TAC 2009 Road Safety Engineering Award

Nomination of
ALBERTA TRANSPORTATION HIGH-TENSION MEDIAN CABLE BARRIER PROGRAM

THE NOMINATED ROAD SAFETY ENGINEERING PROGRAM

EBA Engineering Consultants Ltd. wishes to nominate the **Median Cable Barrier Program of Alberta Transportation (AT)** for the 2009 Road Safety Engineering Award of the Transportation Association of Canada. Shown below is the cable barrier installation on Highway 2 in Calgary.

This submission briefly describes AT's overall road safety approach, and presents the details of the nominated program as required in TAC's call for nominations.

ALBERTA TRANSPORTATION'S APPROACH TO ROAD SAFETY

Enhancing road safety is a paramount objective of Alberta Transportation. The Department lists "Managing provincial transportation safety" as Core Business No. 2 among its four core businesses. Core Business No. 1 is "Developing and preserving the provincial highway network". To ensure that the required organizational effort is devoted to safety, the Department has a dedicated Transportation Safety Services Division headed by an Assistant Deputy Minister. The division includes an Office of Traffic Safety, which manages AT's safety plans and coordinates province-wide transportation safety initiatives. Reflecting the importance given to safety in the Department,

the Office of Traffic Safety reports functionally to the Deputy Minister, although administratively to the Assistant Deputy Minister of Transportation Safety Services.

AT's "Alberta Traffic Safety Initiative" has been in place since 1996. In 2003, AT commissioned an independent review of the Alberta government's traffic safety programs, which included very extensive consultations with stakeholders. The result was the June 2004 McDermid Report, "Saving Lives on Alberta's Roads: Report and Recommendations for a Traffic Collision Fatality and Injury Reduction Strategy".

In response to the McDermid Report, and building upon the 1996 Alberta Traffic Safety Initiative, in 2006 AT implemented an ambitious initiative titled "**Alberta's Traffic Safety Plan: Saving Lives on Alberta's Roads (TSP)"**, a comprehensive strategy designed to reduce traffic-related deaths and injuries in the province. The TSP directly supports Canada's national Road Safety Plan, Road Safety Vision 2010.

The TSP contains ambitious, quantitative overall targets, as well as several sub-targets, that focus on specific, critical areas of road safety. The plan identifies **10 targeted areas**:

1. Unbelted occupants and occupant restraints
2. Impaired driving
3. Speeding
4. Intersections
5. Rural roadways
6. Commercial vehicles
7. Young drivers and riders
8. Vulnerable road users (pedestrians, cyclists and motorcyclists)
9. High risk and medically unfit drivers
10. Aging drivers

The TSP achieves results through plans and programs under **eight concurrent strategies**:

1. Leadership and coordination
2. Communications and advocacy
3. Aboriginal traffic safety
4. Education
5. Enforcement
6. Legislation
7. Research and evaluation
8. Engineering and infrastructure

To ensure that the strategies and actions of the Traffic Safety Plan are implemented in a timely manner, AT developed a target based three-year Alberta Traffic Safety Action Plan and annual operational plans for each of the years 2007/08, 2008/09, and 2009/10. The action and operational plans for 2011/12 to 2013/14 are currently being developed.

The highlights presented above demonstrate that AT's road safety approach is methodical, stakeholder/user-centred, comprehensive, integrated, results-based, and cost effective. Utilizing this approach in its safety plans, AT has implemented hundreds of road safety projects resulting in tangible improvements. Thus, the number of traffic fatalities decreased 10.5 per cent in 2008 compared to 2007 (from 458 fatalities in 2007 to 410 in 2008). This means that 48 fewer people were killed on Alberta roads in 2008. As well, the number of traffic injuries decreased 10.3 per cent, from 24,530 injuries in 2007 to 22,015 in 2008 – the lowest number of injuries since 1995.

HIGH-TENSION MEDIAN CABLE BARRIER PROGRAM

Introduction

Alberta's provincial highway network has 31,000 km of which 2,335 km are multi-lane divided highways. The subject of this nomination is the program, that AT has implemented under the "engineering and infrastructure" strategy (Strategy No. 8 in the above list), of installing pre-stretched, post-tensioned, high-tension median cable barriers on high volume divided highways with relatively narrow medians. The program is consistent with Canada's Road Safety Vision 2010.

The purpose of the program is to prevent fatalities and serious injuries caused by vehicles crossing over the median into the opposing traffic lanes. To date, the following three median cable barrier projects totalling 144 km have been/are being installed on Alberta Highway 2, the main primary highway between Calgary and Edmonton.

