STATE OF NEW HAMPSHIRE
BRIDGE DESIGN MEMORANDUM

FROM: L. Robert Landry, Jr., PE
Administrator
DATE: May 15, 2018
AT (Office): Bureau of Bridge Design

SUBJECT: Design Memorandum 2018-03
Temporary Barrier for Bridge Projects

TO: Bureau of Bridge Design Staff, Bridge Design Consultants, FHWA, NHDOT Bureaus

The Bureau of Bridge Design is updating the Bridge Design Manual. During this process, certain design decisions are being issued for immediate implementation. Consequently, the Bridge Design Manual, Bridge Details, and Bridge Detail Sheets have been modified as follows:

A. Bridge Design Manual:
   • Chapter 7, Section 7.6.5 Temporary Barrier

B. Bridge Detail Sheets:
   • Portable Concrete Barrier – Braced
   • Texas Restrained Barrier (X-Bolt)

C. Special Provision:
   • Item 606.41741 – Portable Concrete Barrier for Traffic Control (Bridge)

D. Summary: The above noted revisions are being implemented to specify the following:
   • NHDOT policy for required use of temporary barrier for bridge projects has been added.
   • Bridge Detail Sheets (.dgn and .pdf format) for use on bridge projects are located on the Bureau of Bridge Design web page:

E. Background:

This memorandum incorporates modifications to current NHDOT Bridge Design Manual and Bridge Detail Sheets and provides the modified details on the NHDOT Bridge Design Website.

For bridge construction, the workers are in close proximity to the portable concrete barrier (pcb). In order to protect the workers and the traveling public, the required deflection room behind the pcb shall be provided or a low deflection barrier shall be used for all phased bridge projects (rehabilitation and new).

Item 606.4171, Portable Concrete Barrier for Traffic Control (Bridge) shall be used for all bridge projects except as noted in Chapter 7, Section 7.6.5. This pcb is the Braced or Texas Restrained Barrier (X-Bolt). Both barrier bridge detail sheets shall be included in the contract plans and the Contractor can choose which barrier to use. Both barriers have been successfully crash tested per requirements of updated NCHRP Report 350, TL 3-11 (MASH TL-3). Both barriers remained connected with a dynamic deflection of approximately 27-in.

Each barrier has layout requirements and limitations as noted on their respective detail sheets and Chapter 7, Section 7.6.5.

This memorandum clarifies NHDOT’s policy for the use of a temporary barrier for bridge construction projects and incorporates the details that shall be included in the contract plans.
F. Implementation:

The update to the Bridge Design Manual, Bridge Details shall be implemented as of the date of this memorandum and shall be used on all applicable projects.

L. Robert Landry, Jr., PE
Administrator, Bureau of Bridge Design

Enclosures
7.6.5 Temporary Barrier

Temporary barriers are used in work zone areas and shall be crash tested to be able to contain, redirect, and shield vehicles, as well as workers with a limited escape route.

January 7, 2016 FHWA memorandum states, “Temporary work zone devices, including portable barriers, manufactured after December 31, 2019, must have been successfully tested to the 2016 edition of MASH. Such devices manufactured on or before this date, and successfully tested to NCHRP Report 350 or 2009 edition of MASH, may continue to be used throughout their normal service life.”

A. Temporary Barrier Types

NHDOT preferred temporary barriers are listed as follows:

