

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN DRAWINGS FOR VISUAL AIR NAVIGATION FACILITIES



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UNIFIED FACILITIES CRITERIA (UFC)

DESIGN STANDARDS FOR VISUAL AIR NAVIGATION FACILITIES

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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

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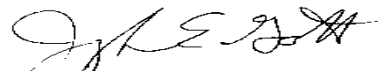
UFC are effective upon issuance and are distributed only in electronic media from the following source: Whole Building Design Guide web site <http://dod.wbdg.org/>.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC) REVISION SUMMARY SHEET

Subject: UFC 3-535-02, *Design Drawings for Visual Air Navigation Facilities*

Supersedes: UFC 3-535-02 (Draft), 30 JUNE 2014

Description of Changes: This revision updates the graphics details that have been in a draft document into the form of a UFC document required by UFC 3-100-01. Each graphic detail has been updated to be consistent with UFC 3-535-01 and NAVAIR 51-50 AAA-2. The details have been provided with updated designer notes and notes to be used with the drawings. AutoCAD cells of these graphics details and drawing notes will be located on a public web site for use by designers of airfield lighting projects. The details will be readily accessible and easily modified for each project. Where the technical content varies according to the needs of the military services (Air Force, Army, Navy) service-specific technical content has been provided in the details.

Reasons for Changes:

- The changes were made to bring the draft details up to the current state of military airfield lighting practice. The previous details were not consistent in graphic style, and did not meet current military graphics standards. They were not suitable for use on new projects without re-drawing each detail for each project.

Impact: Cost impact is negligible. However, the following benefit should be realized:

- Designers will have a better understanding of the design requirements.

Unification Issues

- Chapter 9 Wave-off & Wheels-up Lighting Systems and Chapter 10 Simulated Carrier Deck Systems are Navy only requirements from NAVAIR 51-50AAA-2 General Requirements for Shorebased Airfield Marking and Lighting.
- Lighting base can details may indicate a drain, this drain can be used on Army/Air Force projects, but is not used on Navy projects. This service difference will be indicated throughout this UFC wherever there is a light base can.
- Lighting base can details have service differences for the counterpoise lightning protection system. The Navy has differences in connecting the counterpoise wire to all metal objects on the airfield. Army/Air Force requirements are

selective on where the counterpoise is connected. This service difference will be indicated throughout this UFC wherever there is a light base can.

- Figures 50A, 50B, 50C, 51, 56 and 57 are service specific due to the runway threshold lighting configurations being different between the services. For the Navy this requirement is from NAVAIR 51-50AAA-2.

UFC 3-535-02
21 May 2018

Table of Contents

CHAPTER 1	INTRODUCTION.....	1
1-1	PURPOSE.....	1
1-2	SCOPE.....	1
1-3	SUMMARY OF CHANGES.....	1
1-4	APPLICATION.....	1
1-5	FAA STANDARDS.....	2
1-6	INTERNATIONAL MILITARY STANDARDS.....	2
1-7	BASE RIGHTS AGREEMENTS.....	3
1-8	METRICATION OF DIMENSIONS.....	3
1-9	PHOTOMETRIC REQUIREMENTS.....	3
1-10	STRUCTURAL DESIGN.....	4
1-11	SUPPLEMENTAL INFORMATION.....	4
CHAPTER 2	UNDERGROUND CABLE, CONDUIT AND DUCTS.....	5
2-1	DIRECT BURIED DUCT/CONDUIT DETAILS.....	5
2-1.1	Figures 1A, 1B.....	5
2-1.2	Figures 2A, 2B.....	6
2-1.3	Figures 3A, 3B.....	7
2-2	Marker Installation at Pavement Edge.....	15
2-2.1	Figure 4.....	15
2-3	Duct Markers.....	17
2-3.1	Figure 5.....	17
2-4	Concrete Encased Duct Bank Details – Typical Arrangements.....	19
2-4.1	Figures 6A, 6B, 6C.....	19
2-5	Field Attached Plug-in Splice FAA Type L-823.....	24
2-5.1	Figures 7A, 7B.....	24
CHAPTER 3	Runway and Taxiway Lighting.....	28
3-1	Fixture Installation Tolerances.....	28
3-1.1	Notes to Designer.....	28
3-2	Base Mounted Elevated Fixture Installation.....	29
3-2.1	Figure 9.....	29
3-3	In-Pavement Runway Light (Deep Base).....	32
3-3.1	Figures 11A, 11B.....	32
3-4	Base and Anchor Details (New Construction).....	36
3-4.1	Figure 12.....	36
3-5	Deep Base Installation in Rigid Pavement (New Construction).....	39
3-5.1	Figure 13.....	39
3-6	Flexible Pavement or Overlay (Flexible, Rigid) Installation.....	41
3-6.1	Figure 14.....	41
3-7	In-Pavement Light Fixture on Full Base and Snow Plow Ring in Rigid (PCC) Pavement.....	43
3-7.1	Figures 17A, 17B, 17C, 18A, 18B, 19A, 19B.....	43
3-8	Elevated Runway Guard Light/Holding Position Edge Light Detail.....	54
3-8.1	Figures 20A, 20B.....	54

CHAPTER 4	Airfield Guidance Signs.....	59
4-1	Airfield Guidance Sign Detail.....	59
4-1.1	Figures 29A, 29B.....	59
4-2	Sign Base Power Leg Mounting Detail.....	64
4-2.1	Figures 30A, 30B.....	64
CHAPTER 5	Approach Lighting Systems.....	67
5-1	L-867 Size D Handhole.....	67
5-1.1	Figure 31.....	67
5-2	Voltage Driven Sequenced Flasher Power Supply and Junction Box Mounting Detail.....	69
5-2.1	Figure 32.....	69
5-3	Typical MG-20 L.I.R. Structure 6'-1" (1854mm) to 21'-1" (6.43m).	71
5-3.1	Figure 33.....	71
5-4	Foundation for L.I.R. Structure MG-20 Plan View.....	73
5-4.1	Figure 34.....	73
5-5	Foundation for L.I.R. Structure MG-20 Sections A and B.....	75
5-5.1	Figure 35.....	75
5-6	Typical MG-20 L.I.R. Structure Tower Wiring Detail.....	77
5-6.1	Figure 36.....	77
5-7	2" (53mm) LB Conduit Detail.....	79
5-7.1	Figure 37.....	79
5-8	Typical MG-30 L.I.R. Structure 21'-2" (6.45m) to 30'-0" (9.14m).	81
5-8.1	Figure 38.....	81
5-9	Typical MG-40 L.I.R. Structure 30'-0" (9.14m) to 40'-0" (12.19m).	83
5-9.1	Figure 39.....	83
5-10	Foundation for MG-30/40 L.I.R. Structures.....	85
5-10.1	Figure 40.....	85
5-11	Typical MG-30/40 L.I.R. Structure Tower Wiring Detail.....	87
5-11.1	Figure 41.....	87
5-12	Tower Mounted Steady Burning Approach Light Detail.....	90
5-12.1	Figure 42.....	90
5-13	Tower Mounted SFL and Approach Light Detail.....	92
5-13.1	Figure 43.....	92
5-14	MALSR and SSALR Approach Light System Configuration.....	94
5-14.1	Figure 44A, 44B.....	94
5-15	Remote Flasher Installation 6' 0" (1800mm) Maximum.....	97
5-15.1	Figure 45.....	97
5-16	Typical High Intensity Approach Light Bar.....	99
5-16.1	Figures 46A, 46B, 46C, 46D, 46E, 46F, 46G.....	99
5-17	Typical Elevated High Intensity Approach Light Bar 0' to 6'0" (0mm to 1800mm) Maximum.....	108
5-17.1	Figure 47.....	108
5-18	Typical In-Pavement High Intensity Threshold Light Foundation with Interleaved Edge Light Circuits.....	110

5-18.1	Figures 48A, 48B, 48C, 48D, 48E.	110
5-19	Typical Elevated High Intensity Approach/ Threshold Light 6'0" (1800mm) Maximum.....	117
5-19.1	Figure 49.	117
5-20	ALSF-1 Approach Light System Configuration.	119
5-20.1	Figures 50A, 50B, 50C.	119
5-21	ALSF-2 Approach Light System Configuration (Air Force).	123
5-21.1	Figure 51.	123
5-22	MALSRLR Wiring Diagram.	125
5-22.1	Figure 52.	125
5-23	SSALRLR Wiring Diagram.	127
5-23.1	Figure 53.	127
5-24	L.I.R. Structure MS-20.....	129
5-24.1	Figure 54.	129
5-25	Approach Light Structure 40' to 128' (12m to 38.4m).	131
5-25.1	Figure 55.	131
5-26	High Intensity Threshold Bar Wiring Diagram (Air Force).	133
5-26.1	Figure 56.	133
5-27	Threshold Bar Wiring Diagram (Army).....	135
5-27.1	Figure 57.	135
5-28	High Intensity ALSF-1/SSALRLR Wiring Diagram.	137
5-28.1	Figure 59.	137
5-29	High Intensity ALSF-2/SSALRLR Wiring Diagram.	139
5-29.1	Figure 60A.....	139
5-30	ALSF-2/SSALRLR Wiring Diagram Modification.....	141
5-30.1	Figures 60A, 60B, 60C.	141
CHAPTER 6	PAPI and REIL Systems	144
6-1	FAA L-880 Style A (Constant Voltage) PCU Mounting Details.	144
6-1.1	Figure 61.	144
6-2	FAA L-880 Style A (Constant Voltage) System Wiring Diagram.....	146
6-2.1	Figures 62A, 62B.....	146
6-3	FAA L-880 Style B (Constant Current) System Wiring Diagram.....	148
6-3.1	Figure 63.	149
6-4	FAA L-880 Style B (Constant Current) PAPI Power and Control Schematic Diagram.	151
6-4.1	Figure 64.	151
6-5	PAPI Light Housing Unit (LHU) Installation Detail.	153
6-5.1	Figures 65A, 65B.....	153
6-6	PAPI Sighting Calculations and Obstacle Clearance Surfaces.....	156
6-6.1	Figure 65C.....	156
6-7	L-880 Signal Presentation and Installation Tolerances.....	158
6-7.1	Figure 65D.....	158
6-8	REIL Systems Schematic Wiring Diagrams.....	160
6-8.1	Figure 66.	160

6-9	Master and Slave REIL Unit Installation.	162
6-9.1	Figure 67.	162
CHAPTER 7	Miscellaneous (Rotating Beacons, Wind Cones, Can Plazas, Manholes, and High Mast Lighting)	164
7-1	51' (15.5m) Pre-Fabricated Beacon Tower.....	164
7-1.1	Figure 68.	164
7-2	Beacon Dimensions and Wiring Diagram.	166
7-2.1	Figure 69.	166
7-3	Beacon Tower Platform Details.	168
7-3.1	Figure 70.	168
7-4	Tower Safety Climbing Device.....	170
7-4.1	Figure 71.	170
7-5	L-806 Windcone Assembly (Frangible).....	172
7-5.1	Figure 72.	172
7-6	L-807 Windcone Assembly (Rigid Installation).	174
7-6.1	Figure 73.	174
7-7	Junction Can Plaza, Type A.	176
7-7.1	Figure 74.	176
7-8	Junction Can Plaza, Type B.	179
7-8.1	Figure 75.	179
7-9	Drain for Junction Cans (Air Force Only).....	182
7-9.1	Figure 76.	182
7-10	Manhole Grounding, Optional Cable Rack and Marker Details.	184
7-10.1	Figure 80A.....	184
7-10.2	Figure 80B.....	187
7-10.3	Figure 80C.....	189
7-11	Manhole Foldout Diagrams and Circuit Schedule.....	191
7-11.1	Figures 80D, 80E.....	191
7-12	Traffic Signs and Signals Installation.....	195
7-12.1	Figures 84A, 84B, 84C, 84D.....	195
CHAPTER 8	Helicopter Pad Systems	200
8-1	Helipad Perimeter Lighting.	200
8-1.1	Figure 85.	200
8-2	Hospital Helipad Perimeter Lighting.	202
8-2.1	Figure 86.	202
8-3	Helipad Landing Direction Lights.	204
8-3.1	Figure 87.	204
8-4	Helipad Approach Direction Lights.	206
8-4.1	Figure 88.	206
8-5	Helipad Lighting Wiring and Control Diagram.....	208
8-5.1	Figure 89.	208
CHAPTER 9	Naval Facilities Specific Wave-Off & Wheels-Up Lighting Systems ...	210
9-1	Location Plans: Wave-Off & Wheels-Up Lighting Systems.....	210
9-1.1	Figure 90.	210

9-2	Equipment Pad and Duct Details.....	213
9-2.1	Figure 91.	213
9-3	Wave-Off System Wiring Details.	215
9-3.1	Figure 92.	215
9-4	Flashhead and PCU Wiring Diagram.....	217
9-4.1	Figure 93.	217
9-5	Wave-Off Fixture Mounting.....	219
9-5.1	Figure 94.	219
9-6	Wave-Off Fixture Aiming.	221
9-6.1	Figure 95.	221
9-7	Power Converter Unit.	223
9-7.1	Figure 96.	223
9-8	Wheels-Up Lighting System Layout.....	225
9-8.1	Figure 99.	225
9-9	Wheels-Up Lighting Wiring Diagram.....	227
9-9.1	Figure 100.	227
9-10	Wheels-Up Light Fixture.	229
9-10.1	Figure 101.	229
9-11	Wheels-Up Light Fixture.	231
9-11.1	Figure 102.	231
9-12	Wheels-Watch Control Panel.....	233
9-12.1	Figures 103A, 103B.....	233
CHAPTER 10	Naval Facilities Specific Simulated Carrier Deck Systems.....	236
10-1	Simulated Carrier Deck Lighting System Layout Plan & Wiring Diagram.....	236
10-1.1	Figures 104A, 104B, 104C.	236
10-2	LSO Handhole Details.	241
10-2.1	Figure 105.	241
10-2.2	Notes to Designer.....	241
10-3	Handhole and Transformer Housing.....	243
10-3.1	Figures 106A, 106B.....	243
10-4	Simulated Carrier Deck Lighting Control Wiring Diagram.....	246
10-4.1	Figure 107A, 107B.....	246
10-5	LSO Control Panel and Portable Control Switch.	249
10-5.1	Figure 108.	249
10-6	Simulated Carrier Deck Light Fixture – Shallow Base and Saw Kerf Installation.	251
10-6.1	Figure 109.	251
10-7	Simulated Carrier Deck Light Core Details.	253
10-7.1	Figure 110.	253
10-8	Saw Kerf Wireway Details – Simulated Carrier Deck Lights.	255
10-8.1	Figure 111.	255
10-9	IFLOLS Pad Location.	257
10-9.1	Figure 112.	257
10-10	IFLOLS and Siting Mirror Pad Details.....	260

10-10.1 Figure 113. 260

List of Figures

Figure 1A. Edge Lighting Direct Buried Duct / Conduit Detail (Air Force/Army)	9
Figure 1B. Edge Lighting Direct Buried Duct / Conduit Detail (Navy)	10
Figure 2A. Grounding for Light Base Cans (Air Force / Army)	11
Figure 2B. Grounding for Light Base Cans (Navy)	12
Figure 3A. Grounding Connections to Light Base Can (Air Force / Army).....	13
Figure 3B. Grounding Connections to Light Base Can (Navy)	14
Figure 4. Duct Marker Installation at Pavement Edge	16
Figure 5. Duct Markers.....	18
Figure 6A. Concrete Encased Duct Bank Details – Typical Arrangements	21
Figure 6B. Concrete Encased Duct Bank Details – Typical Arrangements (continued)	22
Figure 6C. Hold Down Bar Installation Detail	23
Figure 7A. Field Attached Plug-in Splice FAA Type L-823	Error! Bookmark not defined.
Figure 7B. Typical L-823 Connector Detail Without Heat Shrink.....	27
Figure 9. Base Mounted Elevated Fixture Installation	31
Figure 11A. In-Pavement Fixture Installation (Deep Base)	34
Figure 11B. In-Pavement Light Detail (Deep Base)	35
Figure 12. Base and Anchor Details (New Construction)	38
Figure 13. Deep Base Installation in Rigid Pavement (New Construction).....	40
Figure 14. Flexible Pavement or Overlay Installation	42
Figure 17A. Light Base Mounting in Shoulder Pavement Plan (Air Force / Army).....	46
Figure 17B. Light Base Mounting in Shoulder Pavement Plan (Navy)	47
Figure 17C. Airfield Isolation Transformer Platform.....	49
Figure 18A. In-Pavement Light Materials	50
Figure 18B. Flush Light in Full Strength PCC.....	51
Figure 19A. In-Pavement Light Fixture Mounting	52
Figure 19B. In-Pavement Light Fixture Mounting (continued)	53
Figure 20A. L-804 Elevated Runway Guard Light/Holding Position Edge Light Installation Materials	56
Figure 20B. L-804 Elevated Runway Guard Light Aiming Diagram.....	57
Figure 29A. Airfield Guidance Sign Detail (Air Force / Army)	62
Figure 29B. Airfield Guidance Sign Detail (Navy).....	63
Figure 30A. Sign Base Power Leg Mounting Detail (Air Force / Army)	65
Figure 30B. Sign Base Power Leg Mounting Detail (Navy)	66
Figure 31. L-867 Size D Handhole	68
Figure 32. Voltage Driven Sequenced Flasher Power Supply and Junction Box Mounting Detail	70
Figure 33. Typical MG-20 L.I.R. Structure 6'-1" (1854mm) to 21'-1" (6.43m)	72
Figure 34. Foundation for L.I.R. Structure MG-20 Plan View	74

Figure 35. Foundation for L.I.R. Structure MG-20 Sections A and B.....	76
Figure 36. Typical MG-20 L.I.R. Structure Tower Wiring Detail.....	78
Figure 37. 2" (53mm) LB Conduit Detail.....	80
Figure 38. Typical MG-30 L.I.R. Structure 21'-2" (6.45m) to 30'-0" (9.14m)	82
Figure 39. Typical MG-40 L.I.R. Structure 30'-0" (9.14m) to 40'-0" (12.19m)	84
Figure 40. Foundation for MG-30/40 L.I.R. Structures	86
Figure 41. Typical MG-30/40 L.I.R. Structure Tower Wiring Detail.....	88
Figure 42. Tower Mounted Approach Light Detail	91
Figure 43. Tower Mounted SFL and Approach Light Detail.....	93
Figure 44A. MALSR Approach Light System Configuration	95
Figure 44B. SSALR Approach Light System Configuration.....	96
Figure 45. Remote Flasher Installation 6' 0" (1828mm) Maximum.....	98
Figure 46A. In-Pavement High Intensity Approach Light Bar – Section View Materials	101
Figure 46B. Grounding Connections Air Force, Army, Navy Projects	102
Figure 46C. Typical High Intensity Approach Light Bar (Air Force/Army).....	103
Figure 46D. Typical High Intensity Approach Light Bar (Navy)	104
Figure 46E. In-Pavement High Intensity Approach Light Base – Section View and Conduit Installation.....	105
Figure 46F. Existing Trenching, Sawcut Asphalt and Trench, Set L-868 Base Can and Framework	106
Figure 46G. Place Concrete, Remove Brace/Plywood Cover, Base Can in Place.....	107
Figure 48A. Runway Threshold Wing Bar Light Foundation – Plan View.....	112
Figure 48B. Runway Threshold Wing Bar Light Foundation – Elevation View	113
Figure 48C. Threshold Light in Concrete Beam	114
Figure 48D. Threshold Light Beam	115
Figure 48E. Mounting Hardware	116
Figure 49. Typical High Intensity Elevated Approach/Threshold Light 6'0" (1800mm) Maximum.....	118
Figure 50A. ALSF-1 Approach Light System Configuration (Air Force).....	120
Figure 50B. ALSF-1 Approach Light System Configuration (Army).....	121
Figure 50C. ALSF-1 Approach Light System Configuration (Navy).....	122
Figure 51. ALSF-2 Approach Light System Configuration (Air Force).....	124
Figure 52. MALSR Wiring Diagram	126
Figure 53. SSALR Wiring Diagram.....	128
Figure 54. L.I.R. Structure MS-20	130
Figure 55. Approach Light Structure 40' to 128' (12m to 38.4m)	132
Figure 56. High Intensity Threshold Bar Interleaved Wiring Diagram (Air Force).....	134
Figure 57. Threshold Bar Wiring Diagram (Army)	136
Figure 59. High Intensity ALSF-1/SSALR Wiring Diagram	138
Figure 60A. High Intensity ALSF-2/SSALR Wiring Diagram.....	140
Figure 60B. ALSF-2/SSALR Wiring Diagram Modification – Sheet 1	142
Figure 60C. ALSF-2/SSALR Wiring Diagram Modification – Sheet 2.....	143
Figure 61. FAA L-880 Style A (Constant Voltage) PCU Mounting Details.....	145

Figure 62A. FAA L-880 Style A (Constant Voltage) System Wiring Diagram	147
Figure 62B. Power Control Unit 3 Lamp, 4 Projector	148
Figure 63. FAA L-880 Style B (Constant Current) System Wiring Diagram.....	150
Figure 64. FAA L-880 Style B (Constant Current) PAPI Power and Control Schematic Diagram	152
Figure 65A. PAPI Light Housing Unit (LHU) Installation Detail.....	154
Figure 65B. PAPI Light Housing Unit (LHU) Installation Detail (continued).....	155
Figure 65C. Obstacle Clearance Surfaces	157
Figure 65D. L-880 Signal Presentation	159
Figure 66. REIL Systems Schematic Wiring Diagrams	161
Figure 67. Master and Slave REIL Unit Installation.....	163
Figure 68. 51' (15.5m) Pre-Fabricated Beacon Tower	165
Figure 69. Beacon Dimensions	167
Figure 70. Beacon Tower Platform Details.....	169
Figure 71. Tower Safety Climbing Device	171
Figure 72. L-806 Windcone Assembly (Frangible)	173
Figure 73. L-807 Windcone Assembly (Rigid Installation).....	175
Figure 74. Junction Can Plaza, Type A.....	178
Figure 75. Junction Can Plaza, Type B.....	181
Figure 76. Drains for Junction Cans (Air Force Only).....	183
Figure 80A. Grounding Detail for Airfield Lighting Manhole.....	186
Figure 80B. Cable Rack Option Detail.....	188
Figure 80C. Brass Survey Marker Detail	190
Figure 80D. Example Manhole Cable Foldout Diagram	193
Figure 80E. Markings, Circuit Description, Manhole and Duct Identifier.....	194
Figure 84A. Plan View of Traffic Sign/Signal Installation.....	196
Figure 84B. Roadway Sign Detail	197
Figure 84C. Pedestal Foundation – Top View, In Earth	198
Figure 84D. Roadway Signal Assembly Detail	199
Figure 85. Helipad Perimeter Lighting	201
Figure 86. Hospital Helipad Perimeter Lighting	203
Figure 87. Helipad Landing Direction Lights.....	205
Figure 88. Helipad Approach Direction Lights	207
Figure 89. Helipad Lighting Wiring and Control Schematic Diagram.....	209
Figure 90. Location Plans – Wave-Off & Wheels-Up Lighting Systems	212
Figure 91. Equipment Pad and Duct Details	214
Figure 92. Wave-Off System Wiring Details	216
Figure 93. Flashhead and PCU Wiring Diagram	218
Figure 94. Wave-Off Fixture Mounting	220
Figure 95. Wave-Off Fixture Aiming	222
Figure 96. Power Converter Unit.....	224
Figure 99. Wheels – Watch System Layout	226
Figure 100. Wheels-Up Wiring Diagram.....	228
Figure 101. Wheels-Up Light Fixture.....	230

Figure 102. Wheels-Up Light Fixture.....	232
Figure 103A. Wheels-Watch Control Panel.....	234
Figure 103B. Wave-Off Control SW	235
Figure 104A. Simulated Carrier Deck Lighting System – Layout Plan	238
Figure 104B. Simulated Carrier Deck Lighting System – Detail	239
Figure 104C. Simulated Carrier Deck Lighting System – Wiring Diagram.....	240
Figure 105. LSO Handhole Details.....	242
Figure 106A. Handhole and Transformer Housing.....	244
Figure 106B. Handhole and Transformer Section	245
Figure 107A. Simulated Carrier Deck Lighting – Control Wiring Diagram – Sheet 1..	247
Figure 107B. Simulated Carrier Deck Lighting – Control Wiring Diagram – Sheet 2..	248
Figure 108. LSO Control Panel and Portable Control Switch	250
Figure 109. Simulated Carrier Deck Light Fixture – Shallow Base and Saw Kerf Installation	252
Figure 110. Simulated Carrier Deck Light Core Details.....	254
Figure 111. Saw Kerf Wireway Details: Simulated Carrier Deck Lights.....	256
Figure 112. IFLOLS (Optical Landing System) Pad Location.....	259
Figure 113. IFLOLS and Siting Mirror Pad Details	261

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE.

This document provides drawing details for design and construction of individual components of visual navigation facilities. Use this document when designing, planning, constructing, and installing new systems.

1-2 SCOPE.

This document applies to United States Air Force, Army, Navy, Air National Guard, Army National Guard, Air Reserve, Army Reserve and Naval Reserve bases with responsibility for maintaining their airfield facilities. Existing systems and components are not required to be upgraded to these drawing details unless as part of a major rehabilitation.

This document contains the drawing details for design and construction for visual air navigation facilities, except marking, at Air Force, Navy, and US Army facilities.

Additional Navy requirements are currently contained in Naval Air Systems Command (NAVAIR) 51-50AAA-2. When using the NAVAIR document, be certain that the complementary markings are installed and that no conflict occurs with the placement of light fixtures.

1-3 SUMMARY OF CHANGES.

This edition of UFC 3-535-02, *Design Drawings for Visual Air Navigation Facilities*, supersedes the draft version dated 30 June 2014. Drawings are representative and not to scale. The English units govern.

1-4 APPLICATION.

This volume is not intended as a design specification or an instruction manual for untrained persons. A trained person is one who has the skills and knowledge related to the design, construction and operation of the airfield lighting systems and has received technical and safety training to design, construct and operate airfield lighting systems while recognizing and avoiding the hazards.

When using this manual, be certain that the complementary markings are installed and that no conflict occurs with the placement of light fixtures.

Specifically, this document contains figures that reference individual AutoCAD files containing the drawings, individual files containing the notes to designer for each diagram (text also provided within this document), and figure numbers for cross-referencing the drawings with this document.

1-5 FAA STANDARDS.

The Army and Air Force generally follow FAA standards that are primarily published as Advisory Circulars (ACs), handbooks, and specifications. However, when FAA documents are in conflict with the Air Force or Army requirements, this UFC takes precedence.

1-6 INTERNATIONAL MILITARY STANDARDS.

1-6.1 This UFC satisfies the requirements of international military standards to the greatest extent possible.

1-6.1.1 NATO STANAGs are promulgated by the NATO Standardization Office (NSO).

1-6.1.2 ASIC Air Standards (AIR STD) are promulgated by representatives of the military air forces of Australia, Canada, New Zealand, United Kingdom, and the United States. AIR STDs governing airfield lighting and marking, obstructions, helipads, and heliports have been cancelled.

1-6.2 Applicable international military standards take precedence over standards in this UFC as follows:

1-6.2.1 NATO.

NATO STANAGs apply at Army and Air Force facilities in NATO theater countries except the United States and Canada, or wherever NATO funding is provided for the work, regardless of location.

1-6.2.2 ASIC.

At Army and Air Force facilities in New Zealand and Australia, contact:
AF/A8XX - USAF International Standardization Office
ASIC (Air & Space Interoperability Council)
Andrews AFB MD
+1.240.612.4237 DSN 312.612.4237

1-7 **BASE RIGHTS AGREEMENTS.**

When the Army or Air Force builds an airfield in a foreign country, the United States obtains a Base Rights Agreement. Provisions of the Base Rights Agreement must be observed and may require that construction complies with standards of the host nation. Under such an agreement, and whether or not international standards conform with standards of the host nation, the host nation must approve all plans. It may also be desirable to use equipment produced in the host nation.

1-8 **METRICATION OF DIMENSIONS.**

Generally, all dimensions are provided in English units with metric units following in parentheses. It is expected that designers who use these details will be using the English dimensions for stateside construction projects, and the metric dimensions for international projects. The alternate dimensions will be deleted from the graphic details for each project.

English and metric units for manufactured products are described to the precision of the manufacturer's published dimensions.

English conduit sizes are standard trade sizes listed in the National Electrical Code (NEC). Metric conduit sizes are the metric designation for the same conduits listed in the NEC. They are not the same as the metric sizes for conduits provided on the international market.

English wire sizes are standard trade sizes listed in the NEC. Metric wire sizes are metric wire sizes that are available on the international market.

English and metric units for field construction dimensions are nominal dimensions that allow for the normal variance in field construction. The round-off from English to metric units follows the convention used in ICAO standards, as follows: 1 inch = 25 mm, 12 inches = 300 mm, 5 feet = 1.5 meters, 10 feet = 3 meters, 100 feet = 30 meters, 1000 feet = 300 meters, etc.

Note that Executive Order 12770 requires use of metric units in procurement of supplies and services.

1-9 **PHOTOMETRIC REQUIREMENTS.**

Photometric requirements in this UFC are based on standards established by the ICAO and FAA. They have been modified as necessary to accommodate Air Force requirements.

1-10 STRUCTURAL DESIGN.

Details that indicate the construction of steel-reinforced concrete structures, pads and foundations must be designed by a licensed or registered structural engineer. Concrete used in underground structures, such as manholes, handholes and foundations must be designed with minimum 28-day structural strength of 4000 psi, except structures in areas where freeze AutoCAD files for the details in this UFC can be downloaded from the following site:

<http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-535-02>

and thaw conditions are common. They must be designed with concrete with minimum 28-day structural strength of 4500 psi. Concrete used for non-structural equipment pads, mowing buffers and similar items must be designed with minimum 28-day structural strength of 2000 psi.

1-11 SUPPLEMENTAL INFORMATION.

This volume supplements UFC 3-535-01, *Design Standards for Visual Air Navigation Facilities* (Army and Air Force only). Technical Manual NAVAIR 51-50AAA-2, *General Requirements for Shorebased Airfield Marking and Lighting* (Navy only), provides the guidance and detailed information on standard configurations and equipment, and is generally in compliance with the FAA criteria. Use these manuals when designing, planning, constructing, and installing new systems. AutoCAD files for the details in this UFC can be downloaded from the following site:

<http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-535-02>

CHAPTER 2 UNDERGROUND CABLE, CONDUIT AND DUCTS

2-1 DIRECT BURIED DUCT/CONDUIT DETAILS.

2-1.1 Figures 1A, 1B.

2-1.1.1 Notes to Designer.

1. Where duct / conduit is installed under pavement, specify the type of pavement to be installed on top of the trench. Where trench is cut through existing pavement, specify that the pavement on top of trench match existing material and strength.
2. Location of Counterpoise:
 - a. For Air Force / Army projects, the counterpoise is located half way between the full-strength runway or taxiway pavement and the row of edge light fixtures. The counterpoise is not connected to the light base cans for elevated light fixtures. The counterpoise is connected to the light base cans for in-pavement light fixtures.
 - b. For Navy projects, the counterpoise is located above the conduits between the light base cans. The counterpoise is connected to each light base can.
3. All counterpoise must be solid bare copper wire (conductor) #6 (16 square mm) minimum for Air Force/Army and stranded bare copper wire (conductor) #4 (25 square mm) minimum for Navy, and will be bonded to ground rods using exothermic welds.
4. All ground rods must be $\frac{3}{4}$ " (20mm) diameter minimum and 10' (3m) long.
5. Refer to UFC 3-535-01, Chapter 1 for more information. Refer to Figures 6A, 6B and 6C for more requirements.
6. Where soil is highly corrosive, refer to NFPA 780, Chapter 11 for more information.

2-1.1.2 Drawing Notes for Figure 1A (Air Force / Army).

1. Ducts under full strength pavement must be concrete encased with a minimum of 3" (75mm) concrete encasement on top, bottom, and sides. Ducts under turf or paved shoulders must be installed in a bed of sand backfill.

2. Locate counterpoise half way between full-strength runway or taxiway pavement and center line of light base cans. Install counterpoise 8" (200mm) minimum below finished grade.
3. Provide minimum conduit slope of 0.5 percent, where possible.
4. Where duct or conduit is below a paved shoulder, the patch material must match the existing pavement.

2-1.1.3 Drawing Notes for Figure 1B (Navy).

1. Ducts under full-strength pavement, turf or paved shoulders must be installed in a bed of sand backfill.
2. Locate counterpoise above the conduits between the light base cans. Install counterpoise 8" (200mm) to 12" (300mm) above top duct / conduit.
3. Provide minimum duct / conduit slope of 0.5 percent where possible.
4. Where duct or conduit is below a paved shoulder, the patch material must match the existing pavement.

2-1.2 Figures 2A, 2B.

2-1.2.1 Drawing Notes for Figure 2A (Air Force / Army).

1. Locate counterpoise half way between full strength runway or taxiway pavement and center line of light base cans. Install counterpoise 8" (200mm) minimum below finished grade.
2. See Figure 3A for grounding connection to external lug on light base can.
3. If light base cans are spaced more than 5' (1.5m), the cans are isolated and must each have a ground rod.
4. Install counterpoise ground rods every 2000' (600M) maximum on straight runs of ducts/conduits.

2-1.2.2 Drawing Notes for Figure 2B (Navy).

1. Locate counterpoise above the conduits between the center line of light base cans. Install counterpoise 8" (200mm) to 12" (300mm) above top duct / conduit.
2. See Figure 3B for connection to external lug on light base can.

3. Install ground rods every 2000' (600m) maximum on straight runs of ducts / conduits.

2-1.3 Figures 3A, 3B.

2-1.3.1 Notes to Designer.

1. These details show the grounding connections to light base cans.
2. Location of Counterpoise:
 - a. For Air Force / Army projects, the counterpoise is located half way between the full-strength runway or taxiway pavement and the row of edge light fixtures. The counterpoise is not connected to the light base cans.
 - b. For Navy projects, the counterpoise is located above the conduits between the light base cans. The counterpoise is connected to each light base can.
3. Install the ground rod on the side of the trench that is closest to the pavement.
4. All counterpoise and grounding conductors must be #6 (16 square mm) solid bare copper minimum bonded to ground rods using exothermic welds for Air Force/Army projects. Use #4 (25 square mm) for Navy projects.
5. All ground rods must be 3/4" x 10' (20mm x 3m).
6. Where soil is highly corrosive, refer to NFPA 780, Chapter 11, for additional information.

2-1.3.2 Drawing Notes for Figure 3A (Air Force / Army).

1. Each light base can must have an external one-hole ground lug. Connect an exothermic one-hole lug to grounding cable. Connect cable lug to base can lug with bronze or stainless steel bolted hardware.
2. Connect grounding cable to reinforcement cage, if one is provided. Use exothermic weld.
3. Connect ground rods to counterpoise at 2000' (600m) maximum spacing for straight runs, using exothermic welds. Do not break counterpoise.
4. Locate counterpoise half way between full-strength runway or taxiway pavement and center line of light base cans.

5. Install the ground rod on the side of the trench that is closest to the runway or taxiway pavement. Ground rod must be separated from counterpoise by minimum 12" (300mm).

2-1.3.3 Drawing Notes for Figure 3B (Navy).

1. Each light base can must have an external one-hole ground lug. Connect an exothermic one-hole lug to grounding cable connected to counterpoise. Connect cable lug to base can lug with bronze or stainless steel bolted hardware.
2. Connect ground rods to counterpoise at 2000' (600m) maximum spacing for straight runs, using exothermic welds. Do not break counterpoise.
3. Locate counterpoise above the conduits between the light base cans.
4. Install the ground rod on the side of the trench that is closest to the runway or taxiway pavement.

Figure 1A. Edge Lighting Direct Buried Duct / Conduit Detail (Air Force/Army)

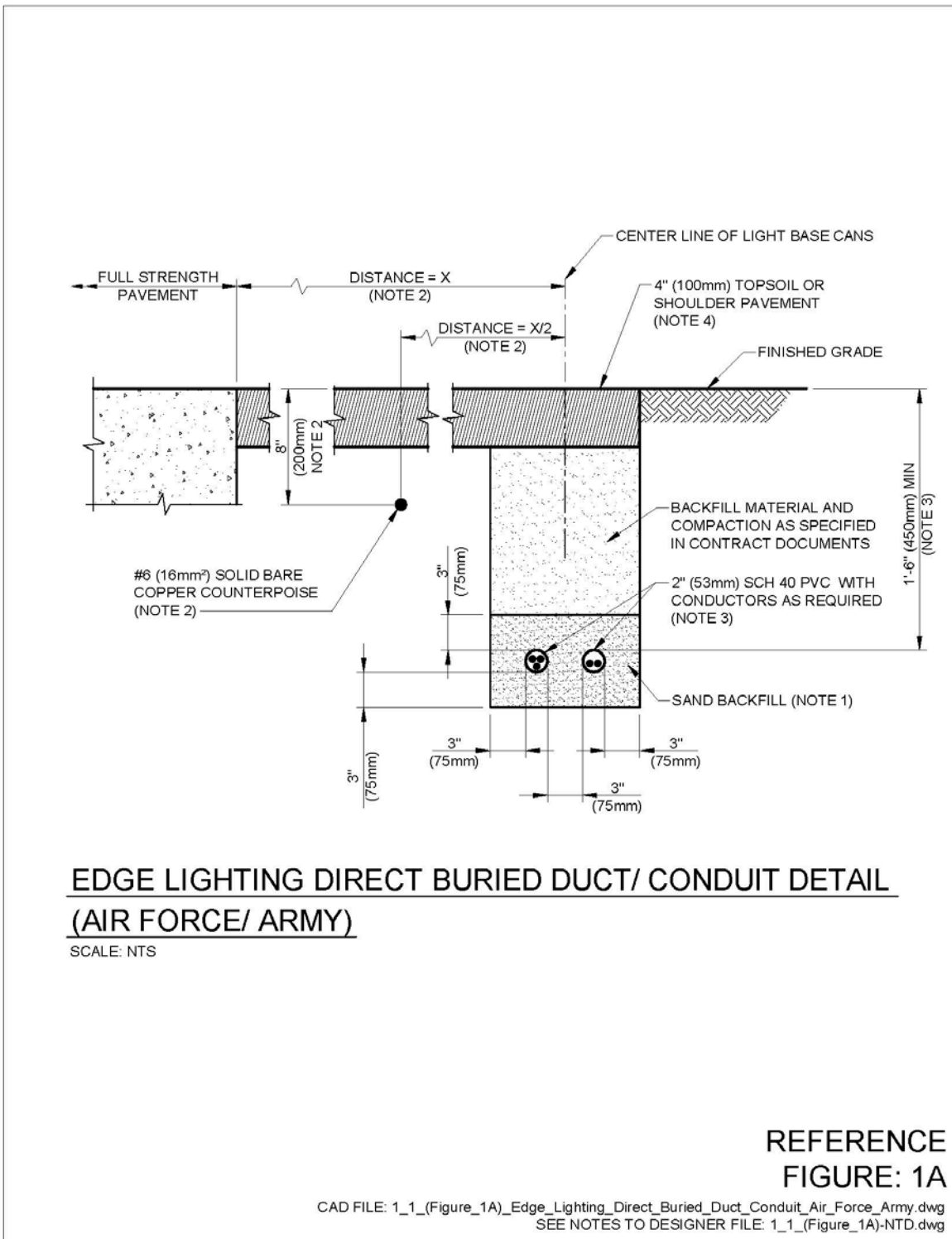


Figure 1B. Edge Lighting Direct Buried Duct / Conduit Detail (Navy)

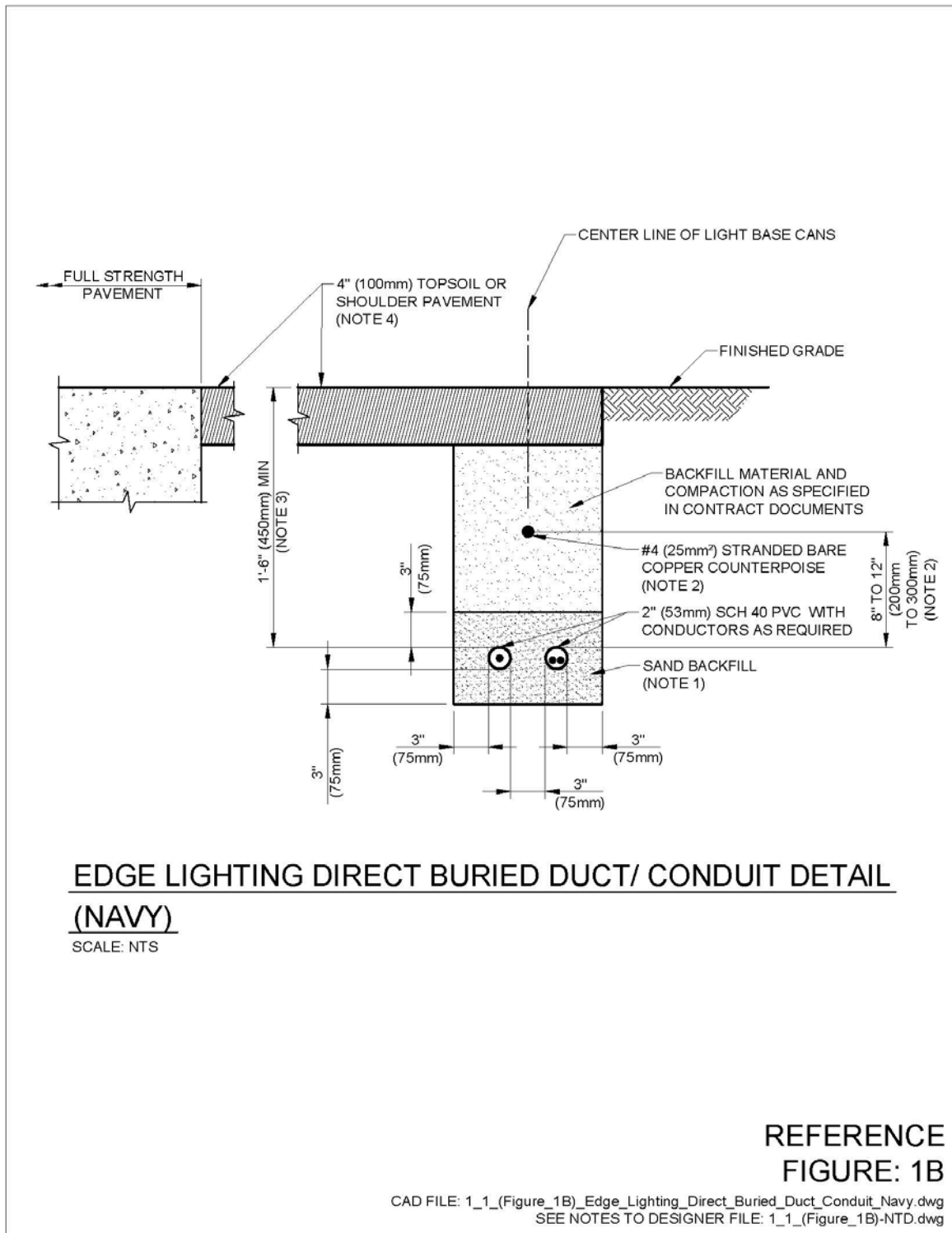


Figure 2A. Grounding for Light Base Cans (Air Force / Army)

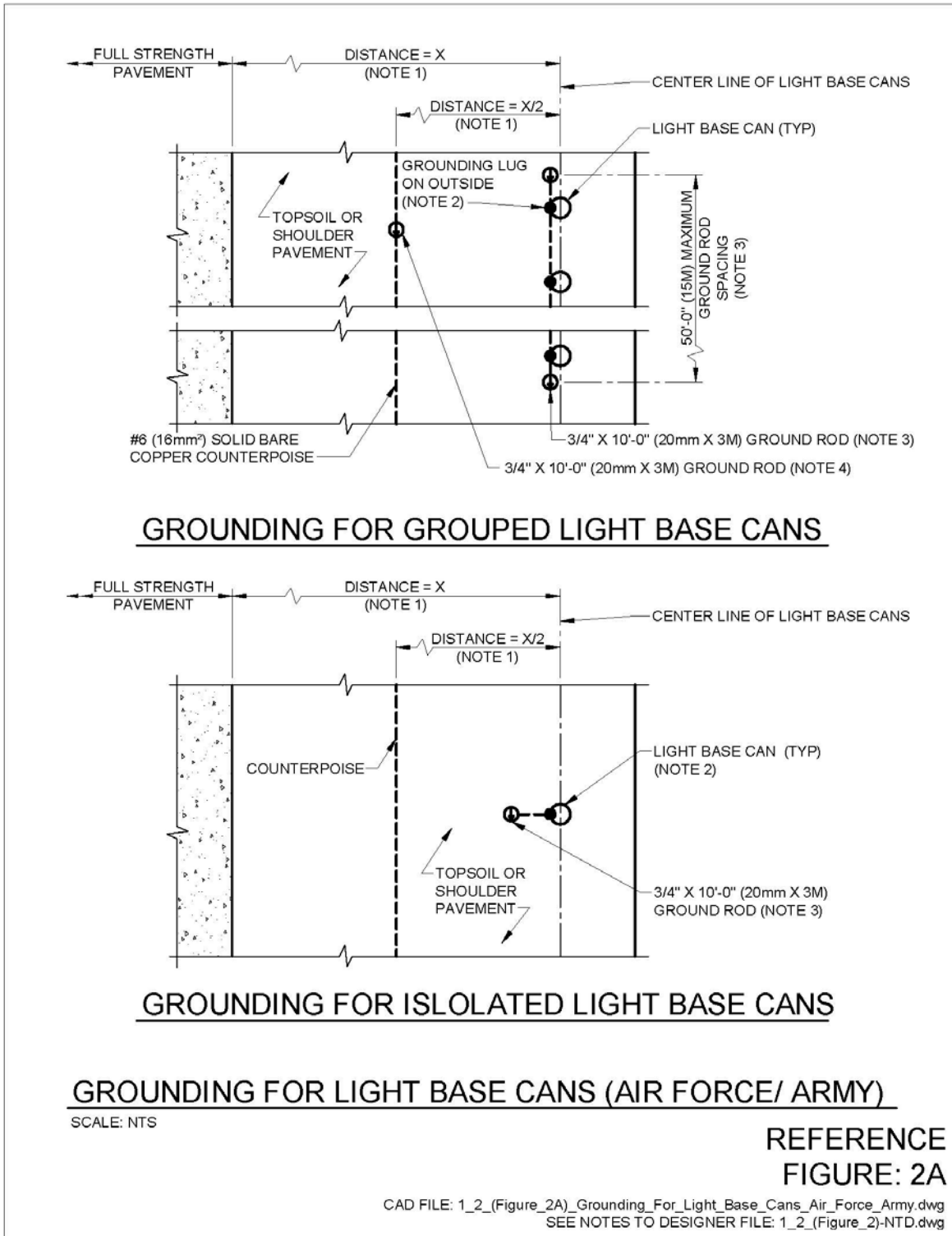


Figure 2B. Grounding for Light Base Cans (Navy)

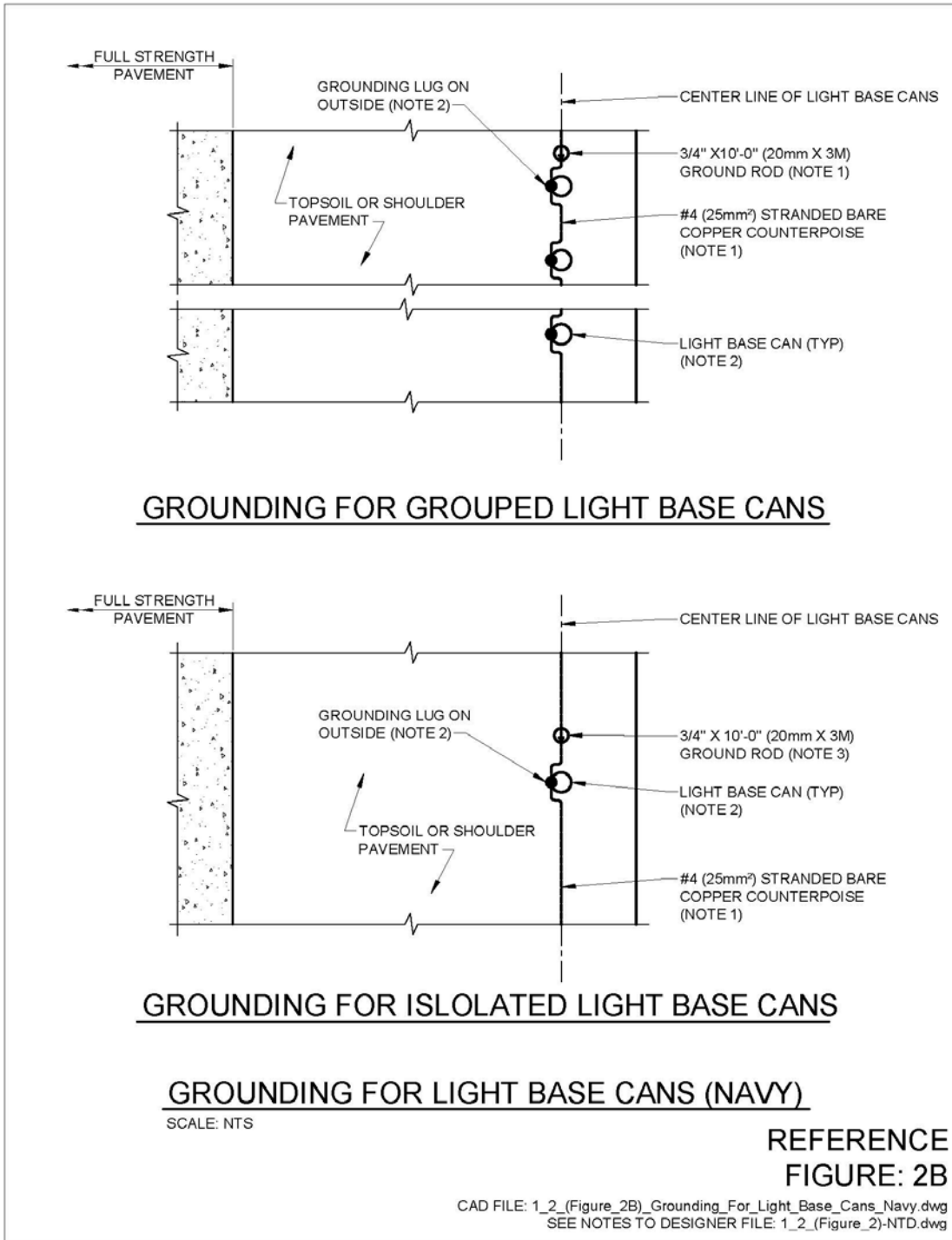
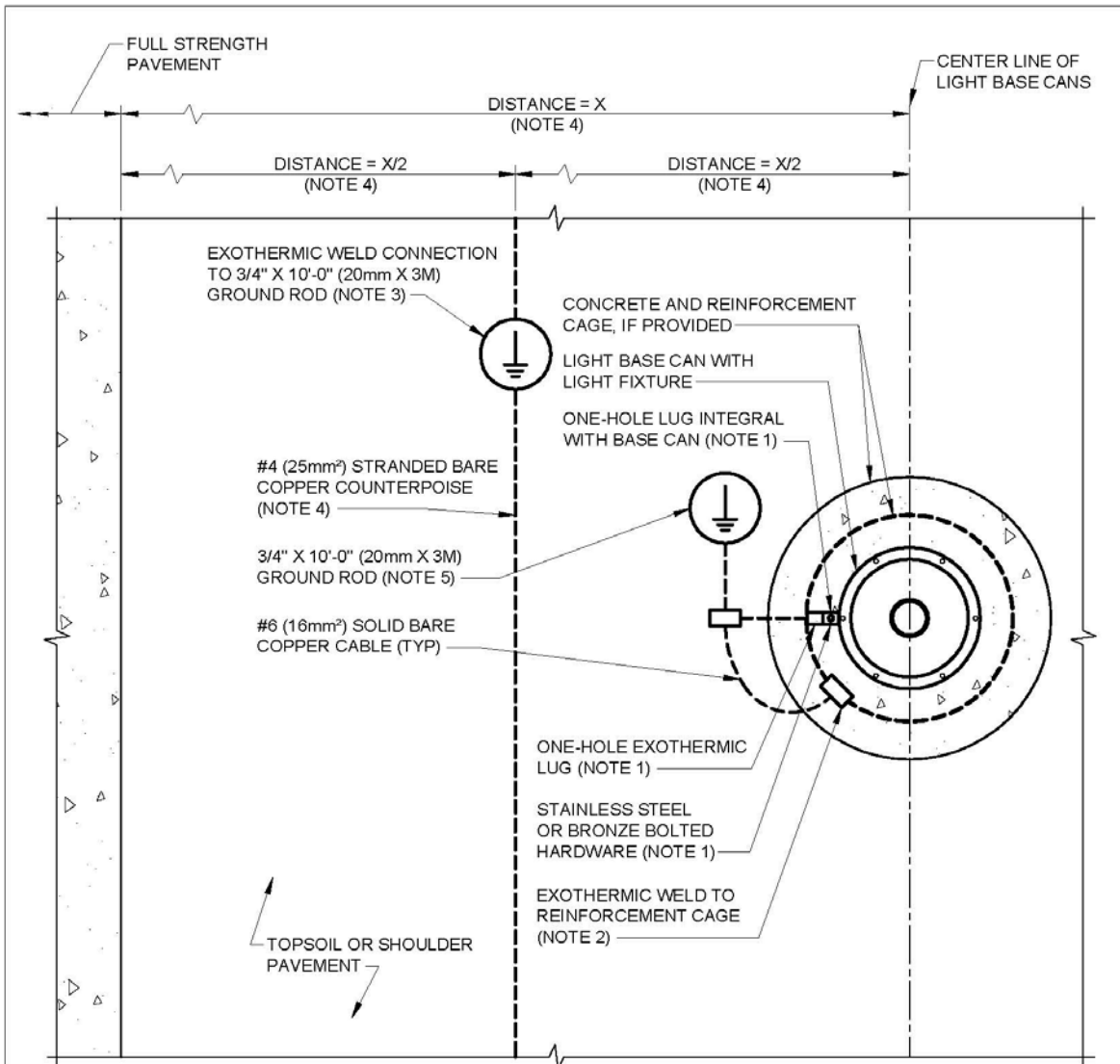


Figure 3A. Grounding Connections to Light Base Can (Air Force / Army)



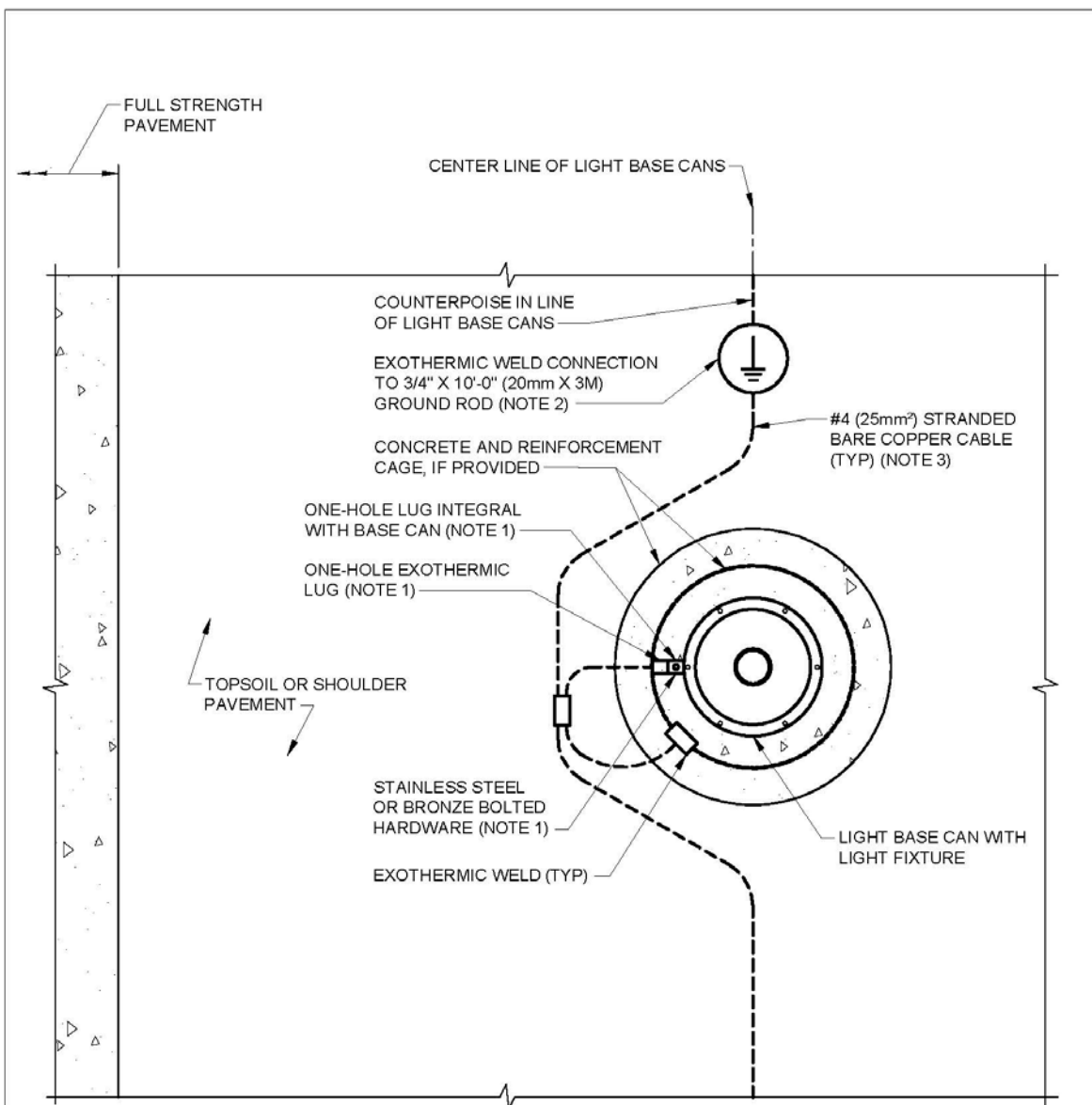
GROUNDING CONNECTIONS TO LIGHT BASE CAN
(AIR FORCE/ ARMY)

SCALE: NTS

REFERENCE
FIGURE: 3A

CAD FILE: 1_3_(Figure_3A)_Grounding_Connections_To_Light_Base_Can_Air_Force_Army.dwg
SEE NOTES TO DESIGNER FILE: 1_3_(Figure_3)-NTD.dwg

Figure 3B. Grounding Connections to Light Base Can (Navy)



GROUNDING CONNECTIONS TO LIGHT BASE CAN (NAVY)

SCALE: NTS

REFERENCE
FIGURE: 3B

CAD FILE: 1_3_(Figure_3B)_Grounding_Connections_To_Light_Base_Can_Navy.dwg
SEE NOTES TO DESIGNER FILE: 1_3_(Figure_3)-NTD.dwg

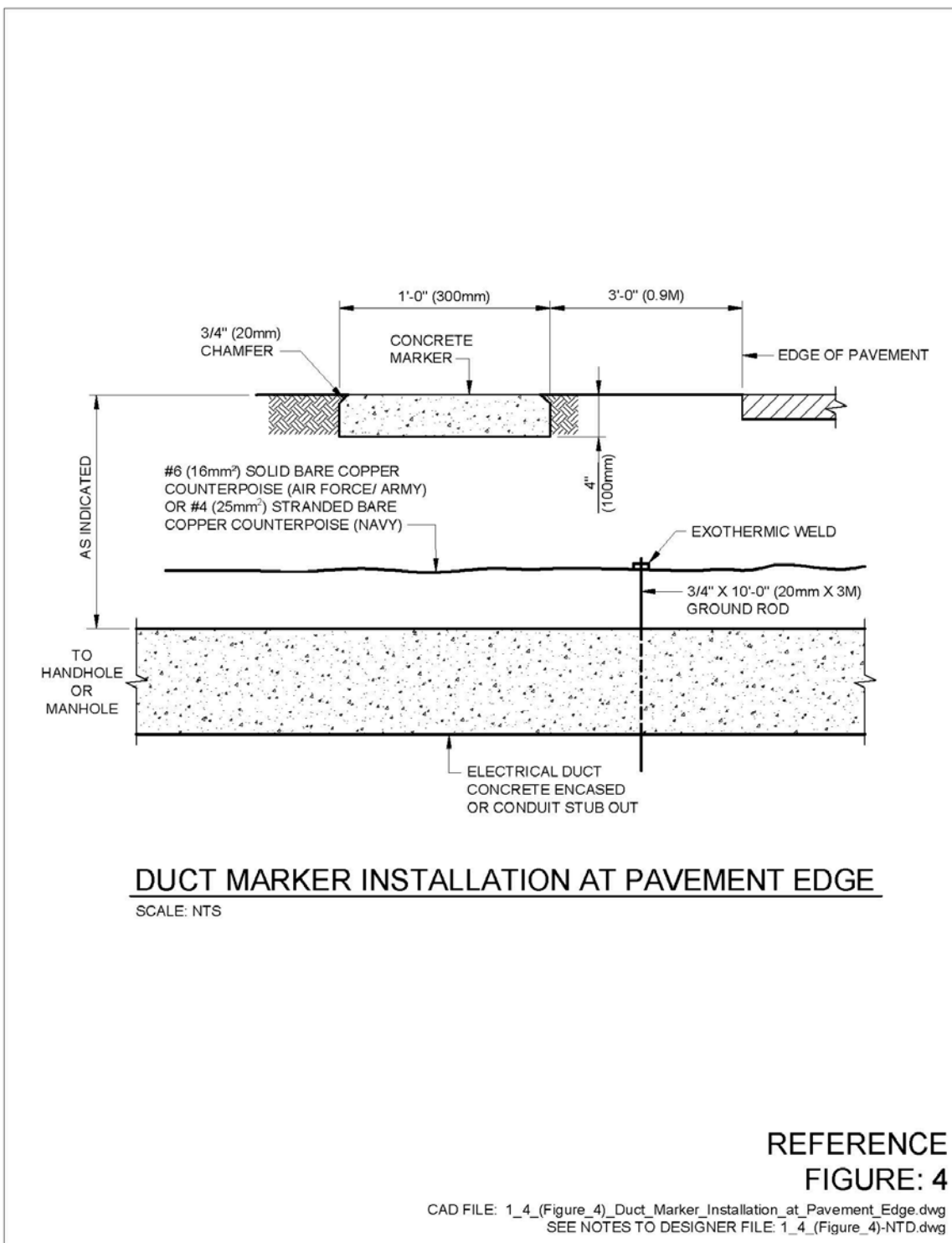
2-2 **Marker Installation at Pavement Edge.**

2-2.1 **Figure 4.**

2-2.1.1 **Notes to Designer.**

1. An option for installing the counterpoise would be to ground the counterpoise to a ground rod 3' (0.9m) before the runway or taxiway pavement and not install counterpoise over duct bank where duct run is beneath pavement.
2. The depth of the duct bank below pavement should be indicated in the duct bank details.
3. All counterpoise must be solid bare copper wire (conductor) #6 (16 square mm) minimum (Air Force/Army) and stranded bare copper wire (conductor) #4 (25 square mm) minimum (Navy), and must be bonded to ground rods using exothermic welds.

Figure 4. Duct Marker Installation at Pavement Edge



2-3 **Duct Markers.**

2-3.1 **Figure 5.**

2-3.1.1 **Notes to Designer.**

1. Duct markers are placed directly over the cable trench with the arrows indicating direction of duct run. Maximum spacing of markers should not exceed 200' (60m) and place the duct run changes direction. No markers are required where the duct runs in a straight line from light base to light base.
2. Duct markers are typically used at the edges of pavement to locate duct crossings beneath pavement. Where the entire lighting system is in ducts or conduit, locate the duct markers the same as cable markers.

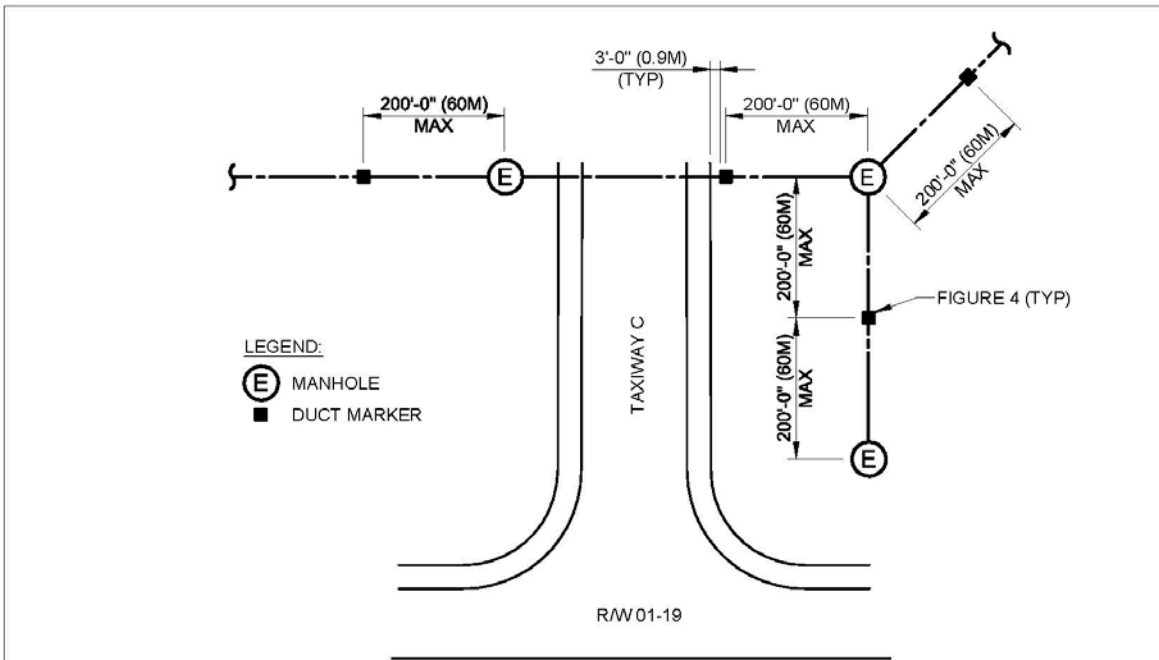
2-3.1.2 **Drawings Notes for Figure 5, Typical Duct Marker Layout.**

1. Install duct markers at each change of direction.
2. Install duct marker every 200' (60m) along straight runs with no access structure.
3. On straight runs less than 200' (60m) install duct marker at midpoint.
4. Install duct marker at ends of ducts that are not terminated at manholes.

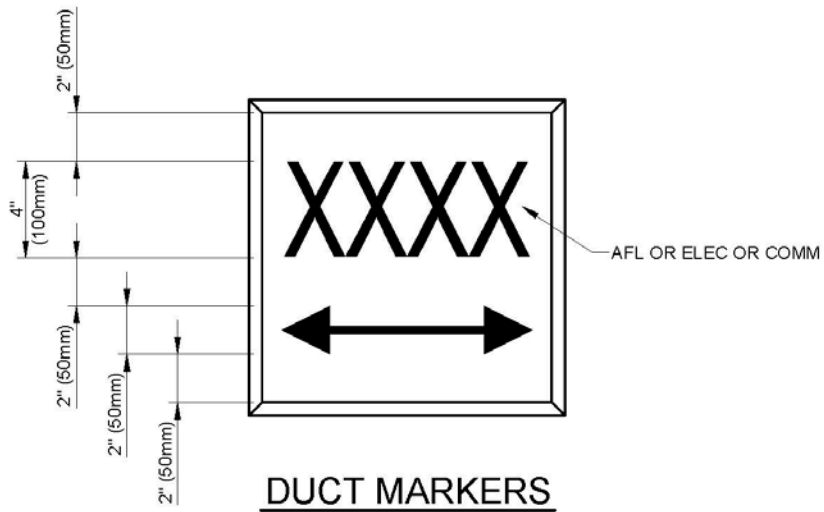
2-3.1.3 **Drawings Notes for Figure 5, Duct Markers.**

1. Hand lettering not allowed on markers. Lettering is to be boldly impressed. Line width must be 1/2" (13mm) minimum. Depth of impression must be 1/4" (6mm) minimum.
2. Arrow on marker to indicate direction of ducts (where applicable).
3. All markers are concrete with a minimum of 4" (100mm) in thickness.

Figure 5. Duct Markers



TYPICAL DUCT MARKER LAYOUT
SCALE: NTS



REFERENCE
FIGURE: 5

CAD FILE: 1_5_(Figure_5)_Typical_Duct_Marker_Layout.dwg
SEE NOTES TO DESIGNER FILE: 1_5_(Figure_5)-NTD.dwg

2-4 **Concrete Encased Duct Bank Details – Typical Arrangements.**

2-4.1 **Figures 6A, 6B, 6C.**

2-4.1.1 **Notes to Designer.**

1. Indicated to minimize weak points in the duct bank.
2. Several types of duct spacers will accomplish the required duct spacing. Some spacers allow for installation of several tiers on a single duct spacer thereby requiring less labor for installation.
3. It is recommended the minimum depth of the duct bank be at least 12" (300mm) below frost line.
4. If there are no communication ducts intended, they may be deleted from the details.
5. Ducts should terminate in handholes, junction plazas, or manholes wherever possible. The handholes or manholes should be located outside of the runway or taxiway safety areas, if feasible.
6. Slope duct lines (minimum 0.5% slope) where practical for drainage towards manholes/handholes, or duct ends. Where handholes or manholes do not exist at the ends of duct banks for drainage, consider the use of available natural features that are environmentally-approved or environmentally-friendly. Drainage should be designed to limit possible wildlife entrance.
7. Spacing of ducts indicated is minimum in power group for series circuits. Refer to Article 310 in the National Electrical Code, NFPA-70, when ducts are carrying parallel (constant voltage) AC circuits.
8. Number and size of ducts will vary depending on project. Adjust duct number, arrangement and layout accordingly.
9. Red concrete is recommended for Air Force and Army projects. Red concrete is not required for Navy projects.
10. Use UG plates for Navy projects.
11. All counterpoise will be solid bare copper wire (conductor) #6 (16 square mm) minimum (Air Force/Army) and stranded bare copper wire (conductor) #4 (25 square mm) minimum (Navy), and will be bonded to ground rods using exothermic welds.

12. See Paragraph 2.1, UFC 3-535-02, UFC 3-585-01 and NFPA 780, Chapter 11 for location of counterpoise(s) above duct banks.

2-4.1.2 Drawings Notes for Figures 6A and 6B, Duct Banks.

1. For size and number of conduits as well as duct bank formation, see plans.
2. Separate the communications conduit group from the power group on either left or right side as indicated on plans.
3. Concrete cover on top; bottom and sides must be 3" (75mm) minimum.
4. Duct banks may be bored under existing pavement. No open cutting of the pavement may occur without base approval. All installation techniques, methods, materials, etc., must be submitted to contracting officer for review prior to starting work. Refer to UFC 3-550-01, and NAVAIR 51-500 AAA-2 for guidance.
5. Conduit and duct bank runs must be straight ($\pm 4"$ (100mm) of centerline between manholes, handholes, and base cans) except where designated differently on design drawings.
6. Conduit temperature must be at burial temperature for 24 hours before covering or making manhole/handhole connections.

2-4.1.3 Drawings Notes for Hold Down Bar, Figure 6C.

1. The hold down bar is used to prevent duct flotation during the concrete pour.
2. Drive rebar into the ground at an angle of approximately 15 to 25 degrees off perpendicular. Drive rebar until hold down bar is slightly deformed. Use additional rebars according to number of ducts used.
3. Install retaining ring above hold down bar. Place rebar cover above retaining ring.
4. Place hold down bars up to 5' (1.5m) apart unless conduit is stacked more than one duct high. It may be necessary to place hold down bars closer together if it is not possible to get a good anchor in the ground with the rebar.
5. Contractor must watch concrete pour to ensure that concrete does not hit one end on the hold down bar and cause bar to rotate and release ducts.

Figure 6A. Concrete Encased Duct Bank Details – Typical Arrangements

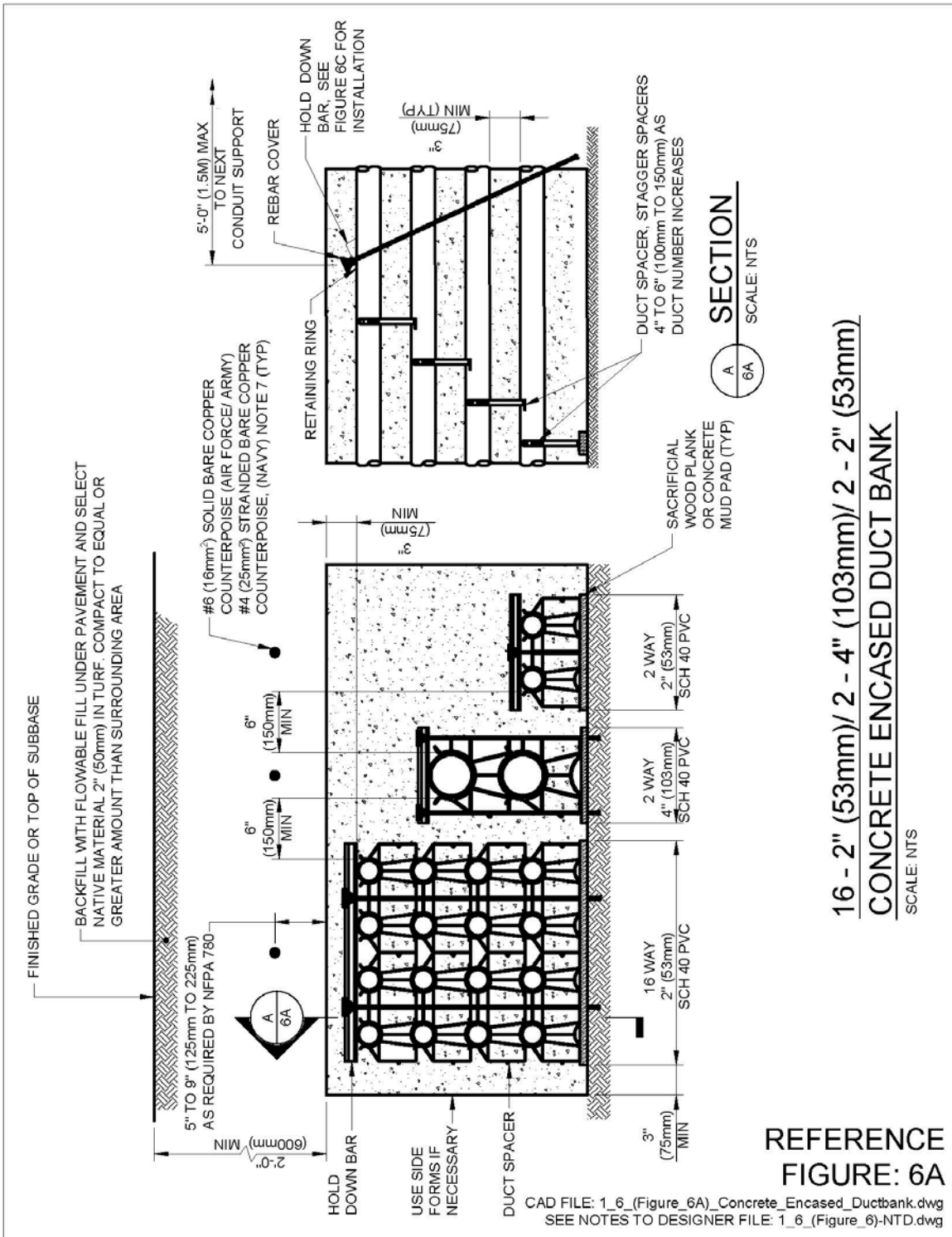


Figure 6B. Concrete Encased Duct Bank Details – Typical Arrangements
(continued)

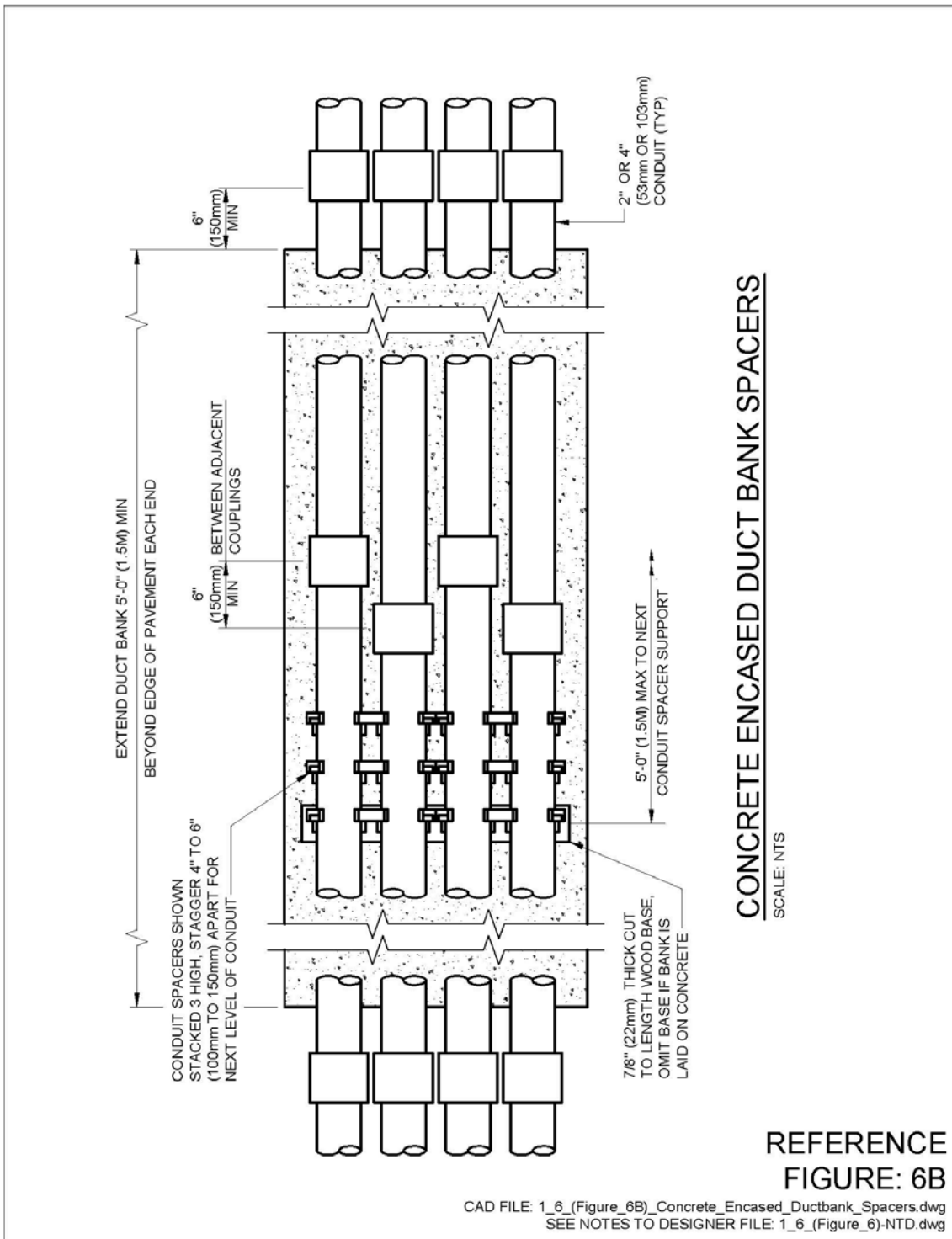
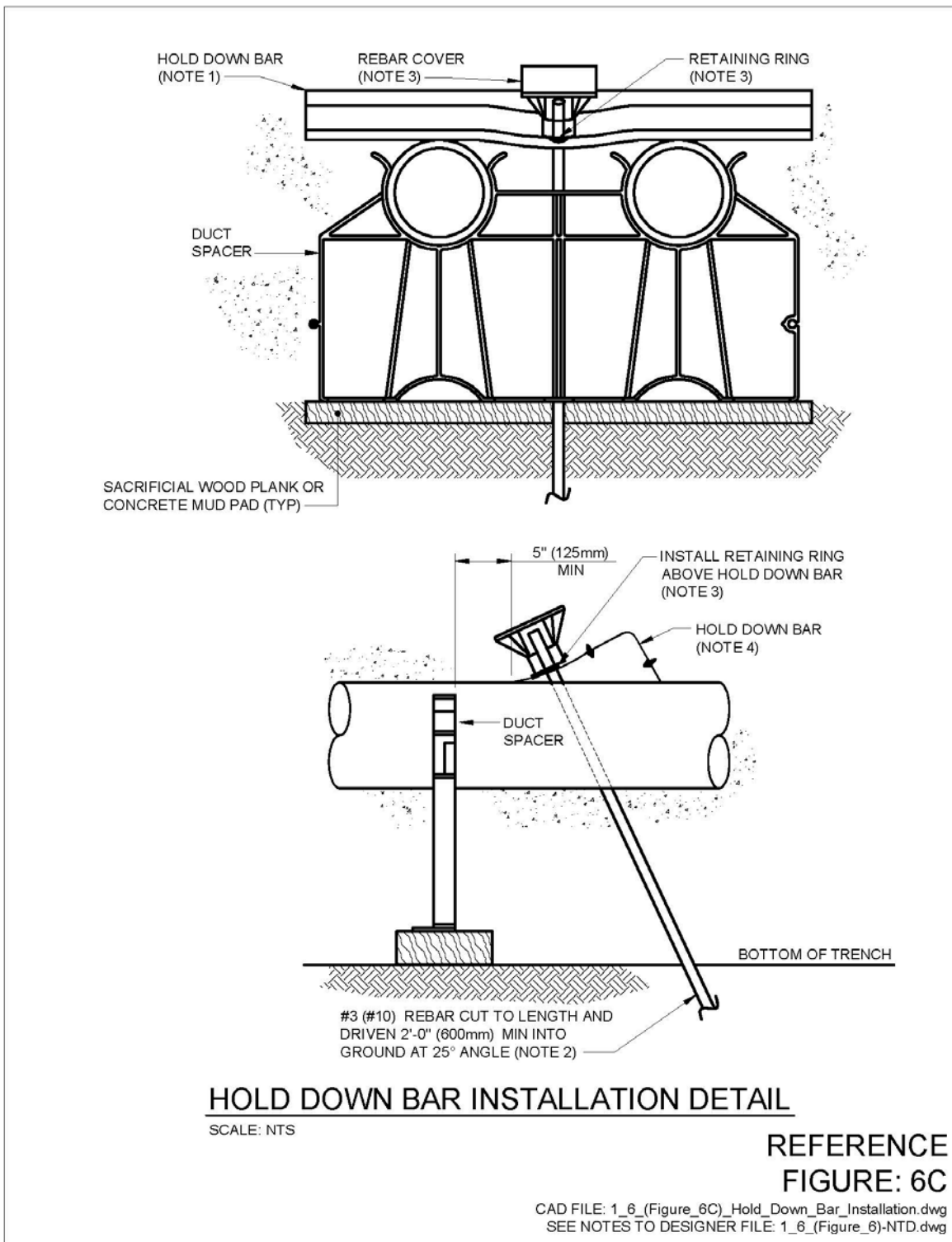


Figure 6C. Hold Down Bar Installation Detail



2-5 **Field Attached Plug-in Splice FAA Type L-823.**

2-5.1 **Figures 7A, 7B.**

2-5.1.1 **Notes to Designer.**

1. If heat-shrink tubing is used, it is recommended that single piece heat-shrink tubing and sealant be applied only at each end of the splice. Tubing with sealant coated on the entire interior will actually adhere to the L-823 connector thereby requiring a new connector be installed every time the splice is entered.
2. The cable ties act as an indicator to maintenance personnel for the location of the mating faces on the connector. When maintenance personnel need to enter the splice, the tubing is cut between the two ridges formed by the cable ties. Each piece of the tubing may now be rolled back to expose the connector. To re-seal the splice, the old tubing is removed and a new piece of heat-shrink with sealant at ends is installed.
3. The designer should contact several manufacturers of L-823 splice connectors and become familiar with their recommended installation requirements. See Figure 7B.
4. Make cable conductor connections using a crimping tool designed to make a complete crimp before the tool can be removed.

