4.2

Architecture Design

4.2.1

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

4.2.2

Pumping Station

PROJECT : WASTE WATER TREATMENT PLANT -

ITEM : INTERMEDIATE PUMPING STATION

STRUCTURAL CALCULATION SHEET

STRUCTURAL ANALYSIS ITEMS :

A. MAIN FRAME STRUCTURAL ANALYSIS

B. ATTACHED RESULT SHEETS

STRUCTURAL CALCULATION SHEET

* **Project :** Wastewater Treatment Plant

* **Item :** Intermediate Wastewater Pumping Station

Part I : CALCULATION OF LOAD

A. DEAD LOAD :

- **Roof Floor :**

No.	Material	Calculation	Applying load(kg/m^2)
1	Steel purlin, metal roof sheet		30
		TOTAL	g^{tc}= 30 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 :

  $W^{tc} = n \times W^{tc}_0 \times k \times C$, 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

D. CRANE :

- Vertical load of crane :
  P_{crane} = 18 T
- Horizontal load of crane is calculated with the biggest value (because it's not requested).
  T_{crane} = 5 T

Part II : STRUCTURAL ANALYSIS PROGRESS

- The structure of Intermediate to be calculated by structural analysis program SAP2000
- 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	Roof dead load
LIVE	Roof live load
LWIND	Wind load (along X axis, from left)
RWIND	Wind load (along X axis, from right)
LCRANE	Loadding of crane
RCRANE	Loadding of crane

- **Load Combination**

Load combination	Description
COMB1	DEAD+LIVE+LWIND+LCRANE
COMB2	DEAD+LIVE+RWIND+RCRANE
COMB3	Envelop value of above combinations

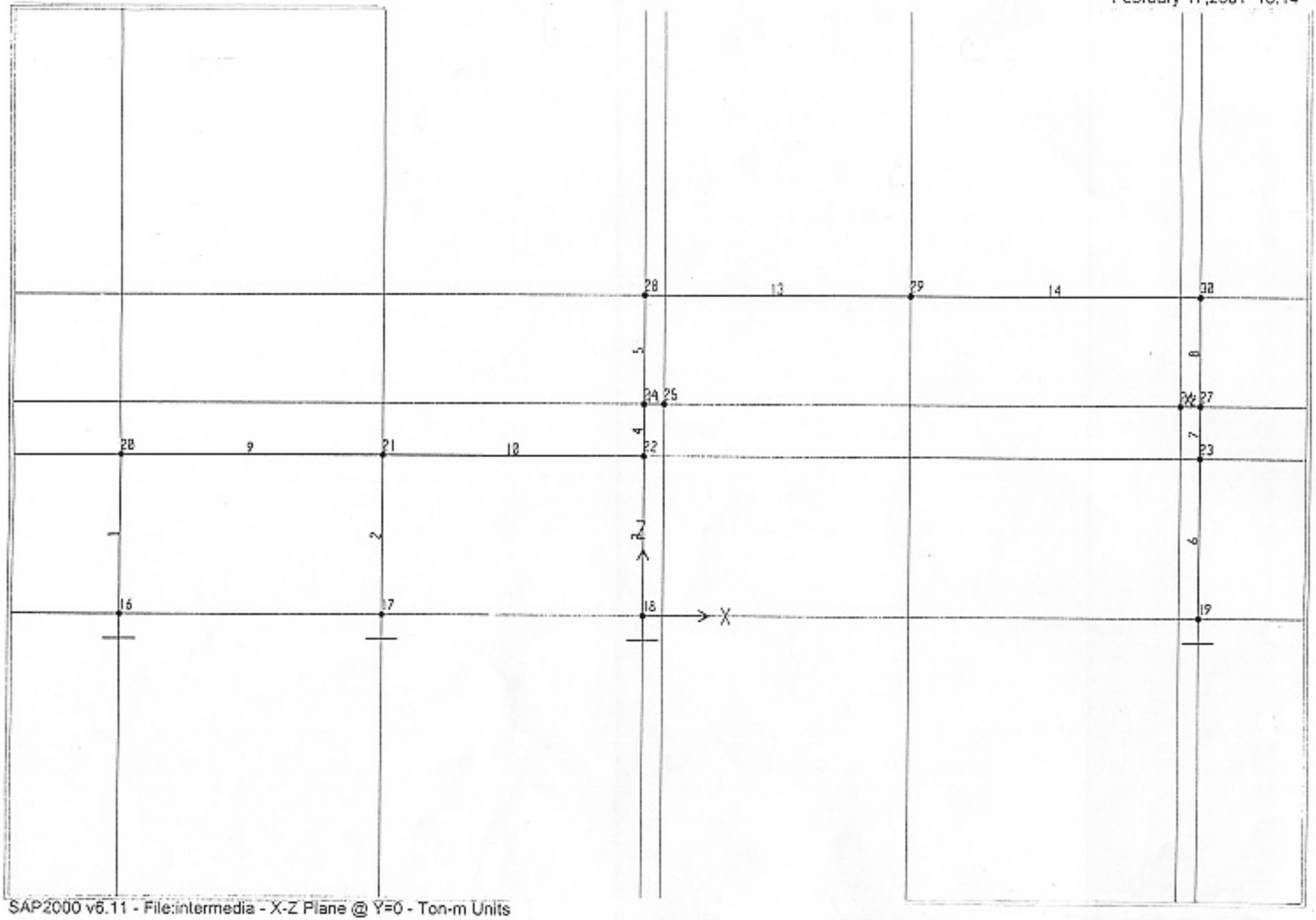
PROJECT : WASTE WATER TREATMENT PLANT

ITEM : INTERMEDIATE PUMPING STATION

RESULT SHEETS

SAP2000

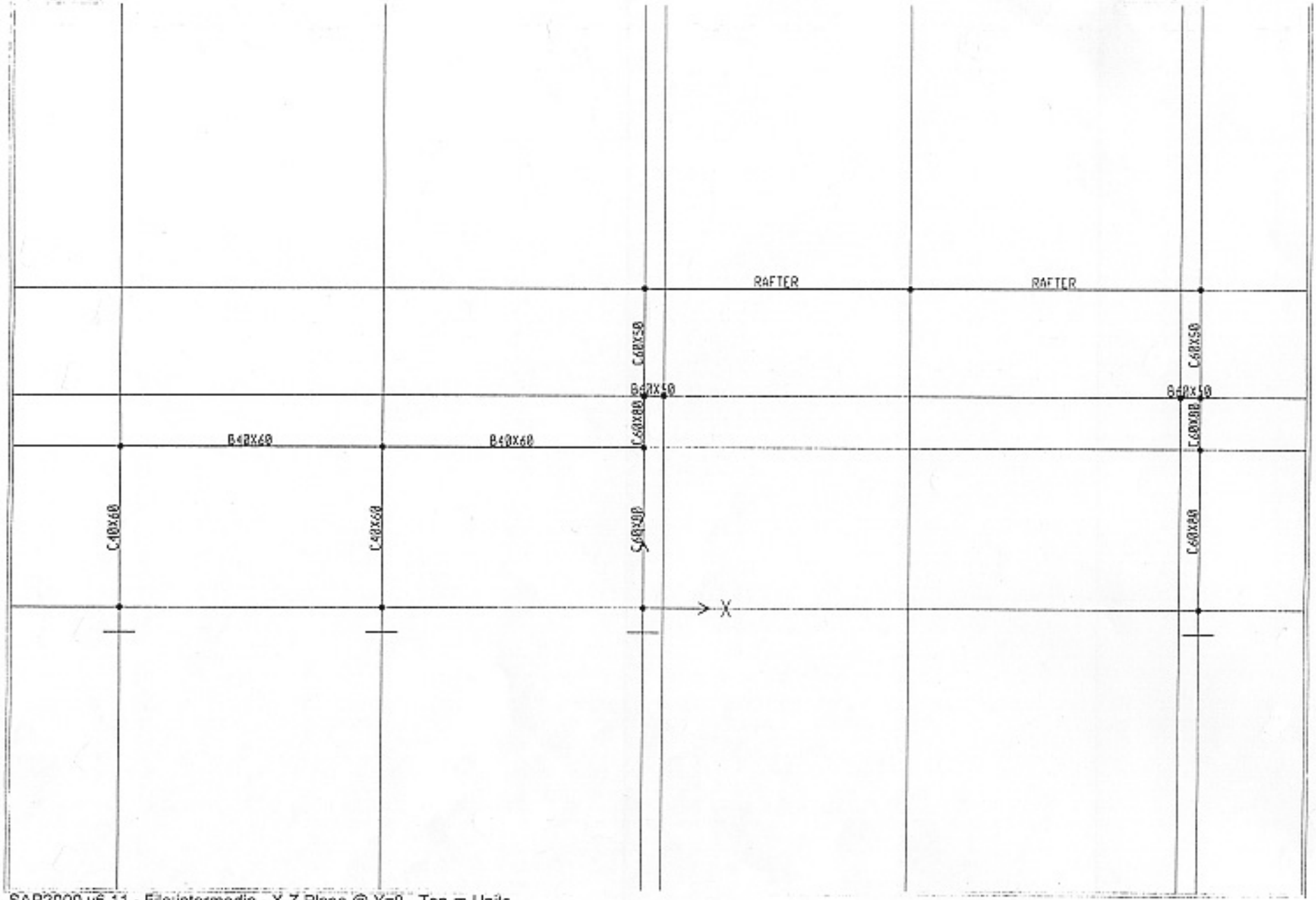
February 17,2001 16:14



SAP2000 v6.11 - File:intermedia - X-Z Plane @ Y=0 - Ton-m Units

SAP2000

February 17,2001 16:14



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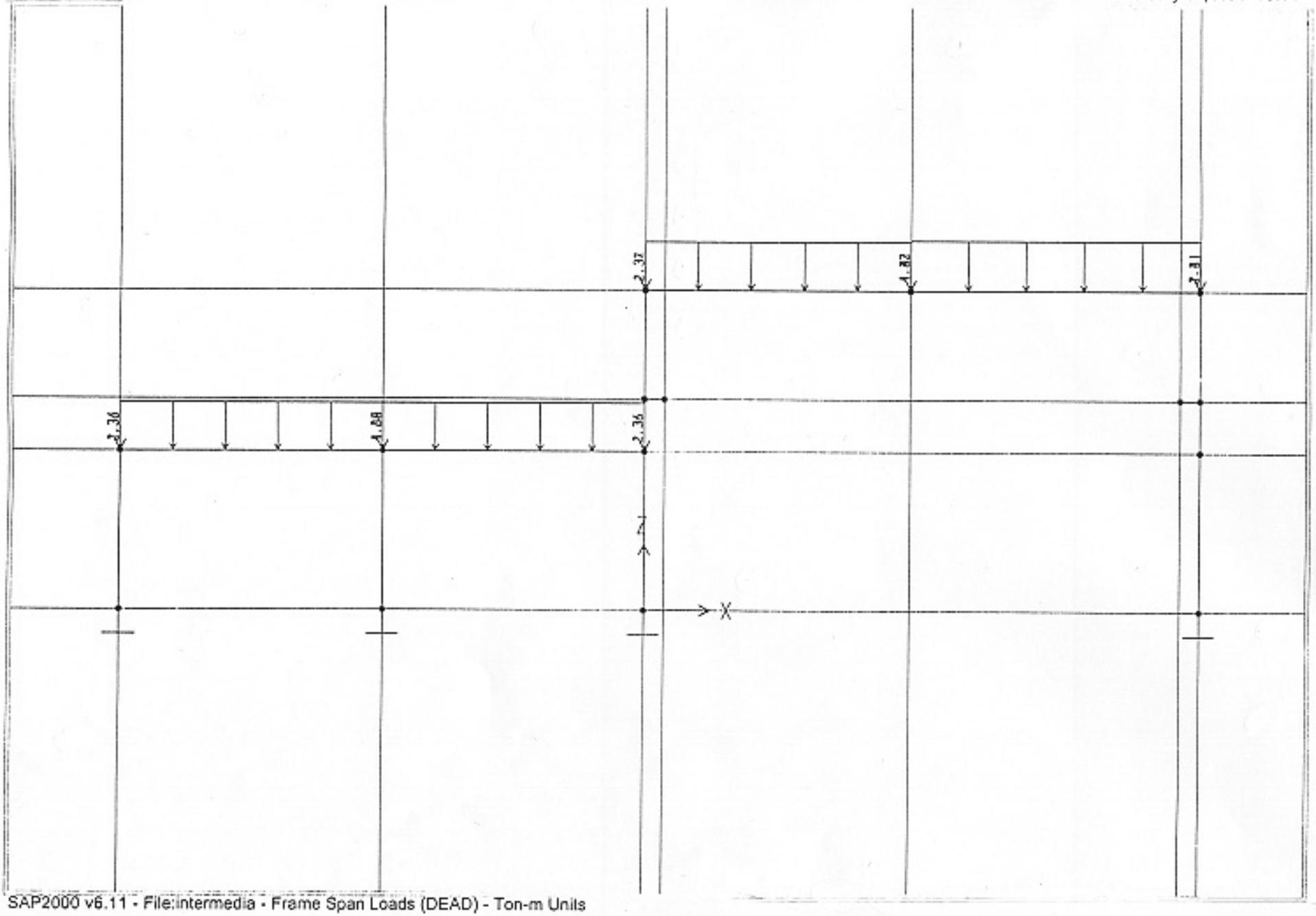
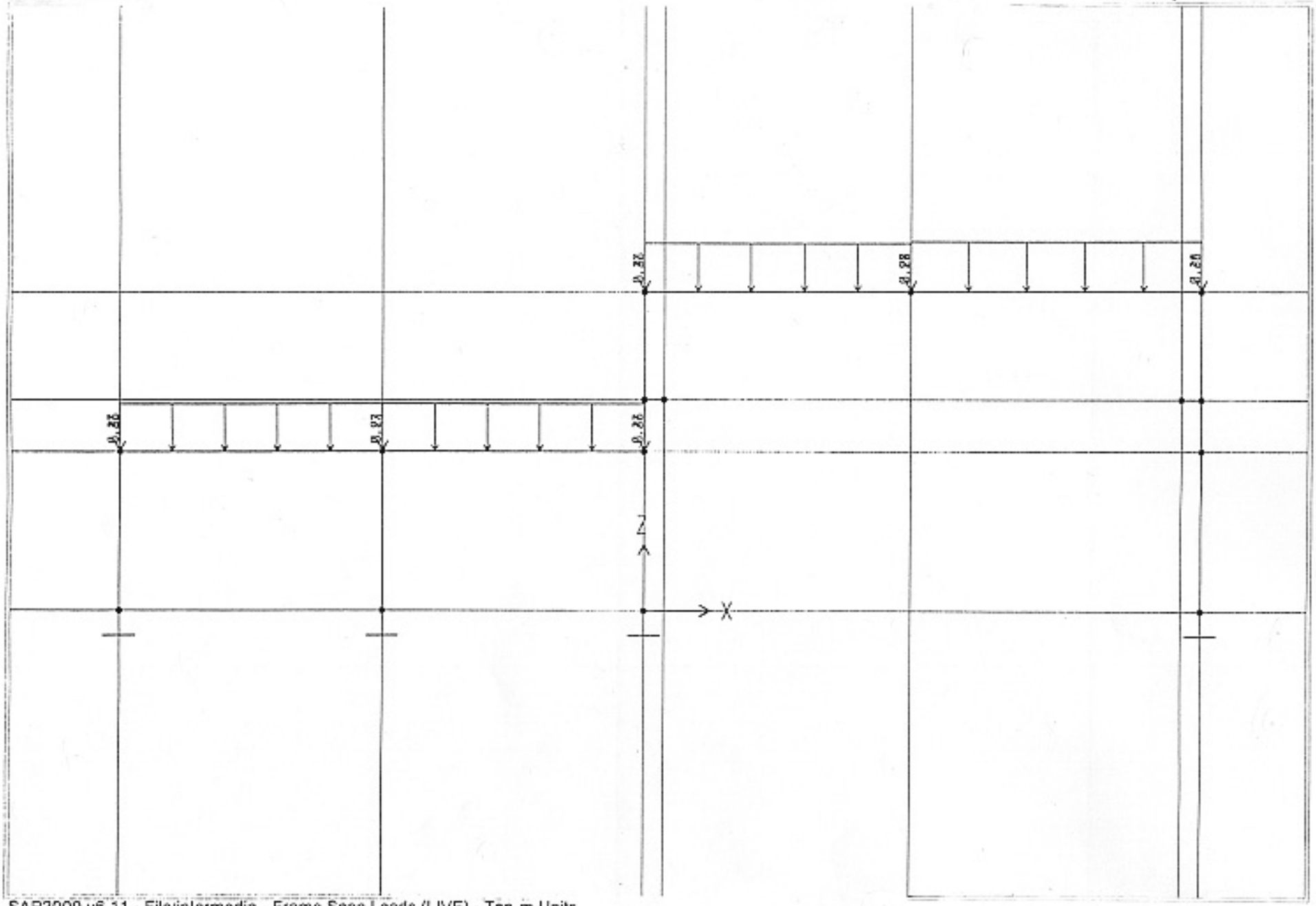
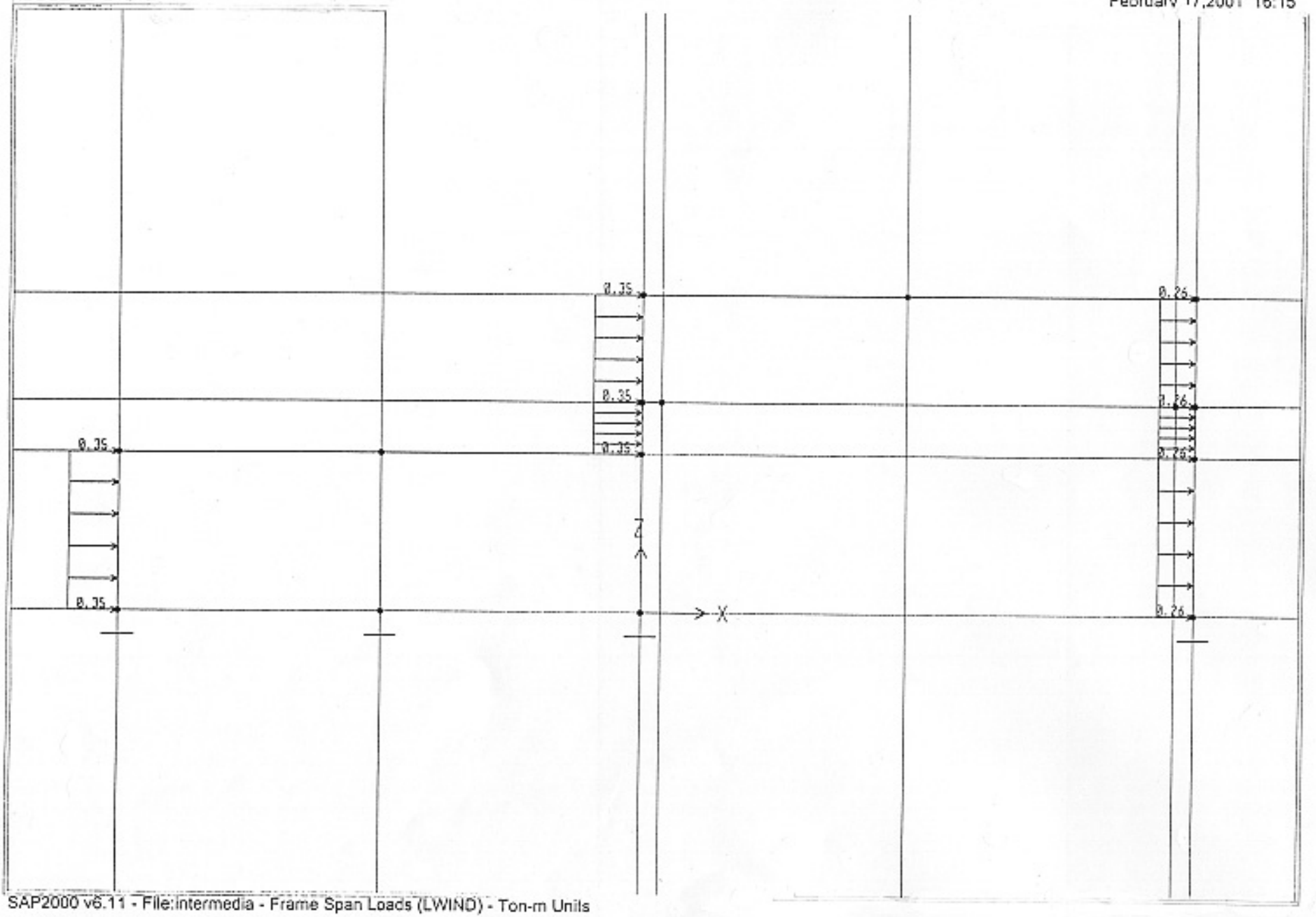

