


Project Title:	MASH (TL-1 or TL-2) Crash Testing of Concrete Barrier Sloped End Terminals (2023-01-LCB)
Project Synopsis:	<p>State DOT's have several options to terminate concrete barrier runs. One of the options is to use concrete sloped end terminals. The sloped end terminal can be used when concrete barrier cannot be tapered away from the roadway, cannot be buried into a cut slope, or when a lower cost option than using an impact attenuator is desired.</p> <p>There is need to determine if concrete barrier sloped end terminal designs are MASH compliant when errant vehicles hit the terminal. This study will investigate concrete sloped end terminals for MASH compliance.</p> 
Project Goal(s):	Evaluate concrete barrier sloped end terminals for MASH crashworthiness and make design changes if needed.
Project Background:	WSDOT and other agencies allow concrete barrier runs to be terminated with a sloped end terminal under certain policy conditions. For instance, WSDOT allows concrete end terminals to be installed outside the Design Clear Zone, on trailing ends of barrier runs when it is outside the Design Clear Zone for opposing traffic, on trailing ends of barrier runs on one-way roadways, and where posted speed is 25 mph or lower. WSDOT is not aware of any crash tests associated with concrete sloped end terminals and there is a concern about the stability of the vehicles when interacting with such barriers.

	<p>Roadside Design Guide Section 8.4.4.1 recommends terminating a concrete barrier by tapering the end when other options are not feasible and in roadways with traffic speeds less than 40 mph. However, this recommendation is not based on research.</p> <div style="border: 1px solid black; padding: 5px;"> <p>8.4.4.1 Sloped Concrete End Treatment</p> <p>When preferred treatments are not feasible, terminating a concrete barrier by tapering the end is occasionally necessary, even though this end treatment has not met acceptable crash-testing criteria. This treatment should be used only in locations where the traffic speeds are 60 km/h [40 mph] or less and space is limited by right-of-way constraints or the other roadside features that preclude using a crash-worthy end treatment. Recommended length of the taper is 6 m [20 ft], with 9 m to 12 m [30 ft to 40 ft] desirable. The height of the end of the taper should be no greater than 102 mm [4 in.] (8). Other applications include locations where the barrier is flared out beyond the clear zone or where end-on impacts are not likely to occur. Figure 8-43 shows a typical tapered end treatment on a concrete barrier.</p> </div>
<p>Proposed Work Plan:</p>	<ol style="list-style-type: none"> 1.) Task 1: Literature review and State Survey <ul style="list-style-type: none"> • Perform literature review for past and current research about concrete barrier sloped end terminals • Gather current state standards or drawings and identify needs or common practices 2.) Task 2: Simulation Analysis and Design <ul style="list-style-type: none"> • Perform FE simulations with pickup truck and small car models according to MASH test matrix for terminals, and determine the critical tests • Identify the critical end terminal configurations and impact locations • Make design changes if needed and select final design for full-scale crash testing 3.) Task 3: MASH Crash Test (TL-1 or TL-2) on Selected Design <ul style="list-style-type: none"> • Perform two critical full-scale MASH crash tests 4.) Task 4: Reporting <ul style="list-style-type: none"> • Prepare final report
<p>Deliverables:</p>	<p>Final report documenting research effort, crash tests and engineering drawings of the MASH crashworthy concrete sloped end terminal.</p>
<p>Urgency and Expected Benefit:</p>	<p>A successfully MASH crash tested concrete sloped end terminal will give Agencies the confidence to use this type of end terminal within the Design Clear Zone on low-speed roadways.</p>
<p>Problem Funding and Research Period:</p>	<p>Task 1 – \$8,107 Task 2 – \$55,940 Task 3 – \$145,637 Task 4 – \$7,829 Total Estimated Cost = \$217,513</p> <p>Research Period = 18 months</p>
<p>Developer(s) of the Problem Statement:</p>	<p>Name: Tim Moeckel, WSDOT Email: MoeckeT@wsdot.wa.gov Phone: (360) 704-6377</p>