April 30, 2002

Refer to: HSA-10/B99

Larry F. Sutherland
Deputy Director, Office of Roadway Engineering Services
Ohio Department of Transportation
P.O. Box 899
Columbus, Ohio 43216-0899

Dear Mr. Sutherland:

In your April 3 letter, you requested the Federal Highway Administration's (FHWA) acceptance of the Ohio Department of Transportation's Thrie-beam transition to a vertical concrete parapet as a National Cooperative Highway Research Program (NCHRP) Report 350 transition design at test level 4 (TL-4). Mr. Powers independently received copies of the Texas Transportation Institute (TTI) test reports dated August 2001, entitled "NCHRP Report 350 Test 3-21 on the Ohio Type 1 Transition from Thrie Beam to Concrete Parapet with Asphalt Curb" and February 2002, entitled "NCHRP Report 350 Test 4-22 on the Ohio Type 1 Transition from Thrie Beam to Concrete Parapet with Asphalt Curb" and videotapes of the two tests that were conducted.

The tested transition design consists of 3810 mm of nested Thrie-beam rail bolted to a vertical-faced concrete parapet at the bridge end and connected to standard w-beam barrier with a 12-gauge symmetric w-beam to Thrie-beam transition piece on the approach end. The first post was approximately 1.26 m from the parapet and the second post 952.5 mm from the first. Both posts were 2440-mm long W200 x 35.9 steel posts. The next three posts were also on 952.5-mm centers, with post no. 3 being a 2440-mm long W150 x 37 and post nos. 4 and 5 being the same size, but only 1830-mm long. Post no. 6 was the same size and length as posts 4 and 5, but with a 1905-mm spacing. All remaining posts were standard strong posts on 1905-mm centers. All posts used routed wood offset blocks. A 7.1-m long, 100-mm high and 152-mm wide asphalt curb was installed with its traffic face 25 mm in front of the Thrie-beam. Enclosure 1 shows these and other design details.

Tests 3-21 (pickup truck) and 4-22 (single unit truck) were conducted on the Ohio transition design and the summary results are shown in Enclosure 2. All evaluation criteria were met, although the passenger compartment intrusion in the pickup truck was judged to be marginal. I am aware that the same test, but without the asphalt curb, resulted in unacceptable passenger compartment intrusion. Thus the 100-mm high curb is an essential design element. This curb can be made of asphalt, as tested, or it may be a concrete curb. You may wish to specify a curb higher than 100 mm to reduce wheel snagging on the concrete parapet and enhance overall crash performance. You should also consider specifying a 10-gauge w-beam to Thrie-beam transition piece in your

design. Tests by other agencies have shown that a 12-gauge piece is not stiff enough when connected directly to nested Thrie-beam and can tear when struck at that location.

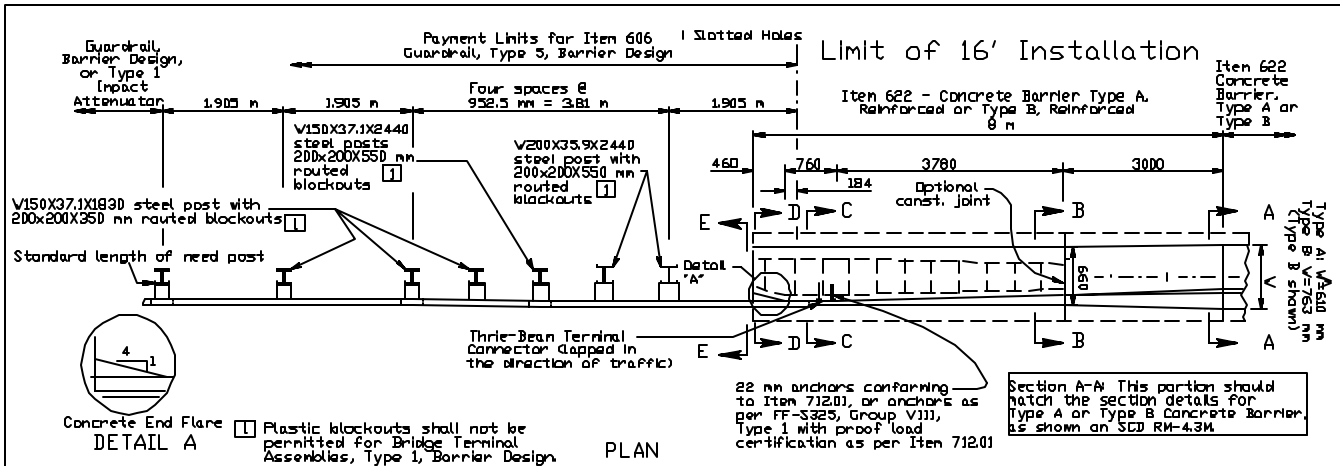
Based on the reported test results, and subject to your consideration of the above recommendations, I conclude that your Thrie-beam transition design satisfies the evaluation criteria for an NCHRP Report 350 test level 4 (TL-4) transition and may be used on the National Highway System.

