

Figure 72. Typical Tubular Steel Beacon Tower.

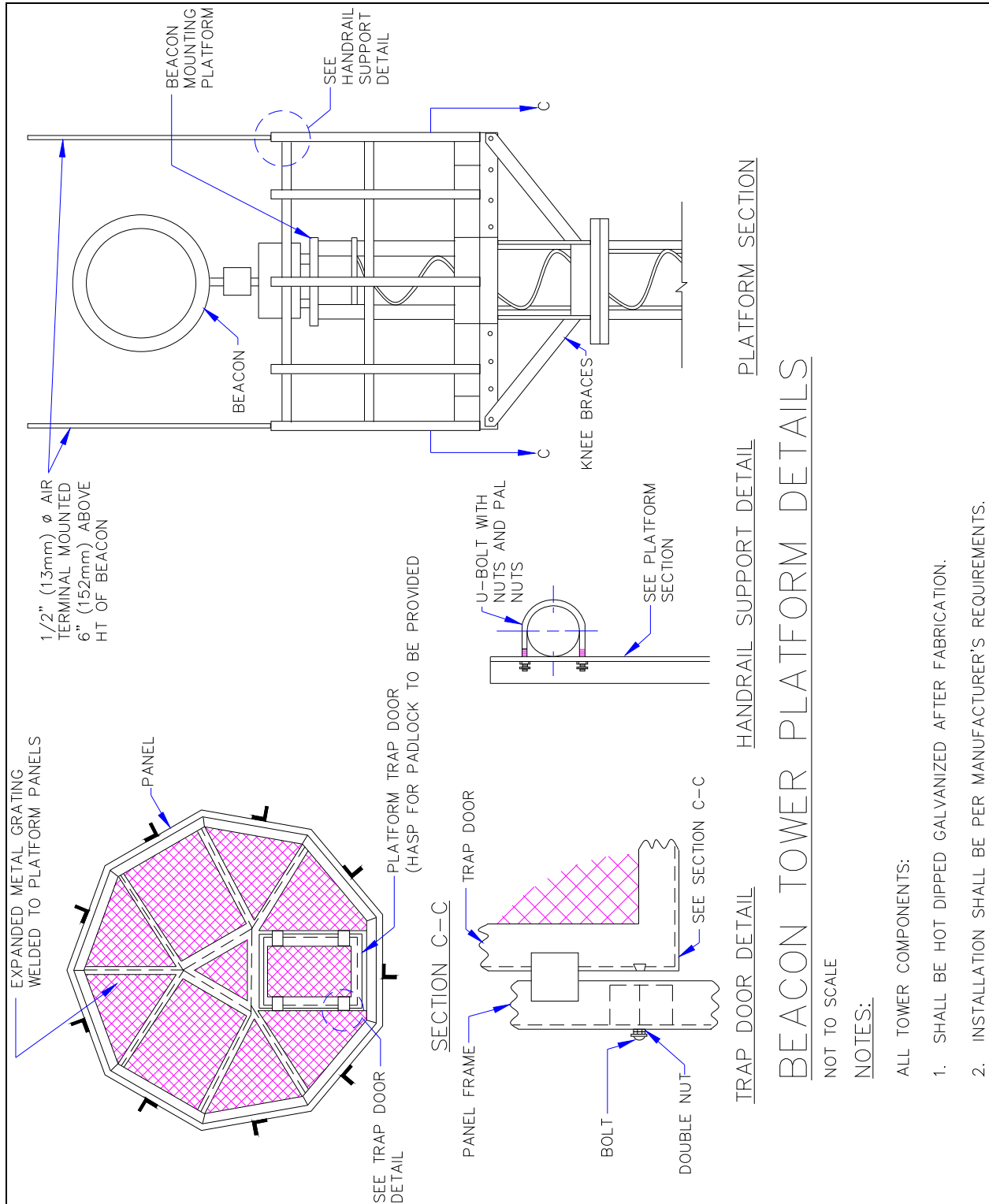


Figure 73. Typical Pre-fabricated Beacon Tower Structure.

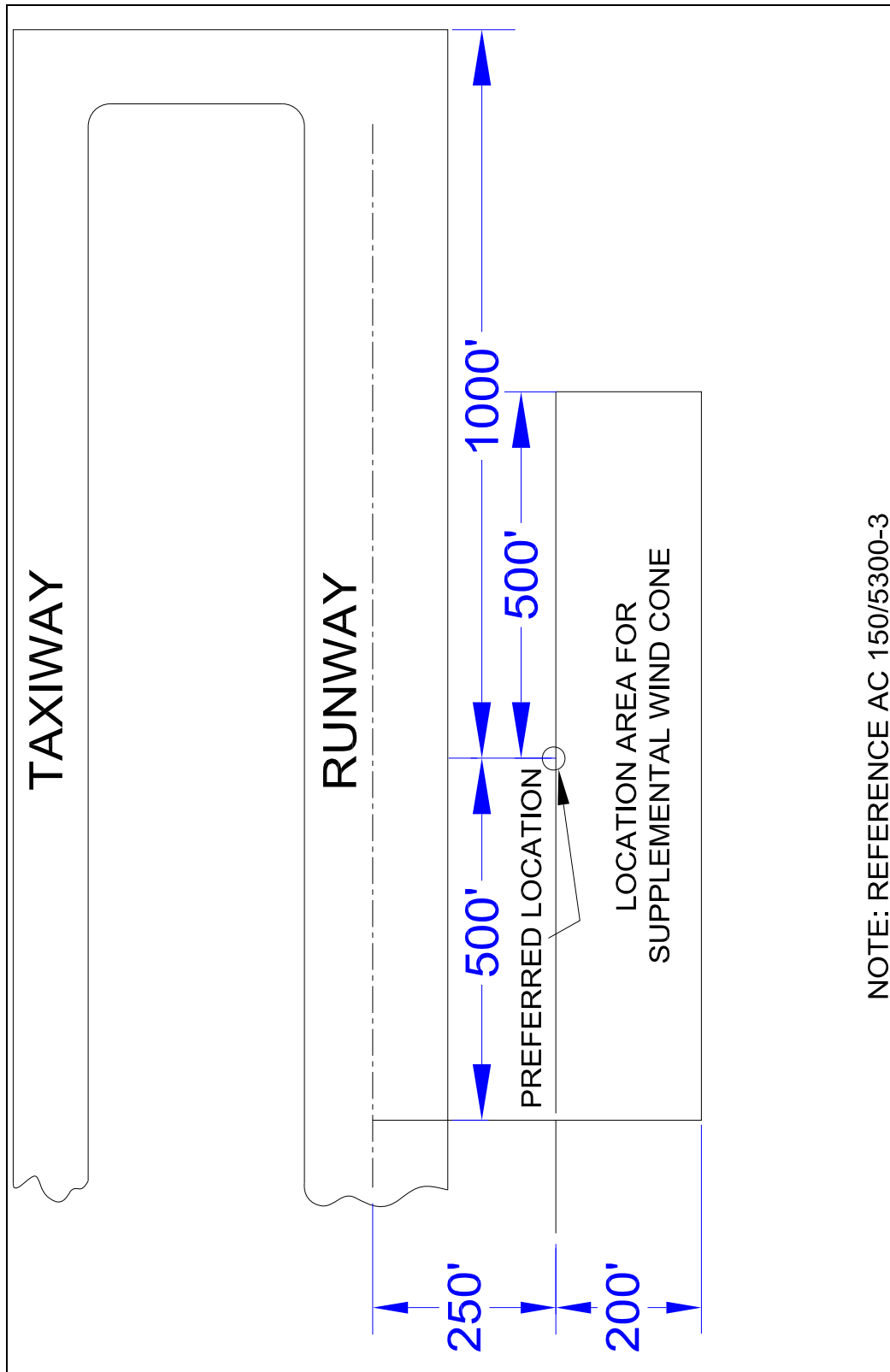


Figure 74. Typical Location of Supplemental Wind Cone.

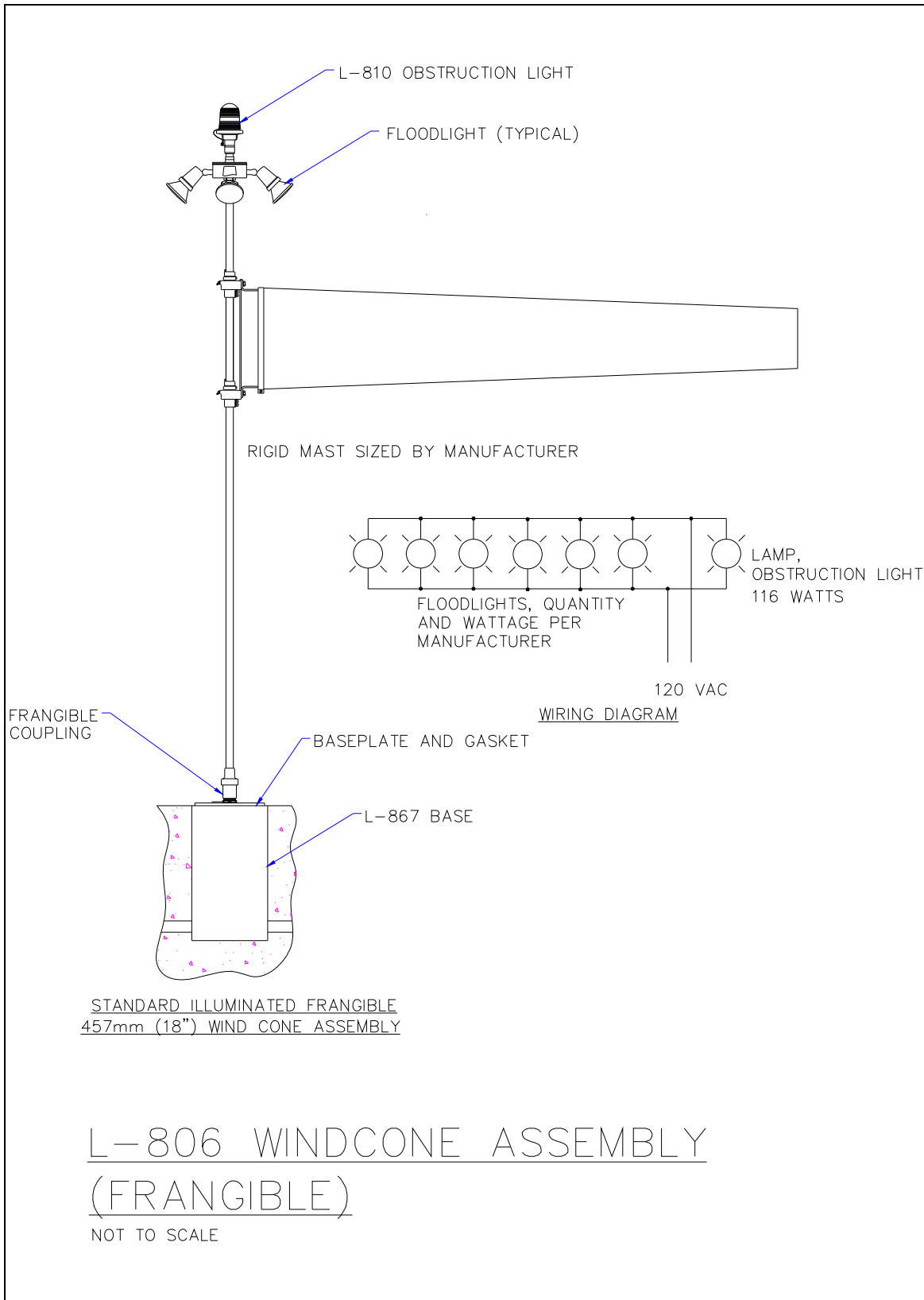


Figure 75. Externally Lighted Wind Cone Assembly (Frangible).

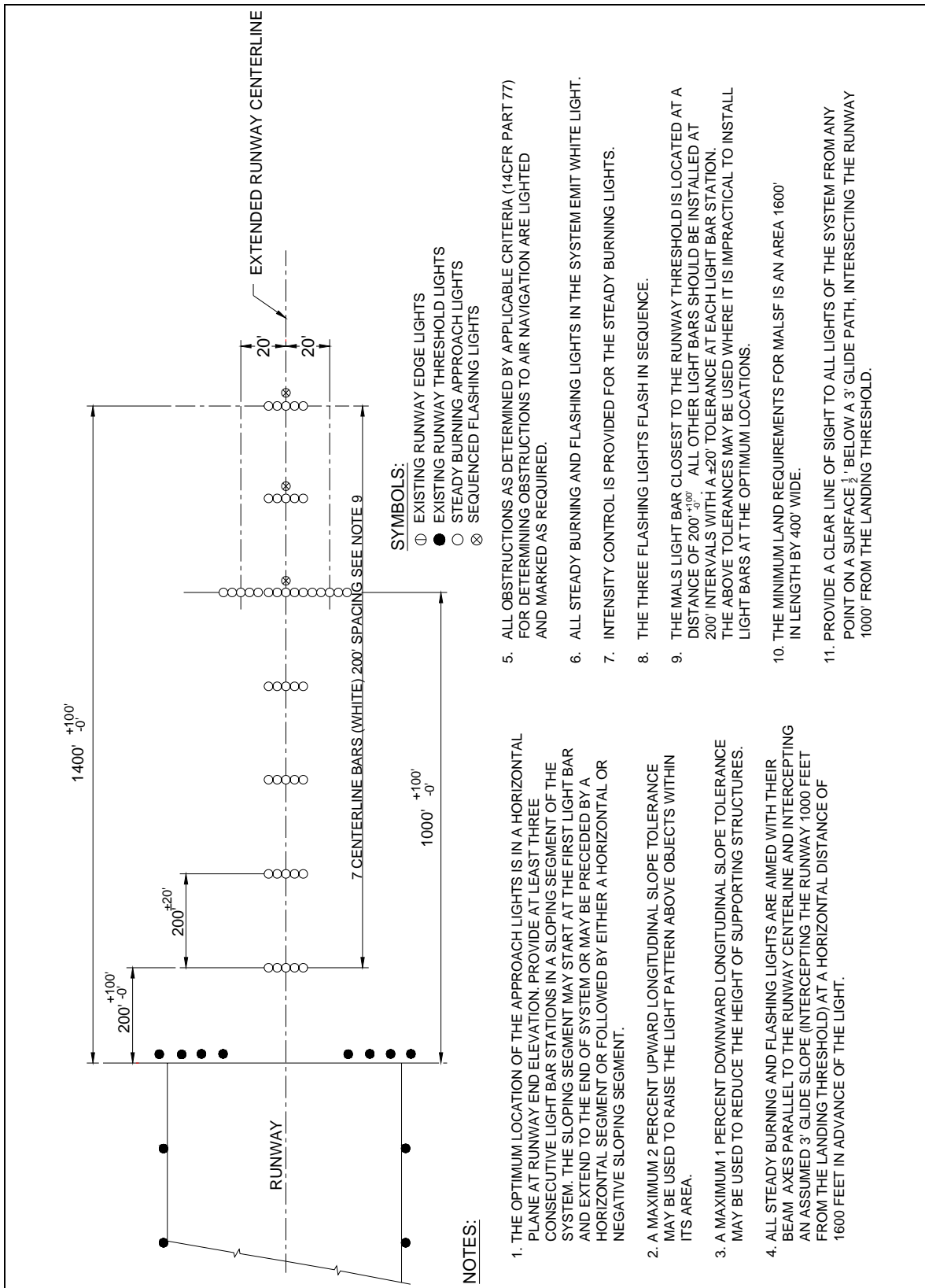
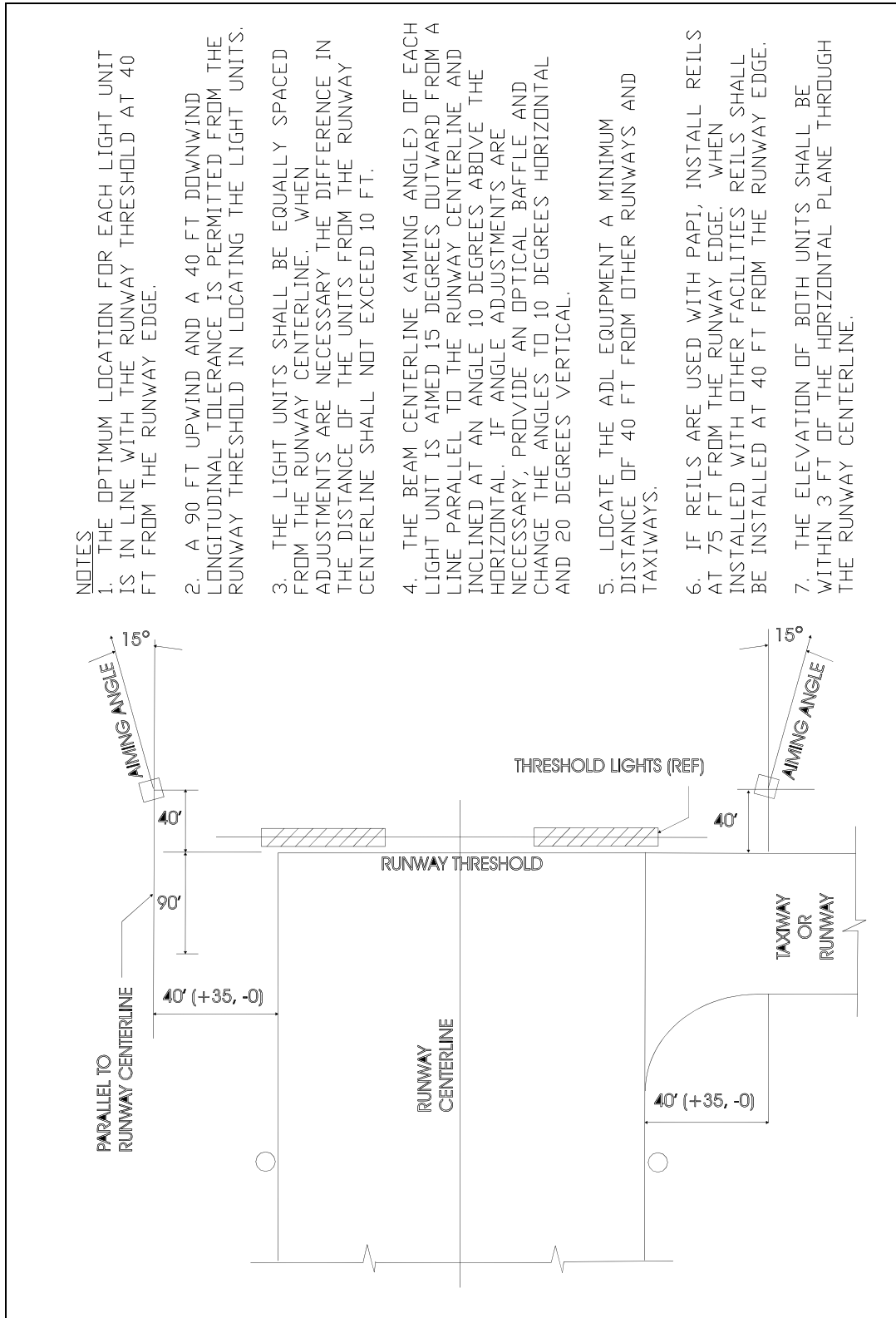


Figure 76. Typical Layout for MALSF.



NOTES
1. THE OPTIMUM LOCATION FOR EACH LIGHT UNIT IS IN LINE WITH THE RUNWAY THRESHOLD AT 40 FT FROM THE RUNWAY EDGE.

2. A 90 FT UPWIND AND A 40 FT DOWNWIND LONGITUDINAL TOLERANCE IS PERMITTED FROM THE RUNWAY THRESHOLD IN LOCATING THE LIGHT UNITS.

3. THE LIGHT UNITS SHALL BE EQUALLY SPACED FROM THE RUNWAY CENTERLINE. WHEN ADJUSTMENTS ARE NECESSARY THE DIFFERENCE IN THE DISTANCE OF THE UNITS FROM THE RUNWAY CENTERLINE SHALL NOT EXCEED 10 FT.

4. THE BEAM CENTERLINE (AIMING ANGLE) OF EACH LIGHT UNIT IS AIMED 15 DEGREES OUTWARD FROM A LINE PARALLEL TO THE RUNWAY CENTERLINE AND INCLINED AT AN ANGLE 10 DEGREES ABOVE THE HORIZONTAL. IF ANGLE ADJUSTMENTS ARE NECESSARY, PROVIDE AN OPTICAL BAFFLE AND CHANGE THE ANGLES TO 10 DEGREES HORIZONTAL AND 20 DEGREES VERTICAL.

