PPM 4/7/98

STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA RIVER INDIAN COMMUNITY

PHASE 2 SANTAN CHANNEL PROJECT
OUTFALL CHANNEL
AND
P-MIP PIPELINES (2)
CONTRACT NO. FCD 97-30
PCN 490012

ADOT PROJECT 600-7-502
TRACS H4314 02 C

QUANTITIES, AND CALCULATIONS

(99% SUBMITTAL)

HDR Engineering, Inc.
2141 E. Highland Avenue, Suite 250
Phoenix, Arizona 85016

CM Review of 95%

ENGINEER'S ESTIMATE OF CONSTRUCTION COST

(Based on 95% Design)

Phase 2 Santan Channel Project

Contract: FCD 97-30 & ADOT Project: 600-7-502

ITEM NO	DESCRIPTION	UNIT	APPROX QTY	UNIT COST NUMBERS	EXTENDED NUMBERS	
105-1	Partnering (SANTAN)	LS	1	$ 5,000.00	$ 5,000.00	
105-2	Partnering (P-MIP)	LS	1	$ 5,000.00	$ 5,000.00	
107-1	NPDES/SWPPP Permits (SANTAN)	LS	1	$ 3,200.00	$ 3,200.00	
107-2	NPDES/SWPPP Permits (P-MIP)	LS	1	$ 1,800.00	$ 1,800.00	
107-3	Public Information and Notification Allowance (SANTAN)	LS	1	$ 5,000.00	$ 5,000.00	?
107-4	Project Signs Allowance (SANTAN)	LS	1	$ 2,500.00	$ 2,500.00	
107-5	Project Signs Allowance (P-MIP)	LS	1	$ 2,500.00	$ 2,500.00	
202-1	Mobilization (SANTAN)	LS	1	$ 64,000.00	$ 64,000.00	
202-2	Mobilization (P-MIP)	LS	1	$ 36,000.00	$ 36,000.00	
211-1	Channel Fill Construction (SANTAN)	CM	11,290	$ 3.50 ~~11.00~~	$ ~~124,190.00~~	39515.00
211-2	GRIC Access Road Compaction (SANTAN)	SM	5,568	$ 1.25 ~~2.50~~	$ ~~13,920.00~~	6960.00
215-1	Channel Excavation (SANTAN)	CM	46,507	$ 3.25 ~~6.50~~	$ ~~302,295.50~~	151147.50
215-2	Drainage Excavation (SANTAN)	CM	825	$ 3.25 ~~5.75~~	$ ~~4,743.75~~	2681.25
220-1	Riprap (Plain) (SANTAN)	CM	151	$ 115 ~~92.00~~	$ ~~13,892.00~~	17365.00
300-1	Roadway Detours (SANTAN)	LS	1	$ 179,908.00	$ 179,908.00	
300-2	Roadway Detours (P-MIP)	LS	1	$ 179,908.00	$ 179,908.00	
310-1	Aggregate Base Class 2 (O&M Road) (SANTAN)	CM	1,231	$ 26 ~~24.00~~	$ ~~29,544.00~~	32,006.00
336-1	Remove and Replace Pavement (AZ Block Windows) (MAG 336) (P-MIP)	LS	1	$ 35,000.00	$ 35,000.00	
350-1	Remove Fencing (SANTAN) LM	~~LS~~	1,045	$ 3.90	$ 4,075.50	
350-2	Remove and Replace Fencing (P-MIP)	LS	1	$ 8,550.00	$ 8,550.00	
350-3	Miscellaneous Removals (SANTAN)	LS	1	$ 80,000.00	$ 80,000.00	
350-4	Miscellaneous Removals (P-MIP)	LS	1	$ 20,000.00	$ 20,000.00	
350-5	Install Plug (P-MIP)	LS	1	$ 800.00	$ 800.00	
350-6	Removal of Pipe (COC/SANTAN)	LM	279	$ ~~25.00~~	$ ~~6,975.00~~	
360-1	PVC Pipe (SDR 35) (76mm) (Pipe Sleeve) (P-MIP)	LM	182	$ 32 ~~25.00~~	$ ~~4,550.00~~	5824
401-1	Traffic Control (SANTAN)	LS	1	$ 105,740.95	$ 105,740.95	
401-2	Traffic Control (P-MIP)	LS	1	$ 105,740.95	$ 105,740.95	
420-1	Chain Link Fence ADOT Type I (1830mm) (SANTAN)	LM	3,762	$ 39 ~~29.00~~	$ ~~109,098.00~~	146,718
505-1	Structural Concrete (Class A) (SRP/SANTAN)	CM	5	$ 325.00	$ 1,625.00	
505-2	Reinforcing Steel (SRP/SANTAN)	KG	25	$ 1.00	$ 25.00	
505-3	RCBC 1 (2-3.048m x 2.134m, Type 1) (SANTAN)	LM	16.5	1950 ~~3,357.33~~	$ ~~55,395.95~~	32,175
505-4	RCBC 2 (2-3.048m x 2.438m, Type 4) (SANTAN)	LM	142.7	2000 ~~3,976.23~~	$ 567,408.02	285,400
505-5	RCBC 3 (2-3.048m x 2.438m, Type 1) (SANTAN)	LM	794.3	1950 ~~3,031.25~~	$ 2,407,721.88	1,548,885
505-6	RCBC 4 (2-3.048m x 2.438m) (RAILROAD) (SANTAN)	LM	10.6	2500 ~~4,385.00~~	$ ~~46,481.00~~	26,500
505-7	RCBC 5 (2-3.048m x 2.438m, Type 1) (SANTAN)	LM	4.8	2000 ~~3,286.42~~	$ ~~15,774.82~~	9600
505-8	RCBC 6 (3-3.048m x 1.219m, Type 1) (SANTAN)	LM	11.2	3000 ~~3,562.42~~	$ 39,899.10	33600
505-9	RCBC 7 (1-3.048m x 2.438m, Type 1) (SANTAN)	LM	3	1300 ~~1,974.00~~	$ ~~5,922.00~~	3900
505-10	Headwall (C-16.10) (SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00	
505-11	Headwall (610mm) (Detail D13) (SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00	
505-12	Headwall (610mm) (Detail B5) (SANTAN)	Ea.	3	$ 300.00	$ 900.00	
505-13	Headwall w/Trashrack (610mm) (Detail B4) (SANTAN)	Ea.	3	$ 6,000.00	$ 18,000.00	
505-14	Headwall w/Trashrack (1370mm) (Detail B4) (SANTAN)	Ea.	1	$ 10,000.00	$ 10,000.00	OK
? 505-15	Concrete Channel Lining (152mm) (w/steel) (SANTAN)	SM	34,779	$ ~~95~~ ~~46.00~~	$ ~~1,599,834.00~~	~~2,951,415~~ 3,756,215
505-16	Concrete Spillway (80mm) (w/wire mesh) (SANTAN)	LM	11	$ 30.00	$ 330.00	
505-17	RCBC Plug (Permanent) (SANTAN)	Ea.	1	$ 2,500.00	$ 2,500.00	
505-18	RCBC Plug (Temporary) (SANTAN)	Ea.	1	$ 1,000.00	$ 1,000.00	
505-19	P-MIP Pipe Plug (Temporary) (P-MIP)	Ea.	2	$ 500.00	$ 1,000.00	
505-20	Gate Structure (610mm) (Detail B1&B2) (SANTAN)	Ea.	3	$ 15,000.00	$ 45,000.00	
505-21	Gate Structure (1370mm) (Detail B3) (SANTAN)	Ea.	1	$ 25,000.00	$ 25,000.00	
520-1	Steel Hand Rails (SANTAN)	LM	107	$ 99.00	$ 10,593.00	

525-1	Pneumatically Placed Mortar (SRP/SANTAN)	SM	6,400	$ ~~54~~ ~~30.00~~	$ ~~192,000.00~~	~~345,600~~
602-1	Steel Casing (762mm) (COC/SANTAN)	LM	19	$ 850.00	$ 16,150.00	
602-2	Bore & Jack Union Pacific Railroad (COC/SANTAN)	LM	19	$ 750.00	$ 14,250.00	
615-1	Vitrified Clay Pipe (376mm) (15") (COC/SANTAN)	LM	481	$ 98.50 ~~275.00~~	$ 132,275.00	47378.50
615-2	Vitrified Clay Pipe (600mm) (24") (COC/SANTAN)	LM	71	$ 207 ~~430.00~~	$ ~~30,530.00~~	14,697
615-3	Ductile Iron Pipe (406mm) (16") (COC/SANTAN)	LM	22	$ 130 ~~425.00~~	$ 9,350.00	2860
615-4	Connect to Exst Manhole (COC/SANTAN)	Ea.	1	$ 1,000.00	$ 1,000.00	
618-1	Reinforced Concrete Pipe (610 mm) (Class IV) (SANTAN)	LM	621	$ 120 ~~300.00~~	$ ~~186,300.00~~	74 520
618-2	Reinforced Concrete Pipe (760 mm) (Class IV) (SANTAN)	LM	21	$ 150 ~~375.00~~	$ ~~7,875.00~~	3150
618-3	Reinforced Concrete Pipe (760 mm) (SRP/SANTAN)	LM	92	$ 150 ~~375.00~~	$ 34,500.00	13800
618-4	Reinforced Concrete Pipe (910 mm) (Class IV) (SANTAN)	LM	26	$ 206 ~~470.00~~	$ ~~12,220.00~~	5352
618-5	Reinforced Concrete Pipe (910 mm) (SRP/SANTAN)	LM	30	$ 206 ~~470.00~~	$ ~~14,100.00~~	6180
618-6	Reinforced Concrete Pipe (1370 mm) (Class V) (SANTAN)	LM	338	$ 430 ~~905.00~~	$ ~~305,890.00~~	145340
618-7	Reinforced Concrete Pipe (1370mm) (P-MIP)	LM	1,035	$ 430 ~~905.00~~	$ ~~936,675.00~~	445,600
618-8	Reinforced Concrete Pipe (2130mm) (P-MIP)	LM	1,503	$ 750 ~~1,230.00~~	$ ~~1,848,690.00~~	1,127,250
621-1	Pipe Corrugated Metal (610mm) (SANTAN)	LM	2.2	$ 125 ~~230.00~~	$ ~~506.00~~	275
621-2	Concrete Pipe Collar (ADOT C-1380) (SANTAN)	Ea.	1	$ 200.00	$ 200.00	
621-3	Flap Gate Watertight (610mm) (SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00	
625-1	Standard Manhole (MAG 522) (SANTAN)	Ea.	3	$ 5,000.00	$ 15,000.00	
625-2	Irrigation Drop Manhole (Detail D20)	Ea.	2	$ 5,500.00	$ 11,000.00	
625-3	Pressure Manhole (MAG 521 Modified) (Detail P1) (P-MIP)	Ea.	4	$ 5,500.00	$ 22,000.00	
625-4	Non-Pressure Manhole (MAG 521 Modified) (Detail P2) (P-MIP)	Ea.	1	$ 8,550.00	$ 8,550.00	
625-5	Manhole,Sanitary Sewer (MAG 420) (COC/SANTAN)	Ea.	7	$ 5,000.00	$ 35,000.00	
625-6	Reshape Manhole Floor (COC/SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00	
630-1	Siphon Clean-Out (Detail P6) (P-MIP)	Ea.	2	$ 1,200.00	$ 2,400.00	
	Subtotal			~~9,442,316~~	~~$ 10,150,802.41~~	~~8,629,114.64~~
	10% Contingency				~~$ 1,015,080.24~~	~~862,411.96~~
	Total				~~$ 11,165,882.65~~	

~~$ 9,442,031.60~~

$ 7,169,158.64 Subtotal $ 8,679,139.64

$ 716,915.86 10% Contingencies 867,913.96

$ 7,886,074.50 Total - $ 9,547,053.60

~~9,001,561.07~~

~~7,529,898.25~~

~~1,471,662.77~~

3.28 million

Sheet U-1.3 -

1. See sheet U-1.1 comments.
2. Show the location of the new relocated gas lines in the profile.
3. Show the channel in the profile.

*4. The slopes and distances in the sewer line profiles should be provided between each manhole.

Cross Section Sheets -

1. At Sta. 0+840; show the invert access ramp.
2. Beginning at Sta. 1+080; add the PMIP pipes **to all sections as required.**
3. Use these cross sections as a means of identifying the slopes to be used to match existing grade.

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ENGINEER'S ESTIMATE AND QUANTITIES -

1. The estimate must be evaluated to include impacts to costs due to such construction challenges as relocating and maintaining the Pecos Drain and north/south laterals during construction, UPRR down time, detour and traffic control on 56th Street and I-10, limited access along the north side of the Pecos Road alignment, etc. It is the expectation of the FCDMC to have the estimate within 10% of the low bid amount received at bid opening.

*2. Cost share "splits" between the SEVRDS and the P-MIP components must be determined for -
-- The Partnering Conferences
-- Traffic control on I-10 and 56th Street
-- Placement (excavation, installation and backfill) of the culvert and pipeline through the common alignment across I-10 right-of-way.

*3. Complete quantity calculations supporting all bid quantities must be provided prior to the 90% submittal.

*4. The bid schedule and Engineer's Estimate must follow exactly the bid item names and numbers used in the SGC's and the SP's. See revisions and additions to the SGC's and SP's which affect the listing in the bid schedule.

*5. The review of the 60% Engineer's Estimate will be doe at a later date and possibly before the scheduled review meeting on October 24.

<u>ADDITIONAL REVIEW COMMENTS</u>; 10/24/97 ==>>

6. Additional cost share items will include the "Project Signs", mobilization, and NPDES.

7. Need to determine how to share the excavation and backfill costs for the I-10 crossing.

8. Based on the "Independent Costs" breakdown, it would appear that the traffic control would be split 50/50. Based on a percentage basis of the independent costs, a split of about 36/64 PMIP/SEVRDS.

9. Bid units will remain in metric, but descriptions will be in English.

10. Unit cost revisions should include: Partnering = $10,000, Mobilization = $100,000, Project Signs = $5,000,.

11. A detailed breakdown of the Traffic Control costs must be provided.

12. Should make the roadway restoration for both detours incidental to the Traffic Control Detour bid items. This can be done by providing sufficient detail and plans for the detours and reconstruction work.

13. Unit costs appear to be low in metric units versus English units for: Concrete at $265/CM, Concrete Channel Lining at $30/SM, Shotcrete at $20/SM.

14. The 215-1 Channel Excavation quantity appears to be very low.

15. The Special Provisions for structure excavation and backfill for the box culvert should be based on the excavation and backfill as incidental to the culvert construction bid item (505), with the bid basis as L.M. There will be no structure excavation or backfill bid item, and this should also be explained in Section 505 as a component of the bid item cost.

16. The Special Provisions for Channel Excavation (215) should be a separate bid item in C.M. for all excavation from existing grade to the outside (bottom, earth side) of the concrete lining prism. This should be clearly described in the Special Provisions.

17. As many "common items" as possible that can be identified and bid separately for the SEVRDS and the PMIP should be so bid. In particular this would apply to 336, 350, and 420 bid items.

18. A bid item is required for pavement replacement on Pecos Road for the SEVRDS.

19. The Engineer's Estimate must calculate the extend amounts to the nearest penny, and not rounded to the nearest whole dollar.

20. There are many bid items for which quantities and/or unit costs have not been provided. This must be corrected in the next submittal.

@ 1.5 mo³

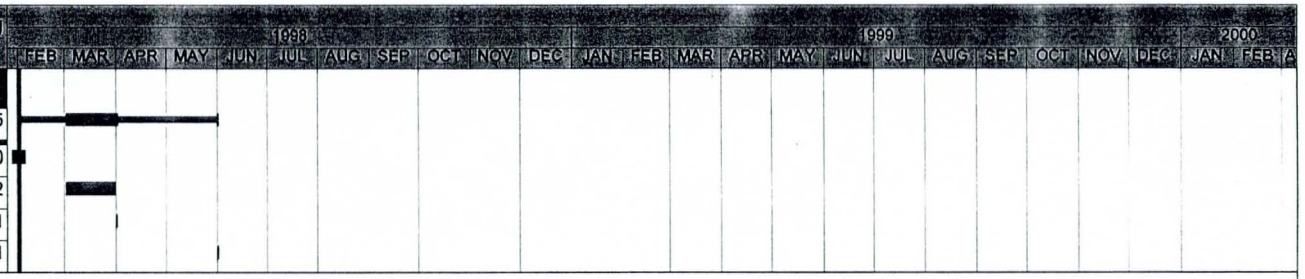
Act ID	Activity Description	Orig Dur
Construction		
		319
1999	Mobilization	22
2010	Excavate Outlet Channel & Box Culverts	43
2110	Install Box Culverts East of I-10 (CIP)	307
2020	Construct Outlet Channel Sta 0+16 To 0+860	168
2030	Construct Outlet Channel Sta 0+860 To 1+062	39
3020	Install Broadacres Irrigation Pipeline	5
3000	Install 2130mm & 1370mm Irrigation Pipes	82
2040	Construct Outlet Channel Sta 2+035 To 2+822	125
2070	Construct Transition Structures (2) West of I-10	22
4000	Construct EB I-10 Detour & WB Lane Shift	22
2060	Install Box Culverts West of I-10 (CIP)	10
2000	Construct Outfall Structure	22
3010	Install 2130mm & 1370mm Irr. Pipes Under EB I-10	5
2080	Install Box Culverts Under EB I-10 (CIP)	49
2120	Construct Box Culvert Under UPRR (Precast)	10
4010	Install Replacement EB I-10 Paving	5
4020	Remove EB I-10 Detour & WB Lane Shift	5
3040	Install 2130mm & 1370mm Irr. Pipes Under UPRR	10
3200	Install New Chandler Sewer, Incl. Bore & Jack	32
4030	Construct WB I-10 Detour & EB Lane Shift	22
3050	Install 2130mm & 1370mm Irr. Pipes Under WB	5
2090	Install Box Culverts Under WB I-10 (CIP)	31
3210	Remove Existing Chandler Sewer	10
4070	Construct 56th Street Detour	10
2100	Install Box Culverts Under 56th St (CIP)	17
4040	Install Replacement WB I-10 Paving	5
3060	Install 2130mm & 1370mm Irr. Pipes Under 56th St	5
3310	Install SRP Pecos Drain Under 56th St	5
4050	Remove WB I-10 Detour & EB Lane Shift	5
4080	Remove 56th Street Detour	5
4060	Restore I-10 EB & WB to Original Condition	5
2130	Construct Transition Structures (2) East of I-10	22
3100	Install Basin Piping & Headwalls	55
3130	Construct Gate Structures	44
3300	Install SRP Pecos Drain	44

Start date	02FEB98
Finish date	30AUG99
Data date	02FEB98
Run date	05JAN98

Early bar
Progress bar

HDR Engineering

Act ID	Activity Description	Orig Dur
Preconstruction		
		85
1000	Complete 100% Plans	0
1010	Advertise for Bids	22
1020	Bid Award	1
1030	Notice to Proceed	1



PMIP @ 10 MONTHS @ $3,120,094.5

= $312009/mo

= $936028/QTR

+8% = $74,882

⇒ $1,010,910.27 → $1M

Start date	02FEB98
Finish date	30AUG99
Data date	02FEB98

HDR Engineering

Early bar

Progress bar

Don Rerick - FCDX

From: Don Rerick - FCDX
Sent: Wednesday, February 11, 1998 8:53 AM
To: Don Rerick - FCDX
Subject: RE: SEVRDS Phase 2 - Proposed Construction Schedule

From FBF on 2/11/98 - Shewa reviewed and felt it was a very reasonable schedule for 15 months, not to fat and not to tight.

-----Original Message-----
From: Don Rerick - FCDX
Sent: Saturday, February 07, 1998 9:12 AM
To: Fred Fuller - FCDX
Cc: Don Rerick - FCDX
Subject: SEVRDS Phase 2 - Proposed Construction Schedule

Have you had a chance to review and comment on the proposed schedule as prepared by the ADOT consultant.

Need your comments by 2.13.

Thanks.

ENGINEER'S ESTIMATE

ENGINEER'S ESTIMATE OF CONSTRUCTION COST

Phase 2 Santan Channel Project

Contract: FCD 97-30 & ADOT Project: 600-7-502

ITEM NO	DESCRIPTION	UNIT	APPROX QTY	UNIT COST NUMBERS	EXTENDED NUMBERS
105-1	Partnering	LS	1	$ 10,000.00	$ 10,000.00
107-1	NPDES/SWPPP Permits	LS	1	$ 5,000.00	$ 5,000.00
107-2	Public Information and Notification Allowance	LS	1	$ 5,000.00	$ 5,000.00
107-3	Project Signs Allowance	LS	1	$ 5,000.00	$ 5,000.00
202-1	Mobilization	LS	1	$ 100,000.00	$ 100,000.00
211-1	Channel Fill Construction (SANTAN)	CM	11,567	$ 15.00	$ 173,505.00
215-1	Drainage Excavation (SANTAN)	CM	44,275	$ 4.50	$ 199,237.50
220-1	Plain Riprap - Gradation No. 1 (SANTAN)	CM	151	$ 92.00	$ 13,892.00
220-2	Plain Riprap - Gradation No. 2 (SANTAN)	CM	12	$ 84.00	$ 1,008.00
301-1	GRIC Access Road Compaction (SANTAN)	SM	5,568	$ 2.50	$ 13,920.00
310-1	Aggregate Base, Class 2 (O&M Road) (SANTAN)	CM	1,231	$ 24.00	$ 29,544.00
336-1	Remove and Replace Pavement (P-MIP)	LS	1	$ 16,000.00	$ 16,000.00
350-1	Remove Fencing (SANTAN)	LM	1,045	$ 3.90	$ 4,075.50
350-2	Removals and Replacements (P-MIP)	LS	1	$ 12,550.00	$ 12,550.00
350-3	Removal of Pipe (COC/SANTAN)	LM	279	$ 25.00	$ 6,975.00
350-4	Miscellaneous Removals	LS	1	$ 80,000.00	$ 80,000.00
401-1	56th Street Traffic Control	LS	1	$ 41,669.90	$ 41,669.90
401-2	I-10 Traffic Control	LS	1	$ 296,069.20	$ 296,069.20
401-3	56th Street Detour	LS	1	$ 43,912.00	$ 43,912.00
401-4	I-10 Detour	LS	1	$ 318,504.00	$ 318,504.00
420-1	Chain Link Fence ADOT Type I (1830mm) (SANTAN)	LM	3,762	$ 29.00	$ 109,098.00
505-1	Class "A" Concrete (SANTAN)	CM	278	$ 215.00	$ 59,770.00
505-2	RCBC 1 (2-3.048m x 2.134m, Type I) (SANTAN)	LM	15.9	$ 2,316.38	$ 36,830.44
505-3	RCBC 2 (2-3.048m x 2.438m, Type IV) (I-10 CROSSING) (SANTAN)	LM	145.7	$ 2,724.81	$ 397,004.82
505-4	RCBC 3 (2-3.048m x 2.438m, Type I) (SANTAN)	LM	797.1	$ 2,091.88	$ 1,667,437.55
505-5	RCBC 4 (2-3.048m x 2.438m) (Detail D 14) (AT RAILROAD) (SANTAN)	LM	10.6	$ 3,294.25	$ 34,919.05
505-6	RCBC 5 (2-3.048m x 2.438m, Type I) (SANTAN)	LM	4.8	$ 2,266.93	$ 10,881.26
505-7	RCBC 6 (3-3.048m x 1.219m, Type I) (SANTAN)	LM	11.2	$ 2,494.66	$ 27,940.19
505-8	RCBC 7 (1-3.048m x 2.438m, Type I) (SANTAN)	LM	3	$ 1,358.00	$ 4,074.00
505-9	Head Wall (610mm CMP) (Detail D13) (SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00
505-10	Head Wall w/Rip Rap (610mm) (Detail B5) (SANTAN)	Ea.	3	$ 3,000.00	$ 9,000.00
505-11	Head Wall w/Trashrack (610mm) (Detail B4) (SANTAN)	Ea.	2	$ 6,000.00	$ 12,000.00
505-12	Head Wall w/Trashrack (1370mm) (Detail B4) (SANTAN)	Ea.	1	$ 10,000.00	$ 10,000.00
505-13	Concrete Spillway (80mm) (w/wire mesh) (SANTAN)	LM	11	$ 30.00	$ 330.00
505-14	Gate Structure 101 (Detail B1) (SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00
505-15	Gate Structure 102,103 (Detail B2) (SANTAN)	Ea.	2	$ 1,525.00	$ 3,050.00
505-16	Gate Structure 104 (Detail B3) (SANTAN)	Ea.	1	$ 6,540.00	$ 6,540.00
505-17	Manhole 100,101,102 (SANTAN)	Ea.	3	$ 1,500.00	$ 4,500.00
505-18	Concrete Channel Lining (Detail D7 or D22) (SANTAN)	SM	34,729	$ 35.00	$ 1,215,515.00
505-19	RCBC 7 Permanent Plug (SANTAN)	Ea.	1	$ 30.00	$ 30.00
505-20	RCBC 6 Temporary Plug (SANTAN)	Ea.	1	$ 2,500.00	$ 2,500.00
520-1	Steel Handrail (SANTAN)	LM	107	$ 99.00	$ 10,593.00
602-1	Steel Casing (762mm) (COC/SANTAN)	LS	1	$ 30,400.00	$ 30,400.00
610-1	Gate Valves and Water Line (COC/SANTAN)	LS	1	$ 3,000.00	$ 3,000.00
615-1	Vitrified Clay Pipe (381mm) (15") (COC/SANTAN)	LM	481	$ 275.00	$ 132,275.00
615-2	Vitrified Clay Pipe (610mm) (24") (COC/SANTAN)	LM	71	$ 430.00	$ 30,530.00
615-3	Ductile Iron Pipe (406mm) (16") (COC/SANTAN)	LM	22	$ 425.00	$ 9,350.00
615-4	Connect to Exist Manhole (COC/SANTAN)	Ea.	1	$ 1,000.00	$ 1,000.00
615-5	Plug (MAG Detail 427) (COC/SANTAN)	Ea.	1	$ 500.00	$ 500.00
618-1	Reinforced Concrete Pipe (610 mm) (Class IV) (SANTAN)	LM	119	$ 150.00	$ 17,850.00
618-2	Reinforced Concrete Pipe (760 mm) (Class IV) (SANTAN)	LM	21	$ 220.00	$ 4,620.00
618-3	Reinforced Concrete Pipe (910 mm) (Class II) (SANTAN)	LM	20	$ 260.00	$ 5,200.00
618-4	Reinforced Concrete Pipe (910 mm) (Class III) (SANTAN)	LM	6	$ 280.00	$ 1,680.00

618-5	Reinforced Concrete Pipe (610 mm) (Class V) (SANTAN)	LM	502	$ 160.00	$ 80,320.00
618-6	Reinforced Concrete Pipe (1370 mm) (Class V) (SANTAN)	LM	231	$ 600.00	$ 138,600.00
618-7	Reinforced Concrete Pipe (1370mm) (P-MIP)	LM	908	$ 705.00	$ 640,069.50
618-8	Reinforced Concrete Pipe (2130mm) (P-MIP)	LM	915	$ 1,085.00	$ 992,449.50
618-9	Reinforced Concrete Pipe (1370mm) (INTERSTATE 10) (P-MIP)	LM	126.3	$ 1,395.00	$ 176,188.50
618-10	Reinforced Concrete Pipe (2130mm) (INTERSTATE 10) (P-MIP)	LM	126.3	$ 1,725.00	$ 217,867.50
618-11	PVC Pipe (76mm) (P-MIP)	LM	182	$ 15.00	$ 2,730.00
618-12	P-MIP Permanent Plug	Ea.	2	$ 800.00	$ 1,600.00
618-13	P-MIP Temporary Plug	Ea.	2	$ 500.00	$ 1,000.00
618-14	Siphon Clean-Out (Detail P5) (P-MIP)	Ea.	2	$ 1,200.00	$ 2,400.00
618-15	SRP Irrigation Facilities	LS	1	$ 276,968.00	$ 276,968.00
621-1	Pipe Corrugated Metal (610mm) (SANTAN)	LS	1	$ 2,206.00	$ 2,206.00
625-1	Irrigation Drop Manhole (Detail D20) (SANTAN)	Ea.	2	$ 5,500.00	$ 11,000.00
625-2	Pressure Manhole (MAG 521 Modified) (Detail P1) (P-MIP)	Ea.	7	$ 5,500.00	$ 38,500.00
625-3	Manhole,Sanitary Sewer (MAG 420) (COC/SANTAN)	Ea.	7	$ 5,000.00	$ 35,000.00
625-4	Reshape Manhole Floor (COC/SANTAN)	Ea.	1	$ 1,500.00	$ 1,500.00
	Project Total				$ 7,855,679.41

