THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY

January 13, 2021

DESIGN BULLETIN No. 21-01

SUBJECT: Illinois Tollway Temporary Concrete Barrier

The following revisions to the Illinois Tollway Standard Drawings, Section D, have been implemented, adding Standard D10 (Temporary Concrete Barrier with Cross-bolt Connection). This new temporary concrete barrier will be effective immediately on all contracts under design and not advertised. The IL F-Shape barrier currently in contracts advertised prior to this bulletin will continue their use through the end of their contract.

The new standard and associated manual revisions are listed below:

Standard D10 (Temporary Concrete Barrier with Cross-bolt Connection)
Structural Design Manual Article 8.2
Roadway Traffic Control and Communications Manual
Quality Standard for Work Zone Traffic Control Devices
M-MOT-700 (To be updated at a later date)

Design Bulletin revisions are described below:

- Illinois Tollway Standard D10-00, Temporary Concrete Barrier with Cross-bolt Connection, Single Face (attached).
    - This new standard is 12'-6" in length and 2' wide with a cross section open notch of 6".
    - The barrier contains an upper and lower cross bolt connection, horizontally connecting from the front to the opposite side of the adjacent barrier. The 7/8" diameter, 30" long threaded rod is inserted through the leave-out block and tightened with a heavy hex bolt.
    - The rebar has been increased compared to the IL F-Shape in order to secure favorable crash resistance and structural integrity of the barrier.
    - The new design will have a reduced deflection of 3'-6" not anchored reduced from the current deflection of 3'-9" with the IL F-Shape.

- Structural Design Manual Article 8.2
    - On bridge decks, barriers shall maintain 3'-6" or greater distance from the edge of slab when not anchored.
    - On existing bridge decks, anchored barriers shall be a minimum distance of 6" from the back of the barrier to the edge of the slab.

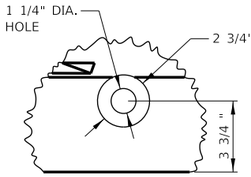
- Roadway Traffic Control and Communications Manual Article 6.4.7
    - Article was updated to show cross-bolt connection.
    - Removed references to NCHRP 350-Test Level 3 requirements.

- Quality Standard for work zone traffic control devices Section 7
    - Article was updated to show cross-bolt as criteria for evaluation.

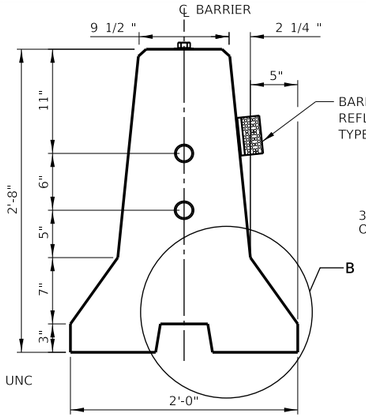
Design Section Engineers are hereby directed to incorporate this Design Bulletin into all contracts currently under design and all future contracts not yet advertised.

