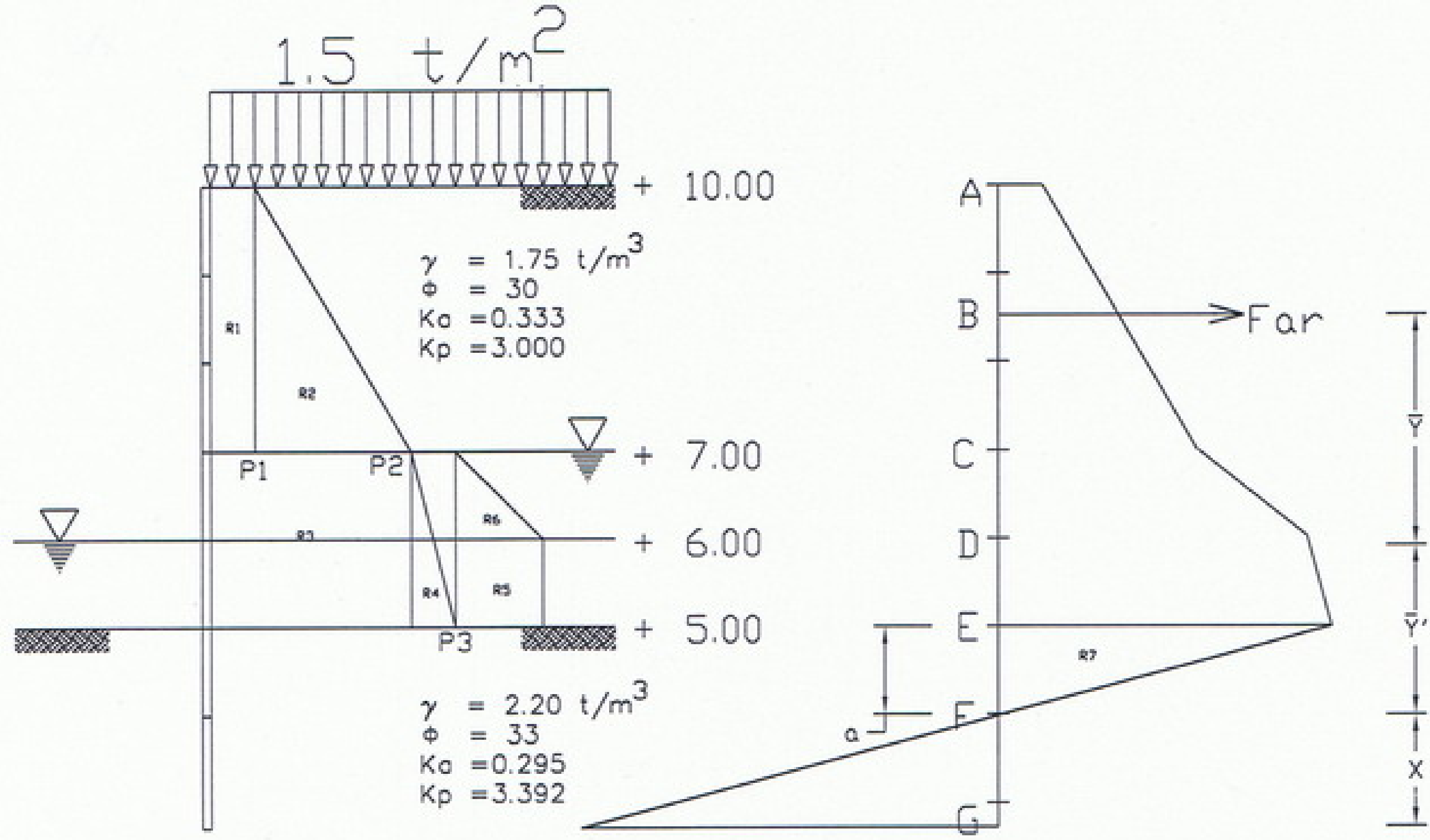
Sheet Pile 15.00 m



Design for sheet pile type A size 40x60 cm L = 15 m

P1 = W x Ka

= 1.5 x 0.333

= 0.5 t/m^2

P2 = $(W+\gamma_1 h_1)K_a$

= (1.5+1.75x3) x 0.333

= 2.248 t/m^2

P3 = $(W+\gamma_1 h_1+\gamma_{\cdot 2h2})$ x Ka

= (1.5+1.75x3+0.75x2) x 0.333

= 2.747 t/m^2

$\overline{Pa}$ = P_3+P_W

= 2.747+1

= 3.747 t/m^2

a = $\frac{\overline{Pa}}{\gamma'(Kp - Ka)}$

= $\frac{3.747}{1.2(3.392-0.295)}$

= 1.015 m

R1 = 1.5 t/m

R2 = 2.622 t/m

R3 = 4.496 t/m

R4 = 0.499 t/m

R5 = 0.5 t/m

R6 = 1 t/m

R7 = 0.5 x $\overline{Pa}$ x a

= 1.902 t/m

Ra = $\sum_{1}^{7} R$

= 1.5 + 2.622 + 4.496 + 0.499 + 0.5 + 1 +1.902

= 12.519 t/m

Locating the resultant with respect to point O as shown,

$$\sum M_o = R_a \overline{Y'}$$

$$R_a \overline{Y'} = (\frac{3}{2}+2+1.015)R1 + (\frac{3}{3}+2+1.015)R2 + (\frac{2}{2}+1.015)R3$$

$$+ (\frac{2}{3}+1.015)R4 + (\frac{1}{3}+1+1.015)R5 + (\frac{1}{2}++1.015)R6$$

$+ (\frac{2}{3} x1.015)R7$

$= \quad 4.515\ R1 + 4.015\ R2 + 2.015\ R3 + 1.682\ R4 + 2.348\ R5$

$+ 1.51\ R6 + 0.677\ R7$

$= \quad 31.175$

$$\overline{Y'} = \frac{31.175}{12.519}$$

$= \quad 2.490$ m above point O

Location the resultant from the anchor rod,

$$\overline{Y} = 2.5 + 1.015 - 2.490$$

$= \quad 1.025$ m

From Eq.(8 -7)

$$\frac{X^3}{3}\gamma' K' + \frac{X^2}{2}\gamma' K'(H+a) - Ra\overline{Y} = 0$$

$1.239X3 + 6.532X2 - 12.832 = 0$

$X = 1.259$ m

Use 40 percent increase in D

$D = 1.4(1.259+1.015)$

$= 3.184$ m

$L = 5 + 3.184$

$= 8.184$ m

Used 15.00 m

To find the anchor-rod force we must evaluate the pressure.

$$Rp = \frac{1}{2} \times \gamma' \times K'p \times X2$$

$= 2.945$ t/m

and summing forces in the horizontal direction (Eq. 8-8)

