I-395/Route 9 Transportation Study
Preferred Alternative's Design to Incorporate a Centerline-Cable-Barrier

A centerline-cable-barrier separating lanes on a 2+1 road in Sweden.
http://en.wikipedia.org/wiki/Cable_barrier

Alternative 2B-2 and the Centerline-Cable-Barrier:

This document introduces the ***"2+1" design*** adopted in Sweden ***for two-lane highways—a design utilizing a centerline-cable-barrier with alternating passing lanes.***

- ***A centerline-cable-barrier has been sanctioned by the MDOT Commissioner as part of the construction of alternative 2B-2 to minimize head-on collisions,*** a promise made to Carol Woodcock (Office of Senator Collins) as acknowledged in an April 8, 2013 email.

BUT—there will be no passing—apparently the recommended alternating passing lanes are not included in the cable-barrier design for 2B-2. It is presumed that the cable-barrier is designed for the full 6.1 mile length of the new pavement of 2B-2, but that fact has yet to be substantiated as this information has not been officially released to the public by the MDOT.

The I-395/Route 9 Transportation Study started with the premise to design a four-lane divided highway using freeway design criteria from I-395 in Brewer to Route 9 at the Eddington/Clifton border. The connector would initially be built as a two-lane undivided highway within a right-of-way large enough to add the extra two lanes in the future as safety and traffic required. The design retrogressed (downgraded in standards) sometime by October 2011 to a two-lane highway using freeway design criteria within a 200' right-of-way only large enough to support two lanes thus removing the future safety upgrade to a four-lane divided highway. I was told that the MDOT would save $1.0 million by reducing ROW.

This downgraded design initiated research into four-lane highways terminating into two-lane highways and the safety concerns with two-lane highways and head-on collisions. Carol Woodcock, determined to make sure this connector would at least be safe, voiced her concerns directly to the FHWA and the MDOT—based on excerpts from the report on pages 3-7 of this paper. (Complete report @ http://www.cti.uconn.edu/pdfs/ucnr15-5_ivan_final-report.pdf.)

- ***FOAA Documents indicate another downgraded design will be advanced following the conclusion of the National Environmental Policy Act process. That design will be a two-lane highway with the design standard downgraded from freeway criteria to rolling criteria within only a 100' right-of-way. (Another cost-saving retrograde in standards?)***

I normally wouldn't write a paper with such limited facts; however, I think it's important that this information, as limited as it may be, gets out there for you to decide if the centerline-cable-barrier without the alternating passing lanes is a good idea and if safety should ever be constrained by cost.

Was the MDOT/FHWA's decision not to integrate the recommended passing lanes simply a cost-savings measure? The combination of a rolling rural design within a decreased 100' ROW footprint and the centerline-cable-barrier without the addition of the recommended alternating passing lanes may cause traffic congestion and conflicting vehicle movements on this connector that would substantially increase the potential for new safety concerns and hazards.

THE EFFECT OF
SEGMENT CHARACTERISTICS
ON THE SEVERITY
OF HEAD-ON CRASHES
ON TWO-LANE RURAL HIGHWAYS

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PART II. ANALYSIS IN MAINE

ABSTRACT

More than two out of three of all fatal crashes in Maine occur on rural collectors or arterials and roughly 95% of the rural highways miles are only two lanes wide. Head-on crashes on these roads account for less than 5% of the crashes, but they are responsible for almost half of all fatalities. Data analyzed in this study was provided by Maine Department of Transportation and covers all head-on crashes for 2000 to 2002 during which period there were 3,136 head-on crashes reported. Out of these, 127 were fatal crashes and 235 produced incapacitating but not fatal injuries. These two categories make up about 90% of the crash cost. A clear majority of head-on crashes on two-lane, rural roads in Maine are caused by drivers making errors or misjudging situations. Fatigue is responsible for around one in 40 crashes and one in 12 fatal crashes. Alcohol or drugs is a factor in one in 12 crashes and one in nine fatal head-on crashes. An analysis of the primary cause of fatal head-on crashes shows that less than 8% involved someone overtaking another vehicle, and that, in total, only around 14% involved a driver intentionally crossing the centerline. Illegal/unsafe speed was a factor in 32% of these crashes while driver inattention/distraction was a primary factor in 28%. Two in three fatal head-on crashes occurred on straight segments and 67% of these happened on dry pavement, 10% on wet pavement, and 23% on snow covered or icy roadways. Among crashes on curves, 81% happened on dry pavements, 9% on wet pavements and 9% on snow covered or icy roadways. There is a clear trend towards higher speed limits leading to a higher percentage of crashes becoming fatal or having incapacitating injuries. There is also a clear trend—if one keeps speeds constant and AADT within a certain range—that wider shoulders give higher crash severities. Also, for higher-speed roads, more travel lanes (than two) increase crash severity. In summary, there seems to be two major reasons why people get across the centerline and have head-on collisions: a) People are going to fast for the roadway conditions; or b) people are inattentive and get across the centerline more or less without noticing it. The number of the latter category of crashes could possibly be reduced significantly if centerline rumble-strips where installed. More or less all head-on collisions could be eliminated if median barriers were installed. However, it would be difficult to find the funds for this or even to get acceptance among drivers in Maine. Reducing speed limits would be another positive measure but to do that across the board would again be politically difficult. Rather, today's speed limits should be better enforced—or enforced through photo enforcement and/or in-vehicle technology—since a high percentage of serious crashes involve illegal speeding. This could be combined with lower speed limits for a few targeted high-crash segments.