5. LOCATE THE ADL EQUIPMENT A MINIMUM DISTANCE OF 40 FT FROM OTHER RUNWAYS AND TAXIWAYS.

6. IF REILS ARE USED WITH PAPI, INSTALL REILS AT 75 FT FROM THE RUNWAY EDGE. WHEN INSTALLED WITH OTHER FACILITIES REILS SHALL BE INSTALLED AT 40 FT FROM THE RUNWAY EDGE.

7. THE ELEVATION OF BOTH UNITS SHALL BE WITHIN 3 FT OF THE HORIZONTAL PLANE THROUGH THE RUNWAY CENTERLINE.

Figure 77. Typical Layout for Runway End Identifier Lights (REILs).

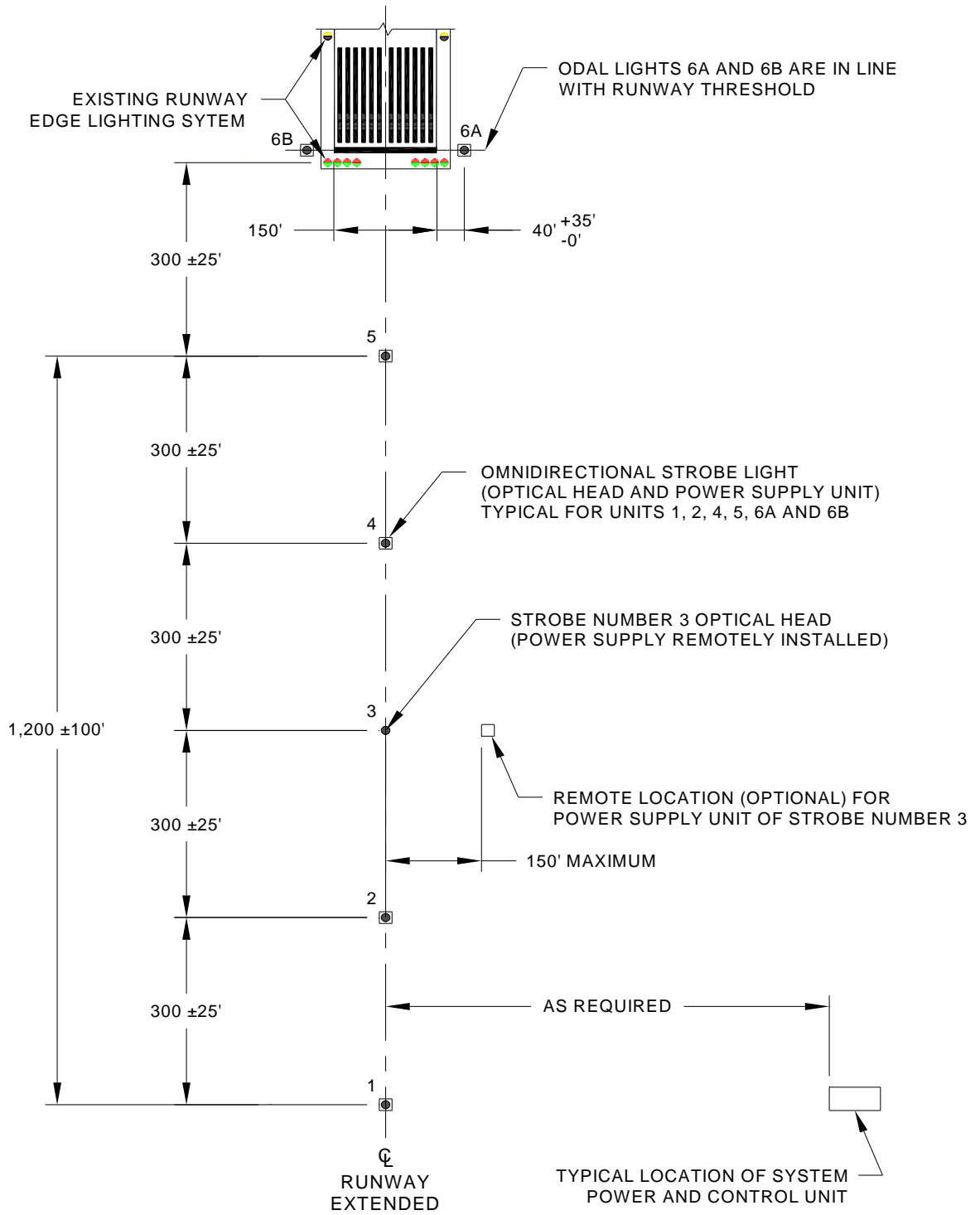
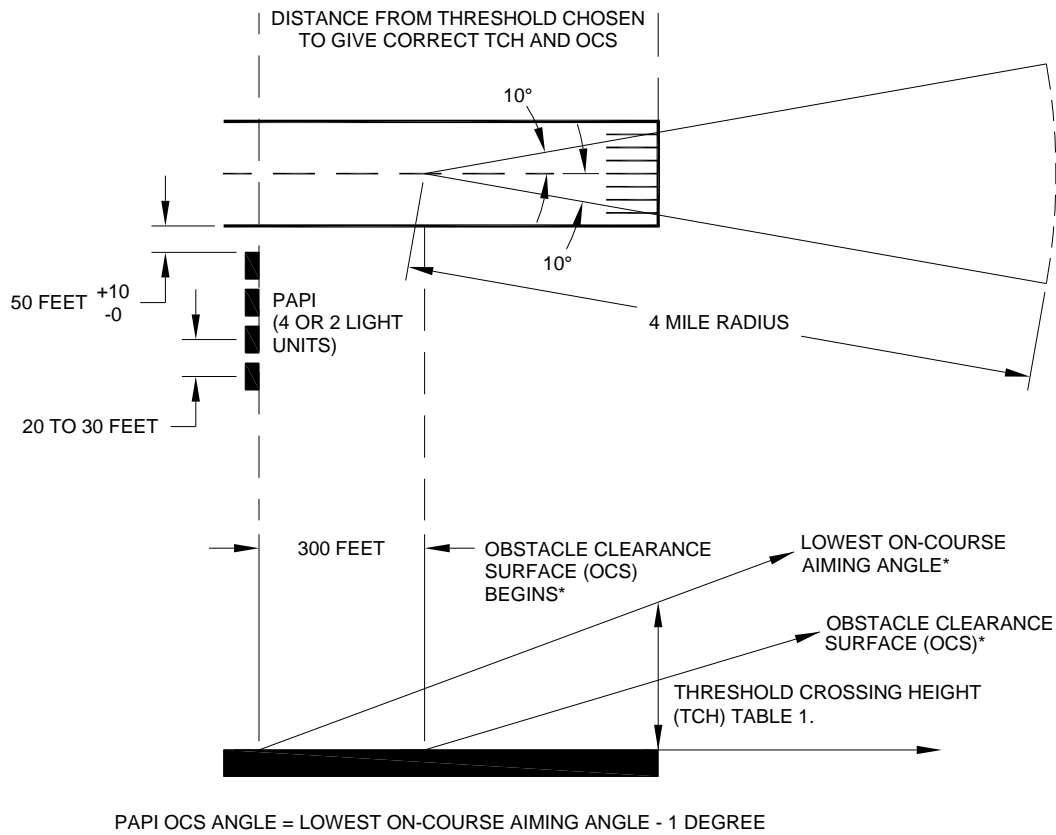


Figure 78. Typical ODALS Layout



NOTES:

1. THE VISUAL GLIDE PATH ANGLE IS THE CENTER OF THE ON-COURSE ZONE, AND IS A NOMINAL 3 DEGREES WHEN MEASURED FROM THE HORIZONTAL SURFACE OF THE RUNWAY.
 - A. FOR NON-JET RUNWAYS, THE GLIDE PATH MAY BE RAISED TO 4 DEGREES MAXIMUM TO PROVIDE OBSTACLE CLEARANCE.
 - B. IF THE PAPI GLIDE PATH IS CHANGED TO A HIGHER ANGLE FROM THE NOMINAL 3 DEGREES, IT MUST BE COMMUNICATED IN A NOTICE TO AIRMAN (NOTAM) AND PUBLISHED IN THE AIRPORT FACILITY DIRECTORY.
2. PAPI OBSTACLE CLEARANCE SURFACE (OCS).
 - A. THE PAPI OCS PROVIDES THE PILOT WITH A MINIMUM APPROACH CLEARANCE.
 - B. THE PAPI MUST BE POSITIONED AND AIMED SO NO OBSTACLES PENETRATE ITS SURFACE.
 - (1) THE OCS BEGINS 300 FEET [90M] IN FRONT OF THE PAPI SYSTEM.
 - (2) THE OCS IS PROJECTED INTO THE APPROACH ZONE DEGREE LESS THEN AIMING ANGLE OF THE THIRD LIGHT UNIT FROM THE RUNWAY FOR AN L-880 SYSTEM, OR THE OUTSIDE LIGHT UNIT FOR AN L-881 SYSTEM.

Figure 79. PAPI Obstacle Clearance Surface.

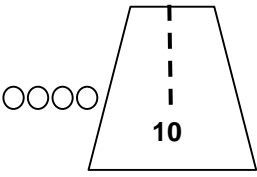
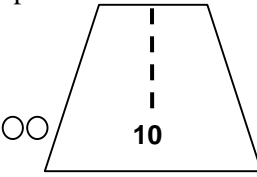
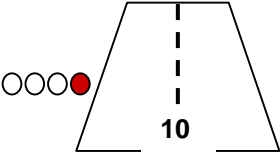
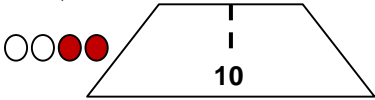
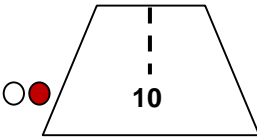
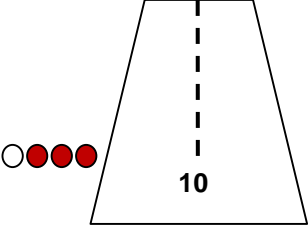
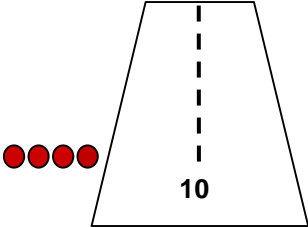
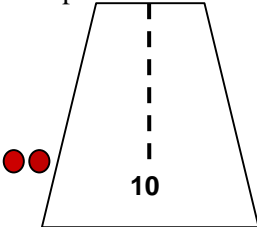
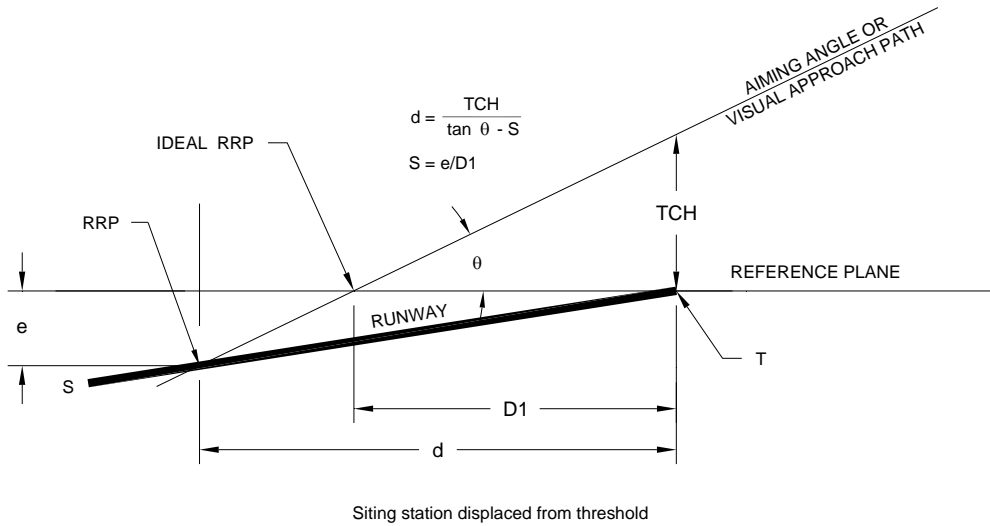
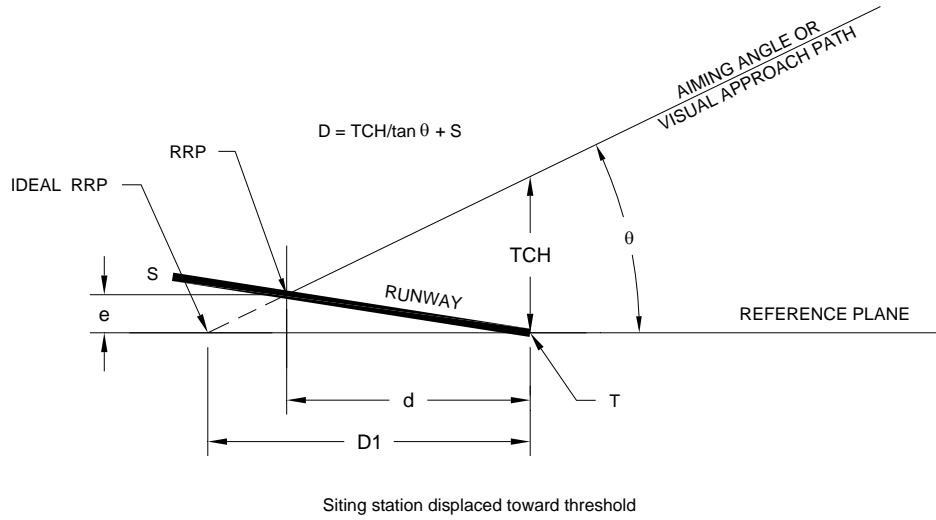
<p>(1) Above correct glide path All lamps white.</p> 	<p>(1) Above the correct glide path: 2 white lamps.</p> 
<p>(2) Slightly above correct glide path. 3 white, 1 red.</p> 	
<p>(3) On the correct glide path. Two white, two red.</p> 	<p>(2) On the correct glide path: 1 white, 1 red.</p> 
<p>(4) Slightly below the correct glide path. 1 white, 3 red.</p> 	
<p>(5) Below the correct glide path: All red.</p> 	<p>(3) Below the correct glide path: Two red lamps.</p> 
<p>Type L-880</p>	<p>Type L-881</p>
<p>NOTE: <i>The PAPI is a system of either four or two identical light units placed on the left of the runway in a line perpendicular to the centerline. The boxes are positioned and aimed to produce the visual signal shown above.</i></p>	

Figure 80. PAPI Signal Presentation.



SYMBOLS:

- D1 = ideal (zero gradient) distance from threshold
- RWY = runway longitudinal gradient
- TCH = threshold crossing height
- T = threshold
- e = elevation difference between threshold and RRP
- RRP = runway reference point (where aiming angle or visual approach path intersects runway profile)
- d = adjusted distance from threshold
- θ = aiming angle
- S = percent slope of runway = e/d
(S is used in decimal form in the equations)

Figure 81. Correction for Runway Longitudinal Gradient.

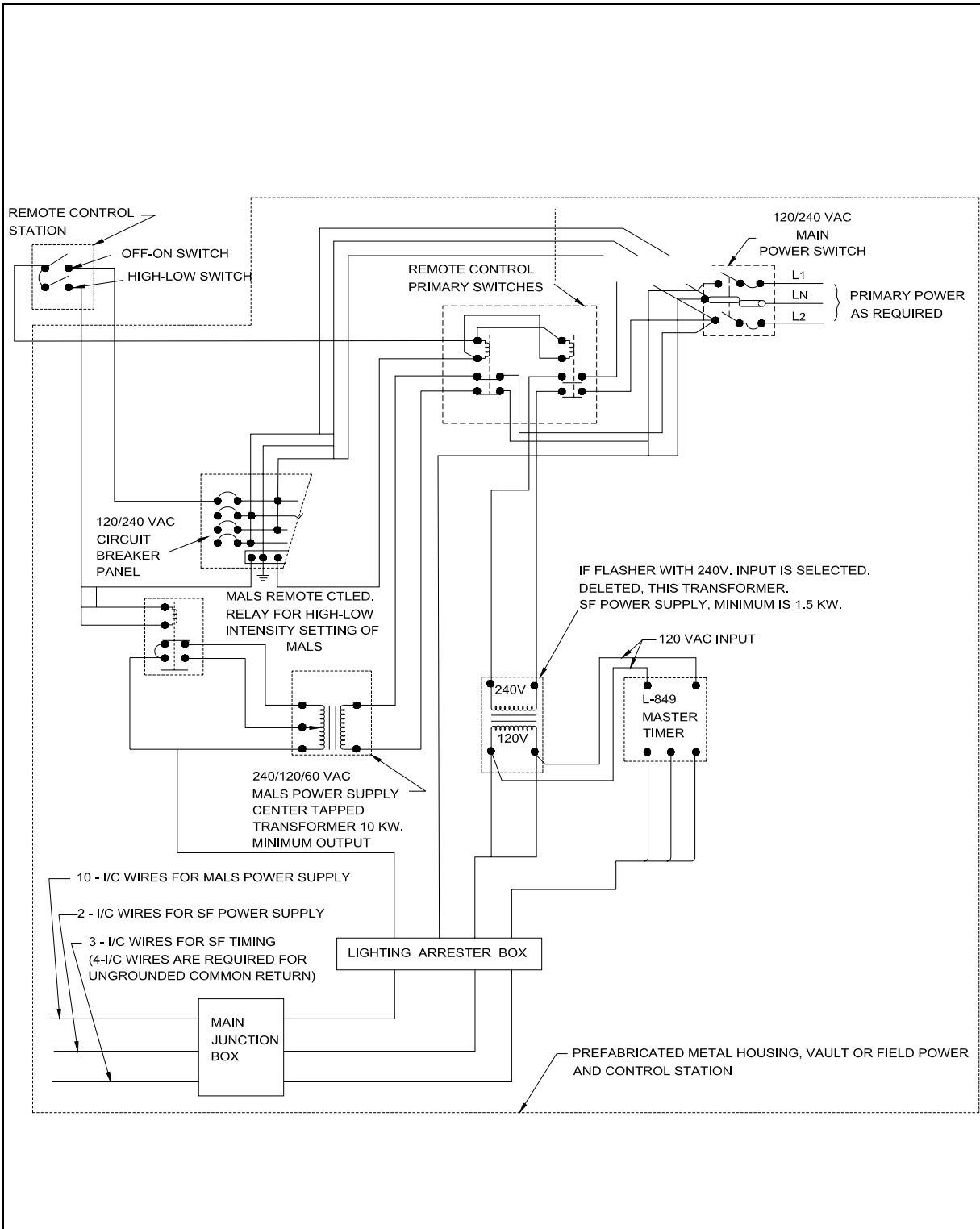


Figure 82. General Wiring Diagram for MALS with 120-Volt, AC Remote Control.

