APPENDIX G 90% DESIGN SUPPORTING CALCULATIONS

90% Design Supporting Calculations

ADJUSTABLE REMOVABLE WEIRS FULL OPEN **Rev 8**

TABLE FOR DWG C-112 WEIR ELEVATIONS

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Fishway Fall (out-migration)		Fishway Spring (In-migration)		Fishway Fall (out-migration)	
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	Minimum Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)
Entrance Pool	23.90										
Weir #1 (Fixed)	24.11	25.61	26.28	26.36	26.94	26.03	26.28	1.08	4.07	0.42	0.84
Weir #2 (Fixed)	24.77	26.27	26.93	27.02	27.60	26.68	26.93	1.08	4.07	0.42	0.84
Weir #3 (Fixed)	25.42	26.92	27.59	27.67	28.26	27.34	27.59	1.08	4.07	0.42	0.84
Weir #4 (Fixed)	26.08	27.58	28.25	28.33	28.91	27.99	28.24	1.08	4.07	0.42	0.84
Weir #5 (Fixed)	26.73	28.23	28.90	28.99	29.57	28.65	28.90	1.08	4.07	0.42	0.84
Weir #6 (Fixed)	27.39	28.89	29.56	29.64	30.23	29.31	29.56	1.08	4.07	0.42	0.84
Weir #7 (Fixed)	28.05	29.55	30.21	30.30	30.88	29.96	30.21	1.08	4.07	0.42	0.84
Weir #8 (Fixed)	28.70	30.20	30.87	30.95	31.54	30.62	30.87	1.08	4.07	0.42	0.84
Weir #9 (Fixed)	29.36	30.86	31.53	31.61	32.19	31.28	31.53	1.08	4.07	0.42	0.84
Weir #10 (Fixed)	30.02	31.52	32.18	32.27	32.85	31.93	32.18	1.08	4.07	0.42	0.84
Centerline Turning Pool	30.40			32.27	32.85	31.93	32.18				
Weir #11 (Fixed)	30.70	32.20	32.87	32.95	33.53	32.62	32.87	1.08	4.07	0.42	0.84
Weir #12 (Fixed)	31.40	32.90	33.57	33.65	34.24	33.32	33.57	1.08	4.07	0.42	0.84
Weir #13 (Fixed)	32.11	33.61	34.27	34.36	34.94	34.02	34.27	1.08	4.07	0.42	0.84
Weir #14 (Fixed)	32.81	34.31	34.98	35.06	35.64	34.73	34.98	1.08	4.07	0.42	0.84
Weir #15 (Removable)	33.26	35.01	35.68	35.76	36.34	35.43	35.68	1.08	4.07	0.42	0.84
Weir #16 (Removable)	33.22	35.71	36.38	36.46	37.04	36.13	36.38	1.08	4.07	0.42	0.84
Weir #17 (Removable)	33.19	36.41	37.08	37.16	37.74	36.83	37.08	1.08	4.07	0.42	0.84
Weir #18 (Removable)	33.15	37.11	37.78	37.86	38.44	37.53	37.78	1.08	4.07	0.42	0.84
Weir #19 (Removable)	33.11	37.81	38.48	38.56	39.14	38.23	38.48	1.08	4.07	0.42	0.84
Weir #20 (Removable)	33.07	38.51	39.18	39.26	39.84	38.93	39.18	1.08	4.07	0.42	0.84
Weir #21 (Removable)	33.04	39.21	39.88	39.96	40.54	39.63	39.88	1.08	4.07	0.42	0.84
Isolation Gate	32.93				40.54		Bottom Isolation Gate Full Open El.38.5 ft				
Stoplog Guide	32.86						Close isolation gate at spillway gate full open				
Exit Channel	32.62						Stoplog Down Top at El. 42.86 ft				

FISHWAY BAFFLES DESIGN
90% DESIGN
RESERVOIR DAM
194-6444
3/14/19 PG. 1 OF 5
TCC / TA

ADJUSTABLE REMOVABLE WEIRS FULL OPEN **Rev 8**

TABLE FOR DWG C-112 WEIR ELEVATIONS

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Adjustable Weir Position		Fishway Spring (In-migration)	
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	% Open	Position	Minimum Flow (cfs)	Maximum Flow (cfs)
Entrance Pool	23.90								
Weir #1 (Fixed) Adjustable Weir Full Open	24.11	25.61	26.28	26.36	26.94	n/a	n/a	1.08	4.07
Weir #2 (Fixed) Adjustable Weir Full Open	24.77	26.27	26.93	27.02	27.60	n/a	n/a	1.08	4.07
Weir #3 (Fixed) Adjustable Weir Full Open	25.42	26.92	27.59	27.67	28.26	n/a	n/a	1.08	4.07
Weir #4 (Fixed) Adjustable Weir Full Open	26.08	27.58	28.25	28.33	28.91	n/a	n/a	1.08	4.07
Weir #5 (Fixed) Adjustable Weir Full Open	26.73	28.23	28.90	28.99	29.57	n/a	n/a	1.08	4.07
Weir #6 (Fixed) Adjustable Weir Full Open	27.39	28.89	29.56	29.64	30.23	n/a	n/a	1.08	4.07
Weir #7 (Fixed) Adjustable Weir Full Open	28.05	29.55	30.21	30.30	30.88	n/a	n/a	1.08	4.07
Weir #8 (Fixed) Adjustable Weir Full Open	28.70	30.20	30.87	30.95	31.54	n/a	n/a	1.08	4.07
Weir #9 (Fixed) Adjustable Weir Full Open	29.36	30.86	31.53	31.61	32.19	n/a	n/a	1.08	4.07
Weir #10 (Fixed) Adjustable Weir Full Open	30.02	31.52	32.18	32.27	32.85	n/a	n/a	1.08	4.07
Centerline Turning Pool	30.40			32.27	32.85				
Weir #11 (Fixed) Adjustable Weir Full Open	30.70	32.20	32.87	32.95	33.53	n/a	n/a	1.08	4.07
Weir #12 (Fixed) Adjustable Weir Full Open	31.40	32.90	33.57	33.65	34.24	n/a	n/a	1.08	4.07
Weir #13 (Fixed) Adjustable Weir Full Open	32.11	33.61	34.27	34.36	34.94	n/a	n/a	1.08	4.07
Weir #14 (Fixed) Adjustable Weir Full Open	32.81	34.31	34.98	35.06	35.64	n/a	n/a	1.08	4.07
Weir #15 (Removable) Adjustable Weir Full Open	33.26	35.01	35.68	35.76	36.34	100%	Full Down	1.08	4.07
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.13	35.80		36.34	75%	Partially Down		3.31
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.26	35.93		36.34	50%	Partially Down		2.58
Weir #16 (Removable) Adjustable Weir Full Open	33.22	35.71	36.38	36.46	37.04	100%	Full Down	1.08	4.07
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.83	36.50		37.04	75%	Partially Down		3.31
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.96	36.63		37.04	50%	Partially Down		2.58
Weir #17 (Removable) Adjustable Weir Full Open	33.19	36.41	37.08	37.16	37.74	100%	Full Down	1.08	4.07
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.53	37.20		37.74	75%	Partially Down		3.30
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.66	37.33		37.74	50%	Partially Down		2.58
Weir #18 (Removable) Adjustable Weir Full Open	33.15	37.11	37.78	37.86	38.44	100%	Full Down	1.08	4.07
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.23	37.90		38.44	75%	Partially Down		3.30
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.36	38.03		38.44	50%	Partially Down		2.58
Weir #19 (Removable) Adjustable Weir Full Open	33.11	37.81	38.48	38.56	39.14	100%	Full Down	1.08	4.07
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	37.93	38.60		39.14	75%	Partially Down		3.30
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	38.06	38.73		39.14	50%	Partially Down		2.58
Weir #20 (Removable) Adjustable Weir Full Open	33.07	38.51	39.18	39.26	39.84	100%	Full Down	1.08	4.07
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.63	39.30		39.84	75%	Partially Down		3.30
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.76	39.43		39.84	50%	Partially Down		2.58
Weir #21 (Removable) Adjustable Weir Full Open	33.04	39.21	39.88	39.96	40.54	100%	Full Down	1.08	4.07
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.33	40.00		40.54	75%	Partially Down		3.30
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.46	40.13		40.54	50%	Partially Down		2.58
Isolation Gate	32.93				40.54		Bottom Isolation Gate Full Open El.38.5 ft		
Isolation Gate	32.93						Close isolation gate at spillway gate full open		
Stoplog Guide	32.86						Stoplog Down Top at El. 42.86 ft		
Exit Channel	32.62								

FISHWAY BAFFLES
90% DESIGN
RESERVOIR DAM
194-6444
3/14/19 pg. 2 of 5
TCC/TA

ADJUSTABLE REMOVABLE WEIRS PARTIALLY CLOSED TO LIMIT Qmax = 3.3 cfs in March-April **Rev 8**

TABLE FOR DWG C-112 WEIR ELEVATIONS

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Adjustable Weir Position		Fishway Spring (In-migration)	
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	% Open	Position	Minimum Flow (cfs)	Maximum Flow (cfs)
Entrance Pool	23.90								
Weir #1 (Fixed) Adjustable Weir 74% Open	24.11	25.61	26.28	26.36	26.82	n/a		1.08	3.29
Weir #2 (Fixed) Adjustable Weir 74% Open	24.77	26.27	26.93	27.02	27.47	n/a		1.08	3.29
Weir #3 (Fixed) Adjustable Weir 74% Open	25.42	26.92	27.59	27.67	28.13	n/a		1.08	3.29
Weir #4 (Fixed) Adjustable Weir 74% Open	26.08	27.58	28.25	28.33	28.79	n/a		1.08	3.29
Weir #5 (Fixed) Adjustable Weir 74% Open	26.73	28.23	28.90	28.99	29.44	n/a		1.08	3.29
Weir #6 (Fixed) Adjustable Weir 74% Open	27.39	28.89	29.56	29.64	30.10	n/a		1.08	3.29
Weir #7 (Fixed) Adjustable Weir 74% Open	28.05	29.55	30.21	30.30	30.75	n/a		1.08	3.29
Weir #8 (Fixed) Adjustable Weir 74% Open	28.70	30.20	30.87	30.95	31.41	n/a		1.08	3.29
Weir #9 (Fixed) Adjustable Weir 74% Open	29.36	30.86	31.53	31.61	32.07	n/a		1.08	3.29
Weir #10 (Fixed) Adjustable Weir 74% Open	30.02	31.52	32.18	32.27	32.72	n/a		1.08	3.29
Centerline Turning Pool	30.40			32.27	32.72				
Weir #11 (Fixed) Adjustable Weir 74% Open	30.70	32.20	32.87	32.95	33.41	n/a		1.08	3.29
Weir #12 (Fixed) Adjustable Weir 74% Open	31.40	32.90	33.57	33.65	34.11	n/a		1.08	3.29
Weir #13 (Fixed) Adjustable Weir 74% Open	32.11	33.61	34.27	34.36	34.81	n/a		1.08	3.29
Weir #14 (Fixed) Adjustable Weir 74% Open	32.81	34.31	34.98	35.06	35.52	n/a		1.08	3.29
Weir #15 (Removable) Adjustable Weir Full Open	33.26	35.01	35.68	35.76	36.34	100%	Full Down	1.08	4.07
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.13	35.80		36.34	75%	Partially Down		3.31
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.26	35.93		36.34	50%	Partially Down		2.58
Weir #16 (Removable) Adjustable Weir Full Open	33.22	35.71	36.38	36.46	37.04	100%	Full Down	1.08	4.07
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.83	36.50		37.04	75%	Partially Down		3.31
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.96	36.63		37.04	50%	Partially Down		2.58
Weir #17 (Removable) Adjustable Weir Full Open	33.19	36.41	37.08	37.16	37.74	100%	Full Down	1.08	4.07
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.53	37.20		37.74	75%	Partially Down		3.30
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.66	37.33		37.74	50%	Partially Down		2.58
Weir #18 (Removable) Adjustable Weir Full Open	33.15	37.11	37.78	37.86	38.44	100%	Full Down	1.08	4.07
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.23	37.90		38.44	75%	Partially Down		3.30
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.36	38.03		38.44	50%	Partially Down		2.58
Weir #19 (Removable) Adjustable Weir Full Open	33.11	37.81	38.48	38.56	39.14	100%	Full Down	1.08	4.07
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	37.93	38.60		39.14	75%	Partially Down		3.30
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	38.06	38.73		39.14	50%	Partially Down		2.58
Weir #20 (Removable) Adjustable Weir Full Open	33.07	38.51	39.18	39.26	39.84	100%	Full Down	1.08	4.07
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.63	39.30		39.84	75%	Partially Down		3.30
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.76	39.43		39.84	50%	Partially Down		2.58
Weir #21 (Removable) Adjustable Weir Full Open	33.04	39.21	39.88	39.96	40.54	100%	Full Down	1.08	4.07
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.33	40.00		40.54	75%	Partially Down		3.30
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.46	40.13		40.54	50%	Partially Down		2.58
Isolation Gate	32.93				40.54		Bottom Isolation Gate Full Open El.38.5 ft		
Isolation Gate	32.93						Close isolation gate at spillway gate full open		
Stoplog Guide	32.86						Stoplog Down Top at El. 42.86 ft		
Exit Channel	32.62								

FISHWAY BAFFLES
90% DESIGN
RESERVOIR DAM
194-6444
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ADJUSTABLE REMOVABLE WEIRS PARTIALLY CLOSED TO LIMIT Qmax = 2.56 cfs in May **Rev 8**

