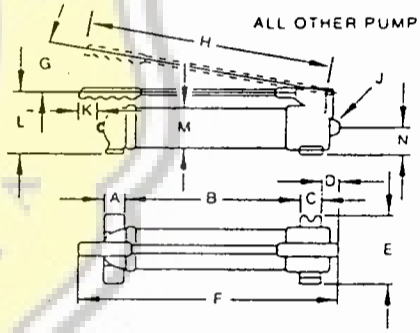
PC-10

Convert a P-39 pump to foot power with the PC-10 Kit. Includes instructions for easy conversion.

P-462 and P-464



ALL OTHER PUMPS



Dimensions (Inches)

Model No.	A	B	C	D	E	F	G	H	J	K	L	M	N
P-39	1 15/32	15/32	1 1/2	1 3/8	5 1/4	22 11/16	40°	18 1/4	3/8 NPTF	2 5/8	4 7/16	2 1/8	1 1/4
P-80	1	16 1/4	1 3/4	1 3/16	5 3/4	23	50°	20 1/2	3/8 NPTF	1/2	6 1/8	3 3/4	2 1/8
P-84	1	16 1/4	1 3/4	1 3/16	5 3/4	26 1/2	50°	20 1/2	3/8 NPTF	1/2	6 3/32	3 3/4	1 5/16
P-462	3 1/8	12 1/16	3 1/8	–	12 1/2	25 5/16	74°	26 7/16	3/8 NPTF	3 1/8	10 5/8	7 5/16	–
P-464	3 1/8	12 1/16	3 1/8	–	12 1/2	25 5/16	74°	26 7/16	1/4 NPTF	3 1/8	10 5/8	7 1/8	–

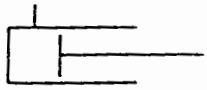
Selection Chart

Model No.	Pump Speed	Max. Pressure Rating (PSI)		Usable Oil Cap. (Cu. In.)	Oil Vol. Per Stroke (Cu. In.)	Piston Dia. (In.)	Piston Stroke (In.)	Weight (Lbs.)
P-39	Single	10,000		43	16	1	3	13
P-80	Two-Speed	1st Stage 2nd Stage	350 10,000	140	99 15	1 1/4 1/2	1	28
P-84	Two-Speed	1st Stage 2nd Stage	350 10,000	140	99 15	1 1/4 1/2	1	33

ENERPAC

ingle-Acting, Solid Plunger Hydraulic Cylinders

_S Series - 10,000 PSI **50 - 1000 Ton Capacities**

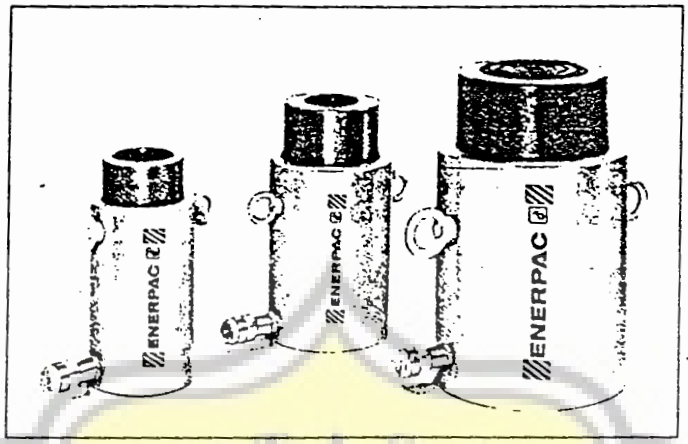


pplications

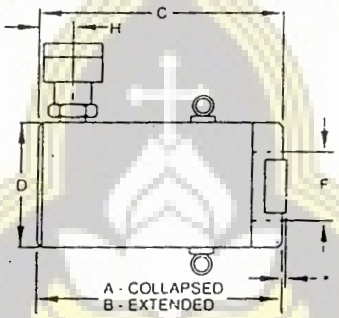
ıe CLS series high tonnage linders are designed for lifting ıd maintenance applications. ıese economical cylinders are :signed for intermittent duty.

eatures

66 models.
Includes CR-400 coupler.
Overflow port for stroke restriction.
Lifting eyes facilitate cylinder handling.
Removable, hardened saddles are standard in all models.
Optional tilt saddles are recommended to reduce cylinder offset loading.
Gravity return.
Special synthetic high-tech coating (easily identified as dark green colour) on the plunger, bore and base of the cylinder.
Advantages - Withstand higher sideloading without scoring
- Lower friction for smoother operation.
- Corrosion protection, can be used under water for a period of time.



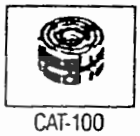
HIGH TONNAGE CYLINDERS



Accessories

Tilt Saddles

Tilt saddles will pivot 5° to reduce cylinder offset loading. Use only with cylinder in upright position.



