Methodology to Rehabilitate Heavy Rail Retaining Walls to Extend their Useful Life

Date: 2012 (Posted 2016)

Project Name: MTA Long Island Railroad (LIRR) Capital Projects

Abstract: By effectively utilizing the construction techniques described in this lesson, the LIRR was able to rehabilitate their continuous retaining walls in a timely, cost-effective manner, with minimal disruption to the riding public.

Project Phase(s): Design and Construction

Category: Cost, Schedule, and Scope

1. Background

The MTA Long Island Rail Road (LIRR) is one of the busiest commuter rail in North America, with operations dating back to 1834. The LIRR system includes 11 rail lines stretching from Montauk, on the eastern tip of Long Island, to Penn Station in the heart of Manhattan, approximately 120 miles away. Due to the age of the system, the LIRR continuously modernizes its assets to maintain a State of Good Repair. A recent project provided for the rehabilitation of 8,600 feet of the retaining walls on the Port Washington Branch to extend the useful life by thirty years. The retaining walls are semi-gravity walls, built in the early 1930s and are located on both the north and south sides of the two tracks.

Issue:

The retaining walls, supporting the track structure along the Port Washington branch, exhibited significant deterioration with spalling, cracking, efflorescence and alkali silica reaction-induced disintegration. In some locations, the field inspections showed that the walls were not repairable. Complicating the repair/rehabilitation process was the need to maintain LIRR train service on this important branch, with minimal disruption. A typical cross section is shown in Figure 1.

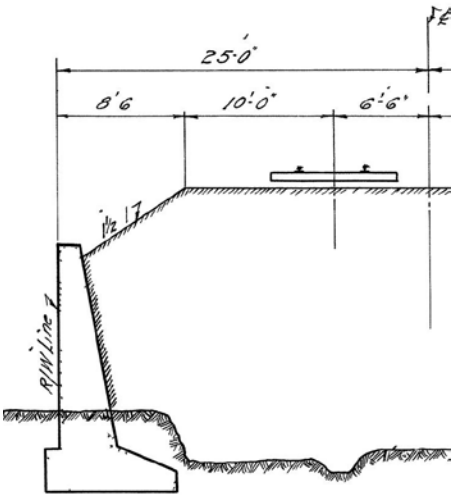

Figure 1: Cross Section of the Typical Retaining Wall and Track Configuration

Solution:

The design philosophy developed for this project was to rehabilitate the retaining walls, rather than reconstructing. Two rehabilitation types were performed; Type "A" repair for moderate damage, where the walls were repairable and Type "B" for severe damage, where the walls were not repairable. The unique aspect of the Type "B" rehabilitation included the use of soil nails which were used to replace the function of the existing walls, as opposed to replacing the walls with new, conventional retaining walls. The three critical advantages of this application were:

- Temporary sheeting, which would have been difficult to install, due to proximity of the railroad track, was not required;
- Construction could be performed without affecting railroad operations; and
- Construction of the soil nail walls was significantly less costly than the total replacement of the walls.

Construction Methodology of the Type "B" Repair:

- Core pockets of concrete at the wall face. Drill holes into the soil and install the soil nails. Grout the soil nails into place. Anchor the soil nails to the remaining portion of the retaining wall until the new wall's construction is complete; See Figure 2.
- Remove nine inches of the existing wall face and 12 inches at the top of the wall; See Figure 3.
- Install new reinforcing steel at the top of the wall and along the wall face and then pour the new concrete wall. Attach the soil nails to the new wall with anchor plates and welded shear studs. See Figure 4.

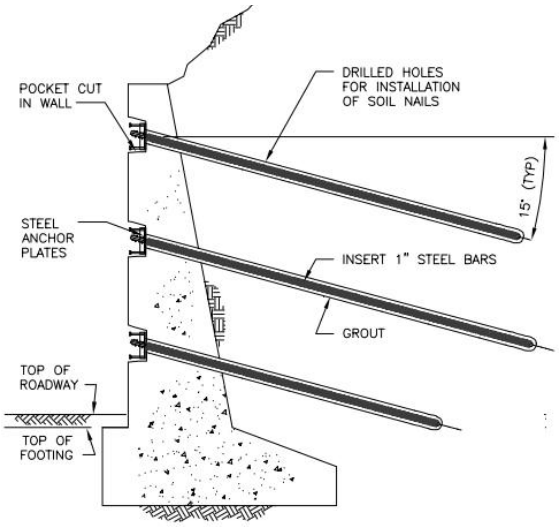

Figure 2: Installation of Soil Nails

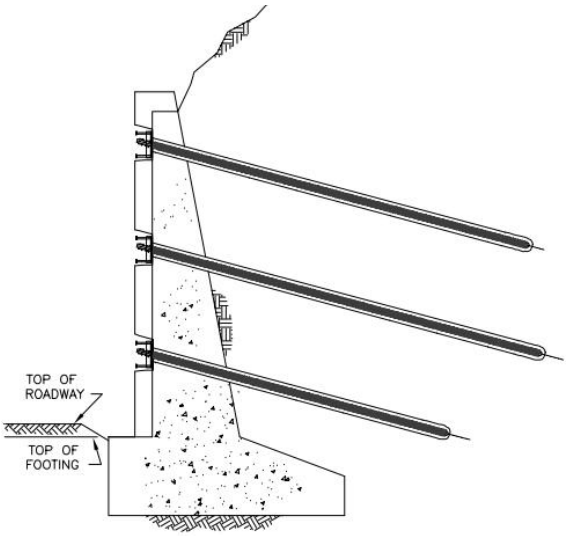

Figure 3: Removal of Concrete at the Wall Faces and Cap

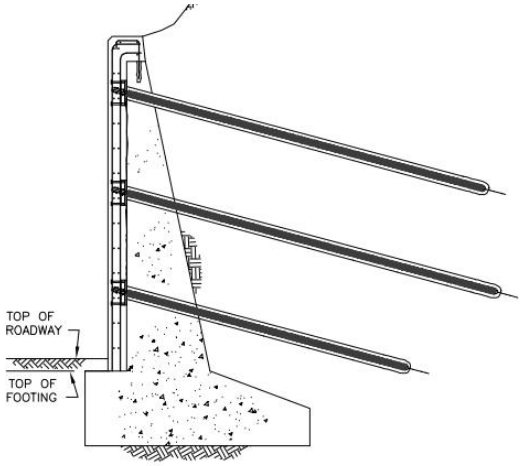

Figure 4: Construction of the Reinforced Concrete Wall and Cap

Construction Methodology for Wall Stability:

Ground anchors were installed to improve the factor of safety for sliding and overturning to meet the latest American Railway Engineering and Maintenance-of-Way Association (AREMA) standards. The following is the sequence of operation:

- Drill holes at the base of the retaining wall, approximately ten feet on center, with an inclination angle of 15 degrees;
- Insert high-strength strand tension anchors into the drilled holes; and
- Load test the ground anchor to ensure design performance.

2. The Lesson

By effectively utilizing this construction technique, the LIRR was able to rehabilitate their continuous retaining walls in a timely, cost-effective manner, with minimal disruption to the riding public. The rehabilitation is expected to add 30 years of useful life. The critical success factor was the use of soil nails that were used to replace the function of the

existing walls, as opposed to replacing the walls with new, conventional retaining walls, which would have required temporary sheeting and would have been significantly more disruptive to train service operations. An additional success factor was the ability to improve the factor of safety, while reducing overturning and sliding tendencies, by installing ground anchors.

3. Applicability

The lessons learned by the LIRR are applicable to all transit properties that must replace continuous retaining wall structures supporting their track bed system.

4. Contact Person/Info

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