UFC 3-535-02
XX August 2004

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN DRAWINGS FOR VISUAL AIR NAVIGATION FACILITIES

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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INTRODUCTION

This volume supplements UFC 3-535-01, *Design Standards for Visual Air Navigation Facilities* (Army and Air Force only), and Technical Manual NAVAIR 51-50AAA-2, *General Requirements for Shorebased Airfield Marking and Lighting* (Navy only), by providing the guidance and detailed information on standard configurations and equipment. Use these manuals when designing, planning, constructing, and installing new systems.

When using these manuals, 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 MS Word 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.

The figures contained within this Volume were compiled from several sources and construction projects. The following firms and organizations contributed to the development of these figures:

- ADB Alnaco
- Amerace Ltd.
- Aviation Alliance Inc.
- Crawford, Murphy & Tilly Inc.
- Crouse-Hinds Airport Lighting Products
- Dufresne-Henry Inc.
- Federal Aviation Administration
- Flash Technology Corporation
- Jaquith Industries Inc.
- Lean Engineering Consultants, Ltd.
- Multi Electric Mfg. Inc.
- United States Air Force
- United States Army Corps of Engineers
- United States Naval Facilities Engineering Command
- Integic

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LIST OF SUPERCEDED DOCUMENTS

The following is a list of documents that are superseded by this manual and should no longer be used for the design of airfield systems:

MIL-HDBK-1023/1	Military Handbook, Airfield Lighting, 29 Jan 1988 w/notice 1, 15 Oct 1990.

Definitive Design Drawings P-272

1404273	Portable Optical Landing Systems Plot Plan
1404291	Wheels-up & Runway Wave-off Lighting Plan, Wiring Diagrams & Details
1404292	Wheels-up & Runway Wave-off Lighting Wiring Diagram & Details
1404356	Wheels-up & Runway Wave-off Lighting Equipment Vault Plans & Details
1404676	Runway Edge Lighting System Plan, Details, and Wiring Diagram
1404677	Runway Edge Lighting Light Fixture and Handhole Installation Details
1404678	Runway Edge Lighting Duct System Plan and Details
1404679	Circling Guidance Lighting System Plan, Details and Wiring Diagrams
1404680	Runway Centerline Lighting System Plan, Wiring Diagram, Schedule & Notes
1404681	Runway Centerline Lighting Installation Details
1404682	Touchdown Zone Lighting Wiring Diagram, Schedule and Details
1404683	Touchdown Zone Lighting Fixture Installation Details
1404684	Runway End Indicator Lights Plan, Schedule and Details
1404685	Runway Threshold & End Lights Site Plan – Details & Notes
1404686	Threshold Lighting Threshold Bar Plan, Details, and Notes
1404688	Simulated Carrier Deck Lighting Plan, Circuit Wiring, and Details
1404689	Simulated Carrier Deck Lighting Wiring Diagrams and Details
1404690	Simulated Carrier Deck Lighting Details
1404692	Precision Approach Path Indicator, Details and Wiring Diagrams
1404789	Taxiway Lighting Details and Schedule
1404790	Approach Lighting System Site and Layout Plans – General Data
1404791	Approach Lighting System Vault Details and Diagrams
1404792	Approach Lighting System Circuit Diagram and Schedule
1404793	Approach Lighting System Sequence Flashing Lights
1404794	Approach Lighting System Light Bar Details
1404795	Approach Lighting System Centerline Light Bars
1404796	Approach Lighting System Details and Sections

Chapter 1: UNDERGROUND CABLE, CONDUIT AND DUCTS

1.1. Direct Buried Duct/Conduit Detail

See figure 1.

Notes to Designer:

1. Where duct/conduit is below pavement, specify type of pavement to be installed on top of trench. Where trench is cut through existing pavement, specify pavement on top of trench shall match existing.

2. Location of counterpoise is shown for two situations:

   a. Trench running parallel to pavement - see detail note #3.

   b. Trench not running parallel to pavement - see detail note #4.

Refer to ~~Volume I~~UFC 3-535-01 for more information.

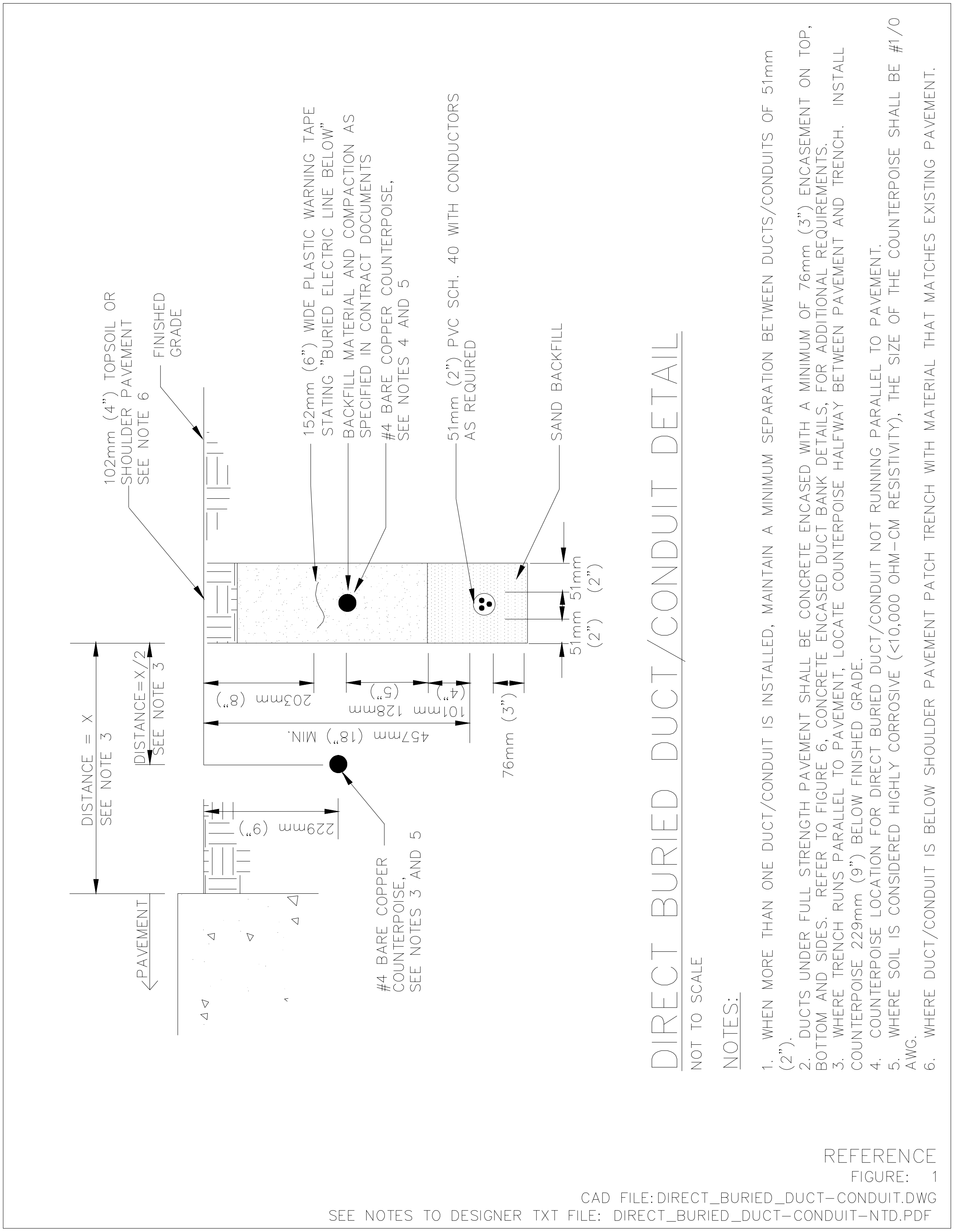


Figure 1. Direct Buried Duct/Conduit Detail

1.2. Direct Buried Duct/Conduit Detail (Navy Only)

See figure 1N.

Notes to Designer:

1. Where duct/conduit is below pavement, specify type of pavement to be installed on top of trench. Where trench is cut through existing pavement, specify pavement on top of trench shall match existing.

2. On projects where counterpoise is to be specified, use figure 1 for installation details.

Refer to UFC 3-535-01 for more information.

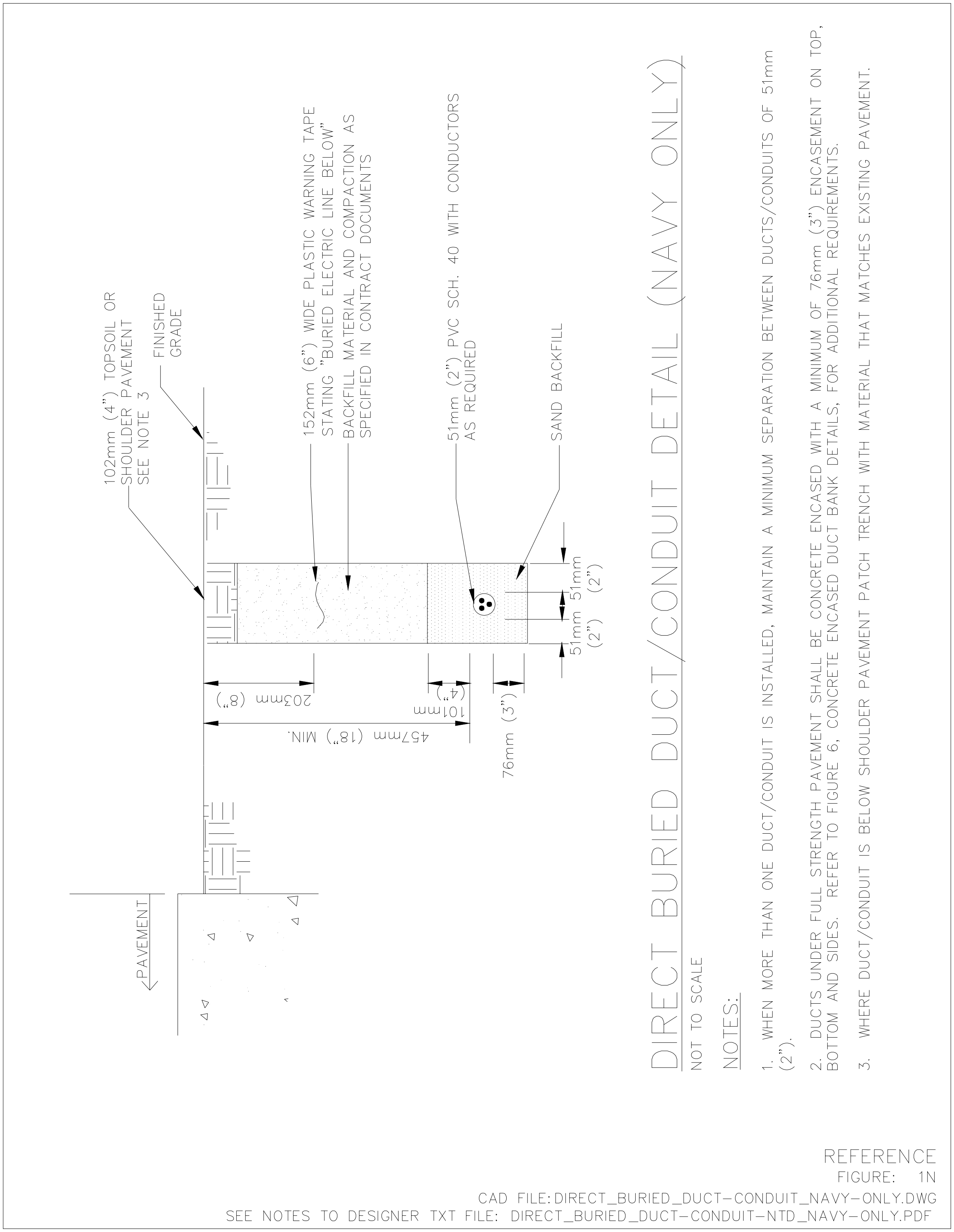


Figure 1N. Direct Buried Duct/Conduit Detail (Navy Only)

~~1.2.~~ 1.3. Direct Buried Cable Trench Details

See figure 2.

Notes to Designer:

1. Duct/conduit installation is the preferred method of installation. Refer to Chapter 13 in ~~Volume I~~UFC 3-535-01 of the manual.

2. Type of trench restoration must be specified. As a minimum, the trench should be restored to match original condition (i.e., must include seed & mulch spec if turf has already been established).

3. Use #8 for 6.6 amp circuits and #6 for 20 amp circuits.

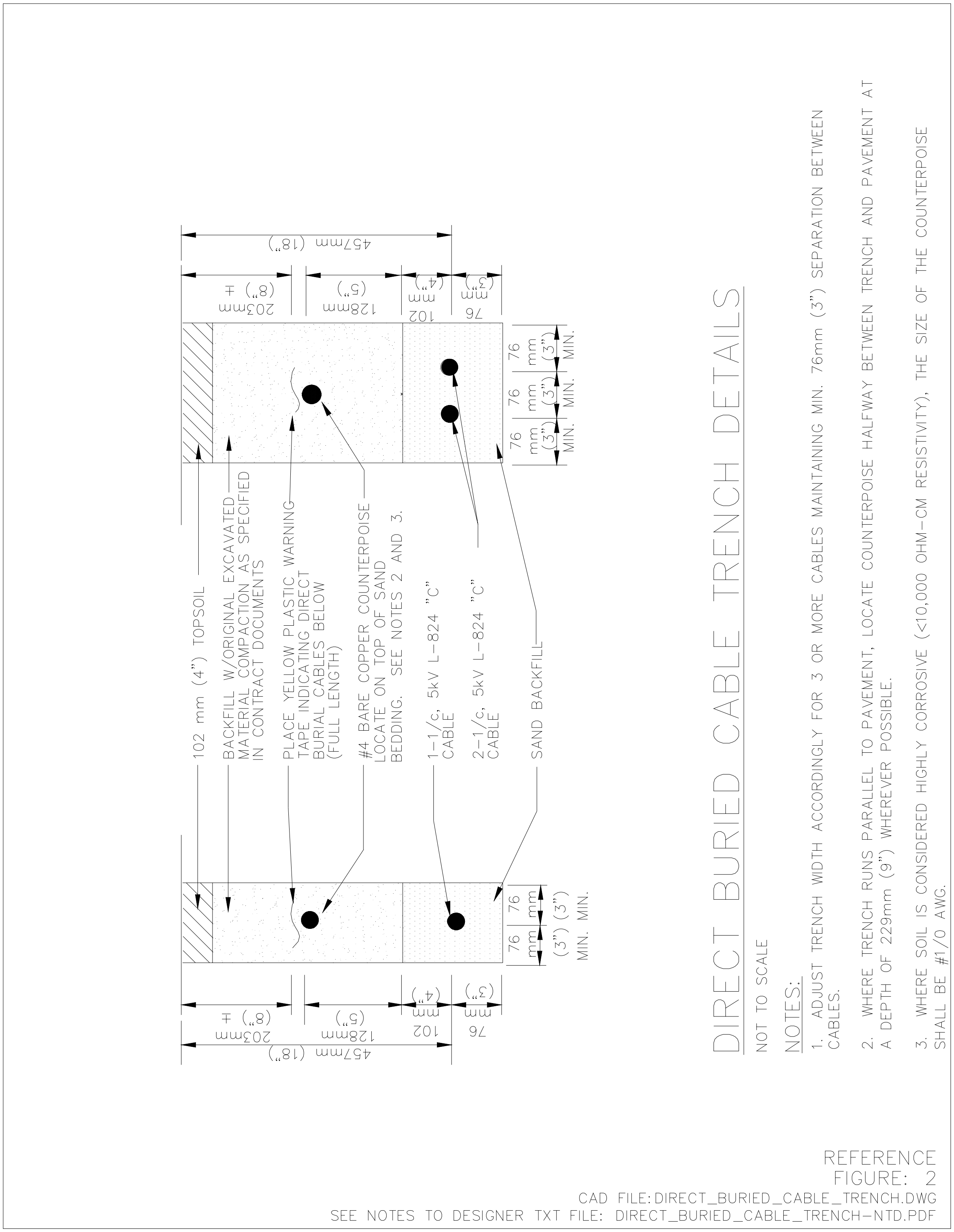


Figure 2. Direct Buried Cable Trench Details

1.4. Direct Buried Cable Trench Details (Navy Only)

See figure 2N.

Notes to Designer:

1. Duct/conduit installation is the preferred method of installation. Refer to Chapter 13 in UFC 3-535-01 of the manual.

2. Type of trench restoration must be specified. As a minimum, the trench should be restored to match original condition (i.e., must include seed & mulch spec if turf has already been established).

3. Use #8 for 6.6 amp circuits and #6 for 20 amp circuits.

4. On projects where counterpoise is to be specified, use figure 2 for installation details.

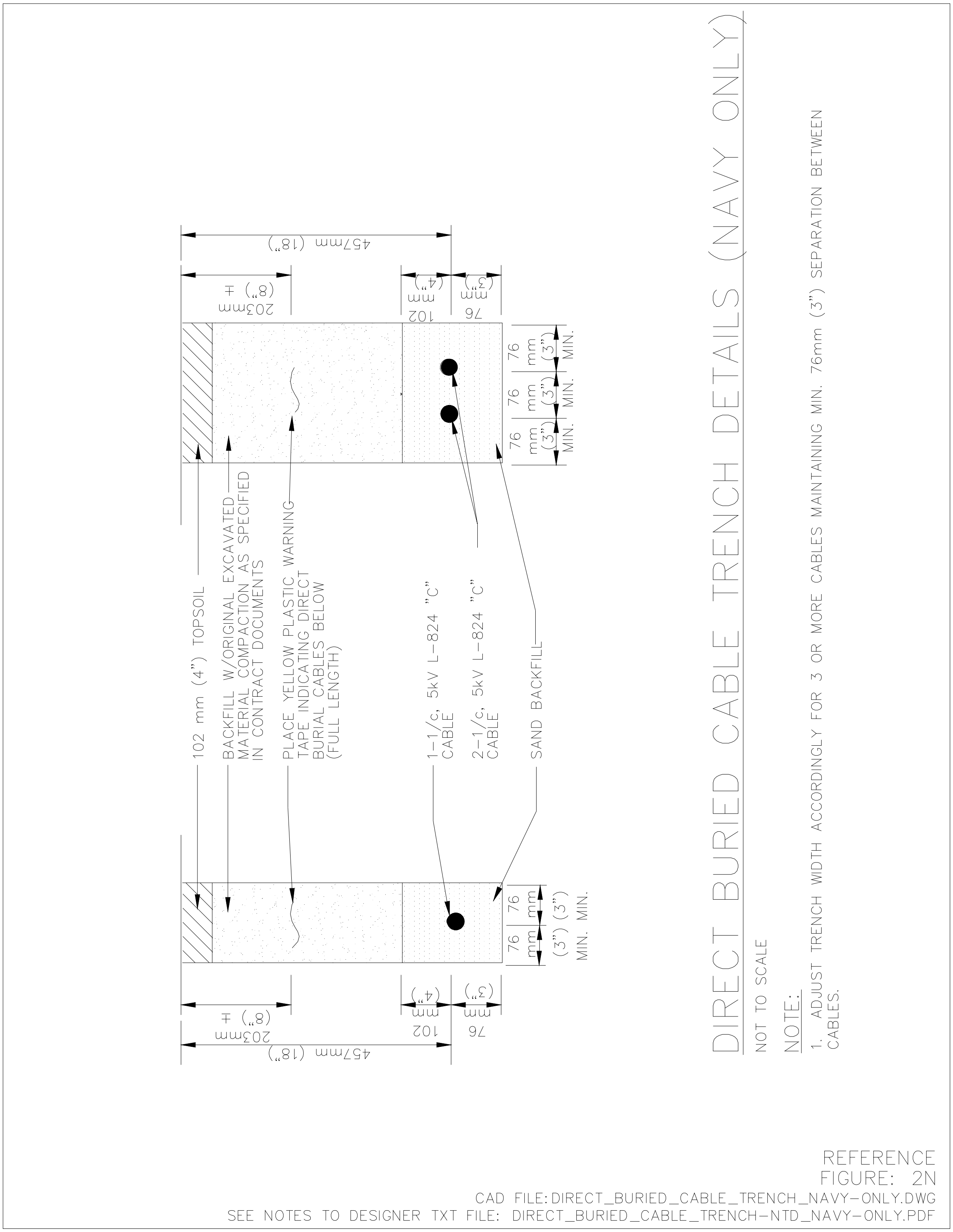


Figure 2N. Direct Buried Cable Trench Details (Navy Only)

~~1.3.~~ 1.5. Counterpoise & Ground Rod Installation Detail

See figure 3.

Notes to Designer:

1. This detail shows the installation of the ground rod to ground the counterpoise.

2. It is recommended the ground rod be driven on the side of the trench that is closest to the pavement.

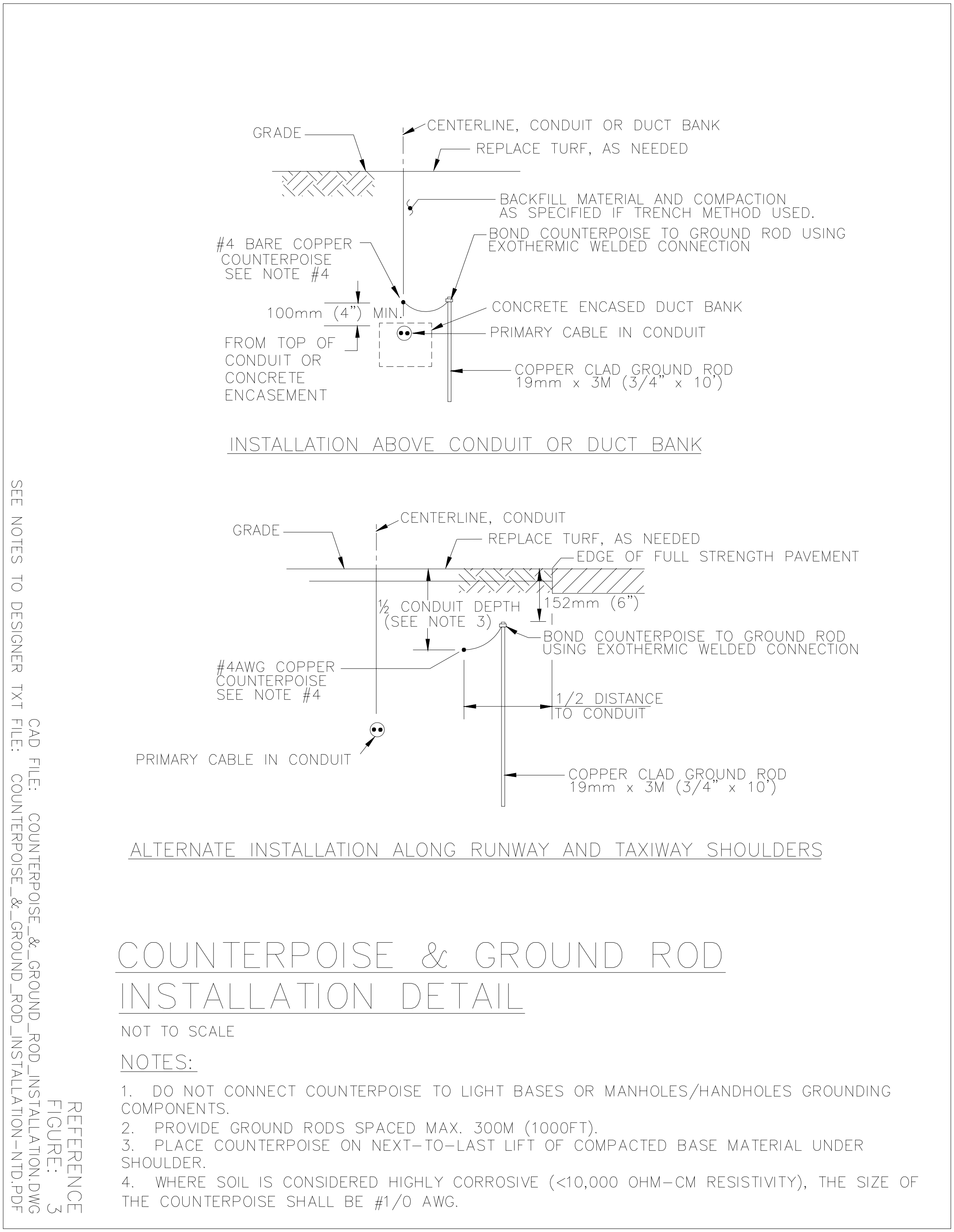


Figure 3. Counterpoise & Ground Rod Installation Detail

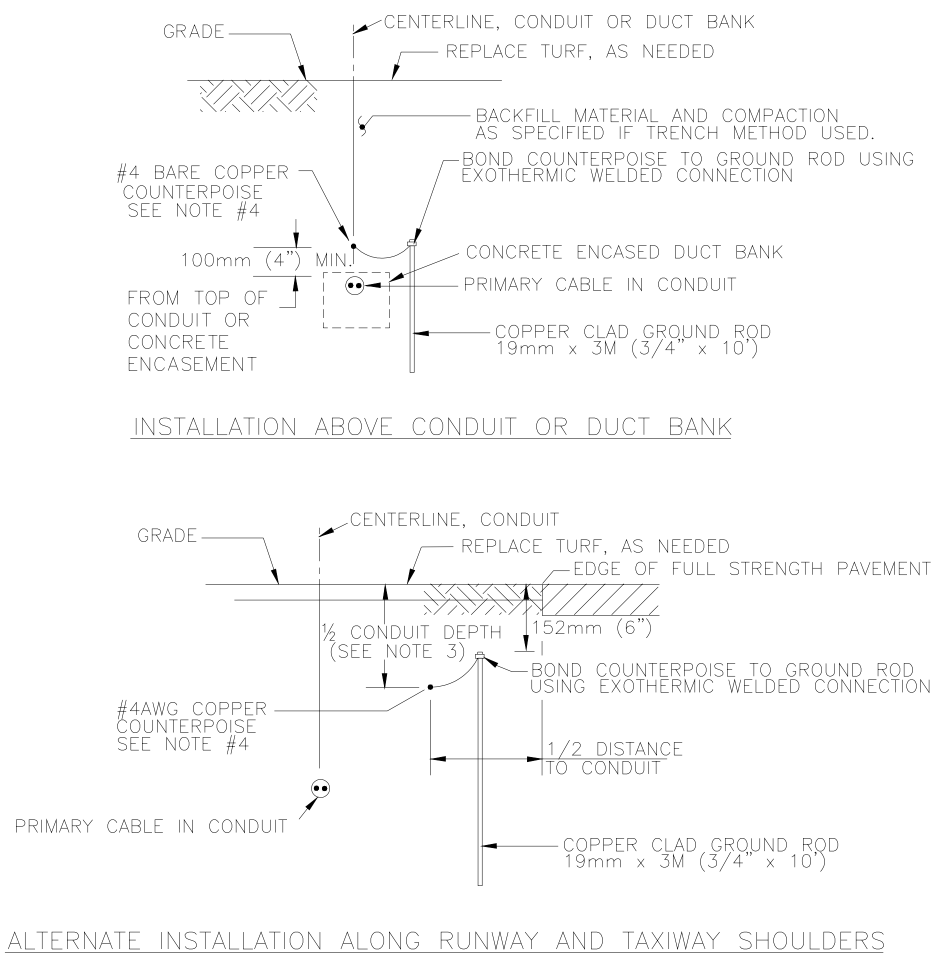
1.6. Counterpoise & Ground Rod Installation Detail (Navy Only)

See figure 3N.

Notes to Designer:

1. This detail shows the installation of the ground rod to ground the counterpoise.

2. It is recommended the ground rod be driven on the side of the trench that is closest to the pavement.



COUNTERPOISE & GROUND ROD INSTALLATION DETAIL (NAVY ONLY)

NOT TO SCALE

NOTES:

1. CONNECT COUNTERPOISE TO EACH LIGHT BASE AND MANHOLE/HANDHOLE GROUNDING COMPONENTS, UNLESS OTHERWISE SPECIFIED.
2. PROVIDE GROUND RODS SPACED MAX. 300M (1000FT).
3. PLACE COUNTERPOISE ON NEXT-TO-LAST LIFT OF COMPACTED BASE MATERIAL UNDER SHOULDER.
4. WHERE SOIL IS CONSIDERED HIGHLY CORROSIVE (<10,000 OHM-CM RESISTIVITY), THE SIZE OF THE COUNTERPOISE SHALL BE #1/0 AWG.

REFERENCE FIGURE: 3N
CAD FILE: COUNTERPOISE_&_GROUND_ROD_INSTALLATION-NAVY ONLY.DWG
SEE NOTES TO DESIGNER TXT FILE: COUNTERPOISE_&_GROUND_ROD_INSTALLATION-NTD-NAVY ONLY.PDF

Figure 3N. Counterpoise & Ground Rod Installation Detail (Navy Only)

~~1.4.~~ 1.7. Duct Marker Installation at Pavement Edge

See figure 4.

Notes to Designer:

1. An option for installing the counterpoise would be to ground the counterpoise to a ground rod 1M (3') before the 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 shown in the duct bank details.

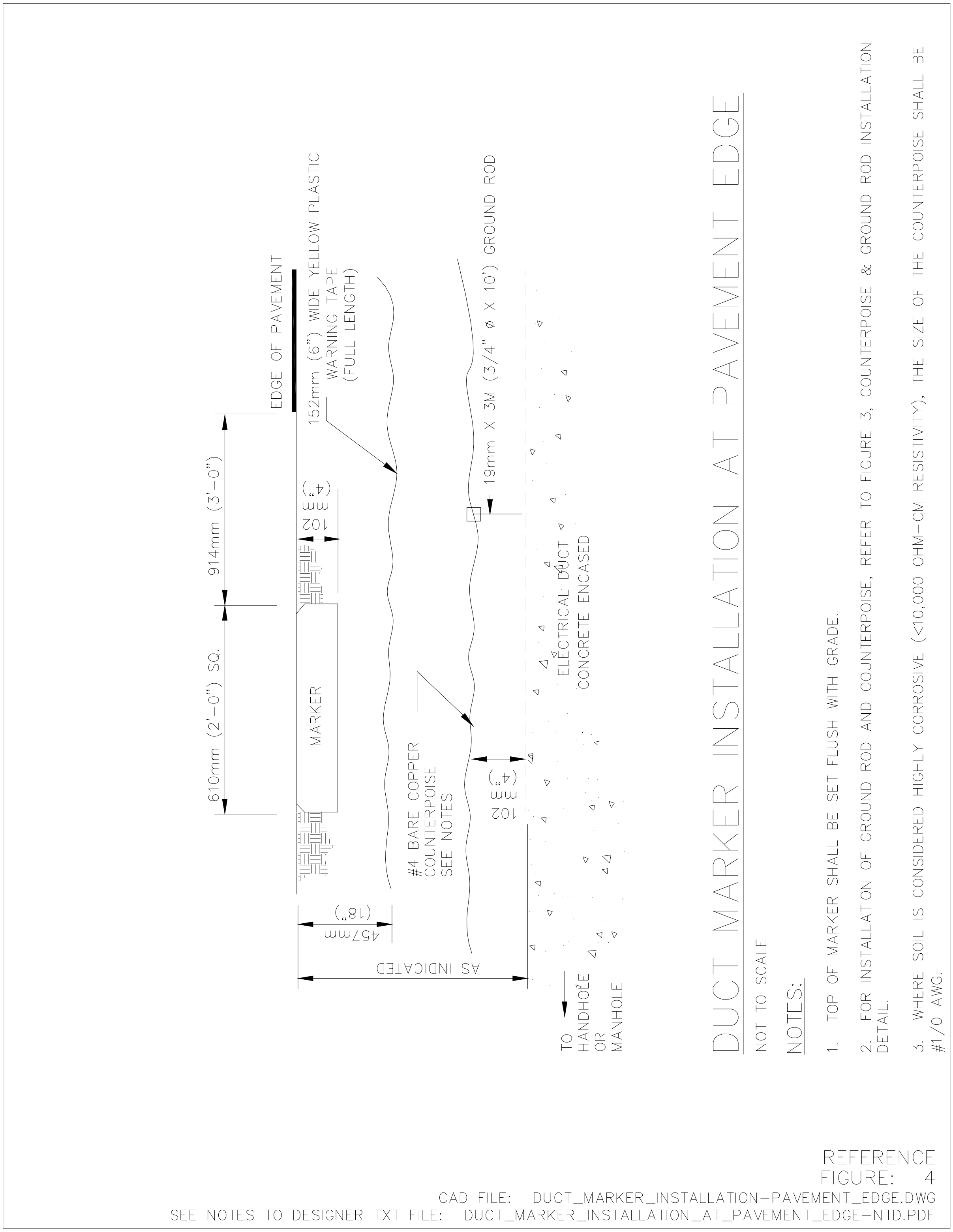


Figure 4. Duct Marker Installation at Pavement Edge

1.8. Duct Marker Installation at Pavement Edge (Navy Only)

See figure 4N.

Notes to Designer:

1. Where counterpoise is to be installed, use figure 4 for installation details.

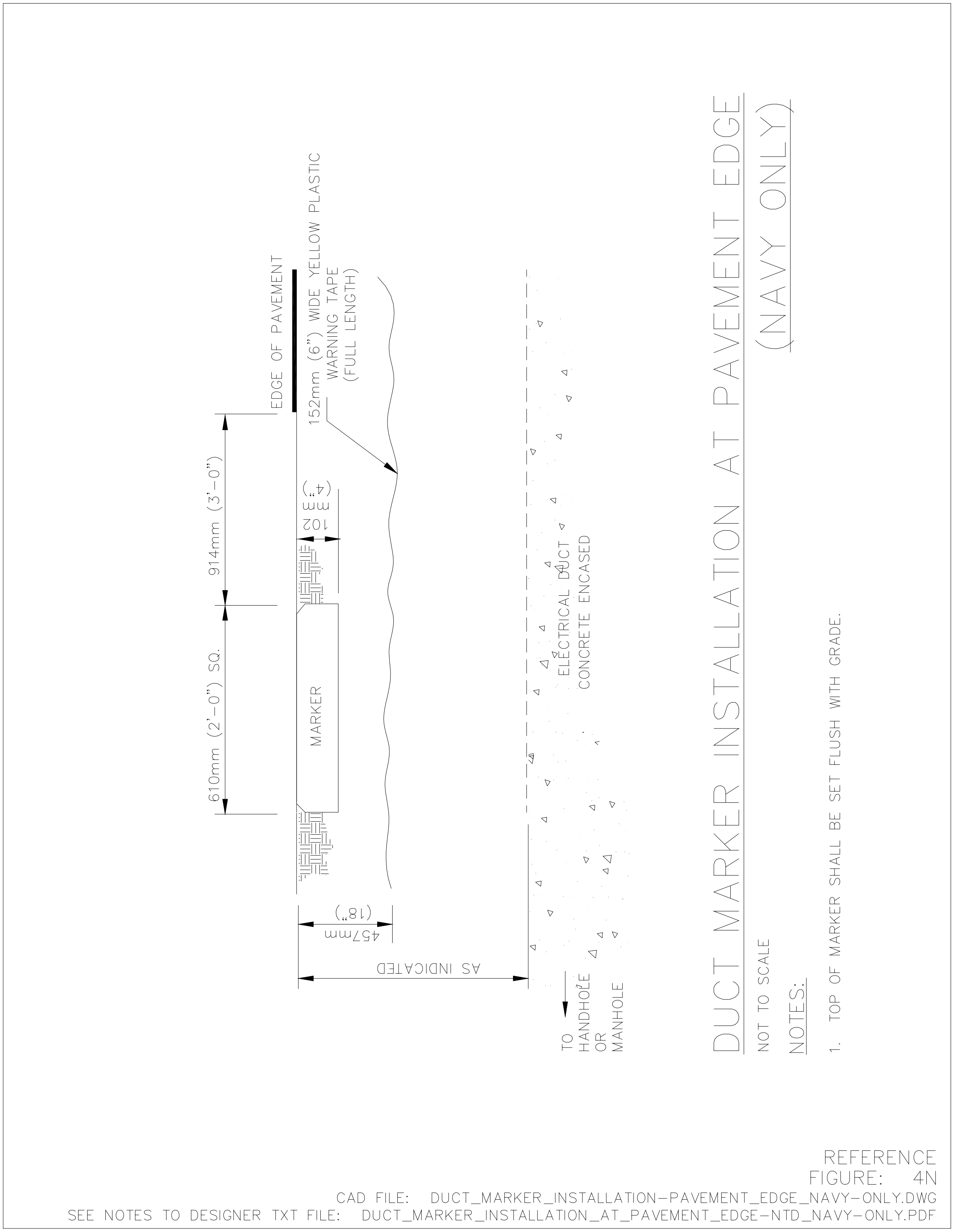


Figure 4N. Duct Marker Installation at Pavement Edge (Navy Only)

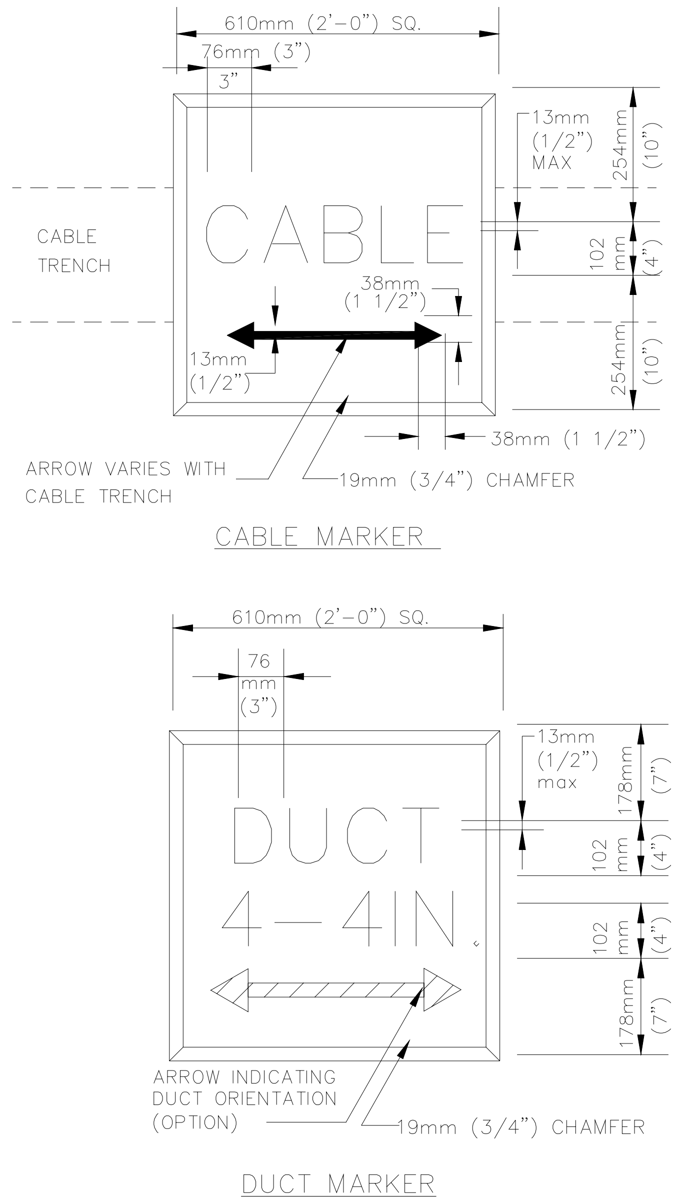
~~1.5.~~ 1.9. Cable and Duct Markers

See figure 5.

