REINFORCED CONCRETE OF ABUTMENT A-1 = A-2

KREO BRIDGE

REINFORCED CONCRETE OF ABUTMENT A-1 :

The earth pressure under the normal condition (Case I):

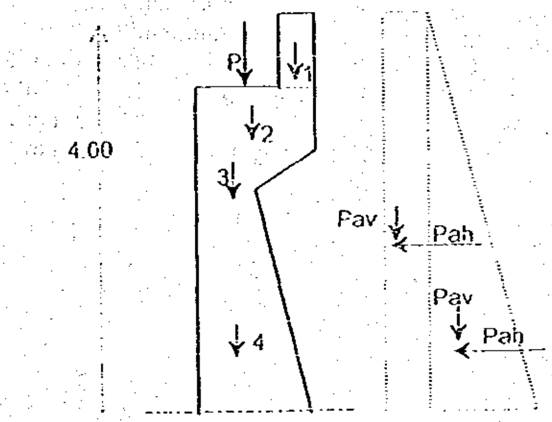
Height of Abutment	H =	5.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	2.7	m
Load	q =	1.0	t / m'

Pa1 = 1/2 * g * H^2 * Ka * L =	12.1869 t
Pa2 = pa2 * H * L =	3.2076 t
Pa1h = Pa1 * cos δ =	10.5556 t
Pa1v = Pa1 * sin δ =	6.0944 t
Pa2h = Pa2 * cos δ =	2.7778 t
Pa2v = Pa2 * sin δ =	1.6038 t

part	Weight of part (ton)		Arm (m)	Moment (ton m)
1	0.3*1.27*2.5*2.7 =	2.5718	0.965	2.4817
2	1.115*0.5*2.5*2.7 =	3.7631	0.5575	2.0979
3	(1.115+0.5)/2*0.53*2.5*2.7=	2.8888	0.8075	2.3327
4	((1+0.5)/2)*1.7*2.5*2.7 =	8.6063	0.75	6.4547
P	46	46.0000	0.25	11.5000
Pa1v	6.09444	6.0944	1.1150	6.7953
Pa1h	10.55557	10.5556	-1.3333	-14.0741
Pa2v	1.60380	1.6038	1.1150	1.7882
Pa2h	2.77778	2.7778	-2.0000	-5.5556
	Total : Σ FV =	84.8615	Σ Mr =	13.8210

Mdes = 1.2 * Mr =	16.58518 ton m =	165.852 kNm
Normal Force N =	63.8300 ton =	638.3 kN

The concrete stress fc' = 22.05 Mpa
The yield stress of steel fy = 156.86 Mpa



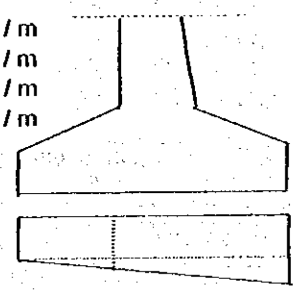
REINFORCED CONCRETE OF ABUTMENT ON TOE AND HEEL : *File:RC-A1-3*

Compute soil pressure :

qmax = { S Fv / B } * { 1 + (6*e)/B } = 53.700 ton / m
qmin = { S Fv / B } * { 1 - (6*e)/B } = 17.595 ton / m

q1 = 36.105 ton / m
q2 = 12.37886 ton / m
q2-2 = 29.97386 ton / m
Berat sendiri q = 1.875 ton / m
L1 = 1.3 m

Mmax1 = qmin * L1*L1/2 = 13.283 ton m / m
Mmax2 = 1/2*q2*L1*1/3*L1 = 3.487 ton m / m
Mmax total = 16.770 ton m / m
Mdes = 1.2 * Mmax = 20.124 ton m / m



The concrete stress fc' = 22.05 Mpa
The yield stress of steel fy = 156.86 Mpa
Dimension of concrete ht = 1000 mm
b = 1000 mm
d = 850 mm

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.08051
ρmin = 1.4/fy = 0.00893
Coeficient k = 0.022
ρ = k*ρb = 0.00177
As1 = ρ * b * d = 1505.61 mm^2
T1 = As1*fy = 236169.47 N
a1 = T1 / (0.85*fc'*b) = 12.60 mm
Z = d - 0.5 a1 = 843.70 mm
Mr1 = T1 * Z = 199256091 Nmm
199.26 KNm
Mmax = 201.24 KNm
Because Mmax > Mr1 , required double reinforced concrete
ΔM = Mmax -Mr1 = 1.99 KNm
As2 = ΔM / fy(d-d') = 16.87 mm^2
As= As1 + As2 = 1522.48 mm^2

tensile of steel bars :	D 19 - 150	As terpsg =	1889.23 mm^2
compressive of steel bars :	D 16 - 250	As' terpsg =	803.84 mm^2
Longitudinal steel bars : 20 % As =			304.50 mm^2
	D 13 - 250	As bagi =	530.66 mm^2

REINFORCED CONCRETE OF ABUTMENT A-1=A-2

File:RC-A2-3

The earth pressure under the normal condition :

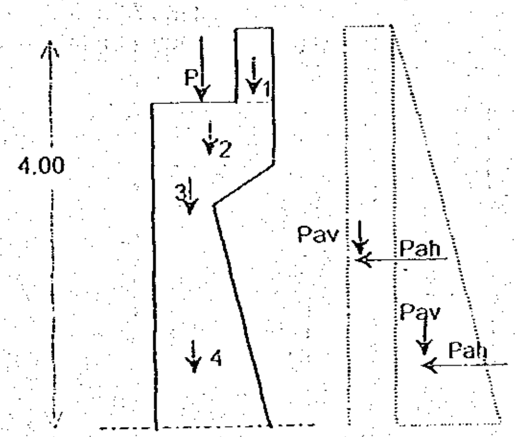
Height of Abutment	H =	5.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	2.7	m
Load	q =	1.0	t / m'

Pa1 = 1/2 * γ * H^2 * Ka * L =	8.2984 t
Pa2 = pa2 * H * L =	4.6102 t
Pa1h = Pa1 * cos δ =	7.8005 t
Pa1v = Pa1 * sin δ =	2.8380 t
Pa2h = Pa2 * cos δ =	4.3336 t
Pa2v = Pa2 * sin δ =	1.5767 t

part	Weight of part (ton)		Arm (m)	Moment (ton m)
1	0.3*1.27*2.5*2.7 =	2.5718	0.965	2.4817
2	1.115*0.5*2.5*2.7 =	3.7631	0.5575	2.0979
3	(1.115+0.5)/2*0.53*2.5*2.7=	2.8888	0.8075	2.3327
4	((1+0.5)/2)*1.7*2.5*2.7 =	8.6063	0.75	6.4547
P	46	46.0000	0.25	11.5000
Pa1v	2.83804	2.8380	1.1150	3.1644
Pa1h	7.80045	7.8005	-1.3333	-10.4006
Pa2v	1.57669	1.5767	1.1150	1.7580
Pa2h	4.33358	4.3336	-2.0000	-8.6672
	Total : Σ Fv' =	63.8300	Σ Mr =	10.7217

Mdes = 1.2 * Mr =	12.866 ton m =	128.661 kNm
Normal Force N =	63.8300 ton =	638.3 kN

The concrete stress fc' = 22.05 Mpa
The yield stress of steel fy = 156.86 Mpa



REINFORCED CONCRETE OF ABUTMENT ON TOE AND HEEL : *File:RC-A2-3*

Compute soil pressure :

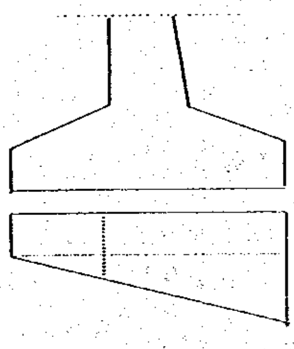
qmax = { Σ Fv / B } * { 1 + (6*e)/B } =	29.809 ton / m
qmin = { Σ Fv / B } * { 1 - (6*e)/B } =	12.095 ton / m

q1 =	17.71391 ton / m
q2 =	6.073341 ton / m
q2-2 =	18.16852 ton / m
Weight of concrete q =	1.875 t/m
L1 =	1.2 m
qw = qmin - q =	10.220 t/m
Mmax1 = qw * L1*L1/2 =	1.350 ton m / m
Mmax2 = 1/2*q2*L1*1/3*L1 =	1.458 ton m / m
Mmax total =	2.808 ton m / m
Mdes = 1.2 * Mmax =	3.369 ton m / m

the concrete stress fc' =	22.05 Mpa
the yield stress of steel fy =	156.86 Mpa
Dimension of concrete ht =	1000 mm
b =	1000 mm
d =	850 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.08051
ρmin = 1.4/fy =	0.00893
Koefisien k =	0.02
ρ = k*ρb =	0.0016
As1 = ρ * b * d =	1368.73 mm^2
T1 = As1*fy =	214699.5 N
a1 = T1 / (0.85*fc'*b) =	11.46 mm
Z = d - 0.5 a1 =	844.27 mm
Mr1 = T1 * Z =	181264872 Nmm
	181.26 KNm
Mmax =	33.69 KNm

Because Mmax < Mr1 , required single reinforced concrete :

As = ρ * b* d =		1368.73 mm^2
dipakai tulangan :	D 19 - 150	1889.23 mm^2



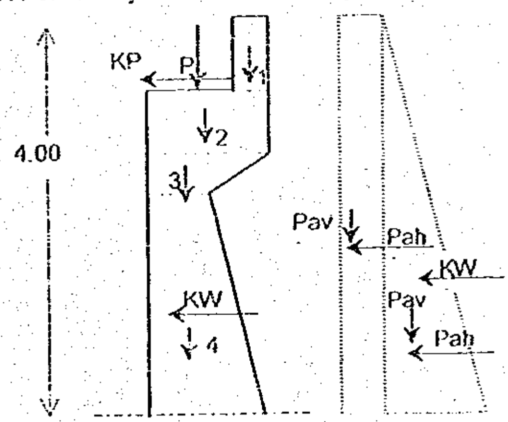
REINFORCED CONCRETE OF ABUTMENT A-1=A-2 :

The earth pressure under the normal condition :

Height of Abutment	H =	5.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	2.7	m
Load	q =	1.0	t / m'
Pa1 = 1/2 * γ1 * H1^2 * Kea * L =		19.3709	t
Pa2 = pea2 * H1 * L =		5.0976	t
Pa1h = Pa1 * cos δ =		18.7123	t
Pa1v = Pa1 * sin δ =		5.0171	t
Pa2h = Pa2 * cos δ =		4.9243	t
Pa2v = Pa2 * sin δ =		1.3203	t

part	Weight of part (ton)		Arm (m)	Moment (ton m)
1	0.3*1.27*2.5*2.7 =	0.9525	0.965	0.9192
2	1.115*0.5*2.5*2.7 =	1.3938	0.5575	0.7770
3	(1.115+0.5)/2*0.53*2.5*2.7=	1.0699	0.8075	0.8640
4	((1+0.5)/2)*1.7*2.5*2.7 =	3.1875	0.75	2.3906
P	46	46.0000	0.25	11.5000
Pa1v	5.01706	5.0171	1.1150	5.5940
Pa1h	18.71227	18.7123	-1.3333	-24.9497
Pa2v	1.32028	1.3203	1.1150	1.4721
Pa2h	4.92428	4.9243	-2.0000	-9.8486
KP		6.9000	-2.7800	-19.1820
Kw1		0.9906	-1.3650	-1.3521
Kv/2		4.4961	-2.0000	-8.9922
	Total : ΣFv' =	52.6037	ΣMr =	-40.8076

P =	46.0000	ton	
Wabutment =	6.6037	ton	
Wsoil =	29.9739	ton	
KP = 0,15 * P =	6.9000	ton	
KW1 = 0,15*Wabut =	0.9906	ton	
Kv/2= 0,15*Wsoil =	4.4961	ton	
Mdes = 1.2 * Mr =	48.969	ton m =	489.691 kNm
Normal Force N =	52.6037	ton =	526.0 kN
the concrete stress fc' =	33.075	Mpa	*(earthquake condition fc' = 1.5xfc')*
the yield stress of steel fy =	235.29	Mpa	*(earthquake condition fy = 1.5xfy)*



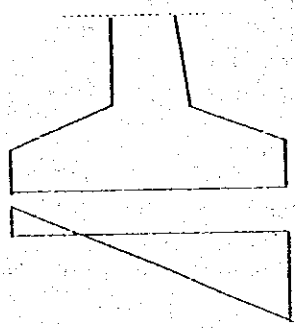
REINFORCED CONCRETE OF ABUTMENT ON TOE AND HEEL : *File:RC-A3-3*

Compute soil pressure :

qmax = { Σ Fv / B } * { 1 + (6*e)/B } =	83.822	ton / m
qmin = { Σ Fv / B } * { 1 - (6*e)/B } =	-13.416	ton / m
L1 =	1.2	m
Mmax1 =1/2qmin * L1*L1*2/3 =	6.439	ton m / m
Mmax total =	6.439	ton m / m
Mdes = 1.2 * Mmax =	7.727	ton m / m
the concrete stress fc' =	33.075	Mpa
*(earthquake condition fc=1.5*fc')*		
the yield stress of steel fy =	235.29	Mpa
*(earthquake condition fy=1.5*fy)*		
Dimension of concrete ht =	1000	mm
b =	1000	mm
d =	850	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.0730	
ρmin = 1.4/fy =	0.0060	
Koefisien k =	0.0300	
ρ = k*ρb =	0.0022	
As1 = ρ * b * d =	1860.32	mm^2
T1 = As1*fy =	437715.4	N
a1 = T1 / (0.85*fc'*b) =	15.57	mm
Z = d - 0.5 a1 =	842.22	mm
Mr1 = T1 * Z =	368650620	Nmm
	368.65	KNm
Mmax =	77.27	KNm

Because Mmax < Mr1 required single reinforced

As = ρ * b* d =		1860.32	mm^2
use reinforced :	D 19 - 150	1889.23	mm^2



REINFORCED CONCRETE OF ABUTMENT A-1 = A-2 : File:RC-A4-3

The earth pressure under the earthquake condition (Case IV) :

Height of Abutment	H =	5.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	2.7	m
Load	q =	1.0	t / m'

Coefficient of active earth pressure :

Kea = 0.472

Acting earth pressure :

H1 = + 153.60 - 151.80 = 1.8 m

H2 = H - H1 = 2.2 m

pa1 = Kea * γl *H1 = 3.5872 t /m^2

pa2 = Kea * q = 0.472 t /m^2

pa3 = (pa1 + pa2) = 4.0592 t /m^2

pa4 = Kea * γsub *H2 = 0.93456 t /m^2

Pa1 = 1/2 * γl * H1^2 * Kea * L = 3.92260 t

Pa2 = pea2 * H1 * L = 2.29392 t

Pa3 = pea3*H2*L = 24.11165 t

Pa4 =pea4*H2/2*L = 2.77564 t

cos 15 = 0.96593

sin 15 = 0.25882

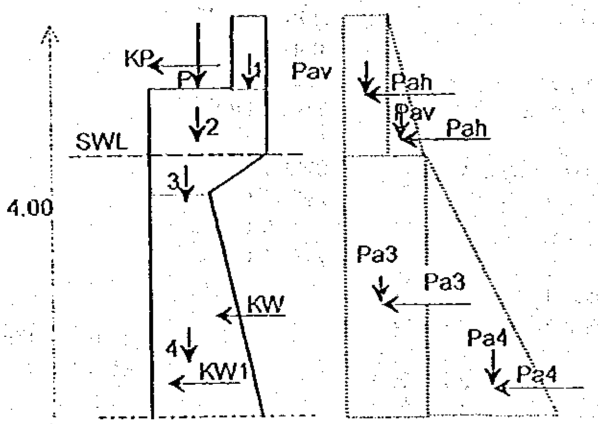
		length from bottom of footing	
Pa1h = Pa1 * cos δ =	3.78896 t	h1 = 2.8	m
Pa1v = Pa1 * sin δ =	1.01525 t		
Pa2h = Pa2 * cos δ =	2.21577 t	h2 = 3.1	m
Pa2v = Pa2 * sin δ =	0.59371 t		
Pa3h = Pa3 * cos δ =	3.92090 t	h3 = 1.1	m
Pa3v = Pa3 * sin δ =	1.05060 t		
Pa4h = Pa4 * cos δ =	2.68108 t	h4 = 0.733	m
Pa4v = Pa4 * sin δ =	0.71839 t		

part	Weight of part (ton)		Arm (m)	Moment (ton m)
1	0.3*1.27*2.5*2.7 =	2.5718	0.965	2.4817
2	1.115*0.5*2.5*2.7 =	3.7631	0.5575	2.0979
3	(1.115+0.5)/2*0.53*2.5*2.7=	2.8888	0.8075	2.3327
4	((1+0.5)/2)*1.7*2.5*2.7 =	8.6063	0.75	6.4547
P	46	46.0000	0.25	11.5000
Pa1v	1.01525	1.0152	1.1150	1.1320
Pa1h	3.78896	3.7890	-2.8000	-10.6091
Pa2v	0.59371	0.5937	1.1150	0.6620
Pa2h	2.21577	2.2158	-3.1000	-6.8689
Pa3v	1.05060	1.0506	1.1150	1.1714
Pa3h	3.92090	3.9209	-1.1000	-4.3130
Pa4v	0.71839	0.7184	1.1150	0.8010
Pa4h	2.68108	2.6811	-0.7333	-1.9661
KP		6.9000	-2.7800	-19.1820
Kw1		2.6745	-1.3650	-3.6507
Kv/2		1.1421	-2.0000	-2.2841
	Total : ΣFv' =	63.8300	ΣMr =	-20.2404

