# NOISE BARRIER WALL DESIGN GUIDELINES

**CS: Statewide**

# MICHIGAN NOISE BARRIER WALL
# DESIGN GUIDELINES

## Design Guidance Preamble

The proceeding design guidance serves as an aid to administrative, engineering, and technical staff. Engineering practice requires that professionals use a combination of technical skills and judgment in decision making. Engineering judgment is necessary to allow decisions to account for unique site-specific conditions and considerations to provide high quality products, within budget, and to protect the public health, safety, and welfare. This manual provides the general operational guidelines; however, it is understood that adaptation, adjustments, and deviations are sometimes necessary. Innovation is a key foundational element to advance the state of engineering practice and develop more effective and efficient engineering solutions and materials. As such, it is essential that our engineering manuals provide a vehicle to promote, pilot, or implement technologies or practices that provide efficiencies and quality products, while maintaining the safety, health, and welfare of the public. It is expected when making significant or impactful deviations from the technical information from these guidance materials, that reasonable consultations with experts, technical committees, and/or policy setting bodies occur prior to actions within the timeframes allowed. It is also expected that these consultations will eliminate any potential conflicts of interest, perceived or otherwise. MDOT Leadership is committed to a culture of innovation to optimize engineering solutions.

The National Society of Professional Engineers Code of Ethics for Engineering is founded on six fundamental canons. Those canons are provided below.

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform Services only in areas of their competence.
3. Issue public statement only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, reasonably, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession

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# INDEX

## 2.01

## INTRODUCTION

This guidance text addresses procedures involved in the design and plan preparation of noise barrier walls on the interstate/freeway, arterial, collector, and local road system governed by the Michigan Department of Transportation (MDOT).

A major portion of this text is devoted to design items that should be investigated for every project. However, other sections provide details on constructability, plan preparation, and involvement of other agencies affected by the noise barrier wall projects. In general, the Noise Barrier Wall Design Guidance is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of producing noise barrier wall plans.

The design of noise barrier walls in Michigan is based on the **MDOT Standard Specifications for Construction** and **AASHTO LRFD Bridge Design Specifications**. 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 Noise Barrier Wall Design Guidance 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.

## 2.01.01

**References**

**A. Noise Analysis and Abatement Handbook, MDOT**

**B. MDOT Standard Specifications for Construction**

**C. AASHTO LRFD Bridge Design Specifications**

**D. PCI Design Handbook**

**E. Drainage Manual, MDOT (Chapter 4)**

**F. Road Design Manual, MDOT**

**G. Geotechnical Manual, MDOT**

**H. Bridge Design Manual, MDOT**

**I. Special Provision for Structural Precast Concrete Noise Barrier Wall**

## 2.01.02

**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

FHWA .....Federal Highway Administration

LRFD .....Load and Resistance Factor Design

MASH .....Manual for Assessing Safety Hardware

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MDOT..... Michigan Department of Transportation

ROW..... Right-of-Way

**4D Rule** – The FHWA provides the 4D rule, which states that the overlap or termination distance of a barrier wall should equal 4 times the wall gap or the distance between the back of the wall and the last noise-sensitive receiver.

**Active Earth Pressure** - Lateral pressure resulting from the retention of the earth by a structure or component that is tending to move away from the soil mass.

**Appurtenances** - Barriers, signs, and miscellaneous structures used alongside noise barrier walls.

**Bolster** - A concrete spacer between the top of shaft and bottom of panel.

**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).

**Front side (of Wall)** – The side of wall facing the noise source (e.g., a roadway)

**Back side (of Wall)** – The side of wall facing opposite of the noise source (e.g., a private residence)

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

**Noise Barrier Wall** - A wall constructed along a roadway to reduce the noise level in areas behind the wall. May also be referred to as “Noise Wall” or “Sound Wall.”

**Noise Sensitive Receptor –** A discrete or representative location impacted by traffic noise.

**Post and Panel Noise Barrier Wall** - A type of noise barrier wall construction consisting of vertical posts supported on a structure or on foundations with panels spanning horizontally between adjacent posts.

**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.

## 2.02

## NOISE BARRIER WALL SITE PLANNING

Site planning of noise barrier walls must follow and account for specifications outlined in the **MDOT Road Design and Bridge Design Manuals.** Coordinate site planning with the project's noise analyst.

In scenarios where proper sizing, spacing, or placement of the wall do not satisfy the site's noise analysis, consider incorporating sound absorptive material. Design using sound absorptive material must be project specific and additional material loads must be accounted for.

## 2.02.01

### Wall Types

Various wall types and alternatives exist throughout Michigan. The proceeding sections provide brief information on these wall types and those that are preferred for ground mounted applications. Note that Appendix B - Guidelines for Noise Barrier Wall Plan Preparation only applies to the ground mounted precast concrete post and panel wall type. For information on wall types specific to bridge mounted applications, see the **Bridge Design Manual Section 7.02.30**. Design of other wall types must be separate and site-specific.

While various density materials are suitable for use as noise barriers, a minimum density of about 4 pounds per square foot is required to adequately prevent sound transmission through the material.

### A. Preferred Wall Types

Earth berms and ground mounted precast concrete post and panels are the preferred ground mounted noise barrier wall options in Michigan. These are briefly discussed as follows:

1. Earth Berm - If sufficient ROW exists to place an earth berm, consider its implementation into the project to minimize or eliminate the need for a structural wall and improve aesthetics.

The Engineer must follow noise analysis procedures laid out in the **Noise Analysis and Abatement Handbook** to confirm that placement of a berm will provide sufficient noise abatement in addition to or in place of a noise barrier wall.

In instances where a standalone earth berm provides sufficient noise abatement, it is preferred that the side slopes grade down towards the roadway at a slope of 3(H):1(V) to facilitate maintenance.

When earth berms are used in conjunction with a noise barrier wall, construct them with a 2' bench sloping at 5% away from the wall. This helps to prevent sloughing and helps inspectors traverse along the alignment of the wall. Additionally, side slopes grading down from the bench are preferred to have a slope of 3(H):1(V) to facilitate access and maintenance. The noise barrier wall requires site specific design in instances where a slope steeper than 3(H):1(V) is provided.

2. Ground Mounted Precast Concrete Post and Panel - Ground mounted precast concrete post and panels with drilled shafts serve as the primary option for newly constructed noise barrier walls in the state of Michigan. The standard design of these elements is using conventional reinforcement and based on a 20'-0" center-to-center post spacing and a wall height of 20'-0" measured from the top of the post to the top of the shaft.

### B. Alternative Wall Types

Consider alternative wall types in scenarios when their design and implementation is beneficial to a project. Alternatives are deemed acceptable upon approval by the Engineer and governing authority. The following list presents primary alternatives to consider:

1. Galvanized Steel Posts

2. Cast-In-Place Wall Elements

3. Prestressed Wall Elements

4. Alternate Wall Materials (e.g., Acrylic Noise Barrier Walls)

5. Spread footings in place of drilled shafts

### C. Historic Wall Types

Historically, Michigan has implemented some additional noise barrier wall types. However, new construction using these requires site specific design and approval from the governing authority. These are briefly discussed as follows:

1. Brick – Were proven to be a popular noise barrier wall material, especially in an urban setting. Typically consisted of concrete base walls with 4” thick clay brick wall laid on top, utilizing brick pilasters on the residence side for rigidity and strength. If the wall was placed back from the highway, the concrete base wall was typically omitted, and the wall would be constructed entirely of brick (though brick also requires a footing). These walls were found to be more expensive than concrete walls in initial costs and maintenance. Often requiring frequent aesthetic fixes such as replacement of bricks that have fallen off. Form liners for concrete can now provide the same aesthetic look with a reduced level of maintenance. A range of colors were available for these walls.

2. Metal - Metal noise barrier walls were an outgrowth of metal building construction. Their principal advantage was that they could be painted to almost any desired color, e.g., brown, if earth tones are desired. Their alignment could be easily jogged or could be built through or near trees that needed to be saved. For visual effects, their heights could be easily varied. They required more maintenance than concrete walls but were less expensive initially as they did not require full-length footings. Different color selections and textures were available.

3. Wood – Some of the earliest noise barrier walls were built of wood. Initially, there were visual problems because of the blotchy effect of the creosote preservative, and warpage of the boards created cracks that allowed the sound to go through the wall. More modern techniques called for water-borne and Penta preservatives, and panels were constructed of 2" x 6" lumber with double walled treated plywood. These panels could be 2' x 10', or 2' x 12'. Advantages of wood were that it was comparatively light, allowing its use for noise barrier walls on top of bridge railings, and it did not require full length footings.

4. Stab-in concrete panels - As the term implies, stab-in noise barrier walls were composed of precast concrete panels that had stability by virtue of having about one-third of their length embedded in the ground, thus eliminating the need for supporting H-beam columns. The panels were usually heavier than the simple panels used for precast concrete post and panels, preceding, and had tongue and grooved edges that allowed sealing of the joints. They required no foundation, and the height of the panels could be staggered. However, the required depth of embedment was not compatible with a concentration of underground utilities.

5. Concrete block - Concrete block was a rather economical alternate to other forms of concrete noise barrier walls. Blocks could be made rough on one side and smooth on the other or could be alternated to achieve a pattern. It was essential that water be kept out of the core holes, otherwise it would freeze and break off the block faces. One wall was constructed with a concrete block bottom and a wood wall higher up. Concrete block walls required full length footings. A wide range of colors and textures are available.

## 2.02.02

### 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:

1. Seek public input on color of coating and texture of form liners if a corridor-specific aesthetic is not already in place.

2. When color coating is desired, it is recommended that one-color systems be used, when possible, to ease future color matching and painting over graffiti.

3. Form flat or nearly flat surfaces for the tops of panels and posts. Consider a slight slope on the top of the post and top panel to encourage water runoff.

4. When form liners are used, liners must be stopped a minimum of 6" short of the top wall panel to create a coped look. The maximum depth of form liners must be limited to 2" to avoid unnecessary cost and weight of non-structural concrete.

## 2.02.03

### Right-of-Way Coordination

Place noise barrier walls 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.

## 2.02.04

### Drainage

Noise barrier walls must be accounted for in the project drainage design. Noise barrier walls act as a dam which can lead to water pooling at the wall, backing up into adjacent properties and leading to wall maintenance issues. Drainage design must follow the requirements and procedures in the **MDOT Drainage Design Manual**. Drainage features must implement soil erosion measures per the **Road Design Manual**. The following drainage features may be implemented to convey water through or away from the wall.

#### A. Ditching

Longitudinal ditching may be implemented along either side of the noise barrier wall. For ease of maintenance, side slopes of ditches are preferred to be graded at 3(H):1(V). The bottom width of ditches may vary with the longitudinal profile of the site.

In instances where the site's topography conveys water away from the wall, longitudinal ditching may not be required.

#### B. Drainage Structures

Drainage structures may be installed along the alignment of the wall when flooding is a concern. Location and size of these structures must be determined by the Engineer.

#### C. Raising Bottom Panels

Raising bottom panels creates a gap between the final grade noise barrier wall which allows water to flow through the wall. This option requires coordination with the noise analyst to ensure the wall provides proper noise abatement. Long-term maintenance of the gap

required for it to function as a drainage path must be considered.

## 2.02.05

### Appurtenances

#### A. Fire Hose Access

Provide fire hose access openings based on project specific needs. Coordinate with the local fire department during the design process. Details for the openings must be shown on the plans. Water lines must be coordinated with other project features.

#### B. Signs

Attachment of signage to noise barrier walls is heavily discouraged. If necessary, the design of noise barrier walls must account for all relevant loads from the signage. Signage must be located as to not interfere with the construction, inspection, or maintenance of the wall.

#### C. Fencing

Often when noise barrier walls are placed existing private property or ROW fencing is within the vicinity of the wall. Consider the presence of fencing and potential tie-ins to the wall during design.

## 2.02.06

### Construction Access

Assume a minimum of 10’-0” on each side of the CL of the noise barrier wall for construction related activities. Any temporary work outside the right-of-way requires a Consent and the Real Estate Services Section of the Development Services Division or Region Real Estate will determine just compensation for the Consent which is offered to the property owner. Clearly show temporary access limits on the design plans. For further details on ROW coordination, see **Section 2.02.03**.

Consider how the contractor will access the wall alignment from the roadway. Steep existing slopes may require constructing benches or haul roads.

## 2.02.07

### Inspection and Maintenance Access

Access for inspection and maintenance of the front side of the wall must be provided. Access to the back side of the wall is also preferred. In instances where backside access is being considered, coordination with MDOT’s real estate staff must take place.

See **Section 2.02.03** for additional information regarding ROW.

#### A. Wall Gaps and Required Termination Lengths

Location and width of wall gaps must be coordinated with the noise analyst. When determining the length of termination or overlap, follow the FHWA’s 4D Rule.

## 2.02.08

### Vegetation Trimming, Removal, and Placement

Coordinate with MDOT Roadside Development Design Unit and the Region Resource Specialists to determine landscape needs of trees and other sensitive vegetation early in the project development. Before doing so, establish tree removal counts. Coordination must take place no later than the preliminary plan review meeting.

Provide trimming of vegetation only in instances where its presence interferes with construction access. When vegetation comes in contact with the permanent wall it should be removed.

Avoid removal as much as possible. However, the removal plan must consider construction access to the wall alignment and the space along the horizontal alignment required to build the wall (see **Section 2.02.05**).

When placement of trees or vegetation is desired, place them so that their branches and roots will stay clear of the wall once fully mature and will not impede maintenance and inspection access to the wall. Because of this, small ornamental trees and columnar shape trees are preferred.

## 2.03

# NOISE BARRIER WALL LAYOUT

## 2.03.01

### Horizontal Alignment

The horizontal alignment of the wall must follow what has been prescribed by the site's noise analysis. 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.

For safety reasons, it is preferred that the horizontal alignment does not result in blunt edges. Consider this regardless of the wall's placement in relation to the roadway clear zone.

### A. Post Spacing and Panel Alignment Deviation

Place posts at a standard center to center spacing of 20'-0".

Place panels so that their centerline does not deviate more than 6-degrees from the centerline of the post. This deviation results in a minimum allowable radius of approximately 95' for the horizontal wall alignment.

Larger deviation angles may be used when permitted by the Engineer and governing agency. If larger angles are to be used, keep deviations in 45 and 90-degree increments to assist with fabrication and construction.

### B. Adjustments for Roadways/Driveways

Consider intersecting roadways and driveways during the design phase. When these obstructions interfere with the 4D Rule, the designer must coordinate with the noise analyst on the adjustment of wall termination locations.

### C. Adjustments for Underground Obstructions

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

Add notes to design plans to emphasize the contractor's responsibility to locate utilities and provide the preferred clearances of the utility owner prior to construction.

## 2.03.02

### Clear Zone

Locate noise barrier walls outside of the upper bound clear zone distance specified in the **Road Design Manual** when feasible. The preferred location is 3'-0" from the right-of-way line. Locating the wall this distance from the ROW limits the space behind the wall requiring maintenance. Additionally, the 3'-0" offset provides room for the following features used on typical projects:

1. Drilled shaft foundations.

2. Drainage structures along the back side of the wall if needed.

3. Grading and erosion control measures behind the wall.

When none of these conditions are present, the back of the wall may be placed as close to the ROW line as the geometry of the foundation will allow.