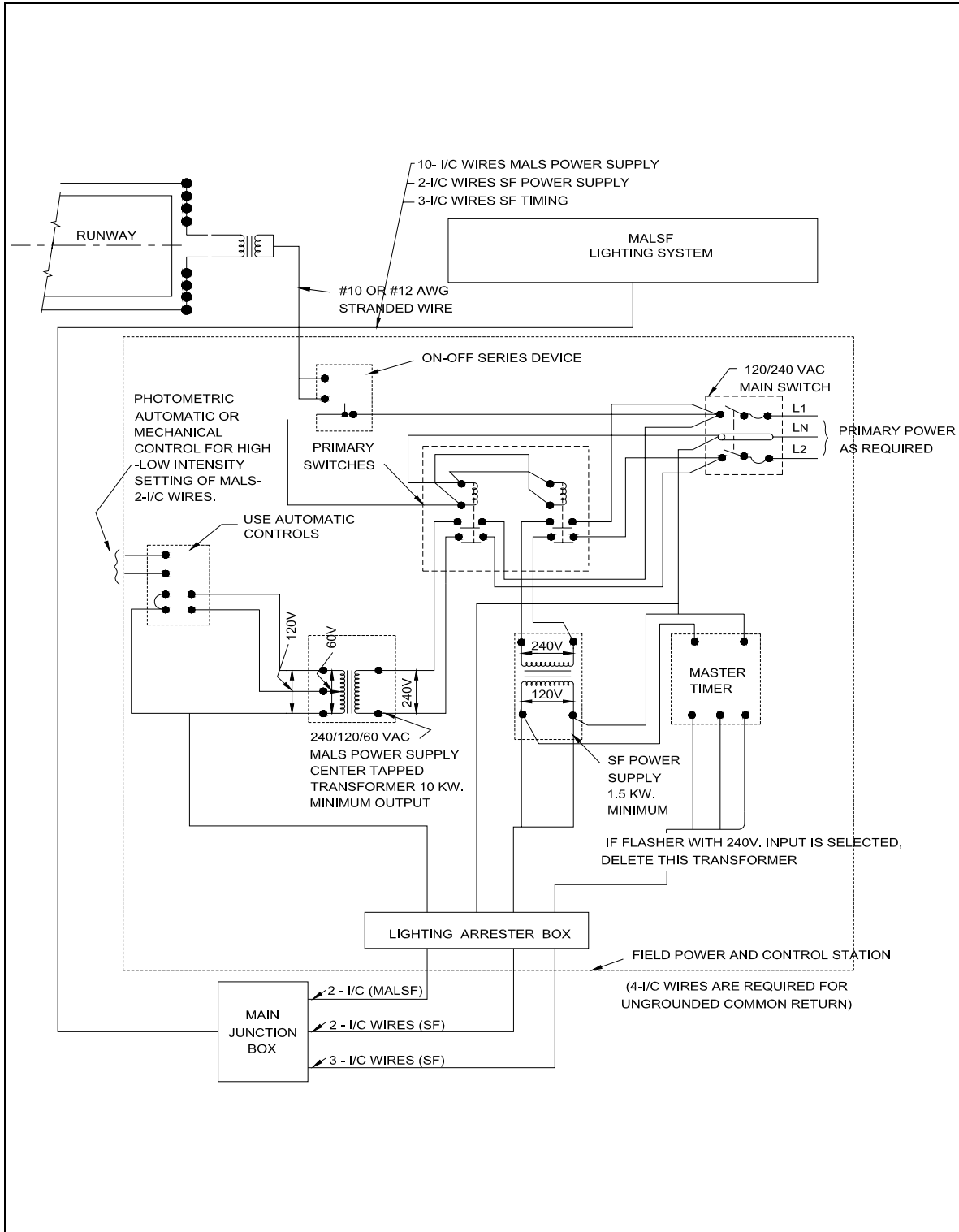
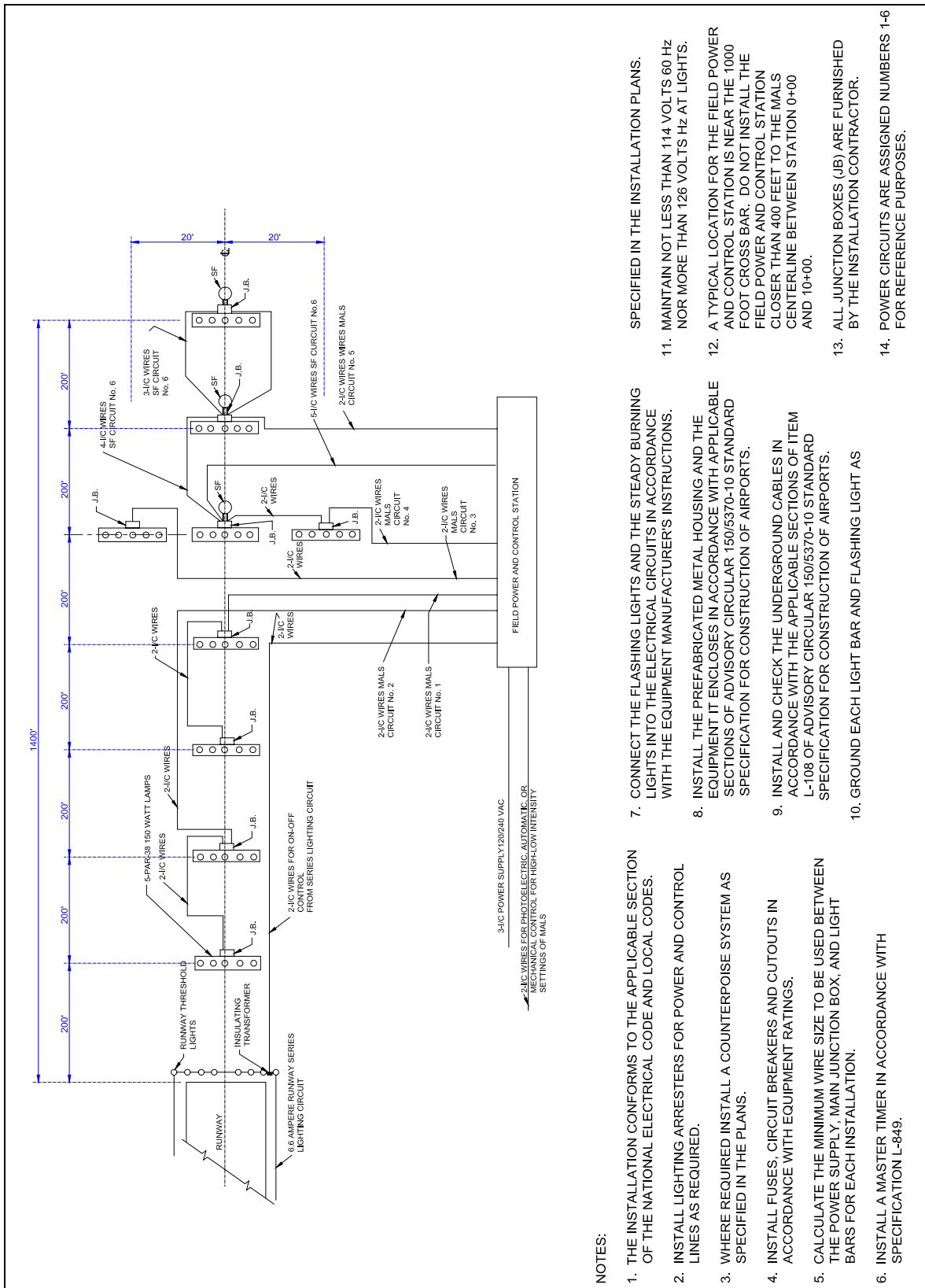


Figure 83. Typical Wiring Diagram for MALSF Controlled from Runway Lighting Circuit.



NOTES:

1. THE INSTALLATION CONFORMS TO THE APPLICABLE SECTION OF THE NATIONAL ELECTRICAL CODE AND LOCAL CODES.
2. INSTALL LIGHTING ARRESTERS FOR POWER AND CONTROL LINES AS REQUIRED.
3. WHERE REQUIRED INSTALL A COUNTERPOISE SYSTEM AS SPECIFIED IN THE PLANS.
4. INSTALL FUSES, CIRCUIT BREAKERS AND CUTOUTS IN ACCORDANCE WITH EQUIPMENT RATINGS.
5. CALCULATE THE MINIMUM WIRE SIZE TO BE USED BETWEEN THE POWER SUPPLY, MAIN JUNCTION BOX, AND LIGHT BARS FOR EACH INSTALLATION.
6. INSTALL A MASTER TIMER IN ACCORDANCE WITH SPECIFICATION L-849.
7. CONNECT THE FLASHING LIGHTS AND THE STEADY BURNING LIGHTS INTO THE ELECTRICAL CIRCUITS IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S INSTRUCTIONS.
8. INSTALL THE PREFABRICATED METAL HOUSING AND THE EQUIPMENT IT ENCLOSES IN ACCORDANCE WITH APPLICABLE SECTIONS OF ADVISORY CIRCULAR 150/5370-10 STANDARD SPECIFICATION FOR CONSTRUCTION OF AIRPORTS.
9. INSTALL AND CHECK THE UNDERGROUND CABLES IN ACCORDANCE WITH THE APPLICABLE SECTIONS OF ITEM L-108 OF ADVISORY CIRCULAR 150/5370-10 STANDARD SPECIFICATION FOR CONSTRUCTION OF AIRPORTS.
10. GROUND EACH LIGHT BAR AND FLASHING LIGHT AS SPECIFIED IN THE INSTALLATION PLANS.
11. MAINTAIN NOT LESS THAN 114 VOLTS 60 Hz NOR MORE THAN 126 VOLTS Hz AT LIGHTS.
12. A TYPICAL LOCATION FOR THE FIELD POWER AND CONTROL STATION IS NEAR THE 1000 FOOT CROSS BAR. DO NOT INSTALL THE FIELD POWER AND CONTROL STATION CLOSER THAN 400 FEET TO THE MALS CENTERLINE BETWEEN STATION 0+00 AND 10+00.
13. ALL JUNCTION BOXES (JB) ARE FURNISHED BY THE INSTALLATION CONTRACTOR.
14. POWER CIRCUITS ARE ASSIGNED NUMBERS 1-6 FOR REFERENCE PURPOSES.

Figure 84. Typical Field Wiring Circuits for MALS.

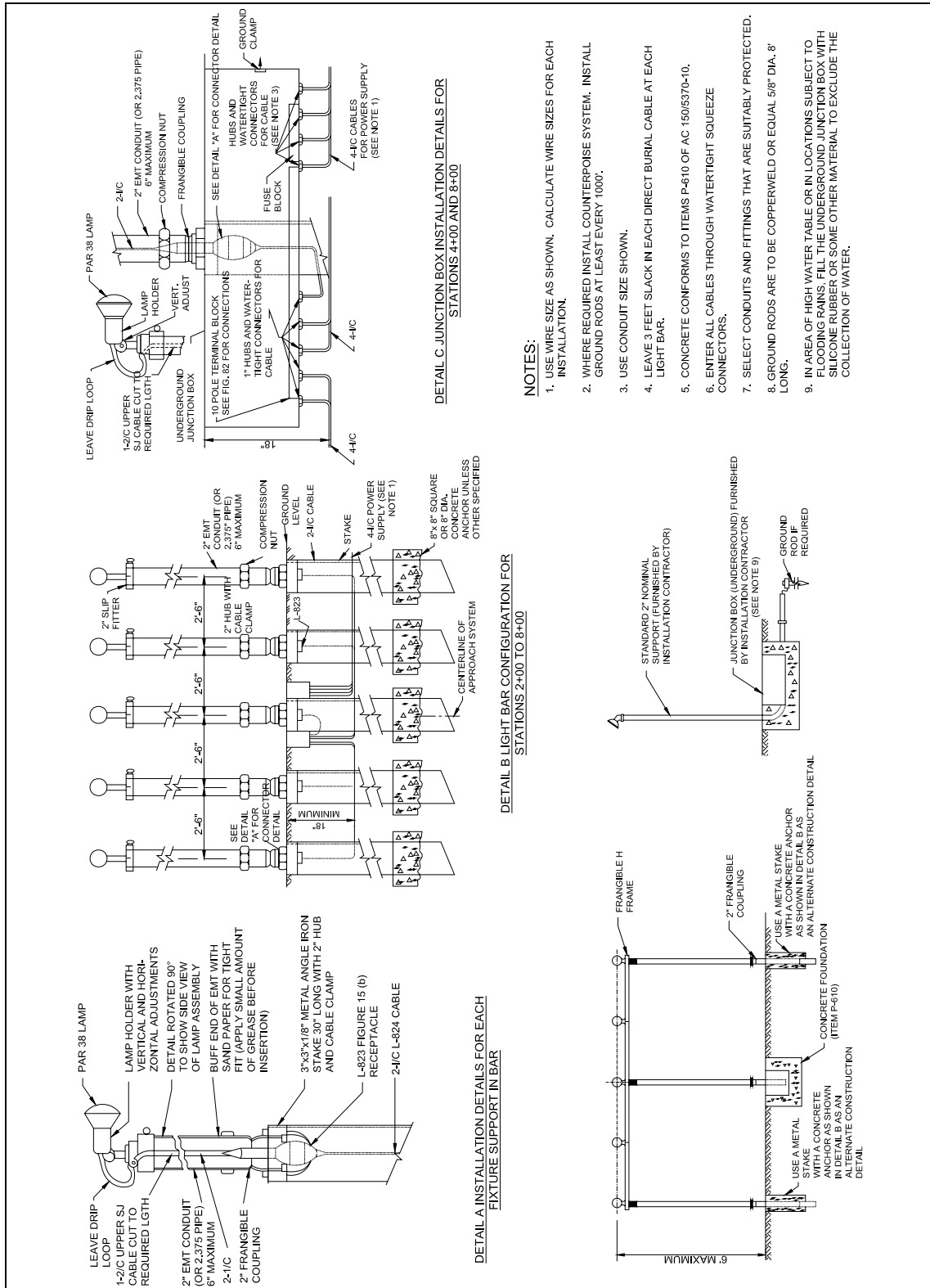
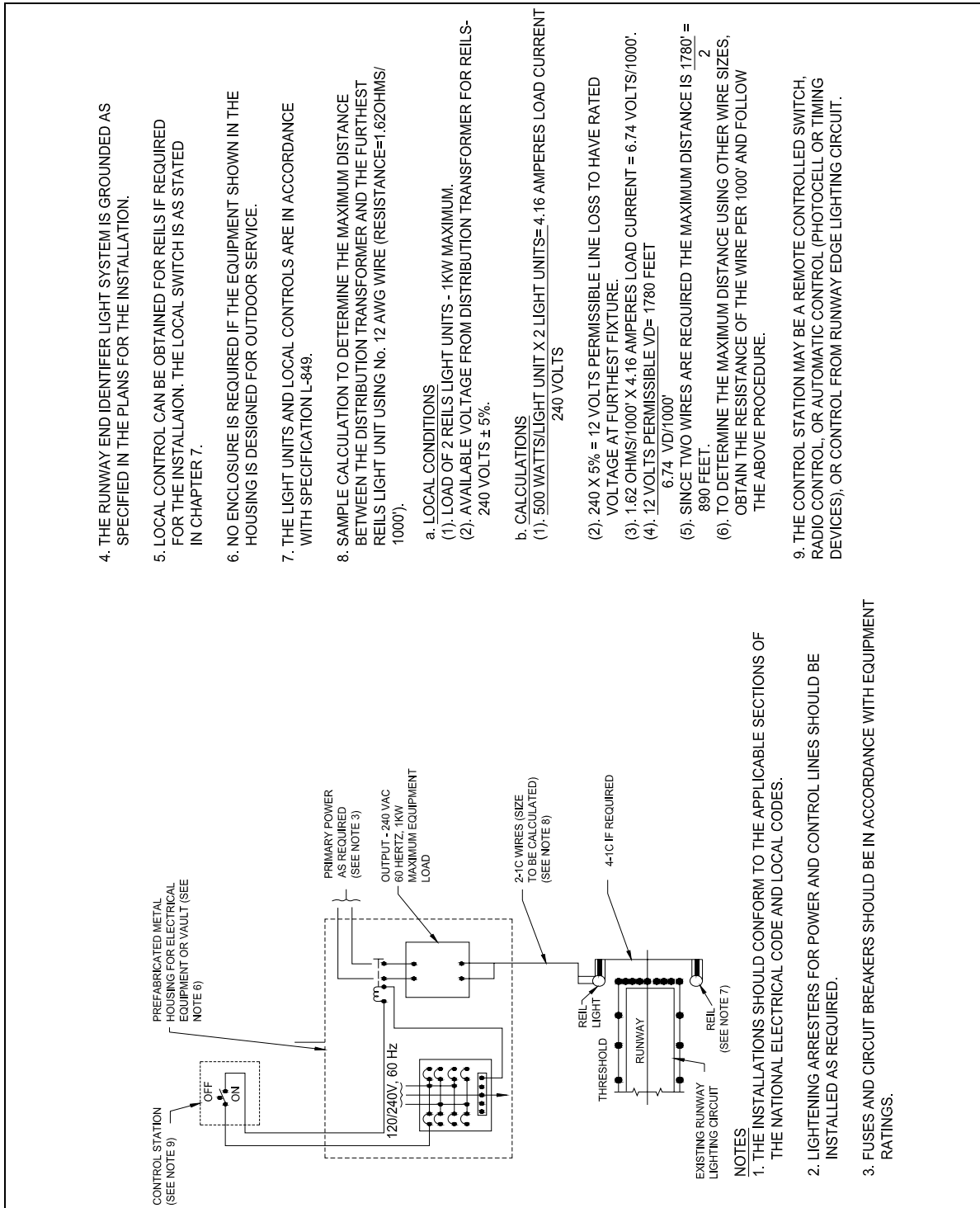


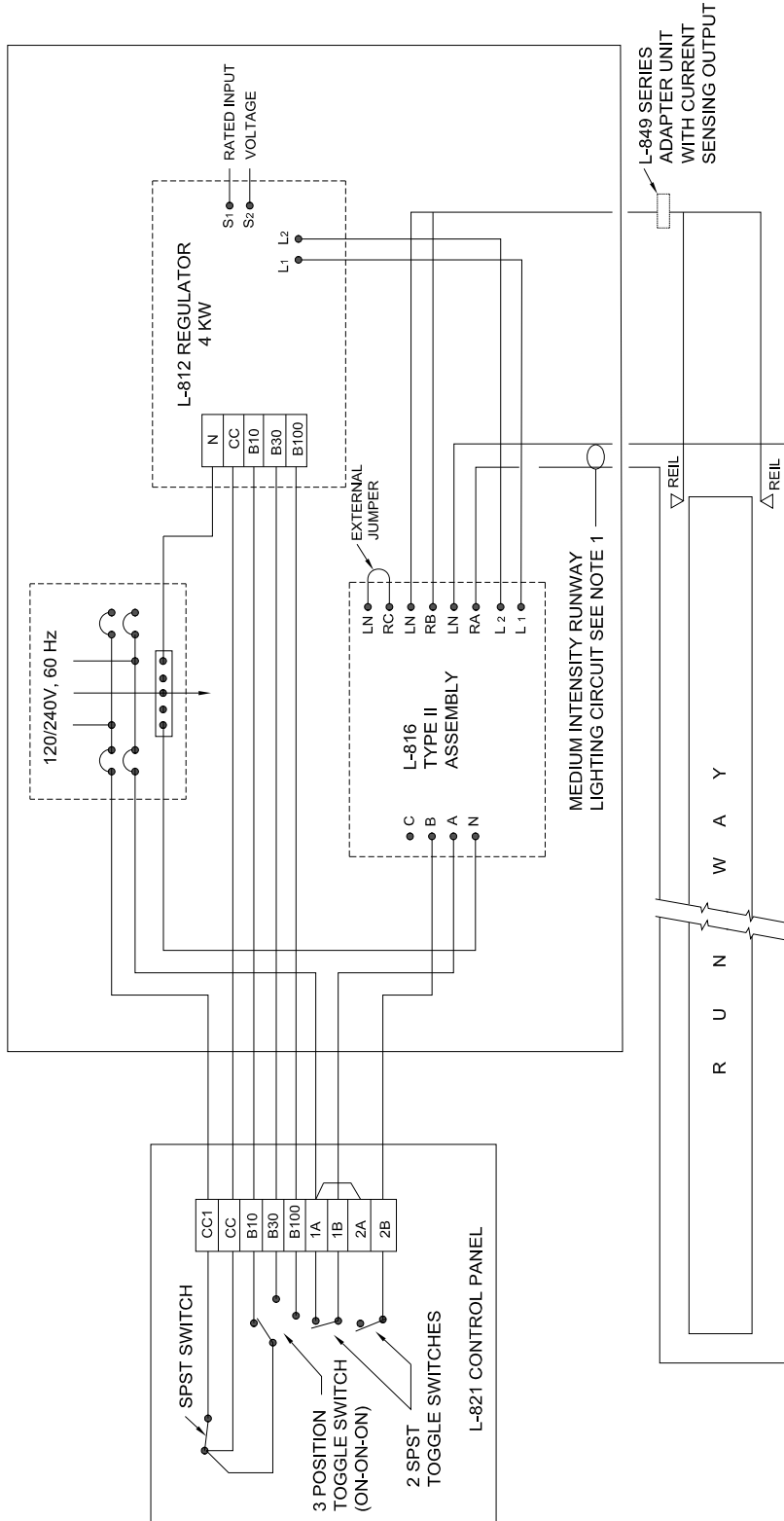
Figure 85. Typical Installation Details for Frangible MALS Structures – 6 foot (1.8 m) Maximum.



