TRAM

PACOIMA CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
RICHARD JEFFERSON SMITH JR.
No. C 041002
Exp. 12/31/??
STATE OF CALIFORNIA

PROFILE DATA

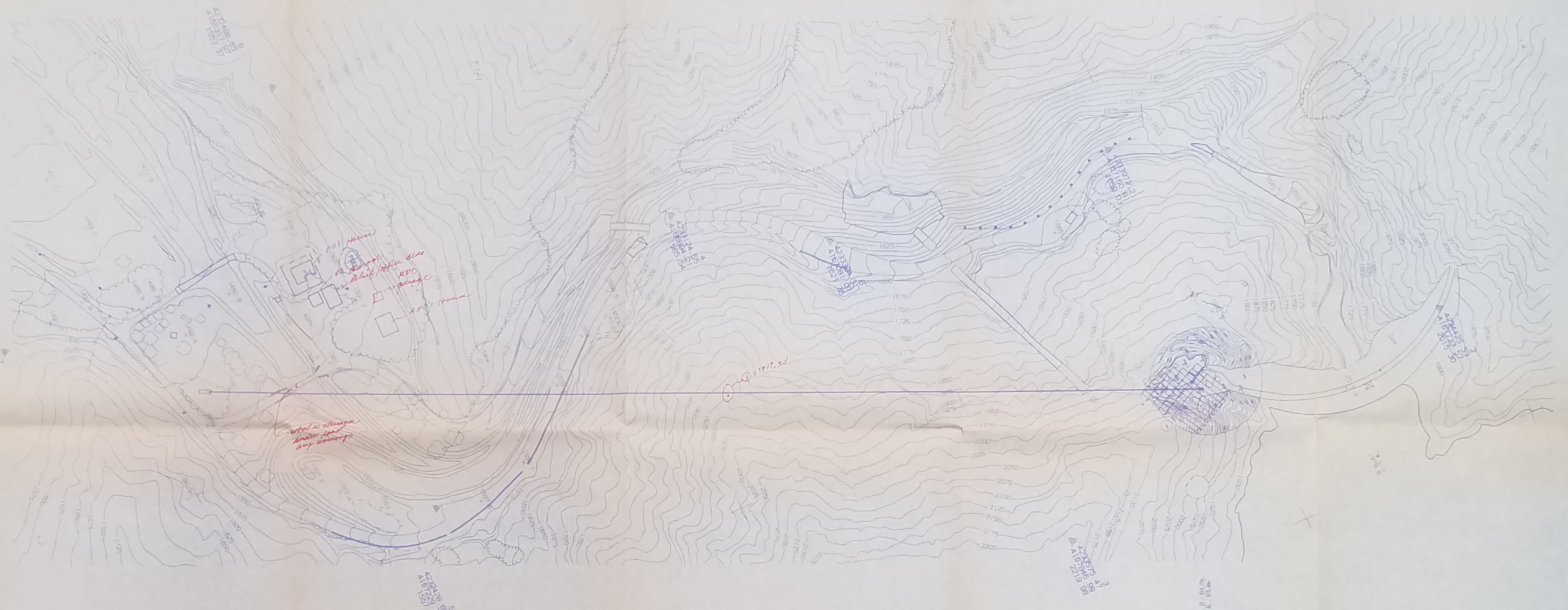
LIFT MODEL	SINGLE REVERSIBLE BI-CABLE TRAMWAY	SPEED:	2.00 m/s
ROTATION	CW	CAPACITY:	60 pph
CARRIER TYPE	12-PLACE CABIN	CARRIERS:	1
GRIP TYPE	8-SHEAVE BI-CABLE CARRIAGE W/ TRACK ROPE BRAKE	TRIP TIME:	5.30 min
TRACK ROPE	Ø 28mm LOCKED COIL TRACK STRAND 3.79 DaN/m	TRACK ROPE TENSION PRESSURE:	110 BARS
HAUL ROPE	Ø 16mm 5x19 RLL 0.85 DaN/m	TRACK ROPE TENSION FORCE:	20200 DaN
SLOPE LENGTH:	635.42 m	HAUL ROPE TENSION PRESSURE:	119 BARS
VERTICAL RISE:	158.26 m	HAUL ROPE TENSION FORCE:	4000 DaN
AVERAGE GRADE:	25.72 %	ORIGIN OF SURVEY:	L.M.GUY
LINE 1/2 GAUGE:	1.83 m		
DRIVE LOCATION:	BOTTOM		
TENSION LOCATION:	BOTTOM		

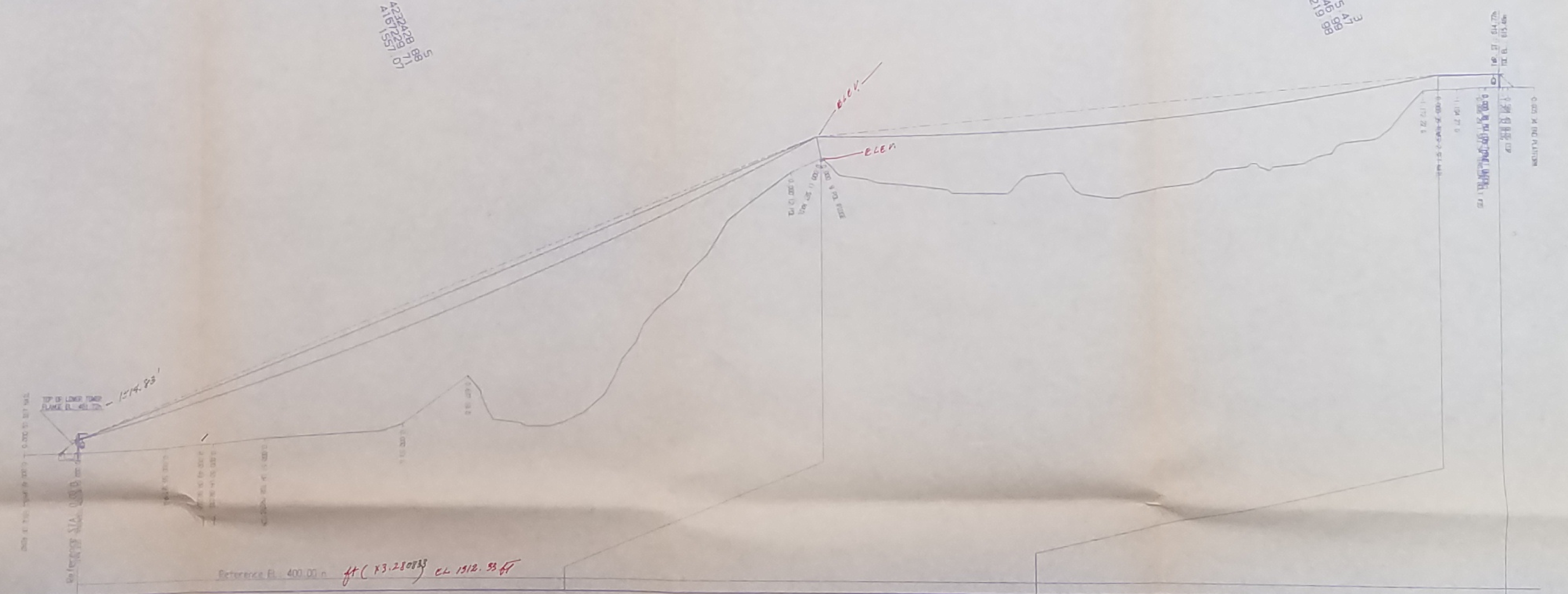
E			
D			
C			
B			
A	ADDED TOWER AND TERMINAL CONCRETE STATIONS AND ELEVATIONS.	04/03/00	DESIGN

DRAWN BY: J.R. LARSON

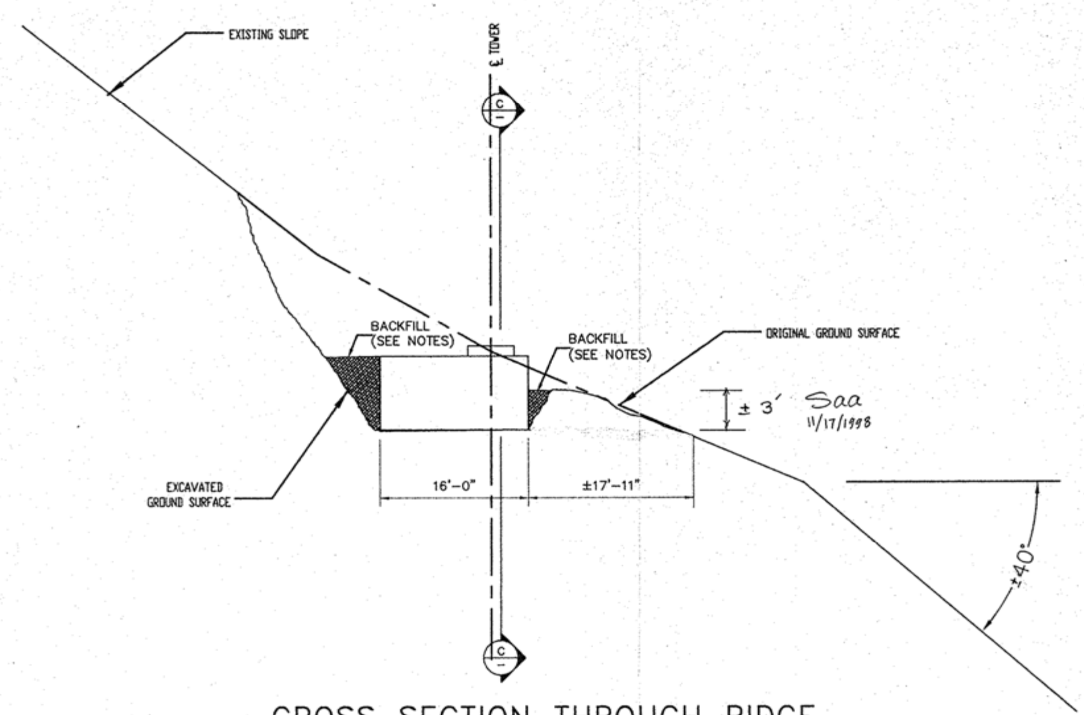
C51013 A

CHECKED BY:



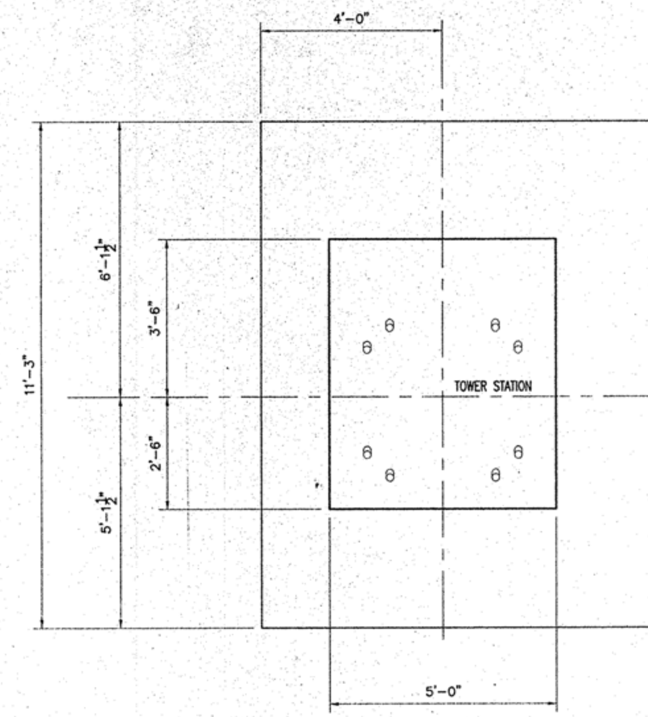


			DRIVE / TENSION		1		2		RETURN
LAYOUT	TOP OF CONCRETE STATION	(m)	0.00		323.58		589.13		614.77m RETURN TOWER
	TOP OF CONCRETE ELEVATION	(m)	---		583.87 ·= 1919.30'		614.67		615.46 RETURN TOWER TOC
	SLOPE DISTANCE BETWEEN TOWERS	(m)		307.31		207.36		24.29	
TOWERS	TOWER TUBE LENGTH	(m)	---		9.50		6.00		---
	INCLINATION	(°)	0.00		20.00		0.00		0.00
	[illegible]	(m)			1.83 OFFSET RT LOOKING UPHILL		1.83 OFFSET RT LOOKING UPHILL		
	[illegible]		SADDLE + 1		SADDLE + 10 SHEAVES		SADDLE + 4 SHEAVES		SADDLE + 12
	[illegible]		US 3114.514		US 3114.513		US 3114.515		US 3114.516



CROSS SECTION THROUGH RIDGE

N.T.S.



SECTION A

1/2"=1'-0"

NOTES:

- CONCRETE SHALL HAVE MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 P.S.I.
- CONCRETE SHALL BE AIR ENTRAINED WITH 6% AIR MINIMUM.
- REINFORCING STEEL SHALL BE ASTM-A615 GRADE 60.
- FOOTING DESIGN IS BASED ON AN ALLOWABLE BEARING CAPACITY OF 6000 P.S.F. (DAMES AND MOORE LETTER REPORT TO AGBABIAN ASSOCIATES DATED NOVEMBER 9, 1998)
- SPLICE LAPS SHALL BE ALLOWED PROVIDED THE BARS LAP 48" MINIMUM.
- REINFORCING STEEL SHALL BE CLEAN, WITH NO OIL OR MUD ON BONDING SURFACES.
- ALL CONSTRUCTION SHALL CONFORM TO ACI STANDARD 318 AND U.B.C.
- ANCHOR BOLT CAGE HAS FOUR ANGLES, TOP OF CONCRETE SHALL BE FINISHED TO SAME ELEVATION AS TOP OF ANGLES.
- REINFORCING STEEL SHALL BE KEPT 3" FROM THE EDGE OF CONCRETE.
- BACKFILL AROUND FOUNDATION WITH 1 TO 1.5-SACK SLURRY UP TO ELEVATION OF EXISTING GRADE OR TO TOP OF FOUNDATION BLOCK, WHICHEVER IS LOWER. (SEE DAMES AND MOORE REPORT TO AGBABIAN ASSOC. DATED NOV. 9, 1998)
- BOTTOM OF FOOTING SHALL BE POURED DIRECTLY AGAINST EXCAVATED ROCK.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY
911 Wilshire Boulevard, Suite 700, L.A., CA 90017, (213) 996-2200

REGISTERED PROFESSIONAL ENGINEER WOLFGANG H. ROTH GE 739 Exp. GEOTECHNICAL STATE OF CALIFORNIA

GEOTECHNICAL REVIEW

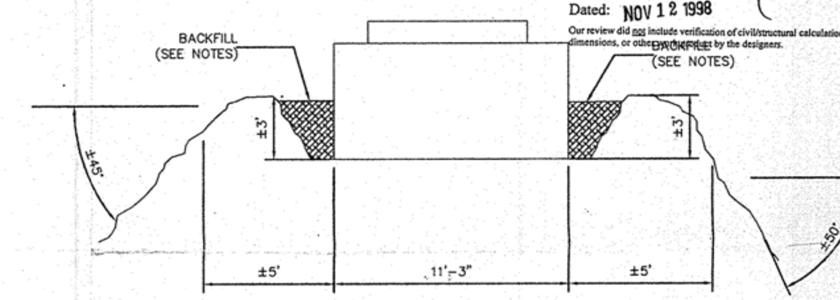
These plans were reviewed by Dames& Moore to check for conformance with geotechnical recommendations presented in our report(s) dated:

D&M Job No: 39406-002-015

Signed:

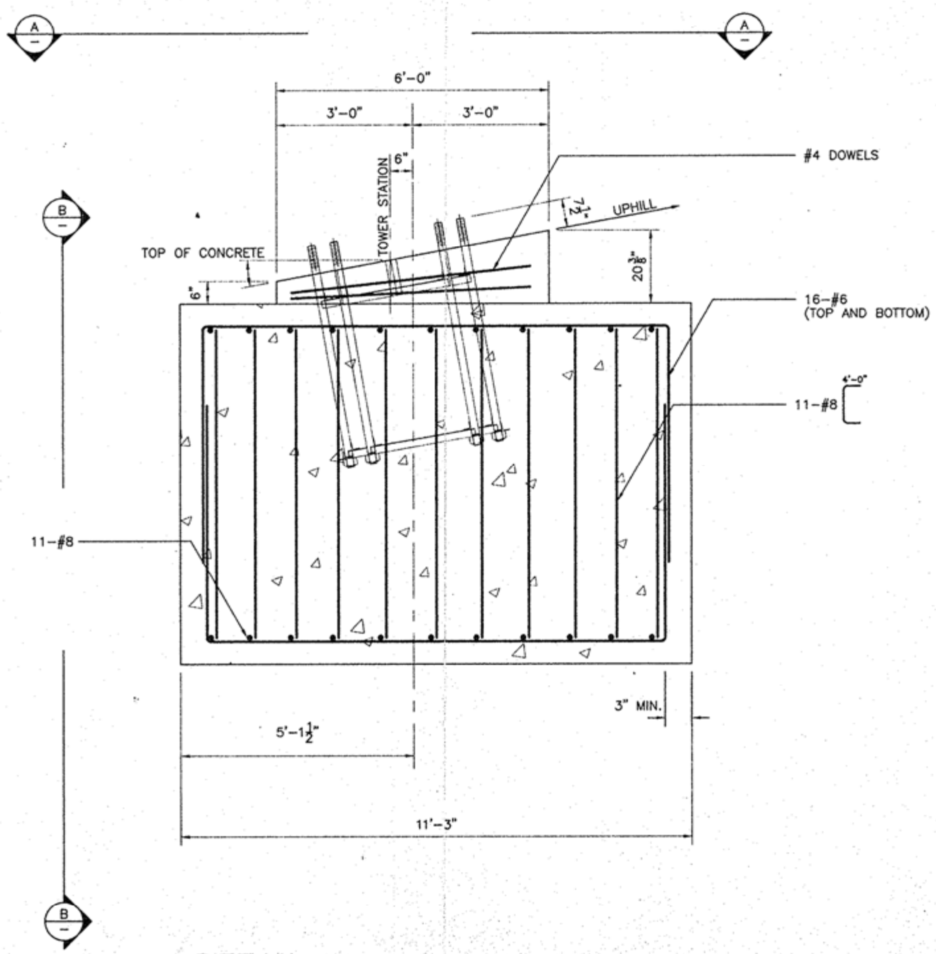
Dated: NOV 12 1998

Our review did not include verification of civil/structural calculations, dimensions, or other ... by the designers.



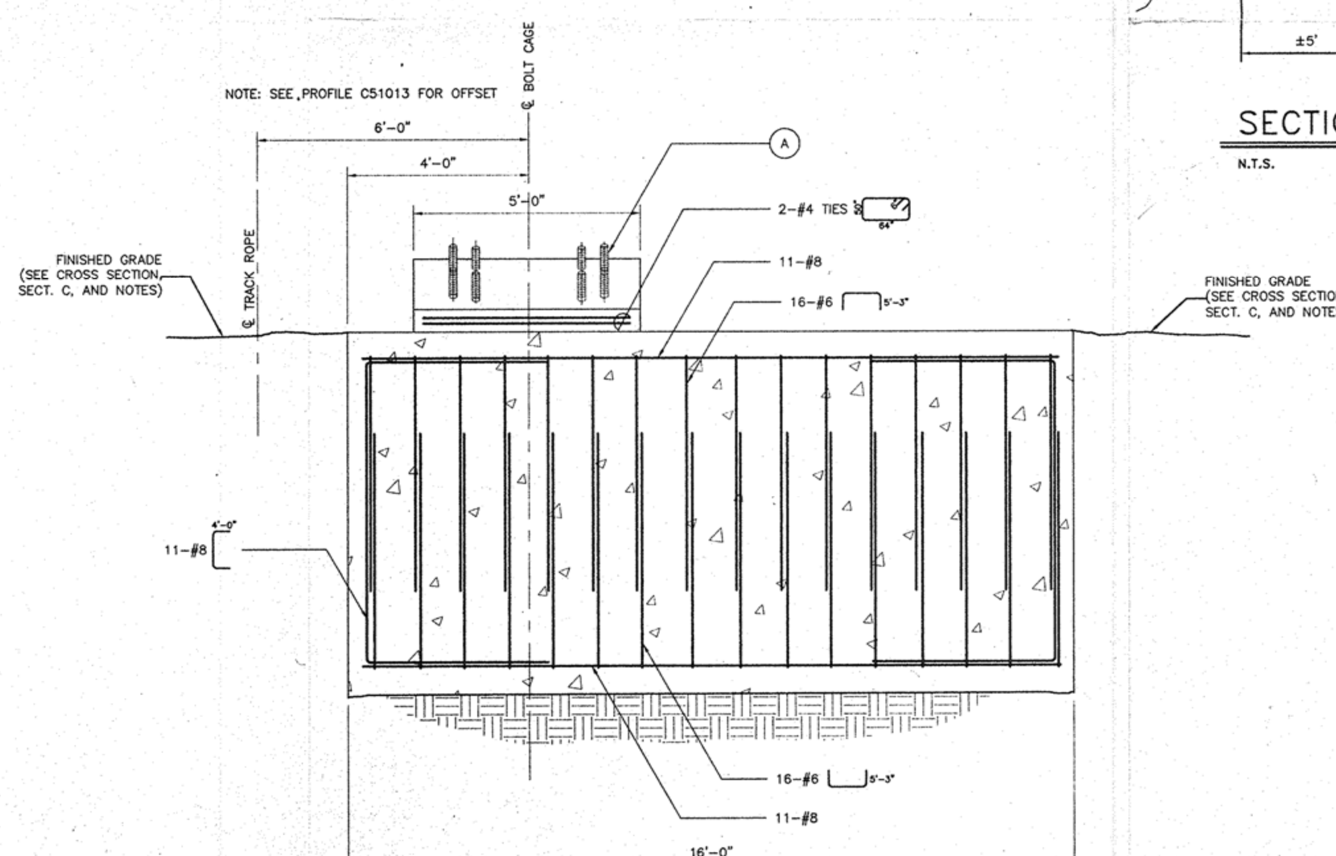
SECTION C

N.T.S.



DETAIL 1

1/2"=1'-0"



SECTION B

1/2"=1'-0"

BUILDING AND SAFETY DIVISION
Department of Public Works
APPROVED
UNDER TITLE 26
BY
JAN 26 1999

This set of plans and specifications MUST be kept on the job at all times and it is unlawful to make any changes or alterations on same without written permission from the Division of Building and Safety, County of Los Angeles. The stamping of this plan and specifications SHALL NOT be held to permit or to be an approval of the violation of any provisions of any County Ordinance or of State Law.

CONCRETE VOLUME = 54.6 C.Y.

REGISTERED PROFESSIONAL ENGINEER KIM M. CARAVALHO C057164 EXP. 12/31/01 CIVIL STATE OF CALIFORNIA

Kim Caravalho 11/10/98
KIM M. CARAVALHO DATE
PLANS PREPARED UNDER THE DIRECTION OF

AGBABIAN ASSOCIATES
engineers and consultants
1111 South Arroyo Parkway, Suite 470, Pasadena, CA 91105
Phone: (626) 441-1080 Fax: (626) 441-0757

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./LBS.	REFERENCE	FORMAT
A		A-BOLT CAGE: US4072.438 (8 x 2T BOLTS)				

REV	DESCRIPTION OF REVISION	DATE	BY
D	MODIFY FOOTING FOR EXISTING SOIL CONDITIONS (DONE BY AGBABIAN ASSOC.)	11/10/98	JBS
C	CHANGE TO GRAVITY STYLE FOOTING	6/20/98	JS
B	ADD SECTION & DETAIL CALLOUTS, ADD DIMENSIONS	6/10/98	KAC
A	MODIFY NOTES, ADD PLAN VIEW, SHEET 5 OF 9	5/21/98	JS

JIGBACK TRAM
TOWER 1

MODEL YEAR 1998

TOWER 1 FOUNDATION

PACOIMA TRAM C51013

TOLERANCES UNLESS INDICATED
FABRICATION: FRACTIONAL ...... ±1/16; ANGULAR .... ±1/2°
MACHINING: DECIMAL W/.X ... ±.05; DECIMAL W/.XX .. ±.01; DECIMAL W/.XXX . ±.005; ANGULAR .... ±.1°

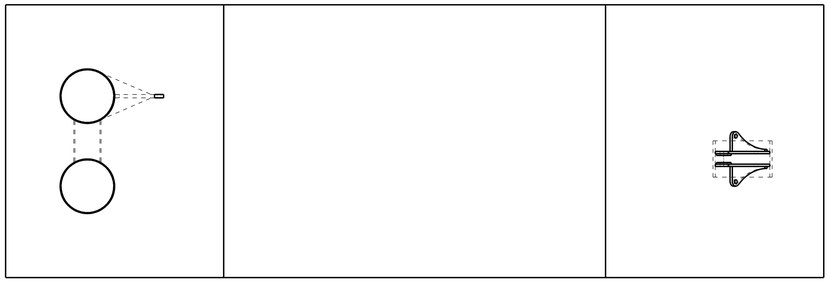
PRODUCTION USE ONLY

POMA OF AMERICA — CABLE TRANSPORT SYSTEMS — SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS — GRAND JUNCTION COLORADO, USA

DRAWN BY: JBS
DESIGNED BY: KMC
DATE: 11/10/98
SCALE: 1/2"=1'-0"

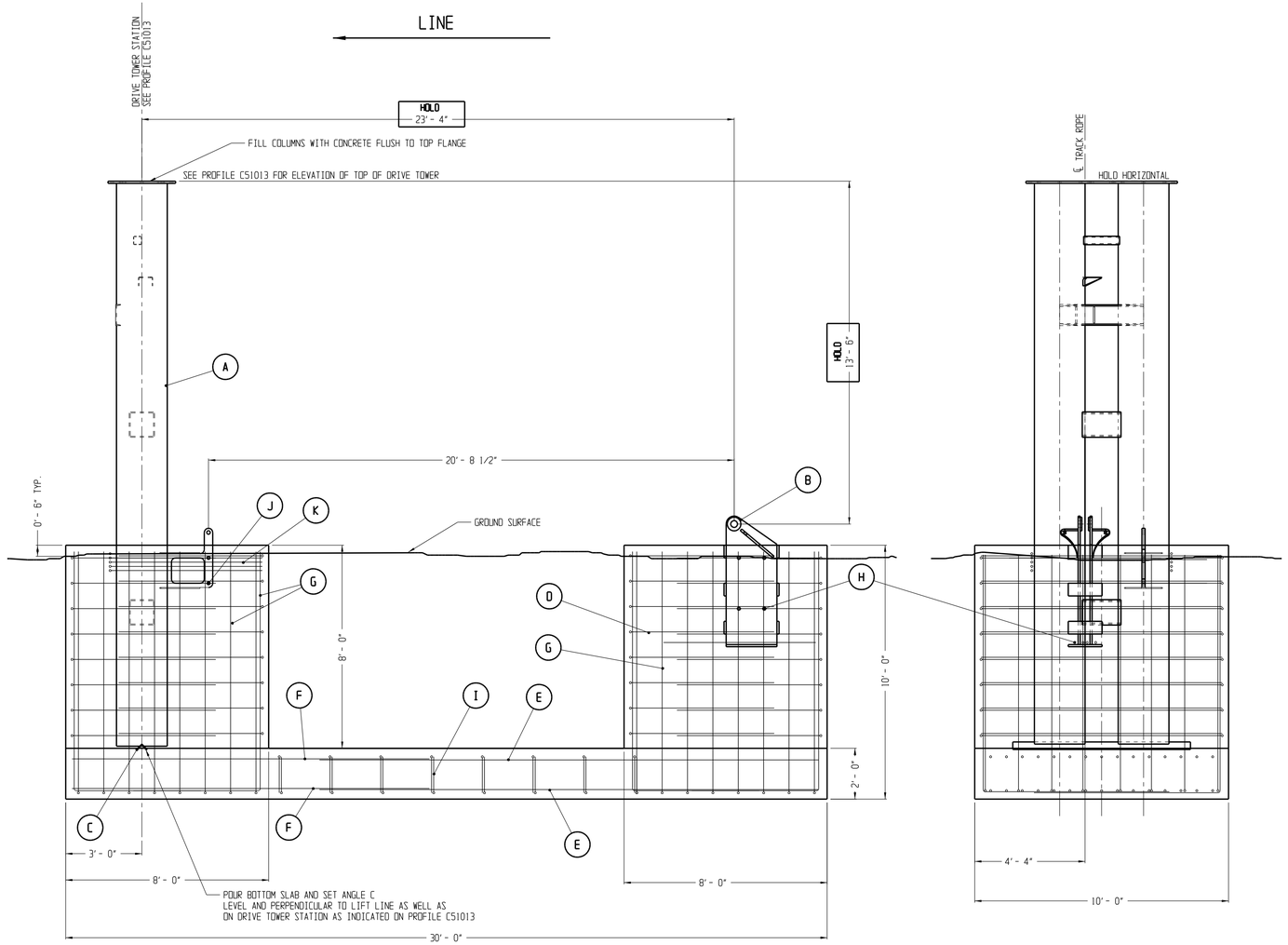
FORMAT: D
DRAWING NUMBER: 3114.513
SHEET 7 OF 9
REVISION: D

3114567



NOTES:

- CONCRETE SHALL HAVE MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 P.S.I.
- CONCRETE SHALL BE AIR ENTRAINED WITH 6% AIR MINIMUM.
- REINFORCING STEEL SHALL BE ASTM-A615 GRADE 60.
- FOOTINGS SHALL BE POURED IN UNDISTURBED SOLID GROUND.
- BACKFILL SHALL BE NATIVE SOIL WITH NO ORGANICS.
- FOOTING DESIGN IS BASED ON AN ALLOWABLE SOIL BEARING CAPACITY OF 5000 P.S.F.
- AS STATED IN THE DAMES & MOORE GEOTECHNICAL EVALUATION PACOIMA AERIAL TRAM DATED MARCH 25, 1998 ALLOWABLE SOIL BEARING CAPACITY SHALL BE VERIFIED IN FIELD BY DAMES & MOORE.
- SPLICE LAPS SHALL BE ALLOWED PROVIDED THE BARS LAP 48" MINIMUM.
- REINFORCING STEEL SHALL BE CLEAN, WITH NO OIL OR MUD ON BONDING SURFACES.
- ALL CONSTRUCTION SHALL CONFORM TO ACI STANDARD 318 AND U.B.C.
- RUNOFF WATER SHALL DRAIN AWAY FROM FOUNDATION



CONCRETE VOLUME 72.7 C.Y. INCLUDES 3.1 C.Y. IN TOWER

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./LBS.	REFERENCE	FORMAT
K	5	5'-6" / 6'-0"	# 8 BAR	L= 17'-6"		TL= 87'-6"
J	2	6'-0"	# 8 BAR	L= 6'-0"		TL= 12'-0"
I	16	1'-8" / 9'-4"	# 5 BAR	L= 12'-4"		TL= 197'-4"
H	8	6'-0"	# 8 BAR	L= 6'-0"		TL= 48'-0"
G	64	0'-4" / 7'-4"	# 8 BAR	L= 16'-8"		TL= 1066'-8"
F	30	14'-0"	# 8 BAR	L= 14'-0"		TL= 420'-0"
E	30	20'-0"	# 8 BAR	L= 20'-0"		TL= 600'-0"
D	32	5'-8" / 7'-4"	# 4 BAR	L= 18'-8"		TL= 597'-4"
C	1	ANGLE 5 x 5 x 1/4 - 7'-0" LG.	ASTM A-36	/	/	/
B	1	TRACK ROPE ANCHOR	ASTM A-36	/	US 4075641	/
A	1	DRIVE TOWER	ASTM A-538	/	US 4075640	/

REV	DESCRIPTION OF REVISION	DATE	BY
A	CHANGE NOTES, ADD PLAN VIEW, GROUND LEVEL. SHEET 3 OF 9	5/21/98	JS

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES • UNLESS INDICATED •
• FABRICATION •
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°
• MACHINING •
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

JIGBACK TRAM
DRIVE TERMINAL
MODEL YEAR 1998

DRIVE FOUNDATION

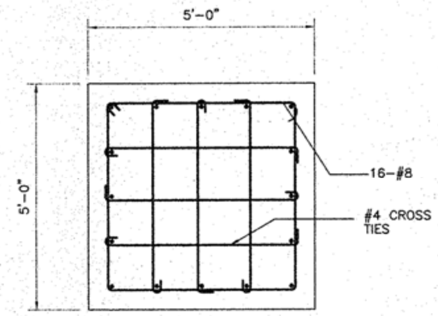
PACOIMA TRAM C51013

CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO , USA

DRAWN BY:	SMITH J.
DESIGNED BY:	SMITH J.
DATE:	3/31/98
SCALE(S):	1/32

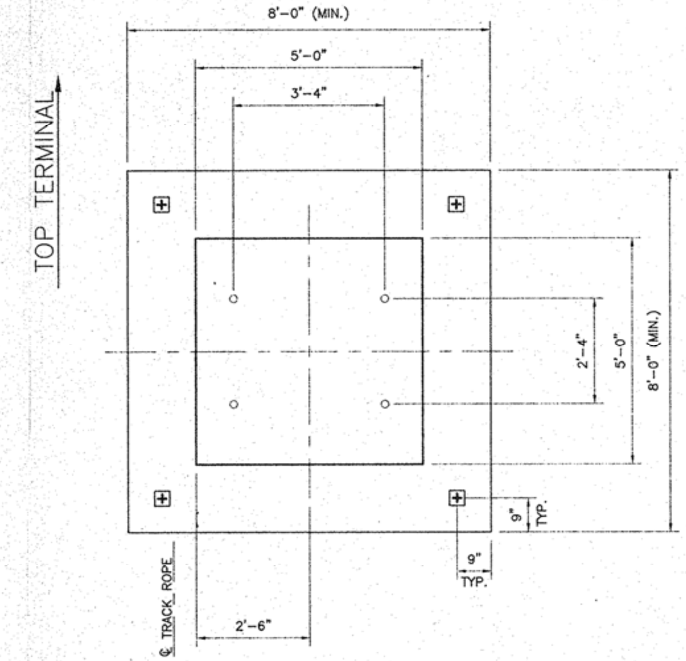
TREATMENT: / TOTAL WT./LBS.: /
MARKING REQ'D.: / QTY. REQ'D.: /
MARK LOCATION: / OTHER REF.: /

