DESIGN BULLETIN #1/2001

ROADSIDE DESIGN - Guidelines for Clear Zones, Barriers etc.

Superseded January 2008 by Roadside Design Guide, November 2007
http://www.transportation.alberta.ca/3451.htm

Summary: This technical bulletin is being issued to clarify some points in regard to the department's current policy on clear zone, hazard mitigation, barrier installation and retrofitting of barrier systems. The bulletin is effective immediately. The department's practices are due to be reviewed this year and a new document may be issued at the conclusion of the review. The subjects covered by this bulletin are as follows:

1. Current Practices/Documents
2. Clear Zone and Design Envelope
3. Post Sizes (Lengths) and Materials
4. Bridge Rails
5. Transitions between bridge systems and roadway systems
6. Retrofitting (a strategic approach)
7. Tolerance for height of installation
8. Practices for choosing a system
9. Grading design to include barriers/slopes
10. Economic analysis for barrier design
11. Suitable slopes for deflection zone
12. Barrier End Treatments
13. Shy distances
14. Conflicts between drawings

1. Current Practices / Documents

The department's current documents on this subject are listed below. These documents are used on all roadways in the province where Alberta Infrastructure is responsible for the capital cost of construction. The current practice includes the need to apply engineering judgement to fully assess the risks and benefits in order to achieve cost-effective designs on a network that includes some high volume highways and many low volume roads. Because of evolving enhancements in design practices, agency policies and barrier systems, there is a need to periodically update Alberta Infrastructure's policy on Roadside Design. A general review of Alberta's Roadside Design practices will take place in 2001 and subsequently an updated document on this subject will be made available.

- Traffic Control Standards Manual - Traffic Barriers Chapter (1995) - provides barrier details and some warrants
- Highway Geometric Design Guide - Section C.5 Roadside Design (1999) - provides the latest Clear Zone criteria.

- Standard Drawings for Bridge Rails - approved in November 2000. - transitions are shown also.
- Standard Drawings for Barriers
- Standard Specification for Highway Construction - see 2.19, 4.2, 5.25, 5.26, 5.27.

The TAC 1999 Geometric Design Guide for Canadian Roads and AASHTO's 1996 Roadside Design Guide are used as additional reference material where supplemental information is needed.

2. Clear Zone and Design Envelope

The department's current Clear Zone criteria are shown in the Highway Geometric Design Guide. This Guide was issued in 1995 however the Clear Zone criteria were updated in 1999. Designers should use the August 1999 version of section C.5 of this Guide.

Currently the "design envelope" is the standard method for determining the length of need based on the location of hazards that vehicles require protection from. In recent years the envelope method has been used on all Primary Highways however the practices followed on Secondary Highways across the province may not have been consistent due to local conditions and municipal responsibility for these roadways. On Local Roads where the department was responsible for barrier protection due to the presence of a bridge structure, a standard length was normally used as per the standard drawings for bridge end treatments.

It is recognised that there may be some merit to increasing the number of traffic volume ranges in the Clear Zone Distance table to better suit Alberta's network, which includes a significant number of lower volume roads. This table will be reviewed and the ranges fine-tuned in the future. The design guidelines to be used for determination of "length of barrier" on the various roadway systems will also be revisited.

3. Post Sizes (Length) and Materials

The current standard sizes of posts to be used for the various systems are shown in the Traffic Control Standards Manual. The most common post currently used is the 1.52m (5 foot) 152mm x 203mm wooden post. The designer has a responsibility to ensure that the post chosen is suitable for the intended purpose. In some cases due to the type of soil, size of the embankment, steepness of slopes etc, it may be appropriate to use longer posts. In these cases designers may choose a 1.825m (6 foot) or 2.130m (7 foot) post as required. The standard post length used in the newly adopted Standard Drawings for Bridge Rail Transitions is 1.825m .

Designers are expected to choose the most appropriate approved materials that are available to construct barrier systems that will provide the best value to the department while still delivering the expected level of protection to the road user. The department maintains a "Recognized Products List" which may be accessed at the following website: http://www.tu.gov.ab.ca/ Follow the links for Highway Network, Technology Development, Recognized Products, Traffic Control Devices, W-Beam Guardrail and Posts. A recycled plastic post produced by an Alberta company (Amity Plastics Ltd of Clyde) is now recognized as an acceptable product to use as a substitute for the standard wood post of the same dimensions in Alberta Infrastructure barrier systems. As plastic posts are currently at the "introduction" stage in Alberta, the department prefers to use them primarily in lower risk locations at this time until a more complete record of their in-service performance has

been compiled. The department's practices in regard to use of plastic posts will be reviewed in the spring of 2001. This process will be used to review the use of various materials including steel, plastic and wood posts and to develop a more comprehensive strategy for inclusion of newer materials in new and existing barrier systems.

4. Bridge Rails

Alberta Infrastructure adopted a new design standard for the design of standard bridgerails in November 2000. This standard is effective immediately. The standard requires the designer to choose an appropriate "Performance Level" for the barrier system based on predefined criteria. Standard drawings have been prepared by UMA Engineering (under contract to the department) to illustrate the details of standard barrier systems available for the bridge structure and transitions. The standard drawing numbers are S-1642-00, S-1643-00 and S-1648-00 through to S-1653-00. These standard drawings are to be used by designers to achieve the desired performance level. The drawings may be obtained by contacting Technical Standards Branch at 415 1042 (Wilf Schneider).