In instances where site topography or noise abatement requires installation within the clear zone, one of the following protection methods must be met:

4. If the noise barrier wall is to be placed greater than 12' from the travel way, guardrail

protection is recommended for the protection of the motorist as appropriate per Chapter 7 of the **Road Design Manual**.

5. If the noise barrier wall is to be placed 12’ or closer to the travel way, concrete barrier (per Standard Plan R-54 Series) is recommended for protection of the motorist. While placement of the noise barrier wall 12’ or closer to the traveled way is an option, it is not desirable. When installing concrete barrier, the noise barrier wall face must be a minimum of 3’-3” from the top of the traffic face of the barrier. In addition, a 4” sidewalk section with subbase and foundation drainage must be provided between the barrier and the noise barrier wall. Place the top of the sidewalk section at the same elevation as the top of the concrete barrier, sloping away from the noise barrier wall.

Noise barrier walls located ≤4’ from the traffic face of the barrier must be designed for vehicle impact per **AASHTO LRFD Bridge Design Specifications**.

For details regarding roadside safety barriers, see the **Road Design Manual**.

Consider roadway snow removal storage in regard to noise barrier wall placement and barriers.

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

## 2.03.03

### Vertical Alignment

The top of wall must meet or exceed the acoustic profile obtained from procedures outlined in the **Noise Analysis and Abatement Handbook**.

Concrete panels are typically detailed as either 2ft or 4ft tall. Therefore, the height of the wall must be kept to 2ft increments.

Minimize steps in the top of the wall. More infrequent but larger steps are preferred to many smaller steps. Do not stepthe beginning or end of the wall’s layout.

Embed the bottom of the panels a minimum of 6”. Cast-in-place concrete bolsters are used at each shaft to step panels if necessary. Bolsters do not need to be standardized for a given project. Set bolster heights as needed to minimize the overall wall area and to meet the provisions noted above.

## 2.04

## STRUCTURAL DESIGN

## 2.04.01

### Foundation Types

Review historic structure borings before new borings are obtained. If poor soils are shown, the Engineer must coordinate with the noise analyst during the Base Plan phase to ensure the design stays within the cost threshold specified in the **Noise Analysis and Abatement Handbook**.

New soil borings must be obtained along the proposed alignment of the noise barrier wall consistent with the requirements in the **Geotechnical Manual**.

### A. Drilled Shafts

Drilled shafts serve as the standard foundation type for noise barrier walls. See Appendix A – Drilled Shaft Tables for standard drilled shaft designs and for drilled shaft design assumptions. Confirm with the project geotechnical engineer whether casing is recommended. Standard designs are provided in Appendix A for typical posts, not for corner posts or posts where the panel deviation is greater than that shown on the details in Appendix B – Guidelines for Noise Barrier Wall Plan Preparation. Those posts require a site-specific design.

### B. Spread Footings

Spread footings may be considered as an alternative to drilled shafts when the following conditions exist:

1. Competent bearing stratum, as defined by the geotechnical engineer, exists within 5 feet of the ground surface along the wall alignment and foundations will not bear on or within undocumented fills. Competent bearing stratum identified in soil borings must be verified as representative through hand auger borings during construction and other construction testing.

2. Total estimated settlement is less than 1” for the design life of the structure.

3. Differential settlement is estimated to be less than 0.75” between consecutive posts for the design life of the structure.

4. No existing underground utilities or historically abandoned underground utilities are located within the foundation footprint, or within 5 feet laterally in all directions beyond the limits of the foundation excavation.

5. Support excavations to protect existing pavement or other features from damage such as undermining, excessive settlement, or lateral deflection.

Use of spread footings must be approved by MDOT Geotechnical Services Section during the Preliminary Plan phase.

## 2.04.02

### Design Specifications

Noise barrier walls in Michigan must be designed according to the current edition of the **AASHTO LRFD Bridge Design Specifications.**

## 2.04.03

### Loadings

Noise barrier walls must be designed for the loadings and load combinations required by the **AASHTO LRFD Bridge Design Specifications** and the **PCI Design Handbook** for handling, hauling, and lifting. The posts, panels, and foundations must be designed for a load case where the entire height of the wall from top of foundation upwards is subject to wind load and a case where the soil on one side of the wall is 2’-0” higher than the other side.

For handling, hauling, and lifting checks, assume the component to be supported at the locations of lifting devices and apply an equivalent static load multiplier of 1.5 to the component weight in Service and Strength Cases in addition to the load factors to account for dynamic effects.

Avoid designing ground mounted noise barrier walls for vehicle impact. Locate them outside of the clear zone or protected if located inside the clear zone. If design for vehicular impact is absolutely necessary, walls must be designed for the specific needs of the project. Follow the **AASHTO LRFD Bridge Design Specifications** for Vehicle impact design

### A. Sound Absorptive Material

When sound absorptive material is used, its weight must be accounted for in the design of wall components.

## 2.04.04

### Handling, Hauling, & Lifting

Include plan notes requiring concrete panels to be shipped, stored, and handled in the upright position. This prevents excess cracking in the panels. Show lifting devices in the panels and posts near the ¼ points.

## 2.04.05

### Deflection Limits

Analyze deflection using the Service load combinations per the **AASHTO LRFD Bridge Design Specifications**. The following limits for ground mounted walls must be checked:

The top of post deflection, including the translation and rotation of the foundation, must be less than H/100, where H is measured from the top of the foundation to the top of the wall.

The maximum horizontal deflection of any panel with respect to the posts must be less than L/240, where L is measured as the clear distance of the panel between posts. The calculated panel deflection need not include deflection of the posts or the foundation.

The horizontal deflection at the top of the foundation must be less than 1”.

## 2.04.06

### Structural Details

Recommended details are shown in the Noise Barrier Wall Sample Plans provided in Appendix B.

### A. Foundation Anchorages

The preferred foundation anchorage detail is to embed the posts into the foundation a minimum of 6’-0”. Additional transverse shear reinforcement must be provided in the embedment zone.

Post-to-foundation connections using anchor bolts are prohibited.

### B. Bolsters

Design bolsters following the detail shown in Appendix B – Guidelines for Noise Barrier Wall Plan Preparation.

## 2.05

## PLAN PREPARATION

### 2.05.01

**Naming Noise Barrier Walls**

Noise barrier wall plans must use the naming convention "NW-XXXXXX" where NW-XXXXXX is the ID of the noise barrier wall. Designers must contact the MDOT Ancillary Structures program after the Base Plan Review Meeting to confirm the name of all noise barrier walls on the project.

Additionally, each noise barrier wall for a given project must be assigned their own funding category. Confirm funding categories with MDOT during the Base Plan Review Meeting.

### 2.05.02

**Preliminary Plan Composition**

Use the following list and ordering of sheets for the Preliminary Plan stage of noise barrier wall projects. This list assumes no major work aside from the wall is included in the project:

A. Title Sheet

B. Project Information Sheet

C. Legend Sheet

D. Note Sheet

E. Survey Information

F. Noise Barrier Wall Plan and Profile*

*Use Appendix B – Guidelines for Noise Barrier Wall Plan Preparation as a reference for these sheets.

At the Preliminary Plan stage the noise barrier wall plan and profile sheet must convey the wall alignment, wall profile, and proposed wall type at a minimum. If multiple wall types are used, call out in the wall profile view with lengths of each type shown.

### 2.05.03

**Final Plan Composition**

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

A. Title Sheet

B. Project Information Sheet

C. Legend Sheet

D. Note Sheet

E. Miscellaneous Quantities

F. Typical Cross Sections

G. Miscellaneous Details

H. Survey Information

I. Alignment

J. Noise Barrier Wall Plan and Profile*

K. Noise Barrier Wall Details*

L. Maintenance of Traffic

M. Soil Boring Data*

*Use Appendix B – Guidelines for Noise Barrier Wall Plan Preparation as a reference for these sheets.

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

### 2.05.04

**Structural Details**

Use the structural details provided in Appendix B – Guidelines for Noise Barrier Wall Plan

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Preparation as a template when preparing noise barrier wall plans. 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.

Apply the details to instances where concrete post and panel walls supported on drilled shafts are proposed. Details are shown for a 20ft maximum post spacing and 20ft maximum wall height (measured from top of shaft to top of highest panel). When post spacing or wall height exceed these limits, site specific design is required.

Provide conventionally reinforced section details. Use epoxy coated reinforcing steel above ground. Reinforcing steel below ground may be left uncoated.

If alternative details are proposed, it is preferred that mild reinforced sections be used. However, prestressed sections may be utilized upon approval from the Engineer.

MDOT requires a 75-year service life for noise barrier walls.

## APPENDIX A – DRILLED SHAFT TABLES

The following assumptions were made for lateral and axial analyses:

1. Loads at the top of foundation were calculated per the loading criteria provided in Section 1.04.03 of the Noise Barrier Wall Design Guidelines.
2. Service loads were utilized for evaluating settlement and lateral deflection.
    a. Maximum tolerable foundation settlement of 1 inch.
    Maximum tolerable lateral deflection of 1 inch at top of foundation.
3. To evaluate minimum required foundation depth to resist axial loads, 100 percent of factored axial side resistance plus 30 percent of the factored axial end bearing resistance was utilized, and the foundations were assumed to have permanent casing or temporary casing-left in place.
4. An additional factor of 0.75 was applied to the nominal axial side resistance to account for permanent casing or temporary casing-left in place.
5. Resistance factors for axial evaluation:
    a. 0.45 for clay and 0.55 for sand for frictional resistance to axial compressive load
    b. 0.40 for clay and 0.50 for sand and for end bearing resistance to compressive load
6. The foundations were modeled as uncased concrete for lateral loading.
7. Drilled shaft diameter will be 42 inches. A maximum stickup of 3 inches above ground line was assumed. Foundation lengths were measured from top of drilled shaft, and not from ground line.
8. Analysis assumed vertical reinforcement consisting of 11 #9 bars (approximately one percent of drilled shaft volume).
    a. Reinforcing bars were assumed to have yield strength of 60 ksi and an elastic modulus of 29,000 ksi.
9. The 28-day compressive strength (f'c) of the drilled shaft concrete was assumed to be 3,000 psi.
10. The P-y curves used for the lateral analysis will be the default P-y curves provided in the LPile software.
    a. 1,000 cycles of loading were assumed.
11. Ground surface was modelled as both flat (horizontal) and inclined at 18.43 degrees (3H:1V).
12. Groundwater was assumed at a depth of 3 feet below ground surface.
13. Soil resistance in the upper 3.5 feet of the profile has been modeled as disturbed soil consisting of low strength sand for all cases in accordance with LRFD design updates developed for the 2023 traffic signal foundation standards. The soil properties applied in the upper 3.5 feet are summarized below in Table 1:

**Table 1 - Summary of Disturbed Soil Parameters**

| Depth Range (feet) | Lpile P-y curve | Effective Unit Weight (pcf) | Effective Friction Angle (Degrees) | Horizontal Modulus of Subgrade Reaction (pci) |
|---|---|---|---|---|
| 0.25 to 3.25 | Sand (Reese) | 100.0 | 28 | 5 |
| 3.25 to 3.75 | Sand (Reese) | 38.0 | 28 | 5 |

14. Soil categories below a depth of 3.5 feet are consistent with the current designs such as the Strain Pole Foundation Chart, SIG-DESIGN-153-A (dated 02/15/11), and as noted below in Table 2. These soil properties were applied to soil below a depth of 3.5 feet. Effective unit weights are used below the groundwater depth.

**Table 2 - Soil Property Summary for Soils below 3.5 feet**

| Soil Category | Soil Condition | | Total Unit Weight[C] (pcf) | Effective Friction Angle (Degrees) | Horizontal Modulus of Subgrade Reaction[D], k (pci) | Modeled Undrained Shear Strength (psf) | Strain at 50% Stress | Lpile P-Y Curve Utilized |
|---|---|---|---|---|---|---|---|---|
| | $S_u$[A] (psf) | $N_{60}$[B] (bpf) | | | | | | |
| Low Sand | NA[E] | $5 \leq N_{60} < 10$ | 105 | 28 | 20 | NA[E] | NA[E] | Sand (Reese) |
| Medium Sand | NA[E] | $10 \leq N_{60} < 20$ | 114 | 30 | 60 | NA[E] | NA[E] | Sand (Reese) |
| High Sand | NA[E] | $N_{60} \geq 20$ | 120 | 32 | 75 | NA[E] | NA[E] | Sand (Reese) |
| Low Clay | $500 \leq S_u < 1000$ | NA[E] | 120 | NA[E] | NA[E] | 500 | 0.01 | Soft Clay |
| Medium Clay | $1000 \leq S_u < 2000$ | NA[E] | 125 | NA[E] | NA[E] | 1000 | 0.007 | Stiff Clay without Free Water |
| High Clay | $S_u \geq 2000$ | NA[E] | 130 | NA[E] | NA[E] | 2000 | 0.006 | Stiff Clay without Free Water |

Footnotes:
A) $S_u$ = Undrained Shear Strength in Cohesive Soils (psf)
B) $N_{60}$ = Standard Penetration Resistance (blows/foot determined in accordance with ASTM D1586), corrected to 60 % hammer efficiency utilizing the hammer's calibration energy
C) Effective unit weight will be used below groundwater elevation
D) Assumes soil is below groundwater elevation
E) NA = Not Applicable

**MICHIGAN NOISE BARRIER WALL**
**DESIGN GUIDELINES**

Additional Analysis Notes:

1. Axial capacity analysis was performed for the lower bound undrained shear strength for each cohesive soil category and the lower bound N60 value for each granular soil category.
2. Per AASHTO 10.8.3.5.2b-4 for each cohesionless soil category, an m coefficient of 0.6 was assumed. Analysis was completed with and without the resistance factor for casing reduction.
3. Lateral analyses were performed based on foundation lengths determined by the axial analysis results.

**MICHIGAN NOISE BARRIER WALL**
**DESIGN GUIDELINES**

| Granular Soil Foundation Depth Table | | | | | |
|---|---|---|---|---|---|
| Post Spacing = 20ft | | Shaft Diameter (in) | Soil Type | Soil Condition N60 (bpf) | Foundation Depth (ft) |
| Wall Height (ft) | 10 | 42 | Low Sand | 5 ≤ N60 < 10 | 24.5 |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 18.0 |
| | | 42 | High Sand | N60 ≥ 20 | 13.0 |
| | 12 | 42 | Low Sand | 5 ≤ N60 < 10 | 27.5 |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 21.0 |
| | | 42 | High Sand | N60 ≥ 20 | 15.0 |
| | 14 | 42 | Low Sand | 5 ≤ N60 < 10 | 30.5 |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 23.0 |
| | | 42 | High Sand | N60 ≥ 20 | 17.0 |
| | 16 | 42 | Low Sand | 5 ≤ N60 < 10 | 34.0 |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 25.0 |
| | | 42 | High Sand | N60 ≥ 20 | 18.5 |
| | 18 | 42 | Low Sand | 5 ≤ N60 < 10 | 37.0 |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 27.5 |
| | | 42 | High Sand | N60 ≥ 20 | 20.5 |
| | 20 | 42 | Low Sand | 5 ≤ N60 < 10 | *Site Specific |
| | | 42 | Medium Sand | 10 ≤ N60 < 20 | 30.0 |
| | | 42 | High Sand | N60 ≥ 20 | 22.0 |

**Notes:**

* Site Specific Design is required for scenarios where soil type or stratigraphy differs from standard soil categories shown or foundation depth exceeds 40ft based assumptions provided in Appendix A - Drilled Shaft Tables of the Noise Barrier Wall Design Guidance

Shaft diameters shown assume permanent casing or temporary casing-left in place is included.

