CHAPTER 2
PUMP DRAINAGE IMPROVEMENT (PACKAGE B)

2.1

Civil Design

2.1.1

Design Standard

1.1.1 Design Standard

(1) Permanent Structure

(a) Unit Weight

Reinforced concrete $\gamma c = 2.5 t/m^3$

Backfill sand $\gamma s = 1.8 t/m^3$ (under Ground water $0.8 t/m^3$)

(b) Design Stress

• Concrete

Concrete	
Bending compressive stress σca	210(kg/cm^2)

• Reinforcement

Reinforcement	deformed bar
Tensile and compressive stress τsa	3,000(kg/cm^2)

(c) Allowable Stress

• Concrete

Concrete	210(kg/cm^2)
Bending compressive stress σca	70(kg/cm^2)
Shearing stress τca	3.6(kg/cm^2)

• Reinforcement

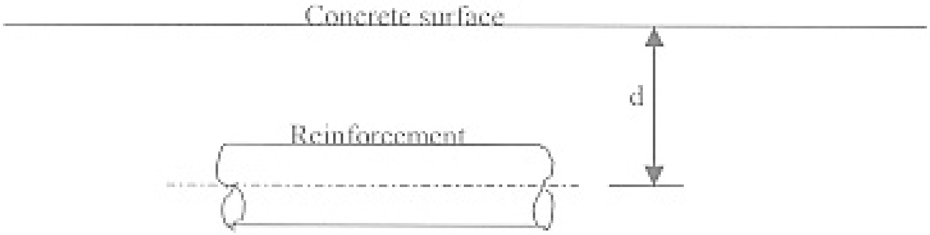
Reinforcement	deformed bar
Tensile and compressive stress τsa	1,600(kg/cm^2)

(d) Reinforcement Arrangement

• Diameter (mm)

6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 25, 28, 30, 32, 36

• Cover (d mm)



Underside of bottom slab d = 120 mm (with pile structure)
d = 100 mm (without pile structure)
Other slab and wall d = 70 mm (h ≧ 300mm)
d = 50 mm(h < 300mm)
Beam and Columnd = 70mm

- Minimum space between two bars of reinforcement (face to face)

For slab and wall t0 = 100mm
(In this calculation, the space between two bars (center to center) should be taken following two cases, 125mm or 250mm.)
For beam and column t0 = 50mm

- Minimum amount of reinforcement

Deformed bar

Beam	As =	0.002 b·d ≦ As ≦ 0.02 b·d
Column	As =	0.0015 A ≦ As ≦ 0.06 A

- Lap length

Plain bar and Deformed bar L = 35d (d = diameter of reinforcement)

(e) Design Load

- Basic parameters

Unit weight of soil	γ =	1.8(t/m^3),	friction angle φ = 30 °
Under ground water	γ' =	0.8(t/m^3)	
Vehicle load	H30 (30T)		

- Vertical load

Soil load p1 = h × γ
Vehicle load p2 = (n × P)/A
Back axle weight = 12T
One tire weight P = 12/2 = 6T (The space of tire Is 1.6m)
Loading area
A = (0.2+2 × h × tan30°) × (0.6+2 × h × tan30°)
n : over load factor 1.3

(If depth of upper slab is more than 1.4m, two tire loads should be considered)

Under ground water load Pw (unit weight is $1.0t/m^3$)

・Horizontal load

Soil pressure P = (vertical soil load) × Ko

Ko = 0.5 (Earth pressure at rest)

Horizontal load pressure Pv = (Vertical load) × Ko

(For calculation of Box Culvert. Vertical vehicle load and horizontal vehicle load are not loaded at the same time.))

Axial load Pa = $1.0\ t/m^2$ (For calculation of under ground wall. If there is no road near the structure, axial load is $0.5t/m^2$))

Under ground water pressure Pw

・Inside of structure

Vertical water load

Horizontal water pressure

・Equipment weight

Mechanical equipment load (activity load)

Electrical equipment load

・Building load

・Uplift strength

(2) Temporary structure

(a) Sheet Pile : Stress for calculation

Tensile Stress	2,700 kg/cm^2
Bending Compressive Stress	2,700 kg/cm^2
Shearing Stress	1,300 kg/cm^2

(b) H section steel

Tensile Stress	2,100 kg/cm^2
Bending Compressive Stress (*)	2,100 kg/cm^2
Shearing Stress	1,200 kg/cm^2

ε * Bending Compressive Stress is according to length of H section

$l/r \leq 20$ 2,100 kg/cm^2

$20 < l/r < 93$ $\{1,400 - 8.4(l/r - 20)\}$

$93 \leq l/r$ $\{12,000,000 / (6700 + (l/r)^2)\} \times 1.5$

Here l : length of H section
r = radius gyration of H section

(c) Stress Iron Weld Connection

Allowable stress of Shop Welding is same as the above.
Allowable stress of Field Welding is 80 % of Shop welding.

(d) Stress for Bolt Connection

Shearing Stress	1,300 (kg/cm^2)
Surface Compressive	2,900 (kg/cm^2)

2.1.2

Thanh Da Pumping Station

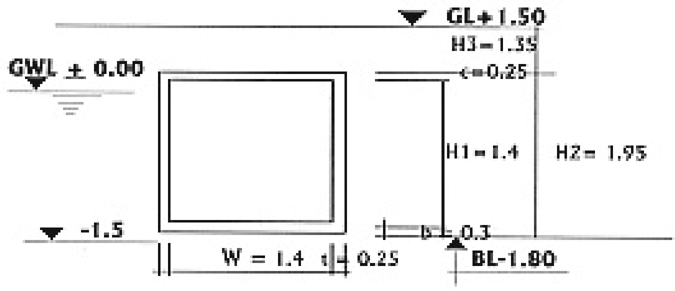
CALCULATION FOR THANH DA PUMPING STATION

I-Calculation for culvert 1400x1400

(The calculation based on Japanese standard - JIS1999)

1-Geometry dimensions for calculation :

(Calculation made for one m long of culvert):



2-Material properties and soil conditions:

Ground water level:	GWL=	±0.00
Concrete: Grade 210,	Rn =	70 kg/cm^2
	RS=	3.6 kg/cm^2
Reinforcement type JIS:	Ra=	1600 kg/cm^2
Back fill sand:	γ_s= 1.8T/m3 ; Coeficient of earth pressure at rest K_o=	0.5
Internal friction =		20deg

3-Loading and calculation scheme:

3.1 Vehicle load:

Vehicle type: H30 So design load is calculated as following formula:

Pde=(1+I)X2P/Wo

Where:

P,weight of back wheel 12.00T

Wo,width of occpied area of vehicle Wo= 2.75m

i, impact coefficent, i=0.3

Pde=2x12x(1+0.3)/2.75=11.35

W1=2h+0.2=2x1.35+0.2=2.90m

P1=Pde/W1=11.35/2.9=3.91T/m2

3.2 Soil load on cover slab

P2= H3*γ_s=1.475*1.8=2.655T/m2

3.3 Horizontal load from vertical load P1+P2 on two side of culvert

PH= 2.655x0.5+0.5= 1.83T/m2

3.4 Horizontal triangle load due to earth from both side of the culvert

Pw = 1.83+0.5x0.8x1.65+1.0x1.65=4.14T/m2

3.5 Reaction at the bottom slab of culvert

Pb= 3.91+2.655+0.63+1.75/1.65=8.25T/m2

4-Checking pressure to base soil

Total pressure to base soil

Ps= 8.25+0.3x2.5=9T/m2

So at the depth of 3.3m strength of base soil must be bigger than 9T/m2

5-Checking uplift that due to ground water

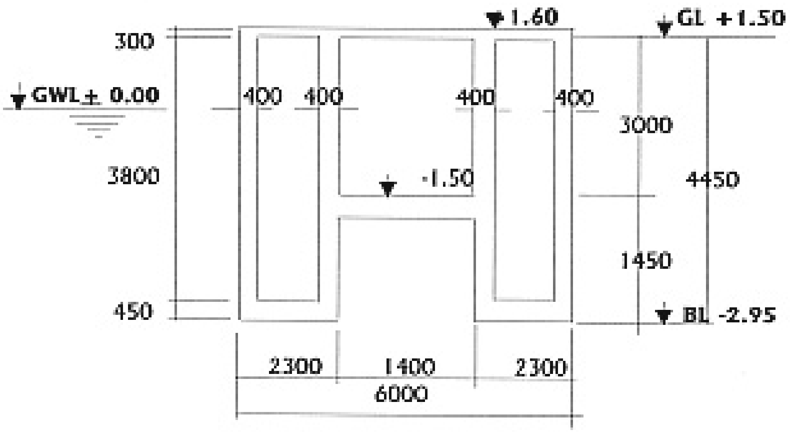
Ground water level ± 0.00 and the culvert it empty

Total pressure : Ps=Psoil+Pself = 2.655+2.29=4.945T/m2 >Puplift

II-Calculation for pumping station

(Checking for section 6-6)

1-Geometry dimensions for calculation :



2-Loading and calculation scheme:

2.1 Vertical load

Surchange load on the cover slab Ps =0.50T/m2

2.2 Horizontal triangle distributed load due to earth from both side of the pumping station above ground water level

P_{s1}=1.8x1.45x0.5=1.31T/m2

2.3 Horizontal distributed uniform load due to surchange load from both side of the pumping station

P_{s2}=0.5x0.5=0.25T/m2

2.4 Horizontal triangle distributed load due to earth from both side of the pumping station under ground water level

Ps3=(1.8-1)x2.725x0.5+1.0x2.725=3.82T/m2

Total horizontal load from both side of the pumping station

$P_{hor}=P_{s1}+P_{s2}+P_{s3}$=1.31+0.25+3.82=5.38T/m2

2.5 Pressure due to water inside from both wall of the pumping station

THA
2

$Pw = 1.0x2.73 = 2.73T/m2$

2.6 Reaction at the bottom slab of pumping station

$Pb = Ps + (Wsl + Ww)/b = (0.50 + 0.75) + (4x4.18 + 3.5/5.6) = 4.86T/m2$

III-Calculation for streses and force:

Refer to attached result sheet for calcution value of stress steel area for scheet elements

THA
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Calculation for bar arrangement for Thanh Da pumping station

Base on attached results of shell forces analised by SAP2000, choosing the most dangerous forces for calculation:

$A_o = M/R_n b h_o^2$ Where, M: Maximum bending moment(T.m)

h_o: Effective depth of bearing area(cm)

h_o= (Element thickness-Cover thickness)

b: Width of calculated area(cm)

Required area of reinforcement:

Fa= M/γRaho Where: $\gamma = 0.5 + ((1\text{-}2Ao)^{1/2})/2$

NAME OF ELEMENT	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement	
					φ(mm)	a(mm)
CULVERT1400X1400 b=1.00 h=0.25 b=1.00 h=0.30	1.280 1.160 1.040 1.520	0.0564 0.0511 0.0281 0.0410	0.971 0.974 0.986 0.979	4.58 4.14 4.40 4.22	14 14 14 14	**250** **250** **250** **250**
PUMPING STATION No13 bxh=1x0.3	2.360	0.0637	0.967	6.63	14	**125**
ELEMENT No 16 bxh=1x0.4	3.830 3.110	0.0502 0.0408	0.974 0.979	7.45 6.02	14 14	**125** **125**
ELEMENT No 17 bxh=1x0.45	3.770	0.0373	0.981	6.32	14	**125**
ELEMENT No 18 bxh=1x0.4	3.430	0.0450	0.977	6.65	14	**125**

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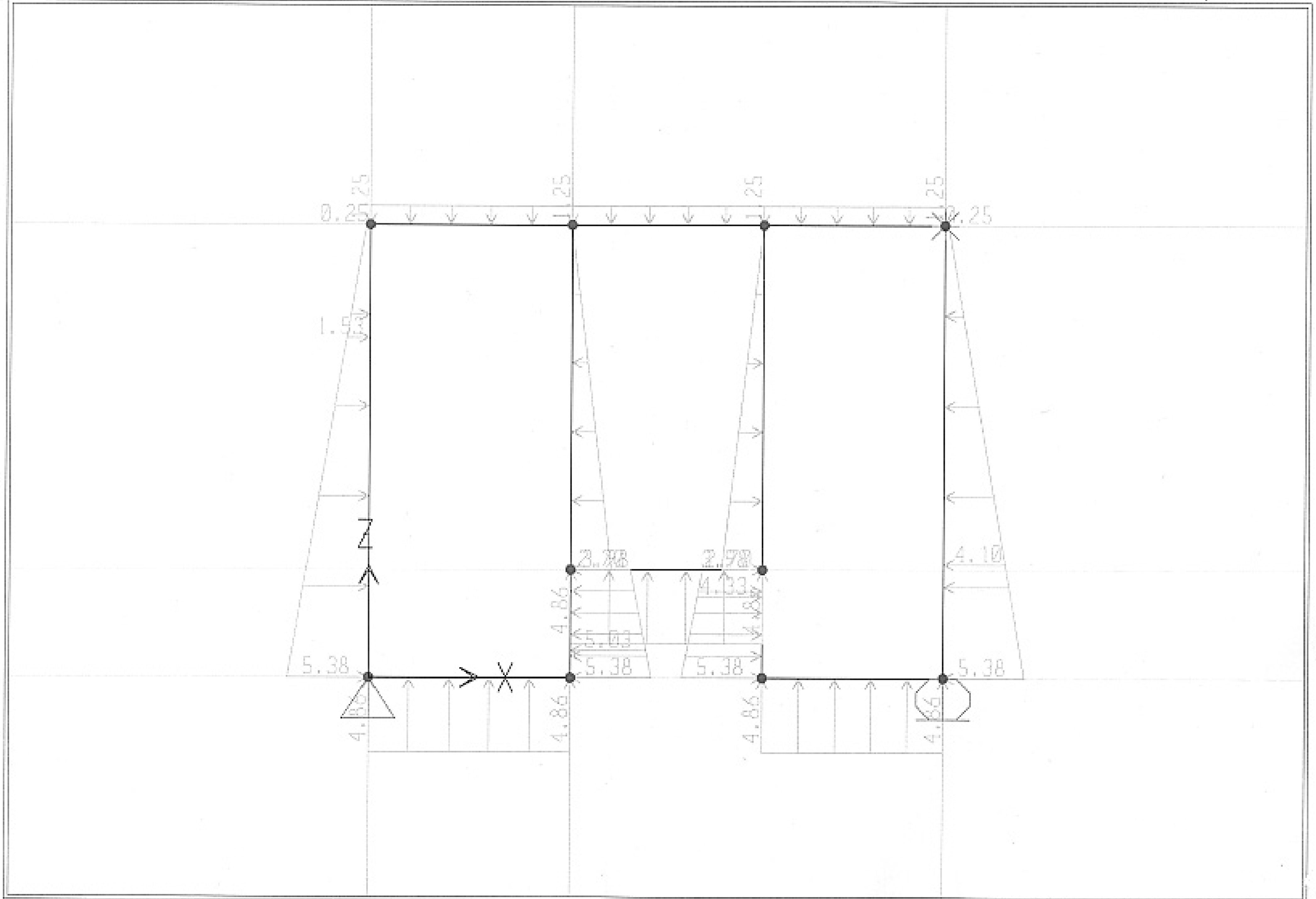
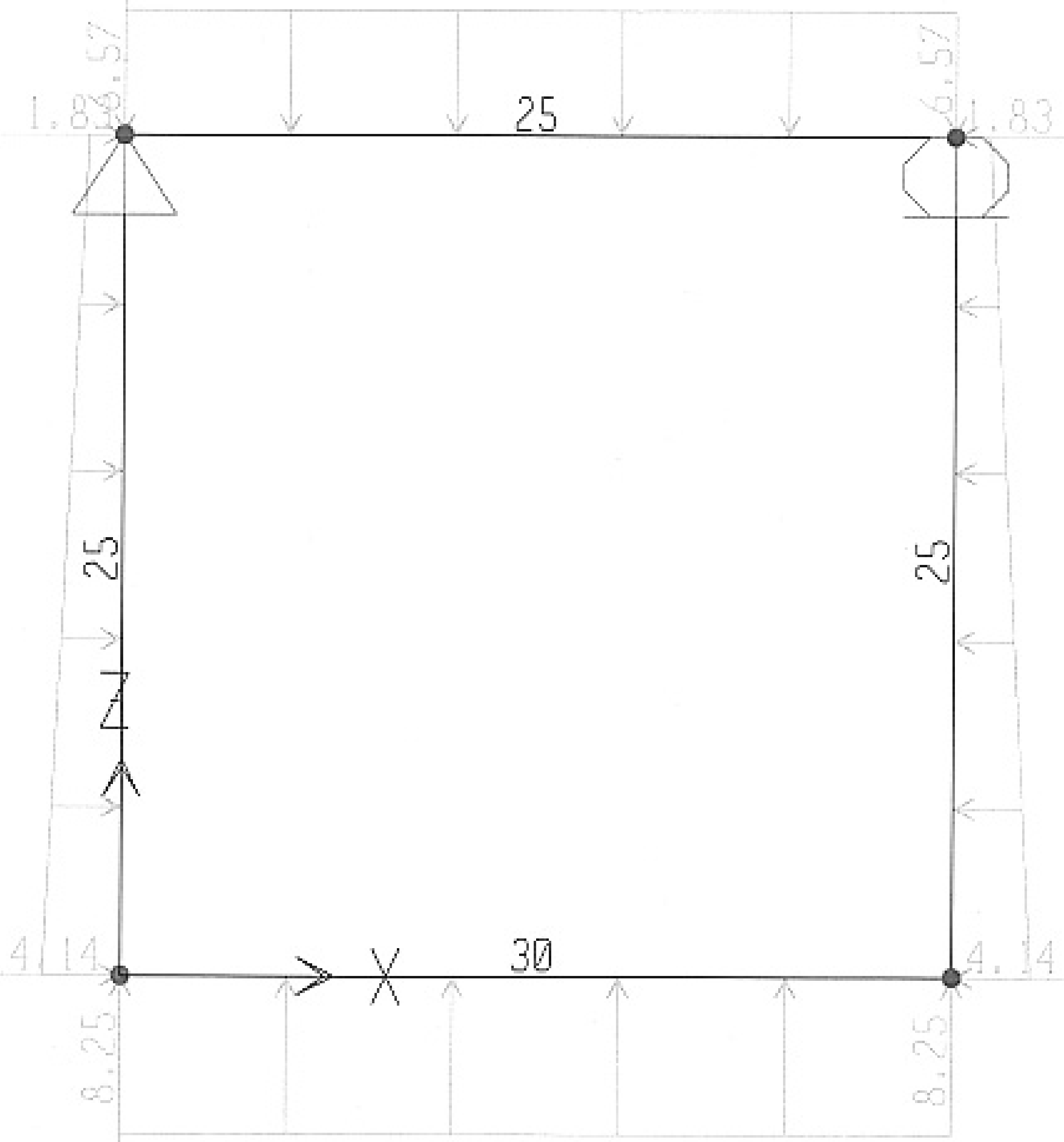
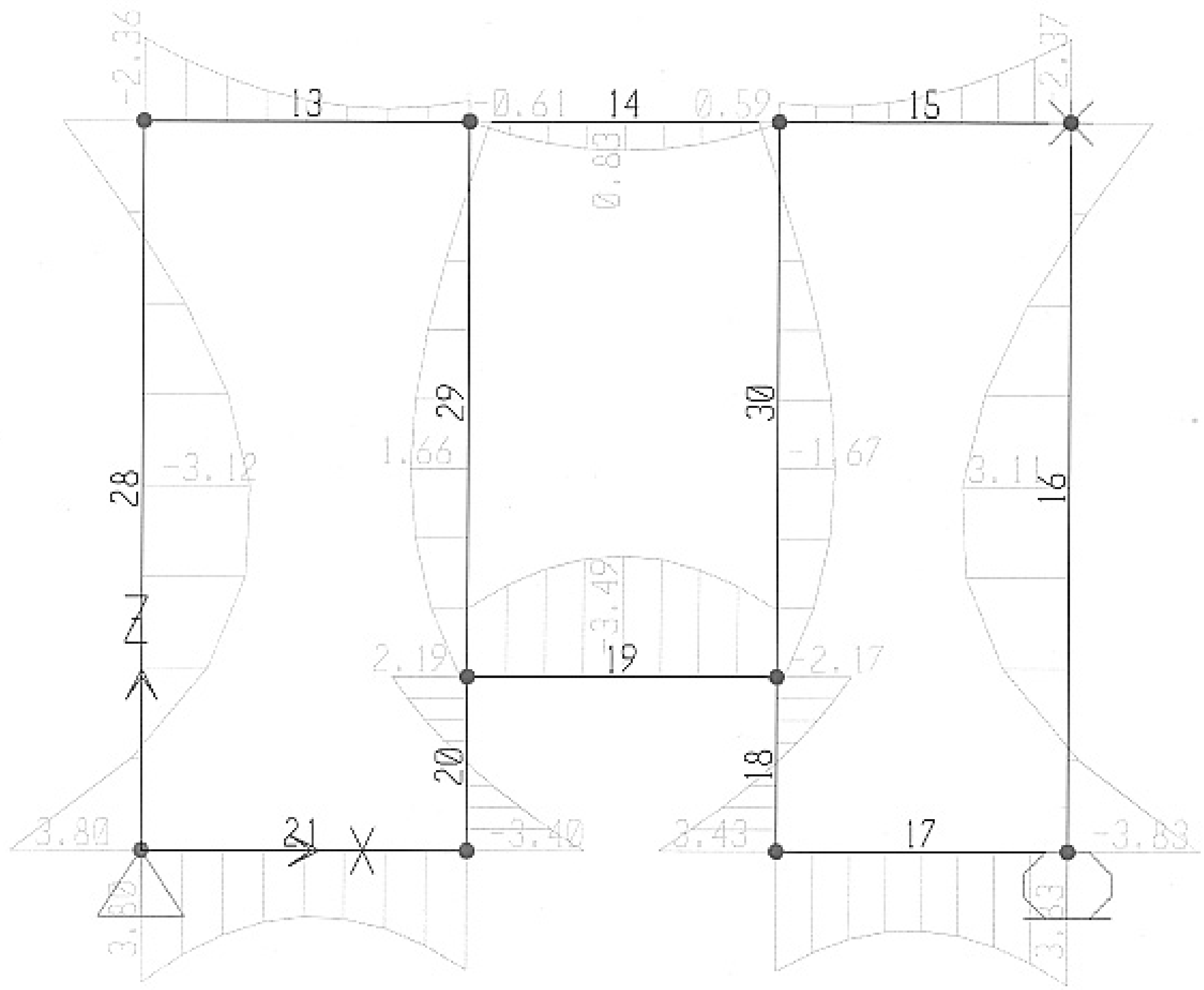


