

junctions & crossings

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4.1 Layout of junctions

The design of cycle facilities at junctions mainly depends on:

- the issue of priority.
- whether or not segregation is needed.

4.1.1 Right of way at junctions and crossings

The decision on whether or not to give cyclists priority depends largely upon:

- the possibility of altering motorised traffic flows (circulation or speed) on the main road;
- to what extent this can be done;
- the volumes of turning traffic;
- the volumes of bicycle traffic;
- the traffic speed on the main road.

Table 4.1 gives an indication of where and when cyclists should give way, or should be given priority (this is the same table 2.3 as presented in chapter 2). The table is based on different road functions, and also takes into account locations where cycle routes run alongside roads.

If the cycle route runs along a major road for motorised traffic, cyclists also benefit from the priority on the major road. This also applies to two-way cycle tracks (if the design is revised).

If a main cycle route crosses a road for mixed traffic (mostly residential streets), the cycle route may be given priority. Certainly this should be the case if the volume of cycle traffic is substantially greater than the volume of motorised traffic on the road to be crossed, and if it is obvious to road users that the cycle route is more important. The priority can be emphasised in the design, for example by the application of speed inhibitors for motorised

traffic. If a cycle route crosses a main road, and the priority cannot be given to the cycle route (because of the high speed and volumes of motorised traffic) then the following options should be considered:

- apply a grade separation;
- facilities should be designed to inconvenience cyclists to the least extent. For example: traffic lights can be adjusted to minimise the waiting times for cyclists by setting short waiting times (see traffic lights).

The above option should take into account the need to minimise the delay and provide safe areas for cyclists to stop and wait.

TABLE 4.1 | RECOMMENDATIONS FOR RIGHT OF WAY AT DIFFERENT TYPES OF JUNCTIONS

Cycle Route Along	Intersecting		
	Main urban road	District collector road	Residential street
Main urban road		Priority must be given to cycle and motorised traffic on the main urban road	Priority must be given to cycle and motorised traffic on the main urban road
District collector road	Highest priority (at traffic lights) or priority must be given to all traffic on the main urban road. At junctions with traffic lights, short waiting times should be given to cycle traffic.		Priority must be given to cycle traffic and to motorised traffic using the district collector road
Residential street	Highest priority (at traffic lights) or priority is given to all traffic on the main urban road. At junctions with traffic lights, short waiting times should be given to cycle traffic.	Priority should be given to all traffic on the district collector road.	

Refer to Table 2.3

4.1.2 Segregation versus integration at junctions and crossings

The choice between segregating or integrating cyclists and motorised traffic at junctions depends on:

- volumes and/or speeds of motorised traffic;
- the presence of segregated cycle tracks or on-road cycle tracks;
- the manoeuvres cyclists make on or close to the junction area.

There are no warrants or graphs currently available to assist in deciding between segregation and integration.

A significant disadvantage of visual or physical segregation is the resulting increase in junction size. This increase can lead to confusion and a false sense of security.

Advantages of segregated cycle facilities:

- guaranteed dedicated space for cyclists at a junction;
- cyclists can overtake waiting cars and can cross the junction without being obstructed by other traffic;
- they can provide a protective space where cyclists can calmly consider when to cross the junction;
- at junctions, they provide improved linkage with other cycling facilities;
- segregated cycle facilities make it possible to minimise waiting time for cyclists at traffic lights.



Cycle Track Through Junction (Holland)

4.2 Design tools

4.2.1 Curve radii for cycle tracks

The design speed of a cycle track determines the desired minimum curve radius. The relationship between curve radius and cycling speed is given in figure 4.1.

Low radii at junctions or intersections may be acceptable since lower design speeds might be desired or needed. Sometimes a bend with a low radius is deliberately created as a 'speed-inhibitor'. However, these should not be used too often. The absolute minimum curve radius is 4.00m. If lower radii are used, the cycling speed will drop below 12 km/h which makes it difficult for cyclists to keep their balance.

Figure 4.2 gives an indication of measures used at a junction with segregated cycle facilities.

FIGURE 4.1 | THE RELATIONSHIP BETWEEN CURVE RADIUS AND CYCLING SPEED

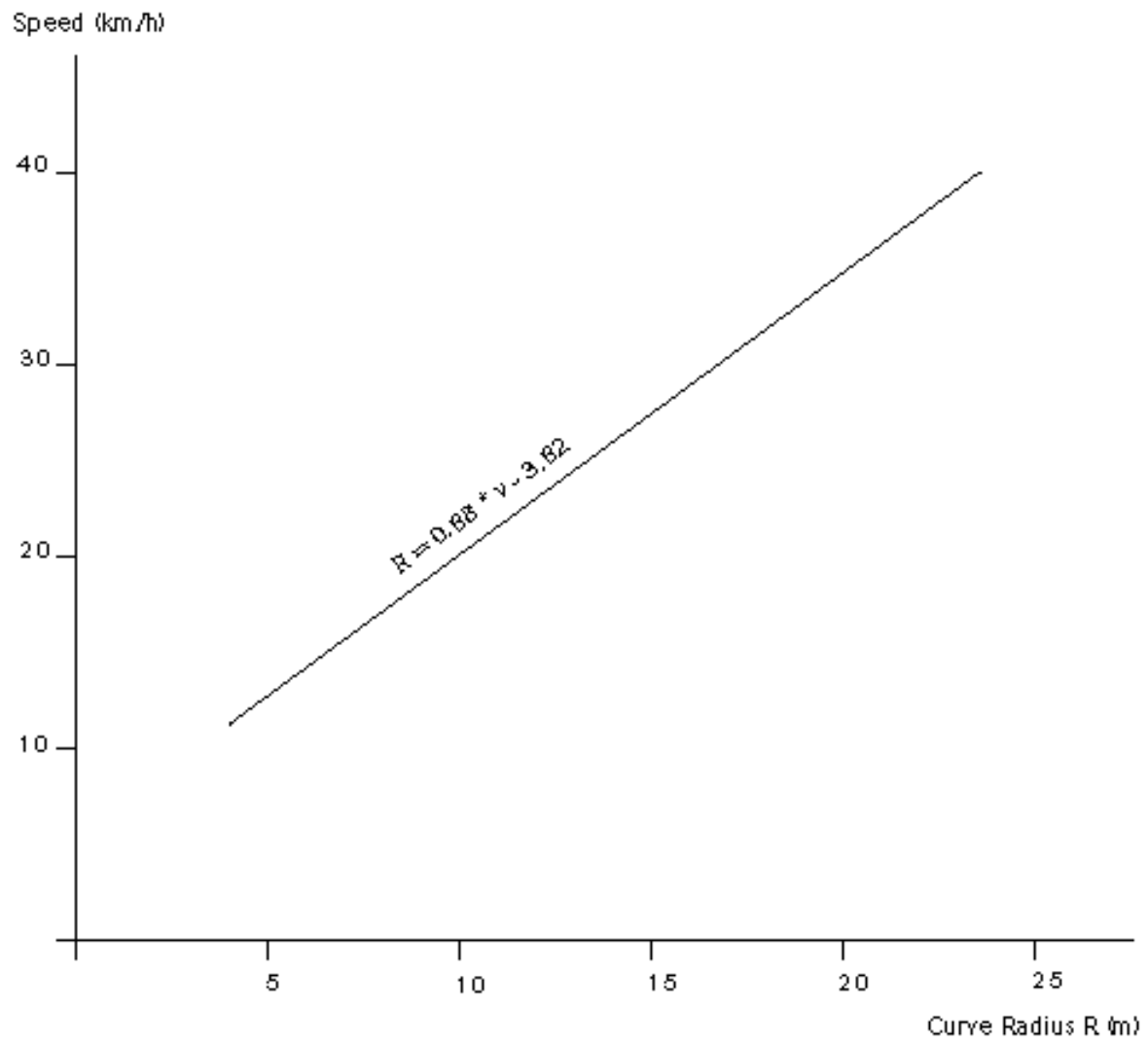
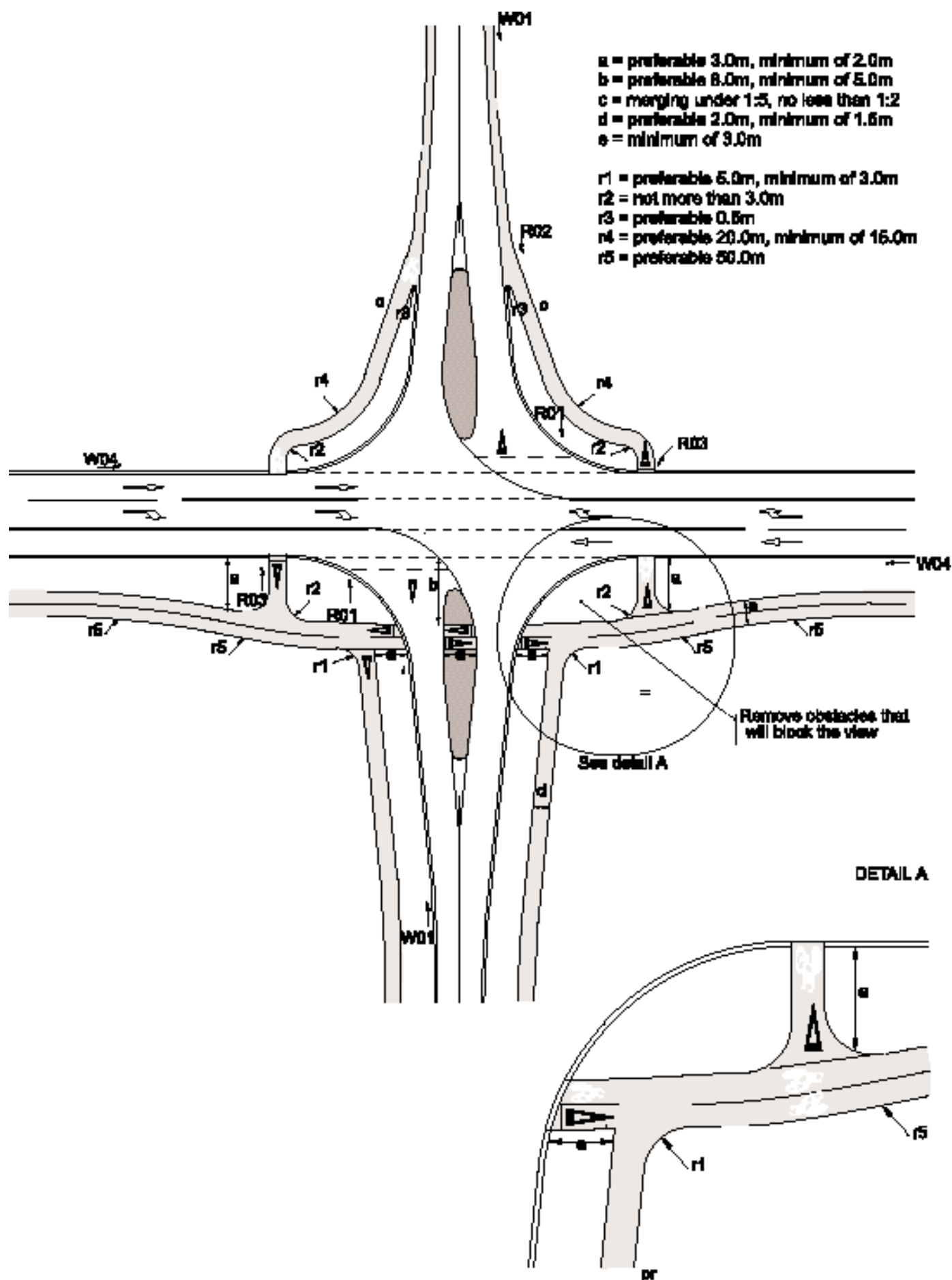


FIGURE 4.2 | JUNCTION WITH SEGREGATED CYCLE FACILITIES



4.2.2 Sight distances

The distance from which a cyclist can see an intersection and assess the speed of the approaching traffic is an important design element for all intersections or junctions.

