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CENTRAL REGION

STANDARD DETAIL DEVELOPMENT REPORT (CRSDR)

Regional Plan No.: CR-G-28

Title: Long Span Concrete Barrier for > 25' Spans

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Use: Regional Detail CR-G-28 shows how to use MASH concrete barrier over shallow obstacles using MASH guardrail transitions. While DOT&PF Std Plan G-29 shows long spans of 25 feet or less using only W31 guardrail, CR-G-28's intent is to solve longer spans of obstacles of more than 25 feet wide.

Design and Application Considerations:

Std Plan G-32 shows a currently approved MASH transition to Alaska two-tube bridge rail. This has been crash tested and accepted by FHWA in October 2020 using 34-3/4" tall thrie beam transitions. Combined with Std Plan G-09.05S, the G-32 transition connects W31 guardrail (31" tall), and one symmetrical thrie beam transition panel, to modified steel post thrie beam guardrail (34-3/4" tall as tested), and then to new style bridge rail (38" tall). This height transition works for new guardrail transitions to new bridge rail However, this transition is higher than 32" tall MASH concrete barrier (Std Plan G-47) or some older bridge rails. This is mainly due to the symmetrical thrie beam transition which adds 3" of height (W31 plus 3" results in 34" to 34-3/4" tall thrie beam rail).

A lower height is needed to transition from W31 to thrie beam guardrail to G-47 concrete barrier. G-47 concrete barrier is frequently used in temporary work zones, to span large drainage culverts, pedestrian tunnels, or major utility vaults, or transition to older, lower bridge rails.

W-beam guardrail to concrete barrier connections have been in use by DOT&PF in varying transition details for past projects. Past standard wood post thrie beam guardrail was 31" high which allowed for a transition that maintains 31" and was within the height of G-47 concrete barrier. (2019 Std Plan G-09.04W is now out of use in favor of steel posts).

CR-G-28 maintains a consistent 31" rail height. The posts and rail layout follow MASH accepted patterns developed by Alaska DOT and Texas DOT for guardrail to bridge rail transitions.

CR-G-28 connects W31 guardrail, with an asymmetric transition, 31" steel post thrie beam (unmodified for height), and nested thrie beam connection to the face of concrete barrier. Nested thrie beam strengthens the concrete barrier face across joints and has been used on at least four locations in the field for more than 20 years without problems in Central Region.

History:

- 1999 - Old Glenn Highway Matanuska River Bridge #1951 Replacement.

  This project built thrie beam reinforced concrete barrier over shallow gas lines and pedestrian tubes at four locations. These spans have been in use for over two decades on a high AADT roadway without any known problems or increased maintenance.

- 2003 -Std Drwg G-27 Guardrail Stiffening at Obstacles

  This drawing continued previous standard drawings in place for more than a decade. This drawing solved guardrail at obstacles by increasing post density and stiffening rail leading up to and across the obstacle. Often this was a retaining wall or bridge abutment. This drawing was an original basis for CR-G-28. The older G-27 method of transitioning to a rigid object or wall is the same as has been used for bridge approaches since at least 1987.

- 1987 - Std Drwg G-29 Steel Post Thrie Beam Guardrail Terminal Transition at Bridges

  This drawing and later versions used the same guardrail stiffening plan for posts and thrie beam as Std Drwg G-27 for obstacles noted above.

- 2019 – Std Drwg G-09.04W Wood Post Thrie Beam Guardrail

  This drawing allowed for wood post 31” thrie beam, unmodified for height. G-09.04S allowed the same option in steel posts but at 34” height. Both used the symmetric thrie beam transition panel.

- FHWA on wood and steel posts (as of 7/20/22)

  FHWA Office of Safety publishes guidance on “frequently asked questions” including Barriers, item 2, which considers steel and wood posts interchangeable in w-beam installations outside of the terminal, with wood blockouts for wood posts and composite or steel blockouts for steel posts. https://safety.fhwa.dot.gov/roadway_dept/countermeasures/faqs/qa_bttabr.cfm#brrs2)

Design Backup:

October 2020 – HSST-1/B-350: Std Plan G-32 MASH Bridge Rail Thrie Beam Transition (to 34-3/4” height)

This detail was recently crash tested for AK DOTPF to meet MASH TL3, by Texas Transportation Institute (TTI). It is essentially similar to thrie beam transitions used since 1987, with an added post for six posts spaced at 1 foot, 6-3/4 inches apart. The 3’1-1/2” post spacing is the same through the thrie beam transition panel and has an extra post to adapt to 6’3” W31 rail beyond that. The main point is guardrail to bridge rail transitions have maintained this 6’3” to 3’1-1/2” to 1’3/4”spacing pattern over decades. The added posts for stiffening and transitions from W31 match TTI tests for Texas in 2013, and match AK DOTPF Standard Drawings from 1987 forward, with modifications to newer heights and attachments to W31 splicing. The transition pattern is the same as historical patterns.