Paul D. Kovacs, P.E.
Chief Engineering Officer

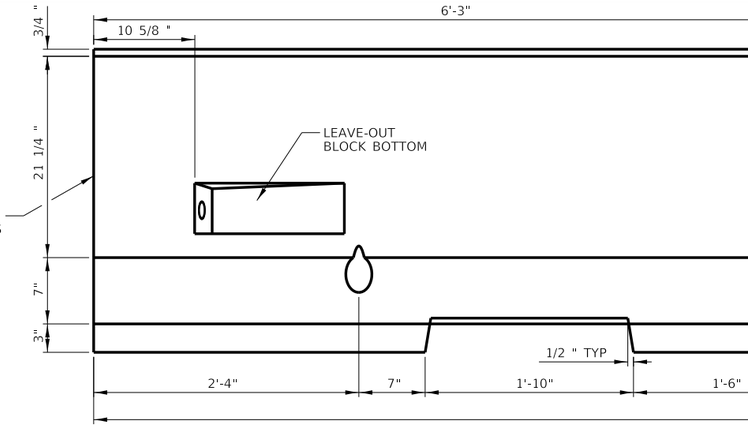
01/13/2021
Date



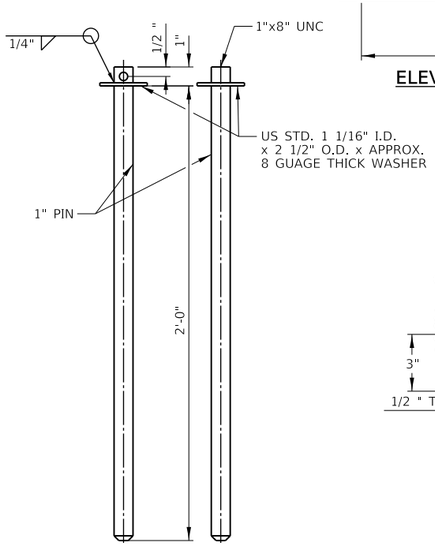
DETAIL A
TYP 6 PLACES



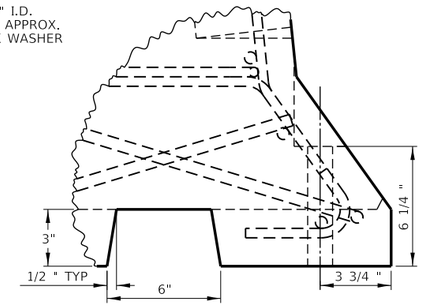
ELEVATION VIEW
END



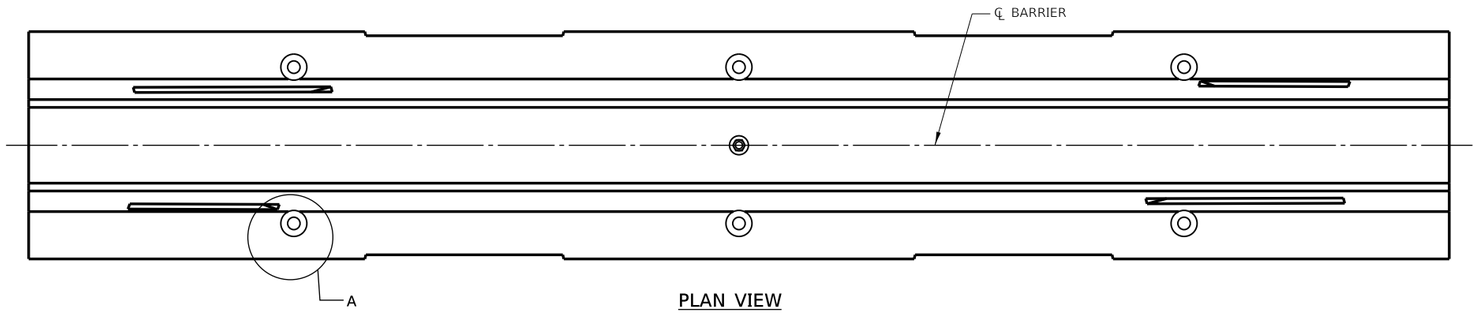
ELEVATION VIEW



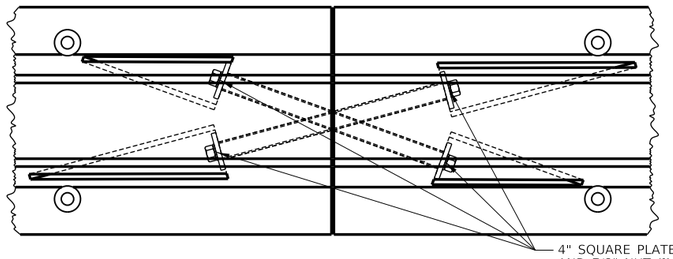
ANCHOR PIN
(END MAY BE BEVELED
1/4" MAX.)



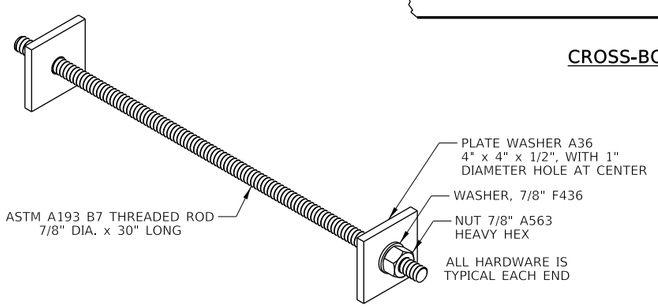
DETAIL B



PLAN VIEW

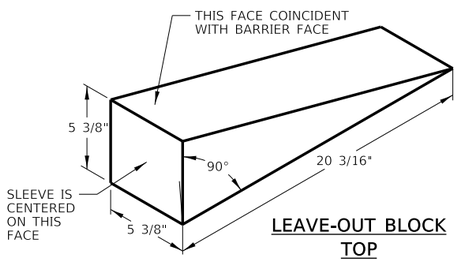


CROSS-BOLT CONNECTION DETAIL

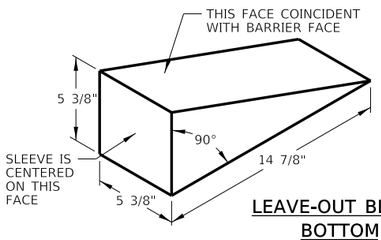


4" SQUARE PLATE WASHER, 7/8" WASHER AND 7/8" NUT (IMPACT WRENCH TIGHT) AT EACH END OF BOTH CROSS-BOLTS

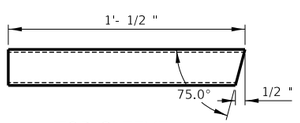
CROSS-BOLT CONNECTION HARDWARE
2 SETS OF HARDWARE NEEDED FOR EACH BARRIER



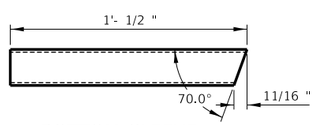
LEAVE-OUT BLOCK
TOP



LEAVE-OUT BLOCK
BOTTOM



TOP SLEEVE
PIPE, 1-1/2" SCH. 40 PVC



BOTTOM SLEEVE
PIPE, 1-1/2" SCH. 40 PVC

NOTES

1. EACH F SHAPE BARRIER UNIT SHALL BE CLEARLY MARKED WITH "IL TOLLWAY F SHAPE", THE PRODUCER'S MARK AND THE DATE OF MANUFACTURE. THE MARKING SHALL BE RECESSED IN THE BARRIER BY 1/2" OR PAINTED THEREON WITH WATERPROOF PAINT/INK.
2. THE INSERT FOR THE 1/2" BOLT AT THE TOP OF THE BARRIER SHALL BE THREADED GALVANIZED STEEL, CAPABLE OF 3000 LB PULL-OUT STRENGTH.
3. AT LOCATIONS WHERE THE BARRIER SEPARATES OPPOSING FLOWS OF TRAFFIC, TYPE C REFLECTORS SHALL BE ON BOTH SIDES OF BARRIER. SEE STANDARD D4 FOR DIMENSIONS OF TYPE C REFLECTOR.
4. ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4" CHAMFER, EXCEPT WHERE SHOWN OTHERWISE.
5. REINFORCEMENT BARS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-31 (ASTM A706), GRADE 60, DEFORMED BARS.
6. REINFORCEMENT BAR BENDING DETAILS SHALL BE IN ACCORDANCE WITH THE LATEST "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES, ACI 315.
7. REINFORCEMENT BAR BENDING DIMENSIONS ARE OUT TO OUT.
8. COVER (CL.) IS 1-1/2" UNLESS OTHERWISE INDICATED.
9. CONCRETE SHALL BE PORTLAND CEMENT CONCRETE, CLASS PS (4000 PSI).
10. TWO OF EACH LEAVE-OUT BLOCK AND TWO OF EACH SLEEVE NEEDED FOR EACH BARRIER.

