



## Identification of Standards for Acceptability of In-Place Temporary Concrete Barriers

Requested by  
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# Executive Summary

## **Background**

Temporary concrete barrier (K-rail or Jersey barrier) is an important traffic control device used abundantly within work zones. Each barrier section must meet certain quality criteria to ensure that it performs its intended function without posing a hazard to motorists or highway workers. Caltrans currently uses guidance from the American Traffic Safety Services Association (ATSSA) for evaluating the condition of temporary concrete barriers. Caltrans uses the 2008-2009 edition of ATSSA's Quality Guidelines for Temporary Traffic Control Devices and Features, which includes specific language related to spalls: "Any spalled concrete could cause a vehicle to 'snag' and twist from the direction it is going. Any spall greater than 1.5 inches in depth or connecting loop broken or damaged is cause for rejection."

In 2014, the ATSSA guidance was updated and the reference to spall dimension was removed. Without specific guidance such as this related to spall size and other deterioration that would make K-rail sections unacceptable, disagreement may result in the field between Caltrans inspectors and contractor staff regarding acceptability. To avoid this, Caltrans would like to develop specific guidance for in-service concrete barrier acceptability, with documentation to support the guidance.

To support this effort, CTC & Associates surveyed state DOTs about the guidelines they use to evaluate the condition of temporary concrete barriers and the basis for those guidelines. The survey was distributed to the members of AASHTO's Subcommittee on Construction. In addition, we conducted a literature review and contacted experts in the field, with a goal of identifying relevant research in this area. This Preliminary Investigation compiles the results of the state survey, literature review and expert interviews.

## **Summary of Findings**

The survey of state DOTs asked states about the basis for their guidance for evaluating the condition of temporary concrete barrier. Of the 27 states that responded, 11 use guidance developed within their own agency. Nine states use the ATSSA guidance; five use the 2008-2009 guidance and four use the revised 2014 guidance. The remaining seven states have no formal guidance for determining acceptability of temporary concrete barriers; this is typically left to the engineer's discretion.

Because Caltrans is already familiar with the ATSSA guidance, this Preliminary Investigation focuses on the 11 states that have developed their own guidance. These guidance documents are described below.

## **State-Developed Guidance**

### **Evaluation Criteria Based on Measurements and Dimensions**

Four states have developed their own highly detailed guidance that differs from the ATSSA guidelines and includes specific measurements and dimensions for evaluating barrier condition. Through a literature search, we identified a fifth agency with this type of guidance—the Illinois State Toll Highway Authority.

- **Illinois State Toll Highway Authority** uses three condition levels similar to the ATSSA guidance, including the specification of 1.5 inches in depth for spalling from ATSSA's 2008-2009 guidelines. The Toll Authority also specifies tolerances for the length and slope of certain defects: "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)."
- **Indiana DOT's** 2016 Standard Specifications require the inspection of the surface of a 10-foot barrier and allow variation of no more than 0.25 inch along the surface of the barrier's length. The specifications also require the same method to be applied regarding variation in the vertical and horizontal alignment of adjacent barriers. If barrier sections develop defects or visible cracks during the contract, they may be repaired with concrete.
- **Iowa DOT** has guidance that addresses surface defects, such as honeycombing and spalling, and other damage such as corner breaks, and bottom spalls. The guidance provides tolerances for length, width and height of the barrier, as well as horizontal straightness, top straightness and deviation from square of the exposed barrier ends. The connecting loop must be undamaged and true to dimensions.
- **Pennsylvania DOT** developed guidance that contains a great deal of detail regarding chips and cracks, including specific dimensions and proportions. A graphic displays each of the condition criteria.
- **South Carolina DOT** defines defects as gouges, cracks, chips or spalled areas, and the agency's guidance provides very specific dimensions for these defects. In addition, any exposed rebar is considered unacceptable.

#### Guidance with Less Specific Evaluation Criteria

Five states have developed guidance that does not incorporate measurements or dimensions for evaluating barrier condition. Of these five, Minnesota and Wisconsin DOTs provide the most detailed guidelines; Wisconsin uses a ranking system similar to ATSSA's.

- **Alabama DOT** has guidance that provides images of acceptable and unacceptable examples of barrier. Most examples relate to the condition of the barrier connections, with one image portraying an unacceptable condition of barrier due to physical damage.
- **Kansas DOT** requires certification (prepared by the manufacturer or contractor) that the barrier complies with requirements in KSDOT's contract documents. These contract documents allow new or used barrier, with the engineer providing a visual inspection affirming their compliance.
- **Minnesota DOT** considers the condition of connecting loops, delamination of the barrier that may expose rebar, and cracking and chipping of the barrier concrete. There are no specific measurements associated with these conditions, but the agency's guidance includes images of acceptable and unacceptable barrier.
- **Virginia DOT** addresses barrier condition in its 2007 Road and Bridge Specifications. The specifications require that concrete barrier be structurally sound with no missing

concrete, no through cracks, and no exposed rebar. There are no measurements or acceptable levels of deterioration provided.

- **Wisconsin DOT** evaluates concrete barrier using the three conditions of acceptable, marginal and unacceptable—much like the ATSSA guidance. WisDOT does not provide dimensions for damaged areas; the agency’s guidance includes graphics to assist the engineer in determining condition. WisDOT requires replacement of marginal barrier, not just unacceptable barrier.

#### Guidance Similar to ATSSA Guidelines

Two states have developed guidance that is very similar to the ATSSA guidelines:

- **Illinois DOT** has incorporated the 2008-2009 ATSSA guidance, which includes the spall dimension of 1.5 inches in depth. IDOT uses the same language as ATSSA, including the three condition levels—acceptable, marginal and unacceptable. The graphics displaying the barrier conditions are also the same as used in the ATSSA guidance, save for those displaying acceptable condition.
- **Ohio DOT** has incorporated the ATSSA guidance into its Quality Standard for Temporary Concrete Barrier, with a few exceptions:
  - **Acceptable** condition is the same as ATSSA.
  - **Marginal** condition is the same, except that the Ohio standard excludes the requirement for the connecting loops to be sound and in place.
  - **Unacceptable** condition differs in that ATSSA’s statements about spalled concrete have been removed:
    - “Any spalled concrete could cause a vehicle to ‘snag’ and twist from the direction it is going.”
    - “The spalled wall could cause tire damage if hit especially along the base.”

The Ohio guidance also includes the criteria “one (1) or more connecting loop is missing,” which is not part of the ATSSA guidance.

