15 CROSSINGS

CROSSING FACILITIES FOR PEDESTRIANS
Designing crossing facilities at, and away from intersections
Pedestrians' crossing requirements
Drivers' crossing requirements
Different crossing types and specifications

15.1 Introduction

Pedestrians cross the road an average of two to three times on every walking trip [476] and may also need to cross railways, waterways or other natural features. Their perceptions of the walking experience largely focus on difficulties crossing roads [169] and any problems with this can cause delays and create a sense of insecurity. Therefore, correctly designing, building and signing appropriate crossing facilities should be a major consideration when developing pedestrian routes. This applies not only to facilities in the road reserve, but also to off-road environments shared with cars, such as car parks.

Photo 15.1 – Pedestrians crossing, Christchurch (Photo: Megan Fowler)

15.2 General design considerations for pedestrian crossing points

As an integral part of the pedestrian network, crossings should meet the same minimum standards as through routes on the footpath, especially in:

- the maximum permissible crossfall
- maintaining adequate overhead clearances and protrusions
- the surface standard (stable and firm, and slip resistant even when wet)
- not containing grates and covers.

All crossing points should be designed to minimise pedestrians' crossing distance, which means ensuring [92]:

- they are at right angles to the direction of the road
- the roadway is as narrow at the crossing point as possible.

Where possible, crossings should be located on the pedestrian desire line. Where this is not possible or unsafe, use environmental and/or tactile cues to guide pedestrians to the crossing point [92]. Other road users should be able to predict the route of pedestrians who are about to leave the kerbs [92].

Street furniture that may obscure visibility should be located well away from the crossing, and vegetation should be regularly trimmed [46, 66]. Parking should be prohibited for at least 15 m either side of the crossing point (although this can be six metres if there is a kerb extension at least two metres deep). To ensure compliance, this may need enforcing every now and then, or additional infrastructure could be installed [139].

Some crossings are raised to the same level as the footpath, while others require pedestrians to change grade. In both cases, it is important to ensure that all types of pedestrian can make the transition between the footpath and the crossing safely and easily (see section 3). Later parts of this section cover specific issues for each type of crossing.

All pedestrian crossing points must be monitored so they continue to be appropriate for the location while operating safely and efficiently [86,139, 173]. They may need removing if pedestrian numbers have declined substantially and are unlikely to increase, or upgrading if pedestrian numbers have increased [173].

Crossing point design includes considering the cost and ease of maintenance, repair, reinstatement and replacement, especially in the materials used. It also includes considering the implications of maintenance for pedestrians and other road users.

Overdimension load transport is also an issue in designing pedestrian crossing points, especially on routes commonly used for this purpose. These routes require a 'design envelope' 11m wide and six metres high. Islands should have mountable kerbs and load bearing surfaces, with signs, poles and rails conveniently removed or folded at ground level. Where the road edge protrudes into the 'design envelope' such as at kerb protrusions, road furniture, signs, poles and other objects should be less than one metre high or be conveniently removed or folded over.

15.3 Crossing sight distance

At most crossing points pedestrians need to choose gaps in the traffic stream to cross safely, so they must be able to see the approaching traffic in good time. This distance, known as the 'crossing sight distance' [10], is a critical element in ensuring pedestrians can cross the road safely. It is calculated as [10]:

$$\text{Crossing sight distance (m)} = \frac{\text{crossing distance (m)}}{\text{walking speed (m/s)}} \times \frac{\text{85th percentile vehicle speeds (km/h)}}{3.6}$$

Crossing sight distance should be calculated carefully to take account of conditions at the site. For example:

- the pedestrian line of sight may be blocked by permanent or temporary obstructions
- walking speed can vary owing to factors such as pedestrian ages and physical condition, route gradients, pedestrian densities and environmental conditions [145]
- some pedestrians may take additional time to start crossing, because of mobility or visual impairments, uncertainty or double-checking that it is safe [13]
- the signed speed limit in the area should not be used as an indication of actual vehicle speeds. Actual speeds are usually faster than posted limits.

As walking speeds can vary, the one assumed at a crossing point should generally be biased towards slower pedestrians [13].

Where required crossing sight distances cannot be provided, they can be reduced with devices such as kerb extensions or refuges, or the traffic speed can be slowed. If neither is possible, provision of any facility that would encourage pedestrians to cross at that point should not be installed.

15.4 Design considerations for drivers

Drivers should be able to see all crossings easily so they can adjust their speed and be aware of the potential for pedestrians to step into the roadway [10]. They should be able to see the crossing over at least the appropriate 'approach sight distance' (see table 15.1), although an extra safety factor is recommended.

Table 15.1 – Minimum approach sight distances [10]			
Speed (km/h)	Approach sight distance (m)		
	Rural		Urban
	Normal R=2.5s	Alerted R=2s	R=1.5s
10	-	6	5
20		14	11
30		23	19
40		35	30
50		45	40
60		65	55
70		85	70
80	115	105	95
R = driver's reaction speed.			

The figures in table 15.1 presume emergency braking and adequate skid resistance. It is important to assess the skid resistance of the roadway upstream of a pedestrian crossing point, to help drivers avoid a crash if a pedestrian steps out unexpectedly. Treatment is justified if the skid resistance (sideways force coefficient) is less than 0.55 [157].

Advance road signing [154] and more intense lighting [68] may be required to make crossings more conspicuous.

15.5 Landscaping at pedestrian crossing points

Some pedestrian crossing points, such as kerb extensions and pedestrian islands, create opportunities for landscaping or public art. While this can provide an amenity value for pedestrians, it must not obscure visibility for pedestrians or drivers, particularly on the upstream side, at any time of the year. The crossing point must also continue to operate effectively during any landscaping maintenance, which means ensuring:

- drivers are not distracted by maintenance work or vehicles
- maintenance work or vehicles do not obscure pedestrian or driver visibility
- maintenance work or vehicles do not wholly or partially block pedestrian routes and force those on foot to change direction
- loose material is not spilled into the pedestrian route
- auditory cues (important to vision impaired pedestrians) are not obscured.

Photo 15.2 – Landscaping, Christchurch
(Photo: Andy Carr)

15.6 Kerb crossings

Kerb crossings are an integral part of every crossing facility, whether mid-block or at intersections. Kerb crossings are of two types, kerb ramps and blended crossings.

15.6.1 Kerb ramps

When designing kerb ramps, it is important to ensure that:

- if there is a kerb ramp on one side of the roadway, there is also one on the other to prevent pedestrians being 'stranded' on the roadway itself
- there are no low points in the gutter where water can collect [13, 139]
- if installed at a pedestrian crossing point, the whole kerb ramp is contained within the crossing markings [118].

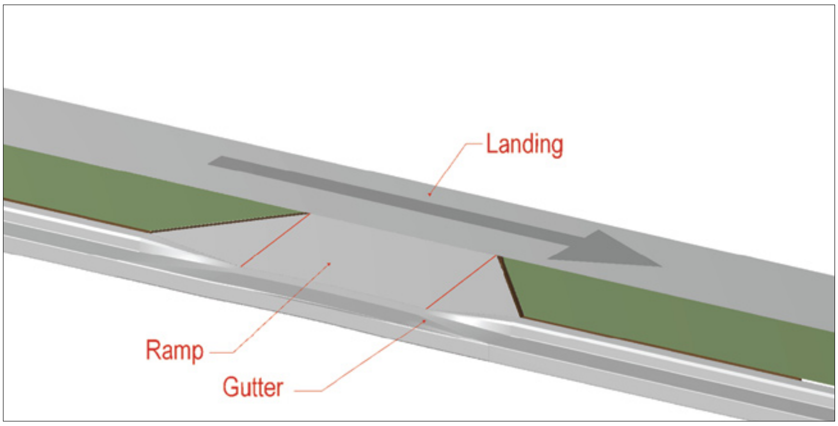
Every kerb ramp comprises [13, 46, 66, 139]:

- the ramp, which is the area pedestrians cross to change their grade
- the top landing, which is where pedestrians move between the ramp and the footpath
- the approach, which is the section of footpath next to the top landing
- the gutter, which is the drainage trough at the roadway edge.

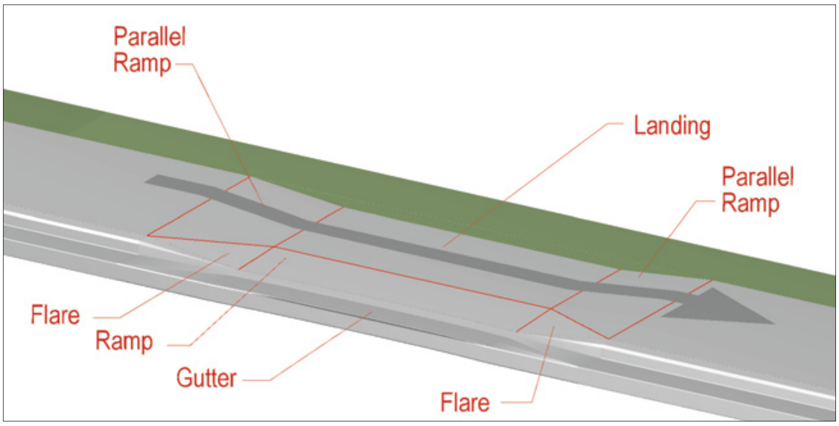
Many kerb ramps also have flared sides, which are sloping areas next to the ramp, to prevent pedestrians tripping on the ramp edges [13]. Some ramps also have a bottom landing. Return kerbs can be used instead if the kerb ramp is carefully located within the street furniture zone or at a kerb extension [13].

The various elements of kerb ramps can be combined in a number of ways, as shown in figure 15.1 [13, 46, 66, 139].

Perpendicular



Combination



Parallel

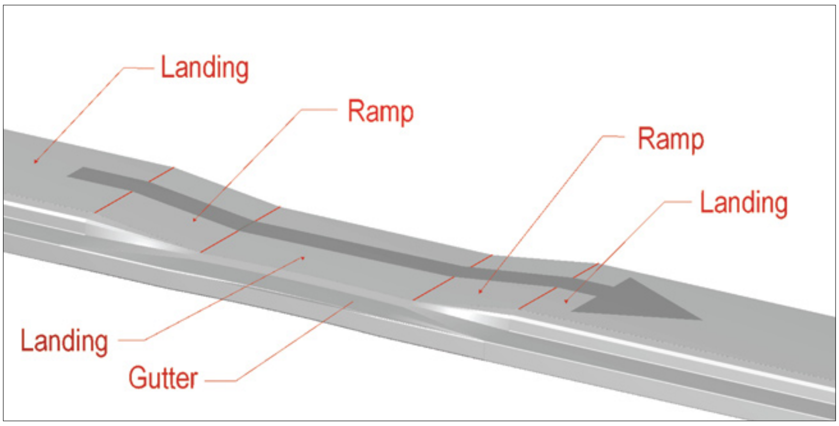


Figure 15.1 – Examples of kerb ramps

Table 15.2 covers the key design issues for the elements within kerb ramps [6, 13, 42, 92, 134, 139].

