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4.5 NOISE BARRIERS

4.5.1 Introduction

Noise barriers have been in use in the United States since 1963 and in Wisconsin since 1983. Most noise barriers have been assigned a unique structure number, similar to how a bridge is assigned a number. Noise barrier structure numbers are identified with the letter 'N' although some of the older structures were originally identified with a 'SN' prefix. Refer to Part 1, Chapter 5 for discussion on identification numbering of noise barriers.

A noise barrier is a constructed appurtenance, either alone or integrated with other systems that alter the normal noise travel at a site. The purpose of a noise barrier inspection is to assess the functionality of the barrier (that is, the ability to actually reduce noise transmission volume and projection from the roadway) and to ascertain the condition of the structure for maintenance and repair needs to prevent local or global structural failure. Very minor breaches in the wall substantially reduce its effectiveness to reduce traffic noise. Therefore the inspector should note any issues with material deterioration, joint separation or other distress that could adversely affect the performance of the wall. Oftentimes noise barriers or portions thereof will be installed on other systems, such as bridge railings, or be placed along property lines without immediate access to one or both sides. Consequently, general maintenance or repair work of these barriers may require extensive preplanning including traffic control and permitting.

Noise barriers are generally classified into two categories: Ground-Mounted and Structure-Mounted. The required inspection interval for Structure-Mounted and Ground-Mounted Noise Barrier Walls is not to exceed six (6) calendar years. Further information on inspection interval can be found in Part 4, Chapter 1 of this manual.

When a noise barrier is present on a supporting bridge or retaining wall structure, and an inspection of that supporting structure is being conducted, the inspector shall perform a cursory inspection of the noise barrier as part of the bridge or retaining wall inspection. If any significant distress is observed, the owner of the noise barrier structure should be contacted.

There are three subcategories for both Structure-Mounted and Ground-Mounted noise barriers: Double-Sided Sound Absorptive Noise Barriers; Single-Sided Sound Absorptive Noise Barriers; and Reflective Noise Barriers. Double-Sided Noise Barriers absorb sound on both sides of the wall, Single-Sided Noise Barriers absorb sound on only one side, and Reflective Noise Barriers reflect any sound transmitted towards them.

This chapter will discuss the different types of noise barriers and specific characteristics common to them, modes of failure, and inspection methodology.

4.5.1.1 Ground-Mounted Noise Barriers

Ground-mounted noise barriers are appurtenances founded on soil. There are three basic types in this category: Noise Barrier Berms; Noise Barrier Walls; and a combination of the two.

Noise Barrier Berms

Noise barrier berms are earthen mounds constructed on-site from natural materials such as soil, stone, rock, rubble, etc., and are constructed in an unsupported manner according to their

naturally stable slope. Noise barrier berms typically require more width than noise barrier walls due to the required slope of the sides, which needs to be gradual enough to maintain stability. Noise protection is typically warranted in more urban settings. Consequently, the available footprint for a structure is limited due to the higher cost associated with it. This results in the construction of a Noise Barrier Wall rather than Noise Barrier Berm in nearly all instances in Wisconsin. WisDOT does not inventory or inspect Noise Barrier Berms. Refer to Figure 4.5.1-1 for a view of a noise barrier berm.



Figure 4.5.1-1: Noise Barrier Berm between Residential Buildings (Foreground) and a Roadway (Background).

Noise Barrier Walls

A noise barrier wall is typically a designed-cantilever structure. The components are typically prefabricated off-site and assembled on-site. A variety of noise barrier wall designs exist including: post & panel; brick & masonry block; freestanding noise walls; direct burial panels; noise walls as earth retention structures; and cast-in-place concrete walls. Refer to Figure 4.5.1-2 for a view of a noise barrier wall.



Figure 4.5.1-2: Ground Mounted Metal Panel Noise Barrier Wall.