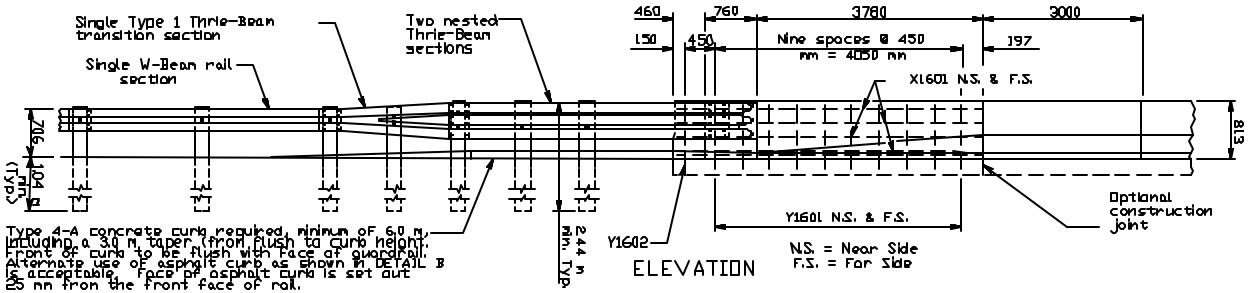
Sincerely yours,

(original signed by A. George Ostensen)

A. George Ostensen
Program Manager, Safety

2 Enclosures





NOTES

GENERAL: For additional details, see SCD's GR-1.1M, GR-1.2M and other Drawings pertaining to design of specific guardrail types. See SCD RM-4.3M for concrete barrier details.

APPLICATION: The Bridge Terminal Assembly, Type 1, Barrier Design, shall be used to connect Type 5 barrier design guardrail or Type 1 Impact Attenuators to concrete median barriers.

POSTS: General - Posts may be set in drilled holes or driven to grade.

Wood Posts shall be square-sawed pressure treated wood as per Item 710.14 and fabricated with square ends. Bolt holes shall be bored and the tops of posts trimmed, if required, after posts are set.

Steel Posts and Blockouts may be furnished as an alternate. The steel alternates for wood posts are listed below.

Wood Posts	250x250 mm	200x200 mm
Steel Posts	W200x35.9	W150x37.1

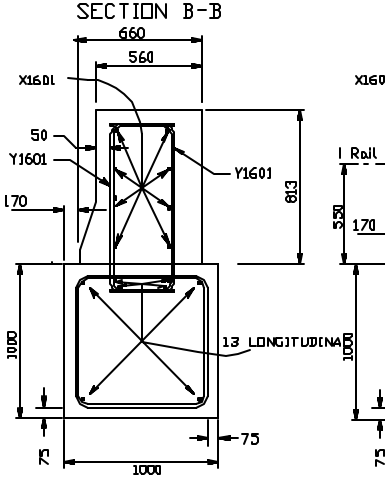
REINFORCING: All reinforcing bars shall be epoxy coated and included in the cost of Item 622.

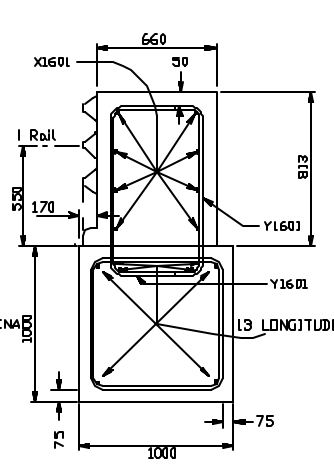
PAYMENT: Payment for the guardrail transition section will be made at the unit price bid per Each for Item 606 - Bridge Terminal Assembly, Type 1, Barrier Design and shall include the extra cost, in excess of normal guardrail costs, for additional and different type posts and blockouts, nested thrie beam sections, terminal connectors, thrie beam transitions sections, bolts, anchors, washers, and other hardware.

