

LIGHTING GUIDELINES

STRUCTURES

DESIGN

CS: Statewide

**MICHIGAN LIGHTING STRUCTURES
DESIGN GUIDELINES**

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5.01

INTRODUCTION

This guidance text addresses procedures involved in the design and plan preparation of frangible light poles, non-frangible light poles, and high mast lighting towers (HMLT) on the interstate/freeway system governed by the Michigan Department of Transportation (MDOT).

A major portion of this text is devoted to design items to be investigated for every project. However, other sections provide details on plan preparation and involvement of other agencies affected by the lighting structure projects. In general, the Lighting Structures Design Guidelines is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of producing frangible, non-frangible, and HMLT lighting plans.

Lighting plans are developed in accordance with Section 819 of the **MDOT Standard Specifications for Construction (MDOT SSC)** and may be prepared either internally or externally. It is the responsibility of the Contractor to provide the light standard design and calculations in accordance with Section 918 of the **MDOT SSC**. The design of lighting structures in Michigan is based on the **AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (AASHTO LRFDLTS)** and **MDOT SSC**. However, it is understood that sometimes adaptations and deviations may be necessary as these publications can be vague or leave decisions up to the judgement of the Engineer.

As procedures and guidelines change, the Lighting Structures Design Guidelines will be continually updated to keep the text as current as possible. These updates will describe the revision, explain the reason, serve as commentary, and assign the date of its implementation.

5.01.01

References

Where national standards or specifications (e.g., AASHTO, MUTCD) are referenced herein, the designer shall utilize the current edition, including all interim revisions, as formally adopted by the Federal Highway Administration (FHWA) in 23 CFR 625 (Design Standards for Highways) at the time of project scoping, unless otherwise directed by MDOT.

- A. **AASHTO LRFD Bridge Design Specifications (LRFDBDS)**
- B. **AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LRFDLTS)**
- C. **AASHTO Roadway Lighting Design Guide**
- D. **Bridge Design Manual, MDOT**
- E. **FHWA Lighting Handbook**
- F. **Frequently Used Special Provisions (FUSP), MDOT**
- G. **Geotechnical Manual, MDOT**
- H. **Michigan Ancillary Structures Inspection Manual (MiASIM), MDOT**
- I. **Preconstruction Process Documentation Manual (PPDM), MDOT**
- J. **Real Estate Procedure Manual, MDOT**
- K. **Road Design Manual, MDOT**
- L. **Special Detail R-50 Series, MDOT**
- M. **Special Detail R-130 Series, MDOT**
- N. **Special Detail R-131 Series, MDOT**
- O. **Special Detail R-132 Series, MDOT**

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P. Special Detail R-135 Series, MDOT

Q. Special Detail B-103 Series, MDOT

**R. Special Provision for Luminaire,
Roadway, MDOT**

**S. Special Provision for Solar Lighting
System, MDOT**

**T. Standard Specifications for
Construction (SSC), MDOT**

**U. Title 23 Code of Federal Regulation Part
625**

5.01.02

Abbreviations and Definition of Terms

When the following abbreviations are used in the guidance text, they have the meanings listed below.

AASHTO.....American Association
of State Highway and Transportation Officials

ANSI.....American National
Standards Institute

FAA.....Federal Aviation
Administration

FHWA.....Federal Highway
Administration

IES.....Illuminating
Engineering Society of North America

LRFD.....Load and Resistance
Factor Design

MASH.....Manual for Assessing
Safety Hardware

MDOT.....Michigan Department
of Transportation

ROW.....Right-of-Way

SUE.....Subsurface Utilities
Engineering

Appurtenance – A miscellaneous device or attachment mounted to a structure that can include signs, antennas, and other devices.

Breakaway – A design feature that allows a sign, luminaire, or pole top-mounted traffic signal support to yield, fracture, or separate near ground level.

Clear Zone – The unobstructed, traversable roadside area provided beyond the edge of the through traveled way that allows a driver to stop safely or regain control of a vehicle that has left the roadway.

Deflection – The degree to which a part of a structural element is displaced (typically under a load).

Design Life – The period of time assumed in design that the structure will perform its intended function without need for major rehabilitation or replacement.

Drilled Shaft – A foundation type, constructed by placing concrete in a drilled hole with steel reinforcement.

Engineer – Person responsible for the design of the structure or review of design-related field submittals such as erection plans, or both.

Frangible – A component readily or easily broken on impact.

Frangible Transformer Base – A base constructed of a brittle material and designed for breakaway performance, used to support a pole structure.

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Ground Mounted – Supported directly on foundations extending into the soil (not mounted on a bridge, retaining wall or other type of structure).

Luminaire – A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the electric power supply.

Right-of-Way (ROW) – The entire area reserved for the construction, operation, and maintenance of the roadway and the improvement of the roadside such as landscaping, sidewalks, pathways, or transit stops. ROW will either be free access or limited access. Limited access ROW is when the inherent right of access to a public highway by the abutting owner or occupant is acquired along with the title to the ROW.

Roadside – Portion of the right-of-way outside of the footprint of the roadway.

Sensor – A device that detects and measures changes in traffic or the environment that can be mounted to a pole.

Sign – A device conveying a specific message by means of words or symbols, erected for the purpose of regulating, warning, or guiding traffic.

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5.02

LIGHTING SITE PLANNING

Site planning of freeway lighting structures must follow and account for specifications outlined in the **MDOT Road Design Manual** and **Bridge Design Manual**. Coordinate site planning with **MDOT's Municipal Utilities Unit**.

5.02.01

Project Scoping and Survey

Understanding the project scope is critical for the Engineer to establish what deliverables (e.g., permits, easement acquisition, design exceptions, etc.) are required. To ensure consistency across projects, the Engineer must follow the scoping process provided by the **MDOT PPDM Task Series 2100 – EPE Scoping Analysis through Series 2800 – Contamination Investigation**.

Proper survey, specifically those related to the structures and roadway, is critical to ensure a project can provide what has been scoped. The Engineer must review **MDOT PPDM Task Series 3100 – Scope Verification through Series 3600 – Utilities/Railroad** before survey takes place so that consistent and thorough survey can be prescribed.

A. ACT 51

MDOT installs, owns, maintains, and pays the utility bill for lighting along freeways. They do not install (or own, maintain, pay utility bills) on M-routes or other non-freeway locations such as carpool lots. However, while local agencies are responsible for street lighting, MDOT is responsible for the costs associated with removing and replacing streetlights that are impacted by trunkline highway projects.

B. Agreements

Local agencies (LA) are 100% responsible for lighting in non-freeway areas. They may apply for funding through MDOT for projects under

the Local Agency Program. Additionally, agreements between MDOT and LA may cover cost sharing responsibilities such as installation cost, maintenance cost, electrical usage, ownership, and other related obligations.

The need for an agreement should be identified during project scoping whenever a lighting project involves shared responsibilities between MDOT and a LA, or when responsibilities for construction, operation, maintenance, ownership, or energy costs must be formally documented. Refer to the section 14.41 of the **MDOT Road Design Manual** for guidance on MDOT Trunkline Agreements, including agreement requirements, approval processes, and coordination procedures.

5.02.02

Lighting Types and Selection

Frangible light poles, non-frangible light poles, and high mast lighting towers are the freeway lighting structure types that exist throughout Michigan. The design life of MDOT lighting structures in accordance with **AASHTO LRFDLTS**, standard plans, and special details is assumed to be 40 years. The proceeding sections provide brief information on these pole types and when they are preferred.

Frangible and non-frangible poles are standard roadway lighting structures that reach less than 55 feet in height and are commonly found along freeways across Michigan. High mast lighting towers extend 55 feet in height or greater and can be found at many major freeway interchanges. These three structure types are briefly discussed as follows:

1. Frangible Light Standard - The frangible lighting structure is a steel or aluminum pole with a cast aluminum frangible transformer base mounted to a concrete foundation with anchor bolts. The frangible transformer base is designed to break away at impact for the safety of motorists. A luminaire is attached to the top of the frangible light pole to illuminate an area of roadway beneath.

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2. Non-Frangible Light Standard - The non-frangible lighting structure is a steel or aluminum pole mounted on a concrete foundation with a standard base plate and anchor bolts. Non-frangible light poles are not considered breakaway structures. A luminaire is attached to the top of the non-frangible light pole to illuminate an area of roadway beneath. Refer to **subsection 5.02.08** for further guidelines regarding non-frangible Light Standards.

3. High Mast Lighting Towers - HMLT are light poles 55 feet in height or greater mounted on a concrete foundation and support a lighting array containing multiple luminaires. The poles are typically constructed from multiple pole sections joined together with slip joints to reach the desired height. An HMLT can provide more illumination to a larger area of freeway than frangible or non-frangible poles due to their height and luminaire arrangement. Note that HMLT cannot be placed on frangible transformer bases.

The following sections provide location specific design recommendations for lighting structures.

A. High Mast Lighting Towers

Install high mast lighting towers to illuminate the main critical area of an interchange. Critical areas of an interchange include entrance and exit ramps, ramp terminals, and merge points. Utilize 1000-watt minimum comparative Light Emitting Diode (LED) Luminaires with four, six, eight, or twelve luminaires per tower.

The Tower height is project specific, with a recommended range of 80 to 125 feet. The Tower height depends on the surrounding terrain and the lighting performance or photometrics specified.

B. Freeway Lighting

Consider the use of freeway lighting based on the geometry and characteristics of the roadway and the surrounding environment, with consideration of maintenance, economic,

and aesthetic factors. Common examples that frequently require freeway lighting are locations with a high frequency of nighttime crashes, areas with high traffic volumes, interchanges, ramp terminals, sharp curves, and intersections.

Additional information on conditions for use of lighting may be found in the **AASHTO Roadway Lighting Design Guide** and the **FHWA Lighting Handbook**.

Freeway lighting consists of frangible or non-frangible Light Standards installed along the road shoulder or within the median. Review the following guidelines for installing freeway lighting on median barrier walls and/or along ramp shoulders:

1. Two or three lane freeways (per direction) – install lights on only one side of the roadway.

2. Three to five lane freeways (per direction) – Install lights on both the outside of the freeway and in the median. If the median lighting is installed on median barrier, a single LED Luminaire is preferred.

3. Five or more lane freeways (per direction) – locate Light Standards on either side of the freeway and within the median.

The recommended pole height for frangible and non-frangible Light Standards along the freeway is 45 feet. Utilize 250/400-watt high intensity discharge (HID) comparative LED Luminaires. Light Standards installed along freeways must be placed 120-180 feet apart as determined by photometric calculations. Refer to **MDOT Special Provision for Luminaire, Roadway** for photometric calculation details.

C. Roundabout and Ramp Lighting

Frangible and non-frangible Light Standards are the preferred lighting type used at roundabouts and ramps. Regardless of type, avoid placing poles where they will be continually hit. Install lighting along the exterior shoulders of roundabouts and ramps, spaced 50-120 feet apart as determined by

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photometric performance calculations. Utilize 250 watt HID comparative LED Luminaires. The recommended pole height is 30-35 feet.

Place light foundations at the entry lanes and not centered between entry and exit lanes to minimize errant hits.

D. Welcome Center/Rest Area Lighting

Install frangible or non-frangible Light Standards along the edge of sidewalks, parking lots, and associated ramps of Welcome Center and Rest Areas. Space light poles 50 feet apart along sidewalks and 80-100 feet apart for parking areas, determined by the required photometric performance calculations. Utilize 250/400 watt HID comparative LED Luminaires. The recommended pole height for sidewalk lighting is 12-30 feet and 30-45 feet for parking area lighting.

E. Carpool Park-n-Ride Lot Lighting

Install frangible or non-frangible Light Standards at Carpool Park-n-Ride lots. Determine whether to utilize 250-watt HID comparative electric-type LED Luminaires or wireless Solar LED Assemblies, depending on available power sources. Since lighting for carpool lots does not qualify as freeway lighting in terms of funding based on Act 51, use solar lighting to avoid regular utility payments. Refer to Special Provisions for minimum Lot Photometric requirements. Place light poles at intervals of 40-50 feet, determined by Photometric performance calculations, with a recommended pole height of 20-30 feet.