$$\sum F_x = 0$$

$$Far = Ra - Rp$$

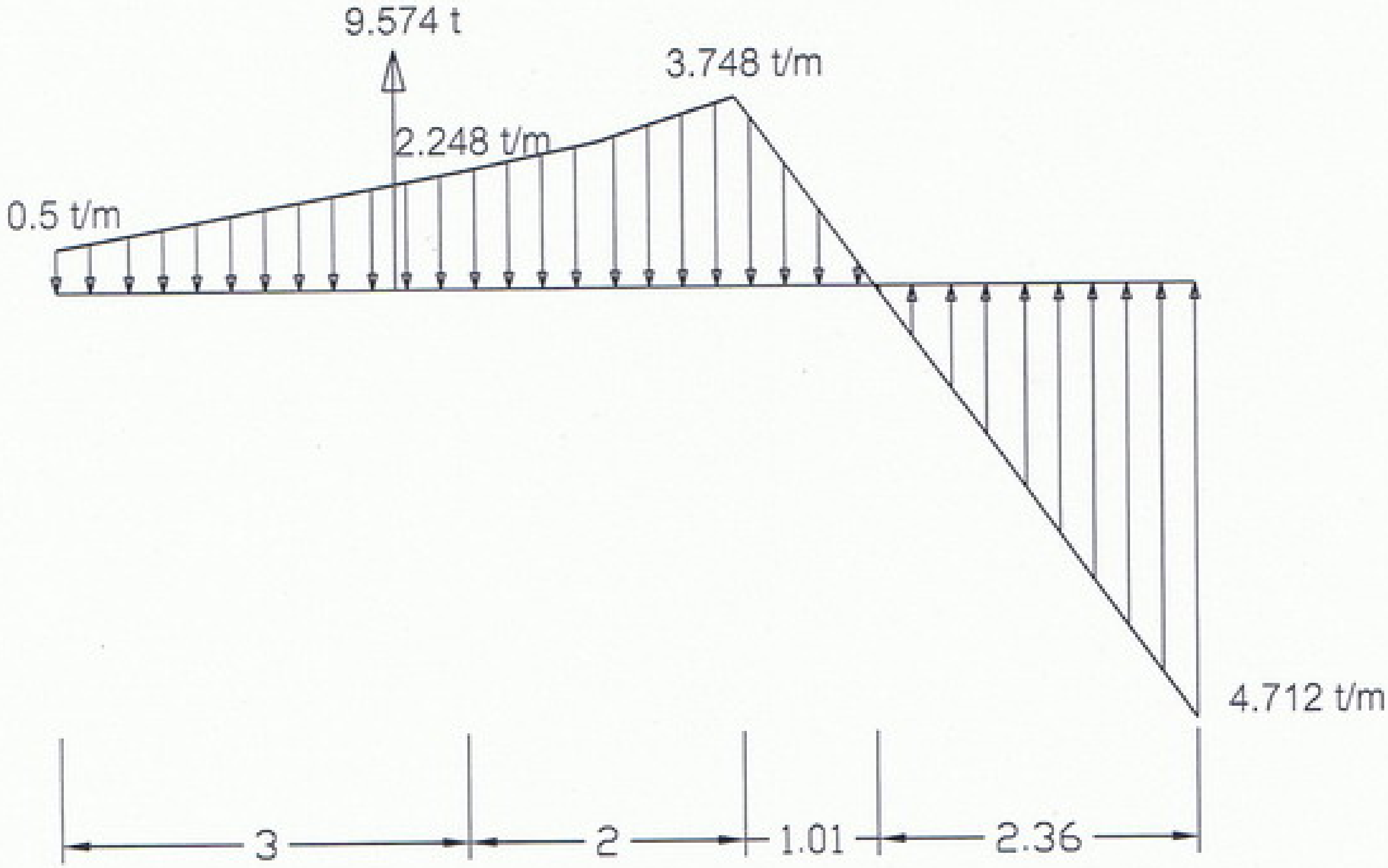
$= 12.519 - 2.945$

$= 9.574$ t/m

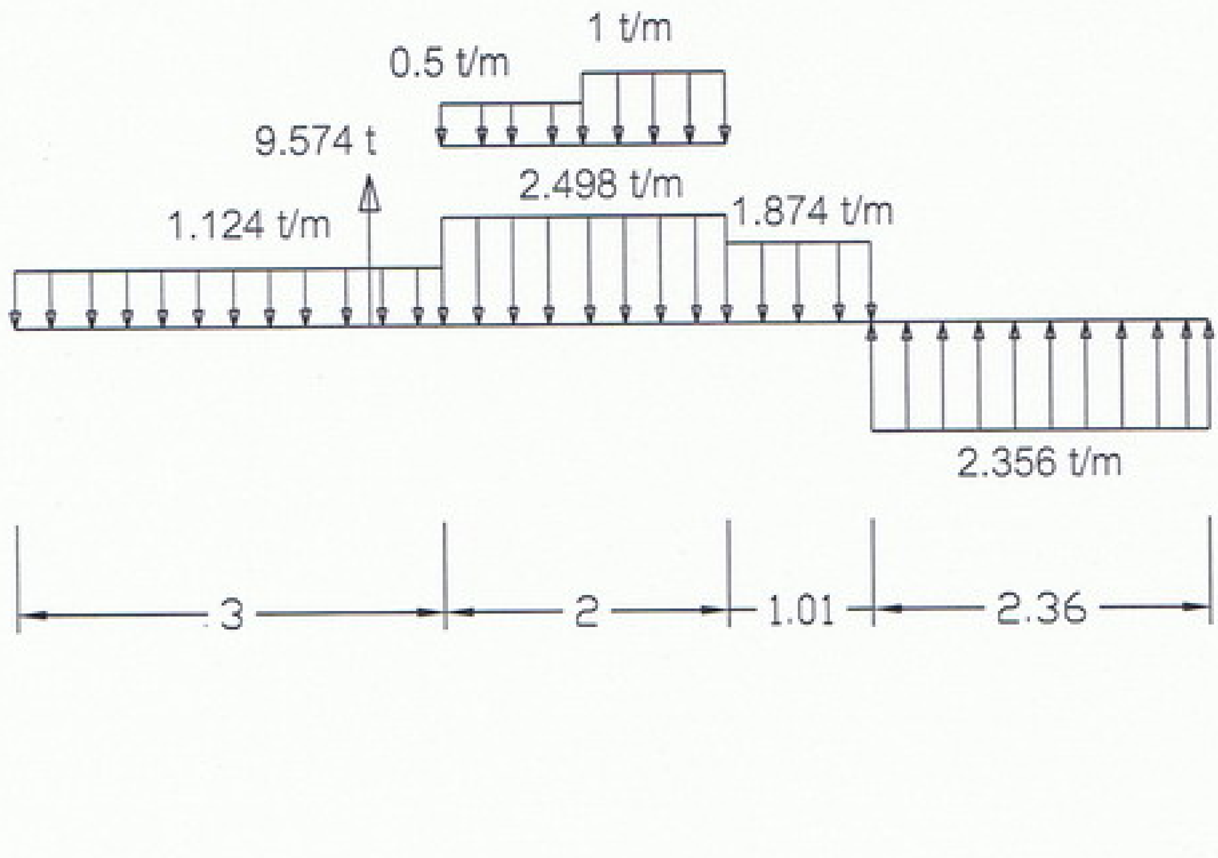
In summary:

Total length of sheet pile	15.00	m
Length of embedment	3.184	m
Anchor rod force	9.574	ton

Presure diagram



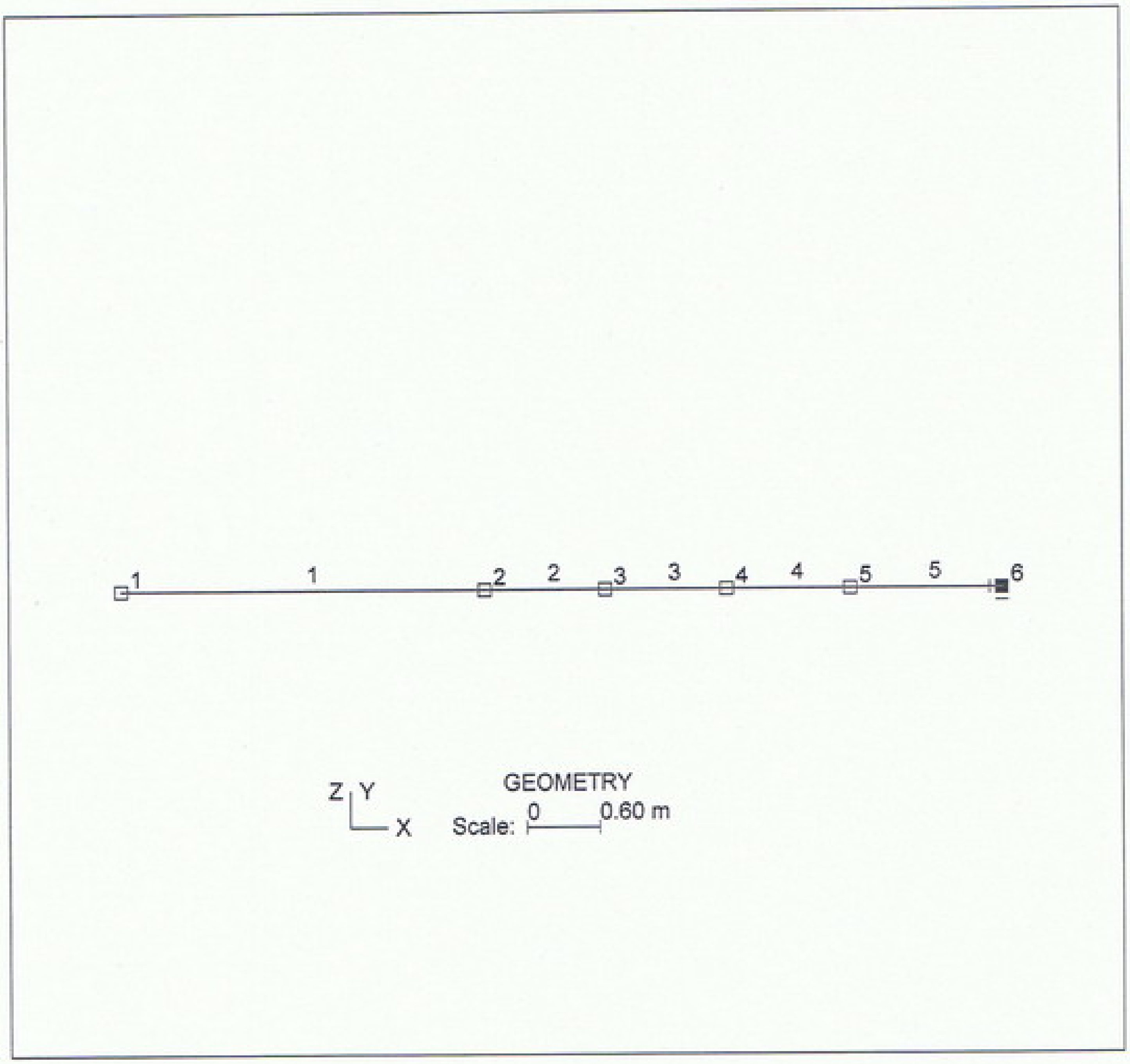
convert to



> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
	node Symbol	Yes	Element no.	Yes
	Node no.	Yes	Material set	No
	Max results	No	Stress value	No

Rotate-X = 0 degree		Rotate-Y = 90 degree		Enlarge Scale = 1.0



> Node Data

Node	X-Coor (m)	Y-Coor (m)	X-Boun	Y-Boun	Rotn
1	0.00	0.00			
2	3.00	0.00			
3	4.00	0.00			
4	5.00	0.00			
5	6.02	0.00			
6	7.27	0.00	L	L	L

> Element Data

Elem	StartNode	EndNode	MatSet	HingeCode	AddSection
1	1	2	1		
2	2	3	1		
3	3	4	1		
4	4	5	1		
5	5	6	1		

> Material Data

Set	E-modulus (ton/m^2)	Area (m^2)	Inertia (m^4)	G-modulus (ton/m^2)	J-Torsion (m^4)	Section BxD
1	2.10E+06	0.2400	0.0032	9.13E+05	0	0.6x0.4