- **Portable Concrete Barrier – Braced:**
  - 20-ft. long F-shape precast concrete barrier with a structural steel tube attached. The barrier system has been crash tested with a 27.6-in. dynamic deflection which will allow the braced barrier to be placed a minimum 12-in. from the back of the barrier to the edge of the deck, unanchored, since the barrier did not separate (i.e., stayed connected acting as one long unit).
  - The barrier has a minimum radius of curvature of approximately 230-ft. Gaps created between structural tubes and concrete barrier, during a radial layout, shall be shimmed with 8”x8”x1/2” plates and fender washers to firmly attach structural tubing to barrier.
  - The weight of one 20-ft. F-shape barrier segment is approximately 4.16-tons.
  - A minimum of two 20-ft. braced segments shall extend beyond the bridge work area before they can be flared or connected to NHDOT Highway Design 10-ft. portable concrete barrier for speeds greater than 45-mph. The final 20-ft. concrete segment shall be anchored into the ground as shown on the Bridge Detail Sheet.
  - Layout and installation shall be according to the Bridge Detail Sheet: Portable Concrete Barrier – Braced located at: https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/detailsheets/index.htm
• Texas Restrained Barrier (X-Bolt):
  o Crash tested by Texas Transportation Institute May 2005 per requirements of updated NCHRP Report 350, TL 3-11 (MASH TL-3). Test report is located at: https://static.tti.tamu.edu/tti.tamu.edu/documents/0-4692-1.pdf
  o 10-ft. long F-shape precast concrete barrier with a steel bolts crossing at joints. The barrier system has been crash tested with a 27.0-in. dynamic deflection which will allow the braced barrier to be placed a minimum 12-in. from the back of the barrier to the edge of the deck, unanchored, since the barrier did not separate (i.e., stayed connected acting as one long unit).
  o The barrier has a minimum radius of curvature of approximately 125-ft. and the relative angle that can be achieved between barrier segments is 4-degrees.
  o The weight of one 10-ft. F-shape barrier segment is approximately 2.38-tons.
  o The 10-ft. long cross-bolt segments shall extend a minimum of 50-ft. beyond the bridge work area before they can be flared or connected to NHDOT Highway Design 10-ft. portable concrete barrier for speeds greater than 45-mph.
  o The Bridge Detail Sheet: Portable Concrete Barrier – X-Bolt is located at: https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/detailsheets/index.htm
• NHDOT 10-ft. Portable Concrete Barrier:
  o The 10-ft. long F-shape precast concrete barrier, unanchored, with a pin and loop connection has been crash tested with a 5.0 to 5.5-ft. dynamic deflection.
  o The weight of one 10-ft. F-shape barrier segment is approximately 2.0-tons.
  o The Bridge Detail Sheet: *Portable Concrete Barrier (10-ft. long)* is located at: https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/detailsheets/index.htm

Portable Concrete Barrier – Texas X-Bolt

*Figure 7.6.5-2*

Portable Concrete Barrier – NHDOT

*Figure 7.6.5-3*
• **Iowa DOT (BA-400) HP steel beam (concrete filled) with double nested standard beam guardrail:**
  
  o Crash tested by University of Nebraska-Lincoln (Steel H-section Barrier for temporary use on bridge decks) per requirements of NCHRP Report 350, TL 3-11. The FHWA approval letter HSA-10/B-117 (9/12/2003) is located at: https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing.cfm?code=long&filter=

  o The HP steel beam (concrete filled) with double nested standard beam guardrail has been crash tested with a 9.5-in. dynamic deflection.

  o The weight of HP steel beam (concrete filled) with double nested standard beam guardrail is approximately 321-lb/ft.

  o The stacked HP steel beams are 29¼-in. high and 13 5/8-in. depth that are anchored into the deck with ¾-in. diameter x 1¾-in. long ASTM A307 Grade B heavy hex bolt and a ¾-in. Red Head Multi-set II drop-in anchor.

  o Plans are located at Iowa DOT Standard Road Plans – BA Series located at: https://iowadot.gov/design/stdplne-ba

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**Temporary Barrier Rail – Iowa BA-400**

*Figure 7.6.5-4*

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B. **Temporary Barrier Selection**

The following is NHDOT Bridge Design’s policy for selecting temporary barrier for use on bridges, unless approved otherwise by the Bridge Design Chief:

- Bridges on National Highway System (NHS); use Test Level 3 (minimum).
- Bridges not on NHS and speeds posted ≥ 45 mph; use Test Level 3 (minimum).
- Bridges not on NHS and speeds posted < 45 mph; use Test Level 2 (minimum).
- For bridge construction, the workers are in close proximity to the portable concrete barrier (pcb). In order to protect the workers and the traveling public, the required deflection room behind the pcb shall be provided or a low deflection barrier shall be used for all bridge projects (rehabilitation and new).
When developing phase construction on bridges, the following recommendations shall be considered:

1) New bridge decks and widenings:
   o Use the maximum clear distance from behind the pcb to the edge of the deck while meeting the required lane widths and minimal phases. See Chapter 7, Section 7.7 Preservation and Rehabilitation of Structures for further information on developing phase construction and minimum lane widths.
   o Use Item 606.4171, Portable Concrete Barrier for Traffic Control (Bridge), for all bridge projects except as noted below. This pcb is the Braced or Texas Restrained Barrier (X-Bolt). Both barrier sheets shall be included in the contract plans and the Contractor can choose which barrier to use.
   o For bridges on Tier 1 roads, the minimum clear distance from behind the pcb to the edge of the deck shall be 2-ft. (0.6-m). If 2-ft. (0.6-m) cannot be obtained, use Iowa DOT (BA-400) HP steel beam (concrete filled) or an anchored pcb that has been MASH crash-tested. Avoid anchoring through precast concrete panels, if possible. If there is no other option, the panels need to be designed for loss of strains due to the possibility of the anchor hitting the strands.
   o For bridges on Tier 2, 3, 4 or 5 roads, the minimum clear distance from behind the pcb to the edge of the deck shall be 1-ft. (0.3-m). If 1-ft. (0.3-m) cannot be obtained, use use Iowa DOT (BA-400) HP steel beam (concrete filled) or an anchored pcb that has been MASH crash-tested.

2) Rehabilitated bridge decks:
   o Use Item 606.4171, Portable Concrete Barrier for Traffic Control (Bridge), for all rehabilitation work (e.g., deck patching, pavement and membrane removal, expansion joint work, and bridge curb and railing work); all roads. This pcb is the Braced or Texas Restrained Barrier (X-Bolt). Both barrier sheets shall be included in the contract plans and the Contractor can choose which barrier to use.

3) Bridge decks requiring a lighter portable concrete barrier:
   o Use Iowa DOT (BA-400) HP steel beam (concrete filled) with double nested standard beam guardrail. The weight of HP steel beam (concrete filled) with double nested standard beam guardrail is approximately 321-lb/ft.


SPECIAL PROVISION

AMENDMENT TO SECTION 606 -- GUARDRAIL

Item 606.41741 – Portable Concrete Barrier for Traffic Control (Bridge)

Add to 3.7:

3.7.5 Portable Concrete Barrier for Traffic Control (Bridge). Either of the following barriers are considered acceptable by the Department.

3.7.5.1 Braced. Braced portable concrete barrier shall consist of 20 foot long sections and shall be braced and pinned as detailed on the contract plans or as otherwise approved.

3.7.5.2 Texas Restrained Barrier (TRB). The TRB portable concrete barrier shall consist of 10 foot long sections and shall be connected as detailed on the contract plans or as otherwise approved.

Amend to 4.4.2 to read:

4.4.2 Portable concrete barrier for traffic control of the type specified will be measured by the linear foot for barrier delivered and installed for use on the project. Relocating portable concrete barriers on the project will not be measured for payment.

Amend 5.3 to read:

5.3 The accepted quantity of permanent concrete barrier of the type specified and portable concrete barrier for traffic control of the type specified will be paid for at the contract unit price per linear foot.

Add to 5.3

5.3.6 No separate payment will be made for the required bracing, pinning, or connections of the portable concrete barrier for traffic control. All structural steel, steel rods and hardware will be subsidiary.