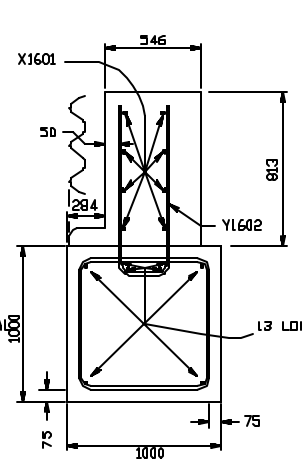
Payment for the concrete transition section will be made at the unit price bid per Meter for Item 622 - Concrete Barrier, Type ___ (A, Reinforced or B, Reinforced) and shall include all materials, labor, and reinforcing steel required to construct the barrier as shown within the limits defined. (See Plan View)

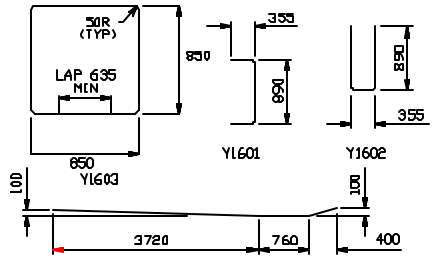
NOT DRAWN TO SCALE
All dimensions are in millimeters unless otherwise noted.

REFERENCE OHIO DOT DRAWING GR-3.5M FOR ORIGINAL DETAILS

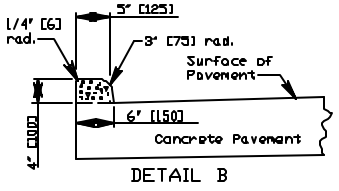








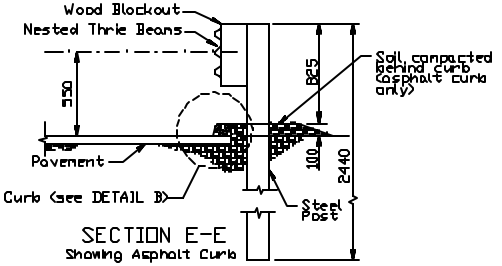
BENDING DIAGRAMS



DETAIL B

REINFORCING BAR LIST

MARK	LENGTH (mm)	SHAPE	QUANITY
X1601	4880	Bent	8 Each
Y1601	1530	Bent	20 Each
Y1602	2060	Bent	1 Each
Y1603	3400	Bent	11 Each



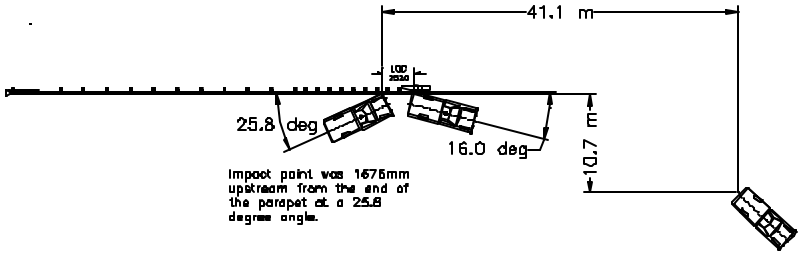
SECTION E-E
Showing Asphalt Curb

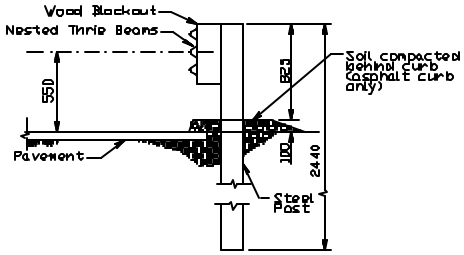
0.000 s

0.148 s

0.247 s

0.370 s





General Information

Test Agency	Texas Transportation Institute
Test No.	401021-5
Date	07/03/01

Test Article

Type	Transition
Name	Ohio Type 1 Transition
Installation Length (m)	33.7
Material or Key Elements	Nested Thrie Beam Transition to Concrete Parapet with Asphalt Curb
Soil Type and Condition	Standard Soil, Dry

Test Vehicle

Type	Production
Designation	2000P
Model	1996 Chevrolet 2500 pickup truck
Mass (kg)	
Curb	1897
Test Inertial	2000
Dummy	76
Gross Static	2076