SAP2000 v6.11 - File:Thanhda - Frame Span Loads (LOAD1) - Ton-m Units


1.83
6.57
25
6.57
1.83
25
25
Z
4.14
30
4.14
8.25
8.25



SAP2000 v6.11 - File:Thanhda - Moment 3-3 Diagram (LOAD1) - Ton-m Units

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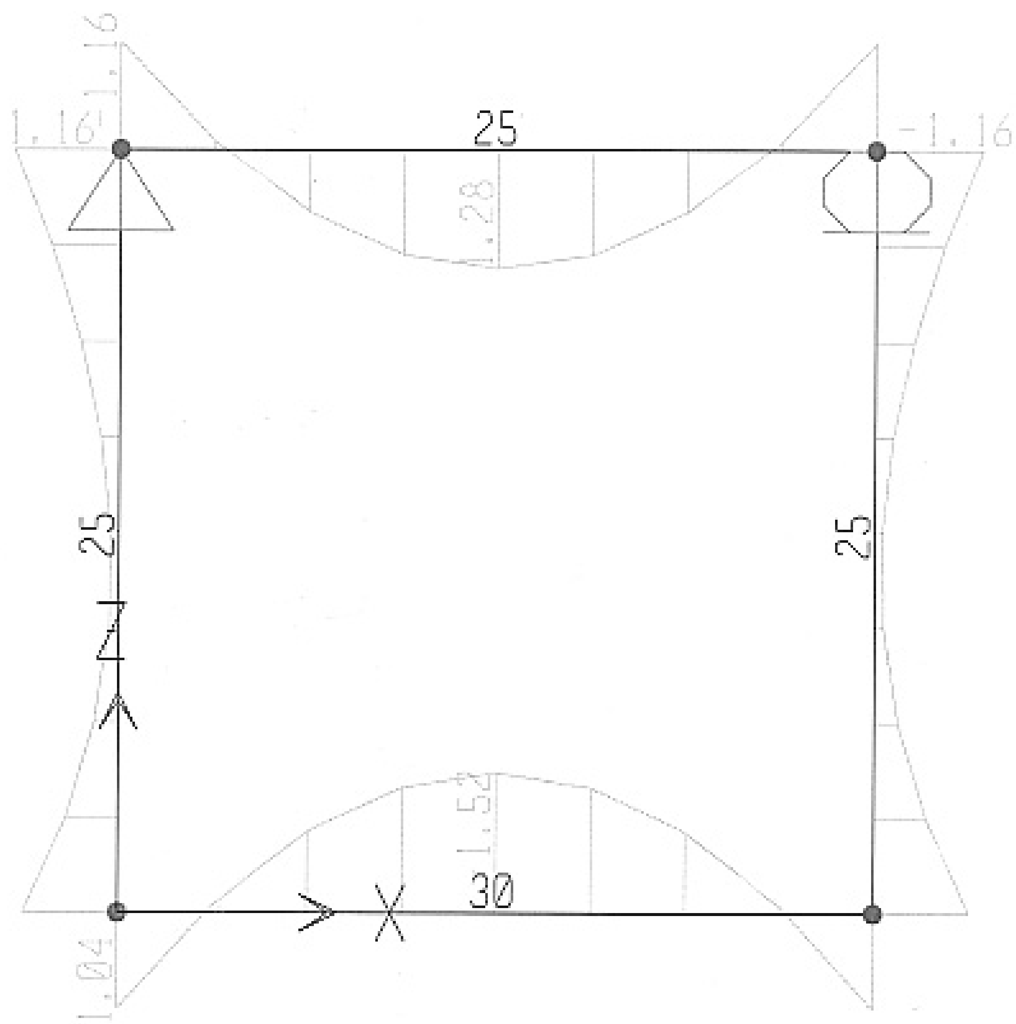
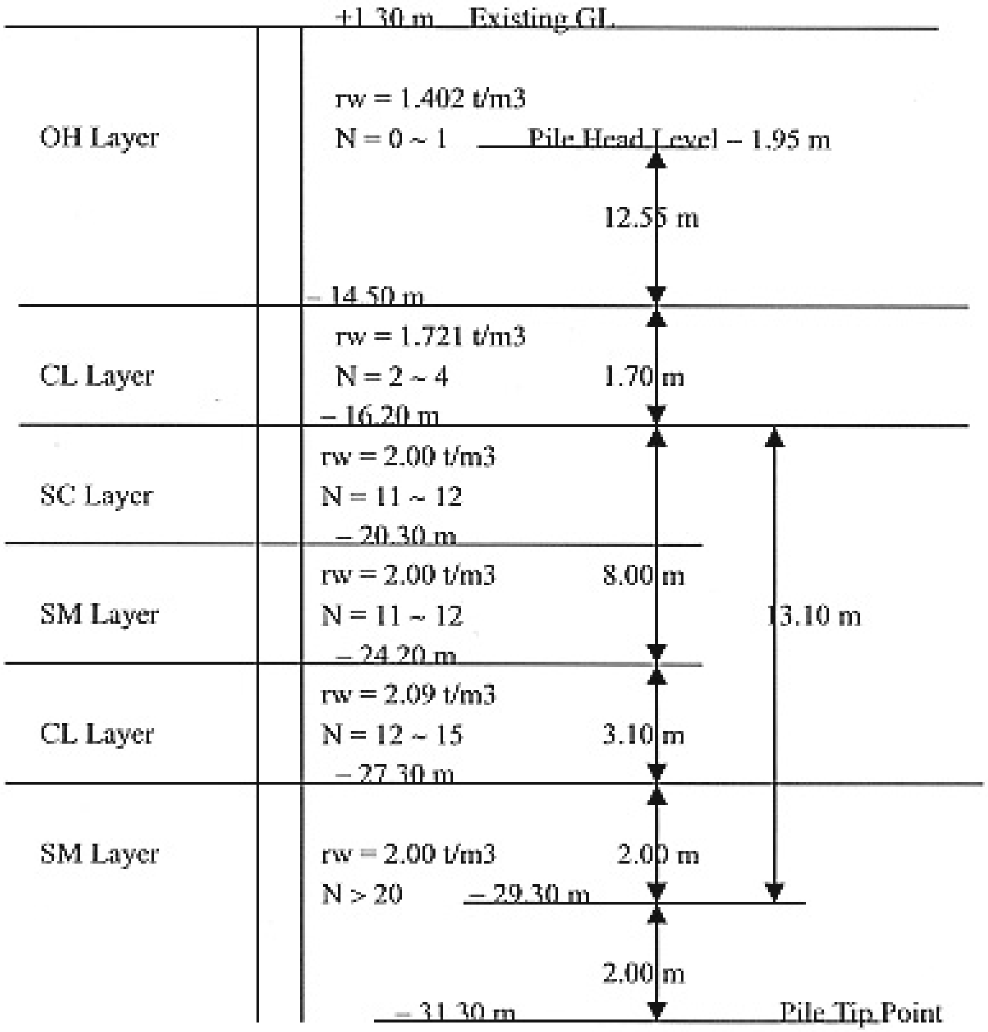


SAP2000 v6.11 - File:Sluicetd - Moment 3-3 Diagram (LOAD1) - Ton-m Units

Pile Foundation Calculation for THANH DA Pumping Station

(1) Soil condition of THANH DA Pumping Station

Typical soil condition of is shown in bellow.



(2) Calculation Condition

Pile Concrete Pile 300 × 300
Embed depth for SM Layer is 2.00 m (N > 20)
Consider a positive friction for pile from SC Layrer (N > 10)
Pile Length L = 31.30 – 1.95 = 29.35 m

(3) Calculation of Allowable Bearing Capacity of Pile

$Ra = 1/3\ (Ru - Ws) + Ws - W$

Ra : Allowable vertical bearing capacity of pile at pile head (t/pile)

Ru : Assumed ultimate bearing capacity of pile

$Ru = qd \times A + U \times \Sigma\ Li \times Fi$

qd : 30 × N (t/m2)

A : area of tip point of pile (m2)

U : The girth of pile (m)

Li : Thickness of layer which consider positive friction (m)

Fi : Maximum friction of layer which consider positive friction (Fi = 0.2 × N (t/m2))

Ws : Effective weight of soil which permute by soil (t)

W : Effective weight of pile and soil in the pile (t)

Average unit weight of soil (under ground water)

(0.402 × 12.55 + 0.721 × 1.70 + 1.00 × 8.00 + 1.09 × 3.10 + 1.00 × 4.00) ÷ 29.35 = 0.74 t/m3

Consider positive friction for layer of N > 10.

Ru = 30 × 20 × 0.30 × 0.30 + 0.30 × 4 × ((13.10 × (0.2 × 10) × + 2.00 × (0.2 × 20))
= 95.04 t

Ws = 0.30 × 0.30 × 29.35 × 0.74 (t/m3) = 1.95 t

W = 0.30 × 0.30 × 29.35 × 1.50 (t/m3) = 3.96 t

Ra = 1/3 × (95.04 − 1.95) + 1.95 − 3.96 = 29.00 t/pile

(4) Pile number calculation

1) Total load

Concrete

Right Upstream	7.55 m3
Pumping Station	111.86 m3
Left Upstream	4.46 m3
Right Downstream	6.82 m3
Sub Total	130.69 m3

130.69 m3 × 2.50 t/m3 = 326.73 t

Equipment load

Main pump	3.36 t
Flap gate	1.10 t
Screen	0.20 t
Sub Total	4.66 t

Water load 149.09 t

Total Load 481.29 t

2) Pile Numbers

Allowable bearing capacity of pile = 29.00 t/pile

Necessary numbers of pile

N = (481.29 t / 29.00 t/pile) = 17 piles

21 piles are arranged

(481.29 t / 21 piles) = 22.92 t < 29.00 t / piles OK

2.1.3

Ben Me Coc (1) Pumping Station

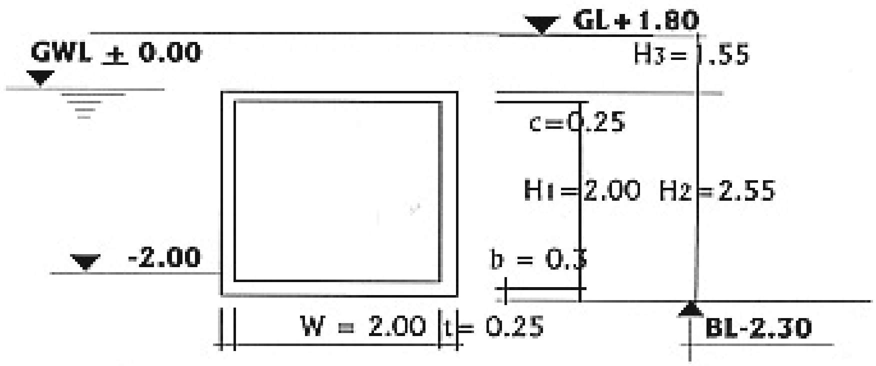
CALCULATION FOR BEN ME COC PUMPING STATION

I-Calculation for culvert 2000X2000

(The calculation based on Japanese standard - JIS1999)

1-Geometry dimensions for calculation :

(Calculation made for one m long of culvert):



2-Material properties and soil conditions:

Ground water level:	GWL=	±0.00
Concrete: Grade 210,	Rn =	70 kg/cm^2
	RS=	3.6 kg/cm^2
Reinforcement type JIS:	Ra=	1600 kg/cm^2
Back fill sand:	γ_s= 1.8T/m3 ; Coeficient of earth pressure at rest K_o=	0.5
Internal friction =		20deg

3-Loading and calculation scheme:

3.1 Vehicle load:

Vehicle type: H30 So design load is calculated as following formula:

Pde=(1+I)X2P/Wo

Where:

P,weight of back wheel 12.00T

Wo,width of occpied area of vehicle Wo= 2.75m

I, Impact coefficent, i=0.3

Pde=2x12x(1+0.3)/2.75=11.35

W1=2h+0.2=2x1.55+0.2=3.30m

P1=Pde/W1=11.35/3.3=3.44T/m2

3.2 Soil load on cover slab

P2= H3*γ_s=1.55*1.8=2.79T/m2

3.3 Horizontal load from vertical load P2 on two side of culvert

PH= 1.8x1.8x0.5+0.5= 2.12T/m2

3.4 Horizontal triangle load due to earth from both side of the culvert

Pw = 2.12+0.5x0.8x2.15+1.0x2.15=5.13T/m2

3.5 Reaction at the bottom slab of culvert

Pb= 2.79+3.44+0.63+1.75/1.65=7.97T/m2

4-Checking pressure to base soil

Total pressure to base soil

Ps= 7.97+0.3x2.5=8.72T/m2

So at the depth of 3.3m strength of base soil must be bigger than 8.72T/m2

5-Checking uplift that due to ground water

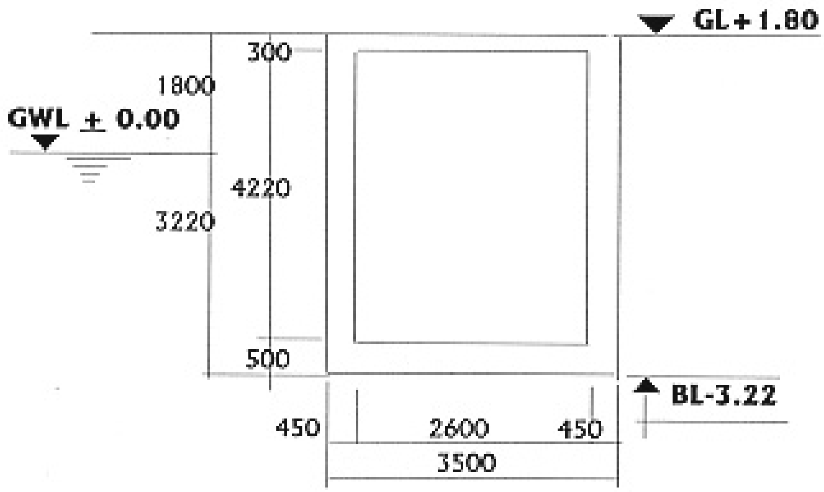
Ground water level ± 0.00 and the culvert it empty

Total pressure : Ps=Psoil+Pself

= 2.79+0.55X2.5+(2X0.5X2.5)/2.5=5.165T/m2 >Puplift=2.15X1=2.15T/m2

II-Calculation for pumping station

1-Geometry dimensions for calculation :



2-Loading and calculation scheme:

2.1 Vertical load

Surchange load on the cover slab Ps =0.50T/m2

2.2 Horizontal triangle distributed load due to earth from both side of the pumping station above ground water level

$P_{s1} = 1.8x1.80x0.5 = 1.62T/m2$

2.3 Horizontal distributed uniform load due to surchange load from both side of the pumping station

$P_{s2} = 0.5x0.5 = 0.25T/m2$

2.4 Horizontal triangle distributed load due to earth from both side of the pumping station under ground water level

$P_{s3} = (1.8-1)x2.97x0.5 + 1.0x2.97 = 4.16T/m2$

Total horizontal load from both side of the pumping station

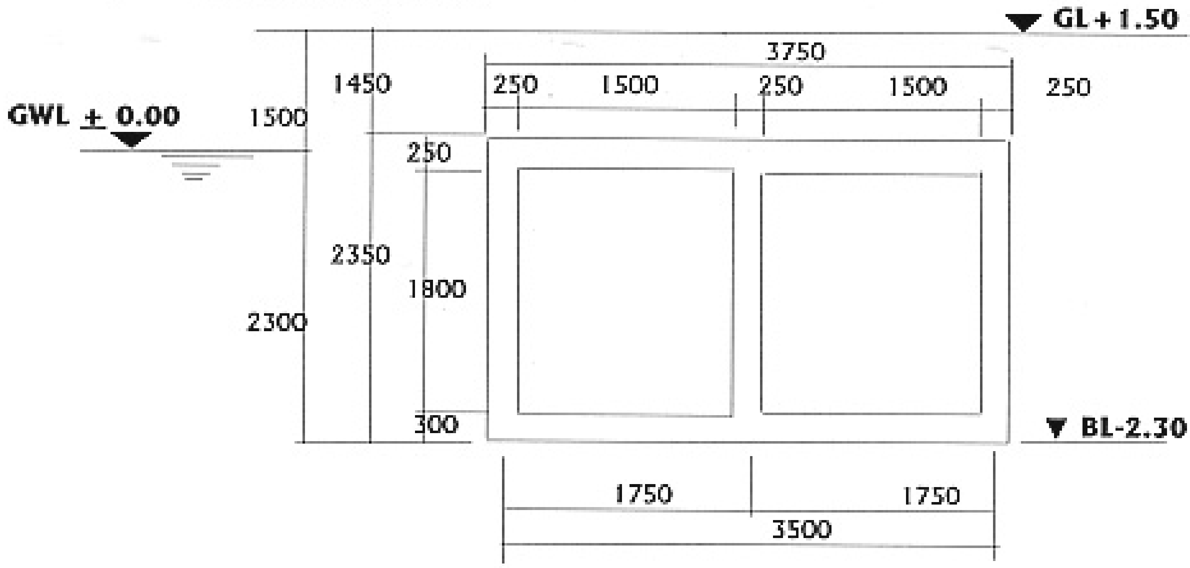
$P_{hor} = P_{s1} + P_{s2} + P_{s3} = 1.62 + 0.25 + 4.16 = 6.03T/m2$

2.5 Reaction at the bottom slab of pumping station

$P_{bott} = Ps + (Wsl + Ww)/b = (0.50 + 0.75) + (2x4.74/3.05) = 4.36T/m2$

III-Calculation for control gate

1-Geometry dimensions for calculation :



2-Loading and calculation scheme:

2.1 Vertical load

Surchange load on the cover slab Ps = 0.50T/m2

2.2 Soil load on cover slab

P2= $H3*\gamma_s = 1.45*1.8 = 2.61T/m2$

2.3 Horizontal distributed uniform load due to surchange load from both side of the pumping station

P_{s1}=0.5x0.5=0.25T/m2

2.4 Horizontal triangle distributed load due to earth from both side of the pumping station above ground water level

P_{s2}= 1.8x1.50x0.5=1.35T/m2

2.5 Horizontal triangle distributed load due to earth from both side of the pumping station under ground water level

P_{s3}=(1.8-1)x2.075x0.5+1.0x2.075=2.91T/m2

2.6 Reaction at the bottom slab of pumping station

P_{bott}=Ps+(Wsl+Ww)/b=(0.50+2.61+1.375)+(3x1.8x0.25x2.5/3.5)=5.46T/m

IV-Calculation for streses and force:

Refer to attached result sheet for calcution value of stress steel area for scheet elements

Calculation for bar arrangement for Me coc pumping station

Base on attached results of shell forces analised by SAP2000, choosing the most dangerous forces for calculation:

$A_o = M/R_n b h_o^2$ Where, M: Maximum bending moment(T.m)

h_o: Effective depth of bearing area(cm)

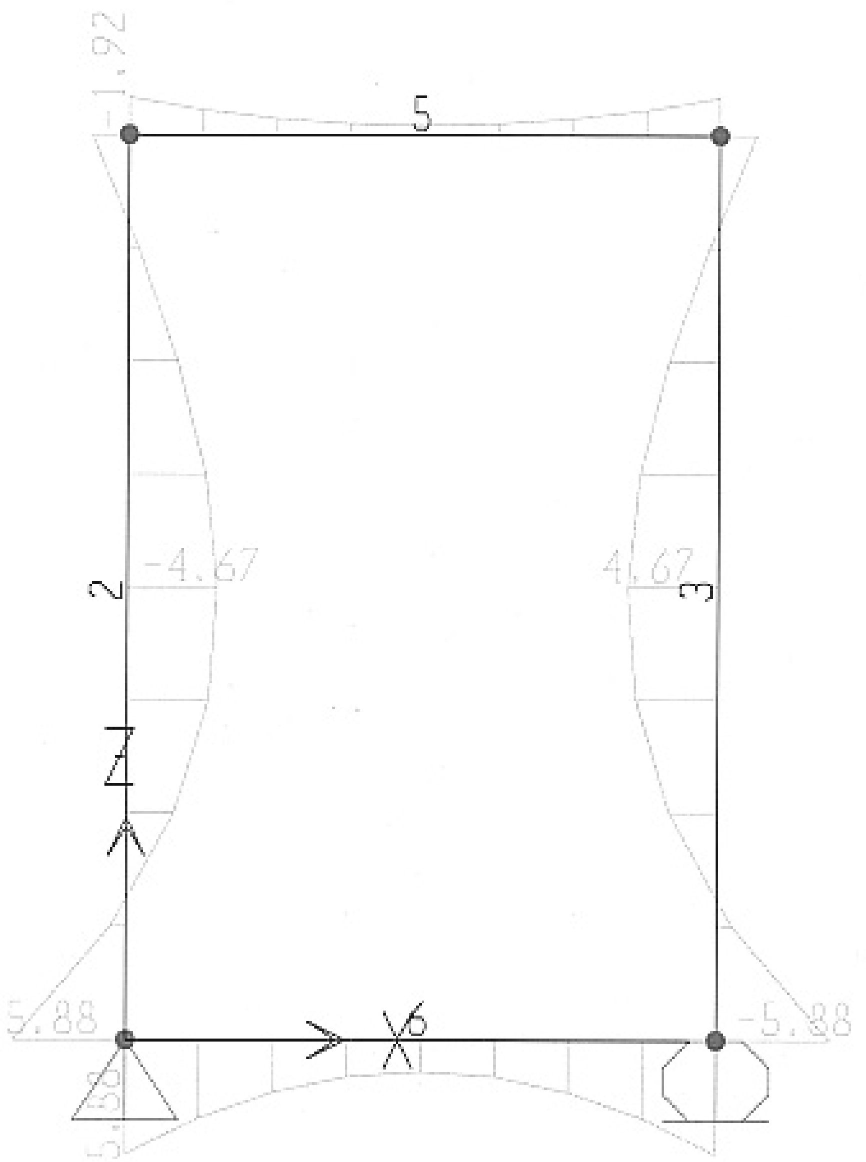
h_o= (Element thickness-Cover thickness)

b: Width of calculated area(cm)

Required area of reinforcement:

Fa= M/γRaho Where: $\gamma = 0.5 + ((1-2Ao)^{1/2})/2$

NAME OF ELEMENT	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement	
					φ(mm)	a(mm)
CULVERT 2000X2000						
b=1.00	2.210	0.0974	0.949	8.09	14	**125**
h=0.25	2.110	0.0930	0.951	7.70	14	**125**
b=1.00	2.110	0.0930	0.951	7.70	14	**125**
h=0.30	2.470	0.1089	0.942	9.10	14	**125**
ME COC P.S						
b=1.00	1.920	0.0518	0.973	5.36	14	**250**
h=0.30						
b=1.00	5.880	0.0582	0.970	9.97	16	**125**
h=0.45	4.670	0.0462	0.976	7.87	16	**125**
b=1.00	5.880	0.0582	0.970	9.97	16	**125**
h=0.50						
CONTROL GATE						
b=1.00	1.030	0.0454	0.977	3.66	14	**125**
h=0.25	0.550	0.0243	0.988	1.93	12	**250**
b=1.00	1.340	0.0591	0.970	4.80	14	**125**
h=0.30	0.660	0.0291	0.985	1.82	14	**125**



SAP2000 v6.11 - File:Mecocps - Moment 3-3 Diagram (LOAD1) - Ton-m Units

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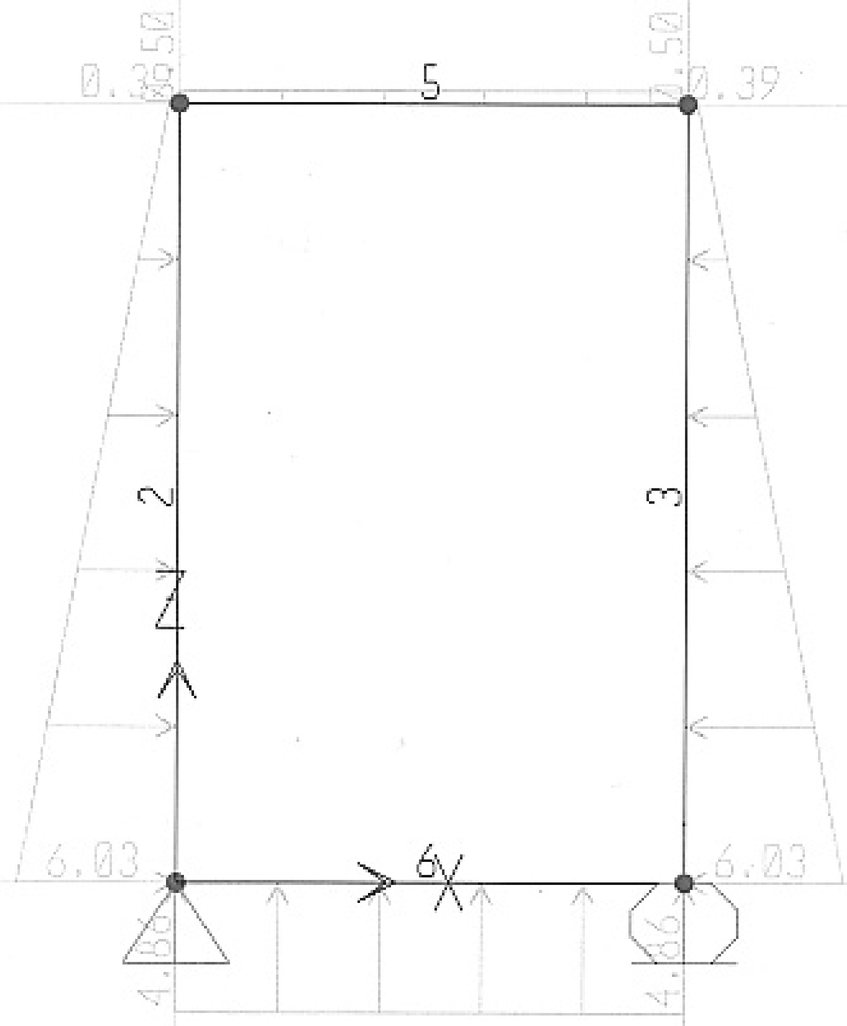
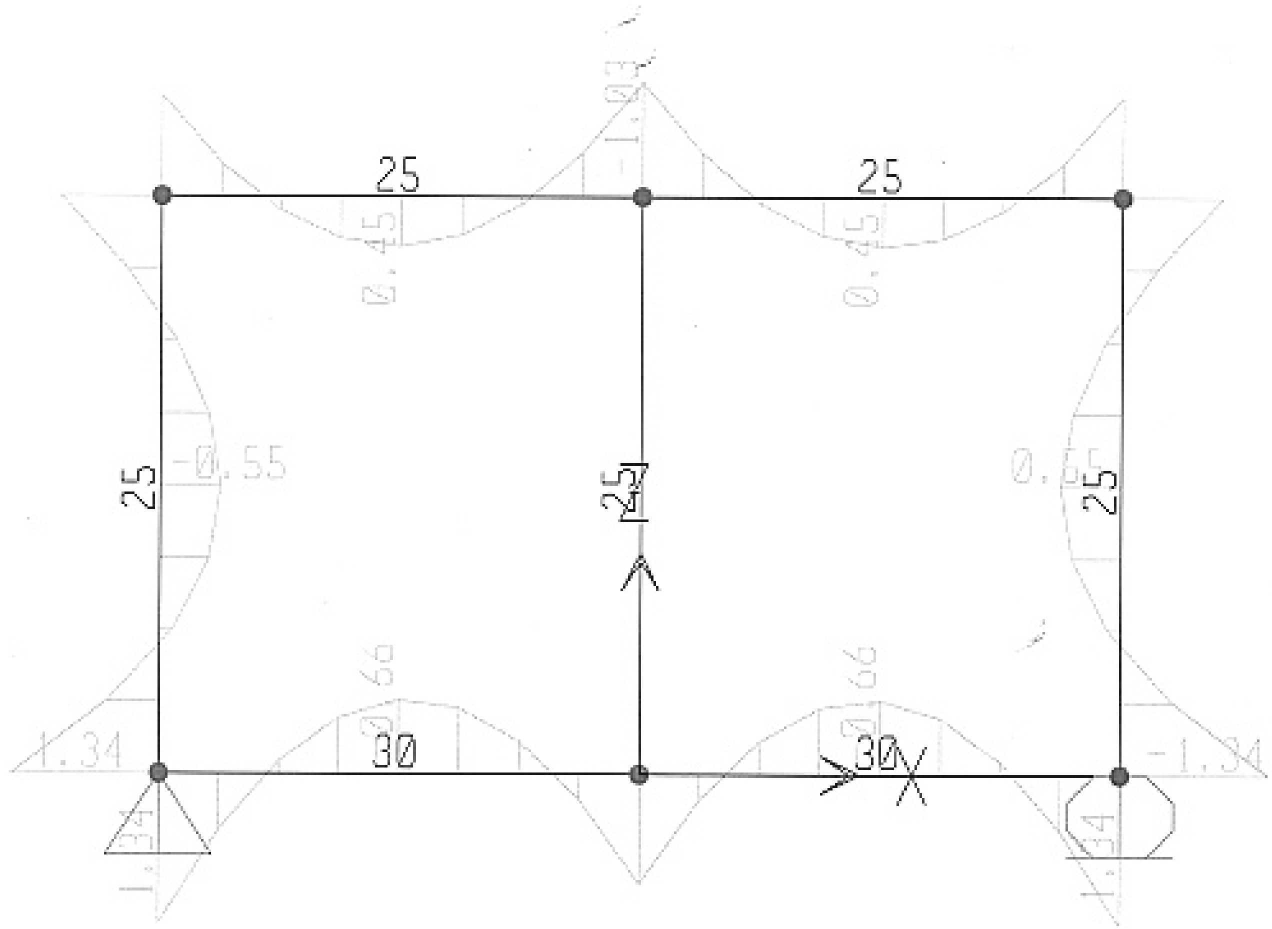


