

Project Title: Concrete Barrier Design for Use in Front of a Slope of on MSE Wall

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Project Objective

Develop and test a design for a rigid concrete barrier that can be placed in front of slopes as steep as 1.5H:1V or on top of an MSE wall. The design would not require a moment slab and minimize the amount of widening behind the barrier. The design feature would be a concrete barrier with a single slope face. It should be assumed that the barrier would be precast with a 20' maximum length. Adjacent barrier segments will be connected using the grouted rebar-grid connection. The barrier would be tested using MASH-08 criteria.

Work Performed to Date

In previous quarters, TTI researchers evaluated the strength of the grouted rebar-grid connection in a bogie vehicle impact test using two single-slope barrier (SSB) segments. The researchers also developed a finite element model of the barrier installation used in the bogie test. The properties of the surrogate grouted rebar-grid connection used in the simulation model were calibrated to match the lateral deflection of the barrier observed in the test. The details of this testing and simulation can be found in previous Quarterly Progress Reports.

In this quarter, using the deflection response of a single grouted rebar-grid connection, the researchers developed a finite element model to evaluate a free-standing 100-ft installation of the SSB. Simulation results indicated that the free standing barrier will result in deflection of greater than 1.5 feet in a full-scale 2270-kg vehicle impact. This deflection is more than acceptable as per the objectives of this research. Thus, the researchers started to evaluate constraining the barrier by embedding it in soil.

The scope of the original project included conducting quasi-static push tests on compacted soil layers of different thicknesses to measure their force-deflection response. The idea was to include this force-deflection response in the system finite element model of the SSB installation and evaluate if the barrier was adequately constrained for a TL-3 impact. On re-evaluation of the scope, the researchers determined that the quasi-static push tests were not adequate to measure the soil response. Dynamic soil resistance due to the mass inertia of the soil would have been missing in the quasi-static push tests. Therefore, after consultation and approval of the Technical Task Representative, instead of using the quasi-static push tests, the researchers conducted another surrogate bogie impact test with two SSB segments connected via grouted rebar-grid connection and embedded in a 10-inch soil layer (as shown in figure 1).

Use of this bogie test helped evaluate the response of the single grouted rebar-grid connection when embedded in a 10-inch soil layer. When impacted with a 5004-lb bogie at a speed of 14.4 mph, the maximum permanent barrier deflection was 4.45 inches at the joint. The researchers then incorporated the 10-inch soil layer into the finite element model of the

bogie test and calibrated soil properties to match the barrier deflection observed in the bogie test as shown in figure 2.

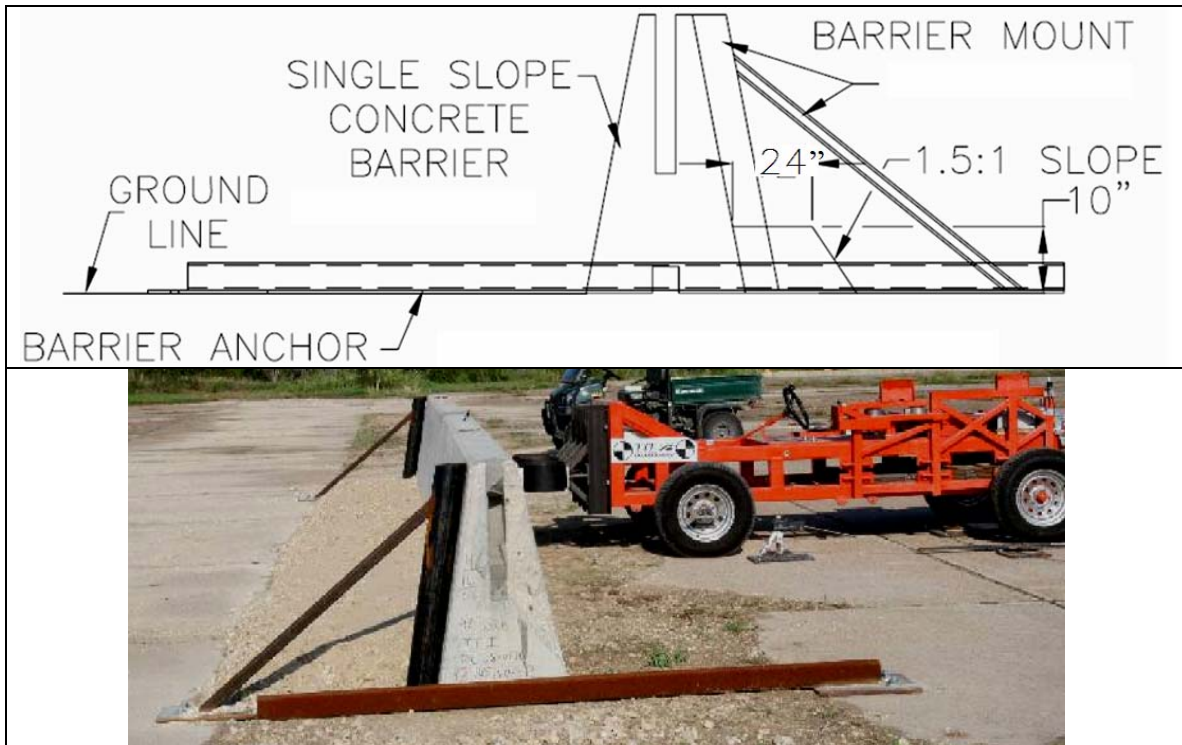


Figure 1: Bogie test setup for embedded barriers.