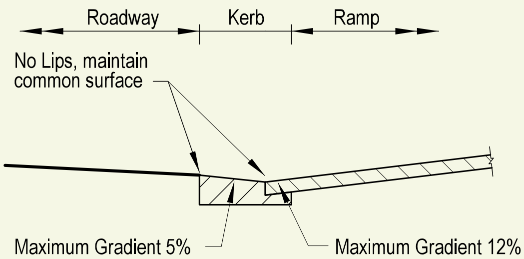
<table>
<tr><th colspan="3">Table 15.2 – Design elements of kerb ramps</th></tr>
<tr><th>Element</th><th>Key issues</th><th>Additional information</th></tr>
<tr><td rowspan="5">Ramp</td><td>Normal maximum gradient 8% (1:12)
Maximum gradient 12% (1:8)</td><td>A gradient of 10% should only be considered for constrained situations where the vertical rise is less than 150 mm.
A gradient of 12% should only be considered for constrained situations where the vertical rise is less than 75 mm.
Slopes more than 12% are very difficult for the mobility impaired to negotiate.
To avoid using these steeper gradients, lower the footpath as shown in figure 15.1</td></tr>
<tr><td>Maximum crossfall 2% (1:50)</td><td>Should be consistent across the whole ramp – avoid twist.</td></tr>
<tr><td>Minimum width 1 m</td><td>1.5 m is recommended.</td></tr>
<tr><td>Maximum width: equal to the width of the approaching footpath</td><td>Wider ramps are difficult for the vision impaired to detect.</td></tr>
<tr><td>Tactile paving</td><td>For more advice, see Guidelines for facilities for blind and vision-impaired pedestrians [92].</td></tr>
<tr><td rowspan="2">Gutter</td><td>Maximum gradient 5% (1:20)</td><td>Anything greater can cause wheelchair users to lose their balance at the transition.</td></tr>
<tr><td>Transition between gutter and ramp</td><td>Should be smooth with no vertical face. Ensure that this does not inadvertently happen when the roadway has been resurfaced [13].


Figure 15.2 – Typical gutter design</td></tr>
<tr><td rowspan="4">Landing</td><td>Maximum gradient 2% (1:50)</td><td rowspan="3">To prevent wheelchair users overbalancing, or accidentally rolling, and to provide a rest area.</td></tr>
<tr><td>Maximum crossfall 2% (1:50)</td></tr>
<tr><td>Width: equal to that of the ramp</td></tr>
<tr><td>Minimum depth 1.2 m (top landing)</td><td>A depth of 1.5 m is preferred.</td></tr>
<tr><td rowspan="2">Flare</td><td>Maximum gradient 16% (1:6)</td><td>Use the steeper value if a vision impaired person could inadvertently enter and leave the kerb ramp from the side and bypass the tactile paving.</td></tr>
<tr><td>Maximum gradient: as per the ramp section</td><td>Use these gentler values if mobility impaired people are expected to enter and leave the kerb ramp from the side due to the top platform being too small. For a kerb ramp perpendicular to a straight kerb this results in a splay angle of 45°.</td></tr>
</table>

Figure 15.3 shows a typical kerb ramp design for a footpath with a kerb height of 100 mm that incorporates these dimensions.

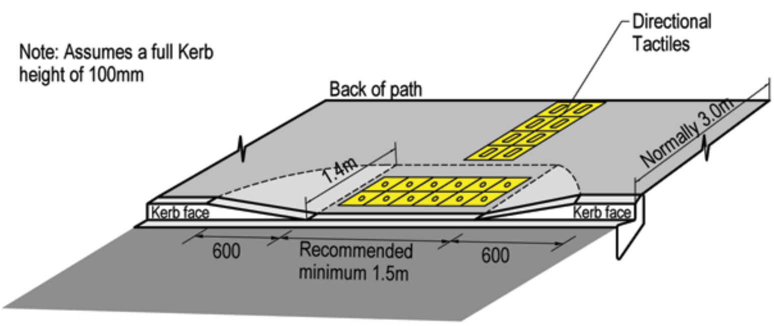


Figure 15.3 – Typical kerb ramp design

Mobility impaired people should not have to change direction while on the ramp [4]. This means curved kerbs require kerb ramps with bottom landings (see figure 15.4).

Kerb ramps create particular problems for the vision impaired. This is because they often use the kerb face as a tactile cue for the footpath edge [6, 13] and kerb ramps can increase the risk of their inadvertently walking out into the roadway. To avoid this, all kerb ramps should incorporate appropriate tactile ground surface indicators. Refer to *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

Section 14.15 has advice on kerb ramps at intersections.

15.6.2 Blended kerb crossings

Blended kerb crossings are where the footpath and roadway meet at the same level. This can occur at a number of locations, particularly at pedestrian platforms. The design advice on demarcation and surfacing of pedestrian platforms should be referred to for all blended crossings (see section 15.11).

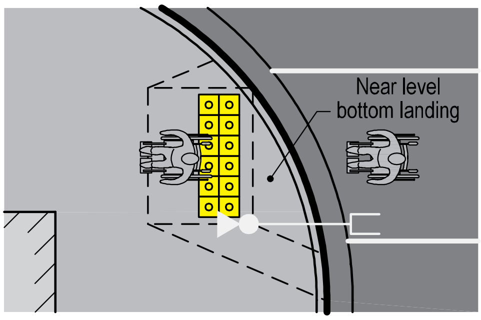


Figure 15.4 – Correct bottom landing arrangement

Photo 15.3 – Kerb ramp, Featherston St, Wellington (Photo: Tim Hughes)

Photo 15.4 – Kerb ramp, near bus stop, SH 1, Russley Rd, Christchurch (Photo: Tim Hughes)

Photo 15.5 – Blended kerb crossing at platform, Taupo (Photo: Else Tutert)

15.7 Selecting the appropriate crossing facility

The choice of crossing facilities should always be appropriate for the prevailing environment. Section 6.5 covers crossing facility selection.

15.8 Pedestrian islands

Pedestrian islands should be built as kerbed islands (0.15 m to 0.18 m above the road's surface) and be a different colour from the road. If they are large enough, low plants that do not obscure children or signage may be planted [58]. Figure 15.5 shows the three pedestrian island layouts commonly used [58].

Of these, the diagonal style is favoured for a 'stand-alone' pedestrian island because [24, 58, 72]:

- pedestrians are turned to face oncoming traffic (a 45° angle strikes an appropriate balance between turning pedestrians and extending their route)
- there are some installation and maintenance benefits.

The chicane design is also useful as it offers space for handrails and can hold more pedestrians on narrow roads [58, 72]. The 'stagger' between entry and exit is also helpful in preventing pedestrians trying to cross the whole road in one movement [72]. The island should have resting rails. A fence is desirable on chicane layouts. Both of these encourage pedestrians to cross at the cut-through or kerb ramps.

Kerb crossings (built according to section 15.6) on the adjacent footpaths must be used where pedestrian islands are provided.

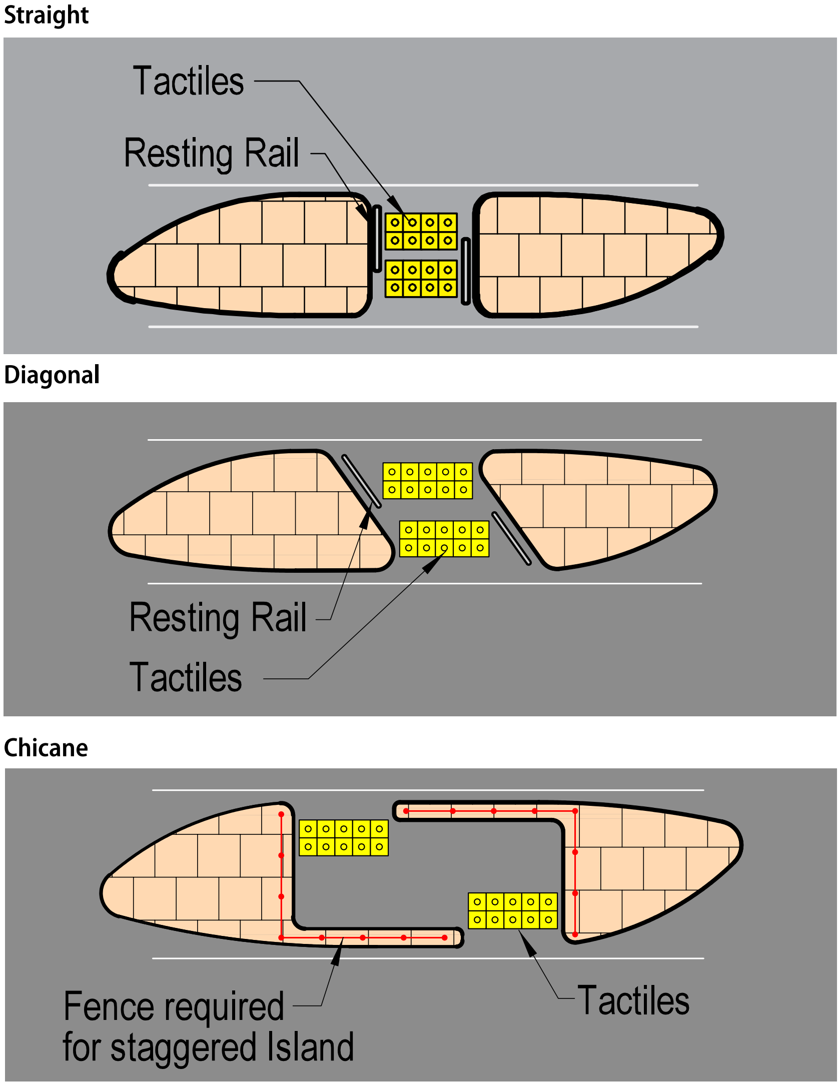


Figure 15.5 – Pedestrian island layouts

Table 15.3 covers the key design issues for pedestrian islands, while figure 15.6 is an example of a compliant pedestrian island [6, 10, 42, 46, 58, 68, 92, 126, 139, 154].

Table 15.3 – Design elements of pedestrian islands

Key issues	Requirement	Additional information
Islands	Length at least 8 m	Site specific according to: • the road type (larger islands on busier, wider roads) • the potential number of pedestrians waiting on the island • possible vehicles turning into adjacent accesses.
	Approach nosing taper 10%	In accordance with the *Manual of traffic signs and markings* (MOTSAM) [154].
	Approach nosing radius 0.6 m	In accordance with MOTSAM [154].
Island depth	At least 1.8 m, preferably 2 m	This is required so that waiting pedestrians and/or their belongings do not protrude into adjacent traffic lanes. In constrained situations, the 'depth' can be measured parallel to the waiting area. Where the roadway has a constrained width, the desirable width can be achieved by narrowing the traffic lanes.
Width of route through island	At least 1.5 m or the width of the adjacent kerb ramps (whichever is greatest)	The actual width should be based on the potential number of pedestrians waiting on the island, so it is also affected by the island's depth.
Ramps within the island	If provided, there must be a level area between ramps of at least 1.2 m	It is preferable to not change grade within the island and use a cut-through instead. If used, they must comply fully with the kerb ramp design criteria.
Resting rails	1 m high At least 0.35 m from the kerb face at the edge of adjacent traffic lane(s)	Rails should be frangible to avoid injury to drivers whose vehicles leave the roadway, and built of iron pipe or some other such material (figure 15.7). They should be conspicuous and painted in a contrasting colour to their surroundings. They should not reduce the route width to below the minimum and should have a bar near ground level that the vision impaired can detect.
Fences	See section 16.8	These are required when using a chicane layout to avoid creating a trip hazard.
Lighting	In accordance with AS/NZS 1158.3.1: 1999 [88]	Some RCAs have used a white globe (similar to a Belisha beacon) mounted on a 4 m high white pole within the island. Floodlighting (as used for zebra crossings) has also been used. Lighting poles on islands must fold down for overdimension loads.
Island kerbing	Mountable splay kerbs	Other kerbs are only acceptable if the traffic lanes more than 3.2 m wide **and** the island is wider than 2 m. It is advisable to paint the island kerbs with white or reflective paint.
Signs	RG-17 or RG17.1 ('keep left')	Installed as close to the island ends as possible and facing oncoming vehicles. No more than 0.15 m between the bottom of the sign and the island surface.
Roadway markings	Merge/diverge tapers on approaches	In accordance with MOTSAM [154].
Overdimension loads	Maintain 11 metre wide envelope	Refer section 15.2