SAP2000 v6.11 - File:MECOCPS - Frame Span Loads (LOAD1) - Ton-m Units



SAP2000 v6.11 - File:MECOCCTRGATE - Moment 3-3 Diagram (LOAD1) - Ton-m Units

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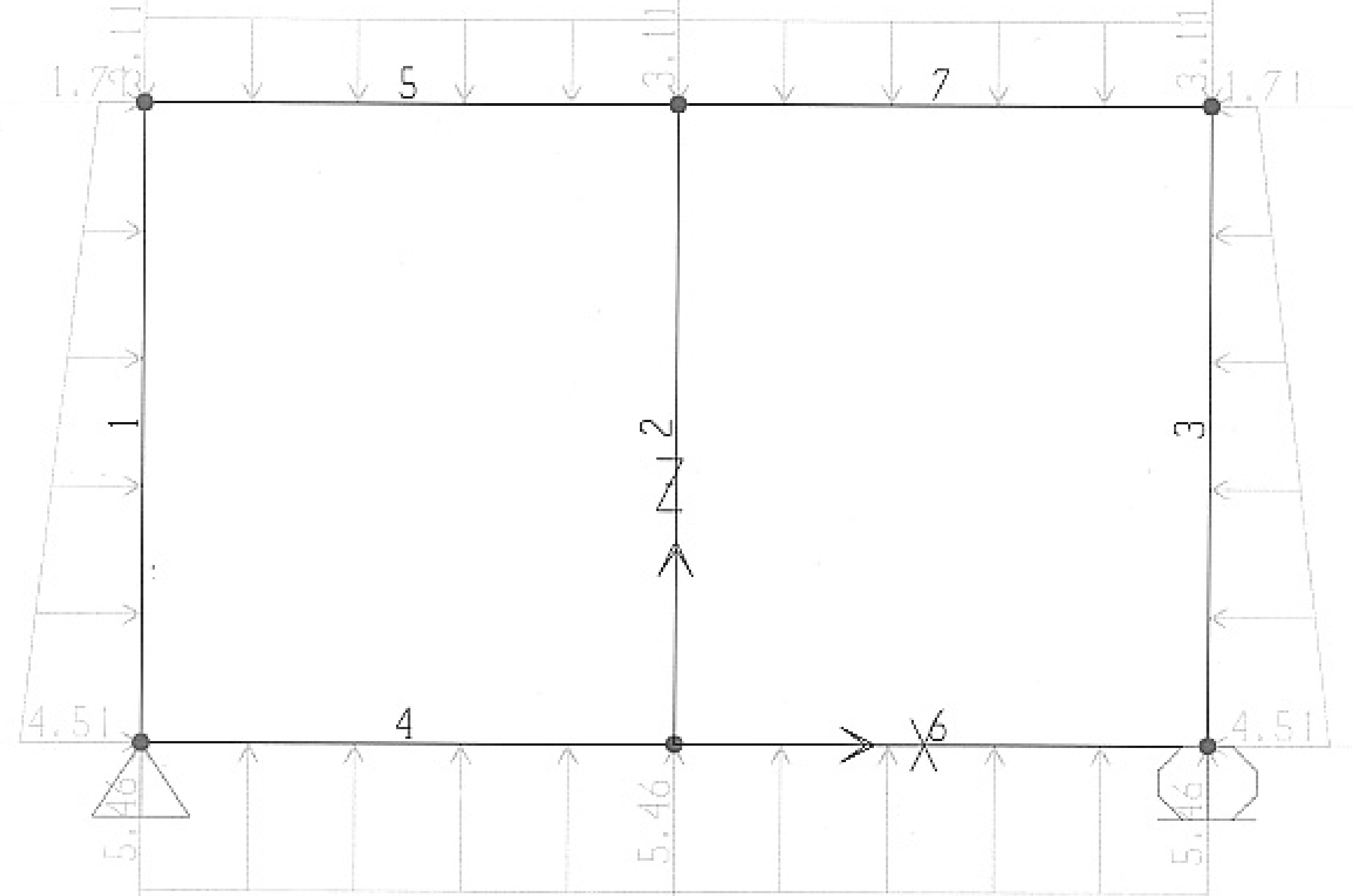
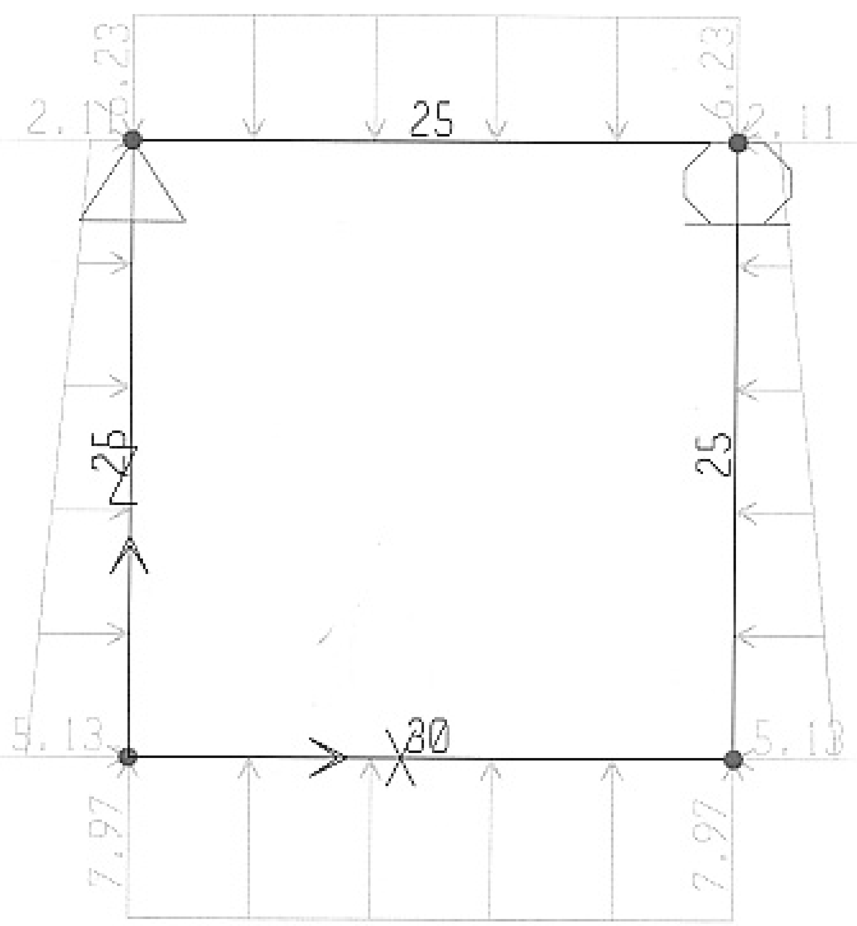
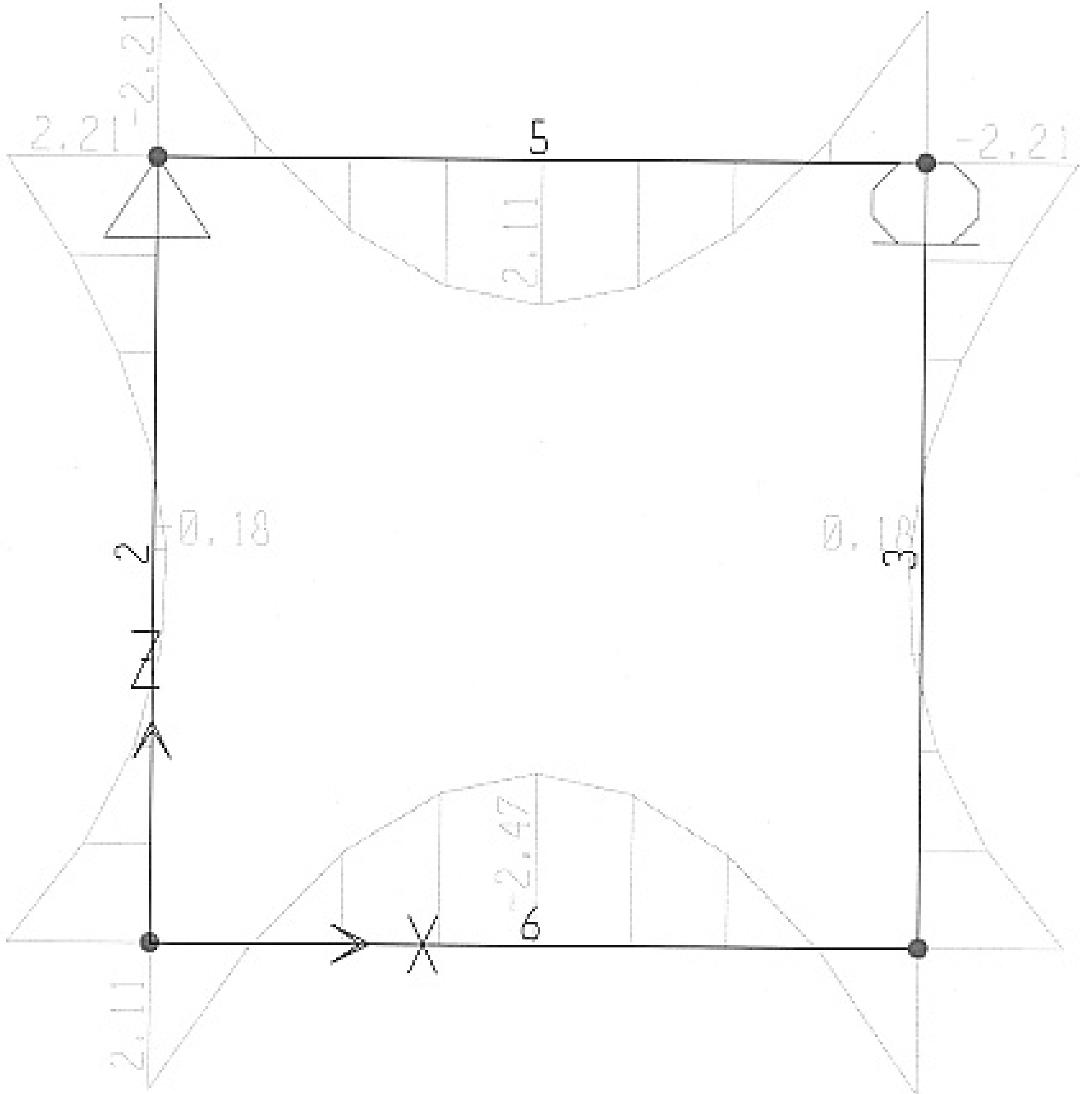


SAP2000 v6.11 - File:MECOCCTRGATE - Frame Span Loads (LOAD1) - Ton-m Units



SAP2000 v6.11 - File:MECOC2000X2000 - Frame Span Loads (LOAD1) - Ton-m Units

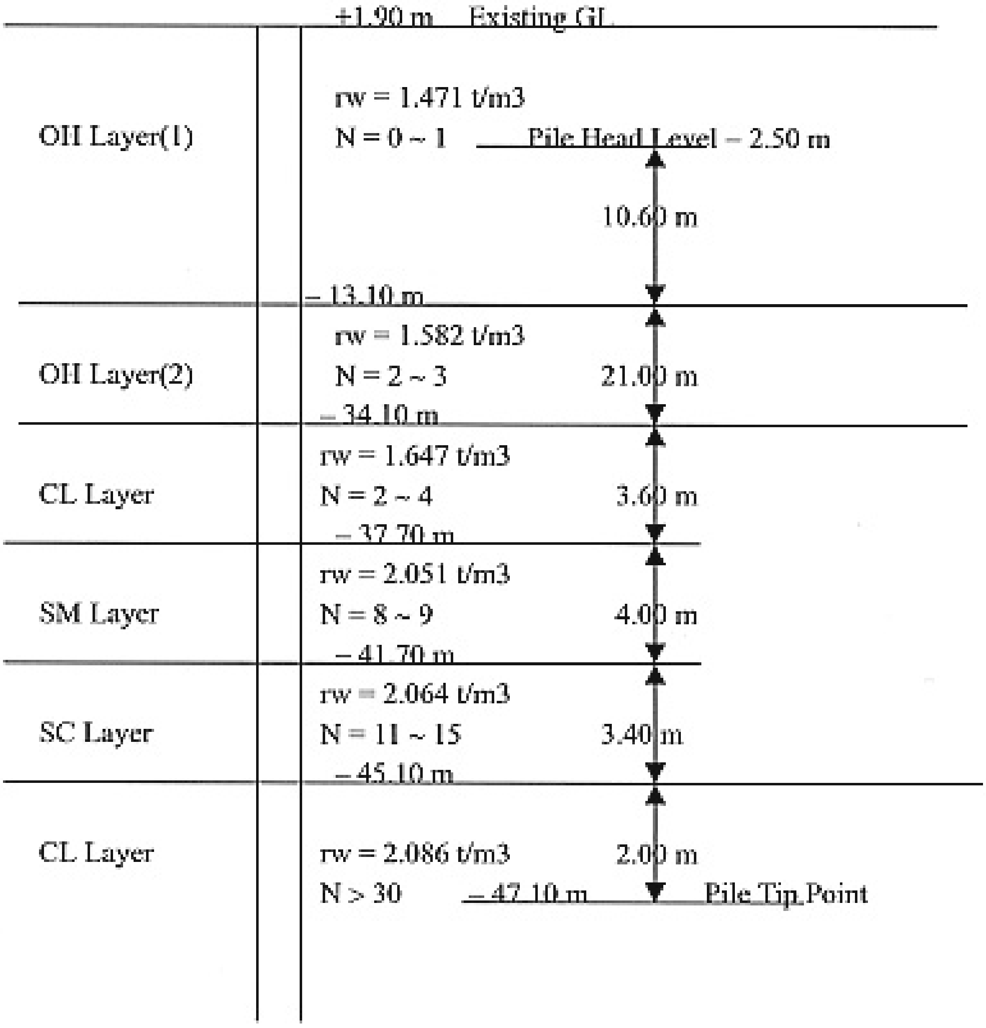


SAP2000 v6.11 - File:MECOC2000X2000 - Moment 3-3 Diagram (LOAD1) - Ton-m Units

Pile Foundation Calculation for BEN ME COC (1) Pumping Station

(1) Soil condition of BEN ME COC (1) Pumping Station

Typical soil condition of is shown in bellow.



(2) Calculation Condition

Pile Concrete Pile 300 × 300
Embed depth for CL Layer is 2.00 m (N > 20)
Consider a positive friction for pile from SC Layrer (N > 10)
Pile Length L = 47.10 − 2.50 = 44.60 m

(3) Calculation of Allowable Bearing Capacity of Pile

$Ra = 1/3 (Ru - Ws) + Ws - W$

Ra : Allowable vertical bearing capacity of pile at pile head (t/pile)
Ru : Assumed ultimate bearing capacity of pile

$Ru = qd \times A + U \times \Sigma Li \times Fi$

qd : $30 \times N$ (t/m2)

A : area of tip point of pile (m2)

U : The girth of pile (m)

Li : Thickness of layer which consider positive friction (m)

Fi : Maximum friction of layer which consider positive friction ($Fi = 0.2 \times N$ (t/m2))

Ws : Effective weight of soil which permute by soil (t)
W : Effective weight of pile and soil in the pile (t)

Average unit weight of soil (under ground water)
$(0.471 \times 10.60 + 0.582 \times 21.00 + 0.647 \times 3.60 + 1.051 \times 4.00 + 1.064 \times 3.40 + 1.086 \times 2.00) \div 44.60 = 0.66$ t/m3

Consider positive friction for layer of N > 10.

$Ru = 30 \times 30 \times 0.30 \times 0.30 + 0.30 \times 4 \times ((3.40 \times (0.2 \times 10) \times + 2.00 \times (0.2 \times 30))$
$= 103.56$ t

$Ws = 0.30 \times 0.30 \times 44.60 \times 0.66$ (t/m3) $= 2.65$ t

$W = 0.30 \times 0.30 \times 44.60 \times 1.50$ (t/m3) $= 6.02$ t

$Ra = 1/3 \times (103.56 - 2.65) + 2.65 - 6.02 = 30.27$ t/pile

(4) Pile number calculation

1) Total load

Concrete

Pit	10.12 m3
Pumping Station	84.26 m3
Sub Total	94.38 m3

94.38 m3 × 2.50 t/m3 = 235.95 t

Equipment load

Main pump	2.60 t
Flap gate	1.10 t
Screen	0.20 t
Sub Total	3.90 t

Water load 99.39 t

Total Load 339.24 t

2) Pile Numbers

Allowable bearing capacity of pile = 30.27 t/pile

Necessary numbers of pile

N = (339.24 t / 30.27 t/pile) = 12 piles

13 piles are arranged

(339.24 t / 13 piles) = 26.10 t < 30.27 t / piles OK

2.2

Architecture Design

2.2.1

Design Standard

CALCULATION SHEET
GENERAL NOTES

1. **Design standards**

   - TCVN : Vietnamese Standard
   - BS : British Standard
   - JIS : Japanese Standard
   - ASTM : American Standard for Materials

2. **Load :**

   - Load has been calculated based on standard loads defined in TCVN, ASTM. Some special loads has been calculated following the informations provided by the owner and Kirby company. These load to be clarified in below items

   a. **Gravity :**

   - Concrete : $\gamma = 2500$ kg/m^3
   - Reinforcement $\gamma = 7850$ kg/m^3
   - Brick wall $\gamma = 1800$ kg/m^3
   - Galvanized sheet $\gamma = 30$ kg/m^2

   b. **Live load :**

   Live load has been calculated based on requirements of each items, and it was shown on every calculation sheet

   c. **Wind load :**

   - Standard wind load : $q_{tc} = 95$ kg/m^2, in accordance with Vietnamese Standard
   - Calculation method of wind load to be shown in every calculation sheet
   - When calculation of wind, the designer did not consider dynamic wind load, because height of all items of this project is below 40 meters

   d. **Water, muddy gravity :**

   - Water : $\gamma = 1000$ kg/m^3
   - Mud : $\gamma = 1950$ kg/m^3

   These above load are only considered when calcultion of water tanks with water and mud inside. These water tanks are designed with reinforcement concrete wall and bottom slab, which is enable to bear the water and muddy load

   e. **Crane load :**

   - Maximum vertical crane load applying to crane beam has been provided by the owner, and has been shown carefully in every calculation sheet
   - Maximum horizontal crane load is unique for all item. It was 5 tons

   f. **Machine and equipment load :**

   - Weight of machines and equipments has been taken following the technology and engineering drawings supplied by the owner

   g. **Safety load factor :**

- Safety load factor was not considered in structural calculation

h. Load combinations :

- Load combinations have been shown clearly in every calculation sheet

3. **Materials :**

- Concrete was used is C210 type (cylinder test) for all items, equivalent to C250 type (cubic test) in Vietnamese Standard
- Properties of C250 concrete :
  * Compressive strength : R_n = 110 kg/cm^2
  * Tensile strength : R_k = 8.8 kg/cm^2
- When consider safety factor k=1.1 (safety load factor was not considered in structural calculation) :
  * Compressive strength : R_n = 100 kg/cm^2
  * Tensile strength : R_k = 8.0 kg/cm^2
- Reinforcement steel bar has been calculated with tensile strength R_k = 2000 kg/cm^2 with a safety factor (according to Japanese Standard)

4. **Design and structural analysis softwares :**

- SAP2000 : Calculation of stress
- DAS 1.2 : Calculation of stress and design of reinforcement concrete
- Sap Steel V1.0 : Design of reinforcement concrete from SAP2000 result files
- Excel worksheets to be programmed for calculation of reinforcement concrete slab
- Design of reinforcement concrete was in accordance with Japanese Standard, with material properties shown on item 3

2.2.2

Thanh Da Pumping Station

PROJECT : PUMP DRAINAGE IMPROVEMENT
ITEM : THANH DA PUMP STATION

STRUCTURAL CALCULATION SHEET

STRUCTURAL ANALYSIS ITEMS :

A. MAIN FRAME STRUCTURAL ANALYSIS
B. ATTACHED RESULT SHEETS

STRUCTURAL CALCULATION SHEET

* Project : Pump Drainage Improvement

* Item : Thanh Da Pump Station

Part I : CALCULATION OF LOAD

A. DEAD LOAD :

- Roof :

No.	Material	Calculation	Applying load(kg/m^2)
1	Steel purlin & roof sheet	-	40
2	Others	-	50
		TOTAL	g^{tc}= 90 kg/m^2

B. LIVE LOAD :

- Live load to be taken based on Vietnamese Standard TCVN 2737-1995 :

  * Roof : p^{tc} = 75 kg/m^2

- Load safety factor was not mentioned on above calculation because it will be included in structural analysis progress (see attached calculation sheet)

- Uniform load applying to beam to be shown on attached calculation sheet

C. WIND LOAD :

- Wind load imposed on project to be calculated based on Vietnamese Standard TCVN 2737-1995
- Wind load is calculated as follows :

  $W^{tc} = n x W^{tc}_0 x k x C$, where :

  n : load safety factor, taken as n=1

  W^{tc}_0 : standard wind pressure, area IIA, W_0^{tc} = 83 kg/m^2

  k : factor due to affect of project height and topography

  C : factor of dynamic wind , C=0.8 for the area where wind load imposes directly, C=0.6 for the opposite side
- Refer to calculation sheet for further informations

Part II : STRUCTURAL ANALYSIS PROGRESS

- The structure of Thanh Da Pump Station to be calculated by structural analysis program DAS

- The structural diagram is modelled as a frame with rigid connection at first floor elevation

- All details about input load, beam and column section, static load case and load combination to be shown on calculation sheet

- Refer to attached result sheets for calcaluted value of stress, displacement, steel area for beam and column elements

Part III : LOAD COMBINATION

- **Static Load Cases :**

Load case mark	Description
DEAD	Ground floor & Roof dead load
LIVE	Ground floor & Roof live load
LWIND	Wind load (from left to right)
RWIND	Wind load (from right to left)