2.37
1.82
2.31
2.36
1.88
2.36
Z
X

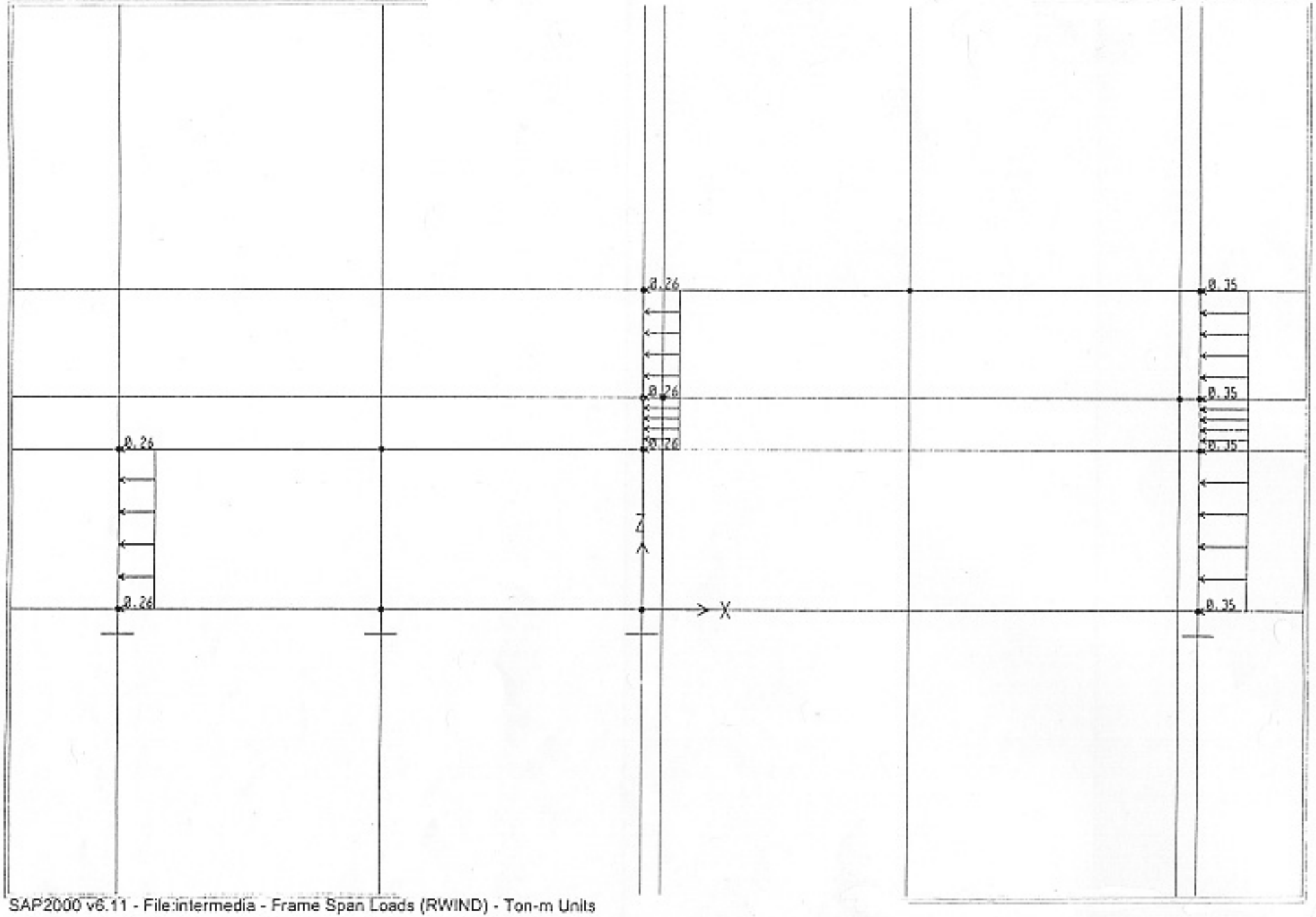

0.32
0.28
0.28
0.28
0.23
0.28

SAP2000

February 17,2001 16:15

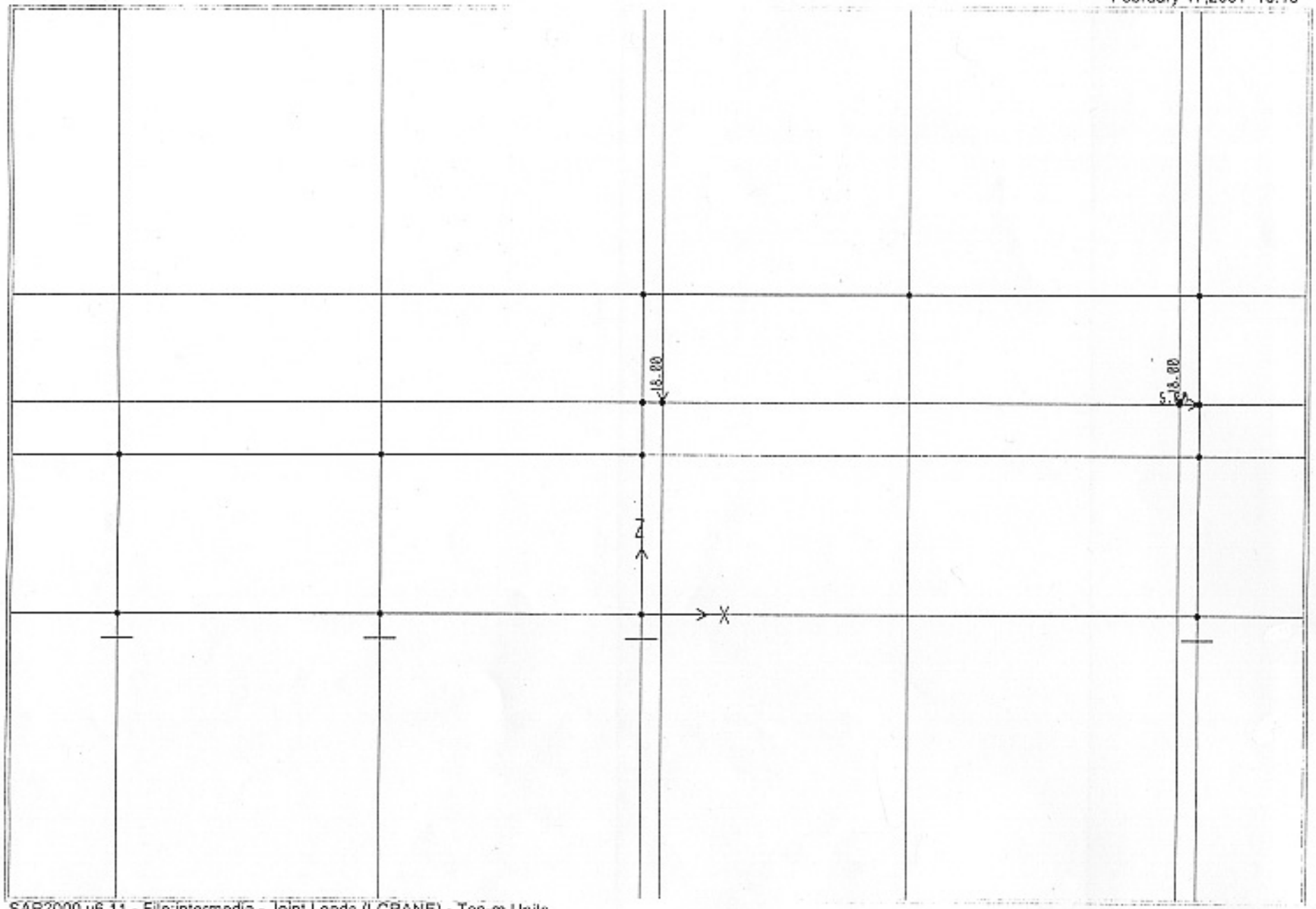


SAP2000 v6.11 - File:intermedia - Frame Span Loads (LWIND) - Ton-m Units

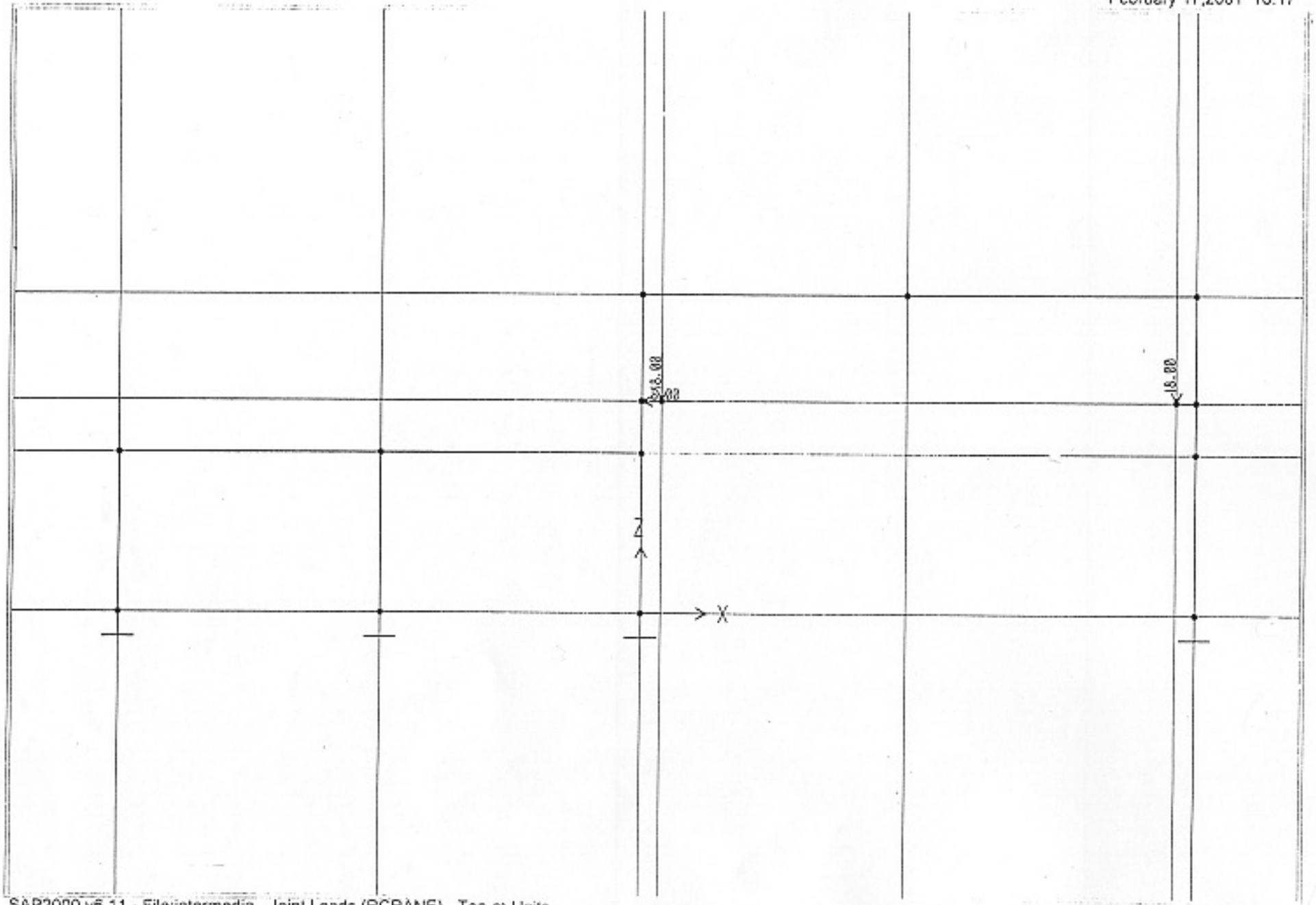

0.26
0.26
0.26
0.26
0.35
0.35
0.35
0.35
Z
X

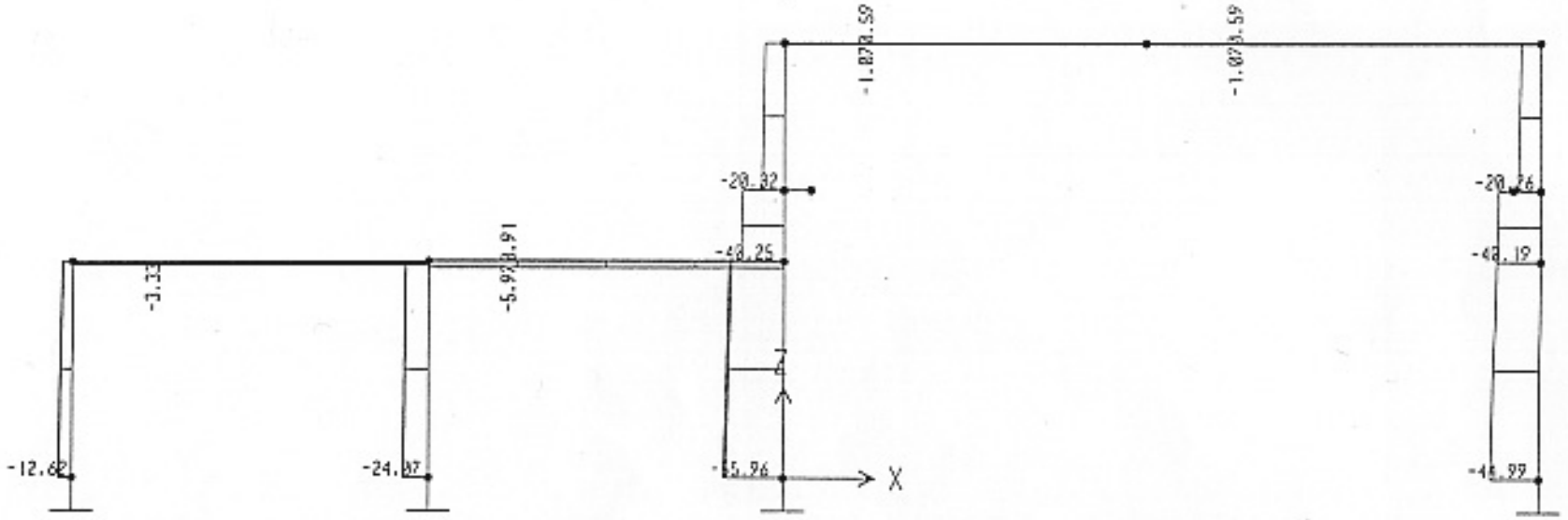
SAP2000

February 17,2001 16:15

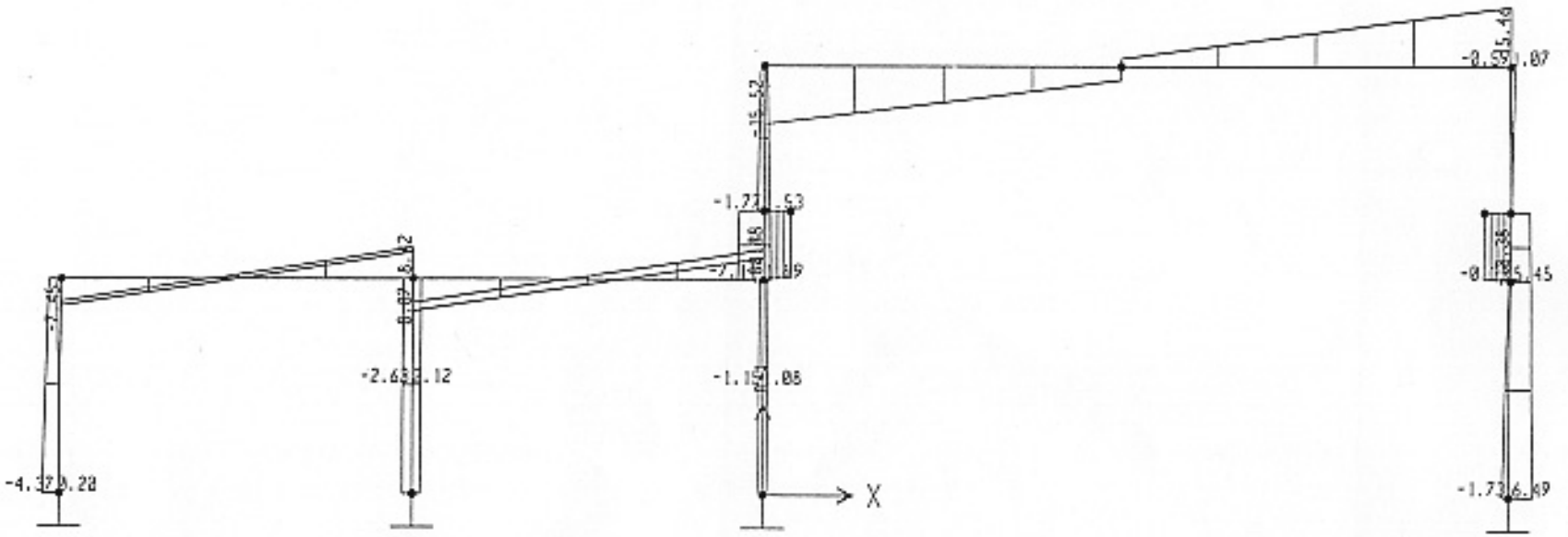


SAP2000 v6.11 - File:intermedia - Joint Loads (LCRANE) - Ton-m Units

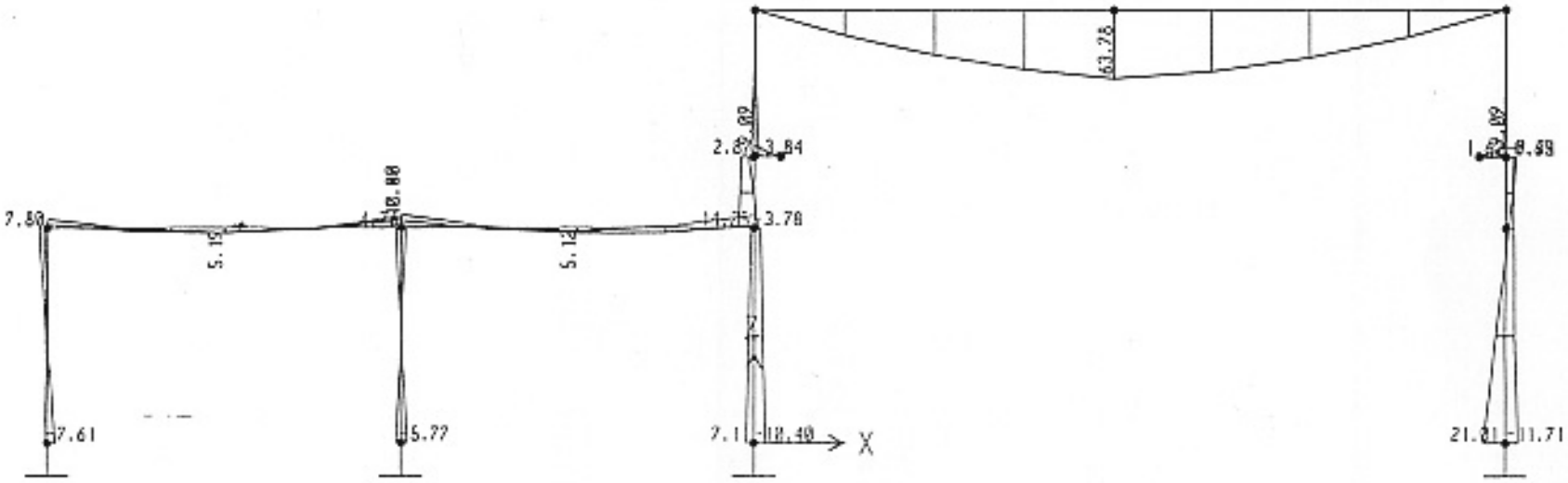

16.00
16.00
Z
X



SAP2000 v6.11 - File:intermedia - Axial Force Diagram (COMB3) - Ton-m Units



SAP2000 v6.11 - File:intermedia - Shear Force 2-2 Diagram (COMB3) - Ton-m Units



4-2-17

SAP2000 v6.11 - File:intermedia - Moment 3-3 Diagram (COMB3) - Ton-m Units

CIDECO

L O A D C O M B I N A T I O N M U L T I P L I E R S

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB3	ENVE				COMB3
		COMB1	1,0000	COMBO	
		COMB2	1,0000	COMBO	