Combination Noise Berm & Barrier Wall

Many systems use a combination of types to obtain the required height of the noise barrier. Noise walls are frequently erected on top of a noise berm. Refer to Figure 4.5.1-3 for a view of a berm and noise barrier combination structure.



Figure 4.5.1-3: Combination Noise Barrier Berm and Wall.

4.5.1.2 Structure-Mounted Noise Barrier Walls

Structure-mounted noise barrier walls are systems attached to a structure, or integrally constructed with the structure. Noise barrier walls are frequently mounted on bridges and

retaining walls. For bridge inspections, it is the inspector’s task to identify all non-‘N’ numbered noise barriers, and record them as Element 8610 Noise Barrier – Structure Mounted on the bridge inspection form. Refer to Section 4.5.3 of this manual for further information on Noise Barrier Elements. If the noise barrier has an ‘N’ number assigned to it, then the noise barrier will not be recorded on the supporting structure inspection form, but will be properly inventoried and inspected under its own report and inspection interval. The inspector shall, however, note within the ‘Structure Specific Notes’ of the supporting structure report the ‘N’ number structure, where its located and perform a cursory inspection of the noise barrier and note them within this section. If significant defects affecting the functionality of the barrier or the safety of the travelling public are discovered, the owner of the noise barrier shall be notified immediately. Non ‘N’ numbered noise barriers will not be assigned ‘N’ numbers in the future. Therefore, the inspector is required to include non ‘N’ numbered structure-mounted noise barriers within the supporting structure inspection report with the appropriate element and defects. Refer to Figure 4.5.1-4 through Figure 4.5.1-6 for views of structure-mounted noise barrier walls.



Figure 4.5.1-4: Precast Panel Noise Barrier Wall Mounted on a Bridge.



Figure 4.5.1-5: Precast Concrete Panel Noise Barrier Wall Mounted on a Retaining Wall.



Figure 4.5.1-6: Precast Concrete Noise Barrier Wall Mounted on Concrete Vehicular Crash Barrier.



4.5.2 Noise Barrier Wall Inspection

Noise barriers are inspected using elements and assessments, as described in the following section. Refer to Section 4.6.3 for guidance on the elements and Section 4.5.6 for guidance on assessments. Common defects will be covered in this section.

Element Level Inspection

All noise barrier wall elements are recorded in units of linear feet. Each linear foot includes the top and both sides of the vertical projection of the exposed height of the wall element. This area is inspected and evaluated for any distress with deficiencies captured and quantified under the appropriate noise wall defects. Refer to the next section for the available defects for these elements. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The same inspection process is conducted for any remaining elements along the noise barrier wall. The inspector must also record and assess the conditions of all existing assessments on the wall. Refer to Section 4.5.6 Assessments for WisDOT noise barrier wall assessments, definitions and assessment states.

The inspector is to carefully note the type, location and measurement of any area exhibiting Condition State 3 or 4 defects. An associated photograph and/or sketch shall be provided within the report for all CS3 and CS4 defects.

Due to the similar material composition as retaining walls, the following list may be used when inspecting noise barrier walls to verify proper material function and wall stability.

- Obtain minimum edge-of-lane to wall distance.
- Verify set elevations along the face of the wall for signs of settlement.
- Inspect the vertical alignment of the wall with a plumb-bob. Most noise barrier walls should be vertical (verify with plans).
- Examine the opening of the construction joints between sections of the wall.
- Inspect joints near ground line for any fill material washing out from between or below the panels.
- Inspect panel joints for differential movement or rotation. Sight down panel face to note individual rotation or tipping out of plane.
- Inspect for erosion of the embankment material in front and in back of the wall.
- Inspect for heaving of the embankment material in front and in back of the wall.
- Inspect for settlement of the fill material along the wall.