P =	46.0000 ton
Wabutment =	17.8300 ton
Wsoil =	7.6137 ton
KP = 0,15 * P =	6.9000 ton
KW1 = 0,15*Wabut =	2.6745 ton
Kw2= 0,15*Wsoil =	1.1421 ton

Mdes = 1.2 * Mr =	24.288 ton m =	242.884 kNm
Normal Force N =	63.8300 ton =	638.3 kN

the concrete stress fc' =	33.075 Mpa	*(earthquake condition fc' = 1.5xfc')*
the yield stress of steel fy =	235.29 Mpa	*(earthquake condition fy = 1.5xfy)*



REINFORCED CONCRETE OF ABUTMENT ON TOE AND HEEL

File:RC-A4-3

Compute soil pressure :

qmax = { Σ Fv / B } * { 1 + (6*e)/B } = 64.9167 ton / m
qmin = { Σ Fv / B } * { 1 - (6*e)/B } = -12.3928 ton / m
L1 = 1.3 m

Mmax1 =1/2qmin * L1*L1*2/3 = 6.981 ton m / m
Mmax total = 6.981 ton m / m
Mdes = 1.2 * Mmax = 8.378 ton m / m

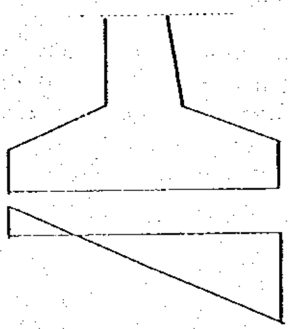
the concrete stress fc' = 33.075 Mpa
(earthquake condition fc'=1.5 x fc')
the yield stress of steel fy = 235.29 Mpa
(earthquake condition fy=1.5 x fy)

Dimension of concrete	ht =	1000	mm
	b =	1000	mm
	d =	850	mm

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.0730	
ρmin = 1.4/fy =	0.0060	
Koefisien k =	0.015	
ρ = k*ρb =	0.00109	
As1 = ρ * b * d =	930.16	mm^2
T1 = As1*fy =	218857.7	N
a1 = T1 / (0.85*fc'*b) =	7.78	mm
Z = d - 0.5 a1 =	846.11	mm
Mr1 = T1 * Z =	185177183	Nmm
	185.18	KNm
Mmax =	83.78	KNm

Because Mmax < Mr1 required single reinforced concrete

As = ρ * b* d = 930.16 mm^2
dipakai tulangan D 19 - 150 1889.23 mm^2



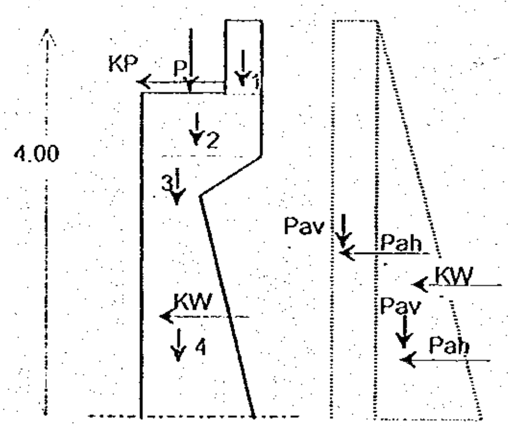
The earth pressure under the earthquake condition (Case V) :

Height of Abutment	H =	5.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	2.7	m
Load	q =	1.0	t / m'
Pa1 = 1/2 * γ * H^2 * Kea * L =		19.371	t
Pa2 = pa2 * H * L =		5.098	t
Pa1h = Pa1 * cos δ =		18.712	t
Pa1v = Pa1 * sin δ =		5.017	t
Pa2h = Pa2 * cos δ =		4.924	t
Pa2v = Pa2 * sin δ =		1.320	t

part	Weight of part (ton)		Arm (m)	Moment (ton m)
1	0.3*1.27*2.5*2.7 =	3.3338	0.965	3.2171
2	1.115*0.5*2.5*2.7 =	4.8781	0.5575	2.7196
3	(1.115+0.5)/2*0.53*2.5*2.7=	3.7448	0.8075	3.0239
4	((1+0.5)/2)*1.7*2.5*2.7 =	11.1563	0.75	8.3672
P	46	46.0000	0.25	11.5000
Pa1v	5.01706	5.0171	1.1150	5.5940
Pa1h	18.71227	18.7123	-1.3333	-24.9497
Pa2v	1.32028	1.3203	1.1150	1.4721
Pa2h	4.92428	4.9243	-2.0000	-9.8486
KP	6.90000	6.9000	-2.7800	-19.1820
Kw1	3.46694	3.4669	-1.3650	-4.7324
Kw2	4.49608	4.4961	-2.0000	-8.9922
	Total : Σ FV =	69.1129	Σ Mr =	-31.8109

P =	46.0000	ton
Wabutment =	23.1129	ton
Wsoil =	29.9739	ton
KP = 0,15 * P =	6.9000	ton
KW1 = 0,15*Wabut =	3.4669	ton
Kw2= 0,15*Wsoil =	4.4961	ton

Mdes = 1.2 * Mr =	38.173	ton m =	381.731	kNm
Normal Force N =	69.1129	ton =	691.129	kN
the concrete stress fc' =	33.075	Mpa	*(earthquake condition fc' = 1.5xfc')*	
the yield stress of steel fy =	235.29	Mpa	*(earthquake condition fy = 1.5xfy)*	



REINFORCED CONCRETE OF ABUTMENT ON TOE AND HEEL

File:RC-A5-3

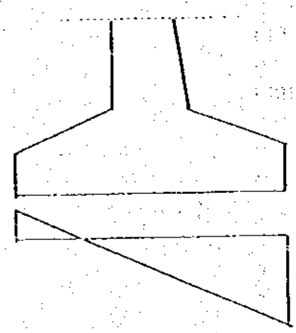
Compute soil pressure :

qmax = { Σ Fv / B } * { 1 + (6*e)/B } =	63.7590	ton / m
qmin = { Σ Fv / B } * { 1 - (6*e)/B } =	6.3680	ton / m
L1 =	1.3	m
Mmax1 =1/2qmin * L1*L1*2/3 =	3.587	ton m / m
Mmax total =	3.587	ton m / m
Mdes = 1.2 * Mmax =	4.305	ton m / m

the concrete stress fc' =	33.075	Mpa
(earthquake condition fc'=1.5xfc')		
the yield stress of steel fy =	235.29	Mpa
(earthquake condition fc'=1.5xfc')		
Dimension of concrtete ht =	1000	mm
b =	1000	mm
d =	850	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.07295	
ρmin = 1.4/fy =	0.00595	
Koefisien k =	0.022	
ρ = k*ρb =	0.00160	
As1 = ρ * b * d =	1364.24	mm^2
T1 = As1*fy =	320991.3	N
a1 = T1 / (0.85*fc'*b) =	11.42	mm
Z = d - 0.5 a1 =	844.29	mm
Mr1 = T1 * Z =	271010142	Nmm
	271.01	KNm
Mmax =	43.05	KNm

Because Mmax < Mr1required single reinforced concrete

As = ρ * b* d =	1364.24	mm^2
use reinforced concrete D 19 - 150	1889.23	mm^2



REINFORCED CONCRETE OF UPPER ABUTMENT (cross section 1-1) :

File:RC-Upper

The subjected force on upper abutment :

Case	Horizontal Force	Arm (m)	Moment (ton m)	Total Moment
Case I :				
Pa2h =	0.881971 ton	0.635	0.56005	
Pa1h =	1.064098 ton	0.423	0.45047	1.0105
Case II :				
Pa2h =	1.375464 ton	0.635	0.87342	
Pa1h =	0.786077 ton	0.423	0.33277	1.2062
Case III :				
Pa2h =	1.563 ton	0.635	0.9927	
Pa1h =	1.886 ton	0.423	0.7985	1.7912
Case IV :				
Pa2h =	1.563 ton	0.635	0.9927	
Pa1h =	1.886 ton	0.423	0.7985	1.7912
Case V :				
Pa2h =	1.5633 ton	0.635	0.9927	
Pa1h =	1.8862 ton	0.423	0.7985	1.7912

Mmax total = 1.7912 ton m

Mdes = 1.2*Mmax= 2.1494 ton m

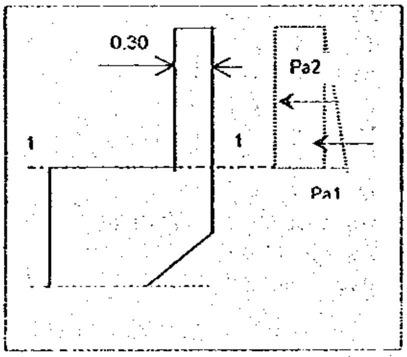
the concrete stress fc' = 22.05 Mpa

the yield stress of steel fy = 156.86 Mpa

Dimension of concrete ht = 300 mm

b = 1000 mm

d = 200 mm



Normal Force N = 0.9525 ton

Eccentricities e :

eo1 = Mu / Nu = 23.15 m

23149.61 mm

ht = 300 mm

b = 1000 mm

Lk = 1270 mm

eo2 =1/30 ht>20 mm: 33.33 mm

eo = eo1 + eo2 = 23182.94 mm

eo / ht = 77.28 mm

Tabel : C1 = 1.00 C2 = 7.00

e1 = C1*C2*[Lk/100h 0.00296 mm

e2 = 0.15 * ht = 45 mm

eu = eo+e1+e2 = 23227.94 mm

The cross section area of steel bars :

Nu / {ϕ*Ag*0.85*fc'} = 2.802E-08

Nu / {ϕ*Ag*0.85*fc'}*{et/h} = 2.169E-06

from graphic obtained r = 0.001 β = 0.90

Total cross section : Astot = r * β * Ag = 270 mm^2

As1 = As2 = 0.5 As tot = 135 mm^2

the principle steel bar D 19 - 300 Asterpasang = 945 mm^2

Longitudinal steel bars = 20 % As1 = 27 mm^2

use longitudinal steel D 13 - 300 As' = 442 mm^2

REINFORCED CONCRETE OF UPPER ABUTMENT (cross section 2-2) :

File:RC-Upper2

The subjected force on upper abutment :

Case I :	Horizontal Force	Arm (m)	Moment (ton m)	Total Moment
Pa2h =	1.597271 ton	1.15	1.83686	
Pa1h =	3.490036 ton	0.767	2.67569	4.5126
Case II :				
Pa2h =	2.490997 ton	1.15	2.86465	
Pa1h =	2.578182 ton	0.767	1.97661	4.8413
Case III :				
Pa2h =	2.831 ton	1.150	3.2559	
Pa1h =	6.186 ton	0.767	4.7428	7.9987
Case IV :				
Pa2h =	2.831 ton	1.150	3.2559	
Pa1h =	6.186 ton	0.767	4.7428	7.9987
Case V :				
Pa2h =	2.8312 ton	1.15	3.2559	
Pa1h =	6.1863 ton	0.767	4.7428	7.9987

Mmax total = 7.9987 ton m

Mdes = 1.2*Mmax= 9.5985 ton m

the concrete stress fc' = 22.05 Mpa

the yield stress of steel fy = 156.86 Mpa

Dimension of concrete ht = 500 mm

b = 1000 mm

d = 400 mm

Normal Force N = 3.4162 ton

Eccentricities e :

eo1 = Mu / Nu = 2.81 m

2809.70 mm

ht = 300 mm

b = 1000 mm

Lk = 2300 mm

eo2 =1/30 ht>20 mm= 33.33 mm

eo = eo1 + eo2 = 2843.03 mm

eo / ht = 9.48 mm

Tabel : C1 = 1.00

C2 = 7.00

e1 = C1*C2*[Lk/100ht]^2*ht 0.00537 mm

e2 = 0.15 * ht = 45 mm

eu = eo+e1+e2 = 2888.04 mm

The cross section area of steel bars :

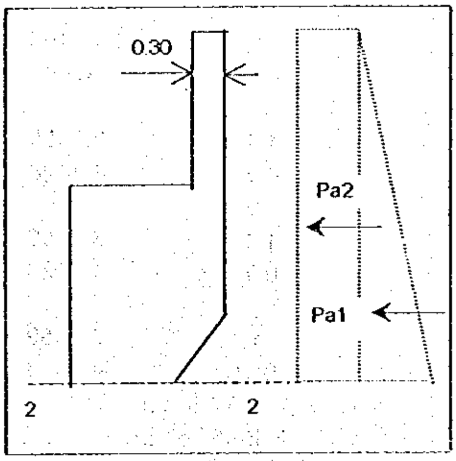
Nu / {ϕ*Ag*0.85*fc'} = 7.148E-07

Nu / {ϕ*Ag*0.85*fc'}*{et/h} = 6.881E-06

from graphic obtained r = 0.001

β = 0.90

Total cross section :		Astot = r * β * Ag =	270 mm^2
		As1 = As2 = 0.5 As tot =	135 mm^2
the principle steel bars :	D 19 - 300	Asterpasang =	945 mm^2
Longitudinal steel bars = 20 % As1 =			27 mm^2
use longitudinal steel bars :	D 13 - 300	As' =	442 mm^2



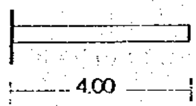
Koefisien k = 0.065
ρ = k∗ρb = 0.00523
As1 = ρ * b * d = 1831.69 mm^2
T1 = As1*fy = 287318.47 N
a1 = T1 / (0.85*fc'*b) = 15.33 mm
Z = d - 0.5 a1 = 342.34 mm
Mr1 = T1 * Z = 98359199 Nmm
98.36 KNm

Mmax = 103.60 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax - Mr1 = 5.24 KNm
As2 = Δ M / fy(d-d') = 111.33 mm^2
As= As1 + As2 = 1943.02 mm^2

the tensile of steel bars :	D 19 - 140	As terpsg =	2024 mm^2
the compressive of steel bars	D 19 - 140	As' terpsg =	2024 mm^2
Longitudinal steel bars : 20 % As =			389 mm^2
	D 13 - 300	Asbagi =	442 mm^2

The earth pressure on wingwall of abutment : (*look at cross section 3-3*)

qmax = pa1 + pa2
qmax = 1.087 t/m
L1 = 4.0 m H = 1.4 m



Mmax = qmax * L1*L1/2 = 8.696 ton m / m
Mmax total = 8.696 ton m / m
Mdes = 1.20 * Mmax = 10.435 ton m / m

the stress concrete fc' = 22.05 Mpa
the yield stress of steel fy = 156.86 Mpa
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.080514
ρmin = 1.4/fy = 0.008925
Koefisien k = 0.06
ρ = k∗ρb = 0.00483
As1 = ρ * b * d = 1690.79 mm^2
T1 = As1*fy = 265217.05 N
a1 = T1 / (0.85*fc'*b) = 14.15 mm
Z = d - 0.5 a1 = 342.92 mm
Mr1 = T1 * Z = 90949481 Nmm
90.95 KNm
Mmax = 104.35 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax - Mr1 = 13.40 KNm
As2 = Δ M / fy(d-d') = 284.85 mm^2
As= As1 + As2 = 1975.64 mm^2

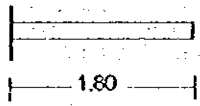
the tensile of steel bars :	D 19 - 140	As terpsg =	2024 mm^2
the compressive of steel bars	D 19 - 140	As' terpsg =	2024 mm^2
Longitudinal steel bars : 20 % As =			395 mm^2
	D 13 - 300	Asbagi =	442 mm^2

REINFORCED CONCRETE OF WING WALL ABUTMENT

File:RC-WINGNormal

The earth pressure on wingwall of abutment : (*look at cross section 1-1*)

qmax = pa1 + pa2
qmax = 3.119 t/m
L1 = 1.8 m   H = 5 m



Mmax = qmax * L1*L1/2 = 5.052 ton m / m
Mmax total = 5.052 ton m / m
Mdes = 1.2 * Mmax = 6.062 ton m / m

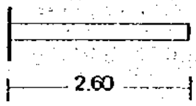
the stress concrete fc' =	22.05	Mpa
the yield stress of steel fy =	156.86	Mpa
Dimension of concrete ht =	400	mm
b =	1000	mm
d =	350	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.080514	
ρmin = 1.4/fy =	0.008925	
Koefisien k =	0.03	
ρ = k*ρb =	0.00242	
As1 = ρ * b * d =	845.39	mm^2
T1 = As1*fy =	132608.52	N
a1 = T1 / (0.85*fc'*b) =	7.08	mm
Z = d - 0.5 a1 =	346.46	mm
Mr1 = T1 * Z =	45943862	Nmm
	45.94	KNm
Mmax =	60.62	KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =		14.68 KNm		
As2 = Δ M / fy(d-d') =		374.34 mm^2		
As= As1 + As2 =		1219.74 mm^2		
the tensile of steel bars :	D 19 - 225		As terpsg =	1259 mm^2
the compressive of steel bars	D 19 - 225		As' terpsg =	1259 mm^2
Tulangan bagi : 20 % As =				244 mm^2
	D 13 - 300		Asbagi =	442 mm^2

The earth pressure on wingwall of abutment : (*look at cross section 2-2*)

qmax = pa1 + pa2
qmax = 2.554 t/m
L1 = 2.6 m   H = 4.0 m



Mmax = qmax * L1*L1/2 = 8.633 ton m / m
Mmax total = 8.633 ton m / m
Mdes = 1.20 * Mmax = 10.360 ton m / m

