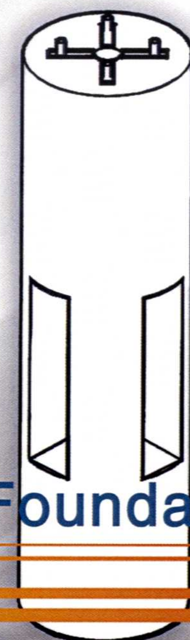

Universal Light Pole Foundation

FEATURES:

Adjustable Bolt Circle Diameter
Adjustable Bolt Diameter
Flexable Conduit Openings
Designed for Light Poles 40' High x 8" Diameter

Binghamton P&S Precast & Supply

A full service company providing products for all phases of construction.

Binghamton Precast and Supply Corp.

At Binghamton Precast & Supply, we strive to be a world class manufacturing company providing our customers with quality precast concrete. We offer competitive pricing and consistently deliver products that meet the requirements of our customers' construction time frame.

We are certified by the National Precast Concrete Association, an established industry benchmark for testing, inspection, and quality of precast concrete. We are proud to maintain our listing on the New York State DOT approved list, as well as in the Commonwealth of Pennsylvania DOT Bulletin 15.

Binghamton Precast & Supply Corp. has served contractors and the construction industry throughout New York State and northern Pennsylvania since 1978.

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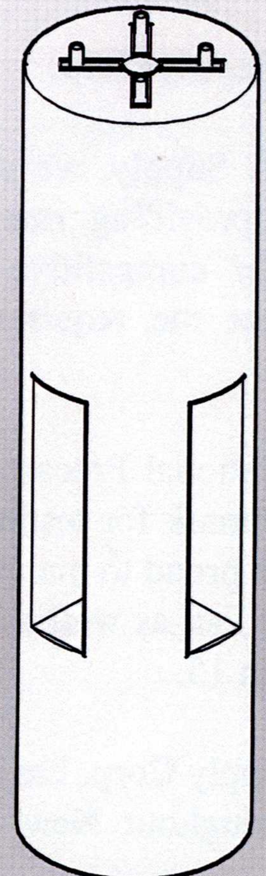
Binghamton P&S Precast & Supply

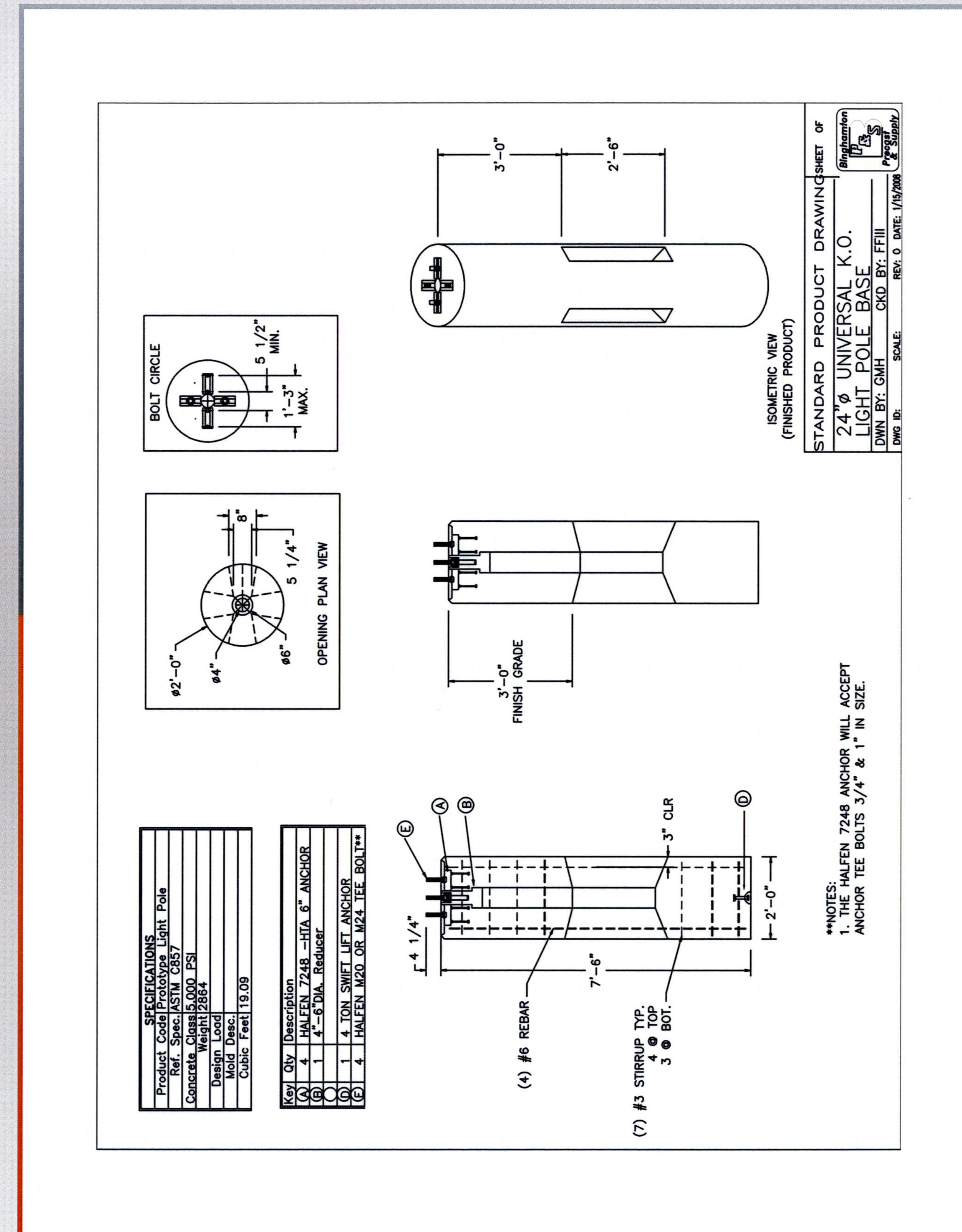
UNIVERSAL LIGHT POLE FOUNDATION



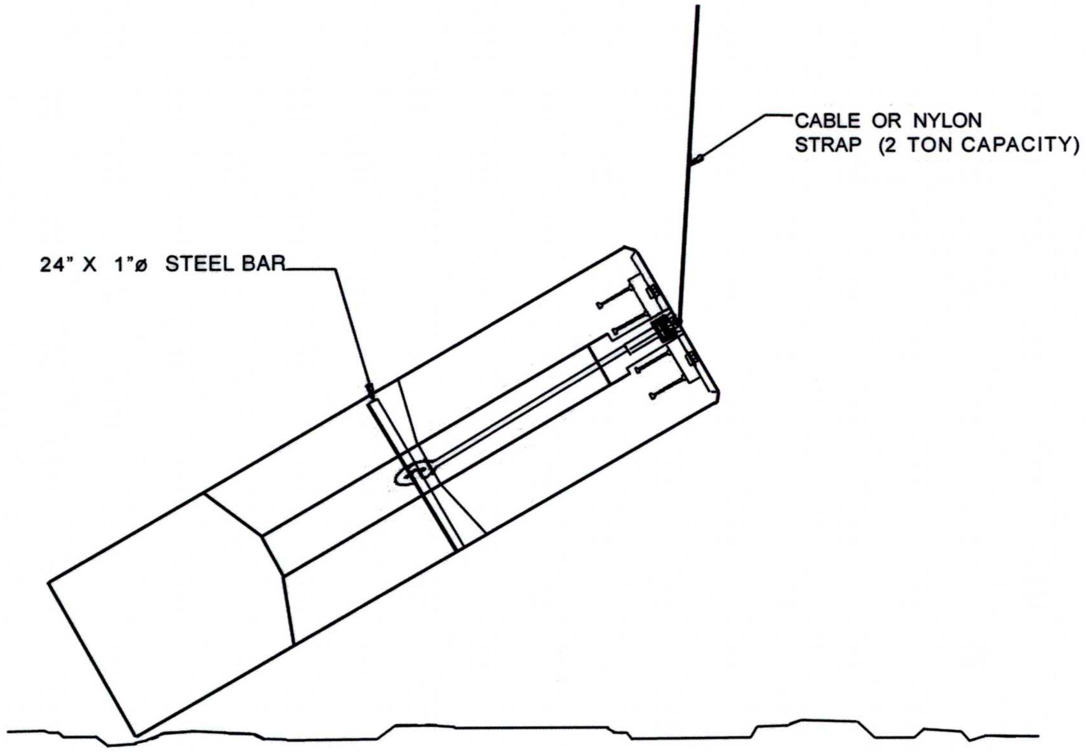
FEATURES:

- ADJUSTABLE BOLT CIRCLE DIAMETER
- ADJUSTABLE BOLT DIAMETER
- FLEXABLE CONDUIT OPENINGS
- DESIGNED FOR LIGHT POLES 40' HIGH X 8" DIAMETER