Lastly, whereas ATSSA uses at least two graphics to display each barrier condition, Ohio uses one graphic for each condition rating.

#### **Basis for State Guidance**

The survey asked states what they used as a basis for the guidance they developed or adopted. The question gave the examples of experience, research study, or another agency’s practices, but respondents were not limited to those choices.

Of the 11 states that developed their own guidance, nine noted that experience was at least part of the basis for that guidance. One state responded that its guidance was based on experience and other states’ practices. Two states did not respond to this question.

Of the nine states that adopted ATSSA standards, all nine included adopting other agency practices (presumably ATSSA) as at least part of the basis for that decision. Two of those states also noted that experience was a component of the reason for adopting the ATSSA standards.

## **Consultation with Experts**

To supplement the information gathered through the survey of states and the literature review, we contacted several experts in this area, including FHWA staff, a TRB committee chair, and university researchers. Our goal was to identify any studies that had been conducted to establish standards for acceptability of in-place temporary concrete barriers.

The contacts we spoke with pointed to research on related topics, but no one was aware of any studies that specifically addressed this issue. Two of our contacts noted that this topic has been the subject of proposed research several times, including at the national level, but that it has not been ranked high enough to receive funding. One suggested that this topic may become a bigger issue in the future as states implement the new AASHTO Manual for Assessing Safety Hardware (MASH) and need to determine when existing barrier that was approved using *NCHRP Report 350* criteria has reached the end of its service life.

## **Related Research**

Of the existing research in this area, the most relevant is a 2012 Montana DOT research project that examined corrosion of temporary concrete barrier connection systems. The project examined approaches to rating this corrosion, compiled state practices on maintenance and replacement, and made recommendations for addressing the corrosion in the future. See page 24 of this Preliminary Investigation for more on this project.

## **Gaps in Findings**

Although there was little research available for Caltrans to reference when developing guidelines for evaluating the condition of in-place temporary concrete barriers, the survey of states completed for this Preliminary Investigation resulted in a range of state approaches that Caltrans may find useful. There may be additional relevant guidance available from other agencies, especially internal guidance that is not publicly available online. Potential sources include:

- Internal guidance documents at state DOTs other than the 27 states that responded to our survey.
- Internal guidance documents from non-DOT sources, such as the guidance we identified from the Illinois State Toll Highway Authority.

## **Next Steps**

Moving forward, Caltrans may want to examine especially those state-developed guidelines for evaluating temporary concrete barrier that provide specific dimensions and tolerances for defects (guidelines from Indiana, Iowa, Pennsylvania and South Carolina DOTs and the Illinois State Toll Highway Authority). There may be elements of these guidelines that Caltrans could incorporate into its own revised guidance.

The sources we interviewed indicated that evaluating the condition of in-place temporary concrete barrier has been proposed as a national-level research topic on multiple occasions but has yet to receive funding. This points to the need for research on this topic, and Caltrans may want to consider conducting a research project aimed at examining this topic more closely.

## Detailed Findings

### Survey of Current Practice

We conducted a brief email survey of members of AASHTO's Subcommittee on Construction to gather information about state DOTs' practices for determining the acceptability of in-place temporary concrete barrier. The survey asked about the guidance that states provide to their inspectors and contractors to make these determinations and the basis for that guidance. The survey consisted of a brief paragraph to provide context and four questions:

CTC & Associates is helping the California Department of Transportation gather information about how other state DOTs determine the acceptability of in-service sections of temporary concrete barrier (K-rail or Jersey barrier) used in highway construction work zones. Criteria could include such things as the size of spalls or cracks and the condition of connecting loops. The findings will be compiled in a summary report to be made available on Caltrans' website.

1. Please provide your contact information for follow-up questions.
  - A. Name
  - B. Agency
  - C. Email
  - D. Phone
2. Does your agency have guidance (criteria) for determining the acceptable/unacceptable condition of in-place temporary concrete barriers (Jersey barrier or K-rail) used within construction work zones? (yes or no)
3. If yes to #2, please provide the text of the guidance or a link to the online document.
4. If yes to #2, what is the basis for the guidance (research study, experience, other agency's practice, etc.)?

Note that because states' standards for temporary concrete barrier vary, the survey referenced both K-rail and Jersey barrier, and the states' responses and guidelines may not all be applicable to K-rail as it is specifically defined by Caltrans.

We received responses from 27 state DOTs:

- Alabama.
- Arizona.
- Connecticut.
- Delaware.
- Florida.
- Idaho.
- Illinois.
- Indiana.
- Iowa.
- Kansas.
- Louisiana.
- Michigan.
- Minnesota.
- Montana.
- New Hampshire.
- New Mexico.
- North Dakota.
- Ohio.
- Pennsylvania.
- Rhode Island.
- South Carolina.
- Utah.
- Vermont.
- Virginia.
- Washington.
- West Virginia.
- Wisconsin.

Common themes and key points drawn from the summaries below are presented in the Executive Summary of this Preliminary Investigation.

## State-Developed Guidance

This section summarizes key points from the guidelines from the 11 state DOTs that have developed their own guidance on determining the acceptability of in-place temporary concrete barrier. The other 16 state DOTs either use the ATSSA guidelines or do not have any specific guidance in this area. The complete survey results from all 27 state DOT respondents are included in the Survey Results section beginning on page 14.

In addition to the guidelines from state DOTs that responded to the survey, this section includes guidance developed by the Illinois State Toll Highway Authority, which differs significantly from the Illinois DOT guidance. The Toll Authority guidance was identified through a literature review.

### Alabama DOT

“ALDOT Traffic Control Device Quality Guide,” March 2014. See [Appendix A](#). This guide provides example photos of portable concrete barrier rail in acceptable and unacceptable condition. These examples are primarily related to barrier connections, with one example of physical damage.

### Illinois DOT

“Quality Standard for Work Zone Traffic Control Devices,” 2010.  
<http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Safety-Engineering/Work%20Zone%20Traffic%20Control%20Devices%202010.pdf>

This Quality Standard is designed to “aid the inspector in determining the quality of work zone devices. ... The Engineer shall be the sole judge as to the acceptability of placement and maintenance of all traffic control devices.”

The standard details the following grades for temporary concrete barriers (see pages 14-17):

**Acceptable:** The wall is new, or in new condition with few minor blemishes. Spalls and chipped concrete are no greater than 1.5 inches in depth. Connecting loop bars are in place and in good condition.