QUANTITIES

Santan Outfall Channel

Wood, Patel and Associates

Summary of Quantities

CHANNEL FILL CONSTRUCTION	**CM**	**11567**
Santan Drainage Channel (w/10% Compaction Ratio)		11567
GRIC ACCESS ROAD COMPACTION	**SM**	**5568**
Along I-10		5568
CHANNEL EXCAVATION	**CM**	**43450**
Santan Drainage Channel (Inroads)		38342
Santan Drainage Channel (Concrete Thickness)		5108
DRAINAGE EXCAVATION	**CM**	**825**
Rip-Rap		151
Gila Floodway		42
AB Roadway (in cut sections)		632
RIPRAP (DUMPED)	**CM**	**151**
Gila Floodway Outfall		151
AGGREGATE BASE, CLASS 2 (O&M ROAD)	**CM**	**1231**
I-10 west side of channel		574
56th St east (north side of channel)		417
56th St east (south side of channel)		240
CHAIN LINK FENCE, TYPE 1 (1.8m)	**LM**	**3762**
I-10 Section		1649
56th St to Gila Drain		2113
CONCRETE CHANNEL LINING (152MM) (W/STEEL)	**SM**	**34729**
RCBC 1 to Sta 0+860		16503
Sta 0+861 to RCBC 2		3977
RCBC 4 to RCBC 5		12622
Transition Sta 0+016.5+-		265
Transition Sta 1+042.181+-		321
Transition Sta 2+014.728+-		230
Transition Sta 2+802.108+-		306
Ramp Sta 0+071		128
Ramp Sta 0+860		138
Ramp Sta 2+065		121
Ramp Sta 2+786		121
610mm Headwall		-3

44,275

? vs 215

Santan Outfall Channel
Summary of Quantities

Wood, Patel and Associates

CONCRETE SPILLWAY (80MM) (W/WIRE MESH)	**LM**	**11**
Spillway from I-10		4
Spillway from I-10		7
RCBC PLUG (PERMANENT)	**EA**	**1**
2-10'x8'		1
RCBC PLUG (TEMPORARY)	**EA**	**1**
4-4'x10' RCBC		1
METAL HANDRAIL	**LM**	**107**
Station 0+000		19
Station 0+016.5		27
Station 1+062.261		21
Station 2+014.728		20
Station 2+802.108		20
PIPE CORRUGATED METAL, 610mm (STORM DRAIN)	**LM**	**2**
610 mm pipe station 0+485		2
CONCRETE PIPE COLLAR (C-13.80)	**EA**	**1**
610 mm pipe		1
FLAP GATE WATERTIGHT (610 mm)	**EA**	**1**
610 mm pipe outlet		1
REMOVE EXISTING FENCE (I-10 SECTION)	**LM**	**1045** ✓
Remove Fence		1045 ✓
HEADWALL @ STA 0+485	**EA**	**1**
Headwall		1
EXCESS EXCAVATION	**CM**	**48637**
RCBC1		212
RCBC2		2442
RCBC3		11627
RCBC4		
RCBC5		21
RCBC6		250

Santan Outfall Channel
Summary of Quantities

Wood, Patel and Associates

RCBC7		21
Misc. Drainage Excavation		825
Channel Excavation		43450
Channel Fill Construction		-11567
AB Roadway		1206
Rip-Rap		150

RCBC Summary

Structural Concrete	CM		$215.00	$1/cu/cy				
Reinforeing Steel	KG		$0.80	$0.36/#				
Structural Excavation	CM		$7.00	$5.34/cy				
Structural Backfill	CM		$18.00	$13.75/cy				
Drainage Excavation	CM		$4.50					
Culvert Item	***Unit***	***Quantity***	***Unit Price***	***Amount***				
RCBC 1 (2-10'x7')								
Structural Concrete	CM	117	$215.00	$25,155.00		Headwall, RCBC, Hdwl Ext.		
Reinforeing Steel	KG	9484	$0.80	$7,587.20				
Structural Excavation	CM	375	$7.00	$2,625.00				
Structural Backfill	CM	148	$18.00	$2,664.00				
Drainage Excavation	CM	42	$4.50	$189.00				
Length of RCBC	16.5							
Cost Per Linear Meter	***$2,316.38***							
RCBC 2 (2-10'x8')(Type 4)								
Structural Concrete	CM	1246	$215.00	$267,890.00		RCBC, Hdwl Ext.		
Reinforeing Steel	KG	82975	$0.80	$66,380.00				
Structural Excavation	CM	4050	$7.00	$28,350.00				
Structural Backfill	CM	1462	$18.00	$26,316.00				
Drainage Excavation	CM	0	$4.50	$0.00				
Length of RCBC	142.739							
Cost Per Linear Meter	***$2,724.81***							
RCBC 3 (2-10'x8')								
Structural Concrete	CM	4946	$215.00	$1,063,390.00		RCBC		
Reinforeing Steel	KG	432822	$0.80	$346,257.60				
Structural Excavation	CM	18924	$7.00	$132,468.00				
Structural Backfill	CM	6634	$18.00	$119,412.00				
Drainage Excavation	CM	0	$4.50	$0.00				
Length of RCBC	794.276							
Cost Per Linear Meter	***$2,091.88***							
RCBC 5 (2-10'x8')								
Structural Concrete	CM	33	$215.00	$7,095.00		RCBC, Hdwl Ext.		
Reinforeing Steel	KG	2855	$0.80	$2,284.00				
Structural Excavation	CM	114	$7.00	$798.00				
Structural Backfill	CM	39	$18.00	$702.00				
Drainage Excavation	CM	0	$4.50	$0.00				

RCBC Summary

Length of RCBC	4.799							
Cost Per Linear Meter	***$2,266.93***							
RCBC 6 (3-10'x4')								
Structural Concrete	CM	88	$215.00	$18,920.00		RCBC, Hdwl Ext.		
Reinforeing Steel	KG	7791	$0.80	$6,232.80				
Structural Excavation	CM	222	$7.00	$1,554.00				
Structural Backfill	CM	37	$18.00	$666.00				
Drainage Excavation	CM	0	$4.50	$0.00				
Length of RCBC	11.15							
Cost Per Linear Meter	***$2,454.96***							
RCBC 7 (1-10'x8')								
Structural Concrete	CM	13	$215.00	$2,795.00		RCBC, Hdwl Ext.		
Reinforeing Steel	KG	1000	$0.80	$800.00				
Structural Excavation	CM	35	$7.00	$245.00				
Structural Backfill	CM	13	$18.00	$234.00				
Drainage Excavation	CM	0	$4.50	$0.00				
Length of RCBC	3							
Cost Per Linear Meter	***$1,358.00***							
610 mm Headwall								
Structural Concrete	CM	2.2	$215.00	$473.00		RCBC, Hdwl Ext.		
Reinforeing Steel	KG	110	$0.80	$88.00				
Structural Excavation	CM	6	$7.00	$42.00				
Structural Backfill	CM	3	$18.00	$54.00				
Drainage Excavation	CM	0	$4.50	$0.00				
# of Headwalls	1							
Cost Per Headwall	***$657.00***							

Santan Outfall Channel

Channel Earthwork

Wood, Patel Associates

BASELINE STATION NUMBER	STATION CUT VOLUME	STATION FILL VOLUME
0+000	0	0
0+030	518	0
Begin Trap Channel		
0+036.5	360	132
0+090	377	383
0+120	335	420
0+150	301	425
0+180	267	452
0+210	272	475
0+240	308	484
0+270	334	529
0+300	339	574
0+330	346	588
0+360	344	616
0+390	377	601
0+420	395	585
0+450	377	594
0+480	370	574
0+510	371	553
0+540	388	530
0+570	465	432
0+600	684	209
0+630	734	148
0+660	640	224
0+690	656	194
0+720	691	163
0+750	742	128
0+780	796	85
0+810	834	55
0+840	880	39
0+870	914	33
0+900	981	19
0+930	1100	3
0+960	1215	0
0+990	1376	0
1+020	1565	0
1+042.181	1235	5
End Trap Channel	***21369***	***10252***
1+050	1671	7
1+080	1308	7

Santan Outfall Channel

Channel Earthwork

Wood, Patel Associates

BASELINE STATION NUMBER	STATION CUT VOLUME	STATION FILL VOLUME
1+110	1124	0
1+140	1672	0
1+170	1960	0
1+200	1645	0
1+230	1195	0
1+260	1031	0
1+290	1037	0
1+320	1013	0
1+350	1023	0
1+380	1019	0
1+410	1009	0
1+440	1000	0
1+470	995	0
1+500	994	0
1+530	978	0
1+560	970	0
1+590	964	0
1+620	948	0
1+650	940	0
1+680	931	0
1+710	919	0
1+740	906	0
1+770	895	0
1+800	897	0
1+830	879	0
1+860	839	0
1+890	821	0
1+920	821	0
1+950	813	0
1+980	717	0
2+010	694	0
Begin Trap Channel		
2+034.768	0	0
2+035	6	0
2+065	708	0
2+095	689	0
2+125	651	0
2+155	606	5
2+185	586	12
2+215	566	19
2+245	562	19

Santan Outfall Channel
Channel Earthwork

Wood, Patel Associates

BASELINE STATION NUMBER	STATION CUT VOLUME	STATION FILL VOLUME
2+275	566	15
2+305	559	23
2+335	548	35
2+365	548	37
2+395	550	34
2+425	558	31
2+455	573	20
2+485	597	10
2+515	663	3
2+545	728	0
2+575	776	0
2+605	802	0
2+635	793	0
2+665	777	0
2+695	773	0
2+725	769	0
2+755	765	0
2+785	783	0
2+802.422	471	0
End Trap Channel	***16973***	***263***
2+815	810	0
2+830	210	0

10252
263
10515 x 1.1 = 11567 CM
CHAN. FILL

21369
16973
38342 CM
CHAN. EX.

Measurements per ADOT Std. Det. B-19.50

RCBC #	Beginning Station (m)	Ending Station (m)	Beginning Station (ft)	Ending Station (ft)	Span (ft)	Height (ft)	RCBC Fill Table No.	Wall Thickness (in)	Top Slab Thickness (in)	Bot. Slab Thickness (in)	# of Barrels	Conc. Quantity (C.Y./L.F.	Steel Quantity (Lbs./L.F.)	Depth of cover at begin station (ft)	Depth of cover at end station (ft)	Outside Box Width (ft)	Outside Box Height (ft)	Length (ft)	Dim A (ft)	Dim C (ft)	0.75*C (Side Slope)	Conc. Quantity (C.Y.)	Conc. Quantity (C.M.)	Steel Quantity (Lbs.)	Steel Quantity (Kg)	Structural Ex. Quantity	Structural Ex. Quantity (C.M.)	Structural Backfill Quantity	Structural Backfill Quantity (C.M.)	Excess RCBC Excavation	Excess RCBC Excavation
1	0+000.000	0+016.500	00+00	00+54	10.0	7.0	1	11.0	10.5	12.5	2	2.372	355.9	2	0	22.75	8.92	52.1	24.42	8.92	6.69	124	94	18542	8411	424	324	142	109	267	204
2	1+062.261	1+205.000	34+85	39+53	10.0	8.0	4	11.0	17.0	19.0	2	3.400	381.3	15.1	15.1	22.75	11.00	477.9	24.42	11.00	8.25	1625	1242	182223	82655	5298	4050	1912	1462	3194	2442
3	1+205.000	1+999.276	39+53	65+59	10.0	8.0	1	11.0	10.5	12.5	2	2.474	364.9	9.2	4	22.75	9.92	2615.0	24.42	9.92	7.44	6470	4946	954214	432822	24752	18924	8677	6634	15207	11627
5	2+009.876	2+014.675	65+94	66+10	10.0	8.0	1	13.0	10.0	12.0	2	2.474	364.9	5	5.5	23.25	9.83	15.8	24.92	9.83	7.38	39	30	5765	2615	150	114	52	39	93	71
6	2+822.742	2+833.892	92+61	92+98	10.0	4.0	1	11.0	10.5	12.5	3	2.987	446.4	4	0	33.67	5.92	36.5	35.33	5.92	4.44	109	83	16294	7391	291	222	48	37	238	182
7	0+000.000	0+003.000	00+00	00+10	10.0	8.0	1	13.0	10.0	12.0	1	1.423	188.1	5	5.5	12.17	9.83	9.8	13.83	9.83	7.38	14	11	1851	840	52	40	32	25	16	13
																							6473		540492		23921		8394		14688

only Partial excavation + BACKFILL Payment

Backfill Sideslopes= 0.75:1 per AGRA Soils Report

Dim A = "Box bottom width + wall thicknesses + 8" (RCBC bottom ears) + 12" (6" ex line on each side of RCBC)
Dim B= " Not used yet
Dim C= "Distance from top outside to bottom outside of RCBC)
Bottom Slab Thickness = Top Slab Thickness = 2" (Except single RCBC)

WOOD/PATEL

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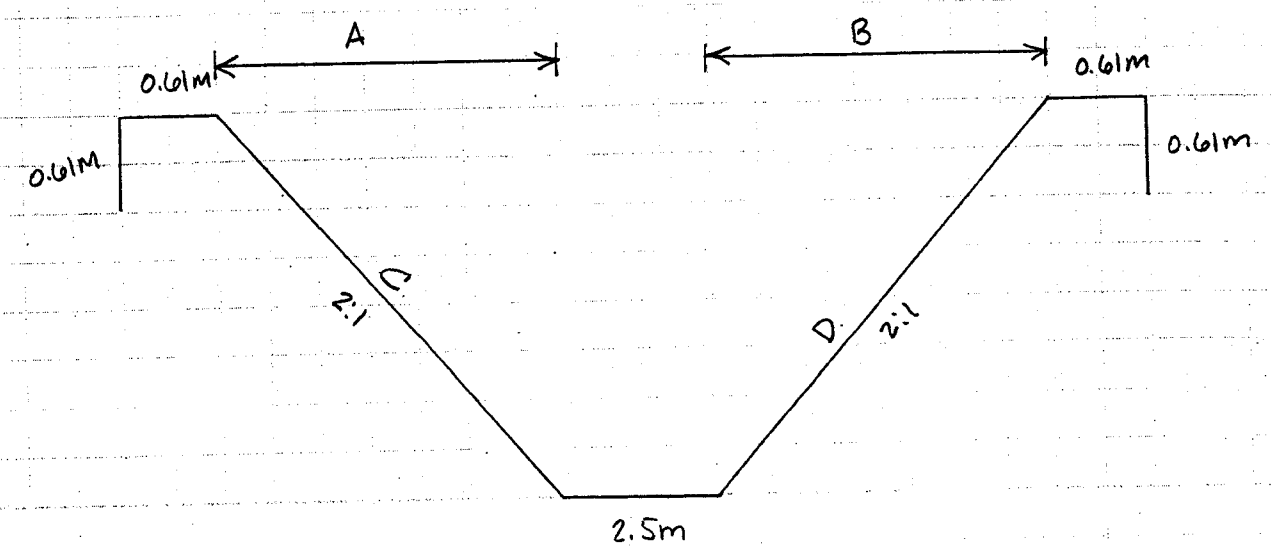
PROJECT Santan Outfall channel

PROJECT NO. 96543 SHEET NO. 1 OF

CALCULATED BY FLS DATE 11-14-97 CHECKED BY DATE

Concrete Channel Lining Quantities



Sta 0+036.5 to 0+860

length = 823.5m

A = 6.7M

B = 6.8M

C = 7.5m

D = 7.6m

AREA / LM = (4)(0.61) + 2.5 + 7.5 + 7.6 = 20.04m

AREA = (20.04m)(823.5m) = 16503 m^2

Sta 0+860 to 1+042.181

length = 182.181m

A = 6.7 to 8.3 AVG = 7.5

B = 6.8 to 8.4 AVG = 7.6

C = 8.39m

D = 8.50m

AREA / LM = (4)(0.61) + (2.5) + 8.39 + 8.50 = 21.83m

AREA = (21.83)(182.181) = 3977 m^2

WOOD/PATEL

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PROJECT Santan outfall channel

PROJECT No. 96543 SHEET No. 2 OF

CALCULATED BY FKS DATE 11-14-97 CHECKED BY DATE

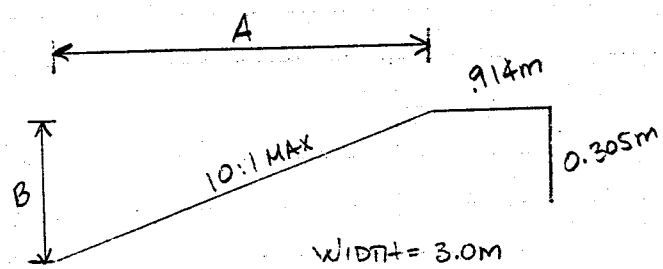
Concrete channel lining Quantities

Sta 2+034.822 to 2+802.108

length = 767.286 M
A = 5.1m
B = 5.2m
C = 5.7M
D = 5.81m

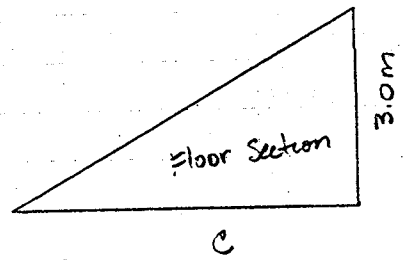
AREA/LIN = (4)(0.61) + 2.5 + 5.7 + 5.81 = 16.45 m

AREA = (16.45)(767.286) = 12622 m²



Ramp @ Sta 0+071
C = 11M
A = 35m
B = 3.4m
Ramp = 35.2m

AREA = (3)(35.2) + $\frac{(3)(11)}{2}$ = 123 m² + 4m² = 127m²



Ramp @ Sta 0+860

A = 35m
B = 3.4m
C = 18m
Ramp = 35.2m

AREA = (3)(35.2) + $\frac{(3)(18)}{2}$ = 133m² + 4m² = 137m²

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PROJECT Santan Outfall Channel

PROJECT NO. 96543 SHEET NO. 3 OF

CALCULATED BY FKS DATE 11-14-97 CHECKED BY DATE

Conc Channel Lining Quantities

Ramp @ Sta 2+065

A= 30m
B= 2.6m
C= 17m
Ramp= 30.1 m

AREA = (3)(30.1) + $\frac{(3)(17)}{2}$ = 116 m² + 4m² = 120m²

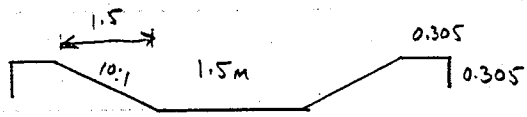
Ramp @ Sta 2+786

A= 30m
B= 2.6m
C= 17m
Ramp = 30.1m

AREA = (3)(30.1) + $\frac{(3)(17)}{2}$ = 116m² + 4m² = 120m²

Conc. Spillways (2)

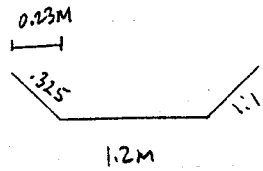
WIDTH = 4.7 m



AREA = ((4)(0.305) + (3)(1.5)) * 4.7 = 26.9m³ EA

Omit

ADOT overside Drains (Conc.)



Thickness = 80MM

AREA/LM = 1.2 + (2)(0.23m) = 1.7m²/m
Volume Conc /LM = (1.7m²)(0.08m) = 0.15m³/LM

LENGTH 1 = 4.1m − 0.61 = 3.5m Long

LENGTH 2 = 8.0m − 0.61 = 7.4m Long

$/LM = $200 * 0.15 = $30/LM

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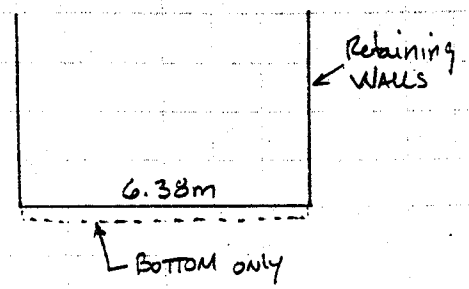
PROJECT Santan Outfall channel

PROJECT NO. 96543 SHEET NO. 4 OF

CALCULATED BY FKS DATE 11-15-97 CHECKED BY DATE

Conc. Channel Channel Lining

@ AC/DC TRANSITION Sta 0+016.5 to 0+036.5

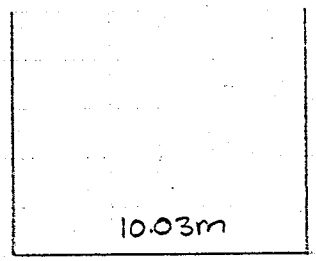


AREA @ sta 0+036.5 per previous Calc's = 20.04 m²/Lm
AREA @ sta 0+016.5 = 6.38m²/Lm

AVG AREA = 13.21 m²/Lm
LENGTH = 20.0m

AREA = (13.21)(20) = 265 m²

@ AC/DC TRANSITION sta 1+042.181 to 1+062.261

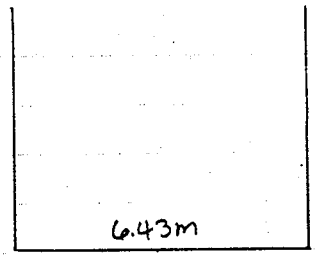


AREA @ sta 1+042.181 per previous Calcs = 21.83 m²/Lm
AREA @ sta 1+062.261 = 10.03 m²/Lm

AVG AREA = 15.93 m²/Lm
LENGTH = 20.1 m

AREA = (20.1)(15.93) = 321 m²

@ AC/DC TRANSITION Sta 2+014.728 to 2+034.822



AREA @ sta 2+034.822 per previous Calc's = 16.45 m²/Lm
AREA @ Sta 2+014.728 = 6.43 m²/Lm

AVG AREA = 11.44 m²/Lm
LENGTH = 20.1 Lm

AREA = (20.1)(11.44) = 230 m²

WOOD/PATEL

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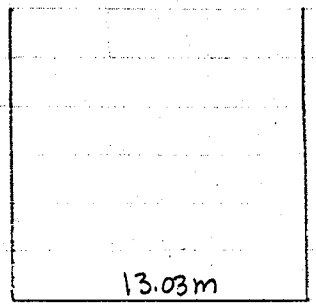
PROJECT Santan Outfall channel

PROJECT NO. 96543 SHEET NO. 5 OF

CALCULATED BY FKS DATE 11-15-97 CHECKED BY DATE

Conc. Channel Lining Quantities

@ AC/DC TRANSITION Sta 2+802.108 to 2+822.789



AREA @ Sta 2+802.108 per previous Calc's = 16.45 m²/Lm

AREA @ Sta 2+822.789 = 13.03 m²/Lm

AVG AREA = 14.74 m²/Lm

LENGTH = 20.7 m

AREA = (20.7)(14.74) = 306 m²

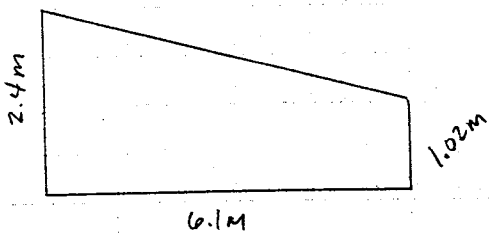
610 mm CMP HEADWALL (Subtraction)

HEIGHT = 2.5 m @ 2:1

length = 1.118m

AREA = (2.5)(1.118) = 3m² (Subtraction)

Gila Floodway outlet wings (RCBC 1)

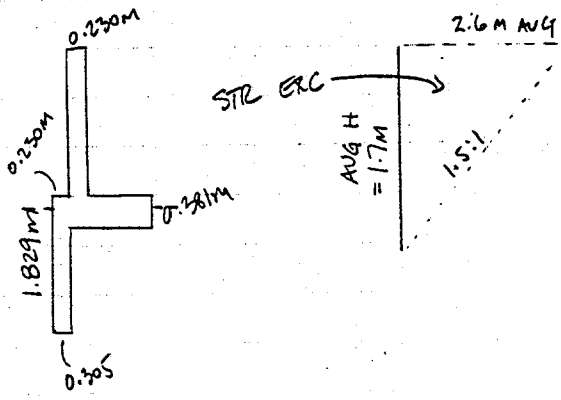


Conc = 20 cm

steel = 833 kg

structural ex = 14 cm + 37 cm = 51cm

What about other locations?



WOOD/PATEL

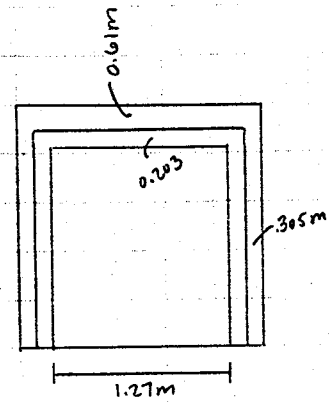
CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

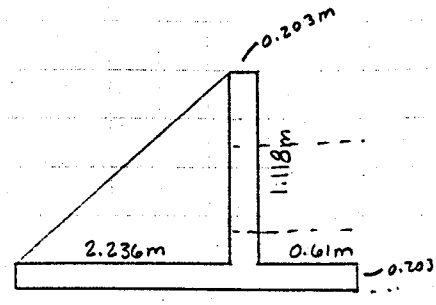
PROJECT Santan outfall channel

PROJECT NO. 96543 SHEET NO. 6 OF

CALCULATED BY EKS DATE 11-16-97 CHECKED BY DATE

HEADWALL w/ GATE @ sta 0+485





BOTTOM: $[1.27+(2)(0.305)+(2)(0.203) * 2.236+0.203+0.61] * 0.203\,m$

$= 1.4\ m^3$

BACK: $(1.27+(2)(0.203) * 1.118 * 0.203) - \left[\pi \frac{(0.61)^2}{4}\right] * 0.203 = 0.32\ m^3$

Sides: $\left(\frac{1.118}{2} * 2.236 * 0.203\right) * 2$

$= 0.51\ m^3$

Excavation = $7m^3$

Conc = $2.2\ m^3$

steel = 50#/cy = 110 kg

Volume of Conc in channel (Added to Excavation + Excess dirt)

AREA = $34{,}725\ m^2$ − TRANSITIONS ($1122\ m^2$) = $33{,}603\ m^2$

Volume = $(33{,}603\ m^2)(0.152m) = 5108\ m^3$ ✓

6"

PROJECT Santan Outfall Channel

PROJECT NO. 96543 SHEET NO. 7 OF

CALCULATED BY FKS DATE 11-16-97 CHECKED BY DATE

Extended HEADWALL Quantities

Sta 0+016.5

W = 6.94m

T = 0.254m Volume = 3m³

H = 1.566m

Sta 1+062.261 (2-10'x8')

W = 6.94m

T = 0.254m Volume = 4m³

H = 2.152m

Sta 1+062.261 (1-10'x8')

W = 3.6m

T = 0.254 Volume = 2m²

H = 2.152

Sta 2+014.728

W = 6.94m

T = 0.254m Volume = 3m²

H = 1.382m

Sta 2+822.789

W = 10.3m

T = 0.254m Volume = 5m²

H = 1.791m

Steel = 810 kg

GRIC Access Road

LENGTH = 1113.6m

WIDTH = 5m

AREA = (5)(1113.6) = 5568 LM

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Santan Outfall channel

PROJECT NO. 96543 SHEET NO. 8 OF

CALCULATED BY FKS DATE 11-6-97 CHECKED BY DATE

AB for MAINT Roads

Sta 0+016.5 to sta 1+062.261

LENGTH = 1046m

WIDTH = 4.39m

T = 0.125m

Volume = 574 m^3

Sta 1+~~976~~ 2+000.207 to 2+833.938

LENGTH = 857.7 Lm

WIDTH = 3.89 m

T = 0.125

Volume = 417 m^3

Sta 2+009.261 to 2+530

LENGTH = 520.7

WIDTH = 3.14m

T = 0.125 m

Volume = 205 m^3

Volume @ HDWL Sta 2+014± = 13.5 * 5.7 x 0.125 = 10 m^3

Handrail

Sta 0+000

wings = (2)(6.096) = 12.2 m

HDWL = 6.9 m

Sta 0+016.5

2 walls = 4.92 + 21.7 = 26.6m

Sta 1+062.261

1 wall = 20.6m

Sta 2+014.728

1 wall = 20.3 m

Sta 2+802.108

1 wall = 20 m

length = 106.6 Lm

SANTAN OUTFALL CHANNEL

STRUCTURAL CALCULATIONS

FEBRUARY 1998

File Detail D4 | Job 00173-097-044 | No.