> Load Case no.1 :
> Uniform Load Data

Elem	Wz-Load (ton/m)
1	-1.37
2	-2.50
3	-2.50
4	-1.87
5	2.36

> Load Case no.2 :
> Point Load Data

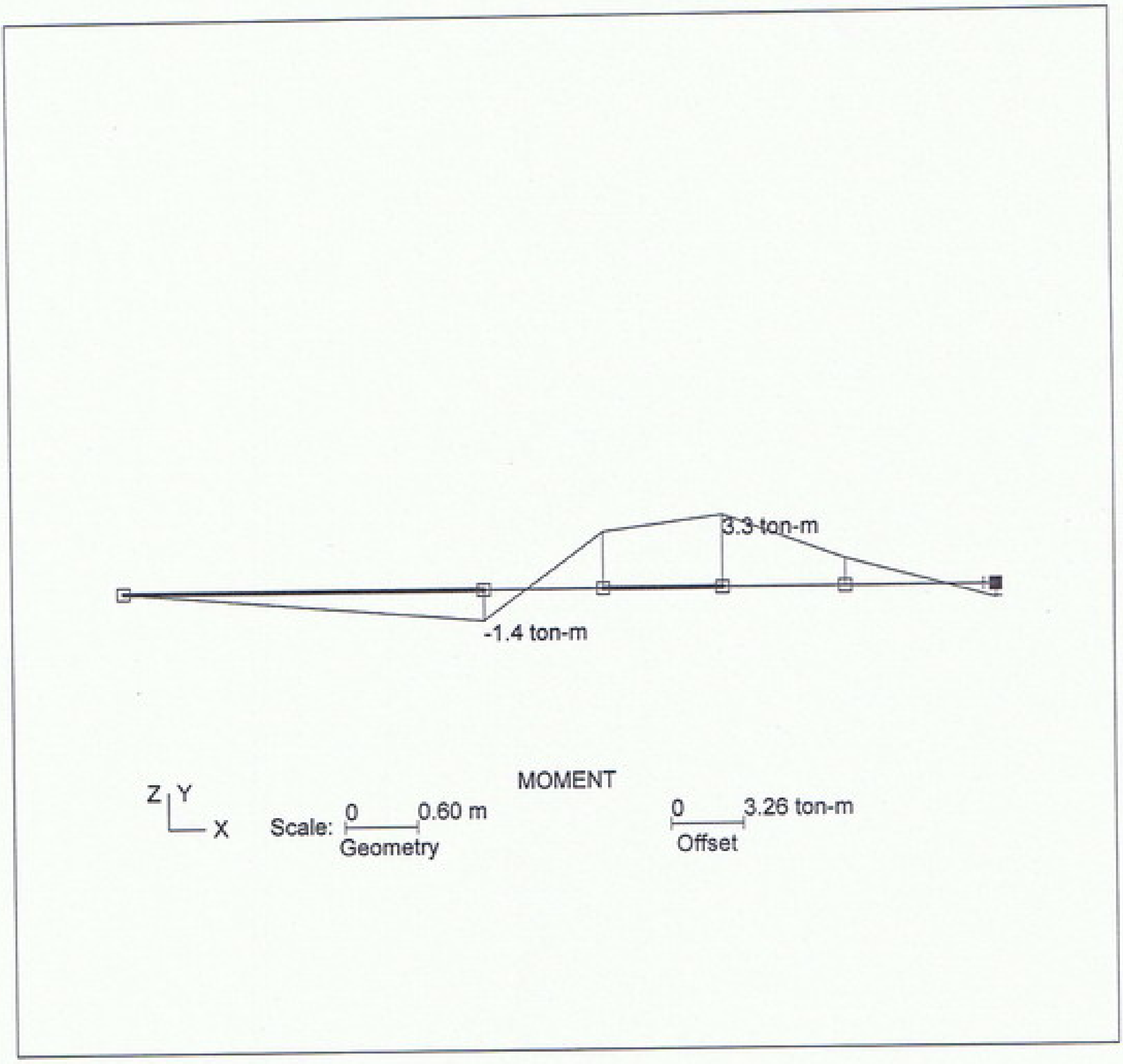
Elem	Pz-Load (ton)	distance (m)	(m)
1	9.57	2.500	

> Load Case no.3 :
> Uniform Load Data

Elem	Wz-Load (ton/m)
2	-0.50
3	-1.00

> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
node Symbol	Yes	Element no.	No	
Node no.	No	Material set	No	
Max results	Yes	Stress value	No	
Rotate-X = 0 degree		Rotate-Y = 90 degree		Enlarge Scale = 1.0

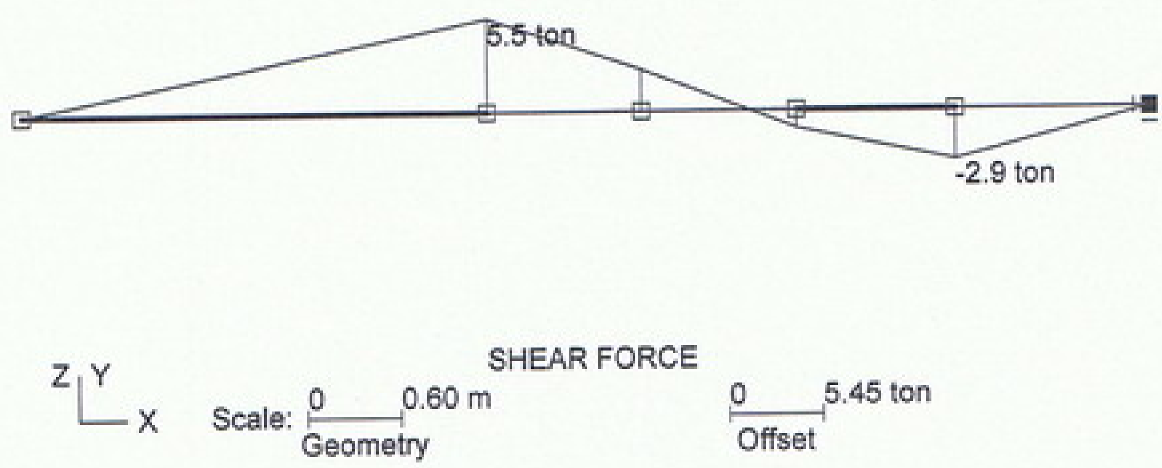


Project : 15m
Filename :
Authority :
Engineer :

> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
	node Symbol	Yes	Element no.	No
	Node no.	No	Material set	No
	Max results	Yes	Stress value	No

Rotate-X = 0 degree   Rotate-Y = 90 degree   Enlarge Scale = 1.0



> Stress Combination

Load Factor: 1/1/1

Elem	Set	Hinge	Section (m)	Torsion (ton-m)	Shear (ton)	Moment (ton-m)
1	1		0.00	0.00	0.00	0.00
			3.00	0.00	5.45	-1.40
2	1		0.00	0.00	5.45	-1.40
			1.00	0.00	2.45	2.56
3	1		0.00	0.00	2.45	2.56
			1.00	0.00	-1.04	3.26
4	1		0.00	0.00	-1.04	3.26
			1.02	0.00	-2.95	1.24
5	1		0.00	0.00	-2.95	1.24
			1.26	0.00	0.02	-0.60

> Summary of Selected Results

Stresses	Elem	Max(+)	Elem	Max(-)
T (ton-m)	- - -	- - -	- - -	- - -
V (ton)	1	5.45	4	-2.95
M (ton-m)	3	3.26	1	-1.40

+Mmax = 4.91 t-m

for 0.60 m width

= 4.91 x 0.6

= 2.946 t-m

- Mmax = -3.02 t-m

for 0.6 m width

= 3.02 x 0.6

= 1.812 t-m

Design for dead man

$$Areq = \frac{F_{ar}}{K_p \gamma Hi}$$

$$= \frac{9.574x2}{3x1.75x2.5}$$

= 1.459 t/m^2

Used deadman 1.6 x 1.6 , t = 0.5 m , A = 2.56 m^2

Design tied-rod

$$Areq = \frac{19.148x1000}{1200}$$

$= 15.957 \ cm^2$

NO. of DB 25 mm

$= \frac{15.957}{4.91}$

$= 3.250$

Used 4 - DB25mm

Design for sheet pile type B size 40x60 cm L = 19 m

P1 = W x Ka1

= 0.5 x 0.333

= 0.167 t/m^2

P2 = (W+ γ 1h1)Ka1

= (0.5+1.75x5) x 0.333

= 3.080 t/m^2

P'2 = (W+ γ 1h1)Ka2

= (0.5 + 1.75x5) x 0.295

= 2.729 t/m^2

P3 = (W+γ 1h1+γ '2h2) x Ka2

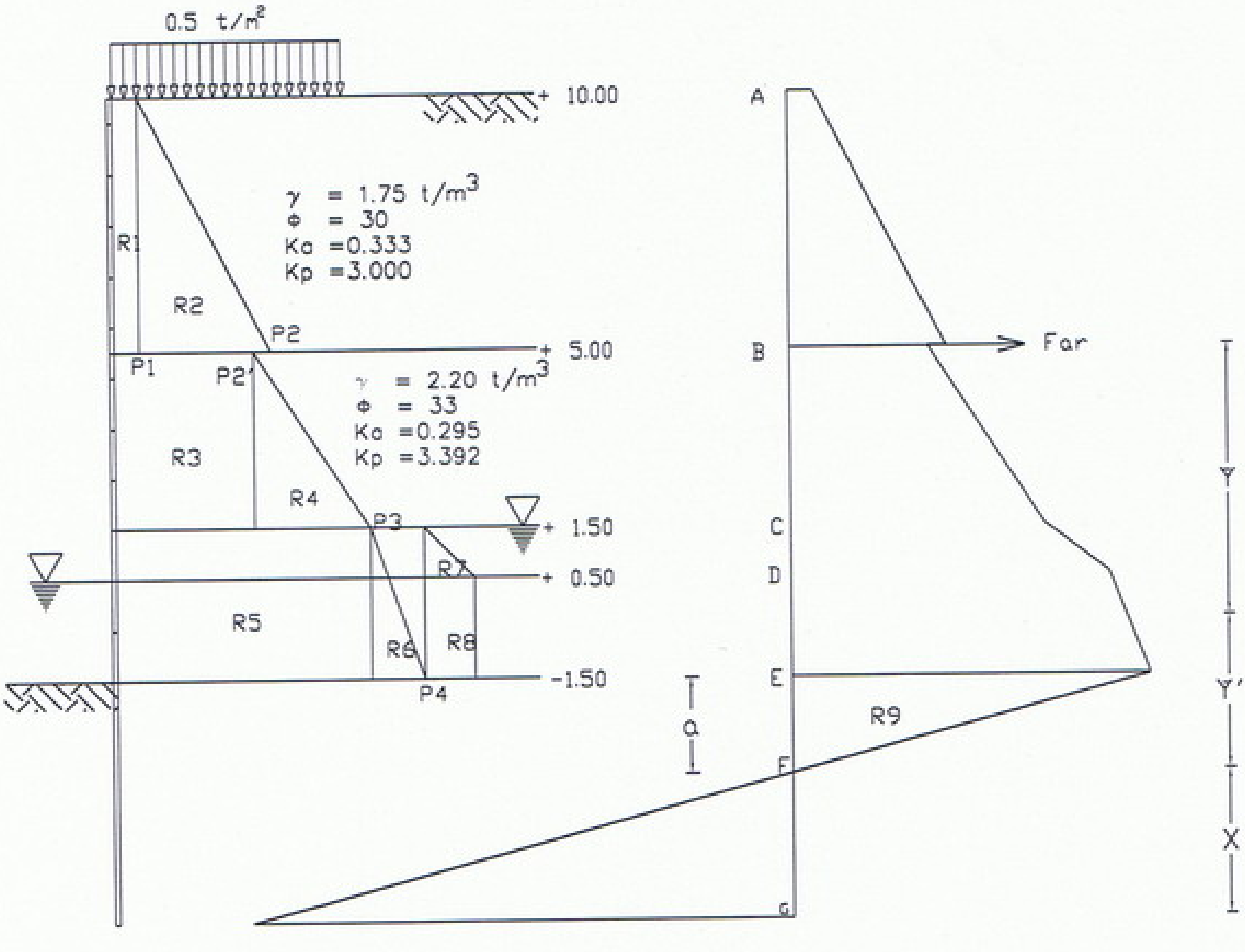
= (0.5+1.75x5x2.2x3.5) x 0.295

= 5.000 t/m^2

P4 = [16.950+($\gamma' h$ 3)] x Ka2

= 20.550x0.295

= 6.062 t/m^2


0.5 t/m²
+ 10.00
γ = 1.75 t/m³
Φ = 30
Ka =0.333
Kp =3.000
R1
R2
P2
P1
+ 5.00
P2'
γ = 2.20 t/m³
Φ = 33
Ka =0.295
Kp =3.392
R3
R4
P3
+ 1.50
R7
+ 0.50
R5
R6
R8
-1.50
P4
A
B
Far
C
D
E
F
G
R9
a
Y
Y'
X