March 2013 – TTI Test Report 9-1002-12-4: TxDOT guardrail to rigid barrier (all at 31” height)

Texas DOT and TTI tested guardrail to rigid barrier with post stiffening and an asymmetric thrie beam transition panel. This was tested to MASH TL3. Other than the a asymmetrical transition panel and shorter posts in the thrie beam transition, post stiffening patterns used by TTI are the same as used in the latest AK DOTPF testing in 2020.

January 2012 - HSST/B-231: Midwest Road Safety Facility Bridge Rail Transition (February 2009)

This transition demonstrates a variation on post stiffening approaching a bridge, with an asymmetric thrie beam transition panel to maintain 31” height from W31 guardrail. The MwRSF test required an added thrie beam panel to more gradually stiffen the rail towards the bridge. This was tested with the asymmetric transition panel at 31” and passed MASH TL3. The significant difference from AK DOTPF testing was the lower density of longer posts in Midwest’s tests approaching the bridge, and an added 6’3” thrie beam panel and splice before the bridge.

Transition: In conclusion, Alaska and Texas tested a successful pattern of uniform and consistent post densities approaching a bridge, with both symmetric and asymmetric transitions, at 34” and 31” heights. It is reasonable to expect the asymmetric transition feature performs equally to the historic symmetric panel. It is reasonable to find both the Texas test layout and the Alaska test layout are essentially the same but at different heights, both successfully MASH tested.

Concrete Barrier : Concrete barrier is semi-rigid, or not quite as rigid as bridge rail. Based upon MASH crash testing of portable concrete barrier with and without stiffening, additional concrete barrier stiffening is used in this regional detail in three ways

a) nested thrie beam is continued along the face of the first concrete panel,

b) anchor pins are used into the pavement, and

c) blockouts are increased in relative density compared to normal bridge rail post spacing.

MASH tests show barrier stiffening using steel box beam or anchor pins individually reduces concrete barrier deflection by 61% to 82% respectively compared to unstiffened, unanchored barrier. Combining both stiffening features is expected to reduce concrete barrier deflections to less than 0.7 feet or 80% to 90% overall. Minimized deflections is in line with Alaska and Texas tested transitions for rigid bridge rail.

	Review of available Semi-Rigid MASH options towards Immediate Solution Needs for HSIP MP 37-52 Seward Hwy Passing Lanes, at wide/shallow pipe crossings						**3/16/2022**
				Deflection (ft)			
	Downstream Connection	**FHWA Review**	**Type**	**Dynamic Deflection**	**Variance in similar tests (ft)**	**Reduction from Concrete Barrier alone (ft)**	**Reduction in Deflection**
Bridge	Rigid	B350	Symmetric Thrie Beam Transition to AK 2-Tube bridge rail 34"	0.3	0.3	-5.4	**-90%**
Bridge	Rigid	9-1002-12-4 (TTI)	Asymmetric Thrie Beam Transition to TexDOT bridge rail 31"	0.6		-5.0	**-84%**
Untreated	Semi-Rigid	B233	F Shape Barrier	4.7	2.0	-1.0	-16%
Untreated	Semi-Rigid	B215	F Shape Barrier	6.6		1.0	16%
Alternative	Semi-Rigid	B255	Concrete Barrier w/box beam face, top plate	3.6	1.6	-2.1	-35%
Alternative	Semi-Rigid	B239	NY Concrete Barrier w/box beam face	2		-3.7	-61%
Alternative	Semi-Rigid	B251	Strongstown Anchor Pin, with Plate	1.6	0.8	-4.1	-68%
Alternative	Semi-Rigid	B52	EasiSet Anchor Pin	0.7		-4.9	-82%
Alternative	Semi-Rigid		CR-G-28 Proposed Long Span Concrete Barrier with a) Nested Thrie Beam + b) Anchor Pins + c) 1/2 blockout density = 3 stiffening treatments	0.5-1 expected			**-80-90% expected**
			*Conclusion by comparison: CR-G-28 Proposed should perform equal or better to the combination of Rigid tests and stiffened/pinned barrier combinations				

Construction Considerations:

Gaps. Guardrail pile drivers are limited by the driving equipment "shoe" to 10" of clearance from the obstacle. It is important to note the maximum gap allowed from the last guardrail post to the concrete barrier or obstacle and still be able to construct/install posts to maintain the maximum gap of 3'9" or less (from center of post to center of post).

