Chapter 4
BRIDGE

4.1 Spillway Bridge

BILL OF QUANTITIES FOR SPILLWAY BRIDGE (SUPER STRUCTURE)

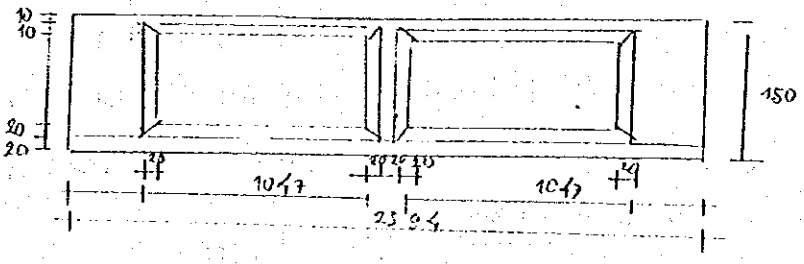
Item No.	Description	Unit	Quantity
A.1.1	Precast Prestressed Concrete Beam including Tensioning and Erection	L.S.	
A.1.2	Precast Concrete Diaphragm including. Tensioning and Erection	L.S.	
A.1.3	Precast Concrete Panel including Erection	L.S.	
A.1.4	Concrete, Type B including Formwork	m^3	35
	formwork for A.1.4	m^2	102
A.1.5	Deformed Reinforcing Bars	kg	5,296
A.1.6	Asphalt Concrete	tonne	21
A.1.7	Expansion Joint	m	11
A.1.8	Hand Rail	kg	168
A.1.9	Drain Pipe, PVC Pipe Dia. 100 mm	m	11
A.1.10	Elastometric Bearing Pad (350 x 280 x 73)	No.	6
A.1.11	Rubber Sheet (40 x 10 x 3)	No.	6

Concrete Volume

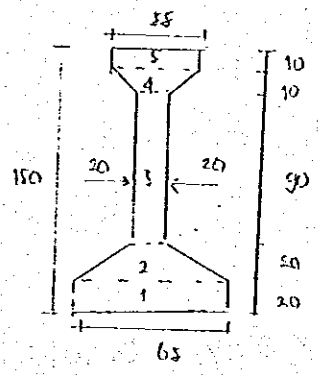
	unit	
concrete K400 for girder	cu.m	38
reinforcing bar	kg	5457
concrete K400 for diaphragm	cu.m	2
reinforcing bar	kg	160
concrete K250 for panel plate	cu.m	5
reinforcing bar	kg	705
concrete K250 for slab+curb	cu.m	35
reinforcing bar	kg	5296

Name of Structure	SPILLWAY BRIDGE	Category of calculation	CONCRETE VOLUME	Page	2/6

I. MAIN GIRDER



CENTRE BEAM



$A_1 = 0,65 \times 0,20 = 0,130\ m^2$

$A_2 = \frac{0,20 \times 0,65}{2} \times 0,20 = 0,085\ m^2$

$A_3 = 0,20 \times 0,90 = 0,180\ m^2$

$A_4 = \frac{0,55 \times 0,20}{2} \times 0,10 = 0,0375\ m^2$

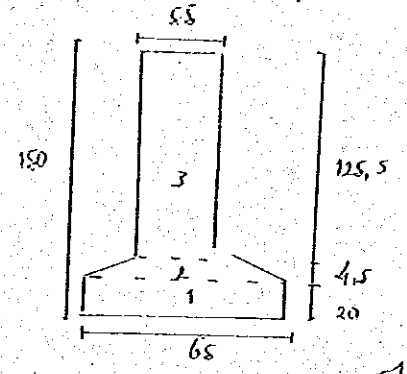
$A_5 = 0,55 \times 0,10 = 0,055\ m^2$

TOTAL $= 0,4875\ m^2$

Volume $= \Sigma A \times L$

$V_1 = 0,4875 \times 10,47 \times 2 = 10,21\ m^3$

END BEAM



$A_1 = 0,65 \times 0,20 = 0,130\ m^2$

$A_2 = \frac{0,55 + 0,65}{2} \times 0,045 = 0,027\ m^2$

$A_3 = 0,55 \times 1,255 = 0,690\ m^2$

TOTAL $= 0,847\ m^2$

Volume $= \Sigma A \times L$

$= (0,847 \times 1,00) \times 2 + \left(\frac{0,4875 + 0,847}{2} \times 0,20 \times 4\right) + (0,847 \times 0,20)$

$V_2 = 1,694 + 0,534 + 0,169 = 2,397\ m^3$

Name of Structure	SPILLWAY BRIDGE	Category of calculation	CONCRETE VOLUME	Page	3/6

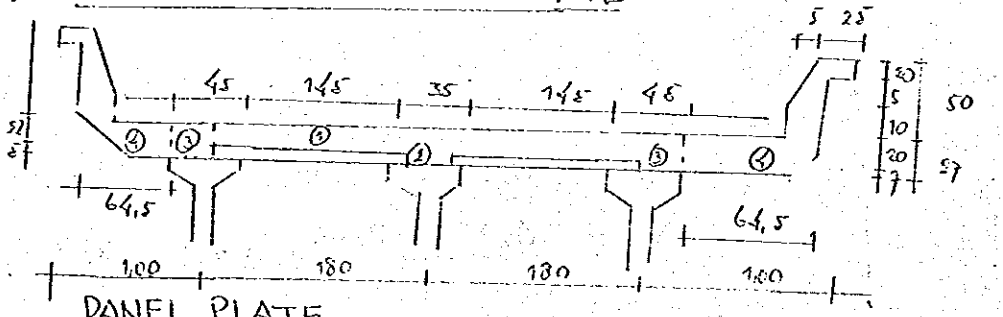
- TOTAL VOLUME FOR ONE BEAM $= V_1 + V_2$

$\Sigma_V = 10,21 + 2,397 = 12,607\ m^3$

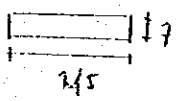
- TOTAL VOLUME FOR ALL BEAM IN BRIDGE $= (V_6)$

$V_6 = 3 \times \Sigma_V = 3 \times 12,607 = 37,821\ m^3$

II. BED PLATE AND PANEL PLATE



PANEL PLATE



FOR ONE PANEL PLATE

Volume $= 1,45 \times 1,00 \times 0,07 = 0,1015\ m^3$

FOR ONE GIRDER (Length $= 2180 - 60 = 2120$ m)

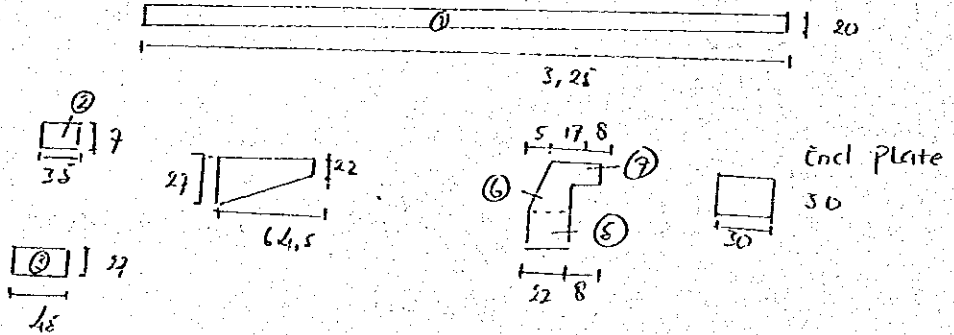
Volume $= 23 \times 0,1015 + (1,45 \times 034 \times 0,07)$

$V = 2,369\ m^3$

- TOTAL VOLUME FOR ALL PANEL, PLATE IN BRIDGE (V_p)

$V_p = 2 \times V = 2 \times 2,369 = 4,738\ m^3$

- SLAB



Name of Structure	SPILLWAY BRIDGE	Category of calculation	CONCRETE VOLUME	Page	4/6

$A_1 = 3,25 \times 0,20 = 0,65\ m^2$

$A_2 = 0,35 \times 0,07 \times 1 = 0,025\ m^2$

$A_3 = 0,45 \times 0,27 \times 2 = 0,243\ m^2$

$A_4 = \frac{0,27 + 0,22}{2} \times 0,645 \times 2 = 0,316\ m^2$

$A_5 = 0,22 \times 0,10 \times 2 = 0,044\ m^2$

$A_6 = \frac{0,17 + 0,22}{2} \times 0,40 \times 2 = 0,156\ m^2$

$A_7 = 0,08 \times 0,20 \times 2 = 0,032\ m^2$

TOTAL $= 1,466\ m^2$

Length of plate (L) $= 23,94 - 60 = 23,34$ cm
$= 23,34$ m

Volume (V_1) $= A \times L$
$= 1,466 \times 23,34$
$= 34,216\ m^3$

END PLATE

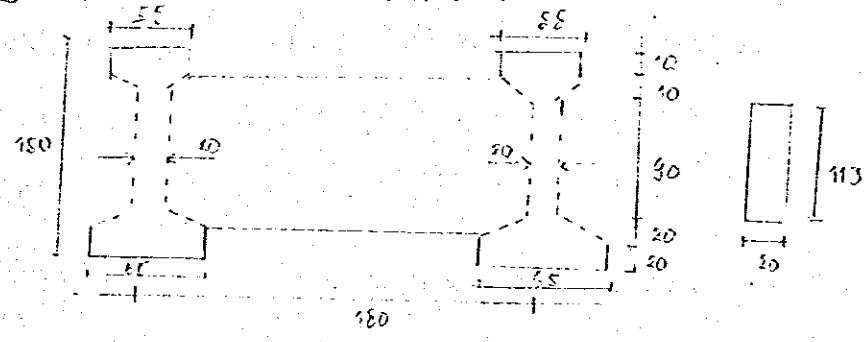
$V_2 = 0,30 \times 0,30 \times 5,44 \times 2 = 0,979\ m^3$

Total Volume All plate in Bridge (V_B)

$V_B = V_1 + V_2$
$= 34,216 + 0,0979 = 35,195\ m^3$

Name of Structure	SPILLWAY BRIDGE	Category of calculation	CONCRETE VOLUME	Page	5/6

III. CROSS BEAM (DIAPRHAGM)



For one Cross Beam

$$\text{Volume} = 0,20 \times 1,13 \times 1,25 = 0,283\ m^3$$

Total volume for all Cross Beam in Bridge (V_{EB})

$$V_{EB} = 2 \times 3 \times 0,283 = 1,695\ m^3$$

Name of Structure	SPILLWAY BRIDGE	Category of calculation	CONCRETE VOLUME	Page	6/

Concrete Volume

- MAIN GIRDER = 37,821 m^3 (K.400)
- SLAB = 35,195 m^3 (K.250)
- PANEL PLATE = 4,738 m^3 (K.250)
- CROSS BEAM = 1,695 m^3 (K.400).

TOTAL = 79,449 m^3

- Concrete Quality K.400 = 39,516 m^3 ✓
- Concrete Quality K.250 = 39,933 m^3 ✓

Name of Structure		Category of calculation		Page	1/6

SUMMARY OF BROAD FORM WORK

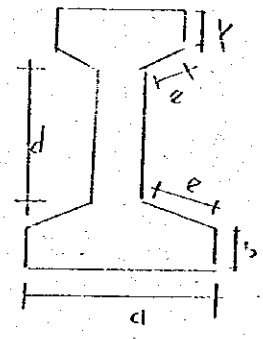
- Main Girder	=	290.91 m^2
- Slab	=	4.38 m^2
- Side Walk	=	98.01 m^2
- Panel Plat	=	91.47 m^2
- Diaprhagm	=	22.30 m^2
Total	=	507.07 m^2

Name of Structure	SPILLWAY BRIDGE	Category of calculation	FORM WORK VOLUME	Page	2/6

FORM WORK

I. BEAM

CENTRE BEAM

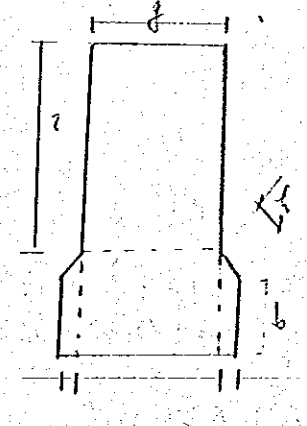


$a = 65 + 3 = 68$ cm
$b = 20 + 3 = 23$ cm
$c = 35 + 3 = 38$ cm
$d = 90 + 3 = 93$ cm
$e = 12 + 3 = 15$ cm
$f = 10 + 3 = 11{,}5$ cm

$L = 2{,}485$ cm $= 2{,}485$ m

Length of Centre Beam $= 20.94$ m
A (Volume of Form) $= 2{,}485 \times 20{,}94$
$= 52{,}04$ m²

END BEAM

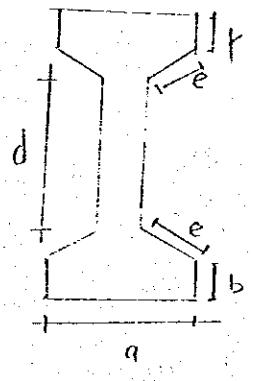


$a = 68$ cm
$b = 23$ cm
$h = 6{,}75 + 3 = 9{,}75$ cm
$i = 125{,}5 + 3/2 = 127$ cm

Name of Structure	SPILLWAY BRIDGE	Category of calculation	FORM VOLUME	Page	3/6

I. MAIN GIRDER

CENTRE BEAM



Thick of Plate

$a = 65 + \frac{3}{2} \times 2 = 68$ cm

$b = 20 + \frac{3}{2} \times 2 = 23$ cm

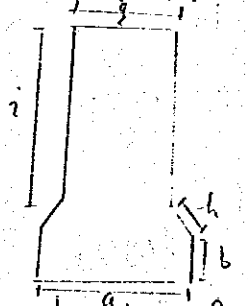
$c = 35 + \frac{3}{2} \times 2 = 38$ cm

$d = 90 + \frac{3}{2} \times 2 = 93$ cm

$e = 12 + \frac{3}{2} \times 2 = 15$ cm

$f = 10 + \frac{3}{2} = 11{,}5$ cm

END BEAM



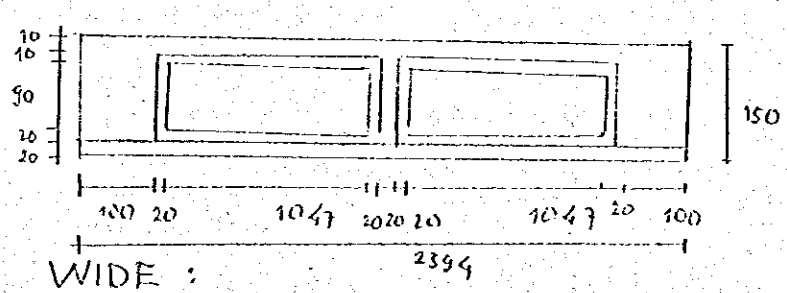
$a = 68$ cm

$b = 23$ cm

$h = 6{,}75 + \frac{3}{2} \times 2 = 9{,}75$ cm

$i = 125{,}5 + \frac{3}{2} = 127$ cm

Lenght of Beam $= 23{,}94$ cm $= 23{,}94$ m



WIDE :