PROJECT PUMP DRAINAGE IMPROVEMENT

ITEM THANH DA PUMP STATION

RESULT SHEETS

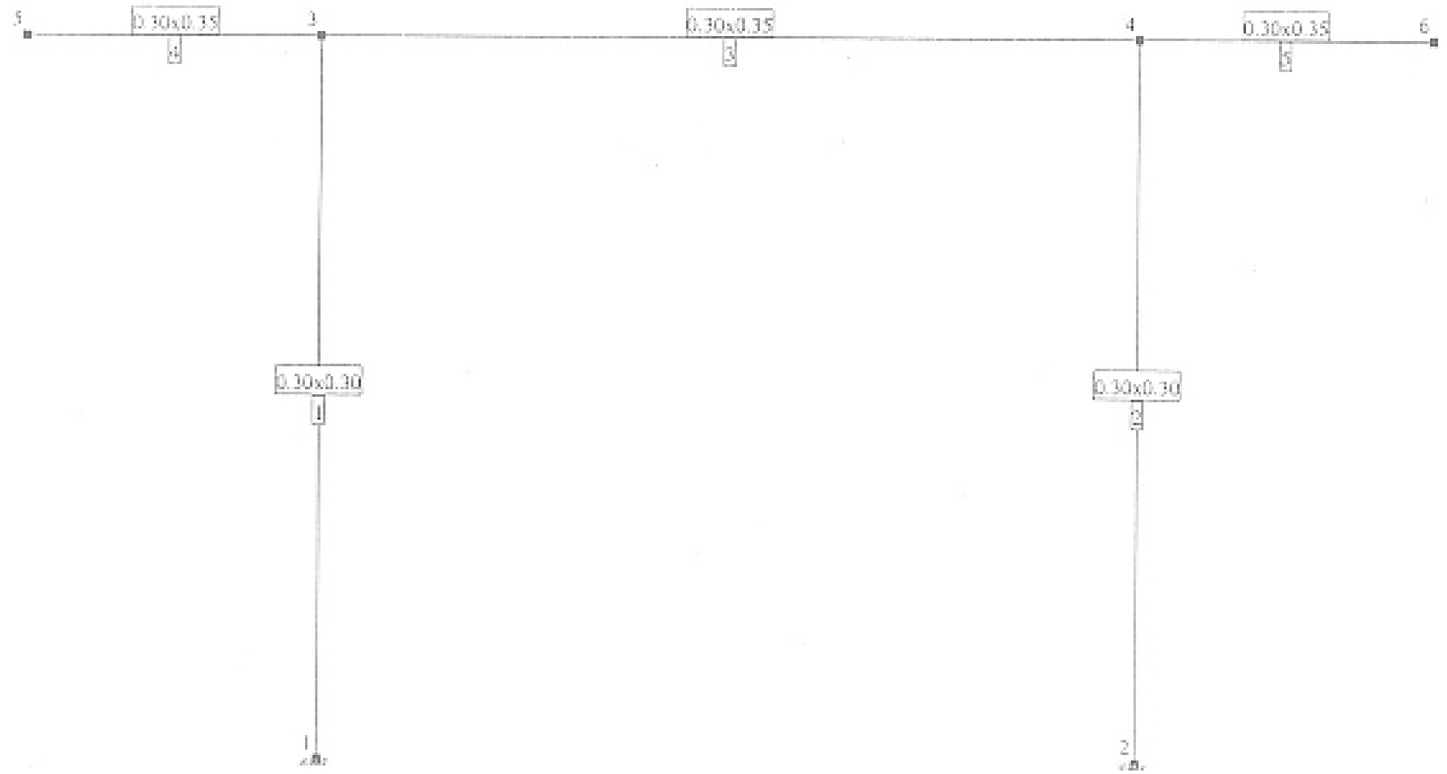
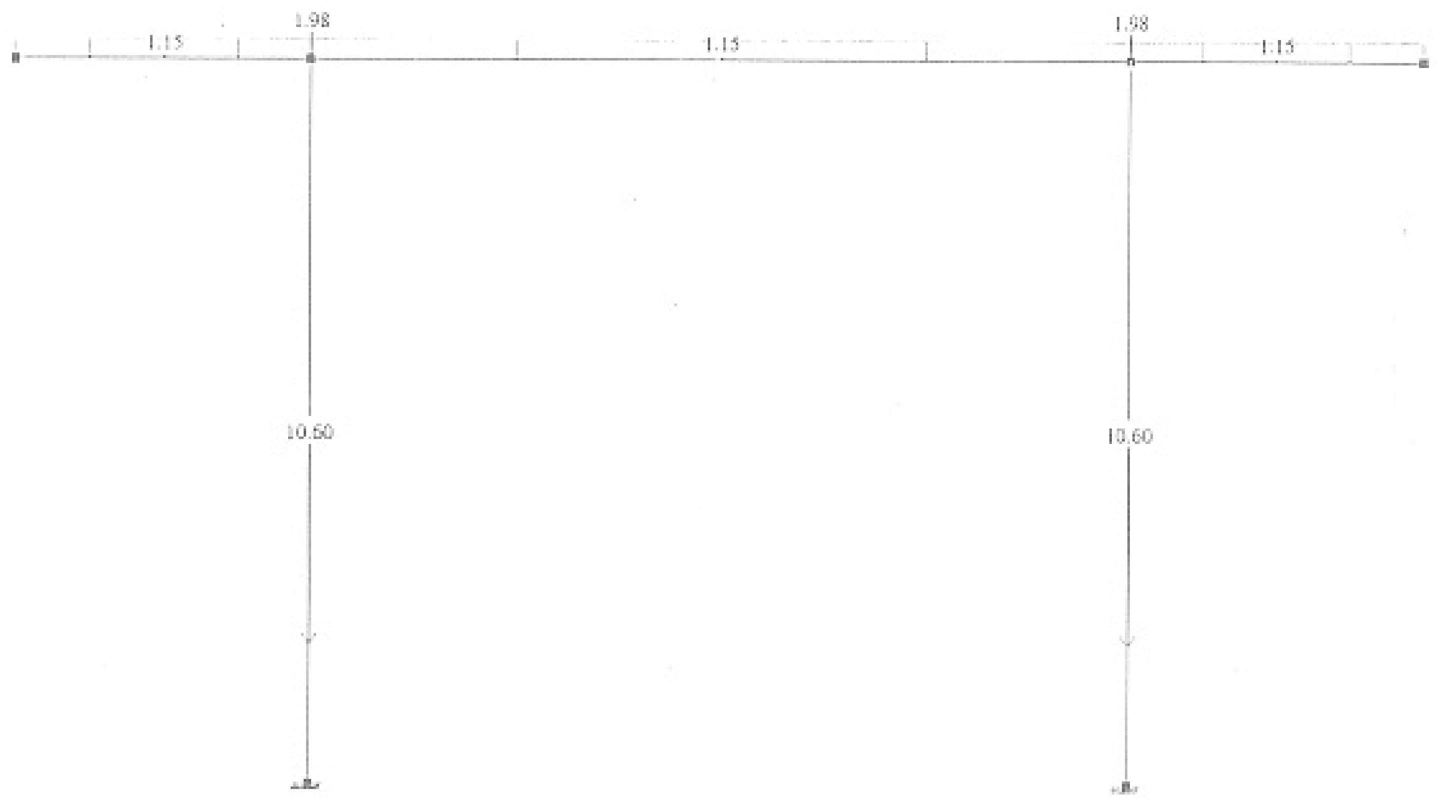
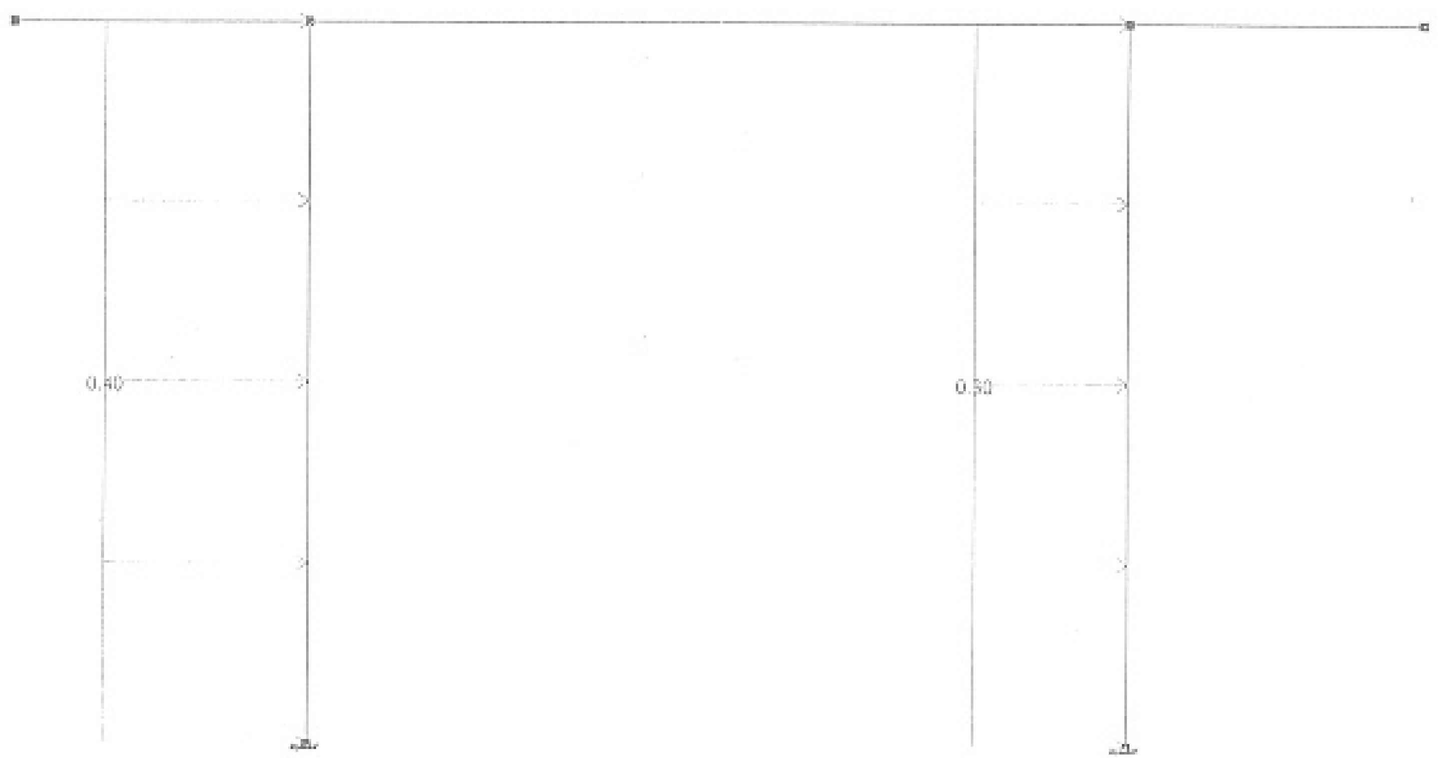


DIAGRAM OF SECTION



LOADDING FOR LOAD CASE 1



LOADDING FOR LOAD CASE 2

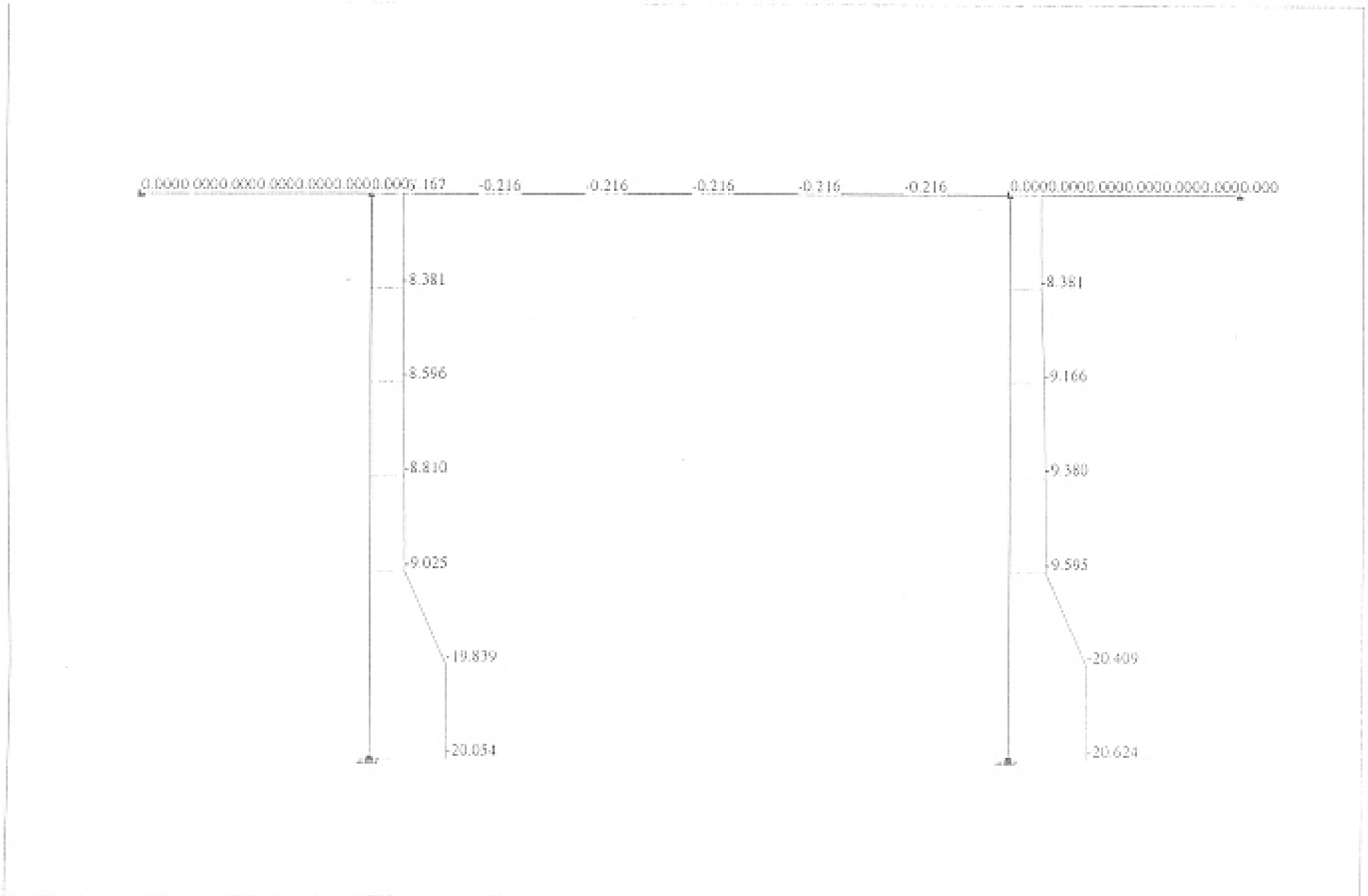


DIAGRAM OF MIN-MAX AXIAL

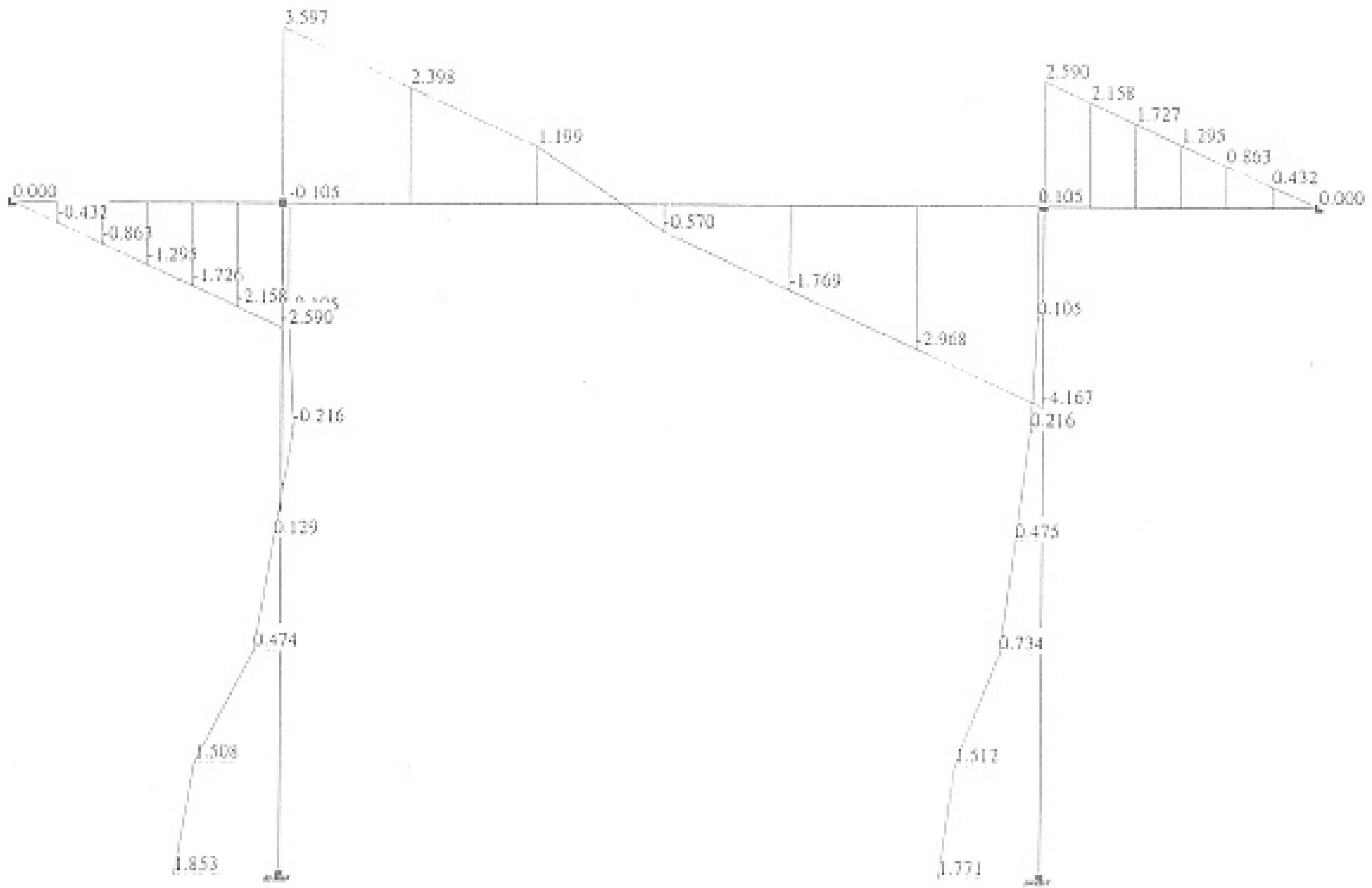


DIAGRAM OF MIN-MAX SHEAR ON 2-AXIS

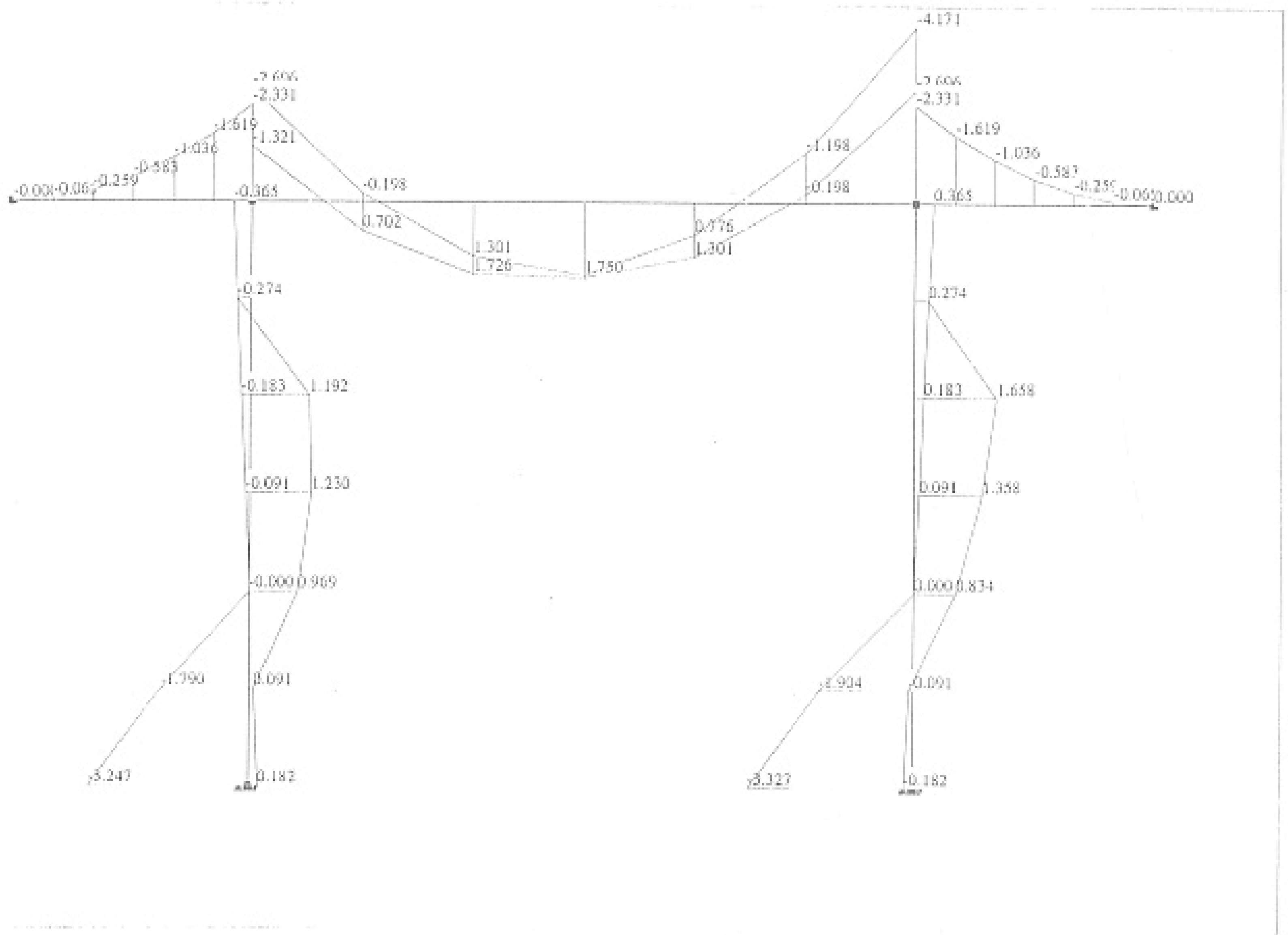


DIAGRAM OF MIN-MAX BENDING MOMENT 3-AXIS

COMBINATION FOR 3-AXIS STRESSES

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
1	0.00	0.182	-20.054	-3.247	-19.484	0.182	-20.054	1.853
1	0.87	0.091	-19.839	-1.790	-19.269	0.091	-19.839	1.508
1	1.73	0.969	-8.455	0.000	-9.025	0.000	-9.025	0.474
1	2.60	1.230	-8.240	-0.091	-8.810	-0.091	-8.810	0.129
1	3.47	1.192	-8.026	-0.183	-8.596	-0.183	-8.596	-0.216
1	4.33	-0.274	-8.381	-0.274	-8.381	-0.274	-8.381	-0.105
1	5.20	-0.365	-8.167	-0.365	-8.167	-0.365	-8.167	-0.105
2	0.00	-0.182	-20.054	-3.327	-20.624	-3.327	-20.624	1.771
2	0.87	-0.091	-19.839	-1.904	-20.409	-1.904	-20.409	1.512
2	1.73	0.834	-9.595	0.000	-9.025	0.834	-9.595	0.734
2	2.60	1.358	-9.380	0.091	-8.810	1.358	-9.380	0.475
2	3.47	1.658	-9.166	0.183	-8.596	1.658	-9.166	0.216
2	4.33	0.274	-8.381	0.274	-8.381	0.274	-8.381	0.105
2	5.20	0.365	-8.167	0.365	-8.167	0.365	-8.167	0.105
3	0.00	-1.321	-0.216	-2.696	-0.105	-1.321	-0.216	3.597
3	0.83	0.702	-0.216	-0.198	-0.105	0.702	-0.216	2.398
3	1.67	1.726	-0.216	1.301	-0.105	1.726	-0.216	[illegible]
3	2.50	1.800	-0.105	1.750	-0.216	1.750	-0.216	-0.370
3	3.33	1.301	-0.105	0.776	-0.216	0.776	-0.216	[illegible]
3	4.17	-0.198	-0.105	-1.198	-0.216	-1.198	-0.216	[illegible]
3	5.00	-2.696	-0.105	-4.171	-0.216	-4.171	-0.216	[illegible]

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
4	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.30	-0.065	0.000	-0.065	0.000	-0.065	0.000	-0.432
4	0.60	-0.259	0.000	-0.259	0.000	-0.259	0.000	-0.863
4	0.90	-0.583	0.000	-0.583	0.000	-0.583	0.000	-1.295
4	1.20	-1.036	0.000	-1.036	0.000	-1.036	0.000	-1.726
4	1.50	-1.619	0.000	-1.619	0.000	-1.619	0.000	-2.158
4	1.80	-2.331	0.000	-2.331	0.000	-2.331	0.000	-2.590
5	0.00	-2.331	0.000	-2.331	0.000	-2.331	0.000	2.590
5	0.30	-1.619	0.000	-1.619	0.000	-1.619	0.000	2.158
5	0.60	-1.036	0.000	-1.036	0.000	-1.036	0.000	1.727
5	0.90	-0.583	0.000	-0.583	0.000	-0.583	0.000	1.295
5	1.20	-0.259	0.000	-0.259	0.000	-0.259	0.000	0.863
5	1.50	-0.065	0.000	-0.065	0.000	-0.065	0.000	0.432
5	1.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000