The table above is based on ground slopes from level 3(H):1(V). Ground slopes steeper than 3(H):1(V) will require site specific design.

Foundation depth shown in table assumed to extend below top of shaft.

**MICHIGAN NOISE BARRIER WALL**
**DESIGN GUIDELINES**

| Cohesive Soil Foundation Depth Table | | | | | |
|---|---|---|---|---|---|
| Post Spacing = 20ft | | Shaft Diameter (in) | Soil Type | Soil Condition: Su (psf) | Foundation Depth (ft) |
| Wall Height (ft) | 10 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | 21.5 |
| | | 42 | High Clay | Su ≥ 2000 | 11.5 |
| | 12 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | 25.5 |
| | | 42 | High Clay | Su ≥ 2000 | 13.0 |
| | 14 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | 29.5 |
| | | 42 | High Clay | Su ≥ 2000 | 15.0 |
| | 16 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | 33.5 |
| | | 42 | High Clay | Su ≥ 2000 | 17.0 |
| | 18 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | 37.5 |
| | | 42 | High Clay | Su ≥ 2000 | 19.0 |
| | 20 | 42 | Low Clay | 500 ≤ Su < 1000 | *Site Specific |
| | | 42 | Medium Clay | 1000 ≤ Su < 2000 | *Site Specific |
| | | 42 | High Clay | Su ≥ 2000 | 21.0 |

**Notes:**

* Site Specific Design is required for scenarios where soil type or stratigraphy differs from standard soil categories shown or foundation depth exceeds 40ft based assumptions provided in Appendix A - Drilled Shaft Tables of the Noise Barrier Wall Design Guidance

Shaft diameters shown assume permanent casing or temporary casing-left in place is included.

The table above is based on ground slopes from level 3(H):1(V). Ground slopes steeper than 3(H):1(V) will require site specific design.

Foundation depth shown in table assumed to extend below top of shaft.

Top 5 feet of soil profile neglected for axial side resistance for clay soils per AASHTO section 10.8.3.5.1b

# APPENDIX B – GUIDELINES FOR NOISE BARRIER WALL PLAN PREPARATION

# GUIDELINES FOR NOISE BARRIER WALL PLAN PREPARATION

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## PURPOSE AND APPLICATION

This set of sample plans is intended for use as a guideline for preparing a set of noise barrier wall construction plans for the Michigan Department of Transportation. The examples of various sheets illustrate preferred techniques to ensure the uniformity, quality, and continuity of plans.

The Noise Barrier Wall Details sheets (NW DET 001 through 007) show preferred structural details. CAD files for these drawings should be downloaded from the following link and must be reviewed and adjusted as needed for individual projects. This includes but is not limited to, the aesthetic and drainage details for which the details shown are only placeholders and must be updated and/or expanded to fully show all required information for each noise barrier wall in a project.
<need link to MDOT website>

Other sheets are examples of various plan sheets, based on the most commonly occurring situations. However, it is recognized that some projects will have unusual circumstances that may allow for some variations from the preferred techniques contained herein.

This set is not to be considered or used as a single, coordinated plan, but as a collection of individual sheet types. In many cases, copies of actual plan sheets have been used to develop the sheets contained herein. Since modifications have been made to those sheets to develop an appropriate sample, they are not to be considered an official record of the plans from which they were taken.

Where the information shown on the sample plan sheets is in conflict with the design standards or practices of Michigan Department of Transportation as contained in its standard Specifications for Construction special provisions, design manuals or design standards, the standards and practices supersede any sample plan sheet information.

Boxed numbers refer to the plan guidelines located on the plan Guidelines Sheet at the beginning of each section.

See MDOT Guidelines for Bridge Plan Preparation for general plan preparation guidelines not specific to noise barrier walls such as guidelines for sheet layout, text, dimensions, plan notes, etc.

See MDOT Guidelines for Plan Preparation for guidelines related to sheets not specific to noise barrier walls such as survey, alignment, and typical section sheets.

Errors and omissions can be reported to MDOT-Ancillary@Michigan.gov.

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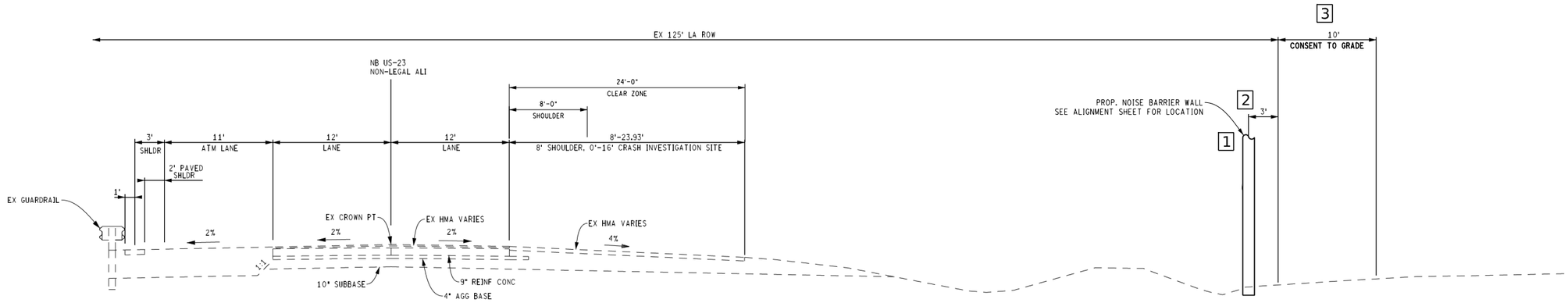


PROP NORMAL SECTION

SECTION APPLIES TO:
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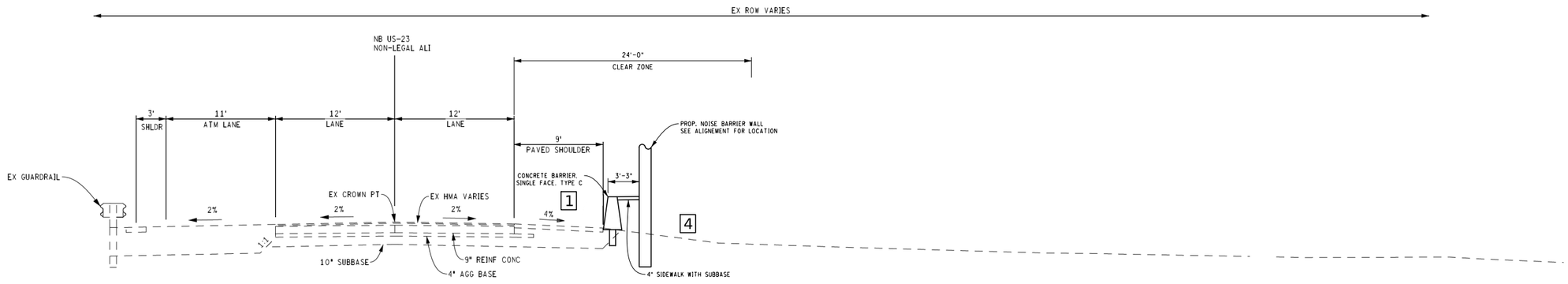
SW01 OF 47013 NON-LEGAL ALI STA 5012+67.11 TO STA 5016+23.00




PROP NORMAL SECTION

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SW01 OF 47013 NON-LEGAL ALI STA 5020+21.54 TO STA 5027+00.00

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| PRTYP 001 | SECT 1 |

## TYPICAL SECTIONS

1. Place noise barrier walls outside of the clear zone. When this is not feasible provide protection as described in Section 1.03.02.

2. The preferred location of the wall centerline is 3'-0" from the existing right-of-way line. This allows for installation of drilled shaft foundations, drainage structures, or grading and erosion control measures behind the wall. When none of these conditions are present, the wall may be placed as close to the right-of-way line as the foundation installation will allow.

3. Design plans should assume a minimum of 10'-0" on each side of the CL of the noise barrier wall is required for construction related activities.

4. Slopes no steeper than 3H:1V are preferred to facilitate access and maintenance.

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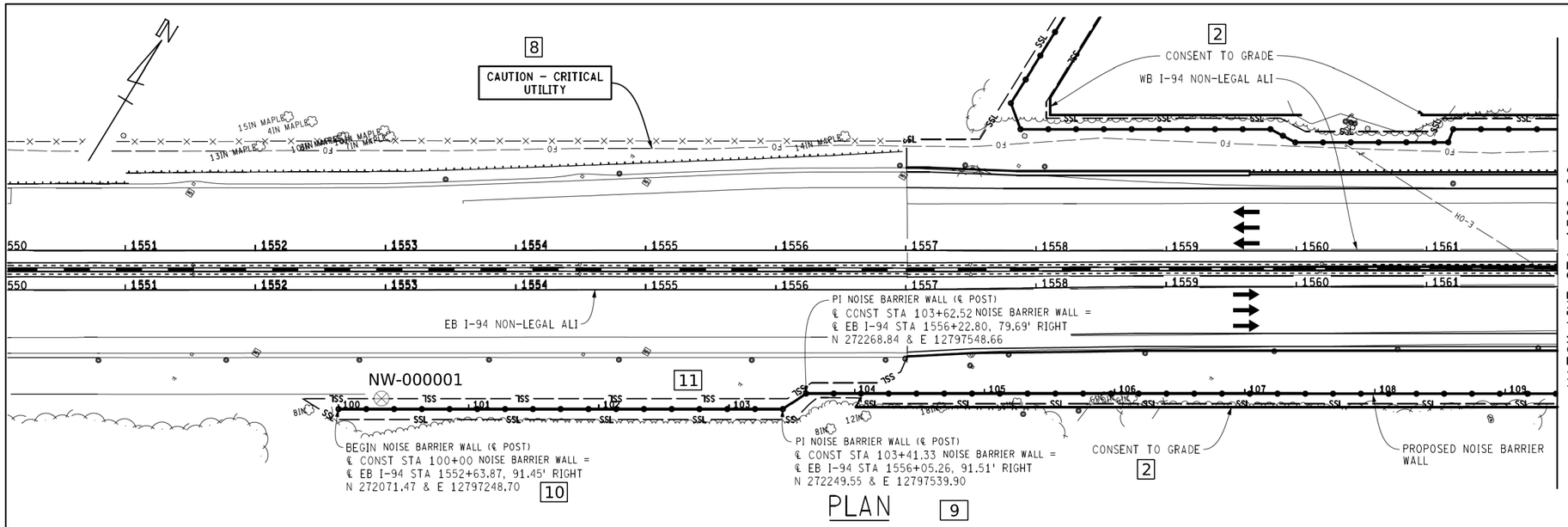
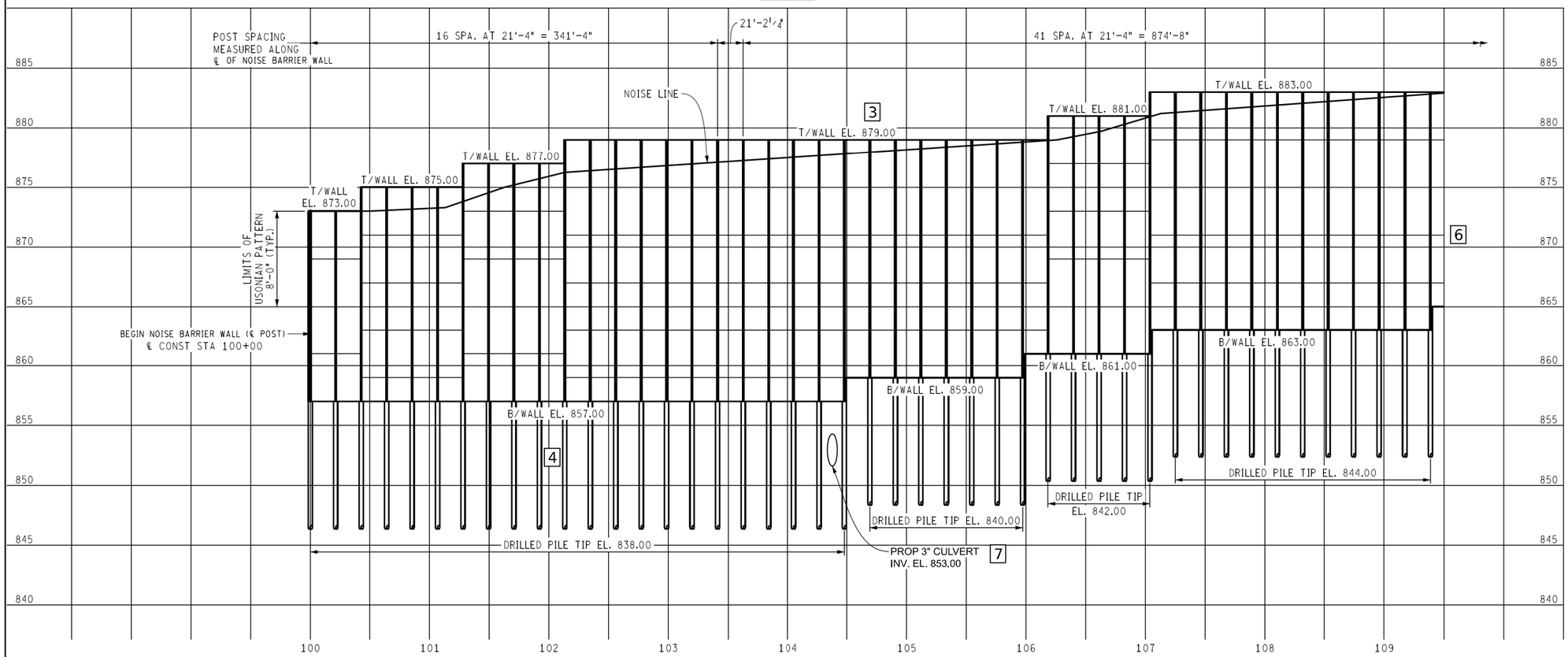



PLAN 9




PROFILE

(USONIAN PATTERN NOT SHOWN FOR CLARITY)

## MISCELLANEOUS QUANTITIES

| CAT 0001 AMOUNT | CAT 0006 AMOUNT | UNIT | Item |
|---|---|---|---|
| - | 1 | LSUM | Structures, Rem Portions (NW-000001 of 39002) |
| - | 1 | LSUM | Drilled Shaft Equipment, Furnished (NW-000001 of 39002) |
| - | 7800 | Cyd | Backfill, Structure, CIP |
| - | 7800 | Cyd | Excavation, Fdn |
| - | 554 | Ft | Underdrain, Fdn, 4 inch |
| 40 | - | Ft | Underdrain Outlet, 4 inch |
| 2 | - | Ea | Underdrain Outlet Ending, 4 inch |
| 8585 | - | Ft | Fence, Temp |
| - | 2144 | Cyd | Substructure Conc, High Performance |
| - | 126 | Sft | Wall Drain |
| - | 466 | Syd | Texturing Conc |
| - | 168686 | Sft | Noise Barrier Wall, Precast Conc, Erect |
| - | 168686 | Sft | Noise Barrier Wall, Precast Conc, Furn |
| - | 270 | Sft | Joint Waterproofing |
| - | 1 | LSUM | Conc Surface Coating, Warranty (NW-000001 of 39002) |
| - | 7410 | Ft | Drilled Shaft, 42 inch |
| - | 7410 | Ft | Temp Casing-Left in Place |
| - | 1 | LSUM | Monitoring Structure (NW-000001 of 39002) |
| - | 62,325 | Lb | Reinforcement, Steel |
| - | 2 | Cyd | Conc, Grade 3500 |

NOTES:

THE WORK COVERED BY THESE PLANS INCLUDES REMOVAL OF THE EXISTING NOISE WALLS AND CONSTRUCTION OF THE PROPOSED NOISE WALLS AND DRILLED SHAFTS. ALL OTHER WORK IS INCLUDED IN THE ROAD PLANS THAT ARE PART OF THIS CONTRACT.