4. THE RUNWAY END IDENTIFIER LIGHT SYSTEM IS GROUNDED AS SPECIFIED IN THE PLANS FOR THE INSTALLATION.
5. LOCAL CONTROL CAN BE OBTAINED FOR REILS IF REQUIRED FOR THE INSTALLATION. THE LOCAL SWITCH IS AS STATED IN CHAPTER 7.
6. NO ENCLOSURE IS REQUIRED IF THE EQUIPMENT SHOWN IN THE HOUSING IS DESIGNED FOR OUTDOOR SERVICE.
7. THE LIGHT UNITS AND LOCAL CONTROLS ARE IN ACCORDANCE WITH SPECIFICATION L-849.
8. SAMPLE CALCULATION TO DETERMINE THE MAXIMUM DISTANCE BETWEEN THE DISTRIBUTION TRANSFORMER AND THE FURTHEST REILS LIGHT UNIT USING No. 12 AWG WIRE (RESISTANCE=1.62OHMS/1000').
 - a. LOCAL CONDITIONS
 - (1). LOAD OF 2 REILS LIGHT UNITS - 1KW MAXIMUM.
 - (2). AVAILABLE VOLTAGE FROM DISTRIBUTION TRANSFORMER FOR REILS- 240 VOLTS ± 5%.
 - b. CALCULATIONS
 - (1). $\frac{500 \text{ WATTS/LIGHT UNIT} \times 2 \text{ LIGHT UNITS} = 4,16 \text{ AMPERES LOAD CURRENT}}{240 \text{ VOLTS}}$
 - (2). $240 \times 5\% = 12 \text{ VOLTS PERMISSIBLE LINE LOSS TO HAVE RATED VOLTAGE AT FURTHEST FIXTURE.}$
 - (3). $1.62 \text{ OHMS/1000'} \times 4.16 \text{ AMPERES LOAD CURRENT} = 6.74 \text{ VOLTS/1000'}$.
 - (4). $\frac{12 \text{ VOLTS PERMISSIBLE VD} = 1780 \text{ FEET}}{6.74 \text{ VD/1000'}}$
 - (5). SINCE TWO WIRES ARE REQUIRED THE MAXIMUM DISTANCE IS $\frac{1780'}{2} = 890 \text{ FEET}$.
 - (6). TO DETERMINE THE MAXIMUM DISTANCE USING OTHER WIRE SIZES, OBTAIN THE RESISTANCE OF THE WIRE PER 1000' AND FOLLOW THE ABOVE PROCEDURE.
9. THE CONTROL STATION MAY BE A REMOTE CONTROLLED SWITCH, RADIO CONTROL, OR AUTOMATIC CONTROL (PHOTOCELL OR TIMING DEVICES), OR CONTROL FROM RUNWAY EDGE LIGHTING CIRCUIT.

- NOTES
1. THE INSTALLATIONS SHOULD CONFORM TO THE APPLICABLE SECTIONS OF THE NATIONAL ELECTRICAL CODE AND LOCAL CODES.
 2. LIGHTENING ARRESTERS FOR POWER AND CONTROL LINES SHOULD BE INSTALLED AS REQUIRED.
 3. FUSES AND CIRCUIT BREAKERS SHOULD BE IN ACCORDANCE WITH EQUIPMENT RATINGS.

Figure 86. Typical Wiring for REILs Multiple Operation



NOTES

1. INSTALL MEDIUM INTENSITY FEEDER CABLES IN COMMON TRENCH WITH REIL FEEDER CABLES.
2. AN ADDITIONAL LOAD OF UP TO 3KW MAY BE ADDED TO THE REGULATOR IF THE REILS UNITS ARE CONNECTED INTO THE RUNWAY LIGHTING CIRCUIT.
3. THE REILS UNITS ARE CONNECTED INTO THE ELECTRICAL CIRCUITS IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

Figure 87. Typical Wiring for REIL Series Operation

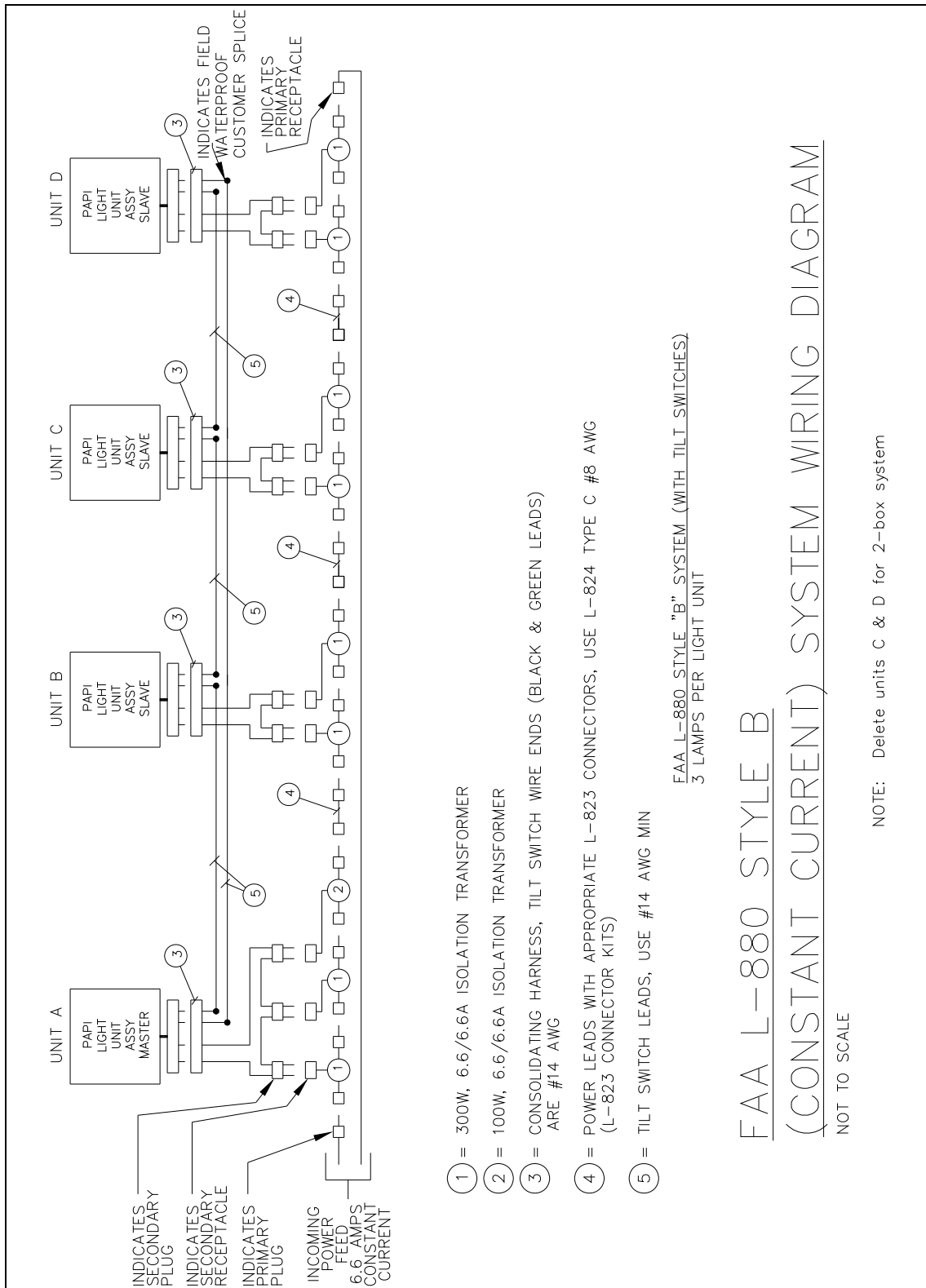


Figure 88. FAA L-880 Style B (Constant Current) System Wiring Diagram.

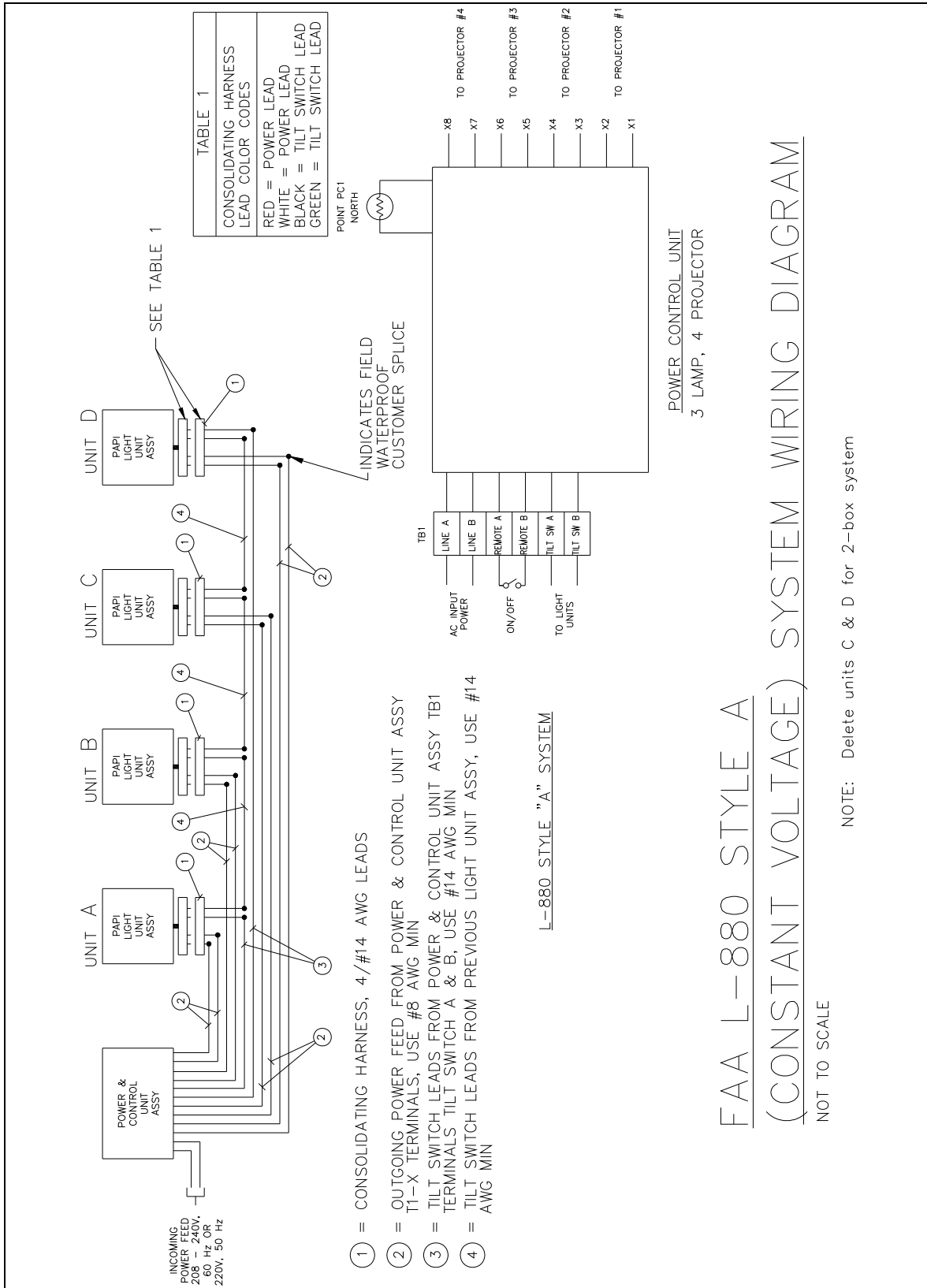


Figure 89. FAA L-880 Style A (Constant Voltage) System Wiring Diagram.

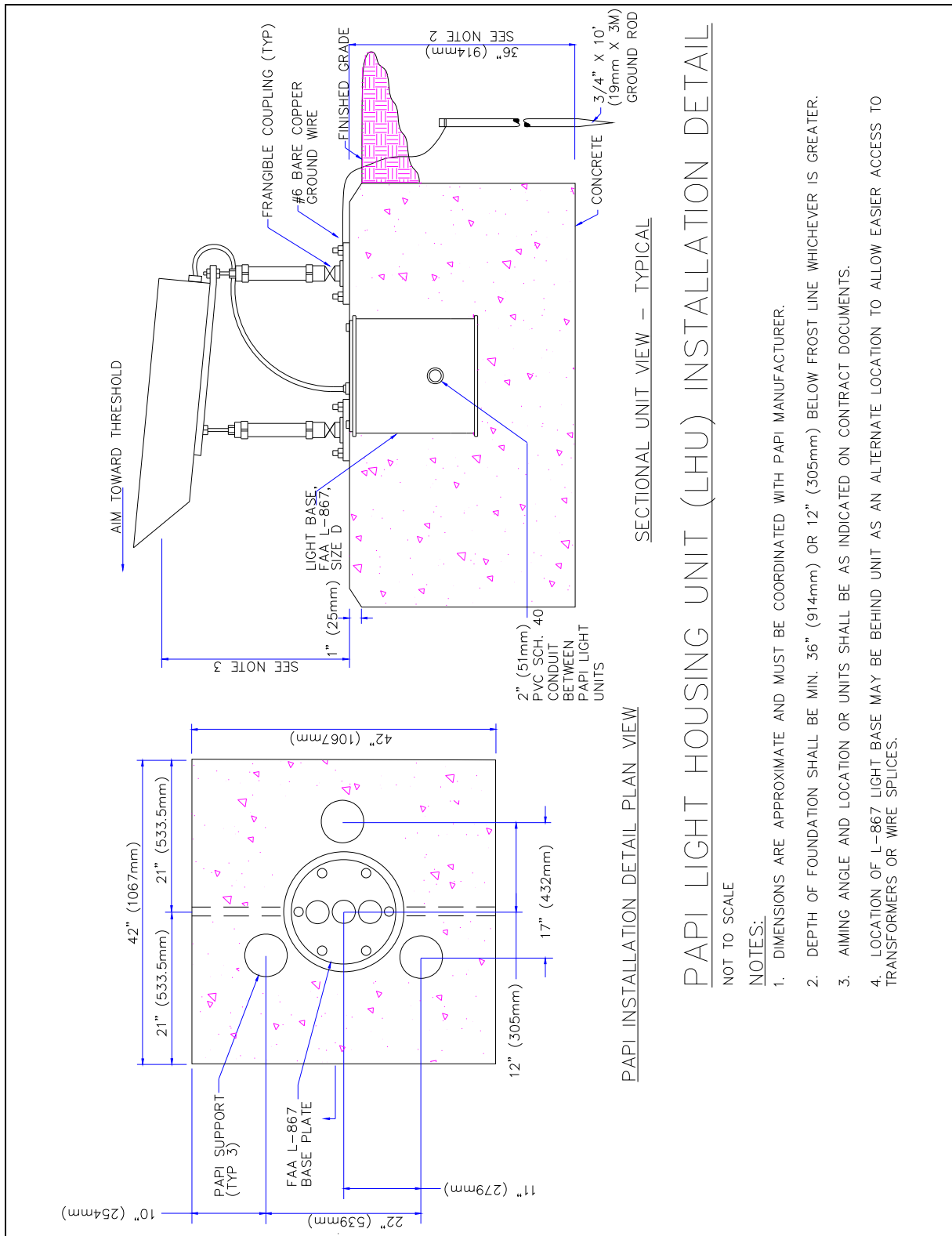


Figure 90. PAPI Light Housing Unit (LHU) Installation Detail.

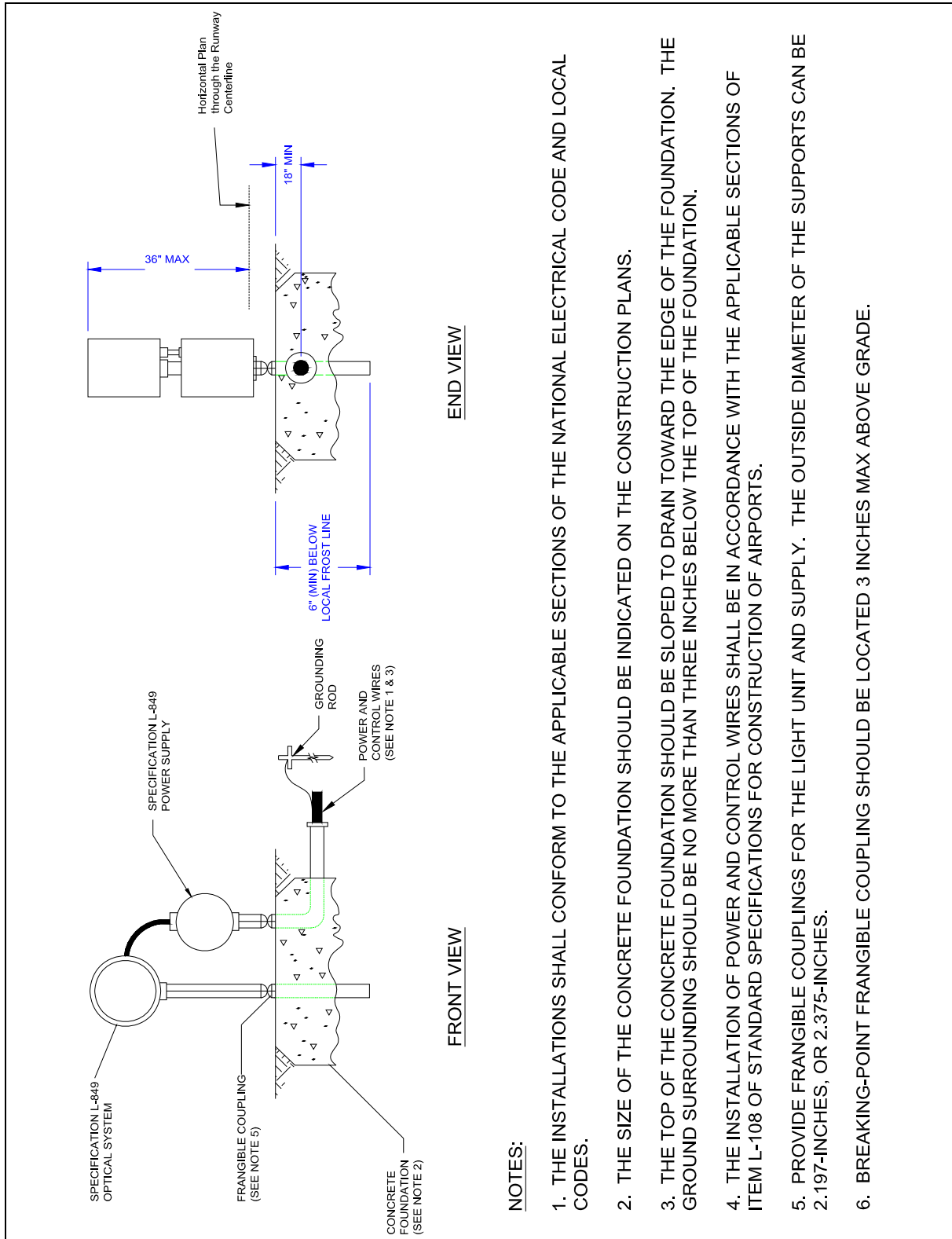


Figure 91. Typical Installation Details for Runway End Identifier Lights (REILs).