FORMAT	DRAWING NUMBER	SHEET 3 OF 9	REVISION
D	3114514		A



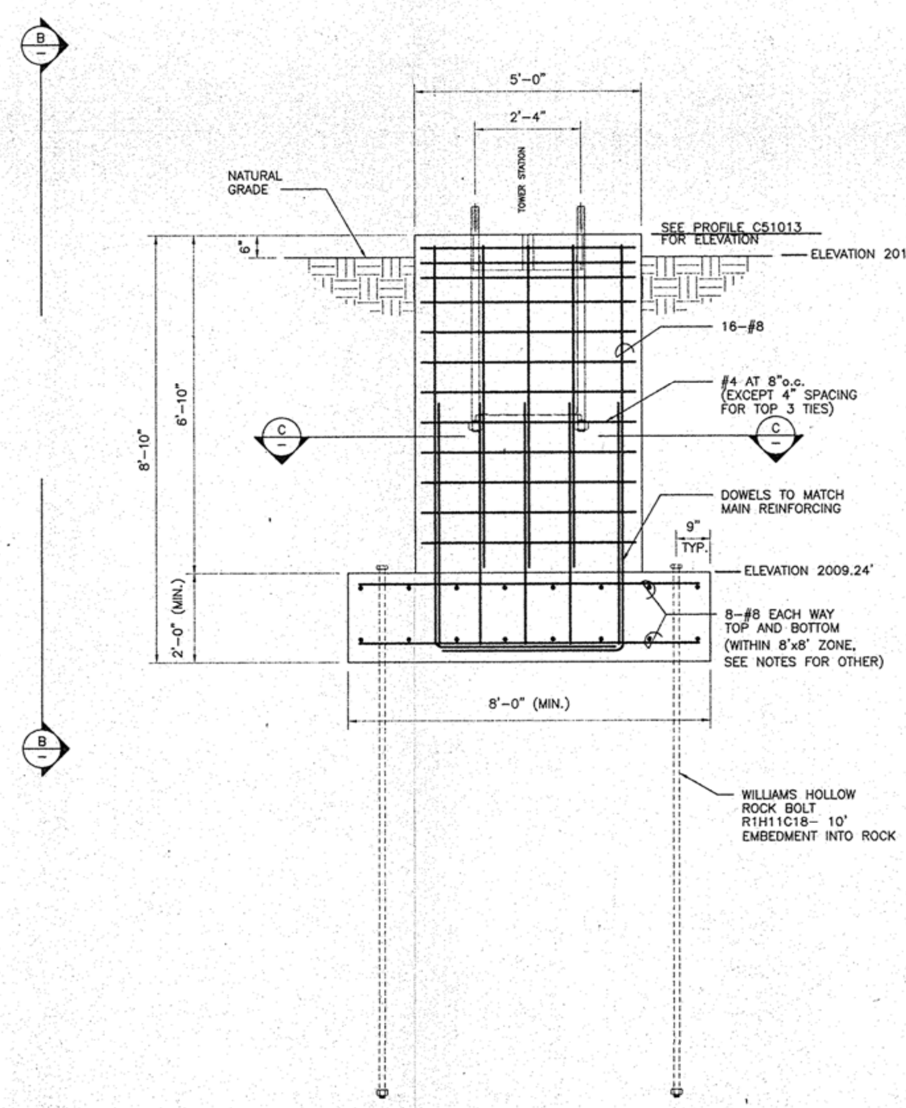
SECTION C

1/2"=1'-0"



SECTION A

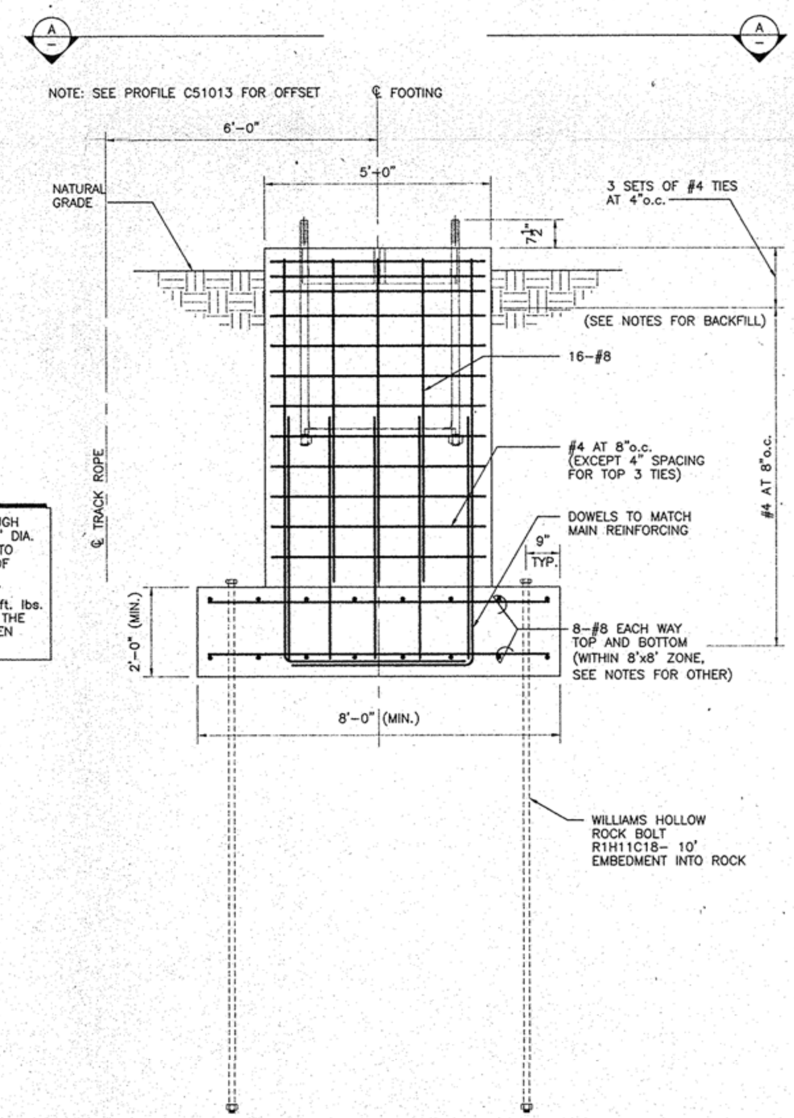
1/2"=1'-0"



DRILL $2\frac{1}{2}$" DIA. HOLES THROUGH CONCRETE SLAB (OR CAST 3" DIA. PVC PLASTIC PIPE IN SLAB) TO PROVIDE A MINIMUM DEPTH OF 10'-0" INTO ROCK. PLACE BOLTS AND SET ANCHORS BY TORQUING THE ROD TO 750 ft. lbs. POST TENSION BY TORQUING THE NUT TO 400 ft. lbs. AND THEN GROUT PER WILLIAMS SPECS.

DETAIL 1

1/2"=1'-0"



SECTION B

1/2"=1'-0"

NOTES:

- CONCRETE SHALL HAVE MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 P.S.I.
- CONCRETE SHALL BE AIR ENTRAINED WITH 6% AIR MINIMUM.
- REINFORCING STEEL SHALL BE ASTM-A615 GRADE 60.
- FOOTING DESIGN IS BASED ON AN ALLOWABLE BEARING CAPACITY OF 6000 P.S.F. (DAMES AND MOORE LETTER REPORT DATED OCTOBER 7, 1998 TO AGBABIAN ASSOCIATES)
- SPLICE LAPS SHALL BE ALLOWED PROVIDED THE BARS LAP 48" MINIMUM.
- REINFORCING STEEL SHALL BE CLEAN, WITH NO OIL OR MUD ON BONDING SURFACES.
- ALL CONSTRUCTION SHALL CONFORM TO ACI STANDARD 318 AND 1994 U.B.C.
- ANCHOR BOLT CAGE HAS FOUR ANGLES, TOP OF CONCRETE SHALL BE FINISHED TO SAME ELEVATION AS TOP OF ANGLES.
- REINFORCING STEEL SHALL BE KEPT 3" FROM THE EDGE OF CONCRETE.
- ALLOWABLE PASSIVE PRESSURE = 260 pcf (DAMES AND MOORE LETTER REPORT DATED 10/7/98 TO AGBABIAN ASSOCIATES)
- EXCAVATION FLOOR SHALL BE PRESSURE GROUTED AS PER DAMES AND MOORE LETTER REPORTS DATED 10/7/98 & 1/7/99 TO AGBABIAN ASSOCIATES
- BACKFILL SHALL BE COMPACTED FILL AS RECOMMENDED IN DAMES AND MOORE REPORT DATED MARCH 25, 1998. IN LIEU OF COMPACTED FILL, BACKFILL MAY CONSIST OF 1 TO 1.5-SACK SLURRY.
- BOTTOM OF FOOTING SHALL BE POURED DIRECTLY AGAINST EXCAVATED ROCK.
- IF CONTRACTOR INTENDS TO POUR BASE OF FOUNDATION TO LIMITS OF EXISTING EXCAVATION, A MINIMUM THICKNESS OF 2' SHALL BE MAINTAINED. THE SHOWN #8 BARS SHOULD BE EXTENDED TO THE LENGTH OF THE FOUNDATION. ADDITIONAL #8 BARS AT 12" C.C. SHALL BE ADDED IN EACH DIRECTION TOP AND BOTTOM WITH 3" COVER OUTSIDE THE 8'x8' REGION.
- CONTRACTOR SHALL CLEAN OUT ALL DEBRIS FROM BOTTOM OF EXCAVATION PRIOR TO PLACING FOUNDATION.
- ROCK BOLTS SHALL BE INSTALLED AFTER CONSOLIDATION GROUTING HAS BEEN PERFORMED.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY
911 Wilshire Boulevard, Suite 700, L.A. CA 90017, (213) 996-2200

GEOTECHNICAL REVIEW

These plans were reviewed by Dames & Moore to check for conformance with geotechnical recommendations presented in our report(s) dated: OCT 07 1998

D&M Job No: 39406 002-015

Signed:

Dated: JAN 13 1999

Our review did not include verification of civil/structural calculations dimensions, or other work product by the designers.

REGISTERED PROFESSIONAL ENGINEER · WOLFGANG H. ROTH · GE 739 · Exp. 12/31/2 · GEOTECHNICAL · STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER · KIM M. CARAVALHO · C057164 · Exp. 12/31/01 · CIVIL · STATE OF CALIFORNIA

Kim Caravalho 1/13/99
KIM M. CARAVALHO DATE

PLANS PREPARED UNDER THE DIRECTION OF

AGBABIAN ASSOCIATES
engineers and consultants
1111 South Arroyo Parkway, Suite 470, Pasadena, CA 91105
Phone: (626) 441-1060 Fax: (626) 441-0757

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./LBS.	REFERENCE	FORMAT
A	1	A-BOLT CAGE: US4075.816 (4 x 2"T BOLTS)				

REV	DESCRIPTION OF REVISION	DATE	BY
F	MODIFY FOOTING FOR EXISTING EXCAVATION (DONE BY AGBABIAN ASSOC.)	1/12/99	JBS
E	MODIFY FOOTING FOR EXISTING SOIL CONDITIONS (DONE BY AGBABIAN ASSOC.)	10/7/98	JBS
D	MODIFY FOOTING FOR SOIL	6/23/98	JS
C	ADD DETAIL, SECTION CALLOUTS	6/10/98	KAC
B	CHANGE NOTES, ADD SHEET 7 OF 9	5/21/98	JS
A	MODIFY ROCK BOLT SIZE 1"T TO 1-3/8"T	4/8/98	JS

JIGBACK TRAM
TOWER 2
1998

TOWER 2 FOUNDATION

PACOIMA TRAM C51013

TOLERANCES UNLESS INDICATED

FABRICATION	
FRACTIONAL	±1/16
ANGULAR	±1/2°

MACHINING	
DECIMAL W/.X ...	±.05
DECIMAL W/.XX ..	±.01
DECIMAL W/.XXX .	±.005
ANGULAR	±.1°

PRODUCTION USE ONLY

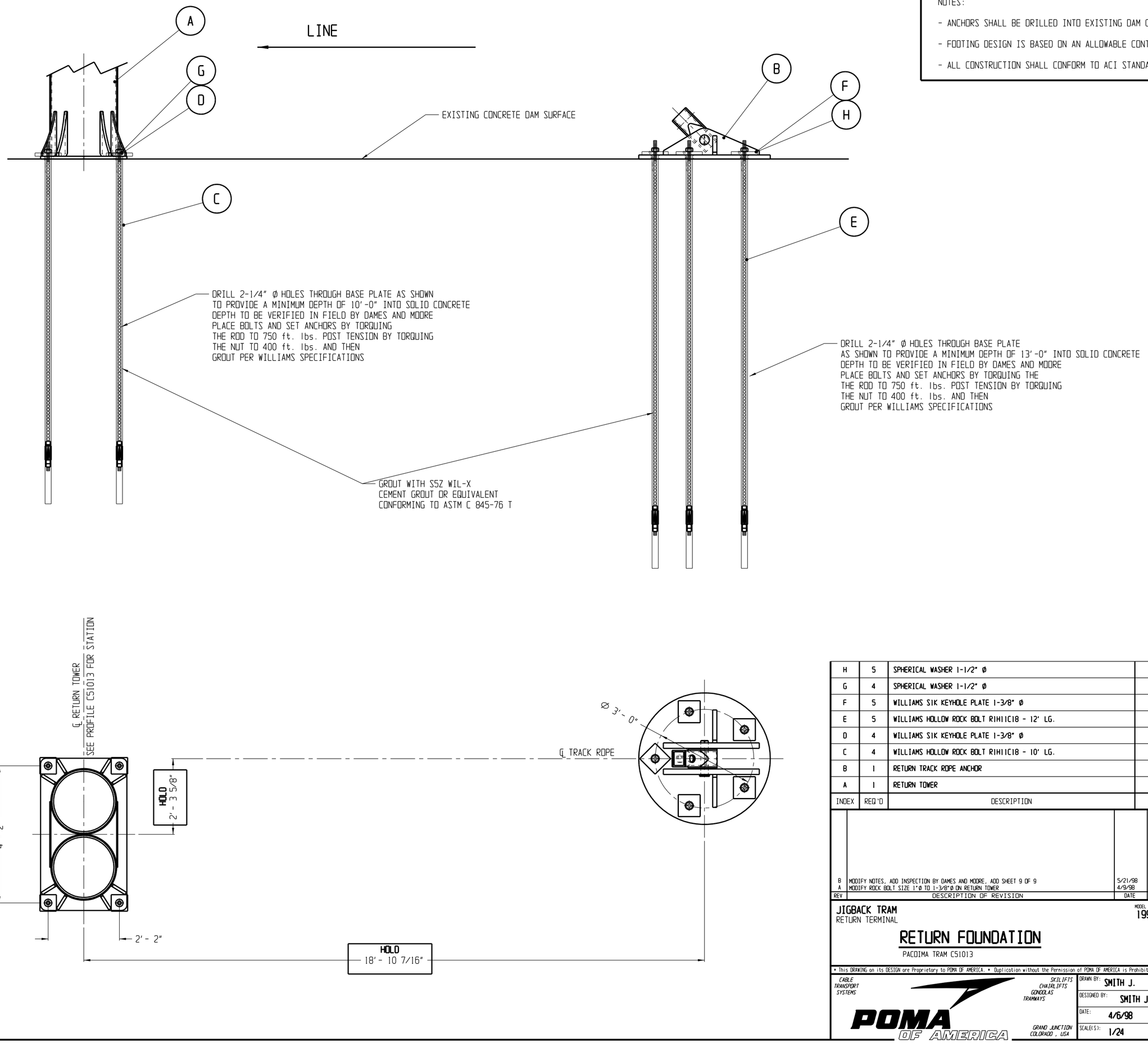
CABLE TRANSPORT SYSTEMS
POMA
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
GRAND JUNCTION

DRAWN BY: JBS
DESIGNED BY: KMC
DATE: 1/12/99

FORMAT: D
DRAWING NUMBER: 3114.515
SHEET 7 OF 9
REVISION: F

NOTES:

- ANCHORS SHALL BE DRILLED INTO EXISTING DAM CONCRETE AS SHOWN.
- FOOTING DESIGN IS BASED ON AN ALLOWABLE CONTACT PRESSURE OF 500 P.S.I.
- ALL CONSTRUCTION SHALL CONFORM TO ACI STANDARD 318 AND U.B.C.



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
H	5	SPHERICAL WASHER 1-1/2" Ø			5059124	
G	4	SPHERICAL WASHER 1-1/2" Ø			5059124	
F	5	WILLIAMS SIK KEYHOLE PLATE 1-3/8" Ø			5062028	
E	5	WILLIAMS HOLLOW ROCK BOLT R1H11C18 - 12' LG.			5062029	
D	4	WILLIAMS SIK KEYHOLE PLATE 1-3/8" Ø			5062028	
C	4	WILLIAMS HOLLOW ROCK BOLT R1H11C18 - 10' LG.			5062030	
B	1	RETURN TRACK ROPE ANCHOR			4075663	/
A	1	RETURN TOWER			4075663	/

REV	DESCRIPTION OF REVISION	DATE	BY
B	MODIFY NOTES, ADD INSPECTION BY DAMES AND MOORE, ADD SHEET 9 OF 9	5/21/98	JS
A	MODIFY ROCK BOLT SIZE 1"Ø TO 1-3/8"Ø ON RETURN TOWER	4/9/98	JS

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES - UNLESS INDICATED *

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

JIGBACK TRAM
RETURN TERMINAL

MODEL YEAR 1998

RETURN FOUNDATION

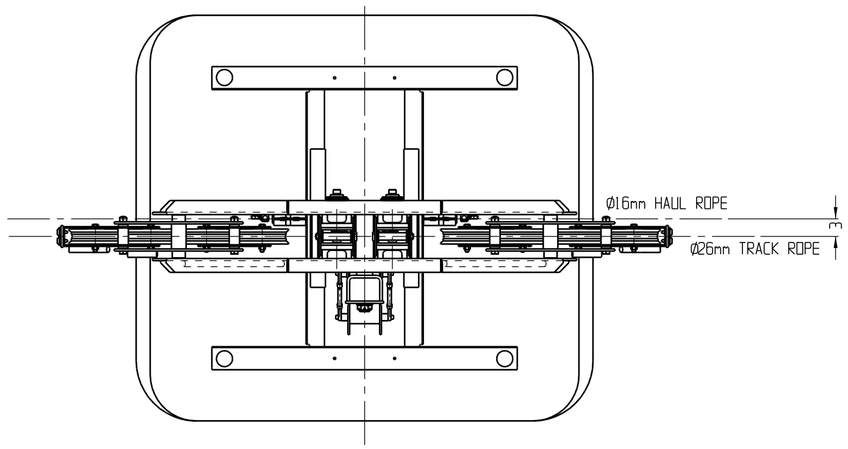
PACOIMA TRAM C51013

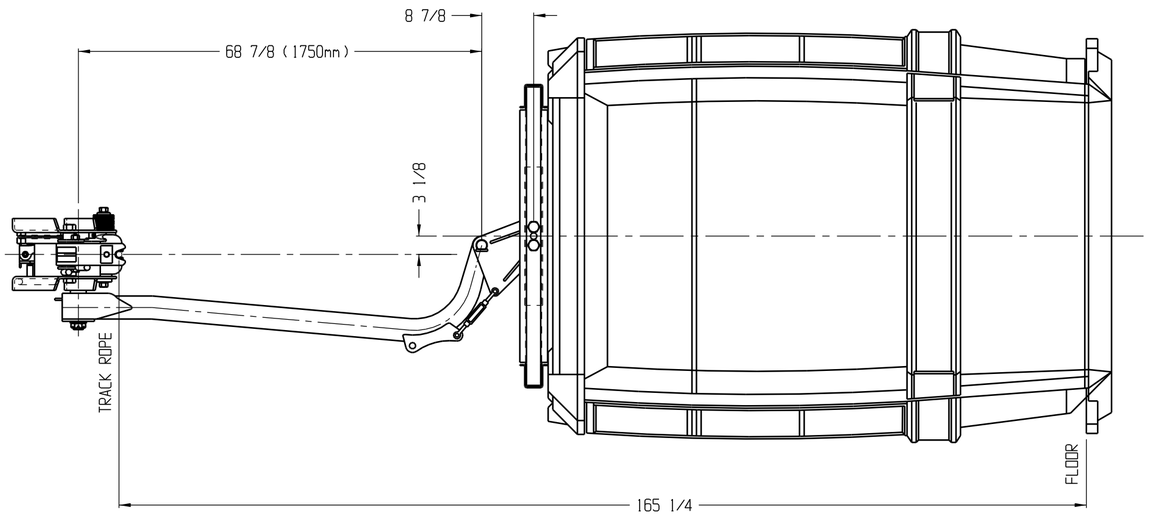
CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

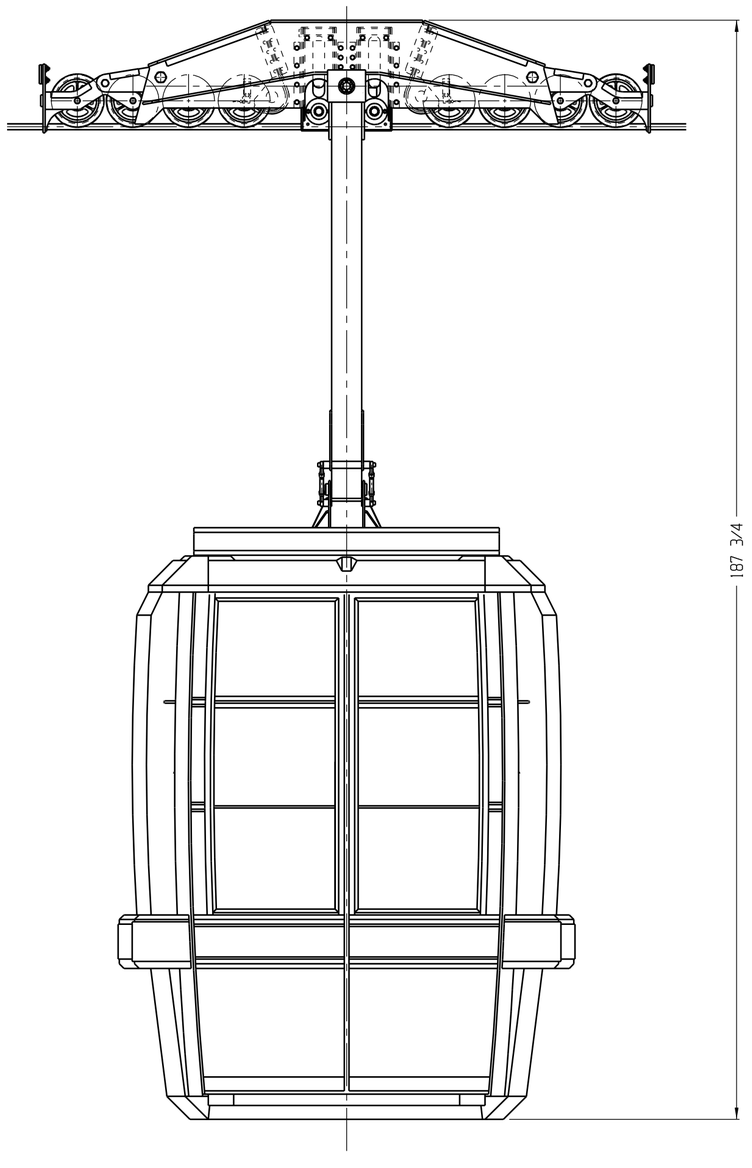
DRAWN BY: SMITH J.
DESIGNED BY: SMITH J.
DATE: 4/6/98
SCALE(S): 1/24

TREATMENT: /
TOTAL WT./LBS.: /
MARKING REQ'D.: /
QTY. REQ'D.: /
MARK LOCATION: /
OTHER REF.: /

FORMAT	DRAWING NUMBER	SHEET 9 OF 9	REVISION
C	3114516		B







INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT

REV	DESCRIPTION OF REVISION	DATE	BY
A	ADDED SECOND TRACK ROPE BRAKE	4/30/09	NT

AERIAL TRAMWAY
PACOIMA DAM, CA

1998

CABIN ASSEMBLY

12PL SIGMA CABIN WITH HANGER AND TRUCK, 2240 LBS PAYLOAD

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO, USA

DRAWN BY:	N. TUSBERG
DESIGNED BY:	N. TUSBERG
DATE:	04.06.98
SCALE(S):	1/20

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

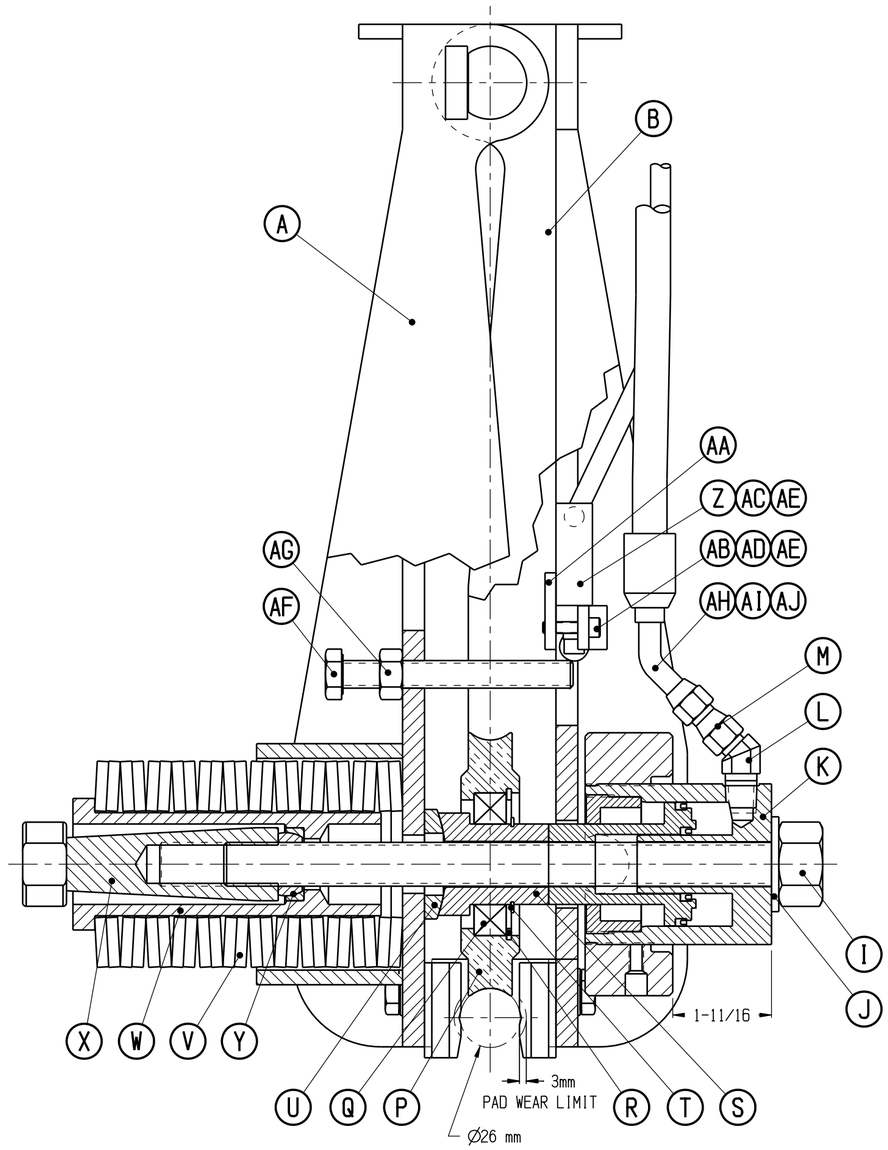
TOLERANCES UNLESS INDICATED

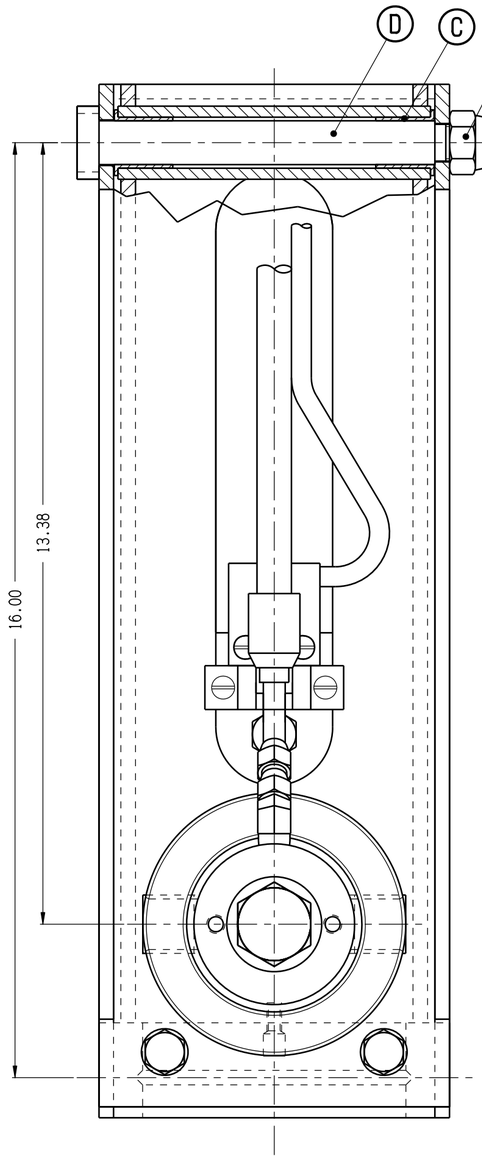
FABRICATION
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

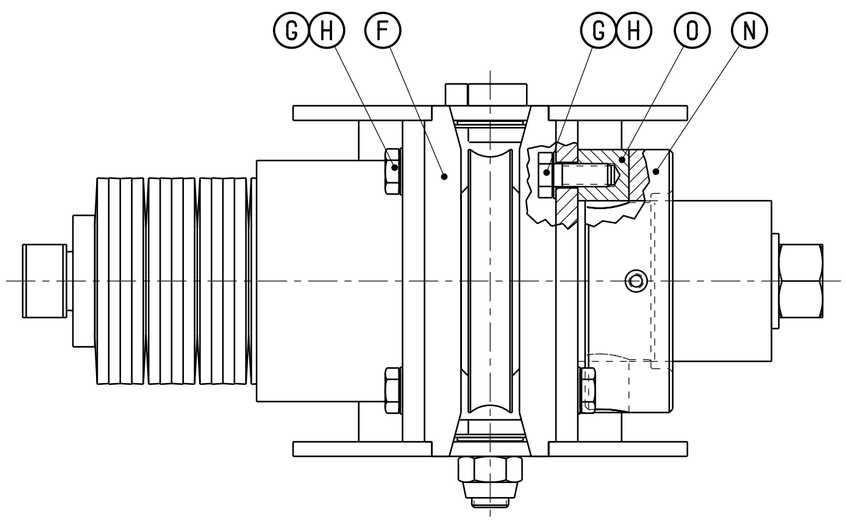
MACHINING
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

TREATMENT:
TOTAL WT./LBS.: ≈1910
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

FORMAT	DRAWING NUMBER	REVISION
C	US3038.772	A







	INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
NOT SHOWN	AJ	30"	NYLON PROTECTION SLEEVE 1/4", ATTACH TO "AH" WITH ZIP TIES			5350509	
NOT SHOWN	AI	1	ADAPTER-ELBOW 4MJ-4FJX90, AT TRUCK MOUNTED TEE			5350041	
	AH	1	HOSE 4FJX45/4-100R2AT-4FJX 30"			5350508-2.5	
	AG	1	NUT LOW HM 12 8.8 PLATED			058052	
	AF	1	BOLT HM 12x100/100 8.8 PLATED			057222	
	AE	4	LOCKWASHER TYPE J INT M5			5059066	
	AD	2	BOLT CM 5x20/20 4.8 PLATED			5057409	
	AC	2	BOLT CM 5x16/16 4.8 PLATED			5057159	
	AB	1	COUNTERPLATE, SWITCH			US3231.119	A
	AA	1	MOUNT, BRAKE SWITCH			US3231.118	A
	Z	1	SWITCH, TM 9007-XMS13FS0600			5206250	
	Y	1	BEARING, PLAIN SPHERICAL THRUST			5080112	
	X	1	ADJUSTING NUT			US3225.576	A
	W	1	INNER GUIDE, SPRING PACK			US3225.575	A
	V	24	SPRING WASHER, 90/46/5			059068	
	U	1	WASHER, SPHERICAL CONE, CL-7-SW PLATED			5059039	
	T	1	EXT SNAP RING, Ø1-3/8"			5070059	
	S	1	SPINDLE, GUIDE WHEEL			US3225.573	A
	R	1	INT SNAP RING, Ø2-7/16"			5070062	
	Q	1	BEARING, SKF 6007 2RS			080027	
	P	1	GUIDE WHEEL			US3225.572	A
	O	2	PIVOT			US3226.906	A
	N	1	COLLAR, PIVOTING			US3226.905	A
	M	1	ADAPTER 4MJ-4FJX			5350507	
	L	1	ADAPTER ELBOW 45° 4MP-4MJ			5350506	
	K	1	BRAKE CYLINDER			US3115.227	A
	J	1	WASHER 3/4" F436 PLATED			5059078	
	I	1	BOLT 3/4"-10NC x 9 1/2 GR.8 PLATED			US4075.686	A
	H	6	LOCKWASHER JZC10 PLATED			059285	
	G	6	BOLT HM10x25/25 8.8 PLATED			057212	
	F	2	BRAKE PAD			US3225.570	B
	E	1	NYLOCK NUT M16 8.8 PLATED			058188	
	D	1	AXLE, BRAKE PIVOT			US3225.574	A
	C	2	BEARING, IGLIDE GFI-1214-16			5080108	
	B	1	PINCER, CYLINDER SIDE			US4075.685	C
	A	1	PINCER, SPRING SIDE			US4075.684	C