Notes to Designer:

1. Cable markers are placed directly over the cable trench with the arrows indicating direction of cable run. Maximum spacing of markers should not exceed 61M (200') plus every place the cable run changes direction. No markers are required where the cable runs in a straight line from light base to light base.

2. Duct markers are typically used at the edge 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.



CABLE AND DUCT MARKERS

NOT TO SCALE

NOTES:

1. HAND LETTERING NOT ALLOWED ON MARKERS. LETTERING IS TO BE BOLDLY IMPRESSED. LINE WIDTH AND DEPTH SHALL BE 13mm (1/2") MINIMUM.
2. ARROW ON CABLE MARKER TO INDICATE DIRECTION OF CABLES (WHERE APPLICABLE).
3. DUCT MARKER SHALL INDICATE NUMBER AND SIZE OF DUCTS INSTALLED IN DUCT BANK. (4 – 4" SHOWN FOR EXAMPLE)
4. ALL MARKERS SHALL BE CONCRETE WITH A MINIMUM OF 102mm (4") IN THICKNESS.

REFERENCE
FIGURE: 5
CAD FILE: CABLE_&_DUCT_MARKERS.DWG
SEE NOTES TO DESIGNER TXT FILE: CABLE_&_DUCT_MARKERS-NTD.PDF

Figure 5. Cable and Duct Markers

~~1.6.~~ 1.10. Concrete Encased Duct Bank Details – Typical Arrangements

See figure 6.

Notes to Designer:

1. Stagger the couplings as shown to minimize weak points in the duct bank.

2. There are several types of duct spacers that 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. In areas of potential frost, it is recommended the minimum depth of the duct bank be at least 305mm (12") 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 plaza (Air Force only), or manholes wherever possible. The handholes or manholes should be located outside of the runway or taxiway safety areas, if feasible.

6. Duct banks must slope towards drain.

7. Spacing of ducts shown is minimum in power group for series circuits. Refer to Figure 310-60 in the National Electric Code NFPA-70 when ducts are carrying parallel (constant voltage) AC circuits.

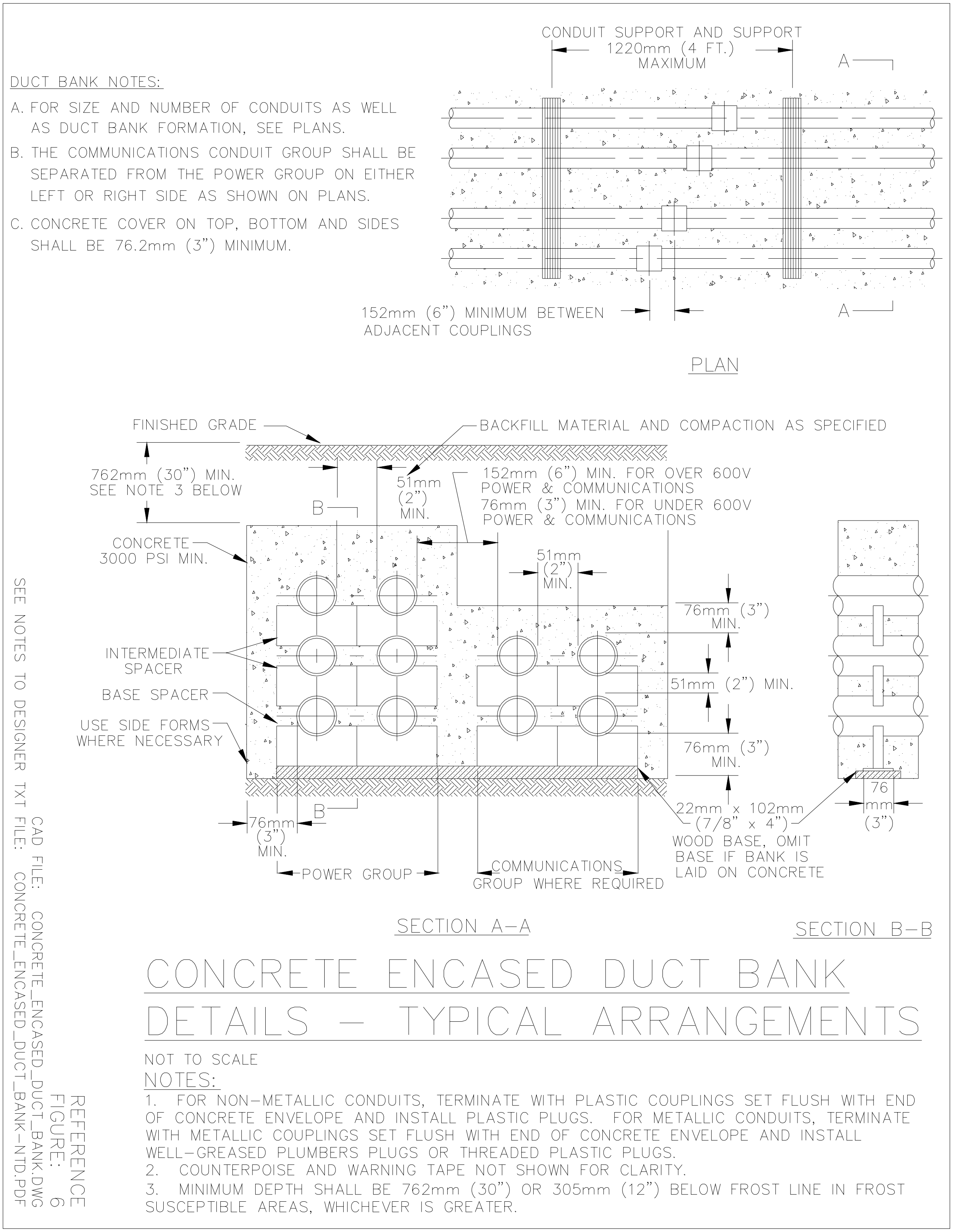


Figure 6. Concrete Encased Duct Bank Details – Typical Arrangements

~~1.7.~~ 1.11. Field Attached Plug-in Splice FAA Type L-823

See figure 7.

Notes to Designer:

1. It is recommended that single piece heat shrink tubing with sealant only at each end be utilized. 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 personnel want to re-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 over the connector.

3. Shapes of L-823 splice connectors vary with manufacturer. One particular manufacturer (Amerace, Ltd.) has designed a new type of seal and does not recommend the use of heat shrink. Tape is used around the mating face overlap to keep out dirt. The designer should contact several FAA approved manufacturers of L-823 splice connectors and become familiar with their recommended installation requirements.

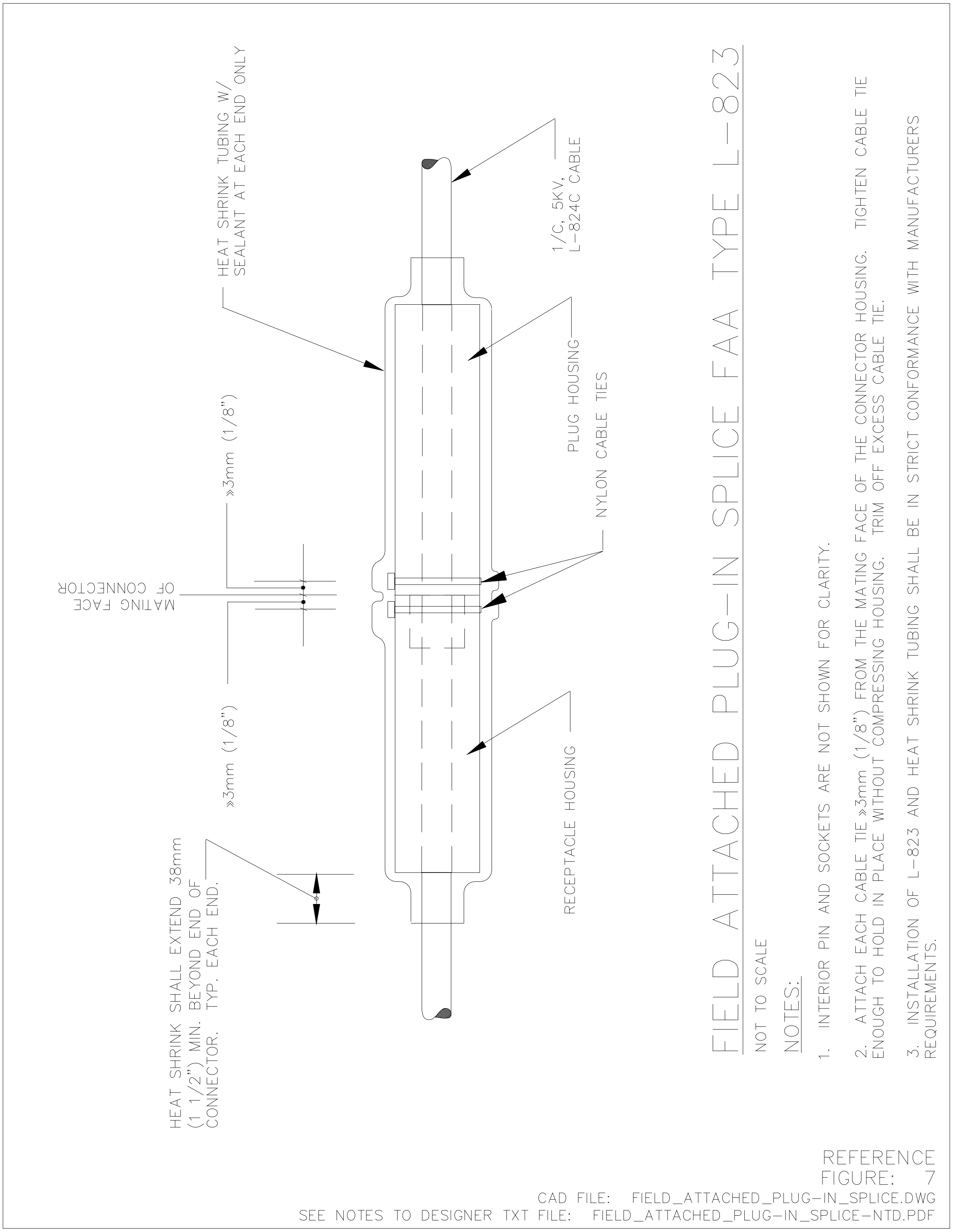


Figure 7. Field Attached Plug-in Splice FAA Type L-823

Chapter 2: RUNWAY AND TAXIWAY LIGHTING

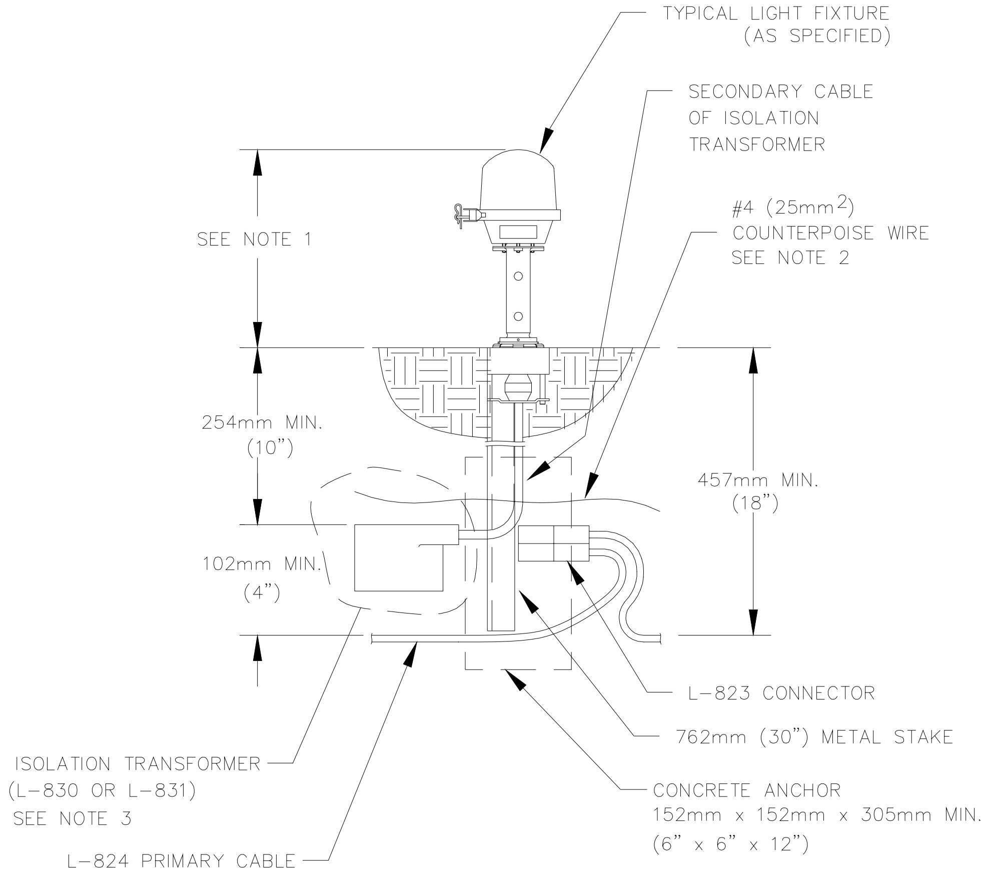
2.1. Stake Mounted Elevated Fixture Installation

See figure 8.

Notes to Designer:

1. The preferred method for mounting elevated lights is the base mounting installation. The stake mounting may be used as a temporary installation. The concrete anchor as shown in the detail may be deleted in a temporary installation. In some cases the stake mounted method could be used as a permanent installation depending on project design criteria. In these cases the concrete anchor is required.

2. The 762mm (30") stake acts as a ground rod for grounding the fixture assembly.



STAKE MOUNTED ELEVATED FIXTURE INSTALLATION

NOT TO SCALE

FOR TEMPORARY INSTALLATION ONLY

NOTES:

1. STANDARD HEIGHT IS 356mm (14"). HEIGHT MAY BE ADJUSTED PER FIGURE 10 IN AREAS SUBJECT TO SNOW CONDITIONS.

2. ROUTE COUNTERPOISE AROUND STAKE TOWARDS PAVEMENT. DO NOT CONNECT TO STAKE.

3. TRANSFORMER AND SLACK CABLES SHALL BE PLACED ON A BED OF SAND AND COVERED WITH SAND SUCH THAT TRANSFORMER AND SLACK CABLES ARE SURROUNDED WITH MIN. 102mm (4") SAND BACKFILL.

REFERENCE FIGURE: 8
CAD FILE: STAKE_MOUNTED_ELEVATED_FIXTURE_INSTALLATION.DWG
SEE NOTES TO DESIGNER TXT FILE: STAKE_MOUNTED_ELEVATED_FIXTURE_INSTALLATION-NTD.PDF

Figure 8. Stake Mounted Elevated Fixture Installation

2.2. Stake Mounted Elevated Fixture Installation (Navy Only)

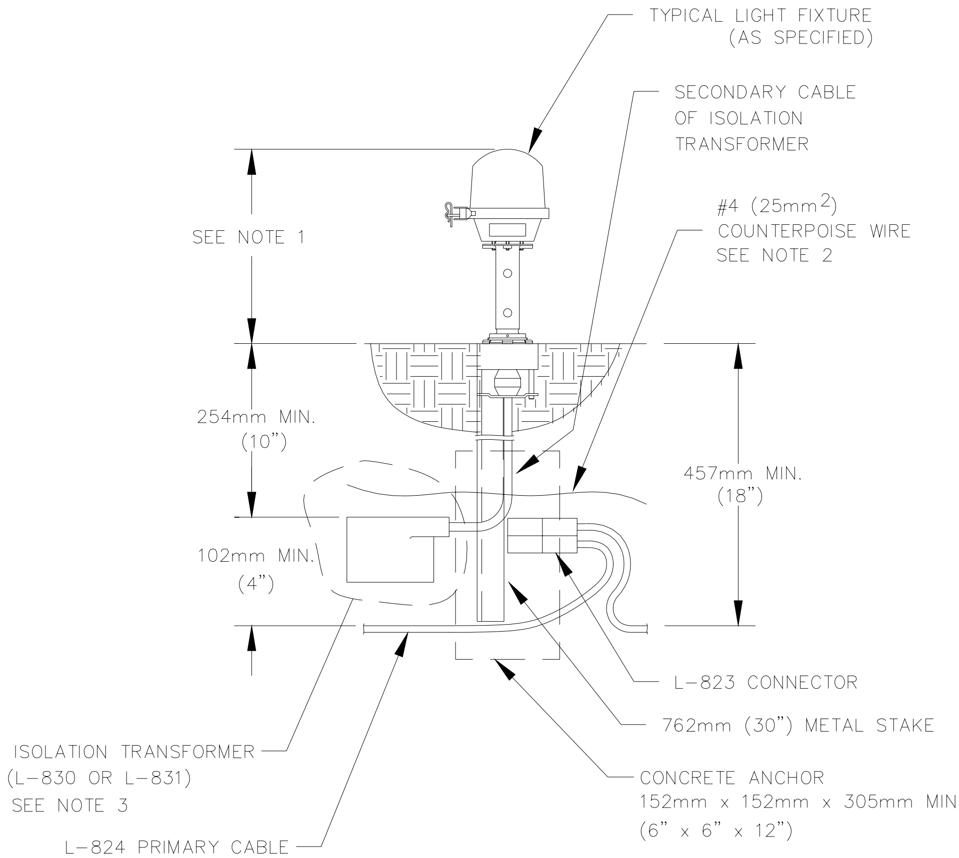
See figure 8N.

Notes to Designer:

1. The preferred method for mounting elevated lights is the base mounting installation. The stake mounting may be used as a temporary installation. The concrete anchor as shown in the detail may be deleted in a temporary installation. In some cases the stake mounted method could be used as a permanent installation depending on project design criteria. In these cases the concrete anchor is required.

2. The 762mm (30") stake acts as a ground rod for grounding the fixture assembly.

3. Where no counterpoise is required, delete counterpoise and note #2 from detail.



STAKE MOUNTED ELEVATED FIXTURE INSTALLATION (NAVY ONLY)

NOT TO SCALE

FOR TEMPORARY INSTALLATION ONLY

NOTES:

1. STANDARD HEIGHT IS 356mm (14"). HEIGHT MAY BE ADJUSTED PER FIGURE 10 IN AREAS SUBJECT TO SNOW CONDITIONS.

2. CONNECT COUNTERPOISE TO STAKE WITH APPROVED GROUND LUG.

3. TRANSFORMER AND SLACK CABLES SHALL BE PLACED ON A BED OF SAND AND COVERED WITH SAND SUCH THAT TRANSFORMER AND SLACK CABLES ARE SURROUNDED WITH MIN. 102mm (4") SAND BACKFILL.

REFERENCE
FIGURE: 8N
CAD FILE: STAKE_MOUNTED_ELEVATED_FIXTURE_INSTALLATION_NAVY-ONLY.DWG
SEE NOTES TO DESIGNER TXT FILE: STAKE_MOUNTED_ELEVATED_FIXTURE_INSTALLATION-NTD_NAVY-ONLY.PDF

Figure 8N. Stake Mounted Elevated Fixture Installation (Navy Only)

~~2.2.~~ 2.3. Base Mounted Elevated Fixture Installation

See figure 9.

Notes to Designer:

1. The flexible conduit allows for minor adjustments in alignment during installation and also allows flexibility of the conduit runs during freeze/thaw cycles in cold climates. The use of the flexible conduit is optional. The conduit shall meet the requirements of NEMA TC12 and should be at least 305mm (12") long.

2. Many contractors will purchase the L-867 bases and send them to pre-cast shops for the concrete encasement. The conduit stubs are slid through the grommets prior to casting. A minimum of 152mm (6") should be protruding from the encasement to allow the 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. Bases at the low point should be ordered with an additional hub and connect a 50mm (2") conduit between the underdrain and the light base. Where there is no underdrain installed the conduit may run to the closest storm water catch basin. Maintain slope such that water drains out of light base toward underdrain or catch basin.

4. The equipment ground routed to each base via the conduit system shall be connected to the system ground at the lighting vault.

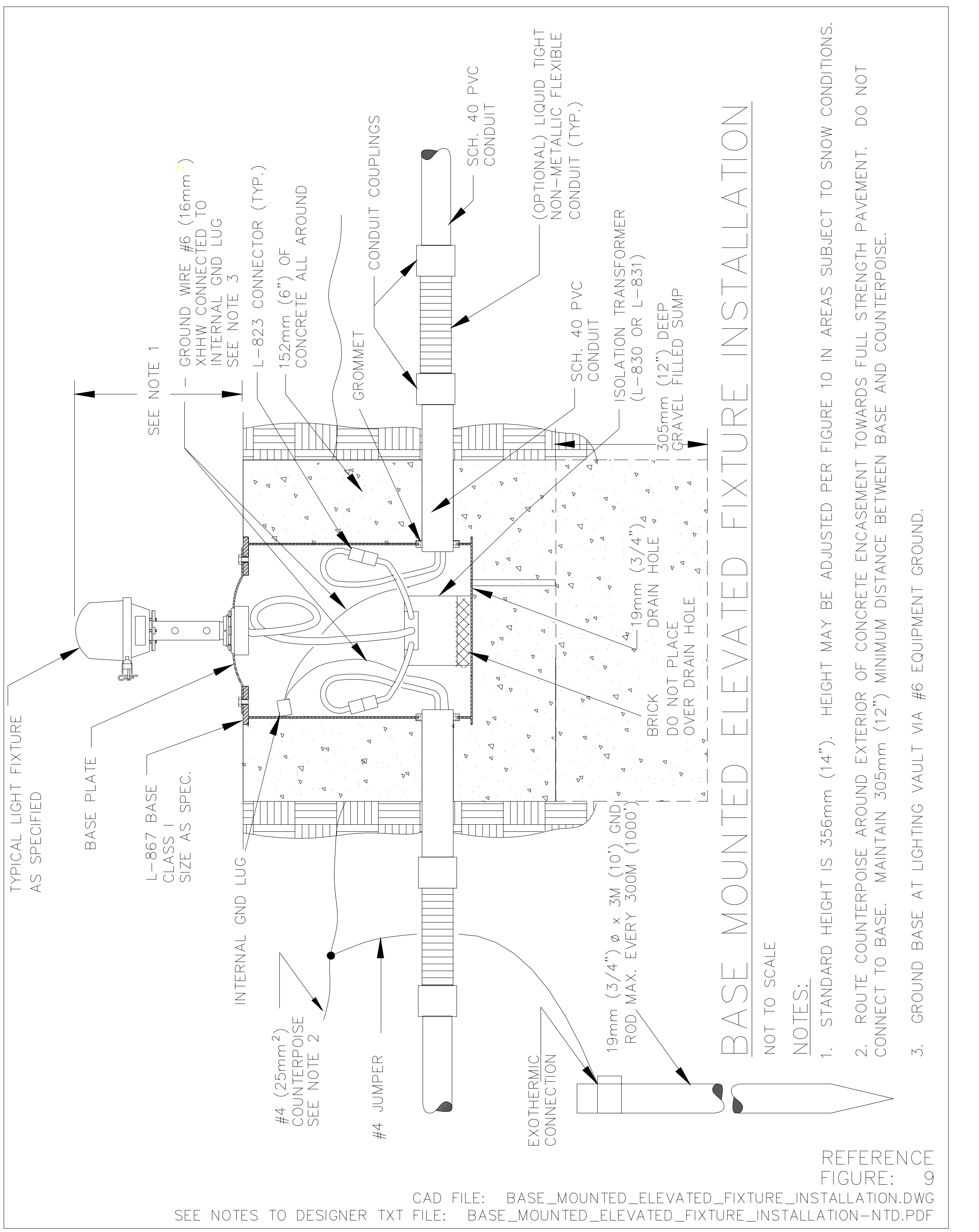


Figure 9. Base Mounted Elevated Fixture Installation

2.4. Base Mounted Elevated Fixture Installation (Navy Only)

See figure 9N.

Notes to Designer:

1. The flexible conduit allows for minor adjustments in alignment during installation and also allows flexibility of the conduit runs during freeze/thaw cycles in cold climates. The use of the flexible conduit is optional. The conduit shall meet the requirements of NEMA TC12 and should be at least 305mm (12") long.

2. Many contractors will purchase the L-867 bases and send them to pre-cast shops for the concrete encasement. The conduit stubs are slid through the grommets prior to casting. A minimum of 152mm (6") should be protruding from the encasement to allow the 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. Bases at the low point should be ordered with an additional hub and connect a 50mm (2") conduit between the underdrain and the light base. Where there is no underdrain installed the conduit may run to the closest storm water catch basin. Maintain slope such that water drains out of light base toward underdrain or catch basin.

4. Where no counterpoise is required, delete counterpoise, ground rod, connection to base can and note #2 from detail.

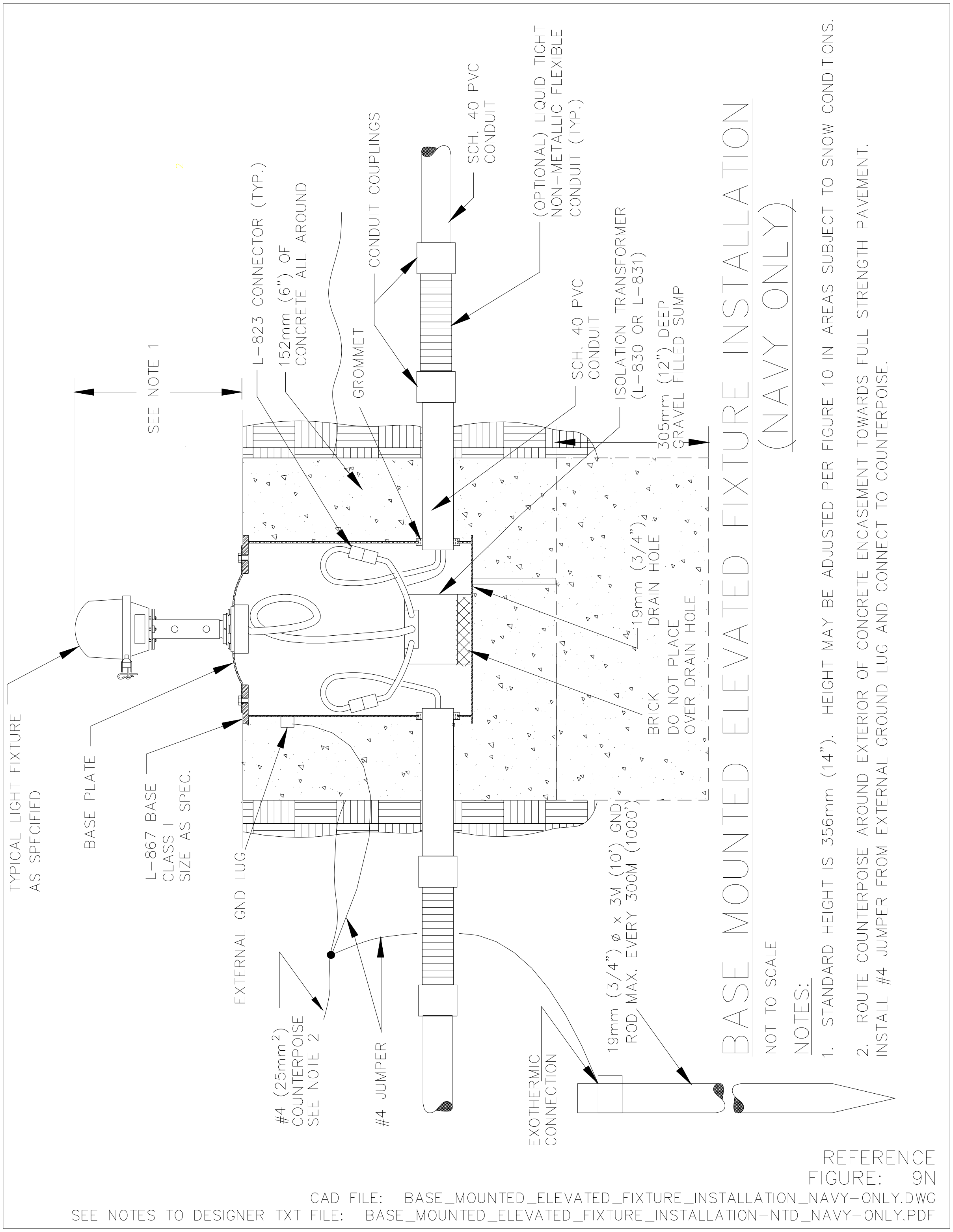


Figure 9N. Base Mounted Elevated Fixture Installation (Navy Only)

~~2.3.~~ 2.5. Adjustment of Edge Light Elevation Due to Snow Conditions

See figure 10.

Notes to Designer:

1. As indicated in the detail, the edge lights may be increased in height above the standard elevation in areas where the snowfall exceeds 0.6M (2'). However, this adjustment may only be made as the light is moved outward from 1.5M (5') to 3M (10'). Lights mounted at 1.5M (5') from pavement edge shall be a maximum of 356mm (14") above grade.

2. Typically, the lights are mounted at the 3M (10') distance on runways used by jet aircraft to avoid possible damage by jet blasts.

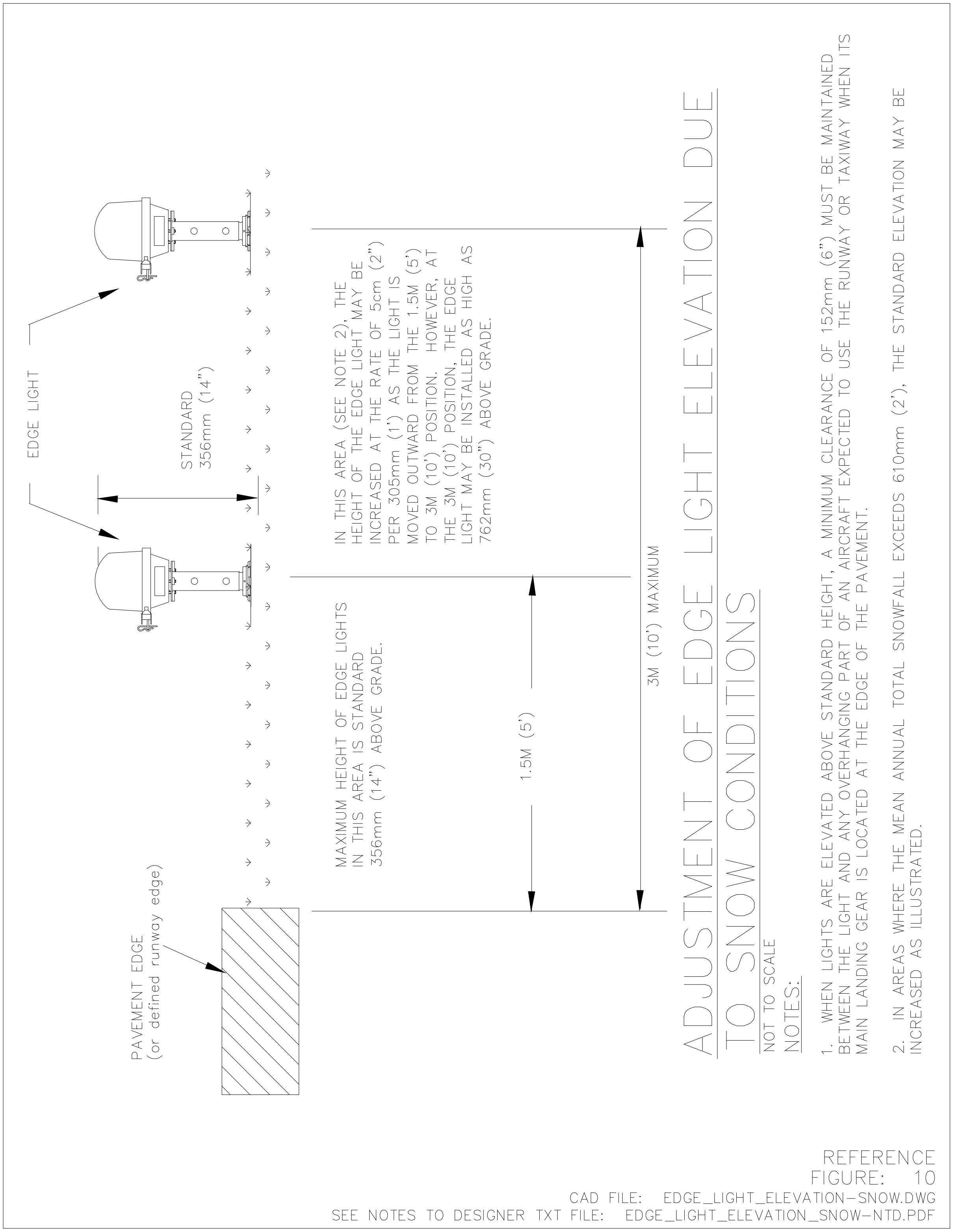


Figure 10. Adjustment of Edge Light Elevation Due to Snow Conditions

~~2.4.~~ 2.6. Semiflush Runway Light (Deep Base)

See figure 11.

Notes to Designer:

1. All semiflush 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. A maximum of 2 spacer rings should be used.

3. The sealing compound must be compatible with the type of pavement being installed and the contractor must follow the manufacturer's preparation instructions.

4. The "deep can" method is preferred in new construction with the isolation transformers for the in-pavement fixture housed within the base (can).

5. It is recommended that the designer review the profile of the in-pavement lighting system and provide drainage at the low points in the same manner as the edge lighting system.

6. Installation methods for semiflush fixtures are also contained in advisory circular AC 150/5340-4c, Installation Details for Runway Centerline and Touchdown Lighting Systems.

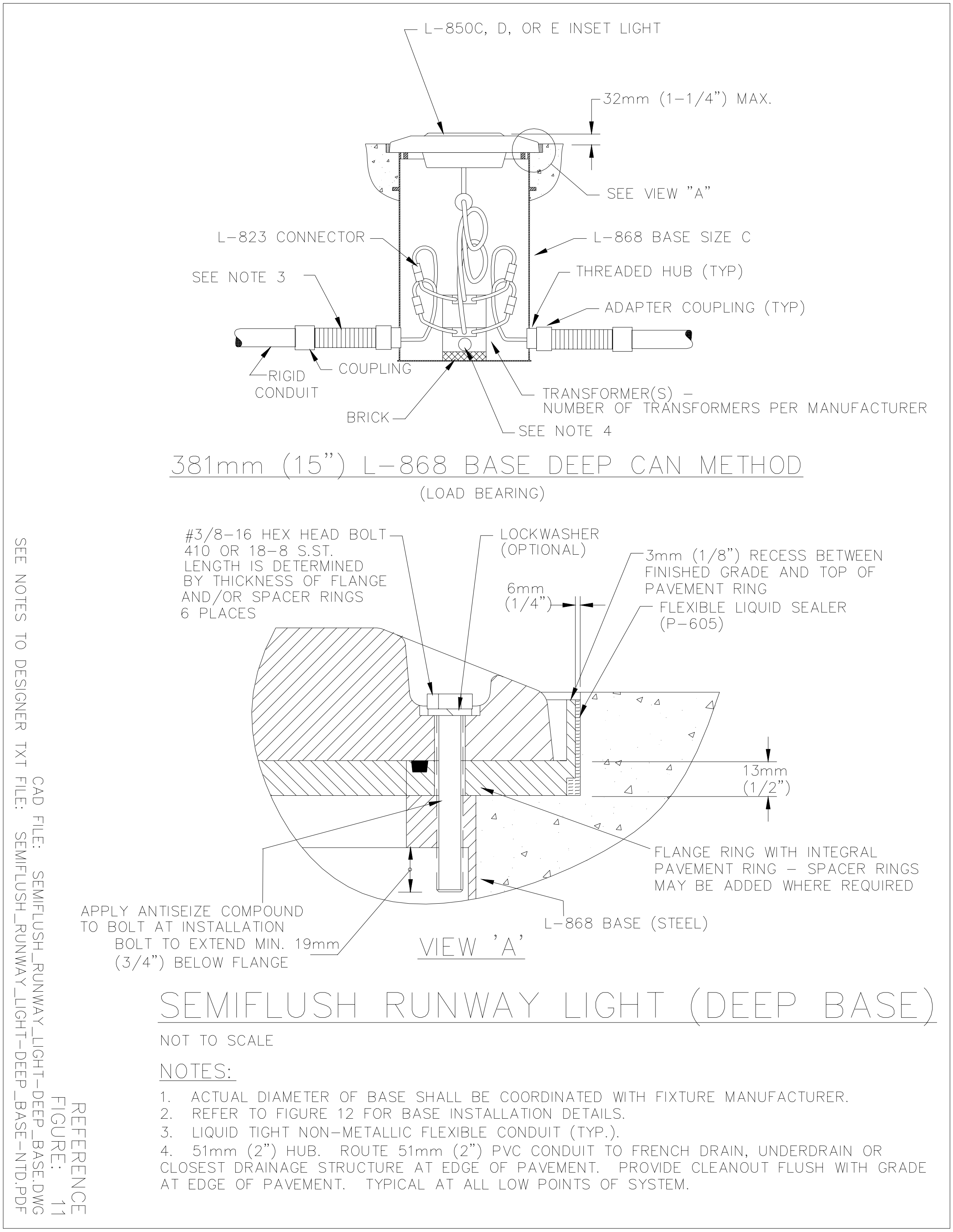


Figure 11. Semiflush Runway Light (Deep Base)

~~2.5.~~ 2.7. Base and Anchor Details (New Construction)

See figure 12.