2-5.1.2 **Drawings Notes for Figure 7A.**

1. Interior pin and sockets are not indicated for clarity.
2. Attach each cable tie 1/8" (3mm) from the mating face of the connector housing. Tighten cable tie enough to hold in place without compressing housing. Trim off excess cable tie.
3. Installation of L-823 and heat shrink tubing must be in strict conformance with manufacturer's requirements.

2-5.1.3 **Drawings Notes for Figure 7B.**

1. Contractor must provide cable circuit identification markers attached to both sides of each cable connection.
2. Attach cable identification markers with corrosion resistant material.
3. Thoroughly clean the cable prior to the installation of the L-823 connector kit.

4. Complete installation of the pin/receptacle with “crimping” tool supplied or recommended by the manufacturer and designed for this specific purpose. Two crimping tools must be turned over to the government upon completion of the project.
5. Attach each cable tie enough to hold in place without compressing housing. Trim off excess cable tie.
6. Installation of complete kit connector must be in strict conformance with manufacturer’s requirements.

Figure 7A. Field Attached Plug-in Splice FAA Type L-823

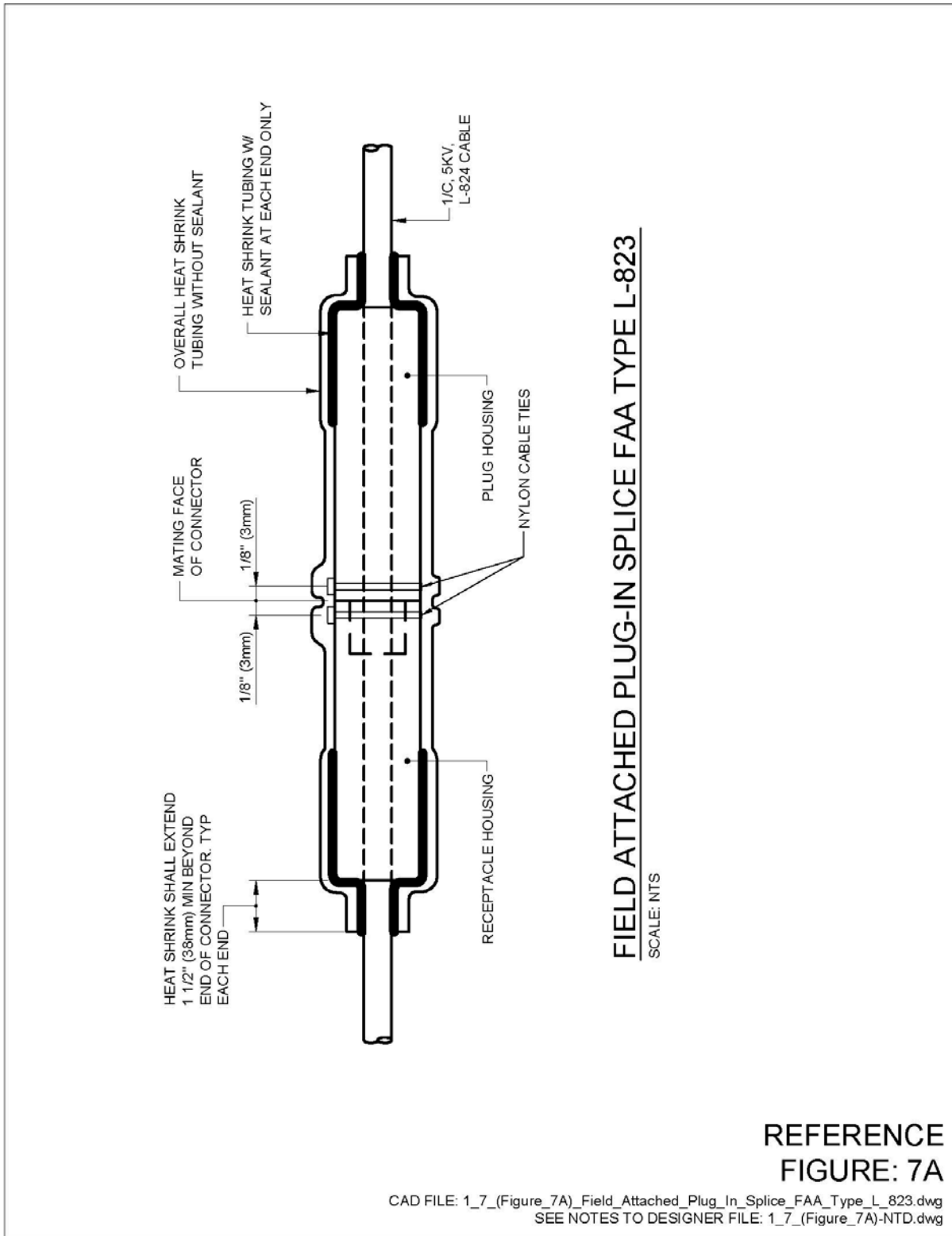
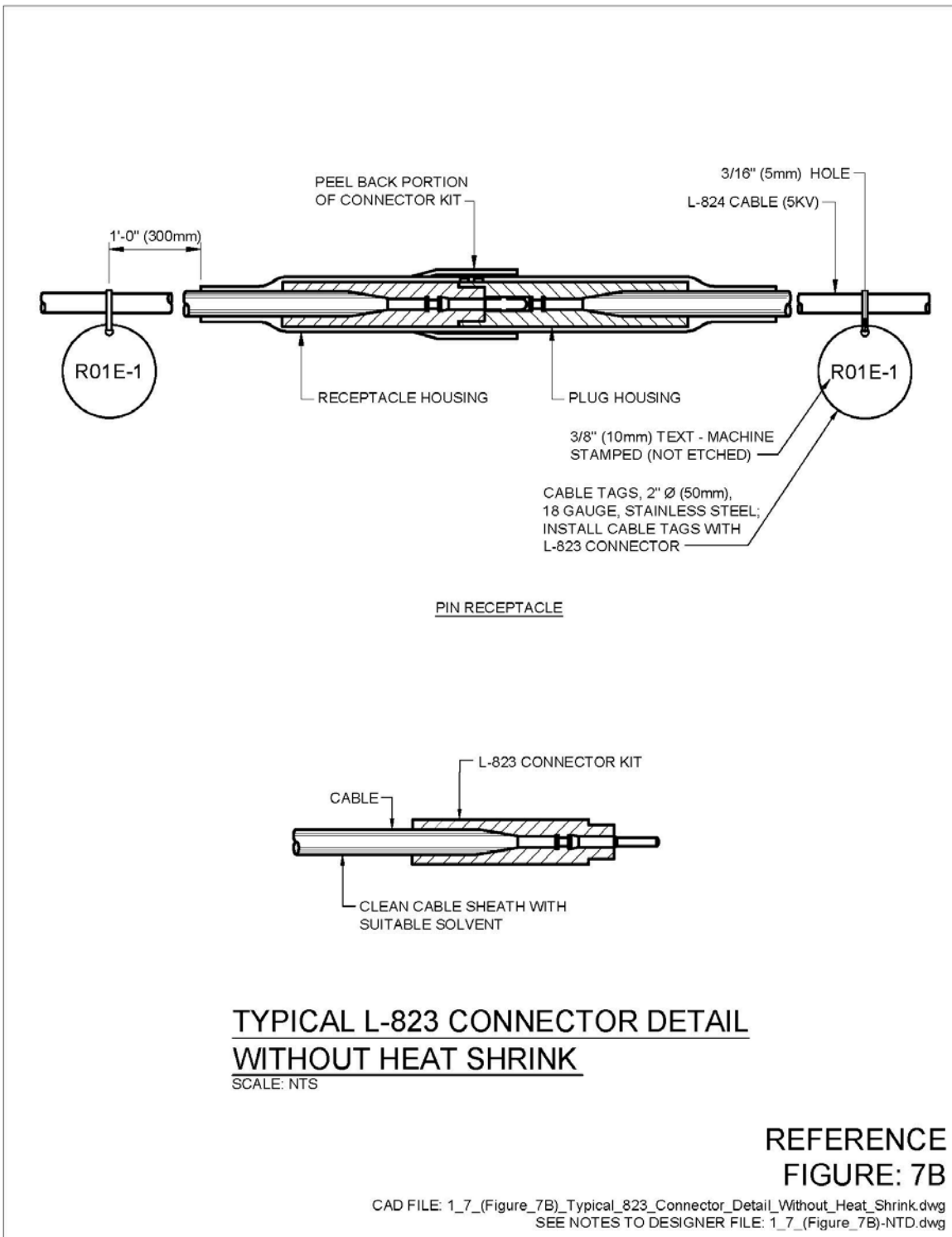


Figure 7B. Typical L-823 Connector Detail Without Heat Shrink



CHAPTER 3 Runway and Taxiway Lighting

3-1 Fixture Installation Tolerances.

Figure 8. Reserved.

3-1.1 Notes to Designer.

Tolerances below must be indicated in the airfield lighting system specifications.

Light Fixture Installation Tolerances

	IN-PAVEMENT	ELEVATED
ELEVATION (relative to finished pavement surface for in-pavement; relative to finished grade at fixture for elevated)	+0", -1/16" (1.6mm) (fixture edge on low side in snow areas or on high side in non-snow areas) +1/4" (6mm), -0"	
AZIMUTH (*) (w/respect to line parallel to RW/TW centerline)	±1/2 degree	±1/2 degree
LEVEL	±1/2 degree	±1/2 degree
STATIONING (in line parallel to RW/TW centerline)	±2" (50mm)	±2" (50mm)
OFFSET (perpendicular to RW/TW centerline)	±1/4" (6mm)	±1/4" (6mm)

3-2 **Base Mounted Elevated Fixture Installation.**

3-2.1 **Figure 9.**

3-2.1.1 **Notes to Designer.**

1. Flexible conduit, if required, allows for minor adjustments in alignment during installation and also allows flexibility of the conduit runs during freeze/thaw cycles in cold climates. Conduit must meet the requirements of NEMA TC12 and should be at least 12" (300mm) long.
2. Many contractors will purchase L-867 bases and send them to pre-cast shops for the concrete encasement. Conduit stubs are slid through the grommets prior to casting. A minimum of 6" (150mm) should be protruding from the encasement to allow installation of the conduit couplings.
3. Some installations have underdrains around the runway or taxiway. The designer should review the profile of the lighting system together with the profile of the pavement. For Air Force and Army airfields, bases at the low point should be ordered with an additional hub and a 2" (53mm) conduit should be connected between the underdrain and the light base. Where there is no underdrain exists, the conduit may run to the closest storm water catch basin. For Navy airfields, the bottom drain is not used. Maintain slope so that water drains out of light base toward underdrain or catch basin.
4. All counterpoise will be solid bare copper wire (conductor) #6 (16 square mm) minimum (Air Force/Army) and stranded bare copper wire (conductor) #4 (25 square mm) minimum (Navy), and will be bonded to ground rods using exothermic welds.
5. For installations in existing pavement that do not require new conduit, and where no counterpoise is available, add an external ground rod outside of light base, and connect it to the base can with #6 (16 square mm) solid bare copper wire (Air Force/Army) or #4 (25 square mm) stranded bare copper wire (Navy). Use exothermic welds to connect the ground wire to the ground rod. Exothermically weld a one-hole ground lug to the wire, and bolt the lugs together.

3-2.1.2 **Drawings Notes for Figure 9.**

1. Standard height is 14" (350mm). Height may be adjusted in areas subject to snow conditions.

2. Air Force / Army Airfields: Ground rod location is outside the base can on the side adjacent to the counterpoise and connected to the external ground lug and reinforcement cage. Provide 12" (300mm) separation from counterpoise. Navy Airfields: Connect the counterpoise to the external ground lug and reinforcement cage.
3. Air Force / Army Airfields: Bottom drain is optional. Navy Airfields: Bottom drain not required.
4. Provide 48" (1200mm) braided copper grounding strap equivalent to #6 (16 square mm) wire.

Figure 9. Base Mounted Elevated Fixture Installation

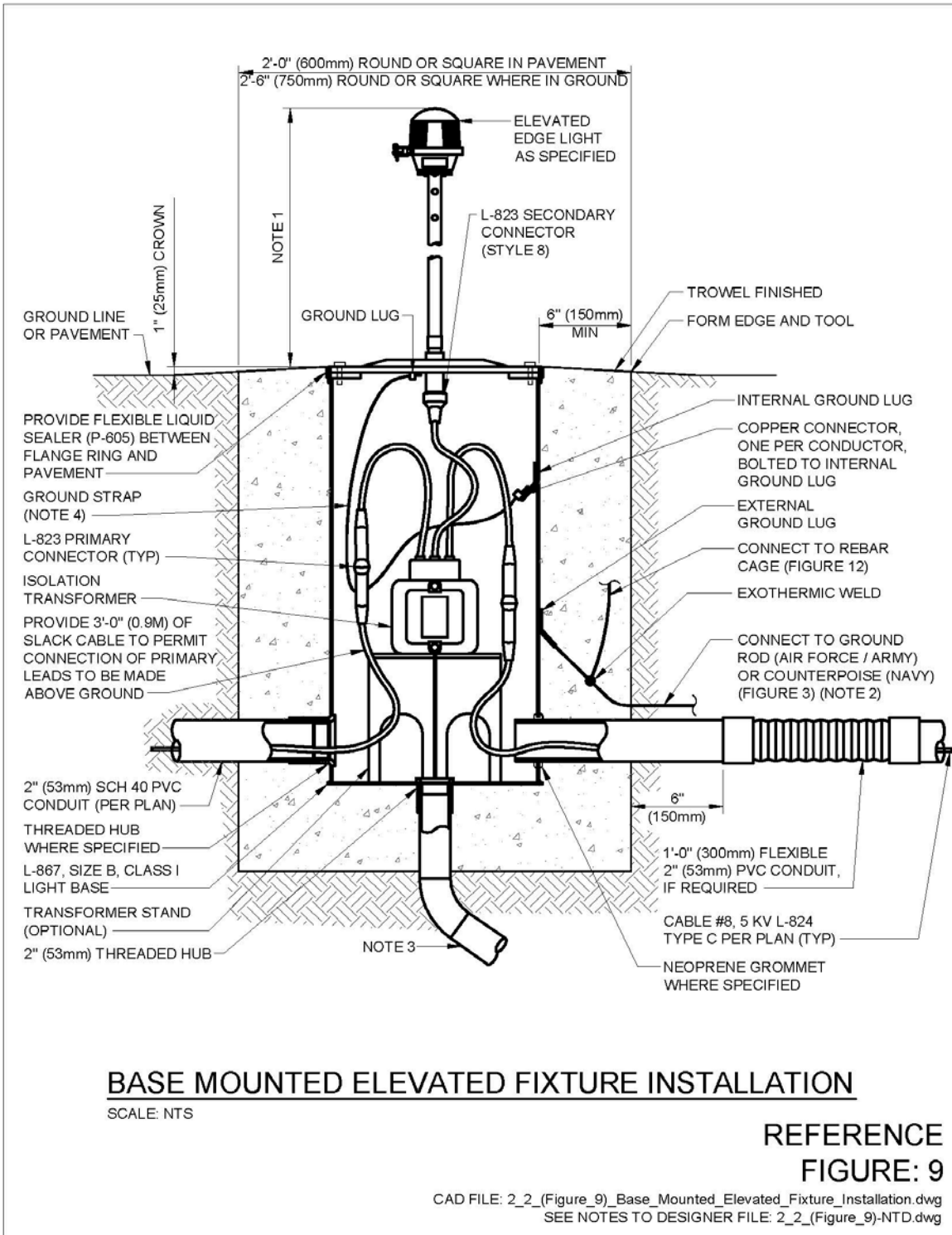


Figure 10. Reserved.

3-3 **In-Pavement Runway Light (Deep Base).**

3-3.1 **Figures 11A, 11B.**

3-3.1.1 **Notes to Designer.**

1. All in-pavement lights should be installed on a load-bearing base FAA type L-868. The diameter of the base will depend on the fixture manufacturer and type of fixture being installed.
2. It is recommended that the fixture be set inside a flange ring that has an integral pavement ring. Spacer rings (or shims) should be set on top of the base and the flange ring will mount on top of the spacer rings. This allows lowering of the fixture in flexible pavements if the pavement is slumping. No more than 2 spacer rings should be used.
3. The sealing compound must be compatible with the adjacent pavement material and the contractor must follow the manufacturer's preparation instructions.
4. It is recommended that the designer should review the profile of the in-pavement lighting system and provide drainage at the low points.
5. Installation methods for in-pavement fixtures are also contained in advisory circular (AC) 150/5340-30, Design and Installation Details for Airport Visual Aids.
6. For installations in existing pavement that do not require new conduit, no counterpoise is required.
7. This detail covers runway and taxiway airfield lighting fixtures installed in a deep base.

3-3.1.2 **Drawings Notes for Figure 11A.**

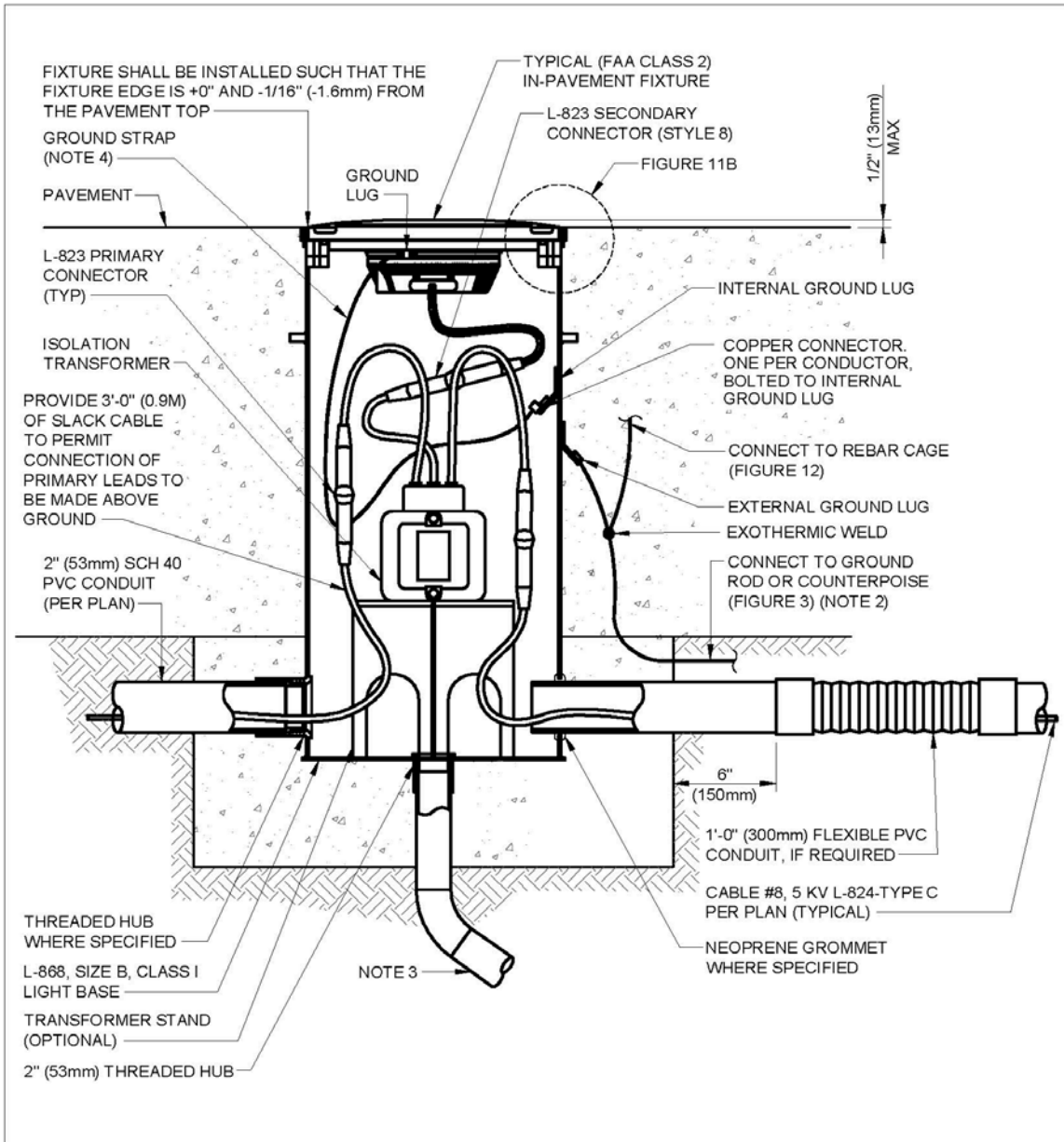
1. Refer to Figure 12 for base installation details.
2. Air Force / Army Airfields: Ground rod location is outside the base can on the side opposite the counterpoise and connected to the external ground lug. Navy Airfields: Connect counterpoise to external grounded lug and reinforcement cage.
3. Air Force / Army Airfields: Bottom drain is optional. Navy Airfields: Bottom drain not required.

4. Provide 48" (1200mm) braided copper ground strap between light base can and light fixture. Strap must be equivalent to No. 6 (16 square mm) cable.

3-3.1.3 Drawings Notes for Figure 11B.

1. Refer to Figure 12 for base installation details.
2. Two-piece stainless steel locking washer. Do not use split-ring type.
3. Spacer rings may be required for proper alignment of the light fixture.
4. Do not use anti-seize compound on ceramic-metallic fluoropolymer coated bolt.

Figure 11A. In-Pavement Fixture Installation (Deep Base)



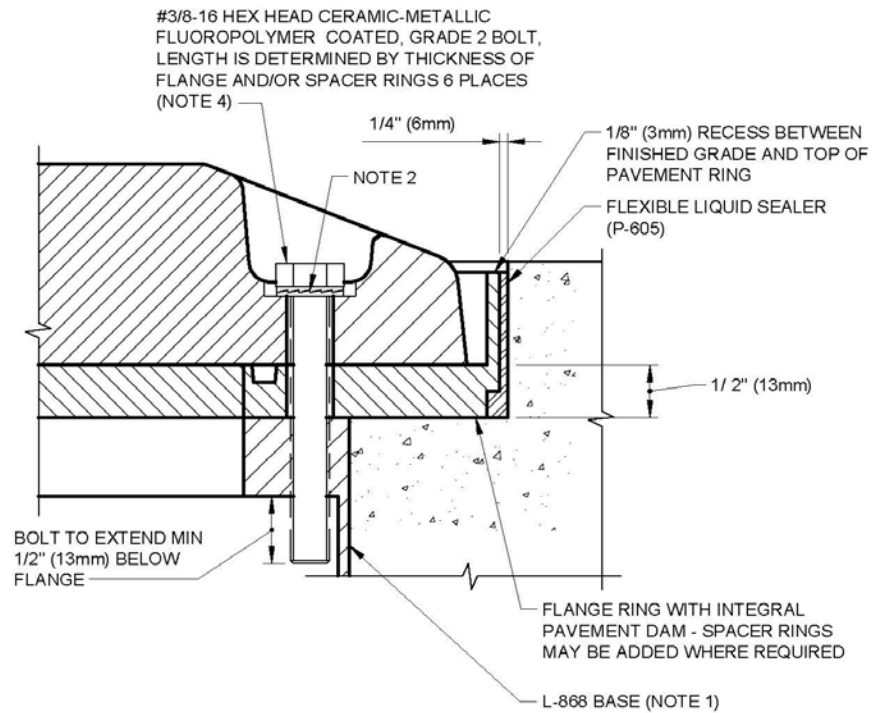
IN-PAVEMENT FIXTURE INSTALLATION (DEEP BASE)

SCALE: NTS

REFERENCE
FIGURE: 11A

CAD FILE: 2_4_(Figure_11A)_In_Pavement_Fixture_Installation_(Deep_Base).dwg
SEE NOTES TO DESIGNER FILE: 2_4_(Figure_11)-NTD.dwg

Figure 11B. In-Pavement Light Detail (Deep Base)



IN-PAVEMENT LIGHT DETAIL (DEEP BASE)

SCALE: NTS

REFERENCE
FIGURE: 11B

CAD FILE: 2_4_(Figure_11B)_In_Pavement_Light_Detail_(Deep_Base).dwg
SEE NOTES TO DESIGNER FILE: 2_4_(Figure_11)-NTD.dwg

3-4 **Base and Anchor Details (New Construction).**

3-4.1 **Figure 12.**

3-4.1.1 **Notes to Designer.**

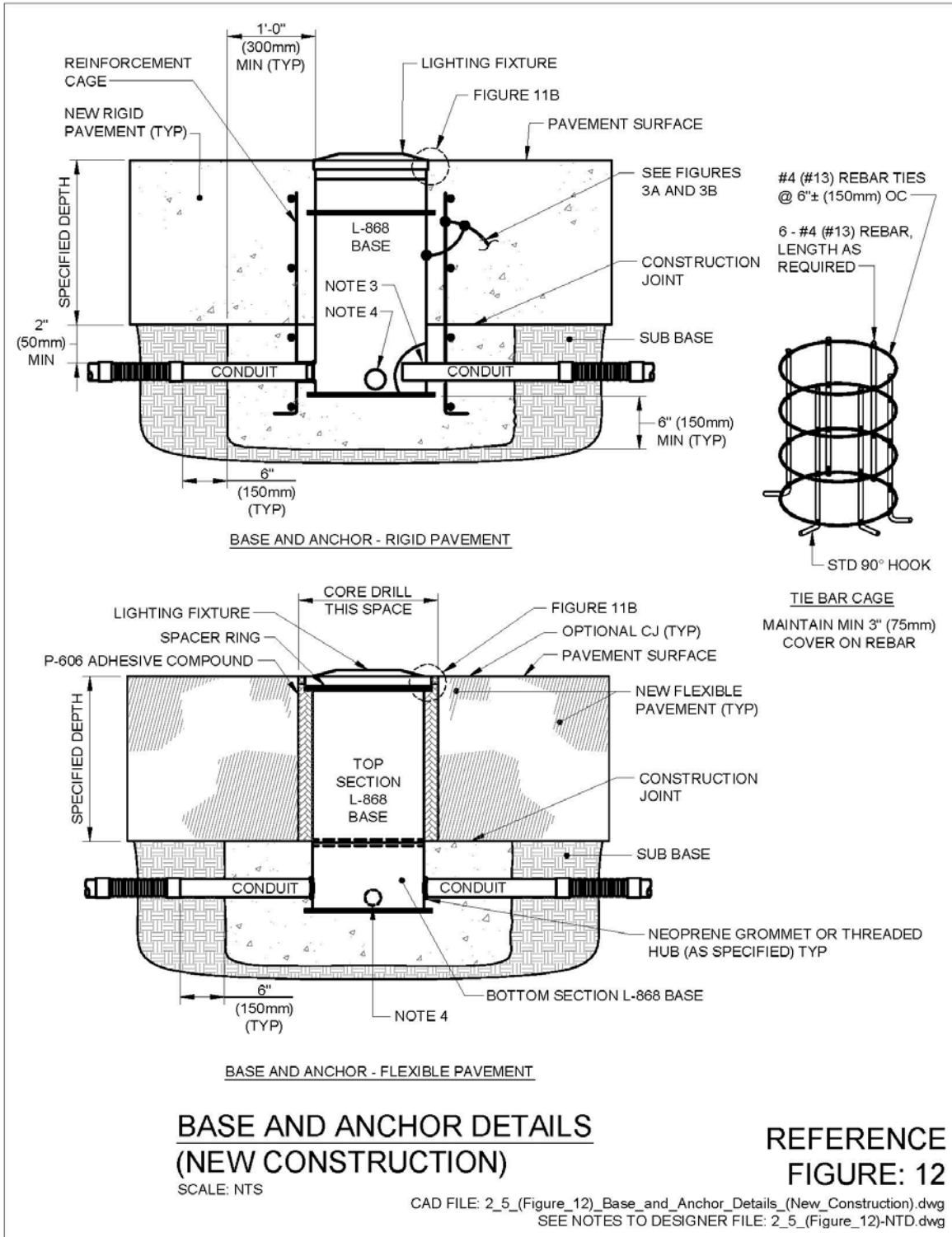
1. Construction methods will be specified in the project specifications for the type of pavement. Details should be indicated on the drawings in enough detail to complement the specifications.
2. Preparation for the base and anchor in either rigid or flexible pavement is the same. At each light location a hole is excavated in the sub base which will be minimum 12" (300mm) wider than the light base and 6" (150mm) below the bottom of the light base. A trench is excavated between the light base locations for the conduit. Depth of the trench must provide a minimum 2" (50mm) cover over and 3" (75mm) below the conduit and also allow the conduit to enter the base at the proper elevation.
3. A single section light base is used in rigid pavements and a two or three section light base (depending on pavement depth and lifts) must be used in flexible pavements.
4. The flexible conduit allows for minor base adjustments before the concrete anchor hardens.
5. A reinforcement cage is installed around the light base in rigid pavement.
6. For flexible pavement, a 2-piece light base may be used as an alternative to a 1-piece base.
7. See The Design, Installation, & Maintenance of In-Pavement Airport Lighting (Reference book by Arthur S. Schai). Available from FAA website:

http://www.faa.gov/airports/engineering/airport_lighting/media/schai_airport_lighting.pdf

3-4.1.2 **Drawings Notes for Figure 12.**

1. The use of mud plates, spacer rings, extensions, etc., is dependent on paving techniques.
2. Orientation tolerance for the base is $\pm 1/2$ degree from the centerline indicated on the plans.
3. Conduit entrance can be made with either a hub or grommet. If grommet is used, conduits must protrude into light base not more than 3/4" (19mm) for steel and 1" (25mm) to 1-1/2" (38mm) for PVC.
4. Air Force / Army Airfields: 2" (53mm) PVC conduit to nearest catch basin or French drain is optional, typically at each low point of lighting system. Navy Airfields: Side drain not required.

Figure 12. Base and Anchor Details (New Construction)



3-5 **Deep Base Installation in Rigid Pavement (New Construction).**

3-5.1 **Figure 13.**

3-5.1.1 **Notes to Designer.**

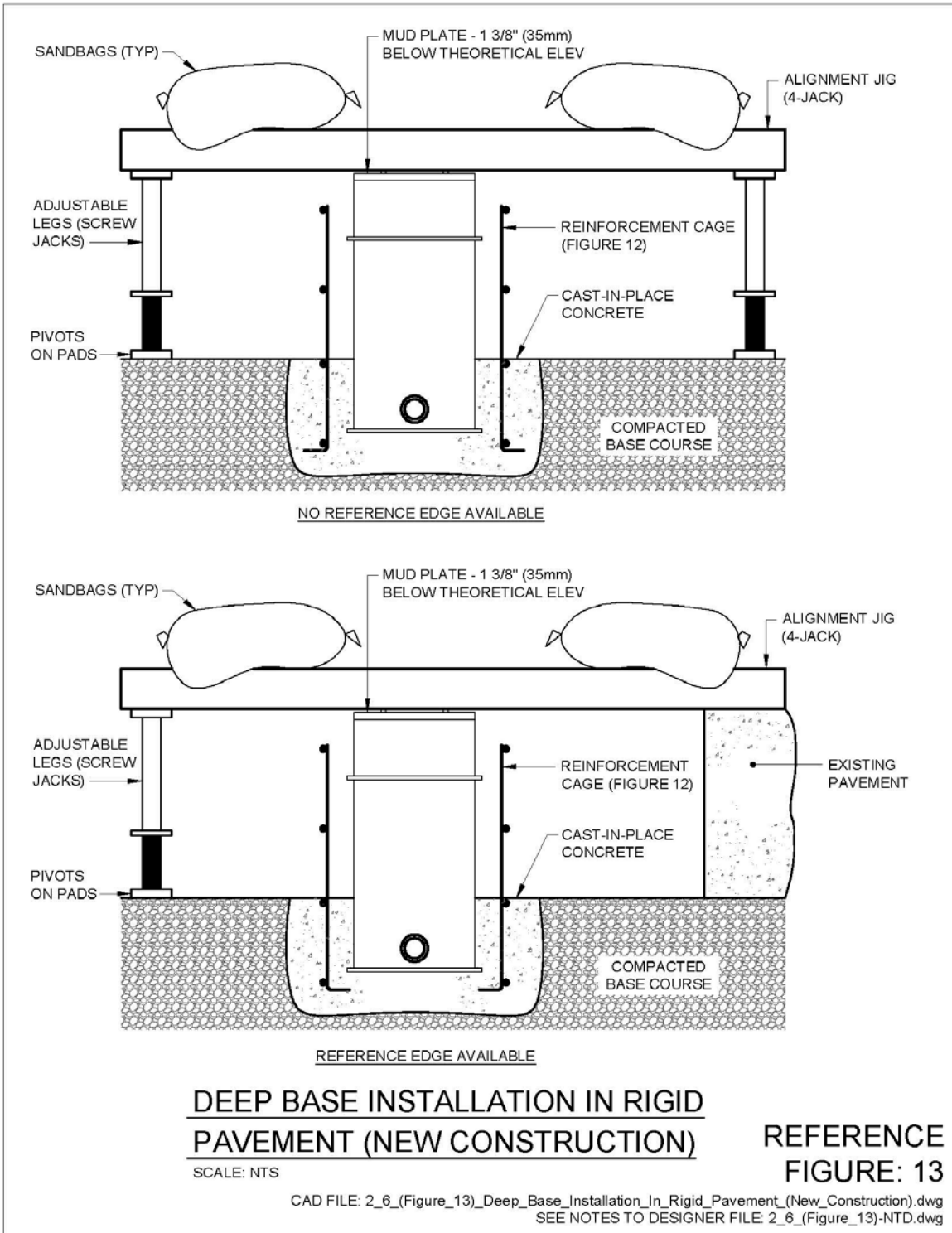
1. Light location, elevation, azimuth (direction of the light beam measured in a horizontal plane) is extremely critical. It is recommended that contract documents require all points for setting the lights be accomplished by survey and a mandatory construction meeting be included with representatives from the Architect-Engineer (A/E) team, contractor, government and field personnel. The purpose of this meeting will be to review the proposed construction techniques.
2. For flexible pavement, a two-piece light base may be used as an alternative to a one-piece light base.
3. See The Design, Installation, & Maintenance of In-Pavement Airport Lighting (Reference book by Arthur S. Schai). Available at the FAA website:

http://www.faa.gov/airports/engineering/airport_lighting/media/schai_airport_lighting.pdf

3-5.1.2 **Drawings Notes for Figure 13.**

1. Install the alignment jig per the base manufacturer's requirements. The jig should be provided with adjustable legs for setting elevation and alignment pins for setting azimuth.
2. Once light bases are set at correct elevation, conduit is installed between the bases and reinforcement cages are formed around the base. Sufficient weight, such as sand bags, should be placed on top of the jig to prevent the light base from floating during concrete installation. The concrete anchor is poured around the base and along the conduit trench. Instruct the contractor to ensure that all voids or loose material beneath the conduit have been eliminated prior to encasing in concrete. Concrete should be flush with sub base and not protrude above sub base.
3. Once the concrete has cured a minimum of 24 hours, the jig may be removed.
4. Paving cannot commence until light base concrete anchor has cured for 3 days or reached a strength of 3000 psi.

Figure 13. Deep Base Installation in Rigid Pavement (New Construction)



3-6 **Flexible Pavement or Overlay (Flexible, Rigid) Installation.**

3-6.1 **Figure 14.**

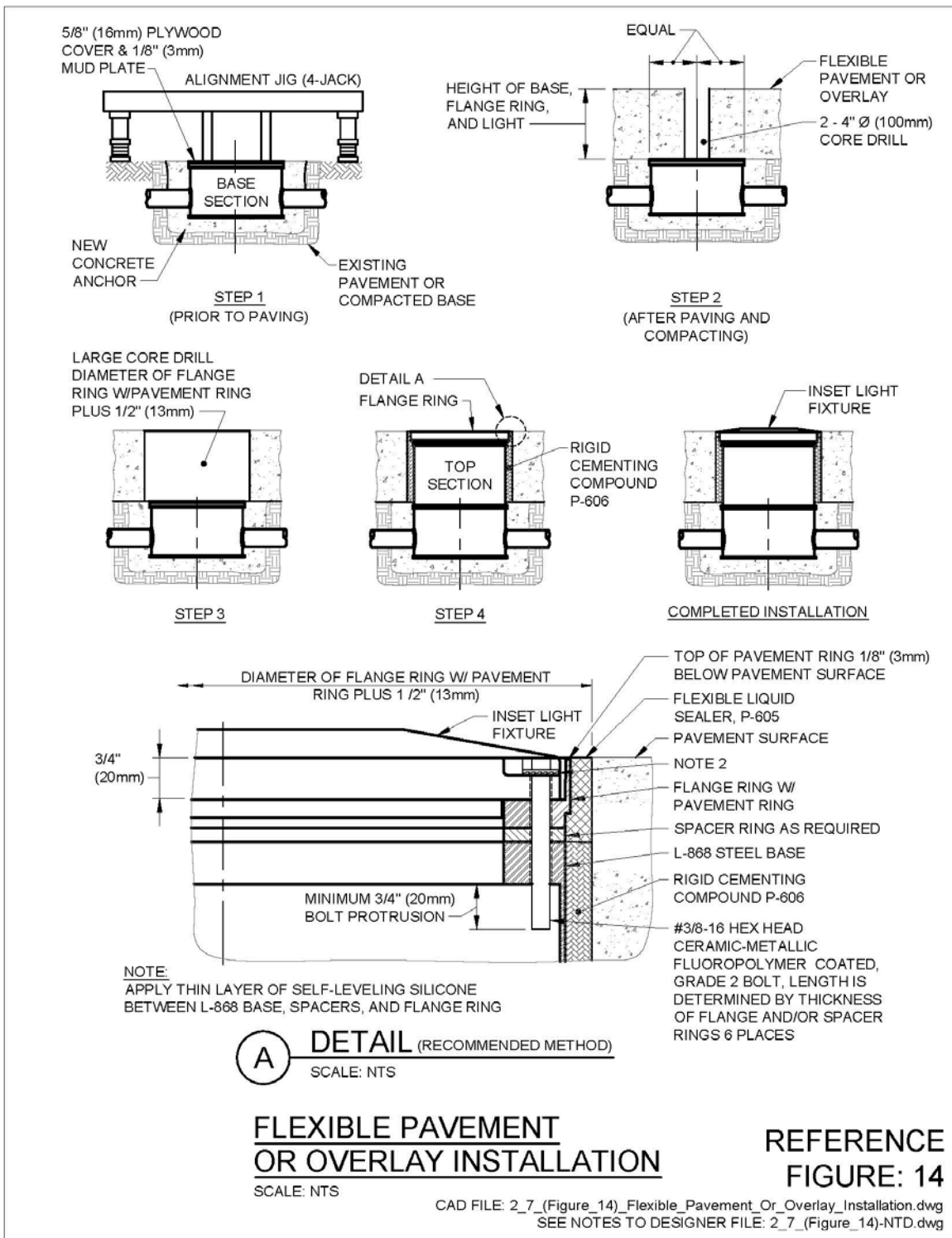
3-6.1.1 **Notes to Designer.**

1. Installation in flexible pavement is similar to rigid except a sectional base is used and there is no reinforcement cage.

3-6.1.2 **Drawings Notes for Figure 14.**

1. Typical installation in new flexible pavement or overlay of flexible or rigid (PCC) pavement.
2. Two-piece stainless steel locking washer. Do not use split-ring type.
3. The bottom section of the light base is set at an elevation such that the top of the plywood cover and mud plate is flush with the surrounding base course. The concrete anchor is poured and allowed to cure for 24 hours.
4. The jig may then be removed and paving operations may be accomplished.
5. Ensure core drilling for the light bases is accomplished after compaction has been completed and the pavement has been accepted by the government.
6. Rigid Cementing Compound P-606 is used to firmly set the top section or base extension in place and bond to pavement. The flexible P-605 is installed from the top of the top section or base extension to the top of the finished pavement surface. This allows future adjustment of the fixture by removing or adding spacer rings without disruption of the base. Both P-606 and P-605 must be specified as being compatible with type of pavement being installed.

Figure 14. Flexible Pavement or Overlay Installation



3-7 **In-Pavement Light Fixture on Full Base and Snow Plow Ring in Rigid (PCC) Pavement.**

Figure 15. Reserved.

Figure 16. Reserved.

3-7.1 **Figures 17A, 17B, 17C, 18A, 18B, 19A, 19B.**

3-7.1.1 **Notes to Designer.**

1. Figures 18A, 18B, 19A and 19B show the installation of an in-pavement light fixture in PCC pavement. The fixture is mounted in a snow plow ring in lieu of the standard flange ring with pavement dam. The purpose of the snow plow ring is to minimize the potential for damage to the fixture by snow plow blades (snow plow blades must be rubber or some other flexible material) during snow removal operations. Special attention should be paid to the thickness and diameter of the ring and the installation elevation.
2. Where the pavement may be higher at one side of the base than the other, the use of beveled spacer rings may be required. This allows an adjustment of the ring to compensate for the slope of pavement at the outside edge of the ring.

3-7.1.2 **Drawing Notes for In-Pavement Fixtures, Figures 18A and 18B.**

1. Install corner edge of snow plow ring flush with pavement surface with a tolerance of +0", -1/16" (1.6mm).
2. Submit all base can installation techniques, methods, materials, etc., to the government for review and approval prior to the start of work.
3. Before paving may proceed, the contractor must demonstrate to the government that the base cans are at the correct location, elevation, azimuth and rotation and that the proper clearance exists between the base can and the paver.
4. The spacer ring is designed as a nominal 3/4" (19mm) thickness. The spacer ring may be required to be thinner or thicker depending on base can installation and paving techniques / tolerances. This contractor must measure and determine the required thickness of each individual spacer ring required to put the airfield lighting fixture at the correct elevation, azimuth and rotation. The contractor may use multiple spacer rings of varying heights. No more than 3 spacer rings may be used on any one light installation. The maximum height displacement for one or more spacer rings will be 2" (50mm) or less.

5. The finished pavement surface must be protected from foreign substances which could cause staining, i.e. concrete, oil, etc. The contractor must immediately clean all spills and correct/clean any stained surfaces at the contractor's expense.
6. The base can cover mounting bolts must extend thru the base can mounting flange into the base can a minimum of ½" (13mm). The bolts must be threaded the full length of the bolt.
7. For blank base cans, delete light fixture and install ¾" (19mm) steel blank cover.
8. Connect to ground rod (Air Force/Army) or counterpoise (Navy) to base cans.
9. Install top of edge of snow plow ring flush with pavement surface with a tolerance of +0", -1/16" (1.6mm).
10. If the distance between the edge of the snow ring and concrete is 1/8" (3mm) or less, seal top of opening with P-605 silicone sealant and delete the P-606 compound.
11. The top of fixture must not exceed the top of the snow plow ring (+0", -1/8" (3mm)).
12. The contractor must pre-assemble in-pavement light fixture with snow plow rings to assure each individual unit assembly is within tolerance. Use a straight edge to verify the fixture is level (to 1/8" (3mm)). Any units not within this tolerance will be rejected. Assure snow plow rings are configured with correct number and width of openings.

The contractor must install a 25" (635mm) deep base can where the PCC pavement thickness is 15" (375mm) and must install a 30" (750mm) deep base can where the pavement thickness is 20" (500mm).
13. Contractor must ensure sealant installation is in accordance with elevation tolerances of light fixture installation.
14. Contractor must ensure snow plow rings are compatible and appropriate for use with base cans and fixtures.
15. Use drainage layer and concrete for Air Force/Army installations.

16. Use the following installation tolerances for Figure 18B:

Installation Tolerance

Item	Tolerance
Light beam orientation	$\pm 1/2$ " (13mm)
Lateral spacing	$\pm 1/4$ " (6mm)
Fixture level	$\pm 1/2$ degree in X and Y direction
Fixture elevation (low side of pavement)	+0 - $1/16$ " (1.6mm)
Longitudinal spacing	$\pm 1/4$ degree

3-7.1.3 Drawing Notes for Straightedge Check, Figure 19B.

1. Straightedge should be 10' (3m) long. Notch approximately 1" (25mm) high, and about 1"-2" (25mm-50mm) longer than fixture diameter.
2. A $1/16$ " (1.6mm) Allen wrench is a good tool to use to determine height tolerance of fixture (or snow plow ring) relative to low side of pavement. Slide straightedge on to fixture or snow plow ring edge to measure. If straightedge rides up on the edge, fixture is too high. If edge is more than $1/16$ " (1.6mm) below straightedge, the fixture is too low.
3. Check straightedge in both directions to verify there is no unusual pavement build-up in the proximity of the light that might block part of the light beam.
4. A level on top of the straightedge can verify compliance with level tolerance.

Figure 17A. Light Base Mounting in Shoulder Pavement Plan (Air Force / Army)

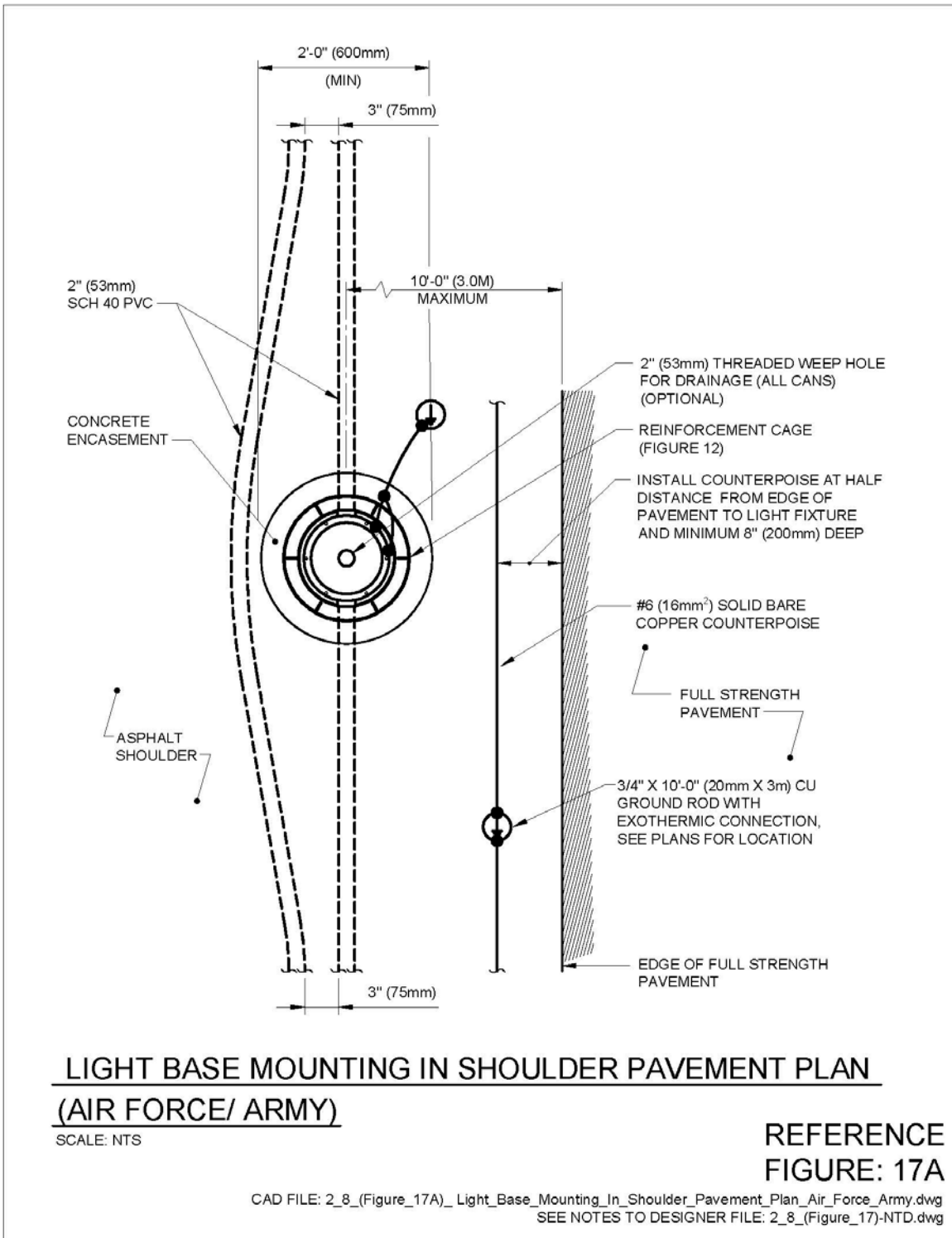


Figure 17B. Light Base Mounting in Shoulder Pavement Plan (Navy)

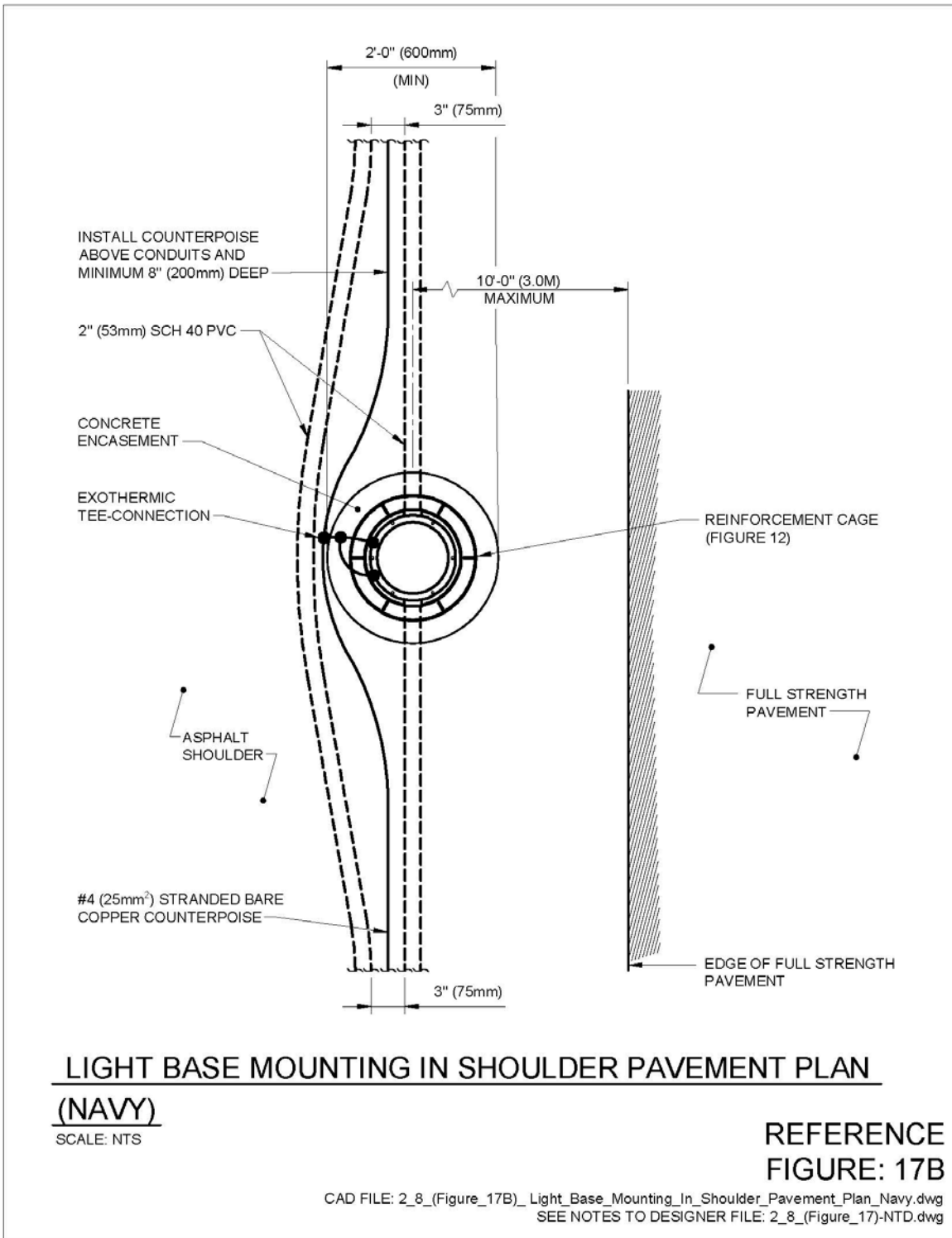
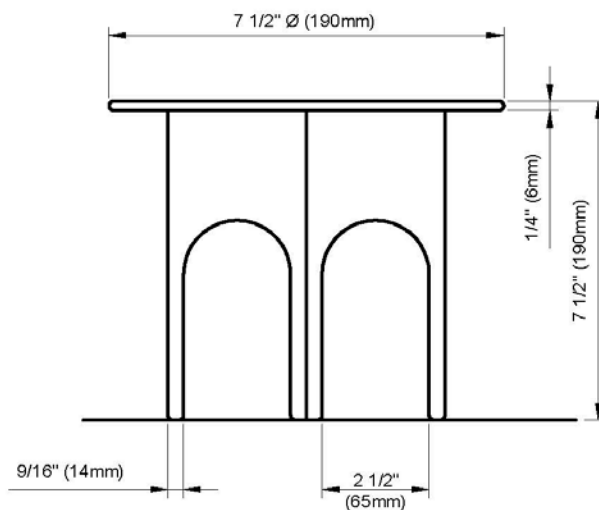


Figure 17C. Airfield Isolation Transformer Platform



AIRFIELD ISOLATION TRANSFORMER PLATFORM

SCALE: NTS

REFERENCE
FIGURE: 17C

CAD FILE: 2_8_(Figure_17C)_Airfield_Isolation_Transformer_Platform.dwg
SEE NOTES TO DESIGNER FILE: 2_8_(Figure_17)-NTD.dwg

Figure 18A. In-Pavement Light Materials

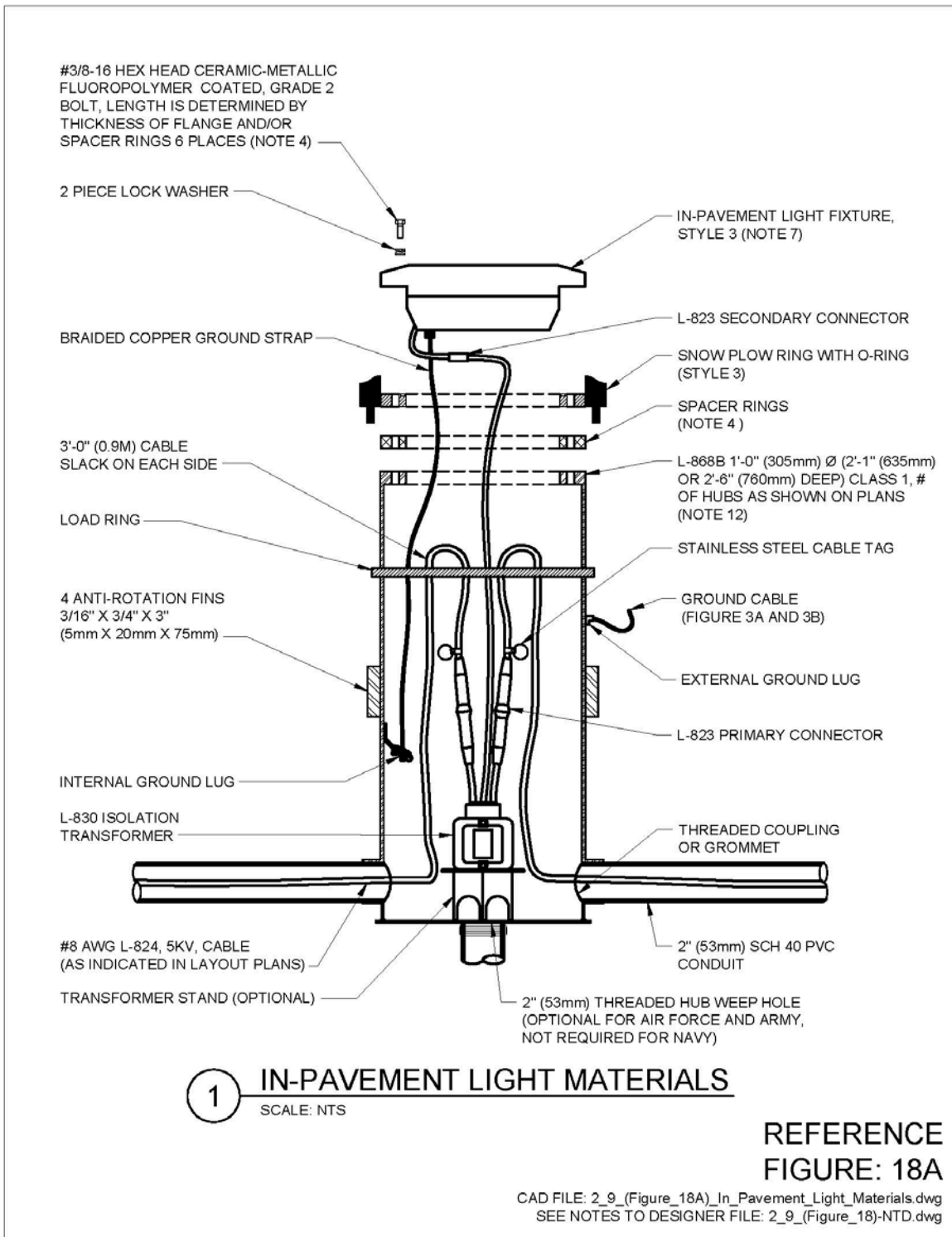
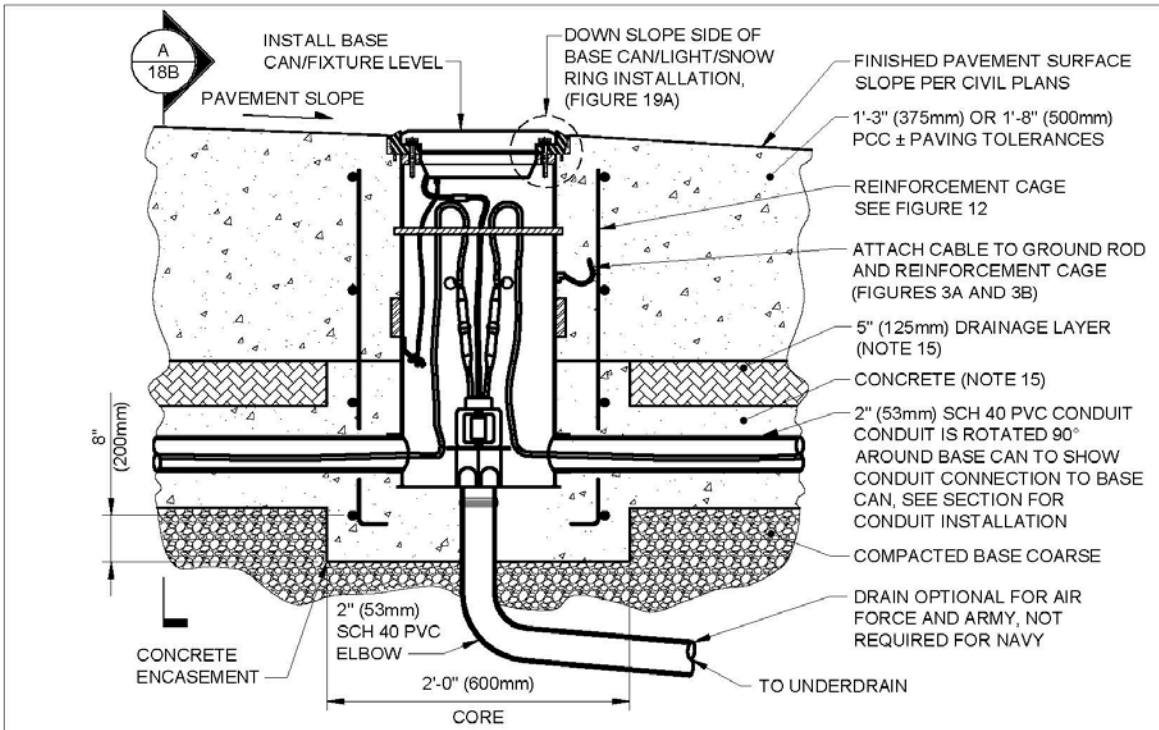
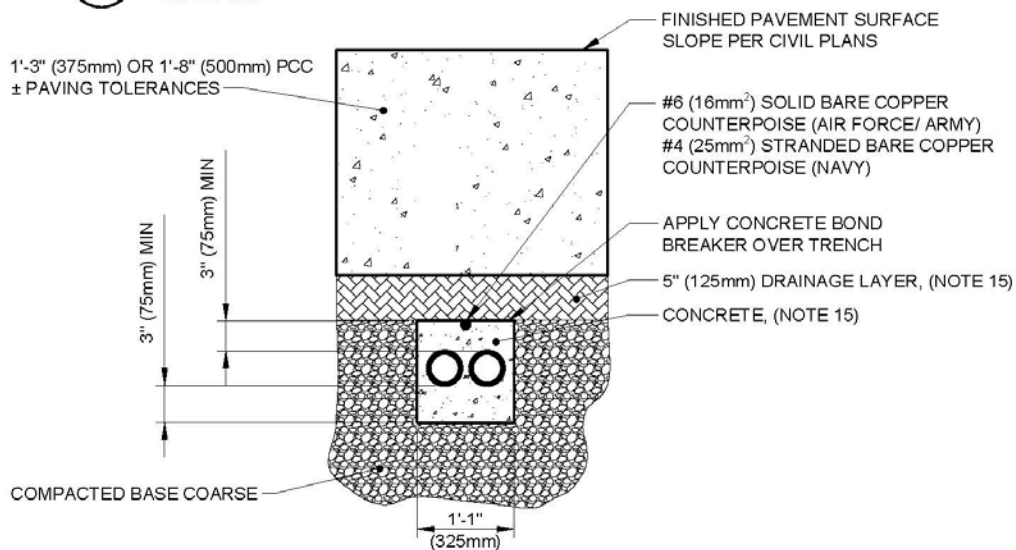


Figure 18B. Flush Light in Full Strength PCC



2 IN-PAVEMENT LIGHT IN FULL STRENGTH PCC
SCALE: NTS



A SECTION
18B SCALE: NTS

REFERENCE
FIGURE: 18B

CAD FILE: 2_9_(Figure_18B)_In-Pavement_Light_In_Full_Strength_Pcc.dwg
SEE NOTES TO DESIGNER FILE: 2_9_(Figure_18)-NTD.dwg

Figure 19A. In-Pavement Light Fixture Mounting

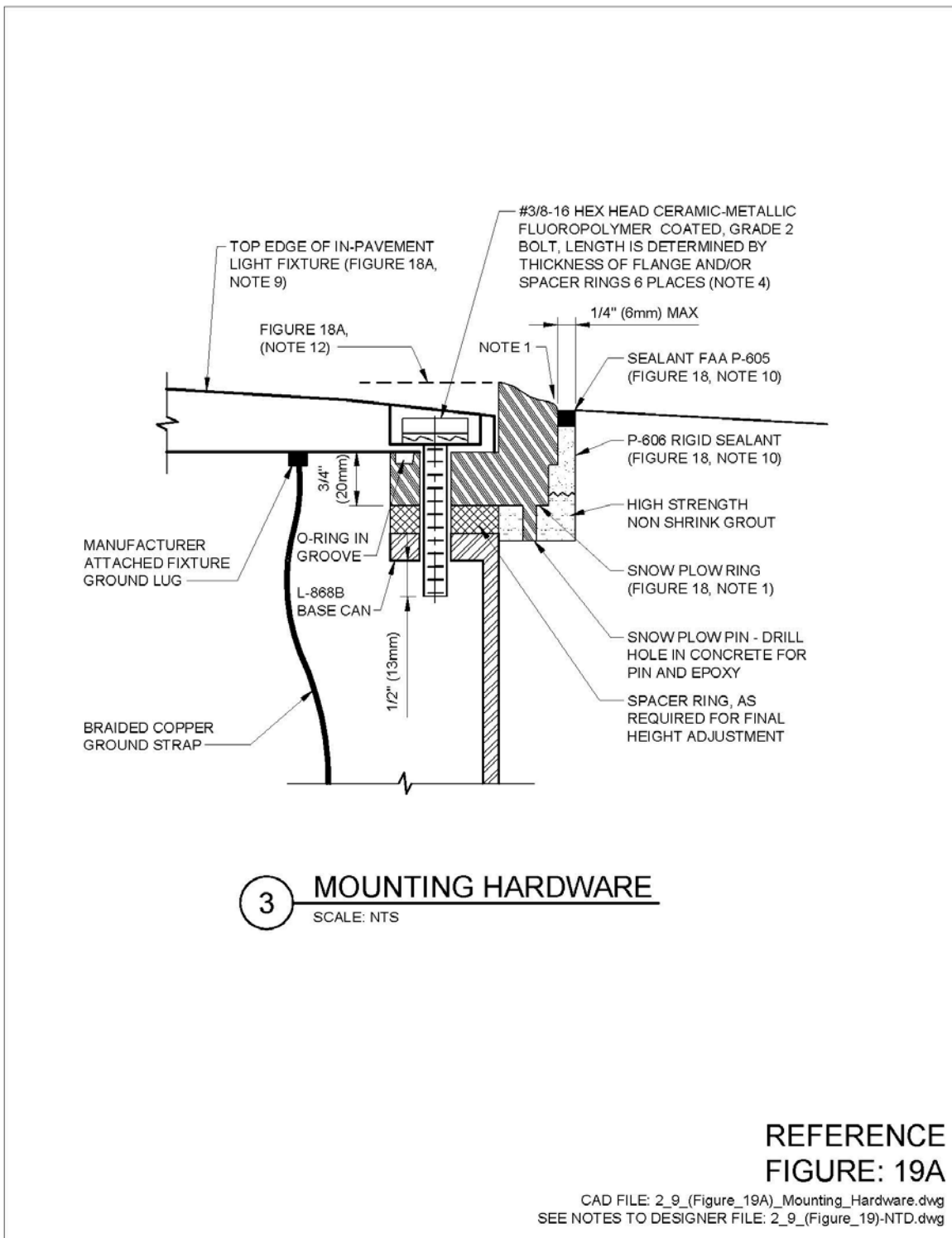
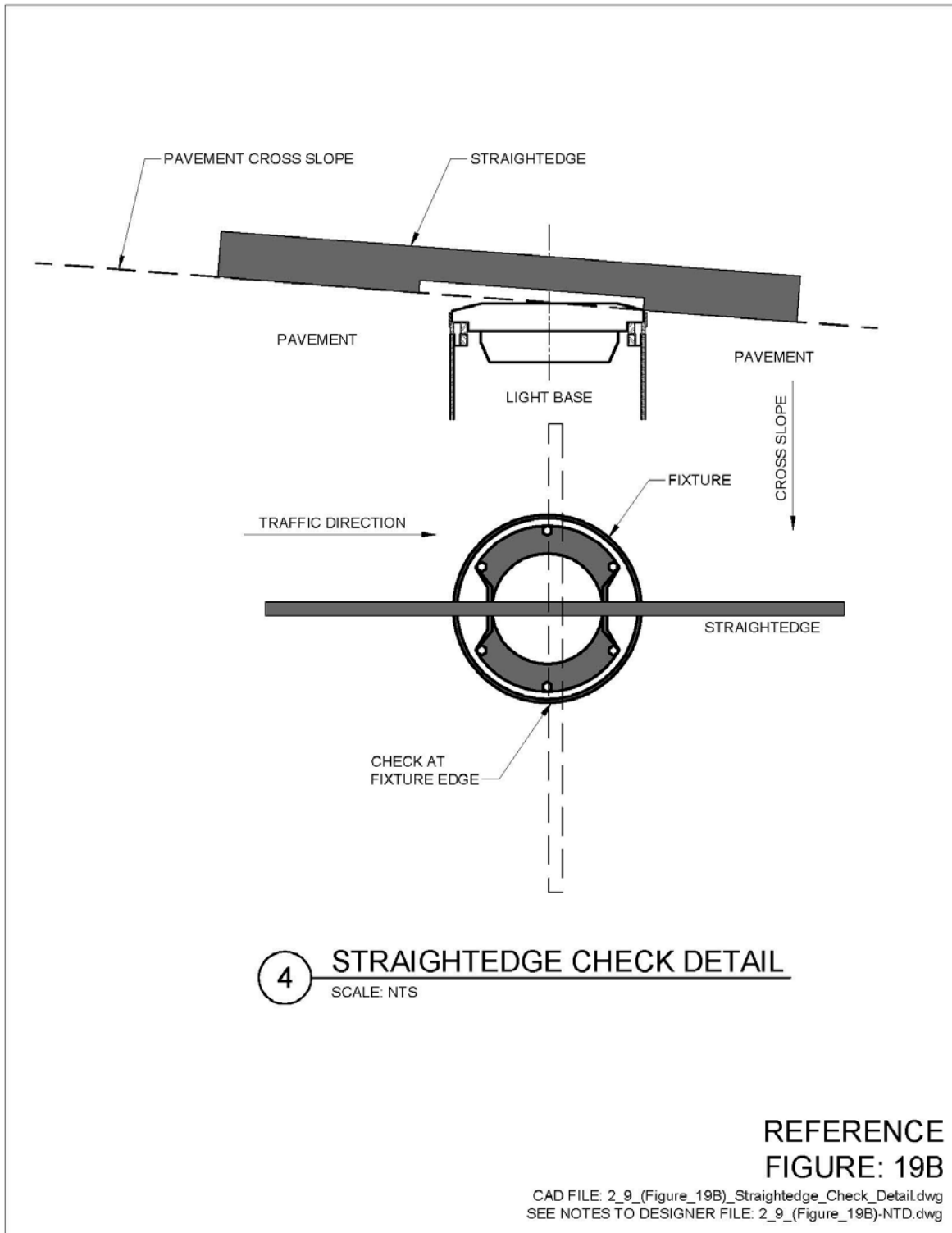


Figure 19B. In-Pavement Light Fixture Mounting (continued)



3-8 **Elevated Runway Guard Light/Holding Position Edge Light Detail.**

3-8.1 **Figures 20A, 20B.**

3-8.1.1 **Notes to Designer.**

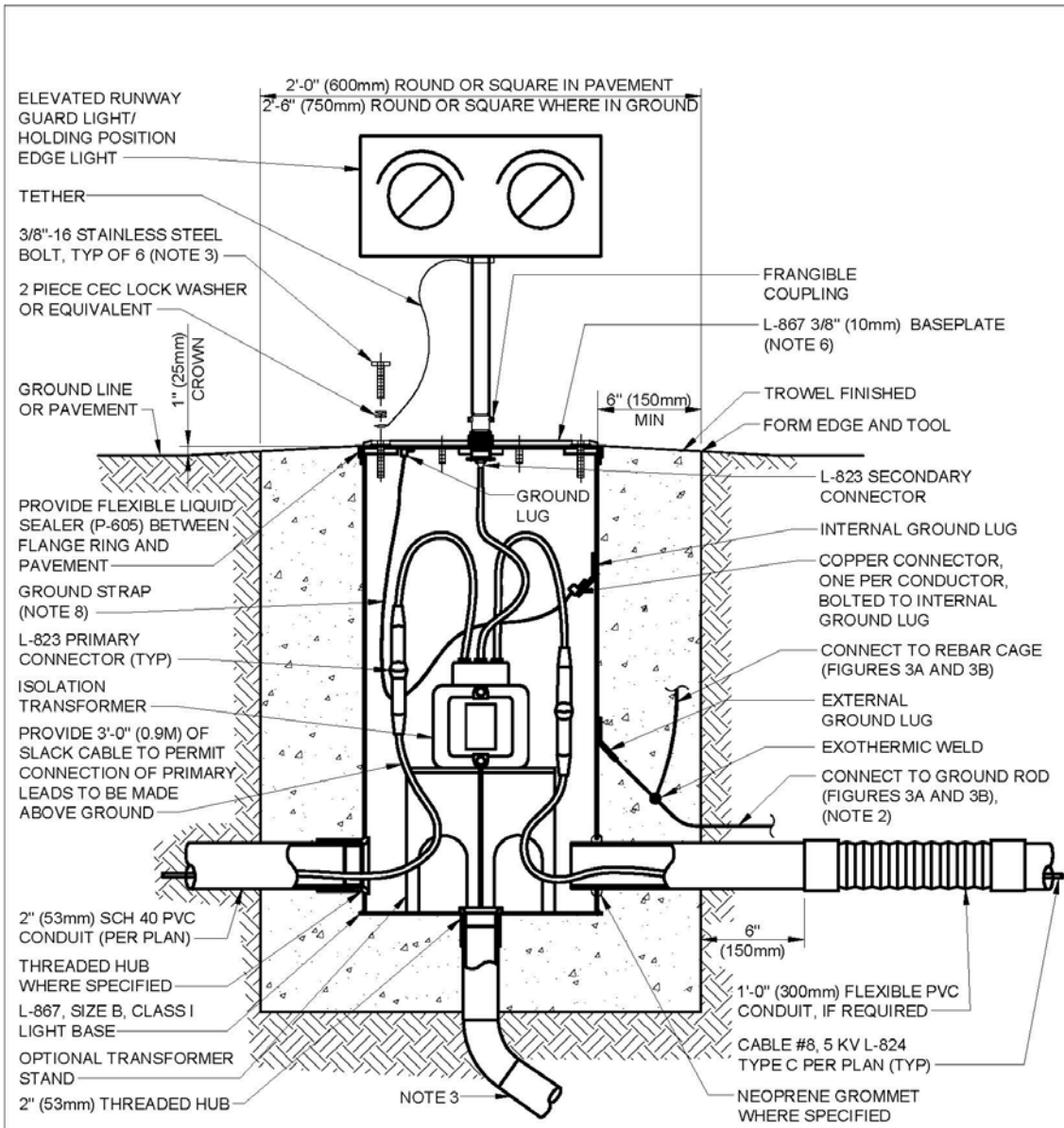
1. Holding position edge lights (HPL) are similar fixtures for Navy facilities. Designer must refer to NAVAIR 51-50AAA-2 for Navy requirements.
2. Elevated runway guard lights are optional at Army facilities and optional at Air Force facilities for Category I precision approach runways down to a runway visual range (RVR) of 2400' (720m). They are required at Air Force facilities that conduct operations at Category II (down to an RVR of 1200' (360m).
3. Installation of the base can and top section is similar to the installation of an elevated fixture in shoulder pavement. See Figure 9.