REV	DESCRIPTION OF REVISION	DATE	BY
C	UPDATED TO '09 REVISION	04.30.09	NT
B	ADDED FOUR INDEX "V" SPRINGS (SET OF 2 PAIRS)	05.24.05	NT
A	UPDATED FOR PIVOTING CYLINDER AND NEW BRAKE CYLINDER NUMBER	04.23.02	NT

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES UNLESS INDICATED

FABRICATION
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

MACHINING
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

AERIAL TRAM 1998

TRACK ROPE BRAKE ASSY

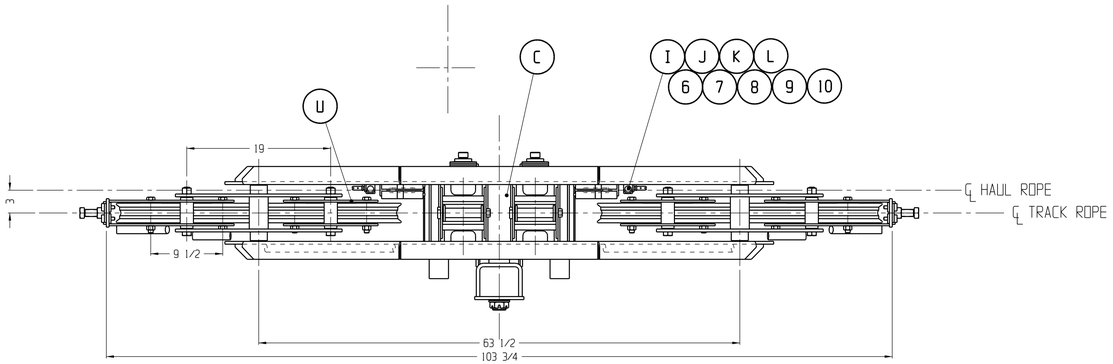
12pl CABIN, 26nn TRACK ROPE, 4-1/2 TON

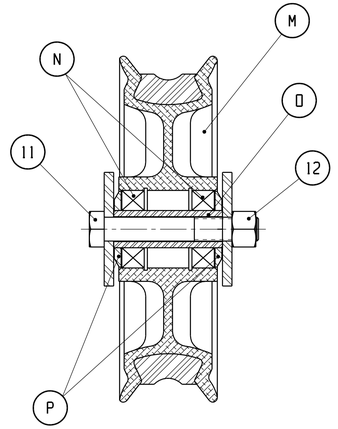
CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

DRAWN BY: N.TUSBERG
DESIGNED BY: N.TUSBERG
DATE: 03.09.99
SCALE(S): 1/2

TREATMENT:
TOTAL WT./LBS.: FINISHED
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

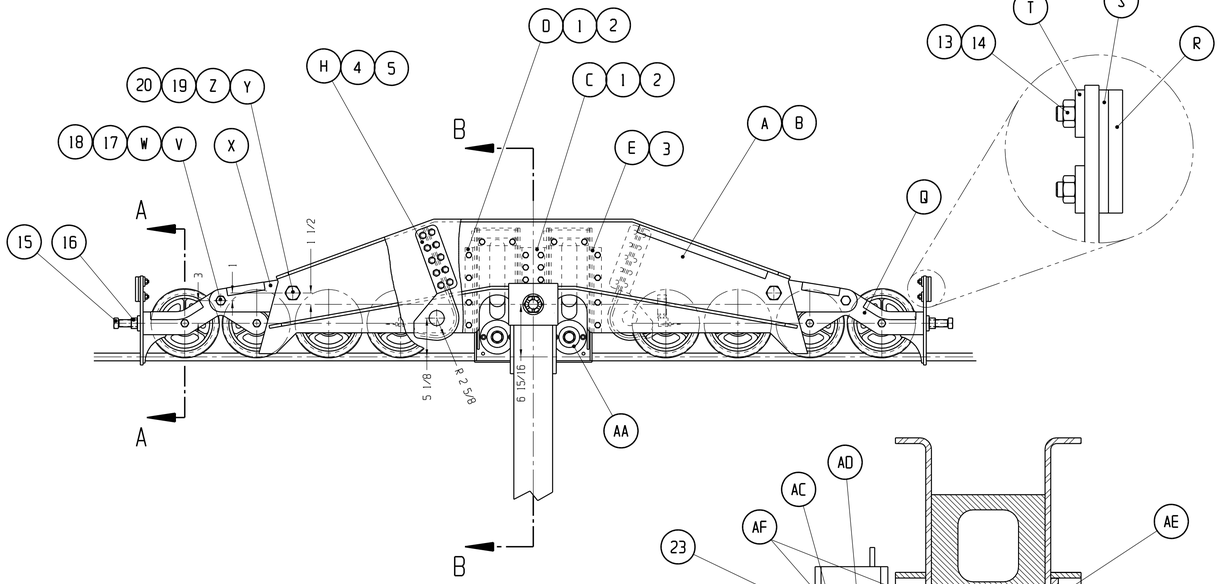
FORMAT	DRAWING NUMBER	REVISION
C	US3038.868	C

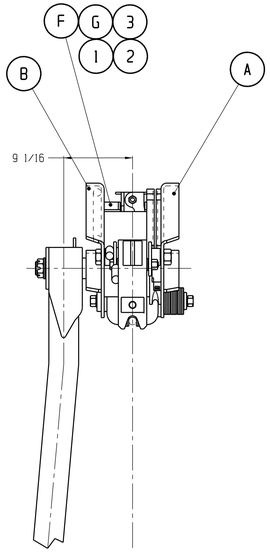


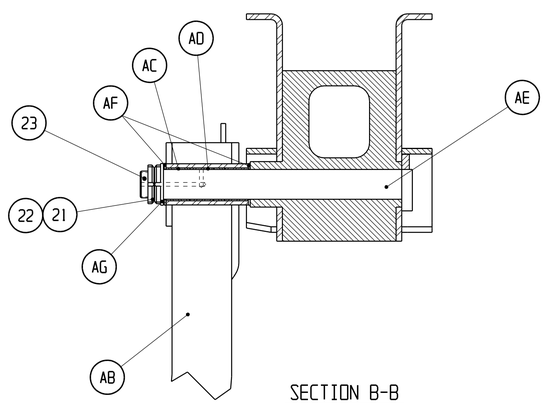


SECTION A-A

SCALE = 1/2







SECTION B-B

SCALE = 1/5

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
23	1	ROLL PIN 6x60			060028	
22	1	LOCKWASHER SKF M89			059006	
21	2	LOCK NUT SKF KM9			058286	
20	2	NYLOCK NUT M27 8.8 PLATED			058201	
19	2	BOLT HM27x250/80 8.8 PLATED			5057316	
18	4	NYLOCK NUT M20 8.8 PLATED			058192	
17	4	BOLT HM20x150/80 8.8 PLATED			057626	
16	2	NUT HuM24 8.8 PLATED			058013	
15	2	BOLT HM24x90/90 8.8 PLATED			5057267	
14	8	NYLOCK NUT M10 8.8 PLATED			058185	
13	8	WASHER M10u PLATED			059105	
12	8	NYLOCK NUT M16 8.8 PLATED			057058	
11	8	BOLT HM16x110/38 8.8 PLATED			058188	
10	2	NUT HuM5 8.8 PLATED			058003	
9	2	LOCKWASHER JZC5 PLATED			059282	
8	2	SCREW HM5x10/10 8.8 PLATED			5057044	
7	4	LOCKWASHER JZC14 PLATED			059281	
6	4	BOLT HM4x20/20 8.8 PLATED			057201	
5	20	LOCKWASHER JZC14 PLATED			059287	
4	20	BOLT HM14x60/35 8.8 PLATED			057036	
3	48	BOLT FHC/90 M8x20/20 8.8 PLATED			057462	
2	44	LOCKWASHER JZC12 PLATED			059286	
1	44	BOLT HM12x35/35 8.8 PLATED			057217	
AG	1	WASHER			3110.953	A
AF	2	BRONZE THRUST WASHER			3110.952	A
AE	1	AXLE, HANGER TO TRUCK			3225.571	B
AD	1	BUSHING GLY Pg 50/55/40A, L=.628"			082512	
AC	3	BUSHING GLY Pg 50/50/40A			082512	
AB	1	HANGER			8082519	
AA	2	TRACK ROPE BRAKE, ASSY			3038.868	C
Z	2	SPINDLE			3225.517	A
Y	4	BEARING, IGLIDE GFI-2426-24			5080106	
X	2	4 ROCKER, IR & IL			4075.682	B
W	4	SPINDLE			3225.518	A
V	8	BEARING, IGLIDE GFI-1820-24			5080111	
U	2	2 ROCKER, INSIDE			4075.681	B
T	2	INSULATOR			3225.568	A
S	8	INSULATOR BUSHING			3225.566	A
R	4	CONTACT, CABIN CHARGER			4075.683	A
Q	2	2 ROCKER, OUTSIDE, IR & IL			4075.680	C
P	16	SHIELD/BEARING SPACER			3225.520	A
O	8	SPINDLE			3225.519	A
N	16	BEARING, 6205 2RS			080066	
M	8	Ø200mm SHEAVE			3114.521	A
L	2	CLAMP, LANYARD TO HAUL ROPE			5100443	
K	2	LANYARD, 1/16" x 24"			5100442	
J	2	KEY, TM XCK-Y01			5206249	
I	2	SWITCH, TM XCK-P591			5206248	
H	2	CABLE CLAMP, MOBILE JAW			3225.569	B
G	4	PAD, STOP BLOCK			3225.556	A
F	4	STOP BLOCK, BRAKE			3225.555	A
E	4	GUIDE PAD			3225.553	A
D	2	BRAKE GUIDE			3225.552	A
C	1	TRUCK SPACER, CENTER			3225.554	C
B	1	SIDE PLATE, HANGER SIDE			4075.679	C
A	1	SIDE PLATE, HAUL ROPE SIDE			4075.678	D

REV.	DESCRIPTION OF REVISION	DATE	BY
A	ADDED SECOND TRACK ROPE BRAKE AND ASSOCIATED PARTS	04/30/09	NT

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES UNLESS INDICATED

• FABRICATION •
FRACTIONAL . . . . ±1/16
ANGULAR . . . . . ±1/2°

• MACHINING •
DECIMAL W/.X . . . ±.05
DECIMAL W/.XX . . ±.01
DECIMAL W/.XXX . ±.005
ANGULAR . . . . . ±.1°

AERIAL TRAM

MODEL YEAR 1998

8 SHEAVE TRUCK ASSEMBLY

12 PLACE HANGER

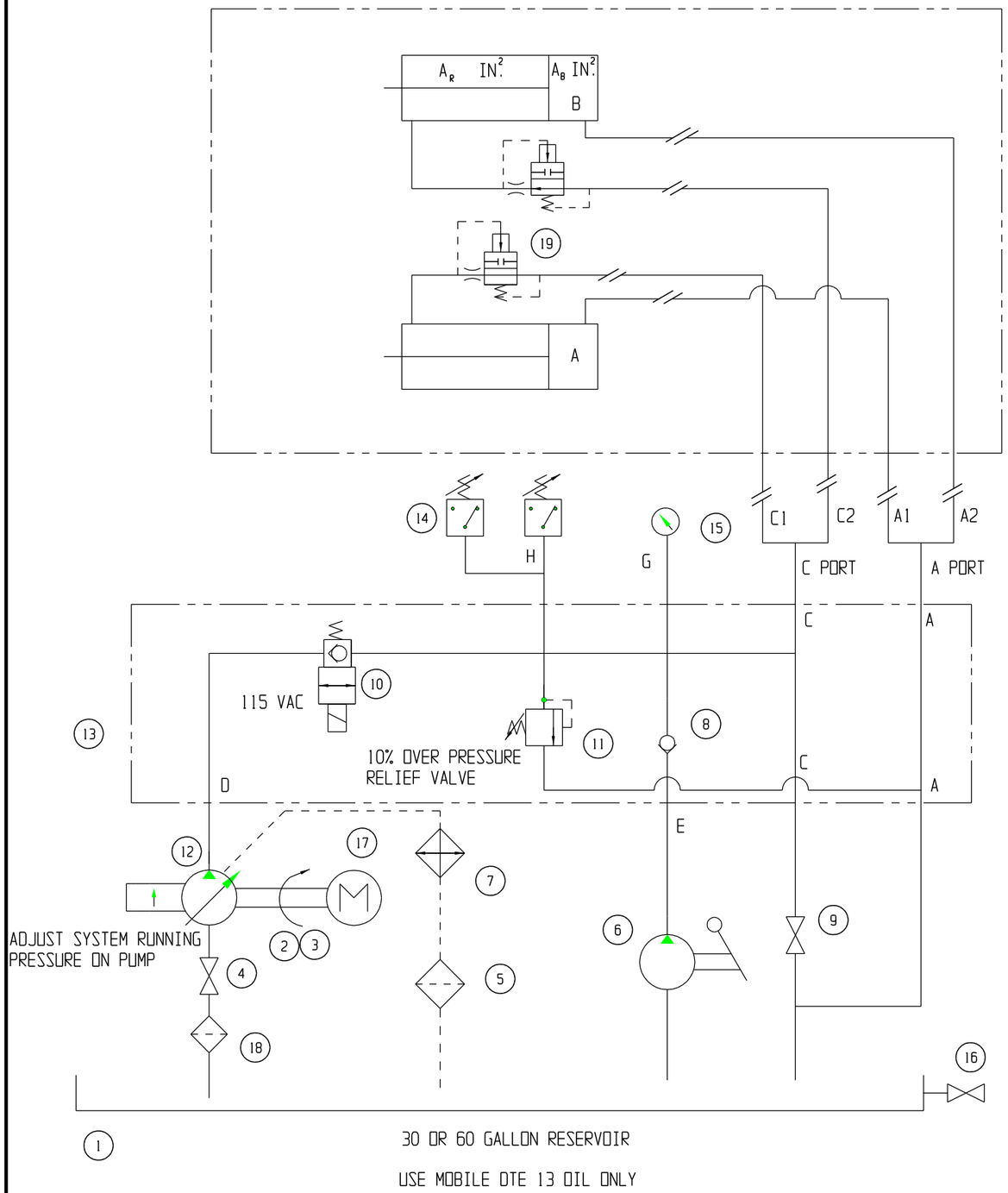
TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS

POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 4/14/99
SCALES 1: 1/10, 1/5, 1/2

FORMAT	DRAWING NUMBER	REVISION
D	US3038.883	A



INDEX	REQ'D	DESCRIPTION	MANUF. PART NUMBER	POMA PART NUMBER
19	2	POW-R-OIL VELOCITY FUSE (FOR MEMORY)	92919-3.3	5300.121
18	1	ZINGA SUCTION STRAINER	SS-100-03-100	5300.202
17	1	LEESON ELEC. MTR. 3HP/230/460/3/182TC W/ A16N12B HOFFMAN ENCL.	130326	5001.037
16	1	LHA BALL VALVE 3/4" NPT	BV-12N	5300.199
15	1	LENZ PRESSURE GAUGE 0-3000	BAC-3M-25	5300.198
14	2	BARKSDALE PRESSURE SWITCH	B1T-H32	5300.197
13	1	TEI CUSTOM MANIFOLD (COMP. II)		5300.196
12	1	DENISON PUMP	PV-6-2LIC-C00-SP1075	5300.195
11	1	STERLING HYDRAULICS RELIEF VALVE WITH TAMPER PROOF CAP	MODEL A5B020TN #TC1125	5300.194
10	1	STERLING HYDRAULICS SOLENOID VALVE 115VAC	GS020600N - SOLENOID CCS-115-D	5300.193
9	1	STAUFF 1/2" BALL VALVE	BBV-2008001	5300.192
8	1	STERLING HYDRAULICS CHECK VALVE	D2A025-0.2N	5300.191
7	1	AMERICAN INDUSTRIAL AIR/OIL HEAT EXCHANGER	ADRM-20-S	5300.190
6	1	BRAND HAND PUMP	HP-61-DA-TL	5300.153
5	1	MPS RETURN FILTER ASSEMBLY	MPS-505-RG2/CS650-P1DA/CI-20	5300.251
4	1	B&K GATE VALVE 3/4"	NPT 100-004	5300.188
3	1	VESCOR PUMP/MOTOR ADAPTOR	1960	5300.187
2	1	HAYES COUPLING	2AN-13-07	5300.186
1	1	VESCOR 30 OR 60 GALLON RESERVOIR	10030 OR 10060	5300.160 OR .136

REV.	DESCRIPTION OF REVISION	DATE	BY
A	UPDATE 5, 17 FOR 1995	5/18/95	CWT

TOTAL WEIGHT/ POUNDS,

TREATMENT,

ASSEMBLY REFERENCE,

OTHER REFERENCE,

HYDRAULIC SCHEMATIC

COMPETITION II TENSIONING UNITS

DRAWN BY	DESIGNED BY
B.R.HOOPES	R.J. SMITH
DATE: 5.4.94	SCALE: N/S

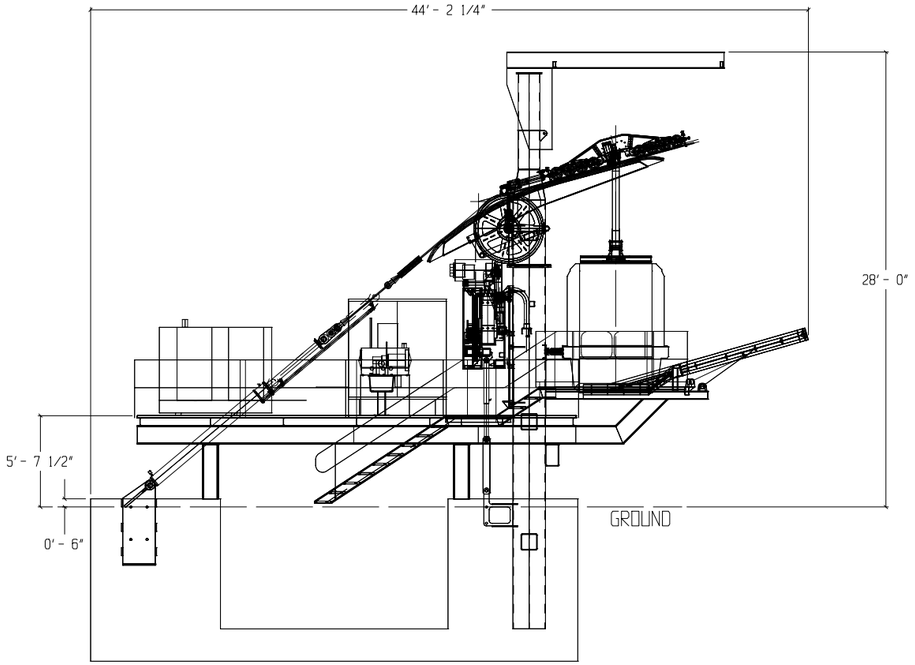
AERIAL TRAMWAY SYSTEMS

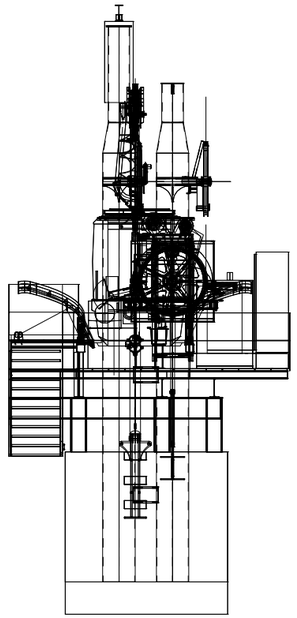
2510 FORESIGHT CIRCLE
GRAND JUNCTION, COLORADO U.S.A.

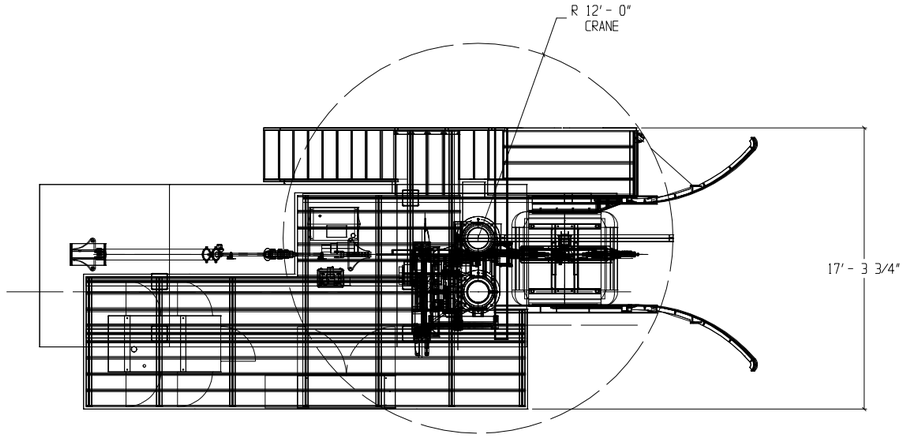
POMA OF AMERICA

FORMAT	DRAWING NUMBER
B	US 3038.547

A







REV	DESCRIPTION OF REVISION	DATE	BY
A	ADD SHEET 2 OF 9	5.21.98	CS

PACOIMA DAM
AERIAL TRAMWAY

MODEL YEAR 1998

DRIVE TERMINAL ASSEMBLY

CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

DRAWN BY: JTC
DESIGNED BY: J.COPELAND/ N. TUSBERG
DATE: 4.6.98
SCALE(S): 1/12

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

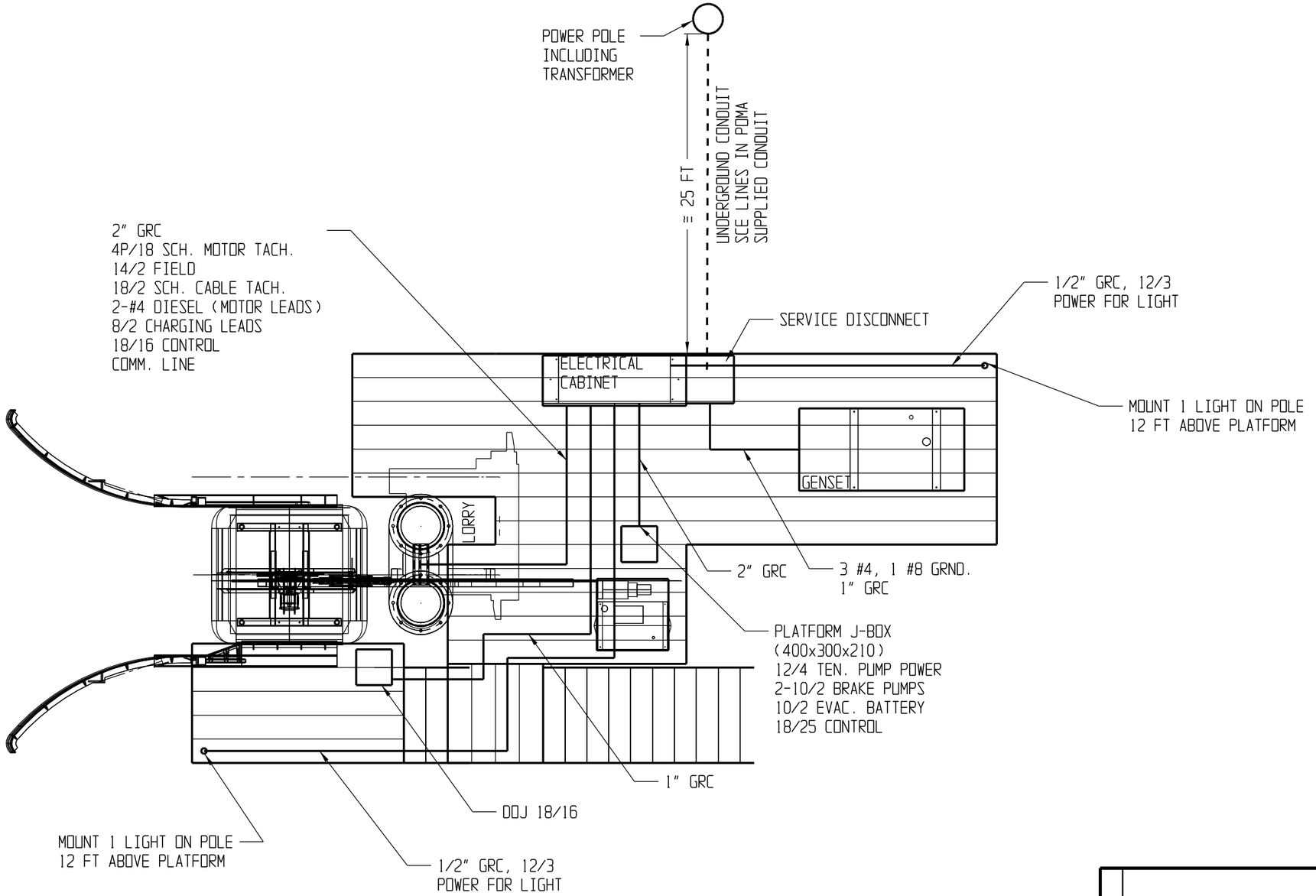
TOLERANCES
* UNLESS INDICATED

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX ... ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

FORMAT	DRAWING NUMBER	SHEET 2 OF 9	REVISION
C	3038.767		A



REV	DESCRIPTION OF REVISION	DATE	BY
B	ADDED WIRING PLAN	5.27.98	JTC
A	ADDED LIGHTING PLAN	4.28.98	JLS

PACOIMA DAM
AERIAL TRAMWAY

MODEL YEAR 1998

WIRING/POWER/LIGHTING PLAN

DRIVE

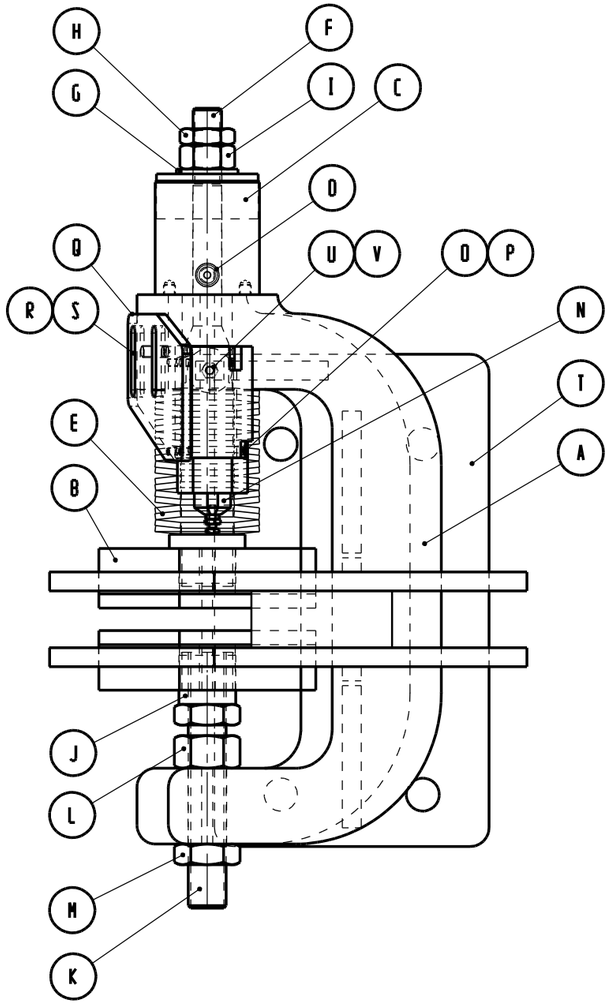
DRAWN BY:	DESIGNED BY:	DATE:	SCALE(S):	TOTAL WT./LBS.:
J.COPELAND	RM	4.2.98	1/60	

CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA
GRAND JUNCTION
COLORADO, USA

FORMAT B
QTY. REQ'D.:
OTHER REF.:

DRAWING NUMBER 3038.773
REVISION B



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
V	1	NUT HuM6 8.8 PLATED	8.8 PLATED	/	058004	
U	1	PAULSTRA	/	/	051011	
T	1	BRAKE MOUNT	/	/	US4075.677	C
S	2	LOCKWASHER JCZ8 PLATED	PLATED	/	059284	
R	2	BOLT HM8 x 20/20 8.8 PLATED	8.8 PLATED	/	057002	
Q	1	SWITCH BRACKET	/	/	US3225.543	A
P	2	LOCKWASHER JCZ5 PLATED	PLATED	/	059282	
O	2	BOLT CM5 x 45/22 5.6 PLATED	5.6 PLATED	/	5057237	
N	1	MICRO SWITCH LSV1A	/	/	5206201	
M	2	NUT LOW 1" - 12 NF GR. 5 PLATED	GR.5 PLATED	/	5058124	
L	1	NUT 1" -12 NF GR. 5 PLATED	GR.5 PLATED	/	5058123	
K	1	ALLTHREAD 1"-12 NF x 6-3/4" LG. GR. 5 PLATED	GR.5 PLATED	/	5057737	
J	1	ADAPTER, BRAKE PAD	/	/	US3225.542	A
I	1	NUT LOW 3/4" - 16 NF GR. 8 PLATED	GR.8 PLATED	/	5058126	
H	1	NUT 3/4" 16 NF- GR. 8 PLATED	GR.8 PLATED	/	5058065	
G	1	WASHER 3/4" PLATED	PLATED	/	5059029	
F	1	BRAKE SHAFT, HYD CYL.	/	/	US3225.541	B
E	20	SPRING WASHER 70/35.5/4 PLATED	PLATED	/	059063	
D	1	ELBOW 90° 4MP-4MJ	/	/	5050277	
C	1	BRAKE CYLINDER	/	/	US3115.227	A
B	2	BRAKE SHOE	/	/	3065.308	A3
A	1	BRAKE FRAME	/	/	US3225.540	B

REV	DESCRIPTION OF REVISION	DATE	BY
A	CHANGED HYD CYLINDER TO US3115.227	05.17.02	NT

/
/

MODEL YEAR
1999

SERVICE/E-BRAKE ASSEMBLY

4 TON

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO , USA

DRAWN BY: SMITH J.
DESIGNED BY: TUSBERG N.
DATE: 3/10/99
SCALE(S): 1/4

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

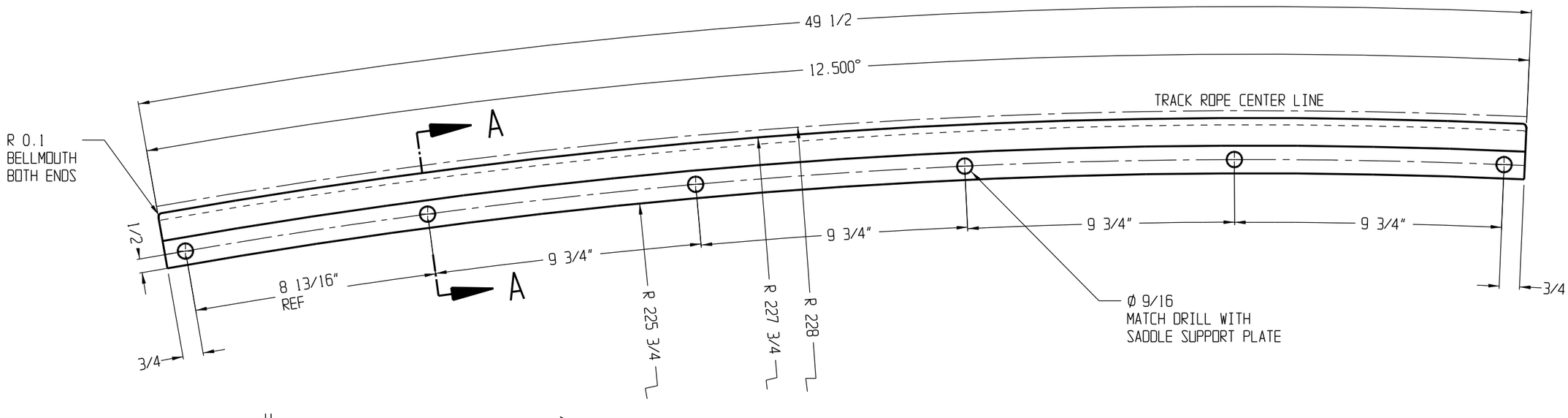
TOLERANCES
* UNLESS INDICATED *

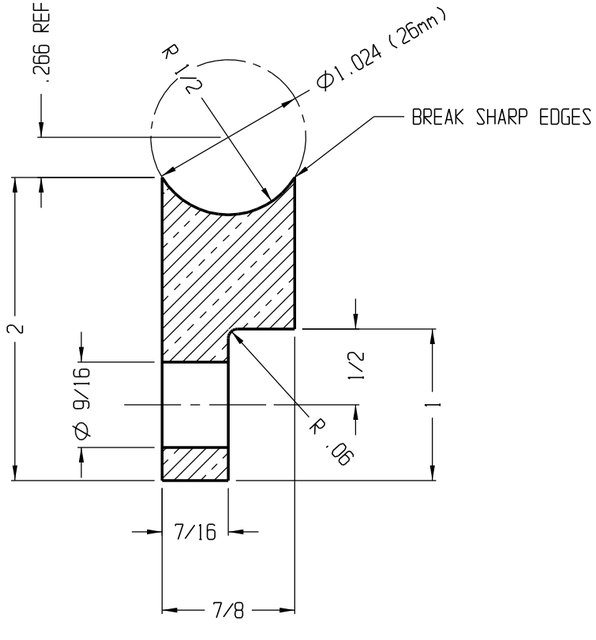
* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.:
QTY. REQ'D.: PER PROJECT
MARK LOCATION:
OTHER REF.:

FORMAT	DRAWING NUMBER	REVISION
B	US3038.869	A





SECTION A-A
SCALE: 1/1

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A	1	RECT BAR 1 x 2 x 49 1/2 FINISHED LENGTH (BRASS)	ASTM-B16 C360	28	/	/