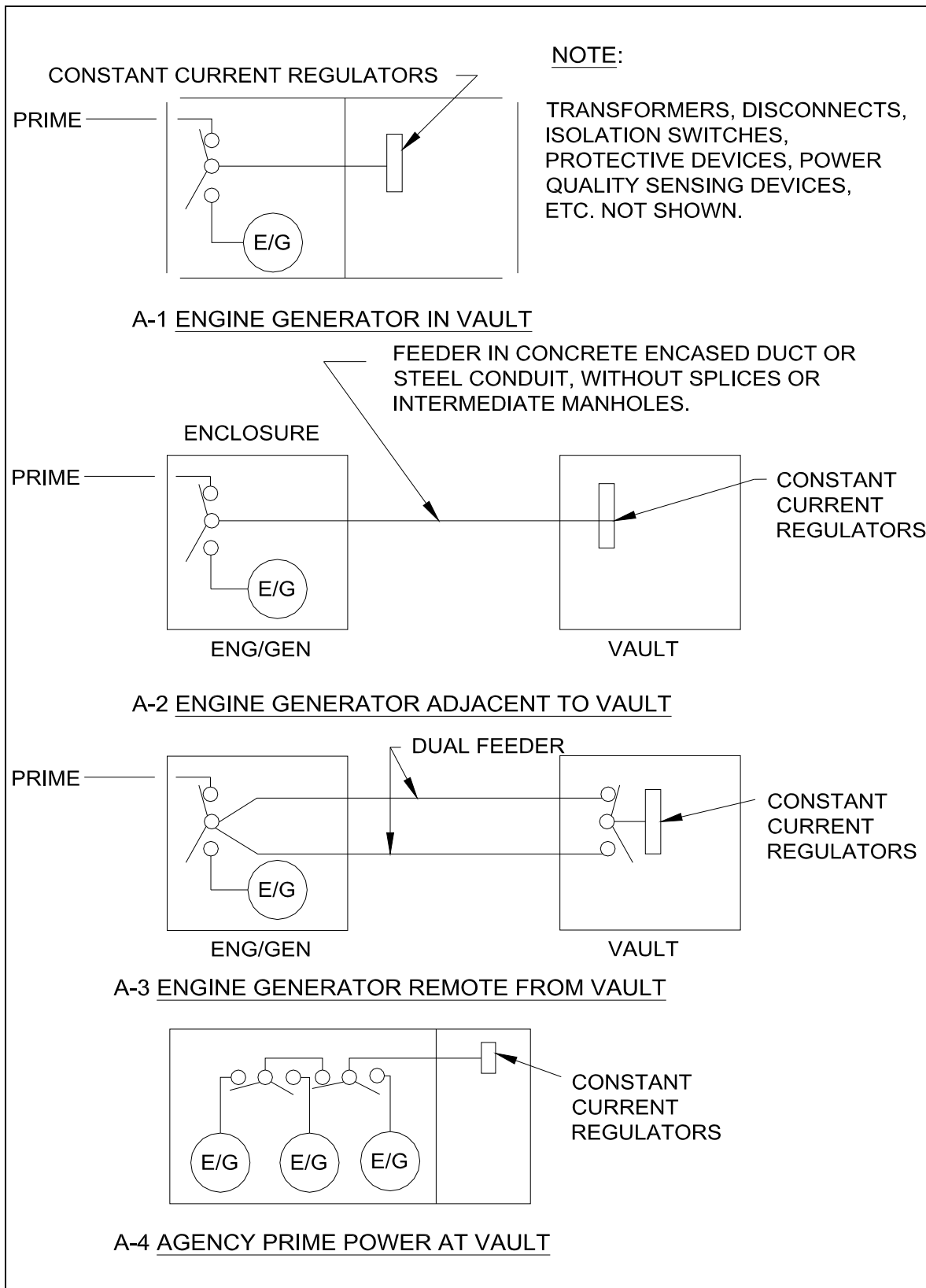


Figure 92. Configuration “A” Electrical Power.

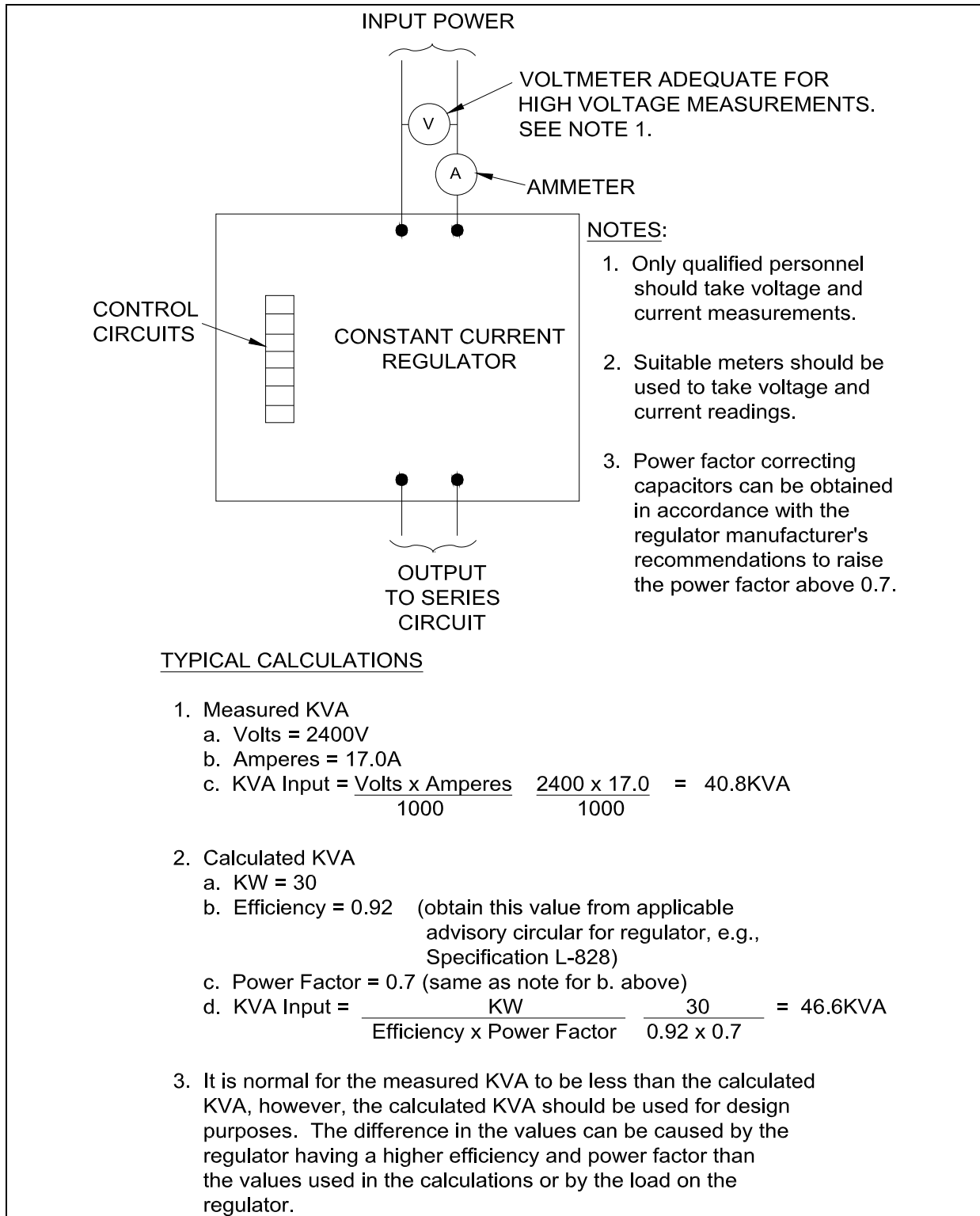
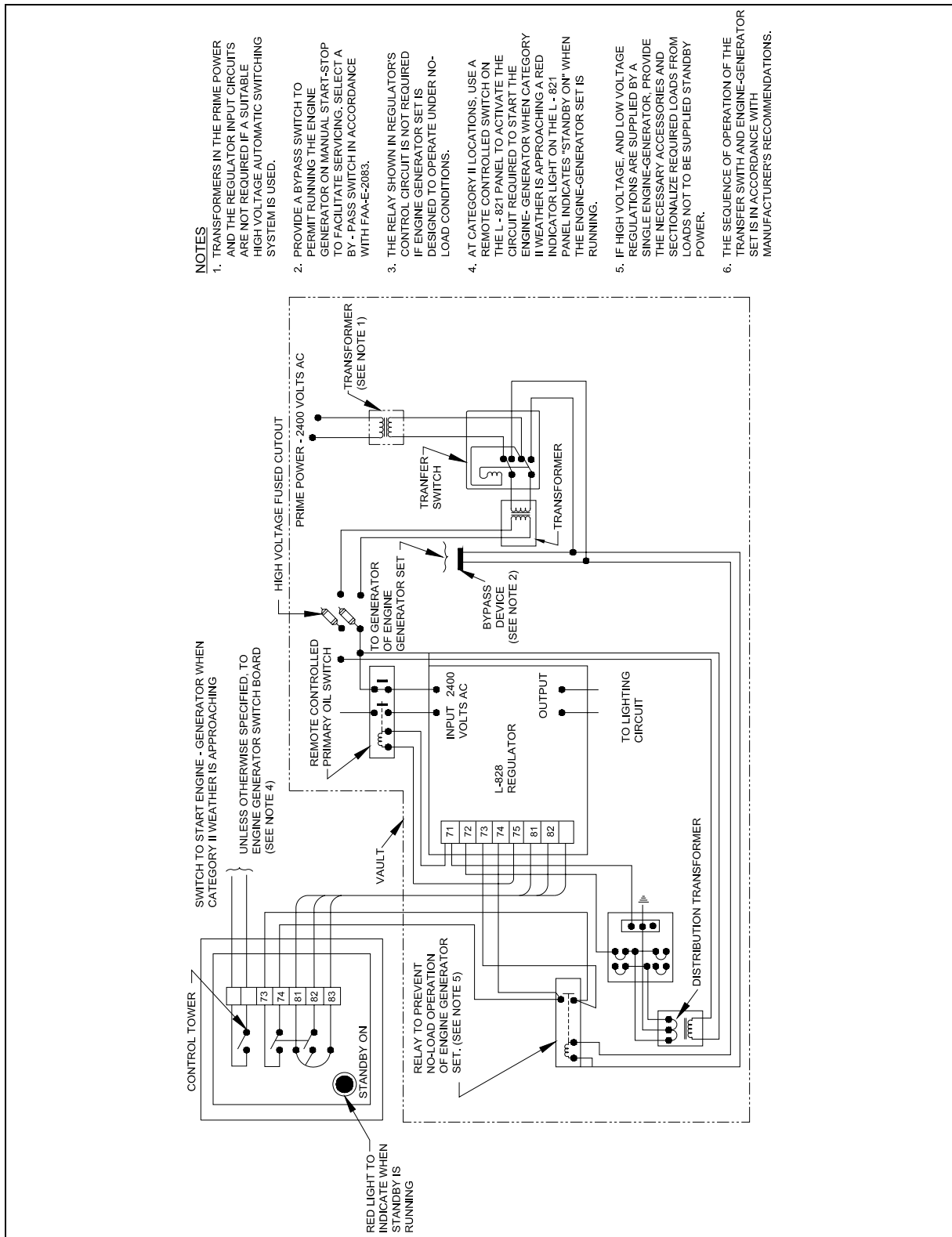


Figure 93. Typical KVA Input Requirements.



NOTES

1. TRANSFORMERS IN THE PRIME POWER AND THE REGULATOR INPUT CIRCUITS ARE NOT REQUIRED IF A SUITABLE HIGH VOLTAGE AUTOMATIC SWITCHING SYSTEM IS USED.
2. PROVIDE A BYPASS SWITCH TO PERMIT RUNNING THE ENGINE GENERATOR ON MANUAL START-STOP TO FACILITATE SERVICING. SELECT A BY-PASS SWITCH IN ACCORDANCE WITH FAA-E-2083.
3. THE RELAY SHOWN IN REGULATORS CONTROL CIRCUIT IS NOT REQUIRED IF ENGINE GENERATOR SET IS DESIGNED TO OPERATE UNDER NO-LOAD CONDITIONS.
4. AT CATEGORY II LOCATIONS, USE A REMOTE CONTROLLED SWITCH ON THE L - 821 PANEL TO ACTIVATE THE CIRCUIT REQUIRED TO START THE ENGINE- GENERATOR WHEN CATEGORY II WEATHER IS APPROACHING A RED INDICATOR LIGHT ON THE L - 821 PANEL INDICATES "STANDBY ON" WHEN THE ENGINE-GENERATOR SET IS RUNNING.
5. IF HIGH VOLTAGE, AND LOW VOLTAGE REGULATIONS ARE SUPPLIED BY A SINGLE ENGINE-GENERATOR, PROVIDE THE NECESSARY ACCESSORIES AND SECTIONALIZE REQUIRED LOADS FROM LOADS NOT TO BE SUPPLIED STANDBY POWER.
6. THE SEQUENCE OF OPERATION OF THE TRANSFER SWITCH AND ENGINE-GENERATOR SET IS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

Figure 94. Typical Wiring Diagram for Configuration "A" Electrical Power.

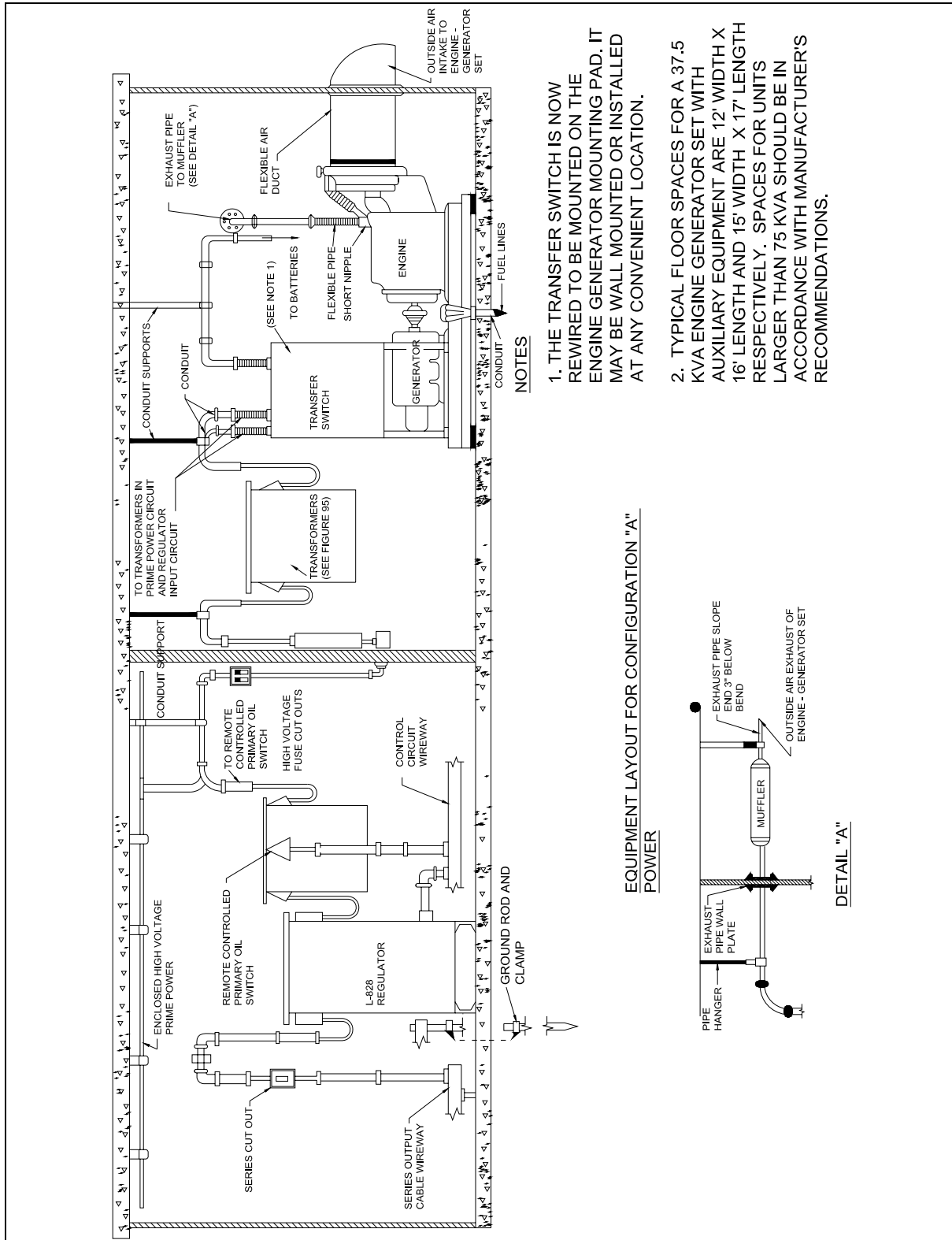


Figure 95. Typical Equipment Layout for Configuration "A" Electrical Power.

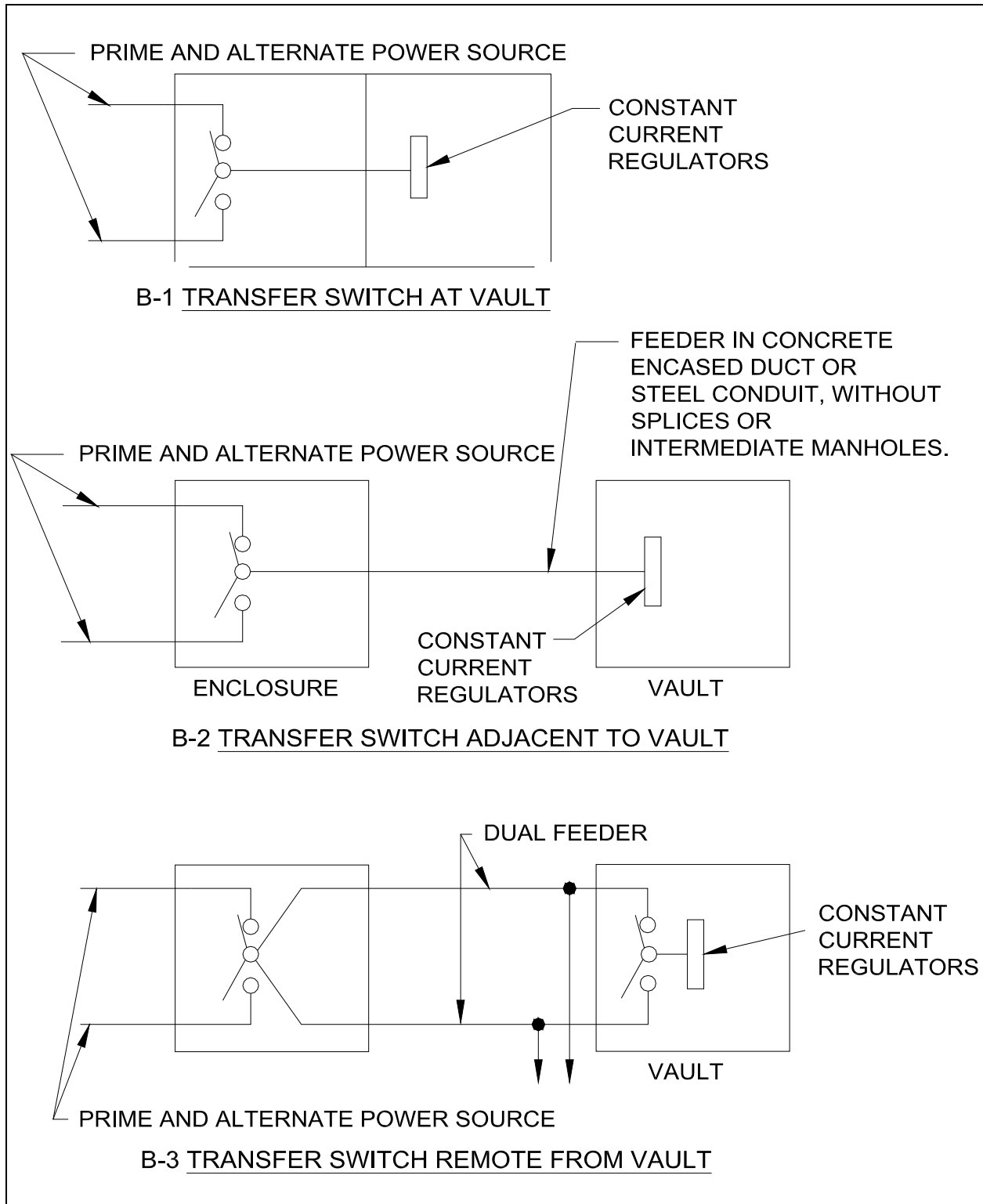


Figure 96. Configuration “B” Electrical Power.