24" Ø X 7'-6"
LIGHT POLE FOUNDATION
Drawing Number 23-SLP24



UNIVERSAL LIGHT POLE FOUNDATION



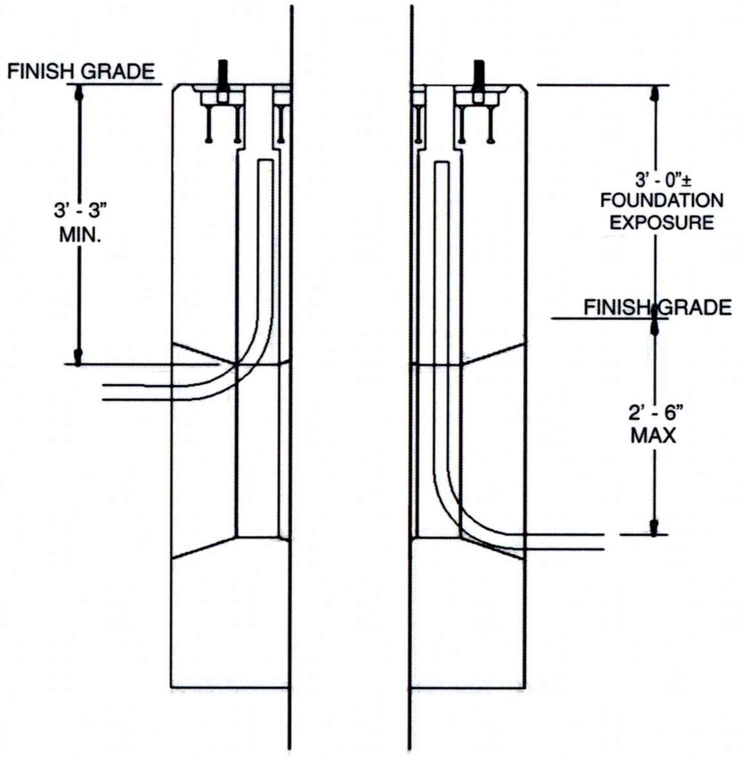
• LIFTING DETAIL FOR UNLOADING AND SETTING

24" ø X 7' - 6"
LIGHT POLE
FOUNDATION

Drawing Number 23-SLP24E

UNIVERSAL LIGHT POLE FOUNDATION

ABOVE GRADE EXPOSURE FLEXIBILTY

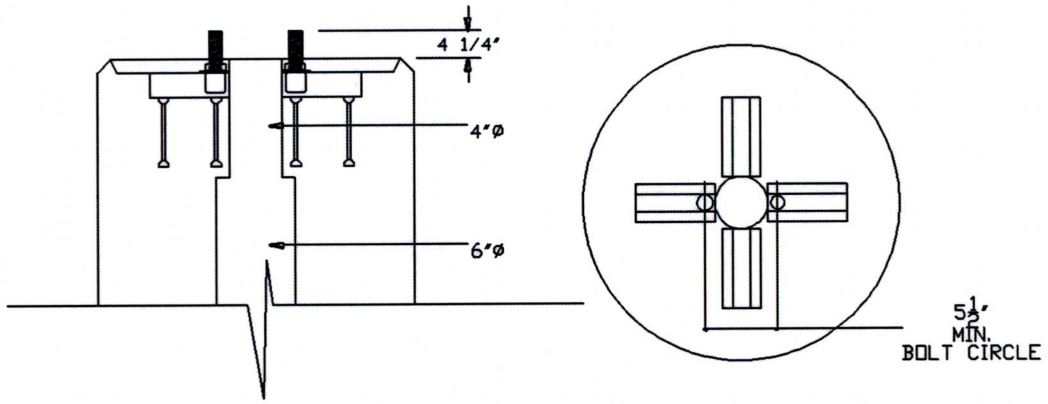


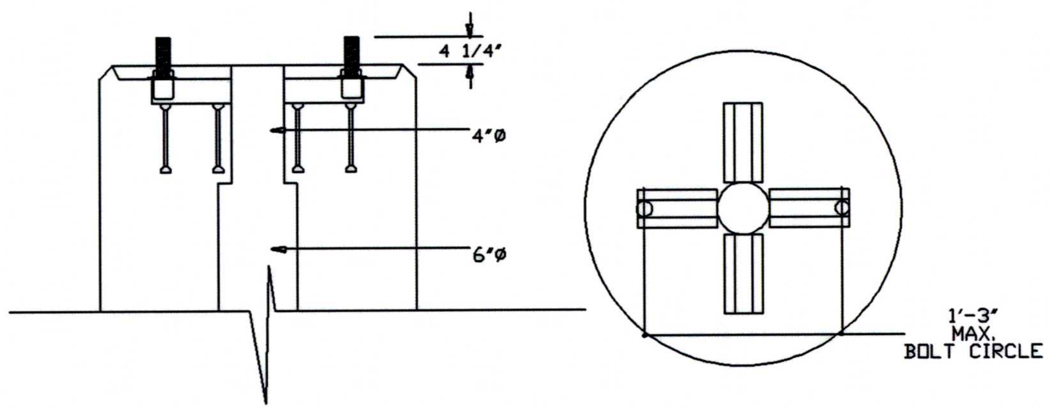
24" ø X 7' - 6"
LIGHT POLE
FOUNDATION

Drawing Number 23-SLP24B

UNIVERSAL LIGHT POLE FOUNDATION

BOLT CIRCLE FLEXIBILITY





24" ø X 7' - 6"
LIGHT POLE
FOUNDATION

Binghamton P&S Precast & Supply

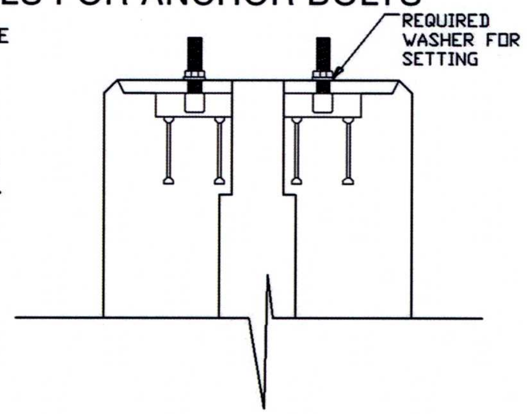
Drawing Number 23-SLP24

UNIVERSAL LIGHT POLE FOUNDATION

INSTALLATION DETAILS FOR ANCHOR BOLTS

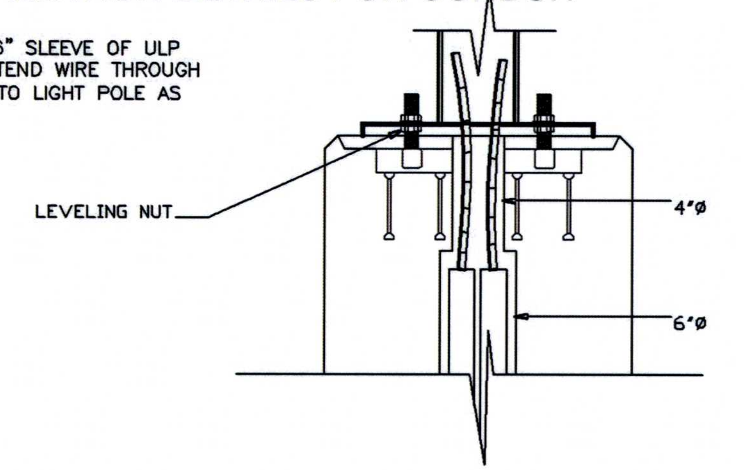
1) POSITION TEE BOLT TO PROPER BOLT CIRCLE THEN TIGHTEN NUT WITH WASHER FIRMLY TO ENGAGE BOTTOM OF TEE BOLT WITH HALFEN ANCHOR.

2) GROUT FILL RECESSED ANCHOR TO TOP OF CONCRETE FOUNDATION. ALLOW 24 HOURS FOR GROUT TO SET BEFORE INSTALLING LIGHT POLE.



INSTALLATION DETAILS FOR CONDUIT

BRING CONDUIT INTO 6" SLEEVE OF ULP FOUNDATION. THEN EXTEND WIRE THROUGH 4" SLEEVE AND UP INTO LIGHT POLE AS REQUIRED.



24" ø X 7' - 6"
LIGHT POLE
FOUNDATION

Binghamton P&S Precast & Supply

Drawing Number 23-SLP24

DESIGN COMPUTATIONS

A full service company providing products for all phases of construction.