REV	DESCRIPTION OF REVISION	DATE	BY

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES * UNLESS INDICATED *

* FABRICATION *

FRACTIONAL	±1/16
ANGULAR	±1/2°

* MACHINING *

DECIMAL W/.X	±.05
DECIMAL W/.XX	±.01
DECIMAL W/.XXX	±.005
ANGULAR	±.1°

AERIAL TRAM
PACOIMA

MODEL YEAR 1998

SADDLE Ø 26mm x R 228" x 12.5°

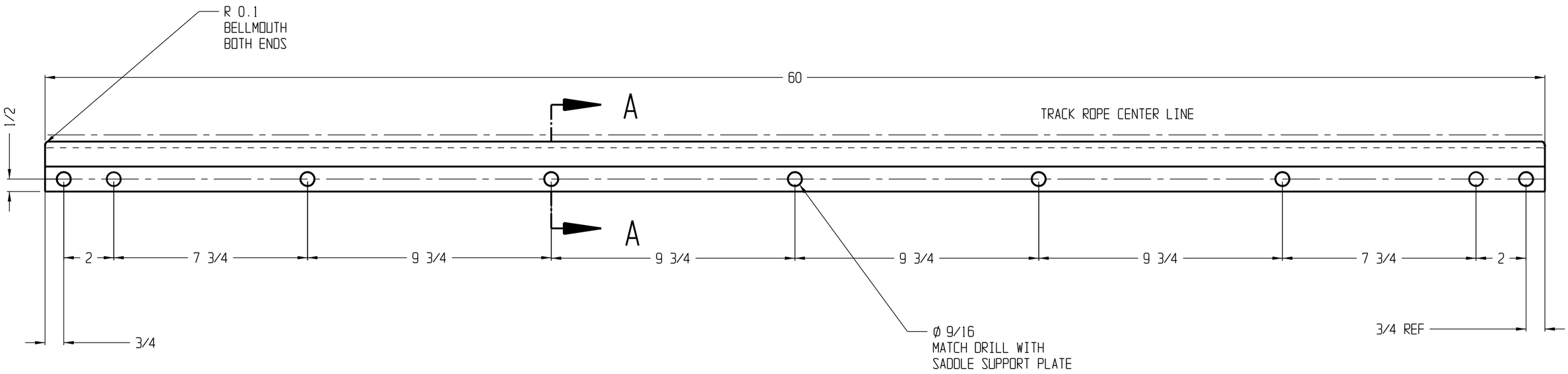
/

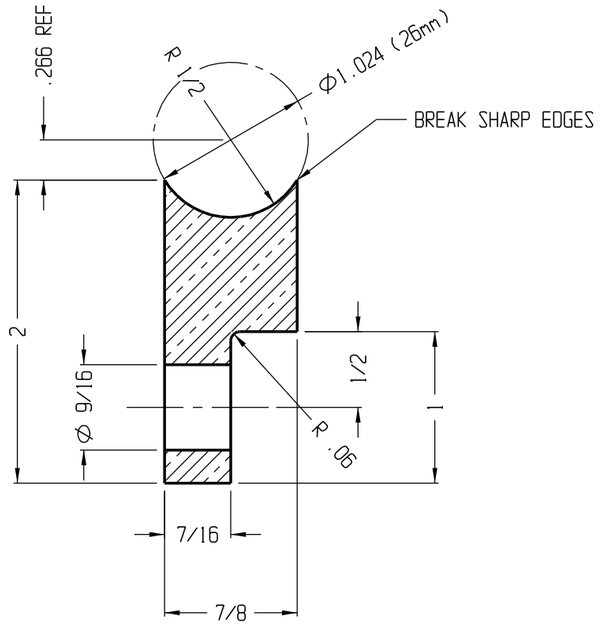
CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

DRAWN BY: C. SPRAUER
DESIGNED BY: J. COPELAND
DATE: 4.13.98
SCALE(S): 1/4, 1/1

TREATMENT: /
TOTAL WT./LBS.: FINISHED 16
MARKING REQ'D.: 5528
QTY. REQ'D.: /
MARK LOCATION: SIDE
OTHER REF.: /

FORMAT: B
DRAWING NUMBER: 3325.528
REVISION: /





SECTION A-A
SCALE: 1/1

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A	1	RECT BAR 1 x 2 x 60 (BRASS)	ASTM-B16 C360	34	/	/

REV	DESCRIPTION OF REVISION	DATE	BY
A	ADDED 2 Ø9/16 HOLES FOR BRITTLE BAR ACCESS	5.27.98	JLS

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

AERIAL TRAM
PACOIMA

MODEL YEAR 1998

SADDLE Ø 26mm x 60" LG

/

TOLERANCES * UNLESS INDICATED *

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

TREATMENT: /
TOTAL WT./LBS.: FINISHED 20
MARKING REQ'D.: 5530
QTY. REQ'D.: /
MARK LOCATION: SIDE
OTHER REF.: /

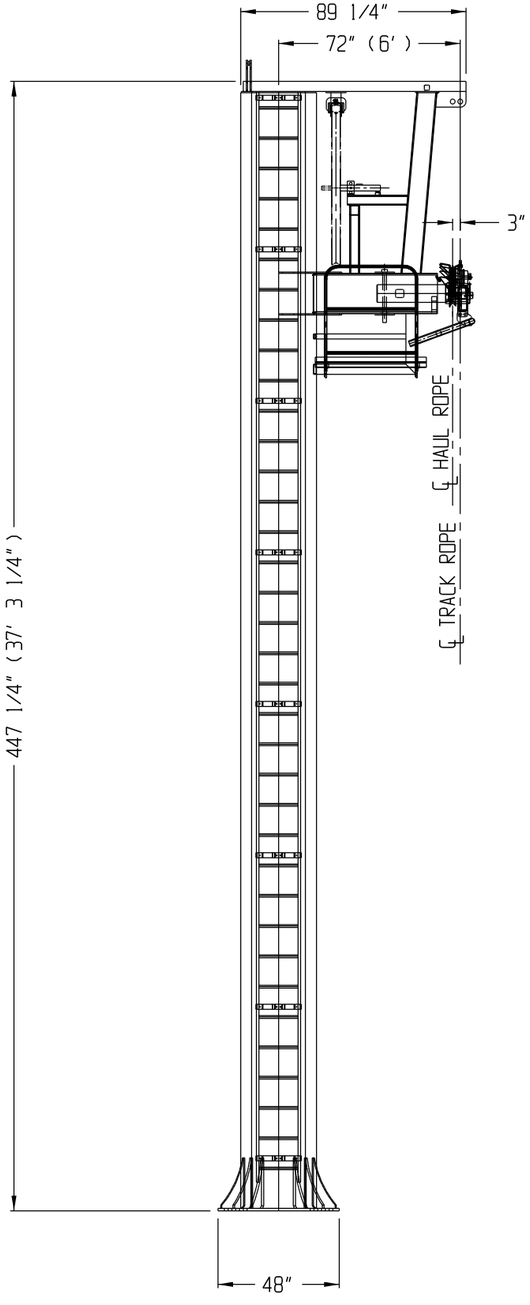
CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

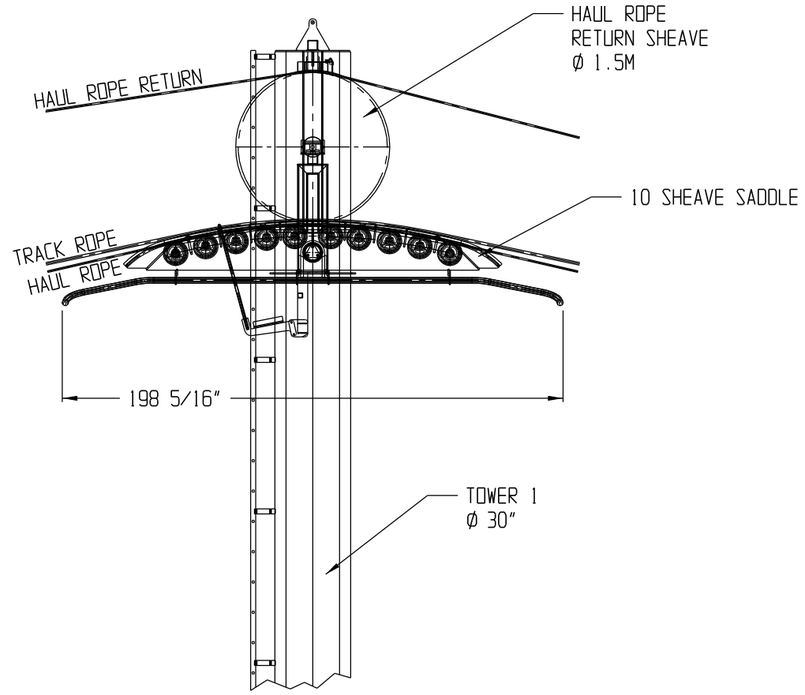
POMA OF AMERICA

GRAND JUNCTION
COLORADO , USA

DRAWN BY: C. SPRAUER
DESIGNED BY: J. COPELAND
DATE: 4.13.98
SCALE(S): 1/4, 1/1

FORMAT: B
DRAWING NUMBER: 3225.530
REVISION: A





REV	DESCRIPTION OF REVISION	DATE	BY
A	ADD SHEET 4 OF 9	5.21.98	CS

PACOIMA DAM
AERIAL TRAMWAY

MODEL YEAR
1998

TOWER 1 ASSEMBLY

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO, USA

DRAWN BY:	J.COPELAND
DESIGNED BY:	J.COPELAND
DATE:	3.31.98
SCALE(S):	1/60

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES * UNLESS INDICATED *

* FABRICATION *

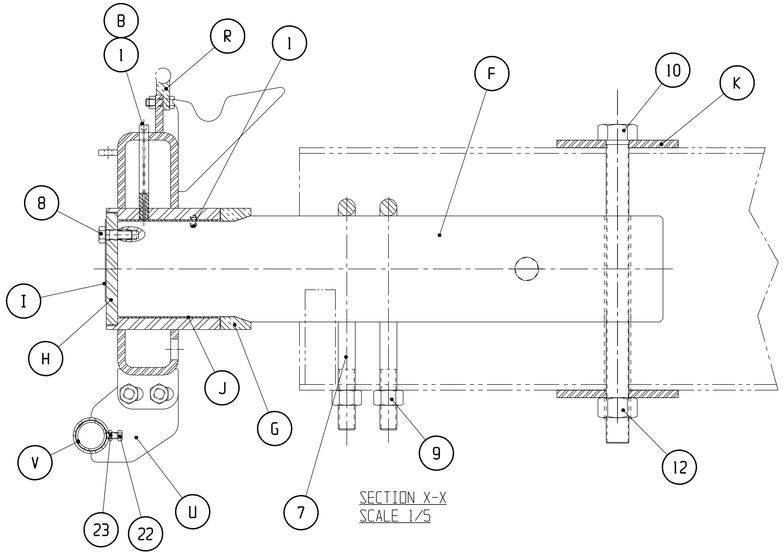
FRACTIONAL	±1/16
ANGULAR	±1/2°

* MACHINING *

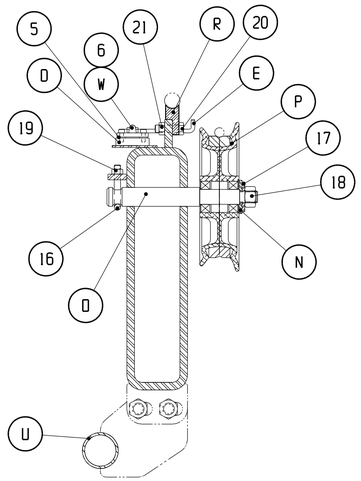
DECIMAL W/.X	±.05
DECIMAL W/.XX	±.01
DECIMAL W/.XXX	±.005
ANGULAR	±.1°

TREATMENT:	/
TOTAL WT./LBS.:	/
MARKING REQ'D.:	/
QTY. REQ'D.:	/
MARK LOCATION:	/
OTHER REF.:	/

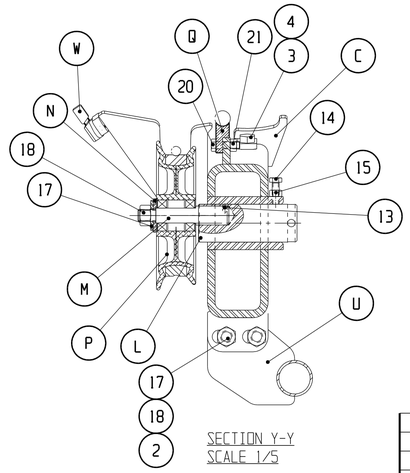
FORMAT	DRAWING NUMBER	SHEET 4 OF 9	REVISION
B	3038.769		A



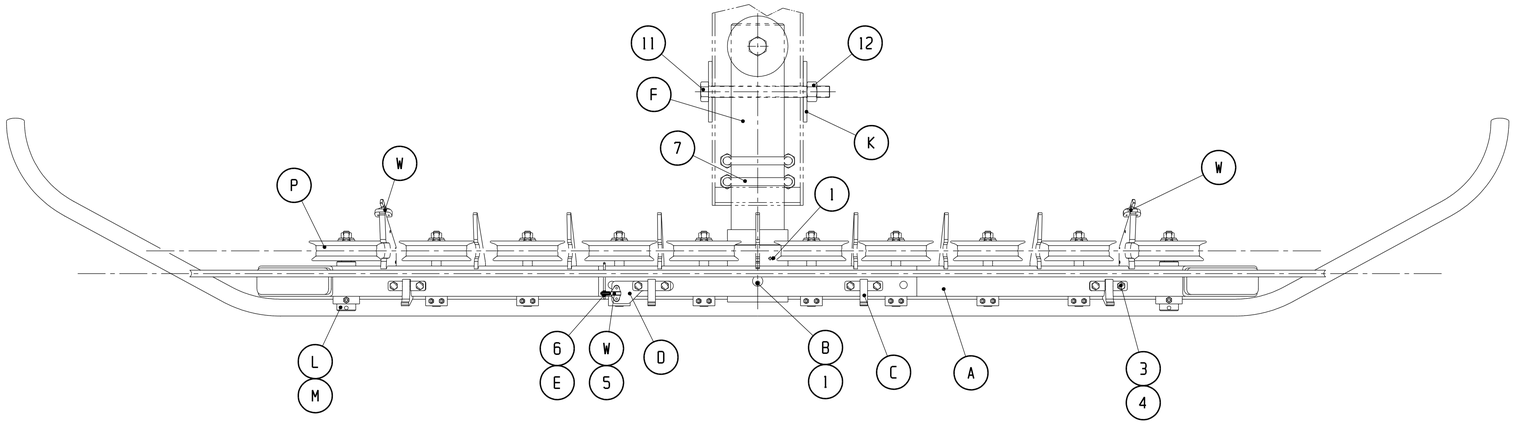
SECTION X-X
SCALE 1/5

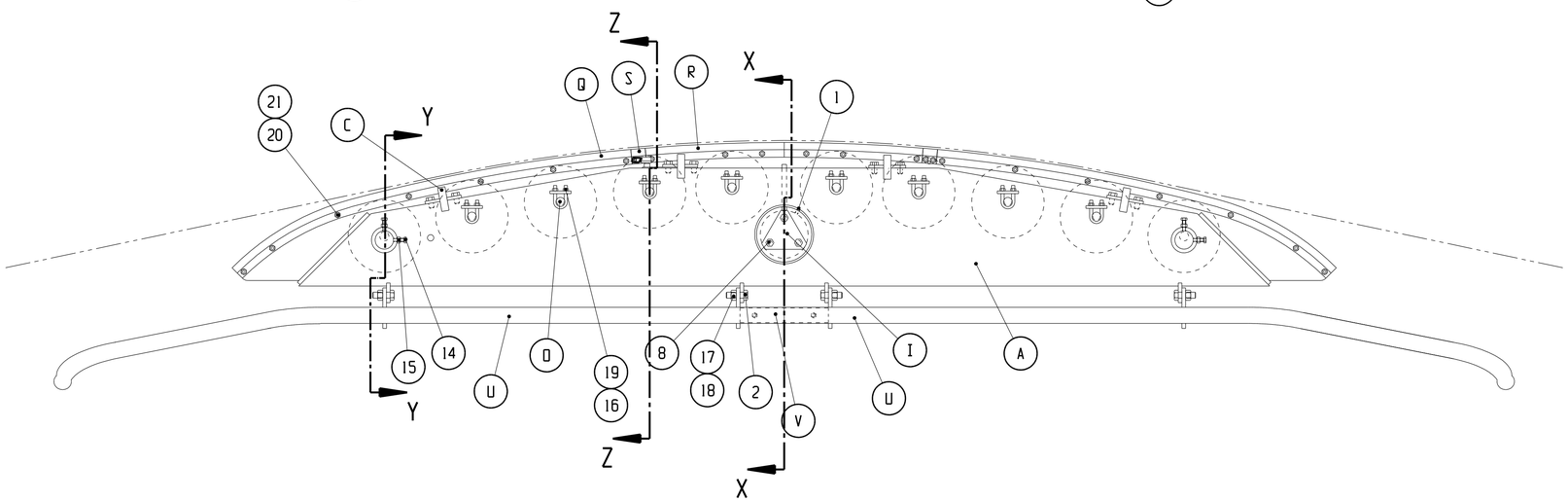


SECTION Z-Z
SCALE 1/5



SECTION Y-Y
SCALE 1/5





INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
23	2	NUT LOW HM 10 8.8 PLATED			058051	
22	2	BOLT HM 10x20/20 8.8 PLATED			057211	
21	23	NYLON LOCKNUT M12 8.8 PLATED			058186	
20	23	BOLT HM 12x40/40 8.8 PLATED			057020	
19	16	NYLON LOCKNUT M10 8.8 PLATED			058185	
18	18	NYLON LOCKNUT M20 8.8 PLATED			058192	
17	18	FLAT WASHER M20U PLATED			059110	
16	8	U-BOLT M10-15/16 x 2-3/4/1 PLATED		1.6	US 3110.836	A
15	4	NUT LOW HM 12 8.8 PLATED			058052	
14	4	BOLT HM 12 x 30/30 8.8 PLATED			057271	
13	2	ROLL PIN Ø8mm x 15mm			060058	
12	2	NYLON LOCKNUT 1.5-12NF A325 PLATED			5058047	
11	1	BOLT 1.5-12NF-16/16 A325 PLATED			5057736	
10	1	BOLT 1.5-12NF-20/20 A325 PLATED			5057573	
9	4	NYLON LOCKNUT M27 8.8 PLATED			058201	
8	3	BOLT HM 16x45/30 8.8 PLATED			5057149	
7	2	U-BOLT/RD M27, 7-3/8x13-11/16x3-3/4		16.8	US 3110.826	A
6	2	NUT HU M6 8.8 PLATED			058004	
5	2	WASHER M6U PLATED			059103	
4	8	LOCKWASHER JZC16 PLATED			059288	
3	8	BOLT HM 16x30/30 8.8 PLATED			057269	
2	8	BOLT HM 20x60/46 8.8 PLATED			057082	
1	2	GREASE ZERK 1/8" NPT			3530001	
W	3	BRITTLE BAR			1031120	
V	1	CABIN GUIDE CONNECTION TUBE		4.7	US 3225.477	A
U	2	CABIN GUIDE		80	US 4075.638	B
T						
S	2	Ø26 mm SADDLE "KNOCK OUT"		1.4	US 3225.473	A
R	1	Ø26mm SADDLE, MIDDLE PIECE, R19'		13.5	US 3225.472	B
Q	2	Ø26mm SADDLE, END PIECE, R19'		40.6	US 3225.471	B
P	10	STANDARD 8" ALUMINUM SHEAVE ASSM.			2031195	
O	8	Ø200 mm SHEAVE AXLE		22.4	US 3225.453	B
N	10	NYLON DUST SEAL WASHER		0.25	US 3110.837	A
M	2	ECCENTRIC AXLE SHAFT		3	US 3225.452	B
L	2	ECCENTRIC AXLE BODY - Ø200mm SHEAVE		16.2	US 3225.451	B
K	4	CROSS ARM WASHER Ø8 x 1 9/16 x 1/2		28	US 3110.948	A
J	2	BUSHING SKF GLY.PG 160/165/80 A			5018076	
I	1	LOCK PLATE		0.4	US 3225.481	A
H	1	AXLE END PLATE		9	US 3225.480	A
G	1	AXLE SPACER		1.7	US 3225.479	A
F	1	10 SHEAVE SADDLE AXLE		374	US 3225.478	B
E	1	BRITTLE BAR EXTENSION 6mm ALLTHREAD		0.07	US 3225.624	A
D	1	TRACK ROPE BRITTLE BAR MOUNT		0.7	US 4075.728	A
C	4	TRACK ROPE CATCHER		6.8	US 4075.730	B
B	1	GREASE ZERK HOUSING		0.5	US 3225.470	A
A	1	10 SHEAVE SADDLE		740.7	US 4075.635	D

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

REV	DESCRIPTION OF REVISION	DATE	BY
A	REMOVED INDEX "T" TRACK ROPE DEROPEMENT STRAP PER RJS LOADTEST NOTES	03-23-05	NT

TOLERANCES UNLESS INDICATED

• FABRICATION •
FRACTIONAL . . . . . ±1/16
ANGULAR . . . . . ±1/2°

• MACHINING •
DECIMAL W/.X . . . ±.05
DECIMAL W/.XX . . ±.01
DECIMAL W/.XXX . . ±.005
ANGULAR . . . . . ±.1°

AERIAL TRAM
MODEL YEAR 1998

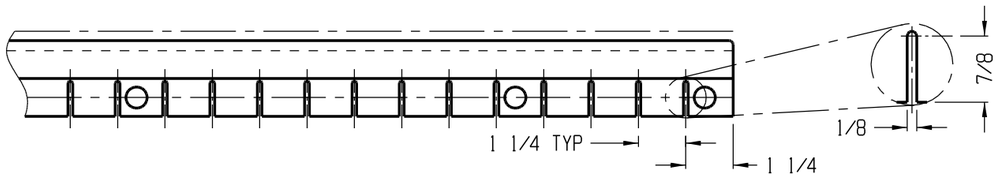
10 SHEAVE SADDLE ASSEMBLY

TREATMENT:
TOTAL WT./LBS.: ~1370
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

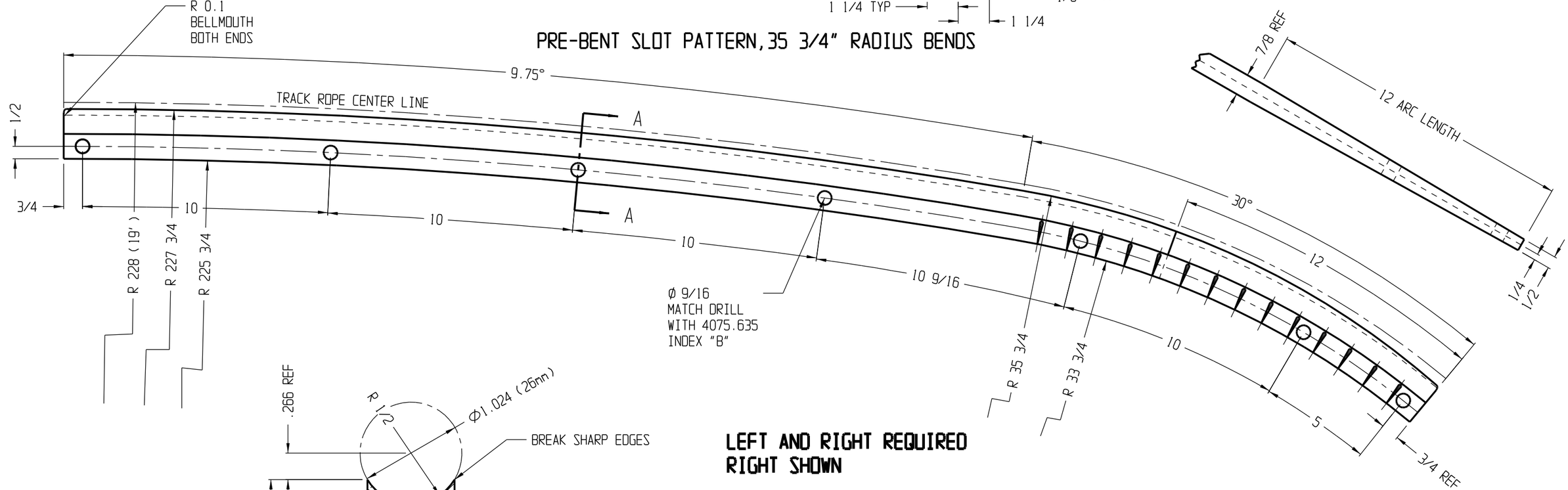
CABLE TRANSPORT SYSTEMS
SKILIFTS · CHAIRLIFTS · GONDOLAS · TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO , USA

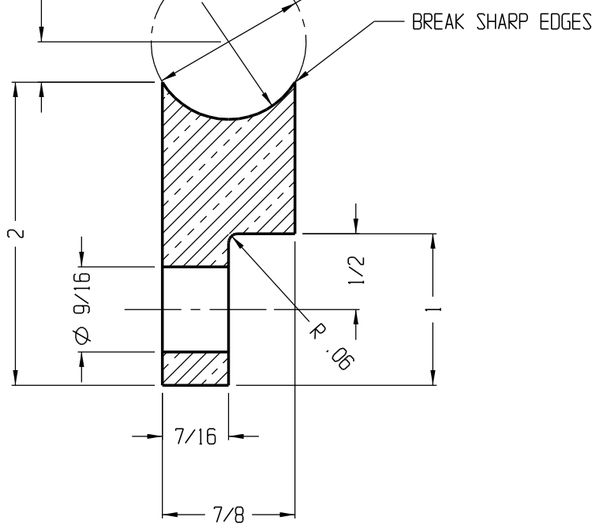
DRAWN BY: LYNCH-STAUNTON
DESIGNED BY: J.COPELAND
DATE: 5.20.98
SCALE(S): 1/10

FORMAT: D
DRAWING NUMBER: US3038.782
REVISION: A



PRE-BENT SLOT PATTERN, 35 3/4" RADIUS BENDS





SECTION A-A
SCALE 1/1

LEFT AND RIGHT REQUIRED
RIGHT SHOWN

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A	1	RECT BAR 1 x 2 x 56 3/4 FINISHED LENGTH (FREE CUTTING BRASS)	ASTM-B16 C360	20.3		

REV	DESCRIPTION OF REVISION	DATE	BY

12 PLC TRAM

MODEL YEAR 1998

26mm SADDLE, END PIECE

19' RADIUS, 10 SHEAVE SADDLE

CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION COLORADO, USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 3.12.98
SCALE(S): 1/4, 1/1

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

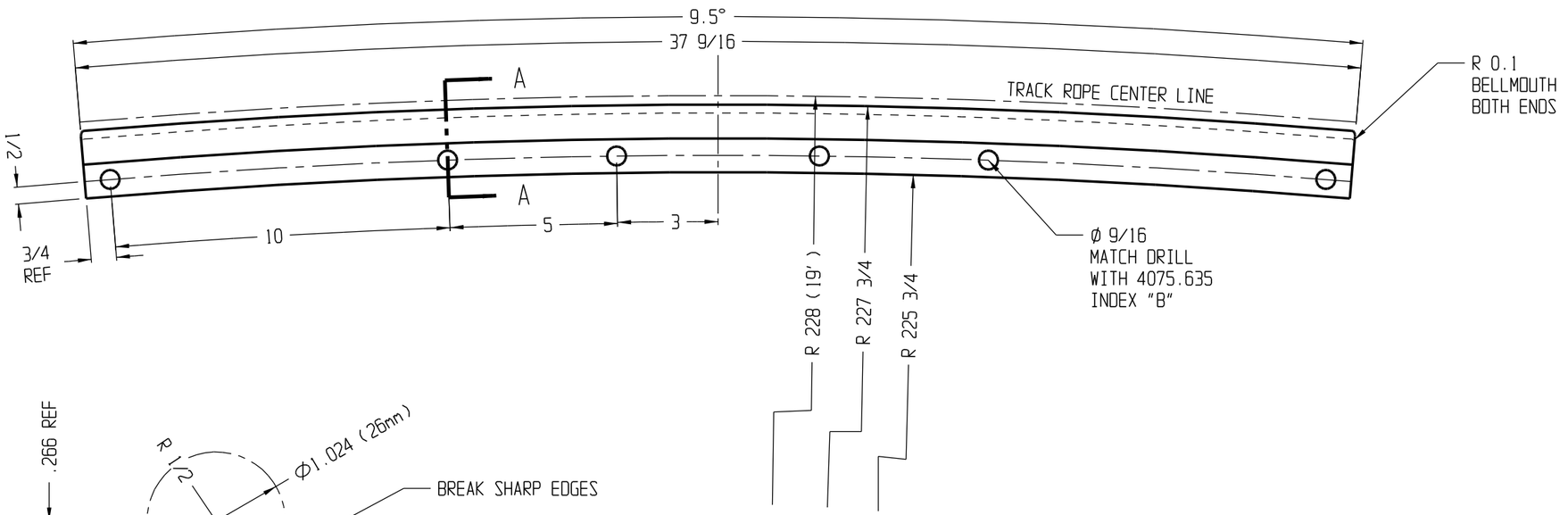
TOLERANCES * UNLESS INDICATED *

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.25°

TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.: PART #
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

FORMAT	DRAWING NUMBER	REVISION
B	3225.471	/



SECTION A-A
SCALE 1/1

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A	1	RECT BAR 1 x 2 x 37-9/16 FINISHED LENGTH (FREE CUTTING BRASS)	ASTM-B16 C360	13.5		

REV	DESCRIPTION OF REVISION	DATE	BY

12 PLC TRAM

MODEL YEAR 1998

26mm SADDLE, MIDDLE PIECE

19' RADIUS, 10 SHEAVE SADDLE

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO , USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 3.20.98
SCALE(S): 1/4,1/1

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

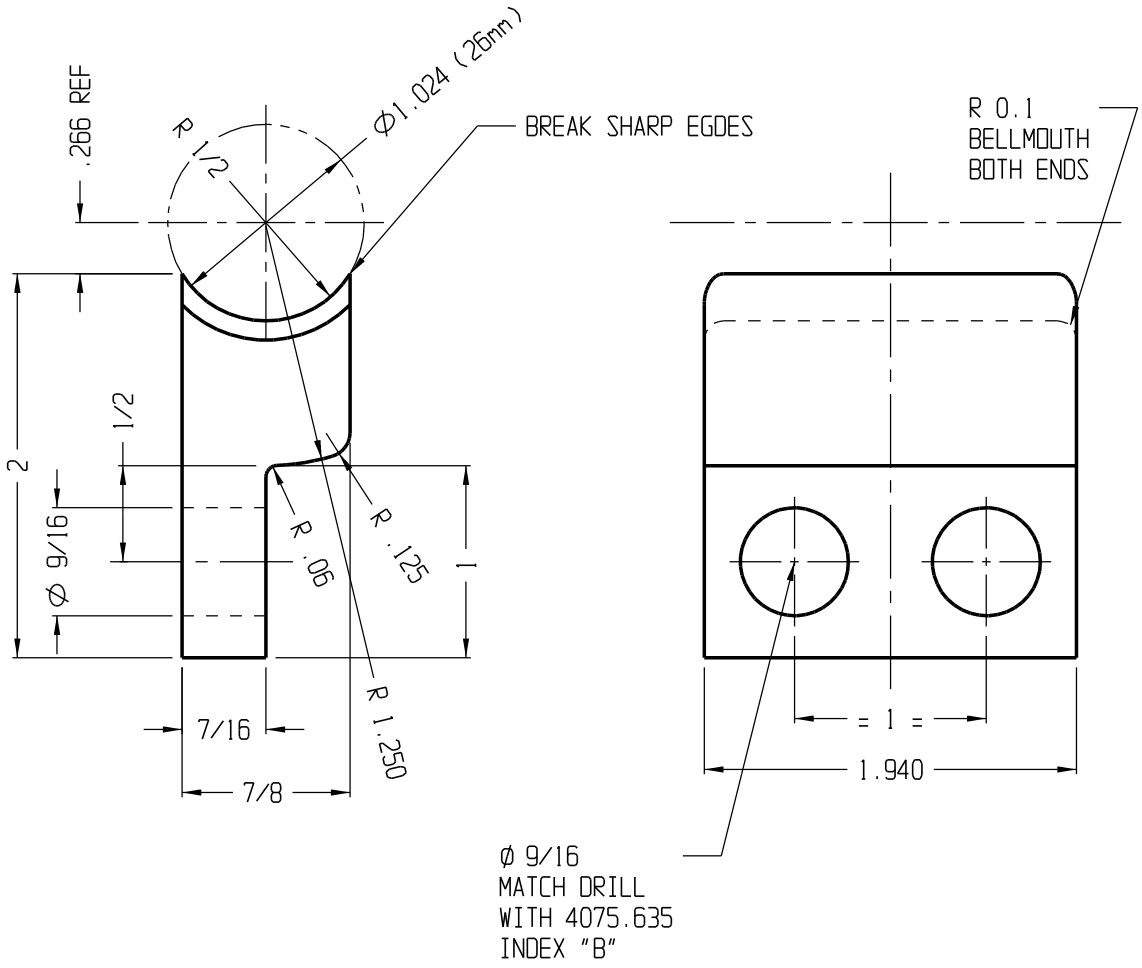
TOLERANCES * UNLESS INDICATED *

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.25°

TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.: PART #
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

FORMAT	DRAWING NUMBER	REVISION
B	3225.472	/



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A	1	RECT BAR 1 x 2 x 2 LG. (FREE CUTING BRASS)	ASTM-B16 C360	0.7		

REV	DESCRIPTION OF REVISION	DATE	BY

QUANTITY:

USED FOR:

DUE DATE:

PRODUCTION USE ONLY

TOLERANCES * UNLESS INDICATED *

* FABRICATION *

FRACTIONAL	±1/16
ANGULAR	±1°

* MACHINING *

DECIMAL W/.X	±.05
DECIMAL W/.XX	±.01
DECIMAL W/.XXX	±.005
ANGULAR	±.25°

12 PLC TRAM

MODEL YEAR 1998

26mm SADDLE KNOCK OUT

2" LONG

TREATMENT:

TOTAL WT./LBS.: /

MARKING REQ'D.: PART #

QTY. REQ'D.:

MARK LOCATION:

OTHER REF.:

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION COLORADO , USA

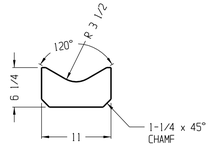
DRAWN BY: J.COPELAND

DESIGNED BY: J.COPELAND

DATE: 3.16.98

SCALE(S): 1/1

FORMAT	DRAWING NUMBER	REVISION
A	3225.473	/



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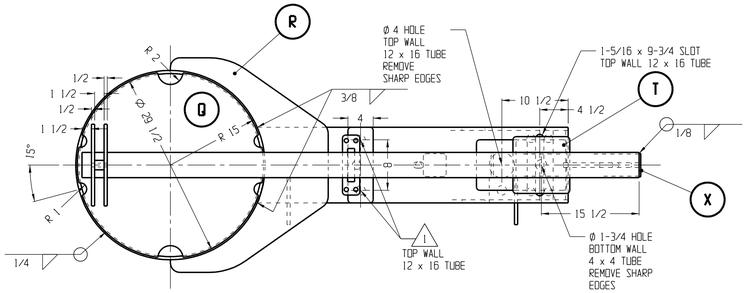

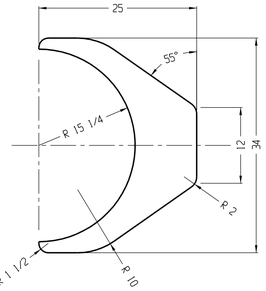

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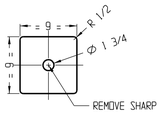

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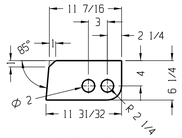

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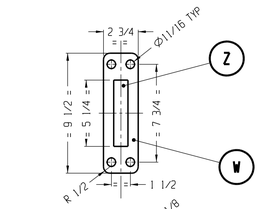
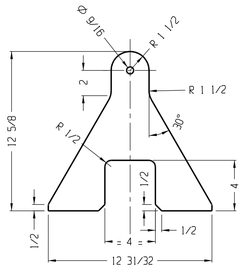


DETAIL A
SCALE 1/6



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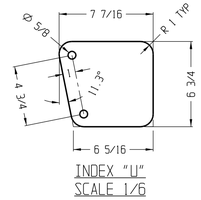
SCALE 1/6



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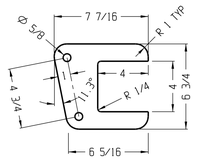
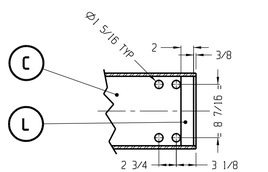
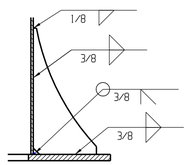
SCALE 1/6



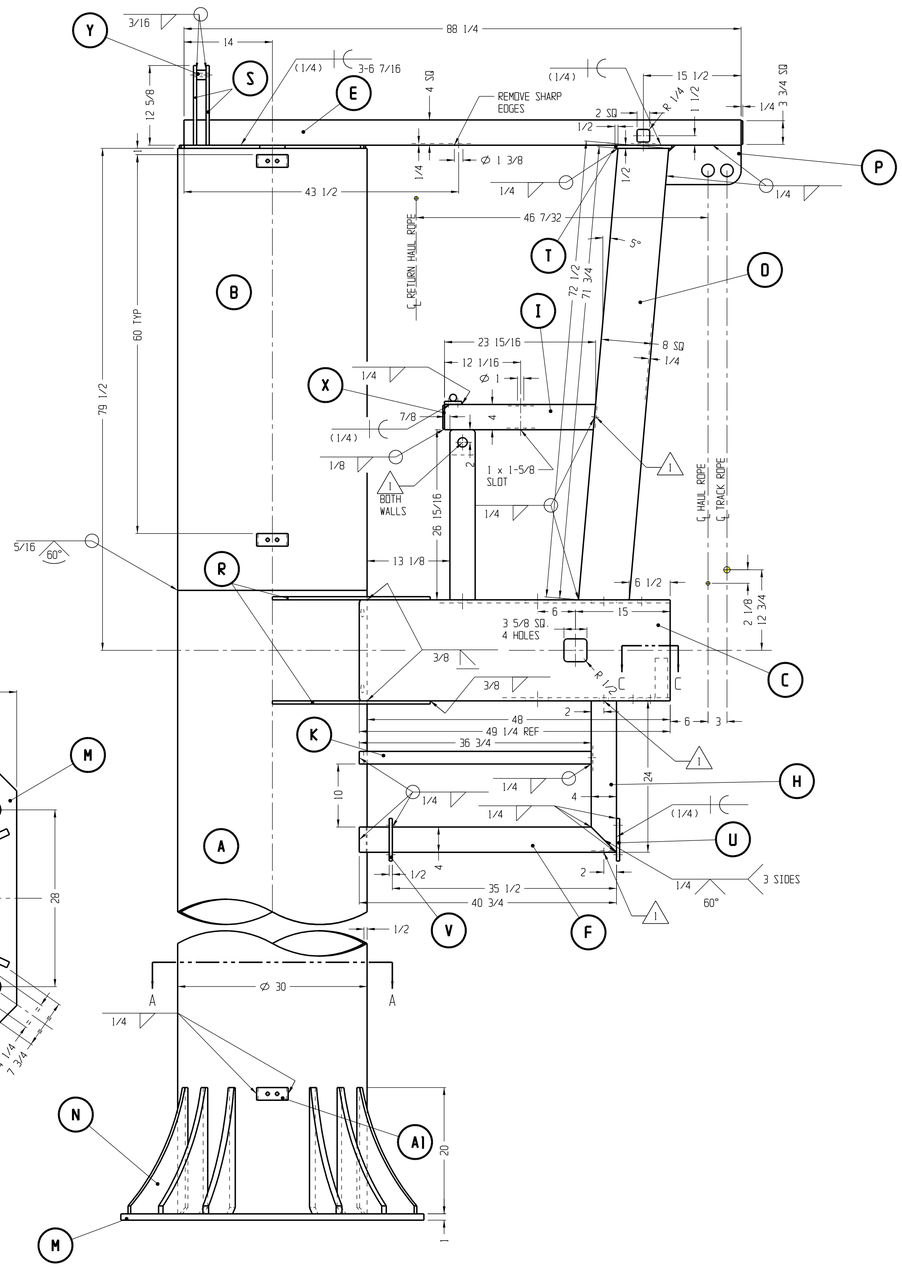
INDEX "V"
SCALE 1/6

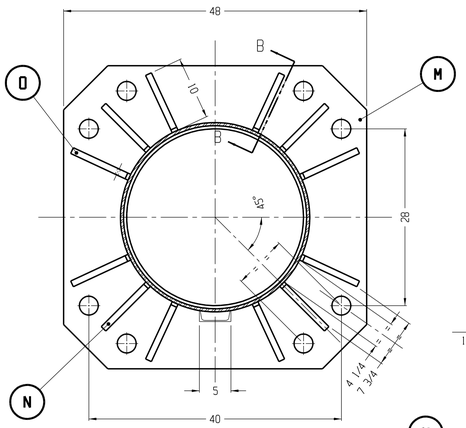


SECTION C-C

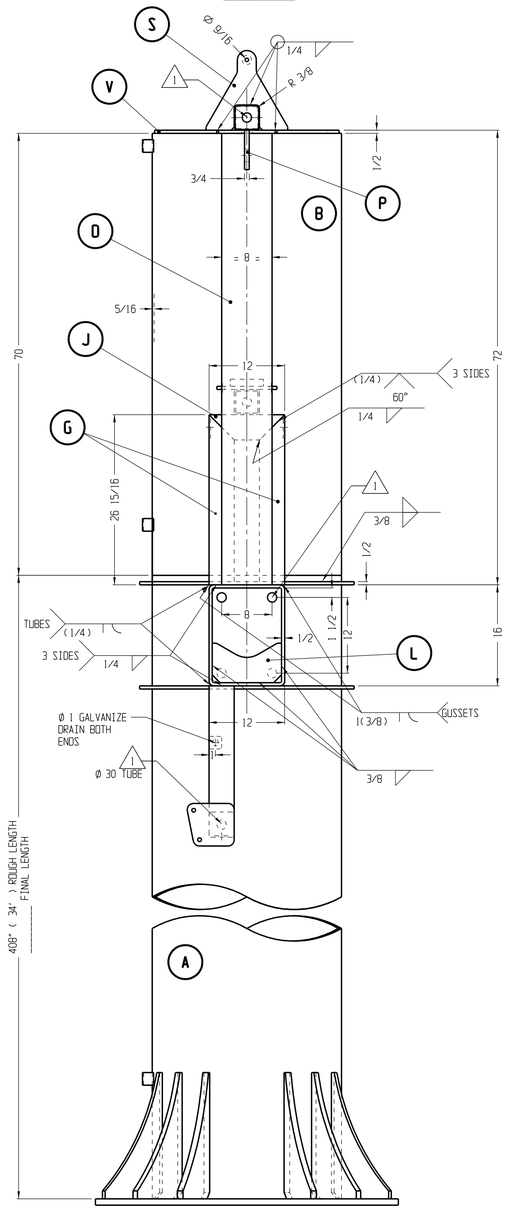


SECTION B-B





SECTION A-A



NOTE:

1 Ø 1-1/2 GALVANIZE DRAIN HOLE

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
A1	8	LADDER MOUNT CHANNEL	ASTM-A36	8.8	US3221.996	A
Z	1	RND. Ø 1-1/8 x 5-1/4 LG	1018	1.5		
Y	1	ROUND MECH TUBE Ø 1-1/2 x 7/16 WALL x 1-1/2 LG	ASTM-A500B	0.6		
X	2	PLATE 1/4 x 3-3/4 x 3-3/4	ASTM-A36	1.8	FLAME CUT	DXF
W	1	PLATE 1/2 x 2-3/4 x 9-1/2	ASTM-A36	3.6	FLAME CUT	DXF
V	1	PLATE 1/2 x 6-3/4 x 7-7/16	ASTM-A36	4.2	FLAME CUT	DXF
U	1	PLATE 1/2 x 6-3/4 x 7-7/16	ASTM-A500B	6.9	FLAME CUT	DXF
T	1	PLATE 1/2 x 9 x 9	ASTM-A36	11.1	FLAME CUT	DXF
S	2	PLATE 1/2 x 12-5/8 x 12-31/32	ASTM-A36	19.4	FLAME CUT	DXF
R	2	PLATE 1/2 x 25 x 34	ASTM-A36	87.4	FLAME CUT	DXF
Q	1	PLATE 1/2 x Ø 29-1/2	ASTM-A36	94.1	FLAME CUT	DXF
P	1	PLATE 3/4 x 6-1/4 x 11-31/32	ASTM-A36	13.9	FLAME CUT	DXF
O	1	Ø 30" BASE GUSSET 1" x 10" x 20" W/GROUNDING LUG HOLE	ASTM-A36	25	US3224.930	A
N	11	Ø 30" BASE GUSSET 1" x 10" x 20"	ASTM-A36	275	US3220.741	A
M	1	TOWER BASE PLATE 1" x 48" x 48"	ASTM-A36	435	US3220.597	A
L	1	PLATE 2 x 6-1/4 x 11	ASTM-A36	30.8	FLAME CUT	DXF
K	1	SQ. TUBE 2 x 2 x 3/16 WALL x 36-3/4 LG	ASTM-A500B	13.3		
J	1	SQ. TUBE 4 x 4 x 1/4 WALL x 12 LG	ASTM-500B	12.2		
I	1	SQ. TUBE 4 x 4 x 1/4 WALL x 23-15/16 LG	ASTM-A500B	24.4		
H	1	SQ. TUBE 4 x 4 x 1/4 WALL x 24 LG	ASTM-A500B	24.4		
G	2	SQ. TUBE 4 x 4 x 1/4 WALL x 26-15/16 LG	ASTM-A500B	54.8		
F	1	SQ. TUBE 4 x 4 x 1/4 WALL x 40-3/4 LG	ASTM-A500B	41.5		
E	1	SQ. TUBE 4 x 4 x 1/4 WALL x 88-1/4 LG	ASTM-A500B	89.8		
D	1	SQ. TUBE 8 x 8 x 1/4 WALL x 72-1/2 LG	ASTM-A500B	156		
C	1	RECT. TUBE 12 x 16 x 1/2 WALL x 49-1/4 LG	ASTM-A500B	368		
B	1	PIPE Ø 30 x 5/16 WALL x 70" LG STRUCTURAL PIPE WITH VERY GOOD WELDABILITY MIN YIELD 35000 MIN STRENGTH 60000	ASTM-A53B	577		
A	1	PIPE Ø 30 x 1/2 WALL x 40 FT LG STRUCTURAL PIPE WITH VERY GOOD WELDABILITY MIN YIELD 35000 MIN STRENGTH 60000	ASTM-A53B	5355		

REV.	DESCRIPTION OF REVISION	DATE	BY

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES • UNLESS INDICATED •
* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°
* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

12 PLC TRAM
MODEL YEAR 1998

LINE TOWER

TOWER 1, 10 SHEAVE SADDLE

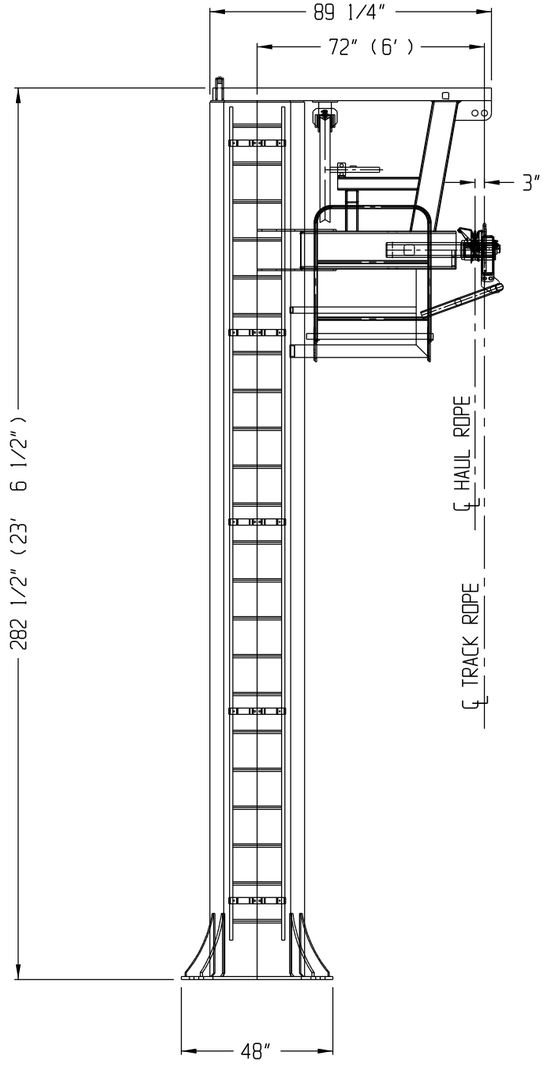
TREATMENT: GALVANIZE
TOTAL WT./LBS. W/LG PIPE: 7736

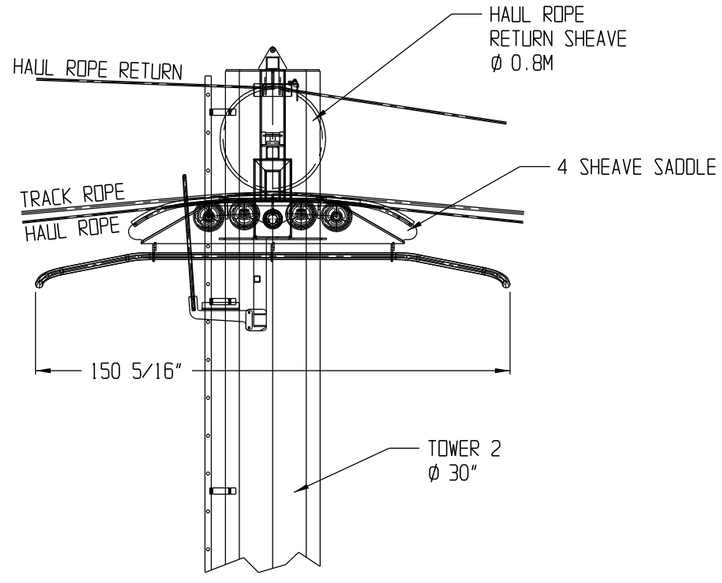
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.: 3110.822

CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO , USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 3.18.98
SCALE(S) 1: 1/12

FORMAT: D
DRAWING NUMBER: 4075.639
REVISION: /





REV	DESCRIPTION OF REVISION	DATE	BY
A	ADD SHEET 6 OF 9	5.21.98	CS

PACOIMA DAM
AERIAL TRAMWAY

MODEL YEAR 1998

TOWER 2 ASSEMBLY

CABLE TRANSPORT SYSTEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO , USA

DRAWN BY:	J.COPELAND
DESIGNED BY:	J.COPELAND
DATE:	3.31.98
SCALE(S):	1/48

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES * UNLESS INDICATED *

* FABRICATION *

FRACTIONAL	±1/16
ANGULAR	±1/2°

* MACHINING *

DECIMAL W/.X	±.05
DECIMAL W/.XX	±.01
DECIMAL W/.XXX	±.005
ANGULAR	±.1°

TREATMENT: /	TOTAL WT./LBS.: /
MARKING REQ'D.: /	QTY. REQ'D.: /
MARK LOCATION: /	OTHER REF.: /

FORMAT	DRAWING NUMBER	SHEET 6 OF 9	REVISION
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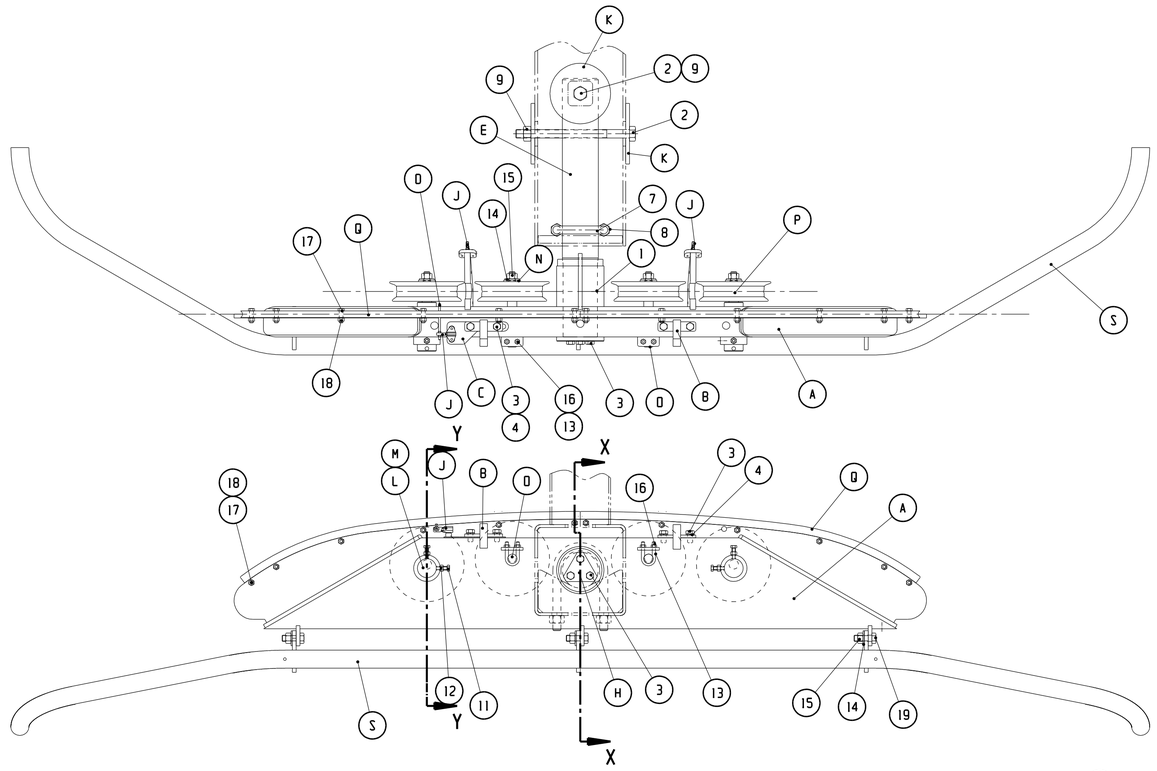
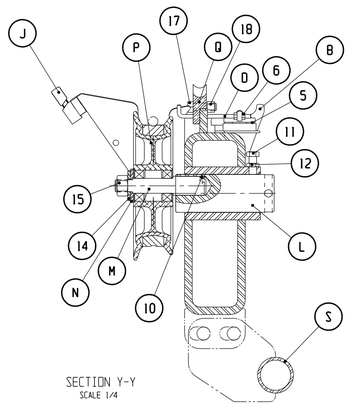
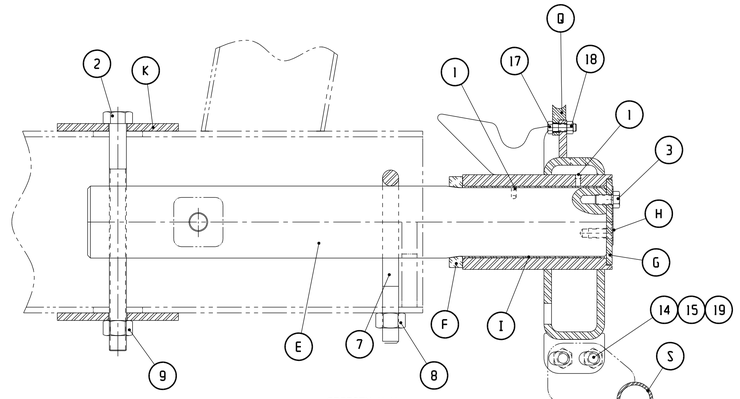




SECTION Y-Y
SCALE 1/4



SECTION X-X
SCALE 1/4

19	6	BOLT HM 20x60/46 8.8 PLATED			057082	
18	12	NYLON LOCKNUT M12 8.8 PLATED			058186	
17	12	BOLT HM 12x40/40 8.8 PLATED			057020	
16	4	NYLON LOCKNUT M10 8.8 PLATED			058185	
15	10	NYLON LOCKNUT M20 8.8 PLATED			058192	
14	10	FLAT WASHER M20U PLATED			059110	
13	2	U-BOLT M10-15/16 x 2-3/4/1 PLATED		1.6	US 3110.836	A
12	4	NUT LOW HM 12 8.8 PLATED			058052	
11	4	BOLT HM 12 x 30/30 8.8 PLATED			057271	
10	2	ROLL PIN Ø8m x 15m			060058	
9	2	NYLON LOCKNUT 1 1/8-12NF A325 PLATED			5058006	
8	2	NYLON LOCKNUT M27 8.8 PLATED			058201	
7	1	U-BOLT/410 M27, 5-1/8x10-3/16/3-3/4		6.4	US 3220.732	A
6	2	NUT HJ M5 8.8 PLATED			058004	
5	2	WASHER M8U PLATED			059103	
4	4	LOCKWASHER JIC16 PLATED			059288	
3	7	BOLT HM 16x30/30 8.8 PLATED			057269	
2	2	BOLT 1 1/8-12NF-15 LG A325 PLATED		8.4	US 3220.852	A
1	2	GREASE ZERK 1/8" NPT			3530001	

S	1	CABIN GUIDE 4 SHEAVE SADDLE		61.5	US 4075.648	B
R						
Q	2	Ø85m SADDLE, R19"		33	US 3225.494	B
P	4	STANDARD 8" ALUMINUM SHEAVE ASSEMBLY			2031195	
O	2	Ø200 mm SHEAVE AXLE		22.4	US 3225.453	B
N	4	NYLON DUST SEAL WASHER		0.25	US 3110.837	A
M	2	ECCENTRIC AXLE SHAFT		3	US 3225.452	B
L	2	ECCENTRIC AXLE BODY - Ø200m SHEAVE		16.2	US 3225.451	B
K	4	CROSS ARM WASHER Ø8 x 1 3/16 x 1/2		28	US 3220.726	A
J	3	BRITTLE BAR			1031120	
I	3	BUSHING SKF GLY.PG 115/120/70 A			082519	
H	1	LOCK PLATE		0.4	US 3220.734	A
G	1	STOP WASHER		2.5	US 3220.733	A
F	1	AXLE SPACER		0.4	US 3221.944	A
E	1	6 SUPPORT CENTRAL AXLE		160	US 3220.757	B
D	1	BRITTLE BAR EXTENSION 6mm ALLTHREAD		0.07	US 3225.624	A
C	1	TRACK ROPE BRITTLE BAR MOUNT		0.7	US 4075.728	A
B	2	TRACK ROPE CATCHER		3.4	US 4075.730	B
A	1	4 SHEAVE SADDLE		397.4	US 4075.647	D
INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT

REV	DESCRIPTION OF REVISION	DATE	BY
A	REMOVED INDEX "R" - TRACK ROPE DEROPEMENT STRAP PER LOAD TEST NOTES	03-23-05	MT

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

AERIAL TRAM
YEAR MDL 1998

4 SHEAVE SADDLE ASSEMBLY

TOLERANCES UNLESS INDICATED

• FABRICATION •
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°

• MACHINING •
DECIMAL W/.X .... ±.05
DECIMAL W/.XX .... ±.01
DECIMAL W/.XXX .... ±.005
ANGULAR ..... ±.1°

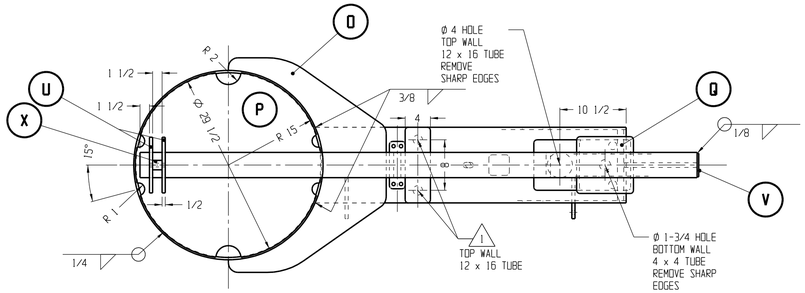
CABLE TRANSPORT SYSTEMS
DETACHABLE CHAIRLIFTS CONSULTANTS TRAINING

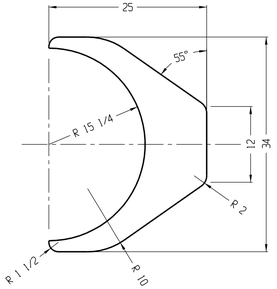
POMA OF AMERICA
GRAND JUNCTION COLORADO . USA

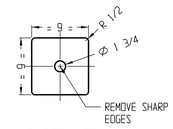
DRAWN BY: LYNCH-STAUNTON
DESIGNED BY: J.COPELAND
DATE: 5.22.98
SCALE(S): 1/8

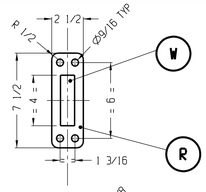
DOCUMENT: TOTAL WT./LBS.: 1350
MARKING REQ'D.: QTY. REQ'D.:
MARK LOCATION: OTHER REF.:

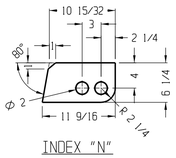
FORMAT: D
DRAWING NUMBER: US3038.783
REVISION: A

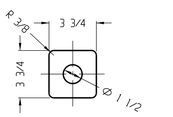


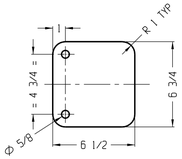


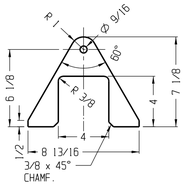


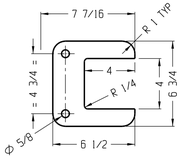


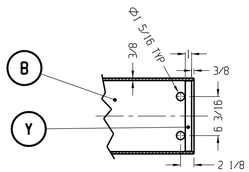


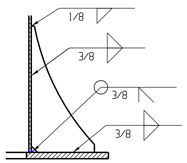


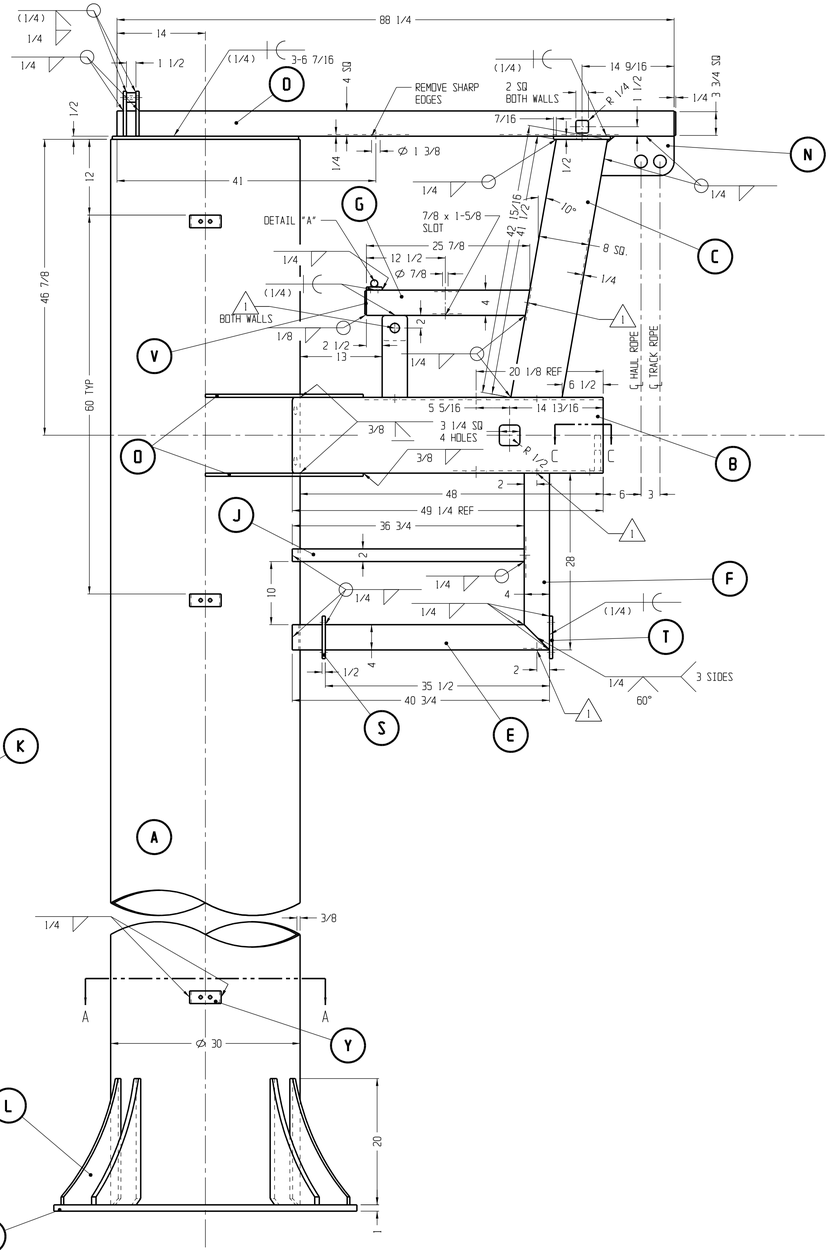


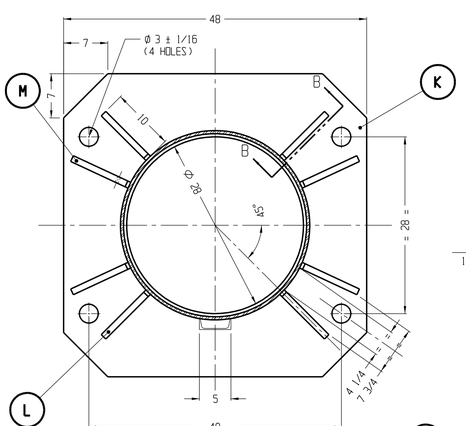


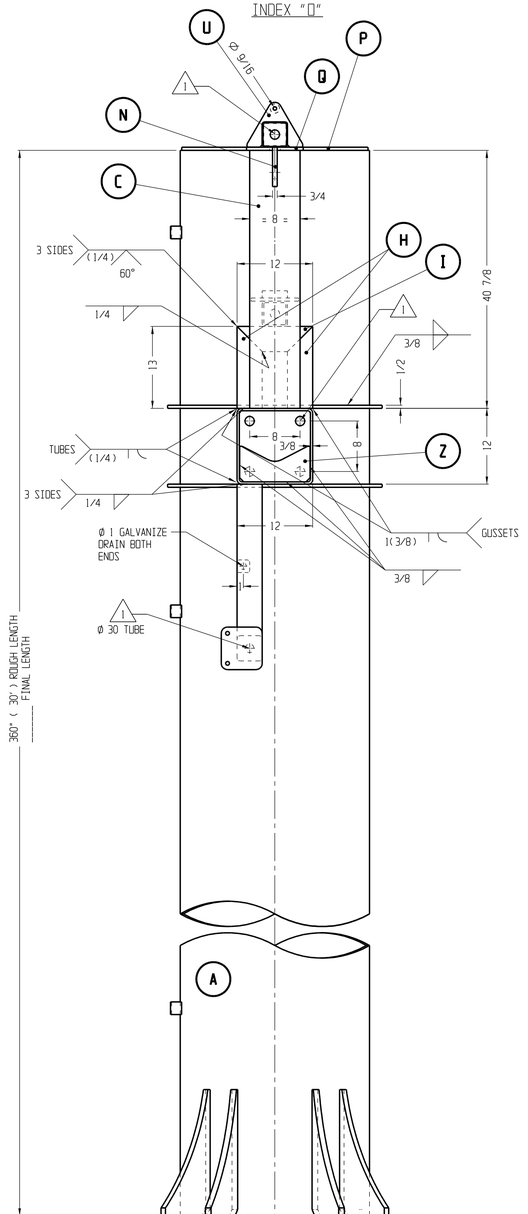












NOTE:

⚠1 **Ø 1-1/2 GALVANIZE DRAIN HOLE**

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
Z	1	AXLE SUPPORT PLATE		14	US3220.745	A
Y	5	LADDER MOUNT CHANNEL		5.5	US3221.996	A
X	1	ROUND MECH TUBE Ø1-1/2 x 7/16 WALL x 1-1/2 LG	ASTM-A500B	0.6		
W	1	RND. Ø 1-1/8 x 4 LG	1018	1.2		
V	2	PLATE 1/4 x 3-3/4 x 3-3/4	ASTM-A36	1.8	FC 4075639X	DXF
U	2	PLATE 1/2 x 7-1/8 x 8-13/16	ASTM-A36	6.0	FLAME CUT	DXF
T	1	PLATE 1/2 x 6-1/2 x 6-3/4	ASTM-A36	6.0	FLAME CUT	DXF
S	1	PLATE 1/2 x 6-1/2 x 6-3/4	ASTM-A36	3.7	FLAME CUT	DXF
R	1	PLATE 1/2 x 2-1/2 x 7-1/2	ASTM-A36	2.7	FLAME CUT	DXF
Q	1	PLATE 1/2 x 9 x 9	ASTM-A36	11.1	FC 4075639T	DXF
P	1	PLATE 1/2 x Ø 29-1/2	ASTM-A36	94.1	FC 4075630	DXF
O	2	PLATE 1/2 x 25 x 34	ASTM-A36	87.4	FC 4075639R	DXF
N	1	PLATE 3/4 x 6-1/4 x 11-9/16	ASTM-A36	13.0	FLAME CUT	DXF
M	1	Ø 30" BASE GUSSET 1" x 10" x 20" W/GROUNDING LUG HOLE	ASTM-A36	25	US3224.930	A
L	7	Ø 30" BASE GUSSET 1" x 10" x 20"	ASTM-A36	175	US3220.741	A
K	1	PLATE 1 x 48 x 48, REF 3220.597 TOWER BASE PLATE	ASTM-A36	435	FC 3220597	DXF
J	1	SQ. TUBE 2 x 2 x 3/16 WALL x 36-3/4 LG	ASTM-A500B	13.3		
I	1	SQ. TUBE 4 x 4 x 1/4 WALL x 12 LG	ASTM-500B	12.2		
H	2	SQ. TUBE 4 x 4 x 1/4 WALL x 13 LG	ASTM-A500B	26.5		
G	1	SQ. TUBE 4 x 4 x 1/4 WALL x 25-7/8 LG	ASTM-A500B	26.3		
F	1	SQ. TUBE 4 x 4 x 1/4 WALL x 28 LG	ASTM-A500B	28.5		
E	1	SQ. TUBE 4 x 4 x 1/4 WALL x 40-3/4 LG	ASTM-A500B	41.5		
D	1	SQ. TUBE 4 x 4 x 1/4 WALL x 88-1/4 LG	ASTM-A500B	89.8		
C	1	SQ. TUBE 8 x 8 x 1/4 WALL x 42-15/16 LG	ASTM-A500B	117		
B	1	SQ. TUBE 12 x 12 x 3/8 WALL x 49-1/4 LG	ASTM-A500B	238.5		
A	1	PIPE Ø 30 x 3/8 WALL x 360" LG STRUCTURAL PIPE WITH VERY GOOD WELDABILITY MIN YIELD 36000 MIN STRENGTH 60000	ASTM-A53B	3569		

REV	DESCRIPTION OF REVISION	DATE	BY

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

12 PLC TRAM
MODEL YEAR 1998

LINE TOWER

TOWER 2, 4 SHEAVE SADDLE

TOLERANCES • UNLESS INDICATED •
* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR ..... ±1/2°
* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR ..... ±.1°

TREATMENT: GALVANIZE
TOTAL WT./LBS.: 5045
W/LG PIPE
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.: 3110.822

CABLE TRANSPORT SYSTEMS

POMA OF AMERICA

SKI LIFTS CHAIR LIFTS GONDOLAS TRAMWAYS

GRAND JUNCTION COLORADO , USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 3.27.98
SCALE(S): 1/12

FORMAT: D
DRAWING NUMBER: 4075.651
REVISION: /

Structural Calculations

for

Aerial Tram at Pacoima Dam

C51013

May 11, 1998

Pacoima Aerial Tram
Computer Output
Abstract of Explanation

The ropeline calculation for a tramway consists of a series of individual calculations for the angles, tensions, sags, and loads resulting from one discrete position of the loaded tram cabin.