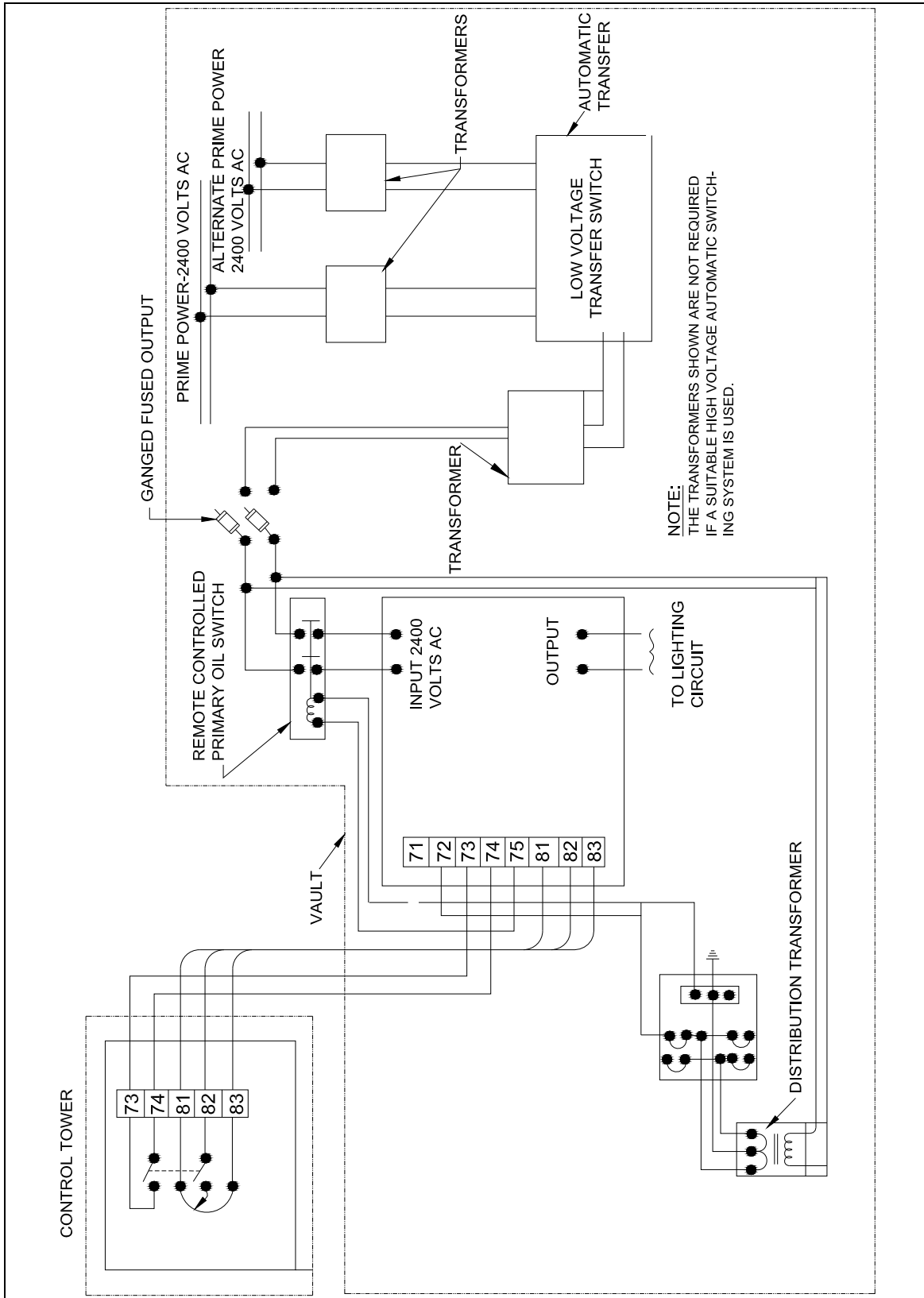


Figure 97. Typical Wiring Diagram for Configuration "B" Electrical Power.

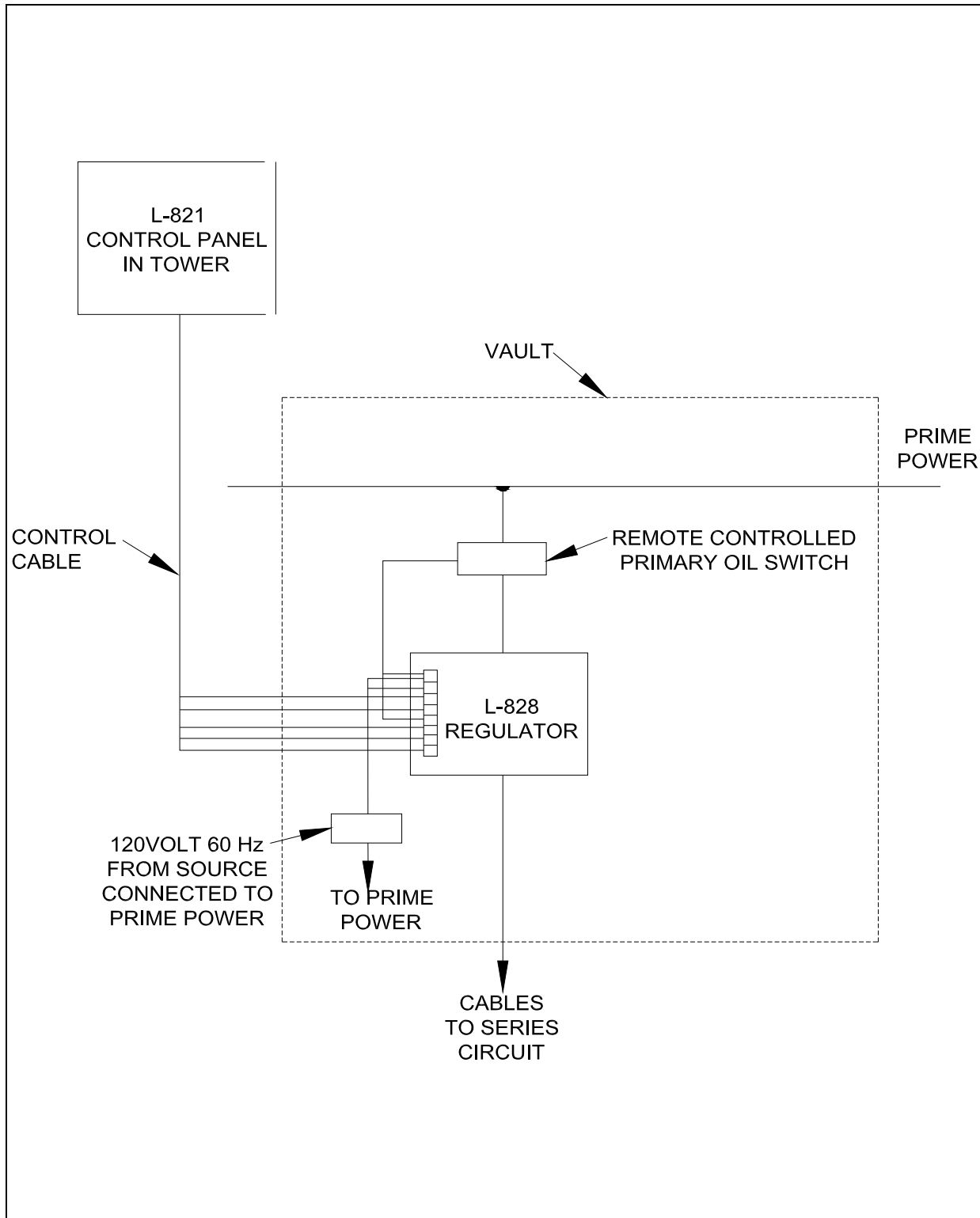


Figure 98. Typical Wiring Diagram for Configuration "C" Power.

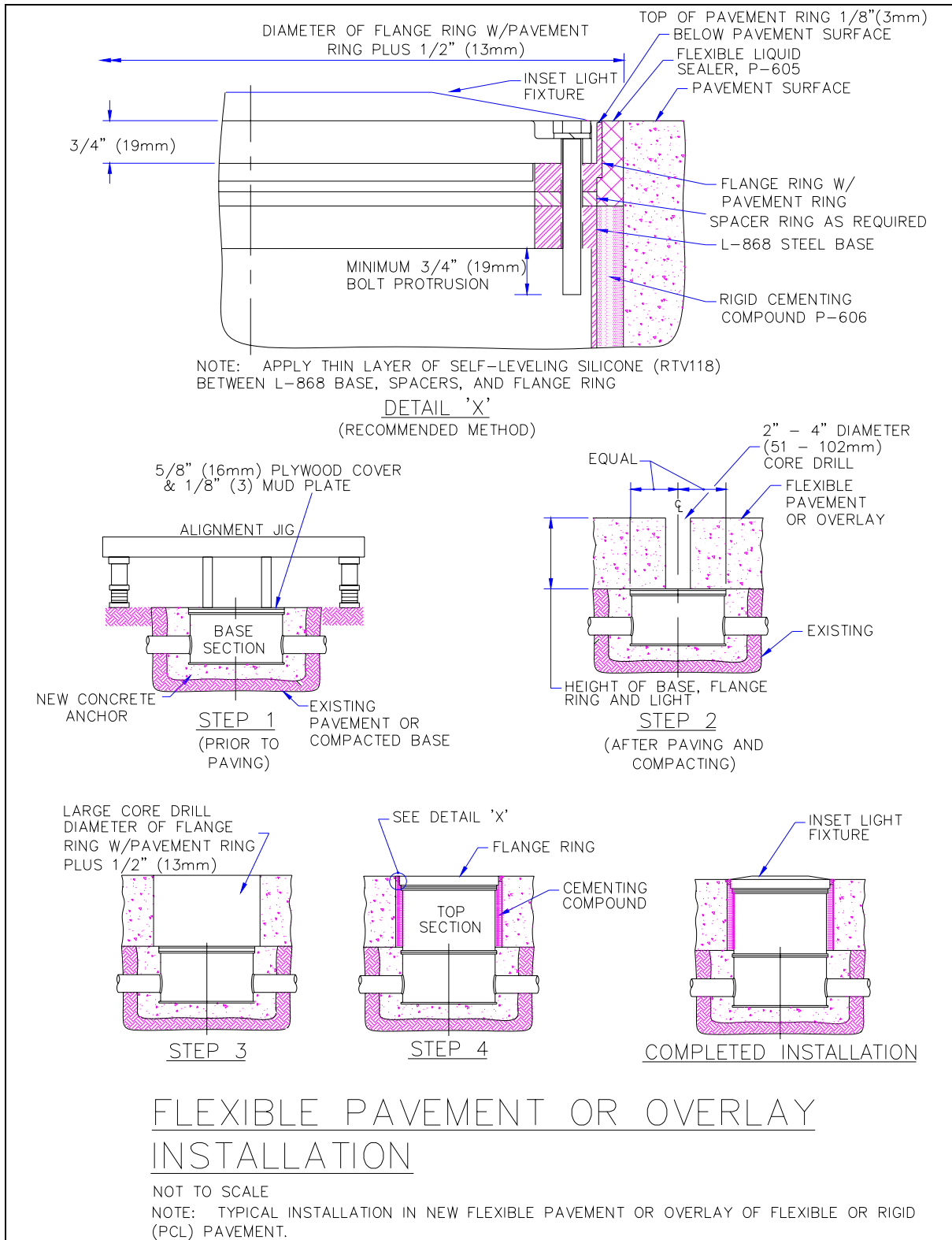
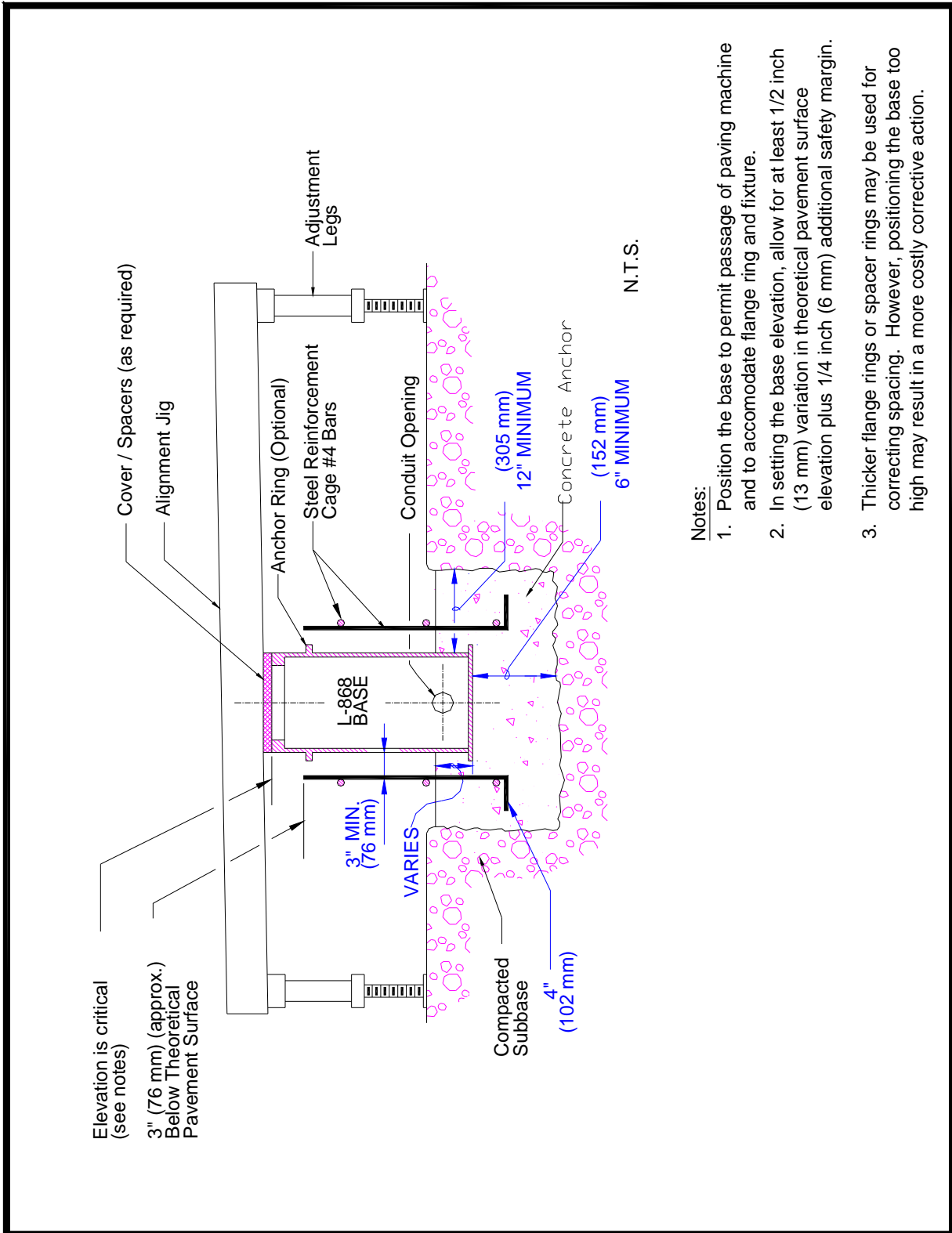


Figure 99. Flexible Pavement or Overlay Installation.



Notes:

1. Position the base to permit passage of paving machine and to accommodate flange ring and fixture.
2. In setting the base elevation, allow for at least 1/2 inch (13 mm) variation in theoretical pavement surface elevation plus 1/4 inch (6 mm) additional safety margin.
3. Thicker flange rings or spacer rings may be used for correcting spacing. However, positioning the base too high may result in a more costly corrective action.

Figure 100. Use of Alignment Jig, No Reference Edge Available, Non-adjustable Base and Conduit System.

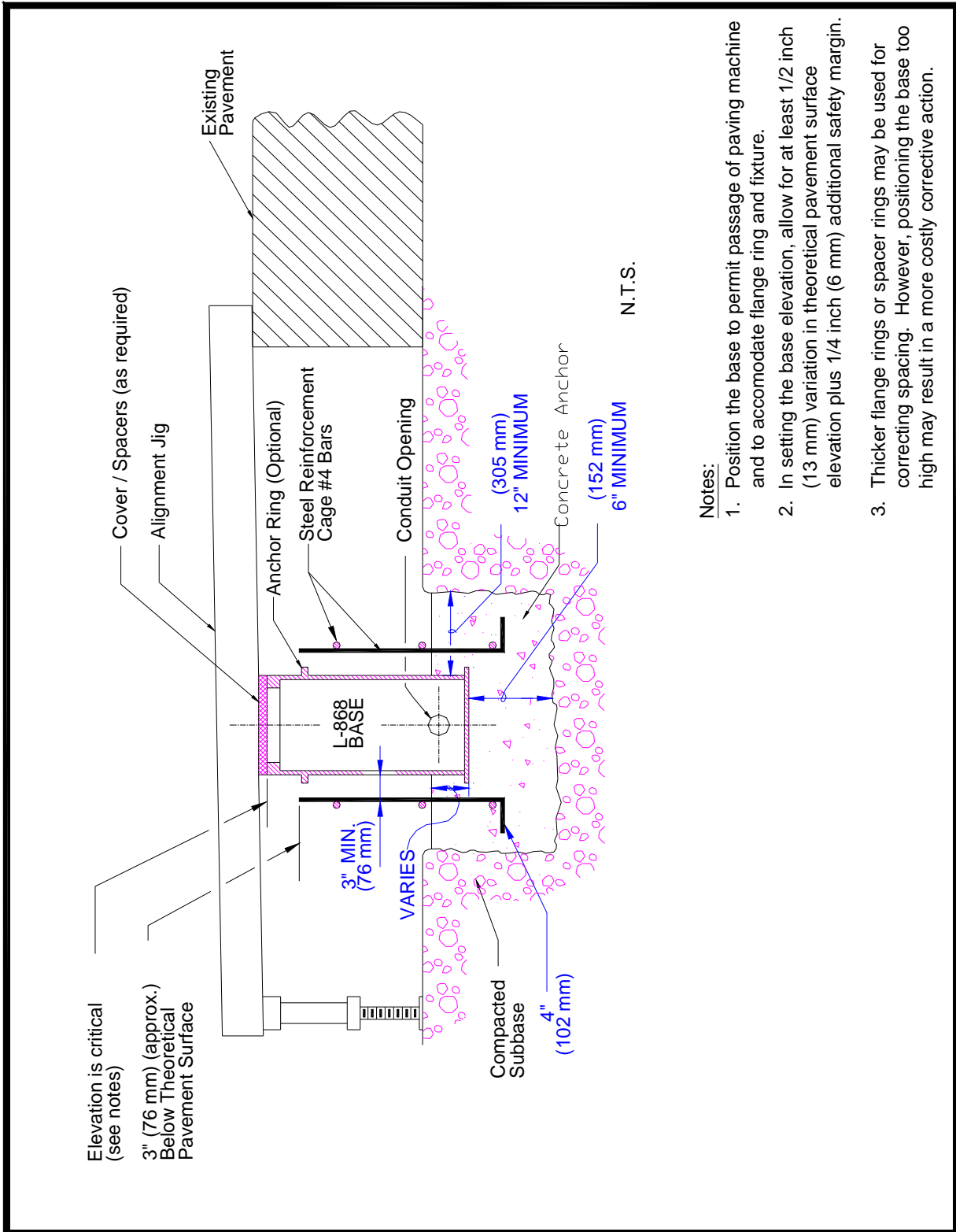


Figure 101. Use of Alignment Jig, Reference Edge Available, Non-adjustable Base and Conduit System.