CONCLUSIONS AND DISCUSSION

A clear majority of head-on crashes on two-lane, rural roads in Maine are caused by drivers making errors or misjudging situations. It is a well-known fact that fatigue—and actually falling asleep—is a major reason for crashes on Maine's Interstates (Gårder and Alexander, 1994). But on two-lane roads, fatigue is responsible for only around one in forty crashes and one in 12 fatal crashes. Alcohol or drugs is a factor in one in 12 crashes and one in nine fatal head-on crashes. Only a small minority of head-on crashes occur because someone is trying to pass another vehicle (one in 19 crashes and one in 14 fatal crashes). Illegal or unsafe speed is a common factor contributing to almost every third crash whereas inattention/distraction is a factor in at least every second crash. Almost a third of head-on crashes occur on wintry roads.

There seems to be two major reasons why people get across the centerline and have head-on collisions: a) People are going to fast for the roadway conditions; or b) people are inattentive and get across the centerline more or less without noticing it. The number of the latter category of crashes could possibly be reduced significantly if centerline rumble-strips where installed.
A similar analysis from the mid 1980's of all fatal head-on collisions in North Carolina shows that roughly 50% were caused by inattentive or sleepy drivers crossing the centerline by mistake. Drivers losing control of their vehicles caused almost all of the remaining fatal head-on crashes. According to the crash reports in that study, drivers most commonly lost control of their vehicles by entering right-hand curves at too high a speed, which is likely to be influenced by the radius of the curve, the distance from the previous curve, and the roadway width. Other causes for unintended centerline crossings include over-correction after running off the right edge of the pavement, which may be affected by the design and quality of the pavement edge (presence of a paved shoulder, or poor grading of an unpaved shoulder). Interestingly enough, only a very small percentage of the North Carolina fatal head-on crashes were caused by intentional crossing of the centerline when overtaking slower vehicles. (Gårder, 1990)

Overall, the findings suggest that efforts to reduce the incidence of head-on crashes are best aimed at reducing unintentional crossings of the centerline, rather than improving information given to drivers about when it is safe to intentionally cross the centerline. In other words, improving passing sight distance and no-passing zone signage and pavement markings would not appear to have much potential for reducing the frequency of fatal head-on collisions. On the other hand, treatments such as installing centerline rumble strips or addition of a flush or raised median through horizontal curves show more promise for reducing this type of crash. However, the most effective treatment would probably be to install a continuous barrier along the centerline of two-lane roads, and to widen them up with an extra passing lane where appropriate. Adding an extra passing lane by itself, as illustrated in Figure II-4 (courtesy of the Swedish Road Administration), did for the above mentioned reasons not have much of a safety effect in Sweden and the potential safety benefits in Maine would also be minimal—even if it could provide substantial mobility benefits at times.

Figure II-4. 2+1-lane road

Figure II-5. 2+1-lane road with barrier

By more or less eliminating the shoulders, the pavement width of a three-lane road with a central barrier can be kept at 13.5 meters (44 ft) as shown in Figure II-6. Such roads—where the passing lane alternates between the two travel directions—have been constructed in Sweden since 1998. There were about 1,000 km (620 miles) of 2+1-lane roads opened to traffic in the summer of 2004. They all have cable barriers. Solid concrete barriers of New Jersey style could be an alternative where speeds are below 70 km/h (44 mph) whereas cable-barriers should be used at higher speeds since a collision with a cable-barrier typically does not injure the occupants of the vehicle. Traditional steel guardrails are said to have properties in between cable barriers and concrete barriers. The safety effect of these Swedish reconstructions has been better than expected. The number of injured people on these segments has been reduced by around 55% and fatalities have been reduced by 85%[7] compared to the before situation with two 12-foot lanes and 10-foot shoulders. The total number of property-damage-only crashes has increased somewhat. There is a slight (non-significant) increase in rear-end crashes and a large number of guardrail collisions in the after situation. The average frequency of center-barrier collisions is around 0.40 collisions per million vehicle-kilometers (0.64 per million vehicle-miles) on 90-km/h (56-mph)