DESIGN COMPUTATIONS FOR

Universal Utility Pole Foundation
24" Diameter x 7' - 6"

PREPARED FOR:

Binghamton Precast & Supply Corp
18 Phelps Street
Binghamton, NY 13901

PREPARED BY:

DELTA
ENGINEERS, ARCHITECTS, & LAND SURVEYORS

184 Court Street, Binghamton, New York 13901
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EMAIL: precast@deltaengineers.com
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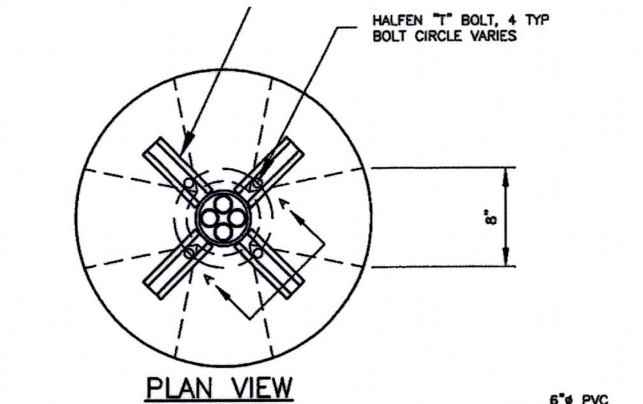
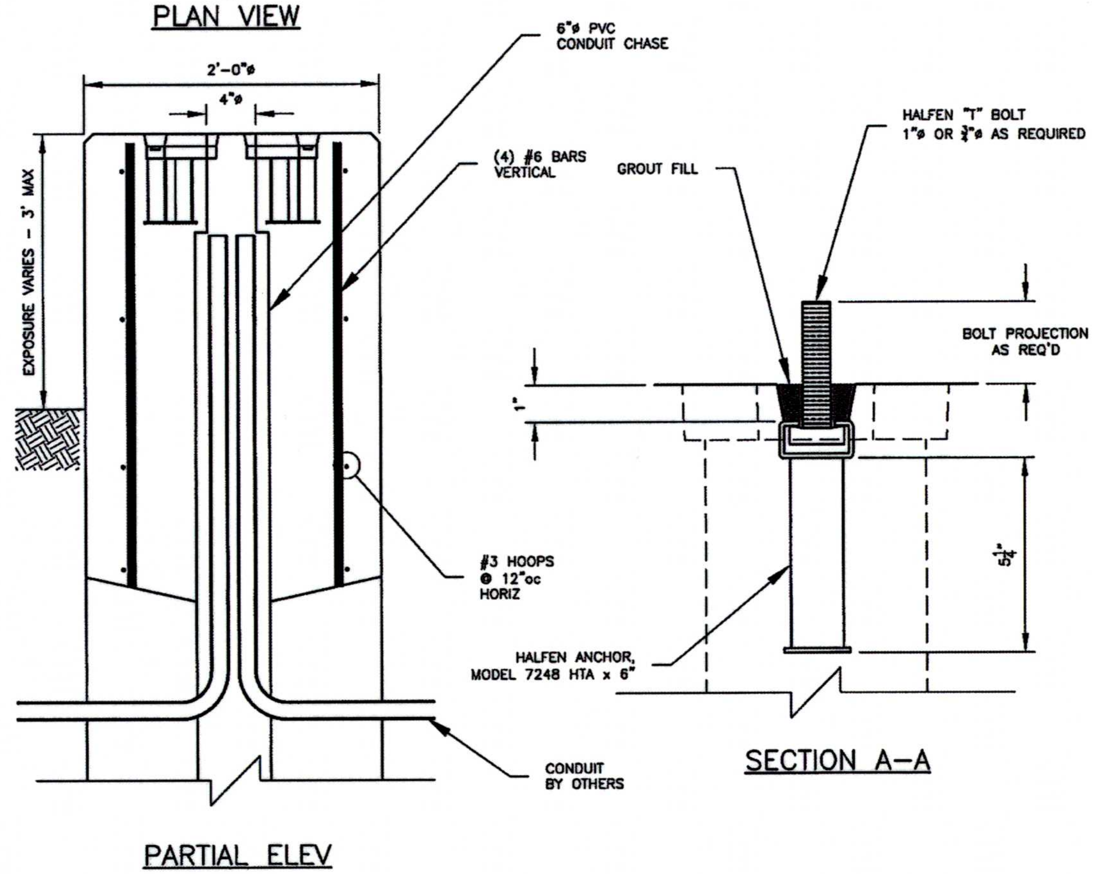
STATE OF NEW YORK
LICENSED PROFESSIONAL ENGINEER
12-3-07

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR, TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.



NOTES:
1. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINARIES, AND TRAFFIC SIGNALS.
2. MAXIMUM WIND LOAD FOR DESIGN = 90mph
3. ASSUMED SOIL FRICTION ANGLE = 32°
4. MAXIMUM APPLIED MOMENT = 13100ft–lbs
5. MAXIMUM APPLIED SHEAR = 535lbs
6. MINIMUM BURIAL DEPTH = 4.5'
7. SHAFT SHALL BE PROPERLY BACKFILLED WITH COMPACTED GRAVEL OR FLOWABLE FILL
8. CONCRETE STRENGTH = 5000psi MIN
9. REINFORCING STEEL – ASTM A615, GRADE 60
10. MATERIALS AND MANUFACTURING SHALL CONFORM TO ASTM C857



REV.NO.	DATE	REVISION

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PREPARED BY:
DELTA
ENGINEERS, ARCHITECTS, & LAND SURVEYORS
184 COURT STREET, BINGHAMTON, NY 13901
TEL: (607) 231-6600 FAX: (607) 231-6650

DATE: 11/25/09	SHEET TITLE: DESIGN SUMMARY	DRWN BY: RET
SCALE: N.T.S.		CKD BY: SLV
PROJECT: 24"ø X 7'-6" UNIVERSAL LIGHT POLE FOUNDATION		
CONTRACTOR:		DWG. I.D. RS-01
DELTA PROJ. NO.: 2009.003.029		SHT. NO. 2 OF 11

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JOB 2009.003.029 Binghamton Precast
DESCRIPTION Standard Pole Base Design
SHEET NO. 3 OF 11 SCALE
CALCULATED BY RET DATE 12/2/2009
CHECKED BY SLJ DATE 12/2/09

DESIGN UNIVERSAL POLE FOUNDATION

1 Provide stability analysis and reinforcing design for a 24" diameter x 7'6" deep shaft foundation

2 Design Assumptions

2.1 Design in accordance with AASHTO Standard Specification for Structural Supports for Highways Signs, Luminaires, and Traffic Signals

2.2 Maximum Wind Velocity for New York State is 90mph

2.3 Consider the following five (5) pole configurations to determine forces

2.3.1 4" Square x 16' High

2.3.2 6" Square x 20' High

2.3.3 6" Square x 25' High

2.3.4 6' Round x 30' High

2.3.5 8" Round x 40' High

2.4 Assume a total fixture contact area of 4.0sf located at the top of each pole

2.4.1 Drag coefficient, Cd, for fxtures is assumed to be 1.2. Effective Pressure Area (EPA) is equal to the contact area times Cd.

2.5 Check burial depth of shaft for 40' high x 8" round pole configuarion

2.5.1 As much as 3' of shaft may be exposed above grade

2.6 Soil Properties - Assumes proper backfill with granular or flowable fill

2.6.1 Internal Friction Angle, ϕ = 32°

2.6.2 Unit Weight of Soil, γ = 120pcf

2.7 Torsional forces are assumed to be negligible

3 Determine maximum tension force applied to a Halfen Anchor with with 1" or 3/4" T-Bolts

4 Pie shaped voids are placed in the center of the shaft for conduit access. Analyze the resulting concrete section between the voids as a 6" wide rectangular beam using the forces determined from the 40' pole configuration

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JOB 2009.003.029 Binghamton Precast
DESCPTION Standard Pole Base Design
SHEET NO. 4 OF 11 SCALE
CALCULATED BY RET DATE 12/2/2009
CHECKED BY SLV DATE 12/2/09

Compute Wind Load

REFERENCE:
AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition

Basic Wind Speed	V=	90 mph		
Velocity Conversion Factor (50yr)	Cv=	1		Table 3-4
	Cv * d * v=	30 < 78mph-ft?	Yes	
	Cd (Round) =	1.55	Is pole round? N (Y or N)	
	Corner Radius of Square Pole =	0.125 Rs =	0.031	
	Cd (Square) = 2- 6rs =	1.813		
Importance Factor (50 year)	Ir=	1		Table 3-2
Wind Drag Coefficient - Pole	Cd=	1.81		Table 3-6
Wind Drag Coefficient - Fixtures	Cd=	1.20 Flat Sides		Table 3-6
Height and Exposure Factor	Kz=	0.87		Table 3-5
Gust Factor	G=	1.14		Section 3.8.5
	$P=0.00256K_zGV^2I_rC_d=$	37.28 psf	Pole	EQ. 3.1
		24.68 psf	Fixtures	

Pole Width/Diameter	4 in			
Pole Height	16 ft			
Fixture Contact Area	4 ft^2	Note: If luminaire or fixture EPA is given, set Cd above to 1.0		
Fixture Eccentricity	0 ft			
Moment	3170 ft-lbs	=	3.17 kip-ft	
Shear	297.5 lbs	=	0.298 kips	
Torsion	0 ft-lbs	=	0 kip-ft	

Determine Anchor Bolt Tension

Number of Bolts 4

Bolt Circle Diameter (in)	6.5	8	9	10	11	12
Bolt Tension (lbs/bolt)	4138	3362	2989	2690	2445	2241

Halfen Anchor Capacity	10000 lbs	Model 7248 HTA x 6" Based on Proof-of-Load test 1/10/08		
T-Bolt Capacity	10450 lbs	1" Diameter	7250 lbs	3/4" Diameter
Minimum Bolt Circle	6.5 in		6.5 in	

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JOB 2009.003.029 Binghamton Precast
DESCPTION Standard Pole Base Design
SHEET NO. 5 OF 11 SCALE
CALCULATED BY RET DATE 12/2/2009
CHECKED BY SLV DATE 12/2/09

Compute Wind Load

REFERENCE:
AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition

Basic Wind Speed	V=	90 mph		
Velocity Conversion Factor (50yr)	Cv=	1		Table 3-4
	Cv * d * v=	45 < 78mph-ft?	Yes	
	Cd (Round) =	0.91	Is pole round? N (Y or N)	
	Corner Radius of Square Pole =	0.125 Rs =	0.021	
	Cd (Square) = 2- 6rs =	1.875		
Importance Factor (50 year)	Ir=	1		Table 3-2
Wind Drag Coefficient - Pole	Cd=	1.88		Table 3-6
Wind Drag Coefficient - Fixtures	Cd=	1.20 Flat Sides		Table 3-6
Height and Exposure Factor	Kz=	0.94		Table 3-5
Gust Factor	G=	1.14		Section 3.8.5
	$P=0.00256K_zGV^2I_rC_d=$	41.66 psf	Pole	EQ. 3.1
		26.66 psf	Fixtures	