F. Emergency Pull Off Area Lighting

Install frangible or non-frangible Light Standards at the exterior shoulder of Emergency Pull Off Areas (EPOA). Refer to **MDOT Maintaining Traffic Typical 380-Pulloff-FW** for lighting placement. Determine whether to utilize 250-watt HID comparative electric-type LED Luminaires or wireless Solar LED Assemblies, depending on available power sources. The recommended pole height

for electric installations is 20-30 feet. Solar Lighting Systems are limited to a maximum pole height of 25 feet. Refer to the **MDOT Special Provision for Luminaire, Roadway and MDOT Special Provision for Solar Lighting System** for luminaire and solar lighting system requirements respectively.

G. Lighting on Bridge Structures

Lighting installations on bridge structures require coordination with the **MDOT Bureau of Bridges and Structures** early in the project development process. Bridge-mounted lighting should be considered when required to maintain lighting continuity across a structure, improve nighttime visibility, eliminate roadside pole conflicts, or where geometric or right-of-way constraints limit the use of ground-mounted light standards.

When lighting is installed directly on a bridge, the Engineer must verify that the proposed attachment does not adversely affect the structural integrity, serviceability, inspection access, or future maintenance of the structure. All bridge-mounted light standards and attachments must comply with the current **MDOT Bridge Design Manual** and applicable **Special Detail B-103 Series** requirements. Refer to **section 5.05** for design considerations.

H. Under-Bridge and Tunnel Lighting

Lighting is recommended for bridges or tunnels that are 100 feet or longer. Lighting is required when either, or both, of the approach roadways to bridges or tunnels are lit, or when the exit location is not visible from the entrance location (for example on curved roadways, etc.). Install luminaires overhead, on sidewalks, or both, as required to meet all MDOT specified performance criteria. For tunnels in excess of 100 feet, consider ANSI/IES RP-22-11 recommendations and evaluations.

I. Solar Lighting Assembly

The design of solar lighting must meet the requirements outlined in the **AASHTO**

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LRFDLTS and the **MDOT Special Provision for Solar Lighting System**.

5.02.03

Pole Material Types

Consider the following general guidelines for the material type of lighting structures:

HMLT poles must be constructed of galvanized steel and may be round or multi-sided.

Frangible and non-frangible Light Standards are required to have a round shaft of either galvanized steel or aluminum material with matching Light Standard Arm. The pole material is chosen by the contractor. Designers may only specify a material type for frangible or non-frangible light poles if either of the following special conditions apply:

1. Maintenance Requirements – Material type may be specified to meet the maintenance needs of the municipality.
2. Other Conditions – Additional considerations may justify specifying a pole material type. Consult with **MDOT's Municipal Utilities Unit** before dictating the pole material.

Ensure the material type is in accordance with **AASHTO LRFDLTS** and **MDOT SSC** and **Standard Plans**.

5.02.04

Aesthetics

Designers must coordinate aesthetic treatments with **MDOT's Roadside Development Design Unit**. If applicable, follow corridor-specific aesthetic design guides.

Beyond this, consider the following general guidelines for aesthetic features:

A. Light Standard Shaft

Local agencies are responsible for any

aesthetic-related costs outside of hot-dip galvanizing for steel poles. On occasion, local agencies may require certain coloring or coating characteristics of their Light Standard Shafts in addition to hot-dip galvanizing. All costs associated with aesthetic preferences must be covered by the local agency.

B. Light Standard Arm

Light Standards may have a single or double bracket arm attachment to support the luminaire. The design of the Light Standard Arm must comply with **MDOT Special Detail R-130 Series**.

C. Luminaire

The luminaire attachment to Light Standards must follow the **MDOT Special Detail R-130 Series**. The recommended color temperature for LED Lighting is 4000 degree Kelvin for Light Standard Luminaires or 5000 degree Kelvin for HMLT Luminaires. Refer to the **MDOT Special Provision for Luminaire, Roadway** for more information on luminaires.

5.02.05

Right-of-Way Coordination

Place lighting structures within the ROW wherever possible. Coordinate with **MDOT Region Real Estate** staff early in the project schedule to determine real estate needs and impacts to the project schedule. Any temporary work outside the ROW requires a legal agreement such as a Consent or Temporary Construction Easement. The **Real Estate Services Section** of the **Development Services Division** or **Region Real Estate** will determine just compensation for the agreement which is offered to the property owner. Permanent ROW acquisition may also need to be considered. Review Chapter 16 of the **MDOT Real Estate Procedure Manual** for more details on ROW considerations during design.

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5.02.06

Appurtenances

Although it is not common, appurtenances may be added to some lighting structures. Possible attachments could include signs, cameras, sensors, or radios. Consider these during the design process to ensure all loading has been accounted for.

5.02.07

Inspection and Maintenance Access

Provide access for safe inspection and maintenance of the lighting structures. All light poles must have handholes for the purposes of routine maintenance and inspection. **MDOT's Ancillary Structures Program** manages the inspection of these assets as outlined in the **Michigan Ancillary Structures Inspection Manual (MiASIM)**.

A. HMLT Lighting Array

The lighting array on an HMLT is mounted with a lowering device contained within the pole to allow for the array to be lowered for luminaire maintenance. Lowering devices must be easily accessible for maintenance and inspection needs.

5.02.08

Guardrail

When non-frangible Light Standards or HMLTs are placed inside the clear zone, protective barriers such as guardrail or concrete barriers must be utilized. Though frangible light standards do not require shielding due to the breakaway performance of the structure, refer to subsection 7.01.25.E of the **MDOT Road Design Manual** for more information regarding guardrail placement. Additional considerations such as not placing the pole within the deflection distance of the guardrail and guardrail posts must also be taken into account.

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5.03

LIGHTING PLACEMENT

5.03.01

Horizontal Alignment

The horizontal alignment of the lighting structures must follow what has been prescribed by subsection 9.03.01 of the **MDOT Road Design Manual**. If the alignment requires attachment to an existing structure, the feasibility of this placement must be discussed with the **MDOT Bureau of Bridges and Structures**. Special permission must be obtained for any deviations.

Light Standard Arms must be aligned perpendicular to the roadway and extend over the edge of shoulder pavement to provide proper illumination.

Underground obstructions such as drainage structures or utilities must be considered during the design phase. Adjust pole spacing to clear the obstruction. It is preferred to minimize the number of poles with non-uniform spacings for ease of construction.

5.03.02

Clear Zone

Place HMLTs outside of the upper bound roadway clear zone distance specified in Chapter 7 of the **MDOT Road Design Manual** if possible.

All exposed Light Standards installed within the clear zone require the use of Frangible Transformer Bases. Any Light Standards installed on the median barrier walls, located behind a protective barrier, or installed outside of the clear zone will NOT require Frangible Transformer Bases to be included on the Light Standards. Refer to Chapter 7 of the **MDOT Road Design Manual** for requirements for clear deflection zones.

Coordinate with the MDOT Project Manager on the future changes in the clear zone for highway expansion before finalizing lighting placement.

5.03.03

Utility Coordination

Compile existing utility information as part of the preliminary design phase. This includes SUE if incorporated in the contract. Avoid utility impacts when possible. If lighting work will impact site utilities, additional coordination with utility owners will be needed. Coordinate with MDOT's local utilities and permitting engineer if impacts are anticipated.

Place lighting structures to avoid underground and aboveground obstructions. Include language in the design plans emphasizing the contractor's responsibility to perform utility conflict assessment and provide adequate clearance of facilities identified by the facility owner prior to construction.

5.03.04

MDOT Roadway

Roadway lighting is provided to ensure that the pavement reaches desired levels of illumination for the safety of motorists. Refer to the **MDOT Special Provision for Luminaire, Roadway** for details on the required illumination level and desired road surface classification.

5.03.05

Municipal Streetscape

Municipal streetscape improvements may include the installation of decorative lighting structures. It is recommended to avoid covering the anchor bolts and nuts, since this can accelerate corrosion and decrease the service life of the base. Any decorative attachments such as banners, hanging plants, signs, etc. must be considered during design.

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5.04

PERMITTING

The Project Manager must review the guidelines in the **MDOT Road Design Manual** to determine if the FAA requires notification of any freeway lighting, particularly HMLT, placement and construction.

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5.05

STRUCTURAL DESIGN

Typically, a site-specific design is not required if the Engineer uses the existing standards and special details from the **MDOT Road Design Manual** and **Bridge Design Manual**. Verify the design meets all criteria outlined in the **Special Details R-50, R-130, R-131, R-135, and B-103 Series**. If the design falls outside the applicable standard requirements, a site-specific design will be required and **MDOT's Municipal Utilities Unit** and **MDOT's Geotechnical Services Unit** must be contacted. The following sections provide best practices and recommendations for freeway lighting structural design.

5.05.01

Foundation Types

Review historic structure borings before new borings are obtained. If poor soils are shown, the Engineer must coordinate with **MDOT's Geotechnical Services Unit**. All preliminary foundation investigations and new soil boring obtainment per foundation location should follow requirements outlined in the **MDOT Geotechnical Manual**. The designer shall verify that no underground geotechnical anomalies are present in conflict with the ancillary structure foundation. When a site-specific design is required, refer to **Special Detail R-132** for foundation loads for frangible and non-frangible light standards.

A. Drilled Shafts

Drilled shafts serve as the standard foundation type for frangible and non-frangible Light Standards and HMLTs. Refer to the **Special Detail R-130 Series** for details on the drilled shaft foundations for frangible or non-frangible Light Standards. Refer to **Special Detail R-131 Series** for details on short light poles 20 ft and under in height. Refer to **Special Detail R-135 Series** for details on HMLT foundations. Drilled shafts can be cased or uncased. Follow all procedures outlined in Section 718 of the

MDOT SSC for casing installation for drilled shaft foundations.

Consult with a geotechnical engineer to determine the necessity of temporary supports for assets. Determine the allowable proximity of the drilled shaft to other utilities and structures.

The installation and removal of temporary support must be evaluated by the designer in coordination with **MDOT's Geotechnical Services Unit** based on the project soil types, groundwater conditions anticipated during construction, and proximity to existing structures or utilities. Consider temporary support especially for soft cohesive soils and granular soils where the groundwater table is above the bottom of drilled shaft elevation, or where structures or utilities exist within 5 times the drilled shaft diameter.

Do not place drilled shaft foundations in close proximity to each other as this will reduce the capacity of the surrounding soil. Center-to-center spacing within 5 times the drilled shaft diameter requires evaluation of group effects for the corresponding soil type per recommendations in **AASHTO LRFD BDS**.

5.05.02

Design Specifications and Special Provisions

Frangible and non-frangible Light Standards and HMLTs in Michigan must be designed according to the current edition of the **AASHTO LRFD LTS**. Also reference the most up to date lighting standards, special details, and **FUSPs** on MDOT's website. All projects under federal aid funding must meet **Title 23 Code of Federal Regulation Part 625**.

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5.05.03

Loading

Frangible and non-frangible Light Standards and HMLTs must be designed for the loadings and load combinations required by the **AASHTO LRFDLTS**. The primary load cases for lighting structures are wind loading and dead load. The weight of the lowering device for HMLTs is included in the dead load of the structure.

Design Light Standards and HMLTs in accordance with the fatigue design procedures outlined in the **AASHTO LRFDLTS**.

5.05.04

Dampeners

Dampeners may be needed for Light Standards mounted on bridges due to increased wind loading effects. Include an internal dampener for Light Standards as recommended by the manufacturer.

5.05.05

Bridge-Mounted Light Poles

Non-frangible Light Standards may be mounted to bridges. Refer to **Special Detail B-103 Series** regarding Light Standards attachments to bridges.

5.05.06

Wall and Barrier-Mounted Light Poles

Non-frangible Light Standards may be mounted to retaining walls or concrete barrier walls. Refer to **Special Detail R-50 Series** regarding Light Standards mounted to concrete barriers.

5.05.07

Deflection Limits

Deflections for luminaire support structures must meet the required limit per the **AASHTO LRFDLTS**.

5.05.08

Structural Details

The designer must include all relevant special details and standards in the contract plans. Recommended details are shown in the Freeway Lighting Sample Plan provided in **Appendix A**.

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5.06

SHOP DRAWING REVIEW PROCESS

MDOT's Shop Drawing Review Process must be followed when the Engineer receives shop drawings from a manufacturer. This ensures that responsibilities have been properly coordinated and consistency is provided between all parties performing the reviews. All shop drawings for lighting structures must be sent to both the **MDOT Municipal Utilities Unit** and the **MDOT Structural Fabrication Unit** for review. Other disciplines such as the **MDOT Geotechnical Services Unit** may be engaged as well. Structural calculations require peer review by a licensed Professional Engineer as part of the shop drawing review process.