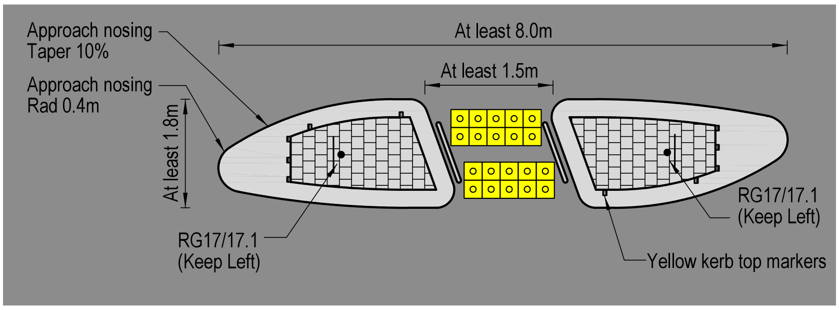


Figure 15.6 – Example of a compliant pedestrian island

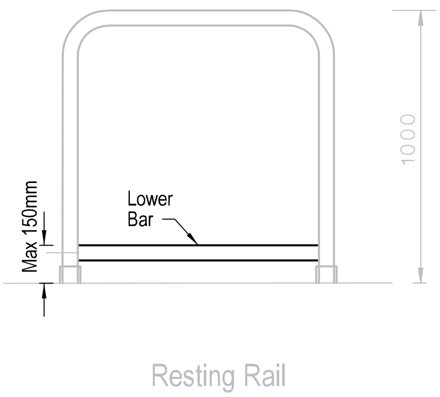


Figure 15.7 – Resting rail – recommended design

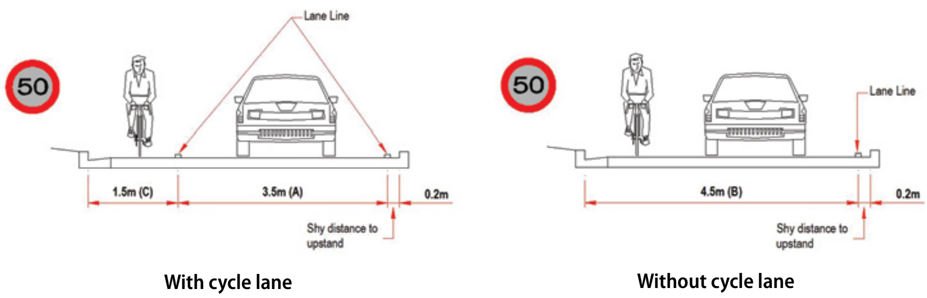
Photo 15.6 – Pedestrian island lighting column and globe, Hamilton (Photo: Shaun Peterson)

If there is another pedestrian island nearby, consider linking the two with a continuous raised or flush median [58, 139]. If a flush median is already there, it should be smoothly widened if necessary to enclose the raised island [58]. Traffic lanes should never terminate immediately before an island [46].

Photo 15.7 – Pedestrian island, Highsted Rd, Christchurch (Photo: Tim Hughes)

Roadway width

When providing pedestrian islands, or any device that narrows the roadway, it is important to maintain enough width for cyclists and vehicles to pass each other. In the absence of a cycle lane, there should normally be at least 4.5 m, and no more than five metres width for each direction of travel. If a cycle lane is provided, there should normally be five metres width for each direction of travel. Where the width is less than this, the vehicular lane, not the cycle lane, should be narrowed. Figure 15.8 illustrates these dimensions.



(A) May be reduced to a minimum of 3 m if heavy vehicles are rare and next to mountable kerb.

(B) May be reduced to a minimum of 4 m if heavy vehicles are rare and next to mountable kerb.

(B & C) Increase by 0.5m for 70 km/h speed limits.

Figure 15.8 – Desirable minimum roadway widths for cyclists

The appropriate width must also be maintained along all approaches and departures, so in constrained situations this may mean removing car parking. Figure 15.9 shows two good practice examples of this.

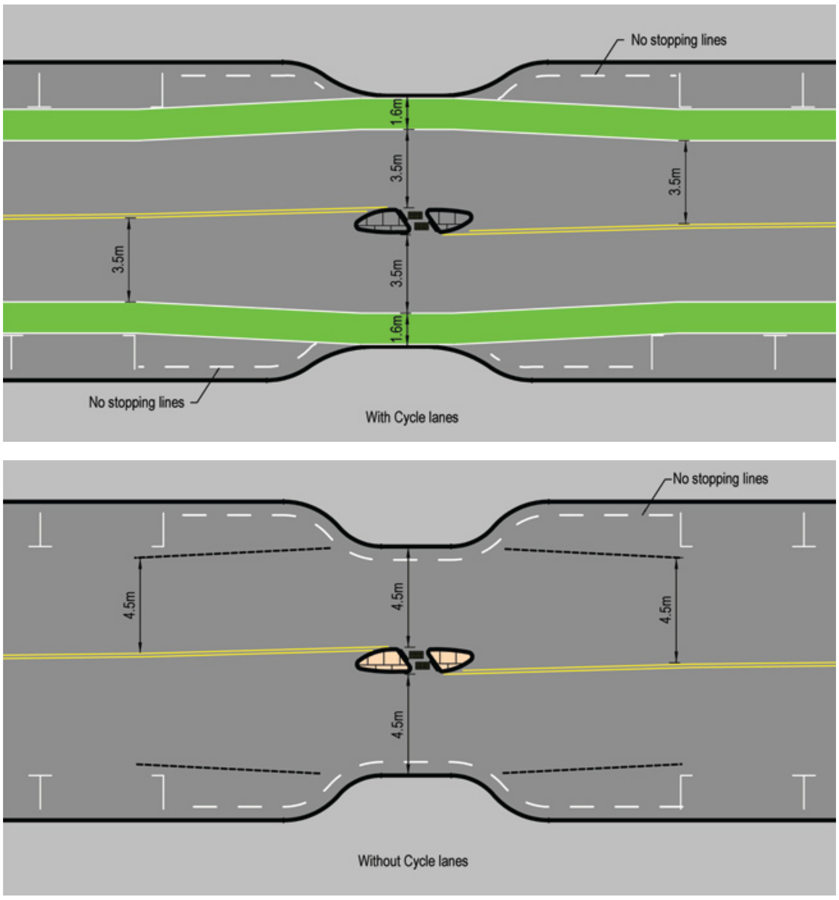


Figure 15.9 – Good practice examples of pedestrian island layout

15.9 Medians

Medians may be flush or raised. Raised medians are similar to pedestrian islands in many respects.

Flush medians enable pedestrians to cross the road in many locations. However, care is required to ensure kerb ramps are at suitable locations for the mobility impaired to cross the road. Raised medians require cut-throughs (or kerb ramps) at the crossing locations, which should be consistent with pedestrian islands (see section 15.8). Table 15.4 details other median design considerations.

Photo 15.8 – Median with path cut through island, SH 74 Main Nth Rd, Christchurch (Photo: Susan Cambridge)

Table 15.4 – Design elements of medians			
Key issues		**Requirement**	**Additional information**
Median depth		At least 1.8 m, preferably 2.0 m	This is required so that waiting pedestrians or their belongings (prams, wheel chairs etc) do not protrude into the adjacent traffic lanes. In constrained locations, the desirable width may be achieved by narrowing the traffic lanes.
Lighting		In accordance with AS/NZS 1158.3.1: 1999 [68].	
Raised medians only	Width of the path through a raised median	At least 1.5 m or the width of the adjacent kerb ramps (whichever is greatest)	The width should be based on the potential number of pedestrians waiting on the median to cross, so this is also affected by the median depth.
	Ramps within raised medians	If provided, there must be a level area between ramps of at least 1.2 m	It is preferable to maintain the grade within the raised median and use a cut-through instead. If used, they must comply fully with kerb ramp design criteria.
	Resting rails	1 m high At least 0.35 m from kerb face at edge of adjacent traffic lane(s)	As for section 15.8
	Barriers	See section 16.8	These should not reduce the route width to below the minimum.

15.10 Kerb extensions

Kerb extensions should be designed on a case-by-case basis. In each case, access to the crossing point should be facilitated by kerb ramps installed partly or wholly within the kerb extensions, to the standard in section 15.6.

Extensions installed at intersections should enable large vehicles to turn safely and without mounting the kerb. Section 15.15 has advice on designing intersections for pedestrians.

When providing kerb extensions it is important to keep enough width for cyclists and vehicles to pass each other through the crossing. Section 15.8 covers adequate widths.

Kerb extensions should comply with the general dimensions in table 15.5. Figure 15.10 is an example of a mid-block kerb extension.

Table 15.5 – General dimensions for kerb extensions		
Key issues	**Requirement**	**Additional information**
Extension depth	0 m to 7 m, typically 2 m to 4 m	This is determined by the width of the nearside lane, keeping an adjacent lane width of at least 4.5 m if the adjacent lane has no cycle lane or 5 m if it has. See figure 15.8
Extension length	At least 3 m	The length should be based on the potential number of pedestrians waiting to cross, so it is also affected by the extension depth.
Approach length	2 m to 5 m	
Departure length	2 m to 8 m	
Curve radii	0.5 m to 6.5 m, typically above 5 m (concave) 0.5 m to 5 m, typically above 2 m (convex)	Above 5 m facilitates mechanical street sweeping.
Lighting	In accordance with AS/NZS 1158.3.1: 1999 [68]	
Signs and roadway markings	Bridge end markers on upstream approaches	It is advisable to paint the kerbs with white or reflective paint.
Overdimension loads	Maintain 11 metres wide envelope	Refer section 15.2

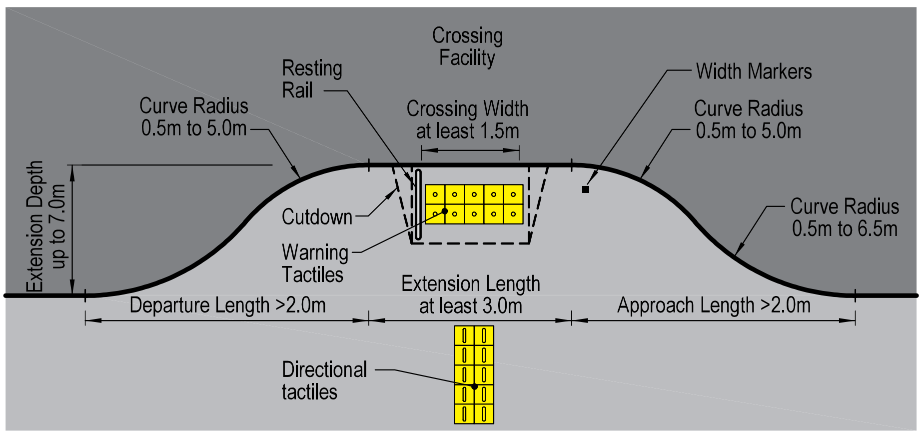


Figure 15.10 – Example of mid-block kerb extension

15.11 Pedestrian platforms

Pedestrian platforms are raised above the level of the surrounding road. Platforms on their own do not affect give-way priority unless they are also marked as a zebra crossing. Their exact design depends on [58]:

- the number of (crossing) pedestrians
- the number of vehicles
- the street function
- the street width
- whether the crossing is controlled or uncontrolled
- landscape/streetscape factors
- the types of vehicles
- vehicle speed
- the roadway surface slope and drainage.