Sight distance

To be able to cross a carriageway at a junction safely, cyclists must have a good sight line of the traffic on the road to be crossed. They should also be able to estimate the distance and speed of the traffic. Sight distance values for cyclists are given in Table 4.2.

Stopping distance

The stopping distance of cyclists is closely related to the sight distance. The stopping distance is defined as the distance covered during the perception-reaction time added to the braking time. The perception-reaction time of a cyclist to see, decide and start slowing or braking is approx. 2 sec. The deceleration rate of the bicycle is 1.5 m/s^2 . Table 4.3 shows the relationship between stopping distance and cycle speed.

TABLE 4.2 | INDICATIVE SIGHT DISTANCE VALUES FOR CYCLISTS CROSSING A CARRIAGEWAY

Crossing length	Crossing time for cyclists	Approach speed of motorised traffic (V85) and cyclists sight distance		
		30 km/h	50 km/h	70 km/h
5.00m	Approx. 4.5 sec	40m	65m	100m
6.00m	Approx. 4.9 sec	44m	70m	110m
7.00m	Approx. 5.3 sec	47m	75m	120m
8.00m	Approx. 5.6 sec	50m	80m	125m

TABLE 4.3 | INDICATIVE VALUES OF THE STOPPING DISTANCES FOR CYCLISTS

	10 km/h	15 km/h	20 km/h	25 km/h
Stopping distance	8m	14m	21m	30m

4.3 Possible cycle facilities at junctions

TABLE 4.4 | POSSIBLE CYCLE FACILITIES AT JUNCTIONS

Category		Shape	Reference to §
Without traffic lights	Physical segregation	Bending-out;	§ 4.4.1
		Bending-out of cycle track without raised crossing;	§ 4.4.1
		Bent-in cycle track;	§ 4.4.2
		Cycle track not bent-in nor out;	§ 4.4.3
		Exit construction with raised crossing	§ 4.4.4
		Cycle track not bent-in nor out with a speed hump;	§ 4.4.4
		Cycle facilities at roundabouts	§ 4.7.1 - 4.7.4
	Visual segregation	On-road cycle tracks	§ 4.5
		On-road cycle tracks at roundabouts	§ 4.7.4
	Mixed	No cycle facilities at junctions No cycle facilities at roundabouts	§ 4.6 § 4.7.5
With traffic lights	Physical segregation	Cycle facilities at major junctions	§ 4.8.2
		Facilities for cyclists turning right	§ 4.8.5
		Cycle facilities at large roundabouts	§ 4.8.6
	Visual segregation	Weaving lanes	§ 4.8.3
		Advanced stop line	§ 4.8.4
	Mixed	Bicycle friendly phasing strategies	§ 4.8.1
Crossing Facilities		With central barrier	§ 4.9
		With raised crossing	§ 4.4.4, § 4.9
		With a road narrowing	§ 4.9
		Only with road markings *	
		Toucan crossing	§ 4.9.1

* Note: see also fig 7.26 Signs and Lines Manual

4.4 Junctions with segregated cycle facilities

To cross a junction or a side road a cycle track can be bent-out or bent-in. Before presenting the different design options, an overview is given in table 4.5 of the segregated cycle facilities which may be applied at different junction types.

TABLE 4.5 | DESIGNS FOR SEGREGATED CYCLE FACILITIES AT JUNCTIONS

Intersection of Shape	Main Urban Road / District Collector Road	District Collector Road / District Collector Road	Main Urban Road / Residential Street	District Collector Road / Residential Street
1. Bending out	✓			
2. Bending out with raised crossing	✓			
3. Bending out of 2-way cycle track without raised crossing	✓			
4. Bending out of 2-way cycle track with raised crossing	✓			
5. Bent-in cycle track	✓	✓		
6. Cycle track not bent in or out	✓	✓	✓	✓
7. Cycle track not bent in or out with a speed hump	✓	✓	✓	✓
8. Cycle track crossing exit construction			✓	✓

4.4.1 Bending out of cycle tracks

Specification

- The bending-out of cycle-tracks away from the main carriageway should be gradual. In this way cyclists do not get the feeling that they are being forced to make a detour at a junction. Other road-users are not led to believe that cyclists are turning left.

Dimensions

- The limited bending-out of a cycle track to a distance of 5.00 m will optimise both safety and comfort. It will create adequate streaming space for vehicles entering and exiting the side road, and ensure that the bicycle crossing is kept sufficiently close to the main carriageway to make sure there is good visibility between cyclist and motorised traffic.
- A curve radius of 30m is recommended for one-way cycle tracks. The desirable minimum radius to be used is 10m. (absolute minimum is 4.0m - see 4.3)
- A curve radius of 50m is recommended for two-way cycle-tracks.

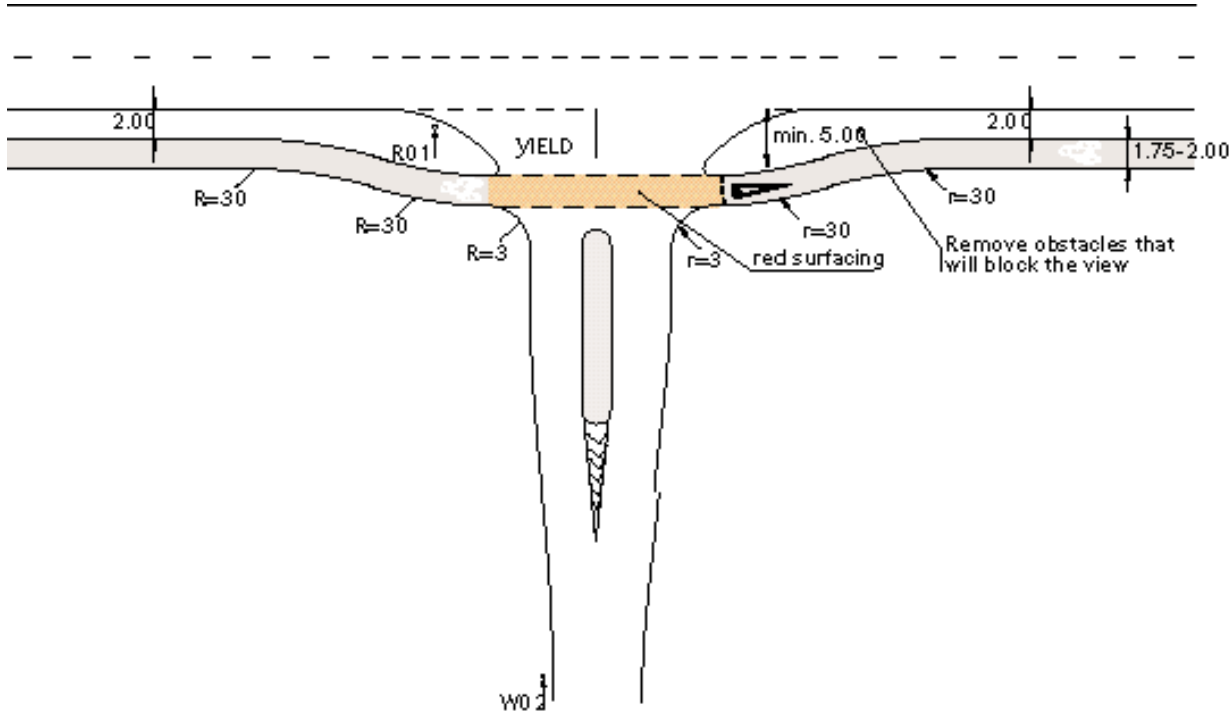
Legal status

- Cycle traffic should give way unless the cycle track is crossing an exit construction over a platform gateway.

General comments

- A significant advantage of a bent-out cycle track is the space gained for traffic tuning left from the main carriageway.
- If the cycle track gets bent-out more than 15m, cycle traffic will experience this as a detour unless, there is a clear reason (e.g. trees, electricity sub-stations or other physical objects).

FIGURE 4.3 | BENDING-OUT OF A CYCLE TRACK



4.4.2 Bending in of cycle tracks (fig 4.4)

Specification

- In this case, the segregated cycle track is pulled towards the main carriageway and merges into an on-road cycle track.
- By bending in cycle tracks, motorists turning left from the main road, will be in a better position to anticipate cyclists going straight ahead and to give them priority.
- The on-road cycle track should have a red surface.
- The on-road cycle track is bordered with broken white lines at a junction.

Dimensions

- The bending in should take place at least 30m before a junction. This minimum length of the on-road cycle track is related to the speed and braking distance of traffic turning left from the main carriageway (see table 4.3).

Legal status

- Cyclists as well as other traffic on the main road must be given priority.

General comments

- An advantage of this type of facility is that left turning large vehicles coming from the main road can see approaching cyclists more efficiently on the on-road cycle track by using their inside mirror. The blind spot is minimised.
- Disadvantages of bending-in of cycle tracks (compared to bending-out) are:

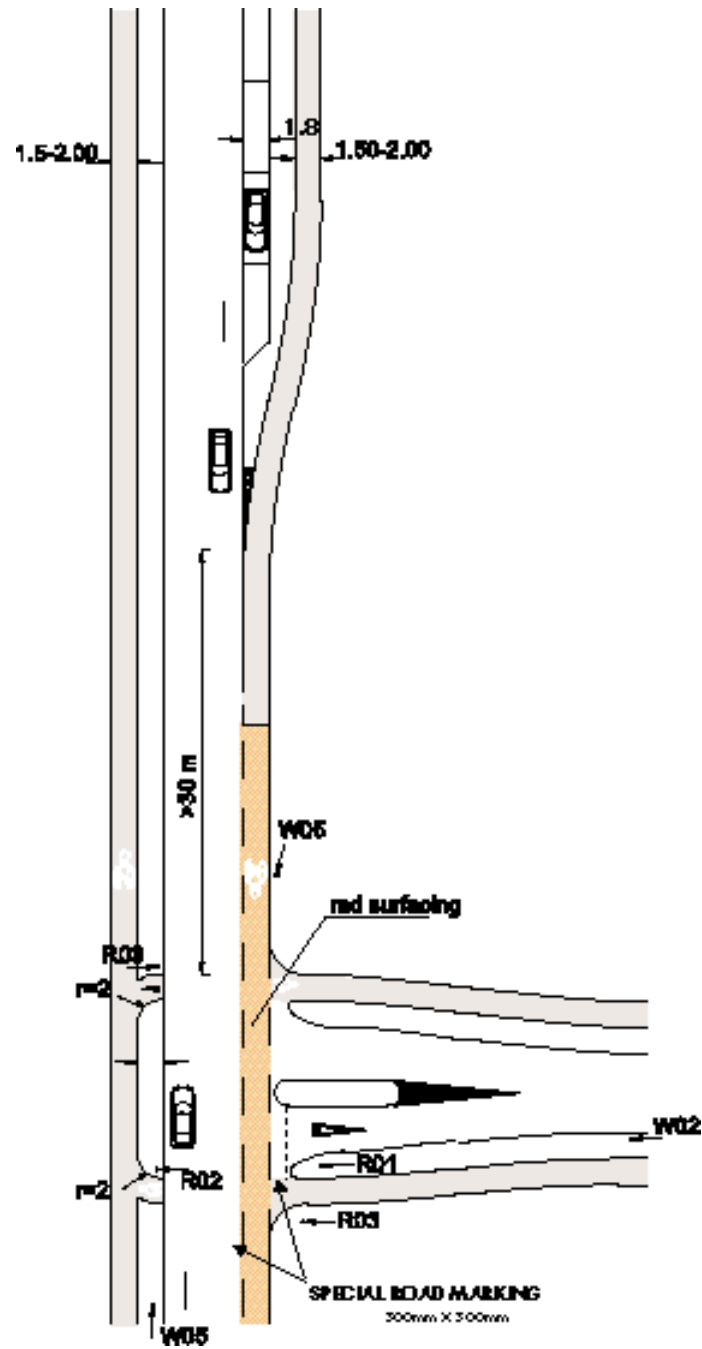
motorised vehicles on the main road and turning across the cycle track might, under

the pressure of the main traffic flow, take higher risks and not give priority to cyclists to ride straight ahead.

the bicycle-crossing can become blocked by vehicles waiting to come out of the side-road.