Computation

HDR

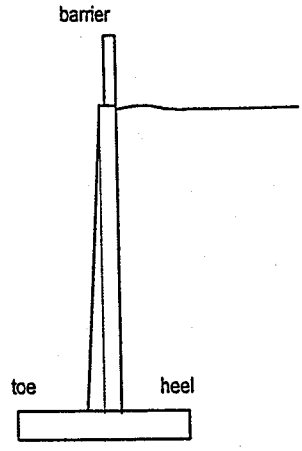
Project Santan Outfall Channel | Compute BKV | Date 2/23/98

Subject Headwall - Detail D4 | Checked | Date

Task Retaining Wall Design | Sheet 1 | Of 6

GEOMETERY:

Wall Height	2 052 mm
Wall Thickness (top)	254 mm
Wall Thickness (bottom)	254 mm
Wall Cover	50 mm
d	204 mm
Toe Length	0 mm
Toe Thickness	254 mm
Toe Cover	75 mm
Soil Height on toe	0 mm
Heel Length	1 000 mm
Heel Thickness	254 mm
Heel Cover	50 mm
Total Footing Length	1 254 mm
Total Wall Height	2 306 mm
Barrier Width	25 mm
Barrier Height	1 000 mm



LOADING:

Surcharge	12.360	kN
Eq. soil height	600.000	mm
Barrier Weight	1.000	kN
Barrier Impact Load	1334	kN/m at top of wall
Barrier Impact Load Adjusted for Wall Height	3.244	kN/m at base of wall

MATERIAL PROPERTIES:

f_y		400.000	MPa
E_s		2.00E+08	kPa
f'_c		20.000	MPa
Unit weight of concrete		24.000	kN/m^3
E_c	w_c^1.5 $0.0428\sqrt{f'_c}$ =	2.25E+07	kPa
f_c		10	MPa
f_s		165	MPa
n		8.885	
Unit weight of soil		20.600	kN/m^3
Allowable soil bearing pressure		120.000	kPa
Horizontial earthquake acceleration (kh)		0.040	g
Vertical earthquake acceleration (kv)		0.027	g
f		23.20	°
b		90.00	°
a		0.00	°
g		35.00	°
Coefficient of Sliding Friction (μ)		0.50	

$$Ka = \frac{\sin^2(b+f)}{(\sin^2(b)\cdot\sin(b-g))\left[1+\left(\frac{\sin(f+g)\cdot\sin(f-a)}{\sin(b-g)\cdot\sin(a+b)}\right)^{1/2}\right]^2} = 0.384$$

Kae = Ka + 3/4 kh = 0.414

Equivalent Fluid Pressure 7.906 kPa per meter

File Detail D4 | Job No. | No.

Computation

HDR

Project Santan Outfall Channel | Computed BKV | Date 2/23/98

Subject Headwall - Detail D4 | Checked | Date

Task Overturning and Shear - Case 1 | Sheet 2 | Of 6

OVERTURNING:

Overturning Moment: (Mo) per meter of wall:

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Moment (kN•m)
Soil	21.020	0.769	16.157	1.69	35.523	27.305
Surcharge	10.938	1.153	12.612	2.17	23.747	27.380
Barrier Impact	3.244	3.306	10.724	2.17	7.042	23.281
Total	35.202	Mo =	39.493		66.312	77.967

Righting Moment: (Mr) per meter of wall

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Force (kN•m)
Footing	7.644	0.627	4.793	1.69	12.919	8.100
Wall Taper	0.000	0.000	0.000	1.69	0.000	0.000
Wall	12.509	0.127	1.589	1.69	21.140	2.685
Barrier	1.000	0.242	0.242	1.69	1.690	0.408
Surcharge	12.360	0.754	9.319	2.17	26.834	20.233
Soil	42.271	0.754	31.872	1.69	71.438	53.864
Total Rv =	75.785	Mr =	47.815		134.021	85.290

Factor of Safety against Overturning: Mr / Mo 1.21 < 2.0 NO GOOD

SLIDING:

Forces Causing Sliding: (Vs)

Cause	Force (kN)
Soil	21.020
Surcharge	10.938
Total per meter of wall	31.958

Forces Resisting Sliding: (Vr)

Cause	Force (kN)
Footing	7.644
Wall Taper	0.000
Wall	12.509
Surcharge	12.360
Soil	42.271
Total per meter of wall	74.785

Factor of Safety against Sliding: μ Vr / Vs = 1.17 < 1.5 KEY REQUIRED

File Detail D4

Job No.

No.

Computation

HDR

Project Santan Outfall Channel

Subject Headwall - Detail D4

Task Soil Pressures

Compute BKV

Checked

Sheet 3

Date 2/23/98

Date

of 6

FOOTING SOIL PRESSURES:

Resultant Vertical Force (Rv) 76 kN

Location of Resultant Force from the toe of the footing (Mr - Mo) / Rv = 110 mm NO GOOD - Outside middle 1/3

Soil Pressure = -Rv / A ± Mc / I

Area for 1 meter strip, A = 1.254 m²

I = 1/12 bh^3 = 0.16 m^4

c = Footing width / 2 = 0.627 m

e = c - x = 0.517 m

M = Rv * (Footing width / 2 - x) = 39.194 kN•m

-Rv / A = -60.434 kPa

M c / I = 149.548 kPa

Toe Pressure -Rv / A - Mc / I = -210 kPa

Heel Pressure -Rv / A + Mc / I = 89 kPa

File Detail D4 | Job No. | No.

Computation

HDR

Project Santan Outfall Channel | Compute BKV | Date 2/23/98

Subject Headwall - Detail D4 | Checked | Date

Task Stem Design, ASD | Sheet 4 | Of 6

LATERIAL FORCES:

Cause		*Force (kN)*		*Factor*		*Moment (kN)*		*Lever Arm (m)*		*Moment (kN•m)*
Static	Soil	16.644	x	1.000	=	16.644	x	0.684	=	11.385
	Surcharge	9.733	x	1.000	=	9.733	x	1.026	=	9.986
	Impact on Rail	3.244	x	1.000	=	3.244	x	3.052	=	9.900
	Total	29.621				29.621				31.271
Sesmic	Soil	17.467	x	1.000	=	17.467	x	1.026	=	17.921
	Soil Interia	1.691	x	1.000	=	1.691	x	1.026	=	1.735
	Barrier Interia	0.040	x	1.000	=	0.040	x	3.052	=	0.122
	Wall Interia	0.500	x	1.000	=	0.500	x	1.026	=	0.513
	Wall Taper Interia	0.000	x	1.000	=	0.000	x	0.684	=	0.000
	Total	17.467				17.467				20.291
	Reduced (3/4)	13.100				13.100				15.218

Design Shaer and Moment 29.621 kN 31.271 kN•m

CHECK SHEAR AT BASE OF STEM:

d Stem Width - cover - 1/2 Bar diameter = 193 mm

Vc 0.079 √f'c bd = 72.073 kN > 29.621 kN OK

DESIGN STEM FOR MOMENT:

k = fc/(fc+(fs/n)	0.350	
j = 1 - k/3	0.883	
d	193	mm
b	1000	mm
bd²	3.721E+07	m^3
As = M / fs j d	1112	mm²
Bar size	7	
Bar Spacing	300	mm
Bar diameter	22	mm
Bar Area	388	mm²
As provided	1292	mm²
p = As / bd	0.0067	
pn	0.0595	
k = (2pn + (pn)²)^½ - pn	0.291	
j = 1 - k/3	0.903	
fc = 2M / bd² k j	6.404	kPa < 10.000 OK
fs = M / As j d	138.889	kPa < 165.000 OK

Temp & Shrinkage steel:

As required (265 mm² per m²) 265 mm² per m² = 265 mm²

Inside Face

Bar size	4	
Bar Spacing (450 mm or 3 t m	300 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	422 mm²	

Outside Face

Bar size	4	
Bar Spacing (450 mm or 3 t max)	300 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	422 mm²	

File Detail D4 | Job No. | No.

Computation

HDR

Project Santan Outfall Channel | Computed BKV | Date 2/23/98

Subject Headwall - Detail D4 | Checked | Date

Task Heel Design, ASD | Sheet 5 | of 6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN•m)
Static	Soil	42.271	x	1.000	=	42.271	x	0.500	=	21.136
	Surcharge	12.360	x	1.000	=	12.360	x	0.500	=	6.180
	Concrete	6.096	x	1.000	=	6.096	x	0.500	=	3.048
Design Shear and Moment						60.727				30.364

Shear Check:

d - Footing Depth - cover - 1/2 Bar diameter = 193 mm

Vc 0.079 √f'c bd = 68.147 kN > 60.727 kN OK

Moment:

k = fc/(fc+(fs/n)	0.350		
j = 1 - k/3	0.883		
d	0.193 m		
bd² (b = 1m)	0.037 m^3		
As = M / fs j d	1080 mm²/m		
Bar size	7		
Bar Spacing	300 mm		
Bar diameter	22 mm		
Bar Area	388 mm²		
As provided	1292 mm²/m		OK
ld provided	254 mm >	940 mm	NO GOOD
p = As / bd	0.0067		
pn	0.0595		
k = (2pn + (pn)²)^.5 - pn	0.291		
j = 1 - k/3	0.903		
fc = 2M / bd² k j	6.219 kPa <	10.000	OK
fs = M / As j d	134.859 kPa <	165.000	OK

Temp & Shrinkage steel:

As required 265 mm² per m² = 265 mm²

Top Face

Bar size	4	
Bar Spacing (450 mm or 3 t max)	450 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	

Bottom Face

Bar size	4	
Bar Spacing (450 mm or 3 t max)	450 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	
As Total	562 mm²	OK

File	Detail D4	Job No.		No.	

Computation

HDR

Project	Santan Outfall Channel	Computed	BKV	Date	2/23/98
Subject	Headwall - Detail D4	Checked		Date	
Task	Toe Design, ASD	Sheet	6	Of	6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN·m)
Static	Soil Pressure (retangular area)	0.000	x	1.000	=	0.000	x	0.000	=	0.000
	Soil Pressure (triangular area)	0.000	x	1.000	=	0.000	x	0.000	=	0.000
	Concrete	0.000	x	0.000	=	0.000	x	0.000	=	0.000
Design Shear and Moment						0.000				0.000

Shear Check:

d	Footing Depth - cover - 1/2 Bar diameter =	196	mm		
Vc	0.079 √fc bd =	69.269	kN >	0.000 kN	OK

Moment:

k = fc/(fc+(fs/n)	0.350			
j = 1 - k/3	0.883			
d	0.196	m		
bd² (b = 1m)	0.038	m^3		
As = M / fs j d	0	mm²/m		
Bar size	5			
Bar Spacing	300	mm		
Bar diameter	16	mm		
Bar Area	198	mm²		
As provided	660	mm²/m		OK
ld provided	0	mm >	533 mm	NO GOOD
p = As / bd	0.0034			
pn	0.0299			
k = (2pn + (pn)²)^.5 - pn	0.217			
j = 1 - k/3	0.928			
fc = 2M / bd² k j	0.000	kPa <	10.000	OK
fs = M / As j d	0.000	kPa <	165.000	OK

Temp & Shrinkage steel:

As required	265 mm² per m² =	265	mm²	
Top Face				
Bar size		4		
Bar Spacing (450 mm or 3 t max)		450	mm	OK
Bar diameter		13	mm	
Bar Area		126	mm²	
As provided		281	mm²	
Bottom Face				
Bar size		4		
Bar Spacing (450 mm or 3 t max)		450	mm	OK
Bar diameter		13	mm	
Bar Area		126	mm²	
As provided		281	mm²	
As Total		562	mm²	OK

File	Channel Transition Wall, 4700mm, Detail D9	Job No.	00173-159-044	No.	

Computation

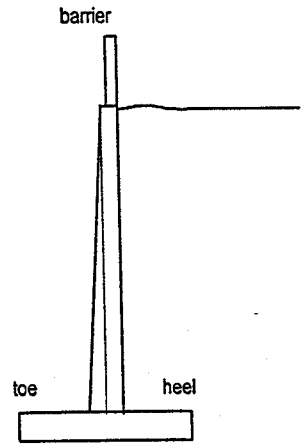
HDR

Project	Santan Outfall Channel	Compute	BKV
Subject	Channel Transition - Detail D19	Checked	
Task	Retaining Wall Design	Sheet	1

Date	2/23/98		
Date			
of	6		

GEOMETERY:

Wall Height	4 700 mm
Wall Thickness (top)	350 mm
Wall Thickness (bottom)	350 mm
Wall Cover	50 mm
d	300 mm
Toe Length	1 000 mm
Toe Thickness	650 mm
Toe Cover	75 mm
Soil Height on toe	0 mm
Heel Length	1 650 mm
Heel Thickness	650 mm
Heel Cover	50 mm
Total Footing Length	3 000 mm
Total Wall Height	5 350 mm
Barrier Width	25 mm
Barrier Height	1 000 mm



LOADING:

Surcharge	12.360	kN
Eq. soil height	600.000	mm
Barrier Weight	1.000	kN
Barrier Impact Load	1334	kN/m at top of wall
Barrier Impact Load Adjusted for Wall Height	1.418	kN/m at base of wall

MATERIAL PROPERTIES:

f_y		400.000	MPa
E_s		2.00E+08	kPa
f'_c		20.000	MPa
Unit weight of concrete		24.000	kN/m^3
E_c	w_c^1.5 $0.0428\sqrt{f'_c}$ =	2.25E+07	kPa
f_c		10	MPa
f_s		165	MPa
n		8.885	
Unit weight of soil		20.600	kN/m^3
Allowable soil bearing pressure		120.000	kPa
Horizontial earthquake acceleration (kh)		0.040	g
Vertical earthquake acceleration (kv)		0.027	g
f		33.20	°
b		90.00	°
a		0.00	°
g		35.00	°
Coefficient of Sliding Friction (μ)		0.50	

$$K_a = \frac{\sin^2(b+f)}{(\sin^2(b)\cdot\sin(b-g))\left[1+\left(\frac{\sin(f+g)\cdot\sin(f-a)}{\sin(b-g)\cdot\sin(a+b)}\right)^{1/2}\right]^2} = 0.267$$

$$K_{ae} = K_a + 3/4\ k_h = 0.297$$

Equilvalent Fluid Pressure 5.509 kPa per meter

File Channel Transition Wall, 4700mm, Detail D9 | Job No. 00173-159-044 | No.

Computation

HDR

Project Santan Outfall Channel | Computed BKV | Date 2/23/98

Subject Channel Transition - Detail D19 | Checked | Date

Task Overturning and Shear - Case 1 | Sheet 2 | Of 6

OVERTURNING:

Overturning Moment: (Mo) per meter of wall:

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Moment (kN•m)
Soil	78.839	1.783	140.597	1.69	133.238	237.609
Surcharge	17.684	2.675	47.304	2.17	38.391	102.696
Barrier Impact	1.418	6.350	9.005	2.17	3.079	19.550
Total	97.941	Mo =	196.906		174.708	359.855

Righting Moment: (Mr) per meter of wall

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Force (kN•m)
Footing	46.800	1.500	70.200	1.69	79.092	118.638
Wall Taper	0.000	1.000	0.000	1.69	0.000	0.000
Wall	39.480	1.175	46.389	1.69	66.721	78.397
Barrier	1.000	1.338	1.338	1.69	1.690	2.260
Surcharge	20.394	2.175	44.357	2.17	44.275	96.299
Soil	159.753	2.175	347.463	1.69	269.983	587.212
Total	Rv = 267.427	Mr =	509.746		461.761	882.807

Factor of Safety against Overturning: Mr / Mo 2.59 > 2.0 OK

SLIDING:

Forces Causing Sliding: (Vs)

Cause	Force (kN)
Soil	78.839
Surcharge	17.684
Total per meter of wall	96.523

Forces Resisting Sliding: (Vr)

Cause	Force (kN)
Footing	46.800
Wall Taper	0.000
Wall	39.480
Surcharge	20.394
Soil	159.753
Total per meter of wall	266.427

Factor of Safety against Sliding: μ Vr / Vs = 1.38 < 1.5 KEY REQUIRED

Computation

HDR

Project	Santan Outfall Channel	Compute BKV	Date 2/23/98
Subject	Channel Transition - Detail D19	Checked	Date
Task	Soil Pressures	Sheet 3	Of 6

FOOTING SOIL PRESSURES:

Resultant Vertical Force (Rv) 267 kN

Location of Resultant Force from the toe of the footing (Mr - Mo) / Rv = 1 170 mm OK - Inside middle 1/3

Soil Pressure = -Rv / A ± Mc / I

Area for 1 meter strip, A =	3.000 m²
I = 1/12 bh^3 =	2.25 m^4
c = Footing width / 2 =	1.500 m
e = c - x =	0.330 m
M = Rv * (Footing width / 2 - x) =	88.300 kN•m
-Rv / A =	-89.142 kPa
M c / I =	58.867 kPa

Toe Pressure	-Rv / A - Mc / I =	-148 kPa
Heel Pressure	-Rv / A + Mc / I =	-30 kPa

Computation

HDR

Project	Santan Outfall Channel	Compute BKV	Date 2/23/98
Subject	Channel Transition - Detail D19	Checked	Date
Task	Stem Design, ASD	Sheet 4	Of 6

LATERIAL FORCES:

Cause		Force (kN)		Factor		Moment (kN)		Lever Arm (m)		Moment (kN·m)
Static	Soil	60.846	x	1.000	=	60.846	x	1.567	=	95.325
	Surcharge	15.535	x	1.000	=	15.535	x	2.350	=	36.508
	Impact on Rail	1.418	x	1.000	=	1.418	x	5.700	=	8.083
	Total	77.799				77.799				139.916
Sesmic	Soil	65.867	x	1.000	=	65.867	x	2.350	=	154.788
	Soil Interia	6.390	x	1.000	=	6.390	x	2.350	=	15.017
	Barrier Interia	0.040	x	1.000	=	0.040	x	5.700	=	0.228
	Wall Interia	1.579	x	1.000	=	1.579	x	2.350	=	3.711
	Wall Taper Interia	0.000	x	1.000	=	0.000	x	1.567	=	0.000
	Total	65.867				65.867				173.744
	Reduced (3/4)	49.400				49.400				130.308

Design Shaer and Moment 77.799 kN 139.916 kN·m

CHECK SHEAR AT BASE OF STEM:

d — Stem Width - cover - 1/2 Bar diameter = 286 mm

Vc — 0.079 √f'c bd = 105.990 kN > 77.799 kN OK

DESIGN STEM FOR MOMENT:

k = fc/(fc+(fs/n)	0.350	
j = 1 - k/3	0.883	
d	286	mm
b	1000	mm
bd²	8.161E+07	m^3
As = M / fs j d	3360	mm²
Bar size	9	
Bar Spacing	150	mm
Bar diameter	29	mm
Bar Area	645	mm²
As provided	4301	mm²
p = As / bd	0.0151	
pn	0.1338	
k = (2pn + (pn)²)^½ - pn	0.400	
j = 1 - k/3	0.867	
fc = 2M / bd² k j	9.881 kPa < 10.000	OK
fs = M / As j d	131.416 kPa < 165.000	OK

Temp & Shrinkage steel:

As required (265 mm² per m²) — 265 mm² per m² = 265 mm²

Inside Face				Outside Face			
Bar size	4			Bar size	4		
Bar Spacing (450 mm or 3 t m	450	mm	OK	Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm		Bar diameter	13	mm	
Bar Area	126	mm²		Bar Area	126	mm²	
As provided	281	mm²		As provided	281	mm²	

File	Channel Transition Wall, 4700mm, Detail D9	Job No.	00173-159-044	No.	

Computation

HDR

Project	Santan Outfall Channel	Computed	BKV	Date	2/23/98
Subject	Channel Transition - Detail D19	Checked		Date	
Task	Heel Design, ASD	Sheet	5	Of	6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN·m)
Static	Soil	159.753	x	1.000	=	159.753	x	0.825	=	131.796
	Surcharge	20.394	x	1.000	=	20.394	x	0.825	=	16.825
	Concrete	25.740	x	1.000	=	25.740	x	0.825	=	21.236
Design Shear and Moment						205.887				169.857

Shear Check:

d — Footing Depth - cover - 1/2 Bar diameter = 587 mm

Vc — $0.079\sqrt{f'c}\,bd$ = 207.492 kN > 205.887 kN OK

Moment:

k = fc/(fc+(fs/n)	0.350		
j = 1 - k/3	0.883		
d	0.587 m		
bd² (b = 1m)	0.345 m^3		
As = M / fs j d	1984 mm²/m		
Bar size	8		
Bar Spacing	250 mm		
Bar diameter	25 mm		
Bar Area	506 mm²		
As provided	2026 mm²/m		OK
ld provided	1350 mm >	1219 mm	OK
p = As / bd	0.0034		
pn	0.0306		
k = (2pn + (pn)²)^.5 - pn	0.219		
j = 1 - k/3	0.927		
fc = 2M / bd² k j	4.855 kPa <	10.000	OK
fs = M / As j d	153.999 kPa <	165.000	OK

Temp & Shrinkage steel:

As required 265 mm² per m² = 265 mm²

Top Face

Bar size	4	
Bar Spacing (450 mm or 3 t max)	450 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	

Bottom Face

Bar size	4	
Bar Spacing (450 mm or 3 t max)	450 mm	OK
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	
As Total	562 mm²	OK

File Channel Transition Wall, 4700mm, Detail D9 | Job No. 00173-159-044 | No.

Computation

HDR

Project Santan Outfall Channel | Computed BKV | Date 2/23/98

Subject Channel Transition - Detail D19 | Checked | Date

Task Toe Design, ASD | Sheet 6 | Of 6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN•m)
Static	Soil Pressure (retangular area)	30.276	x	1.000	=	30.276	x	0.500	=	15.138
	Soil Pressure (triangular area)	58.867	x	1.000	=	58.867	x	0.667	=	39.244
	Concrete	-15.600	x	0.000	=	0.000	x	0.500	=	0.000
Design Shear and Moment						89.142				54.382

Shear Check:

d	Footing Depth - cover - 1/2 Bar diameter =	592	mm		
Vc	0.079 √f'c bd =	209.175	kN >	89.142 kN	OK

Moment:

k = fc/(fc+(fs/n)	0.350			
j = 1 - k/3	0.883			
d	0.592	m		
bd² (b = 1m)	0.351	m^3		
As = M / fs j d	630	mm²/m		
Bar size	5			
Bar Spacing	300	mm		
Bar diameter	16	mm		
Bar Area	198	mm²		
As provided	660	mm²/m		OK
ld provided	1000	mm >	533 mm	OK
p = As / bd	0.0011			
pn	0.0099			
k = (2pn + (pn)²)^.5 - pn	0.131			
j = 1 - k/3	0.956			
fc = 2M / bd² k j	2.473	kPa <	10.000	OK
fs = M / As j d	145.488	kPa <	165.000	OK

Temp & Shrinkage steel:

As required 265 mm² per m² = 265 mm²

Top Face

Bar size	4		
Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm	
Bar Area	126	mm²	
As provided	281	mm²	

Bottom Face

Bar size	4		
Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm	
Bar Area	126	mm²	
As provided	281	mm²	
As Total	562	mm²	OK

File	Channel Transition Wall, 4700mm, half way up	Job No.	00173-097-044	No.	

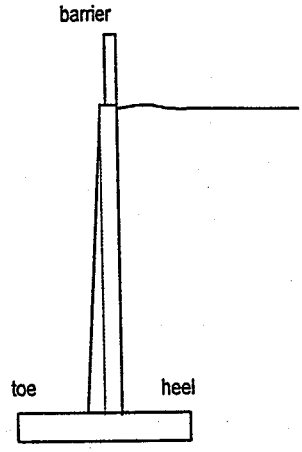
Computation

HDR

Project	Santan Outfall Channel	Compute	BKV	Date	2/23/98
Subject	Channel Transition, Detail D19, half way up stem wall	Checked		Date	
Task	Retaining Wall Design	Sheet	1	of	6

GEOMETERY:

Wall Height	2 100 mm
Wall Thickness (top)	325 mm
Wall Thickness (bottom)	325 mm
Wall Cover	50 mm
d	275 mm
Toe Length	1 000 mm
Toe Thickness	600 mm
Toe Cover	75 mm
Soil Height on toe	0 mm
Heel Length	1 650 mm
Heel Thickness	600 mm
Heel Cover	50 mm
Total Footing Length	2 975 mm
Total Wall Height	2 700 mm
Barrier Width	25 mm
Barrier Height	1 000 mm



LOADING:

Surcharge	12.360	kN
Eq. soil height	600.000	mm
Barrier Weight	1.000	kN
Barrier Impact Load	1334	kN/m at top of wall
Barrier Impact Load Adjusted for Wall Height	3.170	kN/m at base of wall

MATERIAL PROPERTIES:

f_y		400.000	MPa
E_s		2.00E+08	kPa
f'_c		20.000	MPa
Unit weight of concrete		24.000	kN/m^3
E_c	w_c^1.5 $0.0428\sqrt{f'_c}$ =	2.25E+07	kPa
f_c		10	MPa
f_s		165	MPa
n		8.885	
Unit weight of soil		20.600	kN/m^3
Allowable soil bearing pressure		120.000	kPa
Horizontial earthquake acceleration (kh)		0.040	g
Vertical earthquake acceleration (kv)		0.027	g
f		33.20	°
b		90.00	°
a		0.00	°
g		35.00	°
Coefficient of Sliding Friction (μ)		0.50	

$$Ka = \frac{\sin^2(b+f)}{(\sin^2(b)\cdot\sin(b-g))\left[1+\left(\frac{\sin(f+g)\cdot\sin(f-a)}{\sin(b-g)\cdot\sin(a+b)}\right)^{1/2}\right]^2} = 0.267$$

$$Kae = Ka + 3/4\ kh = 0.297$$

Equilvalent Fluid Pressure 5.509 kPa per meter

Computation

HDR

Project	Santan Outfall Channel	Computed	BKV
Subject	Channel Transition, Detail D19, half way up stem wall	Checked	
Task	Overturning and Shear - Case 1	Sheet	2

Date	2/23/98
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OVERTURNING:

Overturning Moment: (Mo) per meter of wall:

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Moment (kN•m)
Soil	20.080	0.900	18.072	1.69	33.935	30.542
Surcharge	8.924	1.350	12.048	2.17	19.375	26.156
Barrier Impact	3.170	3.700	11.728	2.17	6.882	25.462
Total	32.174	Mo =	41.848		60.192	82.159

Righting Moment: (Mr) per meter of wall

Cause	Force (kN)	Lever Arm (m)	Moment (kN•m)	Load Factor	Factored Force (kN)	Factored Force (kN•m)
Footing	42.840	1.488	63.725	1.69	72.400	107.694
Wall Taper	0.000	1.000	0.000	1.69	0.000	0.000
Wall	16.380	1.163	19.042	1.69	27.682	32.181
Barrier	1.000	1.313	1.313	1.69	1.690	2.218
Surcharge	20.394	2.150	43.847	2.17	44.275	95.192
Soil	71.379	2.150	153.465	1.69	120.631	259.356
Total	Rv = 151.993	Mr =	281.391		266.678	496.641

Factor of Safety against Overturning: Mr / Mo 6.72 > 2.0 OK

SLIDING:

Forces Causing Sliding: (Vs)

Cause	Force (kN)
Soil	20.080
Surcharge	8.924
Total per meter of wall	29.004

Forces Resisting Sliding: (Vr)

Cause	Force (kN)
Footing	42.840
Wall Taper	0.000
Wall	16.380
Surcharge	20.394
Soil	71.379
Total per meter of wall	150.993

Factor of Safety against Sliding: μ Vr / Vs = 2.60 > 1.5 OK

File Channel Transition Wall, 4700mm, half way up

Job No. 00173-097-044

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Computation

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Project Santan Outfall Channel

Subject Channel Transition, Detail D19, half way up stem wall

Task Soil Pressures

Compute BKV

Checked

Sheet 3

Date 2/23/98

Date

Of 6

FOOTING SOIL PRESSURES:

Resultant Vertical Force (Rv)		152 kN	
Location of Resultant Force from the toe of the footing (Mr - Mo) / Rv =		1 576 mm	OK - Inside middle 1/3
Soil Pressure = -Rv / A ± Mc / I	Area for 1 meter strip, A =	2.975 m²	
	I = 1/12 bh^3 =	2.19 m^4	
	c = Footing width / 2 =	1.488 m	
	e = c - x =	-0.089 m	
	M = Rv * (Footing width / 2 - x) =	-13.453 kN•m	
	-Rv / A =	-51.090 kPa	
	M c / I =	-9.120 kPa	
Toe Pressure	-Rv / A - Mc / I =	-42 kPa	
Heel Pressure	-Rv / A + Mc / I =	-60 kPa	

File Channel Transition Wall, 4700mm, half way up | Job No. 00173-097-044 | No.

