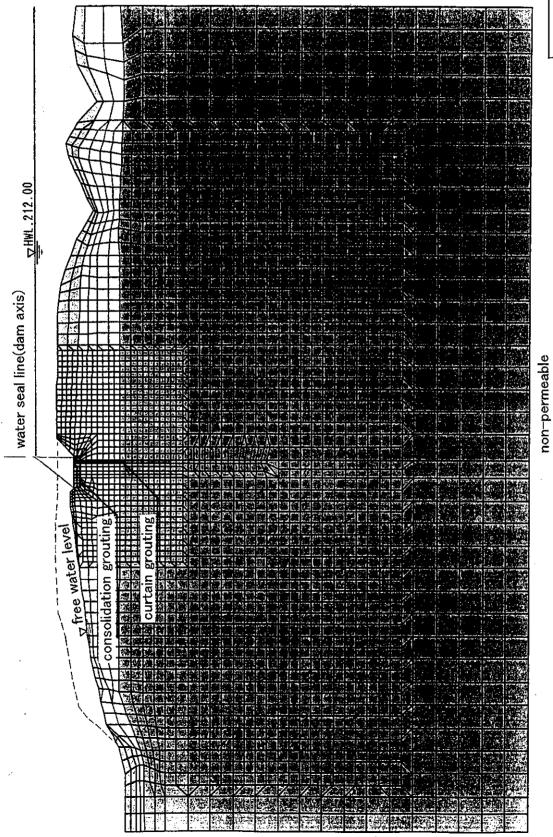


11-3-12



Fig.5 (2) Analysis model (section 2)

non-permeable



non-permeable

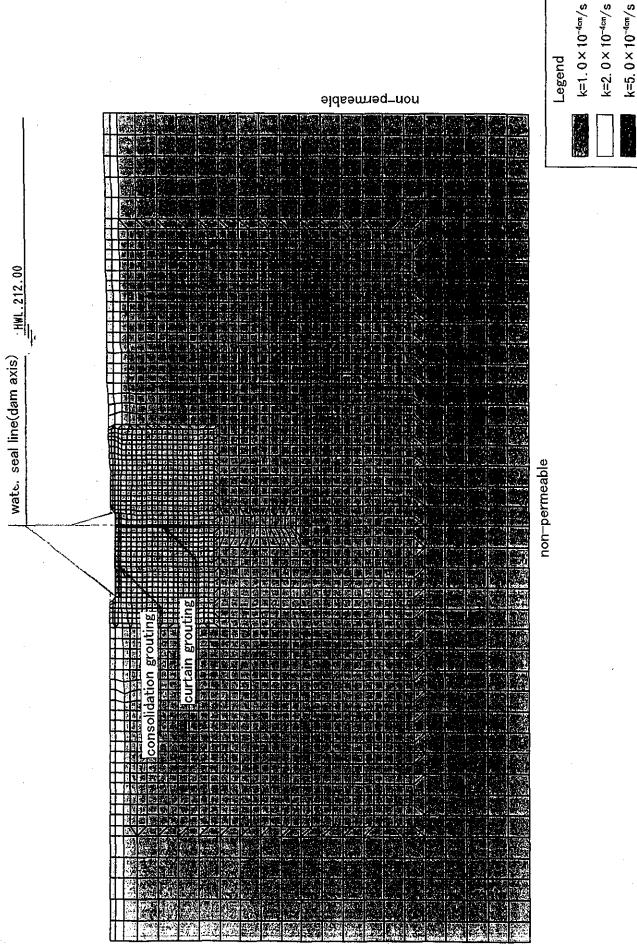
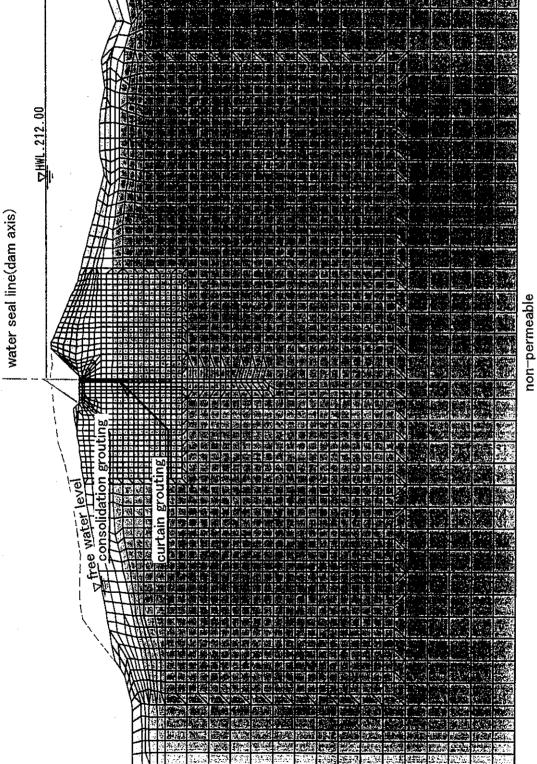


Fig.5 (3) Analysis model (section 3)

59°

wate. seal line(dam axis)





non-permeable

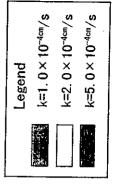
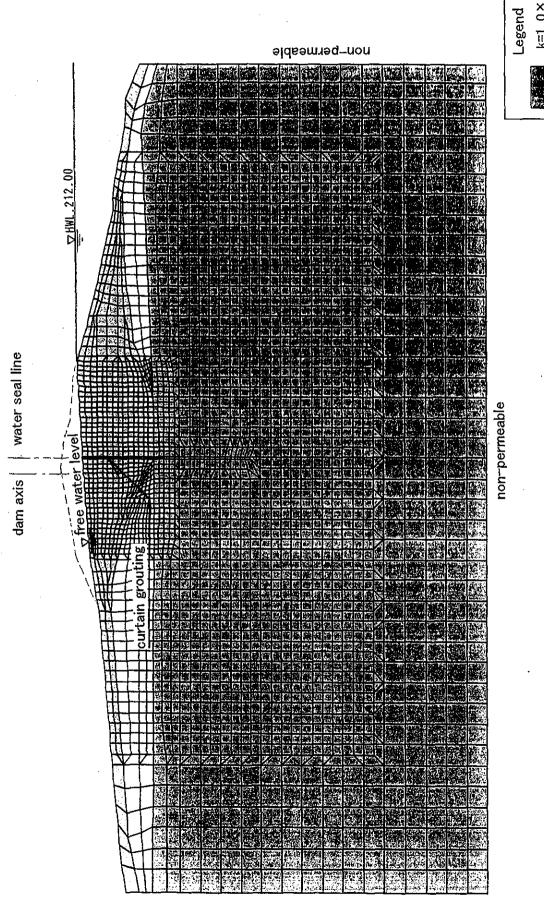


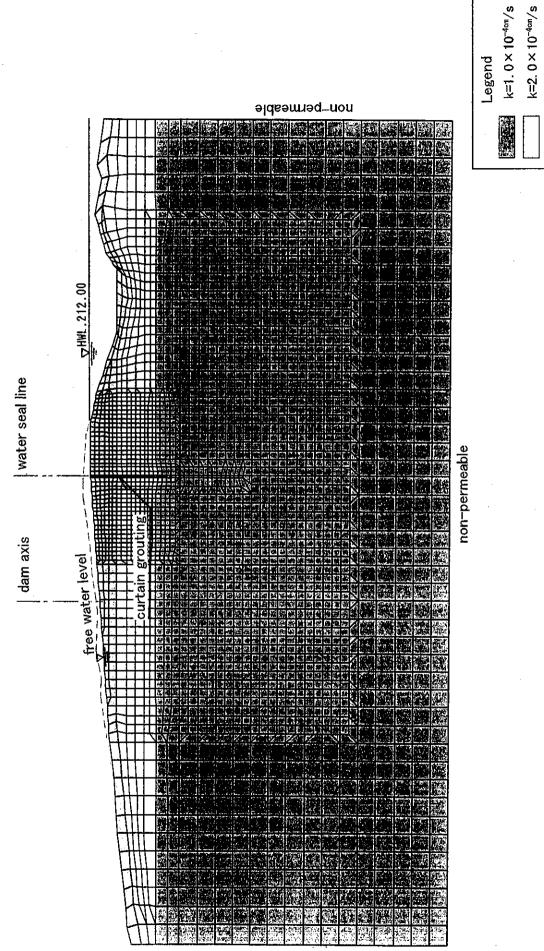
Fig.5 (4) Analysis model (section 4)





k=1. 0 × 10^{-4cm}/s k=2. 0 × 10^{-4cm}/s k=5. 0 × 10^{-4cm}/s

11-3-16



k=5. 0 × 10^{~4cm}/s

S. 7. 432

11-3-17

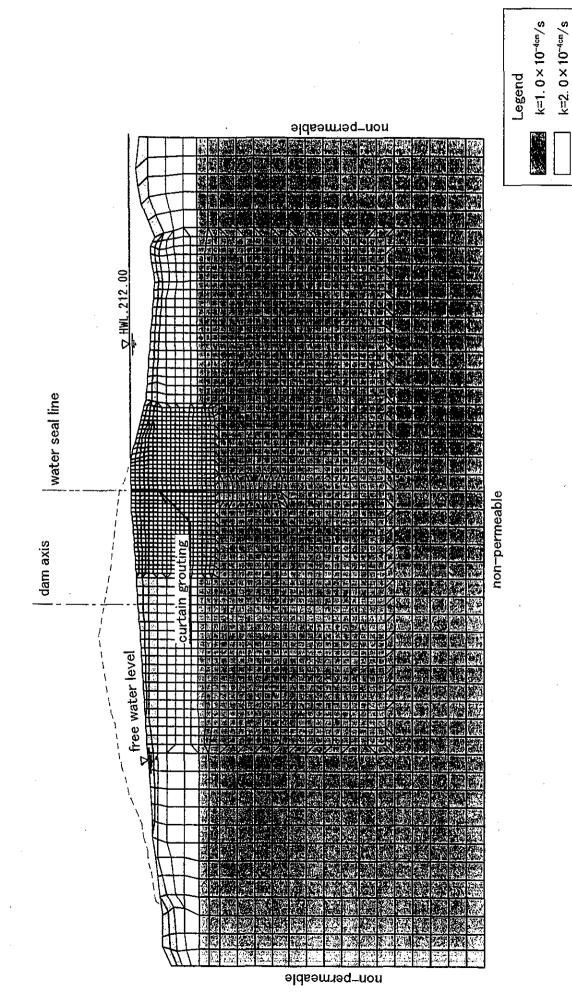


Fig.5 (7) Analysis model (section 7)

 $k=5.0 \times 10^{-4cm/s}$

.



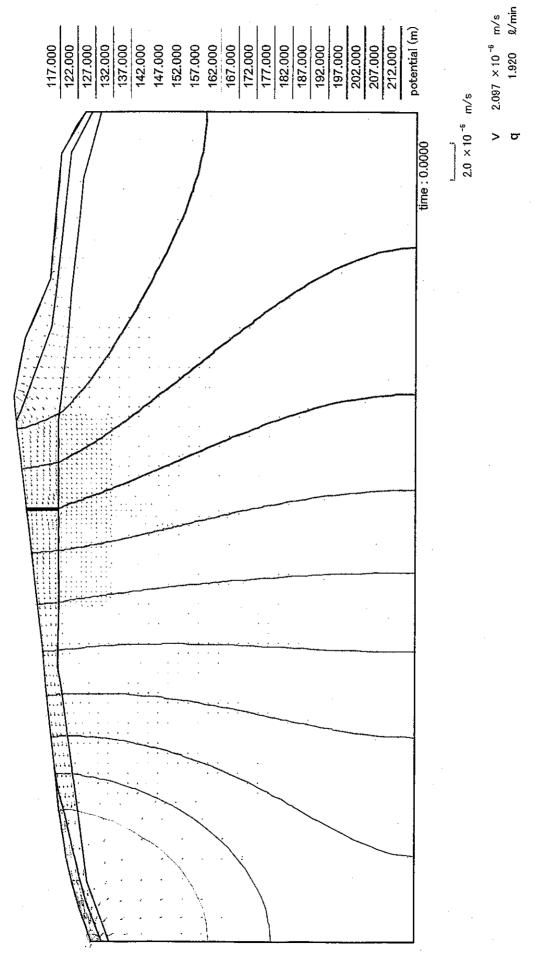
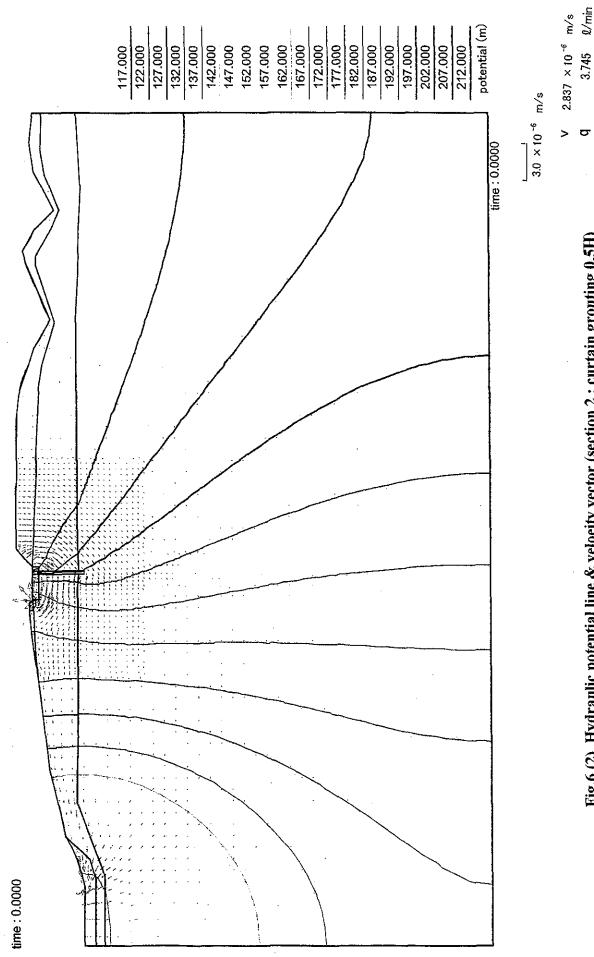