Notes to Designer:

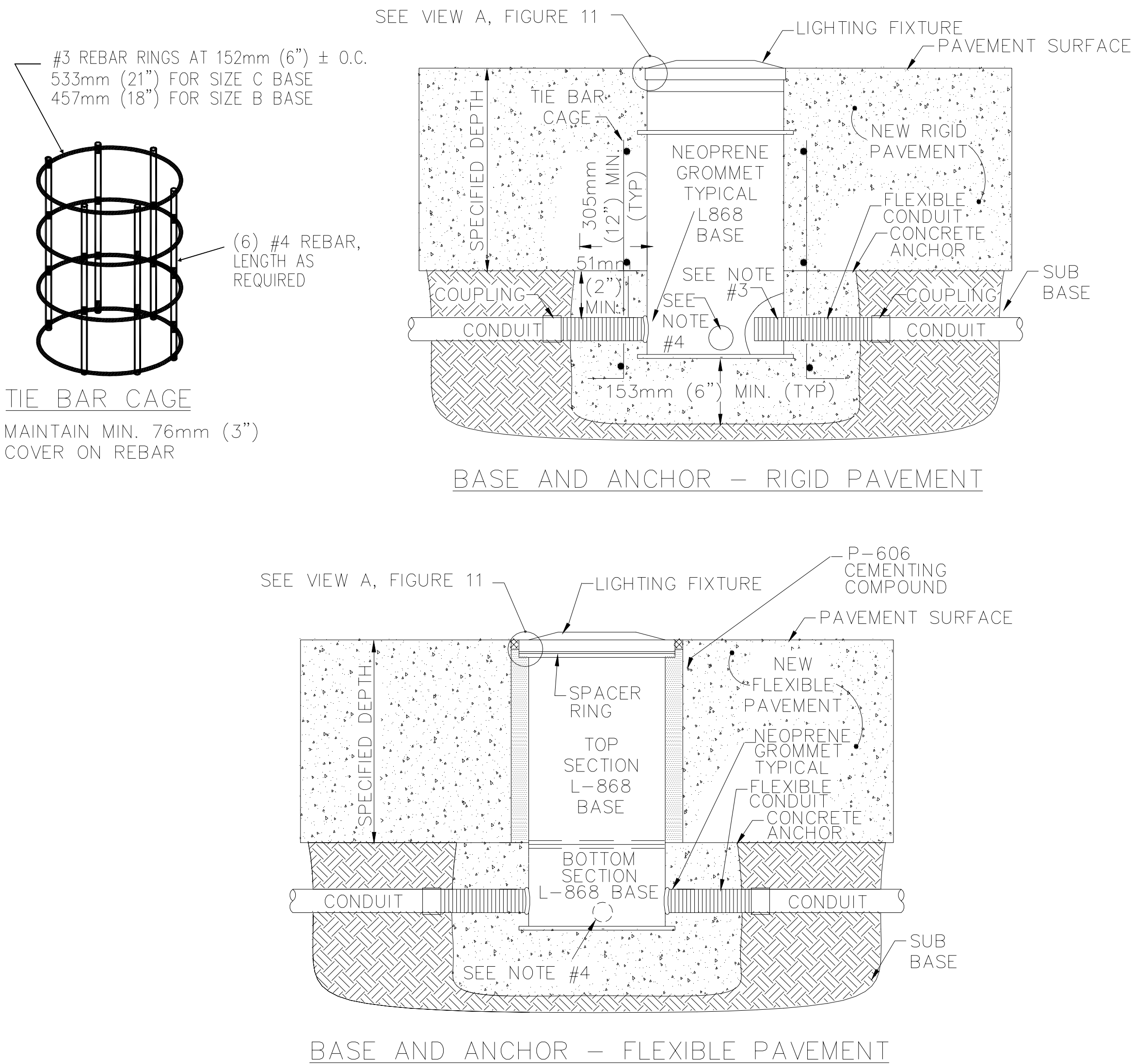
1. Construction methods will be specified in the project specifications for the type of pavement. Details should be shown on the drawings in enough detail to complement the specifications.

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 305mm (12") wider than the light base and 152mm (6") 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 51mm (2") cover over and 76mm (3") 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) will be used in flexible pavements.

4. The flexible conduit allows for minor base adjustments before the concrete anchor hardens.

5. A tie bar cage (#4 deformed) is installed around the light base in rigid pavement.



BASE AND ANCHOR DETAILS (NEW CONSTRUCTION)

NOT TO SCALE

NOTES:

1. THE USE OF MUD PLATES, SPACER RINGS, EXTENSIONS, ETC., IS DEPENDANT ON PAVING TECHNIQUES.
2. ORIENTATION TOLERANCE FOR THE BASE IS ±1/2 DEGREE FROM THE CENTERLINE SHOWN ON THE PLANS.
3. CONDUITS SHALL PROTRUDE INTO LIGHT BASE 19mm (3/4") FOR STEEL AND 51mm (2") FOR PVC AND SHALL BE A MINIMUM 305mm (12") LONG.
4. 51mm (2") PVC CONDUIT TO NEAREST CATCH BASIN OR FRENCH DRAIN. TYPICAL AT EACH LOW POINT OF LIGHTING SYSTEM.

REFERENCE FIGURE: 12
CAD FILE: BASE_&_ANCHOR-NEW.DWG
SEE NOTES TO DESIGNER TXT FILE: BASE_&_ANCHOR-NEW-NTD.PDF

Figure 12. Base and Anchor Details (New Construction)

~~2.6.~~ 2.8. Deep Base Installation (New Construction), Rigid Pavement

See figure 13.

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 A/E team, contractor, government and field personnel. The purpose of this meeting will be to review the proposed construction techniques.

2. The installation of the alignment jig shall be per the base manufacturer's requirements.

3. Once the light bases are set at the correct elevation, the conduit is installed between the bases and the tie bare cages are formed around the base. 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.

4. Once the concrete has cured approximately 24 hrs., the jig may be removed.

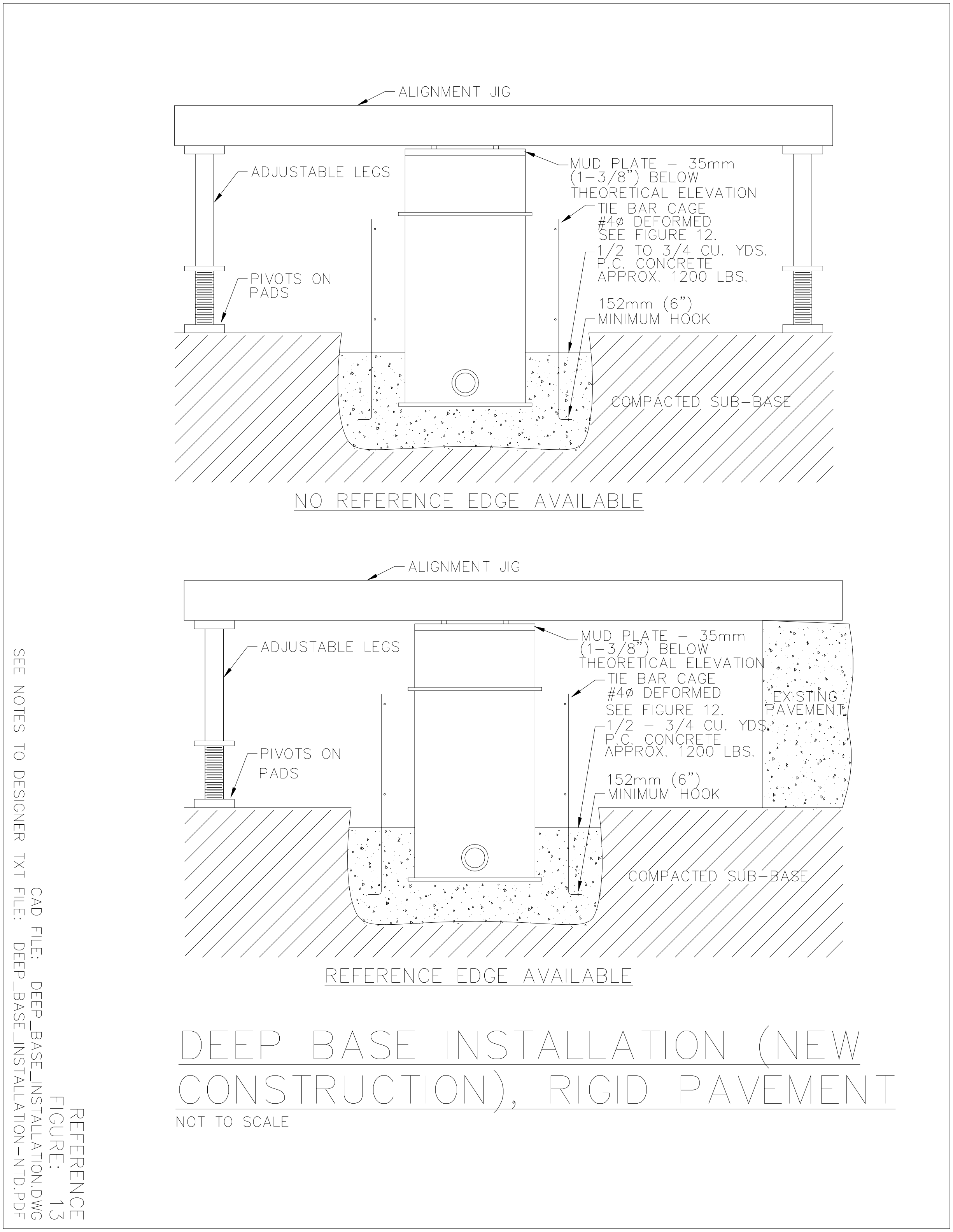


Figure 13. Deep Base Installation (New Construction), Rigid Pavement

~~2.7.~~ 2.9. Flexible Pavement or Overlay (Flexible, Rigid) Installation

See figure 14.

Notes to Designer:

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

2. 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. The concrete anchor is poured and allowed to cure for 24 hours.

3. The jig may then be removed and paving operations may be accomplished.

4. Ensure contractor core drills the light bases after compaction has been completed and the pavement has been accepted.

5. The rigid 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.

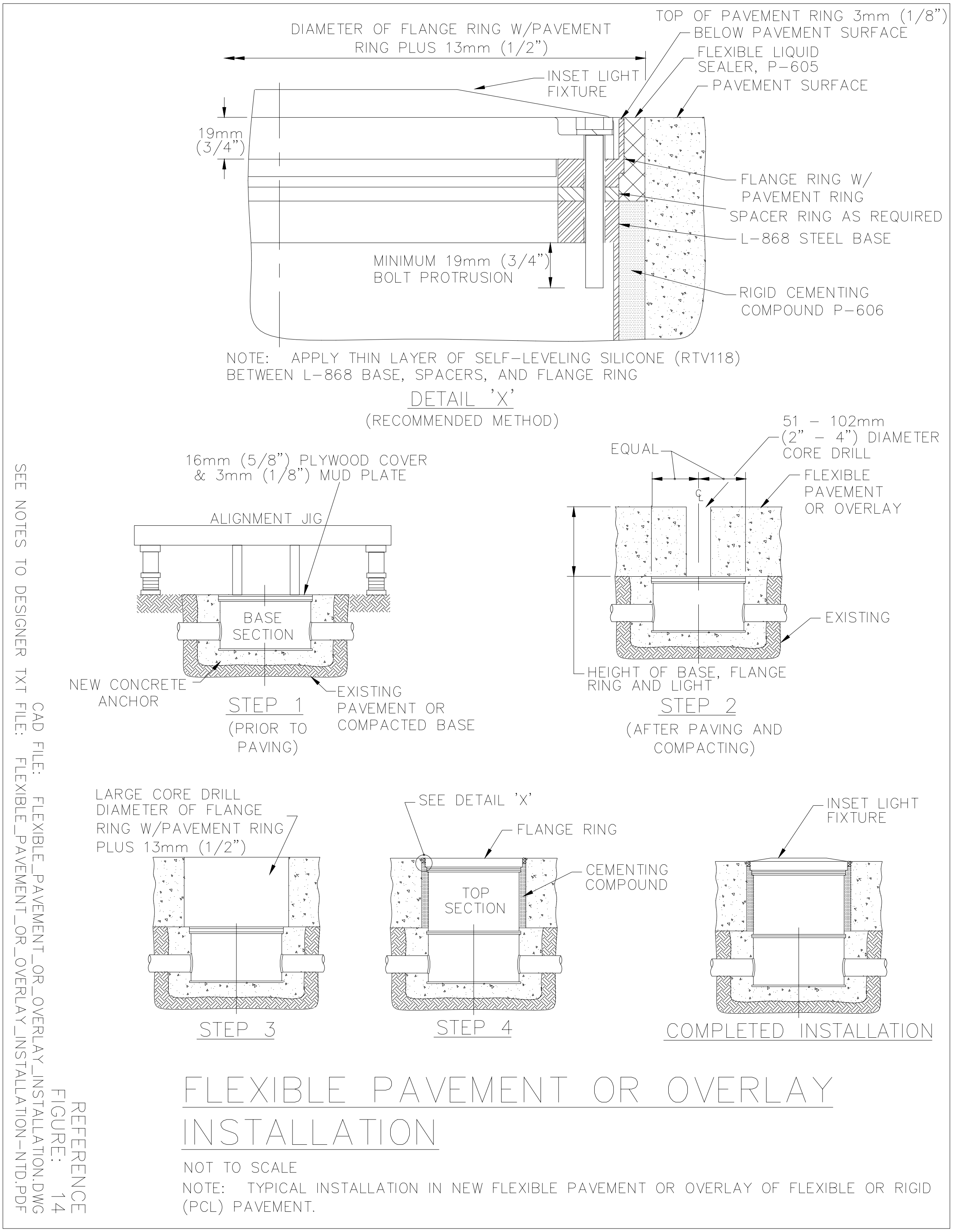


Figure 14. Flexible Pavement or Overlay Installation

~~2.8.~~ 2.10. Saw Kerf Wireway Details – R/W Centerline and TDZ Lights

See figure 15.

Notes to Designer:

1. The preferred method for installation of runway centerline and touchdown zone (TDZ) lights in new construction is to utilize deep base housing; the individual isolation transformer and each base 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. The pavement is core drilled to a depth and diameter recommended by the fixture manufacturer. The fixture is then "glued-in" utilizing sealant that is chemically compatible with the pavement. It is extremely important to specify the proper sealant to prevent possible separation. A shallow base with anti-rotational fins and pavement anchors is recommended. Some problems have been encountered with the "direct mounted" type fixtures that have a smooth exterior finish.

3. 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.

4. 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.

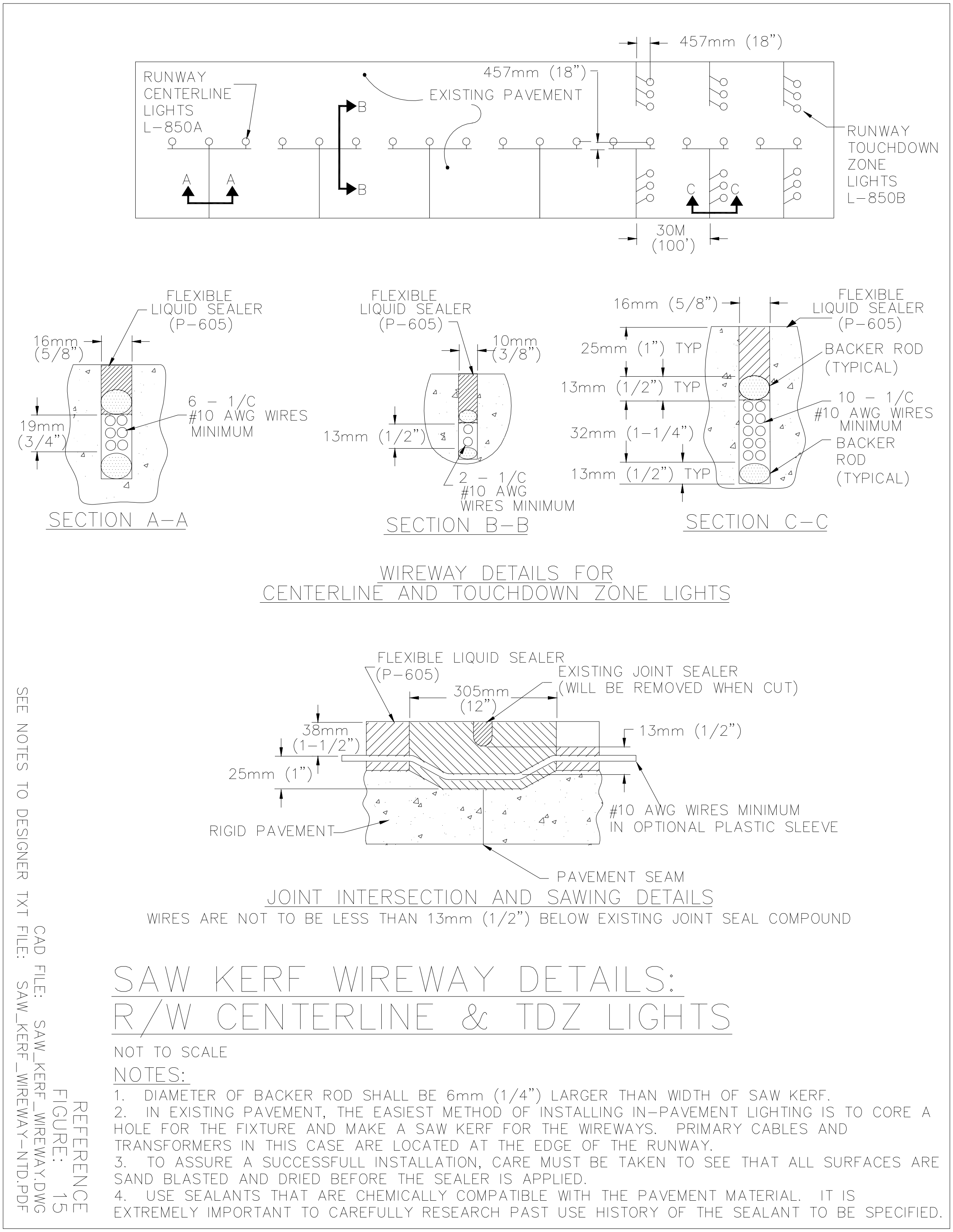


Figure 15. Saw Kerf Wireway Details – R/W Centerline and TDZ Lights

~~2.9.~~ 2.11. Saw Kerf Orientation Details – R/W Centerline and TDZ Lights

See figure 16.

Notes to Designer:

1. Additional information may be found in FAA Advisory Circular AC 150/5340-4c, Installation Details for Runway Centerline and Touchdown Lighting Systems.

2. It is recommended to install the secondary conductors without any splices. However, where splices are unavoidable they may be installed in an L-869 junction box as outlined in AC 150/5340-4c.

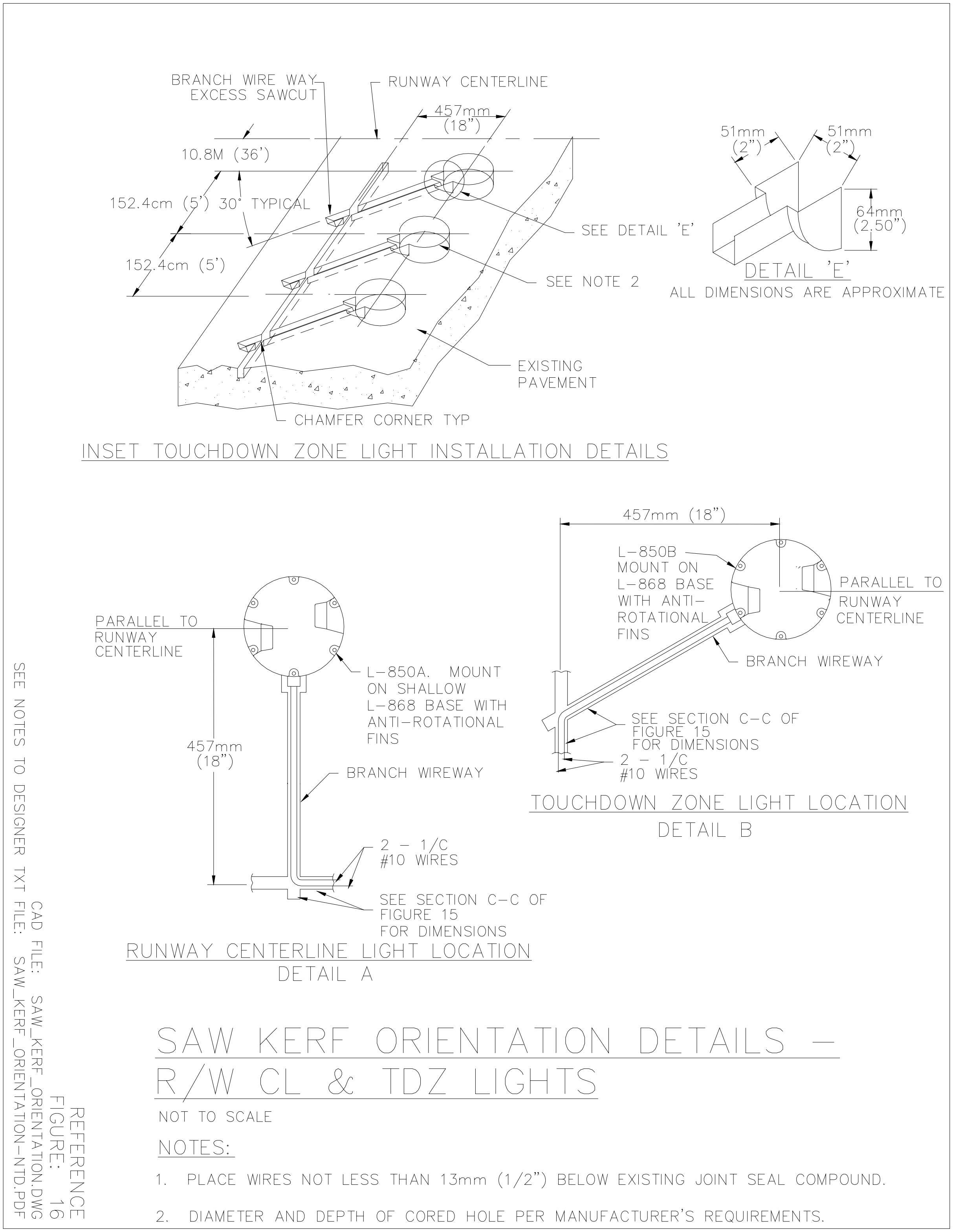


Figure 16. Saw Kerf Orientation Details – R/W Centerline and TDZ Lights

~~2.10.~~ 2.12. Runway Centerline Light – Shallow Base and Conduit Installation

See figure 17.

Notes to Designer:

1. More and more installations have been utilizing conduit for the secondary conductors. If conduit is used a water tight seal where the conduit enters the base must be specified.

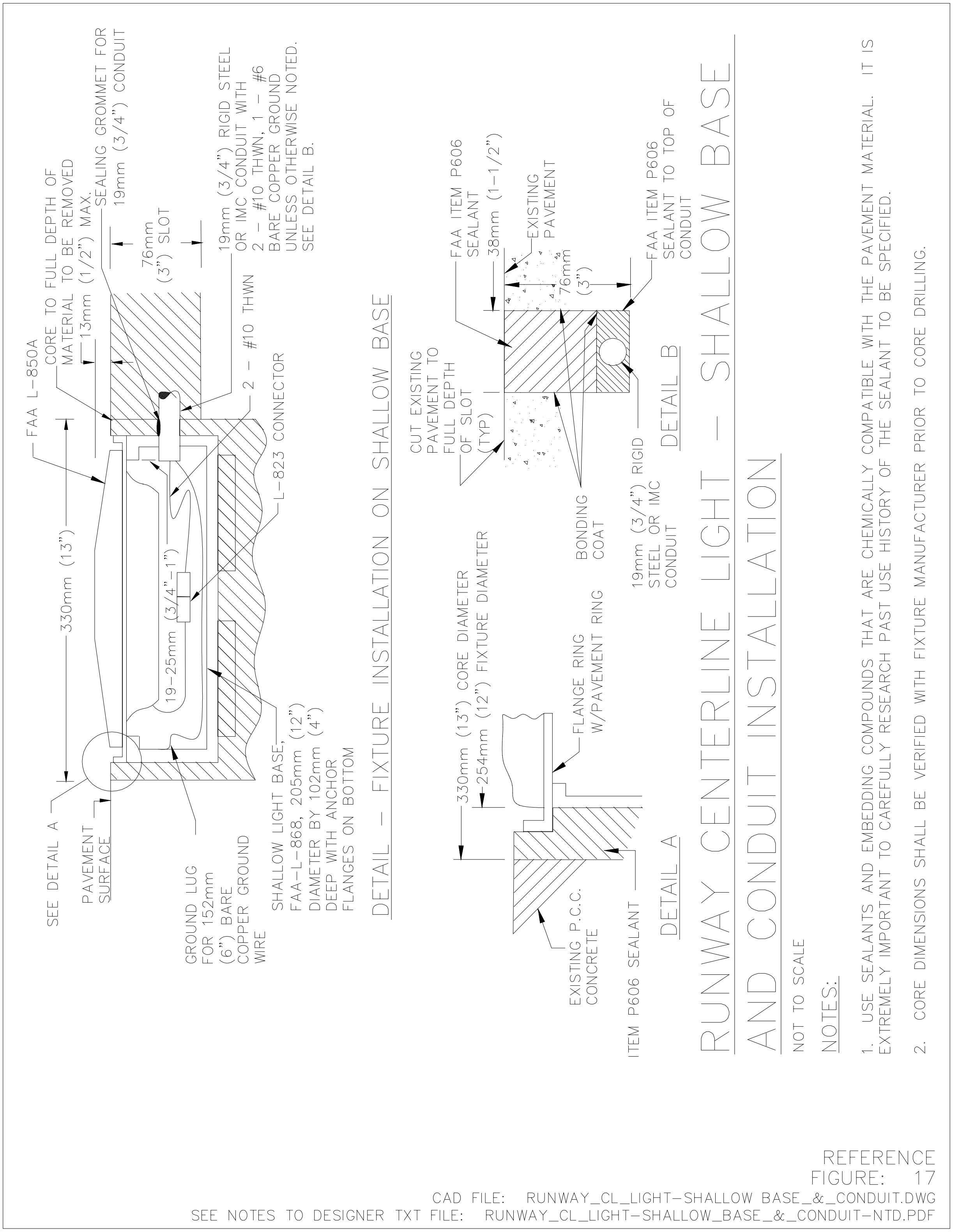


Figure 17. Runway Centerline Light – Shallow Base and Conduit Installation

~~2.11.~~ 2.13. Semiflush Shallow Base Runway Edge End or Threshold Light

See figure 18.

Notes to Designer:

1. This detail shows one particular manufacturer's shallow base. However, recommend specifying the base with anti-rotational and anchoring fins or specify the fixture manufacturer demonstrate the base will not rotate or separate from the embedding material.

2. Recommend stating in basis of design the particular fixture manufacturer the design was based on.

3. Deep base installation is the preferred installation method. Recommend prior approval for this installation before design.

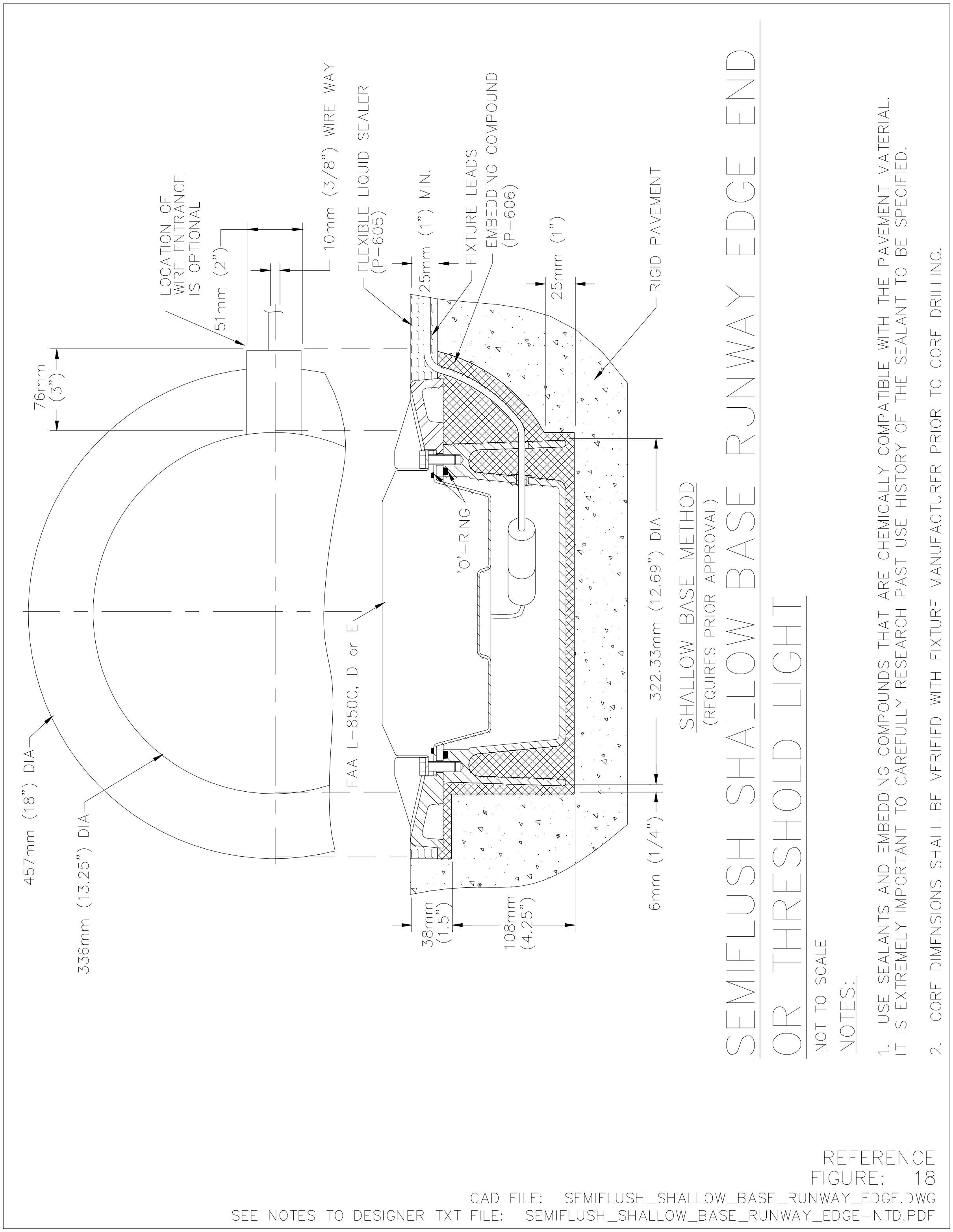


Figure 18. Semiflush Shallow Base Runway Edge End or Threshold Light

~~2.12.~~ 2.14. Semiflush Shallow Base Runway Centerline or TDZ Light

See figure 19.

Notes to Designer:

1. This detail shows one particular manufacturer's shallow base. However, recommend specifying the base with anti-rotational and anti-lift fins or specify the fixture manufacturer demonstrate the base will not rotate or separate from the embedding material.

2. Recommend stating in basis of design the particular fixture manufacturer the design was based on.

3. Deep base installation is the preferred installation method. Recommend prior approval for this installation before design.

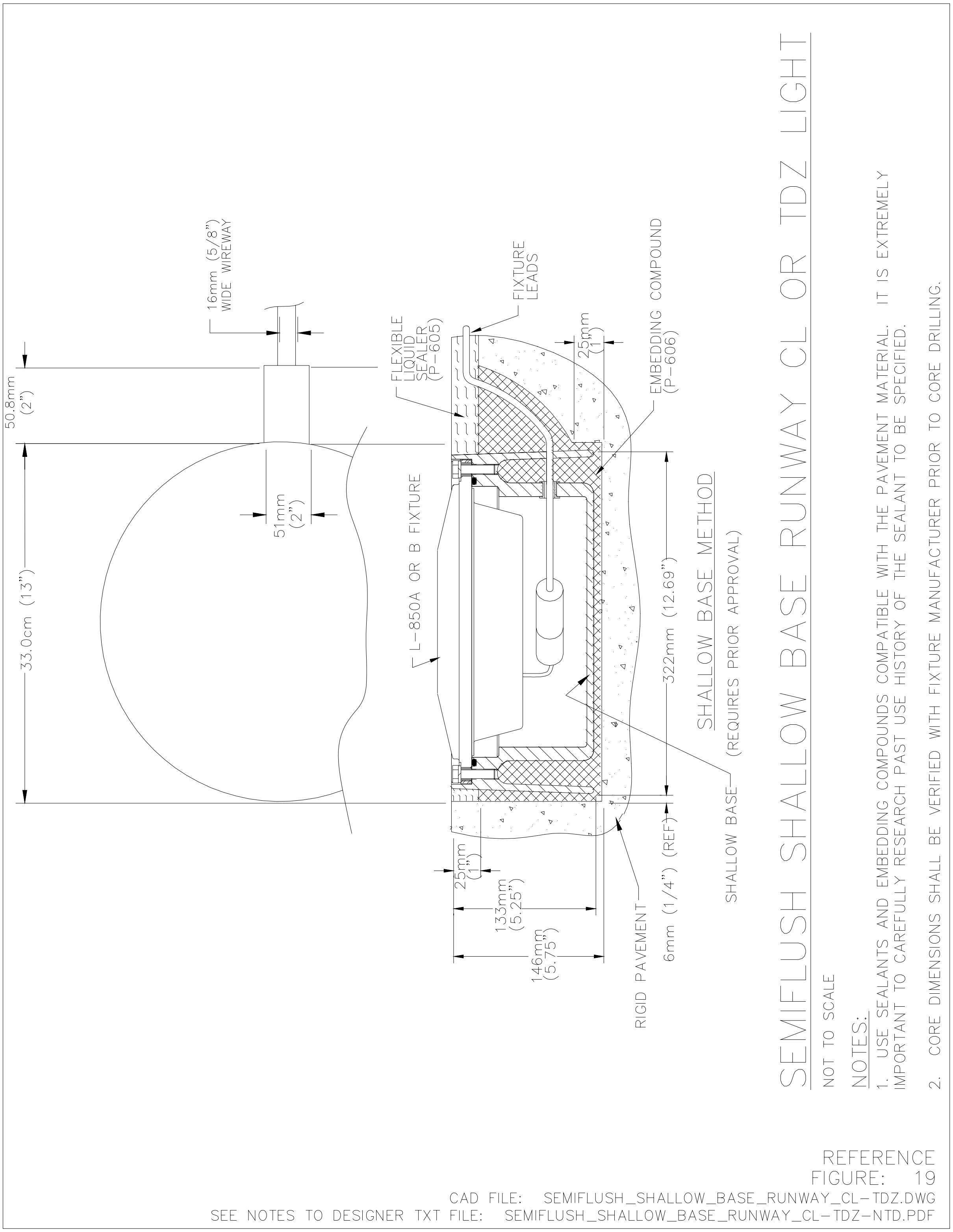


Figure 19. Semiflush Shallow Base Runway Centerline or TDZ Light

~~2.13.~~ 2.15. Taxiway Centerline Lights Wiring Methods

See figure 20.

Notes to Designer:

1. Additional information on taxiway centerline lighting may be found in FAA Advisory Circular AC 150/5340-28, Low Visibility Taxiway Lighting Systems.

2. Installation of wiring in saw kerfs is similar to the methods used for other in-pavement fixtures.

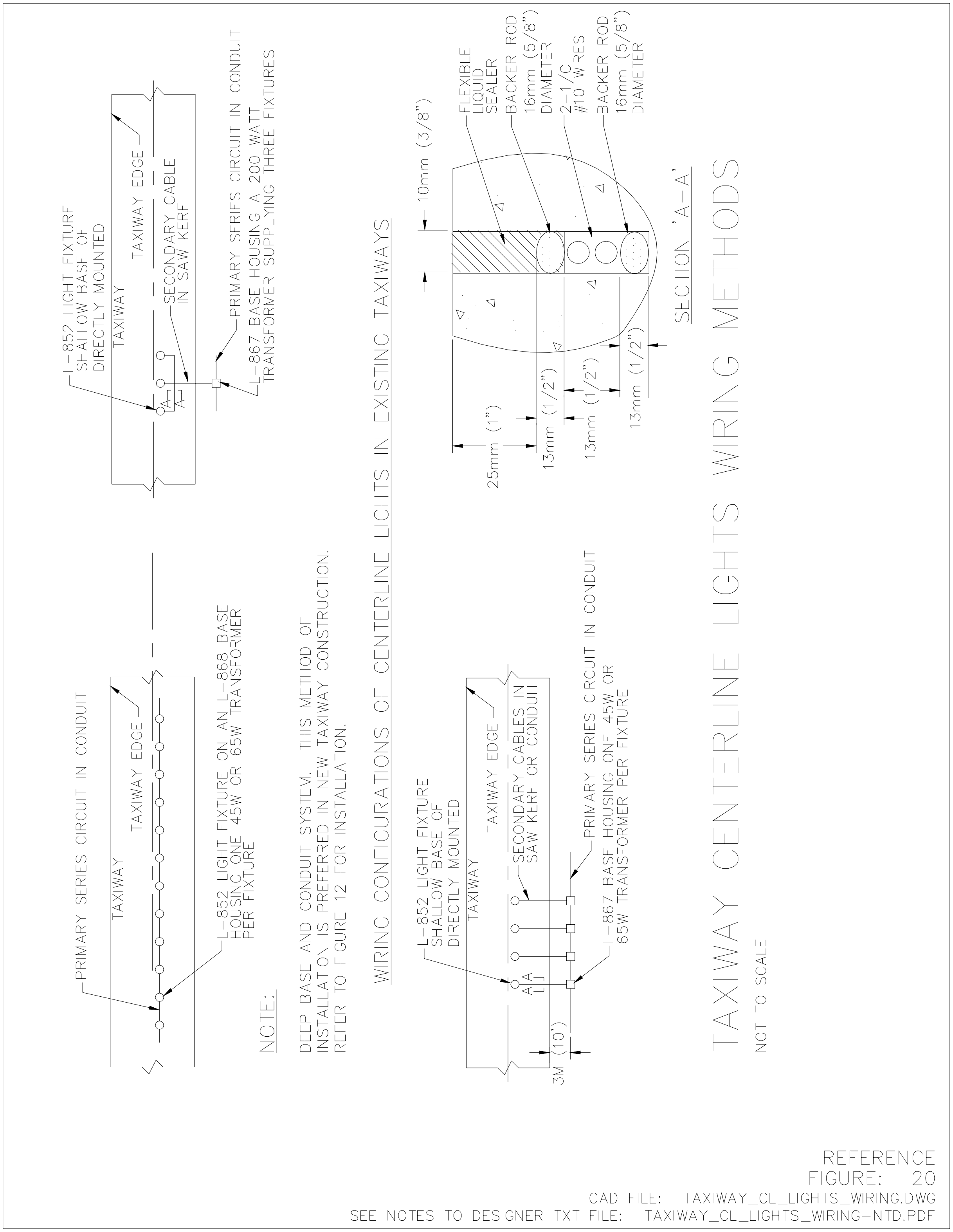


Figure 20. Taxiway Centerline Lights Wiring Methods

~~2.14.~~ 2.16. Semiflush Shallow Base Taxiway Centerline Light

See figure 21.

Notes to Designer:

1. This detail shows one particular manufacturer's shallow base. However, recommend specifying the base with anti-rotational and anti-lift fins or specify the fixture manufacturer demonstrate the base will not rotate or separate from the embedding material.

2. Recommend stating in basis of design the particular fixture manufacturer the design was based on.

3. Deep base installation is the preferred installation method. Recommend prior approval for this installation before design.