Computation

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Project Santan Outfall Channel | Compute BKV | Date 2/23/98

Subject Channel Transition, Detail D19, half way up stem wall | Checked | Date

Task Stem Design, ASD, Half Way Up (Wall Height = 2.1 meters) | Sheet 5 | Of 6

LATERIAL FORCES:

Cause		Force (kN)		Factor		Moment (kN)		Lever Arm (m)		Moment (kN•m)
Static	Soil	12.147	x	1.000	=	12.147	x	0.700	=	8.503
	Surcharge	6.941	x	1.000	=	6.941	x	1.050	=	7.288
	Impact on Rail	3.170	x	1.000	=	3.170	x	3.100	=	9.826
	Total	22.258				22.258				25.617
Sesmic	Soil	13.150	x	1.000	=	13.150	x	1.050	=	13.807
	Soil Interia	2.855	x	1.000	=	2.855	x	1.050	=	2.998
	Barrier Interia	0.040	x	1.000	=	0.040	x	3.100	=	0.124
	Wall Interia	0.655	x	1.000	=	0.655	x	1.050	=	0.688
	Wall Taper Interia	0.000	x	1.000	=	0.000	x	0.700	=	0.000
	Total	13.150				13.150				17.617
	Reduced (3/4)	9.862				9.862				13.213

Design Shaer and Moment 22.258 kN 25.617 kN•m

CHECK SHEAR AT BASE OF STEM:

d Stem Width - cover - 1/2 Bar diameter = 265 mm

Vc 0.079 √f'c bd = 97.157 kN > 22.258 kN OK

DESIGN STEM FOR MOMENT:

k = fc/(fc+(fs/n)	0.350	
j = 1 - k/3	0.883	
d	265	mm
b	1000	mm
bd²	7.048E+07	m^3
As = M / fs j d	662	mm²
Bar size	6	
Bar Spacing	300	mm
Bar diameter	19	mm
Bar Area	285	mm²
As provided	951	mm²
p = As / bd	0.0036	
pn	0.0318	
k = (2pn + (pn)²)^½ - pn	0.222	
j = 1 - k/3	0.926	
fc = 2M / bd² k j	3.530 kPa < 10.000	OK
fs = M / As j d	109.648 kPa < 165.000	OK

Temp & Shrinkage steel:

As required (265 mm² per m²) 265 mm² per m² = 265 mm²

Inside Face				Outside Face			
Bar size	4			Bar size	4		
Bar Spacing (450 mm or 3 t m	450	mm	OK	Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm		Bar diameter	13	mm	
Bar Area	126	mm²		Bar Area	126	mm²	
As provided	281	mm²		As provided	281	mm²	

File Channel Transition Wall, 4700mm, half way up

Job No. 00173-097-044

No.

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Computation

Project Santan Outfall Channel

Subject Channel Transition, Detail D19, half way up stem wall

Task Heel Design, ASD

Computed BKV

Checked

Sheet 5

Date 2/23/98

Date

Of 6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN-m)
Static	Soil	71.379	x	1.000	=	71.379	x	0.825	=	58.888
	Surcharge	20.394	x	1.000	=	20.394	x	0.825	=	16.825
	Concrete	23.760	x	1.000	=	23.760	x	0.825	=	19.602
Design Shear and Moment						115.533				95.315

Shear Check:

d — Footing Depth - cover - 1/2 Bar diameter = 537 mm

Vc — 0.079 √f'c bd = 189.827 kN > 115.533 kN OK

Moment:

k = fc/(fc+(fs/n)	0.350		
j = 1 - k/3	0.883		
d	0.537 m		
bd² (b = 1m)	0.289 m^3		
As = M / fs j d	1217 mm²/m		
Bar size	8		
Bar Spacing	250 mm		
Bar diameter	25 mm		
Bar Area	506 mm²		
As provided	2026 mm²/m		OK
ld provided	1650 mm >	1219 mm	OK
p = As / bd	0.0038		
pn	0.0335		
k = (2pn + (pn)²)^.5 - pn	0.227		
j = 1 - k/3	0.924		
fc = 2M / bd² k j	3.141 kPa <	10.000	OK
fs = M / As j d	94.754 kPa <	165.000	OK

Temp & Shrinkage steel:

As required 265 mm² per m² = 265 mm²

Top Face

Bar size	4	OK
Bar Spacing (450 mm or 3 t max)	450 mm	
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	

Bottom Face

Bar size	4	OK
Bar Spacing (450 mm or 3 t max)	450 mm	
Bar diameter	13 mm	
Bar Area	126 mm²	
As provided	281 mm²	
As Total	562 mm²	OK

File Channel Transition Wall, 4700mm, half way up | Job No. 00173-097-044 | No.

Computation

HDR

Project Santan Outfall Channel | Computed BKV | Date 2/23/98

Subject Channel Transition, Detail D19, half way up stem wall | Checked | Date

Task Heel Design | Sheet 6 | Of 6

VERTICAL FORCES:

Cause		Force (kN)		Factor		Load (kN)		Lever Arm (m)		Moment (kN·m)
Static	Soil Pressure (retangular area)	41.970	x	1.000	=	41.970	x	0.500	=	20.985
	Soil Pressure (triangular area)	9.120	x	1.000	=	9.120	x	0.667	=	6.080
	Concrete	-14.400	x	0.000	=	0.000	x	0.500	=	0.000
Design Shear and Moment						51.090				27.065

Shear Check:

d	Footing Depth - cover - 1/2 Bar diameter =	542	mm		
Vc	0.079 √f'c bd =	191.510	kN >	51.090 kN	OK

Moment:

k = fc/(fc+(fs/n)	0.350			
j = 1 - k/3	0.883			
d	0.542	m		
bd² (b = 1m)	0.294	m^3		
As = M / fs j d	343	mm²/m		
Bar size	5			
Bar Spacing	300	mm		
Bar diameter	16	mm		
Bar Area	198	mm²		
As provided	660	mm²/m		OK
ld provided	1650	mm >	533 mm	OK
p = As / bd	0.0012			
pn	0.0108			
k = (2pn + (pn)²)^.5 - pn	0.137			
j = 1 - k/3	0.954			
fc = 2M / bd² k j	1.412	kPa <	10.000	OK
fs = M / As j d	79.237	kPa <	165.000	OK

Temp & Shrinkage steel:

As required 265 mm² per m² = 265 mm²

Top Face

Bar size	4		
Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm	
Bar Area	126	mm²	
As provided	281	mm²	

Bottom Face

Bar size	4		
Bar Spacing (450 mm or 3 t max)	450	mm	OK
Bar diameter	13	mm	
Bar Area	126	mm²	
As provided	281	mm²	
As Total	562	mm²	OK

MATERIAL PROPERTIES:

fy	60000	psi
f'c	3000	psi
concrete	150	pcf

GEOMETRY:

la	5.00	feet	short direction
lb	5.33	feet	long direction
x	0.00	feet	short direction for equipment pad
p	0.00	feet	long direction for equipment pad
slab t	12.00	inches	
b	12.00	inches	
d	9.50	inches	#9 bars + 2" cover
LL	100.00	psf	Standard Live Load
DL	1035.00	psf	Misc equipment
PL	0	lbs	equipment load
Case(1-9)	1		see table section

MOMENT COEFFICIENTS:

m = la/lb 0.938

Neg. Moment	Ca =	0.0000
	Cb =	0.0000
DL Moment	Ca =	0.0403
	Cb =	0.0328
LL Moment	Ca =	0.0403
	Cb =	0.0328
W Ratio	Wa =	0.5531
	Wb =	0.4469

FACTORED LOADS:

Live Load	0.100 x 1.7 =	0.170	ksf
Dead Load	1.035 x 1.4 =	1.449	ksf
	0.150 x 1.4 =	0.210	ksf
Total		1.829	ksf
Point Load	0.000 x 1.4 =	0.000	kips

MOMENT LIMITS:

Simple span with Point Load in the center	M =	5.716	kip-ft	wl^2/8 + Pl/4
Fixed End with Point Load in the center	M =	3.810	kip-ft	wl^2/12 + Pl/4

DISTRIBUTION OF POINT LOADS: Pa/Pb = lb/la

Pa = P*lb/(la+lb)	0.000	kips
Pb = P*la/(la+lb)	0.000	kips

Computation

HDR

Project	Santan Outfall Channel	Computed BKV	Date 2/23/98
Subject	Gate Structure - Detail B1 & B2	Checked	Date
Task	Base Walls	Sheet 2	Of 5

NEGATIVE MOMENTS:

Ma- = Ca¦w¦la^2+P¦la/4	0.000 kip-ft
Mb- = Cb¦w¦lb^2+P¦lb/4	0.000 kip-ft

POSITIVE MOMENTS:

Ma+ = [Cawla^2]dl+[Cawla^2]ll+Pala/8	0.383 kip-ft
Mb+ = [Cbwlb^2]dl+[Cbwlb^2]ll+Pblb/8	0.354 kip-ft

SHEAR AT CONTINUOS EDGE:

Va = .5Wa¦w¦la + xPa/la	2.529 klf
Vb = .5Wb¦w¦lb + pPb/lb	2.179 klf

DESIGN FOR NEGATIVE MOMENT - DIRECTION A:

Mu = Mn/.9	0.000 kip-ft
Rn = Mu/(•bd^2)	0
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0000
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0033
As = pbt	0.480 in^2/ft

DESIGN FOR NEGATIVE MOMENT - DIRECTION B:

Mu = Mn/.9	0.000 kip-ft
Rn = Mu/(•bd^2)	0
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0000
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0033
As = pbt	0.480 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION A:

Mu = Mn/.9	0.426 kip-ft
Rn = Mu/(•bd^2)	5.24
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0001
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0033
As = pbt	0.480 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION B:

Mu = Mn/.9	0.393 kip-ft
Rn = Mu/(•bd^2)	4.84
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0001
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0033
As = pbt	0.480 in^2/ft

DESIGN OF SHEAR:

Vc = 2(f'c)^.5¦bd	12.488 klf
Va	2.529 OK
Vb	2.179 OK

This solution uses the method described in chapter eight of the book:

DESIGN OF CONCRETE STRUCTURES Tenth Edition
by Arthur H. Nilson / George Winter
McGraw-Hill Book Company

File Gate Structure, Detail B1 & B2

Job No. 00173-159-044

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Computation

Project Santan Outfall Channel

Subject Gate Structure - Detail B1 & B2

Task Base Walls

Computed BKV

Date 2/23/98

Checked

Date

Sheet 3

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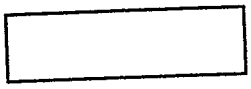
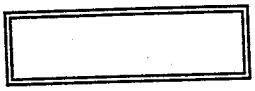
DESIGN CASES:

Case 1

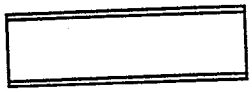


Case 2

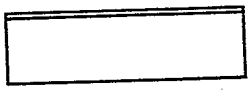


Case 3

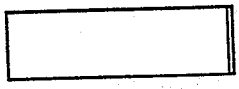
Case 5



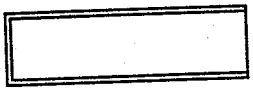
Case 6



Case 7



Case 9



The double edge indicates that the slab continues across, or is fixed at, the support; a single edge indicates a support at which torsion resistance is negligible.

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Table 8.3 - Coefficients for negative moments in slabs

Ma = Ca w l^2 where w = total uniform dead plus live load

Mb = Cb w l^2

m = la / lb

m \	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.000	0.045	0.000	0.050	0.075	0.071	0.000	0.033	0.061
	Cb	0.000	0.045	0.076	0.050	0.000	0.000	0.071	0.061	0.033
0.95	Ca	0.000	0.050	0.000	0.055	0.079	0.075	0.000	0.038	0.065
	Cb	0.000	0.041	0.072	0.045	0.000	0.000	0.067	0.056	0.029
0.90	Ca	0.000	0.055	0.000	0.060	0.080	0.079	0.000	0.043	0.068
	Cb	0.000	0.037	0.070	0.040	0.000	0.000	0.062	0.052	0.025
0.85	Ca	0.000	0.060	0.000	0.066	0.082	0.083	0.000	0.049	0.072
	Cb	0.000	0.031	0.065	0.034	0.000	0.000	0.057	0.046	0.021
0.80	Ca	0.000	0.065	0.000	0.071	0.083	0.086	0.000	0.055	0.075
	Cb	0.000	0.027	0.061	0.029	0.000	0.000	0.051	0.041	0.017
0.75	Ca	0.000	0.069	0.000	0.076	0.085	0.088	0.000	0.061	0.078
	Cb	0.000	0.022	0.056	0.024	0.000	0.000	0.044	0.036	0.014
0.70	Ca	0.000	0.074	0.000	0.081	0.086	0.091	0.000	0.068	0.081
	Cb	0.000	0.017	0.050	0.019	0.000	0.000	0.038	0.029	0.011
0.65	Ca	0.000	0.077	0.000	0.085	0.087	0.093	0.000	0.074	0.083
	Cb	0.000	0.014	0.043	0.015	0.000	0.000	0.031	0.024	0.008
0.60	Ca	0.000	0.081	0.000	0.089	0.088	0.095	0.000	0.080	0.085
	Cb	0.000	0.010	0.035	0.011	0.000	0.000	0.024	0.018	0.006
0.55	Ca	0.000	0.084	0.000	0.092	0.089	0.096	0.000	0.085	0.086
	Cb	0.000	0.007	0.028	0.008	0.000	0.000	0.019	0.014	0.005
0.50	Ca	0.000	0.086	0.000	0.094	0.090	0.097	0.000	0.089	0.088
	Cb	0.000	0.006	0.022	0.006	0.000	0.000	0.014	0.010	0.003

Table 8.4 - Coefficients for dead load positive moments in slabs

Ma = Ca w l^2 where w = total uniform dead load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	Cb	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	Ca	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	Cb	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	Ca	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	Cb	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	Ca	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	Cb	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	Ca	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	Cb	0.023	0.011	0.020	0.013	0.009	0.015	0.022	0.015	0.010
0.75	Ca	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	Cb	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	Ca	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	Cb	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	Ca	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	Cb	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	Ca	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	Cb	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	Ca	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	Cb	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	Ca	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	Cb	0.006	0.002	0.007	0.004	0.001	0.003	0.007	0.004	0.002

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Table 8.5 - Coefficients for live load positive moments in slabs

Ma = Ca w l^2 where w = total uniform live load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	Cb	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	Ca	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	Cb	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	Ca	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	Cb	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	Ca	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	Cb	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	Ca	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	Cb	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	Ca	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	Cb	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	Ca	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	Cb	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	Ca	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	Cb	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	Ca	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	Cb	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	Ca	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	Cb	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	Ca	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	Cb	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

Table 8.6 - Ratio of load W in la and lb directions for shear in slab and load on supports

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Wa	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	Wb	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	Wa	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	Wb	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	Wa	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	Wb	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	Wa	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	Wb	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	Wa	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	Wb	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	Wa	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	Wb	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	Wa	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	Wb	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	Wa	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	Wb	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	Wa	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	Wb	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	Wa	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	Wb	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	Wa	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	Wb	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

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Computed BKV

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MATERIAL PROPERTIES:

fy	60000	psi
f'c	3000	psi
concrete	150	pcf

GEOMETRY:

la	6.00	feet	short direction
lb	6.00	feet	long direction
x	3.00	feet	short direction for equipment pad
p	3.00	feet	long direction for equipment pad
slab t	8.00	inches	
b	12.00	inches	
d	5.50	inches	#9 bars + 2" cover
LL	100.00	psf	Standard Live Load
DL	100.00	psf	Misc equipment
PL	16000	lbs	equipment load
Case(1-9)	1		see table section

MOMENT COEFFICIENTS:

m = la/lb 1.000

Neg. Moment	Ca =	0.0000
	Cb =	0.0000
DL Moment	Ca =	0.0360
	Cb =	0.0360
LL Moment	Ca =	0.0360
	Cb =	0.0360
W Ratio	Wa =	0.5000
	Wb =	0.5000

FACTORED LOADS:

Live Load	0.100	x 1.7 =	0.170 ksf
Dead Load	0.100	x 1.4 =	0.140 ksf
	0.100	x 1.4 =	0.140 ksf
Total			0.450 ksf
Point Load	16.000	x 1.4 =	22.400 kips

MOMENT LIMITS:

Simple span with Point Load in the center	M =	35.625 kip-ft	wl^2/8 + Pl/4
Fixed End with Point Load in the center	M =	18.150 kip-ft	wl^2/12 + Pl/4

DISTRIBUTION OF POINT LOADS: Pa/Pb = lb/la

Pa = P*lb/(la+lb)	11.200 kips
Pb = P*la/(la+lb)	11.200 kips

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NEGATIVE MOMENTS:

Ma- = Ca¦w¦la^2+P¦la/4	16.800 kip-ft
Mb- = Cb¦w¦lb^2+P¦lb/4	16.800 kip-ft

POSITIVE MOMENTS:

Ma+ = [Cawla^2]dl+[Cawla^2]ll+Pala/8	8.802 kip-ft
Mb+ = [Cbwlb^2]dl+[Cbwlb^2]ll+Pblb/8	8.802 kip-ft

SHEAR AT CONTINUOS EDGE:

Va = .5Wa¦w¦la + xPa/la	6.275 klf
Vb = .5Wb¦w¦lb + pPb/lb	6.275 klf

DESIGN FOR NEGATIVE MOMENT - DIRECTION A:

Mu = Mn/.9	18.667 kip-ft
Rn = Mu/(•bd^2)	686
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0136
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0136
As = pbt	1.306 in^2/ft

DESIGN FOR NEGATIVE MOMENT - DIRECTION B:

Mu = Mn/.9	18.667 kip-ft
Rn = Mu/(•bd^2)	686
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0136
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0136
As = pbt	1.306 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION A:

Mu = Mn/.9	9.780 kip-ft
Rn = Mu/(•bd^2)	359.22
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0065
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0065
As = pbt	0.622 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION B:

Mu = Mn/.9	9.780 kip-ft
Rn = Mu/(•bd^2)	359.22
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0065
p min. = 200/fy	0.0033
p used = max(p,p min.)	0.0065
As = pbt	0.622 in^2/ft

DESIGN OF SHEAR:

Vc = 2(f'c)^.5¦bd	7.230 klf
Va	6.275 OK
Vb	6.275 OK

This solution uses the method described in chapter eight of the book:

DESIGN OF CONCRETE STRUCTURES Tenth Edition
by Arthur H. Nilson / George Winter
McGraw-Hill Book Company

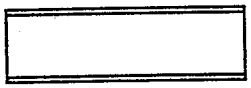
DESIGN CASES:

Case 1

Case 2

Case 3

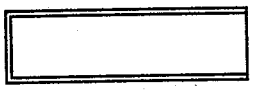
Case 5



Case 6

Case 7

Case 9



The double edge indicates that the slab continues across, or is fixed at, the support; a single edge indicates a support at which torsion resistance is negligible.

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Table 8.3 - Coefficients for negative moments in slabs

Ma = Ca w l^2 where w = total uniform dead plus live load

Mb = Cb w l^2

m = la / lb

m \	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.000	0.045	0.000	0.050	0.075	0.071	0.000	0.033	0.061
	Cb	0.000	0.045	0.076	0.050	0.000	0.000	0.071	0.061	0.033
0.95	Ca	0.000	0.050	0.000	0.055	0.079	0.075	0.000	0.038	0.065
	Cb	0.000	0.041	0.072	0.045	0.000	0.000	0.067	0.056	0.029
0.90	Ca	0.000	0.055	0.000	0.060	0.080	0.079	0.000	0.043	0.068
	Cb	0.000	0.037	0.070	0.040	0.000	0.000	0.062	0.052	0.025
0.85	Ca	0.000	0.060	0.000	0.066	0.082	0.083	0.000	0.049	0.072
	Cb	0.000	0.031	0.065	0.034	0.000	0.000	0.057	0.046	0.021
0.80	Ca	0.000	0.065	0.000	0.071	0.083	0.086	0.000	0.055	0.075
	Cb	0.000	0.027	0.061	0.029	0.000	0.000	0.051	0.041	0.017
0.75	Ca	0.000	0.069	0.000	0.076	0.085	0.088	0.000	0.061	0.078
	Cb	0.000	0.022	0.056	0.024	0.000	0.000	0.044	0.036	0.014
0.70	Ca	0.000	0.074	0.000	0.081	0.086	0.091	0.000	0.068	0.081
	Cb	0.000	0.017	0.050	0.019	0.000	0.000	0.038	0.029	0.011
0.65	Ca	0.000	0.077	0.000	0.085	0.087	0.093	0.000	0.074	0.083
	Cb	0.000	0.014	0.043	0.015	0.000	0.000	0.031	0.024	0.008
0.60	Ca	0.000	0.081	0.000	0.089	0.088	0.095	0.000	0.080	0.085
	Cb	0.000	0.010	0.035	0.011	0.000	0.000	0.024	0.018	0.006
0.55	Ca	0.000	0.084	0.000	0.092	0.089	0.096	0.000	0.085	0.086
	Cb	0.000	0.007	0.028	0.008	0.000	0.000	0.019	0.014	0.005
0.50	Ca	0.000	0.086	0.000	0.094	0.090	0.097	0.000	0.089	0.088
	Cb	0.000	0.006	0.022	0.006	0.000	0.000	0.014	0.010	0.003

Table 8.4 - Coefficients for dead load positive moments in slabs

Ma = Ca w l^2 where w = total uniform dead load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	Cb	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	Ca	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	Cb	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	Ca	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	Cb	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	Ca	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	Cb	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	Ca	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	Cb	0.023	0.011	0.020	0.013	0.009	0.015	0.022	0.015	0.010
0.75	Ca	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	Cb	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	Ca	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	Cb	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	Ca	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	Cb	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	Ca	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	Cb	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	Ca	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	Cb	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	Ca	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	Cb	[illegible]	[illegible]	0.007	0.004	0.001	0.003	0.007	0.004	0.002

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Table 8.5 - Coefficients for live load positive moments in slabs

Ma = Ca w l^2 where w = total uniform live load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	Cb	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	Ca	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	Cb	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	Ca	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	Cb	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	Ca	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	Cb	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	Ca	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	Cb	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	Ca	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	Cb	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	Ca	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	Cb	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	Ca	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	Cb	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	Ca	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	Cb	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	Ca	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	Cb	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	Ca	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	Cb	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

Table 8.6 - Ratio of load W in la and lb directions for shear in slab and load on supports

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Wa	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	Wb	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	Wa	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	Wb	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	Wa	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	Wb	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	Wa	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	Wb	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	Wa	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	Wb	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	Wa	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	Wb	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	Wa	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	Wb	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	Wa	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	Wb	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	Wa	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	Wb	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	Wa	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	Wb	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	Wa	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	Wb	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

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MATERIAL PROPERTIES:

fy	60000	psi
f'c	3000	psi
concrete	150	pcf

GEOMETRY:

la	9.50	feet	short direction
lb	11.71	feet	long direction
x	0.00	feet	short direction for equipment pad
p	0.00	feet	long direction for equipment pad
slab t	36.00	inches	
b	12.00	inches	
d	33.50	inches	#9 bars + 2" cover
LL	100.00	psf	Standard Live Load
DL	1600.00	psf	Misc equipment
PL	0	lbs	equipment load
Case(1-9)	1		see table section

MOMENT COEFFICIENTS:

m = la/lb 0.811

Neg. Moment	Ca =	0.0000
	Cb =	0.0000
DL Moment	Ca =	0.0511
	Cb =	0.0254
LL Moment	Ca =	0.0511
	Cb =	0.0254
W Ratio	Wa =	0.6694
	Wb =	0.3306

FACTORED LOADS:

Live Load	0.100	x 1.7 =	0.170 ksf
Dead Load	1.600	x 1.4 =	2.240 ksf
	0.450	x 1.4 =	0.630 ksf
Total			3.040 ksf
Point Load	0.000	x 1.4 =	0.000 kips

MOMENT LIMITS:

Simple span with Point Load in the center	M =	34.302 kip-ft	wl^2/8 + Pl/4
Fixed End with Point Load in the center	M =	22.868 kip-ft	wl^2/12 + Pl/4

DISTRIBUTION OF POINT LOADS: Pa/Pb = lb/la

Pa = P¦lb/(la+lb)	0.000 kips
Pb = P¦la/(la+lb)	0.000 kips

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NEGATIVE MOMENTS:

Ma- = Ca¦w¦la^2+P¦la/4	0.000 kip-ft
Mb- = Cb¦w¦lb^2+P¦lb/4	0.000 kip-ft

POSITIVE MOMENTS:

Ma+ = [Cawla^2]dl+[Cawla^2]ll+Pala/8	3.692 kip-ft
Mb+ = [Cbwlb^2]dl+[Cbwlb^2]ll+Pblb/8	2.790 kip-ft

SHEAR AT CONTINUOS EDGE:

Va = .5Wa¦w¦la + xPa/la	9.668 klf
Vb = .5Wb¦w¦lb + pPb/lb	5.884 klf

DESIGN FOR NEGATIVE MOMENT - DIRECTION A:

Mu = Mn/.9	0.000 kip-ft
Rn = Mu/(•bd^2)	0
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0000
p min. = 200/fy or 4/3 p	0.0000
p used = max(p,p min.)	0.0000
As = pbt	0.000 in^2/ft

DESIGN FOR NEGATIVE MOMENT - DIRECTION B:

Mu = Mn/.9	0.000 kip-ft
Rn = Mu/(•bd^2)	0
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0000
p min. = 200/fy or 4/3 p	0.0000
p used = max(p,p min.)	0.0000
As = pbt	0.000 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION A:

Mu = Mn/.9	4.103 kip-ft
Rn = Mu/(•bd^2)	4.06
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0001
p min. = 200/fy or 4/3 p	0.0001
p used = max(p,p min.)	0.0001
As = pbt	0.039 in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION B:

Mu = Mn/.9	3.100 kip-ft
Rn = Mu/(•bd^2)	3.07
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0001
p min. = 200/fy or 4/3 p	0.0001
p used = max(p,p min.)	0.0001
As = pbt	0.029 in^2/ft

DESIGN OF SHEAR:

Vc = 2(f'c)^.5¦bd	44.037 klf
Va	9.668 OK
Vb	5.884 OK

This solution uses the method described in chapter eight of the book:

DESIGN OF CONCRETE STRUCTURES Tenth Edition
by Arthur H. Nilson / George Winter
McGraw-Hill Book Company

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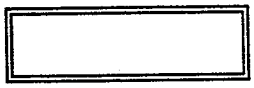
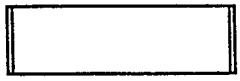
DESIGN CASES:

Case 1

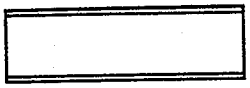
Case 2



Case 3

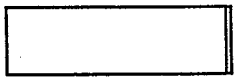


Case 5

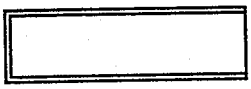


Case 6

Case 7



Case 9



The double edge indicates that the slab continues across, or is fixed at, the support; a single edge indicates a support at which torsion resistance is negligible.