CIDECO

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	UX	UY	UZ	RX	RY	RZ
16	COMB3 MAX	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
16	COMB3 MIN	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
17	COMB3 MAX	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
17	COMB3 MIN	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
18	COMB3 MAX	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
18	COMB3 MIN	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
19	COMB3 MAX	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
19	COMB3 MIN	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
20	COMB3 MAX	7,529E-04	0,0000	-7,130E-05	0,0000	4,587E-04	0,0000
20	COMB3 MIN	-1,060E-03	0,0000	-7,927E-05	0,0000	1,033E-04	0,0000
21	COMB3 MAX	7,391E-04	0,0000	-1,509E-04	0,0000	2,200E-05	0,0000
21	COMB3 MIN	-1,098E-03	0,0000	-1,588E-04	0,0000	-1,162E-04	0,0000
22	COMB3 MAX	7,496E-04	0,0000	-1,780E-04	0,0000	3,228E-04	0,0000
22	COMB3 MIN	-1,166E-03	0,0000	-1,960E-04	0,0000	-5,276E-04	0,0000
23	COMB3 MAX	1,713E-03	0,0000	-1,479E-04	0,0000	5,677E-04	0,0000
23	COMB3 MIN	-1,296E-03	0,0000	-1,479E-04	0,0000	-5,985E-04	0,0000
24	COMB3 MAX	1,360E-03	0,0000	-2,226E-04	0,0000	5,991E-04	0,0000
24	COMB3 MIN	-1,885E-03	0,0000	-2,305E-04	0,0000	-5,112E-04	0,0000
25	COMB3 MAX	1,360E-03	0,0000	-5,374E-05	0,0000	7,501E-04	0,0000
25	COMB3 MIN	-1,885E-03	0,0000	-6,168E-04	0,0000	-3,602E-04	0,0000
26	COMB3 MAX	2,397E-03	0,0000	-6,236E-05	0,0000	2,825E-04	0,0000
26	COMB3 MIN	-2,178E-03	0,0000	-6,576E-04	0,0000	-9,080E-04	0,0000
27	COMB3 MAX	2,397E-03	0,0000	-1,924E-04	0,0000	4,335E-04	0,0000
27	COMB3 MIN	-2,178E-03	0,0000	-1,924E-04	0,0000	-7,570E-04	0,0000
28	COMB3 MAX	3,402E-03	0,0000	-2,950E-04	0,0000	4,216E-03	0,0000
28	COMB3 MIN	-3,864E-03	0,0000	-3,029E-04	0,0000	4,215E-03	0,0000
29	COMB3 MAX	3,412E-03	0,0000	-0,0197	0,0000	2,663E-04	0,0000
29	COMB3 MIN	-3,882E-03	0,0000	-0,0197	0,0000	2,657E-04	0,0000
30	COMB3 MAX	3,422E-03	0,0000	-2,645E-04	0,0000	-4,202E-03	0,0000
30	COMB3 MIN	-3,901E-03	0,0000	-2,645E-04	0,0000	-4,202E-03	0,0000

CIDECO

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	COMB3	MAX						
		0,00	-11,47	1,996E-01	0,00	0,00	0,00	1,45
		2,00	-10,27	-5,004E-01	0,00	0,00	0,00	1,75
		4,00	-9,07	-1,20	0,00	0,00	0,00	7,80
1	COMB3	MIN						
		0,00	-12,62	-4,37	0,00	0,00	0,00	-7,61
		2,00	-11,42	-3,85	0,00	0,00	0,00	6,194E-01
		4,00	-10,22	-3,33	0,00	0,00	0,00	3,45
2	COMB3	MAX						
		0,00	-22,93	2,12	0,00	0,00	0,00	4,33
		2,00	-21,73	2,12	0,00	0,00	0,00	9,503E-02
		4,00	-20,53	2,12	0,00	0,00	0,00	4,76
2	COMB3	MIN						
		0,00	-24,07	-2,63	0,00	0,00	0,00	-5,77
		2,00	-22,87	-2,63	0,00	0,00	0,00	-5,019E-01
		4,00	-21,67	-2,63	0,00	0,00	0,00	-4,14
3	COMB3	MAX						
		0,00	-53,67	1,08	0,00	0,00	0,00	7,11
		2,00	-51,27	1,08	0,00	0,00	0,00	4,96
		4,00	-48,87	1,08	0,00	0,00	0,00	2,81
3	COMB3	MIN						
		0,00	-55,96	-1,15	0,00	0,00	0,00	-10,40
		2,00	-53,56	-1,15	0,00	0,00	0,00	-8,10
		4,00	-51,16	-1,15	0,00	0,00	0,00	-5,81
4	COMB3	MAX						
		0,00	-40,25	1,99	0,00	0,00	0,00	14,25
		6,5E-01	-39,47	1,76	0,00	0,00	0,00	13,03
		1,30	-38,69	1,53	0,00	0,00	0,00	11,96
4	COMB3	MIN						
		0,00	-40,25	-7,11	0,00	0,00	0,00	-3,78
		6,5E-01	-39,47	-6,94	0,00	0,00	0,00	7,923E-01
		1,30	-38,69	-6,77	0,00	0,00	0,00	5,25
5	COMB3	MAX						
		0,00	-20,32	1,53	0,00	0,00	0,00	2,87
		1,35	-19,30	1,06	0,00	0,00	0,00	1,12
		2,70	-18,29	5,899E-01	0,00	0,00	0,00	0,00
5	COMB3	MIN						
		0,00	-20,32	-1,77	0,00	0,00	0,00	-3,94
		1,35	-19,30	-1,42	0,00	0,00	0,00	-1,68
		2,70	-18,29	-1,07	0,00	0,00	0,00	0,00
6	COMB3	MAX						
		0,00	-44,99	6,49	0,00	0,00	0,00	21,01
		2,00	-42,59	5,97	0,00	0,00	0,00	8,55
		4,00	-40,19	5,45	0,00	0,00	0,00	-2,87
6	COMB3	MIN						
		0,00	-44,99	-1,73	0,00	0,00	0,00	-11,71
		2,00	-42,59	-1,03	0,00	0,00	0,00	-8,96
		4,00	-40,19	-3,276E-01	0,00	0,00	0,00	-7,60
7	COMB3	MAX						
		0,00	-40,19	5,45	0,00	0,00	0,00	-2,87
		6,5E-01	-39,41	5,28	0,00	0,00	0,00	-6,36
		1,30	-38,63	5,11	0,00	0,00	0,00	-7,47
7	COMB3	MIN						
		0,00	-40,19	-3,276E-01	0,00	0,00	0,00	-7,60
		6,5E-01	-39,41	-1,001E-01	0,00	0,00	0,00	-7,47
		1,30	-38,63	1,274E-01	0,00	0,00	0,00	-9,74
8	COMB3	MAX						
		0,00	-20,26	1,274E-01	0,00	0,00	0,00	1,62
		1,35	-19,24	5,999E-01	0,00	0,00	0,00	1,13
		2,70	-18,23	1,07	0,00	0,00	0,00	0,00
8	COMB3	MIN						
		0,00	-20,26	1,121E-01	0,00	0,00	0,00	-6,450E-01
		1,35	-19,24	-2,389E-01	0,00	0,00	0,00	-5,594E-01
		2,70	-18,23	-5,899E-01	0,00	0,00	0,00	0,00
9	COMB3	MAX						
		0,00	-1,20	-6,30	0,00	0,00	0,00	-3,45
		1,65	-1,20	-2,62	0,00	0,00	0,00	3,91
		3,30	-1,20	1,06	0,00	0,00	0,00	5,19

	4,95	-1,20	4,74	0,00	0,00	0,00	1,73
	6,60	-1,20	8,42	0,00	0,00	0,00	-7,24
9	COMB3 MIN						
	0,00	-3,33	-7,45	0,00	0,00	0,00	-7,80
	1,65	-3,33	-3,77	0,00	0,00	0,00	1,44
	3,30	-3,33	-8,608E-02	0,00	0,00	0,00	4,62
	4,95	-3,33	3,59	0,00	0,00	0,00	4,039E-01
	6,60	-3,33	7,27	0,00	0,00	0,00	-10,45
10	COMB3 MAX						
	0,00	9,148E-01	-6,58	0,00	0,00	0,00	-6,32
	1,65	9,148E-01	-2,90	0,00	0,00	0,00	1,51
	3,30	9,148E-01	7,768E-01	0,00	0,00	0,00	5,12
	4,95	9,148E-01	4,46	0,00	0,00	0,00	4,58
	6,60	9,148E-01	8,14	0,00	0,00	0,00	-2,03
10	COMB3 MIN						
	0,00	-5,97	-8,87	0,00	0,00	0,00	-12,00
	1,65	-5,97	-5,19	0,00	0,00	0,00	-4,027E-01
	3,30	-5,97	-1,51	0,00	0,00	0,00	3,26
	4,95	-5,97	2,17	0,00	0,00	0,00	-1,06
	6,60	-5,97	5,85	0,00	0,00	0,00	-11,45
11	COMB3 MAX						
	0,00	0,00	-18,38	0,00	0,00	0,00	-9,09
	1,3E-01	0,00	-18,28	0,00	0,00	0,00	-6,80
	2,5E-01	0,00	-18,19	0,00	0,00	0,00	-4,52
	3,8E-01	0,00	-18,09	0,00	0,00	0,00	-2,26
	5,0E-01	0,00	-18,00	0,00	0,00	0,00	0,00
11	COMB3 MIN						
	0,00	0,00	-18,38	0,00	0,00	0,00	-9,09
	1,3E-01	0,00	-18,28	0,00	0,00	0,00	-6,80
	2,5E-01	0,00	-18,19	0,00	0,00	0,00	-4,52
	3,8E-01	0,00	-18,09	0,00	0,00	0,00	-2,26
	5,0E-01	0,00	-18,00	0,00	0,00	0,00	0,00
12	COMB3 MAX						
	0,00	0,00	-18,38	0,00	0,00	0,00	-9,09
	1,3E-01	0,00	-18,28	0,00	0,00	0,00	-6,80
	2,5E-01	0,00	-18,19	0,00	0,00	0,00	-4,52
	3,8E-01	0,00	-18,09	0,00	0,00	0,00	-2,26
	5,0E-01	0,00	-18,00	0,00	0,00	0,00	0,00
12	COMB3 MIN						
	0,00	0,00	-18,38	0,00	0,00	0,00	-9,09
	1,3E-01	0,00	-18,28	0,00	0,00	0,00	-6,80
	2,5E-01	0,00	-18,19	0,00	0,00	0,00	-4,52
	3,8E-01	0,00	-18,09	0,00	0,00	0,00	-2,26
	5,0E-01	0,00	-18,00	0,00	0,00	0,00	0,00
13	COMB3 MAX						
	0,00	5,899E-01	-15,52	0,00	0,00	0,00	0,00
	1,67	5,899E-01	-12,52	0,00	0,00	0,00	23,49
	3,35	5,899E-01	-9,52	0,00	0,00	0,00	41,95
	5,02	5,899E-01	-6,52	0,00	0,00	0,00	55,38
	6,70	5,899E-01	-3,52	0,00	0,00	0,00	63,78
13	COMB3 MIN						
	0,00	-1,07	-15,52	0,00	0,00	0,00	0,00
	1,67	-1,07	-12,52	0,00	0,00	0,00	23,49
	3,35	-1,07	-9,52	0,00	0,00	0,00	41,95
	5,02	-1,07	-6,52	0,00	0,00	0,00	55,38
	6,70	-1,07	-3,52	0,00	0,00	0,00	63,78
14	COMB3 MAX						
	0,00	5,899E-01	2,01	0,00	0,00	0,00	63,78
	1,83	5,899E-01	5,38	0,00	0,00	0,00	57,04
	3,65	5,899E-01	8,74	0,00	0,00	0,00	44,16
	5,48	5,899E-01	12,10	0,00	0,00	0,00	25,15
	7,30	5,899E-01	15,46	0,00	0,00	0,00	0,00
14	COMB3 MIN						
	0,00	-1,07	2,01	0,00	0,00	0,00	63,78
	1,83	-1,07	5,38	0,00	0,00	0,00	57,04
	3,65	-1,07	8,74	0,00	0,00	0,00	44,16
	5,48	-1,07	12,10	0,00	0,00	0,00	25,15
	7,30	-1,07	15,46	0,00	0,00	0,00	0,00

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WRITTEN BY NGUYEN TRUONG THANH

REINFORCEMENT RESULT FOR FILE : Intermediate.txt
FORCE UNIT : Ton
LENGTH UNIT : m
Eb = 240000.00
Rb = 100.00
Rk = 8.00
Ra = 2000.00

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11	0.00	1.35	0.05	Þ6a200/3	-10.51	0.39	Þ6a170/3
11	0.00	1.35	0.05	Þ6a200/3	-10.51	0.39	Þ6a170/3
11	0.13	1.35	0.05	Þ6a200/3	-7.78	0.29	Þ6a170/3
11	0.13	1.35	0.05	Þ6a200/3	-7.78	0.29	Þ6a170/3
11	0.25	1.35	0.05	Þ6a200/3	-5.12	0.19	Þ6a170/3
11	0.25	1.35	0.05	Þ6a200/3	-5.12	0.19	Þ6a170/3
11	0.38	1.35	0.05	Þ6a200/3	-2.53	0.09	Þ6a170/3
11	0.38	1.35	0.05	Þ6a200/3	-2.53	0.09	Þ6a170/3
11	0.50	1.35	0.05	Þ6a200/3	1.35	0.05	Þ6a170/3
11	0.50	1.35	0.05	Þ6a200/3	1.35	0.05	Þ6a170/3
12	0.00	1.35	0.05	Þ6a200/3	-10.51	0.39	Þ6a170/3
12	0.00	1.35	0.05	Þ6a200/3	-10.51	0.39	Þ6a170/3
12	0.13	1.35	0.05	Þ6a200/3	-7.78	0.29	Þ6a170/3
12	0.13	1.35	0.05	Þ6a200/3	-7.78	0.29	Þ6a170/3
12	0.25	1.35	0.05	Þ6a200/3	-5.12	0.19	Þ6a170/3
12	0.25	1.35	0.05	Þ6a200/3	-5.12	0.19	Þ6a170/3
12	0.38	1.35	0.05	Þ6a200/3	-2.53	0.09	Þ6a170/3
12	0.38	1.35	0.05	Þ6a200/3	-2.53	0.09	Þ6a170/3
12	0.50	1.35	0.05	Þ6a200/3	1.35	0.05	Þ6a170/3
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13	1.67	1.80	0.05	Þ6a150/3	13.56	0.38	Þ6a300/3
13	3.35	1.80	0.05	Þ6a150/3	25.05	0.70	Þ6a300/3
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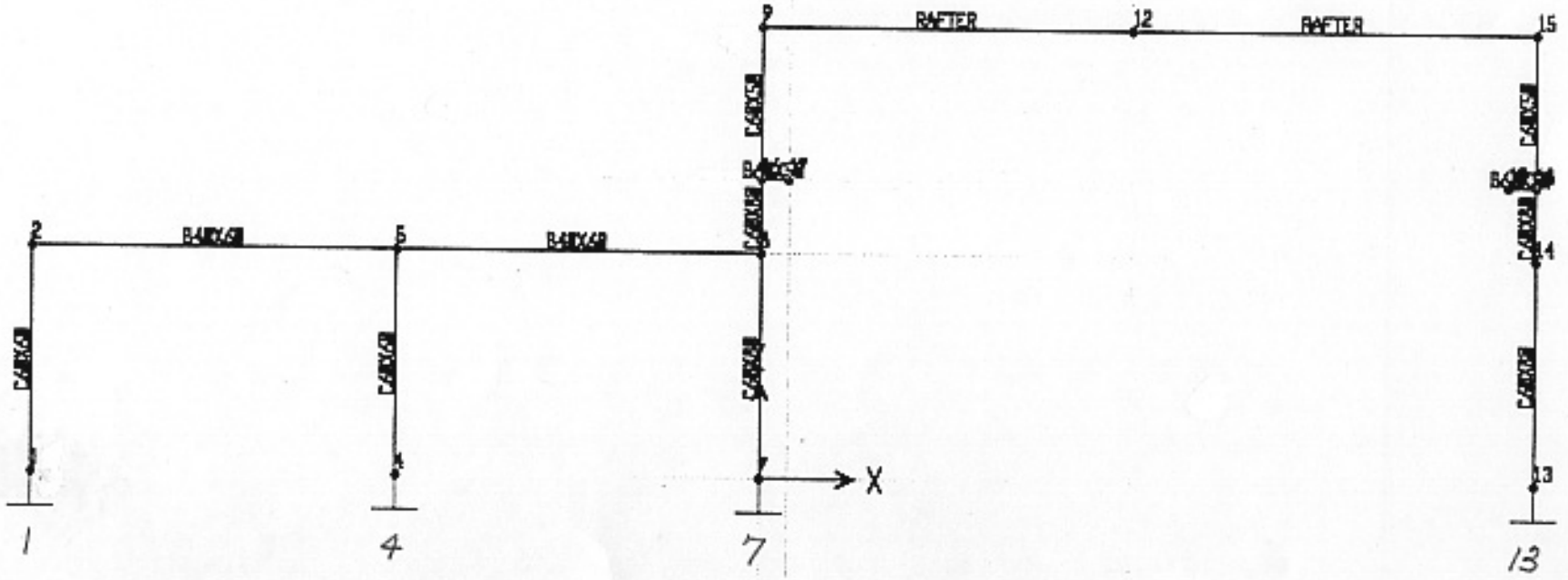
14	0.00	1.80	0.05	Þ6a150/3	39.84	1.11	Þ6a300/3
14	0.00	1.80	0.05	Þ6a150/3	39.84	1.11	Þ6a300/3
14	1.83	1.80	0.05	Þ6a150/3	35.11	0.98	Þ6a300/3
14	1.83	1.80	0.05	Þ6a150/3	35.11	0.98	Þ6a300/3
14	3.65	1.80	0.05	Þ6a150/3	26.48	0.74	Þ6a300/3
14	3.65	1.80	0.05	Þ6a150/3	26.48	0.74	Þ6a300/3
14	5.48	1.80	0.05	Þ6a150/3	14.56	0.40	Þ6a300/3
14	5.48	1.80	0.05	Þ6a150/3	14.56	0.40	Þ6a300/3
14	7.30	1.80	0.05	Þ6a150/3	1.80	0.05	Þ6a300/3
14	7.30	1.80	0.05	Þ6a150/3	1.80	0.05	Þ6a300/3


RAFTER
RAFTER
X
1
4
7
13

SAP2000 v6.11 File: INTERMEDIA Ton-m Units PAGE 1
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L O A D C O M B I N A T I O N M U L T I P L I E R S

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB3	ENVE				COMB3
		COMB1	1.0000	COMBO	
		COMB2	1.0000	COMBO	

SAP2000 v6.11 File: INTERMEDIA Ton-m Units PAGE 2
November 17, 2000 20:21

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	COMB3 MAX	4.8310	0.0000	13.9834	0.0000	8.7400	0.0000
1	COMB3 MIN	-0.2359	0.0000	12.7176	0.0000	-2.0511	0.0000
4	COMB3 MAX	3.0078	0.0000	25.0545	0.0000	6.8528	0.0000
4	COMB3 MIN	-2.4377	0.0000	24.0714	0.0000	-5.2850	0.0000
7	COMB3 MAX	0.4095	0.0000	55.9694	0.0000	8.1583	0.0000
7	COMB3 MIN	-0.7583	0.0000	53.7206	0.0000	-6.1376	0.0000
13	COMB3 MAX	1.6318	0.0000	44.9902	0.0000	10.9478	0.0000
13	COMB3 MIN	-6.4481	0.0000	44.9902	0.0000	-20.6707	0.0000