Splices. At least 3 concrete barrier panels are required to cross shallow spans of 25 feet or more. Splicing at or near the ends of concrete barrier can be difficult. Concrete barrier panels are 12'6" long, the same increments as steel barrier panels. This means approach steel rail transitions splice at or near the end of the concrete barrier. This is a difficult location to make a fully blocked out, fully faced splice. It is also the location of the most internal reinforcing steel inside the concrete barrier. CR-G-28 provides at least three options for making splices to simplify installation and avoid problem connections:

Option 1- Asymmetric Splices positioned 12'6" from the thrie beam transition panel landing on and near the approach end to the concrete barrier. Over a distance of 3 or more concrete barrier sections, this can mean more asymmetric splice conficts at the downstream end of concrete barrier. This can be addressed with an added blockout as shown.

Option 2 – Symmetric Splices with full width nested rail and blockouts. Similar to Midwest Road Safety Transitions in 2009, this option uses a 6'3" thrie beam panel adjacent to the thrie beam transition panel to move the next splices midway along the concrete barrier panel. This is a more convenient location for splices. This may still require an added blockout at or near concrete barrier ends to maintain maximum gaps between posts and concrete.

Option 3 – Symmetric Splices with tapered rail and blockouts. This also use a 6'3" thrie beam panel adjacent to the thrie beam transition panel to allow mid-concrete barrier splices to be made. However the thrie beam can be tapered to the face of concrete barrier. Additional concrete barrier sections can be inserted for longer spans as needed.

M&O Considerations: No special considerations. Concrete barrier and transition rails are commonly used and present no new maintenance considerations.

Abbreviations:

CR	Central Region
DOTPF	(Alaska) Department of Transportation and Public Facilities
M&O	Maintenance and Operations

Attachment:

1. Proposed CR-G-28.00 (3 Sheets, 3 Options)

References:

2. Current Standard Plans: G-00.05, G-09.04W, G-09.05S, G-11, G-29, G-32, G-47
3. Past Standard Plans: G-05.11S, G-27, G-29
4. Past Design: 1996 Old Glenn Matanuska River Bridge Replacement Sheet E6

   <u>FHWA and TTI Crash Test Acceptance Letters:</u>

5. 2020 HSST-1/B350 AK DOT&PF MASH 2-Tube Bridge Rail Transition (symmetric)
6. 2013 TTI Test Report 9-1002-12-4 TxDOT T131RC Bridge Rail Transition (asymmetric)
7. 2013 HSST/B-231 Steel Post MGS to thri-beam asymmetric transition
8. 2011 HSST/B215 Free Standing F-Shape Temporary Concrete Barrier
9. 2013 HSST/B-233 Delta bloc DB 80 F-Shape Concrete Barrier
10. 2012 HSST/B-239 New York State Temporary Concrete Barrier with Box Beam Stiffener
11. 2012 HSST/B-52C EasiSet J-J Hooks Pin Down F-Shape Concrete Barrier
12. 2014 HSST/B-251 Portable Concrete Barrier (PCB) Deflection Reducing Retrofit
13. 2015 HSST/B-255A MWRSF Low-Deflection Portable Concrete Barrier Version 2
14. 2015 HSST/B-255 MWRSF Low-Deflection Portable Concrete Barrier Version 1

EXAMPLES

Old WBeam / Symmetrical Modified Steel Post Thrie Beam Transition to taller Concrete Barrier

Older Wood Post Thrie Beam Transition to 32” concrete barrier

Modified Steel Post Thrie Beam Transition height difficulty to Concrete Barrier

2022 CR-G-28 Implementation of W31 to Asymmetric Thrie Beam to Concrete Barrier over Low Fill Pipe Arches, Seward Hwy Summit Lakes area (1 of 4)

1994 Long Span Conrete Barrier and symmetric thrie beam transition over ped tube and shallow gas main,

Old Glenn Hwy Palmer