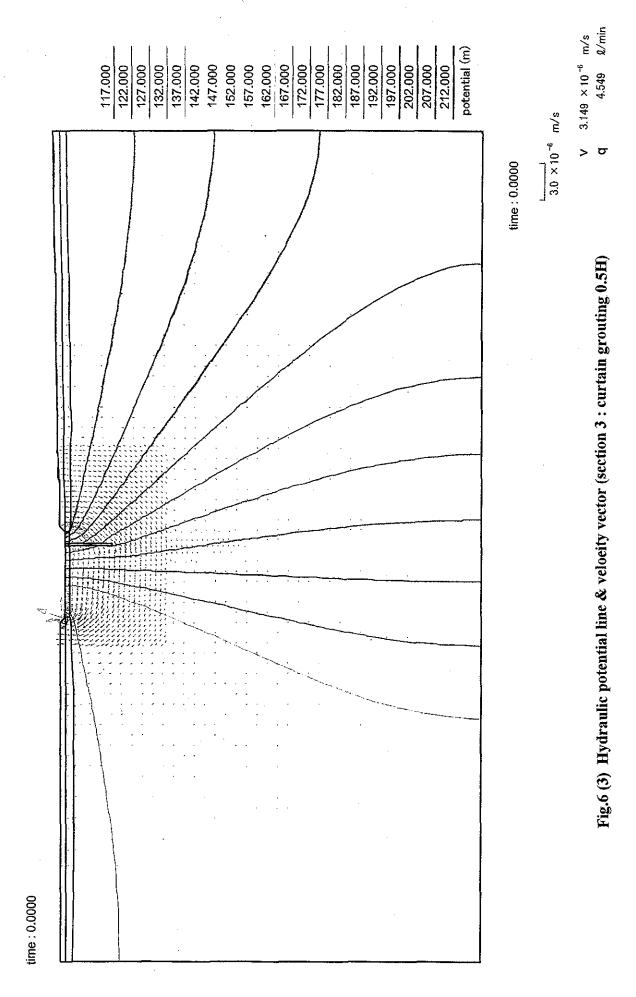
Fig.6 (1) Hydraulic potential line & velocity vector (section 1 : curtain grouting 0.5H)

11-3-19

time: 0.0000







11-3-21

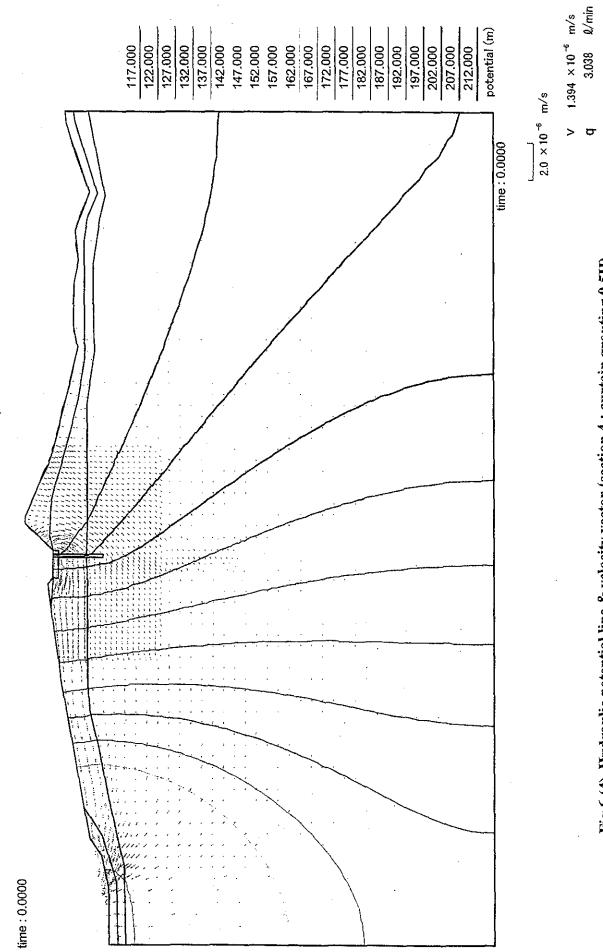
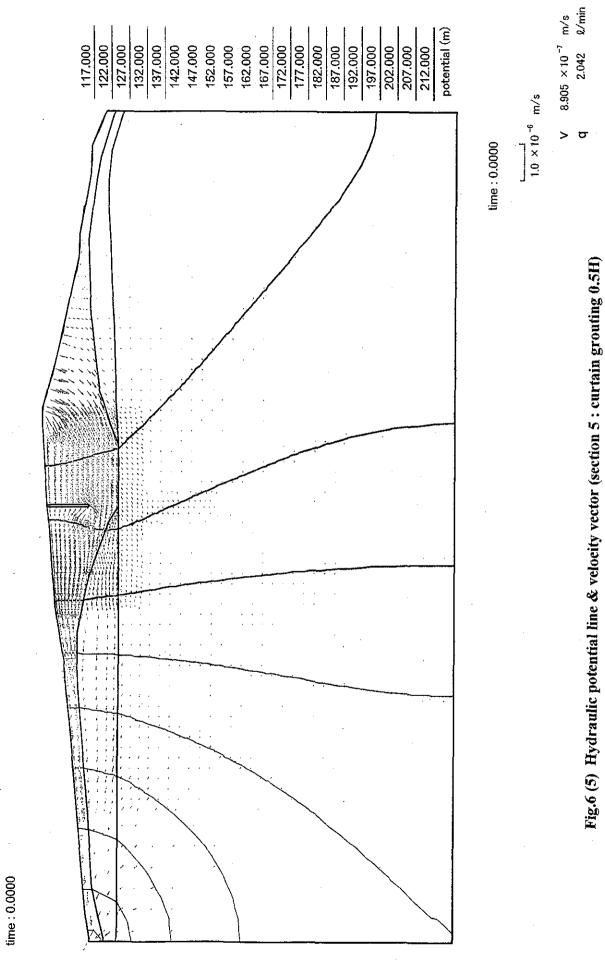
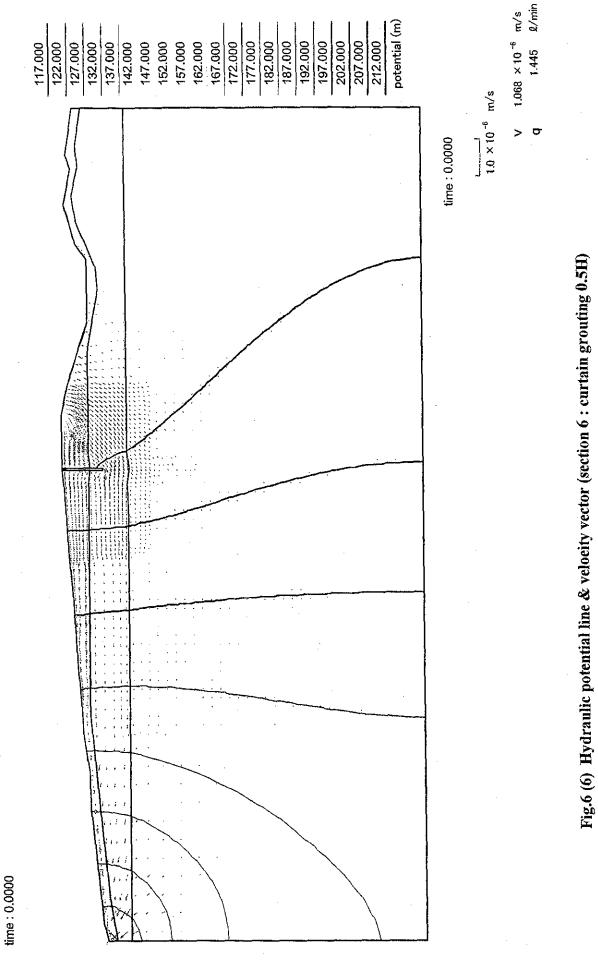


Fig.6 (4) Hydraulic potential line & veloeity vector (section 4 : curtain grouting 0.5H)

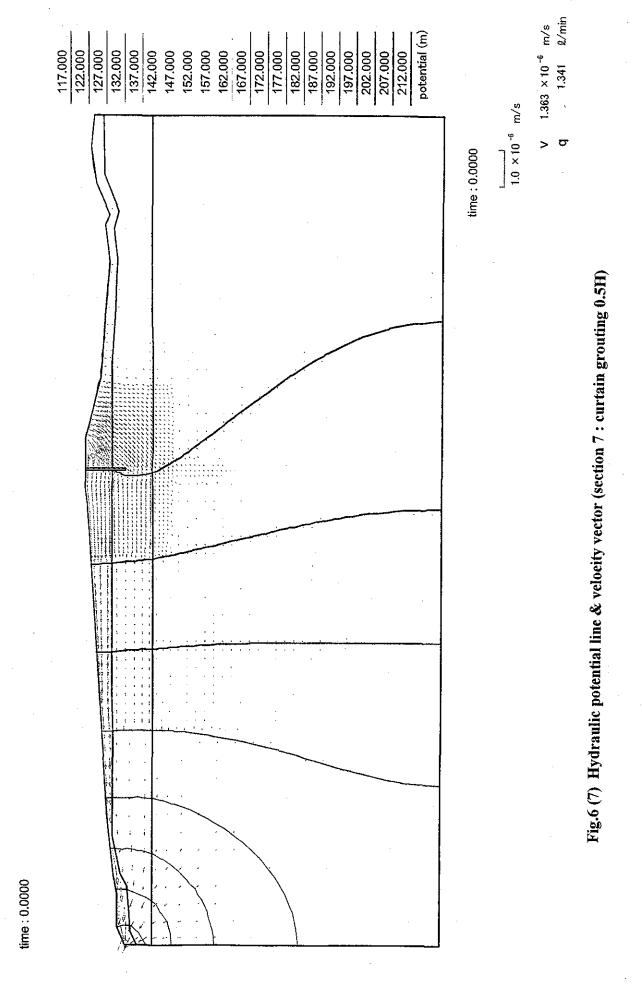
11-3-22







11-3-24



Appendix 11.4

Dam Stability Analysis

671 (672)

Parameter Study	[0.15]							
				<u>Case : 0,15</u>		- · · · · ·		
Case Selection			INPUT					
		Case : 0.15			Sav	ve as		
-Dam Shape (m)		-Water Level (m)-	· · · · · · · · · · · · · · · · · · ·	-Wave height due t	ი _ (თ) _	Basio Geometry		
Crown EL	214.5	HWL	212	wind	1.01	5		
Bottom EL	127	SWL	212	earthquake	0.698			
Fillet EL	170	NWL [212	Unit Weight (tf/m ²	9			
Crown Width	5	_		Concrete (Yo)	2.35	*,1:0.8 H=0.00(m)		
	<u> </u>	Sediment]	185	Water (Yw)	1			
Slope Upstream	<u> </u>	Downstream	134	Sediment (7s)	1.1	1:03		
1 7 1		-Coefficient						
Upstream fillet	0.3		Sedim	ent Pressure (Ce)	0.5	Consideration		
Downstream	0.8	Desig	m Seismi	city Horizontal (W	0.15	Uplift force IV Gallery		
	Shei	ring Strength of Fou	Indation P	Rock (To) tf/m ²	250	Water pressure		
		Internal Frict	ion of Fo	undation Rook (P) 🔽	0.84	Upstream Static + Westergaard 💌		
		Allowable Compr	essive St	ress (Ơoa) tf/m² 🖵	800.00	Downstream Static only		
-Drain (m)								
	Hor	izontal distance to d	Irain from	uptream heal up/	12	Calculation Elevation		
-Gallery (m)		to center of gallery		aunt (t) [12	*		
		· · · ·		· · · · · · · · · · · · · · · · · · ·	3			
		artical distance to be						
Diamater	of hood p	ant(a) 2 h	ieignt of I	rectangular part(b)	1.5	Print		
Comment :	Default					- Print		
						≁ Run		
	-							

			Cas	e: 0.15			
C.	ase Selection	γ	INF	דטי	<u> </u>	OUTPU	T
	in an		·			· · · ·	
nalysis Case	for water level at	HWLIND-			Basio Geo	metry	
			<u> </u>			5	$(x_1,y_2) \in \mathbb{C}^{n+1}$
Ecce	entrio distance (e)) m 5.35	7 < (1./6 = 13.82)				
Stress at	uptream (Ou) ti	2 55.759	9 > 0, <(<i>d</i> ca =)	800) ····O			
	wnstream (Ød) ti		4 <(gca = 800)	0	к 🕴 👘 т.:	ບ	:0.8 H=87.50(
· · · · ·				•••0			•
itety factor fo	or shearing sliding	; (Fs) 5.88	5 > 4		к 1:03	1	• <u> </u>
(Area c	of basic geometry	m ² 3371.100	<u> </u>			1	
	1 A A A A A A A A A A A A A A A A A A A	يراجع المحادثة ويرواح وأحكاري					
<u></u>	· · · · · · · · · · · · · · · · · · ·					L=82.90(m)	l
			Result	of Analysis]	: <u>L=82.90(m</u>))
SURMARY	HANTUN	SHAFTUR	Result	of Analysis	NALE	: <u>L=82.90(m)</u> Empt s (N)	Empty(E)
SURMARY	e(m)	SHUM Jultime	~	· / · · · · · · · · · · · · · · · · · ·	NALED Area	~	
			GINKE	NAILINO		~	
twl(N)	e(m)	Jutti/m2)	ର୍ୟାମର ଅସ୍ଥାର୍ମ ଅ	NAILINO Fs	Area	~	
twlon) Swlond	e(m) 5.357	oru(tt/m2) 55.759	544LE) 0°d(tf/m2) 126.374	NATLINO Fs 5.885	Area 3371.100	~	
TWL (N) SWL (N) SWL (E)	e(m) 5.357 5.357	0 ⁷ u(ttf/m2) 55.759 55.759	SMUE ord(tf/m2) 126.374 126.374	NHLIN) Fs 5.885 5.885	Area 3371.100 3371.100	~	
SURMARY TWL(N) SWL(N) SWL(E) TWL(N) TWL(N)	e(m) 5.357 5.357 9.135	0 [°] u(tt/m2) 55.759 55.759 30.878	SMUE 0'd(tf/m2) 126.374 126.374 151.364	NALINO Fs 5.885 5.885 4.890	Area 3371.100 3371.100 3371.100	~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
TWL (N) SWL (N) SWL (E) WHL (N)	e(m) 5.357 5.357 9.135 5.357	0 u(tf/m2) 55.759 55.759 30.878 55.759	SMUE 0'd(tt/m2) 126.374 126.374 151.364 126.374 176.363 147.004	NALINO Fs 5.885 5.885 4.890 5.885	Area 3371.100 3371.100 3371.100 3371.100	~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
TWL(N) SWL(N) SWL(E) SWL(E) WL(N) WL(E)	e(m) 5.357 5.357 9.135 5.357 12.909	♂u(tt/m2) 55.759 55.759 30.878 55.759 5.987	SMUE 0'd(tt/m2) 126.374 126.374 151.364 126.374 126.374 176.363	NALINO Fs 5.885 5.885 4.890 5.885	Area 3371.100 3371.100 3371.100 3371.100 3371.100	~	Empta(E)
TWL (N) SWL (N) SWL (E) WL (N) WL (N) WL (E) Empty (N)	e(m) 5.357 5.357 9.135 5.357 12.909 7.566	Juilt/m2 55.759 55.759 30.878 55.759 30.878 55.759 59.759 59.87 42.975	SMUE 0'd(tt/m2) 126.374 126.374 151.364 126.374 176.363 147.004	NALINO Fs 5.885 5.885 4.890 5.885	Area 3371.100 3371.100 3371.100 3371.100 3371.100 3371.100 3371.100	~	Empty(E)
TWL (N) SWL (N) SWL (E) WL (N) WL (N) WL (E) Empty (N)	e(m) 5.357 5.357 9.135 5.357 12.909 7.566 9.683	Juilt/m2 55.759 55.759 30.878 55.759 30.878 55.759 59.759 59.87 42.975	SMUE 0'd(tt/m2) 126.374 126.374 151.364 126.374 176.363 147.004	NALINO Fs 5.885 5.885 4.890 5.885	Area 3371.100 3371.100 3371.100 3371.100 3371.100 3371.100 3371.100	~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