- CENTRE $A_1 = (a + 2b + 2c + 2d + 2e + 2f) \times L$

$= (0{,}68 + 0{,}46 + 0{,}76 + 1{,}86 + 0{,}30 + 0{,}23) \times 20{,}94$

$A_1 = 4{,}29 \times 20{,}94 = 89{,}833$ m²

- END $A_2 = (a + 2b + 2h + 2i) \times L$

$= (0{,}68 + 0{,}46 + 0{,}195 + 2{,}54) \times 2{,}20$

$A_2 = 3{,}875 \times 2{,}20 = 8{,}525$ m²

Name of Structure	SPILLWAY BRIDGE	Category of calculation	FORM VOLUME	Page	4/6

- BETWEEN $A_3 = \left[\left(\frac{0,90 + 1,20}{2} \times 0,20 + 2 \times \frac{1}{2} \times 0,20 \times 0,20\right) \times 4\right] \times 2$

$$A_3 = (0,21 + 0,04) \times 4 \times 2 = 2,00\ m^2$$

- GOVER END BEAM

$$A_4 = \left[\left((0,68 \times 0,23) + \left(\frac{0,68 - 0,58}{2} \times 0,095\right) + (0,58 \times 1,285)\right] \times 2\right.$$

$$= (0,1564 + 0,0473 + 1,4906) \times 2$$

$$A_4 = 1,6943 \times 2 = 3,389\ m^2$$

Total Form Volume in Bridge (F_6)

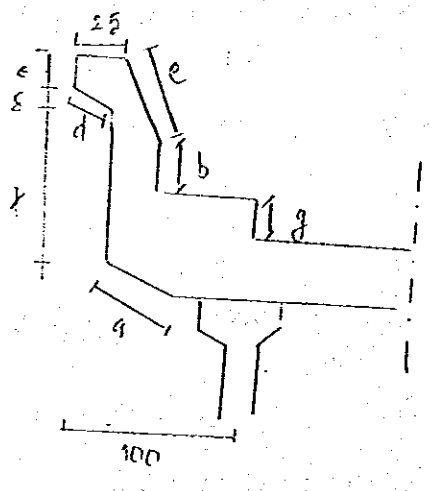
$$F_6 = \Sigma_A \times 3$$

$$= (89,833 + 8,515 + 2,00 - 3.389) \times 3$$

$$F_6 = 96,969 \times 3 = 290,907\ m^2$$

Name of Structure	SPILLWAY BRIDGE	Category of calculation	FORM VOLUME	Page	5 ½

I. SLAB AND HAND RAIL



Thick of Plate = 3 cm

a = 64.69 × 3/2 = 66,19 cm
b = 10 × 3/2 = 11,5 cm
c = 40.31 × 3/2 = 41,81 cm
d = 9.43 × 3/2 × 2 = 12,43 cm
e = 20 × 3/2 = 21,5 cm
f = 72 × 3/2 × 2 = 75 cm
g = 25 cm

HAND RAIL

Leght of Beam = 23.94 cm = 23.94 m

Wide $A_1 = [(a+b+c+d+e+(f-g)] \times L \times 2$

$= [(66,19 + 11,5 + 41,81 + 12,43 + 21,5 + (75-25)] \times 23,94 \times 2$

$A_1 = 203,43 \times 23,94 \times 2 = 974022,8\ cm^2$

$= 97,402\ m^2$

END COVER

Wide $A_2 = \left[(b \times 0,28) + \left(\frac{0,20+0,28}{2} \times 0,40\right) + \left(\frac{0,20-0,25}{2} \times 0,11\right) \times 4\right]$

$= [(0,115 \times 0,28) + (0,096 + 0,025)] \times 4$

$A_2 = 0,153\ m^2 \times 4 = 0,612\ m^2$

Total Wide $F_{sw_1} = 97,402 + 0,612 = 98,014\ m^2$

Total Form in Bridge = 98,014 m^2

Name of Structure		Category of calculation		Page	6.6

• SLAB

End side $A = [(0,33 \times 3,25) - 2(\frac{1}{2} \times 0,645 \times 0,05) + 2 \times (0,30 \times 1,25) + 2 \cdot (0,30 \times 0,661) \times 2$

$= 4,375 \text{ m}^2$

• PANEL PLATE

$A_1 = (1,48 \times 1,03) + 2 \cdot (0,085 \times 1,48) + 2 \times (0,085 \times 1,03)$

$= 1,951 \text{ cm}^2$

Wide

$A_2 = (1,48 \times 0,37) + 2(0,285 \times 1,48) + 2 \times (0,085 \times 0,37)$

$= 0,8621 \text{ m}^2$

Total wide $= (23 \times 1,951) + 0,8621 \times 1 = 45,735 \text{ m}^2$

Total Form in Bridge $= 2 \times 45,735 = 91,47 \text{ m}^2$

• DIAPHRAGM

$A = 2 \times (1,25 \times 1,13) + (1,25 \times 0,26) + 4 \times (0,175 \times 0,81)$

$= 3,717 \text{ m}^2$

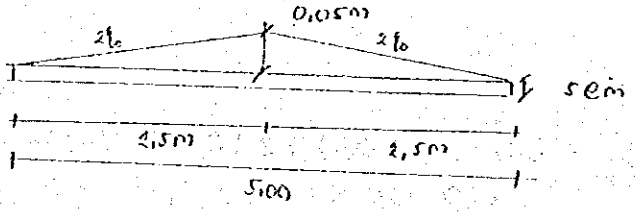
Total wide $= 2 \times 3,717 = 7,434 \text{ m}^2$

Total Form in Bridge $= 3 \times 7,434 = 22,302 \text{ m}^2$

Name of Structure	SPILLWAY BRIDGE	Category of calculation		Page	1/1

ASPHALT PAVEMENT

Length of beam = 2394 cm = 23,94 m
Thick of asphalt = 5 cm = 0,05 m

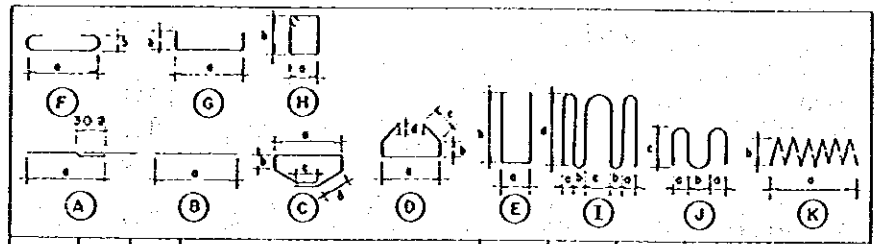


Broad = $(0,05 \times 5,00) + 2.(2 \times 2,5 \times 0,05) = 0,375\ m^2$
Volume = $0,375\ m^2 \times 23,94\ m = 8,98\ m^3$

Reinforcing Bar Calculation (Spillway Bridge)

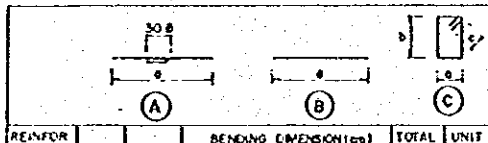
	unit	amount
main girder	kg	5,457
panel plate	kg	705
diaphragm	kg	160
total	kg	6,322
slab	kg	4,451
handrail and curb	kg	845
total	kg	5,296
PC cable		
K1 12 strand (D=12.7mm)	kg	1,147
K2 7 strand (D=12.7mm)	kg	667
K3 12 strand (D=12.7mm)	kg	1,151
PC cable for diaphragm (D=12.5mm)	kg	23
total	kg	2,988

Name of Structure	SPILWAY BRIDGE	Category of calculation	REINFORCING Volume	Page	2/4



REINFORCING BAR NO	ø (mm)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	f	TOTAL LENGTH (m)	UNIT WEIGHT/m (kg/m)	NUMBER	WEIGHT (kg)	REMARKS
B1	13	D	57	15	35	20			1.97	1.04	3x141	682	
B2	13	E	12	186					3.74	1.04	3x111	1 295	
B3	13	C	47	4	12	20			1.19	1.04	3x95	353	
B4	13	A	2,385						24.25	1.04	3x4	303	
B5	13	A	2,234						22.73	1.04	3x10	709	
B6	13	G	55	10					0.75	1.04	3x1	2	
B7	13	A	2,386						24.34	1.58	3x8	923	
B8	13	A	2,386						24.25	1.04	3x2	151	
B9	13	N	47	142	65				3.91	1.04	3x18	220	
B10	13	B	92	25					130	1.04	3x10	41	
B11	10	F	16	4					0.24	0.617	3x240	107	
B12	16	A	2,386						24.34	1.58	3x4	462	
B13	13	I	6	8	38				2.36	1.04	6x2	30	
B14	13	J	7	10					0.95	1.04	6x4	28	
B15	13	K	50	18					3.391	1.04	6x6	127	
B16	13	B	15						0.90	1.04	6x2	11	
B17	13	B	30						2.10	1.04	6x1	13	
											TOTAL	= 5 457	

LIST OF REINFORCING BAR OF MAIN GIRDER

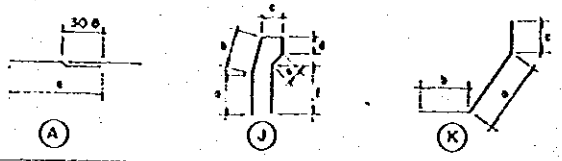


REINFORCING BAR NO.	ø (mm)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	TOTAL LENGTH (m)	UNIT WEIGHT (kg/m)	WEIGHT PER BAR	NUMBER	WEIGHT (kg)	REMARKS
S1	D16	B	130					1.30	1.58	2.054	345	709	
S2	D16	B	536					5.36	1.58	8.469	125	1059	
S3	D16	B	130					1.30	1.58	2.054	230	472	
S4	D16	B	360					3.60	1.58	5.688	121	688	
S5	D16	B	115					1.15	1.58	1.817	12	22	
S6	D10	C	27	22	5			1.06	0.56	0.608	28	17	
S7	D10	D	25	10	5			0.55	0.56	0.308	44	14	
S8	D13	A	2423					24.23	1.04	25.199	28	706	
S9	D13	A	2423					24.23	1.04	25.199	28	706	
											TOTAL	= 4451 kg	

LIST OF REINFORCING BAR OF DECK SLAB

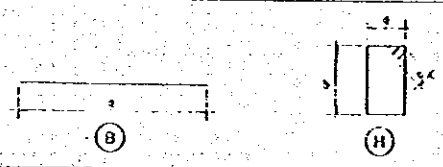
Name of Structure	SPILWAY BRIDGE	Category of calculation	REINFORCING VOLUME.	Page	3/4

LIST OF REINFORCING BAR OF HAND RAIL



REINFORCING BAR NO.	ø (mm)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	f	TOTAL LENGTH (m)	UNIT WEIGHT/m (kg/m)	NUMBER	WEIGHT (kg)	REMARKS
T1	13	J	20	35	20	15	10	30	1.30	1.04	24×20	325	
T2													
T3	13	L	12	40	15				0.87	1.04	24×20	187	
T4	13	A	2,413						24.25	1.04	24×7	353	
											TOTAL = 845 kg		

LIST OF REINFORCING BAR OF DIAPHRAGM

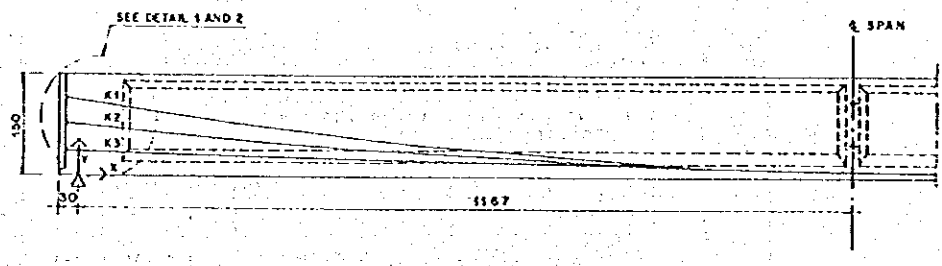


REINFORCING BAR NO.	ø (mm)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	f	TOTAL LENGTH (m)	UNIT WEIGHT/m (kg/m)	NUMBER	WEIGHT (kg)	REMARKS
D1	13	B	107						1.20	1.04	72	90	
D2	9	H	12	112	4.5				2.57	0.50	54	70	
											TOTAL = 160 kg		

REINFORCING BAR NO.	ø (mm)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	f	TOTAL LENGTH (m)	UNIT WEIGHT/m (kg/m)	NUMBER	WEIGHT (kg)	REMARKS
	▱ 145 x 100 (46)												
P1	13	B	90						0.926	1.04	276	266	
P2	13	B	130						1.36	1.04	276	390	
P3	9	I	20	10	12				0.439	0.50	184	40	
	▱ 145 x 20 (2)												
P1'	13	B	10						0.23	1.04	10	2	
P2'	13	B	130						1.43	1.04	4	6	
P3'	9	I	20	10	12				0.439	0.50	4	1	
											TOTAL = 705 kg		

LIST OF REINFORCING BAR OF PANEL PLATE

Name of Structure	SPILWAY BRIDGE	Category of calculation	REINFORCING VOLUME .	Page	4/4



CABLE ELEVATION

SCALE . A

		X	0	100	200	300	400	500	600	700	800	900	1000	1100	1167
KABLE (K3)	Y	30.0	26.9	24.1	21.6	19.2	17.2	15.4	13.9	12.6	11.6	10.8	10.3	10.0
	Z	0	1.3	3.5	5.1	6.5	7.7	8.8	9.7	10.4	11.1	11.5	11.8	12.0
KABLE (K2)	Y	65.0	56.6	48.8	41.8	33.4	29.8	24.9	20.6	17.1	14.3	12.2	10.8	10.1
	Z	0	0	0	0	0	0	-3.0	-5.5	-7.7	-9.4	-10.7	-11.5	-11.9
KABLE (K1)	Y	100	85.2	73.5	62.0	51.6	42.6	34.3	27.4	21.7	17.1	13.6	11.3	10.1
	Z	0	0	0	0	0	0	0	0	0	0	0	0	0

LIST OF CABLE COORDINATE (Cm)

REINFORCING BAR NO	ϕ (m/m)	TYPE	BENDING DIMENSION (cm) a	b	c	d	e	f	TOTAL LENGTH (m)	UNIT WEIGHT/m (kg/m)	NUMBER	WEIGHT (kg)	REMARKS
K 1	12.7	12 STIRRUPS	289.67						288.67	2/7.1077=	3	1.167	
K 2	12.7	7 STIRRUPS	168.24						168.24	0.774	3	657	
K 3	12.7	12 STIRRUPS	289.03						289.03	2/7.1077=	3	1.151	
											TOTAL	2.965	kg