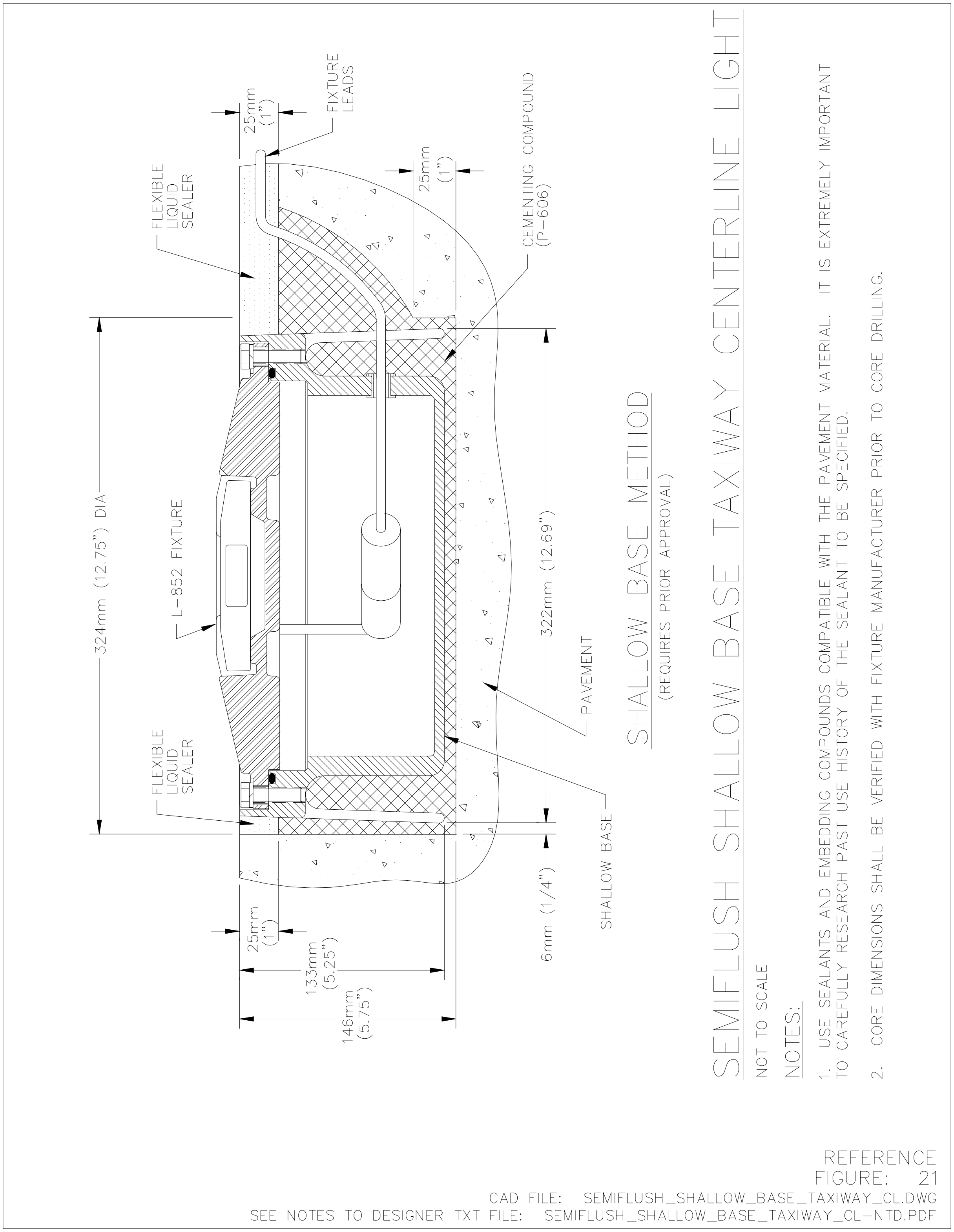


Figure 21. Semiflush Shallow Base Taxiway Centerline Light

~~2.15.~~ 2.17. Typical Touchdown Zone Light Wiring Details

See figure 22.

Notes to Designer:

1. Refer to ~~Volume I~~UFC 3-535-01 for circuiting considerations.

2. The monitoring requirements for Cat II and III runways require the number of lamps out to be monitored. The use of lamp shorting devices, either relay or film disk type, must be avoided for monitoring system to successfully detect lamps out. Fixtures connected with lamps in series won't be able to be monitored if shorting devices are employed.

3. Monitoring and control systems exist that utilize existing load cables to communicate via power line carrier technology. Individual lamp control and status monitoring can be achieved with these systems. System computers in vault can communicate control and load status signals to control tower or other remote locations.

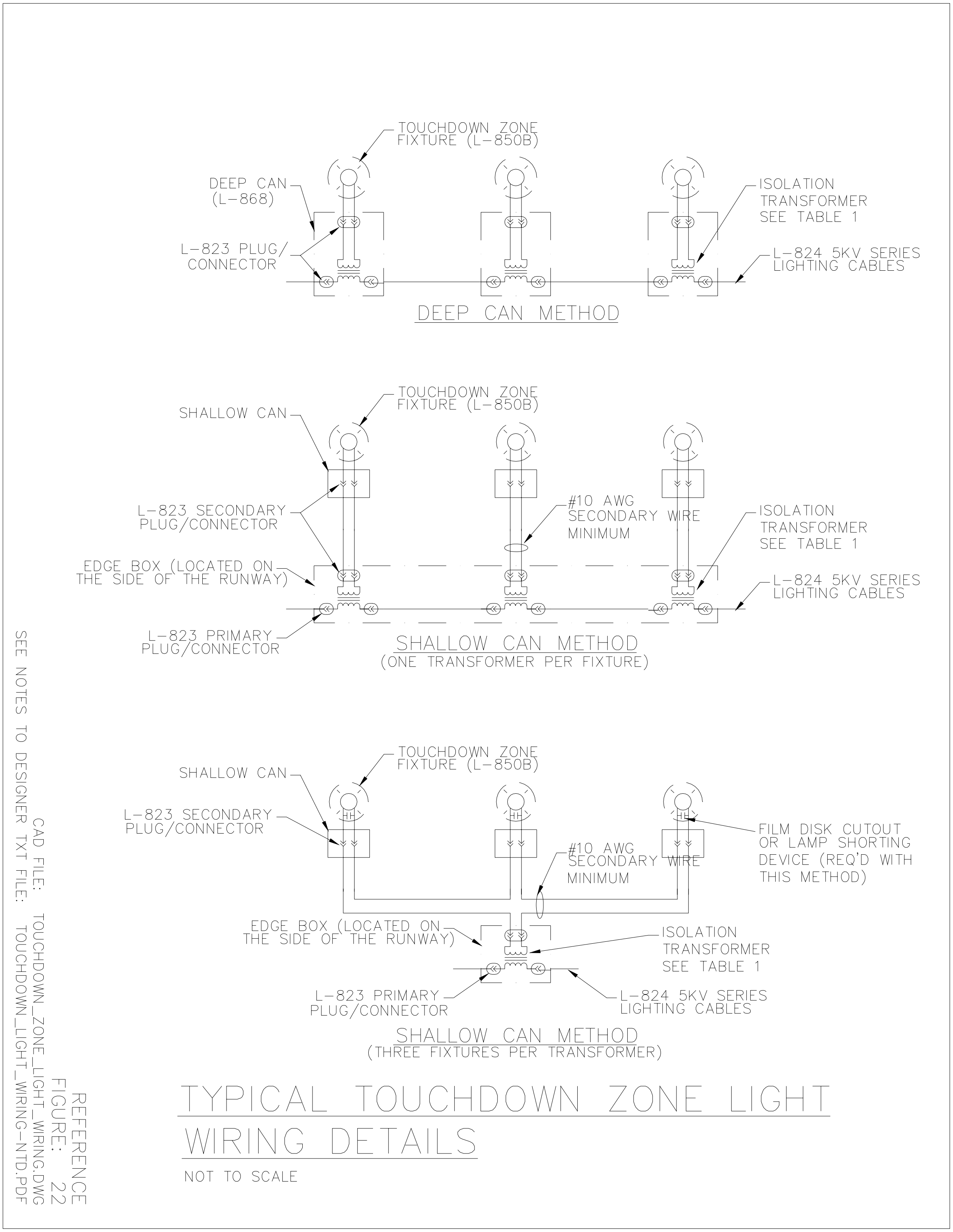


Figure 22. Typical Touchdown Zone Light Wiring Details

~~2.16.~~ 2.18. Touchdown Zone Lighting Wiring Diagram – Single Circuit

See figure 23.

Notes to Designer:

1. Refer to ~~Volume I~~UFC 3-535-01 for circuiting considerations.

2. The monitoring requirements for Cat II and III runways require the number of lamps out to be monitored. The use of lamp shorting devices, either relay or film disk type, must be avoided for monitoring system to successfully detect lamps out. Fixtures connected with lamps in series won't be able to be monitored if shorting devices are employed.

3. Monitoring and control systems exist that utilize existing load cables to communicate via power line carrier technology. Individual lamp control and status monitoring can be achieved with these systems. System computers in vault can communicate control and load status signals to control tower or other remote locations.

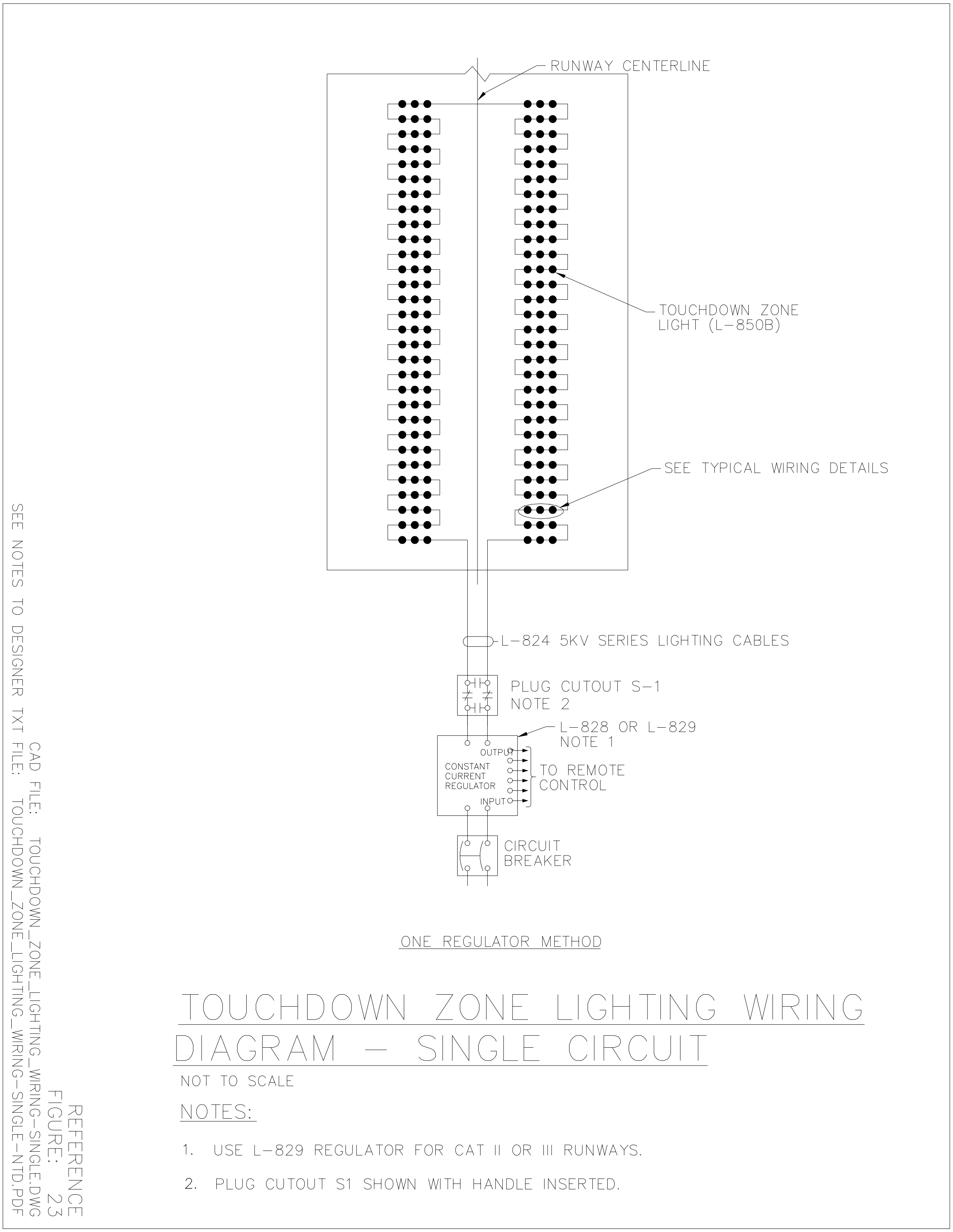


Figure 23. Touchdown Zone Lighting Wiring Diagram – Single Circuit

~~2.17.~~ 2.19. Typical Interleaved Touchdown Zone Lighting Wiring Diagram

See figure 24.

Notes to Designer:

1. Refer to ~~Volume I~~UFC 3-535-01 for circuiting considerations.

2. The monitoring requirements for Cat II and III runways require the number of lamps out to be monitored. The use of lamp shorting devices, either relay or film disk type, must be avoided for monitoring system to successfully detect lamps out. Fixtures connected with lamps in series won't be able to be monitored if shorting devices are employed.

3. Monitoring and control systems exist that utilize existing load cables to communicate via power line carrier technology. Individual lamp control and status monitoring can be achieved with these systems. System computers in vault can communicate control and load status signals to control tower or other remote locations.

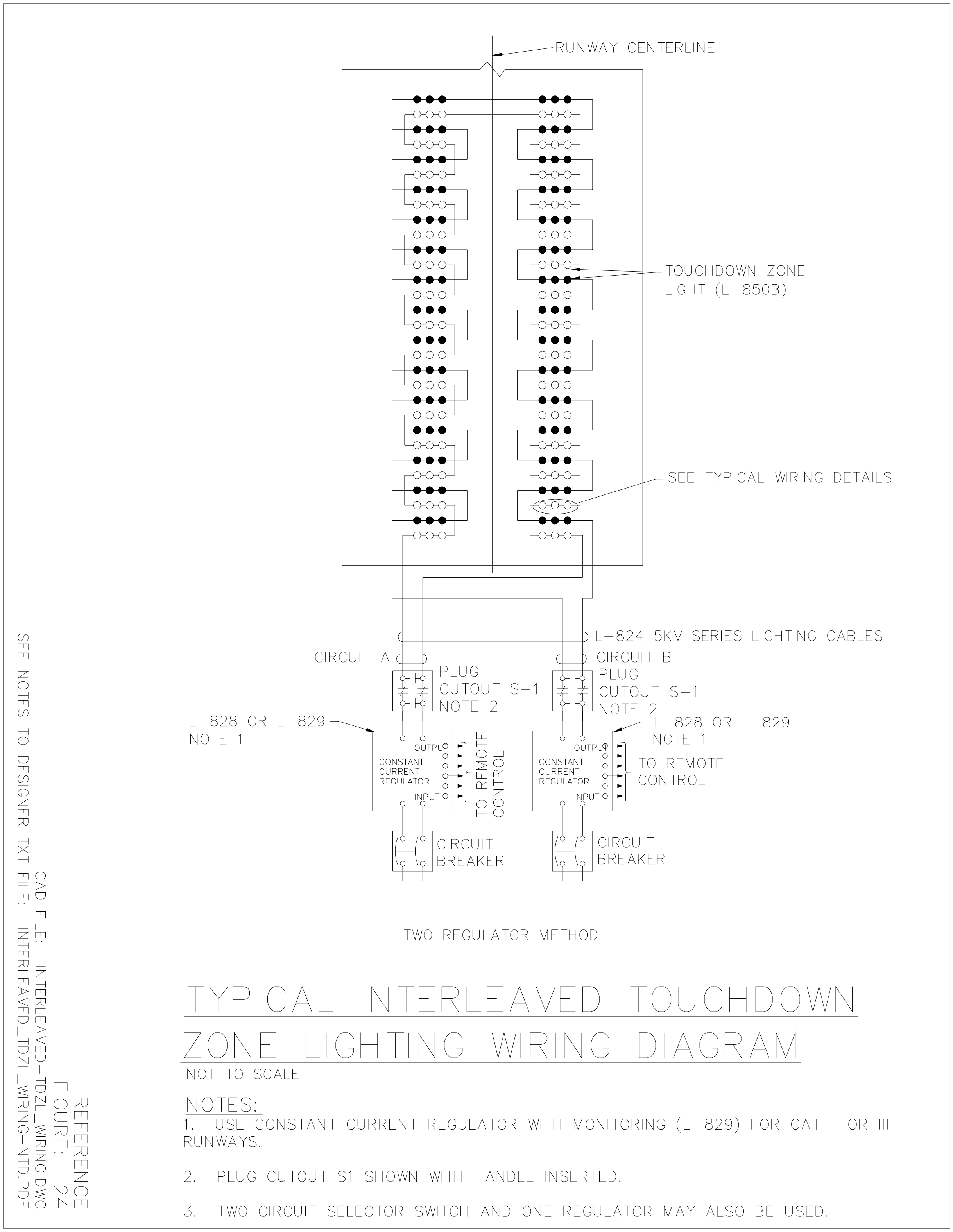


Figure 24. Typical Interleaved Touchdown Zone Lighting Wiring Diagram

~~2.18.~~ 2.20. Typical Interleaved Centerline Light Wiring Diagram

See figure 25.

Notes to Designer:

1. Refer to ~~Volume I~~UFC 3-535-01 for circuiting considerations.

2. The monitoring requirements for Cat II and III runways require the number of lamps out to be monitored. The use of lamp shorting devices, either relay or film disk type, must be avoided for monitoring system to successfully detect lamps out. Fixtures connected with lamps in series won't be able to be monitored if shorting devices are employed.

3. Monitoring and control systems exist that utilize existing load cables to communicate via power line carrier technology. Individual lamp control and status monitoring can be achieved with these systems. System computers in vault can communicate control and load status signals to control tower or other remote locations

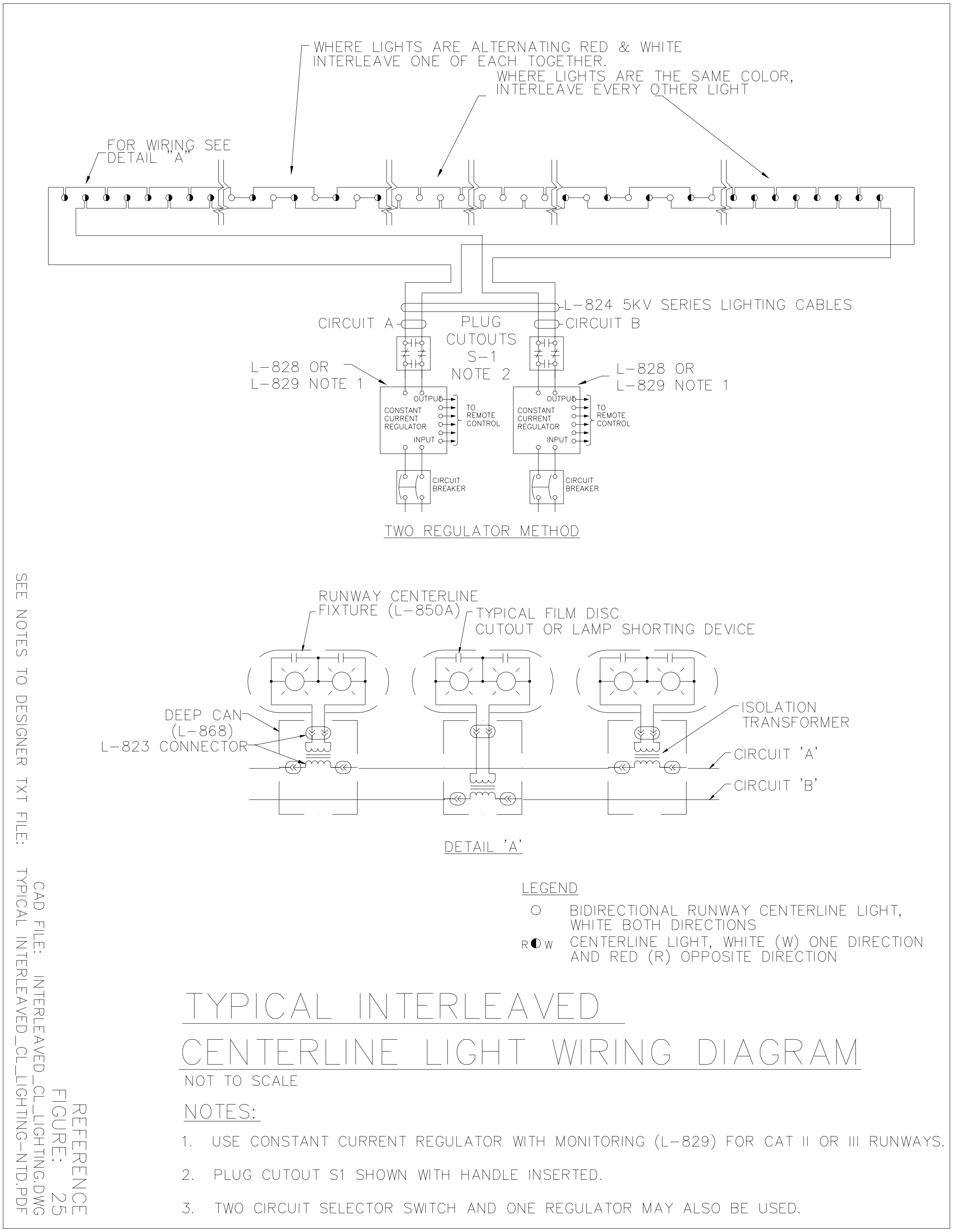


Figure 25. Typical Interleaved Centerline Light Wiring Diagram

~~2.19.~~ 2.21. Typical Interleaved Circuit Runway Lighting Wiring Diagram

See figure 26.

Notes to Designer:

1. This figure shows the interleaving method for circuiting the runway lighting system. Refer to ~~Volume I~~UFC 3-535-01 for circuit design considerations.

2. This method is more expensive since the amount of cable is doubled, two regulators are required, and there are parallel controls.

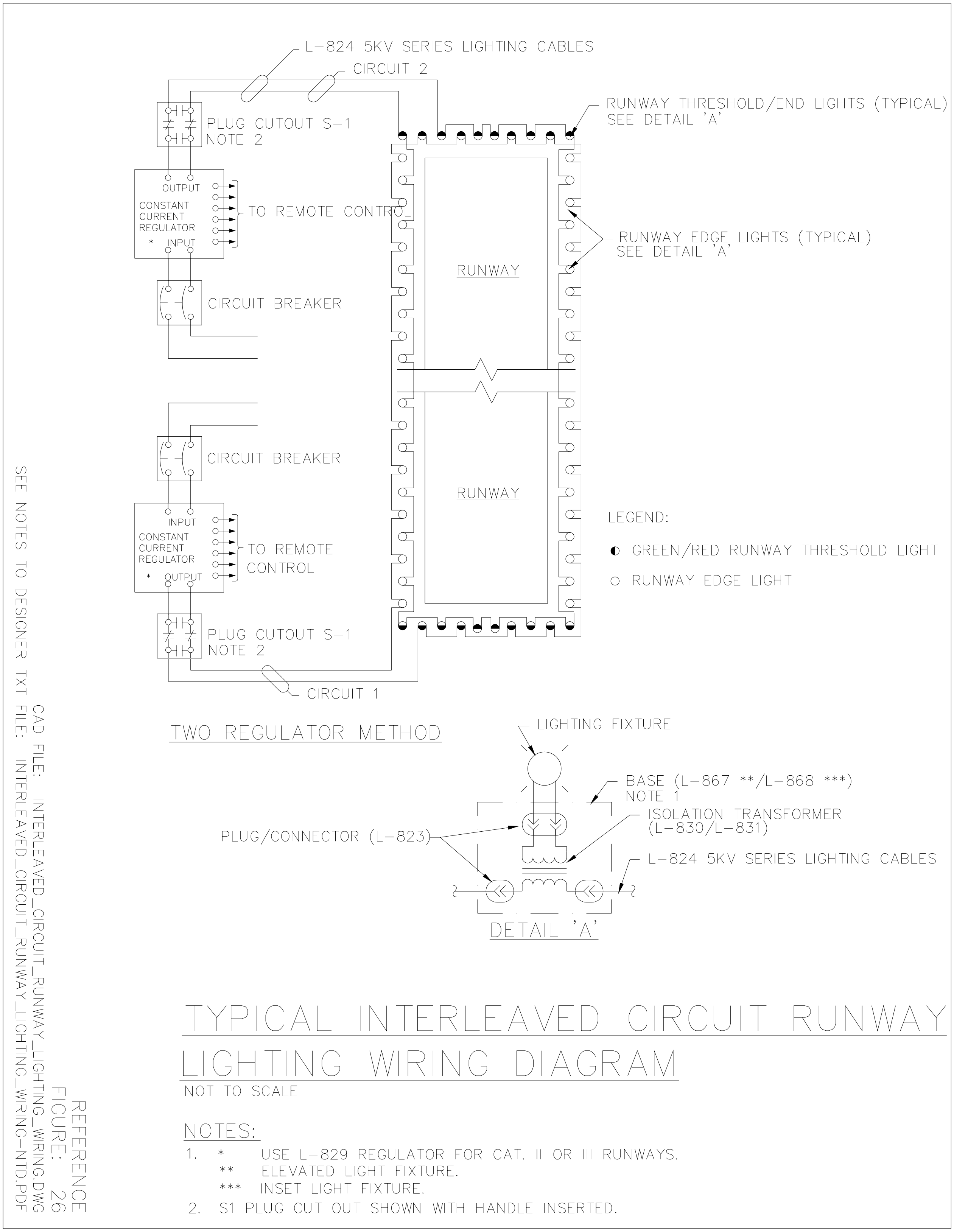


Figure 26. Typical Interleaved Circuit Runway Lighting Wiring Diagram

~~2.20.~~ 2.22. Typical Two Circuit/One Regulator Wiring Diagram

See figure 27.

Notes to Designer:

1. This method uses an L-847 selector switch and one regulator. The circuits are still interleaved so if there is an open in one of the circuits that circuit may be bypassed by turning off C1 and C2 (or vice versa) will still operate.

2. Circuit selector switches are available with up to 4 circuits and are useful during low visibility operations (SMGCS) where only designated taxi routes are used.

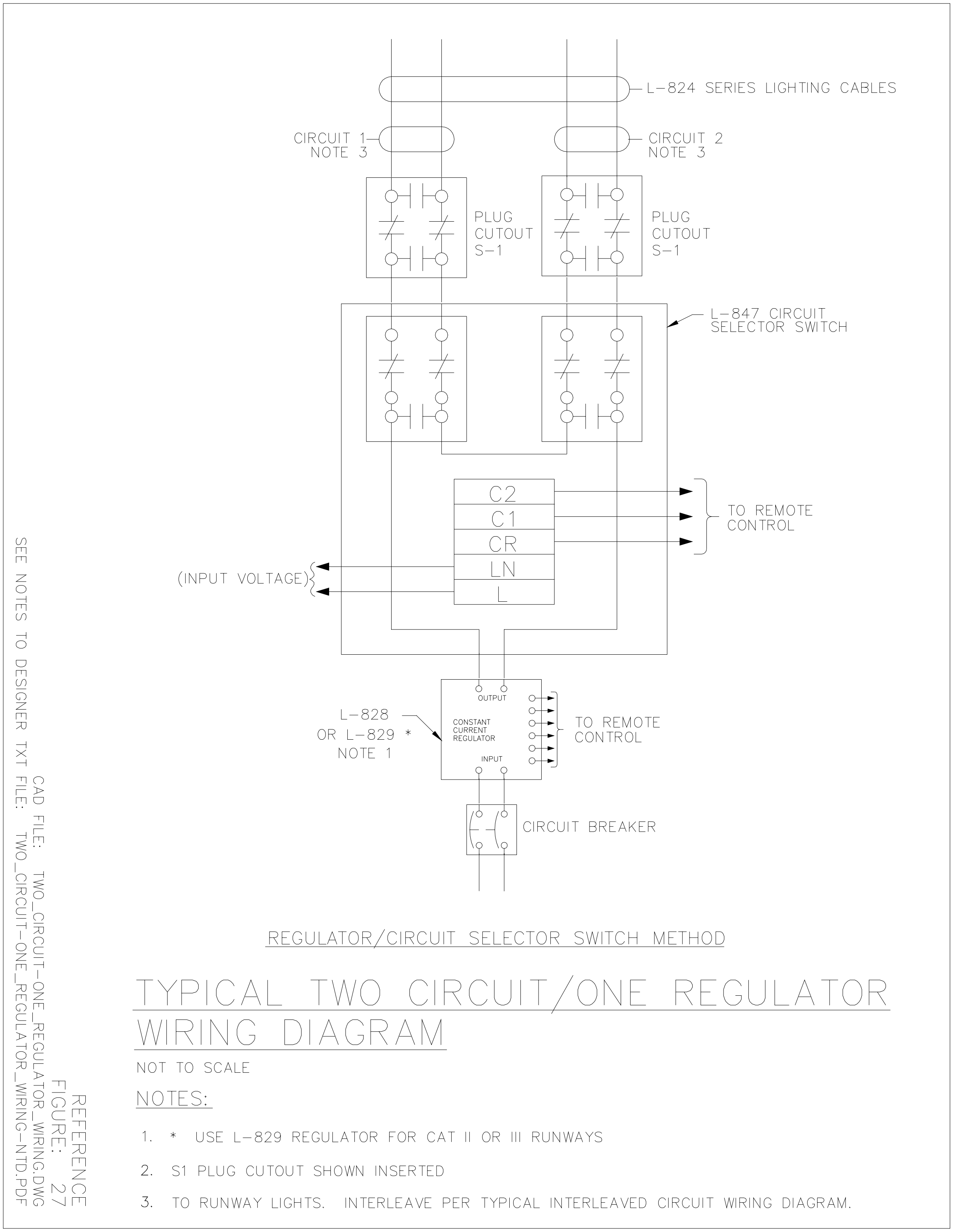


Figure 27. Typical Two Circuit/One Regulator Wiring Diagram

~~2.21.~~ 2.23. Radio Control of Constant Current Regulator Wiring Diagram

See figure 28.

Notes to Designer:

1. This diagram shows energizing the regulator by the use of an L-854 radio controller and interface device.

2. The serial outputs (#1, #2, #3) are energized one at a time by either 3, 5, or 7 clicks within a 5 second period on the pilot's radio. This provides a break before make contact arrangement.

3. The parallel outputs (#1, #2, #3) are energized sequentially (i.e., 1, 1+2, 1+2+3) by the same 3, 5, or 7 clicks of the pilot's radio. These outputs may be used to energize contactors feeding constant voltage equipment such as REILs or PAPIs.

4. Ensure regulator manufacturer is consulted prior to designing radio control system.

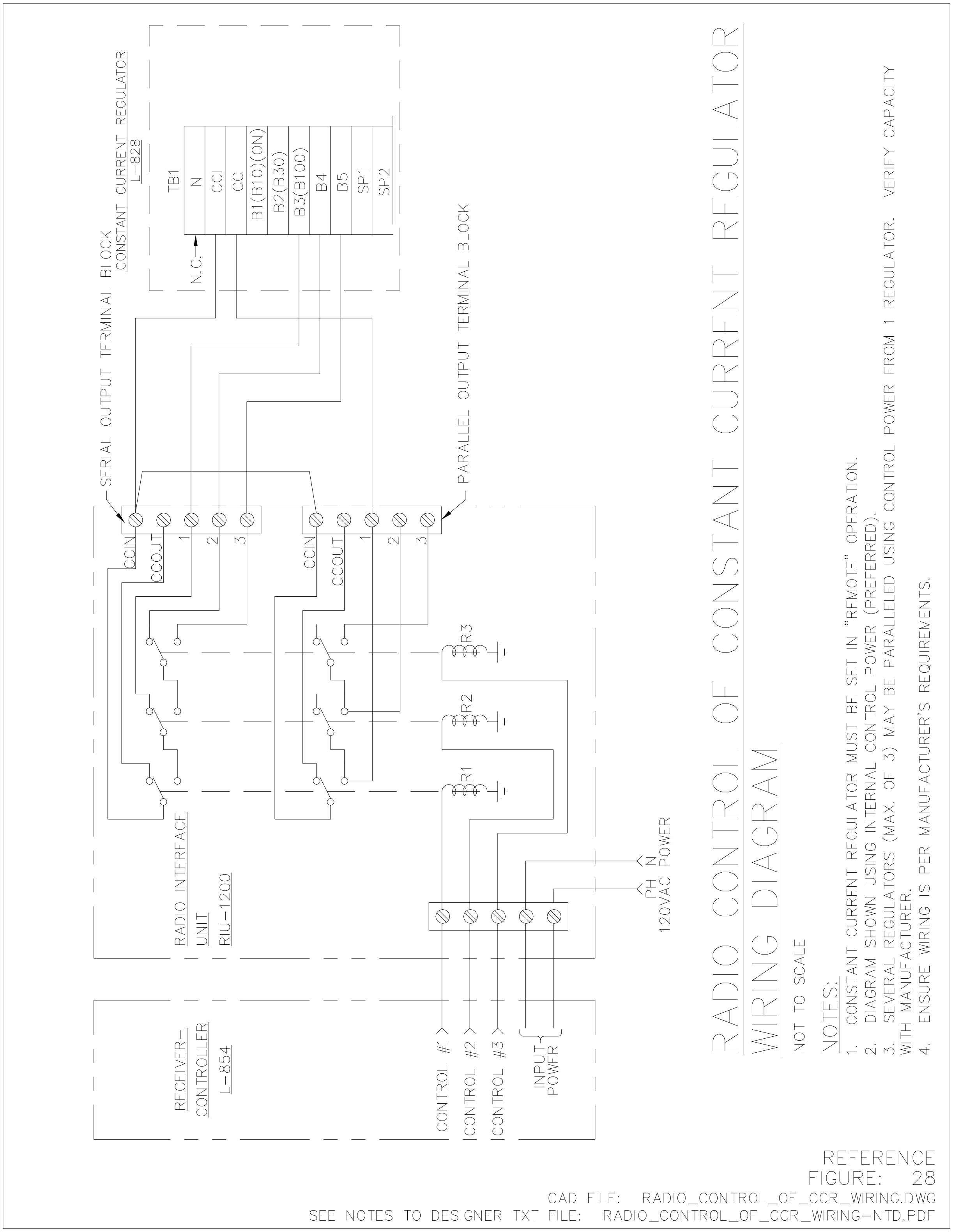


Figure 28. Radio Control of Constant Current Regulator Wiring Diagram

Chapter 3: AIRFIELD GUIDANCE SIGNS

3.1. Airfield Guidance Sign Detail

See figure 29.

Notes to Designer:

1. In addition to FAA AC 150/5340-18 and FAA AC 150/5345-44, the FAA has published a series of supplements known as SAMS (Signs and Marking Supplement). These supplements were established as a vehicle to provide answers to questions about signs and marking standards.

2. The L-867 handhole houses the sign's isolation transformer. It is typically mounted separately from the sign but within 610mm (2') 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 which connects between the transformer's output cable and the sign's input cable. Even though the output cable on an isolation transformer is 1.22M (48") ± 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. Several types of cable retaining clips (or cable clamps) are available and will depend on the type of mounting used for the sign's power leg (i.e. L-867 junction box or 2" 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.

3. Recommend specifying, in the project contract documents, the maximum VA load allowed for each size of sign. This VA load should include the losses in the sign's isolation transformer. Refer to ~~Volume I~~UFC 3-535-01 for typical VA loads of guidance signs.

4. The flexible conduit allows for minor adjustments in alignment during installation and also allows flexibility of the conduit runs during freeze/thaw cycles in cold climates. The use of the flexible conduit is optional. The conduit shall meet the requirements of NEMA TC12 and should be at least 305mm (12") long.

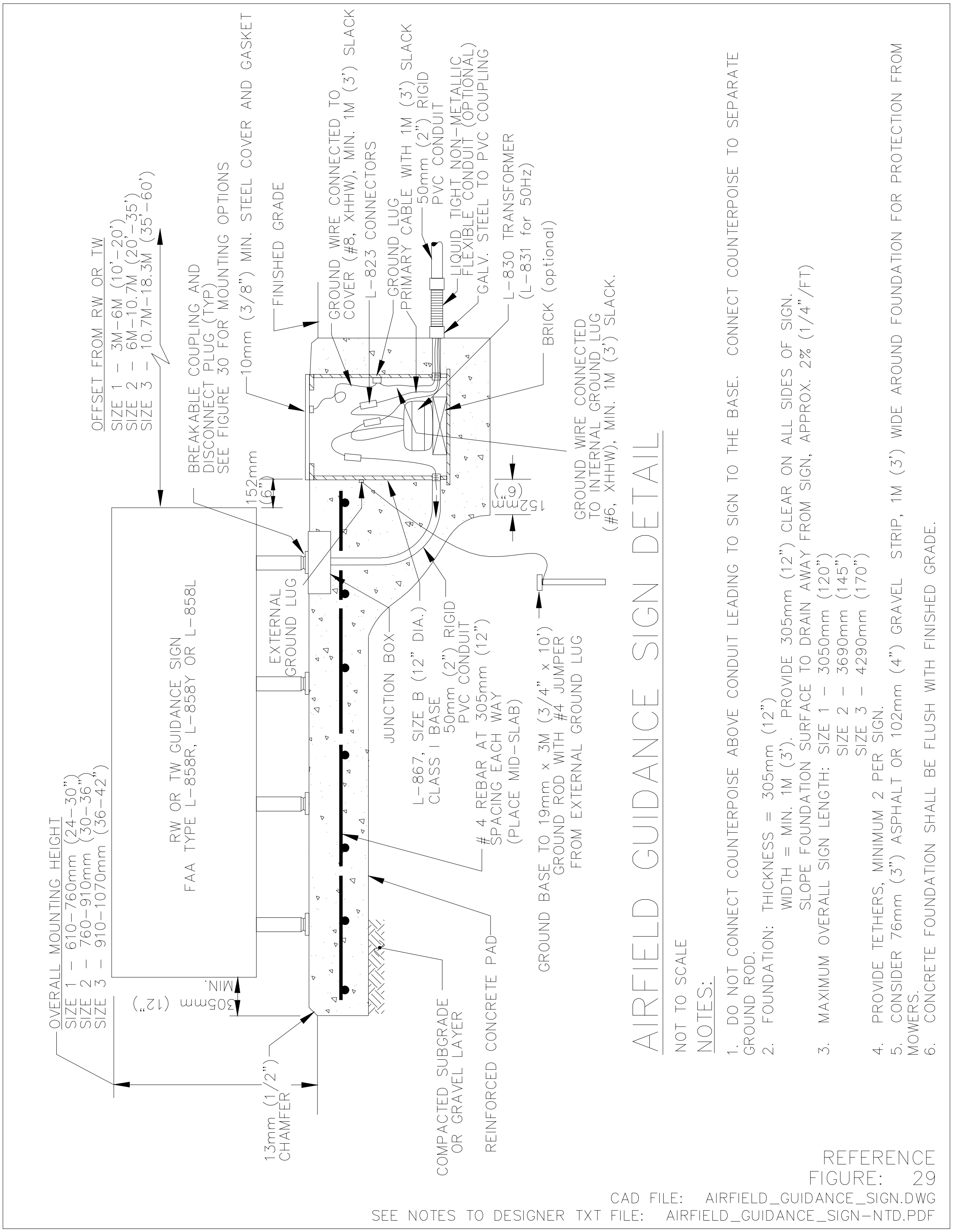


Figure 29. Airfield Guidance Sign Detail

3.2. Airfield Guidance Sign Detail (Navy Only)

See figure 29N.

Notes to Designer:

1. In addition to FAA AC 150/5340-18 and FAA AC 150/5345-44, the FAA has published a series of supplements known as SAMS (Signs and Marking Supplement). These supplements were established as a vehicle to provide answers to questions about signs and marking standards.