TABLE FOR DWG C-112 WEIR ELEVATIONS

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Adjustable Weir Position		Fishway Spring (In-migration)	
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	% Open	Position	Minimum Flow (cfs)	Maximum Flow (cfs)
Entrance Pool	23.90								
Weir #1 (Fixed) Adjustable Weir 50% Open	24.11	25.61	26.28	26.36	26.70			1.08	2.60
Weir #2 (Fixed) Adjustable Weir 50% Open	24.77	26.27	26.93	27.02	27.35			1.08	2.60
Weir #3 (Fixed) Adjustable Weir 50% Open	25.42	26.92	27.59	27.67	28.01			1.08	2.60
Weir #4 (Fixed) Adjustable Weir 50% Open	26.08	27.58	28.25	28.33	28.67			1.08	2.60
Weir #5 (Fixed) Adjustable Weir 50% Open	26.73	28.23	28.90	28.99	29.32			1.08	2.60
Weir #6 (Fixed) Adjustable Weir 50% Open	27.39	28.89	29.56	29.64	29.98			1.08	2.60
Weir #7 (Fixed) Adjustable Weir 50% Open	28.05	29.55	30.21	30.30	30.63			1.08	2.60
Weir #8 (Fixed) Adjustable Weir 50% Open	28.70	30.20	30.87	30.95	31.29			1.08	2.60
Weir #9 (Fixed) Adjustable Weir 50% Open	29.36	30.86	31.53	31.61	31.95			1.08	2.60
Weir #10 (Fixed) Adjustable Weir 50% Open	30.02	31.52	32.18	32.27	32.60			1.08	2.60
Centerline Turning Pool	30.40			32.27	32.60				
Weir #11 (Fixed) Adjustable Weir 50% Open	30.70	32.20	32.87	32.95	33.29			1.08	2.60
Weir #12 (Fixed) Adjustable Weir 50% Open	31.40	32.90	33.57	33.65	33.99			1.08	2.60
Weir #13 (Fixed) Adjustable Weir 50% Open	32.11	33.61	34.27	34.36	34.69			1.08	2.60
Weir #14 (Fixed) Adjustable Weir 50% Open	32.81	34.31	34.98	35.06	35.40			1.08	2.60
Weir #15 (Removable) Adjustable Weir Full Open	33.26	35.01	35.68	35.76	36.34	100%	Full Down	1.08	4.07
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.13	35.80		36.34	75%	Partially Down		3.31
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.26	35.93		36.34	50%	Partially Down		2.58
Weir #16 (Removable) Adjustable Weir Full Open	33.22	35.71	36.38	36.46	37.04	100%	Full Down	1.08	4.07
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.83	36.50		37.04	75%	Partially Down		3.31
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.96	36.63		37.04	50%	Partially Down		2.58
Weir #17 (Removable) Adjustable Weir Full Open	33.19	36.41	37.08	37.16	37.74	100%	Full Down	1.08	4.07
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.53	37.20		37.74	75%	Partially Down		3.30
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.66	37.33		37.74	50%	Partially Down		2.58
Weir #18 (Removable) Adjustable Weir Full Open	33.15	37.11	37.78	37.86	38.44	100%	Full Down	1.08	4.07
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.23	37.90		38.44	75%	Partially Down		3.30
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.36	38.03		38.44	50%	Partially Down		2.58
Weir #19 (Removable) Adjustable Weir Full Open	33.11	37.81	38.48	38.56	39.14	100%	Full Down	1.08	4.07
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	37.93	38.60		39.14	75%	Partially Down		3.30
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	38.06	38.73		39.14	50%	Partially Down		2.58
Weir #20 (Removable) Adjustable Weir Full Open	33.07	38.51	39.18	39.26	39.84	100%	Full Down	1.08	4.07
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.63	39.30		39.84	75%	Partially Down		3.30
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.76	39.43		39.84	50%	Partially Down		2.58
Weir #21 (Removable) Adjustable Weir Full Open	33.04	39.21	39.88	39.96	40.54	100%	Full Down	1.08	4.07
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.33	40.00		40.54	75%	Partially Down		3.30
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.46	40.13		40.54	50%	Partially Down		2.58
Isolation Gate	32.93				40.54		Bottom Isolation Gate Full Open El.38.5 ft		
Isolation Gate	32.93						Close isolation gate at spillway gate full open		
Stoplog Guide	32.86						Stoplog Down Top at El. 42.86 ft		
Exit Channel	32.62								

FISHWAY BAFFLES
90% DESIGN
RESERVOIR DAM
194-6444
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TCC / TA

ADJUSTABLE REMOVABLE WEIRS Rev 8

TABLE FOR DWG C-112 WEIR ELEVATIONS File: P:\Scituate Reservoir Dam - 2018\90% Design \Weir Heights Rev 7.xlsx ; sheet Proposed 2019 Weir Config. ; cells H224 - P266

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Adjustable Weir Position	Fishway Fall (out-migration)	
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	% Open	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)
Entrance Pool	23.90							
Weir #1 (Fixed) Adjustable Weir 50% Open	24.11	25.61	26.28	26.36	26.70	n/a	26.03	26.28
Weir #2 (Fixed) Adjustable Weir 50% Open	24.77	26.27	26.93	27.02	27.35	n/a	26.68	26.93
Weir #3 (Fixed) Adjustable Weir 50% Open	25.42	26.92	27.59	27.67	28.01	n/a	27.34	27.59
Weir #4 (Fixed) Adjustable Weir 50% Open	26.08	27.58	28.25	28.33	28.67	n/a	27.99	28.24
Weir #5 (Fixed) Adjustable Weir 50% Open	26.73	28.23	28.90	28.99	29.32	n/a	28.65	28.90
Weir #6 (Fixed) Adjustable Weir 50% Open	27.39	28.89	29.56	29.64	29.98	n/a	29.31	29.56
Weir #7 (Fixed) Adjustable Weir 50% Open	28.05	29.55	30.21	30.30	30.63	n/a	29.96	30.21
Weir #8 (Fixed) Adjustable Weir 50% Open	28.70	30.20	30.87	30.95	31.29	n/a	30.62	30.87
Weir #9 (Fixed) Adjustable Weir 50% Open	29.36	30.86	31.53	31.61	31.95	n/a	31.28	31.53
Weir #10 (Fixed) Adjustable Weir 50% Open	30.02	31.52	32.18	32.27	32.60	n/a	31.93	32.18
Centerline Turning Pool	30.40			32.27	32.60		31.93	32.18
Weir #11 (Fixed) Adjustable Weir 50% Open	30.70	32.20	32.87	32.95	33.29	n/a	32.62	32.87
Weir #12 (Fixed) Adjustable Weir 50% Open	31.40	32.90	33.57	33.65	33.99	n/a	33.32	33.57
Weir #13 (Fixed) Adjustable Weir 50% Open	32.11	33.61	34.27	34.36	34.69	n/a	34.02	34.27
Weir #14 (Fixed) Adjustable Weir 50% Open	32.81	34.31	34.98	35.06	35.40	n/a	34.73	34.98
Weir #15 (Removable) Adjustable Weir Full Open	33.26	35.01	35.68	35.76	36.34	100%	35.43	35.68
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.13	35.80	35.88	36.34	75%	n/a	n/a
Weir #15 (Removable) Adjustable Weir Partially Open	33.26	35.26	35.93	36.01	36.34	50%	n/a	n/a
Weir #16 (Removable) Adjustable Weir Full Open	33.22	35.71	36.38	36.46	37.04	100%	36.13	36.38
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.83	36.50	36.58	37.04	75%	n/a	n/a
Weir #16 (Removable) Adjustable Weir Partially Open	33.22	35.96	36.63	36.71	37.04	50%	n/a	n/a
Weir #17 (Removable) Adjustable Weir Full Open	33.19	36.41	37.08	37.16	37.74	100%	36.83	37.08
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.53	37.20	37.28	37.74	75%	n/a	n/a
Weir #17 (Removable) Adjustable Weir Partially Open	33.19	36.66	37.33	37.41	37.74	50%	n/a	n/a
Weir #18 (Removable) Adjustable Weir Full Open	33.15	37.11	37.78	37.86	38.44	100%	37.53	37.78
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.23	37.90	37.98	38.44	75%	n/a	n/a
Weir #18 (Removable) Adjustable Weir Partially Open	33.15	37.36	38.03	38.11	38.44	50%	n/a	n/a
Weir #19 (Removable) Adjustable Weir Full Open	33.11	37.81	38.48	38.56	39.14	100%	38.23	38.48
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	37.93	38.60	38.68	39.14	75%	n/a	n/a
Weir #19 (Removable) Adjustable Weir Partially Open	33.11	38.06	38.73	38.81	39.14	50%	n/a	n/a
Weir #20 (Removable) Adjustable Weir Full Open	33.07	38.51	39.18	39.26	39.84	100%	38.93	39.18
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.63	39.30	39.38	39.84	75%	n/a	n/a
Weir #20 (Removable) Adjustable Weir Partially Open	33.07	38.76	39.43	39.51	39.84	50%	n/a	n/a
Weir #21 (Removable) Adjustable Weir Full Open	33.04	39.21	39.88	39.96	40.54	100%	39.63	39.88
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.33	40.00	40.08	40.54	75%	n/a	n/a
Weir #21 (Removable) Adjustable Weir Partially Open	33.04	39.46	40.13	40.21	40.54	50%	n/a	n/a
Isolation Gate	32.93				40.54	Bottom Isolation Gate Full Open El.38.5 ft		
Isolation Gate	32.93					Close isolation gate at spillway gate full open		
Stoplog Guide	32.86					Stoplog Down Top at El. 42.86 ft		
Exit Channel	32.62							

FISHWAY BAFFLES
90% DESIGN
RESERVOIR DAM
194-6444
3/14/19 pg. 5 of 5
TCC/TA

TETRA TECH

SUBJECT QUANTITIES 90% DESIGN

PROJECT RESERVOIR DAM

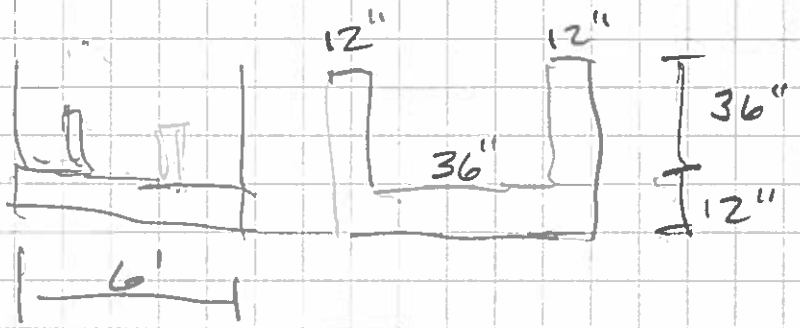
TC/P NO. 194-6444

ORIGINATOR TCC CHECKED TA

DATE 4/25/19 PAGE 1 OF 4 PAGES

UPDATE 2017 60% DESIGN QUANTITIES
CALCULATE ADDITIONAL QUANTITIES AND ADD TO 2017 QUANTITIES
FISHWAY EXIT CHANNEL (1.5' LOWER)

CONCRETE DEMOLITION



VOL. = 1'x3'x6'x2x1/27 = 1.3 cy.
+ 5'x1'x6'x1/27 = 1.1 cy.
+ 2'x1'x3'x2x1/27 = 0.4 cy
2.8 cy.

USE (40 (cy)) + 3 TNS ≅ 45 cy. (2019)

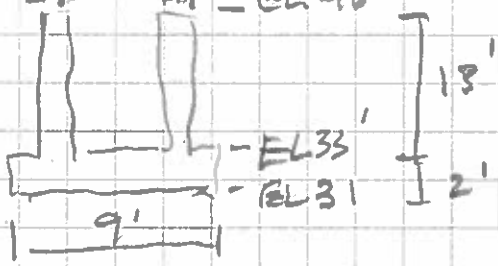
EXCAVATION:

1.5'x40'x15'W x1/27 = 33.3 cy

USE 600 cy (2017) + 35 cy = 635 cy (2019)

L ≅ 6'

CONC.



VOL.: $9' \times 2' \times 6' \times 1/27 = 4$ cy.

$+ 2' \times 13' \times 6' \times 2 \times 1/27 = 31$ cy.

RECALCULATE 2017 VOL. 35 cy.
SEE PG-3

REBAR: USE RATIO OF 2014 REBAR/CONC.

FISHWAY = $\frac{7 \text{ TNS}}{65 \text{ cy}} = 0.1$ TNS/cy

SPILLWAY: 0.4 TNS/5 cy = 0.08 TN/cy.
USE 0.1 TNS/cy

FORMWORK:

$4 \times 15' \times 6' = 360$ ft^2

USE 2000 SF + 360 ft^2 ≈ 2400 ft^2
(2017) (2019)

BACKFILL: $1.5' \times 4' \times 10' \times 1/27 = 2.2$ cy.

USE 525 cy + 2.2 cy ≈ 530 cy.
(2017) (2019)

PLATFORM STEEL:

USE RATIO OF LENGTHS

$\frac{6'}{10'}$ (2019 ADDED) / (2017) $\times 1$ TN. = 0.6 TN

USE 1 TN + 0.6 TN = 2 TNS
(2017) (2019)

GRATING:

$5' \times 6' \times 2 = 60$ ft^2

USE 120 ft^2 + 60 ft^2 = 180 ft^2
(2017) (2019)

HANDRAIL: 64' + (2 × 2 × 6') = 88 ft
(2017) (2019)

CALC. FISHWAY EXIT CHANNEL CONC.

WALLS: $L = \frac{21'}{2} + 20' + 14' + 3' \approx 48'$
(2017)

DWG. C-112 $h = 11.5'$ (2017)

VOL. $2 \times 2' \times 11.5' \times 48 \times \frac{1}{27} = 81.8$ cy.

SLAB: $L = 21 + 20' + 14 + 3 = 59'$
(2017) $W = 3' + 2 + 2' + 1 + 1 = 9'$

VOL. $= 9' \times 59' \times 2' \times \frac{1}{27} = 39.3$ cy.

ADD 1.5' WALL HEIGHT FOR 2019

VOL. $2 \times 2' \times 1.5' \times 48 \times \frac{1}{27} = 10.6$ cy.

ADD 6' WALL LENGTH (Pg. 2) = 35 cy

TOTAL CONC. VOL = 166.7 cy
USE 170 cy.