CHAPARRAL STABILITY

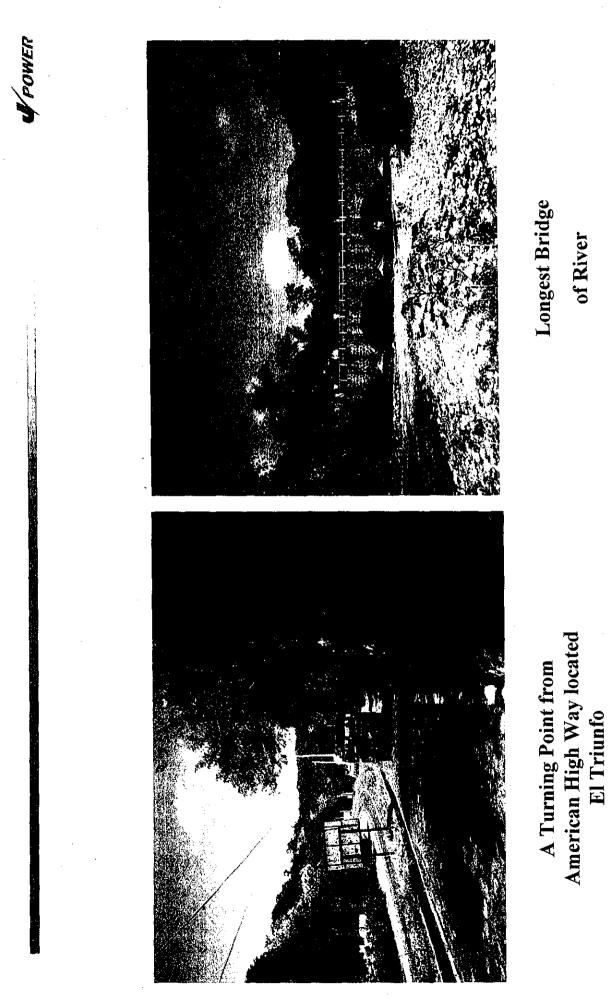
CASE		1	2	check	3	4	5	6	7	8	check
Deer Sharafaa)					•						·
Dam Shape(m)		214.5	214.5		214.5	214.5	214.5	214.5		214.5	
Crown EL	m m	127.0	127.0		127.0	127.0	127.0	127.0	214.5	127.0	
Bottom EL Fillet EL	m	127.0	170.0		170.0	170.0	150.0	170.0	127.0	170.0	
Grown Width	m	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	
Grown math	10 1	0,0		I	0.0		0.01	0.0 [
Slope										· · · ·	
Upstream		0	0		0	0	0	0	0	Ö	
Upstream Fillet		0	0.3		0.2	0.1	0.3	0.2	0	0.3	
Downstream		0.8	0.8		0.8	0.8	0.8	0.8	0.8	0.8	
· · · · · · · · · · · · · · · · · · ·											
Water Level (m)	1										
HWL	<u>m</u>	212.0	212.0		212.0	212.0	212.0	212.0	212.0	212.0	
<u></u>	m	212.0	212.0]	212.0	212.0	212.0	212.0	212.0	212.0	
NWL	m	212.0	212.0		212.0	212.0	212.0	212.0	212.0	212.0	
Sediment	m	185.0	185.0		185.0	185.0	185.0	185.0	185.0	185.0	
Downstream	lm	134.0	134.0		134.0	134.0	134.0	134.0	134.0	134.0	
Wave height due to (m)										·	
wind	m	1.0	1.0		1.0	1.0	1.0	1.0	1,0	1.0	
earthquake	m	0.7	0.7	····	0.7	0.7	0.7	0.7	0.7	0.7	
								/]			
Unit Weight (tf/m3)											
Concrete(r c)	tf/m3	2.35	2.35		2.35	2.35	2.35	2.35	2.35	2.35	
Water(y w)	tf/m3	1.0	1.0		1,0	1.0	1.0	1.0	1.0	1.0	
sediment(7s)	tf/m3	1.1	1.1		1.1	1.1	1,1	1.1	1,1	1.1	
Coefficient	<u>.</u>	· • - •			م – 1		1			<u>-</u> -	
Sadiment Pressure(Ce)	 	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	
Seismic Horizontal (k)	L	0.12	0.12	<u>. </u>	0.12	0.12	0.15	0.15	0.15	0.15	
Strength characteristic				<u> </u>					+		
Shearing Strength of Foundation Rock (7 o)	+f/m2	250	250	(*************************************	250	250	250	250	250	250	
Internal Friction of Foundation Rock (f)	100 1112	0.84	0.84		0.84	0.84	0.84	0.84	0.84	0.84	· · · · · · · · ·
Allowable Compressive Stress (or ca)	tf/m2	800	800		800	800	800	800	800	800	
· ·											
Drain											
Horizontal distance to drain from upstream	1										
heal (Ip)	1m	10	12	L	8	4	12		10	<u>12</u>	
Gallery						.,					
Horizontal distance to center of gallery from	1	(· · · ·)		(1		· · ·				
upstream surface (lg)	m	10	12		8	4	12	8	10	12	
Vertical distance to bed of gallery from base						-		11 A.		1 · ·	
(hg)	<u>im</u>	3	3		. 3	3	. 3	3	3		
Out-out	1	NO	OK	ок	01/	NG	NG	NO		(!	
Output	m	NG 9.725	OK							OK	
<u>Eccentric distance(e)</u> HWL Stress at uptream(σu)			5 257		OK 5.027			NG 5.027	NG 0 725	OK	ок
(N) Stress at downstream(o d)	lff/m		<u>5.357</u>		5.927	6.612	7.362	5.927	9.725	5.357	7.1
	tf/m* tf/m*	13.828	55.759	54.513	5.927 49.471	6.612 41.74	7.362 37.023	5.927 49.471	9.725 13.828	5.357 55.759	54.513
	tf/m tf/m	13.828 152.357	55.759 126.374	54.513 126.77	5.927 49.471 131.236	6.612 41.74 137.375	7.362 37.023 136.966	5.927 49.471 131.236	9.725 13.828 152.357	5.357 55.759 126.374	÷.
Safety factor for shearing sliding(Fs) Eccentric distance(e)		13.828	55.759	54.513	5.927 49.471	6.612 41.74	7.362 37.023	5.927 49.471	9.725 13.828	5.357 55.759	54.513 126.77
Safety factor for shearing sliding(Fs)	tf∕m'	13.828 152.357 4.867	55.759 126.374 5.885	54.513 126.77	5.927 49.471 131.236 5.569	6.612 41.74 137.375 5.254	7.362 37.023 136.966 5.402	5.927 49.471 131.236 5.569	9.725 13.828 152.357 4.867	5.357 55.759 126.374 5.885	54.513 126.77
Safety factor for shearing sliding(Fs) Eccentric distance(e)	tf/m [*] m	13.828 152.357 4.867 9.725 13.828 152.357	55.759 126.374 5.885 5.357	54.513 126.77 5.879 53.571 127.821	5.927 49.471 131.236 5.569 5.927 49.471 131.236	6.612 41.74 137.375 5.254 6.612 41.74 137.375	7.362 37.023 136.966 5.402 7.362 37.023 136.966	5.927 49.471 131.236 5.569 5.927	9.725 13.828 152.357 4.867 9.725	5.357 55.759 126.374 5.885 5.357 55.759 126.374	54.513 126.77 5.879 53.571 127.821
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs)	tf/m m tf/m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867	55.759 126.374 5.885 5.357 55.759 126.374 5.885	54.513 126.77 5.879 53.571	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885	54.513 126.77 5.879 53.571
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(or u) Stress at downstream(or d) Safety factor for shearing sliding(Fs) Eccentric distance(e)	tf/m m tf/m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409	54.513 126.77 5.879 53.571 127.821 5.842	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 14.542	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135	54.513 126.77 5.879 53.571 127.821 5.842
Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(σ u)	tf/m m tf/m tf/m m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666	54.513 126.77 5.879 53.571 127.821 5.842 34.418	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 14.542 -20.481	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878	54.513 126.77 5.879 53.571 127.821 5.842 29.629
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at ownstream(σ u)	tf/m m tf/m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936 180.121	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975	5.927 49.4711 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665	5.367 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.136 30.878 151.364	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at downstream(σu) (N) Stress at downstream(σu) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σu) (E) Stress at uptream(σu) Stress at downstream(σu) Stress at optream(σu) Stress at optream(σu)	tf/m m tf/m tf/m m tf/m tf/m	13.828 152.357 9,725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05	5.927 49.4711 131.236 5.569 5.927 49.4711 131.236 5.569 9.154 27.227 153.556 4.796	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 9.919 21.946 158.837 4.641	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 4.867 14.542 -20.481 186.665 4.08	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89	54.513 126.77 5.879 53.571 127.821 5.842 29.629
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptraem(cru) (N) Stress at downstream(cru) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(cru) (E) Stress at uptream(cru)	tf/m m tf/m tf/m m tf/m tf/m tf/m	13.828 152.357 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 9.725	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05	5.927 49.4711 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927	9.725 13.828 152.357 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.136 30.878 151.364 4.89 5.357	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) Safety factor for shearing sliding(Fs) Eccentric distance(e) NWL. Stress at uptream(σ u) Eccentric distance(e) NWL. Stress at uptream(σ u)	tf/m m tf/m tf/m m tf/m tf/m tf/m	13.828 152.357 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 9.725 13.828	55.759 126.374 5.885 5.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 55.757	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62	5.927 49.4711 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.736 5.927 49.471	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 16.971 16.2.184 4.535 6.612 41.74	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 49.471	9.725 13.828 152.357 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (N) Stress at downstream(σ u) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (C) Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at downstream(σ u) (Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u)	tf/m m tf/m tf/m m tf/m tf/m tf/m	13.828 152.357 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 9.725 13.828 152.357	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 55.757 126.374	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 5.05 52.62 128.882	5.927 49.4711 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 9.919 21.946 158.837 4.641 5.927 49.471 131.236	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 152.357	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374	54.513 126.77 5.879 53.571 127.821 127.821 5.842 29.629 151.763 4.885 52.62 128.882
Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(GU) (N) Stress at downstream(GU) Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(GU) (E) Stress at uptream(GU) (E) Stress at uptream(GU) (E) Stress at uptream(GU) (E) Stress at uptream(GU) (N) Stress at uptream(GU) Stress at uptream(GU) Stress at uptream(GU) Stress at uptream(GU) Stress at uptream(GU)	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 9.725 13.828 180.121 4.211 9.725 13.828 152.357 4.867	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 5.357 55.757 126.374 5.885	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62	5.927 49.4711 131.236 5.569 5.927 49.4711 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236 5.569	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 4.9471 131.236 5.569	9.725 13.828 152.357 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 9.725 13.828 152.357 4.867	5.367 55.759 126.374 5.885 5.357 5.5.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374 5.885	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σu) (N) Stress at downstream(σd) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σu) (E) Stress at uptream(σu) (E) Stress at downstream(σu) (E) Stress at uptream(σu) (B) Stress at uptream(σu) (N) Eccentric distance(e)	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 9.725 13.828 152.357 4.867 4.867 13.623 -13.936 180.121 4.211 9.725 13.828 152.357 4.867 17.523	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.357 55.757 126.374 5.885 5.357 55.757 126.374	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 4.796 5.927 4.796 5.927 4.796 5.927 49.471 131.236 5.569 12.38	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 4.535 6.612 4.737 16.971 162.184 4.535 6.612 4.744 137.375	7.362 37.023 36.966 5.402 7.362 37.023 36.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 136.966 5.402 15.736	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 49.471 131.236 5.569 13.91	9.725 13.828 152.857 9.725 13.828 152.357 9.725 13.828 152.357 4.867 14.542 -20.481 186.65 4.08 9.725 13.828 152.357 4.867 18.828 152.357 4.867 18.828 152.357 18.828 152.357 18.828 19.725 19.828 19.725 19.828 19.2357 19.828 19.2357 19.828 19.2357 19.828 19.3357 19.361 19.361 19.361 19.361 19.361 19.361 19.755 19.361 19.361 19.755 19.	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.136 30.878 151.364 4.89 5.357 55.759 126.374 5.885 5.367 5.885 5.3857 5.885 5.3857 5.885 5.3857 5.885 5.357	54.513 126.77 5.879 53.571 127.821 53.629 151.763 4.885 52.62 128.882 52.62
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (E) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) Safety factor for shearing sliding(Fs) Eccentric distance(e) NWL Stress at uptream(σ u) Stress at uptream(σ u) Stress at uptream(σ u) NWL Stress at uptream(σ u)	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 9.725 13.828 152.357 4.867 17.523 17.523	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.357 5.357 5.357 5.357 126.374 5.885 11.458 11.458 11.458	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313	5.927 49.471 131.2369 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 133.236 5.569 12.38 4.973	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 4.641 158.837 4.641 131.236 5.569 13.911 131.236	9.725 13.828 152.837 4.867 9.725 13.828 152.837 14.542 -20.481 186.665 4.08 9.725 186.665 4.08 9.725 186.665 4.08 9.725 18.828 162.357 4.867 19.3611 -54.801	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 126.374 5.855 126.374 5.885 12.909 5.885	54,513 126,77 5,879 53,571 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 4,736
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (N) Stress at downstream(σ u) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) (Stress at uptream(σ u) Stress at uptream(σ u) (N) Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u)	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 9.725 13.828 180.221 13.828 152.357 4.867 1.7.523 -4.1713 207.898	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 33.666 146.575 5.355 5.357 5.357 5.357 5.357 126.374 5.885 11.458 115.584 165.786	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 153.556 153.556 153.556 153.556 131.236 5.569 12.38 4.973 175.886	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.2184 4.535 6.612 41.74 137.375 5.254 13.463 5.254 13.463 -7.81 187.005	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 136.946 4.516 7.362 37.023 37.023 136.946 5.402 136.966 5.402 136.966	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 4.641 5.527 49.471 131.236 5.569 131.91 -5.589 186.448	9.725 13.828 152.357 4.867 9.725 13.828 152.357 14.542 -20.481 152.657 14.542 -20.481 158.665 13.828 13.828 152.357 4.867 152.357 4.867 152.357 4.867 -54.802	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374 5.885 129.397 55.885 126.394 5.885 126.399 5.885 126.397 176.363	54,513 126,77 5,879 53,571 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 5,805 4,736 176,765
Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(or u) (N) Stress at downstream(or d) Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(or u) (E) Stress at uptream(or u) (N) Stress at uptream(or u) (E) Stress at uptream(or u) Stress at uptream(or	tf/m m tf/m	13.828 152.857 4.867 9.725 13.828 182.857 4.867 13.623 -13.936 180.121 4.827 13.623 180.121 4.211 9.725 13.828 152.357 4.867 17.523 -41.713 207.898 3.711	55.759 126.374 5.885 5.357 55.759 126.374 5.885 5.855 5.8409 35.666 146.575 5.357 5.357 5.357 5.357 5.357 5.357 126.374 5.885 11.458 15.564 166.786 4.431	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236 5.927 49.471 131.236 5.569 9.12.38 4.973 175.886 4.211	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 13.453 6.612 41.74 13.463 -7.81 187.005 3.989	7.362 37.023 31.36.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736 -19.627 193.941 3.881	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 158.837 4.641 158.27 49.471 131.236 5.569 13.91 -5.589 13.91 -5.589	9.725 13.828 152.837 4.867 9.725 13.828 152.837 14.542 -20.481 186.665 4.08 9.725 186.665 4.08 9.725 186.665 4.08 9.725 18.828 162.357 4.867 19.3611 -54.801	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.136 30.878 151.364 4.89 5.357 55.759 126.374 5.855 12.909 5.987 176.863 4.183	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62 128.882 5.805 5.62 128.882 5.805 4.736 178.765