2. The L-867 handhole houses the sign's isolation transformer. It is typically mounted separately from the sign but within 610mm (2') 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:

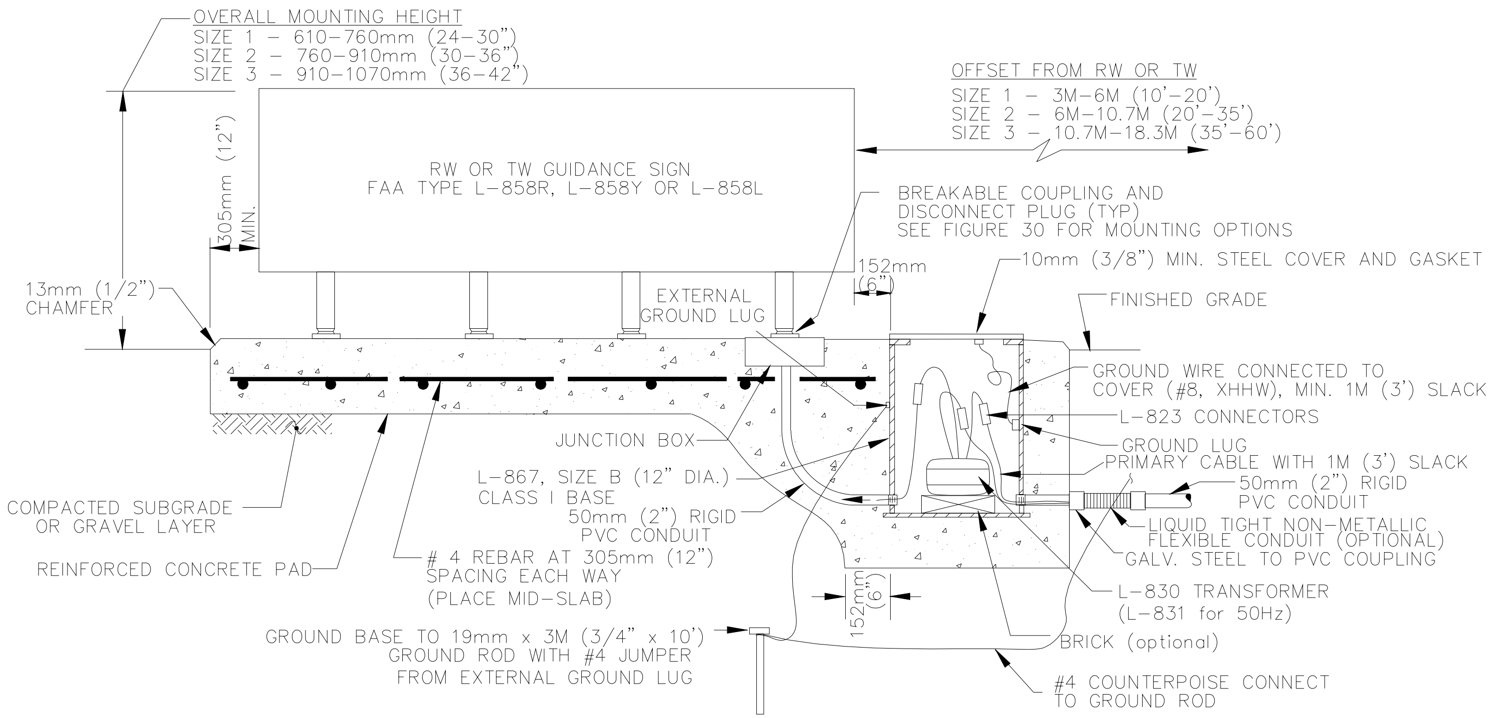
   a. A secondary jumper cable must be provided which connects between the transformer's output cable and the sign's input cable. Even though the output cable on an isolation transformer is 1.22M (48") ± in length, do not connect this to the sign's input cable since it would defeat the purpose of mounting the isolation transformer separately.

   b. Several types of cable retaining clips (or cable clamps) are available and will depend on the type of mounting used for the sign's power leg (i.e. L-867 junction box or 2" 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.

3. Recommend specifying, in the project contract documents, the maximum VA load allowed for each size of sign. This VA load should include the losses in the sign's isolation transformer. Refer to UFC 3-535-01 for typical VA loads of guidance signs.

4. The flexible conduit allows for minor adjustments in alignment during installation and also allows flexibility of the conduit runs during freeze/thaw cycles in cold climates. The use of the flexible conduit is optional. The conduit shall meet the requirements of NEMA TC12 and should be at least 305mm (12") long.

5. Where no counterpoise is required, delete counterpoise and note #1 from detail.



AIRFIELD GUIDANCE SIGN DETAIL (NAVY ONLY)

NOT TO SCALE

NOTES:

1. CONNECT COUNTERPOISE TO GROUND ROD AT BASE.
2. FOUNDATION: THICKNESS = 305mm (12")
   WIDTH = MIN. 1M (3'). PROVIDE 305mm (12") CLEAR ON ALL SIDES OF SIGN.
   SLOPE FOUNDATION SURFACE TO DRAIN AWAY FROM SIGN, APPROX. 2% (1/4"/FT)
3. MAXIMUM OVERALL SIGN LENGTH: SIZE 1 - 3050mm (120")
   SIZE 2 - 3690mm (145")
   SIZE 3 - 4290mm (170")
4. PROVIDE TETHERS, MINIMUM 2 PER SIGN.
5. CONSIDER 76mm (3") ASPHALT OR 102mm (4") GRAVEL STRIP, 1M (3') WIDE AROUND FOUNDATION FOR PROTECTION FROM MOWERS.
6. CONCRETE FOUNDATION SHALL BE FLUSH WITH FINISHED GRADE.

REFERENCE
FIGURE: 29N
CAD FILE: AIRFIELD_GUIDANCE_SIGN_NAVY-ONLY.DWG
SEE NOTES TO DESIGNER TXT FILE: AIRFIELD_GUIDANCE_SIGN-NTD_NAVY-ONLY.PDF

Figure 29N. Airfield Guidance Sign Detail (Navy Only)

~~3.2.~~ 3.3. Sign Base Power Leg Mounting Detail

See figure 30.

Notes to Designer:

1. The type of mounting for the power leg of the sign will usually be determined by the sign manufacturer. These details show different options that could be used. Whichever one is used, it is recommended that details shown on contract documents state that installation shall be per manufacturer's requirements.

2. Use flexible conduit between the sign base and the L-867 handhole when the handhole is not a part of the sign base. This will allow for movement between the base and handhole during possible freeze/thaw cycles in cold climates. If freeze/thaw cycles are not a problem, then the use of the flexible conduit is optional.

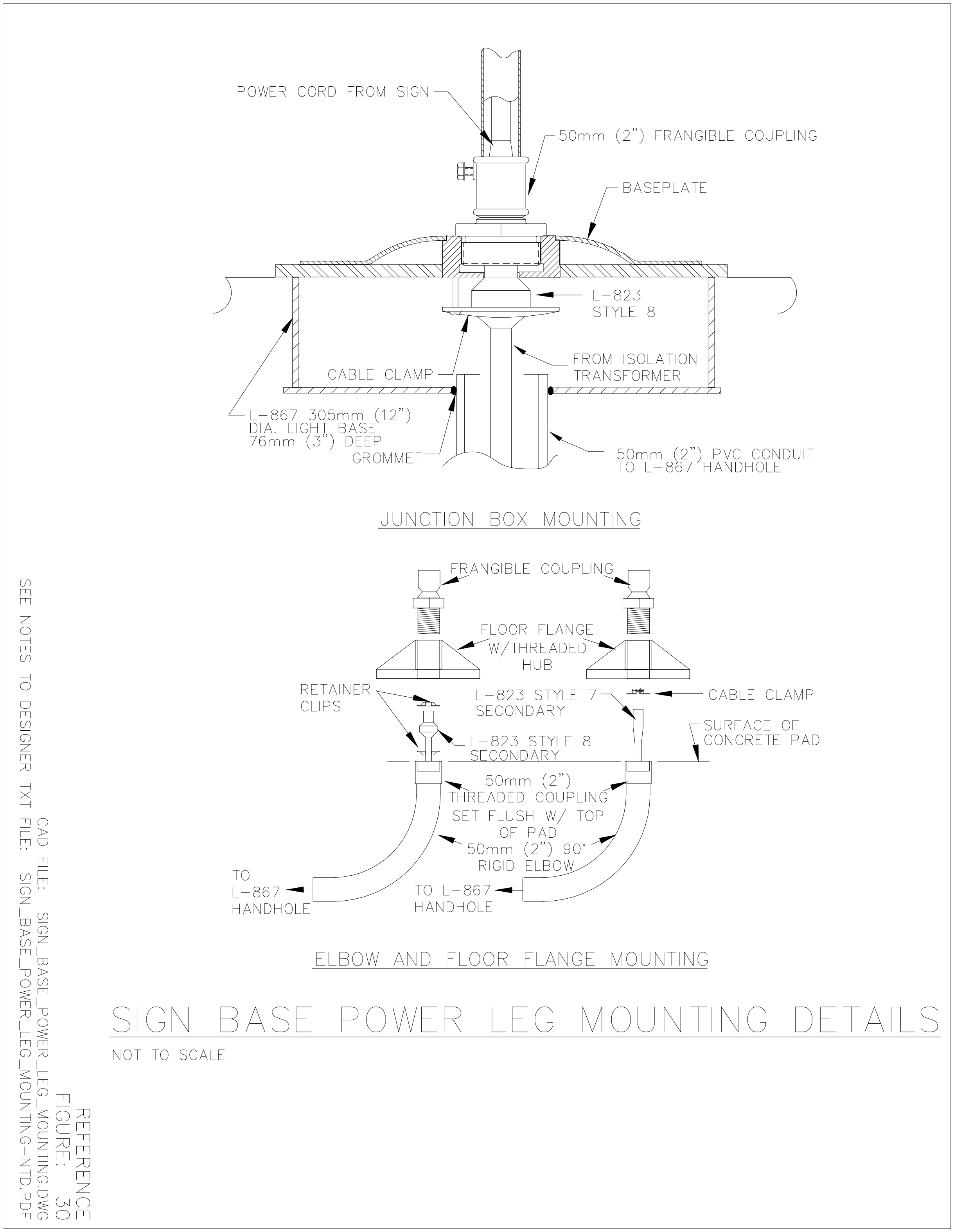


Figure 30. Sign Base Power Leg Mounting Detail

Chapter 4: APPROACH LIGHTING SYSTEMS

4.1. L-867 Size D Handhole

See figure 31.

Notes to Designer:

1. The handhole is ~~utilized~~used at each sequenced flasher station and tower mounted approach light station. It acts as a cable pulling handhole and houses the isolation transformers in an ALSF, SSALR, MALSR, or SALS approach light system.

2. The flexible conduit allows for movement during freeze/thaw cycles in cold climates thereby reducing the possibility of shearing the conduits. If freeze/thaw cycles are not a problem, then the use of the flexible conduit is optional.

3. The 51mm (2") conduit between handholes is a minimum. The actual dimension depends on the number of cables being routed. A #8, L-824C, 5kv conductor is equivalent in diameter to #2 THWN and a #6, L-824C, 5kv is equivalent in diameter to a #1 THWN. 51mm (2") hubs are standard on an L-867 base and other sizes are optional. Ensure contract documents specify hub size.

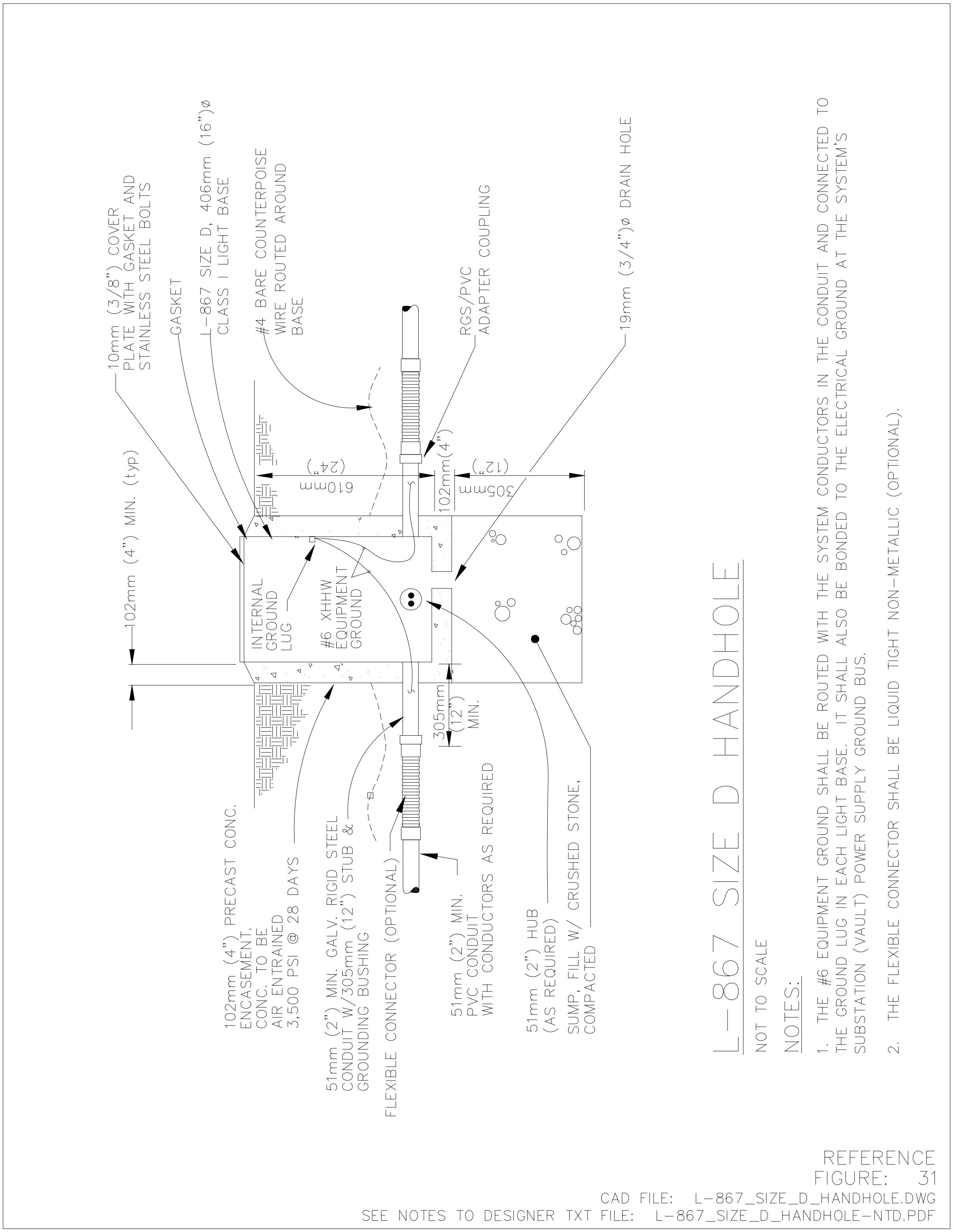


Figure 31. L-867 Size D Handhole

4.2. L-867 Size D Handhole (Navy Only)

See figure 31N.

Notes to Designer:

1. The handhole is used at each sequenced flasher station and tower mounted approach light station. It acts as a cable pulling handhole and houses the isolation transformers in an ALSF, SSALR, MALSR, or SALS approach light system.

2. The flexible conduit allows for movement during freeze/thaw cycles in cold climates thereby reducing the possibility of shearing the conduits. If freeze/thaw cycles are not a problem, then the use of the flexible conduit is optional.

3. The 51mm (2") conduit between handholes is a minimum. The actual dimension depends on the number of cables being routed. A #8, L-824C, 5kv conductor is equivalent in diameter to #2 THWN and a #6, L-824C, 5kv is equivalent in diameter to a #1 THWN. 51mm (2") hubs are standard on an L-867 base and other sizes are optional. Ensure contract documents specify hub size.

4. Where no counterpoise is required, delete counterpoise, jumper and note #1 from detail.

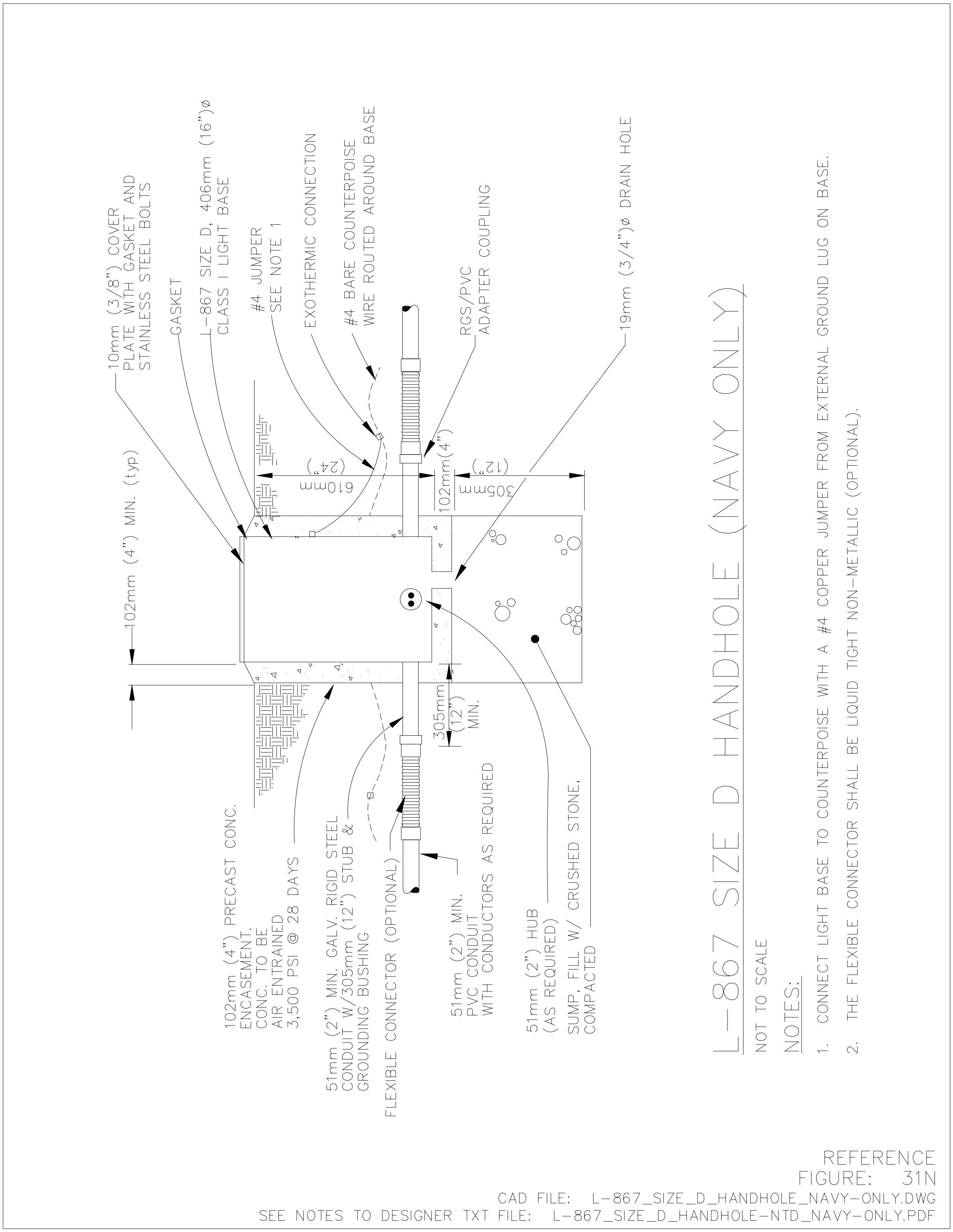


Figure 31N. L-867 Size D Handhole (Navy Only)

~~4.2.~~ 4.3. Sequenced Flasher Power Supply and Junction Box Mounting Detail

See figure 32.

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 18.3M (60') 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 12.2M (40'), 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. 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 shown below grade by a 51mm (2") conduit. Some manufacturers connect the two directly with a short section of 51mm (2") conduit.

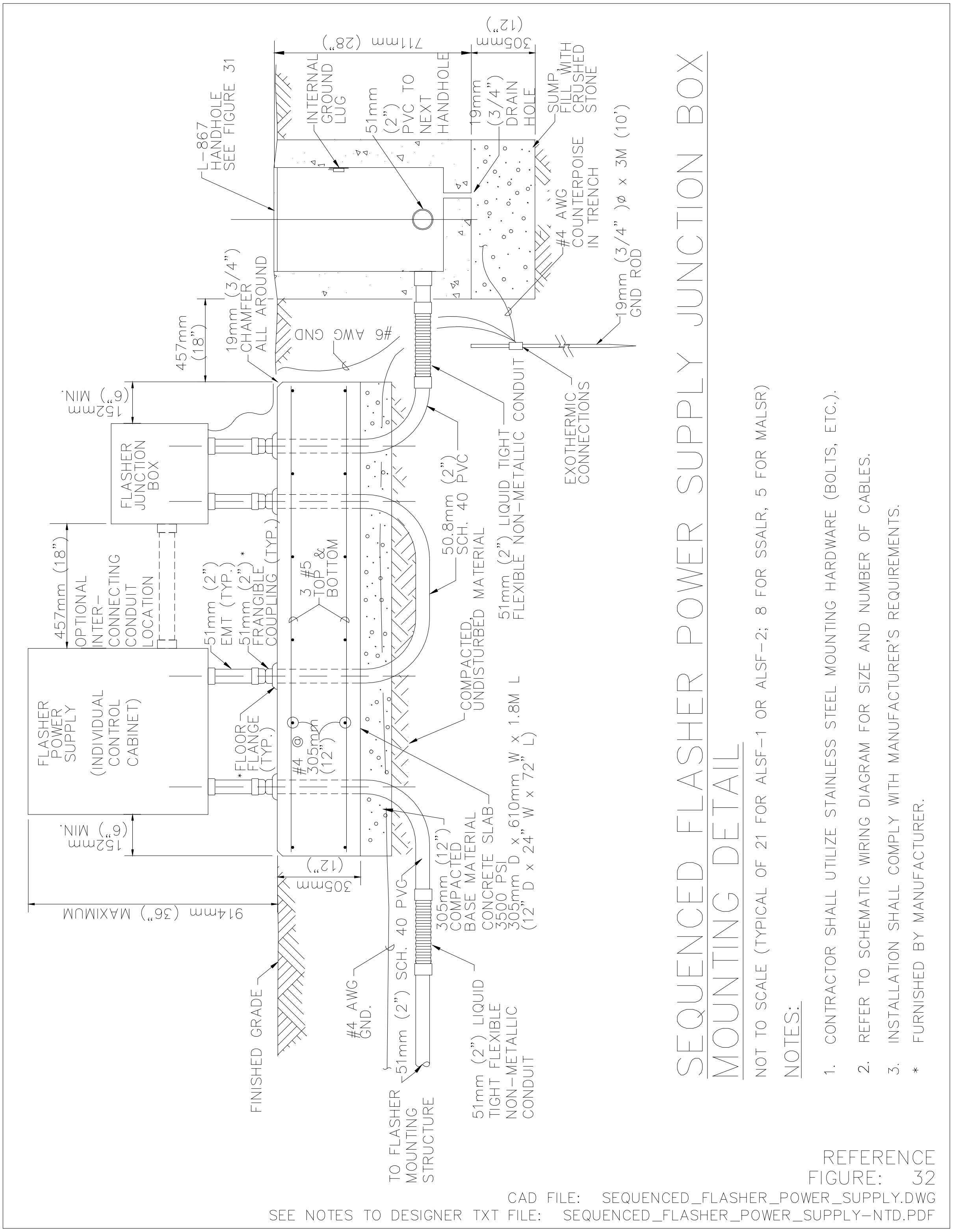


Figure 32. Sequenced Flasher Power Supply and Junction Box Mounting Detail

4.4. Sequenced Flasher Power Supply and Junction Box Mounting Detail (Navy Only)

See figure 32N.

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 18.3M (60') 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 12.2M (40'), 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. 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 shown below grade by a 51mm (2") conduit. Some manufacturers connect the two directly with a short section of 51mm (2") conduit.

5. Where no counterpoise is required, delete counterpoise and #4 jumper from detail.

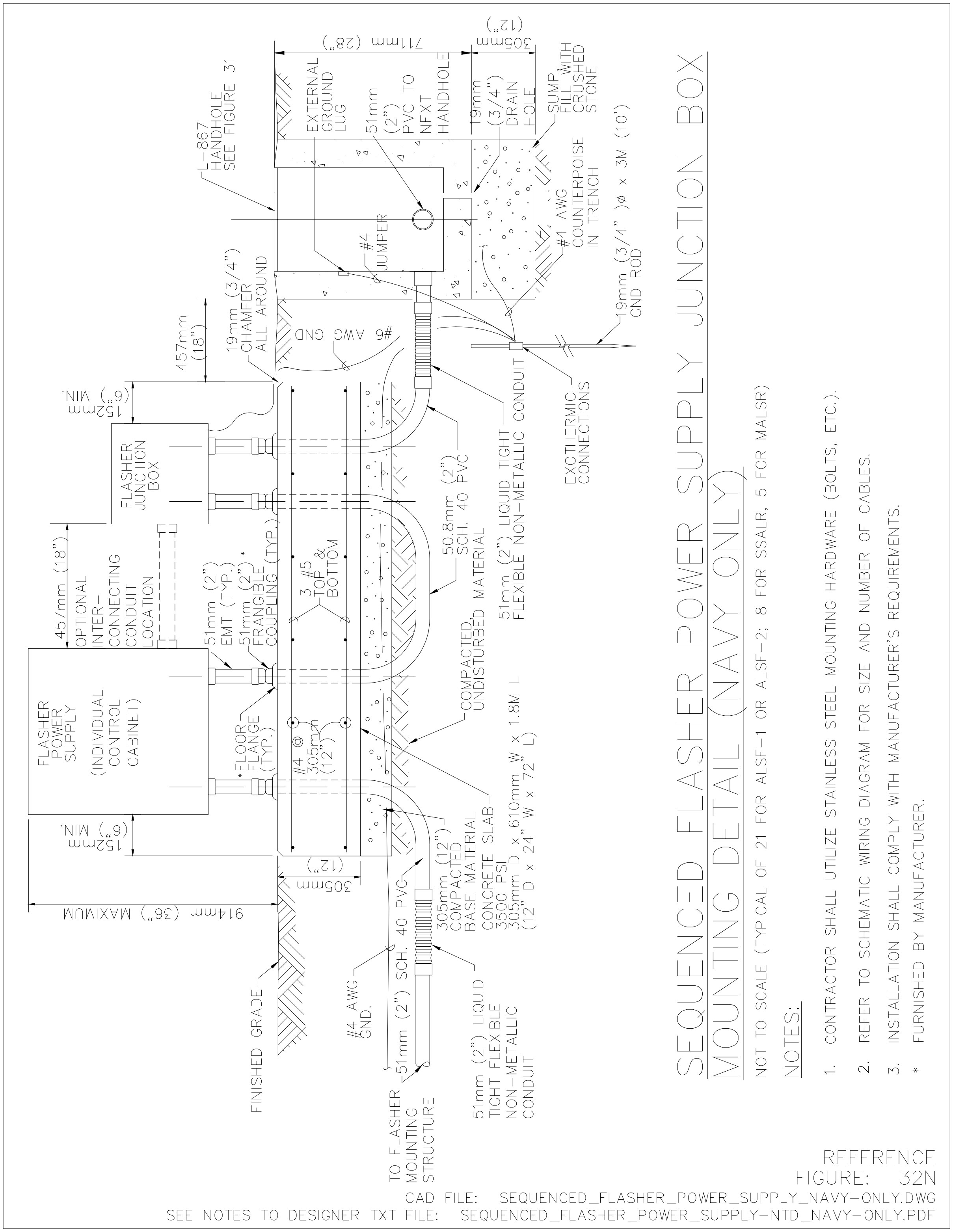


Figure 32N. Sequenced Flasher Power Supply and Junction Box Mounting Detail (Navy Only)

~~4.3.~~ 4.5. Typical MG-20 L.I.R. Structure 1854mm (6'-1") to 6.43M (21'-1")

See figure 33.

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 ~~Volume I~~UFC 3-535-01 of the manual 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.

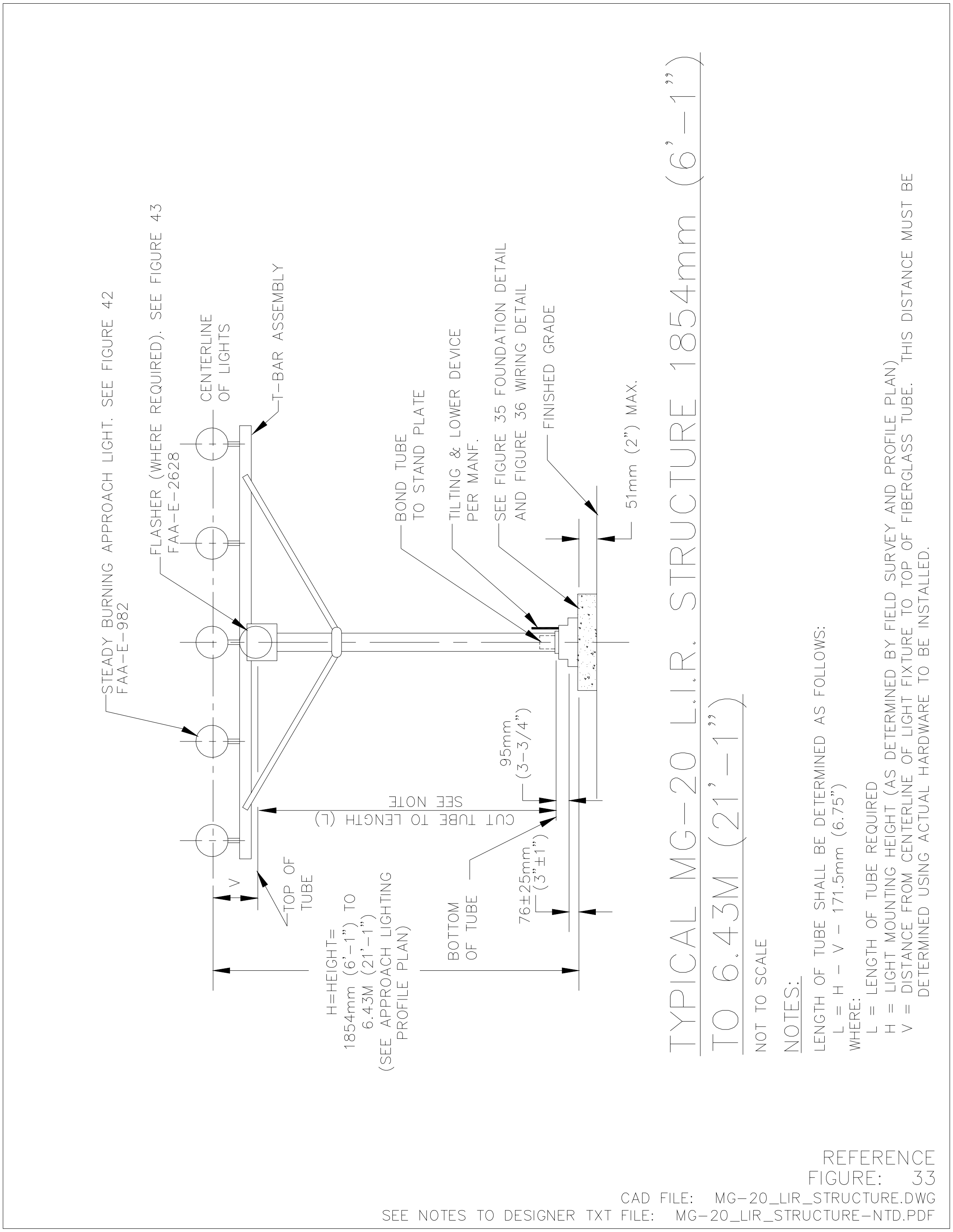


Figure 33. Typical MG-20 L.I.R. Structure 1854mm (6’-1”) to 6.43M (21’-1”)

~~4.4.~~ 4.6. Foundation for L.I.R. Structure MG-20 Plan View

See figure 34.

Notes to Designer:

1. The female couplings are for mounting the 51mm (2”) frangible couplings and condulet 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 shown 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.

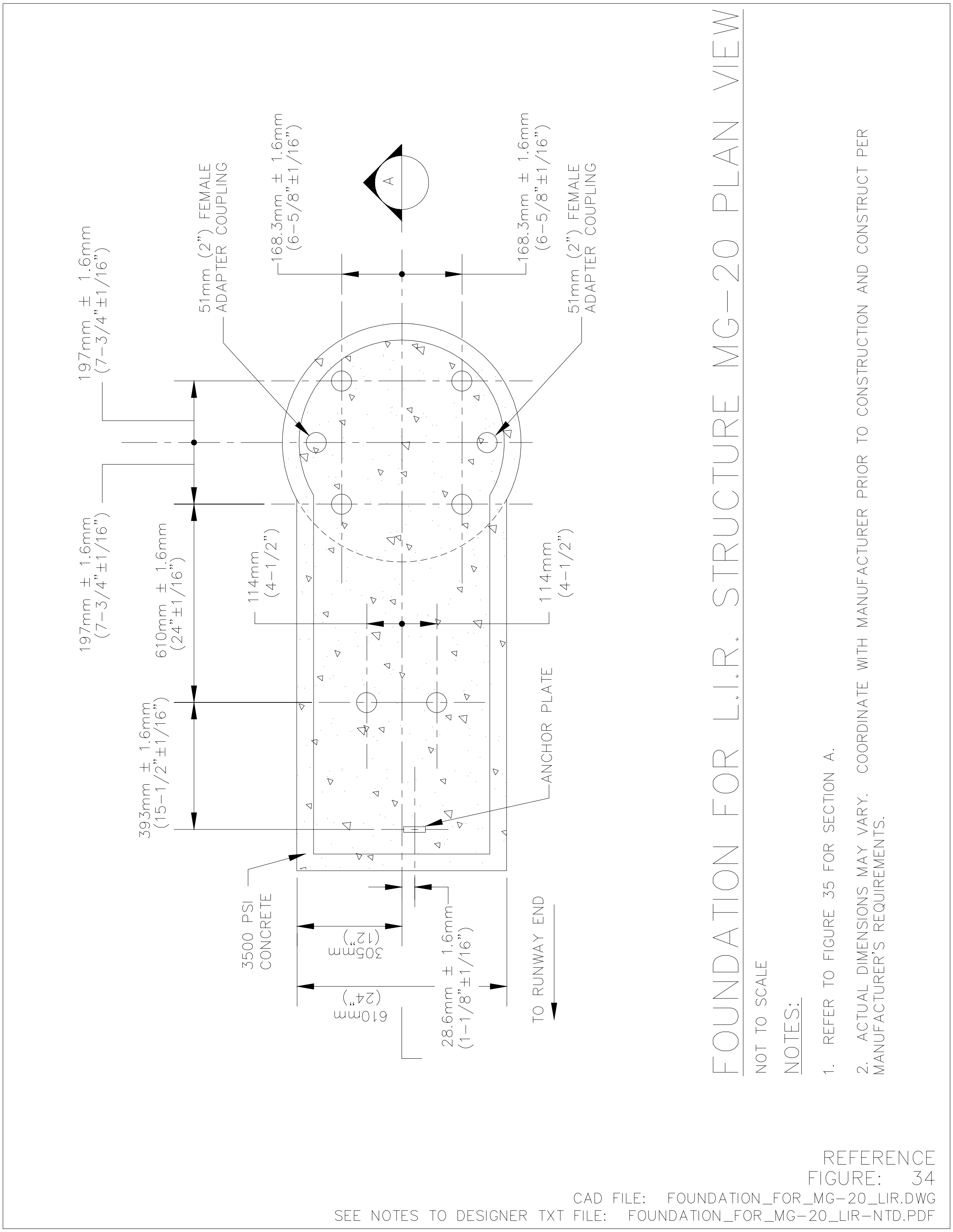


Figure 34. Foundation for L.I.R. Structure MG-20 Plan View

~~4.5.~~ 4.7. Foundation for L.I.R. Structure MG-20 Sections A & B

See figure 35.

Notes to Designer:

1. The foundation shown is a suggested foundation by the tower manufacturer (Jaquith Industries Inc.). 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 shall include the proposed fixtures and hardware to be installed on the tower.

3. In areas that are susceptible to frost, a rectangular foundation is recommended. The foundation should include a spread footing to resist uplift. The foundation should also be continuous from grade down to the footing with necessary rebar and eliminate the cantilevered portion, as shown in the detail.

