FORM DQP 2.01-1
LEVEL 1 CHECK PRINT SIGN-OFF SHEET

Client Name:	**Ohio Department of Transportation**
Job Title:	**Cleveland Innerbelt Design-Build Contract**
Job Number:	**CUY-90-14.90**
Document Title:	Design Navigation Light Anchor Bolts

Check Level (Mark One):

- [X] 1A 100% Document Check
- [ ] 1B 100% Input Check

Enter description below:

	Print Name	Signature	Date
[X] Originator	Kolbe Gravatt		6-27-12
[X] Checker	LJ DICKENS		7/5/12
[X] Backchecker	KDGravatt		7-15-12
[X] Updater	Kolbe Gravatt		7-15-12
[X] Validater	LJ DICKENS		7/20/12

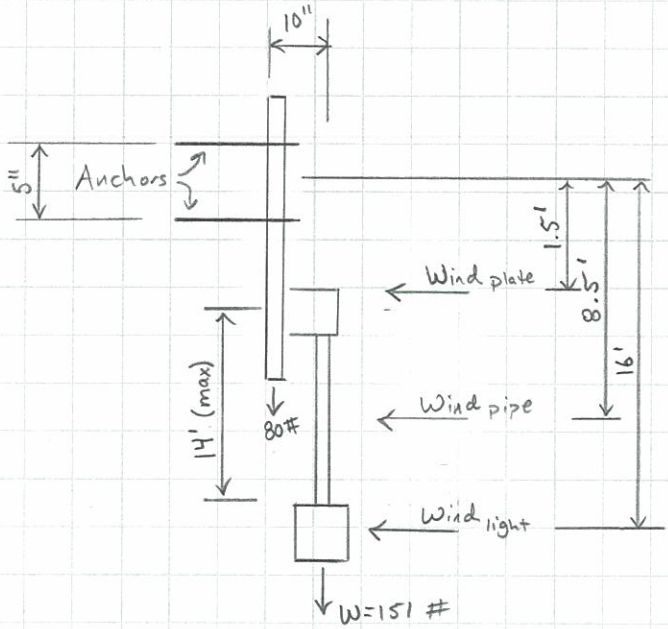
Insert an "X" in the box to indicate a required QC activity.

For	Cleveland Innerbelt	Job no.	49633	Sheet no.	
Made by	KDG	Checked by	LJD	Backchecked by	KDG
Date	6-27-12	Date	7/5/2012	Date	7-15-12

HNTB

Design Anchor bolts for navigation light

AASHTO Standard Spec. for Structural Support for Highway Signs, Luminaires and Traffic Signals



Assume light weighs ≈ 100 #

sch 40 steel pipe = 3.65 #/ft (14') = 51.1 #

Use 50 psf wind pressure

Wind on ½" Plate:

Area of Plate below bridge deck = 12" x 12" = 1 ft²

W_{Plate} = 1 ft² (50 #/ft²) = 50 #

Wind on Pipe:

Area of Pipe = 2.375"/12 * 14' = 2.77 ft²

W_{pipe} = 2.77 ft² (50 #/ft²) = 140 #

Wind on light:

Area of light = (10" * 16") / 144 = 1.11 ft²

wind on light = (1.11)(50) = 56 #

Moment from wind:

50#(1.5')(12) + 140#(8.5')(12) + 56#(16')(12) = 26 k·in

Moment from DL: 10"(151 #) = 2 k·in

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HNTB

Design Navigation Light (cont.)

Total Moment = 26 k·in + 2 k·in = 28 k·in

Bolt Force:

$$R_T = \left(\frac{M}{Spa}\right) / 2\,bolts = \frac{28\ k\cdot in}{5\ in} / 2\ bolts = 2.8\ k/bolt$$

(5.17.4.2) Allowable Stress: Assume Anchor Bolts are F1554 grade 55

$$F_{y\,bolt} = 55\ ksi$$

Tensile Stress

$$F_t = 0.5\ F_{y\,bolt} = 0.5(55) = 27.5\ ksi$$

$$f_t = \frac{2.8}{\frac{\pi\,(1/2)^2}{4}} = \frac{2.8}{0.196} = 14.26\ ksi$$

$$f_t < F_t \quad \text{OK}$$

Shear Stress

$$F_v = 0.3\ F_{y\,bolt} = 16.5\ ksi$$

$$f_v = \frac{231\#}{0.196} = 1.2\ ksi < 16.5 \quad \text{ok}$$

Combined Stress

$$\left(\frac{f_v}{F_v}\right)^2 + \left(\frac{f_t}{F_t}\right)^2 = \sqrt{\left(\frac{1.2}{16.5}\right)^2 + \left(\frac{14.26}{27.5}\right)^2} = 0.52 < 1.0 \quad \text{ok}$$