HIGH-TENSION MEDIAN CABLE BARRIER PROJECTS IN ALBERTA

PROJECT LOCATION ON HIGHWAY 2	YEAR	LENGTH km	AADT Vehicles/day	MEDIAN WIDTH (shoulder line to shoulder line)	MEDIAN SIDE SLOPE
Deerfoot Trail, Calgary	2006/07	11	140,000 to 160,000	16.1m to 30.5m	6H:1Vor flatter
Through Airdrie	2009/10	8	60,000	22.6m	6H:1V
Airdrie to Red Deer, and at Leduc	2009/10	125	25,000 to 60,000	6.9m to 26.2m	4H:1V to 6H:1V

In addition, a short section of median cable barrier was installed at the Highway 16/Highway 21 interchange east of Edmonton.

Research

In keeping with its methodical approach, before embarking on the median cable barrier program in 2005 AT commissioned a study which analyzed the crossover collision record on Deerfoot Trail (Highway 2) within the City of Calgary, compared the advantages and disadvantages and economics of various barrier types, and recommended that a cable-and-post median barrier system would be most cost-effective. As part of the preliminary engineering and design study for the 11 km Deerfoot Trail project, commissioned in 2006, extensive research was conducted into the available high-tension median cable barrier systems and their suitability for the project.

High-tension cable barriers are available with three or four cables of pre-stretched steel ropes strung on weak steel posts; when the cable barrier is hit by an errant vehicle, the posts break off at the ground level. After installation the cables are post-tensioned to a designated tension level. The anchors at either end of a run of cable barrier, tied into strong foundation blocks of concrete or driven steel, take the tension. The posts can be driven into the ground, or placed in sockets in

concrete/driven-steel foundations. When an errant vehicle hits a high-tension cable barrier, the high tension cables absorb the energy of the impact and cushion the vehicle rather than deflect it back into the traffic stream as is the case for more rigid barriers. They retain their tension after a hit and can take additional hits, unlike low tension cable barriers.

The 1993 "NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features" published by the US Transportation Research Board's National Cooperative Highway Research Program, partly supplanted by the 2009 Manual for Assessment of Safety Hardware (MASH) published by the American Association of State Highway and Transportation Officials, defines six test levels (TL) for longitudinal highway barriers: TL-1, TL-2, and TL-3 tests involve two test vehicles, an 820 kg car and a 2,000 kg pickup truck. TL-4 test adds a third vehicle, an 8,000 kg single-unit truck. TL-5 substitutes a 36,000 kg tractor/van for the 8,000 kg single-unit truck in the TL-4 test, and TL-6 substitutes a 36,000 kg tractor/tank trailer for the 8,000 kg single-unit truck in the TL-4 test. No TL-5 and TL-6 level cable barriers are yet available. For the Deerfoot Trail project, a TL-4 median cable guardrail barrier was specified.

Proprietary cable barrier designs are tested by independent laboratories, on the basis of which the US Federal Highway Administration (FHWA) issues letters of approval indicating the maximum cable barrier deflection, post spacing and other conditions, guidelines and caveats under which the approved barriers can be used.

A highlight of the research phase was a workshop in Calgary involving AT staff, the design consultant, the safety audit consultant, three proprietary cable barrier manufacturers/suppliers (Brifen, Gibraltar and Trinity), and the Deerfoot Trail maintenance contractor. The purpose was to discuss the various technological, design, safety and maintenance factors taking into account the local characteristics of the highway section where the cable barrier was to be installed.

Innovation

With 144 km of high-tension median cable barrier installed/underway, Alberta Transportation is clearly the pioneer in Canada for this road safety measure. The 11 km installation on the Deerfoot Trail in Calgary completed in May 2007 was the first major high-tension median cable guardrail project in Canada. The province of BC installed a 3 km high-tension median cable barrier on Highway 1 through Chilliwack in the spring of 2007, and is planning a 3 km installation on Highway 99 south of Vancouver in 2010. To the best of our knowledge, no other Canadian province appears to have installed high-tension cable barriers. Contacts with the officials of the ministries of transportation in Quebec and Ontario indicated that neither province has yet installed median cable barriers, although Ontario has installed roadside high-tension cable barriers at three locations.

The challenge was to eliminate cross-over collisions with an innovative median traffic barrier that would be as effective as, but more economical and forgiving than, the other barriers used on Alberta highways. The innovative adaptation of the design and installation of the cable barrier on Alberta Highway 2 projects had to meet many challenges, including among others, compliance with the FHWA approval conditions (which vary for different products, and are dependent on the median side slope); and the maximum design deflection and post spacing of the proprietary cable barrier systems. These overall conditions must be met while accommodating: the unique local characteristics of the site; one barrier or two to protect both directions of travel; safe placement of the barrier on median slope or centre; minimizing breaks in the barrier.; the requirement to stop cars and pickups as well as single unit trucks; protection of currently unprotected hazards (e.g. overhead

sign structures); tie-in to or bypassing of existing guardrails protecting hazards (e.g. bridge piers); ease of installation; and ease of maintenance. These challenges were successfully addressed through extensive research and a collaborative approach among the consultants, Alberta Transportation, cable barrier manufacturers/suppliers, the maintenance contractor, and the construction contractor.

