



U.S. Department
of Transportation

**Federal Highway
Administration**

400 Seventh St. S.W.
Washington, D.C. 20590

October 10, 1997

Refer to: HNG-14

Dean L. Sicking, Ph.D., P.E.
Associate Professor and Director of MwRSF
University of Nebraska-Lincoln
W348 Nebraska Hall
P.O. Box 880531
Lincoln, Nebraska 68588-0531

Dear Dr. Sicking:

Mr. Ronald K. Faller, in his December 6, 1996, letter to Mr. Gerald L. Eller, requested the Federal Highway Administration's (FHWA) acceptance of 3800-mm long, pre-cast, F-shape concrete barrier segments joined by a pin and loop connection as a National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) traffic barrier. To support this request, Mr. Faller sent a Midwest Roadside Safety Facility report dated December 1996 entitled "Development of a TL-3 F-Shape Temporary Concrete Median Barrier," which documented the results of the acceptance tests run on this design. Although the NCHRP Report 350 recommends two tests on longitudinal barriers, the aforementioned report concluded that test 3-10 was not needed since an 820-kg car impacting at 100 km/h and at 20 degrees has been run on permanent F-shape designs with acceptable results and the impact severity of such a crash is not likely to cause significant deflection in the temporary system that you tested with a 2000-kg pickup truck. We can agree with this conclusion.

As evidenced in the videotape of test ITMP-2 and noted in your report, significant vehicular roll (48.7 degrees), pitch (22.8 degrees), and yaw (64.3 degrees) occurred and the test vehicle was momentarily on top of the barrier. However, the pickup truck did not overturn and occupant impact velocities and ridedown accelerations were within the NCHRP Report 350

evaluation criteria. We concur with the report's description of these test results as marginal. As was also noted in your test report under "Summary and Conclusions," satisfactory performance of this system depends upon limiting the rotation of the individual segments by assuring that the pin and loop connection is installed and maintained exactly as tested and as shown in Enclosure 1.

As can be seen in Enclosure 2, a summary of the test, the maximum permanent deflection of the barrier in the test was 1140 mm. The impact point was approximately 45.5 m from the upstream end of the 81.5-m long test installation. Similar impacts closer to either end can be expected to result in greater lateral deflection and degraded performance. In your September 30 letter to Mr. James Hatton you reported on your analysis of the effects shortening the installation would have on its deflection under impact. Based on this information and the fact that the severity index of the test you conducted was approximately 17 percent above the nominal test requirement, we have concluded that, in the absence of further testing, a minimum of 10.75 units (approximately 41.7 m) upstream from the beginning of the length of need (LON) and 9.25 units (approximately 35.9 m) downstream of the end of the LON will be needed to ensure acceptable performance within the LON under the NCHRP Report 350 recommended evaluation impact conditions. This implies, of course, that high-speed, high-angle impacts into the "anchor" sections of barrier would result in greater deflections and poorer performance than impacts within the LON sections. Thus, care should be taken in introducing and terminating a barrier installation to minimize high-angle hits near either end of the barrier.

Mr. Faller's December 6 letter requested acceptance of a design that differed from the design that was tested. In response to questions we raised concerning the effect of these changes on barrier performance, you sent a follow-up letter on July 25 to Mr. Hatton requesting FHWA acceptance of the tested design only and provided a new set of drawings of that design. These are the drawings shown in Enclosure 1.

Based on the above discussion, we concur that the temporary barrier system shown in Enclosure 1, when installed with adequate anchoring units upstream and downstream from the LON, minimally satisfies NCHRP Report 350 TL-3 evaluation criteria and that it may be used on the National Highway System when such use is requested by a State department of transportation agency. We would add that we believe there are some relatively low-cost design changes that could be made in the barrier that would significantly improve its performance. We would encourage you and your sponsors to explore possible improvements in the barrier.