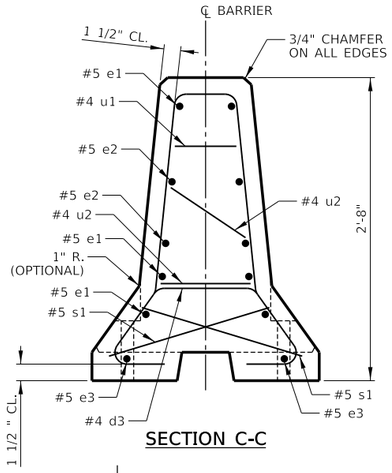
APPROVED BY:
Paul Kovacs
CHIEF ENGINEERING OFFICER
DATE: 01/13/2021

Illinois Tollway

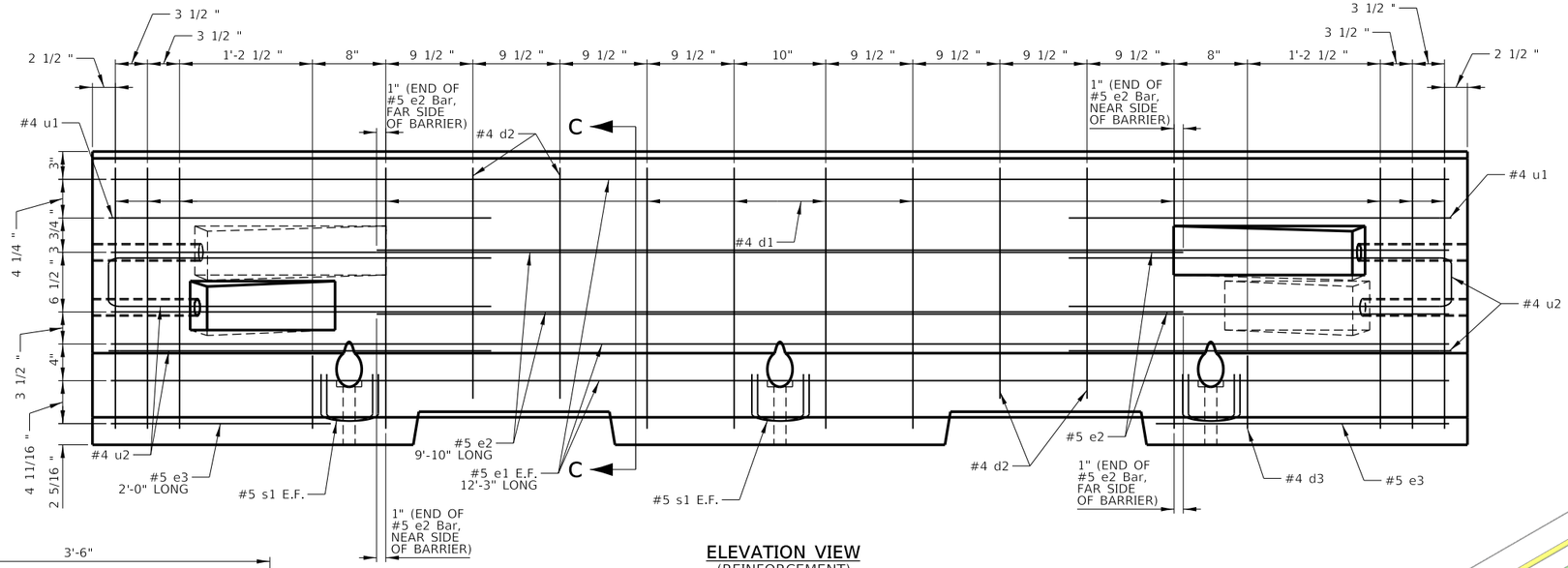
REVISIONS	
DATE	DESCRIPTION

TEMPORARY CONCRETE BARRIER WITH CROSS-BOLT CONNECTION

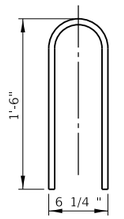
VERSION:	STANDARD:	SHEET:
2021-01	D10-00	1 OF 2



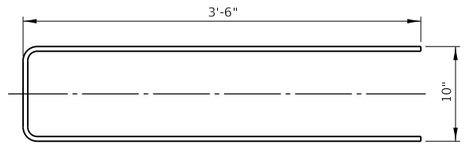
SECTION C-C



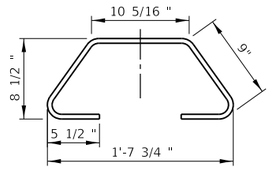
ELEVATION VIEW
(REINFORCEMENT)



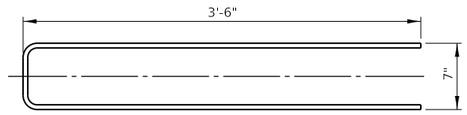
s1 BAR
No. 5 REBAR



u2 BAR
No. 4 REBAR



d3 BAR
No. 4 REBAR



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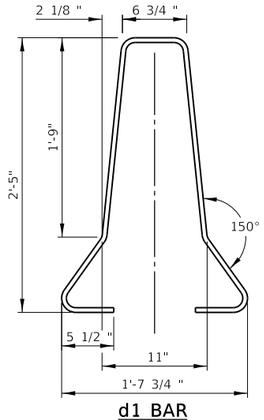
No. 4 REBAR



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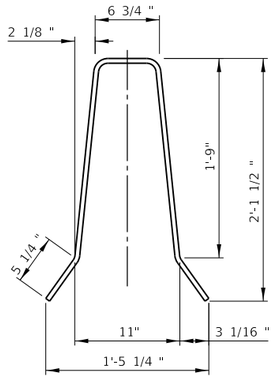