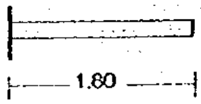
the stress concrete fc' =	22.05	Mpa
the yield stress of steel fy =	156.86	Mpa
Dimension of concrete ht =	400	mm
b =	1000	mm
d =	350	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.080514	
ρmin = 1.4/fy =	0.008925	

REINFORCED CONCRETE OF WING WALL ABUTMENT

File:RC-WINGgempa

The earth pressure on wingwall of abutment : (*look at cross section 1-1*)

qmax = pa1 + pa2
qmax = 4.956 t/m
L1 = 1.8 m H = 5 m

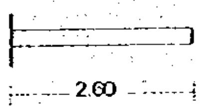


Mmax = qmax * L1*L1/2 = 8.029 ton m / m
Mmax total = 8.029 ton m / m
Mdes = 1.05 * Mmax = 8.430 ton m / m

the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950
Kcefisien k = 0.04
ρ = k*ρb = 0.00292
As1 = ρ * b * d = 1021.35 mm^2
T1 = As1*fy = 240314.35 N
a1 = T1 / (0.85*fc'*b) = 8.55 mm
Z = d - 0.5 a1 = 345.73 mm
Mr1 = T1 * Z = 83082928 Nmm
83.08 KNm
Mmax = 84.30 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 1.22 KNm
As2 = Δ M / fy(d-d') = 20.72 mm^2
As= As1 + As2 = 1042.07 mm^2
the tensile of steel bars : D 19 - 250 As terpsg = 1134 mm^2
the compressive of steel bars D 19 - 250 As' terpsg = 1134 mm^2
Tulangan bagi : 20 % As = 208 mm^2
D 13 - 300 Asbagi = 442 mm^2

The earth pressure on wingwall of abutment : (*look at cross section 2-2*)

qmax = pa1 + pa2
qmax = 4.059 t/m
L1 = 2.6 m H = 4.0 m



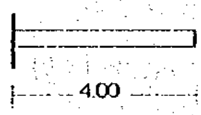
Mmax = qmax * L1*L1/2 = 13.720 ton m / m
Mmax total = 13.720 ton m / m
Mdes = 1.05 * Mmax = 14.406 ton m / m

the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950

Koefisien k = 0.06
$\rho = k*\rho b$ = 0.00438
As1 = ρ * b * d = 1532.03 mm^2
T1 = As1*fy = 360471.53 N
a1 = T1 / (0.85*fc'*b) = 12.82 mm
Z = d - 0.5 a1 = 343.59 mm
Mr1 = T1 * Z = 123854071 Nmm
123.85 KNm

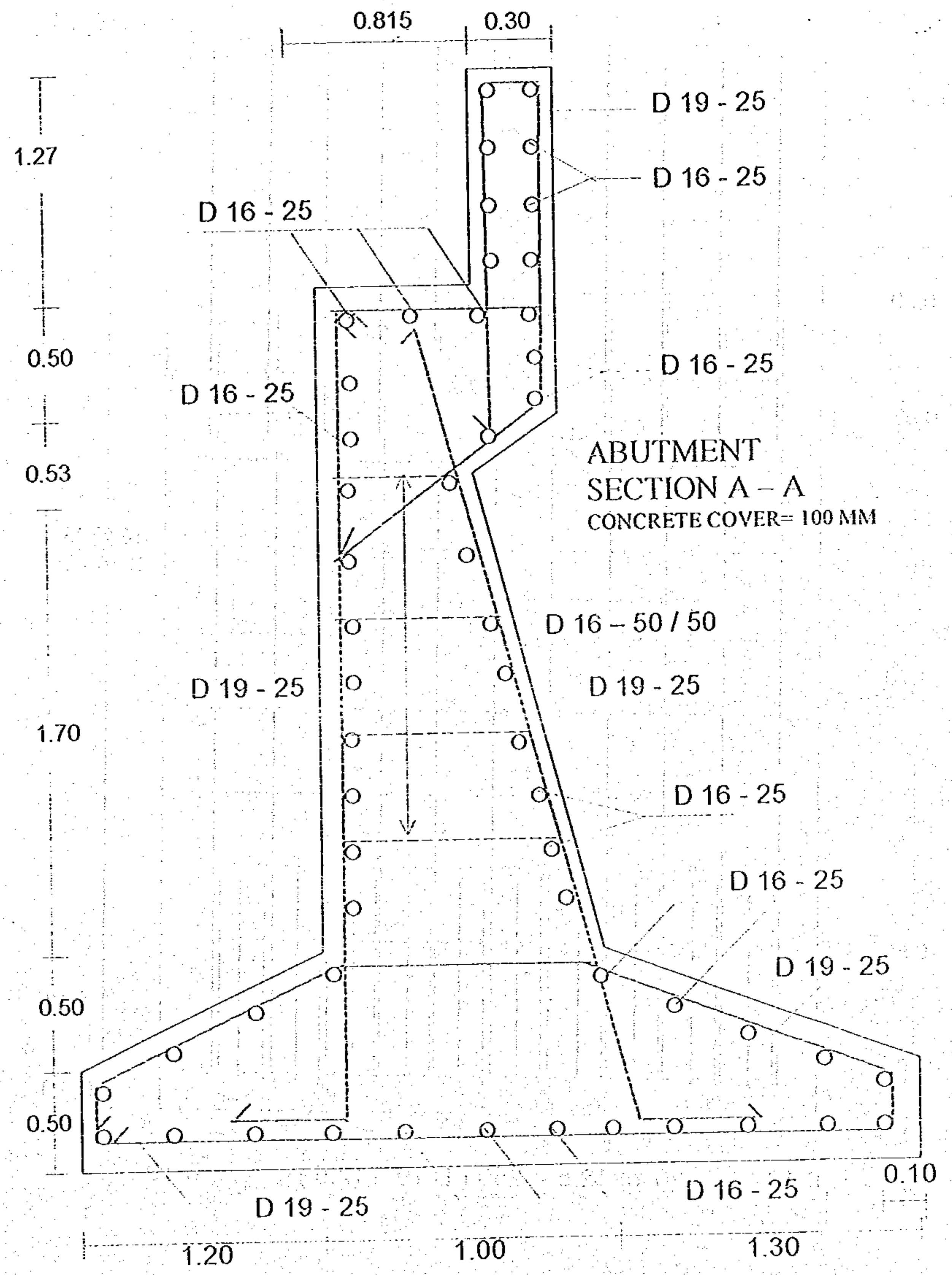
Mmax = 144.06 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax - Mr1 = 20.21 KNm
As2 = Δ M / fy(d-d') = 286.27 mm^2
As= As1 + As2 = 1818.30 mm^2
the tensile of steel bars : D 19 - 150 As terpsg = 1889 mm^2
the compressive of steel bars D 19 - 150 As' terpsg = 1889 mm^2
Longitudinal steel bars : 20 % As = 364 mm^2
D 13 - 300 Asbagi = 442 mm^2

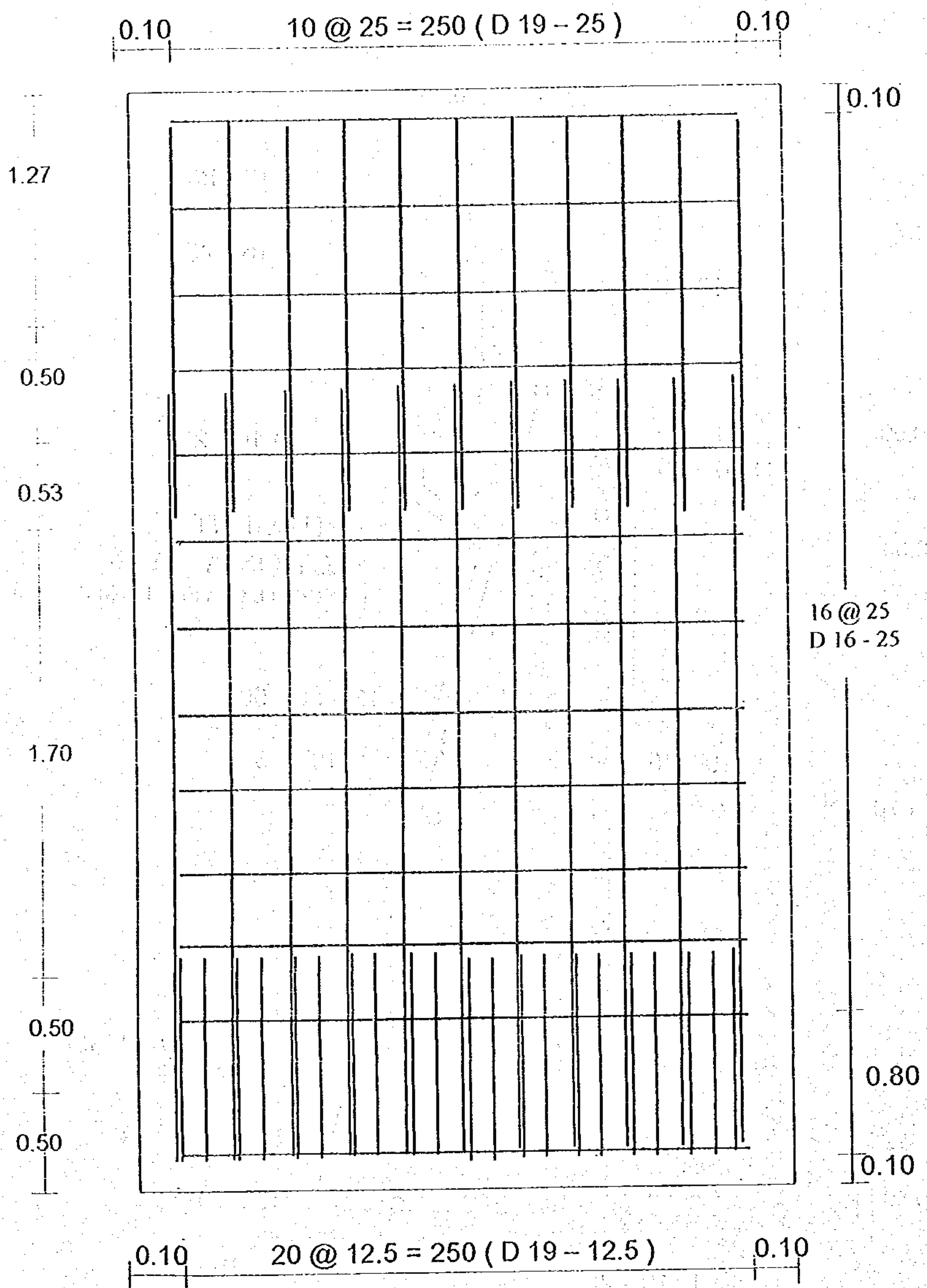
The earth pressure on wingwall of abutment : (*look at cross section 3-3*)
qmax = pa1 + pa2
qmax = 1.728 t/m
L1 = 4.0 m H = 1.4 m

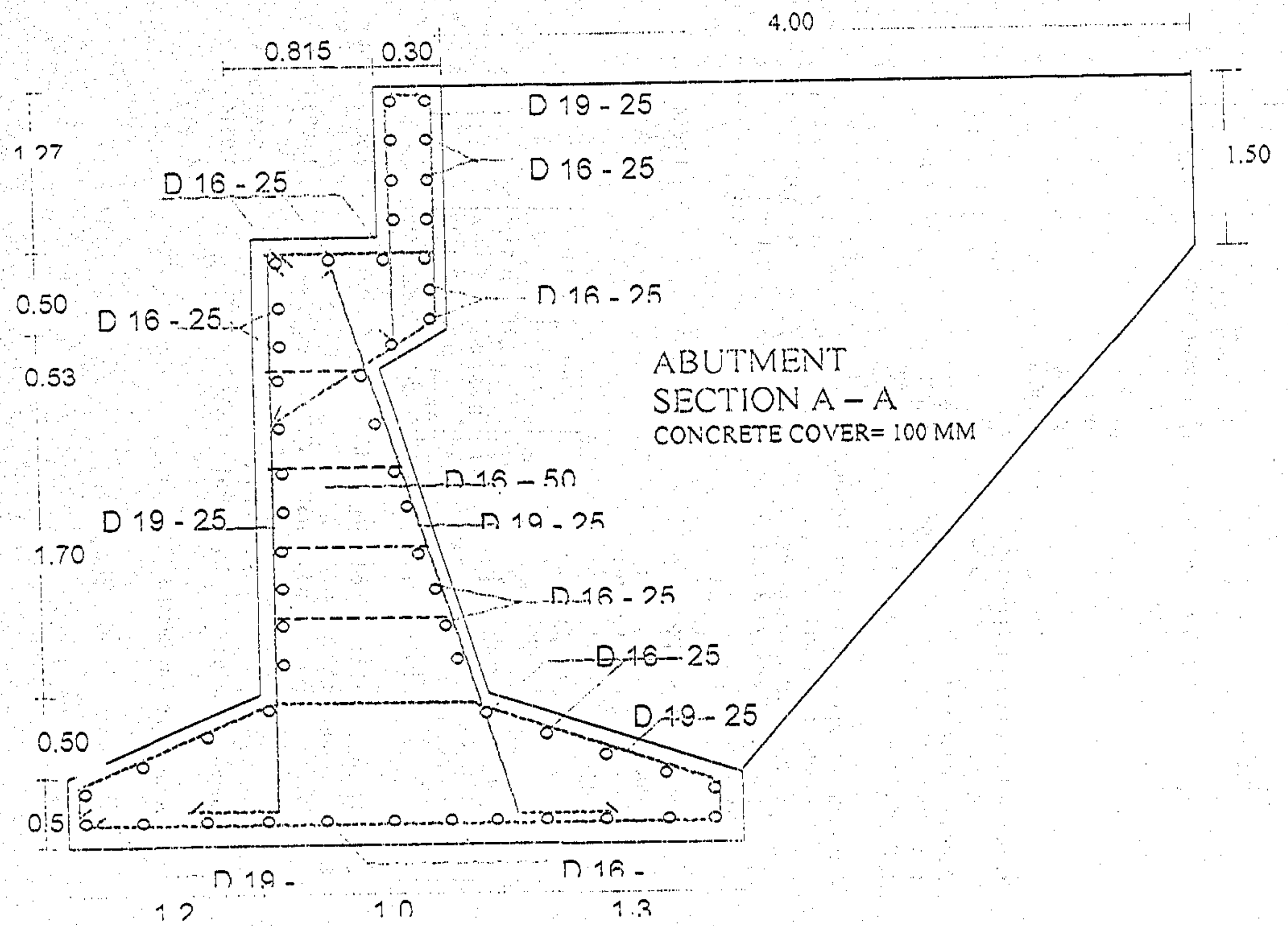


Mmax = qmax * L1*L1/2 = 13.820 ton m / m
Mmax total = 13.820 ton m / m
Mdes = 1.05 * Mmax = 14.511 ton m / m

the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'= 1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy= 1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950
Koefisien k = 0.05
$\rho = k*\rho b$ = 0.00365
As1 = ρ * b * d = 1276.69 mm^2
T1 = As1*fy = 300392.94 N
a1 = T1 / (0.85*fc'*b) = 10.68 mm
Z = d - 0.5 a1 = 344.66 mm
Mr1 = T1 * Z = 103532693 Nmm
103.53 KNm
Mmax = 145.11 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax - Mr1 = 41.58 KNm
As2 = Δ M / fy(d-d') = 589.05 mm^2
As= As1 + As2 = 1865.74 mm^2
the tensile of steel bars : D 19 - 150 As terpsg = 1889 mm^2
the compressive of steel bars D 19 - 150 As' terpsg = 1889 mm^2
Longitudinal steel bars : 20 % As = 373 mm^2
D 13 - 300 Asbagi = 442 mm^2


0.815
0.30
1.27
0.50
0.53
1.70
0.50
0.50
D 19 - 25
D 16 - 25
D 16 - 25
D 16 - 25
D 16 - 25
ABUTMENT
SECTION A – A
CONCRETE COVER= 100 MM
D 16 – 50 / 50
D 19 - 25
D 19 - 25
D 16 - 25
D 16 - 25
D 19 - 25
D 19 - 25
D 16 - 25
0.10
1.20
1.00
1.30


0.10
10 @ 25 = 250 (D 19 – 25)
0.10
0.10
1.27
0.50
0.53
1.70
0.50
0.50
16 @ 25
D 16 - 25
0.80
0.10
0.10
20 @ 12.5 = 250 (D 19 – 12.5)
0.10



ABUTMENT
SECTION A – A
CONCRETE COVER= 100 MM
4.00
0.815
0.30
1.50
1.27
0.50
0.53
1.70
0.50
0.5
D 19 - 25
D 16 - 25
D 16 - 25
D 16 - 25
D 16 - 25
D 16 – 50
D 19 - 25
D 19 - 25
D 16 - 25
D 16 – 25
D 19 – 25
D 19 -
D 16 -
1.2
1.0
1.3

DESIGN OF ABUTMENT FROM MASONRY MATERIAL

File:Masonry-I

Case I : Water is empty + 147.60 (NORMAL CONDITON)

Parameter of soil for bank fill :

ϕ = 30 degree
γ = 1.9 t/m^3
C = 0 t / m^2

Coefficient of active earth pressure :

$$Ka = \frac{\cos^2(\phi-\theta)}{\cos^2(\theta)\cos^2(\theta-\delta)\left[1-\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\delta)}{\cos(\theta+\delta)\cos(\theta-\alpha)}}\right]^2}$$

ϕ = 30 degree
δ = 0 degree
α = 0 degree
θ = 0 degree

Coefficient of active earth pressure :

Ka = 0.333

Acting earth pressure :

pa1 = Ka * γ *H = 1.2654 t /m^2
pa2 = Ka * q = 0.333 t /m^2

The earth pressure under the normal condition :