Photo 15.9 – Platform with good footpath to road contrast, Kilbirnie, Wellington (Photo: Tim Hughes)

Generally, pedestrian platforms should comply with the criteria in table 15.6 [12, 31, 34, 35, 39, 46, 58, 66, 68, 81, 118, 139, 145]. Figure 15.11 shows their typical dimensions.

Table 15.6 – Design issues for raised pedestrian platforms

Element	Key issues	Additional information
Vehicle approach ramp	Maximum gradient 10%	Greater values are more effective in slowing vehicle speeds.
	Minimum gradient 5%	
	The ramp leading edge should be flush with the road surface.	
	Ramp faces should be clearly marked (see below).	
Platform dimensions	Maximum height 0.10 m	The platform should be high enough to encourage vehicles to reduce their speed, and can tie in to the height of the adjacent kerb.
	Minimum height 0.075 m	
	Maximum length 6 m	Use longer platforms where there are higher numbers of large vehicles or pedestrians.
	Minimum length 2 m	
Siting	Not on sharp bend.	
	Roadway width should be no more than two live lanes of traffic, one in each direction.	
	Set back 5 m or more from junction mouths.	
	Should be preceded by a feature that causes vehicles to slow (such as yielding the right of way).	
	Speed limit: 50 km/h or less.	
	These are only suitable for local roads and possibly collector roads. They are not for arterials except in major shopping areas where this function exceeds the arterial function.	

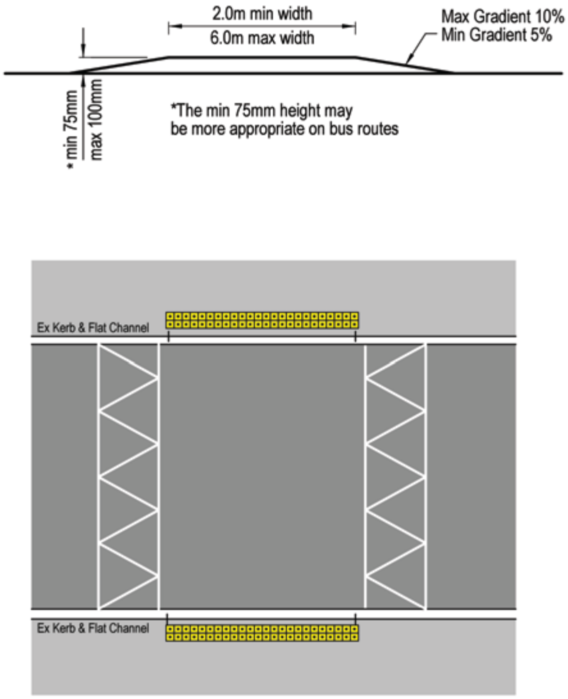


Figure 15.11 – Typical dimensions of a pedestrian platform

Photo 15.10 – Sign on bollard delineates edge of roadway, Palmerston North (Photo: Tim Hughes)

It is important that pedestrians do not falsely perceive the platform as a continuation of the footpath. This especially applies where there are concentrations of pedestrians who may lack experience or understanding, such as children or the elderly [80, 81].

To avoid misunderstanding:

- the material on top of the platform should be significantly different in colour and/or texture from the paved footpath
- there should be a clear demarcation between the platform and the footpath.

There are a number of ways to follow these design criteria and indicate who has priority. These include [58]:

- using different surfacing materials
- maintaining a significant height difference between the top of the platform and the footpath
- using a white concrete beam between the edge of the platform and the footpath
- using colour contrasted tactile warning indicator paving along the footpath at the boundary with the platform
- using bollards or other street furniture.

This should reduce the need for any signage, although some road controlling authorities (RCAs) have installed signs on platforms, such as 'Pedestrians watch for vehicles' or 'Pause'.

A wide variety of different surfacing materials can be used. They must [58]:

- be highly durable
- be able to withstand the impact of moving traffic
- retain their colour, texture and/or contrast well
- have a high skid resistance, with a sideways force coefficient higher than 0.55 [157]
- bond well with road marking material
- be compatible with underlying or adjacent material
- minimise the effects of glare, bright-sky reflection and wet roads at night.

Pedestrian platforms can be combined with other types of pedestrian crossing, as long as the latter are appropriate. The overall design must comply with all relevant requirements, including all signing and roadway marking regulations.

Drivers must be made aware of a pedestrian platform in good time so they can reduce their speed. An approved warning sign (PW-39) is available for this [80]. Markings are also required on the approach ramps as the drivers' view of the top of the platform is restricted. A 'zigzag' marking in white reflective paint, such as that in figure 15.12, should be installed across the full width of the approach ramp.

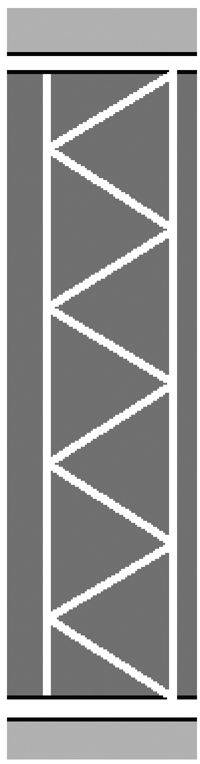


Figure 15.12 – Reflective 'zigzag' marking on platform approach, lines 150mm wide

15.12 Zebra crossings

Zebra crossings should not normally be sited [58, 146]:

- within 100 m of:
  - any other pedestrian crossing point on the same route
  - a major intersection unless located at the intersection
  - a signalised pedestrian crossing
- near speed humps, unless they are combined with the speed hump (as a platform)
- where the speed limit exceeds 50 km/h, without specific approval from Land Transport NZ.

Table 15.7 highlights locations where zebra crossings are not normally suitable [58, 66].

Photo 15.11 – Zebra crossing, Marine Parade, New Brighton. Christchurch (Photo: Basil Pettigrew)

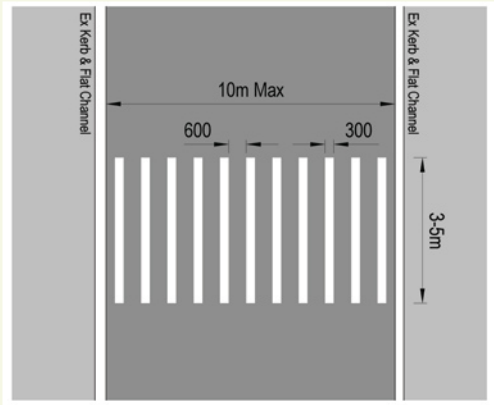
Table 15.7 – Unsuitable locations for zebra crossings

Unsuitable location	Difficulties	Solution
Multi-lane or divided roads	**Stationary vehicles can obscure pedestrians.** **Some drivers will overtake a car stopped in another lane.**	**Consider pedestrian islands.** **Consider mid-block pedestrian signals.** **In the rare cases where a zebra crossing is justified, it should be made more conspicuous through extra signing and other measures.**
Close to junctions	**Drivers focus on the junction rather than the crossing.** **Forward visibility of the crossing may be less than desirable.**	**Consider pedestrian islands.** **Consider signalising the junction and including a pedestrian phase.**

Kerb ramps on the adjacent footpaths (installed to the standards in section 15.6) provide access to zebra crossings.

In urban areas, pedestrian desire lines for zebra crossings may be very close to, or at, a lightly used driveway. Locating them here is not a safety hazard [58], although pedestrians may find their route blocked or become confused by a turning vehicle [58]. However, the transition between the footpath and the crossing must be carefully considered, as a standard driveway cut-down will not meet the minimum standards for a kerb ramp [58].

Table 15.8 summarises the key features of zebra crossings. Further details can be found in MOTSAM [154].

Table 15.8 – Design elements of zebra crossings		
Sign/marking		**Dimension and location**
Roadway markings	Bar markings	Transverse bars must be painted reflectorised white, at least 2 m long (3 m or more desirable) and 0.3 m wide with a 0.6 m gap between. 
	Diamond	An advance warning diamond can be located at least 50 m in advance of the crossing on each approach. However, if the 85%ile speed is consistently and significantly less than 50 km/h, the diamond should be at the safe stopping distance plus 5 m.
	Centrelines	If a centreline is marked on the roadway, a single white line 50 m long (rural) or 30 m long (urban) should be marked, terminating at the hold line on both approaches. The centreline should not pass through the crossing.
	Hold lines	A single white limit line 300 mm wide must be installed 5 m back from the bar markings.
	Edge lines	These should be stopped short of the crossing at the hold lines.
	No stopping lines	At least 6 m (preferably 8 m to 15 m) of broken yellow line on the upstream approach to the crossing.
Other signs and markings	Crossing poles	Black and white (preferably reflectorised) striped poles, at least 2 m high and 75 mm wide, located within 2 m and upstream of each end of the crossing including any traffic islands.
	Lighting	Crossings must be illuminated at night. If the RCA is of the opinion that the crossing will not be used at night it must still be illuminated by street lighting.
	Belisha beacons/fluorescent orange discs	An internally lit flashing amber beacon, or fluorescent orange disc, at least 300 mm in diameter, mounted on the crossing poles.
	PW-30 warning signs	These must be used on both approaches in advance of the crossing.

Although zebra crossings may be legally up to 15 m long, none should be longer than 10 m [58, 146]. Where a longer distance is likely, kerb extensions should be used to reduce the distance travelled in one crossing movement [58]. If kerb extensions cannot be used, pedestrian islands may be installed instead. Islands should be at least two metres wide [58] and be of the chicane or diagonal type so that pedestrians are turned to face oncoming vehicles. In traffic-calmed environments (where speeds are less than 50 km/h) zebra crossings can be installed on pedestrian platforms, as long as they use zebra crossing signs and markings. The bar markings on the platform must be reflectorised white material.

Figures 15.13, 15.14 and 15.15 show the signs and markings for zebra crossings on platforms, with kerb extensions and with a pedestrian island. For other situations, see MOTSAM [154].

