REFINING RAISED SAFETY PLATFORM DESIGN FOR AUCKLAND

(This paper has been peer reviewed)

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ABSTRACT

Raised safety platforms (RSPs) can be controversial for communities, but they have proven their effectiveness for safety and accessibility. It is essential to ensure that they can meet all user needs so that they can continue to be used effectively.

Many RSPs have been installed across Auckland's urban streets over many years. Initially, they were installed as speed tables to manage speeds on collector and local streets where speed and volume of traffic was felt to be excessive. More recently, they have been used more on local residential and collector streets to support 30 and 40 km/h design speeds, at intersections for safe crossings and at mid-block crossings on arterial roads with a high risk of death or serious injury.

Concerns with noise and vibration at some sites and excessive severity of ramps led to further research. Auckland Transport Design Manual Practice Note PN-02 Use of raised devices on the AT Network Edition 2 provides a guide to design and construction of RSPs that responds to issues of actual effects and public acceptance.

This paper covers:

- Deaths and Serious Injuries saved by RSPs in Auckland
- Response to customer issues (Design and construction problems; Noise and vibration issues; Emergency vehicle response effects)
- Research of profiles using track tests, dynamic modelling and drone surveys
- Development of Edition 2 (Conditions for use – policy development; Profiles; Design & Construction including site surveys; Standard Engineering Details)
- Better, Faster, Cheaper approach (In-situ concrete, Pre-cast Concrete, Asphalt, Rubber)
- Some innovative examples to support accessibility:
    - Wheelchair-friendly crossing on a steep street
    - Swedish table without refuge island
    - Side-road RSP for narrow berm with cycleway and footpath
    - Remedial treatment for height and grade problems

INTRODUCTION

Raised safety platforms (RSPs) can be controversial for communities, but they have proven their effectiveness for safety and accessibility. It is essential to ensure that they can meet all user needs so that they can continue to be used effectively. Many RSPs have been installed across Auckland's urban streets over many years. Initially, they were installed as speed tables to manage speeds on collector and local streets where speed and volume of traffic was felt to be excessive. More recently, they have been used more on local residential and collector streets to support 30 and 40 km/h design speeds, at intersections for safe crossings and at mid-block crossings on arterial roads with a high risk of death or serious injury.

Concerns with noise and vibration at some sites and excessive severity of ramps led to further research. Auckland Transport Design Manual (TDM) Practice Note *PN-02 Use of raised devices on the AT Network Edition 2* provides a guide to design and construction of RSPs that responds to issues of actual effects and public acceptance.

This study sets out the issues encountered by Auckland Transport (AT) in using RSPs on all classes of road managed by AT and the research and development of our design standards to meet Better, Faster, Cheaper objective of Auckland Council.

Figure 1: Swedish RSP (Photo: AT, 2024)

Figure 2: Overnight installation of Pre-cast concrete RSP (Photo: Fulton Hogan, 2023)

DEATHS AND SERIOUS INJURIES SAVED BY RSPS IN AUCKLAND

In 2019 Auckland Transport (AT) responded to the high level of deaths and serious injuries occurring on local roads of all categories by seeking opportunities for quick actions. A Mass Action Pedestrian Improvement (MAPI) programme of RSP installation at high-risk pedestrian crossings was enacted. A total of 37 pedestrian crossings were treated. There were 21 injury crashes reported at these crossings over 5 years, of which 8 were death or serious injury (DSI). Since then, no deaths or serious injuries have occurred at those crossings. Mistakes have led to seven crashes, all involving minor injuries mostly involving small-wheel devices, showing the effectiveness of the RSP installations to achieve Vision Zero outcomes reliably.

As this programme was carried out at pace, designs were developed and approved concurrently, generally using 100 mm high RSPs with 1:10 or 1:15 ramps following standard design for traffic calming in the TDM. It was soon found that this profile was not suited to application to isolated mid-block crossings on arterial roads. This led to the publication of *Raised Safety Platforms (Speed tables) – Practice Note 02* in August 2022. This set out a range of profiles for use in different situations, based on experience with pilot designs adopted in the later stages of MAPI and referring to international best practice and providing design guidance.

RESPONSE TO CUSTOMER ISSUES

Nearly 3000 vertical devices including raised intersections, speed tables, speed humps and speed cushions are recorded in Auckland Region. Of those, 177 are on arterial roads and 1206 are on collector roads.

Customer complaints that have been received by AT have mostly related to RSPs on these higher-traffic volume roads, particularly used by trucks travelling at higher free speeds. AT has responded to these issues by investigating the sites where complaints have been received. In several cases, the RSPs have been found to exceed construction tolerances. Often this is due to the irregularity of the existing road surface in the vicinity of the RSP or misinterpretation of the design standards. In other cases, it was found that the traffic conditions had not been understood by designers or that the standard applied resulted in performance that could not be accepted by road users or by the occupiers of properties close to the site.

