Texas A&M Transportation Institute
Recent & Ongoing Research

SCOBS T-7 Meeting
June 27, 2018
Burlington, Vermont
William Williams, P.E.
36-INCH VERTICAL WALL

Sponsor: TXDOT
36-inch Vertical Wall

• Background
  – Current TxDOT T221 bridge rail is a 32-inch vertical parapet
  – TTI Recommends 36-inch minimum barrier height based on previous testing and simulations
36-inch Vertical Wall

• Objective
  – Redesign T221 bridge rail by increasing wall height
  – Test according to MASH TL-4
36-inch Vertical Wall

- Test Matrix for MASH TL-4
  - Test 4-10
    - MASH Test 5-10 conducted on a 42-inch vertical profile barrier. Passed
  - Test 4-11
    - MASH Test 4-11 conducted on Variation of T221 bridge rail (MSE Wall). Passed
  - Test 4-12
36-inch Vertical Wall

Plan View

Elevation View

Chamfer 3/4" each way
Typical 2 places on Parapet and 2 on Deck
36-inch Vertical Wall
36-inch Vertical Wall
MASH Test 4-12
MASH Test 4-12
MASH Test 4-12
MASH Test 4-12
Summary

- MASH Test 4-12 performed on 36-inch vertical wall
- Passed MASH TL-4 evaluation criteria
TxDOT Single Slope Barrier with ACP Overlay

Sponsor: TxDOT
TxDOT Single Slope Barrier with ACP Overlay

• Background
  – One means of anchoring concrete barrier to pavement is to key it in to the pavement using an ACP overlay
  – TxDOT implements this for 32-inch F-Shape barrier and 42-inch Single Slope barrier
TxDOT Single Slope Barrier with ACP Overlay

• Objective
  – Test TL-4 barrier system with 1-inch ACP overlay
TxDOT Single Slope Barrier with ACP Overlay

• Test matrix
  – 32-inch F-Shape barrier does not meet recommended TL-4 minimum rail height
  – 42-inch Single Slope barrier
    • Only Test 4-12 needed to evaluate structural adequacy of barrier keyed in 1-inch ACP overlay
    • If successful, the less critical 32-inch F-Shape TL-3 barrier would be considered compliant with MASH TL-3
TxDOT Single Slope Barrier with ACP Overlay

- Chamfer top edges, 3/4" each way
- TxDOT Class C (3500 psi) Concrete
- Welded Wire
- TxDOT Type D Asphalt 1" thick, Typ both sides

Dimensions:
- 42" height
- 9'-0" width

TxDOT Single Slope Barrier with ACP Overlay
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TxDOT Single Slope Barrier with ACP Overlay
• Summary
  – MASH Test 4-12 performed on TxDOT Single Slope barrier with 1-inch ACP Overlay
  – Passed MASH TL-4 evaluation criteria
  – 32-inch F-Shape TL-3 barrier can be considered acceptable according to MASH TL-3
TxDOT Single Slope Barrier Free-Standing

Sponsor: TxDOT
Objective

- Evaluate performance of TL-4 free-standing 42-inch Single Slope barrier with X-bolt connection
TxDOT Single Slope Barrier Free-Standing

- 30-ft segments; 42-inch height
TxDOT Single Slope Barrier Free-Standing
TxDOT Single Slope Barrier Free-Standing
MASH Test 4-12
MASH Test 4-12
TxDOT Single Slope Barrier Free-Standing

- Maximum dynamic deflection of 33 inches
TxDOT Single Slope Barrier Free-Standing
TxDOT Single Slope Barrier Free-Standing

• Summary
  – MASH Test 4-12 performed on free-standing 42-inch TxDOT Single Slope barrier with x-bolt connection
  – Passed MASH Test 4-12 evaluation criteria
Design & Full Scale testing of Retrofit Bridge Rail for 24.8 Miles Long Southbound Causeway Bridge, New Orleans, Louisiana

Sponsor: Greater New Orleans Expressway Commission
Lake Pontchartrain Causeway Bridges New Orleans, Louisiana

LAKE PONTCHARTRAIN CAUSEWAY BRIDGES (2)  24.8 MILES LONG

ROUTE 11 BRIDGE  5 MILES LONG
American Society of Civil Engineers

National Historic Civil Engineering Landmark Designation

September 26, 2013
Lake Pontchartrain Causeway Construction
Lake Pontchartrain Causeway Construction

September 26, 2013
Lake Pontchartrain Causeway Construction

SLAB #1932 SWINGS INTO PLACE ON LAKE PONTCHARTRAIN CAUSEWAY 6/9/76

September 26, 2013
Lake Pontchartrain Causeway Construction
Lake Pontchartrain Causeway Construction

September 26, 2013
Lake Pontchartrain Causeway Construction
Southbound Causeway Railing Details

FRONT VIEW

LAKE PONTCHARTRAIN CAUSEWAY SOUTHBOUND BRIDGE RAIL
Current Southbound Details

ALUMINUM CAST POST @ 8'-0" O.C W/ 4" O.D. ALUM. PIPE RAIL.