Height of Abutment	H = 2	m
Width of footing Abutment	B = 1.6	m
Length of footing Abutment	L = 1	m
Load	q = 1	t / m'

Pa1 = 1/2 * γ * H^2 * Ka = 1.2654 t/m
Pa2 = pa2 * H = 0.666 t/m

Compute overturning stability :

Set up table and refer to figure : ....

part	Weight of part (ton/m)		Arm (m)	Moment (ton m)
1	0.3*1.7*2.2 =	1.1730	0.45	0.5279
2	0.5 1.7*0.7*2.3 =	1.3685	0.833333	1.1404
3	0.3*1.6*2.3	1.1040	0.8	0.8832
	Total : Σ Fv' =	3.6455	Σ Mr =	2.5515

Sum of Moments to Resist Overturning : Σ Mr = 2.5515 ton m

Sum of Overturning Moments :

Σ Mo=Pa1*1/3*H+Pa2*H/2= 1.5096 ton m

Total Vertical Force : Σ Fv = Σ Fv' + Pa1v + Pa2v = 3.6455 ton

Total Horizontal Force : Σ Fh = Pa1 + Pa2 = 1.9314 ton

The overturning safety factor is :

$FS = \Sigma Mr / \Sigma Mo =$ 1.690161 > 1.5 Ok

Compute Sliding Force : *Use base soil parameter*

Parameter of soil :

ϕ = 36 degree
γ = 2 t/m^3
C = 18 t / m^2

$Fr = C * B*L + \Sigma Fv * \tan\phi$ Fr = 31.4486 ton

The sliding safety factor is :

$FS = Fr / \Sigma Fh =$ 16.2828 > 1.5 Ok

Located the resultant on the base of footing. From rigid body static and moment summation can be taken at any location. Using the toe, as we already have most of the moments computed :

$\Delta M = \Sigma Mr - \Sigma Mo =$ 1.042 ton m

$x = \Delta M / \Sigma Fv =$ 0.28580 m (*from toe*)

$e = \{ B/2 \} - x =$ 0.51420 m

$B / 6 =$ 0.26667 m

→ e < (B/6) OK
0.51420 < 0.26667
OK

Compute soil pressure :

$q_{max} = \{ \Sigma Fv / B \} * \{ 1 + (6*e)/B \} =$ 6.67188 ton / m
$q_{min} = \{ \Sigma Fv / B \} * \{ 1 - (6*e)/B \} =$ -2.11500 ton / m

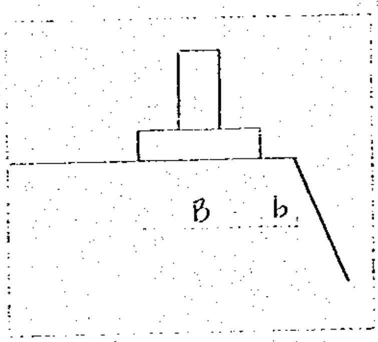
$Q_{max} = q_{max} * L =$ 6.671875 ton
$Q_{min} = q_{min} * L =$ -2.115 ton

Checking of Bearing Capacity on soil :

$$Qu = A' * [\alpha * k * c * Nc + 0.156 * k * q * Nq + 0.5 * \gamma_i * B' * \beta' * N\gamma$$

b= 1.5 m
R = 6
B = 1.6 m

$$\frac{b}{R \times B} = 0.156$$



where :

Qu = ultimate bearing capacity
A' = effective loading area on footing
α, β = coefficient depending on shape of footing
c = cohesion of foundation ground (ton/m^2)
q = ground surface surcharge (t/m^2)

$q = \gamma * Df$

$\gamma 2$ = unit weight of soil on front of abutments (t/m^3) = 1.8 t/m^3
$\gamma 1$ = unit weight of soil of ground foundation (t/m^3) = 2.0 t/m^3
B',L' = width and length of effective loading area
e = distance from entrance of footing to acting point of resultant force on footing (m)
Df = depth from ground surface on front of abutment to bottom of footing (m)
Df' = height of toe (m) = 0.3 m
k = coefficient ⟶ k = (1 + 0,3 * Df' / B')
Nq , Nc , Nγ = bearing capacity factors

A' = L' * B' = (B - 2eb) * (L - 2el)
A' =(B - 2*eb) * (L - 2*el) = 0.571591 m^2
α = (1 + 0.3B'/L') = 1.17148
β = (1 - 4*B'/L') = -1.28636
q = γ2 * Df = 3.6 t/m^2
k = (1 + 0,3 * (Df'/B')) = 1.1575
For tan θ =ΣFh/ ΣFv = 0.530 Nc= 15
ϕ = 36 Nq = 10
Nγ = 4
Qu = 211.29 ton
FS = 3
Qsafe = Qu / FS = 70.43 ton
Checking the bearing capacity is :
Qmax = 6.67 ton < Qsafe = 70.43 ton OK

Name of Structure		Category of calculation		Page	

REINFORCED CONCRETE OF WING WALL ABUTMENT

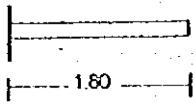
File:RC-WINGNormal

The earth pressure on wingwall of abutment : (*look at cross section 1-1*)

qmax = pa1 + pa2 .

qmax = 3.119 t/m

L1 = 1.8 m   H = 5 m



Mmax = qmax * L1*L1/2 = 5.052 ton m / m

Mmax total = 5.052 ton m / m

Mdes = 1.2 * Mmax = 6.062 ton m / m

the stress concrete fc' = 22.05 Mpa

the yield stress of steel fy = 156.86 Mpa

Dimension of concrete ht = 400 mm

b = 1000 mm

d = 350 mm

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.080514

ρmin = 1.4/fy = 0.008925

Koefisien k = 0.03

ρ = k*ρb = 0.00242

As1 = ρ * b * d = 845.39 mm^2

T1 = As1*fy = 132608.52 N

a1 = T1 / (0.85*fc'*b) = 7.08 mm

Z = d - 0.5 a1 = 346.46 mm

Mr1 = T1 * Z = 45943862 Nmm

45.94 KNm

Mmax = 60.62 KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 = 14.68 KNm

As2 = Δ M / fy(d-d') = 374.34 mm^2

As= As1 + As2 = 1219.74 mm^2

the tensile of steel bars : D 19 - 225   As terpsg = 1259 mm^2

the compressive of steel bars D 19 - 225   As' terpsg = 1259 mm^2

Tulangan bagi : 20 % As = 244 mm^2

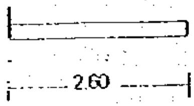
D 13 - 300   Asbagi = 442 mm^2

The earth pressure on wingwall of abutment : (*look at cross section 2-2*)

qmax = pa1 + pa2

qmax = 2.554 t/m

L1 = 2.6 m   H = 4.0 m



Mmax = qmax * L1*L1/2 = 8.633 ton m / m

Mmax total = 8.633 ton m / m

Mdes = 1.20 * Mmax = 10.360 ton m / m

the stress concrete fc' = 22.05 Mpa

the yield stress of steel fy = 156.86 Mpa

Dimension of concrete ht = 400 mm

b = 1000 mm

d = 350 mm

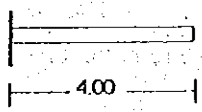
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.080514

ρmin = 1.4/fy = 0.008925

Name of Structure		Category of calculation		Page	

Koefisien k = 0.065
ρ = k*ρb = 0.00523
As1 = ρ * b * d = 1831.69 mm^2
T1 = As1*fy = 287318.47 N
a1 = T1 / (0.85*fc'*b) = 15.33 mm
Z = d - 0.5 a1 = 342.34 mm
Mr1 = T1 * Z = 98359199 Nmm
98.36 KNm
Mmax = 103.60 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 5.24 KNm
As2 = Δ M / fy(d-d') = 111.33 mm^2
As= As1 + As2 = 1943.02 mm^2
the tensile of steel bars : D 19 - 140 As terpsg = 2024 mm^2
the compressive of steel bars D 19 - 140 As' terpsg = 2024 mm^2
Longitudinal steel bars : 20 % As = 389 mm^2
D 13 - 300 Asbagi = 442 mm^2

The earth pressure on wingwall of abutment : (*look at cross section 3-3*)
qmax = pa1 + pa2
qmax = 1.087 t/m
L1 = 4.0 m H = 1.4 m



Mmax = qmax * L1*L1/2 = 8.696 ton m / m
Mmax total = 8.696 ton m / m
Mdes = 1.20 * Mmax = 10.435 ton m / m

the stress concrete fc' = 22.05 Mpa
the yield stress of steel fy = 156.86 Mpa
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.080514
ρmin = 1.4/fy = 0.008925
Koefisien k = 0.06
ρ = k*ρb = 0.00483
As1 = ρ * b * d = 1690.79 mm^2
T1 = As1*fy = 265217.05 N
a1 = T1 / (0.85*fc'*b) = 14.15 mm
Z = d - 0.5 a1 = 342.92 mm
Mr1 = T1 * Z = 90949481 Nmm
90.95 KNm
Mmax = 104.35 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 13.40 KNm
As2 = Δ M / fy(d-d') = 284.85 mm^2
As= As1 + As2 = 1975.64 mm^2
the tensile of steel bars : D 19 - 140 As terpsg = 2024 mm^2
the compressive of steel bars D 19 - 140 As' terpsg = 2024 mm^2
Longitudinal steel bars : 20 % As = 395 mm^2
D 13 - 300 Asbagi = 442 mm^2

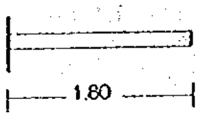
Name of Structure		Category of calculation		Page	

REINFORCED CONCRETE OF WING WALL ABUTMENT

File:RC-WINGgempa

The earth pressure on wingwall of abutment : (*look at* cross section 1-1)

qmax = pa1 + pa2
qmax = 4.956 t/m
L1 = 1.8 m   H = 5 m



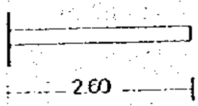
Mmax = qmax * L1*L1/2 = 8.029 ton m / m
Mmax total = 8.029 ton m / m
Mdes = 1.05 * Mmax = 8.430 ton m / m

the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm

ρb = [{(β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950
Koefisien k = 0.04
ρ = k*ρb = 0.00292
As1 = ρ * b * d = 1021.35 mm^2
T1 = As1*fy = 240314.35 N
a1 = T1 / (0.85*fc'*b) = 8.55 mm
Z = d - 0.5 a1 = 345.73 mm
Mr1 = T1 * Z = 83082928 Nmm
83.08 KNm
Mmax = 84.30 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 1.22 KNm
As2 = Δ M / fy(d-d') = 20.72 mm^2
As= As1 + As2 = 1042.07 mm^2
the tensile of steel bars : D 19 - 250 As terpsg = 1134 mm^2
the compressive of steel bars D 19 - 250 As' terpsg = 1134 mm^2
Tulangan bagi : 20 % As = 208 mm^2
D 13 - 300 Asbagi = 442 mm^2

The earth pressure on wingwall of abutment : (*look at* cross section 2-2)

qmax = pa1 + pa2
qmax = 4.059 t/m
L1 = 2.6 m   H = 4.0 m



Mmax = qmax * L1*L1/2 = 13.720 ton m / m
Mmax total = 13.720 ton m / m
Mdes = 1.05 * Mmax = 14.406 ton m / m

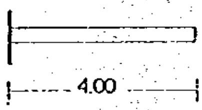
the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm

ρb = [{(β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950

Name of Structure		Category of calculation		Page	

Koefisien k = 0.06
ρ = k*ρb = 0.00438
As1 = ρ * b * d = 1532.03 mm^2
T1 = As1*fy = 360471.53 N
a1 = T1 / (0.85*fc'*b) = 12.82 mm
Z = d - 0.5 a1 = 343.59 mm
Mr1 = T1 * Z = 123854071 Nmm
123.85 KNm
Mmax = 144.06 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 20.21 KNm
As2 = Δ M / fy(d-d') = 286.27 mm^2
As= As1 + As2 = 1818.30 mm^2
the tensile of steel bars : D 19 - 150 As terpsg = 1889 mm^2
the compressive of steel bars D 19 - 150 As' terpsg = 1889 mm^2
Longitudinal steel bars : 20 % As = 364 mm^2
D 13 - 300 Asbagi = 442 mm^2

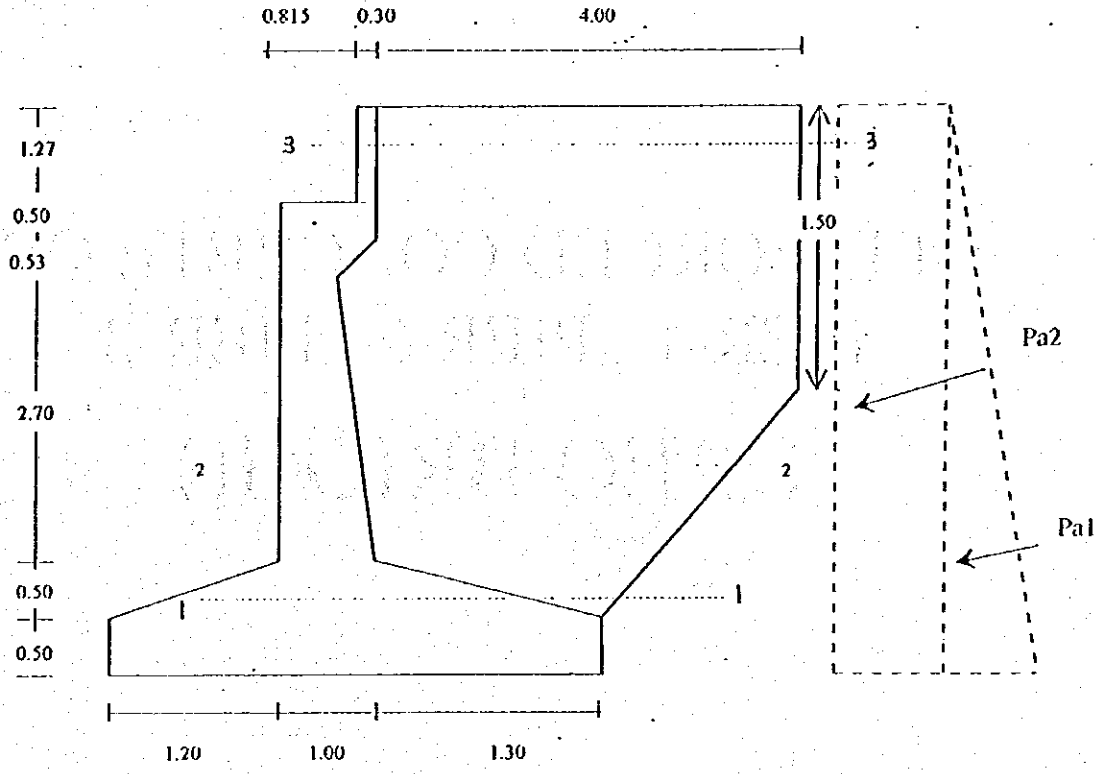
The earth pressure on wingwall of abutment : (*look at cross section 3-3*)
qmax = pa1 + pa2
qmax = 1.728 t/m
L1 = 4.0 m H = 1.4 m

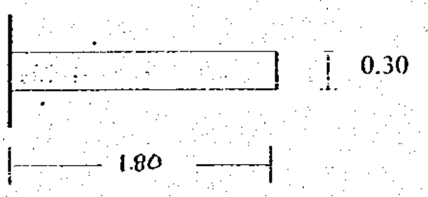


Mmax = qmax * L1*L1/2 = 13.820 ton m / m
Mmax total = 13.820 ton m / m
Mdes = 1.05 * Mmax = 14.511 ton m / m

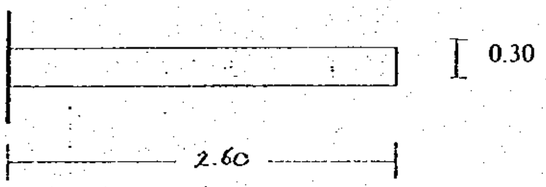
the stress concrete fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 400 mm
b = 1000 mm
d = 350 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.072954
ρmin = 1.4/fy = 0.005950
Koefisien k = 0.05
ρ = k*ρb = 0.00365
As1 = ρ * b * d = 1276.69 mm^2
T1 = As1*fy = 300392.94 N
a1 = T1 / (0.85*fc'*b) = 10.68 mm
Z = d - 0.5 a1 = 344.66 mm
Mr1 = T1 * Z = 103532693 Nmm
103.53 KNm
Mmax = 145.11 KNm
Because Mmax > Mr1 required double reinforced concrete :
ΔM = Mmax -Mr1 = 41.58 KNm
As2 = Δ M / fy(d-d') = 589.05 mm^2
As= As1 + As2 = 1865.74 mm^2
the tensile of steel bars : D 19 - 150 As terpsg = 1889 mm^2
the compressive of steel bars D 19 - 150 As' terpsg = 1889 mm^2
Longitudinal steel bars : 20 % As = 373 mm^2
D 13 - 300 Asbagi = 442 mm^2

Name of Structure		Category of calculation		Page	94

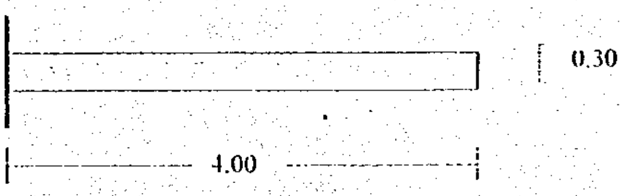




CROSS SECTION 1-1



CROSS SECTION 2-2



CROSS SECTION 3-3

DESIGN OF WING ABUTMENT A-1 = A-2

REINFORCED CONCRETE OF
PIER-1 , PIER-2 , PIER-3

KREO BRIDGE

21:19 Licensed to: Licensee name not yet specified.