At several sites, RSPs have been removed, replaced with alternative treatments or altered to reduce the adverse effects. Observations and research, together with reference to more recent published design guidance, led AT to revise our standards for all raised devices used on roads under AT control.

DESIGN AND CONSTRUCTION PROBLEMS

Application of standards in design and construction

It was found that designers often did not provide sufficient detail to contractors to ensure that the correct profile was achieved on site or that the RSP had been checked after construction to meet the design standards. Awkward changes of gradient or crossfall and kerb edge detailing made some RSPs difficult to form, so that ramps were higher or steeper in places than intended.

Noise and vibration issues

In addition to cases of discomfort for road users, some RSPs were found to generate noise and vibrations affecting people living in buildings close to the site. This problem had not been evident for the majority of raised devices used on local streets as part of area traffic calming measures. It arose mostly at mid-block sites with higher approach free speeds and use by trucks other than the waste collection and occasional deliveries common on local residential streets.

AT has responded to complaints by firstly visiting the sites, surveying the profiles and following up in several cases with vibration testing in rooms reported to be affected by vibration. These tests have substantiated several complaints, although others have been deemed to fall within permitted levels using international standards.

One factor that appears to contribute to propagation of vibration is the road pavement structure. Typical New Zealand thin flexible pavements, especially combined with soft and clayey subsoils and groundwater, are not well suited to absorbing the energy of the vertical impact loads.

New Zealand house construction that is made flexible to meet earthquake design standards leads to vibration transmission not necessarily encountered in other regions. Homes built on slopes below the level of ridge roads are also more susceptible to vibration transmission. We have specified that the soil conditions should be examined to determine if there is a high risk of soft conditions. Mapping of areas of peaty soils and high groundwater levels, typical to the Takanini swamp area and former estuaries, enables some areas to be ruled out for vertical features, except for some newly-constructed roads where deep sand carpet pavement has proven capable of strong roads where raised features have not caused problems. Local knowledge from Building Consents can sometimes identify conditions that indicate a high risk of vibration.

To counter the problem of weak pavement at the site of raised devices, we have specified that the construction of devices should include strengthening of the pavement under and adjacent to the device. This does add to the cost of installation, but it does give a greater likelihood of reducing effects to an acceptable level. Standard Engineering Drawings published in TDM show suitable pavement designs for raised devices to simplify project design.

Emergency vehicle response effects

Concern regarding emergency vehicle response times has been expressed by Fire and Emergency NZ and St. John Ambulance. AT has undertaken research to identify appropriate design standards to ensure that use of RSPs does not lead to this unintended consequence.

The profiles now adopted have been verified for acceptable performance for emergency vehicles. However, there have been reports that traversing RSPs at speed can cause damage to ladders carried on FENZ vehicles, so we see that care should be taken to manage the number of devices that will be encountered when responding to an emergency call-out.

RESEARCH INTO THE ISSUES

Track tests

Early research focussed on comfort for bus passengers, as more and more RSPs were being planned on bus routes. An in-house AT test project was carried out. Several different profiles of table were constructed in a depot of maintenance contractor Fulton Hogan. Volunteers sat in various positions on three different types of bus, equipped with mobile phone accelerometers positioned on the bus structure next to their seats. Readings from these were processed to give speed and vertical acceleration traces, combined with subjective comfort ratings, while video recordings of the buses crossing the platforms were made. From this, table-top lengths, ramp gradients and heights were chosen that could be specified for bus routes.

Dynamic Modelling

WSP used their PC-Crash™ dynamic modelling for AT in 2023. A confidential report modelled a range of vehicle types including cars, buses, trucks and fire appliances crossing a variety of profiles. Vertical acceleration and impact loading were reported to assess comfort, effect on speed behaviour and pavement loading. This enabled AT to update the profile and pavement specifications with greater confidence in their suitability for different vehicle types and probable vibration generation.

Drone surveys

Construction of RSPs across the road network including arterial and collector routes has led to concerns over route productivity due to delays caused by isolated RSP crossings. To investigate the effects of RSPs on vehicle speeds at crossing locations, Eliga carried out a series of drone video surveys at 15 RSP locations across the network. Various road categories, site contexts and RSP profiles were carried out. Profiles were surveyed in detail. The videos were analysed using AI to produce approach and departure speed and time profiles. Delays averaged 2.5 seconds.

DEVELOPMENT OF THE PN02 SECOND EDITION

Conditions for use – policy development

Concerns from public and politicians led to a governance decision to be specific about where various types of vertical devices should be used in Auckland. Practice Note PN-02 Edition 2 was expanded to provide the standards that should be applied when deciding on devices for different categories of road. This limits use on strategic network roads. The requirement for Departure from Standard application allows each case to be reviewed for approval at a high level of delegation, while permitting devices in the situations accepted in the Policy table.