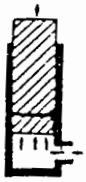
CAT-100

Selection Chart

Model No.	Type of Saddle	For Use With Cylinder CLS
CAT-100	Tilt	50,100 Ton
CAT-200		150,200 Ton
CAT-250		250 Ton
CAT-300		300 Ton
CAT-400		400 Ton
CAT-500		500 Ton
CAT-600		600 Ton
CAT-800		800 Ton
CAT-1000		1000 Ton

Selection Chart

Model No.	Cyl. Cap. (Tons)	Stroke* (In.)	Cyl. Effect. Area (Sq. In.)	Oil Cap. (Cu. In.)	A Collapsed Ht. (In.)	B Ext. Ht. (In.)	C Body Lgth. (In.)	D Out. Dia. (In.)	Cyl. Bore Dia. (In.)	F Pigr. Dia (In.)	H Base To Adv. Port. (In.)	Saddle Dia. (In.)	K Saddle Protrusion From Pigr. (In.)	Weight (Lbs.)
CLS-502	50	2	11.05	22	5 1/16	7	4 15/16	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	31
CLS-504	50	4	11.05	44	7	10 15/16	6 7/8	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	40
CLS-506	50	6	11.05	65	9	14 7/8	8 7/8	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	51
CLS-508	50	8	11.05	87	10 15/16	18 13/16	10 13/16	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	62
CLS-5010	50	10	11.05	109	12 7/8	22 3/4	12 13/16	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	71
CLS-5012	50	12	11.05	131	14 7/8	26 11/16	14 3/4	4 15/16	3 3/4	3 3/4	1 3/16	2 13/16	1/8	84
CLS-1002	100	2	20.66	41	5 5/8	7 5/8	5 1/2	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	51
CLS-1004	100	4	20.66	81	7 5/8	11 9/16	7 1/2	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	68
CLS-1006	100	6	20.66	122	9 9/16	15 1/2	9 7/16	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	90
CLS-1008	100	8	20.66	163	11 9/16	19 3/8	11 7/16	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	110
CLS-10010	100	10	20.66	203	13 1/2	23 7/8	13 3/8	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	126
CLS-10012	100	12	20.66	244	15 1/2	27 1/4	15 3/8	6 1/2	5 1/8	5 1/8	1 3/16	2 13/16	1/8	146
CLS-1502	150	2	30.69	60	6 1/2	8 7/16	6 7/16	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	93
CLS-1504	150	4	30.69	121	8 7/16	12 3/8	8 3/8	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	123
CLS-1506	150	6	30.69	181	10 7/16	16 5/16	10 3/8	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	154
CLS-1508	150	8	30.69	242	12 3/8	20 1/4	12 5/16	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	181
CLS-15010	150	10	30.69	302	14 3/8	24 3/16	14 5/16	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	207
CLS-15012	150	12	30.69	362	16 5/16	44 1/2	16 1/4	8 1/16	6 1/4	6 1/4	1 9/16	5 1/8	1/16	234



