

Delivering median barriers in narrow medians

Safe System
case study



SH1 Centennial Highway median barrier project

In mid-2004, following two head-on crashes that resulted in fatalities, public concern was reignited regarding the safety of the road.

As a result, on 23 August 2004 the speed limit was dropped from 100km/h to 80km/h and the challenge of installing a median barrier in this difficult environment began.

Around three months later, a 700 metre wire rope median barrier was installed separating north and southbound traffic in the area where the most recent fatalities had occurred. Physical works on the median barrier began on 26 October 2004, and on 22 November 2004, the \$1 million project was completed.

The safety performance offered by the median barrier became well established over the following two years and the public continued to advocate for the barrier to be extended over the remainder of the road.

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Flexible median barriers are a part of the Safe System approach to road safety

The Safe System approach aims to create a forgiving road environment that reduces harm when people make mistakes.

Flexible median barriers are described as a primary Safe System intervention because of their ability to eliminate the occurrence of fatal and serious injuries. By separating opposing traffic flows, while still retaining opportunities for overtaking where appropriate, high severity crashes are less likely to occur because road users are physically separated from opposing traffic flows with which they may otherwise have head-on collisions.

While the narrow median on Centennial Highway has resulted in an increase in maintenance costs due to impacts on the flexible median barrier, this cost has been significantly offset by reductions in trauma costs.

nzta.govt.nz/safety/safety-resources

Works to complete the remaining 2.8kms along this section began in September 2006 and were completed in October 2007, at a cost of \$14.5 million.

Road closures and delays caused by crashes result in significant disruption, often impacting significantly on commercial carriers.

Wire-rope barriers are made up of three or four tensioned wire cables supported by steel posts. They are known as flexible barriers because they stretch to absorb the force of the crash. The barriers use a dual mechanism to slow down and divert excessive force away from the people inside the vehicles. The ropes deflect and absorb the energy and the posts collapse, slowing down and redirecting the vehicle away from the hazard with very little rebound.

The wire rope barrier system used on the first 700m stage had been tested to international standards with a test level 3 (TL3) design deflection [3] of 1.9m at a post spacing of 2.0m and a design deflection of 2.5m at a post spacing of 3.0m [4]. With an offset of 0.75m between the median barrier and the centreline, this meant that deflection upon impact could extend into the opposing traffic lane. To minimise the amount of deflection, the post spacing was reduced to 1m. For the remaining 2.8km extension, the wire rope barrier post spacing was selected to achieve a maximum TL3 design deflection of 1.5m

There has been no evidence of any issues associated with potential deflection into the opposing lane from crash reports or from observations of performance during an impact.

Project challenges

Implementing physical changes to this section of highway presented a significant challenge.

The road extends through a narrow corridor carved between a rocky coastline and a steep hill range.

This physical constraint is compounded even further by a parallel railway line running along the hillside.

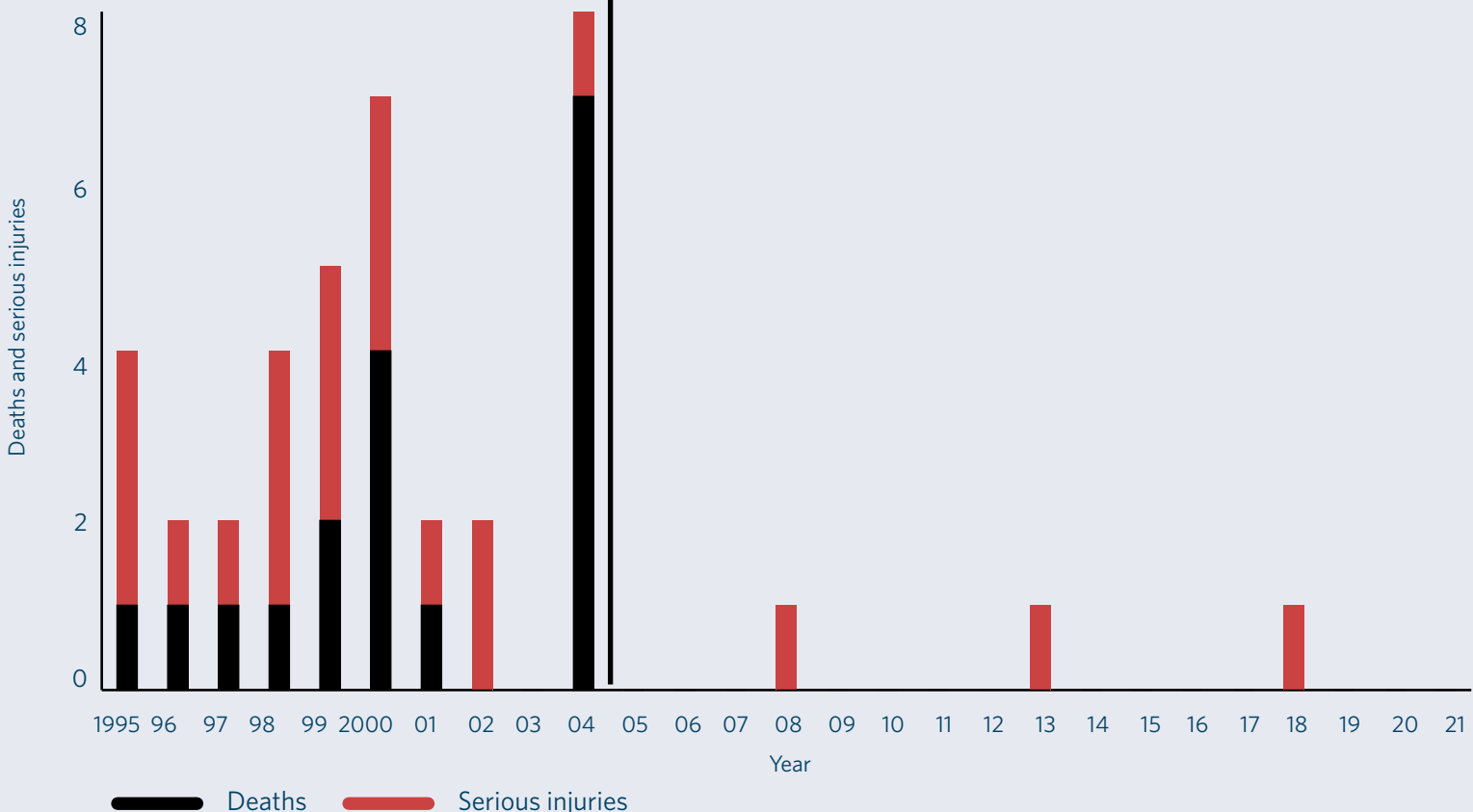
Around 22,000 vehicles use this section of highway each day.