- Examine the wall for deterioration of the material, such as cracking, spalling, corrosion, discoloration, etc. noting the width, length, depth, and/or orientation of the deterioration. Provide photographs for Condition State 3 and 4 defects.
- Check wall for evidence of efflorescence or rust staining.
- Examine Panel connections & frame, if applicable.
- Examine post base and anchorage systems if present. Fasteners and connections should be checked for tightness and distress.
- Note any varmint holes around foundation or footing base.
- Note condition of fire hydrant holes or access holes, if applicable.
- Examine and probe drains within the vicinity of the wall for signs of clogging.
- Examine site grading for any locations that may prohibit proper drainage along the wall.
- Inspect sidewalk or roadway components along the wall for signs of joint separation, potholes and areas of settlement which may indicate a more global impact on the noise barrier system.
- Examine vegetation growth along the wall. Root infiltration may create undesirable stresses on the wall and may induce cracking or failure if left untreated.
- Note previous inspection interval and recommend inspection interval.
- Examine the I.D. plaque, if applicable. Note location within the Structure Specific Notes on the inspection report.

Element Defects

WisDOT simplifies noise barrier wall distress into three defects, one concerning wall material defects and two with wall or panel movement. The defect 8903 Wall Deterioration essentially acts as an umbrella defect which refers the inspector to the unique defects of the primary material of which the wall is constructed. While there is only one material defect to code within the inspection report, it is highly recommended the inspector note the specific material defect observed and measured under the defect note. For all non-post and panel noise walls, any lateral, vertical or rotational movement shall be coded under the defect 8902 Wall Movement. Post and panel walls exhibiting movement shall be captured under the defect 1640 Masonry or Panel Displacement. Refer to the following sections for wall defects and condition state definitions. The inspector should refer to sections 4.5.4 Wall Panel Deterioration and 4.5.5 Wall Panel or Post Movement for material deterioration and potential failure modes of noise barrier walls, respectively.

The inspector shall utilize the Defect Hierarchy concerning overlapping defects within a unit of measure when rolling up the total element condition state quantities. Refer to Part 2 Chapter



3 for the Defect Hierarchy. However, only the controlling defect will be counted in the total element condition state quantity.

4.5.2.1 Wall Movement (Defect 8902)

This defect pertains to all wall types with the exception of Post and Panel Noise Barrier Walls and captures the global movement of the wall. Movement includes lateral movement (whether in or out along the plane of the wall), differential settlement or global settlement. The major function of all noise walls is to effectively redirect or absorb sound in order to allow a quieter atmosphere on the opposing side of the wall. Therefore, movement can disrupt this redirection or absorption or may be an indication that a portion of the wall may fail resulting in functional and potential safety concerns. Any movement must therefore be recorded, measured and monitored.

Refer to the following for condition state descriptions:

- Condition State 1: None. No movement is observed or measured.
- Condition State 2: Differential movement has started to occur. Wall may be strapped to prevent further movement, or movement has been arrested through countermeasures.
- Condition State 3: Wall rotation/sliding/settlement is active; if a retaining wall, then sloughing of retained material behind wall is evident. Wall may have been strapped or stabilized to prevent further movement, but this device has failed.
- Condition State 4: Wall has failed.

It is important to note that these condition states are for the linear foot unit of measure. Therefore condition states 3 and 4 shall have representative measurements and photographs within the report.

4.5.2.2 Wall Deterioration (Defect 8903)

This defect reflects the localized material breakdown of the major wall components. It describes the material flaws, defects, etc. in the overall wall system. This defect refers the inspector to the specific material defects comprising the wall. That is, when inspecting reinforced concrete wall components, the inspector shall refer to the reinforced concrete defects, or when inspecting a steel panel noise barrier wall, the inspector shall refer to steel defects. All material defects can be found in the WisDOT Field Manual or within Part 2 Appendix A. Refer to the following for condition state descriptions:

Refer to the following for condition state descriptions:

- Condition State 1: The wall material has deterioration described in the applicable CS1 material defects of section loss and wall integrity.
- Condition State 2: The wall material has deterioration described in the applicable CS2 material defects for section loss and wall integrity.