LIST OF PC CABLE OF MAIN GIRDER

4.2 Approach Bridge to Goa Kreo Cave

BILL OF QUANTITIES FOR APPROACH BRIDGE TO GOA KREO CAVE

Item No.	Description	Unit	Quantity
A.1	Preparatory Works		
A.1.1	Temporary Construction Road	L.S.	
A.2	Bridge and Approach Road		
	(Superstructure)		
A.2.1	Concrete, Type B including Formwork	m^3	99
A.2.2	Deformed Reinforcing Bars	kg	17,616
	formwork for A.1.4	m^2	663
A.2.3	Asphalt Concrete	tonne	23
A.2.4	Expansion Joint	m	10
A.2.5	Hand Rail	kg	476
A.2.6	Drain Pipe, PVC Pipe Dia. 100 mm	m	48
A.2.7	Elastometric Bearing Pad (316 x 316)	No.	16
	(Substructure and Approach Road)		
A.2.8	Stripping of Top Soil	m^3	47
A.2.9	Excavation	m^3	1,023
A.2.10	Backfilling	m^3	879
A.2.11	Embankment	m^3	103
A.2.12	Concrete, Type C-1 including Formwork	m^3	155
	formwork	m^2	410
	scaffolding	m^2	43
A.2.13	Deformed Reinforcing Bars	kg	11,473
A.2.14	Leveling Concrete, Type E	m^3	8
A.2.15	Wet Stone Masonry	m^3	136
A.2.16	Weep Hole, Dia. 50 mm	No.	70
A.2.17	Asphalt Concrete	tonne	18
A.2.18	Gravell	m^3	31
A.3	Gate Relocation		
A.3.1	Demolition of Existing Gate	L.S.	
A.3.2	Excavation	m^3	14
A.3.3	Concrete, Type C-1 including Formwork	m^3	6
	formwork	m^2	2
A.3.4	Wet Stone Masonry Reconstruction	m^3	7
A.3.5	Temple Stone Reconstruction	m^3	21

THE SUMMARY TABLE of SUPERSTRUCTURE

NAME and KIND			Concrete 400 m3	Concrete 250 m3	Reinforcement kg	PC cable 7T12.7 kg	PC cable 12T12.7 kg	PC cable 1T12.5 kg	Form m2	pavement m3	Expansion joint m	Road rail m	Drain pipe m	Bearing shoe size mm	Bearing shoe Number	Note
Spillway	1	Pc														
Gua kureo	1	Rc	—	24.833	4.404	—	—	—	165.67	2.550	4.00	34.00	12.00	316x316	4	
	2	Rc	—	24.833	4.404	—	—	—	165.67	2.550	2.00	34.00	12.00	316x316	4	
	3	Rc	—	24.833	4.404	—	—	—	165.67	2.550	2.00	34.00	12.00	316x316	4	
	4	Rc	—	24.833	4.404	—	—	—	165.67	2.550	2.00	34.00	12.00	316x316	4	
	total			99.332	17.616				662.68	10.200	10.00	136.00	48.00		16	
simon weir	1	Rc										(34.00)				
	2	Pc														
	3	Pc														
	4	Pc														
	5	Rc														
	6	Rc														
	7	Rc														
	total															
Asin	no1	Pc														
	no2	Pc														
	pump	Pc														
	total															
SYNTHETIC TOTAL																

Name of Structure	APPROACH BRIDGE TO KREO CAVE	Category of calculation		Page	2/19

SUMMARY OF BILL QUANTITY.

I. CONCRETE.

1. Slab	:	12.121 m^3.
2. Beam.	:	11.973 m^3.
3. Diaphragm.	:	0.739 m^3.
	Σ :	24.833 m^3.

II. FORM WORK.

1. Slab.	:	76.240 m^2.
2. Beam.	:	83.128 m^2
3. Diaphragm	:	6.30 m^2.
	Σ :	165.67 m^2.

III. REINFORCING.

1. Beam.	:	2523. kg.
2. Slab.	:	812 kg.
3. Diaphragm.	:	134 kg.
4. Curb.	:	930 kg.
	Σ :	4404 kg.

Name of Structure		Category of calculation		Page	3/19

(IV). Pavement : 2.55 m^3

(V). PVC. Drainage pipe : 12.00 m.

(VI). Hand rail : 32.00 m.

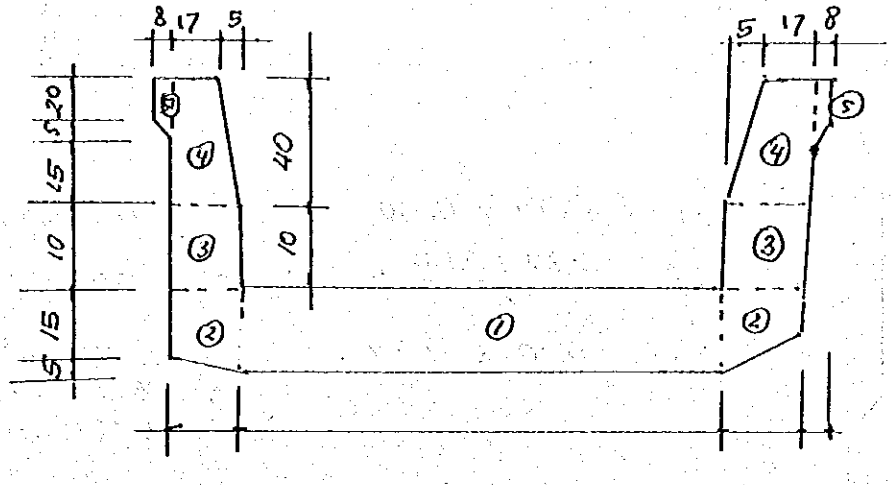
(VII). Expansion joint : 4.00 m.

(VIII). Bearing shoe : 4 nos.

Name of Structure	APPROACH BRIDGE TO GUA LEGO CANG	Category of calculation	CONCRETE VOLUME.	Page	X. 4/9

(I) CONCRETE VOLUME.

(1) Slab and curb.



(1) $0.20 * 0.200 = 0.40\ m^2$. ✓

(2) $\frac{0.15 * 0.20}{2} * 0.22 * 2 = 0.077\ m^2$ ✓

(3) $0.22 * 0.10 * 2 = 0.044\ m^2$. ✓

(4) $\frac{0.17 + 0.22}{2} * 0.40 * 2 = 0.156\ m^2$. ✓

(5) $\frac{0.20 + 0.25}{2} * 0.08 * 2 = 0.036\ m^2$ ✓

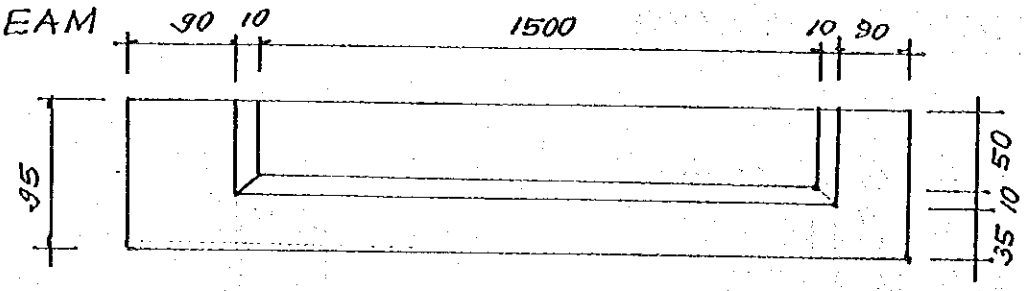
Total = $0.713\ m^2$. ✓

Length of spans L = 17.00 m.

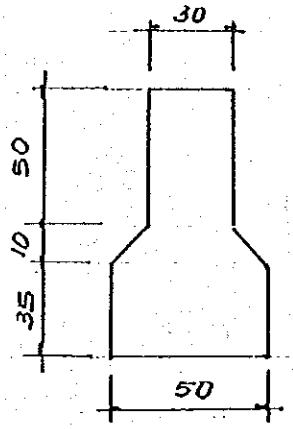
Volume Σ A. L = $0.713 * 17 = \boxed{12.121\ m^3}$ ✓

Name of Structure	APPROACH BRIDGE TO GUA KREO CAVE	Category of calculation	CONCRETE VOLUME.	Page	25/19

2. BEAM



CENTRE OF BEAM.



$A_1 = 0.35 * 0.50 = 0.175\ m^2$. ✓

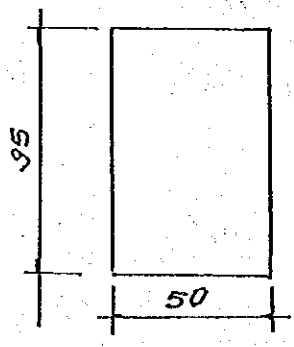
$A_2 = \frac{0.30 + 0.50}{2} * 0.10 = 0.040\ m^2$. ✓

$A_3 = 0,30 * 0,50 = 0,150\ m^2$ ✓

$\Sigma A = 0,365\ m^2$. ✓

$V_1 = 0,365 * 15.00 = 5.475\ m^3$. ✓

END OF BEAM.



$A = 0.50 * 0,95 = 0,475\ m^2$

Volume :

$V_2 = 0,475 * 0.90 + \frac{0,475 + 0,365}{2} * 0,10 * 2 = 0,512\ m^3$ ✓

TOTAL VOLUME OF BEAM

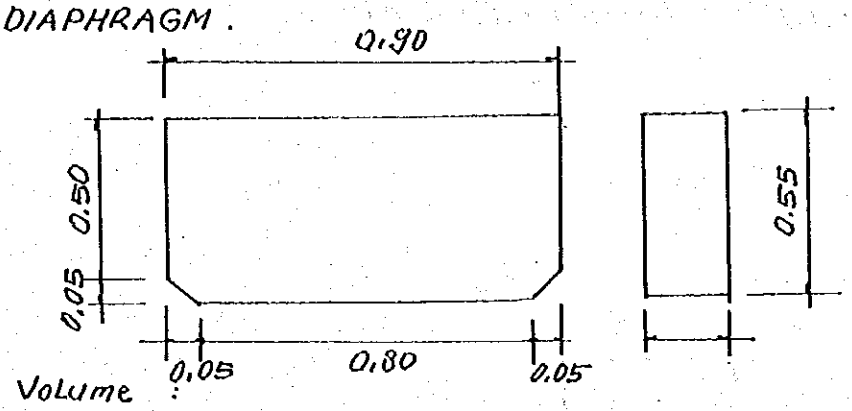
$\Sigma V = V_1 + V_2 = 5.475 + 0,512 = 5.986\ m^3$. ✓

Number of Beam : 2.

Total Volume of beam = $2 * 5.9865 =$ **11.973 m^3**.

Name of Structure	APPROACH BRIDGE TO GUA KRED CAVE	Category of calculation	CONCRETE VOLUME.	Page	36/15.

3. DIAPHRAGM.



Volume :

$= 0.30 * 0.55 * 0.90 - 2(0.50 * 0.05 * 0.050 * 0.30)$

$= 0.1478\ m^3$. /

Number of Diaphragm : 5 NOS.

Total volume of Diaphragm : $5 * 0.1478$

$= 0.739\ m^3$. ✓

Total Volume Concrete K.200 = $24.833\ m^3$.

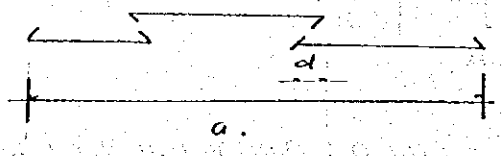
1.	SLAB and CURB	:	$12.121\ m^3$.
2.	BEAM	:	$11.973\ m^3$
3.	DIAPHRAGM	:	$0.739\ m^3$.
		Σ =	$24.833\ m^3$. /

Name of Structure		Category of calculation		Page	9 1

(II) BRIDGE REINFORCEMENT.

1. BEAM.

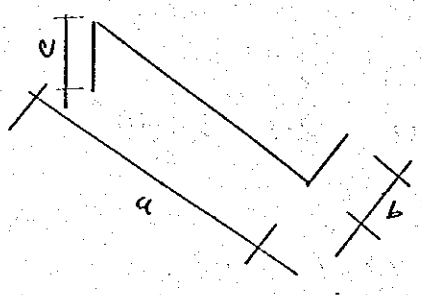
(B1)



a = 1694 cm.
d = 150 cm.
Hook : 45 cm.
Total length : a + d + hook.

1694 + 150 + 45 = 1889 cm
= 18.89 m.

(B2)

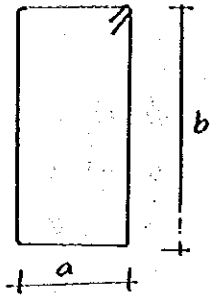


a = 160 cm.
b = 40 cm
c = 37.5 cm.
Hook : 15 cm.

Total. a + b + c + Hook.
= 160 + 40 + 37.5 + 15
= 252,5 cm
= 2.53 m. ✓

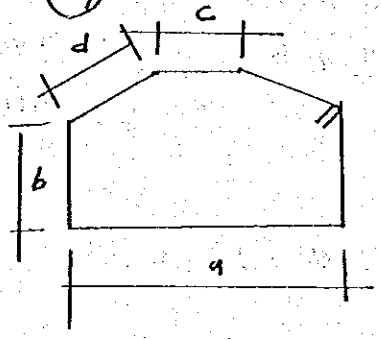
Name of Structure	APPROACH BRIDGE TO GUA KREO CAVE	Category of calculation	REINFORCEMENT VOLUME .	Page	10 /

B.3



a : 24 cm
b : 109 cm .
Hook : 6 cm .
Total length : 2a + 2b + Hook .
: 2*24 + 2*109 + 6
= 272,0 cm
= 2..720 m . ✓

B4

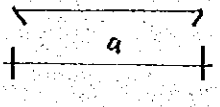


a = 44 cm .
b = 29 cm .
c, 24 cm .
d = 12 cm !
Hook : 6 cm !
total length : a + 2b + c + 2d + Hook .
=44 + 2*29 + 24 + 2*12+6
= 156 cm
= 1.56 m ✓

B31

a = 44 cm .
b : 109 ; cm
Hook : 6 cm .
Total length : 2a + 2b + Hook .
: 2 . 44 + 2 * 109 + 6
= 312.. cm .
= 3.12.. m /.

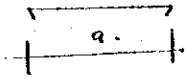
B5



a : 44 cm .
Hook : 6 cm .
Total length : a + Hook
= 44 + 6 = 50 cm
: 0.50 m ✓

Name of Structure	APPROACH Bridge TO GUA KREO CAVE	Category of calculation	Reinforcement Volume .	Page	11 1

B7'



a = 24 cm .

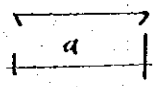
Hook = 6 cm .

Total length : a + Hook .

24 + 6 cm = 30 cm .

= 0,3 m . ✓

B86



a = 94 cm .

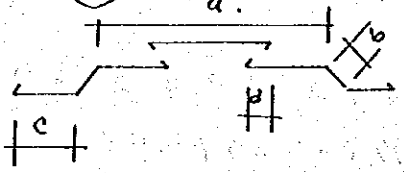
Hook : 6cm .

Total length : a + Hook .

: 89. + 6 cm = 95 cm .

= 0,95 m . ✓

B6'



a = 1500 cm . Hook : 18 cm .

b = 14. cm .

c : 87. cm .

d : 150 cm .

Total length : a + 2b + 2c + Hook .

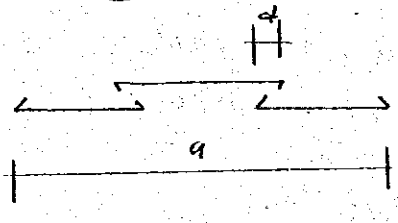
= 1500 + 2 * 14 + 2 * 87

+ 150 + 18

= 1870 cm .

= 18.70 m .

B7'



a : 1560 cm . Hook : 18 cm .

d , 150

Total length : a + d + Hook .

: 1560 + 150 + 18

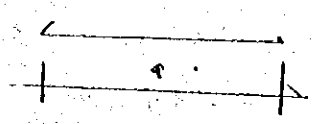
: 1728 cm .

: 17.28 m .