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Table 8.3 - Coefficients for negative moments in slabs

Ma = Ca w l^2 where w = total uniform dead plus live load

Mb = Cb w l^2

m = la / lb

m \	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.000	0.045	0.000	0.050	0.075	0.071	0.000	0.033	0.061
	Cb	0.000	0.045	0.076	0.050	0.000	0.000	0.071	0.061	0.033
0.95	Ca	0.000	0.050	0.000	0.055	0.079	0.075	0.000	0.038	0.065
	Cb	0.000	0.041	0.072	0.045	0.000	0.000	0.067	0.056	0.029
0.90	Ca	0.000	0.055	0.000	0.060	0.080	0.079	0.000	0.043	0.068
	Cb	0.000	0.037	0.070	0.040	0.000	0.000	0.062	0.052	0.025
0.85	Ca	0.000	0.060	0.000	0.066	0.082	0.083	0.000	0.049	0.072
	Cb	0.000	0.031	0.065	0.034	0.000	0.000	0.057	0.046	0.021
0.80	Ca	0.000	0.065	0.000	0.071	0.083	0.086	0.000	0.055	0.075
	Cb	0.000	0.027	0.061	0.029	0.000	0.000	0.051	0.041	0.017
0.75	Ca	0.000	0.069	0.000	0.076	0.085	0.088	0.000	0.061	0.078
	Cb	0.000	0.022	0.056	0.024	0.000	0.000	0.044	0.036	0.014
0.70	Ca	0.000	0.074	0.000	0.081	0.086	0.091	0.000	0.068	0.081
	Cb	0.000	0.017	0.050	0.019	0.000	0.000	0.038	0.029	0.011
0.65	Ca	0.000	0.077	0.000	0.085	0.087	0.093	0.000	0.074	0.083
	Cb	0.000	0.014	0.043	0.015	0.000	0.000	0.031	0.024	0.008
0.60	Ca	0.000	0.081	0.000	0.089	0.088	0.095	0.000	0.080	0.085
	Cb	0.000	0.010	0.035	0.011	0.000	0.000	0.024	0.018	0.006
0.55	Ca	0.000	0.084	0.000	0.092	0.089	0.096	0.000	0.085	0.086
	Cb	0.000	0.007	0.028	0.008	0.000	0.000	0.019	0.014	0.005
0.50	Ca	0.000	0.086	0.000	0.094	0.090	0.097	0.000	0.089	0.088
	Cb	0.000	0.006	0.022	0.006	0.000	0.000	0.014	0.010	0.003

Table 8.4 - Coefficients for dead load positive moments in slabs

Ma = Ca w l^2 where w = total uniform dead load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	Cb	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	Ca	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	Cb	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	Ca	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	Cb	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	Ca	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	Cb	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	Ca	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	Cb	0.023	0.011	0.020	0.013	0.009	0.015	0.022	0.015	0.010
0.75	Ca	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	Cb	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	Ca	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	Cb	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	Ca	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	Cb	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	Ca	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	Cb	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	Ca	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	Cb	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	Ca	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.007	0.004	0.002

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Table 8.5 - Coefficients for live load positive moments in slabs

Ma = Ca w l^2 where w = total uniform live load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	Cb	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	Ca	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	Cb	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	Ca	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	Cb	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	Ca	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	Cb	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	Ca	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	Cb	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	Ca	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	Cb	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	Ca	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	Cb	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	Ca	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	Cb	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	Ca	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	Cb	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	Ca	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	Cb	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	Ca	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	Cb	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

Table 8.6 - Ratio of load W in la and lb directions for shear in slab and load on supports

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Wa	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	Wb	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	Wa	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	Wb	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	Wa	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	Wb	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	Wa	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	Wb	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	Wa	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	Wb	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	Wa	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	Wb	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	Wa	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	Wb	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	Wa	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	Wb	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	Wa	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	Wb	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	Wa	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	Wb	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	Wa	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	Wb	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

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MATERIAL PROPERTIES:

fy	60000	psi
f'c	3000	psi
concrete	150	pcf

GEOMETRY:

la	3.63	feet	short direction
lb	5.33	feet	long direction
x	1.81	feet	short direction for equipment pad
p	2.67	feet	long direction for equipment pad
slab t	8.00	inches	
b	12.00	inches	
d	5.50	inches	#9 bars + 2" cover
LL	100.00	psf	Standard Live Load
DL	100.00	psf	Misc equipment
PL	16000	lbs	equipment load
Case(1-9)	1		see table section

MOMENT COEFFICIENTS:

m = la/lb		0.680
Neg. Moment	Ca =	0.0000
	Cb =	0.0000
DL Moment	Ca =	0.0699
	Cb =	0.0150
LL Moment	Ca =	0.0699
	Cb =	0.0150
W Ratio	Wa =	0.8228
	Wb =	0.1772

FACTORED LOADS:

Live Load	0.100	x 1.7 =	0.170	ksf
Dead Load	0.100	x 1.4 =	0.140	ksf
	0.100	x 1.4 =	0.140	ksf
Total			0.450	ksf
Point Load	16.000	x 1.4 =	22.400	kips

MOMENT LIMITS:

Simple span with Point Load in the center	M =	21.039	kip-ft	wl^2/8 + Pl/4
Fixed End with Point Load in the center	M =	10.643	kip-ft	wl^2/12 + Pl/4

DISTRIBUTION OF POINT LOADS: Pa/Pb = lb/la

Pa = P*lb/(la+lb)	13.335	kips
Pb = P*la/(la+lb)	9.065	kips

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NEGATIVE MOMENTS:

Ma- = Ca¦w¦la^2+P¦la/4	12.085	kip-ft
Mb- = Cb¦w¦lb^2+P¦lb/4	12.085	kip-ft

POSITIVE MOMENTS:

Ma+ = [Cawla^2]dl+[Cawla^2]ll+Pala/8	6.327	kip-ft
Mb+ = [Cbwlb^2]dl+[Cbwlb^2]ll+Pblb/8	6.175	kip-ft

SHEAR AT CONTINUOS EDGE:

Va = .5Wa¦w¦la + xPa/la	7.339	klf
Vb = .5Wb¦w¦lb + pPb/lb	4.745	klf

DESIGN FOR NEGATIVE MOMENT - DIRECTION A:

Mu = Mn/.9	13.428	kip-ft
Rn = Mu/(•bd^2)	493	
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0092	
p min. = 200/fy	0.0033	
p used = max(p,p min.)	0.0092	
As = pbt	0.885	in^2/ft

DESIGN FOR NEGATIVE MOMENT - DIRECTION B:

Mu = Mn/.9	13.428	kip-ft
Rn = Mu/(•bd^2)	493	
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0092	
p min. = 200/fy	0.0033	
p used = max(p,p min.)	0.0092	
As = pbt	0.885	in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION A:

Mu = Mn/.9	7.031	kip-ft
Rn = Mu/(•bd^2)	258.24	
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	0.0045	
p min. = 200/fy	0.0033	
p used = max(p,p min.)	0.0045	
As = pbt	0.437	in^2/ft

DESIGN FOR POSITIVE MOMENT - DIRECTION B:

Mu = Mn/.9		
Rn = Mu/(•bd^2)	6.861	kip-ft
p = .85f'c/fy(1-(1-2Rn/.85f'c)^.5)	252.02	
p min. = 200/fy	0.0044	
p used = max(p,p min.)	0.0033	
As = pbt	0.0044	
	0.425	in^2/ft

DESIGN OF SHEAR:

Vc = 2(f'c)^.5¦bd	7.230	klf
Va	7.339	NO GOOD
Vb	4.745	OK

This solution uses the method described in chapter eight of the book:

DESIGN OF CONCRETE STRUCTURES Tenth Edition
by Arthur H. Nilson / George Winter
McGraw-Hill Book Company

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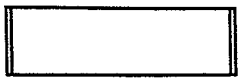
Task Roof Design

DESIGN CASES:

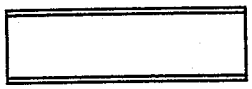
Case 1

Case 2

Case 3

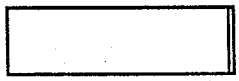


Case 5

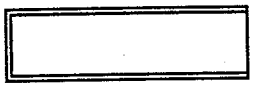


Case 6

Case 7



Case 9



The double edge indicates that the slab continues across, or is fixed at, the support; a single edge indicates a support at which torsion resistance is negligible.

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Table 8.3 - Coefficients for negative moments in slabs

Ma = Ca w l^2 where w = total uniform dead plus live load

Mb = Cb w l^2

m = la / lb

m \	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.000	0.045	0.000	0.050	0.075	0.071	0.000	0.033	0.061
	Cb	0.000	0.045	0.076	0.050	0.000	0.000	0.071	0.061	0.033
0.95	Ca	0.000	0.050	0.000	0.055	0.079	0.075	0.000	0.038	0.065
	Cb	0.000	0.041	0.072	0.045	0.000	0.000	0.067	0.056	0.029
0.90	Ca	0.000	0.055	0.000	0.060	0.080	0.079	0.000	0.043	0.068
	Cb	0.000	0.037	0.070	0.040	0.000	0.000	0.062	0.052	0.025
0.85	Ca	0.000	0.060	0.000	0.066	0.082	0.083	0.000	0.049	0.072
	Cb	0.000	0.031	0.065	0.034	0.000	0.000	0.057	0.046	0.021
0.80	Ca	0.000	0.065	0.000	0.071	0.083	0.086	0.000	0.055	0.075
	Cb	0.000	0.027	0.061	0.029	0.000	0.000	0.051	0.041	0.017
0.75	Ca	0.000	0.069	0.000	0.076	0.085	0.088	0.000	0.061	0.078
	Cb	0.000	0.022	0.056	0.024	0.000	0.000	0.044	0.036	0.014
0.70	Ca	0.000	0.074	0.000	0.081	0.086	0.091	0.000	0.068	0.081
	Cb	0.000	0.017	0.050	0.019	0.000	0.000	0.038	0.029	0.011
0.65	Ca	0.000	0.077	0.000	0.085	0.087	0.093	0.000	0.074	0.083
	Cb	0.000	0.014	0.043	0.015	0.000	0.000	0.031	0.024	0.008
0.60	Ca	0.000	0.081	0.000	0.089	0.088	0.095	0.000	0.080	0.085
	Cb	0.000	0.010	0.035	0.011	0.000	0.000	0.024	0.018	0.006
0.55	Ca	0.000	0.084	0.000	0.092	0.089	0.096	0.000	0.085	0.086
	Cb	0.000	0.007	0.028	0.008	0.000	0.000	0.019	0.014	0.005
0.50	Ca	0.000	0.086	0.000	0.094	0.090	0.097	0.000	0.089	0.088
	Cb	0.000	0.006	0.022	0.006	0.000	0.000	0.014	0.010	0.003

Table 8.4 - Coefficients for dead load positive moments in slabs

Ma = Ca w l^2 where w = total uniform dead load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	Cb	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	Ca	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	Cb	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	Ca	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	Cb	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	Ca	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	Cb	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	Ca	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	Cb	0.023	0.011	0.020	0.013	0.009	0.015	0.022	0.015	0.010
0.75	Ca	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	Cb	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	Ca	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	Cb	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	Ca	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	Cb	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	Ca	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	Cb	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	Ca	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	Cb	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	Ca	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	Cb	0.006	0.002	0.007	0.004	0.001	0.003	0.007	0.004	0.002

File Detail 3B Top | Job No. | No.

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Table 8.5 - Coefficients for live load positive moments in slabs

Ma = Ca w l^2 where w = total uniform live load

Mb = Cb w l^2

m = la / lb

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Ca	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	Cb	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	Ca	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	Cb	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	Ca	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	Cb	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	Ca	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	Cb	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	Ca	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	Cb	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	Ca	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	Cb	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	Ca	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	Cb	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	Ca	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	Cb	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	Ca	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	Cb	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	Ca	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	Cb	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	Ca	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	Cb	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

Table 8.6 - Ratio of load W in la and lb directions for shear in slab and load on supports

m	Case >	1	2	3	4	5	6	7	8	9
1.00	Wa	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	Wb	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	Wa	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	Wb	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	Wa	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	Wb	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	Wa	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	Wb	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	Wa	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	Wb	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	Wa	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	Wb	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	Wa	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	Wb	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	Wa	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	Wb	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	Wa	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	Wb	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	Wa	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	Wb	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	Wa	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	Wb	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

Job No. 00173-159-044 | No.

HDR Computation

HDR

Project	Santan Channel	Computed BT	Date 11/30/97
Subject	UPRR RCBC	Checked	Date
Task	Sta. 1+999.276 to Sta. 2+009.876	Sheet 1	Of 4

STRUCTURAL DESIGN DOCUMENTATION

Job No. 00173-159-044 | No.

HDR Computation

HDR

Project Santan Channel	Computed BT	Date 11/19/97
Subject UPRR RCBC	Checked	Date
Task Sta. 1+999.276 to Sta. 2+009.876	Sheet 2	Of 4

Loads:

From AREA 96, Section 16.2. (attached), uniform distributed load to top of box for 3' of fill (t.o. rail to t.o. box):

D = 400 (Soil + Track)
L = 1500 (E80)
I = 400
2300 psf

Wt. of RCBC = 3.64 cy/ft (27 ft³/cy)(150 #/ft³) / 23.67' = 623 psf

Soil Pressure

Min. allowable soil pressure = 1900 (D+L) - 623 (wt.) = 2523 → use 3000 psf (140 kPa)

RCBC Design

Use UPRR Engineering Standards, Page No. 4208-A adopted 12/1/87 and revised 1/26/90 (attached), except reduce width of barrel from 10' (3048 mm) to 9'-9" (2972 mm) to accommodate thinner interior wall of ADOT Std. RCB at interface. The modification eliminates the need for a jog detail at the exterior walls. Flow constriction not an issue per J. Zorne, 11/19/97.

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HDR Computation

HDR

Project: Santan Channel	Computed: RT	Date: 11/30/97
Subject: UPRR RCBC	Checked:	Date:
Task: Sta. 1+999.276 to Sta. 2+009.876	Sheet: 3	Of: 4

Quantities

UPRR Std. — Top Slab — Bott. Slab

Conc.: 9.131 − [76 (432 + 457)] 2/1000 = 8.996 m³/m

Adj. to W to accommodate ADOT Std.

10.6 m

95.36 m³ → use 96 m³

× $215 = 20640

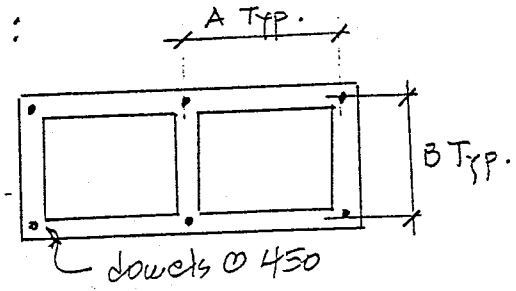
UPRR Std.

Reinf.*: 1149 kg/m (10.6 m) = 12179 kg → use 12180 kg

× $0.80 = 9744

* Assume no adjustment to rebar ("a" bars shortened by 2(76) = 152 mm ; "W" reduced by 76 mm but no elimination of longit. reinf.)

Dowels:



Section

A = 432/2 + 2972 + 254/2 = 3315 mm

3315/450 = 7.37 → use 8 spaces

B = 432/2 + 2438 + (432+25)/2 = 2882.5

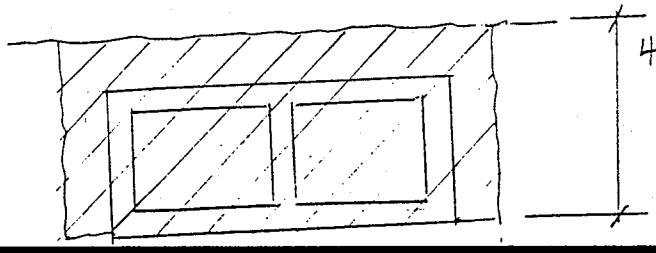
2882.5/450 = 6.41 → use 7 spaces

dowels = [2(9) + 2(8) + 3(6)] 2 → 104

CJ's

× $10 = 1040

Structural Excavation:



432 + 2438 + 432 + 25 + 1000 = 4327 mm

4.327 (7.962)(10.6) → 365 m³

L

× $7 = 2555

Job No. 00173-159-044 No.

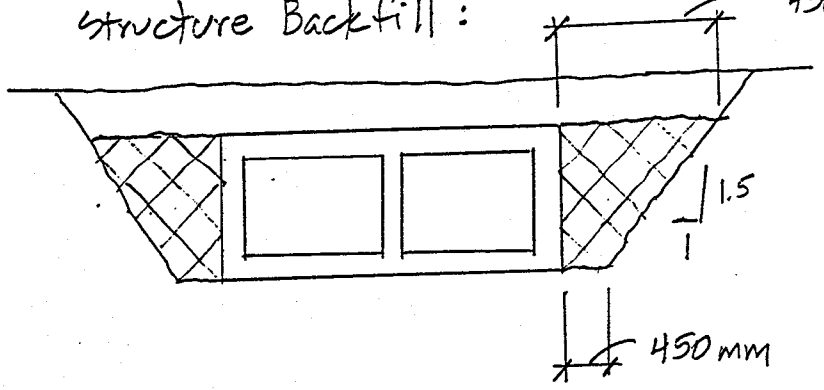
HDR Computation

HDR

Project Santan Channel	Computed RT	Date 11/30/97
Subject UPRR RCBC	Checked	Date
Task Sta. 1+999.276 to Sta. 2+009.876	Sheet 4	Of 4

Structure Backfill:

$450 + (1.0/1.5)(432 + 2438 + 432 + 25) = 2668$ mm



$2[0.450(3.327) + 1/2(2.668 - 0.450)(3.327)](10.6) \longrightarrow 110\ m^3$ (L)

$\times \$18 = 1980$

References (attached)

- Excerpts from 1996 AREA Manual for Railway Engineering – Chapter 8, Section 16.2, page 1-5
- UPRR RCBC Standards, Page No. 4208-A
- Excerpts from Geotechnical Investigation Report by AGRA Earth & Environmental, AEE Job No. 6-117-000356, Report No. 2, dated 11/7/97, page 3-8
- ADOT Metric Standard Drawing No. B-19.50 dated 1995.

TOTAL COST = \$35,959 ÷ 10.6 m = \$3392/LM

Section 16.2 Design Principles

16.2.1 General (1984)

Specifications for Design of Reinforced Concrete Members as prescribed in Part 2, Reinforced Concrete Design, shall govern except as described herein.

16.2.2 Assumptions (1984)

The design shall be based on the slabs and walls acting as a continuous frame with the positive and negative bending moments determined by an acceptable method of analysis.

16.2.3 Design Loads (1984)

a. The following loads shall be used in the design of box culverts supporting track:

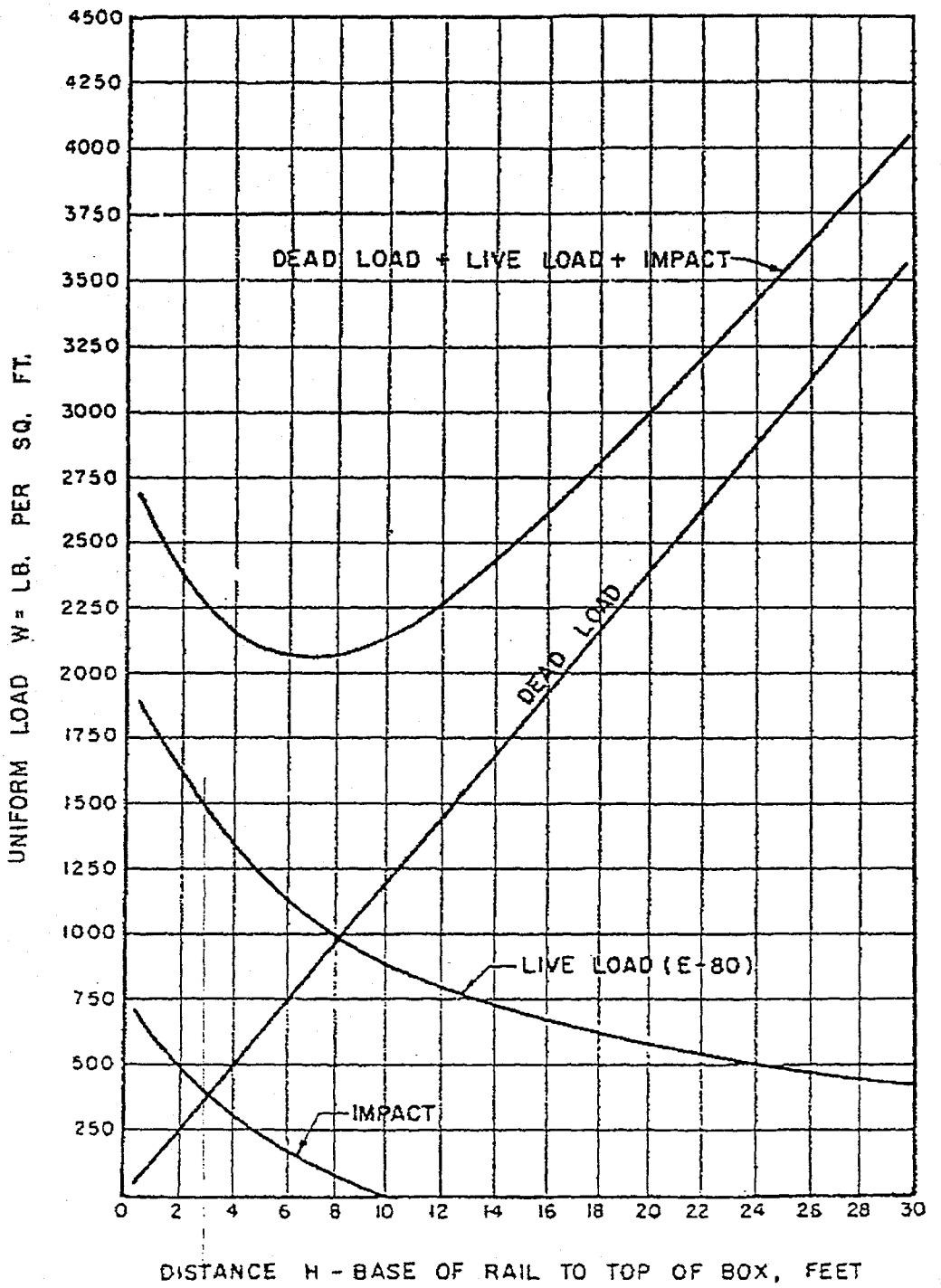
   (1) Dead load.

   (2) Live load.

   (3) Impact.

b. The uniformly distributed loads per square foot to the top of the box for various depths of fill are shown on Figure 16-1.

Figure 16-1. Uniformly Distributed Load to Top of Box



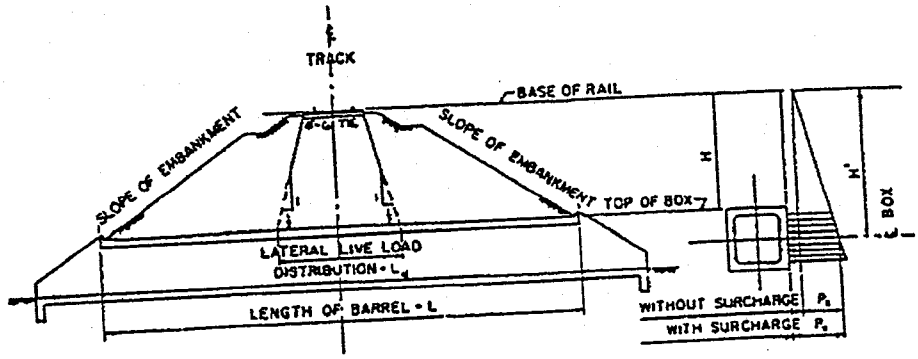
3'

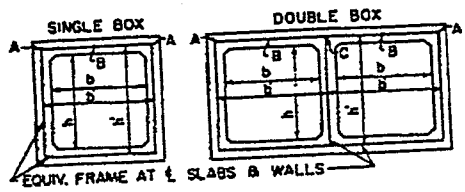
16.2.4 Dead Load (1984)

a. The dead load shall consist of the estimated weight of the track, fill and top slab of the structure distributed to the culvert as shown on Figure 16-2.

b. The minimum lateral pressure on the sides of the box shall be based on an assumed earth pressure coefficient of 0.4 and the maximum lateral pressure shall be based on an assumed earth pressure coefficient of 1.0. A lower minimum coefficient shall be used if actual conditions justify. The lateral pressures shown on each side of the box shall be assumed uniformly distributed over the entire height, equal and opposite in direction. The design equations shown inFigure 16-2 assume that the lateral pressures are uniformly distributed over the entire height. If a more exact distribution is to be used, a more rigorous analysis is required.

Figure 16-2. Distribution of Loads and Design Equations





DESIGN EQUATIONS FOR SINGLE BOX:

$$\text{MAX } M_B = \frac{Wb^2}{24}\left(\frac{1+3K}{1+K}\right) - \frac{P_e h^2}{12}\left(\frac{K}{1+K}\right) - \text{USE MIN VALUE OF } P_e$$

$$\text{MAX } M_A = \frac{Wb^2}{12}\left(\frac{1}{1+K}\right) + \frac{P_s h^2}{12}\left(\frac{K}{1+K}\right) - \text{USE MAX VALUE OF } P_e \text{ OR } P_s$$

$$V_A = \frac{Wb}{2}$$

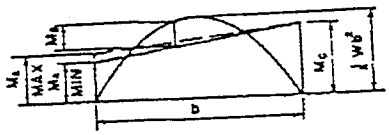
DESIGN EQUATIONS FOR DOUBLE BOX:

$$\text{MAX } M_A = \frac{Wb^2}{12}\left(\frac{1}{1+2K}\right) + \frac{P_s h^2}{6}\left(\frac{K}{1+2K}\right) - \text{USE MAX VALUE OF } P_e \text{ OR } P_s$$

$$\text{MIN } M_A = \frac{Wb^2}{12}\left(\frac{1}{1+2K}\right) + \frac{P_e h^2}{6}\left(\frac{K}{1+2K}\right) - \text{USE MIN VALUE OF } P_e$$

$$\text{MAX } M_C = \frac{Wb^2}{12}\left(\frac{1+3K}{1+2K}\right) - \frac{P_e h^2}{12}\left(\frac{K}{1+2K}\right) - \text{USE MIN VALUE OF } P_e$$

MAX M_B = (FROM MOMENT CURVE)



ASSUME M_C SAME FOR M_A MAX & M_A MIN

$$V_A = \frac{Wb}{4}\left(\frac{2+3K}{1+2K}\right) - \frac{P_s h^2}{4b}\left(\frac{K}{1+2K}\right) - \text{USE MAX VALUE OF } P_e \text{ OR } P_s$$

$$V_C = \frac{Wb}{4}\left(\frac{2+5K}{1+2K}\right) - \frac{P_e h^2}{4b}\left(\frac{K}{1+2K}\right) - \text{USE MIN VALUE OF } P_e$$

NOMENCLATURE & DESIGN CONSTANTS

Live Load = E80

Loads on Top Slab:

$W = W_{LL}(1.0 + {}^1/_{100}) + W_{DL}$ Uniform Load per Sq. Ft.

$$W_{LL} = \frac{80000}{5 \times L_d}$$

$$W_{DL} = W_e H + \frac{200}{L_d} + W_s$$

I (Impact) From 40% at H = 0.0 Ft. To 0% at H = 10 Ft.

