Illinois Department of Transportation
Office of Highways Project Implementation / Bureau of Construction
2300 South Dirksen Parkway / Springfield, Illinois 62764

Subject:
Policies and procedures for monitoring IL F-Shape Temporary Concrete Barrier

CONSTRUCTION MEMORANDUM NO. 90
BSPE MEMO NO. 90
Effective: February 3, 2020
Expires: Indefinite

This joint Construction/Safety Programs and Engineering Memorandum provides direction for monitoring IL F-Shape Temporary Concrete Barrier (TCB) performance upon a vehicular impact. Monitoring is needed to validate the Department's IL F-Shape TCB deployment guidelines are consistent with field performance.

A BSPE WZ4 form (see Attachment A) must be submitted for any known impact to the IL F-Shape TCB regardless of impact severity and TCB deflection. Reporting all impacts will allow the Department to validate the IL F-Shape TCB performance compared to crash testing deflection results. The BSPE WZ4 must be submitted by the Resident Engineer (or their designee) to the Central Bureau of Safety Programs and Engineering (via e-mail to DOT.BSPEWZ@illinois.gov).

See Attachment B for additional background.

Attachment

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Engineer of Construction

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Attachment A

Illinois Department of Transportation

IL F-Shape Temporary Concrete Barrier (TCB) Impact Incident Report

Contract Number	**District**	**Marked Route**	**Location** (direction of travel and distance from nearest crossroad)

Date of Crash	**Time of Crash** (if available)	**Work Zone Posted Speed Limit**	**Normal Posted Speed Limit**
		MPH	MPH

Type of Vehicle (choose or enter a value (if available))	**Barrier Restraint at Point of Impact**

Crash Reported to Police? ☐ Yes ☐ No

Number of Lanes Open to Traffic Adjacent to Barrier Run		Each
Length of Barrier Run (length of the entire barrier deployed, measured from the first to last segment, excluding the length of impact attenuators)		Feet
Location of Impact		
Distance from Point of Impact to the Nearest End of the Barrier Run		Feet
Distance from Back of Barrier to Drop Off Prior to Impact		Inches
Drop-Off Depth		Inches
Maximum Barrier Deflection (deflection of the barrier measured at the point where the maximum movement was experienced, measure to the nearest 1/2 in.)		Inches
Number of Barrier Segments Displaced (number of barrier segments displaced from the original deployed location)		Each

Physical Damage of Barrier
(describe any barrier damage due to the impact: spalls, cracks, number of segments damaged, pieces broken off,what size, etc. provide photos, if possible)

Comments (optional)

This form shall be used to document any impact to the IL F-Shape temporary concrete barrier (TCB) regardless of impact severity. Please submit this form within one week of the barrier impact.

Submitted by:

Name	Title	Date

Construction /BSPE Memorandum 90 Attachment B
February 3, 2020

Background for IL F-Shape Temporary Concrete Barrier Implementation Guidelines Under MASH 2016

Based on the historical performance of the IL F-Shape temporary concrete barrier (TCB), and the successful crash testing of similar systems under MASH 2016 testing criteria, the Illinois Department of Transportation (IDOT) submitted and received approval from the Federal Highway Administration (FHWA) on the determination of crash worthiness of the IL F-Shape TCB under MASH testing criteria. Due to this approval, IDOT will continue deploying the IL F-Shape TCB under the current deployment guidelines outlined by Safety Policy 4-15, Standard Specifications for Road and Bridge Construction Sections 701 and 704, and applicable Highway Standards.

The Illinois F-Shape TCB has been used on Illinois roadways in most projects requiring the use of TCB since October 1, 2002, the New-Jersey barrier that predated the Illinois F-Shape barrier was completely phased out between 2002 and 2008. The Bureau of Design and Environment (BDE) Policy Memorandum 27-02 stated that the IL F-Shape TCB was required to provide a deflection distance of 42 in. behind the back of the IL F-Shape TCB for freestanding TCB deployments. In 2008, IDOT issued Safety Policy 4-08 which modified the IL F-Shape TCB deployment distance requirements based on risk exposure. In 2015, Safety Policy 4-08 was updated to provide better guidance on the pinning requirements of TCB.

The Illinois F-Shape TCB utilizes the shape and reinforcement from the approved Midwest TCB, and the pin and loop connection similar to the Oregon TCB. A deflection distance of 42 in. referred to in BDE Policy Memorandum 27-02 was the estimated deflection based upon the deflections of the two TCB's of which the IL F-Shape TCB was comprised; the Midwest TCB with a 45 in. deflection and the Oregon TCB with a 30 in. deflection under NCHRP 350 testing criteria. The Midwest and Oregon TCB's experienced 79 in. and 63.4 in. dynamic deflections, respectively, under MASH testing criteria for test level 3.

In 2008, IDOT issued Safety Policy 4-08 which provided warrants for the use of TCB based on posted speed limits, location of drop off, and drop off depth to better assist designers in mitigating the drop-off while preparing plans.