THE DESIGN OF THIS NOISE BARRIER IS BASED ON CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS WIND EXPOSURE C AND 115 MILE PER HOUR WIND LOADING.

PRIOR TO WORKING DRAWING DEVELOPMENT, THE CONTRACTOR SHALL LOCATE ALL ACTIVE UNDERGROUND UTILITIES PRIOR TO STARTING WORK AND SHOP DRAWING DEVELOPMENT AND SHALL CONDUCT HIS OPERATIONS IN SUCH A MANNER AS TO ENSURE THAT THOSE UTILITIES NOT REQUIRING RELOCATION WILL NOT BE DISTURBED. ADJUST POST SPACING IF NECESSARY TO AVOID CONFLICTS WITH UTILITIES. PAYMENT FOR ADJUSTING POST SPACING IS INCLUDED IN THE PAY ITEM "NOISE BARRIER WALL, PRECAST CONC, FURN".

FIELD MEASURE LOCATIONS OF EXISTING NOISE WALL FOUNDATIONS PRIOR TO SHOP DRAWING CREATION TO CONFIRM THAT THERE ARE NO CONFLICTS WITH PROPOSED DRILLED SHAFTS. ADJUST NOISE WALL POST SPACING PRIOR TO WORKING DRAWING SUBMITTAL, AS APPROVED BY THE ENGINEER, TO AVOID ANY CONFLICTS THAT ARE IDENTIFIED (INCLUDED IN THE PAY ITEM "NOISE BARRIER WALL, PRECAST CONC, FURN").

PLACE TEMPORARY FENCE ALONG THE RIGHT-OF-WAY OR CONSENT-TO-GRADE, WHICHEVER IS CLOSEST TO RESIDENTIAL PROPERTY, AND AS DIRECTED BY THE ENGINEER TO SECURE THE PERIMETER OF THE PROJECT.

REMOVAL OF THE EXISTING NOISE WALLS INCLUDES REMOVAL OF THE EXISTING NOISE WALL PANELS, CUTTING OFF AND REMOVING STEEL/CONCRETE POSTS AND PORTIONS OF THE CONCRETE FOUNDATIONS. DO NOT REMOVE ENTIRE CONCRETE FOUNDATIONS UNLESS OTHERWISE APPROVED BY THE ENGINEER. REMOVE EXISTING POSTS AND FOUNDATIONS TO 6 INCHES BELOW THE BOTTOM OF PROPOSED NOISE WALL PANELS. REMOVALS ARE INCLUDED IN THE PAY ITEMS "STRUCTURES, REM PORTIONS (NOISE WALLS)"

ALL LABOR, EQUIPMENT AND MATERIALS REQUIRED TO RESOLVE CONFLICTS BETWEEN THE EXISTING NOISE WALLS AND THE PROPOSED NOISE WALLS WILL NOT BE PAID FOR SEPARATELY BUT INCLUDED IN THE PAY ITEM "STRUCTURES, REM PORTIONS (NOISE WALLS)".

SEE ROAD PLANS FOR SOIL EROSION AND SEDIMENTATION CONTROLS.

SEE ROAD PLANS FOR VERTICAL EXPLORATORY INVESTIGATION.

13

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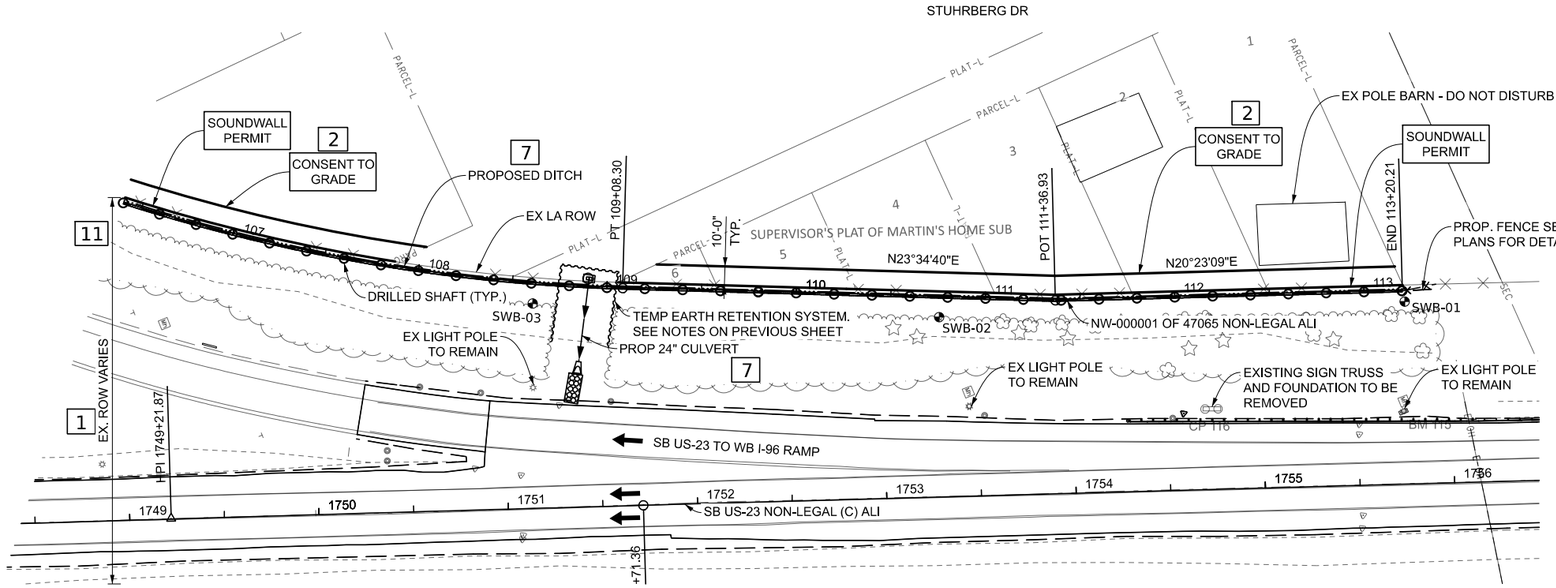
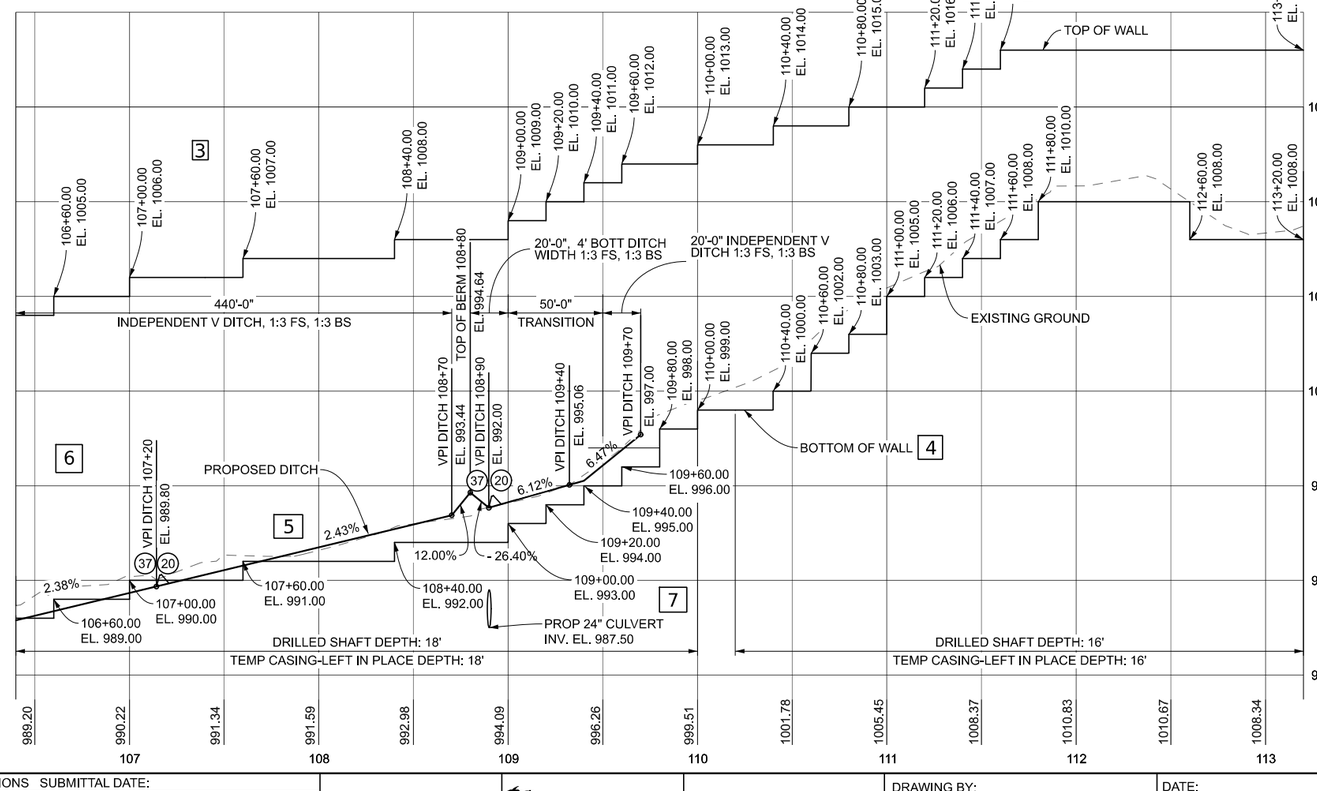
| NW PLAN 001 | SECT 1 |




## PLAN 9




## MISCELLANEOUS QUANTITIES

NW-000001 OF 47065
JN 210068A

| CAT 0024 | UNITS | Pay Item Name |
|---|---|---|
| 30,750 | Lb | Reinforcement, Steel |
| 5 | Cyd | Conc, Grade 3500 |
| 9080 | Sft | Noise Barrier Wall, Precast Conc, Furn |
| 9080 | Sft | Noise Barrier Wall, Precast Conc, Erect |
| 64 | Syd | Substructure Horizontal Surface Sealer (NW-000001 of 47065) |
| 580 | Ft | Drilled Shaft, 42 inch |
| 580 | Ft | Temp Casing-Left in Place |
| 9 | Cyd | Embankment, CIP |
| 15000 | Dlr | Obstruction Rem |

14

## SOIL EROSION & SEDIMENTATION CONTROL QUANTITIES

NW-000001 OF 47065
JN 210068A

| CAT 0001 | UNITS | Pay Item Name |
|---|---|---|
| 22 | Ft | Erosion Control, Check Dam, Stone (37) |
| 2 | Ea | Erosion Control, Sediment Trap (20) |

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NOISE BARRIER WALL PLAN AND PROFILE
NW-000001 OF 47065 12
STA 106+40 TO STA 113+20

DRAWING: NW PLAN 001
SHEET: SECT 1

## NOISE BARRIER WALL PLAN AND PROFILE

1. Label ROW according to the MDOT Guidelines for Plan Preparation.

2. Show consent to grade lines if applicable. Assume a minimum of 10'-0" on each side of the centerline of the noise barrier wall is required for construction related activities.

3. Top of wall elevations and stationing shall be provided at every wall step. Steps should be provided as infrequently as possible and in large increments when used. The top of wall must exceed the acoustical profile from the noise analysis.

4. Bottom of wall elevations and stationing shall be provided at every wall step. Provide steps as necessary to keep the wall height to 2ft increments and maintain 6" minimum embedment of the bottom panel below proposed ground.

5. The profile of drainage mitigation measures shall be provided on the wall profile. Each change in grade must be labeled.

6. Fire hose access openings, access points, and any other appurtenances attached to the wall or running through the wall must be shown and dimensioned on the wall plans.

7. Utilities, drainage features, and any known underground obstructions shall be labeled and shown on the wall plan and profile along with any known elevation information.

8. Show all existing utilities. Label in accordance with the MDOT Guideline for Plan Preparations.

9. The plan view should show a topographic survey of the area within 150' beyond the ends of the noise barrier wall and 100' outside each face of the proposed wall. Show the following:
a. Alignments of noise barrier wall(s) and roads with stationing
b. Wall alignment points
c. Curbs and pavement edges
d. Bodies of water and wetland boundaries
e. ROW and Consent to Grade lines
f. Existing and proposed features
g. Existing and proposed utilities including sewers and drainage structures and utility poles
h. Traffic flow arrows
i. Temporary sheeting or access roads required for construction
j. Soil boring locations

10. Stations for the beginning, end, and changes in alignment of the wall should be provided.

11. Outlines of drilled shafts should be provided on the plan view.

12. See Section 1.05.01 of the design guidelines for noise barrier wall naming system.

13. Include noise barrier wall plans in Section 1 along with the road plans.

14. SESC quantities shown on this plan sheet are for a unique circumstance. SESC quantities should be placed on road sheets.