Sincerely yours,



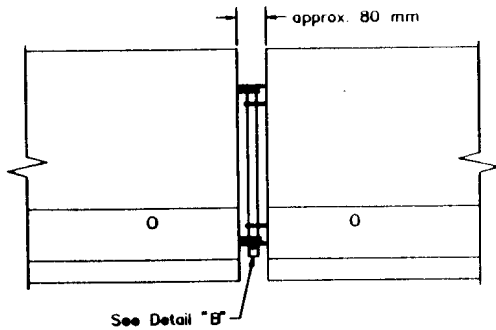
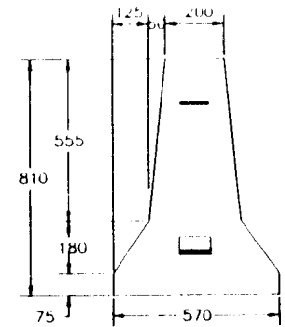
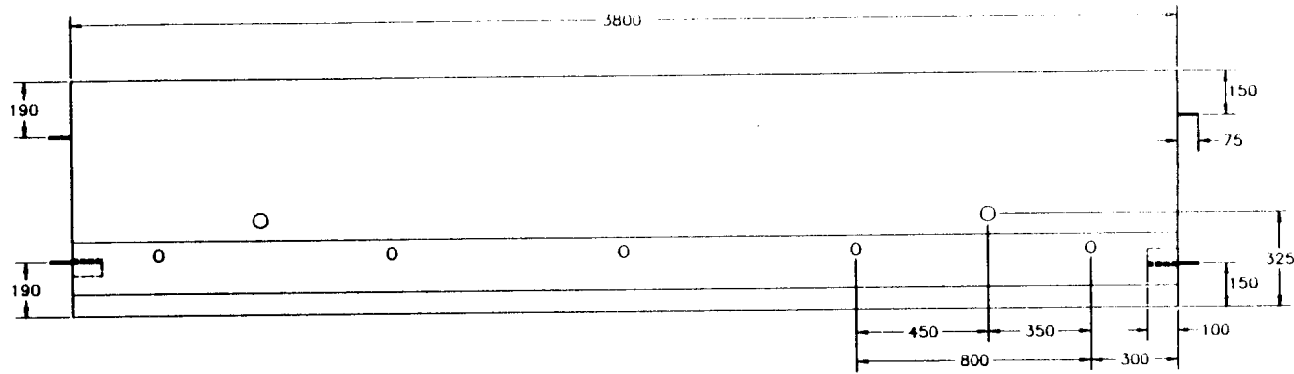
Dwight A. Horne, Chief
Federal-Aid and Design Division

2 Enclosures

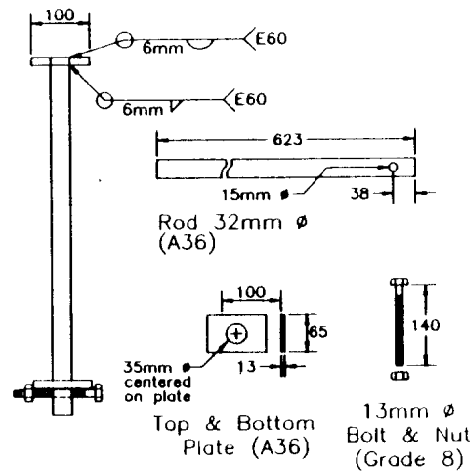
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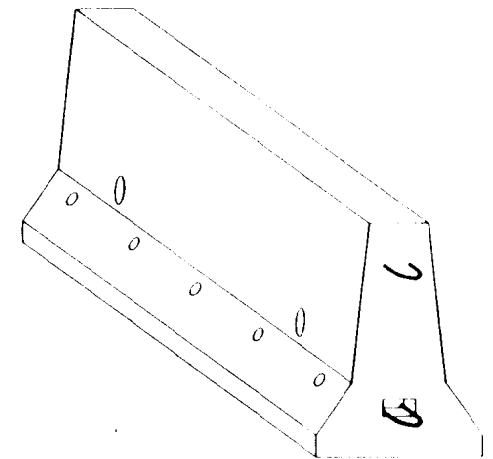
ACCEPTANCE LETTER B-4i