$\overline{Pa}$ = P4+Pw

= 6.062+1

= 7.062 t/m^2

$$a = \frac{\overline{Pa}}{\gamma'(Kp - Ka)}$$

= 1.900 m

R1 = 0.835 t/m

R2 = 7.283 t/m

R3 = 9.552 t/m

R4 = 3.974 t/m

R5 = 15.00 t/m

R6 = 1.593 t/m

R7 = 0.5 t/m

R8 = 2 t/m

R9 = $0.5 \times \overline{Pa} \times a$

= 6.709 t/m

$$Ra = \sum_{1}^{9} R$$

$$= 0.835+7.283+9.552+3.974+15+1.593+0.5+2+6.709$$

$$= 47.446 \quad t$$

Locating the resultant with respect to point O as shown,

$$\sum M_o = R_a \overline{Y'}$$

$$Ra\overline{Y'} = (\frac{5}{2}+3.5+3+1.9)R1 + (\frac{5}{3}+3.5+3+1.9)R2 + (\frac{3.5}{2}+3+1.9)R3$$

$$+ (\frac{3.5}{3}+3+1.9)R4 + (\frac{3}{2}+1.9)R5 + (\frac{3}{3}+1.9)R6$$

$$+ (\frac{1}{3}+2+1.9)R7 + (\frac{2}{2}+1.9)R8 + (1.9x\frac{2}{3})R9$$

$$= 10.9\ R1 + 10.06\ R2 + 6.65\ R3 + 6.06\ R4 + 3.4\ R5$$

$$+ 2.9\ R6 + 4.233\ R7 + 2.9R8 + 1.267R9$$

$$= 242.087$$

$$\overline{Y'} = \frac{242.087}{47.446}$$

$$= 5.102 \quad m \quad \text{above point O}$$

Location the resultant from the anchor rod,

$\overline{Y}$ = 6.5 + 1.9 – 5.102

= 3.298 m

From Eq.(8 -7)

$$\frac{X^3}{3}\gamma' K' + \frac{X^2}{2}\gamma' K'(H+a) - Ra\overline{Y} = 0$$

1.239X3 + 15.609X2 – 156.477 = 0

X = 2.858 m

Use 40 percent increase in D

D = 1.4(2.858+1.9)

= 6.661 m

L = 11.5 + 6.661

= 18.161 m

Used 19.00 m

To find the anchor-rod force we must evaluate the pressure.

Rp = $\frac{1}{2}$ x γ' x K'p x X2

= 0.5 x 1.2 x 3.097 x 2.8582

$= 15.178$ t/m

and summing forces in the horizontal direction (Eq. 8-8)

$\sum F_x = 0$

Far = Ra - Rp

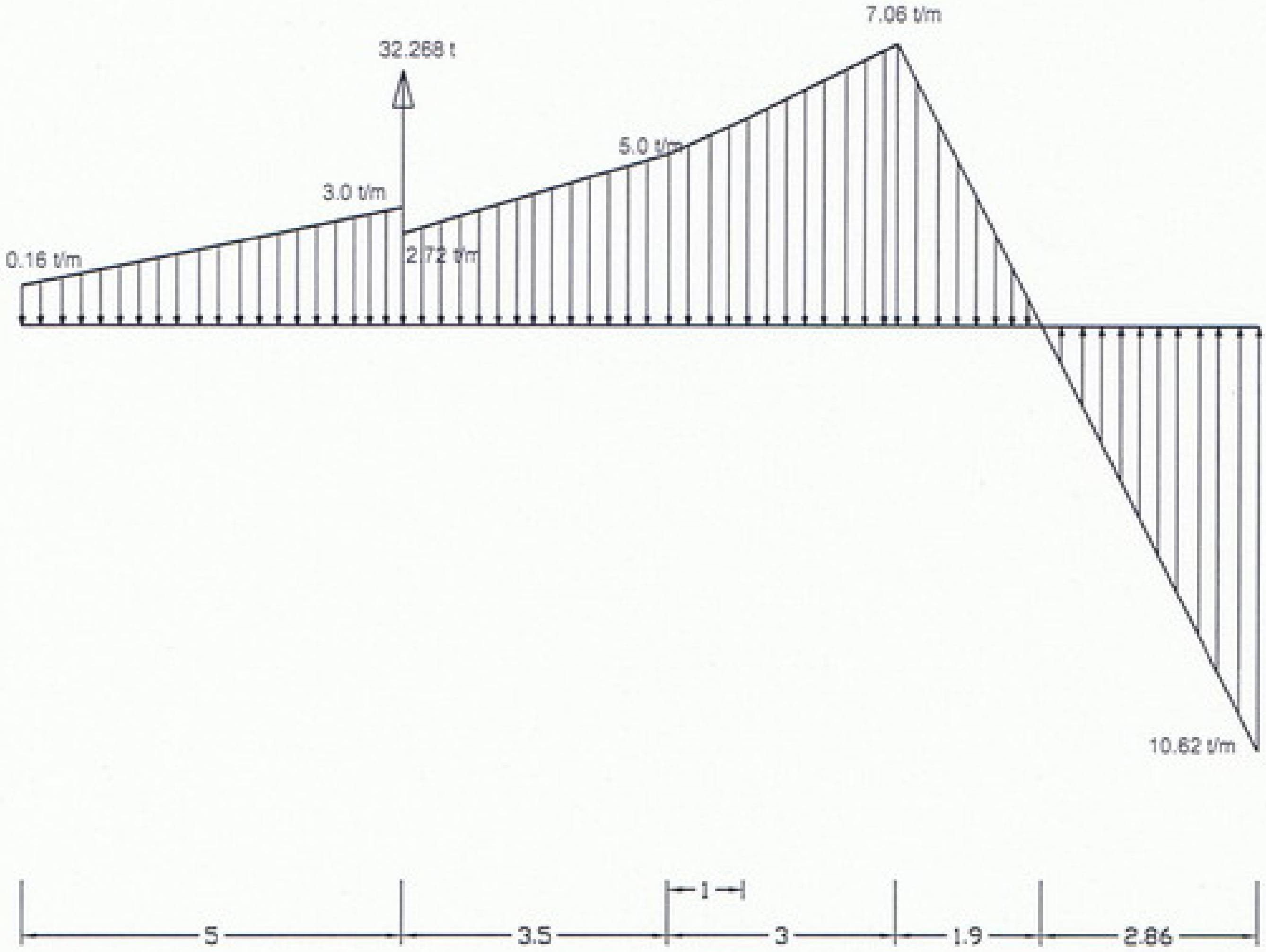
= 47.446 – 15.178

= 32.268 t/m

In summary:

Total length of sheet pile	19.00	m
Length of embedment	6.661	m
Anchor rod force	32.268	ton