[7] The percentage is somewhat uncertain but the reduction is impressive with 13 fatalities in the after situation compared to 87 fatalities expected had the before situation been kept. These 13 include two people killed in a moose crash. So far, there have been no fatalities from head-on collisions on the reconstructed sites.

roads and 0.56 collisions per million vehicle-kilometers (1.03 per million vehicle-miles) on 110-km/h (68-mph) roads. The cost of repairing the damages from approximately 3,000 barrier collisions[8] has been substantial—not least from a worker-safety perspective—but at this point, no serious injuries have occurred during these repairs while more than 40 fatalities in head-on collisions have been eliminated. The average repair costs are around 70,000 SEK per year and kilometer[9], or $14,000 per mile and year[10]. Also, plowing and snow-removal costs have increased by around 7,000 SEK per year and kilometer, or $1,400 per mile and year. Finally, with respect to attitudes, when the first segment was built, less than 1% of Swedish drivers thought the design idea was good. But within one year, 40% of users supported the design concept and now a majority likes these roads. A remaining problem is that some drivers with epileptic tendencies say they are bothered by the shadows cast by the posts and that motorcyclists[11] fear what could happen if they crash into the cable barrier. (Carlsson and Bergh, 2004)

To get a large number of center-barriers installed in Maine is probably unrealistic no matter how effective they may be. As noted above, Maine has 5,544 miles of numbered routes and if installing centerline barriers costs $68,000[12] per mile, 5,544 miles of roadway installations would cost around $377 million[13]. However, to have centerline barriers installed along some high-crash sections may be a realistic goal. Other sections could have continuous centerline rumble strips installed. For mobility reasons, two-lane roads with center barriers need passing lanes at regular intervals. An alternating passing lane and cable barriers can be provided within the footprint of a two-lane road with 10-foot wide shoulders if the shoulders are narrowed to about one foot each. However, bicyclists and other slow-moving traffic will frequently need wide shoulders to travel safely and 4-foot shoulders should still be provided if there aren't alternative routes for bicyclists. Also, if former shoulders are to be used as travel lanes, their bearing capacity must be upgraded to carry trucks.

To widen two-lane roads and provide extra travel lanes without providing center barriers seem to influence the crash severity negatively. And, if we keep AADT and speeds constant, there is a clear tendency that roads with no shoulders or narrow shoulders have crashes producing few serious injuries while roads with wider shoulders (7 feet or wider) give a higher risk of fatalities and incapacitating injuries. If we cannot put in center-barriers to 'eliminate' crossovers or

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[8] Typically, 10 to 14 posts need to be replaced. The passing lane is closed off while this work is undertaken

[9] Only about 10% of this cost has been carried by the Road Administration. 90% has been paid for through driver insurance

[10] This can be compared to an annual maintenance and repair costs estimated at $2,014/km for a similar cable system in the center of I-5 in Oregon according to "Three-Cable Barrier Makes I-5 Safer" in Oregon Department of Transportation Research Notes August 1998, which can be accessed at http://www.oregon.gov/ODOT/TD/TP_RES/research_notes/cable.pdf#search='cable%20barrier%20installation%20cost'

[11] Through 2004, there hadn't been any serious injuries among motorcyclists

[12] Washington State Department of Transportation News 2002 "I-5 Cable Median Barrier in Northern Clark County Saves Lives and Money," can be accessed at http://www.wsdot.wa.gov/news/dec02/median_barrier_clarkcounty.htm

[13] Maine Department of Transportation is budgeting $483 million for the entire program area Highways and Bridges for the fiscal biennium 2004-2005 according to the Biennial Transportation Improvement Program, Fiscal Years 2004-2005, Maine Department of Transportation

install centerline rumble strips to reduce involuntary crossovers caused by driver inattention, the most effective way of reducing crash severity, according to the data presented here, is to reduce speeds. However, it would be difficult to get acceptance among drivers in Maine for reducing speed limits across the board. And since two-thirds of all fatalities occur on straight segments, reducing the speed at sharp curves only would not be very effective. Rather, speed limits should be better enforced—or enforced through photo enforcement and/or in-vehicle technology—since a high percentage of serious crashes involve illegal speeding. This could be combined with lower speed limits for a few targeted high-crash segments.

- ***However, the most effective treatment would probably be to install a continuous barrier along the centerline of two-lane roads, and to widen them up with an extra passing lane where appropriate.*** (page 5)
- ***For mobility reasons, two-lane roads with center barriers need passing lanes at regular intervals.*** An alternating passing lane and cable barriers can be provided within the footprint of a two-lane road with 10-foot wide shoulders if the shoulders are narrowed to about one foot each. (page 7)
- ***To get a large number of center-barriers installed in Maine is probably unrealistic no matter how effective they may be. As noted above, Maine has 5,544 miles of numbered routes and if installing centerline barriers costs $68,000 per mile, 5,544 miles of roadway installations would cost around $377 million.*** (page 7) (in 2006 dollars)

Why were the alternating passing lanes not incorporated in the engineering design for alternative 2B-2 as advocated in this comprehensive 2006 report on the Severity of Head-on Crashes on Two-lane Rural Highways by the University of Maine's Department of Civil Engineering, the University of Connecticut and the Connecticut Transportation Institute?

