

INDIANA DEPARTMENT OF TRANSPORTATION



INTER-DEPARTMENT COMMUNICATION



232-5347

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DESIGN MEMORANDUM No. 04-16 TECHNICAL ADVISORY

TO All Design, Operations, and District Personnel and Consultants

FROM: /s/ Anthony L. Uremovich
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SUBJECT: Thrie Beam Guardrail and Transitions

EFFECTIVE: March 16, 2005, Letting

I. INTRODUCTION

Guardrail barriers are used extensively along highways to shield motorists from roadside hazards. Steel strong-post W-beam guardrail is the primary type of guardrail utilized by INDOT to shield motorists from obstacles along roadways. Variations in post spacing affect the allowable clearance of the guardrail from the obstruction being shielded. This clearance is based on the distance from the face of the guardrail, considering the combined width of the rail element, blockout, post "thickness," and the rail deflection properties.

Thrie-beam guardrails with various post and blockout configurations are currently used by INDOT as transitions between W-beam guardrail and bridge railings, bridge piers/crashwalls, and barrier walls.

The thrie-beam guardrail assembly with a modified blockout configuration has been adopted as the Indiana thrie-beam guardrail, and is shown on INDOT *Standard Drawing* 601-MTGR-01. All INDOT *Standard Drawings* referenced herein are posted on the Department's website and its

Design and Construction Reference Guide CD. This assembly is in accordance with the National Highway Cooperative Research Program *Report 350* Test Level 4 (TL-4) requirements.

The dynamic lateral deflection is 0.8 m (2.7 ft) for 1.905 m (6.25 ft) post spacing. The 865 mm (2'-10") rail height is effective in containing larger vehicles and preventing vehicle rollover in crashes. The lower portion of the thrie-beam element and the flange of the steel blockout bend inward upon impact, keeping the rail face nearly vertical as the posts are pushed backwards.

II. BENEFITS OF THRIE-BEAM GUARDRAIL

Thrie-beam guardrail requires virtually no repairs for shallow angle impacts, thus minimizing maintenance efforts and costs. This impact performance makes this type of guardrail more appropriate for use in areas where the existing guardrail is impacted frequently or where the roadway curves.

III. WARRANTS FOR USING THRIE-BEAM GUARDRAIL

A. Outside Shoulder

Thrie-beam guardrail should be considered as follows:

1. New Facility, Location Within the Limits of a Horizontal Curve with a Radius of 437 m (1435 ft) or Less. All of the following conditions must be satisfied.
 - a. Guardrail is warranted;
 - b. design speed is equal to or greater than 80 km/h (50 mph); and
 - c. design year AADT is equal to or greater than 10,000.
2. New Facility, Location on Horizontal Curve with Radius of Greater Than 437 m (1435 ft) or on Tangent Roadway. Both of the following conditions must be satisfied.
 - a. Guardrail is warranted; and
 - b. design year AADT is equal to or greater than 100,000.
3. 3R or 4R Project, Location Within the Limits of a Horizontal Curve with a Radius of 437 m (1435 ft) or Less. All of the following conditions must be satisfied.

- a. Guardrail is in place and must be moved transversely to accommodate lanes or shoulders widened to 3R or 4R standards or horizontal curves improved to 3R or 4R standards, and such guardrail is still warranted;
 - b. design speed is equal to or greater than 80 km/h (50 mph); and
 - c. design year AADT is equal to or greater than 10,000.
4. 3R or 4R Project, Location on Horizontal Curve with Radius of Greater Than 437 m (1435 ft) or on Tangent Roadway. Both of the following conditions must be satisfied.
- a. Guardrail is in place and must be moved transversely to accommodate lanes or shoulders widened to 3R or 4R standards or horizontal curves improved to 3R or 4R standards, and such guardrail is still warranted; and
 - b. design year AADT is equal to or greater than 100,000.
5. Partial 3R Project. All of the following conditions must be satisfied.
- a. Guardrail is currently in place;
 - b. guardrail is still warranted; and
 - c. a run of guardrail has been damaged, or gets impacted, on average, two or more times per year.

Guardrail impacts should be determined from the reported accident data (for the most recent available 3-year period) provided by the Program Development Division's Safety/Congestion Management Unit. This information may be unavailable or may not indicate an average of at least two impacts per year. If so, the appropriate operations or maintenance personnel should be contacted for information which may reveal a history of an average of two or more impacts per year.

