DESIGN BULLETIN #24/2005 (Revised September 2007)

ROADSIDE DESIGN – Refinements to Practices

Superseded in January 2008 by Roadside Design Guide:
http://www.transportation.alberta.ca/3451.htm

September 2007 Update to Design Bulletin #24/2005:
Systems Type and Maximum Deflection Table.

March 2007 Update to Design Bulletin #24/2005:
Section 1.0 (Second Bullet) of this Design Bulletin regarding the use of plastic posts.

Summary: The subjects covered by this bulletin are as follows:
1. Guideline for Selection of System Type / End Treatment Type.
2. Runout Length (Revisions for Roads with AADT < 800)
3. Embankment Warrants (Revisions for Roads with AADT < 400)
4. Turn Down End Treatment Grandfathered
5. Provision of Stopping Sight Distance (SSD) on Directional Ramps at New Interchanges
6. Provision of Barrier Free Cross-Section on Underpasses.
7. Future Developments (Possible Enhancements to W Beam Weak Post System)

1.0 Guideline for Selection of System Type/ End Treatment Type

The type of barrier system and end treatment type to be used on Alberta highways is generally chosen based on the traffic volume (AADT), traffic speed (posted and/or design), deflection room available, stiffness required for connection to other structures such as bridges, severity of hazard, aesthetics, special maintenance conditions (such as prevailing snow drifting problems etc) and other constraints or considerations. The guideline for selection shown here deals with many of the special conditions and also documents the normal practice which is generally followed in the absence of special conditions / constraints.

The Department has adopted the crash performance criteria as documented in the US National Co-operative Highway Research Program (NCHRP) Report 350. In general Test Level 3 (TL-3), which is appropriate for 100 km/h, is used as a minimum for all Alberta highways where the posted speed is 100 km/h or higher. Also, where a roadway is designed for 100 km/h or higher but is posted at a lower speed on a temporary basis (perhaps due to gravel surfacing), TL-3 is normally used. Where the design speed is 70 km/h or less, either TL-2 (for 70km/h) or TL-1 (for 50 km/h) may be used as appropriate. In exceptional cases, such as where the hazard is very severe and/or the exposure is very high e.g. as dictated by the bridge code, or where the Department requests a higher degree of protection, e.g. in vicinity of power transmission line facilities etc, TL-4, TL-5 or TL-6 may be required. The higher test

levels may also be required due to the Canadian Bridge Code. These higher test levels provide protection against heavier vehicles as well as providing for the lighter vehicles. In all cases, designers are required to produce a customized design to meet the needs of the project however the following general guidelines are provided for normal use:

- Anthony Henday Drive, Calgary Ring Road (including Stoney Trail, Highway 22X, East Freeway, etc.), Deerfoot Trail and Deerfoot Extension:
  TL -4. Normally the Modified Thrie Beam system on steel posts is used. See drawing TEB 3.70 attached.

- All divided highways and undivided highways with AADT >2500 :
  TL-3. Normally the Strong Post Blocked Out W Beam system is used with wood, plastic or steel posts. The blocks are either wood or plastic. Steel blocks are not permitted. See drawing TEB 3.09 attached.

  Plastic Posts are now permitted on Highway 2 between Edmonton and Calgary (as well as on all other divided highways and undivided highways with AADT >2500 where TL-3 is required) except in connections to rigid systems, as part of proprietary end treatments and where a deflection of less than 1.5m is required.

- All other highways under provincial jurisdiction:
  The Alberta Weak Post W Beam system with no blocks is normally used. See drawing TEB 3.12 attached. This system has not been crash tested or rated according to the NCHRP guidelines to date however it is "grandfathered" based on past performance for use on Alberta highways. Enhancements to this system are under consideration and may be implemented later, subject to successful testing.

- If the AADT > 10,000 and the Design Speed > 100 km/h, crash worthy end treatments rated at TL-3 are normally used. AASHTO's Roadside Design Guide provides information on many acceptable systems for this application.

- For all other barriers, the Alberta Turn Down End Treatment may be used. See drawing TEB 3.12 attached.