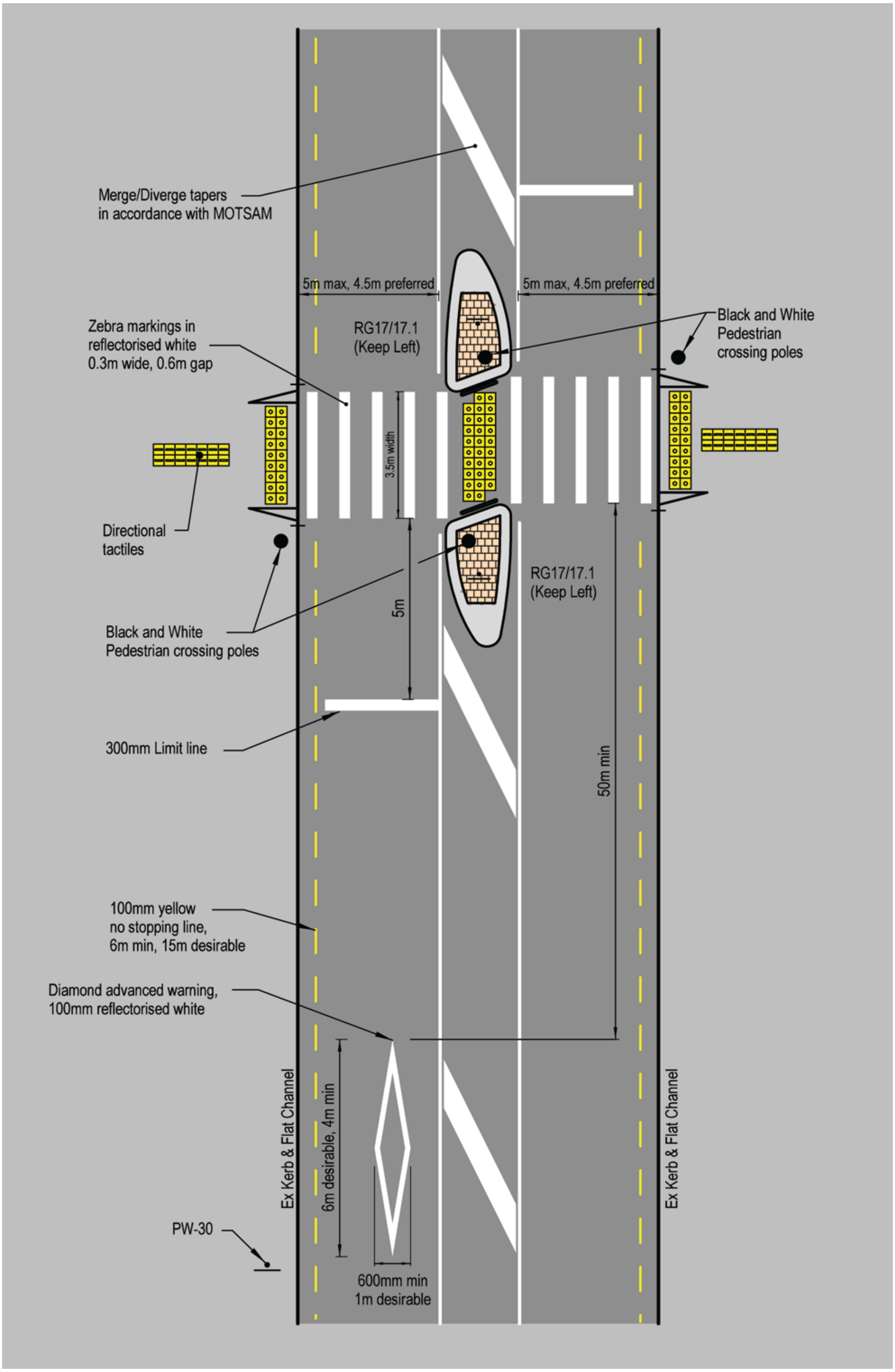


Figure 15.13 – Markings for zebra crossing with island

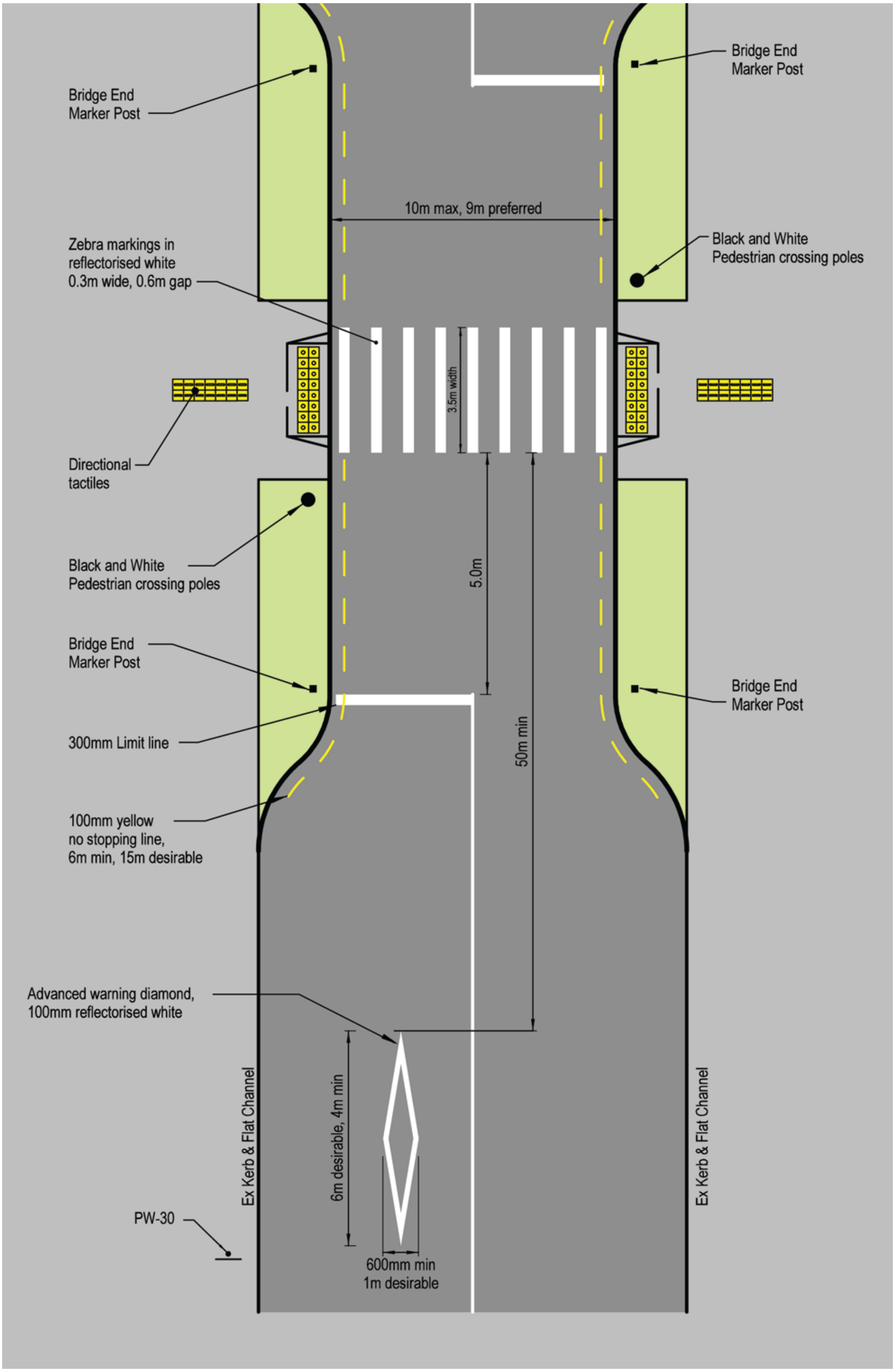


Figure 15.14 – Markings for zebra crossing with kerb extensions

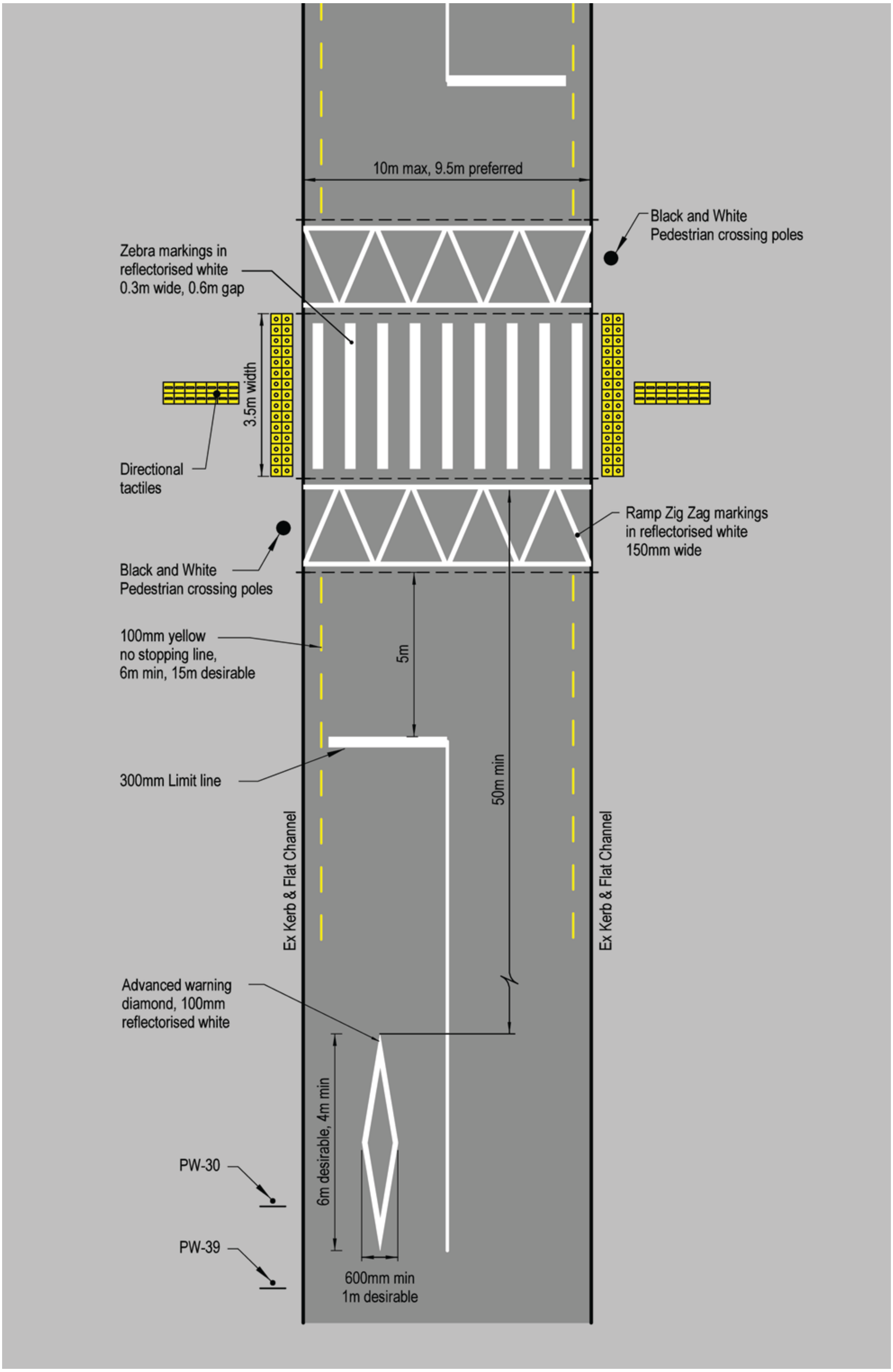


Figure 15.15 – Markings for zebra crossing on platform

15.13 Mid-block pedestrian signals

Pedestrian signals are usually installed only where there are enough pedestrians to ensure the signals are activated regularly. If the signals are not activated regularly, drivers can develop the expectation that pedestrians will not be crossing, leading to safety issues. The alternative may be to signalise a nearby intersection.

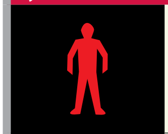
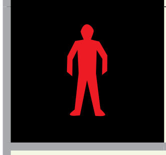
Timings

Safe operation of signals requires high levels of pedestrian compliance so the signals should respond promptly to pedestrian demand. This needs to be considered in relation to system coordination needs for efficient traffic flow [66]. There are two ways of improving signal responsiveness to pedestrians:

- Exclude the mid-block pedestrian signals from the coordinated system and rely on the system to correct the delays.
- Consider the wider area and determine if the system reflects the road user hierarchy. Shorten the system cycle times accordingly.

The signal timings should allow for the maximum practical crossing time for pedestrians. Table 15.9 summarises ideal pedestrian timings.

Table 15.9 – Symbols of pedestrian signal heads

Symbol		Meaning	Ideal timings	Minimum timings
	Steady red pedestrian figure	Do not step out on to the road. Wait by the kerb.	The green walking pedestrian symbol should be displayed as soon as practicable after the call button is pressed.	The longest average waiting time should be 30 seconds to avoid pedestrians choosing their own gap and trying to cross.
	Green walking pedestrian figure	After checking it is safe to do so, walk across the road.	Provide sufficient time for all waiting pedestrians to enter the crossing. This depends on depth of waiting space occupied and agility of users.	Five seconds (six seconds preferred). At shorter intervals, some pedestrians may start to cross and then turn back.
	Flashing red pedestrian figure	Do not step out on to the road, but finish crossing if already in the road.	A pedestrian who has just entered the roadway and is travelling at the 15th percentile speed (default 15 m/s) on the longest valid crossing route, should be able to reach the opposite kerb before the steady red pedestrian figure appears.	