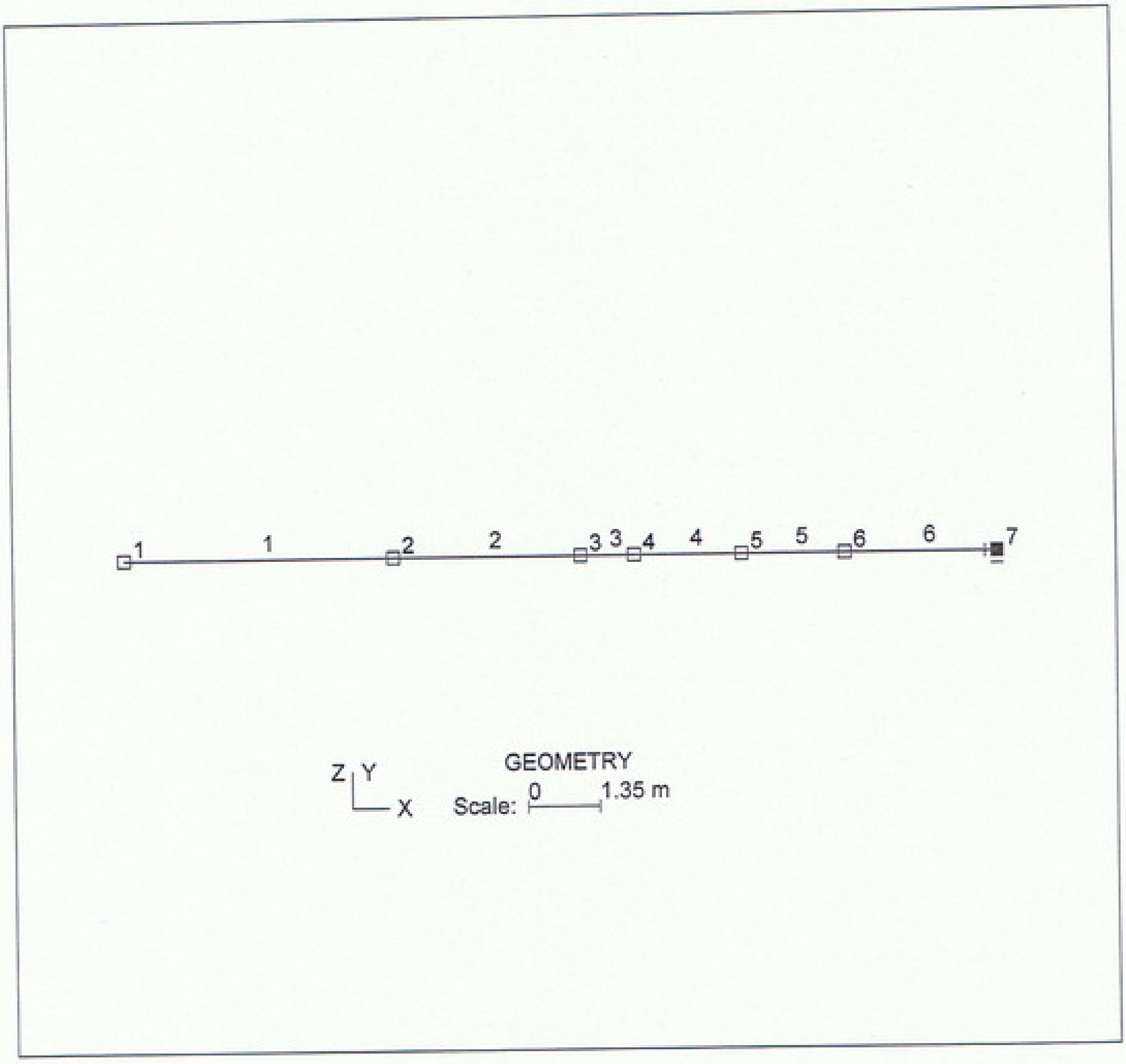
Presure diagram



convert to

> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
	node Symbol	Yes	Element no.	Yes
	Node no.	Yes	Material set	No
	Max results	No	Stress value	No
	Rotate-X = 0 degree		Rotate-Y = 90 degree	Enlarge Scale = 1.0



> Node Data

Node	X-Coor (m)	Y-Coor (m)	X-Boun	Y-Boun	Rotn
1	0.00	0.00			
2	5.00	0.00			
3	8.50	0.00			
4	9.50	0.00			
5	11.50	0.00			
6	13.40	0.00			
7	16.25	0.00	L	L	L

> Element Data

Elem	StartNode	EndNode	MatSet	HingeCode	AddSection
1	1	2	1		
2	2	3	1		
3	3	4	1		
4	4	5	1		
5	5	6	1		
6	6	7	1		

> Material Data

Set	E-modulus (ton/m^2)	Area (m^2)	Inertia (m^4)	G-modulus (ton/m^2)	J-Torsion (m^4)	Section BxD
1	2.10E+06	0.2400	0.0032	9.13E+05	0	0.6x0.4

> Load Case no.1 : uniform load
> Uniform Load Data

Elem	Wz-Load (ton/m)
1	-1.62
2	-3.86
3	-5.53
4	-5.53
5	-3.52
6	5.30

> Load Case no.2 : point load
> Nodal Force Data

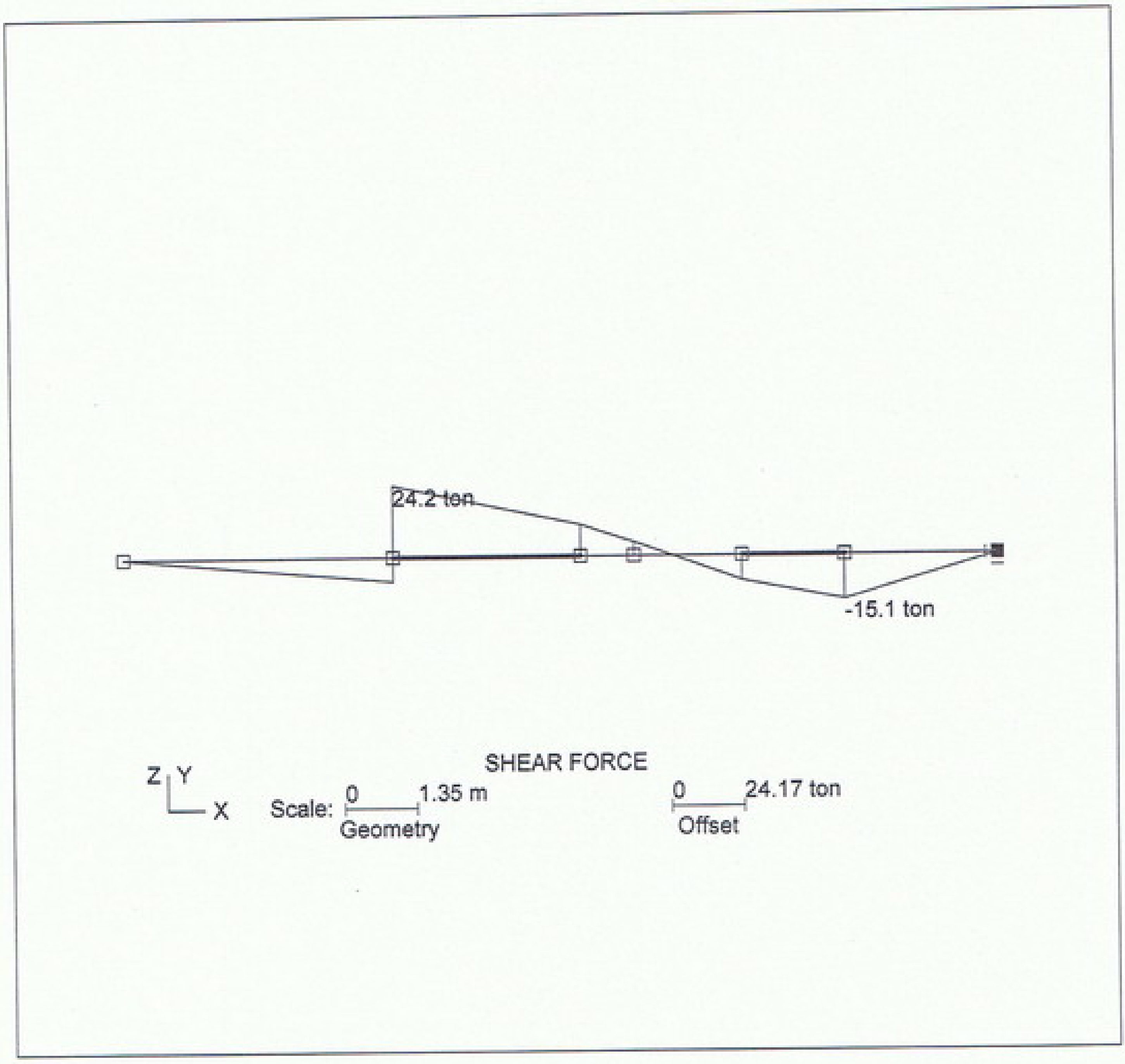
Node	Z-Forc (ton)	Mom-Mx (ton-m)	Mom-My (ton-m)
2	32.27	0.00	0.00

> Load Case no.3 : pressure
> Uniform Load Data

Elem	Wz-Load (ton/m)
3	-0.50
4	-1.00

> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

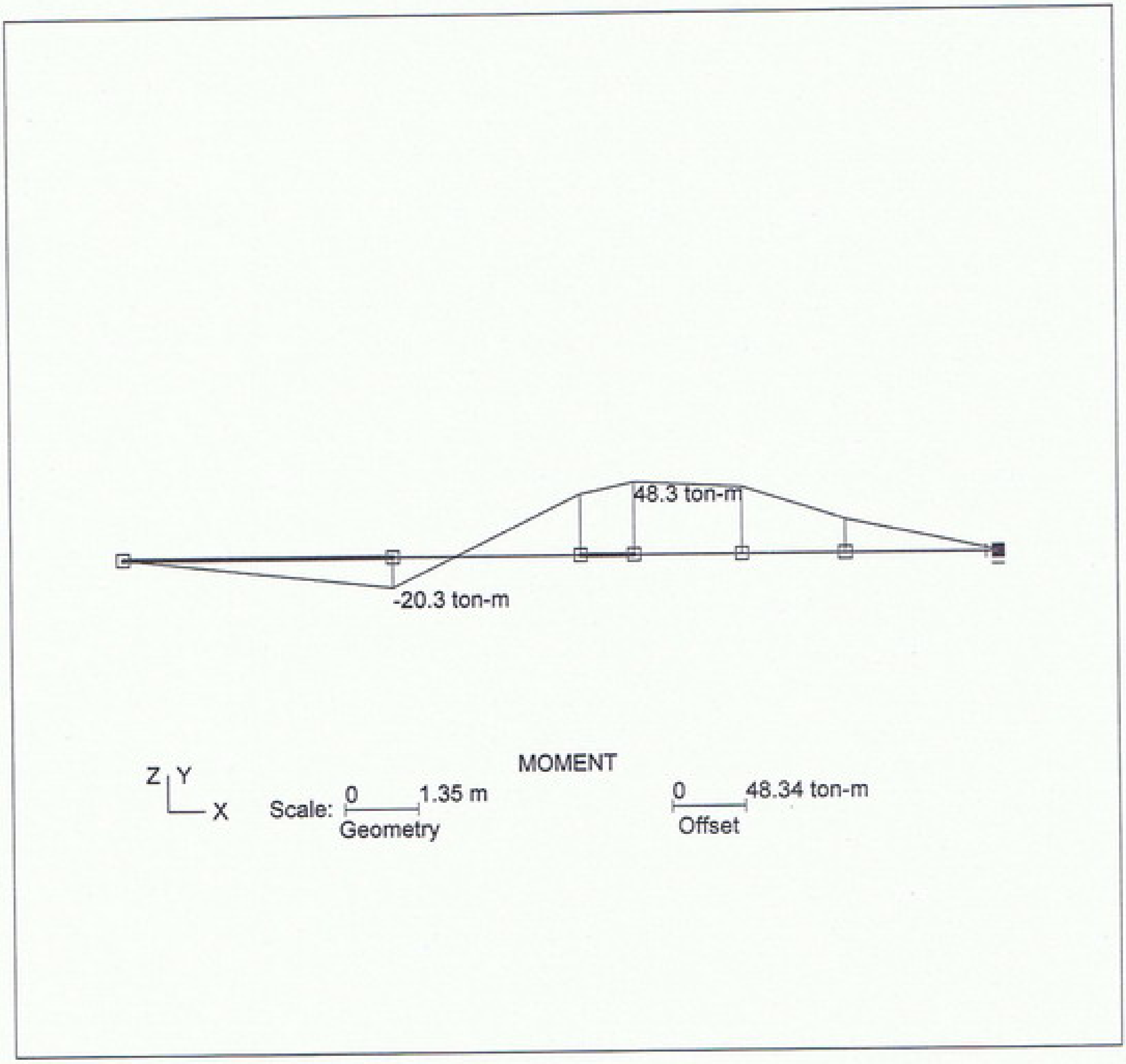
Print Options:				
	node Symbol	Yes	Element no.	No
	Node no.	No	Material set	No
	Max results	Yes	Stress value	No
	Rotate-X = 0 degree	Rotate-Y = 90 degree	Enlarge Scale = 1.0	