5.06.01

Product Specifications

Verify that the proposed lighting structures meet all product specifications as outlined in the **MDOT FUSPs** and Section 819 of the **MDOT SSC**.

5.06.02

Photometric Calculations

Verify the proposed design meets the required Photometric Performance Design Calculations, as specified in **MDOT Special Provision for Luminaire, Roadway**. Photometric Calculations must be included with any Lighting Submittals.

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5.07

PLAN PREPARATION

5.07.01

Preliminary Plan Composition

Use the following list and ordering of sheets = for the Preliminary Plan stage of freeway lighting projects. This list assumes stand-alone lighting projects:

- A. Title Sheet
- B. Project Information Sheet
- C. Legend Sheet
- D. Note Sheet
- E. Survey Information
- F. Lighting Plan*

*Use **Appendix A** – Guidelines for Freeway Lighting Structures Plan Preparation as a reference for these sheets.

At the Preliminary Plan stage, the lighting structure plan sheets must convey the pole alignment and proposed pole type at a minimum. If multiple pole types are used, they must be called out in the lighting plan view with locations of each type shown.

5.07.02

Final Plan Composition

Use the following list and ordering of sheets for the final plan stage of freeway lighting projects. This list assumes no major work aside from the lighting structures is included in the project:

- A. Title Sheet
- B. Project Information Sheet
- C. Legend Sheet
- D. Note Sheet
- E. Miscellaneous Quantities
- G. Miscellaneous Details
- H. Survey Information
- I. Alignment
- J. Lighting Plan*
- K. Lighting Details*
- L. Maintenance of Traffic
- M. Soil Boring Data*

*Use **Appendix A** – Guidelines for Freeway Lighting Structures Plan Preparation as a reference for these sheets.

See the **MDOT Road Design Manual** and **Bridge Design Manual** for guidance on all other sheets.

5.07.03

Structural Details

The structural details provided in all special details mentioned in this guidance must be included. These details may be modified to fit the project specific needs. The design of these details must be analyzed if modifications will impact the structural capacity.

The details should be included where lighting structures supported on drilled shafts or light poles with a frangible transformer base are proposed.

**MICHIGAN LIGHTING STRUCTURES
DESIGN GUIDELINES**

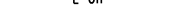
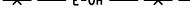
**APPENDIX A – GUIDELINES FOR FREEWAY LIGHTING STRUCTURES PLAN
PREPARATION**

GUIDELINES FOR FREEWAY LIGHTING STRUCTURES PLAN PREPARATION



FINAL ROW PLAN REVISIONS SUBMITTAL DATE:								 MDOT Michigan Department of Transportation	NO SCALE		DATE:	CS:		DRAWING	SHEET
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ELECTRICAL

	HANDHOLE - EXISTING
	HANDHOLE, ROUND
	HANDHOLE, ROUND, 3 FOOT DIAMETER
	HANDHOLE, TYPE D
	MANHOLE - EXISTING
	SERVICE METER - EXISTING
	TRANSFORMER - PAD MOUNTED - EXISTING
	TRANSFORMER - POLE MOUNTED - EXISTING
	CABLE
	CABLE - TO BE REMOVED
	CABLE OVERHEAD
	CABLE OVERHEAD - TO BE REMOVED
	CABLE IN CONDUIT
	CABLE IN CONDUIT - TO BE REMOVED
	CABLE IN CONDUIT - DIRECTIONAL BORE

LIGHTING

	CONTROL PANEL - EXISTING
	CONTROL PANEL
	FLOOD LIGHT
	HANDHOLE, ROUND
 R&S	LIGHT STANDARD - EXISTING TO BE REMOVED & SALVAGED
	LIGHT STANDARD DOUBLE ARM - EXISTING
	LIGHT STANDARD DOUBLE ARM
	LIGHT STANDARD POST TOP - EXISTING
	LIGHT STANDARD POST TOP
	LIGHT STANDARD SINGLE ARM - EXISTING
	LIGHT STANDARD SINGLE ARM
	LUMINAIRE WALL MOUNTED UNDER BRIDGE - EXISTING
	LUMINAIRE WALL MOUNTED UNDER BRIDGE
 T-	TOWER LIGHTING UNIT - EXISTING
 T-	TOWER LIGHTING UNIT

ABBREVIATIONS

B	BRIDGE
CE	CONSUMERS ENERGY COMPANY
DIA	DIAMETER
DTE	DETROIT EDISON COMPANY
FB	INDICATES ST LTG UNIT WITH FRANGIBLE TRANSFORMER BASE
LCP	LIGHTING CONTROL PANEL
R	REMOVE
R&S	REMOVE & SALVAGE
RW	RETAINING WALL
SF	SINGLE FACE BARRIER WALL

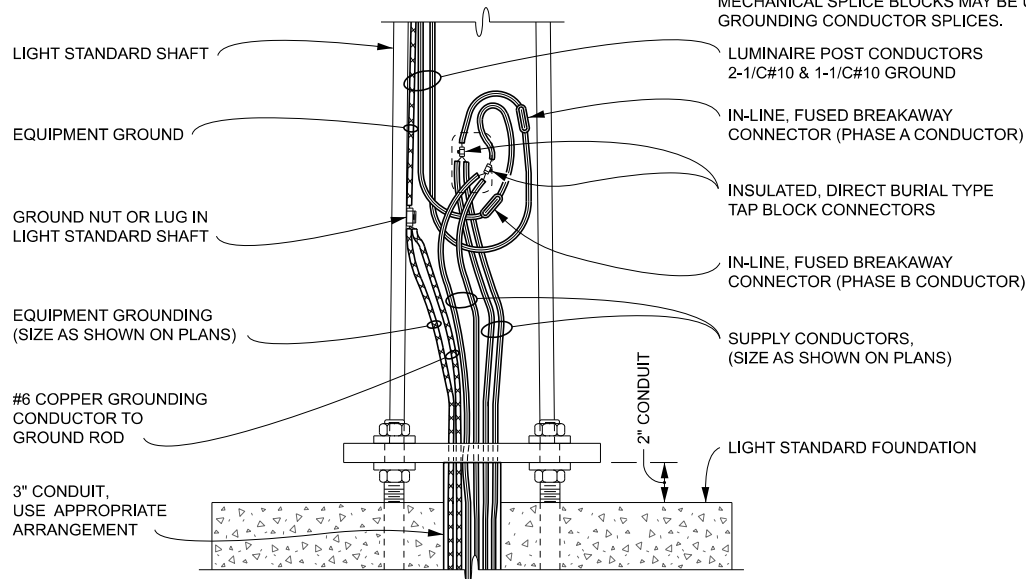
PUBLIC UTILITIES

FOR THE PROTECTION OF UNDERGROUND UTILITIES, THE CONTRACTOR SHALL DIAL 1-800-482-7171 A MINIMUM OF 72 HOURS PRIOR TO EXCAVATING IN THE VICINITY OF THE UTILITIES LINES. ALL MISS DIG PARTICIPATING MEMBERS WILL THUS BE ROUTINELY NOTIFIED. THIS DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY OF NOTIFYING UTILITY OWNERS WHO MAY NOT BE A PART OF THE "MISS DIG" ALERT SYSTEM.

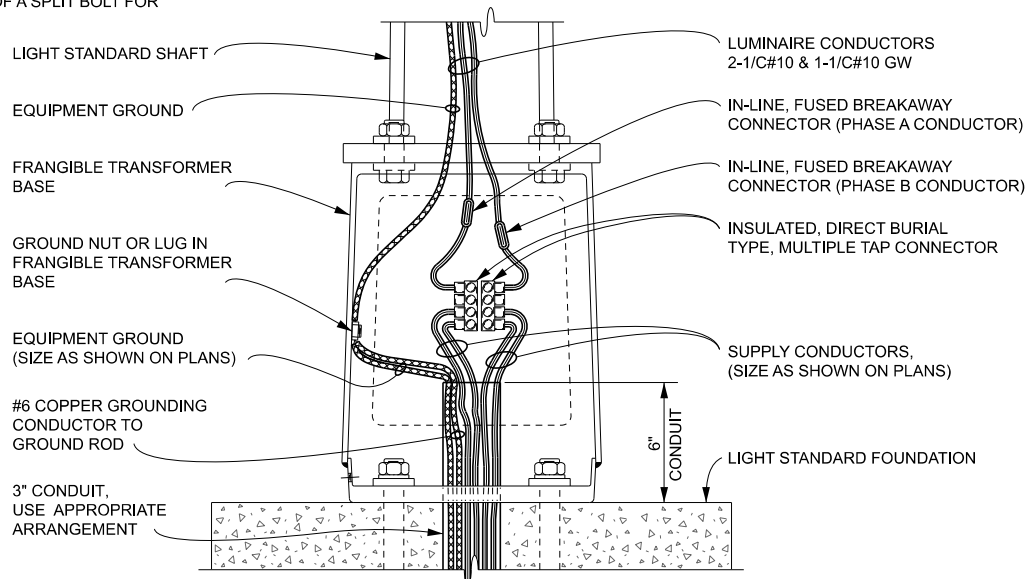
NOTES - THESE NOTES ARE FOR INFORMATION ONLY

1. ELECTRICAL SERVICE FOR LIGHTING CONTROLLERS SHALL BE 240/480 VOLT, 1 PHASE, 3 WIRE.
2. STREET LIGHTING LUMINAIRES SHALL BE LED, MEDIUM DISTRIBUTION, CUTOFF, EXCEPT AS OTHERWISE NOTED.
3. LIGHT POLES FOR SHOULDER LIGHTING SHALL BE STEEL POLES (WITH TENON) AND HAVE A MOUNTING HEIGHT OF 40 FT WITH A SINGLE BRACKET ARM. MEDIAN LIGHTING MOUNTING HEIGHT IS 45'-0" ABOVE GRADE.
4. LIGHT POLES FOR RAMP LIGHTING SHALL BE STEEL POLES (WITH ARM) AND HAVE A MOUNTING HEIGHT OF 30 FT WITH A 12 FT SINGLE BRACKET ARM, UNO.
5. ALL LIGHT STANDARDS FURNISHED ON THIS CONTRACT SHALL BE OF THE SAME STYLE AND MATERIAL AND FROM THE SAME MANUFACTURER, EXCEPT AS OTHERWISE SPECIFIED ON THE PLANS.
6. ALL DIRECT BURIAL CONDUIT SHALL HAVE A 2'-6" MINIMUM COVER UNLESS OTHERWISE NOTED.
7. ALL CONDUIT CROSSING PAVEMENT SHALL EXTEND 4' BEYOND CURB, EDGE OF PAVEMENT, OR PAVED SHOULDER AND SHALL HAVE 30" MINIMUM COVER.
8. SMOOTH SURFACE CONDUIT ONLY IS ALLOWED ON THIS JOB. ALL PVC CONDUIT IS TO BE SCHEDULE 80. INSTALL EXPANSION JOINTS BETWEEN FIXED POINTS AND WHERE EMERGING FROM GRADE PER NEC. SECURE CONDUIT IN A METHOD THAT WILL ALLOW MOVEMENT FOR EXPANSION AND CONTRACTION.
9. ALL CABLE SHALL BE INSTALLED IN CONTINUOUS UN CUT LENGTH BETWEEN HANDHOLES OR LIGHT STANDARDS.
10. ALL SPLICES, TEMPORARY CIRCUITS AND CABLE CUTTING REQUIRED TO MAINTAIN CONTINUITY OF THE LIGHTING CIRCUITS ARE INCLUDED IN THE PROJECT AND WILL NOT BE PAID FOR SEPARATELY.
11. TREES AND SHRUBS DAMAGED BY THE CONTRACTOR'S OPERATION SHALL BE REPLACED (IN KIND) AT THE CONTRACTORS EXPENSE, AS DIRECTED BY THE ENGINEER.
12. BREAKAWAY CONNECTOR SHALL BE BUSSMAN TYPE HEP WITH INSULATING BOOTS, HOMAC MANUFACTURING CO. "FLOOD-SEAL" SDK-M, LITTLE FUSE LEBAAS, IDEAL SLK OR APPROVED EQUAL.
13. IN ACCORDANCE WITH STATE LAW MICHIGAN P.A.217 SECTION 338.883E MDOT WILL REQUIRE AND ENFORCE COMPLIANCE OF THE 1:3 LICENSED ELECTRICIAN/APPRENTICE RATIO FOR WORK ON ANY ELECTRICAL SYSTEM WITHIN MDOT ROW. THE PROJECT ENGINEER SHALL REQUIRE THE CONTRACTOR TO FURNISH THE ELECTRICIAN'S/APPRENTICE NAME AT THE PRECONSTRUCTION MEETING.
14. ALL SPLICES FOR THE PHASE CONDUCTORS AND GROUNDED (NEUTRAL) CONDUCTOR TO BE MADE ABOVE GRADE IN THE LIGHT STANDARD USING A UL LISTED INSULATED "SAME SIDE" MECHANICAL SPLICE BLOCK (BURNDY# BIBS-4-4 OR UL LISTED EQUAL). IF SPLICING IS NECESSARY BELOW GRADE, SPLICE WILL BE MADE USING A UL LISTED DIRECT BURIAL "SAME SIDE" MECHANICAL SPLICE BLOCK (ILSCO #PED3-350SS-DB OR UL LISTED EQUAL) SPLIT BOLT CONNECTORS UL LISTED OF COPPER CONSTRUCTION WILL BE ALLOWED ONLY ON GROUNDING CONDUCTORS. UL LISTED "SAME SIDE" MECHANICAL SPLICE BLOCKS MAY BE USED IN LIEU OF A SPLIT BOLT FOR GROUNDING CONDUCTOR SPLICES.