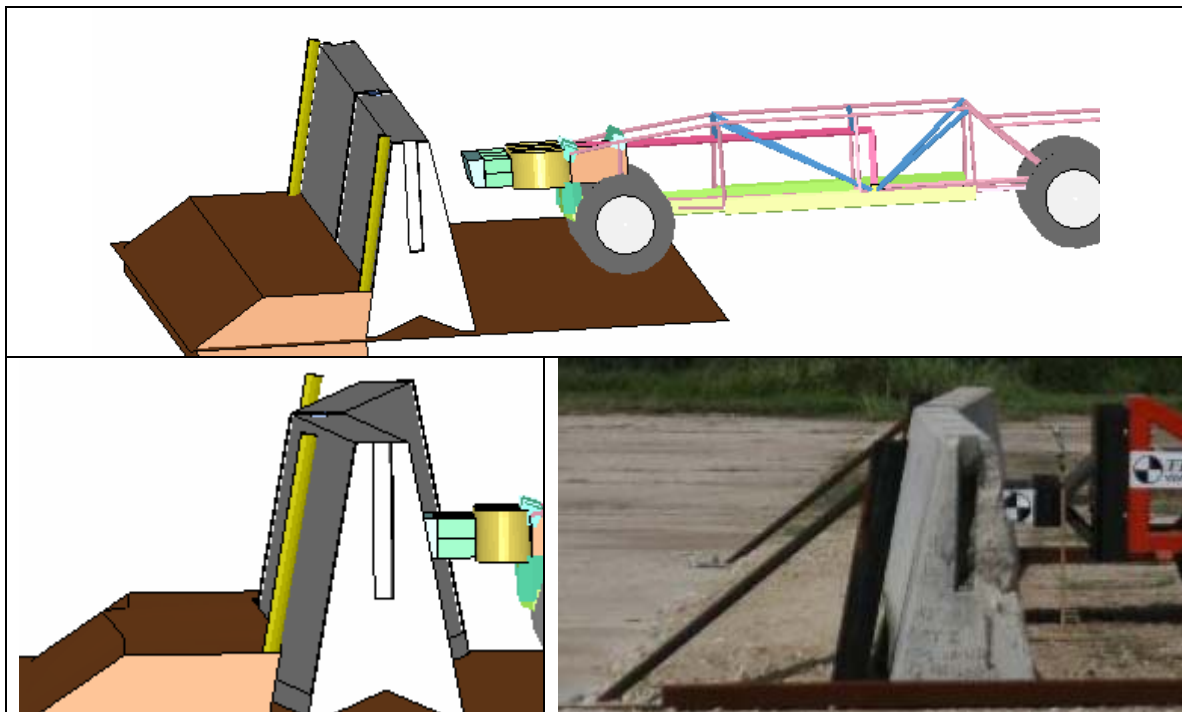


Figure 2: Simulation and test results of bogie test with embedded barriers.

The researchers have started incorporating the soil embedment of the barriers in the 100-ft system model of the SSB to evaluate its performance under a test-level 3 (TL-3) impact.

Results of Work Performed

The deflection of the embedded barrier segments in the bogie test is shown in figure 2. The deflection of the calibrated bogie test model is also shown in figure 2. The finite element model of the 100-ft embedded SSB system is shown in figure 3. The model is currently under development.

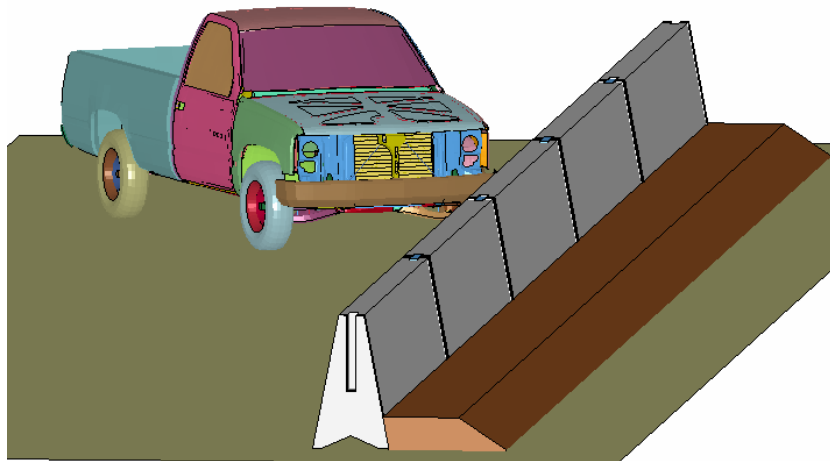


Figure 3: System model of 100-ft SSB installation.

Work Remaining to be Completed

Simulation analysis will be performed to evaluate the performance of the embedded SSB system under MASH-08 impact conditions. If the simulation results indicate an acceptable overall deflection of the barrier system, a full scale crash test will be performed to verify simulation results. If however the simulation results indicate that the embedded barrier will result in unacceptable deflections, the researchers will have look into other methods of restraining the barrier, such as by using pins, straps, modifying connection types, etc. In this scenario, the project scope and budget will have to be revised in consultation with the project Technical Task Representative.