- This facility is not advised at roads with a large number of vehicles turning left off the main road.
- At roads with a large number of vehicles turning right, coming from the opposite direction on the main road, a vehicular right turning lane should be provided.

FIGURE 4.4 | BENT-IN CYCLE TRACK



4.4.3 Not bending the cycle track in or out (fig 4.5)

Specification

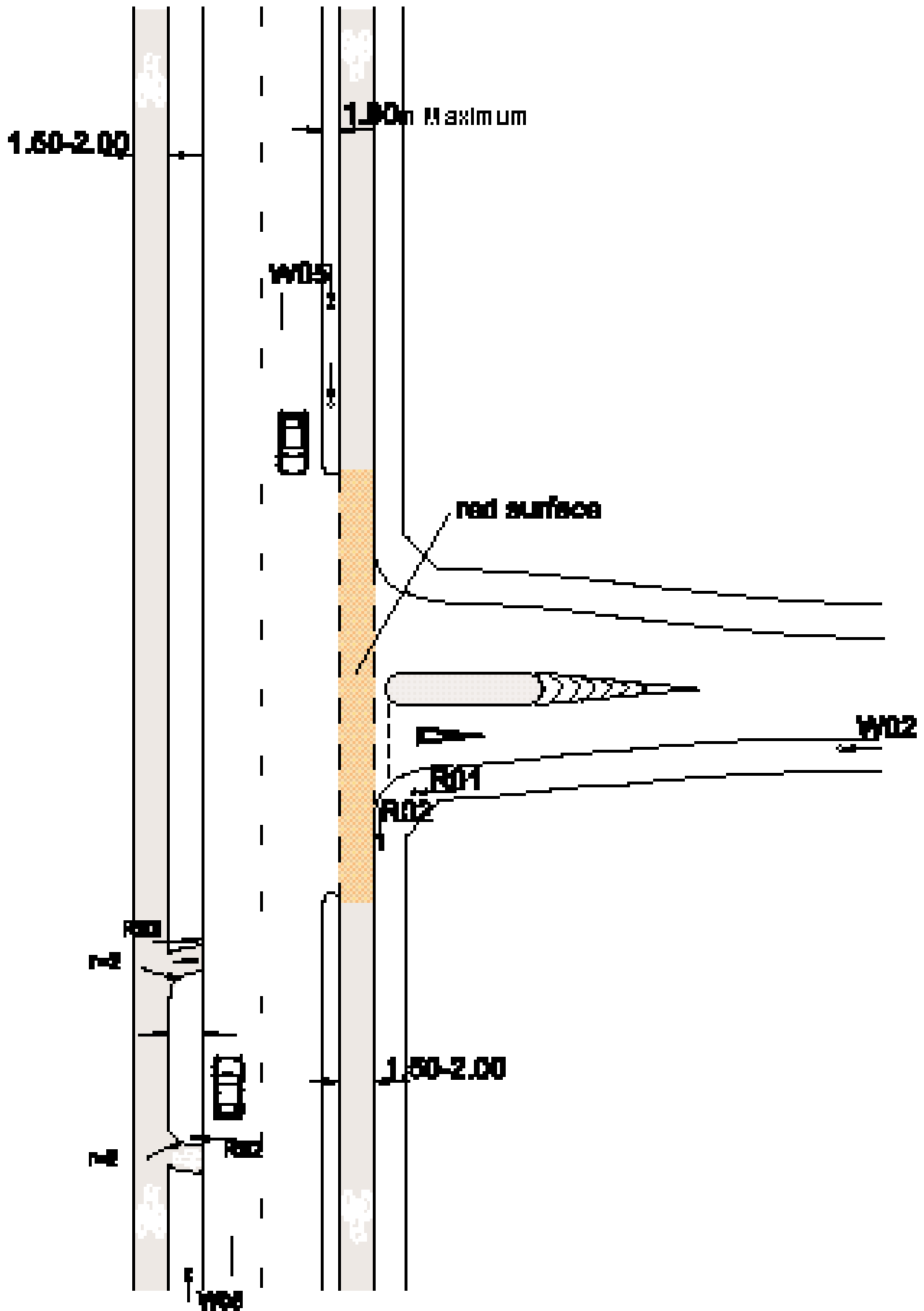
- Where cycle tracks are adjacent to the carriageway or only a narrow shoulder exists between them (< 1.0m), motorists are continually faced with the presence of cyclists. They will therefore be able to react correctly to cyclists at junctions and it is not necessary to bend adjacent cycle tracks in or out at junctions.
- A dividing verge between 1.0m and 5.0m wide at junctions should be avoided. In this case, the blind spot of side mirrors of turning motorised vehicles is at its maximum.

Legal status

- Since the cycle track clearly is part of the traffic on the main road, traffic coming from or going to a side road must yield to cyclists on the main road.
- Where the dividing verge is less than 1.0m wide, it will be clear to motorists that they must yield to cycle traffic on the main road. However, where the dividing verge is more than 1.0m wide, the situation will not apply except in the case of an Exit Construction.

- when priority is in favour of cycle traffic, the cycle track should be continued in red surfacing across the junction and marked with broken white lines.
- when priority is in favour of car traffic, this should be clearly indicated at the cycle track by yield markings.

FIGURE 4.5 | CYCLE TRACK NOT BENT-IN OR OUT (ADJACENT)



4.4.4 Road crossings

Three examples of road crossings are outlined:

1. a road crossing where the cycle track yields to vehicular traffic;
2. raised crossing (exit construction);
3. hump between the main carriageway and the cycle track.

Specification

- Where the cycle track yields to vehicular traffic the crossing should be at grade and not on a platform or raised crossing.
- The raised crossings will slow down moving traffic to a driving speed below 30 km/h.
- In general a slope on the ramp (or the hump) of 1:10 will be consistent with a design speed of not more than 30 km/h.
- The ramp (or the hump) is to slow down motorised traffic. The height difference may not therefore lead to any discomfort for cycle traffic.

Dimensions

- See figures 4.6, 4.7, 4.8.

1. A road crossing where the cycle track yields to vehicular traffic (fig 4.6)

- The road to be crossed is carrying significant volumes of traffic, ie not residential road category.
- The cycle track is not running adjacent to the main road or 'on road' through the junction.
- The cycle track is segregated from the main road by more than 1 metre *see fig 4.3 and 4.6.*

2. Raised Crossing (exit construction) (fig 4.7)

- A so called 'exit construction' is defined as an entry or exit that crosses the footpath. Motorised traffic has to give priority to pedestrians since they clearly make use of the pedestrian pavement.
- At side roads (with residential streets) the footpath is continued at the same level across the side road.
- Two ramps (one at the side street and one at the exit with the main carriageway) are provided to allow motorised traffic to pass. A cycle track is continued over the exit.
- No connecting curves are applied at the linking of the side-road to the main carriageway.
- An exit construction presents the most obvious solution for separate one- or two-way cycle tracks along major roads within a built-up area because car traffic has to give priority to cyclists/pedestrians.
- Motorists coming off the carriageway will legally intrude onto the space of pedestrians and cyclists to whom they (motorists) must give priority in this area. No traffic signs are needed.
- Exit constructions are an ideal solution at side roads with a minor traffic function such as a residential street.

3. Hump between the main carriageway and the cycle track (fig 4.8)

- The introduction of a small speed control hump between the main carriageway and the cycle crossing is a measure which can solve the conflict between vehicles turning left at high speed and cyclists travelling straight ahead. This is particularly the case at junctions with left turning lanes and those designed with large radii.