15. ALL ELECTRICAL CONNECTIONS, TERMINALS, AND METAL RACEWAY THREADS SHALL BE COATED WITH AN ELECTRICAL JOINT COMPOUND TO PREVENT OXIDATION.
16. ALL EXPOSED FIELD CUT THREADS, OR UNTREATED METAL SURFACES SHALL BE COATED WITH A ZINC COMPOUND.
17. ALL CONDUCTORS AWG #2 OR SMALLER WILL BE COLORED THE ENTIRE LENGTH. PHASING TAPE OR PAINT WILL NOT BE ALLOWED.
PHASE "A" - RED
PHASE "B" - BLACK
GROUNDED/NEUTRAL CONDUCTOR - WHITE
GROUND CONDUCTOR - GREEN OR BARE COPPER
ALL CURRENT CARRYING CONDUCTORS #12 AND LARGER TO BE COPPER STRANDED 600V USE/RHH/RHW RATED.
18. ALL ENCLOSURES TO BE 316L GRADE NEMA 4X STAINLESS. ALL HARDWARE FOR MOUNTING, SUPPORTING OR SECURING ENCLOSURES, CONDUIT AND GUTTERS SHALL BE OF HOT DIPPED GALVANIZED OR STAINLESS STEEL.
19. CONTRACTOR TO FURNISH AND INSTALL LCP, PROVIDE ALL DISCONNECTS SHOWN ON LIGHTING AND SIGNAL CONTROL DIAGRAMS.
THIS WORK TO BE PAID FOR IN THE PAY ITEM, "LIGHTING CONTROL PANEL".
20. CONDUIT AND HANDHOLE PLACEMENT ON PLANS ARE NOT EXACT AND MUST BE FIELD VERIFIED AND APPROVED BY RESIDENT ENGINEER AND MDOT PRIOR TO INSTALLATION.
21. SUSPENDED/CEILING MOUNTED UNDERPASS LUMINAIRES, RACEWAYS, AND CABLES SHALL BE INSTALLED PER UNDERPASS LIGHTING DETAILS.
22. CAP AND SEAL CONDUITS INSTALLED UNDER STAGE 1 THAT WILL BE COMPLETED AT A LATER DATE DURING STAGE 2 ACTIVITIES.
23. FURNISH AND INSTALL DUAL METER RACK WITH TWO (2) METER SOCKETS AND TWO (2) NEMA 4X DISCONNECT SWITCHES. SIZE OF METERS AND DISCONNECT SWITCHES PER WIRING DIAGRAMS. INSTALL DISCONNECTS ON LOAD SIDE OF METER. CONTRACTOR TO PROVIDE ALL EQUIPMENT AND METER RACK. THE UTILITY SHALL TERMINATE SERVICE CABLES AND INSTALL METERS IN SOCKETS.
24. EXISTING LIGHTING CONTROL PANELS SHALL BE USED FOR TEMPORARY LIGHTING CONDITIONS IN ACCORDANCE WITH THE MOT PLANS. NEW LIGHTING CONTROL PANELS SHALL BE INSTALLED NEXT TO EXISTING CONTROL STATION RACKS. FURNISH AND INSTALL RACK PER REQUIREMENTS OUTLINED UNDER THE METER RACK DETAILS FOR NEW LIGHTING CONTROL PANELS. INSTALL NEW CONDUIT AND CONDUCTORS FROM EXISTING CONTROLLERS TO THE NEW CONTROLLERS FOR A SWITCHOVER TO MAKE A COMPLETE FUNCTIONING ELECTRICAL SYSTEM PRIOR TO ACCEPTANCE OF FINAL CONDITIONS.
25. CONTRACTOR SHALL COMPLETE A STAKE REQUEST FORM 5300 "MDOT UNDERGROUND INFRASTRUCTURE STAKING REQUEST FORM" PRIOR TO BEGINNING WORK AND IDENTIFYING EXISTING UTILITIES NEAR THE LIGHTING CONTROL STATIONS.
26. WALL MOUNTED UNDERPASS LUMINAIRES, RACEWAYS, AND CABLES SHALL BE INSTALLED PER UNDERPASS LIGHTING DETAILS AND SHALL BE VANDAL RESISTANT WITH OPTIONAL WIRE GUARDS.



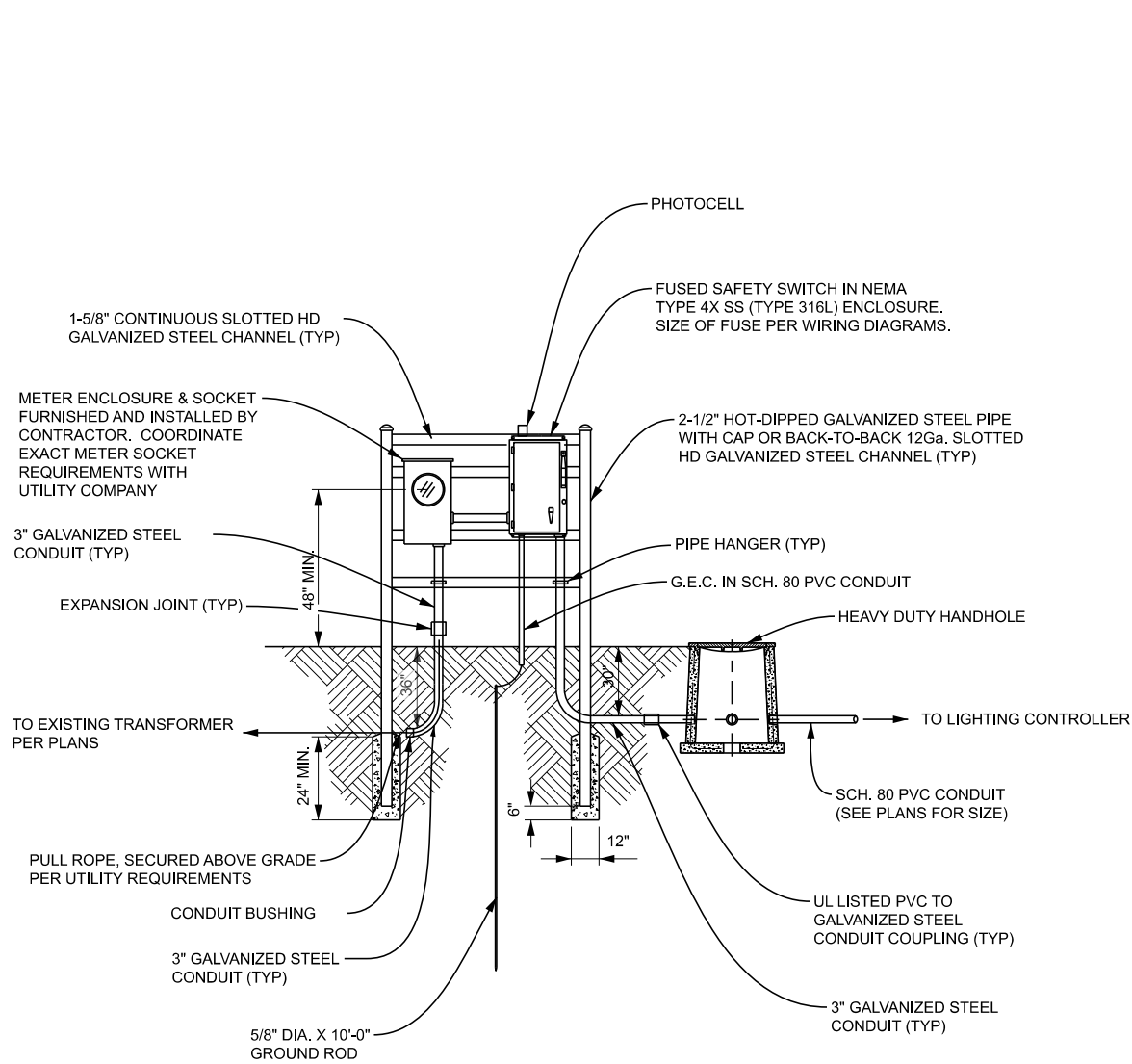
TYPICAL MULTIPLE STREET LIGHTING CONNECTION
@ LIGHT STANDARD
NOT TO SCALE



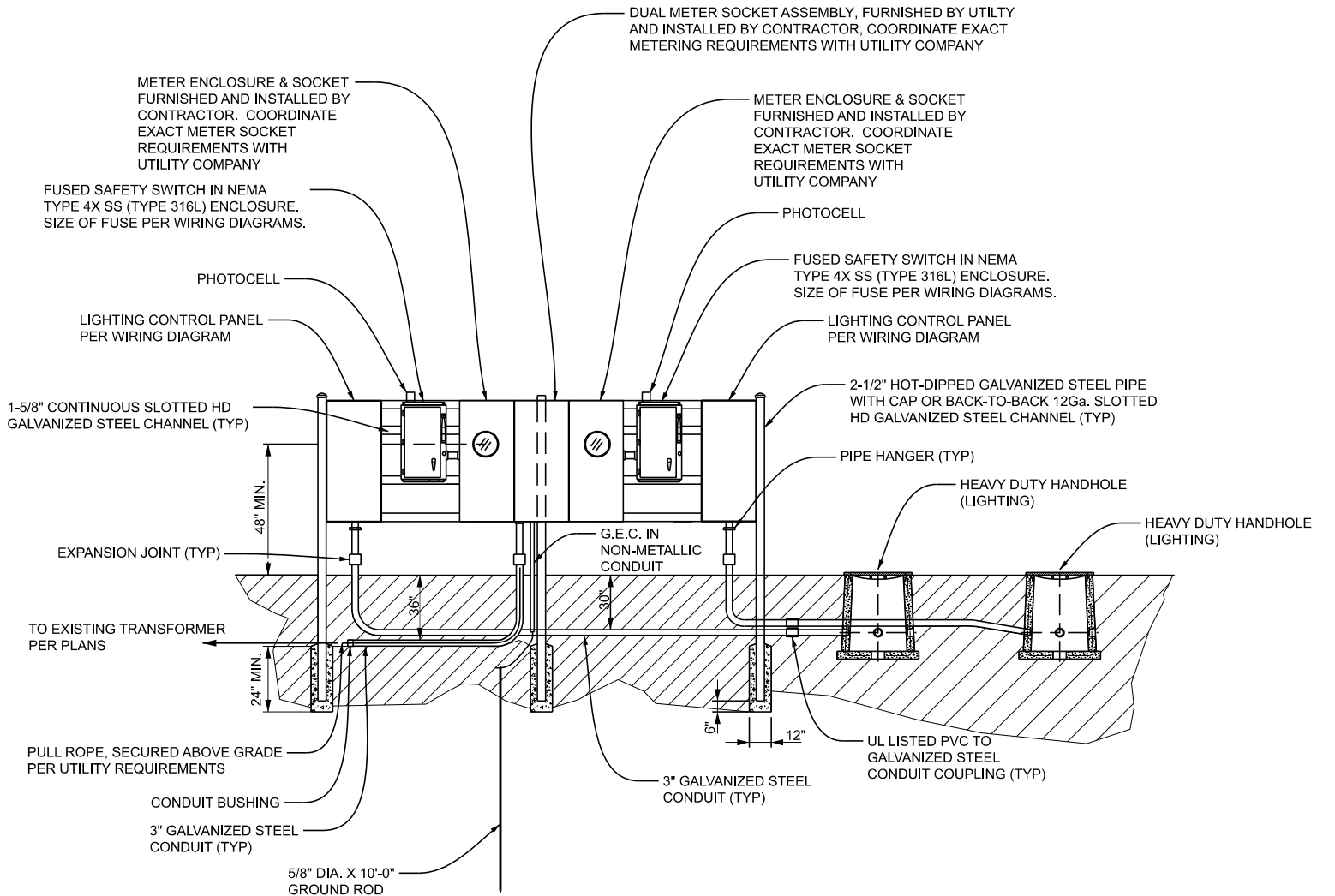
TYPICAL MULTIPLE STREET LIGHTING CONNECTION
@ LIGHT STANDARD
W/ FRANGIBLE TRANSFORMER BASE
NOT TO SCALE

NOTE:
EXISTING ITEMS ARE REPRESENTED BY THIN LINE WEIGHTS
PROPOSED ITEMS ARE REPRESENTED BY HEAVIER LINE WEIGHTS.