3-8.1.2 **Drawing Notes for Runway Guard Lights, Figures 20A and 20B.**

1. Power the elevated runway guard lights (RGL/HPL) from the circuit indicated.
2. Before coring in pavement may proceed, the contractor must demonstrate to the contracting officer that the base cans are at the correct location. Before casting concrete around base can, the contractor must demonstrate to the contracting officer that the base cans are at the correct elevation, azimuth and rotation.
3. Air Force/Army Airfields: Bottom drain is optional. Navy Airfields: Bottom drain not required.
4. The inside edge of the RGL housing must be 10' (3m) to 17' (5.1m) from the edge of full strength pavement. The inside edge of the HPL must be not less than 3' (0.9m) beyond the outside edge of the holding position sign for Navy airfields.
5. The finished pavement surface must be protected from foreign substances which could cause staining, i.e. concrete, oil, etc. The contractor must immediately clean all spills and correct/clean any stained surfaces at the contractor's expense.
6. The contractor must use a heavy duty base plate for installation of the L-804 RGL/HPL. Provide stainless steel tether for RGL/HPL.
7. Installation of the base can is similar to the installation of an elevated fixture in shoulder pavement. See Figures 20A and 20B.

8. Provide braided copper ground strap between light base can and light fixture.
Strap must be equivalent to No. 6 (16 square mm) cable.

Figure 20A. L-804 Elevated Runway Guard Light/Holding Position Edge Light Installation Materials



**L-804 ELEVATED RUNWAY GUARD LIGHT/
HOLDING POSITION EDGE LIGHT
INSTALLATION MATERIALS**

SCALE: NTS

**REFERENCE
FIGURE: 20A**

CAD FILE: 2_10_(Figure_20A)_L_804_Elevated_Runway_Guard_Light_Holding_Position_Edge_Light_Installation.dwg
SEE NOTES TO DESIGNER FILE: 2_10_(Figure_20A)-NTD.dwg

Figure 20B. L-804 Elevated Runway Guard Light Aiming Diagram

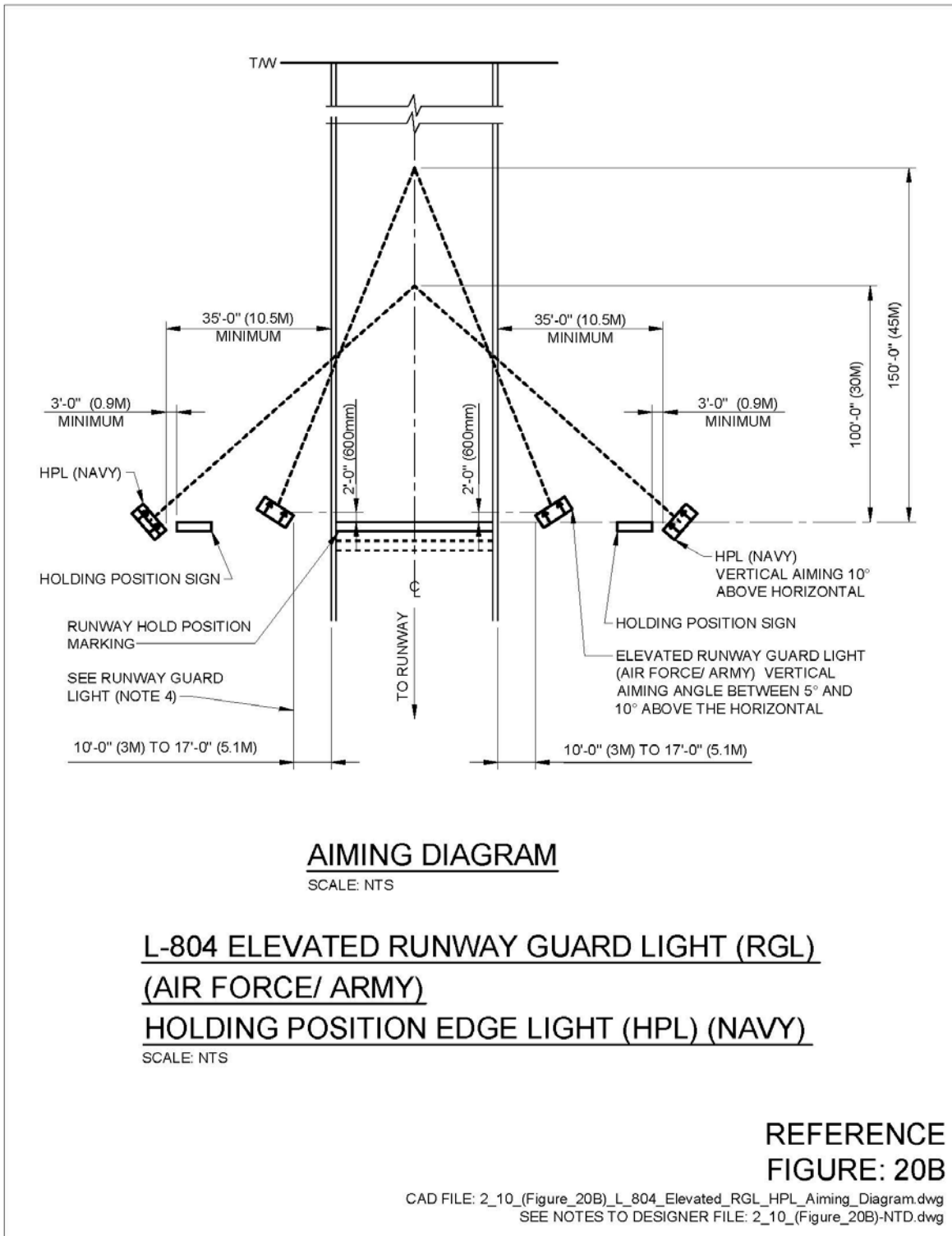


Figure 21. Reserved.

Figure 22. Reserved.

Figure 23. Reserved.

Figure 24. Reserved.

Figure 25. Reserved.

Figure 26. Reserved.

Figure 27. Reserved.

Figure 28. Reserved.

CHAPTER 4 Airfield Guidance Signs

4-1 Airfield Guidance Sign Detail.

4-1.1 Figures 29A, 29B.

4-1.1.1 Notes to Designer.

1. The L-867 base houses the sign's isolation transformer. It is typically mounted separately from the sign but within 3' (900mm) from the sign's adjacent edge. This is done to allow access to the transformer without removing the sign. The following points should be noted about the installation of the power wiring to the sign:
 - a. A secondary jumper cable must be provided to connect the transformer's output cable to the sign's input cable. Though the output cable on an isolation transformer is 48" (1.2m) ± in length, do not connect this to the sign's input cable since it would defeat the purpose of mounting the isolation transformer separately.
 - b. The type of retaining clips (or cable clamps) will depend on the type of mounting used for the sign's power leg (i.e. L-867 base or 2" (53mm) conduit and floor flange) and the style of L-823 connector on the secondary jumper cable. The retaining clips hold the secondary jumper cable in place below the frangible coupling.
2. Recommend the project contract documents contain specifications for the maximum VA load allowed for each size of sign. VA load should include the losses in the sign's isolation transformer.
3. The guidance sign foundation should be designed by a licensed structural engineer. The foundation will vary in thickness and reinforcing depending on the number of sign modules, sign size, and wind loading (jet blast) either 200 mph or 300 mph. Some of the factors that must be taken into account for the foundation design are:
 - a. Are the signs located in an area where there is a potential for high soil saturation?
 - b. Breaking point of the frangible couplings (wind speed of 200 mph or 300 mph).

- c. Soil bearing capacity.
- d. Concrete weight.
- e. Sign weight including one, two, three or four modules.
- f. Minimum 1.2 factor of safety against overturning.
- g. Minimum 1.2 factor of safety against sliding.
- h. Soil conditions regarding passive pressure consideration for the transformer base can below the footing.
- i. There should be no tolerance for sign foundation movement.
- j. Considerations for freeze/thaw conditions in areas prone to frost.

4-1.1.2 **Drawing Notes for Figure 29A.**

- 1. Air Force / Army: Do not connect counterpoise to the transformer base. Connect transformer base and counterpoise to separate ground rods.
- 2. Sign pad must have a 1/2" (13mm) chamfer on all exposed horizontal edges. Extend pad 36" (900mm) clear on all sides of sign. Slope the top surface to drain away from sign, approximately 1% (1/8"/ft) (3mm/300mm). The top of the pad must be approximately 1" (25mm) above the surrounding grade.
- 3. Maximum overall sign length: size 3 - 14'-2"(4290mm).
- 4. One tether at each end of the sign if separate sign modules are connected together within a continuous frame.
- 5. The frangibility point must be no greater than 3" (75mm) above the grade adjacent to the pad.
- 6. Surrounding grade must slope 1/4" (6mm) per foot away from the pad for 15' (4.5m). Sod or seed as required.
- 7. Pad thickness and reinforcing will vary depending on the length and number of sign modules installed as well as the wind loading (jet blast) expected.

4-1.1.3 **Drawing Notes for Figure 29B.**

- 1. Navy: Delete grounds rods. Connect counterpoise to base can.

2. Sign pad must have a 1/2" (13mm) chamfer on all exposed horizontal edges. Extend pad 36" (900mm) clear on all sides of sign. Slope the top surface to drain away from sign, approximately 1% (1/8"/ft) (3mm/300mm). The top of the pad must be approximately 1" (25mm) above the surrounding grade.
3. Maximum overall sign length: size 3 - 14'-2"(4290mm).
4. One tether at each end of the sign if separate sign modules are connected together within a continuous frame.
5. The frangibility point must be no greater than 3" (76mm) above the grade adjacent to the pad.
6. Surrounding grade must slope 1/4" (6mm) per foot away from the pad for 15' (4.5m). Sod or seed as required.
7. Pad thickness and reinforcing will vary depending on the length and number of sign modules installed as well as the wind loading (jet blast) expected.
8. For Navy Size 2 signs, distance from RW or TW can be 25' to 35' (7.5m to 10.5m) if sign height is not more than 2'-0" (0.6m) above RW or TW edge of full-strength pavement.

Figure 29A. Airfield Guidance Sign Detail (Air Force / Army)

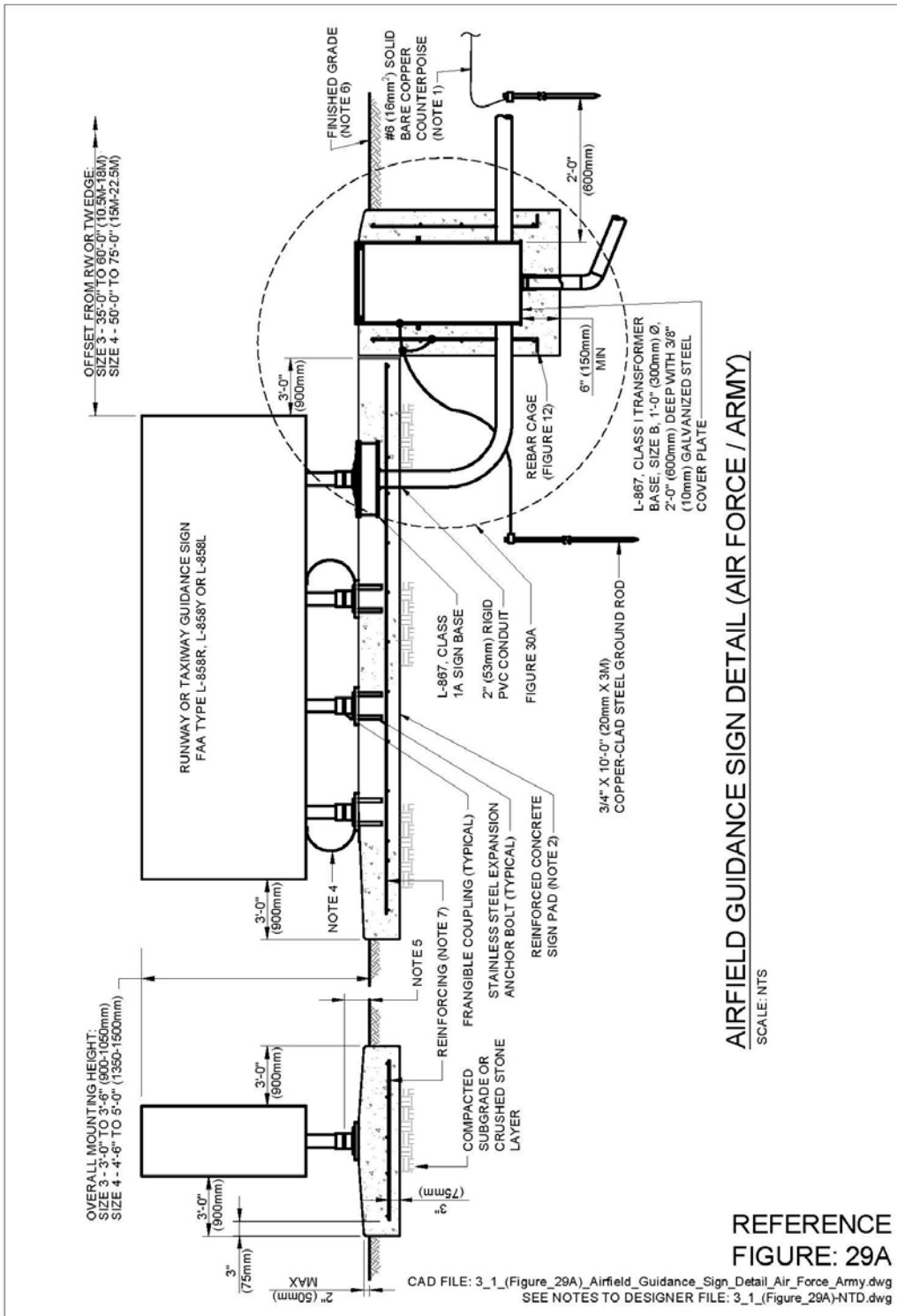
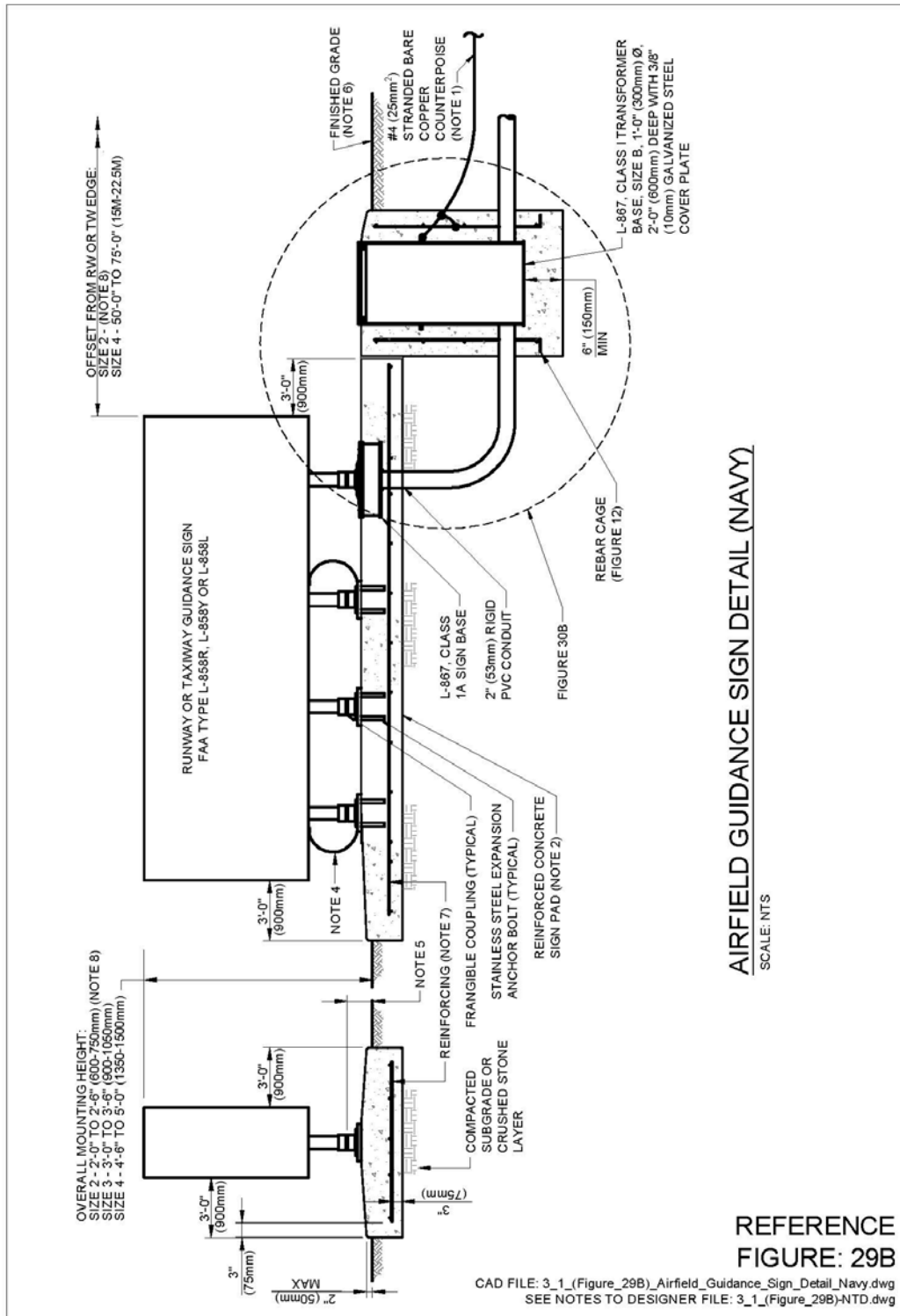


Figure 29B. Airfield Guidance Sign Detail (Navy)



4-2 **Sign Base Power Leg Mounting Detail.**

4-2.1 **Figures 30A, 30B.**

4-2.1.1 **Notes to Designer.**

1. The mounting for the power leg of the sign will usually be determined by the sign designer and manufacturer options. The following details show several approved options. Details indicated on contract documents should state that installation must be in accordance with the sign manufacturer's requirements.

4-2.1.2 **Drawing Notes for Figures 30A and 30B.**

1. See specifications for additional grounding requirements inside the sign.
2. Grounding conductors must be THWN-2 or XHHW-2.
3. Gravel sump below fixture base is not required where drain line is run to pavement under-drain system. The preferred method for draining the base can be to route the drain line to pavement under drain system or closest catch basin. If a gravel sump (French drain) is installed, caution should be taken to prevent the undermining of the sign foundation.

Figure 30A. Sign Base Power Leg Mounting Detail (Air Force / Army)

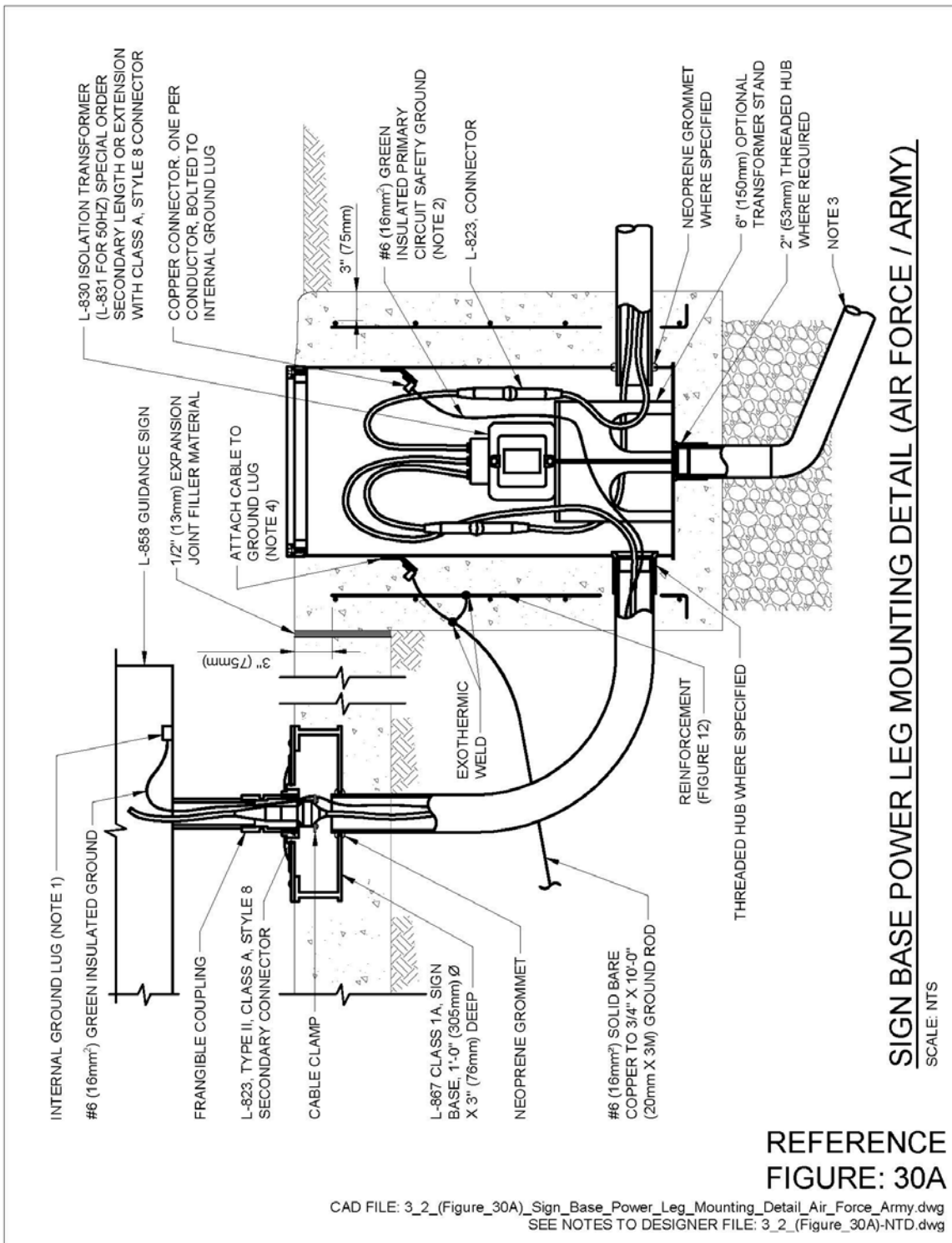
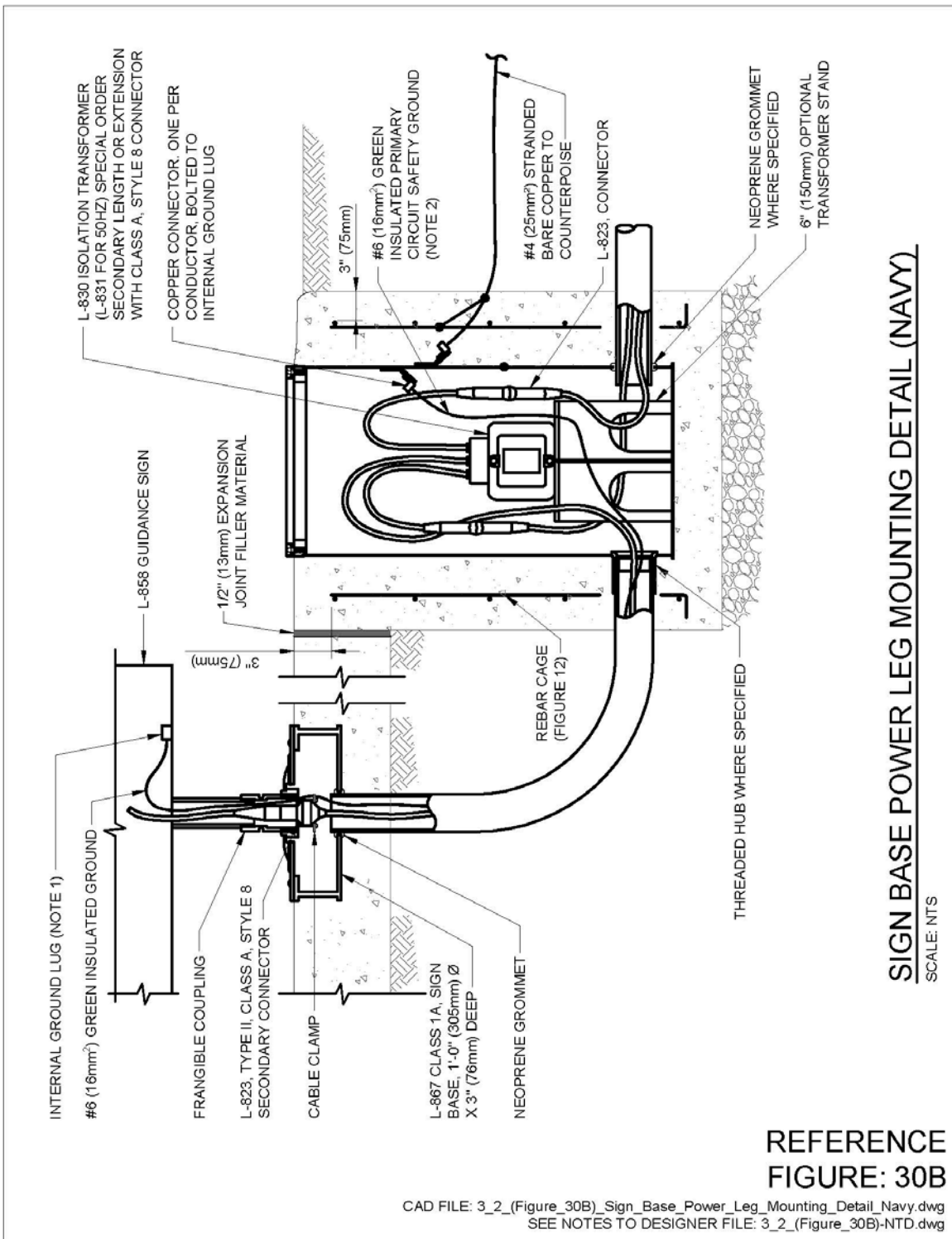


Figure 30B. Sign Base Power Leg Mounting Detail (Navy)



CHAPTER 5 Approach Lighting Systems

5-1 L-867 Size D Handhole.

5-1.1 Figure 31.

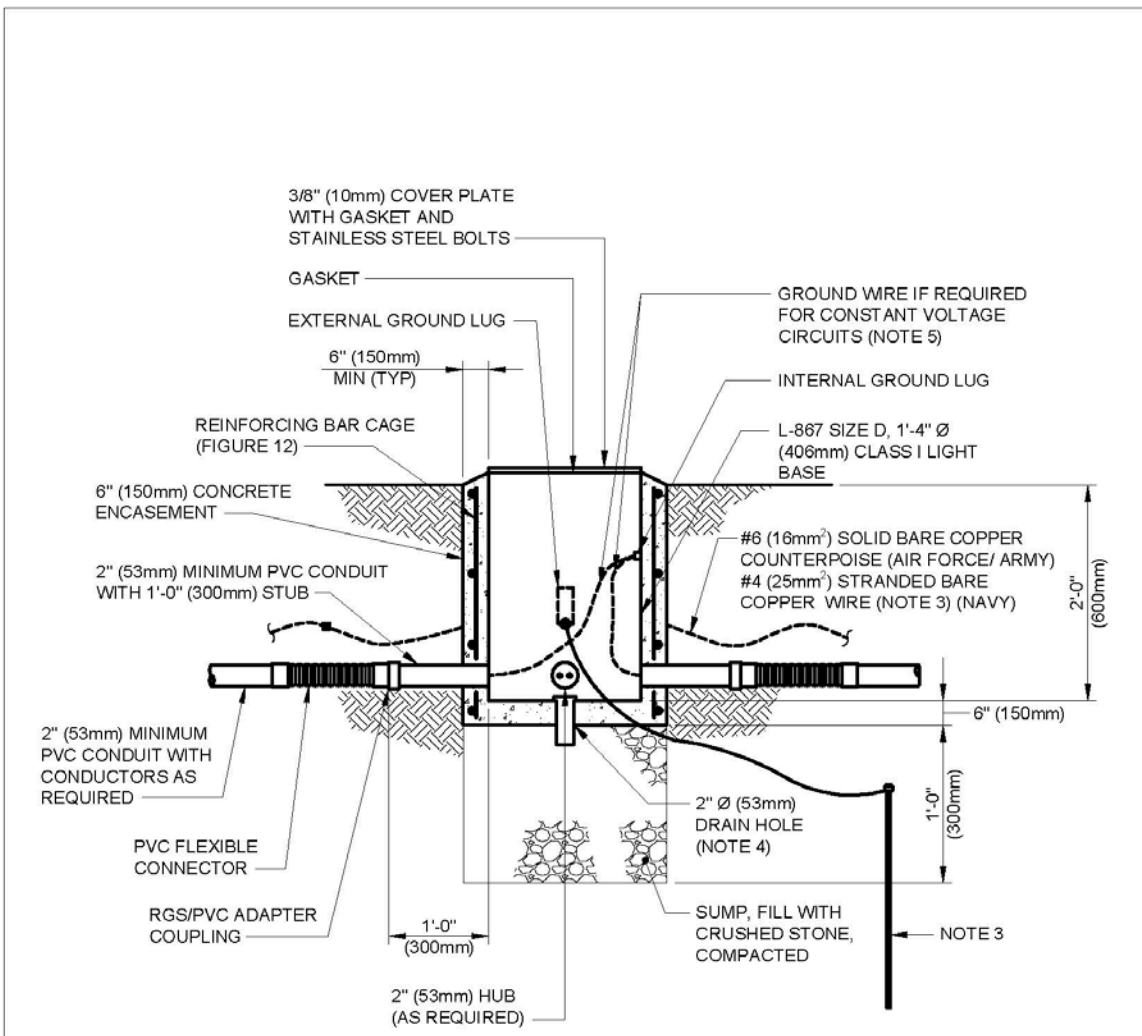
5-1.1.1 Notes to Designer.

1. A handhole is required at each sequenced flasher station and tower-mounted approach light station to house isolation transformers. Handholes must contain any hardware which may aid with cable pulling.
2. The flexible conduit allows for movement during freeze/thaw cycles in cold climates thereby reducing the possibility of shearing the conduits.
3. The 2" (53mm) conduit between handholes is a minimum. The actual dimension depends on the number of cables being routed. Ensure contract documents specify hub size.

5-1.1.2 Drawing Notes for Figure 31.

1. If constant voltage circuits are routed through the handholes the minimum #6 (16 square mm) equipment ground must be routed with the system conductors in the conduit and connected to the ground lug in each light base. It must also be bonded to the electrical ground at the system's substation (vault) power supply ground bus. Provide green insulated THWN-2 or XHHW-2 ground wire sized per NEC for constant voltage circuits.
2. The flexible connector must be PVC.
3. For Air Force / Army Airfields, connect ground rod to handhole external ground lug with #6 (16 square mm) solid bare copper and let counterpoise pass the handhole without connection. For Navy airfields, connect #4 (25 square mm) stranded bare copper counterpoise to external ground lug. Do not provide ground rod at handhole.
4. For Air Force / Army Airfields, bottom drain is optional. For Navy airfields, bottom drain is not required.

Figure 31. L-867 Size D Handhole



L-867 SIZE D HANDHOLE

SCALE: NTS

**REFERENCE
FIGURE: 31**

CAD FILE: 4_1_(Figure_31)_L_867_Size_D_Handhole.dwg
SEE NOTES TO DESIGNER FILE: 4_1_(Figure_31)-NTD.dwg

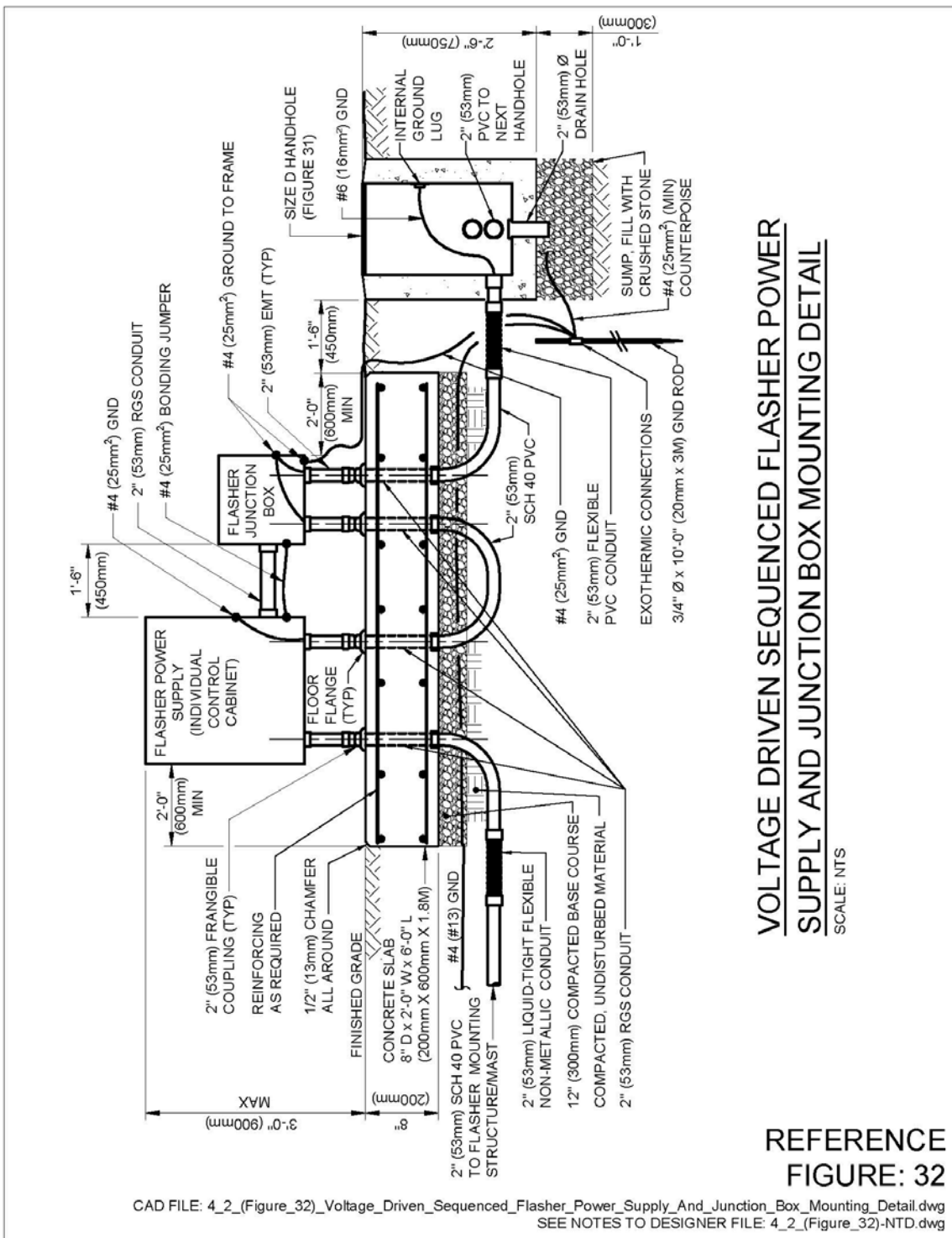
5-2 **Voltage Driven Sequenced Flasher Power Supply and Junction Box Mounting Detail**

5-2.1 **Figure 32.**

5-2.1.1 **Notes to Designer.**

1. Each sequenced flasher requires its own power supply (individual control cabinet) and junction box. These are normally mounted as close to the flash head as possible. The standard manufacturer furnished cable between the flash head and the power supply is 60' (18m) maximum. The interconnecting wiring between the flasher junction box and the power supply is furnished by the contractor. If the flasher is mounted on a structure that is above 40' (12m), then the power supply is mounted up on the maintenance platform and the junction box is mounted at the base of the tower.
2. The flexible conduit allows for shifting due to freeze/thaw cycles in cold climates or to align conduits. If freeze/thaw cycles are not a problem, then the use of the flexible conduit is optional.
3. Recommend becoming familiar installation requirements from several different manufacturers.
4. The connection between the junction box and power supply is indicated below grade by a 2" (53mm) conduit. Some manufacturers connect the two directly with a short section of 2" (53mm) conduit.

Figure 32. Voltage Driven Sequenced Flasher Power Supply and Junction Box



Mounting Detail

5-3 **Typical MG-20 L.I.R. Structure 6'-1" (1854mm) to 21'-1" (6.43m).**

5-3.1 **Figure 33.**

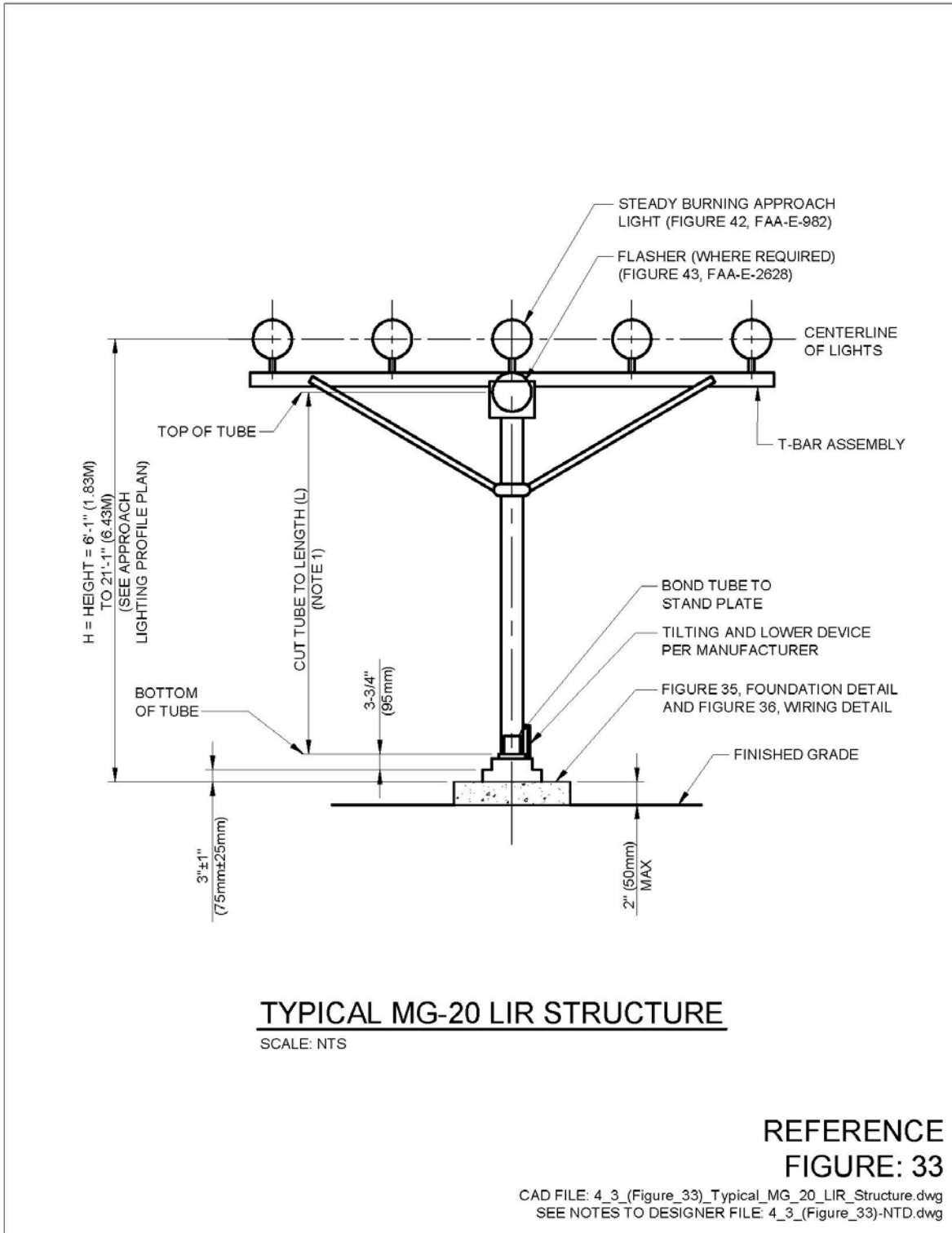
5-3.1.1 **Notes to Designer.**

1. The contract documents should include an approach lighting profile plan that will state by station # the height above grade.
2. Refer to Chapter 3 in UFC 3-535-01 (Air Force/Army) or NAVAIR 51-50AAA-2 (Navy) for the spacing and number of the lights on the T-bar assembly. Specify the appropriate spacing (for the system being installed) in this detail and modify the detail to show the appropriate number of lights.

5-3.1.2 **Drawing Notes for Figure 33.**

1. Determine exact length of tube in accordance with manufacturer's instructions.

Figure 33. Typical MG-20 L.I.R. Structure 6'-1" (1854mm) to 21'-1" (6.43m)



5-4 **Foundation for L.I.R. Structure MG-20 Plan View**

5-4.1 **Figure 34.**

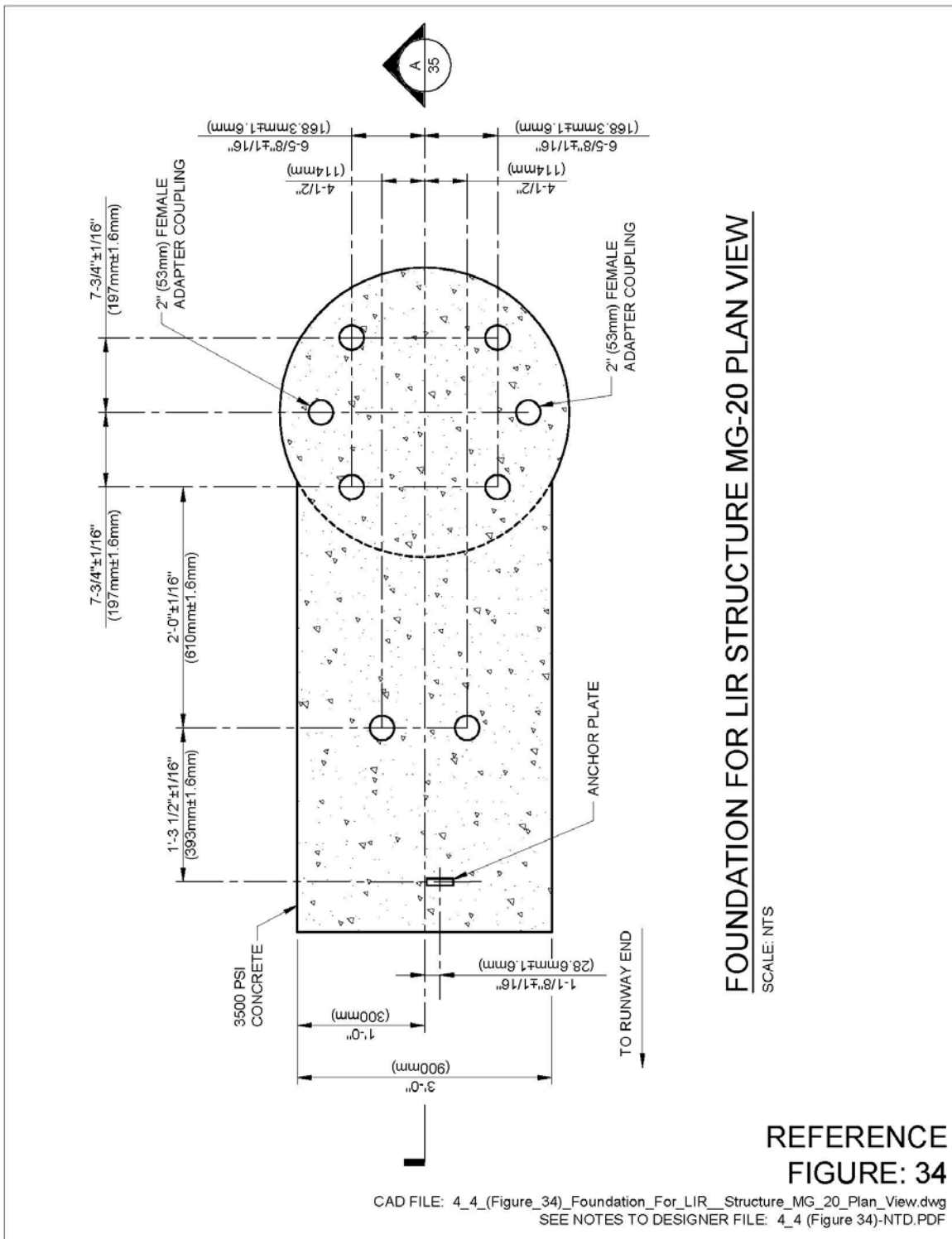
5-4.1.1 **Notes to Designer.**

1. The female couplings are for mounting the 2" (53mm) frangible couplings and condulets for wiring to the tower. Two are required (one on each side) if both a sequenced flasher and steady burn lights are co-located on a tower.
2. Foundation indicated is as recommended by tower manufacturer. However, rectangular foundations have been used in some installations. Consult with tower manufacturer for different options based on soil conditions, bearing capacity, etc.

5-4.1.2 **Drawing Notes for Figure 34.**

1. Refer to Figure 35, Section A.
2. Actual dimensions may vary. Coordinate with manufacturer prior to construction and construct per manufacturer's requirements.

Figure 34. Foundation for L.I.R. Structure MG-20 Plan View



5-5 **Foundation for L.I.R. Structure MG-20 Sections A and B.**

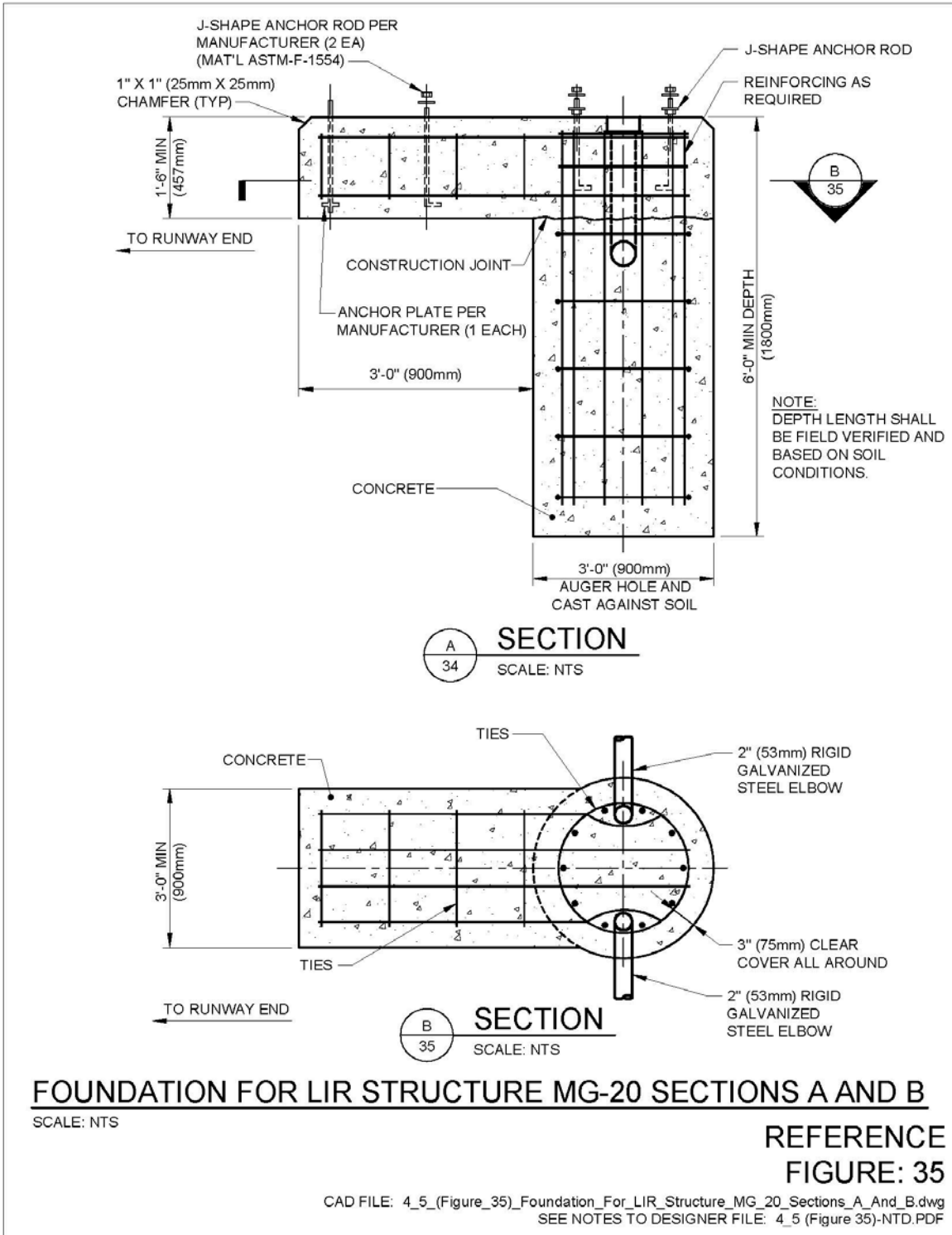
5-5.1 **Figure 35.**

5-5.1.1 **Notes to Designer.**

1. The foundation indicated is a suggested foundation from one tower manufacturer. The diameter was increased to allow the installation of the conduits in the foundation and still allow clearance for the tilt base on the tower.

2. Prior to designing the foundation for the tower, borings should be taken in the field for soil analysis. Many factors will affect the type and size of foundation to be installed (i.e. type of soil, existence of rock or ledge, soil bearing capacity, frost depth, etc.). The designer should base the foundation design on these factors and consult with the tower manufacturer regarding EPA (Effective Projected Area) for wind loading. The wind loading must include the proposed fixtures and hardware to be installed on the tower.

Figure 35. Foundation for L.I.R. Structure MG-20 Sections A and B



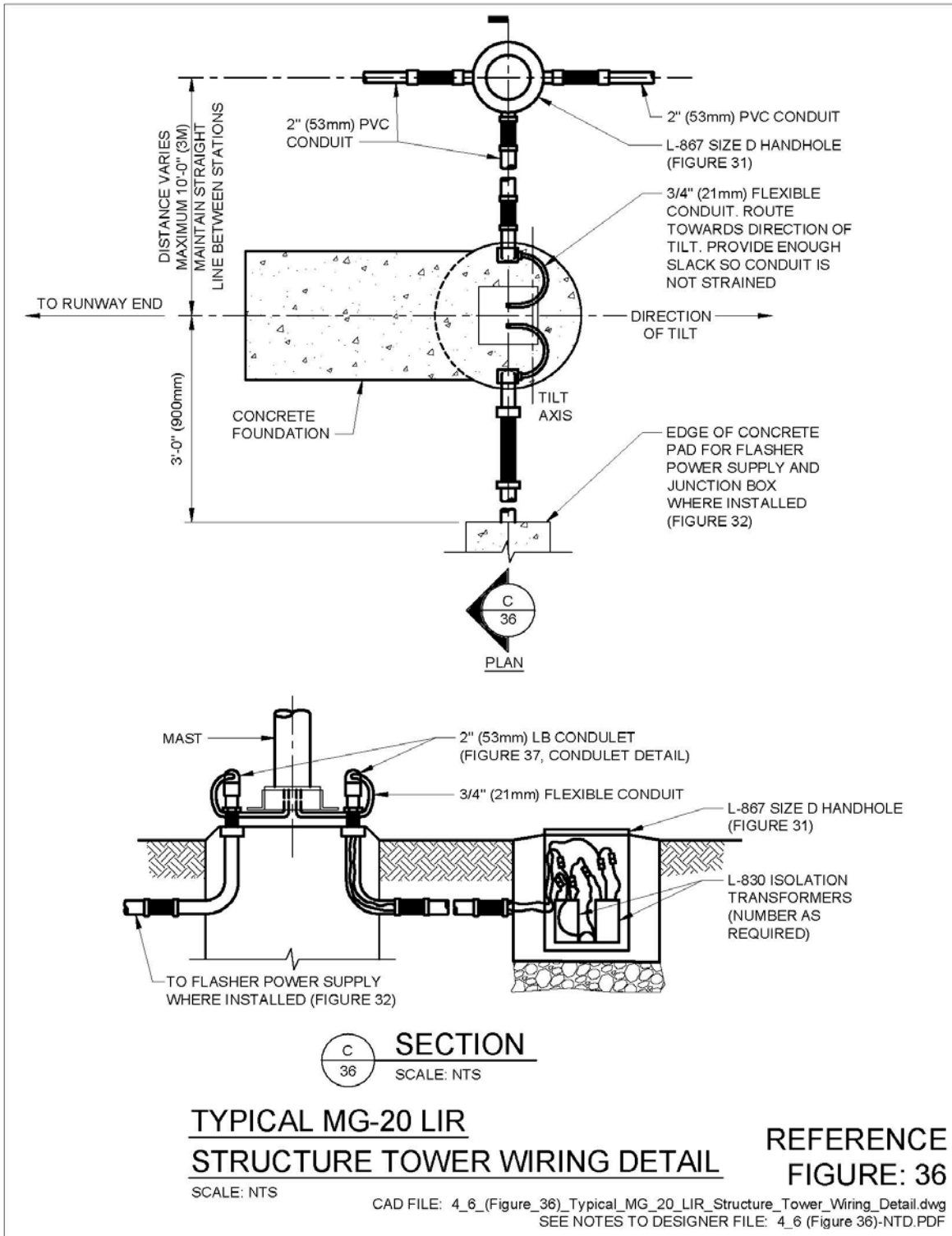
5-6 **Typical MG-20 L.I.R. Structure Tower Wiring Detail.**

5-6.1 **Figure 36.**

5-6.1.1 **Notes to Designer.**

1. Location of the handhole with respect to the tower foundation will depend on system layout. Recommend keeping same distance from each tower foundation throughout system thereby allowing a straight run between handholes.
2. The tower tilts away from the end of runway and towards the approach. Routing the conduit towards the direction of the tilt and maintaining slack will prevent putting strain on the conduit while the tower is raised and lowered.
3. The number of isolation transformers will depend on the wattage and number of lamps to be installed. If more than one lamp is installed per isolation transformer, then the steady burn approach light must be specified with a lamp shorting device so the other lamps will remain on if one lamp burns out.
4. Number of conductors will vary depending on number of isolation transformers used, requirements of sequenced flashers, etc. Verify requirements with system wiring diagrams and provide (furnish and install) necessary conductors.

Figure 36. Typical MG-20 L.I.R. Structure Tower Wiring Detail



5-7 **2" (53mm) LB Conduit Detail.**

5-7.1 **Figure 37.**

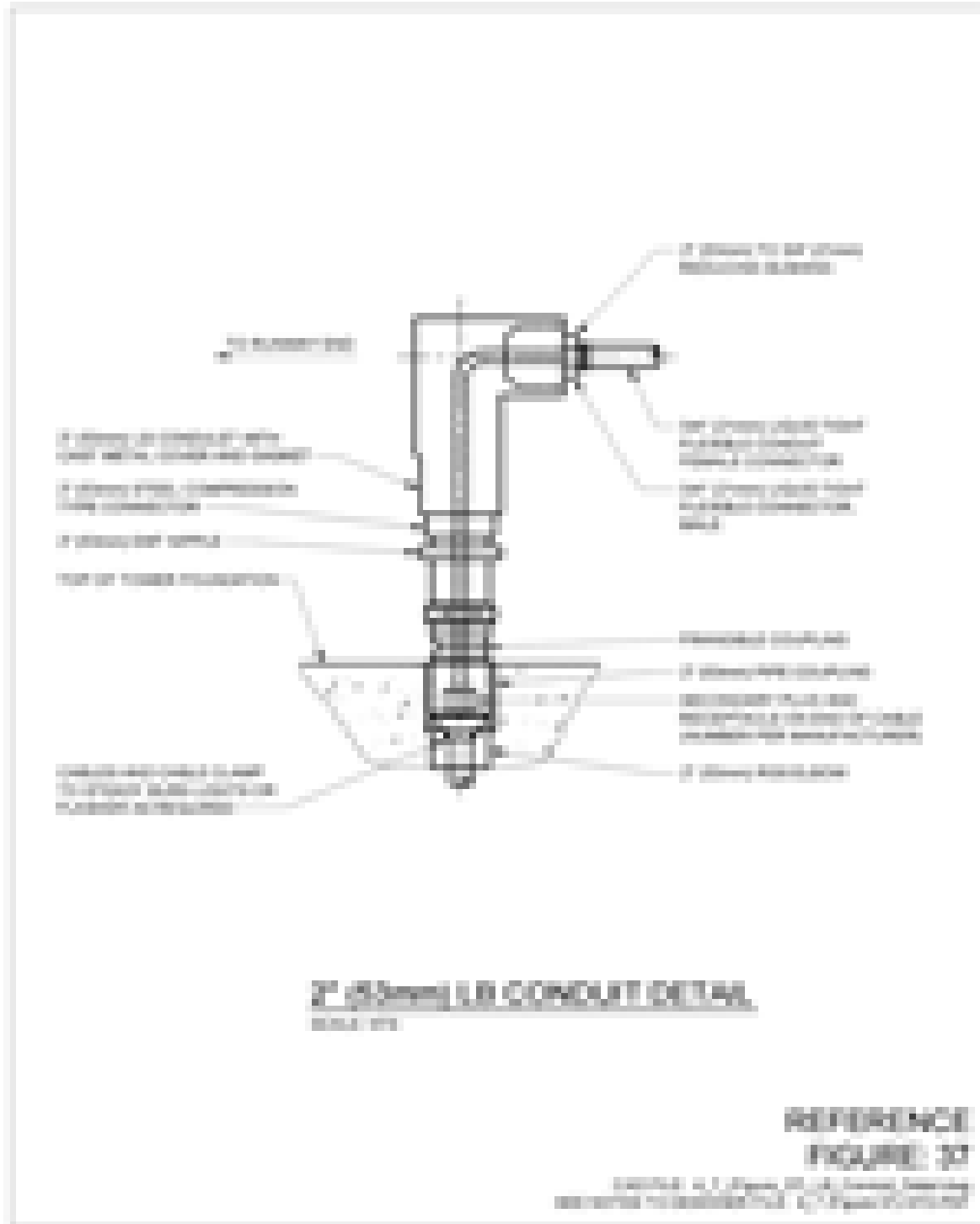
5-7.1.1 **Notes to Designer:**

1. Figure is self-explanatory.

5-7.1.2 **Drawing Notes for Figure 37.**

1. Provide number of cables as required. Refer to system wiring diagrams.
2. Face conduit away from runway end and toward approach.

Figure 37. 2" (53mm) LB Conduit Detail



5-8 **Typical MG-30 L.I.R. Structure 21'-2" (6.45m) to 30'-0" (9.14m).**

5-8.1 **Figure 38.**

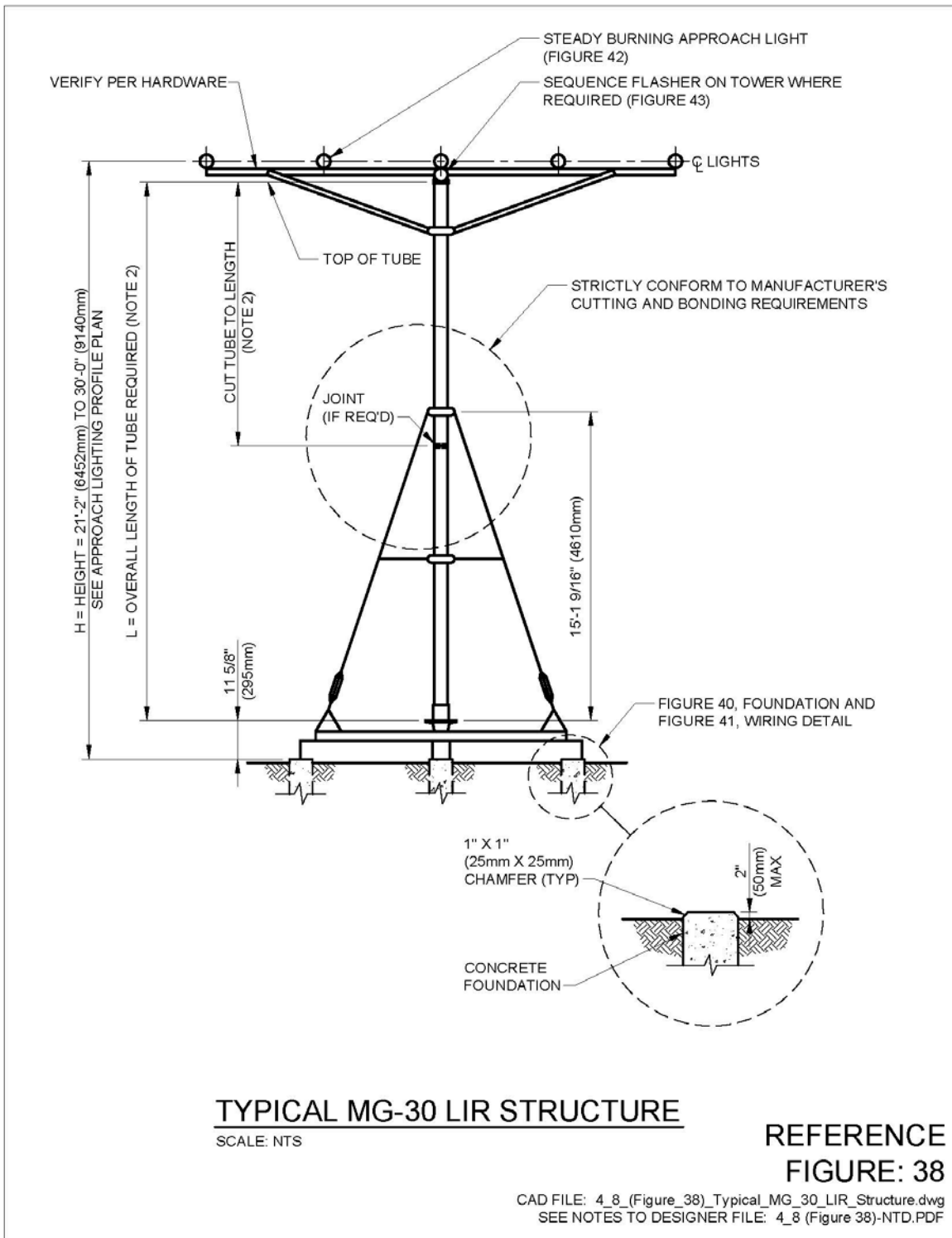
5-8.1.1 **Notes to Designer.**

1. The contract documents should include an approach lighting profile plan that will state by station # the height above grade.
2. Refer to Chapter 3 in UFC 3-535-01 for spacing and number of lights on the T-bar assembly. Specify the appropriate spacing (for the system being installed) in this detail and modify the detail to show the appropriate number of lights.

5-8.1.2 **Drawing Notes for Figure 38.**

1. Foundations, connections, stabilizers, tilt devices, and associated components must be per manufacturer's written specifications.
2. Determine length of tube per manufacturer's requirements.

Figure 38. Typical MG-30 L.I.R. Structure 21'-2" (6.45m) to 30'-0" (9.14m)



5-9 **Typical MG-40 L.I.R. Structure 30'-0" (9.14m) to 40'-0" (12.19m).**

5-9.1 **Figure 39.**

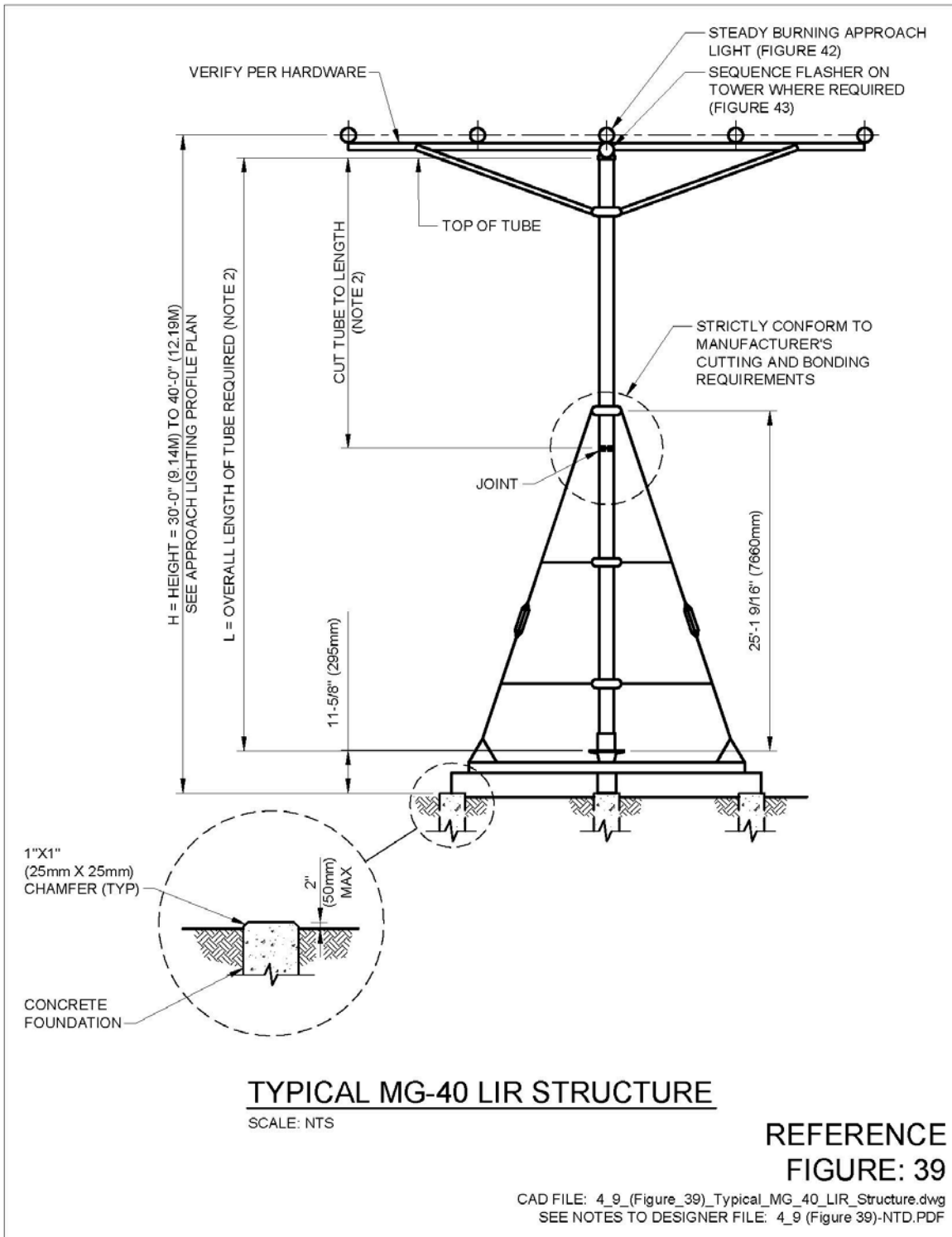
5-9.1.1 **Notes to Designer.**

1. The contract documents should include an approach lighting profile plan that will state by station # the height above grade.
2. Refer to Chapter 3 in UFC 3-535-01 for spacing and number of lights on the T-bar assembly. Specify the appropriate spacing (for the system being installed) in this detail and modify the detail to show the appropriate number of lights.

5-9.1.2 **Drawing Notes for Figure 39.**

1. Foundations, connections, stabilizers, tilt devices, and associated components must be per manufacturer's written specifications.
2. Determine length of tube per manufacturer's requirements.

Figure 39. Typical MG-40 L.I.R. Structure 30'-0" (9.14m) to 40'-0" (12.19m)



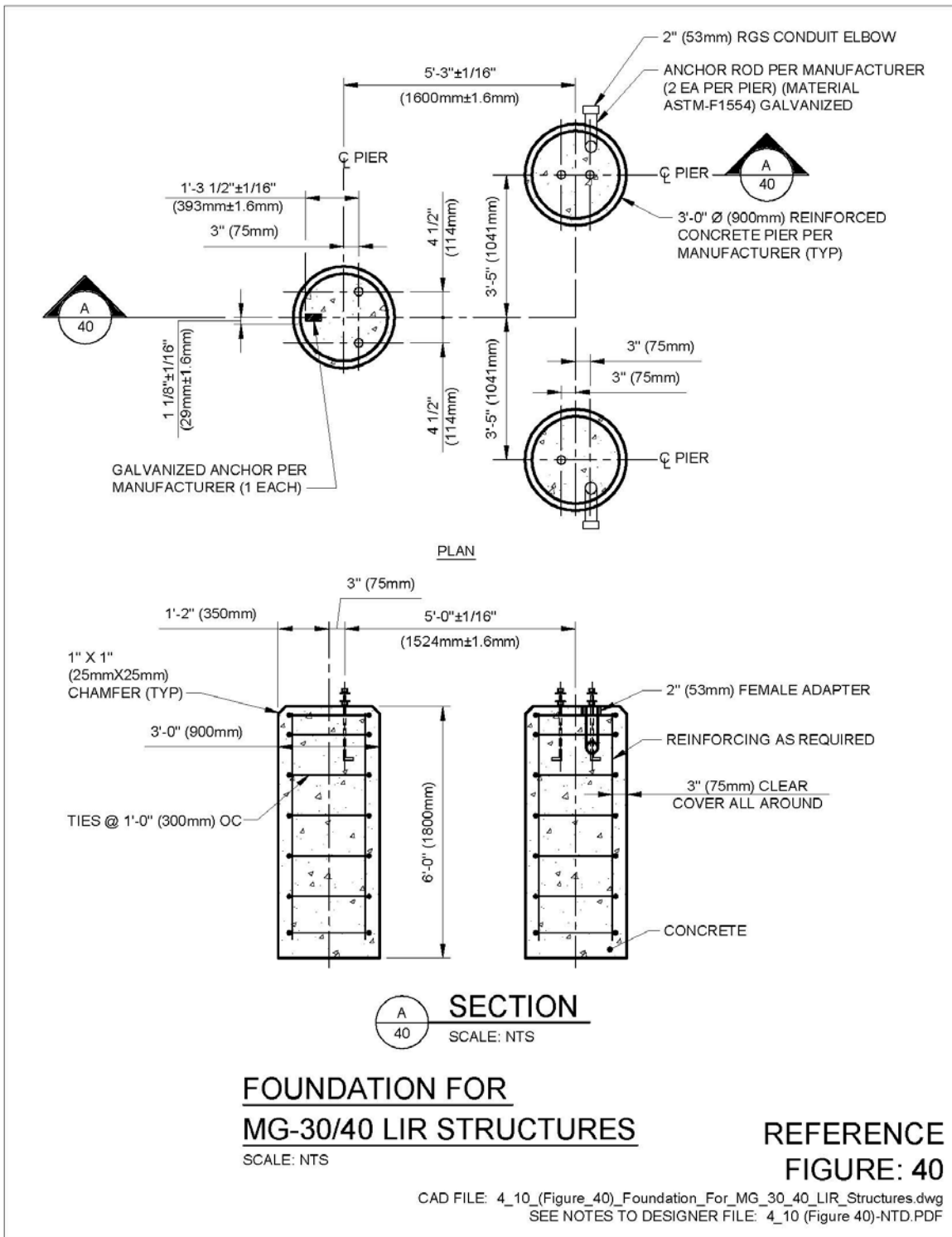
5-10 **Foundation for MG-30/40 L.I.R. Structures.**

5-10.1 **Figure 40.**

5-10.1.1 **Notes to Designer.**

1. The foundation indicated is a suggested foundation from one tower manufacturer. The diameter was increased to allow the installation of the conduits in the foundation and still allow clearance for the tilt base on the tower.
2. Prior to designing the foundation for the tower, borings should be taken in the field for soil analysis. Many factors will affect the type and size of foundation to be installed (i.e. type of soil, existence of rock or ledge, soil bearing capacity, frost depth, etc.). The designer should base the foundation design on these factors and consult with the tower manufacturer regarding EPA (Effective Projected Area) for wind loading. The wind loading must include the proposed fixtures and hardware to be installed on the tower.
3. Reinforce per the manufacturer's written requirements.

Figure 40. Foundation for MG-30/40 L.I.R. Structures



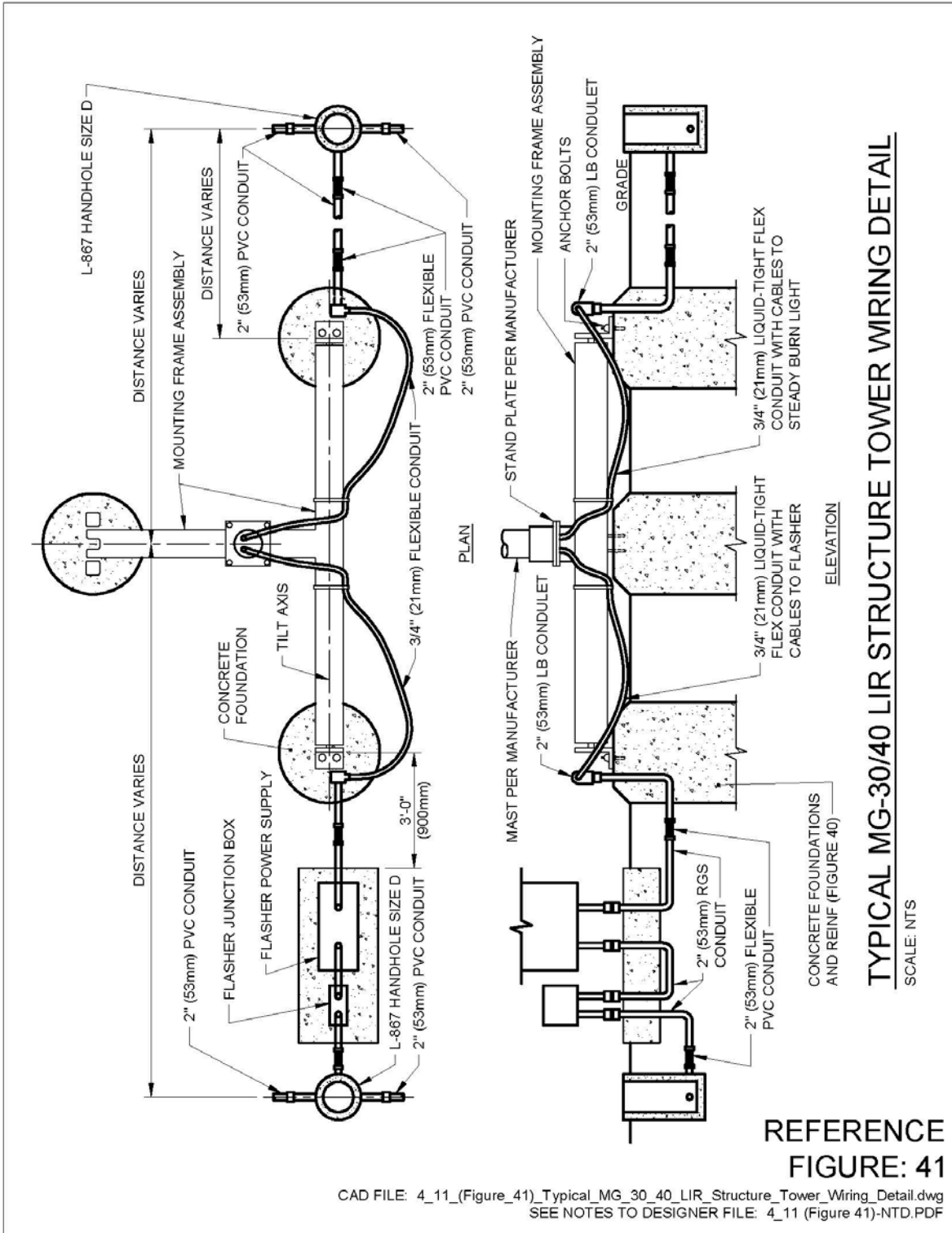
5-11 **Typical MG-30/40 L.I.R. Structure Tower Wiring Detail.**

5-11.1 **Figure 41.**

5-11.1.1 **Notes to Designer.**

1. Location of the handhole with respect to the tower foundation will depend on system layout. Recommend keeping same distance from each tower foundation throughout system thereby allowing a straight run between handholes.
2. The tower tilts away from the end of runway and towards the approach. Routing the conduit towards the direction of the tilt and maintaining slack will prevent putting strain on the conduit while the tower is raised and lowered.
3. The number of isolation transformers will depend on the wattage and number of lamps to be installed. If more than one lamp is installed per isolation transformer, then the steady burn approach light must be specified with a lamp shorting device so the other lamps will remain on if one lamp burns out.

Figure 41. Typical MG-30/40 L.I.R. Structure Tower Wiring Detail



5-12 **Tower Mounted Steady Burning Approach Light Detail.**

5-12.1 **Figure 42.**

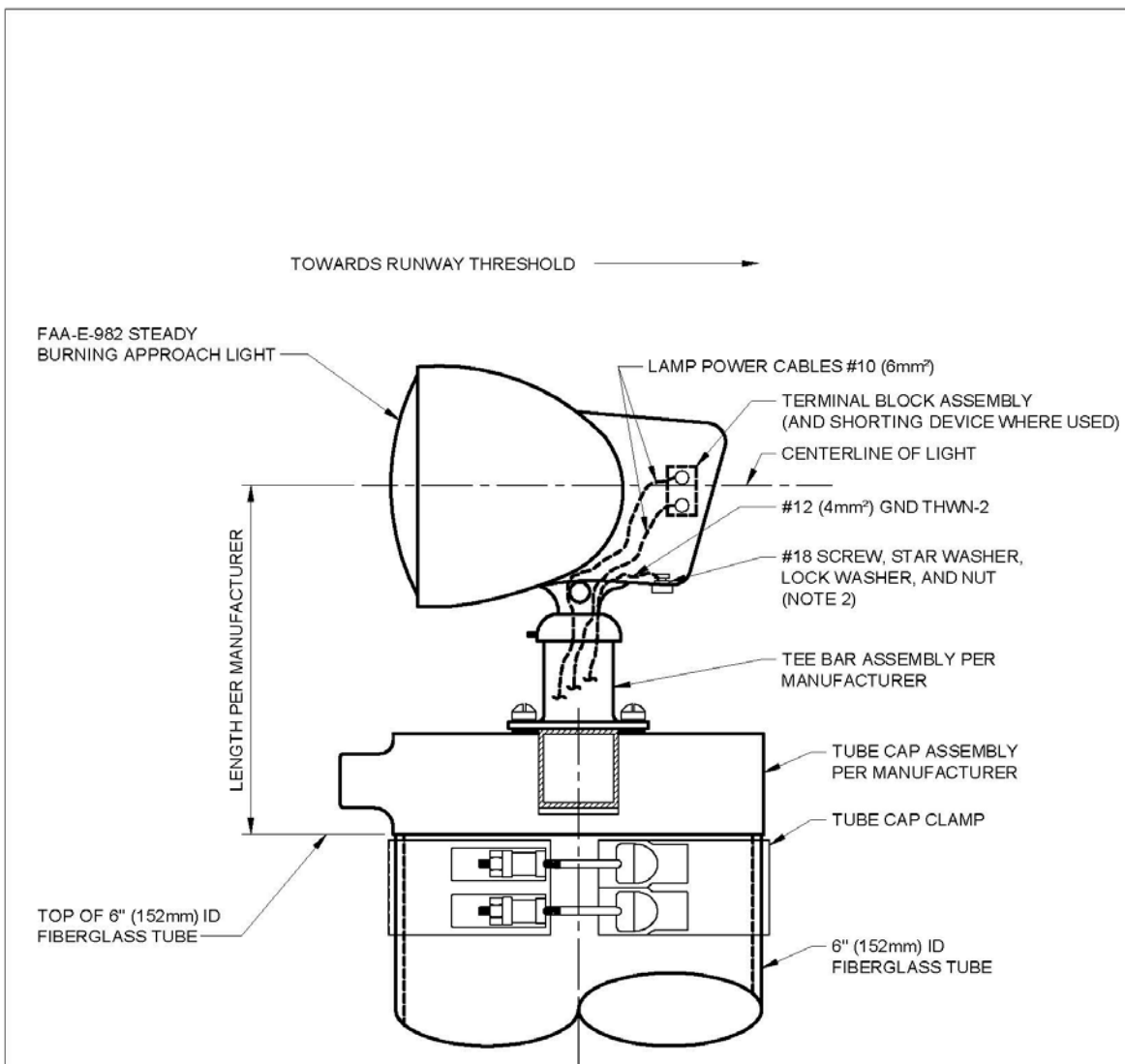
5-12.1.1 **Notes to Designer.**

1. The FAA does not require a grounding terminal in the lamp holder. However, more recent installations have installed an equipment ground to the lamp holder. The ground conductor is routed with the circuit conductors and is bonded to the steel base plate and mounting assembly. This in turn is bonded to a ground.