PUSH TYPE
Gravity Return

Selection Chart

Model No.	Cyl. Cap. (Tons)	Stroke* (In.)	Cyl. Effect. Area (Sq. In.)	Oil Cap. (Cu. In.)	A Collapsed Ht. (In.)	B Ext. Ht. (In.)	C Body Lgth. (In.)	O Out. Dia. (In.)	Cyl. Bore Dia. (In.)	F Plgr. Dia. (In.)	H Base To Adv. Port (In.)	Saddle Dia. (In.)	K Saddle Protrusion From Plgr. (In.)	Weight (Lbs.)
CLS2002	200	2	41.31	81	7 5/8	9 9/16	7 1/2	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	146
CLS2004	200	4	41.31	163	9 9/16	13 1/2	9 1/2	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	176
CLS2006	200	6	41.31	244	11 9/16	17 7/16	11 7/16	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	220
CLS2008	200	8	41.31	325	13 1/2	23/8	13 7/16	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	260
CLS20010	200	10	41.31	406	15 1/2	25 5/16	15 3/8	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	298
CLS20012	200	12	41.31	488	17 7/16	19 1/4	17 3/8	9 1/4	7 1/4	7 1/4	2	5 1/8	1/16	331
CLS2502	250	2	56.79	112	7 5/8	9 9/16	7 1/2	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	187
CLS2504	250	4	56.79	224	9 9/16	13 1/2	9 1/2	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	242
CLS2506	250	6	56.79	335	11 9/16	17 7/16	11 7/16	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	298
CLS2508	250	8	56.79	447	13 1/2	21 3/8	13 7/16	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	353
CLS25010	250	10	56.79	559	15 1/2	25 5/16	15 3/8	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	406
CLS25012	250	12	56.79	671	17 7/16	29 1/4	17 3/8	10 13/16	8 1/2	8 1/2	2	5 7/8	1/16	450
CLS3002	300	2	70.84	139	9 1/4	11 1/4	9 1/16	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	300
CLS3004	300	4	70.84	279	11 1/4	15 1/8	11	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	364
CLS3006	300	6	70.84	418	13 3/16	19 1/16	13	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	430
CLS3008	300	8	70.84	558	15 1/8	23	14 15/16	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	494
CLS30010	300	10	70.84	697	17 1/8	27	16 15/16	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	558
CLS30012	300	12	70.84	836	19 1/16	30 7/8	18 7/8	12 3/16	9 1/2	9 1/2	2 3/8	5 1/2	3/16	624
CLS4002	400	2	86.65	171	10 7/16	12 3/8	10 1/4	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	430
CLS4004	400	4	86.65	341	12 3/8	16 5/16	12 3/16	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	514
CLS4006	400	6	86.65	512	14 3/8	20 1/4	14 3/16	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	595
CLS4008	400	8	86.65	682	16 5/16	24 3/16	16 1/8	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	679
CLS40010	400	10	86.65	853	18 5/16	28 1/8	18 1/8	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	760
CLS40012	400	12	86.65	1023	20 1/4	32 1/16	20 1/16	13 3/4	10 1/2	10 1/2	2 3/4	6 1/4	3/16	844
CLS5002	500	2	113.15	223	11 5/8	13 9/16	11 7/16	15 3/4	12	12	3 1/8	7 1/16	3/16	628
CLS5004	500	4	113.15	445	13 9/16	17 1/2	13 3/8	15 3/4	12	12	3 1/8	7 1/16	3/16	734
CLS5006	500	6	113.15	668	15 9/16	21 7/16	15 3/8	15 3/4	12	12	3 1/8	7 1/16	3/16	842
CLS5008	500	8	113.15	891	17 1/2	25 3/8	17 5/16	15 3/4	12	12	3 1/8	7 1/16	3/16	950
CLS50010	500	10	113.15	1113	19 1/2	29 5/16	19 5/16	15 3/4	12	12	3 1/8	7 1/16	3/16	1058
CLS50012	500	12	113.15	1336	21 7/16	33 1/4	21 1/4	15 3/4	12	12	3 1/8	7 1/16	3/16	1166
CLS6002	600	2	132.84	262	12 3/16	14 3/16	12	16 15/16	13	13	3 3/8	7 5/8	3/16	760
CLS6004	600	4	132.84	523	14 3/16	18 1/8	14	16 15/16	13	13	3 3/8	7 5/8	3/16	886
CLS6006	600	6	132.84	784	16 1/8	22 1/16	15 15/16	16 15/16	13	13	3 3/8	7 5/8	3/16	1012
CLS6008	600	8	132.84	1046	18 1/8	26	17 7/8	16 15/16	13	13	3 3/8	7 5/8	3/16	1135
CLS60010	600	10	132.84	1307	20 1/16	29 15/16	19 7/8	16 15/16	13	13	3 3/8	7 5/8	3/16	1261
CLS60012	600	12	132.84	1568	22 1/16	33 7/8	21 7/8	16 15/16	13	13	3 3/8	7 5/8	3/16	1384
CLS8002	800	2	182.75	360	14	15 15/16	13 3/4	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	1206
CLS8004	800	4	182.75	719	15 15/16	23 13/16	15 3/4	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	1375
CLS8006	800	6	182.75	1079	17 7/8	25 13/16	17 3/4	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	1547
CLS8008	800	8	182.75	1438	19 7/8	27 3/4	19 11/16	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	1719
CLS80010	800	10	182.75	1798	21 7/8	31 11/16	21 5/8	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	1891
CLS80012	800	12	182.75	2158	23 13/16	35 5/8	23 5/8	19 7/8	15 1/4	15 1/4	3 15/16	8 13/16	3/16	2065
CLS10002	1000	2	227.08	447	15 1/8	17 1/8	14 15/16	22 1/16	17	17	4 5/16	9 13/16	3/16	1609
CLS10004	1000	4	227.08	894	17 1/8	21 1/16	16 15/16	22 1/16	17	17	4 5/16	9 13/16	3/16	1821
CLS10006	1000	6	227.08	1341	19 1/16	25	18 7/8	22 1/16	17	17	4 5/16	9 13/16	3/16	2033
CLS10008	1000	8	227.08	1787	21 1/16	28 15/16	20 7/8	22 1/16	17	17	4 5/16	9 13/16	3/16	2244
CLS100010	1000	10	227.08	2234	23	32 7/8	22 15/16	22 1/16	17	17	4 5/16	9 13/16	3/16	2455
CLS100012	1000	12	227.08	2681	25	36 13/16	24 13/16	22 1/16	17	17	4 5/16	9 13/16	3/16	2667