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SINGLE METER RACK
NTS



DUAL METER RACK
NTS

GENERAL NOTES:

1. LCP FURNISHED AND INSTALLED BY CONTRACTOR.
2. CONTRACTOR IS RESPONSIBLE FOR COORDINATING TERMINAL SIZE RATINGS WITH CONDUCTOR SIZES INDICATED ON WIRING DIAGRAM.
3. PROVIDE A 316L, STAINLESS STEEL, NEMA 4X SERVICE ENTRANCE RATED DISCONNECT ENCLOSURES. FUSE SIZES PER PAY ITEM AND SPECIAL PROVISION FOR POWER SERVICE. PROVIDE ONE PADLOCK FOR EACH ENCLOSURE. PADLOCK SHALL BE IN ACCORDANCE WITH THE SPECIAL PROVISIONS. PROVIDE AND ATTACH LABEL WITH SITE ADDRESS TO OUTSIDE OF THE ENCLOSURE.
4. PROPER BONDING OF METALLIC CONDUIT CONTAINING SERVICE ENTRANCE CONDUCTORS IS REQUIRED. PROVIDE BUSHINGS OR OTHER METHODS APPROVED BY THE LOCAL UTILITY.
5. PROVIDE #6 GROUNDING ELECTRODE CONDUCTOR (G.E.C.) BONDED TO SOLID GROUND BUS IN DISCONNECT SWITCH; BOND GROUND BUS TO SOLID NEUTRAL BUS WITH #6 CONDUCTOR.
6. BOND ALL METALLIC CONDUITS ENTERING AN ENCLOSURE TO A GROUND BUS, PREFERABLY BY USE OF GROUNDING BUSHINGS AND #6 GROUND. BOND ALL GROUND BUSES TO FACTORY INSTALLED GROUND LUG ON SIDE OF ENCLOSURE.

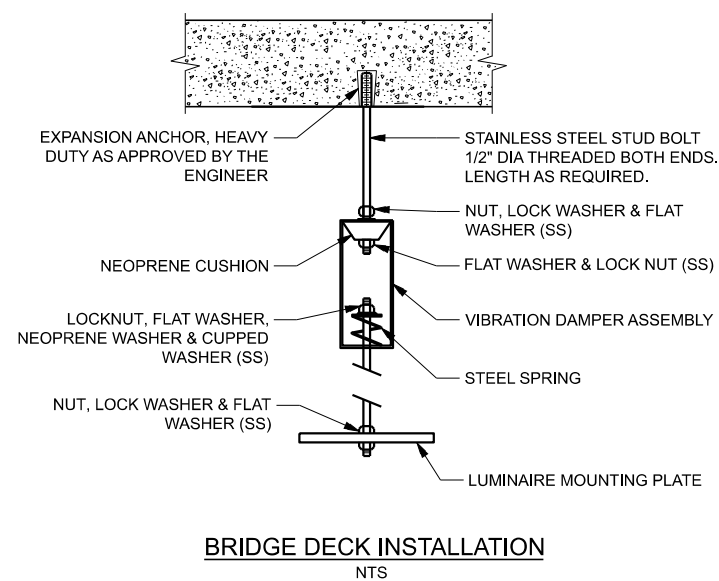
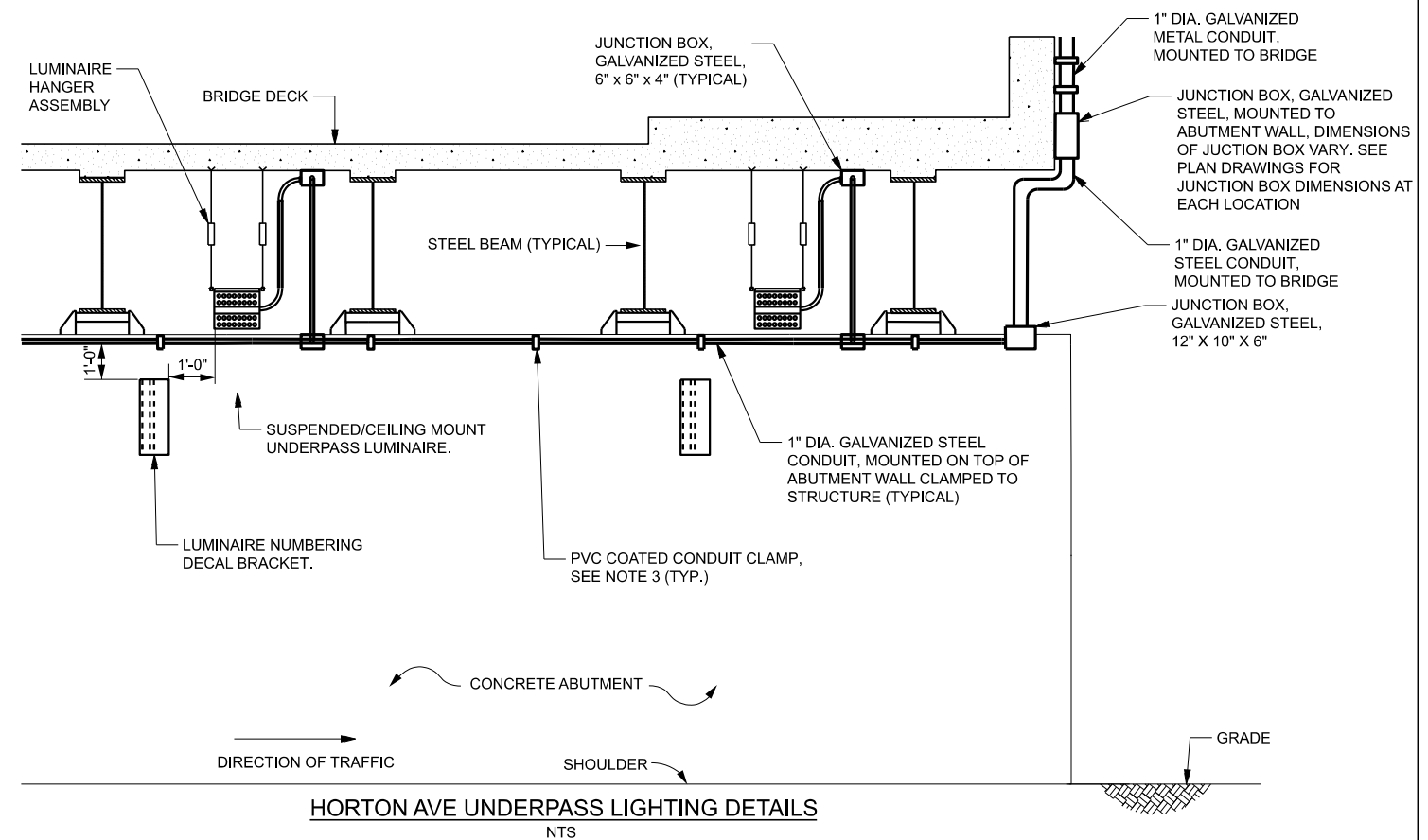
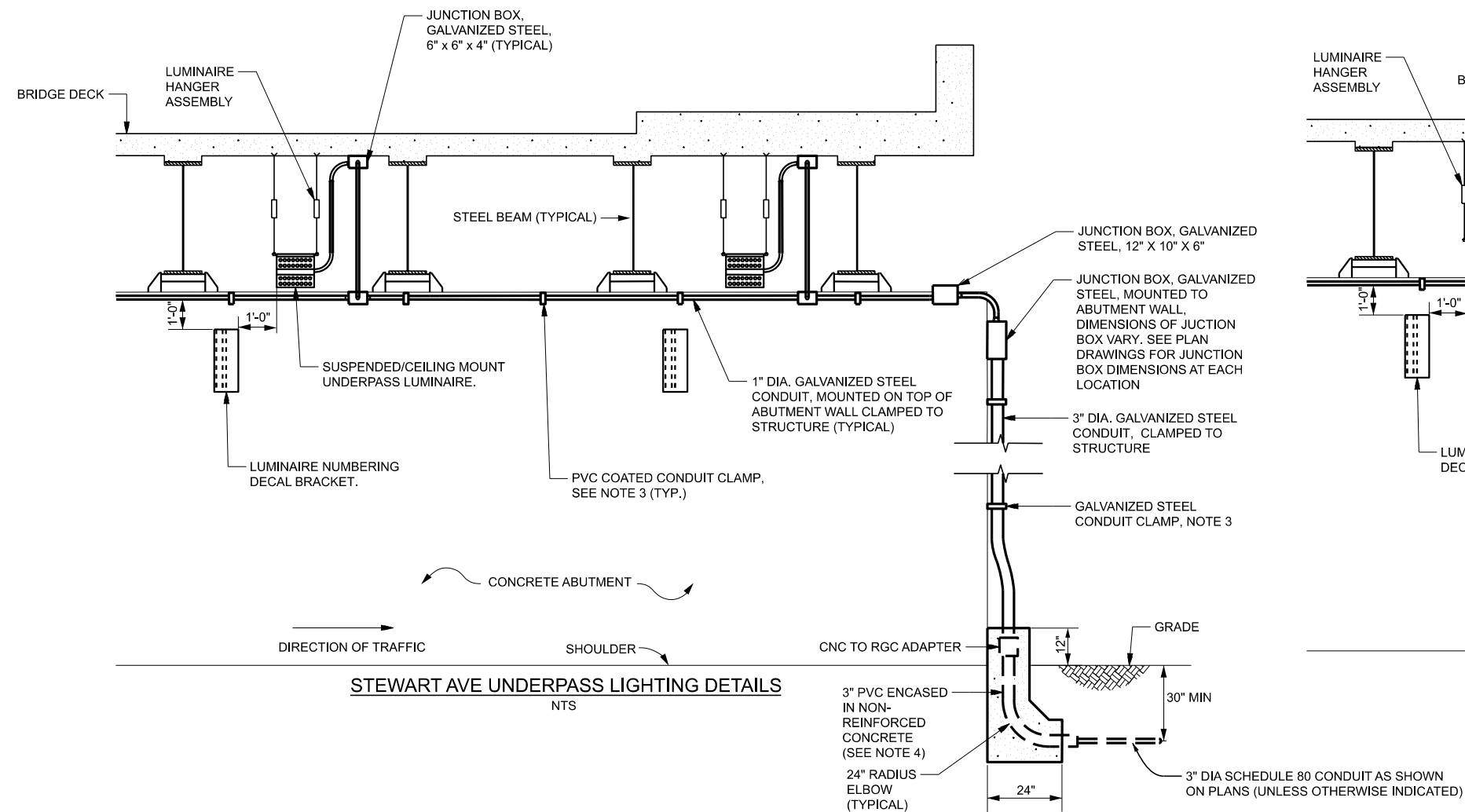
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1. THE MATERIAL AND WORKMANSHIP TO BE IN ACCORDANCE WITH THE CURRENT M.D.O.T. STANDARD SPECIFICATIONS.
2. THE CONTRACTOR MAY CONSTRUCT THE HANDHOLE STRUCTURE OF CONCRETE MASONRY, OR OF PRECAST REINFORCED CONCRETE.
3. THE INNER SURFACE OF THE HANDHOLE TO BE SMOOTH.
4. ALL CASTINGS TO BE CLEANED BY SAND BLASTING.
5. THE CASTINGS TO BE FREE OF POURING FAULTS, BLOW HOLES, CRACKS, AND OTHER IMPERFECTIONS. THEY ARE TO BE SOUND, TRUE TO FORM AND THICKNESS, CLEAN AND NEATLY FINISHED AND TO BE COATED WITH COAL TAR PITCH VARNISH.
6. HANDHOLE TO BE EQUIPPED WITH CABLE RACK AND HOOKS TO TRAIN CABLE.
7. THE SEATING FACE OF THE COVER AND THE SEAT FOR THE COVER ON THE FRAME IF REQUIRED, TO BE GROUND OR MACHINED SO THAT THE COVER HAS AN EVEN BEARING ON ITS SEAT TO PREVENT ROCKING OR TILTING.
8. LIGHT DUTY COVER TO BE BOLTED TO FRAME WITH NOT LESS THAN 2 COUNTERSUNK HEX HEAD BRONZE BOLTS.
9. PRECAST HANDHOLE WITH HEAVY DUTY COVER TO BE SET ON A CONCRETE SLAB.