Anchor Embed

From Hilti Literature ½" ϕ threaded Rod @ 4½" embed = 5275 # Allow

Spacing Reduction = 0.85, edge distance Reduction = 0.85

Adjusted Allowable = 5275(0.85)(0.85) = 3811 # > 2.8 k

∴ 4½" embed OK

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HNTB

Check Fatigue on Anchor bolts

Section 11 : Fatigue design

Per section 11.6 Navigation Lights will be Category III

I_f (Natural Wind) = 0.55
I_f (Truck Induced) = 0.70

Natural Wind (11.7.3)

$P_{NW} = 5.2\ C_d\ I_f = 5.2\ (1.7)\ 0.55 = 4.86$ psf

wind on Plate = 1 (4.86) = 4.86 #
wind on pipe = 2.77 (4.86) = 13.46 #
wind on light = 1.11 (4.86) = 5.39 #

moment from wind = $4.86\,(1.5)(12) + 13.46\,(8.5)(12) + 5.39\,(16)(12) = 2,495$ #·in

$T_{fat} = \frac{2495}{5''} / 2\ \text{bolts} = 250$ # / bolt

$f_{fat.wind} = \frac{250}{0.196} = 1.3$ ksi

Anchor Bolts are fatigue catigory D with a stress limit of 7 ksi

7 > 1.3 ok for fatigue from wind

ME101-1204

For	Cleveland Innerbelt	Job no.	49633	Sheet no.	
Made by	KDG	Checked by	LJD	Backchecked by	KDG
Date	7-5-12	Date	7/5/2012	Date	7-15-12

HNTB

Truck induced vibration:

The light will vibrate up and down as the superstructure deflects with the Live Load

weight of Light and Mounting plate

$$W = 151 + 80 = 231\ \#$$

Moment arm = 10"

Fatigue Impact Factor = 1.15

$$Moment = 231\#(10")1.15 = 2{,}660\#in$$

Tension in Anchor Bolt

$$T = 2660/5" = 532\ \#$$

Assume same moment happens in the positive and Negitive direction

$$\therefore\ T_{Range} = 532\ \#\ (2) = 1{,}064\ \#$$

$$\sigma_{Vib} = \frac{1064\ \#}{0.196\ in^2} = 5.43\ ksi$$

Anchor Bolts are stress catigory D with maximum stress range of 7 ksi.

$$7 > 5.84$$

OK for vibration from LL on Superstructure

3.2.7 HIT-RE 500 Epoxy Adhesive Anchoring System

HIT-RE 500 Allowable and Ultimate Bond/Concrete Capacity for HAS Rods in Normal Weight Concrete[1,2,3,4]