FIGURE 4.6 | BICYCLE CROSSING ON A SIDE ROAD FOR A TWO-WAY CYCLE TRACK

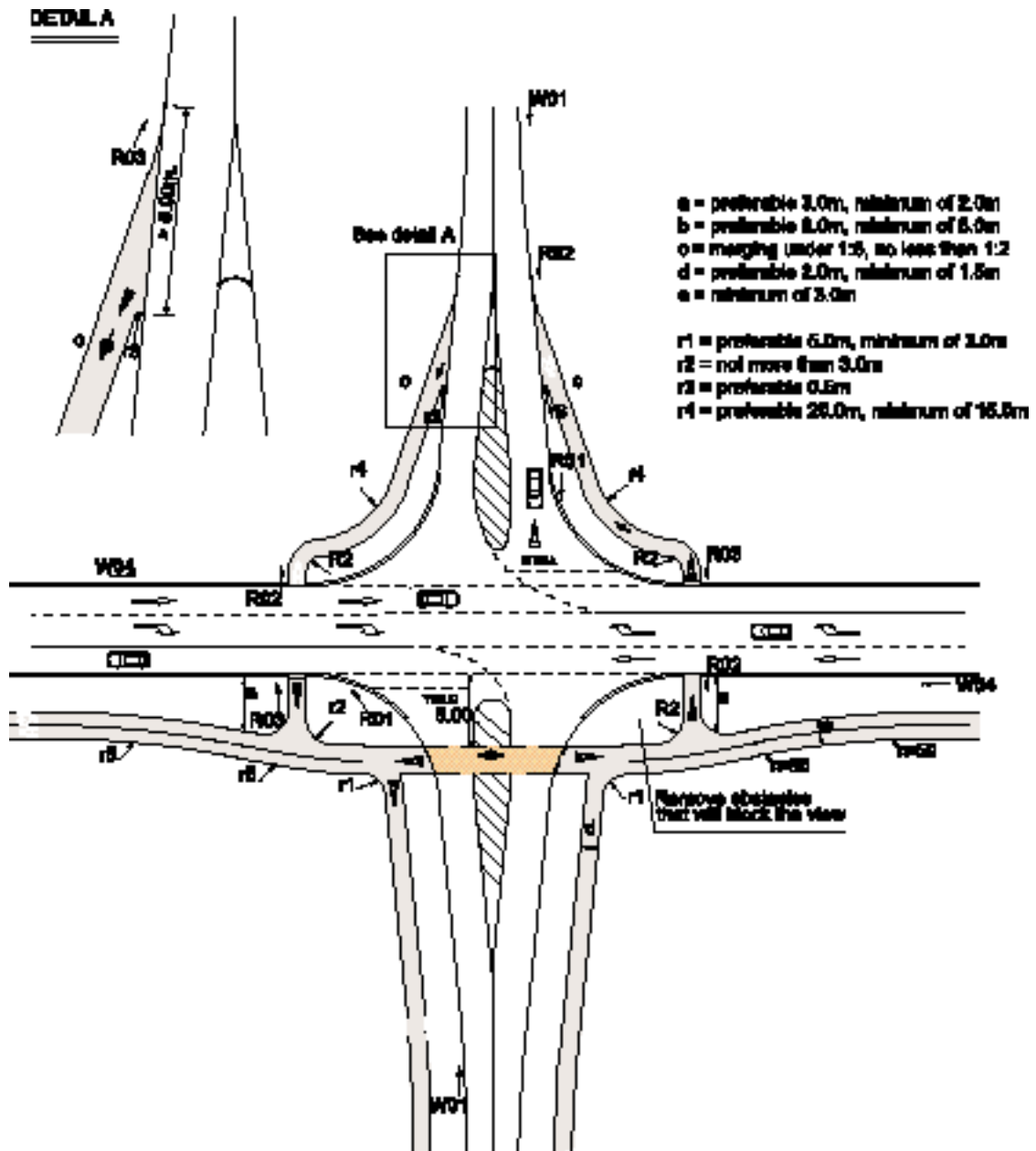
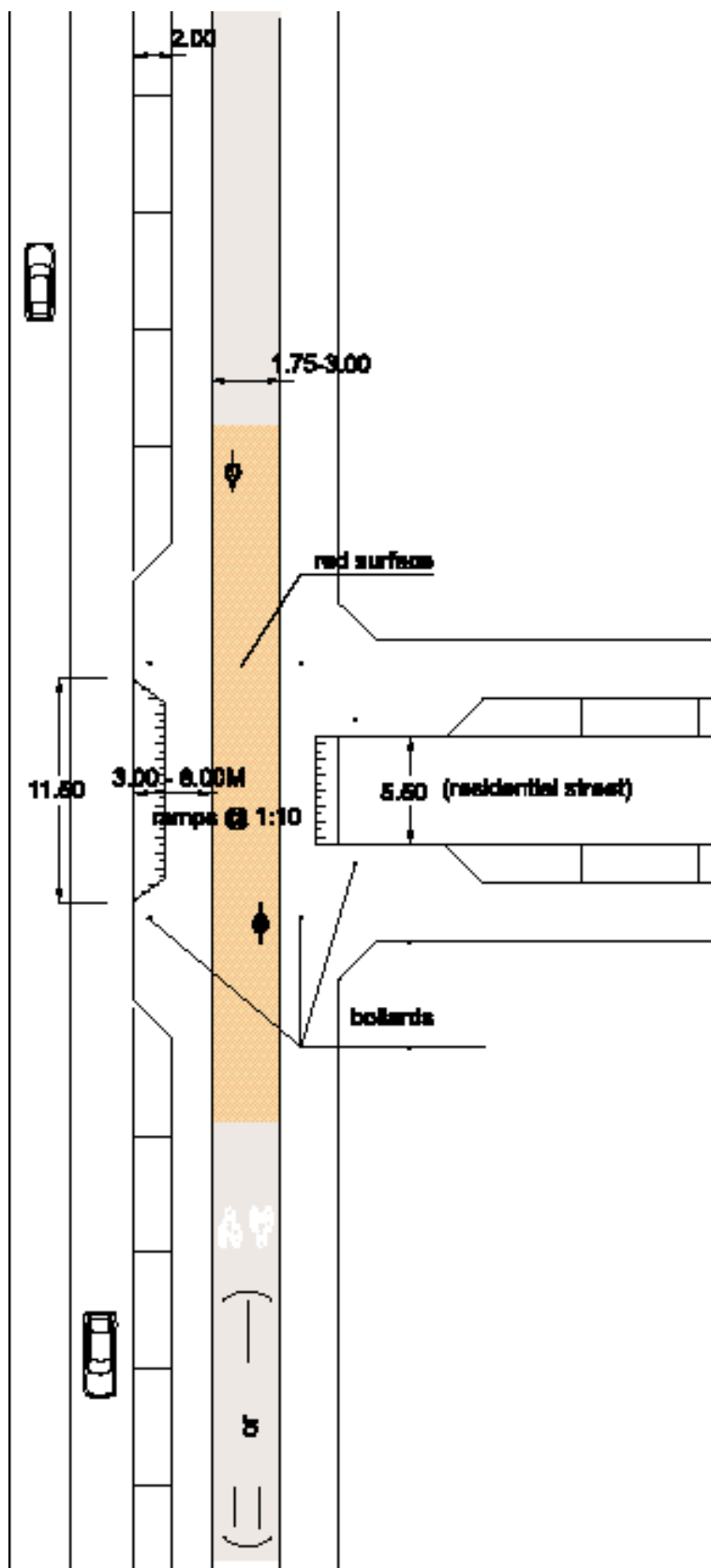
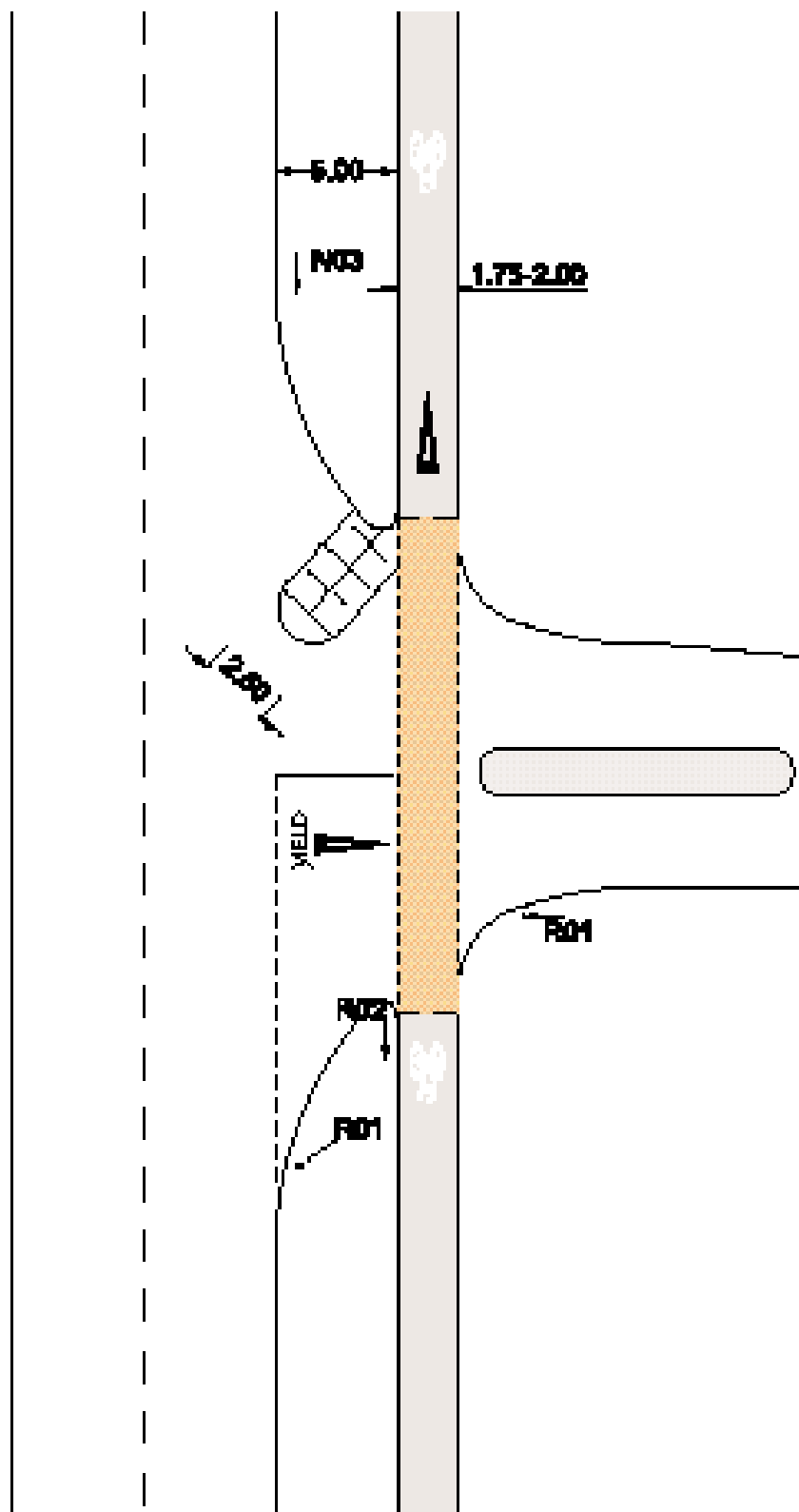


FIGURE 4.7 | BICYCLE CROSSING AT AN EXIT CONSTRUCTION



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4.5 Junctions with on-road cycle tracks

Specification

- A broken white line must always mark the edges of the on-road cycle track (this will allow for crossing traffic).
- A cycle logo should be applied to the road surface before and after the junction.
- At junctions without traffic lights it is strongly recommended that the surface of the on-road cycle track should be coloured red. This will greatly emphasise the legal position of both the motorised and cycle traffic.

Dimensions

- See figure 4.9.

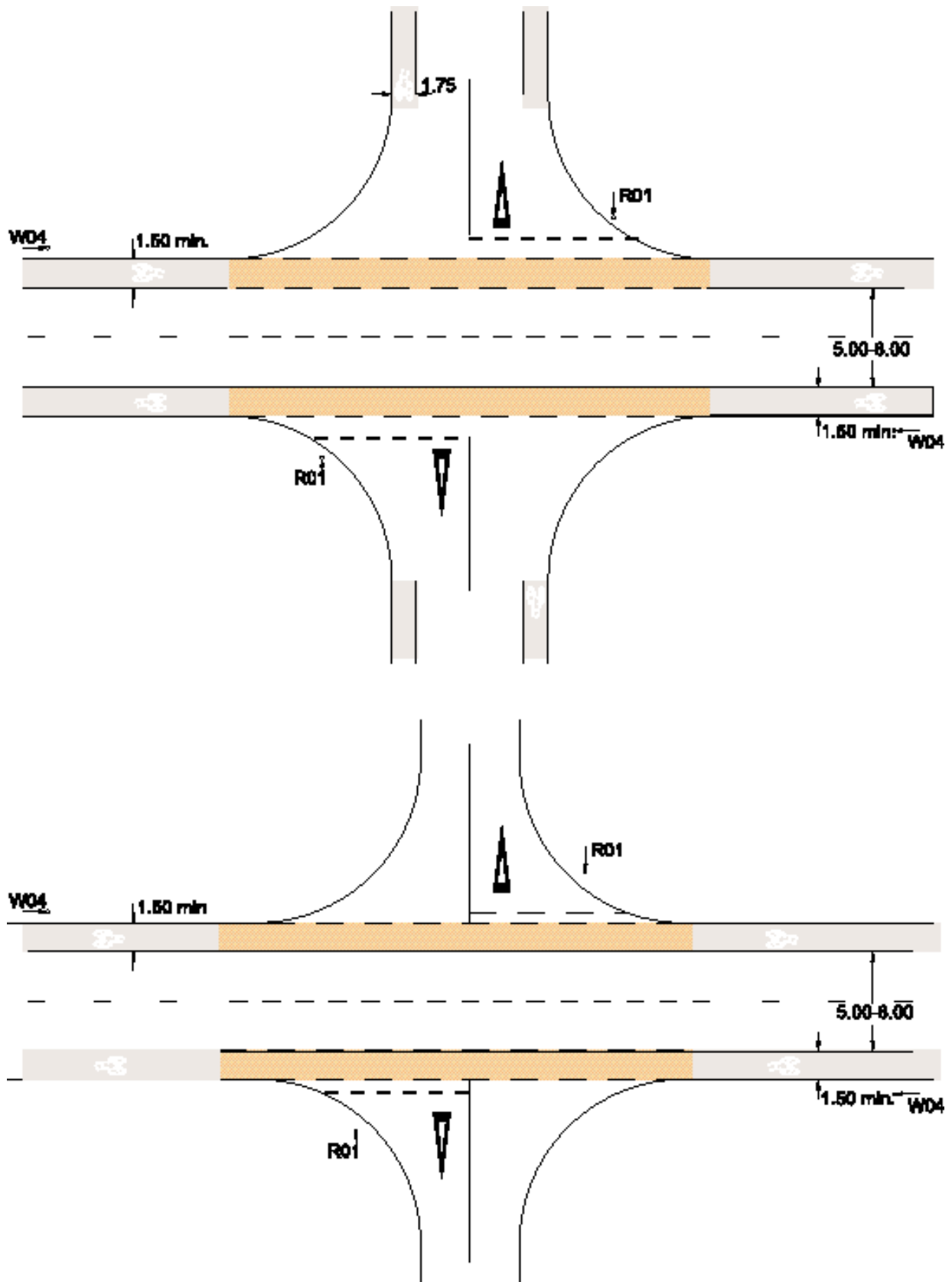
Legal status

- Cycle traffic as well as other traffic on the main road must have right of way. Turning motorised traffic leaving the main road is required to yield to cyclists.
- If cycle traffic can not be given priority over traffic turning from the main road (because of high volumes of turning vehicles) then segregated cycle facilities at the junction should be designed, such as a bent out cycle track construction.