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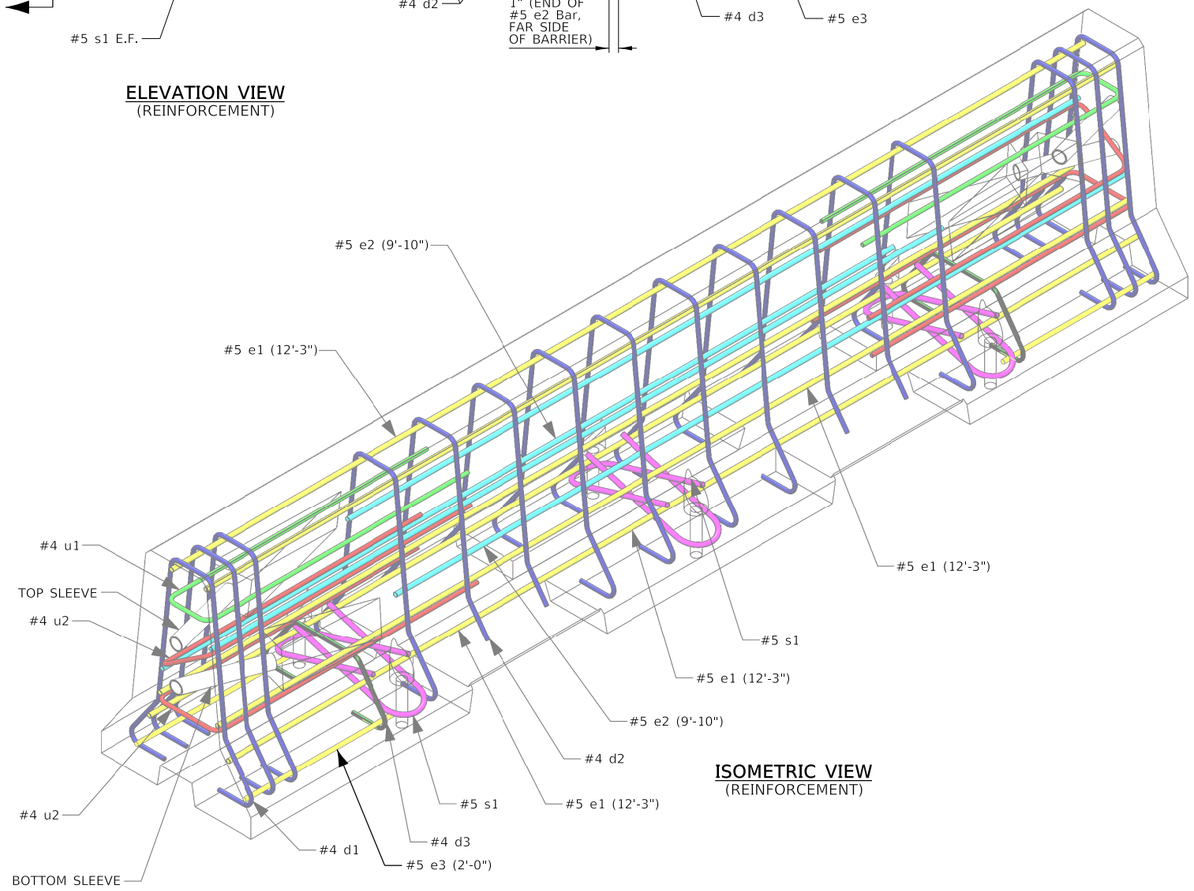


ISOMETRIC VIEW
(REINFORCEMENT)

APPROVED BY:
Paul Kovacs
CHIEF ENGINEERING OFFICER

DATE:
01/13/2021

Illinois Tollway

TEMPORARY CONCRETE BARRIER WITH CROSS-BOLT CONNECTION

VERSION:	STANDARD:	SHEET:
2021-01	D10-00	2 OF 2

SECTION 8.0 CONSTRUCTION STAGING

8.1 General

The plans shall clearly identify and show all stages of construction, both superstructure and substructure details, required to replace, widen or reconstruct each structure, while simultaneously maintaining traffic in one or both directions. For an example of a Construction Staging Plan, see Figure 8.1.1. Construction stage lines shall be shown and located in all plan views and cross sections. The Designer shall verify that the structure and adjacent roadway staging match. Stage lines shall be located along a lane line wherever possible, and at a distance greater than ¼ of the beam spacing from the centerline of any beam (within the middle half of the beam spacing). If stage lines cannot be located along a lane line, they shall be located within the center third of the lane. Pay items for structural removal shall be per bridge.

8.2 Temporary Concrete Barriers

The Construction Staging Plans shall also show the location of all temporary concrete barriers for each stage of construction where barriers are required. The temporary concrete barrier shall be anchored to the existing deck slab when the distance from the back of the barrier to the edge of the slab is less than 3'-6", a minimum distance of 6" from the back of the barrier to the edge of the slab shall be provided. Drilling of anchors into new deck slabs shall not be permitted and the 3'-6" distance to the edge of the new slab shall be provided.

8.3 Protective Shield System

A drawing or drawings shall be included in the bridge plans to define the limits of a protective shield system when it is required. The quantity of protective shield system to be installed shall be stated within the Plans. Removal of protective shield system shall not be measured for payment. The cost of designing, furnishing, erecting, maintaining and removing temporary protective shields at the locations and limits shown in plans shall be in accordance with IDOT Standard Specification Section 501. 03. The Contractor is responsible for the convenience and safety of the public during erection and construction of each element of the structure in accordance with Article 107.09 of the latest Illinois Tollway Supplemental Specifications.

A protective shield system shall be required under the superstructure or at the lower level of the superstructure whenever equipment, falling objects or material may cause damage to existing aerial wire lines, railroads, streets, highways, regulatory waterways, vehicular or waterway traffic or injury to pedestrians, bicyclist or individuals traveling in trains, vehicles or water craft.