In 2015, IDOT issued Safety Policy 4-15 which established TCB deployment guidance based upon containing 85% of impacting vehicles for all locations except on critical locations such as bridge deck edge, approach slab, or similar locations with a large drop-off where TCB deflection of 95% of impacting vehicles should be contained. These percentiles equate to an allowed deflection of 24 in. and 37 in. respectively. The reduced 85% and 95% crash criteria were adopted based on computer modeling performed for the Midwest TCB by Midwest Roadside Safety Facility (MwRSF) at the University of Nebraska-Lincoln in 2003.

MASH Testing Results

In 2009, MwRSF completed testing of the freestanding Midwest TCB system. The testing determined the freestanding TCB provided an acceptable safety performance when impacted by the ½ ton, four door pick-up truck, meeting the requirements of what is now known as MASH Test Level 3 (TL-3) requirements. The resulting dynamic TCB deflection of the crash test was 79 in.

In 2018, TTI conducted crash testing of the freestanding Oregon TCB system. The testing determined the freestanding TCB performed acceptable for MASH TL-3. The resulting dynamic TCB deflection of the crash test was 63.4 in.

Crash Data and Crash Reports

For the development of Safety Policy 4-15, the Bureau of Safety Engineering prepared a memorandum to document the updated process. At that time, there was a comprehensive evaluation of crashes performed to obtain all crash involvement of TCB or other Temporary Longitudinal Traffic Barriers (TLTB). Following is an excerpt of the section of the development memorandum of the evaluation of crashes with TCB at the time.

> "All available crash reports for fatal work zone crashes from 2008 through 2013 were reviewed to learn of any involvement of TCB, or other (TLTB). Also, crash reports for all A-injury crashes in work zones for 2008 and 2012 were reviewed to provide a larger sampling. The fatal crashes from 2008 through 2013, and A-injury crashes from 2008 and 2012 were of interest because they include the time periods with varying levels of enforcement of pinning and anchoring specifications. Enforcement of pinning and anchoring of TCB has increased since about 2011. This selection of years' data helps to identify any significant safety performance changes between the past enforcement practices and current ones.
>
> Crash data for 2013 is not final at the time of gathering this information. As of data collection on January 22, 2014, no fatal crashes in work zones involved concrete median barrier (CMB) (the data item usually coded for TCB). Also, none of the 19 fatalities involving CMB is coded as happening in a work zone.
>
> Two fatal crashes involving TCB appear in this total sample of 110 crashes covering the years 2008 through 2012 inclusive. In one crash from 2008 some segments of TCB were installed perpendicular to traffic as a road closure. This should not be considered a failure of the TCB, but a use of TCB for purposes other than roadside safety. In 2011 a tractor semi-trailer impacted sand barrels and TCB before running off the roadway into a ditch, overturning and catching fire that resulted in a fatality. It is not clear that the TCB and/or sand barrels contributed to the severity of this crash.

> Crash data show there were 171 A-injury crashes in work zones in 2012. Of these, five involved TCB. Data for A-injury crashes from 2008 showed four of the 174 A-injury crashes in work zones included an event with TCB."

In order to complement the analysis performed in 2014, the Bureau of Safety Programs and Engineering reviewed crash data from 2013 through 2018. Fatal crash reports were reviewed to determine involvement of TCB or other TLTB. A total of 166 fatal crashes were reported in work zones during the six (6) year period. The review indicated that there were no work zone fatal crashes from the vehicle impacting the IL F-Shape TCB as the primary event. Multiple crash reports mentioned TCB or other TLTB being impacted as a result of other primary events. Similar to the analysis performed in 2014, work zone A-injury crashes were evaluated to determine the involvement of the IL F-Shape TCB or other TLTB in these crashes. There were 790 crashes in work zones resulting in A-injuries. Of the 790 crashes, two (2) were reported as resulting from the vehicle at fault (unit 1) impacting the Concrete Median Barrier (CMB) as the primary event. From the crash reports and site pictures it appears the CMB refers to permanent concrete median barrier, not TCB.

Conclusion

In summary, the review of the crashes in work zones (2008 through 2018) indicated that no evidence currently exists of the IL F-Shape TCB underperforming under IDOT's current TCB deployment guidelines. IDOT will continue to deploy the IL F-Shape TCB under current guidelines as outlined under Safety Policy 4-15, Illinois Highway Standards, Standard Specification, and Special Provisions with continual monitoring and assessments.

In order to document the in-field performance of the IL F-Shape barrier, the IL F-Shape Temporary Concrete Barrier (TCB) Impact Incident Report (BSPE WZ4) must be submitted to the Central Bureau of Safety Programs and Engineering.

A BSPE WZ4 form must be submitted for any known impact to the TCB regardless of the resulting deflection of the TCB. It is known that several impacts may go unreported and fields requested on the form may not be able to be completed. However, form must be completed to the best possible. Reporting of all impacts will allow the Department to validate the performance of the barrier compared to crash testing deflection results.