REBAR: $170 \text{ cy} \times 0.1 \frac{\text{TN}}{\text{cy}} = 17$ TNS

ADD 2 REMOVABLE BAFFLES.

REL LADDER: $L \approx 65'$ (DWG C-110)
ALONG TOP SPILLWAY WALL.

SEPTIC SYSTEM UPGRADE

ASSUME TREATMENT SYSTEM GOOD

UPGRADE LEACH FIELD ON

EXCAVATE TOP EXISTING FIELD

$40' \times 60' \times 2' \times 1/27 = 180$ cy.

INFILTRATION CHAMBERS: 125 LF.

SAND $4' \times 60' \times 30' \times 1/27 = 710$ cy.

TOP SOIL: $60' \times 80' \times 1' \times 1/27 = 20$ cy.

SEEDING: $60' \times 80' \times 2 = 9600$ SF.

$= 1100$ SY

FLOOD PROTECTION:

FILL IN LOW AREAS 3 PROPERTIES

TOP SOIL $= 3 \times 1' \times 100' \times 100' \times 1/27$

$= 1100$ cy.

SEED $= 3 \times 100' \times 100' = 30,000$ SF.

$= 3,400$ SY.

TETRA TECH

SUBJECT IMPACTED BVW
90% DESIGN

PROJECT RESERVOIR DAM

TC/P NO. 194-6444

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AREAS OF IMPACTED BVW - TACKFACTORY AND FROM CAD MEASUREMENTS

EL. 39.8' to EL. 40.4 : 338,925 Sq. ft
(FIGURE D-5)

EL. 40.4' to EL. 40.2': 29,406 Sq. Ft
(MEASURED) (9% TOTAL)

EL. EL. 40.0' to EL 39.8': 206,566 Sq. Ft.
(MEASURED) (60% TOTAL)

EL. 40.2' to EL. 40.0':
(CALCULATED)

338,925 - 29,406 - 206,566 = 102,953 Sq. Ft.
(31% TOTAL)

60% Design Supporting Calculations

Alternative 8A - Spillway Replacement w/ Lower Crest at El. 36.4 ft

TCC **Spillway Rating Curve - Existing Crest with New Gate Crest (Ogee Discharge Coefficient) and additional Gated spillway**

First Herring Brook - Reservoir Dam

$Q = CLH^{3/2}$ Existing Ogee-shaped Spillway Crest

NAVD 1988 **Lower Existing Spillway Crest = El. 36.4 ft** 36.4 ft

New Crest El. = **36.4** ft

L 0 ft L 36.5 ft per survey minus 6" gate guides

C 3.1 C 3.1

	Spillway			Dam			
	EL.	H (ft)	Q (cfs)	EL.	H (ft)	Q (cfs)	Total Q (cfs)
	36.4	0	0				0
	38.9	2.50	0	38.9	2.50	447	447
	39.9	3.50	0	39.9	3.50	741	741
	40.4	4.00	0	40.4	4.00	905	905
	40.9	4.50	0	40.9	4.50	1080	1080
	41.9	5.50	0	41.9	5.50	1459	1459
1/2 PMF	42.9	6.50	0	42.9	6.50	1875	1875
	43.5	7.10	0	43.5	7.10	2141	2141
	43.905	7.51	0	43.905	7.51	2326	2326
top of dam	45.0	8.60	0	45.0	8.60	2854	2854
	45.19	8.79	0	45.19	8.79	2951	2951
	46.75	10.35	0	46.75	10.35	3768	3768
	46.83	10.43	0	46.83	10.43	3811	3811
	47.00	10.60	0	47.00	10.60	3905	3905
	47.25	10.85	0	47.25	10.85	4044	4044
	48.00	11.60	0	48.00	11.60	4470	4470
	49.00	12.60	0	49.00	12.60	5061	5061

Use El. 42.0 ft as maximum water level to provide 0.5 ft freeboad with 2.5 ft wave for 50 mph wind; 0.2 ft freeboard with 2.8 ft wave for 100 mph wind.

For 3 ft freeboard no wave action, need 36.5 ft long spillway crest at El. 34.5 ft

Lower Spillway 4.4 ft

EXCEL SPREADSHEET FILE: WEIR HEIGHTS.XLS

SPILLWAY DISCHARGE RATING CURVE

60% DESIGN

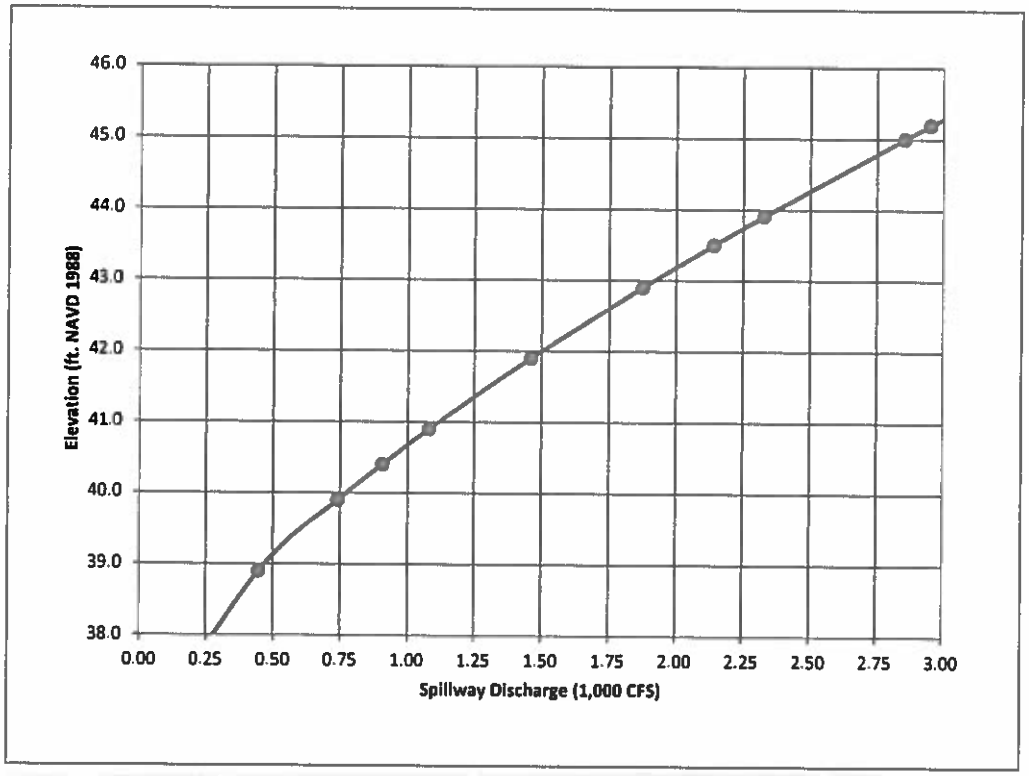
RESERVOIR DAM

PROJ # 194-5938

5/2/17 PAGE 1 OF 2

TCC, NM

Figure 8 - Reservoir Dam Spillway Discharge Rating Curve with Emergency Spillway



SPILLWAY DISCHARGE RATING CURVE
60% DESIGN
RESERVOIR DAM
PROJ. # 194-5938
5/2/17 PAGE 2 OF 2
TCC; NM

CONFIGURATION

TABLE FOR DWG C-113 WEIR ELEVATIONS

40.4

Location	Proposed Fishway Weir Data			Fishway Spring (In-migration)		Fishway Spring (out-migration)		
	Bottom El. (ft NAVD 88)	Notch El. (ft NAVD 88)	Weir Crest El. (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	Minimum Pool Level (ft NAVD 88)	Maximum Pool Level (ft NAVD 88)	
Entrance Pool	23.90							
Weir #1 (Fixed)	24.11	25.61	26.28	26.03	27.11	26.03	26.28	
Weir #2 (Fixed)	24.77	26.27	26.93	27.02	27.77	26.68	26.93	
Weir #3 (Fixed)	25.42	26.92	27.59	27.67	28.42	27.34	27.59	
Weir #4 (Fixed)	26.08	27.58	28.25	28.33	29.08	27.99	28.24	
Weir #5 (Fixed)	26.73	28.23	28.90	28.99	29.74	28.65	28.90	
Weir #6 (Fixed)	27.39	28.89	29.56	29.64	30.39	29.31	29.56	
Weir #7 (Fixed)	28.05	29.55	30.21	30.30	31.05	29.96	30.21	
Weir #8 (Fixed)	28.70	30.20	30.87	30.95	31.70	30.62	30.87	
Weir #9 (Fixed)	29.36	30.86	31.53	31.61	32.36	31.28	31.53	
Weir #10 (Fixed)	30.02	31.52	32.18	32.27	33.02	31.93	32.18	
Centerline Turning Pool	30.40			32.27	33.02	31.93	32.18	
Weir #11 (Fixed)	30.70	32.20	32.87	32.95	33.70	32.62	32.87	
Weir #12 (Fixed)	31.40	32.90	33.57	33.65	34.40	33.32	33.57	
Weir #13 (Fixed)	32.11	33.61	34.27	34.36	35.11	34.02	34.27	
Weir #14 (Fixed)	32.81	34.31	34.98	35.06	35.81	34.73	34.98	
Weir #15 (Fixed)	33.51	35.01	35.68	35.76	36.51	35.43	35.68	
Weir #16 (Fixed)	34.21	35.71	36.38	36.46	37.21	36.13	36.38	Fishway not operable below El. 36.46 ft
Weir #17 (Removable)	34.97	36.38	37.05	37.30	37.88	36.80	37.05	
Weir #18 (Removable)	34.93	37.05	37.72	37.97	38.55	37.46	37.71	
Weir #19 (Removable)	34.90	37.72	38.38	38.63	39.22	38.13	38.38	
Weir #20 (Removable)	34.86	38.38	39.05	39.30	39.88	38.80	39.05	
Weir #21 (Removable)	34.83	39.05	39.72	39.97	40.55	39.47	39.72	
Isolation Gate	34.72		44.22					Close isolation gate at spillway gate full open Top of gate at El. 44.22 ft)
Stoplog Guide	34.66							
Exit Channel	34.51							

FISHWAY WEIRS
60% DESIGN
RESERVOIR DAM
PROJ # 194-5938
5/2/17 PAGE 1 OF 2
TCC, NM

FISHWAY WEIRS
60% DESIGN
RESERVOIR DAM
PROS-4-L94-5938
5/2/17 PAGE 2 OF 2
TCC, NM

Fishway Weir Flow
C = average discharge coefficient
h1 = water level over notch (5 inches minimum; 29 inches maximum)
h2 = water level over weir = h1 - 8"
h3 = water level over baffle = h1 - 20"
L1 = notch width = 6"
L2 = weir width = 18" - L1 = 12"
L3 = baffle width = 36" - L1 - L2 = 18"

Q (cfs) = C L H^3/2 Qtotal = Q1 + Q2 + Q3
C = 3.1

Assume h1 (inches)	Assume h1 (ft)	Q1 (cfs)	h2 (ft)	Q2 (cfs)	h3 (ft)	Q3 (cfs)	Qtotal (cfs)	
5	0.42	0.42					0.42	minimum downstream
8	0.67	0.84	0	0.00			0.84	maximum downstream
								Use 0.6 cfs for average downstream passage flow
9	0.75	1.01	0.08	0.07			1.08	Minimum upstream passage flow top fixed weir
11	0.92	1.36	0.25	0.39			1.75	
13	1.08	1.75	0.42	0.83			2.58	Target upstream passage flow
15	1.25	2.17	0.58	1.38			3.55	
17	1.42	2.61	0.75	2.01			4.63	
19	1.58	3.09	0.92	2.72			5.81	Maximum upstream passage flow
20	1.67	3.34	1.00	3.10	0	0.00	6.44	
24	2.00	4.38	1.33	4.77	0.33	0.89	10.05	
28	2.33	5.52	1.67	6.67	0.67	2.53	14.73	

TETRA TECH

SUBJECT SPILLWAY - 60% DESIGN STABILITY ANALSIS

PROJECT RESERVOIR DAM

TC/P NO. 194-5938

ORIGINATOR NICK CHECKED NM

DATE 6/1/17 PAGE 1 OF 7 PAGES

PURPOSE: ANALYZE PROPOSED SPILLWAY STABILITY WITH BOTTOM-HINGED CREST GATE

ASSUMPTIONS:

1) CREST @ EL. 36.44 FT (DWG. C-110) NAVD88.
2) GATE CONFIGURATION SHOWN ON DWG C-110
3) TOP GATE FULL CLOSED @ EL. 40.4 ft
4) MAX. FLOOD LEVEL (1/2 PMF) @ EL. 43.0 ft (SEE 1/2 PMF CALCULATION) IN POND.
5) CONCRETE ON SOIL COEFFICIENT OF FRICTION = μ = 0.50 SEE PAGE 2
6) SOIL DENSITY = 120 #/ft^3 DRY.

METHODOLOGY: CHECK 2 CRITICAL CONDITIONS

CONDITION 1 – CREST GATE FULL CLOSED; NO FLOW

CONDITION 2 – 1/2 PMF FLOW; GATE FULL OPEN

SPILLWAY – 60% DESIGN
STABILITY ANALYSIS
B. JOHNSON T COOK
N. M

RESERVOIR AREA
194-5938
6-24-14 PG-20f7

EM 1110-3-446
20 Aug 92

TABLE C-1

Friction Coefficient for Concrete Cast on Soil
(reference 4)

Interface Materials	Friction Coefficient, f
Mass concrete on the following foundation materials:	
Clean sound rock	0.70
Clean gravel, gravel--sand mixtures, coarse sand	0.55 to 0.60
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	0.45 to 0.55
Clean fine sand, silty or clayey fine to medium sand	0.35 to 0.45
Fine sandy silt, nonplastic silt	0.30 to 0.35
Very stiff and hard residual or preconsolidated clay	0.40 to 0.50
Medium stiff and stiff clay and silty clay	0.30 to 0.35

C-4.2. Dimension of thrust block for downward directed thrust is calculated by;

$$A_b = S\ F_r T_r / q_s$$

where;

A_b = bottom area of thrust block,
T_r = vertical component of thrust force,
q_s = allowable bearing capacity of soil, and
F_r = Factor of Safety.