Pole Width/Diameter	6 in			
Pole Height	20 ft			
Fixture Contact Area	4 ft^2	Note: If luminaire or fixture EPA is given, set Cd above to 1.0		
Fixture Eccentricity	0 ft			
Moment	6300 ft-lbs	=	6.3 kip-ft	
Shear	523.3 lbs	=	0.523 kips	
Torsion	0 ft-lbs	=	0 kip-ft	

Determine Anchor Bolt Tension

Number of Bolts 4

Bolt Circle Diameter (in)	6.5	7.5	9	10	11	12
Bolt Tension (lbs/bolt)	8224	7127	5939	5345	4859	4454

Halfen Anchor Capacity	10000 lbs	Model 7248 HTA x 6" Based on Proof-of-Load test 1/10/08		
T-Bolt Capacity	10450 lbs	1" Diameter	7250 lbs	3/4" Diameter
Minimum Bolt Circle	6.5 in		7.5 in	

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JOB 2009.003.029 Binghamton Precast
DESCIPTION Standard Pole Base Design
SHEET NO. 6 OF 11 SCALE
CALCULATED BY RET DATE 12/3/2009
CHECKED BY SLV DATE 12/3/09

Compute Wind Load

REFERENCE:
AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition

Basic Wind Speed	V=	90 mph	
Velocity Conversion Factor (50yr)	Cv=	1	Table 3-4
	Cv * d * v=	45 < 78mph-ft? Yes	
	Cd (Round) =	0.91	Is pole round? N (Y or N)
	Corner Radius of Square Pole =	0.125 Rs = 0.021	
	Cd (Square) = 2- 6rs =	1.875	
Importance Factor (50 year)	Ir=	1	Table 3-2
Wind Drag Coefficient - Pole	Cd=	1.88	Table 3-6
Wind Drag Coefficient - Fixtures	Cd=	1.20 Flat Sides	Table 3-6
Height and Exposure Factor	Kz=	1.00	Table 3-5
Gust Factor	G=	1.14	Section 3.8.5
	$P=0.00256K_zGV^2I_rC_d=$	44.32 psf Pole	EQ. 3.1
		28.37 psf Fixtures	

Pole Width/Diameter	6 in		
Pole Height	25 ft		
Fixture Contact Area	4 ft^2	Note: If luminaire or fixture EPA is given, set Cd above to 1.0	
Fixture Eccentricity	0 ft		
Moment	9762 ft-lbs	=	9.762 kip-ft
Shear	667.5 lbs	=	0.668 kips
Torsion	0 ft-lbs	=	0 kip-ft

Determine Anchor Bolt Tension

Number of Bolts 4

Bolt Circle Diameter (in)	7.5	8	9	10	11	12
Bolt Tension (lbs/bolt)	11045	10354	9204	8283	7530	6903

Halfen Anchor Capacity 10000 lbs Model 7248 HTA x 6" Based on Proof-of-Load test 1/10/08
T-Bolt Capacity 10450 lbs 1" Diameter 7250 lbs 3/4" Diameter
Minimum Bolt Circle 9 in 12 in

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JOB 2009.003.029 Binghamton Precast
DESCIPTION Standard Pole Base Design
SHEET NO. 7 OF 11 SCALE
CALCULATED BY RET DATE 12/2/2009
CHECKED BY SLV DATE 12/2/09

Compute Wind Load

REFERENCE:
AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition

Basic Wind Speed	V=	90 mph	
Velocity Conversion Factor (50yr)	Cv=	1	Table 3-4
	Cv * d * v=	45 < 78mph-ft? Yes	
	Cd (Round) =	0.91	Is pole round? Y (Y or N)
	Corner Radius of Square Pole =	0.125 Rs = 0.021	
	Cd (Square) = 2- 6rs =	1.875	
Importance Factor (50 year)	Ir=	1	Table 3-2
Wind Drag Coefficient - Pole	Cd=	0.91	Table 3-6
Wind Drag Coefficient - Fixtures	Cd=	1.20 Flat Sides	Table 3-6
Height and Exposure Factor	Kz=	1.00	Table 3-5
Gust Factor	G=	1.14	Section 3.8.5
	$P=0.00256K_zGV^2I_rC_d=$	21.63 psf Pole	EQ. 3.1
		28.37 psf Fixtures	

Pole Width/Diameter	6 in		
Pole Height	30 ft		
Fixture Contact Area	4 ft^2	Note: If luminaire or fixture EPA is given, set Cd above to 1.0	
Fixture Eccentricity	0 ft		
Moment	8271 ft-lbs	=	8.271 kip-ft
Shear	437.9 lbs	=	0.438 kips
Torsion	0 ft-lbs	=	0 kip-ft

Determine Anchor Bolt Tension

Number of Bolts 4

Bolt Circle Diameter (in)	7.5	8	9	10	11	12
Bolt Tension (lbs/bolt)	9357	8772	7798	7018	6380	5848

Halfen Anchor Capacity 10000 lbs Model 7248 HTA x 6" Based on Proof-of-Load test 1/10/08
T-Bolt Capacity 10450 lbs 1" Diameter 7250 lbs 3/4" Diameter
Minimum Bolt Circle 7.5 in 10.0 in

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JOB	2009.003.029 Binghamton Precast
DESCRIPTION	Standard Pole Base Design
SHEET NO.	10 OF 11 SCALE
CALCULATED BY	RET DATE 12/2/2009
CHECKED BY	SLJ DATE 12/3/09

Compute Wind Load

REFERENCE:
AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition

Basic Wind Speed	V=	90 mph	
Velocity Conversion Factor (50yr)	Cv=	1	Table 3-4
	Cv * d * v=	60 < 78mph-ft? Yes	
	Cd (Round) =	0.63	Is pole round? Y (Y or N)
Corner Radius of Square Pole =	0.125 Rs =	0.016	
	Cd (Square) = 2- 6rs =	1.906	
Importance Factor (50 year)	Ir=	1	Table 3-2
Wind Drag Coefficient - Pole	Cd=	0.63	Table 3-6
Wind Drag Coefficient - Fixtures	Cd=	1.20 Flat Sides	Table 3-6
Height and Exposure Factor	Kz=	1.05	Table 3-5
Gust Factor	G=	1.14	Section 3.8.5
	$P=0.00256K_zGV^2I_rC_d=$	15.62 psf Pole	EQ. 3.1
		29.79 psf Fixtures	

Pole Width/Diameter	8 in	
Pole Height	40 ft	
Fixture Contact Area	4 ft^2	Note: If luminaire or fixture EPA is given, set Cd above to 1.0
Fixture Eccentricity	0 ft	
Moment	13099 ft-lbs	= 13.1 kip-ft
Shear	535.8 lbs	= 0.536 kips
Torsion	0 ft-lbs	= 0 kip-ft

Determine Anchor Bolt Tension

Number of Bolts	4						
Bolt Circle Diameter (in)	7.5	8	9	10	11	12	
Bolt Tension (lbs/bolt)	14820	13893	12350	11115	10104	9262	
Halfen Anchor Capacity	10000 lbs	Model 7248 HTA x 6" Based on Proof-of-Load test 1/10/08					
T-Bolt Capacity	10450 lbs	1" Diameter	7250 lbs	3/4" Diameter			
Minimum Bolt Circle	12 in		N/A in				

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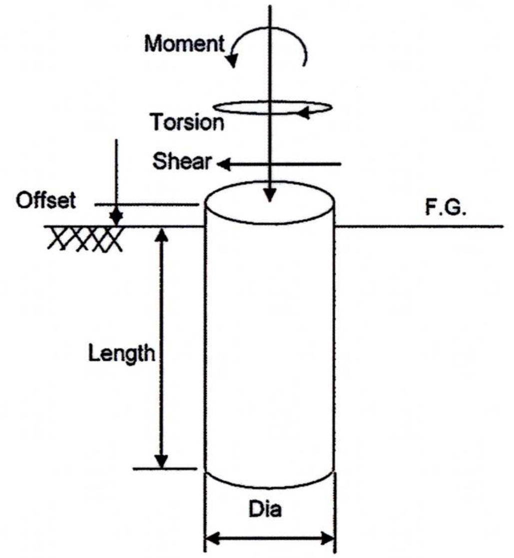
JOB	2009.003.029 Binghamton Precast
DESCRIPTION	Standard Pole Base Design
SHEET NO.	7 OF 11 SCALE
CALCULATED BY	RET DATE 12/2/2009
CHECKED BY	SLJ DATE 12/3/09