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) (B) Stress at uptream(σ u) (B) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (Stress at uptream(σ u) (E) Stress at uptream(σ u) <td>tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/</td> <td>13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.823 152.357 13.823 152.357 4.867 13.828 152.357 4.867 17.523 -41.713 207.898 3.711 1.1.749</td> <td>55.759 120.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 126.374 5.885 11.458 11.458 11.4581 15.564 15.564 16.786</td> <td>54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426</td> <td>5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236 5.569 12.38 4.973 12.886 4.973</td> <td>6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 137.463 5.254 13.463 -7.81 187.005 3.989 10.305</td> <td>7.362 37.023 31.36.966 5.402 7.362 37.023 37.023 31.36.966 5.402 11.55 8.603 165.446 4.516 7.362 37.023 136.966 5.402 15.736 15.736 15.736 15.738 136.966 5.402 15.738 136.966 15.738 136.966 15.738 136.966 15.738 15.827 15.827 15.828 15.888 15.828 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.85888 15.8588 15.8588 15.85888 15.8588 15.</td> <td>5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 4.641 5.527 49.471 131.236 5.569 131.91 -5.589 186.448</td> <td>9.725 13.828 152.957 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 152.357 4.867 13.828 152.357 4.867 13.828 14.857 14.857 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15</td> <td>5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374 5.885 129.397 55.885 126.394 5.885 126.399 5.885 126.397 176.363</td> <td>54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62 128.882 5.805 5.62 128.882 5.805 4.736 178.765</td>	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.823 152.357 13.823 152.357 4.867 13.828 152.357 4.867 17.523 -41.713 207.898 3.711 1.1.749	55.759 120.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 126.374 5.885 11.458 11.458 11.4581 15.564 15.564 16.786	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236 5.569 12.38 4.973 12.886 4.973	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 137.463 5.254 13.463 -7.81 187.005 3.989 10.305	7.362 37.023 31.36.966 5.402 7.362 37.023 37.023 31.36.966 5.402 11.55 8.603 165.446 4.516 7.362 37.023 136.966 5.402 15.736 15.736 15.736 15.738 136.966 5.402 15.738 136.966 15.738 136.966 15.738 136.966 15.738 15.827 15.827 15.828 15.888 15.828 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.85888 15.8588 15.8588 15.85888 15.8588 15.	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 4.641 5.527 49.471 131.236 5.569 131.91 -5.589 186.448	9.725 13.828 152.957 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 152.357 4.867 13.828 152.357 4.867 13.828 14.857 14.857 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15.8588 15	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374 5.885 129.397 55.885 126.394 5.885 126.399 5.885 126.397 176.363	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62 128.882 5.805 5.62 128.882 5.805 4.736 178.765
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (N) Stress at downstream(σ d) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) (E) Stress at uptream(σ u) (N) Stress at uptream(σ u) (Stress at uptream(σ u) (Stress at uptream(σ u) (E) Stress at uptream(σ u) Safety factor for shearing sliding(Fs) Eccentric distance(e) Eccentric distance(e) Endertric distance(e) Endertris distance(e) Endertric distan	tf/m m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 4.211 9.725 13.828 152.357 4.867 17.523 -41.713 207.898 3.711 1.749 -0.724	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 136.555 5.357 5.357 5.357 5.357 126.374 15.564 15.564 145.676 15.566 147.004	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426 145.288	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.569 153.556 4.796 5.569 12.38 5.569 12.38 4.973 175.886 4.211 8.917 31.109	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81 187.005 3.989 10.3005 16.306	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736 136.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 15.736 139.966 5.402 139.9666 139.9666 139.9666 139.9666 139.9666 139.9666 139.9666	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 158.837 4.641 131.236 5.569 13.917 13.91 13.91 13.91 13.918 13.978 8.917 31.109	9.725 13.828 152.857 4.867 9.725 13.828 152.857 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 186.655 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 13.828 152.357 4.867 13.828 13.828 152.357 4.867 13.828 13.828 13.828 152.357 4.867 13.828 13.828 13.828 13.828 152.357 4.867 13.828 13.725 13.828 13.828 13.725 13.828 13.828 13.725 13.7577 13.7577 13.7577 13.7577 13.75777 13.75777 13.75777 13.7577777777 13.757777777777777777777	5.357 55.759 126.374 5.885 5.357 55.759 128.374 5.885 9.135 30.878 13.3678 151.364 4.89 5.357 157.759 126.374 58.855 12.909 5.987 176.363 4.183 7.566 147.007	54,513 126,77 58,379 53,571 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 4,736 176,765 4,178 145,288
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(Gu) (N) Stress at downstream(Gd) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(Gu) (E) Stress at uptream(Gu) (E) Stress at uptream(Gu) Safety factor for shearing sliding(Fs) Eccentric distance(e) NWL. Stress at uptream(Gu) (N) Stress at uptream(Gu) (N) Stress at uptream(Gu) (N) Stress at uptream(Gu) (Stress at uptream(Gu) (E) Stress at upt	tf/m m tf/m tf/m tf/m tf/m tf/m tf/m tf/	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.823 152.357 13.823 152.357 4.867 13.828 152.357 4.867 17.523 -41.713 207.898 3.711 1.1.749	55.759 120.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 126.374 5.885 11.458 11.458 11.4581 15.564 15.564 16.786	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 49.471 131.236 5.569 12.38 4.973 12.886 4.973	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 137.463 5.254 13.463 -7.81 187.005 3.989 10.305	7.362 37.023 31.36.966 5.402 7.362 37.023 37.023 31.36.966 5.402 11.55 8.603 165.446 4.516 7.362 37.023 136.966 5.402 15.736 15.736 15.736 15.738 136.966 5.402 15.738 136.966 15.328 11.55 15.238 136.966 15.328 15	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 49.471 131.236 5.569 13.911 -5.589 16.448 3.978 8.817	9.725 13.828 152.857 4.867 9.725 13.828 152.857 4.867 14.542 -20.481 186.665 4.08 9.725 4.867 182.857 4.867 182.857 4.867 19.361 -54.802 220.986 3.511 11.749 -0.724	5.357 55.759 126.374 5.885 5.357 55.759 125.374 5.885 9.135 30.878 151.364 4.89 5.357 55.759 126.374 5.855 126.374 5.885 126.374 5.885 12.909 5.987 176.363 4.183 7.566	54,513 126,77 5.879 53,571 127,821 5.842 29,629 151,763 4.885 52,62 128,882 52,62 128,882 52,62 128,882 52,62 128,882 52,62 128,882 52,62 128,882 52,62 5,805 5,805 4,736 178,76 4,736
Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(or u) (N) Stress at downstream(or d) Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(or u) (E) Stress at uptream(or u) (E) Stress at uptream(or u) (N) Stress at uptream(or u) (E) Stress at uptream(or u) (E) Stress at uptream(or u) (E) Stress at uptream(or u) (V) Stress at uptream(or u)	tf/m m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 4.867 13.623 -13.936 180.121 4.211 4.211 9.725 13.828 152.357 4.867 17.523 -41.713 207.898 3.711 1.749 -0.724	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 136.555 5.357 5.357 5.357 5.357 126.374 15.564 15.564 145.676 15.566 147.004	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426 145.288	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.569 153.556 4.796 5.569 12.38 5.569 12.38 4.973 175.886 4.211 8.917 31.109	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81 187.005 3.989 10.3005 16.306	7.362 37.023 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736 193.941 3.881 8.936 29.971 163.529	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 158.837 4.641 131.236 5.569 13.917 13.91 13.91 13.91 13.918 13.978 8.917 31.109	9.725 13.828 152.857 4.867 9.725 13.828 152.857 4.867 14.542 -20.481 186.665 4.08 9.725 4.867 182.857 4.867 182.857 4.867 19.361 -54.802 220.986 3.511 11.749 -0.724	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135	54,513 126,77 5,879 53,571 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 4,736 176,765 4,178 145,288 39,845
Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σu) (N) Stress at downstream(σd) Safety factor for shearing sliding(Fs) Eccentric distance(e) SWL. Stress at uptream(σu) (E) Stress at uptream(σu) (E) Stress at uptream(σu) (E) Stress at uptream(σu) (N) Stress at uptream(σu) (E) Stress at uptream(σu) Safety factor for shearing sliding(Fs) Eccentric distance(e) Safety factor for shearing sliding(Fs)	tf/m m tf/m tf/m tf/m m tf/m m tf/m	13.828 152.357 4.867 9.725 13.828 152.357 13.623 -13.936 180.121 9.725 13.828 180.121 9.725 13.828 152.357 4.867 1.7.523 -4.1.713 207.898 3.711 11.749 -0.724 207.091 -1.553 -1.575 -1.5	55.759 120.374 5.885 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.055 5.357 126.374 15.564 15.564 15.564 15.564 15.564 15.564 15.564 14.2004 4.431 7.5666 147.004	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.188 4.426 145.288	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.796 5.927 153.556 4.796 5.927 1131.236 5.927 49.471 131.236 5.927 17.2377 17.2377 17.2377 17.23777 17.2377777777777777777777777777777777777	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81 187.005 3.989 10.305 16.806 183.466	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736 -19.827 18.9966 -19.827 18.9966 29.171 18.936 29.171 163.529 	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 158.837 4.641 5.927 49.471 131.236 5.569 13.911 -5.589 186.448 3.978 8.917 31.109 163.735	9.725 13.828 152.857 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 152.357 4.867 1.3.828 1	5.357 55.759 126.374 5.885 5.357 55.759 125.374 5.885 9.135 30.878 151.364 4.89 5.3577 55.759 126.374 5.885 126.374 5.885 12.909 5.9877 176.363 4.183 7.566 147.007 42.975 	54.513 126.77 5.879 53.571 127.821 5.842 29.629 151.763 4.885 52.62 128.882 5.805 4.736 176.765 4.178 145.288 33.845
Safety factor for shearing sliding(Fs) Eccentric distance(c) (N) Stress at uptream(or u) (N) Stress at downstream(or d) Safety factor for shearing sliding(Fs) Eccentric distance(c) SWL Stress at uptream(or u) (E) Stress at uptream(or u) (E) Stress at uptream(or u) (E) Stress at uptream(or u) (B) Stress at uptream(or u) (N) Stress at uptream(or u) (E) Stress at uptream(or u) (V) Stress at uptream(or u) (V) Stress at uptream(or u) ty(N) Stress at uptream(or u) (V) Stress at uptream(or u) ty(N) Stress at uptream(or u) Stress at uptream(or u) Stress at uptream(or u) (VE) Stress at uptream(or u) Stress at uptream(or u) Stress at	tf/m m tf/m m tf/m m	13.828 152.357 4.867 13.829 152.357 13.828 152.357 13.823 152.357 4.867 13.828 152.357 4.867 13.828 152.357 4.867 13.828 13.828 13.207.898 3.711 11.749 -0.724 207.091 -1.7518	55.759 126.374 5.885 5.357 55.759 126.374 5.885 8.409 35.866 135.866 5.357 5.555 5.357 126.374 56.757 126.374 15.564 145.675 56.757 126.374 15.564 145.676 145.676 145.676 147.004 4.2375 	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.975 5.05 52.62 128.882 5.805 14.313 167.189 4.426 145.288 39.845	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.27 135.566 4.796 4.796 5.927 49.471 131.236 5.569 12.38 4.973 175.886 4.211 8.917 31.109 183.335 	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81 187.005 16.806 183.466 -12.048	7.362 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.446 4.516 7.362 37.023 136.966 5.402 15.736 15.736 15.9827 193.941 3.881 8.935 29.171 163.529 	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.919 21.946 131.236 158.837 4.641 5.927 4.641 131.236 5.569 135.21 131.236 5.569 133.21 131.236 5.569 133.235 135.2589 186.448 3.978 8.917 31.109 163.735 	9.725 13.828 152.857 4.867 9.725 13.828 152.857 14.542 -20.481 186.665 4.08 9.725 4.867 13.828 152.357 4.867 13.828 152.357 4.867 19.361 13.828 152.357 4.867 19.361 1.3.28 152.357 4.867 19.361 1.3.28 152.357 4.867 19.361 1.3.28 1	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.135 30.878 151.364 4.89 5.357 151.364 4.89 5.357 126.374 58.759 126.374 58.759 126.374 126.374 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 5.885 12.909 126.374 126.364 126.365 126.365 126.365 126.365 126.374 126.374 126.374 126.374 126.364 126.365 126.365 126.365 126.365 126.374 126.365 126.365 126.365 126.365 126.365 126.365 137.365 126.3	54,513 126,77 5,879 53,571 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 4,736 176,765 4,178 4,178 33,845
Safety factor for shearing sliding(Fs) Eccentric distance(e) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (N) Stress at uptream(σ u) (E) Stress at uptream(σ u) (N) Stress at uptream(σ u) (S) Stress at uptream(σ u) (S) Stress at uptream(σ u) (S) Stress at uptream(σ u) (C) Stress at uptream(σ u) (E) Stress at uptream(σ u) (I) Stress	tf/m m tf/mi tf/mi	13.828 152.357 4.867 9.725 13.828 152.357 13.623 -13.936 180.121 9.725 13.828 180.121 9.725 13.828 152.357 4.867 1.7.523 -4.1.713 207.898 3.711 11.749 -0.724 207.091 -1.553 -1.575 -1.5	55.759 126.374 5.835 5.357 55.759 126.374 5.885 8.409 35.666 146.575 5.357 5.357 5.357 5.357 126.374 5.885 11.458 15.564 15.564 15.686 147.004 4.2375 	54.513 126.77 5.879 53.571 127.821 5.842 34.418 146.875 5.05 52.62 128.882 5.805 14.313 167.189 4.426 145.288 39.845	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.154 27.227 153.556 4.736 5.927 49.471 131.236 5.927 49.471 131.236 5.569 12.38 4.973 12.38 4.973 12.38 4.973 12.38 4.973 12.38 4.917 31.109 163.735 	6.612 41.74 137.375 5.254 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 10.037 16.971 162.184 4.535 6.612 41.74 137.375 5.254 13.463 -7.81 137.035 3.989 10.305 18.9466 183.466 	7.362 37.023 37.023 136.966 5.402 7.362 37.023 136.966 5.402 11.55 8.603 165.448 4.516 7.362 37.023 136.966 5.402 15.736 193.941 3.881 8.936 29.171 163.529 	5.927 49.471 131.236 5.569 5.927 49.471 131.236 5.569 9.9110 9.9110 9.	9.725 13.828 152.957 4.867 9.725 13.828 152.357 4.867 14.542 -20.481 186.665 4.08 9.725 13.828 152.357 4.867 19.361 186.665 13.828 152.357 19.361 19.361 19.361 19.361 11.749 -0.724 207.091 -0.724 207.091 -0.724 13.96 -0.285 -20.85 -20.85 -20.85 -20.95	5.357 55.759 126.374 5.885 5.357 55.759 126.374 5.885 9.126.374 5.885 9.126.374 5.885 9.126.374 5.357 55.759 126.374 5.885 12.909 5.357 126.374 5.885 12.909 5.387 126.374 5.885 12.909 5.387 126.374 5.885 12.909 5.887 126.374 5.885 12.909 5.887 126.374 5.885 12.909 5.887 126.374 5.885 12.909 5.357 126.374 5.885 12.909 5.357 12.5755 12.57	54,513 126,77 5,879 53,871 127,821 5,842 29,629 151,763 4,885 52,62 128,882 5,805 5,805 4,736 176,765 4,178 145,288 33,845