5-12.1.2 **Drawing Notes for Figure 42.**

1. Measure distance between center of light and top of tube using actual equipment installed.
2. Attach #12 (4 square mm) ground to fixture housing by installing a #8 screw through hole provided in bottom of housing. Sand away paint and anodizing around hole on inside of housing to bare metal. Push screw up through hole and install star washer over screw on interior of housing. Crimp an insulated ring terminal on the end of the ground wire and install on screw. Place lock washer and nut on screw and tighten. Verify with manufacturer length and size of screw, star washer, lock washer, and nut to be utilized to maintain clearance from terminal block assembly.

Figure 42. Tower Mounted Approach Light Detail



TOWER MOUNTED STEADY BURNING APPROACH LIGHT DETAIL

SCALE: NTS

REFERENCE
FIGURE: 42

CAD FILE: 4_12_(Figure_42)_Tower_Mounted_Steady_Burning_Approach_Light_Detail.dwg
SEE NOTES TO DESIGNER FILE: 4_12 (Figure 42)-NTD.PDF

5-13 **Tower Mounted SFL and Approach Light Detail.**

5-13.1 **Figure 43.**

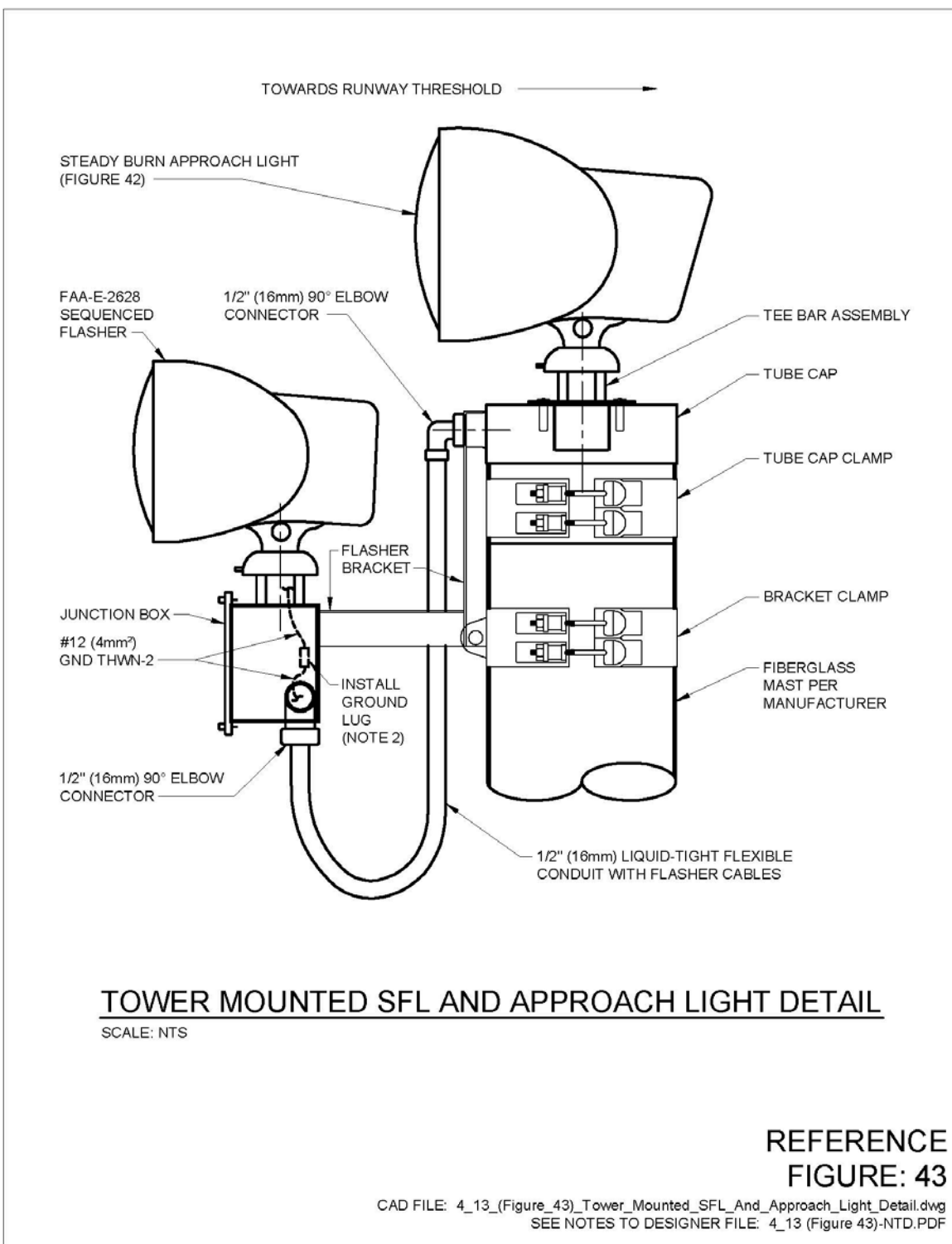
5-13.1.1 **Notes to Designer.**

1. The flasher equipment ground conductor may be bonded to the ground conductor for the steady burn lights inside the tube cap assembly.
2. The number of conductors to the flasher must be verified. Typically, 2 #12 (4 square mm) and 3 #16 (1.5 square mm), 3kV, are used and are provided by the manufacturer. Ensure size of flexible conduit is adequate for these cables.

5-13.1.2 **Drawing Notes for Figure 43.**

1. Flasher junction box/bracket and bracket clamp furnished as an assembly. Install on mast per manufacturer's requirements.
2. Install ground lug on one of the 2 aluminum angles inside the junction box and route a #12 (4 square mm) THWN-2 from flasher and fiberglass mast to lug. Terminate ground wire on lug.

Figure 43. Tower Mounted SFL and Approach Light Detail



5-14 **MALSR and SSALR Approach Light System Configuration.**

5-14.1 **Figure 44A, 44B.**

5-14.1.1 **Notes to Designer.**

1. Recommend including the system layout as part of the contract documents.
2. The SSALR configuration may be achieved with a dual mode ALSF/SSALR system and is used when Category I weather conditions exist thereby allowing an energy savings without having to use the full ALSF-2 system.

Figure 44A. MALSR Approach Light System Configuration

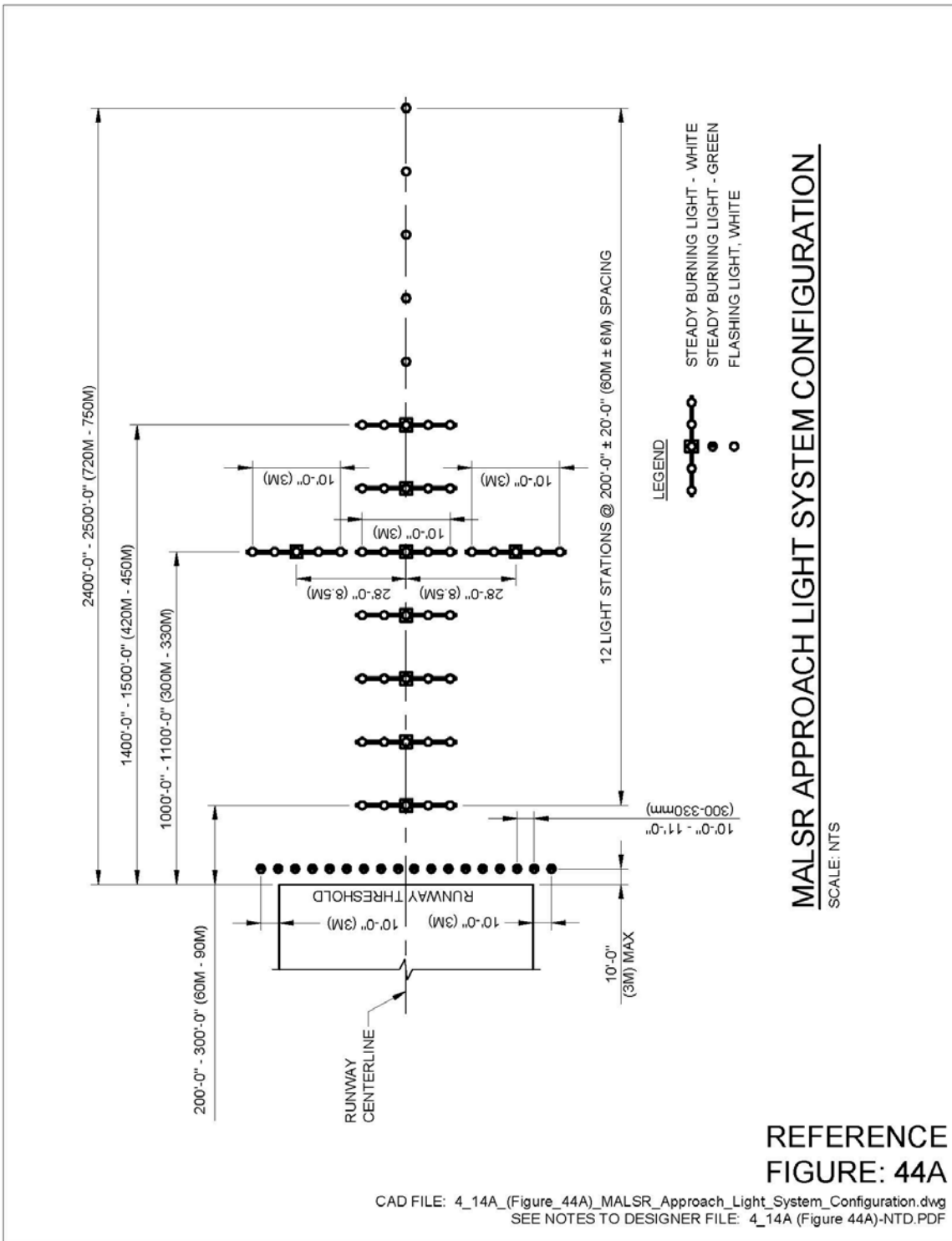
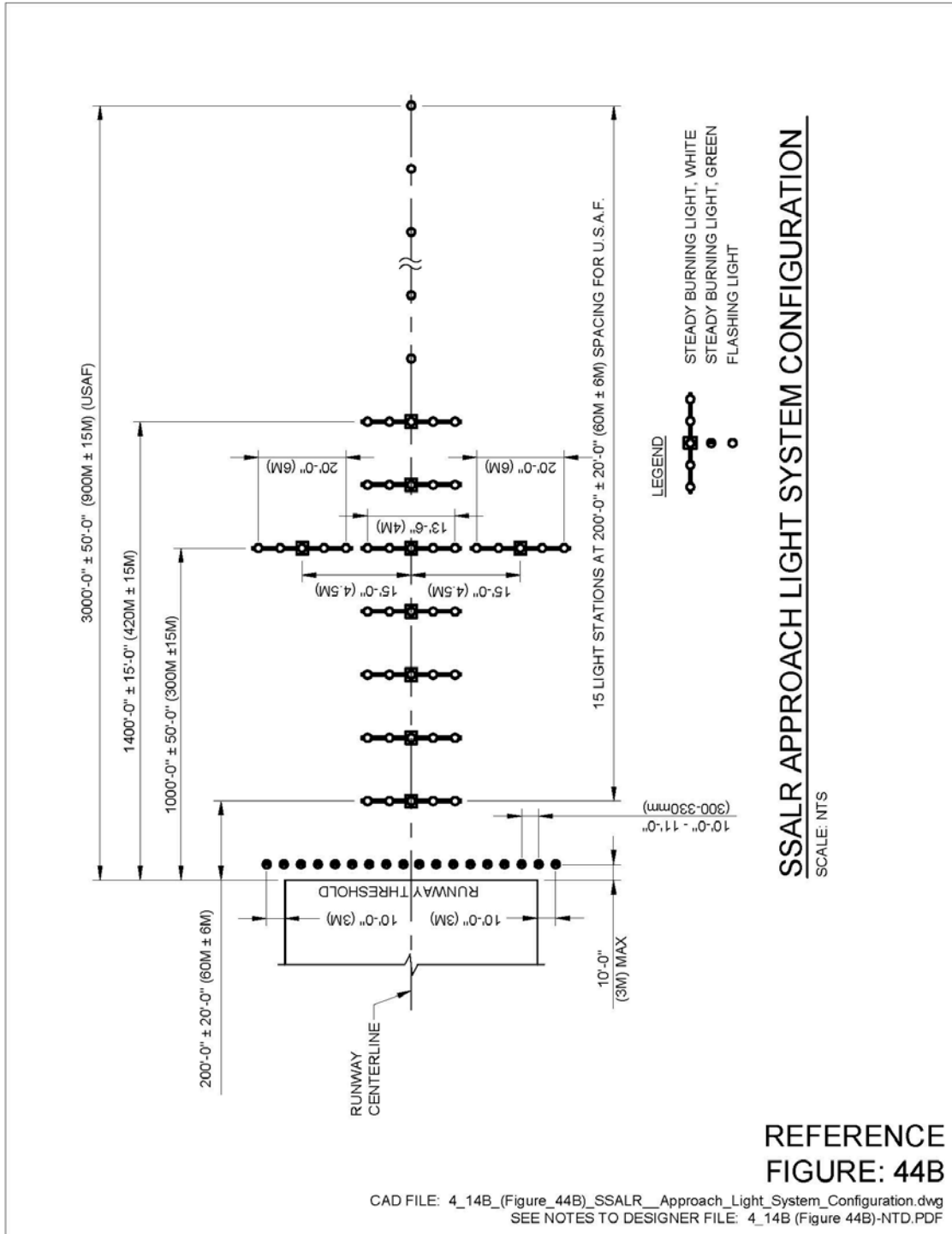


Figure 44B. SSALR Approach Light System Configuration



5-15 **Remote Flasher Installation 6' 0" (1800mm) Maximum.**

5-15.1 **Figure 45.**

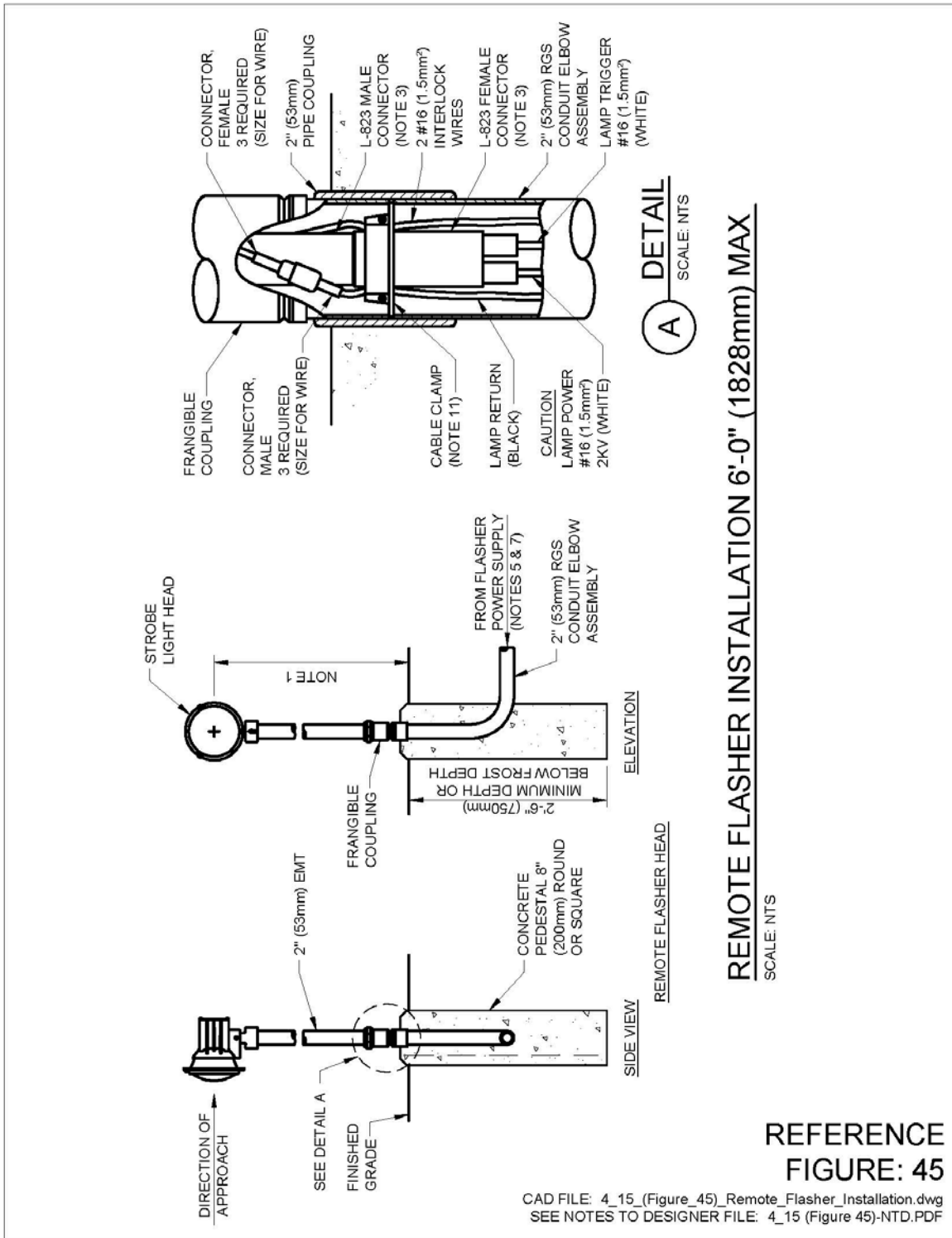
5-15.1.1 **Notes to Designer.**

1. This detail shows a remote flasher installation. The high voltage cable is normally supplied with the flasher and about 50' (15m) in length. Locate the flasher power supply within this distance.
2. Where the flasher is co-located with an approach light bar; the flasher may be mounted a maximum 5' (1.5m) in front of light bar and a maximum of 4' (1.2m) below the centerline of the approach light plane. When the flashers are mounted below the centerline, they must be uniformly mounted throughout the system.

5-15.1.2 **Drawing Notes for Figure 45.**

1. Maximum mounting height of configuration indicated is 5'-11" (1.775m) for mounting installation of more than 6'-0" (1800mm) see tower installation details.
2. Terminate all conduits with a standard grounding bushing.
3. Connection must be clean and dry with a light coating of silicone grease only.
4. Continuity of power cables must be maintained between flasher stations. Where splices are required, they must be epoxy resin type with plastic shell. Equip conductors with mechanical wire clamps.
5. Ground clearance of electrical boxes must be determined in field, and must be 8" (200mm) minimum.
6. Flasher power supply/junction box unit must be located 35' (10.5m) from extended centerline of runway.
7. Insert lamp return wire into cable clamp prior to final assembly/tightening.

Figure 45. Remote Flasher Installation 6' 0" (1828mm) Maximum



5-16 **Typical High Intensity Approach Light Bar.**

5-16.1 **Figures 46A, 46B, 46C, 46D, 46E, 46F, 46G.**

5-16.1.1 **Notes to Designer.**

1. Figures 46A, 46B, 46C, 46D, 46E and 46F show the installation of an approach light bar in a concrete monolith. The pavement is excavated at the location where the bar will be installed. Depth and width of the excavation must be enough to allow setting the base cans, installing reinforcement and backfill with concrete.
2. Figures 46E and 46F show setting the base cans with the support brace spanning the excavated area. Sandbags are used on top of the bracing to prevent the base from floating during concrete installation.
3. The thickness of the snow plow ring is crucial in setting the base at the correct height. The plywood cover must match the diameter and thickness of the snowplow ring so that when removed the ring will fit properly and the outside edge of the ring is flush with the existing top of pavement.

5-16.1.2 **Drawing Notes for Figure 46D.**

1. Set the light base that mimic exact diameter and thickness of snow ring. Completely wrap plywood cover in roofing paper. See Figures 46E and 46F.
2. Light bases must meet or exceed to AC 150/5345-42, Specification for Airport Light Bases and Transformer Housing, Type L-868.
3. The contractor must provide 3/8" (10mm) -16 x 1-1/4" (30mm) long stainless steel bolts and stainless steel split lock-washers for bolting snow plow ring to L-868 base can.
4. Fill space with sealing compound P-606 for concrete or flexible pavement. Provide certification that sealer is compatible with pavement type.
5. Seal unused hole in light bases with pipe plugs.

5-16.1.3 **Drawing Notes for Figures 46E, 46F and 46G.**

1. Details for high intensity approach in-pavement light fixture/base can only. Installation methodology indicated for contractor information only. The methodology indicated on this sheet is general in nature. Final installation methodology must be determined by the contractor.

2. See civil plans for typical pavement section.

Figure 46A. In-Pavement High Intensity Approach Light Bar – Section View Materials

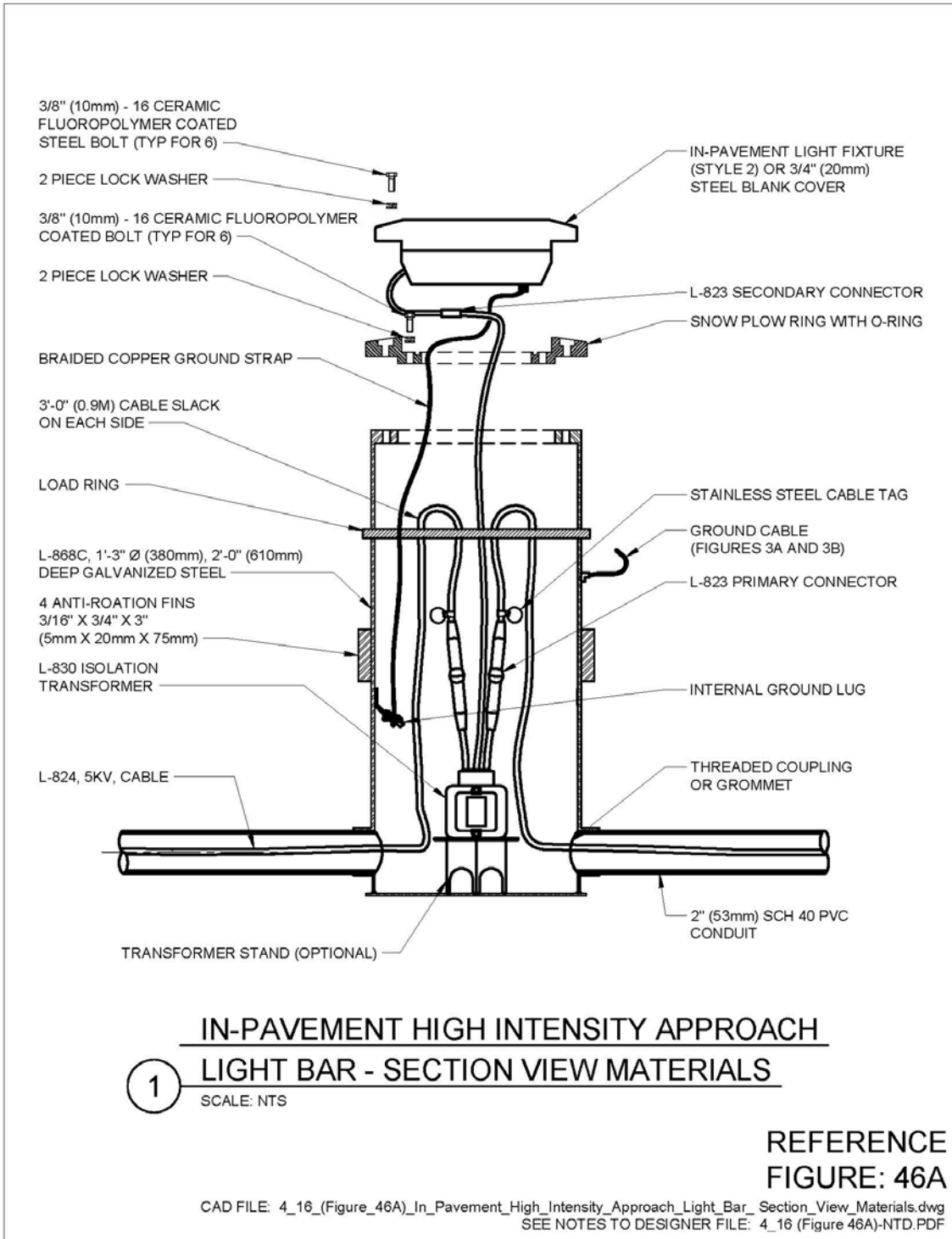


Figure 46B. Grounding Connections Air Force, Army, Navy Projects

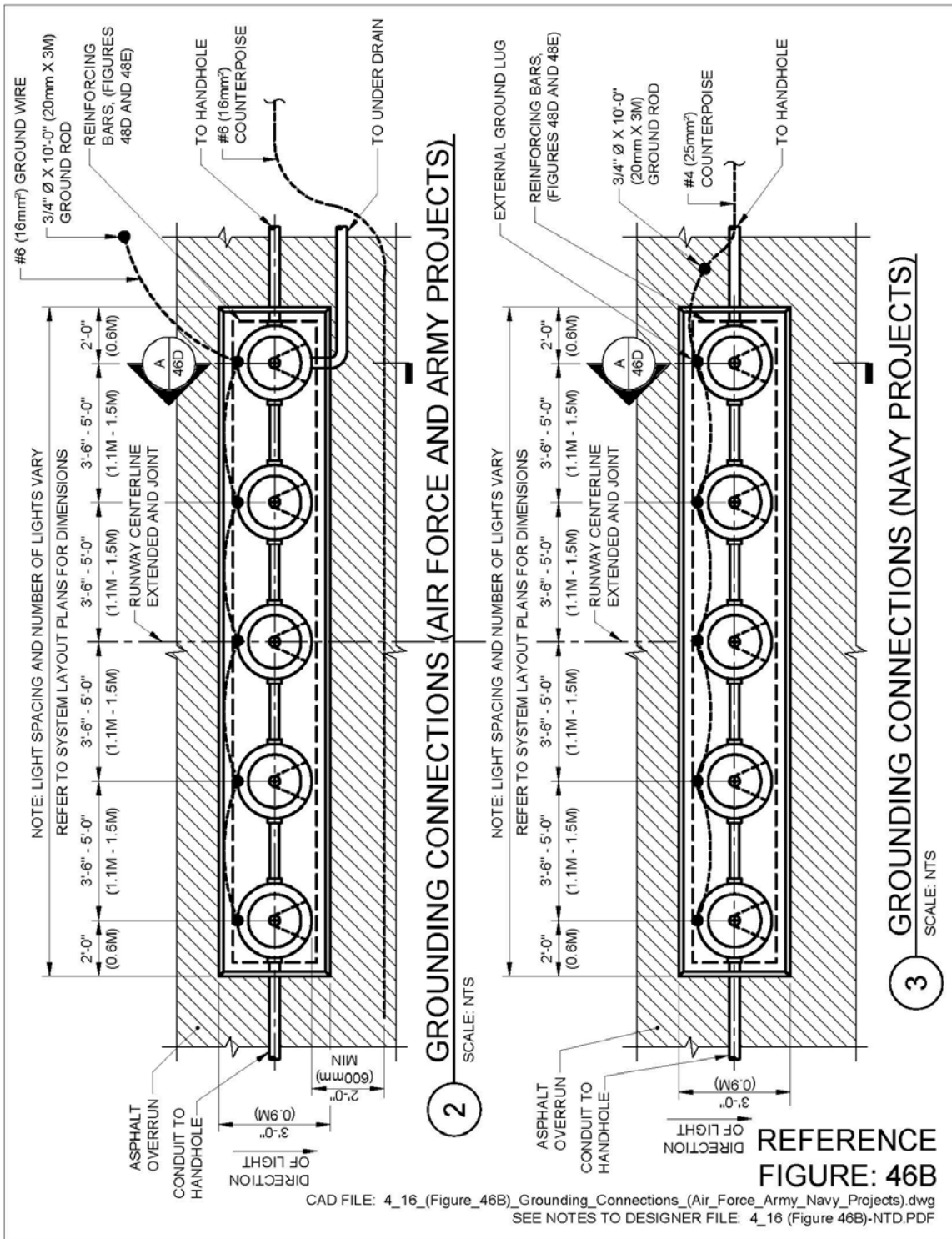


Figure 46C. Typical High Intensity Approach Light Bar (Air Force/Army)

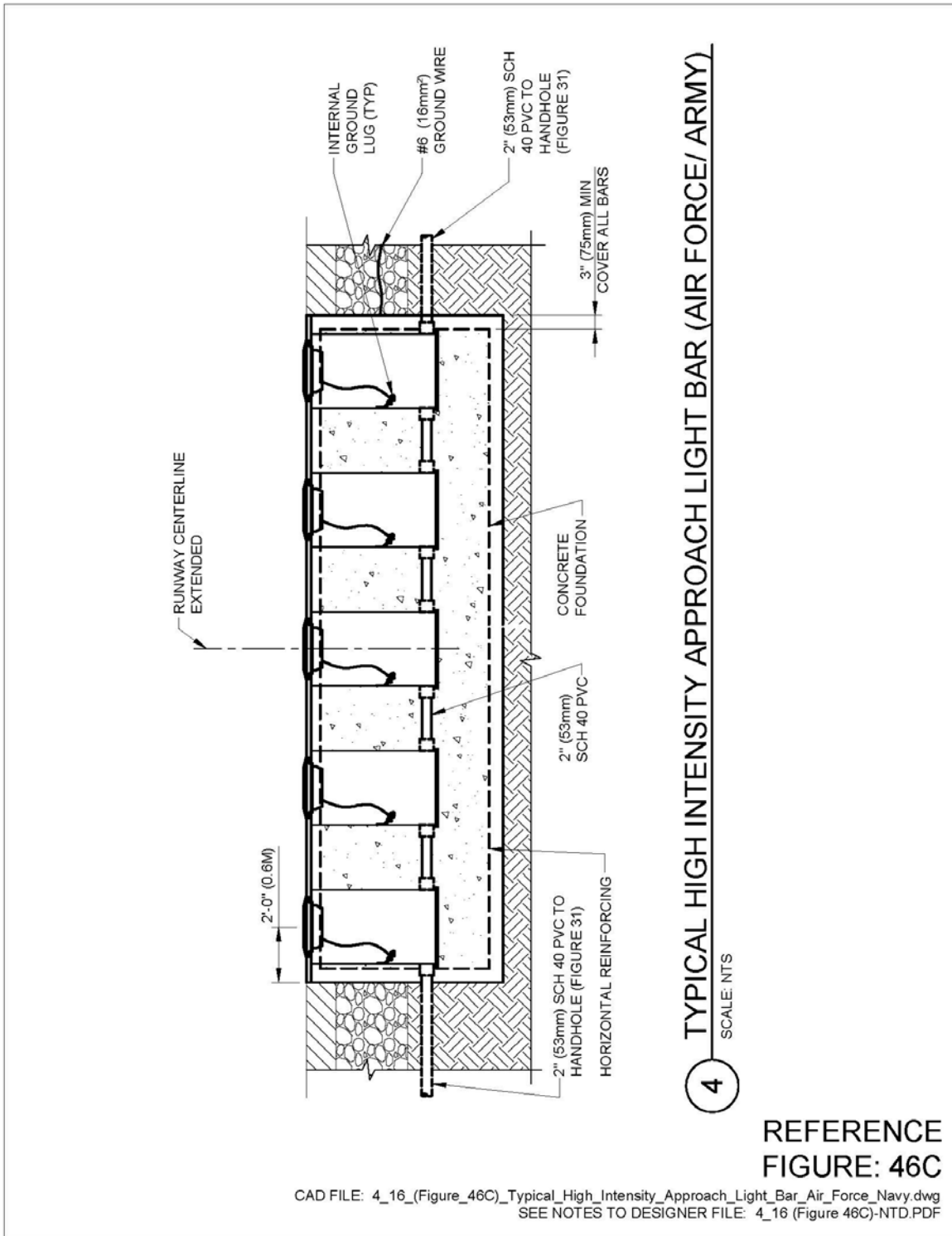


Figure 46D. Typical High Intensity Approach Light Bar (Navy)

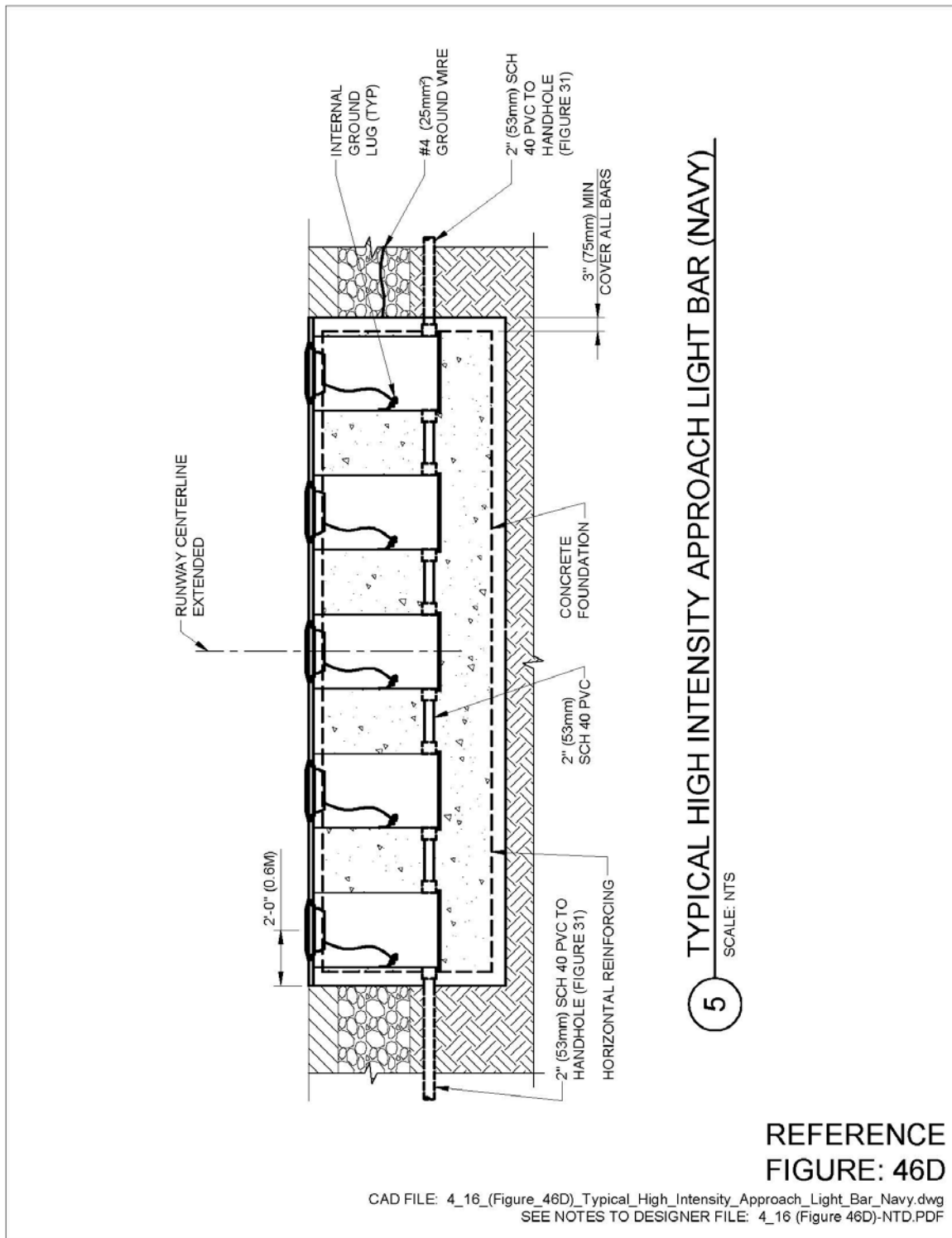


Figure 46E. In-Pavement High Intensity Approach Light Base – Section View and Conduit Installation

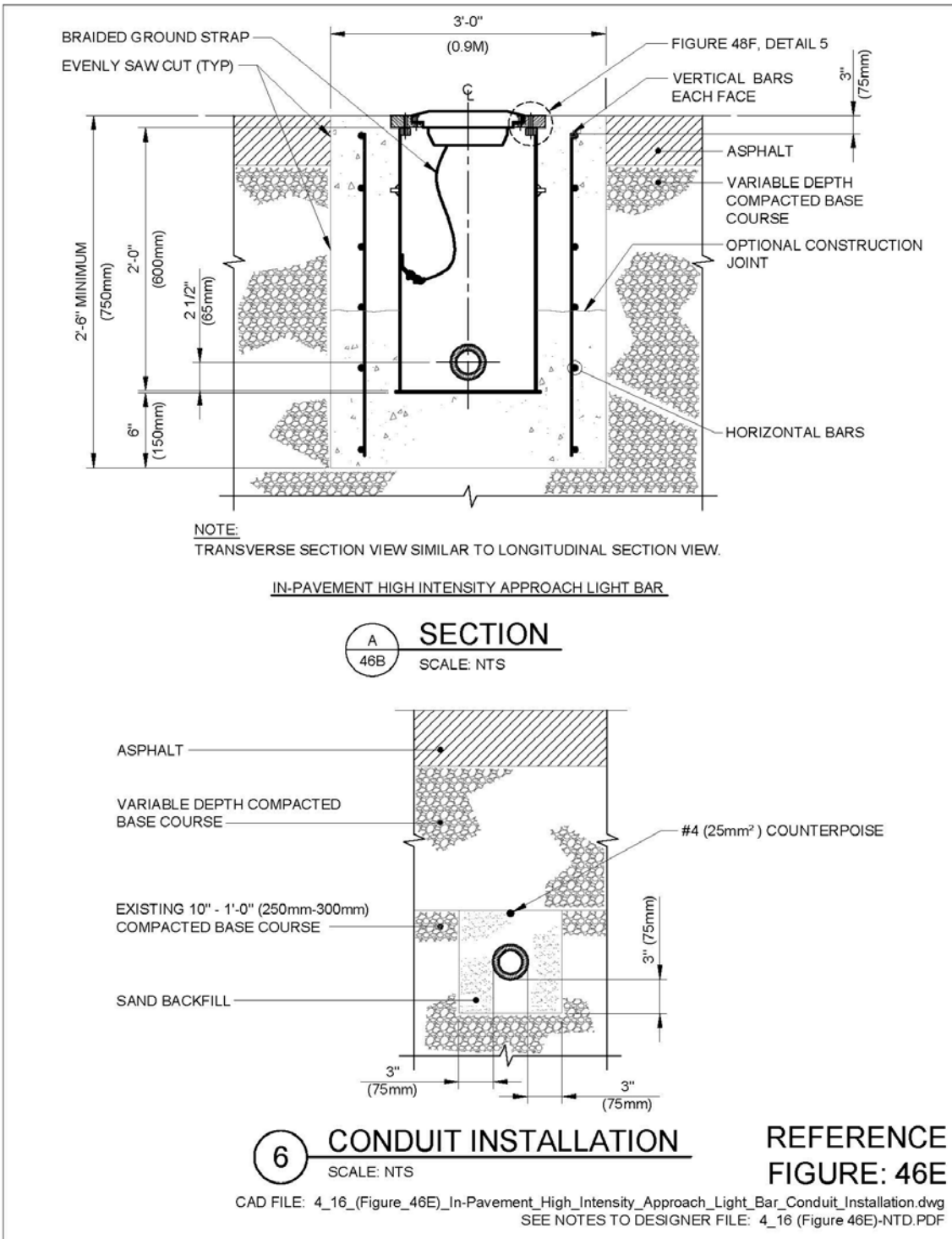


Figure 46F. Existing Trenching, Sawcut Asphalt and Trench, Set L-868 Base Can and Framework

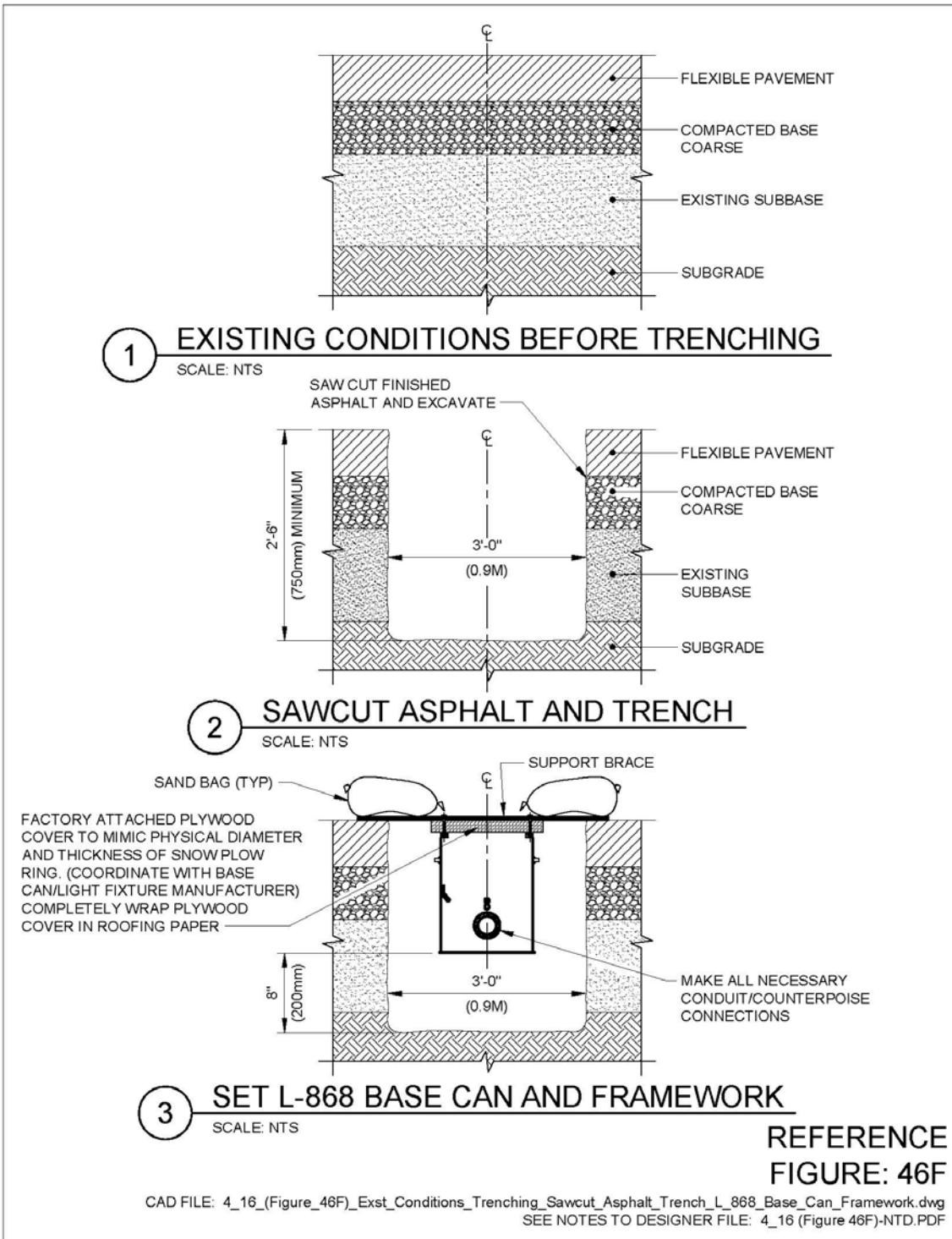
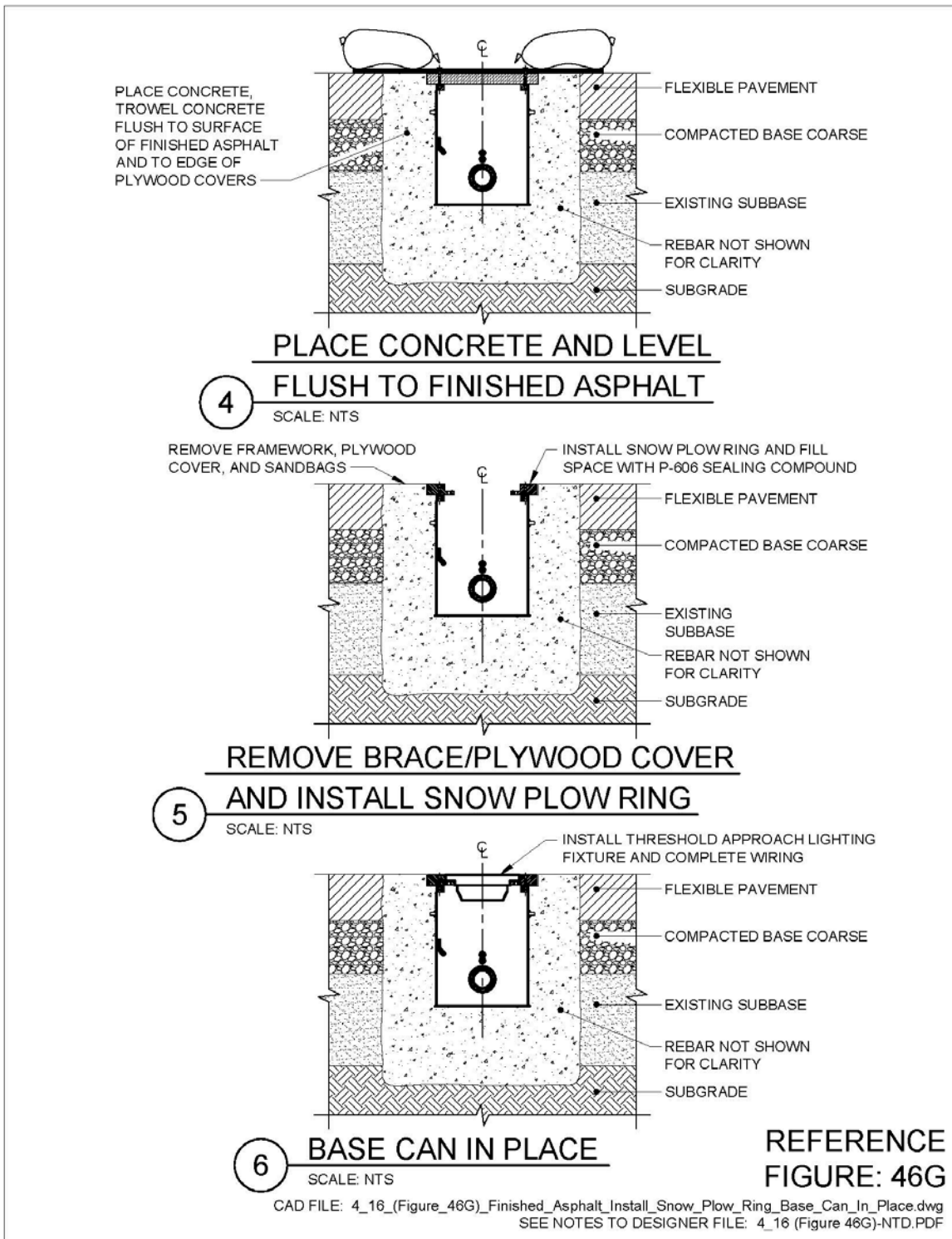


Figure 46G. Place Concrete, Remove Brace/Plywood Cover, Base Can in Place



5-17 **Typical Elevated High Intensity Approach Light Bar 0' to 6'0" (0mm to 1800mm) Maximum.**

5-17.1 **Figure 47.**

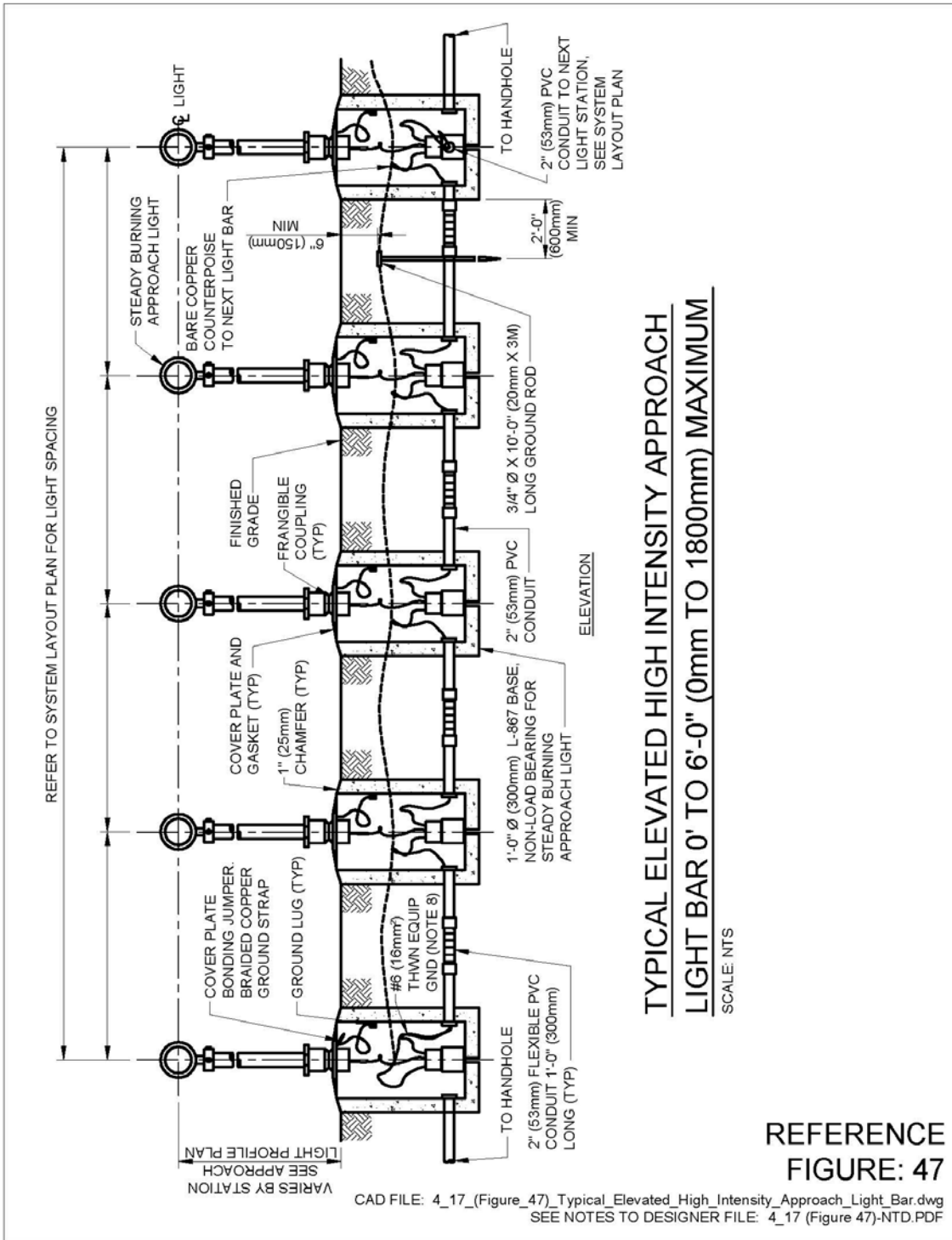
5-17.1.1 **Notes to Designer.**

1. This detail shows the elevated approach light bar. Spacing between the lights will depend on which system is installed.
2. The contract documents should contain an overall layout plan showing the spacing of the lights. Refer to UFC 3-535-01 for the spacing requirements for each system.
3. The flexible conduit allows for shifting due to freeze/thaw cycles in cold climates. If freeze/thaw cycles are not a problem, then the use of the flexible conduit is optional.
4. In some instances, the light bar may be installed in a reinforced concrete foundation similar to an in-pavement light bar as indicated in Figures 46A, 46B, 46C, 46D, 46E and 46F. The installation of the foundation would be the same except the light fixtures would be elevated. Typically, L-867 (non-loadbearing) base cans are used when the lights are located in turf areas. However, some commands require L-868 (load-bearing) base cans. Attention should be paid to the difference in the bolt circles for the two cans and providing the correct cover plate for the can being installed. L-867 cans utilize a 10 ½" (265mm) B.C. and L-868 utilize an 11 ¼" (285mm) B.C. Also, in some instances, a 15" (380mm) diameter can is required rather than 12" (305mm) diameter. The designer should consult with the Major Command for which the project is being designed for their requirements.

5-17.1.2 **Drawing Notes for Figure 47.**

1. Place all elevated light fixtures on 12" (305mm)Ø L-867, non-load bearing bases.
2. Maximum mounting height of configuration indicated is 6'-0" (1800mm). For mounting installation of more than 6'-0" (1800mm), see tower installation details.

Figure 47. Typical Elevated High Intensity Approach Light Bar 0' to 6'0" (0mm to 1800mm) Maximum



5-18 **Typical In-Pavement High Intensity Threshold Light Foundation with Interleaved Edge Light Circuits.**

5-18.1 **Figures 48A, 48B, 48C, 48D, 48E.**

5-18.1.1 **Notes to Designer.**

1. These figures show a typical foundation for a threshold light bar with interleaved edge light circuits.
2. No more than five lights should be in a bar before an expansion joint is installed.
3. Ensure photometric requirements are specified. Threshold lights must meet 10,000 CD min. average in green for a high intensity system.
4. The use of high-density polyethylene (HDPE) conduit allows the flexibility required of routing the conduit around cans. Two edge light and one threshold circuit feed the lights in the threshold bar. Refer to Figure 56 for high intensity threshold bar wiring diagram.

5-18.1.2 **Drawing Notes for Figures 48A and 48B.**

1. Not all fixtures in threshold bar are indicated for clarity. Threshold bar continues across runway and is symmetrical about runway centerline.
2. Interweave conduits as indicated.
3. Refer to Figure 56 for typical wiring diagram.

5-18.1.3 **Drawing Notes for Flush Fixtures, Figure 48E.**

1. Install corner edge of snow plow ring flush with pavement surface with a tolerance of +0", -1/16" (1.6mm). Check tolerance with straight edge. See Figure 19B.
2. Submit all base can installation techniques, methods, materials, etc., to the government for review and approval prior to the start of work.
3. Before backfilling around the base cans, the contractor must demonstrate to the government that the base cans are at the correct location, elevation, azimuth, and rotation.

4. Protect the finished pavement surface from foreign substances which could cause staining, i.e., concrete, oil, etc. The contractor must immediately clean all spills and correct/clean any stained surfaces at no additional cost to the government.
5. The base can cover mounting bolts must extend thru the base can mounting flange into the base can a minimum of 0.5" (13mm). The bolts must be threaded the full length of the bolt.
6. Concrete around base cans and duct/conduit must be completely consolidated by mechanical means and free of any voids.
7. For blank base cans, delete light fixture and install 3/4" (19mm) steel blank cover.
8. Air Force / Army Airfields: Connect local ground rod to base cans. Route counterpoise around base cans. Navy Airfields: Connect counterpoise to base cans.
9. Install top of edge of snow plow ring flush with pavement surface with a tolerance of +0", -1/16" (1.6mm).
10. If the distance between the edge of the snow ring and concrete is 1/8" (3mm) or less, seal top of opening with P-605 sealant and delete the P-606 compound.
11. The top of fixture must not exceed the top of the snow plow ring (+0, -1/8" (3mm)).
12. Install finished surface of concrete beam flush with adjacent pavement (+0, -1/16" (1.6mm))

Figure 48A. Runway Threshold Wing Bar Light Foundation – Plan View

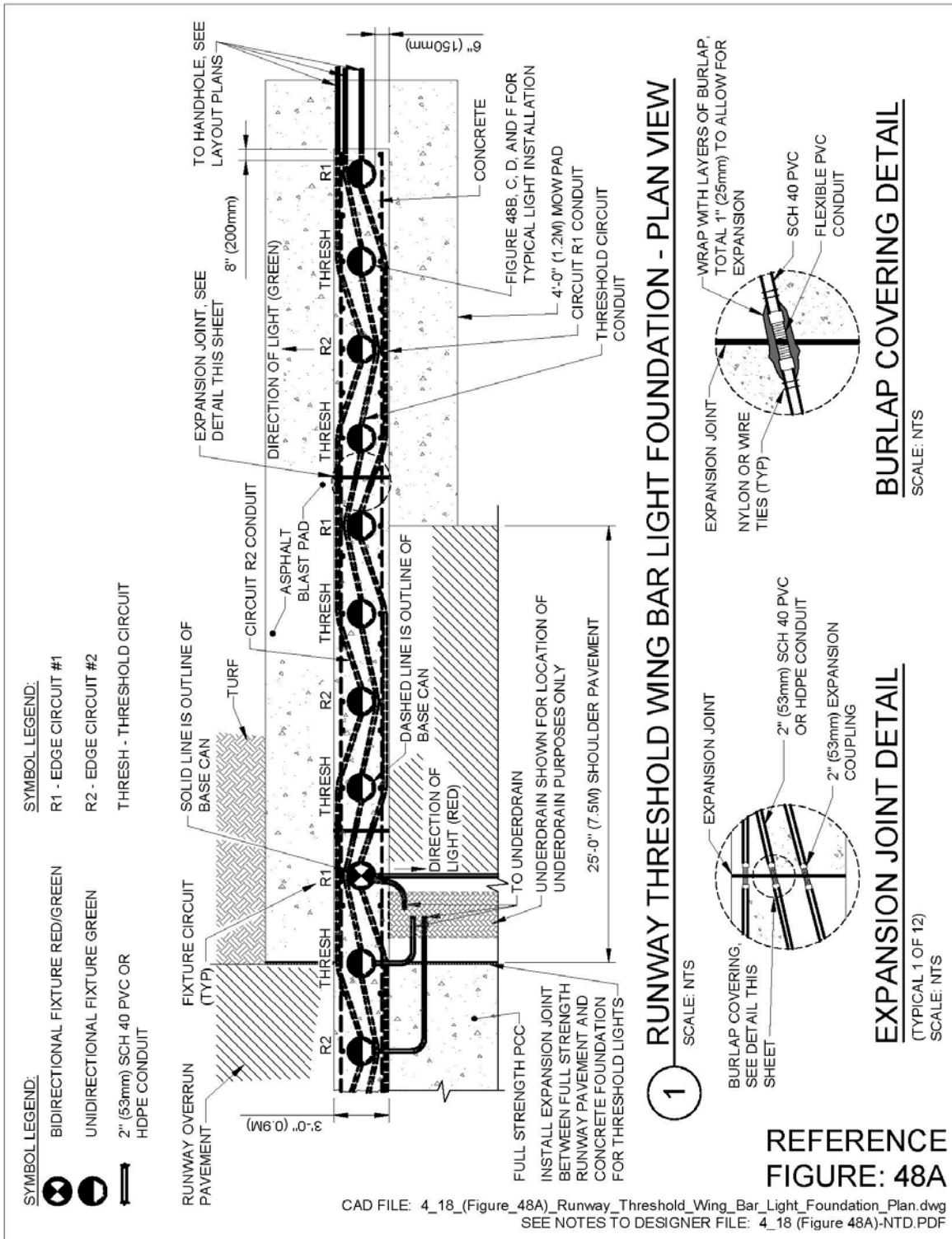


Figure 48B. Runway Threshold Wing Bar Light Foundation – Elevation View

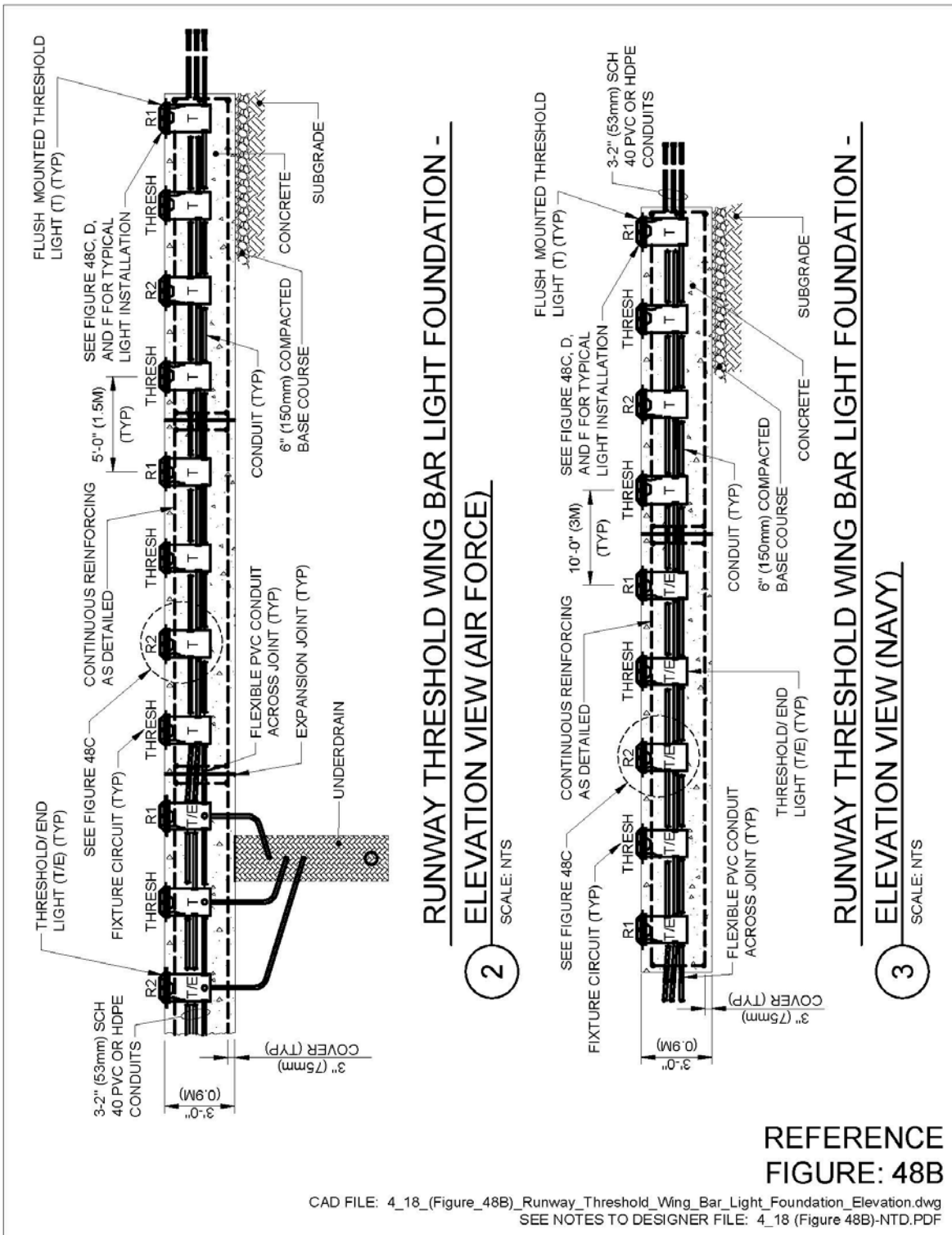
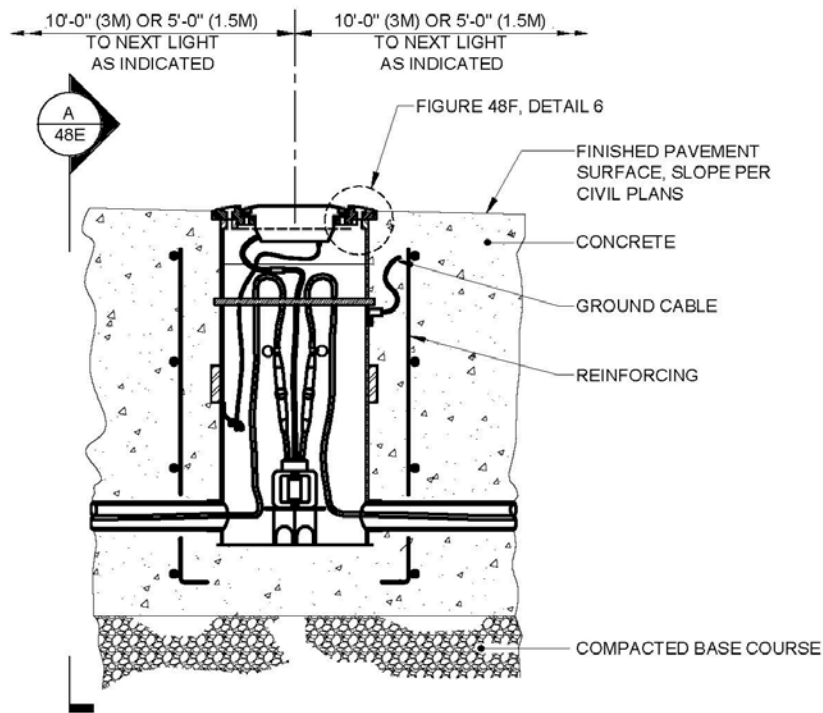


Figure 48C. Threshold Light in Concrete Beam



4 THRESHOLD LIGHT IN CONCRETE BEAM
SCALE: NTS

REFERENCE
FIGURE: 48C

CAD FILE: 4_18_(Figure_48C)_Threshold_Light_In_Concrete_Beam.dwg
SEE NOTES TO DESIGNER TXT FILE: 4_18 (Figure 48C)-NTD.PDF

Figure 48D. Threshold Light Beam

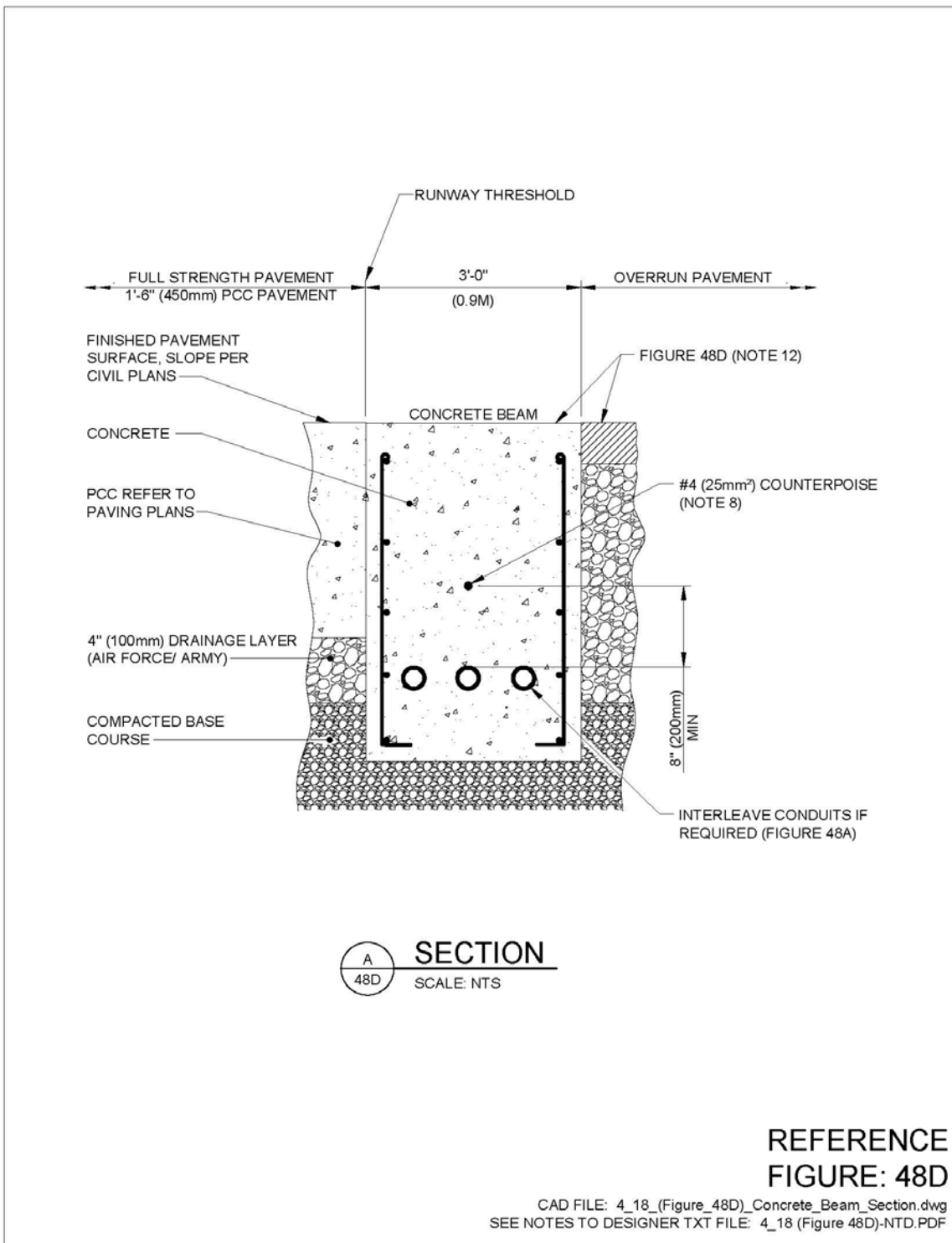
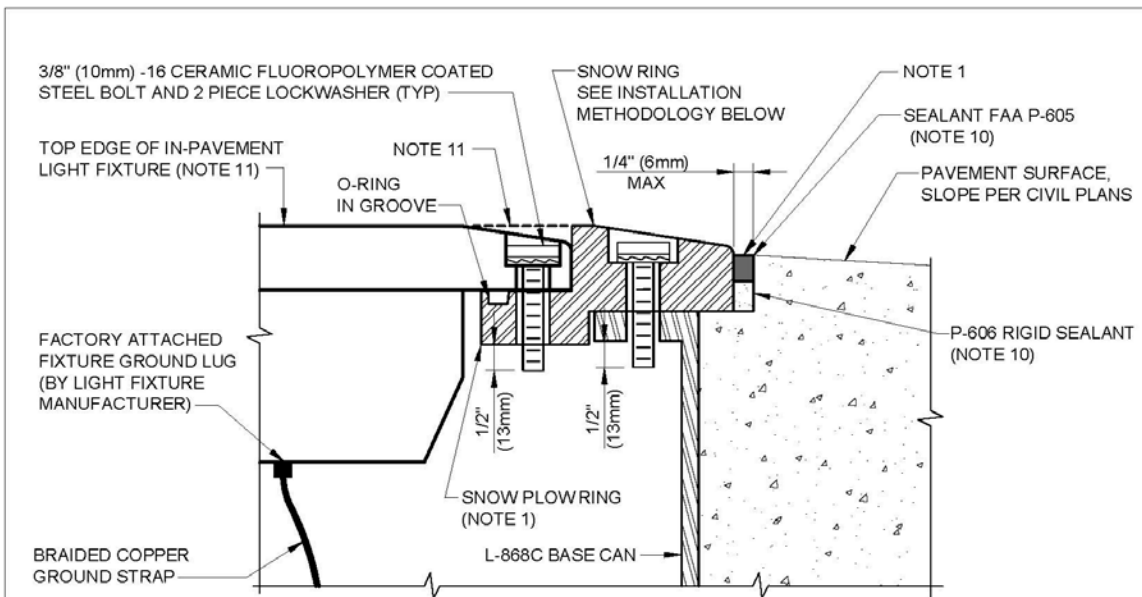
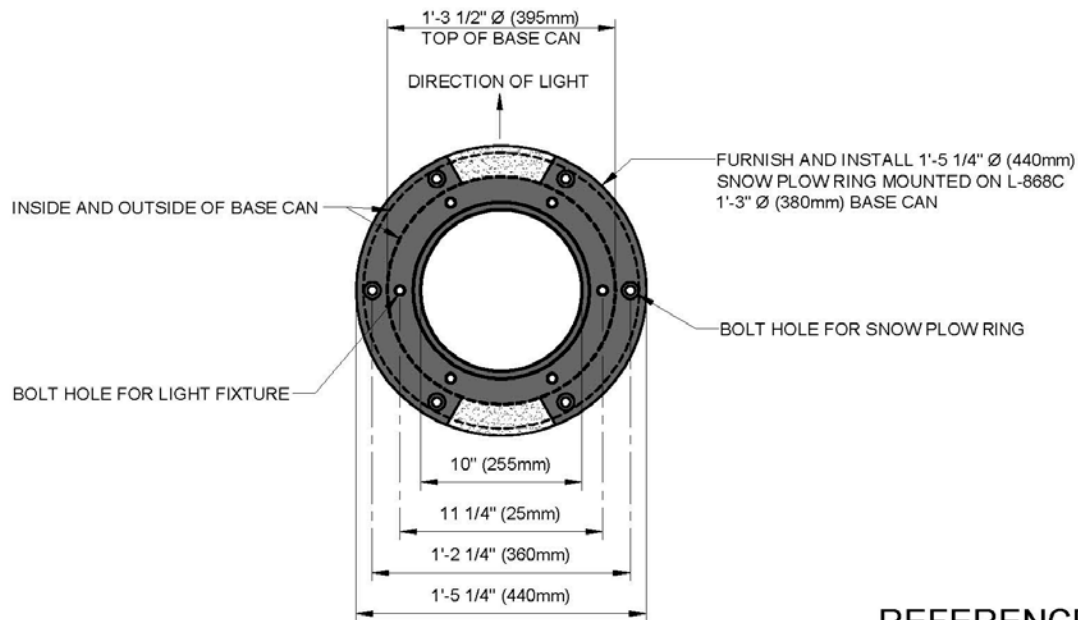


Figure 48E. Mounting Hardware



5 MOUNTING HARDWARE
SCALE: NTS



6 TOP VIEW
SCALE: NTS

REFERENCE
FIGURE: 48E

CAD FILE: 4_18_(Figure_48E)_Mounting_Hardware.dwg
SEE NOTES TO DESIGNER FILE: 4_18 (Figure 48E)-NTD.PDF

5-19 **Typical Elevated High Intensity Approach/ Threshold Light 6'0"
(1800mm) Maximum.**

5-19.1 **Figure 49.**

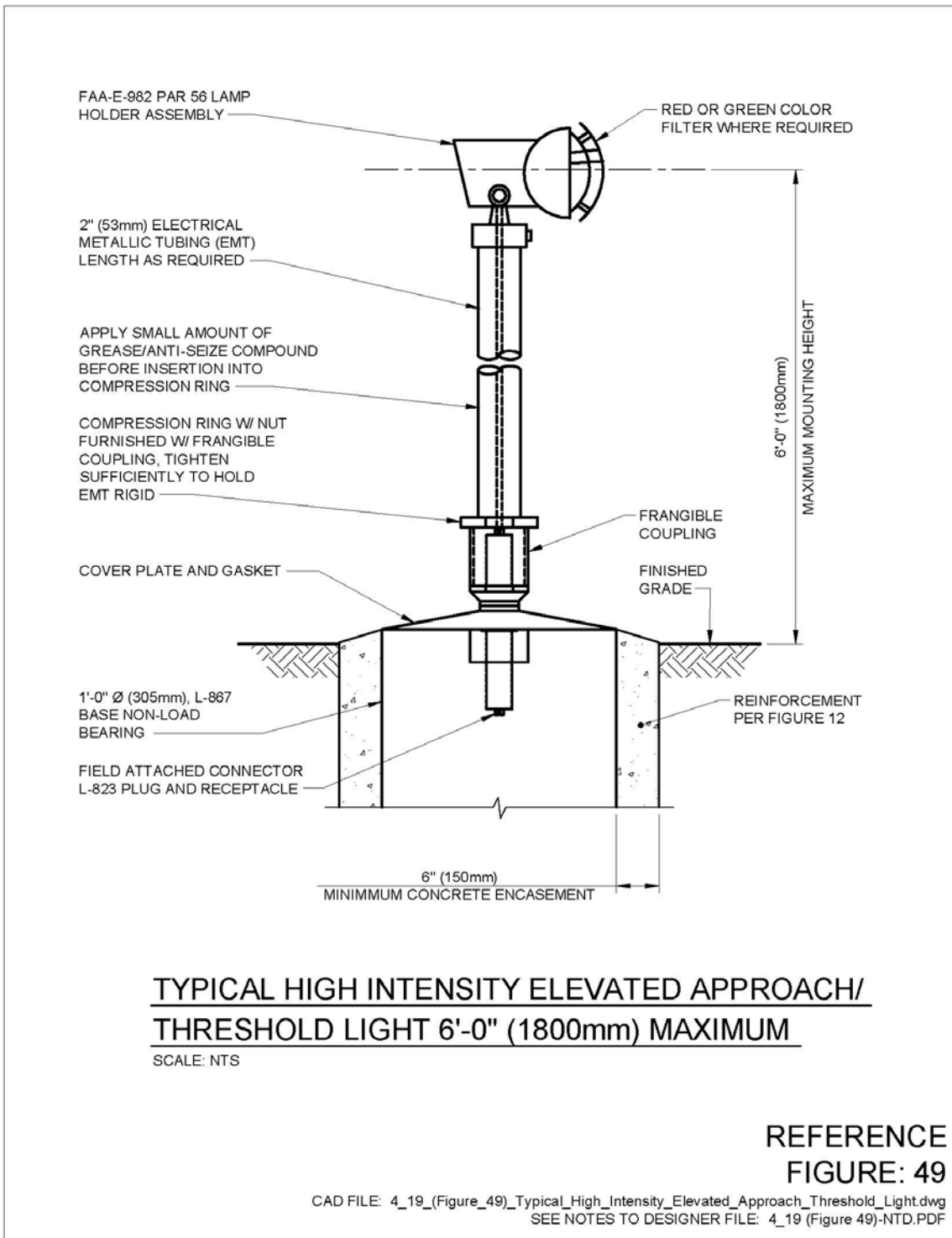
5-19.1.1 **Notes to Designer.**

1. The color filter used is dictated by the system.
2. Ensure proper lamp wattage is utilized to meet the photometric requirements specified in UFC 3-535-01. Recommend specifying photometric requirements in the contract documents.

5-19.1.2 **Drawing Notes for Figure 49.**

1. Green color filter for threshold bar.
2. Red color filter for side row barrettes (ALSF-2); pre-threshold and terminating bars (ALSF-1, SALS).
3. No color filter for centerline bars; 500' (150m) bar (ALSF-2); 1000' (300m) bar (ALSF-1, ALSF-2, SALS, SSALR).

Figure 49. Typical High Intensity Elevated Approach/Threshold Light 6'0"



(1800mm) Maximum

5-20 **ALSF-1 Approach Light System Configuration.**

5-20.1 **Figures 50A, 50B, 50C.**

5-20.1.1 **Notes to Designer.**

1. Recommend including the system layout as part of the contract documents.

5-20.1.2 **Drawing Notes for Figures 50A, 50B, 50C.**

1. The threshold and the approach light system up to and including station 9+00 are in-pavement in paved overruns, and elevated in non-paved overruns.
2. For reference only, runway end lights consist of 10 red lights arranged in two groups of 5 lights. The lights in each group must have a uniform spacing of 10' (3m). The outboard most light in each group must be in line with the line of the runway edge lights on that side of the runway. The groups must be located symmetrically about, and on a line perpendicular to, the runway centerline within 10' (3m) of the end of the usable runway surface. Where they are collocated, runway end lights may be incorporated into the opposite end threshold fixtures.
3. The threshold bar may be "gated" to alleviate the problem of tail hook bounce. The threshold gate is accomplished by eliminating those lights in the center 70' (21m) portion centered about the runway centerline.