General comments

- By using red surfacing across the junction emphasis is being put on the priority status for cycle traffic.

FIGURE 4.9 | JUNCTIONS WITH ON-ROAD CYCLE TRACKS



4.6 Junctions without any cycle facilities (fig 4.10)

Specification

- The road is meant for mixed use.
- It is recommended that tight radii ($R < 10\text{m}$) be applied to slow down the speed of turning vehicles.
- If the priority status has to be assigned to one type of traffic (for instance to give priority to the road with the cycle route), this can easily be achieved with road markings.

Legal status

- The same traffic rules apply to both motorised traffic and cycle traffic.

General comments

- Traffic volumes are usually very low and additional facilities for cyclists are not needed. This applies to most of the junctions in residential areas.
- If the speed of motorised vehicles is $> 30\text{ km/h}$, speed control devices should be applied.
- Traffic calming measures have proven to be very effective for the safety of pedestrians and cyclists. Applying these measures at junctions is advisable.

4.7 Roundabouts (Table 4.6)

Roundabouts can be classified into two types:

- roundabouts designed for use at high capacity junctions;
- roundabouts designed as “speed control devices”, without losing too much capacity for urban traffic.

(see Table 4.6)

Roundabout for high traffic capacity

A roundabout designed for use at high traffic capacity junctions has the following main features:

- the roundabout carriageway has two or more traffic lanes;
- large radii and wide entry and exit connections to the roundabout are designed to maintain driving speeds.

Roundabout as a speed control device

A roundabout designed as a speed control device has the following main features:

- the roundabout carriageway has one traffic lane;
- tight radii and narrow entry and exit connections to the roundabout.

These roundabouts are built to increase road safety. As a result of the relatively tight dimensions, the speed of motorised traffic using the roundabout is reduced to a maximum of 30 km/h. The total number, and severity, of injury-related accidents is substantially lower than at other junction types. These roundabouts are very useful at junctions with lower traffic flows. (i.e. less than 20,000 vehicles per day).

4.7.1 Roundabout for high traffic capacity (fig 4.11)

Specification

- The roundabout carriageway has two or more traffic lanes.
- Large radii and wide entry and exit connections to the roundabout to maintain high design speeds.
- Cycle facilities must always be physically segregated.
- Where the cycle track crosses both directions of traffic on the roundabout approach roads, a middle island must be provided.
- Cycle tracks crossing the approach roads should be 20m away from the roundabout. This distance gives cyclists more time to assess whether motorised traffic is leaving the roundabout. To locate the crossing any closer would make it difficult for cyclists to anticipate the intentions of motorised traffic on the roundabout. The 20m distance therefore improves the safety of cyclists.

Legal status

- Crossing cycle traffic must yield.
- Motorised traffic leaving the roundabout can be made aware of crossing cyclists by using a road warning sign.

General comments

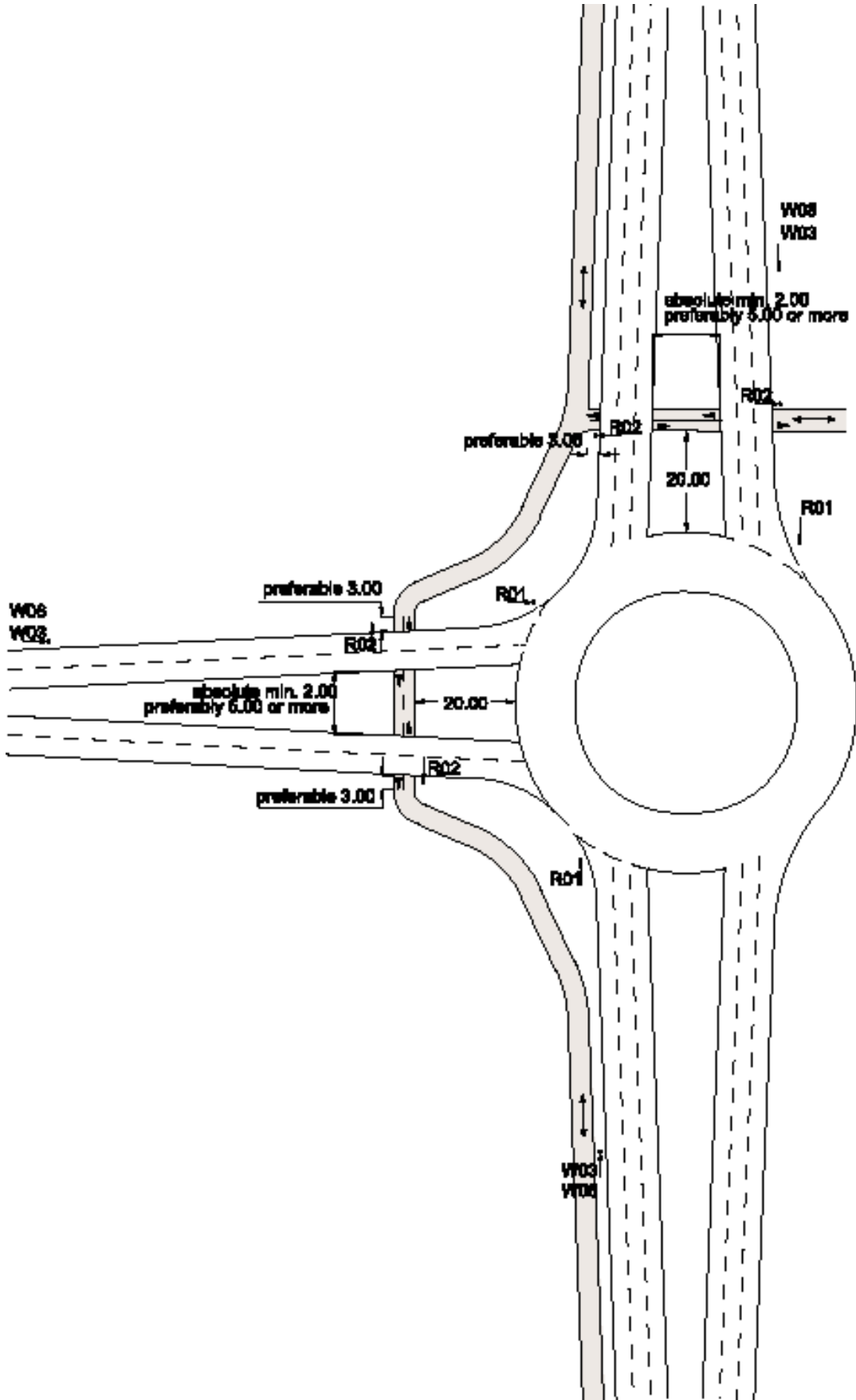
- Large roundabouts are designed for main urban road junctions.
- Where a roundabout has surplus capacity, the design can be adjusted to reduce its size. Before doing so the function of the roundabout in the network must be considered.

- At high traffic capacity roundabouts, the provision of grade separation or of traffic lights for pedestrians and cyclists should be considered. When installing traffic lights, the green phase should be timed to avoid waiting at the middle island.

TABLE 4.6 | ROUNDABOUTS

Shape	Motor vehicles per day	Remarks
Roundabout for high traffic capacity	> 20,000	For junctions on main urban roads; Segregated cycle facilities are always required traffic lights can be used.
Roundabouts as speed control devices:		
Segregated cycle facilities where the priority is not in favour for the cycle traffic	10,000 - 20,000	For junctions of main urban roads with district collector roads; Traffic lights or a Toucan crossing can be used, however this is not always necessary.
Roundabout with on-road cycle tracks	2,500 - 10,000	Suitable for junctions on district collector roads and in residential areas; Traffic lights are not used.
Mixed traffic on the roundabout	< 2,500	Suitable for residential areas; Traffic lights are not used.

FIGURE 4.11 | HIGH CAPACITY ROUNDABOUT





Cycle Facilities (Holland)

4.7.2 Roundabouts with segregated cycle track facilities where priority is not given to cycle traffic (fig 4.12)

Specification

- The cycle track is designed so that cyclists cross the approach roads at right angles, and that the cycle track continues separate from the carriageway. This design, emphasises the need for cyclists to yield to motorised traffic.
- Cars queuing at the roundabout should not block the cycle crossing. A queuing area of about 5.0m between the roundabout and the bicycle crossing must be incorporated.
- The central island incorporates a 1.5m strip which large vehicles can cross. This improves the manoeuvring room.

Legal status

- Cycle traffic has to yield to motorised traffic.

General comments

- A raised crossing should not be provided for cycle traffic as this would give a false sense of security.
- If the radii for R1 and R2 are much greater than shown in the figure, then speed humps should be used on the carriageway ahead of the cycle crossing.
- At a junction of two main cycle routes, a two-way cycle track around the roundabout can be implemented. The disadvantage of cyclists having to yield (negative effect on comfort and directness) will be offset by giving greater freedom of movement to cyclists.

4.7.3 Roundabouts with on-road cycle tracks

(fig 4.13)

Specification

- Partial physical segregation should be provided between the on-road cycle track and motorised traffic. It should consist of a narrow raised dividing verge of maximum width 0.5m , sometimes called a 'hedgehog'.
- When designing the roundabout the radii to and from the side roads must tie in with the carriageway edge on the roundabout and not with the on-road cycle tracks on the roundabout. Therefore, the width of the on-road cycle track is additional to the width of the lane for motorised traffic on the roundabout.
- The central island incorporates a 1.5m wide strip which large vehicles can cross. This improves manoeuvring room.