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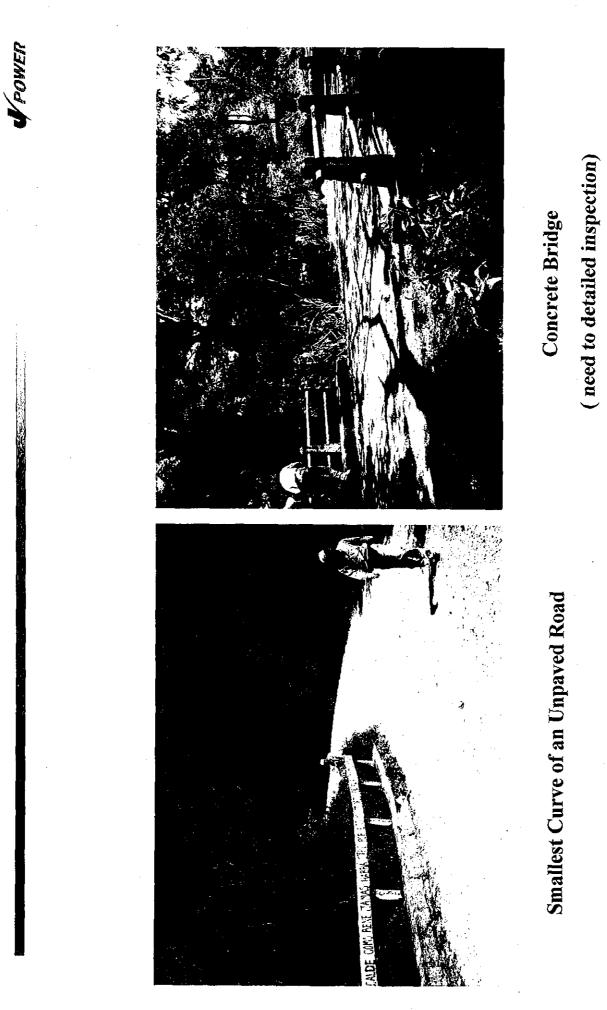
Appendix 11.5

Transportation Route to Project Site

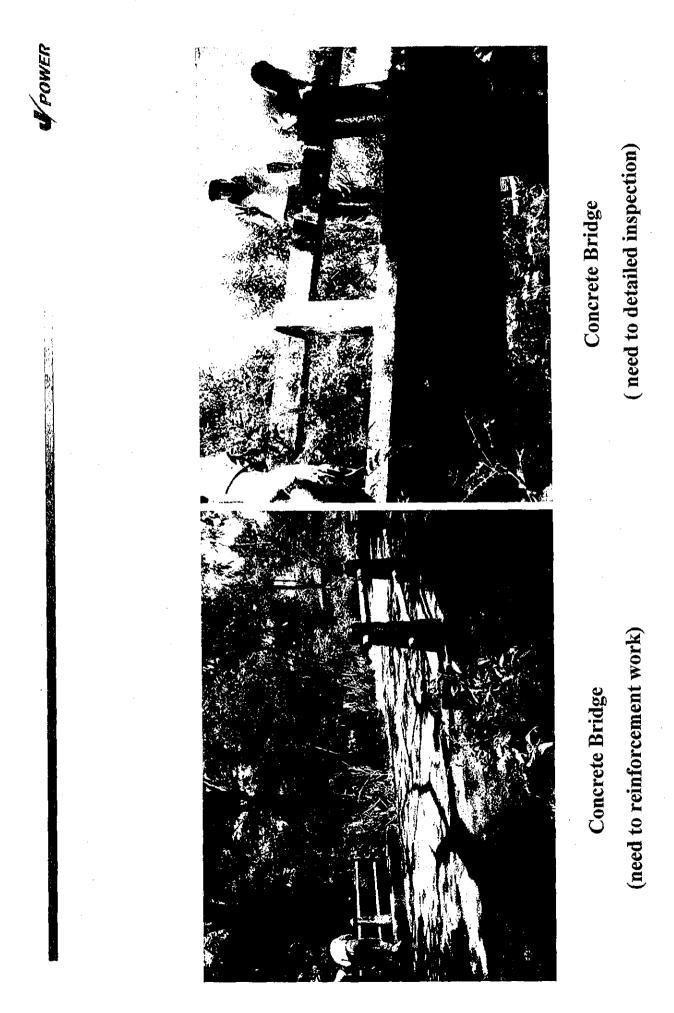
675 (676)

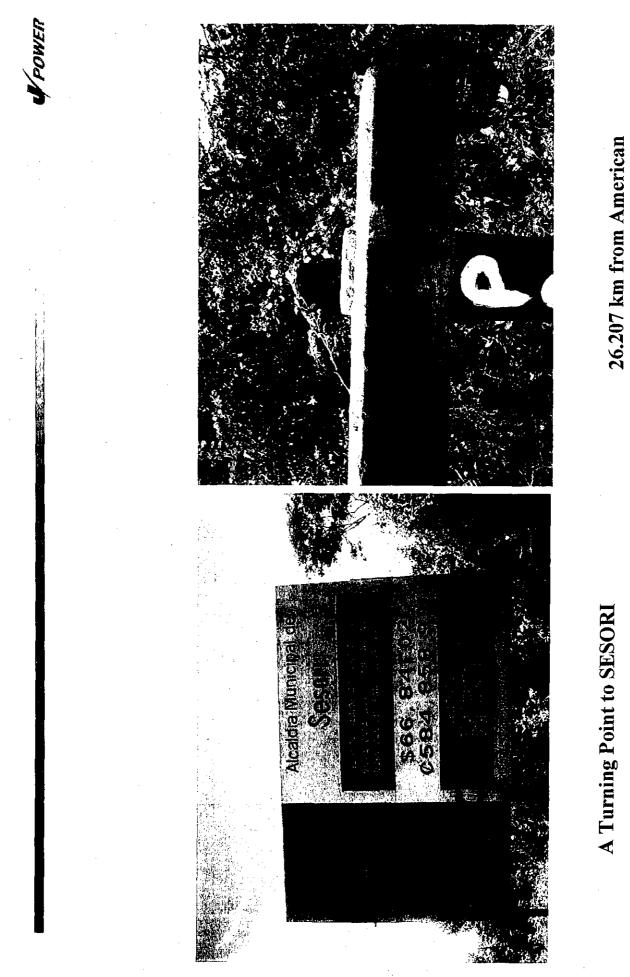


11-5-1

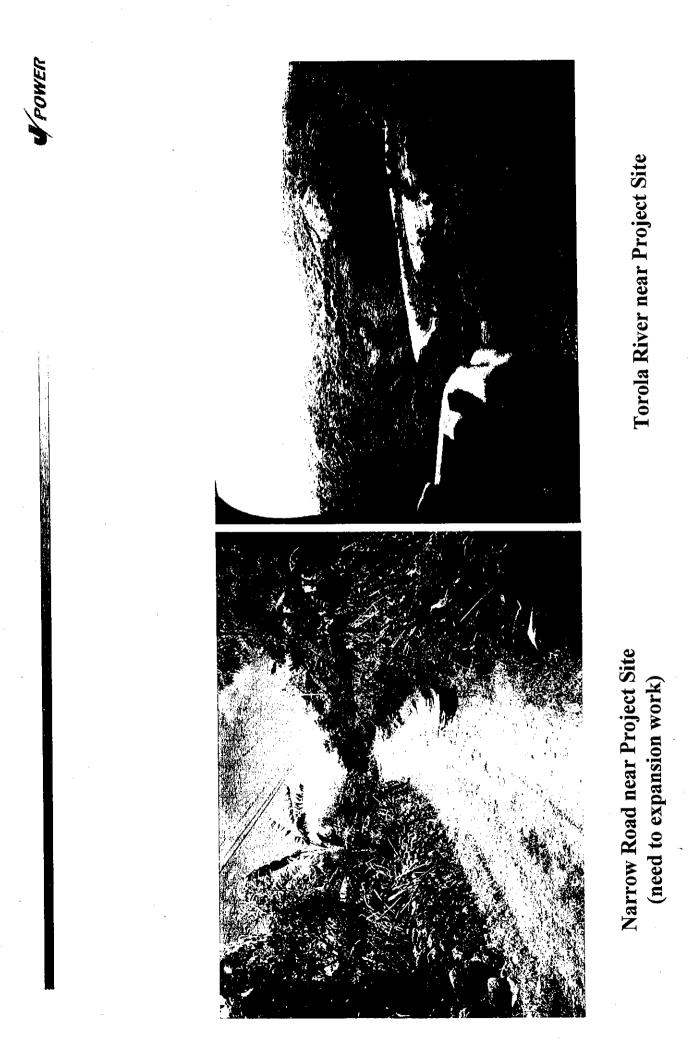


11-5-2





6.207 km from Amer Highway



Chapter 12: Construction Plan and Cost of Construction

Appendix 12.1: Construction Plan

Appendix 12.2: Cost of Construction

Appendix 12.2.1: Summary of El Chaparral Project Cost

Appendix 12.2.2: Details of Project Cost (Civil)

Appendix 12.2.3: Details of Project Cost (Electric)

Appendix 12.2.4: Disbursement Schedule

Appendix 12.3: Calculated Quantity

Appendix 12.3.1: Summary of Quantity

Appendix 12.3.2: Civil Works

683 (684) Appendix 12.3.3: Hydromechanical Equipment

Appendix 12.1

Construction Plan

685 (686)

Table 12.1 EL Chaparral Project Construction Schedule

	· · · · · · · · · · · · · · · · ·			, 	·····	· · · · · · · · · · · · · · · · · · ·	·	
item		unit	quantity	1 st year	2nd year	3rd year	4th year	
				AMJJASOND	JFMAMJJASOND	JFMAMJJASOND	J F M A M J J A S O N D	·
1 Preparatory works								· · · · · · · · · · · · · · · · · · ·
construction road 1 (B=6m) exi	isting road improvement	km	6					
construction road 2 (B=6m) new	w road (permanent)	km	3					
construction road 3 (B=11m) new	w road (temporary)	km	2					
camp & office facility		LS	1					
temporary yard development	· • · · · · · · · · · · · · · · · · · ·	LS	1					
temporary construction facility wa	ter supply, electric supply	LS	1					۱ <u>ــــــــــــــــــــــــــــــــــــ</u>
agg	gregate/concrete plant	LS	1					
cab	ole crane & others	LS	1					
2 Main civil works					diversion			
Care of river								
upstream coffer dam exc	cavation	m ³	5,400					· · · · · · · · · · · · · · · · · · ·
dau	m concrete	m ³	14,400					15,360 m ³ /month (24day/mo
downstream coffer dam exc	cavation	m^3	5,000					
dar	m embankment	m ³	3,000					
diversion tunnel exc	cavation	m ³	8,200					
tun	nnel excavation(L=380m)	m ³	_ 24,000					144 m/month (24day/month×
lin	ing concrete(L=80m)	- m ³	2,100					120 m/month (24day/month-
clo	osing (plug concrete)	LS	1					
Dam								
Dam								
excavation		m^3	311,200					50,000 m ³ /month (20day/mo
RCC dam concrete inr	ner concrete	m ³	247,600					57,600 m ³ /month (20day/mo
conventional dam concrete out	ter concrete	m ³	121,600					
curtain grouting bo	ring (cement injection)	m	46,800					
	ring (cement injection)	m	4,400					
Spillway	· · · · · · · · · · · · · · · · · · ·		1					
	er, guide wall and others	m ³	23,000					
gate installation gat		LS	1				╈┥╎╎╿╢╖╖╖	· · · · · · · · · · · · · · · · · · ·
			·	Freedom Family accelerate				<u></u>

remarks
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onin×20n/day×20 times/n×2.0m ×0.8)
n×1.5m/cycle×4cycle/day)
n÷2day/1cycle×10m/1cycle)
<u>and the second s</u>
onth×2,500m ³ /day)
onth×20h/day×20 times/h×6.0m ³ ×0.8×1.5)
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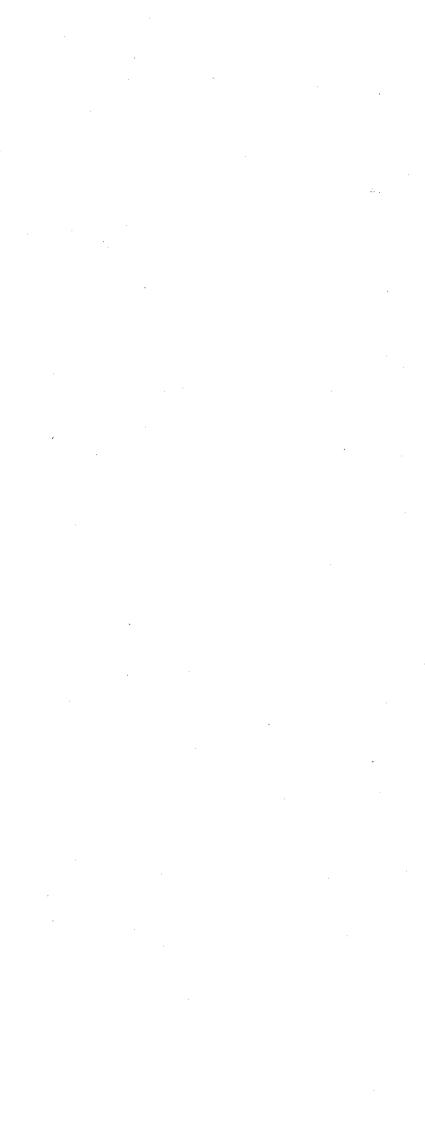