PN-02 Ed 2 (see References) states:

Speed controls must be considered holistically and in line with the function of the street shown in Future Connect and mapped AT GIS.

It is a requirement that alternative speed management tools such as horizontal speed controls be considered as the preferred option first, before raised devices can be proposed.

Raised devices may be considered in any of these locations below and where raised devices are considered an important element to achieve the viability and objective of the project; Departure from Standards approval may be required as shown:

- *near marae and educational facilities and major transport hubs*
- *within the boundary of a recognised metro, town, or local centre (Roads and Streets Framework – High place value (P3))*
- *Locations that have an assessed safety risk (see Appendix 1), where alternative safety improvement tools are not deemed available and where incremental benefit from phased project implementation is not deemed applicable.*

When implemented, raised devices should achieve a mean speed of 40 km/h on arterials over the device with 30 km/h accepted on collectors and local roads where the traffic volume is less than an AADT of 5000 and HCV below 3%.

Arterial Roads **Frequent and Strategic Bus Network** **Level 1 Freight Network** **Strategic Freight Areas** **Emergency Lifeline Routes**	Raised devices may not be used on these roads. A Departure from Standard must be requested in any of these locations if raised devices are considered an essential element to achieve the objective of the project: When implemented they should achieve a mean speed reduction of 10 km/h at the device.
Other Collector Roads	Raised devices are permitted if they are designed to achieve a mean speed of 40 km/h over the device with

	30kmh accepted on collectors where the traffic volume is less than an AADT of 5000 and HCV below 3%.
Other Local Roads	Isolated devices on local roads must be designed to achieve a mean speed of 30km/h. Effect of all devices on availability of on-street parking must be considered.

Table 1: Policy from *Practice Note 02 Use of raised devices on the AT Network Ed 2*

This policy has allowed vertical devices to continue to be installed in suitable places to achieve safety outcomes without unduly affecting vehicle traffic, especially where other safety treatments are not feasible a design mean speed of 40 km/h on high-use roads is considered reasonable to achieve safety outcomes. This is supported by the speed measurements and safety records at the MAPI treatment sites. 30 km/h is still used for low volume roads and within traffic-calmed areas.

For the present, the formal Report, Review and Approval process of Departure from Standard allows each case to be tested to ensure that it is safe for all users, effective in enabling users' journeys and activities and fitting in terms of consistent appearance and contribution to the overall form and function of the street it is on.

Profiles

The profiles that AT has found to be suitable for different circumstances under this policy are shown in Table 2 and 3. Swedish departure ramps are recommended for use wherever possible as they are found to be significantly more suited for heavy vehicles and particularly in mid-block applications. Standard departure ramps, matching the approach ramps, can be used on side roads at intersections where turning speeds are low and where road width does not allow Swedish ramps to be used.

Arterial Roads, Frequent and Strategic Bus Network, Level 1 Freight Network, Strategic Freight Areas, Emergency Lifeline Routes	**To be used by departure from standard only:** • 75mm high speed cushions used for channelising flows on the approach legs to roundabouts that cannot achieve the correct entry speed criteria. • RSP Type 1S, 1, 2S, 2, 3S or 3
Other Collector Roads	• 75mm high speed cushions used for channelising flows on the approach legs to roundabouts that cannot achieve the correct entry speed criteria. • RSP Type 1S, 1, 2S, 2, 3S or 3 • RSP Type 4S or 4 on a Collector Road terminating at a priority control intersection where there is a pedestrian or cycle crossing (by departure from standard only) • 75mm high sinusoidal speed humps • Horizontal speed controls as defined in the Transport Design Manual: Engineering Design Code – Traffic Calming
Other Local Roads	• Horizontal speed controls must be considered first. • 100mm high sinusoidal speed humps • Isolated crossings and crossings on traffic-calmed streets: RSP Type 4S or 4

Table 2: Device selection from *Practice Note 02 Use of raised devices on the AT Network Ed 2*

Type	Approach Speed (4) (km/h)	Profile (1)				
		Nominal grade change	Approach ramp	Top (2)	Departure ramp	
					Swedish (3)	Standard
1S	70 - 80	1:25	1875 x 75	6000	4500 x 75	
1	70 - 80	1:25	1875 x 75	6000		1875 x 75
2S	60	1:20	1500 x 75	6000	3000 x 75	
2	60	1:20	1500 x 75	6000		1500 x 75
3S	50	1:15	1125 x 75	4000	3000 x 75	
3	50	1:15	1125 x 75	6000		1125 x 75
4S	<50	1:15	1500 x 100	4000	4000 x 100	
4	<50	1:15	1500 x 100	6000		1500 x 100

1. Ramp profiles are given as length and height in mm relative to the mean gradient of the road surface over a length of 2.0 m adjoining the ramp.
2. Top dimension may be extended through an intersection if the entire intersection is to be raised.
3. Swedish table profiles: Departure ramp length is the minimum; height is the maximum.
4. Approach speed may be either a posted speed limit or a measured or predicted operating speed.