1. ALL CONCRETE MASONRY TO BE PER SECTION 913 IN THE GENERAL SPECIFICATION.
2. LIGHT DUTY COVER AND FRAME TO BE EJ #2982A-24 OR NEENAH FOUNDRY #R-6012 D FOR CIRCULAR COVER OR AN APPROVED EQUAL.
3. HEAVY DUTY COVERS TO BE CASTINGS WHICH MEET THE REQUIREMENTS OF THE CURRENT SPECIFICATIONS FOR GRAY IRON CASTINGS ASTM DESIGNATION A48 AND TO HAVE A MINIMUM STRENGTH AS PROVIDED FOR CLASS # 30B GRAY IRON CASTINGS.
4. HEAVY DUTY COVERS & FRAMES FOR USE IN EARTH TO BE EJ #2860Z / #1120A (COVER / FRAME) OR NEENAH FOUNDRY #R-6052 D FOR CIRCULAR COVER OR AN APPROVED EQUAL.
5. HEAVY DUTY COVERS & FRAMES FOR USE IN PAVED AREAS SHALL BE EJ #3100Z / #1120A (COVER / FRAME) FOR CIRCULAR COVER OR AN APPROVED EQUAL.

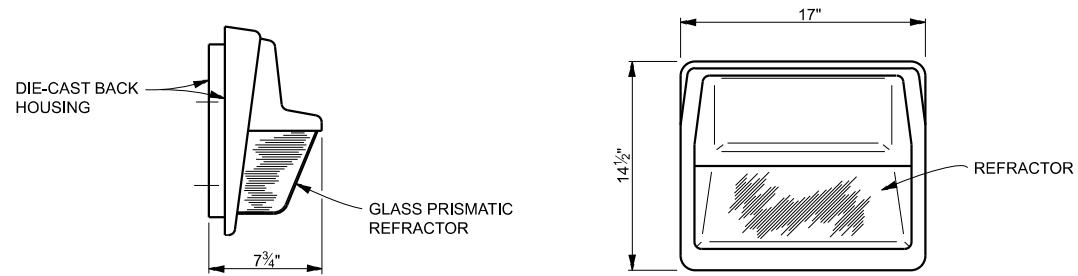
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GENERAL NOTES:

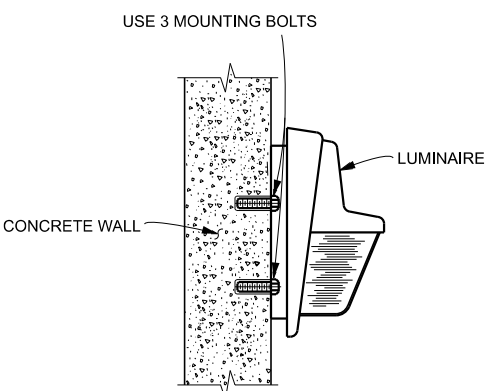
1. SEE UNDERPASS LIGHTING PLANS FOR INSTALLATION LOCATION OF UNDERPASS LIGHTING LUMINAIRES.
2. UNDERPASS LUMINAIRE SHALL HAVE A MOUNTING HEIGHT OF 1" BELOW THE TOP OF PIER OR ABUTMENT WALL TYPICAL FOR WALL MOUNTED UNDERPASS LUMINAIRES UNLESS OTHERWISE NOTED.
3. SECURE THE CONDUIT WITH PVC COATED CONDUIT CLAMPS OR CONDUIT BEAM CLAMPS AS SHOWN AT 5'-0" INTERVALS FOR LATERALS AND WITHIN 2'-0" MAXIMUM FROM ANY JUNCTION BOX, FLEXIBLE CONDUIT, OR CHANGE IN DIRECTION. ALL PVC COATED CONDUIT CLAMPS OR BEAM CLAMPS SHALL BE INCLUDED WITH THE COST OF THE "LUMINAIRE, WIRING SYSTEM" PAY ITEM.
4. THE CONCRETE ENCASED CONDUIT TRANSITION SHALL BE INCLUDED IN THE COST OF THE "LUMINAIRE, WIRING SYSTEM" PAY ITEM.
5. ALL CONDUIT ATTACHED TO STRUCTURE SHALL GALVANIZED STEEL, TYPICAL.
6. THE UNDERPASS LUMINAIRE HANGER ASSEMBLY COMPLETE WITH HEAVY DUTY ANCHORS/INSERTS AND ALL APPLICABLE HARDWARE SHALL BE INCLUDED IN THE COST OF THE UNDERPASS LUMINAIRE PAY ITEM.

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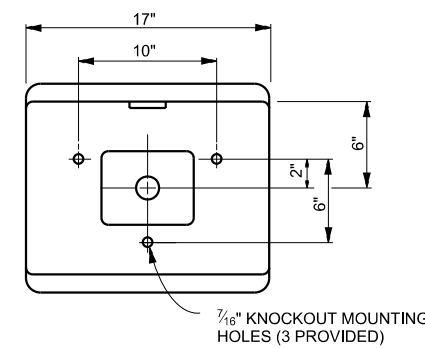


SIDE VIEW OF LUMINAIRE

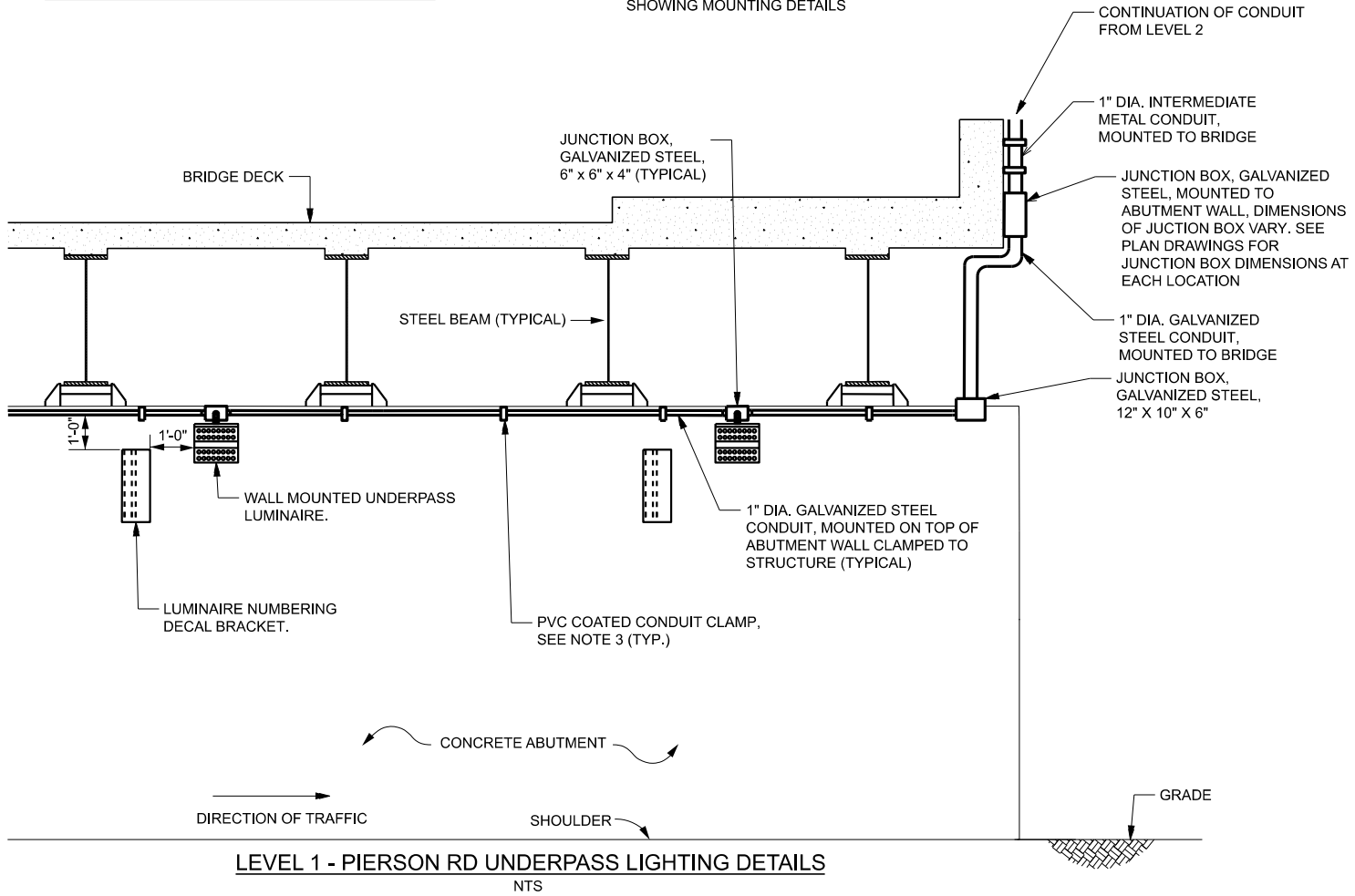
FRONT VIEW OF HOUSING



TYPICAL WALL MOUNTING DETAIL



BACK VIEW OF HOUSING
SHOWING MOUNTING DETAILS



LEVEL 1 - PIERSON RD UNDERPASS LIGHTING DETAILS
NTS

1" DIA. GALVANIZED METAL CONDUIT, MOUNTED ON TOP OF ABUTMENT WALL CLAMPED TO STRUCTURE (TYPICAL)

TO PIERSON ROAD UNDERPASS LIGHTING, SEE LEVEL 1 DETAIL ON THIS SHEET FOR CONTINUATION OF CONDUIT.