> LOAD CASE ==> Combined Load Cases

Load Factor : 1/1/1

Print Options:				
	node Symbol	Yes	Element no.	No
	Node no.	No	Material set	No
	Max results	Yes	Stress value	No
	Rotate-X = 0 degree		Rotate-Y = 90 degree	Enlarge Scale = 1.0



> Stress Combination

Load Factor: 1/1/1

Elem	Set Hinge	Section (m)	Torsion (ton-m)	Shear (ton)	Moment (ton-m)
1	1	0.00	0.00	0.00	0.00
		5.00	0.00	-8.10	-20.25
2	1	0.00	0.00	24.17	-20.25
		3.50	0.00	10.66	40.70
3	1	0.00	0.00	10.66	40.70
		1.00	0.00	4.63	48.34
4	1	0.00	0.00	4.63	48.34
		2.00	0.00	-8.43	44.53
5	1	0.00	0.00	-8.43	44.53
		1.90	0.00	-15.12	22.16
6	1	0.00	0.00	-15.12	22.16
		2.85	0.00	-0.02	0.59

> Summary of Selected Results

Stresses	Elem	Max(+)	Elem	Max(-)
T (ton-m)	- - -	- - -	- - -	- - -
V (ton)	2	24.17	5	-15.12
M (ton-m)	3	48.34	1	-20.25

+Mmax = 58.75 t-m

for 0.60 m width

= 58.75 x 0.6

= 35.25 t-m

- Mmax = -13.89 t-m

for 0.6 m width

= 13.89 x 0.6

= 8.334 t-m

Design for dead man

$$A_{req} = \frac{F_{ar}}{K'_p \gamma H i}$$

$$= \frac{32.268x2}{3x1.75x5}$$

= 2.459 m^2

Used deadman 1.6 x 1.6 t = 0.5 m , A = 2.56 m^2

Design tied-rod

$$A_{req} = \frac{64.536x1000}{1200}$$

$= 53.78 \ cm^2$

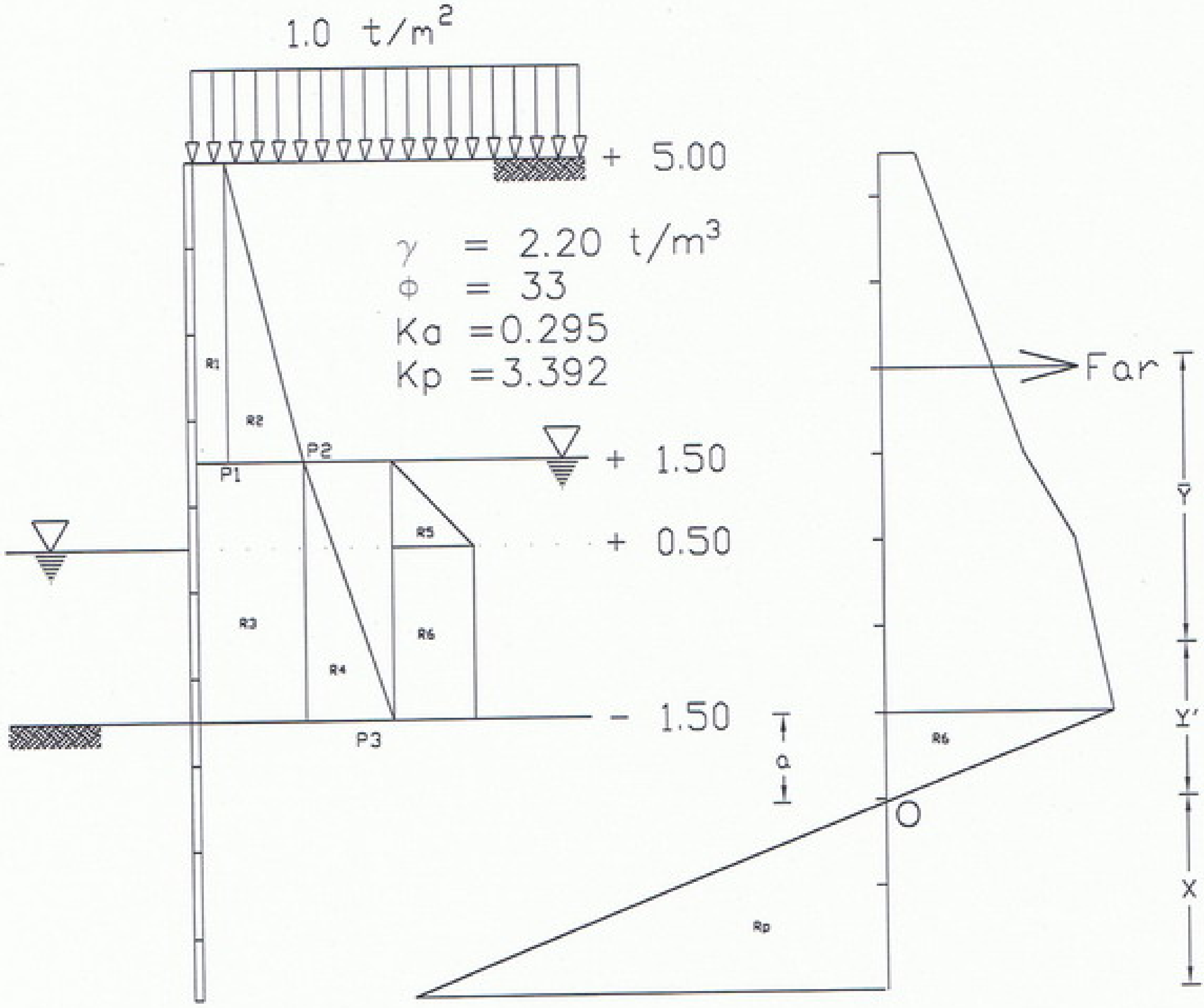
NO. of DB 25 mm

$$= \frac{53.78}{4.91}$$

$= 10.463$

Used 14 – DB25mm

Sheet Pile 12.00 m



Design for sheet pile type A size 40x60 cm L = 12 m

P1 = W x Ka

= 1.5 x 0.295

= 0.295 t/m^2

P2 = $(W+\gamma_1 h_1)K_a$

= (1+2.2x3.5) x 0.295

= 2.567 t/m^2

P3 = $(W+\gamma_1 h_1+\gamma'_{2h2})$ x Ka

= (1+2.2x3.5+1.2x3) x 0.295

= 3.629 t/m^2

$\overline{Pa}$ = P_3+P_W

= 3.629+1

= 4.629 t/m^2

a = $\dfrac{\overline{Pa}}{\gamma'(Kp - Ka)}$

= $\dfrac{4.629}{1.2(3.392 - 0.295)}$

= 1.246 m

R1 = 0.295 x 3.5 = 1.033 t/m

R2 = 0.5x(2.567-0.295)x3.5 = 3.976 t/m

R3 = 2.567x3 = 7.701 t/m

R4 = 0.5x(3.629-2.567)x3 = 1.593 t/m

R5 = 0.5 t/m

R6 = 2 t/m

R7 = $0.5 \times \overline{Pa} \times a$

= 2.884 t/m

Ra = $\sum_{1}^{7} R$

= 1.033+3.976+7.701+1.593+0.5+2+2.884

= 19.687 t/m

Locating the resultant with respect to point O as shown,

$$\sum M_o = R_a \overline{Y'}$$

$$Ra\,\overline{Y'} = \left(\frac{3.5}{2}+3+1.246\right)R_1 + \left(\frac{3.5}{3}+3+1.246\right)R_2 + \left(\frac{3}{2}+1.246\right)R_3$$

$$+ \left(\frac{3}{3}+1.246\right)R_4 + \left(\frac{1}{3}+2+1.246\right)R_5 + \left(\frac{2}{2}+1.246\right)R6$$

$+ (\frac{2}{3} x1.246)R7$

$= \quad 5.996R_1 + 5.413\ R_2 + 2.746\ R_3 + 2.246\ R_4 + 3.579\ R_5$

$+ 2.246\ R_6 + 0.831\ R_7$

$= \quad 61.119$

$\overline{Y}' = \frac{61.119}{19.687}$

$= \quad 3.105$ m above point O

Location the resultant from the anchor rod,

$\overline{Y} = 4+1.246+3.105$

$= \quad 2.141$ m

From Eq.(8 -7)

$$\frac{X^3}{3}\gamma' K' + \frac{X^2}{2}\gamma' K'(H+a) - Ra\overline{Y} = 0$$

$$1.239X^3 + 9.750X^2 - 42.150 = 0$$

$X = 1.869$ m

Use 40 percent increase in D

$D = 1.4(1.869+1.246)$

$= \quad 4.361$ m

$L = 6.5+4.361$

$= 10.861$ m

Used 12.00 m

To find the anchor-rod force we must evaluate the pressure.