Starting from the bottom terminal, Case Number 1 positions the loaded cabin at horizontal X = 10 m, vertical y = 465.782 m and calculates the resulting tensions, cable angles, sags and applied loads for the track as well as both the uphill and downhill sides of the haul cable.

Case Number 2 increments the loaded cabin to position horizontal x = 80 m, vertical y = 487.741 m and calculates the resulting tensions, cable angles, sags and applied loads. This process is repeated through Case Number 14, which positions the loaded cabin just approaching the top terminal.

Case Number 15 positions the cabin at a terminal and provides the tensions, angles, sags and applied loads with no cabin on the line.

Beginning on page 32 of the computer output are minimum and maximum values for both the track rope and both sides of the haul rope resulting from the 15 load cases analyzed.

Accordingly, the resulting minimum and maximum values derived from the loading cases are used to find the maximum torque required, the maximum loads on the saddles and line sheaves, the maximum tensions in the track and haul rope, the minimum and maximum angles of the cables as well as the required travel of the tensioning systems.

For instance, the maximum torque required is found by subtracting the minimum tension in the uphill side haul rope at G1 = 1529 daN from the maximum tension in the downhill side haul rope at G1 = 2471 and multiplying this by the radius of the bullwheel 1.25 m/2= 0.625 m.

So the maximum torque is (2471 - 1529) 0.625 = 588.75 daNm. The sum of these two values must also be equal to the tension system applied force so 2417 + 1529 = 4000 daN, which is the applied tension.

This method of incrementing the loaded cabin along the path of the tram and calculating the resulting characteristics of the cables provides the basis for the design and selection of the required components of the tramway system.

Design Code Used:

AMERICAN NATIONAL STANDARD for Passenger Tramways, Aerial Tramways, Aerial Lifts, Surface Lifts and Tows - Safety Requirements B77.1 - 1982 with supplements ANSI B7.1a - 1986, ANSI B77.1b - 1988

American Institute of Steel Construction, "Manual of Steel Construction Allowable Stress Design," Ninth Edition

American Concrete Institute, "Building Code Requirements for Structural Concrete," ACI 318-95

Design Criteria:

Material Properties:

Structural Steel Pipe, ASTM A - 53 B no hydro test, fy = 35,000 psi
Steel Plate ASTM A - 36, fy = 36,000 psi
Structural Tubes in Shapes ASTM A500 - B, fy = 42,000 psi
Concrete f'c = 3000 psi
Reinforcing Steel ASTM A - 615, fy = 60,000 psi
Bolts are Metric grade 8.8, fy = 113,800 psi used per AISC Manual of Steel Construction
F_T = 0.33 fy Fv = 0.17 fy
Williams Rock Bolts, see pages 6 and 7 of Williams Catalogue in appendix
Tower 1 anchor bolts are ASTM A - 36 M fy = 60,000 psi
Track Rope Breaking Strength = 148,837 lbs.
Haul Rope Breaking Strength = 34,840 lbs.

Dead Loads:

Concrete = 150 pcf
Steel = 490 pcf
Haul Cable = 0.58 lbs./ft.
Track Rope = 2.56 lbs./ft.
Cabin Weight = 1850 lbs.
Cabin line load = 2240 lbs.

Maximum design wind load = 100 mph
Seismic design load, See letter dated November 17, 1997, from Agbabian Associates, including Response Spectra in appendix

For details of towers and foundation please refer to full size prints attached hereto and referenced on the relevant pages of the calculation.

Allowable Soil Pressure:

Drive: See Dames & Moore Report Geotechnical Evaluation Pacoima Aerial Tram dated March 25, 1998 in Appendix

Tower 1: Tower is assumed to be on solid rock. Site is currently inaccessible due to steep cliffs. Design requires 6 feet of excavation to form platform for foundation base. Rock Contact Pressure is assumed to be in excess of 15,000 PSF. If Rock Quality

Designation of very poor is assumed, a contact pressure of 20,000 psi is justified. The Allowable Rock Contact Pressure will be verified by Dames and Moore in the field after footing excavation.

Tower 2: Tower is assumed to be on solid rock of the left Dam Abatement. Rock Contact Pressure of 15,000 psi is assumed. Pressure to be verified by Dames and Moore after gunnite is removed.

Return Terminal: The return terminal bears on the existing concrete of the left dam abutment a concrete compressive strength of 3000 psi is assumed.

Pacoima Aerial Tramway
Determination of Natural Frequency
of
Columns

Modeling these columns as slender columns with axial load, and using Rayleigh's energy method we apply *the* following equation to find the frequency.

$$f_n = \frac{1}{2}\sqrt{\frac{g}{w}\left(\frac{EI\pi^2}{32l^3} - \frac{w}{8l}\right)}$$

where g = acceleration of gravity
w = weight supported by column
E = Modules of Elasticity
I = Moment of Inertia
l = effective length of column

Assuming the load w is concentrated at the top of the columns and including the weight of a loaded cabin we substitute the following values for each tower.

Drive Tower:
w = 43,000 lb
I = 3884.6 in^4
l = 18.33 ft
f_n = 2.70 hz.

Tower #1:
w = 38,700 lb
I = 5042.2 in^4
l = 29 ft
f_n = 1.6 hz.

Tower #2:
w = 17,500 lb
I = 3829.4 in^4
l = 19 ft
f_n = 4.0 hz.

Return Tower:
w = 54,000 lb
I = 6558.4 in^4
l = 18.75 ft
f_n = 3.0 hz.

Pacoima Tram
Drive Tower # 4075.640
Steel Column Analysis

Applied moment along line due to cable tensions, frictions, and equipment load = 399.1 Kip ft.

Applied moment across the line due to wind load generated by a 100 mile per hour wind on track cable, haul cables, communications cable, tower and carrier, and including moment due to the unsymmetrical loading of the track rope of 29.5 kip ft = 159.5 kip ft.

Axial load due to weight of assembly and cable reactions = 43 kip.

Natural frequency of drive tower assembly = 2.7 hz
Earthquake accelerations from Agbabian Associates' letter of November 17, 1997 are:
fault normal = 1.9 g
fault parallel = 1.9 g
fault vertical = 0.9 g
Seismic dead load = 18.9 kip
Moment due to earthquake = 18.9 (18.33)(1.9) = 658 kip ft.
Since 658 kip ft is greater than 159.5 kip feet earthquake loading controls the design.

Since the tower is braced against sidesway along the line by the track rope, assume earthquake moment acts concurrently with moment across the line.

Therefore at base of tower
M along line = 399 kip ft.
M across line = 29.5 + 658 = 687.5 kip ft.
Axial load = 43 kip

Tower is made from two 24"Ø x 3/8" wall pipes. See drawing #4075640
I along line = 3884.6 in^4 = Ixx
I across line = 48420.6 in^4 = Iyy
Area = 55.67 in^2

By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

Fa = 17.44 ksi
fa = 43/55.67 = 0.77 ksi
fa/Fa = 0.77/17.44 = 0.044 < 0.15 therefore H1-3

fbx = 399(12)(12)/3884.6 = 14.8 ksi
fby = 687.5(12)(32)/48420.6 = 5.45 ksi

H1-3 $0.044 + \frac{14.8}{(23.1)} + \frac{5.45}{1.33(23.1)} = 0.86 < 1.0$ **OK**

Pacoima Tram
Tower #1 #4075639
Steel Column Analysis

Applied moment along line due to cable tensions and equipment load is negligible. The moment along line due to track and haul rope friction = 61 kip ft.

Applied moment across the line due to wind = 344 kip ft.
Applied moment across the line due to haul, track cable reactions, cabin and machinery weight = 222 kip ft.

Axial load due to weights including cable reactions = 38.7 kip ft.

Natural frequency of tower assembly = 1.68 hz.
Earthquake accelerations are: fault normal 1.5 g
fault parallel 1.4 g
fault vertical 0.7 g
Seismic dead load = 11.6 kip
Moment due to earthquake = 11.6 (29)(1.5) = 504.6 kip ft.

Design moment across the line is therefore the moment due to the sum of earthquake loads and the haul and track rope, cabin and machinery weights = 504.6 + 222 = 726.6 kip ft.

Therefore the loads at the base of the tower are:
M along line = 61 kip ft.
M across line = 726.6 kip ft
Axial load = 38.7 kip

Tower is 30"Ø x ½" wall pipe, see drawing #4075639
$I = 5042.2\ in^4$
$A = 46.34\ in^2$

By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

Fa = 16.07 ksi
fa = 38.7 / 46.34 = 0.84 ksi
fa/Fa = 0.052 < 0.15 therefore H1-3

fbx = 726.6(12)(15) / 5042.2 = 25.94
fby = 61(12)(15) / 5042.2 = 2.18

$$0.052 + \frac{25.94}{1.33(23.1)} + \frac{2.18}{23.1} = 0.99 < 1.0$$ **OK**

Torsional Displacement due to track rope brake application

$J = 10084\ in^4$
$\theta = \frac{TL}{JG} = \frac{3024(6)(31)(144)}{10084\ (12E06)} = 0.0007\ rad = 0.038°$
Deflection at end of saddle $\delta = 0.04"$

Pacoima Tram
Tower #2 #4075651
Steel Column Analysis

Applied moment along line due to cable tensions and equipment load is negligible. The moment along the line due to track rope friction = 14.7 kip ft.

Applied moment across the line due to wind = 130 kip ft.
Applied moment across the line due to haul, track cable reactions, cabin and machinery weights = 81.4 kip ft.

Axial load due to weights including cable reactions = 17.5 kip

Natural frequency of tower assembly = 3.99 hz
Earthquake accelerations are: fault normal = 2.65 g
fault parallel = 2.7 g
fault vertical = 1.7 g
Seismic dead load = 9.86 kip
Moment due to earthquake = 9.86(19)(2.7) = 505.8 kip ft.

Design moment across the line is therefore the moment due to the sum of the earthquake loads and the haul and track rope, cabin and machinery weights = 505.8 = 81.4 = 587.2 kip ft.

Therefore loads at the base of the tower are:
M along line = 14.7 kip ft.
M across line = 587.2 kip ft.
Axial load = 17.5 kip

Tower is 30"Ø x 3/8" wall pipe, see drawing #4075651
$I = 3829.4\ in^4$
$A = 34.90\ in^2$

By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

Fa = 18.25 ksi
fa = 17.5/34.9 = 0.50 ksi
fa/Fa = 0.5/18.25 = 0.03 < 0.15 therefore, H1-3

fbx = 587.2(12)(15)/3829.4 = 27.60 ksi
fby = 14.7(12)(15)/3829.4 = 0.69 ksi

$$0.03 + \frac{27.60}{1.33(23.1)} + \frac{0.69}{23.1} = 0.96 < 1.0$$ **OK**

Torsional Displacement due to track rope brake application

$J = 7659\ in^4$
$\theta = \frac{TL}{JG} = \frac{3024(6)(19.26)(144)}{7659\ (12E06)} = 0.0005$ rad = 0.031°
Deflection at end of saddle $\delta = 0.02$"

Pacoima Tram
Return Tower #4075692
Steel Column Analysis

Applied moment along line due to cable tensions and equipment loads = 266 kip ft.

Applied moment across the line due to wind load = 62.4 kip ft.
Applied moment across the line due to unsymmetrical loading of the track rope = 111.5 kip ft.
Axial load due to weights including cable reactions, cabin and machinery weight = 54 kip

Natural frequency of return tower assembly = 3.0 hz
Earthquake accelerations are: fault normal = 2.2 g
fault parallel = 2.2 g
fault vertical = 1.0 g
Seismic dead load = 14.7 kip
Moment along line due to earthquake = 14.7(18.75)(2.2) = 606 kip ft. Since the tower is braced against sidesway by the crutch, assume earthquake moment acts concurrently with moment across the line.

Therefore at the base of the return tower:
M along the line = 266 kip ft.
M across the line = 111.5 + 606 = 717.5 kip ft.
Axial load = 54 kip

Tower is made from two 24"Ø x 3/8" wall pipes, see drawing #4075692
I along line = 6558.4 in^4
I across line = 12764 in^4
Area = 73.66 in^2
By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

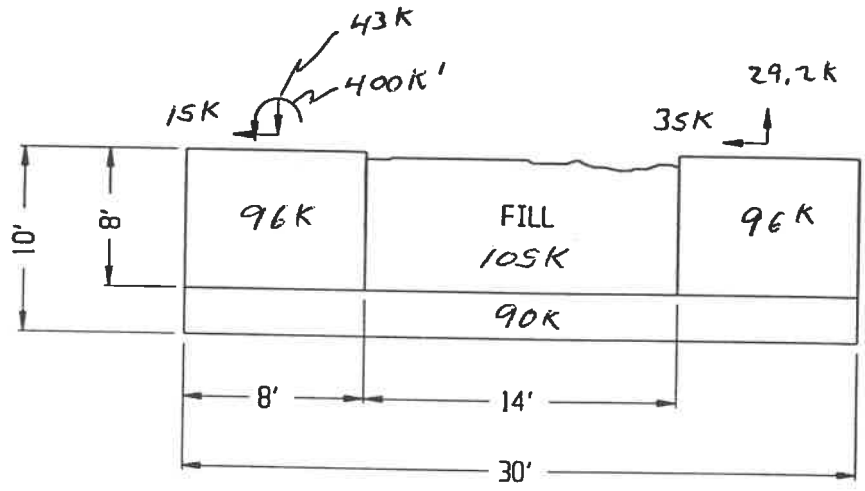
Fa = 17.64 ksi
fa = 54/73.66 = 0.73 ksi
fa/Fa = 0.73/17.64 = 0.04 < 0.15 therefore H1-3

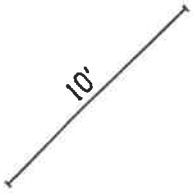
fbx = 266 (12)(12.375)/6558.4 = 6.02 ksi
fby = 717.5 (12)(24)/12764 = 16.19 ksi

$$0.04 + \frac{16.19}{1.33(23.1)} + \frac{6.02}{23.1} = 0.83 < 1.0$$ **OK**

Pacoima Tram
Drive Foundation #3114514
Design Analysis

The foundations for the Pacoima Tramway have been designed in accordance with the American National Standard A.N.S.I. B77.1-1992 Aerial Tramways, Aerial Lifts, Surface Lift and Tows - Safety Requirements Section 2.1.1.6.2 Foundations. See Geotechnical Evaluation Pacoima Dam Aerial Tram, Dames & Moore, Job No. 39406-001-015, March 25, 1998.





Overturning due to Wind Loads and Line Loads

ΣMOT = 400 + (15 + 35)(10) + 29.2(26.33) = 1669 kip ft.
ΣMRT = 96(4) + 43(3) + 195(15) + 96(26) = 5934 kip ft.

$$\text{Safety factor} = \frac{5934}{1669} = 3.56 > 2.0$$

OK

Overturning due to Earthquake Loads and Line Loads

$\Sigma MOT = 658 + 18.9(1.9)(10) = 1017$ kip ft.
$\Sigma MRT = (96 + 96 + 105 + 90 + 43)5 = 2150$ kip ft.
Safety Factor $= \frac{2150}{1017} = 2.1 > 1.0$ **OK**

Slip

$\Sigma WT = 96 + 43 + 195 + 96 = 430$ kip

$\mu = 0.4$ $\mu \Sigma wt = 0.4\ (430) = 172$ kip

Safety factor $= \frac{172}{50} = 3.4 > 2.0$ **OK**

Soil Pressure

$\Sigma fy = -430 + Pt(10)(x)(\frac{1}{2}) = 0$

$\Sigma Mo = -1669 + 5934 - Pt(10)(x)(\frac{x}{3})(\frac{1}{2}) = 0$

$x = 29.76$ ft
$Pt = 2.89$ k.s.f.

Transverse Soil Pressure due to wind
$PTR\ (5)(30)(\frac{1}{2})(\frac{10}{3}) = 258.5$ kip ft.
$PTR = 1.03$ ksf

Total Soil Pressure
$1.03 + 2.89 = 3.92$ ksf < 5.0 ksf **OK**

Steel Design

Top Longitudinal Steel

Design Moment = 805 kip ft.
Steel 15 #8's As = 11.85 in^2 a = 2.32 in
$M_u = 0.9(60)(11.85)(20 - \frac{2.32}{2})/12 = 1004 > 805$ kip ft. **OK**

Bottom Longitudinal Steel

Design Moment = 786 kip ft.
Steel 15 #8's As = 11.85 in^2 a = 2.32 in
$M_u = 0.9(60)(11.85)(20 - \frac{2.32}{2})/12 = 1004 > 786$ kip ft. **OK**

Transverse Steel

Design Moment = 9.2 kip ft/ft
Steel #5's @ 2' on center
As = 0.155 in^2/ft a = 0.3 in
$M_u = 0.9(60)(0.15)(20 - \frac{0.3}{2})/12 = 13.4 > 9.2$ kip ft./ft. **OK**

Vertical steel in front and rear blocks

Design Moment = 1438 kip ft.
Steel 8 #8's As = 6.32 in^2 a = 1.55 in
$M_u = 0.9(60)(6.32)(92 - \frac{1.55}{2})/12 = 2594 > 1438$ kip ft. **OK**

AGBABIAN ASSOCIATES
engineers and consultants

STRUCTURAL CALCULATIONS

FOR

PACOIMA DAM AERIAL TRAM

TOWER 1 FOUNDATION

November 11, 1998

STRUCTURAL CALCULATIONS

FOR

PACOIMA DAM AERIAL TRAM

TOWER 1 FOUNDATION

for

Los Angeles County, Department of Public Works
Hydraulic/Water Conservation Division
900 South Fremont Avenue, 2nd Floor
Alhambra, California 91803-1331

by

Agbabian Associates, Inc.
1111 South Arroyo Parkway, Suite 470
Pasadena, California 91105
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11/11/98

November 11, 1998
Report No. 9834-6679

AGBABIAN ASSOCIATES

SUBJECT PACOIMA DAM TRAM PROJECT
TOWER 1 FOUNDATION DESIGN
AUTHOR K. Caravalho DATE 10/15/98 FILE NO. 9834
CHECKED BY [signature] DATE 10/26/98 PAGE 1 OF 8

TOWER 1 FOUNDATION:

Design Criteria:

1) $f'_c = 3000$ psi $f_y = 60{,}000$ psi (Grade 60 reinforcing steel)

2) Clear cover for reinforcement = 3"

3) Allowable bearing pressure = 6,000psi (see Dames & Moore Report dated Nov. 9, 1998)

4) Little to no passive pressure

5) Coefficient of friction = 0.5 to 0.6

6) Foundation to be a massive concrete block

7) Maximum forces & moments @ top of footing (base of tower) taken from values used in Poma's original calculations

Forces & Moments on Foundation:

Loads @ Top of footing from Tower: (taken from Poma's Tower #1 Steel Column Analysis, see Appendix A)

$M_{along\ line}$ (due to track rope friction) = 61 k·ft

$M_{across\ line}$ (due to wind) = 344 k·ft

$M_{across\ line}$ (due to cable reactions, etc.) = 222 k·ft

$M_{along\ or\ across\ line}$ (due to Earthquake) = 504.6 k·ft

(Tower 1 Foundation, Cont.)

Design Moments:

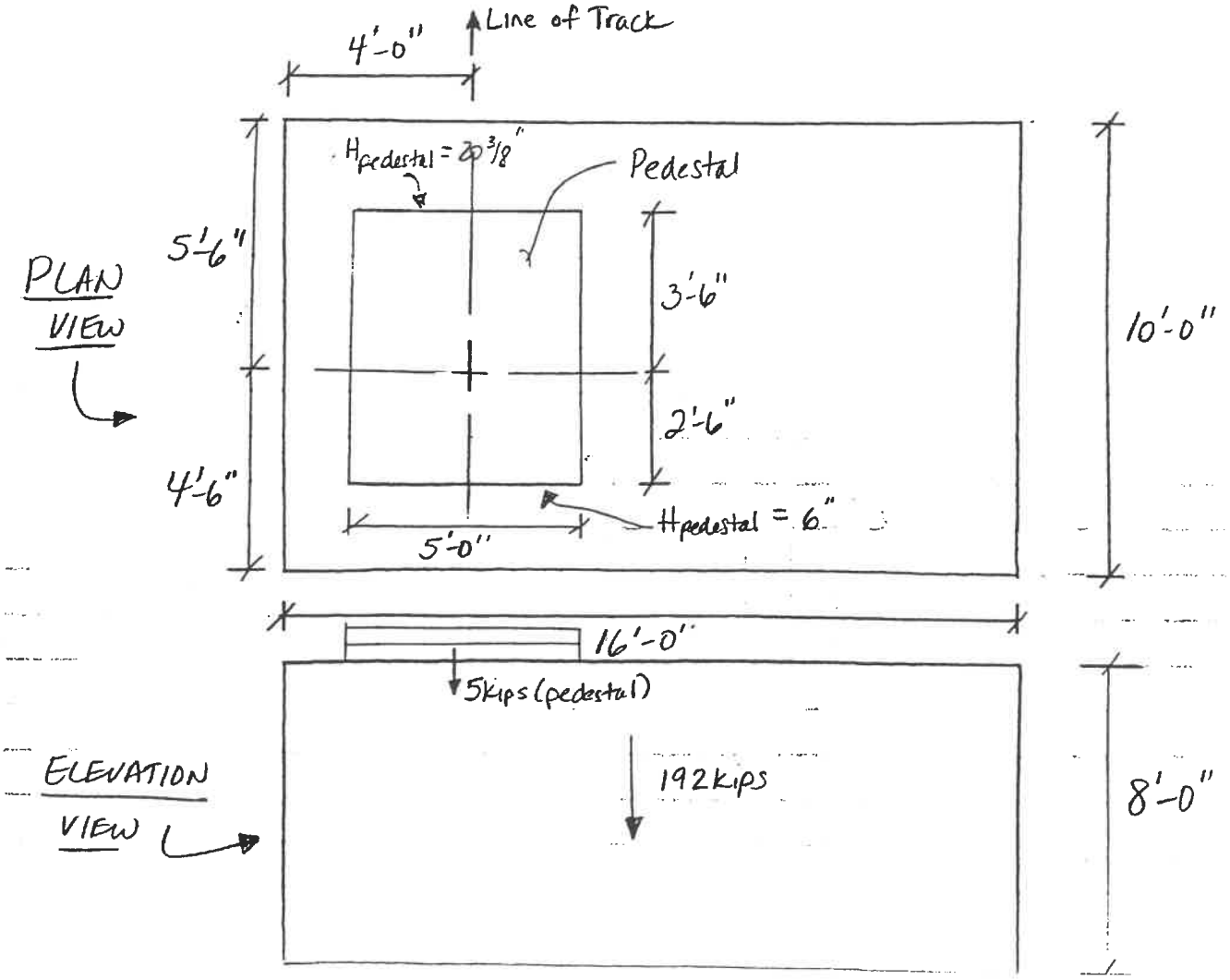
M_{max} along line = 504.6 k-ft + 61 k-ft = 565.6 k-ft (EQ + Friction)

M_{max} across line = 344 k-ft + 222 k-ft = 566 k-ft (WIND + LINE LOAD)
= 504.6 k-ft + 222 k-ft = 726.6 k-ft ← governs (EQ + LINE LOAD)

Axial load due to weight = 38.7 kips, Seismic DL = 9.86 k

V_{max} = 17.4 kips (EQ)

V_{max} = 12.5 kips (WIND + LINE LOAD)



(Tower 1 Foundation, Cont.)

Check Bearing Area for Axial Forces Only:

$$q = \frac{38.7K + 192\,kips + 5\,kips}{10' \times 16'} = 1.47\,ksf = 1473\,psf < 6000\,psf \quad OK$$

Wind Load on Foundation:

Consider wind effects on foundation:

$$P = C_e C_q q_s I_w$$

$q_s = 25.6\,psf$ for 100 mph wind

$C_e = 1.06$ (Exposure C)

$C_q = 1.4$ $\quad I_w = 1.15$

$$P = 1.06 \times 1.4 \times 25.6\,psf \times 1.15 = 43.7\,psf$$

$M_{along\ line}$ (due to wind on foundation) $= 43.7\,psf \times 8' \times 16' \times \frac{8'}{2} = 22.4\,k\cdot ft$

$M_{across\ line}$ (due to wind on foundation) $= 43.7\,psf \times 8' \times 10' \times \frac{8'}{2} = 14.0\,k\cdot ft$

Seismic Load on Foundation:

$M_{along\ or\ across\ line}$ (due to EQ on foundation) $= 192K \times 0.8g \times \frac{8'}{2} + 5K \times 0.8g \times (8' + \frac{1.1'}{2})$

$= 649\,k\cdot ft$

(Tower 1 Foundation, Cont.)

Check Overturning:

Due to Wind + Line Load (Across Line):

$\Sigma M_{OT} = 12.5 kips \times 8.55' + 566 k\cdot ft + 14.0 k\cdot ft = 687 k\cdot ft$

(8.55' = $8' + \left(\frac{23.375" + 6"}{2}\right)\frac{1}{2} \times \frac{1}{12}$)

$\Sigma M_{RT} = (38.7k + 5k)(4') + 192k \times 16'/2 = 1710.8 k\cdot ft$

$SF = \frac{1710.8 k\cdot ft}{687 k\cdot ft} = 2.49 > 1.5$ OK

Due to Seismic + Line Load (Across Line):

$\Sigma M_{OT} = 17.4k \times 8.55' + 649 k\cdot ft + 726.6 k\cdot ft = 1524.4 k\cdot ft$

$SF = \frac{1710.8}{1524.4} = 1.12 > 1.0$ OK

Due to Seismic + Fricti Load (Along Line):

$\Sigma M_{OT} = 17.4k \times 8.55' + 566 k\cdot ft + 649 k\cdot ft = 1364 k\cdot ft$

$\Sigma M_{RT} = (38.7k + 5k) \times 4.5' + 192k \times \frac{10'}{2} = 1157 k\cdot ft$

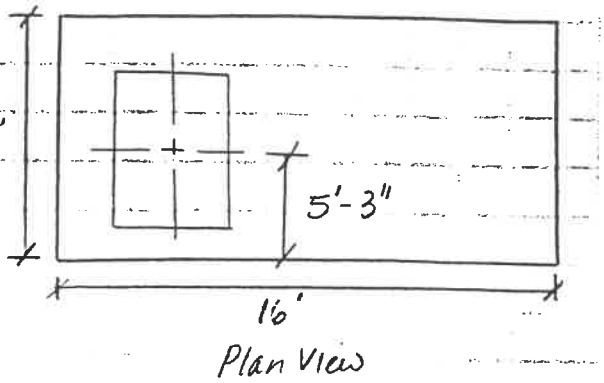
$SF = \frac{1157.1 k\cdot ft}{1364 k\cdot ft} = 0.85 < 1.0$ No Good

*Need larger foundation

(Tower 1 Foundation, Cont.)

Try 11'-3" x 16' Foundation:

Wt. of foundation = 216 kips



Plan View

M across line due to wind on foundation = $43.7 psf \times 8' \times 11.5' \times \frac{8'}{2}$ = 16.1 k·ft

M along or across line due to EQ on foundation = $216.0k \times 0.8 \times \frac{8'}{2} + 5k \times .8g \times (8' + \frac{1.1'}{2})$ = 725 k·ft

Check overturning:

- Due to Wind + Line Load (Across Line):

$\Sigma M_{OT} = 12.5k \times 8.55' + 566 k\cdot ft + 16.1 k\cdot ft = 689 k\cdot ft$

$\Sigma M_{RT} = (38.7 + 5) \times 4' + 216.0k \times \frac{16'}{2} = 1903 k\cdot ft$

SF = 2.76 > 1.5 OK

- Due to EQ + Line Load (Across Line):

$\Sigma M_{OT} = 17.4k \times 8.55' + 726.6 k\cdot ft + 725 k\cdot ft = 1600 k\cdot ft$

$SF = \frac{1903.0}{1600} = 1.19 > 1.0$ OK

- Due to EQ + Friction Load (Along Line):

$\Sigma M_{OT} = 17.4k \times 8.55' + 566 k\cdot ft + 725 k\cdot ft = 1440 k\cdot ft$

$\Sigma M_{RT} = (38.7 + 5) \times 5.25' + 216.0k \times \frac{11.25'}{2} = 1444 k\cdot ft$

$SF = \frac{1444 k\cdot ft}{1440 k\cdot ft} = 1.00$ OK

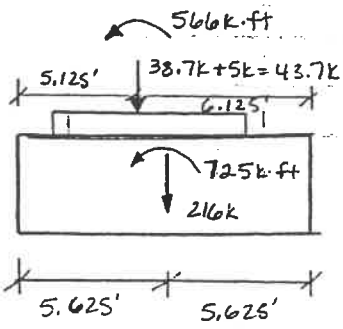
Use 11'-3" x 16' Foundation

(Tower 1 Foundation, Cont.)

Check Sliding:

(See Dames & Moore soil report dated Nov. 9, 1998)

SOIL PRESSURE: (Under Uniaxial Moment)



Along Line:

$\Sigma F_y = 43.7k + 216k = 260k$

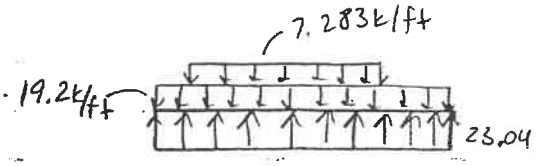
$\Sigma M_o = 566\,k.ft + 17.4k \times 8.55' + 725\,k.ft - 43.7k \times 5.125' - 216k \times 5.625'$
$= 0.81\,k.ft$

$e = \frac{0.81\,k.ft}{260k} \approx 0$

$q_{max} = \frac{260k}{11.25' \times 16'}(1 \pm 0) = 1.44\ ksf < 6.0\ ksf$ OK

$M_{max} = 29.4\,k\text{-}ft$

$M_{min} \cong 0$

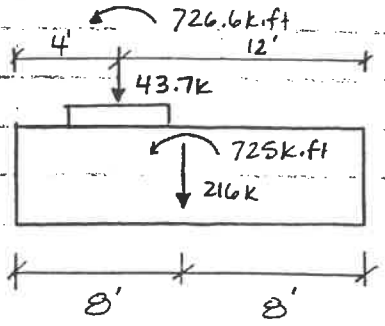


Use Minimum Steel

*Use #6 @ 12" Top + Bottom

($A_s = 0.44\ in^2/ft$, $M_u = 181\,kip\cdot ft/ft$)

(Tower 1 Found., Cont.)