C-4.3. There is also a horizontal component of thrust (T_h) in vertical bends. The sizing of thrust block for the horizontal component is calculated by the same formula used for horizontal bends, except the term T is replaced by $T_h = 2PA \sin \theta/2 \cos \theta$.

C-4.4. These are shown in Figures C-4, C-5, C-6 and C-7.

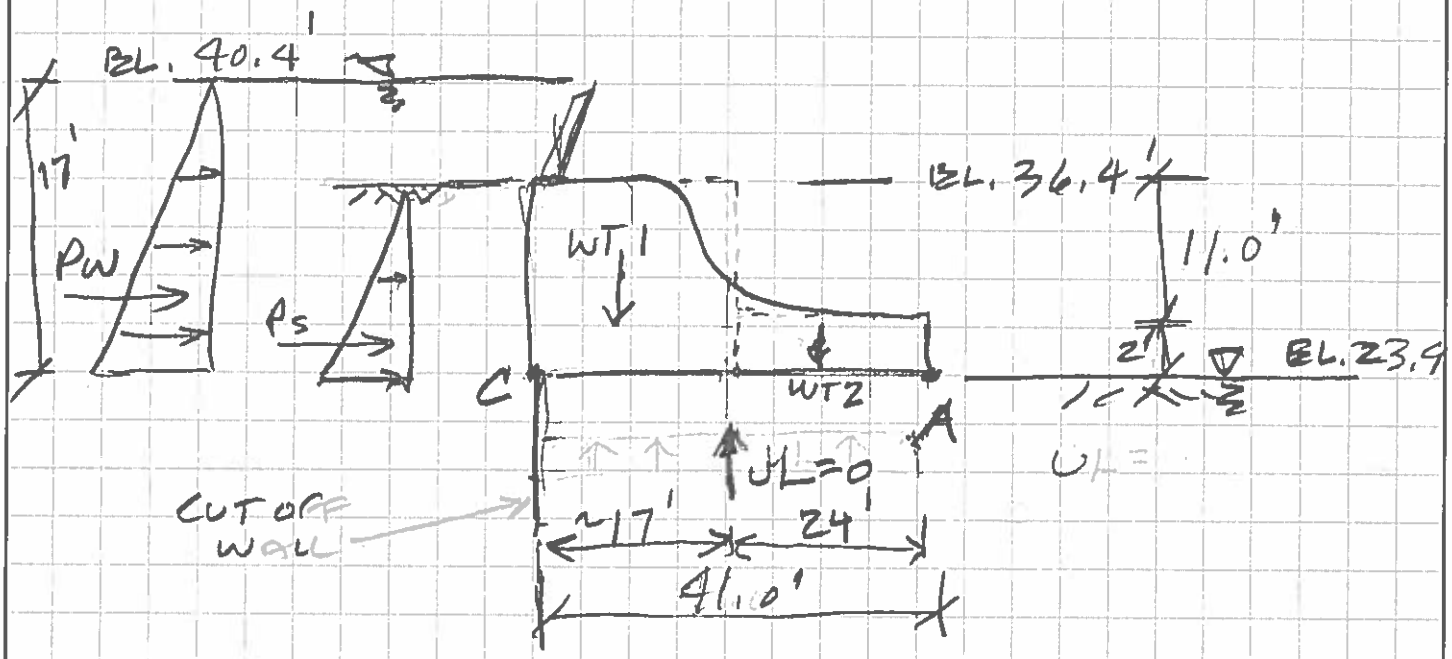
C--5. Restrained Joints. There are several approaches to this. They all calculate the length of pipe to be restrained on both sides of the joint. The length to be restrained may be determined by;

$$L = F_r(PA \tan \theta/2)/(F_r + 0.5\ R\ (\pm\ \Sigma\ K_f\ D_i)$$

where;

CONDITION 1 – FULL POND; GATE FULL CLOSED

LOADING DIAGRAM



$$P_W = \left(\frac{62.4\ ^{lb}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(17')\left(\frac{17'}{2}\right) = \rightarrow 9.02\ ^{k}/_{1}$$

$$M_{A\,PW} = 9.02\ ^{k}/_{1} \times \frac{17'}{3} = 51.1\ ^{1k}/_{1}$$

ACTIVE SOIL FORCE: $K_A = 0.33$

$$P_S = \left(\frac{120\ ^{lb}/_{ft^3} - 62.4\ ^{lb}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(13.0')\left(\frac{13.0'}{2}\right)(0.33)$$

$$P_S = \rightarrow 1.6\ ^{k}/_{1}$$

$$M_{A\,PS} = 1.6\ ^{k}/_{1} \times \frac{13.0'}{3} = 6.9\ ^{1k}/_{1}$$

UL = 0 NO FLOW IN STREAM.

$$WT1 = \left(\frac{150\ ^{\#}/_{FT^3}}{1000\ ^{\#}/_{K}}\right)(17')(12.5') = 31.9^{K}\downarrow$$

$$M_{A.WT1} = 31.9^{K} \times \left(\frac{17'}{2} + 24'\right) = 1036.8^{\text{K}'}\leftarrow$$

$$WT2 = \left(\frac{150\ ^{\#}/_{FT^3}}{1000\ ^{\#}/_{K}}\right)(24')(2') = 7.2^{K}\downarrow$$

$$M_{AWT2} = 7.2^{K} \times \frac{24'}{2} = 86.4^{\text{K}'}\leftarrow$$

SLIDING FACTOR SAFETY =

$$\frac{\Sigma F_R}{\Sigma F_S} = \frac{(WT1 + WT2)(0.5)}{P_W + P_S}$$

$$= \frac{(31.9 + 7.2)(0.5)}{9.02^{K} + 1.6^{K}} = \frac{19.6^{K}}{10.6^{K}}\leftarrow$$

$$FS_{sliding} = 1.9 \quad \text{STABLE}$$

OVERTURNING FACTOR SAFETY =

$$\frac{\Sigma M_R}{\Sigma M_O} = \frac{M_{AWT1} + M_{AWT2}}{M_{AP_W} + M_{AP_S}}$$

$$= \frac{1,036.8^{\text{K}'} + 86.4^{\text{K}'}}{51.1^{\text{K}'} + 6.9^{\text{K}'}} = \frac{1123.2^{\text{K}'}}{58.0}$$

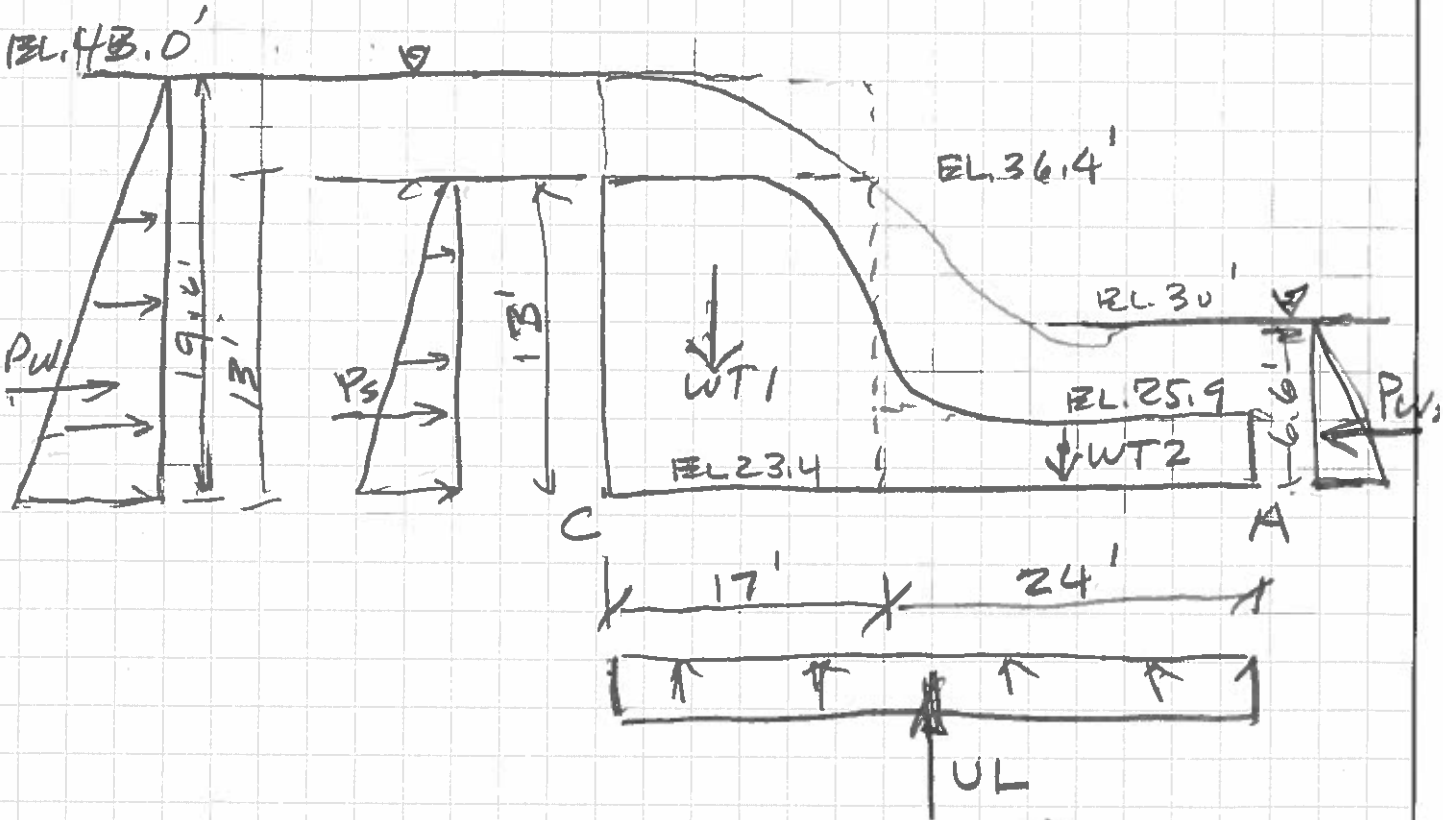
$$F_{S\ OVERTURN} = 19.3 \quad \text{STABLE.}$$

CONDITION 2 — ½ PMF, CREST GATE FULL OPEN

ASSUME TAILWATER IS SAME DEPTH AS WATER OVER CREST.

TAILWATER (TW.) DEPTH = EL. 43.0'
− EL. 36.4'
6.6'

USE TW = EL. 23.4' BOTTOM
+ 6.6
EL. 30.0'



$$P_W = \left(\frac{62.4\ ^{lb}/_{ft^3}}{1000\ lb/k}\right)(19.6')\left(\frac{19.6'}{2}\right) = 12.0\ ^{k}/_{l}$$

$$M_{A\,PW} = 12.0\ ^{k}/_{l} \times \frac{19.6'}{3} = 78.4\ ^{lk}/_{l}$$

$K_a = 0.33$

$$P_S = \left(\frac{120 - 62.4\ ^{lb}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(13')\left(\frac{13'}{2}\right)(0.33)$$

$$P_S = 1.6^{\ k/_1}$$

$$M_{APS} = 1.6^{\ k/_1} \times \frac{13'}{3} = 7.0^{\ lk/_1}$$

$$U_L = \left(\frac{62.4\ ^{lb}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(6.6')(17'+24') = 16.8^{\ k/_1}$$

$$M_{AUL} = 16.8^{\ k/_1} \times \frac{41'}{2} = 344.5^{\ k/_1}$$

$$\Sigma M_O = M_{APW} + M_{APS} + M_{AUL}$$

$$= 78.4^{\ lk} + 7.0^{\ lk/_1} + 344.5^{\ lk/_1}$$

$$\Sigma M_O = 429.9^{\ lk/_1}$$

$$\Sigma M_R = 1123.2^{\ lk/_1}$$ SEE PAGE 4

OVERTURNING FACTOR SAFETY $= \frac{\Sigma M_R}{\Sigma M_O}$

$$FS_{overturning} = \frac{1123.2^{\ lk/_1}}{436.4^{\ lk/_1}} = 2.6$$

STABLE

SLIDING FACTOR SAFETY

$$\frac{\Sigma F_R}{\Sigma F_O} = \frac{(W_{T1} + W_2 - U_L)\mu}{P_W + P_S}$$

$$= \frac{(31.9^{\ k/_1} + 7.2^{\ k/_1} - 16.8^{\ k/_1})(0.5)}{12.0 + 1.6} = \frac{11.2^{\ k}}{13.6^{\ k}}$$

ADD WT. WATER OVER SPILLWAY CREST

$$WT\ 3 = \left(\frac{62.4\ ^{\#}/_{FT^3}}{1000\ ^{\#}/_{K}}\right)(17')\left(\frac{6.6'}{2}\right) = 3.5^{K}\downarrow$$

$$\Sigma F_R = 12.4^{K} + 3.5^{K} = 15.9^{K}/_{\downarrow}$$

SLIDING $\frac{\Sigma F_R}{\Sigma F_D} = \frac{15.9\ ^{1K}/_{\downarrow}}{13.6\ ^{K}/_{\rightarrow}} = 1.2$ STABLE

CONSERVATIVE, HIGHER FACTOR SHOULD IF GATE WT. INCLUDED.