4-2-24

4.2.3

Generator Room

PROJECT : INTERMEDIATE WASTEWATER PUMPING STATION

ITEM : GENERATOR BUILDING

STRUCTURAL CALCULATION SHEET

STRUCTURAL ANALYSIS ITEMS :

A. MAIN FRAME STRUCTURAL ANALYSIS

B. ATTACHED RESULT SHEETS

STRUCTURAL CALCULATION SHEET

* Project : Intermediate Wastewater Pumping Station

* Item : Generator Building

Part I : CALCULATION OF LOAD

A. DEAD LOAD :

- Roof slab :

No.	Material	Calculation	Applying load(kg/m^2)
1	100 THK R.C slab	2500x0.1	250
2	20mm THK cement mortar	1800x0.02	36
		TOTAL	g^{tc}= 286 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

Part II : STRUCTURAL ANALYSIS PROCESS

- The structure of Generator Building 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 : INTERMEDIATE WASTEWATER PUMPING STATION

ITEM : GENERATOR BUILDING

RESULT SHEETS

DỮ LIỆU BẢN SÀN
SLAB DATA

Công trình — INTERMEDIATE WASTEWATER PUMPING STATION
Project

Hạng mục — GENERATOR
Item

Ký hiệu *Symbol*	Kích thước *Dimension*			Tĩnh tải *Dead load*				Hoạt tải *Live load*	
	l_x	l_y	h	Gạch *Tile*	Vữa trát *Mortar*	Khác *Others*	Tổng *Total*	Tiêu chuẩn *Standard*	Tổng *Total*
	m	m	cm	0/1	cm	kg/m^2	kg/m^2	kg/m^2	kg/m^2
S1	4.00	6.00	10		2		290	75	97.5

BẢNG TÍNH TOÁN SÀN
CALCULATION SHEET OF SLAB

Công trình: INTERMEDIATE WASTEWATER PUMPING STATION
Project

Hạng mục: GENERATOR
Item

Cốt thép
Reinforcement: 2000 kg/cm^2

Ký hiệu *Symbol*	l_1	l_2	h	g	q	Cốt thép tính toán *Calculate Reinf.*				Cốt thép chọn *Selection Reinf.*							
	m	m	cm	kg/m^2	kg/m^2	Fa_1 cm^2	$Fa_{\phi 1}$ cm^2	Fa_2 cm^2	$Fa_{\phi 2}$ cm^2	Fa_1		$Fa_{\phi 1}$		Fa_2		$Fa_{\phi 2}$	
										f	@	f	@	f	@	f	@
1	4.00	9.00	10	290	97.5	2.87	4.18	0.49	0.90	8	180	10	190	8	1030	10	870

BẢNG CHIA TẢI TRỌNG SÀN
DIVIDE SHEET OF SLAB

Công trình: INTERMEDIATE WASTEWATER PUMPING STATION
Project

Hạng mục: GENERATOR
Item

Ký hiệu *Symbol*	Kích thước *Dimension*			Tải trọng *Loadding*				Tĩnh tải *Dead load*		Hoạt tải *Live load*	
	l_1	l_2	$b=l_1/2l_2$	TT *Dead*	HT *Live*	$q_d^{tt}=qxl_1$	$q_d^{ht}=qxl_1$	Ngắn *Short*	Dài *Long*	Ngắn *Short*	Dài *Long*
	m	m		kg/m²	kg/m²	kg/m	kg/m	kg/m	kg/m	kg/m	kg/m
1	4.00	9.00	0.22	290	97.5	1160	390	362.50	529.08	121.88	177.88

BẢNG PHÂN TẢI VÀO DẦM
CALCULATION SHEET FOR FRAME LOAD

Công trình — INTERMEDIATE WASTEWATER PUMPING STATION
Project

Hạng mục — GENERATOR
Item

FRAME AXIS 2

Chỉ số PT *Frame ID*	Ô bản 1 *1st Slab*		Ô bản 2 *2nd Slab*		Tĩnh tải *Dead load*		Hoạt tải *Live load*
	Dài *Long*	Ngắn *Short*	Dài *Long*	Ngắn *Short*	Tường *Wall*	(kg/m)	(kg/m)
3	1		1		1350	2871.67	355.76
4					1350	1350.00	0.00
5					1350	1350.00	0.00

ROOF BEAM DM1

Chỉ số PT *Frame ID*	Ô bản 1 *1st Slab*		Ô bản 2 *2nd Slab*		Tĩnh tải *Dead load*		Hoạt tải *Live load*
	Dài *Long*	Ngắn *Short*	Dài *Long*	Ngắn *Short*	Tường *Wall*	(kg/m)	(kg/m)
1		1				350.00	121.22
2		1				350.00	75.88

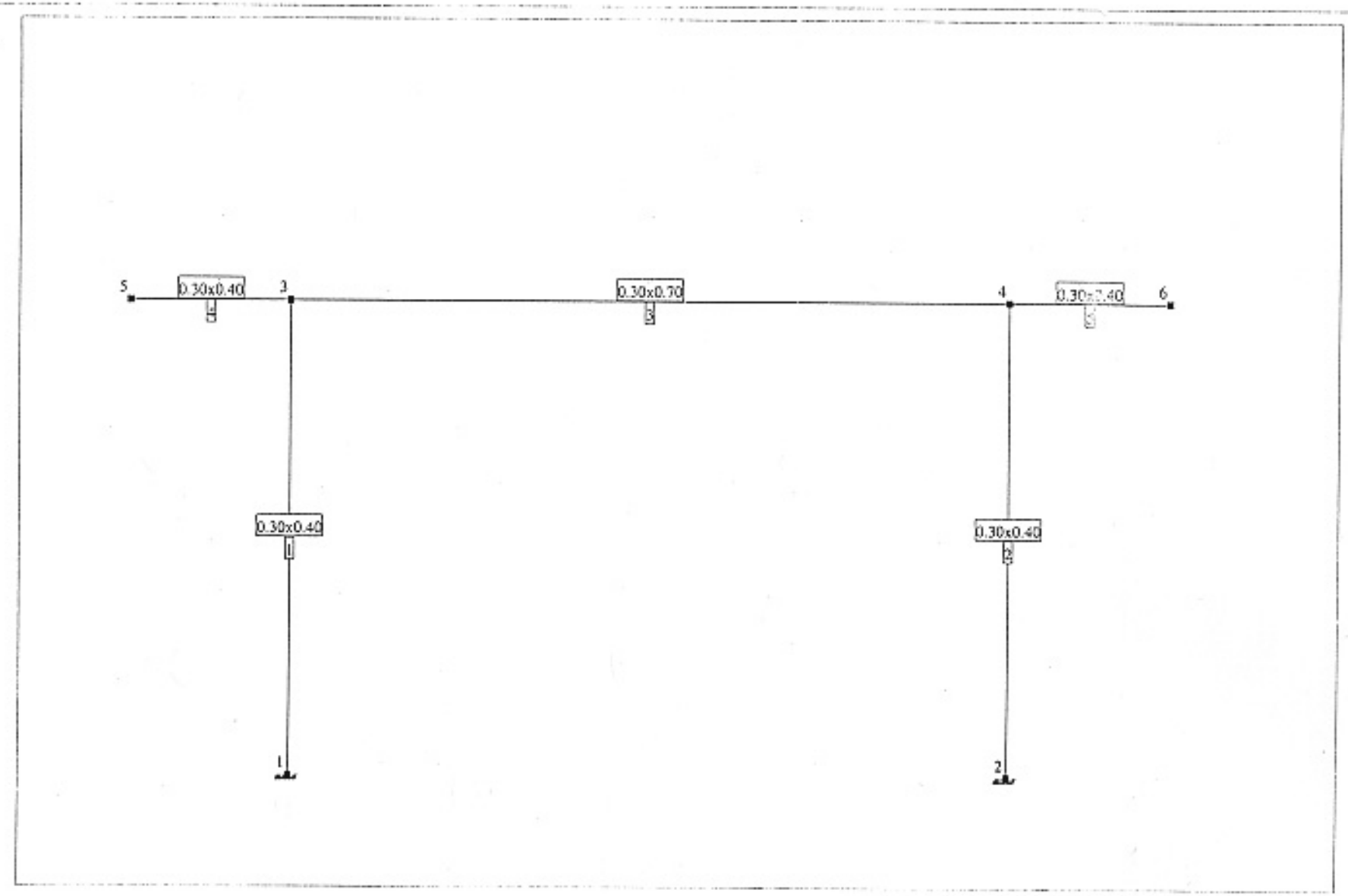
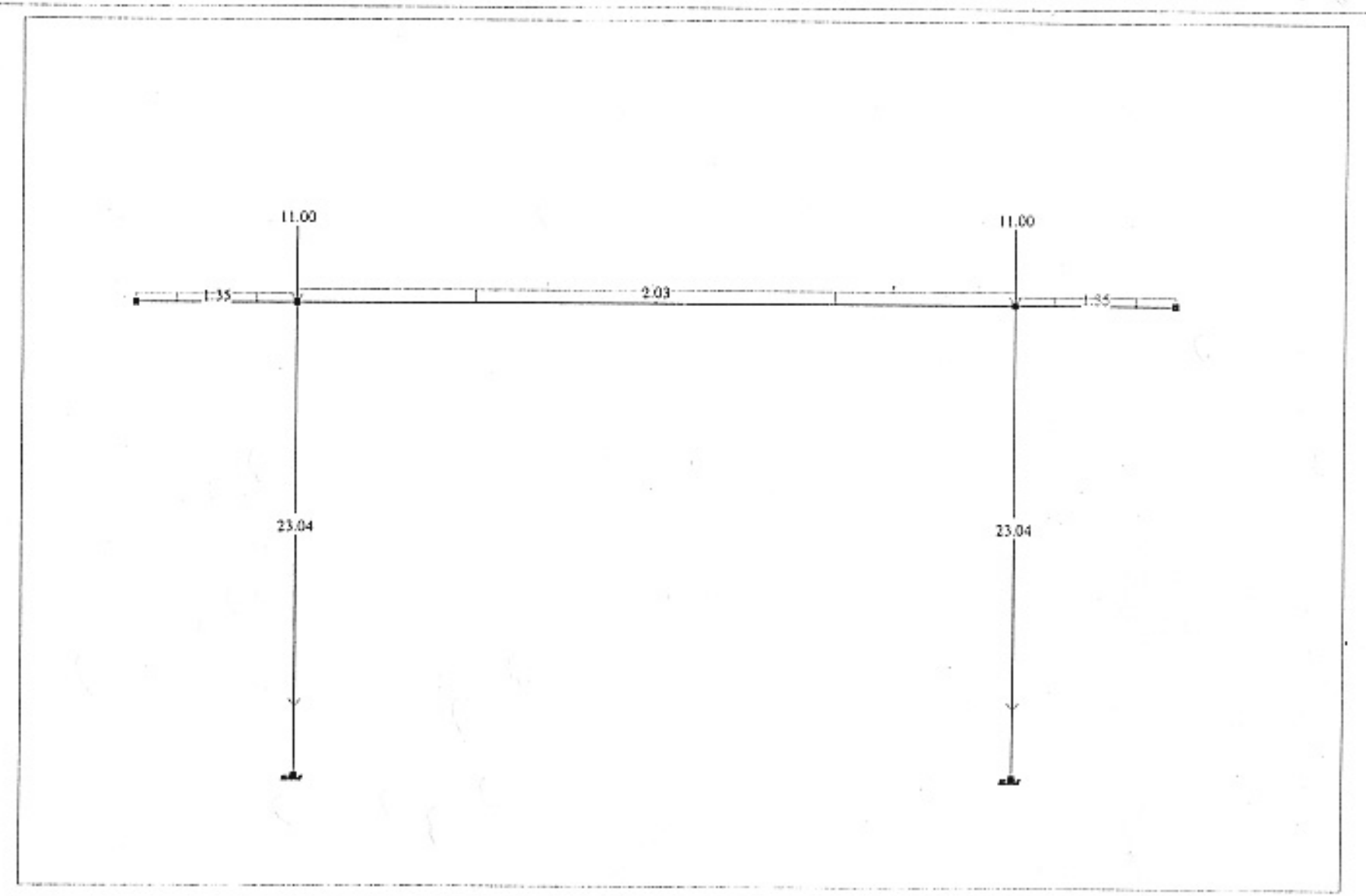
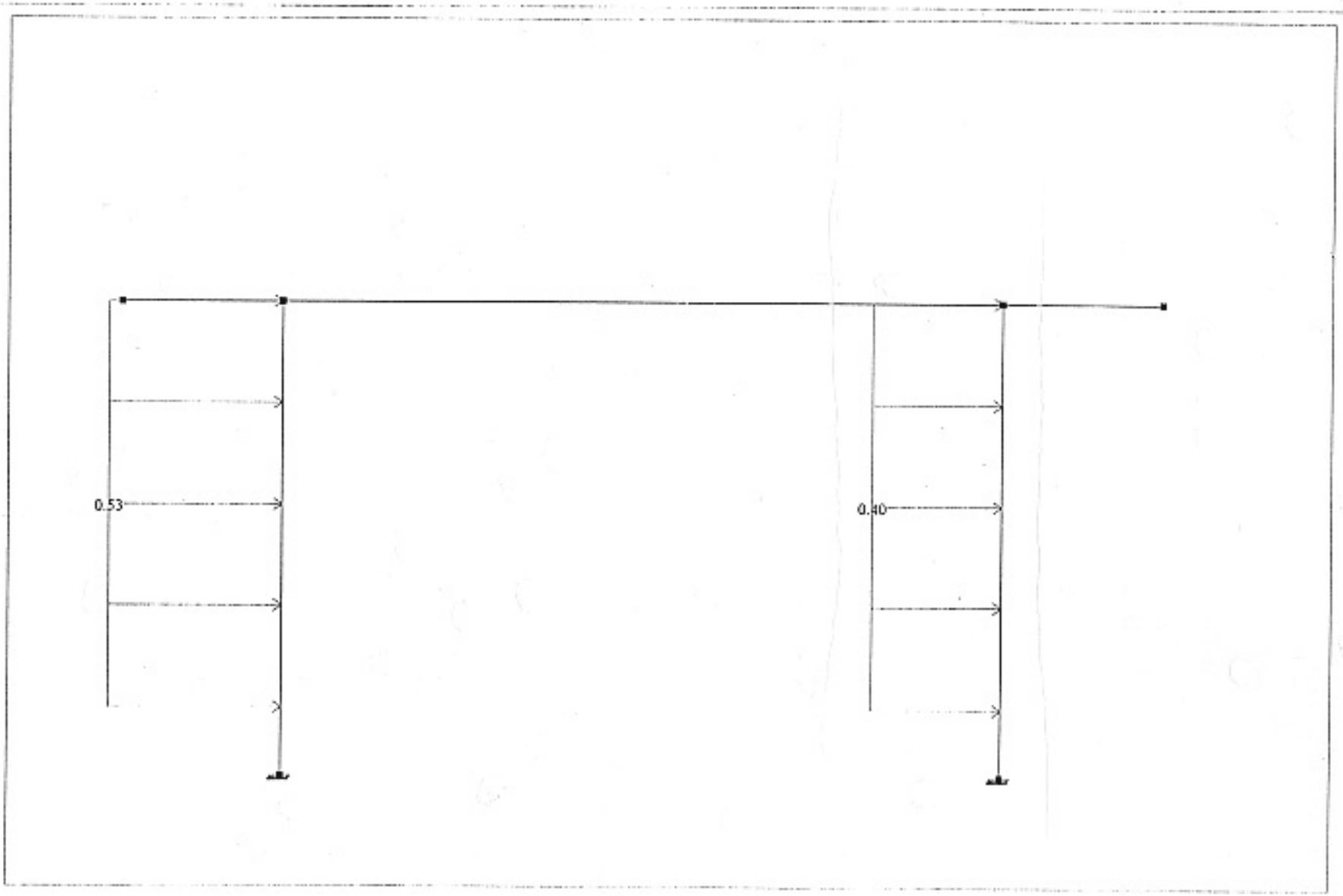


