Obstructions behind MSE Walls and Feasible Solutions

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Obstruction behind MSE wall and Feasible Solutions

Typical MSE Wall

- Facing Element
- Soil Reinforcement
- Select Backfill

**Typical MSE Wall**
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Obstructions hinder the Normal placement of the soil reinforcement that can affect the MSE Wall Structure.

This presentation will present feasible solutions to deal with obstruction in the MSE Wall backfill.
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AASHTO Section 11.10.10.4

General Guidelines - Obstructions in the MSE wall Backfill

1. Design the surrounding reinforcement layers to carry the additional load which would have been carried by the severed reinforcements.
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AASHTO Section 11.10.10.4

General Guidelines - Obstructions in the MSE wall Backfill

2. Place a structural frame around the obstruction

3. Skew the reinforcements around the obstruction.
Additional General Guidelines

Section 5.4 of FHWA-NHI-10-024: Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume I (FHWA, 2009a).

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The AASHTO recommendations provides:

1. General guidance only

2. Guidance for only two types of obstructions behind the MSE wall – an inlet and a circular shaft.

3. Does not cover the more complex cases.
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Drainage Structures Behind MSE Walls
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RW-IR Inlet – Avoid this Inlet
This inlet was not intended to be used behind an MSE wall

Issues with this inlet

1. Do not connect panel directly to the inlet.
2. No room to attach angle or structural frame around obstruction.
3. 12’ Long Inlet.
4. Lateral Pipe in the backfill
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Issues with this inlet
1. 16’-4” long inlet – undesirable large skew angle.
2. Design for Bin Pressure between Inlet and panel.
3. Special backfill required
4. Taller inlets – check for the stability of Inlet - may require backer panels
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Avoid Long Inlets within the MSE Backfill
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Avoid Lateral Pipe in MSE Wall Backfill

1. Difficult to construct and compact around pipes.
2. Skew Soil Reinforcements over or beneath pipe.
3. Things change in field - contractor takes matters into his own hands.
4. Flexible connections in RCP should be used and designed to tolerate the estimated movement and stress – NHI Manual.
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Avoid Lateral Pipe in MSE Wall Backfill
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Avoid Lateral Pipe in MSE Wall Backfill
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Avoid Lateral Pipe in backfill - But if absolutely necessary then:

1. Locate Pipe such the max. skew angle is 15 degrees or less.

2. Limit Max. diameter of pipe to 24” - AASHTO limits 33” between soil reinforcement layers

3. Pressurized water mains should not be constructed within an MSE structure. NHI Manual.
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1. Design for Bin pressure between Wall and back-up panel.
2. This detail should not be used at the top of the wall or bottom of wall – cantilever design with no strips above or below of pipe.
3. If Traffic Barrier with moment slab at top of wall – additional loading from Impact load.
4. If you absolutely needs this detail – check the structural capacity of the angle and bolts.

Figure 5-23 NHI Manual - Example of backup panels for large horizontal obstructions.

Avoid this detail
Relocated RCP out of Backfill
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Feasible solution
Inlet and Lateral Pipes

Recommendations:

1. Use normal size Inlet (6’ wide max.) and maintain at 6” between the back of panel and the inlet – allow space for the angle iron.

2. Place Lateral pipe outsides the limits of the soil reinforcements.

3. Exit RCP out back of inlet.
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Feasible Solution - Texas DOT RWRI Inlet

1. The very **Best/Most Feasible Solution** for a drainage Structure behind an MSE wall - **Texas DOT RW-RI Inlet**

2. This inlet was specifically design for an MSE wall.

3. Shallow inlet – will not hinder placement of soil reinforcements

4. Easily skew strips around the vertical riser pipe.
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Avoid Skewed Box Culvert

1. Creates an acute corner next the Box culvert
2. Difficult to Design and Construct – potential of panel bulging outwards
2. Special Backfill required
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MSE Wall panel bulged outwards at Acute Corner
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Feasible solution

1. Box Culvert perpendicular to MSE Wall.
2. Alternatively, Box Culvert 25-degree maximum skew angle to MSE Wall.
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Shafts behind MSE Walls
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Avoid
1. Avoid shafts directly behind the back of the panel.
2. Avoid shafts in the corner.
3. Limit Size of Shaft diameter to allow placement of the soil reinforcements.

Drilled Shafts behind the MSE wall
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Avoid shafts directly behind the back of Panel. Field modifications were required

Avoid shafts in corner Difficult/Impossible to construct.
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Avoid Large Diameter Shafts/Closely Spaced Shafts.
Difficult to construct and cannot attach soil reinforcement to the panel
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**Feasible Solutions**

1. Locate the shaft to achieve a 15-degree skew angle
2. Do not locate shaft in the corner
3. Limit the size of shaft.
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1. Maintain at least a min. clearance of 1’-6” in all directions.

2. Max. skew angle = 30 degrees with the necessary review and modifications.

Feasible Solutions
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Phase Line Construction
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Plan View – Phase Line Construction

**Most Feasible Solution**
Construct the temporary MSE wall Perpendicular to the permanent MSE Wall
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Temporary MSE wire wall with Metallic soil reinforcements

Areas of Concern for overlapping Metallic Soil reinforcements:

1. The temporary wire wall could be supplied by a different wall supplier.

2. Concern - non-galvanized Soil reinforcements making contact with the galvanized soil reinforcement.

Phase Line Construction
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Temporary MSE wire wall with Geosynthetic soil reinforcements

Areas of Concern for overlapping Metallic & Geosynthetic Soil reinforcement:

1. Two different types of soil reinforcement – metal is inextensible vs geosynthetic is extensible – can cause issues.

2. Depending on the type of geosynthetic reinforcement, the wire wall can bulge outward, which is normal, however this can cause issue with the permanent precast wall panel.
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Phase Line Construction
Issues with Geosynthetic soil reinforcement bulging causing the permanent panels to move horizontally.
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Centerline of the Roadway is on a Skew relative to the Bridge Abutment

Avoid placing the Temporary wire wall on a skew angle relative to the MSE wall.
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Phase 1 is not an issue
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**Challenges**

1. An acute corner is formed between the Temporary MSE wire wall and permanent MSE wall (Yellow shade).
2. Permanent Soil reinforcement cannot be extended the full length to reinforce the soil (Green Shade).
3. Need pressure relief wall to remove the horizontal load off the acute corner – basically the Temporary wall becomes a permanent MSE wall.

**Phase 2 has Design and Construction Challenges**
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Feasible Solution

Construct the temporary MSE wall Perpendicular to the permanent MSE Wall

Slight adjustment of Temporary wire Wall
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Conclusion

- This presentation is being presented to convey the most feasible solutions for the most common obstructions located behind MSE walls.

- These solutions could then be considered by the owner’s engineers when developing the contract plans for the owner.

- The goal would be to eliminate difficult design and construction issues, potential field problems, and provide an overall better design of the MSE wall for the owner.
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**Conclusion**

- Keep in mind, the wall supplier and the contractor are not part of the development of the contract plans. Therefore, they are not part of the initial project planning.

- So, it is vital that a careful review and consideration of the proposed feasible solutions for MSE walls be considered during the project planning stage.

- If proper coordination among various entities involved can be achieved, then it makes it possible to achieve optimum designs with respect to reinforcement reconfiguration around obstructions found within reinforced fill.
Questions

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