TETRA TECH

SUBJECT SPILLWAY CONCRETE DESIGN

ORIGINATOR TCC CHECKED NM

PROJECT RESERVOIR DAM

TC/P NO. 194-5938

DATE 5/22/17 PAGE 1 OF 7 PAGES

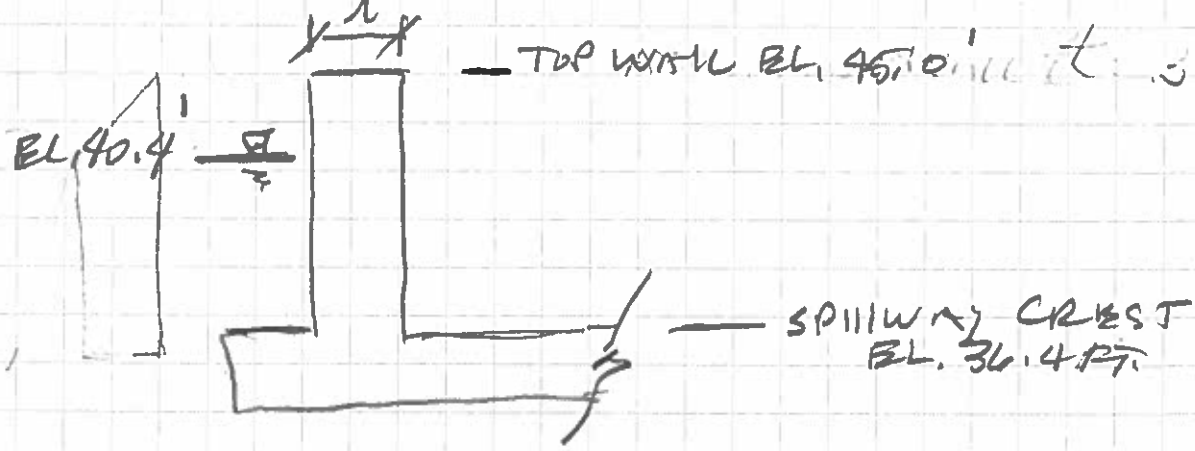
PURPOSE: SPILLWAY CONCRETE DESIGN

ASSUMPTIONS:

1) SPILLWAY CONFIGURATION SHOWN ON DWG. C-110.
2) MAX. FLOOD (½ PMF) EL. 4830' NAVD 88 WITH SPILLWAY FLOW
3) NORMAL POOL MAX. = EL. 40.4' NAVD 88
4) WORST CASE CONDITION IS NORMAL MAX. POOL; NO SPILLWAY FLOW.

REFERENCES: 1) DESIGN HANDBOOK, ACI SP-17(73)

METHODOLOGY: CONFIGURATION:



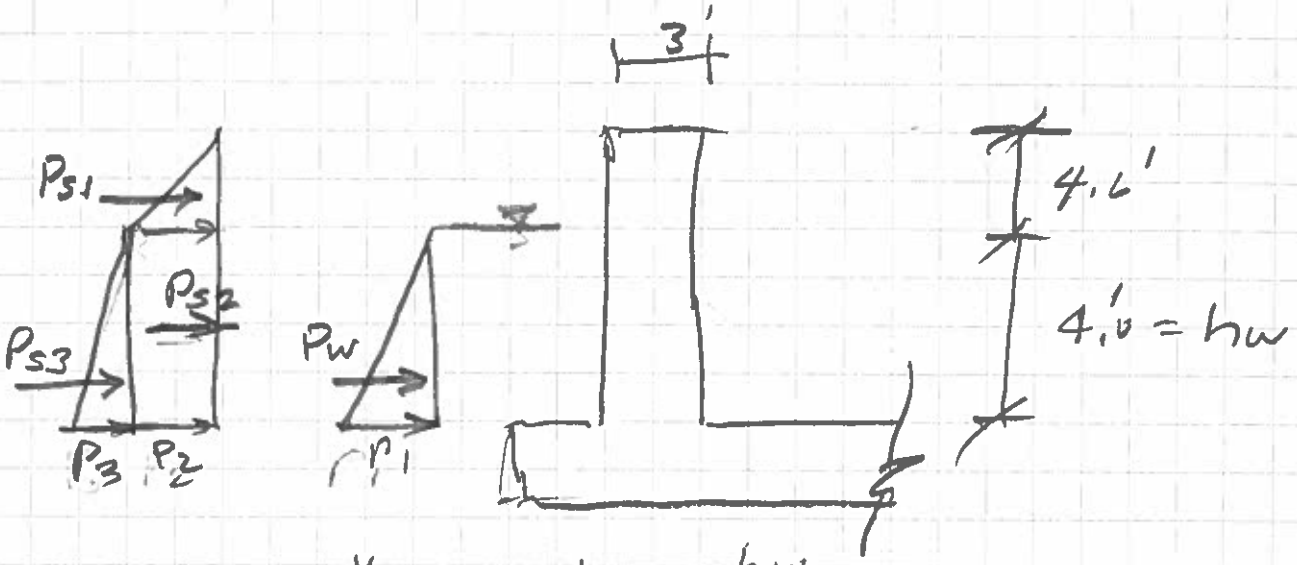
Try $t = 2.0'$ w/ 4" COVER, $d = 24" - 4" = 20"$

FROM REFERENCE 1, FLEXURE 5, pg. 115

$w/d = 20"$; $R = 0.400$; $F = \frac{Mu}{\phi w}$

$b = 12"$

LOADING ON WALL



$$P_W = \left(62.4\ ^{\#}/_{FT^3}\right)\left(\overset{h_W}{4.0}\right)\left(\frac{\overset{h_W}{4.0}}{2}\right) = 0.5\ ^{K}/_{1} \rightarrow$$

$$\times ARM = \frac{4'}{3} = \times 1.33'$$

$$P_W\ MOMENT = 0.67\ ^{1K}/_{1} \curvearrowright$$

SOIL: USE $\gamma = 120\ ^{\#}/_{FT^3}$ USE ACTIVE SOIL PRESSURE COEFFICIENT $\rightarrow K_A = 0.33$

$$P_{S1} = 0.12\ ^{K}/_{FT^3} \times \overset{h_{S1}}{4.6'} \times \frac{4.6'}{2} \times 0.33 = 0.42\ ^{K}/_{1} \rightarrow$$

$$\times ARM = \frac{4.6}{3} + 4.0' = 5.53'$$

$$P_{S1}\ MOMENT = 2.32\ ^{1K}/_{1} \curvearrowright$$

$$P_{S2} = 0.12\ ^{K}/_{FT^2} \times \overset{h_{S1}}{4.6'} \times 4.0' \times 0.33 = 0.73\ ^{K}/_{1} \rightarrow$$

$$\times ARM = \frac{4.0}{2} = 2.0'$$

$$1.44\ ^{1K}/_{1} \curvearrowright$$

P_{S3} = SUBMERGED SOIL $\gamma_s = 120 - 22.4\ \#/ft^3$

$\gamma_s = 57.6\ \#/ft^3$

$P_{S3} = (0.0576\ \#/ft^3)(4.0') \times \frac{4.0'}{2} \times 0.33 = 0.15^{k}/_{1}$

*ARM $= \frac{4'}{3} = 1.33'$

P_{S3} MOMENT $= 0.20^{1k}/_{1}$

MAX. MOMENT $= 0.20^{1k}/_{1} + 0.67^{1k}/_{1} + 2.32^{1k}/_{1} + 1.46^{1k}/_{1}$

AT BASE OF WALL $= 4.65^{1k}/_{1}$

HORIZONTAL FORCE $= 0.15^{k} + 0.42^{k} + 0.73^{k} + 0.15^{k}$
$= 1.8^{k}$ AT BASE OF WALL

CHECK CONDITION WITH WATER BELOW SPILLWAY:

$P_{S\,DRY} = 0.12\ \#/ft^3 \times 8.6' \times \frac{8.6'}{2} \times 0.33 = 1.46^{1k}/_{1}$

$\times$ ARM $= \frac{8.6'}{3} = 2.87'$

$P_{S\,DRY}$ MOMENT $= 4.19^{1k}/_{1}$

$P_{S\,DRY} < P_{SSUBMERGED}$; NOT CRITICAL.

USE MAX MOMENT $= 4.65^{1k}/_{1}$

$K_U = \frac{M_U}{F}$ (SEE Pg. 1)

M_U = applied Design moment

$K_U = \frac{4,45^{1K/'}}{0.400} = 11.16$

FROM FLEXURE 1.12 (REFERENCE 1)

W/ $K_U < 71$ $f'_c = 4,000$ psi

$f_y = 60,000$ psi

$\rho \leq 0.0073$

USE $\rho_{min} = 200/f_y = \frac{200}{60,000} = 0.0033$

$A_s = \rho b d = 0.0033 \times 12'' \times 20''$

$= 0.79 \text{ in}^2/\text{L.F.}$

FROM REFERANCE 1 REINFORCEMENT 16

USE # 8 @ 12" O.C.

VERTICAL OUTSIDE WALL

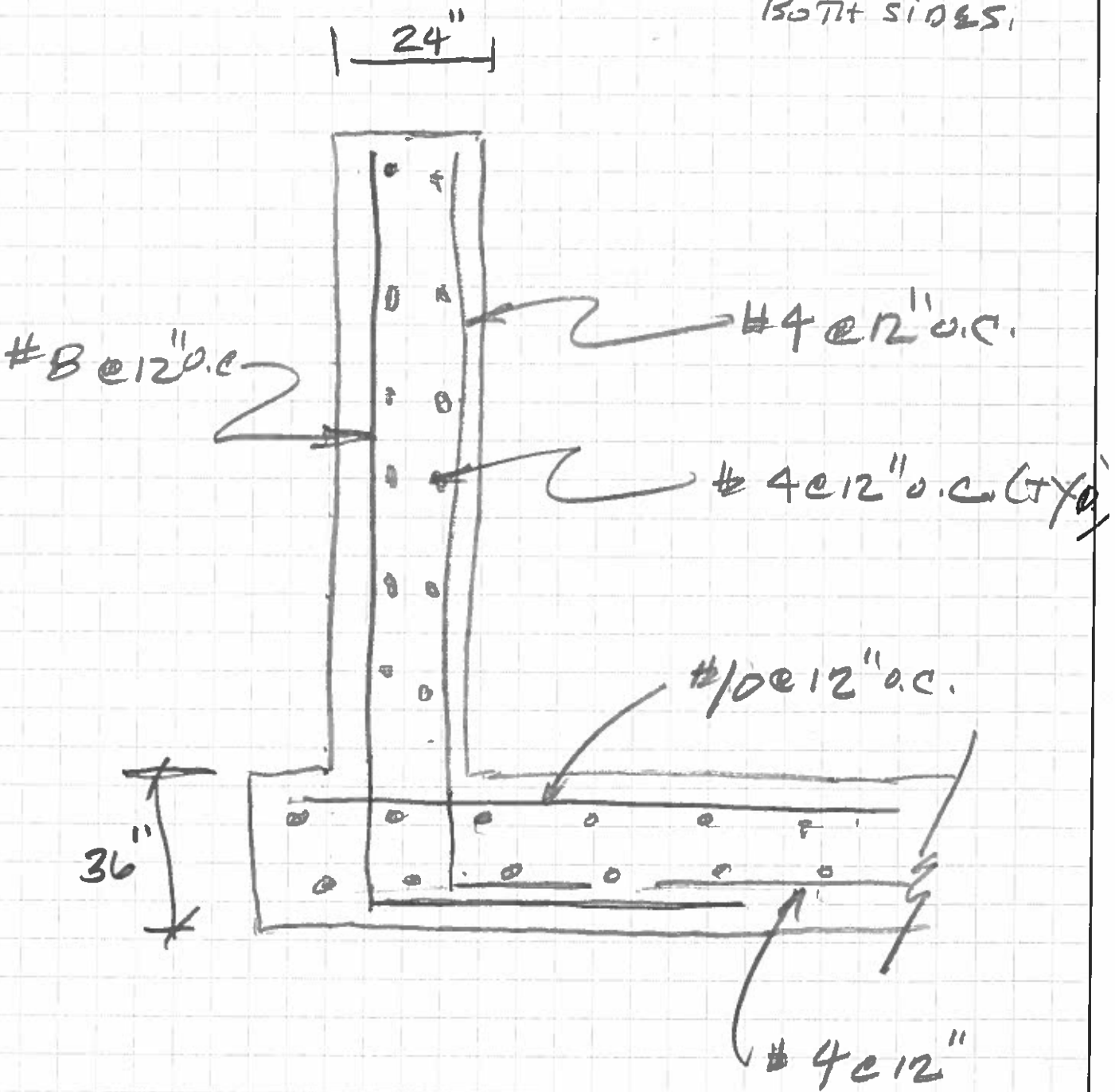
FOR SHRINKAGE USE $\rho = 0.0018$ PER VOLUME

USE $\rho = \frac{0.0018}{4} = 0.00045$ EACH WAY EACH FACE

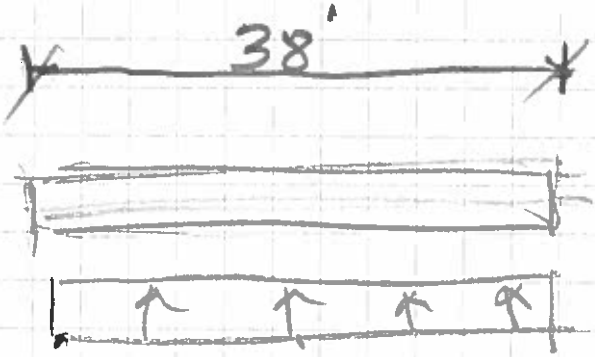
Use $\rho_{SHRINKAGE} = 0.00045 \times 20'' \times 12''$

$= 0.1080 \text{ in}^2/\text{FT.}$

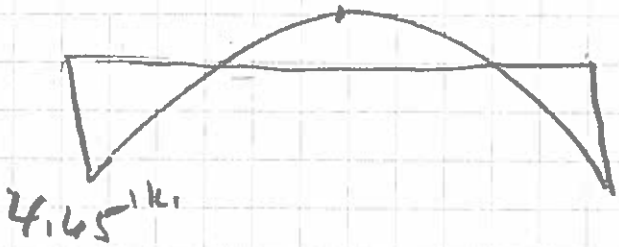
USE #4 @ 12" HORS/VERT BOTH SIDES.