DIAGRAM OF SECTION



LOADDING FOR LOAD CASE 1



LOADDING FOR LOAD CASE 2

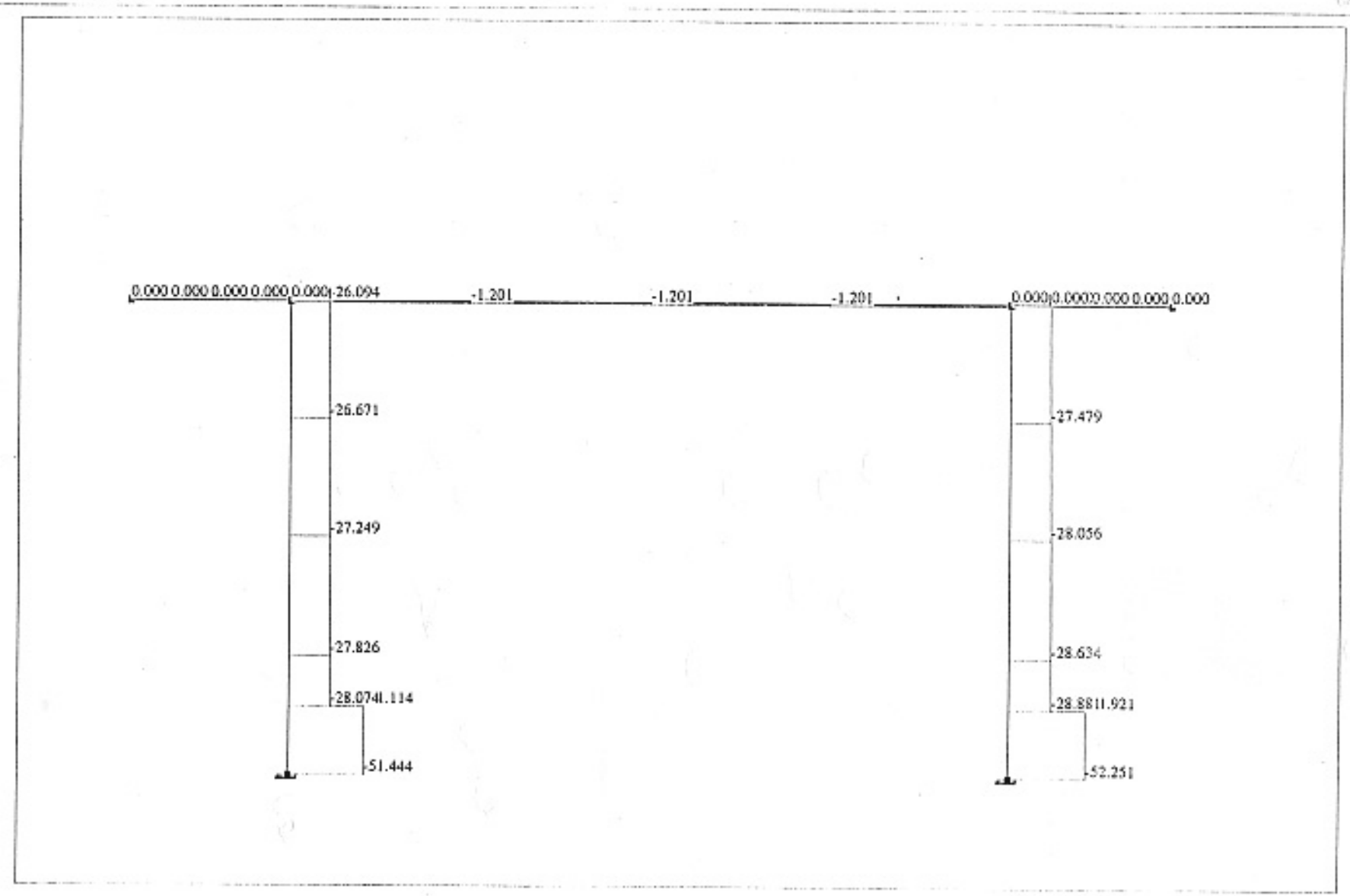


DIAGRAM OF MIN-MAX AXIAL

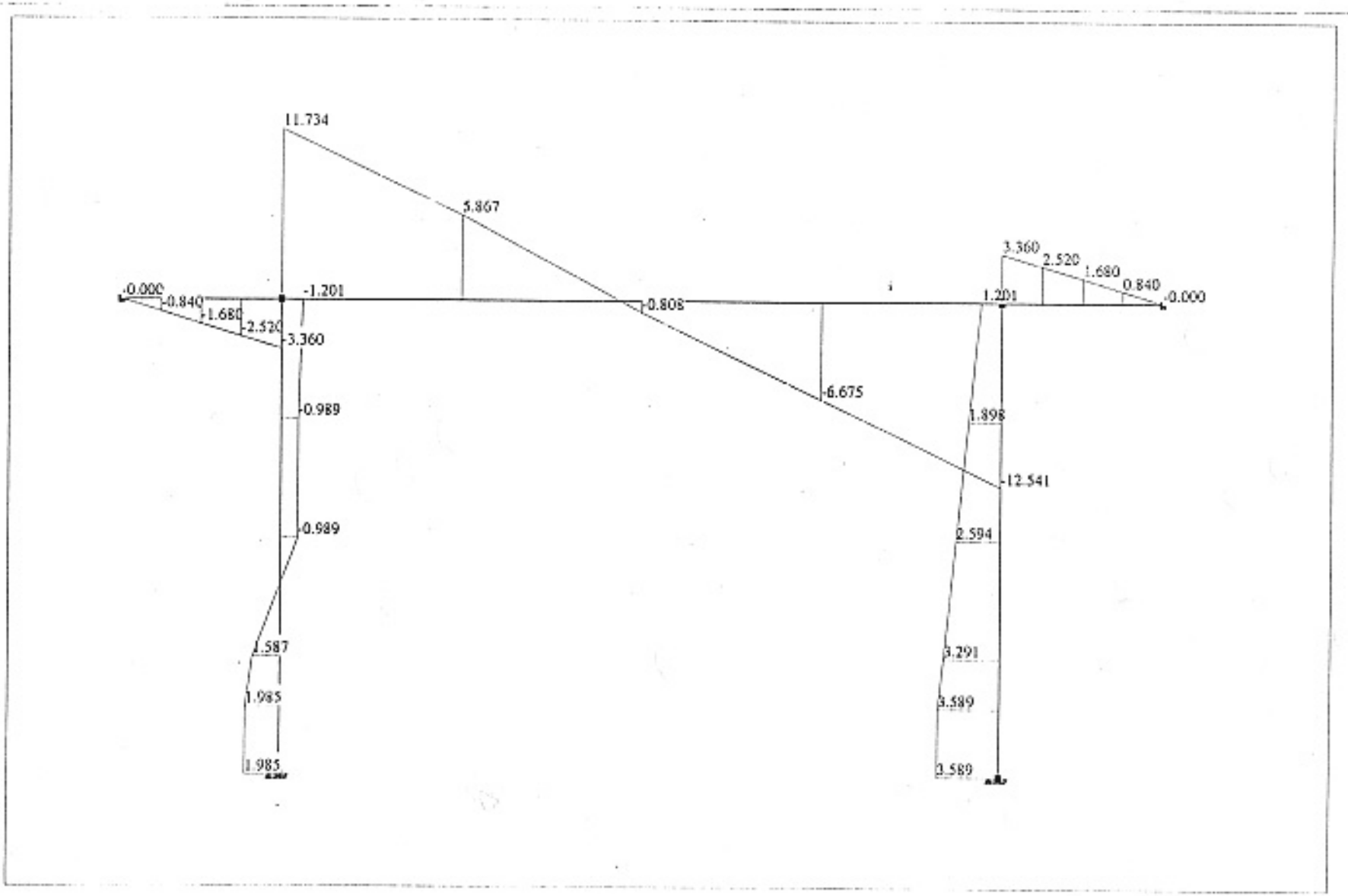


DIAGRAM OF MIN-MAX SHEAR ON 2-AXIS

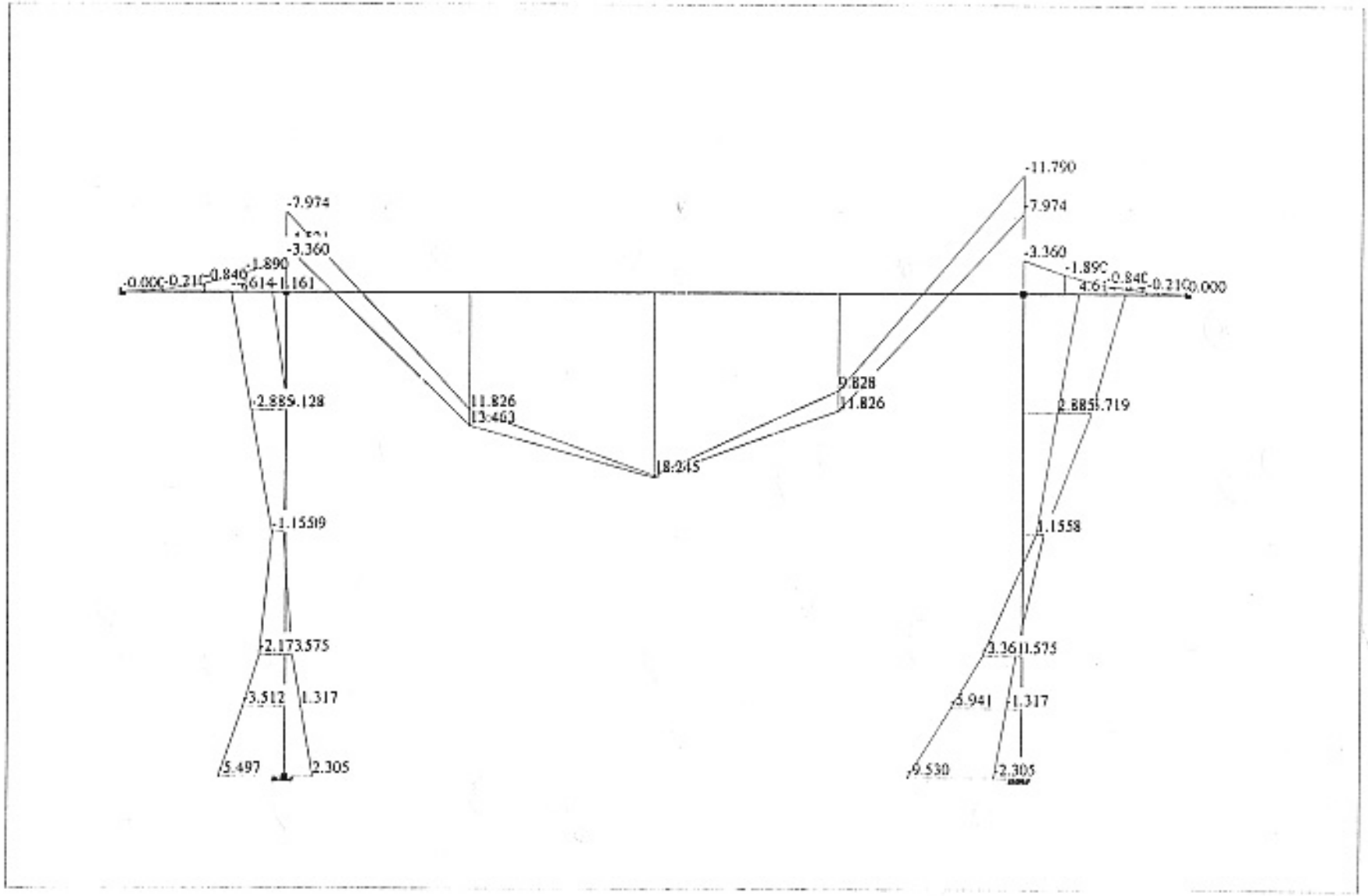


DIAGRAM OF MIN-MAX BENDING MOMENT 3-AXIS

COMBINATION FOR 3-AXIS STRESSES

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
1	0.00	2.305	-51.444	-5.497	-50.636	2.305	-51.444	1.985
1	1.00	1.317	-51.114	-3.512	-50.306	1.317	-51.114	1.985
1	1.00	1.317	-28.074	-3.512	-27.266	1.317	-28.074	1.985
1	1.75	0.575	-27.826	-2.173	-27.019	0.575	-27.826	1.587
1	3.50	-0.209	-26.441	-1.155	-27.249	-1.155	-27.249	0.989
1	5.25	0.128	-25.864	-2.885	-26.671	-2.885	-26.671	0.989
1	7.00	-1.161	-25.286	-4.614	-26.094	-4.614	-26.094	1.201
2	0.00	-2.305	-51.444	-9.530	-52.251	-9.530	-52.251	3.589
2	1.00	-1.317	-51.114	-5.941	-51.921	-5.941	-51.921	3.589
2	1.00	-1.317	-28.074	-5.941	-28.881	-5.941	-28.881	3.589
2	1.75	-0.575	-27.826	-3.361	-28.634	-3.361	-28.634	3.291
2	3.50	1.788	-28.056	1.155	-27.249	1.788	-28.056	2.594
2	5.25	5.719	-27.479	2.885	-26.671	5.719	-27.479	1.898
2	7.00	8.430	-26.901	4.614	-26.094	8.430	-26.901	1.201
3	0.00	-4.521	-1.201	-7.974	-0.989	-4.521	-1.201	1.734
3	2.25	13.463	-1.201	11.826	-0.989	13.463	-1.201	3.867
3	4.50	18.426	-0.989	18.245	-1.201	18.245	-1.201	3.808
3	6.75	11.826	-0.989	9.828	-1.201	9.828	-1.201	3.675
3	9.00	-7.974	-0.989	-11.790	-1.201	-11.790	-1.201	2.541
4	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.50	-0.210	0.000	-0.210	0.000	-0.210	0.000	0.840

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
4	1.00	-0.840	0.000	-0.840	0.000	-0.840	0.000	-1.680
4	1.50	-1.890	0.000	-1.890	0.000	-1.890	0.000	-2.520
4	2.00	-3.360	0.000	-3.360	0.000	-3.360	0.000	-3.360
5	0.00	-3.360	0.000	-3.360	0.000	-3.360	0.000	3.360
5	0.50	-1.890	0.000	-1.890	0.000	-1.890	0.000	2.520
5	1.00	-0.840	0.000	-0.840	0.000	-0.840	0.000	1.680
5	1.50	-0.210	0.000	-0.210	0.000	-0.210	0.000	0.840
5	2.00	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	2.160	0.400	CHECKOK
1	1.00	0.000	0.000	OUTPLANE	2.160	0.400	CHECKOK
1	1.00	0.000	0.000	OUTPLANE	2.160	0.400	CHECKOK
1	1.75	0.000	0.000	OUTPLANE	2.160	0.400	CHECKOK
1	3.50	0.000	0.000	OUTPLANE	2.160	0.400	CHECKOK
1	5.25	0.000	0.000	OUTPLANE	2.160	0.400	CHECKOK
1	7.00	0.000	0.000	OUTPLANE	2.991	0.554	CHECKOK
2	0.00	0.000	0.000	OUTPLANE	-14.091	1.305	Ø6a150/2
2	1.00	0.000	0.000	OUTPLANE	-8.384	0.776	Ø6a150/2
2	1.00	0.000	0.000	OUTPLANE	-8.384	0.776	Ø6a150/2
2	1.75	0.000	0.000	OUTPLANE	-4.604	0.426	Ø6a150/2
2	3.50	0.000	0.000	OUTPLANE	2.409	0.223	Ø6a150/2
2	5.25	0.000	0.000	OUTPLANE	8.049	0.745	Ø6a150/2
2	7.00	0.000	0.000	OUTPLANE	12.278	1.137	Ø6a150/2
3	0.00	0.000	0.000	OUTPLANE	-6.191	0.328	Ø6a230/2
3	2.25	0.000	0.000	OUTPLANE	10.662	0.564	Ø6a230/2
3	4.50	0.000	0.000	OUTPLANE	14.873	0.787	Ø6a230/2
3	6.75	0.000	0.000	OUTPLANE	9.309	0.493	Ø6a230/2
3	9.00	0.000	0.000	OUTPLANE	-9.280	0.491	Ø6a230/2
4	0.00	0.000	0.000	OUTPLANE	-0.540	0.050	Ø6a150/2
4	0.50	0.000	0.000	OUTPLANE	-0.540	0.050	Ø6a150/2

Element ID	Section	Fa2(cm2)	muy	Stirrup	Fa3(cm2)	muy	Stirrup
4	1.00	0.000	0.000	OUTPLANE	-1.121	0.104	Ø6a150/2
4	1.50	0.000	0.000	OUTPLANE	-2.549	0.236	Ø6a150/2
4	2.00	0.000	0.000	OUTPLANE	-4.603	0.426	Ø6a150/2
5	0.00	0.000	0.000	OUTPLANE	-4.603	0.426	Ø6a150/2
5	0.50	0.000	0.000	OUTPLANE	-2.549	0.236	Ø6a150/2
5	1.00	0.000	0.000	OUTPLANE	-1.121	0.104	Ø6a150/2
5	1.50	0.000	0.000	OUTPLANE	-0.540	0.050	Ø6a150/2
5	2.00	0.000	0.000	OUTPLANE	0.540	0.050	Ø6a150/2

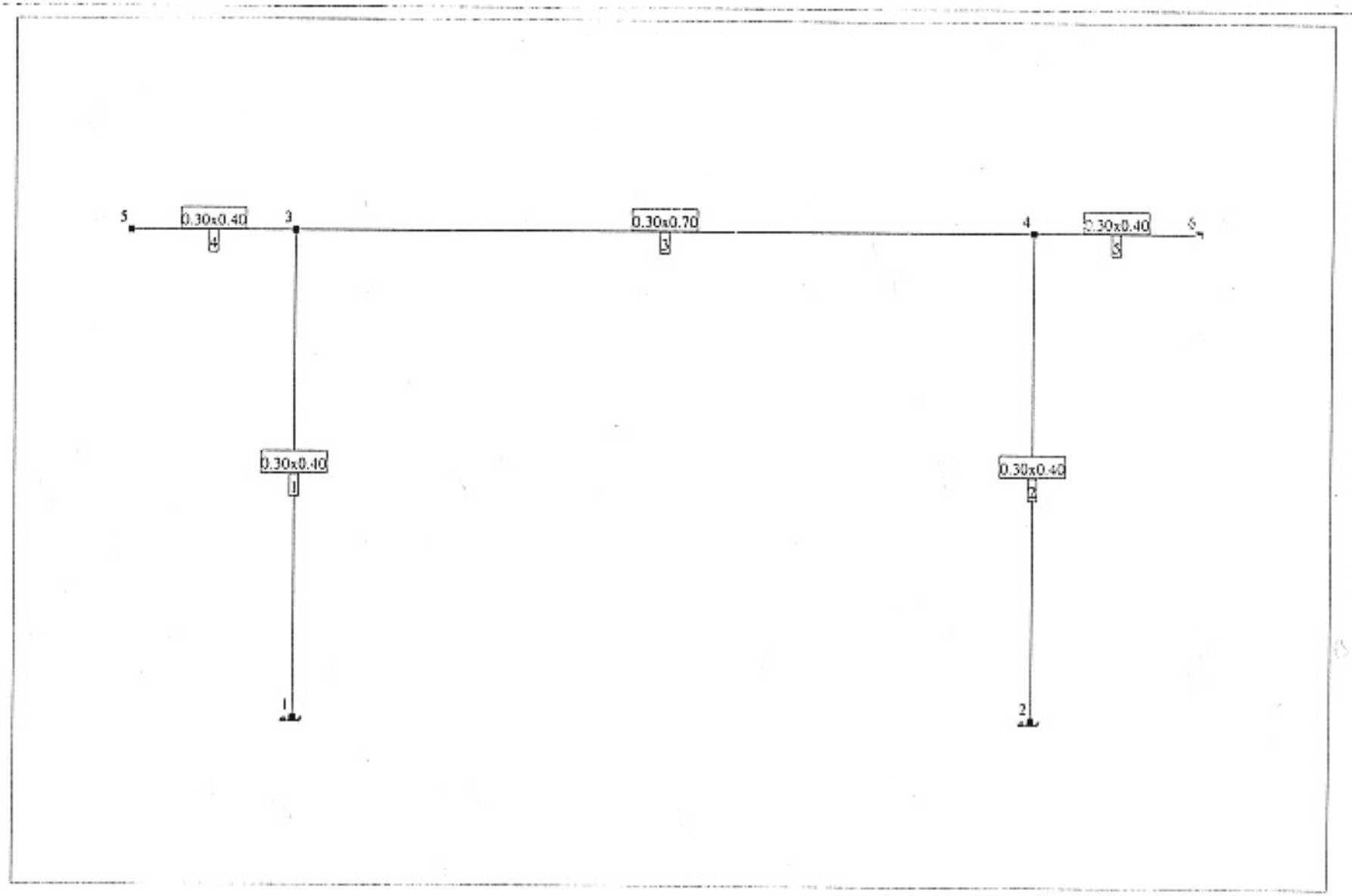
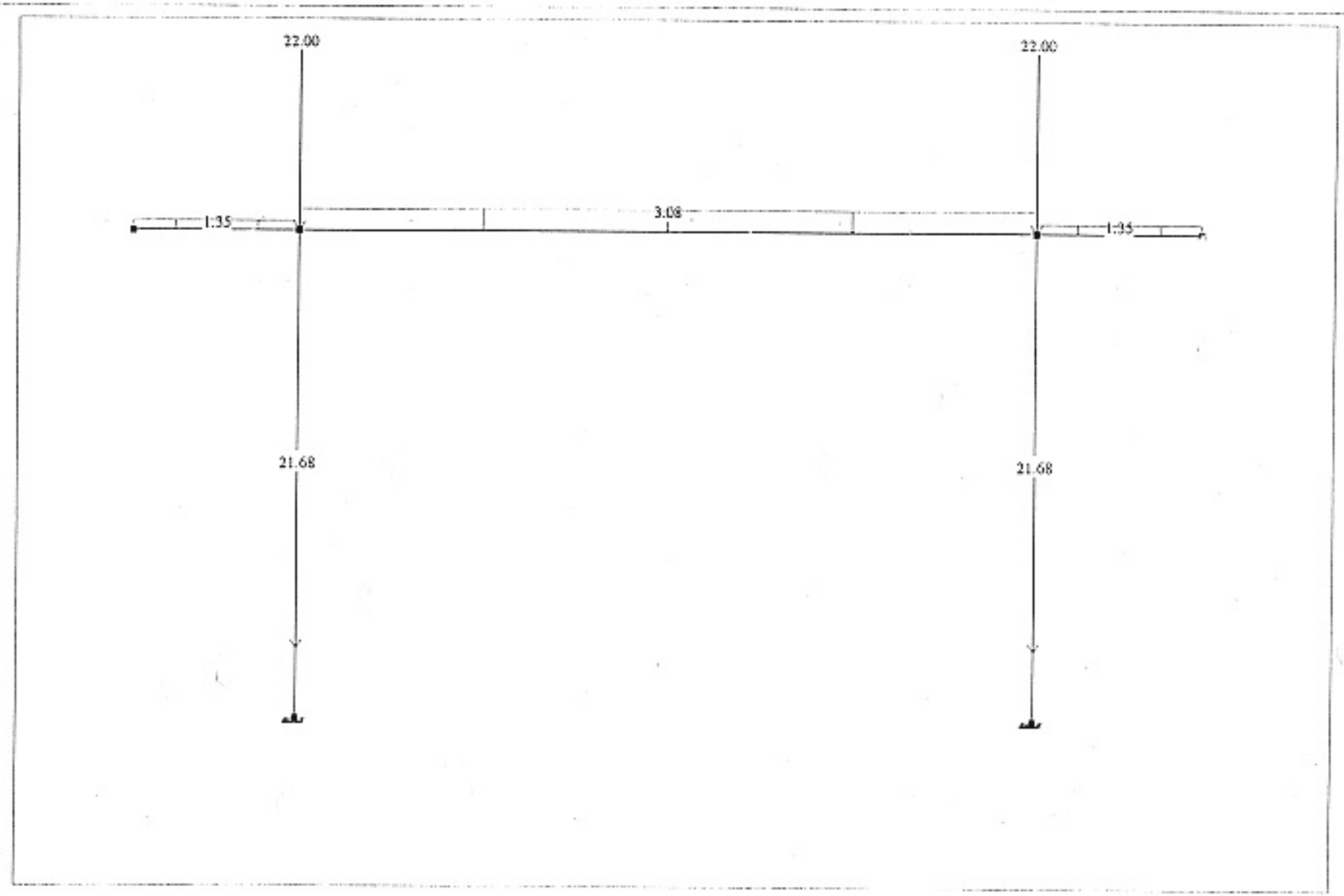
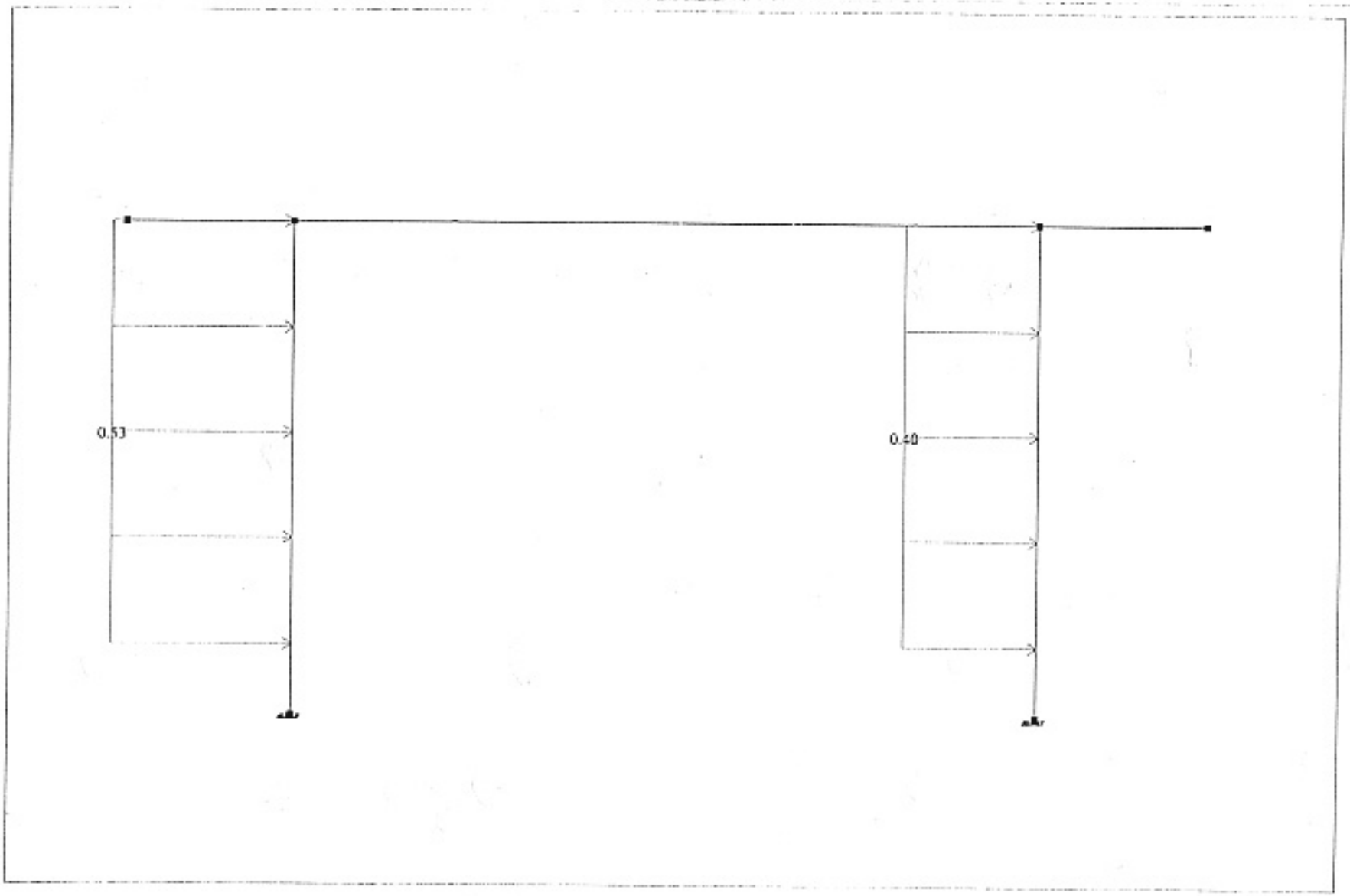