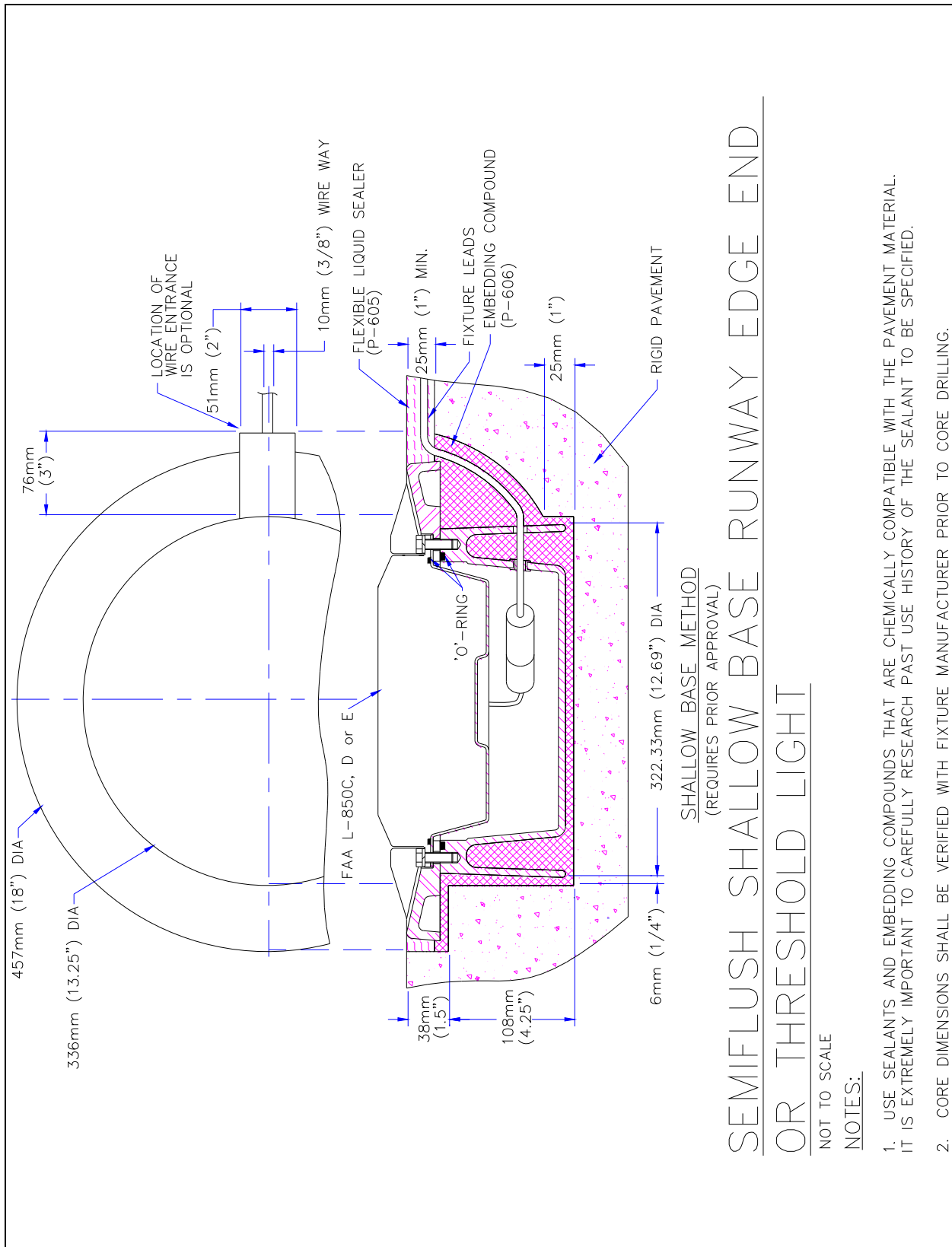


Figure 102. In-pavement Shallow Base Runway Edge End or Threshold Light.

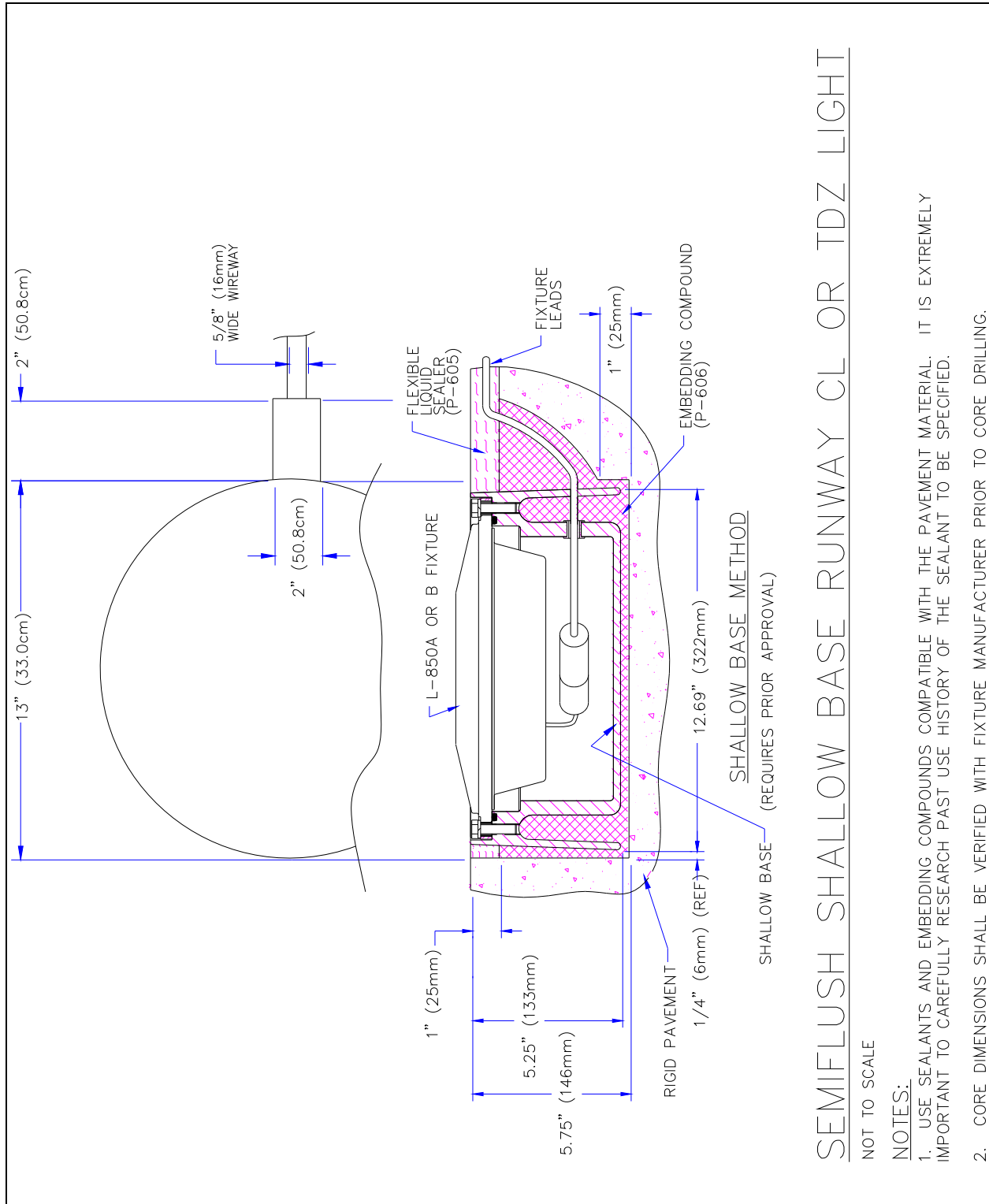


Figure 103. In-pavement Shallow Base Runway Centerline or TDZ Light.

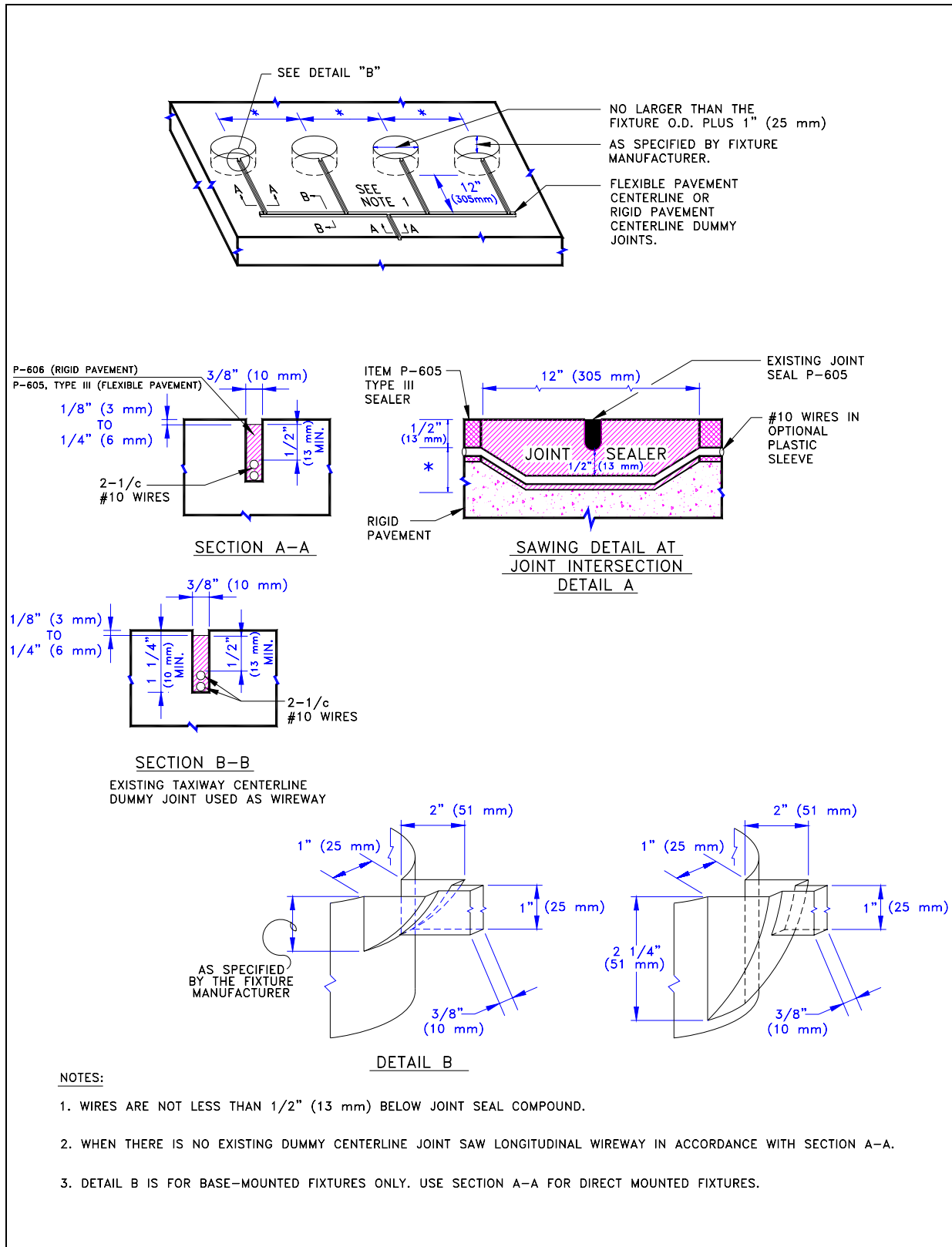


Figure 104. Sawing and Drilling Details for In-Pavement Taxiway Centerline Lights.

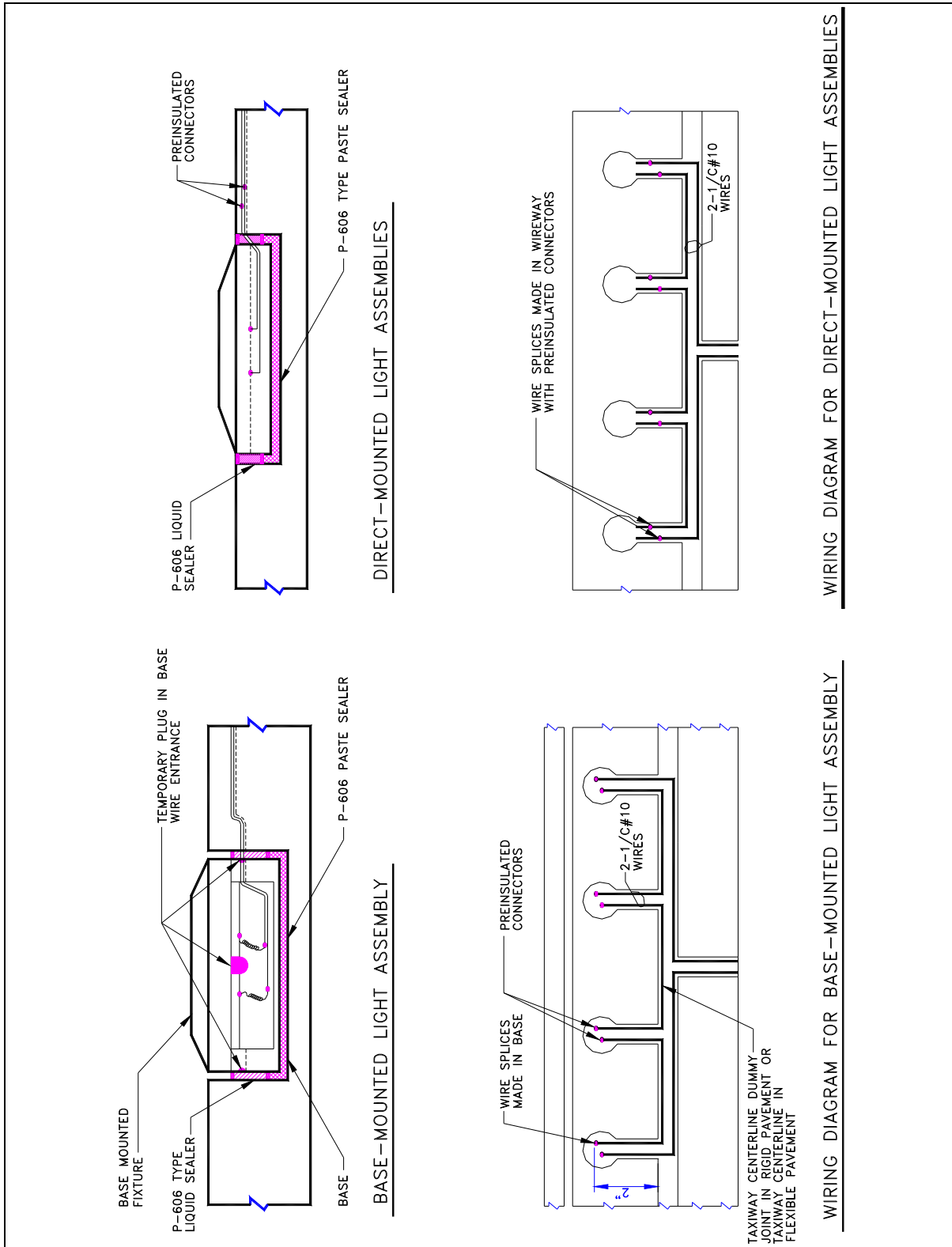


Figure 105. Wiring Details for Direct- and Base-Mounted Taxiway Centerline Lights.

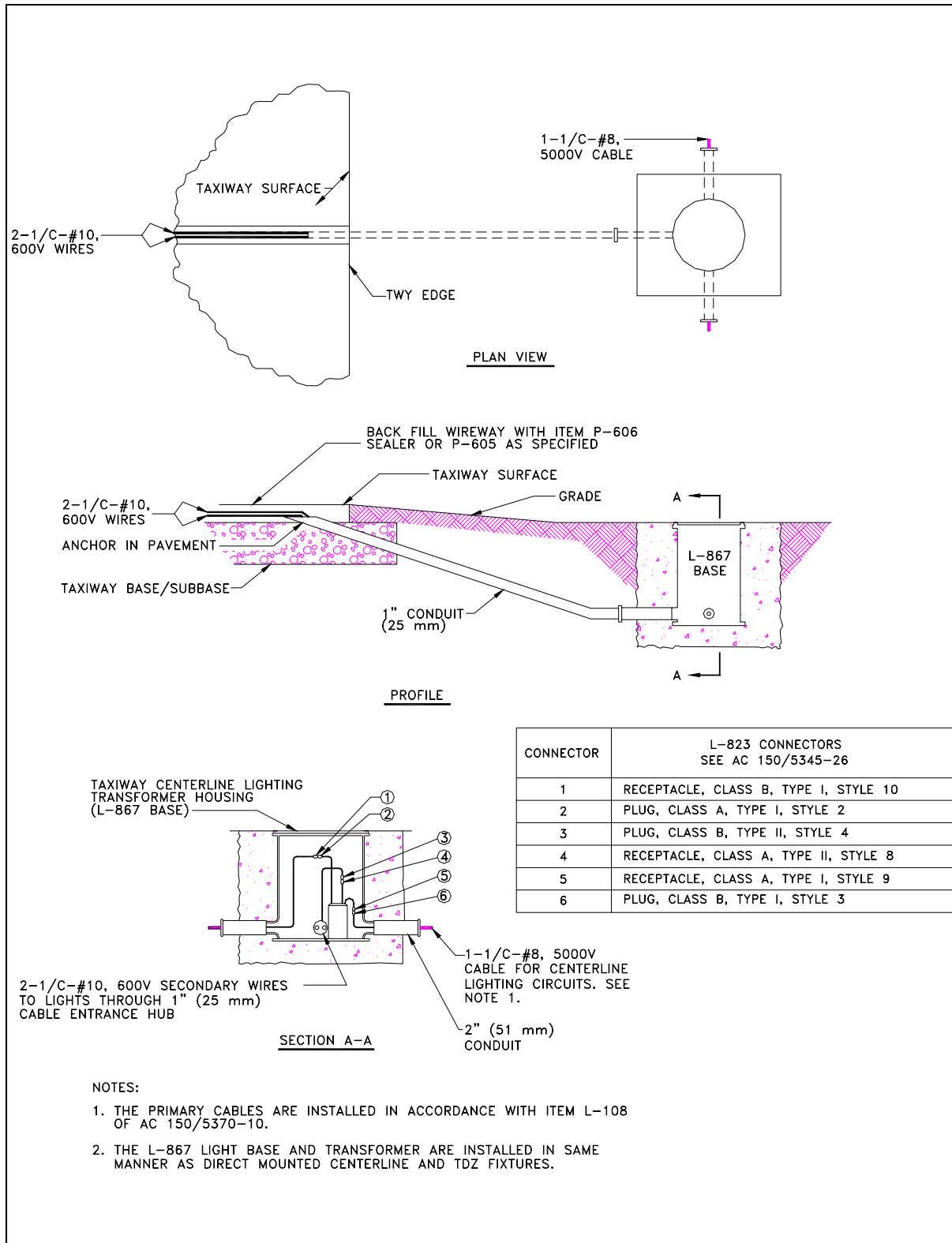


Figure 106. Typical Transformer Housing and Conduit Installation Details for Taxiway Centerline Lights.

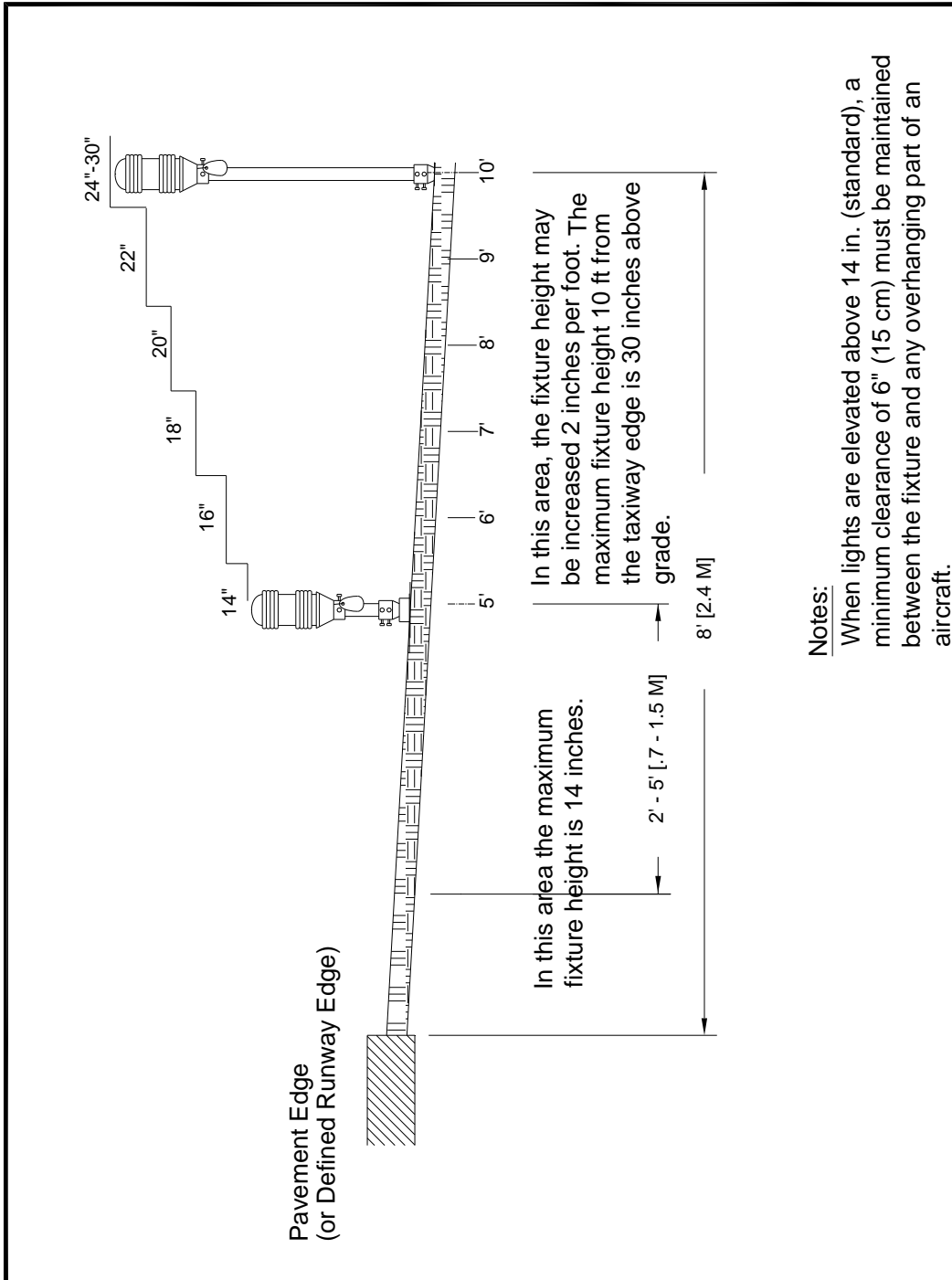


Figure 107. Adjustment of Edge Light Elevation for High Snowfall Areas.