REINFORCEMENT OF R.C. STRUCTURE

Element ID	Section	Fa2(cm2)	muy	Stirrup	Fa3(cm2)	muy	Stirrup
1	0.00	0.000	0.000	OUTPLANE	3.414	0.843	CHECKOK
1	0.87	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	1.73	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	2.60	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	3.47	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	4.33	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	5.20	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	0.00	0.000	0.000	OUTPLANE	3.595	0.888	CHECKOK
2	0.87	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	1.73	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	2.60	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	3.47	0.000	0.000	OUTPLANE	1.712	0.423	CHECKOK
2	4.33	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	5.20	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
3	0.00	0.000	0.000	OUTPLANE	-4.228	0.447	Ø6a150/2
3	0.83	0.000	0.000	OUTPLANE	1.071	0.113	Ø6a150/2
3	1.67	0.000	0.000	OUTPLANE	2.669	0.282	Ø6a150/2
3	2.50	0.000	0.000	OUTPLANE	2.788	0.295	Ø6a150/2
3	3.33	0.000	0.000	OUTPLANE	2.001	0.212	Ø6a150/2
3	4.17	0.000	0.000	OUTPLANE	-1.840	0.195	Ø6a150/2
3	5.00	0.000	0.000	OUTPLANE	-6.688	0.708	Ø6a150/2

Element ID	Section	Fa2(cm2)	muy	Stirrup	Fa3(cm2)	muy	Stirrup
4	0.00	0.000	0.000	OUTPLANE	-0.473	0.050	Ø6a150/2
4	0.30	0.000	0.000	OUTPLANE	-0.473	0.050	Ø6a150/2
4	0.60	0.000	0.000	OUTPLANE	-0.473	0.050	Ø6a150/2
4	0.90	0.000	0.000	OUTPLANE	-0.888	0.094	Ø6a150/2
4	1.20	0.000	0.000	OUTPLANE	-1.588	0.168	Ø6a150/2
4	1.50	0.000	0.000	OUTPLANE	-2.500	0.265	Ø6a150/2
4	1.80	0.000	0.000	OUTPLANE	-3.636	0.385	Ø6a150/2
5	0.00	0.000	0.000	OUTPLANE	-3.636	0.385	Ø6a150/2
5	0.30	0.000	0.000	OUTPLANE	-2.500	0.265	Ø6a150/2
5	0.60	0.000	0.000	OUTPLANE	-1.588	0.168	Ø6a150/2
5	0.90	0.000	0.000	OUTPLANE	-0.888	0.094	Ø6a150/2
5	1.20	0.000	0.000	OUTPLANE	-0.473	0.050	Ø6a150/2
5	1.50	0.000	0.000	OUTPLANE	-0.473	0.050	Ø6a150/2
5	1.80	0.000	0.000	OUTPLANE	0.473	0.050	Ø6a150/2

CALCULATION OF FOUNDATION M1 (1.600 x 2.400)

1. Material:

CONCRETE #

Compressible strength	Rn =	100	(Kg/cm2)
Tensible strength	Rk =	6	(Kg/cm2)

REINFORCEMENT #

Yield strength	Ra,Ra' =	2000	(Kg/cm2)

2. Standard foundation soil bearing capicity (after check displacement):

	$R^{II}tc$ =	9.00	(T/m2)

3. Sizing of foundation:

Calculated moment	Mtt =	3.30	(Tm)	
Calculated axial force	Ntt =	20.60	(T)	
Calculated shear force	Qtt =	1.77	(T)	
Standard moment at foundation bottom	ΣMtc =	3.79	(Tm)	
Standard axial force at foundation bottom	ΣNtc =	28.82	(T)	
Eccentricity	e_o =	0.132	(m)	e_o = ΣM/ΣN
Preliminary area of foundation bottom	Fm =	3.20	(m2)	F≥ Ntc/(Rtc-γ*hd)
Ration between foundation length & width	a/b =	1.50		
Preliminary width of foundation	bm =	1.46	(m)	
Chosen width of foundation	Bm =	1.60	(m)	
Chosen length of foundation	Am =	2.40	(m)	
Length of column cross section	ac =	0.30	(m)	
Width of column cross section	bc =	0.30	(m)	

4. Check of pressure of foundation bottom:

σ = (SN/F)±(SM/W)

Overage pressure of foundation bottom	σ tb =	7.50	(T/m2)	≤ Rtc= 9.00 (T/m2) → O.K
Minimum pressure of foundation bottom	σ min =	5.04	(T/m2)	
Maximum pressure of foundation bottom	σ max =	9.97	(T/m2)	≤ 1.2Rtc= 10.80 (T/m2) → O.K

5. Check of shear strength of foundation:

Minimum heigth of foundation	$H^{min}m$ =	0.57	(m)
Minimum heigth of step-foundation	$h^{min}d$ =	0.25	(m)
Chosen heigth of foundation	Hm =	0.60	(m)

Shear strength checking

Ntt -σtb(ac +2Hmo)*(bc+2Hmo) ≤ 2(ac+bc+2Hmo)*(2/3)*Hmo*Rk

6 (T) ≤ 99.73333 (T) → O.K

6. Reinforcement calculation:

Moment (at long side of foundation)	Ma =	9.02	(Tm)	
Moment (at short side of foundation)	Mb =	4.38	(Tm)	
Rein. section (at long side of foundation)	Fa =	9.11	(cm2)	Chosen 8.9 Ø 12 @180
Rein. section (at short side of foundation)	Fb =	4.42	(cm2)	Chosen 4.3 Ø 12 @560

2.2.3

Ben Me Coc Pumping Station

PROJECT : PUMP DRAINAGE IMPROVEMENT
ITEM : BEN ME COC O/M OFFICE

STRUCTURAL CALCULATION SHEET

STRUCTURAL ANALYSIS ITEMS :

A. MAIN FRAME STRUCTURAL ANALYSIS
B. ATTACHED RESULT SHEETS

STRUCTURAL CALCULATION SHEET

*** Project :** Pump Drainage Improvement

*** Item :** Ben Me Coc O/M Office

Part I : CALCULATION OF LOAD

A. DEAD LOAD :

- **Roof :**

No.	Material	Calculation	Applying load(kg/m^2)
1	Steel purlin & roof sheet	-	40
2	Others	-	50
		TOTAL	g^{tc}= 90 kg/m^2

B. LIVE LOAD :

- Live load to be taken based on Vietnamese Standard TCVN 2737-1995 :

  * Roof : p^{tc} = 75 kg/m^2

- Load safety factor was not mentioned on above calculation because it will be included in structural analysis progress (see attached calculation sheet)
- Uniform load applying to beam to be shown on attached calculation sheet

C. WIND LOAD :

- Wind load imposed on project to be calculated based on Vietnamese Standard TCVN 2737-1995
- Wind load is calculated as follows :

  $W^{tc} = nxW^{tc}_0xkxC$, where :

  n : load safety factor, taken as n=1

  W^{tc}_0 : standard wind pressure, area IIA, W_0^{tc} = 83 kg/m^2

  k : factor due to affect of project height and topography

  C : factor of dynamic wind , C=0.8 for the area where wind load imposes directly, C=0.6 for the opposite side

- Refer to calculation sheet for further informations

BEN
7

Part II : STRUCTURAL ANALYSIS PROGRESS

- The structure of Ben Me Coc O/M Office to be calculated by structural analysis program DAS

- The structural diagram is modelled as a frame with rigid connection at first floor elevation

- All details about input load, beam and column section, static load case and load combination to be shown on calculation sheet

- Refer to attached result sheets for calcaluted value of stress, displacement, steel area for beam and column elements

Part III : LOAD COMBINATION

- **Static Load Cases :**

Load case mark	Description
DEAD	Ground floor & Roof dead load
LIVE	Ground floor & Roof live load
LWIND	Wind load (from left to right)
RWIND	Wind load (from right to left)

BEN
2

PROJECT : PUMP DRAINAGE IMPROVEMENT

ITEM : BEN ME COC O/M OFFICE

RESULT SHEETS

BEN
3

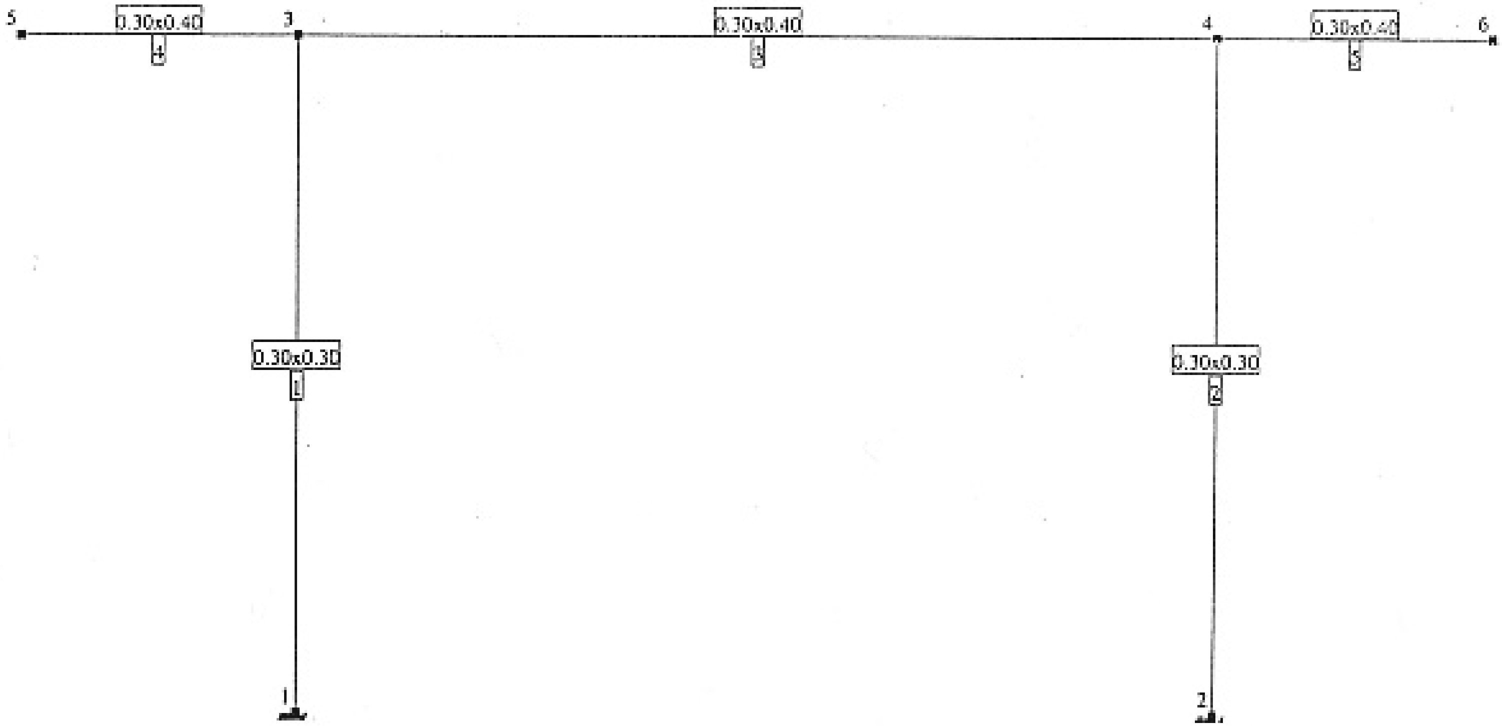
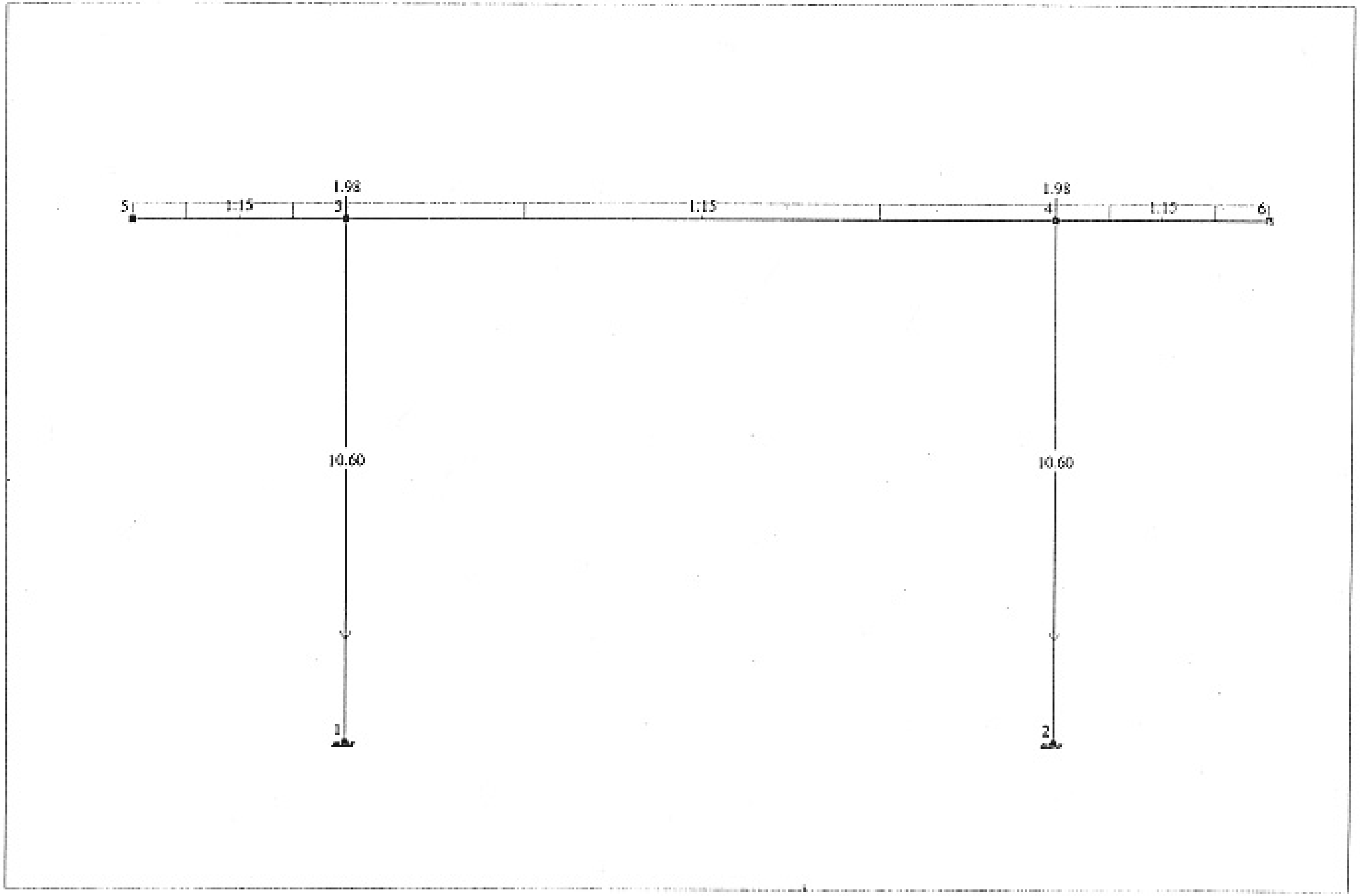
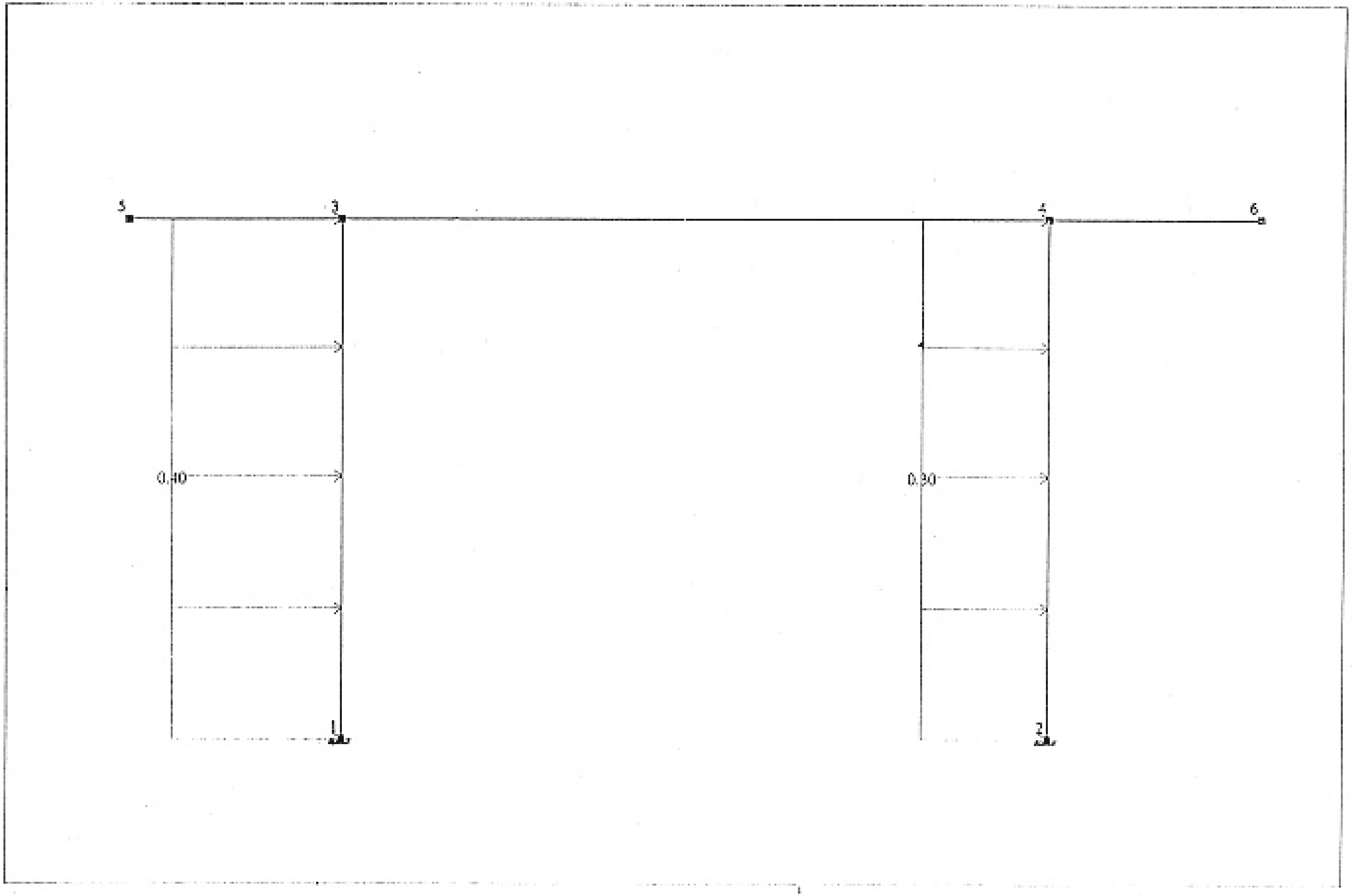