DIAGRAM OF SECTION



LOADDING FOR LOAD CASE 1



LOADDING FOR LOAD CASE 2

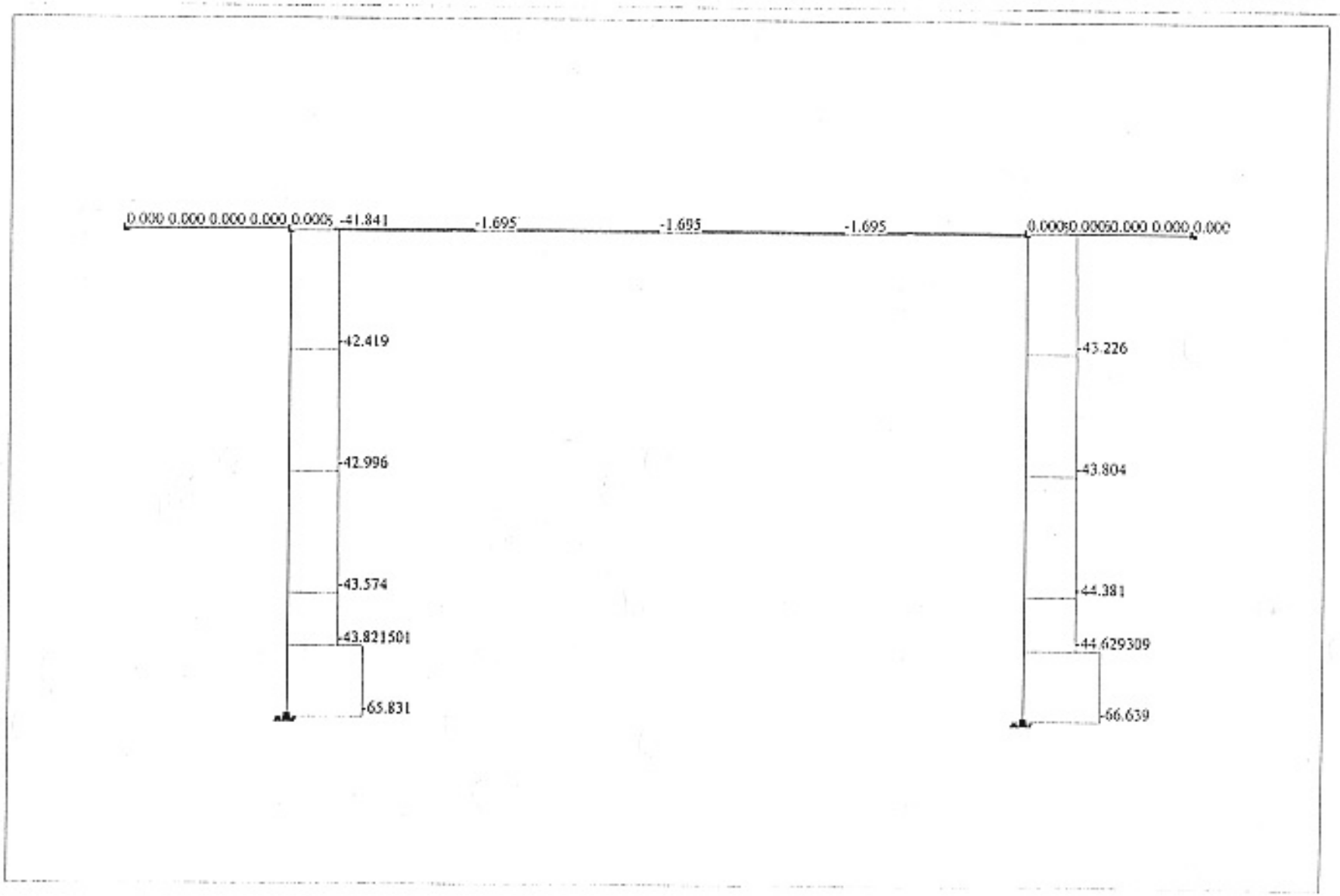


DIAGRAM OF MIN-MAX AXIAL

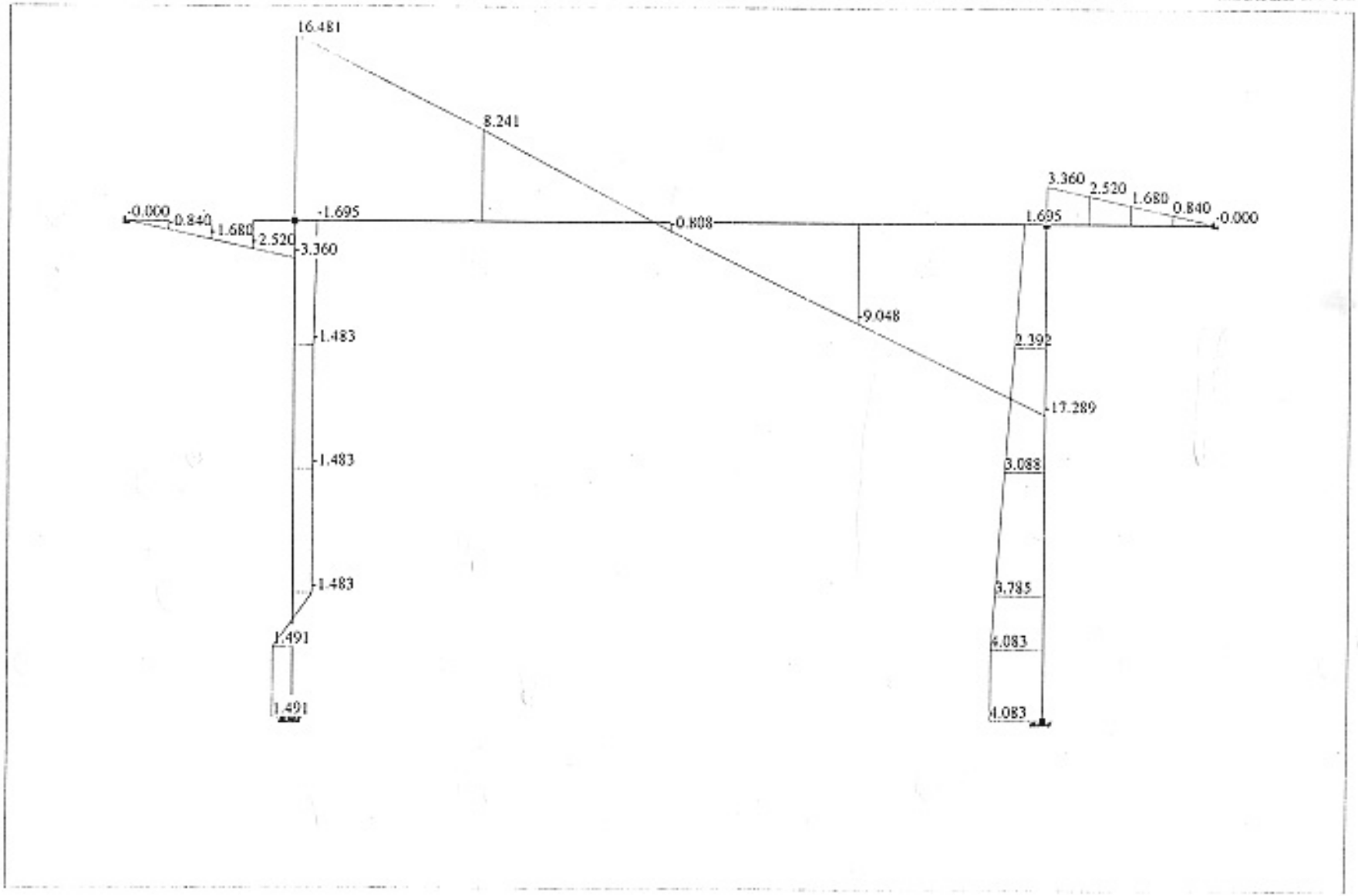


DIAGRAM OF MIN-MAX SHEAR ON 2-AXIS

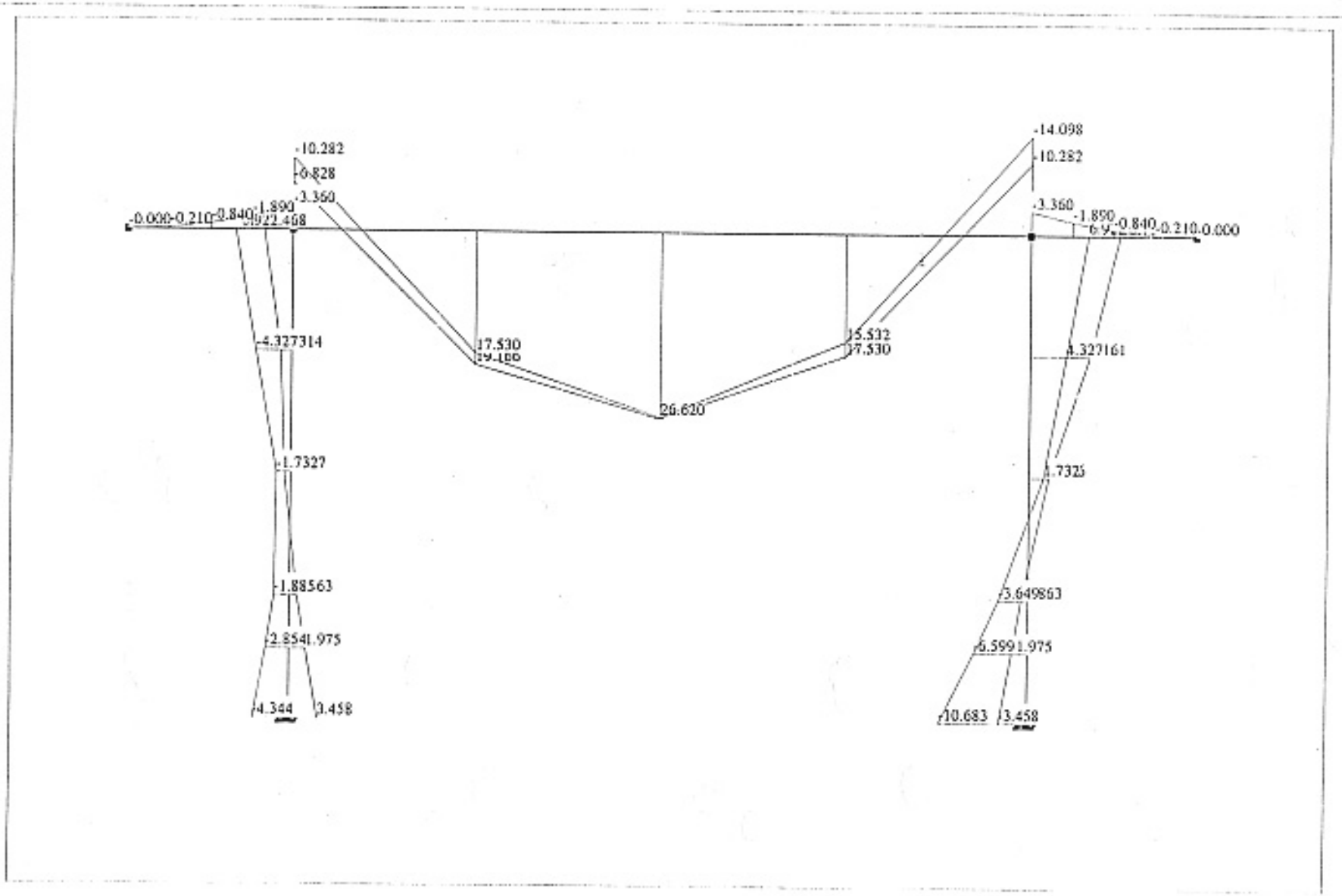


DIAGRAM OF MIN-MAX BENDING MOMENT 3-AXIS

Element ID	Section	Mmax	Nsync	Mmin	Nsync	Msync	Nmax	Qmax
4	1.00	-0.840	0.000	-0.840	0.000	-0.840	0.000	-1.680
4	1.50	-1.890	0.000	-1.890	0.000	-1.890	0.000	-2.520
4	2.00	-3.360	0.000	-3.360	0.000	-3.360	0.000	-3.360
5	0.00	-3.360	0.000	-3.360	0.000	-3.360	0.000	3.360
5	0.50	-1.890	0.000	-1.890	0.000	-1.890	0.000	2.520
5	1.00	-0.840	0.000	-0.840	0.000	-0.840	0.000	1.680
5	1.50	-0.210	0.000	-0.210	0.000	-0.210	0.000	0.840
5	2.00	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	8.926	2.204	CHECKOK
1	1.05	0.000	0.000	OUTPLANE	6.183	1.527	CHECKOK
1	2.10	0.000	0.000	OUTPLANE	1.761	0.435	CHECKOK
1	3.15	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
1	4.20	0.000	0.000	OUTPLANE	2.199	0.543	CHECKOK
1	5.25	0.000	0.000	OUTPLANE	2.944	0.727	CHECKOK
1	6.30	0.000	0.000	OUTPLANE	2.525	0.623	CHECKOK
2	0.00	0.000	0.000	OUTPLANE	10.548	2.604	CHECKOK
2	1.05	0.000	0.000	OUTPLANE	7.190	1.775	CHECKOK
2	2.10	0.000	0.000	OUTPLANE	2.056	0.508	CHECKOK
2	3.15	0.000	0.000	OUTPLANE	1.620	0.400	CHECKOK
2	4.20	0.000	0.000	OUTPLANE	4.254	1.050	CHECKOK
2	5.25	0.000	0.000	OUTPLANE	6.661	1.645	CHECKOK
2	6.30	0.000	0.000	OUTPLANE	8.298	2.049	CHECKOK
3	0.00	0.000	0.000	OUTPLANE	1.399	0.130	Ø6a200/2
3	1.50	0.000	0.000	OUTPLANE	3.230	0.299	Ø6a200/2
3	3.00	0.000	0.000	OUTPLANE	3.987	0.369	Ø6a200/2
3	4.50	0.000	0.000	OUTPLANE	3.750	0.347	Ø6a200/2
3	6.00	0.000	0.000	OUTPLANE	3.187	0.295	Ø6a200/2
3	7.50	0.000	0.000	OUTPLANE	1.540	0.143	Ø6a200/2
3	9.00	0.000	0.000	OUTPLANE	-3.979	0.368	Ø6a200/2

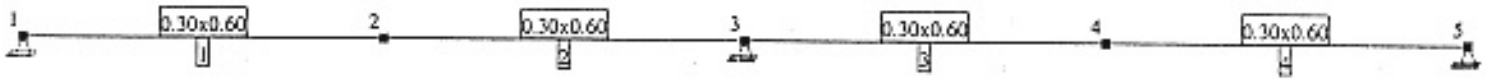
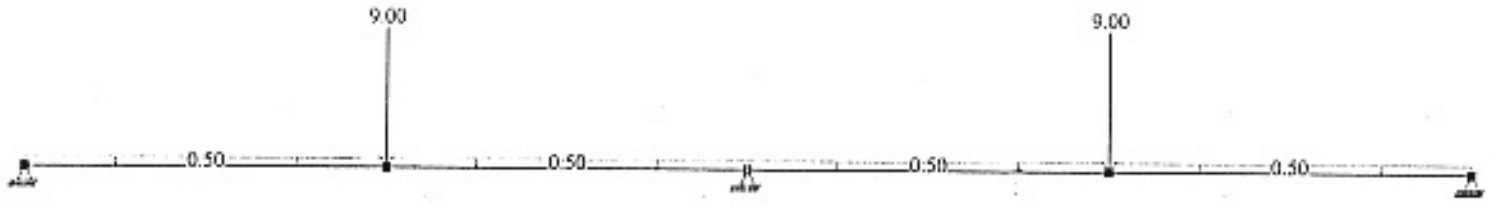