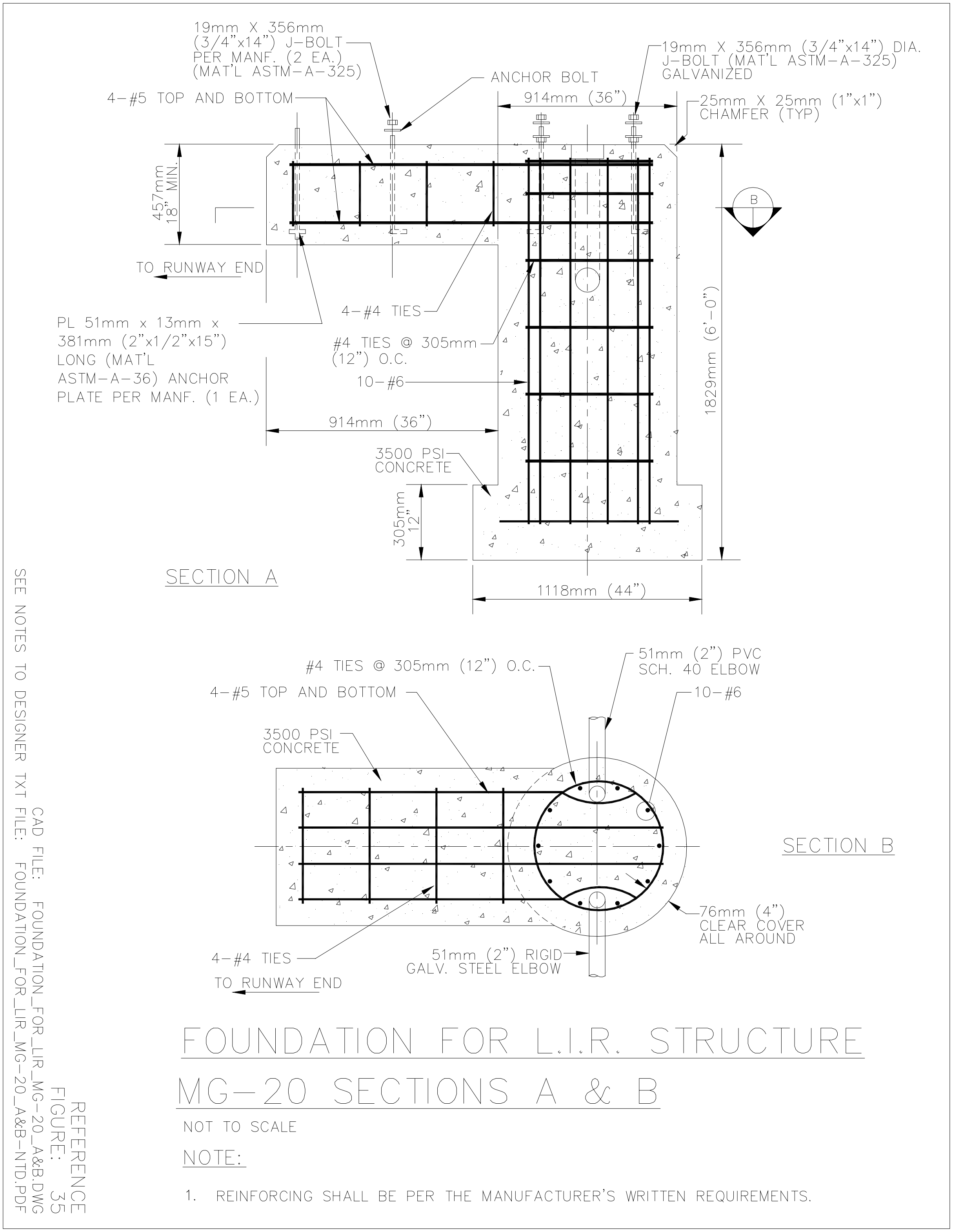


Figure 35. Foundation for L.I.R. Structure MG-20 Sections A & B

~~4.6.~~ 4.8. Typical MG-20 L.I.R. Structure Tower Wiring Detail

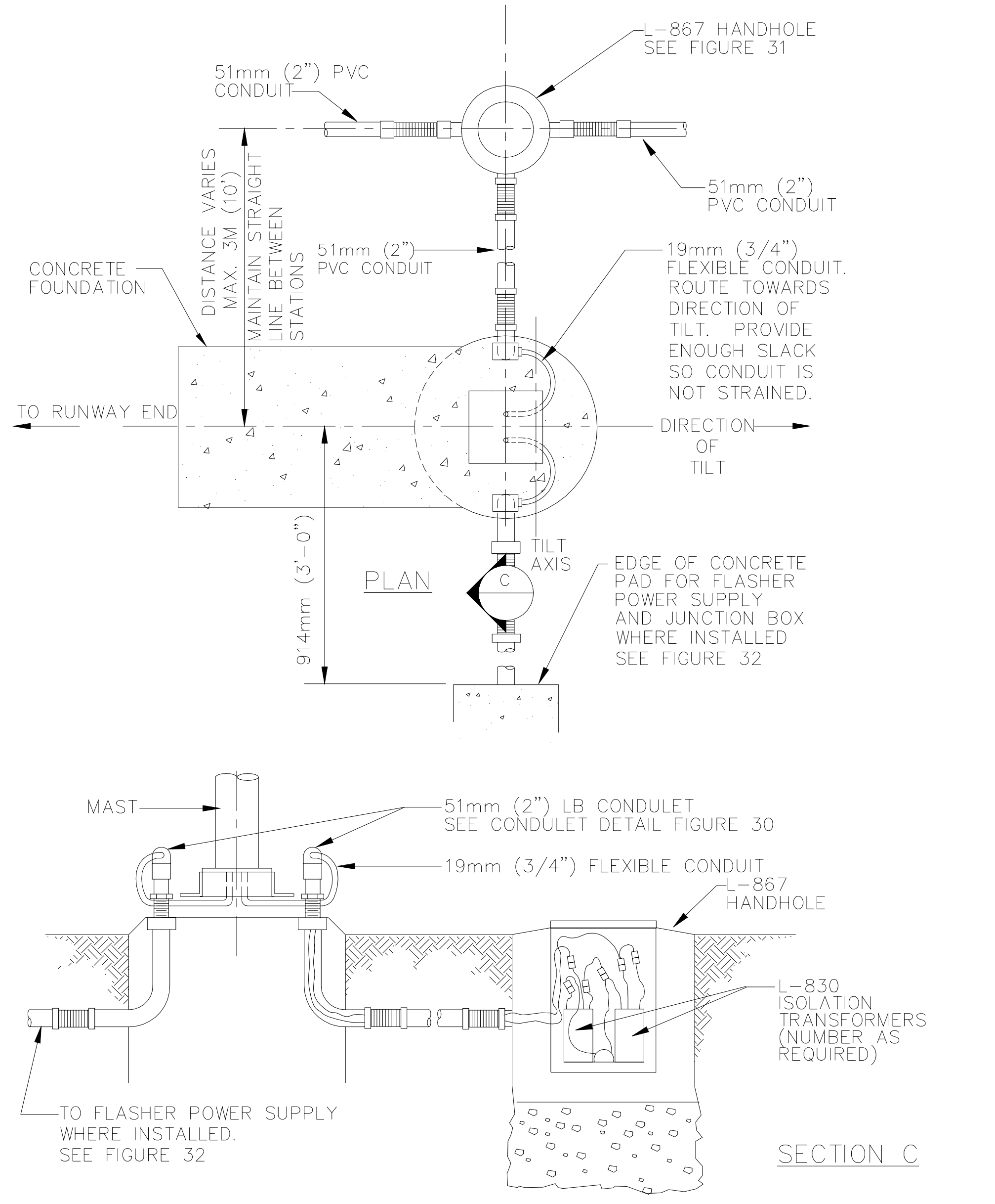
See figure 36.

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.



TYPICAL MG-20 L.I.R. STRUCTURE TOWER WIRING DETAIL

NOT TO SCALE

NOTE:

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.

REFERENCE
FIGURE: 36
CAD FILE: MG-20_LIR_TOWER.DWG
SEE NOTES TO DESIGNER TXT FILE: MG-20_LIR_TOWER-NTD.PDF

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

~~4.7.~~ 4.9. 51mm (2”) LB Conduit Detail

See figure 37.

Notes to Designer:

Figure is self-explanatory.

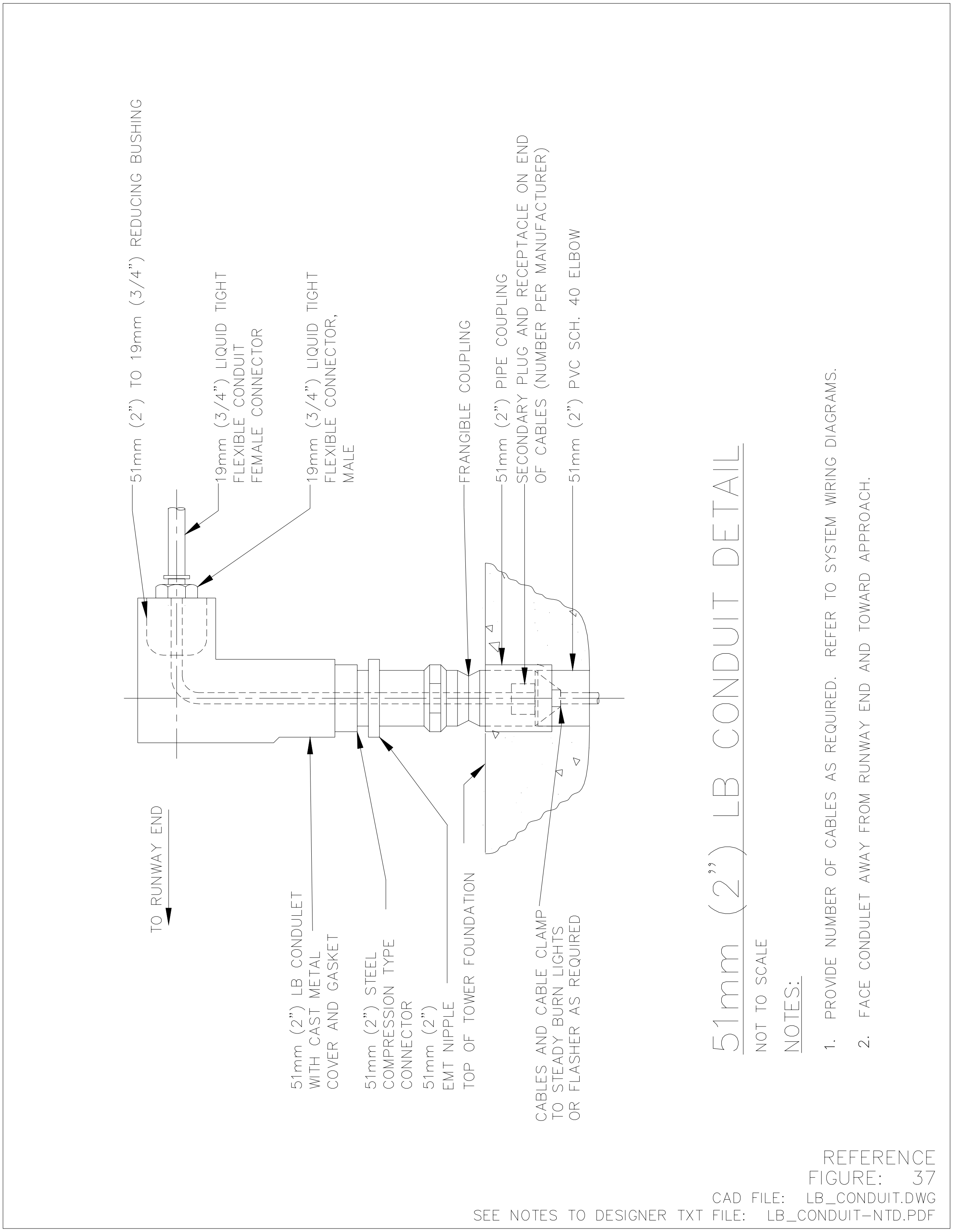


Figure 37. 51mm (2") LB Conduit Detail

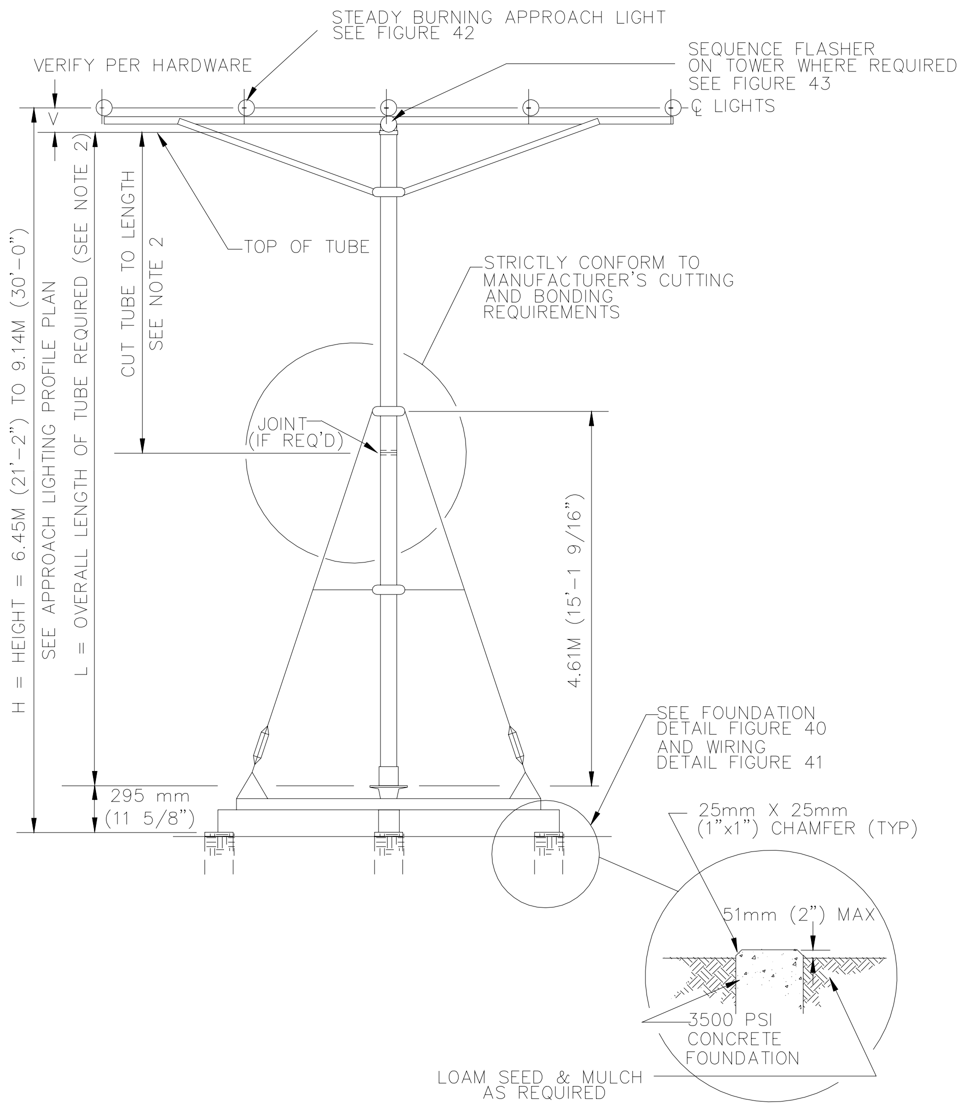
~~4.8.~~ 4.10. Typical MG-30 L.I.R. Structure 6.45M (21'-2") to 9.14M (30'-0")

See figure 38.

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 ~~Volume I~~UFC 3-535-01 of the manual 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.



TYPICAL MG–30 L.I.R. STRUCTURE
6.45M (21'–2") TO 9.14M (30'–0")

NOT TO SCALE

NOTES:

1. FOUNDATIONS, CONNECTIONS, STABILIZERS, TILT DEVICES AND ASSOCIATED COMPONENTS SHALL BE PER MANUFACTURER'S WRITTEN SPECIFICATIONS.

2. LENGTH OF TUBE SHALL BE DETERMINED AS FOLLOWS: L = H – V – 6.38M (20' + 11 5/8")
WHERE L = OVERALL LENGTH OF TUBE REQUIRED
H = LIGHT MOUNTING HEIGHT (AS DETERMINED BY FIELD SURVEY AND PROFILE PLAN)
V = DISTANCE FROM CENTERLINE OF FIXTURE TO TOP OF FIBERGLASS TUBE. THIS DISTANCE MUST BE DETERMINED USING ACTUAL HARDWARE TO BE INSTALLED.

REFERENCE
FIGURE: 38
CAD FILE: MG-30_LIR.DWG
SEE NOTES TO DESIGNER TXT FILE: MG-30_LIR-NTD.PDF

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

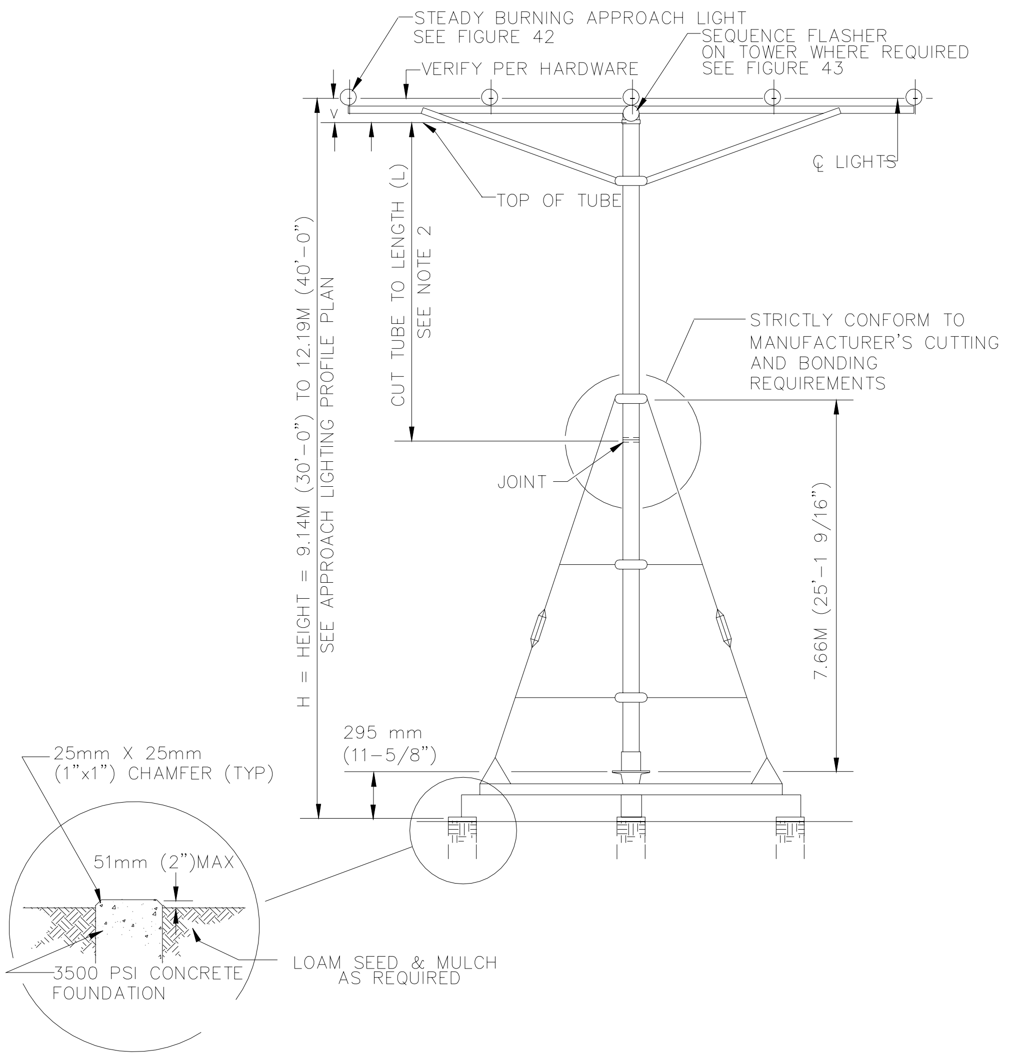
~~4.9.~~ 4.11. Typical MG-40 L.I.R. Structure 9.14M (30'-0") to 12.19M (40'-0")

See figure 39.

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 ~~Volume I~~UFC 3-535-01 of the manual 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.



TYPICAL MG-40 L.I.R. STRUCTURE
9.14M (30'-0") TO 12.19M (40'-0")

NOT TO SCALE

NOTES:

1. FOUNDATIONS, CONNECTIONS, STABILIZERS, TILT DEVICES AND ASSOCIATED COMPONENTS SHALL BE PER MANUFACTURER'S WRITTEN SPECIFICATIONS.

2. LENGTH OF TUBE SHALL BE DETERMINED AS FOLLOWS: L = H − V − 6.38M (20' + 11-5/8")
WHERE L = OVERALL LENGTH OF TUBE REQUIRED
H = LIGHT MOUNTING HEIGHT (AS DETERMINED BY FIELD SURVEY AND PROFILE PLAN)
V = DISTANCE FROM CENTERLINE OF FIXTURE TO TOP OF FIBERGLASS TUBE. THIS DISTANCE MUST BE DETERMINED USING ACTUAL HARDWARE TO BE INSTALLED.

REFERENCE
FIGURE: 39
CAD FILE: MG-40_LIR.DWG
SEE NOTES TO DESIGNER TXT FILE: MG-40_LIR-NTD.PDF

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

~~4.10.~~ 4.12. Foundation for MG-30/40 L.I.R. Structures

See figure 40.

Notes to Designer:

1. The foundation shown is a suggested foundation by the tower manufacturer (Jaquith Industries Inc.). 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 shall include the proposed fixtures and hardware to be installed on the tower.

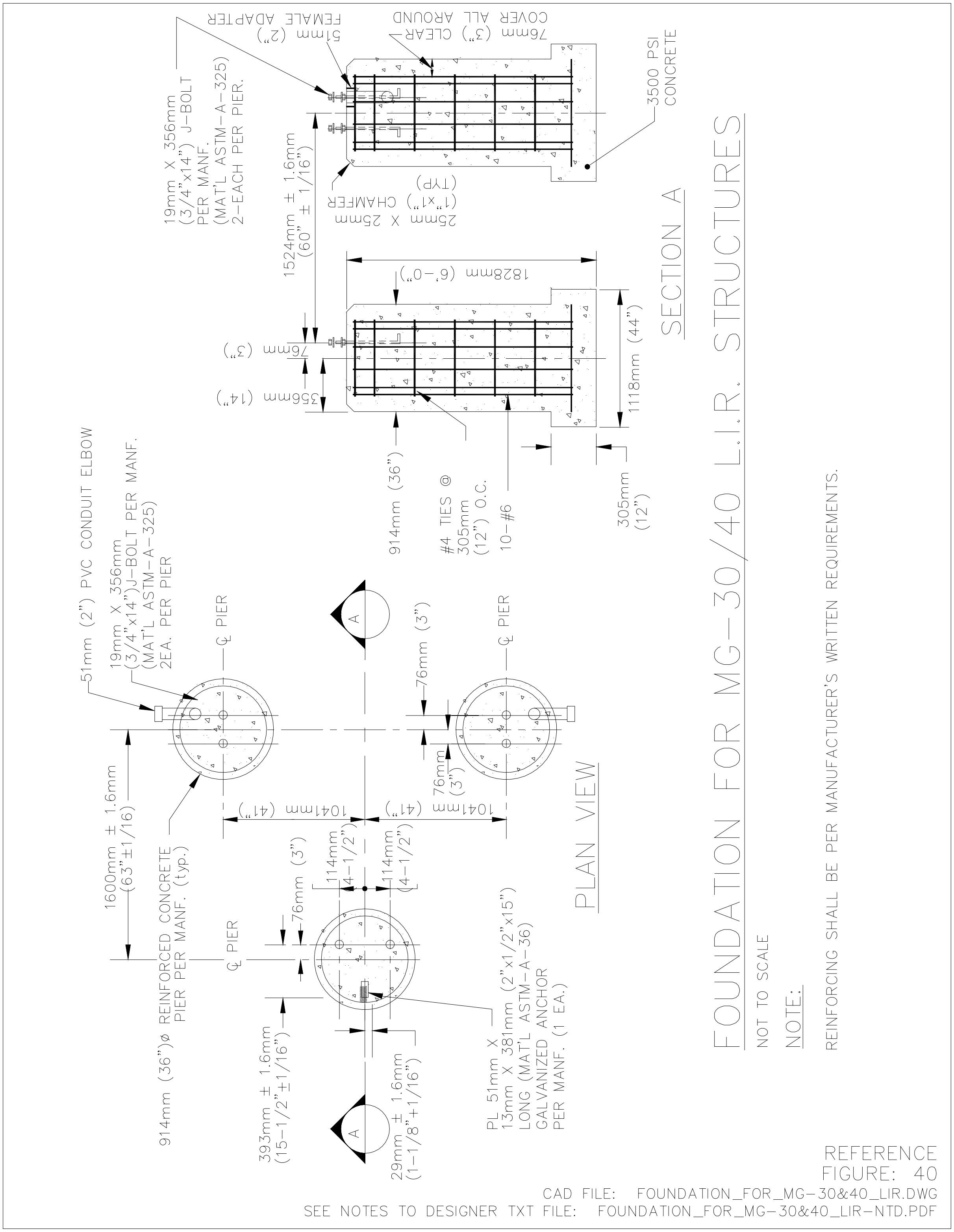


Figure 40. Foundation for MG-30/40 L.I.R. Structures

~~4.11.~~ 4.13. Typical MG-30/40 L.I.R. Structure Tower Wiring Detail

See figure 41.

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.

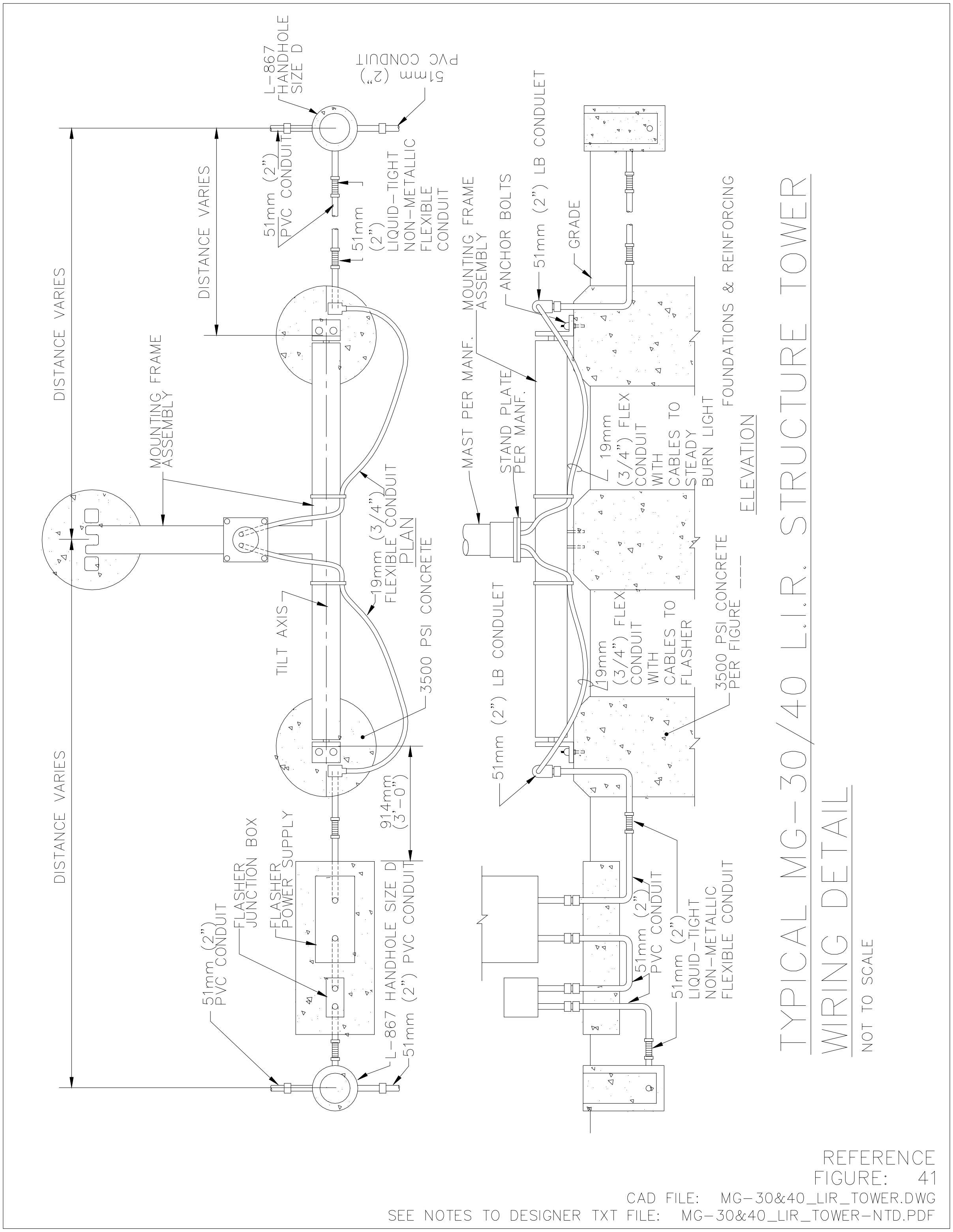


Figure 41. Typical MG-30/40 L.I.R. Structure Tower Wiring Detail

~~4.12.~~ 4.14. Tower Mounted Approach Light Detail

See figure 42.

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.

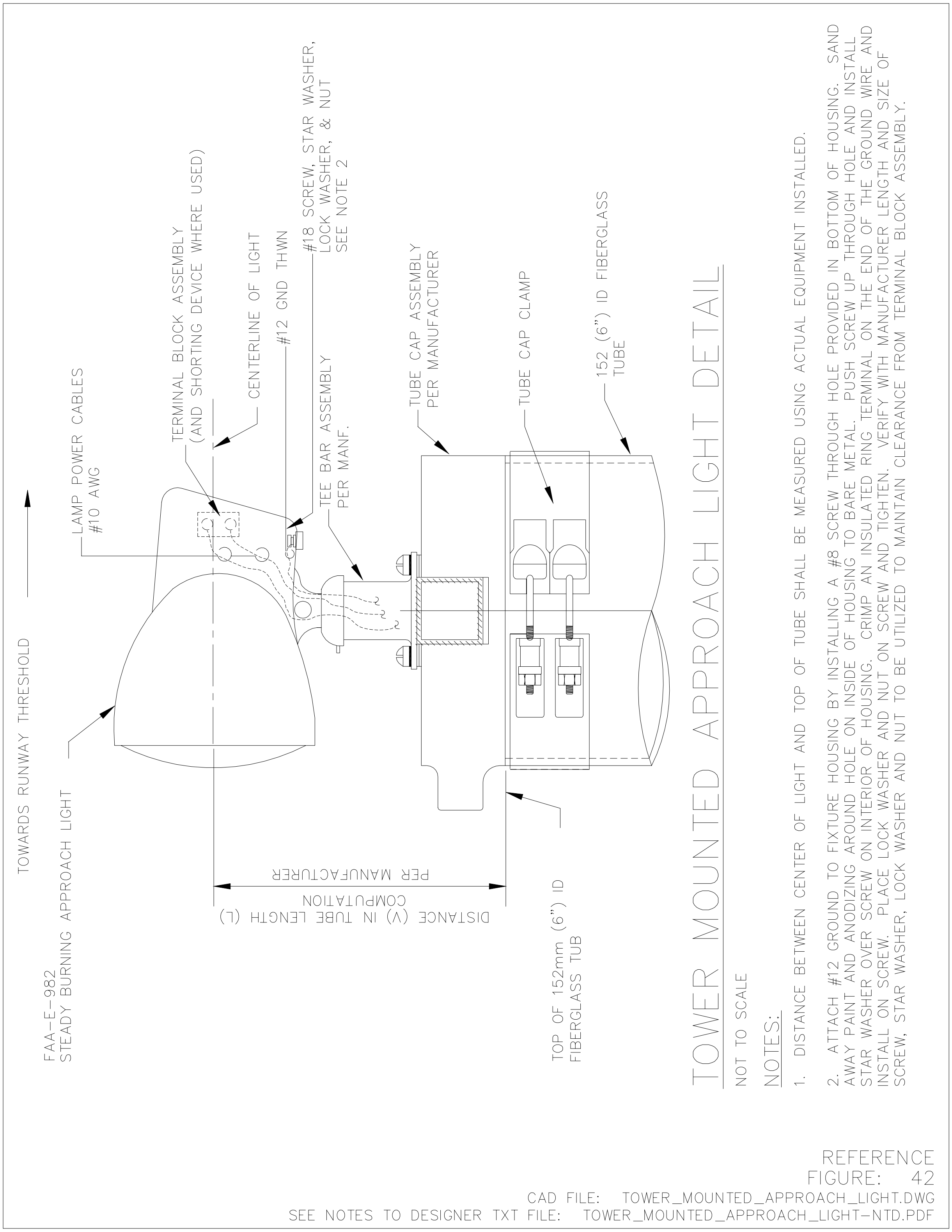


Figure 42. Tower Mounted Approach Light Detail

~~4.13.~~ 4.15. Tower Mounted SFL and Approach Light Detail

See figure 43.

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 and 3 #16, 3kv, are used and are provided by the manufacturer. Ensure size of flexible conduit is adequate for these cables.

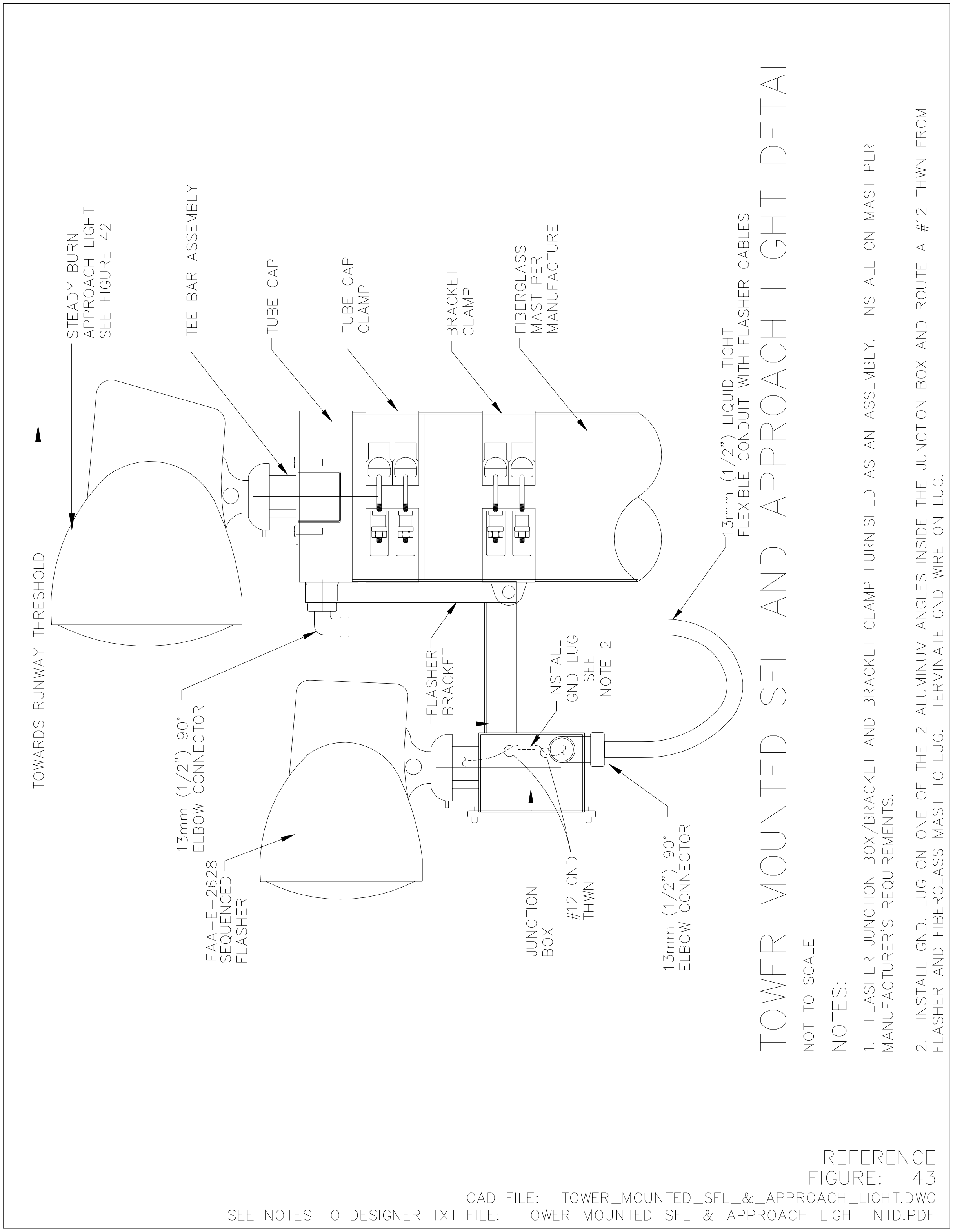


Figure 43. Tower Mounted SFL and Approach Light Detail

~~4.14.~~ 4.16. MALSR and SSALR Approach Light System Configuration

See figure 44.

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 1 weather conditions exist thereby allowing an energy savings without having to use the full ALSF-2 system.

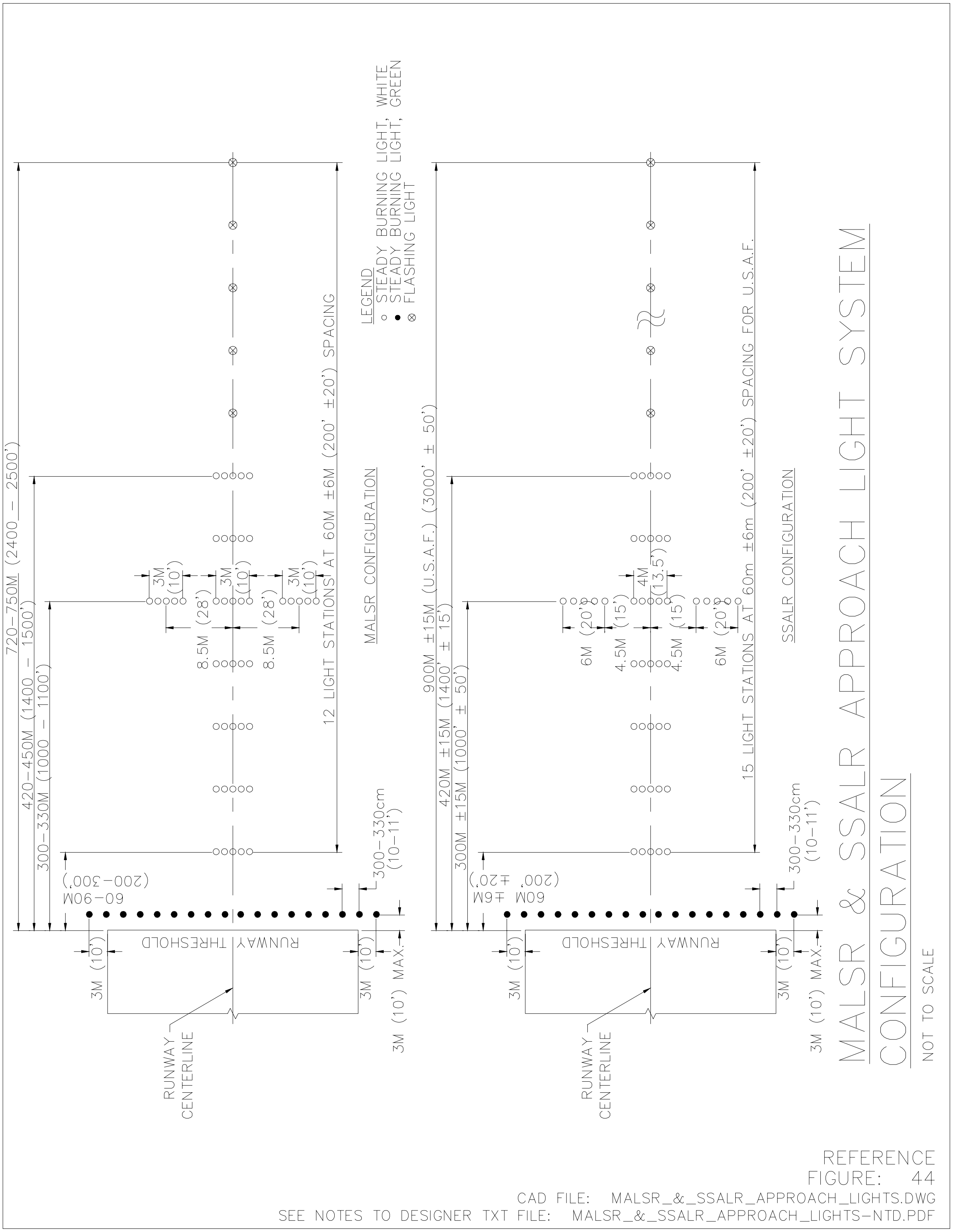


Figure 44. MALSR and SSALR Approach Light System Configuration

~~4.15.~~ 4.17. Remote Flasher Installation 1828mm (6' 0") Maximum

See figure 45.

Notes to Designer:

1. This detail shows a remote flasher installation. The high voltage cable is normally supplied with the flasher and about 15.2M (50') 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 1.5M (5') in front of light bar and a maximum of 1.3M (4') below the centerline of the approach light plane. When the flashers are mounted below the centerline, they must be uniformly mounted throughout the system.