Figure 50A. ALSF-1 Approach Light System Configuration (Air Force)

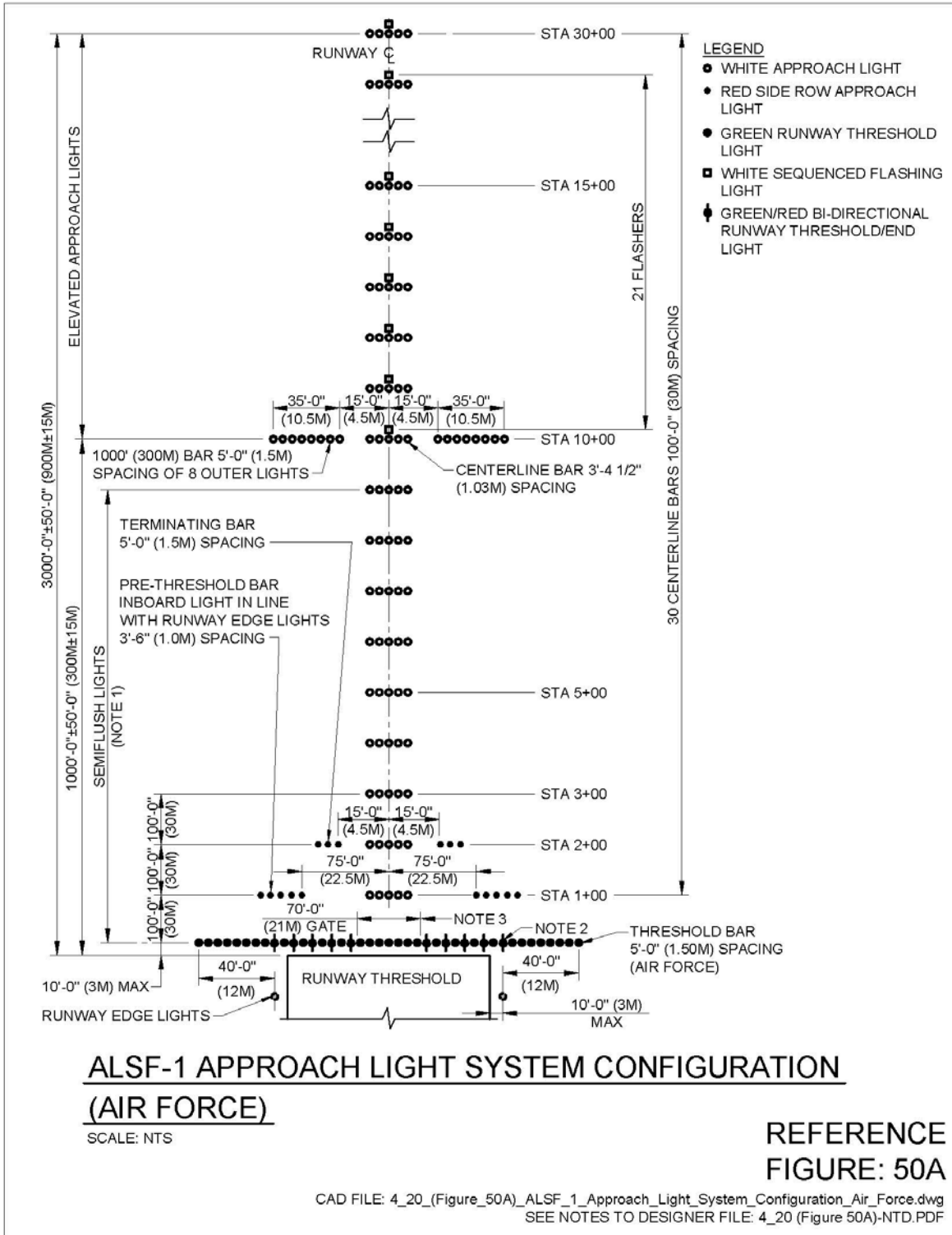


Figure 50B. ALSF-1 Approach Light System Configuration (Army)

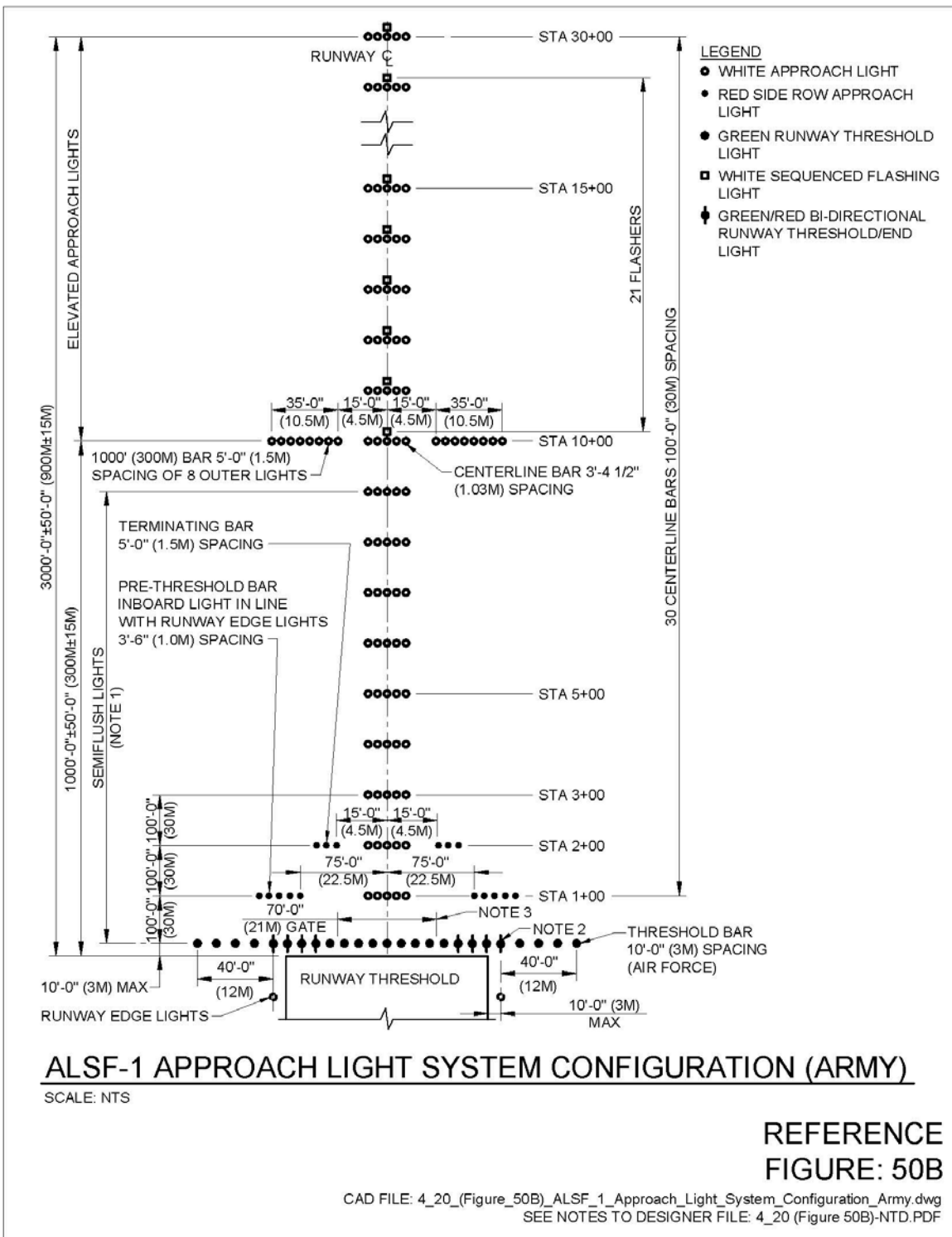
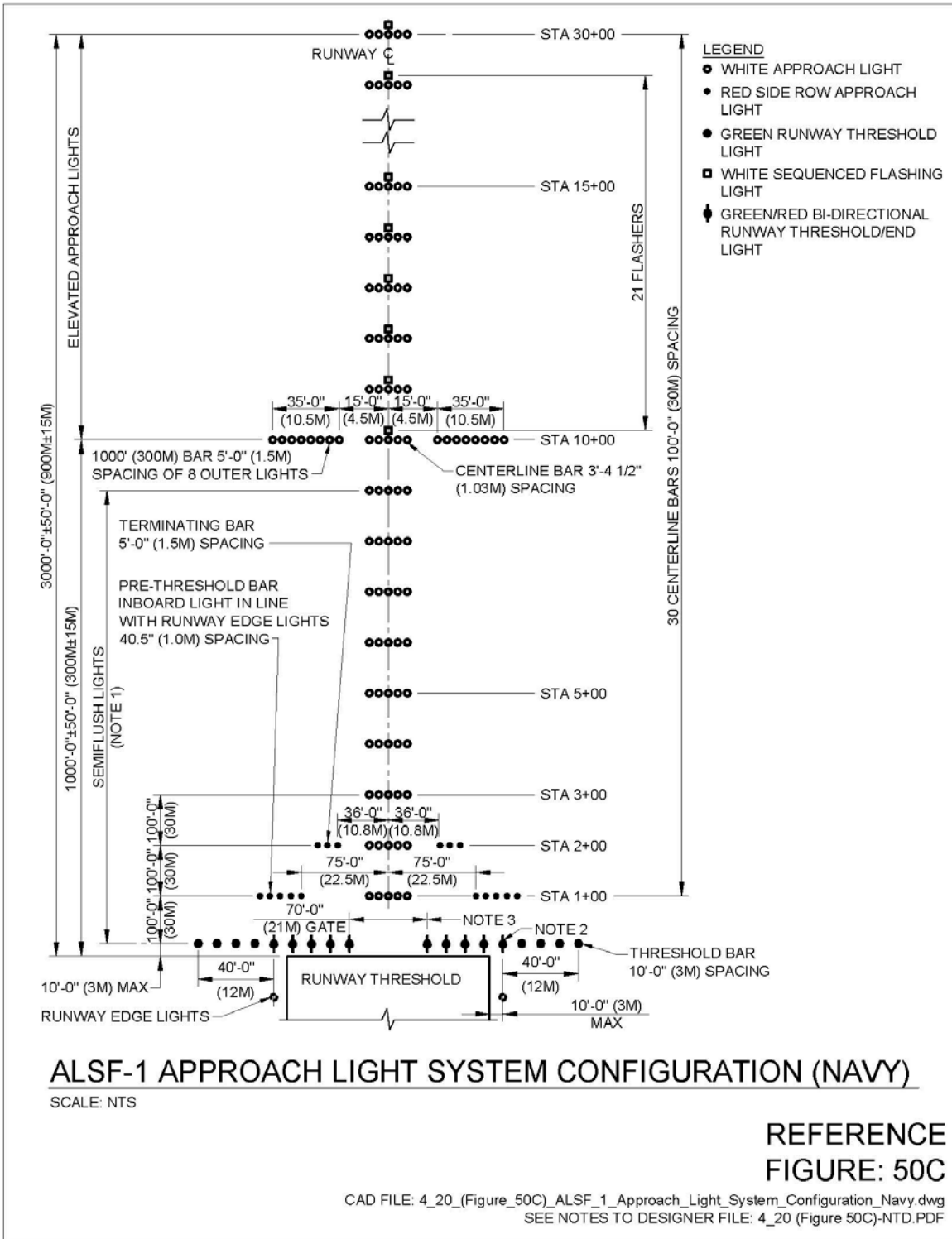


Figure 50C. ALSF-1 Approach Light System Configuration (Navy)



5-21 **ALSF-2 Approach Light System Configuration (Air Force).**

5-21.1 **Figure 51.**

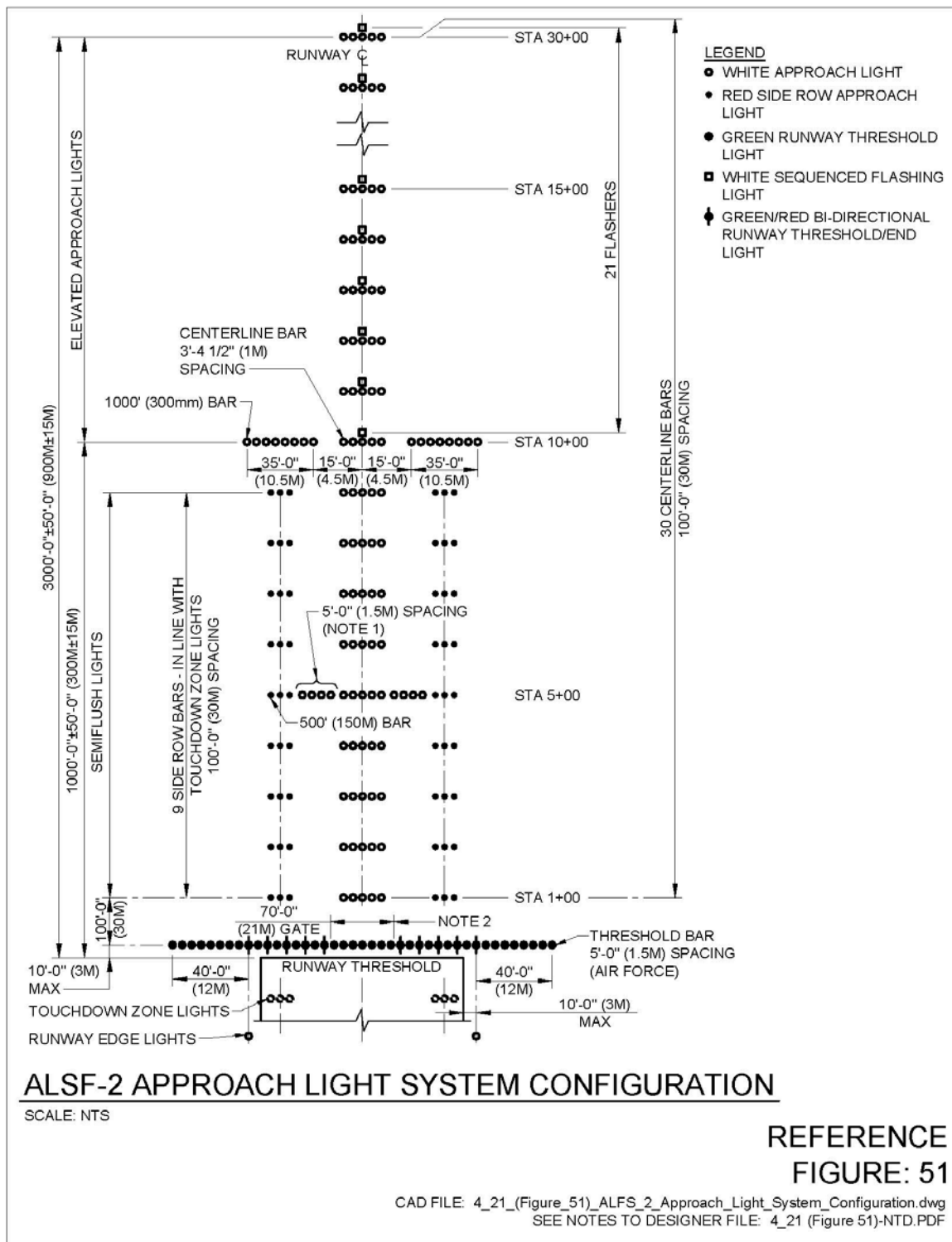
5-21.1.1 **Notes to Designer.**

1. Recommend including the system layout as part of the contract documents.

5-21.1.2 **Drawing Notes for Figure 51.**

1. Locate 4-light barrettes equidistant between side row bars and centerline bars
2. The threshold bar may be “gated” to alleviate the problem of tail hook bounce. The threshold gate is accomplished by eliminating those lights in the center 70' (21m) portion centered about the runway centerline.

Figure 51. ALSF-2 Approach Light System Configuration (Air Force)



5-22 **MALSR Wiring Diagram.**

5-22.1 **Figure 52.**

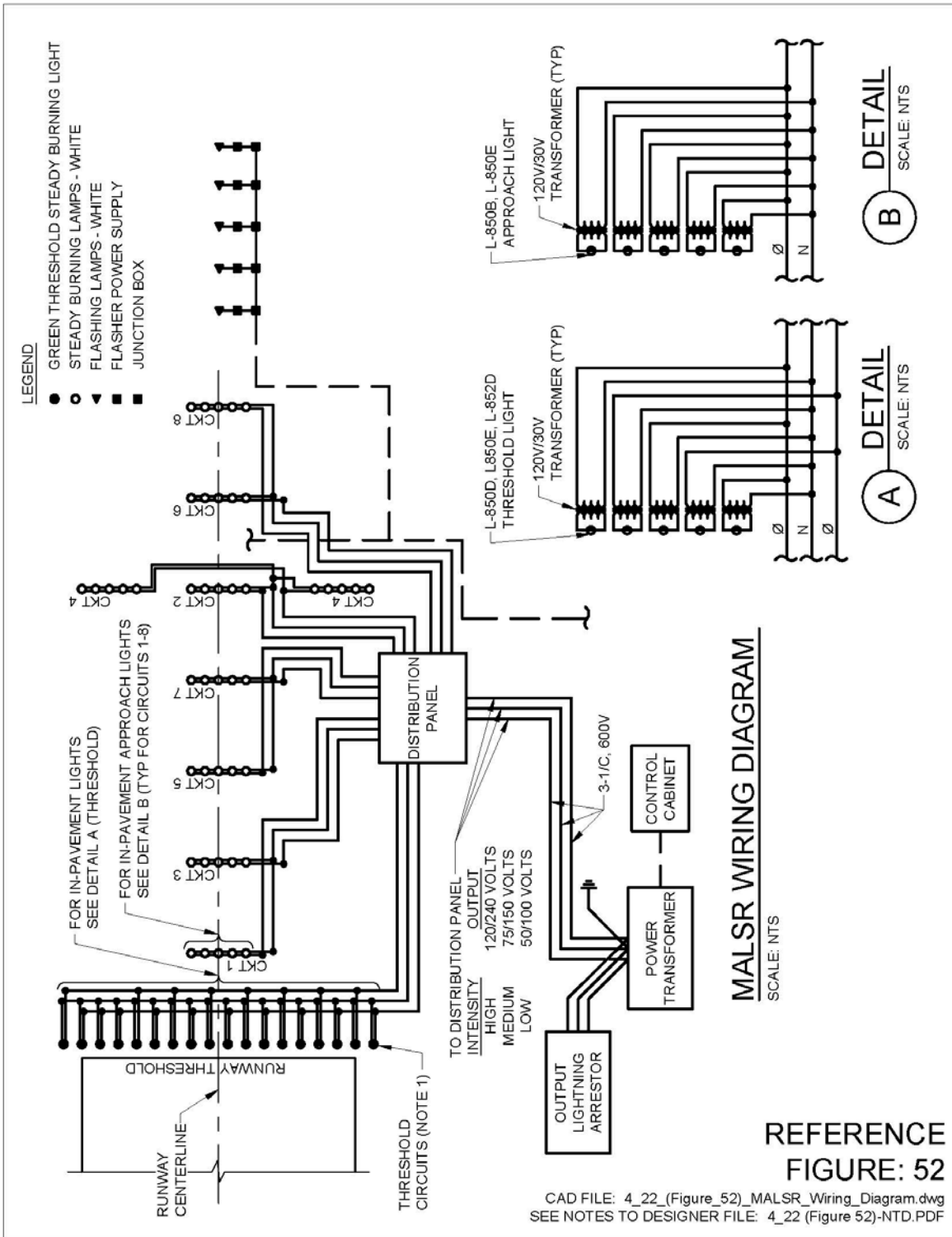
5-22.1.1 **Notes to Designer.**

1. The MALSR system is a constant voltage (parallel) system. When designing system close attention must be given to voltage drop.
2. The MALSR system utilizes the same type of LIR structures as the high intensity ALSF systems. The light spacing on the T-bar assembly is different, however, and the lamp holder is for a PAR 38 in lieu of a PAR 56 as used on a high intensity system.

5-22.1.2 **Drawing Notes for Figure 52.**

1. Threshold lights are wired alternately between phases and are fed by a 2-pole breaker.

Figure 52. MALSR Wiring Diagram



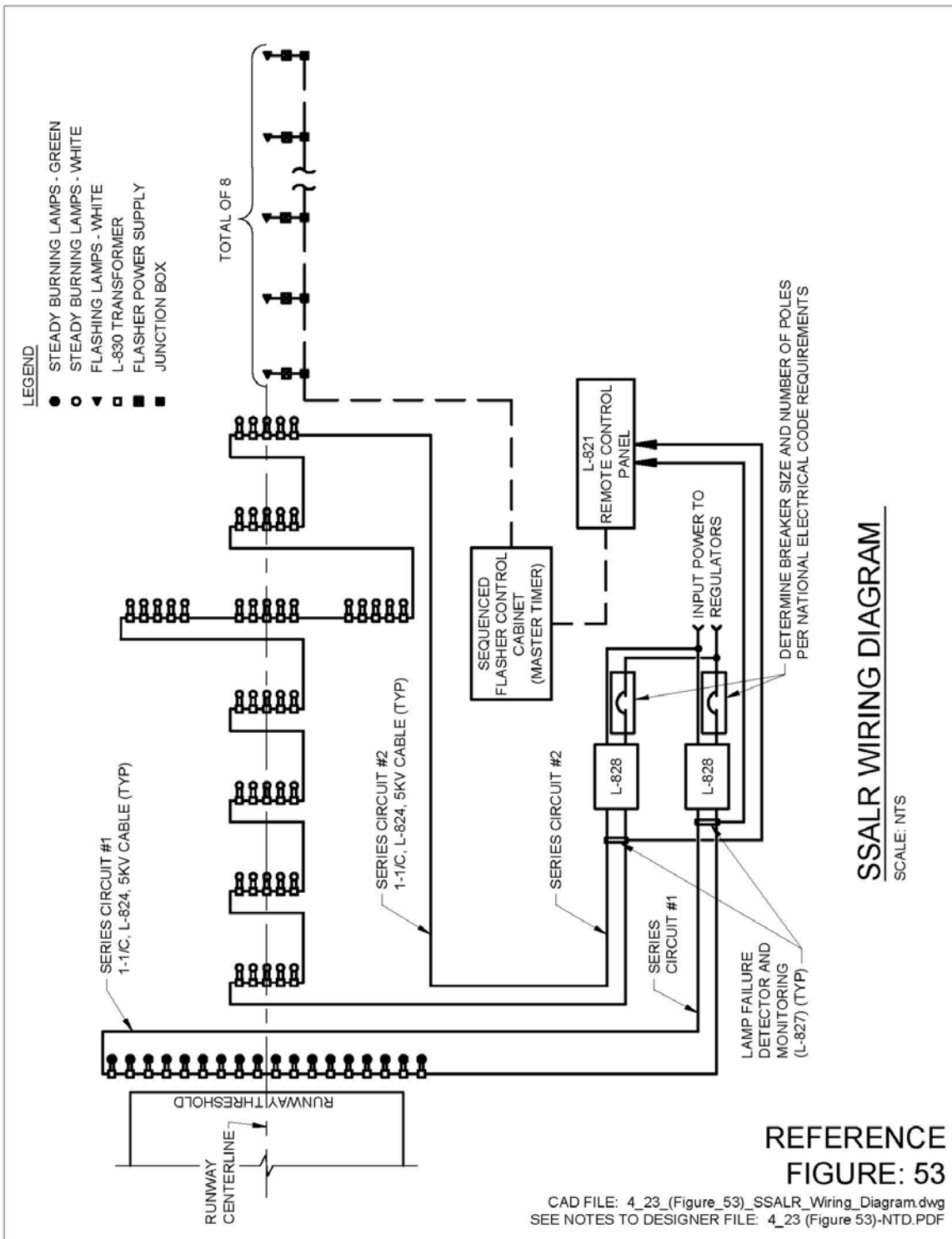
5-23 SSALR Wiring Diagram.

5-23.1 Figure 53.

5-23.1.1 Notes to Designer.

1. Typically high intensity approach light systems are 20 amp circuits. The size of the regulators depends on the fixtures to be used. On major upgrades or new installations recommend researching the use of most recent 200 watt 6.6 amp lamp that meets the photometric requirements for the steady burn lamp. An energy savings and smaller regulator size may result. Refer to UFC 3-535-01 for more information.

Figure 53. SSALR Wiring Diagram



5-24 **L.I.R. Structure MS-20.**

5-24.1 **Figure 54.**

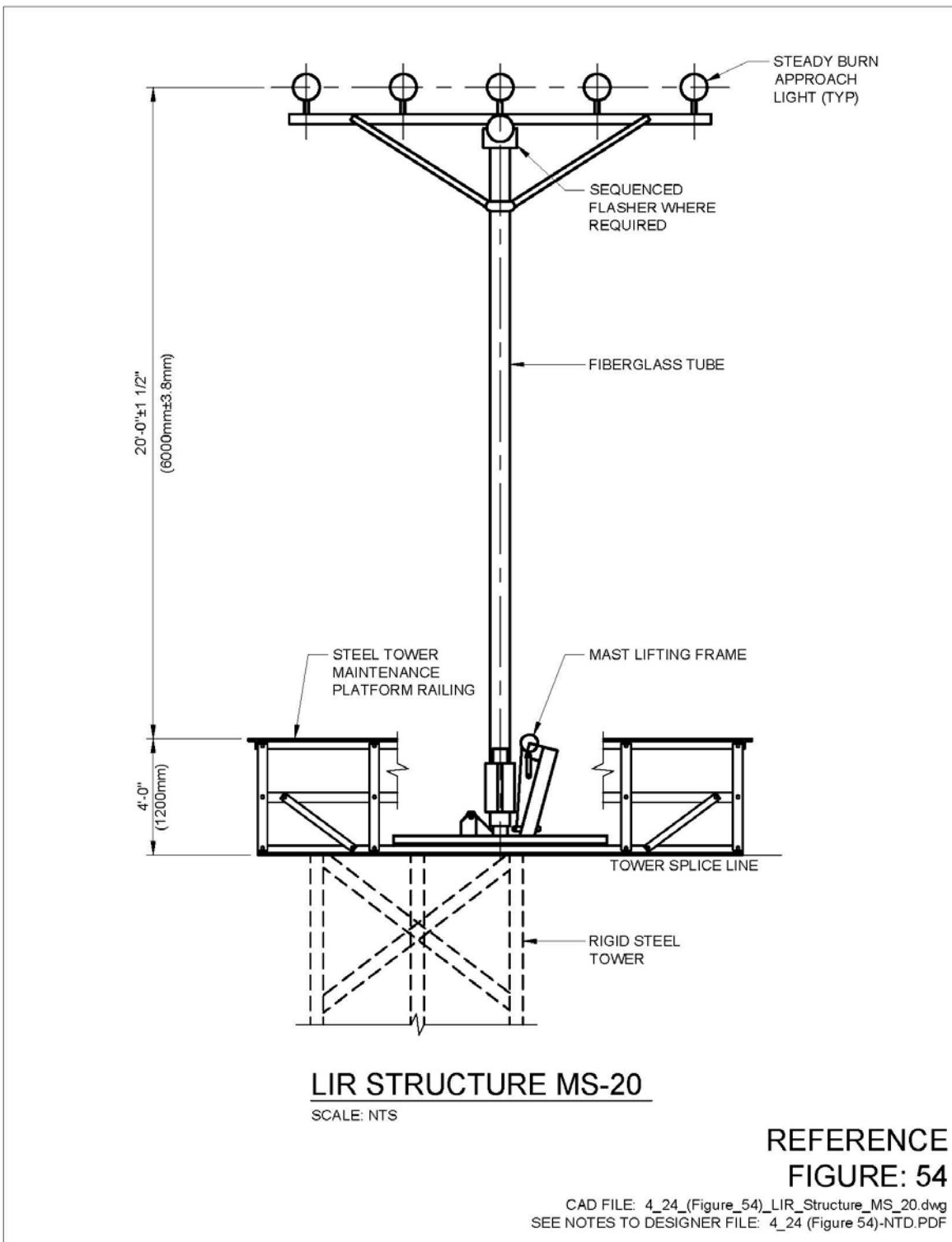
5-24.1.1 **Notes to Designer.**

1. The MS-20 structure includes the crossbar and lowering device. The manufacturer provides standard details for mounting the MS-20 structure onto the tower platform. These details should be given to the proposed tower manufacturer.
2. Conduit and wiring details for the structure should be included in the contract documents. Conduit size and number of conductors will depend on the number and types of lights installed. Approved manufacturers of approach light systems should be consulted.
3. If a sequenced flasher is to be installed, the flasher power supply should be installed on the maintenance platform and the flasher junction box should be installed at grade. However, if installation is in a flood plain or wet area both flasher power supply and junction box should be installed on the maintenance platform. Cables may then be routed underground or aurally.

5-24.1.2 **Drawing Notes for Figure 54.**

1. Install mast lifting frame, fiberglass tube, and lights per manufacturer's requirements.
2. Install maintenance platform on steel tower per manufacturer's requirements.

Figure 54. L.I.R. Structure MS-20



5-25 **Approach Light Structure 40' to 128' (12m to 38.4m).**

5-25.1 **Figure 55.**

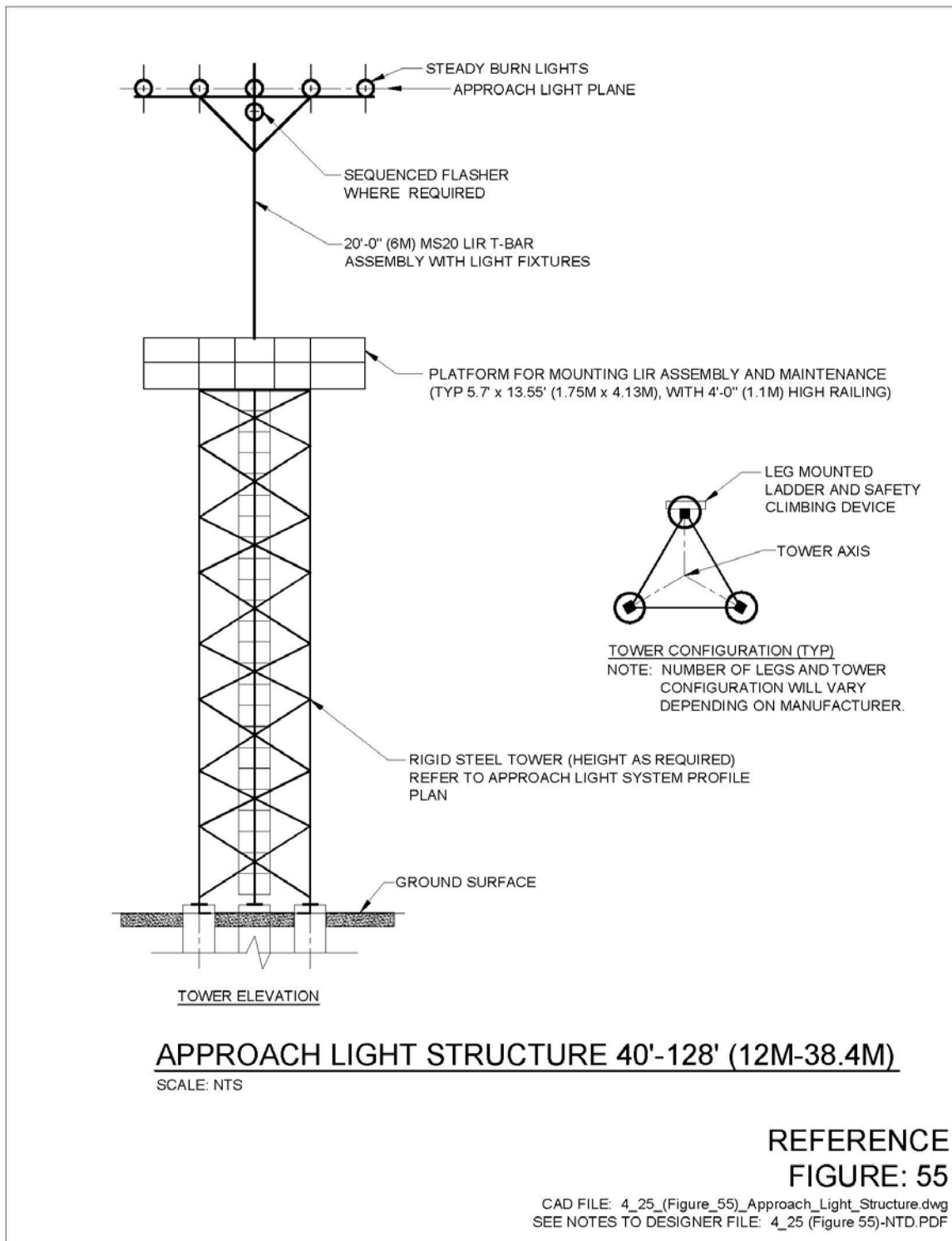
5-25.1.1 **Notes to Designer.**

1. The top 20' (6m) of the structure is the low impact resistant portion of the overall structure. The height of the required rigid steel tower is determined by subtracting 20' (6m) for the L.I.R. structure and 4'-0" (1.2m) for the maintenance platform and railing from the overall height as indicated in the approach light system profile plan.
2. Prior to designing the foundation for the tower, borings should be taken in the field for soil analysis. Many factors will affect the type and size of foundation to be installed (i.e. type of soil, existence of rock or ledge, soil bearing capacity, frost depth, etc.). The designer should base the foundation design on these factors and consult with the tower manufacturer regarding EPA (Effective Projected Area) for wind loading. The wind loading must include the proposed fixtures and hardware to be installed on the tower.

5-25.1.2 **Drawing Notes for Figure 55.**

1. Design tower for appropriate loads based on ANSI/TIA-222, or on stricter local codes if required at site.
2. Base foundation design on local terrain and subsurface conditions, and tower loads.
3. Provide ladder for climbing entire height of rigid tower, with safety climbing device, meeting ANSI/TIA-222.
4. Provide suitable locking device for nuts on all tower and anchor bolts.
5. Tower manufacturer should provide detail fabrication drawings based on furnished height and load requirements.
6. Provide grounding for the steel tower and platform per ANSI/TIA-222.

Figure 55. Approach Light Structure 40' to 128' (12m to 38.4m)



5-26 **High Intensity Threshold Bar Wiring Diagram (Air Force).**

5-26.1 **Figure 56.**

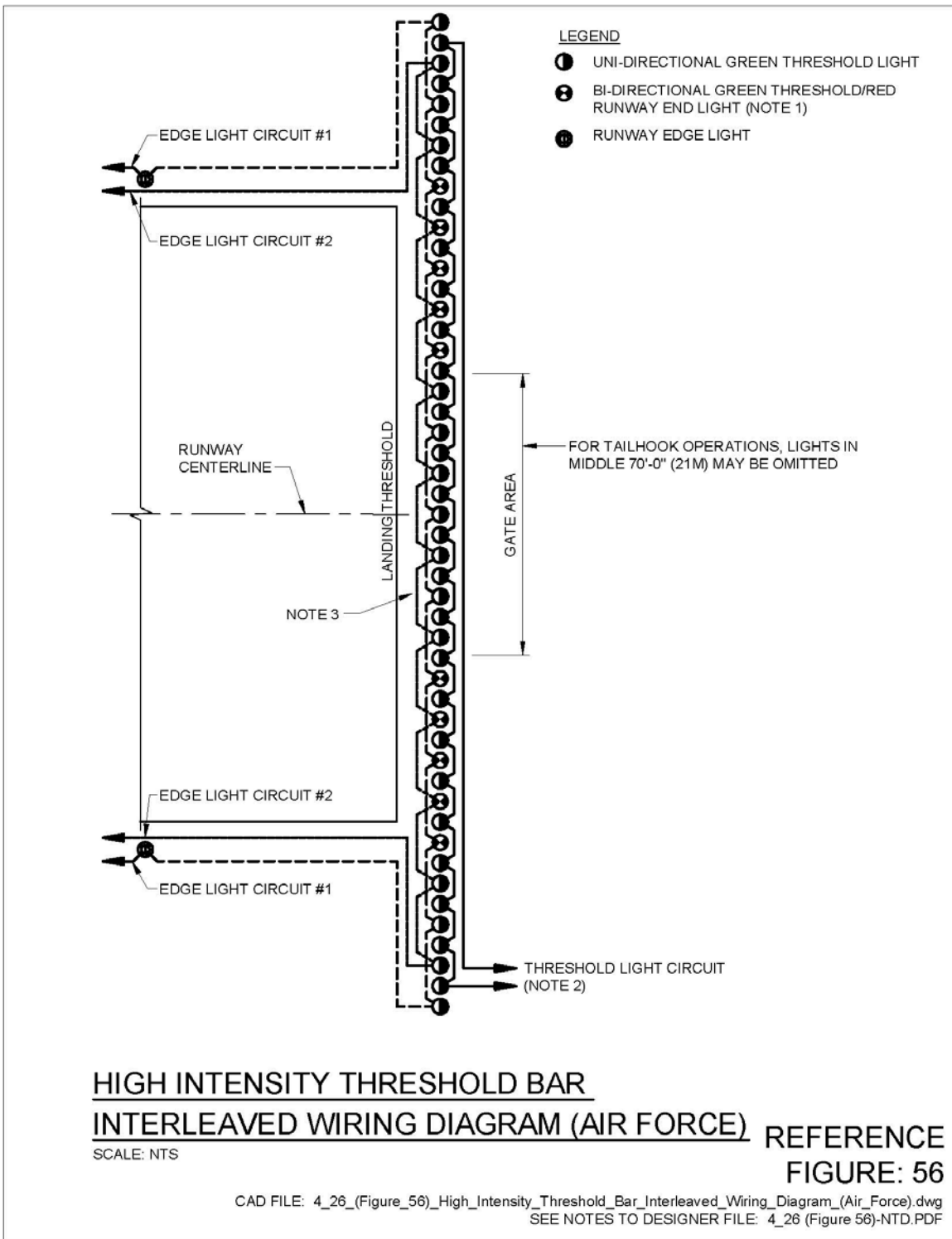
5-26.1.1 **Notes to Designer.**

1. Figure is self-explanatory.

5-26.1.2 **Drawing Notes for Figure 56.**

1. The bi-directional runway end/threshold light may be installed as separate uni-directional fixtures. The bi-directional fixture must meet the photometrics for threshold and end lights as indicated in UFC 3-535-01.
2. Control circuits for threshold regulator must be wired in parallel with edge lighting control circuits. For runway edge light regulator(s) such that threshold lights are energized and at same intensity as runway edge lights.
3. Where there are an even number of threshold bar lights, the two adjacent lights about the runway centerline must be connected to the same circuit to provide a symmetrical lighting pattern on each side of the runway centerline.

Figure 56. High Intensity Threshold Bar Interleaved Wiring Diagram (Air Force)



5-27 **Threshold Bar Wiring Diagram (Army).**

5-27.1 **Figure 57.**

5-27.1.1 **Notes to Designer.**

Figure is self-explanatory.

5-27.1.2 **Drawing Note for Figure 57.**

Where there are an even number of threshold bar lights, the two adjacent lights about the runway centerline must be connected to the same circuit to provide a symmetrical lighting pattern on each side of the runway centerline.

Figure 57. Threshold Bar Wiring Diagram (Army)

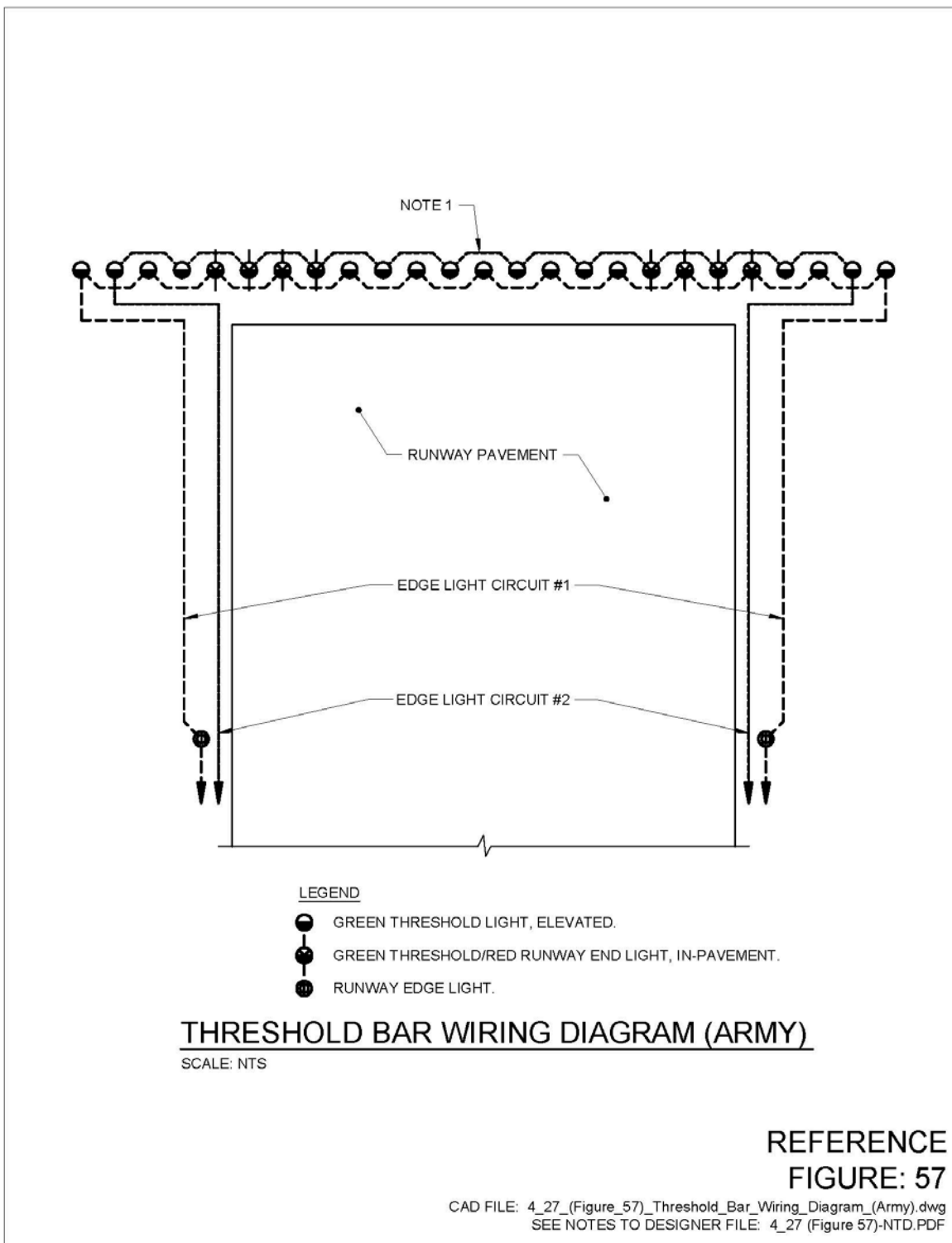


Figure 58. Reserved.

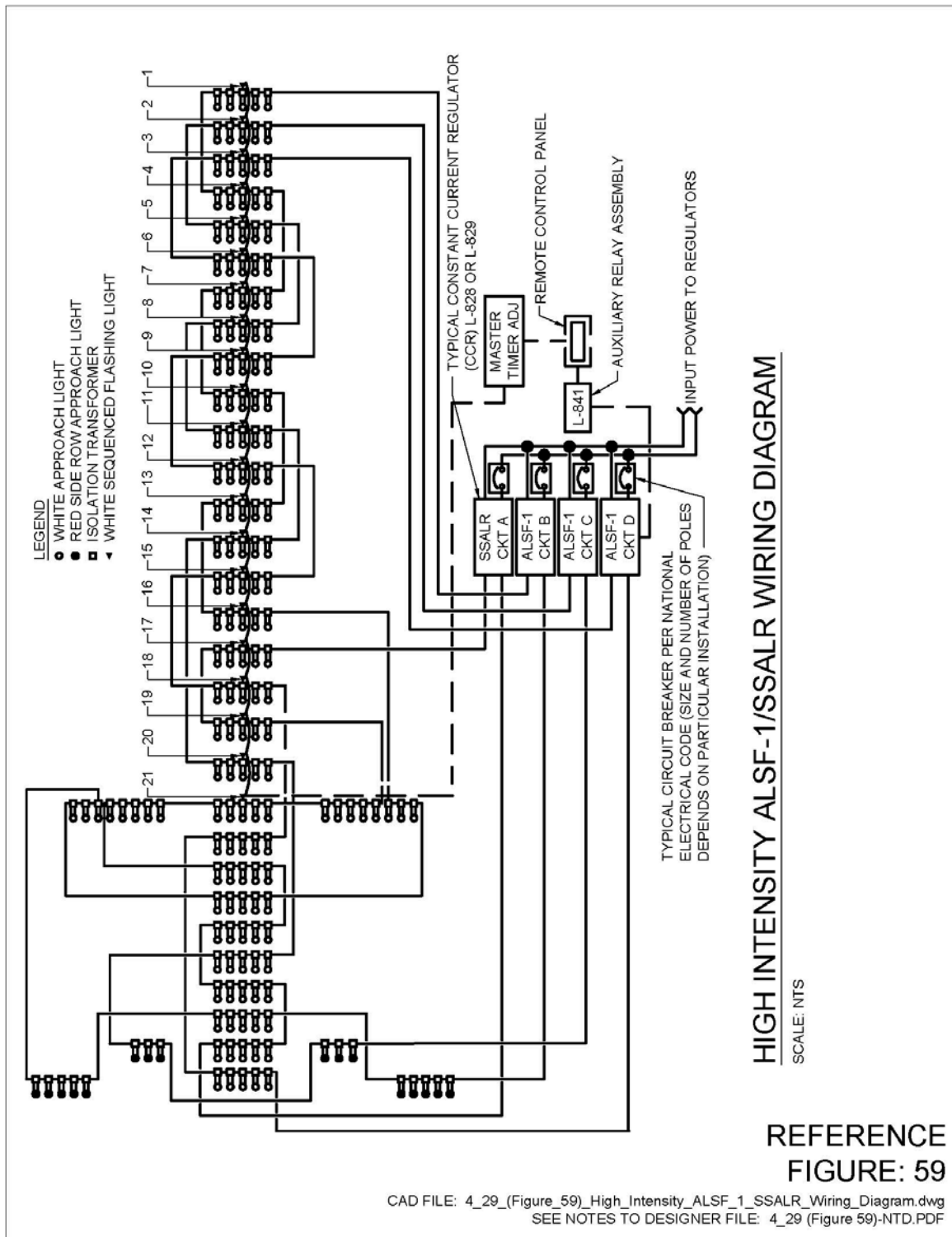
5-28 **High Intensity ALSF-1/SSALR Wiring Diagram.**

5-28.1 **Figure 59.**

5-28.1.1 **Notes to Designer.**

1. When designing the approach light system, several factors must be taken into account:
 - a. Each regulator should be equal in kw capacity,
 - b. No two adjacent light bars should be on the same circuit.
 - c. Circuiting should be symmetrical about the runway centerline.
2. Some locations may use a single 1500 watt isolation transformer to feed five 300 watt tower mounted lights.
3. The present trend is to limit the regulator size to 30kw, 20 amp. This is being done to lower the available voltage throughout the system for safety reasons. Also, the trend may be to utilize 6.6 amps rather than 20 amps and newly developed light sources.
4. 50kw and 70kw regulators and 2400V input are not approved by FAA for new installations, only for replacement of existing units.
5. In SSALR mode, only flashers #1, 3, 5, 7, 9, 11, 13 and 15 operate. All 21 flashers operate in full ALSF mode.

Figure 59. High Intensity ALSF-1/SSALR Wiring Diagram



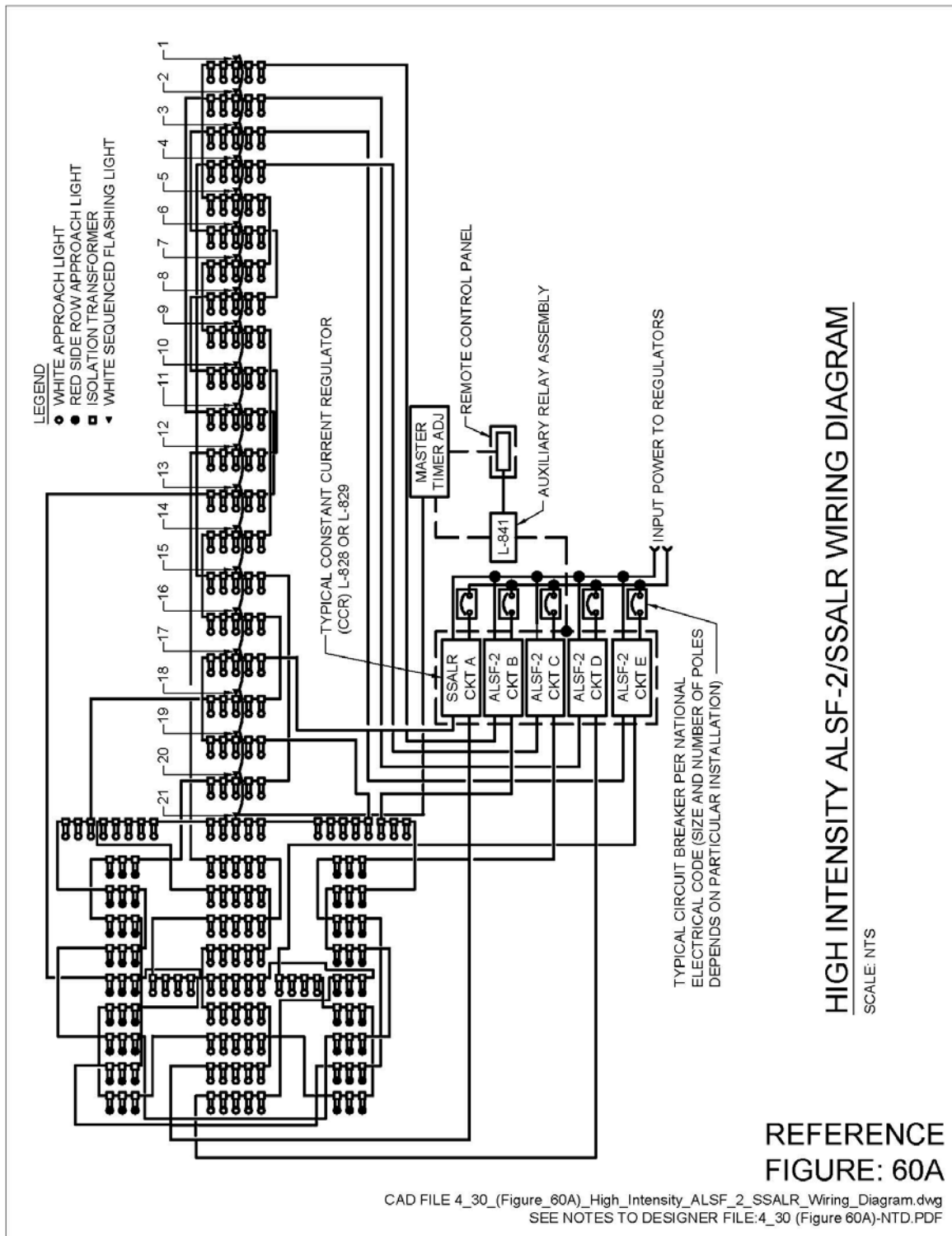
5-29 **High Intensity ALSF-2/SSALR Wiring Diagram.**

5-29.1 **Figure 60A.**

5-29.1.1 **Notes to Designer.**

1. When designing the approach light system, several factors must be taken into account:
 - a. Each regulator should be equal in kw capacity,
 - b. No two adjacent light bars should be on the same circuit, and
 - c. Circuiting should be symmetrical about the runway centerline.
2. Some locations may use a single 1500 watt isolation transformer to feed (5) 300 watt tower mounted lights.
3. The present trend is to limit the regulator size to 30kw, 20 amp. This is being done to lower the available voltage throughout the system for safety reasons. Also, the trend may be to utilize 6.6 amps rather than 20 amps and newly developed light sources.
4. This wiring diagram depicts the latest circuiting from the FAA utilizing (5) 30kw regulators in lieu of (3) 50kw regulators used in older systems.
5. 50 kw and 70 kw regulators and 2400V input is not approved by FAA for new installations, only for replacement of existing units.
6. In SSALR mode, only flashers #1, 3, 5, 7, 9, 11, 13 and 15 operate. All 21 flashers operate in full ALSF mode.

Figure 60A. High Intensity ALSF-2/SSALR Wiring Diagram



5-30 **ALSF-2/SSALR Wiring Diagram Modification.**

5-30.1 **Figures 60A, 60B, 60C.**

5-30.1.1 **Notes to Designer.**

1. Figure 60A depicts a wiring diagram for an ALSF-2/SSALR system using more efficient lamps. Older FAA systems utilized 300-watt lamps for elevated lights and 500-watt lamps for in-pavement lights.
2. The isolation transformer must be sized by the fixture manufacturer and the photometric requirements of the fixture must conform to UFC 3-535-01.
3. This wiring diagram depicts four circuit loops for the ALSF-2/SSALR system and one circuit loop for the threshold.
4. Similarly, an ALSF-1/SSALR system could be reduced to three circuit loops for the system and one circuit loop for the threshold
5. The contract documents for the installation of an approach light system should include a plan and profile of the complete system showing stationing and light plane slopes.

Figure 60B. ALSF-2/SSALR Wiring Diagram Modification – Sheet 1

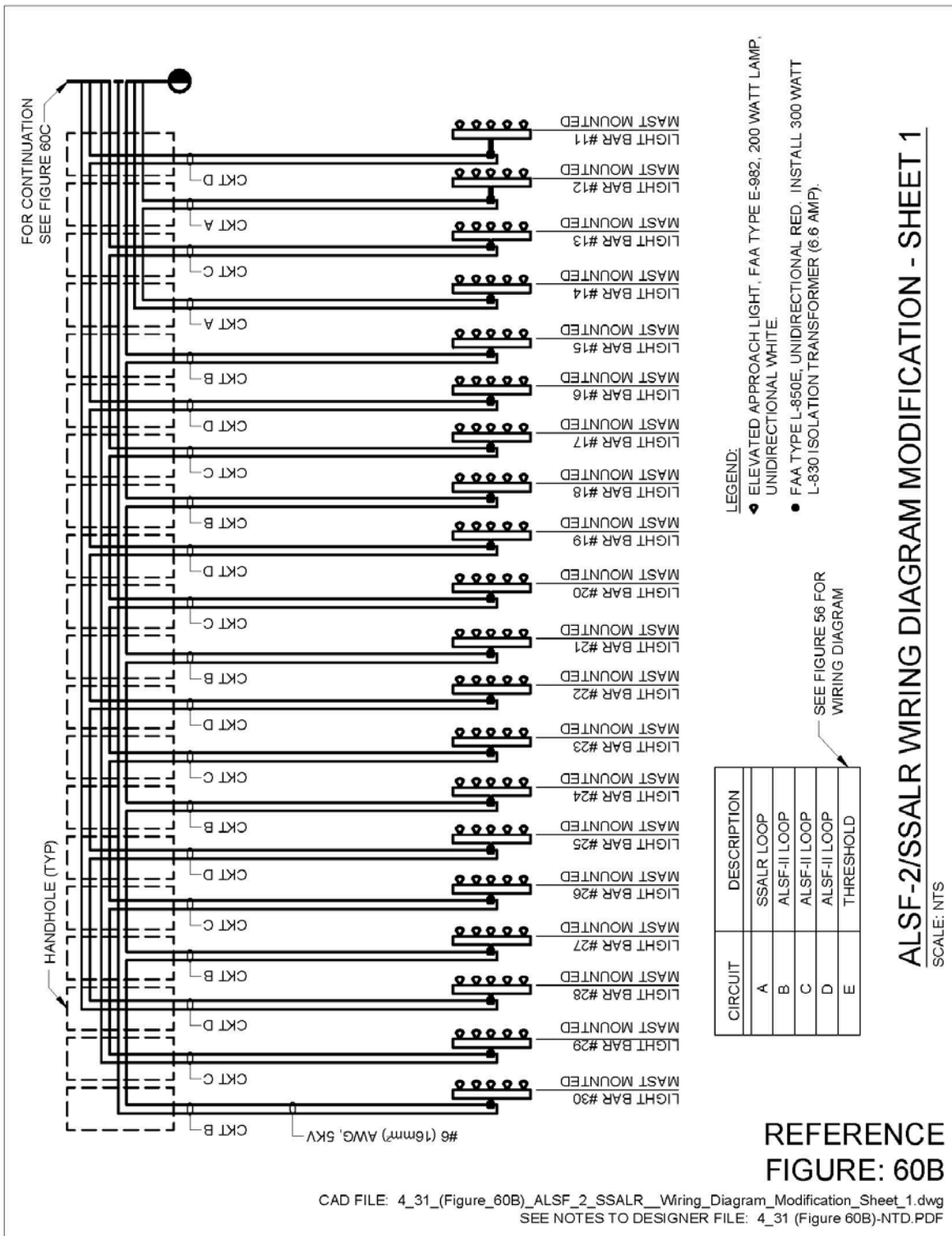
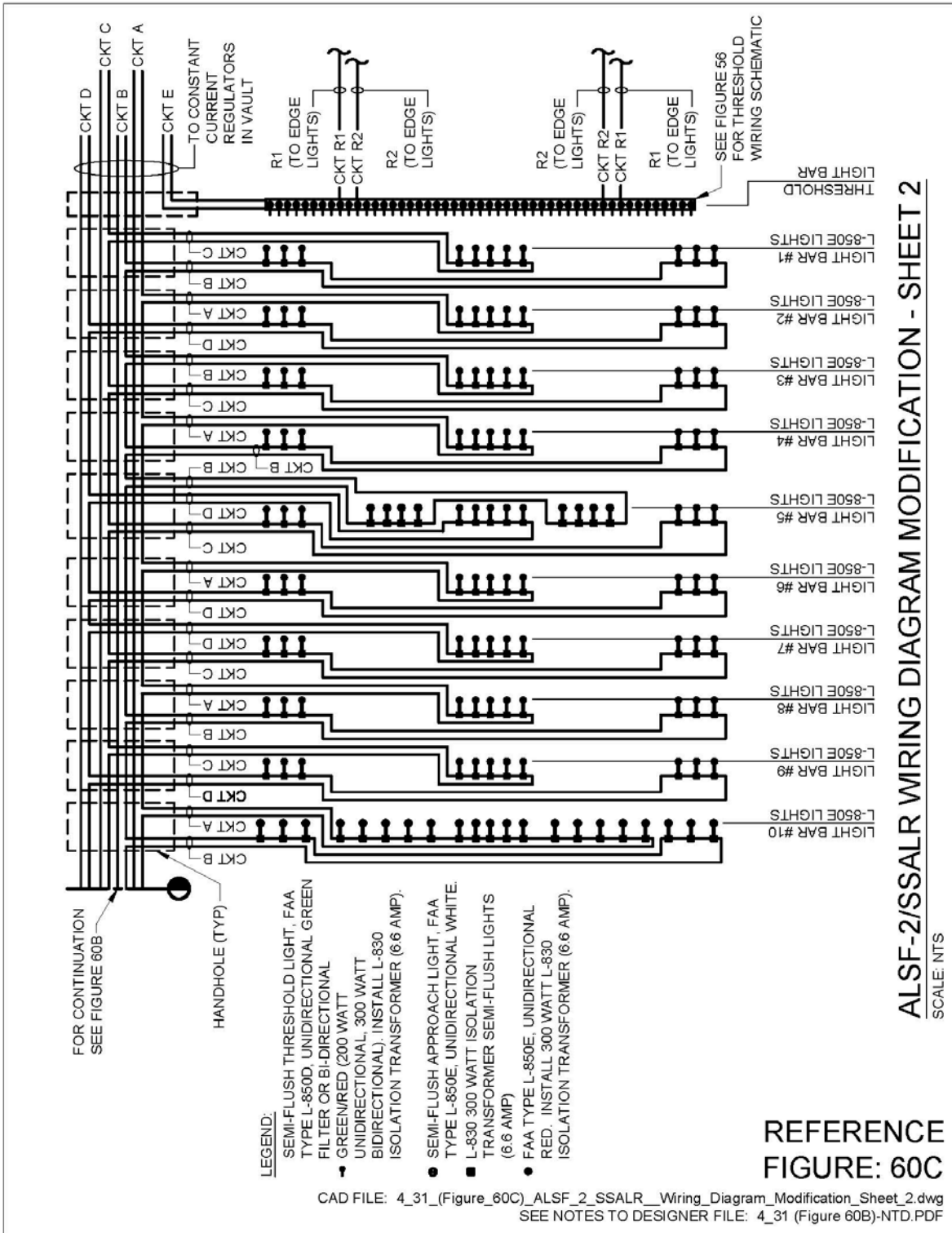


Figure 60C. ALSF-2/SSALR Wiring Diagram Modification – Sheet 2



CHAPTER 6 PAPI and REIL Systems

6-1 FAA L-880 Style A (Constant Voltage) PCU Mounting Details.

6-1.1 Figure 61.

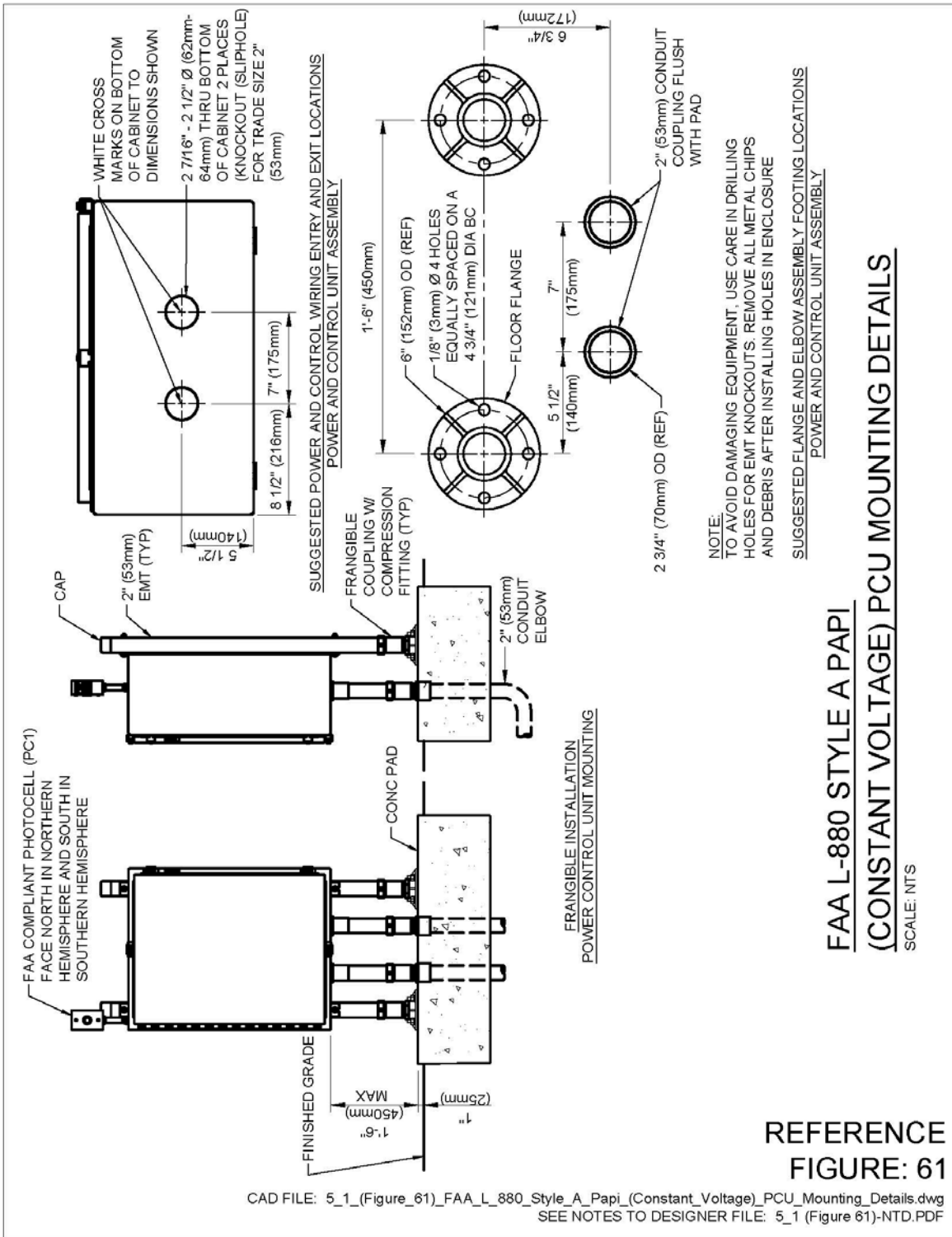
6-1.1.1 Notes to Designer.

1. Verify with manufacturer mounting dimensions and hardware.
2. Pad size indicated is minimum for this particular unit. Pad must be designed by a Registered Structural Engineer.

6-1.1.2 Drawing Notes for Figure 61.

1. Verify dimensions with equipment manufacturer.
2. Concrete pad must be minimum 30" x 18" x 12" (750mm x 450mm x 300mm).
3. Mounting hardware must be stainless steel sized per manufacturer's requirements.
4. Installation must be per manufacturer's requirements.

Figure 61. FAA L-880 Style A (Constant Voltage) PCU Mounting Details



6-2 **FAA L-880 Style A (Constant Voltage) System Wiring Diagram.**

6-2.1 **Figures 62A, 62B.**

6-2.1.1 **Notes to Designer.**

1. The L-880 Style A uses a constant voltage to power the system. Intensity control is accomplished automatically by an integral photocell. The system is at maximum brightness during the daytime and lower brightness \approx 20% during hours of darkness.
2. A constant voltage source must be available within the vicinity of the system. Design must take into account voltage drop back to the supply.
3. The three-lamp version is preferred. However, newer units utilizing two lamps that meet the photometric requirements have been developed.
4. Consult with manufacturer for power requirements.

Figure 62A. FAA L-880 Style A (Constant Voltage) System Wiring Diagram

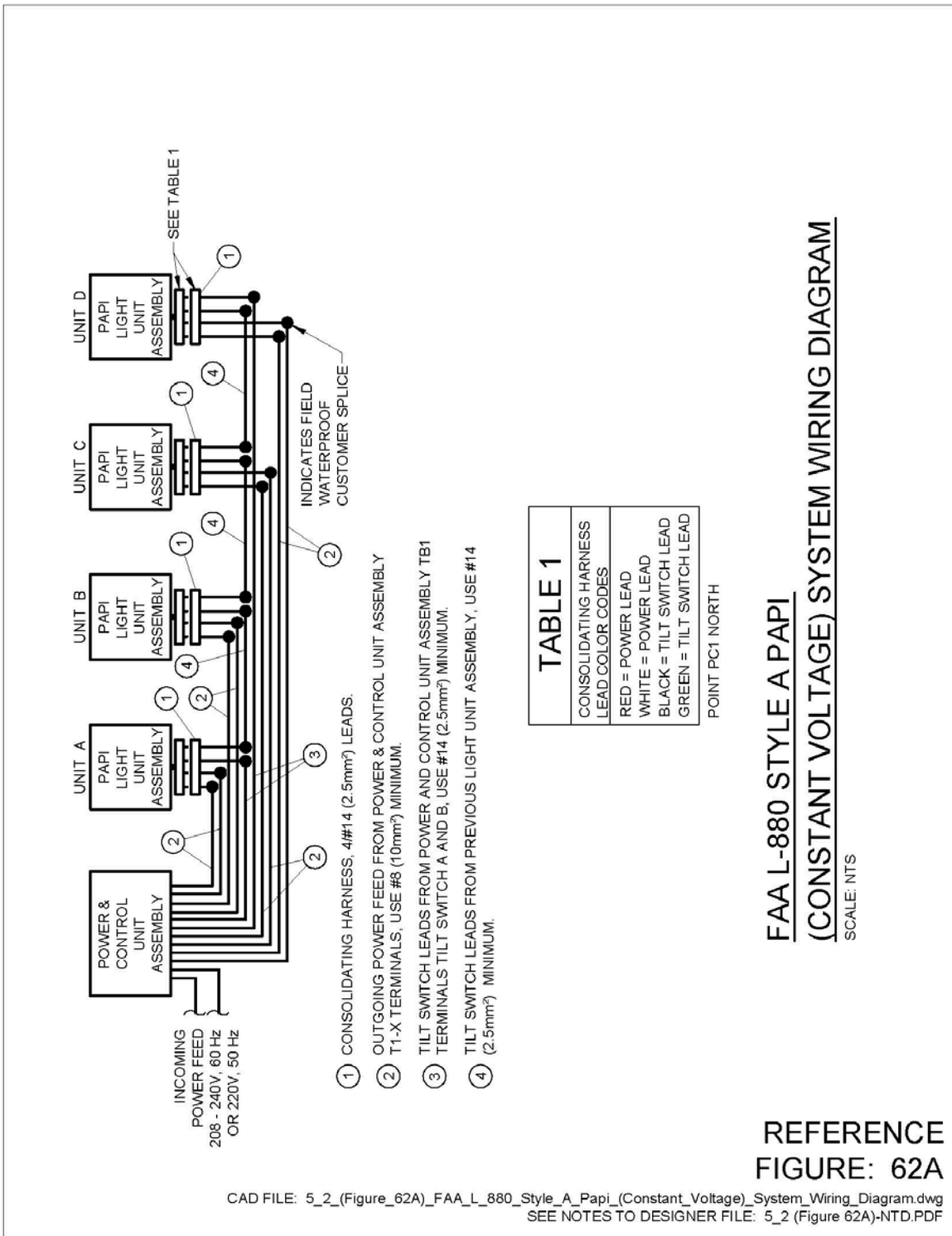
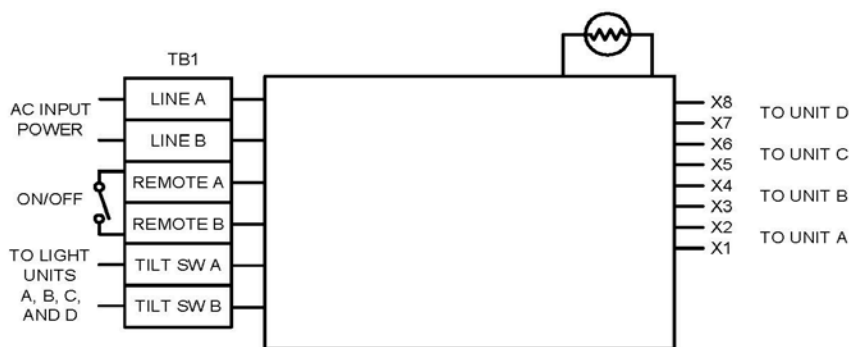


Figure 62B. Power Control Unit 3 Lamp, 4 Projector
FAA L-880 Style B (Constant Current) System Wiring Diagram.



FAA L-880 STYLE A PAPI
POWER CONTROL UNIT
3 LAMP, 4 LIGHT UNITS
SCALE: NTS

REFERENCE
FIGURE: 62B

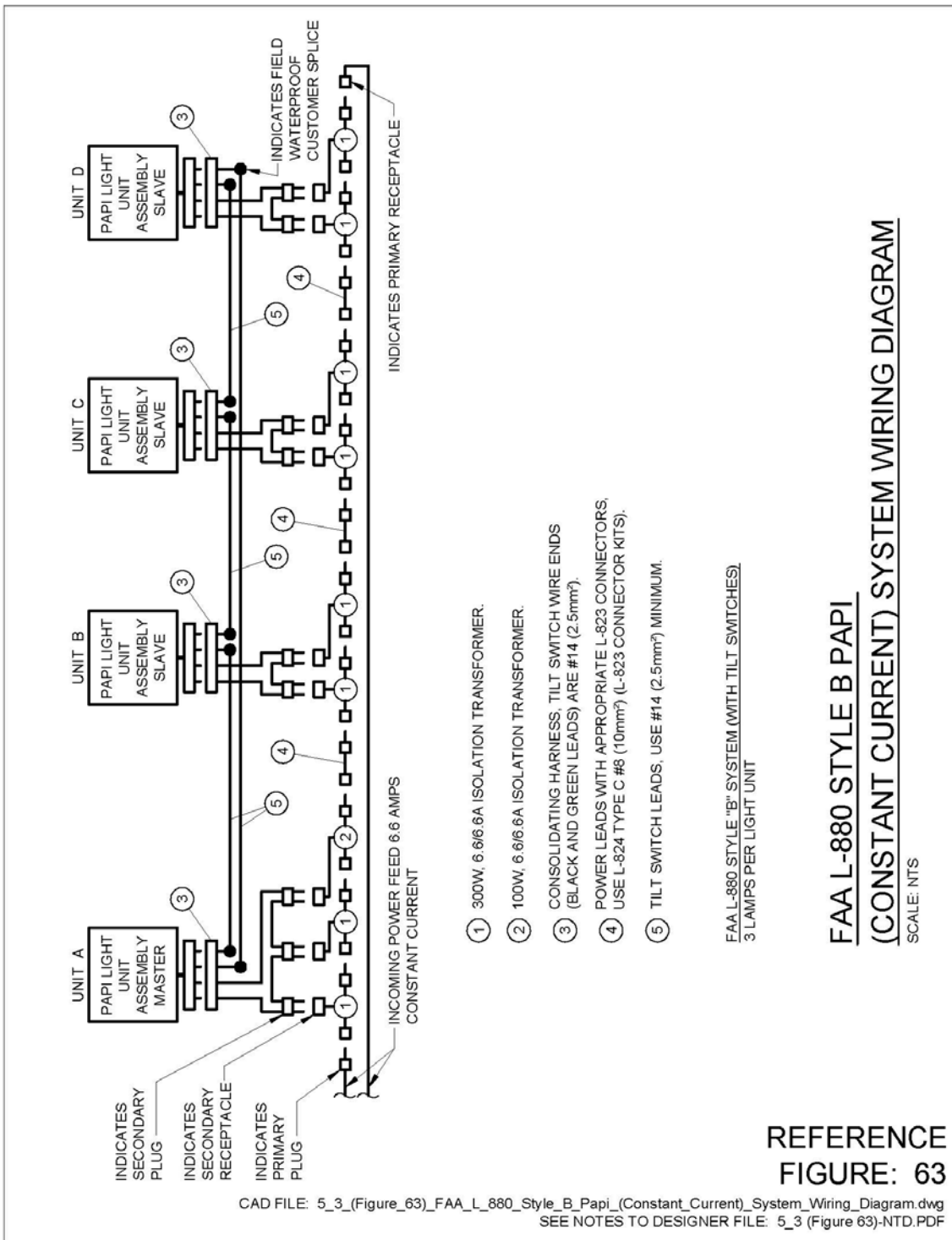
CAD FILE: 5_2_(Figure 62B)_FAA_L-880_Style_A_Papi_Power_Control_Unit_3_Lamp_4_Lamp_Units.dwg SEE NOTES TO
DESIGNER FILE: 5_2_(Figure 62B)-NTD.PDF

6-2.2 **Figure 63.**

6-2.2.1 **Notes to Designer.**

1. The L-880 Style B uses a constant current source to power the system. This is typically done using a 4kw constant current regulator with 5 brightness steps. Intensity is selected manually at the control panel in the tower or vault at airfields that have 24-hour tower control. A different control scheme is used at part time or unmanned tower airfields.
2. The three-lamp version is preferred. However, newer units utilizing two lamps that meet the photometric requirements have been developed.
3. Consult with manufacturer for power requirements.

Figure 63. FAA L-880 Style B (Constant Current) System Wiring Diagram



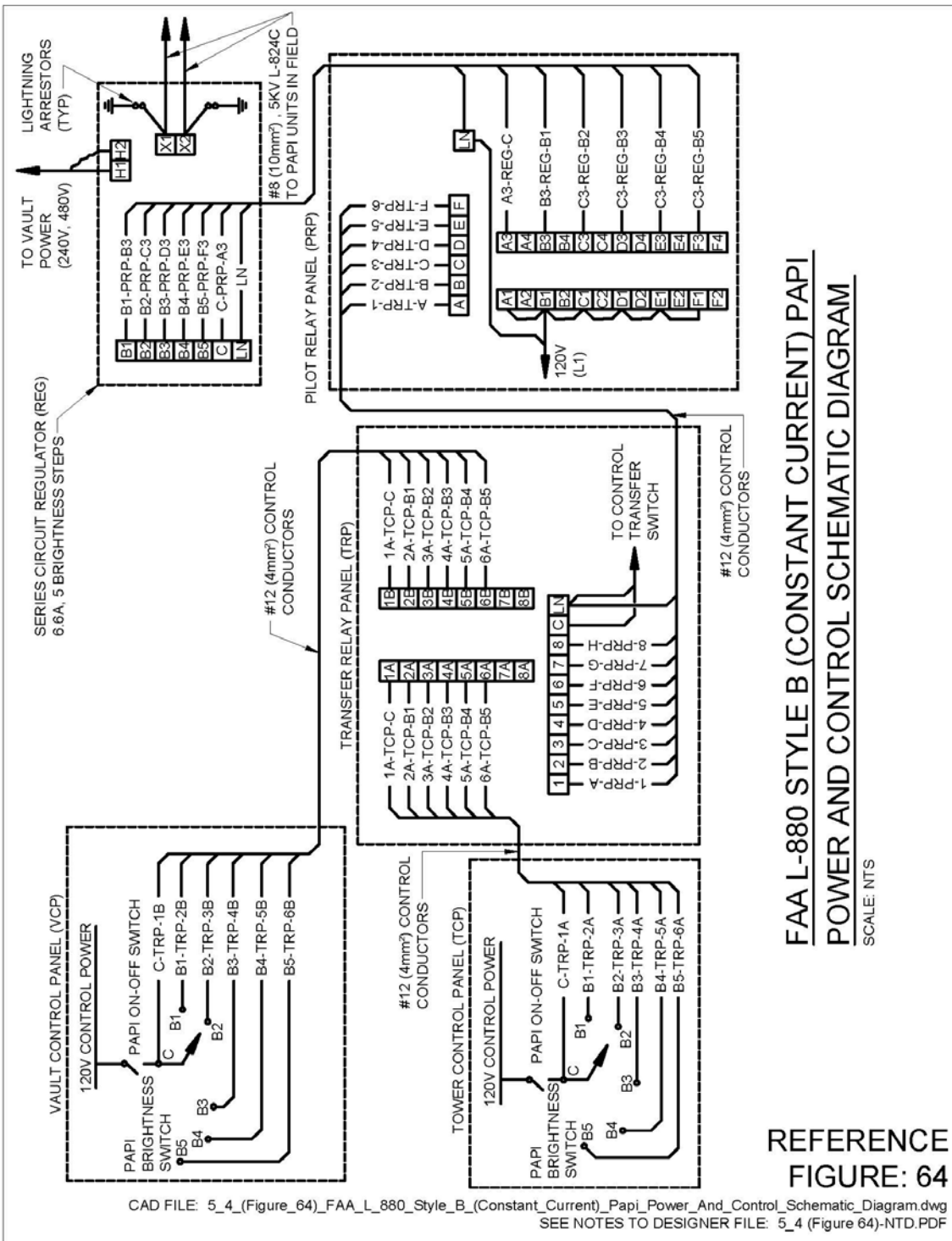
6-3 **FAA L-880 Style B (Constant Current) PAPI Power and Control Schematic Diagram.**

6-3.1 **Figure 64.**

6-3.1.1 **Notes to Designer.**

1. This detail shows a typical schematic diagram of a Style B system. The actual control diagram used will depend on site specific requirements.
2. Newer installations may use computer control systems with touch-screen monitors for the control panels.
3. Although this diagram is provided for a constant current powered PAPI system served by 5-step constant current regulator, it can be used for any 5-step regulator powered system with control panels in two locations.