- ***Has the MDOT consulted with the University of Maine on how the exclusion of alternating passing lanes affect the efficiency of a center-barrier (2+1) design?***
- ***What is the recommended passing interval for 6.1 miles of continuous roadway?***

- ***In my opinion, the reasons and concerns (bulleted below) MDOT/FHWA Transportation Professionals specified for removing the original 2B alternative from consideration in Jan2003, plus the addition of the centerline-cable-barrier without the recommended passing lanes, including the downgrade in design standard from freeway to rolling rural with the drastically reduced ROW will all lead to an unsafe condition for the full 10.3 mile length of the new connector from Brewer to Clifton. The many concerns documented in Jan2003 seem to be now totally disregarded by the same MDOT/FHWA Transportation Professionals still working on the project today.***
  - Alternative 2B ***would use approximately 5 miles of Route 9. Traffic congestion and conflicting vehicle movements on this section of Route 9 would substantially increase the potential for new safety concerns and hazards.***
  - ***The lack of existing access controls and the inability to effectively manage access along this section of Route 9, and the number of left turns, contribute to the poor LOS and safety concerns, and the inability of Alternative 2B to satisfy the system linkage purpose and need effectively.***

http://www.monroemonitor.com/2012/12/27/does-sweden-have-the-answer-for-u-s-2/

Does Sweden have the answer for U.S 2?

Safety activist proposes European cable barrier system

By Polly Keary, Editor

(Excerpts of article below)

On Sweden's national roads, such as this one seen near the city of Linköping, cable barriers and alternating passing lanes have been credited with a significant reduction in highway fatalities.

- ***Sweden has, since the 1990s, adopted a road system called a "2+1." That means that the road is mostly two-lane, but has passing lanes on alternating sides of the road. Down the center of those roads are high-tension cable barriers.***

The cable barriers are posts that are set into brackets. Unlike older cable barriers that flexed as much as 12 feet when struck by a speeding semi, these flex eight feet at the most.

- ***And when there is an accident, police can pull the posts out of the brackets and re-route traffic, so that accidents never cause the road to be closed.***
- ***Furthermore, unlike jersey barriers, they can be used on a sloped road, where pooling water might otherwise create a hazard.***

Indeed, studies do seem to show that the cable barriers have at least been quite successful in Sweden.

"The 2+1 system was estimated to eliminate 20 to 50 percent of all severe link accidents. The design was soon judged to be a major success," reads a 2005 U.S. Transportation Research Board Business Office report. And according to a Canadian study, cable barriers are not only effective at improving safety, they are cost-effective, too.

"This initial assessment of flexible barrier use predicts that major savings of up to 90 percent in death and serious injury can be achieved, with no evidence of increased road trauma for motorcyclists," it reads. "An estimate of the economic value of these savings is several times larger than the investment costs."

Are you <u>still</u> wondering why the MDOT has not completely adopted the comprehensive "2+1" concept? It appears that median cable barriers are highly effective in reducing head-on collisions but they require, for mobility reasons, alternating passing lanes to be installed at regular intervals—where are the 2B-2 passing lanes?

- Today's traffic encompasses drivers of diverse capabilities and all ages from 15 to 90 driving at varied speeds above and below the posted speed limit; add a few tractor trailers, some inattention and a little bit of road rage caused by the elderly gentleman ten cars ahead suddenly slowing down to 40 mph for no good reason—that is an accident waiting to happen, especially knowing there is no passing.

Many believe this project is completely money driven because of the marginally acceptable 1.1 Benefits-to-Cost Ratio and believe that the cost has been continuously and intentionally driven below the benefits to keep the project viable. Adding the cable-barrier of the "2+1" design without adopting the recommended alternating passing lanes seems to prove out that theory.

"Adding more miles to our transportation system in this current fiscal environment doesn't make financial sense," said <u>Bernhardt</u>, "Our responsibility going forward is to manage our existing infrastructure within our existing budget." With current funding levels stable at best, MaineDOT concluded that the expenditure of funds on new infrastructure was not justifiable. (8.01.11) http://www.maine.gov/tools/whatsnew/index.php?topic=DOT_Press_Releases&id=279591&v=article

The $61 million in state and federal funds that would be saved by cancelling the I-395/Route 9 Connector would be better spent on the <u>unmet transportation needs of our state</u>.

Thank you for your time and consideration of my views, Larry Adams