Anchor Diameter in (mm)	Embedment Depth in (mm)	HIT-RE 500 Allowable Bond/Concrete Capacity				HIT-RE 500 Ultimate Bond/Concrete Capacity			
		Tensile		Shear		Tensile		Shear	
		f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)
3/8 (9.5)	1-3/4 (44)	645 (2.9)	1095 (4.9)	1510 (6.7)	2135 (9.5)	2580 (11.5)	4370 (19.4)	4530 (20.2)	6405 (28.4)
	3-3/8 (86)	2190 (9.7)	2585 (11.5)	3155 (14.0)	4460 (19.8)	8760 (39.0)	10345 (46.0)	9460 (42.1)	13380 (59.5)
	4-1/2 (114)	2420 (10.8)	2585 (11.5)	4855 (21.6)	6860 (30.5)	9685 (43.1)	10335 (46.0)	14560 (64.8)	20580 (91.5)
1/2 (12.7)	2-1/4 (57)	1130 (5.0)	1965 (8.7)	2510 (11.2)	3550 (15.8)	4530 (20.2)	7860 (35.0)	7525 (33.5)	10640 (47.3)
	4-1/2 (114)	4045 (18.0)	5275 (23.5)	5610 (25.0)	7935 (35.3)	16185 (72.0)	21095 (93.8)	16820 (74.8)	23800 (105.9)
	6 (152)	4775 (21.2)	5380 (23.9)	8635 (38.4)	12210 (54.3)	19095 (84.9)	21520 (95.7)	25900 (115.2)	36620 (162.9)
5/8 (15.9)	2-7/8 (73)	1690 (7.5)	3045 (13.5)	5245 (23.3)	7420 (33.0)	6770 (30.1)	12175 (54.2)	15735 (70.0)	22250 (99.0)
	5-5/8 (143)	6560 (29.2)	7355 (32.7)	8760 (39.0)	12395 (55.1)	26240 (116.7)	29420 (130.9)	26280 (116.9)	37180 (165.4)
	7-1/2 (190)	7320 (32.6)	7515 (33.4)	13615 (60.6)	19080 (84.9)	29290 (130.3)	30060 (133.7)	40480 (180.1)	57240 (254.6)
3/4 (19.1)	3-3/8 (86)	2310 (10.3)	4515 (20.1)	7335 (32.6)	10370 (46.1)	9250 (41.1)	18065 (80.4)	22000 (97.9)	31108 (138.4)
	6-3/4 (172)	8670 (38.6)	10755 (47.8)	12615 (56.1)	17840 (79.4)	34685 (154.3)	43020 (191.4)	37840 (168.3)	53520 (238.1)
	9 (229)	10385 (46.2)	12995 (57.8)	19430 (86.4)	27470 (122.2)	41535 (184.8)	51985 (231.2)	58280 (259.2)	82400 (366.5)
7/8 (22.2)	4 (101)	3005 (13.4)	5665 (25.2)	7795 (34.7)	11020 (49.0)	12030 (53.5)	22670 (100.8)	23375 (104.0)	33050 (147.0)
	7-7/8 (200)	12495 (55.6)	15875 (70.6)	17175 (76.4)	24290 (108.0)	49975 (222.3)	63495 (282.4)	51520 (229.2)	72860 (324.1)
	10-1/2 (267)	14705 (65.4)	16185 (72.0)	26440 (117.6)	37390 (166.3)	58820 (261.6)	64730 (287.9)	79320 (352.8)	112160 (498.9)
1 (25.4)	4-1/2 (114)	3945 (17.5)	8440 (37.5)	10035 (44.6)	14190 (63.1)	15790 (70.2)	33765 (150.2)	30104 (133.9)	42565 (189.3)
	9 (229)	13845 (61.6)	17365 (77.2)	22435 (99.8)	31720 (141.1)	55380 (246.3)	69465 (309.0)	67300 (299.4)	95160 (423.3)
	12 (305)	17935 (79.8)	17935 (79.8)	34535 (153.6)	48830 (217.2)	71740 (319.1)	71740 (319.1)	103600 (460.8)	146480 (651.6)
1-1/4 (31.8)	5-5/8 (143)	5760 (25.6)	12815 (57.0)	14760 (65.7)	20870 (92.8)	23045 (102.5)	51270 (228.1)	44280 (197.0)	62610 (278.5)
	11-1/4 (286)	24610 (109.5)	31620 (140.7)	35050 (155.9)	49570 (220.5)	98430 (437.8)	126480 (562.6)	105140 (467.7)	148710 (661.5)
	15 (381)	34130 (151.8)	35270 (156.9)	53960 (240.0)	76300 (339.4)	136525 (607.3)	141090 (627.6)	161880 (720.1)	228900 (1018.2)

1 Influence factors for spacing and/or edge distance are applied to allowable concrete/bond values above, and then compared to the steel value. The lesser of the values is to be used for the design.

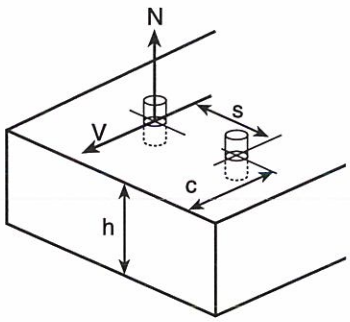
2 Average ultimate concrete shear capacity based on Strength Design method for standard and deep embedment and based on testing for shallow embedment.

3 All values based on holes drilled with carbide bit and installed per manufacturer's instructions. Ultimate tensile concrete/bond loads represent the average values obtained in testing.

4 For all underwater applications up to 165 feet/50m depth reduce the tabulated concrete/bond values 30% to account for reduced mechanical properties of saturated concrete.