- The design deflection for various system types are as follows:

System Type and Maximum Deflection

System Type	Maximum Deflection (metres)
Modified Thrie Beam • TL-3 • TL-4	 0.6 0.9
Strong Post Blocked Out W Beam (Blocks are either Wood or Plastic) ▪ Wood or Steel Post ▪ Plastic Post	 0.9 1.5

Alberta Weak Post W Beam (No Blocks)	2.5

System Type	Maximum Deflection (metres)
Permanent Concrete Barriers	0
Weak Post Box Beam	1.5
Three Strand Cable (Low Tension)	3.5
High Tension Cable Barrier System	2.0 *

* or as per the specifications of the proprietary system.

2.0 Runout Length (Revisions for Roads with AADT < 800)

The length of need for roadside barrier is determined using the clear zone distance and the run-out length using the "protection envelope" method. This was described in the Department's Traffic Control Standards Manual published in June 1995 (note, this manual is currently out of print) as shown in Figure 4 attached. Due to the inclusion of a vast network of lower volume highways under provincial jurisdiction, it has become necessary to refine the minimum run-out length requirements for lower volume highways. The attached revised Table 3 shall be used in determining the suggested minimum run-out lengths (L_R) for barrier design.

The Department is currently in the process of developing a Roadside Design Guide. The Roadside Design Guide will include the protection envelope method and the revised Table 3 which were referenced in the Department's Traffic Control Standards Manual. In the interim, Figure 4 and Table 3 attached shall be used.

3.0 Embankment Warrants (Revised for Low Volume Roads)

To better address the needs of a provincial network that includes some high and intermediate volume roads, as well as many low volume roads, an additional Embankment Warrant Chart has been developed for lower volume roads (Figure C-5.3.1c). The existing chart (Figure C-5.3.1a) will be used only where the AADT exceeds 400. See the attached Figures C-5.3.1a and C-5.3.1c for details.

4.0 Turn Down End Treatment Grandfathered

The standard Alberta Turn Down End Treatment is shown in drawing TEB 3.12 attached.

This configuration has performed well in service on Alberta highways over the last 30 years. Although this end treatment has not yet been crash tested according to the latest NCHRP criteria, it has performed well and there is no urgent need to replace it at this time. This system offers the advantages of simplicity and small size. Because of the relatively small size compared to many of the proprietary end treatments, there is less exposure to traffic and therefore less snow drifting and less vehicular impacts with the system.

5.0 Provision of Stopping Sight Distance (SSD) on Directional Ramps at New Interchanges

Where directional ramps are built going over or under other roadways, there is normally an obstruction to the horizontal line of sight due to either the roadside barrier (often the F shape concrete barrier where the subject road is going over) or the bridge pier/barrier system (where subject road is going under). The minimum sight distance required on any roadway is stopping sight distance. The department normally establishes a desirable design speed for a ramp based on the anticipated operating speed, driver expectations, functional needs of the interchange and other constraints / considerations. After the horizontal and vertical curvature has been established, it is often found that the design speed is constrained by the stopping sight distance as a result of barriers or other roadside obstacles. Stopping sight distance requirements vary for cars and trucks due to differences in eye height and braking characteristics. While a truck driver can generally see further than a passenger car driver due to the eye height advantage, in some instances the higher eye height is a disadvantage - for example, a sag vertical curve where visibility is "cut-off" by an overpass. Also, where the visibility is "cut-off" by an obstacle such as a barrier, the eye height advantage is eliminated and therefore the stopping sight distance for trucks with conventional braking systems (see Table 1.2.5.4 of the 1999 TAC Geometric Design Guide for Canadian Roads) should be provided. The TAC table provides a range of SSDs based on a range of operating speeds. An appropriate value should be used for design purposes based on an estimate of the operating speed of a typical design truck at this location on the ramp (based on the vertical alignment of the ramp and other considerations). The SSD requirements at any location also should be adjusted based on the effects of grade on the braking distance component.

In the event that horizontal and vertical alignments are constrained, additional SSD can be provided by providing additional offset to the barrier (or other obstacle). This is normally done by increasing the shoulder width (or essentially providing additional offset between the outside edge of shoulder and the face of barrier). Where a very wide offset is needed and there is a possibility of drivers thinking there is an extra lane, additional guidance devices such as pavement marking and / or rumble strips may be used. Frequently, directional ramps are curved to the left (in the direction of travel) in which case it is the left offset that needs to be increased. Even where additional width is provided on the left, normal practice is to continue to provide the full shoulder width as per the design standard on the right hand side. This is needed as a wide shoulder on one side does not reduce the need for a consistent shoulder on the other side i.e. provision of additional shoulder widths is permitted but any reduction of shoulder width is undesirable on either side.