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0000000    00000    00000    00000    00000   00
00    00  00   00  00   00  00   00  00   00  00
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00         00000   00   00   00000    00000   00000  (TM)
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Computer program for the Strength Design of Reinforced Concrete Sections

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General Information:
=====================

File Name: A:\KREO-P1.COL
Project: KREO BRIDGE
Column: PIER-1
Engineer: Ir.Purwanto MS.

Code: ACI 318-89
Units: SI Metric
Date: 10/10/99 Time: 18:07:11

Run Option: Investigation
Run Axis: Biaxial

Short (nonslender) column
Column Type: Structural

Material Properties:
====================

f'c = 33.075 MPa
Ec = 29076 MPa
fc = 15.0549 MPa
eu = 0.003 mm/mm
Stress Profile: Block

fy = 235.29 MPa
Es = 210000 MPa
erup = 0 mm/mm
Beta1 = 0.810152

Geometry:
=========

Rectangular: Width = 2000 mm   Depth = 900 mm

Gross section area, Ag = 1.8e+006 mm^2
Ix = 1.215e+011 mm^4   Xo = 0 mm
Iy = 6e+011 mm^4   Yo = 0 mm

Reinforcement:
==============

Rebar Database: User-defined

Size	Diam	Area	Size	Diam	Area	Size	Diam	Area
10	11	100	15	16	200	19	19	284
20	20	300	25	25	500	30	30	700
35	36	1000	45	44	1500	55	56	2500

Confinement: Tied; phi(c) = 0.7, phi(b) = 0.9, a = 0.8
N-15 ties with N-55 bars, N-15 with larger bars.

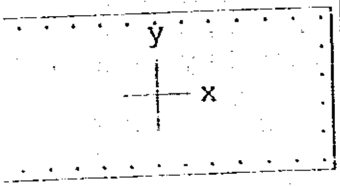
Layout: Rectangular
Pattern: Sides Different [Cover to transverse reinforcement (ties)]

Total steel area, As = 9639 mm^2 at 0.54%

	Top	Bottom	Left	Right
Bars	13 N-19	13 N-19	4 N-19	4 N-19
Cover(mm)	30	30	30	30

	Applied Loads			Computed Strength			Computed/
Pt.	P (kN)	Mx (kN-m)	My (kN-m)	P (kN)	Mx (kN-m)	My (kN-m)	Applied Ray length
1	1204	0	0	-2041	-0	-0	1.695
2	1186	0	0	-2041	-0	-0	1.721
3	1186	959	959	1659	1357	1361	1.409
4	1186	515	515	4410	1952	1947	3.736

Program completed as requested!



2000 x 900 mm

f'c = 33 MPa

fy = 235 MPa

Confinement: Tied

clr cover = 46 mm

spacing = 138 mm

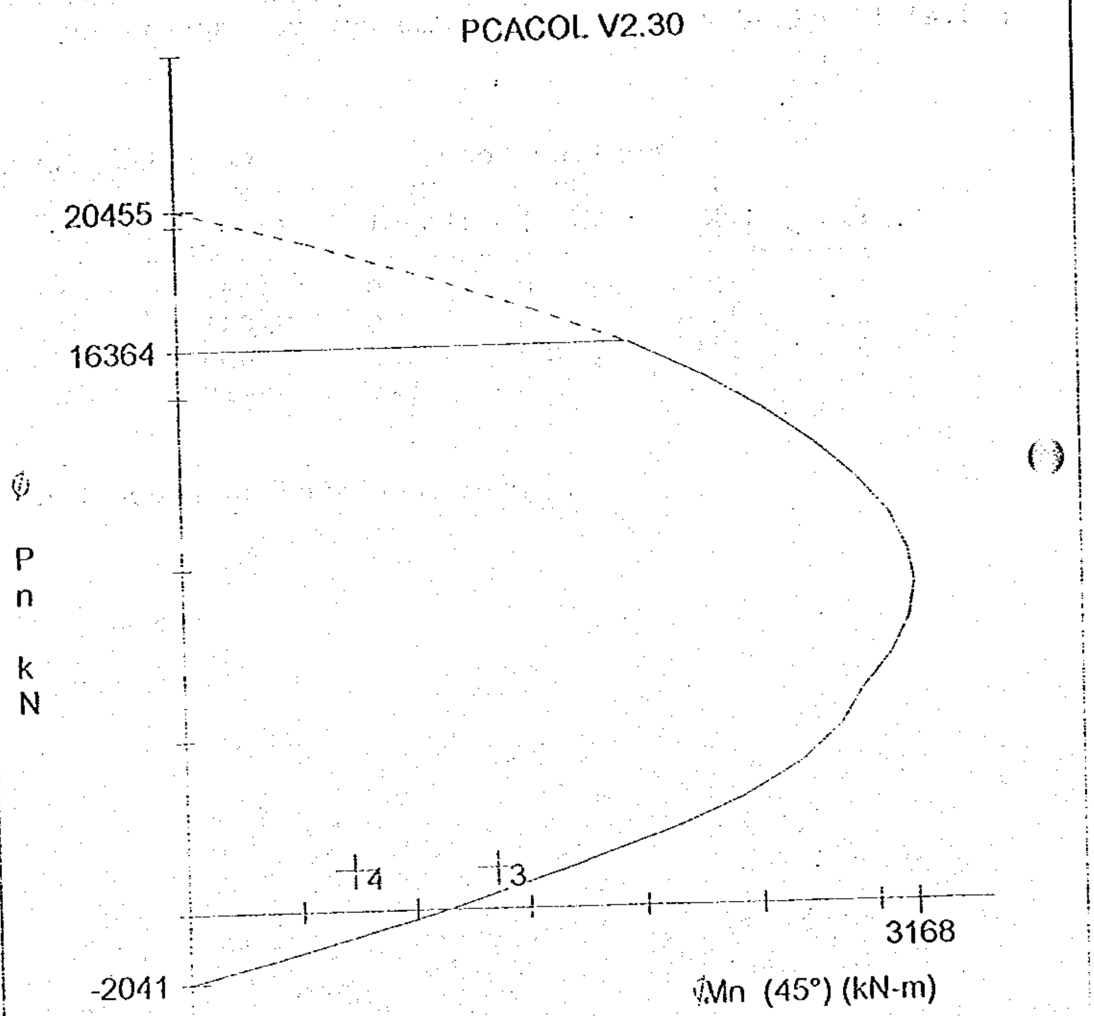
34 N-19 at 0.54%

As = 9639 mm^2

Ix = 1.215e+011 mm^4

Iy = 6.000e+011 mm^4

Xo = 0 mm



Licensed To: Licensee name not yet specified.

File name: A:\KREO-P1.COL

Project: KREO BRIDGE

Column Id: PIER-1

Engineer: Ir.Purwanto MS.

Date: 10/10/99 Time: 18:07:11

Code: ACI 318-89

Units: Metric

Material Properties:

Ec = 29076 MPa eu = 0.003 mm/mm

fc = 15.05 MPa Es = 210000 MPa

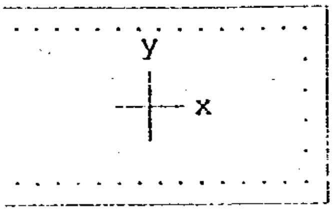
Beta1 = 0.81

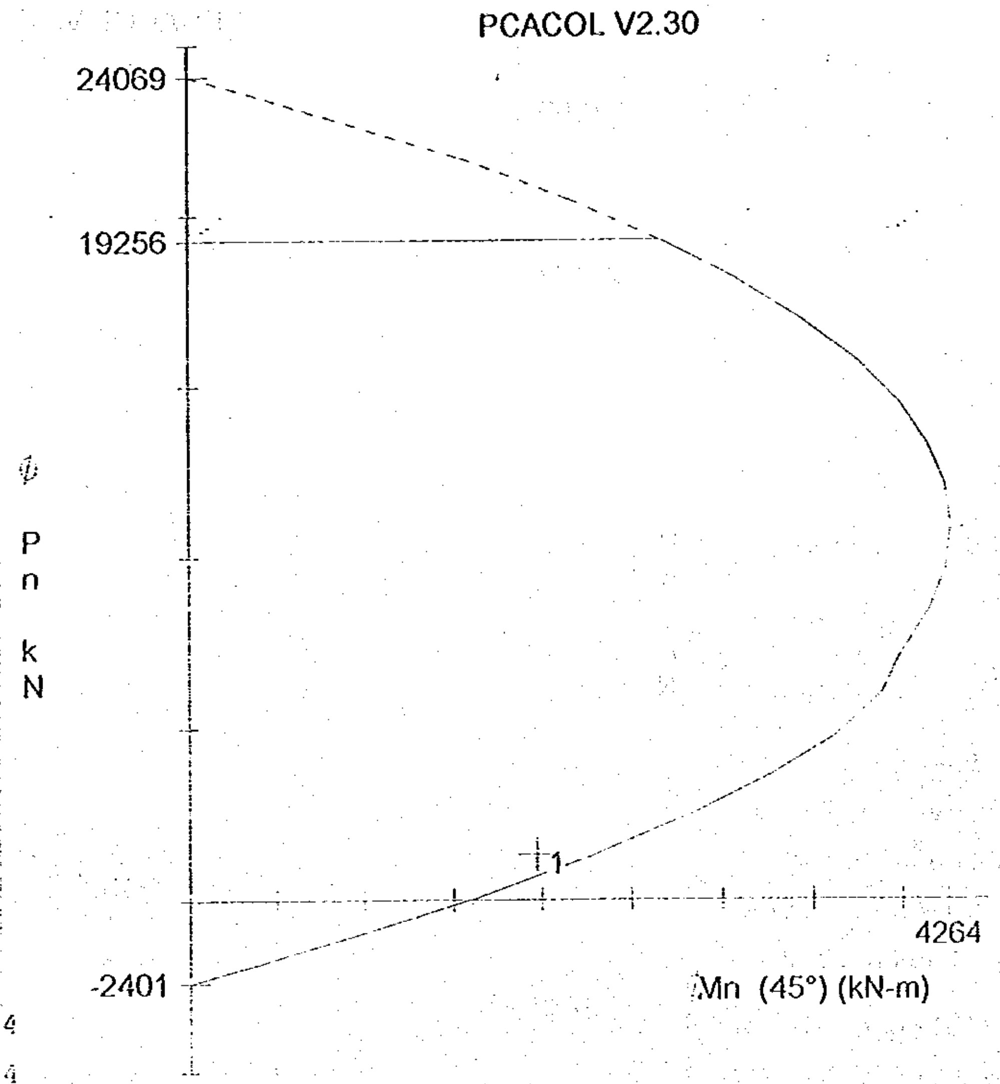
Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90

X-axis slenderness is not considered.

Y-axis slenderness is not considered.





2000 x 1100 mm

'c = 33 MPa

y = 235 MPa

onfinement: Tied

lr cover = 111 mm

pacing = 98 mm

40 N-19 at 0.52%

.s = 11340 mm^2

x = 2.218e+011 mm^4

y = 7.333e+011 mm^4

:c = 0 mm

.1993 PCA

icensed To: Licensee name not yet specified.

ile name: A:\KREO-P?.COL

roject: KREO BRIDGE

olumn Id: PIER-?

ngineer: Ir.Purwanto, MS

ate: 10/28/99 Time: 07:00:50

ode: ACI 318-89

nits: Metric

-axis slenderness is not considered.

-axis slenderness is not considered.

Material Properties:

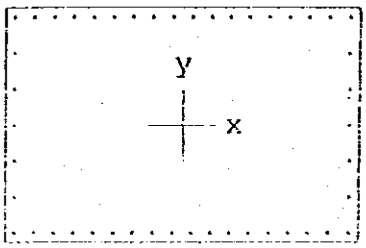
Ec = 29076 MPa eu = 0.003 mm/mm

fc = 14.49 MPa Es = 210000 MPa

Beta1 = 0.81

Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90



2000 x 1300 mm

f'c = 33 MPa

fy = 235 MPa

Confinement: Tied

clr cover = 41 mm

spacing = 93 mm

46 N-19 at 0.50%

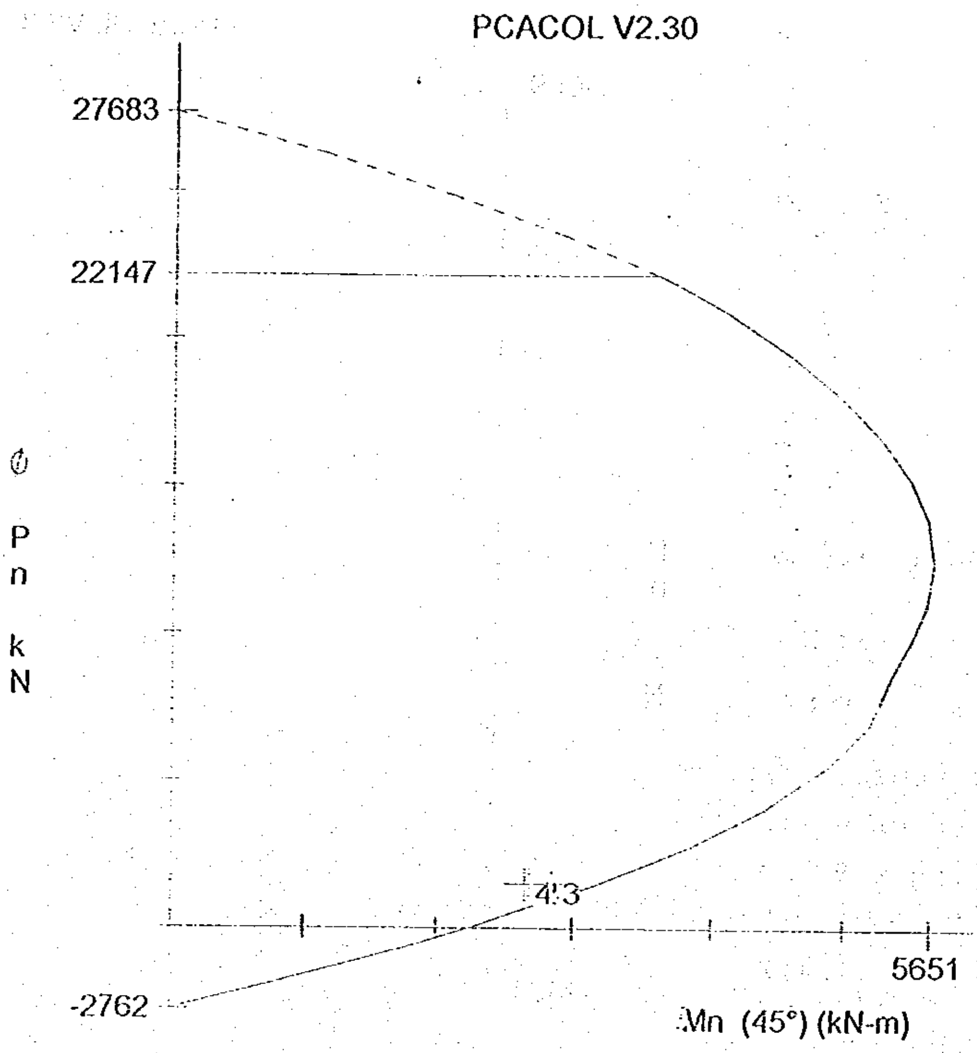
As = 13041 mm^2

Ix = 3.662e+011 mm^4

Iy = 8.667e+011 mm^4

Xo = 0 mm

Yo = 0 mm



Licensed To: Licensee name not yet specified.

File name: A:\KREO-P2.COL

Project: KREO BRIDGE

Column Id: PIER-2

Engineer: I.Purwanto, MS

Date: 10/28/99 Time: 04:44:58

Code: ACI 318-89

Units: Metric

X-axis slenderness is not considered.

Y-axis slenderness is not considered.