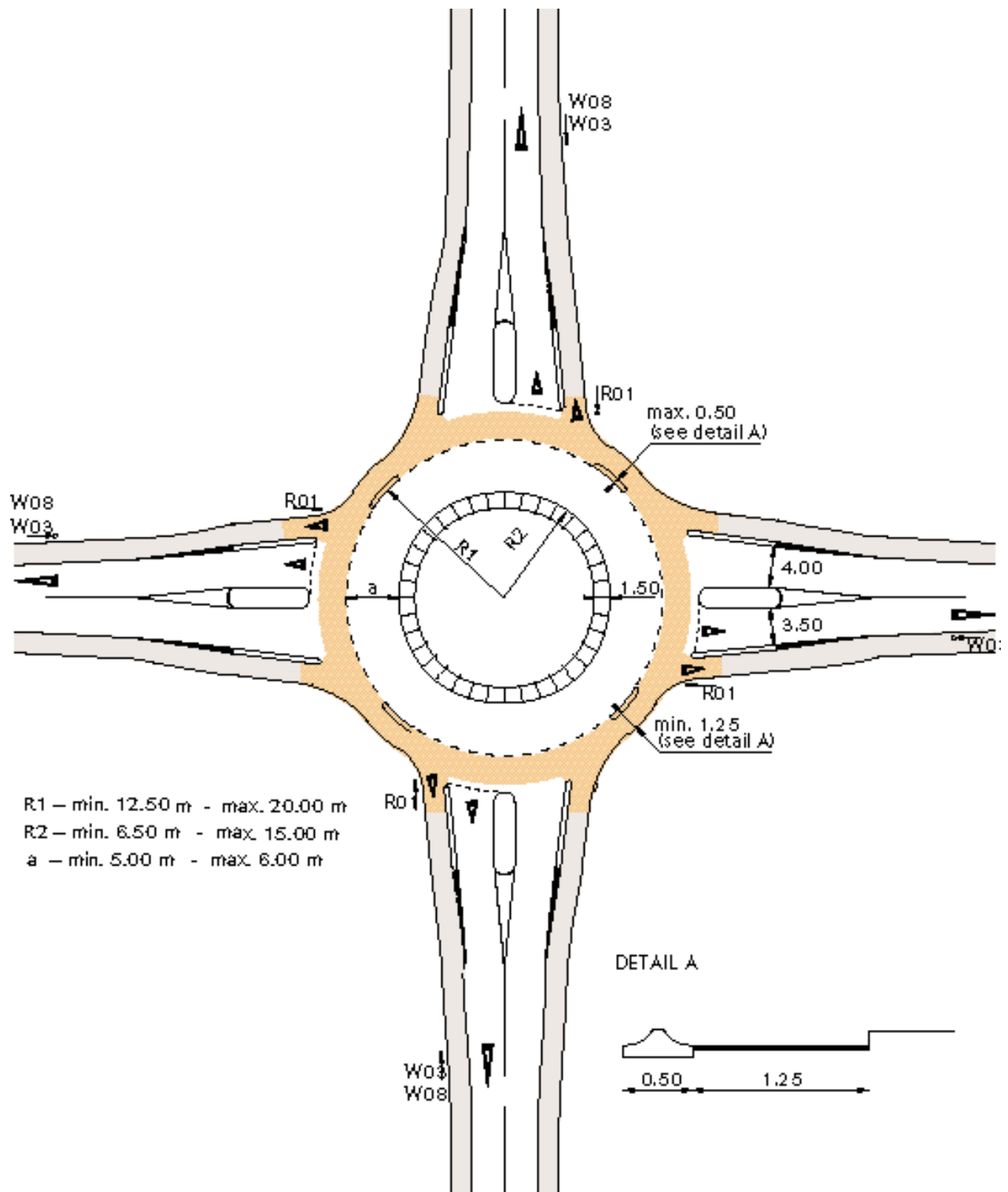
Legal status

- All traffic approaching and leaving the roundabout should yield to cycle traffic on the roundabout.

General comments

- It is recommended that a narrow physical segregation be introduced on the approach and exit roads of the roundabout as a safety measure for cyclists. This helps to ensure that cyclists approaching or leaving the junction are not hit by motorised traffic.

FIGURE 4.13 | ROUNDABOUT WITH ON-ROAD CYCLE TRACK AND PHYSICAL SEPARATION (HEDGEHOGS).



4.7.4 Roundabouts with mixed traffic (Fig 4.14)

Specification

- Roundabouts with mixed traffic should be used at locations with a low volume of motorised traffic. The geometric design includes safety features.
- The central island incorporates a 1.5m wide strip which can be crossed by large vehicles. This improves manoeuvring room.

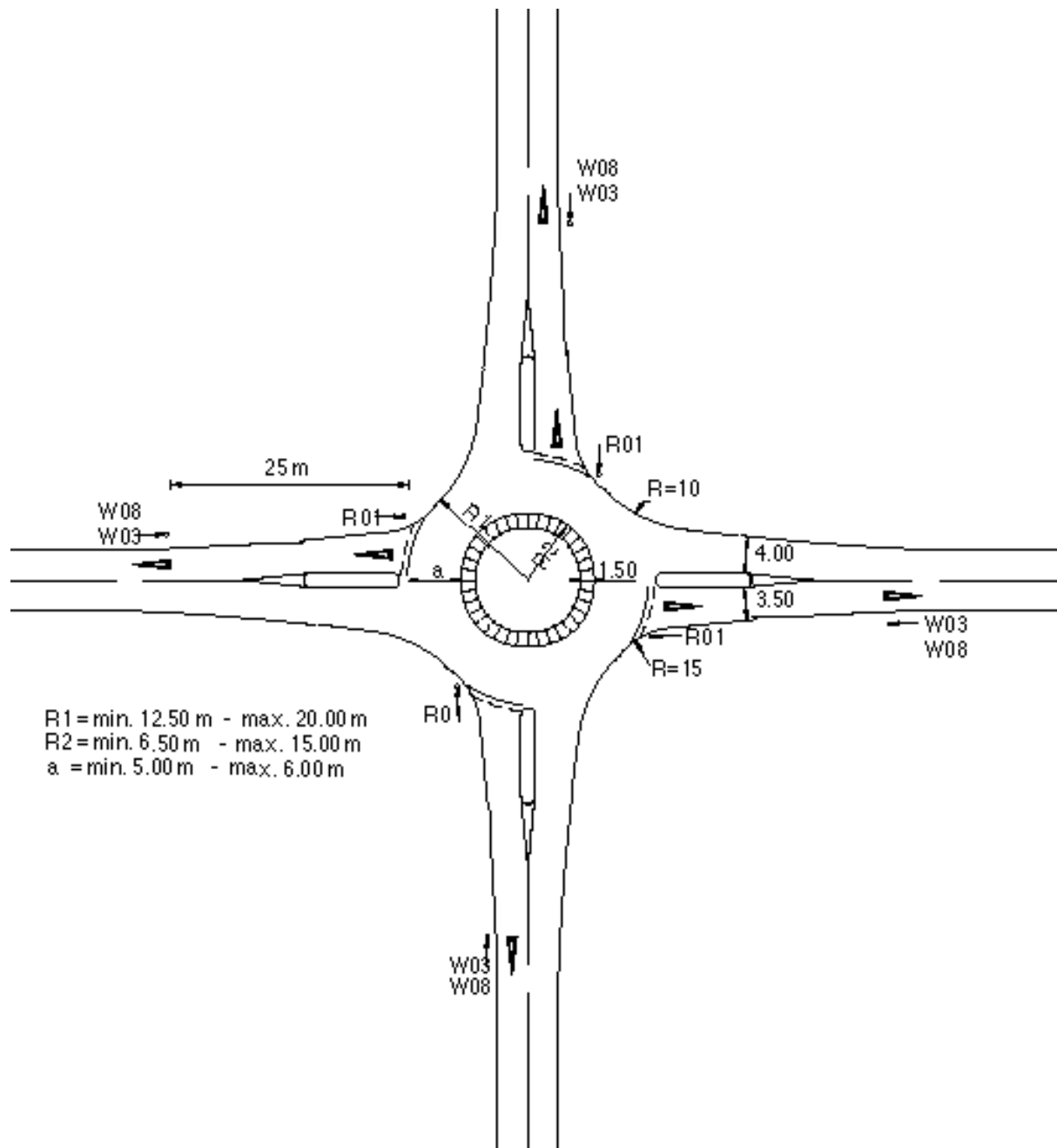
Legal status

- All traffic approaching the roundabout has to yield to traffic (including cycle traffic) on the roundabout.

General comments

- Roundabouts with an integrated traffic flow have few conflict points, and motor vehicles leaving the roundabout must not cut across cyclists on the roundabout. Conflicts at roundabout exits are therefore avoided, but cyclists can still 'disappear' in the blind spots of goods vehicles and buses.

FIGURE 4.14 | ROUNDABOUT FOR MIXED USE



4.8 Traffic lights

Directness of route and safety are the main requirements for designing cycle facilities at traffic lights:

- directness: can generally be achieved by designing bicycle-friendly traffic light phasing;
- safety: the safety of the facility depends largely upon its design.

The design of traffic light phasing and cycle facilities are closely related to each other. For example, if cyclists have to wait a long time for a green light and there is no other traffic crossing the junction, they can feel frustrated enough to 'jump' the red light. Therefore the design of cycle facilities at traffic lights (phasing strategy as well as geometric design) needs to be logical.

The recommendations given are based on:

- vehicle-actuated traffic lights;
- separate traffic lights for cyclists.

4.8.1 Traffic light phasing strategies

In setting up a traffic light phasing strategy the following three questions must be addressed:

- how many green phases are there, and what duration must be given to each direction?;
- in what sequence must the green be given to the different directions?;
- what is the total cycle time?

Maximum waiting time

The phasing of traffic lights can be adjusted to provide minimum waiting times for cyclists where appropriate. The maximum waiting time is a very practical parameter to use in setting up a phasing strategy. The maximum waiting time decides the limit for the waiting time for each direction. If one, or more, directions needs a short waiting time for example 2 green phases of 20 seconds, instead of 1 green phase of 40 seconds, then an extra green phase can be built in to the green sequence of the phasing strategy. This will have consequences for the waiting times for other directions, and on the total length of the cycle time. In setting up a control strategy for each specific location, priority can clearly be given to certain directions or traffic modes. This creates the possibility of influencing traffic flow and behaviour.

These possibilities and situations are described as follows:

Locating cyclist detection equipment

The cyclist can benefit from the use of detection loops placed some distance in advance of the stop line. The greater the distance the loops are from the stop line, the shorter the waiting time for cyclists. Another benefit of detection loops is that the green phase can be lengthened.

Conversely, push buttons only allow cyclists to make a request at the last moment, which means waiting at a stop line.

Peak and off-peak periods

During peak periods a fairly rigid programme of phasing is maintained as there is constant traffic from all directions. The inclusion in the programme of an additional phase for cyclists will shorten waiting times for them, but will also lengthen the programme cycle time, and result in longer queues of waiting cars. This applies even more to co-ordinated sets of traffic lights for vehicles.

During the off-peak period, the programme will be vehicle-activated, giving a green phase to a direction on demand.

Co-ordinated traffic lights at large junctions

If the distance between two crossings is short, the use of linked lights for cyclists should be considered, for example at large junctions with a wide middle island or split level intersections. At these junctions, cycle traffic should not have to wait twice to cross one road. Linking traffic lights can therefore reduce waiting times for cyclists and improve the safety of crossings.

All directions green for cyclists

Attention should be given to any large number of cyclists turning right at signalled junctions. A possible solution at junctions with heavy cycle traffic is to give a green phase for all directions at once.

4.8.2 Cycle signals at major signalised junctions

Where to apply

These facilities would apply at junctions with segregated off-road cycle tracks regulated with traffic lights. The criteria for applying traffic lights are not outlined in this manual. However in general traffic lights at junctions are required when two main urban roads cross each other or when a main urban road crosses a district collector road. The decision to use traffic lights mainly depends on road safety and road capacity.

Specification

- When a junction is regulated with traffic lights all conflicts must be regulated. This should not be restricted to the conflicts between car traffic but to all conflicts between all traffic participants. As traffic volumes increase the need for regulation also increases.
- Crossings for cyclists and pedestrians should be regulated for all directions and at both sides of the junction.
- Regulating the crossing for pedestrians should be combined with the regulation of cycle traffic.
- The visibility of the lights should not be obstructed by road signs or bushes.

Dimensions

- The locations of the traffic lights for cyclists are indicated on figure 4.15.
- The distance between the cycle stop line and the carriageway edge is 1.00m.