**Marginal:** The wall has minor spalls with hairline cracks, and minor imperfections along the base. It is still structurally sound. Connecting loop bars are in place and in good condition.

**Unacceptable:** The barrier wall has large spalls and cracks, with unsound concrete that could easily dislodge when hit. The spalled wall could cause tire damage if hit, especially along the base. Spalled concrete could cause the vehicle to “snag” and twist from the direction it is going. Any spall greater than 1.5 inches in depth or broken/damaged connecting loop is cause for rejection.

## **Illinois State Toll Highway Authority**

“Quality Standard for Temporary Concrete Barrier,” Construction Bulletin No. 14-03, June 2014.  
<http://www.illinoistollway.com/documents/10157/36930/14-03+Construction+Bulletin+No+14-03+Quality+Standard+for+Temporary+Concrete+Barrier>

Excerpt:

**Acceptable** – 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 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.

**Marginal** – The walls have minor spalls with hairline cracks and minor imperfections along the base but are still structurally sound. The connecting loops are all in place and in good condition.

Concrete spalling, chipping and delamination greater than 1.5 inches and up to and including a depth of 2.5 inches shall be repaired according to Tollway Recurring Special Provision, TEMPORARY CONCRETE BARRIER.

Concrete spalling, chipping and delamination greater than 2.5 inches in depth shall be repaired by methods proposed by the Contractor and approved by the Engineer.

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.

**Unacceptable** – The barrier walls have large spalls and cracks, with unsound concrete that could be easily removed when hit, and the connecting loop bars may be broken or damaged.

Concrete spalling, chipping and delamination greater than 2.5 inches in depth with any cracks exhibiting displacement or multiple defects which combine to make the barrier structurally unsound per engineering judgment, is cause for rejection.

Barriers that have open cracks with the cracks extending completely through the barrier shall not be accepted. Barrier with cracks that extend from the edge of the wall base to the pinholes shall not be accepted.

A wall is deemed unacceptable if the overall safety shape profile of the barrier is compromised, there may be a potential snag point on the barrier system during an impact, or the wall is not structurally sound.

## **Indiana DOT**

“Temporary Traffic Barriers,” Section 801.10, 2016 Standard Specifications.

<http://www.in.gov/dot/div/contracts/standards/book/sep15/sep.htm>

Excerpt from Section 801.10:

Type 1 temporary traffic barriers shall be used to separate two-way traffic and shall be precast concrete in accordance with applicable requirements of 707 and 602 and as shown on the plans. Type 1 barriers may also be used to separate traffic from the work zone. The surfaces of individual precast units shall vary no more than 1/4 inch in 10 feet from the specified cross section, as measured from a longitudinal straightedge. The maximum variation in the vertical and horizontal alignment of adjacent units shall be 1/4 inch across the joint, as measured from a 10 foot longitudinal straightedge. Sections that have obvious defects or visual cracks shall not be used. Sections that develop any of these conditions during the contract shall be repaired with concrete or replaced within a reasonable amount of time.

## **Iowa DOT**

“Concrete Barrier,” Section 2513, Standard Specifications, 2016.

<http://www.iowadot.gov/erl/current/GS/content/2513.htm>

Excerpt from Subsection 2513.03:

### **H. Tolerances**

1. Ensure all newly fabricated units of temporary barrier rail are free from honeycomb, surface spalling, and surface defects. Ensure corner breaks and bottom spalls after shipping and placement do not exceed 1 square foot of total surface area, which includes the base.

2. Other than honeycomb, shallow voids, not exceeding 3/4 inch diameter, which appear on the formed surface after proper consolidation will not be considered as surface defects. They need not be filled unless they appear in an abnormal concentration.

3. For concrete barrier, apply the tolerances of Table 2513.03-4:

**Table 2513.03-4: Tolerances for Concrete Barrier**

Item	Precast Fabrication <sup>(a)</sup> (Permanent or Temporary)	Cast-In-Place or Slip Form Installation
Length	± 3/4 inch	
Width	± 1/4 inch	(b)
Height	± 1/4 inch	(b)
Horizontal Straightness (Sweep)	1/2 inch maximum in 10 feet	3/4 inch maximum in 10 feet
Top Straightness (Vertical)	1/4 inch maximum in 10 feet	3/4 inch maximum in 10 feet
Exposed Ends (Deviation from square)	± 1/4 inch	
<sup>(a)</sup> Installation of permanent precast barrier includes shimming and grouting such that adjoining sections match within 1/4 inch on the sides and top, and the finished height is not less than required by the contract documents. <sup>(b)</sup> The width and depth are not to be less than required by the contract documents.		

4. Ensure each unit of temporary barrier rail does not have spalls, corner breaks, and bottom spalls totaling more than 5 square feet of surface area, including the base.

5. Ensure connecting loops on all barriers are not deformed. Ensure they are true to dimensions.

6. Ensure gaps between units do not exceed the dimensions shown in the contract documents.

## **Kansas DOT**

Kansas DOT's contract documents include these requirements:

Provide certification (prepared by the manufacturer or Contractor) that the temporary precast concrete safety barrier complies with the requirements on the Contract Documents. Provide either new or used, temporary precast concrete safety barrier. The Engineer will accept, either new or used, temporary precast concrete safety barrier upon acceptance of the provided certification, and visual inspection of the delivered and installed temporary precast concrete safety barrier on the project.

## Minnesota DOT

Special Provisions 2533, Concrete Median Barrier, Design 8337, Work Zone Standards and Specifications.

[http://www.dot.state.mn.us/trafficeng/workzone/doc/pcb\\_quality\\_spec.pdf](http://www.dot.state.mn.us/trafficeng/workzone/doc/pcb_quality_spec.pdf)

Excerpt:

To be acceptable, the barrier shall meet the following minimum requirements:

- Connecting loops shall be intact and undamaged. In the case of wire rope, there shall be no delamination or missing strands.
- No more than hairline cracking due to handling and wear shall be present.
- Barrier faces and/or ends have areas where surface concrete has been lost, but no area that would affect impacting vehicle travel/direction or overall structural integrity.
- Rebar surface is partially exposed but is not likely to affect impacting vehicle travel/direction or overall structural integrity.
- Finished edges are reasonably square with no loss of concrete and minimal chipping due to wear.