- Condition State 3: The wall material has deterioration described in the applicable CS3 material defects for section loss and wall integrity.
- Condition State 4: The wall material has deterioration/section loss that has caused the wall to fail and no longer performs the intended function.

It is important to note that these condition states are for the linear foot unit of measure. Therefore condition states 3 and 4 shall have representative measurements and photographs within the report.

4.5.2.3 Masonry or Panel Displacement (Defect 1640)

This defect shall be available only for post and panel noise barrier walls. It describes panels and their movement in relation to the overall wall. Therefore, when individual panels are observed to move, the inspector shall use Masonry or Panel Displacement defect to describe movement rather than Defect 8902. Refer to the following for condition state descriptions:

Refer to the following for condition state descriptions:

- Condition State 1: None. No movement is observed or measured.
- Condition State 2: Block, stone or panel has shifted slightly out of alignment.
- Condition State 3: Block, stone or panel has shifted significantly out of alignment or is missing but does not warrant a structural review.
- Condition State 4: The condition warrants a structural review to determine the effect on strength or serviceability of the element, or a review has been completed and it has been found that the defects impact strength or serviceability.

It is important to note that these condition states are for the linear foot unit of measure. Therefore condition states 3 and 4 shall have representative measurements and photographs within the report.

4.5.3 Noise Barrier Wall Elements

Two noise barrier elements are available during an inspection: Noise Barrier Wall – Ground Mounted (8609) and Noise Barrier Wall – Structure Mounted (8610). Depending on the construction of the wall, the inspector shall choose the appropriate noise barrier wall element and perform an inspection of all exposed surfaces of the element recording all defects and attached assessments along its length.

4.5.3.1 Noise Barrier Wall – Ground Mounted (Element 8609)

Noise walls that are not attached to other systems are considered ground mounted.



Figure 4.5.3-1: Ground Mounted Noise Wall.

4.5.3.2 Noise Barrier Wall – Structure Mounted (Element 8610)

Noise walls that are attached to other systems are considered structure mounted. If the noise barrier is attached to the bridge and has an 'N' number assigned to it, then the noise barrier will not be recorded on the bridge inspection form. However, it is the inspector's due diligence to perform a cursory inspection of the noise barrier to ensure that the travelling public is not threatened by any notable deterioration of the noise barrier. Any areas of concern can be captured as maintenance items, but would not have the element associated with it.



Figure 4.5.3-2: Structure Mounted Noise Wall. Mounted to Retaining Wall Structure.



4.5.3.3 Bridge Rail (Elements 330-334)

Noise walls may have or may be mounted to bridge rail elements. As part of a structure mounted system, these rail elements should already be inspected under the appropriate structure inspection (either a 'B' or 'R' numbered inspection). Therefore, structure mounted 'N' numbered noise barriers need not have bridge rail elements within the inspection report. However, similar to 'N' number structures on support structures, the inspector shall note the bridge rail element within the 'Structure Specific Notes' portion of the report and note any distress or deterioration that may adversely affect the noise wall. In addition, if it is deemed the distress is significant enough to encroach upon the safety of the travelling public, the owner of the bridge railing element shall be notified.

For non-'N' numbered noise barrier wall elements on bridge railing elements, the inspector shall include the appropriate bridge rail element and evaluate its condition along its length similar to a bridge railing element inspection under Part 2 of the Structure Inspection Manual. Refer to Part 2.6.7 Traffic Safety Features for Bridge Rail Element definitions and defects.

4.5.4 Wall Panel Deterioration

Failure of the construction material is frequently observed at older noise barrier structures. The following section is a brief outline of material defects typically found during inspections. Many of the types of defects associated with noise barriers are the same as those associated with retention structures. As such, the discussion of material defects will be relatively similar. Refer to Part 2, Section 1.1.4 of this Manual for a more in-depth description of the defects and causes associated with these materials.