CHECK MOMENT IN @ INTERIOR TOP SLAB



$P_W = 62.4^{\#}/_{ft^3} \times 4' = 0.25^{K}/_{ft^2}$



Mom. center $= -4.65^{K/'} + 0.25^{K}/_{ft^2} \times 38' \times \frac{38'}{2}$

$= -4.65^{(K)}/_{ft} + 180.5^{(K)}/_{ft}$

$= 175.8^{(K)}/_{ft}$

Use $t = 2'$ $F = 0.400$ $d = 20''$

See Pg. 1

$Ku = \frac{175.8}{0.400} = 439.5$

w/ 60,000 psi = fy ; 4000 psi = f'_c

$\rho = 0.0088$ (FLEXURE 1.2)

$A_s = 0.0088 \times 20'' \times 12''$

$A_s = 2.11 \text{ in}^2/\text{LF}$

USE 3' SLAB; $d = 36'' - 4'' = 32''$

$\Phi = 1.02$

$K_U = \frac{175.8^{1K}}{1.02} = 172.4$

$\rho = 0.0033 \geq 0.0033$ MIN.

$A_s = \rho b d = 0.0033 \times 12'' \times 32''$

$= 1.27 \text{ in}^3/\text{LF}$

USE #10 @ 12" O.C.

SHRINKAGE USE $\rho = \frac{0.0018}{4} = 0.00045$

$A_s = 0.00045 \times 32'' \times 12'' = 0.17 \text{ in}^2/\text{LF}$

USE #4 @ 12" O.C. $A_s = 0.21 \text{ in}^2$

TETRA TECH

SUBJECT FISHWAY - 60% DESIGN STABILITY ANALYSIS | PROJECT RESERVOIR DAM | TC/P NO. 194-5938 | ORIGINATOR TCC | CHECKED NM | DATE 6/2/17 | PAGE 1 OF 5 PAGES

PURPOSE: ANALYZE PROPOSED FISHWAY EXIT CHANNEL STABILITY

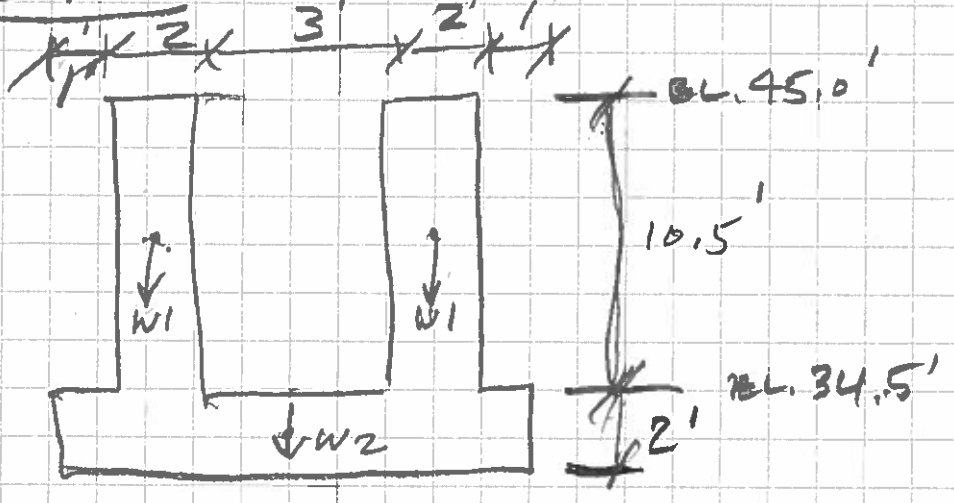
ASSUMPTIONS:

1) EXIT CHANNEL CONFIGURATION PER DWG C-112
2) CRITICAL CASE - ½ PMF, ISOLATION GATE CLOSED, NO FISHWAY FLOW
3) MAX. ½ PMF LEVEL = EL. 43.0 ft.
4) CONCRETE ON SOIL COEFFICIENT = $\mu = 0.5$ SEE PAGE 2

METHODOLOGY:

1) ANALYZE STRUCTURE AS WHOLE

CROSS SECTION:



PISTON VALVE 60% DESIGN

STABILITY ANALYSIS

B. JOHNSON T COOK
N. M

RESERVOIR ARMY
194-5938
6-24-14 PG 2 of 5

ETL 1110-3-446
22 Aug 92

TABLE C-1

Friction Coefficient for Concrete Cast on Soil
(reference 4)

Interface Materials	Friction Coefficient, f
Mass concrete on the following [illegible] materials:	
Clean sound rock	0.70
Clean gravel, gravel--sand mixtures, coarse sand	0.55 to 0.60
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	0.45 to 0.55
Clean fine sand, silty or clayey fine to medium sand	0.35 to 0.45
Fine sandy silt, nonplastic silt	0.30 to 0.35
Very stiff and hard residual or preconsolidated clay	0.40 to 0.50
Medium stiff and stiff clay and silty clay	0.30 to 0.35

C-4.2. [illegible] of thrust block for downward directed thrust is calculated by;

$$A_b = S\ F_s T_v / q_s$$

[illegible];

A_b = bottom area of thrust block,
T_v = vertical component of thrust force,
q_s = allowable bearing capacity of soil, and
F_s = factor of Safety.

C-4.3. There is also a horizontal component of thrust (T_h) in vertical bends. The sizing of thrust block for the horizontal component is calculated by the same [illegible] used for horizontal bends, except the term T is replaced by $T_h = 2PA \sin \theta/2 \cos \theta$.

C-4.4. These are shown in Figures C-4, C-5, C-6 and C-7.

C--5. Restrained Joints. There are several approaches to this. They all [illegible] the length of pipe to be restrained on both sides of the joint. The length to be restrained may be determined by;

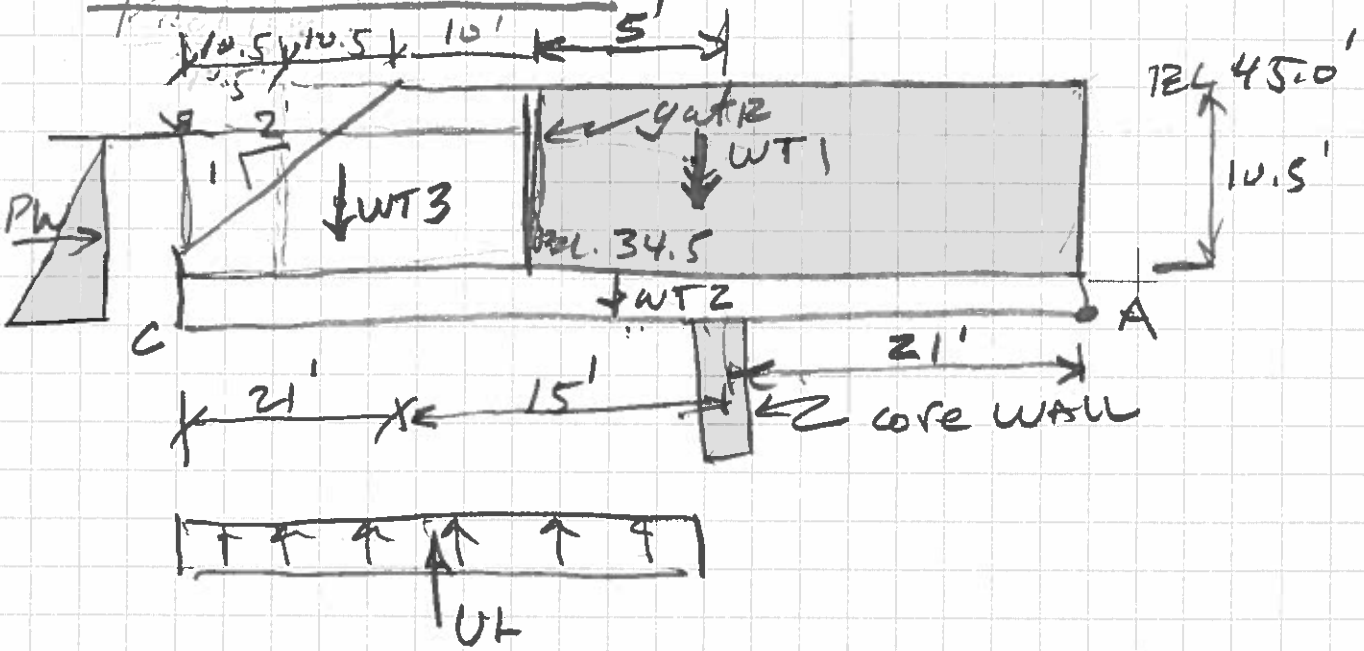
$$L = S\ F_s(PA \tan \theta/2)/(F_f + 0.5\ R\ (= Z\ K_s\ D.)$$

where;

$$W_1 = \left(\frac{150\ ^{k}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(2' \times 10.5') = 3.15\ ^{k}/_{l} \downarrow$$

$$W_2 = \left(\frac{150\ ^{lb}/_{ft^3}}{1000\ ^{lb}/_{k}}\right)(2' \times 9') = 2.7\ ^{k}/_{l} \downarrow$$

LOADING DIAGRAM:



$$WT1 = 2W_1\left(21' + 15 + \frac{21'}{2}\right) = (2)\left(3.15\ ^{k}/_{l}\right)(46.5')$$

$$WT1 = 293^{k} \downarrow$$

$$WT2 = W_2(21 + 15 + 21') = \left(2.7\ ^{k}/_{l}\right)(57')$$

$$WT2 = 153.9^{k} \downarrow$$

$$WT3 = \left(\frac{62.4\ ^{k}/_{ft^3}}{1000\ ^{\#}/_{k}}\right)(3'+1'+1')(31') = 9.7^{k}\downarrow$$

$$M_{AWT1} = 293^{k} \times \frac{46.5'}{2} = 6{,}812.2^{1k}\ \leftarrow$$

$$M_{AWT2} = 153.9^{k} \times \frac{57'}{2} = 4{,}386.2^{1k}\ \leftarrow$$

$$M_{AWT3} = 9.7^{k} \times \left(21+5+\frac{31'}{2}\right) = 402.5^{1k}\ \leftarrow$$

$$\Sigma M_R = M_{AWT1} + M_{AWT2} + M_{AWT3}$$

$$\Sigma M_R = 6{,}812.2 + 4386.2 + 402.5$$

$$\Sigma M_R = 11{,}600.9^{1k}\ \leftarrow$$

$$P_W = \left(\frac{62.4\ ^{k}/_{ft^3}}{1000\ ^{\#}/_{k}}\right)(12.5')\left(\frac{12.5'}{2}\right)(9') = 43.9^{k}\ \rightarrow$$

$$M_{APW} = 43.9^{k} \times \frac{12.5}{3} = 182.8^{1k}\ \rightarrow$$

$$UL = \left(\frac{62.4\ ^{k}/_{ft^3}}{1000\ ^{\#}/_{k}}\right)(12.5')(9')(36') = 252.7^{k}\uparrow$$

$$M_{AUL} = 252.7^{k} \times \left(\frac{36'}{2}+21\right) = 9855.3^{1k}\ \rightarrow$$

$$\Sigma M_O = M_{APW} + M_{AUL} = 182.8 + 9855.3^{1k}$$

$$= 10{,}038.1^{1k}$$

ADD SOIL ON FOOTING

$$WT4 = \left(\frac{120^{\#}/_{43}}{1000^{\#}/_{K}}\right)(2')(10.5')(57') \downarrow$$

$$WT4 = 143.6^{K} \downarrow$$

$$M_{A\,WT4} = 143.6^{K} \times \frac{57'}{2} = 4{,}093.7^{K} \curvearrowleft$$

$$\Sigma M_R = 11{,}600.9^{K} \text{ (see pg. 4)} + 4{,}0937.7^{K}$$

$$\Sigma M_R = 15{,}694.6^{K}$$

$$\frac{\Sigma M_R}{\Sigma M_O} = \frac{15{,}694.6^{K}}{10{,}038.1^{K}} = 1.56$$ FACTOR SAFETY OVERTURNING

STABLE.

CHECK SLIDING:

$$\Sigma WT = WT1 + WT2 + WT3 + WT4$$
$$= 293.0^{K} + 153.9^{K} + 9.7 + 143.6^{K} = 600.2^{K}$$

$$\Sigma V = \Sigma WT - UL = 600.2^{K} - 252.7^{K} = 347.5^{K}$$

$$\Sigma F_R = \Sigma V \times \mu = 347.5^{K} \times 0.5 = 173.8^{K}$$

$$\Sigma F_S = P_W = 43.9^{K} \rightarrow$$

$$\frac{\Sigma F_R}{\Sigma F_S} = \frac{173.8}{43.9} = 4.0$$ FACTOR SAFETY SLIDING

FISHWAY STABLE

TETRA TECH

SUBJECT TACK FACTORY POND FLOOD LEVELS

PROJECT RESERVOIR DAM

TC/P NO. L94-5938

ORIGINATOR TCC CHECKED NM

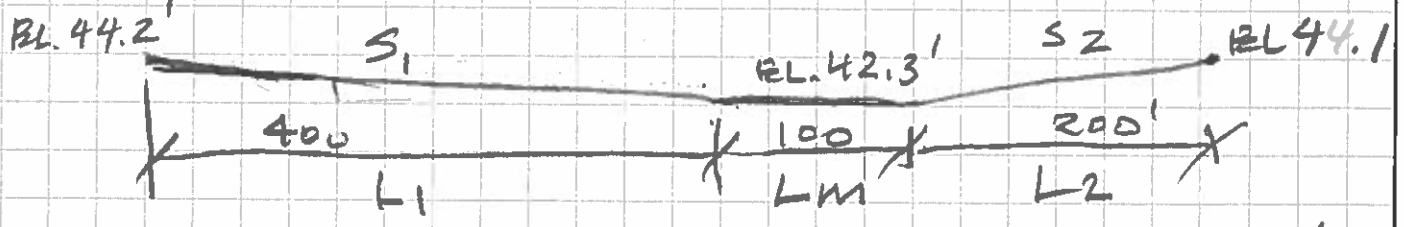
DATE 6/2/17 PAGE 1 OF 2 PAGES

PURPOSE: APPROXIMATE WATER LEVEL IN TACK FACTORY POND AT ½ PMF PEAK DISCHARGE

ASSUMPTIONS:

1) ½ PMF ≈ 1,800 CFS.
2) FLOW THROUGH CULVERT NEGLIGIBLE.
3) CJCH ACT AS A BROAD CRESTED WEIR WITH C = 2.6
4) CROSS SECTION OF CJCH PER DWG C-101

CJCH PROFILE:



$S_1 = \frac{1.9}{400'} = 0.00475'/'$ $S_2 = \frac{1.8}{200} = 0.009'/'$

WEIR FORMULA

$$Q = CLH^{3/2}$$

$$L = \frac{L1}{2} + \frac{L2}{2} + Lm$$

$L_1 = H \times S_1 = (0.00475)(H)$

$L_2 = H \times S_2 = (0.009)(H)$

Assume H.	L_1	L_2	L	$Q = 2.6 L H^{3/2}$
1	211'	111'	261'	677 CFS.
1.5	316'	167'	342'	1,634 CFS.
1.6	337'	178'	358'	1,884 CFS
2.0	422'	222'	422'	3,103 CFS.