Name of Structure	APPROACH BRIDE TO GUA KREO CAVE	Category of calculation		Page	12 1

(2) DIAPRHAGM :

(D1)



a : 120 cm. ✓ Hook :

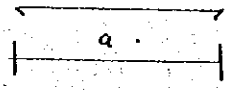
Total length : a + Hook.

= 120 + 9.6 =

= 129.6 cm,

= 1,296 m ✓

(D2)



a = 120 cm. Hook = 7.2 cm.

Total Length : a + Hook

: 120 + 7.2 cm.

= 127.2 cm.

= 1.272 cm. ✓

(D3)

a = 24 cm.

b = 49 cm.

Hook : 7.2 cm.

Total length : 2a + 2b + Hook.

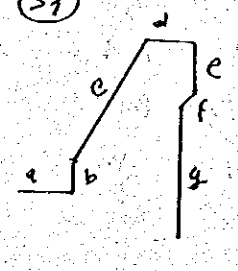
: 2 x 24 + 2 x 49 + 7.2

= 153.2 cm.

= 1.532 cm. ✓

(3) Curb and Slab.

(S1)



a = 35 e = 14

b = 10 f = 6

c = 45 g = 40

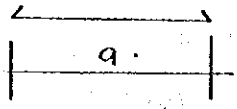
d = 20 hook = 7.2

Total length : = 1772 cm

= 17.72 m ✓

Name of Structure	APPROACH BRIDGE TO GUA KREO CAVE	Category of calculation	REINFORCEMENT VOLUME.	Page	13

(S2)



a : 16 cm.

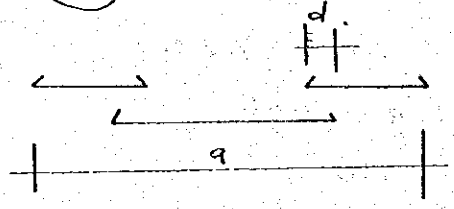
Hook 7.2 cm.

Total length : a + hook.

: 16 + 7.2 cm = 23.2 cm.

: 0.232 m. ✓

(S3)



a : 1694 cm. d : 150 cm. /

Hook : 14.4 cm.

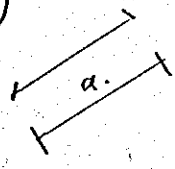
Total length : a + d + Hook.

= 1694 + 150 + 14.4

= 1858,40 cm.

= 18,584 m. /

(S4)



a = 50 cm.

Hook : 7.2 cm.

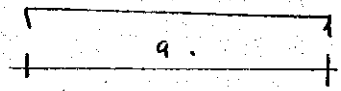
Total length : a + hook

= 50 + 7.2 : 57.2 cm.

= 0.572 m. /

(3) Slab :

(Tua)



a = 238 cm.

Hook : 7.2 cm.

total length : a + Hook

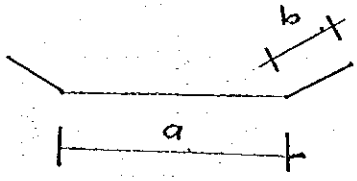
= 238 + 7.2 cm :

: 245,2 cm.

= 2.452 m /

Name of Structure	APPROACH BRIDGE TO GUA KRED CAVE	Category of calculation	Reinforcement Volume.	Page	14

Tub



a : 200 cm.

b = 24 cm.

Hook : 7.2 cm.

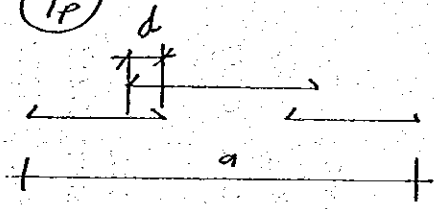
total length : a + 2b + Hook.

= 200 + 24 x 2 + 7.2

= 255,2 cm.

= 2,552 m.

Tp



a = 1694 cm.

Hook : 21.6 cm.

d : 150 cm.

Total length : a + d + Hook

1694 + 150 + 21.6

= 1851.2 cm

= 18.512 m.

EXPANSION JOINT WITH CLOSING PRESS. TYPE

a : 200 cm.

Number of expansion joint : 5

Total length : 5 * 2 * 200 = 2000 cm

= 20 m.

REINFORCEMENT BAR OF APPROACH BRIDGE TO GUA KREO CAVE.

REINF NO	DIA	TYPE	BENDING DIMENSION (cm) a	b	c	d	hook	TOTAL LENGTH (m)	WEIGHT (kg/m)	NUMBER	NO OF BEAM	TOTAL WEIGHT (kg).	REMARK.
	22	B_1	1694	-	-	150	45	18.890	3.850	10	2	1454.53	
	22	B_2	160	40	38		15	2.530	3.850	8	2	155.85	
BEAM	10	B_3	24	109	-	-	6	2.720	0.616	102	2	341.81	
	10	B_3'	44	109	-	-	6	3.120	0.616	28	2	107.63	
	10	B_4	44	29	24	12	6	1.560	0.616	102	2	196.04	
	10	B_5	44	-	-	-	6	0.500	0.616	158	2	97.33	
	10	B_5'	24	-	-	-	6	0.300	0.616	102	2	37.70	
	10	B_6	89	-	-	-	6	0.950	0.616	4	2	4.682	
	10	B_6'	1500	14	87	150	18	18.700	0.616	2	2	46.08	
	10	B_7	1500	-	-	150	18	17.280	0.616	4	2	85.156	
													2528.
	16	D_1	120	-	-	-	9.6	1296	1.577	8	5	81.752	
DIAP.	12	D_2	120	-	-	-	7.2	1.272	0.887	2	5	11.283	
	12	D_3	24	49	-	-	7.2	1.532	0.887	6	5	40.767	
													134.
SLAB	12	T_{ua}	238	-	-	-	7.2	2.452	0.887	86	1	187.04	
	12	T_{ub}	200	24	-	-	7.2	2.552	0.887	86	1	194.67	
	12	Tp.	1694	-	-	150	21.6	18.656	0.887	26	1	430.25	
													812.

Name of Structure	APPROACH BRIDGE TO GUA KREO CAVE
Category of calculation	CONCRETE REINFORCEMENT
Page	15/19.

Name of Structure	APPROACH BRIDE TO GUA KREO CAVE	Category of calculation	CONCRETE REINFORCEMENT	Page	HQ.15/19

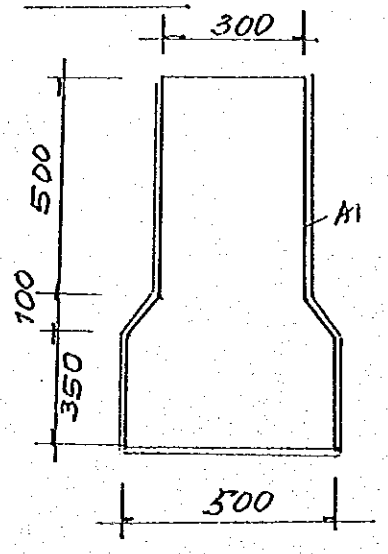
REINFORCEMENT BAR OF APPROACH BRIDGE TO KREO CAVE.
CONTINUE

REINF NO	DIA	TYPE	BENDING DIMENSION (cm) a	b	c	d	hook	TOTAL LENGTH (m)	WEIGHT (Kg/m)	NUMBER	NO OF BEAM	TOTAL WEIGHT (kg).	REMARK.
CURB/	12	S_1	170	–	–	–	7.2	1.772	0,887	172	2	540.687	
RAILING	12	S_2	16	–	–	–	7.2	0.232	0,887	172	2	70.79	
	12	S_3	1694	–	–	150	14.4	18.584	0,887	7	2	230.78	
	12	S_4	50	–	–	–	7.2	0.572	0,887	86	2	87.27	
													130
											TOTAL	4402.07	4404.

Name of Structure		Category of calculation		Page	16 | 15

(III) Form Work.

FOR BEAM.



CENTRE SPANS..

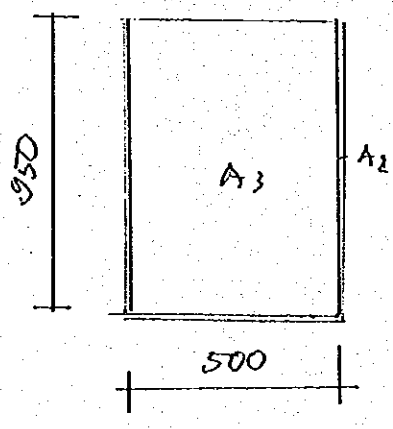
$L = 500 \times 2 + 141.42 * 2 + 350 * 2 + 500 = 2.482,84 \text{ mm}.$

$= 2,4828 \text{ m}.$

Length : 150 m.

$A_1 = 2.4828 * 15 = 37.230 \text{ m}^2$.

END OF BEAM.



L: $0,45 * 2 + 0,5 = 2,4$ m.

Length : 1,41 m.

$A_2 = 1,41 * 2.4 = 3.384 \text{ m}^2$.

SIDE END BEAM.

$A_3 = 0.5 * 0,95 * 2 = 0,95 \text{ m}^2$.

Total Form of Beam :

$A_1 = 37.230 \text{ m}^2$

$A_2 = 3.384 \text{ m}^2$

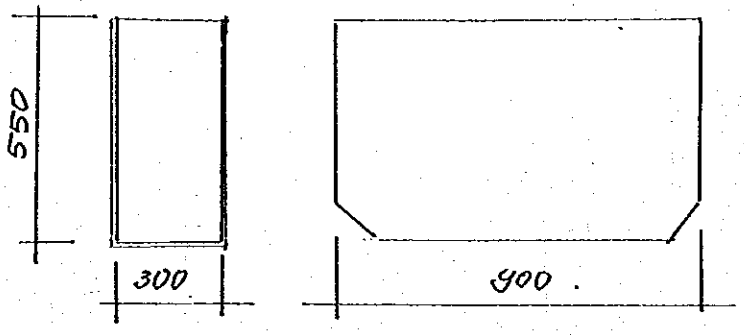
$A_3 = 0,95 \text{ m}^2$.

$\Sigma A = 41.564 \text{ m}^2$.

Number of Beam : $2 * A = 2 * 41,564 =$ **83.128 m²**.

Name of Structure		Category of calculation		Page	17 19

- DIAPHRAGM.



$L = 0.55 \times 2 + 0.30 = 1.40\ m.$

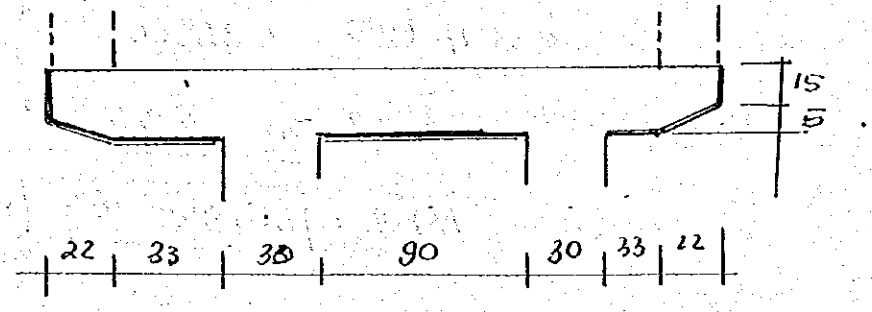
Length Diaphragma : 0.90 m

$A = 0.90 * 1.40 = 1.26\ m^2.$

Number of dia : 5

$\Sigma A = 5 * 1.26 = \boxed{6.3\ m^2}$ /

- SLAB AND Hand rail.



$L = 2 * 0.15 + 2\sqrt{0.05^2 + 0.22^2} + 2 \times 0.33 + 0.90 = 2.3112\ m$ /

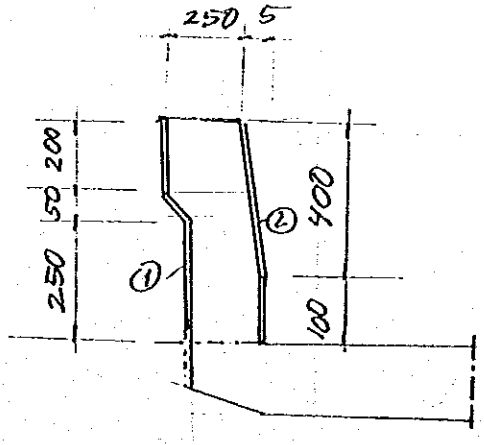
Length of slab = 17 m :

Area of Form = $17 * 2.3112 = 39.291\ m^2$

End of plate : $0.20 * 2.60 \times 2 = 1.040\ m^2$

total: $\boxed{40.331\ m^2}$ /

Name of Structure		Category of calculation		Page	18/19



L_1 = 025 + 0.20 + $\sqrt{0.05^2 + 0.08^2}$ = 0,544 m ✓

L_2 = 0,10 + $\sqrt{0.40^2 + 0.05^2}$ = 0,503 m.

ΣL = 1,0473 m ✓

Leng of Curb = 17 m.

A = 17 * 1.04734 = 17,805 m^2. ✓

Number of Curb = 2.

A = 2 * 17.805 = 35.609 m^2 ✓

End of curb : 2 * 0.3 * 0.5 = 0.30 m^2

total : 35,909 m^2 ✓

Total Area of Form Work

1. Beam = 83,128 m^2. ✓
2. Diaphragm = 6.30 m^2. ✓
3. Slab = 40.331 m^2. ✓
4. Curb = 35.909 m^2. ✓

Σ = 165.668 m^2. ✓

Name of Structure	APROACH BRIDGE TO GOA KREO CAVE.	Category of calculation	VOLUME OF PAVEMENT.	Page	19/19

IV Pavement :

Width of traffic : 2.00 m.

length : 17.00 m.

A : $(0.03 + 0.05)/2 * 2 = 0.08\ m^2$.

Volume : $17.00 * 0.08 = 1.36\ m^3$.

V. PVC Drainage pipe

PVC ϕ 10 cm.

length : 1.20 m

Total length : $1.20 * 5 * 2 = 12.00$ m.

VI. Hand rail

length of Bridge : 17 m :

Number of handrail : 2 → right & Leyth.

length of hand rail : $2 * 17 = 34$ m.