DIAGRAM OF SECTION



LOADDING FOR LOAD CASE 1

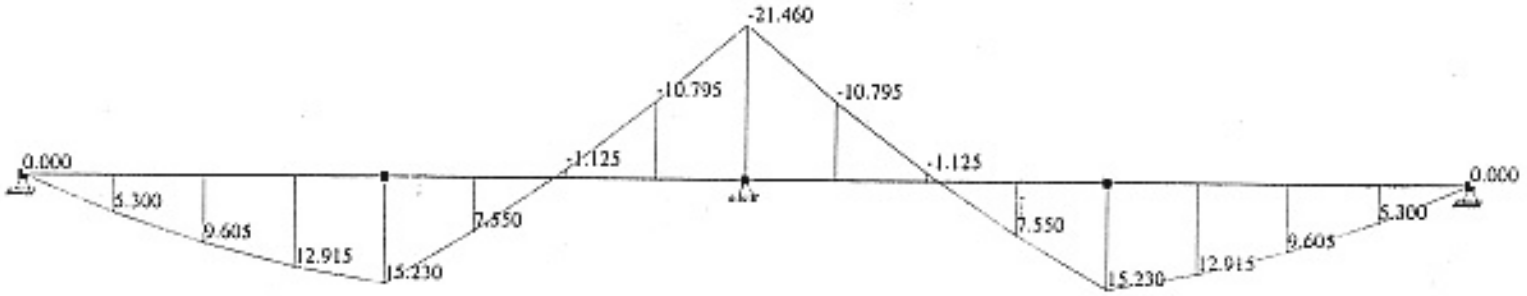


DIAGRAM OF BENDING MOMENT 3-AXIS LOAD CASE 1

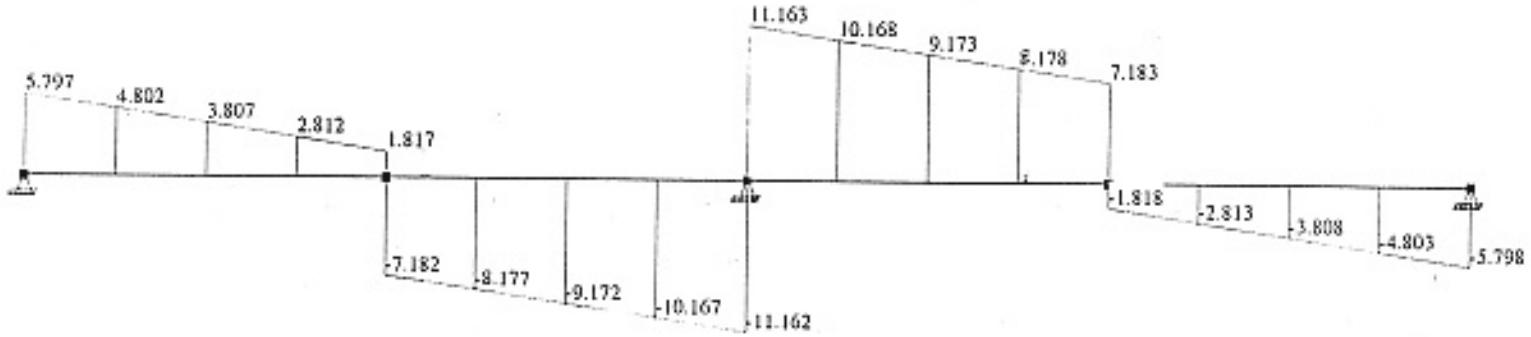


DIAGRAM OF SHEAR ON 2-AXIS LOAD CASE 1

STRETCH FOR LOAD CASE 1

Element ID	Section	Axial	Shear 2	Shear 3	Torsion	Moment 2	Moment 3
1	0.00	0.000	5.797	0.000	0.000	0.000	0.000
1	1.00	0.000	4.802	0.000	0.000	0.000	5.300
1	2.00	0.000	3.807	0.000	0.000	0.000	9.600
1	3.00	0.000	2.812	0.000	0.000	0.000	12.915
1	4.00	0.000	1.817	0.000	0.000	0.000	15.250
2	0.00	0.000	-7.182	0.000	0.000	0.000	15.250
2	1.00	0.000	-8.177	0.000	0.000	0.000	7.550
2	2.00	0.000	-9.172	0.000	0.000	0.000	-1.125
2	3.00	0.000	-10.167	0.000	0.000	0.000	-10.795
2	4.00	0.000	-11.162	0.000	0.000	0.000	-21.460
3	0.00	0.000	11.163	0.000	0.000	0.000	-21.460
3	1.00	0.000	10.168	0.000	0.000	0.000	-10.795
3	2.00	0.000	9.173	0.000	0.000	0.000	-1.125
3	3.00	0.000	8.178	0.000	0.000	0.000	7.550
3	4.00	0.000	7.183	0.000	0.000	0.000	15.250
4	0.00	0.000	-1.818	0.000	0.000	0.000	15.250
4	1.00	0.000	-2.813	0.000	0.000	0.000	12.915
4	2.00	0.000	-3.808	0.000	0.000	0.000	9.600
4	3.00	0.000	-4.803	0.000	0.000	0.000	5.300
4	4.00	0.000	-5.798	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	0.810	0.050	Ø6a200/2
1	1.00	0.000	0.000	OUTPLANE	4.788	0.296	Ø6a200/2
1	2.00	0.000	0.000	OUTPLANE	8.862	0.547	Ø6a200/2
1	3.00	0.000	0.000	OUTPLANE	12.121	0.748	Ø6a200/2
1	4.00	0.000	0.000	OUTPLANE	14.475	0.894	Ø6a200/2
2	0.00	0.000	0.000	OUTPLANE	14.475	0.894	Ø6a200/2
2	1.00	0.000	0.000	OUTPLANE	6.895	0.426	Ø6a200/2
2	2.00	0.000	0.000	OUTPLANE	-0.997	0.062	Ø6a200/2
2	3.00	0.000	0.000	OUTPLANE	-10.020	0.619	Ø6a200/2
2	4.00	0.000	0.000	OUTPLANE	-21.156	1.306	Ø6a200/2
3	0.00	0.000	0.000	OUTPLANE	-21.156	1.306	Ø6a200/2
3	1.00	0.000	0.000	OUTPLANE	-10.020	0.619	Ø6a200/2
3	2.00	0.000	0.000	OUTPLANE	-0.997	0.062	Ø6a200/2
3	3.00	0.000	0.000	OUTPLANE	6.895	0.426	Ø6a200/2
3	4.00	0.000	0.000	OUTPLANE	14.475	0.894	Ø6a200/2
4	0.00	0.000	0.000	OUTPLANE	14.475	0.894	Ø6a200/2
4	1.00	0.000	0.000	OUTPLANE	12.121	0.748	Ø6a200/2
4	2.00	0.000	0.000	OUTPLANE	8.862	0.547	Ø6a200/2
4	3.00	0.000	0.000	OUTPLANE	4.788	0.296	Ø6a200/2
4	4.00	0.000	0.000	OUTPLANE	0.810	0.050	Ø6a200/2

PROJECT : INTERMEDIATE WASTEWATER PUMPING STATION
ITEM : GENERATOR BUILDING

CALCULATION OF BAND FOUNDATION M1 (1.800 x 18.000)

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 =		(Tm)	
Calculated axial force	Ntt =	118.60	(T)	
Calculated shear force	Qtt =		(T)	
Standard moment at foundation bottom	ΣMtc =	0.00	(Tm)	
Standard axial force at foundation bottom	ΣNtc =	195.15	(T)	
Eccentricity	e_o =	0.000	(m)	e_o = ΣM/ΣN
Preliminary area of foundation bottom	Fm =	21.66	(m2)	F≥ Ntc/(Rtc-γ*hd)
Ration between foundation length & width	a/b =	1.50		
Preliminary width of foundation	bm =	3.80	(m)	
Chosen width of foundation	Bm =	1.80	(m)	
Chosen length of foundation	Am =	18.00	(m)	
Length of column cross section	ac =	0.40	(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 =	6.02	(T/m2)	≤	Rtc= 9.00 (T/m2) → O.K
Minimum pressure of foundation bottom	σ min =	6.02	(T/m2)		
Maximum pressure of foundation bottom	σ max =	6.02	(T/m2)	≤	1.2Rtc= 10.80 (T/m2) → O.K

5. Reinforcement calculation of slab foundation:

Moment (at short side of foundation)	Ma =	1.70	(Tm)	
Rein. section (at short side of foundation)	Fa =	2.69	(cm2)	Chosen 2.6 Ø 12 @690

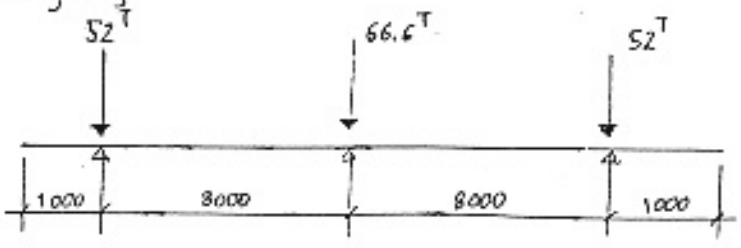
BANG KET QUA TINH TOAN
KriCom Software Version 1.2

PACKAGE C - GENERATOR ROOM
FOUNDATION M1

Momen quan tinh = 1.140E-02
Be rong = 1.800E+00
He so nen = 4.000E+02
Modul dan hoi = 2.400E+06

Hoanh do	Do vong	Luc cat	Momen
0.000	2.663E-02	1.918E-04	9.588E-10
0.100	2.618E-02	1.901E+00	9.533E-02
0.200	2.572E-02	3.769E+00	3.791E-01
0.300	2.526E-02	5.605E+00	8.481E-01
0.400	2.480E-02	7.407E+00	1.499E+00
0.500	2.434E-02	9.176E+00	2.328E+00
0.600	2.388E-02	1.091E+01	3.333E+00
0.700	2.342E-02	1.261E+01	4.510E+00
0.800	2.296E-02	1.428E+01	5.855E+00
0.900	2.249E-02	1.592E+01	7.365E+00
1.000	2.202E-02	1.752E+01	9.038E+00
1.000	2.202E-02	-3.448E+01	9.037E+00
1.800	1.826E-02	-2.288E+01	-1.376E+01
2.600	1.481E-02	-1.338E+01	-2.813E+01
3.400	1.199E-02	-5.697E+00	-3.565E+01
4.200	1.001E-02	5.975E-01	-3.761E+01
5.000	8.887E-03	5.997E+00	-3.493E+01
5.800	8.578E-03	1.099E+01	-2.813E+01
6.600	8.920E-03	1.600E+01	-1.734E+01
7.400	9.659E-03	2.134E+01	-2.430E+00
8.200	1.045E-02	2.714E+01	1.693E+01
9.000	1.083E-02	3.330E+01	4.110E+01
9.000	1.083E-02	-3.330E+01	4.109E+01
9.800	1.045E-02	-2.714E+01	1.693E+01
10.600	9.659E-03	-2.134E+01	-2.430E+00
11.400	8.920E-03	-1.600E+01	-1.734E+01
12.200	8.578E-03	-1.099E+01	-2.813E+01
13.000	8.887E-03	-5.997E+00	-3.493E+01
13.800	1.001E-02	-5.975E-01	-3.761E+01
14.600	1.199E-02	5.697E+00	-3.565E+01
15.400	1.481E-02	1.338E+01	-2.813E+01
16.200	1.826E-02	2.288E+01	-1.376E+01
17.000	2.202E-02	3.448E+01	9.038E+00
17.000	2.202E-02	-1.752E+01	9.038E+00
17.100	2.249E-02	-1.592E+01	7.365E+00
17.200	2.296E-02	-1.428E+01	5.855E+00
17.300	2.342E-02	-1.261E+01	4.510E+00
17.400	2.388E-02	-1.091E+01	3.333E+00
17.500	2.434E-02	-9.176E+00	2.328E+00
17.600	2.480E-02	-7.407E+00	1.499E+00
17.700	2.526E-02	-5.604E+00	8.481E-01
17.800	2.572E-02	-3.769E+00	3.791E-01
17.900	2.618E-02	-1.901E+00	9.533E-02
18.000	2.663E-02	0.000E+00	0.000E+00

Sơ đồ tính dầm móng băng



4.3

Mechanical Equipment

DETERMINATION OF PUMP RATING

(66.7m3/min for Phase 1)

PROJECT : Ho Chi Minh City Water Environment Improvement Project

1. BASIC CONDITIONS

1-1) Main Pump

1) Pump service	:	Sewage water	
2) Pump type	:	Submersible motor mixed flow pump	
3) Number of installed pumps	:	3	sets
4) Number of operating pumps (N)	:	2	sets
5) Total capacity of water (Q)	:	133.30	m3/min

1-2) Water levels

1) Design suction water level (SWL)	:	-12.406	m
	Say	-12.400	m

$SWL = IWL - Hf1 - Hf2$

IWL: Design inlet chamber water level	:	-12.243	m

Hf1: Inlet chamber loss

$Hf1 = v^2 \times n^2 / R^{4/3} \times L$: 0.143

v: Velocity in inlet chamber	:	2.93	m/s
n: Loss coefficient	:	0.017	
R: Average depth of fluid	:	0.58	m
L: Length of chamber	:	28.00	m

Hf2: Gate opening loss

$Hf2 = f2 \times v^2 / 2g$: 0.021 m

f2: Loss coefficient	:	0.50	
v: Velocity through gate opening	:	0.90	m/s

2) Design discharge water level (DWL)	:	0.492	m
	Say	0.550	

$DWL = OWL + Hf3 + Hf4 + Hf5$

OWL: Design outlet chamber water level	:	0.450	m

Hf3: Gate opening loss

$Hf3 = f3 \times v^2 / 2g$: 0.021 m

f3: Loss coefficient	:	0.500	
v: Velocity through gate opening	:	0.90	m

Hf4: Grit chamber loss

$Hf4 = v^2 \times n^2 / R^{4/3} \times L$		:	0.000	m
v:	Velocity in grit chamber	:	0.27	m/s
n:	Loss coefficient	:	0.017	
R:	Average depth of fluid	:	0.94	m
L:	Length of chamber	:	19.50	m

Hf5: Gate opening loss

$Hf5 = f5 \times v^2 / 2g$		:	0.021	m
f5:	Loss coefficient	:	0.500	
v:	Velocity through gate opening	:	0.90	m

2. CALCULATION OF BASIC DATA

2-1) Pump capacity per unit (q)

$q = Q / N$	:	66.70	m3/min

2-2) Pump station loss (Hp)

$Hp = \Sigma (Hp1 \text{ to } Hp8)$

Hp:	Pump station loss	:	0.891	m

a) Screen loss

Hp1:	Screen loss	:	0.100	m

b) Discharge pipe loss

$Hp5 = p5 \times L / D \times v^2 / 2g$

Hp5:	Discharge pipe loss	:	0.365	m
p5:	Pipe loss coefficient	:	0.03	
L:	Length of discharge pipe	:	20.00	m
D:	Pipe diameter	:	0.70	m
v:	Velocity through pipe	:	2.89	m/s

c) Residual velocity head

$Hp8 = 1.0 \times v^2 / 2g$

Hp8:	residual velocity head	:	0.426	m
v:	Velocity through pipe	:	2.89	m/s

2-3) Static head (Ha)

Ha=DWL-SWL		:	12.95	m

3. PUMP TOTAL HEAD (HT)

HT=Hp+Ha	:	13.84	m
Accordingly, Pump Total Head is as follows;	:	14.00	m

4. DRIVER OUTPUT (P)

4-1) DRIVER OUTPUT (P)

$P=K \times \gamma \times q \times HT \times (1+\alpha) / \eta P / \eta G$		:	218.80	kw
Where,	K : 0.163 (Motor), 0.222 (Engine)	:	0.163	
	γ : Specific gravity of water	:	1.00	kgf/l
	q : Pump capacity per unit	:	66.70	m3/min
	HT : Pump total head	:	14.00	m
	ηP : Pump efficiency	:	80.00	%
	α : Allowance	:	15.00	%
Accordingly, driver output is as follows;		:	220	kw

5. PUMP REVOLUTION SPEED (n)

5-1) Net positive suction head NPSH (AV)

NPSH (AV) = HA - Hs - hV - HL ----------(1)		:	13.24	m
Where,	HA : Atomospheric pressure $10.33x(1-2.257x10^{-5}xh)^{5.526}$	:	10.33	m
	h : Altitude	:	0.00	m
	Hs : Suction lift (Negative suction = '+')	:	-3.25	m
	hV : Saturated vapor press. (20 ℃)	:	0.24	m
	HL : Suction pipe loss at rated capacity	:	0.10	m

5-2) Net positive suction head NPSH (RQ)

NPSH (RQ) = $(n \times q^{1/2}/S)^{4/3}$ ----------(2)

Where,	n : Pump revolution speed (min-1)			
	q : Pump capacity per unit	:	66.70	m3/min
	S : Suction specific speed	:	1,300	
	Centrifugal pump (S=1500)			

Mixed flow pump	(S=1300)
Axial flow pump	(S=1200)

From (1) and (2)、these values shall be NPSH (AV) > NPSH (RQ).

$n < Sx(NPSH(AV))^{3/4}/q^{1/2}$ therefor, n 1,105 min-1

5-3) Specific speed (Ns)

n = Ns x HT3/4/q0.5 : 798 min-1

Where, Ns : Specific speed : 900
Ns is depended on pump type and characteristics.
q : Pump capacity per unit : 66.70 m3/min
In case of double suction, half capacity is adopted.
HT : Pump total head : 14.00 m
In case of multi stage pump, pump head per one stage shall be adopted.

From the above revolution speed, following synchronous speed is adopted in consideration with power supply frequency and motor pole number.
This speed is satisfied with both formula (1) and (2).

: 750 min-1

6. CAVITATION

At the one pump operation, NPSH (AV) and NPSH (RQ) shall be compared when the static head is changed.

6-1) Suction water level

1) Low water level	(L.W.L)	: -13.30	m
2) Design water level	(D.W.L)	: -12.40	m
3) High water level	(H.W.L)	: -11.80	m

6-2) Discharge water level

1) Low water level	(L.W.L)	: 0.55	m
2) Design water level	(D.W.L)	: 0.55	m
3) High water level	(H.W.L)	: 0.55	m

6-3) Net positive suction head NPSH

	Static head (m)	Hs (m)	NPSH (AV) (m)	NPSH (RQ) (m)
Design	12.95	-3.25	13.24	7.50
Maximum	13.85	-2.35	12.34	7.50
Minimum	12.35	-3.85	13.84	8.50

In the above table, NPSH (RQ) is based on the pump performance curve from pump manufacturer.
From this table, NPSH (AV) is larger than NPSH (RQ) at the all operating range. Accordingly, cavitation will not be anticipated.