½ PMF FLOOD LEVEL IN TACK FACTORY POND

AT EL. 42.3' + 1.6' = EL. 43.9'

↳ EQUAL TO PRMA FLOOD LEVEL

100 YR Flood at EL. 44.0'

TETRA TECH

SUBJECT ESTIMATED WAVE HEIGHT

PROJECT RESERVOIR DAM

TC/P NO. 194-5938

ORIGINATOR TCC CHECKED NM

DATE 6/2/17 PAGE 1 OF 1 PAGES

PURPOSE: DETERMINE WAVE HEIGHT AT RESERVOIR DAM

ASSUMPTIONS:

1) 80 mph wind CONCURRENT WITH ½ PMF

2) FETCH PER DWG C-103 ≈ 2,200 FT

REFERENCE: 1) STANDARD HANDBOOK FOR CIVIL ENGINEERS, MERRITT

ASSUMPTIONS:

1) FETCH IS 2,200 FT SCALED FROM DWG C-103; F in nautical miles

2) 80 mph WIND OCCURS DURING PEAK ½ PMF FLOW (MAX. RESERVOIR LEVEL); U in MPH.

METHODOLOGY:

FROM EQUATION 23-11, MERRITT,

$H = 0.0455\ U\ F^{0.5}$; F = 0.42 miles

U	H
50	1.8 FT
80	2.9 FT
100	3.6 FT.

USE 3 FT WAVE HEIGHT MAXIMUM

$\frac{H}{2}$ = 1.5 FT TOP WAVE OVER POOL LEVEL

TETRA TECH

SUBJECT FISHWAY CONCRETE DESIGN

PROJECT RESERVOIR DAM

TC/P NO. 194-5938

ORIGINATOR TCL CHECKED NM

DATE 6/2/17 PAGE 1 OF 5 PAGES

PURPOSE: FISHWAY CONCRETE DESIGN

ASSUMPTIONS:

1) FISHWAY CONFIGURATION SHOWN ON DWG C-112

2) MAX. FLOOD (½ PMF) EL. 43.6' NAVD88 WITH NO FISHWAY FLOW.

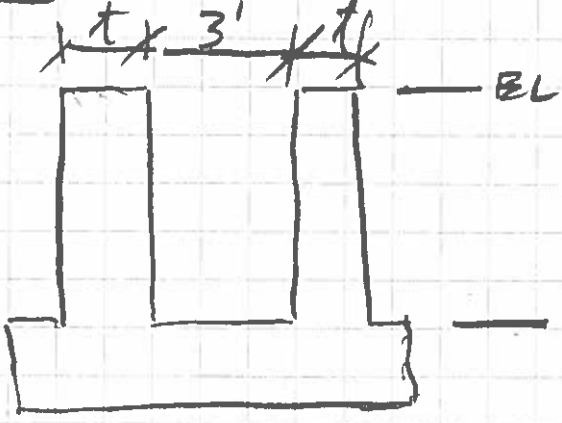
3) WORST CASE IS MAX FLOOD NO FISHWAY FLOW.

REFERENCES:

1) DESIGN HANDBOOK, ACI SP-17(73)

METHODOLOGY:

CONFIGURATON



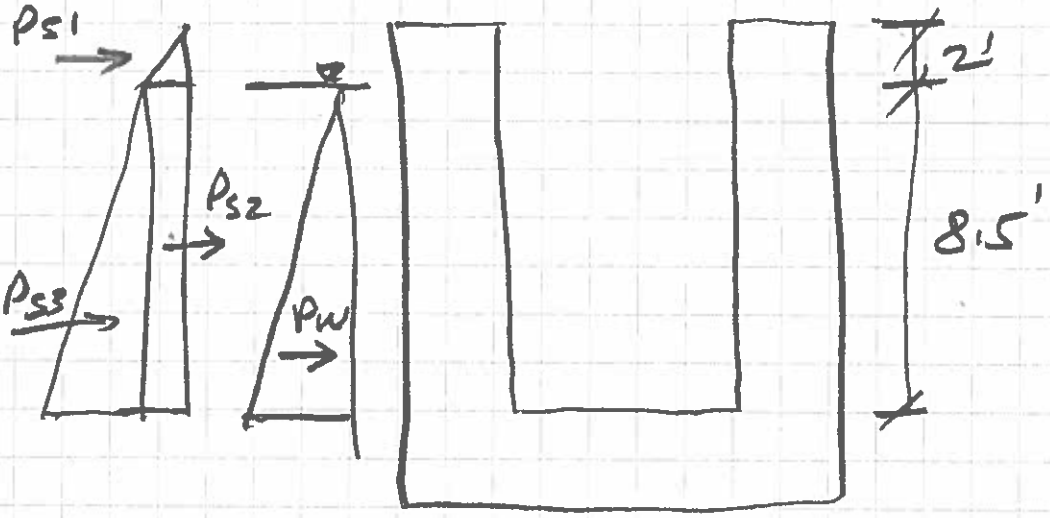
EL 43.0'

TRY $t = 24"$ W/ 4" COVER $d = 20"$

FROM REFERENCE 1, PIERS 5, Pg: 115

W/ $20" = d$ $b = 12"$

$F = 0.406$



	FORCE →	ARM	MOM.
$P_W = 62.4\,\#/ft^3 \times 8.5' \times \frac{8.5'}{2} = 2.25\,k/l$		$\times \frac{8.5}{3} = 2.83$	$= 6.38\,'k/l$
USE $K_a = 0.33$ (ACTIVE SOIL PRESSURE COEFFICIENT)			
$P_{s4} = 0.120\,\#/ft^3 \times 2' \times \frac{2}{2} \times 0.33 = 0.08\,k/l$		$\times 8.5 \times \frac{2}{3} = 5.67'$	$= 0.45\,'k/l$

$P_{S2} = 0.12 \times 2' \times 8.5' \times 0.33 = 0.67^{k/l}$

$\times \frac{8.5'}{2} = 4.25'$

$= 2.85^{k/l}$

P_{S3} = SUBMERGED SOIL $\gamma = 120 - 62.4^{\#/ft^3}$

$\gamma = 57.6^{\#/ft^3}$

$P_{S3} = (0.576^{k/ft^3})(8.5')(\frac{8.5}{2})(0.33) = 6.87^{k/l}$

$ARM = \frac{8.5'}{3} = 2.83'$

$MOMENT = 19.46^{k/l}$

MOMENT AT BASE WALL =

$M_{max} = 6.38^{k/l} + 0.45 + 2.85 + 19.46^{k/l}$

$M_{max} = 29.14^{k/l}$

$K_U = \frac{M_U}{F} = \frac{29.14^{k/l}}{0.40} = 72.9$

FROM FLEXURE 1.2 (REFERENCE 1)

$W/K_U = 72.9 \quad \rho = 0.0013$

Use $\rho_{min} = 200/f_y = \frac{200}{60ksi} = 0.0033$

$A_{s,min} = 0.0033 \times 12'' \times 20''$

$= 0.79 in^2/LF$

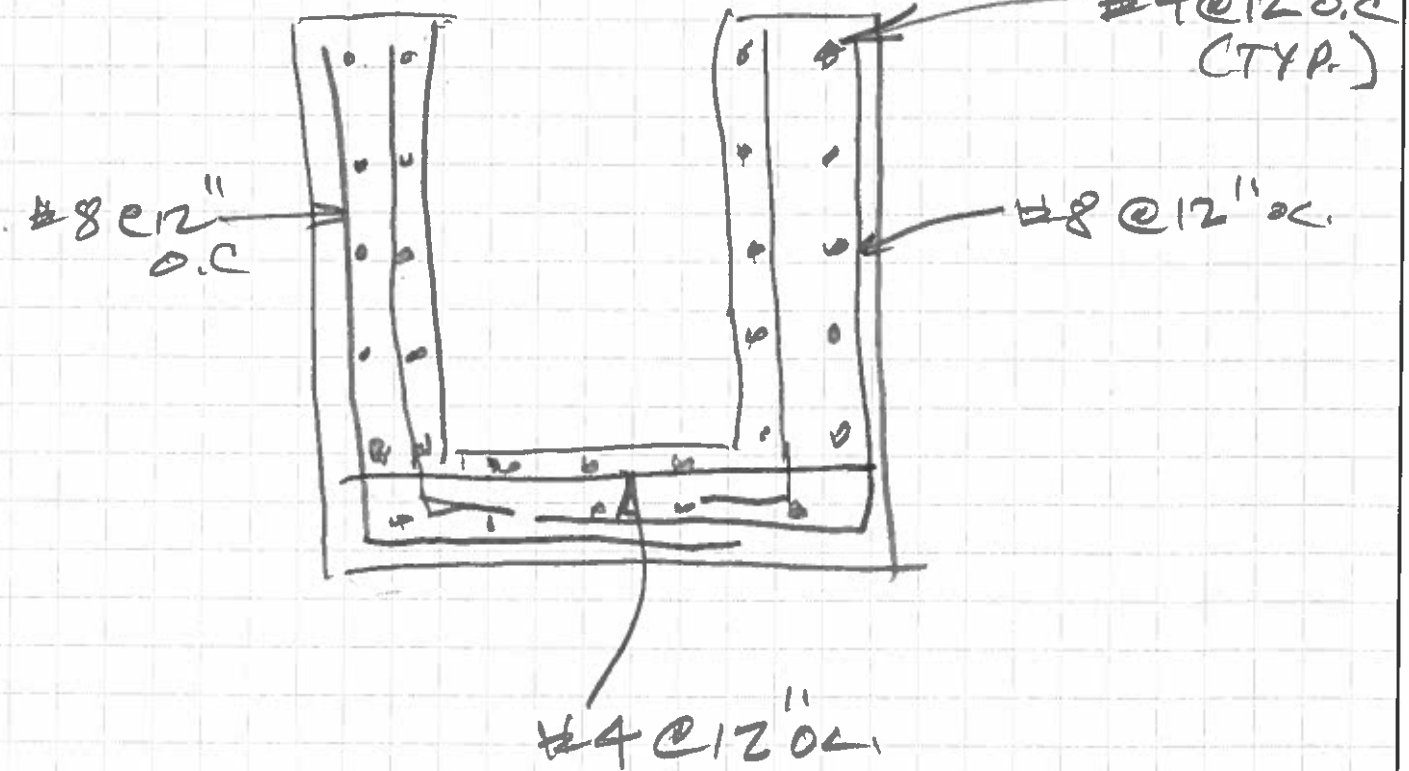
USE #8 @ 12" O.C.

FOR SHRINKAGE USE $\rho = \frac{0.0018}{4}$

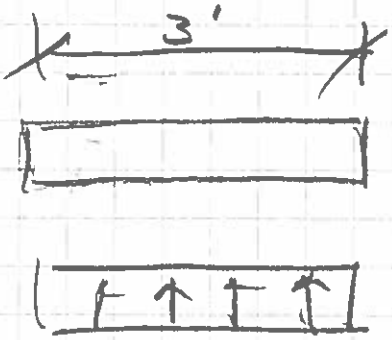
$\rho_{shrinkage} = 0.00045$

USE #4 @ 12" O.C. HORZ & VERT

$0.00045 \times 12'' \times 20 = 0.108 in^2$ REQ'D — BOTH SIDES $0.20 in^2$ PROVIDED



FOR FISHWAY.



$p_w = 62.4 \times 4 = 0.25^{k/ft^2}$

mom. center $= -4.65 + (0.25^{k/ft^2})(3')\frac{(3')}{2}$

$= -4.65 + 1.12^{1k/1'} = -3.5^{1k/ft}$

USE ρ_{shrink} in top slab

ρ_s

PURPOSE: SPILLWAY BRIDGE STRUCTURAL STEEL DESIGN (PRELIMINARY)

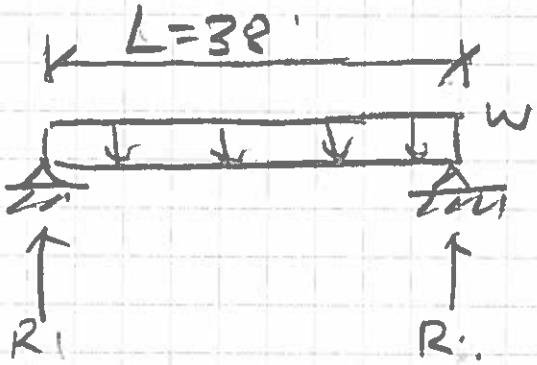
ASSUMPTIONS:

1) CLEAR SPAN 38'
2) 6' WIDTH
3) LOADING 200 #/ft² LIVE LOAD
4) LIVE LOAD FACTOR 1.7
5) SIMPLE BEAM, UNIFORMLY DISTRIBUTED
6) USE 36 ksi = fy, STRUCTURAL STEEL

REFERENCE:

1) MANUAL OF STEEL CONSTRUCTION AISC, 7TH EDITION

METHODOLOGY: CONFIGURATION (2 BEAMS)



1K = 1000#

$W = 200\ \#/ft^2 \times 3'$

$= 600\ \#/LF$

$R = \frac{Wl}{2} = \frac{600\ \# \times 38'}{2}$

$R = 11.4\ kips$

Moment at center $= \frac{wl^2}{8}$

$M_{MAX} = (600^{\#})\frac{(38)^2}{8}$

$= 108.3^{1K}$

$M_U = 108.3^{1K} \times 1.7 = 184.1^{1K}$

Δ MAX @ CENTER $= \frac{5wl^4}{384EI}$

$E \cong 29{,}000$ ksi

$F_b = 0.60 F_y$ USE $F_y = 36$ ksi

$F_b = 21.6$ ksi.

