Are Trinity Guardrail End Caps Defective and Dangerous?

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Recently there has been considerable attention brought to bear on the performance of the energy-absorbing, guardrail terminals manufactured by Trinity Highway Products of Dallas Texas. It would appear that much of that attention developed from information released as a result of a law suit between Trinity and its competitor, SPIG Industries of Bristol Virginia. In the law suit, the President of SPIG, Joshua Harman, claimed that Trinity had designed its ET Plus guardrail in such a way that it began harpooning striking vehicles. It was further alleged that Trinity did not inform the U.S. Federal Highway Administration (FHWA) of this redesign and therefore the FHWA continued to approve the installation of the ET Plus throughout American highways. At present, the trial has to be re-tried and will commence in November, 2014. However the repercussions of a possibly defective end treatment to a very large number of the guardrails of North America and beyond, could be enormous if the allegations prove to be correct.

It has been reported that Trinity is a globally dominant producer of guardrail systems. Its earlier product, the ET-2000, was functioning well in the field. However, in about 2002 to 2005 it is alleged that the ET-2000 was redesigned to the current ET-Plus system which is alleged to be defective. The issue appears to be with respect to the width of a channel on the end of the guardrail through which the "W" rail is supposed to pass when the terminal plate is struck and displaced toward that rail. The original ET-2000 channel was 5 inches wide thus allowing easier motion of the rail through that wider channel. However, in Trinity's redesign it is alleged that the channel's width was reduced from 5 inches to 4 inches, effectively reducing the gap within which the rail could pass. This reduced gap caused the rail to become jammed within the channel creating a "harpoon" end point that would pierce through a striking vehicle.

The verbal description of the problem can be difficult to visualize therefore we conducted a brief inspection of a guardrail with similar features to the Trinity guardrail in London, Ontario, Canada. The guardrail we examined was located on the southbound off-ramp from the Highbury Avenue expressway onto Bradley Avenue in south London. Figure 1 provides a view of the west side of the ramp and the terminal end cap on the north end of that guardrail.

The westward, side view in Figure 2 may help to visualize the mechanism by which a striking vehicle causes the end plate to be driven against the "W" rail. As the end plate is displaced it rides on the rail and allows the rail to pass through its channel. The eastward view in Figure 3 provides a further indication of how the "W" rails rides within the channel.

Figure 1: View, looking south, at the north end of the terminal end cap of the guardrail on the west side of the exit ramp from the Highbury Ave expressway onto Bradley Ave in south London, Ontario, Canada.