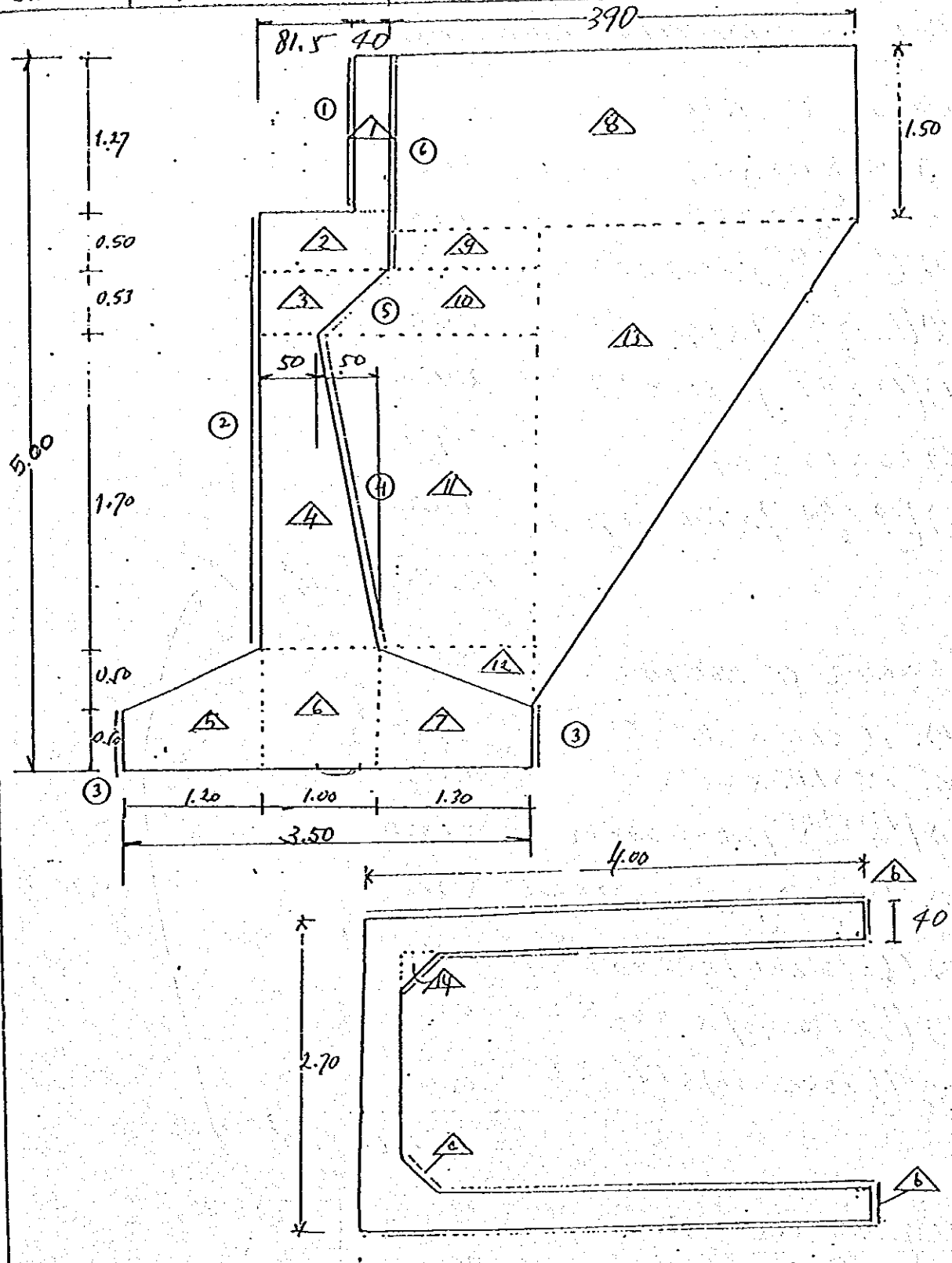
VII. Expansion joint : $2 * 2 = 4$m.

VIII. Bearing Shoe : $2 * 2 = 4$ nos.

Approach Bridge to Goa Kreo Cave (Sub-structure/Aproach Road)
Work Quantity

	stripping of top soil	excavation	backfilling	embankment	concrete	reinforcing bars	form work	scaffolding	leveling concrete	wet stone masonry	weep hole	asphalt concrete	gravel
					(C-1)				(E)		(PVC 50)		
unit	m^3	m^3	m^3	m^3	m^3	kg	m^2	m^2	m^3	m^3	No.	tonne	m^3
Abutment A-1	0	124.48	92.40	0.00	30.10	1,819.19	130.06	0.00	1.07	42.17	0	0	0
Abutment A-2	0	146.35	92.40	0.00	30.10	1,819.19	130.06	0.00	1.07	86.33	0	0	0
Pier P-1	0	168.52	155.78	0.00	19.19	1,595.15	38.60	0.00	1.37	0.00	0	0	0
Pier P-2	0	273.21	245.63	0.00	43.67	3,363.33	43.20	27.58	2.26	0.00	0	0	0
Pier P-3	0	310.72	293.27	0.00	30.68	2,587.11	39.80	14.98	1.76	0.00	0	0	0
Approach Road	47.26	0.00	0.00	103.29	1.04	289.15	27.84	0.00	0.00	7.80	70	17.71	30.78
total	47.26	1023.28	879.48	103.29	154.784	11,473.12	409.56	42.56	7.53	136.3	70	17.71	30.78

Name of Structure	CREO CAVE BRIDGE ABUTMEN NO 1.	Category of calculation	CONCRETE FOR ABUTMENT.	Page	1/20



ABUTMENT : A-1.

Name of Structure	KREO CAVE BRIDGE ABUTMENT NO. 1.	Category of calculation	CONCRETE FOR ABUTMENT.	Page	2/20

BILL OF QUANTITY ABUTMENT A-1 :

CONCRETE - K225

1) $0.4 \times 1.27 \times 2.7 = 1.3716$
2) $1.215 \times 0.5 \times 2.7 = 1.6403$
3) $\left(\frac{1.215+0.5}{2}\right) \times 0.53 \times 2.7 = 1.2271$
4) $\left[\frac{1.0+0.5}{2}\right] \times 1.70 \times 2.7 = 3.4425$
5) $\left[\frac{1.0+0.5}{2}\right] \times 1.20 \times 2.7 = 2.4300$
6) $1.0 \times 1.0 \times 2.7 = 2.700$
7) $\left[\frac{1.0+0.5}{2}\right] \times 1.30 \times 2.7 = 2.6325$

$15.4440 \ m^3$ ✓

CONCRETE OF WING WALL :

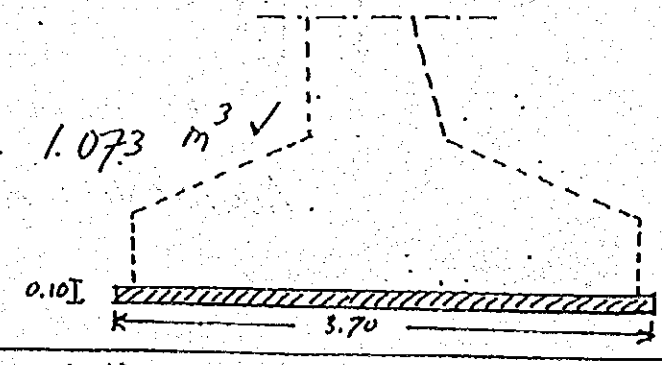
8) $4.0 \times 1.50 \times 0.40 \times 2 = 4.800$
9) $0.27 \times 1.185 \times 0.40 \times 2 = 0.2560$
10) $\left[\frac{1.80+1.185}{2}\right] \times 0.53 \times 0.40 \times 2 = 0.6328$
11) $\left[\frac{1.80+1.30}{2}\right] \times 2.70 \times 0.40 \times 2 = 3.348$
12) $\left(\frac{1}{2} \times 1.30 \times 0.50\right) \times 0.40 \times 2 = 0.260$
13) $\left(\frac{1}{2} \times 2.80 \times 4.0\right) \times 0.40 \times 2 = 4.480$
14) $\left(\frac{1}{2} \times 0.40 \times 0.40\right) \times 5.50 \times 2 = 0.880$

$= 14.6568 \ m^3$

30.1008

LEVELING CONCRETE

$0.10 \times 3.70 \times 2.90 = 1.073 \ m^3$ ✓



Name of Structure	KREO CAVE BRIDGE ABUTMENT NO. 1.	Category of calculation	FORM AREA FOR ABUTMENT	Page	3/20

FORM AREA OF ABUTMENT

① $1.27 \times 2.70 = 3.429$ ✓
② $3.73 \times 2.70 = 10.071$ ✓
③ $0.50 \times 2.70 \times 2 = 2.700$ ✓
④ $2.75 \times 2.70 = 7.425$ ✓
⑤ $0.81 \times 2.70 = 2.187$ ✓
⑥ $1.77 \times 2.70 = 4.779$ ✓

$= 30.591 \ m^2$ ✓

△1. $0.3 \times 1.27 \times 2 = 1.016$
△2. $1.115 \times 0.5 \times 2 = 1.215$
△3. $\frac{1.115 + 0.5}{2} \times 0.53 \times 2 = 0.909$
△4. $\frac{0.5 + 1.0}{2} \times 2.7 \times 2 = 4.0500$
△5. $\frac{0.5 + 1.0}{2} \times 1.20 \times 2 = 1.800$
△6. $1.0 \times 1.0 \times 2 = 2.000$
△7. $\frac{0.5 + 1.0}{2} \times 1.30 \times 2 = 1.950$

$= 12.940 \ m^2$

FORM AREA OF WING WALL :

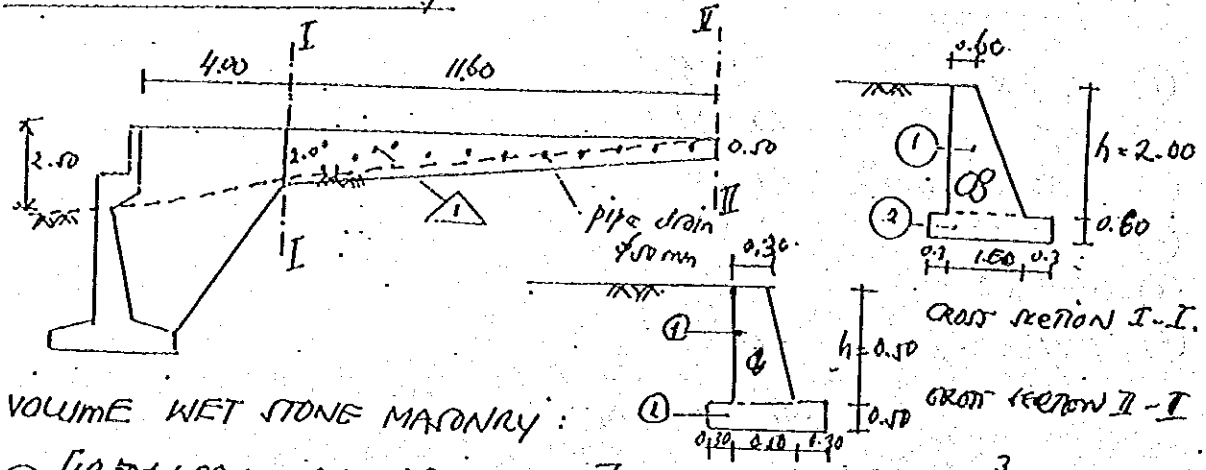
△8 $(4.0 \times 1.50 \times 2) \times 2 = 24.00$
△9 $(0.27 \times 1.185 \times 2) \times 2 = 1.280$
△10 $\left(\frac{1.8 + 1.185}{2} \times 2\right) \times 2 \times 0.53 = 3.164$
△11 $\left(\frac{1.8 + 1.30}{2} \times 2.7 \times 2\right) \times 2 = 16.740$ ✓
△12 $\left[\left(\frac{1}{2} \times 1.30 \times 0.50\right) \times 2\right] \times 2 = 1.300$ ✓
△13 $\left(\frac{1}{2} \times 2.80 \times 4.0 \times 2\right) \times 2 = 22.400$
△a $(0.442 \times 5.50 \times 2) \times 2 = 12.485$
△b $[0.44 \times (1.50 + 5.0)] \times 2 = 5.200$ ✓

$= 86.529 \ m^2$ ✓

TOTAL FORM AREA : $30.591 + 12.940 + 86.529 = 130.060 \ m^2$ ✓

Name of Structure	KREO CAVE BRIDGE ABUTMENT No. 1.	Category of calculation	WET STONE MASONRY FOR ABUTMENT.	Page	4/20

WET STONE MASONRY



*) VOLUME WET STONE MASONRY :

① $\left[\left(\frac{0.50+1.00}{2}\right) \times \left(\frac{2.0+0.5}{2}\right) \times 11.60\right] \times 2 = 21.750\ m^3.$

② $(0.55 \times 1.60 \times 11.60) \times 2 = 20.416\ m^3.$

$= 42.166\ m^3$ /+

- EMBANKMENT :

△1 $\left(\frac{1}{2} \times 2.50 \times 15.60\right) \times 2,10 = 40.950\ m^3.$ ✓

- PIPE DRAIN PVC ϕ50 mm. Length : 1000 mm.

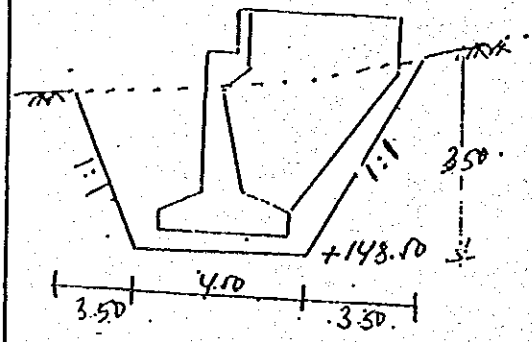
12 x 2 = 24 piece. /

12 x 2 = 24 unit palmfibre. /

- EXCAVATION

$(0.50 \times 1.80 \times 11.60) \times 2 = 20,88\ m^3.$ /

- EXCAVATION AT ABUTMENT.



VOLUME : $\left[\left(\frac{11.50+4.5}{2}\right) \times 3.50\right] \times 3.70\ m^3$

$= 103,600\ m^3.$ ✓

TOTAL EXCAVATION = 20,88 + 103,600 = 124,480 m^3 /

Name of Structure	KREO CAVE BRIDGE ABUTMENT No. 1.	Category of calculation	VOLUME OF BACK FILLING	Page	-5/20

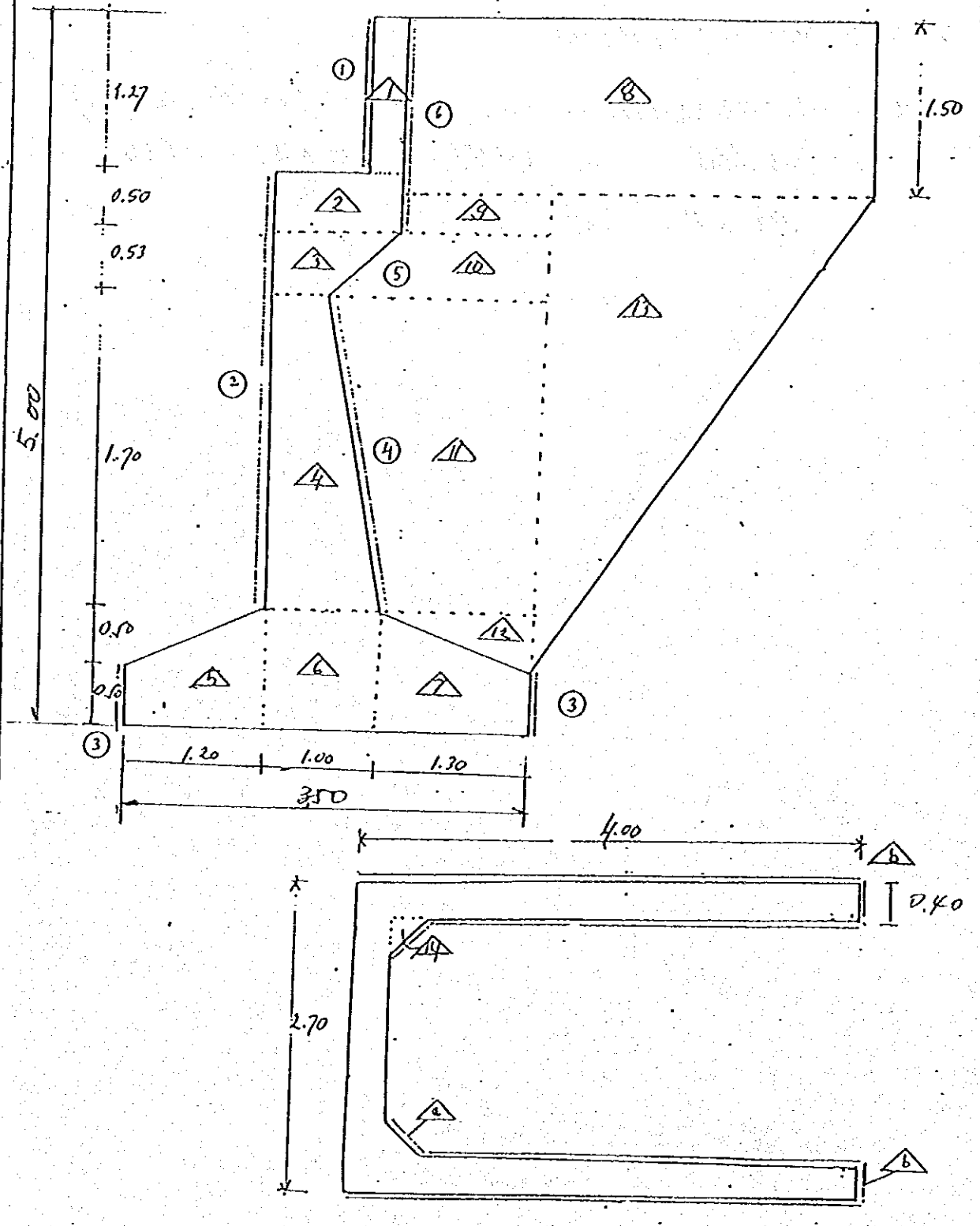
VOLUME OF BACKFILLING

VOL = VOL. EXCAVATION − VOL. ABUTMENT. (A + A + A + A)

= 103.600 − (3.4425 + 2.43 + 2.70 + 2.6325)

= 92.395 M^3.