The high-tension cable barrier is a relatively new concept in Canada. Alberta's installations have demonstrated innovative ways to adapt this technology to accommodate local requirements and conditions. The end result is a cable barrier design and installation that has already saved lives, and can be considered to have set a benchmark and template for future such installations in Canada.

AT's cable barrier initiative has **won several national and provincial awards**:

- The paper "Design of a TL-4 Median Cable Barrier for Deerfoot Trail, Calgary" was awarded the C.W. Gilchrist Medal for the best technical paper in the field of highway transportation presented at the 2007 Annual Conference of the Transportation Association of Canada, thus recognizing the groundbreaking, innovative merits of the project.
- In 2009, an independent panel awarded the Deerfoot Trail cable barrier project the Alberta Transportation Minister's Award for Technical Innovation.
- In February 2010, the Deerfoot Trail cable barrier project won a Consulting Engineers of Alberta Showcase Award.

Safety Benefits and Cost-effectiveness

During the 34 month operation (May 2007 to February 2010) of the median cable barrier on the Deerfoot Trail, there were 135 incidents of vehicles hitting the cable barrier resulting in the replacement of posts, hairpins and/or lock plates. No crossover fatal collisions occurred in these 34 months (nearly three years), compared to seven fatal crossover collisions in the seven year period 1999 to 2005 on the same section of the Deerfoot Trail. (The photo below shows a pickup truck stopped by the high-tension cable barrier on the Deerfoot Trail).

This result is generally consistent with the experience with cable barriers in the United States, where crossover fatal collision reductions of up to 100% have been reported (as reported by selective US states on http://tig.transportation.org/?siteid=57&pageid=2197).

The supply and installation cost of Deerfoot Trail cable barrier was $92/m in 2007 dollars. This compares to the provincial average 2007 cost of $125/m for W-Beam Strong Post Guardrail (1.4 times the cable barrier cost), and $308/m for Concrete Barrier (3.3 times than the cable barrier cost). Comparative maintenance and repair costs (excluding traffic accommodation) of the various barrier types on the Deerfoot Trail itself during the 2007/2008 fiscal year were: Cable Barrier, $4.14/m; W-Beam Guardrail, $6.74/m; Thrie-Beam Guardrail, $17.54/m; and Concrete Barrier, $1.72/m.

Median cable barriers nearly eliminate crossover fatal collisions, and in terms of other collision types they significantly reduce the number of severe injury crossover collisions, but tend to increase the number of property damage collisions because some errant vehicles which now hit the cable barrier might have recovered themselves if the barrier had not been present. Since the economic costs of fatal and serious injury collisions are much higher than property damage collisions, the overall economics of median cable barriers are highly favourable. Thus, a 2005 report by Washington State Department of Transportation, which analyzed the before and after crossover crash data for 58 miles (94 km) of low-tension or high-tension cable barrier installations, concluded that the societal benefit of cable median barriers was $420,000 per mile ($260,000 per km) annually (http://www.transportation.org/sites/aashtotig/docs/Washington%20State%20TIG%20CMB%20Presentation%20(2005).pdf).

In Alberta, the benefit/cost analysis conducted as part of the 2008 pre-engineering study for the Airdrie to Red Deer/Leduc section on Highway 2 (using a TL-4 four-cable high-tension median barrier and a 20-year analysis period), showed a net present value of $32.1 million, an internal rate of return of 19.7% and a payback period of six years.

Other Benefits

The length of time to perform repairs and maintenance on the cable barrier is much less than for other barrier systems; most repairs take less than three hours and are normally performed on the same day as the barrier is hit. The cable barrier is visually pleasing, does not obstruct the drivers' view. Unlike beam guardrails or concrete barriers, the cable barrier does not act as a snow fence.

Applicability and Transferability

The high-tension cable barrier technology, and AT's research and design innovations for adapting it to local project characteristics and conditions, are directly applicable in other jurisdictions in Canada. AT has always been enthusiastic in sharing its innovations with other jurisdictions, and encourages publication of papers based on its projects, thus making the results available to a wide audience of potential users.

Organizational and Funding Support

AT has shown firm and consistent commitment and support for the median cable barrier technology. Within a year of the Deerfoot Trail installation, AT recognized the life saving results and cost-effectiveness of median cable barriers, and authorized funding for the two additional cable barrier projects listed above. AT is considering additional cable barrier installations on other sections of Highway 2 and on other high volume divided highways in the province.

CONCLUDING COMMENT

Alberta Transportation's cost-effective program of high-tension median cable barriers has already saved lives, and can serve as a model of innovative adaptation and applicability in other Canadian jurisdictions. EBA Engineering Consultants Ltd. believes that the program is a fully deserving candidate for the 2009 Road Safety Engineering Award of the Transportation Association of Canada.

Respectfully submitted,

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