Loads on Walls:

$P_e = k_e W_e H'$ = Uniform Load per Sq. Ft.

$$P_s = k_s W_e \left(H' + \frac{80000}{5 W_e L_d}\right) = \text{Uniform Load per Sq. Ft.}$$

I_s = Moment of Inertia of Slab—Gross Sect.

I_w = Moment of Inertia of Wall—Gross Sect.

$$S = \frac{I_s}{I_w} \qquad R = \frac{b'}{h'} \qquad K = \frac{S}{R}$$

M_A = Maximum Negative Moment at Corner.

M_B = Maximum Positive Moment in Slab.

M_C = Maximum Neg. Mom. at Center Wall.

V_A = Vertical Shear at Face of Wall.

V_C = Vertical Shear at Face of Center Wall.

W_e = Weight of Earth = 120 lb. per cu. ft.

W_s = Weight of Slab per sq. ft.

k_e = 0.4 Min., 1.0 Max.

k_s = 0.4

L_d = Lateral Live Load Distribution in feet.

16.2.5 Live Load (1984)

a. The recommended live load for each track is Cooper E 80. The distribution of the live load to the culvert shall be in accordance with Figure 16-2.

b. No increase in load shall be used for multiple track loadings. The live load will be assumed to increase the lateral pressure on the sides of the box due to a surcharge load in accordance withFigure 16-2. The lateral pressure from such surcharge load shall be calculated, using an assumed earth pressure coefficient of 0.4, or lower if actual conditions justify.

16.2.6 Impact (1984)

a. Impact forces shall be added to the live load as specified inFigure 16-2 . They shall be distributed the same as the live load.

b. No impact shall be added to the lateral forces on the sides of box.

16.2.7 Other Forces (1984)

In general, centrifugal forces, wind force and longitudinal forces resulting from starting and stopping of trains need not be considered.

QUANTITIES:

	Structural Excavation (cubic meters)	Structural Backfill (cubic meters)	Concrete (27 MPa) (cubic meters)	Concrete (20 Mpa) (cubic meters)	Reinforcing Steel (kg)
Reinforced Concrete Box	365	110	96	--	12180
Channel Transition					
Retaining Wall 0+016.500 to 0+036.500	303	140	--	66	5420
Retaining Wall 1+042.181 to 1+062.261	355	141	--	72	5622
Retaining Wall 2+014.675 to 2+034.768	253	141	--	61	5284
Retaining Wall 2+802.422 to 2+822.742	256	142	--	62	5344
Gate Structure 101	--	--	--	6	267
Gate Structure 102	--	--	--	6	295
Gate Structure 103	--	--	--	6	295
Gate Structure 104	--	--	--	27	921

File		Job No.	No.

Computation

HDR

Project	SANTAN	Computed JKE	Date 2/20/98
Subject	Basin Piping Headwalls w/ Trashrack #1,2,4	Checked	Date
Task	Quantities (Reinforcement)	Sheet 1	of 1

Longitudinal

LOCATION	Size English Bar	Length Meters	Num.	Linear Meters	Weight kg/m	TOTAL kg
Left Side Wall	4	1.74	9	16	0.994	15.53
Right Side Wall	4	1.74	9	16	0.994	15.53
Back Wall	4	1.74	8	14	0.994	13.80
Partial bars	4	1.09	2	2	0.994	2.16
Bottom	4	1.30	5	7	0.994	6.47
Front Wall	4	0.51	6	3	0.994	3.03
	4					

Transverse

Left Side Wall	4	2.23	7	16	0.994	15.49
Corner bars	4	0.91	14	13	0.994	12.72
Right Side Wall	4	2.23	7	16	0.994	15.49
Corner bars	4	0.91	14	13	0.994	12.72
Back Wall	4	1.32	8	11	0.994	10.50
Partial bars	4	1.10	2	2	0.994	2.18
	4	0.60	1	1	0.994	0.59
Diagonal	4	0.90	8	7	0.994	7.16
Bottom	4	1.12	6	7	0.994	6.66
Front Wall	4	1.30	3	4	0.994	3.88

143.93
14.53
158.46 kg ⇒
160 kg

File | Job No. | No.

Computation

Projec SANTAN | Computed JKE | Date 2/20/98

Subjec Basin Piping Headwalls w/ Trashrack #3 | Checked | Date

Task Quantities (Reinforcement) | Sheet | Of

Longitudinal

LOCATION	Size English Bar	Length Meters	Num.	Linear Meters	Weight kg/m	TOTAL kg
Left Side Wall	4	2.03	9	18	0.994	18.15
Right Side Wall	4	2.03	9	18	0.994	18.15
Back Wall	4	2.03	8	16	0.994	16.13
partial bars	4	0.53	1	1	0.994	0.53
	4	0.67	2	1	0.994	1.33
	4	1.24	2	2	0.994	2.47
Bottom	4	2.34	5	12	0.994	11.61
Front Wall	4	0.72	9	6	0.994	6.40

Transverse

Left Side Wall	4	2.23	8	18	0.994	17.70
Corner bars	4	0.91	16	15	0.994	14.47
Right Side Wall	4	2.23	8	18	0.994	17.70
Corner bars	4	0.91	16	15	0.994	14.54
Back Wall	4	2.34	8	19	0.994	18.58
Corner bars	4	1.18	2	2	0.994	2.35
	4	0.88	2	2	0.994	1.74
Diagonal	4	1.60	8	13	0.994	12.72
Bottom	4	1.12	9	10	0.994	9.99
Front Wall	4	3.39	4	14	0.994	13.46

198.01

14.53

212.54 kg

Job No. 0172-160-044 | No.

Computation

Project	SANTAN OUTFALL CHANNEL	Computed JKE	Date 1/27/98
Subject	Basin Piping	Checked DJS	Date 1/27/98
Task	Excavation and Backfill	Sheet 1	Of 2

Assumptions:
MAG SPEC 601
Vertical Trench
Granular Bedding to Springline
150 mm of Bedding Under Pipe
610mm pipe 76mm Wall Thickness
1370mm pipe 248mm Wall Thickness

Excavation= (((Gound1-(Inv1-Wall-Bed))+(Ground 2-(Inv2-Wall-Bed))/2) * Width * Length

Backfill = (((Gound1-(Inv1+Size/2))+(Ground 2-(Inv2+Size/2)))/2) *Width*Length-((PI*(OD/2)^2)/2)

Station	Size	Ground Elev	Invert	Width of Trench	Length	Excavation	Backfill
0+015.0 15.5 LT to 0+015.0 0m Rt	610	348 353.3	346.75 346.67	1245	16.0	83.02	72.21
0+015.0 0m Rt to 0+65.0 0m Rt	610	353.2 353.3	346.67 346.44	1245	50.0	431.21	397.67
0+65.0 0m Rt to 0+115.0 0m Rt	610	353.3 353.4	346.44 346.2	1245	50.0	452.03	418.5
0+115.0 0m Rt to 0+165.0 0m Rt	610	353.4 353.5	346.2 345.97	1245	50.0	472.76	439.23
0+165.0 0m Rt to 0+215.0 0m Rt	610	353.5 353.65	345.97 345.74	1245	50.0	495.04	461.51
0+215.0 0m Rt to 0+265.0 0m Rt	610	353.65 353.8	345.74 345.23	1245	50.0	527.41	493.88
0+265.0 0m Rt to 0+315.0 0m Rt	610	353.8 354	345.23 345.27	1245	50.0	552.81	519.28
0+315.0 0m Rt to 0+365.0 0m Rt	610	354 354	345.27 345.03	1245	50.0	565.14	531.60
0+365.0 0m Rt to 0+415.0 0m Rt	610	354 354	345.03 344.80	1245	50.0	579.77	546.23
0+415.0 0m Rt to 0+465.0 0m Lt	610	354 354	344.80 344.57	1245	50.0	594.24	560.71
0+465.0 15.5m Lt to 0+465.0 0m Rt	610	348 354	346.75 344.57	1245	16.0	111	100.12

Job No. 0172-160-044 No.

Computation

Project SANTAN OUTFALL CHANNEL

Subject Basin Piping

Task Excavation, Bedding and Backfill

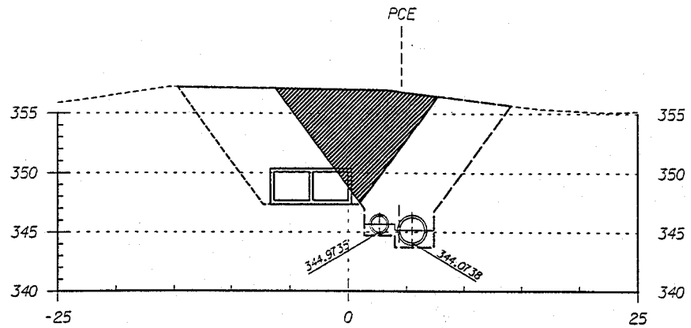
Computed JKE Date 1/27/98

Checked DJS Date 1/27/98

Sheet 2 Of 2

Station	Size	Ground Elev	Invert	Width of Trench	Length	Excavation	Backfill
0+465.0 0m Rt to 0+465.0 35.9m Rt	610	354 345.5	344.57 344.4	1245	36.0	246.31	222.1
0+437.1 36.7 m Rt to 0+403.6 3m Rt	1370	345.5 353.8	343.78 343.49	2800	50.0	897.96	745.27
0+403.6 3m Rt to 0+353.6 3m Rt	1370	353.8 353.83	343.49 343.20	2800	50.0	1521.7	1369
0+353.6 3m Rt to 0+303.6 3m Rt	1370	353.83 353.86	343.20 342.91	2800	50.0	1566.5	1413.8
0+303.6 3m Rt to 0+253.6 3m Rt	1370	353.86 353.89	342.91 342.62	2800	50.0	1611.2	1458.5
0+253.6 3m Rt to 0+223.6 3m Rt	1370	353.89 353.92	342.62 342.46	2800	30.0	988.3	896.26
0+223.6 3m Rt to 0+173.6 3m Rt	1370	353.92 353.95	342.46 342.16	2800	50.0	1683.9	1531.2
0+173.6 3m Rt to 0+123.6 3m Rt	1370	353.95 354	342.16 341.86	2800	50.0	1730.9	1578.2
0+123.6 3m Rt to 0+123.6 10.6m Rt	1370	354 354	341.86 341.82	2800	8	275.68	250.35
0+240.0 33.4m Lt to 0+219.3 33.4 m Lt	610	354 347.5	347.04 347.00	1245	21	103.55	89.33
0+240.0 33.4m Lt to 0+260.8 33.4m Lt	610	354 347.5	347.04 347.00	1245	21	103.55	89.33
0+240.0 27.5m Rt to 0+240.0 33.4m Lt	610	348 354	347.15 347.04	1245	61	313.96	273.10

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-7-502			
		202L MA 050			

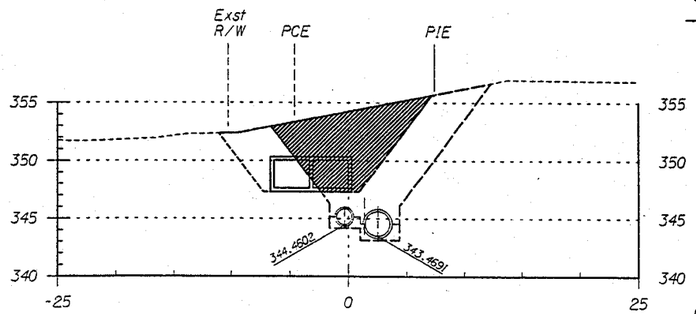


SANTAN 1+140 = P-MIP 0+938.5939

G) P-MIP AREA = 147.3542 M^2
H) SANTAN AREA = 149.4076 M^2
K) SHARED AREA = 67.2973 M^2
NET TOTAL AREA (G+H)-K = 229.4645 M^2
NET P-MIP AREA (G-K) = 80.0569 M^2
NET SANTAN AREA (H-K) = 82.1103 M^2

VOLUMES
P-MIP VOLUME (D+G)/2 x 30 = 4020.4005 M^3
+ SANTAN VOLUME (E+H)/2 x 30 = 3503.9235 M^3
- SHARED VOLUME (F+K)/2 x 30 = 1886.3655 M^3
NET TOTAL VOLUME = 5638 M^3

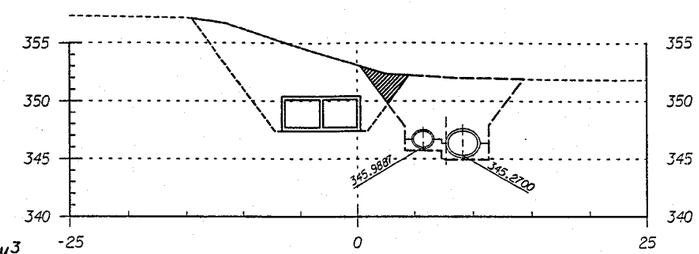
TOTAL VOLUMES
+ SANTAN VOLUME = 13273.3080 M^3
P-MIP VOLUME = 14370.9105 M^3
- SHARED VOLUME = 5728.0170 M^3
TOTAL EXCAVATION VOLUME = 21916.2015 M^3



SANTAN 1+110 = P-MIP 0+968.0934

D) P-MIP AREA = 120.6725 M^2
E) SANTAN AREA = 84.1873 M^2
F) SHARED AREA = 58.4604 M^2
NET TOTAL AREA (D+E)-F = 146.3994 M^2
NET P-MIP AREA (D-F) = 62.2121 M^2
NET SANTAN AREA (E-F) = 25.7269 M^2

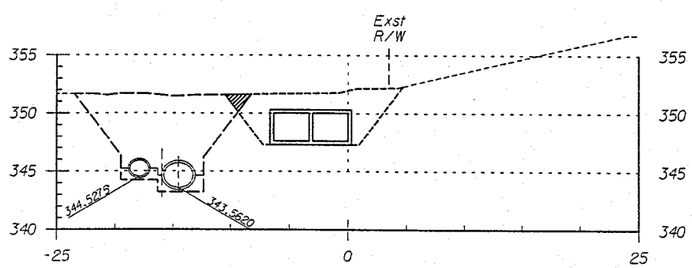
VOLUMES
P-MIP VOLUME (A+D)/2 x 30 = 2986.5945 M^3
+ SANTAN VOLUME (B+E)/2 x 30 = 2054.8080 M^3
- SHARED VOLUME (C+F)/2 x 30 = 902.3070 M^3
NET TOTAL VOLUME = 4139 M^3



SANTAN 1+200 = P-MIP 0+880.2461

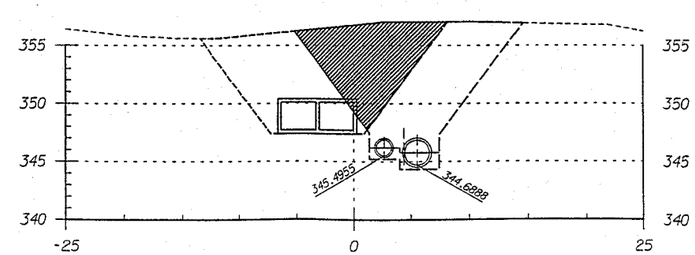
P) P-MIP AREA = 63.0507 M^2
Q) SANTAN AREA = 93.9349 M^2
R) SHARED AREA = 5.4512 M^2
NET TOTAL AREA (P+Q)-R = 151.5344 M^2
NET P-MIP AREA (P-R) = 57.5995 M^2
NET SANTAN AREA (Q-R) = 88.4837 M^2

VOLUMES
P-MIP VOLUME (L+P)/2 x 30 = 3049.6815 M^3
+ SANTAN VOLUME (M+Q)/2 x 30 = 3441.2430 M^3
- SHARED VOLUME (N+R)/2 x 30 = 1005.8265 M^3
NET TOTAL VOLUME = 5485 M^3



SANTAN 1+080 = P-MIP 1+004.7174

A) P-MIP AREA = 78.4338 M^2
B) SANTAN AREA = 52.7999 M^2
C) SHARED AREA = 1.6934 M^2
NET TOTAL AREA (A+B)-C = 129.5403 M^2
NET P-MIP AREA (A-C) = 76.7404 M^2
NET SANTAN AREA (B-C) = 51.1065 M^2



SANTAN 1+170 = P-MIP 0+908.5939

L) P-MIP AREA = 140.2614 M^2
M) SANTAN AREA = 135.4813 M^2
N) SHARED AREA = 61.6039 M^2
NET TOTAL AREA (L+M)-N = 214.1388 M^2
NET P-MIP AREA (L-N) = 78.6575 M^2
NET SANTAN AREA (M-N) = 73.8774 M^2

VOLUMES
P-MIP VOLUME (G+L)/2 x 30 = 4314.2340 M^3
+ SANTAN VOLUME (H+M)/2 x 30 = 4273.3335 M^3
- SHARED VOLUME (K+N)/2 x 30 = 1933.5180 M^3
NET TOTAL VOLUME = 6654 M^3

	NAME	DATE
DESIGN	JJZ	02-98
DRAWN	KAJ	02-98
CHECKED	JJZ	02-98

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
AND
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

I-10 CROSSING
EARTHWORK QUANTITIES

ROUTE 202L
LOCATION SANTAN OUTFALL CHANNEL & P-MIP PIPELINES

PRELIMINARY
95%
Review
NOT FOR CONSTRUCTION OR RECORDING

TRACS NO. H4314 02 C | 600-7-502 | ___ OF ___

Metric

CCCCCSYSTIMECCCCCCCCCCDGNCSPECIFICATIONCCCCC

VIEW NAME:

SURVEY NO.	FINISHED PLANS	REVISIONS	LOCATION	DATE

FILE: C:\SANTAN\DGN\I-10\ERTH.DGN
DATE: 20-JAN-98 12:50

HDR Computation

HDR

Project P-MIP Ph. I		Computed RDT	Date 1/26/98
Subject 100% Quantities		Checked	Date
Task Notes & Equations		Sheet 1	Of 23

LOW HEAD PIPE

Trench IE = Pipe IE - Wall Thickness - Clearance
= Pipe IE - 0.203 - 0.152
= Pipe IE - 0.355

d = depth = Ground El. - Trench IE
W = 3.376 m, see attached sketches

Area of pipe (based on outer dia)

$$A_L = \frac{\pi d^2}{4} = \frac{\pi (2.54)^2}{4} = 5.067\ m^2$$

Bedding Area = 1.294 m^2
- electronically planimetered, see attached sketches

Exc. Area = d · W

BackFill Area = Exc. Area - Bedding Area - Pipe Area

Slurry Area = (d · W) - Area of Pipe

HIGH HEAD PIPE

Trench IE = Pipe IE - Wall Thickness - Clearance
= Pipe IE - 0.140 - 0.102
= Pipe IE - 0.242

Area of Pipe (based on outer dia).

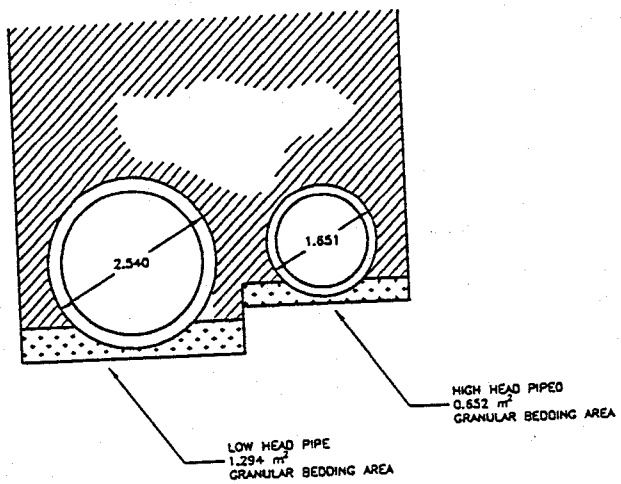
$$A_H = \frac{\pi d^2}{4} = \frac{\pi (1.651)^2}{4} = 2.141\ m^2$$

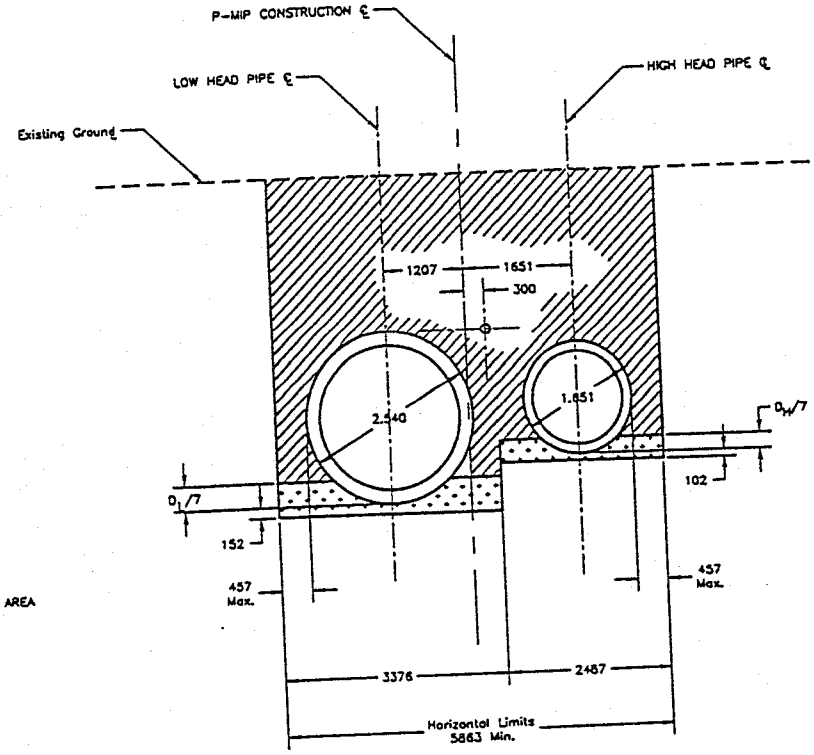
Bedding Area = 0.652 m^2

Slurry Area = (d · w) - Area of Pipe

P-MIP Ph. I
100% Quantities
Design Sketches

Computed: RDT Date: 1/26/98
Sheet 2 of 22



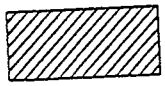


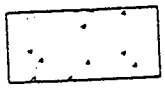
TRENCH TYPE "A"
(Type I Compaction)

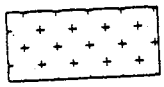
(N.T.S)

Trench Type Locations

From Sta.	To Sta.	Trench Type	Comments
0+000	0+051.2	A	
0+051.2	0+078.6	B	UPRR
0+078.6	0+878	A	56th Str.
0+878	0+959	B	I-10
0+959	0+992	C	I-10
0+992	1+004.3	B	I-10
1+004.3	1+040.958	A	


Pipe Backfill


One Sack ABC Slurry per MAG Section 728


Granular Bedding

P-MIP Ph. I
100% Quantities
Design Sketches

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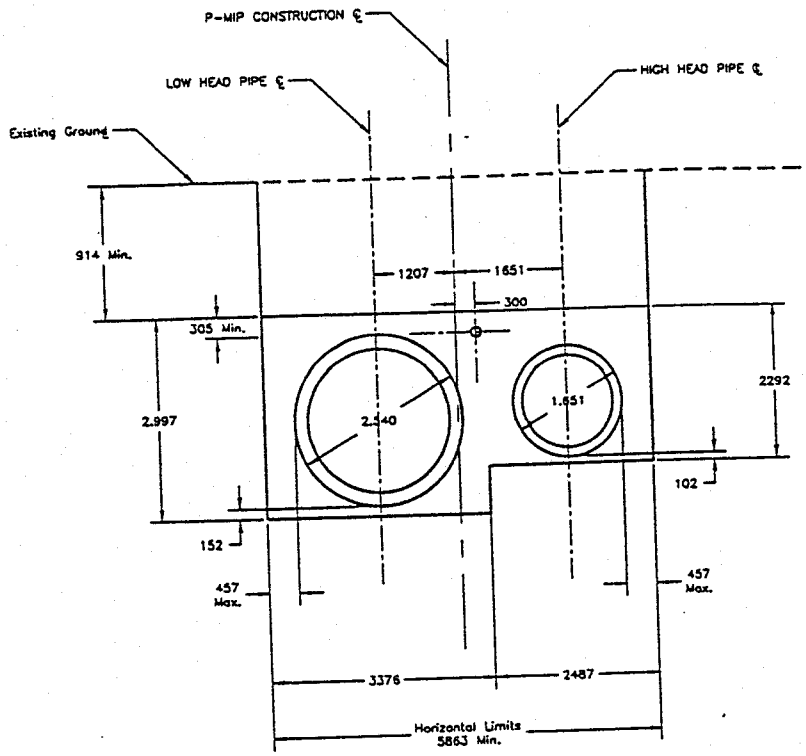
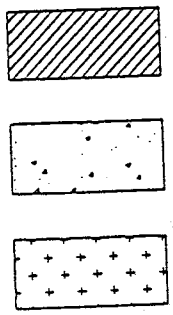


TRENCH TYPE "B"
(Type I Compaction)
(N.T.S)

Trench Type Locations

From Sta.	To Sta.	Trench Type	Comments
0+000	0+051.2	A	
0+051.2	0+078.6	B	UPRR
0+078.6	0+878	A	56th Str.
0+878	0+959	B	I-10
0+959	0+992	C	I-10
0+992	1+004.3	B	I-10
1+004.3	1+040.958	A	



P-MIP Ph. I
100% Quantities
Design Sketches

Computed: RDT Date: 1/26/98
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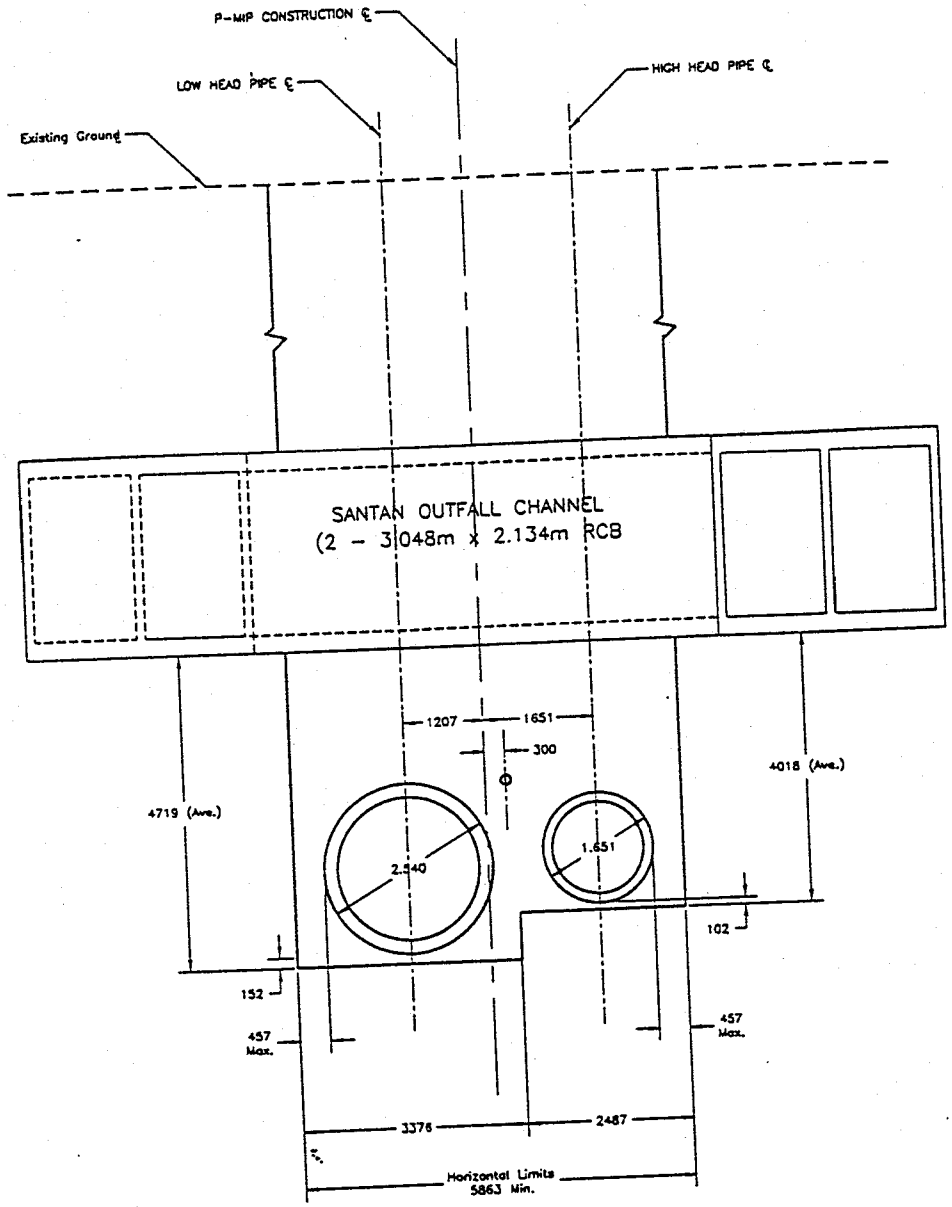
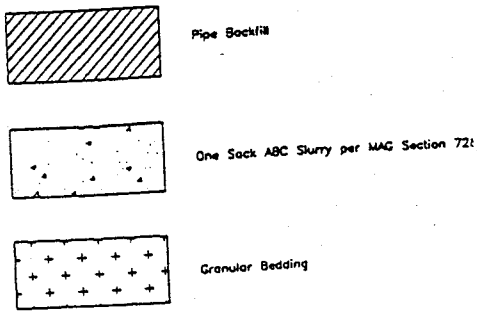