The barrier is unacceptable in the following cases:

- Any connecting loops are cracked or, in the case of wire rope, are delaminated or missing strands.
- Barrier section has major cracking that is likely to affect its structural integrity.
- Barrier faces have extensive loss of surface concrete which would affect vehicle travel/direction.
- Finished edges are so worn and rounded that the Type "F" face is no longer well-defined.
- Barrier is delaminated to the point that rebars are completely exposed and are likely to affect impacting vehicle travel/direction or structural integrity.

## Ohio DOT

"Quality Standard for Temporary Concrete Barrier," Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles, October 2010.

[http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/qualityguidelines/Documents/QualityStandards\\_October2010\\_101410.PDF](http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/qualityguidelines/Documents/QualityStandards_October2010_101410.PDF)

The standard includes the following classification system (see page 11 of the PDF):

**Acceptable:** To be acceptable, the temporary barrier shall meet all of the following conditions.

- The wall shall appear new with few minor blemishes.
- Spalls and chipped concrete are not greater than one and one-half (1.5) inches in depth.

- The connecting loops are all sound and in place with no broken strands.

**Marginal:** Temporary barrier is considered marginal when it meets the following conditions.

- The wall has minor spalls with hairline cracks and minor imperfections along the base but is still structurally sound.

**Unacceptable:** Temporary barrier is considered unacceptable when any of the following conditions exist.

- The wall has large spalls and cracks, with unsound concrete that could be easily removed when hit.
- The spalls are greater than one and one-half (1.5) inches in depth or connecting loop is broken or damaged.
- One (1) or more connecting loop is missing.

## **Pennsylvania DOT**

“Reuse of Concrete Median Barrier,” Project Office Manual, April 2013.

See [Appendix B](#).

Excerpt:

Concrete barrier to be used in construction zones (MPT) must be visually inspected prior to its reuse and placement. This inspection is to be documented in the project records. Any element showing any one of the following discrepancies will not be installed.

- Cracked or destroyed slot and plate connection where more than 25% is missing or broken.
- Crack on top which runs down either vertical face for more than 16 inches.
- Chip on top or vertical face which is more than 1 square foot in area and/or 2 inches deep—smaller areas and depths can be field patched. Chips less than inches depth and reasonable area will not require attention.
- Horizontal crack in web which is greater than L/2 or any length that forms a Y with arms greater than 12 inches.
- Horizontal crack in sloping area that is greater than L/2 and/or intersects a vertical crack.
- Chip on vertical curb greater than 1 square foot and/or 3 inches deep—smaller areas and depths can be field patched. Chips less than inch depth and reasonable area will not require attention.
- Vertical crack across bottom and up curb into sloping face. “Crack” is defined as an opening of at least 1/8-inch, measured with a feeler gauge when barrier is at rest or in place.

## **South Carolina DOT**

According to survey respondent Joe Sease, South Carolina DOT provides the following language regarding temporary concrete barrier:

Previously used temporary concrete barrier walls are subject to inspection and approval by the Resident Construction Engineer (RCE) before use. Ensure that previously used temporary concrete barrier walls are in good condition. Defects to a temporary concrete barrier wall that may disqualify a section of wall for use include gouges, cracks, chipped, or spalled areas. A defect that exposes reinforcing steel warrants immediate disqualification. A disqualification grade type defect shall consist of measurements in excess of 1 inch, entirely or partially within the boundaries of the end connection areas and the drainage slot areas as illustrated in the “Standard Drawings for Road Construction”, and/or in excess of 4 inches for all areas beyond the end connection areas. To warrant disqualification, these measurements shall exceed the specified dimensions in all three directions, width, height, and depth. A defect that exceeds the specified dimensions in only one or two of the three directions does not warrant disqualification.

Temporary concrete barrier walls with defects less than 6 inches in all three directions, width, height, and depth that do not expose reinforcing steel may be repaired in accordance with the following requirements. Repair is prohibited on temporary concrete barrier walls with defects 6 inches or greater in all three directions, width, height and depth.

Below is an example of how this language was used in a Request for Proposals (see page 14):

Addendum #2, I-77 Widening and Rehabilitation MM 15 to 27—Design Build, Project ID P027002, September 2015.

[http://www.scdot.org/doing/doingPDFs/I77/I-77\\_Addendum\\_2.pdf](http://www.scdot.org/doing/doingPDFs/I77/I-77_Addendum_2.pdf)

Additional guidance:

“Temporary Concrete Barrier,” Sub-section 605.2.3.2, Standard Specifications for Highway Construction, 2007.

[http://www.scdot.org/doing/doingPDFs/2007\\_full\\_specbook.pdf](http://www.scdot.org/doing/doingPDFs/2007_full_specbook.pdf)

“Temporary Concrete Barriers,” Section 605-100, Standard Drawings.

[http://206.74.144.33/falconWebV3-data/2016\\_600\\_MaintenanceTrafficControl.pdf](http://206.74.144.33/falconWebV3-data/2016_600_MaintenanceTrafficControl.pdf) (see page 43).

## **Virginia DOT**

“Procedures,” Section 512.03, Road and Bridge Specifications, 2007.

<http://www.virginiadot.org/business/resources/const/2007SpecBook.pdf>

Excerpt from page 573 of the PDF:

Concrete barrier sections shall be structurally sound with no concrete missing along the top, bottom, sides, or end sections of the barrier; no through cracks; and no exposed rebar.

## **Wisconsin DOT**

“Quality Standards for Temporary Concrete Barrier,” Section 1-45.12.5, Construction and Materials Manual.

<http://roadwaystandards.dot.wi.gov/standards/cmm/cm-01-45.pdf> (see page 10 of the PDF)

This guidance is based on three levels of device quality: acceptable, marginal and unacceptable. Temporary concrete barrier introduced to the work site must be in acceptable condition. It may degrade to marginal quality during the project, but once the barrier has been determined to be unacceptable it must be replaced with acceptable barrier.

## **Complete Survey Results**

The full text of each survey response is provided below. For reference, we have included an abbreviated version of each question before the response; for the full question text, please see page 6 of this Preliminary Investigation.

### **Alabama**

Contact: Jeff Benefield, Alabama DOT, 334-242-6213, [benefieldj@dot.state.al.us](mailto:benefieldj@dot.state.al.us).

2. **Guidance for determining condition of temporary concrete barriers?** No specific guidance. We do publish a “Traffic Control Device Quality Guide” that depicts unacceptable conditions of rail, but the inspector’s decision to reject is still somewhat subjective. See pages 7 and 8 for examples.
3. **Text of guidance or link to online document:** Attached. [See [Appendix A.](#)]
4. **Basis for guidance:** [No response.]