HIT-RE 500 Epoxy Adhesive Anchoring System 3.2.7

Anchor Spacing and Edge Distance Guidelines in Concrete

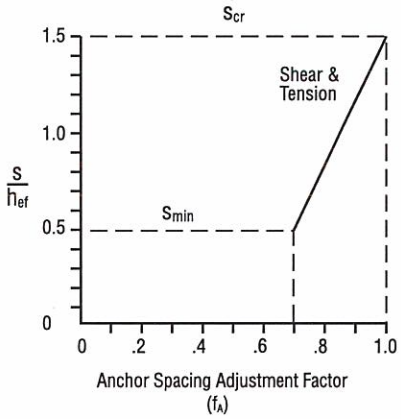


Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing Tension/Shear $s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$ $f_A = 0.3(s/h_{ef}) + 0.55$ for $s_{cr} > s > s_{min}$
Edge Distance Tension $c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$ $f_{RN} = 0.3(c/h_{ef}) + 0.55$ for $c_{cr} > c > c_{min}$
Edge Distance Shear (⊥ toward edge) $c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$ $f_{RV1} = 0.54(c/h_{ef}) - 0.09$ for $c_{cr} > c > c_{min}$
Edge Distance Shear (II to or away from edge) $c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$ $f_{RV2} = 0.36(c/h_{ef}) + 0.28$ for $c_{cr} > c > c_{min}$

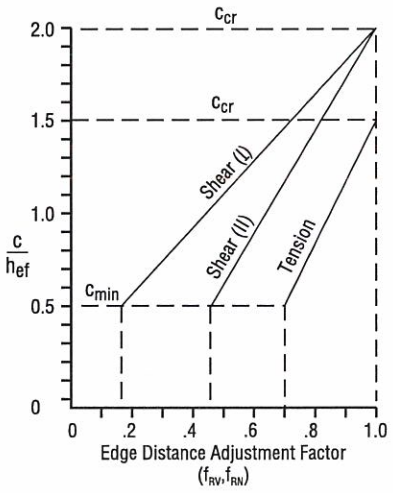
Anchor Spacing Adjustment Factors

s = Actual spacing
h_{ef} = Actual embedment
s_{min} = 0.5 h_{ef}
s_{cr} = 1.5 h_{ef}



Edge Distance Adjustment Factors

c = Actual edge distance
h_{ef} = Actual embedment
c_{min} = 0.5 h_{ef} Tension and shear
c_{cr} = 1.5 h_{ef} Tension
= 2.0 h_{ef} Shear
⊥ = Perpendicular to edge
II = Parallel to edge



Load Adjustment Factors for 3/8" Diameter Anchors													
Anchor Diameter		3/8" diameter											
Adjustment Factor		Spacing Tension/Shear f_A			Edge Distance Tension f_{RN}			Edge Distance Shear (⊥ toward edge) f_{RV1}			Edge Distance Shear (II to or away from edge) f_{RV2}		
Embedment Depth, in		1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2
Spacing (s)/Edge Distance (c), in.	7/8	0.70			0.70			0.18			0.46		
	1	0.72			0.72			0.22			0.49		
	1 11/16	0.84	0.70		0.84	0.70		0.43	0.18		0.63	0.46	
	2	0.89	0.73		0.89	0.73		0.53	0.22		0.69	0.49	
	2 1/4	0.94	0.75	0.70	0.94	0.75	0.70	0.60	0.27	0.18	0.74	0.52	0.46
	2 5/8	1.00	0.78	0.73	1.00	0.78	0.73	0.72	0.33	0.23	0.82	0.56	0.49
	3		0.82	0.75		0.82	0.75	0.84	0.39	0.27	0.90	0.60	0.52
	3 1/2		0.86	0.78		0.86	0.78	1.00	0.47	0.33	1.00	0.65	0.56
	4		0.91	0.82		0.91	0.82		0.55	0.39		0.71	0.60
	5 1/16		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	5 1/2			0.92			0.92		0.79	0.57		0.87	0.72
	6			0.95			0.95		0.87	0.63		0.92	0.76
	6 3/4			1.00			1.00		1.00	0.72		1.00	0.82
	8									0.87			0.92
	9									1.00			1.00