The limits of the protective shield system for bridge projects limited to full and partial depth deck patching shall be set considering the area of the deck to be improved. The protective shield system shall extend a minimum of 10' beyond the indicated limits of repair shown in the plans or 5' beyond the actual limits of partial or full depth repair as identified in the

Article 6.6.6.1 PCMS Specifications
- Deleted references to non-TIMS PCMS.

Article 6.7.5 Barrier Reflectors
- Updated reference to Section 701.

Article 6.7.7 Truck Mounted Attenuators
- Added section.

Article 7.1 Typical Positve Protection Devices – Temporary Concrete Barrier
- Delete reference to barrier contours.

Article 11.4.1 Work and Storage Locations
- Updated reference to Section 701.

Article 12.2 Flagging and Spotting
- Included spotter in the requirements.
- Provided spotter functions and equipment requirements.

APPENDIX A – CONSTRUCTION COMMUNICATIONS ROLES AND RESPONSIBILITIES
- Added the Illinois Tollway Project Manager as a PCL.
-

APPENDIX C - PROCEDURES FOR PLACING TRAFFIC CONTROL SIGNAGE
- Added Type III barricades for use as check barricades.

APPENDIX D – WORK ZONE SAFETY INSPECTION CHECKLIST
- Included spotters in the checklist
- Checklist symbology was updated

January 11, 2021
Article 6.4.7 Barriers
- Revised section to incorporate cross-bolted temporary concrete barrier

Barricade warning lights attached to Type II, Type III, Vertical or Direction Indicator barricades, when required, shall be placed above the top rail with the bottom of the lens 38 to 62 inches above the ground. The light shall be mounted close to the outboard end of the reflectorized rail on the side facing traffic. No portion of the light housing should obstruct the reflectorized rail in the predominant traffic direction.

6.4.5 Vertical Panels

(a) Specifications - Vertical panels used as channelizing devices shall be 8 to 12 inches wide and, at least 24 inches high, with the top positioned a minimum of 48 inches above the elevation of the roadway in accordance with IDOT Standard 701901 (See Appendix E). The entire face shall be colored and reflectorized following the same pattern and specifications given for barricade rails.

(b) Applications - The predominant use of vertical panels is to provide channelization and delineation where restricted lateral clearance precludes the use of barricades or drums. They may be used to delineate the edge of temporary roadways, such as crossovers and runarounds.

6.4.6 Tubular Markers

(a) Specifications - Tubular markers shall be predominantly orange, not less than 36 inches high and at least 2 inches wide facing traffic. They shall be made of a material that can be struck without damaging vehicles. For nighttime use, tubular markers shall be reflectorized.

(b) Application - Tubular markers have less visible area than other devices and should be used only where space restrictions do not allow for the use of other devices. Tubular markers shall not be used to separate opposite directions of traffic on Illinois Tollway facilities.

6.4.7 Barriers

(a) Applications - Barriers are devices designed to minimize penetration by a motor vehicle while redirecting an impacting vehicle in such a manner as to minimize damage to the vehicle and its occupants.

(b) Barrier Specifications - The standard type of temporary barrier to be used on the Illinois Tollway is the Temporary Concrete Barrier (TCB), per the Illinois Tollway Special Provision for Temporary Concrete Barrier.

Barrier sections shall be precast in 12.5 feet sections. The ends of each section shall provide a cross-bolt connection which causes the barrier sections to act as a continuous line when impacted. An additional provision may be made for fastening the units to an underlying pavement or bridge deck when allowable deflection is to be limited. Sections shall be designed to provide lifting points and sufficient reinforcing to withstand lifting stresses. Recesses shall be provided on the bottom sides which are of sufficient size to permit water to flow under the barrier without clogging.

Other forms of temporary barriers may be considered. The design for other barrier types or the proposed use of proprietary barriers however, must be submitted to the Illinois Tollway's Engineering Department for review and acceptance.

(c) Use of Barriers - Applications for when barriers may be warranted are discussed in Section 7, Use of Positive Protection Devices.

(d) Placement Considerations - Barriers shall not be used as channelizing tapers where merging is required. In such instances the lane should be closed using channelizing devices, such as barricades, to provide recovery space before the barrier is introduced.

Barriers are most effective when they are placed essentially parallel to traffic flows. However, when conditions are such that they are placed on a flare with the downstream end toward traffic, the rates shown in Table 1 in Article 6.4.7 (e) 5) shall be used.

The upstream end of barriers shall be treated in such a way as to preclude impact. This can be accomplished by flaring the barrier away from the travel path to a point well outside the clear zone. The preferred treatment is the use of a NCHRP 350 or MASH approved impact attenuators at the exposed end.

When a temporary barrier is placed such that it longitudinally abuts another barrier system, such as a guardrail or a bridge rail, a structural connection that meets MASH Test-Level 3, shall be provided to form a continuous barrier system with a smooth face in the direction of traffic flow.

(e) Barrier Installation

When installing a TCB, a certain amount of space must be provided behind the barrier. This space allows for lateral deflection of the barrier in the event of an impact from an errant vehicle. The amount of space needed behind the barrier depends on the design of the barrier being installed.

Construction strategy consideration shall be given to worker or equipment exposure when a particular construction activity will encroach within the barrier clearance distance. Providing concrete anchoring systems may be desirable based on the distance and time that workers or equipment are present within this zone along with the Longitudinal Drop-Off Policy discussed in Section 8.

TCB is to be seated on bare, clean pavement or paved shoulder and cross-bolted together in a smooth, continuous line. TCB is not to be anchored on new bridge decks or bridge approach slabs. Where alternate anchoring details are necessary, these should be shown on the plans. The barrier unit at each end of the installation shall be secured to the pavement or paved shoulder using six anchoring pins. This anchorage is necessary to establish the required tension in the barrier system. The end barrier unit facing oncoming traffic shall be shielded with a temporary impact attenuator listed as Severe Use on IDOT's APPROVED LIST OF IMPACT ATTENUATORS, TEMPORARY, meeting the requirements of NCHRP 350-Test Level 3 or MASH-Test Level 3.