Add to Pay items and units:

606.41741 Portable Concrete Barrier for Traffic Control (Bridge) Linear Foot
GENERAL NOTES:
1. PREFABRICATED CONCRETE BARRIER SHALL BE FURNISHED BY THE CONTRACTOR AND PAID FOR AS PER PROPOSED PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL (BRIDGE). CONCRETE CURB AND ALL ATTACHMENTS SHALL BE FURNISHED IN ACCORDANCE WITH SPECIAL PROVISIONS. ALL BARRIER UNITS SHALL BE FABRICATED IN ACCORDANCE WITH SPECIAL PROVISIONS.
2. PREFABRICATED CONCRETE BARRIER SHALL BE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY MODIFICATIONS TO THE PLANS. CONCRETE CURB AND ALL ATTACHMENTS SHALL BE FURNISHED IN ACCORDANCE WITH SPECIAL PROVISIONS.
3. ALL STEEL FOR CONNECTIONS SHALL BE GALVANIZED IN ACCORDANCE WITH SECTION 550. ALL STEEL FOR CONNECTIONS SHALL BE GALVANIZED IN ACCORDANCE WITH SECTION 550.
4. CONNECTION BOLTS SHALL BE 2" GALVANIZED HIGH STRENGTH THREADED RODS CONFORMING TO ASTM A325. STEEL PIPES, PLATE WASHERS, AND CONNECTION PLATES SHALL BE GALVANIZED IN ACCORDANCE WITH SECTION 550. STEEL PIPES, PLATE WASHERS, AND CONNECTION PLATES SHALL BE GALVANIZED IN ACCORDANCE WITH SECTION 550.
5. THE CONNECTION BOLTS AT THE BARRIER JOINTS SHALL BE TIGHTENED TO THE "TURN OF THE NUT" METHOD IN ACCORDANCE WITH SECTION 550.3.11.6.4 OF NHDOT STANDARD SPECIFICATIONS.
6. THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
7. THE CONTRACTOR SHALL FURNISH AND INSTALL APPROVED RETROREFLECTIVE DELINEATORS AT 25-FOOT INTERVALS ALONG TOP AND/OR ONE FOOT DOWN THE SIDE OF PORTABLE CONCRETE BARRIER, SUBSIDIARY TO ITEM 606.41741 (SEE STANDARD NO. DL-1 OF NHDOT STANDARD SPECIFICATIONS). THE CONCRETE BARRIER SHALL EXTEND A MINIMUM OF 50' BEYOND THE BRIDGE AT EACH END, PERMITTED TO THE ROADWAY CURVATURE. THE ENDS OF THE BARRIER SHALL CONFORM TO THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
9. THE TEXAS X-BOLT BARRIER MAY BE INSTALLED WITH A 125' MINIMUM RADIUS OF CURVATURE AFTER INSTALLATION, ALL X-BOLT JOINTS SHALL BE CHECKED BY THE CONTRACT ADMINISTRATOR CONFIRMING THEY MEET THE TIGHTENED REQUIREMENT. THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
10. THE CONTRACTOR SHALL FURNISH AND INSTALL APPROVED RETROREFLECTIVE DELINEATORS AT 25-FOOT INTERVALS ALONG TOP AND/OR ONE FOOT DOWN THE SIDE OF PORTABLE CONCRETE BARRIER, SUBSIDIARY TO ITEM 606.41741 (SEE STANDARD NO. DL-1 OF NHDOT STANDARD SPECIFICATIONS). THE CONCRETE BARRIER SHALL EXTEND A MINIMUM OF 50' BEYOND THE BRIDGE AT EACH END, PERMITTED TO THE ROADWAY CURVATURE. THE ENDS OF THE BARRIER SHALL CONFORM TO THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
11. THE CONTRACTOR SHALL FURNISH AND INSTALL APPROVED RETROREFLECTIVE DELINEATORS AT 25-FOOT INTERVALS ALONG TOP AND/OR ONE FOOT DOWN THE SIDE OF PORTABLE CONCRETE BARRIER, SUBSIDIARY TO ITEM 606.41741 (SEE STANDARD NO. DL-1 OF NHDOT STANDARD SPECIFICATIONS). THE CONCRETE BARRIER SHALL EXTEND A MINIMUM OF 50' BEYOND THE BRIDGE AT EACH END, PERMITTED TO THE ROADWAY CURVATURE. THE ENDS OF THE BARRIER SHALL CONFORM TO THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
12. THE CONTRACTOR SHALL FURNISH AND INSTALL APPROVED RETROREFLECTIVE DELINEATORS AT 25-FOOT INTERVALS ALONG TOP AND/OR ONE FOOT DOWN THE SIDE OF PORTABLE CONCRETE BARRIER, SUBSIDIARY TO ITEM 606.41741 (SEE STANDARD NO. DL-1 OF NHDOT STANDARD SPECIFICATIONS). THE CONCRETE BARRIER SHALL EXTEND A MINIMUM OF 50' BEYOND THE BRIDGE AT EACH END, PERMITTED TO THE ROADWAY CURVATURE. THE ENDS OF THE BARRIER SHALL CONFORM TO THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.
13. THE CONTRACTOR SHALL FURNISH AND INSTALL APPROVED RETROREFLECTIVE DELINEATORS AT 25-FOOT INTERVALS ALONG TOP AND/OR ONE FOOT DOWN THE SIDE OF PORTABLE CONCRETE BARRIER, SUBSIDIARY TO ITEM 606.41741 (SEE STANDARD NO. DL-1 OF NHDOT STANDARD SPECIFICATIONS). THE CONCRETE BARRIER SHALL EXTEND A MINIMUM OF 50' BEYOND THE BRIDGE AT EACH END, PERMITTED TO THE ROADWAY CURVATURE. THE ENDS OF THE BARRIER SHALL CONFORM TO THE TRANSITION UNIT AND THEN TO NHDOT PCB FLARED OUT THE REQUIRED CLEAR ZONE AS SHOWN ON DETAILS A.