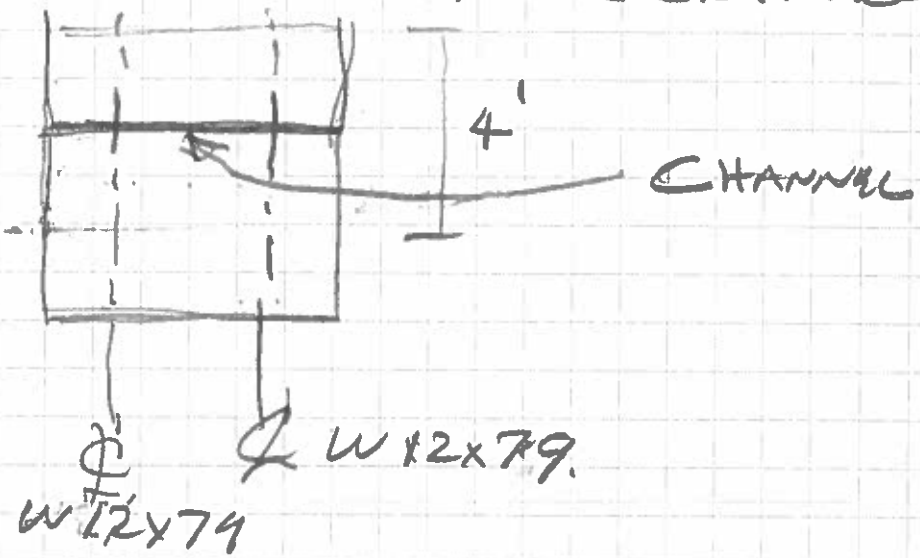
$f_b = \frac{M}{S} = \frac{184.1^{1K} \times 12''}{S_{min}}$

$S_{min} = \frac{184.1^{1K} \times 12''}{21.6\ K/in^2} = 102.3\ in^3$

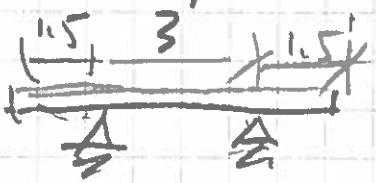
W 12 x 79 : $S = 107\ in^3$ $I_x = 663\ in^4$

$\Delta_{MAX} = \frac{(5)(0.6\ k/ft)(38\ ft)(3.8' \times 12''/ft)^3}{(384)(29{,}000\ ksi)(663\ in^4)} = 1.46$ in

USE CHANNEL SUPPORT FRAME TO SUPPORT FLOOR GRATING



LOAD PER CHANNEL.



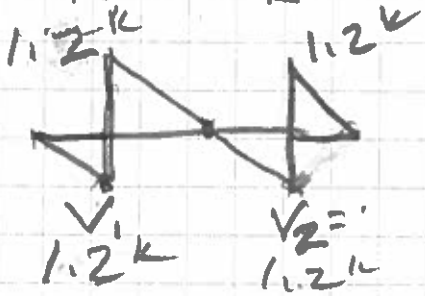
$W = 200\ ^{\#}/_{FT^2} \times 4'$

$= 800\ ^{\#}/_{LF}$

$R = \frac{800\ ^{\#}/_{} \times 6'}{2}$

$R = 2.4^{K}$

V



$V_1 = 800 \times 1.5$

$= 1,200^{K} \downarrow$

$V_1 = V_2$

M

$M_1 = M_2 = 1.2^{k} \times \frac{1.5'}{2} = 0.9^{1k}$ (

= AREA UNDER V DIAGRAM

$M_C = 1.2 \times \frac{1.5}{2} - 0.9 = 0$

$M_U = 0.9^{1k} \times 1.7 = 1.53^{1k}$

$F_b = 21.6\ ksi$

$f_b = \frac{M_U}{S}$

$S = \frac{1.53^{1k} \times 12''/1}{21.6\ k/in^2} = 0.85 in^3$

USE C 4 x 5.4 FOR SUPPORT FRAME ON SPILL

TETRA TECH

SUBJECT FISHWAY BRIDGE STRUCTURAL STEEL

PROJECT RESERVOIR DAM

TC/P NO. 194-5938

ORIGINATOR TCC CHECKED NM

DATE 5/29/17 PAGE 1 OF 2 PAGES

PURPOSE: FISHWAY BRIDGE STRUCTURAL STEEL DESIGN (PRELIMINARY)

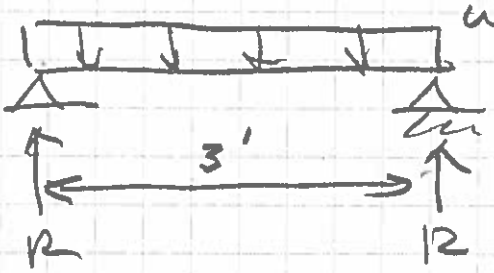
ASSUMPTIONS:

1) CLEAR SPAN 3.0'
2) WIDTH = 6.0'
3) LOADING 200 $^{\#}/_{FT^2}$ LIVE LOAD
4) SIMPLE BEAM; UNIFORMLY DISTRIBUTED
5) LIVE LOAD FACTOR = 1.7

REFERENCE: 1) MANUAL OF STEEL CONSTRUCTION, AISC, 7TH EDITION

METHODOLOGY: CONFIGURATION (2 END BEAMS)

$w = 200^{\#}/_{FT^2} \times 3' = 600^{\#}/_{LF}$



$R = 600^{\#}/_{1} \times \frac{3'}{2}$

$R = 900^{\#} \times \frac{1K}{1000\#}$

$= 0.9K$

$M_{center} = \frac{wl^2}{8} = \frac{0.900^{K} \times (3)^2}{8}$

$M_C = 1.01^{1K}$

$M_U = 1.7 \times 1.01 = 1.72^{1K}$

$$\frac{M_U}{F_b} = S_{min} = \frac{1.72^{1k} \times 12^{in.}}{21.6\ ksi} = 0.96\ in^3$$

USE C 4 x 5.4

$S_x = 1.93\ in^3 > 0.96\ in^3$

USE C 4 x 5.4 FRAME FOR FISHWAY BRIDGE

TETRA TECH	SUBJECT FISHWAY BARRIER SUPPORT FRAME	PROJECT RESERVOIR DAM
	ORIGINATOR TCC CHECKED NM	TC/P NO. 194-5938
		DATE 5/29/17 PAGE 1 OF 4 PAGES

PURPOSE: PRELIMINARY DESIGN OF REMOVABLE FISHWAY WEIR MOTOR HOIST STEEL FRAME SUPPORT

ASSUMPTIONS:

1) USE DUAL SCREW STEMS WITH .5HP MOTOR (WT. = 100 # MAX.)

2) EACH REMOVABLE WEIR HAS OPERATOR.

3) OPERATOR WITH DOUBLE STEM TO KEEP CENTER NOTCH CLEAR OF OBSTRUCTIONS.

REFERENCES:

1) MANUAL STEEL CONSTRUCTION, AISC

2) DWG C-1 #2

METHODOLOGY:

CONFIGURATION —

FISHWAY EXIT CHANNEL BOTTOM EL. 34.5'

TOP WEIR #21 EL. 39.7'

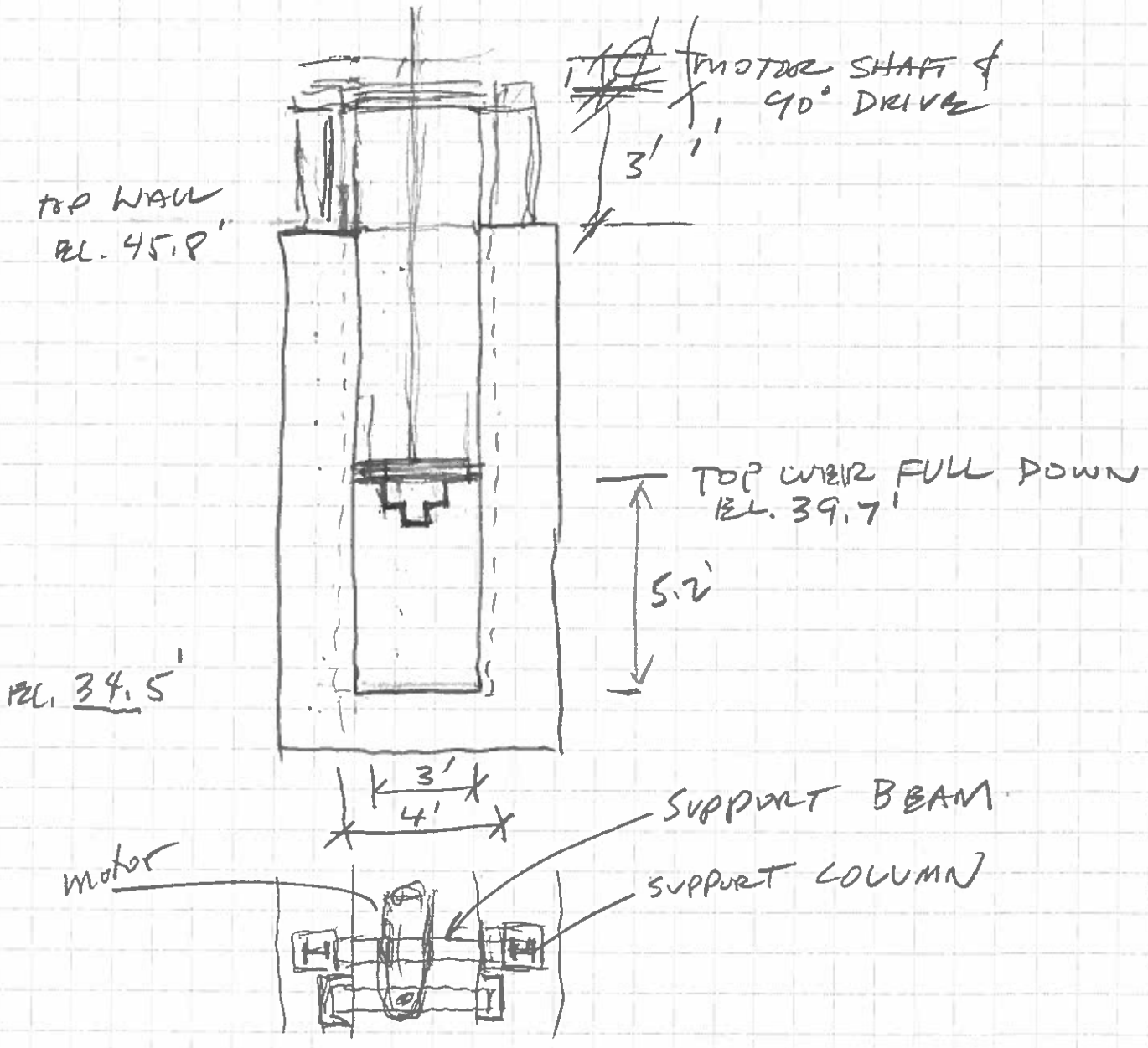
HMAX. WEIR HEIGHT = 39.7' - 34.5' = 5.2'

MAX. POOL OPERATING LEVEL EL. 40.6'

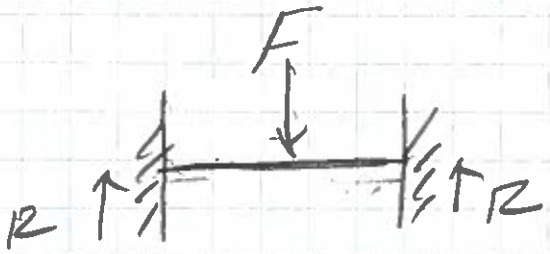
TOP OF WALL @ EL. 45.8'

EL. 45.8' - EL. 40.6' = 5.2'

WEIR IN FULL UP POSITION AT TOP OF WALL



HORIZONTAL BEAM



$$\text{WEIR WT.} = 5.12' \times 4' w \times \tfrac{1}{2}'' \times \frac{ft}{12''}$$

$$= 0.87\ ft^3 \text{ STEEL}$$

$$\times\ 490\ ^{\#}/_{ft^3}$$

$$425^{\#} \text{ PLATE}$$

FOR FRAME ASSUME $25^{\#}/LF$.

USE 4 HORIZONTAL @ 3' long.

& 4 VERTICALS @ 5' long

$$L = (4' \times 3) + (5' \times 4) = 32\ LF$$

$$\times\ 25^{\#}/_{LF}$$

$$800^{\#}$$

USE $425^{\#} + 800^{\#} = 1225^{\#}$

PLUS 20% = $1470^{\#} \Rightarrow 1{,}500^{\#}$

REFERENCE 1) $M_{MAX.} = \frac{PL}{8}$

$$M_{MAX} = \frac{1.5\ kips \times 4'}{8} = 0.75^{\text{'K}}$$

$M_U = 0.75^{1K} \times 1.7$ Load factor $= 1.275^{1K}$

$R = P/2 = \frac{1.500^K}{2} = 0.75^K$

$F_b = 21.6$ ksi for 36 ksi steel.

$S = \frac{1.3^{1K} \times 12''}{21.6^K/in^2} = 0.72\ in^3$

USE W 6 x 15.5 $S_{xx} = 10.0\ in^3$

$A = 4.56\ in^2$

AXIAL LOAD $F_c = 0.75 F_y$

$= 0.75 \times 36^{ksi}$

$= 27$ ksi

$A = \frac{P}{F_c} = \frac{0.75^K}{27 ksi} = 0.03\ in^3$

USE W 6 x 15.5 VERTICALS

$A_s = 4.56\ in^2$