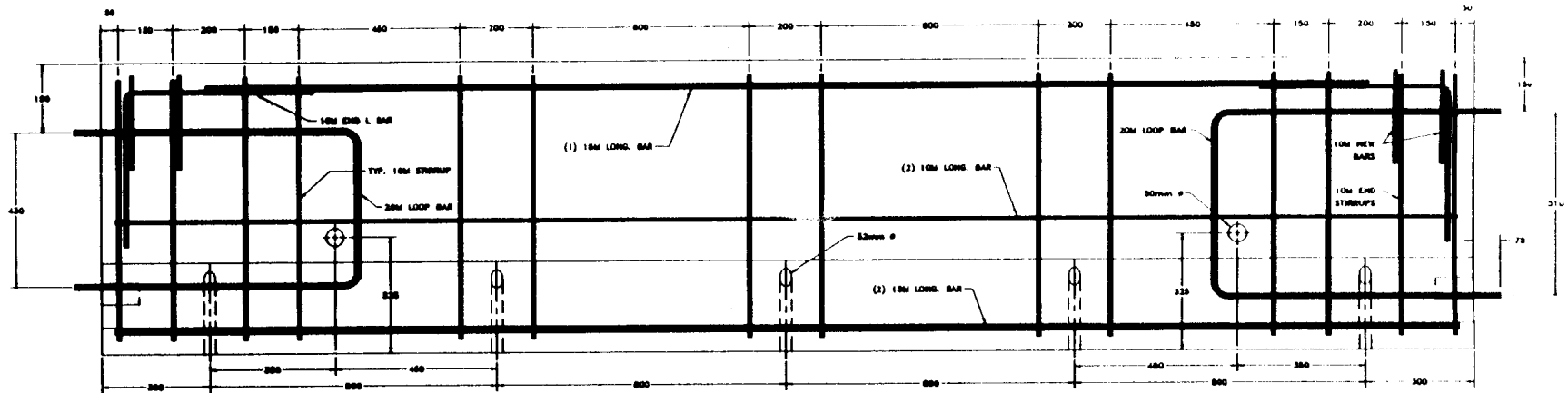


Connection Detail

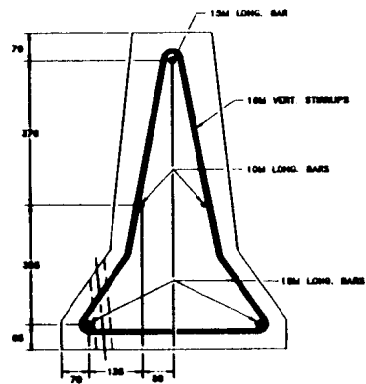


Detail "B"