MATERIAL NOTES:
1. ALL RUBBER SHALL BE LATEX COLOR IN ACCORDANCE WITH SECTION 550. ALL RUBBER SHALL BE LATEX COLOR IN ACCORDANCE WITH SECTION 550.
2. ALL RUBBER SHALL BE LATEX COLOR IN ACCORDANCE WITH SECTION 550.
3. ALL RUBBER SHALL BE LATEX COLOR IN ACCORDANCE WITH SECTION 550.
4. ALL RUBBER SHALL BE LATEX COLOR IN ACCORDANCE WITH SECTION 550.
TEXAS RESTRAINED BARRIER (X-BOLT) (2 OF 3)

PLAN - BARRIER LAYOUT

BENDING SCHEDULE

R = 2"
70°-00'-00"
GRADE 60 (3'-6"
#6 REINFORCING BAR
R = 2"

#5T3
#5T2
#5T1
#4T6
#5T8
#6T5 (TYP)
#5T4
#6T5 Ú (TYP)
#5T7
#6T9

#5T3
#5T2
#5T1
#4T6
#5T8
#6T5 (TYP)
#5T4
#6T5 Ú (TYP)
#5T7
#6T9

CONNECTION PLATE DETAILS

THREADED ROD DETAILS

UPPER CONNECTION
PIPE DETAIL

ISOMETRIC VIEW OF TYPICAL WELD ASSEMBLY

CONNECTION BOLT OR THREADED ROD DETAILS

LOWER CONNECTION
PIPE DETAIL

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION - BUREAU OF BRIDGE DESIGN

PIPE DETAIL

UPPER CONNECTION

CONNECTION PLATE DETAILS

THREADED ROD DETAILS

LOWER CONNECTION
PIPE DETAIL
PORTABLE CONCRETE BARRIER FOR TRAFFIC CONTROL (BRIDGE).

1. TEXAS RESTRAINED BARRIER (TRANSITION UNIT) SHALL BE PAID FOR UNDER ITEM 606.41741.

2. SEE SHEET 1 OF 3 FOR NOTES AND SHEET 2 OF 3 FOR REBAR SCHEDULE.

TEXAS X-BOLT BARRIER

SCALE: 1" = 1'-0"