[41, 46, 66, 111,139]

Walking speeds should always be estimated conservatively (see section 3.4), with additional allowances where needed for [139]:

- some pedestrians, notably the elderly, who can take up to 1.5 seconds longer to start crossing
- people at the back of a large group of pedestrians, who will take some time to enter the crossing
- if the crossing is narrow, obstructions and delays between pedestrians walking in opposite directions.

Pedestrians should be able to see the signal heads whenever they are waiting and crossing [66, 139, 146]. The heads should be at least 2.1 m above the footpath to ensure they do not create a hazard.

Detection

Pedestrians are usually detected when they press a push-button. These push-buttons should have all the audible and tactile features specified in 'AS 2353: 1999: Pedestrian push-button assemblies' (see figure 15.16). For more details, see *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

Pressure-sensitive mats or infrared detection are also used – most often to cancel a phase because the pedestrian has departed [24, 58]. They should always be accompanied by a push-button system. Their use to cancel a phase is not recommended until the technology more reliably detects that the pedestrian has really departed.

Photo 15.12 – Pedestrian call button with explanation (Photo: Tim Hughes)

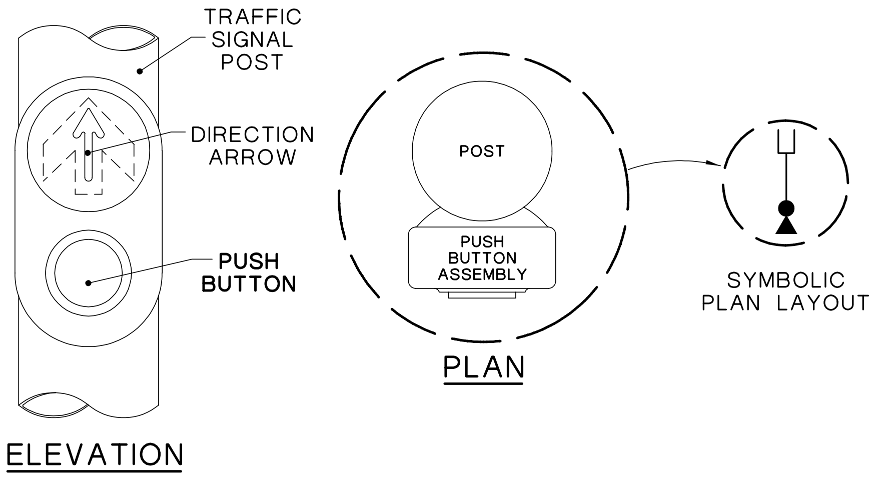


Figure 15.16 – Pedestrian push-button assembly

Detected pedestrians should have their presence acknowledged so they know the signals are working and they will receive a crossing signal [139]. This may be by:

- an indicator light near the push-button
- an audible sound
- the opposite pedestrian signal head lighting up.

Pedestrian push-buttons should be [92]:

- located consistently in relation to the through route and kerb ramps
- placed with the push-button facing the direction of travel, except on medians where the face is parallel to the crossing
- located in the median where the total road crossing distance is more than 36 m, or where the pedestrian phasing requires split crossing phases
- located on the traffic pole next to the crossing
- located less than one metre outside the outside pedestrian crosswalk line and less than one metre from the kerb face
- on the right side of the crossing point when facing the roadway at mid-block crossings.
- within reach of all pedestrians, including children and people using a wheelchair/ mobility scooter (400 mm to 600 mm from the kerb ramp and between 800 mm and 1000 mm above the ground surface)
- clearly accessible, with no obstructions such as the raised portion of an island (which may inhibit wheelchair occupants' ability to press the pedestrian push-button with their elbow)
- mounted with its face perpendicular to the direction of the crossing, so the pedestrian is facing it.

If there is no pole for the push-button, or the poles are too far from the crossing, an additional pole shall be installed and positioned so that it does not confuse pedestrians.

Crossing design

Kerb ramps on the adjacent footpaths (installed to the standard in section 15.6) provide access to the crossing point.

Vision impaired people must be made aware of the crossing opportunity and be able to use it safely. This means [13, 46, 58, 92]:

- installing tactile paving in accordance with *Guidelines for facilities for blind and vision-impaired pedestrians* [92]
- providing audible tactile devices at all new and upgraded installations.

When using audible tactile devices, ensure that locations are treated consistently. More details are available in *Guidelines for facilities for blind and vision-impaired pedestrians* [92]. If they are being installed at unusual or complex locations, designers should also consult potential users or their representatives (such as the Orientation and Mobility instructors from the Royal New Zealand Foundation of the Blind).

MOTSAM [154] covers the appropriate layout for mid-block signals, and figure 15.17 has an example. Drivers must be able to see the signal heads over the whole approach sight distance [146].

Photo 15.13 – Mid-block signals, Riccarton, Christchurch (Photo: Basil Pettigrew)

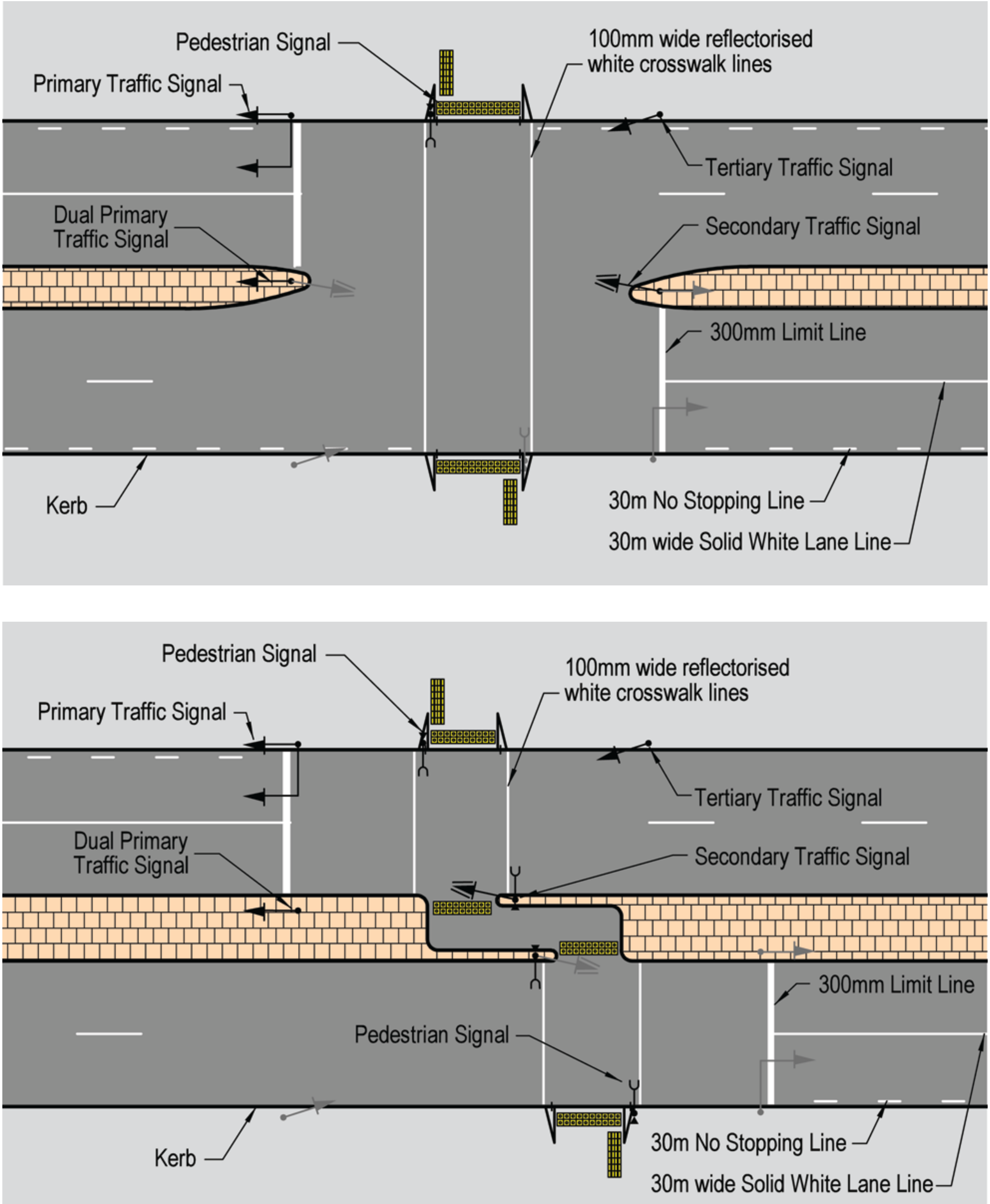


Figure 15.17 – Examples of signalised mid-block pedestrian signals

To shorten the crossing distance, mid-block signals can be combined with kerb extensions. However, where kerb extensions are not possible and the crossing distance is more than 15 m, pedestrian islands and raised medians can be considered [58]. In this case [13, 42, 139, 146]:

- pedestrian detection can be installed to help slower pedestrians who cannot cross in time, or a call-button could be installed to reactivate the pedestrian phase
- a chicane arrangement can be used so that pedestrians are turned to face oncoming vehicles. This also means crossings on either side of the island/median can be activated at different times (staged crossings)
- if using staged crossings, visors should be installed on each set of pedestrian signal heads so that pedestrians do not mistake one set for another.

15.14 Grade separation

Overpasses and underpasses are fundamentally different in their grade changes. However, they do share some common features, notably that they are most effective when pedestrians believe they are easier to use than at-grade crossings [13].

Pedestrians should ideally stay at the same grade when crossing, or have only a minor change in level – if necessary, the road should be elevated or sunk [6, 66, 118, 139, 146]. In planning for new areas where a grade-separated crossing is required, it may be possible to utilise the terrain to achieve this. If this is not possible, ramps and steps that comply with best practice are required (see section 14.10).

Both over- and underpasses usually result in longer walking journeys than at-grade crossings – and they are unlikely to be used where the walking distance is more than 50 percent greater than the at-grade distance [66]. Even when less than this, some pedestrians will try to take the shortest route, so fences may be appropriate [10, 58, 139]. These should be continuous, unclimbable and long enough to prevent people walking around the ends [59].

Many dimensions for over- and underpasses are determined by specific site conditions. Table 15.10 shows some general dimensions [10, 13, 118, 146].

Table 15.10 – Dimensions of width and height

Parameter	Value	Additional information
Width	At least 2.4 m	It should be greater where the route is shared with other road user types.
Overhead clearance	At least 2.1 m	Greater clearance can help make the overpass/underpass feel more 'open'.
Grade change	No more than 6.5 m	For overpasses only.
	No more than 3.5 m	For underpasses only.
Roadway clearance	At least 4.9 m (6 m on over-dimension routes)	For overpasses only.

Pedestrians can be concerned for their personal security at both under- and overpasses [118], particularly if they are not well used [139]. To overcome this [13, 66, 118, 139, 146]:

- structures should be well lit, potentially on a continuous basis
- skylights should be provided in underpasses
- pedestrians should always be able to see their whole route without any obstructions or recesses, and (where possible) from a public place some distance away
- the route should include direction signs
- closed circuit television installations may be used
- each entry/exit should have 'natural surveillance' from adjacent buildings.