3.2.7 HIT-RE 500 Epoxy Adhesive Anchoring System

Anchor Spacing and Edge Distance Guidelines in Concrete

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Load Adjustment Factors for 1/2" Diameter Anchors													
Anchor Diameter		1/2" diameter											
Adjustment Factor		Spacing Tension/Shear f_A			Edge Distance Tension f_{RN}			Edge Distance Shear (⊥ toward edge) f_{RV1}			Edge Distance Shear (II to or away from edge) f_{RV2}		
Embedment Depth, in		2-1/4	4-1/2	6	2-1/4	4-1/2	6	2-1/4	4-1/2	6	2-1/4	4-1/2	6
Spacing	1-1/8	0.70			0.70			0.18			0.46		
	1-1/2	0.75			0.75			0.27			0.52		
	1-3/4	0.78			0.78			0.33			0.56		
	2	0.82			0.82			0.39			0.60		
	2-1/4	0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46	
	2-1/2	0.88	0.72		0.88	0.72		0.51	0.21		0.68	0.48	
	3	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46
	3-3/8	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.21	0.82	0.55	0.48
	4		0.82	0.75		0.82	0.75	0.87	0.39	0.27	0.92	0.60	0.52
	4-1/2		0.85	0.78		0.85	0.78	1.00	0.45	0.32	1.00	0.64	0.55
	5		0.88	0.80		0.88	0.80		0.51	0.36		0.68	0.58
	6		0.95	0.85		0.95	0.85		0.63	0.45		0.76	0.64
	6-3/4		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	7			0.90			0.90		0.75	0.54		0.84	0.70
	8			0.95			0.95		0.87	0.63		0.92	0.76
	9			1.00			1.00		1.00	0.72		1.00	0.82
	10									0.81			0.88
	11									0.90			0.94
	12									1.00			1.00

Spacing Tension/Shear

$s_{min} = 0.5\ h_{ef}$, $s_{cr} = 1.5\ h_{ef}$

$f_A = 0.3(s/h_{ef}) + 0.55$

for $s_{cr} > s > s_{min}$

Edge Distance Tension

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 1.5\ h_{ef}$

$f_{RN} = 0.3(c/h_{ef}) + 0.55$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (⊥ toward edge)

$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV1} = 0.54(c/h_{ef}) - 0.09$

for $c_{cr} > c > c_{min}$

Edge Distance Shear (II to or away from edge)

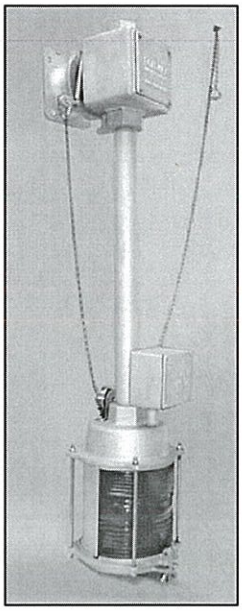
$c_{min} = 0.5\ h_{ef}$, $c_{cr} = 2.0\ h_{ef}$

$f_{RV2} = 0.36(c/h_{ef}) + 0.28$

for $c_{cr} > c > c_{min}$

Load Adjustment Factors for 5/8" and 3/4" Diameter Anchors																									
Anchor Diameter		5/8" diameter												3/4" diameter											
Adjustment Factor		Spacing Tension/Shear f_A			Edge Distance Tension f_{RN}			Edge Distance Shear (⊥ toward edge) f_{RV1}			Edge Distance Shear (II to or away from edge) f_{RV2}			Spacing Tension/Shear f_A			Edge Distance Tension f_{RN}			Edge Distance Shear (⊥ toward edge) f_{RV1}			Edge Distance Shear (II to or away from edge) f_{RV2}		
Embedment Depth, in		2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	3-3/8	6-3/4	9	3-3/8	6-3/4	9	3-3/8	6-3/4	9	3-3/8	6-3/4	9
Spacing (s)/Edge Distance (c), in.	1-7/16	0.70			0.70			0.18			0.46														
	1-11/16	0.73			0.73			0.23			0.49			0.70			0.70			0.18			0.46		
	2	0.76			0.76			0.29			0.53			0.73			0.73			0.23			0.49		
	2-13/16	0.84	0.70		0.84	0.70		0.44	0.18		0.63	0.46		0.80			0.80			0.36			0.58		
	3-3/8	0.90	0.73		0.90	0.73		0.54	0.23		0.70	0.50		0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46	
	3-3/4	0.94	0.75	0.70	0.94	0.75	0.70	0.61	0.27	0.18	0.75	0.52	0.46	0.88	0.72		0.88	0.72		0.51	0.21		0.68	0.48	
	4-5/16	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.22	0.82	0.56	0.49	0.93	0.74		0.93	0.74		0.60	0.26		0.74	0.51	
	4-1/2		0.79	0.73		0.79	0.73	0.76	0.34	0.23	0.84	0.57	0.50	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46
	5-1/16		0.82	0.75		0.82	0.75	0.86	0.40	0.27	0.91	0.60	0.52	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.21	0.82	0.55	0.48
	5-5/8		0.85	0.78		0.85	0.78	0.97	0.45	0.32	0.98	0.64	0.55		0.80	0.74		0.80	0.74	0.81	0.36	0.25	0.88	0.58	0.51
	5-3/4		0.86	0.78		0.86	0.78	1.00	0.46	0.32	1.00	0.65	0.56		0.81	0.74		0.81	0.74	0.83	0.37	0.26	0.89	0.59	0.51
	6-3/4		0.91	0.82		0.91	0.82		0.56	0.40		0.71	0.60		0.85	0.78		0.85	0.78	1.00	0.45	0.32	1.00	0.64	0.55
	8-7/16		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69		0.93	0.83		0.93	0.83		0.59	0.42		0.73	0.62
	10-1/8			0.96			0.96		0.88	0.64		0.93	0.77		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	11-1/4			1.00			1.00		1.00	0.72		1.00	0.82			0.93			0.93		0.81	0.59		0.88	0.73
	12									0.77			0.86			0.95			0.95		0.87	0.63		0.92	0.76
	13-1/2									0.88			0.93			1.00			1.00		1.00	0.72		1.00	0.82
	15									1.00			1.00									0.81			0.88
	16																					0.87			0.92
	18																					1.00			1.00