Across Line:

$\Sigma F_y = 43.7k + 216k = 260k$

$\Sigma M_o = 726.6\,k\cdot ft + 725\,k\cdot ft + 17.4k \times 8.55k - 216 \times 8' - 43.7k \times 4'$

$= -302\,k\cdot ft$

$e = \frac{-302}{260} = -1.16'$

$q_{max,min} = \frac{260k}{11.25' \times 16'}\left(1 \pm \frac{6(1.16)}{16.0}\right) = 2.07\,ksf,\ 0.82\,ksf < 6.0\,ksf$ ok

Bottom Bars

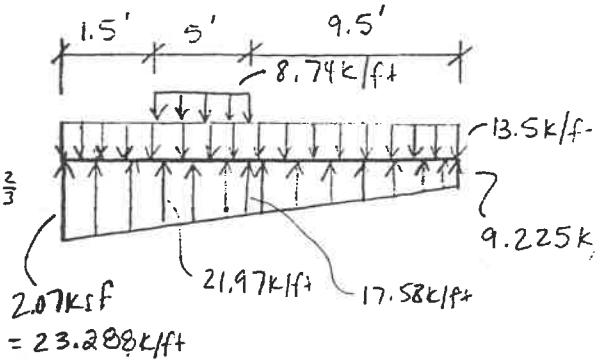
$M'_{max} = \frac{23.288k/ft}{2} \times 1.5' \times 1.5' \times \frac{2}{3} + \frac{21.97k/ft}{2} \times 1.5 \times 1.5 \times \frac{1}{3}$

$M_{max} = 25.7\,k\cdot ft$

Top Bars

$M_{max} = 13.5k/ft \times 9.5' \times \frac{9.5'}{2} - \frac{9.225k/ft}{2} \times 9.5' \times 9.5' \times \frac{2}{3} - \frac{17.58k/ft}{2} \times 9.5' \times 9.5' \times \frac{1}{3}$

$M_{max} = 67.2\,k\cdot ft$



Use Minimum Steel

Use 11-#8 top & bottom ($A_s = 8.69\,in^2$, $M_u = 3567\,k\cdot ft$)

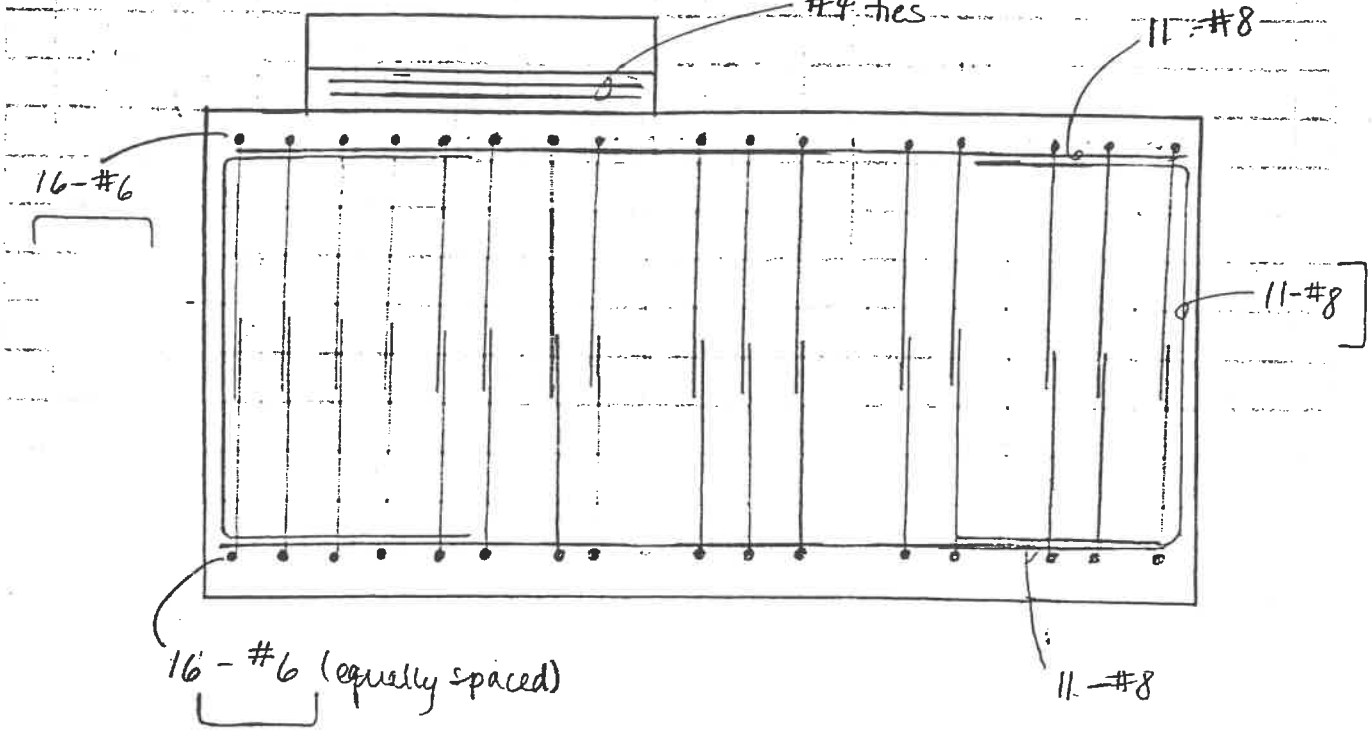
AGBABIAN ASSOCIATES

SUBJECT PACOIMA DAM TRAM PROJECT
TOWER 1 FOUNDATION

AUTHOR K. Caravalho DATE 10/26/98 FILE NO. 9834

CHECKED BY Sam Allen DATE 10/26/98 PAGE 8 OF 8

(Tower 1 Foundation, Cont.)



APPENDIX A

POMA TOWER CALCULATIONS SHOWING LOADS TRANSMITTED TO FOUNDATION

Pacoima Tram
Tower #1 #4075639
Steel Column Analysis

Applied moment along line due to cable tensions and equipment load is negligible. The moment along line due to track and haul rope friction = 61 kip ft.

Applied moment across the line due to wind = 344 kip ft.
Applied moment across the line due to haul, track cable reactions, cabin and machinery weight = 222 kip ft.

Axial load due to weights including cable reactions = 38.7 kip ft.

Natural frequency of tower assembly = 1.6 hz.
Earthquake accelerations are: fault normal 1.5 g
fault parallel 1.4 g
fault vertical 0.7 g
Seismic dead load = 11.6 kip
Moment due to earthquake = 11.6 (29)(1.5) = 504.6 kip ft.

Design moment across the line is therefore the moment due to the sum of earthquake loads and the haul and track rope, cabin and machinery weights = 504.6 + 222 = 726.6 kip ft.

Therefore the loads at the base of the tower are:
M along line = 61 kip ft.
M across line = 726.6 kip ft
Axial load = 38.7 kip

Tower is 30"Ø x ½" wall pipe, see drawing #4075639
$I = 5042.2\ in^4$
$A = 46.34\ in^2$

By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

Fa = 16.07 ksi
fa = 38.7 / 46.34 = 0.84 ksi
fa/Fa = 0.052 < 0.15 therefore H1-3

fbx = 726.6(12)(15) / 5042.2 = 25.94
fby = 61(12)(15) / 5042.2 = 2.18

$$0.052 + \frac{25.94}{1.33(23.1)} + \frac{2.18}{23.1} = 0.99 < 1.0$$ OK

APPENDIX B

PHOTOGRAPHS SHOWING TOWER 1 SITE AND EXCAVATION AS OF JULY 29, 1998

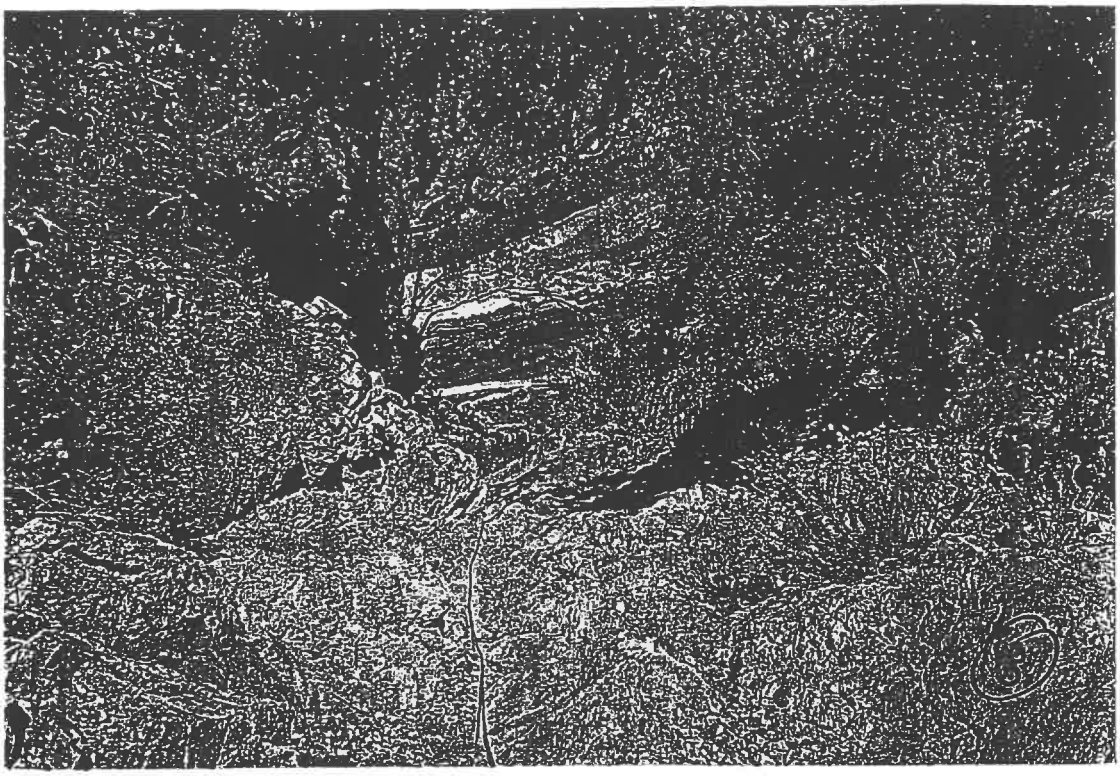
Pacoima Dam – Photo Key

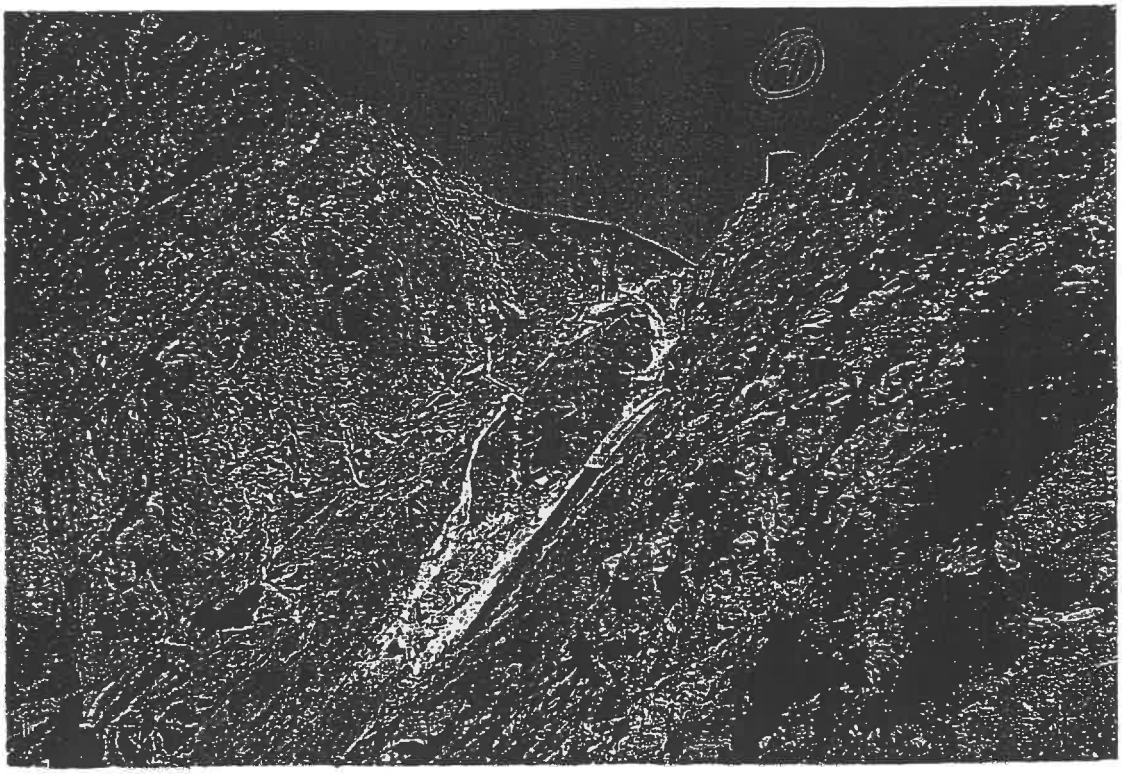
7/29/98

Photo	*Description*
1	Bottom as seen from Tower 1
2	Tower 1 excavation looking downline
3	Tower 1 excavation looking downslope
4	Tower 2 and Top of dam as seen from Tower 1
5	Tower 1 as seen from Tower 2
6	Tower 1 bottom of hole along line
7	Tower 1 bottom of hole across line
8	Tower 1 hillside excavation downline side
9	Tower 1 hillside excavation upline side
10	Tower 1 downline outer corner
11	Tower 1 upline outer corner
12	Tower 1 hillside downline corner
13	Tower 1 hillside upline corner
14	Tower 2 bottom of excavation along line
15	Tower 2 bottom of excavation across line
16	Tower 2 looking downline
17	Tower 2 looking upline
18	Tower 2 left side
19	Tower 2 downline left corner
20	Tower 2 downline right corner
21	Tower 2 upline right corner


0


2



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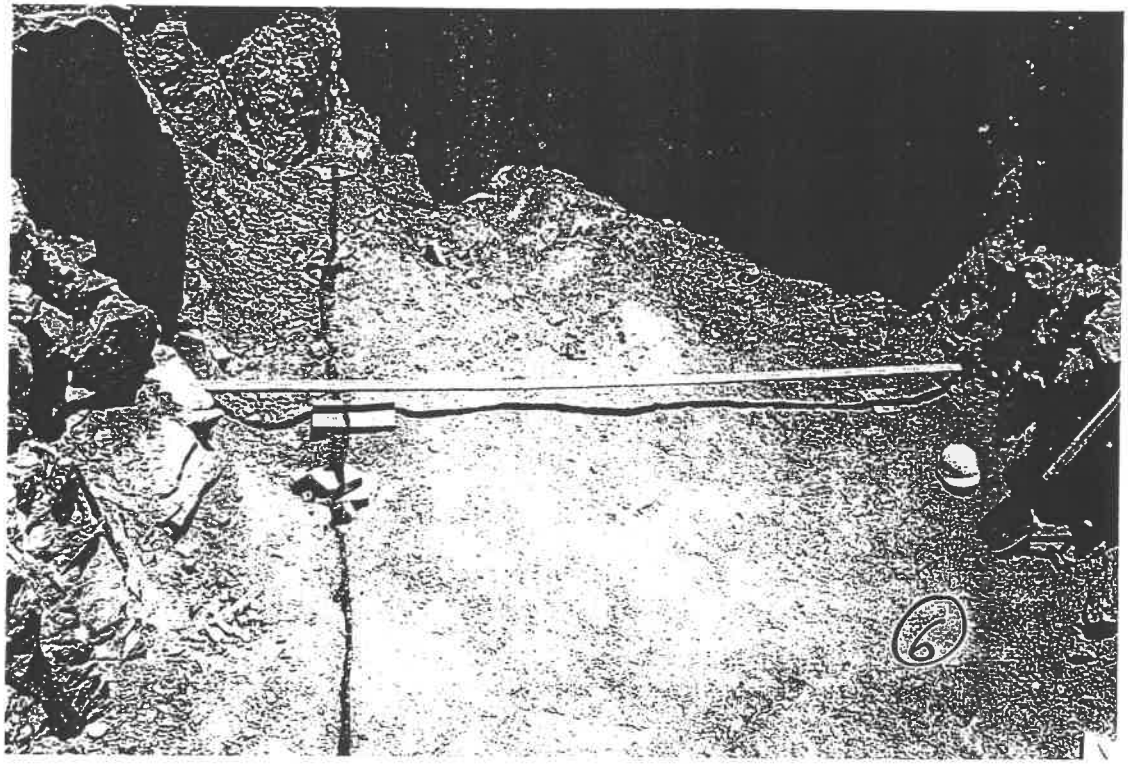
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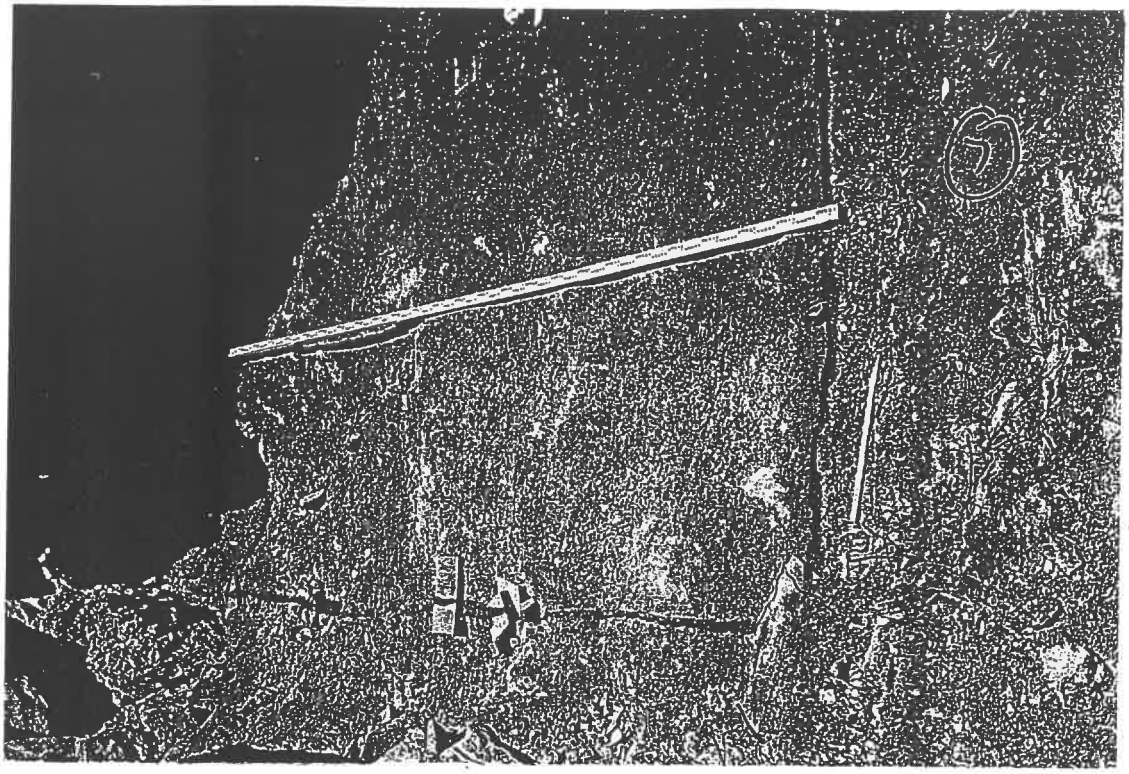

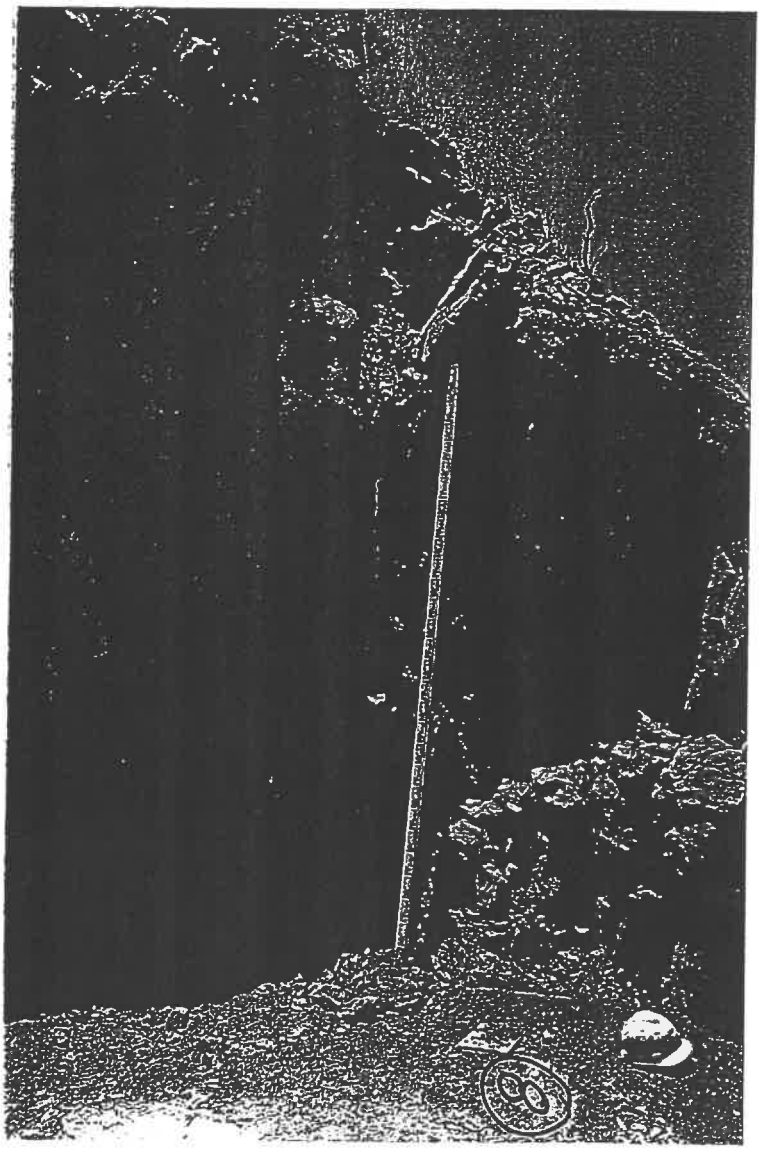

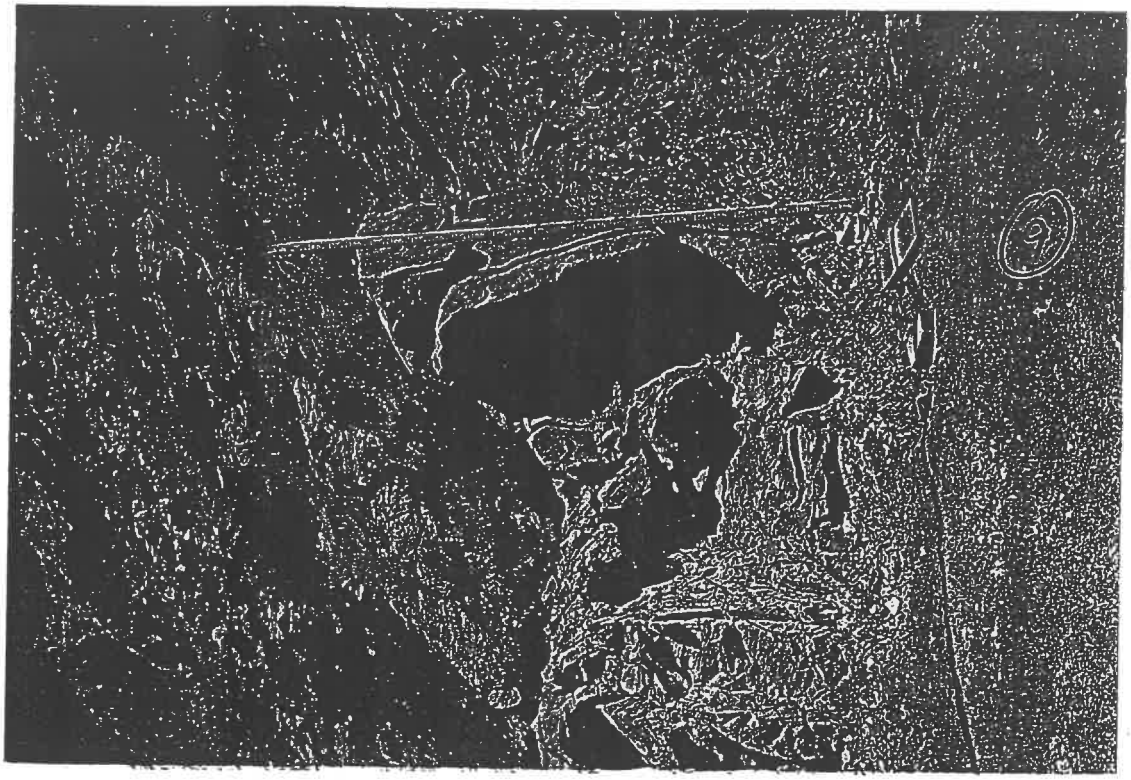

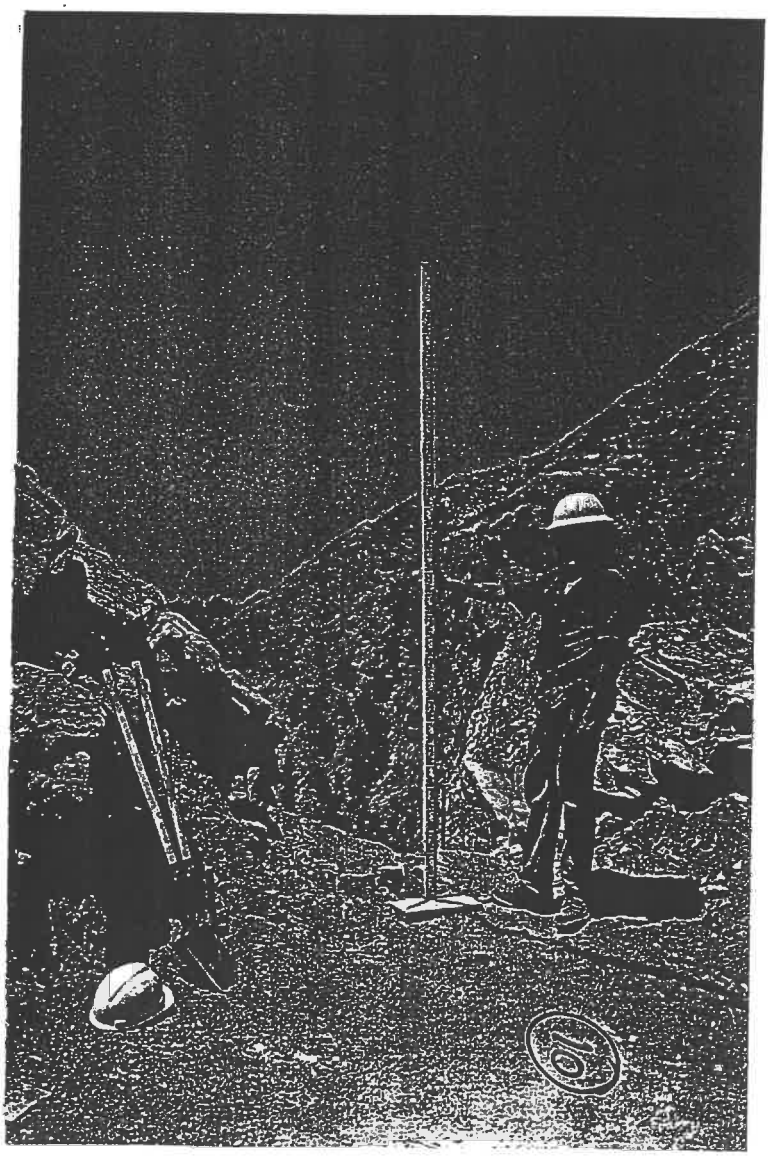

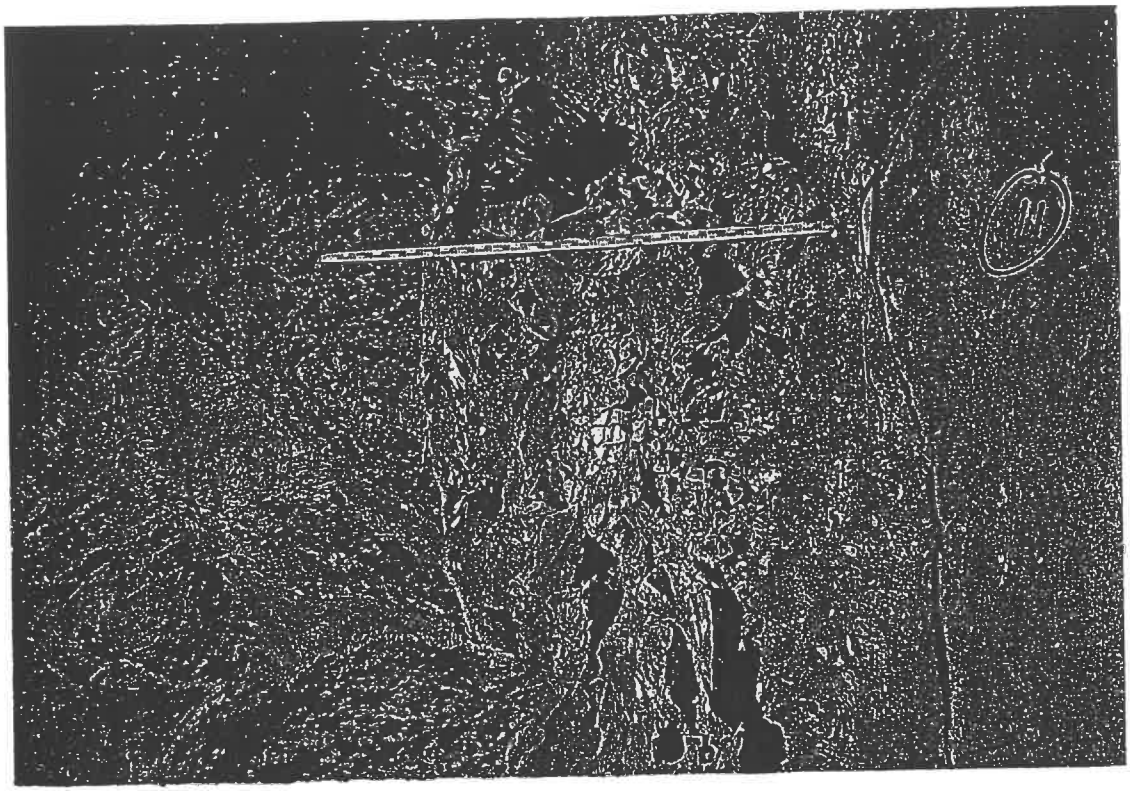
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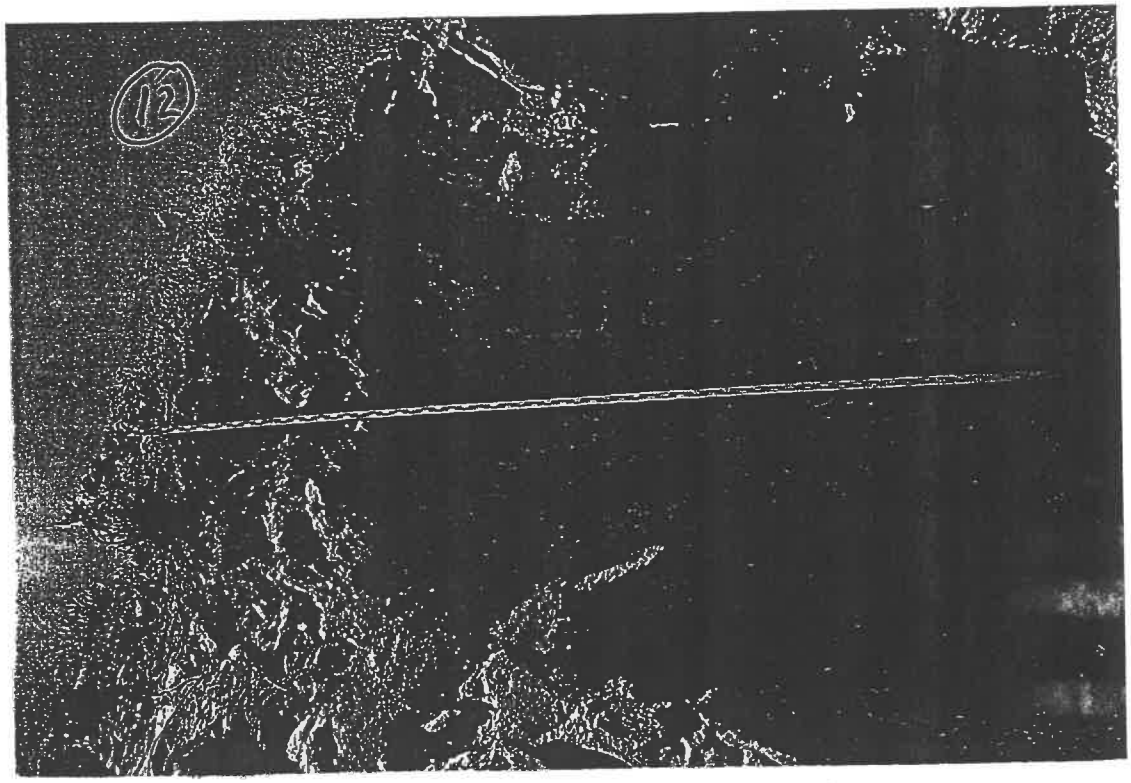
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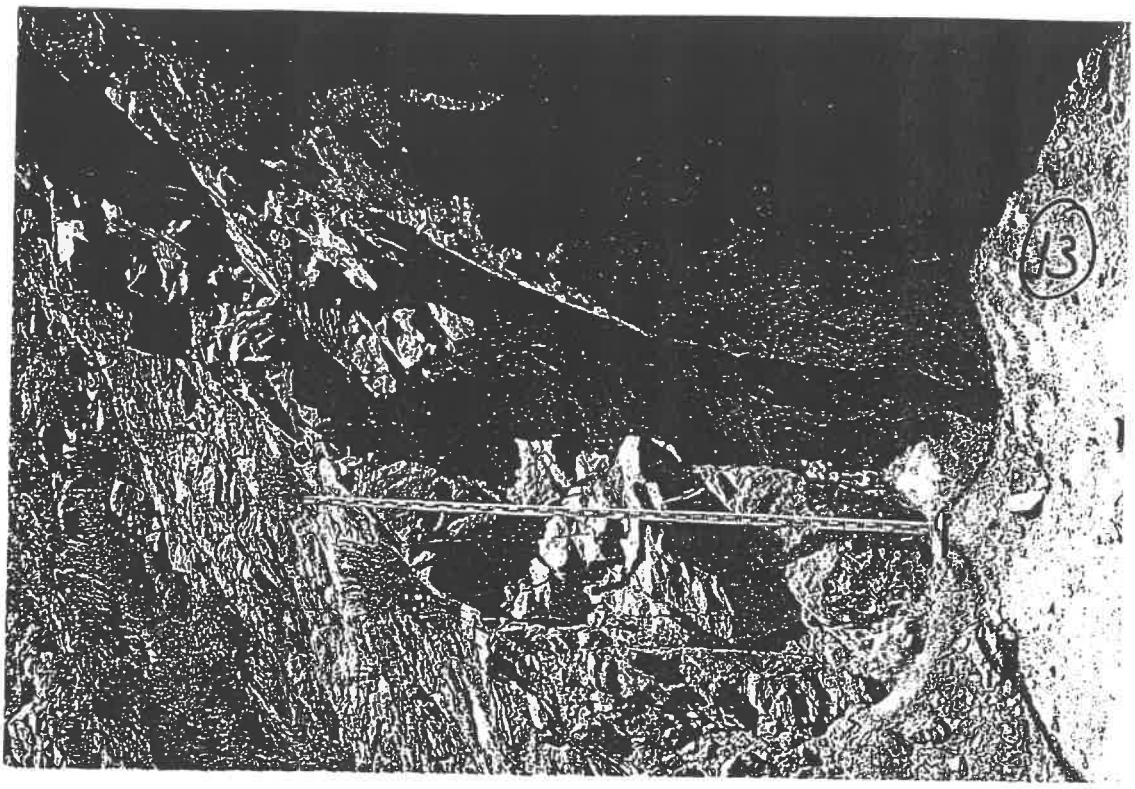
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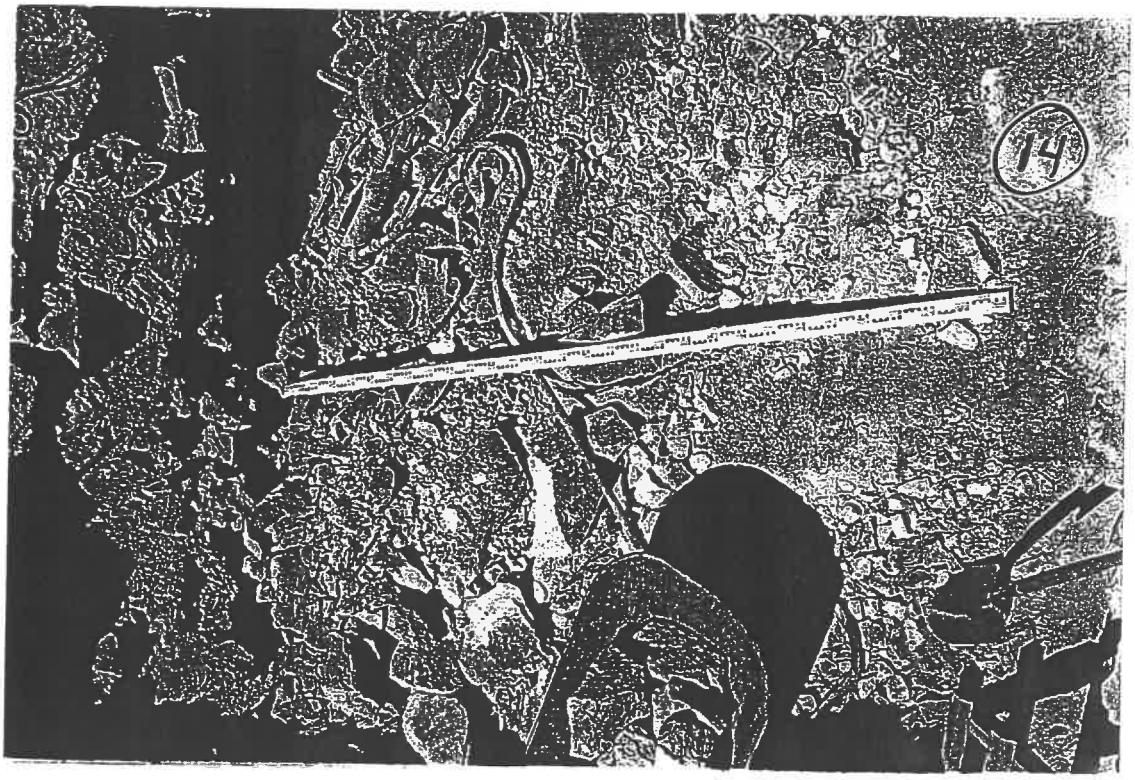
14