Photo 15.14 – Underpass, Pukete, Hamilton (Photo: Tim Hughes)

15.15 General design considerations at intersections

Pedestrian safety is paramount for intersection-based crossings. However, there are a number of competing design objectives [92], such as:

- there should be separate crossings for each direction at a corner
- the kerb crossings should be in the direct line of the pedestrian through route. Where this is not possible, environmental or tactile cues should guide people to the crossing point
- the kerb should be perpendicular to the pedestrian through route
- drivers (particularly those turning left) should be able to predict the location of pedestrians who are about to leave the kerb
- vehicle turning speeds should be slow.

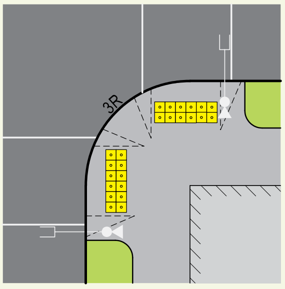
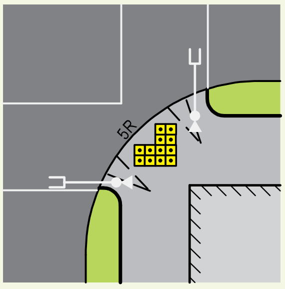
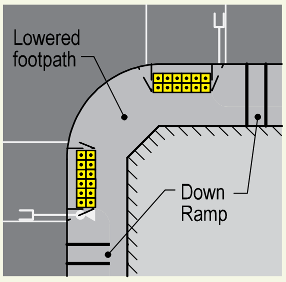
Large corner radii should be minimised, as they compromise nearly all these objectives. Kerb corner radii are also dictated by the needs of larger vehicles likely to turn at the intersection. The hierarchy of space needs is [92]:

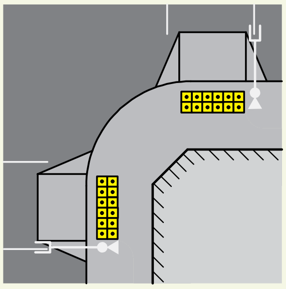
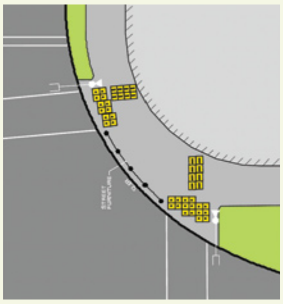
- the largest design vehicle turns left, crossing the centreline in one or both streets (appropriate on low-volume local roads)
- the largest design vehicle turns left without crossing either centreline (appropriate for CBD, collector and minor arterial roads)
- the largest design vehicle turns left from the kerbside lane while staying left of the centreline on the road being entered (turning left from a major road intersection multi-lane approach)
- the largest design vehicle turns left from kerbside lane into kerbside lane without encroaching on any other lane (appropriate for intersections between major multi-lane roads).

Slip lanes separated by islands should be considered if large kerb radii are required.

Section 15.6 covers kerb ramps and design details. Kerb ramp installations at intersections will depend on the location, the type of street and other design constraints [6, 13, 24, 118]. Table 15.11 shows the options.

Table 15.11 – Installing kerb ramps

Kerb ramp arrangement	Diagram	Design issues
Perpendicular		**Requires a suitable top landing for mobility impaired pedestrians.** **It is not suitable for narrow footpaths unless a kerb extension is provided.** **Install kerb ramps in pairs at street corners.** ***Preferred arrangement.***
Diagonal		**This forces mobility impaired pedestrians to change direction within the ramp or roadway.** **It is more difficult to provide unambiguous directional guidance for vision impaired users.** **Audible signals from push-button assemblies are closer together, so more likely to confuse.** **It is cheaper to install than two perpendicular kerb ramps.** ***Not recommended: prefer perpendicular instead.***
Lowered perpendicular		**This is similar to a perpendicular kerb ramp but the entire footpath is lowered near the intersection.** **It is suitable for narrow footpaths as the kerb ramp length is reduced owing to the lower kerb height.** **Attention is required to drainage.** **Install in pairs at street corners.** ***Preferred arrangement for narrow footpaths.***

Kerb ramp arrangement	Diagram	Design issues
Projected		**This ramp:** • **can be installed on narrow footpaths** • **creates a hazard for passing traffic and cyclists** • **creates maintenance problems** • **can create drainage problems** • **can encourage pedestrians to walk into the roadway too soon.** ***Not recommended: use as a last resort for very narrow footpaths.***
Wide radii		**This can be installed at intersections where large kerb radii are unavoidable and slip lanes are not provided.** **The crosswalks are set back to improve the angle that the kerb is crossed and reduce the crossing distance.** **Angled kerb ramps require bottom landings.** **Street furniture is required.** ***Not preferred: where crosswalks cannot be set back diagonal may be better.***

The preferred option is individual kerb ramps separated by a vertical upstand kerb for each of the possible pedestrian directions of travel. There should be at least one metre of full kerb upstand between the ramps to minimise a tripping hazard.

Photo 15.15 – Use of kerb extensions maintains straight continuous accessible path, Featherston St, Wellington (Photo: Tim Hughes)

Photo 15.16 – Short kerb between crossing points is a tripping hazard, Christchurch (Photo: Paul Durdin)

15.16 Signalised intersections

Section 15.13 covers general design considerations for pedestrians at traffic signals, including timings, signal heads and pedestrian call buttons. Section 15.15 covers general intersection design for pedestrians. This section provides additional advice specific to signalised intersections.

Where a signalised intersection has a pedestrian phase, provision should be made for crossing on each junction arm. Without this [66]:

- walking distances can increase
- it can take longer to cross the intersection
- pedestrians will try to cross arms where there is no provision.

Table 15.12 shows the two general pedestrian phase types for signalised intersections [46, 66, 139]. Shorter cycle times are better for both, as this minimises pedestrian waiting times [46].

Table 15.12 – Potential signal phasings

Phasing	Definition	Design issues
Exclusive (dedicated/ Barnes dance)	All vehicles stop and pedestrians can walk in all directions, including across the diagonal.	It is beneficial where there are high pedestrian numbers. It is safer for pedestrians than concurrent phasings. There is greater delay to vehicles. Pedestrian have to wait longer to cross. Those walking on the diagonal have further to travel and may not be able to see the signal heads.
Concurrent (parallel)	Vehicles yield the right of way to pedestrians crossing the road into which they are turning.	Pedestrians normally have a shorter wait. There is less delay to vehicles. Pedestrians may feel intimidated by turning vehicles. A high number of pedestrians can prevent turning vehicles from completing their manoeuvre. Heavy vehicles have blind spots to the side. When turning, drivers may be unable to see pedestrian crossing from alongside.

With concurrent phasing, pedestrians and parallel drivers set off at the same time, and this can lead to conflict with turning vehicles. Fortunately turning traffic speeds are generally low so collision consequences are usually minor unless they involve a heavy vehicle. Heavy vehicles have blind spots to the side. It may not be possible for a driver to see a pedestrian arriving from behind the heavy vehicle.

The likelihood of conflicts between pedestrians and turning traffic and especially heavy vehicles should be assessed and design and phasing options considered that minimise the risks. Arrows can be used to stop turning traffic during the entire pedestrian phase or to hold back the turning traffic until pedestrians are well in view.

Left turn slip lanes manage this heavy vehicle conflict well, increase intersection safety and efficiency for all users. In designing slip lanes it is important to have a high entry angle to reduce traffic speeds and thereby reduce the risk to pedestrians.

At left turn slip lanes, use the approach in section 6.5 to choose the most appropriate crossing facility. As there is only one lane to cross, opportunities to cross will be frequent unless traffic flows are very high, so kerb crossings alone will often be sufficient. If pedestrian priority is desired, consider using a zebra crossing on a platform. Where continuous streams of pedestrian are unduly interrupting left turning traffic, controlling the left turn slip lane with signals may be considered but at the expense of pedestrian delay and compliance. Vision impaired pedestrians prefer signals. Figure 15.18 is an example of appropriate slip lane treatment.

Pedestrian push-buttons should be located close to the side furthest from the intersection [58] and preferably more than three metres apart to ensure there is no confusion about which button to push or audible signal to monitor [92].

Photo 15.17 – Platform pedestrian crossing free turn, Northlands mall exit, Christchurch (Photo: Tim Hughes)

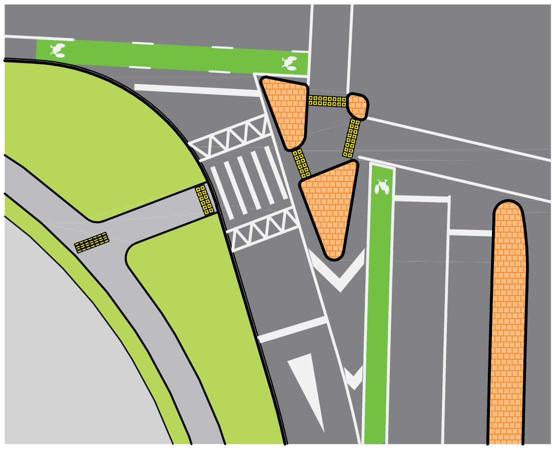


Figure 15.18 – Example of slip-lane treatment

15.17 Roundabouts

When providing pedestrian facilities at roundabouts [9]:

- vehicle speeds should be kept low by providing adequate vehicle deflection, and ensuring that on each approach, vehicle intervisibility to the right is not excessive
- splitter islands should be as large as the site allows, with cut-throughs (designed similar to pedestrian islands) one or two car lengths back from the limit lines
- pedestrians must have an adequate sight distance, which may mean banning parking
- street lighting must illuminate the circulating roadway and the approaches
- signs and vegetation must not obscure small children.

Some vision impaired people find roundabouts particularly difficult to negotiate owing to confusing audible information from cars approaching and exiting the roundabout. This means some vision impaired pedestrians prefer to cross mid-block away from the roundabout – so if there are a number of vision impaired people in the area, install additional mid-block crossing facilities upstream of the roundabout approaches.

Photo 15.18 – Crossing point by roundabout, St Albans, Christchurch (Photo: Tim Hughes)

15.18 Crossing assistance for school children

Section 6.6 discusses planning for, and the advantages and disadvantages of, different crossing assistance schemes and devices for school children. Carefully consider both sections 6.5 and 6.6 first. The two facilities exclusive to school children, school patrol crossings and kea crossings, are forms of control that should be considered after other factors and may not be the most appropriate solution.

For all school crossings, visibility distances must meet or exceed the relevant crossing sight distance [8, 126] detailed in section 15.3 and must exceed the approach sight distance detailed in section 15.4.

15.18.1 School patrol crossings

The zebra crossing that the school patrol operates on should be designed as set out in section 15.12, and may include kerb extensions, pedestrian platforms and pedestrian islands. In addition to the usual signage and markings and any bans of, or controls on, parked vehicles necessary for safety, a PW-33 'SCHOOL' sign should be fitted below the PW-30 sign [154]. The word SCHOOL can also be painted on the approach lane between the standard diamond and the crossing itself.

15.18.2 Kea crossings

Kea crossings must meet the same site, location and design layout requirements as school patrol crossings, except those for signs and markings detailed below. As discussed in section 6.6, a kea crossing operates in the same way as a school patrol zebra crossing, but when it is not operating, the crossing point reverts to a section of road where pedestrians select a safe gap in the traffic. Table 15.13 outlines the elements of a kea crossing.