CM CHANNEL MARGIN LIGHT
Specification



GENERAL: The channel margin light shall be Model CM, as manufactured by B&B Roadway, LLC, (888) 560-2060.

APPLICATIONS: The channel margin navigation light shall be designed for use as a marine signal light for marking channel margin, and shall meet or exceed all Coast Guard recommendations and requirements pertaining to channel margin and obstruction marking signals. (See Model CC for center of channel light.)

HOUSING and GENERAL CONSTRUCTION: The housing shall be of cast aluminum *[option: cast silicon bronze]*. Casting alloy used shall be suitable for marine environment. Construction shall be rain-tight and fully gasketed. The light assembly shall be designed for heavy duty, long life service. Design shall provide ready access for lamp service.

LENS: Lens shall be tempered fresnel glass. Lens section shall be 180 degrees red. Inside lens diameter shall measure approximately 7" (175mm). Outside lens diameter shall measure approximately 8" (205mm). Lens shall have a wide angle of divergence suitable for high mounting on bridges or structures. The angle of divergence shall not be less than 27 degrees.

LAMP and RECEPTACLE: Lamp shall be 100W *[option: 60W]*, 120V, A-19 shape, clear. Lamp shall have a rated life of 20,000 hours and shall be of a rough service design with multiple filament support fingers. Medium base receptacle shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing. *[option: A single medium base 8W, 120V 100,000 hour LED lamp shall be provided in a color to match the lens.]*

STEM: Lamp fixture head shall be suspended from the swivel on a 1 1/2" schedule 40 pipe, 1.90" O.D. (48mm) *[option: 2" schedule 40 pipe, 2.375" O.D. (60mm)]*. Pipe material shall be galvanized steel *[option: stainless pipe used with bronze castings]*. Dimension from center of swivel to focal plane of lens shall be 48" (1219mm) *[option: as specified]*.

SWIVEL: The swivel design shall provide for all wiring to be completely contained inside the light assembly. Gaskets and o-rings shall be used to provide a weather-tight assembly. Swivel shall be of heavy-duty construction, cast of the same material as the fixture head. Spindle shall be of stainless steel.

AUTOMATIC LATCH: An automatic latch shall hold the light securely in normal operating and service positions. A firm pull on the service chain shall automatically release the latch, allowing the fixture to pivot. As the light is raised, latch shall automatically engage to hold light in the service position. Service position shall be 30 degrees from vertical *[option: as specified]*. Fixture assembly shall be dual-handed (i.e. light may be pulled up from either side).

MOUNTING: Base shall be cast of the same material as the fixture head (*aluminum or silicon bronze*). Light assembly shall mount via four 1/2" diameter bolts through the base, provided by installer to suit installation.

SERVICE CHAIN: A stainless steel, #25 sash type service chain shall be provided to facilitate raising and lowering light for service.