Figure 64. FAA L-880 Style B (Constant Current) PAPI Power and Control Schematic Diagram



6-4 **PAPI Light Housing Unit (LHU) Installation Detail.**

6-4.1 **Figures 65A, 65B.**

6-4.1.1 **Notes to Designer.**

1. The contract documents should show location of PAPI units and aiming angles. Refer to UFC 3-535-01 for siting requirements.
2. Verify with manufacturer pad dimensions and number of openings in cover of L-867 can.
3. The detail shows a 4" (100mm) thick concrete mow pad around the housing unit. The mow pad acts as a weed barrier 10' (3m) in front of the unit and 5' (1.5m) behind the unit. Some installations continue the weed barrier between the units. Recommend the weed barrier is extended at least 5' (1.5m) on each side of concrete foundation for the light housing unit.
4. Concrete foundation must be designed by a Registered Structural Engineer.

6-4.1.2 **Drawing Notes for Figures 65A and 65B.**

1. Each light unit must be aimed outward into the approach zone on a line parallel to the runway centerline within $\pm 1/2$ degree.
2. The beam centers of all light units must be within ± 1 " (25mm) of horizontal plane.
3. The front face of each light unit in a bar must be located on a line perpendicular to the runway centerline within a tolerance of ± 1 " (25mm).
4. Dimensions are approximate and must be coordinated with PAPI manufacturer.
5. Aiming angle and location of units must be indicated on contract documents.

Figure 65A. PAPI Light Housing Unit (LHU) Installation Detail

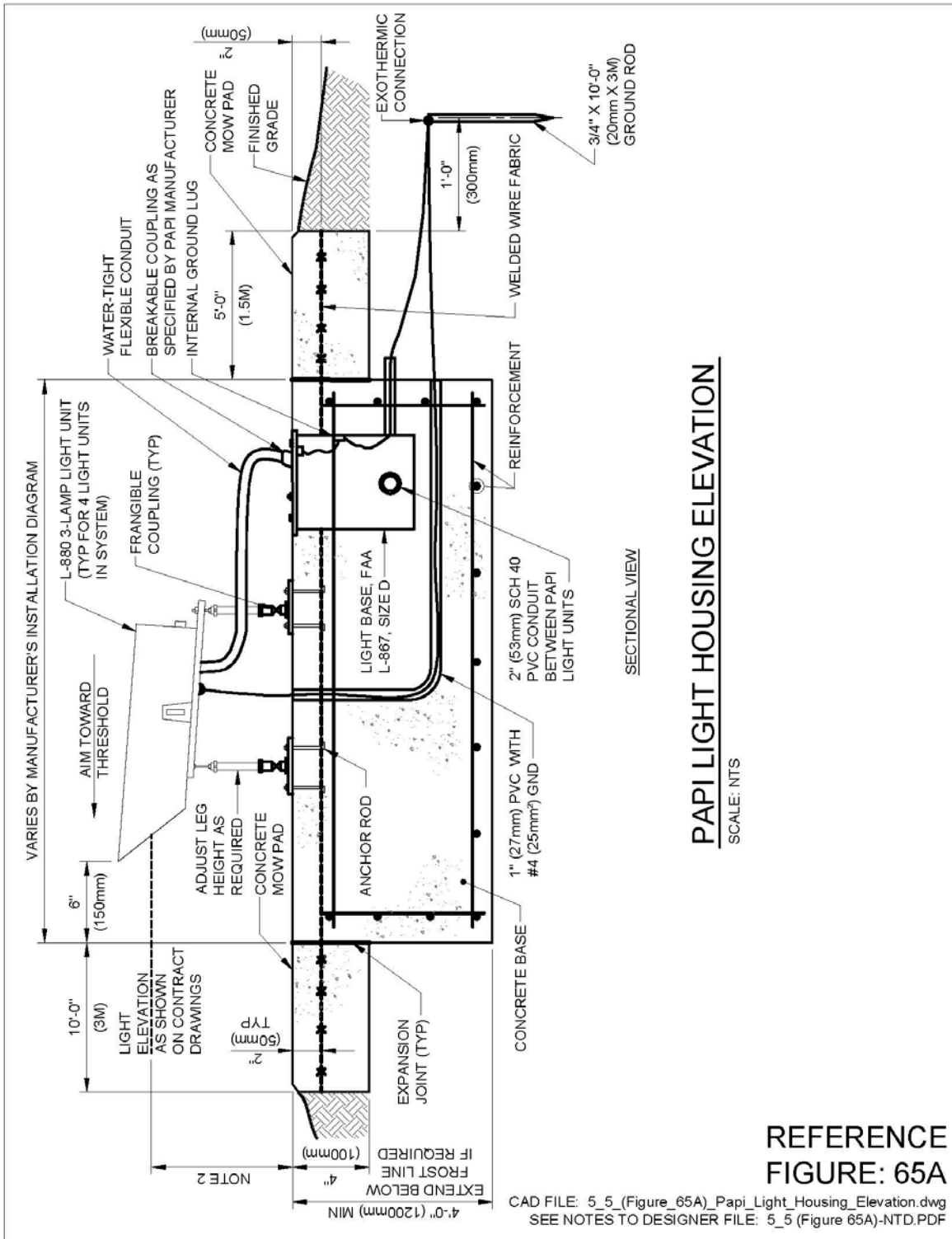
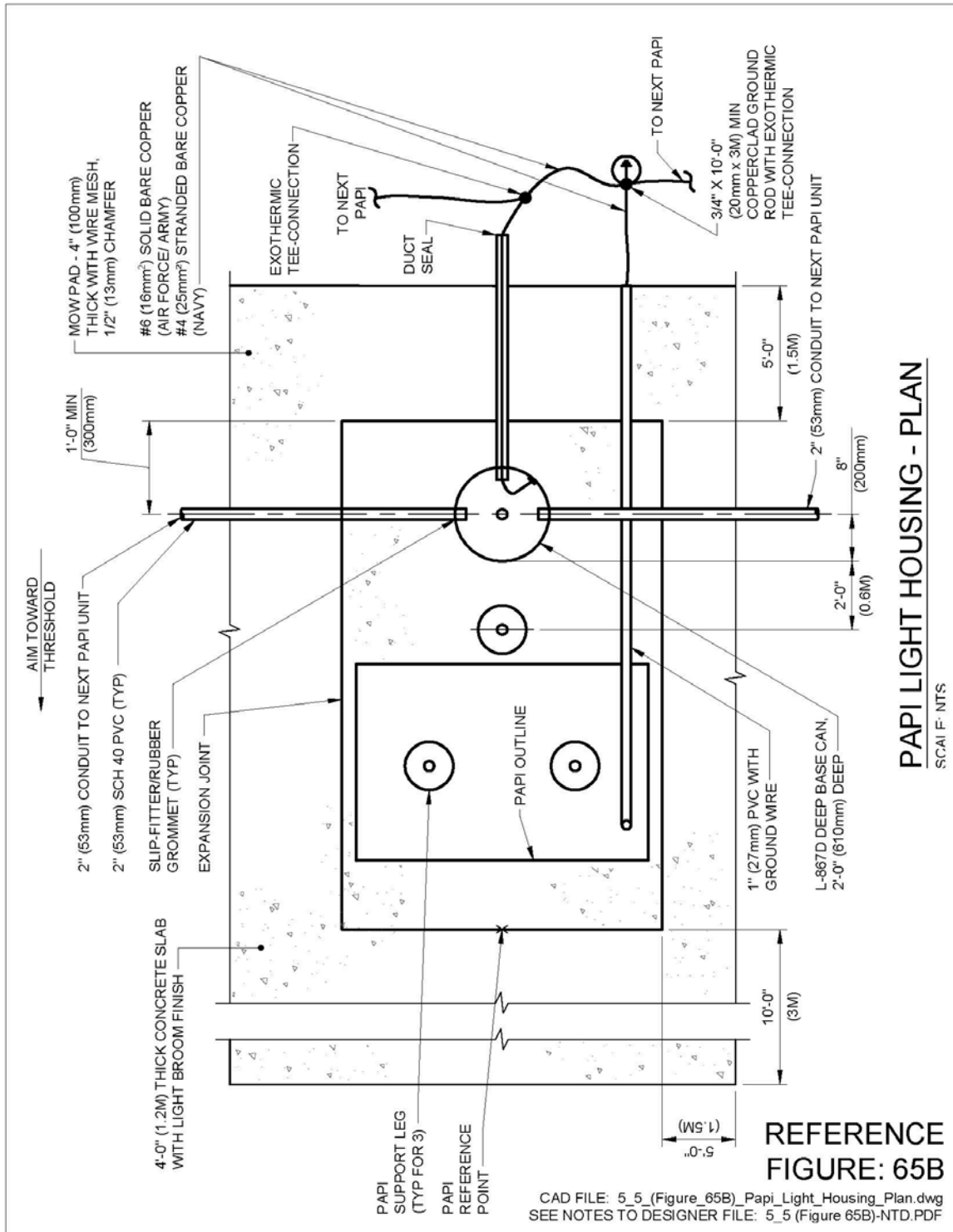


Figure 65B. PAPI Light Housing Unit (LHU) Installation Detail (continued)



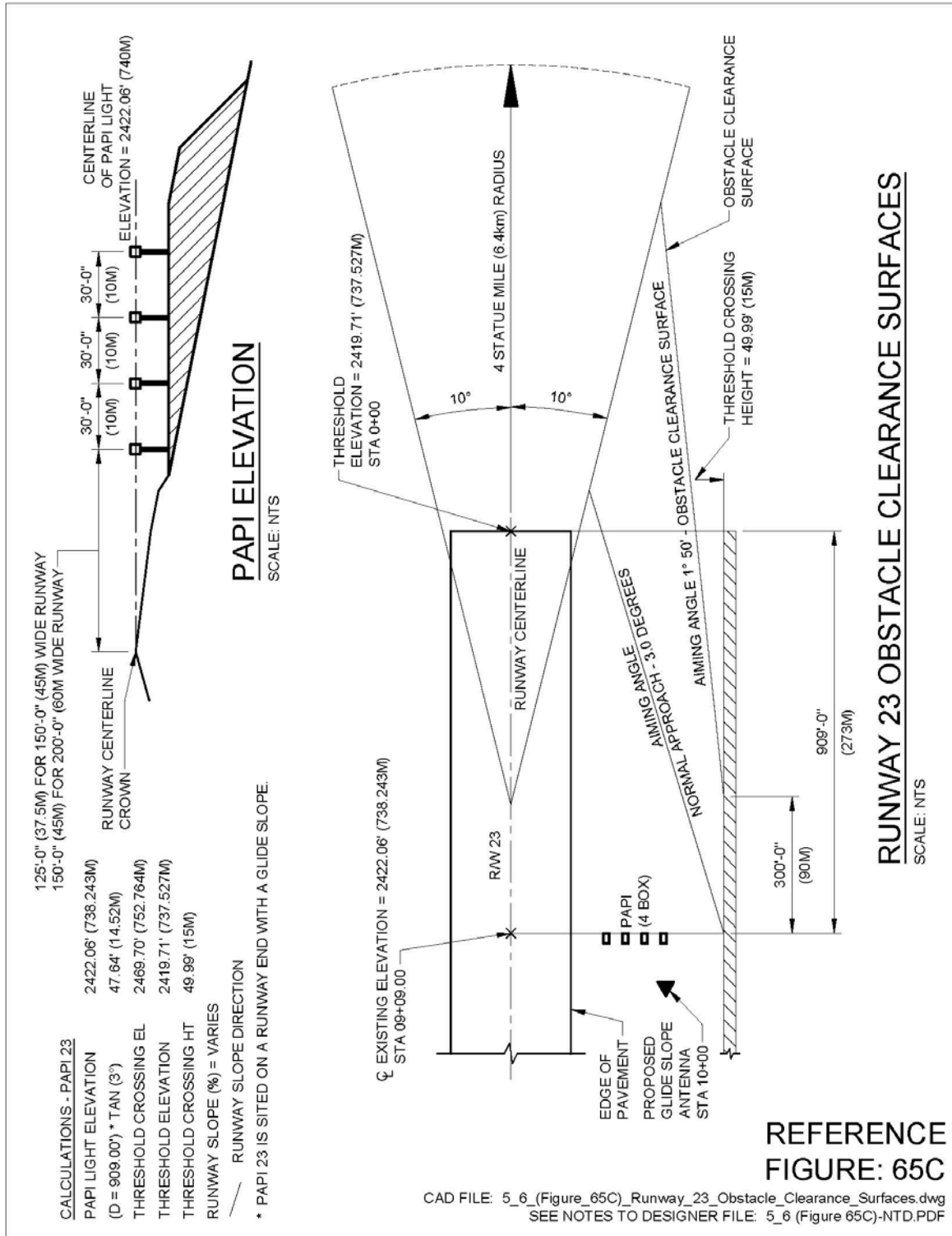
6-5 PAPI Sighting Calculations and Obstacle Clearance Surfaces.

6-5.1 Figure 65C.

6-5.1.1 Notes to Designer.

1. Figure 65C shows examples of PAPI siting calculations (in accordance with UFC 3-535-01) and obstacle clearance surfaces. This information should be included on the contract documents for the project.
2. TCH is based on aiming angle (3 degrees), the same as the glideslope angle.

Figure 65C. Obstacle Clearance Surfaces



6-6 **L-880 Signal Presentation and Installation Tolerances.**

6-6.1 **Figure 65D.**

6-6.1.1 **Notes to Designer.**

1. Figure 65D shows the light signal presentation of a 4-box PAPI (L-880) installation as seen from an approaching aircraft. Also indicated are the installation tolerances and aiming angles of the light units. This information should be included on the contract documents for the project.

6-6.1.2 **Drawing Notes for Figure 65D.**

1. Aiming Parameter table:

Aiming of PAPI relative to pre-selected glide path

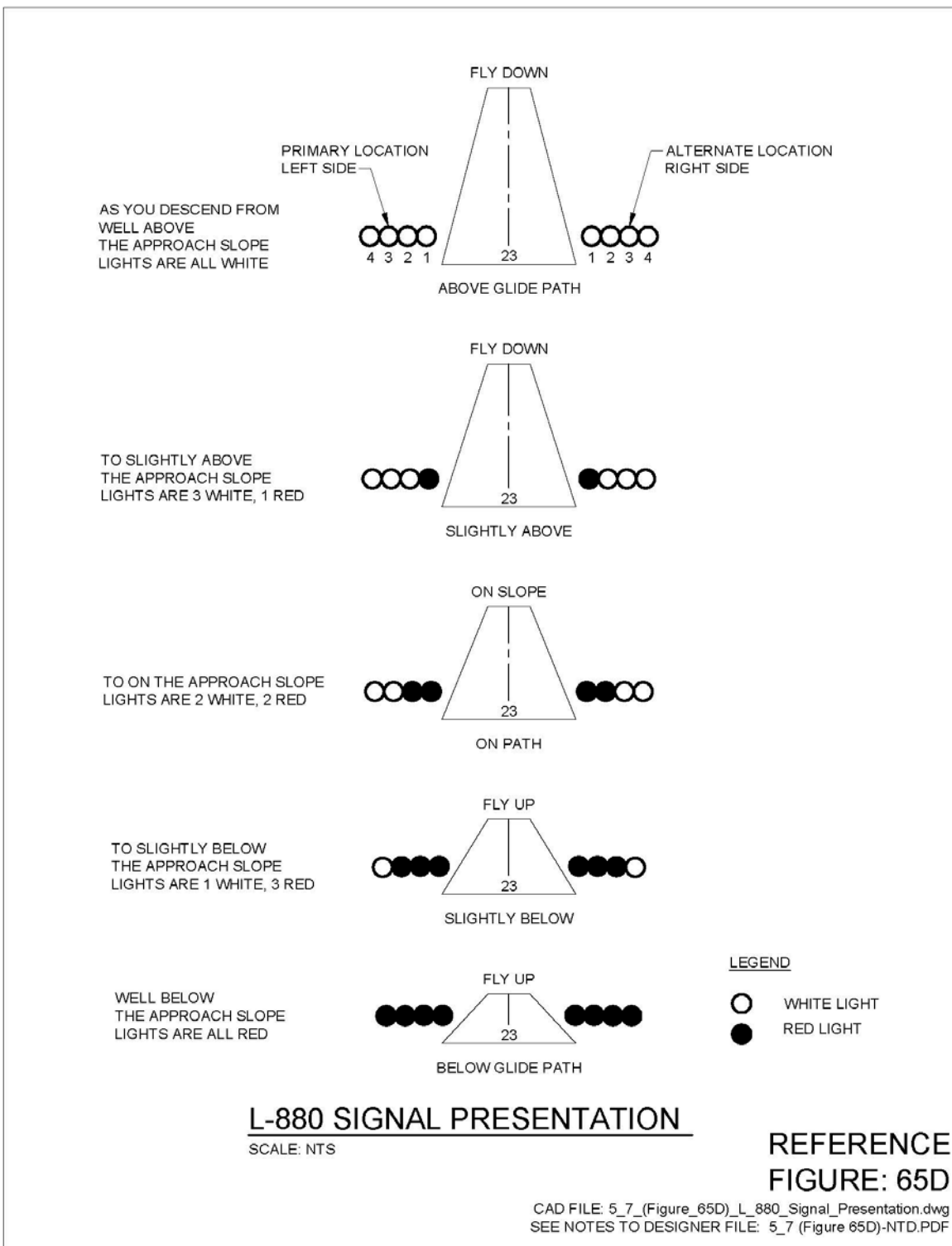
Light unit	Aiming angle (in minutes of arc)
Unit nearest runway	30' (minutes) above glide path
Next adjacent unit	10' (minutes) above glide path
Next adjacent unit	10' (minutes) below glide path
Next adjacent unit	30' (minutes) below glide path

2. Installation Tolerance table:

Installation Tolerance

Item	Tolerance
Azimuthal aiming	$\pm 1/2$ degrees
Mounting height tolerance (from horizontal planes)	± 1 " (25mm)
Tolerance along line perpendicular to runway	± 1 " (25mm)
Horizontal plane through beam center to elevation of runway centerline at intercept point	± 12 " (305mm)

Figure 65D. L-880 Signal Presentation



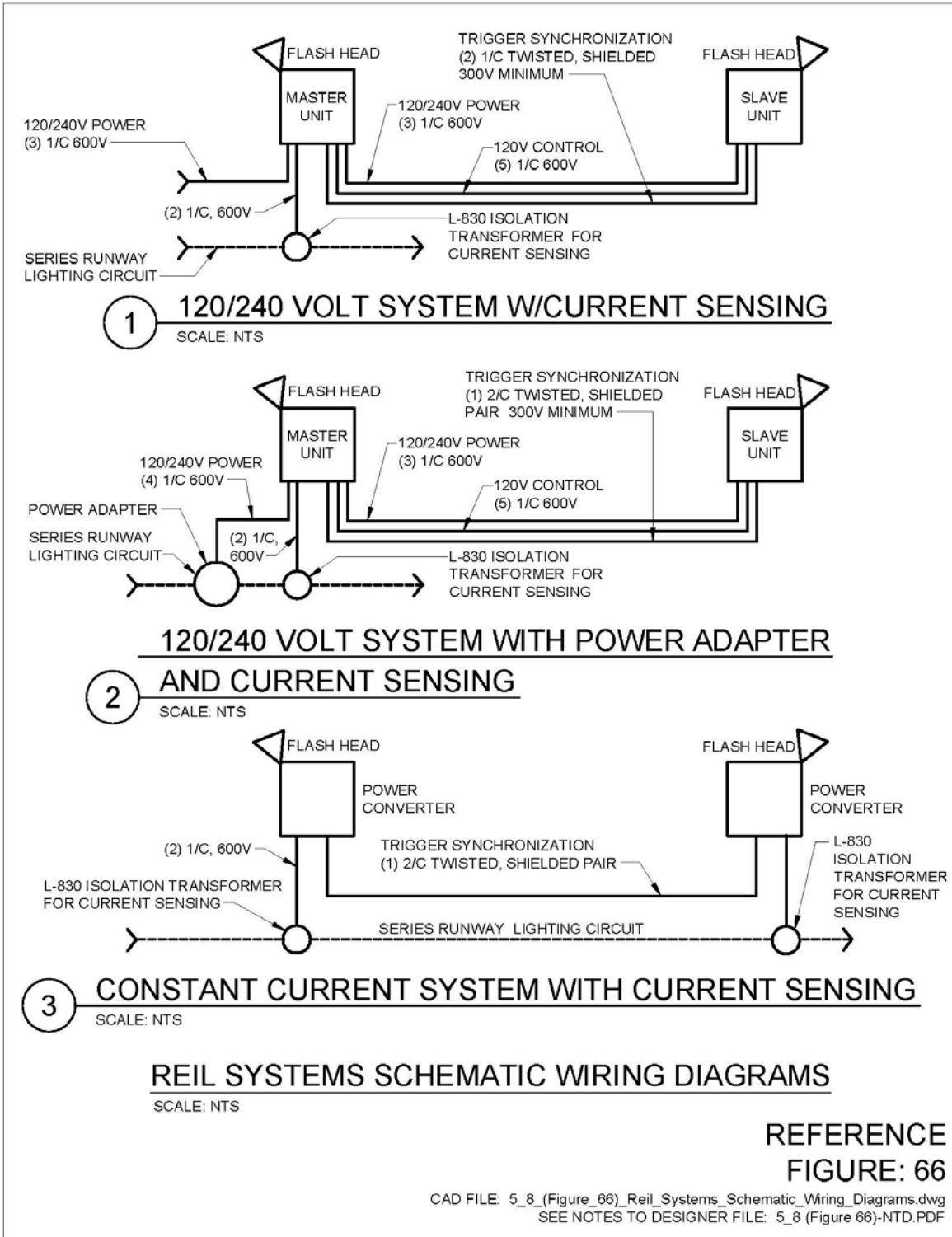
6-7 **REIL Systems Schematic Wiring Diagrams.**

6-7.1 **Figure 66.**

6-7.1.1 **Notes to Designer.**

1. The most common system presently in use is depicted in Detail 1. This system uses a separate 120/240 volt source for the incoming power. When designing this system ensure the separate power source is available near the master unit.
2. Detail 2 uses a power adapter that is installed in series with the series runway lighting circuit. The power adapter converts the constant current from the lighting circuit to a 120/240 volt output. This output is used as the 120/240 volt source to power the system.
3. Some special precautions should be taken when designing this type of system:
 - a. Power adapters often have varied performance. Variations in brightness levels selected, load, and regulators will produce variations in voltage output.
 - b. System may add up to an additional 4kw to runway lighting system.
 - c. System may not work well with certain types of regulators.
4. Recommend coordinating with manufacturer prior to designing this type of system.
5. The system in Detail 3 uses the constant current as the power feed to each unit via an L-830 isolation transformer. The flash heads are synchronized via the twisted pair between the two units. Load on the runway lighting circuit is about 150 watts per flash head or 300 watts for the system.
6. The contract documents should only show the schematic wiring diagram of the actual system to be utilized. Designer should delete the other diagrams.
7. Size and number of conductors must be verified with manufacturer.

Figure 66. REIL Systems Schematic Wiring Diagrams



6-8 **Master and Slave REIL Unit Installation.**

6-8.1 **Figure 67.**

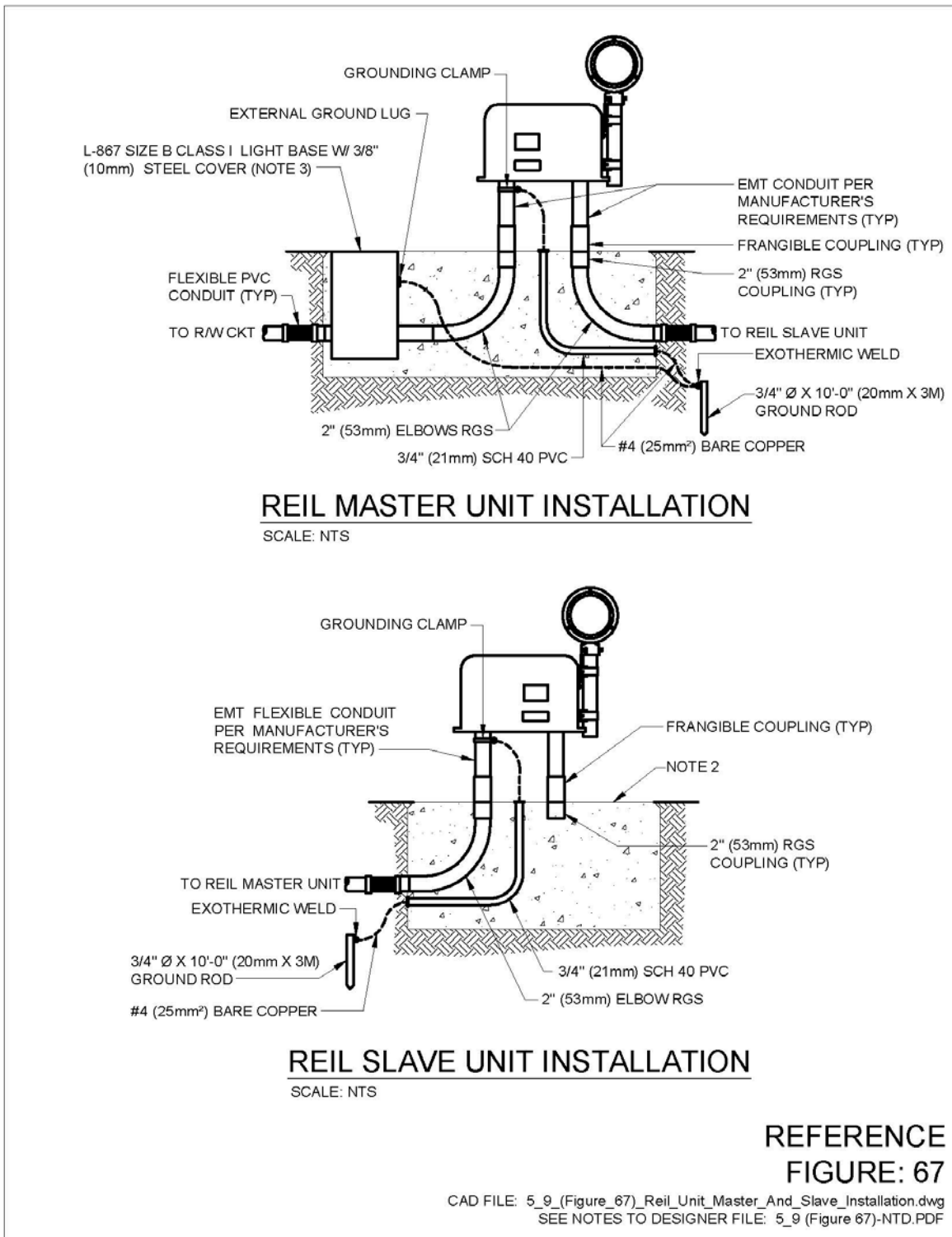
6-8.1.1 **Notes to Designer.**

1. This detail shows a typical 120/240 volt system installation. All manufacturers are similar but arrangements of conduit entrances and support legs may be different. Recommend verifying requirements with several different manufacturers.
2. Foundations will vary with manufacturer.
3. Ensure contract documents show location of REILs and power source. Locations will be as specified in UFC 3-535-01.

6-8.1.2 **Drawing Notes for Figure 67.**

1. Dimensions and layout vary with manufacturer. Install per manufacturer's requirements.
2. Dimension of concrete foundation varies with equipment supplied. Depth must be 36" (900mm) or 6" (150mm) below frost line whichever is greater.
3. L-867 base for mounting L-830 isolation transformer may be part of foundation or mounted separately.
4. Wire per manufacturer's requirements.
5. Incoming power wiring and conduit not indicated for clarity. Power wiring may enter L-867 light base in a separate conduit from the series circuit lighting cables.

Figure 67. Master and Slave REIL Unit Installation



**CHAPTER 7 Miscellaneous (Rotating Beacons, Wind Cones, Can Plazas,
Manholes, and High Mast Lighting)**

7-1 51' (15.5m) Pre-Fabricated Beacon Tower.

7-1.1 Figure 68.

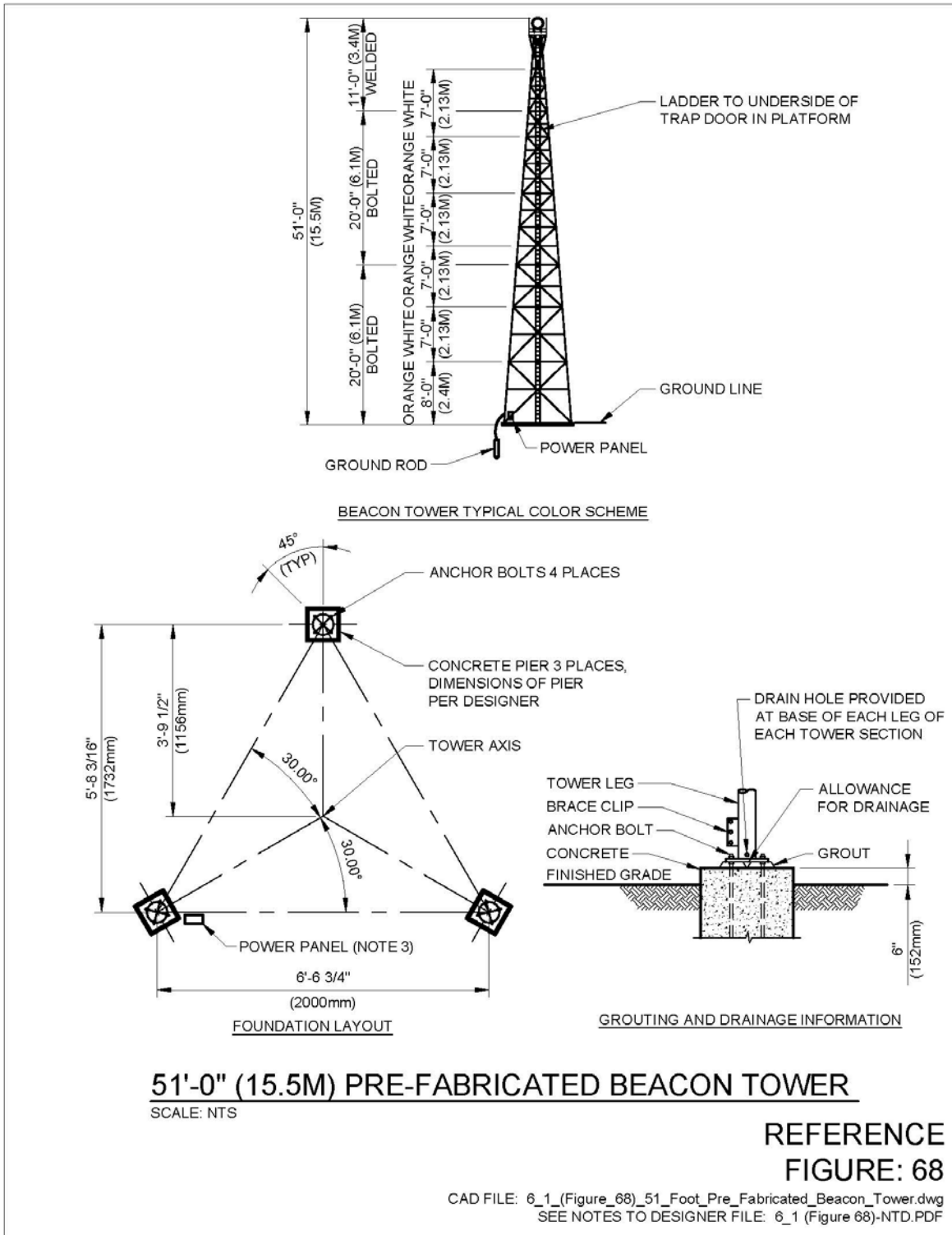
7-1.1.1 Notes to Designer.

1. This diagram shows a typical self-supporting 51' (15.5m) tower. Actual height of tower will depend on site conditions. Refer to UFC 3-535-01 for additional information.
2. Tower is designed by manufacturer. Recommend furnishing manufacturer with following data based on actual site:
 - a. Weight and Effective Projected Area (EPA) of proposed beacon
 - b. Beacon mounting footprint
 - c. Overall height of tower
 - d. Soil bearing capacity and analysis based on borings taken at site.

7-1.1.2 Drawing Notes for Figure 68.

1. Ladder must be furnished with OSHA approved safety climbing tower.
2. Size of piers per Registered Structural Engineer.
3. Install power panel with top at 5'-0" (1.5m) above finished grade.
4. Provide circuits to top of tower for beacon, motor, heater, and obstruction light. Provide disconnect switch for each circuit at top of tower.

Figure 68. 51' (15.5m) Pre-Fabricated Beacon Tower



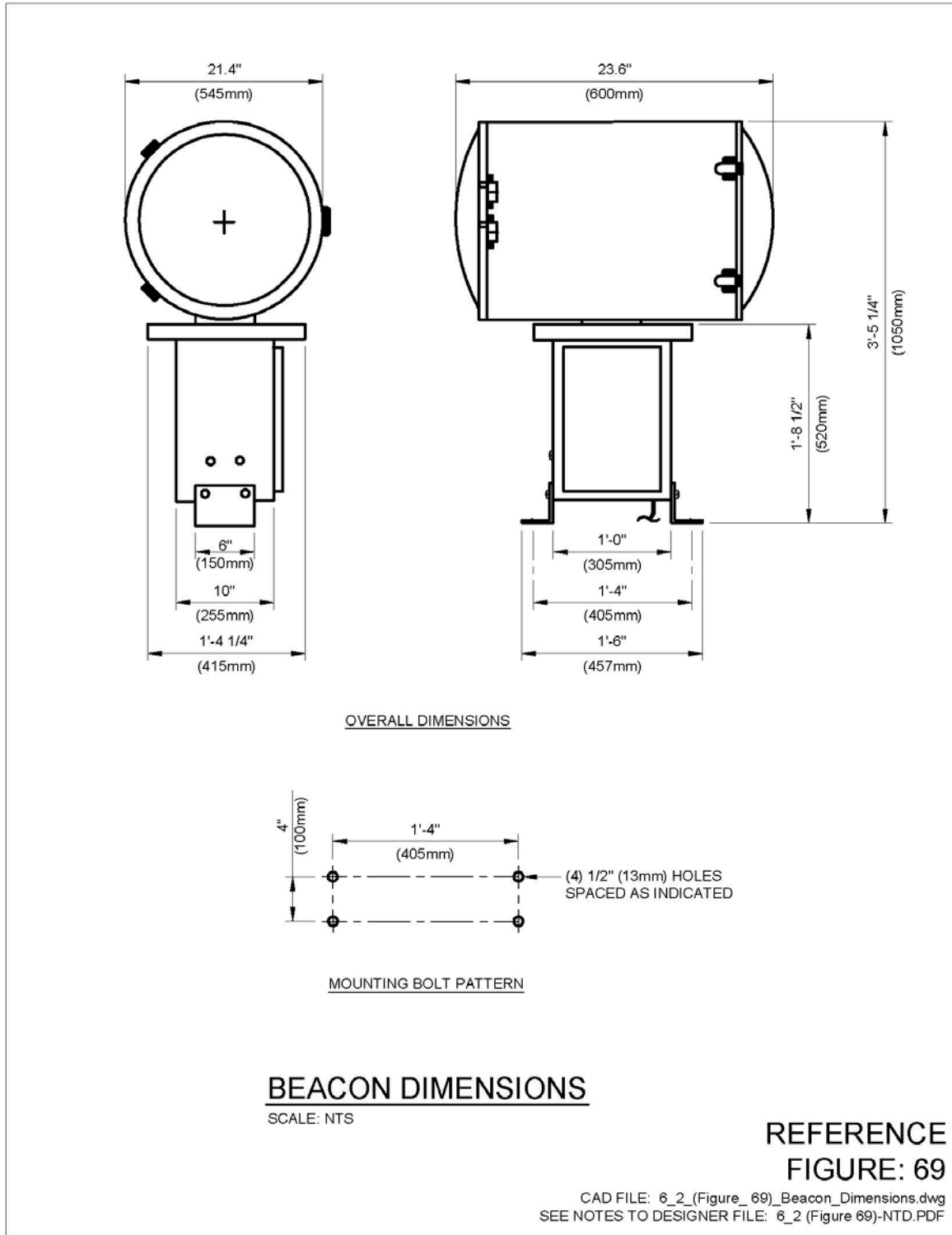
7-2 **Beacon Dimensions and Wiring Diagram.**

7-2.1 **Figure 69.**

7-2.1.1 **Notes to Designer.**

1. The dimensions may vary between manufacturers.
2. Control of the beacon is typically automatic by a photocell or timeclock. Means should be provided in the control tower for overriding the photocell or timeclock. The beacon could be located up to 5000' (1500m) from the nearest runway and power wiring will come from the closest source. The control feed from the tower override could be by radio link, telephone switching relay, etc. Recommend during design that control route and available power be verified.
3. Verify dimensions and wiring with manufacturer.

Figure 69. Beacon Dimensions



7-3 **Beacon Tower Platform Details.**

7-3.1 **Figure 70.**

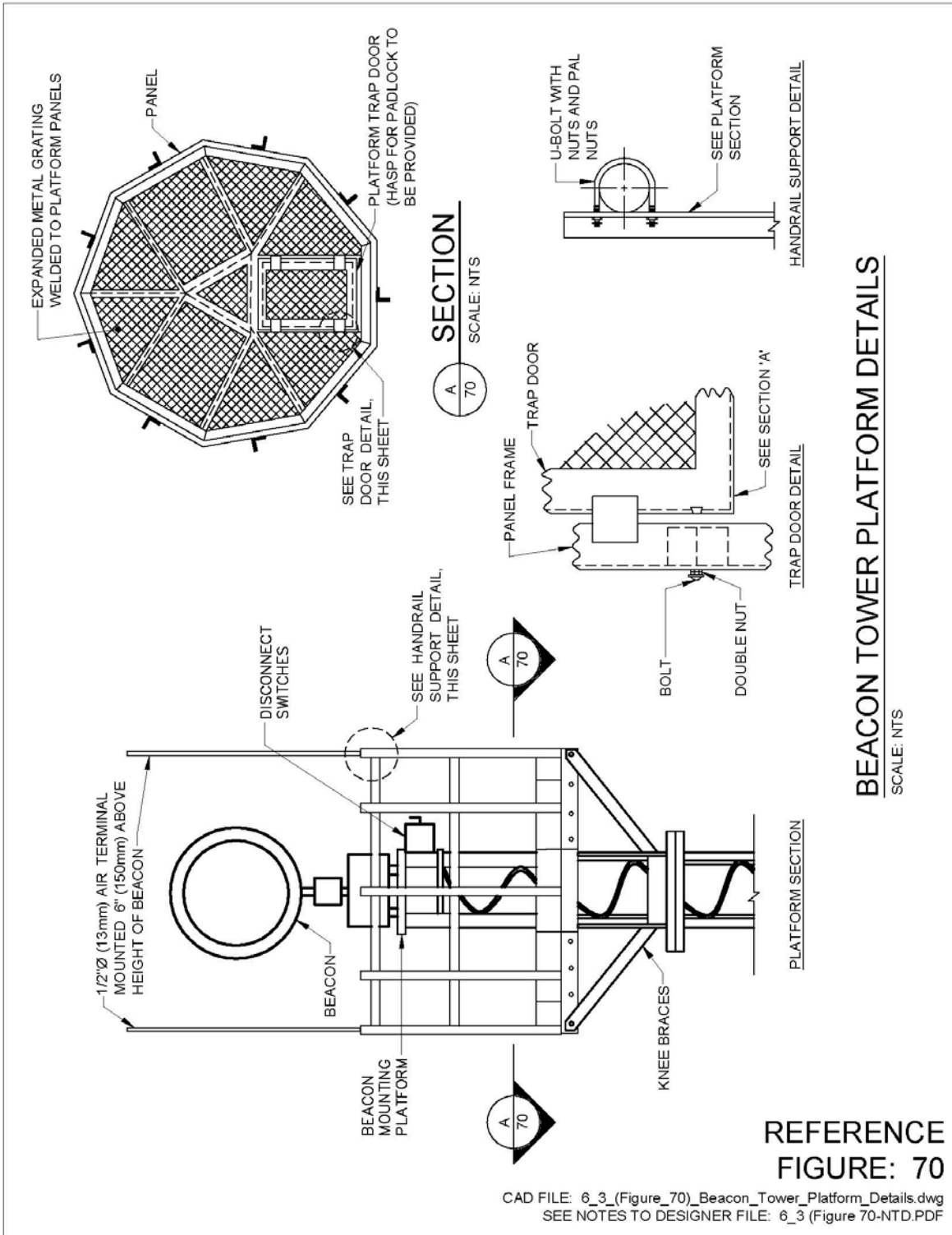
7-3.1.1 **Notes to Designer.**

1. Figure is self-explanatory.

7-3.1.2 **Drawing Notes for all Tower Components, Figure 70.**

1. All tower components must be hot dipped galvanized after fabrication.
2. Install per manufacturer's requirements.
3. Locate disconnect switches on walkway handrail or center structure.

Figure 70. Beacon Tower Platform Details



7-4 **Tower Safety Climbing Device.**

7-4.1 **Figure 71.**

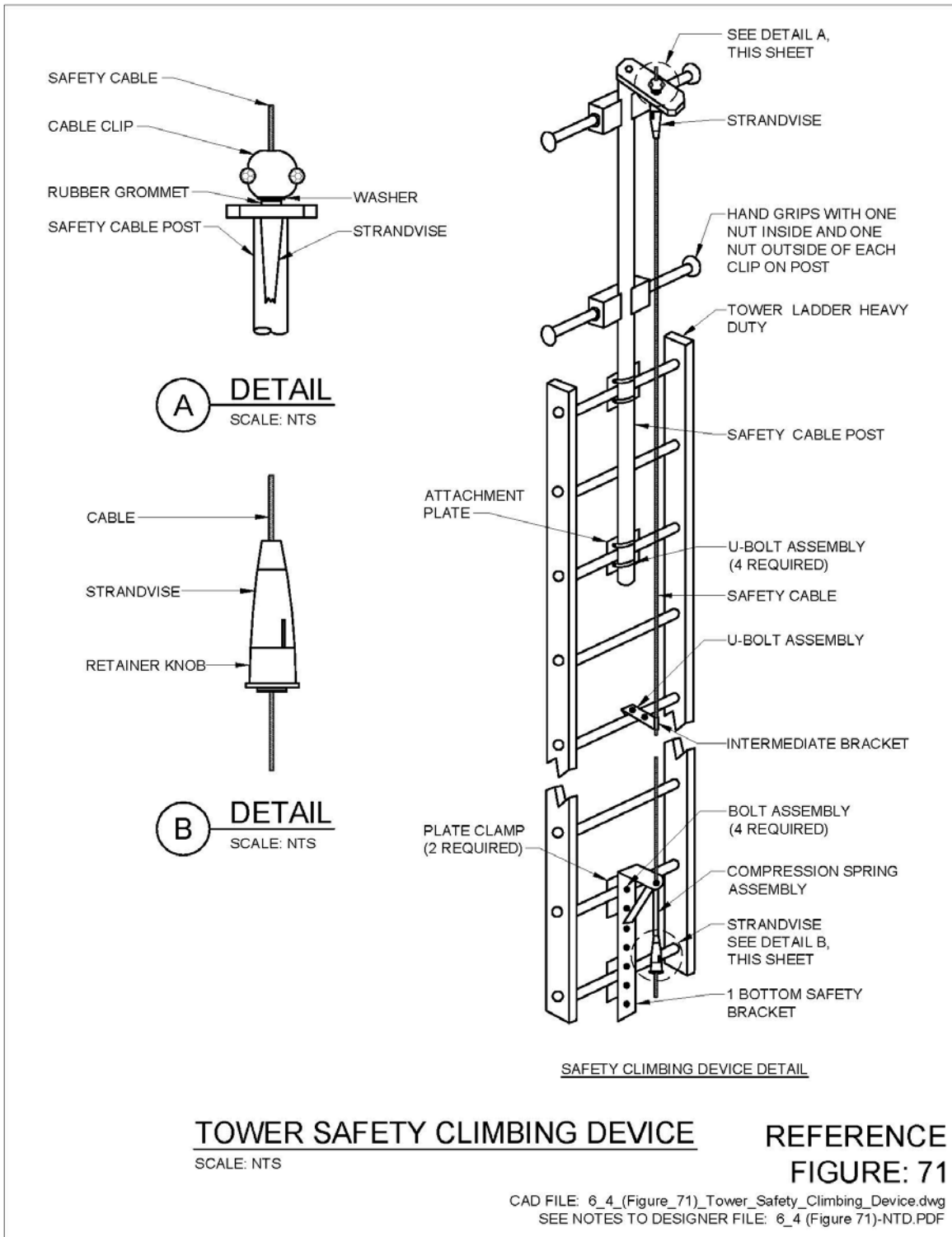
7-4.1.1 **Notes to Designer.**

1. Figure is self-explanatory.

7-4.1.2 **Drawing Notes for Figure 71.**

1. Installation per manufacturer's requirements.
2. Contractor must provide two full body harnesses equipped with d-rings at front, back and both sides. Harness must be fully compatible for use with safety climbing device.
3. Contractor must provide two 6' (1829mm) shock absorbing lanyards, nylon/dacron construction.
4. Climbing device must meet latest OSHA and ANSI standards.

Figure 71. Tower Safety Climbing Device



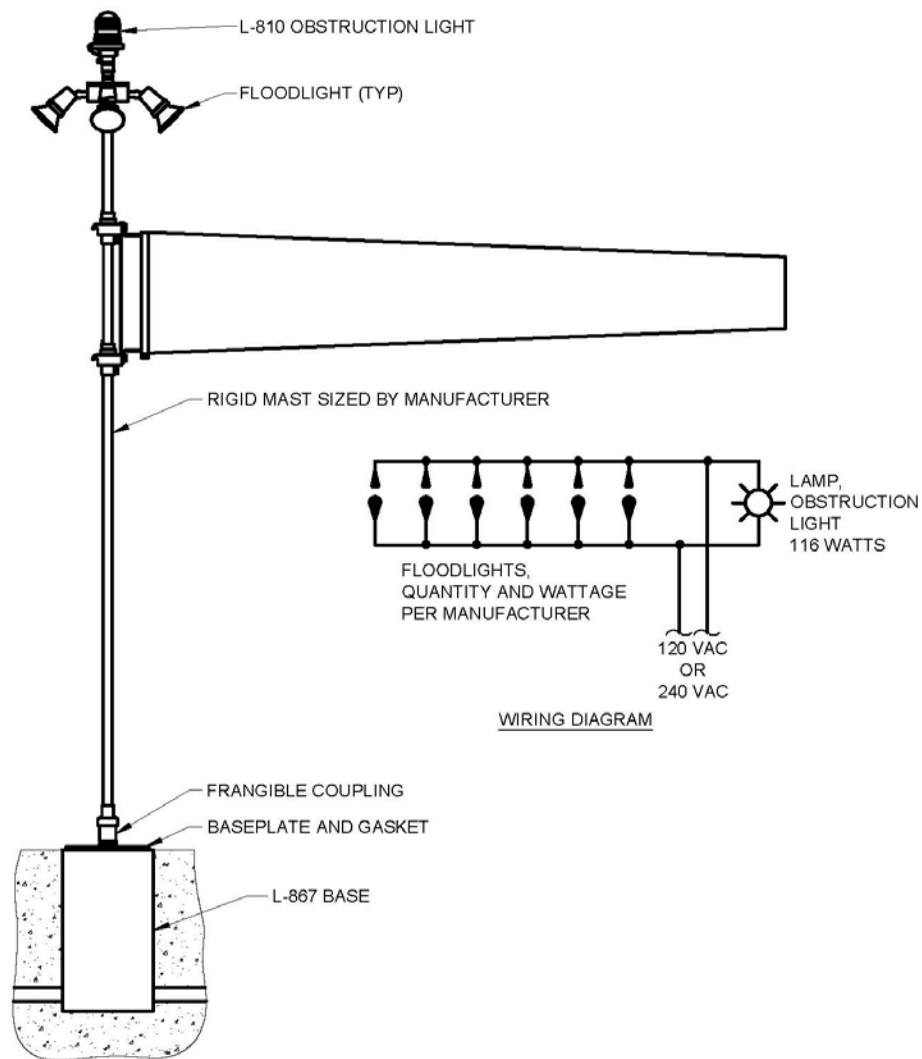
7-5 **L-806 Windcone Assembly (Frangible).**

7-5.1 **Figure 72.**

7-5.1.1 **Notes to Designer.**

1. Typically, windcones are powered from a 120 or 240 volt ac source. Voltage drop must be analyzed. Depending on the length of run, a boosting transformer may have to be added.
2. The windcone should be powered and controlled from a separate circuit independent of runway edge lights.

Figure 72. L-806 Windcone Assembly (Frangible)



STANDARD ILLUMINATED FRANGIBLE
1'-6" (457mm) WIND CONE ASSEMBLY

L-806 WINDCONE ASSEMBLY (FRANGIBLE)

SCALE: NTS

REFERENCE
FIGURE: 72

CAD FILE: 6_5_(Figure_72)_L_806_Windcone_Assembly_(Frangible).dwg
SEE NOTES TO DESIGNER FILE: 6_5_(Figure_72)-NTD.PDF

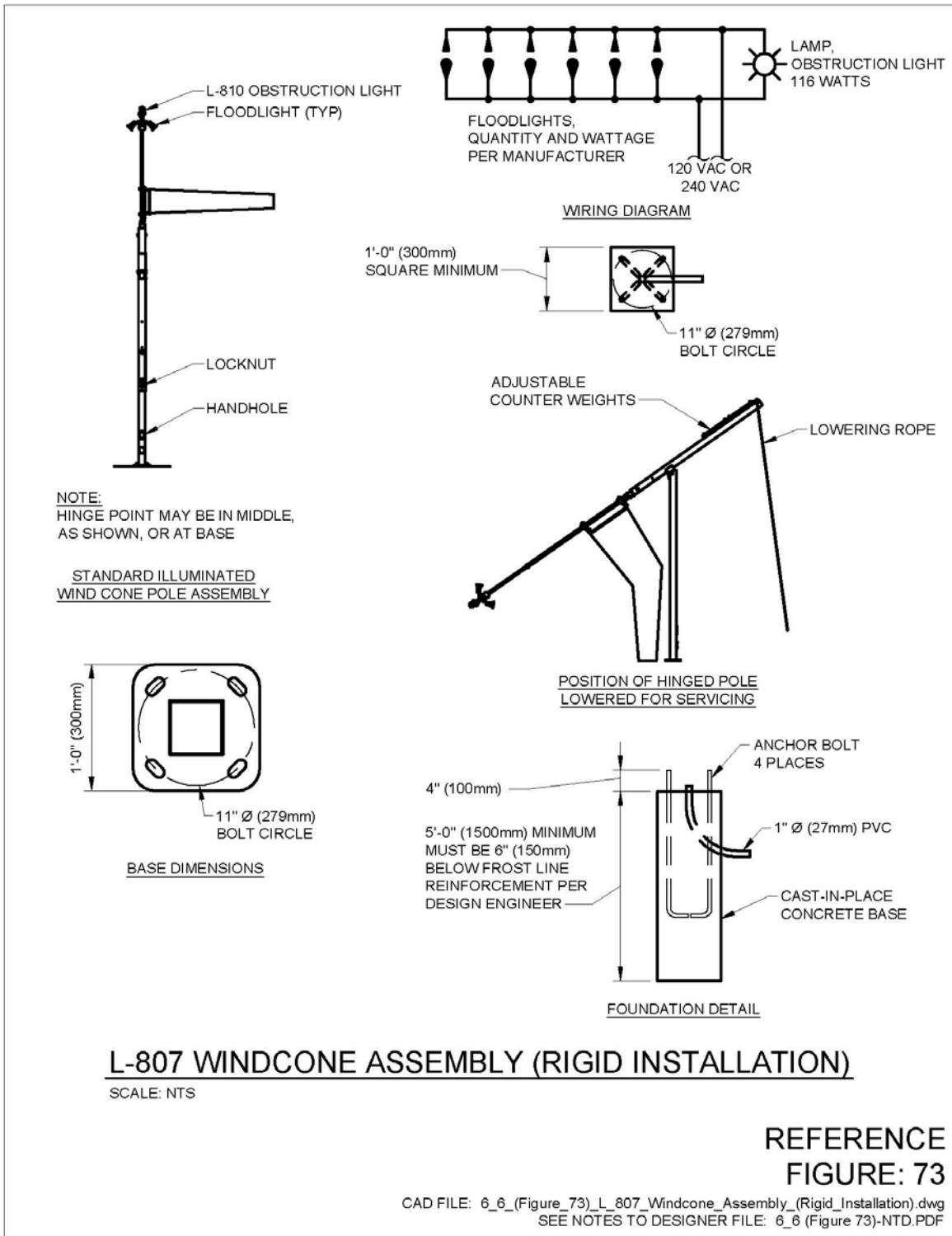
7-6 **L-807 Windcone Assembly (Rigid Installation).**

7-6.1 **Figure 73.**

7-6.1.1 **Notes to Designer.**

1. Typically, windcones are powered from a 120 or 240 volt source. Voltage drop must be analyzed. Depending on the length of run, a boosting transformer may have to be added.
2. The windcone should be powered and controlled from a separate circuit independent of runway edge lights.

Figure 73. L-807 Windcone Assembly (Rigid Installation)



7-7 **Junction Can Plaza, Type A.**

7-7.1 **Figure 74.**

7-7.1.1 **Notes to Designer.**

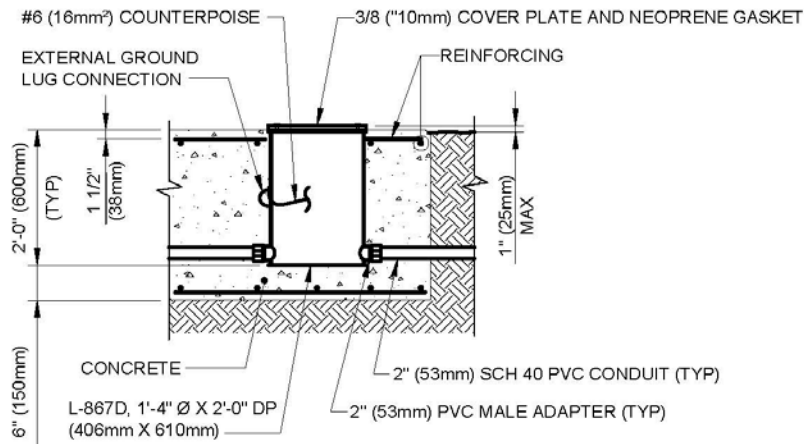
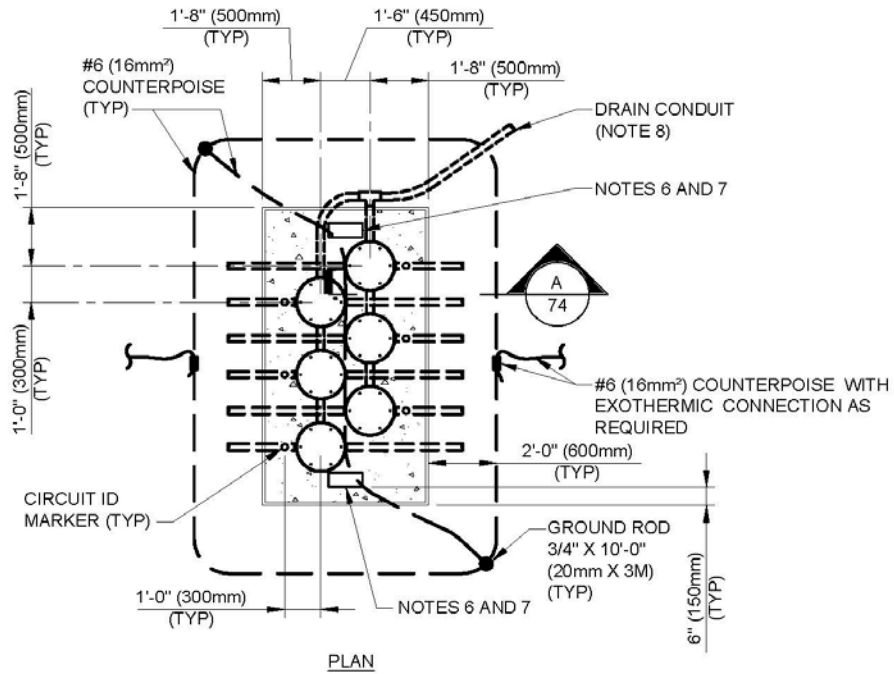
1. The purpose of individual base cans is to segregate the field circuits into separate conduit runs and provide access to each circuit. The advantages are:
 - a. A fault in one circuit will not affect the others.
 - b. Maintenance personnel do not have to be confined space trained (presently required by OSHA to enter manholes).
 - c. Access time is considerably less than manholes.
2. Circuit and junction can plaza IDs should be indicated on the layout plans. The designer should coordinate with maintenance and operations personnel during the design review process to ensure each circuit and junction can is identified correctly for the specific installation.

7-7.1.2 **Drawing Notes for Figure 74.**

1. Number of junction cans and conduit configurations vary. See layout plan sheets for orientation.
2. Conduits which are not used in the project must be capped 12" (300mm) outside of plaza concrete.
3. Orient plaza as indicated on layout plan sheets.
4. Contractor must provide a 2" (50mm) diameter domed bronze marker at each junction can as indicated. Marker must be stamped with circuit identification as indicated on layout plan sheets.
5. Install ground rods and ground loop at all junction can plazas as indicated. Two ground rods per plaza located at opposite corners must be provided. Counterpoise must be located nominally 12" (300mm) below existing grade.
6. Contractor must label 2 ends of each junction can plaza (JCP) by impressing the JCP identification number into the concrete foundation during placement. Letters and numbers must be 4" (100mm) in height, proportional in width, and have a stroke width of 1/2" (13mm) and 1/4" (6mm) depth.
7. See layout plan sheets for JCP identification numbers.

8. Drain conduits must be provided where indicated on the lighting and signage layout sheets. See Figure 76 for connection to junction cans.

Figure 74. Junction Can Plaza, Type A



SECTION
SCALE: NTS

JUNCTION CAN PLAZA, TYPE A (AIR FORCE ONLY)

SCALE: NTS

REFERENCE
FIGURE: 74

CAD FILE: 6_7_(Figure_74)_Junction_Can_Plaza_Type_A_(Air_Force_Only).dwg
SEE NOTES TO DESIGNER FILE: 6_7 (Figure 74)-NTD.PDF

7-8 **Junction Can Plaza, Type B.**

7-8.1 **Figure 75.**

7-8.1.1 **Notes to Designer.**

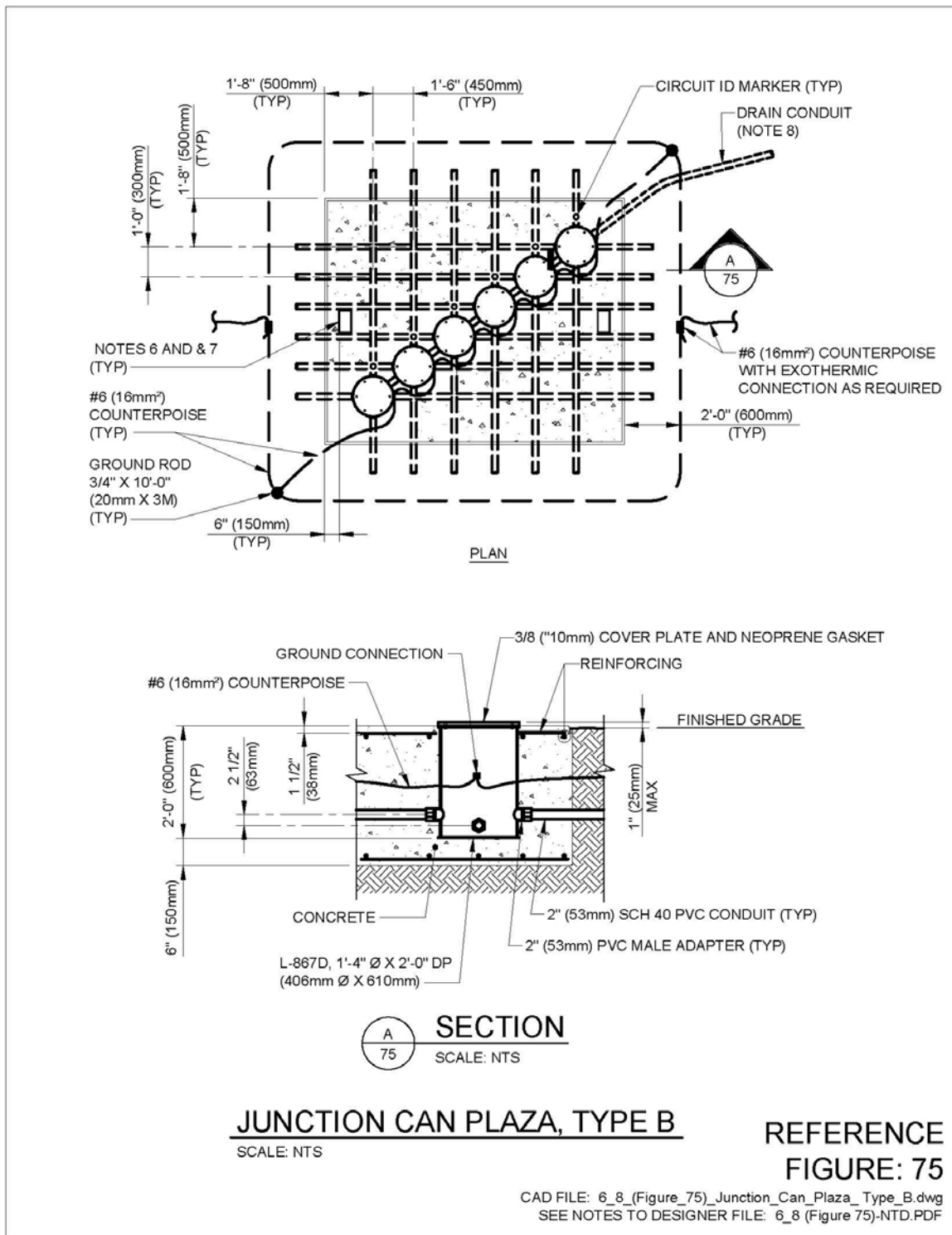
1. The purpose of the base cans is to segregate the field circuits into separate conduit runs and provide access to each circuit. The advantages are:
 - a. A fault in one circuit will not affect the others.
 - b. Maintenance personnel do not have to be confined space trained (presently required by OSHA to enter manholes).
 - c. Access time is considerably less than for manholes.
2. Circuit and junction can plaza IDs should be indicated on the layout plans. The designer should coordinate with maintenance and operations personnel during the design review process to ensure each circuit and junction can is identified correctly for the specific installation.

7-8.1.2 **Drawing Notes for Figure 75.**

1. Number of junction cans and conduit configurations vary. See layout plan sheets for orientation.
2. Conduits which are not used in the project must be capped 12" (300mm) outside of plaza concrete.
3. Orient plaza as indicated on layout plan sheets.
4. Contractor must provide a 2" (50mm) diameter domed bronze marker at each junction can as indicated. Marker must be stamped with circuit identification as indicated on layout plan sheets.
5. Install ground rods and ground loop at all junction can plazas as indicated. Two ground rods per plaza located at opposite corners must be provided. Counterpoise must be located nominally 12" (300mm) below existing grade.
6. Contractor must label 2 ends of each junction can plaza (JCP) by impressing the JCP identification number into the concrete foundation during placement. Letters and numbers must be 4" (100mm) in height, proportional in width, and have a stroke width of 1/2" (13mm) and 1/4" (6mm) depth.
7. See layout plan sheets for JCP identification numbers.

8. Provide drain conduits where indicated on the lighting and signage layout sheets. See Figure 76 for connection to junction cans.

Figure 75. Junction Can Plaza, Type B



7-9 **Drain for Junction Cans (Air Force Only).**

7-9.1 **Figure 76.**

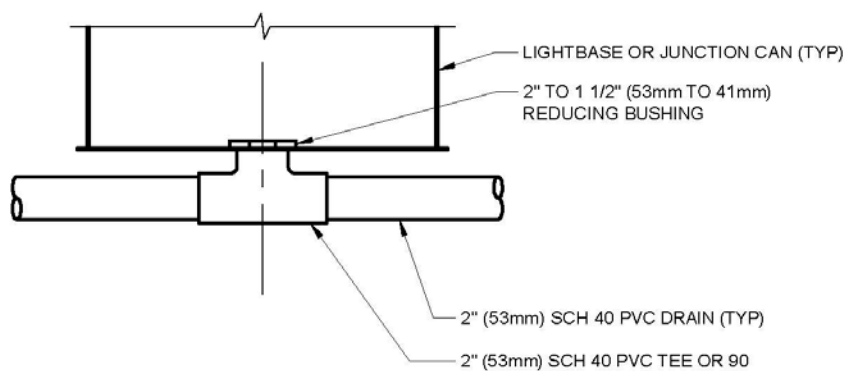
7-9.1.1 **Notes to Designer.**

1. The junction can plaza is for Air Force installations only.
2. The purpose is to segregate the field circuits into separate conduit runs and provide access to each circuit. The advantages are:
 - a. A fault in one circuit will not affect the others.
 - b. Maintenance personnel do not have to be confined space trained (presently required by OSHA to enter manholes).
 - c. Access time is considerably less than manholes.

7-9.1.2 **Drawing Notes for Figure 76.**

1. See layout plan sheets for location of drain conduits.
2. Slope drain conduits 1/8" per foot (3mm per 300mm) minimum toward drainage structures.
3. Penetrate inlet/manhole with drain conduit above storm sewer pipes where possible while maintaining slope requirement.
4. Seal entry around drain conduit at the inlet/manhole with compatible non-shrink grout.

Figure 76. Drains for Junction Cans (Air Force Only)



DRAINS FOR JUNCTION CANS (AIR FORCE ONLY)

SCALE: NTS

REFERENCE
FIGURE: 76

CAD FILE: 6_9_(Figure_76)_Drains_For_Junction_Cans_(Air_Force_Only).dwg
SEE NOTES TO DESIGNER FILE: 6_9 (Figure 76)-NTD.PDF

7-10 **Manhole Grounding, Optional Cable Rack and Marker Details.**

Figure 77. Reserved

Figure 78. Reserved

7-10.1 **Figure 80A.**

7-10.1.1 **Notes to Designer.**

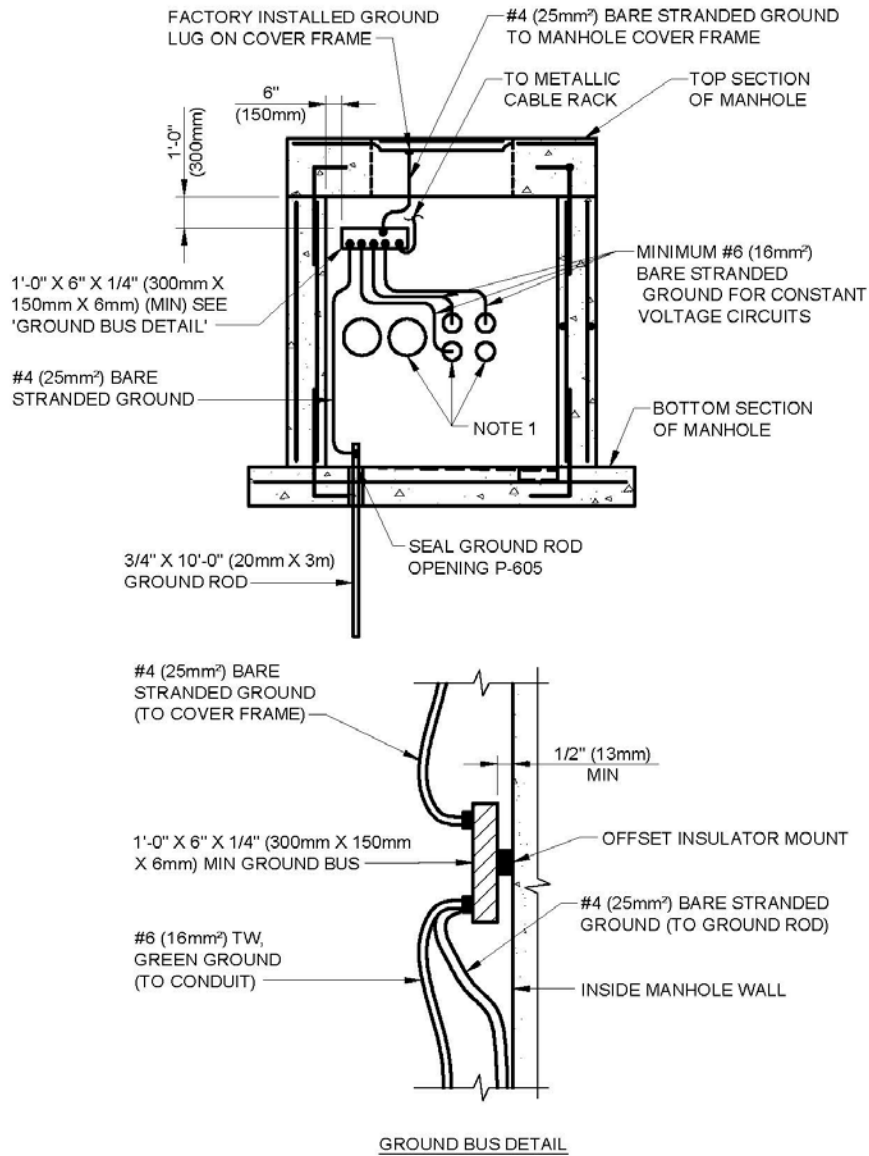
1. Manhole grounding must be installed in all manholes and handholes. Typically, the metal frame of the access cover is grounded by a #4 (25 square mm) solid bare copper conductor connected to a ground lug on the frame and the ground rod. If the cover is removable grounding is also required, utilize flexible cable such as welding cable and connect to the frame and cover. The length of flexible cable should be long enough to allow removal of the cover away from the frame to allow access into the manhole.
2. The length of the cable rack arm is indicated at 14" (355 mm). There are smaller arms available as well as "U" shaped saddle rack that meet the minimum 300 lb loading. In 3' (0.9m) x 3' (0.9m) handholes, the 14" (355mm) arm may hinder access. Recommend using an 8" (200mm) arm or saddle rack.
3. The brass survey marker is used to identify the handhole or manhole for circuit routing and duct bank layouts as well as maintenance schedules. The actual identification number to be used should be coordinated with the facility maintenance personnel.

7-10.1.2 **Drawing Notes for Figure 80A.**

1. All conduits that contain copper cables for constant voltage circuits must be equipped with a minimum #6 (16 square mm), TW green ground wire. All conduits that are empty must not contain a ground wire.
2. Ground all metallic parts of the manhole with a #4 (25 square mm) bare stranded ground wire.
3. The contractor must install a 200 lb polypropylene pull rope/string in each duct and conduit installed and plug or cap the duct. The rope must be securely attached to the pull iron in each manhole, or a stake where the duct terminates underground.

4. All manholes must be installed as indicated on the plans. Coordinate final location with grading and drainage plans. When extending existing duct to new manhole, put manhole in line with existing duct when possible. Manholes must not be installed in ditches, drainage swales or where water will pond on top of the manhole.
5. All PVC conduit and fittings must be Schedule 40 and must be U.L. listed.
6. PVC plugs must be installed in each empty sleeve and duct.
7. Provide pulling irons on all walls opposite conduit entry points.
8. All wall reinforcement (loop and vertical) affected by ductwork must be relocated on either side of the duct and detailed in the submittal.
9. The contractor must submit shop drawings showing all reinforcing steel and other construction details (ship-lap joint, etc.) prior to fabrication.
10. Each duct crossing under pavement must be located and dimensioned on the record drawings, accurate to 0.5' (150mm). The entrance and exit from under the pavement must be marked with an embedded id marker and stamped with the duct bank number.

Figure 80A. Grounding Detail for Airfield Lighting Manhole



1

GROUNDING DETAIL FOR AIRFIELD LIGHTING MANHOLE

SCALE: NTS

REFERENCE
FIGURE: 80A

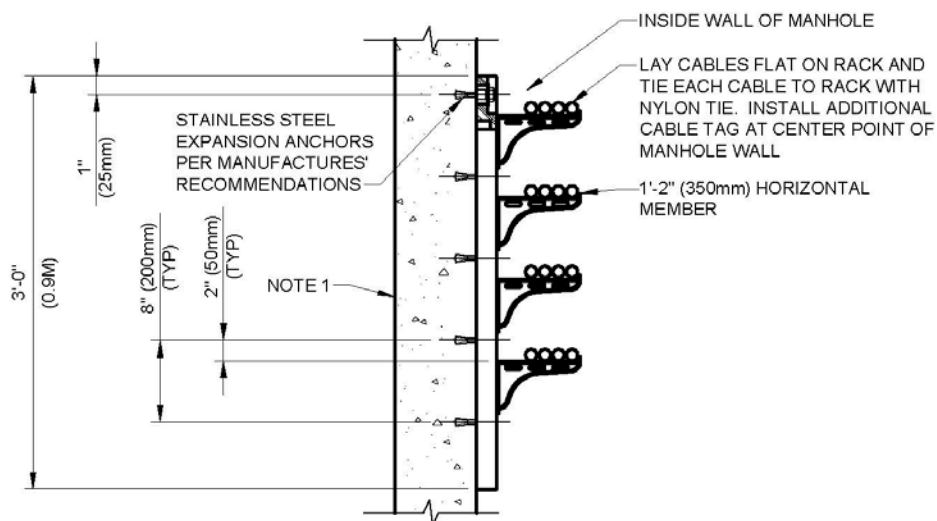
CAD FILE: 6_13_(Figure_80A)_Grounding_Detail_For_Airfield_Lighting_Manhole.dwg
SEE NOTES TO DESIGNER FILE: 6_13 (Figure 80A)-NTD.PDF

7-10.2 **Figure 80B.**

7-10.2.1 **Drawing Notes for Figure 80B.**

1. The cable racking system must be rated for 300 lbs. Cable racks must be placed on all manhole walls whether currently used or not. Cables must be tied to racks using cable ties.
2. Ground all metallic parts of the manhole with a #4 bare stranded ground wire.

Figure 80B. Cable Rack Option Detail



2 CABLE RACK OPTION DETAIL
SCALE: NTS

REFERENCE
FIGURE: 80B

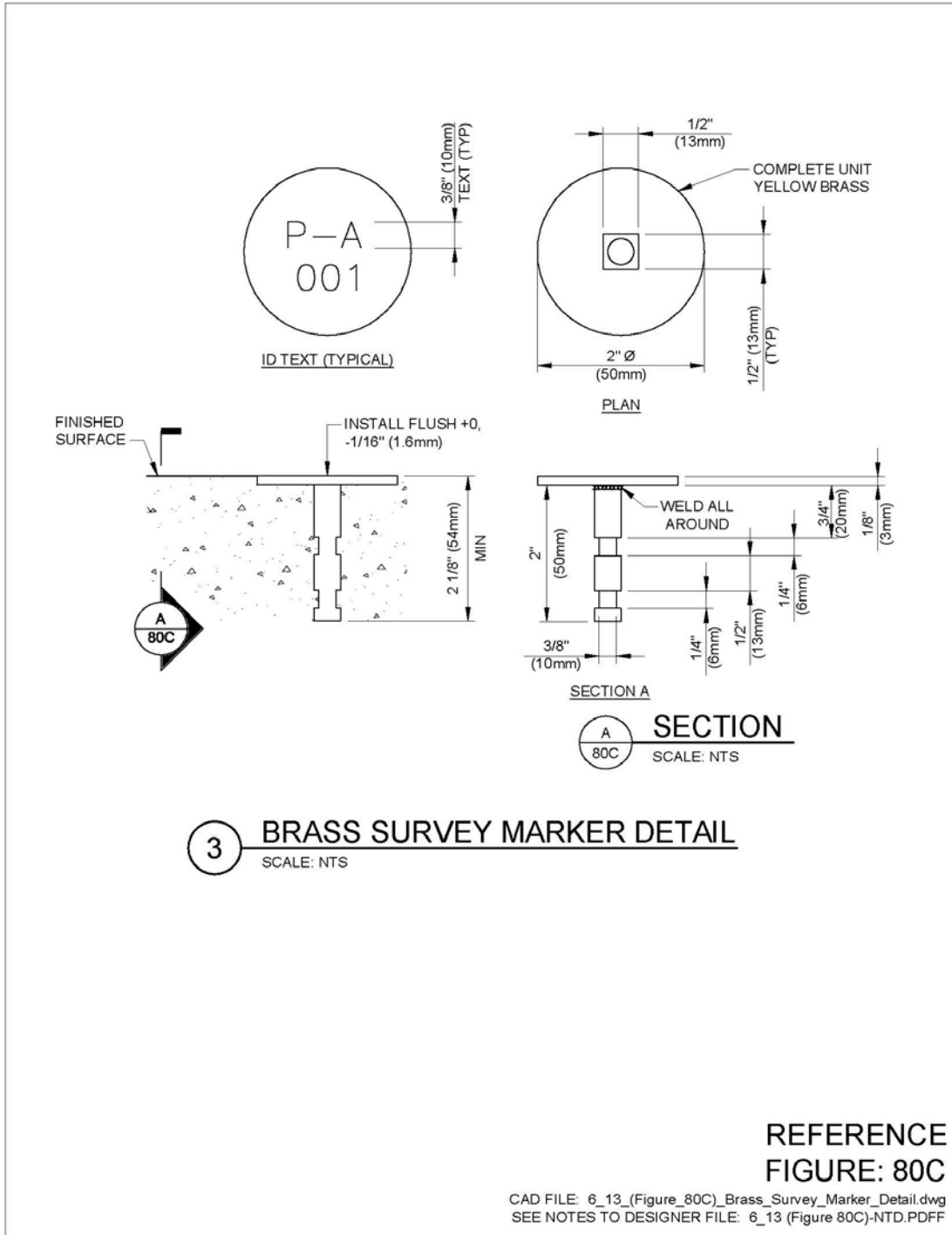
CAD FILE: 6_13_(Figure_80B)_Cable_Rack_Option_Detail.dwg
SEE NOTES TO DESIGNER FILE: 6_13 (Figure 80B)-NTD.PDF

7-10.3 **Figure 80C.**

7-10.3.1 **Drawing Notes for Figure 80C.**

1. Provide a brass survey marker with ID text stamped into it for each airfield lighting manhole.

Figure 80C. Brass Survey Marker Detail



Manhole Foldout Diagrams and Circuit Schedule.