### **Arizona**

Contact: Madhav Mundle, Arizona DOT, 602-712-8544, [mmundle@azdot.gov](mailto:mmundle@azdot.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** Quality Guidelines for Temporary Traffic Control Devices by ATSSA (Evaluation Guide for Temp Concrete Barrier), 2008-2009 edition.
4. **Basis for guidance:** ATSSA Guidelines and experience.

### **Connecticut**

Contact: Mark Rolfe, Connecticut DOT, 860-594-2680, [Mark.Rolfe@ct.gov](mailto:Mark.Rolfe@ct.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes. Connecticut requires a visual inspection of all temporary precast barriers curbs used for traffic control on our projects.
3. **Text of guidance or link to online document:** We use the attached ATSSA publication as

a comparator (2008-2009 pamphlet).

4. **Basis for guidance:** I believe Illinois DOT is the source for the ATSSA information.

## **Delaware**

Contact: Adam Weiser, Delaware DOT, 302-659-4073, [Adam.Weiser@state.de.us](mailto:Adam.Weiser@state.de.us).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** We utilize the guidance in the American Traffic Safety Services Association (ATSSA) Quality Guidelines for Temporary Traffic Control Devices and Features. Currently using 2008-2009 but will begin using 2014 version in the near future.
4. **Basis for guidance:** We use this for all temporary traffic control devices. This was selected because it was available as a quick reference guideline when we responded to FHWA's requirement for addressing quality of temporary traffic control devices as part of the final rule on temporary traffic control. One thing to note, we do not allow contractors to patch barrier in order to meet the acceptable or marginal criteria of this document. If it's damaged and meeting the unacceptable criteria, the barrier must be removed and replaced.

## **Florida**

Contact: Christopher Lewis, Florida DOT, 850-414-5268, [Christopher.lewis@dot.state.fl.us](mailto:Christopher.lewis@dot.state.fl.us).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features 2008-09 Edition.
4. **Basis for guidance:** Adopted practice.

## **Idaho**

Contact: Gary Sanderson, Idaho Transportation Department, 208-334-8211, [Gary.sanderson@itd.idaho.gov](mailto:Gary.sanderson@itd.idaho.gov).

2. **Guidance for determining condition of temporary concrete barriers?** No. We consider concrete barriers in work zones to be Incidental Traffic Control Items for which we have no specific quality description.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **Illinois**

Contact: Tim Kell, Illinois DOT, 217-782-6667, [Tim.Kell@illinois.gov](mailto:Tim.Kell@illinois.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:**  
<http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Safety-Engineering/Work%20Zone%20Traffic%20Control%20Devices%202010.pdf>
4. **Basis for guidance:** The criteria are not necessarily based on research but more on engineering judgment.

## **Indiana**

Contact: Gregory G. Pankow, Indiana DOT, 317-232-5502, [gpankow@indot.in.gov](mailto:gpankow@indot.in.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** The verbiage below is from our 2016 Standard Specifications and can be found on our web page at  
<http://www.in.gov/dot/div/contracts/standards/book/sep15/sep.htm>.

**Type 1** temporary traffic barriers shall be used to separate two-way traffic and shall be precast concrete in accordance with applicable requirements of 707 and 602 and as shown on the plans. Type 1 barriers may also be used to separate traffic from the work zone. The surfaces of individual precast units shall vary no more than 1/4 in. in 10 ft from the specified cross section, as measured from a longitudinal straightedge. The maximum variation in the vertical and horizontal alignment of adjacent units shall be 1/4 in. across the joint, as measured from a 10 ft longitudinal straightedge. Sections that have obvious defects or visual cracks shall not be used. Sections that develop any of these conditions during the contract shall be repaired with concrete or replaced within a reasonable amount of time.

4. **Basis for guidance:** Experience.

## **Iowa**

Contact: Mark R. Bortle, Iowa DOT, 515-239-1587, [mark.bortle@dot.iowa.gov](mailto:mark.bortle@dot.iowa.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:**  
<http://www.iowadot.gov/erl/current/GS/content/2513.htm>
4. **Basis for guidance:** Experience.



## **Kansas**

Contact: Susan Eiseman, Kansas DOT, 785-296-7138, [eiseman@ksdot.org](mailto:eiseman@ksdot.org).

2. **Guidance for determining condition of temporary concrete barriers?** Visual only.
3. **Text of guidance or link to online document:** Provide certification (prepared by the manufacturer or Contractor) that the temporary precast concrete safety barrier complies with the requirements on the Contract Documents. Provide either new or used, temporary precast concrete safety barrier. The Engineer will accept, either new or used, temporary precast concrete safety barrier upon acceptance of the provided certification, and visual inspection of the delivered and installed temporary precast concrete safety barrier on the project.
4. **Basis for guidance:** [No response.]

## **Louisiana**

Contact: Barry Lacy, Louisiana Department of Transportation and Development, 225-379-1584, [barry.lacy@la.gov](mailto:barry.lacy@la.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** Contract includes ATSSA Quality Guidelines (2008-2009 edition).
4. **Basis for guidance:** 2008-2009 edition of ATSSA guidelines.

## **Michigan**

Contact: Chris Brookes, Michigan DOT, 517-636-0300, [brookesc@michigan.gov](mailto:brookesc@michigan.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** Document is not currently online but as a member of the Temporary Traffic Control committee I'm working to make it available via an app for a smart phone. The guidance is the ATSSA Quality Guideline for Temporary Traffic Control Devices and Features.

Pg. 56-59: "This standard applies to temporary concrete barrier furnished by a supplier, subcontractor, or contractor for traffic control in work zones.

ACCEPTABLE – These are examples of acceptable temporary barrier wall. The walls appear new with few minor blemishes. Spalls and chipped concrete pose no threat of damaging or snagging tires. The connecting loops are all sound and in place with no broken strands.

MARGINAL – These are examples of temporary barrier wall which are marginal. The wall have minor imperfections along the base but are still structurally sound. The connecting loops are all sound and in place.

UNACCEPTABLE – These are examples of unacceptable temporary concrete barrier walls. The barrier walls have large spalls and cracks, with unsound concrete that could be easily removed when hit. The spalled wall could cause tire damage if hit especially along the

base. Any spalled concrete could cause the vehicle to “snag” and twist from the direction it is going. Any spalls with exposed rebar or with connecting loops broken or damaged is cause for rejection.”