PARTIAL LIST OF AVAILABLE OPTIONS:

Dual Lamps: A dual lamp shall be provided. An automatic transfer relay shall switch power to the backup lamp upon failure of the primary lamp. The relay shall provide a second independent contact for remote signaling of "primary lamp failure" status. *[Additional option: An indicator light to signal "primary lamp failure" status shall be included, when specified. The indicator light shall have a 360 degree blue Fresnel lens. A 27W lamp shall be included.]* Transfer relay components shall be contained in a cast box of the same material as the fixture head.

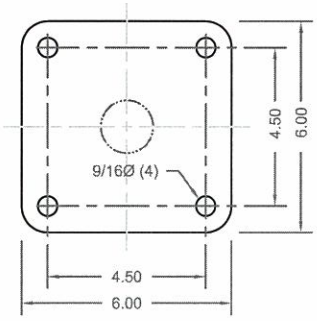
Junction Box: A cast junction box with gasketed access cover shall be provided. Junction box shall be of the same material as the fixture assembly and shall match the navigation light base footprint. Orientation of junction box shall be capable of rotation in 90 degree increments.

Revised 9/10

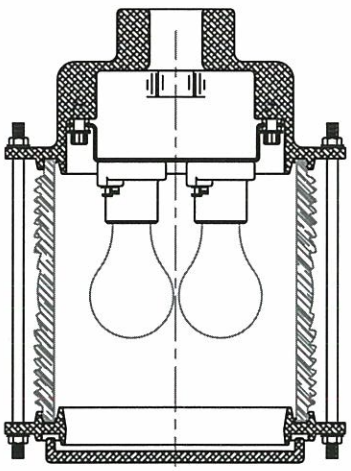
ROADWAY MANUFACTURING

CM CHANNEL MARGIN LIGHT
Basic Dimensions

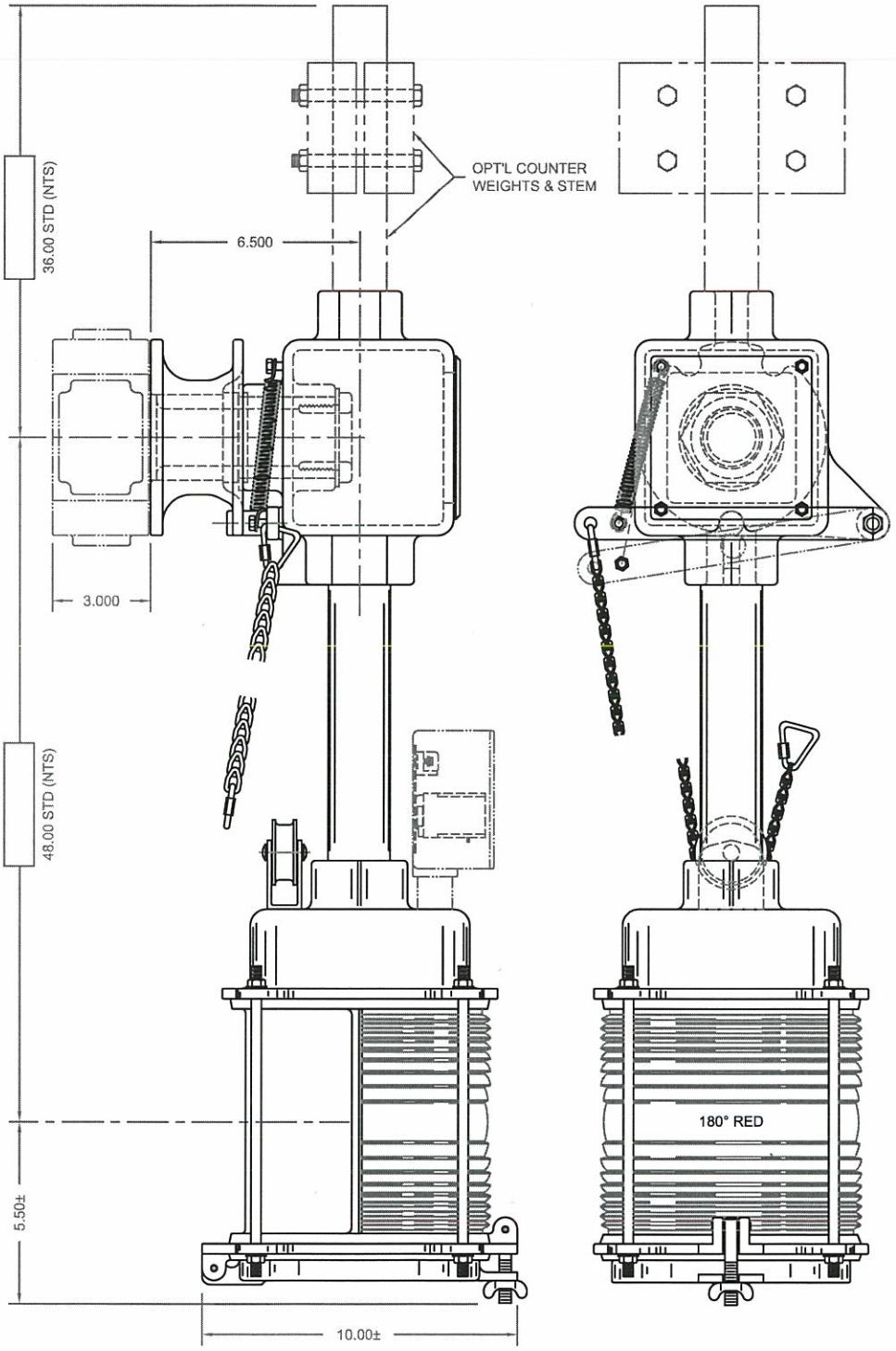
LENS PATTERN



MTG DIM



FIXTURE SECTION

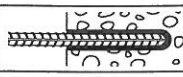
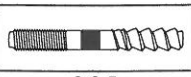
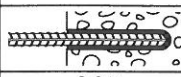


OVERALL DIMENSIONS

Anchor Selection Guide 3.1.14

Applications Grid

Key: ● Very suitable ○ May be suitable per application

Design Criteria \ Anchor Products		HIT-HY 150 MAX-SD Adhesive	HIT-RE 500-SD Epoxy	HIT-HY 150 MAX Adhesive		RE 500 Epoxy
				w/ threaded rod or rebar	w/ HIT-TZ rod	
						
	Section Number:	3.2.3	3.2.4	3.2.6	3.2.5	3.2.7
	ICC-ES ESR:	ESR-3013	ESR-2322	ESR-2262 (AC308) ESR-1967 (AC58)		
Fastening Base Material[1]	Uncracked concrete	●	●	●	●	●
	Cracked concrete	●	●		○	
	Lightweight concrete	○	○	●	○	○
	Hollow core concrete					
	Grout filled concrete block	○	○	●	○	○
	Hollow concrete block					