Name of Structure	KREO CAVE BRIDGE ABUTMENT NO. 2:	Category of calculation	CONCRETE FOR ABUTMENT	Page	6/20



ABUTMENT : A-2

Same with abutment no 1.

Name of Structure	KREO CAVE BRIDGE ABUTMENT No. 2.	Category of calculation	CONCRETE FOR ABUTMENT.	Page	7/20

BILL OF QUANTITY ABUTMENT A-2 :

CONCRETE - K225

1) $0.4 \times 1.27 \times 2.7 = 1.3716$ ✓
2) $1.75 \times 0.5 \times 2.7 = 1.6403$ ✓
3) $\left(\frac{1.75+0.5}{2}\right) \times 0.53 \times 2.7 = 1.2251$ ✓
4) $\left[\frac{1.0+0.5}{2}\right] \times 1.70 \times 2.7 = 3.4425$ ✓
5) $\left[\frac{1.0+0.5}{2}\right] \times 1.20 \times 2.7 = 2.4300$ ✓
6) $1.0 \times 1.0 \times 2.7 = 2.700$ ✓
7) $\left[\frac{1.0+0.5}{2}\right] \times 1.30 \times 2.7 = 2.6325$ ✓

$15.4440 \ m^3$ ✓

CONCRETE OF WING WALL :

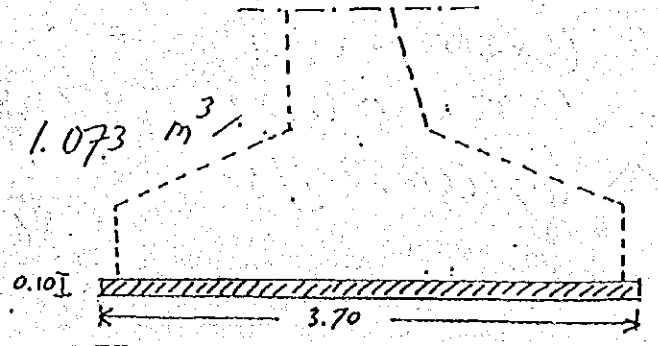
8). $4.0 \times 1.50 \times 0.4 \times 2 = 4.80$ ✓
9). $0.27 \times 1.185 \times 0.4 \times 2 = 0.256$ ✓
10). $\left[\frac{1.80+1.185}{2}\right] \times 0.5 \times 0.4 \times 2 = 0.6328$ ✓
11). $\left[\frac{1.80+1.30}{2}\right] \times 2.70 \times 0.4 \times 2 = 3.348$ ✓
12). $\left(\frac{1}{2} \times 1.30 \times 0.50\right) \times 0.40 \times 2 = 0.260$ ✓
13). $\left(\frac{1}{2} \times 2.80 \times 4.0\right) \times 0.40 \times 2 = 4.480$ ✓
14). $\left(\frac{1}{2} \times 0.4 \times 0.4\right) \times 5.50 \times 2 = 0.880$ ✓

$= 14.6568 \ m^3$ ✓

30.1008

LEVELING CONCRETE

$0.10 \times 3.70 \times 2.90 = 1.073 \ m^3$ ✓



Name of Structure	KREO CAVE BRIDGE ABUTMENT NO. 2.	Category of calculation	FORM AREA FOR ABUTMENT.	Page	8/20

FORM AREA OF ABUTMENT

① $1.27 \times 2.70 = 3.429$ ✓
② $3.73 \times 2.70 = 10.071$ ✓
③ $0.50 \times 2.70 \times 2 = 2.700$ ✓
④ $2.75 \times 2.70 = 7.425$ ✓
⑤ $0.81 \times 2.70 = 2.187$ ✓
⑥ $1.77 \times 2.70 = 4.779$ ✓

$= 30.591\ m^2$ ✓

1. $0.4 \times 1.27 \times 2 = 1.016$ ✓
2. $1.215 \times 0.5 \times 2 = 1.215$ ✓
3. $\frac{1.215 + 0.5}{2} \times 0.53 \times 2 = 0.9090$ ✓
4. $\frac{0.5 + 1.0}{2} \times 1.7 \times 2 = 4.0500$ ✓
5. $\frac{0.5 + 1.0}{2} \times 1.20 \times 2 = 1.800$ ✓
6. $1.0 \times 1.0 \times 2 = 2.000$ ✓
7. $\frac{0.5 + 1.0}{2} \times 1.30 \times 2 = 1.950$ ✓

$= 12.960\ m^2$ ✓

FORM AREA OF WING WALL :

8. $(4.0 \times 1.50 \times 2) \times 2 = 24.00$ ✓
9. $(0.27 \times 1.185 \times 2) \times 2 = 1.280$ ✓
10. $\left(\frac{1.8 + 1.185}{2} \times 2\right) \times 2 \times 0.53 = 3.164$ ✓
11. $\left(\frac{1.8 + 1.30}{2} \times 2.7 \times 2\right) \times 2 = 16.740$ ✓
12. $\left[\left(\frac{1}{2} \times 1.30 \times 0.50\right) \times 2\right] \times 2 = 1.300$ ✓
13. $\left(\frac{1}{2} \times 2.80 \times 4.0 \times 2\right) \times 2 = 22.400$ ✓
- $(0.442 \times 5.50 \times 2) \times 2 = 12.496$ ✓
- $\left[0.4 \times (1.50 + 5.0)\right] \times 2 = 5.20$ ✓

$= 86.529\ m^2$ ✓

TOTAL FORM AREA : $30.591 + 12.960 + 86.529 = 130.080\ m^2$ ✓

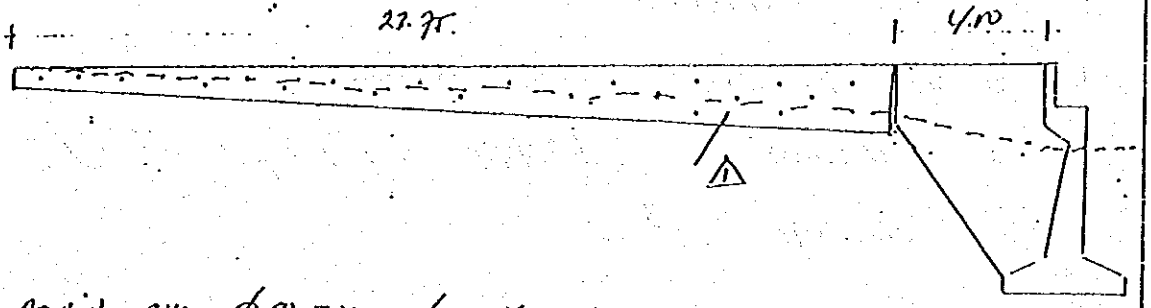
Name of Structure	KREO CAVE BRIDGE ABUTMENT NO. 2.	Category of calculation	WET STONE MASON. Ry. PR. ABUTMENT.	Page	9/20

VOLUME WET STONE MASONRY

$\left[\frac{0.5+1.00}{2} \times \frac{2.0+0.5}{2} \times 23.75\right] \times 2 = 44.531$

$[0.55 \times 1.60 \times 23.75] \times 2 = 41.800$

$86.331\ M^3$. ✓



PIPE DRAIN PVC ϕ50 mm Length : 1000 mm.

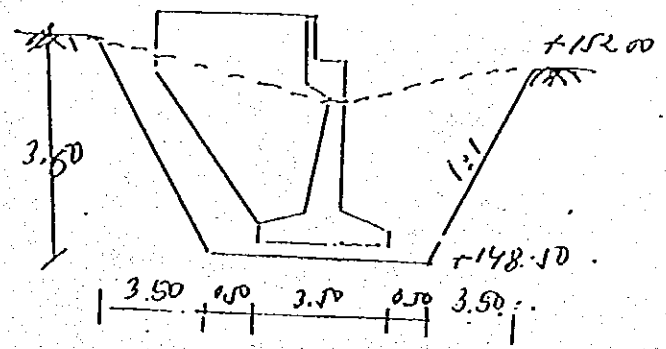
23 X2 = 46 piece

23 X2 = 46 unit palm fibre ✓

EXCAVATION OF WET STONE MASONRY:

$(0.50 \times 1.80 \times 23.75) \times 2 = 42.75\ M^3$. ✓

EXCAVATION OF ABUTMENT:



VOLUME. $\left[\frac{11.50+4.50}{2} \times 3.50\right] \times 3.70 = 103.600\ M^3$.

TOTAL EXCAVATION = 42.75 + 103.600 = 146.350 M^3 ✓

Name of Structure	KRSO CKVE BRIDGE ABUTMENT No. 2.	Category of calculation	EMBANKMENT FOR ABUTMENT.	Page	10 / 20

VOLUME OF EMBANKMENT.

① $\left(\frac{2.00 + 0.50}{2} \times 2.10 \times 23.75\right) = 62.344\ m^3$. ✓

VOLUME OF BACKFILLING :

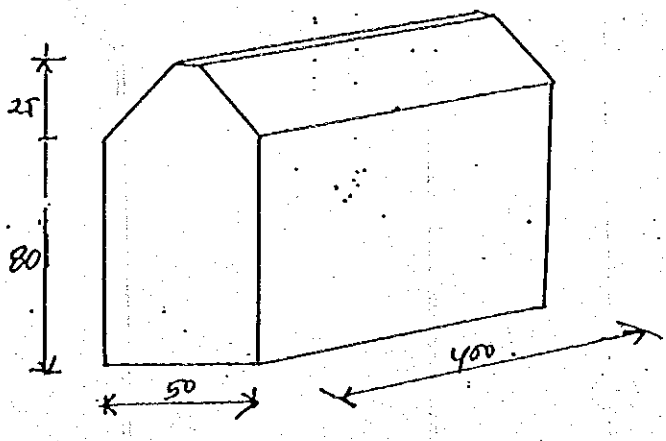
VOL = VOL. EXCAVATION − VOL. ABUTMENT.

= 103.600 − (3.4425 + 2.43 + 2.70 + 2.6325).

= 92.395 m^3. ✓

Name of Structure	KREO CAVE BRIDGE PARAPET.	Category of calculation	WET STONE MASONRY FOR PARAPET	Page	11/20

VOLUME WET STONE MASONRY FOR PARAPET



Stripping
$(11.30+23.45)\times(3.6+3.2)\times0.2 = 49.26\ m^3$

Grovel
$3.6\times(11.30+23.45+8)\times0.2 = 30.78\ m^3$

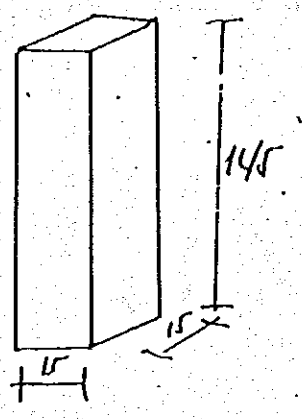
Pavement
$3.6\times(11.3+23.45+8)\times0.05 = 7.70\ m^3$

VOLUME = $(0.8\times0.50\times4)\ *\ 4$ = 6.400 m^3

$\left(\frac{0.50+0.20}{2}\times0.25\right)\ *\ 4\ *\ 4$ = 1.400 m^3.

= 7.800 m^3 ✓

VOLUME POST CONCRETE



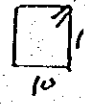
VOLUME CONCRETE = $(0.15\times0.15\times1.45)\times(22+10)$.

= 1.044. m^3. ✓

Form Work = $0.15\times1.45\times4\times(22+10)$

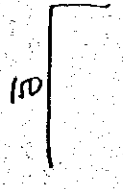
VOLUME STEEL : = 27.8 $\times m^2$

$\phi8-100$: $[(0.10\times4)\ *\ \frac{1}{4}\pi.0.0^2\ *7850]\ *\ 15\ *\ 32$.



= 75.76. kg.