Table 3: RSP Profiles from *Practice Note 02 Use of raised devices on the AT Network Ed 2*

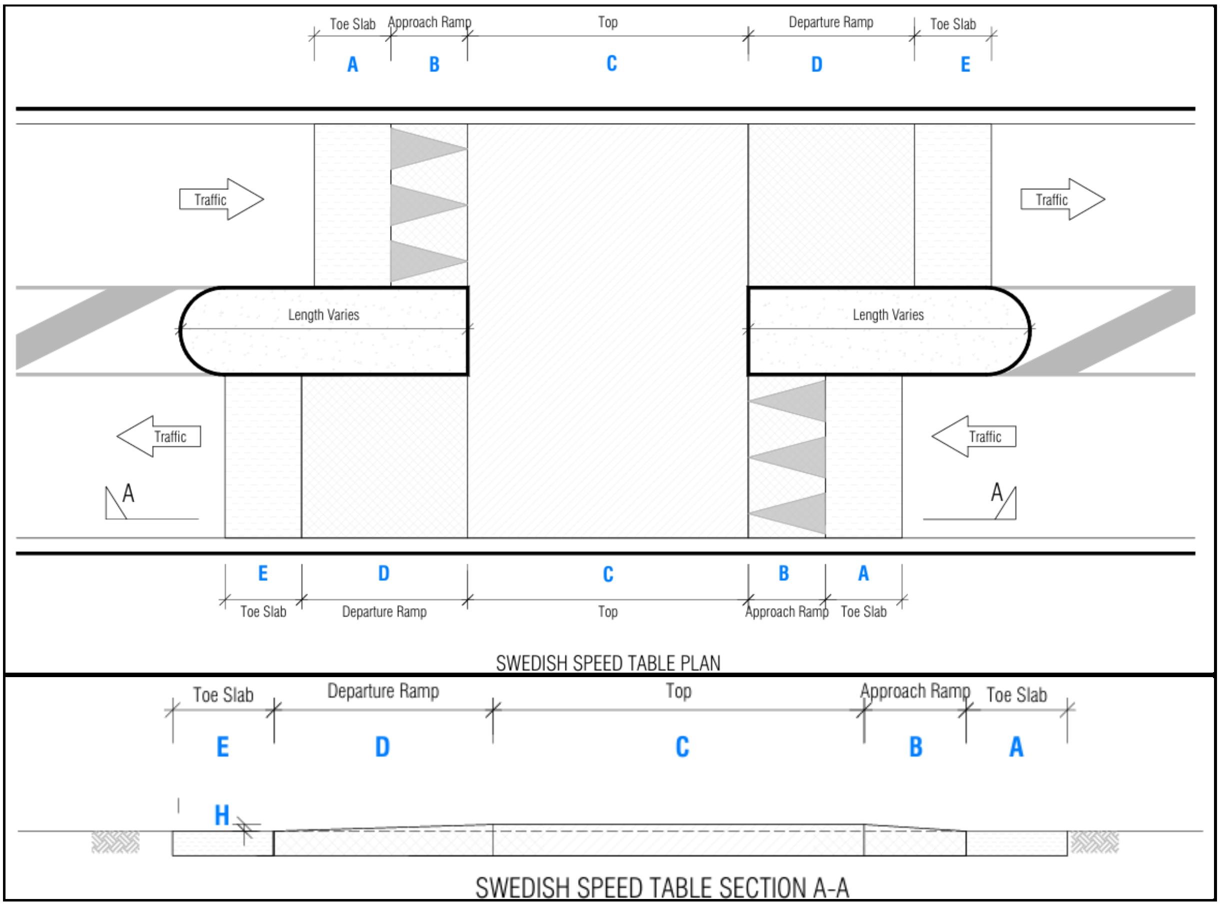

Figure 3: Swedish table profile

Design & construction including site surveys

Through substantial raised device construction programmes by AT and by developers in greenfield areas, we have identified several issues with the design and construction of devices that we have issued guidance for in Edition 2.

Consistent dimensions Designers have often misunderstood profiles as slope gradients and level difference at top and bottom of ramps. Devices are mostly located on roads with a longitudinal gradient, sometimes on a vertical curve and with varying crossfall and pavement irregularity. Designers need to understand the immediate site context, design the form of the device, communicate this clearly to the contractor and enable the contractor to form the device accurately and for it to be checked for compliance with tolerances.

Following complaints that some devices are causing undue discomfort or nuisance to neighbours, we have surveyed these devices to understand whether the design and construction has not resulted in the correct profile. We have found that the most effective survey method for existing sites for design and for checking construction tolerances is a point-cloud lidar survey using a suitable smart phone. This produces a fine-mesh ground model that can be sectioned to check the profile along each wheel track. It is also a suitable method for producing a ground model for design at difficult sites, where the shape of the road surface changes such as at existing intersections.