Before median barrier:

18 deaths and 18 serious injuries in 10 years (3.6pa)

After median barrier:

3 serious injuries in 10 years (0.3pa)





Innovation led to a Safe System outcome

The typical standard width for a road of this type with a median barrier is typically 12 metres with 3.5 metre lane width, 1.5 metre sealed shoulders and a 2 metre median.

However, because of the physical constraints along this road corridor, it wasn't possible to provide a desirable standard width median treatment without huge cost. These physical constraints include a coastline and seawall on one side of the road and a steep rocky hillside on the other.

Investigation into different cross sections led to the choice of a 1.5m wide wire rope median with a slightly reduced lane width (from 3.5m to 3.25m), providing a minimum overall road width of 10m.

The solution needed to ensure a minimum width for each lane of at least 5m to enable two vehicles to pass each other in the event of a breakdown.



Safety performance

In the 10 years before the construction of the first 700m of median barrier, there were 13 fatal and seven serious injury crashes reported that resulted in 18 people being killed and 18 seriously injured. Of these crashes, 13 were head-on crashes. There have been no fatal crashes and no head-on crashes since 2004.



Cost and delivery timeframes

The first section of 700m of median barrier was installed over a three-month period at a total cost of \$1 million. The second section was installed over a 13-month period at a cost of \$14.5 million. The second section was far more complex requiring work to be completed, for example, to the sea wall, drainage and pavement widening.



Vehicle tracking

Comparison of footage from before and after the median barrier installation showed that drivers tended to travel more centrally within their lane with the median barrier in place. However, on the inside of a left hand bend, the proportion of drivers tracking to the left of their lane was generally higher, with a small increase in the number of vehicles cutting the left edgeline.



Barrier strike rate and maintenance costs

Work undertaken in Sweden predicted that there would be one barrier impact for every 1 to 2 million vehicle kms of travel. The initial observed rate was around one in every 1 million vehicle kms but appears to be dropping (Bergh, 1999). In our analysis, it was assumed the barrier will be hit once every 1.5 million vehicle kms – this means that the expected barrier impact rate would see the barrier hit on average once every 10 days.

The average impact along Centennial Highway resulted in 12 damaged posts at a repair cost of \$1356. This represents an average cost of \$11,644 per km a year for the initial 700m section and an average cost of \$7649 per km a year for the extended 3.5km section.

The maximum recorded repair cost was \$6345, which resulted in damage to 56 posts. For 90% of impacts, the damage was limited to 24 posts or less at a cost of \$2394 or less. All costs include traffic management.

The Centennial Highway experience was similar to that of Sweden – both countries experiencing increased maintenance costs associated with impacts on the wire rope median barrier.

Southbound observations

Before installation	After installation
<ul style="list-style-type: none">Majority of vehicles tracking along the centre of the lane (83%).Some vehicles tracking to the right side of the lane (17%).No vehicles tracking to the left side of the lane, cutting the edgeline or cutting the centreline.	<ul style="list-style-type: none">Proportion of vehicles tracking along the centre of the lane largely unchanged (84%).Slight decrease in vehicles tracking to the right side of the lane (10%).Vehicles tracking to the left side of the lane increased (6%).2% of vehicles cutting the edgeline, no vehicles cutting the median centreline.

Northbound observations

Before installation	After installation
<ul style="list-style-type: none">Majority of vehicles tracking along the centre of the lane (71%).Some vehicles tracking to the left side of the lane (28%).1% of vehicles tracking to the right.No vehicles cutting the edgeline or cutting the centreline.	<ul style="list-style-type: none">Some vehicles tracking along the centre of the lane (17%).Majority of vehicles tracking to the left side of the lane (83%).No vehicles tracking to the right side of the lane or cutting the median centreline.5% of vehicles cutting the left edgeline.



For more information:

Check out the Standard Safety Intervention Toolkit which details more about why, when and where this treatment may best be suited. www.nzta.govt.nz/resources/standard-safety-intervention-toolkit/

Check out this short video on median barriers. www.youtube.com/watch?v=bGbBiW6Fhz0