4. **Basis for guidance:** I’m not 100% sure of the original basis behind this document as it was being used when I started at MDOT. We use this for all of our traffic control devices. On page 10 of this document it gets into the details of the % of devices and what condition they can be in during stage changes and at the start of the project. The group that makes this up is DOT members and contractors, so it was a joint effort that is currently being revised this year. I don’t foresee any major changes but thought that I would let you know that.

## **Minnesota**

Contact: Ted Ulven, Minnesota DOT, 651-366-4222, [ted.ulven@state.mn.us](mailto:ted.ulven@state.mn.us).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:**  
[http://www.dot.state.mn.us/trafficeng/workzone/doc/pcb\\_quality\\_spec.pdf](http://www.dot.state.mn.us/trafficeng/workzone/doc/pcb_quality_spec.pdf)
4. **Basis for guidance:** Experience.

## **Montana**

Contact: Jim Wingerter, Montana DOT, 406-454-5897, [jwingerter@mt.gov](mailto:jwingerter@mt.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes, a January 5, 2012 Memo from the Montana Department of Transportation provides Concrete Barrier Guidance. In addition, the FHWA provides requirements for use of three-loop concrete barriers.
3. **Text of guidance or link to online document:** Attached. [Respondent attached a memo regarding FHWA’s 2011 directive to replace two-loop concrete barrier with newer barrier that conforms to *NCHRP Report 350* crash test requirements.]
4. **Basis for guidance:** FHWA directive, experience with barriers within roadway system, and providing safety to traveling public.

## **New Hampshire**

Contact: Theodore Kitsis, New Hampshire DOT, 603-271-2571, [tkitsis@dot.state.nh.us](mailto:tkitsis@dot.state.nh.us).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** We follow ATSSA guidelines.
4. **Basis for guidance:** See attached. [Respondent attached the 2008-2009 ATSSA guidelines.]

## **New Mexico**

Contact: Sally Reeves, New Mexico DOT, 505-467-9887, [sally.reeves@state.nm.us](mailto:sally.reeves@state.nm.us).

2. **Guidance for determining condition of temporary concrete barriers?** No.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **North Dakota**

Contact: Phillip Murdoff, North Dakota DOT, 701-328-2569, [pmurdoff@nd.gov](mailto:pmurdoff@nd.gov).

2. **Guidance for determining condition of temporary concrete barriers?** No.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **Ohio**

Contact: Dan Groh, Ohio DOT, 614-387-1162, [dan.groh@dot.ohio.gov](mailto:dan.groh@dot.ohio.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes, we have a manual for various traffic items that is included in our construction contracts.
3. **Text of guidance or link to online document:**  
<http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/qualityguidelines/Pages/default.aspx>
4. **Basis for guidance:** Experience and other states' practices.

## **Pennsylvania**

Contact: Randy G Lazouras, PennDOT, 717-787-2054, [rlazouras@pa.gov](mailto:rlazouras@pa.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** See attached. [See [Appendix B.](#)]
4. **Basis for guidance:** This guidance was based on experience.

## **Rhode Island**

Contact: Frank Corrao, III, Rhode Island DOT, 401-222-2468 ext. 4202, [frank.corrao@dot.ri.gov](mailto:frank.corrao@dot.ri.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** We still use the ATSSA guidelines as well as common sense. The presence of spalling does not necessarily mean the barrier will not perform its intended function. We employ both functional and aesthetical factors to evaluate

temporary barrier delivered to the work zone. We also realize that there will be significant pushback by the construction industry when we try to have, what we deem unacceptable, barrier removed.

Small cracks and spalling evaluation, even with guidelines, is subjective. We must rely on the experience of the field personnel to use their discretion (and be reasonable) and provide work zones that are safe for the road users and workers. Our primary focus is on the functionality of the barrier so if barrier loops have been compromised, or areas of the barrier are spalled that could cause a catch point for a vehicle passing by, we would discuss with the contractor and seek agreement that barrier is to be removed.

I had not seen the 2014 version that removed the 1.5 inch requirement, however the photos are clear in the 2009 edition, the unacceptable barrier photos are still unacceptable in RI. Frankly, I believe that the 1.5 inch spall requirement was unrealistic to enforce.

4. **Basis for guidance:** ATSSA standards.

## **South Carolina**

Contact: Joe Sease, South Carolina DOT, 803-737-1460, [seasejc@scdot.org](mailto:seasejc@scdot.org).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:**

### Sub-section 605.2.3.2 Temporary Concrete Barrier (paragraph 6) -

Previously used temporary concrete barrier walls are subject to inspection and approval by the Resident Construction Engineer (RCE) before use. Ensure that previously used temporary concrete barrier walls are in good condition. Defects to a temporary concrete barrier wall that may disqualify a section of wall for use include gouges, cracks, chipped, or spalled areas. A defect that exposes reinforcing steel warrants immediate disqualification. A disqualification grade type defect shall consist of measurements in excess of 1 inch, entirely or partially within the boundaries of the end connection areas and the drainage slot areas as illustrated in the "Standard Drawings for Road Construction", and/or in excess of 4 inches for all areas beyond the end connection areas. To warrant disqualification, these measurements shall exceed the specified dimensions in all three directions, width, height, and depth. A defect that exceeds the specified dimensions in only one or two of the three directions does not warrant disqualification.

Temporary concrete barrier walls with defects less than 6 inches in all three directions, width, height, and depth that do not expose reinforcing steel may be repaired in accordance with the following requirements. Repair is prohibited on temporary concrete barrier walls with defects 6 inches or greater in all three directions, width, height and depth.

For repair of temporary concrete barrier walls with defects less than 6 inches in all three directions, width, height, and depth that do not expose reinforcing steel, repair the defect with a premanufactured patching material specifically fabricated for patching structural concrete. The strength of the patch must meet or exceed the design strength of the class 3000 concrete of the temporary concrete barrier wall. Perform the repair procedures in accordance with all requirements and instructions from the manufacturer of the patch material. Use a bonding compound between the patch material and the concrete unless

specifically stated by the manufacturer that a bonding compound is not required. If the manufacturer states that application of a bonding compound is optional, SCDOT requires application of a bonding compound compatible with the patch material. If cracking occurs within the patched area, remove the patch material completely and repeat the repair process. The contractor shall submit documentation stating all repairs have been conducted in accordance with these requirements prior to installing any temporary concrete barrier walls with repairs. Utilization of temporary concrete barrier walls with repairs shall require approval by the RCE prior to installation.