Additional segment anchorage will be required for conditions where barrier clearance distance cannot be met. There are several anchoring systems for use to prevent overturning and lateral deflections greater than those obtained during the MASH tests based on varying conditions.

Barriers located on bridge decks shall be restrained as shown in the plans. Anchor pins shall not be installed through new bridge decks or on bridge approach slabs.
TCB has several critical components to perform properly:

1) Lateral Deflection. See Article 1.3 for definition.

2) Barrier Clearance Distance. See Article 1.3 for definition.

3) Minimum Deployment Length. Minimum assembly of 8 longitudinal concrete barrier segments (100 feet) excluding terminals or end anchorage devices is required for any continuous run of TCB to perform as tested under MASH criteria.

4) Shy Distance. A 1 foot (minimum) or 2 foot (desirable) offset from the travel lane to the temporary concrete barrier for one-way traffic.

5) Flare Rate. The flare rate for temporary precast concrete barriers shall be determined based upon the following:

Table 1

Suggested Flare Rates for TCB

Work Zone Speed (mph)	Shy Line (ft.)	Barrier Inside Shy Line	Barrier at or Beyond Shy Line
65	8.5	28:1	19:1
60	8	26:1	18:1
55	7	24:1	16:1
50	6.5	21:1	14:1
45	6	18:1	12:1
40	5	16:1	10:1
35	4.5	15:1	9:1
30	4	13:1	8:1

6) TCB Quality. Temporary concrete barrier shall conform to requirements in the Illinois Tollway's "Quality Standard for Work Zone Traffic Control Devices" current edition.

7) Barrier Anchorage. The anchorage of TCB to new pavement other than the end units is not preferred.

(f) Temporary Concrete Barrier Anchoring Systems

1) Free-Standing.

Free-standing TCB placement consists of the end and transition barrier units being anchored. The remaining units, which are attached together by a restraining, cross-bolt connection, are set atop pavement. The barrier clearance distance to be provided for this system is 3'-6".

2) Anchor Bolt.

When overturning and lateral deflections cannot be tolerated, the temporary concrete barrier system must be anchored to the bridge deck or concrete pavement. Adequate barrier clearance distance from edge of unprotected deck or pavement drop-off shall be maintained for the type of anchorage system provided. Each barrier segment anchorage shall be installed through holes on the lower portion of the traffic side face of the barrier to constrain deflection. The barrier unit at each end of the installation run shall be secured to the pavement, deck or paved shoulder using six anchoring pins. Barriers located on bridge decks shall be restrained as shown in the plans. Anchor pins shall not be installed through new bridge decks or on new bridge approach slabs.

The Designer shall provide design details indicating the minimum edge distance placement, method of anchorage and barrier clearance distance.

3) HMA Pin Assembly.

On projects with HMA pavement material, epoxy bolt anchoring systems cannot be used because of the different mechanical properties of the bolts when placed in asphalt compared to concrete. On these projects, where barriers are needed closer to the obstacle, the barriers are to be installed with an asphalt barrier pin assembly.

Each barrier segment anchorage shall be installed through holes on the lower portion of the traffic side face of the barrier to constrain deflection. When connected to free-standing temporary concrete barrier there exists a need for a transition in the relative stiffness and deflection of the systems. The free-standing temporary concrete barrier shall have an upstream and downstream transition anchoring the barrier segments into the pavement.

The Designer shall provide design details indicating the minimum edge distance placement, method of anchorage and barrier clearance distance.

4) Temporary Concrete Barrier Anchor Layout Transitions.

a. Anchored TCB to Free-Standing TCB

A transition shall be provided when anchored and free-standing TCB are connected. The transition from anchored to free-standing TCB shall consist of two anchor pins installed in the end holes on the traffic side of the first TCB beyond the anchored TCB section and one anchor pin installed in the middle hole on the traffic side of the second TCB beyond the anchored TCB section. The third TCB beyond the anchored TCB section shall then be unanchored. At a minimum, this transition is required at each end of a TCB installation (See Figure 3).

b. Free-Standing to Rigid Concrete Barrier

When a free-standing temporary concrete barrier system is connected to a rigid barrier, such as a concrete parapet or median barrier, there exists a need for a transition in the relative stiffness and deflection of the systems. The free-standing temporary concrete barrier shall have an upstream transition anchoring the barrier segments into the pavement. The end barrier in this transition section shall be connected to the rigid section with a structural connection that meets MASH-Test Level 3.

The Designer shall provide design details indicating the minimum edge distance placement, method of anchorage and barrier clearance distance.