DIAGRAM OF SECTION

BEN
4



LOADDING FOR LOAD CASE 1



LOADDING FOR LOAD CASE 2

BEN 6

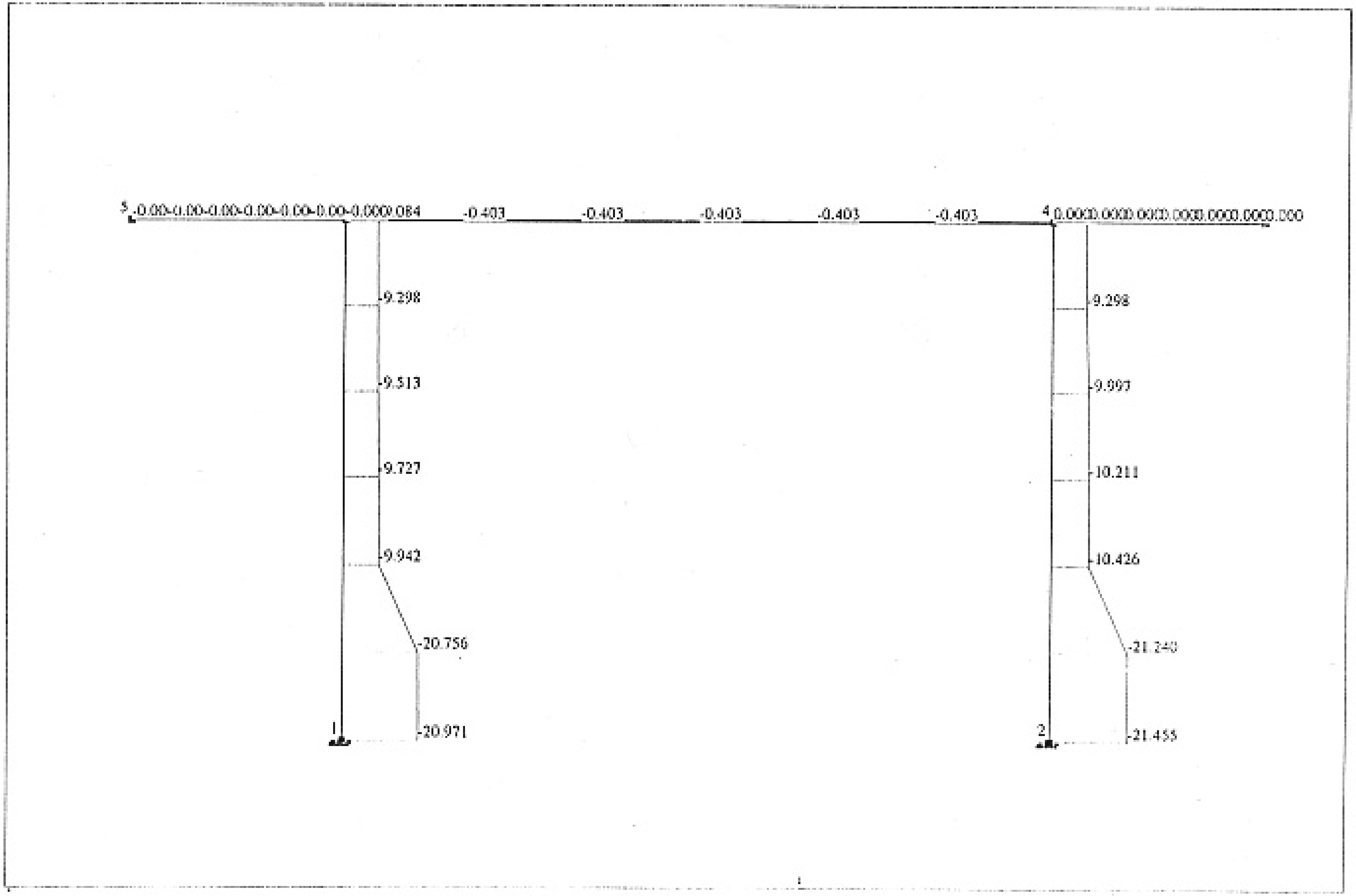


DIAGRAM OF MIN-MAX AXIAL

BEN
7

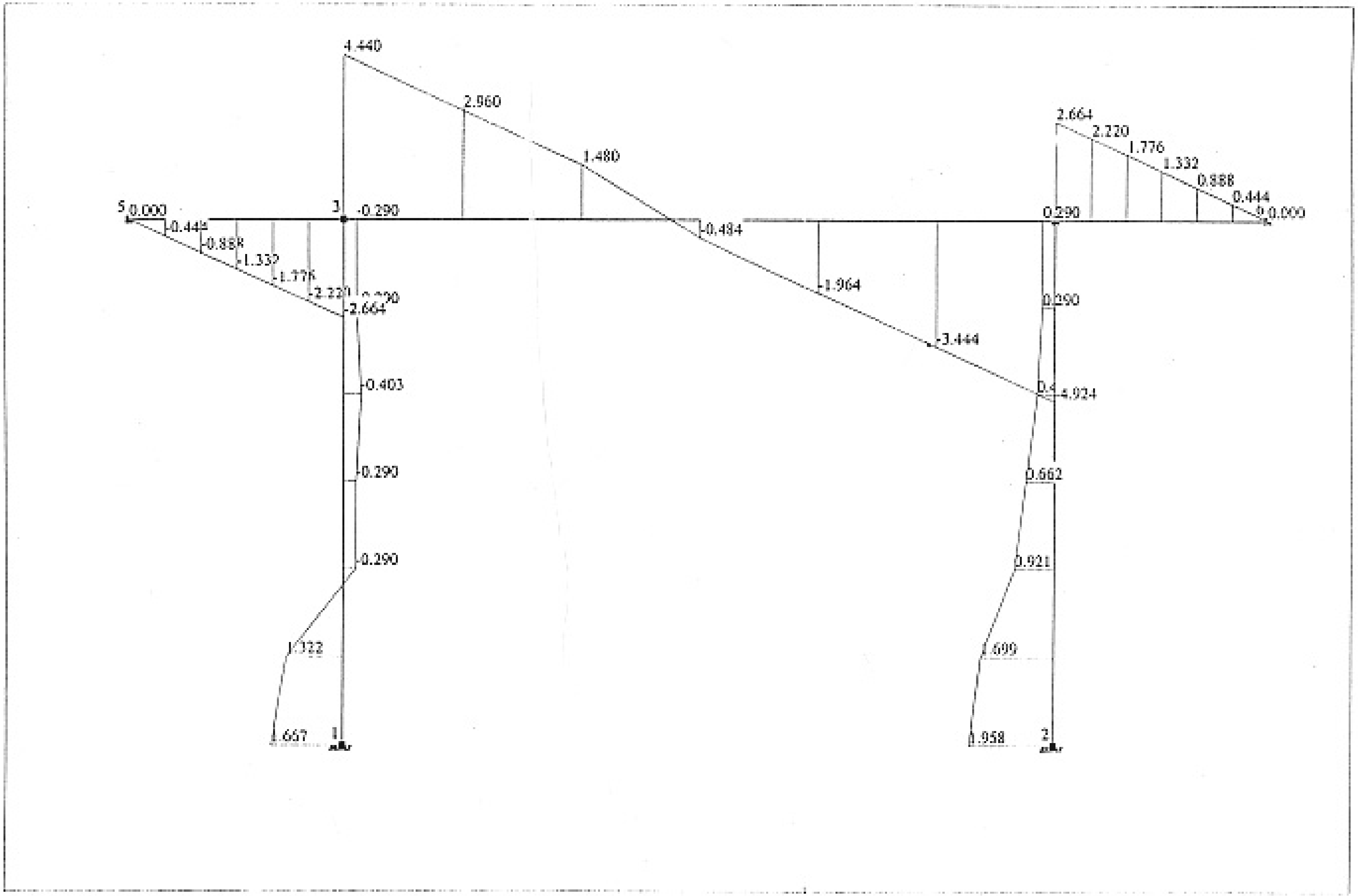


DIAGRAM OF MIN-MAX SHEAR ON 2-AXIS

BEW 8

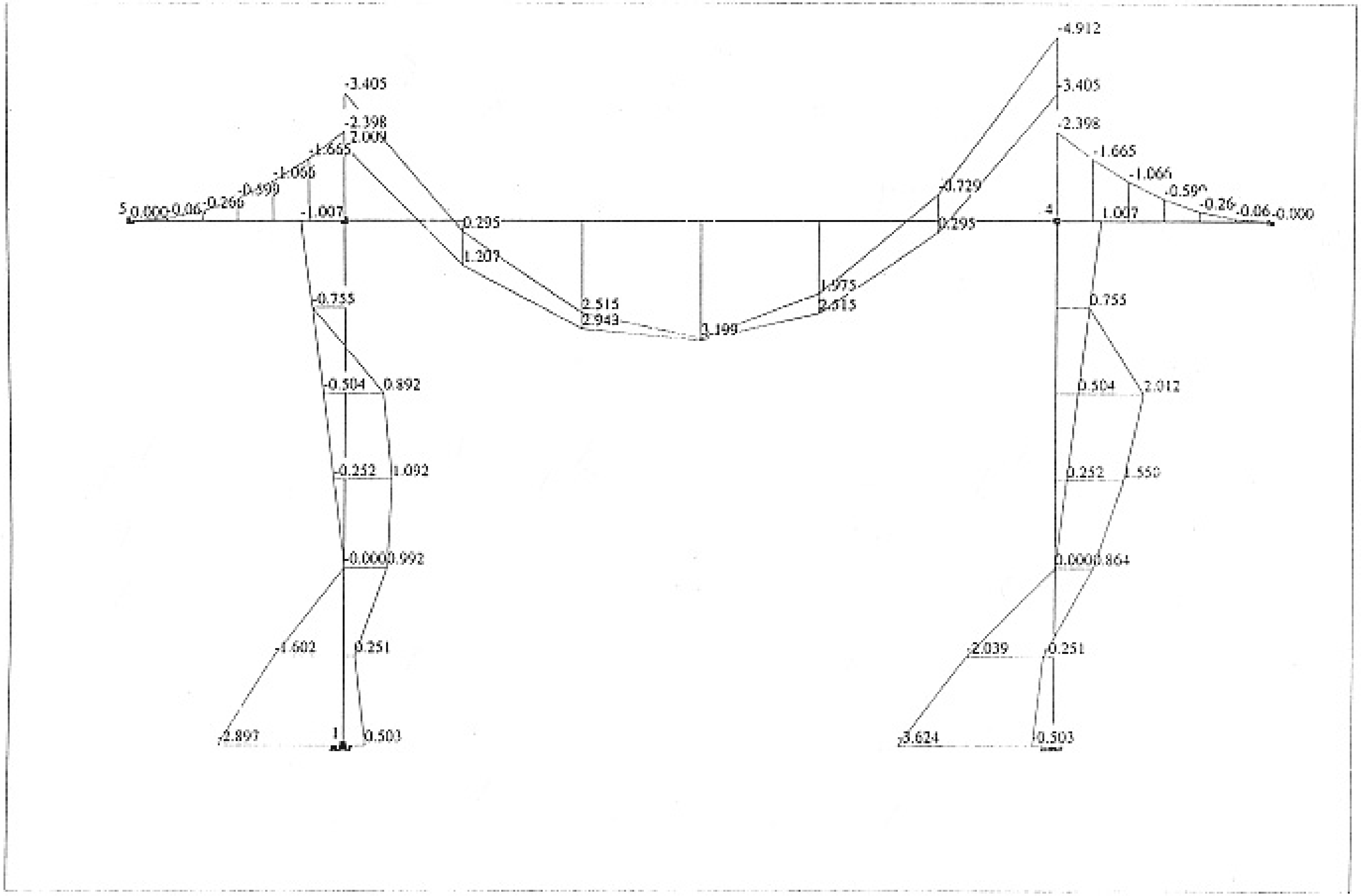


DIAGRAM OF MIN-MAX BENDING MOMENT 3-AXIS

BEN 9

COMBINATION FOR 3-AXIS STRESSES

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
1	0.00	0.503	-20.971	-2.897	-20.487	0.503	-20.971	1.667
1	0.87	0.251	-20.756	-1.602	-20.273	0.251	-20.756	1.322
1	1.73	0.992	-9.458	0.000	-9.942	0.000	-9.942	-0.290
1	2.60	1.092	-9.244	-0.252	-9.727	-0.252	-9.727	-0.290
1	3.47	0.892	-9.029	-0.504	-9.513	-0.504	-9.513	-0.403
1	4.33	-0.755	-9.298	-0.755	-9.298	-0.755	-9.298	-0.290
1	5.20	-1.007	-9.084	-1.007	-9.084	-1.007	-9.084	-0.290
2	0.00	-0.503	-20.971	-3.624	-21.455	-3.624	-21.455	1.958
2	0.87	-0.251	-20.756	-2.039	-21.240	-2.039	-21.240	1.699
2	1.73	0.864	-10.426	0.000	-9.942	0.864	-10.426	0.921
2	2.60	1.550	-10.211	0.252	-9.727	1.550	-10.211	0.662
2	3.47	2.012	-9.997	0.504	-9.513	2.012	-9.997	0.403
2	4.33	0.755	-9.298	0.755	-9.298	0.755	-9.298	0.290
2	5.20	1.007	-9.084	1.007	-9.084	1.007	-9.084	0.290
3	0.00	-2.009	-0.403	-3.405	-0.290	-2.009	-0.403	4.440
3	1.00	1.207	-0.403	0.295	-0.290	1.207	-0.403	2.950
3	2.00	2.943	-0.403	2.515	-0.290	2.943	-0.403	1.460
3	3.00	3.255	-0.290	3.199	-0.403	3.199	-0.403	-0.434
3	4.00	2.515	-0.290	1.975	-0.403	1.975	-0.403	-1.954
3	5.00	0.295	-0.290	-0.729	-0.403	-0.729	-0.403	-3.444
3	6.00	-3.405	-0.290	-4.912	-0.403	-4.912	-0.403	-4.924

BEN
10

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
4	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.30	-0.067	0.000	-0.067	0.000	-0.067	0.000	-0.444
4	0.60	-0.266	0.000	-0.266	0.000	-0.266	0.000	-0.888
4	0.90	-0.599	0.000	-0.599	0.000	-0.599	0.000	-1.332
4	1.20	-1.066	0.000	-1.066	0.000	-1.066	0.000	-1.776
4	1.50	-1.665	0.000	-1.665	0.000	-1.665	0.000	-2.220
4	1.80	-2.398	0.000	-2.398	0.000	-2.398	0.000	-2.664
5	0.00	-2.398	0.000	-2.398	0.000	-2.398	0.000	2.664
5	0.30	-1.665	0.000	-1.665	0.000	-1.665	0.000	2.220
5	0.60	-1.066	0.000	-1.066	0.000	-1.066	0.000	1.776
5	0.90	-0.599	0.000	-0.599	0.000	-0.599	0.000	1.332
5	1.20	-0.266	0.000	-0.266	0.000	-0.266	0.000	0.888
5	1.50	-0.067	0.000	-0.067	0.000	-0.067	0.000	0.444
5	1.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000

BEN
12

REINFORCEMENT OF R.C. STRUCTURE

Element ID	Section	Fa2(cm2)	muy	Stirrup	Fa3(cm2)	muy	Stirrup
1	0.00	0.000	0.000	OUTPLANE	2.538	0.627	CHECKOK
1	0.87	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	1.73	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	2.60	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	3.47	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	4.33	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	5.20	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	0.00	0.000	0.000	OUTPLANE	4.201	1.037	CHECKOK
2	0.87	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	1.73	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	2.60	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	3.47	0.000	0.000	OUTPLANE	2.283	0.564	CHECKOK
2	4.33	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	5.20	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
3	0.00	0.000	0.000	OUTPLANE	-4.666	0.432	Ø6a150/2
3	1.00	0.000	0.000	OUTPLANE	1.616	0.150	Ø6a150/2
3	2.00	0.000	0.000	OUTPLANE	4.013	0.372	Ø6a150/2
3	3.00	0.000	0.000	OUTPLANE	4.455	0.412	Ø6a150/2
3	4.00	0.000	0.000	OUTPLANE	3.414	0.316	Ø6a150/2
3	5.00	0.000	0.000	OUTPLANE	-0.971	0.090	Ø6a150/2
3	6.00	0.000	0.000	OUTPLANE	-6.849	0.634	Ø6a150/2

CALCULATION OF FOUNDATION M1 (1.600 × 2.400)

1. Material:

	CONCRETE #		
Compressible strength	Rn =	100	(Kg/cm2)
Tensible strength	Rk =	8	(Kg/cm2)
	REINFORCEMENT #		
Yield strength	Ra,Ra' =	2000	(Kg/cm2)

2. Standard foundation soil bearing capicity (after check displacement):

	R''tc =	9.00	(T/m2)

3. Sizing of foundation:

Calculated moment	Mtt =	3.60	(Tm)	
Calculated axial force	Ntt =	21.50	(T)	
Calculated shear force	Qtt =	1.96	(T)	
Standard moment at foundation bottom	ΣMtc =	4.15	(Tm)	
Standard axial force at foundation bottom	ΣNtc =	29.60	(T)	
Eccentricity	e_o =	0.140	(m)	$e_o = \Sigma M/\Sigma N$
Preliminary area of foundation bottom	Fm =	3.29	(m2)	F≥ Ntc/(Rtc-γ*hd)
Ration between foundation length & width	a/b =	1.50		
Preliminary width of foundation	bm =	1.48	(m)	
Chosen width of foundation	Bm =	1.60	(m)	
Chosen length of foundation	Am =	2.40	(m)	
Length of column cross section	ac =	0.30	(m)	
Width of column cross section	bc =	0.30	(m)	

4. Check of pressure of foundation bottom: σ = (SN/F)±(SM/W)

Overage pressure of foundation bottom	σ tb =	7.71	(T/m2)	≤ Rtc= 9.00 (T/m2) → O.K
Minimum pressure of foundation bottom	σ min =	5.00	(T/m2)	
Maximum pressure of foundation bottom	σ max =	10.41	(T/m2)	≤ 1.2Rtc= 10.80 (T/m2) → O.K

5. Check of shear strength of foundation:

Minimum heigth of foundation	$H^{min}m$ =	0.57	(m)
Minimum heigth of step-foundation	$h^{min}d$ =	0.25	(m)
Chosen heigth of foundation	Hm =	0.60	(m)

Shear strength checking: Ntt -σtb(ac +2Hmo)*(bc+2Hmo) ≤ 2(ac+bc+2Hmo)*(2/3)*Hmo*Rk

6 (T) ≤ 99.73333 (T) → O.K

6. Reinforcement calculation:

Moment (at long side of foundation)	Ma =	9.36	(Tm)	
Moment (at short side of foundation)	Mb =	4.49	(Tm)	
Rein. section (at long side of foundation)	Fa =	9.46	(cm2)	Chosen 9.2 Ø 12 @170
Rein. section (at short side of foundation)	Fb =	4.54	(cm2)	Chosen 4.4 Ø 12 @550

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2.3

Mechanical Equipment

1. Calculation of intlet gate for Thanh Da P.S. (Rev.1)

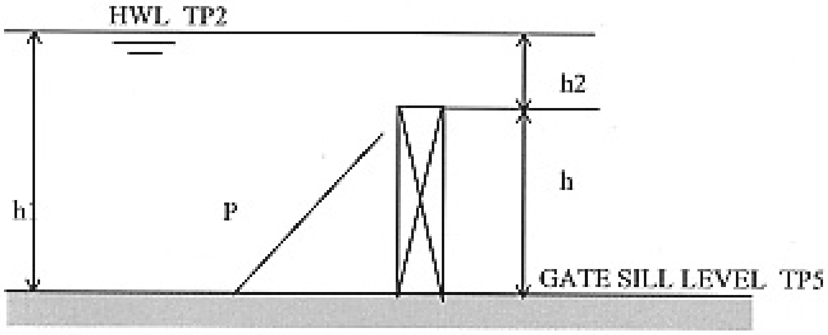
1.1 Basic Conditions

1.1.1 Design data

(a) Method of sealing		Four (4) sides watertight with rubber seal
(b) Method of opening/closing		Single spindle
(c) Opening/closing speed (V)		N.A.
(d) Operation		Manual
(e) Lift of gate	Not less than	1.2 m
(f) Corrosion allowance of plate		0.5 mm for water contact part
(g) Deflection of gate beam	Not more than	1/800
(h) Allowable stress of steel		Refer to calculation sheet
(i) Allowable stress of concrete		55 kgf/cm2 for compression 3.6 kgf/cm2 for shearing
(j) Water quality		River water

1.2 Design Load Condition

1.2.1 Design hydrostatic load at normal condition



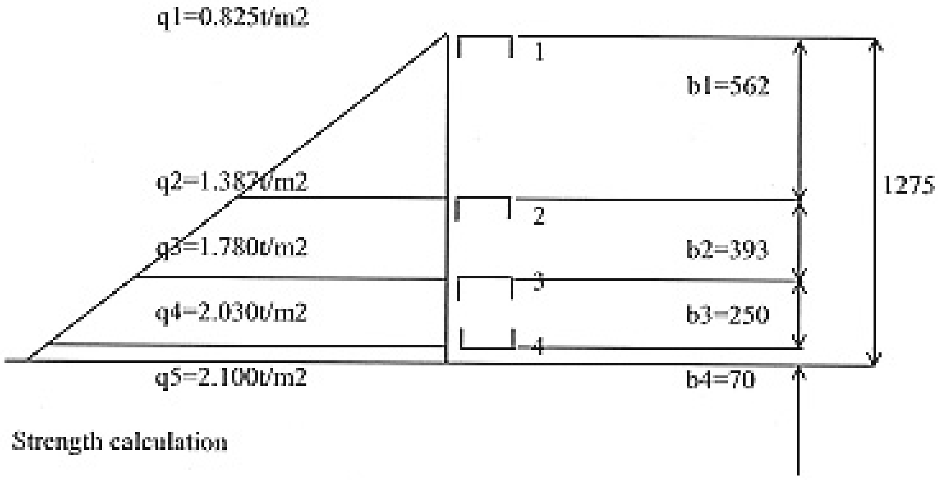
$P = 1/2 \times (h1^2 - h2^2) \times B \times W_0$

P	: Design hydraulic load at normal condition	2.517	tonf
W0	: Specific gravity of water	1.0	tonf/m3
h	: Height of gate	1.275	m
h1	: Design water depth (TP2-TP5)	2.10	m
h2	: h1 - h	0.83	m
TP2	:	0.90	m
TP5	:	-1.2	m
B	: Sealing span (=clear span + 0.15)	1.35	m

1.3 Calculation

1.3.1 Main beam

(a) Arrangement of beams



(b) Strength calculation

Rw1 = b1 x (2 x q1 + q2) / 6

Rw2-Rw3 = bi-1 x (qi-1 + 2 x qi) / 6 + bi x (2 x qi + qi+1) / 6

Rw4 = b3 x (q3 + 2 x q4) / 6 + b4 x (q4 + q5) / 2

q1	: Hydrostatic pressure	0.825	tonf/m2
q2	: Hydrostatic pressure	1.387	tonf/m2
q3	: Hydrostatic pressure	1.78	tonf/m2
q4	: Hydrostatic pressure	2.03	tonf/m2
q5	: Hydrostatic pressure	2.1	tonf/m2
b1	:	0.562	m
b2	:	0.393	m
b3	:	0.25	m
b4	:	0.07	m
Rw1	: Load on beam1	0.284	tonf/m
Rw2	: Load on beam2	0.635	tonf/m
Rw3	: Load on beam3	0.557	tonf/m
Rw4	: Load on beam4	0.459	tonf/m

Mi = Ri x B x (2 x L - B) / 8

B	: Sealing span	1.35	m
L	: Supporting span	1.35	m
M1	: Bending moment of beam1	0.065	tonf-m
M2	: Bending moment of beam2	0.145	tonf-m
M3	: Bending moment of beam3	0.127	tonf-m
M4	: Bending moment of beam4	0.105	tonf-m

S = Ri x B / 2

S1	: Shearing force of beam1	0.192	tonf
S2	: Shearing force of beam2	0.429	tonf
S3	: Shearing force of beam3	0.376	tonf
S4	: Shearing force of beam4	0.310	tonf

[100x50x5x7.5 ([99x49x4x6.5)

I	: Moment of inertia	129.54	cm4
Z	: Section modulus	26.44	cm3
Aw	: Area of web	3.44	cm2

σ = Mi / Z

σ 2	: Bending stress of beam2		547.5	kgf/cm2
		<	1200.0	kgf/cm2

τ = S / Aw < τ a

τ 2	: Shearing stress of beam2		124.7	kgf/cm2
		<	700.0	kgf/cm2

δ = Ri x B x (L3 - 1/2 x L x B2 + B3 / 8) / (48 x E x I)
= 2.0595 x Ri/I

δ 2	: Deflection of beam2	0.101	cm
L / δ 2	:	1336	

1. Calculation of Outlet gate for Thanh Da P.S. (Rev.1)

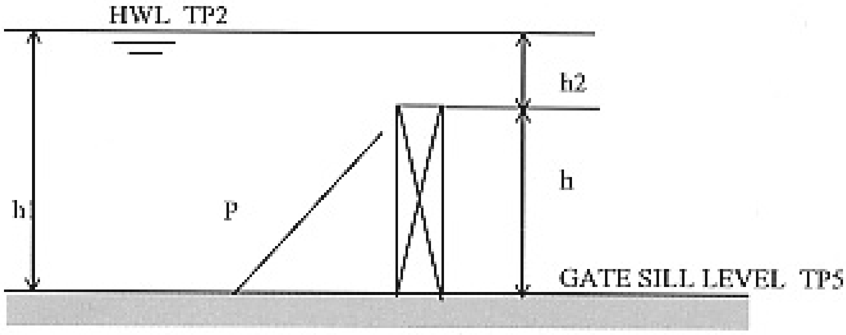
1.1 Basic Conditions

1.1.1 Design data

(a) Method of sealing		Four (4) sides watertight with rubber seal
(b) Method of opening/closing		Single spindle
(c) Opening/closing speed (V)		N.A.
(d) Operation		Manual
(e) Lift of gate	Not less than	1.4 m
(f) Corrosion allowance of plate		0.5 mm for water contact part
(g) Deflection of gate beam	Not more than	1/800
(h) Allowable stress of steel		Refer to calculation sheet
(i) Allowable stress of concrete		55 kgf/cm2 for compression 3.6 kgf/cm2 for shearing
(j) Water quality		River water

1.2 Design Load Condition

1.2.1 Design hydrostatic load at normal condition



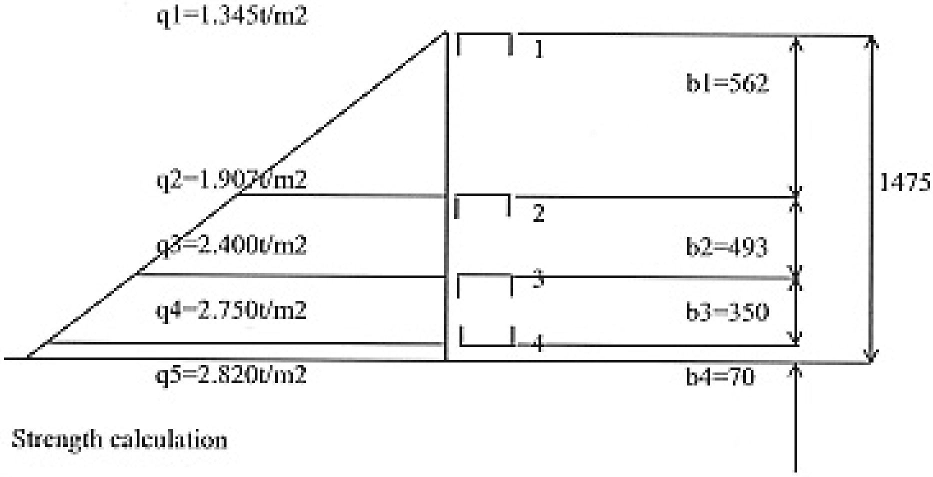
$$P = 1/2 \times (h1^2 - h2^2) \times B \times W_0$$

P	: Design hydraulic load at normal condition	4.761	tonf
W0	: Specific gravity of water	1.0	tonf/m3
h	: Height of gate	1.475	m
h1	: Design water depth (TP2-TP5)	2.82	m
h2	; h1 - h	1.35	m
TP2	:	1.32	m
TP5	:	-1.5	m
B	: Sealing span (=clear span + 0.15)	1.55	m

1.3 Calculation

1.3.1 Main beam

(a) Arrangement of beams



(b) Strength calculation

Rw1 = b1 x (2 x q1 + q2) / 6

Rw2-Rw3 = bi-1 x (qi-1 + 2 x qi) / 6 + bi x (2 x qi + qi+1) / 6

Rw4 = b3 x (q3 + 2 x q4) / 6 + b4 x (q4 + q5) / 2

q1	: Hydrostatic pressure	1.345	tonf/m2
q2	: Hydrostatic pressure	1.907	tonf/m2
q3	: Hydrostatic pressure	2.4	tonf/m2
q4	: Hydrostatic pressure	2.75	tonf/m2
q5	: Hydrostatic pressure	2.82	tonf/m2
b1	:	0.562	m
b2	:	0.493	m
b3	:	0.35	m
b4	:	0.07	m
Rw1	: Load on beam1	0.431	tonf/m
Rw2	: Load on beam2	0.994	tonf/m
Rw3	: Load on beam3	0.992	tonf/m
Rw4	: Load on beam4	0.752	tonf/m

Mi = Ri x B x (2 x L - B) / 8

B	: Sealing span	1.55	m
L	: Supporting span	1.55	m
M1	: Bending moment of beam1	0.129	tonf-m
M2	: Bending moment of beam2	0.298	tonf-m
M3	: Bending moment of beam3	0.298	tonf-m
M4	: Bending moment of beam4	0.226	tonf-m

S = Ri x B / 2

S1	: Shearing force of beam1	0.334	tonf
S2	: Shearing force of beam2	0.770	tonf
S3	: Shearing force of beam3	0.768	tonf
S4	: Shearing force of beam4	0.583	tonf

[125x65x6x8 ([124x64x5x7)

I	: Moment of inertia		292 cm4
Z	: Section modulus		47 cm3
Aw	: Area of web		5.5 cm2

σ = Mi / Z

σ 2	: Bending stress of beam2		635.0 kgf/cm2
		<	1200.0 kgf/cm2

τ = S / Aw < τ a

τ 2	: Shearing stress of beam2		140.0 kgf/cm2
		<	700.0 kgf/cm2

δ = Ri x B x (L3 - 1/2 x L x B2 + B3 / 8) / (48 x E x I)
= 3.5789 x Ri/I

δ 2	: Deflection of beam2	0.122 cm
L / δ 2	:	1273

1. Calculation of Outlet gate for Ben Me Coc (1) P.S. (Rev.1)

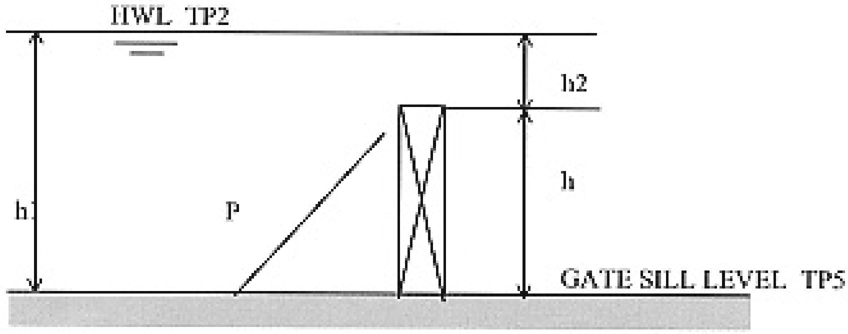
1.1 Basic Conditions

1.1.1 Design data

(a) Method of sealing		Four (4) sides watertight with rubber seal
(b) Method of opening/closing		Single spindle
(c) Opening/closing speed (V)		N.A.
(d) Operation		Manual
(e) Lift of gate	Not less than	2.0 m
(f) Corrosion allowance of plate		0.5 mm for water contact part
(g) Deflection of gate beam	Not more than	1/800
(h) Allowable stress of steel		Refer to calculation sheet
(i) Allowable stress of concrete		55 kgf/cm2 for compression 3.6 kgf/cm2 for shearing
(j) Water quality		River water