Material Properties:

Ec = 29076 MPa eu = 0.003 mm/mm

fc = 14.10 MPa Es = 210000 MPa

Beta1 = 0.81

Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90

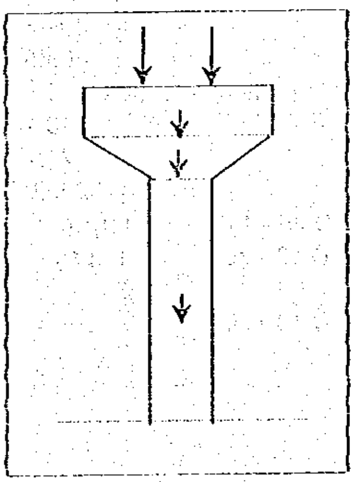
REINFORCED CONCRETE OF PIER-1 (P-1) : *File:RC-P1-1-3*

The earth pressure under the normal condition :

Height of Abutment	H =	6.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	3.5	m

part	Weight of part *(ton)*	
1	1.6*0.4*2.5*2.7 =	4.3200
2	(1.6+0.9)/2*0.4*2.5*(2.7+2)/2=	2.9375
3	0.7*4.3*2.5*2.0 =	19.3500
4	P1	46
5	P2	46
	Total : Σ Fv =	118.6075

Bending moment = 1.2*M =	0.000 ton m /m =	0.00 KNm/m
Normal force N =	118.61 ton / m =	1186.08 N/m
the concrete stress fc' =		22.05 Mpa
the yeild stree of steel fy =		156.86 Mpa



REINFORCED CONCRETE OF PIER-1 ON TOE AND HEEL

File:RC-P1-1-3

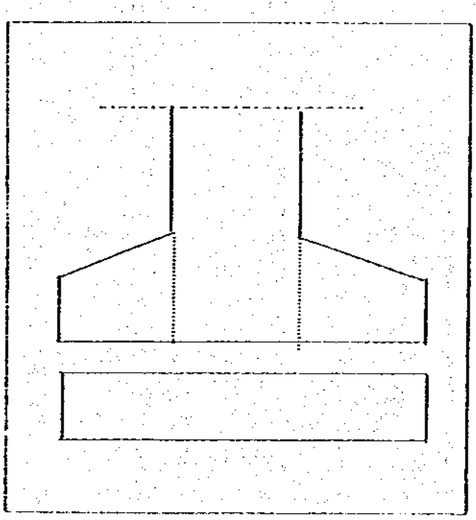
Compute soil pressure :

q_{max} =	39.991 t/m		
L1 =	1.3 m		
Mmax = qmax * L1*L1/2 =		33.792	ton m / m
Mmax total =		33.792	ton m / m
Mdes = 1.2 * Mmax =		40.551	ton m / m
the concrete stress fc' =		22.05	Mpa
the yield stress of steel fy =		156.86	Mpa
Dimension of concrete ht =		900	mm
b =		1000	mm
d =		800	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =		0.0805	
ρmin = 1.4/fy =		0.0089	
Koefisien k =		0.05	
ρ = k*ρb =		0.00403	
As1 = ρ * b * d =		3220.55	mm^2
T1 = As1*fy =		505175.33	N
a1 = T1 / (0.85*fc'*b) =		26.95	mm
Z = d - 0.5 a1 =		786.52	mm
Mr1 = T1 * Z =		397332151	Nmm
		397.33	KNm
Mmax =		405.51	KNm

Because Mmax > Mr1 required double reinforced concrete

ΔM = Mmax -Mr1 =		8.18	KNm
As2 = Δ M / fy(d-d') =		74.47	mm^2
As= As1 + As2 =		3295.02	mm^2

dipakai tulangan tarik :	D 25 - 145	As terpsg =	3384	mm^2
dipakai tulangan tekan :	D 16 - 300	As' terpsg =	670	mm^2
Tulangan bagi : 20 % As =			659	mm^2
	D 13 - 200		663	mm^2



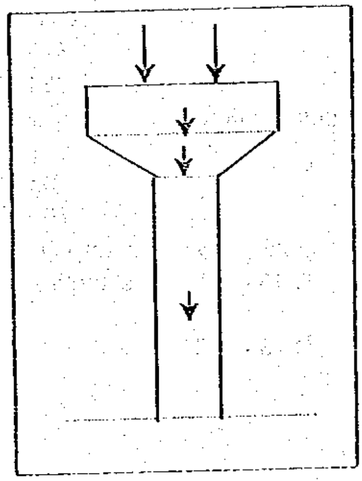
REINFORCED CONCRETE OF PIER -1 (P-1) :

The earth pressure under the normal condition (Case-II) :

Height of Abutment	H =	6.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	3.5	m

part	Weight of part (ton)	
1	1.6*0.4*2.5*2.7 =	4.320
2	(1.6+0.9)/2*0.4*2.5*(2.7+2)/2=	2.938
3	0.9*4.3*2.5*2.0 =	19.350
4	P1	46.000
5	P2	46.000
	Total : Σ Fv =	118.608

Bending moment = 1.2*M =	0.000 ton m /m =	0.00 KNm/m
Normal force N =	118.61 ton / m =	1186.08 N/m
the concrete stress fc' =		22.05 Mpa
the yield stress of steel fy =		156.86 Mpa



REINFORCED CONCRETE OF PIER-1 ON TOE AND HEEL

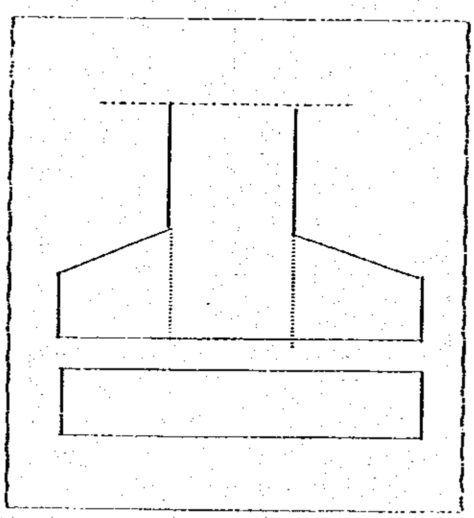
File:RC-P1-2-3

Compute soil pressure :

q_{max} =	32.9420 t/m	
L1 =	1.3 m	
Mmax = qmax * L1*L1/2 =		27.836 ton m / m
Mmax total =		27.836 ton m / m
Mdes = 1.2 * Mmax =		33.403 ton m / m
the concrete stress fc' =		22.05 Mpa
the yield stress of steel fy =		156.86 Mpa
Dimension of concrete ht =		900 mm
b =		1000 mm
d =		800 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =		0.080514
ρmin = 1.4/fy =		0.008925
Koefisien k =		0.041
ρ = k*ρb =		0.00330
As1 = ρ * b * d =		2640.85 mm^2
T1 = As1*fy =		414243.77 N
a1 = T1 / (0.85*fc'*b) =		22.10 mm
Z = d - 0.5 a1 =		788.95 mm
Mr1 = T1 * Z =		326817241 Nmm
		326.82 KNm
Mmax =		334.03 KNm

Because Mmax > Mr1 required double reinforced

ΔM = Mmax -Mr1 =			7.21 KNm
As2 = Δ M / fy(d-d') =			65.71 mm^2
As= As1 + As2 =			2706.56 mm^2
tensile reinforced :	D 25 - 175	As terpsg =	2804 mm^2
compresive reinforced	D 16 - 300	As' terpsg =	670 mm^2
Longitudinal steel: 20 % As =			541 mm^2
	D 13 - 200		663 mm^2



REINFORCED CONCRETE OF PIER - 1 (P-1) : *File:RC-P1-3-3*

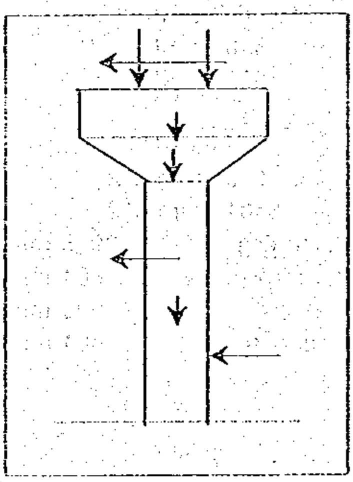
The earth pressure under the earthquake condition (Case III) :

Height of Abutment	H =	6.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	3.5	m

Long Section :

part	Weight of part (ton/m)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+0.9)/2*0.4*2.5*(2.7+2)/2=	2.94	0.000	0.000
3	0.90*4.3*2.5*2 =	19.35	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 0.9315	0.9315	0.201	0.188
7	KP = 13.800	13.80	5.170	71.346
8	KW = 3.992	3.99	2.100	8.383
	Total : Σ Fv =	118.61	ΣMr =	79.917

Bending moment = 1.2*M =	95.900 ton m /m =	959.00 KNm/m	
Normal force N =	118.61 ton / m =	1186.08 N/m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER-1 ON TOE AND HEEL : *File:RC-P1-3-3*

Compute soil pressure :

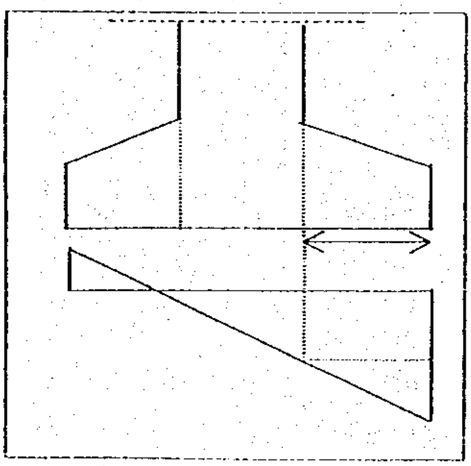
qmax =	88.3362 t/m	weight of concrete q =	1.68 t/m
qmin =	-15.8713 t/m	qmin -q =	14.1913 t/m
		L1 =	1.3 m

q1 = qmax-qmin =	72.4649	t/m
Mmax1 = (qmin-q) * L1*L1/2 =	11.992	ton m / m
Mmax2 = 1/2*q1*L1*(2/3)*L1 =	40.822	ton m / m
Mmax total =	52.814	ton m / m
Mdes = 1.2 * Mmax =	63.376	ton m / m
the concrete stress fc' =	33.075	Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29	Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht =	900	mm
b =	1000	mm
d =	800	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.07295	
ρmin = 1.4/fy =	0.00595	
Koefisien k =	0.05	
ρ = k*ρb =	0.00365	
As1 = ρ * b * d =	2918.15	mm^2
T1 = As1*fy =	686612.43	N
a1 = T1 / (0.85*fc'*b) =	24.42	mm
Z = d - 0.5 a1 =	787.79	mm
Mr1 = T1 * Z =	540905498	Nmm
	540.91	KNm
Mmax =	633.76	KNm

Because Mmax > Mr1 required double reinforced

ΔM = Mmax -Mr1 =	92.86	KNm
As2 = Δ M / fy(d-d') =	563.78	mm^2
As= As1 + As2 =	3481.94	mm^2

use tensile reinforced concrete :	D 25 - 125	As terpsg =	3925 mm^2
use compressive reinforced con.	D 16 - 250	As' terpsg =	804 mm^2
Longitudinal steel bars : 20 % As =			696 mm^2
	D 13 - 150	Asbagi =	884 mm^2



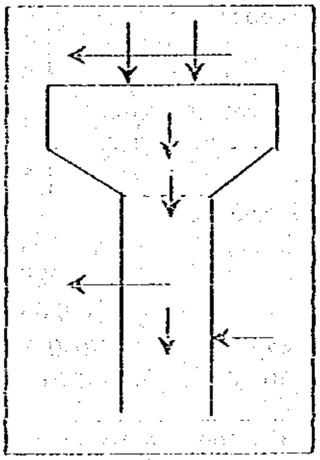
REINFORCED CONCRETE OF PIER-1 (P-1) : *File:RC-P1-4-3*

The earth pressure under theearthquake condition (Case IV):

Height of Abutment	H =	6.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	3.5	m

part	Weight of part (ton/m)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+0.9)/2*0.4*2.5*(2.7+2)/2=	2.94	0.000	0.000
3	0.9*4.3*2.5*2.0 =	19.35	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 2.2365	2.24	0.201	0.450
7	KP = 6.900	6.90	5.170	35.673
8	KW = 3.237	3.24	2.100	6.798
	Total : Σ Fv =	118.61	ΣMr =	42.921

Bending moment = 1.2*M =	51.505 ton m /m =	515.05 KNm/m	
Normal force N =	118.61 ton / m =	1186.08 N/m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*

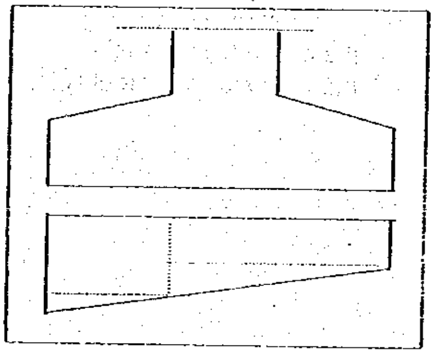


REINFORCED CONCRETE OF PIER-1 (P-1) :

File:RC-P1-4-3

Compute soil pressure :

qmax =	62.571	t/m
qmin =	5.8338	t/m
qmax-qmin =	56.7372	t/m
q1 =	34.04232	t/m
q2=q1+(qmax-qmin)=	39.87612	t/m
q3 = qmax-q2 =	22.69488	t/m
L1 =	1.3	m
Mmax = 0.5*q2*L1^2 =	33.695	
Mmax = 1/2*q3 * L1*2/3*L1 =	12.785	ton m / m
Mmax total =	46.480	ton m / m
Mdes = 1.2 * Mmax =	55.776	ton m / m
thr concrete stress fc' =	33.075	Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29	Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht =	900	mm
b =	1000	mm
d =	800	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.072953848	
ρmin = 1.4/fy =	0.005950104	
coeficient k =	0.05	
ρ = k*ρb =	0.00365	
As1 = ρ * b * d =	2918.15	mm^2
T1 = As1*fy =	686612.43	N
a1 = T1 / (0.85*fc'*b) =	24.42	mm
Z = d - 0.5 a1 =	787.79	mm
Mr1 = T1 * Z =	540905498	Nmm
	540.91	KNm
Mmax =	557.76	KNm



Because Mmax > Mr1 required double reinforced

ΔM = Mmax -Mr1 =	16.86	KNm
As2 = Δ M / fy(d-d') =	102.34	mm^2
As= As1 + As2 =	3020.49	mm^2

tensile reinforced	D 25 - 150	As terpsg =	3271 mm^2
compressive reinforced	D 16 - 300	As' terpsg =	670 mm^2
Longitudinal steel bars : 20 % As =			604 mm^2
	D 13 - 200	Asbagi =	663 mm^2

REINFORCED CONCRETE OF PIER -1 :

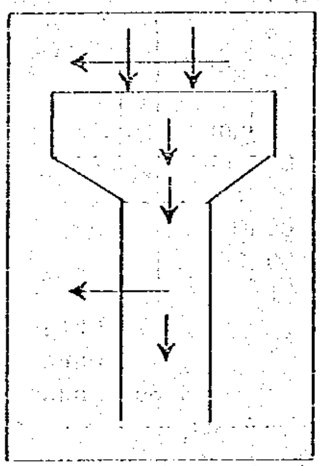
File:RC-P1-5-3

The earth pressure under the earthquake condition (Case V):

Height of Abutment	H =	6.0	m
Width of footing Abutment	B =	3.5	m
Length of footing Abutment	L =	3.5	m

part	Weight of part *(ton/m)*		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+0.9)/2*0.4*2.5*(2.7+2)/2=	2.94	0.000	0.000
3	0.7*4.3*2.5*2 =	19.35	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	KP = 13.8	13.80	5.170	71.346
7	KW = 3.992	3.99	2.100	8.383
	Total : ΣFv =	118.61	ΣMr =	79.729

Bending moment = 1.2*M =	95.675 ton m /m =	956.75 KNm/m	
Normal force N =	118.61 ton / m =	1186.08 N/m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER - 1 ON TOE AND HEEL :

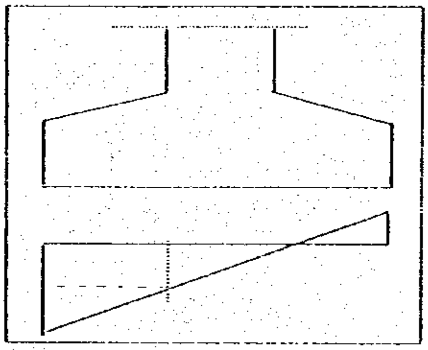
File:RC-P1-5-3

Compute soil pressure :

qmax = 91.5927 t/m
qmin = -11.6098 t/m
weight of concrete q = 1.75 ton m / m
q1 = 50.05406 t/m
q2 = 41.53864 t/m
q3 =q1-q= 48.30406 t/m

L1 = 1.3 m
Mmax = 1/2*q2 * L1*L1*(2/3) = 23.400 ton m / m
Mq = 1/2*q3*L1^2 = 40.817 ton m / m
Mmax total = 64.217 ton m / m
Mdes = 1.2 * Mmax = 77.060 ton m / m

the concrete stress fc' = 33.075 Mpa *(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*
Dimension of concrete ht = 900 mm
b = 1000 mm
d = 800 mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] = 0.07295
ρmin = 1.4/fy = 0.00595
coeficient k = 0.071
ρ = k*ρb = 0.00518
As1 = ρ * b * d = 4143.78 mm^2
T1 = As1*fy = 974989.66 N
a1 = T1 / (0.85*fc'*b) = 34.68 mm
Z = d - 0.5 a1 = 782.66 mm
Mr1 = T1 * Z = 763085321 Nmm
763.09 KNm
Mmax = 770.60 KNm



Because Mmax > Mr1 required double reinforced :
ΔM = Mmax -Mr1 = 7.52 KNm
As2 = Δ M / fy(d-d') = 45.65 mm^2
As= As1 + As2 = 4189.43 mm^2
tensile reinforced : D 25 - 115 As terpsg = 4266 mm^2
compressive reinforced D 16 - 220 As' terpsg = 913 mm^2
Longitudinal steel : 20 % As = 838 mm^2
D 13 - 150 Asbagi = 884 mm^2

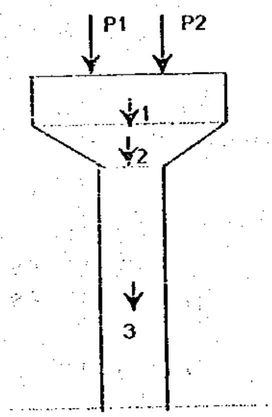
REINFORCED CONCRETE OF PIER-2 (P-2) :

The earth pressure under the normal condition Case I):

Height of Pier	H =	10.00	m
Width of footing Pier	B =	4.55	m
Length of footing Pier	L =	4.55	m

part	Weight of part (ton)	
1	1.6*0.4*2.5*2.7 =	4.32
2	(1.6+1.3)/2*0.4*2.5*(2.7+2)/2=	3.41
3	1.3*8*2.5 =	52.00
4	P1	46.00
5	P2	46.00
	Total : Σ Fv =	151.728