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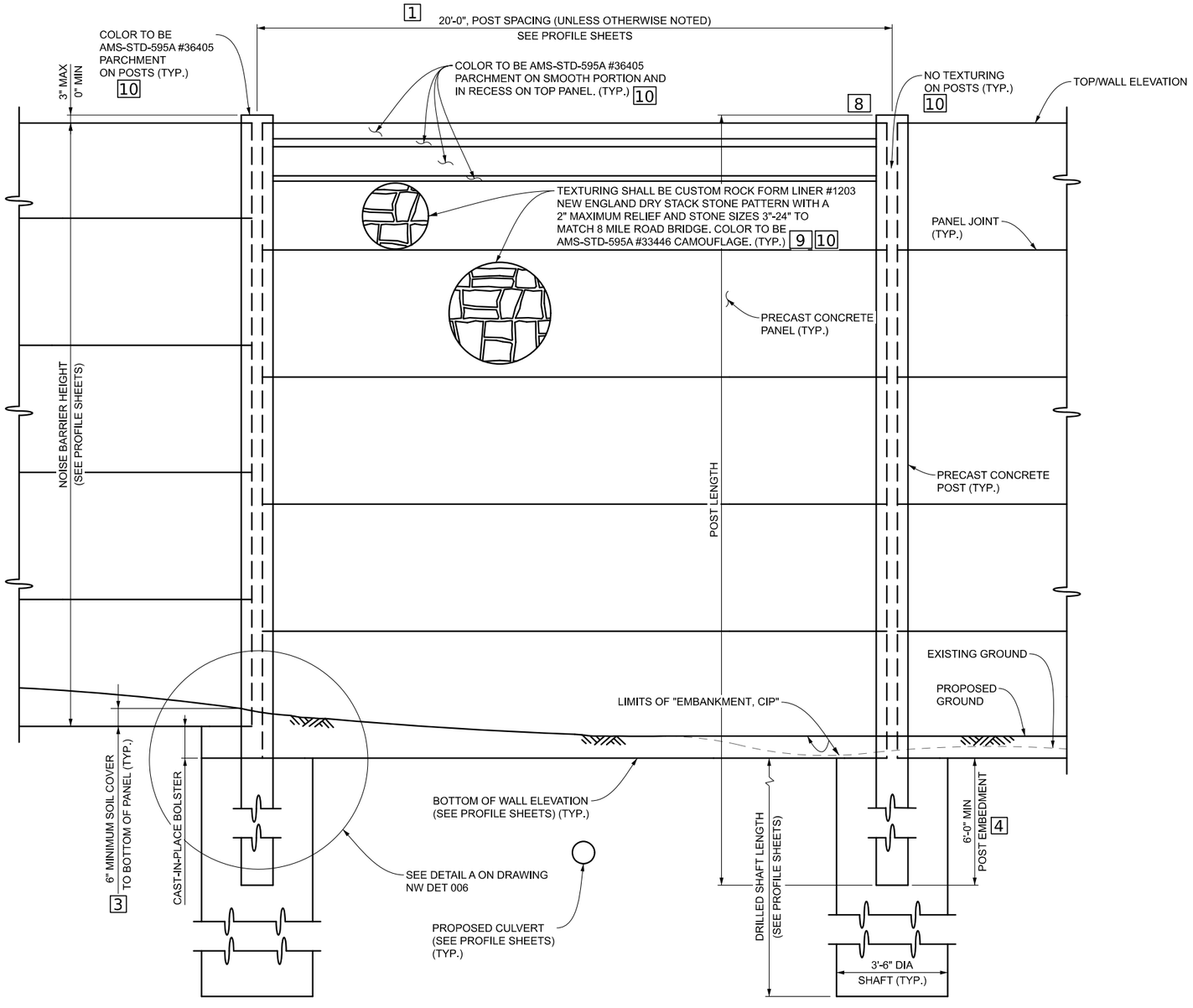


ELEVATION

## NOTES:

ES DENOTES EACH SIDE.

THE DESIGN OF THIS NOISE BARRIER WALL IS BASED ON AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS 9TH EDITION FOR WIND EXPOSURE CATEGORY C AND A 3-SECOND GUST WIND SPEED OF 115 MPH.

THE NOISE BARRIER WALL IS DESIGNED TO RETAIN A DIFFERENCE IN SOIL ELEVATION EQUAL TO 24 INCHES OF EARTH ON EITHER SIDE OF THE WALL. HOWEVER, THE RETAINED FILL DIFFERENCE AT THE END OF CONSTRUCTION SHOULD BE LIMITED TO 18 INCHES TO PROVIDE AN ALLOWANCE FOR FUTURE GRADE CHANGES.

USE CONCRETE WITH A COMPRESSIVE STRENTH AT 28 DAYS OF 5000 PSI FOR POST AND PANELS.

USE GRADE 3500 CONCRETE FOR BOLSTERS.

APPLY LOW TEMPERATURE PROTECTION OF CONCRETE ACCORDING TO SECTION 706.03.J OF THE STANDARD SPECIFICATIONS FOR CONSTRUCTION. LOW TEMPERATURE PROTECTION OF CONCRETE IS INCLUDED IN RELATED ITEMS OF WORK.

REINFORCING STEEL IN PRECAST CONCRETE NOISE WALL PANELS AND POSTS, CAST IN PLACE BOLSTERS, AND CAST IN PLACE DRILLED SHAFTS WILL NOT BE PAID SEPARATELY, BUT IS INCLUDED IN THE RELATED ITEMS OF WORK.

ELASTOMERIC BEARINGS WILL NOT BE PAID FOR SEPARATELY, BUT ARE INCLUDED IN THE PAY ITEMS "NOISE BARRIER WALL, PRECAST CONC, FURN" AND "NOISE BARRIER WALL, PRECAST CONC, ERECT".

PAYMENT FOR CAST IN PLACE BOLSTERS IS INCLUDED IN THE PAY ITEM "DRILLED SHAFT, 42 INCH".

LOCATE ALL ACTIVE UNDERGROUND UTILITIES PRIOR TO STARTING WORK AND SHOP DRAWING DEVELOPMENT. CONDUCT OPERATIONS IN SUCH A MANNER AS TO ENSURE THAT THOSE UTILITIES NOT REQUIRING RELOCATION WILL NOT BE DISTURBED. ADJUST POST SPACING IF NECESSARY AND AS APPROVED BY THE ENGINEER TO AVOID CONFLICTS WITH UTILITIES. PAYMENT FOR ADJUSTING POST SPACING IS INCLUDED IN THE PAYMENT FOR PRECAST NOISE BARRIER WALL SYSTEM.

THE POST MAY PROJECT A MAXIMUM OF 3 INCHES ABOVE THE TOP PANEL. USE A CONSTANT PROJECTION FOR THE ENTIRE WALL.

CENTER ALL POSTS ON THE WALL ALIGNMENT CENTERLINE. AT CHANGES IN WALL ALIGNMENT, PANEL CENTERLINES MAY NOT NECESSARILY COINCIDE WITH WALL ALIGNMENT CENTERLINE.

SET POSTS PLUMB AND WITHIN TOLERANCES SPECIFIED IN THE CONTRACT DOCUMENTS. SET PANELS HORIZONTAL AND WITHIN THE TOLERANCES SPECIFIED IN THE CONTRACT.

CONFIGURE RIGGING SO THAT SLING ANGLES ARE NO LESS THAN 45 DEGREES TO THE HORIZONTAL.

THE DRILLED SHAFT DIAMETER SHOWN IS THE MINIMUM DIAMETER. DETERMINE IF LARGER DIAMETER DRILLED SHAFTS ARE NECESSARY FOR POST FIT UP TOLERANCE. ADJUST STEEL REINFORCEMENT TO THE SATISFACTION OF THE ENGINEER. PAYMENT FOR ADJUSTING SHAFT DIAMETER AND STEEL REINFORCEMENT IS INCLUDED IN THE PAY ITEM "DRILLED SHAFT, 42 INCH".

CONSTRUCT DRILLED SHAFTS SO THAT THE TOP OF SHAFT IS WITHIN ONE INCH OF THE POSITION SHOWN ON THE PLANS.

PROVIDE FULL LENGTH TEMPORARY CASING - LEFT IN PLACE TO PREVENT CAVING DURING SHAFT EXCAVATION.

DO NOT USE VIBRATORY EQUIPMENT FOR DRILLED SHAFT AND CASING CONSTRUCTION.

10 PROVIDE TEXTURING ON BOTH SIDES OF NOISE BARRIER WALL PANELS. SEE THE PRECAST NOISE BARRIER WALL SPECIAL PROVISION FOR TEXTURING PATTERNS. PAYMENT FOR AESTHETIC TEXTURING AND FORMLINERS IS INCLUDED IN THE PAY ITEM "NOISE BARRIER WALL, PRECAST CONC, FURN".

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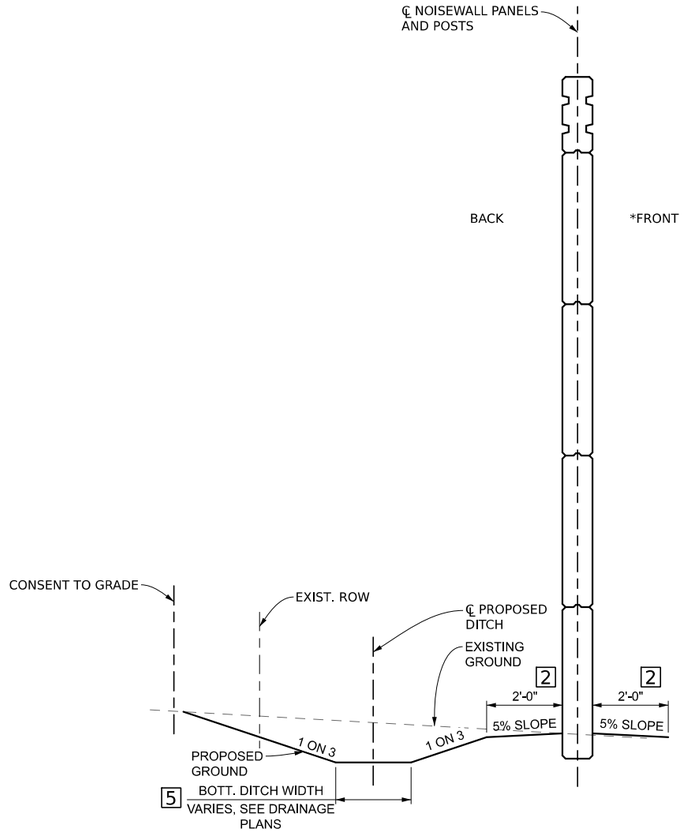
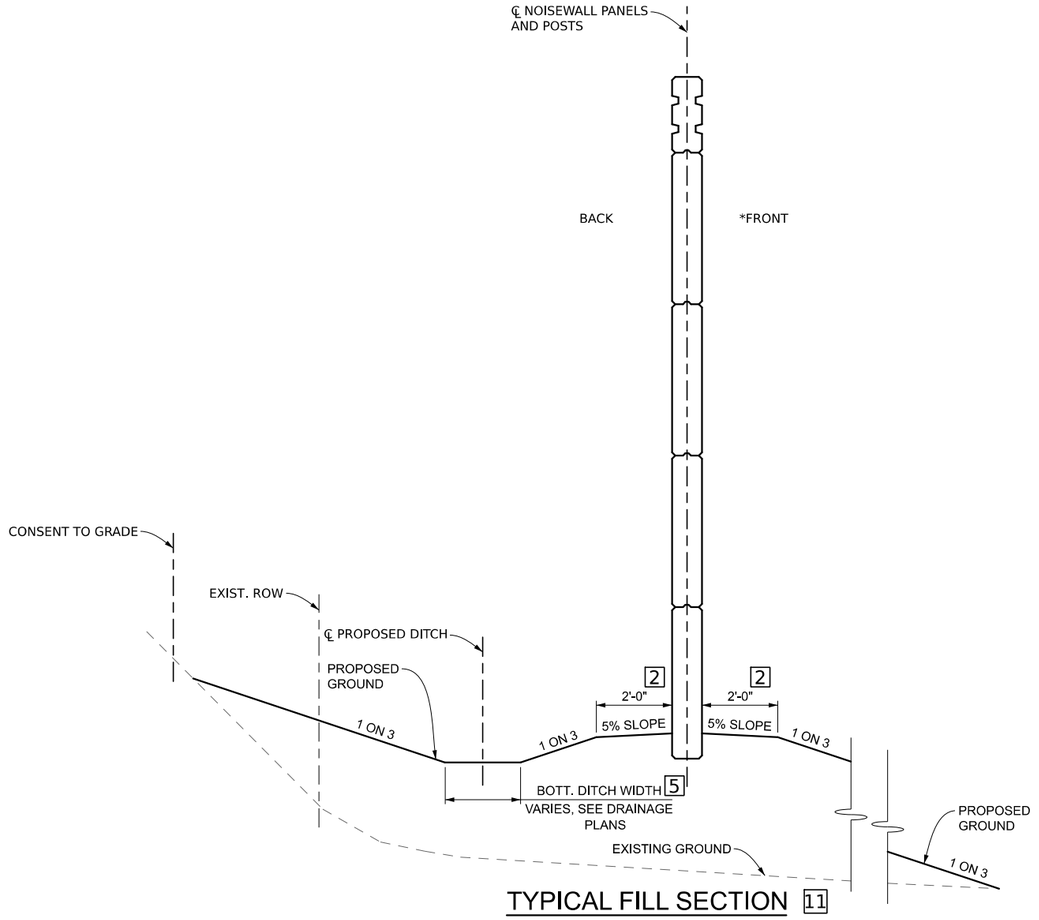
| DRAWING BY: | DATE: | CS: YYYYY | NOISE BARRIER WALL DETAILS |
| CHK'D BY: CORR BY: | DESIGN UNIT: | JN: | NW-XXXXXX OF YYYYY |
| FILE: NW_DET001_2024-08-22.dgn | TSC: | | |

| DRAWING | SHEET |
|---|---|
| NW DET 001 | SECT 1 |




## TYPICAL CUT SECTION 11

APPLIES STA. XXX+XX.XX TO XXX+XX.XX
*THE FRONT SIDE OF THE WALL FACES THE ROADWAY




## TYPICAL FILL SECTION 11

APPLIES STA. XXX+XX.XX TO XXX+XX.XX
*THE FRONT SIDE OF THE WALL FACES THE ROADWAY



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| NO. | DATE | AUTH | DESCRIPTION | NO. | DATE | AUTH | DESCRIPTION |
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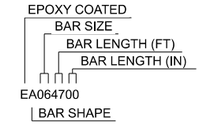
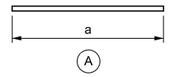
| DRAWING BY: | DATE: | CS: YYYYY | NOISE BARRIER WALL DETAILS |
| CHK'D BY: CORR BY: | DESIGN UNIT: | JN: | NW-XXXXXX OF YYYYY |
| FILE: NW_DET002_2024-08-22.dgn | TSC: | | |