1.2 Design Load Condition

1.2.1 Design hydrostatic load at normal condition



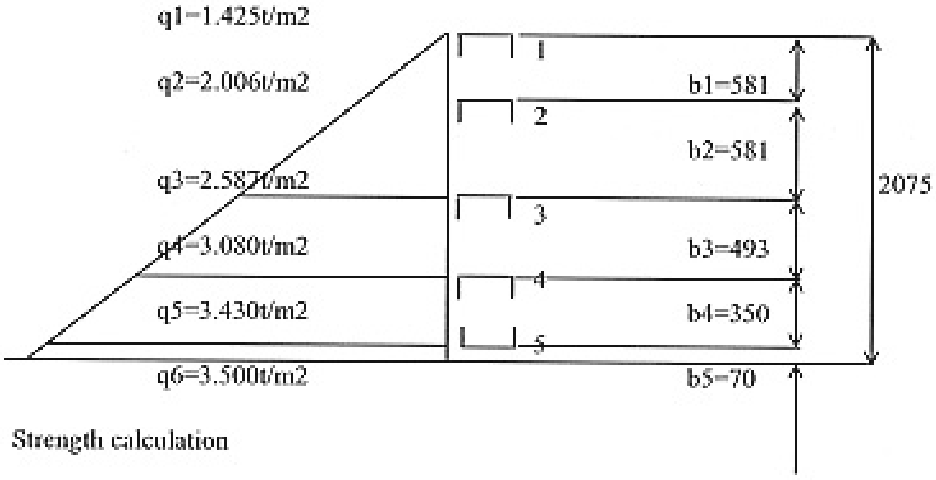
$P = 1/2 \times (h1^2 - h2^2) \times B \times W_0$

P	: Design hydraulic load at normal condition	10.986	tonf
W0	: Specific gravity of water	1.0	tonf/m3
h	: Height of gate	2.075	m
h1	: Design water depth (TP2-TP5)	3.50	m
h2	: h1 - h	1.43	m
TP2	:	1.50	m
TP5	:	-2.0	m
B	: Sealing span (=clear span + 0.15)	2.15	m

1.3 Calculation

1.3.1 Main beam

(a) Arrangement of beams



(b) Strength calculation

Rw1 = b1 x (2 x q1 + q2) / 6

Rw2-Rw4 = bi-1 x (qi-1 + 2 x qi) / 6 + bi x (2 x qi + qi+1) / 6

Rw5 = b4 x (q4 + 2 x q5) / 6 + b5 x (q5 + q6) / 2

q1	: Hydrostatic pressure	1.425	tonf/m2
q2	: Hydrostatic pressure	2.006	tonf/m2
q3	: Hydrostatic pressure	2.587	tonf/m2
q4	: Hydrostatic pressure	3.08	tonf/m2
q5	: Hydrostatic pressure	3.43	tonf/m2
q6	: Hydrostatic pressure	3.5	tonf/m2
b1	:	0.581	m
b2	:	0.581	m
b3	:	0.493	m
b4	:	0.35	m
b5	:	0.07	m
Rw1	: Load on beam1	0.470	tonf/m
Rw2	: Load on beam2	1.165	tonf/m
Rw3	: Load on beam3	1.373	tonf/m
Rw4	: Load on beam4	1.278	tonf/m
Rw5	: Load on beam5	0.661	tonf/m

Mi = Ri x B x (2 x L - B) / 8

B	: Sealing span	2.15	m
L	: Supporting span	2.15	m
M1	: Bending moment of beam1	0.272	tonf-m
M2	: Bending moment of beam2	0.673	tonf-m
M3	: Bending moment of beam3	0.794	tonf-m
M4	: Bending moment of beam4	0.739	tonf-m
M5	: Bending moment of beam5	0.382	tonf-m

S = Ri x B / 2

S1	: Shearing force of beam1	0.505	tonf

S2	: Shearing force of beam2	1.253 tonf
S3	: Shearing force of beam3	1.476 tonf
S4	: Shearing force of beam4	1.374 tonf
S5	: Shearing force of beam5	0.710 tonf

[150x75x6.5x10 ([149x74x5.5x9)

I	: Moment of inertia	906 cm4
Z	: Section modulus	122 cm3
Aw	: Area of web	10.1 cm2

σ = Mi / Z

σ 3	: Bending stress of beam3		650.5 kgf/cm2
		<	1200.0 kgf/cm2

τ = S / Aw < τ a

τ 3	: Shearing stress of beam3		146.2 kgf/cm2
		<	700.0 kgf/cm2

δ = Ri x B x (L3 - 1/2 x L x B2 + B3 / 8) / (48 x E x I)
= 13.249 x Ri/I

δ 3	: Deflection of beam3	0.201 cm
L / δ 3	:	1070

DETERMINATION OF PUMP RATING

Thanh Da PS

1. BASIC CONDITIONS

1.1 DESIGN DATA FOR PUMP

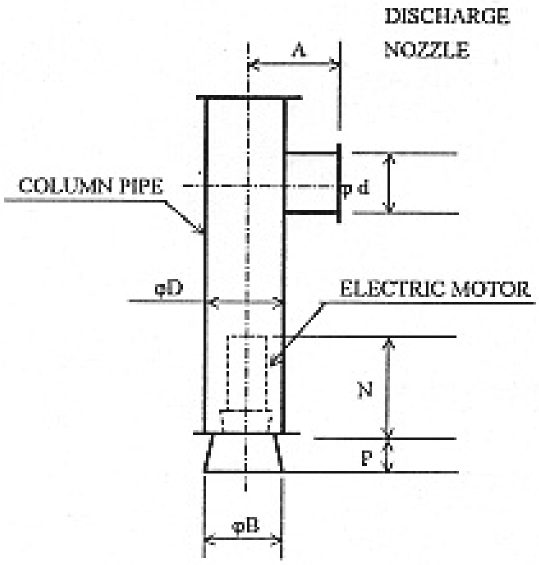
(a)	TOTAL FLOW CAPACITY (QT)	0.70	m3/sec
(b)	NUMBER OF PUMP UNIT (N)	2	units

1.2 DETERMINATION OF COLUMN PIPE DIAMETER

(a)	PUMP CAPACITY PER UNIT (q)	21.00	m3/min
(b)	COLUMN PIPE DIAMETER (D)	600	mm

APPROXIMATE DIMENSIONS

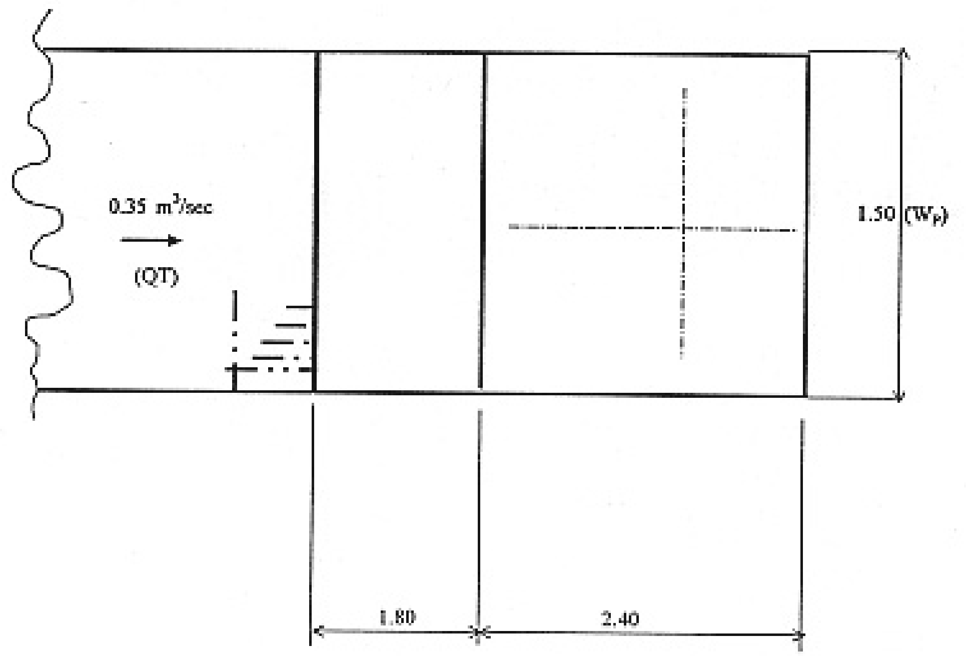
D	B	P	N	A	d
600	480	345	1600	550	400

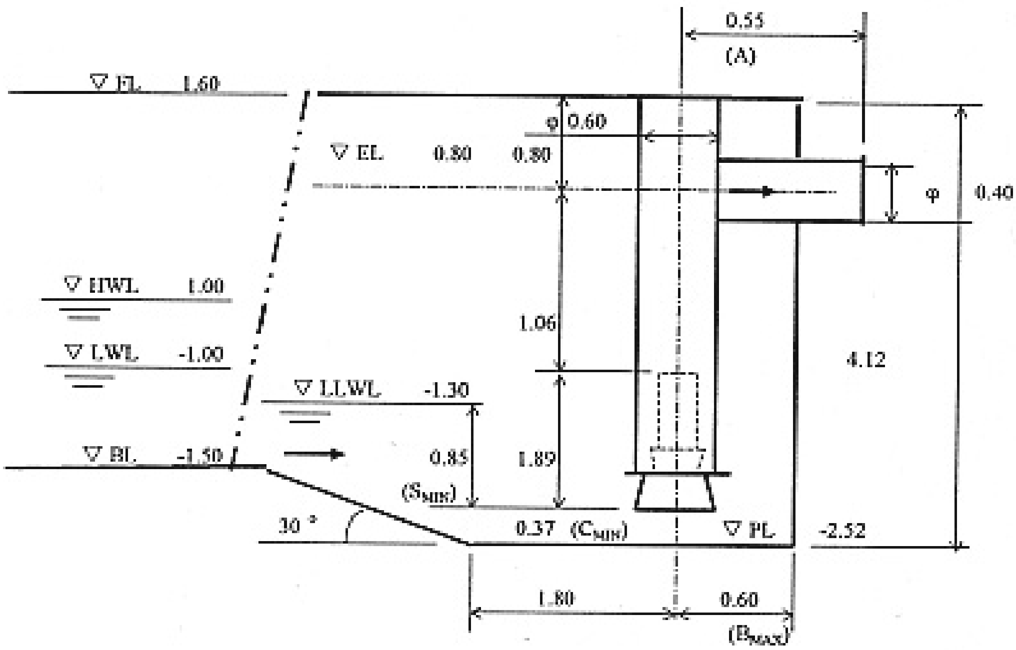


1.3 DESIGN DATA FOR INTAKE CHANNEL AND PIT

(a)	HIGH WATER LEVEL OF INTAKE CHANNEL (H.W.L)	1.00	m
(b)	LOW WATER LEVEL OF INTAKE CHANNEL (L.W.L)	-1.00	m
(c)	LOWEST LOW WATER LEVEL OF INTAKE PIT (L.L.W.L)	-1.30	m
(d)	BASIN LEVEL OF INTAKE CHANNEL (B.L)	-1.50	m
(e)	WIDTH OF INTAKE CHANNEL (WC)	1.50	m
(f)	LEVEL OF INTAKE PIT (P.L)	-2.52	m
(g)	MINIMUM SUBMERGENCE (SMIN)	0.85	m
(h)	MINIMUM BOTTOM CLEARANCE (CMIN)	0.37	m
(i)	MAXIMUN BACK WALL CLEARANCE (BMAX)	0.60	m
(j)	LEVEL OF INSTALLATION FLOOR (F.L)	1.60	m
(k)	ANGLE BETWEEN BASIN AND PIT LEVEL (30o or 45o)	30	deg.

1.4 BASIC DIMENSIONS

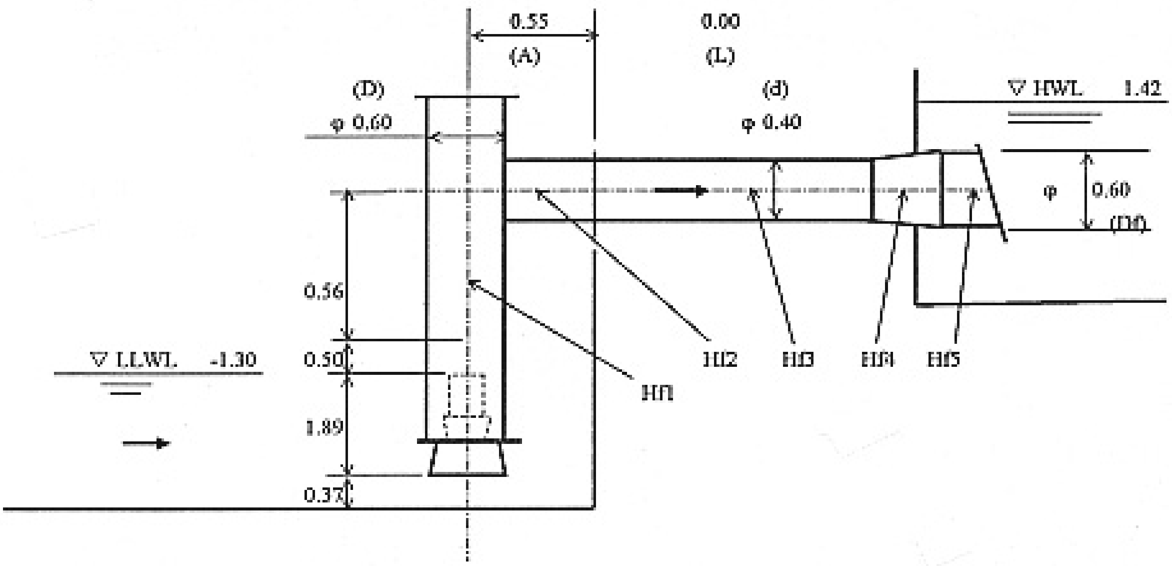




2. PUMP SELECTION

2.1 CALCULATION OF PUMP TOTAL HEAD

(a)	LOWEST LOW WATER LEVEL OF INTAKE PIT (L.L.W.L)	-1.30	m
(b)	HIGH WATER LEVEL OF DISCHARGE PIT (H.W.L)	1.42	m
(c)	DESIGN STATIC HEAD (Ha)	2.72	m
(d)	LENGTH OF DISCHARGE PIPE (L)	0.00	m
(e)	DIAMETER OF DISCHARGE PIPE (d)	0.40	m
(f)	DIAMETER OF DISCHARGE FLAP VALVE (Df)	0.60	m



(g) COLUMN PIPE LOSS (Hf1)

Hf1 = λx (L/D) x (vC2/2g)

Hf1 :	COLUMN PIPE LOSS	0.00	m
λ :	LOSS COEFFICIENT (=(0.02+1/2000/D) x 1.5)	0.03	
L :	LENGTH OF COLUMN PIPE	0.56	m
D :	COLUMN PIPE DIAMETER	0.60	m
vC :	VELOCITY IN COLUMN PIPE	1.24	m/sec

(h) DISCHARGE HEAD LOSS (Hf2)

Hf2 = 1.0 x (vD2/2g)

Hf2 :	DISCHARGE HEAD LOSS	0.40	m
vD :	VELOCITY ON DISCHARGE NOZZLE	2.79	m/sec

(i) DISCHARGE PIPE LOSS (Hf3)

Hf3 = λx (L/d) x (vD2/2g)

Hf3 : DISCHARGE PIPE LOSS	0.00	m
λ : LOSS COEFFICIENT (=(0.02+1/2000/d) x 1.5)	0.03	
L : LENGTH OF DISCHARGE PIPE	0.00	m
d : DISCHARGE PIPE DIAMETER	0.40	m
vD : VELOCITY IN DISCHARGE PIPE	2.79	m/sec

(j) REDUCER PIPE LOSS (Hf4)

Hf4 = 0.25 x (vD - vF)2/2g

Hf4 : REDUCER PIPE LOSS	0.03	m
vF : VELOCITY ON FLAP VALVE	1.24	m/sec
vD : VELOCITY IN DISCHARGE PIPE	2.79	m/sec

(k) FLAP VALVE AND DISCHARGE LOSS (Hf5)

Hf5 = 1.5 x (vF2/2g)

Hf5 : FLAP VALVE AND DISCHARGE LOSS	0.12	m
vF : VELOCITY ON FLAP VALVE	1.24	m/sec

(l) TOTAL HEAD LOSS (Hf)

Hf = Hf1 + Hf2 + Hf3 + Hf4 + Hf5	0.55	m

(m) PUMP TOTAL HEAD (HT)

Ha =	2.72	m
Hf =	0.55	m
HT = Ha + Hf	3.27	m
INCLUDING SOME MARGIN, PUMP TOTAL HEAD IS DECIDED AS ;	3.52	m

2.2 CALCULATION OF MOTOR OUTPUT

(a) MOTOR OUTPUT (P)

P = (0.163 x q x HT x γ/ηP/ηG) x α

P : MOTOR OUTPUT	17.54	kw
q : PUMP CAPACITY PER UNIT	21.00	m3/min
HT : PUMP TOTAL HEAD	3.52	m
γ : SPECIFIC GRAVITY OF WATER	1.00	kg/l
ηP : PUMP EFFICIENCY	79	%
ηG : GEAR EFFICIENCY	100	%
α : ALLOWANCE	1.15	
INCLUDING SOME MARGIN, MOTOR OUTPUT IS DECIDED AS ;	18.50	kw

DETERMINATION OF PUMP RATING

Ben Me Coc (1) PS
Phase 1

1. BASIC CONDITIONS

1.1 DESIGN DATA FOR PUMP

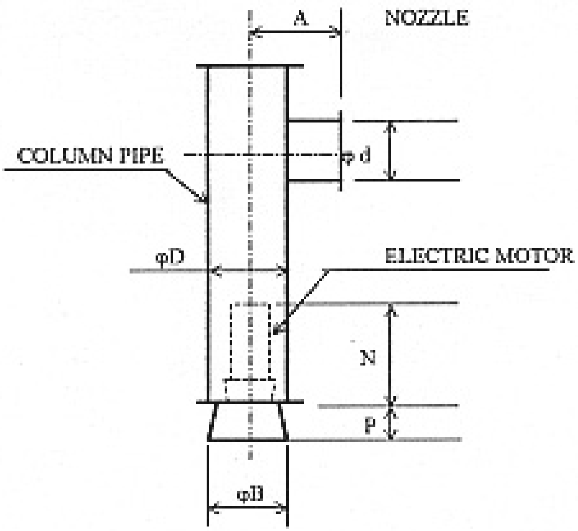
(a)	TOTAL FLOW CAPACITY (QT)	(FOR PHASE 1 ONLY)	0.70	m3/sec
(b)	NUMBER OF PUMP UNIT (N)		2	units

1.2 DETERMINATION OF COLUMN PIPE DIAMETER

(a)	PUMP CAPACITY PER UNIT (q)	21.00	m3/min
(b)	COLUMN PIPE DIAMETER (D)	600	mm

APPROXIMATE DIMENSIONS

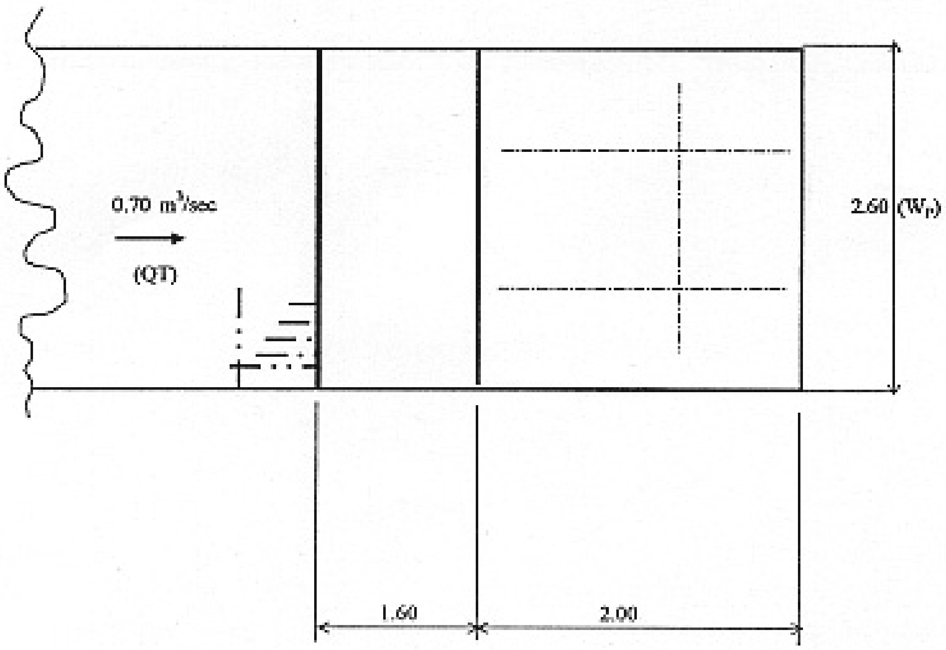
D	B	P	N	A	d
600	480	345	1600	550	400

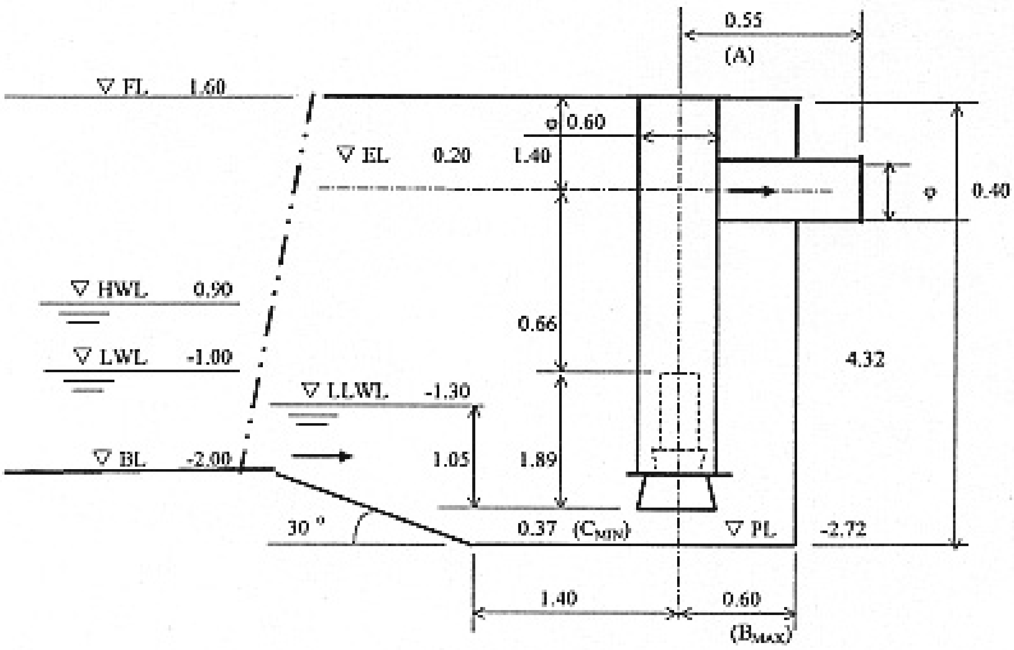


1.3 DESIGN DATA FOR INTAKE CHANNEL AND PIT

(a)	HIGH WATER LEVEL OF INTAKE CHANNEL (H.W.L)	0.90	m
(b)	LOW WATER LEVEL OF INTAKE CHANNEL (L.W.L)	-1.00	m
(c)	LOWEST LOW WATER LEVEL OF INTAKE PIT (L.L.W.L)	-1.30	m
(d)	BASIN LEVEL OF INTAKE CHANNEL (B.L)	-2.00	m
(e)	WIDTH OF INTAKE CHANNEL (WC)	2.60	m
(f)	LEVEL OF INTAKE PIT (P.L)	-2.72	m
(g)	MINIMUM SUBMERGENCE (SMIN)	0.85	m
(h)	MINIMUM BOTTOM CLEARANCE (CMIN)	0.37	m
(i)	MAXIMUN BACK WALL CLEARANCE (BMAX)	0.60	m
(j)	LEVEL OF INSTALLATION FLOOR (F.L)	1.60	m
(k)	ANGLE BETWEEN BASIN AND PIT LEVEL (30o or 45o)	30	deg.