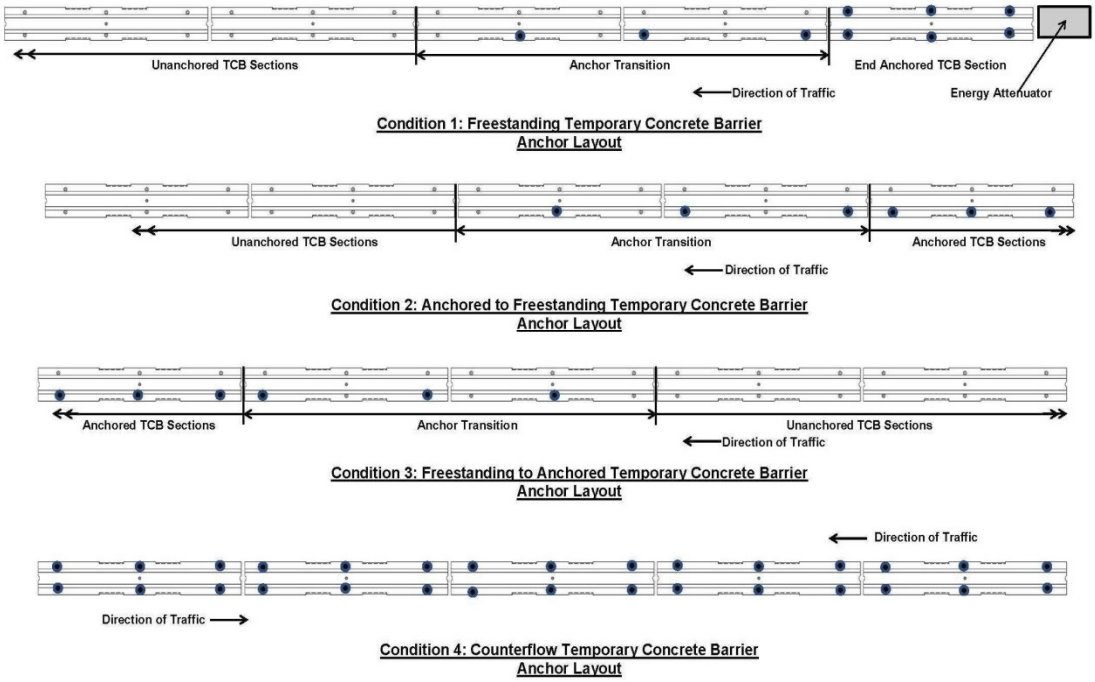


Figure 3

(g) Proprietary Temporary Traffic Barrier (PTTB)

A proprietary temporary traffic barrier (PTTB) may be used for work zones or lane separation situations. The required barrier clearance distance shall be based upon the dynamic deflection exhibited in the manufacturer's crash testing results. When free-standing installations are used, the barrier clearance distance required for roadway excavation edge drop-offs, and equipment and material storage locations shall be based on the MASH-Test level 3 dynamic lateral deflection. MASH-Test Level 3 tested and approved anchoring systems may be used to reduce the above barrier clearance distance, dependent on manufacturer's recommendation.

The Designer shall provide design details indicating the minimum edge distance placement, method of anchorage and barrier clearance distance.

(h) "Y" Shape -Temporary Concrete Barrier.

The "Y" shape concrete barrier is used to split one run of TCB into dual runs. This barrier attaches directly to IDOT's 32-inch TCB. At least one standard TCB segment shall be attached between the "Y" shape and an impact attenuator. This barrier shall not be used in an unanchored configuration. An Impact Attenuator, Temporary (Severe Use, Wide), TL-3 may be used as an alternate to the TCB "Y" connector segment, see Article 6.7.1.

Reference Document (Current Edition): Base Sheet M-MOT-700

(i) Temporary Guardrail

Temporary guardrail must meet current Illinois Tollway Standards for steel plate beam guardrail. Existing guardrail in satisfactory condition may be extended as long as the temporary guardrail matches in design the system to which it attaches and a proper barrier warrant has been completed. Once the temporary guardrail system is no longer in use, the entire guardrail system must be removed and replaced, if necessary, with a new guardrail installation which meets current Illinois Tollway Standards.

Existing guardrail system with steel block-outs may not be modified.

(j) Remove and Reinstall Existing Guardrail

The Illinois Tollway allows the temporary removal and reinstallation of a small (< 50') section of existing guardrail when all of the following conditions have been met:

1) The location of the removed guardrail provides temporary access for the Contractor to get equipment or materials to a work area.

2) It is either impractical or very difficult for construction equipment to go around the entire guardrail system.

3) Rehabilitation of the adjacent roadway, or the replacement/upgrade of the existing guardrail is programmed within the next five years.

4) The existing run of guardrail is not the current Illinois Tollway standard.

The Quality Standard for Work Zone Traffic Control Devices dated March 2020 replaces the version Issued March 2018.

Major Highlight Revisions

- Manual was updated to match current manual format standards.

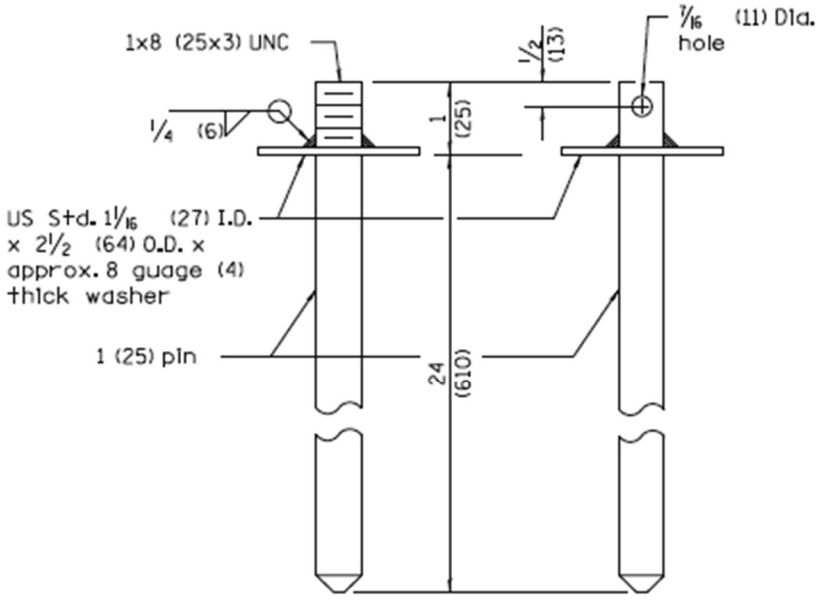
January 11, 2021
Section 7 Quality Standard for Temporary Concrete Barrier
- Revised section to incorporate cross-bolted temporary concrete barrier

SECTION 7.0 QUALITY STANDARD FOR TEMPORARY CONCRETE BARRIER

This standard applies to temporary concrete barrier furnished by a supplier, subcontractor, or contractor for traffic control in work zones. The Temporary Concrete Barrier shall comply with the Illinois Tollway special provision and have the F-shape. Temporary Concrete Barrier shall conform to either IDOT Highway Standard 704001 (for NCHRP Report 350 applications) or the Illinois Tollway Standard "Temporary Concrete Barrier with Cross-Bolt Connection" (for MASH Test Level 3 applications).