The Practice Note requires the designer to ensure that each wheel track is designed to meet the specified grade changes and make ramp heights relative to the grade line of approaching vehicle wheelbase, keeping within tolerances. By setting a standard for the design drawings so that they can be reviewed in detail, the designer is helped to understand the site and the design and the contractor is provided with the setting-out information needed to be able to check construction as the go. This avoids expensive remedial work caused through failure of communication.

Accessibility RSPs for pedestrian crossings provide an opportunity for ensuring that the crossfall experienced by footpath users as they cross a road does not restrict their mobility. 0-2% crossfall is preferred for inclusive accessibility. Where a street may have a gradient up to 8% typically, crossing it at right angles can be a problem for some people. Careful design of the grade changes of the table top can enable the designer to make a steep street accessible in a way that other elements cannot.

Drainage In greenfield development, designers can allow for raised devices in their drainage design. This can be more difficult when retrofitting a device into an existing street. The first consideration should be flood management. Overland flow paths can be diverted by raised devices blocking their path causing flood flow to spread and spill into private property. Limiting the height of devices to 75 mm gives a better prospect for containing flood flows within the road boundary and avoiding nuisance effects. Even so, in some cases RSP crossings are not possible. We have recommended the use of alternative speed management devices on the approach to pedestrian crossings that have less effect on flood flows. Speed cushions or speed humps with open-channel side ramps are found to have good speed management without adverse flood effects, while allowing flush pedestrian crossings to be made safe.

For capture of service-level road run-off (10%AEP rainfall) it is preferred to have catchpits located at the upstream toe of ramps. It is not always feasible or affordable to do this, so some measure of by-pass channel flow may be needed. AT has worked with ACO, an international supplier, to develop the design and use of combined kerb and drainage systems to inlet, convey and discharge by-pass flow. Systems such as ACO Kerbdrain and Marshalls Beany Blocks work well with RSPs, avoiding the inlet blockage and wheel entrapment problems of other common treatments.

Standard engineering details

A thorough review of previous versions was carried out and all drawings were updated and published July 2025 to work with PN-02 Ed 2. These include geometric forms, construction details and drainage options for concrete and asphalt features. They are intended for simple application in conjunction with site-specific construction drawings described in PN-02.

BETTER, FASTER, CHEAPER APPROACH

The Mayor has instructed Council and AT to focus on this for infrastructure works and network management. Practice Note PN-02 embeds this in policy, design and construction. Several alternative construction methods have been used to improve outcomes, especially for retrofit to the existing network.

In-situ concrete

In-situ concrete construction of raised features remains economical in greenfield development where roads do not need to be opened to construction or public traffic until concrete has been given time to gain strength. This is particularly important where low-carbon concrete is used as this requires longer curing time. Increased cement content for early strength gain is feasible but runs counter to the objective of reduced carbon footprint.

Few opportunities for improvement have been found, other than ensuring that good setting-out information is provided. Toolbox talks with designers, supervisors and workers have been delivered to ensure that everyone understands the design objectives and what aspects of construction are critical to success. Permanent formwork may be used in the future to allow continuous pours and screeding rather than boxing for successive panels.

Pre-cast concrete

This offers an opportunity for casting-yard quality control and finishes as well as fast installation to minimise disruption to busy roads. A pilot project was carried out by Fulton-Hogan in an access road at Kumeu to avoid disruption to retail businesses. They have produced a video showing the site preparation and installation of a zebra crossing on RSP that was carried out overnight and the crossing made operative the next day.

Although the installation was a notable success, it did highlight some issues. The overall length of Type 3 RSPs requires a long-load delivery to site unless a transverse joint is included. The weight of the units used does require suitable craneage. The cost of yard pre-cast construction rather than in-situ does not offer significant savings except in the disruption and traffic management costs. Speed of installation may still make development of this method attractive in some circumstances.

Asphalt

Milling pavement and forming asphaltic concrete raised devices can significantly reduce disruption for road users, residents and businesses. Asphalt devices have been used successfully at many sites. Full-depth pavement reconstruction may be needed in most high-use roads to ensure rutting and vibration problems are minimised. Forming the profiles accurately requires a high level of skill and practice by the contractor’s work team. If good workmanship can be achieved, the result can be very effective.

Rubber

The quality of rubber road products has been significantly improved recently, with vulcanised finishes delivering good operational life without discharge of crumbs to the environment. AT has worked with Vanguard and New Zealand Road Safety Products to develop a range of raised device products suited to Auckland road applications. Black rubber units combined with white rubber allow road markings to be integral to the systems. Sizing to match TCD Rule marking dimensions enables single-visit installation of speed cushions, speed tables and raised zebra crossings. Mountable centre-islands for mini-roundabouts have also been used successfully.