Each existing guardrail run of 90 m (300 ft) or shorter which has been damaged, or gets impacted, on average, twice per year should be replaced with thrie-beam guardrail. Undamaged portions of at least 150 m (500 ft) or longer of existing W-beam runs should be left in place. Undamaged portions of existing W-beam runs of less than 150 m (500 ft) between high-impact areas should be replaced with thrie-beam guardrail.

6. Large Cross Drainage Structure. Nested thrie-beam guardrail should be used at a large cross drainage structure where nested guardrail would be required, but a TL-4 device is warranted. *Details for such thrie-beam configuration have not yet been developed as INDOT Standard Drawings.*

B. Median

A median barrier must have been determined to be warranted as described in *Indiana Design Manual* Section 49-4.05(01). Double-faced thrie-beam guardrail (a TL-4 assembly) should be considered for an unpaved median where the minimum distance from the front face of the guardrail to edge of the paved shoulder is 3.6 m (12 ft). The designer should make certain that the placement of guardrail posts does not interfere with sewer pipes, drainage structures, underdrains, etc.

IV. WHERE THRIE-BEAM GUARDRAIL SHOULD NOT BE CONSIDERED

A. Outside Shoulder

Thrie-beam guardrail should not be used for approaching a curved guardrail end treatment at a drive radius.

B. Median Shoulder

A TL-3 median barrier, such as double-faced W-beam guardrail or other approved median guardrail system, should be considered where median-barrier use is identified as optional as described in *Indiana Design Manual* Section 49-4.05(01).

V. SITE REQUIREMENTS FOR PLACEMENT OF THRIE-BEAM GUARDRAIL

A. Outside Shoulder

1. Along Paved Shoulders. Typical shoulder guardrail location criteria should be followed.
2. Outside Usable Shoulder Limits. A maximum slope of 6:1 should be provided in front of guardrail. Guardrail should be placed 3.6 m (12 ft) or more beyond the outside edge of paved shoulder.

B. Median

1. Transverse Location. Double-faced guardrail should be located in the center of the median unless drainage considerations dictate a centerline offset location to be more appropriate.

2. Grass Median. A maximum slope of 6:1 should be provided in front of double-faced guardrail.
3. Variable-Width and/or Independent-Roadway-Grade Median. Single-faced thrie-beam guardrail should be used. It is more appropriate in this situation and should be in accordance with the outside-shoulder placement criteria discussed above.

VI. CONNECTORS

A. Outside Shoulder

A thrie-beam section must be transitioned to a W-beam section, and a guardrail end treatment type OS is attached to the end of the W-beam section. This transition connector is guardrail transition type WGT. The details are shown on INDOT *Standard Drawing* 601-TWGT-01. The WGT guardrail transition must be used to bring the thrie-beam guardrail to the W-beam guardrail height for proper attachment of a guardrail end treatment.

B. Bridge Railing Transition

The thrie-beam guardrail transition, TTT, *Thrie-beam guardrail Transition to Thrie-beam bridge railing transition*, connects a bridge railing transition to the thrie-beam guardrail by providing a height adjustment transition. The TTT transition details are shown on INDOT *Standard Drawing* 601-TMTT-01.

C. Median-Side Shoulder

Where thrie-beam guardrail is terminated in a median, two WGT transitions with staggered posts as shown on INDOT *Standard Drawing* 601-TTMS-01 must be provided unless a median pier or barrier wall, etc., is immediately adjacent. The two WGT guardrail transitions must be used to bring the double-faced thrie-beam guardrail to the double-faced W-beam guardrail height and width for proper attachment of a guardrail end treatment type MS.

VII. CONTRACT DOCUMENT REQUIREMENTS

Inclusion of thrie-beam guardrail in a project requires contract-document considerations as follows:

A. Plans

The location of thrie-beam guardrail or double-faced thrie-beam guardrail and any corresponding grading requirements must be shown on all applicable plan and profile sheets, construction details sheets, and tables. Similar information regarding the guardrail transitions and attenuators must be shown on the appropriate sheets. This information is necessary to inform the contractor where the guardrail described herein and its corresponding pay items listed in the Schedule of Pay Items are to be installed.

B. Pay Items

The code numbers, pay item names, and pay units are as follows:

601-08182	Guardrail, Thrie Beam	meter (linear foot)
601-08183	Guardrail, Thrie Beam, Double-Faced	meter (linear foot)
601-08353	Guardrail, Thrie Beam, Nested	Each
601-08186	Guardrail Transition, TTT	Each
601-08187	Guardrail Transition, WGT	Each

Where double-faced guardrail transition WGT is used in terminating a double-faced thrie-beam guardrail in a median, the pay quantity is 2 each.

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