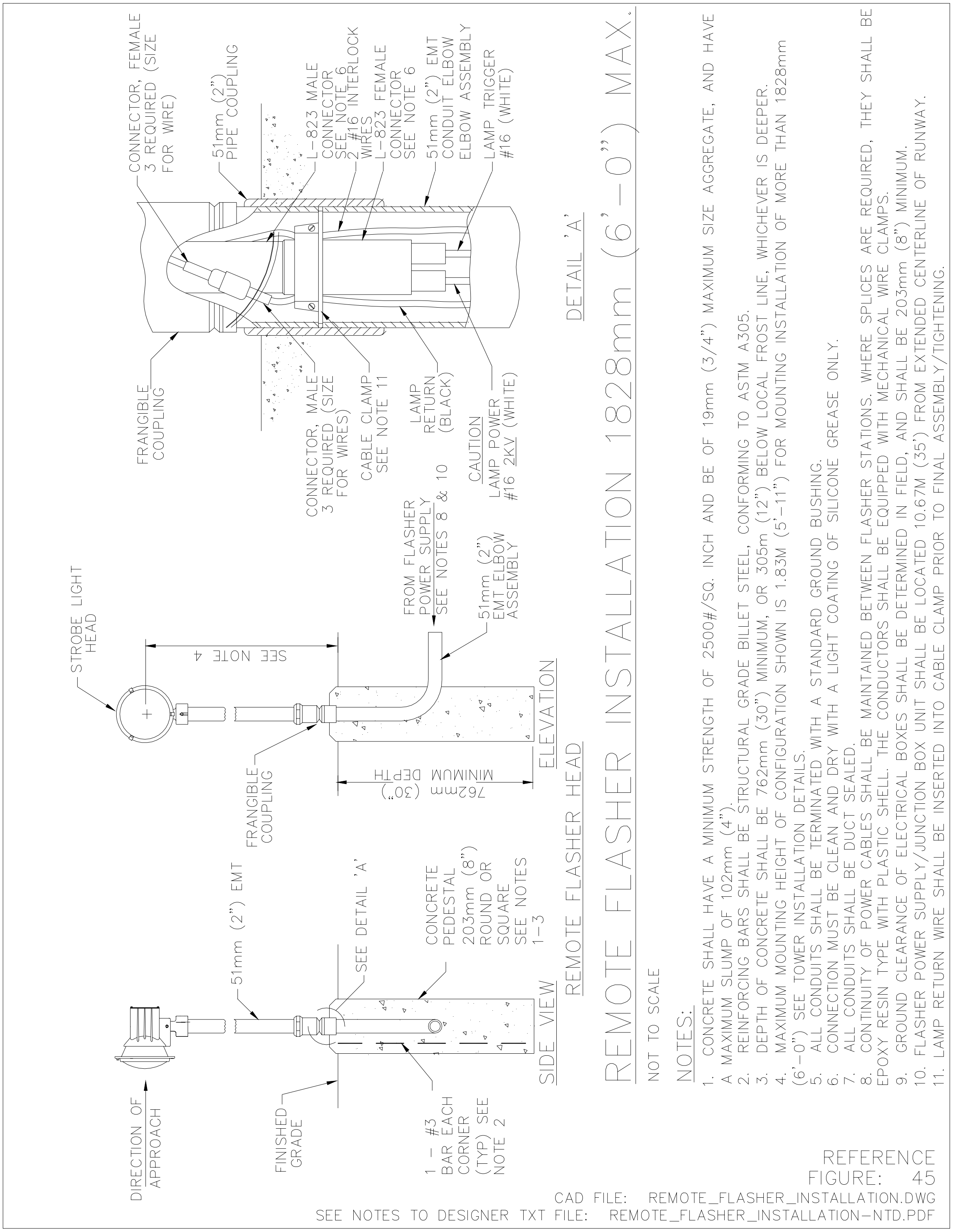


Figure 45. Remote Flasher Installation 1828mm (6' 0") Maximum

~~4.16.~~ 4.18. Typical High Intensity Approach Light Bar

See figure 46.

Notes to Designer:

Figure is self-explanatory.

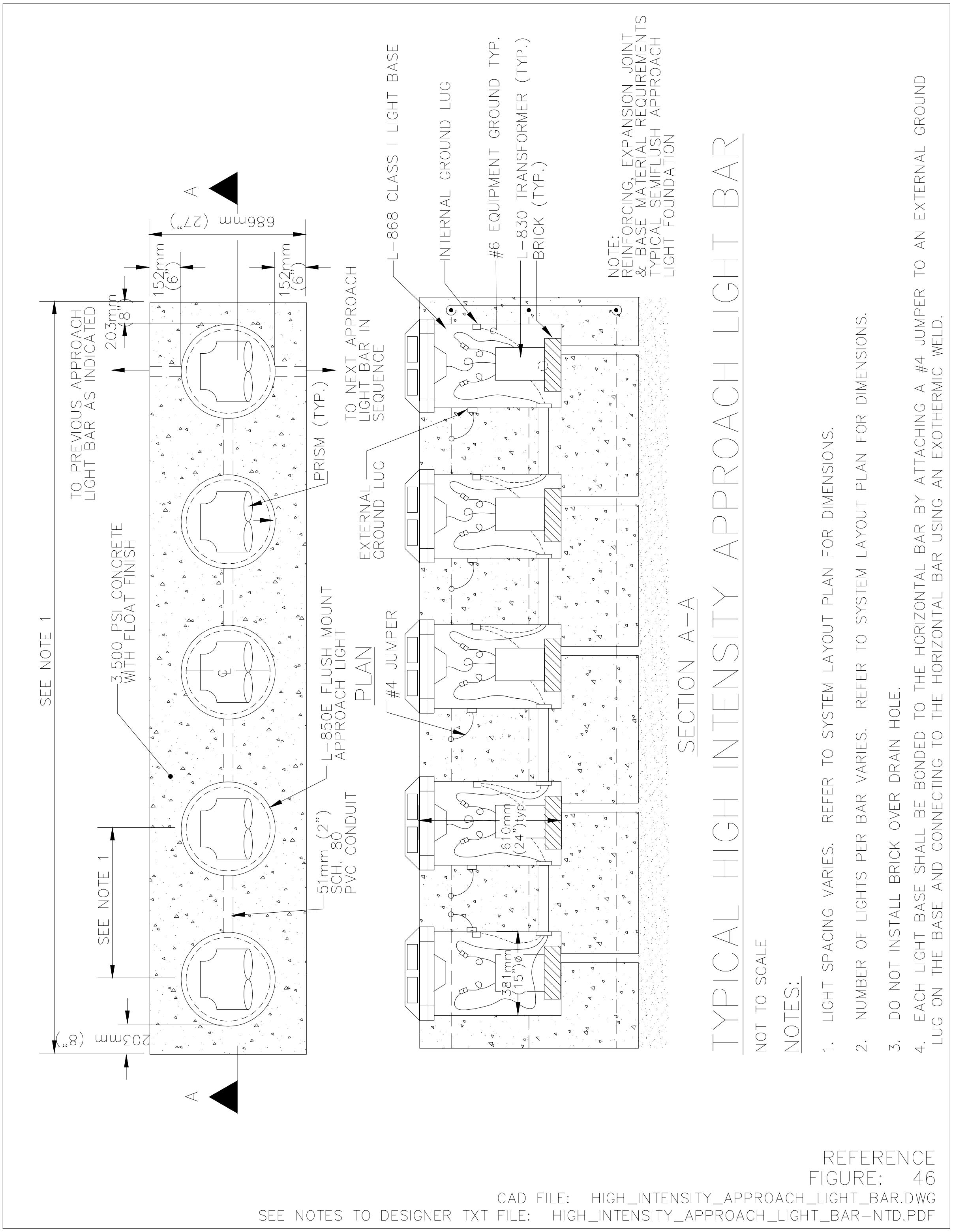


Figure 46. Typical High Intensity Approach Light Bar

4.19. Typical High Intensity Approach Light Bar (Navy Only)

See figure 46N.

Notes to Designer:

Figure is self-explanatory.

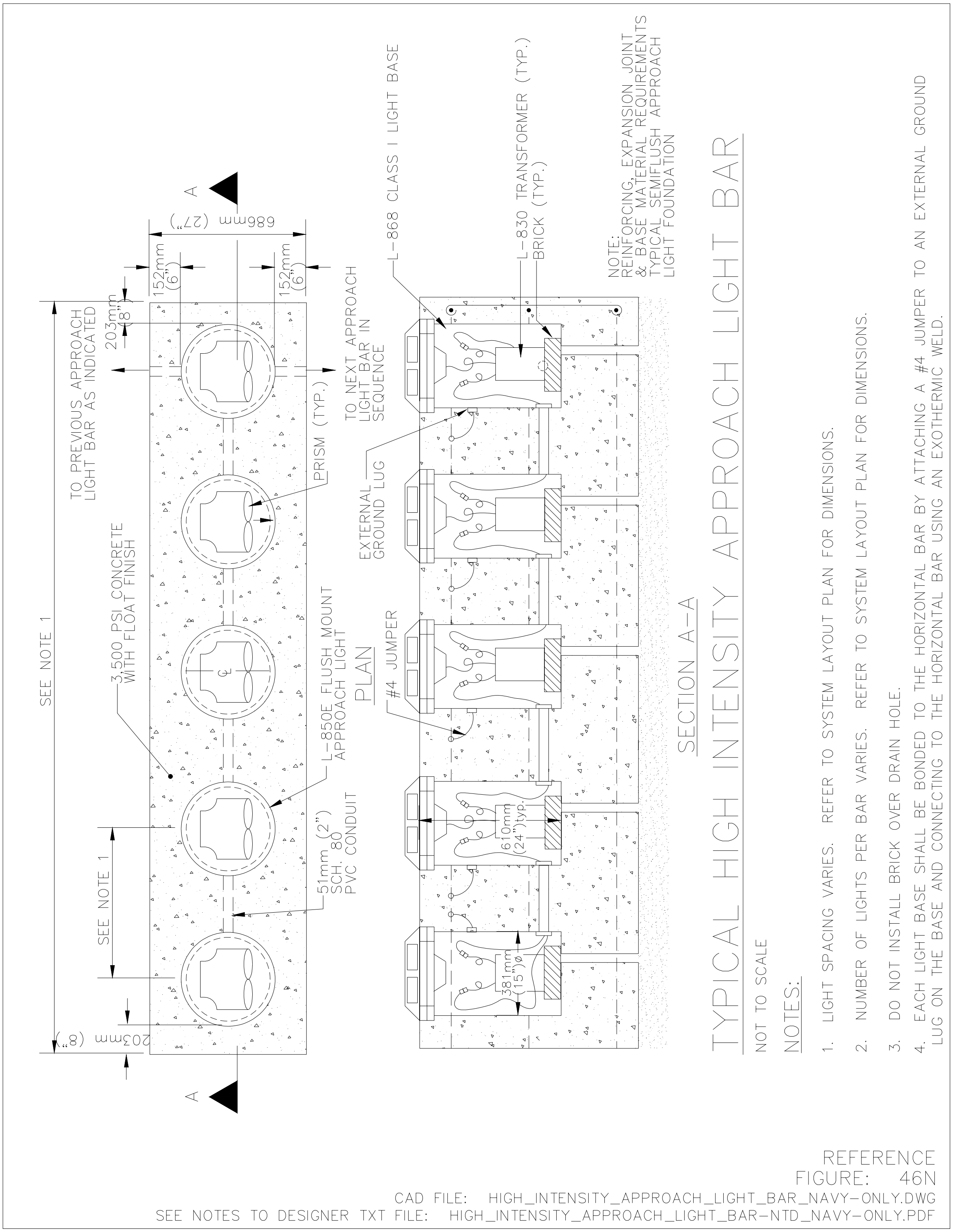


Figure 46N. Typical High Intensity Approach Light Bar (Navy Only)

~~4.17.~~ 4.20. Typical Elevated High Intensity Approach Light Bar 0mm to 1828mm (0' to 6'0") Maximum

See figure 47.

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 ~~Volume I~~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.

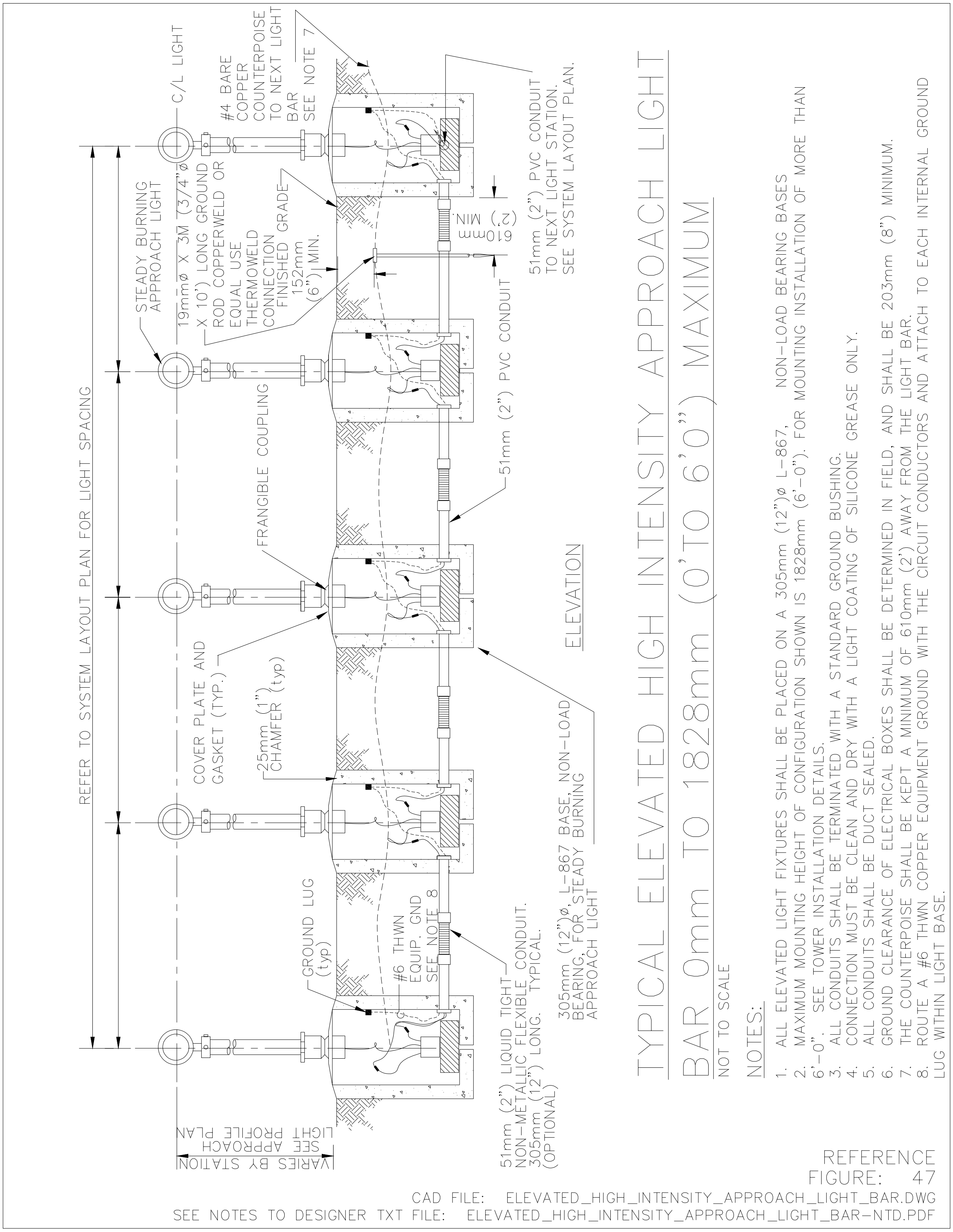


Figure 47. Typical Elevated High Intensity Approach Light Bar 0mm to 1828mm (0' to 6'0") Maximum

4.21. Typical Elevated High Intensity Approach Light Bar 0mm to 1828mm (0’ to 6’0”) Maximum (Navy Only)

See figure 47N.

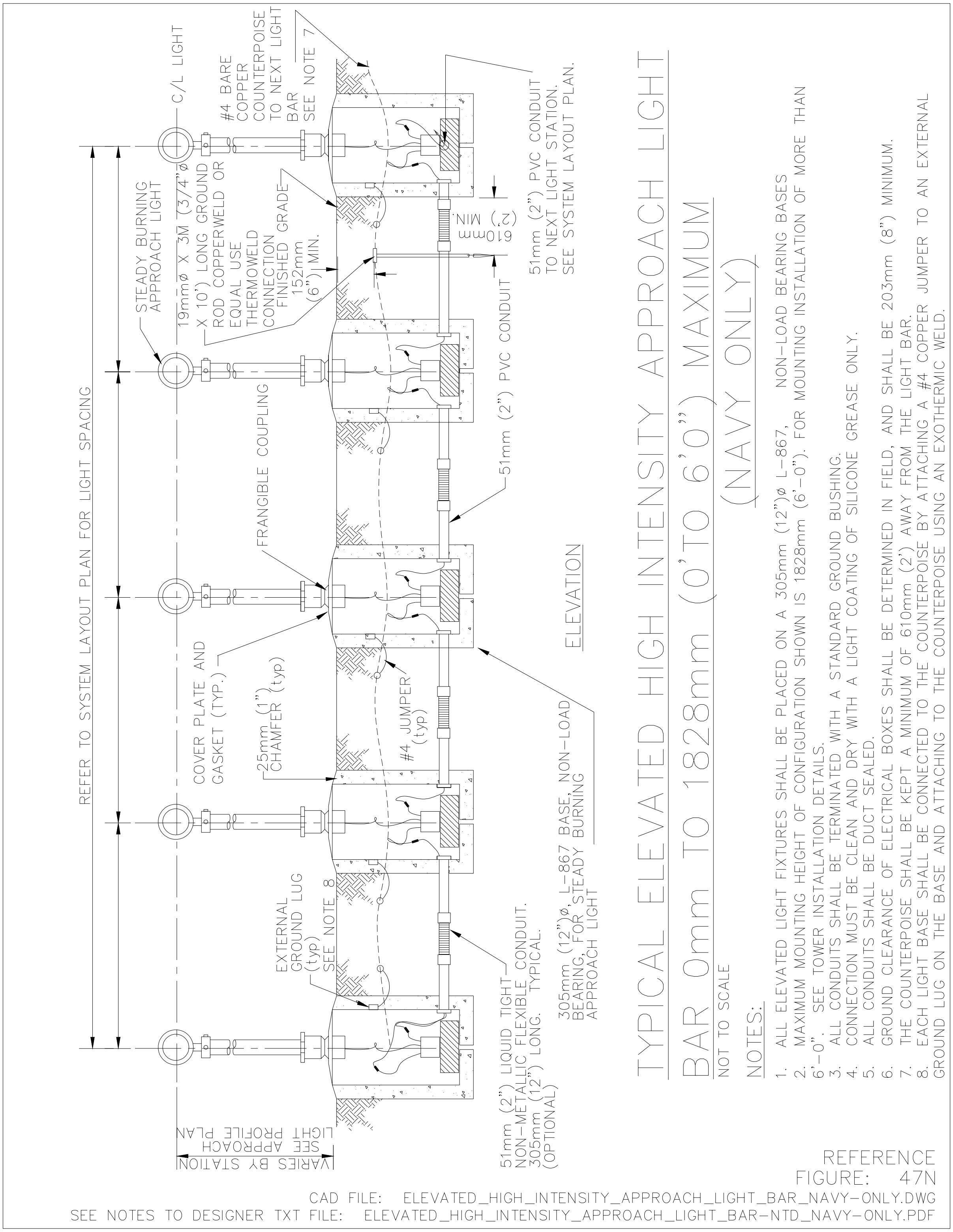
Notes to Designer:

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. Where no counterpoise is required, delete counterpoise, jumpers, ground rod and notes #7 and #8 from detail.



¡

Figure 47N. Typical Elevated High Intensity Approach Light Bar 0mm to 1828mm (0' to 6'0") Maximum (Navy Only)

~~4.18.~~ 4.22. Typical Semiflush High Intensity Approach/Threshold Light Foundation

See figure 48.

Notes to Designer:

1. This detail shows a typical foundation for a semiflush light bar or threshold.

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 for a high intensity system.

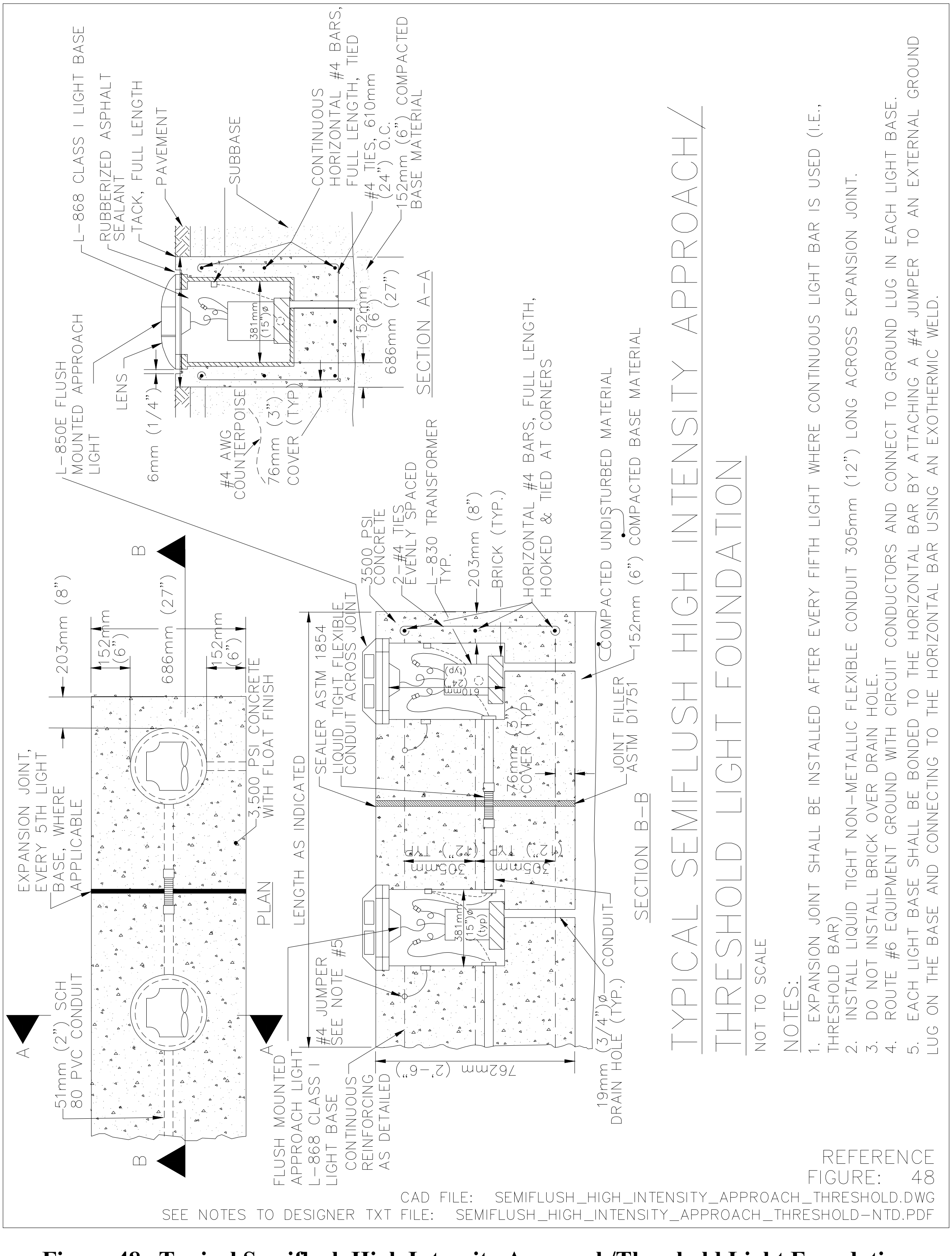


Figure 48. Typical Semiflush High Intensity Approach/Threshold Light Foundation

4.23. Typical Semiflush High Intensity Approach/ Threshold Light Foundation (Navy Only)

See figure 48N.

Notes to Designer:

4. This detail shows a typical foundation for a semiflush light bar or threshold.

5. No more than five lights should be in a bar before an expansion joint is installed.

6. Ensure photometric requirements are specified. Threshold lights must meet 10,000 CD min. average for a high intensity system.

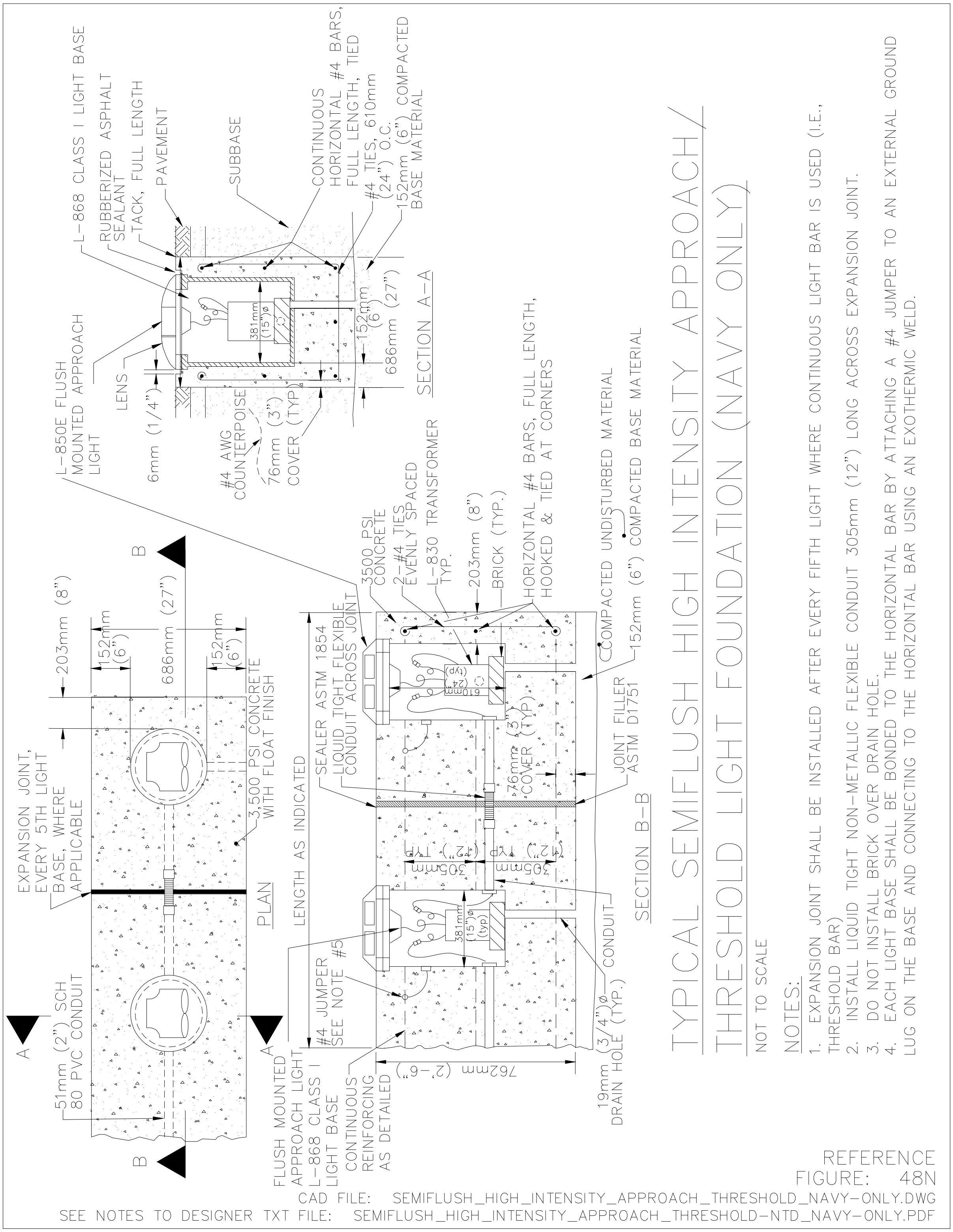


Figure 48N. Typical Semiflush High Intensity Approach/Threshold Light Foundation (Navy Only)

~~4.19.~~ 4.24. Typical Elevated High Intensity Approach/Threshold Light 1828mm (6'0") Maximum

See figure 49.

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 ~~Volume I~~UFC 3-535-01. Recommend specifying photometric requirements in the contract documents.

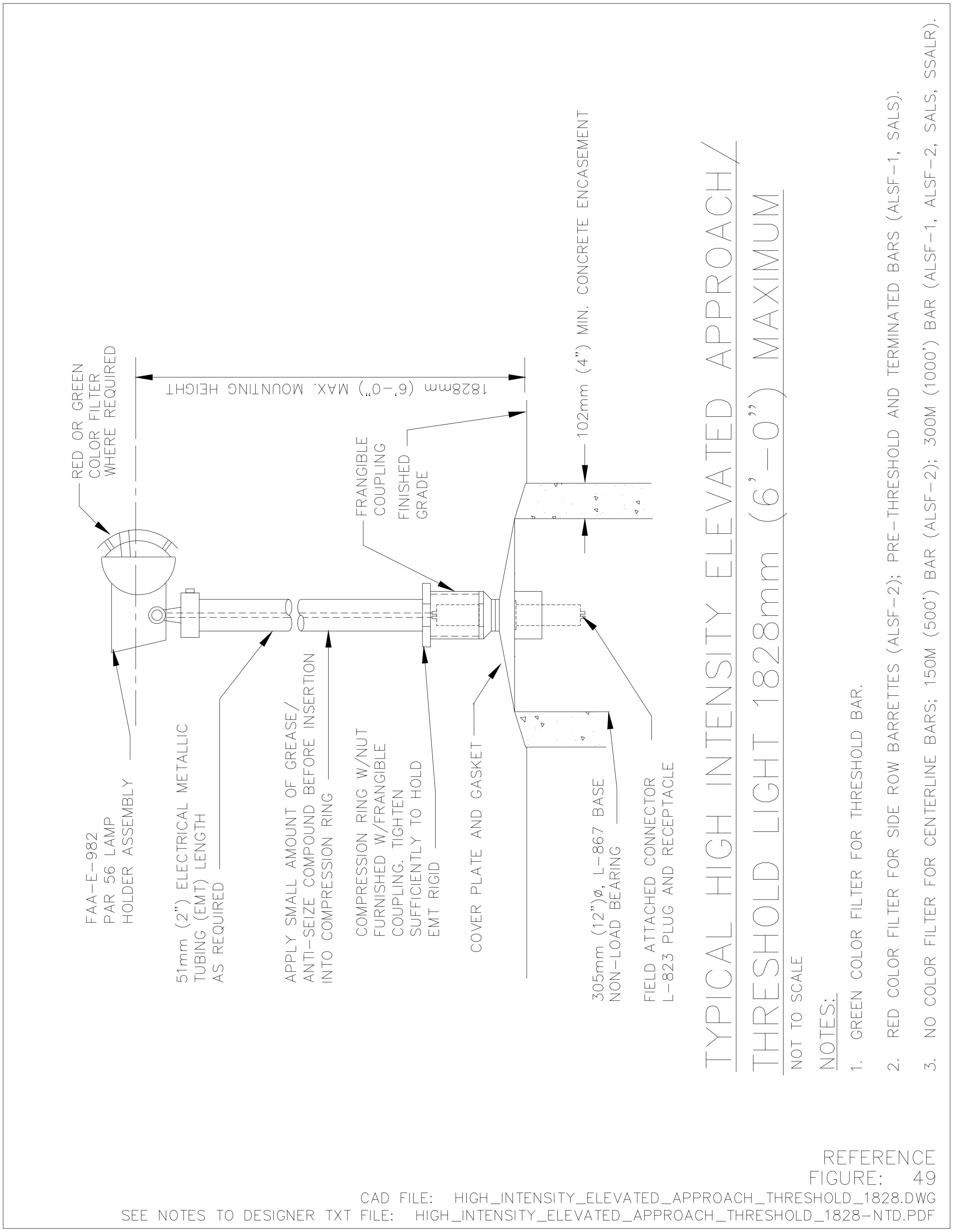


Figure 49. Typical Elevated High Intensity Approach/Threshold Light 1828mm (6'0") Maximum

~~4.20.~~ 4.25. ALSF-1 Approach Light System Configuration

See figure 50.

Notes to Designer:

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

2. Currently, there is no high intensity bidirectional semiflush threshold/end light that meets the photometric requirements. Utilize L-850E with green filters for the threshold and L-850E with red filters for the end lights. Co-locate the end lights with the corresponding threshold light between the runway threshold and 610mm (24") from the threshold light bar.

3. Manufacturers are currently testing light fixtures to be used as a semiflush bidirectional threshold/end light.

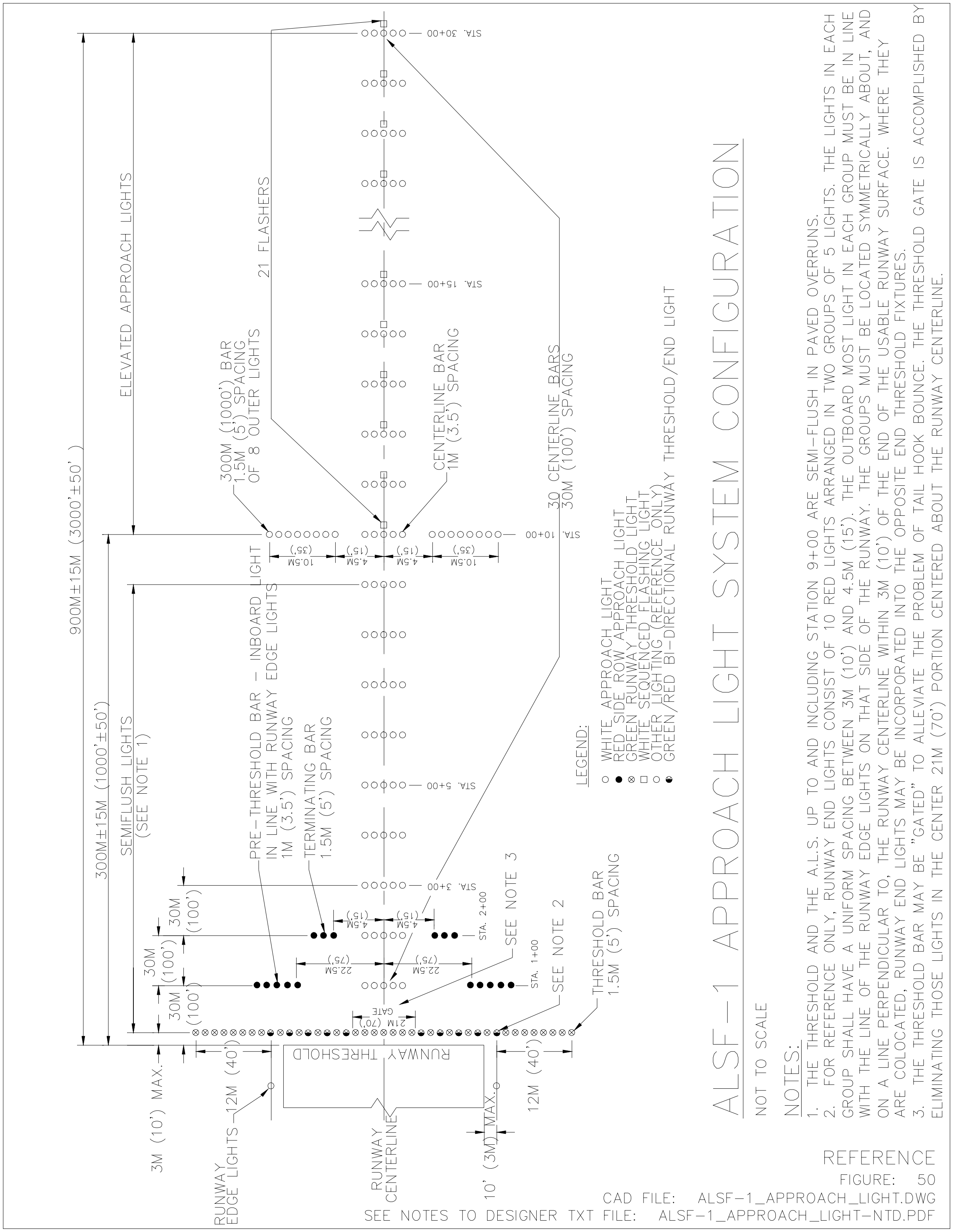


Figure 50. ALSF-1 Approach Light System Configuration

~~4.21.~~ 4.26. ALSF-2 Approach Light System Configuration

See figure 51.

Notes to Designer:

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

2. Currently, there is no high intensity bidirectional semiflush threshold/end light that meets the photometric requirements. Utilize L-850E with green filters for the threshold and L-850E with red filters for the end lights. Co-locate the end lights with the corresponding threshold light between the runway threshold and 610mm (24") from the threshold light bar.

3. Manufacturers are currently testing light fixtures to be used as a semiflush bidirectional threshold/end light.

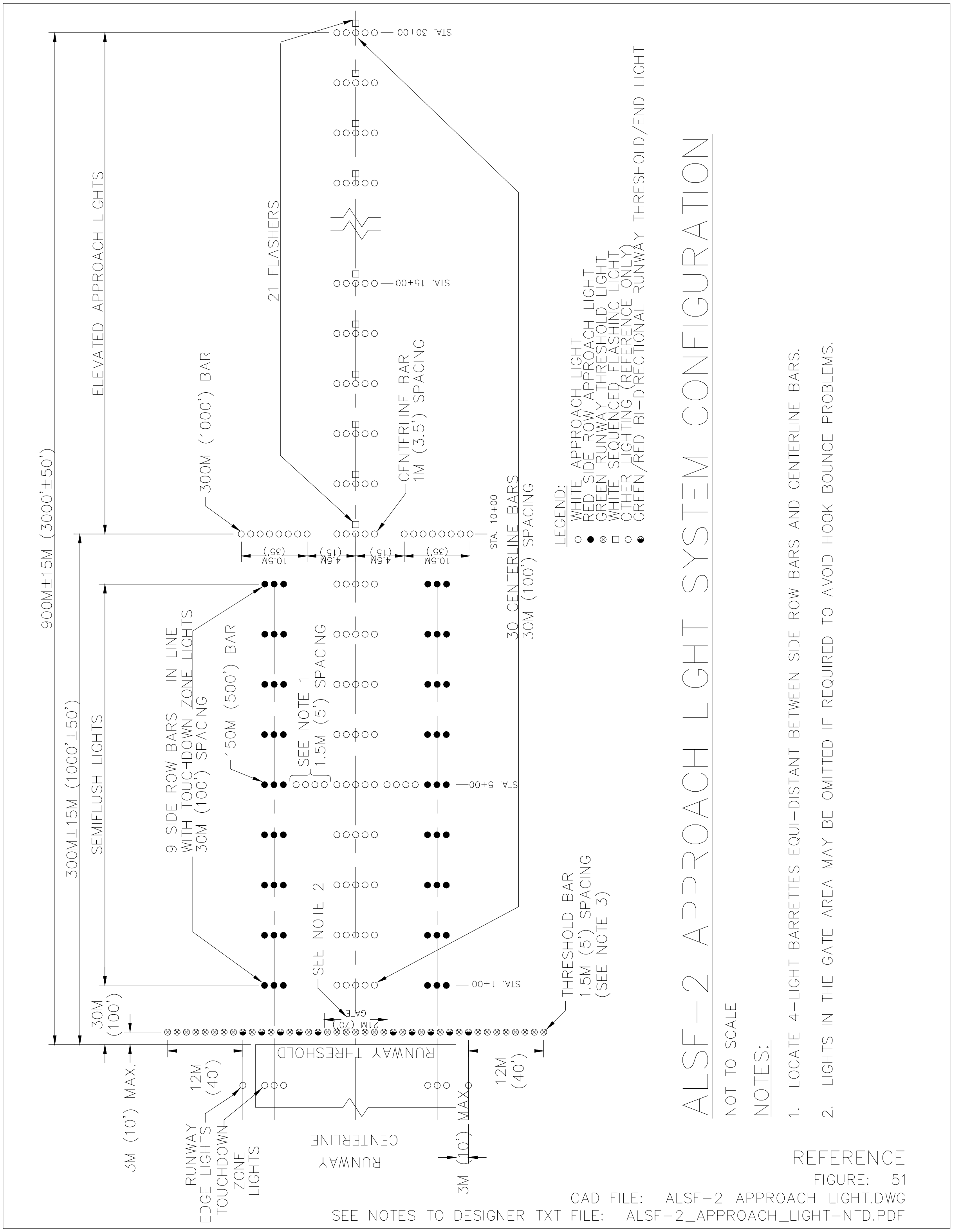


Figure 51. ALSF-2 Approach Light System Configuration

~~4.22.~~ 4.27. MALSR Wiring Diagram

See figure 52.