Design Shaft Foundation

Unit Wgt of Foundation Soil (γ Fou) =	0.12 pcf
Unit Wgt of Concrete (γ Con) =	0.15 pcf
Shaft Diameter (b) =	2.00 ft
Shaft Depth Below F.G. (Len) =	4.50 ft
Shaft Projection Above F.G. (off) =	3.00 in
Foundation Soil Int. Ang. of Fric. (ϕ) =	32 deg
Max Applied Moment (M_{max}) =	13.1 kip-ft
Max Applied Shear Force (V_{max}) =	0.54 kips
Axial Load (P) =	1.00 kips
Max Applied Torsion (T) =	0.00 kip-ft
Safety Factor for Overturning (S.F.) =	2.0
Safety Factor for Torsion ($S.F._{TOR}$) =	1.0
Ko =	0.5
Kp = $\tan(45 + \phi/2)^2$ =	3.25



Pole Base Elevation View

Minimum Shaft Length Required to Resist Overturning:

$$\frac{2(S.F.)(V_{MAX})(Tot.\ Len\ Req'd)}{Kp\,\gamma\, b} + \frac{2(S.F.)(M_{MAX})}{Kp\,\gamma\, b} \leq Tot\ Len\ Req'd^3$$

$$12.35 + 67.08 = 79.43 \leq 91.13 \text{ OK}$$

Torsion Check

Side Resistance

$Ts = (Ko \cdot \gamma Fou \cdot 0.5 \cdot Len^2) \cdot \pi \cdot b \cdot 0.75\tan\phi \cdot 0.5b =$ 1.79 kip-ft

Base Resistance

$Tb = (P + [((\pi \cdot b^2) / 4) \cdot Len \cdot \gamma Con]) \cdot .75 \tan\phi \cdot 0.33b =$ 0.94 kip-ft

Safety Factor = (Ts + Tb) / T = NA

Compute Ultimate Moment

H = M/V = 24.45

$Mu = V \cdot (H + 0.54 \cdot \sqrt{(V / (\gamma \cdot b \cdot Kp))}) =$ 13.34 kip-ft

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JOB	2009.003.029 Binghamton Precast		
DESCPTION	Standard Pole Base Design		
SHEET NO.	10 OF 11	SCALE	
CALCULATED BY	RET	DATE	12/2/2009
CHECKED BY	SLJ	DATE	12/2/09

Design Shaft Reinforcing

MATERIAL PROPERTIES:

1 Concrete Strength, F'c 5000 psi
2 Reinforcing Steel Yield, Fy 60 ksi
3 Concrete Unit Weight 150 pcf
4 Soil Unit Weight 120 pcf

Shaft Diameter, b= 24.00 in
Bar Cover = 3.00 in
Bar Size = 5
Stirrup Size = 3
γh=Ts-2*(Cov+Str+Bar Size/2) = 16.63 in
Ag = 452.4 in^2
Ig = 16286 in^4

$E_c = 57000 \bullet \sqrt{f'c} =$ 4031 ksi
$E_s =$ 29000 ksi
$n = E_s / E_c =$ 7.20
$0.65 < \beta_1 < 0.85 =$ 0.80

$\rho_b = \frac{0.85\beta_1 \bullet f'c}{f_y} \bullet \left[\frac{87{,}000}{87{,}000 + f_y}\right] =$ 0.0335

$f_r = 7.5\sqrt{f'c} =$ 530 psi
Mcr = fr * Ig/y =* Ig/y = 59.98 kip-ft

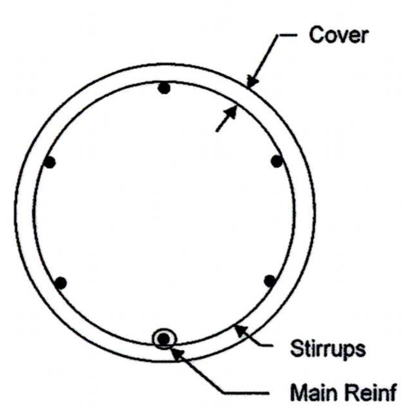
Design Ultimate Moment, Mu = 13.34 kip-ft
Capacity Reduction Factor, ΦM = 0.9

$\rho = \left[1 - \left(\sqrt{1 - \frac{2 \bullet M_u}{\phi Ag \bullet \gamma h \bullet .85f'c}}\right)\right] \bullet \frac{.85f'c}{f_y} =$ 0.00040 < .75pb - OK

Steel Area Req'd; As =ρ * Ag = 0.179 in^2/ft
Main Reinforcing - Use 4 #6 Bars
As Prov = 1.77 in^2
ρ Prov = 0.00391

Add #3 hoops for stirrups @ 12"oc

Shear is OK by inspection



PLAN VIEW

DELTA
ENGINEERS, ARCHITECTS, & LAND SURVEYORS
184 Court Street
BINGHAMTON, NEW YORK 13901
(607) 231-6600 Fax 231-6650

JOB	2009.003.029 Binghamton Precast		
DESCPTION	Standard Pole Base Design		
SHEET NO.	11 OF 11	SCALE	
CALCULATED BY	RET	DATE	12/2/2009
CHECKED BY	SLJ	DATE	12/2/09

Design knockout area of shaft as a 6" wide beam

Member Design Width b = 6.00 in
Member Thickness Ts = 24.00 in
Bar Cover = 3.50 in
Bar Size = 5
d=Ts-Cov-Bar Size/2 = 20.19 in

MATERIAL PROPERTIES:

1 Concrete Strength, F'c 5000 psi
2 Reinforcing Steel Yield, Fy 60 ksi
3 Concrete Unit Weight 150 pcf
4 Soil Unit Weight 120 pcf

$E_c = 57000 \bullet \sqrt{f'c} =$ 4031 ksi
$E_s =$ 29000 ksi
$n = E_s / E_c =$ 7.20
$0.65 < \beta_1 < 0.85 =$ 0.80

$\rho_b = \frac{0.85\beta_1 \bullet f'c}{f_y} \bullet \left[\frac{87{,}000}{87{,}000 + f_y}\right] =$ 0.0335

$f_r = 7.5\sqrt{f'c} =$ 530 psi
Zmax= 130 kips/in
Mcr = 25.46 kip-ft

Design Ultimate Moment, Mu = 15.7 kip-ft
Unfactored Moment, Ma = 12.1 kip-ft
Ultimate Shear, Vu = 0.67 kips

Capacity Reduction Factors
Moment, ΦM = 0.9
Shear, ΦS = 0.85

$\phi Vc = \phi 2\sqrt{f'c} \bullet b \bullet d =$ 14.56 kips/ft > Vu OK

$\rho = \left[1 - \left(\sqrt{1 - \frac{2 \bullet M_u}{\phi b d^2 \bullet .85f'c}}\right)\right] \bullet \frac{.85f'c}{f_y} =$ 0.00144 < .75pb - OK

Steel Area Req'd; As =ρ * b * d = 0.175 in^2/ft
Use 1 #6 Bar
As Prov = 0.44 in^2 ρ Prov = 0.004

HALFEN DETAILS

Binghamton P&S Precast & Supply

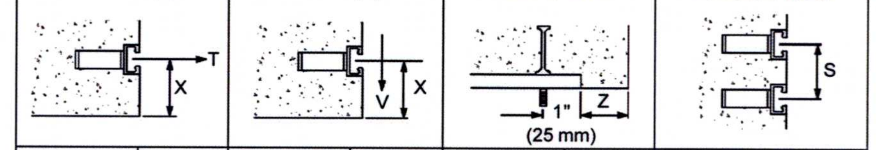
A full service company providing products for all phases of construction.

ANCHOR CHANNELS

HALFEN 7248 HTA

SERIES ANCHOR CHANNELS

LOAD FACTORS



EDGE DISTANCE				END DISTANCE		SPACING	
Pull-Out (T)		Shear (V)		Pull-Out & Shear		Pull-Out & Shear	
Dimension X in. (mm)	Factor	Dimension X in. (mm)	Factor	Dimension Z in. (mm)	Factor	Dimension S in. (mm)	Factor
> 6-1/2(165)	1.00	> 9 (229)	1.00	> 5-1/2(140)	1.00	> 14 (356)	1.00
6 (152)	0.97	7-3/4(197)	0.77	4-3/4(121)	0.90	12 (305)	0.97
5-1/2(140)	0.95	6-1/2(165)	0.57	4 (102)	0.81	10 (254)	0.92
4-3/4(121)	0.90	5-1/4(133)	0.38	3-1/2 (89)	0.76	9 (229)	0.87
4 (102)	0.82	4 (102)	0.23	3 (76)	0.71	8 (203)	0.82

Notes on Anchor Channels:

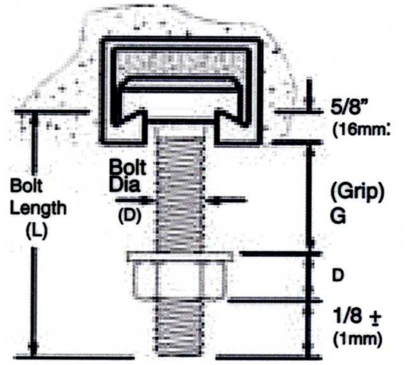
1. All loads are controlled by concrete strength. Stated loads are for unreinforced normal weight 3,000 psi (20.7 MPa) concrete. These loads may be increased for higher strength concrete up to maximum of 5,000 psi (34.5 MPa) using the factor $\sqrt{\frac{\text{Project f'c}}{\text{f'c} = 3{,}000}}$
2. Loads should not be positioned within 1" (25mm) of the end of the anchor channel. Allowable loads are applicable to all other possible load positions along the length of the anchor channel.
3. Check interaction using $\left(\frac{T\ actual}{T_A}\right)^{5/3} + \left(\frac{V\ actual}{V_A}\right)^{5/3} \leq 1.0$