4.5.4.1 Impact Damage

Impact damage is unique to no one noise barrier wall material. Impact damage is the result of a collision between a moving object and the noise barrier structure. This is typically the result of an errant vehicle but may also occur due to forces generated by a severe storm, explosion, or similar such phenomena hurling objects into the wall.

Impact damage is typically confined to an area directly adjacent to the point of contact and is characterized by distortion or crushing of the construction material at the point of contact with cracking, splitting, or splintering radiating from this point. Refer to Figure 4.5.4-1 through Figure 4.5.4-3 for views of impact damage.



Figure 4.5.4-1: Impact Damage to a Noise Barrier Wall.



Figure 4.5.4-2: Impact Damage to a Noise Barrier Wall.



Figure 4.5.4-3: Impact Damage with Failed Post and Paneling of Structure Mounted Noise Wall.

4.5.4.2 Masonry Noise Barrier Walls

The following is a discussion of different types of material defects that may be found when inspecting masonry units. Refer to Figure 4.5.4-4 for an overall view of a masonry noise barrier wall. Refer to Part 4, Section 4.3.1 for photographs of typical Masonry deterioration.



Figure 4.5.4-4: Typical Masonry Noise Barrier Wall.

- **Construction Defects:** Construction flaws are often characterized by damage to the blocks that appear to be due to poor construction technique or errors. Examples might



include evidence of cracked units, open joints in locations other than a bend, or evidence of improper design or construction, such as improper block alignment.

- **Corner Breaks:** One or more of the block corners are cracked or broken off. The plane of fracture is approximately 45 degrees from vertical, and the size of the fracture exceeds 2 inches along all three major axes. Smaller breaks should be considered to be fraying or edge spalls.
- **Cracked Block:** Randomly cracked block units. The direct cause of the crack development is uncertain. Examples might include diagonal or straight crack propagation across the capstone, or vertical crack propagation along the face of the stone.
- **Efflorescence:** Efflorescence, informally referred to as leaching, is a white deposit on the concrete surface caused by the crystallization of soluble salts (calcium chloride, calcium hydroxide) contained within the cement paste. Water traveling through the concrete dissolves these salts and usually deposits them along cracks where the water exits. Efflorescence indicates that water and dissolved chemicals are able to pass through and contaminate the concrete. This is primarily an aesthetic problem, but can serve as evidence of increased block porosity and weakness in extreme cases.
- **Embedded Vegetative Growth:** This is the presence of plant foliage growing from between the block units or in wash-through deposits. The penetration of plant roots into the blocks may cause units to crack either through root growth into pores and small flaws or by extensive plant growth between block units. Neither exposed fine tree and plant roots that have grown through the wall from behind, nor plants present as architectural enhancements are considered Embedded Vegetative Growth.
- **Abrasion:** Abrasion is the loss of surface material due to the action of water or wind-blown particles. This distress may be easily confused with surface scaling and freeze-thaw damage because the latter two are generally more severe in areas of water flow and saturation. Abrasion is typically evidenced by relatively uniform loss of surface mortar along the paths of water flow. Surface scaling and freeze-thaw damage is generally greater in depth.
- **Fraying/Spalling (Block Edges):** Fraying/ spalling is the presence of minor chipping along block edges and corners. Occasionally fraying/ spalling will be the result of improper handling and placement during construction. Other causes include thermal expansion, or the placement of blocks on uneven surfaces. The presence of a large number of spalls in the same place on each block may indicate a problem in manufacturing.
- **Freeze-Thaw Damage:** This is the progressive internal deterioration of saturated block material in the presence of freezing and thawing temperatures. The expansion of water during freezing periods can produce significant internal damage. Resulting defects will appear as areas of crumbling or general deterioration. This type of damage is most often found in areas that are frequently saturated and exposed to freezing conditions. Note if this type of damage is occurring on a vertical or horizontal surface.