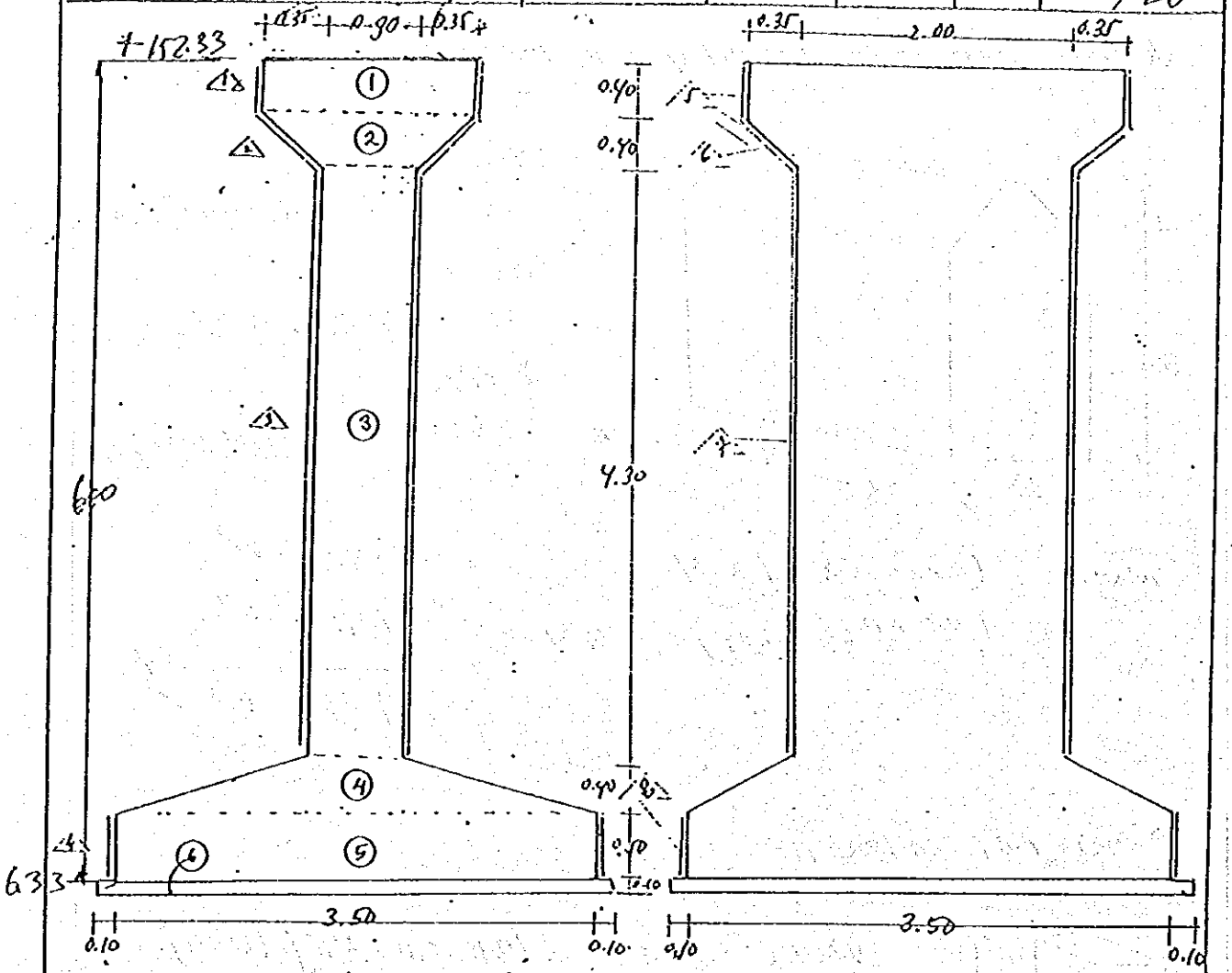
$4\phi13$: $[(1.60\times4)\ *\ \frac{1}{4}\pi0.013^2\ *7850]\times32$.



= 213.39 kg.

TOTAL STEEL : 75.76 + 213.39 = 289.15 kg. ✓

Name of Structure	APPROACH BRIDGE TO GOA KREO CAVE.	Category of calculation	CONCRETE Volume of Pier 1.	Page	12/20



BILL OF QUANTITY OF PIER-1

CONCRETE - K 225 :

(1)	$1.60 \times 0.4 \times 2.70$	=	1.728
(2)	$\frac{1.60+0.90}{2} \times 0.40 \times \frac{2.70+2.0}{2}$	=	1.175
(3)	$0.90 \times 4.30 \times 2.0$	=	7.740
(4)	$\frac{0.90+3.50}{2} \times 0.40 \times \frac{2.0+3.50}{2}$	=	2.420
(5)	$3.50 \times 0.50 \times 3.50$	=	6.125
			19.188 m^3 ✓

LEVELING CONCRETE

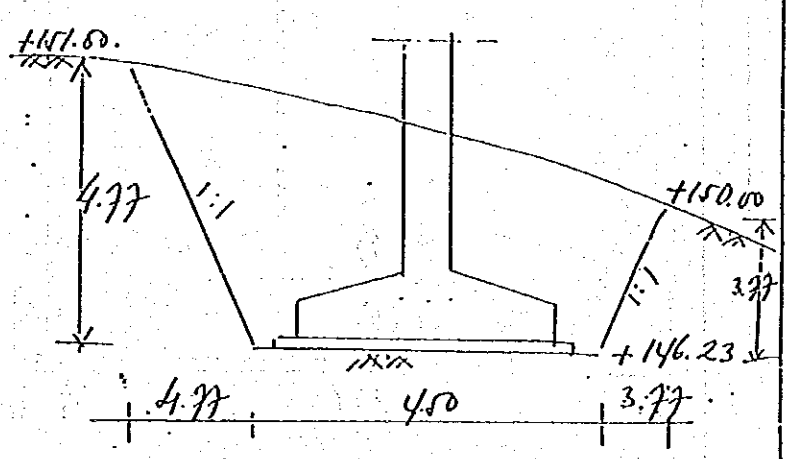
(6)	$0.10 \times 3.70 \times 3.70$	=	1.369 m^3 ✓

Name of Structure	UPACARA BRIDGE TO ETA KREO CAVE	Category of calculation	FORM AREA VOLUME OF PIER-1.	Page	13/20

FORM AREA OF PIER-1 (P-1).

1	0.40 x 2.70 x 2	=	2.160 ✓
2	0.60 x 2.70 x 2	=	3.240 ✓
3	4.30 x 2.00 x 2	=	17.200 ✓
4	0.50 x 3.50 x 2	=	3.500 ✓
1	0.40 x 1.60 x 2	=	1.280 ✓
6	0.53 x 1.60 x 2	=	1.696 ✓
7	4.30 x 0.70 x 2	=	6.020 ✓
8	0.50 x 3.50 x 2	=	3.500 ✓
			38.596 m^2 ✓

EXCAVATION



$$\text{Volume} = \frac{4.50 + 13.04}{2} \times (3.50 + 1.00) \times \frac{4.77 + 3.77}{2}$$

$$= 168.52 \ m^3 \ ✓$$

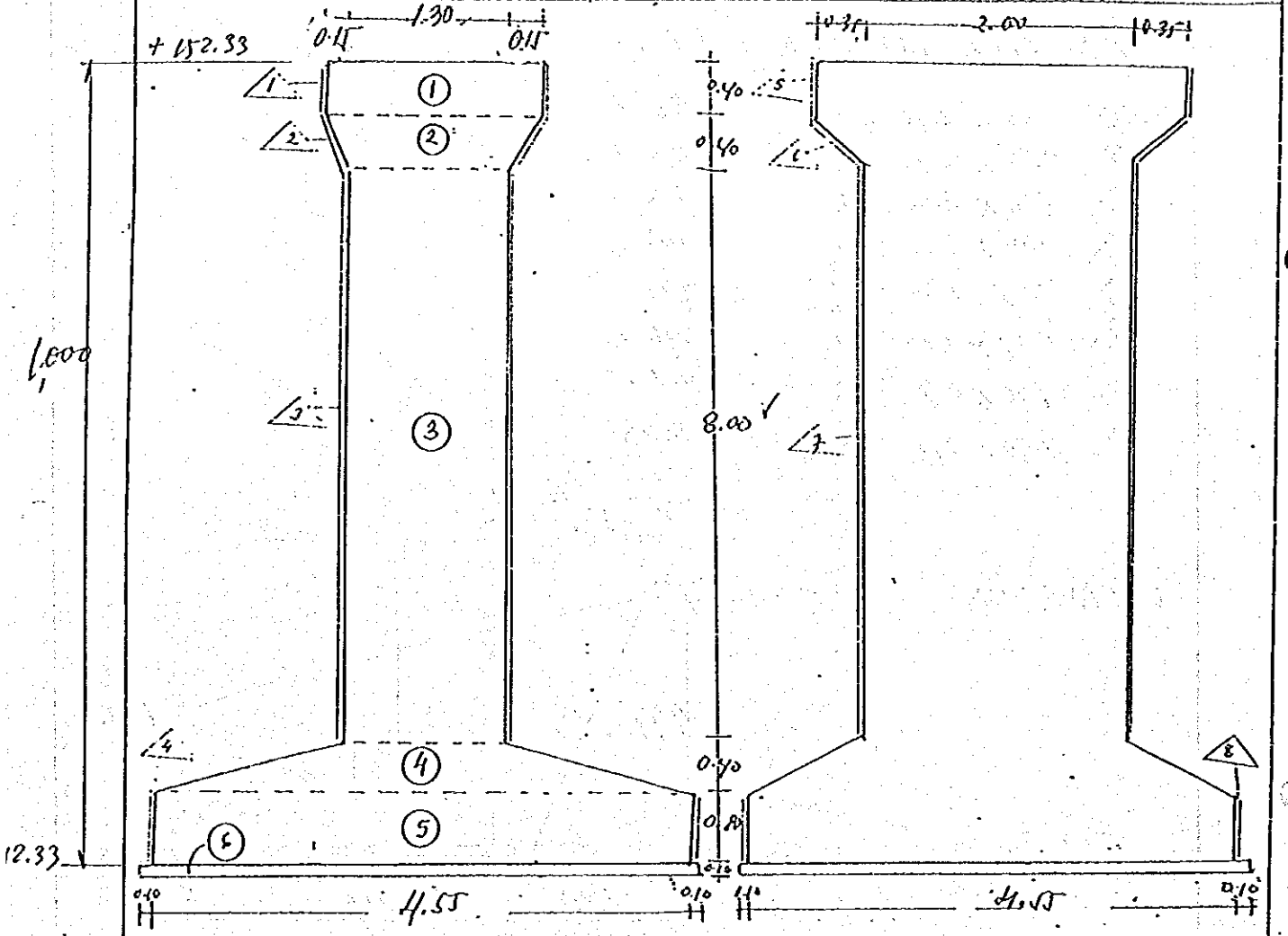
VOLUME OF BACKFILLING :

Vol = Vol. EXCAVATION − Vol. PIER-1. (① + ④ + ⑧).

= 168.520 − {(0.7 x 2.0 x 3.7) + 2.420 + 6.125}.

= 155.775 m^3 ✓

Name of Structure	APPROACH BRIDGE TO KOA KRED CAVE	Category of calculation	CONCRETE VOLUME OF PIER-2.	Page	14/20



BILL OF QUANTITY OF PIER-2 :

CONCRETE K-225

(1.)	$1.60 \times 0.40 \times 2.70$	=	1.728 ✓
(2.)	$\frac{1.60+1.30}{2} \times 0.40 \times \frac{2.70+2.0}{2}$	=	1.363 ✓
(3)	$1.30 \times 8.00 \times 2.0$	=	20.800
(4.)	$\frac{1.30+4.55}{2} \times 0.40 \times \frac{2.0+3.5}{2}$	=	3.218 ✓
(5.)	$4.55 \times 0.80 \times 4.55$	=	16.562
		=	43.671 m^3 ✓

LEVELING CONCRETE

(6)	$0.10 \times 4.75 \times 4.75$	=	2.256 m^3 ✓

Name of Structure	APPROACH BRIDGE TO GOA KASO EXVE.	Category of calculation	FORM AREA VOLUME OF PIER-2.	Page	15/20

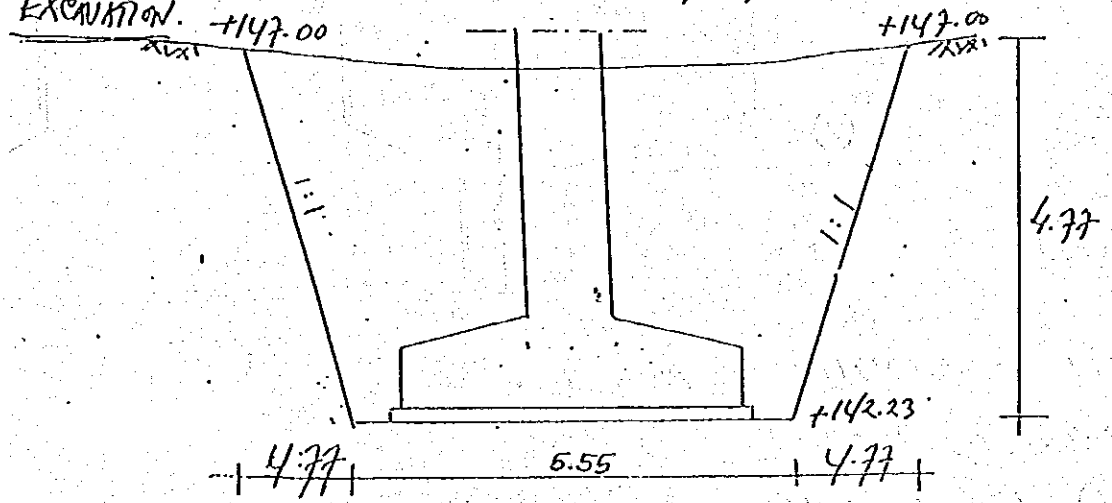
FORM AREA OF PIER-2 (P.2).

1	0.40 x 2.70 x 2	=	2.160	m² ✓
2	0.60 x 2.70 x 2	=	3.240	m² ✓
3	8.00 x 2.00 x 2	=	32.000	m² ✓
4	0.800 x 3.50 x 2	=	5.600	m² ✓
5	0.40 x 1.60 x 2	=	1.280	m² ✓
6	0.57 x 1.60 x 2	=	1.696	m² ✓
7	8.00 x 1.20 x 2	=	19.200	m² ✓
8	0.80 x 3.50 x 2	=	5.600	m² ✓

FORM AREA OF P2 (HEIGHT ≤ 5.00 m) : 1' + 4 + 7' + 8
= (5 x 2 x 2) + 5.60 + 5 x 1.2 x 2 + 5.6 = 43.20 m² ✓

FORM AREA OF P2 (HEIGHT > 5.00 m) : 1 + 2 + 3 + 6 + 5' + 4'.
(SEAFOLDING).
= 2.16 + 3.24 + 1.28 + 1.696 + (3 x 2 x 2) + 3 x 1.2 x 2
= 27.576 m² ✓

EXCAVATION.