$$Rp = \frac{1}{2} \times \gamma' \times K'p \times X^2$$

$= 6.491$ t/m

and summing forces in the horizontal direction (Eq. 8-8)

$$\sum F_x = 0$$

$Far = Ra - Rp$

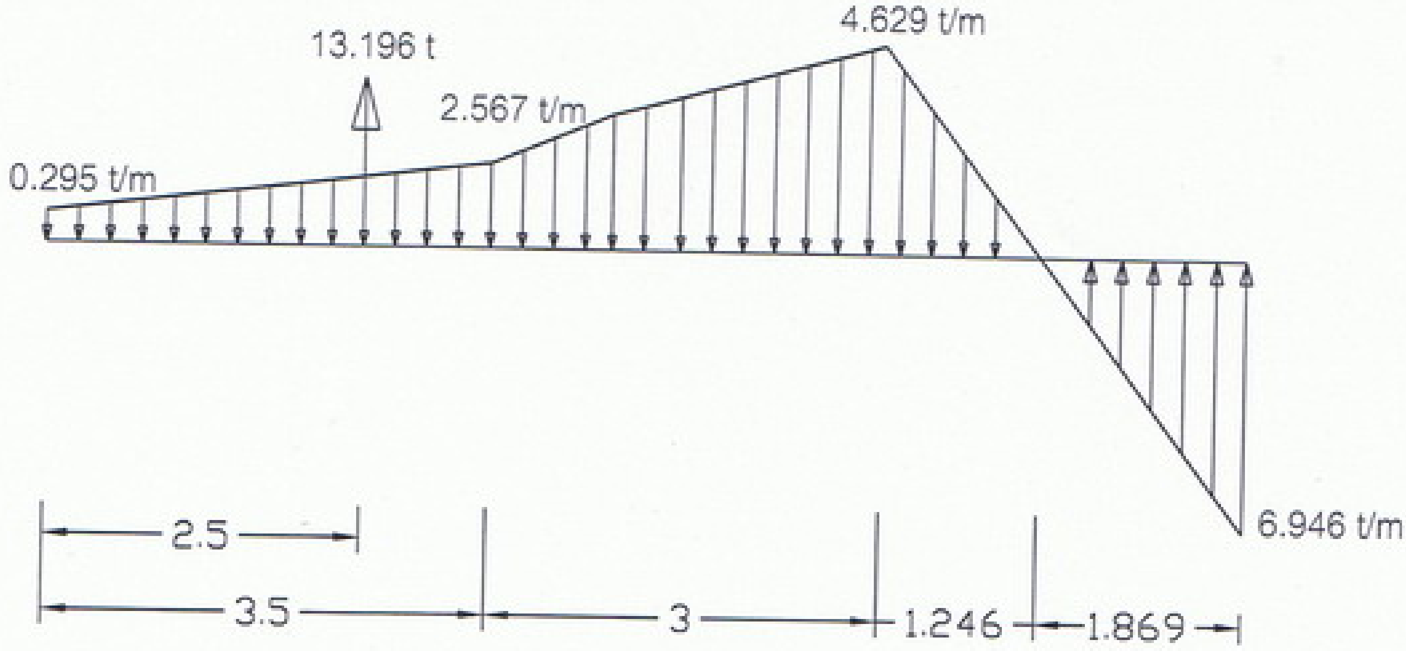
$= 19.687 - 6.491$

$= 13.196$ t/m

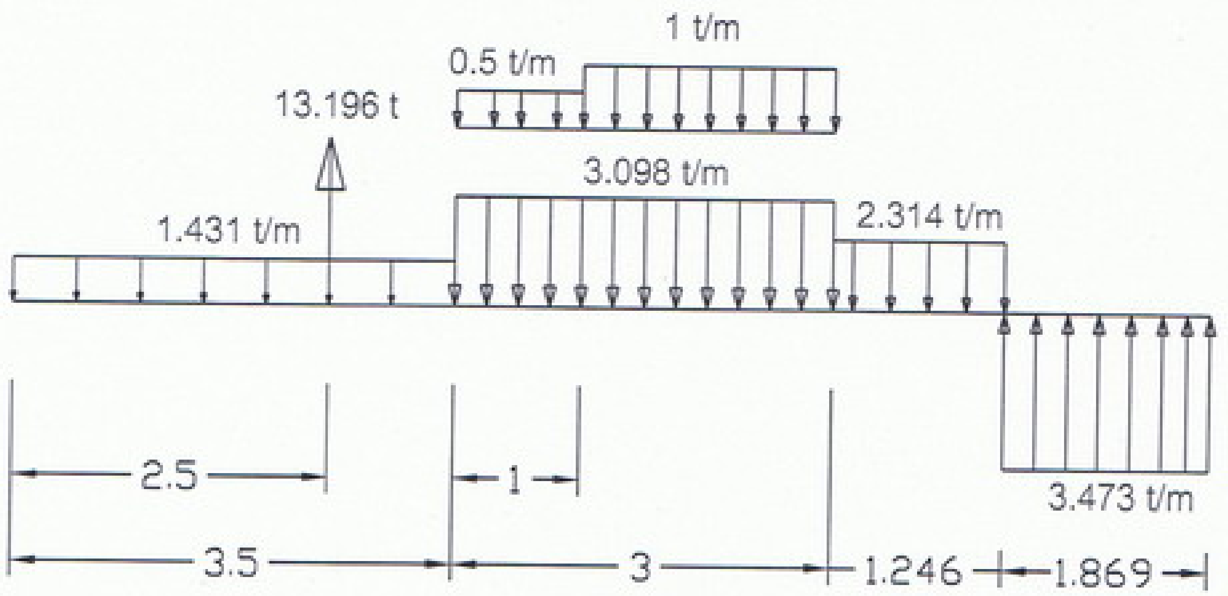
In summary:

Total length of sheet pile	12.00	m
Length of embedment	4.361	m
Anchor rod force	13.196	ton

Presure diagram

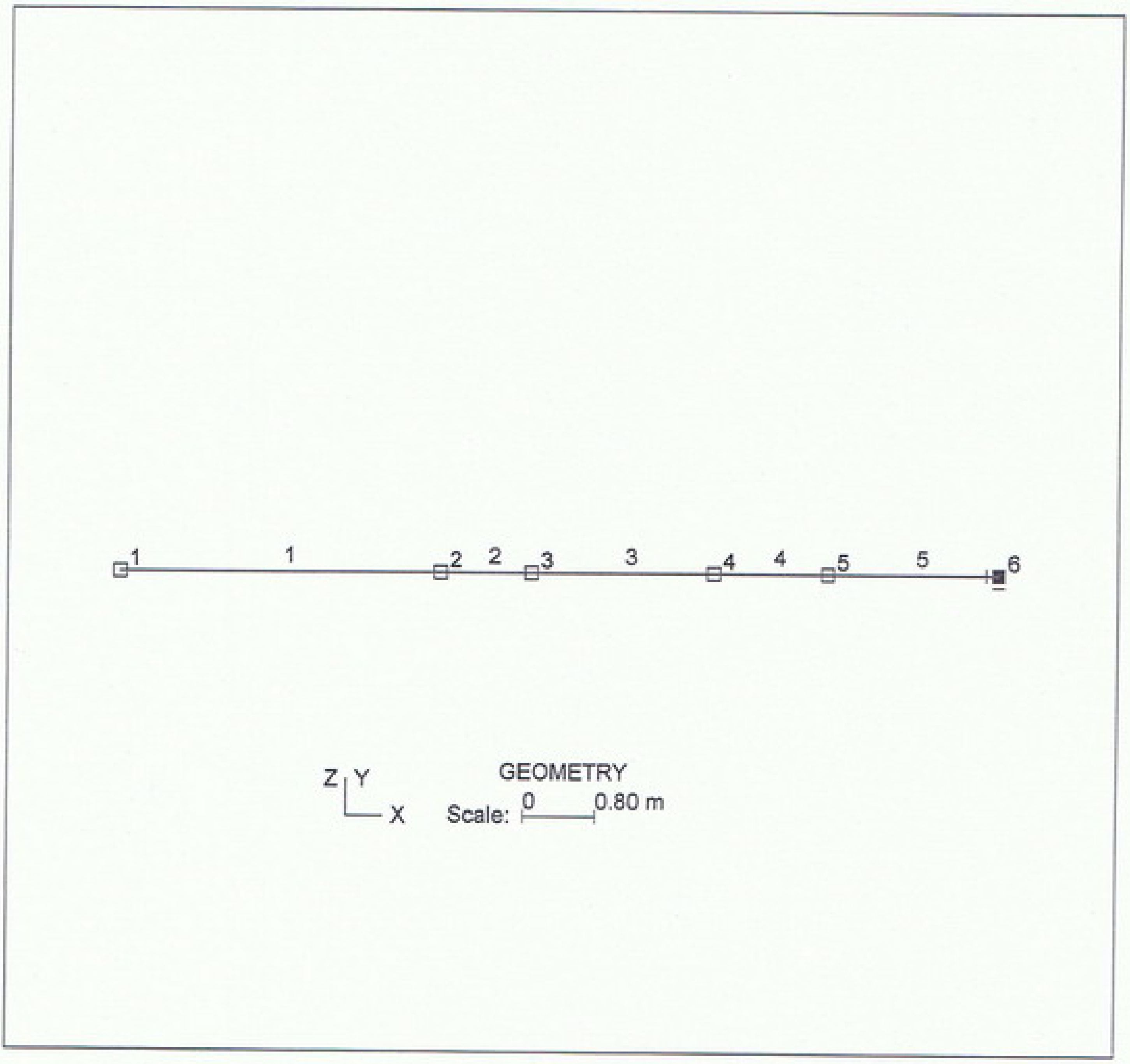


convert to



> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
node Symbol	Yes	Element no.	Yes	
Node no.	Yes	Material set	No	
Max results	No	Stress value	No	
Rotate-X = 0 degree		Rotate-Y = 90 degree		Enlarge Scale = 1.0



Project : sheet12m

Filename :

Authority :

Engineer :

> Node Data

Node	X-Coor (m)	Y-Coor (m)	X-Boun	Y-Boun	Rotn
1	0.00	0.00			
2	3.50	0.00			
3	4.50	0.00			
4	6.50	0.00			
5	7.74	0.00			
6	9.62	0.00	L	L	L

> Element Data

Elem	StartNode	EndNode	MatSet	HingeCode	AddSection
1	1	2	1		
2	2	3	1		
3	3	4	1		
4	4	5	1		
5	5	6	1		

> Material Data

Set	E-modulus (ton/m^2)	Area (m^2)	Inertia (m^4)	G-modulus (ton/m^2)	J-Torsion (m^4)	Section BxD
1	2.10E+06	0.2400	0.0032	9.13E+05	0	0.6x0.4

> Load Case no.1 :