7-10.4 **Figures 80D, 80E.**

7-10.4.1 **Notes to Designer.**

1. The Manhole Foldout Diagram indicates the number and size of duct/conduit entering each wall of a manhole or handhole. For each wall, identify the duct/conduit and the circuits contained within the duct/conduit.
2. A foldout diagram should be provided for each manhole or handhole that a circuit(s) enters from the source, through the duct bank system and to the last manhole or handhole for that circuit.
3. The circuit schedule tabulates the manholes and ducts/conduits within the manholes a specific enters. The manholes are listed in succession and are coordinated with the manhole foldout diagrams.

Example Circuit Schedule Table:

Markings	Circuit Description	Manhole and Duct Identifier						
		(NOTE 1) P-T-025		(NOTE 1) P-T-025		P-A-027		
		SEE SHEET EF-316		SEE SHEET EF-316 (NOTE 2)		SEE SHEET EF-316		
		W	E	W	E	S	W	E (NOTE 3)
05SSALR-17	Runway 05 ALSF No. 1	C	G	C	C	B		C
05ALSF-16	Runway 05 ALSF No. 2	D	H	D	D	C		D
05ALSF-15	Runway 05 ALSF No. 3	E	I	E	E	D		E
05ALSF-14	Runway 05 ALSF No. 4	F	J	F	F	E		F

05ALSF-13 (NOTE 5)	Runway 05 ALSF No. 4 (NOTE 5)	G	K	G	G	F (NOTE 4)	G
-----------------------	-------------------------------------	---	---	---	---	---------------	---

Example Circuit Schedule Notes:

1. Denotes manhole identification number (typ).
2. Denotes contract drawing where foldout diagram is indicated (typ).
3. Denotes wall (north, south, east, west) that ducts containing indicated circuits penetrate (typ).
4. Denotes duct designation containing indicated circuit (typ).
5. Denotes cable marking and circuit designation (typ).

Figure 80D. Example Manhole Cable Foldout Diagram

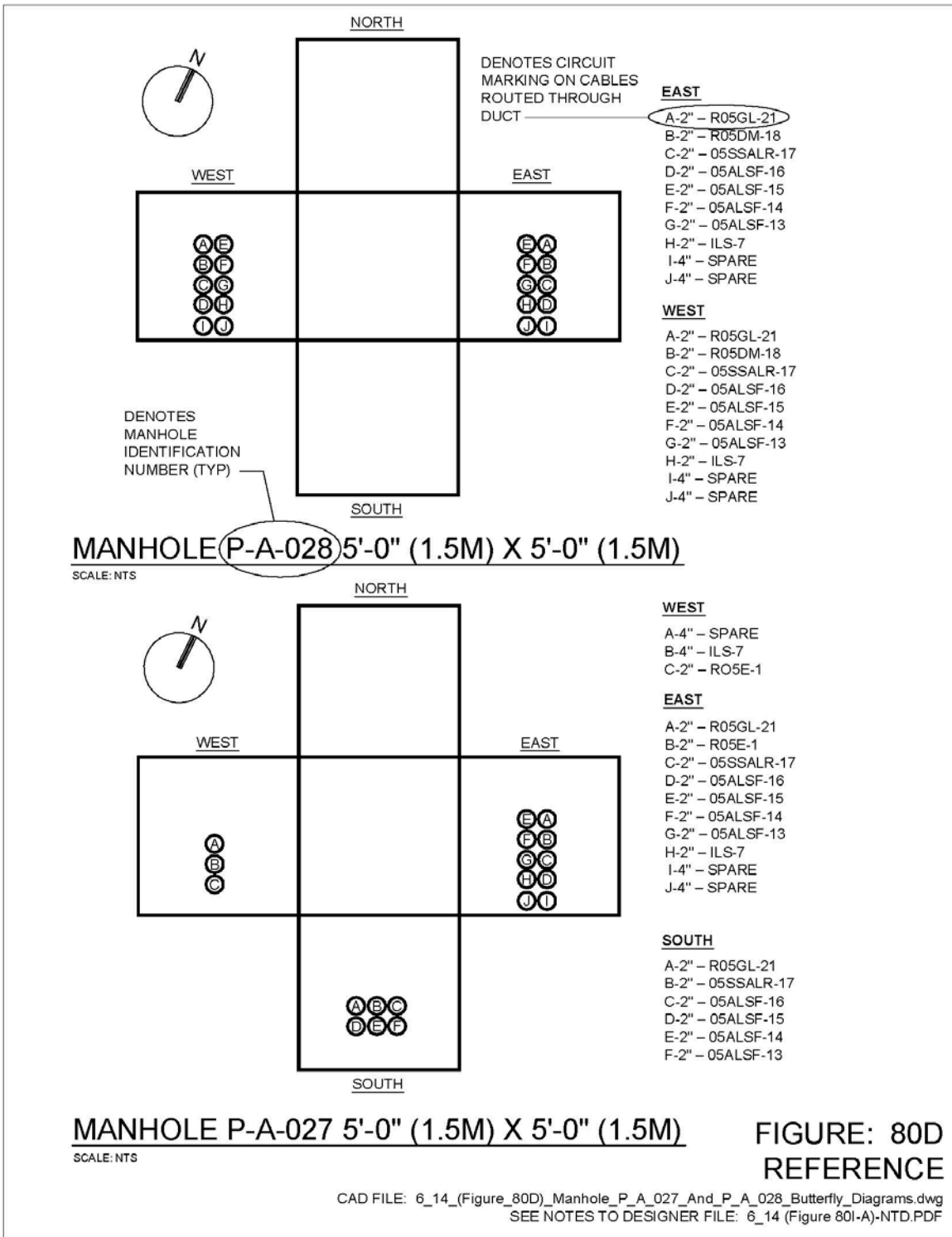


Figure 80E. Markings, Circuit Description, Manhole and Duct Identifier

MARKINGS	CIRCUIT DESCRIPTION	MANHOLE AND DUCT IDENTIFIER									
		P-T-025 (NOTE 1) SEE SHEET EF-316		P-A-026 SEE SHEET EF-316 (NOTE 2)		P-A-027 SEE SHEET EF-316		P-A-026 SEE SHEET EF-316 (NOTE 2)		P-A-027 SEE SHEET EF-316	
		W	E	W	E	S	W	S	W	E	(NOTE 3)
05SSALR-17	RUNWAY 05 ALSF NO. 1	C	G	C	C	B					C
05ALSF-16	RUNWAY 05 ALSF NO. 2	D	H	D	D	C					D
05ALSF-15	RUNWAY 05 ALSF NO. 3	E	I	E	E	D					E
05ALSF-14	RUNWAY 05 ALSF NO. 4	F	J	F	F	E					F
05ALSF-13 (NOTE 5)	RUNWAY 05 ALSF NO. 4 (NOTE 5)	G	K	G	G	F (NOTE 4)					G

NOTES:

1. DENOTES MANHOLE IDENTIFICATION NUMBER (TYP).
2. DENOTES CONTRACT DRAWING WHERE FOLDOUT DIAGRAM IS SHOWN (TYP).
3. DENOTES WALL (NORTH, SOUTH, EAST, WEST) THAT DUCTS CONTAINING INDICATED CIRCUITS PENETRATE (TYP).
4. DENOTES DUCT DESIGNATION CONTAINING INDICATED CIRCUIT (TYP).
5. DENOTES CABLE MARKING AND CIRCUIT DESIGNATION (TYP).

**REFERENCE
FIGURE: 80E**

CAD FILE: 6_14_(Figure_80E)_Manhole_And_Duct_Identifier_Schedule.dwg
SEE NOTES TO DESIGNER FILE: 6_14_(Figure_80D-B)-NTD.PDF

Figure 81. Reserved

Figure 82. Reserved

Figure 82. Reserved.

Figure 83. Reserved.

7-11 **Traffic Signs and Signals Installation.**

7-11.1 **Figures 84A, 84B, 84C, 84D.**

7-11.1.1 **Notes to Designer.**

1. Figures 84A, 84B, 84C and 84D show the installation of traffic signs and signals installed on a roadway that crosses the approach end of a runway. The purpose is to provide visual warning to vehicle traffic that they are near low flying aircraft.
2. Control of the flashing signals is initiated by air traffic control by transmission over a fiber optic cable to the master controller. Ground-to-ground radio transmission might also be used.
3. Figure 84A shows a plan view of master and slave flashers and sign locations. Figures 84B, 84C, and 84D show details of the roadway sign and signal assembly.

7-11.1.2 **Drawing Notes for Figure 84C.**

1. Install signal controller with 8-position M49 cabinet.
2. Integrate signal controller and cabinet into proposed fiber optic system with single mode data transceiver and interconnect center compatible with other fiber optic equipment provided.
3. Signal rests in "dark" mode. Air traffic control will activate signal. Upon activation, display a flashing yellow signal indication, for 5.0 seconds, followed by a 5.0 second solid yellow change interval. Follow change interval with two alternating red signals (i.e. wig-wag). Air traffic control will terminate flashing red. Upon termination of red signal will revert to "dark" mode.

Figure 84A. Plan View of Traffic Sign/Signal Installation

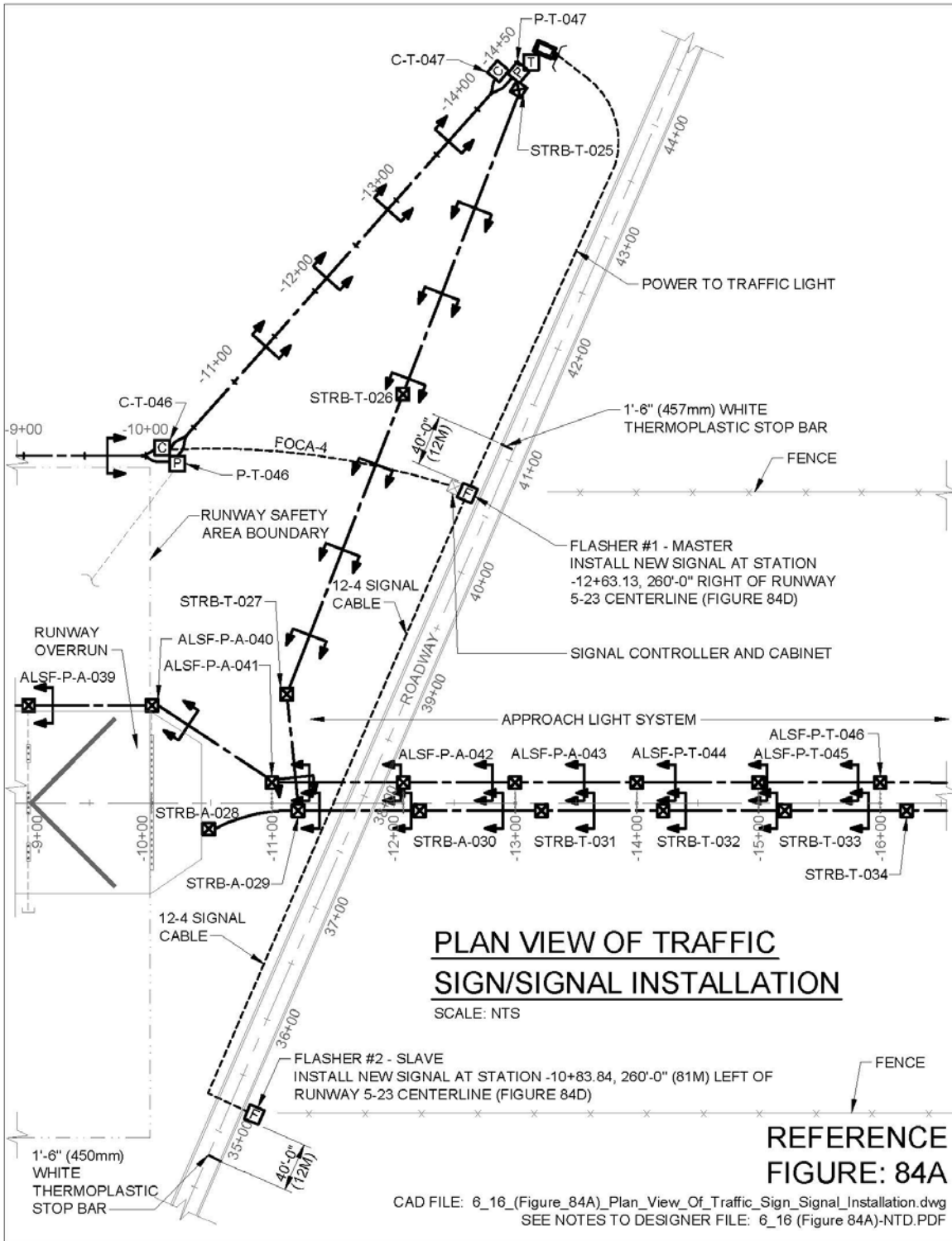
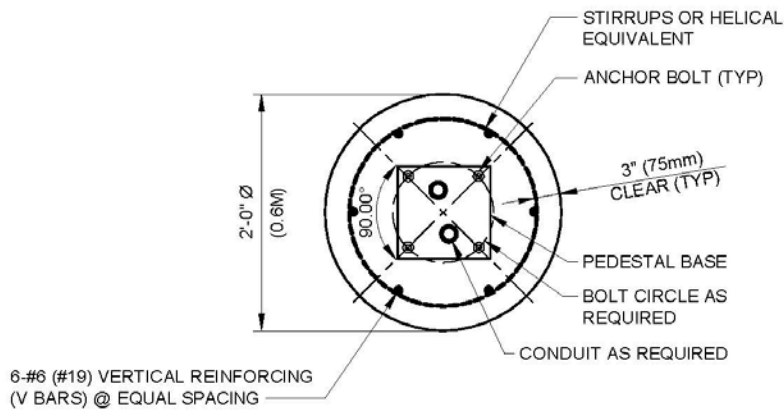
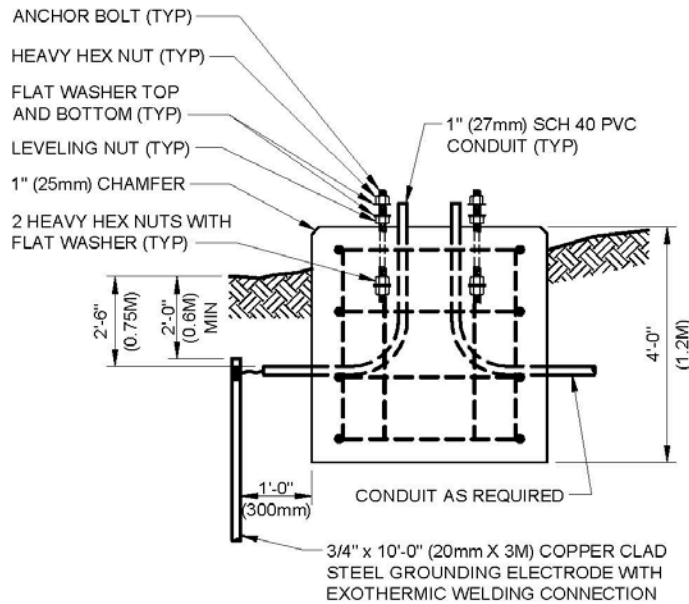


Figure 84C. Pedestal Foundation – Top View, In Earth



2 PEDESTAL FOUNDATION - TOP VIEW
SCALE: NTS

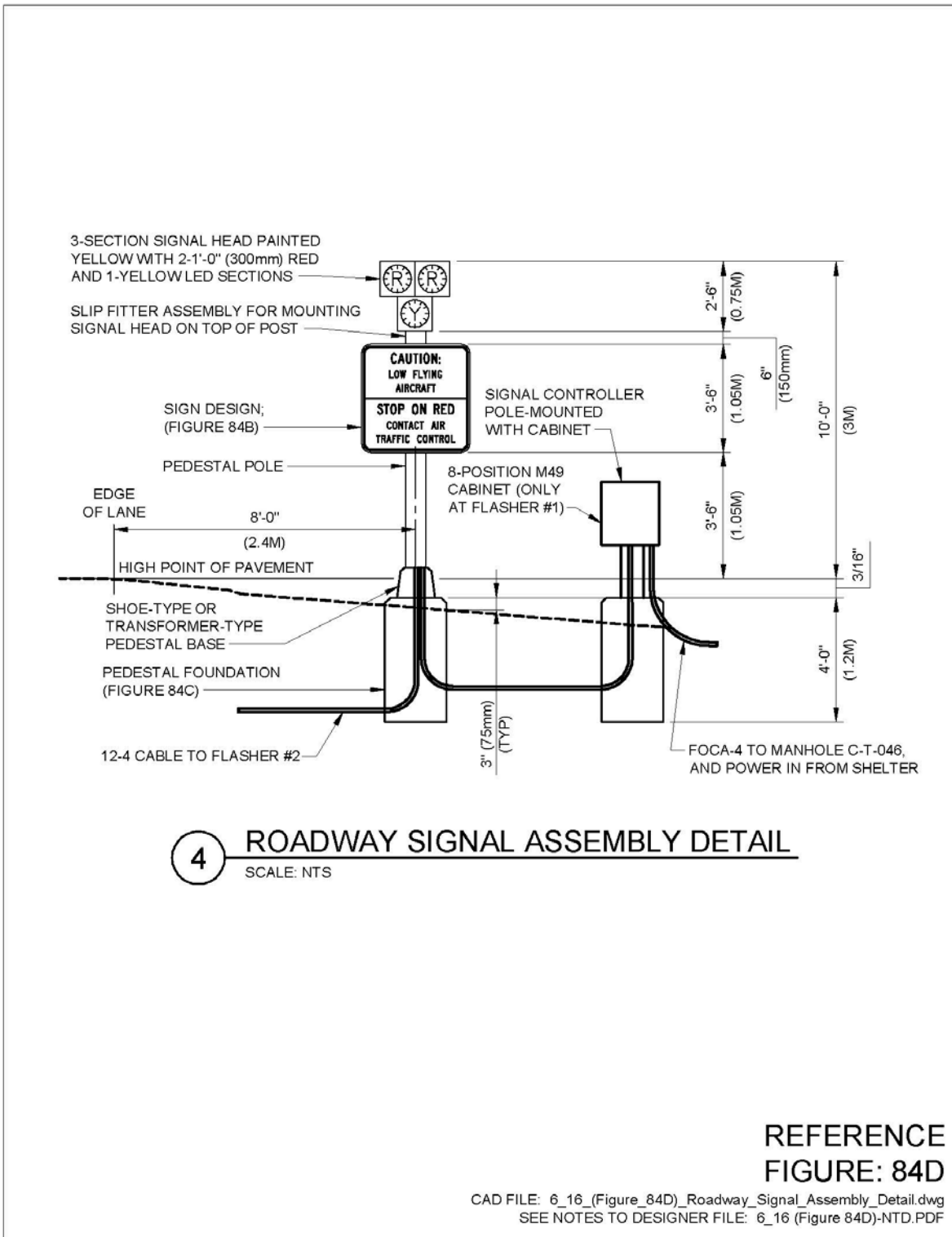


3 PEDESTAL FOUNDATION IN EARTH
SCALE: NTS

REFERENCE
FIGURE: 84C

CAD FILE: 6_16_(Figure_84C)_Pedestal_Foundation_Details.dwg
SEE NOTES TO DESIGNER FILE: 6_16 (Figure 84C)-NTD.PDF

Figure 84D. Roadway Signal Assembly Detail



CHAPTER 8 Helicopter Pad Systems

8-1 Helipad Perimeter Lighting.

8-1.1 Figure 85.

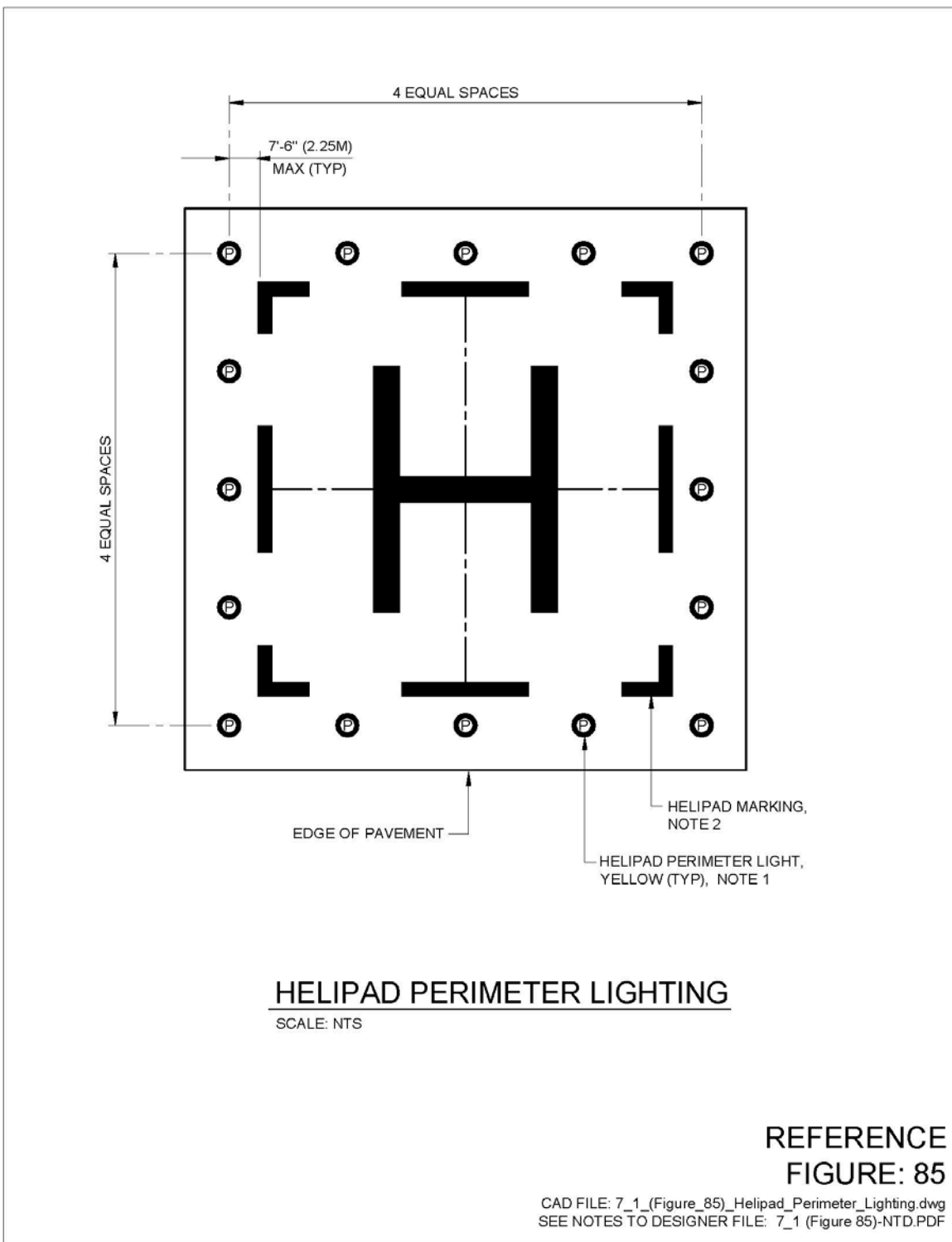
8-1.1.1 Notes to Designer.

1. The standard elevated fixture is an FAA type L-861 base mounted with 45 watt lamp. The maximum height is 14" (350mm) above grade except in areas where snow accumulations of 12" (300mm) or more are frequent, the mounting height may be increased to 24" (600mm) above grade.
2. In areas that are paved and used by wheeled helicopters or vehicles, in-pavement fixtures are used and are FAA type L-852E base mounted fixtures.
3. The perimeter lights are normally powered from a constant current regulator with a minimum of 3 brightness steps. However, some installations may utilize constant voltage circuits (120/240V) such as helipads on rooftops and/or hospitals.
4. The series circuit cable is FAA type L-824C #8 5 kV for 6.6 amp circuits.
5. See ETL 04-2 for Air Force / Army marking standards and NAVAIR 51-50AAA-2 for Navy marking standards.

8-1.1.2 Drawing Notes for Figure 85.

1. Elevated lights must be base mounted FAA type L-861. In-pavement lights must be base mounted FAA type L-852E.
2. Markings based on 100' (30m) x 100' (30m) helipad. For other pads, markings will appear different.

Figure 85. Helipad Perimeter Lighting



8-2 **Hospital Helipad Perimeter Lighting.**

8-2.1 **Figure 86.**

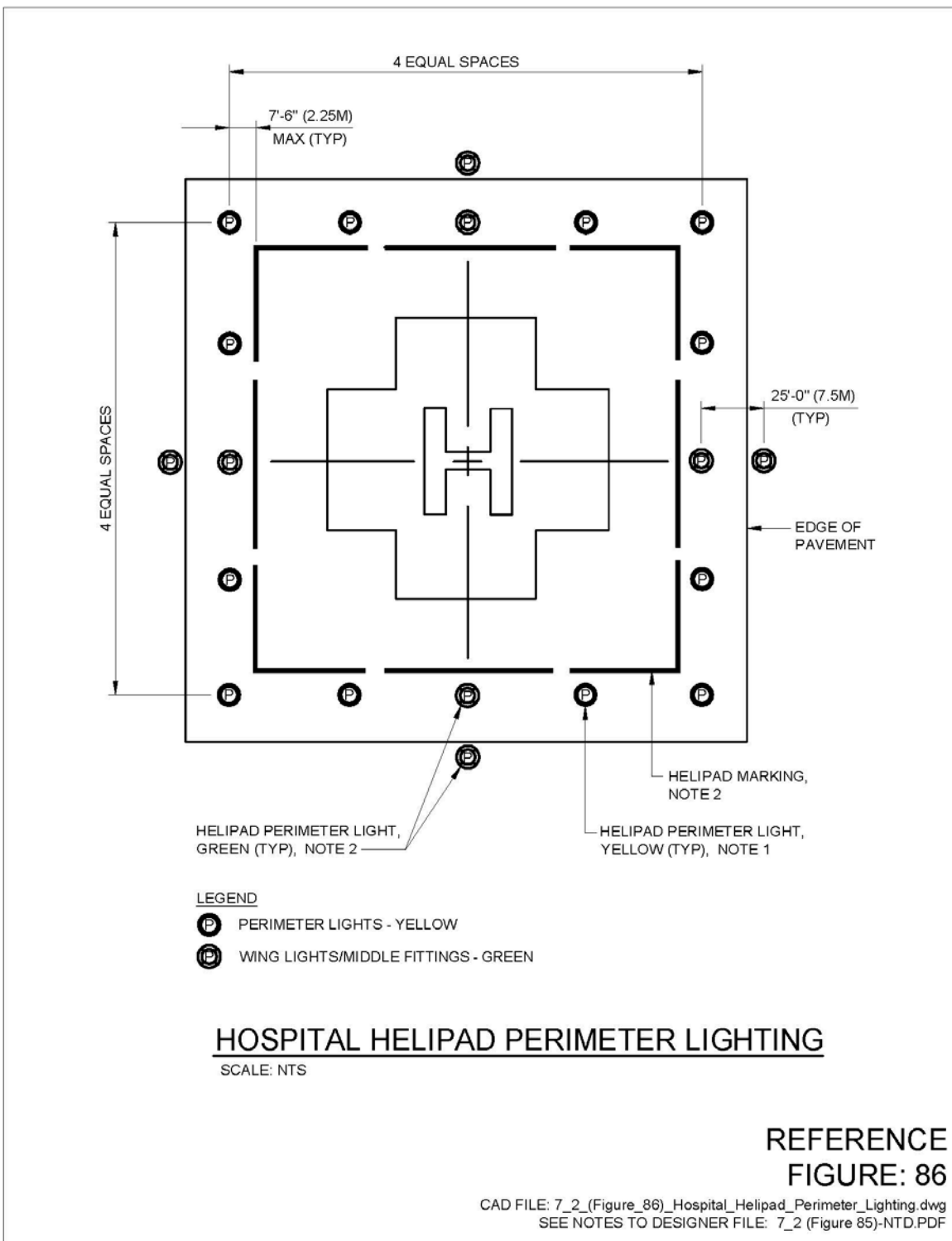
8-2.1.1 **Notes to Designer.**

1. The hospital helipad perimeter light configuration is similar to the standard helipad light configuration except 4 additional lights are added. These lights are located 25' (7.5m) from the middle light on each side of the helipad. These lights and the corresponding middle lights are green. The remaining perimeter lights are yellow.
2. The color of lights for the hospital helipad should be coordinated with the user prior to design.
3. In areas where vehicle traffic will be crossing or accessing the helipad use in-pavement fixtures.
4. See ETL 04-2 for Air Force / Army marking standards and NAVAIR 51-50AAA-2 for Navy marking standards.

8-2.1.2 **Drawing Notes for Figure 86.**

1. Elevated lights must be base mounted FAA type L-861. In-pavement lights must be base mounted FAA TYPE L-852E.
2. Markings based on 100' (30 m) x 100' (30 m) helipad. For other pads, markings will appear different.

Figure 86. Hospital Helipad Perimeter Lighting



8-3 **Helipad Landing Direction Lights.**

8-3.1 **Figure 87.**

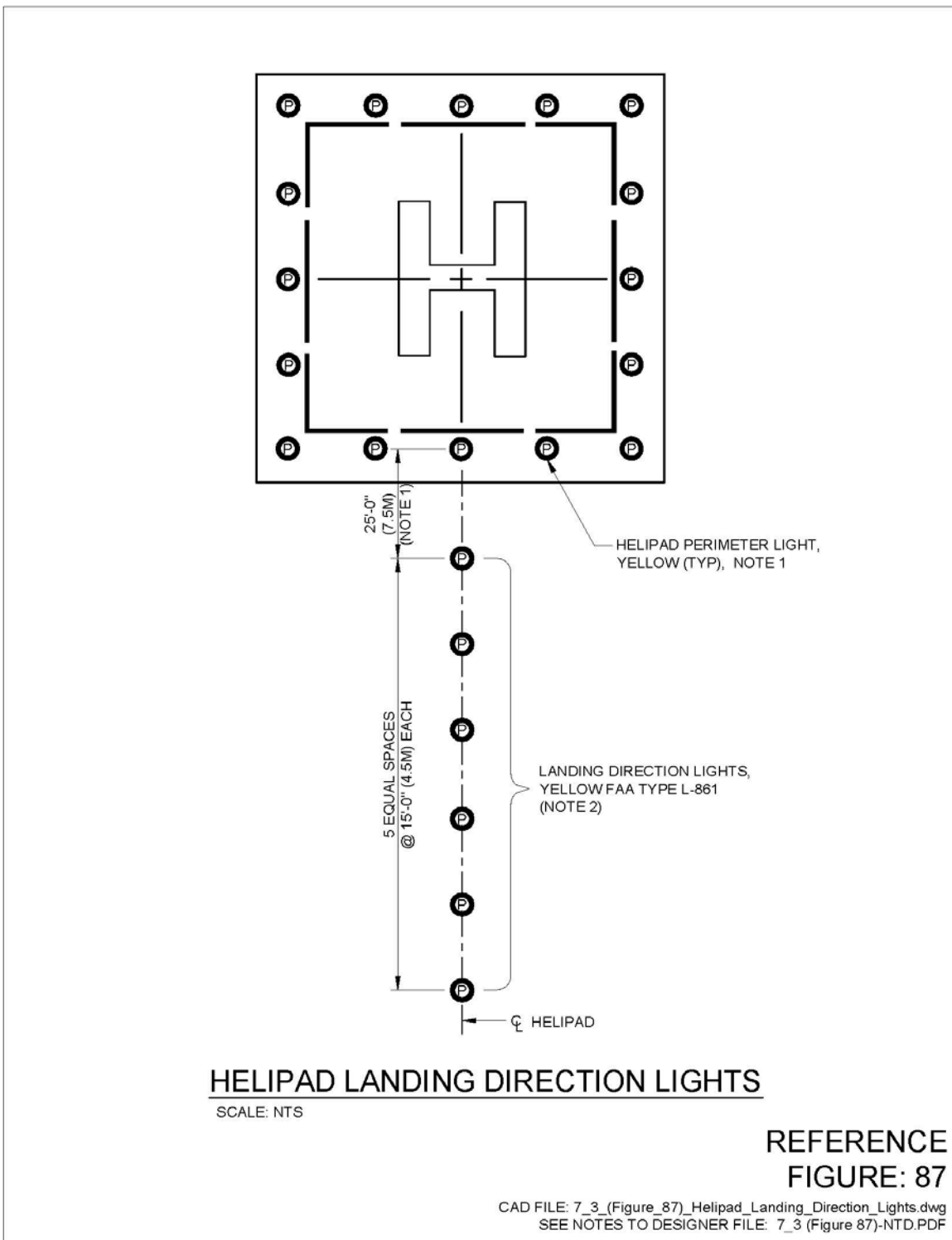
8-3.1.1 **Notes to Designer.**

1. The landing direction lights may be powered from the regulator feeding the perimeter lights. The circuit may be separated by using an FAA type L-847 circuit selector switch, thereby allowing the direction lights to be switched off independently. The landing lights may not be switched on unless the perimeter lights are on.

8-3.1.2 **Drawing Notes for Figure 87.**

1. Landing direction light configuration for hospital helipad must start 25' (7.5m) from the outer perimeter light.
2. In-pavement fixtures must be used in areas of vehicle traffic and must be FAA type L-852E.

Figure 87. Helipad Landing Direction Lights



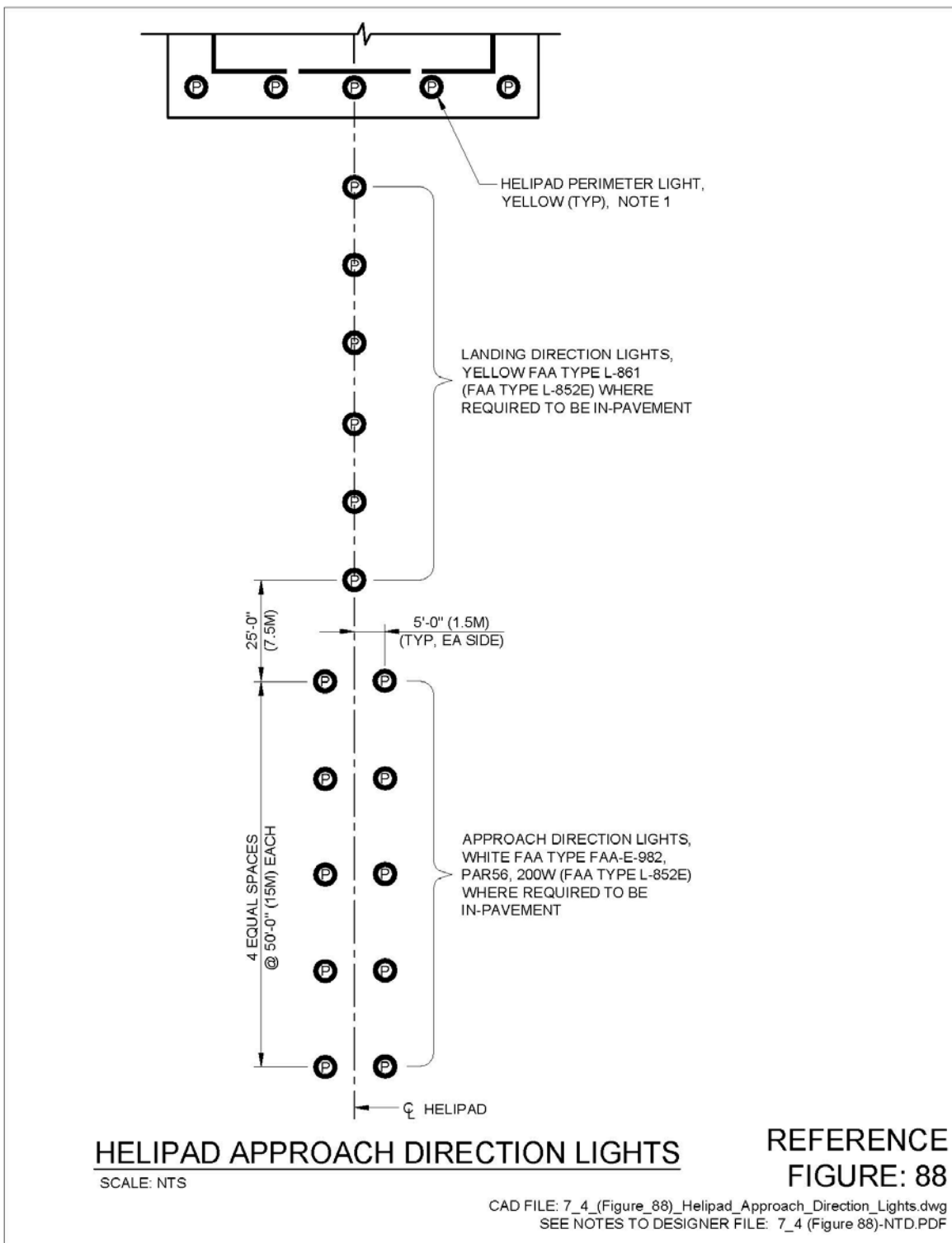
8-4 Helipad Approach Direction Lights.

8-4.1 Figure 88.

8-4.1.1 Notes to Designer.

1. The approach direction lights may be powered from the regulator feeding the perimeter and landing direction lights. The circuits may be separated by using an FAA type L-847 circuit selector switch, thereby allowing the approach direction lights to be switched off independently. The approach direction lights may not be switched on unless the perimeter and landing direction lights are on.

Figure 88. Helipad Approach Direction Lights



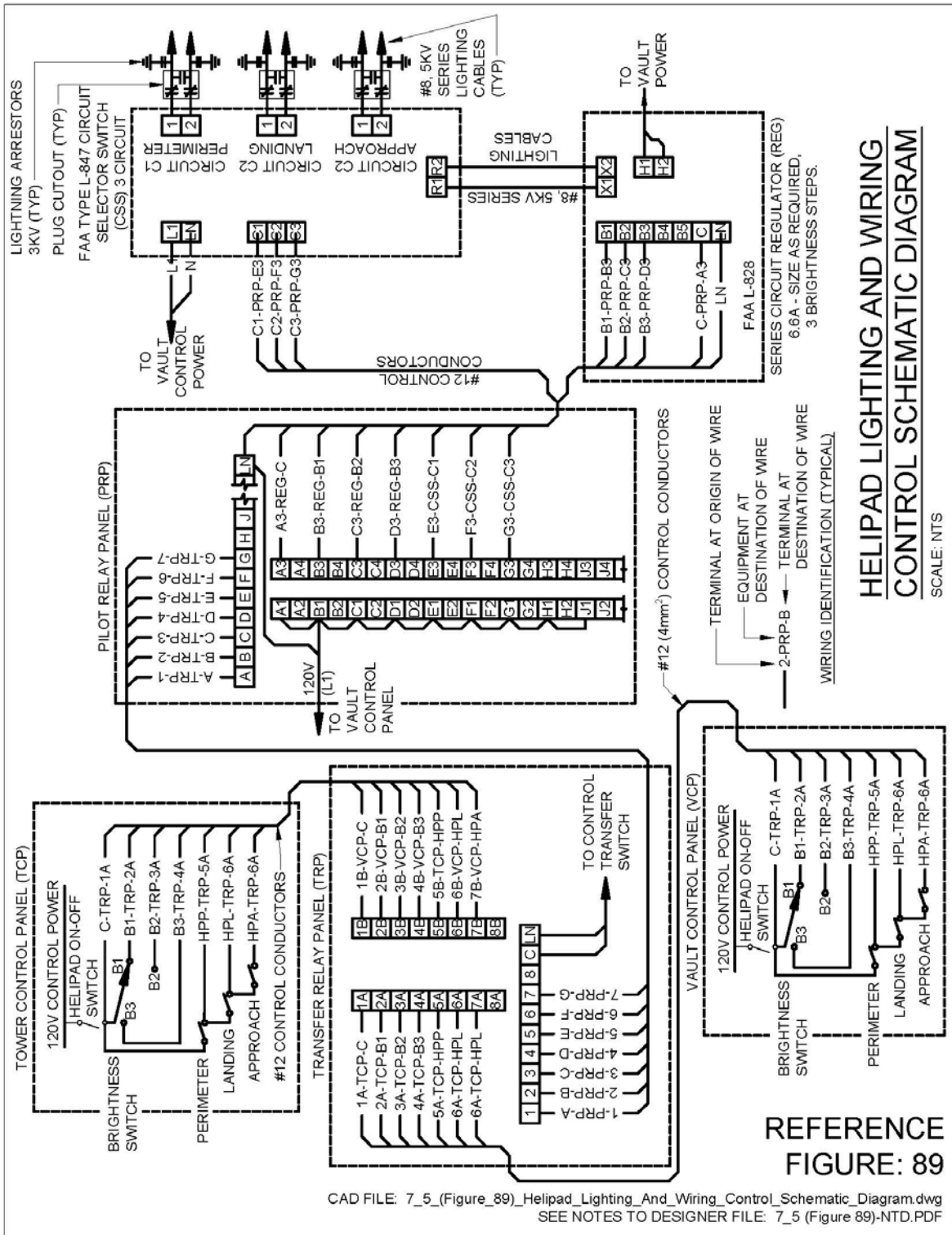
8-5 **Helipad Lighting Wiring and Control Diagram.**

8-5.1 **Figure 89.**

8-5.1.1 **Notes to Designer.**

1. Figure 89 shows a typical control diagram at a facility with an airfield lighting vault and control tower. A single constant current regulator with 3 brightness steps is used to power the system.
2. The helipad lights are separated into 3 circuits: C1 – perimeter, C2 – landing direction, and C3 – approach direction. Each circuit is operated by a SPST toggle switch that energizes the corresponding loop relay in the L-847 circuit selector switch. The 3 switches are connected such that the landing direction lights cannot be on unless the perimeter lights are on and the approach direction lights cannot be on unless the landing direction lights are on.
3. In some installations 120/240V is used to power the circuits in lieu of constant current regulators. In these cases separate branch circuits are used together with lighting contactors and interlock switches.

Figure 89. Helipad Lighting Wiring and Control Schematic Diagram



CHAPTER 9 Naval Facilities Specific Wave-Off & Wheels-Up Lighting Systems

9-1 Location Plans: Wave-Off & Wheels-Up Lighting Systems.

9-1.1 Figure 90.

Notes to Designer.

9-1.1.1 Wave-off Lighting System.

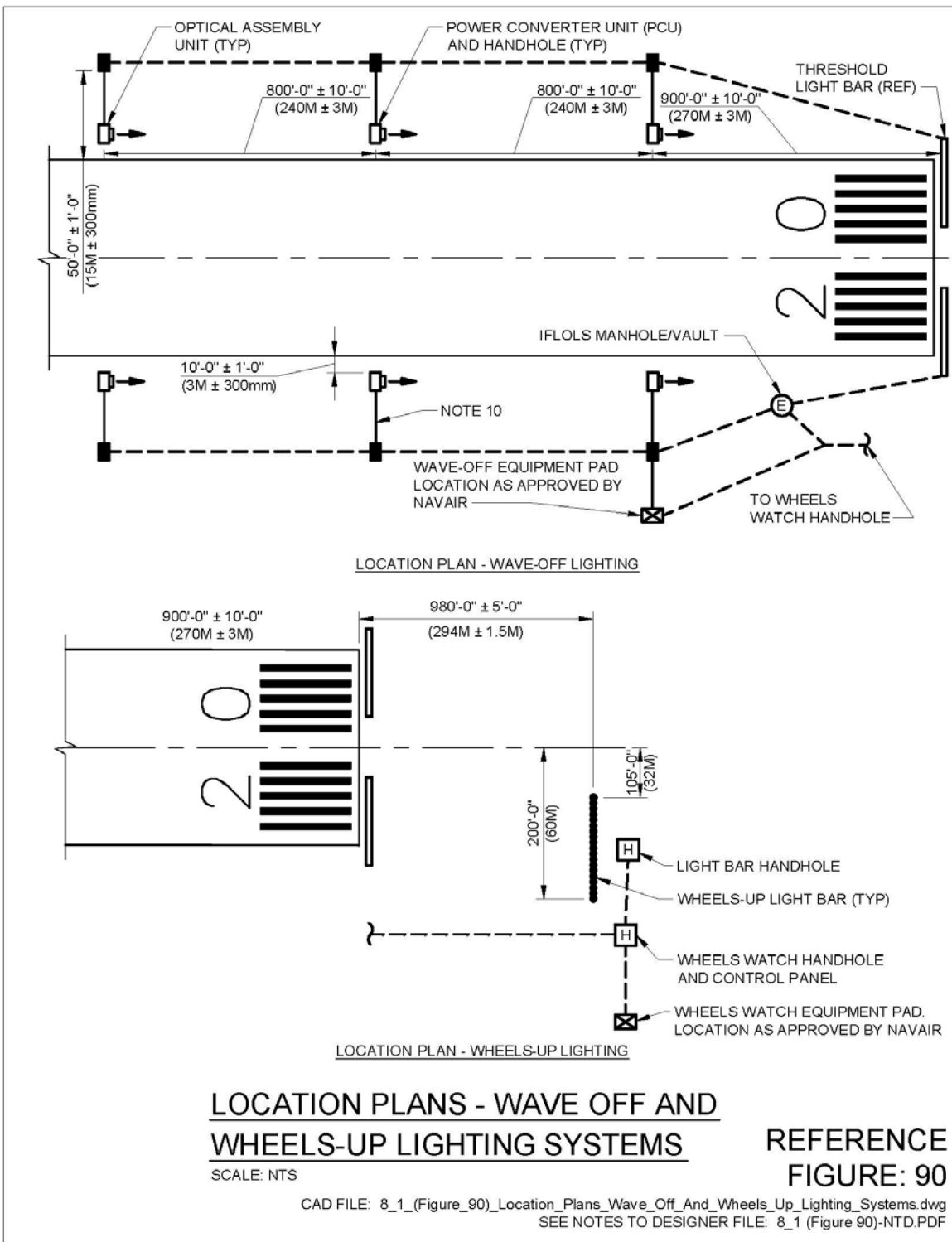
1. Description. The runway wave-off light system consists of sets of simultaneously flashing red lights installed adjacent to the runway which are aimed toward the threshold. They are intended to inform the pilot that an emergency wave-off or missed approach procedure is necessary. The runway wave-off must be activated from either the control tower, airfield lighting vault, or the wheels-watch station.
2. Power Requirements. Power for the wave-off power converter unit (PCU) must be from a 480 volt source. A single 10 kVA minimum 2400/480V pad mount (weatherproof) transformer may supply the power for the wave-off lights via the PCU.
3. Control Requirements. The wave-off lights must be controlled manually using momentary-contact type switches. The switches must be located only at the control tower, airfield lighting vault, and the wheels-watch station.
4. Control relay must be general purpose, hermetically sealed, 4pdt, 3 amp contacts with 120vac, 60hz coil.
5. Time delay relay must have 10 amp, 120vac contacts with 120vac 60hz coil relay must have one normally-open instantaneous contacts and one normally-closed time delay opening contact adjustable from 5 to 60 second delay on energizing but initially set for 15 seconds delay.
6. Contactor must have two normally-open 30 amp, 480vac contacts with 120vac, 60hz coil.
7. Wave-off pushbuttons must be normally-open momentary contacts. Locate pushbuttons within control tower as directed by the air traffic control officer.
8. If possible use spare conductors in the control tower that runs between the airfield lighting vault and the control panel within the control tower.

9. If available use spare pilot and transfer relays within the airfield lighting vault.
10. Provide 2 - 2" (53mm) conduits (1 - spare) between power converter units (PCU). Also provide 2 - 2" (53mm) conduits (1 - spare) between PCU and threshold.
11. Provide 1 - 2" (53mm) conduit between PCUs and optical assembly units.

9-1.1.2 Wheels-up Lighting System.

1. Description. Wheels-up lights are a bar of white lights installed under the approach which are aimed upward and toward the threshold. They are intended to illuminate the underside of landing aircraft to permit observers to determine that the landing gear is fully lowered. The system also includes a portable government furnished wheels-watch shelter which protects the observer from the weather and a wheels-watch control panel.
2. Power Requirements. Wheels-up lights are connected to 120 Vac multiple circuits requiring somewhat in excess of 10kW. A 15 kVA pad mount transformer (weatherproof) is recommended.
3. Control Requirements. Wheels-up lights require on/off control and continuous intensity control from 10 to 100 percent of intensity at the rated voltage. This control is required only at the wheels-watch control panel.
4. The wheels-watch control panel also contains a switch which is activated by the observer that energizes the wave-off lighting system.

Figure 90. Location Plans – Wave-Off & Wheels-Up Lighting Systems



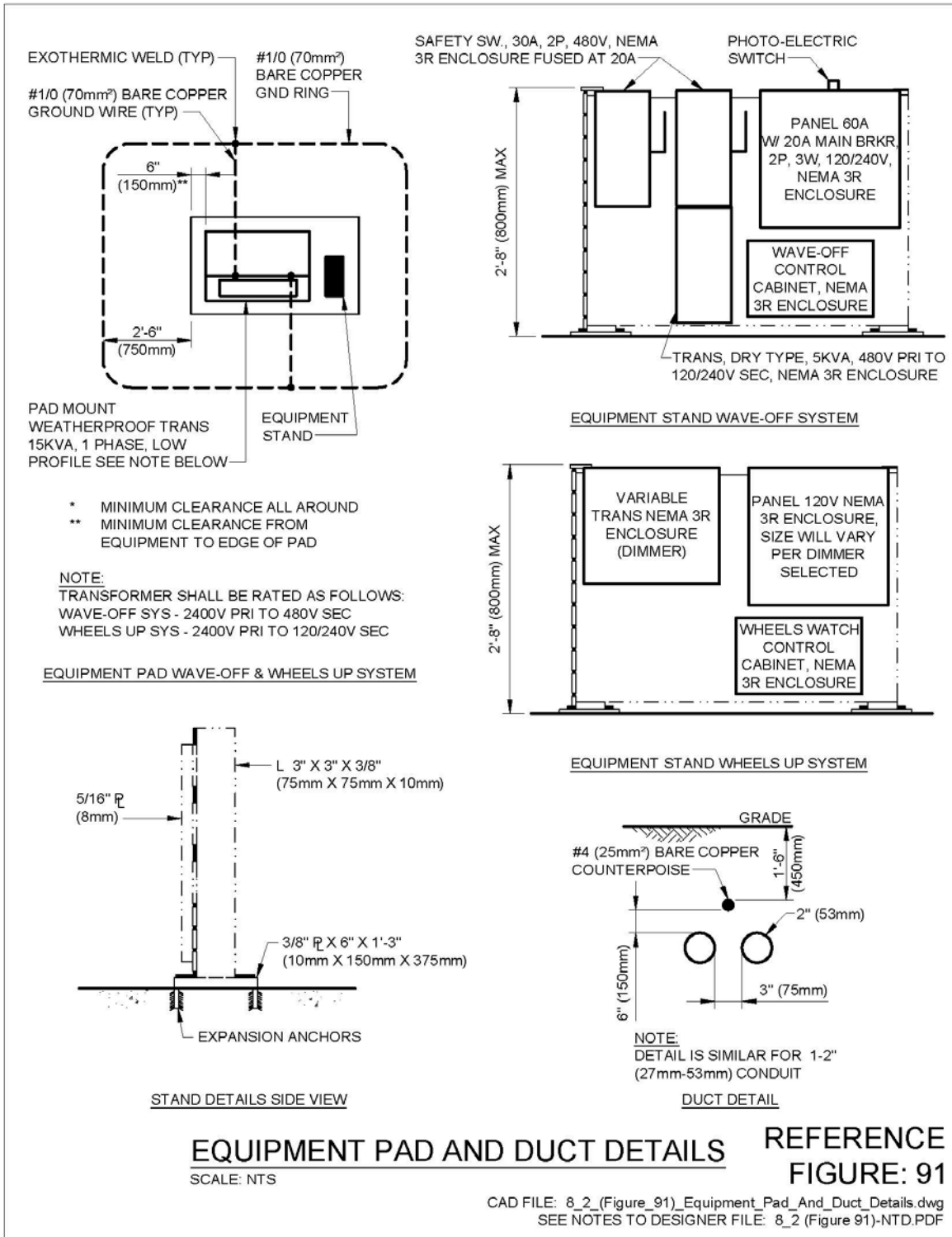
9-2 Equipment Pad and Duct Details.

9-2.1 Figure 91.

9-2.1.1 Notes to Designer.

1. The equipment stands for the wave-off and wheels-up lighting systems are freestanding and a maximum of 32" (800mm) above grade.
2. The equipment is rated NEMA 3R (weatherproof). In some areas where corrosion may be a problem (i.e. salt, sand, etc.); the use of NEMA 4X rated equipment may be justified.
3. The equipment pads should be located as close as possible to the lighting system (first power converter unit (PCU) of wave-off system and wheels-watch control panel) to limit the voltage drop to the system components. However, NAVFAC ENCOM should be consulted before placement within the runway safety area or object free zone.

Figure 91. Equipment Pad and Duct Details



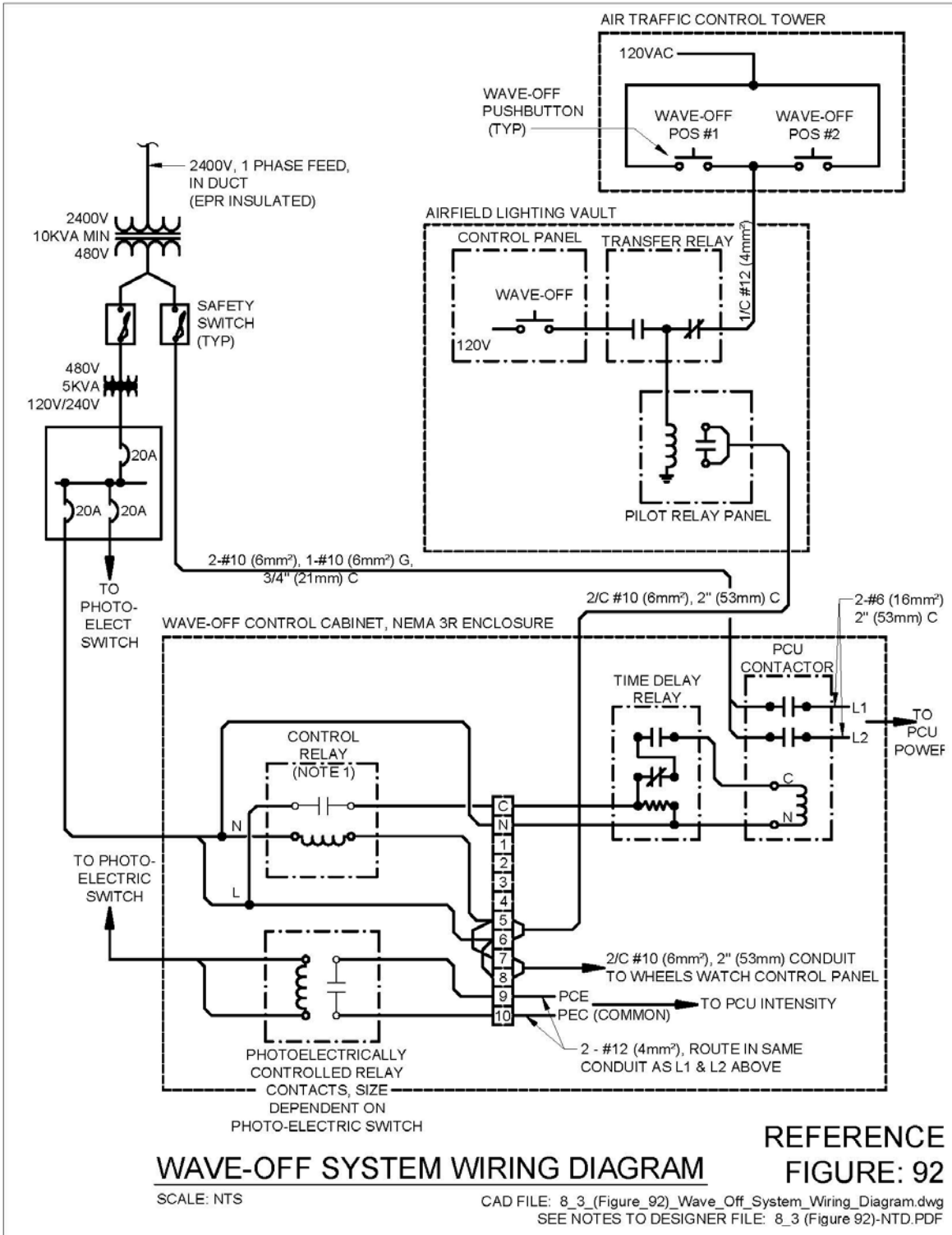
9-3 **Wave-Off System Wiring Details.**

9-3.1 **Figure 92.**

9-3.1.1 **Notes to Designer.**

1. The wave-off system may be activated by the air traffic controller in the control tower or by personnel in the airfield lighting vault via the transfer relay.
2. The system may also be activated by the observer at the wheels watch control panel.
3. The photoelectric switch controls the intensity of the wave-off system. The system operates at maximum intensity during daytime hours and reduced intensity during hours of darkness.

Figure 92. Wave-Off System Wiring Details



9-4 **Flashhead and PCU Wiring Diagram.**

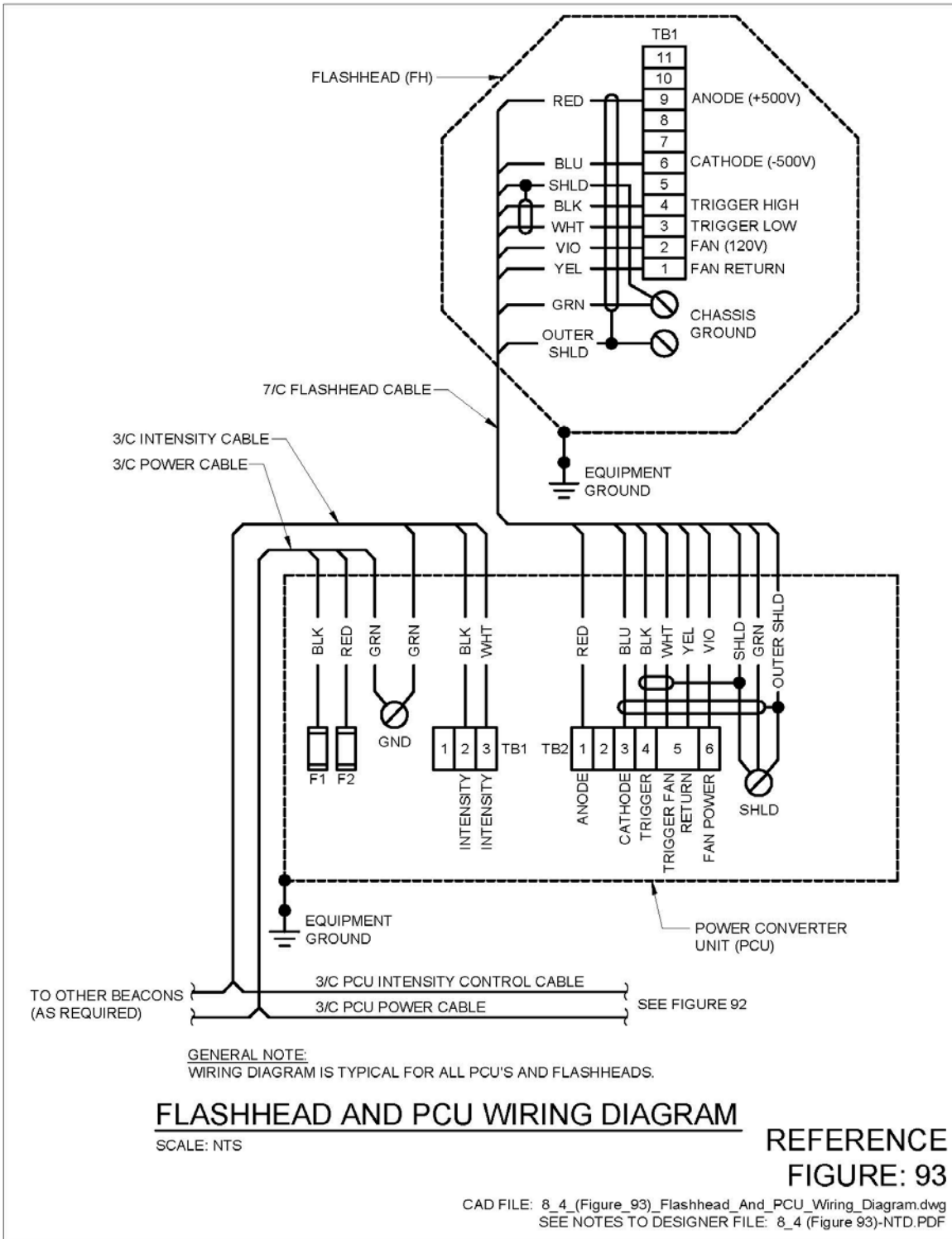
9-4.1 **Figure 93.**

9-4.1.1 **Notes to Designer.**

1. 480 Volts, single phase power is delivered to each power converter unit (PCU) from the PCU contactor located in the wave-off control cabinet.

2. Intensity control to each PCU is routed in the same conduit as the power conductors and originates at the photo-electrically controlled relay in the wave-off control cabinet.

Figure 93. Flashhead and PCU Wiring Diagram



9-5 **Wave-Off Fixture Mounting.**

9-5.1 **Figure 94.**

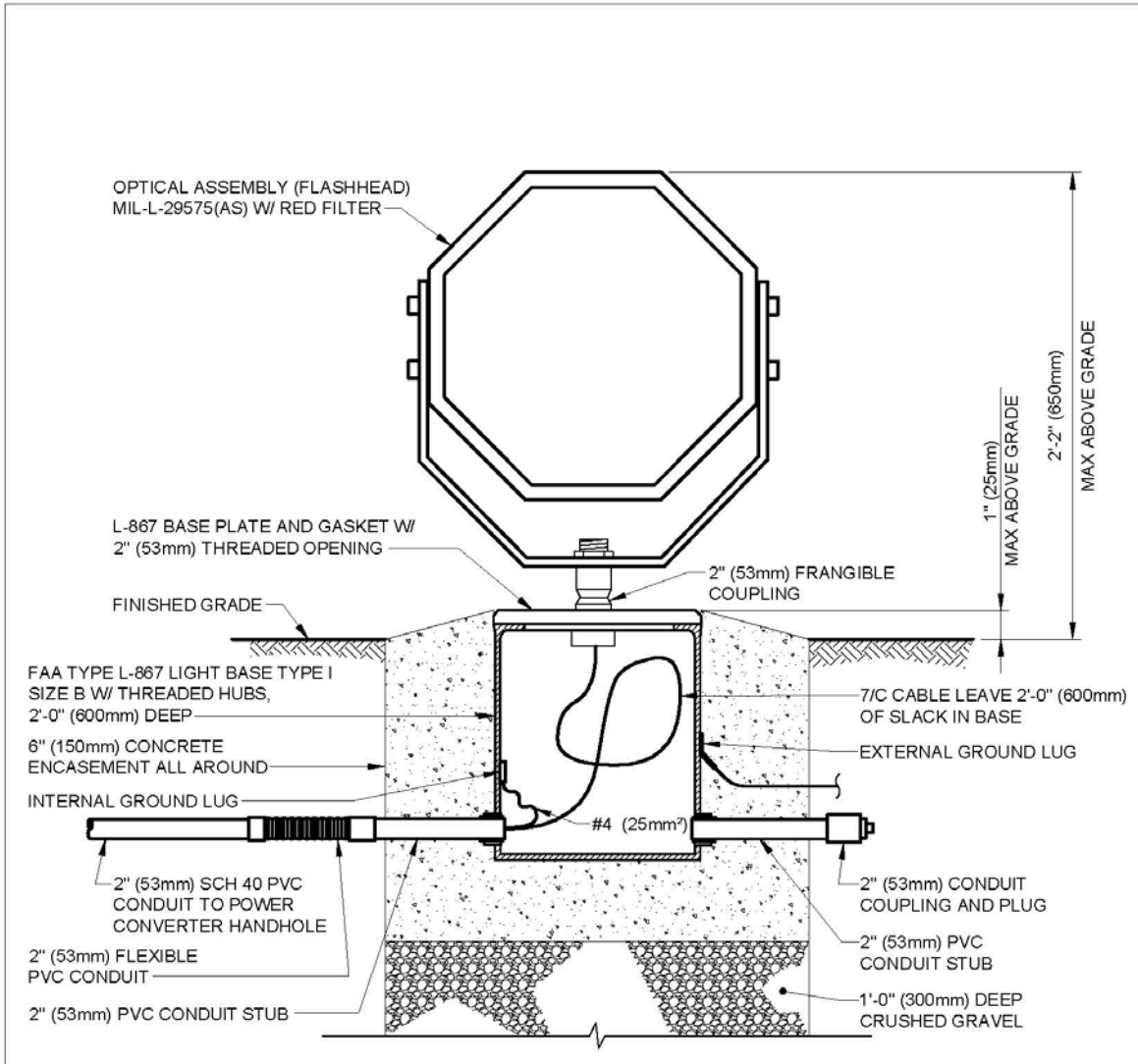
9-5.1.1 **Notes to Designer.**

1. The optical assembly (flash head) is mounted on an FAA type L-867 concrete encased light base.
2. The flexible non-metallic conduit allows movement in the 2" (53mm) conduit due to freeze-thaw cycles in frost susceptible areas.

9-5.1.2 **Drawing Notes for Figure 94.**

1. Reinforcing cage indicated on Figure 12.

Figure 94. Wave-Off Fixture Mounting



WAVE-OFF FIXTURE MOUNTING

SCALE: NTS

**REFERENCE
FIGURE: 94**

CAD FILE: 8_5_(Figure_94)_Wave_Off_Fixture_Mounting.dwg
SEE NOTES TO DESIGNER FILE: 8_5 (Figure 94)-NTD.DOC

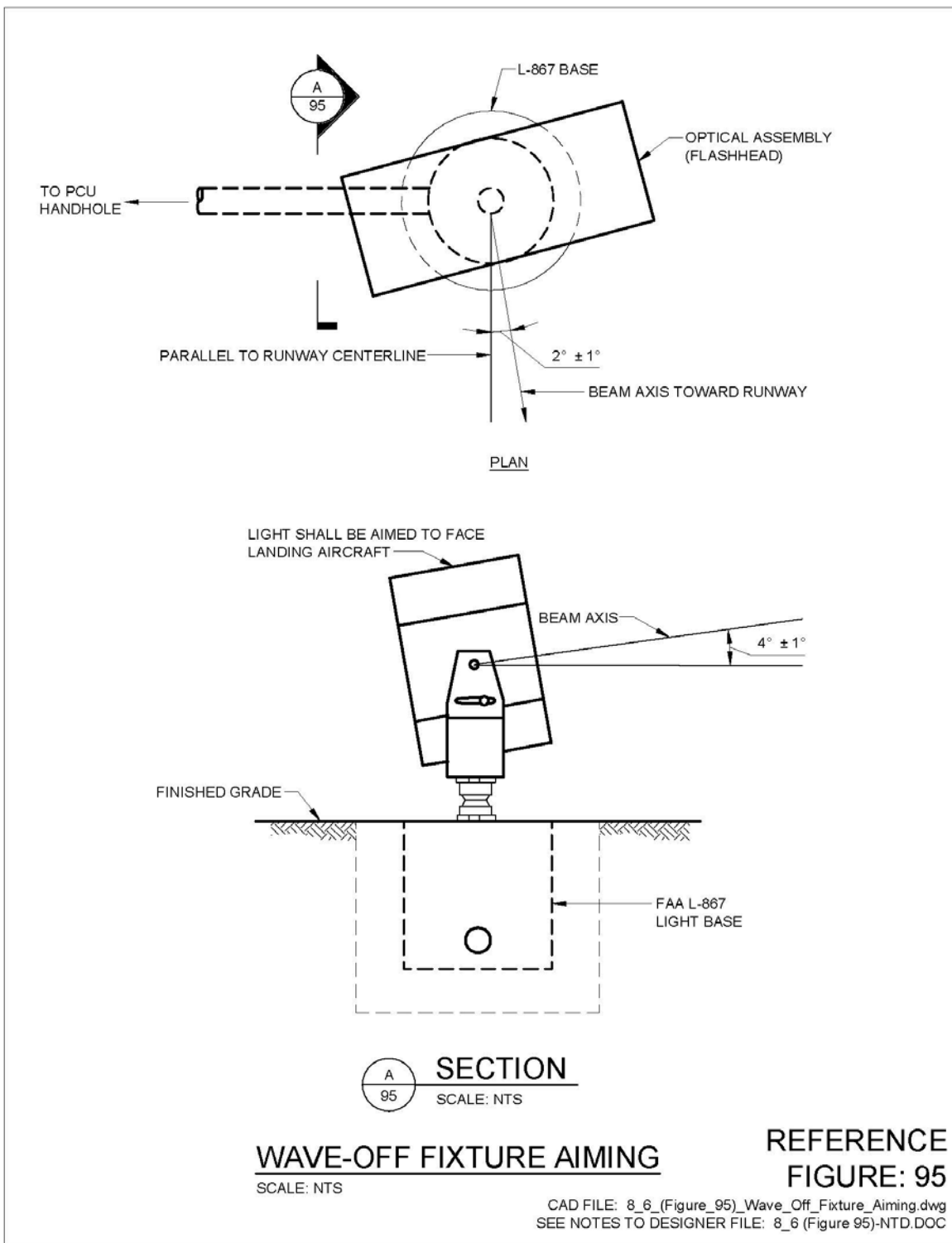
9-6 **Wave-Off Fixture Aiming.**

9-6.1 **Figure 95.**

9-6.1.1 **Notes to Designer.**

1. The wave-off fixture is aimed towards the landing aircraft as indicated.
2. Construction document should include the aiming requirements.

Figure 95. Wave-Off Fixture Aiming



9-7 **Power Converter Unit.**

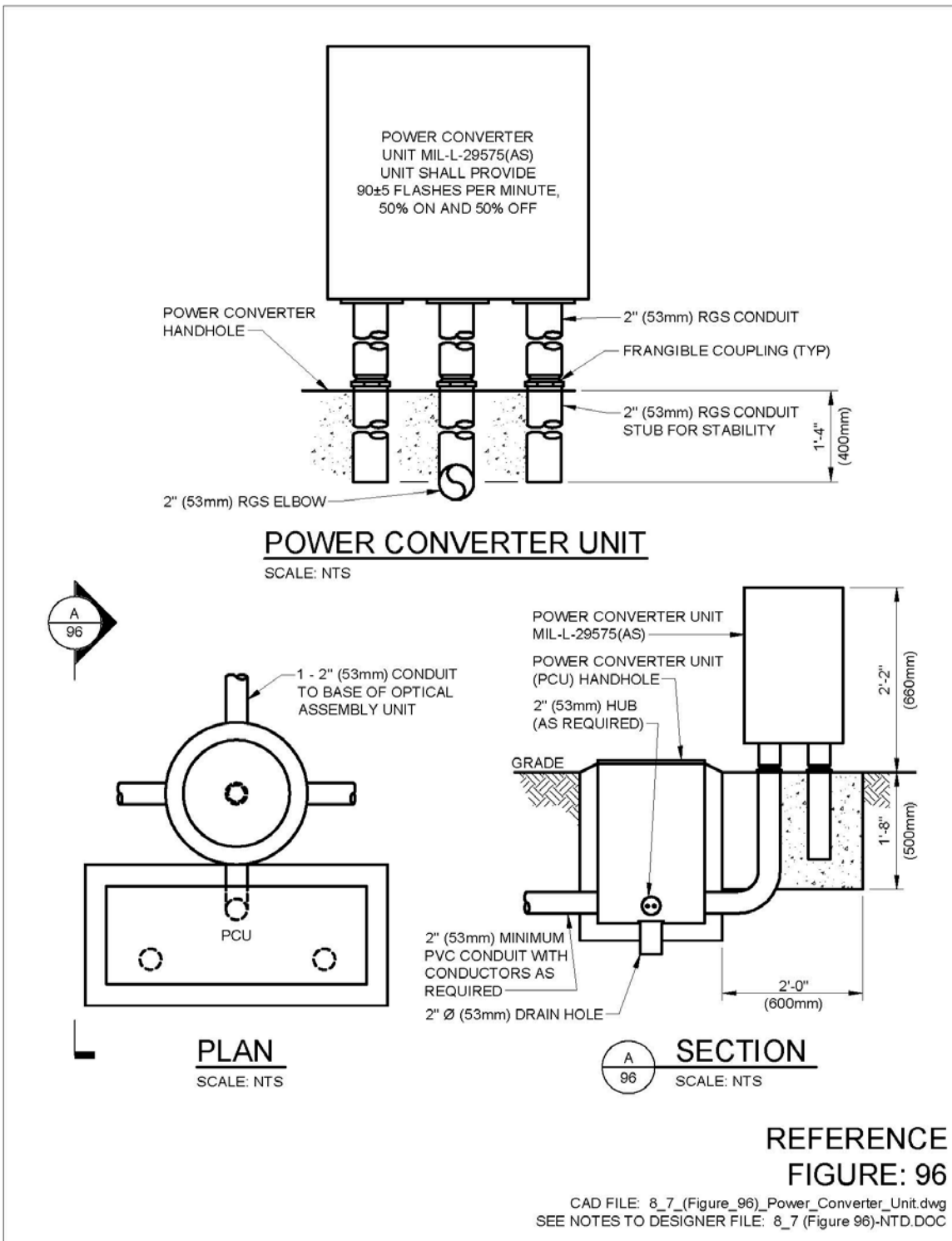
9-7.1 **Figure 96.**

9-7.1.1 **Notes to Designer.**

1. Use an FAA type L-867 Size D (16" Ø) light base concrete encased. Conduit openings are 2" thread hubs and must be specified ((2) 2" (53mm) one above the other at 0 degrees and 180 degrees, (1) 2" (53mm) at 90 degrees and 270 degrees).

2. Install 6" (150mm) long flexible non-metallic conduit (not indicated) on each conduit after leaving handhole.

Figure 96. Power Converter Unit



9-8 **Wheels-Up Lighting System Layout.**

Figure 97. Reserved

Figure 98. Reserved.

9-8.1 **Figure 99.**

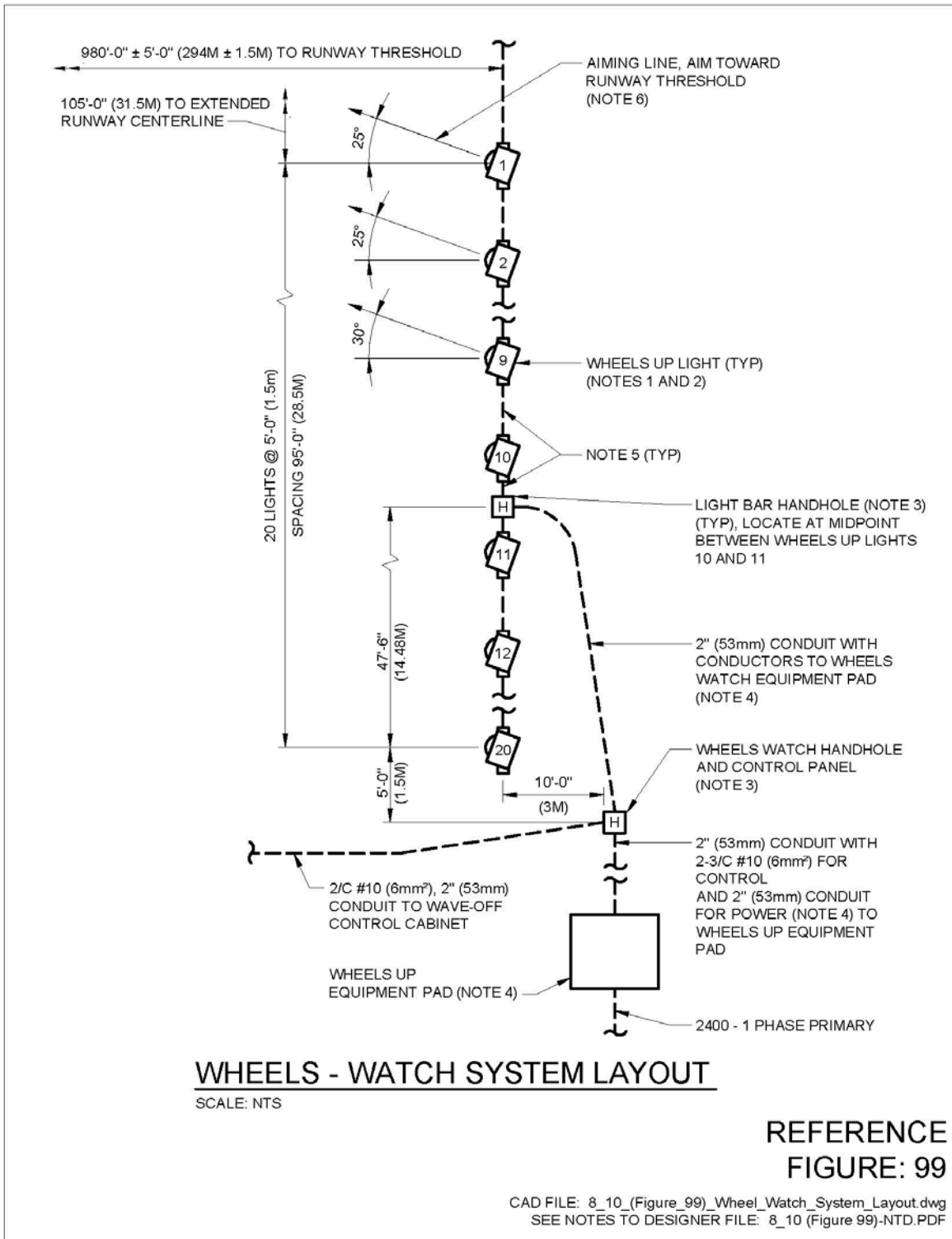
9-8.1.1 **Notes to Designer.**

1. The wheels-up lights are located and aimed as indicated.
2. Coordinate with NAVAIR on location of the equipment pad. Design for a maximum voltage drop of $\pm 4\%$ total from the equipment pad to the farthest fixture in the system. #6 (16 square mm) must be the minimum wire size.

9-8.1.2 **Drawing Notes for Figure 99.**

1. Wheels up light bar must be located on same side of runway as the control tower.
2. Relocation or re-aiming of light bar requires approval of NAVFACENGCOM.
3. Provide L-867D handhole per Figure 31.
4. Conductor size between light bar handhole and wheels up equipment pad must be determined once location of equipment pad is approved by NAVAIR. The total voltage drop for the wheels-up lighting circuit must be maintained to $\pm 4\%$ or less.
5. Conductor size between light bar handhole and wheels-up lights must be 2 #6 (16 square mm), 1 #6 (16 square mm) ground in 2" (53mm) conduit.
6. The three (3) inner most lights are aimed toward the runway at an angle of 25 degrees.

