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Roadside Safety Pooled Fund

www.roadsidepooledfund.org

Pinned F-Shape Temporary Barrier

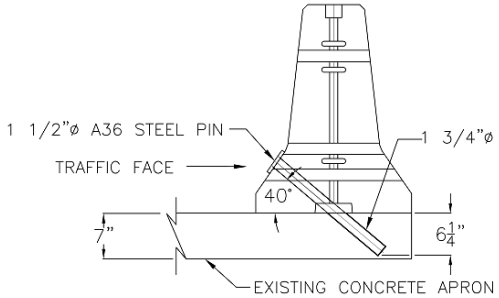
INTRODUCTION

The objective of this research was to develop a limited deflection pinned concrete barrier that meets *NCHRP Report 350* Test Level 3 (TL-3) requirements and limits dynamic deflection to accommodate restricted space requirements in a work zone. The barrier was required to have a safety shape profile and a segment length between 12.5 to 15 feet. It was also required that the barrier be easy to install and cause minimum damage to bridge decks.

DESIGN AND ANALYSIS

Based on review of previously developed designs for anchoring temporary concrete barriers to bridge decks and concrete pavements, the research team adopted the drop-pin approach rather than the bolted-down approach for anchoring the barrier. This design concept restricts lateral barrier movement by using steel pins which are simply dropped into inclined holes that pass through the toe of the barrier and continue a short depth into the bridge deck or concrete pavement underneath.

Finite element modeling and simulation was used to evaluate some of the key design parameters of the pinned barrier design. Among these were the drop-pin inclination angle, barrier profile ('F' or New Jersey), barrier segment length, and drop-pin diameter. Based on the results of the analysis, the final design was selected to have an 'F' shape profile with a segment length of 12.5-ft. The steel drop-pins were inclined at an angle of 40 degrees from the ground and had a diameter of 1.5 inches. The pins passed through the barrier and continued 6.25 inches into the concrete pavement as shown in the figure.



Details of Anchoring Mechanism

Test Installation of Pinned F-Shape Temporary Barrier

CRASH TESTING

A crash test was performed with a 100-ft long installation to verify the performance of the barrier according to NCHRP Report 350 TL-3 criteria. The F-shape precast concrete segments used in the test were 12.5 ft long. Adjacent barrier segments were connected using a pin-and-loop type connection. The loops were made of 0.75-inch diameter round stock steel and a 1-inch diameter × 30-inch long ASTM A449 connecting pin was inserted between the loops to establish the connection. Two 1.875-inch diameter holes inclined 40 degrees from the ground, were cast into the traffic face at the toe of each barrier segment. The holes in the barrier were used as a guide to drill 1.75 inch diameter holes into the un-reinforced concrete pavement.

(CONTINUED)
A 1.5-inch diameter steel drop-pin was placed into each hole to pin-down the barrier.

A 2000P vehicle, traveling at an impact speed of 62.7 mi/h, impacted the barrier at an angle of 25.4 degrees. The barrier successfully contained and redirected the vehicle. The vehicle did not penetrate, underride, or override the installation.

Maximum dynamic and static deflections of the barrier during the test were 11.5 inches and 5.8 inches, respectively. Although the barrier sustained some damage that would require repair, there were no detached elements, fragments, or other debris to penetrate or show potential to penetrate the occupant compartment, or to present undue hazard to others in the area.

Maximum occupant compartment deformation of the vehicle was 1.1 inches. The vehicle remained upright during and after the collision event. Maximum roll angle was 41 degrees. Occupant risk factors were within the limits specified in *NCHRP Report 350*.

The 12.5-ft pinned F-shape temporary barrier performed acceptably according to the requirements of *NCHRP Report 350.*

The drop-pins adjacent to the impact joint were deformed as shown in the photograph, but none of the pins pulled out of the concrete pavement. Other than the drop-pins adjacent to the impact joint, none of the pins were deformed. No significant damage was caused to the concrete pavement due to impact. The damage to one of the drilled holes in the concrete pavement is shown in the photograph.

Barrier after Test

Damage to Drop Pin

Damage to Drilled Hole

In addition to minimizing the damage to the concrete pavement or deck, this restrained barrier design will ease the installation, inspection, and barrier removal or relocation procedures.

For installation, precast inclined holes in the barrier can be used as a guide to drill holes in the underlying concrete pavement or deck. The barrier can then be restrained by simply dropping the pins into these holes.

For removal or relocation of the barrier, the pins can be removed by hand to free the barrier. In case of a vehicular impact, the deflection of the impacted segments is likely to bend the drop-pins such that they cannot be lifted by hand. Such segments can be lifted using a fork lift and the pins can be removed using a cutting torch. This procedure however is needed for a very small number of drop-pins.

In general, the barrier is also easy to inspect for proper installation. The top of the drop-pins should be flush to the barrier surface. Otherwise, it indicates that the pins have not been inserted a sufficient distance into the concrete pavement or deck, and the barrier restraint is not properly installed.

Test Vehicle after Test

Video Access:
Real-Time Panned View
Real-Time Rear View
High-Speed Down the Gut View
High-Speed Rear of Barrier View

Final Report Access

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