The Contractor shall submit certification documents for the patch material utilized for repairs to the Engineer prior to placing temporary concrete barrier walls that have been repaired on the project site.

4. **Basis for guidance:** Experience with contractors providing damaged barrier walls for projects.

## **Utah**

Contact: PJ Roubinet, Utah DOT, 801-648-8818, [Proubinet@utah.gov](mailto:Proubinet@utah.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:**  
Specification 01554 1.10 C.  
Meet the acceptable classification as identified by Quality Standards for Work Zone Traffic Control Devices published by ATSSA for traffic control device.
4. **Basis for guidance:** Experience. This has been UDOT's practice since the early 1990's.

## **Vermont**

Contact: David Hoyne, Vermont DOT, 802-828-2593, [david.hoyne@vermont.gov](mailto:david.hoyne@vermont.gov).

2. **Guidance for determining condition of temporary concrete barriers?** No, but the specification (Section 621) does describe certain defects that are not allowed and the Engineer does have discretion to reject sections of barrier that are not in a "satisfactory" condition. Satisfactory is not defined.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **Virginia**

Contact: Charles Patterson, Virginia DOT, 804-786-1805,  
[Chuck.Patterson@VDOT.Virginia.gov](mailto:Chuck.Patterson@VDOT.Virginia.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** Refer to the Virginia DOT Road and Bridge Specifications section 512.03 (F); page 573. [See <http://www.virginiadot.org/business/resources/const/2007SpecBook.pdf>]
4. **Basis for guidance:** Field experience.

## **Washington**

Contact: Mark Gaines, Washington DOT, 360-705-7827, [gainesm@wsdot.wa.gov](mailto:gainesm@wsdot.wa.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Our agency has no formal guidance on determining acceptable/unacceptable condition of temporary concrete barriers within construction work zones. Our Inspectors look for significant cracks, damaged connecting looks and any significant spalls in the loop anchorage areas. Sections of barrier with these deficiencies are rejected and removed/replaced by the Contractor.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **West Virginia**

Contact: J. Darby Clayton, West Virginia DOT, 304-558-9567, [J.Darby.Clayton@wv.gov](mailto:J.Darby.Clayton@wv.gov).

2. **Guidance for determining condition of temporary concrete barriers?** No.
3. **Text of guidance or link to online document:** N/A
4. **Basis for guidance:** N/A

## **Wisconsin**

Contact: Rich Sorensen, Wisconsin DOT, 608-266-0309, [richard.sorensen@dot.wi.gov](mailto:richard.sorensen@dot.wi.gov).

2. **Guidance for determining condition of temporary concrete barriers?** Yes.
3. **Text of guidance or link to online document:** <http://roadwaystandards.dot.wi.gov/standards/cmm/cm-01-45.pdf>
4. **Basis for guidance:** Agency experience.

## Consultation with Experts

To supplement the information gathered through the survey of state DOTs and the literature review, CTC & Associates contacted several experts in this area, including FHWA staff, a TRB committee chair, and university researchers. Our goal was to identify any studies that had been conducted to establish standards for acceptability of in-place temporary concrete barriers.

No one we spoke to was aware of any studies on this topic. Two of our contacts provided additional perspective on this issue:

- **Nicholas Artimovich of FHWA's Office of Operations** noted that this topic has been discussed by the roadside safety community and has been the subject of proposed research. However, although there have been two projects looking at crash damage to W-beam guardrail, the research project on concrete barrier segments has not been ranked high enough to receive funding. Artimovich stated that Illinois DOT's guidance is being used by other states to assess work zone devices, including concrete barrier.
- **Gerald Ullman at the Texas A&M Transportation Institute** provided a similar response, noting that research on evaluating the condition of temporary in-place concrete barrier has been proposed on several occasions in the past few years but has not yet made the funding cut. Gerald added that this topic will become a bigger issue in the future because the new AASHTO Manual for Assessing Safety Hardware (MASH) implementation plan, as currently proposed, states that existing barrier approved using *NCHRP Report 350* criteria can continue to be used for its useful life. At present, it is left up to the states to develop the criteria they will use to identify when a barrier has reached the end of its useful life.

In addition to these interviews, we made contact with national transportation laboratories and University Transportation Centers, including the following:

- FHWA's Turner-Fairbank Highway Research Center
- TRB Standing Committee on Work Zone Traffic Control (AHB55)
- Collaborative Innovation Center, Carnegie Mellon University
- National Center for Transportation System Productivity and Management, Georgia Institute of Technology
- Roadway Safety Institute, University of Minnesota

The contacts we spoke to at these organizations pointed to research on related topics, but none of them were aware of any existing studies that specifically addressed the determination of acceptable condition of temporary in-place concrete barrier. This was consistent with the findings of our literature review.

## Related Research

**Portable Concrete Barrier Condition and Transition Plan Synthesis**, David Veneziano and Yongxin Li, Montana DOT, June 2012.

[http://www.mdt.mt.gov/other/webdata/external/research/docs/research\\_proj/cmb/final\\_report.pdf](http://www.mdt.mt.gov/other/webdata/external/research/docs/research_proj/cmb/final_report.pdf)

Abstract:

Precast (or portable) Concrete Barrier (PCB) is a guardrail system that is intended to contain and redirect a vehicle that has left the travel lane. Barrier connections are typically formed using steel wire or bar to form loops which are joined by a steel pin. While the materials used in connection systems are quite strong, exposure to the elements and winter maintenance chemicals can, over time, lead to corrosion and loss of effectiveness. The identification of such corrosion was a concern to the Montana Department of Transportation (MDT), which decided that additional research should be done on this issue to determine what, if any, past research has been done regarding PCB in general, PCB connection corrosion, the maintenance of barrier connection systems, and approaches to address corrosion on existing and future installations. The research would also identify approaches that may be taken in developing and implementing a transition plan for replacing PCB if needed.

This report presents a synthesis of information from past published research and reports, as well as information from a survey of transportation agencies conducted as part of this project, regarding precast concrete barriers, the corrosion of their connection systems, approaches to rating/ranking this corrosion, and current state DOT practices for their maintenance and replacement. Potential strategies for prioritizing barrier replacement are identified and discussed.