Impact Conditions

Speed (km/h)	100.4
Angle (deg)	25.8

Exit Conditions

Speed (km/h)	72.4
Angle (deg)	16.0

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	6.2
y-direction	8.9
THIV (km/h)	38.6
Ridedown Accelerations (g's)	
x-direction	-14.5
y-direction	11.0
PHD (g's)	14.9
ASI	1.95
Max. 0.050-s Average (g's)	
x-direction	-9.9
y-direction	15.2
z-direction	6.7

Test Article Deflections (m)

Dynamic	0.25
Permanent	0.55
Working Width	0.47

Vehicle Damage

Exterior	
VDS	11LFQ3
CDC	11FLEK2 &11LYEW2
Maximum Exterior	
Vehicle Crush (mm)	570
Interior	
OCDI	FS0214100
Max. Occ. Compart. Deformation (mm)	120

Post-Impact Behavior

(during 1.0 s after impact)

Max. Yaw Angle (deg)	83
Max. Pitch Angle (deg)	-16
Max. Roll Angle (deg)	-20

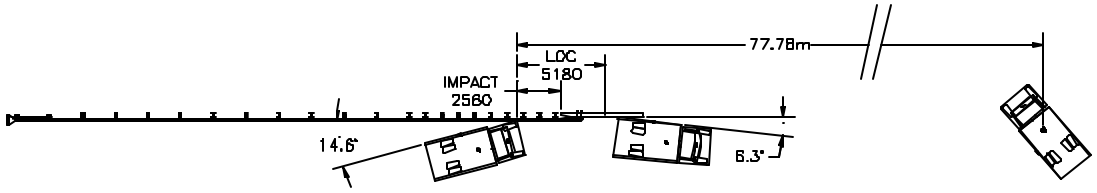
Summary of results for test 401021-5, *NCHRP Report 350* test 3-21.

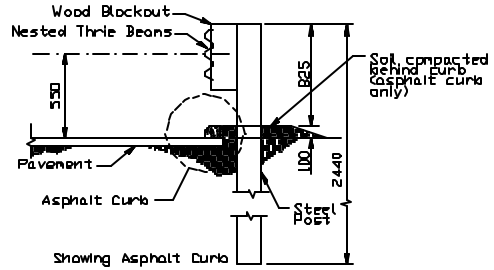
0.000 s

0.242 s

0.726 s

1.935 s





General Information
- Test Agency . . . . . Texas Transportation Institute
- Test No. 401021-2a
- Date 01/16/02

Test Article
- Type . . . . . Transition
- Name . . . . . Ohio Thrie Beam Transition
- Installation Length (m) 9.95
- Material or Key Elements . . . Thrie Beam Guardrail Attached to Concrete Parapet with Asphalt Curb

Soil Type and Condition . . . . . Standard Soil, Dry

Test Vehicle
- Type . . . . . Production
- Designation 8000S
- Model . . . . . 1984 Chevrolet C70 Box Van
- Mass (kg)
  - Curb 5245
  - Test Inertial 8000
  - Dummy . . . . . N/A
  - Gross Static 8000

Impact Conditions
- Speed (km/h) 80.2
- Angle (deg) 14.6

Exit Conditions
- Speed (km/h) 69.4
- Angle (deg) 6.3

Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 2.7
  - y-direction 4.1
- THIV (km/h) 17.8
- Ridedown Accelerations (g's)
  - x-direction . . . . . -5.3
  - y-direction 8.1
- PHD (g's) 8.7
- ASI 0.44
- Max. 0.050-s Average (g's)
  - x-direction . . . . . -2.0
  - y-direction 3.7
  - z-direction 2.6

Test Article Deflections (m)
- Dynamic 0.07
- Permanent 0.18
- Working Width 1.90

Vehicle Damage
- Exterior
  - VDS 11FL1
  - CDC 11FLEW1
- Maximum Exterior
  - Vehicle Crush (mm) 270
- Interior
  - OCDI LF0000000
- Max. Occ. Compart.
  - Deformation (mm) . . . . . None

Post-Impact Behavior
(during 1.0 s after impact)
- Max. Yaw Angle (deg) . . . . . -29.6
- Max. Pitch Angle (deg) . . . . -7.2
- Max. Roll Angle (deg) 21.1

Summary of results for test 401021-2a, *NCHRP Report 350* test 4-22.