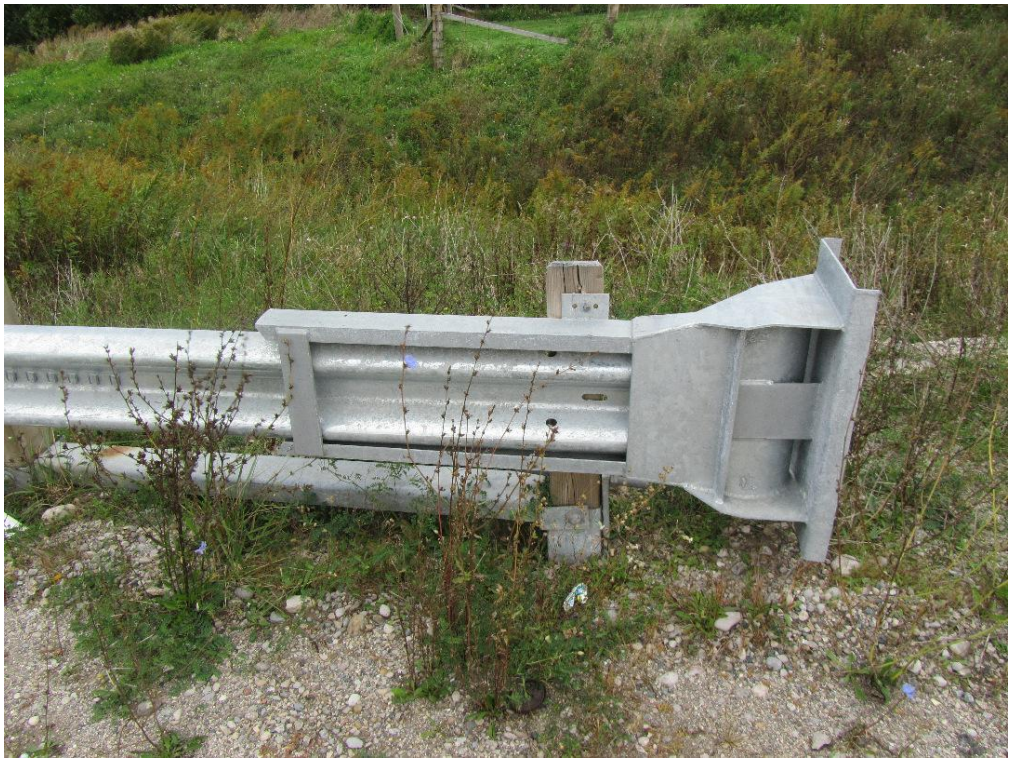

Figure 2: View, looking west, along the end plate and its channel through which the "W" section passes when the end plate is displaced by an impact.

Figure 3: Eastward view of end plate, channel and "W" rail.

Figure 4 provides a close-up view of the backside of the end plate showing a vertical, curved fabrication which is the mechanism that redirects the "W" rail sideways as it exits the channel.

Figure 5 shows a measuring tape spanning the gap of the channel within which the rail is to ride as the end cap and channel are displaced along the rail. We believe it is this gap that is the issue of the defect allegation. As shown in Figure 6 the measured gap of this channel is only 4 inches. So this would appear to be the newly, redesigned channel whose width was reduced from the original 5 inch gap. Yet, we are aware that this guardrail installation is not new. Certainly it existed before 2002 when the channel was allegedly redesigned. So why does it appear that we have the installation of a new end cap and channel?

The reason becomes apparent when we look at the length of the guardrail as shown in Figures 7 and 8. Notice that the "W" rail on the left (south) is darker and older looking than the portion to the right (north), near the end of the guardrail. It becomes clear that, over time, the guardrail has been impacted, damaged and replaced. The most recent replacement came at the north end of guardrail, and at that time the end plate was also replaced.

Figure 4: Close-up view of vertical, curved fabrication behind the end plate that redirects the "W" rail into a sideways orientation as the end plate is being driven along the rail.

Figure 5: View showing measurement being taken of the width of the channel.

Figure 6: Our measurement indicates that this channel is only 4 inches wide therefore it is the newly re-designed one that is the source of the detect allegation.

Figure 7: View of west guardrail showing the older section to the left (south) and the newer section to the right (north) indicating that the north portion, including the end plate, had been recently replaced.

Figure 8: View of the junction between the older and newer "W" rails indicating that the rail had been replaced and this explains why the newer (defective?) end plate was installed on this older system.

There was an interesting discovery when we turned to look at the east guardrail on the other side of the ramp, as shown in Figures 9 and 10. The immediate observation is that the front face of the end plate appears to be different.

Figure 9: View, looking south, at the east guardrail.

Figure 10: View of a possible missing face of the end plate on the east guardrail.

Figure 11 shows some scratches to the top surface of the end plate suggesting that there might have been an impact to it and that, perhaps, some kind of cover should have existed over the front face of the plate that no longer exists.

Figure 11: View of top surface of the end plate indicating some scratches from a possible impact and indications of a possible missing front cover.

Figure 12 shows how we took the same measurement of the width of the channel of the east guard rail as we did on the west guardrail. Figure 13 shows that the width is 5 inches.

Figure 12: View of measurement being taken of the width of the channel on the east guardrail.

Figure 13: Width of channel on east guardrail is 5 inches.

This suggests that the end plate and channel on the east guardrail are of the older system with the wider channel and that this end plate and channel had not been transferred to the newer (defective?) design.

So our review of the guardrails on the exit ramp from the Highbury Ave expressway shows that the guardrails were likely originally equipped with the end plates and channels described as the ET-2000, with the wider, 5 inch channel. Due to damage the west channel and end plate were replaced by the newer ET-PLUS system. The east guardrail maintained its originally-installed end plate.