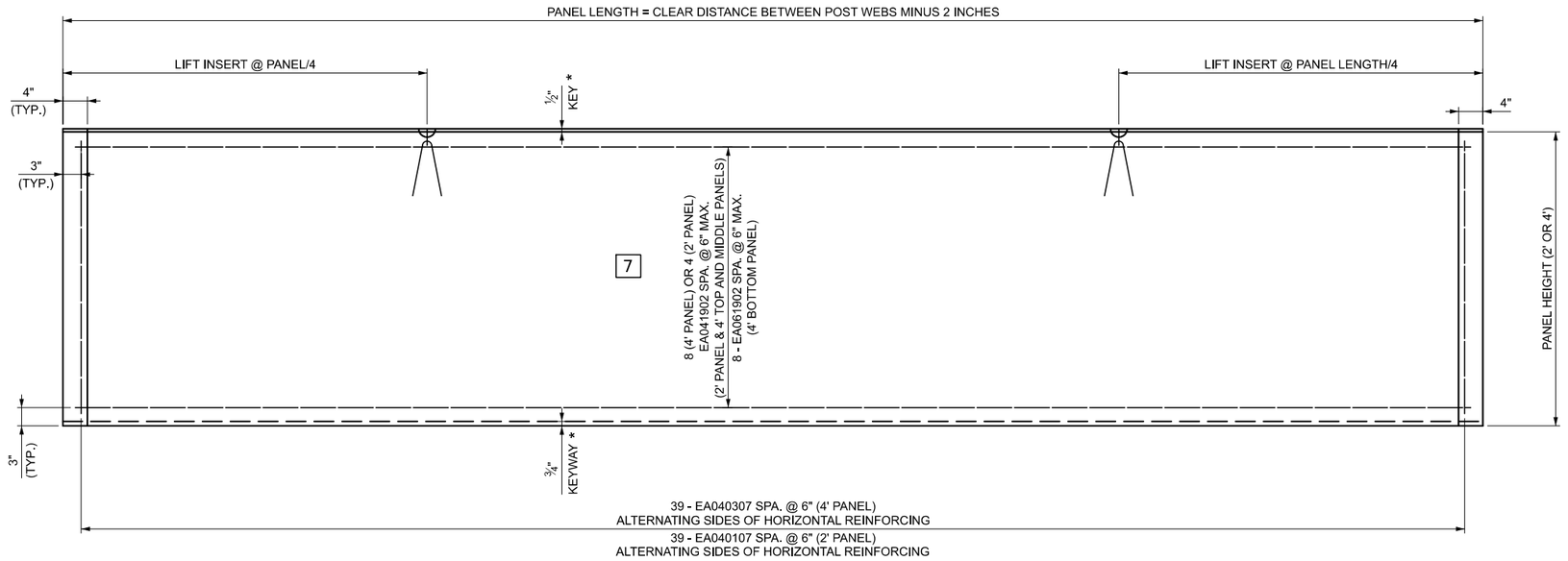
| DRAWING | SHEET |
|---|---|
| NW DET 002 | SECT 1 |

| MEMBER | BAR | DIMENSIONS | | | |
|---|---|---|---|---|---|
| | | a | b | c | d |
| 4' TOP & MIDDLE PANELS | EA040307 | 3'-7" | | | |
| | EA041902 | 19'-2" | | | |
| 4' BOTTOM PANEL | EA040307 | 3'-7" | | | |
| | EA061902 | 19'-2" | | | |
| 2' TOP PANEL | EA040107 | 1'-7" | | | |
| | EA041902 | 19'-2" | | | |



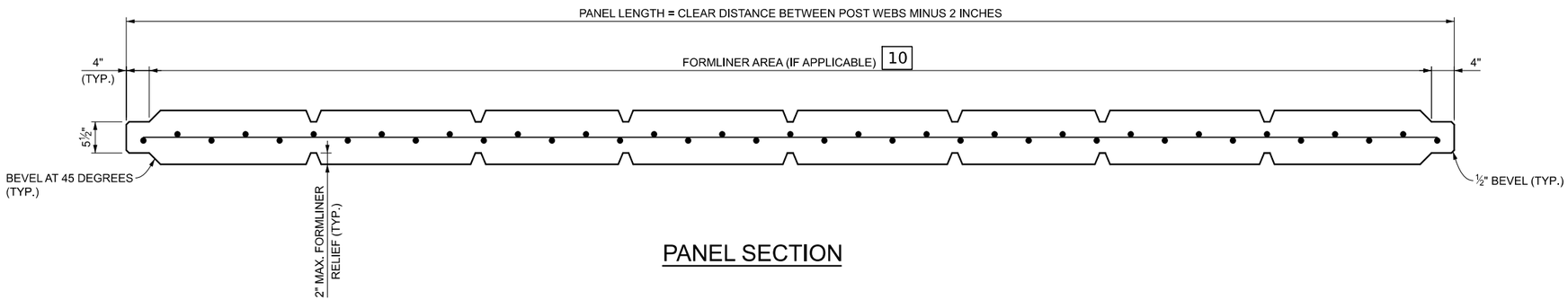




## BAR LEGEND




## PANEL ELEVATION

*EXCEPT AS NOTED ON SECTION THRU PANEL DETAILS




## PANEL SECTION



| FINAL ROW PLAN REVISIONS SUBMITTAL DATE: | | | | | | | |
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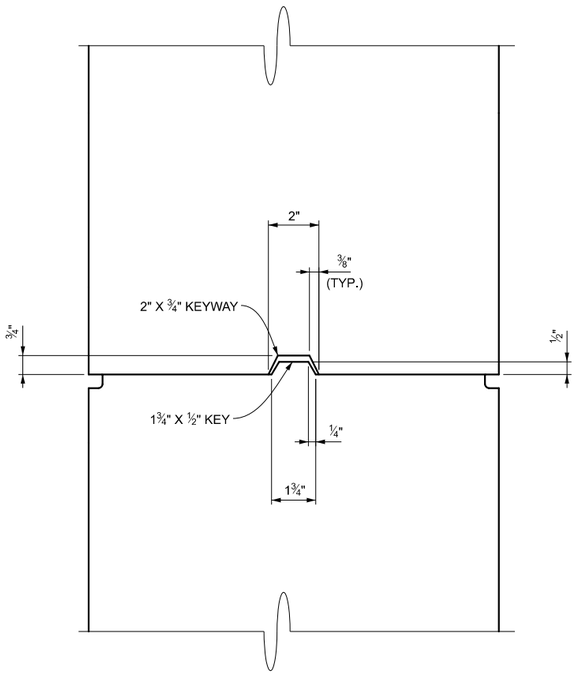
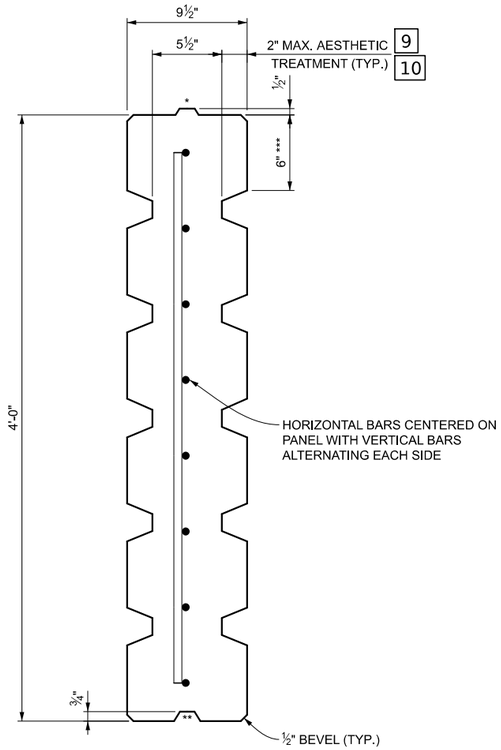
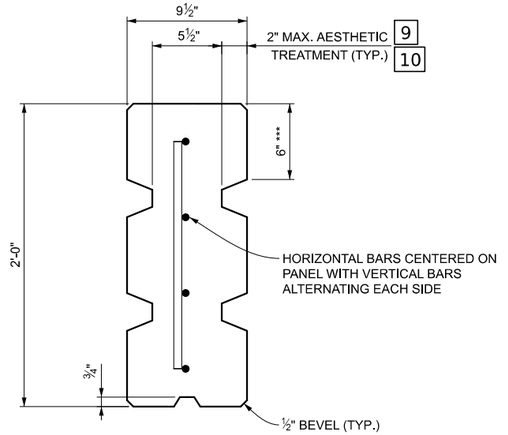
|---|---|---|---|---|
| DRAWING BY: | DATE: | CS: YYYYY | NOISE BARRIER WALL DETAILS | DRAWING / SHEET |
| CHK'D BY: CORR BY: | DESIGN UNIT: | JN: | NW-XXXXXX OF YYYYY | NW DET 003 / SECT 1 |
| FILE: NW_DET003_2024-08-22.dgn | TSC: | | | |




PANEL JOINT DETAIL




SECTION THRU 4"-0" PANEL




SECTION THRU 2"-0" PANEL

USE FOR TOP PANEL ONLY

*OMIT KEY FOR THE TOP ROW OF PANELS
**OMIT KEYWAY FOR THE BOTTOM ROW OF PANELS
***LEAVE FORM LINER 6" MIN. SHORT OF THE TOP ROW OF PANELS



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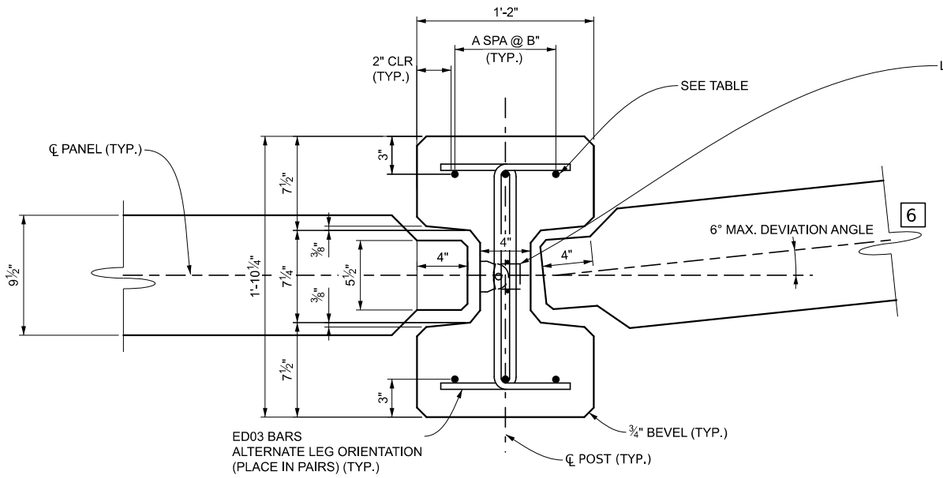
| CHK'D BY: CORR BY: | DESIGN UNIT: | JN: | NW-XXXXXX OF YYYYY | NW DET 004 / SECT 1 |
| FILE: NW_DET004_2024-08-22.dgn | TSC: | | | |

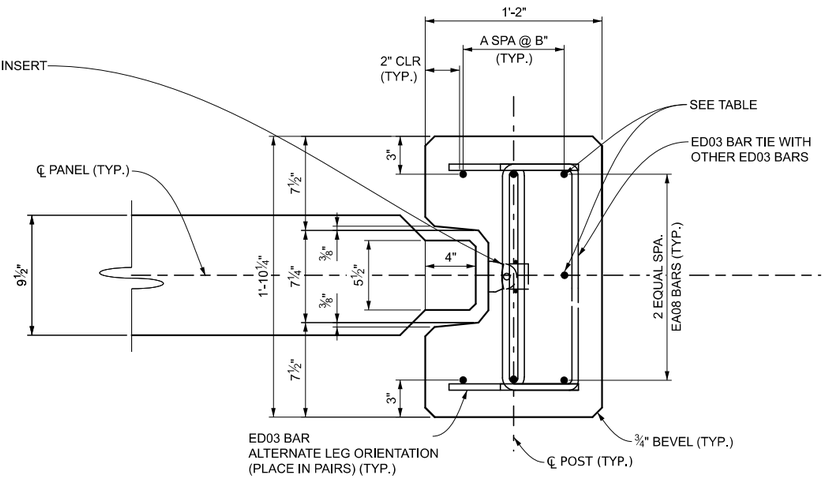
| MEMBER | BAR | DIMENSIONS | | | |
|---|---|---|---|---|---|
| | | a | b | c | d |
| POSTS | ED030206 | 6" | 1'-6" | 6" | |
| | EA06/EA07 | * | | | |

* POST LENGTH MINUS 4"



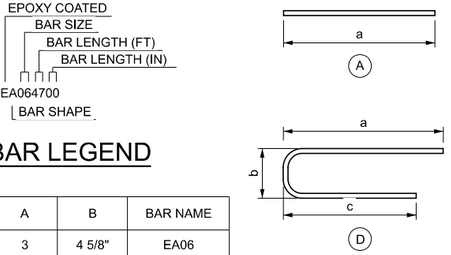

## TYPICAL POST SECTION DETAIL

(PANEL AESTHETIC TREATMENT NOT SHOWN)




## END POST SECTION DETAIL

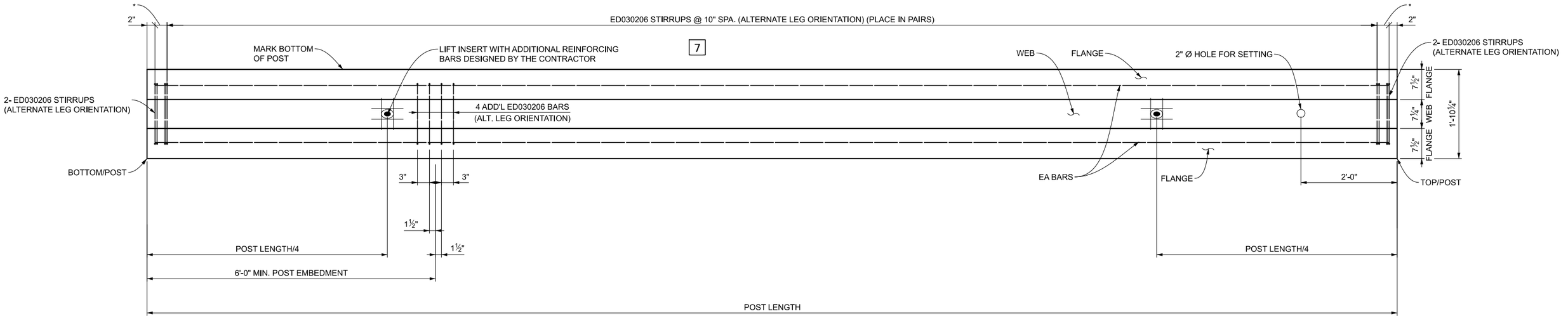
(PANEL AESTHETIC TREATMENT NOT SHOWN)




## BAR LEGEND

| WALL HEIGHT (FT) | A | B | BAR NAME |
|---|---|---|---|
| 10 | 3 | 4 5/8" | EA06 |
| 12 | 3 | 4 5/8" | EA06 |
| 14 | 3 | 4 5/8" | EA06 |
| 16 | 4 | 3 1/8" | EA06 |
| 18 | 4 | 3" | EA07 |
| 20 | 4 | 3" | EA07 |

## POST BAR TABLE




## PRECAST CONCRETE POST ELEVATION

(LAYING HORIZONTAL)