	Solid brick	○	○	○		○
	Hollow brick					
Installation	Oversized holes (per ICC)					○
	Cored holes (per ICC)		●		○	○
	Water saturated concrete (per ICC)	●	●	●	○	○
	Water-filled holes (per ICC)		●		○	○
	Submerged (per ICC)		●			○
	Overhead	●	●	●	○	●
	Sustained load	●	●	●	○	●
Application Criteria[2]	In-place (through) fastening	●	●	●	●	●
	Finish		with HIS Insert	with HIS Insert		with HIS Insert
	Removeable to flush surface		with HIS Insert	with HIS Insert		with HIS Insert
	Seismic	●	●	○	○	○
	High cycle fatigue	○	●	○	○	●
	Shock / Impact load	○	○	○	○	○
	High temperature resistance	○	○	○	○	○
Corrosion[3]	Electro/Mechanically zinc plated	●	●	●	●	●
	Sherardized carbon steel					
	Hot-dipped galvanized	7/8-in.	7/8-in.	7/8-in.		7/8-in.
	Stainless steel	304, 316	304, 316	304, 316	316	304, 316
Miscellaneous	Gel time/Cure time[4]	5 min / 30 min	30 min / 12 hours	6 min / 30 min	6 min / 30 min	30 min / 12 hours
	Fastener diameters available (in.)[5]	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4	3/8, 1/2, 5/8, 3/4	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4
	Anchor working principles[6]	adhesive bond	adhesive bond	adhesive bond	expansion against bonding to base material	adhesive bond

** Refer to product literature for detailed information.

1 Base material may vary widely. Site specific anchor testing may be required.

2 Most testing is perfromed in normal weight concrete. Light weight concrete may be addressed. See product technical information.

3 Refer to Section 2.3 for a more detailed discussion on corrosion and corrision resistance.

4 Gel time and cure time are given at a standard 68°F (20°C).

5 Listed diameters are those with published load data. Larger diameter elements may be used with some adhesive anchor systems, contact Hilti for more information.

6 Refer to Section 3.1.5 for more detailed discussion on anchor working principles.