Where the overpass structure is the critical obstacle to the line of sight to trucks e.g. as may happen on the underpassing roadway, an increase in the vertical clearance should be considered (as well as other possible solutions).

6.0 Provision of Barrier Free Cross-Section on Underpasses

It is generally a good practice to design the cross-section on underpassing roadways at structures (particularly interchanges) so that barriers are not required. An example of this type

of cross-section is shown in Figure C-9.3.3. of the Department's Design Guide. This provides an appearance of openness, less snow drifting, more flexibility for future widening and generally lower maintenance costs and collision costs over the life of the structure. Because there may be constraints that limit the ability to provide an open span, the use of a barrier free cross-section is not dictated as a "minimum" standard. The "minimum" standard is shown on Figure C-9.3.2. Conversely where there are no constraints, the use of "minimum" horizontal clearances is unacceptable to the department. Therefore a design guideline is needed to document the recommended practice for Alberta highways. The guideline is as follows:

6.1 Unless dictated otherwise by significant constraints, it is recommended that all underpasses shall be designed so that barriers are not required between the travel lane and the structure. This guideline applies to all underpassing roadways including the major highway, ramp, collector-distributor road, minor highway etc. The clear zone distance to be used in the design shall be based on current parameters i.e. speed, AADT, slope, horizontal curvature etc.

6.2 Where the subject roadway may be widened in the future (within the service life of the structure), the provision of a structure that would allow for barrier free operation at the future stage should be considered. *The design should* consider the service life of the interchange (not just the structure), staging considerations and economic factors.

7.0 Future Work (Possible Changes to W Beam Weak Post System)

Alberta Infrastructure and Transportation has undertaken computer simulated crash testing of the W Beam Weak Post guardrail system to gauge its suitability for modern vehicles and conditions as identified in the NCHRP Report 350. Several possible enhancements have been identified. The Department will examine the recommendations for changes to the W Beam system and may do some additional testing and / or in-service monitoring before making changes to normal practices. Designers will be advised of changes if and when they are approved.

Conflicts Between Drawings

Where there are conflicts between drawings, the most recently approved or revised drawing should be used. Any outstanding questions should be directed to the Technical Standards Branch (Attention: Bill Kenny, fax (780) 422-2027).

Implementation

1. Length of need and suggested minimum run-out lengths for barrier design:
   - Table 3 - Suggested Minimum Run-out Lengths L_R (m) for Barrier Design.
   - Figure 4 - Traffic Barrier Length of Need

2. Updates to the Traffic Barrier Drawings are as follows:
   - Drawings TEB 3.09 and 3.12.
   - Drawing TEB 3.70, Modified Thrie Beam Guardrail is added to the Traffic Barrier Drawings.

3. Updates to the Highway Geometric Design Guide 1995, Updated 1999 are as follows:
   - The attached Figure C-5.3.1c, Barrier Warrants for Fill Slopes Where AADT < 400 is added to Section C.5.3.1.
   - There is no change to Figure C-5.3.1a , Barrier Warrants for Fill Slopes Where AADT > 400

4. The new guidelines as indicated in this Bulletin are to be implemented immediately unless the cost or timing does not allow such a change to be made on a specific project. The decision to revise or not will be made at the discretion of the Project Sponsor.

Date of Issue: February 23, 2005.
Effective Date: February 23, 2005.
Update 1: March 18, 2005
Update 2: March 1, 2007
Update 3: September 30, 2007

Attachments (Click to view pdf file):

Table 3 - Suggested Minimum Run-out Lengths L_R (m) for Barrier Design.

Figure 4 - Traffic Barrier Length of Need. Revised March 2005

TEB 3.09

TEB 3.12

TEB 3.70

Figure C-5.3.1c, Barrier Warrants for Fill Slopes Where AADT < 400

Figure C-5.3.1a, Barrier Warrants for Fill Slopes Where AADT > 400