- **Manufacturing Flaws:** These are systematic flaws in the block units that are the result of a design or manufacturing problem.
- **Popouts:** Aggregate particles near the surface of the block units that have expanded and caused concrete to flake or chip off. Typically caused by water trapped near the surface of the concrete that freezes and expands.
- **Scaling:** This is a special type of freeze-thaw damage. It is generally characterized by significant exterior damage and crumbling, more so than typical freeze-thaw damage. Refer to Figure 4.5.4-5 for a view of heavy scaling on a masonry noise barrier wall.
- **Staining:** This is the discoloration of block units caused by exposure to elements such as surface runoff containing dark clays or organic material, deicing chemicals, mold growth, moss, and other sources. While staining in general is aesthetic, on other materials such as vinyl or other plastics, it could be an indication of an area of weakening material.
- **Structural Distress:** Any evidence of structural failure of the entire block unit such as shifting and wall movement.



Figure 4.5.4-5: Heavy Scaling with Efflorescence on a Masonry Noise Barrier Wall.

4.5.4.3 Concrete Noise Barrier Walls

The following is a discussion of different types of material defects that may be found when inspecting pre-fabricated concrete panels and cast-in-place concrete. Refer to Figure 4.5.4-6 for an overall view of a concrete noise barrier wall.



Figure 4.5.4-6: Overall View of a Concrete Noise Barrier Wall Comprised of Reinforced Concrete Core and Durisol (wood/cement fiber) Cladding.

- **Fraying/Spalling/Exposed Reinforcing Steel:** Fraying/spalling is the presence of minor chipping along the concrete edges and corners. Occasionally fraying/spalling will be the result of improper handling and placement during construction. Other causes include thermal expansion, or the placement of concrete sections on uneven surfaces, or lowering into place in a cocked position. The presence of a large number of spalls in the same place on each block may indicate a problem in manufacturing. Consistent spalling over time can result in exposed reinforcing steel.
- **Scaling:** This is a special type of freeze-thaw damage. It is generally characterized by significant exterior damage and crumbling.
- **Cracking:** Random cracks in the structure. Examples might include diagonal, straight, or horizontal crack propagation. Cracking may also occur longitudinally within the concrete core of the Durisol type panels which may not be visible except along the bottom face of the bottom panel of structure-mounted noise walls. Refer to Figure 4.5.4-7 for a view of a concrete panel with a horizontal crack. Refer to Figure 4.5.4-8 for a view of cracking along the underside of a bottom panel of a structure mounted noise wall.



Figure 4.5.4-7: Concrete Panel Noise Barrier Wall with a Horizontal Crack at Mid-Panel.



Figure 4.5.4-8: Cracking with Efflorescence Along Midline of Underside Panel.

- **Corrosion:** Corrosion of the steel posts between panels will typically occur along the side facing the roadway spray and especially at the base where debris and deicing agents will accumulate. The inspector should check for scaling, pack rust and section loss. Digging out a few inches of material around the steel posts may be required to fully expose corrosion occurring at the groundline. Refer to Figure 4.5.4-13.

- **Crushing:** Crushing of Durisol type panels is common at the bottom corners where the wall is supported on bearing pads. This is often attributed to inadequate bearing area due to undersized bearing pads or shims.
- **Misalignment:** Improper shimming at the base of the panels may magnify to the upper panels leading to the top panels no longer being held within the flanges of the steel support posts.

4.5.4.4 Timber Noise Barrier Walls

The following is a discussion of different types of material defects that may be found when inspecting timber. Refer to Figure 4.5.4-9 for an overall view of a timber plank noise barrier wall and Figure 4.5.4-10 for a view of missing timber planks on a noise barrier wall.



Figure 4.5.4-9: Timber Plank and Post Noise Barrier Wall.



Figure 4.5.4-10: View of Broken and Missing Timber Planks.

