Dear Dr. Faller:

In your August 25 letter to Mr. A. George Ostensen, you requested the Federal Highway Administration’s formal acceptance of three non-proprietary longitudinal barrier systems for use on the National Highway System (NHS). The first design consisted of stacked steel H-Sections connected end-to-end and bolted to a simulated bridge deck. It was developed specifically for use at locations where typical lateral deflections for temporary concrete barrier would be considered excessive. This design was accepted for use on the NHS as a test level 3 barrier in my September 12 letter, B-117. The second design, an F-shape precast concrete barrier bolted to a bridge deck to eliminate most deflection, will be addressed in this letter, and the final system, w-beam guardrail posts embedded in solid rock, will be covered in a third letter.

Each barrier segment used in the test installation of the concrete barrier bolted to a simulated bridge deck was a 3.8-m long F-shape barrier, having a minimum 28-day compressive strength of 34.5 MPa (5,000 psi). All of the steel reinforcement in the barrier was ASTM A615 Grade 60 rebar, except for the loop bars, which were ASTM A706 Grade 60 steel. Barrier reinforcement consisted of three 16M (No. 5) and two 13M (No. 4) longitudinal bars, twelve 13M (No.4) bars for the vertical stirrups, and six 19M (No. 6) bars for the anchor bolt block reinforcement loops. The anchor bolt block loops were 889-mm (35-in.) long and were bent into a U-shape to reinforce the anchor bolt area. The barriers segments were connected by two sets of three separate rebar loops made from ASTM A706 Grade 60 19M (No. 6) bars on each barrier interconnection. Each segment end had one or two upper and one or two lower loops (for a total of three loops) and the adjacent section had one loop that fit between the two-loop connection of the first section, and two loops that fit over and below the adjacent single loop. The vertical pin used in the connection consisted of a 32-mm (1.25-in.) diameter x 711-mm (28-in.) long round bar composed of ASTM A36 steel. Because of the double shear, triple loop configuration, no retaining nut was used on the vertical pin.

The barriers were fastened to the concrete bridge deck with a 29-mm (1.125-in.) diameter ASTM A307 anchor bolts with heavy hex nuts and 76-mm (3-in.) x 76-mm (3-in.) x 13-mm (0.5-in.) thick washers at each anchor bolt location. Each anchor bolt was epoxied into the concrete to an
embedment depth of approximately 305 mm (12 in). These bolts were installed only on the traffic side of the barrier in order to reduce the propensity for barrier tipping and subsequent vehicle climbing and vaulting. In separate correspondence, you indicated that alternative anchoring designs, including through-bolting, would be acceptable as long as the full tensile strength of the anchor bolts can be developed. Overall barrier dimensions and reinforcement details are shown in Enclosure 1.

The National Highway Cooperative Research Program (NCHRP) Report 350 test 3-11 was successfully conducted on the final design and is described in the Midwest Roadside Safety Facility’s August 22 report entitled, Development and Evaluation of a Tie-Down System for the Redesigned F-Shape Concrete Temporary Barrier.” Enclosure 2 is a summary sheet of the test results. All NCHRP Report 350 evaluation criteria were met. The maximum vehicle roll angle was reported to be 34 degrees. Maximum pitch, although relatively high, was not reported. The concrete spalled at all bolt locations on the two barrier segments in the impact zone (segments 8 and 9) and major structural failure was reported near midspan on segment 9. This failure possibly contributed to the relatively high roll and pitch angles noted after impact. Additional longitudinal reinforcing would likely improve barrier performance and reduce future maintenance/replacement costs. Dynamic deflection, including tipping of the top of the barrier, was limited to 287 mm (11.3 inches). Permanent deformation was 89 mm (3.5 inches).

I agree with your conclusion that this design met all NCHRP Report 350 evaluation criteria for a test level 3 barrier and conclude that it can be used as a temporary barrier on concrete bridge decks on the NHS when its use is acceptable to the contracting agency.

Sincerely yours,

(Original signed by John R. Baxter)
John R. Baxter, P.E.
Director, Office of Safety Design

2 Enclosures
Test Number..................... KTB-1
Date .......................... 7/31/02
Appurtenance .................... Kansas Temporary Barrier Tie Down System
Total Length ..................... 62.23 m
Placement ...................... 25 mm from concrete bridge deck edge
Key Elements ..................... Nine 3,810-mm long Kansas Temporary Barriers Seven 3,810-mm long Iowa F-Shaped Temporary Barriers
Barrier Joint Pin Connections ...... 32-mm diameter by 712-mm long A36 steel rod with 64x102x132-mm plate
Tie-Down Anchors ............... 28.575 mm ASTM A307 Threaded Dowels
   Number per Barrier ............ 3
   Embedment into Concrete ...... 305 mm
   Placement ..................... Traffic side only
Vehicle Model .................... 1997 Chevrolet 2500 ¾-ton pickup
   Curb .......................... 1,991 kg
   Test Inertial .................. 2,018 kg
   Gross Static .................. 2,018 kg
Vehicle Speed
   Impact ......................... 99.8 km/hr
   Exit (resultant) ............... 81.5 km/hr
Vehicle Angle
   Impact (orientation) ............ 25.3 deg
   Exit (trajectory) ............... 14.4 deg
Vehicle Snagging ................ None
Vehicle Pocketing ............... None
Vehicle Stability ............... Satisfactory
Occupant Ridedown Deceleration (10 msec avg.)
   Longitudinal .................. 10.98 G’s < 20 G’s
   Lateral (not required) ........ 10.60 G’s
Occupant Impact Velocity
   Longitudinal .................. 5.68 m/s < 12 m/s
   Lateral (not required) ........ 7.01 m/s
Vehicle Damage .................. Moderate
   TAD14 ......................... 1-RFQ-3
   SAE15 ......................... 1-RFAW3
Vehicle Stopping Distance ......... 56.25 m downstream
                                12.80 m laterally behind
Barrier Damage .................. Moderate
Maximum Rail Deflections
   Permanent Set ................. 89 mm
   Dynamic ....................... 287 mm
Working Width .................. 534 mm

Figure 16. Summary of Test Results and Sequential Photographs, Test KTB-1