TRENCH TYPE "C"
(Type I Compaction)
(N.T.S)



Trench Type Locations

From Sta.	To Sta.	Trench Type	Comments
0+000	0+051.2	A	
0+051.2	0+078.6	B	UPRR
0+078.6	0+878	A	56th Str.
0+878	0+959	B	I-10
0+959	0+992	C	I-10
0+992	1+004.3	B	I-10
1+004.3	1+040.958	A	

HDR Engineering, Inc.
Computation

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Task	Low Head Pipe	Sheet	5 of 22

PIPE SEGMENT NO. 1 LOW HEAD PIPE STA. 0+000 TO STA. 0+051.2
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
0	351.2	347.145	346.790	4.410	3.376	14.888		
							51.200	791
51.2	351.5	347.114	346.759	4.741	3.376	16.006		

TOTAL PIPE EXCAVATION THIS SEGMENT 791

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
0	14.888	6.364	8.524		
				51.200	465
51.2	16.006	6.364	9.642		

TOTAL PIPE BACKFILL THIS SEGMENT 465

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
51.2	1.294	66

TOTAL PIPE BEDDING THIS SEGMENT 66

MANHOLES MH1 Sta. 0+006

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

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Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	6 of 22

PIPE SEGMENT NO. 2 LOW HEAD PIPE

STA. 0+051.2 TO STA. 0+078.6
Trench Type B

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
51.2	351.5	347.114	346.759	4.741	3.376	16.006		
							12.500	207
63.7	351.8	347.105	346.750	5.050	3.376	17.049		
							14.900	244
78.6	351.4	347.094	346.739	4.661	3.376	15.736		

TOTAL PIPE EXCAVATION THIS SEGMENT 451

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
51.2	16.006	10.118	5.888		
				12.500	80
63.7	17.049	10.118	6.931		
				14.900	93
78.6	15.736	10.118	5.618		

TOTAL PIPE BACKFILL THIS SEGMENT 80

ONE SACK ABC SLURRY

Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
27.400	5.051	138

TOTAL SLURRY THIS SEGMENT 138

HDR Engineering, Inc.
Computation

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Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	7 of 22

PIPE SEGMENT NO. 3 LOW HEAD PIPE

STA. 0+078.6 TO STA. 0+816.5
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
78.6	351.4	347.094	346.739	4.661	3.376	15.736		
							54.900	867
133.5	351.4	347.056	346.701	4.699	3.376	15.865		
							12.500	194
146	351.2	347.047	346.692	4.508	3.376	15.220		
							154.000	2372
300	351.2	346.939	346.584	4.616	3.376	15.584		
							18.000	299
318	351.8	346.926	346.571	5.229	3.376	17.652		
							10.000	168
328	351.3	346.919	346.564	4.736	3.376	15.987		
							152.000	2509
480	351.5	346.813	346.458	5.042	3.376	17.022		
							120.000	2080
600	351.6	346.727	346.372	5.228	3.376	17.650		
							216.500	3986
816.5	351.9	346.577	346.222	5.678	3.376	19.169		

TOTAL PIPE EXCAVATION THIS SEGMENT 12475

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I
Subject	100% Quantities
Task	Low Head Pipe

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PIPE SEGMENT NO. 3 LOW HEAD PIPE

STA. 0+078.6 TO STA. 0+816.5
Trench Type A

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
78.6	15.736	6.361	9.375		
				54.900	518
133.5	15.865	6.361	9.504		
				12.500	115
146	15.220	6.361	8.859		
				154.000	1392
300	15.584	6.361	9.223		
				18.000	185
318	17.652	6.361	11.291		
				10.000	105
328	15.987	6.361	9.626		
				152.000	1542
480	17.022	6.361	10.661		
				120.000	1317
600	17.650	6.361	11.289		
				216.500	2608
816.5	19.169	6.361	12.808		

TOTAL PIPE BACKFILL THIS SEGMENT 7782

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
737.9	1.294	955

TOTAL PIPE BEDDING THIS SEGMENT 955

MANHOLES MH2 Sta. 0+814.0

HDR Engineering, Inc.
Computation

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Task	Low Head Pipe	Sheet	9 of 22

PIPE SEGMENT NO. 4 LOW HEAD PIPE STA. 0+816.5 TO STA. 0+878
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
816.5	351.9	346.577	346.222	5.678	3.376	19.169		
							61.500	1320
878	352	345.316	344.961	7.039	3.376	23.763		

TOTAL PIPE EXCAVATION THIS SEGMENT 1320

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
816.5	19.169	6.361	12.808		
				61.500	929
878	23.763	6.361	17.402		

TOTAL PIPE BACKFILL THIS SEGMENT 929

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
61.500	1.294	80

TOTAL PIPE BEDDING THIS SEGMENT 80

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I
Subject	100% Quantities
Task	Low Head Pipe

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PIPE SEGMENT NO. 5 LOW HEAD PIPE

STA. 0+878 TO STA. 0+961.6
Trench Type B
Trench Type C

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
878	352	345.316	344.961	7.039	3.376	23.764		
							15.000	486
893	356.8	345.009	344.654	12.147	3.376	41.007		
							66.000	2790
959	356.2	343.656	343.301	12.900	3.376	43.549		
							2.600	111
961.6	355.6	343.602	343.247	12.353	3.376	41.704		

TOTAL PIPE EXCAVATION THIS SEGMENT 3387

PIPE BACKFILL

Trench Type	Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
	878	23.764	10.118	13.646		
B					15.000	334
	893	41.007	10.118	30.889		
B					66.000	2123
	959	43.549	10.118	33.431		
C					2.600	77
	961.6	41.704	15.931	25.772		

TOTAL PIPE BACKFILL THIS SEGMENT 2534

ONE SACK ABC SLURRY

From Sta.	To Sta.	Trench Type	Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
878.0	959.0	B	81.000	5.051	409
959.0	961.6	C	2.600	10.864	28

TOTAL SLURRY THIS SEGMENT 437

HDR Engineering, Inc.
Computation

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Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	11 of 22

PIPE SEGMENT NO. 6 LOW HEAD PIPE

STA. 0+961.6 TO STA. 1+004.3
Trench Type C
Trench Type B

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
961.6	356	343.602	343.247	12.753	3.376	43.054		
							30.400	1091
992	351.7	343.538	343.183	8.517	3.376	28.753		
							12.300	352
1004.3	351.6	343.512	343.157	8.443	3.376	28.504		

TOTAL PIPE EXCAVATION THIS SEGMENT 1444

PIPE BACKFILL

Trench Type	Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
C	961.6	43.054	15.931	27.123		
					30.400	607
C	992	28.753	15.931	12.822		
					12.300	192
B	1004.3	28.504	10.118	18.386		

TOTAL PIPE BACKFILL THIS SEGMENT 799

ONE SACK ABC SLURRY

From Sta.	To Sta.	Trench Type	Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
961.6	992.0	C	30.400	10.864	330
992.0	1004.3	B	12.300	5.051	62

TOTAL SLURRY THIS SEGMENT 392

SIPHON DRAIN STA. 1+003.9

HDR Engineering, Inc.
Computation

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Task	Low Head Pipe	Sheet	12 of 22

PIPE SEGMENT NO. 7 LOW HEAD PIPE

STA. 1+004.3 TO STA. 1+034.8
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
1004.3	351.6	343.512	343.157	8.443	3.376	28.504		
							15.700	398
1020	351.6	345.393	345.038	6.562	3.376	22.153		
							14.800	279
1034.8	351.4	347.168	346.813	4.587	3.376	15.486		

TOTAL PIPE EXCAVATION THIS SEGMENT 676

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
1004.3	28.504	6.361	22.143		
				15.700	298
1020	22.153	6.361	15.792		
				14.800	184
1034.8	15.486	6.361	9.125		

TOTAL PIPE BACKFILL THIS SEGMENT 482

PIPE BEDDING

From Sta.	To Sta.	Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
1004.3	1034.8	30.5	1.294	39

TOTAL PIPE BEDDING THIS SEGMENT 39

HDR Engineering, Inc.
Computation

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PIPE SEGMENT NO. 8 LOW HEAD PIPE

STA. 1+034.8 TO STA. 1+040.958
Trench Type E

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
1034.8	351.4	347.168	346.813	4.587	3.376	15.486		
							6.158	96
1040.958	351.4	347.146	346.791	4.609	3.376	15.560		

TOTAL PIPE EXCAVATION THIS SEGMENT 96

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
1034.8	15.486	6.361	9.125		
				6.158	56
1040.958	15.560	6.361	9.199		

TOTAL PIPE BACKFILL THIS SEGMENT 56

PIPE BEDDING

From Sta.	To Sta.	Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
1034.8	1040.958	6.158	1.294	8

TOTAL PIPE BACKFILL THIS SEGMENT 8

MANHOLES MH 3 STA. 1+035.0
MH 4 STA. 1+498.2

HDR Engineering, Inc.
Computation

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PIPE SEGMENT NO. 9 HIGH HEAD PIPE

STA. 0+000 TO STA. 0+051.2
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
0	351.2	347.752	347.510	3.690	2.487	9.177		
							51.200	492
51.2	351.5	347.706	347.464	4.036	2.487	10.038		

TOTAL PIPE EXCAVATION THIS SEGMENT 492

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
0	9.177	2.793	6.384		
				51.200	349
51.2	10.038	2.793	7.245		

TOTAL PIPE BACKFILL THIS SEGMENT 349

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
51.2	0.652	33

TOTAL PIPE BEDDING THIS SEGMENT 33

MANHOLES MH5 Sta. 0+003.7

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
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PIPE SEGMENT NO. 10 HIGH HEAD PIPE

STA. 0+051.2 TO STA. 0+078.6
Trench Type B

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
51.2	351.5	347.706	347.464	4.036	2.487	10.038		
							12.500	130
63.7	351.8	347.695	347.453	4.347	2.487	10.811		
							14.900	154
78.6	351.4	347.681	347.439	3.961	2.487	9.851		

TOTAL PIPE EXCAVATION THIS SEGMENT 284

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
51.2	10.038	5.700	4.337		
				12.500	59
63.7	10.811	5.700	5.111		
				14.900	69
78.6	9.851	5.700	4.151		

TOTAL PIPE BACKFILL THIS SEGMENT 59

ONE SACK ABC SLURRY

Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
27.400	3.559	98

TOTAL SLURRY THIS SEGMENT 98

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed		RDT	1/23/98
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Task	Low Head Pipe	Sheet	16	of	22

PIPE SEGMENT NO. 11 HIGH HEAD PIPE

STA. 0+078.6 TO STA. 0+821.4
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
78.6	351.4	347.681	347.439	3.961	2.487	9.851		
							54.900	544
133.5	351.4	347.632	347.390	4.010	2.487	9.974		
							12.500	122
146	351.2	347.620	347.378	3.822	2.487	9.504		
							154.000	1490
300	351.2	347.482	347.240	3.960	2.487	9.849		
							18.000	191
318	351.8	347.466	347.224	4.576	2.487	11.382		
							10.000	108
328	351.3	347.457	347.215	4.085	2.487	10.161		
							152.000	1608
480	351.5	347.320	347.078	4.422	2.487	10.998		
							120.000	1351
600	351.6	347.212	346.970	4.630	2.487	11.515		
							221.400	2687
821.4	351.9	347.013	346.771	5.129	2.487	12.756		

TOTAL PIPE EXCAVATION THIS SEGMENT **8101**

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	17 of 22

PIPE SEGMENT NO. 11 HIGH HEAD PIPE

STA. 0+078.6 TO STA. 0+821.4
Trench Type A

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
78.6	9.851	2.793	7.058		
				54.900	391
133.5	9.974	2.793	7.181		
				12.500	87
146	9.504	2.793	6.711		
				154.000	1060
300	9.849	2.793	7.056		
				18.000	141
318	11.382	2.793	8.589		
				10.000	80
328	10.161	2.793	7.368		
				152.000	1184
480	10.998	2.793	8.205		
				120.000	1016
600	11.515	2.793	8.722		
				221.400	2068
821.4	12.756	2.793	9.963		

TOTAL PIPE BACKFILL THIS SEGMENT 6026

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
742.8	0.652	484

TOTAL PIPE BEDDING THIS SEGMENT 484

MANHOLES MH6 Sta. 0+819.5

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I
Subject	100% Quantities
Task	Low Head Pipe

Computed		RDT	1/23/98
Checked			
Sheet	18	of	22

PIPE SEGMENT NO. 12 HIGH HEAD PIPE

STA. 0+821.4 TO STA. 0+878
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
821.4	351.9	347.013	346.771	5.129	2.487	12.756		
							56.600	728
878	352	347.028	346.786	5.214	2.487	12.967		

TOTAL PIPE EXCAVATION THIS SEGMENT 728

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
821.4	12.756	2.793	9.963		
				56.600	570
878	12.967	2.793	10.174		

TOTAL PIPE BACKFILL THIS SEGMENT 570

PIPE BEDDING

Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
56.600	0.652	37

TOTAL PIPE BEDDING THIS SEGMENT 37

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	19 of 22

PIPE SEGMENT NO. 13 HIGH HEAD PIPE

STA. 0+878 TO STA. 0+961.6
Trench Type B
Trench Type C

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
878	352	346.028	345.786	6.214	2.487	15.454		
							15.000	326
893	356.8	345.767	345.525	11.275	2.487	28.041		
							66.000	1896
959	356.2	344.619	344.377	11.823	2.487	29.405		
							2.600	75
961.6	355.6	344.547	344.305	11.295	2.487	28.091		

TOTAL PIPE EXCAVATION THIS SEGMENT 2297

PIPE BACKFILL

Trench Type	Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
	878	15.454	5.700	9.754		
B					15.000	241
	893	28.041	5.700	22.341		
B					66.000	1519
	959	29.405	5.700	23.705		
C					2.600	54
	961.6	28.091	9.993	18.098		

TOTAL PIPE BACKFILL THIS SEGMENT 1815

ONE SACK ABC SLURRY

From Sta.	To Sta.	Trench Type	Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
878.0	959.0	C	81.000	3.559	288
959.0	961.6	D	2.600	7.852	20

TOTAL SLURRY THIS SEGMENT 309

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	20 of 22

PIPE SEGMENT NO. 14 HIGH HEAD PIPE

STA. 0+961.6 TO STA. 1+004.3
Trench Type C
Trench Type B

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
961.6	356	344.574	344.332	11.668	2.487	29.018		
							30.400	722
992	351.7	344.498	344.256	7.444	2.487	18.513		
							12.300	227
1004.3	351.6	344.467	344.225	7.375	2.487	18.342		

TOTAL PIPE EXCAVATION THIS SEGMENT 949

PIPE BACKFILL

Trench Type	Sta.	Exc. Area (m^2)	Slurry Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
C	961.6	29.018	9.993	19.026		
					30.400	419
C	992	18.513	9.993	8.520		
					12.300	130
B	1004.3	18.342	5.700	12.641		

TOTAL PIPE BACKFILL THIS SEGMENT 549

ONE SACK ABC SLURRY

From Sta.	To Sta.	Trench Type	Length (m)	Slurry Area (m^2)	Bedding Volume (m^3)
961.6	992.0	C	30.400	7.852	239
992.0	1004.3	B	12.300	3.559	44

TOTAL SLURRY THIS SEGMENT 282

SIPHON DRAIN STA. 1+003.9

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	21 of 22

PIPE SEGMENT NO. 15 HIGH HEAD PIPE

STA. 1+004.3 TO STA. 1+028.7
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
1004.3	351.6	344.467	344.225	7.375	2.487	18.342		
							15.700	244
1020	351.6	346.744	346.502	5.099	2.487	12.680		
							8.700	95
1028.7	351.4	348.005	347.763	3.637	2.487	9.045		

TOTAL PIPE EXCAVATION THIS SEGMENT 338

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
1004.3	18.342	2.793	15.549		
				15.700	200
1020	12.680	2.793	9.887		
				8.700	70
1028.7	9.045	2.793	6.252		

TOTAL PIPE BACKFILL THIS SEGMENT 270

PIPE BEDDING

From Sta.	To Sta.	Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
1004.3	1028.7	24.4	0.652	16

TOTAL PIPE BEDDING THIS SEGMENT 16

HDR Engineering, Inc.
Computation

Job No.	07814-015-044	No.

Project	P-MIP Ph I	Computed	RDT 1/23/98
Subject	100% Quantities	Checked	
Task	Low Head Pipe	Sheet	22 of 22

PIPE SEGMENT NO. 16 HIGH HEAD PIPE

STA. 1+028.7 TO STA. 1+034.158
Trench Type A

PIPE EXCAVATION

Sta.	Ground El.	Pipe IE	Trench IE	d (m)	w (m)	Exc. Area (m^2)	Length (m)	Exc. Volume (m^3)
1028.7	351.4	348.005	347.763	3.637	2.487	9.045		
							5.458	49
1034.158	351.4	347.998	347.756	3.644	2.487	9.063		

TOTAL PIPE EXCAVATION THIS SEGMENT 49

PIPE BACKFILL

Sta.	Exc. Area (m^2)	Bedding Area + Pipe Area (m^2)	Backfill Area (m^2)	Length (m)	Backfill Volume (m^3)
1028.7	9.045	2.793	6.252		
				5.458	34
1034.158	9.063	2.793	6.270		

TOTAL PIPE BACKFILL THIS SEGMENT 34

PIPE BEDDING

From Sta.	To Sta.	Length (m)	Bedding Area (m^2)	Bedding Volume (m^3)
1028.7	1034.158	5.458	0.652	4

TOTAL PIPE BEDDING THIS SEGMENT 4

MANHOLES MH 7 STA. 1+030.5

SANTAN CHANNEL DETOURS - CIVIL WORK - CONSTRUCTION COST ESTIMATES

PROJ. NO. 1 SANTAN CHANNEL - 56TH ST. DETOUR - CONSTRUCTION COST ESTIMATE

ITEM NO.	ADOT NO.	DESCRIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	COST
1	2030301	ROADWAY EXCAVATION	m3	496	$ 5.50	$ 2,728.00
2	3030022	AGGREGATE BASE, CLASS 2 (200mm)	m3	528	$ 25.00	$ 13,200.00
3 *	4090003	ASPHALTIC CONCRETE (MISCELLANEOUS STRUCTURAL) (125mm)	m2	2640	$ 10.60	$ 27,984.00
		TOTAL				**$ 43,912.00**

*** Includes Removal and Disposal of Temporary Pavement**

PROJ. NO. 2 SANTAN CHANNEL - I-10 WESTBOUND DETOUR - CONSTRUCTION COST ESTIMATE

ITEM NO.	ADOT NO.	DESCRIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	COST
1	2030301	ROADWAY EXCAVATION	m3	5892	$ 5.50	$ 32,406.00
2	3030022	AGGREGATE BASE, CLASS 2 (200mm)	m3	1231	$ 25.00	$ 30,775.00
3 *	4090003	ASPHALTIC CONCRETE (MISCELLANEOUS STRUCTURAL) (125mm)	m2	6155	$ 10.60	$ 65,243.00
4	5010011	PIPE, CORRUGATED METAL, 600mm	m	310	$ 130.00	$ 40,300.00
		TOTAL				**$ 168,724.00**

*** Includes Removal and Disposal of Temporary Pavement**

PROJ. NO. 3 SANTAN CHANNEL - I-10 EASTBOUND DETOUR - CONSTRUCTION COST ESTIMATE

ITEM NO.	ADOT NO.	DESCRIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	COST
1	2030301	ROADWAY EXCAVATION	m3	5648	$ 5.50	$ 31,064.00
2	3030022	AGGREGATE BASE, CLASS 2 (200mm)	m3	1072	$ 25.00	$ 26,800.00
3 *	4090003	ASPHALTIC CONCRETE (MISCELLANEOUS STRUCTURAL) (125mm)	m2	5360	$ 10.60	$ 56,816.00
4	5010011	PIPE, CORRUGATED METAL, 600mm	m	270	$ 130.00	$ 35,100.00
		TOTAL				**$ 149,780.00**

*** Includes Removal and Disposal of Temporary Pavement**

SUMMARY

SANTAN CHANNEL DETOURS - SUMMARY OF CIVIL WORK - CONSTRUCTION COST ESTIMATE

PROJECT NO.	DESCRIPTION OF WORK	COST
1	SANTAN CHANNEL - 56TH ST. DETOUR - CIVIL WORK - CONSTRUCTION COST ESTIMATE	$ 43,912.00
2	SANTAN CHANNEL - I-10 NORTHBOUND DETOUR - CIVIL WORK - CONSTRUCTION COST ESTIMATE	$ 168,724.00
3	SANTAN CHANNEL - I-10 SOUTHBOUND DETOUR - CIVIL WORK - CONSTRUCTION COST ESTIMATE	$ 149,780.00
	TOTAL	**$ 362,416.00**

SANTAN CHANNEL DETOURS - MAINT. OF TRAFFIC WORK - CONSTRUCTION COST ESTIMATES

PROJ. NO. 1- SANTAN CHANNEL - 56TH ST. TRAFFIC CONTROL - CONSTRUCTION COST ESTIMATE

ITEM NO.	ADOT NO.	DESCRIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	COST
1	7015010	TEMPORARY CONCRETE BARRIER (INSTALLATION & REMOVAL)	m	740	$ 18.00	$ 13,320.00
2	7015020	TEMPORARY IMPACT ATTENUATORS (INSTALLATION & REMOVAL)	EACH	0	$ 1,000.00	$ -
3	7015041	TEMPORARY PAINTED MARKING (ARROW, SYMBOL OR LEGEND)	EACH	2	$ 65.00	$ 130.00
4	7015042	TEMPORARY PAINTED MARKING (STRIPE)	m	1990	$ 0.43	$ 855.70
5	7015051	LEGEND)	EACH	0	$ 20.00	$ -
6	7015052	OBLITERATE PAVEMENT MARKING (STRIPE)	m	2060	$ 1.65	$ 3,399.00
7	7015061	TEMPORARY PAVEMENT MARKERS (RAISED) (REFLECTIVE)	EACH	0	$ 4.00	$ -
8	7015070	OBLITERATE PAVEMENT MARKERS	EACH	0	$ 0.10	$ -
9	7015080	TEMPORARY DELINEATORS (4-M-4.01 OR APPROVED ALTERNATE)	EACH	0	$ 27.00	$ -
10	7015090	SPECIALTY SIGNS	m2	0	$ 110.00	$ -
11	7016020	TEMPORARY CONCRETE BARRIER (IN USE)	m-DAY	36400	$ 0.20	$ 7,280.00
12	7016025	TEMPORARY IMPACT ATTENUATORS (IN USE)	EACH-DAY	0	$ 0.05	$ -
13	7016029	PORTABLE SIGN STANDS - BARRIER MOUNTED	EACH-DAY	0	$ 1.00	$ -
14	7016030	BARRICADE (TYPE II, VERTICAL PANEL, TUBULAR MARKER)	EACH-DAY	2620	$ 0.50	$ 1,310.00
15	7016031	BARRICADE (TYPE III, HIGH LEVEL FLAG TREES)	EACH-DAY	0	$ 0.75	$ -
16	7016032	PORTABLE SIGN STANDS (RIGID)	EACH-DAY	0	$ 1.00	$ -
17	7016033	PORTABLE SIGN STANDS (SPRING TYPE)	EACH-DAY	0	$ 2.10	$ -
18	7016034	DRUM (4-M-2.07 OR APPROVED ALTERNATE)	EACH-DAY	0	$ 1.25	$ -
19	7016035	WARNING LIGHTS (TYPE "A")	EACH-DAY	0	$ 0.25	$ -
20	7016036	WARNING LIGHTS (TYPE "B")	EACH-DAY	940	$ 2.50	$ 2,350.00
21	7016037	WARNING LIGHTS (TYPE "C")	EACH-DAY	2620	$ 0.80	$ 2,096.00
22	7016038	TRAFFIC CONE (711 mm)	EACH-DAY	0	$ 0.40	$ -
23	7016039	EMBEDDED SIGN POST	EACH-DAY	940	$ 0.10	$ 94.00
24	7016047	TEMPORARY SIGN (TYPE II LESS THAN 0.9 m2)	EACH-DAY	660	$ 3.00	$ 1,980.00
25	7016048	TEMPORARY SIGN (TYPE II GREATER THAN 0.9 m2)	EACH-DAY	440	$ 3.00	$ 1,320.00
26	7016050	TRUCK MOUNTED ATTENUATOR	EACH-DAY	0	$ 3.50	$ -
27	7016061	FLASHING ARROW PANEL	EACH-DAY	0	$ 75.00	$ -
28	7016066	CHANGEABLE MESSAGE SIGN	EACH-DAY	14	$ 150.00	$ 2,100.00
29	7016075	FLAGGING SERVICES	HOUR	0	$ 21.00	$ -
31	7016077	FLAGGING SERVICES (UNIFORM OFFICER)	HOUR	0	$ 28.00	$ -
		Subtotal				$ 36,234.70
		15% Item Placement				$ 5,435.20
		TOTAL				**$ 41,669.90**