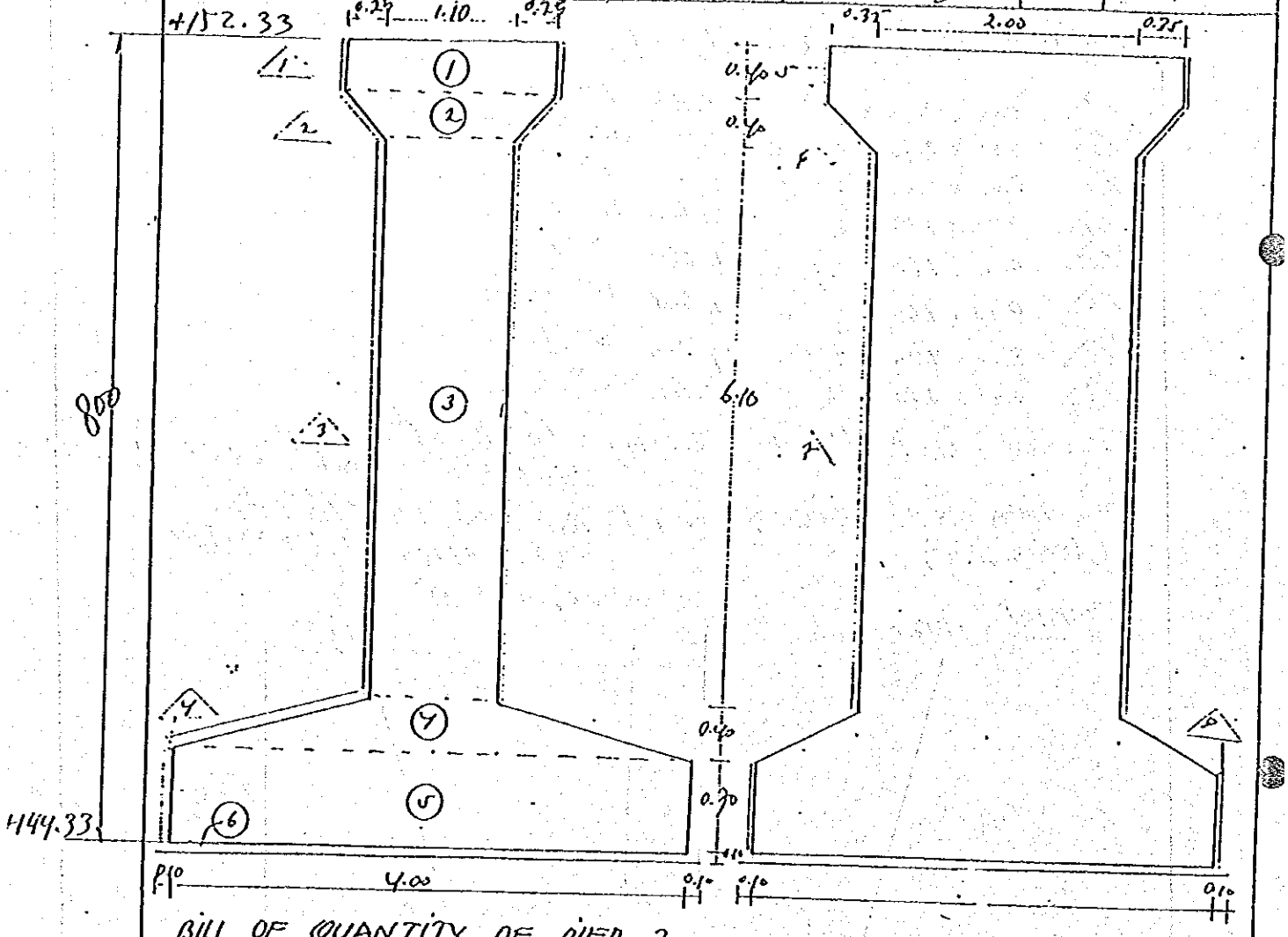


VOLUME : $\frac{5.55 + 15.09}{2} \times 4.77 \times 5.00 = 273.207\ m^3$ ✓

VOLUME OF BACKFILLING

Vol = Vol. EXCAVATION − Vol. PIER-2. (1+2+6)
= 273.207 − {(1.30 x 2.0 x 3.00) + 3.2181 + 16.5623}.
= 245.627 m³ ✓

Name of Structure	APPROACH GRADE TO EVA KREC CAVE	Category of calculation	CONCRETE VOLUME OF PIER-3.	Page	16/20



BILL OF QUANTITY OF PIER-3

CONCRETE K-225 :

(1.) $1.60 \times 0.40 \times 2.70 = 1.728$

(2.) $\frac{1.60 + 1.10}{2} \times 0.40 \times \frac{2.70 + 2.0}{2} = 1.269$

(3.) $1.10 \times 6.10 \times 2.0 = 13.420$

(4.) $\frac{1.10 + 4.00}{2} \times 0.40 \times \frac{2.0 + 4.00}{2} = 3.060$

(5.) $4.00 \times 0.70 \times 4.00 = 11.200$

$= 30.677\ m^3$

LEVELING CONCRETE

(6.) $0.10 \times 4.20 \times 4.20 = 1.764\ m^3$.

Name of Structure	APPROACH BRIDGE TO GOA KREO CAVE	Category of calculation	FORM AREA VOLUME OF PIER-3	Page	17/20

FORM AREA OF PIER-3

① $0.40 \times 2.70 \times 2 = 2.160\ m^2$

② $0.60 \times 2.70 \times 2 = 3.240\ m^2$

③ $6.10 \times 2.00 \times 2 = 24.400\ m^2$

④ $0.70 \times 3.50 \times 2 = 4.900\ m^2$

⑤ $0.40 \times 1.60 \times 2 = 1.280\ m^2$

⑥ $0.53 \times 1.60 \times 2 = 1.696\ m^2$

⑦ $6.10 \times 1.00 \times 2 = 12.200\ m^2$

⑧ $0.70 \times 3.50 \times 2 = 4.900\ m^2$

FORM AREA OF P3 (HEIGHT < 5.00): ③' + ④ + ④' + ⑧

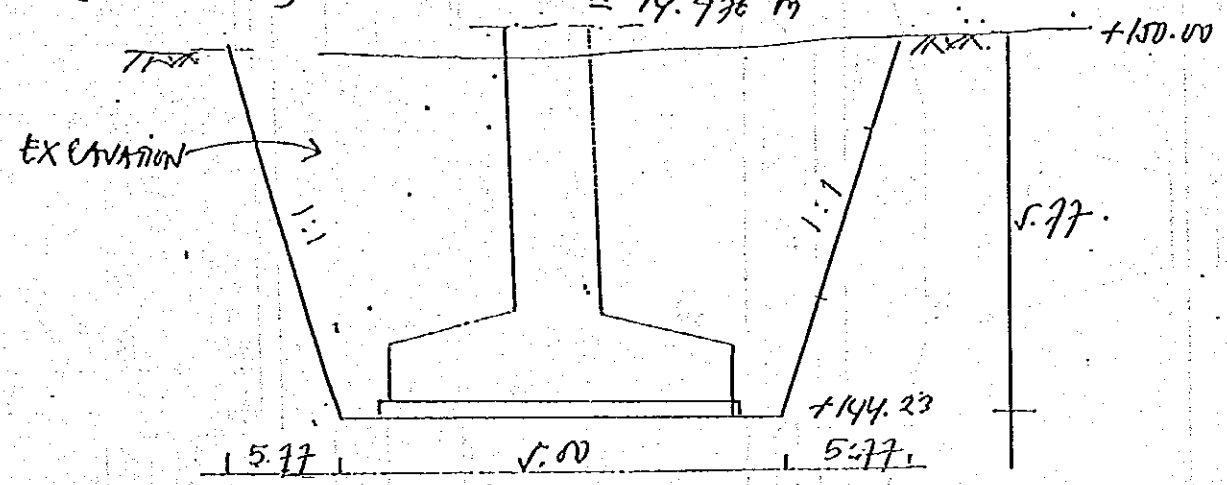
$= 5 \times 2 \times 2 + 4.9 + 5 \times 1 \times 2 + 4.90 = 39.80\ m^2$

FORM AREA OF P3 (HEIGHT > 5.00) (SCAFFOLDING)

$= ① + ② + ④ + ⑥ + ③' + ④'$

$= 2.16 + 3.24 + 1.28 + 1.696 + (1.1 \times 2 \times 2) + (1.1 \times 1 \times 2)$

$= 14.936\ m^2$



Volume: $\frac{5.00 + 16.54}{2} \times 5.77 \times 5.00 = 310.715\ m^3$

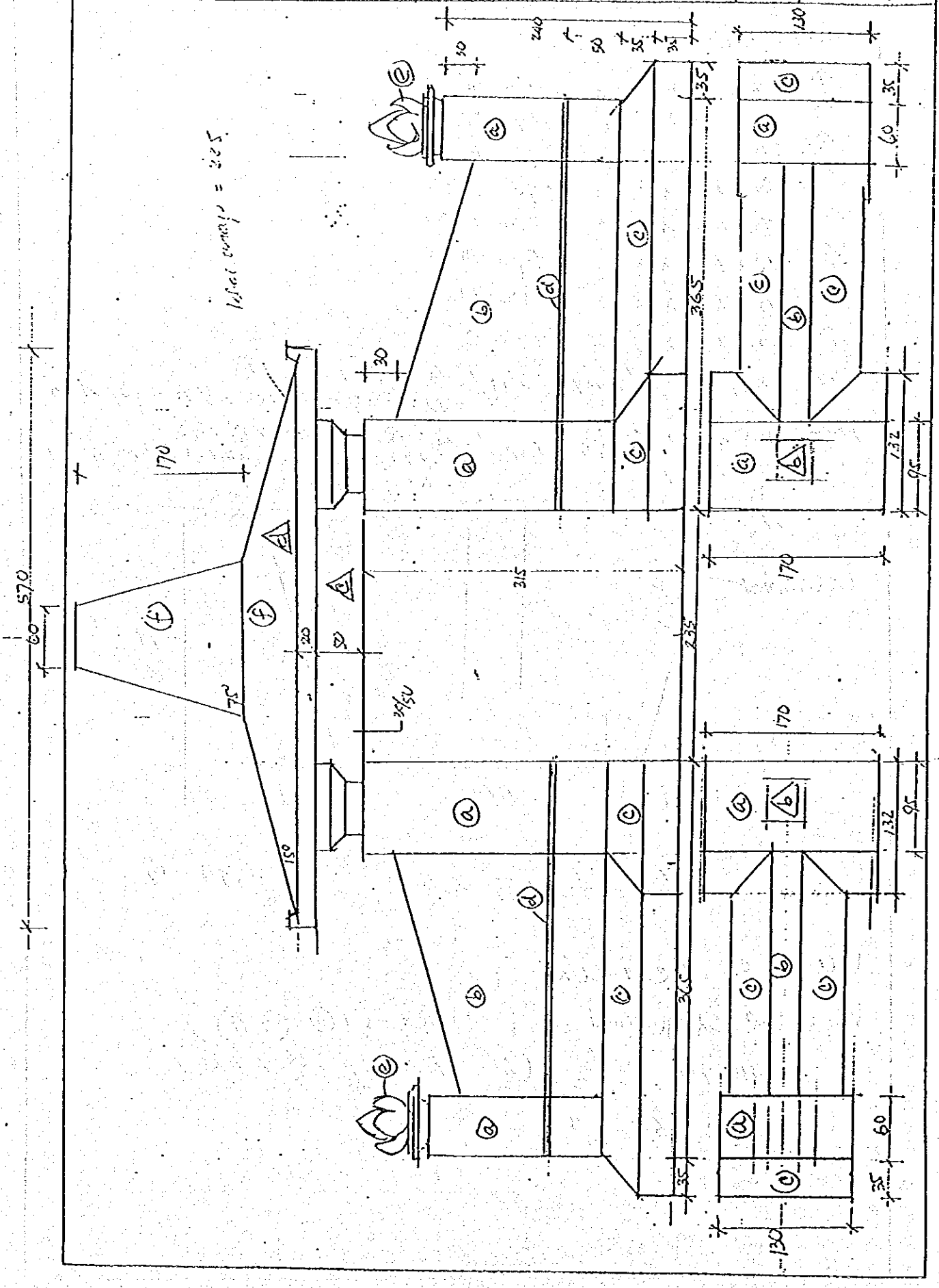
VOLUME OF BACKFILLING :

Vol = Vol. EXCAVATION − Vol. PIER-3 (③ + ④ + ⑧)

$= 310.715 - \{(1.1 \times 1.45 \times 2) + 3.060 + 11.200\}$

$= 293.265\ m^3$

Name of Structure	APPROACH BRIDGE TO GOA KREO CAVE	Category of calculation	VOLUME OF CAVE GOA KREO.	Page	18/20



Name of Structure	APPROACH BRIDGE TO GOA KREO CAVE	Category of calculation	VOLUME OF GATE GOA KREO	Page	19/20.

VOLUME OF GATE GOA KREO :

-) EXCAVATION = 44.40 m^3

*) CONCRETE

(a) TAPERED FOOTING	=	0.60	m^3 /
(b) COLUMN	=	0.75	m^3 /
(c) BEAM	=	0.41	m^3 /
(d) SLAB OF ROOF	=	4.26	m^3 /
TOTAL CONCRETE	=	6.02	m^3 /

o) TEMPLE STONE FOR SURFACE STRUCTURE

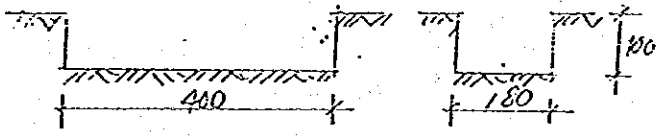
(a) COLUMN	=	13.92	m^3 /	21.27 m^3
(b) WALL	=	2.24	m^3 /	
(c) TAPERED (UMPAK)	=	5.11	m^3 /	
(d) LIST (ORNAMEN)	=	20.60	m'	
(e) ROSE FLOWER ORNAMEN	=	2.00	unit	
(f) SURFACE OF ROOF	=	28.43	m^2	

o) - FOUNDATION OF WET STONE MASONRY = 6.72 m^3 /

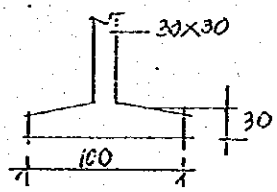
Name of Structure	APPROACH BRIDGE TO GTA KREO CAVE	Category of calculation	VOLUME OF GATE GOA- KREO	Page	20/20

VOLUME OF GATE

1. GALIAN : $4 \times 1,20 \times 2 \times 1 = 14,40\ m^3$.



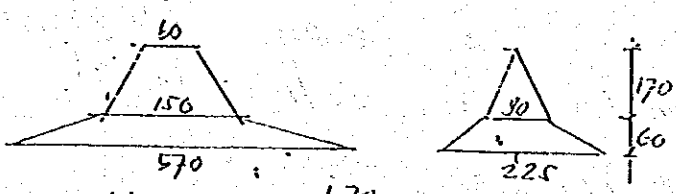
2. PONDASI FOOTPLAT (BETON). $= 0,30 \times 1 \times 1 \times 2 = 0,60\ m^3$.



a. KOLOM $= 0,30 \times 0,30 \times 4,15 \times 2 = 0,747\ m^3$

b. BALOK $= 0,30 \times 0,50 \times 2,170 = 0,405\ m^3$.

c. PLAT ATAP =



$= 1,50 \times 0,90 \times \frac{1,70}{2} = 1,1475\ m^3$

$\frac{(1,50 \times 0,90) + (5,70 \times 2,25)}{2} \times 0,60 = 4,2625\ m^3$.

3. BATU CANDI :

a. KOLOM $= 1,70 \times 0,95 \times 3,15 \times 2 = 10,1745\ m^3$

$1,30 \times 0,60 \times 2,40 \times 2 = 3,744\ m^3$.

$= 13,9185\ m^3$

b. DINDING $= \frac{(2,15 + 1,40)}{2} \times 2,1 \times 2 = 7,455\ m^2$

$= 7,455 \times 0,30 = 2,240\ m^3$.

c. UMPAK $= 3,65 \times 0,70 \times 1 \times 2 = 5,110\ m^3$

d. ORNAMEN/LIST $= (3,65 + 3,65 + 1,70 + 1,30) \times 2 = 20,60\ m^1$.

e. ORNAMEN RELATI $= 2$ bh.

f. PELAPIS ATAP $= \left(\frac{0,60 + 1,50}{2}\right) \times 1,70 \times 2 + \left(\frac{0,90 \times 1,70}{2} \times 2\right)$

$+ \left[\left(\frac{0,90 + 2,25}{2}\right) \times 2,15 \times 2\right] + \left[\left(\frac{1,50 + 5,70}{2}\right) \times 2,15 \times 2\right] = 22,405\ m^2$

4. PONDASI BATU BELAH $= (1,70 \times 1,32 \times 1) + (1,73 \times 1,3 \times 1) \times 2 = 6,72\ m^3$.

work quantity of gate

	unit	amount
excavation	cu.m	14.40
concrete (K225)	cu.m	6.02
formwork	sq.m	2.40
wet stone masonry	cu.m	6.72
temple stone	cu.m	21.27