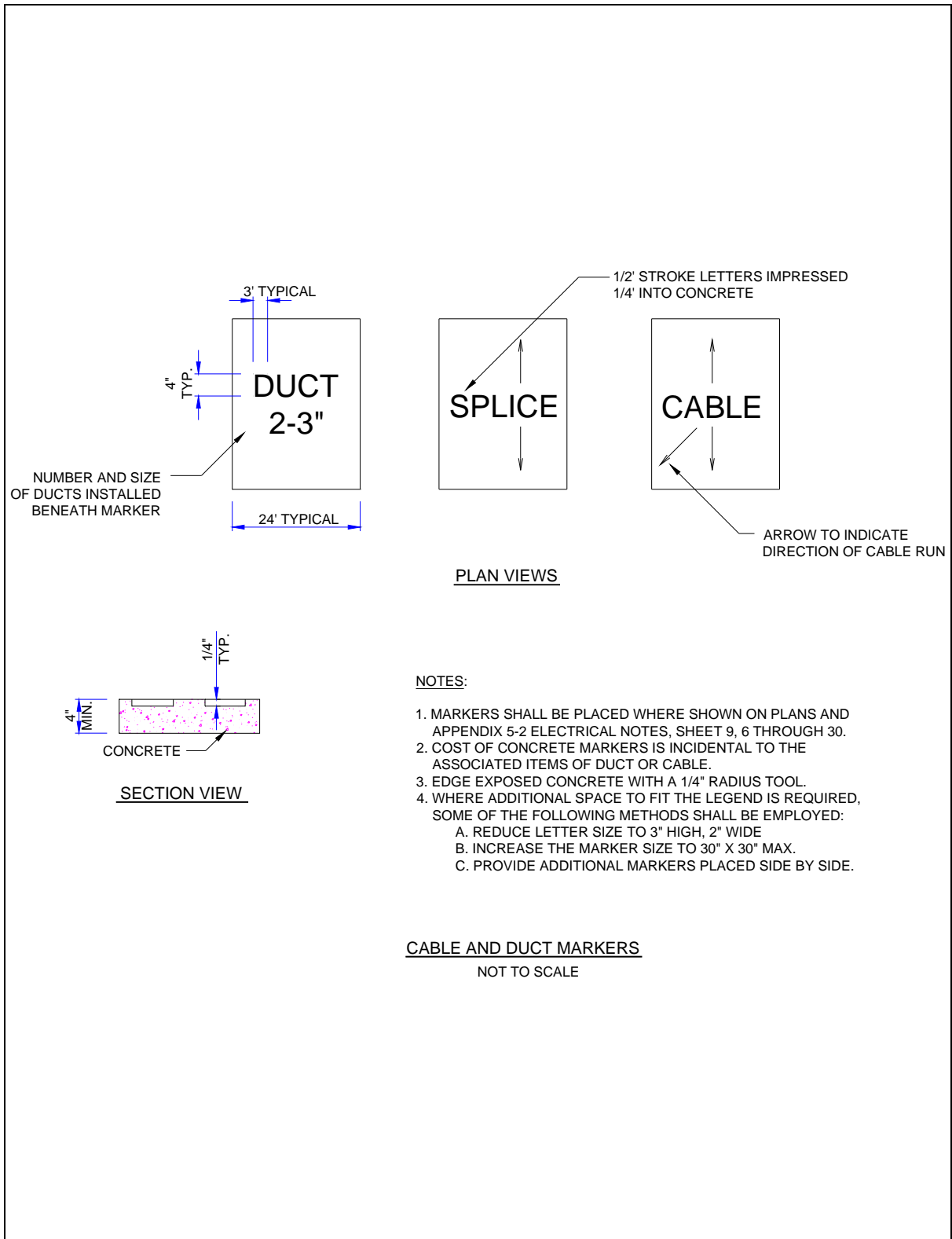


Figure 108. Cable and Duct Markers.

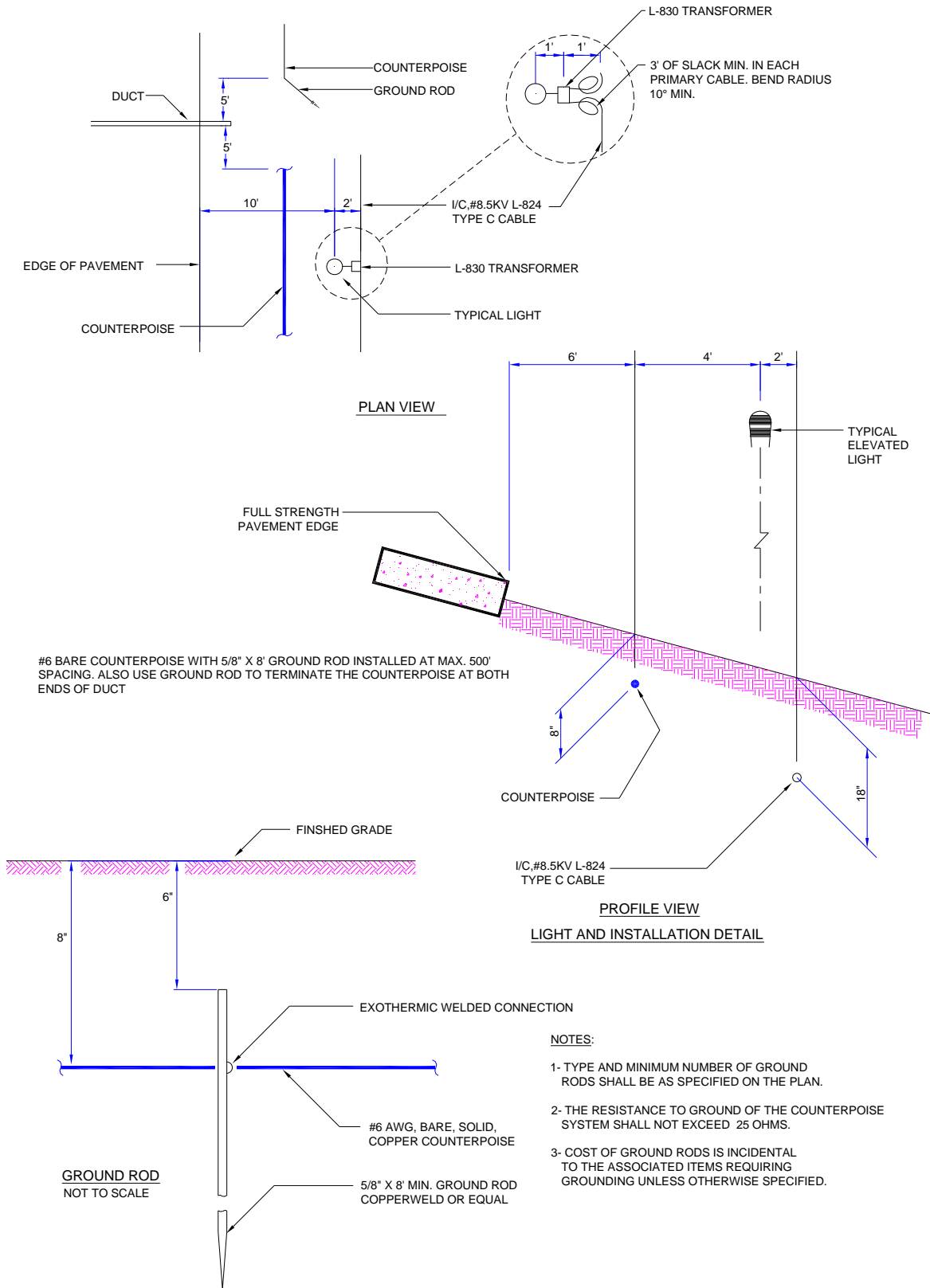


Figure 109. Counterpoise Installation.

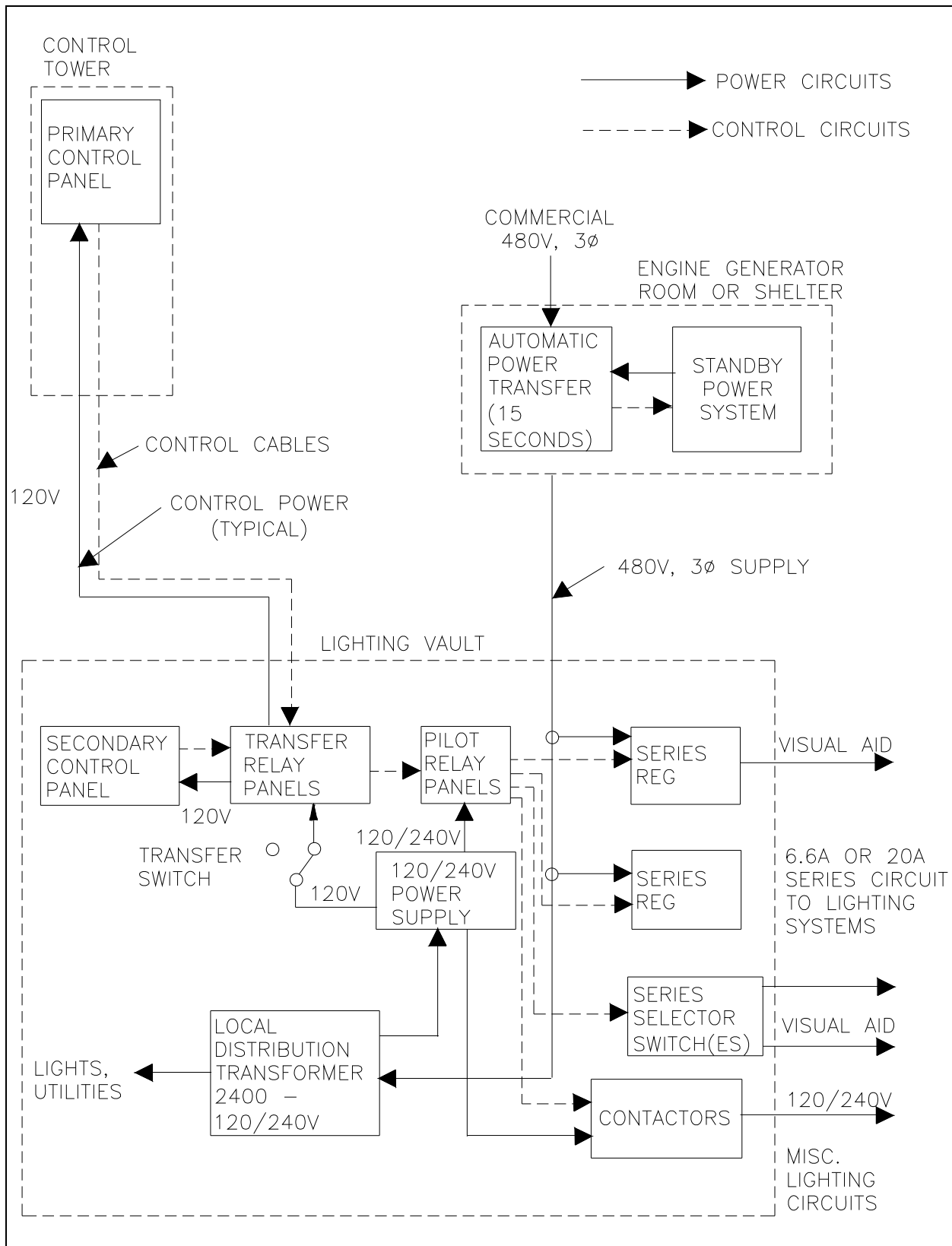


Figure 110. Power and Control System Block Diagram.

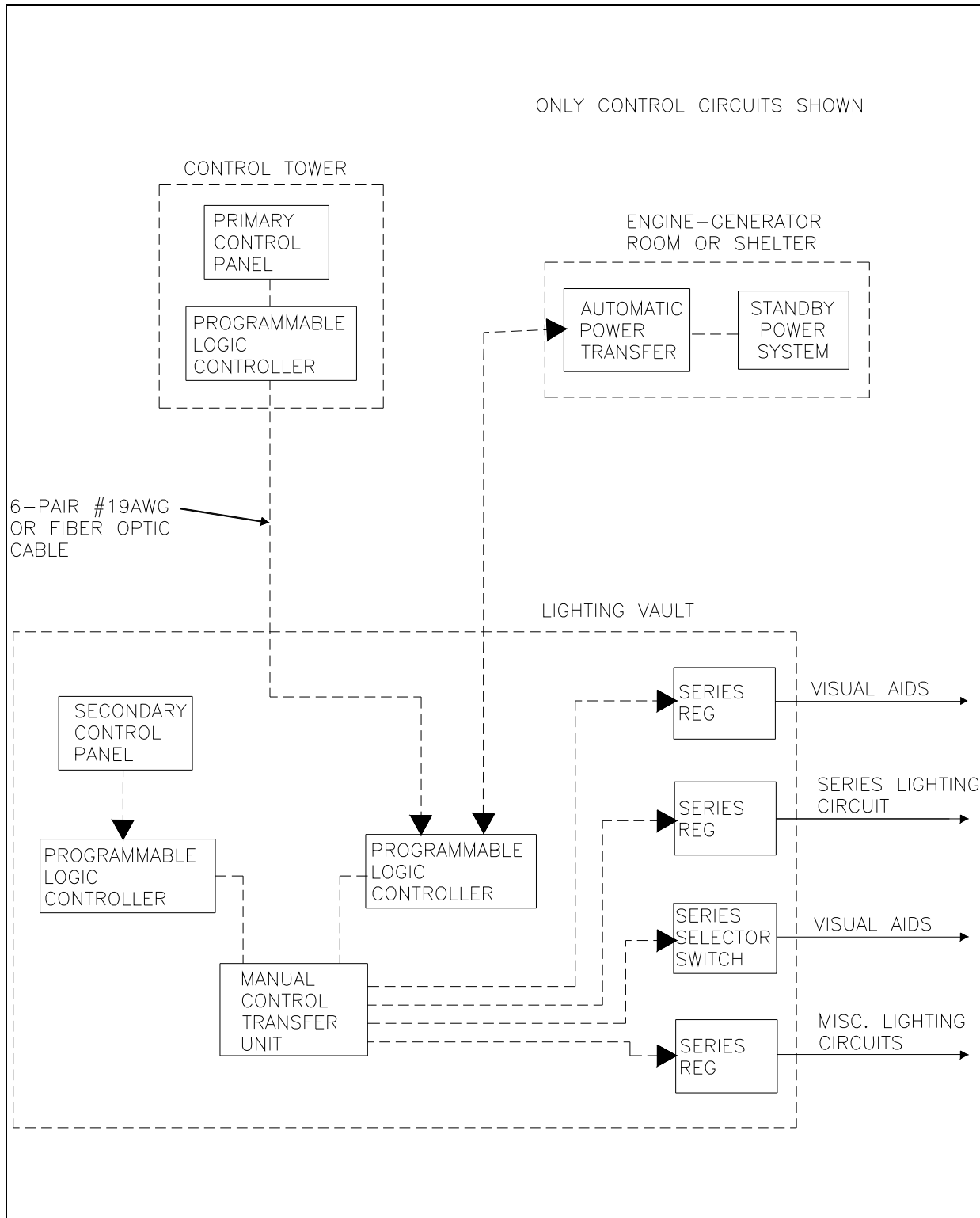


Figure 111. Typical PLC Control System Block Diagram.

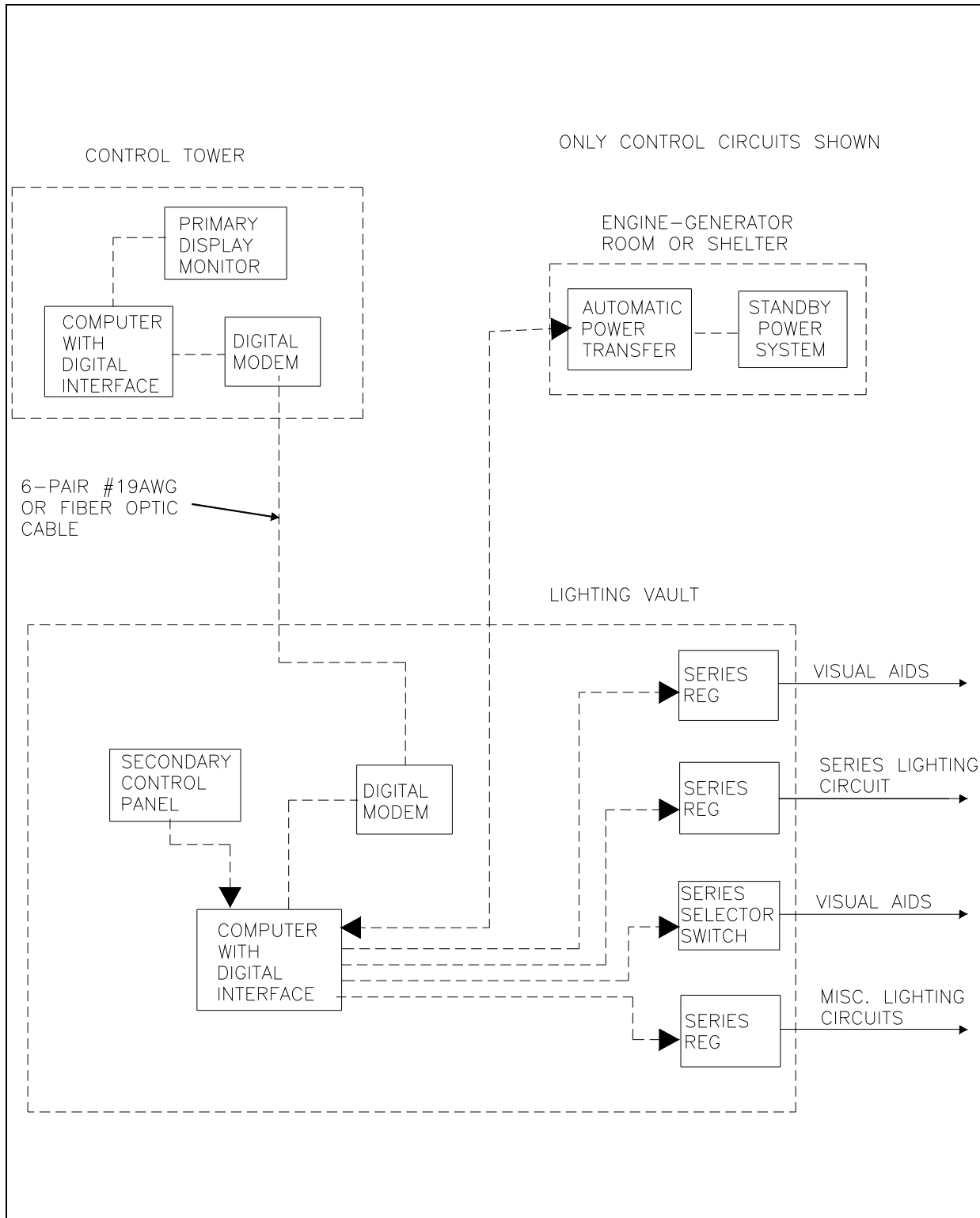


Figure 112. PC Control System Block Diagram.

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