The barrier unit at each end of the installation shall be secured to the pavement or paved shoulder using six anchoring pins as shown on Standard 704001, and protected with an accepted NCHRP Report 350 or MASH Test Level 3 crashworthy device as shown on the plans.

Connecting pins and anchor pins shall be according to Standard 704001.



CONNECTING AND ANCHOR PINS

(End may be beveled 1/4 (6) max.)

The Evaluation Guide provided in this section shall be used to evaluate the general appearance of temporary concrete barrier. The CM and Contractors QC shall verify that temporary concrete barriers are in compliance with these guidelines.

EVALUATION GUIDE - TEMPORARY CONCRETE BARRIER

Acceptable – These are examples of acceptable temporary barrier wall. The walls appear new with few minor blemishes. Wall repaired according to Tollway Recurring Special Provision, TEMPORARY CONCRETE BARRIER is acceptable. The connecting loop bars or connecting cross-bolts are in place and in good condition.

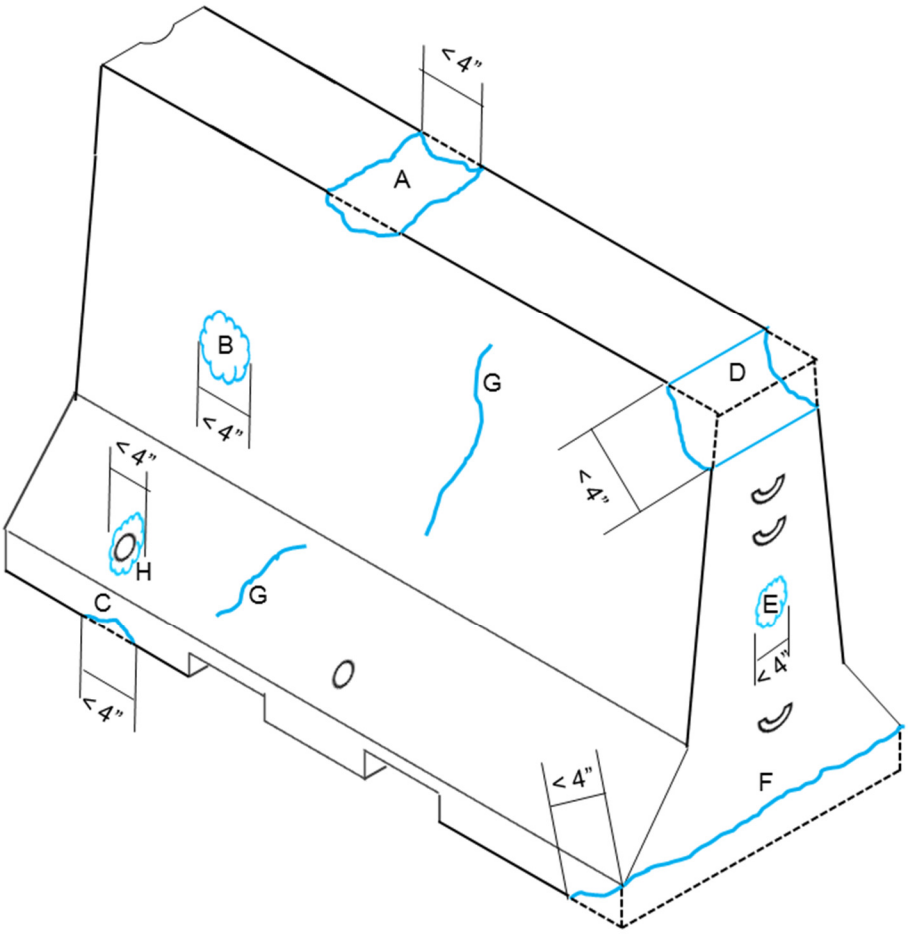
Concrete spalling, chipping and delamination not greater than 1.5 inches in depth and 4.0 inches in length measured horizontally, vertically, or diagonally will not require patching as long as the exposed cavity has side slopes of at least 1:3 (V:H).

Cracks are tightly compressed, exhibiting no displacement and do not compromise the structural integrity of the wall.

Most importantly, the wall is structurally sound and none of the spalling or chipping compromises the overall safety shape profile of the barrier or causes a potential snag point on the barrier system during an impact.

EVALUATION GUIDE- TEMPORARY CONCRETE BARRIER

TYPICAL SAFETY SHAPE DEFECTS (NOT ALL INCLUSIVE)



Above is a diagram of a temporary concrete barrier with some typical defects that may be acceptable. Below are the descriptions of defects that may be deemed acceptable.

A. Spall on top of barrier, less than 4" measured horizontally, vertically, or diagonally and less than 1.5" depth.
B. Spall on surface of barrier, less than 4" measured horizontally, vertically, or diagonally and less than 1.5" depth.
C. Spall on bottom of barrier, less than 4" measured horizontally, vertically, or diagonally. Does not create a snag point or compromise the safety shape.
D. Spall on top corner of barrier, less than 4" measured horizontally, vertically, or diagonally. Does not create a snag point or compromise the safety shape.
E. Spall on end face of barrier, less than 4" measured horizontally, vertically, or diagonally and 1.5" depth. Does not interfere with connecting loop bars or cross-bolts.
F. Spall on bottom corner of barrier, less than 4" measured horizontally, vertically, or diagonally. Does not create a snag point or compromise the safety shape.
G. Crack tightly compressed, exhibiting no surface displacement and not combined with other defects.
H. Spall around pin hole, less than 4" measured horizontally, vertically, or diagonally.