Condition of the road pavement is important, with fixings to be secured using epoxy resign to ensure a good grip. Pilot installations and experience of use in other jurisdictions has allowed AT to authorise use of rubber products, once they have been documented and formally approved, as permanent infrastructure, not just as interim features needing to be replaced with other materials. We expect to find that they will perform well in Auckland. Dimensional compliance is obviously achieved with pre-formed items. Custom drainage features need to be installed in most cases. Side or central refuge islands can also use rubber products to minimise disruption. Should there be any serious vibration issues, rubber products can be removed reasonably quickly and cheaply.

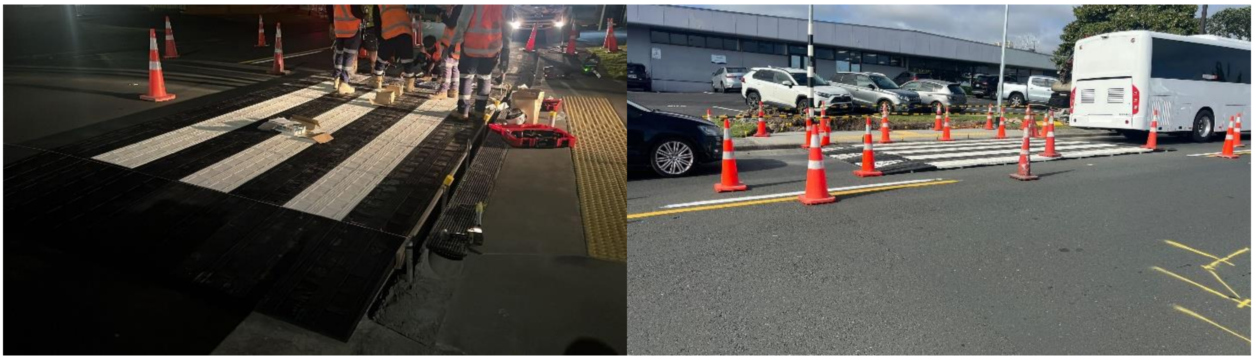

Figure 4: Installation of rubber RSP (Photos: AT, 2025)

SOME INNOVATIVE EXAMPLES TO SUPPORT ACCESSIBILITY

Wheelchair-friendly crossing on a steep street

A site at Pilkington Road in Panmure was to be provided with an improved zebra crossing as part of a town centre pedestrian space upgrade. The road at the site has a 9% grade, making an accessible crossing to key destination facilities difficult. Design of an RSP took advantage of the opportunity by wrapping the zebra crossing onto the uphill ramps, enabling a wheelchair-friendly 3% crossfall 1.5 m wide, identified with wheelchair symbol markings on the footpath. Speed hump triangle markings were moved onto the approach to the toe of the ramp, See Figure 2.. This has been well received by our accessibility review partners.

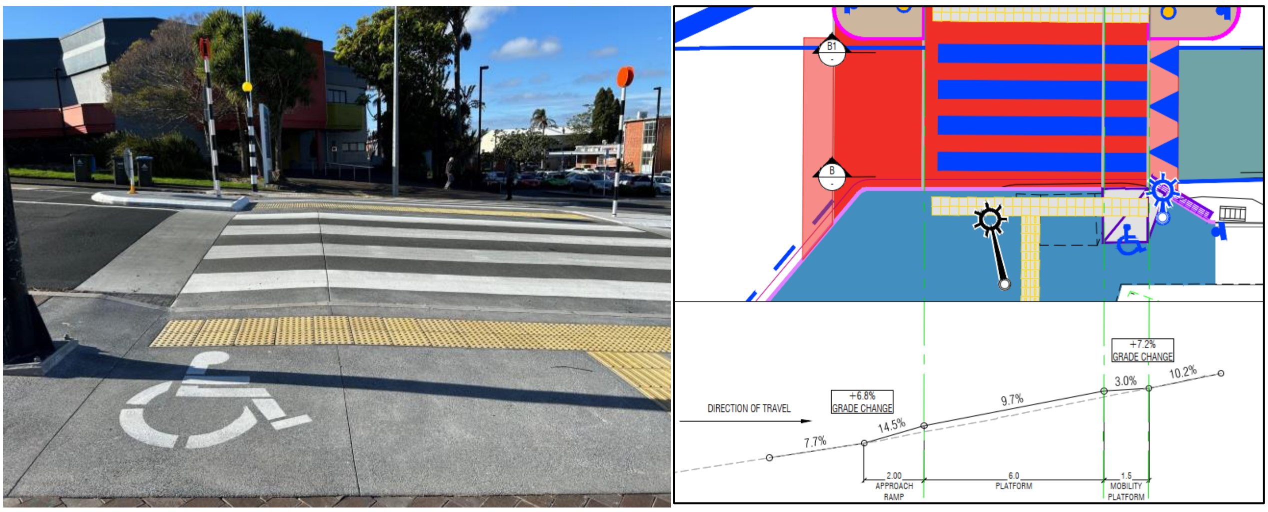

Figure 5: Wheelchair-friendly RSP, Pilkington Road, Panmure (Photo: PTM, 2024)