Bending moment = 1.2*M =	0.000 ton m /m =	0.00 KNm/m
Normal force N =	59.73 ton / m =	597.28 KN/m
the concrete stress fc' =		22.05 Mpa
the yield stress of steel fy =		156.86 Mpa



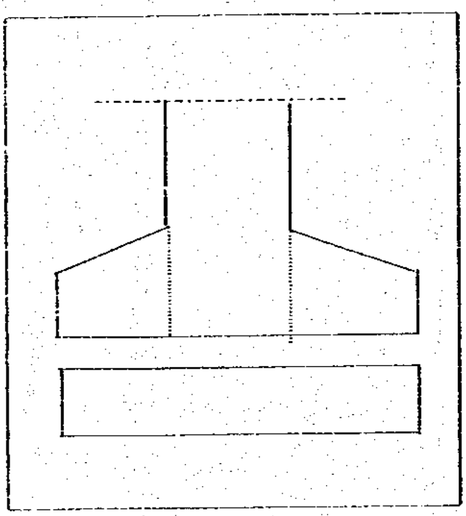
REINFORCED CONCRETE OF PIER -1 ON TOE AND HEEL :

File:RC-P2-1-3

Compute soil pressure :

qmax =	9.792 t/m	
L1 =	1.625 m	
Mmax = qmax * L1*L1/2 =		12.929 ton m / m
Mmax total =		12.929 ton m / m
Mdes = 1.2 * Mmax =		15.514 ton m / m
the concrete stress fc' =		22.05 Mpa
the yield stress of steeel fy =		156.86 Mpa
Dimension of concrete ht =		1300 mm
b =		1000 mm
d =		1100 mm

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =			0.08051	
ρmin = 1.4/fy =			0.00893	
coeficient k =			0.01	
ρ = k*ρb =			0.00081	
As1 = ρ * b * d =			885.65 mm^2	
T1 = As1*fy =			138923.22 N	
a1 = T1 / (0.85*fc'*b) =			7.41 mm	
Z = d - 0.5 a1 =			1096.29 mm	
Mr1 = T1 * Z =			152300674 Nmm	
			152.30 KNm	
Mmax =			155.14 KNm	
Because Mmax > Mr1 required double reinforced :				
ΔM = Mmax -Mr1 =			2.84 KNm	
As2 = Δ M / fy(d-d') =			18.11 mm^2	
As= As1 + As2 =			903.76 mm^2	
tensile reinforced :	D 19 - 250	As terpsg =		1134 mm^2
compressive reinforced	D 13 - 250	As' terpsg =		531 mm^2
Longitudinal steel : 20 % As =				181 mm^2
use longitudinal steel	D 13 - 250			531 mm^2



REINFORCED CONCRETE OF PIER-2 (P-2) ON TOE AND HEEL :

Compute soil pressure : *File:RC-P2-2-3*

q_{max} = 6.083 t/m

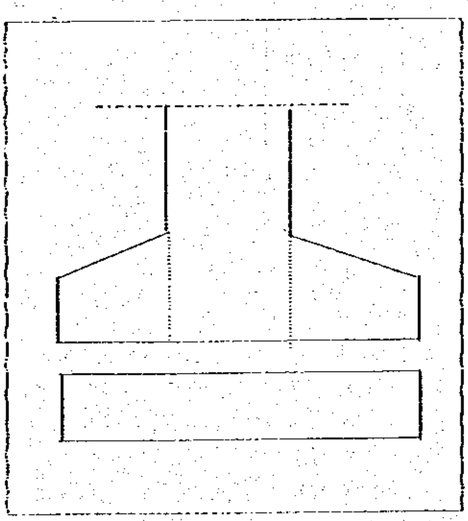
L1 = 1.625 m

Mmax = qmax * L1*L1/2 =	8.031	ton m / m
Mmax total =	8.031	ton m / m
Mdes = 1.2 * Mmax =	9.638	ton m / m
the concrete stress fc' =	22.05	Mpa
the yield stress of steel fy =	156.86	Mpa
Dimension of concrete ht =	1300	mm
b =	1000	mm
d =	1100	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.08051	
ρmin = 1.4/fy =	0.00893	
Koefisien k =	0.006	
ρ = k*ρb =	0.00048	
As1 = ρ * b * d =	531.39	mm^2
T1 = As1*fy =	83353.93	N
a1 = T1 / (0.85*fc'*b) =	4.45	mm
Z = d - 0.5 a1 =	1097.78	mm
Mr1 = T1 * Z =	91503971	Nmm
	91.50	KNm
Mmax =	96.38	KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =	4.87	KNm
As2 = Δ M / fy(d-d') =	31.07	mm^2
As= As1 + As2 =	562.46	mm^2

tensile reinforced concrete	D 19 - 250	As terpsg =	1133.54 mm^2
compressive reinforced concrete	D 13 - 250	As' terpsg =	530.66 mm^2
Longitudinal steel : 20 % As =			112.49 mm^2
use Longitudinal steel	D 13 - 250		530.66 mm^2



REINFORCED CONCRETE OF PIER-3 (P-3) :

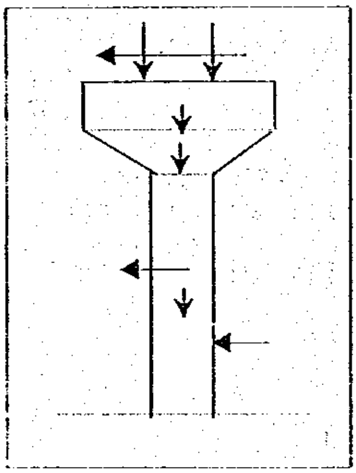
File:RC-P2-3-3

The earth pressure under the earthquake condition (Case III) :

Height of Pier :	H =	10.00	m
Width of footing Pier	B =	4.55	m
Length of footing Pier	L =	4.55	m

part	Weight of part (ton)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+1.3)/2*0.4*2.5*(2.7+2)/2=	3.41	0.000	0.000
3	1.3*8*2.5 =	52.00	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 2.7315 / 2.0	2.73	1.616	4.413
7	KP = 13.800 /2.0	13.80	8.870	122.406
8	KW = 8.342	8.34	3.800	31.700
	Total : Σ Fv =	151.73	ΣMr =	158.519

Bending moment = 1.2*M =	190.223 ton m /m =	1902.23 KNm/m	
Normal force N =	151.73 ton / m =	1517.28 N/m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress of steel fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER-2 ON TOE AND HEEL :

File:RC-P2-3-3

Compute soil pressure :

qmax =	98.9245 t/m	weight of concrete q=	2.5 t/m
qmin =	-32.2884 t/m	q1-q =	47.9888 t/m
q1 =	50.4888 t/m		
L1 =	1.625 m		

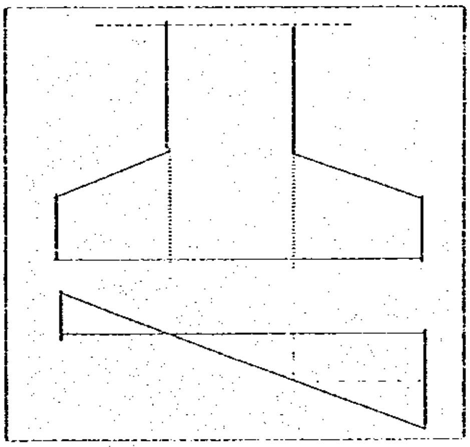
M1 = (q1-q) * L1*L1/2 =	63.360 ton m / m
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =	42.634 ton m / m
Mmax total =	105.994 ton m / m
Mdes = 1.2 * Mmax =	127.192 ton m / m

Mutu beton fc' =	33.075 Mpa	*(earthquake condition fc'=1.5xfc')*
Mutu baja fy =	235.29 Mpa	*(earthquake condition fy=1.5xfy)*
Dimensi beton ht =	1200 mm	
b =	1000 mm	
d =	1100 mm	

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.072953848
ρmin = 1.4/fy =	0.005950104
Koefisien k =	0.06
ρ = k*ρb =	0.00438
As1 = ρ * b * d =	4814.95 mm^2
T1 = As1*fy =	1132910.52 N
a1 = T1 / (0.85*fc'*b) =	40.30 mm
Z = d - 0.5 a1 =	1079.85 mm
Mr1 = T1 * Z =	1223374904 Nmm
	1223.37 KNm
Mmax =	1271.92 KNm

Karena Mmax > Mr1 maka perlu tulangan rangkap

ΔM = Mmax -Mr1 =			48.55 KNm
As2 = Δ M / fy(d-d') =			206.34 mm^2
As= As1 + As2 =			5021.29 mm^2
dipakai tulangan tarik :	D 29 - 125	As terpsg =	5281.48 mm^2
dipakai tulangan tekan :	D 16 - 200	As' terpsg =	803.84 mm^2
Tulangan bagi : 20 % As =			1004.259 mm^2
	D 13 - 125	Asbagi =	1061.32 mm^2



REINFORCED CONCRETE OF PIER -2 (P-2)

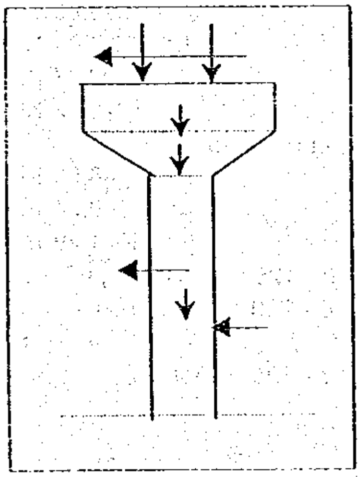
File:RC-P2-4-3

The earth pressure under the earthquake condition (Case IV) :

Height of Pier :	H =	10.00	m
Width of footing Pier	B =	4.55	m
Length of footing Pier	L =	4.55	m

part	Weight of part (ton/m)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.320	0.000	0.000
2	(1.6+1.3)/2*0.4*2.5*(2.7+2)/2=	3.408	0.000	0.000
3	1.3*8.0*2.5*2.0 =	52.000	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 4.0365	4.04	2.859	11.539
7	KP = 13.800	13.80	8.870	122.406
8	KW = 8.959	8.96	3.800	34.044
	Total : Σ Fv =	151.73	ΣMr =	167.989

Bending moment = 1.2*M =	201.587 ton m /m =	2015.87 KNm/m	
Normal force N =	151.73 ton / m =	1517.28 N/m	
Mutu Beton fc' =	33.075 Mpa	*(earthquake condition fc'=1.5xfc')*	
Tulangan Baja fy =	235.29 Mpa	*(earthquake condition fy=1.5xfy)*	



REINFORCED CONCRETE OF PIER-2 ON TOE AND HEEL :

File:RC-P2-4-3

Compute soil pressure :

qmax =	68.9547 t/m	weight of concrete q=	2.5 t/m
qmin =	-3.9186 t/m	q1-q =	32.6633 t/m
q1 =	35.1633 t/m		
L1 =	1.625 m		

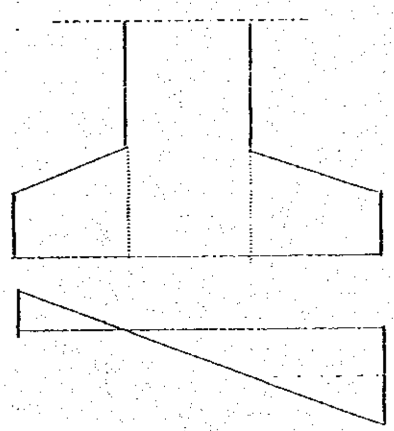
M1 = (q1-q) * L1*L1/2 =	43.126 ton m / m
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =	29.744 ton m / m
Mmax total =	72.869 ton m / m
Mdes = 1.2 * Mmax =	87.443 ton m / m

Mutu beton fc' =		33.075 Mpa	*(earthquake condition fc'=1.5xfc')*
Mutu baja fy =		235.29 Mpa	*(earthquake condition fy=1.5xfy)*
Dimensi beton	ht =	1200 mm	
	b =	1000 mm	
	d =	1100 mm	

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.07295
ρmin = 1.4/fy =	0.00595
Koefisien k =	0.04
ρ = k*ρb =	0.00292
As1 = ρ * b * d =	3209.97 mm^2
T1 = As1*fy =	755273.68 N
a1 = T1 / (0.85*fc'*b) =	26.86 mm
Z = d - 0.5 a1 =	1086.57 mm
Mr1 = T1 * Z =	820655861 Nmm
	820.66 KNm
Mmax =	874.43 KNm

Karena Mmax > Mr1 maka perlu tulangan rangkap

ΔM = Mmax -Mr1 =		53.77 KNm	
As2 = ΔM / fy(d-d') =		22.85 mm^2	
As= As1 + As2 =		3232.82 mm^2	
dipakai tulangan tarik :	D 29 - 200	As terpsg =	3300.93 mm^2
dipakai tulangan tekan :	D 16- 300	As' terpsg =	669.87 mm^2
Tulangan bagi : 20 % As =			646.5648 mm^2
	D 13 - 200	Asbagi =	663.325 mm^2



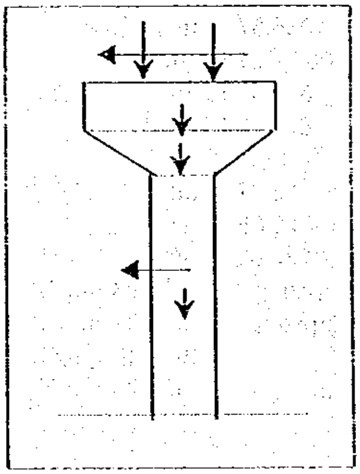
REINFORCED CONCRETE OF PIER -2 (P-2) : *File:RC-P2-5-3*

The earth pressure under the earthquake condition (Case V) :

Height of Pier :	H =	10.00	m
Width of footing Pier	B =	4.55	m
Length of footing Pier	L =	4.55	m

part	Weight of part (ton)		Arm	Moment ton m
1	1.6*0.4*2.5*2.7 =	4.320	0.000	0.000
2	(1.6+1.3)/2*0.4*2.5*(2.7+2)/2=	3.408	0.000	0.000
3	1.3*8*2.5*2.0 =	52.000	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	KP =13.8	13.80	8.870	122.406
7	KW = 8.959	8.96	3.800	34.044
	Total : Σ Fv =	151.73	ΣMr =	156.450

Bending moment = 1.2*M =	187.740 ton m /m =	1877.40 KNm/m	
Normal force N =	151.73 ton / m =	1517.28 N/m	
Mutu Beton fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
Tulangan Baja fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER-2 ON TOE AND HEEL :

File:RC-P2-5-3

Compute soil pressure :

qmax =	107.929 t/m	weight of concrete q=	2.5 t/m
qmin =	-18.825 t/m	q1-q =	57.99235 t/m
q1 =	60.49235 t/m		
L1 =	1.625 m		

M1 = (q1-q) * L1*L1/2 =	76.568 ton m / m
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =	41.754 ton m / m
Mmax total =	118.322 ton m / m
Mdes = 1.2 * Mmax =	141.987 ton m / m

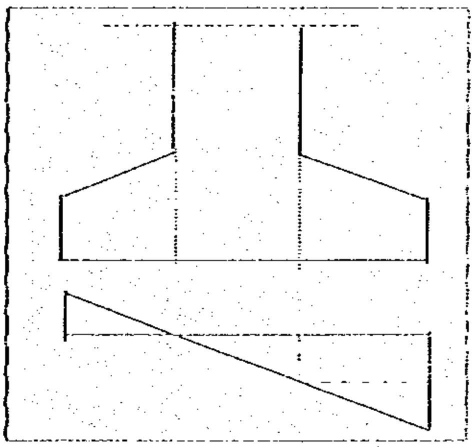
Mutu beton fc' =	33.075 Mpa	*(earthquake condition fc'=1.5xfc')*
Mutu baja fy =	235.29 Mpa	*(earthquake condition fy=1.5xfy)*
Dimensi beton ht =	1200 mm	
b =	1000 mm	
d =	1100 mm	

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.072953848
ρmin = 1.4/fy =	0.005950104
Koefisien k =	0.06
ρ = k*ρb =	0.00438
As1 = ρ * b * d =	4814.95 mm^2
T1 = As1*fy =	1132910.52 N
a1 = T1 / (0.85*fc'*b) =	40.30 mm
Z = d - 0.5 a1 =	1079.85 mm
Mr1 = T1 * Z =	1223374904 Nmm
	1223.37 KNm
Mmax =	1419.87 KNm

Karena Mmax > Mr1 maka perlu tulangan rangkap

ΔM = Mmax -Mr1 =	196.49 KNm
As2 = Δ M / fy(d-d') =	83.51 mm^2
As= As1 + As2 =	4898.46 mm^2

dipakai tulangan tarik :	D 29 - 130	As terpsg =	5078.35 mm^2
dipakai tulangan tekan :	D 16 - 260	As' terpsg =	772.92 mm^2
Tulangan bagi : 20 % As =			979.6928 mm^2
	D 13 - 125	Asbagi =	1061.32 mm^2



REINFORCED CONCRETE OF PIER-3 (P-3) :

File:RC-P3-1-3

The earth pressure under the normal condition :

Height of Pier	H =	8.0	m
Width of footing Pier	B =	4.0	m
Length of footing Pier	L =	4.0	m