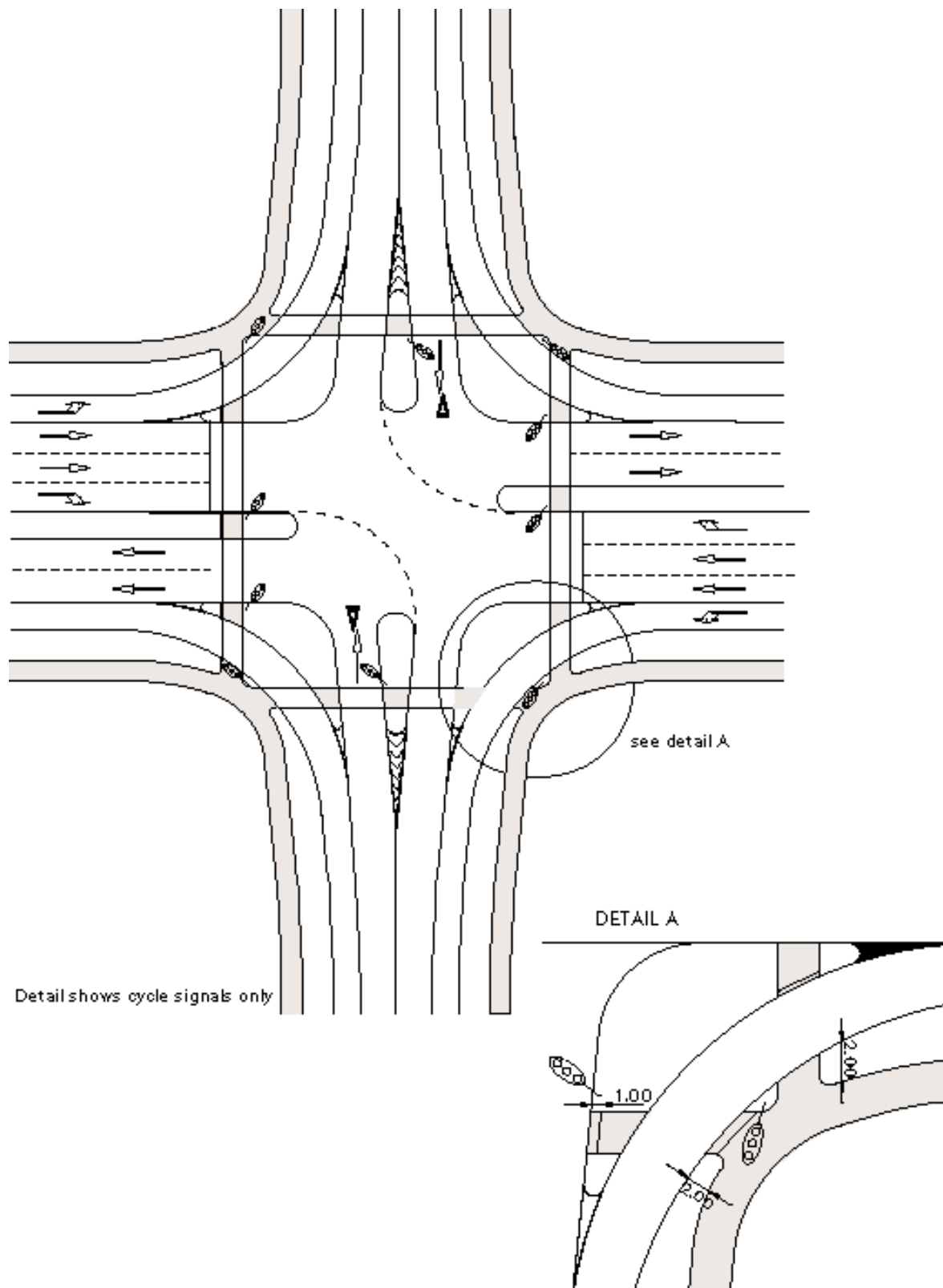
Legal status

- Traffic lights are regulatory road signs prescribed in the Road Traffic (Signs) Regulations. .

General comments

- Cyclists should be able to cross a junction in one movement.
- Push buttons or detection loops are recommended to reduce waiting times (see also remarks on control strategies (§ 4.8.1).

FIGURE 4.15 | TRAFFIC LIGHTS FOR CYCLISTS AT MAJOR JUNCTION



Note: The drawings in this section show layout only for extra signal facilities for cyclists, not the complete traffic signal layout for the junction.

4.8.3 Weaving lanes (fig 4.16)

Where to apply

Weaving lanes are specially designed for use in advance of junctions to protect cyclists in the following situations:

- motor vehicles turning left crossing the path of cyclists travelling straight ahead;
- cyclists turning right crossing the path of a motor-vehicle travelling straight ahead.

They can either be used on junctions with or without traffic lights. When used at traffic lights, weaving lanes can be combined with advanced stop lines.

Specification

- The speed difference between motor vehicles and cyclists near a junction should not be more than about 15 km/h.
- Taking the average speed of cyclists as 20 km/h, the average speed of motorised traffic in the weaving lanes should not be higher than approx. 35 km/h.
- For safety, cyclists who wish to turn at an up-coming junction should not have to weave across more than one lane of traffic.
- Weaving lanes for cyclists should have a red surface.

Dimensions

- The width of weaving lanes for cyclists is a little wider (1.75m - 2.00m) than normal road sections (1.50m). This is to provide more room to manoeuvre and more waiting room at the stop line of the junction. This will improve road safety as well as making them pleasant to use.

- The weaving lanes should start at least 30m before the stop line.

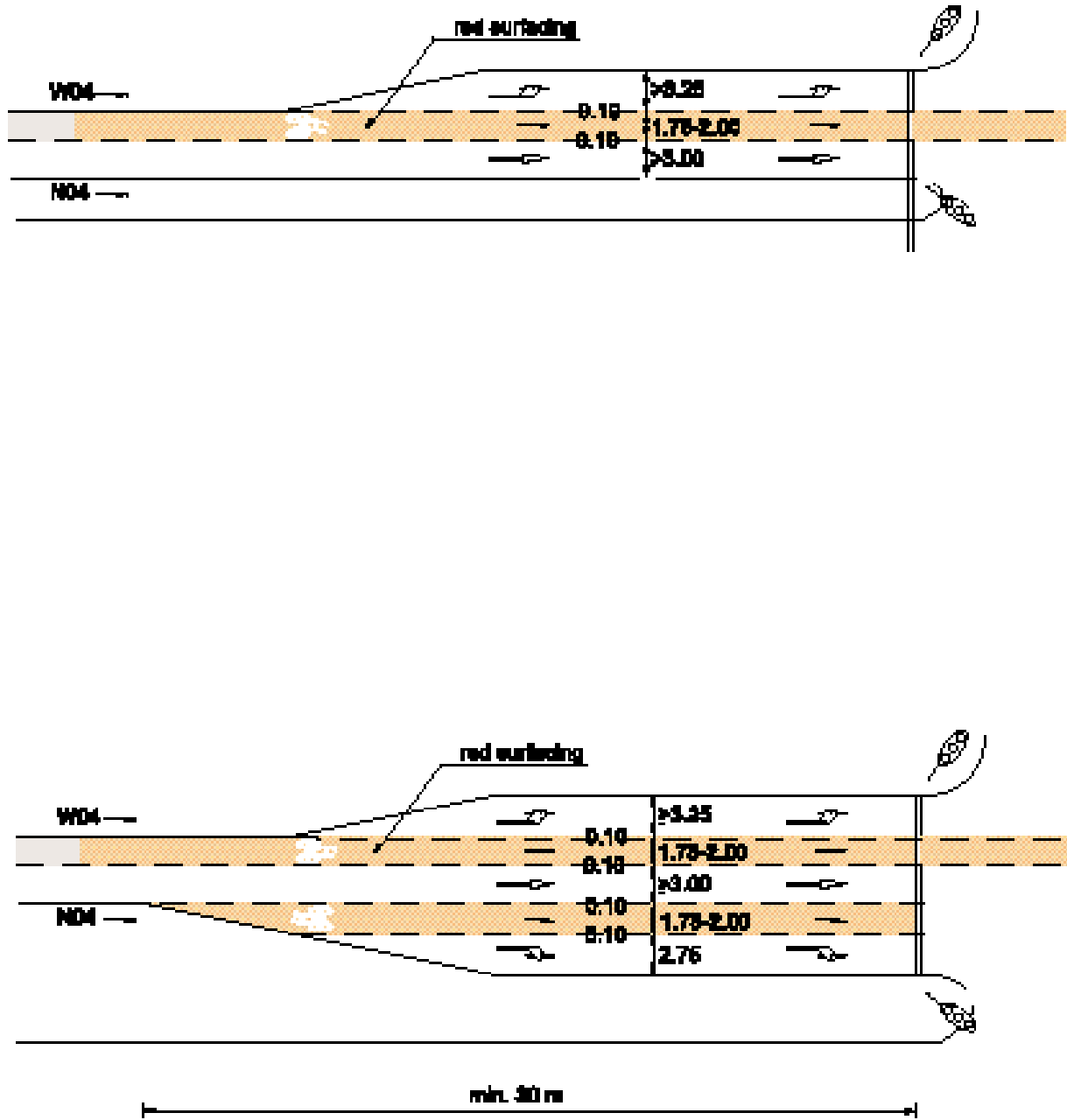
Legal status

- Weaving lanes must be designed as on-road cycle tracks with a broken white line.
- The weaving lanes are designed to ensure clearer anticipation of the movements of motorised traffic and cycle traffic. Road sign N04 (see fold-out page) should be used in association with weaving lanes.

General comment

- Weaving lanes allow cyclists and motorised traffic to take up their appropriate lane positions in advance of a junction, thereby reducing conflicts at the junction itself.

FIGURE 4.16 | WEAVING LANES



4.8.4 Advanced stop line (fig 4.17)

Where to apply

Advanced stop lines are used only at traffic lights. They are particularly suitable for right turning movements and for straight-ahead traffic where cycle volumes are high.

Specification

- The advanced stop line gives dedicated room to cyclists to wait in front of all other traffic, thus allowing them to start crossing the junction before motorised traffic.
- The waiting area at an advanced stop line should preferably have a red surface.