CONTINUATION OF CONDUIT FROM LEVEL 2

1" DIA. INTERMEDIATE METAL CONDUIT, MOUNTED TO BRIDGE

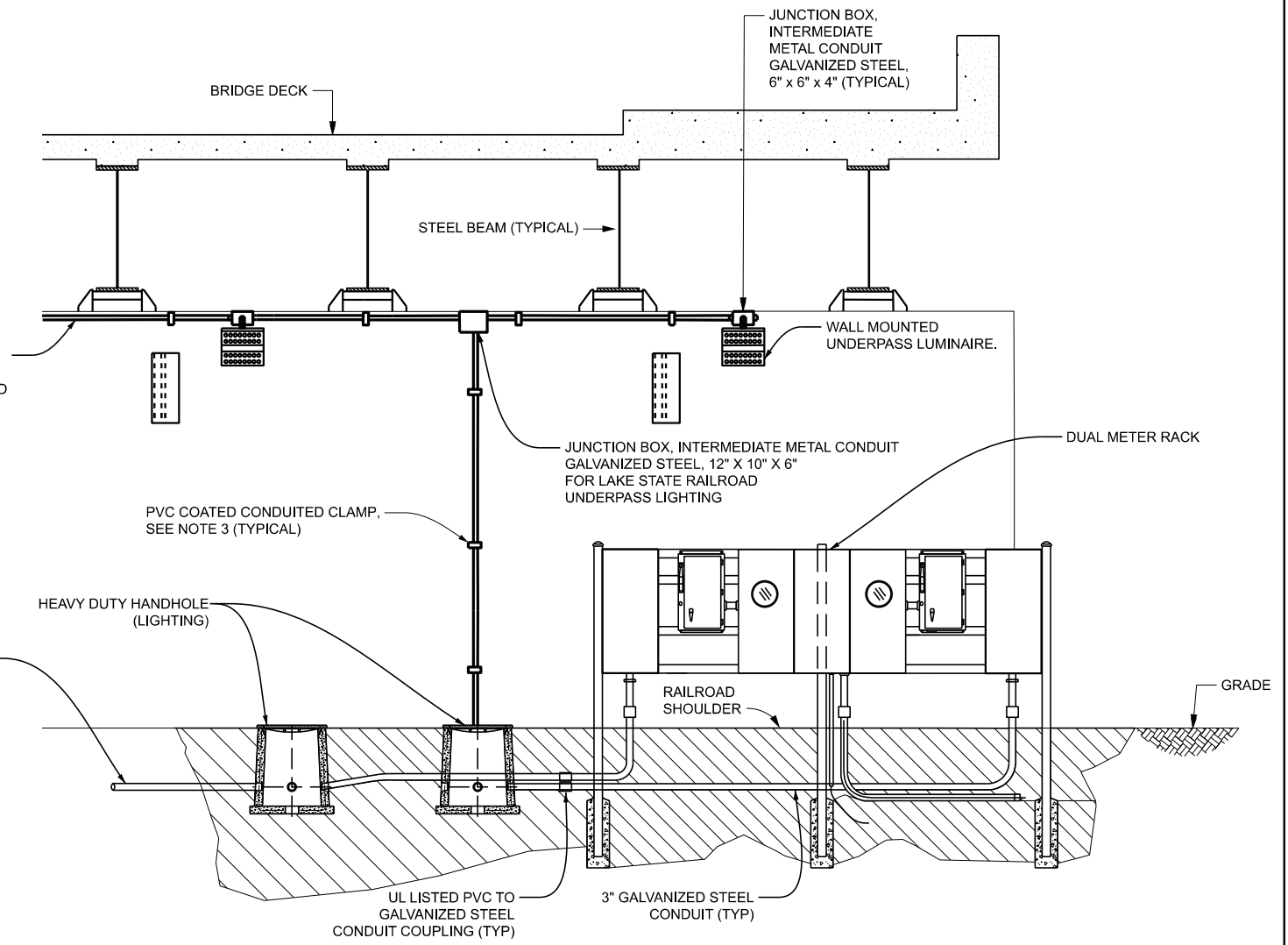
JUNCTION BOX, GALVANIZED STEEL, MOUNTED TO ABUTMENT WALL, DIMENSIONS OF JUNCTION BOX VARY. SEE PLAN DRAWINGS FOR JUNCTION BOX DIMENSIONS AT EACH LOCATION

1" DIA. GALVANIZED STEEL CONDUIT, MOUNTED TO BRIDGE

JUNCTION BOX, GALVANIZED STEEL, 12" X 10" X 6"

1" DIA. GALVANIZED STEEL CONDUIT, MOUNTED ON TOP OF ABUTMENT WALL CLAMPED TO STRUCTURE (TYPICAL)

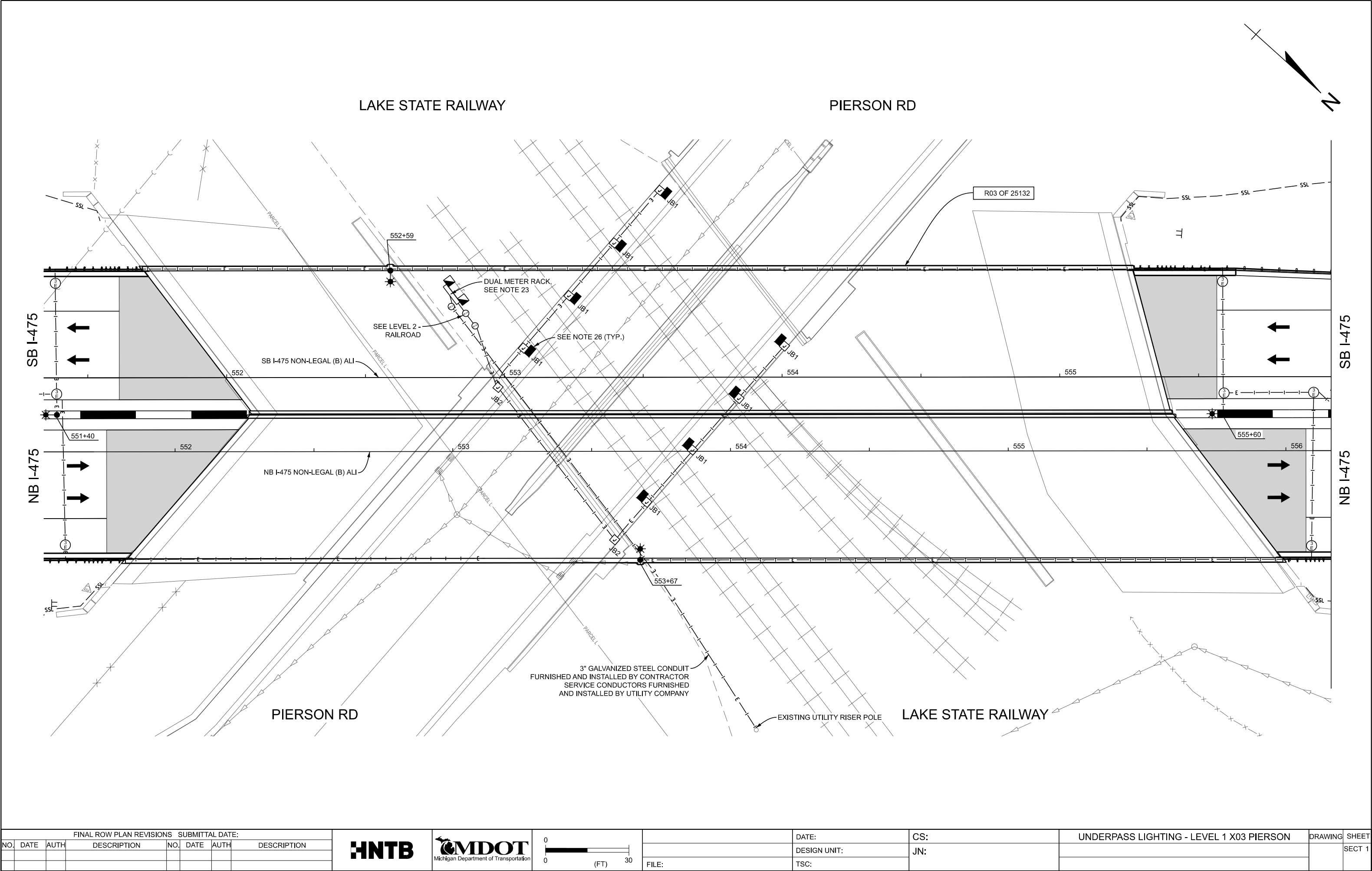
PVC COATED CONDUIT CLAMP, SEE NOTE 3 (TYP.)



LEVEL 2 - LAKE STATE RAILROAD AND PIERSON ROAD UNDERPASS LIGHT DETAILS
NTS

GENERAL NOTES:

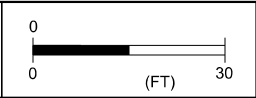
- SEE UNDERPASS LIGHTING PLANS FOR INSTALLATION LOCATION OF UNDERPASS LIGHTING LUMINAIRES.
- UNDERPASS LUMINAIRE MOUNTED TO FACE OF PIER OR ABUTMENT WALL WITH 1/2" ALUMINUM SPACERS. MOUNTING HEIGHT OF 1" BELOW THE TOP OF PIER OR ABUTMENT WALL TYPICAL FOR WALL MOUNTED UNDERPASS LUMINAIRES UNLESS OTHERWISE NOTED.
- SECURE THE CONDUIT WITH PVC COATED CONDUIT CLAMPS OR CONDUIT BEAM CLAMPS AS SHOWN AT 5'-0" INTERVALS FOR LATERALS AND WITHIN 2'-0" MAXIMUM FROM ANY JUNCTION BOX, FLEXIBLE CONDUIT, OR CHANGE IN DIRECTION. ALL PVC COATED CONDUIT CLAMPS OR BEAM CLAMPS SHALL BE INCLUDED WITH THE COST OF THE "UNDERBRIDGE WIRING SYSTEM" PAY ITEM.
- THE CONCRETE ENCASED CONDUIT TRANSITION SHALL BE INCLUDED IN THE COST OF THE "UNDERBRIDGE WIRING SYSTEM" PAY ITEM.
- ALL CONDUIT ATTACHED TO STRUCTURE SHALL BE INTERMEDIATE METAL CONDUIT GALVANIZED STEEL, TYPICAL.



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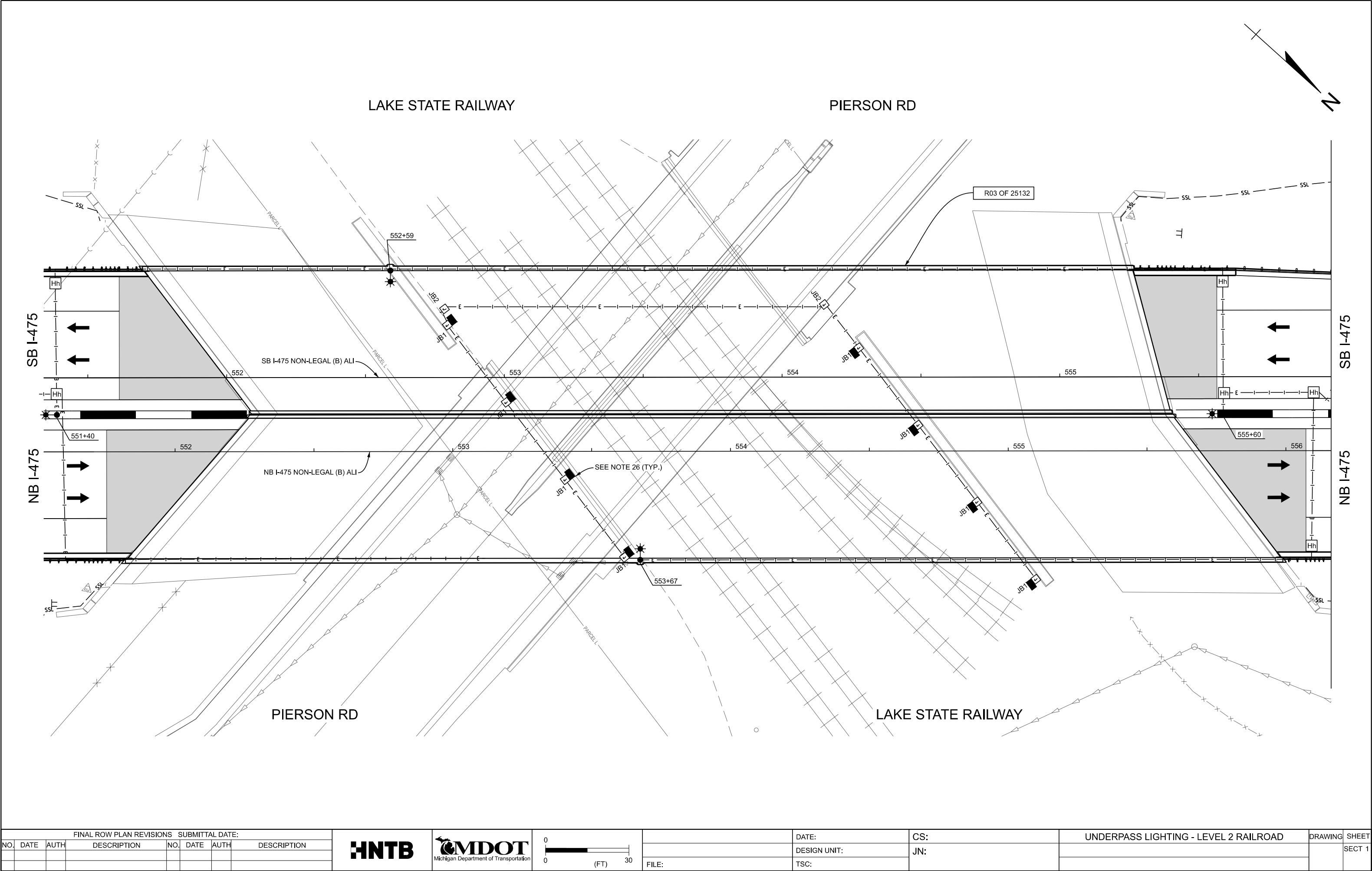