We conducted a further inspection of this site using Google Maps and located an image from September, 2012. Figure 14 shows the Google Street View, looking south along the ramp and we can see the north ends of the east and west guardrails. Surprisingly, it can be seen that the ends of both guardrails are similar to that of the present condition of the east guardrail. From our observation, it would seem that a front face of each end plate is missing.

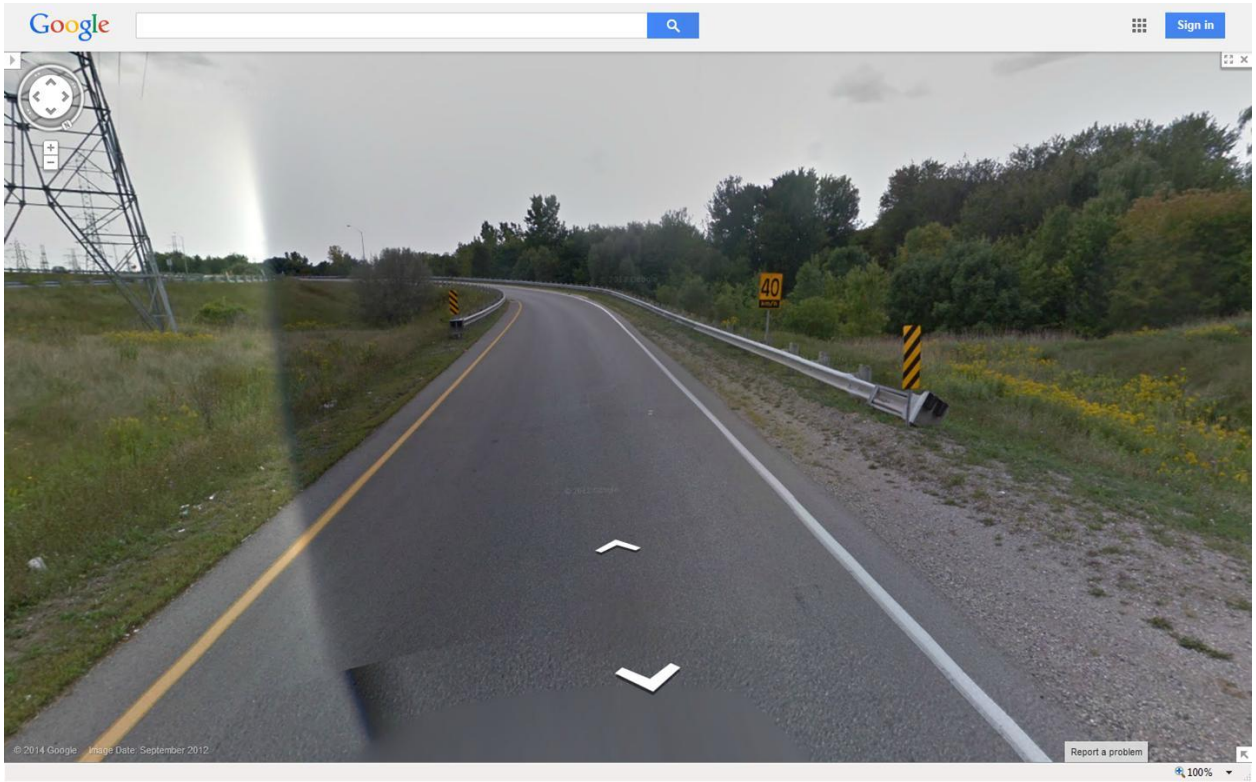

Figure 14: Google Maps view of the guardrails from September, 2012. Note that the ends of both guardrails may be missing a front cover on their end plates.

Figure 15 also shows a closer view from Google Maps of the end of the west guardrail and here we see that its end has been displaced and is at a substantial angle such that one corner is dug into the ground.