Swedish table without refuge island

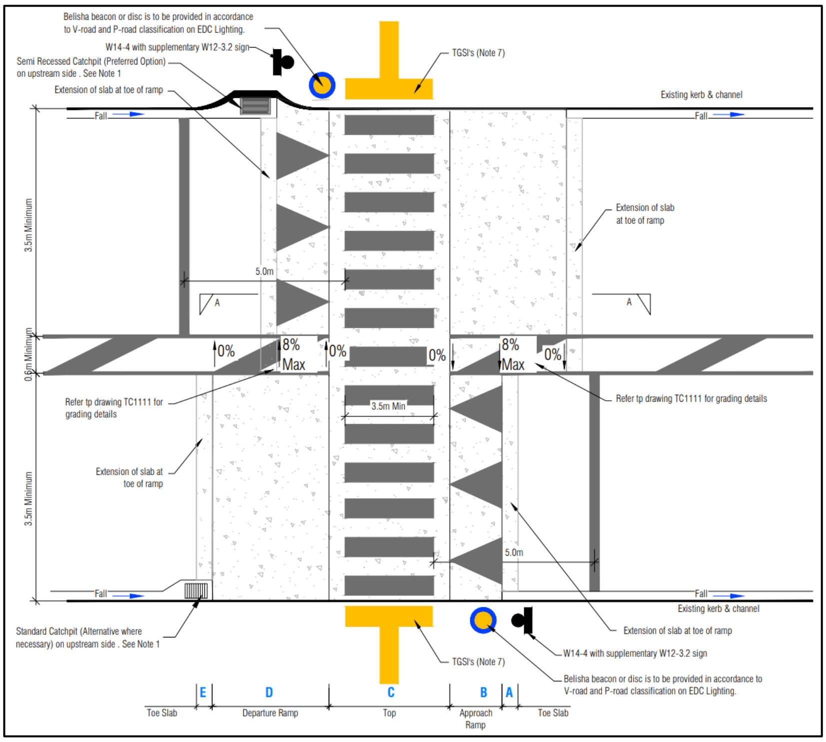

Figure 6: From AT SED TC1014

Not all roads have sufficient width for installation of a refuge island. Vehicle crossings adjacent to a site may also make an island impractical. We have developed a standard design that enables a Swedish table to be installed without an island, provided that a wide centre line or flush median at least 0.6 m wide can be marked on the approaches, see Figure 3. The difference in height between the extended departure ramp and the shorter approach ramp can be flared out in the median width without causing a hazard to road users, especially motorcyclists. An arterial road installation at a signalised crossing has worked well although even when constructed to correct tolerances it has caused excessive vibration in a two-storey end terrace subsequently built next to the site.

Side-road RSP for narrow berm with cycleway and footpath

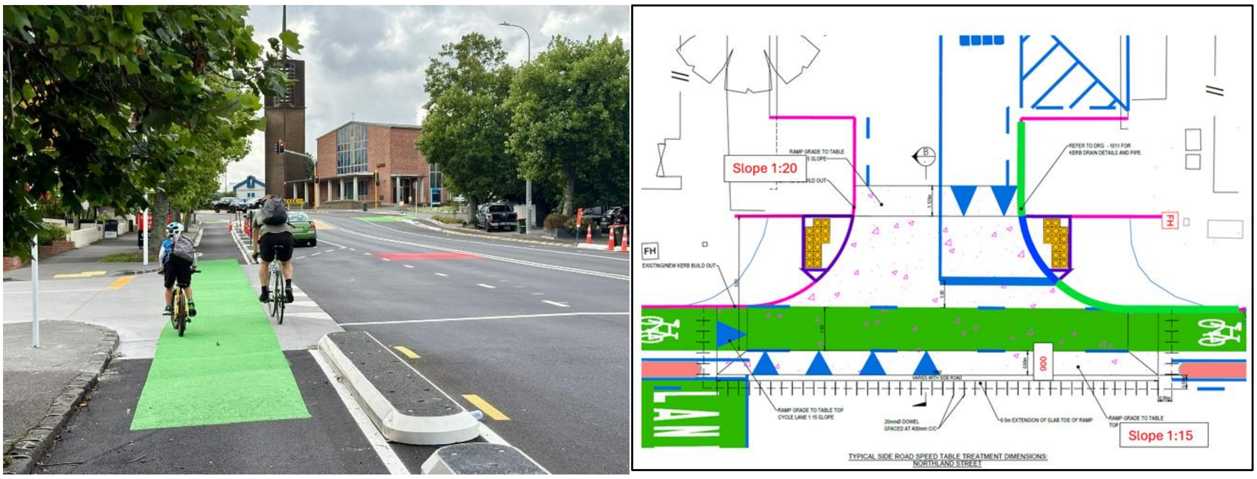

Figure 7: Great North Road side road RSP 1 (Photo: Jolisa Gracewood, 2026)