TEE-BOLT SELECTION CHART

Tee-Bolt Diameter (D) mm (in.)	M20 (3/4)	M20 (3/4)	M24 (1)	M24 (1)	M27 (1-1/8)	M30 (1-1/4)
Strength Grade	4.6 Standard	8.8 Structural	4.6 Standard	8.8 Structural	4.6 Standard	4.6 Standard
Nut Torque ft. lb. (N.m)	89 (120)	295 (400)	147 (200)	500 (680)	220 (300)	295 (400)
Allowable Tension Load (T_B) lb. (kN)	7,250 (32.3)	15,050 (67.0)	10,450 (46.5)	21,700 (96.6)	13,600 (60.5)	16,600 (73.9)
Allowable Shear Load (V_B) lb. (kN)	4,850 (21.6)	10,050 (44.4)	6,950 (30.9)	14,450 (64.3)	9,100 (40.5)	11,100 (49.4)
Allowable Slip Load (V_S) lb. (kN)	740 (3.3)	2,350 (10.5)	970 (4.3)	2,850 (12.7)	1,400 (6.2)	1,850 (8.2)
Length (L) mm (in.)	Tee-bolt and Nut Part No.					
50 (2)	S	BH7622	BH7712	x	x	x
75 (3)	BM7612	x	BM7712	BM7722	S	BM7912
100 (4)	BP7612	x	BP7712	x	S	BP7912
150 (6)	S	x	S	x	x	S
200 (8)	S	x	S	x	x	S

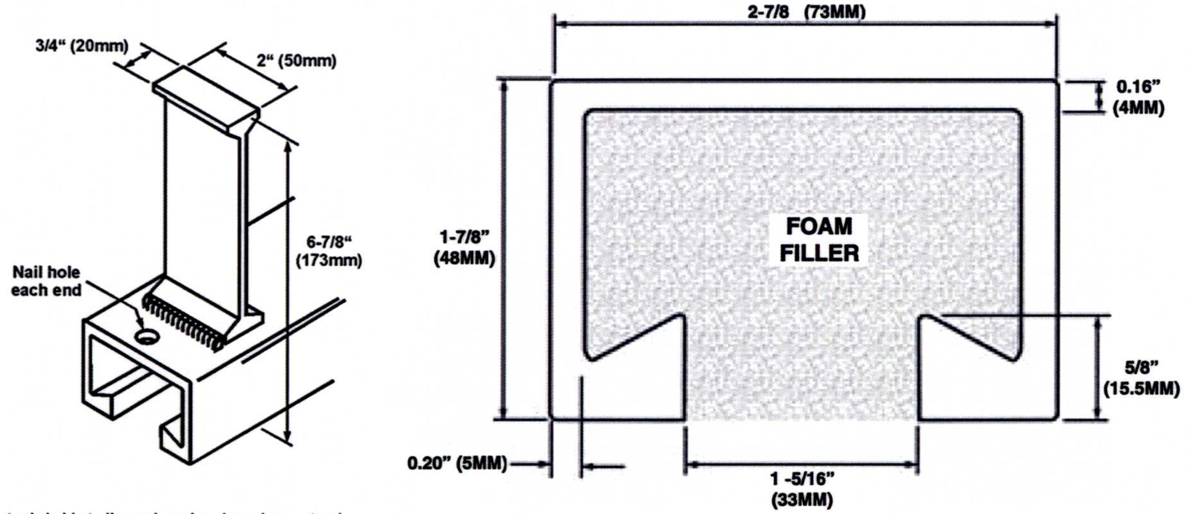
Notes on Tee-bolts:

1. Tee-bolt part numbers ending in 2 are hot dipped galvanized.
2. S indicates special orders, X indicates not available.
3. For stainless steel tee-bolts, see page 51.
4. Bolt capacity may be limited by anchor channel capacity.
5. Check combined loads using $\left(\frac{T\ actual}{T_B}\right)^{2} + \left(\frac{V\ actual}{V_B}\right)^{2} \leq 1.0$
6. To determine minimum bolt length (L), add grip (G) plus bolt diameter (D) plus 3/4" (19mm). Select next larger length from the tee-bolt selection chart.



ANCHOR CHANNELS

HALFEN 7248 HTA SERIES ANCHOR CHANNELS



Material: Hot dip galvanized carbon steel.

LOAD CONFIGURATION		PART NUMBER	CHANNEL LENGTH in. (mm)	MIN. DISTANCE BETWEEN LOAD POINTS in. (mm)	ALLOWABLE LOADS PULL-OUT (T_A) lb. (kN)	SHEAR (V_A) lb. (kN)
Short Anchor Channel, Two I-Anchors, Point Load		HT7506	6 (152)	- -	8,000 (35.6)	7,700 (34.3)
		HT7508	8 (203)	- -	8,000 (35.6)	7,700 (34.3)
		HT7110	10 (254)	- -	8,000 (35.6)	7,700 (34.3)
		HT7112	12 (305)	- -	8,000 (35.6)	7,700 (34.3)
Short Anchor Channel, Two I-Anchors, Load Pair		HT7508	8 (203)	3 (76)	9,800 (43.6)	7,700 (34.3)
		HT7110	10 (254)	3 (76)	9,800 (43.6)	10,000 (44.5)
		HT7112	12 (305)	3 (76)	11,200 (49.8)	10,000 (44.5)
Short Anchor Channel, Three I-Anchors, Load Pair		HT7516	16 (406)	5 (127)	12,000 (53.4)	11,000 (49.0)
		HT7518	18 (457)	6 (152)	15,400 (68.5)	12,000 (53.4)
		HT7124	24 (610)	8 (203)	15,400 (68.5)	12,000 (53.4)
Continuous Lengths to 19'-11" (6070mm), I-Anchors at 10" (254mm) Centers	Point Loads	HT7100	19'-11" (6070)	10 (254)	8,000 (35.6)	a) 7,700 (34.3)
	Equivalent Uniform Load				9,600 lb/ft (140.1 kN/m)	a) 9,300 lb/ft (135.8 kN/m)
Corner Anchor 90 Degrees, Three I-Anchors		HT7112 x 12B	12 (305) (Each Leg)	3 (76)	8,000 lb/bolt (35.6 kN/bolt) 11,200 lb/leg (49.8 kN/leg)	7,700 lb/bolt (34.3 kN/bolt) 10,000 lb/leg (45.5 kN/leg)

a) For determing the shear capacity of continuos lengths, use the edge distance factor for an equivalent edge distance of 0.60 times the actual edge distance.

PULL OUT TEST RESULTS

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184 Court Street , Binghamton, NY 13901-3515
Tel: 607-231-6600 Fax: 607-231-6650 www.deltaengineers.com

February 21, 2008

Mr. Jay Abbey
Binghamton Precast & Supply Corp
Phelps St.
Binghamton, NY 13901

RE: **Light Pole Base Anchor Bolt Test**
Delta Project No. 2008.003.006

Dear Mr. Abbey:

We are pleased to provide this report of the Halfen Anchor Pull-Out Test conducted at your facility on January 10, 2008:

1.0 Purpose

The purpose of this test was to verify the pull-out capacity of the Halfen Anchoring System for use with a precast light pole foundation.

2.0 Executive Summary

2.1 Four anchors (Halfen #7248 HTA) were cast into a modified 24" diameter precast concrete pole base as shown in Figure #1. The slotted anchors are placed around a 4" PVC conduit in the center of the base to allow for variations in bolt circle patterns. Anchors are also recessed 1" from the surface to allow for grouting after the lighting pole is installed on the base. The modified pole base was cast with 5000psi concrete.

2.2 Assuming a minimum anchor bolt pattern of 7", the edge distance from the center of the bolt to the PCV conduit is approximately 1¼"; which is less than recommended by the manufacturer. Therefore, it was deemed appropriate to conduct a physical test for this application in order to verify that the anchor will safely withstand anticipated service loads.

2.3 Based on our report entitled "Light Pole Base Study" dated 12/28/06, the anticipated anchor bolt tension load from a 40' tall light pole mounted to a pole base with a 12" bolt circle is approximately 7600lbs per bolt. Assuming a load factor for wind of 1.3 (Ref. AASHTO), a safe working load of 9880lbs or, say 10,000lbs would be considered adequate for most applications.

2.4 The test was conducted by Atlantic Testing, who provided attached calibration chart which compares the pressure gauge reading in PSI to the actual force in lbs. A hydraulic ram was connected to a 1" diameter threaded rod that was attached to the Halfen anchor and secured to a reaction frame as shown in Figure #2.

We are a seamless extension of our clients' organizations.

Light Pole Base Anchor Test Delta Project No. 2008.003.006

2.5 Force was applied to the test specimen in 500psi increments, or approximately 2300lbs each. A minor crack appeared around the anchor at 4000psi (18,400lbs) or nearly twice the maximum anticipated service load, at which time the test was discontinued.

2.6 The pull-out test clearly demonstrated that the Halfen 7248 HTA Anchor installed per the attached details will safely withstand the anticipated ultimate tensile load of 10,000lbs.

We appreciate the opportunity to assist you with this test report. Please contact me at 607-231-6612 or rthornton@deltaengineers.com if you have any questions or comments.