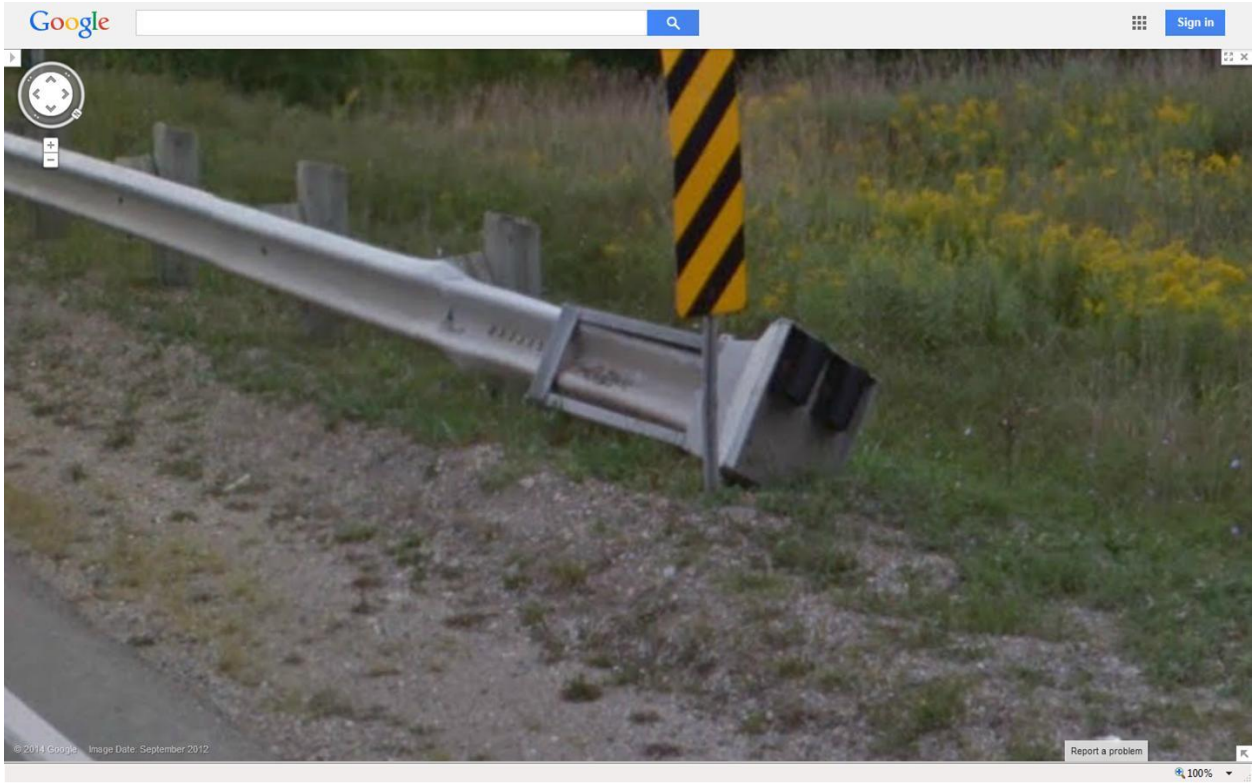

Figure 15: View of deformed end of the west guardrail from a Google Maps image taken in September, 2012.

Further inquiries need to be made whether the end caps shown in Figures 14 and 15 are missing a front cover that existed in the original design. Even without that information, clearly the deformed angle of the west guardrail could not be expected to function properly and could be a danger to the public.

In summary, this review provides some information about what problems may exist in the field. There can be a mixture of older and newer systems installed at any one site. It also shows that even if the proper, non-defective end plates and channels are installed they need to be maintained in order to work properly. It is clear that the west guardrail was in a state of disrepair as evidenced by the Google Maps image of September, 2012.

In the past we have attempted to draw attention to the fact that many horizontal installations can create a hazard of penetration or "harpooning" of a wayward vehicle. Our focus has been on chain link fences with horizontal pipes at their top supports. Those pipes have been known to harpoon a vehicle. However, another hazard has also been brought to our attention in the Kentucky horse regions where there are many fences installed with horizontal boards. A research paper presented a few years ago at an American Academy of Forensic Sciences meeting discussed the number of fatalities that occurred in the region when vehicles were harpooned by those horizontal boards. So the sources of the harpooning problems can be varied.

It becomes important that the trial in the Trinity versus SPIG manufacturers come to a proper and reasoned conclusion whether the redesigned ET-Plus system is defective or not. If it is defective then this presents an enormous cost to all the jurisdictions that have these defective installations as they may need to be replaced. This is a matter of large importance that, to date, has not reached the eyes and ears of the public.

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