Table 12.1 EL Chaparral Project Construction Schedule

item		unit	quantity	1st year	2nd year	3rd year	4th year	
			-	AMJJASOND	JFMAMJJASOND	JFMAMJJASOND	JFMAMJJASOND	
Water way								
Intake								
structural concrete p	bier and others	m ³	1,200					
gate installation	gate and screen	LS	1					
Penstock								
incline schaft excavation		m ³	2,400					L=91m, 60m/month (20day/
penstock tube installation		m	145			┝╍┿╍┥╏╏╎╎╢╢╢╢╢╢╎		L=89m, 30m/month (20day/
filling concrete		m ³	800					
Power house								~EL145m 166,100m ³ , EL
Power house								
excavation		m ³	179,400					50,000m ³ /month (20day/mor
structural concrete f	foundation, slab and others	m ³	11,700					$2,400 \text{m}^3/\text{month}(120 \text{m}^3/\text{day}\times$
Control building								
Control building	35×27×13	LS	1					
Outlet								
excavation	_	m ³	16,200					
Switch yard								
foundation concrete	and when the second second second	m ³	100					
3. Electric equipment	equipment installation	LS	. 1			inundatio		
main draft and overhead travel	ing crane							
main turbine & it's auxiliary equipment								
main generator & it's auxiliary equipment								
sub turbine & generator & it's auxiliary equipment								
power plant equipment								
switchyard equipment and mai	in transformer							
dry and wet test								
transmission line		km	43				╵┝┽╋┥║╽╿║║╹	

remarks	
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ay/month×1.5m/cycle×2cycle/day)	
ay/month÷12day/cycle×18m/cycle)	
L145m~ 31,100m ³	
onth×2,500m ³ /day)	
y×20day/month)	· · · · · · · · · · · · · · · · · · ·
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Appendix 12.2

Cost of Construction

Appendix 12.2.1: Summary of El Chaparral Project Cost
Appendix 12.2.2: Details of Project Cost (Civil)
Appendix 12.2.3: Details of Project Cost (Electric)
Appendix 12.2.4: Disbursement Schedule

Appendix 12.2.1

Summary of El Chaparral Project Cost

693 (694)

Image: constraint of the			3		6				
NET Cost Buttering mod 2 (service)	Item	Quantity	Unit	Unit Price	Total Cost	~0	Foreign urrency	Local Curr <i>e</i> ncy	Subtotal
Mcs Statute St									
Worts Worts System System <thsystem< th=""> <thsystem< th=""></thsystem<></thsystem<>	PROJECT COST								\$ 4 471 800
a rest light for the function of the function	I Preparatory Works	~			007.00	G			
ar rend 3 (new termenery rend, 13–111) 2.9 km s 17,200 5 71,400 5 160,000 5 170,000 0 100,000 5 170,000 0 100,000 0	Construction road 1 (Improved existing road, B=6m)	6.0 2 ^			92,400		ł		
Contraction Contract for the represent y class, 1, mellion 2 mellion <td>Construction road 2 (new permanent payed road, B=0m)</td> <td>3.0</td> <td>Ì</td> <td></td> <td>000100</td> <td></td> <td>1</td> <td></td> <td></td>	Construction road 2 (new permanent payed road, B=0m)	3.0	Ì		000100		1		
Constraint 1 1 5 1,800,00 5 1,8	Construction road 3 (new temporary road, B=11m)	2.0	- 1		14,400	*****			
Construction (heility construction, heility construction, heility Example (heility construction, heility construction) Example (heility (heility) Example (heility) Exampl	Camp & office facility	-			1,800,000		,		
Construction yet directionment 1 1 5 850,000 850,000 850,000 850,000 850,0000 850,0000 850,00	Temporary constructon facility	1		.	1,100,000		,		
Meridian 3500 m² 5 4 5 15,200 5 75,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 76,000 5 77,000	Temporary constructon yard development	-			850,000		,		
Tread 1300 m² 1 15200 5 15200 5 15200 5 15200 5 15600 5 16600 5 16600 5 16600 5 16600 5 16600 5 16600 5 16000 5 16600 5 16000 5 16000 5 16000 5 16000 5 16000 5 16000 5 16000 5 16000 </td <td></td> <td></td> <td></td> <td>~ *</td> <td></td> <td></td> <td></td> <td></td> <td>\$ 57.114.110</td>				~ *					\$ 57.114.110
River Amon Summer Scientific Iso attent Control Iso Science (control Iso Science (control <thiso< td=""><td>Z CIVII WORKS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>ļ</td></thiso<>	Z CIVII WORKS								ļ
Attenent Caffordum 3800 m² 4 5 15 5 76000	Care of River								
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Upstream Cofferdam					•			
Constrained 1,000 n ¹ S 1000 S 3,000 S 3,000 S 4,000 S <th< td=""><td>Common Excavation</td><td>3,800</td><td></td><td></td><td>15,200</td><td></td><td>,</td><td></td><td></td></th<>	Common Excavation	3,800			15,200		,		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Rock Excavation	1,600			16,000				
Observation 1 1s 40000 \$ 20,000 <	Roller Compacted Concrete	14,400			792,000				
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Others		1s .		40,000				
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Downstream Cofferdam							÷	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Common Excevation	3.500			14,000				
	Rock Evoauation	1 500			15.000				
Differs 1 1 1 1 1 1 20,000 5	Pathonkanan ana ang ang ang ang ang ang ang ang	3.000	1		21.000				
	Others	······			40,000		; ;		
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Diversion Tunnel								
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Common Excavation	8,200	i	4	32,800		1		
Turiel Lining Concrete 2,100 'm' \$1,1,1,201 \$241,500 \$244,500	Tunnel Excavation	24,000		150,	3,600,000	<"	1		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Tunnel Lining Concrete	2,100		4.1	483,000				
Diters 1 1s 1s 1051,450 5 630,870 5 420,580 n n n n 124,500 m² 5 1,120,200 5 8,170,800 5 746,800 5 746,800 5 746,800 5 746,800 5 746,800 5 746,800 5 747,600 5 747,600 5 747,600 5 747,200 5 8,170,800 5 747,200 5 747,200 5 747,200 5 747,600 5 747,600 5 747,200 5 710,800 5 5,447,200 5 710,800 5 5,447,200 5 746,800 5 746,800 5 746,800 5 5 5 746,800 5 5 746,800 5 5 746,800 5 5 6 5 6 6 5 5 6 6 5 6 6 5 5 6 6 5	Reinforced Bar	60	~- I	L. 1	90,000				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Others	1	. 1	_]	1,051,450				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			• * •	1					\$ 44,048,400
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$									
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Common Durantica	124 500		• •	498 000				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Rock Pycevation	186.700			1,867,000				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Roller Compared Concrete(Inner Concrete)	247,600			13,618,000				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Conventional Concrete(Dam Crest Con + Outer Con)	121.600			12,160,000	4,5	1		
Idention Grouting Cement 90 t 5 700 5 63,000 5 12,600 5 off-outing Cement 46,800 m 5 × 130 5 6,084,000 5 12,600 5 308,000 5 308,000 5 5 0084,000 5 130,400 5 130,400 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5 576,000 5	Consolidation Grouting Drilling	4,400	1		264,000				
Off-outing Drilling 46,800 m S 130 S 6,084,000 S 1216,800 S 1 Grouting Cement 2,200 1 5 700 5 1,540,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 308,000 5 306,000 5 308,000 5 306,000<	Consolidation Grouting Cement	90	t S	١.	63,000		;		
1 Grouting Cement 2,200 t \$ 700 \$ 1,540,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 308,000 \$ 309,400 \$ 309,400 \$ 309,400 \$ 309,400 \$ 309,400 \$ 309,400 \$ 309,000 \$	Curtain Growting Drilling	46,800	Į	130	6,084,000	1			
i is i 10% S 3,609,400 S 180,470 S real Concrete(Piers, Chute, Walls, etc) 23,000 m² 130 S 2,999,000 S 897,000 S read Bar 1 1 1 1 1 1 1 S 195,000 S 897,000 S 576,000 S 576,000 S 576,000 S 576,000 S 576,000 S 576,000 S 5 576,000 S 576,000 S 576,000 S 576,000 S 576,000 S 5 576,000 S 5 576,000 S 5 <td>Curtain Grouting Cement</td> <td>2,200</td> <td></td> <td>700</td> <td>1,540,000</td> <td></td> <td></td> <td></td> <td></td>	Curtain Grouting Cement	2,200		700	1,540,000				
rral Concrete(Piers,Chute,Walls,etc) 23,000 m ³ \$ 130 \$ 2,990,000 \$ 897,000 \$ 2 ceed Bar 640 t \$ 1,500 \$ 960,000 \$ 576,000 \$ 5 reed Bar 10% \$ 395,000 \$ 19,750 \$	Others	1	ls		3,609,400		;		
al Concrete(Piers, Chute, Walls, etc.) $23,000$ III a 130 b $2,590,000$ c $576,000$ c 2 $2d$ Bar $1,500$ s $1,500$ s $1,500$ s $19,750$ s $19,750$ s $19,750$ s $109,6$ s $109,6$ s $109,6$ s $10,750$ s $10,750$ s $10,750$ s $109,6$ s $109,6$ s $100,6$ s	Spillway	000 00			000 000 0				
26 Bar 040 t 3 1,000 2 70,000 5 19,750 5 19,750 5	Structural Concrete (Piers, Chute, Walls, etc)	25,000			000'046'7			4	
	Reinforced Bar	640			000'006				
	Others	-	15		mnícke				

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Table 12.2 EL CHAPARRAL PROJECT SUMMARY of PROJECT COST (price in Jan. 2003)

Item	Ouantity	Unit Price	Cost		Foreign Currency	Local Currency	cal	Subtotal
		-					÷	1 070 300
Water way							-	
III.a.ke Structural Concrete(Piers etc.)	1 200	m \$ 130	156.000			\$ 109,200	8	
Reinforced Bar	09 09	\$ 1,500	000'06	69	:	\$ 36,000	0	
, Others	1	10%	24,600				02	
Penstock								
Incline Shaft Excavation	2,400	m ³ \$ 200 \$	480,000				8	
Filling Concrete	800	69	152,000				g	
Structural Concrete(Anchor Block)	500	130					8	
Rainforced Bar	20		30,000	69	18,000	\$ 12,000	g	
Others	-	18 1 A 4 5 5 4 4 1 0 % 1 . 8					8	
Powerhouse			,				69	5,784,960
Powerhouse		******						
Common Excavation	35,900		143,600				. 00	
Rock Excavation	143,500	\$ 10	1,435,000	69	861,000	\$ 574,000	8	
Structural Concrete(Slab, Barrel)	11,700	130	1,521,000			Ш	00	
Reinfored Bar	740	s	1,110,000			\$ 444,000	8	
Others	1	·	841,920				20	
Control Building Control Building	12.300	inner m ³ \$ 40 \$	492,000		,	\$ 492,000	00	
Outlet								
Common Excavation	4,900	\$ 4		s			8	
Rock Excavation	11,300	m ³ \$ 10 \$		s	67,800	\$ 45,200	8	
Others	1	20%	26,520	\$			0	
Switchyard			1					
Common Excavation	13,900		55,600	s	27,800	<u> </u>	2	
Structural Concrete(Faundation)	100	64)	13,000				gl	
Others	1	1s 20% \$	13,720			\$ 8,230	8	
3 Hydromechanical Equipment							\$	11,720,000
Spillway Gate	1,130	t \$ 7,000 \$	7,910,000	\$			8	
Intake Gate	90	t \$ 6,000 \$	540,000	s	486,000	\$ 54,000	8	
Intake Screen	20	3,000		Ś			8	
Penstock Tube	350	t \$. ; 5,000 \$		\$			8	
Outlet Gate	20	6,000		\$			8	
Sluiceway Gate & Steel liner	1	Is \$ 1,040,000 \$	1,040,000	\$		\$ 104,000	8	

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	() Blantriv (init							212	[CIar
4 Riectric equipment							6 43	17,786,000	00
Main Turbine and Speed Governing System	1 Is		\$ 5,466,000	↔	4,700,760	ŝ	765,240		
Main Generator and Excitation System	<u> </u>	s		\$	3,722,080	Ś	605,920		
Main Power Transformer	1 18	l	1	s	896,980	S	146,020		
Small Turbine and Sneed Governing System	1 Is	\$		s	365,500	69	59,500		
Small Generator and Excitation System	1 1s	5	\$ 387,000	69	332,820	s	54,180		
Overhead Travel Crane	- 1 1s	s		69	737,020	\$	119,980		
Swichyard Equipment	1 Is	æ		\$	431,720	S	70,280		
Powerplant Equipment	- I 1s	\$ 4,778,000	\$ 4,778,000	\$	4,109,080	s	668,920		
5 Transmission Equipment							64	2,597,000	g
Receiving Switch	1 Is	\$ 177,000	\$ 177,000	\$	152,220	s	24,780		
Transmission Line	1 IS		7		1,742,400	\$	677,600		
6 Environmental Cost							S	7,420,000	8
Infrastructure		· . 							
New Public Road	11 km	\$ 25,000		ŝ	27,500	\$	247,500		
Improved Public Road	33 km	\$ 15,000		Ś	49,500	\$	445,500		
New Bridge (two bridges)	2 ls		\$ 4,000,000	s	3,600,000	69	400,000		
Environmental Mitigation				6	10,000	¢	000 021		
Environmental Mittgation]]3	5 192,000 c 7,458,000	S 192,000	~ ~	245 800	A 64	2 212 200		
	1 22			•	20262-2				
7 Land Acquisition and Resettlement							6 9	9,823,700	00
Land Acquisition for Reservoir (suitable for agriculture)		\$			-	\$	1,872,000		
Land Acquisition for Reservoir (not suitable for agriculture)		5	\$ 3,805,500		•	s	3,805,500		
Land Acquisition for Reservoir (steep land)	81 ha	6	\$ 340,200 \$		-	A 6	340,200		
Land Acquisition for Access Road		1		0	-	9 6	000,011		
Land Acquisition for Camp, Temporary Land		\$ 5,000	5 35,000		-	A 6	000.05		
Land Acquisition for Dam, Powerhouse and Switch yard	o na	.		9 6	_	9 6	1 176 000		
Right of way for Transmission line Relocation and ResetHement Cost	43 km 75 family	\$ 30,000	\$ 2,250,000	~~~	. .	• •	2,250,000		
TOTAL DIRECT COST			\$ 110,932,610	s	54,430,710	\$	56,501,900		
8 Contingency							S	7,763,750	150
Preparatory Works + Civil Works		10%	9		2,275,020	s	3,883,580		
Hydromechanical Equipment			\$ 586,000		527,400	59	58,600		
Electric Equipment + Transmission Equipment		5%	\$ 1,019,150		859,530	59	159,620		
9 Administration & Engineering Cost		:					S	16,639,900	g
Administration & Engineering Cost	1 1s	15%	\$ 16,639,900	59	11,370,600	S	5,269,300		
TOTAL INDIRECT COST		•	\$ 24,403,650	62	15,032,550	S	9,371,100		
TATISTICS AND A TANK A TANK A TANK A TATISTICS							-		
TOTAL PROJECT CONSTRUCTION COST			\$ 135,336,260	69	69,463,260	s	65,873,000		