Respectfully,

DELTA ENGINEERS

STATE OF NEW YORK
RONALD E. THORNTON
077898
LICENSED PROFESSIONAL ENGINEER

2-21-08

Ronald Thornton, PE
Project Manager

Attachments:
1. Figures 1 – 8: Test Photos
2. Halfen Technical Manual Pages 32 – 33
3. Gauge Calibration

Binghamton P&S Precast & Supply

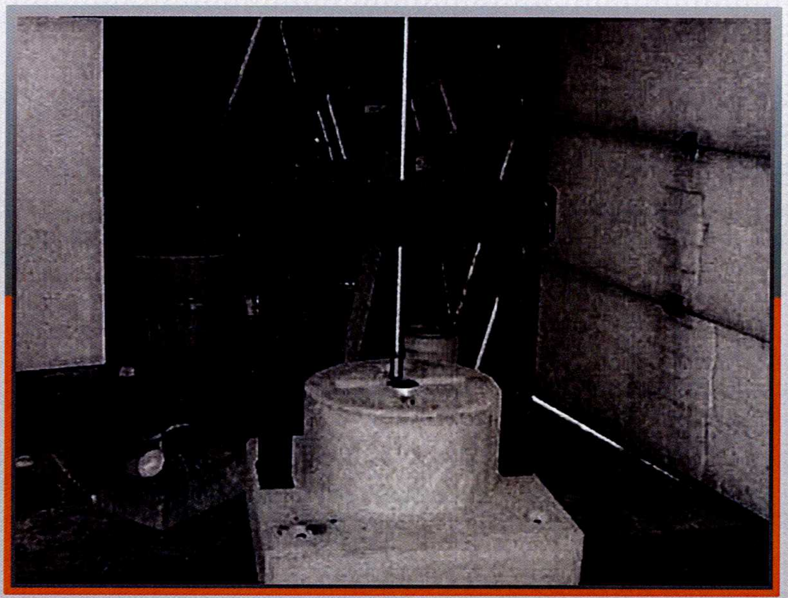

Figure 1 - Modified Light pole Base with Reaction Frame

Figure 2 - Diameter Threaded Rod Secured to Anchor

Light Pole Base Anchor Test
Delta Project No. 2008.003.006

Figure 3 - 7" Diameter Circle

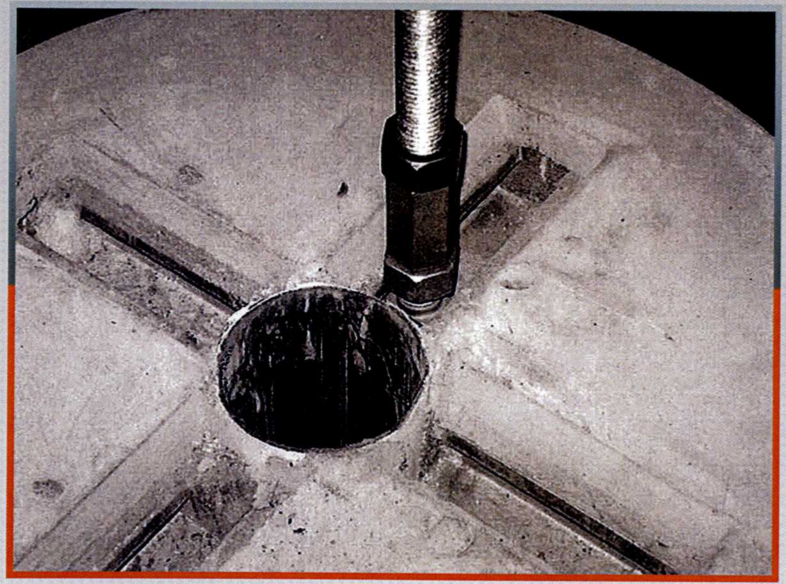

Figure 4 - Close-up

Figure 5 - Edge Distance

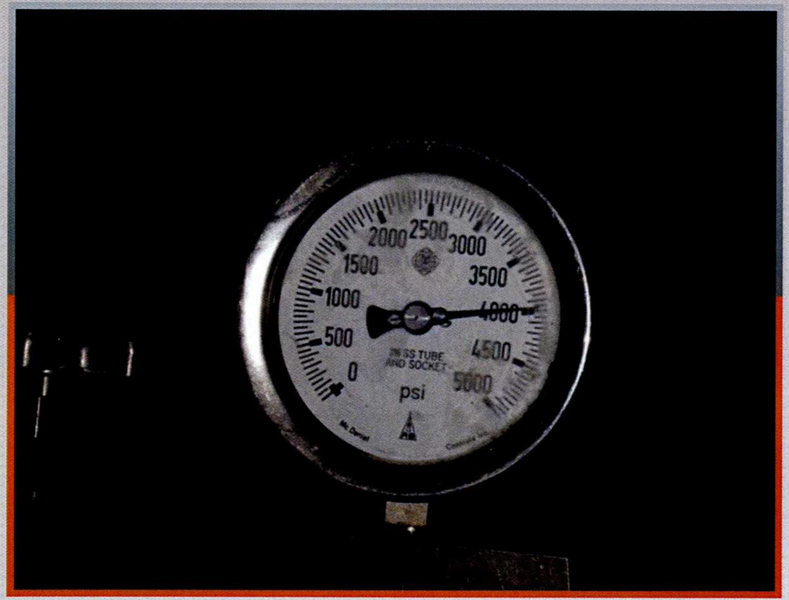

Figure 6 - Gauge Reading at Termination

Light Pole Base Anchor Test
Delta Project No. 2008.003.006

Figure 7 - Showing Crack at Termination.

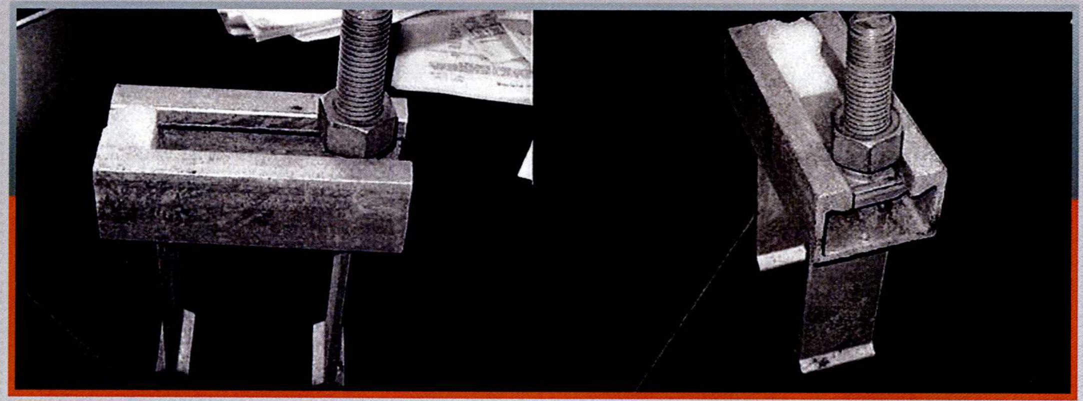

Figure 8 - Halfen Model 7248 HTA as Tested.

HALFEN ANCHORING SYSTEMS

Halfen Technical Manual

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- HALFEN Technical Manual
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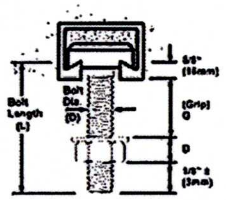
HALFEN 7248 HTA SERIES ANCHOR CHANNELS

LOAD FACTORS							
EDGE DISTANCE				END DISTANCE		SPACING	
Pull-Out (T)		Shear (V)		Pull-Out & Shear 1" (25 mm)		Pull-Out & Shear	
Dimension X in. (mm)	Factor	Dimension X in. (mm)	Factor	Dimension Z in. (mm)	Factor	Dimension S in. (mm)	Factor
≥ 6-1/2 (165)	1.00	≥ 9 (229)	1.00	≥ 5-1/2 (140)	1.00	≥ 14 (356)	1.00
6 (152)	0.97	7-3/4 (197)	0.77	4-3/4 (121)	0.90	12 (305)	0.97
5-1/2 (140)	0.95	6-1/2 (165)	0.57	4 (102)	0.81	10 (254)	0.92
4-3/4 (121)	0.90	5-1/4 (133)	0.38	3-1/2 (89)	0.76	9 (229)	0.87
4 (102)	0.82	4 (102)	0.23	3 (76)	0.71	8 (203)	0.82

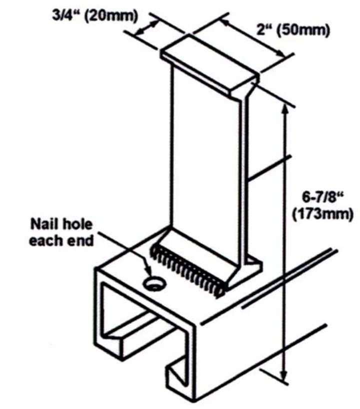
Notes on Anchor Channels:
1. All loads are controlled by concrete strength. Stated loads are for unreinforced normal weight 3,000 psi (20.7 MPa) concrete. These loads may be increased for higher strength concrete up to maximum of 5,000 psi (34.5 MPa) using the factor $\sqrt{\frac{\text{Project } f'c}{f'c = 3000}}$
2. Loads should not be positioned within 1" (25mm) of the end of the anchor channel. Allowable loads are applicable to all other possible load positions along the length of the anchor channel.
3. Check interaction using $\left(\frac{T_{actual}}{T_A}\right)^{5/3} + \left(\frac{V_{actual}}{V_A}\right)^{5/3} \leq 1.0$