* ADJUST SPACING TO FIT ED03 BARS



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| FILE: NW_DET005_2024-08-22.dgn | | TSC: | | |

| DRAWING | SHEET |
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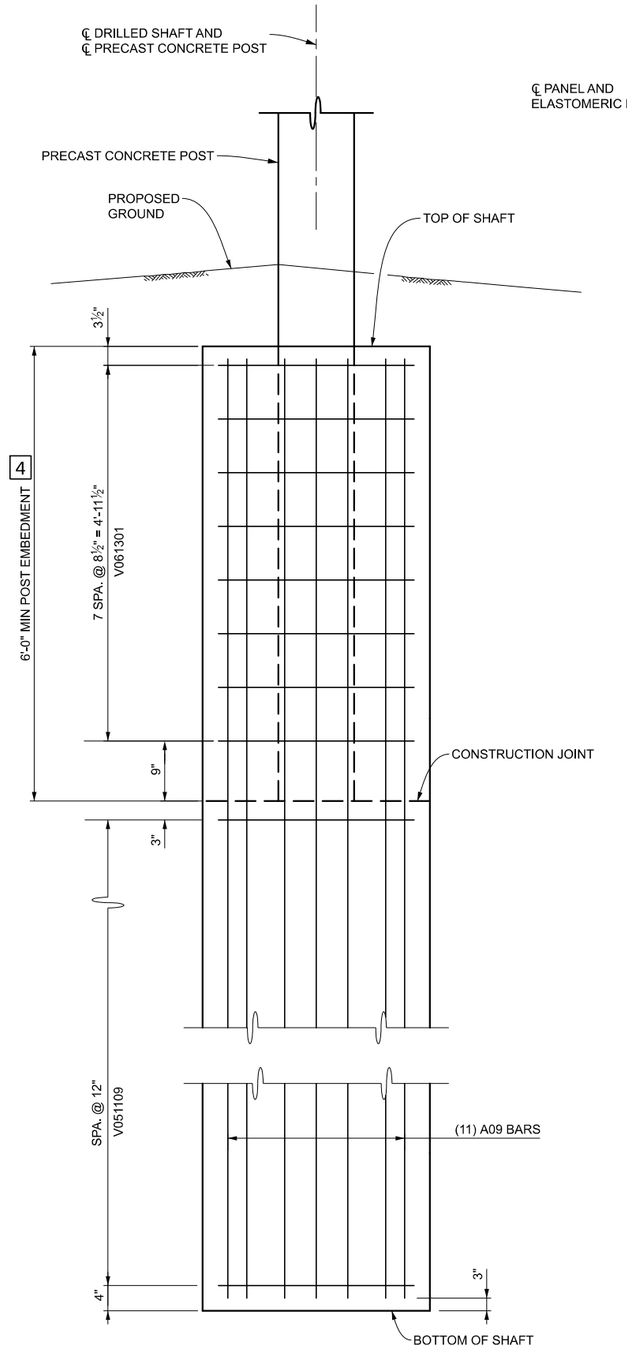
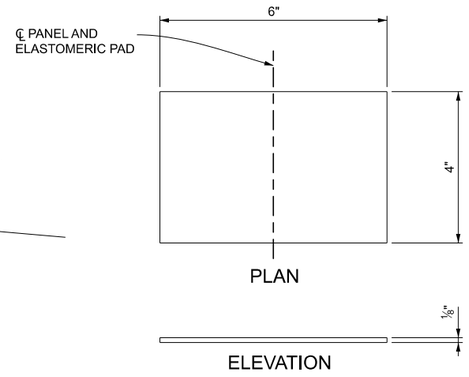
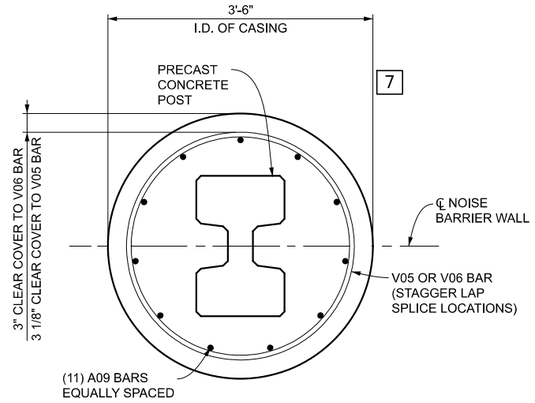
| NW DET 005 | SECT 1 |



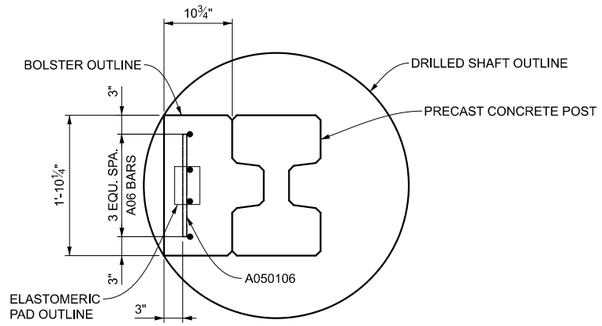

## TYPICAL DRILLED SHAFT ELEVATION




## ELASTOMERIC PAD DETAILS

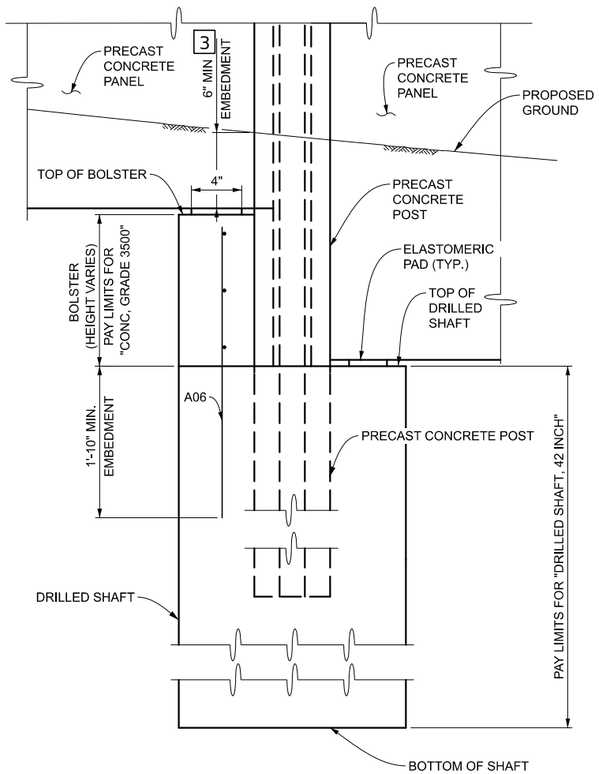



## TYPICAL SECTION THRU DRILLED SHAFT




## TOP VIEW

(DRILLED SHAFT REINFORCEMENT NOT SHOWN)




## DETAIL A

13

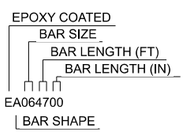
| STEEL REINFORCEMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | BAR | DIMENSIONS | | | | | | NO. REQ'D | TOTAL WEIGHT |
| | | a | b | c | d | e | f | | |
| DRILLED SHAFTS | A091306 | 13'-6" | | | | | | 11 | 505 |
| | A091506 | 15'-6" | | | | | | 11 | 580 |
| | V051109 | 9'-5" | 2'-4" | 1'-5¼" | | | | 17 | 208 |
| | V061301 | 9'-6" | 3'-7" | 1'-5¼" | | | | 8 | 157 |
| | | | | | | | SUBTOTAL: | | 1450 |
| | | | | | | | | | |
| BOLSTERS | A05106 | 1'-6" | | | | | | 8 | 13 |
| | A060301 | 3'-1" | | | | | | 4 | 19 |
| | A060401 | 4'-1" | | | | | | 4 | 25 |
| | | | | | | | SUBTOTAL: | | 57 |
| | | | | | | | | | |
| | | | | | | | TOTAL: | | 1507 |
| | | | | | | | | | |

13

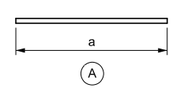
| SHAFT LENGTH | VERTICAL BAR |
|---|---|
| 14'-0" | A091306 |
| 16'-0" | A091506 |

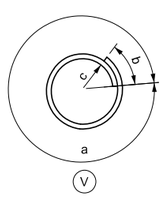
13

| BOLSTER HEIGHT RANGE | VERTICAL BAR |
|---|---|
| 0" < HEIGHT < 1'-6" | A060301 |
| 1'-6" ≤ HEIGHT < 2'-6" | A060401 |




## BAR LEGEND

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| FINAL ROW PLAN REVISIONS SUBMITTAL DATE: | | | | | | | |
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| DRAWING BY: | | DATE: | CS: YYYYY |
| CHK'D BY: | CORR BY: | DESIGN UNIT: | JN: |
| FILE: NW_DET006_2024-08-22.dgn | | TSC: | |

NOISE BARRIER WALL DETAILS

NW-XXXXXX OF YYYYY

| DRAWING | SHEET |
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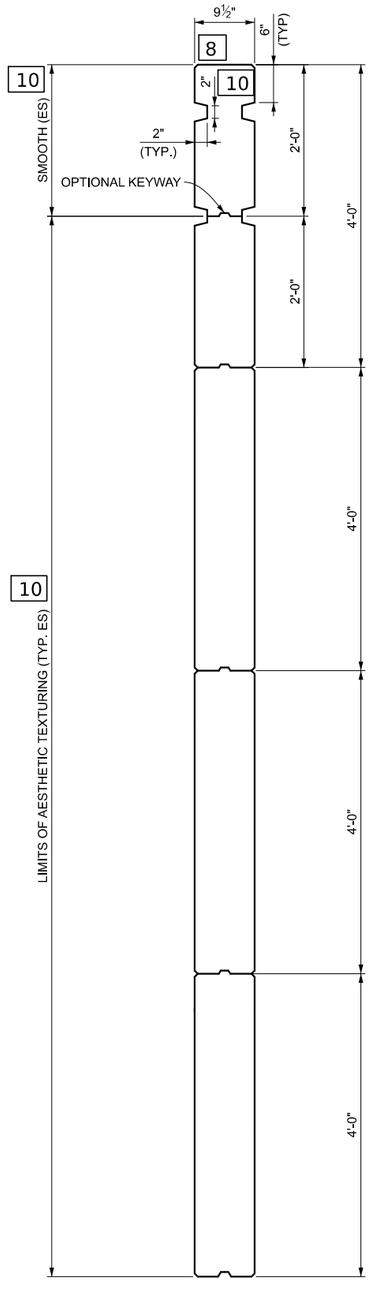
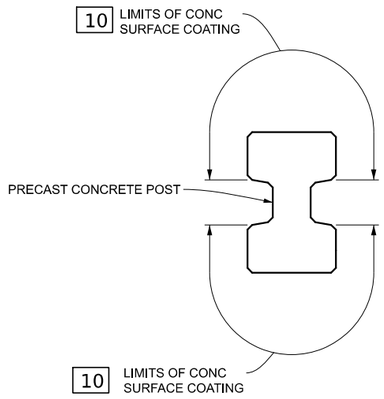
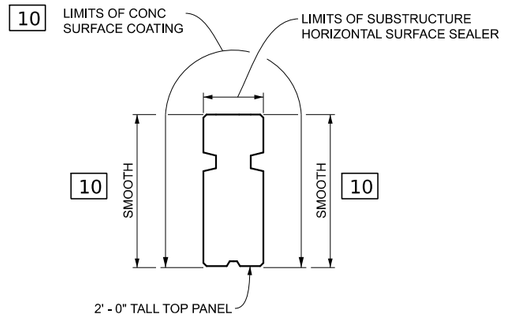
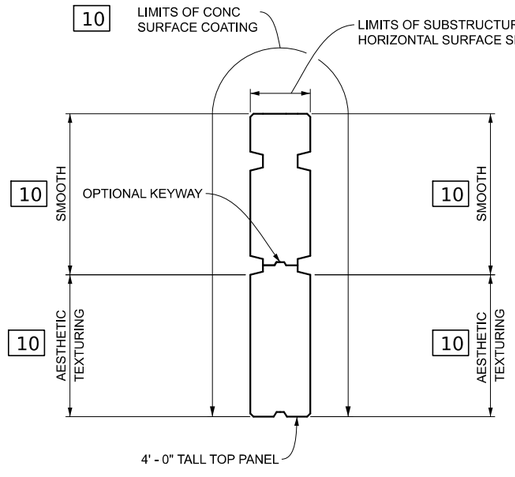
| NW DET 006 | SECT 1 |

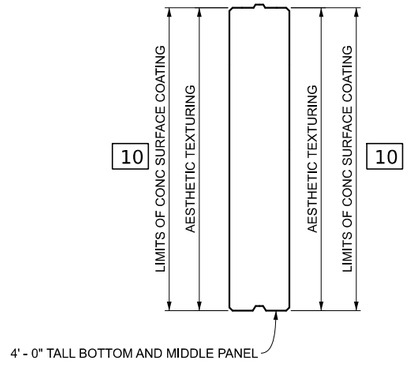



## TYPICAL SECTION THROUGH PANELS 10




10

## NOTES:

APPLY CONCRETE SURFACE COATING TO ALL EXPOSED PORTIONS OF POSTS INCLUDING TOP OF POSTS AND ALL EXPOSED PORTIONS OF PANELS.

APPLY SUBSTRUCTURE HORIZONTAL SURFACE SEALER TO THE TOP OF ALL POSTS AND THE TOP OF ALL PANELS. DO NOT ALLOW HORIZONTAL SURFACE SEALER TO DRIP OR RUN ONTO VERTICAL SURFACE OF POSTS OR PANELS.

APPLY SUBSTRUCTURE HORIZONTAL SURFACE SEALER BEFORE CONCRETE SURFACE COATING.