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Appendix 12.2.2

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Details of Project Cost (Civil)

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1. Preparatory Works (1) Construction road 1 (B= 6m)

d 1 (B= 6m) Improvement of existing road (expanding width of existing road to 6 m) gravel road, L=6 km 15,400 US\$/km X 6 km = 92,400 US\$

(2) Construction road 2 (B= 6m)

New construction road asphalt road, L=3 km 185,000 US\$/km X 3 km = 555,000 US\$

(3) Construction road 3 (B= 11m)

New construction road gravel road, L≃2 km 37,200 US\$/km X 2 km = 74,400 US\$

(4) Camp & office facility

	adopted	A project	C project	remarks
camp facility	3	£	24	civil works x %
		4,098,000	098,000 4,900,000	ns\$

El Chaparral Civil Works Cost = 57,114,110 US\$ X 3% = 1,713,423 = 1,800,000 US\$

(5) Temporary construction facility

1) Power supply

Power supply facility dam concrete volume = 370,000 m3 2,600 kVA power house Installed capacity = 64,400 kW 800 kVA

US\$ 300,000

2) Water supply

adopted A project C project remarks water supply 0.5 0.4 0.5 civil works x % 544,000 1,041,000 US\$					
0 5 0 4 54,000 1,041		adopted	A project	C project	remarks
041,000	supply	0 5 0	04	05	civil works x %
			544,000	1,041,000	US\$

EI Chaparral Civil Works Cost = 57,114,110 US\$ X 05% =285,571 = 300,000 US\$

3) Temporary bridge

Temporary bridge 500,000 US\$ based on J-Power's past records

Temporary construction facility = 1 + 2) + 3) = 300,000 + 300,000 + 500,000 = 1,100,000 US

(6) Temporary yard development

Yard 1 (land area that is located 2 km upstream from dam site. land area for aggregate plant, motor pool, assembly yard, stock yard and power supply yard) Yard 2 (land area at the left side of dam land area for concrete plant) Yard 3 mcludes in the area for Switch yard Yard 4 (land area at the left side of dam, land area for camp & office facility)

Total land area for Yard 1, 2, 4 = 72,300 + 12,500 + 57,500 = 142,300 m2 Excavation volume = 72,300 m2 X 1m + 70,000 m2 X 2m = 212,300 m3 Excavation cost = 212,300 m3 X 4 US\$/m3 = 849,200 US\$ = 850,000 US\$

(Civil Works)																
ţ	4. MI		adopted		id Y	A project in Peru	n,	B proje	project in Costa Rica	Rica	C pro	project in Suri Lanca	i Lanca	D pro	project in Vietnum	mum
	nuur	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)	unit price	FC(%)	LC(%)
common excavation	US\$/m ³	4	50	50	4.3	63	37	3.6	47	53	4	75	25	5 2.3	78	22
rock excavation	US\$/m ³	10	60	40	14.1	64	36	8.4	62	38	14.6	82	18	3.3	67	33
earthfill embankment	US\$/m ³	7.	80	20	5	1	ı	1	ı	ı	6.5	75	25	5 2.7	81	19
tunnel excavation	US\$/m ³	150	80	20	159.8	80	20	1	t	,	84	82	18	4	77	23
shaft excavation	US\$/m ³	200	80	20	201.6	86	14	1	1	1	1	1	I	119.2	95	5
incline shaft excavation	US\$/m ³	200	80	20	1	1			1	1	106	82	18	122.6	93	7
care of river for diversion work	LS	40000	50	50	-	r.	1	1		1	37854	54	46		1	1
RCC dam concrete *1	i∪S\$/m³	55	40	60	1	1	F	51.7	38	62	1	1	1	1	1	ł
conventional dam concrete	US\$/m ³	100	40	60	114.5	18	82	101	38	62	102	78	22	-	. 1	1
structural concrete	US\$/m ³	130	30	70	134.1	17	83	120.6	35	65	132.3	79	21	1	1	ı
tunnel lining concrete	US\$/m ³	230	50	50	237.8	54	46	1	1	ı	131.4	84	16	5 133.9	67	33
tunnel filling concrete	US\$/m ³	190	40	60	192.5	36	64	1	,	1	179.4	78	22	2 114.8	09	40
shaft lining concrete	US\$/m ³	230	50	50	231.7	44	56		-							
control building	US\$/m ³	40	0	100	1		1	;	1	,	1	1	 1 .	36.3	0	100
reinforcement	US\$/t	1500	60	40	1437	35	65	1519.3	64	36	1285.8	11	29	470.9	4	96
spillway gate	US\$/t	7000	90	10	7261	91	6	,	1		7186	88	12	-	1	1
intake gate	US\$/t	6000	06	10	6684	91	6	1	1	1	6873	88	12	-	1	
intake screen	US\$/t	3000	90	10	3388	93	7	1	- - - -		1		1			1
penstock tube	US\$/t	5000	90	10	3799	81	19	1	,	1	5000	88	12	-		1
consolidation grouting drilling	US\$/m	60	20	80	69.8	15	85	ı	1	;	196.1	92		8 48.8	92	8
curtain grouting drilling	US\$/m	130	20	80	139.5	15	85	T	3		196.1	92		8 488	92	80
cement grouting (consoli/curtain	US\$/t	700	20	80	708.7	15	85	,	1		1478.3	72	28	3 491	81	19
*2 excavation unit price includes the cost for excavation, shotcrete and rockbolt	s the cost for exce	avation shot	crete and roc	skbolt												

unit price for civil works, hydromechanical equipment (price in Jan. 2003)

*3 concrete unit price includes the cost for concrete placement and frame work except RCC

(rate of other works)	80	adopted			A project		
% for total cost	FC (%)	LC (%)	total	FC (%)	LC (%)	total	remark
diversion tunnel	60	40	25	58.3	41.7	25.6	25.6 D project (plug concrete, consolidation grout and others)
dam	5	95	10	3.3	96.7	111	A project (water stop, bridge and others)
intake	30	70	10	31.1	68.9	7.7	A project (water stio, staff gauge and others)
penstock tunnel	30	70	10	28.4	71.6	5.9 /	A project (mortal injection and others)
power house	40	60	20	37.3	62.7	21.11	D project (shotcrete, drain work and others)

*4 % is the rate for total cost

2000 4.3% 2000 3.4% 1999 2.7% 1999 -1.0% 1998 1.6% 1998 4.2% 1997 1.7% 1997 1.9% (Inflation rate) (USA) 1995 1996 3.3% (El Salvador) 1995 1996 7.4%

2002 2.4%

2001 1.6%

2002 2.8%

2001 1.4%

El Salvado A project B project 30 30 38 45 30 30 38 42 30 30 38 <u>8</u> 3300-1 (Labor cost : US\$/day) Machine operator Common labor Skilled labor Mechanic Electrician Foreman

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(Material cost)			
	El Salvado	A project	B project
cement	108	129	103
reinforcing bar	250	532	

1	\mathbf{a}	2	7
Т	~	~	· /

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(A project/Detailed Design in Peru) inflation rate (1996-2002) inflation of FC part used the rate in USA = 14% inflation of LC part used the rate in El Salvador = 14%

					UNIT DI ICE (OCA III CAII, 2003 DASC)	
ITEM	unit	FC	*	ΓC	8	total
common excavation	US\$/m³	2.7	63	1.6	37	4.3
rock excavation	US\$/m ³	6	64	5.1	36	14,1
tunnel excavation	US\$/m3	127.3	80	32.5	20	159.8
shaft excavation	US\$/m ³	173.4	86	28.2	14	201.6
conventional dam concrete	US\$/m ³	20.3	18	94.2	82	114.5
structural concrete	US\$/m ³	22.7	17	111.4	83	134.1
tunnel lining concrete	US\$/m ³	127.6	54	110.2	46	237.8
unnel filling concrete	US\$/m ³	69.8	36	122.7	64	192.5
shaft lining concrete	US\$/m ³	103.1	44	128.6	56	231.7
reinforcement	US\$/t	497.4	35	939.6	65	1437
spiliway gate(radial gate)	US\$/t	6627	91	634	6	7261
ntake gate	US\$/t	6050	91	634	6	6684
ntake screen	US\$/t	3143	93	245	7	3388
benstock	US\$/t	3092	81	707	19	3799
drilling for consolidation grouting (L=470m)	US\$/m	10.7	15	59.1	85	69.8
drilling for curtain grouting (L=1520m)	m\\$\$U	21.4	15	118.1	85	139.5
cement grouting (W=300t)	US\$/t	108.6	15	600.1	85	708.7

(rate of other works) % for total cost	FC (%)	rc (%)	total *5	remark
dam	3.3	96.7	11	water stop, bridge and others
intake	31.1	6.89	<u>7.7</u>	water stio, staff gauge and others
pemstock tunnel	28.4	71.6	5.9	9 mortal injection and others

(B project Detailed Design in Costa Rica) inflation rate (1996-2002) inflation of FC part was used the rate in USA = 14% inflation of LC part was used the rate in El Salvador = 14%

(Civil Works) % for total unit price

		5	nit price (U	unit price (US\$ in Jan. 2003 base)	2003 base	~
	מנוור	FC	»e	гс	*	total
common excavation	US\$/m ³	1.7	47	6.1	53	3.6
rock excavation	US\$/m ³	5.2	62	3.2	38	8.4
RCC dam concrete	US\$/m ³	19.6	38	32.1	62	51.7
conventional dam concrete	US\$/m ³	38.6	38	62.4	62	101
structural concrete	US\$/m ³	42.5	35	78.1	65	120.6
reinforcement	US\$/t	969.4	64	549.9	36	1519.3

(C project Deatailed Design in Sri Lanca) inflation rate (1995-2002) inflation of FC part was used the rate in USA = 18% inflation of LC part was used the rate in El Salvador = 22%

(Civil Works)

	ini.	u	iit price (L	unit price (US\$ in Jan. 2003 base)	2003 base)	_
ILENI	ni lit	FC	*	LC_	*	total
common excavation	US\$/m ³	ŝ	75	1	25	4
rock excavation	US\$/m ³	11.9	82	2.7	18	14.6
embankment	US\$/m ³	4.9	75	1.6	25	6.5
tunnel excavation	US\$/m ³	68.9	82	15.1	18	84
inclined shaft excavătion	US\$/m ³	86.5	82	19.5	18	106
care of river for diversion work	LS L	20390	54	17464	46	37854
conventional dam concrete	US\$/m ³	79.2	78	22.8	22	102
structural concrete	US\$/m ³	104.4	67	27.9	21	132.3
tunnel lining concrete	US\$/m ³	109.8	84	21.6	16	131.4
tunnel filling concrete	US\$/m ³	140.4	78	39	22	179.4
reinforcement	US\$/t	914.6	11	371.2	29	1285.8
spillway gate	US\$/t	6351	. 88	835	12	7186
intake gate	US\$/t	6015	88	858	12	6873
penstock	US\$/t	4400	88	600	12	5000
drilling for consolidation grouting (L=2360m)	US\$/m	179.9	92	16.2	8	196.1
drilling for curtain grouting (L=4000m)	US\$/m	179.9	92	16.2	8	196.1
cement grouting (60t)	US\$/t	1060.1	72	418.2	28	1478.3

(D project Contract Cost in Vietnum) inflation rate (1997–2002) inflation of FC part was used the rate in USA = 12% inflation of LC part was used the rate in El Salvador = 12%

% for total unit price (Civil Works)

and the	4.4	3	nit price (L	JS\$ In Jan	unit price (US\$ in Jan 2003 base))
		FC	%	LC	2	total
common excavation	US\$/m ³	81	78	05	22	23
rock excavation	US\$/m ³	22	67	11	33]	33
unnel excavation	US\$/m ³	32.9	77	97	23	42.6
shaft excavation	US\$/m ³	1129	95	63	5	1192
inclined shaft excavation	US\$/m ³	1145	93	81	7	122 6
embankment	US\$/m ³	22	81	90	19	27
unnel lining concrete	US\$/m ³	89 6	67	443	33	1339
unnel filling concrete	US\$/m ³	694	60	454	40	1148
slab concrete	US\$/m ³	369	52	33.9	48	70 8
barrel, casing concrete	US\$/m ³	346	50	351	50	69 7
asphalt facing	US\$/m ²	0	0	6.5	100	65
control building	US\$/m ³	0	0	36 35	100	363
reinforcement	US\$/t	177	4	4532	96	4709
drilling for consolidation grouting (L=8040m)	US\$/m	448	92	4	8	48.8
driling for curtain grouting (L=5600m)	US\$/m	448	92	4	8	488
cement grouting (W=1040t)	US\$/t	397	81	16	61	491

(rate of other works) % for total cost	FC (%)	LC (%)	total	remark
diversion tunnel	583	417	25 6	plug concrete, consolidation grout and others
power house	373	62.7	211	shotcrete, drain work and others

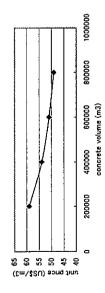
(RCC concrete *1)

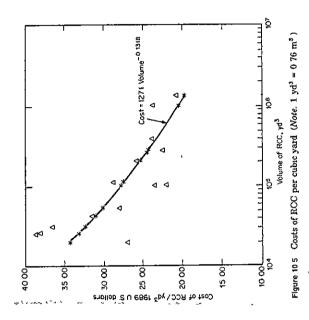
B project in Costarica concrete volume = 552 000 m3 =727000 yd3 RCC concrete unit price = 51 7 US\$/m3

RCC concret unit price in USA (1989 base) unit price = 127.1 / (concrete volume)⁰¹³¹⁸ concrete volume in yard

El Chaparral Project concrete volume = 262000 m3 (unner concrete) =345000 yd3 RCC concrete unit price = 51 7 \times (727000/345000)⁰¹³¹⁸ = 55 US\$/m3

RCC unit price





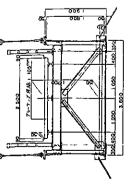
4. Administration & Engineering Cost

	adopted	A project C	C project	remarks
Administration Cos	2	2 2	1.2	direct cost X%
		4,340,000	1,340,000 3,030,000	US\$

El Chaparral Civil Works Cost = directcost × 2%

5. Environmental Cost

New Bridge (1 line, B=4m, L=150m x 2 bridges) = 4,000,000 US\$ 11 km X 25,000 US\$/km = 275,000 US\$ 33 km × 15,000 US\$/km = 495,000 US\$ = 4,770,000 US\$ (cost estimate from contractor in Guatemala) Improved Public Road New Public Road (1) Infrastructure Total



1% 25.00.05.070

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30 000

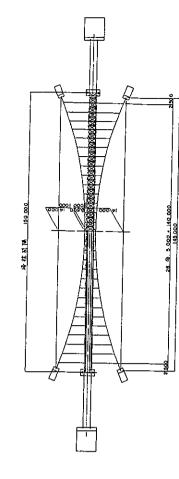


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6 Land Acquisition & Resettlement (unit prices are from CEL)

1) Land Acquisition for Reservor (suitable for agriculture)234 ha x 8,000 US\$/ha = 1,872,000 US\$2) Land Acquisition for Reservor (not suitable for agriculture)234 ha x 5,900 US\$/ha = 3,805,500 US\$3) Land Acquisition for Reservor (not suitable for agriculture)81 ha x 4,200 US\$/ha = 340,200 US\$4) Land Acquisition for Reservor (steep land)23 ha x 5,000 US\$/ha = 115,000 US\$5) Land Acquisition for Access Road23 ha x 5,000 US\$/ha = 35,000 US\$5) Land Acquisition for Camp, Temporary Land7 ha x 5,000 US\$/ha = 35,000 US\$5) Land Acquisition for Dam, Powenhouse & Switch yard6 ha x 5,000 US\$/ha = 35,000 US\$7) Right way for Transmission Line75 family x 30,000 US\$/ha = 1,376,000 US\$8) Relocation and Resettlement Cost5 family x 30,000 US\$/family =2,250,000 US\$7 hotal9,823,700 US\$



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Appendix 12.2.3

Details of Project Cost (Electric)

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<u>El Chaparral Hydroelectric Power Station</u> <u>Cost Estimation of Electro-mechanical Equipment</u>

January, 2004 J-Power,(EPDC)

About the calculation of Electro-mechanical equipment cost, It carried out by price assumption of a level which is FS Design. A price will be confirmed a cost of construction at the 2003 and a reserve fund is 5%.