Photo 15.19 – School patrol, Shirley Road, Christchurch (Photo: Basil Pettigrew)

Table 15.13 – Elements of kea crossings

	Sign/marking	Dimension and location	
Permanent signs and markings	'School' warning signs (PW-31 and PW-32)	One per approach, installed 65 m ahead of the crossing.	
	White reflectorised L-shaped 'limit' lines	One per approach, installed 5 m ahead of the crossing point edge, with a solid centreline on each approach at least 30 m long and a limit line 300 mm wide.	See figure 15.19
	Two pedestrian holding lines on each side of the crossing	1.5 m to 3 m apart, starting 0.75 m behind the kerb face on each side of the crossing or yellow tactile warning indicators across full kerb crossing width.	See figure 15.19
Temporary signs and markings	Fluorescent orange 'children' flag signs (PW-31)	One per approach, mounted on a 2 m white post permanently installed on the footpath within 0.3 m of the vehicle limit lines. The signs should be visible to approaching traffic for at least 60 m.	
	Staff-mounted 'School Patrol – Stop' signs (RG-28)	One per approach on a 'swing-out' mounting, within 0.3 m of both the crossing point definition lines and the kerb face.	

Figure 15.18 shows the road markings, including the elements in Table 15.13.

The roadway width at a kea crossing should be kept to a minimum. However, it is important to consider the needs of cyclists passing through the crossing and provide them with an adequate width. Advice on crossing widths for different situations is provided in section 15.8. To minimise width, the use of kerb extensions and pedestrian islands may be required.

Only an RCA can mark out or maintain a kea crossing [111]. However, approval from Land Transport NZ is not required as long as the speed limit is 50 km/h or less and the crossing fully complies with the specifications in the traffic control devices rule [111].

Photo 15.20 – Kea crossing on platform, St Albans, Christchurch (Photo: Basil Pettigrew)

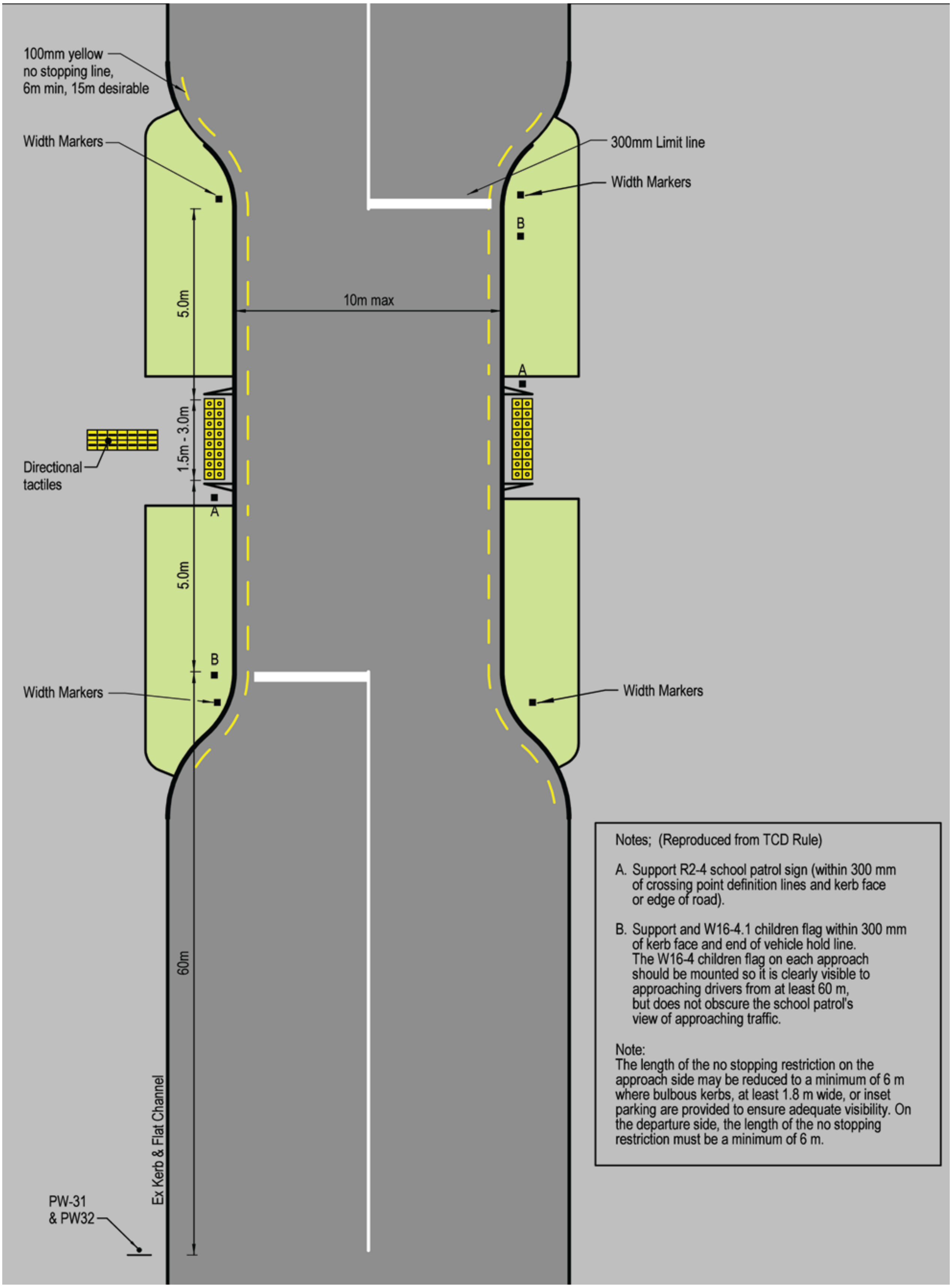


Figure 15.19 – Layout of a kea crossing

15.19 Railway crossings

There are several design issues to address for locations where pedestrians cross a railway line at-grade.

To avoid pedestrians tripping on the rails, the footpath across the railway lines should be at the same level as the top of the rails [10]. If the pedestrian crossing point is adjacent to a vehicle crossing point this can be easily achieved by widening the roadway. The flange gap (the gap between the rails and the pavement, as shown in figure 15.20) should be no greater than 63mm and have a strong edge. This is to minimise the risk of trapping the wheels of a wheelchair.

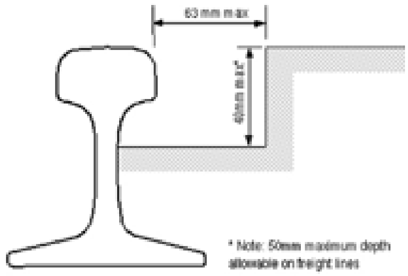


Figure 15.20 – Flange gap requirements

Railway crossings must be accessible for all types of pedestrian, including those using walking aids. Warning must be given to show pedestrians they are entering a hazardous area. Tactile warning indicators should be provided with the nearest edge no closer than 3m from the track centre line and at right angles to the pedestrian direction of travel. Exposure is minimised by ensuring that crossings are perpendicular to the railway lines.

Photo 15.21 – Warning systems, Papakura (Photo: David Croft)

No single treatment will completely solve all safety issues [138] and it is particularly difficult to prevent pedestrians from deliberately crossing when it is unsafe to do so [161]. Thus supplementary signage and physical guidance measures leading up to the crossing point are also required. When pedestrian flows are heavy or trains are frequent [10,138,161]:

- install fencing along the approach footpaths and along the rail reserve near the crossing, to ensure pedestrians use the designated route, as shown in photo 15.22
- if there is an automatic barrier for vehicular traffic, extend it across, or install separate barriers for the pedestrian route, as shown in photo 15.23
- use a maze to deviate the pedestrian route left and right in the immediate approach to the crossing. This encourages pedestrians to look for trains in both directions, as shown in photo 15.24 . A sample design of a pedestrian maze is shown in figure 15.21
- automatic pedestrian gates can be installed to prevent entry by unobservant pedestrians as shown in photo 15.25. Note that when the gate closes an exit maze is opened so pedestrian already on the crossing can escape
- provide notices on how to cross safely, as shown in photo 15.26
- use a higher surface standard for the pedestrian route than for the vehicular crossing, as illustrated by the rubber pad system in photo 15.27. The use of rubber or similarly designed concrete pads also act as a bridge that automatically adjusts to track movement, thereby maintaining a quality surface that does not quickly degrade or go out of alignment
- if the noise of bells is a problem at night time, use quieter bells rather than switching the bells off altogether
- provide advance warning systems to help slower moving pedestrians decide when to cross

Photo 15.22 – Fence between rail and pedestrian area, Christchurch (Photo: Axel Wilke)

These measures must be used in conjunction with each other as they will not be effective enough if used individually. For example, it is not enough to rely solely on bells as a warning system. Bells are especially unsuitable on their own in double-tracked areas where trains may be on either track [62]. Both physical and visual warnings are also necessary in such cases.

Photo 15.23 – Full automatic barriers, Hull, U.K. (Photo: Tim Hughes)

It is important to ensure that pedestrians use only the designated crossing points. Areas adjacent to railway lines that could be seen by pedestrians as attractive crossing points, such as open grassy spaces, should be fenced off to avoid any unsafe and unexpected crossings being made [62] as already shown above in photo 15.22, where the shared pedestrian and cycle track adjacent to the railway is well fenced.

As for any pedestrian facility, once at-grade railway crossings are installed, they must be maintained and checked regularly to ensure they meet pedestrians' needs. Note that all works on or immediately next to a railway line require approval from the appropriate rail access provider.

Photo 15.24 – Pedestrian rail crossing maze, Upper Hutt (Photo: Roy Percival)

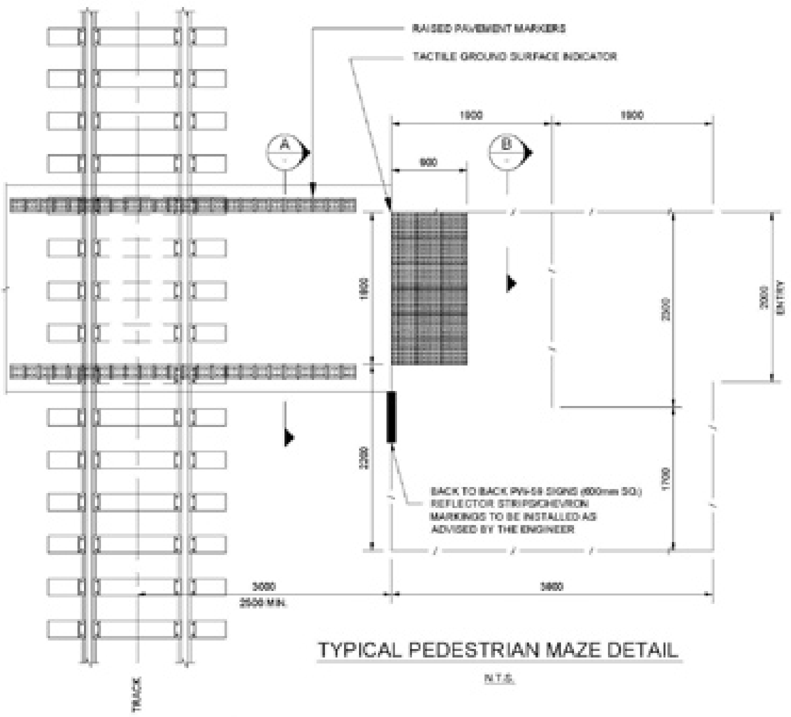


Figure 15.21 – Pedestrian rail crossing maze layout.

Photo 15.25 – Automatic pedestrian gate, Upper Hutt (Photo: Roy Percival)

Photo 15.26 – Safe crossing notice, Papatoetoe (Photo: David Croft)

Photo 15.27 – Rubber crossing surface, Tauranga (Photo: Greg Hackett)