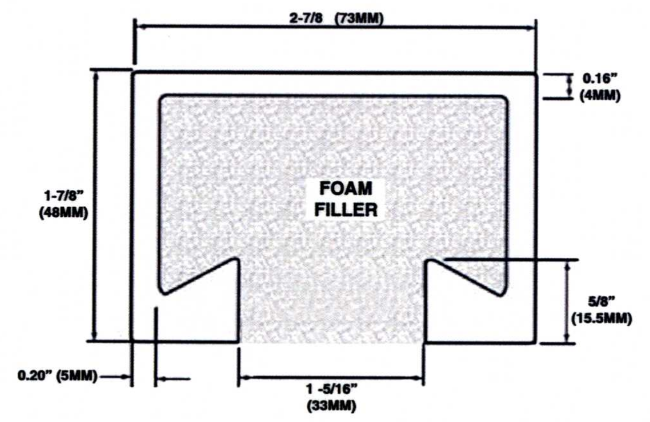
TEE-BOLT SELECTION CHART						
Tee-Bolt Diameter (D) mm (in.)	M20 (3/4)	M20 (3/4)	M24 (1)	M24 (1)	M27 (1-1/8)	M30 (1-1/4)
Strength Grade	4.6 Standard	8.8 Structural	4.6 Standard	8.8 Structural	4.6 Standard	4.6 Standard
Nut Torque ft. lb. (N m)	89 (120)	295 (400)	147 (200)	500 (680)	220 (300)	295 (400)
Allowable Tension Load (T_B) lb. (kN)	7,250 (32.3)	15,050 (67.0)	10,450 (46.5)	21,700 (96.6)	13,600 (60.5)	16,600 (73.9)
Allowable Shear Load (V_B) lb. (kN)	4,850 (21.6)	10,050 (44.4)	6,950 (30.9)	14,450 (64.3)	9,100 (40.5)	11,100 (49.4)
Allowable Slip Load (V_f) lb. (kN)	740 (3.3)	2,350 (10.5)	970 (4.3)	2,850 (12.7)	1,400 (6.2)	1,850 (8.2)
Length (L) mm (in.)	Tee-bolt and Nut Part No.					
50 (2)	S	BH7622	BH7712	x	x	x
75 (3)	BM7612	x	BM7712	BM7722	S	BM7912
100 (4)	BP7612	x	BP7712	x	S	BP7912
150 (6)	S	x	S	x	x	S
200 (8)	S	x	S	x	x	S

Notes on Tee-bolts:
1. Tee-bolt part numbers ending in 2 are hot dipped galvanized.
2. S indicates special orders, X indicates not available.
3. For stainless steel tee-bolts, see page 51.
4. Bolt capacity may be limited by anchor channel capacity.
5. Check combined loads using $\left(\frac{T_{actual}}{T_B}\right)^2 + \left(\frac{V_{actual}}{V_B}\right)^2 \leq 1.0$
6. To determine minimum bolt length (L), add grip (G) plus bolt diameter (D) plus 3/4" (19mm). Select next larger length from the tee-bolt selection chart.



HALFEN 7248 HTA SERIES ANCHOR CHANNELS

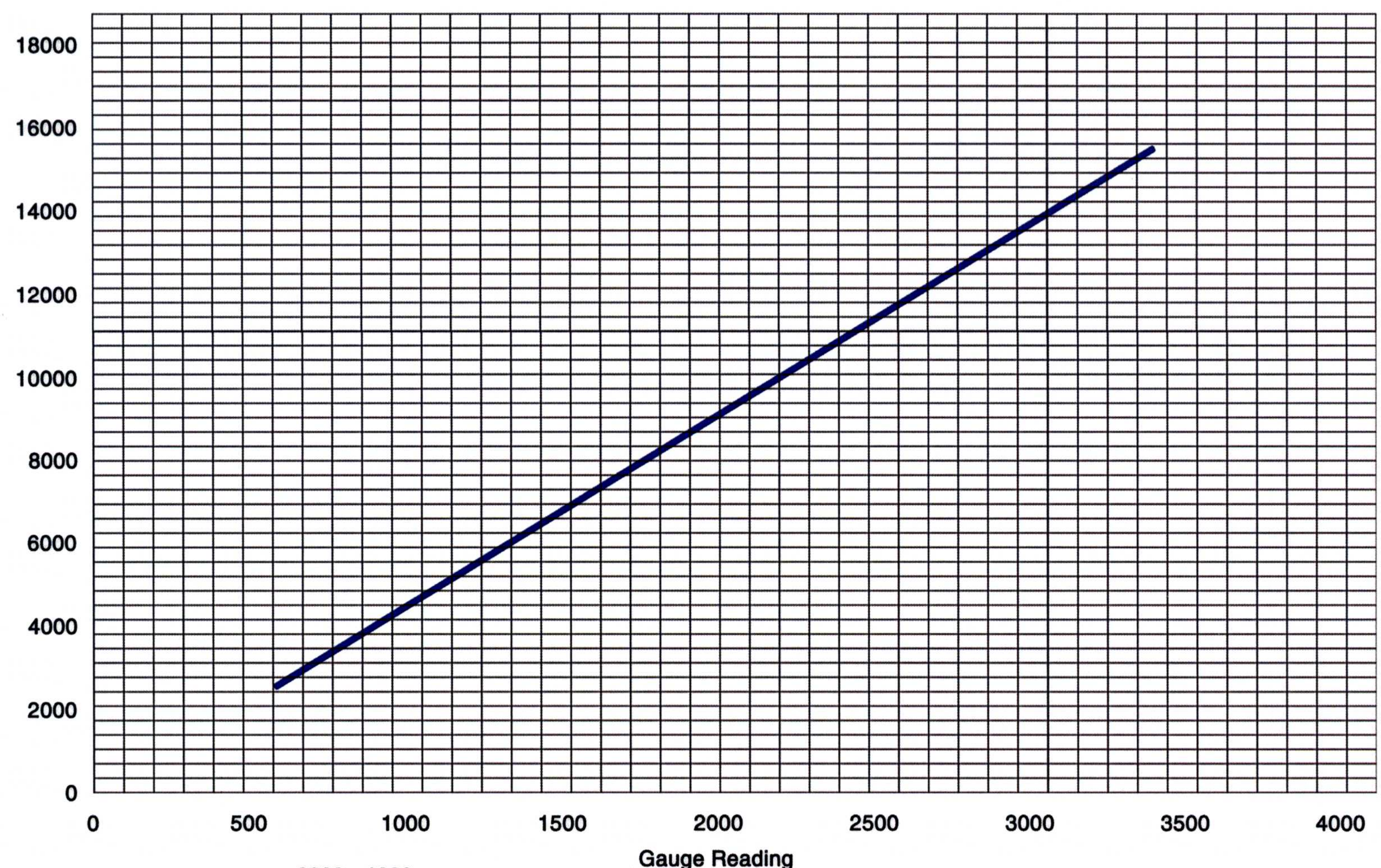




Material: Hot dip galvanized carbon steel.

LOAD CONFIGURATION		PART NUMBER	CHANNEL LENGTH in. (mm)	MIN. DISTANCE BETWEEN LOAD POINTS in. (mm)	ALLOWABLE LOADS PULL-OUT (T_A) lb. (kN)	ALLOWABLE LOADS SHEAR (V_A) lb. (kN)
Short Anchor Channel, Two I-Anchors, Point Load		HT7506	6 (152)	- -	8,000 (35.6)	7,700 (34.3)
		HT7508	8 (203)	- -	8,000 (35.6)	7,700 (34.3)
		HT7110	10 (254)	- -	8,000 (35.6)	7,700 (34.3)
		HT7112	12 (305)	- -	8,000 (35.6)	7,700 (34.3)
Short Anchor Channel, Two I-Anchors, Load Pair		HT7508	8 (203)	3 (76)	9,800 (43.6)	7,700 (34.3)
		HT7110	10 (254)	3 (76)	9,800 (43.6)	10,000 (44.5)
		HT7112	12 (305)	3 (76)	11,200 (49.8)	10,000 (44.5)
Short Anchor Channel, Three I-Anchors, Load Pair		HT7516	16 (406)	5 (127)	12,000 (53.4)	11,000 (49.0)
		HT7518	18 (457)	6 (152)	15,400 (68.5)	12,000 (53.4)
		HT7124	24 (610)	8 (203)	15,400 (68.5)	12,000 (53.4)
Continuous Lengths to 19'-11" (6070mm), I-Anchors at 10" (254mm) Centers	Point Loads	HT7100	19'-11" (6070)	10 (254)	8,000 (35.6)	a) 7,700 (34.3)
	Equivalent Uniform Load				9,600 lb/ft (140.1 kN/m)	a) 9,300 lb/ft (135.8 kN/m)
Corner Anchor 90 Degrees, Three I-Anchors		HT7112 x 12B	12 (305) (Each Leg)	3 (76)	8,000 lb/bolt (35.6 kN/bolt) 11,200 lb/leg (49.8 kN/leg)	7,700 lb/bolt (34.3 kN/bolt) 10,000 lb/leg (45.5 kN/leg)

Proof Load Set #2 (125299)



Slope $S = \frac{3000 - 1000}{13700 - 4500}$

$= .207$

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