12

| FINAL ROW PLAN REVISIONS SUBMITTAL DATE: | | | | | | | |
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| DRAWING BY: | DATE: | CS: YYYYY | NOISE BARRIER WALL DETAILS |
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| FILE: NW_DET007_2024-08-22.dgn | TSC: | | |

| DRAWING | SHEET |
|---|---|
| NW DET 007 | SECT 1 |

## TEST HOLE NO. SWB-01

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 1640 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 80 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1758+46.88 (NB US-23)
STATION OFFSET: 604.02 FEET WEST

BORING DATE: 12/17/21 NORTHING: 376009
GROUND SURFACE ELEVATION: 1008.8 FT EASTING: 13288416

| | | |
|---|---|---|
| 1008.8 | | APPROXIMATELY 7 INCHES OF SANDY BROWN TOPSOIL. |
| 1008.2 | 2 1 2 | |
| 1007.8 | | FILL • VERY LOOSE TO LOOSE POORLY GRADED FINE SAND WITH SILT, TRACE ROOTS, TRACE GRAVEL, BROWN, MOIST (SP-SM) |
| 1005.3 | 2 2 3 | |
| 1002.8 | 16 24 28 | FILL • VERY DENSE SILTY FINE SAND WITH CLAY, WITH GRAVEL, BROWN, MOIST (SM) |
| 1000.3 | 39 29 27 | |
| 998.8 | | MEDIUM DENSE TO LOOSE POORLY GRADED FINE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 995.3 | 5 8 9 | |
| 990.3 | 2 2 3 | MEDIUM DENSE POORLY GRADED FINE TO COARSE SAND WITH GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 985.3 | 7 12 11 | |
| 980.3 | | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) |
| 979.8 | 8 11 15 | |
| 975.3 | 11 15 21 | DENSE POORLY GRADED FINE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 973.8 | | END OF TEST HOLE AT 35 FT. |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: R. CALKINS (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

## TEST HOLE NO. SWB-02

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 1410 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 73 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1756+23.37 (NB US-23)
STATION OFFSET: 706.66 FEET WEST

BORING DATE: 12/17/21 NORTHING: 375778
GROUND SURFACE ELEVATION: 1004.8 FT EASTING: 13288332

| | | |
|---|---|---|
| 1004.8 | | APPROXIMATELY 8 INCHES OF SANDY BROWN TOPSOIL. |
| 1004.1 | 2 2 2 | |
| 1003.8 | | FILL • VERY LOOSE CLAYEY FINE SAND, TRACE GRAVEL, OCCASIONAL TOPSOIL LAYERS WITH ROOTS, BROWN, MOIST (SC) |
| 1001.8 | | |
| 1001.3 | 2 2 2 | FILL • VERY LOOSE SILTY FINE SAND, TRACE CLAY, TRACE ROOTS, TRACE GRAVEL, BROWN, MOIST (SM) |
| 998.8 | 6 8 13 | |
| 996.3 | 7 9 11 | MEDIUM DENSE TO VERY DENSE POORLY GRADED FINE SAND, FEW GRAVEL, TRACE SILT, OCCASIONAL FINE TO MEDIUM SAND LAYERS, BROWN, MOIST (SP) |
| 991.3 | 9 14 20 | |
| 986.3 | 10 18 20 | |
| 981.3 | 17 24 29 | |
| 976.3 | 16 25 24 | DENSE TO VERY DENSE POORLY GRADED FINE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 971.3 | 19 29 30 | |
| 969.8 | | END OF TEST HOLE AT 35 FT. |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: R. CALKINS (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

## TEST HOLE NO. SWB-03

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 1690 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 70 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1754+34.54 (NB US-23)
STATION OFFSET: 809.1 FEET WEST

BORING DATE: 12/16/21 NORTHING: 375582
GROUND SURFACE ELEVATION: 992.5 FT EASTING: 13288245

| | | |
|---|---|---|
| 992.5 | | APPROXIMATELY 6 INCHES OF BROWN SANDY TOPSOIL. |
| 992.0 | 2 1 2 | |
| 991.5 | | FILL • VERY LOOSE SILTY FINE SAND, TRACE ROOTS, TRACE CLAY, TRACE GRAVEL, RED-BROWN, MOIST (SM) |
| 989.5 | | |
| 989.0 | 3 7 12 | FILL • MEDIUM DENSE TO LOOSE CLAYEY FINE TO MEDIUM SAND WITH GRAVEL, TRACE SILT, TRACE ROOTS, BROWN, MOIST (SC) |
| 986.5 | 4 3 5 | |
| 984.0 | 9 | DENSE POORLY GRADED FINE TO COARSE SAND WITH GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 983.5 | 15 18 | |
| 979.0 | 6 11 15 | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) |
| 974.0 | 12 23 30 | VERY DENSE POORLY GRADED FINE TO COARSE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 969.0 | 9 17 20 | |
| 964.0 | 16 22 22 | DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) |
| 959.0 | 12 17 17 | |
| 957.5 | | END OF TEST HOLE AT 35 FT. |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: S. SWAMINATHAN (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

## TEST HOLE NO. SWB-04

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 1390 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 70 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1752+06.38 (NB US-23)
STATION OFFSET: 1010.62 FEET WEST

BORING DATE: 12/16/21 NORTHING: 375338
GROUND SURFACE ELEVATION: 985.3 FT EASTING: 13288063

| | | | |
|---|---|---|---|
| 985.3 | | | PP MC |
| 985.0 | | APPROXIMATELY 4 INCHES OF BROWN SANDY TOPSOIL. | |
| 984.3 | 2 4 4 | | |
| 981.8 | 3 3 12 | FILL • LOOSE TO MEDIUM DENSE SILTY FINE SAND WITH CLAY, TRACE ROOTS, TRACE GRAVEL, RED-BROWN, MOIST (SM) | |
| 979.3 | 3 7 2 | | |
| 976.8 | 4 4 6 | LOOSE TO MEDIUM DENSE POORLY GRADED FINE SAND WITH SILT, TRACE ROOTS, TRACE GRAVEL, BROWN, MOIST (SP-SM) | |
| 971.8 | 8 11 13 | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) (POSSIBLE BOULDER BETWEEN 18.5-20.5 FT.) | |
| 966.8 | 11 36 50 | | |
| 961.8 | 7 13 16 | MEDIUM DENSE POORLY GRADED FINE TO MEDIUM SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) | |
| 956.8 | 9 15 19 | DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) | |
| 951.8 | 6 9 8 | VERY STIFF SANDY LEAN CLAY, TRACE GRAVEL, BROWN (CL) | 3.0 11.5 |
| 950.3 | | END OF TEST HOLE AT 35 FT. | |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: S. SWAMINATHAN (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

## TEST HOLE NO. SWB-05

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 1130 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 65 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1750+36.85 (NB US-23)
STATION OFFSET: 1281.8 FEET WEST

BORING DATE: 12/15/21 NORTHING: 375147
GROUND SURFACE ELEVATION: 979.6 FT EASTING: 13287806

| | | | |
|---|---|---|---|
| 979.6 | | APPROXIMATELY 7 INCHES OF BROWN SANDY TOPSOIL. | PP |
| 979.0 | 2 2 2 | | |
| 978.6 | | FILL • VERY LOOSE TO LOOSE SILTY FINE SAND, TRACE ROOTS, TRACE CLAY, TRACE GRAVEL, RED-BROWN, MOIST (SM) | |
| 976.1 | 2 3 2 | | |
| 973.6 | 5 5 6 | | |
| 971.1 | 5 8 12 | MEDIUM DENSE POORLY GRADED FINE TO MEDIUM SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) | |
| 966.1 | 10 12 11 | | |
| 961.1 | 8 12 12 | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) | |
| 956.1 | 3 4 10 | MEDIUM DENSE SILTY CLAYEY FINE SAND, TRACE GRAVEL, OCCASIONAL SANDY LEAN CLAY LAYERS, BROWN, MOIST (SC-SM) | <> |
| 951.1 | 8 12 13 | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, BROWN, MOIST (SP) | |
| 946.1 | 12 20 20 | DENSE POORLY GRADED FINE TO MEDIUM SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) | |
| 944.6 | | END OF TEST HOLE AT 35 FT. | |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: S. PANETTA (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

## TEST HOLE NO. SWB-06

LOCATION: US-23 SB/I-96 WB RAMP EMBANKMENT

PHYSICAL REFERENCE: 930 FT. NORTH OF I-96 WB
PHYSICAL OFFSET: 63 FT. WEST OF RAMP FROM US-23 SB TO I-96 WB RT EOM

STATION: 1749+28.64 (NB US-23)
STATION OFFSET: 1490.34 FEET WEST

BORING DATE: 12/15/21 NORTHING: 375022
GROUND SURFACE ELEVATION: 975.3 FT EASTING: 13287607

| | | |
|---|---|---|
| 975.3 | | APPROXIMATELY 6 INCHES OF BROWN SANDY TOPSOIL. |
| 974.8 | 2 2 3 | |
| 974.3 | | FILL • LOOSE SILTY FINE SAND, TRACE CLAY, TRACE GRAVEL, RED-BROWN, MOIST (SM) |
| 972.3 | | |
| 971.8 | 4 8 10 | FILL • MEDIUM DENSE POORLY GRADED FINE TO MEDIUM SAND WITH SILT, FEW GRAVEL, TRACE ROOTS, BROWN, MOIST (SP-SM) |
| 969.3 | 5 7 8 | |
| 966.8 | 6 8 10 | MEDIUM DENSE POORLY GRADED FINE TO MEDIUM SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 961.8 | 9 10 7 | MEDIUM DENSE POORLY GRADED FINE SAND, TRACE SILT, TRACE GRAVEL, BROWN, MOIST (SP) |
| 960.3 | | |
| 956.8 | 5 13 21 | DENSE POORLY GRADED FINE TO COARSE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 951.8 | 13 18 18 | |
| 946.8 | 15 21 20 | DENSE POORLY GRADED FINE SAND WITH SILT, TRACE GRAVEL, BROWN, MOIST (SP-SM) |
| 941.8 | 18 22 22 | DENSE POORLY GRADED FINE TO COARSE SAND, FEW GRAVEL, TRACE SILT, BROWN, MOIST (SP) |
| 940.3 | | END OF TEST HOLE AT 35 FT. |

NOTES:
- GROUNDWATER LEVEL DURING DRILLING: NONE
- GROUNDWATER LEVEL UPON COMPLETION: NONE
- LOGGED BY: S. PANETTA (SOMAT)
- CHECKED BY: J. ABADIR/J. SCHMITZER (SOMAT)
- DRILL RIG: CME 55 ATV (RIG 3799935; ER=83.0%)
- METHOD: 2 1/4 INCH HSA
- COORDINATES AND GROUND SURFACE ELEVATION FROM PROJECT SURVEYOR

0 / 0 / 0 — 1st 6 in, 2nd 6 in, 3rd 6 in, 4th 6 in

50/4"

NUMBERS IN CIRCLES DENOTE NUMBER OF BLOWS REQUIRED TO DRIVE A 2" O.D., X 1.5" I.D., SPLIT SPOON SAMPLER 3 OR 4 SUCCESSIVE 6" INCREMENTS USING A 140 LB AUTOMATIC HAMMER FALLING 30".

WHERE THE SAMPLER IS DRIVEN DISTANCES LESS THAN 6" PER INCREMENT, THE DISTANCE IS SHOWN IN THE CIRCLE WITH THE NUMBER OF BLOWS IN THE FORM OF A FRACTION.

PP = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH • TONS/SQ.FT (TSF)
UCS = LAB DETERMINED UNCONFINED COMPRESSIVE STRENGTH • TONS/SQ.FT (TSF)
TV = TORVANE SHEAR TEST, SHEAR STRENGTH • TONS/SQ.FT (TSF)
MC = MOISTURE CONTENT • (%)
DD = DRY DENSITY • LBS/CU.FT (PCF)
DCP = DYNAMIC CONE PENETRATION • (MM/BLOW)

R = ROCK CORE RECOVERY (%)
RQD = ROCK QUALITY DESIGNATION (%)
<> = DISTURBED SAMPLE

CONSISTENCY WAS DETERMINED BY INSPECTION OF SAMPLES AND SUBSTANTIATED BY SOILS RESISTANCE TO DRILLING TOOLS. UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP SYMBOL DETERMINED PER (ASTM) VISUAL-MANUAL PROCEDURES.

THE DCP INDEX IS REPORTED AT DEPTHS EXHIBITING DISTINCT CHANGES IN SLOPE ON A PLOT OF CUMULATIVE PENETRATION VS. NUMBER OF BLOWS. EACH DCP INDEX REPRESENTS THE AVERAGE PENETRATION PER BLOW FOR THE SOIL BELOW THAT POINT. "ETD" = END TEST DEPTH.

GROUNDWATER LEVELS REPRESENT THE CONDITIONS AT THE TIME THE MEASUREMENTS WERE OBTAINED AND SHOULD BE EXPECTED TO FLUCTUATE THROUGHOUT THE YEAR. GROUNDWATER LEVELS MAY ALSO BE INFLUENCED BY RESIDUAL BORING WATER.

THE SOIL BORING LOGS REPRESENT POINT INFORMATION. PRESENTATION OF THIS INFORMATION IN NO WAY IMPLIES THAT SUBSURFACE CONDITIONS ARE THE SAME AT LOCATIONS OTHER THAN THE EXACT LOCATION OF THE BORING.

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:

| NO. | DATE | AUTH | DESCRIPTION | NO. | DATE | AUTH | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

MDOT Michigan Department of Transportation

NO SCALE

| | | | | | |
|---|---|---|---|---|---|
| DRAWING BY: | DATE: | CS: 39002 | SOIL BORING DATA | DRAWING | SHEET |
| CHK'D BY: CORR BY: | DESIGN UNIT: | JN: | NW-000001 OF 39002 | NW BORING 001 | SECT 1 |
| FILE: R03_R04_39022_BORING_002.dgn | TSC: | | | | |

## NOISE BARRIER WALL DETAILS

1. Use 20' post spacing wherever possible. Spacing may be adjusted to avoid utility conflicts or underground obstructions. It is desirable to minimize the number of different post spacings within a project.

2. Earth berms should be constructed with a 2’ bench sloping at 5% away from the wall.

3. Bottom panels shall be buried a minimum of 6" and designed to retain 2'-0" of soil.

4. Posts should be embedded a minimum of 6'-0" into foundations. Details with base plates and anchor bolts are prohibited.

5. Adjust details to show drainage features in the vicinity of the noise barrier walls. The proposed ditch shown is only a placeholder.

6. Panels should be laid out so that their centerline does not deviate more than 6-degrees from the centerline of post.

7. All reinforcement provided in elements above ground shall be epoxy coated. Reinforcement provided in buried wall elements may be left uncoated.

8. Flat or nearly flat surfaces should be formed for the top of post and top panels.

9. Form liners are to be applied to panels only, specified lining must be consistent throughout project. Liners should be stopped 6" minimum short of the top edge of panels. Liner treatments shall be limited to a maximum depth of 2" per side of panel and left 4" short of each end of the panel.

10. Adjust all aesthetic details shown on all sheets to meet project aesthetic requirements (these sheets only show placeholder details). Provide additional sheets if necessary to show all aesthetic details needed to fabricate the posts and panels.

11. Expand and adjust these sections as necessary to show the required grading, ROW, consent to grade, and other notable features adjacent to the noise barrier wall.

12. CAD files for these drawings should be downloaded from this link and adjusted as needed: xxxxxx

13. Provide tables for drilled shaft and bolster reinforcement. When projects require multiple shaft and/or bolster heights, provide tables to specify which bars are needed for a given shaft length or bolster height range.

## SOIL BORING DATA

1. Soil borings must be located with station-offsets and/or state plane northing and easting coordinates. Preferably both are shown.

Show soil boring locations on the noise barrier wall plan and profile sheets.

If there is any soil shear data it shall be shown on this sheet.

| FINAL ROW PLAN REVISIONS SUBMITTAL DATE: | | | | | | | |
|---|---|---|---|---|---|---|---|
| NO. | DATE | AUTH | DESCRIPTION | NO. | DATE | AUTH | DESCRIPTION |
| | | | | | | | |
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NO SCALE

| | | | | |
|---|---|---|---|---|
| DRAWING BY: | DATE: | CS: | NOISE BARRIER WALL PLAN GUIDELINES | DRAWING SHEET |
| CHK'D BY: | DESIGN UNIT: | JN: | | SECT 1 |
| FILE: | TSC: | | | |