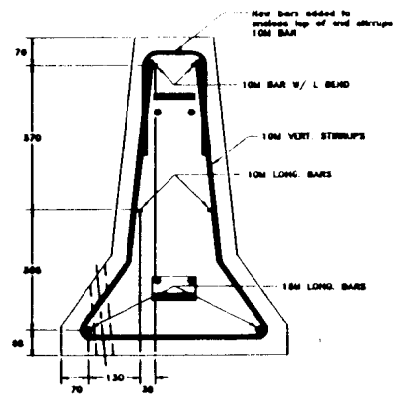




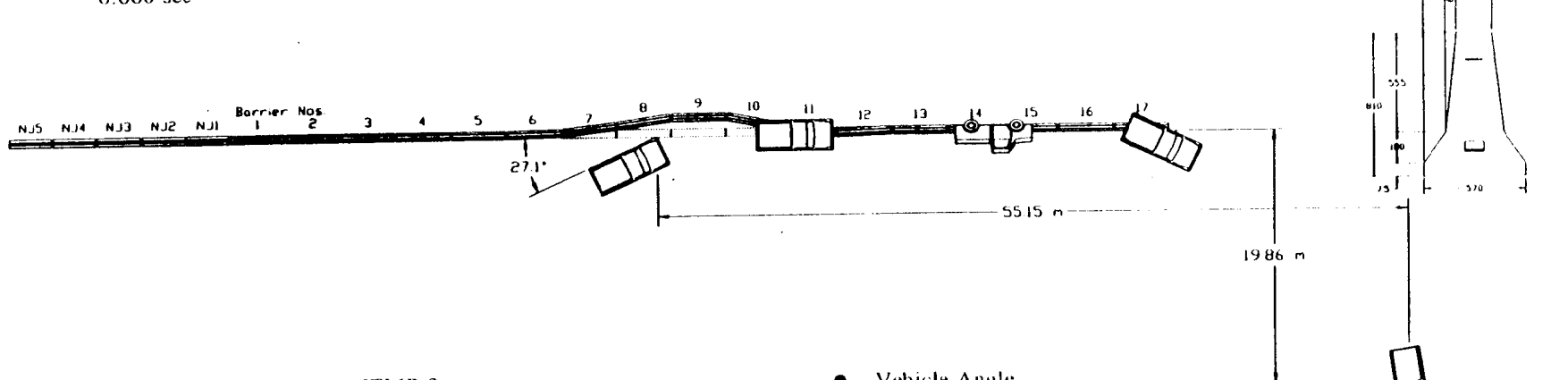
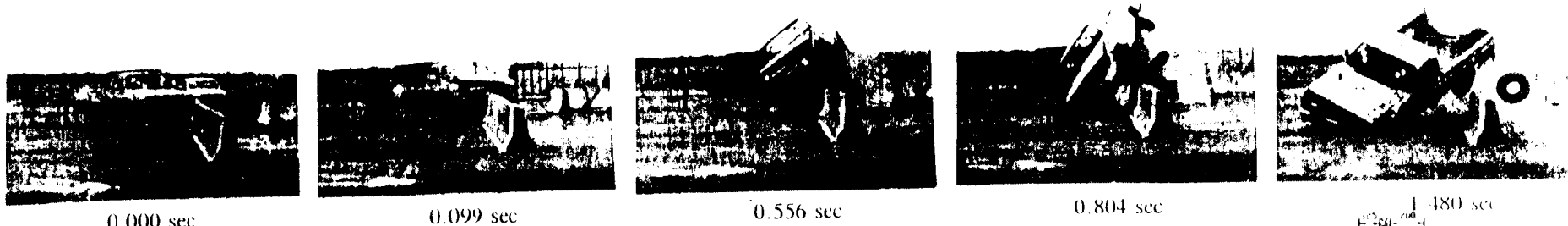
- NOTES:
- 1) All dimensions are in mm.
 - 2) Minimum Cover of 40 mm.
 - 3) All reinforcement is Grade 414MPa ASTM A615M.
 - 4) Minimum lap of all longitudinal bars is 300 mm.



INTERIOR STIRRUP



END STIRRUP (first 2 each end)



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- Test Number ITMP-2
- Date 5/9/96
- Appurtenance F-Shape Concrete Median Barrier
- Total Length 81.52 m
- Barrier
 - Length 3800 mm
 - Height 810 mm
 - Base Width 570 mm
 - Top Width 200 mm
- Connection
 - Type Pin and Rebar
 - Pin Diameter 31.8 mm
 - Rebar Diameter 20 mm
- Vehicle Model 1986 Chevrolet C-20 2WD
 - Curb Weight 2,011 kg
 - Test Inertial Weight 2,005 kg
 - Gross Static Weight 2,005 kg
- Vehicle Speed
 - Impact 100.3 km/hr
 - Exit NA

- Vehicle Angle
 - Impact 27.1 deg
 - Exit NA
- Vehicle Snagging None
- Vehicle Stability Marginal
- Occupant Ridedown Deceleration
 - Longitudinal 7.6 G's < 20 G's
 - Lateral (not required) 10.5 G's
- Occupant Impact Velocity (Normalized)
 - Longitudinal 7.2 m/s < 12 m/s
 - Lateral (not required) 5.3 m/s
- Vehicle Damage Moderate
 - TAD¹⁵ 1 LPQ 5
 - SAE¹⁶ 011.FEW3
- Vehicle Stopping Distance 55.15 m downstream
19.86 m lateral
- Barrier Damage Minimal
- Maximum Deflections
 - Permanent Set 1.14 m
 - Dynamic 1.15 m

Figure 26. Summary of Test Results and Sequential Photographs, Test ITMP-2