3/4" DIA. ALUM. ANCHOR BOLT (TYP.)

12" 12"

18" 14-5/8"

4" 3/8"

6-3/8" 10"

4" x 6'-0" DRAINAGE SLOT

7" 25"

28" 37"

BRIDGE RAIL SECTION VIEW
ISO VIEW OF RAIL REINFORCEMENT

4”x6’-0” DRAINAGE SLOT

24” WIDE POST
Photo of Static Strength Testing
Retrofit Option A

• Use TXDOT T401 Bridge Rail Design
• 39-inch high Single Tube Rail System
• Anchors to top of parapet
• Utilizes existing curb for pedestrians
• Calculated capacity of rail design was approximately 90 kips @ 32-inch height.
Test Installation Details

Test Installation

Existing Runway

Plan View

Elevation View

Section A-A
Scale 1:20

Splice Section
(see 1b)

2 1/4" Joint Parapet and Rail

Detail B
Scale 1:20
TYP x 2

1a. Concrete is 7000 psi.
1b. The Splice Sections are installed with the slots on the south side (left) of the joint for testing.

Roadside Safety and Physical Security Division Proving Ground -

Institute

Project: 690900-GEC 1-3
Lake Ponchartrain Bridge Rail A
Drawn By: GES
Scale: 1:200
Sheet 1 of 9
Test Installation

Approved: William Williams:

Date:
Section Details

Plan View

Elevation View

Detail C

Scale 1:10

2a. Installed with Hilti RE500 epoxy according to manufacturer's directions, minimum 8" embedment in concrete. Tighten Nuts to 75 ft/lbs.
5a. Two pairs at each column, epoxied into Deck.
Splice Section Details

38"  34-1/4"  28-1/4"

Slot - 7/8" x 4"  TYP x 2

Splice Section
Plan View
HSS 7" x 5" x 1/2"
ASTM A500 Grade B

G

Ø7/8" TYP x 2

Section G-G

Isometric View
Option A Test Installation Photos
MASH Single Unit Truck Test
22,000 Lbs., 56 mph, 15 Degs.
After Test Photos
MASH Pickup Truck Test
5,000 lbs., 62 mph, 25 Degs.
MASH Small Car Test
2,400 lbs, 62 mph, 25 Degs.
Summary of Option A Single Rail Testing

• Option A met all the performance requirements for MASH TL-4
• Single Unit Truck Test - PASS
• Pickup Truck Test - PASS
• Small Car Test –m PASS
• Option A Single Rail Design is recommended for implementation on the Southbound Bridge!
Retrofit Option B 2-Rail Design

- Use TXDOT T131RC Bridge Rail
- 46-inch high 2-Tube Rail System
- Anchors to top of parapet
- Utilizes existing curb for pedestrians
- Net height above the curb is 36 inches
- Greater vehicle containment for MASH TL-4
MASH Single Unit Truck Test
22,000 Lbs., 56 mph, 15 Degs.
Summary of Option B-1 2-Rail Testing

• Option B-1 met all the performance requirements for MASH TL-4
• Single Unit Truck Test – PASS
• Pickup Truck Test – PASS
• Small Car Test – PASS
• Option B-1 Two Rail Design is also recommended for implementation on the southbound causeway bridge for MASH TL-4.
• Note: We later performed MASH Test 4-11 @ 70 mph - PASS
Louisiana Bridge Rail with Sidewalk Retrofit

- Approximately 200 miles of vintage concrete post and rail bridge rails built in the 40’s and 50’s
- Design a retrofit to meet MASH TL-4 (Preferred)
8a. Minimum rebar lap distance is 15" for Ø1/2" bars and 18-3/4" for Ø5/8" bars.

8b. Embed #5 Dowels 6" into existing concrete and secure with Hilti HY-HIT 200 epoxy according to manufacturer's instructions.

8c. All rebar is grade 40 ksi unless otherwise indicated. 60 ksi rebar may not be substituted. Contractor shall provide cert papers for all steel components.
1a. Secure with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions, with minimum 6-1/2" embedment. Typical x 5 each Rail section.

1b. All steel components (excluding rebar, but including hardware such as nuts and bolts) shall be galvanized.
Louisiana Bridge Rail with Sidewalk Retrofit

- Constructing installation now for MASH TL-3 testing.
- The strength is borderline. Depending the outcome of the TL-3 Test, will perform MASH TL-4 if the pickup truck test looks good.
Questions?

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Other Ongoing or Completed Research

- TxDOT Mailbox Systems
- TxDOT Pedestal Pole with Beacons
- TxDOT Embedded Wood Post Sign Systems
- TL-2 Short Radius
- Guardrail in Rocky Terrain
- TL-3 Low Profile Barrier
Other Ongoing or Completed Research

- C402 Bridge Rail
- C412 Bridge Rail
- C411 Bridge Rail
- T1W Bridge Rail
• Questions?