A recent project on Great North Road near the city centre has introduced protected cycle lanes along with part-time bus lanes on a 4-lane arterial road. The existing narrow road berm has left limited room for side-road RSPs, further complicated by steep side streets and limitations on Crossing Sight Distance sightlines. To provide protection for cyclists, a novel design of RSP has been tried, see Figure 4. The 0.9 m ramp adjacent to the through road is within the width of the cycle separators. 1:15 ramps are used within the cycle lane, to warn cyclists to slow and look carefully for turning traffic. The table top then covers the width of the cycle lane and the pedestrian crosswalk, into the side street. A decision was made to limit the relative height of the ramps to 65 mm. This has made the detailed design and construction difficult to fit to the shape of the roads. The performance of this design is yet to be fully evaluated in service.

Remedial treatment for height and grade problems

A number of raised crossings have been found to cause problems to road users after construction. Some of those, when investigated, were found to have exceeded construction tolerances, some had been poorly detailed so that contractors had made the table top flush with the top of a full height kerb, making them about 130 mm high and others had been specified 100 mm high on arterial roads which proved to be excessive for traffic conditions.

Concrete RSPs would be very expensive to demolish and reconstruct, so firstly detailed lidar surveys were used to identify the problems. A general objective of remedial design is to retain the existing table top and reconstruct only the ramps and approaches. The toe of the ramps usually need to be raised so that the approach to the toe is satisfactory for comfort and impact, a length of the road surface on the approach is milled and reshaped. The length is determined by the wheelbase of the check vehicle, usually a bus. A new grade line is drawn from this point to a point 75 mm below the top of the ramp. The toe of the new ramp is then set on that grade line 1125 mm from the top of the ramp to give 1:15 relative grade 75 mm high. This is reasonably simple for a contractor to achieve. Although asphalt may be used for the approach road reinstatement, concrete may be cheaper due to plant mobilisation costs, so choice is offered when pricing.

CONCLUSIONS AND RECOMMENDATIONS

- Raised safety platforms remain as very effective safe treatments for high-risk pedestrian crossings but to be used sparingly on high-use urban roads. AT has used field experience and various research methods to provide robust evidence for the design and construction of RSPs that can be accepted by all road users without significant adverse effects.
- Unexpected problems have been found, investigated and design guidance has responded to these. Vibration remains a concern, with the need to allow for measurement and planning remedial action if a device causes damage or nuisance. Early-morning delivery truck movements at speed may cause interrupted sleep even when all other factors seem to be fine. Where such issues can be predicted to be possible, alternative safety management treatments are preferable.
- Design and construction need careful attention to ensure compliance with tight tolerances to avoid mistakes and excessive impacts. Personal guidance to designers and contractors can minimise this risk.
- Working with suppliers to develop materials and products that meet environmental performance objectives and simplify investigation, design and construction can reduce project costs and risks. Materials and designs that allow for removal, replacement or remedial work can give greater confidence to communities and to clients that projects can go ahead with unintended problems investigated and corrected.
- All three objectives of Better, Faster, Cheaper can and should be the focus of future development and use of these effective safety treatments.

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ACKNOWLEDGMENTS

Irene Tse, Technical Lead – Transport Safety, Auckland Transport – manager MAPI programme, safety data analysis, commissioned drone survey research report, collaborated on RSP development and use

Indra Gayawali, Principal Engineer Pavements & Surfacing, Auckland Transport – developed pavement and construction standards for RSPs

Arvind Lal, Senior Digital Designer, Auckland Transport – devised and developed lidar survey method, prepared Standard Engineering Details

Richard Batty, WSP and formerly Auckland Transport – led Track Test research project for buses method, conduct and data analysis

Peter Cenek, WSP – Research lead for confidential reports: Assessment of road safety platform profiles and uses specified in Auckland Transport's Practice Note 02 using PC-Crash™ Report No: 1-A8319.00 Task 3 (2023) and Traffic induced vibrations: Intersection of Takanini School Road with Manuroa Road, Takanini, Auckland: Report No: 5-29J45.00 (2024)

Andrew MacDonald, Eliga – devised methodology and data analysis for confidential report: Speed Evaluation of Post Construction Speed Tables (2024)

Oliver McLean, Vanguard Group; Angela Fulljames, New Zealand Road Safety Products; Connell McBride and Pragnesh Patel, Fulton Hogan – collaborated with AT on development of pre-formed RSP systems

Paul Schiska, PTM – collaboration on design of Wheelchair-friendly RSP, Pilkington Road, Panmure