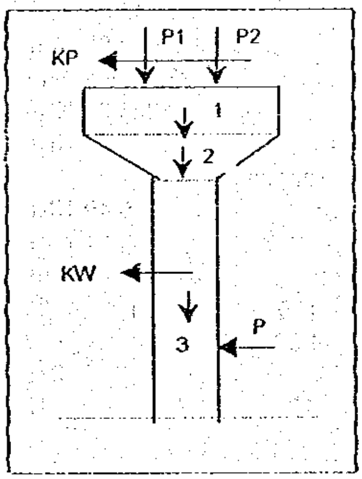
part	Weight of part (ton)	
1	1.6*0.4*2.5*2.7 =	4.320
2	(1.6+1.1)/2*0.4*2.5*(2.7+2)/2=	3.173
3	1.1*6.1*2.5*2.0=	33.550
4	P1= 46	46.000
5	P2 = 46	46.000
	Total : Σ Fv =	133.0425

Mdes = 1.2 * Mr = 0 ton m /m = 0 Nmm/m

Normal Force N = 133.0425 ton / m = 1330425 N/m

the concrete stress fc' = 22.05 Mpa

the yield stress of steel fy = 156.86 Mpa



REINFORCED CONCRETE OF PIER -3 ON TOE AND HEEL :

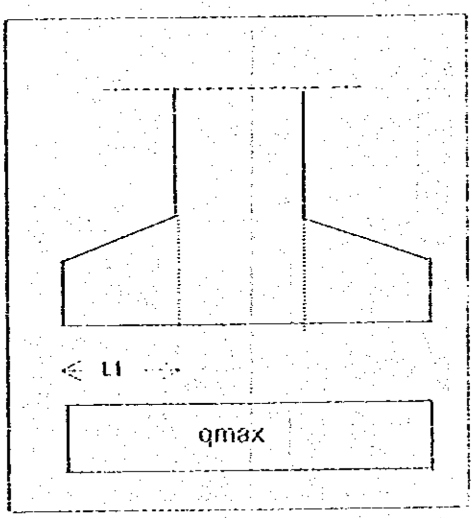
File:RC-P3-1-3

Compute soil pressure :

qmax =	10.536	t/m
L1 =	1.3	m
Mmax = qmax * L1*L1/2 =	8.903	ton m / m
Mmax total =	8.903	ton m / m
Mdes = 1.2 * Mmax =	10.684	ton m / m
the concrete stress fc' =	22.05	Mpa
the yield stress of steel fy =	156.86	Mpa
Dimension of concrete ht =	1100	mm
b =	1000	mm
d =	900	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.080514	
ρmin = 1.4/fy =	0.008925	
coeficient k =	0.01	
ρ = k*ρb =	0.00081	
As1 = ρ * b * d =	724.62	mm^2
T1 = As1*fy =	113664.45	N
a1 = T1 / (0.85*fc'*b) =	6.06	mm
Z = d - 0.5 a1 =	896.97	mm
Mr1 = T1 * Z =	101953344	Nmm
	101.95	KNm
Mmax =	106.84	KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =			4.88	KNm
As2 = Δ M / fy(d-d') =			38.90	mm^2
As= As1 + As2 =			763.53	mm^2
use tensile steel bars :	D 19 - 250	As terpsg =	1134	mm^2
use compressive steel bars :	D 16 - 250	As' terpsg =	804	mm^2
Longitudinal steel bars : 20 % As =			153	mm^2
use longitudinal steel bars :	D 13 - 250		531	mm^2



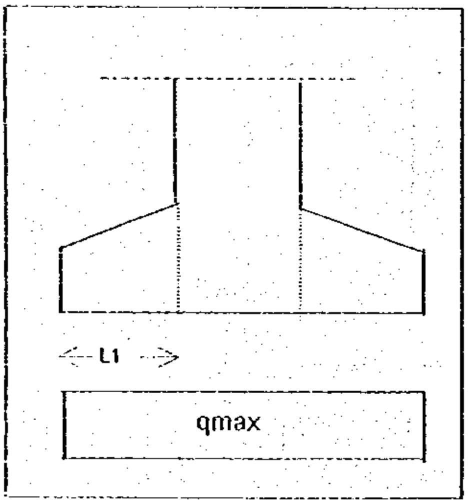
REINFORCED CONCRETE OF PIER-3 ON TOE AND HEEL :

Compute soil pressure : *File:RC-P3-2-3*

qmax =	8.068 t/m		
L1 =	1.3 m		
Mmax = qmax * L1*L1/2 =		6.817 ton m / m	
Mmax total =		6.817 ton m / m	
Mdes = 1.2 * Mmax =		8.181 ton m / m	
the conctere stress fc' =		22.05 Mpa	
the yield stress of steel fy =		156.86 Mpa	
Dimension of concrete ht =		1100 mm	
b =		1000 mm	
d =		900 mm	
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =			0.08051
ρmin = 1.4/fy =			0.00893
Koefisien k =			0.008
ρ = k*ρb =			0.00064
As1 = ρ * b * d =			579.70 mm^2
T1 = As1*fy =			90931.56 N
a1 = T1 / (0.85*fc'*b) =			4.85 mm
Z = d - 0.5 a1 =			897.57 mm
Mr1 = T1 * Z =			81617821 Nmm
			81.62 KNm
Mmax =			81.81 KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =			0.19 KNm
As2 = Δ M / fy(d-d') =			1.53 mm^2
As= As1 + As2 =			581.23 mm^2
use tensile steel bars :	D 19 - 250	As terpsg =	1133.54 mm^2
use compressive steel bars :	D 13 - 250	As' terpsg =	530.66 mm^2
Longitudinal steel bars : 20 % As =			116.2453 mm^2
use longitudinal steel bars :	D 13 - 250		530.66 mm^2



REINFORCED CONCRETE OF PIER-3 (P-3) :

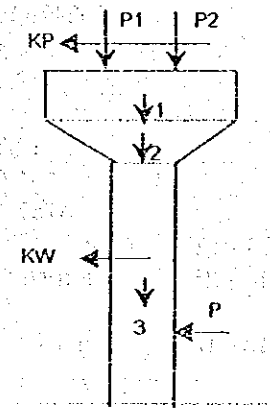
File:RC-P3-3-3

The earth pressure under the earthquake condition (Case III) :

Height of Pier :	H =	8.0	m
Width of footing Pier	B =	4.0	m
Length of footing Pier	L =	4.0	m

part	Weight of part (ton/m)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.320	0.000	0.000
2	(1.6+1.1)/2*0.4*2.5*(2.7+2)/2=	3.055	0.000	0.000
3	1.1*6.1*2.5*2.0 =	33.550	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 1.8315	1.83	0.859	1.573
7	KP = 13.800	13.80	6.970	96.186
8	KW = 6.139	6.14	2.900	17.803
	Total : Σ Fv =	132.93	ΣMr =	115.562

Bending moment = 1.2*M =	138.674 ton m /m =	1386.74 KNm/m	
Normal force N =	132.93 ton / m =	1329.25 N/m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER-3 ON TOE AND HEEL :

File:RC-P3-3-3

Compute soil pressure :

qmax =	95.211 t/m	weight of concrete q=	2.5 t/m
qmin =	-25.463 t/m	q1-q =	48.300 t/m
q1 =	50.800 t/m		
L1 =	1.45 m		

M1 = (q1-q) * L1*L1/2 =	50.776	ton m / m
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =	31.124	ton m / m
Mmax total =	81.900	ton m / m
Mdes = 1.2 * Mmax =	98.280	ton m / m

the concrete stress fc' : 33.075 Mpa *(earthquake condition fc'=1.5xfc')*

the yield stress fy = 235.29 Mpa *(earthquake condition fy=1.5xfy)*

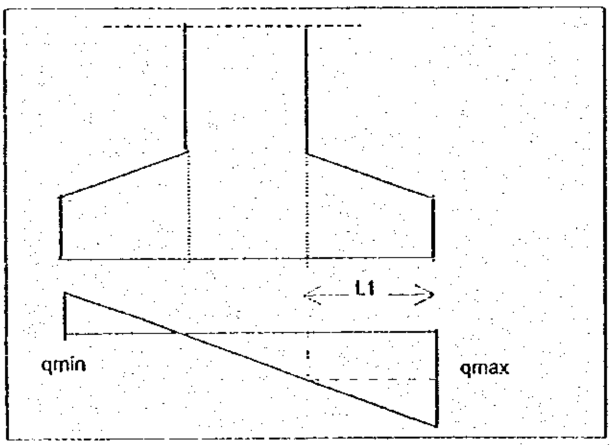
Dimension of concrete	ht =	1100	mm
	b =	1000	mm
	d =	900	mm

ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.07295	
ρmin = 1.4/fy =	0.00595	
coeficient k =	0.07	
ρ = k*ρb =	0.00511	
As1 = ρ * b * d =	4596.09	mm^2
T1 = As1*fy =	1081414.58	N
a1 = T1 / (0.85*fc'*b) =	38.47	mm
Z = d - 0.5 a1 =	880.77	mm
Mr1 = T1 * Z =	952474450	Nmm
	952.47	KNm
Mmax =	982.80	KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =	30.32	KNm
As2 = Δ M / fy(d-d') =	161.09	mm^2
As= As1 + As2 =	4757.19	mm^2

use tensile steel bars :	D 29 - 125	As terpsg =	5281 mm^2
use compressive steel bars :	D 16 - 250	As' terpsg =	804 mm^2
Longitudinal steel bars : 20 % As =			951 mm^2
	D 13 - 125	Asbagi =	1061 mm^2

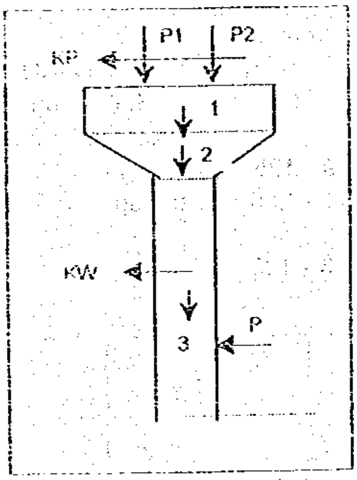


The earth pressure under the earthquake condition (Case IV) :

Height of Pier :	H =	8.0	m
Width of footing Pier	B =	4.0	m
Length of footing Pier	L =	4.0	m

part	Weight of part (ton/m)		Arm	Moment ton m/m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+1.1)/2*0.4*2.5*(2.7+2)/2=	3.173	0.000	0.000
3	1.1*6.1*2.5*2.0 =	33.55	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	P = 3.1365	3.14	0.859	2.693
7	KP = 6.900	6.90	6.970	48.093
8	KW = 5.19375	5.19	2.900	15.062
	Total : Σ Fv =	133.04	ΣMr =	65.848

Mdes = 1.2 * Mr =	79.02 ton m /m =	790174486.80 Nmm/m
Normal Force N =	133.0425 ton / m =	1330425 N/m
the concrete stress fc' =	33.075 Mpa	*(earthquake condition fc'=1.5xfc')*
the yield stress fy =	235.29 Mpa	*(earthquake condition fy=1.5xfy)*



REINFORCED CONCRETE OF PIER -3 (P-3) :

File:RC-P3-4-3

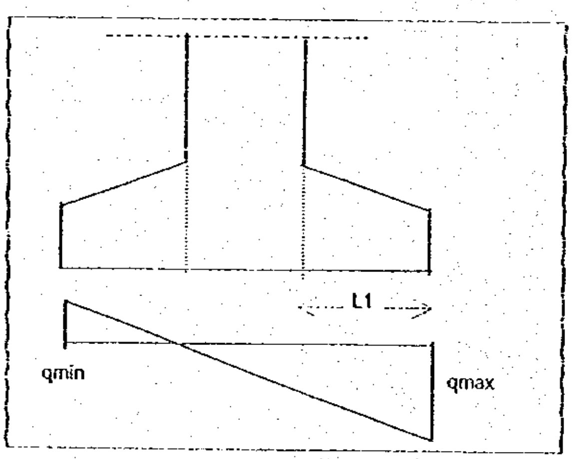
Compute soil pressure :

qmax =	65.235 t/m	weight of concrete q=	2.5 t/m
qmin =	-1.2875 t/m		
q1 =	32.18339 t/m	q1-q =	29.68339 t/m
L1 =	1.3 m		

M1 = (q1-q) * L1*L1/2 =		25.082 ton m / m	
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =		18.619 ton m / m	
Mmax total =		43.702 ton m / m	
Mdes = 1.2 * Mmax =		52.442 ton m / m	
the concrete stress fc' =	33.075 Mpa		*(earthquake condition fc'=1.5xfc')*
the yield stress fy =	235.29 Mpa		*(earthquake condition fy=1.5xfy)*
Dimension of concrete	ht =	1100 mm	
	b =	1000 mm	
	d =	900 mm	
ρb = [(β1*fc'*0.85) / fy]*[600 / 600+fy] =			0.072953848
ρmin = 1.4/fy =		0.00595	
Koefisien k =		0.03	
ρ = k*ρb =		0.00219	
As1 = ρ * b * d =		1969.75 mm^2	
T1 = As1*fy =		463463 N	
a1 = T1 / (0.85*fc'*b) =		16.49 mm	
Z = d - 0.5 a1 =		891.76 mm	
Mr1 = T1 * Z =		413296889 Nmm	
		413.30 KNm	
Mmax =		524.42 KNm	

Because Mmax > Mr1 required double reinforced concrete

ΔM = Mmax -Mr1 =		111.12 KNm	
As2 = Δ M / fy(d-d') =		590.34 mm^2	
As= As1 + As2 =		2560.10 mm^2	
use tensile steel bars	D 29 - 125	As terpsg =	5281 mm^2
use compressive steel bars :	D 22 - 250	As' terpsg =	1520 mm^2
Longitudinal steel bars : 20 % As =			512 mm^2
	D 13 - 125	Asbagi =	1061 mm^2



REINFORCED CONCRETE OF PIER-3 ON TOE AND HEEL :

File:RC-P3-5-3

Compute soil pressure :

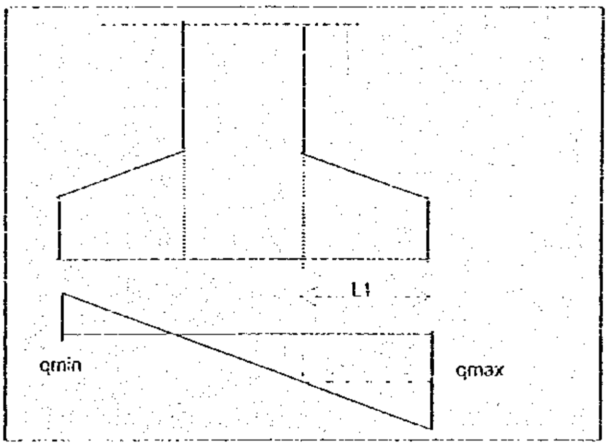
qmax =	101.1354 t/m	weight of concrete q=	
qmin =	-16.8479 t/m		2.5 t/m
q1 =	57.40752 t/m	q1-q =	54.90752 t/m
L1 =	1.3 m		

M1 = (q1-q) * L1*L1/2 =	46.397	ton m / m
M2 = 1/2*(qmax-q1)*L1*L1*2/3 =	24.633	ton m / m
Mmax total =	71.030	ton m / m
Mdes = 1.2 * Mmax =	85.236	ton m / m
the concrete stress fc' = 33.075 Mpa	*(earthquake condition fc'=1.5xfc')*	
the yield stress fy = 235.29 Mpa	*(earthquake condition fy=1.5xfy)*	
Dimension of concrete ht =	1100	mm
b =	1000	mm
d =	900	mm
ρb = [{β1*fc'*0.85} / fy]*[600 / 600+fy] =	0.07295	
ρmin = 1.4/fy =	0.00595	
Koefisien k =	0.06	
ρ = k*ρb =	0.00438	
As1 = ρ * b * d =	3939.51	mm^2
T1 = As1*fy =	926926.79	N
a1 = T1 / (0.85*fc'*b) =	32.97	mm
Z = d - 0.5 a1 =	883.51	mm
Mr1 = T1 * Z =	818953448	Nmm
	818.95	KNm
Mmax =	852.36	KNm

Because Mmax > Mr1 required double reinforced concrete :

ΔM = Mmax -Mr1 =	33.41	KNm
As2 = Δ M / fy(d-d') =	177.49	mm^2
As= As1 + As2 =	4117.00	mm^2

use tensile reinforced concrete :	D 29 - 125	As terpsg =	5281.48 mm^2
use compressive reinforced con :	D 16 - 250	As' terpsg =	803.84 mm^2
Longitudinal steel bars : : 20 % As =			823.40 mm^2
use longitudinal steel bars :	D 13 - 125	Asbagi =	1061.32 mm^2



REINFORCED CONCRETE OF PIER-3 :

File:RC-P3-5-3

The earth pressure under the earthquake condition (Case V) :

Height of Pier :	H =	8.0	m
Width of footing Pier	B =	4.0	m
Length of footing Pier	L =	4.0	m

part	Weight of part (ton)		Arm	Moment ton m
1	1.6*0.4*2.5*2.7 =	4.32	0.000	0.000
2	(1.6+1.1)/2*0.4*2.5*(2.7+2)/2=	3.17	0.000	0.000
3	1.1*6.1*2.5*2.0 =	33.55	0.000	0.000
4	P1	46.00	-0.350	-16.100
5	P2	46.00	0.350	16.100
6	KP =13.8	13.80	6.970	96.186
7	KW =10.388	10.39	2.900	30.124
	Total : Σ Fv =	133.04	ΣMr =	126.310

Mdes = 1.2 * Mr =	151.5717 ton m /m =	1515717000 Nmm/m
Normal Force N =	133.0425 ton / m =	1330425 N/m
the concrete stress fc' =	33.075 Mpa	*(earthquake condition fc'=1.5xfc')*
th eyield stress fy =	235.29 Mpa	*(earthquake condition fy=1.5xfy)*