1. Electro-mechanical Equipment Cost

A transportation cost, installation expense, and insurance are as follows at an installation adjustment delivery price.

- Inland transportation etc. CIF x 1 %

(with customs clearance expense, inland transportation insurance, various taxes)

- Installation construction CIF x 15 % (Total : 16 %)

Therefore, an installation adjustment delivery price is CIF price x 1.16.

2. Turbine and Related Auxiliary Equipment

- Specification: Rated output: 65.9 MW, Effective head:72.8m, Francis type : 1 lot
- $kW/H^{0.5} = 65,900 / 72.8^{0.5} = 7,724$
- From a J^P price curve (CIF) of turbine: 4,712 k\$

3. Generator and Related Auxiliary Equipment

- Specification: Rated capacity: 71.6MVA, Rated RPM: 200 rpm,

Synchronous generator : 1 lot

- kVA/rpm = 71,600 / 200 = 358
- From a J^P price curve (CIF) of generator: 3,731 k\$

4. Transformer and Related Auxiliary Equipment

- Specification: 3- phase type and BIL 550kV, Outdoor type transformer: 1 lot
- Capacity : 73,000 kVA
- From a J^P price curve (CIF) of transformer : 799 k\$
- Fire extinguisher equipment & line between transformer and switchyard : 100 (it calculates from the track record)
- Sum total : 799 + 100 = 899

5. Sub Turbine and Related Auxiliary Equipment

- Specification: Rated output: 1.42 MW, Max. Effective head: 78.13m,

Francis type : 1 lot

- $kW/H^{0.5} = 1,420 / 78.13^{0.5} = 161$
- From a J^P price curve (CIF) of turbine: 366 k\$

6. Sub Generator and Related Auxiliary Equipment

- Specification: Rated capacity: 1.51MVA, Rated RPM: 900 rpm,

Synchronous generator: 1 lot

- kVA/rpm = 1,510 / 900 = 1.68
- From a J^P price curve (CIF) of generator: 334

7. Crane

- Specification: Load rating T=200 tons, Span S= 22m : 1 lot

Manufacturing weight: W ton;

W = 1/2.75(TS/20 + 2S + T) = 1/2.75 (200x22.0/20 + 2x22.0 + 200)

= 169 tons

- From a J^P price curve (CIF) of crane : 739

8. Switching Station Equipment

- Specification: 115kV Breaker and half scheme, 1-Bank, 1-tansmission l

Number CB :3-sets

(Voltage) x (CB number) = $115 \times 3 = 345$

- From a J^P price curve (CIF) of switching station equipment : 433 k\$

9. Power plant Equipment

- a Insulated Phase Buses (IPB: 13.8 kV, 4 kA) 30 m: 1 lot
 - From a J^P track record : 183
- b STR (transformer within a station) 13.8kV/480V and 1,410kVA Mold type, 1 set
 - From a J^P track record : 169
- c Circuit Breaker (CB, 13.8kV, 4,000A) for parallel; 1set
 - From a J^P Track record : 324
- d 13.8 kV Cub (VTSC & Arr, VT& cub.): 1 lot;
 - From a J^P track record : 126
- e 400V Cub. and NFB Cub. and CB for Sub Unit
 - From a J^P track record for 400 kV Cub. and NFB Cub.: 165 k\$ and
 - From a J^P track record for CB (480V, 2,000A) for a sub unit: 12k\$
 Subtotal : 165 + 12 = 177

f A battery and rectifier (800 AH, 45kVA) 2 sets, and a in-butter (5kVA) 2 sets

- J^P from track record: 590
- g Switchboard and control device (with SCADA): 1 lot
 - J^P From a track record : 1,017k\$
- h Line Protection Relay, 115kV Bus protection Relay, Line Fault Locator etc: 1 lot
 - J^P from track record: 828 k\$,
- i Information Transmission system : 1 lot

(Microwave Multiplex Radio Transmission System with a tower of a relay station)

- J^P from track record: 455 k\$,

j An electric wire, cables, communication system, lighting and others: 1 lot
J^P from track record : 250k\$

10. Inclusive Sum (CIF)

$$= (4,712 + 3,731 + 899 + 366 + 334 + 739 + 433 + 4,119)$$

= 15,333

11. The Total Cost of Construction (Full Turn Key Cost) = 15,333 X 1.16 = 17,786 (IC portion = 15,333k\$, LC portion = 2,453 k\$)

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v ς. Appendix 12.2.4

Disbursement Schedule

				Unit:US\$ tl	ousand
Year	1	2	3	4	Total
		00.4		4.477	4.450
Preparatory Works	3,130	894	0	447	4,472
FC	313	89	0	45	447
LC	2,817	805	0	402	4,025
Civil Works	6,815	14,676	28,072	7,551	57,114
FC	2,661	5,731	10,962	2,948	22,303
LC	4,154	8,945	17,110	4,602	34,811
Hydromechanical Equipment	1,758	613	4,190	5,160	11,720
FC	1,738	551	3,771	4,644	10,548
	176	61	419	516	1,172
	1 770				
Electromechanical Equipment	1,779	6,225	8,004	1,779	17,786
FC	1,530	5,354	6,883	1,530	15,296
LC	249	872	1,121	249	2,490
Transmission Line	390	909	1,039	260	2,597
FC	284	663	758	189	1,895
LC	105	246	281	70	702
Environmental Cost	1,855	1,855	1,855	1,855	7,420
FC	986	986	986	986	3,942
	870	870	870	870	3,478
	0.024				0.004
Land Acquisition & Resettlement FC	9,824	0	0	0	<u>9,824</u> 0
	9,824	Ö	0		9,824
		05 170	42.150	10.001	110.000
Total Direct Cost	25,551	25,172	43,159	17,051	110,933
FC	7,356	13,374	23,359	10,342	54,431
LC	18,195	11,798	19,800	6,709	56,502
Contingency	1,191	1,944	3,469	1,160	7,764
FC LC	467	910	1,667	617	3,662
LC	724	1,034	1,802	542	4,102
Administration & Engineering Cost	3,833	3,776	6,474	2,558	16,640
FC	2,619	2,580	4,424	1,748	11,371
LC	1,214	1,196	2,050	810	5,269
	5 024	5 700	9,943	2 717	24 404
Total Indirect Cost	5,024	5,720		3,717 2,365	24,404
FC LC	3,086	3,491 2,230	6,091 3,852	1,352	<u>15,033</u> 9,371
		2,230			2,271
Total Construction Cost	30,574	30,892	53,102	20,769	135,337
FC	10,442	16,864	29,450	12,707	69,463
LC	20,132	14,028	23,652	8,061	65,873

Table 12.3 Project Cost Disbursement Schedule

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1 (Condition of Disbursement)		
(1) Civil Works	Advance payment	10%
	Retention money	10%
	Annual payment	
(2) Hydraulic Equiment	Advance payment	15%
	Payment when accepted	35%
	Payment when installed	40%
	Retention money	10%
(3) Electric Equipment	same as (2)	

3 (Disbursement)					(10	³ US\$)
		1st year	2nd year	3rd year	4th year	total
(1) Preparatory Works		3130.2	894.4	0.0	447.2	4471.8
	10%	447 2	00	00	447.2	894,4
	AP	2683 1	894 4	00	0.0	3577,4
(2) Civil Works		6815.4	14676.0	28072.1	7550.6	57114.1
	10%	5711.4	0.0	0.0	5711.4	11422.8
	AP	1104.0	14676.0	28072.1	1839 2	45691.3
(3) Hydraulic Equipment	penstock	262.5	612.5	700,0	175.0	1750.0
	15%/10%	262.5	0.0	0.0	175.0	437 5
	35%/40%	0.0	612.5	700.0	0.0	1312,5
	gate	1495.5	0.0	3489.5	4985.0	9970.0
	15%/10%	1495 5	0.0	00	997.0	2492.5
	35%/40%	00	00	3489.5	3988.0	7477,5
					-	
(4) Electric Equipment		1778.6	6225.1	8003.7	1778.6	17786.0
	15%/10%	1778.6	0.0	0.0	1778.6	3557.2
	35%/40%	0.0	6225.1	8003.7	0.0	14228.8
(5) Transmission Line		389.6	909.0	1038.8	259.7	2597.0
	15%/10%	389.6	0.0	00	259.7	649.3
,	35%/40%	0.0	909.0	1038 8	0.0	1947.8
(6) Environmental Cost		1855.0	1855.0	1855.0	1855.0	7420.0
		<i>6/1000000000000000000000</i>				//// ~////////////////////////////////
(7) Land Acquisition		9823.7	00	00	0.0	98237
			·····	andan salah salah salah tarah dal	annan 27 - Constantin	
Total Direct Cost		25550.5	25171.9	43159.1		110932.6
10101 011002 0002		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		27 / ~ 68 Martin Martin Carlo - 16	anananan 7 Addan	
(8) Contingency		20 LONIADO	1944.4	3468.8	(- 1159.7	2763 7
(o) Containgonity		1.5	-780-2011/28-78-78-78-78-78-78-78-78-78-78-78-78-78		anaa dalah tati 11 5 S	~
(9) Administration & Enginee	ring	3832.6		6473.9	2557.7	16639.9
		n , sinen enniñ ().		anna ann an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an t	,	
Total Indirect Cost		5023.4	5720.2	9942 7	37174	24403.6
				.2°C-460000000/17.557*9/17688		1. 11. 7 2. 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
Total Project Cost		6.30573.6	30892.1	53101.7	2076R A	135336.2
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Appendix 12.3

Calculated Quantity

Appendix 12.3.1: Summary of Quantity

Appendix 12.3.2: Civil Works

Appendix 12.3.3: Hydromechanical Equipment

719 (UCT)

Appendix 12.3.1

Summary of Quantity

721 (722)

ltem	Unit	Calculated Quantity	Adopted Quantity	note
.3.1 Civil Works				
(1) Care of River	-			
a)Upstream Cofferdam				
Common Excavation	m ³	3,709	3,800	
Rock Excavation	m ³	1,590	1,600	
Dam Concrete (RCC)	m ³	14,344	14,400	
Others	LS	1	1	
b)Downstream Cofferdam				
Common Excavation	m ³	3,417	3,500	<u> </u>
Rock Excavation	m ³	1,465	1,500	
Embankment	m ³	2,906	3,000	
Others	LS	1	1	
c)Diversion Tunnel				
Common Excavation	m ³	8,186	8,200	
Tunnel Excavation	m ³	23,960	24,000	
Lining Concrete	m ³	2,062	2,100	
Reinforced Bar	ton	55	60	
Others	LS	1	1	
(2) Dam				
a)Dam				
Common Excavation		124,419	124,500	
Rock Excavation	m ³	186,628	186,700	
Dam Concrete (RCC)		247,507	247,600	inner concrete
Dam Concrete (conventional)	m³	121,587	121,600	outer concrete
Consolidation Grouting Drilling	m	4,320	4,400	
Consolidation Grouting Cement	ton	81	90	
Curtain Grouting Drilling	m	46,713	46,800	
Curtain Grouting Cement	ton	2,180	2,200	
Others	LS	1	1	
b)Spillway				
Structural Concrete	m³	22,972	23,000	
Reinforced Bar	ton	639	640	
Others	LS	1	1	

EL Chaparral Project Summary of Quantity

EL Chaparral Project Summary of Quantity

Item	Unit	Calculated Quantity	Adpted Quantity	note
3) Water Way				
a)Intake				
Structural Concrete	m ³	1,151	1,200	
Reinforced Bar	ton	58	60	
Others	LS	· 1	1	
b)Penstock				· · · · · ·
Tunnel Excavation		2,365	2,400	
Filling Concrete	m ³	723	800	
Structural Concrete	m ³	468	500	
Rainforced Bar	ton	14	20	
Others	LS	1	1	
		····		
4) Powerhouse				
a)Powerhouse			· · · · · · · · · · · · · · · · · · ·	
Common Excavation	m ³	35,860	35,900	••••
Rock Excavation	m ³	143,439	143,500	
Structural Concrete	m ³	11,668	11,700	
Reinforced Bar	ton	734	740	
Others	LS	t	1	
b)Control Building		1		
Contorol Building	LS	1	1	
c)Outlet				
Common Excavation	m ³	4,830	4,900	
Rock Excavation		11,269	11,300	
Others	Ls	1	1	
d)Switchyard				
Common Excavation	m ³	13,856	13,900	
Concrete (Foundation)	m ³	92	100	
Others	LS	1	1	
lydromechanical Equipment				
Spillway Gate	ton	1,127	1,130	
Intake Gate	ton	84	90	
Intake Screen	ton	20	20	
Penstock Tube *)	ton	350	350	
Outlet Gate	ton	68	70	
Sluiceway and Steel Liner *)	LS	1	1	
· · · · · · · · · · · · · · · · · · ·				