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.

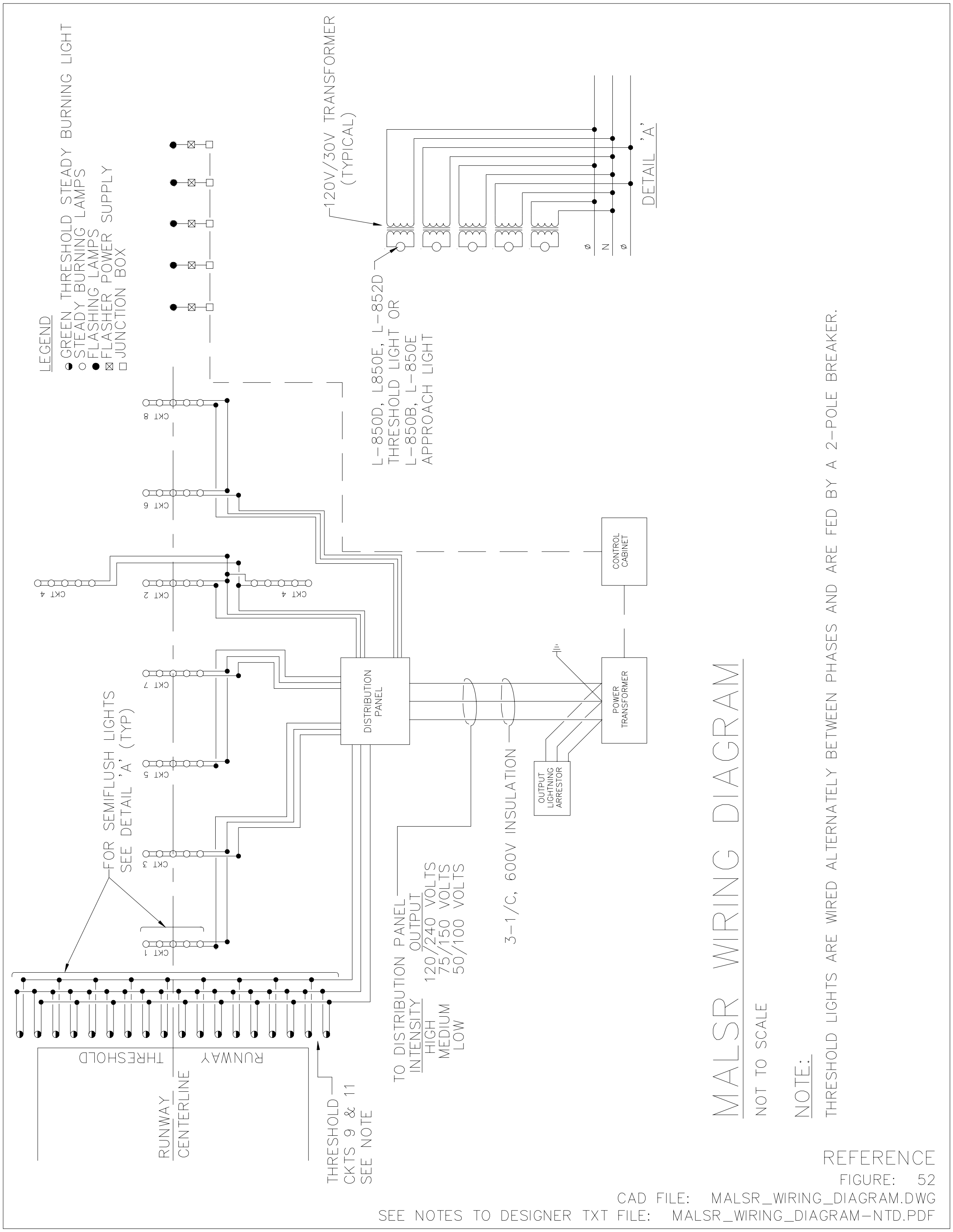


Figure 52. MALSR Wiring Diagram

~~4.23.~~ 4.28. SSALR Wiring Diagram

See figure 53.

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 ~~Volume I~~UFC 3-535-01 for more information.

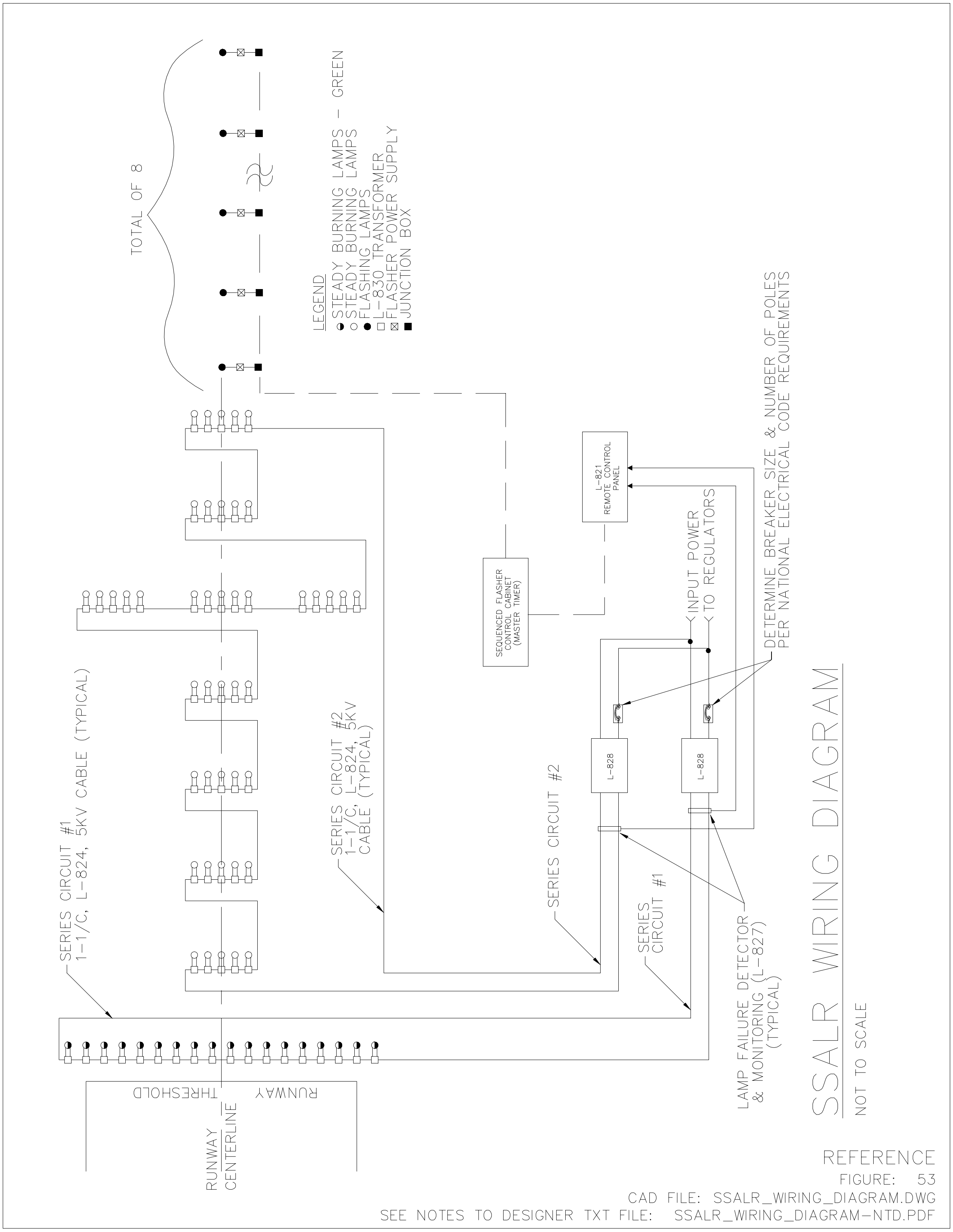


Figure 53. SSALR Wiring Diagram

~~4.24.~~ 4.29. L.I.R. Structure MS-20

See figure 54.

Notes to Designer:

1. The MS-20 structure is manufactured by Jaquith Industries and includes the crossbar and lowering device. Jaquith 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 plane or wet area both flasher power supply and junction box should be installed on the maintenance platform. Cables may then be routed underground or aerially.

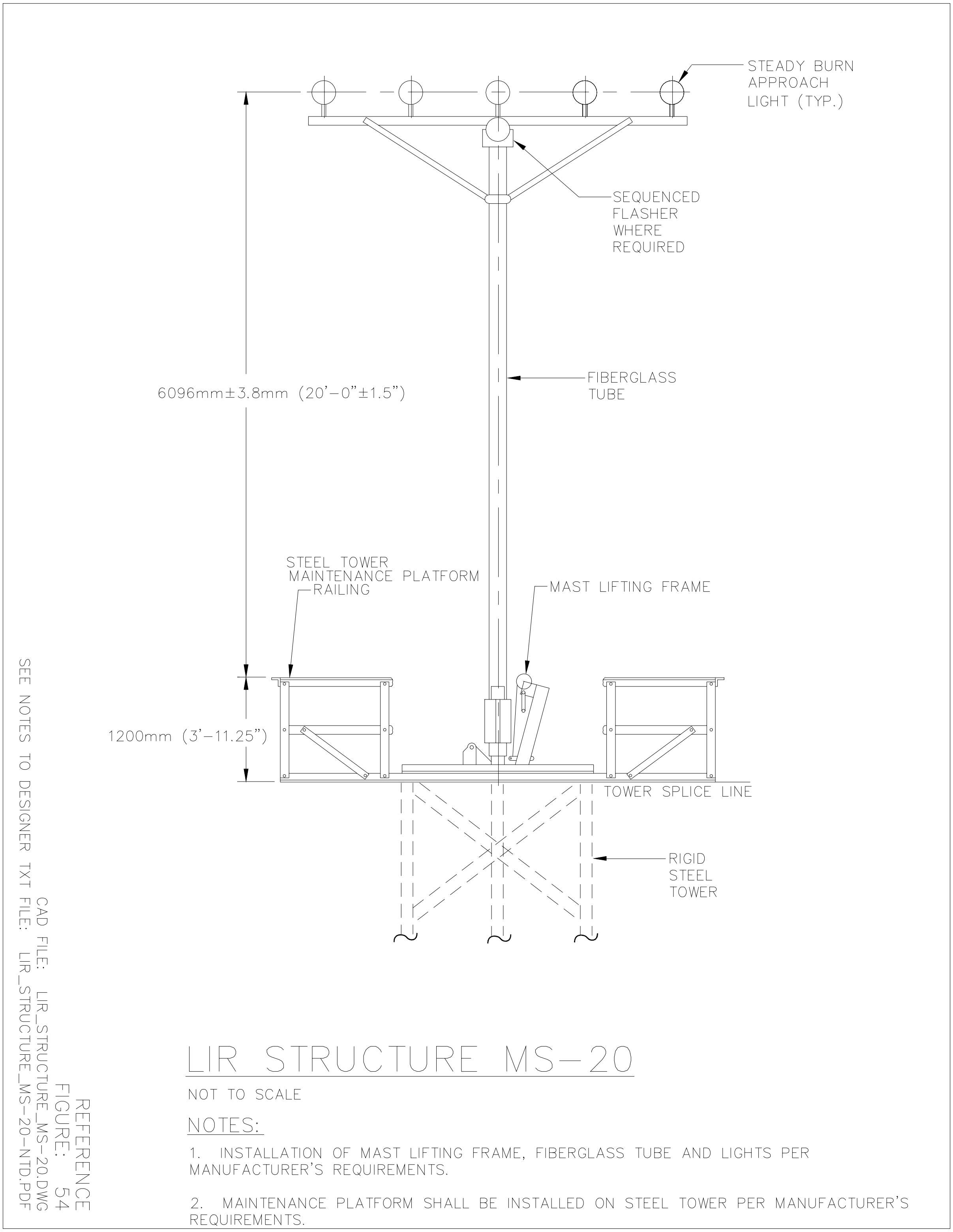


Figure 54. L.I.R. Structure MS-20

~~4.25.~~ 4.30. Approach Light Structure 12.2M to 39M (40' to 128')

See figure 55.

Notes to Designer:

1. The top 6M (20') 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 6M (20') for the L.I.R. structure and 1.2M (3'-11.25") for the maintenance platform and railing from the overall height as shown 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 shall include the proposed fixtures and hardware to be installed on the tower.

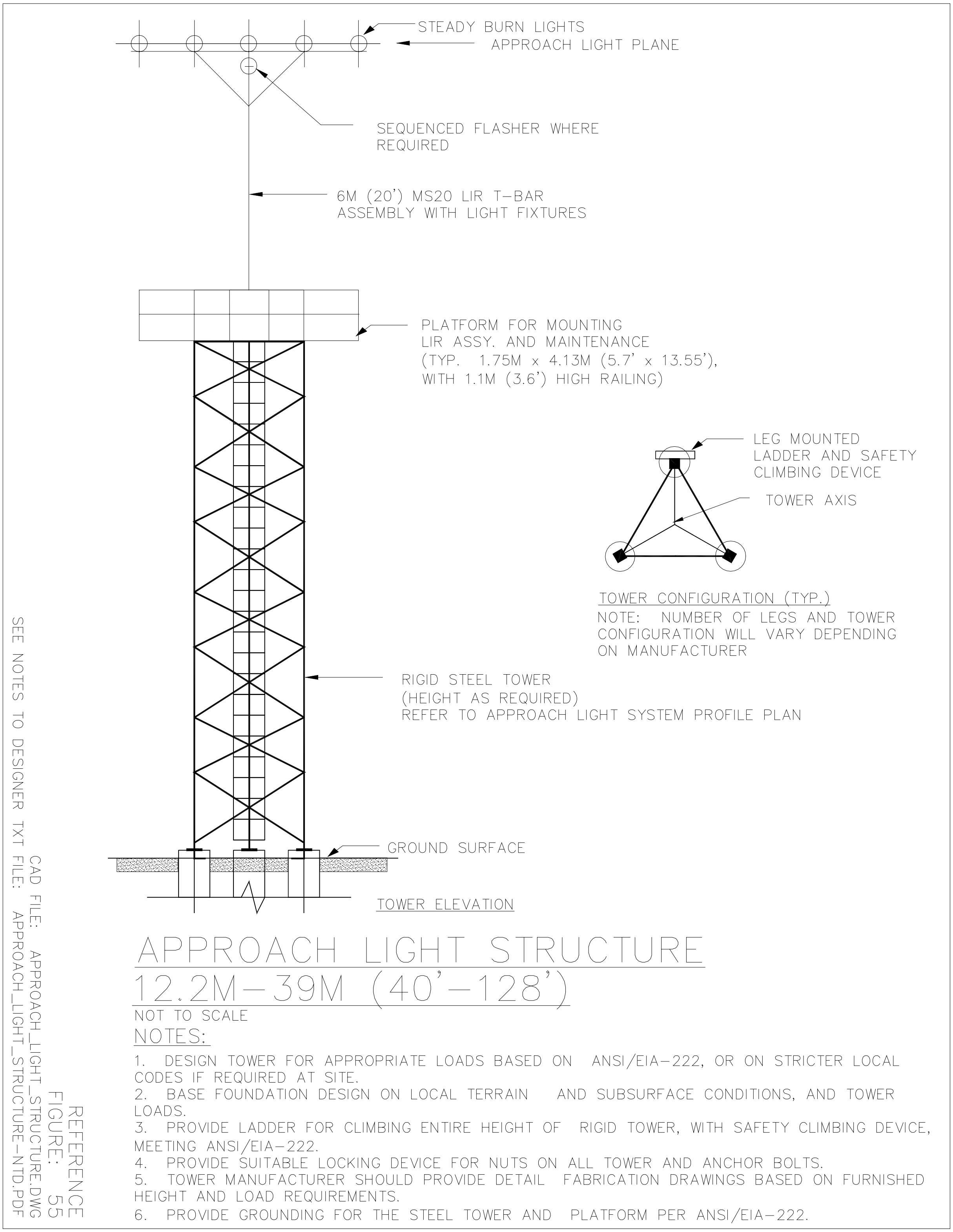


Figure 55. Approach Light Structure 12.2M to 39M (40' to 128')

~~4.26.~~ 4.31. High Intensity Threshold Bar Wiring Diagram – Without Approach Lights (Method #1)

See figure 56.

Notes to Designer:

1. The total load for the threshold bar without approach lights and including lights in the gated area could be as high as 28.1kw with 51 elevated lights at 550 watts each including transformer losses. Recommend specifying in the contract documents a threshold light regulator that would operate in conjunction with the runway edge lights.

2. Circuiting should be split between the runway and threshold regulators. As a minimum, the runway end lights and their co-located threshold lights should be on the runway circuit. The different circuits should cause a symmetrical pattern about the runway centerline.

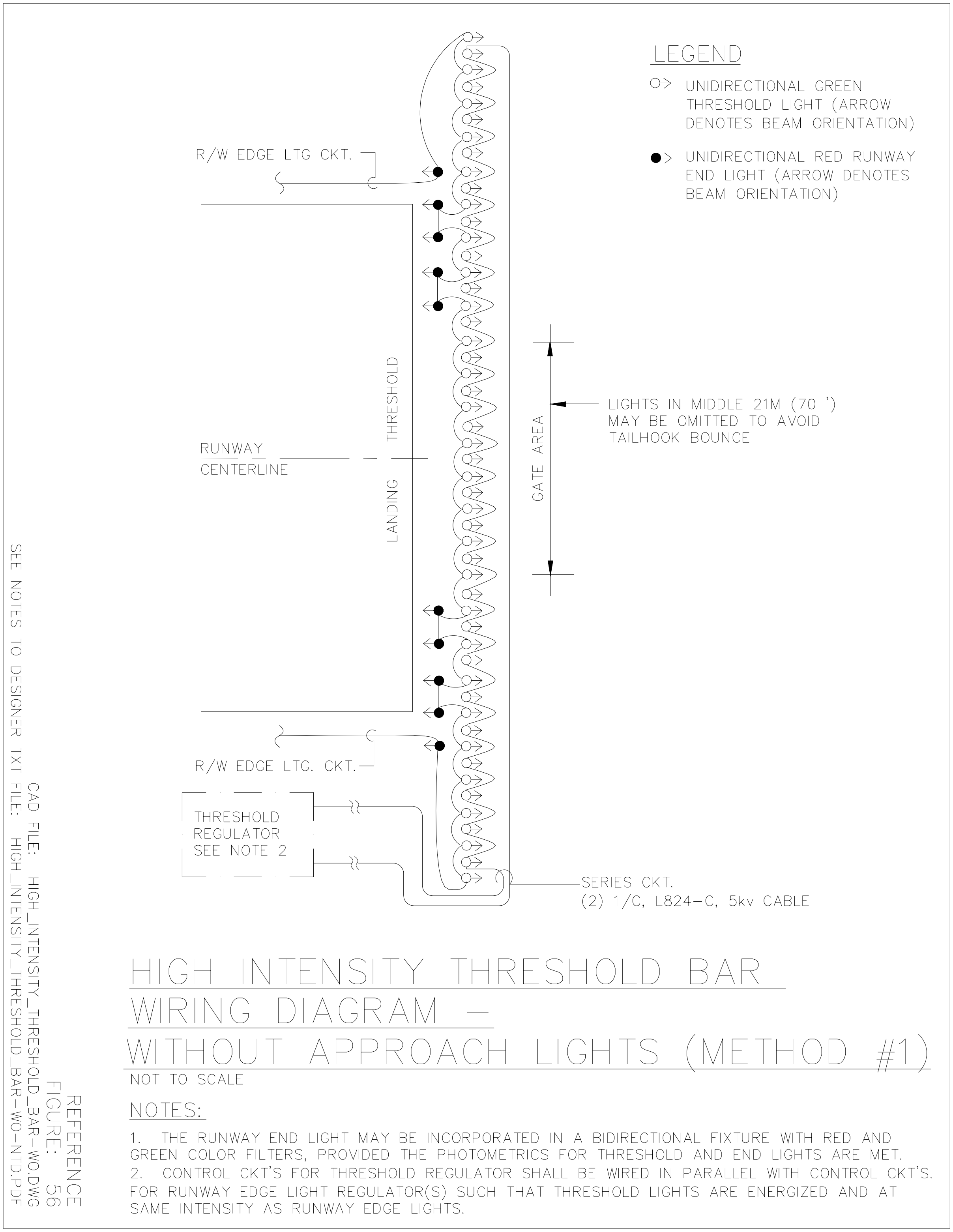


Figure 56. High Intensity Threshold Bar Wiring Diagram – Without Approach Lights (Method #1)

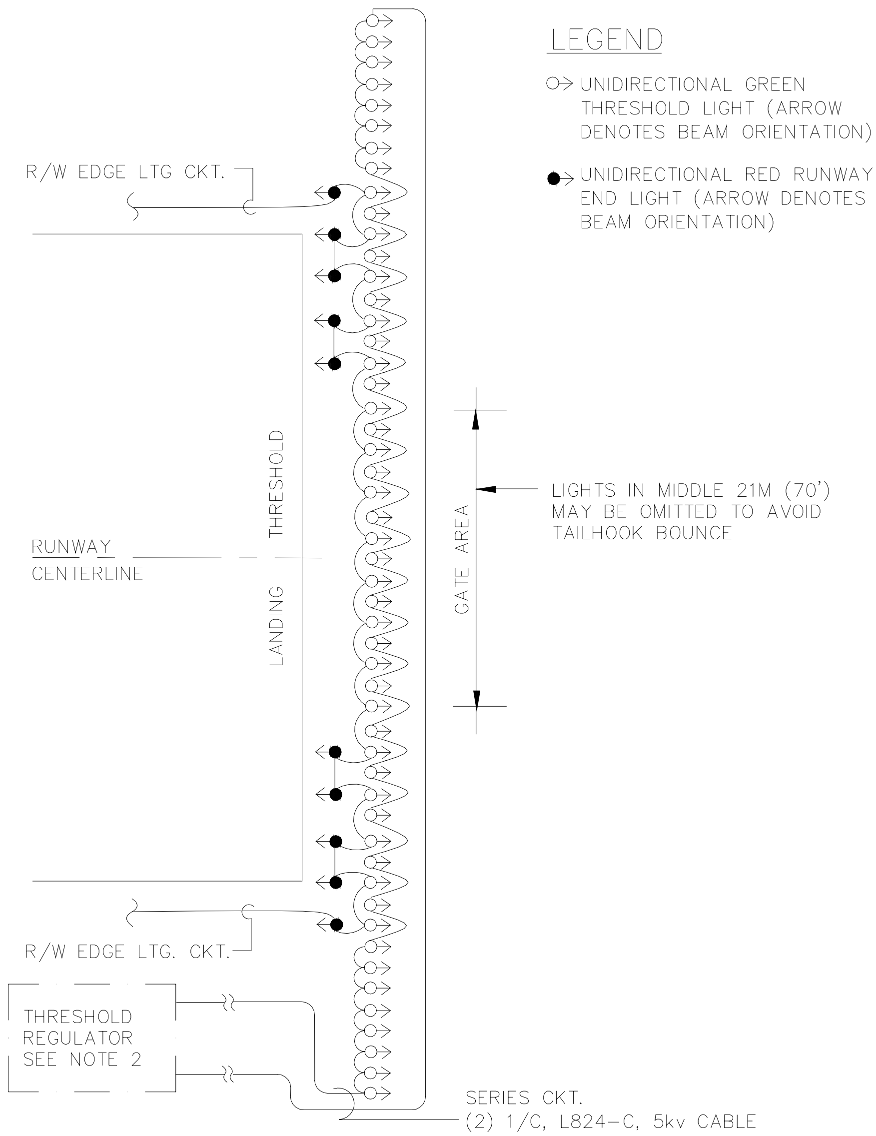
~~4.27.~~ 4.32. High Intensity Threshold Bar Wiring Diagram – Without Approach Lights (Method #2)

See figure 57.

Notes to Designer:

1. The total load for the threshold bar without approach lights and including lights in the gated area could be as high as 28.1Kw with 51 elevated lights at 550 watts each including transformer losses. Recommend specifying in the contract documents a threshold light regulator that would operate in conjunction with the runway edge lights.

2. Circuiting should be split between the runway and threshold regulators. As a minimum, the runway end lights and their co-located threshold lights should be on the runway circuit. The different circuits should cause a symmetrical pattern about the runway centerline.



HIGH INTENSITY THRESHOLD BAR WIRING DIAGRAM – WITHOUT LIGHTS (METHOD #2)

NOT TO SCALE

NOTES:

1. THE RUNWAY END LIGHT MAY BE INCORPORATED IN A BIDIRECTIONAL FIXTURE WITH RED AND GREEN COLOR FILTERS, PROVIDED THE PHOTOMETRICS FOR THRESHOLD AND END LIGHTS ARE MET.
2. CONTROL CIRCUITS FOR THRESHOLD REGULATOR SHALL BE WIRED IN PARALLEL WITH CONTROL CIRCUITS. FOR RUNWAY EDGE LIGHT REGULATOR(S) SUCH THAT THRESHOLD LIGHTS ARE ENERGIZED AND AT SAME INTENSITY AS RUNWAY EDGE LIGHTS.

REFERENCE FIGURE: 57
CAD FILE: HIGH_INTENSITY_THRESHOLD_BAR-WO2.DWG
SEE NOTES TO DESIGNER TXT FILE: HIGH_INTENSITY_THRESHOLD_BAR-WO2-NTD.PDF

Figure 57. High Intensity Threshold Bar Wiring Diagram – Without Approach Lights (Method #2)

~~4.28.~~ 4.33. High Intensity Threshold Bar Wiring Diagram – With Approach Lights

See figure 58.

Notes to Designer:

1. When an approach light system is installed, part of the threshold bar will be circuited with the approach lights and part will be circuited with the runway edge lights.

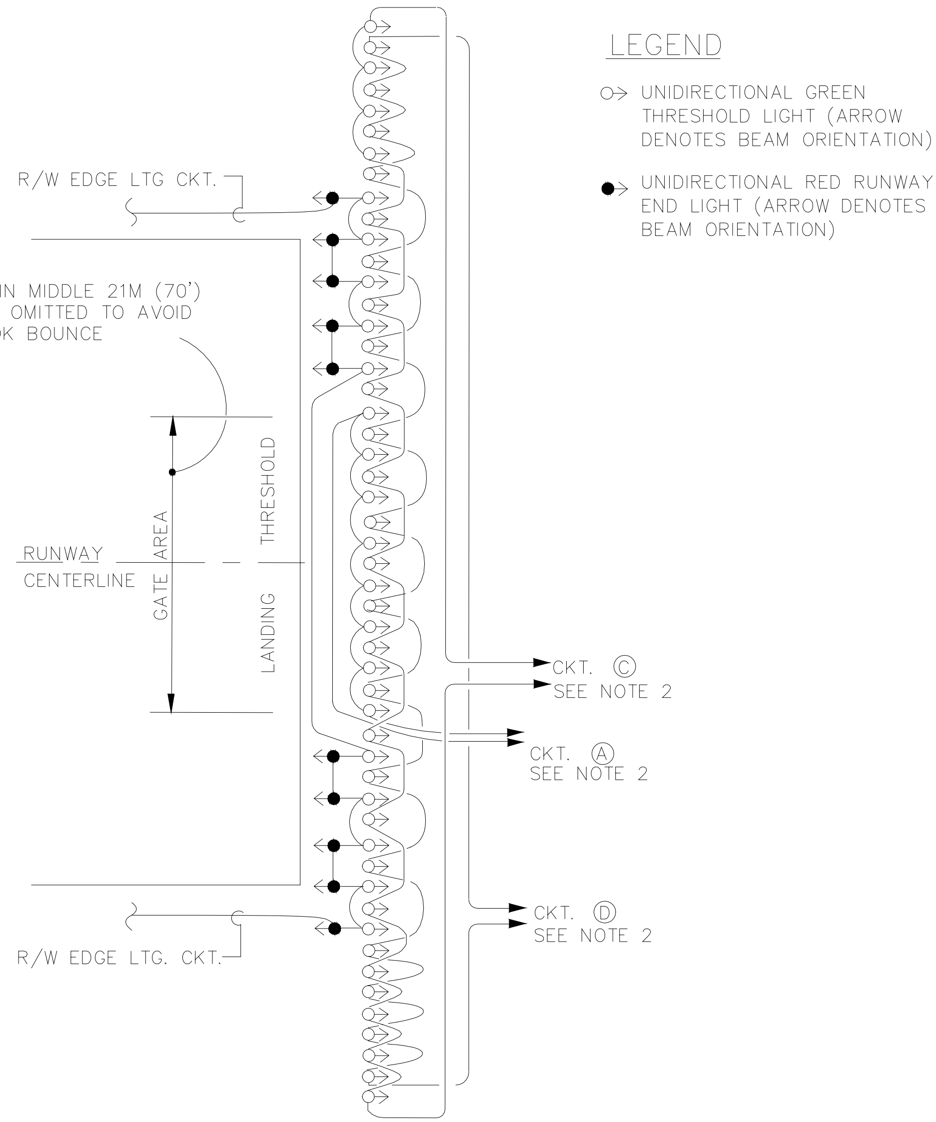
2. Coordinate circuiting with the approach light system and maintain a symmetrical pattern about the runway centerline.

3. As shown in the DWG:

   - R/W LTG CKT turns on the runway end lights and corresponding co-located approach light.

   - CKT A is the SSALR circuit of a dual mode ALSF/SSALR approach lighting system. With the R/W lights and CKT A turned on, the threshold bar light pattern is that of an SSALR configuration.

   - CKTs C and D complete the light pattern for a full ALSF mode and are circuited such that no two adjacent fixtures are on the same circuit. All circuits are on (R/W, A, C, D) for a full ALSF system.



HIGH INTENSITY THRESHOLD BAR WIRING DIAGRAM – WITH APPROACH LIGHTS

NOT TO SCALE

NOTES:

1. THE RUNWAY END LIGHT MAY BE INCORPORATED IN A BIDIRECTIONAL FIXTURE WITH RED AND GREEN COLOR FILTERS, PROVIDED THE PHOTOMETRICS FOR THRESHOLD AND END LIGHTS ARE MET.

2. REFER TO HIGH INTENSITY ALSF/SSALR WIRING DIAGRAMS FOR CONTINUATION.

REFERENCE
FIGURE: 58
CAD FILE: HIGH_INTENSITY_THRESHOLD_BAR-W.DWG
SEE NOTES TO DESIGNER TXT FILE: HIGH_INTENSITY_THRESHOLD_BAR-W-NTD.PDF

Figure 58. High Intensity Threshold Bar Wiring Diagram – With Approach Lights

~~4.29.~~ 4.34. High Intensity ALSF-1/SSALR Wiring Diagram

See figure 59.

Notes to Designer:

1. When designing the approach light system, several factors must be taken into account:
   - Each regulator should be equal in kw capacity,
   - No two adjacent light bars should be on the same circuit, and
   - 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.

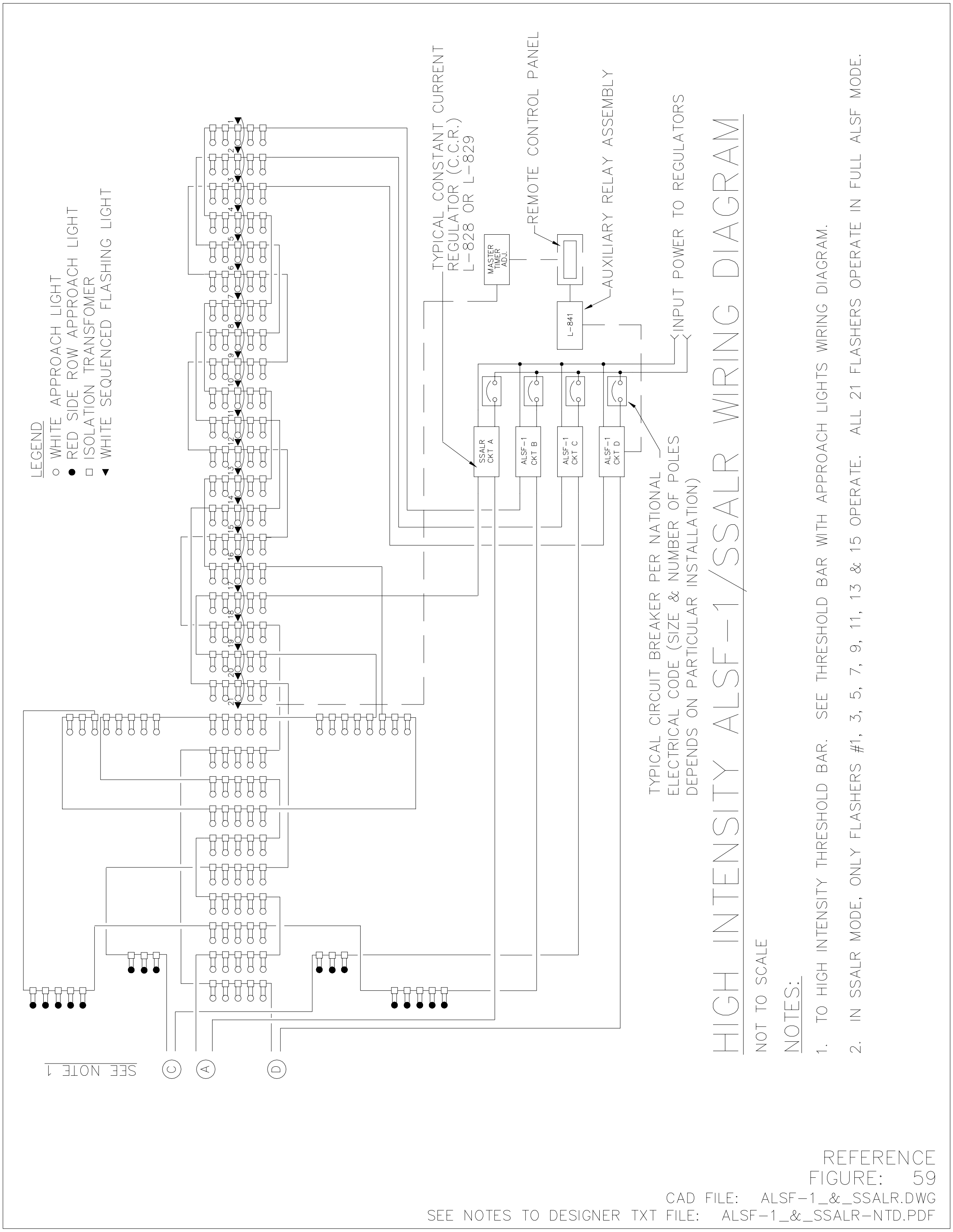


Figure 59. High Intensity ALSF-1/SSALR Wiring Diagram

~~4.30.~~ 4.35. High Intensity ALSF-2/SSALR Wiring Diagram

See figure 60.

Notes to Designer:

1. When designing the approach light system, several factors must be taken into account:
   - Each regulator should be equal in kw capacity,
   - No two adjacent light bars should be on the same circuit, and
   - 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.

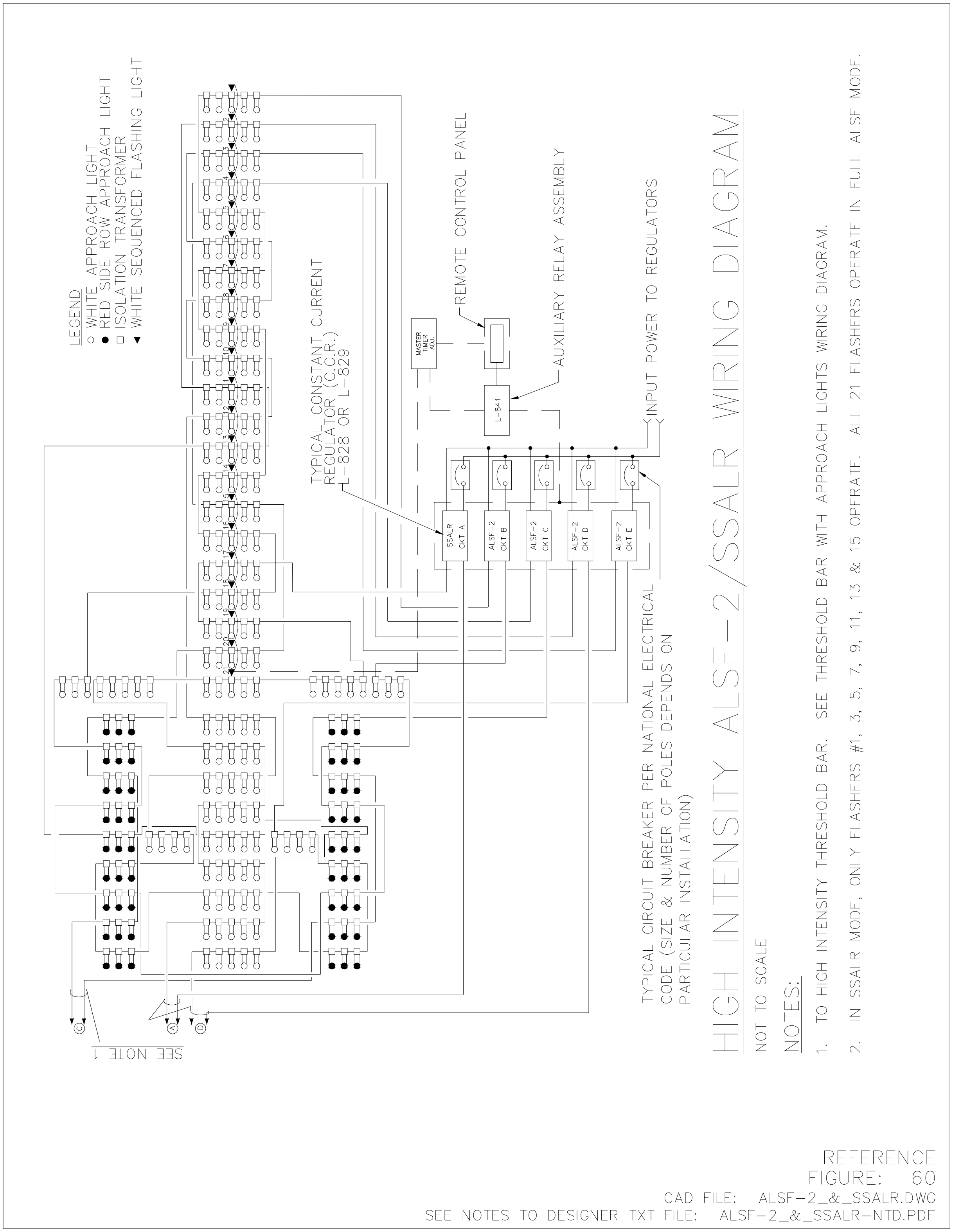


Figure 60. High Intensity ALSF-2/SSALR Wiring Diagram