Figure 99. Wheels – Watch System Layout



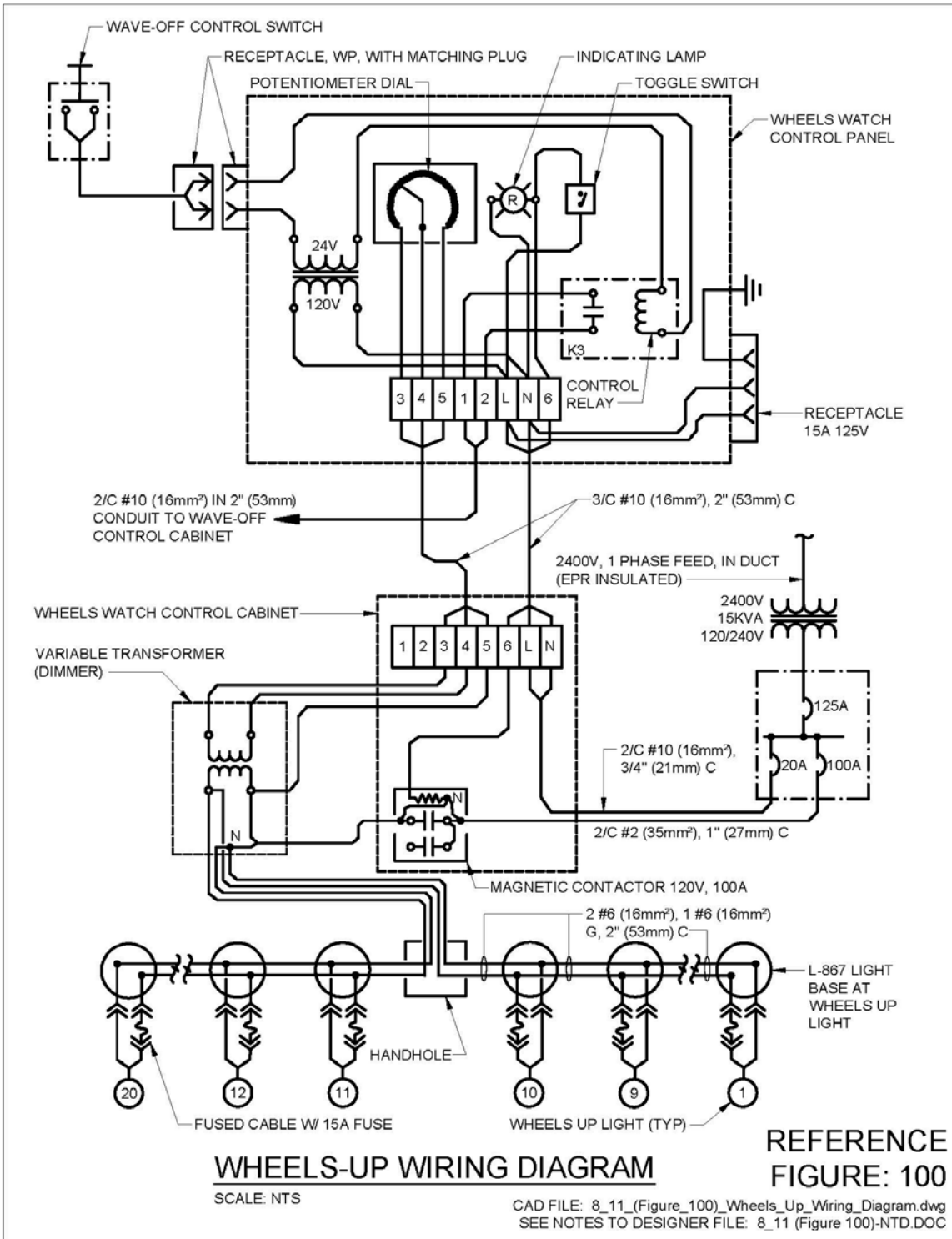
9-9 **Wheels-Up Lighting Wiring Diagram.**

9-9.1 **Figure 100.**

9-9.1.1 **Notes to Designer.**

1. The observer varies the intensity of the lights by the potentiometer located in the control panel.
2. Activation of the wave-off system is accomplished by the wave-off control connected to the control panel by a flexible cord.

Figure 100. Wheels-Up Wiring Diagram



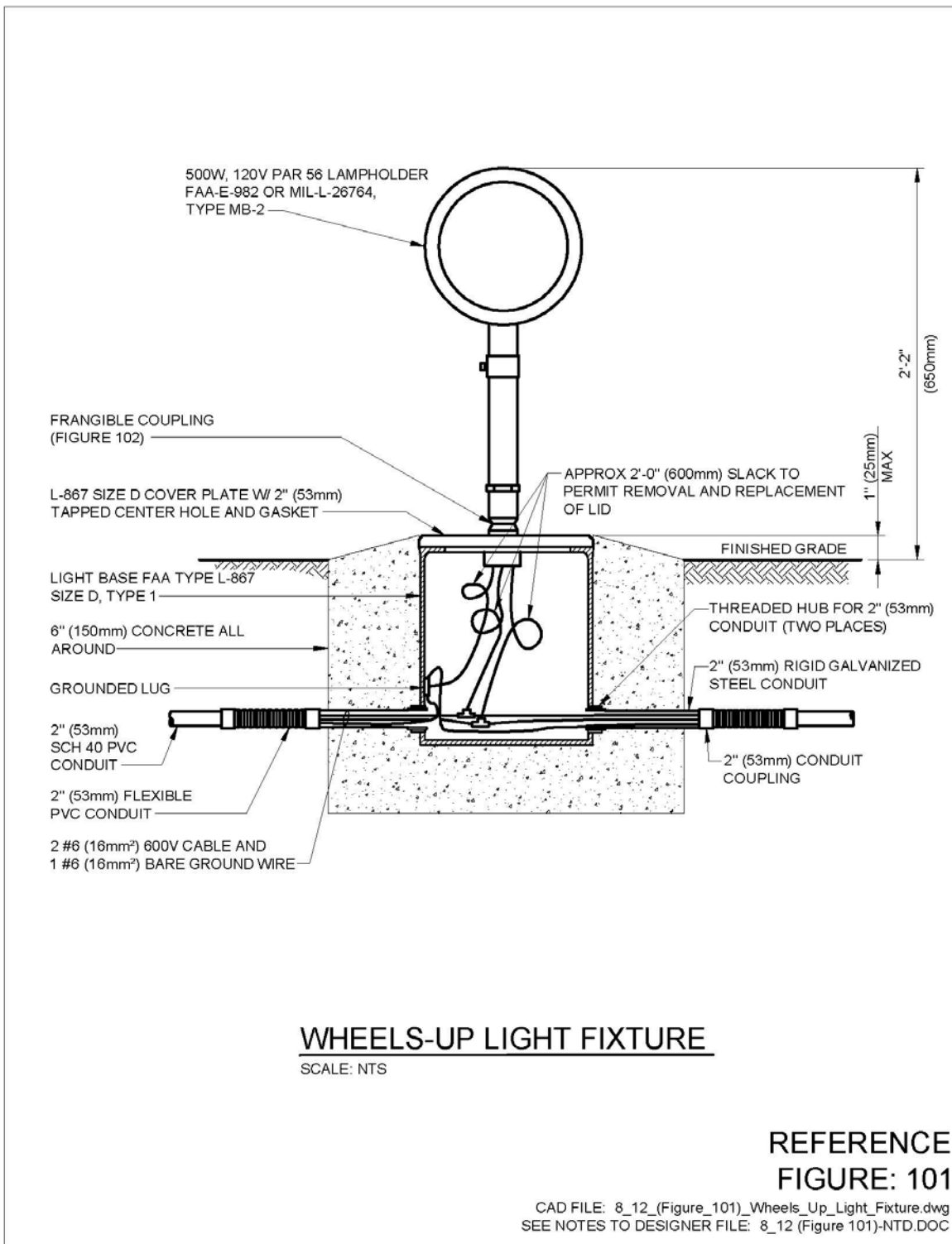
9-10 Wheels-Up Light Fixture.

9-10.1 Figure 101.

9-10.1.1 Notes to Designer.

1. The wheels-up lighting system is a constant voltage system. The lamp shorting device which is part of an FAA-E-982 fixture is not used.
2. The flexible non-metallic conduit allows play in the conduit due to freeze-thaw cycles in areas susceptible to frost penetration or alignment with conduits.

Figure 101. Wheels-Up Light Fixture



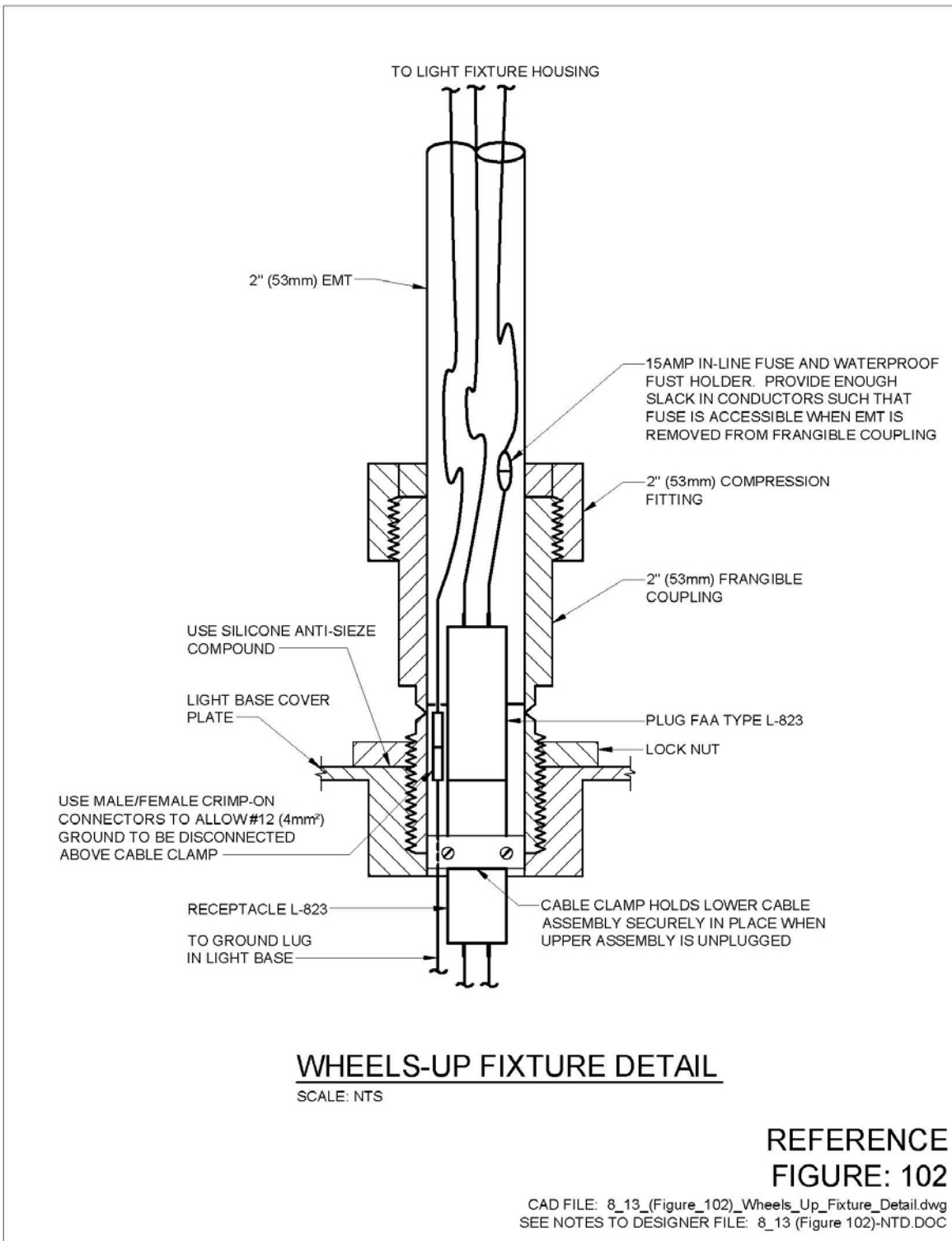
9-11 **Wheels-Up Light Fixture.**

9-11.1 **Figure 102.**

9-11.1.1 **Note to Designer.**

1. The in-line fuse sets inside the EMT conduit. Enough slack should be provided such that the fuse is accessible when the EMT is removed from the frangible coupling.

Figure 102. Wheels-Up Light Fixture



9-12 Wheels-Watch Control Panel.

9-12.1 Figures 103A, 103B.

9-12.1.1 Note to Designer.

1. Use an FAA type L-867 Size D (16" Ø) concrete encase light base with 2" (53mm) threaded hubs for conduit located at 0 degrees, 90 degrees, and 180 degrees.

Figure 103A. Wheels-Watch Control Panel

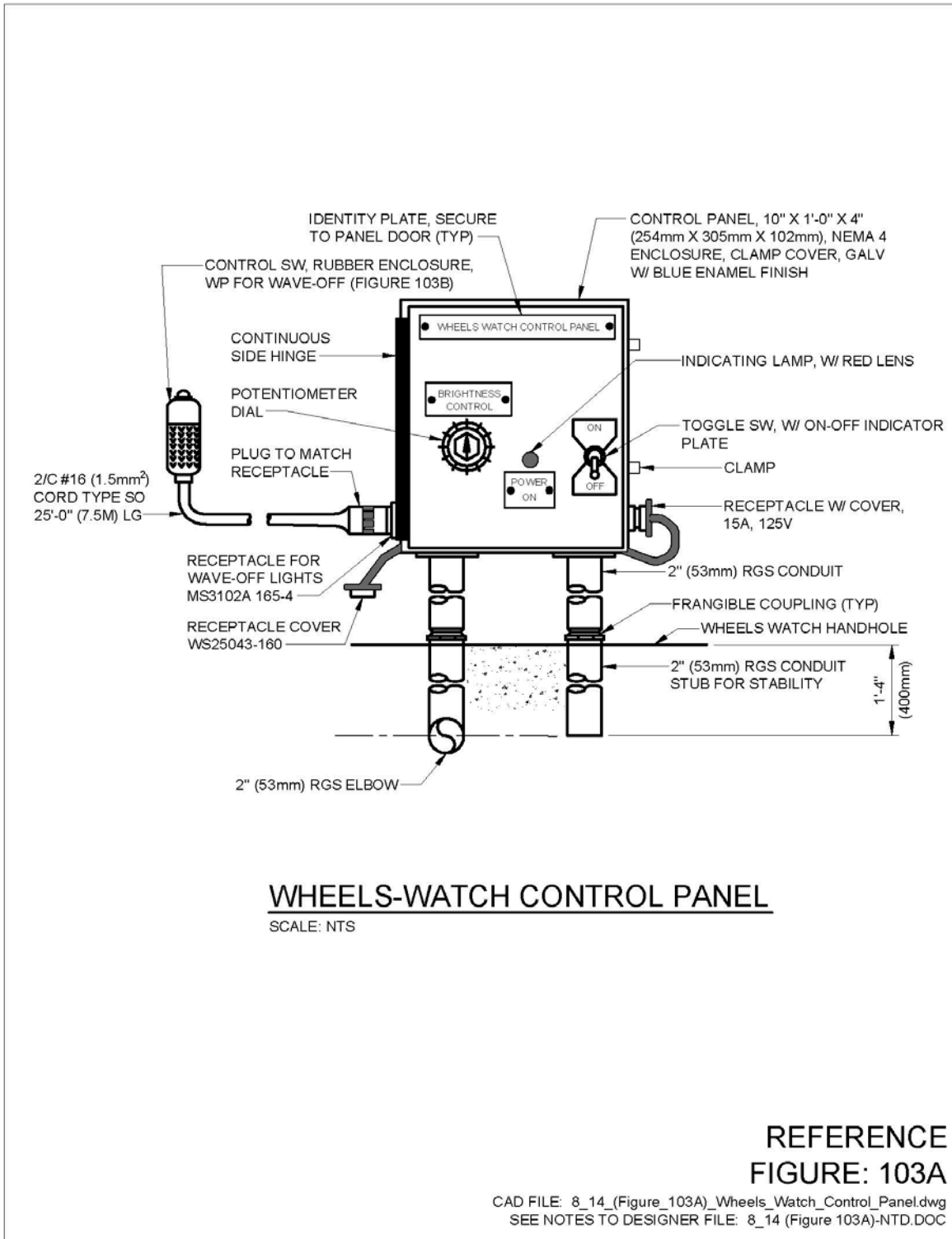
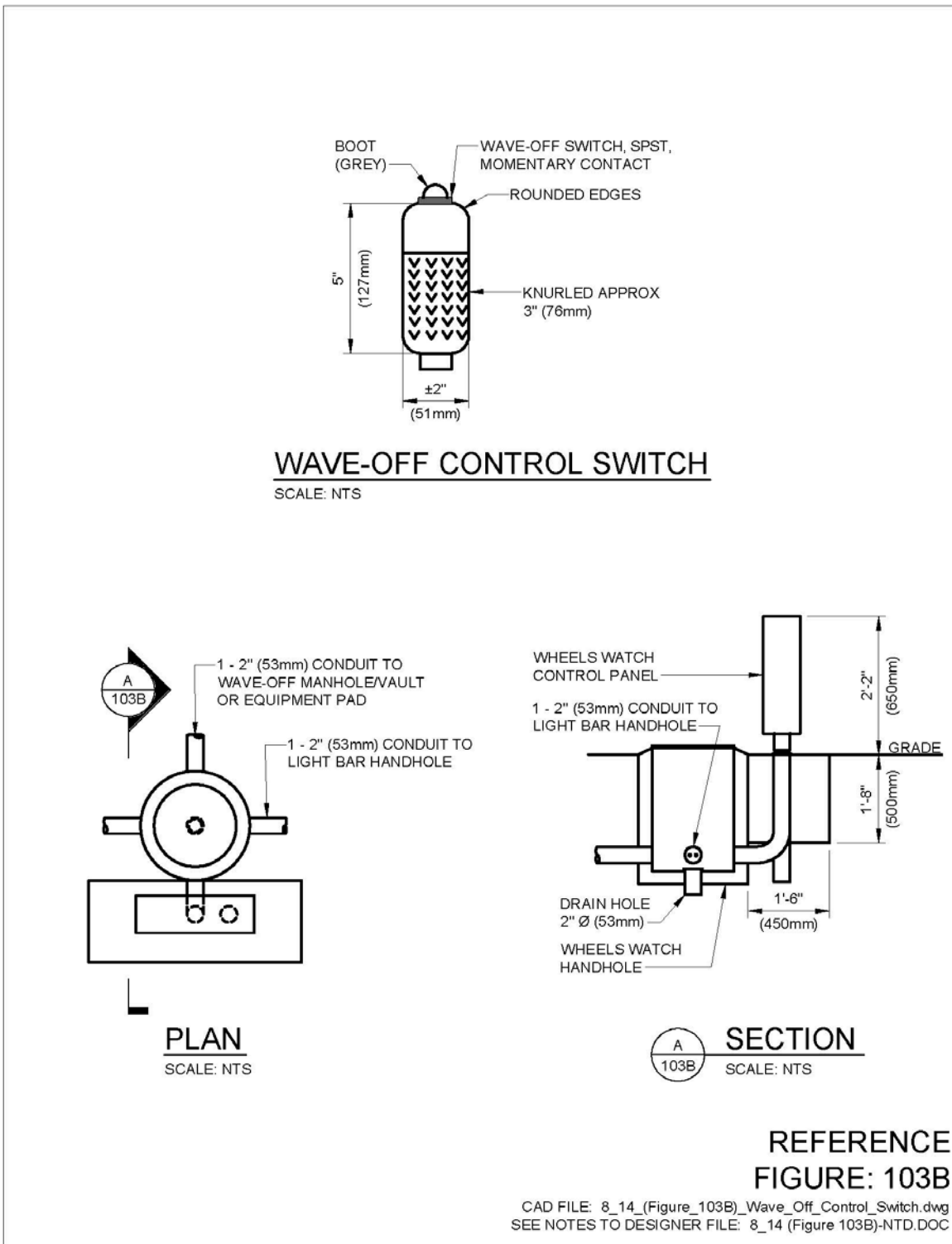


Figure 103B. Wave-Off Control SW



CHAPTER 10 Naval Facilities Specific Simulated Carrier Deck Systems

10-1 Simulated Carrier Deck Lighting System Layout Plan & Wiring Diagram.

10-1.1 Figures 104A, 104B, 104C.

10-1.1.1 Notes to Designer.

1. The simulated carrier deck lighting system is installed on a runway along with the associated carrier deck markings to provide a training and practice environment for carrier deck approaches and landings. The system is controlled by a landing signals officer (LSO) via a portable control panel and control switch. The panel and switch are connected to a submersible terminal box located in the LSO handhole.
2. Siting of simulated carrier deck lighting system must be in accordance with NAVAIR 51-50AAA-2.
3. Designer must lay out simulated carrier deck saw kerfs for minimal crossing of centerline lighting system saw kerfs.
4. All wiring installed in saw kerfs must be single conductor #10 (6 square mm), 600V, type THWN-2.
5. For new runway construction, the entire width of the deck lighting system must be Portland Cement Concrete (PCC). Airfield lighting designer must coordinate installation of FAA L-868 light bases and 2" (53mm) conduit with isolation transformers in each light base.
6. Where simulated carrier deck lighting systems are to be installed in existing runways having a flexible pavement surface, guidance must be received from COMNAVFACENGCOM.
7. Inset light fixtures must be a 45 watt, 6.6 amp, in-pavement, unidirectional inset light per FAA L-852N, type V or VI. Base mounted type must be either type VII or VIII. Fixture must have extra strength stainless steel housing and thickened, hardened top optical casting. Lamps must be provided with a shorting disc to allow operation of other lamps upon single lamp burnout.
8. Distance from runway to handhole varies up to 10 ft (3m) maximum. Designer will minimize offset distance to satisfy field conditions.

9. Marking of runway pavement for simulated carrier deck system must comply with NAVAIR 51-50AAA-2.
10. Lights are aimed parallel with the centerline and toward the runway threshold.
11. Outermost lights on ramp athwartship, and forward athwartship lights must be in line with the carrier deck edge lights; all lights are on 5' (1.5m) spacing.
12. There are 17 centerline lights, 34 edge lights, 12 ramp athwartship lights, and 12 forward athwartship lights.

Figure 104A. Simulated Carrier Deck Lighting System – Layout Plan

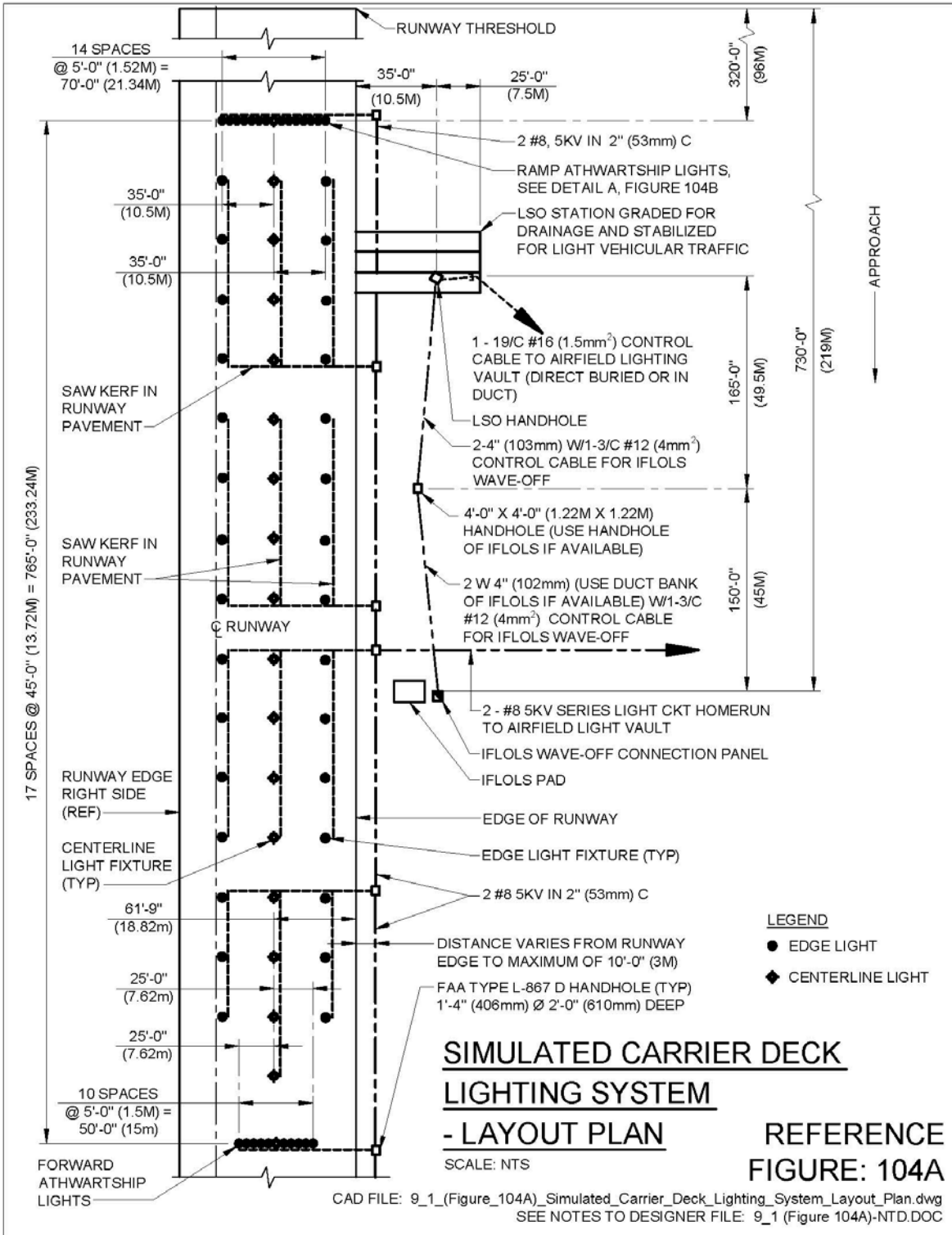


Figure 104B. Simulated Carrier Deck Lighting System – Detail

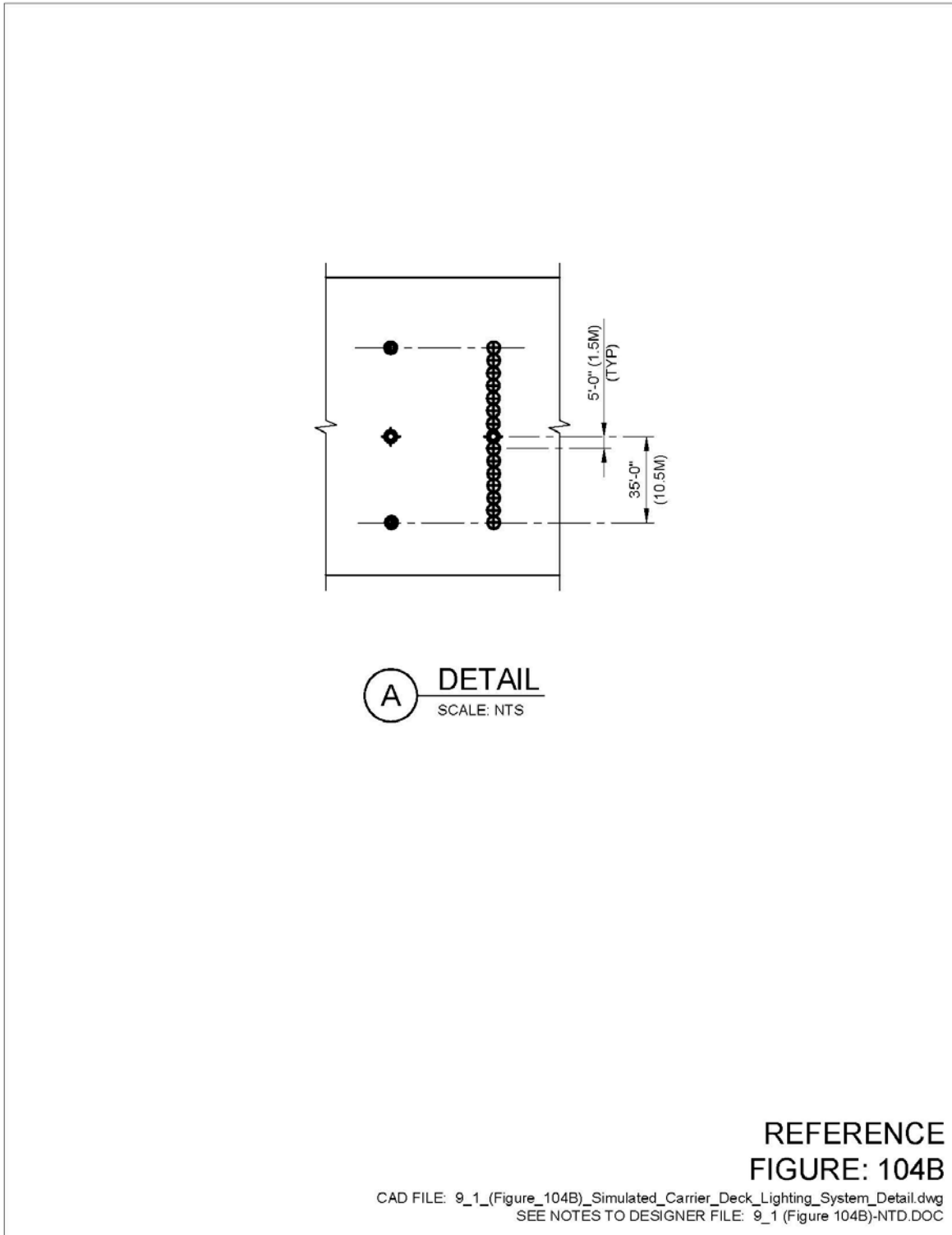
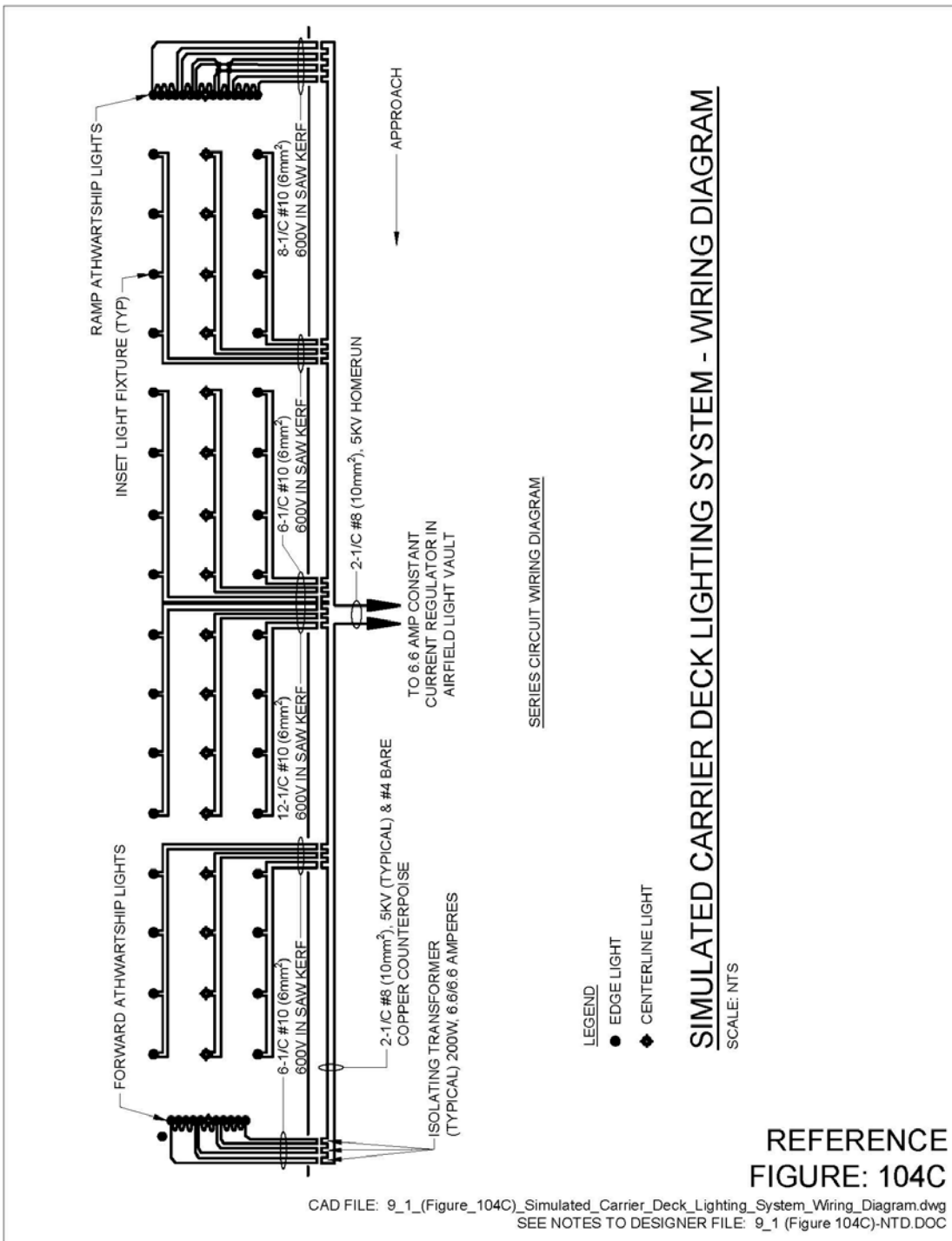


Figure 104C. Simulated Carrier Deck Lighting System – Wiring Diagram



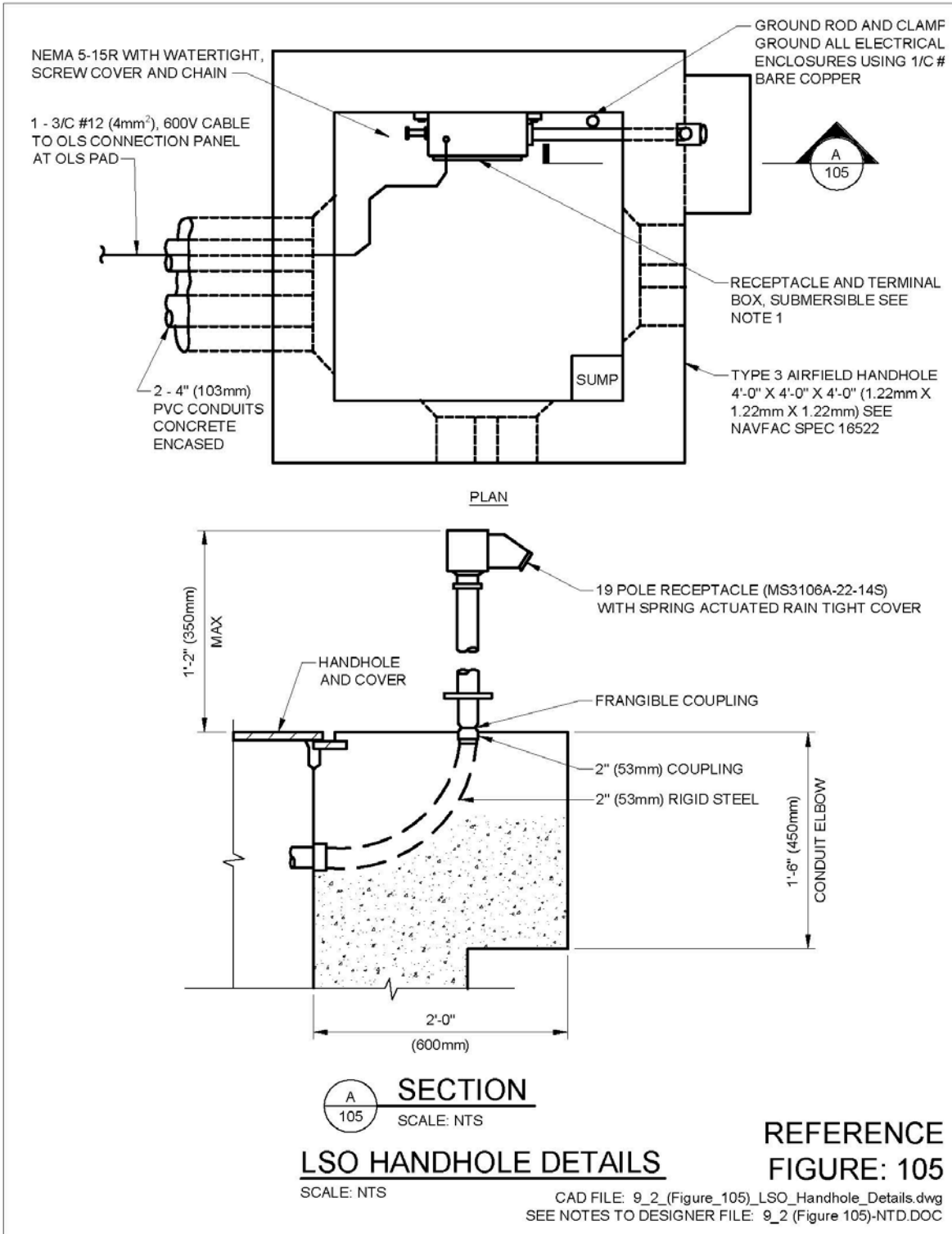
10-2 **LSO Handhole Details.**

10-2.1 **Figure 105.**

10-2.2 Notes to Designer.

1. The LSO handhole has an above-grade terminal box and receptacle. This serves as a junction point for connecting the multiconductor cables from the L.S.O. control panel, portable OLS (optical landing system), and the airfield lighting vault.
2. The handhole is located 115' (34.5m) upwind from the ramp athwartship lights and 62' (18.6m) outboard of the simulated carrier deck edge lights. A 44' (13.2m) wide area extending outboard 60' (18m) from the runway edge must be provided. This area must be graded for drainage and stabilized for light vehicular traffic.
3. Receptacle and terminal box must be rated NEMA 4 and must have threaded hubs.

Figure 105. LSO Handhole Details



10-3 Handhole and Transformer Housing.

10-3.1 Figures 106A, 106B.

10-3.1.1 Notes to Designer.

1. The flexible conduit allows for flexibility of the conduit runs during freeze/thaw cycles in cold climates and should be at least 12" (300mm) long.
2. The handhole should be specified with both an internal and external ground lug. The entire handhole is then bonded to a ground rod by a #6 (16 square mm) bare copper pigtail.

Figure 106A. Handhole and Transformer Housing

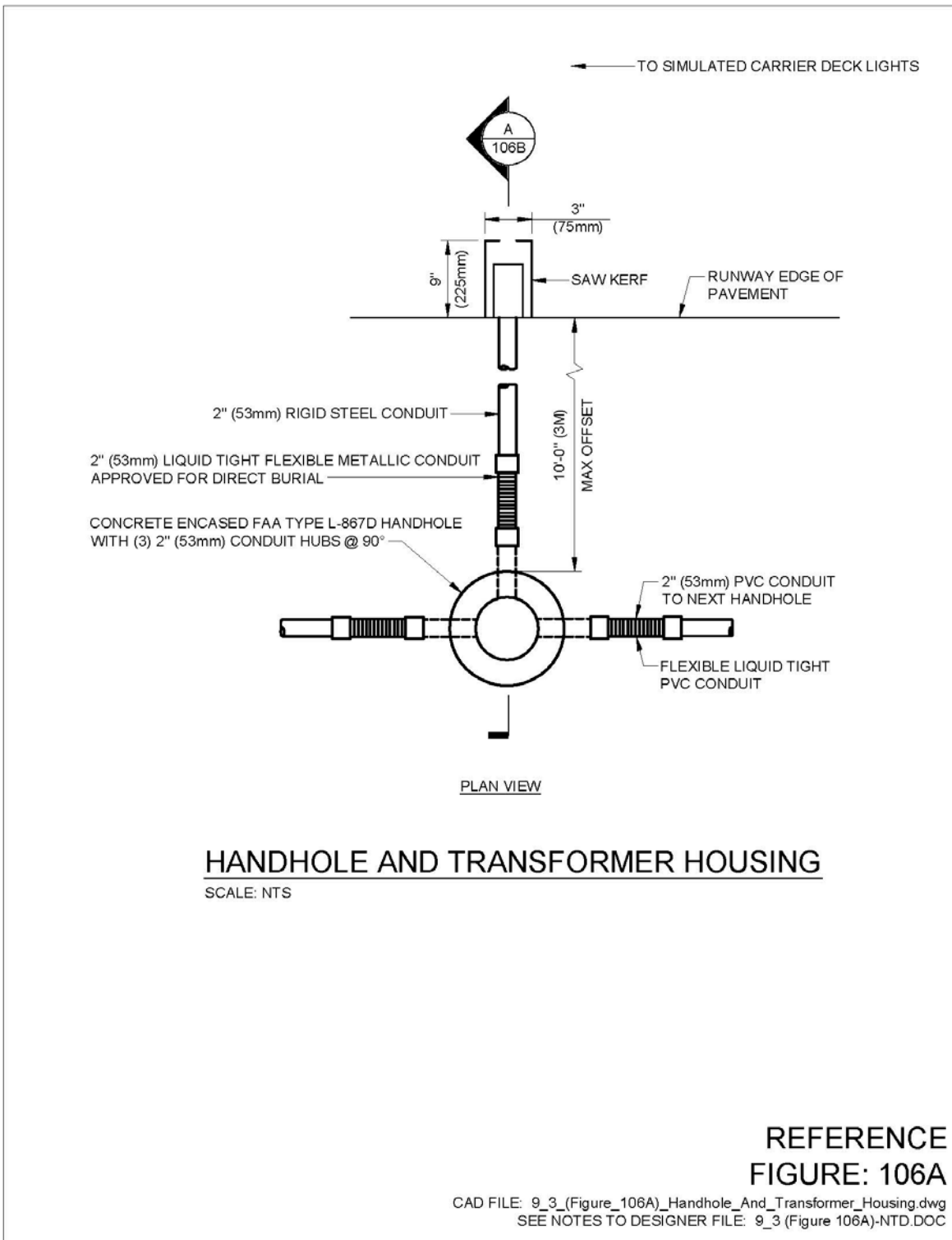
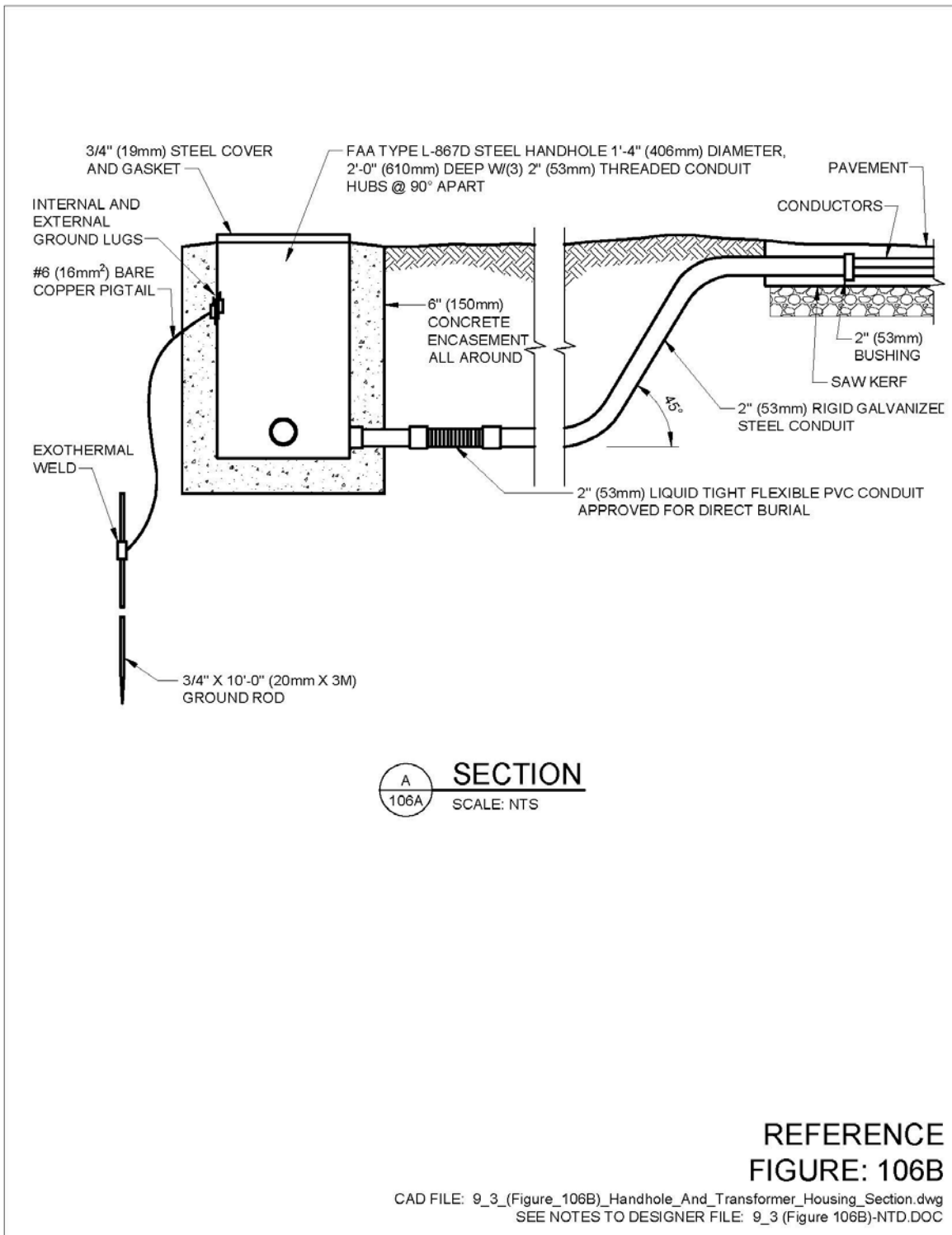


Figure 106B. Handhole and Transformer Section



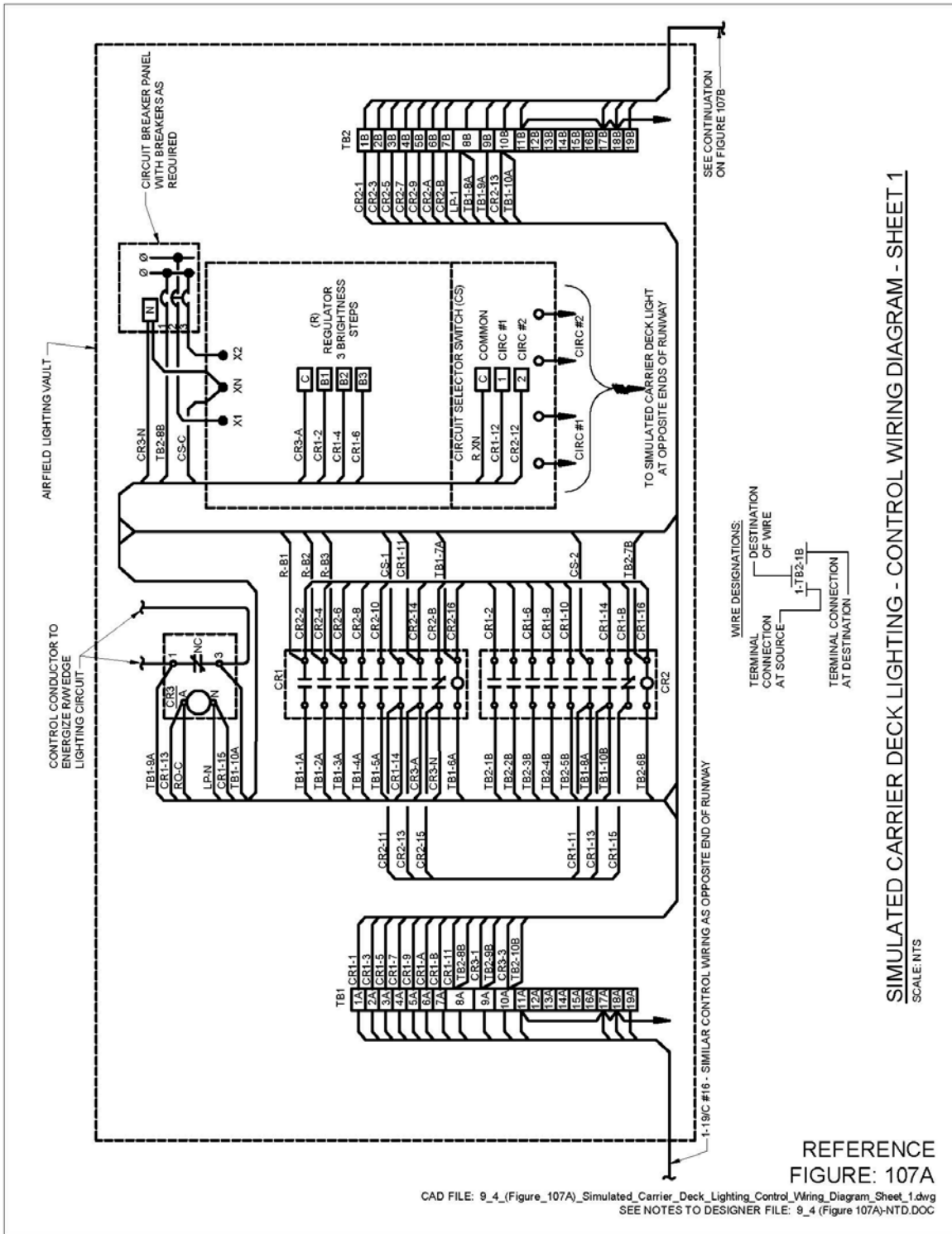
10-4 Simulated Carrier Deck Lighting Control Wiring Diagram.

10-4.1 Figure 107A, 107B.

10-4.1.1 Notes to Designer.

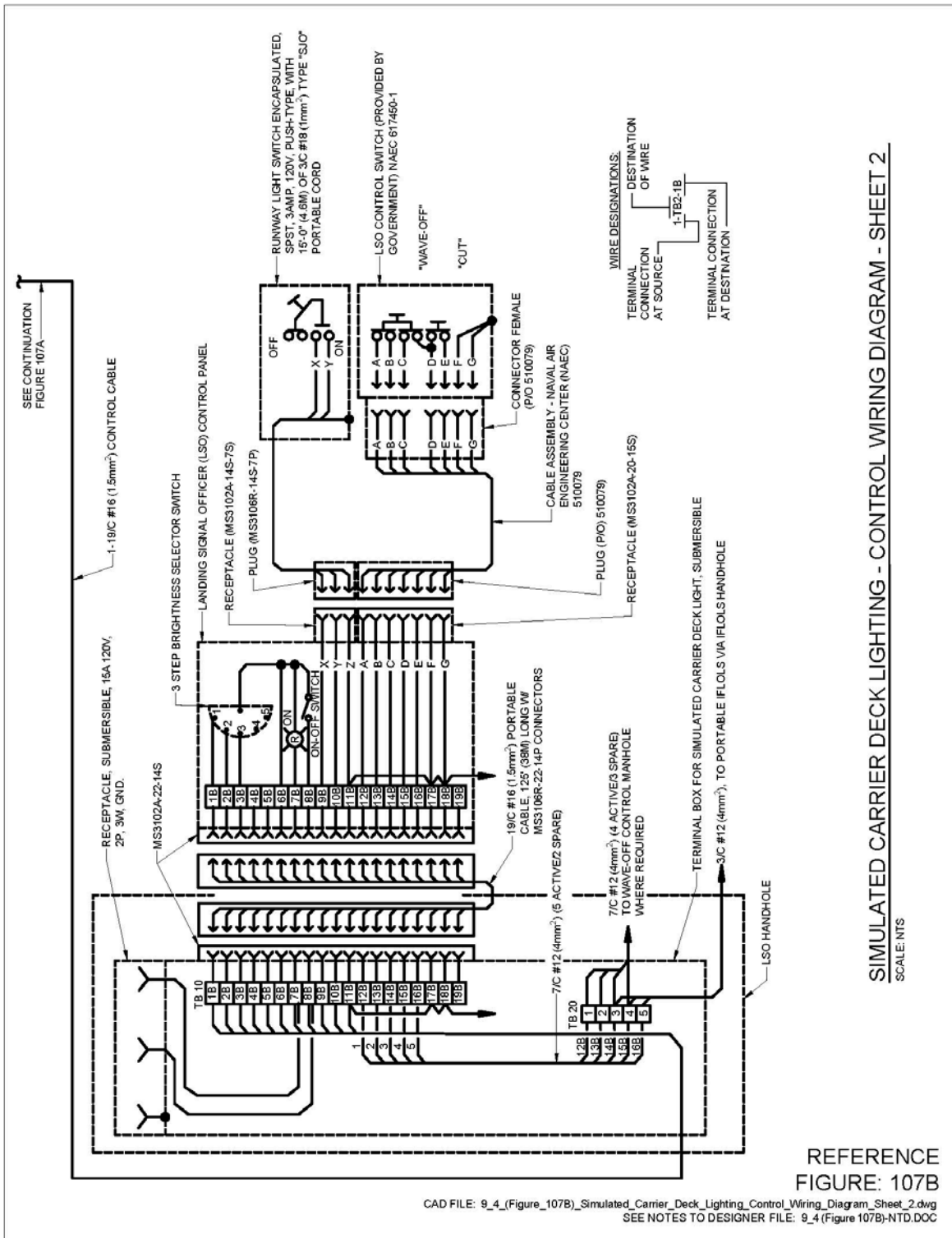
1. The control wiring diagram indicated is for two carrier deck lighting systems at opposite ends of the runway. Where a single system is installed and/or a 5 step regulator is used, modify the wiring diagram as required to show the type system installed.
2. When the carrier deck system is using an optical landing system (OLS), the runway wave-off system must not be used.
3. Contact NAVAIR NAWC for Lighting Control.

Figure 107A. Simulated Carrier Deck Lighting – Control Wiring Diagram – Sheet 1



CAD FILE: 9_4_(Figure_107A)_Simulated_Carrier_Deck_Lighting_Control_Wiring_Diagram_Sheet_1.dwg
SEE NOTES TO DESIGNER FILE: 9_4 (Figure 107A)-NTD.DOC

Figure 107B. Simulated Carrier Deck Lighting – Control Wiring Diagram – Sheet 2



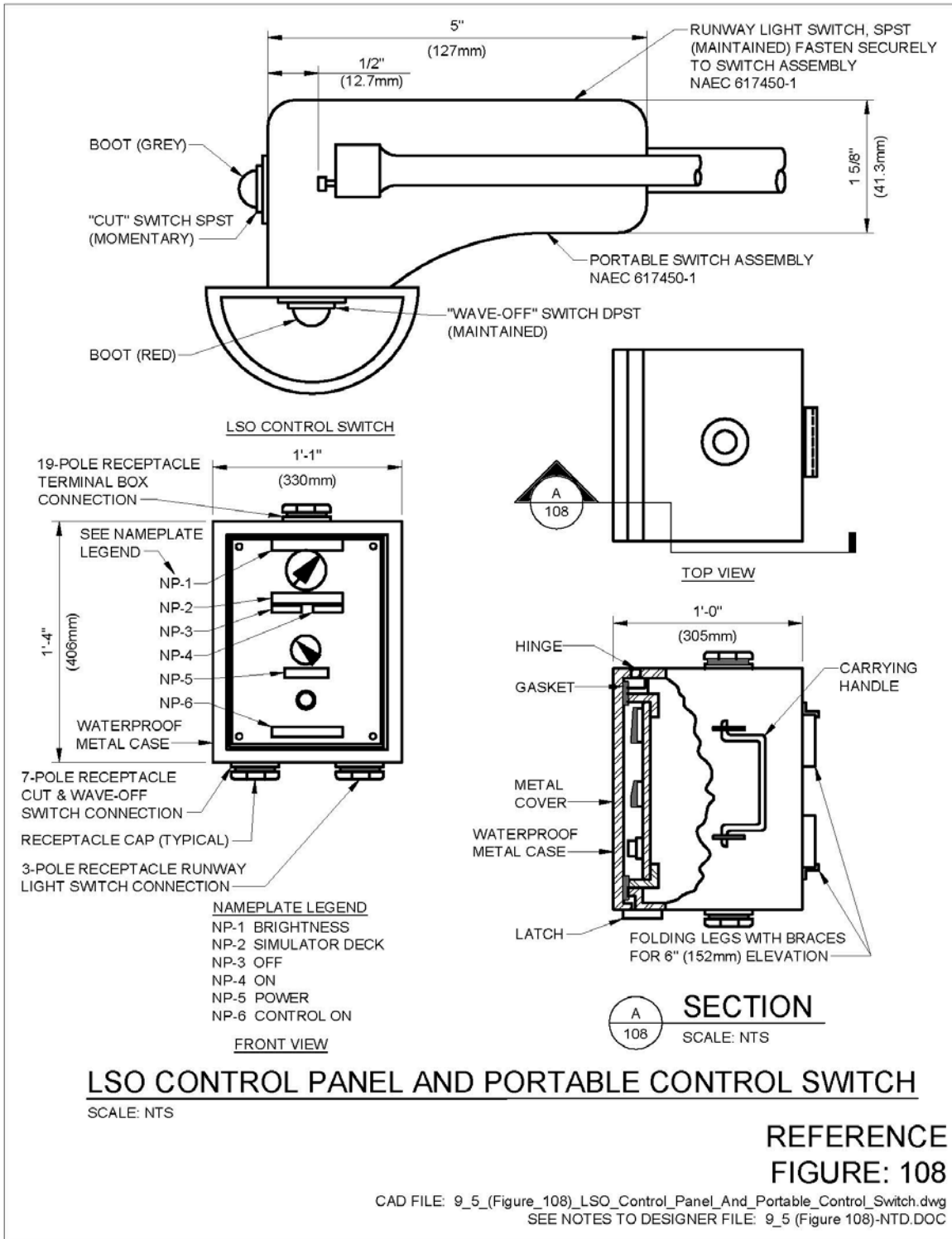
10-5 LSO Control Panel and Portable Control Switch.

10-5.1 Figure 108.

10-5.1.1 Notes to Designer.

1. The control panel connects to the adjacent terminal box above the LSO handhole by a 19/c cable which mates with the above grade receptacle above the handhole.
2. Cabinet, cover and panel of landing signal officer control panel must be of 1/8" (3mm) aluminum alloy 5052-H32. Cover must be hinged and have two or more protective closing latches. Entire assembly must be NEMA 4, watertight and dust tight.

Figure 108. LSO Control Panel and Portable Control Switch



10-6 **Simulated Carrier Deck Light Fixture – Shallow Base and Saw Kerf Installation.**

10-6.1 **Figure 109.**

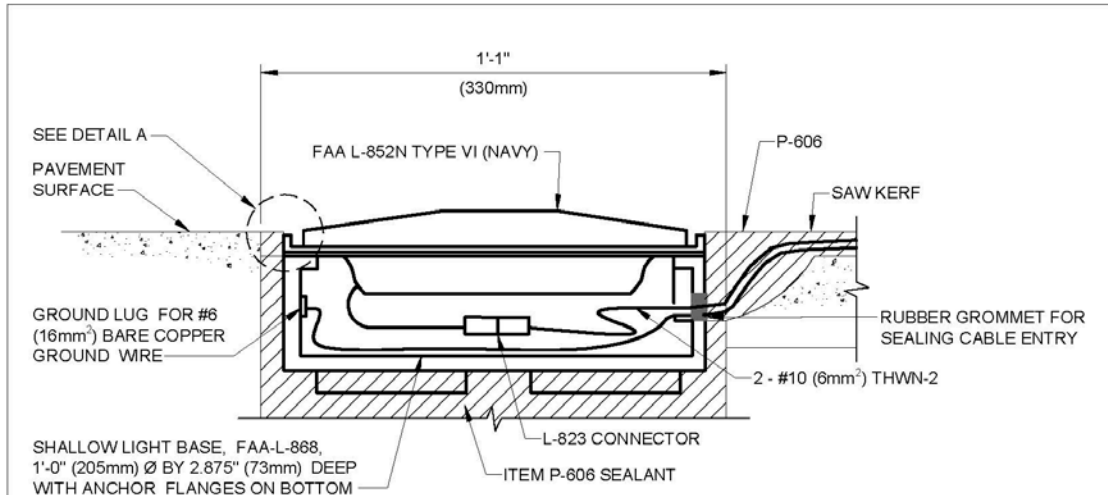
10-6.1.1 **Notes to Designer.**

1. The shallow base installation is used when a system is being installed on an existing runway. The #10 (6 square mm) branch circuit conductors and #6 ground are connected inside the base and run to a handhole at the edge of the pavement where the isolation transformers are housed.
2. The base has anti-rotational and anti-lift fins on the bottom. The base is held in place with rigid FAA type P-606 sealant that is installed flush with the top of the base. The sealant must be compatible with the pavement.
3. A spacer ring and flange ring with pavement ring is then installed on the base. The void between the rings and edge of pavement is then filled with a self-leveling silicone sealer which allows removal of fixture and rings. The sealer is flexible and compatible with both concrete and asphalt pavements.
4. The purpose of the spacer ring is to allow the fixture to be lowered in case of pavement slumping around the fixture. Different thickness rings are available in 1/16" (1.6mm) increments up to 2" (51mm).

10-6.1.2 **Drawing Notes for Figure 109.**

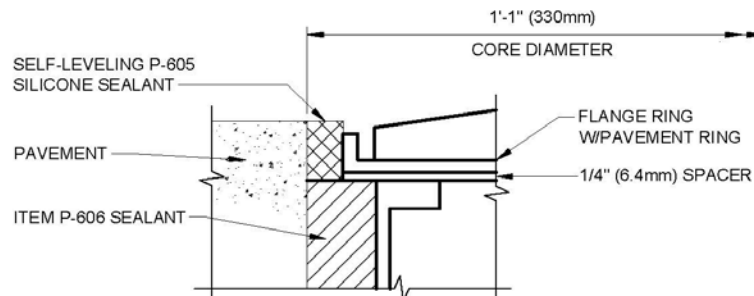
1. Contractor must use a setting jig to hold the base at the proper elevation and azimuth while the P-606 is hardening.
2. Use sealants and embedding compounds that are chemically compatible with the pavement material. It is extremely important to carefully research past use history of the sealant to be specified.
3. Core dimensions must be verified with fixture manufacturer prior to core drilling.

Figure 109. Simulated Carrier Deck Light Fixture – Shallow Base and Saw Kerf Installation



FIXTURE INSTALLATION ON SHALLOW BASE DETAIL

SCALE: NTS



(A) DETAIL
SCALE: NTS

**SIMULATED CARRIER DECK LIGHT FIXTURE -
SHALLOW BASE AND SAW KERF INSTALLATION**

SCALE: NTS

**REFERENCE
FIGURE: 109**

CAD FILE: 9_6_(Figure_109)_Simulated_Carrier_Deck_Light_Fixture_And_Installation.dwg
SEE NOTES TO DESIGNER FILE: 9_6 (Figure 109)-NTD.PDF

10-7 **Simulated Carrier Deck Light Core Details.**

10-7.1 **Figure 110.**

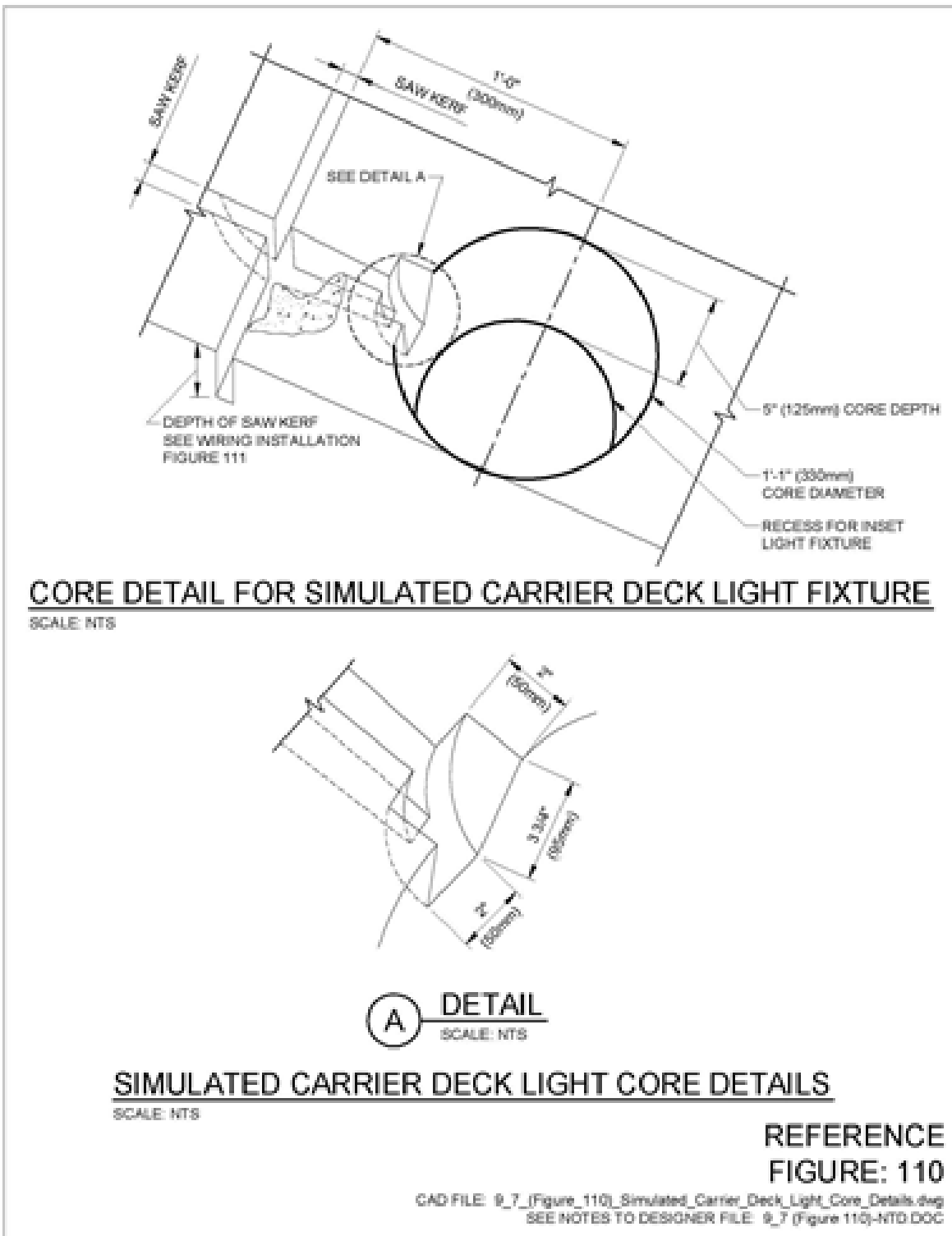
10-7.1.1 **Notes to Designer.**

1. Actual core depth and diameter should be verified with fixture supplier.
2. Ensure saw kerfs, walls and bottom of core are clean of any loose material or debris prior to fixture and wiring installation.
3. Detail A shows a channel for installing the wiring into the fixture.

10-7.1.2 **Drawing Notes for Figure 110.**

1. Edges of saw kerfs and fixture corings must be kept a minimum of 12" (300mm) from existing pavement joints. Where a conflict occurs, relocate fixtures longitudinally to avoid joints.
2. Where a new saw kerf crosses an existing saw kerf or pavement joint, new wiring must be installed as indicated in Figure 111.

Figure 110. Simulated Carrier Deck Light Core Details



10-8 **Saw Kerf Wireway Details – Simulated Carrier Deck Lights.**

10-8.1 **Figure 111.**

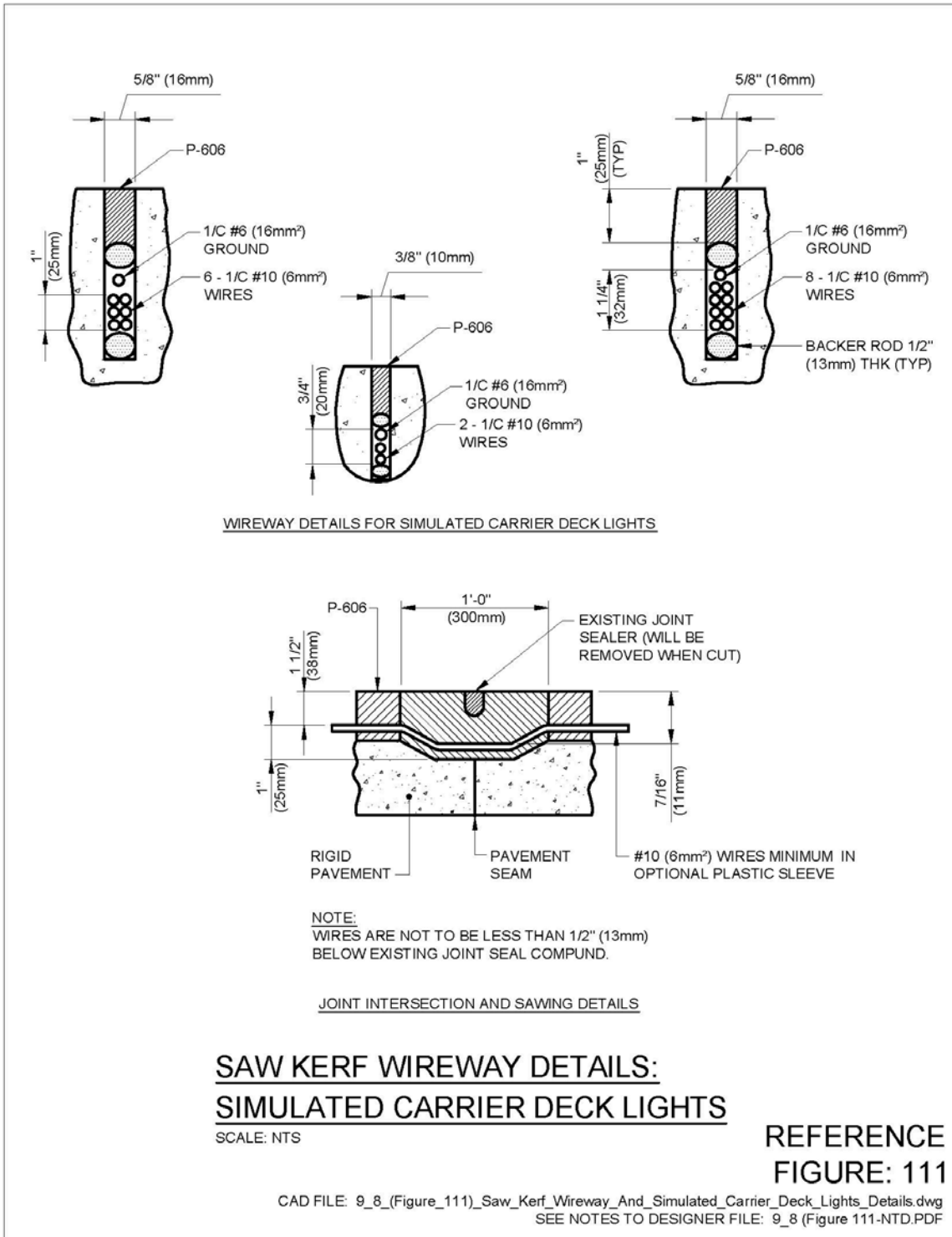
10-8.1.1 **Notes to Designer.**

1. The preferred method for installation of simulated carrier deck lights in new construction is to utilize a deep base at each light housing the individual isolation transformer. Each base is connected by a conduit system. Installation of lights in existing pavement utilizes shallow bases for the lights. The secondary wiring from the lights are run in a saw kerf to the side of the runway and into an L-867 base which houses the isolation transformer(s) for the lights.
2. More recent installations have been utilizing conduit for the secondary wiring in lieu of installing the wires directly in the saw kerf. If conduit is used, a water tight seal where the conduit enters the base must be specified.
3. The backer rod in the saw kerf serves three purposes. It acts as a shock absorber, it keeps the wiring in the saw kerf, and it acts as a sealant dam so if the wiring has to be changed they aren't encased in the sealant. The backer rod should be specified to have a diameter that is 25% maximum larger than the width of the saw kerf.
4. The sealant is a self-leveling cold applied silicone sealant that is compatible with both asphalt and concrete pavements.

10-8.1.2 **Drawing Notes for Figure 111.**

1. Diameter of backer rod must be 25% maximum larger than width of saw kerf.
2. In existing pavement, the easiest method of installing in-pavement lighting is to core a hole for the fixture and make a saw kerf for the wireways. Primary cables and transformers in this case are located at the edge of the runway.
3. To assure a successful installation, care must be taken to see that all surfaces are sand blasted and dried before the sealer is applied.
4. Use sealants that are chemically compatible with the pavement material. It is extremely important to carefully research past use history of the sealant to be specified.
5. Bond #6 (16 square mm) ground wire from each fixture to a single #6 (16 square mm) ground wire and install with circuit conductors back to handhole.

Figure 111. Saw Kerf Wireway Details: Simulated Carrier Deck Lights



10-9 **IFLOLS Pad Location.**

10-9.1 **Figure 112.**

10-9.1.1 **Notes to Designer.**

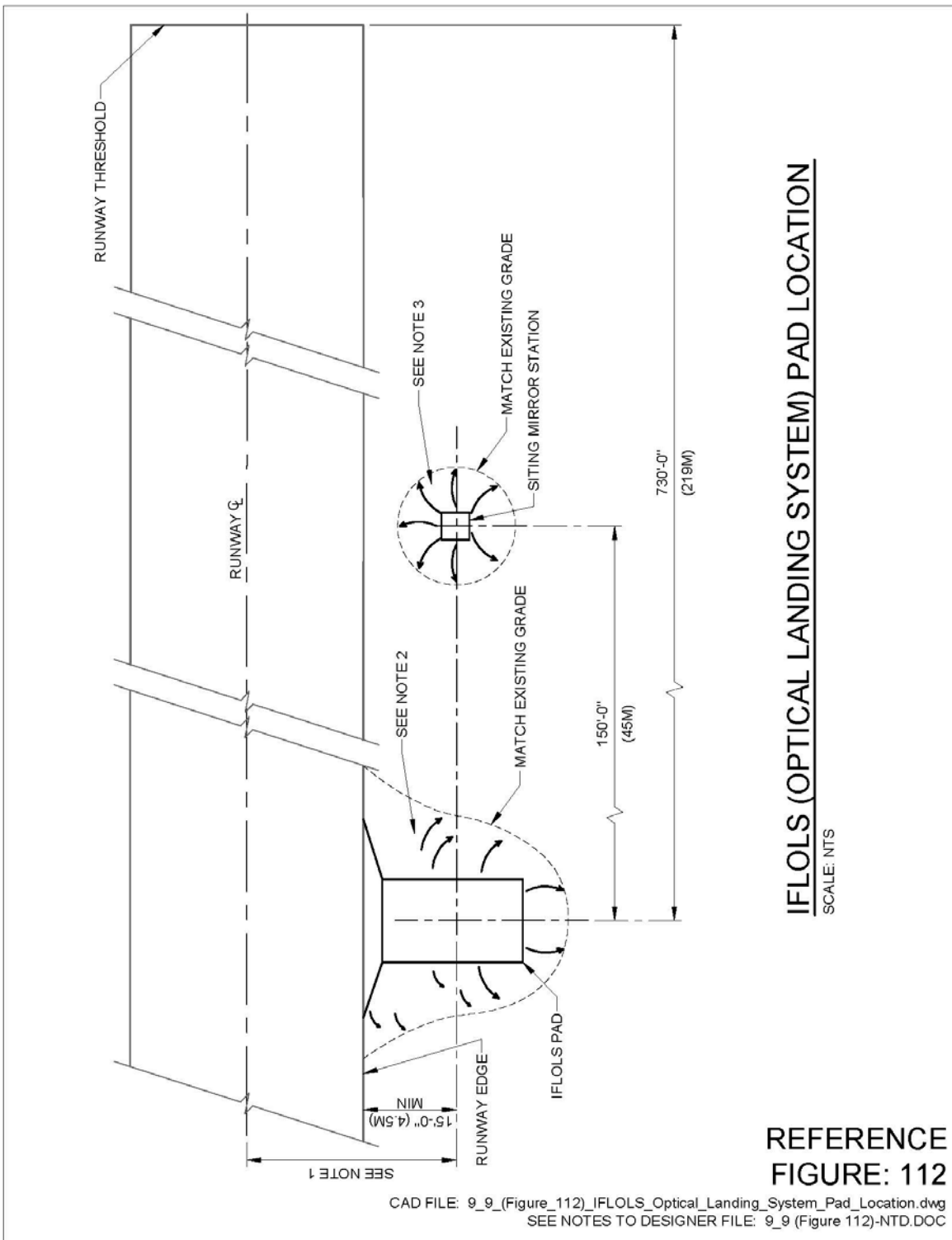
1. The IFLOLS/MOVLAS (Improved Fresnel Lens Optical Landing System/Manually Operated Visual Landing Aid System) are optical landing aids which provide pilots with a visual signal to assist in intercepting and maintaining the correct approach glide slope.
2. Optical Landing Aids (OLA) is a required visual aid for landings on aircraft carriers, but on shore based airfields the OLA is primarily an aid for training or practice. The IFLOLS is a fixed signal system which automatically indicates to the pilot his position in relationship to the established glide path. Power Requirements for the IFLOLS is 10kVA, 120VAC, 60Hz three phase, 5 wire or 10kVA, 120VAC, 60Hz single phase, 5 wire. The wave-off lights in the IFLOLS are controlled by the LSO when FCLPs are being conducted. The MOVLAS is a temporary replacement system for which the LSO (Landing Signal Officer) controls the position of the source (meatball) light. Power requirements for the MOVLAS is 4.6kVA, 120V, single phase, 3 wire.
3. Both systems are mobile and normally government furnished. The equipment pad is at the simulated carrier deck centerline elevation. A permanent survey marker should be installed on the pad giving correct location and alignment of the IFLOLS centerline cells or MOLS mirror. A survey monument for the siting mirror is located 150' (45m) toward the runway threshold from the position for the face of the cells and parallel to the runway centerline. This monument or pad must have a permanent survey marker for correct location on the siting mirror and must be at the same elevation as the OLA equipment mounting pad.

10-9.1.2 **Drawing Notes for Figure 112.**

1. Distance from R/W CL for runways 200' (60m) or less:
 - a. 115' (34.5m) minimum
 - b. 119' +1' / -0m (35.7m +0.3m / -0m) maximum
 - c. For runways used by C-5A or B-747 or equivalent aircraft:
 - d. 153' +1' / 0'
 - e. (45.9m +0.3m / -0m)

2. Area to be filled, graded, and stabilized to allow vehicle access to pad. Maximum slope of graded fill material from top of pad elevation out to existing grade must be 2%.
3. Area to be filled, and graded from top of mirror station elevation out to existing grade with a maximum slope of 2%.

Figure 112. IFLOLS (Optical Landing System) Pad Location



10-10 IFLOLS and Siting Mirror Pad Details.

10-10.1 Figure 113.

10-10.1.1 Notes to Designer.

1. Top of pad elevations are required to be at the same elevation as the simulated carrier deck centerline. The requirement could put the top of the pads more than 3" (75mm) above existing grade and possible damage to aircraft could result if accidentally struck. Suggest sloping up to top of pad with graded material at a maximum slope of 2%. This would minimize damage to aircraft and allow for drainage. The material used around the IFLOLS pad should be stabilized enough to allow vehicle access while installing and removing a FLOLS or MOVLAS.
2. Each pad must have a permanent non-corrosive plaque (brass) set flush with top of pad. The plaque must be either engraved or brazed lettering identifying location alignment of the equipment. It should also state runway centerline elevation.

Figure 113. IFLOLS and Siting Mirror Pad Details