1.4 BASIC DIMENSIONS

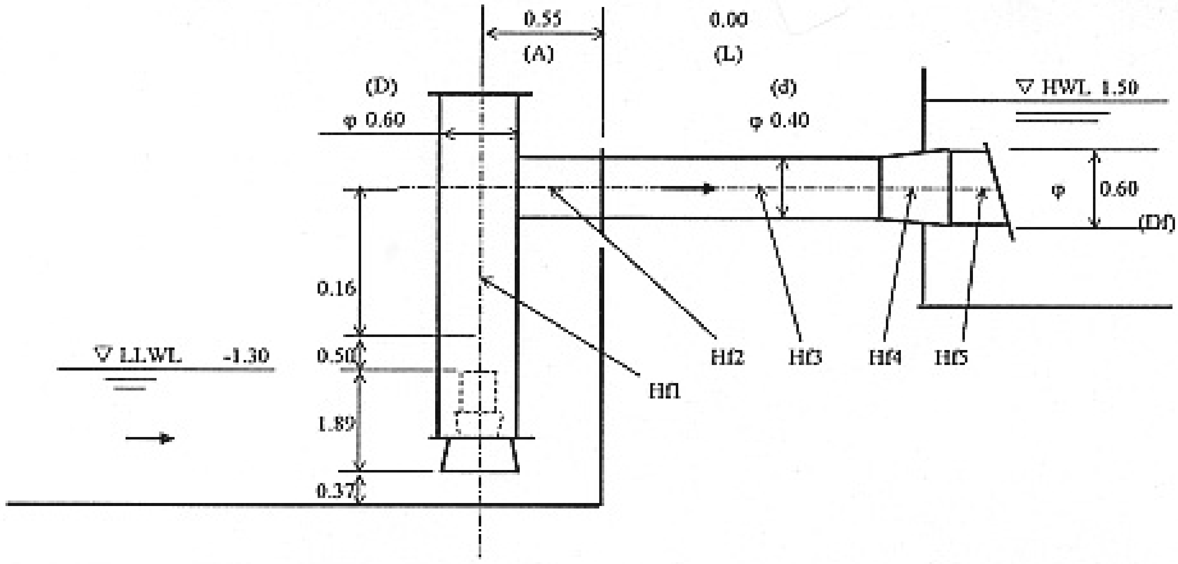




2. PUMP SELECTION

2.1 CALCULATION OF PUMP TOTAL HEAD

(a)	LOWEST LOW WATER LEVEL OF INTAKE PIT (L.L.W.L)	-1.30	m
(b)	HIGH WATER LEVEL OF DISCHARGE PIT (H.W.L)	1.50	m
(c)	DESIGN STATIC HEAD (Ha)	2.80	m
(d)	LENGTH OF DISCHARGE PIPE (L)	0.00	m
(e)	DIAMETER OF DISCHARGE PIPE (d)	0.40	m
(f)	DIAMETER OF DISCHARGE FLAP VALVE (Df)	0.60	m



(g) COLUMN PIPE LOSS (Hf1)

Hf1 = λx (L/D) x (vC2/2g)

Hf1	COLUMN PIPE LOSS	0.00	m
λ	LOSS COEFFICIENT (=(0.02+1/2000/D) x 1.5)	0.03	
L	LENGTH OF COLUMN PIPE	0.16	m
D	COLUMN PIPE DIAMETER	0.60	m
vC	VELOCITY IN COLUMN PIPE	1.24	m/sec

(h) DISCHARGE HEAD LOSS (Hf2)

Hf2 = 1.0 x (vD2/2g)

Hf2	DISCHARGE HEAD LOSS	0.40	m
vD	VELOCITY ON DISCHARGE NOZZLE	2.79	m/sec

(i) DISCHARGE PIPE LOSS (Hf3)

Hf3 = λx (L/d) x (vD2/2g)

Hf3 : DISCHARGE PIPE LOSS	0.00	m
λ : LOSS COEFFICIENT (=(0.02+1/2000/d) x 1.5)	0.03	
L : LENGTH OF DISCHARGE PIPE	0.00	m
d : DISCHARGE PIPE DIAMETER	0.40	m
vD : VELOCITY IN DISCHARGE PIPE	2.79	m/sec

(j) REDUCER PIPE LOSS (Hf4)

Hf4 = 0.25 x (vD - vF)2/2g

Hf4 : REDUCER PIPE LOSS	0.03	m
vF : VELOCITY ON FLAP VALVE	1.24	m/sec
vD : VELOCITY IN DISCHARGE PIPE	2.79	m/sec

(k) FLAP VALVE AND DISCHARGE LOSS (Hf5)

Hf5 = 1.5 x (vF2/2g)

Hf5 : FLAP VALVE AND DISCHARGE LOSS	0.12	m
vF : VELOCITY ON FLAP VALVE	1.24	m/sec

(l) TOTAL HEAD LOSS (Hf)

Hf = Hf1 + Hf2 + Hf3 + Hf4 + Hf5	0.54	m

(m) PUMP TOTAL HEAD (HT)

Ha =	2.80	m
Hf =	0.54	m
HT = Ha + Hf	3.34	m
INCLUDING SOME MARGIN, PUMP TOTAL HEAD IS DECIDED AS ;	3.7	m

2.2 CALCULATION OF MOTOR OUTPUT

(a) MOTOR OUTPUT (P)

P = (0.163 x q x HT x γ/ηP/ηG) x α

P : MOTOR OUTPUT	18.44	kw
q : PUMP CAPACITY PER UNIT	21.00	m3/min
HT : PUMP TOTAL HEAD	3.70	m
γ : SPECIFIC GRAVITY OF WATER	1.00	kg/l
ηP : PUMP EFFICIENCY	79	%
ηG : GEAR EFFICIENCY	100	%
α : ALLOWANCE	1.15	
INCLUDING SOME MARGIN, MOTOR OUTPUT IS DECIDED AS ;	18.50	kw

Table : Equipment List (For Phase 1)

1. Mechanical equipment

Equipment name	Thanh Da P.S.		Ben Me Coc (1) P.S.	
Main pump (1)	0.35m3/s x 3.52m 400mm dia. (18.5kw)	2	0.35m3/s x 3.7m 400mm dia. (18.5kw)	2
Flap valve (1)	600mm dia.	2	600mm dia.	2
Pipe (1)	400 to 600mm dia.	2	400 to 600mm dia.	2
Bar screen (1)	1500mm W x 3100mm H	2	2600mm W x 3600mm H	1
Stoplog(1)	1500mm W x 3100mm H	2	2600mm W x 3600mm H	2
Inlet gate (1) Inlet gate (2)	1200mm W x 1200mm H 1000mm W x 1000mm H	1 1		
By-pass gate	1400mm W x 1400mm H	1	1500mm W x 1500mm H 2000mm W x 2000mm H	1 1
Flap gate (1) Flap gate (2)	1000mm dia. 1200mm dia.	1 1	1500mm dia.	1
Outlet gate (1)	1400mm W x 1400mm H	1	2000mm W x 2000mm H	1

2. Electrical equipment

Equipment name	Thanh Da P.S.		Ben Me Coc (1) P.S.	
H.V. incoming	AC22kV x 50Hz x 3phase Outdoor	1	AC22kV x 50Hz x 3phase Outdoor	1
Transformer	AC22kV/380V x 150kVA Outdoor	1	AC22kV/380V x 200kVA Outdoor	1
L.V. distribution panel	AC380V x 50Hz x 3phase Outdoor	1	AC380V x 50Hz x 3phase Outdoor	1
Main pump panel	AC380V x 50Hz x 3phase Outdoor	1	AC380V x 50Hz x 3phase Outdoor	2
Water level gauge	Bellows type	2	Bellows type	2
Cable		1		1

2.4

Electrical Equipment

HO CHI MINH CITY, VIETNAM

WATER ENVIRONMENT IMPROVEMENT PROJECT

Calculation Sheet

for

MCCB Capacity

Package :B

Plant : Thanh Da Pumping Station

Plant : Ben Me Coc (1) Pumping Station

MCB Size

E - 99H

CUSTOMER VIETNAM/HCMC

100 PUMP WELL

400 OTHER EQUIPMENT

D Direct start

C Aux. Auto TR start

SR Secondary Resistor

SD Star-Delta

MOTORS AND AUXILIARIES LIST

No.	EQUIPMENT NAME	Quantity Phase-1 DUTY	Quantity Phase-1 STAND BY	Quantity Phase-2 DUTY	Quantity Phase-2 STAND BY	Quantity Phase-3 DUTY	Quantity Phase-3 STAND BY	TOTAL	POWER (kW)	VOLTAGE (V)	Reversible Operation	STARTING METHOD	Required Capacity Phase-1 Duty (kW)	Phase-1 Stand-by (kW)	Phase-2 Duty (kW)	Phase-2 Stand-by (kW)	TOTAL Duty (kW)	TOTAL Stand-by (kW)	Rated Current 3 (A)	MCCB Size (AT)
	Thanh Da Pump station																			
	<PUMP WELL>																			
101	No.1 Main Pump	1						1	18.5	380	-	D	18.50				18.50		183	200
102	No.2 Main Pump	1						1	18.5	380	-	D	18.50				18.50		183	200
103	No.1 Sluice Gate	1						1	1.5	380	R	D	1.50				1.50		15	30
104	No.2 Sluice Gate	1						1	1.5	380	R	D	1.50				1.50		15	30
105																				
106	By-pass Gate	1						1	2.2	380	R	D	2.20				2.20		22	30
	PUMP WELL EQUIPMENT TOTAL												37.00				37.00			
	<OTHER EQUIPMENT>																			
401	Miscellaneous (Panel lighting, Space heater etc.)	1						1	20	220	-	D	20.00				20.00		135	150
402	Instrument	1						1	4.2	220	-	D	4.20				4.20		29	30
403	Outdoor Lighting	1						1	10	220	-	D	10.00				10.00		58	75

MCB Size

E - 99H — 100 PUMP WELL

CUSTOMER VIETNAM/HCMC — 400 OTHER EQUIPMENT

D Direct start
O Aux. Auto TR start
SR Secondary Resistor
SD Star-Delta

MOTORS AND AUXILIARIES LIST

No.	EQUIPMENT NAME	Quantity							POWER	VOLTAGE	Reversible Operation	STARTING METHOD
		Phase-1		Phase-2		Phase-3		TOTAL				
		DUTY	STAND BY	DUTY	STAND BY	DUTY	STAND BY		(kW)	(V)		
404	M/O Building	1						1	20.0	220	-	D
405	Guard House	1						1	10.0	220	-	D
405	Spare			1				1	5.0	220	-	D
405	Spare			1				1	5.0	220	-	D
	OTHER EQUIPMENT TOTAL											
	ALL EQUIPMENT TOTAL											

Required Capacity						Rated Current	MCCB Size
Phase-1		Phase-2		TOTAL			
Duty	Stand-by	Duty	Stand-by	Duty	Stand-by	з	
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(A)	(AT)
20.00				20.00		136	150
10.00				10.00		68	75
		5.00		5.00		34	50
		5.00		5.00		34	50
44.20		10.00		54.20			
				91.20			

MCB Size

E - 99H

CUSTOMER VIETNAM/HCMC

100 PUMP WELL
400 OTHER EQUIPMENT

D Direct start
C Aux. Auto TR start
SR Secondary Resistor
SD Star-Delta

MOTORS AND AUXILIARIES LIST

No.	EQUIPMENT NAME	Quantity							POWER	VOLTAGE	Reversible Operation	STARTING METHOD	Required Capacity						Rated Current	MCCB Size
		Phase-1		Phase-2		Phase-3		TOTAL					Phase-1		Phase-2		TOTAL			
		DUTY	STAND BY	DUTY	STAND BY	DUTY	STAND BY		(kW)	(V)			Duty (kW)	Stand-by (kW)	Duty (kW)	Stand-by (kW)	Duty (kW)	Stand-by (kW)	3 (A)	(AT)
	Ben Me Coc(1) Pump station																			
	<PUMP WELL>																			
101	No.1 Main Pump	1						1	18.5	380	-	D	18.50				18.50		77	100
102	No.2 Main Pump	1						1	18.5	380	-	D	18.50				18.50		77	100
103	No.3 Main Pump			1				1	18.5	380	-	D			18.50		18.50		77	100
104	No.2 Sluice Gate (Inlet Gate)	1						1	2.2	380	R	D	2.20				2.20		22	30
105	By-pass Gate	1						1	2.2	380	R	D	2.20				2.20		22	30
106	No.1 Sluice Gate	1						1	2.2	380	R	D	2.20				2.20		22	30
107	Future Sluice Gate			1				1	2.2	380	R	D			2.20		2.20		22	30
	PUMP WELL EQUIPMENT TOTAL												37.00		18.50		55.50			
	<OTHER EQUIPMENT>																			
401	Miscellaneous (Panel lighting, Space heater etc.)	1						1	30.0	220	-	D	30.00				30.00		205	225

MCB Size

E - 99H — 100 PUMP WELL

CUSTOMER VIETNAM/HCMC — 400 OTHER EQUIPMENT

D Direct start
C Aux. Auto TR start
SR Secondary Resistor
SD Star-Delta

MOTORS AND AUXILIARIES LIST

No.	EQUIPMENT NAME	Quantity Phase-1 DUTY	Quantity Phase-1 STAND BY	Quantity Phase-2 DUTY	Quantity Phase-2 STAND BY	Quantity Phase-3 DUTY	Quantity Phase-3 STAND BY	TOTAL	POWER (kW)	VOLTAGE (V)	Reversible Operation	STARTING METHOD
402	Instrument	1						1	4.2	220	-	D
403	Outdoor Lighting	1						1	11.5	220	-	D
404	M/O Building	1						1	20.0	220	-	D
405A	Guard house (Inlet Gate)	1						1	10.0	220	-	D
405B	Guard house (Pump station)	1						1	10.0	220	-	D
207	Spare			1				1	5.0	220	-	D
208	Spare			1				1	5.0	220	-	D
	OTHER EQUIPMENT TOTAL											
	ALL EQUIPMENT TOTAL											

Required Capacity Phase-1 Duty (kW)	Phase-1 Stand-by (kW)	Phase-2 Duty (kW)	Phase-2 Stand-by (kW)	TOTAL Duty (kW)	TOTAL Stand-by (kW)	Rated Current 3 (A)	MCCB Size (AT)
4.20				4.20		29	30
11.50				11.50		78	100
20.00				20.00		136	150
10.00				10.00		60	75
10.00				10.00		51	75
		5.00		5.00		34	50
		5.00		5.00		34	50
55.70		10.00		65.70			
				121.20			

HO CHI MINH CITY, VIETNAM

WATER ENVIRONMENT IMPROVEMENT PROJECT

Calculation Sheet

for

Power Cable Capacity

Package :B

Plant : Thanh Da Pumping Station

Plant : Ben Me Coc (1) Pumping Station

POWER CABLE LIST

Vietnam / Ho Chi Minh City Water Environment Improvement Project

[Pacage B] Than Da Pump Station

区分 Location	Cable No.	Motor No. Motor No.	機器名称 From Name of Equipment	数量 Q'ty	容量 kW	電圧 V	起動方式 Starter	起動電流 S/current	Pf	電圧降下選定の Cable Size	起動電流より選定の Cable Size	Final Cable Size
Substation												
	PTH-1-1	Main S/S	Control Cubicle	1	128	380	D	267.40	0.8	38	150	150
	PTH-1-2	MCC-TD1	Incoming and Distribution Panel	1	40	380	D	83.60	0.8	14	22	22
Pump Pit Equipment												
	PTH-2-1	TD101	No.1 Main Pump	1	18.5	380	D	210.80	0.8	22	100	100
	PTH-2-2	TD102	No.2 Main Pump	1	18.5	380	D	210.80	0.8	22	100	100
Sluice Gate Equipment												
	PTH-3-1	TD103	No.1 Sluice Gate	1	1.5	380	D	17.10	0.8	3.5	3.5	3.5
	PTH-3-2	TD104	No.2 Sluice Gate	1	1.5	380	D	17.10	0.8	3.5	3.5	3.5
	PTH-3-3	TD105	No.3 Sluice Gate	1	2.2	380	D	25.10	0.8	3.5	3.5	3.5
Other Equipment												
	PTH-4-1	MCC-TD1	Incoming and Distribution Panel	1	30.0	380	D	118.40	0.8	38	38	38
	PTH-4-2	MCC-TD1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PTH-4-3	MCC-TD1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PTH-4-4	MCC-TD1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PTH-4-5	MCC-TD1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PTH-4-6	MCC-TD1	Incoming and Distribution Panel	1	10.0	380	D	39.50	0.8	8	5.5	8

TD Power,PK-B-MCCB-Cable .xls

POWER CABLE LIST

Vietnam / Ho Chi Minh City Water Environment Improvement Project												
[Pacage B]			Ben Me Coc (1) Pump Station									
区分 Location	Cable No.	Motor No. Motor No.	機器名称 From Name of Equipment	数量 Q'ty	容量 kW	電圧 V	起動方式 Starter	起動電流 S/current	Pf	電圧降下選定の Cable Size	起動電流より選定の Cable Size	Final Cable Size
Substation												
	PBE-1-1	Main S/S	Control Cubicle	1	200	380	D	417.60	0.8	60	250	250
	PBE-1-2	MCC-BM1	Incoming and Distribution Panel	1	7	380	D	14.60	0.8	38	3.5	38
Pump Pit Equipment												
	PBE-2-1	BM101	No.1 Main Pump	1	18.5	380	D	210.80	0.8	60	100	100
	PBE-2-2	BM102	No.2 Main Pump	1	18.5	380	D	210.80	0.8	60	100	100
Sluice Gate Equipment												
	PBE-3-1	BM104	No.1 Sluice Gate	1	2.2	380	D	43.40	0.8	5.5	5.5	5.5
	PBE-3-2	BM105	No.2 Sluice Gate	1	2.2	380	D	43.40	0.8	5.5	5.5	5.5
	PBE-3-3	BM106	No.3 Sluice Gate	1	2.2	380	D	43.40	0.8	5.5	5.5	5.5
Other Equipment												
	PBE-4-1	MCC-BM1	Incoming and Distribution Panel	1	30.0	380	D	118.40	0.8	38	38	38
	PBE-4-2	MCC-BM1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PBE-4-3	MCC-BM1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PBE-4-4	MCC-BM1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PBE-4-5	MCC-BM1	Incoming and Distribution Panel	1	0.22	380	D	0.80	0.8	3.5	3.5	3.5
	PBE-4-6	MCC-BM1	Incoming and Distribution Panel	1	10.0	380	D	39.50	0.8	8	5.5	8

WATER ENVIRONMENT IMPROVEMENT PROJECT

Issue date Rev.1 : 13-Jan-01

Calculation Sheet

for

Receiving Power Capacity for Thanh Da P/S

1. Introduction ;

The receiving power capacity of the plant is decided from the result of the following study.

1) The classification of all electrical equipments and a character are examined.

2) Total electrical capacity is computed in search of rated capacity of every item.

3) Maximum demand power is calculated by using demand factor of each electrical equipments.

2. Calculation ;

1) The result of the above item 1) and 2) is shown in the Table: Electrical equipment list

2) Total maximum demand power can be looked for by using rated capacity and demand factor from the following formula;

(Receiving power capaci = (Maximum demand power) / (Efficency x Power factor)

[Unit : kW]

Rated capacity	Demand factor	Max. demand power
106.4	0.7	75.5

3. Selection ;

Receiving power capacity was decided from the above result from the following reason.

1) When the operation which become stable is done, paralell operation of receiving transformer is necessary.

2) Future expansion shall be cosidered.

4. Attachment ;

1) Electrical Equipment List for Thanh Da pumping station

SOCIALIST REPUBLIC OF VIETNAM
Independence-Freedom-Happiness

ELECTRICAL EQUIPMENT LIST

Name of electric consumer : Thanh Da Pumping Station
Address :
Working table-time :
Schedule of electric consumer: Issue date Rev.1 13-Jan-01

No.	Electrical equipment name	Q'ty	Capacity		Total	Remarks
			(HB)	(kW)	(kW)	(Demand Factor)
	PUMP WELL					
101	No.1 Main Pump	1	-	18.50	18.50	0.6
102	No.2 Main Pump	1	-	18.50	18.50	0.6
104	Inlet Gate No.1	1	-	1.50	1.50	0.6
105	Inlet Gate No.2	1	-	1.50	1.50	0.6
106	By-pass Gate	1	-	2.20	2.20	0.6
	OTHERS					
401	Miscellaneous	1	-	20.00	20.00	0.6
402	Instrument	1	-	4.20	4.20	0.6
403	Outdoor Lighting	1	-	10.00	10.00	0.9
404	M/O building	1	-	20.00	20.00	1.0
405	Guard house	1	-	10.00	10.00	1.0
	TOTAL				106.40	0.7

WATER ENVIRONMENT IMPROVEMENT PROJECT

Issue date Rev.1 : 13-Jan-01

Calculation Sheet

for

Receiving Power Capacity for Ben Me Coc (1) P/S

1. Introduction ;

The receiving power capacity of the plant is decided from the result of the following study.

1) The classification of all electrical equipments and a character are examined.

2) Total electrical capacity is computed in search of rated capacity of every item.

3) Maximum demand power is calculated by using demand factor of each electrical equipments.

2. Calculation ;

1) The result of the above item 1) and 2) is shown in the Table: Electrical equipment list

2) Total maximum demand power can be looked for by using rated capacity and demand factor from the following formula;

(Receiving power capaci = (Maximum demand power) / (Efficency x Power factor)

[Unit : kW]

Rated capacity	Demand factor	Max. demand power
150.0	0.7	103.8

3. Selection ;

Receiving power capacity was decided from the above result from the following reason.

1) When the operation which become stable is done, paralell operation of receiving transformer is necessary.

2) Future expansion shall be cosidered.

4. Attachment ;

1) Electrical Equipment List for Ben Me Coc (1) pumping station

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ELECTRICAL EQUIPMENT LIST

Name of electric consumer : Ben Me Coc (1) Pumping Station
Address :
Working table-time :
Schedule of electric consumer: Issue date Rev.1 13-Jan-01

No.	Electrical equipment name	Q'ty	Capacity		Total	Remarks
			(HB)	(kW)	(kW)	(Demand Factor)
	PUMP WELL					
101	No.1 Main Pump	1	-	18.50	18.50	0.6
102	No.2 Main Pump	1	-	18.50	18.50	0.6
103	No.3 Main Pump (Future)	1	-	18.50	18.50	0.6
104	No.2 Sluice Gate	1	-	2.20	2.20	0.6
105	By-pass Gate	1	-	2.20	2.20	0.6
106	No.1 Sluice Gate	1	-	2.20	2.20	0.6
107	Future Sluice Gate	1	-	2.20	2.20	0.6
	OTHERS					
401	Miscellaneous	1	-	30.00	30.00	0.6
402	Instrument	1	-	4.20	4.20	0.6
403	Outdoor Lighting	1	-	11.50	11.50	0.9
404	M/O building	1	-	20.00	20.00	1.0
405	Guard house	2	-	10.00	20.00	1.0
	TOTAL				150.00	0.7

ELECTRICAL EQUIPMENT LIST FOR THANH DA PUMPING STATION

No.	Name of Equipment	Type	Specification	Unit	Q'ty	Remarks
2.6.1.1	Electrical Equipment					
2.6.1.1.1	Receiving transformer & meter cubicle	Outdoor, Pole mount type	160kVA, 15(22)kV/380-220V	set	1	
2.6.1.1.2	Distribution panel	Outdoor, Self-standing type	3phase-4wire, 400A, 380-220V	set	1	
2.6.1.1.3	Pump and gate control panel	Outdoor, Self-standing type	3phase-4wire, 400A, 380-220V	sets	2	
2.6.1.1.5	Local control switch box	Outdoor, Stand type	PBS, Indicator	set	5	
2.6.1.2	Instrumentation Equipment					
2.6.1.2.1	Submerged diaphragm type water level meter	Submerged diaphragm type	0-10m, DC 4-20mA	set	2	
2.6.1.2.2	Electrode type water level control switch	Electrode type	4 contacts	set	2	
2.6.1.3	Outdoor Lighting Equipment					
2.6.1.3.1	Lighting panel	Indoor, Wall mount type	MCCB 2P	set	1	

ELECTRICAL EQUIPMENT LIST FOR BEN ME COC (1) PUMPING STATION

No.	Name of Equipment	Type	Specification	Unit	Q'ty	Remarks
3.7.1.1	Electrical Equipment					
3.7.1.1.1	Receiving transformer & meter cubicle	Outdoor, Pole mount type	250kVA, 15(22)kV/380-220V	set	1	
3.7.1.1.2	Distribution panel	Outdoor, Self-standing type	3phase-4wire, 400A, 380-220V	set	1	
3.7.1.1.3	Pump and gate control panel	Outdoor, Self-standing type	3phase-4wire, 400A, 380-220V	sets	2	
3.7.1.1.4	Gate control panel	Outdoor, Self-standing type	3phase-4wire, 400A, 380-220V	set	1	
3.7.1.1.5	Local control switch box	Outdoor, Stand type	PBS, Indicator	set	4	
3.7.1.2	Instrumentation Equipment					
3.7.1.2.1	Submerged diaphragm type water level meter	Submerged diaphragm type	0-10m, DC 4-20mA	set	2	
3.7.1.2.2	Electrode type water level control switch	Electrode type	4 contacts	set	2	
3.7.1.3	Outdoor Lighting Equipment					
3.7.1.3.1	Lighting panel	Indoor, Wall mount type	MCCB 2P	set	1	