- **Decay:** This is the breaking down of a material as a result of bacteria or fungi attack.
- **Insect Infestation:** Often, insects such as termites use timber as food and shelter. These and other insects can be detrimental to the integrity of a timber wall and can cause significant internal damage.
- **Vermin Damage:** Damage by small animals and birds using the timber for shelter can also be significant.
- **Fire Damage:** If the structure appears black, a piece of it has disappeared, or a large amount of ashes are present at the site, it is likely the structure was damaged by fire.

4.5.4.5 Metal Noise Barrier Walls

The following is a discussion of different types of material defects that may be found when inspecting metal. Refer to Figure 4.5.4-11 for an overall view of a metal noise barrier wall.



Figure 4.5.4-11: Steel Noise Barrier Wall.

- **Fatigue Cracking:** Cracks that have formed as a result of cyclic wind loading.
- **Corrosion:** This type of deterioration is the slow, steady deterioration of ferrous material due to exposure of bare metal, moisture and oxygen. Exposure to deicing chemicals act as a catalyst and accelerate metal corrosion. Refer to Figure 4.5.4-12 and Figure 4.5.4-13 for views of metal corrosion.



Figure 4.5.4-12: Severe Corrosion of a Metal Noise Barrier Wall.



Figure 4.5.4-13: View of Through Section Loss Along the Base of a Post for a Post and Panel Noise Wall.

4.5.4.6 Noise Barrier Walls of Other Materials

Several other materials gaining greater use in the construction of noise barriers include transparent panels; plastics; recycled rubber; and FRP composites. Refer to Figure 4.5.4-14 for a view of a plastic composite noise barrier wall. These materials typically exhibit the following types of deterioration:

- **Ultraviolet Degradation:** The material may exhibit cracking, discoloration or show signs of disintegration. This is typically the result of continuous exposure of sun light on materials that are not UV-stable.
- **Material Incompatibility:** In certain instances two or more materials in contact with one another may induce a chemical reaction that is detrimental to one or all of the materials. This is more common with two different metal types touching such as galvanized steel and aluminum however it may occur with other materials as well. The inspector should look for any type of indications at the interfaces between two differing materials. The buildup of scale or leachate may be an indication of distress between the materials.
- **Corrosion Damage:** Similar to steel corrosion, other metals also undergo the same electro-chemical process when exposed to moisture, air and deicing agents.
- **Overstress Damage:** Concrete and steel can withstand tremendous stresses relative to member sizes. Other materials when shaped similarly to their concrete or steel counterparts may not be capable of this same resistance and may exhibit undesirable behavior such as creep or buckling under weight. The inspector should note any warping or rippling occurring within a material surface as this may be an indication of oversteering or over application of a material type.



Figure 4.5.4-14: Plastic Composite Noise Barrier Wall.

4.5.5 Wall Panel or Post Movement

Wall movement may be the result of numerous factors, including soil settlement or material or component failure. Refer to Figure 4.4.7-1 through Figure 4.4.7-6 in Part 4, Chapter 5 Retaining Walls for types of wall movement.

4.5.5.1 Vertical Movement

Vertical movement can occur in the form of uniform settlement or differential settlement. Uniform settlement will have little effect on the structural stability of the wall. Differential settlement, on the other hand, can create serious problems in the wall. Differential settlement may cause the opening of joints or cause wall cracking or transverse tipping of the wall.

The most common causes of vertical movement consist of soil bearing failure; soil consolidation; erosion; and deterioration of the foundation material. On structure-mounted noise walls, the inspector should pay close attention to the panels nearest the transition from bridge to retaining wall. Bridges tend to not settle due to foundations on piling whereas retaining walls will not typically bear on such a robust substructure and are, in fact, designed to settle, often 3 inches or more. Newer designs eliminate this problem by using double posts and ending the noise wall at the bridge/retaining wall joint.