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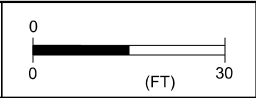
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UNDERPASS LIGHTING - LEVEL 1 X03 PIERSON	DRAWING	SHEET
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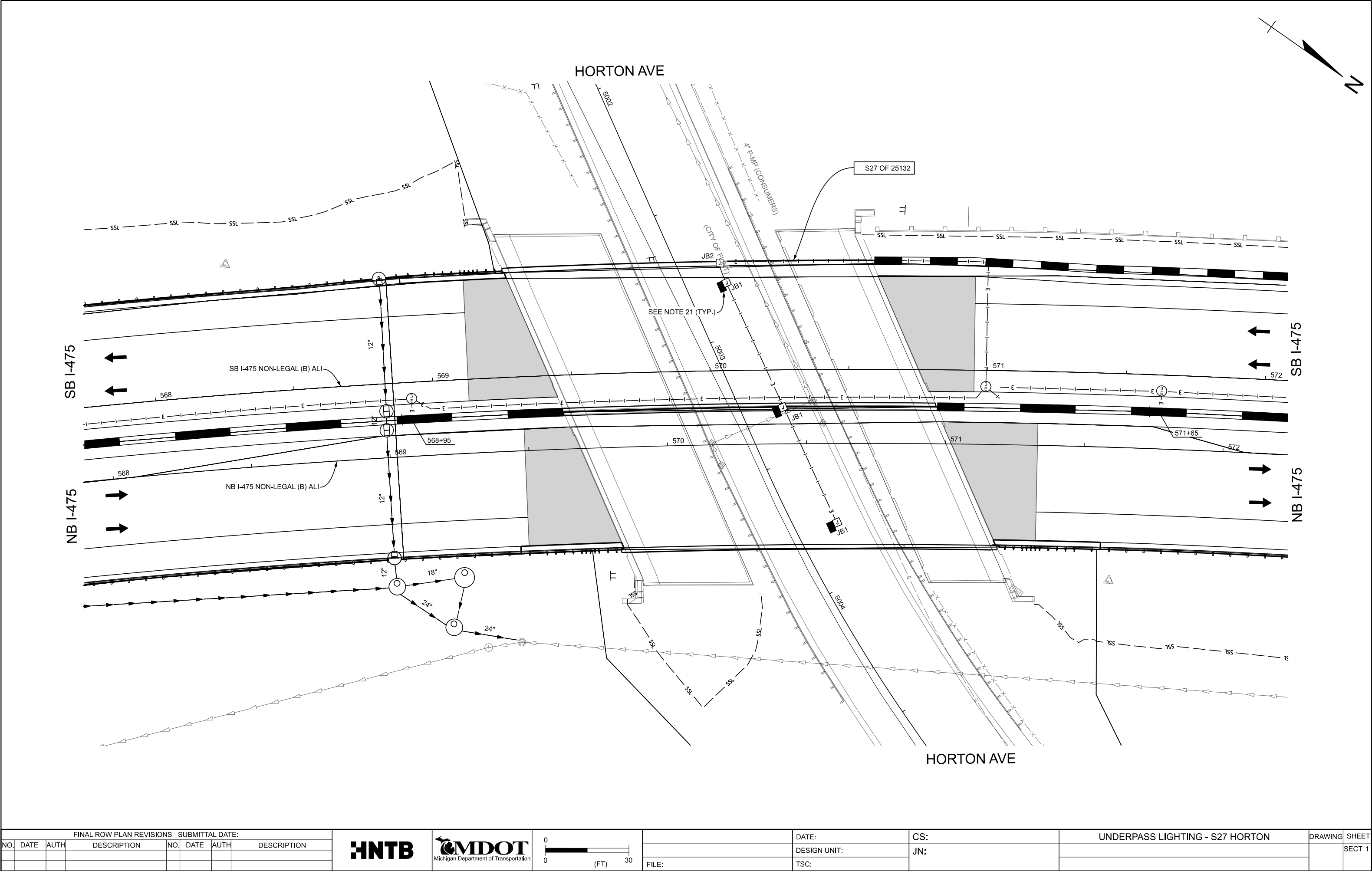
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UNDERPASS LIGHTING - LEVEL 2 RAILROAD

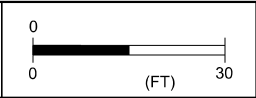
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SECT 1



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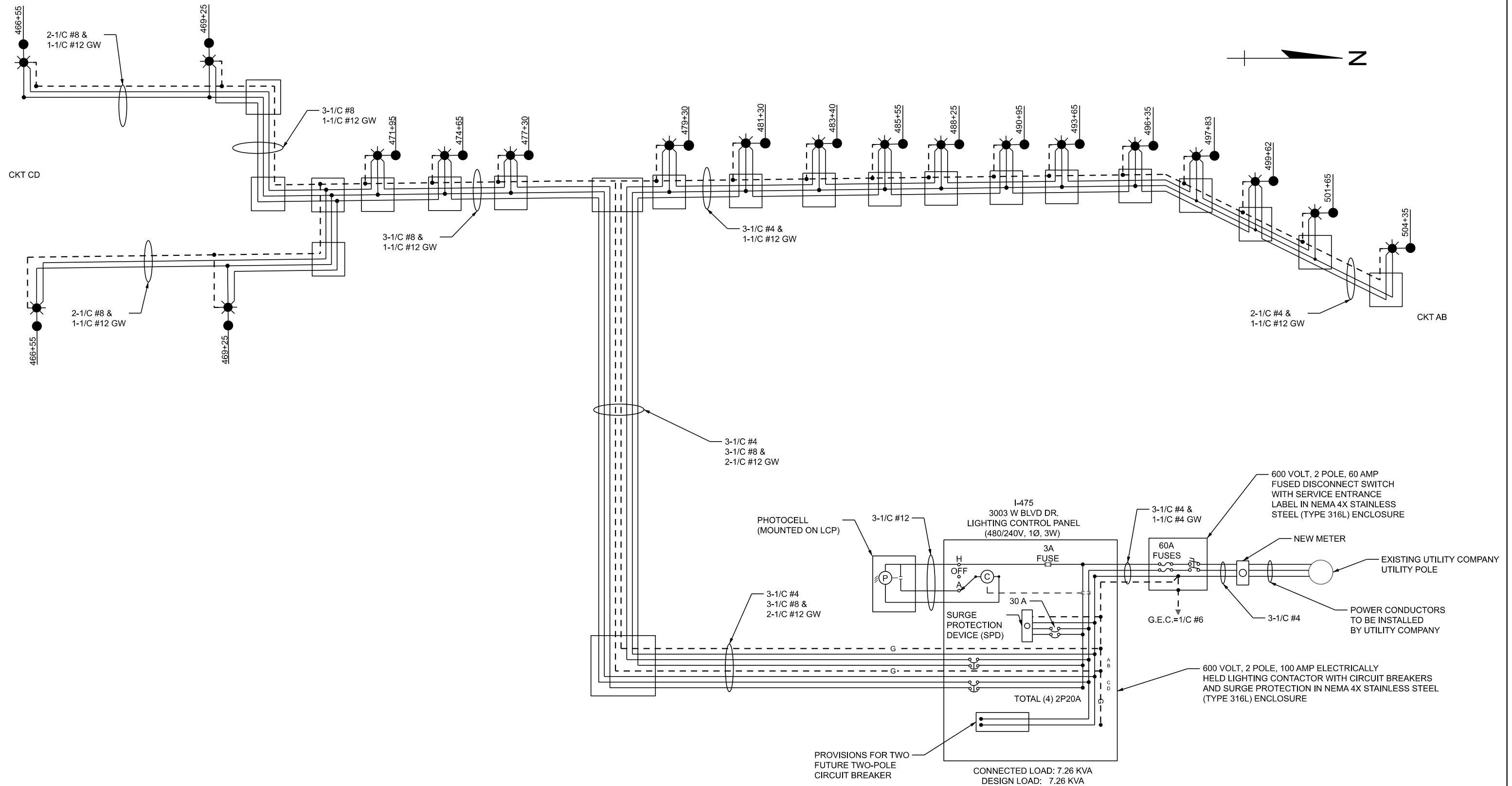
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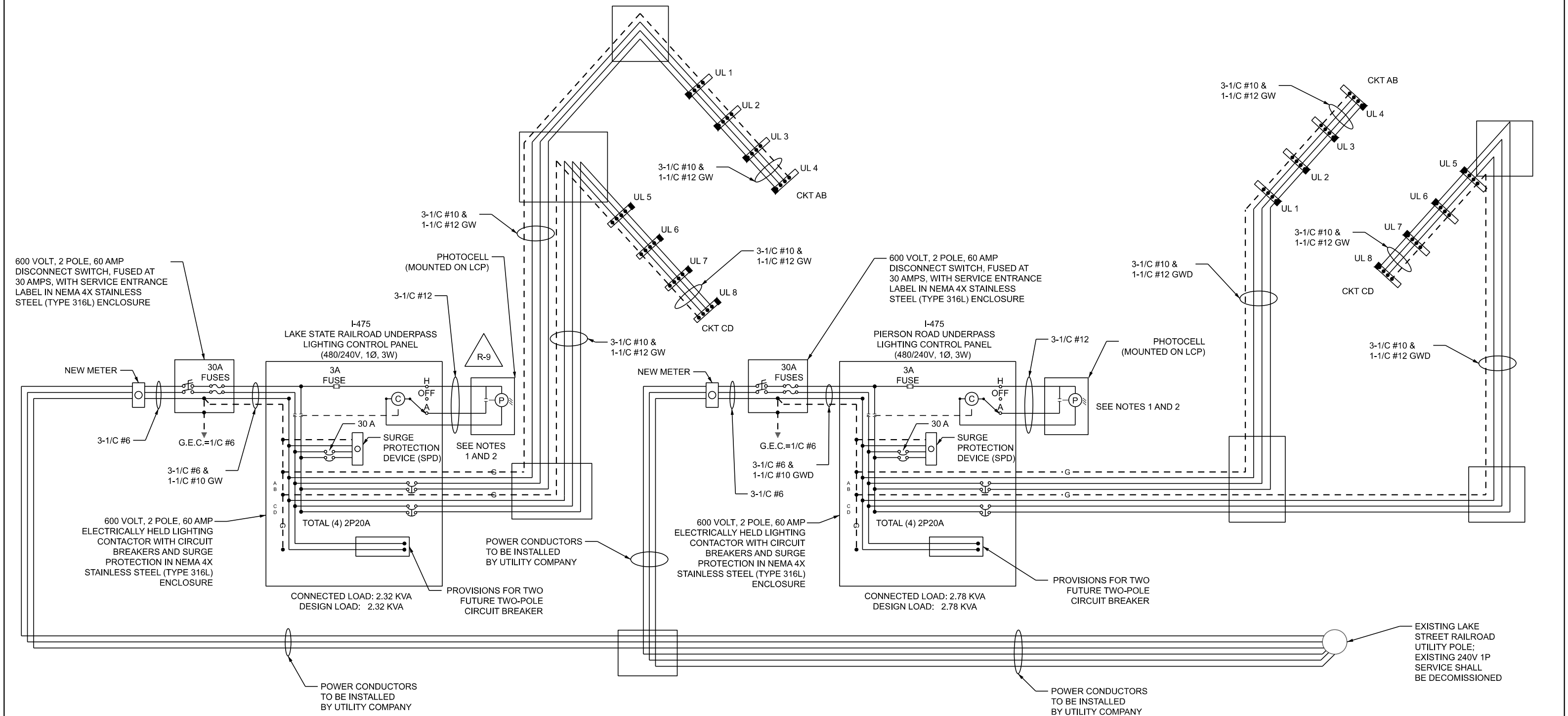
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UNDERPASS LIGHTING - S27 HORTON

DRAWING	SHEET
	SECT 1



- NOTES:
1. REPLACE CONTACTOR/RELAY COILS RATED FOR 480V WITH 240V COILS TO MATCH THE 240V LIGHTING CONTROLLER POWER SUPPLY.
 2. REPLACE PHOTOCCELL WITH UNIT RATED FOR 240V OR FOR A UNIVERSAL RANGE (E.G. 120-277V) THAT INCLUDES 240V.



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