SANTAN CHANNEL DETOURS - MAINT. OF TRAFFIC WORK - CONSTRUCTION COST ESTIMATES

PROJ. NO. 3 SANTAN CHANNEL - I-10 TRAFFIC CONTROL - CONSTR. COST ESTIMATE

ITEM NO.	ADOT NO.	DESCRIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	COST
1	7015010	TEMPORARY CONCRETE BARRIER (INSTALLATION & REMOVAL)	m	6160	$ 18.00	$ 110,880.00
2	7015020	TEMPORARY IMPACT ATTENUATORS (INSTALLATION & REMOVAL)	EACH	10	$ 1,000.00	$ 10,000.00
3	7015041	TEMPORARY PAINTED MARKING (ARROW, SYMBOL OR LEGEND)	EACH	0	$ 65.00	$ -
4	7015042	TEMPORARY PAINTED MARKING (STRIPE)	m	11670	$ 0.43	$ 5,018.10
5	7015051	OBLITERATE PAVEMENT MARKING (ARROW, SYMBOL OR	EACH	0	$ 20.00	$ -
6	7015052	OBLITERATE PAVEMENT MARKING (STRIPE)	m	4410	$ 1.65	$ 7,276.50
7	7015061	TEMPORARY PAVEMENT MARKERS (RAISED) (REFLECTIVE)	EACH	537	$ 4.00	$ 2,148.00
8	7015070	OBLITERATE PAVEMENT MARKERS	EACH	164	$ 0.10	$ 16.40
9	7015080	TEMPORARY DELINEATORS (4-M-4.01 OR APPROVED ALTERNATE)	EACH	0	$ 27.00	$ -
10	7015090	SPECIALTY SIGNS	m2	0	$ 110.00	$ -
11	7016020	TEMPORARY CONCRETE BARRIER (IN USE)	m-DAY	284250	$ 0.20	$ 56,850.00
12	7016025	TEMPORARY IMPACT ATTENUATORS (IN USE)	EACH-DAY	430	$ 0.05	$ 21.50
13	7016029	PORTABLE SIGN STANDS - BARRIER MOUNTED	EACH-DAY	0	$ 1.00	$ -
14	7016030	BARRICADE (TYPE II, VERTICAL PANEL, TUBULAR MARKER)	EACH-DAY	21290	$ 0.50	$ 10,645.00
15	7016031	BARRICADE (TYPE III, HIGH LEVEL FLAG TREES)	EACH-DAY	960	$ 0.75	$ 720.00
16	7016032	PORTABLE SIGN STANDS (RIGID)	EACH-DAY	0	$ 1.00	$ -
17	7016033	PORTABLE SIGN STANDS (SPRING TYPE)	EACH-DAY	0	$ 2.10	$ -
18	7016034	DRUM (4-M-2.07 OR APPROVED ALTERNATE)	EACH-DAY	0	$ 1.25	$ -
19	7016035	WARNING LIGHTS (TYPE "A")	EACH-DAY	1920	$ 0.25	$ 480.00
20	7016036	WARNING LIGHTS (TYPE "B")	EACH-DAY	6380	$ 2.50	$ 15,950.00
21	7016037	WARNING LIGHTS (TYPE "C")	EACH-DAY	20590	$ 0.80	$ 16,472.00
22	7016038	TRAFFIC CONE (711 mm)	EACH-DAY	0	$ 0.40	$ -
23	7016039	EMBEDDED SIGN POST	EACH-DAY	5740	$ 0.10	$ 574.00
24	7016047	TEMPORARY SIGN (TYPE II LESS THAN 0.9 m2)	EACH-DAY	0	$ 3.00	$ -
25	7016048	TEMPORARY SIGN (TYPE II GREATER THAN 0.9 m2)	EACH-DAY	6100	$ 3.00	$ 18,300.00
26	7016050	TRUCK MOUNTED ATTENUATOR	EACH-DAY	0	$ 3.50	$ -
27	7016061	FLASHING ARROW PANEL	EACH-DAY	0	$ 75.00	$ -
28	7016066	CHANGEABLE MESSAGE SIGN	EACH-DAY	14	$ 150.00	$ 2,100.00
29	7016075	FLAGGING SERVICES	HOUR	0	$ 21.00	$ -
31	7016077	FLAGGING SERVICES (UNIFORM OFFICER)	HOUR	0	$ 28.00	$ -
		Subtotal				$ 257,451.50
		15% Item Placement				$ 38,617.70
		TOTAL				**$ 296,069.20**

SUMMARY

SANTAN CHANNEL - SUMMARY OF MAINTENANCE OF TRAFFIC WORK - CONSTRUCTION COST ESTIMATE

PROJECT NO.	DESCRIPTION OF WORK	COST
1	SANTAN CHANNEL - 56TH ST. TRAFFIC CONTROL - CONSTRUCTION COST ESTIMATE	$ 41,669.90
2	SANTAN CHANNEL - I-10 TRAFFIC CONTROL - CONSTRUCTION COST ESTIMATE	$ 296,069.20
	TOTAL	**$ 337,739.10**

56TH ST DETOUR
℄ GEOMETRY

Review Horizontal Alignment All
Project Name: PMIP
Description:
Horizontal Alignment Name: 56th dtr
Description: 56th Detour
Preference: default

	STATION	NORTHING	EASTING
Element: Linear			
POB ( )	0+000.000	253858.43	209005.67
PC ( )	0+050.687	253898.90	209036.19

Tangent Direction: N 37^01'32.23" E
Tangent Length: 50.687

Elements Are Not Colinear

Element: Circular			
PC ( )	0+050.687	253898.90	209036.19
CC ( )		254033.79	208856.11
PT ( )	0+240.615	254078.76	209076.57

Radius: 225.000
Delta: 48^21'52.88" Left
Length: 189.928
Tangent: 101.036
Chord: 184.339
Middle Ordinate: 19.745
External: 21.644
Tangent Direction: N 36^50'10.36" E
Radial Direction: S 53^09'49.64" E
Chord Direction: N 12^39'13.92" E
Radial Direction: N 78^28'17.48" E
Tangent Direction: N 11^31'42.52" W

Elements Are Not Colinear

Element: Linear			
PT ( )	0+240.615	254078.76	209076.57
PC ( )	0+262.131	254099.83	209072.25

Tangent Direction: N 11^36'10.43" W
Tangent Length: 21.516

Elements Are Not Colinear

Element: Circular			
PC ( )	0+262.131	254099.83	209072.25
CC ( )		254180.76	209463.97
PT ( )	0+343.173	254180.31	209063.97

Radius: 400.000
Delta: 11^36'30.35" Right
Length: 81.042
Tangent: 40.660
Chord: 80.904
Middle Ordinate: 2.051
External: 2.061
Tangent Direction: N 11^40'21.80" W

Radial Direction: N 78^19'38.20" E
Chord Direction: N 5^52'06.63" W
Radial Direction: N 89^56'08.55" E
Tangent Direction: N 0^03'51.45" W

NORTH BOUND DETOUR

Review Horizontal Alignment All
Project Name: I-10
Description:
Horizontal Alignment Name: dtr#2
Description:
Preference: default

	STATION	NORTHING	EASTING
Element: Circular			
PC ( )	0+000.0000	253376.0444	208461.9732
CC ( )		254600.3310	211714.2308
PRC ( )	0+213.0762	253577.6350	208393.0638

Radius: 3475.0622
Delta: 3^30'47.2928" Right
Length: 213.0762
Tangent: 106.5715
Chord: 213.0429
Middle Ordinate: 1.6330
External: 1.6338
Tangent Direction: N 20^37'42.4129" W
Radial Direction: N 69^22'17.5871" E
Chord Direction: N 18^52'18.7665" W
Radial Direction: N 72^53'04.8799" E
Tangent Direction: N 17^06'55.1201" W

Element: Circular			
PRC ( )	0+213.0762	253577.6350	208393.0638
CC ( )		253283.3383	207437.3497
PT ( )	0+302.7983	253662.0849	208362.8501

Radius: 1000.0000
Delta: 5^08'26.5004" Left
Length: 89.7220
Tangent: 44.8911
Chord: 89.6920
Middle Ordinate: 1.0061
External: 1.0071
Tangent Direction: N 17^06'55.3368" W
Radial Direction: N 72^53'04.6632" E
Chord Direction: N 19^41'08.5870" W
Radial Direction: N 67^44'38.1628" E
Tangent Direction: N 22^15'21.8372" W

Element: Linear			
PT ( )	0+302.7983	253662.0849	208362.8501
PC ( )	0+362.7983	253717.6151	208340.1259

Tangent Direction: N 22^15'19.7626" W
Tangent Length: 60.0000

Element: Circular			
PC ( )	0+362.7983	253717.6151	208340.1259
CC ( )		254096.3597	209265.6271
PCC ( )	0+548.1978	253894.7120	208286.1690

Radius: 1000.0000
Delta: 10^37'21.3998" Right
Length: 185.3995

Tangent: 92.9662
Chord: 185.1341
Middle Ordinate: 4.2935
External: 4.3121
Tangent Direction: N 22^15'21.3855" W
Radial Direction: N 67^44'38.6145" E
Chord Direction: N 16^56'40.6856" W
Radial Direction: N 78^22'00.0144" E
Tangent Direction: N 11^37'59.9856" W

Element: Circular
PCC ( ) 0+548.1978 253894.7120 208286.1690
CC ( ) 254600.7088 211715.3912
PCC ( ) 0+648.7538 253993.4800 208267.3092
Radius: 3501.1422
Delta: 1^38'44.1127" Right
Length: 100.5560
Tangent: 50.2814
Chord: 100.5525
Middle Ordinate: 0.3610
External: 0.3610
Tangent Direction: N 11^37'59.9536" W
Radial Direction: N 78^22'00.0464" E
Chord Direction: N 10^48'37.8973" W
Radial Direction: N 80^00'44.1591" E
Tangent Direction: N 9^59'15.8409" W

Element: Circular
PCC ( ) 0+648.7538 253993.4800 208267.3092
CC ( ) 254166.9179 209252.1540
PT ( ) 0+832.7625 254176.6070 208252.2009
Radius: 1000.0000
Delta: 10^32'34.5089" Right
Length: 184.0087
Tangent: 92.2648
Chord: 183.7492
Middle Ordinate: 4.2294
External: 4.2474
Tangent Direction: N 9^59'15.9579" W
Radial Direction: N 80^00'44.0421" E
Chord Direction: N 4^42'58.7034" W
Radial Direction: S 89^26'41.4489" E
Tangent Direction: N 0^33'18.5511" E

Element: Linear
PT ( ) 0+832.7625 254176.6070 208252.2009
PC ( ) 0+892.7633 254236.6050 208252.7821
Tangent Direction: N 0^33'17.7512" E
Tangent Length: 60.0008

Element: Circular
PC ( ) 0+892.7633 254236.6050 208252.7821
CC ( ) 254246.2944 207252.8290
PRC ( ) 0+980.1315 254323.8950 208249.8135

Radius: 1000.0000
Delta: 5^00'20.9912" Left
Length: 87.3682
Tangent: 43.7119
Chord: 87.3404
Middle Ordinate: 0.9540
External: 0.9549
Tangent Direction: N 0^33'18.6160" E
Radial Direction: S 89^26'41.3840" E
Chord Direction: N 1^56'51.8796" W
Radial Direction: N 85^32'57.6249" E
Tangent Direction: N 4^27'02.3751" W

Element: Circular
PRC ( ) 0+980.1315 254323.8950 208249.8135
CC ( ) 254593.5616 211714.3968
PT ( ) 1+143.3323 254486.8412 208240.9737
Radius: 3475.0622
Delta: 2^41'26.9003" Right
Length: 163.2008
Tangent: 81.6154
Chord: 163.1858
Middle Ordinate: 0.9580
External: 0.9583
Tangent Direction: N 4^27'02.3643" W
Radial Direction: N 85^32'57.6357" E
Chord Direction: N 3^06'18.9141" W
Radial Direction: N 88^14'24.5360" E
Tangent Direction: N 1^45'35.4640" W

SOUTHBOUND LE[illegible]

Review Horizontal Alignment All
Project Name: I-10
Description:
Horizontal Alignment Name: dtr01
Description:
Preference: default

	STATION	NORTHING	EASTING
Element: Circular			
PC ( )	0+000.0000	253568.7620	208361.3510
CC ( )		253862.8250	209317.1370
PT ( )	0+185.2383	253749.8301	208323.5414

Radius: 1000.0000
Delta: 10^36'48.1400" Right
Length: 185.2383
Tangent: 92.8849
Chord: 184.9736
Middle Ordinate: 4.2861
External: 4.3045
Tangent Direction: N 17^06'04.9000" W
Radial Direction: N 72^53'55.1000" E
Chord Direction: N 11^47'40.8300" W
Radial Direction: N 83^30'43.2400" E
Tangent Direction: N 6^29'16.7600" W

Element: Linear			
PT ( )	0+185.2383	253749.8301	208323.5414
PC ( )	0+245.2383	253809.4458	208316.7616

Tangent Direction: N 6^29'17.3104" W
Tangent Length: 60.0000

Element: Circular			
PC ( )	0+245.2383	253809.4458	208316.7616
CC ( )		253696.4512	207323.1660
PRC ( )	0+335.0427	253898.0998	208302.6239

Radius: 1000.0000
Delta: 5^08'43.4916" Left
Length: 89.8044
Tangent: 44.9324
Chord: 89.7742
Middle Ordinate: 1.0079
External: 1.0090
Tangent Direction: N 6^29'16.6829" W
Radial Direction: N 83^30'43.3171" E
Chord Direction: N 9^03'38.4287" W
Radial Direction: N 78^21'59.8254" E
Tangent Direction: N 11^38'00.1746" W

Element: Circular			
PRC ( )	0+335.0427	253898.0998	208302.6239
CC ( )		254600.7062	211715.3918
PRC ( )	0+435.1161	253996.3938	208283.8547

Radius: 3484.3422
Delta: 1^38'44.1074" Right
Length: 100.0734

Tangent: 50.0401
Chord: 100.0699
Middle Ordinate: 0.3593
External: 0.3593
Tangent Direction: N 11^37'59.7878" W
Radial Direction: N 78^22'00.2122" E
Chord Direction: N 10^48'37.7341" W
Radial Direction: N 80^00'44.3196" E
Tangent Direction: N 9^59'15.6804" W

Element: Circular
PRC ( ) 0+435.1161 253996.3938 208283.8547
CC ( ) 253822.9574 207299.0096
PT ( ) 0+525.6659 254084.7390 208264.1368
Radius: 1000.0000
Delta: 5^11'17.2386" Left
Length: 90.5498
Tangent: 45.3059
Chord: 90.5189
Middle Ordinate: 1.0247
External: 1.0258
Tangent Direction: N 9^59'15.6506" W
Radial Direction: N 80^00'44.3494" E
Chord Direction: N 12^34'54.2699" W
Radial Direction: N 74^49'27.1108" E
Tangent Direction: N 15^10'32.8892" W

Element: Linear
PT ( ) 0+525.6659 254084.7390 208264.1368
PC ( ) 0+585.6659 254142.6466 208248.4299
Tangent Direction: N 15^10'32.8174" W
Tangent Length: 60.0000

Element: Circular
PC ( ) 0+585.6659 254142.6466 208248.4299
CC ( ) 254404.4320 209213.5560
PT ( ) 0+774.7459 254328.7130 208216.4268
Radius: 1000.0000
Delta: 10^50'00.5600" Right
Length: 189.0801
Tangent: 94.8227
Chord: 188.7985
Middle Ordinate: 4.4656
External: 4.4856
Tangent Direction: N 15^10'33.6900" W
Radial Direction: N 74^49'26.3100" E
Chord Direction: N 9^45'33.4100" W
Radial Direction: N 85^39'26.8700" E
Tangent Direction: N 4^20'33.1300" W

C³ 2/19/98

1/2

7015010 Temp. Conc. Barrier (Inst. & Rem)

Stage 1

EB I-10	1+110	to	2+090	(Lt)	980 m
WB I-10	1+120	to	2+090	(Lt)	970 m
					1950

30 days

Stage 2

EB I-10	1+380	to	1+550	(Lt)	170 m
EB I-10	1+650	to	1+850	(Lt)	200 m
EB I-10	1+530	to	1+830	(Rt)	300 m
					670

60 days

Stage 3

EB I-10	1+110	to	1+380	(Lt)	270 m
EB I-10	1+820	to	2+090	(Lt)	270 m
WB I-10	1+120	to	1+550	(Lt)	430 m
WB I-10	1+650	to	2+090	(Lt)	440 m
					1410

45 d

Stage 4

WB I-10	1+300	to	1+550	(Lt)	250 m
" "	1+650	to	1+860	(Lt)	210 m
" "	1+350	to	1+670	(Rt)	320 m
					780

60 d

7015010 con't

Stage 5

EB I-10	1+110	to	1+550	(Lt)	440
EB I-10	1+650	to	2+090	(Lt)	440
WB I-10	1+120	to	1+360	(Lt)	240
WB I-10	1+860	to	2+090	(Lt)	230
20 ℓ					1350

I-10 Total = **6160 m**

56th Street

Phase 1	1+060	to	1+260	(Rt)	20	200 m
Phase 2	1+040	to	1+320	(Lt)		280 m
	1+040	to	1+300	(Rt)	60	260 m

56th Total = **740 m**

C3 2/19/98

1/2

7015020

Temp Imp. Atten (Install & Remove)

Stage 1

1 - EB
1 - WB
2

Stage 2

2 - EB
2

Stage 3

1 - EB
1 - WB
2

Stage 4

2 - WB
2

7015020 con't

Stage 5

1 - EB
1 - WB
2

I-10 Total

10 each

56th Street

0

C3 2/20/98

1/1

7015041 Temp. Pt. Marking (Arrow, sym, Leg)

I-10 → 0

56th

Phase 1	→	0
Phase 2		2
56th Total		2

C³ 2/20/98

1/2

7015042 Temp. Painted Marking (Stripe)

Stage 1

EB I-10	1+110	to	2+090	(x 2.25)	s. white, d. white, s. yellow	2205 m
WB I-10	1+110	to	2+090	(x 1.25)	d. white, s. yellow	1225 m
"	1+110	to	1+270	(x3)	gore s. white	480 m
"	1+510	to	2+090	(x1)	s. white	580 m
						4490 m

Stage 2

EB I-10	1+215	to	2+000	(x2)	s. white, s. yellow	1570 m
EB I-10	1+215	to	2+075	(x1)	s. white	860 m
						2430 m

Stage 3

EB I-10	1+110	to	1+400	(x2.25)	655 m
"	1+800	to	2+090	(x2.25)	655 m
					1310 m

Stage 4

WB I-10	1+140	to	1+980	(x1)	s. white	840 m
"	1+220	to	1+980	(x2)	s. white, s. yellow	1520 m
						2360 m

Stage 5

WB I-10	1+110	to	1+370	(x2.25)	585 m
"	1+870	to	2+090	(x2.25)	495 m
					1080

7015042 con't

I-10 Total 11,670 m

56th Street

Phase 1 → 0 m

Phase 2

	NB Rt. Turn Lane	65m (x 2)	S. White	130 m
Lt. Turn	SB 0+990 to 1+040	50 m (x2)	S. White	100 m
	SB & NB 0+990 to 1+370	(x2)	S. White Edge Lines	760 m
	Median 0+990 to 1+420	(x2)	S. Yellow	860 m
	Median 1+070 to 1+140	(x2)	S. Yellow	140 m
				1990 m

56th Total 1990 m

C3 2/20/98

1/1

7015052 OBLIT. PVMT. MRKNG (STRIPE)

I-10

EB I-10	1+110	to	2+090	(x2.25)	S. yellow S. white D. white
WB I-10	1+110	to	2+090	(x2.25)	"

2,205
2,205
4410

I-10 Total $\boxed{4,410}$

56th

All	0+990 ±	to	1+200 ±	(x6)	2-Edge 4-median
All	1+200 ±	to	1+400 ±	(x.4)	2-Edge 2-med

1,260
800
2060

56th Total $\boxed{2,060}$

C³ 2/20/98

1/1

701561 Temporary Print. M. Keys (Raised) (Reflective)

Stage 1

EB I-10	1+110	to	2+090	(÷12)	82
WB I-10	1+110	to	2+090	(÷12)	82
					164

Stage 2

EB I-10	1+215	to	2+075	(÷12)(x2)	144

Stage 3

EB I-10	1+110	to	1+400	(÷12)	24
"	1+800	to	2+090	(÷12)	24
					48

Stage 4

WB I-10	1+140	to	1+980	(÷12)(x2)	140

Stage 5

WB I-10	1+110	to	1+370	(÷12)	22
	1+870	to	2+090	(÷12)	19
					41

I-10 Total **537**

56th Street **0**

C3 2/20/98

1/1

7015070 Obliq. Pump. Markers

I-10

EB I-10	17110 to 27090	(÷12)	82
WB I-10	17110 to 27090	(÷12)	82
			164

I-10 Total $\boxed{164}$

56th Street

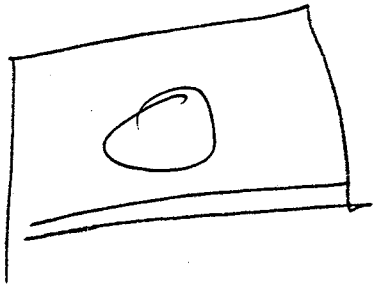
$\boxed{0}$

C3 2/20/98

1/1

7015080 Temp. Delineators

I-10 &
56th



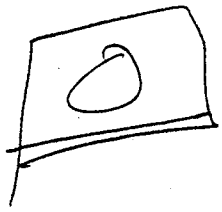
C3 2/20/98

1/1

7015090 Specialty Signs

I-10 &

56th



c3 2/20/98

1/2

7016020 Temporary Conc. Barrier (In Use)

Stage 1

EB I-10	1+110 to 2+090 (Lt)	980 m
WB I-10	1+120 to 2+090 (Lt)	980 m
		1950 m

Stage 2

EB I-10	1+380 to 1+850 (Lt)	470 m
"	1+530 to 1+830 (Rt)	300 m
		770 m

Stage 3

Same as stage 1 — 1950 m

Stage 4

WB I-10	1+300 to 1+860 (Lt)	560 m
"	1+350 to 1+670 (Rt)	320 m
		880 m

Stage 5

Same as Stage 1 & 3 — 1950 m

C³ 2/20/98

2/2

7016020 Con't

56th Phase 1 1+060 to 1+260 (Rt) 200 m

56th Phase 2 1+040 to 1+320 (Lt) 280
1+040 to 1+300 (Rt) 260

540 m

C³ 2/20/98

1/1

7016025 Temp Impact Attenuators (In Use)

Stage 1

EB I-10 1

WB I-10 1

2 each

Stage 2

EB I-10 2 each

Stage 3

EB I-10 1

WB I-10 1

2 each

Stage 4

WB I-10 2 each

Stage 5

EB I-10 1

WB I-10 1

2 each

56th Street 0

C^3 2/20/98

1/1

7016029 Portable Sign Stands - Bar. Mntd

I-10, All stages

0

56th Street, both phases

0

C3 2/20/98

1/2

7016030 Bar. (Type II, Vert. Pnl., Tub. Mrkr.)

Stage 1

EB I-10	1+110 to 1+660.	(Rt)	(÷24)(+1)	24 each
"	1+750 to 2+180	(Rt)	(÷24)(+1)	19 each
"	2+080 to 2+180	(Lt)	(÷24)(+1)	5 each
WB I-10	1+010 to 1+110	(Lt)	(÷24)(+1)	5 each
"	1+710 to 2+090	(Rt)	(÷24)(+1)	17 each

70 ea.

Stage 2

EB I-10	1+215 to 1+530	(Rt)	(÷24)(+1)	14 each
"	1+215 to 1+380	(Lt)	(÷24)(+1)	8 "
"	1+822 to 1+990	(Rt)	(÷12)(+1)	15 "
"	1+840 to 1+990	(Lt)	(÷12)(+1)	13 "
"	1+990 to 2+090	(Rt)	(÷24)(+1)	5 "
"	1+990 to 2+090	(Lt)	(÷24 (+1)	5 "
WB I-10	1+010 to 1+500	(Lt)	(÷24)(+1)	21 "
"	1+700 to 2+090	(Lt)	(÷24)(+1)	17 "
"	1+700 to 2+090	(Rt)	(÷24)(+1)	17 "

115 ea.

Stage 3

Same as stage 1

70 ea.

7016030 con't

Stage 4

EB I-10	1+110 to 1+660	(Rt) (÷24) (+1)	24 ea.
"	1+110 to 1+450	(Lt) (÷24) (+1)	15 "
"	1+750 to 2+180	(Rt) (÷24) (+1)	19 "
"	1+750 to 2+180	(Lt) (÷24) (+1)	19 "
WB I-10	1+100 to 1+200	(Lt) (÷24) (+1)	5 "
"	1+085 to 1+185	(Rt) (÷24) (+1)	5 "
"	1+200 to 1+285	(Lt) (÷12) (+1)	8 "
"	1+185 to 1+340	(Rt) (÷12) (+1)	14 "
"	1+860 to 1+981	(Lt) (÷24) (+1)	6 "
"	1+670 to 1+981	(Rt) (÷24) (+1)	14 "
			129 ea.

Stage 5

same as stage 1 & 3 — 70 ea.

56th Phase 1 est — 20 ea.

56th Phase 2 by count — 37 ea

C^3 2/20/98

1/1

7016031 Bar. (Type III, High Lev. Flag Tree)

Stage 1 — 0 ea.

Stage 2
EB I-10 1+800 ± — 7 each

Stage 3 — 0 ea.

Stage 4
WB I-10 1+360 ± — 9 each

Stage 5 — 0 ea

56th phase 1 — 0 each

56th phase 2 — 0 each

C3 2/20/98

1/1

7016033 Port. Sign Stand (Spring Type)

Stage 1

Coach

Stage 2

C3 2/20/98

1/1

7016035 Warning Lights (Type A)
See Type III barr., 7016031

Stage 1 — 0 each

Stage 2
EB I-10 17800± — 14 each

Stage 3 — 0 each

Stage 4
WB I-10 17360± — 18 each

Stage 5 — 0 each

56th phase I — 0 each

56th Phase 2 — 0 each

c³ 2/20/98

1/1

7016036 Warning Lights (Type B)

Stage 1

EB I-10	Count	14 each
WB I-10	Count	14 each
		28 each

Stage 2

EB I-10	count	17 ea.
WB I-10	"	14 ea.
		31 each

Stage 3

EB I-10	count	14 each
WB I-10	count	14 each
		28 each

Stage 4

EB I-10	count	14 each
WB I-10	"	17 ea.
		31 each

Stage 5

EB I-10	count	14 each
WB I-10	"	14 each
		28 each

56th Phase 1 est 8 each

56th Phase 2 13 each

C3 2/20/98

1/1

7016037 Warning Light (Type "C")

See 7016030 - Barr. (Type II, etc) for breakdown

Stage 1	70 ea.
Stage 2	115 ea
Stage 3	70 ea.
Stage 4	129 ea
Stage 5	70 ea
56th Phase 1	20 ea
56th Phase 2	37 ea

C3 2/20/98

1/1

7016039 Embedded Sign Post

Stage 1

EB I-10	count	14 each
WB I-10	"	14 each
		28 each

Stage 2

EB I-10	count	14 each
WB I-10	"	14 "
		28 each

Stage 3

Same as Stage 1 — 28 each

Stage 4

Same as Stage 2 — 28 each

Stage 5

Same as stages 1 & 3 — 28 each

56th Phase 1 — est. — 8 each

56th Phase 2 — counts — 13 each

C^3 2/20/98

1/1

J016047 Temp Sign (Type II < 0.9m²)

Stage 1	0 ea.
Stage 2	0 ea.
Stage 3	0 ea.
Stage 4	0 ea.
Stage 5	0. ea.
56th Phase 1	6 ea.
56th Phase 2	9 ea.

C^3 2/20/98

1/1

7016048 Temp Sign (Type II > 0.9 m^2)

Stage 1

EB	I-10	Count	14 ea.
WB	I-10	"	14 ea.
			28 ea

Stage 2

EB	I-10	Count	17 ea
WB	I-10	"	14 ea
			31 ea

Stage 3

Same as Stage 1 — 28 ea.

Stage 4

EB	I-10	count	14 ea.
WB	I-10	"	17 ea.
			31 ea.

Stage 5

Same as Stage 1 & 3 — 28 each

56th Phase 1 — est — 4 each

56th Phase 2 — 6 each

C³ 2/20/98

1/1

701 6066 Changeable Message Sign

Stage 1		0 days
Stage 2	EB - 1	7 days
Stage 3		0 days
Stage 4	WB - 1	7 days
Stage 5		0 days
56th Phase 1		0 days
56th Phase 2	NB & SB - 2	14 days

C3 2/20/98

General - For both I-10 & 5th

One you have calculated the cost for I-10 and 5th, Add 15% for the cost of temporary traffic control, used to place the items shown in the plans.