4.5.5.2 Lateral and Rotational Movement

Noise barrier structures that are structure mounted to retaining walls are susceptible to lateral movements or sliding and rotational movements. Lateral movement occurs when the lateral soil pressures behind the retaining wall exceed the resisting soil frictional and shearing forces or anchorages that hold the retaining wall in place. Rotational movement, or tipping, is generally the result of asymmetrical settlements or lateral movements; however, it may result from increased soil pressure behind the retaining wall. As the retaining wall begins to rotate



or tip, the noise wall supported to its top will follow suit. This resulting rotation is magnified by the fact the noise wall extends much higher than the retaining wall.

Noise walls secured to footings in the ground may also exhibit lateral and rotational movement if there is improper drainage or excessive freeze/thaw in the soils. When drainage systems along the wall are not properly removing water from the adjacent soils, the soils can become saturated forcing any additional water to “find” another means of outletting. This can result in slope damage or erosion around the base of the footings. Saturated soils of less cohesive make ups could slide potentially failing the noise wall.

The most common causes of lateral movement are slope failures; seepage; changes in soil characteristics (e.g., frost action and ice); and long term consolidation of the original soil. The most common causes of rotational movement are saturation of backfill due to clogged drains; erosion of the embankment along the front of the wall; and improper design. Refer to Figure 4.5.5-1 for a view of lateral wall movement and its effects on a wall. Refer to Figure 4.5.5-2 for a view of a failed drain tile system resulting in the washout out of material below a noise wall.



Figure 4.5.5-1: Lateral Movement of a Noise Barrier Wall.



Figure 4.5.5-2: Drain tile system failure below noise wall resulting in loss of material and exposure of noise wall footing.

4.5.6 Assessments

Assessments allow for the evaluation of secondary components not necessarily impacting the structural integrity of the structure. The inspector must be familiar with all the available assessments within the HSI system and appropriately capture them within the inspection report for each noise barrier wall structure. Evaluating assessments provides a more accurate picture of the structure being inspected and alerting the Department of potential future issues including traffic hazards or functionality of the wall. All available assessments for noise barrier walls are the same as described for retaining walls. Refer to Part 4 – Chapter 5 Retaining Walls, Section 4.5.4 Retaining Wall Assessments.

4.5.7 Recommended Inspection Procedures

Each structure should be inspected for component deterioration, impact damage and site conditions that may potentially contribute to failure of the barrier. Erosion of the berm material is the only type of deterioration that will compromise the effectiveness of the noise berm. A visual Inspection of Noise Barrier Walls can usually be completed without special access equipment. However, the inspector may need to utilize a bucket truck or ladder to obtain additional information on significant defects above ground, especially at connection or panels of structure-mounted systems. For noise walls that have significant vegetative growth that obscures the view of the wall (often due to wild or intentionally planted ivy), scheduling the inspection in the winter months after the leaves have fallen is recommended.



Inspection reports with documented condition state 3 or 4 defects require accompanying photographs. Each location of condition state 4 distress must have a photograph while an overall condition photo may be permitted for condition state 3.

During an inspection, the inspector is responsible for reviewing and verifying all inventory data such as but not limited to:

- Wall dimensions
- GPS coordinates
- Location
- Inspection procedures

While inspecting of steel components, the inspector should have access to non-destructive testing equipment. Additional evaluation may be required on anchorage systems or fasteners exhibiting excessive section loss to determine whether the component is compromised or in need of repair or complete replacement. D-meter readings and measurements should be performed on steel members in those locations exhibiting heavy scale, such as the post base or at fasteners.

The following general sequence can be used for Noise Barrier Wall inspections:

1. Mobilize to site and set-up traffic control.
2. Identify structure number, if applicable.
3. Perform Inspection.
4. Review inspection notes by inspector to ensure completeness and correctness.
5. Determine previous inspection interval.
6. Recommend new inspection interval (if different from the old).
7. Notify the noise barrier owner if there are any significant safety issues that require immediate correction.
8. Remove traffic control.