AGBABIAN ASSOCIATES
engineers and consultants

STRUCTURAL CALCULATIONS

FOR

PACOIMA DAM AERIAL TRAM

TOWER 2 FOUNDATION

October 8, 1998

STRUCTURAL CALCULATIONS

FOR

PACOIMA DAM AERIAL TRAM

TOWER 2 FOUNDATION

for

Los Angeles County, Department of Public Works
Hydraulic/Water Conservation Division
900 South Fremont Avenue, 2nd Floor
Alhambra, California 91803-1331

by

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October 8, 1998
Report No. 9834-6678

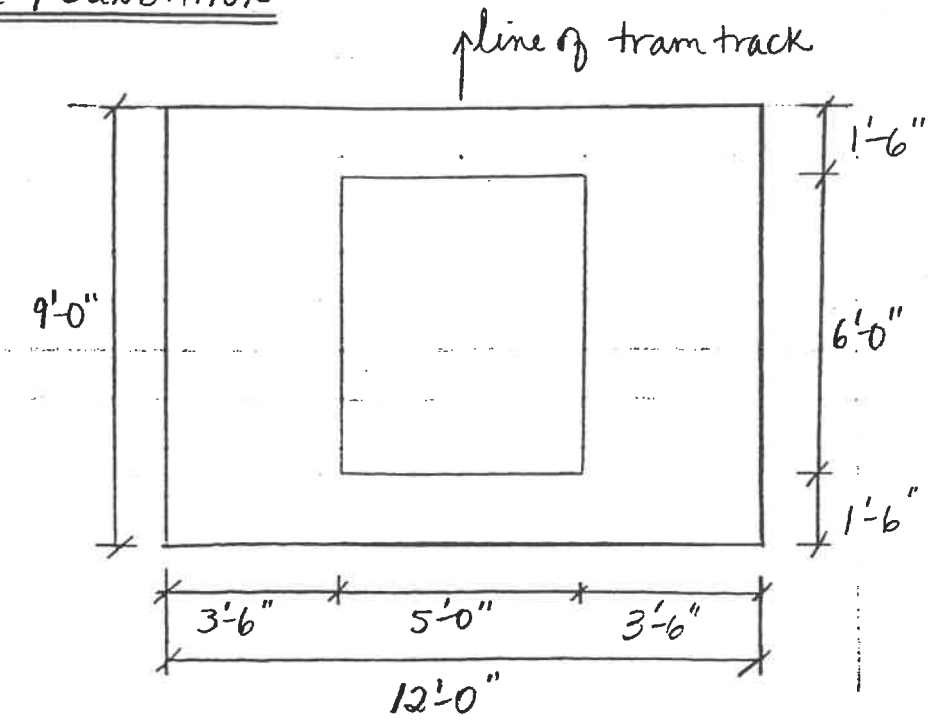
AGBABIAN ASSOCIATES

SUBJECT PACOIMA DAM TRAM PROJECT
FOUNDATION DESIGN

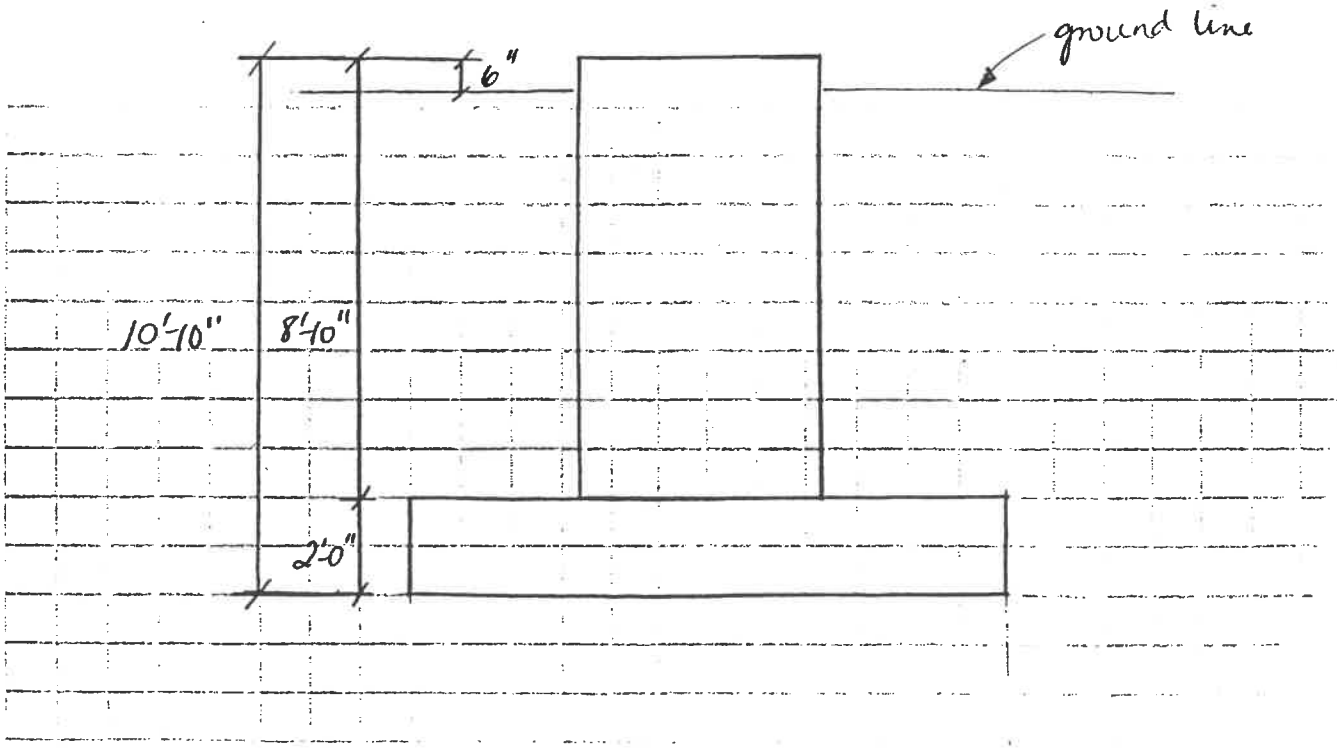
AUTHOR K. Caravalho DATE 9/28/98 FILE NO. 9834

CHECKED BY Sammy Abbas DATE 10/6/98 PAGE 1 OF 7

TOWER 2 FOUNDATION:



PLAN VIEW



(Tower 2 Foundation, cont.)

Design Criteria:

1) $f'_c = 3000$ psi , $f_y = 60{,}000$ psi (Grade 60 reinforcing stee

2) Clear cover for reinforcement = 3"

3) Allowable bearing pressure = 6,000 psi (see Dames + Moore Report dated 10/7/98 – Job # 39406-002-01

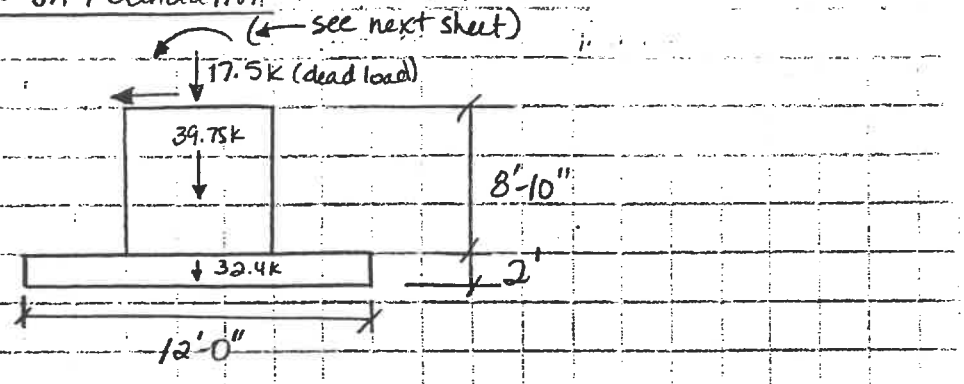
4) Passive Pressure = 260 pcf "

5) Coefficient of friction = 0.5 to 0.6 "

6) Foundation to be a massive concrete block

7) Maximum forces and moments @ the base of the tower (top of footing) taken from values used in Porna's original foundation calculations.

Forces + Moments on Foundation:



Weight of foundation = $[(8.833' \times 5' \times 6') + (2' \times 12' \times 9')] \times 150$ pcf = 72.15 kips (= 39.75k + 32.4 kips)

Weight of backfill over foundation = $(8.33') \times (12 \times 9 - 5 \times 6) \times 100$ pcf = 65k

(Tower 2 FND., CONT.)

Loads @ Top of Footing from Tower: (taken from Poma's Tower #2 Steel Column Analysis) (see Appendix A)

$M_{along\ line} = 14.7\ K\cdot ft$ (due to track rope friction)

$M_{across\ line} = 130\ k\cdot ft$ (due to wind)

$M_{across\ line} = 81.4\ k\cdot ft$ (due to cable reactions, cabin, machinery)

$M_{along\ or\ across\ line} = 505.8\ k\cdot ft$ (due to EQ)

Axial load = 17.5 kips, Seismic DL = 9.86 kips

$M_{max\ along\ line} = 505.8\ k\cdot ft + 14.7\ k\cdot ft = 520.5\ k\cdot ft$ (EQ + Fricti

$M_{max\ across\ line} = 130\ k\cdot ft + 81.4\ k\cdot ft = 211.4\ k\cdot ft$ (say 220) (WIND + LINE LOAD)

$= 505.8\ k\cdot ft + 81.4\ k\cdot ft = 587.2\ k\cdot ft$ (EQ + LINE LOA

$V_{max} = 7.4$ kips (WIND + LINE LOAD)

$V_{max} = 26.6$ kips (EQ)

Check Bearing Area:

$$\text{Req'd Area} = \frac{17.5\ \text{kips} \times 1000}{6000\ \text{psf}} = 2.9\ ft^2 \rightarrow A = 12' \times 9' = 108\ ft^2 \quad \underline{OK}$$

Check Overturning:

Due to Wind + Line Load (Across Line):

$\Sigma M_{OT} = 7.4\ \text{kips} \times 10.83' + 220\ k\cdot ft = 300\ k\cdot ft$

$\Sigma M_{RT} = (17.5K + 39.75K + 32.4K + 65K) \times 6' = 928\ k\cdot ft$

$$SF = \frac{928}{300} = 3.1 > 1.5 \quad \underline{OK}$$

AGBABIAN ASSOCIATES

SUBJECT PACOIMA DAM TRAM PROJECT

AUTHOR K. Caravalho DATE 9/28/98 FILE NO. 9834

CHECKED BY Sam Adm DATE 10/6/98 PAGE 4 OF 7

(Tower 2 Found., Cont.)

Due to Seismic + Line Loads (Across Line):

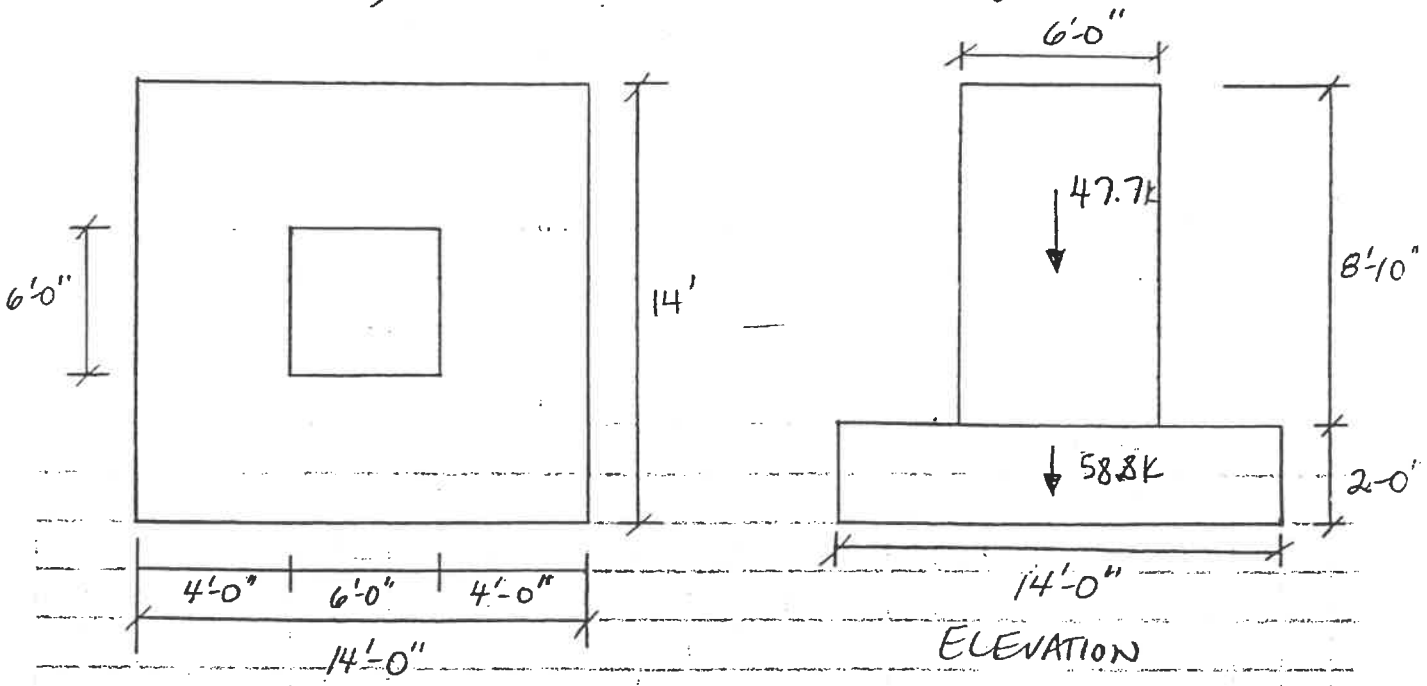
$$\Sigma M_{OT} = 587.2\,k\cdot ft + (9.86k \times 2.7g \times 10.83') + (39.75 + \tfrac{65}{2})k \times 0.8g \times (2' + \tfrac{8.83}{2}) + (32.4k \times 0.8g \times 1')$$

(ZPA value)

$$= 1272\,K\cdot ft$$

$$\Sigma M_{RT} = 927\,K\cdot ft \qquad SF = \frac{927}{1272} = 0.73 \text{ . No Good}$$

No Good, SF < 1.0 → increase size of foundation



Wt of Foundation = $6' \times 6' \times 8.83' \times 150\,kcf + 2' \times 14' \times 14' \times 150\,kcf = 47.7K + 58.8K$

$= 106.5K$

Wt. of Backfill = $(14' \times 14' - 6' \times 6') \times 8.33' \times .100\,kcf = 133.3\,kips$

(Tower 2 Found., Cont.)

Re-Check Overturning:

Due to Wind + Line loads:

$\Sigma M_{OT} = 7.4k \times 10.83' + 220\ k\cdot ft = 300\ k\cdot ft$

$\Sigma M_{RT} = 7.0'(17.5k + 47.7k + 58.8k + 133.3k) = 1801\ k\cdot ft$

} SF = 6.0 > OK

Due to EQ. + Line Loads:

$\Sigma M_{OT} = 587.2\ k\cdot ft + (9.86k \times 2.79 \times 10.83') + (47.7k + \frac{133.3}{2})(0.8)(6.415')$ (½ backfill)
$+ 58.8k(1.0)(0.8)$
$= 1509\ k\cdot ft$

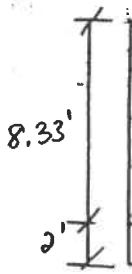
$SF = \frac{1801\ k\cdot ft}{1509\ k\cdot ft} = 1.2 > 1.0$ OK

Check Sliding:

$F_{slide} = 26.6k + 106.5k \times 0.8 + \frac{1}{2} \times 133.3k \times 0.8 = 165.1$ kips
(@ top of foundation due to EQ; foundation (EQ); ½ backfill (EQ))

$F_{resisting\ (friction)} = 0.5 \times (106.5k + 133.3k + 17.5k) = 128.7$ kips

$F_{resisting\ (passive\ pressure)} = (260\#/ft^2/ft)(8.33')(\frac{1}{2})(8.33' \times 6') + \left(\frac{2166.\#/ft^2 + 2686.\#/ft^2}{2}\right)(2')(14')\frac{1}{1000} = 122.1k$



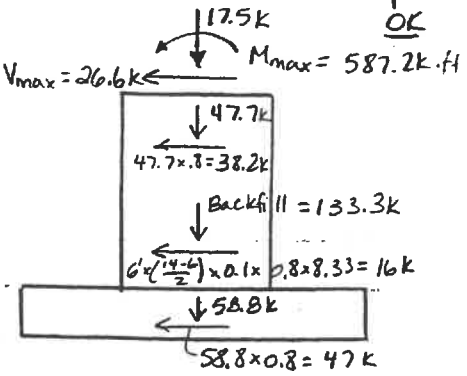
$SF = \frac{122.1 + 128.7}{165.1} = 1.52 > 1.0$ OK

(If slurry backfill is only used for bottom 2' of footing,
$SF = \frac{128.7 + 67.9k}{165.1k} = 1.19 > 1.0$ OK)

(Tower 2 Found, Cont.)

Recheck Bearing for Axial Loads: $q = \frac{(17.5+106.5+133.3+58.8)k \times 1000}{14' \times 14'} = 1613 psf$ < 6000psf OK

SOIL PRESSURE: (Under Uniaxial Moment)



$\Sigma F_y = 17.5k + 47.7k + 133.3k + 58.8k = 257.3k$

$\Sigma M = 587.2 k\cdot ft + 26.6k \times 8.83' + 38.2k \times \frac{8.83'}{2} + 16k \times \frac{8.33'}{2} + 47k \times 1'$

$= 1104.4 k\cdot ft$

$e = \frac{1104.4 k\cdot ft}{257.3k} = 4.3' > \frac{14'}{6}$ → resultant outside of middle 1/3

$q_{max} = \frac{2 \times \Sigma F_y}{3B(L/2 - e)} = \frac{2 \times 257.3k}{3 \times 14'(\frac{14'}{2} - 4.3')} = 4.53 ksf < 6.0 ksf$ OK

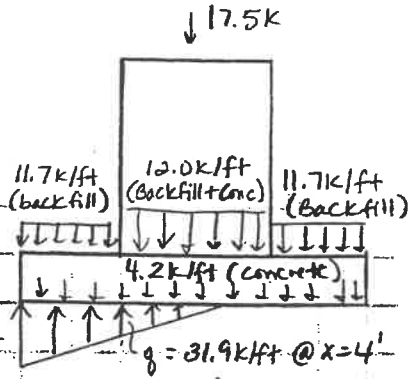
Bottom Bars

$M_{max} = \frac{63 k/ft}{2}(4') \times \frac{2}{3} \times 4' + \frac{31.9 k/ft}{2}(4')(\frac{4'}{3})$

$= 421 k\cdot ft$

$A_{s req'd} = \frac{421 k\cdot ft \times 12"/1' \times 1000}{24000 psi \times 0.9 \times 20"} = 11.7 in^2$

→ Use 16-#8 ($12.61 in^2$)



$M_{max} = 11.7 k/ft \times 4' \times (1.9' + \frac{4'}{2}) + 4.2 k/ft \times \frac{1}{2}(5.9')^2 \times \frac{1}{2}$

$+ 12.0 k/ft \times 1.9' \times 1.9'/2$

$= 277 k\cdot ft$

$A_{s req'd} = \frac{277 k\cdot ft \times 12 \times 1000}{24000 \times 0.9 \times 20} = 7.7 in^2$ ($A_{s min} = 11.2 in^2$)

↳ Use 16-#8

Check shear: $V = 4.53 ksf \left(\frac{14' + 10'}{2}\right) \times 1.67' = 91 kips$

$V_{allow} = 2\sqrt{f'_c}\, b\, d = 2\sqrt{3000} \times 14' \times 12" \times 1.67' \times 12" = 369 kips$

OK

AGBABIAN ASSOCIATES

SUBJECT Pacoima Dam Tram Project

AUTHOR K. Caravalho DATE 9/30/98 FILE NO. 9834

CHECKED BY Samy Gadbaw DATE 10/7/98 PAGE 7 OF 7

(Tower 2 Foundation, Cont.)

Design Steel for Pedestal:

$M_{max} = 1104.4$ k·ft (@ base)

$P_{max} = 257.3$ k (@ base)

$$\gamma = \frac{72 - (3+.5+1)\times 2}{72} = 0.88$$

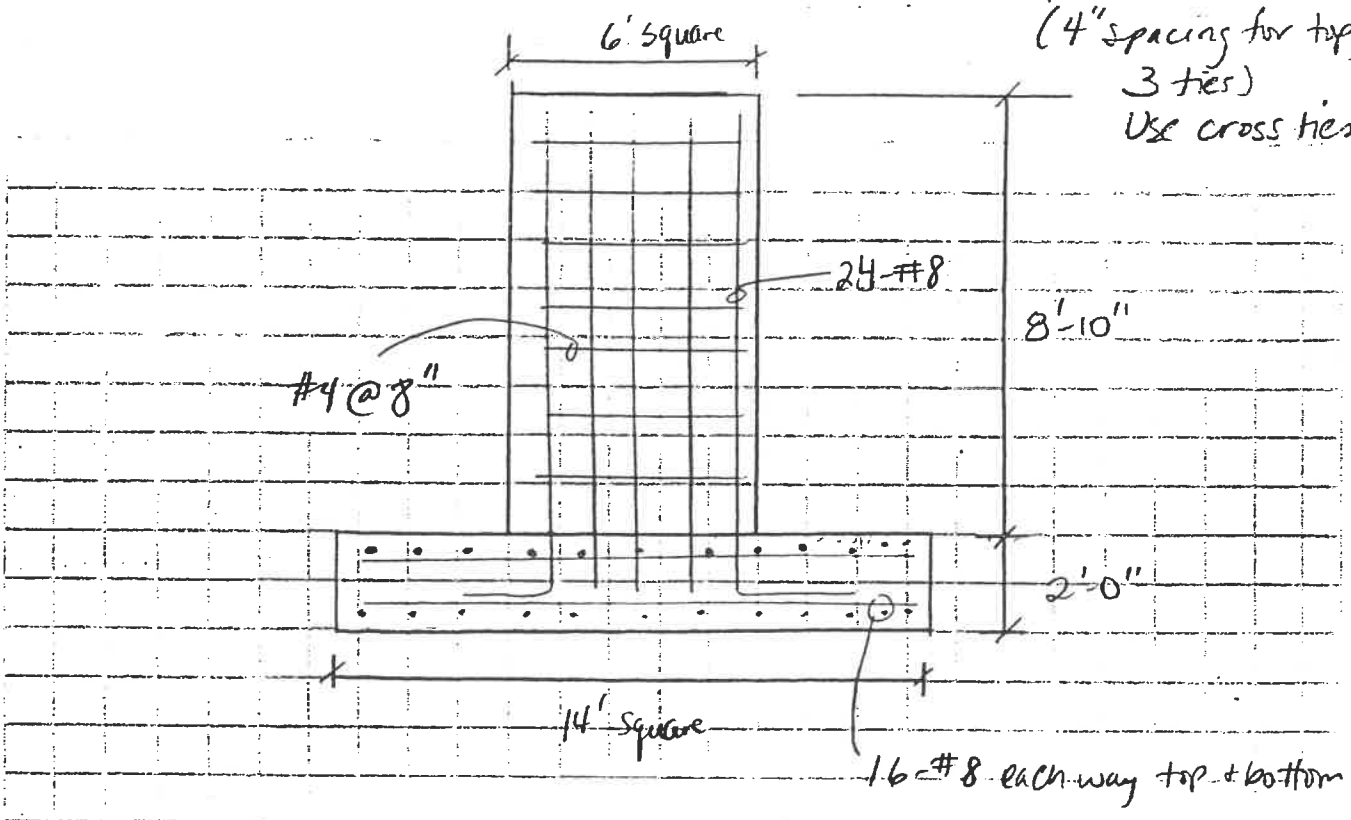
$$\frac{M_n}{A_g h} = \frac{1104.4 \times 12}{72 \times 72 \times 72} = 0.036 \text{ ksi}$$

$$\frac{P_n}{A_g} = \frac{257.3}{72" \times 72"} = 0.05 \text{ ksi}$$

Use $A_{s\,min} = \frac{200}{f_y} b_w d$ (ACI 318-95, Sect. 10.5.1)

$$A_{s\,min} = \frac{200}{f_y} b_w d = \frac{200}{60{,}000}(72")(67.5") = 16.2 \text{ in}^2$$

Use 24 - #8 bars ($A_s = 18.96 \text{ in}^2$) w/ #4 ties @ 8" (4" spacing for top 3 ties) Use cross ties



APPENDIX A

POMA TOWER CALCULATIONS SHOWING LOADS TRANSMITTED TO FOUNDATION

Pacoima Tram
Tower #2 #4075651
Steel Column Analysis

Applied moment along line due to cable tensions and equipment load is negligible. The moment along the line due to track rope friction = 14.7 kip ft.

Applied moment across the line due to wind = 130 kip ft.
Applied moment across the line due to haul, track cable reactions, cabin and machinery weights = 81.4 kip ft.

Axial load due to weights including cable reactions = 17.5 kip

Natural frequency of tower assembly = 4.0 hz
Earthquake accelerations are: fault normal = 2.65 g
fault parallel = 2.7 g
fault vertical = 1.7 g
Seismic dead load = 9.86 kip
Moment due to earthquake = 9.86(19)(2.7) = 505.8 kip ft.

Design moment across the line is therefore the moment due to the sum of the earthquake loads and the haul and track rope, cabin and machinery weights = 505.8 = 81.4 = 587.2 kip ft.

Therefore loads at the base of the tower are:
M along line = 14.7 kip ft.
M across line = 587.2 kip ft.
Axial load = 17.5 kip

Tower is 30"Ø x 3/8" wall pipe, see drawing #4075651
$I = 3829.4\ in^4$
$A = 34.90\ in^2$

By A.I.S.C. Manual of Steel Construction, Ninth Edition, Chapter H

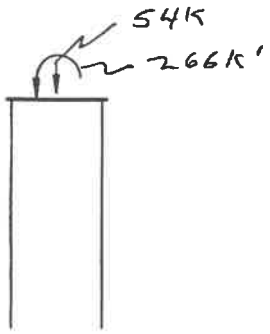
Fa = 18.25 ksi
fa = 17.5/34.9 = 0.50 ksi
fa/Fa = 0.5/18.25 = 0.03 < 0.15 therefore, H1-3

fbx = 587.2(12)(15)/3829.4 = 27.60 ksi
fby = 14.7(12)(15)/3829.4 = 0.69 ksi

$$0.03 + \frac{27.60}{1.33(23.1)} + \frac{0.69}{23.1} = 0.96 < 1.0$$ **OK**

Pacoima Tram
Return Tower Foundation #3114516

The return tower bears directly on the concrete of the left abutment of the Pacoima dam. This tower is founded using postensioned Williams anchor bolts.



Overturning along the line

ΣMOT = 266 kip ft.
ΣMRT = [138(5) + 54(18) + 138(31)] / 12 = 495 kip ft.
Safety factor = $\frac{495}{266}$ = 1.86 > 1.5 **OK**

Earthquake Overturning across the line

ΣMOT = 717.5 kip ft.
ΣMRT = [138(11) + 54 (36) + 138(61)] / 12 = 990 kip ft.
Safety Factor = $\frac{990}{717.5}$ = 1.38 > 1.0 **OK**

Slip

$\Sigma WT = 138(2) + 54 = 330 \quad \mu = 0.4 \quad \mu\Sigma WT = 132$ kip

Safety Factor $= \frac{132}{22} = 6.0 > 1.0$ **OK**

Bearing Pressure

$\Sigma Fy = -138(2) - 54 + PT\,(36)(x)(\frac{1}{2}) = 0$

$\Sigma MO = 8610 - 54(36) - 138(11) - 138(61) + PT(36)(\frac{1}{2})(x)(\frac{x}{3}) = 0$

$PT = 0.617$ ksi

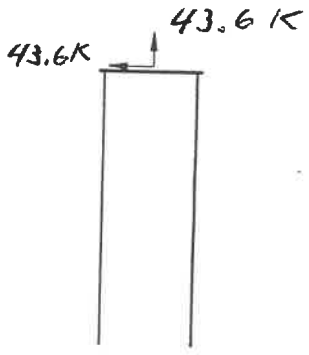
$x = 29.73$ in

$PTR\,(72)(18)(\frac{1}{2})(12) = 3192$ kip in

$PTR = 0.410$ ksi

P Total $= 0.617 + 0.410 = 1.03$ ksi $< 0.7\,(0.85)(3) = 1.785$ ksi **OK**

Return Clutch Anchor



Anchorage using 12 foot deep anchors
Weight of cone of engaged concrete

$$\frac{\pi(12^2)(12)}{3}(145) = 262386 \text{ lbs.}$$

$$\text{Safety Factor} = \frac{262386}{43600} = 6.0 > 2.0$$ **OK**

Shear on bolts

$$\frac{43.6}{5} = 8.72 \text{ kip/bolt} \quad \text{A bolt} = 1.115 \text{ in}^2$$

$$\text{Shear} = \frac{8.72}{1.115} = 7.82 \text{ ksi} < 0.17(124) = 21 \text{ ksi}$$ **OK**

Shear is resisted by friction of plate on concrete surface

$\Sigma WT = 5(69) = 345$ kip $\quad \mu = 0.4 \quad \mu\Sigma wt = 138$ kip

$$\text{Safety Factor} = \frac{138}{43.6} = 3.2 > 2.0$$ **OK**