5. Transitions between bridge systems and roadway systems

Currently designers are to use the appropriate standard drawings as listed above. Designers should be aware that the bridge transition drawings are only showing the length required for a transition from the rigid to the more flexible roadway barrier. The length of need for overall barrier protection on highways should still be calculated using the envelope method.

6. Retrofitting (A strategic approach)

Currently the department follows a policy that includes building all new installations to the standard of the day but using considerable flexibility when assessing and upgrading existing systems. This is due to the impracticality of applying "new" standards to existing infrastructure. This is especially relevant when dealing with existing bridges but also applies to roadways if there is minimal other "grading" work required.

The department's practices in regard to retrofitting or upgrading existing barrier systems is due to be revisited in the coming months. If there is any change in policy, designers will be advised.

7. Design tolerance for height of installation

The department's current design tolerance for height of guardrail on the standard W-beam systems (Strong Post and Weak Post) is plus or minus 75 mm. This is a value that has been selected based on performance expectations.

The tolerance used in the maintenance specification or the construction specification may vary from the design tolerance if such a variance is justified however tolerances in excess of 75 mm can be expected to result in lower performance of the system.

8. Practices for choosing a system

The department's current practice for choosing a roadway barrier system is to begin with the "standard" Flexible W beam system in all rural applications with the exception of Highway 2 between Airdrie and Edmonton. The Semi-Rigid W-Beam system is to be used on the Highway 2 corridor identified. As a general rule, blocks are only used on bridge transitions and on the semi-rigid system. All other W-beam guardrail systems in Alberta are installed without blocks. Concrete barrier (Rigid) systems may be used where minimal deflection is permitted. Other systems such as the Box Beam or cable systems may be used in special applications where the designer has provided site-specific justification.

Although these are the "standard" practices, designers are encouraged to find innovative solutions that may provide better overall value to the department and road-user. Departures from normal practices should be justified and submitted to the department's Project Sponsor for approval. Design exceptions should be documented and filed on the project's design file for future reference.

9. Grading Design to include barriers/slopes

Designers are required to consider roadside design as part of the overall highway design task. This includes considering alternative methods of removing, offsetting or mitigating hazards preferably without the need for roadside barriers. Where barriers are required, designers should again minimize the road user's exposure to the barrier by offsetting the barrier system where possible. Suggested minimum offsets are identified in the Traffic Control Standards Manual (see Table 4, page 1-15) Greater offsets are preferred but barrier systems should be placed such that the typical errant vehicle will strike the barrier at the design elevation without the vehicle's suspension being overly compressed or extended. This generally requires a flat slope or long smooth (consistent) slope in front of the barrier. The barrier should be placed far enough ahead of the hazard to protect the vehicle even when the maximum design deflection occurs.

When designing offset guardrail the acceptable flare rate is a key design parameter. Current practice on department designs is to use the flare rates shown in Table 5 (page 1-16) of the Traffic Control Standards Manual. Where a flexible system is used the flare rates shown for "Semi-Rigid System" are acceptable.

In design of protection systems for culverts, designers should consider all feasible solutions including offsetting the culvert openings, installation of ride-over end treatments (where suitable) etc. Where flat slopes are used over culverts with low cover, designers should consider the additional loading that may occur due to vehicles parking on the slope or include features that will discourage or prevent parking over the culvert.

Designers are expected to use the various economic analysis tools available to assess the costs and benefits associated with the available alternatives and choose the optimum design for the location. Economic analysis shall include collision costs in addition to capital, maintenance and replacement costs for the agency.

10. Economic Analysis for Barrier Design

Currently Alberta Infrastructure follows the Benefit Cost Analysis Guidelines contained in the department's manual with the same title. For barrier design purposes the guidelines contained in TAC's Geometric Design Guide for Canadian Roads may also be used to estimate the safety impacts of various design choices.

11. Suitable slopes for deflection zone

It is recognised that many of Alberta's highways do not have a desirable flat slope through the deflection zone that is recommended for ideal operation of a barrier system. This has evolved due to the department's prior practice of designing the barrier systems after the roadway construction work was substantially completed. This design practice is no longer followed and therefore in current "new construction" design it is expected that suitably flat slopes be provided in front of the barrier system and in the deflection zone.

12. Barrier End Treatments

At this time designers are expected to use the standard turn-down end treatment in general for the end of all W-Beam barrier systems. Other types of end treatments, such as the buried end treatment, have been used on a trial basis in some locations however there has been no decision made yet regarding the adoption of more extensive end treatments for general use. This will be the subject of a future review.

13. Shy Distances

Currently Alberta Infrastructure follows the Shy Distance criteria as set out in the Traffic Control Standard Manual. This will be reviewed in light of the values recommended by TAC in their 1999 Guide.

14. 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 Technical Standards Branch (Attention: Bill Kenny, fax 422 2846).