0-7059: Development of Guidelines for Inspection, Repair, and Use of Portable Concrete Barriers

Background

Portable concrete barriers (PCBs) are roadway safety hardware designed to protect workers in construction zones from traffic. A PCB assembly contains and redirects vehicles during accidents and prevents vehicles from entering the construction zone, while protecting drivers. PCBs are made of precast shaped sections (e.g., F shape, single slope, and low profile) joined together with the help of appropriate connections to form a continuous longitudinal barrier.

Defining the service life of PCBs is important to reduce the risk of inferior unsafe barriers being used on Texas roadways. The *Manual for Assessing Safety Hardware* (MASH) implementation agreement allows state transportation agencies to continue the use of PCBs manufactured on or before December 31, 2019, and successfully tested to National Cooperative Highway Research Program Report 350 or the 2009 edition of MASH, throughout their normal service life. Damage to the precast barriers can occur in transit, in storage, or due to vehicular impact. Often, the barriers sustain damage to the connections, cracks in the barrier, broken corners, and many other forms of damage. No federal guidance, however, has been developed to determine life expectancy for PCBs. There is a need to develop a guideline addressing the type and extent of barrier damage that would constitute replacement of the segment. Continuing to use severely damaged barriers and not replacing them in a timely manner can pose a safety risk, while replacing them too early underestimates their design life and creates an economic burden on state departments of transportation.

What the Researchers Did

The research team documented best practices with respect to management of repairing or replacing PCB segments, and used a combination of engineering evaluation, dynamic component testing, and full-scale crash testing to develop guidelines to assist in developing a process to determine the useful service life.

The researchers constructed test installations for PCBs and conducted bogie tests on these installations to assess the baseline strength/deflection capacities of new barrier segments as well as corresponding residual capacities of damaged barrier segments. This dynamic component testing was helpful to understand and relate the quantitative and qualitative characteristics of post-impact damages seen in barriers (e.g., cracks, spalls, exposure of rebar, and deformation of connections), along with the resulting values of barrier deflections.

Computer simulations were conducted to study the crashworthiness behavior of identified full-scale barrier systems (specifically with induced failure modes) under MASH impact conditions through an engineering analysis. Full-scale crash tests (Figure 1) were conducted to assess the performance of the Texas Department of Transportation's damaged PCBs according to the safety-performance evaluation guidelines included in the MASH guidelines.

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The full-scale crash test results indicated that the tested barrier installations provided crashworthy behavior, even considering the pre-damaged segments and connections used in the system.

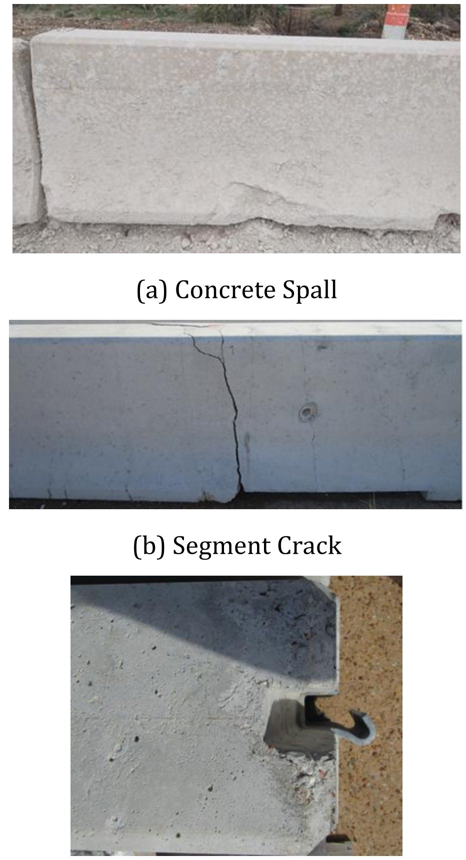
Figure 1. Full-Scale Test on Damaged PCB.

What They Found

Guidelines were proposed for the use and repair of PCBs. The guidelines were developed using the results from a literature review, surveys, computer analysis, and component and full-scale testing. The guidelines discuss the different criteria to classify PCBs into three categories, based on their damage mode statuses (Figure 2):

- Acceptable.
- Acceptable with repair.
- Unacceptable.

Examples of acceptable, acceptable with repair, and unacceptable barriers are illustrated to assist engineers in categorizing PCBs. A PCB can be classified as unacceptable if it meets at least one of the proposed unacceptable conditions. PCBs that are acceptable with repair are also discussed.



(a) Concrete Spall

(b) Segment Crack

(c) Joint (JJ-Hook) Deformation

Figure 2. Typical PCB Damage Modes.

What This Means

The proposed guidelines help determination of the appropriateness of using a specific PCB segment based on existing segment damage modes. These guidelines can be used at several work stages, such as upon delivery to the project site, during initial setup, during phase changes, and periodically throughout the duration of the project.

For More Information

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