**“Concrete Median Barrier Connection Corrosion in the United States: Experience and Future Directions,”** David Veneziano and Yongxin Li, *TRB 94th Annual Meeting Compendium of Papers*, 2015.

Abstract at <http://trid.trb.org/view/2015/C/1337022>

From the abstract:

Precast (or portable) Concrete Barrier (PCB) is a barrier system that when placed along a roadway median or shoulder is intended to contain and redirect a vehicle which has left the travel lane. Barrier connections are typically formed using steel wire or bar to form loops which are joined by a steel pin. While the materials used in connection systems are quite strong, exposure to the elements and winter maintenance chemicals can, over time, lead to corrosion and loss of effectiveness. The work discussed in this paper sought to determine what, if any, past research has been done regarding PCB in general, PCB connection corrosion, the maintenance of barrier connection systems, and approaches to address corrosion on existing and future installations. This review found a number of different designs are currently in use, but only a limited portion of literature focused on connection systems or corrosion / replacement of in-service barriers. A survey of transportation agencies regarding experience with precast concrete barriers, corrosion of connection systems, approaches to rating/ranking corrosion and current practices for maintenance and replacement found that most agencies have not done a great deal in terms of corrosion with their PCB connection systems. Based on the findings of the literature review and survey, potential strategies for prioritizing barrier replacement are identified and discussed.



## Contacts

CTC contacted the individuals below to gather information for this Preliminary Investigation.

### **FHWA**

#### **Turner-Fairbank Highway Research Center**

Eduardo Arispe  
Research Highway Safety Specialist  
202-493-3291, [eduardo.arispe@dot.gov](mailto:eduardo.arispe@dot.gov)

#### **Office of Operations**

Nicholas A. Artimovich, II  
Road Weather and Work Zone Management Team  
202-366-1331, [nick.artimovich@dot.gov](mailto:nick.artimovich@dot.gov)

### **TRB**

Timothy Baughman  
Chair, TRB Standing Committee on Work Zone Traffic Control (AHB55)  
Highway Operations and Safety Manager  
Institute for Transportation Research and Education, North Carolina State University  
919-515-8654, [tbb@ncsu.edu](mailto:tbb@ncsu.edu)

### **University Transportation Centers**

#### **Carnegie Mellon University**

Raj Rajkumar  
Professor, Director  
Collaborative Innovation Center  
412-268-8707, [rajkumar@cmu.edu](mailto:rajkumar@cmu.edu)

#### **Georgia Institute of Technology**

Michael Hunter  
Director, National Center for Transportation System Productivity and Management  
404-894-2278, [michael.hunter@ce.gatech.edu](mailto:michael.hunter@ce.gatech.edu)

#### **Texas A&M Transportation Institute**

Gerald Ullman  
Senior Research Engineer & Program Manager  
Work Zones and Dynamic Message Signs  
979-845-9908, [G-Ullman@tti.tamu.edu](mailto:G-Ullman@tti.tamu.edu)

#### **University of Minnesota**

Max Donath  
Director, Roadway Safety Institute  
612-625-2304, [donath@umn.edu](mailto:donath@umn.edu)

**Cones (continued)**

**Examples of Acceptable (✓) and Unacceptable (X)**



**X** Sprayed with Asphalt



**X** No Sheeting



**X** Dirty and Poor Sheeting



**X** Orange Color Required

**Portable Concrete Barrier Rail**

**Examples of Acceptable (✓) and Unacceptable (X)**



**✓** Good Condition (Bolt and Loop Type)



**✓** Good Condition (J-J Hook Type)

Portable Concrete Barrier Rail (continued)

Examples of Acceptable (✓) and Unacceptable (X)



✓ Info Properly Embossed On Top of Rail



X Bolt Too Small (Minimum Diameter 1 1/4" Required)



X No Nut on Bolt



X Not Bolted at Bottom



X No Reflectors On Top of Rail



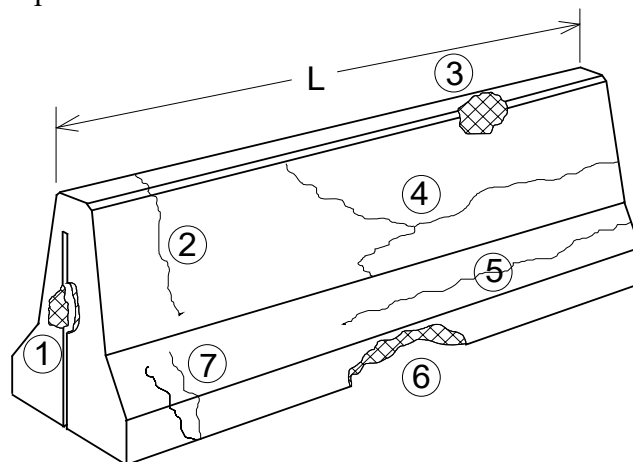
X Physical Damage

REPLACES <b>C.9.8</b>	PENNSYLVANIA DEPARTMENT OF TRANSPORTATION	PART <b>C</b>	SECTION <b>9</b>	PAGE <b>8-1</b>
DATED <b>03/01/2011</b>	<b>PROJECT OFFICE MANUAL</b>	DATE <b>April 25, 2013</b>		
SUBJECT <b>REUSE OF CONCRETE MEDIAN BARRIER</b>				

Concrete barrier to be used in construction zones (MPT) must be visually inspected prior to its reuse and placement. This inspection is to be documented in the project records. Any element showing any one of the following discrepancies will not be installed (Refer to drawing below).

1. Cracked or destroyed slot and plate connection where more than 25% is missing or broken.
2. Crack on top which runs down either vertical face for more than 16 inches.
3. Chip on top or vertical face which is more than 1 square foot in area and/or 2 inches deep - smaller areas and depths can be field patched. Chips less than inches depth and reasonable area will not require attention.
4. Horizontal crack in web which is greater than  $L/2$  or any length that forms a Y with arms greater than 12 inches.
5. Horizontal crack in sloping area that is greater than  $L/2$  and/or intersects a vertical crack.
6. Chip on vertical curb greater than 1 square foot and/or 3 inches deep - smaller areas and depths can be field patched. Chips less than inch depth and reasonable area will not require attention.
7. Vertical crack across bottom and up curb into sloping face.

"Crack" is defined as an opening of at least 1/8-inch, measured with a feeler gauge when barrier is at rest or in place.



PART <b>C</b>	SECTION <b>9</b>	PAGE <b>8-2</b>	DATE <b>April 25, 2013</b>
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