> Uniform Load Data

Elem	Wz-Load (ton/m)
1	-1.43
2	-3.10
3	-3.10
4	-2.32
5	3.47

> Load Case no.2 :

> Point Load Data

Elem	Pz-Load (ton)	distance (m)	(m)
1	13.20	2.500	

> Load Case no.3 :

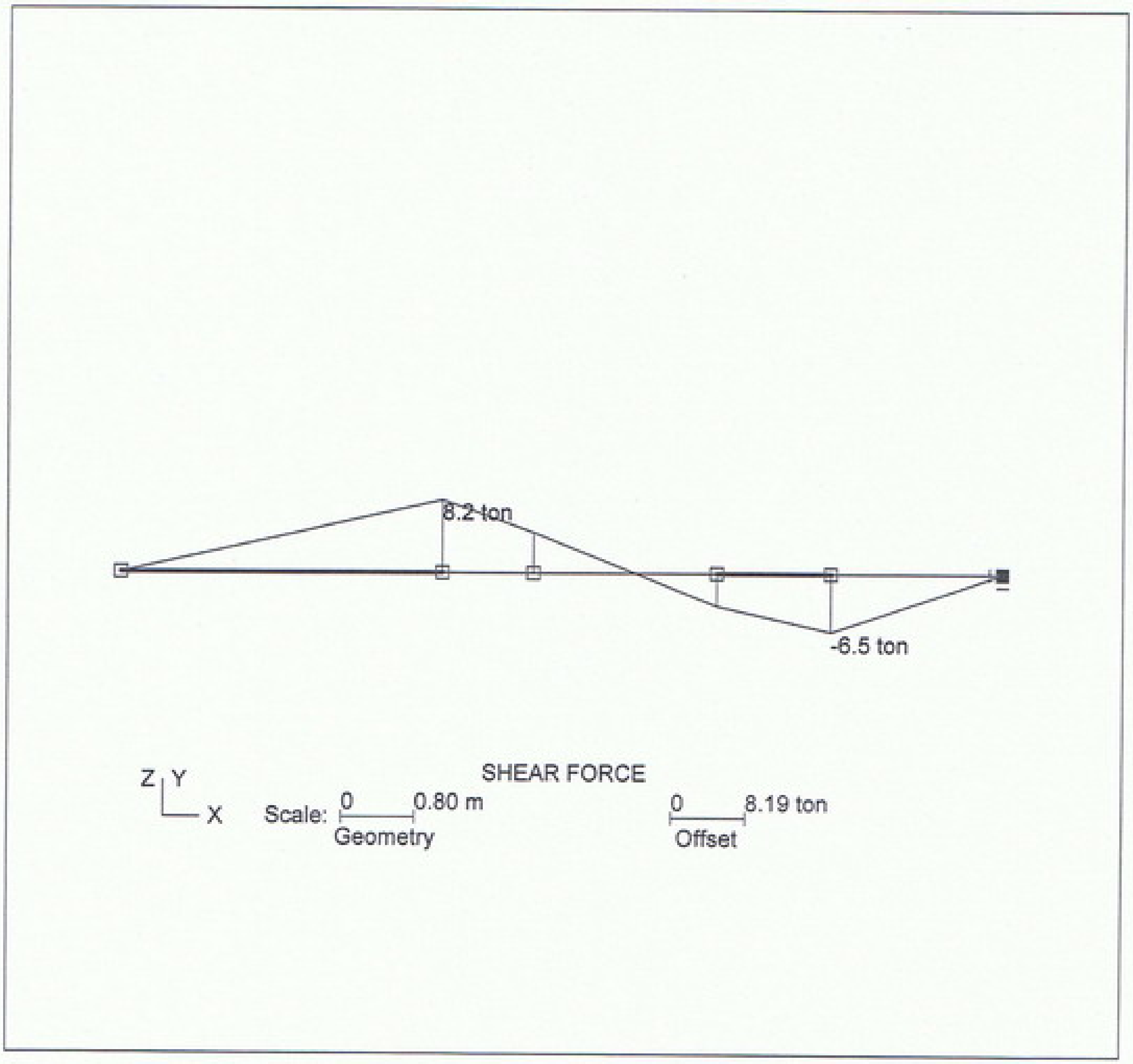
> Uniform Load Data

Elem	Wz-Load (ton/m)
2	-0.50
3	-1.00

> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
	node Symbol	Yes	Element no.	No
	Node no.	No	Material set	No
	Max results	Yes	Stress value	No

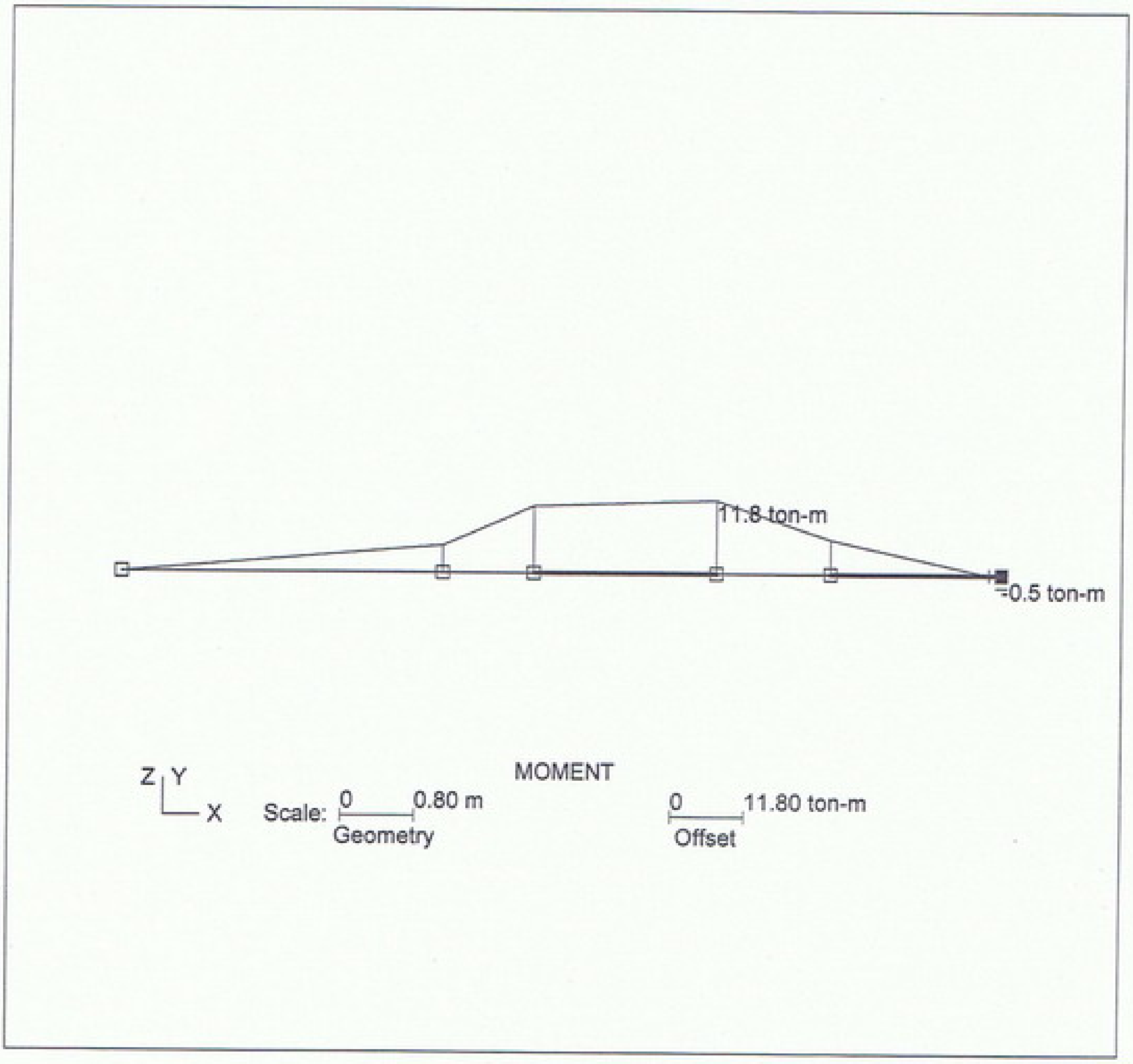
Rotate-X = 0 degree Rotate-Y = 90 degree Enlarge Scale = 1.0



> LOAD CASE ==> Combined Load Cases
Load Factor : 1/1/1

Print Options:				
node Symbol	Yes	Element no.	No
Node no.	No	Material set	No
Max results	Yes	Stress value	No

Rotate-X = 0 degree   Rotate-Y = 90 degree   Enlarge Scale = 1.0



> Stress Combination

Load Factor: 1/1/1

Elem	Set Hinge	Section (m)	Torsion (ton-m)	Shear (ton)	Moment (ton-m)
1	1	0.00	0.00	0.00	0.00
		3.50	0.00	8.19	4.43
2	1	0.00	0.00	8.19	4.43
		1.00	0.00	4.59	10.82
3	1	0.00	0.00	4.59	10.82
		2.00	0.00	-3.61	11.80
4	1	0.00	0.00	-3.61	11.80
		1.24	0.00	-6.48	5.55
5	1	0.00	0.00	-6.48	5.55
		1.88	0.00	0.03	-0.49

> Summary of Selected Results

Stresses	Elem	Max(+)	Elem	Max(-)
T (ton-m)	- - -	- - -	- - -	- - -
V (ton)	1	8.19	4	-6.48
M (ton-m)	3	11.80	5	-0.49

+Mmax = 11.80 t-m

for 0.60 m width

= 11.80 x 0.6

= 7.08 t-m

- Mmax = -0.49 t-m

for 0.6 m width

= 0.49x 0.6

= 0.294 t-m

Design for dead man

$$Areq = \frac{F_{ar}}{K_p \gamma Hi}$$

$$= \frac{13.196 \times 2}{3 \times 3.097 \times 2.5}$$

$$= 1.136 \quad t/m^2$$

Used deadman 1.6 x 1.6 , t = 0.5 m , A = 2.56 m^2

Design tied-rod

$$Areq = \frac{26.392 \times 1000}{1200}$$

$= \quad 21.993 \ cm^2$

NO. of DB 25 mm

$$= \frac{21.993}{4.91}$$

$= \quad 4.479$

Used 8 - DB25mm