4.4
Electrical Equipment

IWPS MCCBε SIZE

E - 99H
CUSTOMER VIETNAM/HOMC

100 PUMP WELL SUBSTATION
200 GRIT CHAMBEI DEG ROOM
300 PUMP ROOM OTHER

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

No.	MOTORS AND AUXILIARIES LIST EQUIPMENT NAME	Quantity Phase-1 DUTY	Quantity Phase-1 STAND BY	Quantity Phase-2 DUTY	Quantity Phase-2 STAND BY	Quantity TOTAL	POWER (kW)	VOLTAGE (V)	Reversible Operation	STARTING METHOD	GENERATOR (EQ. LOAD)
	<PUMP WELL>										
101	No.1 Emergency Gate	1				1	3.7	380	R	D	
101	No.2 Emergency Gate			1		1	3.7	380	R	D	
103	No.1 Fain Screen	1				1	3.7	380	R	D	
103	No.2 Fain Screen			1		1	3.7	380	R	D	
103	No.3 Fain Screen			1		1	3.7	380	R	D	
103	No.4 Fain Screen			1		1	3.7	380	R	D	
104	Garbage Grinder			1		1	7.5	380	R	D	
105	Garbage Washing Equipment			1		1	4.45	380	R	D	
106	Dehydrating Equipment			1		1	5.9	380	R	D	
107	Horizontal Conveyor	1				1	3.7	380	R	D	
108	Inclined Conveyor	1				1	3.7	380	R	D	
109	Hopper			2		2	1.5	380	R	D	
	PUMP WELL EQUIPMENT TOTAL										

Current Calc. Ratio 3

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 (A)	MCCB Size (AT)	Control Center Unit Size (mm)	Ph-1 CC Unit (unit)	Ph-2 CC Unit (unit)
3.70				3.70		36.51	50	480	1	
		3.70		3.70		36.51	50	480		1
3.70				3.70		36.51	50	480	1	
		3.70		3.70		36.51	50	480		1
		3.70		3.70		36.51	50	480		1
		3.70		3.70		36.51	50	480		1
		7.50		7.50		74.01	75	480		1
		4.45		4.45		43.91	50	480		1
		5.90		5.90		58.22	75	480		1
3.70				3.70		36.51	50	480	1	
3.70				3.70		36.51	50	480	1	
		3.00		3.00		14.80	30	240		2
14.80		33.65		50.45					4	9

E - 99H

CUSTOMER VIETNAM/HCMC

100 PUMP WELL SUBSTATION

200 GRIT CHAMBER DEG ROOM

300 PUMP ROOM OTHER

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	GENERATOR (E.G. LOAD)
		Phase-1		Phase-2		TOTAL					
		DUTY	STAND BY	DUTY	STAND BY		(kW)	(V)			
	<GRIT CHAMBER>										
201	Grab Bucket Crane Type Sand Removal Equipment(Travel)	2				2	1.5	380	R	D	
	Grab Bucket Crane Type Sand Removal Equipment(Traverse)	2				2	0.6	380			
	Grab Bucket Crane Type Sand Removal Equipment(Hoist)	1				1	3.5	380			
	Grab Bucket Crane Type Sand Removal Equipment(Opening)	1				1	3.5	380			
202	Hopper			2		2	1.5	380	R	D	
203	Trough Conveyor			1		1	3.7	380	R	D	
	GRIT CHAMBER EQUIPMENT TOTAL										
	<PUMP ROOM>										
301	No.1 700mm Motor for Sewage Pump	1				1	220	380	-	C	1
301	No.2 700mm Motor for Sewage Pump	1				1	220	380	-	C	
301	No.3 700mm Motor for Sewage Pump		1			1	220	380	-	C	
302	No.1 1000mm Motor for Sewage Pump			1		1	460	380	-	C	1

Current Calc. Ratio 3

Required Capacity						Rated Current	MCCB Size	Control Center	Ph-1	Ph-2
Phase-1		Phase-2		TOTAL						
Duty (kW)	Stand-by (kW)	Duty (kW)	Stand-by (kW)	Duty (kW)	Stand-by (kW)	(A)	(AT)	Unit Size (mm)	CC Unit (unit)	CC Unit (unit)
3.00				11.20		200.89	225	1200		
1.20										
3.50										
3.50										
		3.00		3.00		14.80	30	240		2
		3.70		3.70		35.51	50	480		1
11.20		6.70		17.90						3
220.00				220.00		1,101.35	Pump Starter panel			
220.00				220.00		1,101.35	Pump Starter panel			
	220.00				220.00	1,101.35	Pump Starter panel			
		460.00		460.00		2,310.41	Pump Starter panel			

E - 99H

CUSTOMER VIETNAM/HCMC

100 PUMP WELL SUBSTATION
200 GRIT CHAMBEI OEG ROOM
300 PUMP ROOM OTHER

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	GENERATOR REQ. LOAD
		Phase-1		Phase-2		TOTAL					
		DUTY	STAND BY	DUTY	STAND BY		(kW)	(V)			
302	No.2 1000mm Motor for Sewage Pump			1		1	460	380	-	C	
302	No.3 1000mm Motor for Sewage Pump				1	1	460	380	-	C	
303	Overhead Crane(Travel)	2				2	0.75	380	R	D	
	Overhead Crane(Traverse)	1				1	0.55	380	R	D	
	Overhead Crane(Hoist)	1				1	6.0	380	R	D	
304	No.1 Portable Type Drain Pump	1				1	2.2	380	-	D	
304	No.2 Portable Type Drain Pump	1				1	2.2	380	-	D	
305	Air Ventilation Inlet Fan	1				1	22	380	-	D	
305-1	Air Ventilation Outlet Fan	1				1	11	380	-	D	
305-2	Air Ventilation Outlet Fan	1				1	15	380	-	D	
	PUMP ROOM EQUIPMENT TOTAL										
	<GENERATOR ROOM>										
501	750kVA Diesel Generator						600	380	-	D	
502	DC Battery	1				1	65.0	380	-	D	

Current Calc. Ratio 3

Required Capacity						Rated Current	MCCB Size	Control Center	Ph-1	Ph-2
Phase-1		Phase-2		TOTAL						
Duty	Stand-by	Duty	Stand-by	Duty	Stand-by			Unit Size	CC Unit	CC Unit
(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(A)	(AT)	(mm)	(unit)	(unit)
		460.00		460.00		2,310.41	Pump Starter panel			
			460.00		460.00	2,310.41	Pump Starter panel			
1.50				3.05		80.69	100	600		
0.55										
6.00										
2.20				2.20		21.71	30	240	1	
2.20				2.20		21.71	30	240	1	
22.00				22.00		217.11	225	240	1	
11.00				11.00		108.55	150	240	1	
15.00				15.00		148.03	150	240	1	
500.45	220.00	920.00	460.00	1,420.45	680.00				5	
						1,424.43	1600	-		
65.00				65.00		139.80	150	-		

E - 99H

CUSTOMER VIETNAM/HCMC

100 PUMP WELL SUBSTATION

200 GRIT CHAMBEI DEG ROOM

300 PUMP ROOM OTHER

0 Direct start

C Aux. Auto TR start

SR Secondary Resistor

SO Star-Delta

MOTORS AND AUXILIARIES LIST

No	EQUIPMENT NAME	Quantity					POWER	VOLTAGE	Reversible Operation	STARTING METHOD	GENERATOR REQ. LOAD
		Phase-1		Phase-2		TOTAL					
		DUTY	STAND BY	DUTY	STAND BY		(kW)	(V)			
503	1500kVA Diesel Generator						1200	330	-	O	
504	Piming pump for Engin			1		1	3.7	330	-	O	
505	Air complessor			1		1	0.75	380	-	O	
	GENERATOR ROOM EQUIPMENT TOTAL										
	<OTHER EQUIPMENT>										
601	DC Battery	1				1	45.0	350	-	O	
604	Instrument	1				1	10.0	220	-	O	
605	Interior lightring	1				1	80.0	220	-	O	
606	Exterior lightring	1				1	10.0	220	-	O	
607	Outdoor Lighting	20				20	0.4	220	-	O	
	OTHER EQUIPMENT TOTAL										
	ALL EQUIPMENT TOTAL										

Current Calc. Ratio 3

Required Capacity						Rated Current	MCCB Size	Control Center	Ph-1	Ph-2
Phase-1		Phase-2		TOTAL						
Duty (kW)	Standby (kW)	Duty (kW)	Standby (kW)	Duty (kW)	Stand-by (kW)	(A)	(AT)	Unit Size (mm)	CC Unit (unit)	CC Unit (unit)
						2,843.65	3000	-		
		3.70		3.70		38.51	50	-		
		0.75		0.75		7.40	30	-		
55.00		4.45		59.45						
45.00				45.00		94.01	100	-		
10.00				10.00		65.18	75	-		
80.00				80.00		545.45	600	-		
10.00				10.00		65.18	75	-		
8.00				8.00		2.73	30	-		
153.00				153.00						
				1,711.25						

Power Cable Capacity

Vietnam / Ho Chi Minh City Water Environment Improvement Project

[Pacage C] Intermediate Wastewater Pumping Station Phase-1 CABLE SIZE

区分	Motor No.	機器名称	数量	容量	電圧	起動方式 Starting	起動電流 Starting		電圧降下 V/drop	起動電流 S/current	Final
Location	Motor No.	Name of Equipment	Q'ty	kW	V	Method	Current	P.F	Cable Size	Cable Size	Cable Size
Pump Well											
	PIW1-1-1	No.1 Emergency Gate	1	3.7	380	D	73.00	0.8	14	14	14
	PIW1-1-2	No.1 Fine screen	1	3.7	380	D	73.00	0.8	8	14	14
	PIW1-1-3	Horizontal conveyor	1	3.7	380	D	73.00	0.8	5.5	14	14
	PIW1-1-4	Inclined conveyor	1	3.7	380	D	73.00	0.8	5.5	14	14
Grit Chamber											
	PIW1-2-1	Grab backet crane type sand removal equipment	1	11.2	380	D	221.10	0.8	60	100	100
		Grab backet crane type sand removal equipment(Travel)	2	1.5							
		Grab backet crane type sand removal equipment(Traverse)	2	0.6							
		Grab backet crane type sand removal equipment(Hoist)	1	3.5							
		Grab backet crane type sand removal equipment(Opening)	1	3.5							
Pump room											
	PIW1-3-1	No.1 700mm Motor for sewage pump	1	220	380	C	963.40	0.8	150	600	600
	PIW1-3-2	No.2 700mm Motor for sewage pump	1	220	380	C	963.40	0.8	100	600	600
	PIW1-3-3	No.3 700mm Motor for sewage pump	1	220	380	C	963.40	0.8	100	600	600
	PIW1-3-4	Overhead crane	1	8.05	380	D	158.90	0.8	14	60	60
		Overhead crane(Travel)	2	0.75							
		Overhead crane(Traverse)	1	0.55							
		Overhead crane(Hoist)	1	6							
	PIW1-3-5	No.1 Portable Type Drain pump	1	2.2	380	D	43.40	0.8	3.5	5.5	5.5
	PIW1-3-6	No.2 Portable Type Drain pump	1	2.2	380	D	43.40	0.8	14	5.5	14
	PIW1-3-7	Air Ventilation Inlet Fun	1	22	380	D	434.20	0.8	38	250	250
	PIW1-3-8	Air Ventilation outlet Fun	1	11	380	D	217.10	0.8	22	100	100
	PIW1-3-9	Air Ventilation outlet Fun	1	15	380	D	296.10	0.8	38	150	150
22kV Substation											
	PIW1-4-1	1500kVA Transformer	1	1200	22000	D	157.50	0.8	3.5	60	60
	PIW1-4-2	C-GIS Control DC POWER	1	1	110	D	12.50	0.8	14	3.5	14
	PIW1-4-3	C-GIS Control AC POWER	1	3	220	D	18.80	0.8	14	3.5	14
Generator room											
	PIW1-5-1	750kVA, 380V Diesel Generator(5-1 - 5-1a)	1	600	380	D	1253.50	0.8	1000	800	1000
	PIW1-5-2	DC Battery	1	65	380	D	135.80	0.8	100	38	100

Vietnam / Ho Chi Minh City Water Environment Improvement Project											
[Pacage C]		Intermediate Wastewater Pumping Station Phase-1	CABLE SIZE								
						起動方式	起動電流		電圧降下	起動電流	
区分	Motor No.	機器名称	数量	容量	電圧	Starting	Starting		V/drop	S/current	Final
Location	Motor No.	Name of Equipment	Q'ty	kW	V	Method	Current	P**	Cable Size	Cable Size	Cable Size
Control room											
	PIW1-6-1	DC battery	1	43	380	D	89.80	0.8	14	22	22
	PIW1-6-3	Instrument	1	10	220	D	62.50	0.8	38	14	38
	PIW1-6-4	Interior lightning	1	60	220	D	375.00	0.8	250	200	250
	PIW1-6-5	Exterior lightning	1	10	220	D	62.50	0.8	38	14	38
	PIW1-6-6	Outdoor Lighting(6-1 - 6-11)	30	0.4	220	D	2.50	0.8	14	3.5	14
	PIW1-6-7	Control Center Power Supply	1	75	380	D	156.70	0.8	22	60	60

MCCB	AT
0	30
30	50
50	75
75	100
100	150
150	200
200	225
225	400
400	600
600	800
800	1000
1000	1200
1200	1600
1600	2000
2000	2500
2500	3000
3000	4000

WATER ENVIRONMENT IMPROVEMENT PROJECT

Issue dale Rev.1 : #########

Calculation Sheet

for

Receiving Power Capacity for IWPS

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: IWPS Ph-1 & 2.

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
Phase-1	812.2	0.6	487.3
Phase-2	1,413.7	0.7	989.6
Total	2,225.9	0.7	1,446.8

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 IWPS Phase-1

2) Electrical Equipment List for IWPS Phase-2

SOCIALIST REPUBLIC OF VIETNAM

Independence-Freedom-Happiness

ELECTRICAL EQUIPMENT LIST

Name of electric consumer : Intermediate Wastewater Pumping Station (IWPS) - Phase 1
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	Emergency gate	1	-	3.70	3.70	0.3
102	Inlet gate for pump well	2	-	2.20	4.40	0.6
103	Fine screen	1	-	3.70	3.70	0.6
104	Garbage grinder	1	-	7.50	7.50	0.6
105	Garbage washing equipment	1	-	4.45	4.45	0.6
106	Dehydrorating equipment	1	-	5.90	5.90	0.6
107	Horizontal conveyor	1	-	3.70	3.70	0.6
107	Inclined conveyor	1	-	3.70	3.70	0.6
110	Hopper	2	-	1.50	3.00	0.3
	GRIT CHAMBER					
202	Hopper	2	-	1.50	3.00	0.3
203	Trough conveyor	1	-	3.70	3.70	0.3
204	Inlet gate for grit chamber	2	-	2.20	4.40	0.6
205	Outlet gate for grit chamber	2	-	2.20	4.40	0.6
	PUMP ROOM					
301	Sewage pump	3	-	230.00	690.00	0.6
304	Potable type drain pump	3	-	2.20	6.60	0.6
	OTHERS					
401	Miscellaneous	1	-	20.00	20.00	0.6
402	Lighting	1	-	15.00	15.00	0.9
403	Ventilation	1	-	10.00	10.00	1.0
404	Air conditioning unit	1	-	15.00	15.00	1.0
	TOTAL				812.15	0.6

SOCIALIST REPUBLIC OF VIETNAM

Independence-Freedom-Happiness

ELECTRICAL EQUIPMENT LIST

Name of electric consumer : Intermediate Wastewater Pumping Station (IWPS) - Phase 2
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	Emergency gate	1	-	2.20	2.20	0.3
103	Fine screen	1	-	3.70	3.70	0.6
	GRIT CHAMBER					
204	Inlet gate for grit chamber	2	-	2.20	4.40	0.6
205	Outlet gate for grit chamber	2	-	2.20	4.40	0.6
	PUMP ROOM					
301	Sewage pump	3	-	460.00	1,380.00	0.6
	OTHERS					
401	Miscellaneous	1	-	10.00	10.00	0.6
402	Lighting	1	-	5.00	5.00	0.9
403	Ventilation	1	-	2.00	2.00	1.0
404	Air conditioning unit	1	-	2.00	2.00	1.0
	TOTAL				1,413.70	0.7

ELECTRICAL EQUIPMENT LIST FOR INTERMEDIATE WASTEWATER TREATMENT PUMPING STATION (1/3)

No.	Name of Equipment	Type	Specification	Unit	Q'ty	Remarks
3.10.1.1	22kV Substation(MSUB)					
3.10.1.1.1	22kV Incoming C-GIS unit	Outdoor, Cubicle type	24kV, 3phase, 1200A, 31.5kA	sets	2	
3.10.1.1.2	22kV Bus C-GIS unit	Outdoor, Cubicle type	24kV, 3phase, 1200A, 31.5kA	set	1	
3.10.1.1.3	22kV Metering C-GIS unit	Outdoor, Cubicle type	24kV, 3phase, CT, VT	set	1	
3.10.1.1.4	22kV Transformer primary C-GIS unit	Outdoor, Cubicle type	24kV, 3phase, 600A, 25kA	set	1	
3.10.1.2	Electrical Room(ELCR)					
3.10.1.2.1	Main transformer with OLTC	Oil immersed, Outdoor type	15(22)kV/ 380-220V, 1500kVA with OLTC	set	1	
3.10.1.2.2	1500kVA TR Secondary panel	Indoor, Cubicle type	600V, 3phase, 2500A, 65kA	set	1	
3.10.1.2.3	1500kVA TR Secondary duct	Indoor, Air insulated type	3phase-4wire, 600V, 2500A	set	1	
3.10.1.2.4	750kVA Generator incoming panel	Indoor, Cubicle type	600V, 3phase, 1200A, 50kA	set	1	
3.10.1.2.5	220kw Lift pump starter panel	Indoor, Cubicle type	600V, 3phase, 1000A, Auto-TR type	set	3	
3.10.1.2.6	380V Capacitor / Reactor	Indoor, Cubicle type	600V, 3phase, SC & SR for PF 0.9	set	3	
3.10.1.2.7	AC Distribution panel	Indoor, Cubicle type	600V, 3phase, 1000A, 50kA, MCCB 100AF	set	1	
3.10.1.2.8	Motor control center	Indoor, Front unit type	600V, 3phase, 600A, 35kA	set	3	
3.10.1.2.9	Ry panel for MCC	Indoor, Cubicle type	Power Ry unit type	set	1	

ELECTRICAL EQUIPMENT LIST FOR INTERMEDIATE WASTEWATER TREATMENT PUMPING STATION (2/3)

No.	Name of Equipment	Type	Specification	Unit	Q'ty	Remarks
3.10.1.2.10	DC Power supply system	Indoor, Cubicle type	DC110V, Sealed lead acid type battery	set	1	
3.10.1.3	Control Room(CTCR)					
3.10.1.3	22kV Control & Protection panel	Indoor, Cubicle type	OC, OCG, Def, FI, Indication etc.	set	1	
3.10.1.4	1500kVA TR OLTC Panel	Indoor, Cubicle type	Tap control, 90, VM, CS etc.	set	1	
3.10.1.5	Supervisory panel	Indoor, Cubicle type	FI, PI, Pen Recorder etc.	set	1	
3.10.1.6	Billmetering panel	Indoor, Cubicle type	WhM, WM	set	1	
3.10.1.7	Communication System	Indoor, Rack mounted cubicle type	Paging and intercom system	set	1	
3.10.1.4	Generator Room					
3.10.1.4.1	750kVA, 380V Diesel engine generator	Indoor, Soundproof type	750kVA, 3phase-4wire, 380V	set	1	
3.10.1.4.2	Main fuel tank	Indoor type	Diesel fuel, 3hur operation for DEG	set	1	
3.10.1.4.3	Generator control panel	Indoor, Cubicle type	AVR, OC, OCG, UV, OV etc.	set	1	
3.10.1.4.4	Generator primary circuit breaker panel	Indoor, Cubicle type	600V, 3phase, 1200A, 50kA	set	1	
3.10.1.4.5	DC Power supply system	Indoor, Cubicle type	DC24V, Sealed lead acid type battery	set	1	

ELECTRICAL EQUIPMENT LIST FOR INTERMEDIATE WASTEWATER TREATMENT PUMPING STATION (3/3)

No.	Name of Equipment	Type	Specification	Unit	Q'ty	Remarks
3.10.1.5	Instrumentation Equipment					
3.10.1.5.1	Submerged diaphragm type water level meter	Submerged diaphragm type	0-10m, DC 4-20mA	set	2	
3.10.1.5.2	Electrode type water level control switch	Electrode type	4 contacts	set	3	
3.10.1.6	Local Control Panel					
3.10.1.6.1	Local control panel for motors	Indoor and Outdoor type	COS, CS, AM, PBS, Indication etc.	set	10	
3.10.1.6.2	Local control panel for instrument	Indoor and Outdoor type	Signal converter etc.	set	2	
3.10.1.7	Outdoor Lighting Equipment					
3.10.1.7.1	Outdoor lighting switch box	Indoor, Wall mounted type	MCCB 2P	set	1	