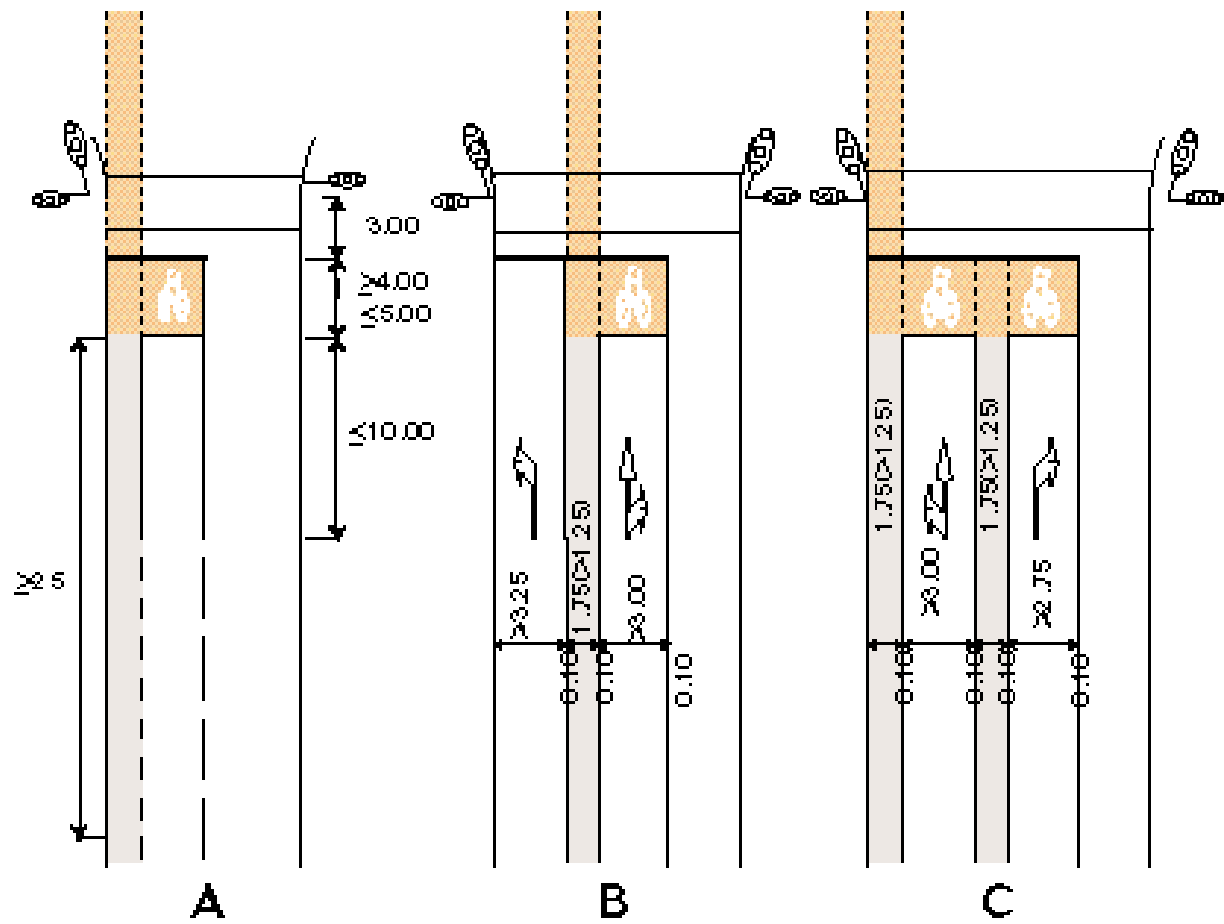
Dimensions

- The waiting area of an advanced stop line should preferably be between 4m and 5m long. This allows enough manoeuvring room for cycle traffic to take up their correct position but discourages motorised traffic from using the area.
- The minimum width of the on-road cycle track is 1.25m, but preferably it should be 1.75m (see also weaving lanes § 4.8.3).

General comments

- Right turning cycle traffic will particularly benefit from the advanced stop line.
- Only right turning cycle traffic will wait on the right hand side of the advanced stop line. Cyclists who intend to go straight ahead should normally wait behind each other on the left side of the advanced stop line.

FIGURE 4.17 | ADVANCED STOP LINE IN FRONT OF MOTORISED TRAFFIC



4.8.5 Facilities for cyclists turning left

Where to apply

Segregated facilities can ensure a smooth flow for cyclists turning left at junctions with traffic lights. Two designs are outlined and shown in the figure 4.18.

When not to apply

The arrangement shown in model A must not be applied if:

- a pedestrian phase exists on the road ahead which could cause a serious conflict with a cyclist turning left;
- there is insufficient space on the road ahead for left turning cyclists to merge with the flow of motor vehicles and bicycles coming from the right.

Specification

- Model A: if the traffic volumes on the road ahead are high, an on-road cycle track with red surfacing should be installed.
- Model B has been designed for high volumes (750/hour) of cycle traffic.

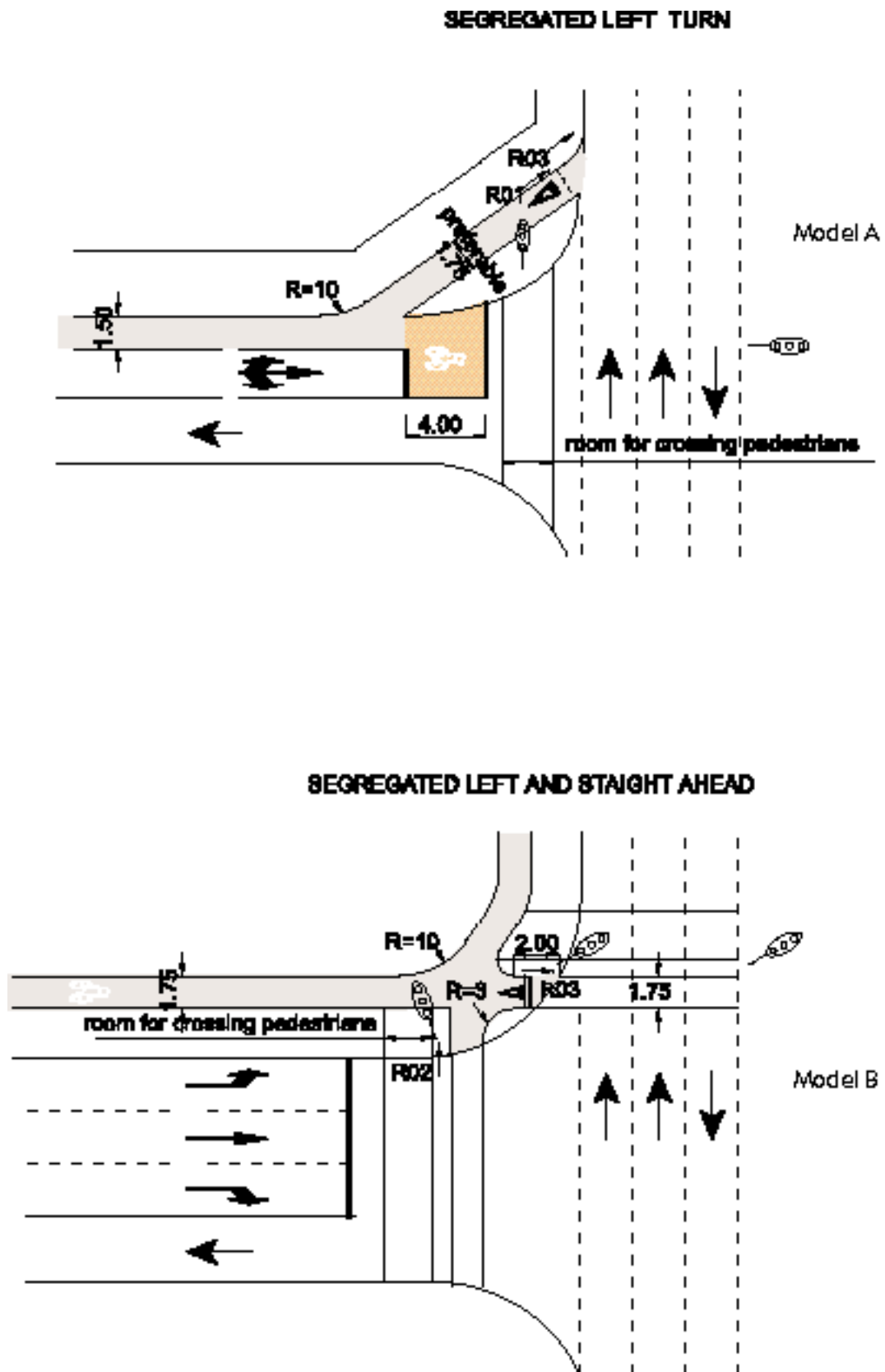
Legal status

- In model A cyclists must give priority to traffic on the road ahead.
- In model B cyclists turning left simply enter the cycle track of the road ahead without being disturbed by motorised traffic.
- Pedestrians crossing the cycle track have to give priority to cycle traffic. This however can be considered as a soft conflict.

General comments

- If segregated facilities are needed at the junction but there are no such facilities along the approaching roads, then models A and B can be introduced 30m before the junction or before the start of the left turning lane for motorised traffic.

FIGURE 4.18 | FACILITIES FOR CYCLISTS TURNING LEFT AT TRAFFIC LIGHTS



4.8.6 Facilities for cyclists turning right in two stages (fig 4.19 a,b,c)

Where to apply

On signal-controlled junctions with on-road cycle tracks, or with segregated cycle tracks alongside a main road, extra facilities are necessary to ensure the safe and smooth flow of cycle traffic turning right.

Specification

- In general, cyclists turning right should be able to take position to the left of the main carriageway at the junction, or in the space between cycle track and the main carriageway in a marked area.
- Cycle traffic turning right has a separate filter on the traffic lights.
- Although a separate signal head for the cyclist turning right with the phasing linked to that of the crossing traffic can be useful, in most situations these cyclists can use the existing traffic lights.
- The waiting area for cycle traffic should preferably have a red surface.

Dimensions

- The layouts shown will allow approximately 3 or 4 cyclists to wait at the same time for a green light.

Legal status

- Priority is decided by the traffic lights.

General comments

- Right turning facilities can be combined with an advanced stop line on the side road.

FIGURE 4.19A | AN EXAMPLE OF FACILITIES FOR CYCLISTS TURNING RIGHT

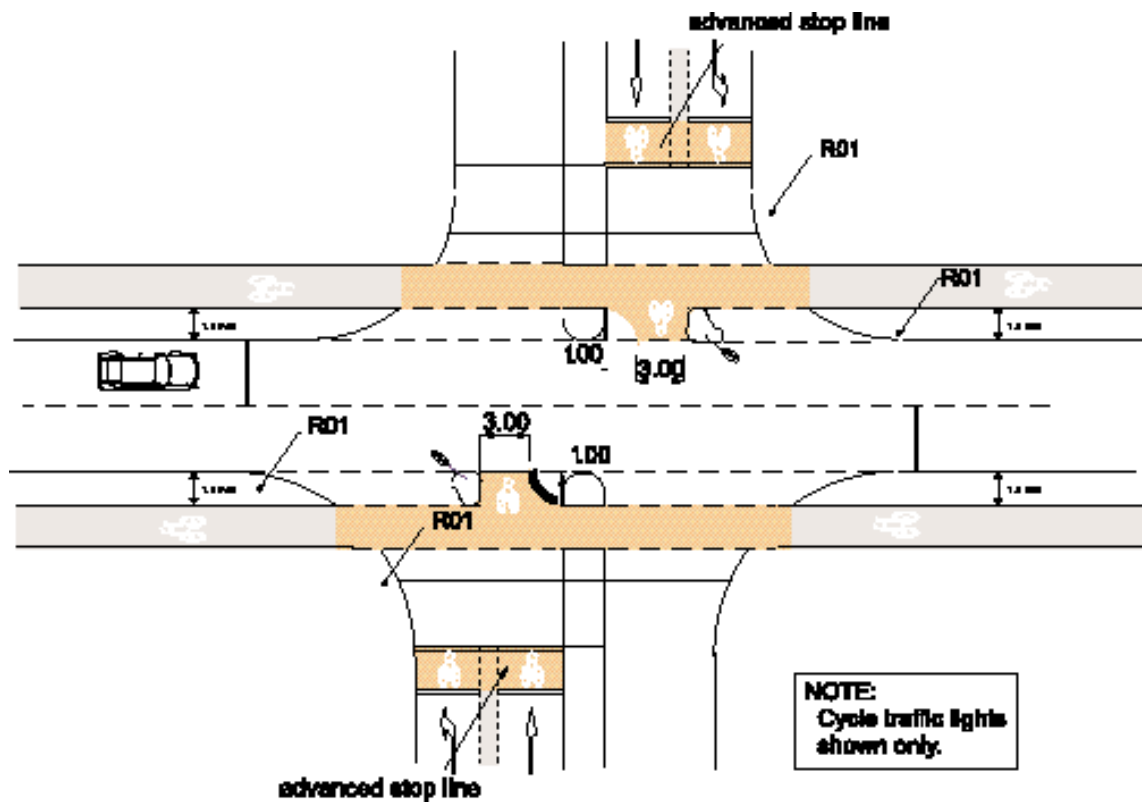
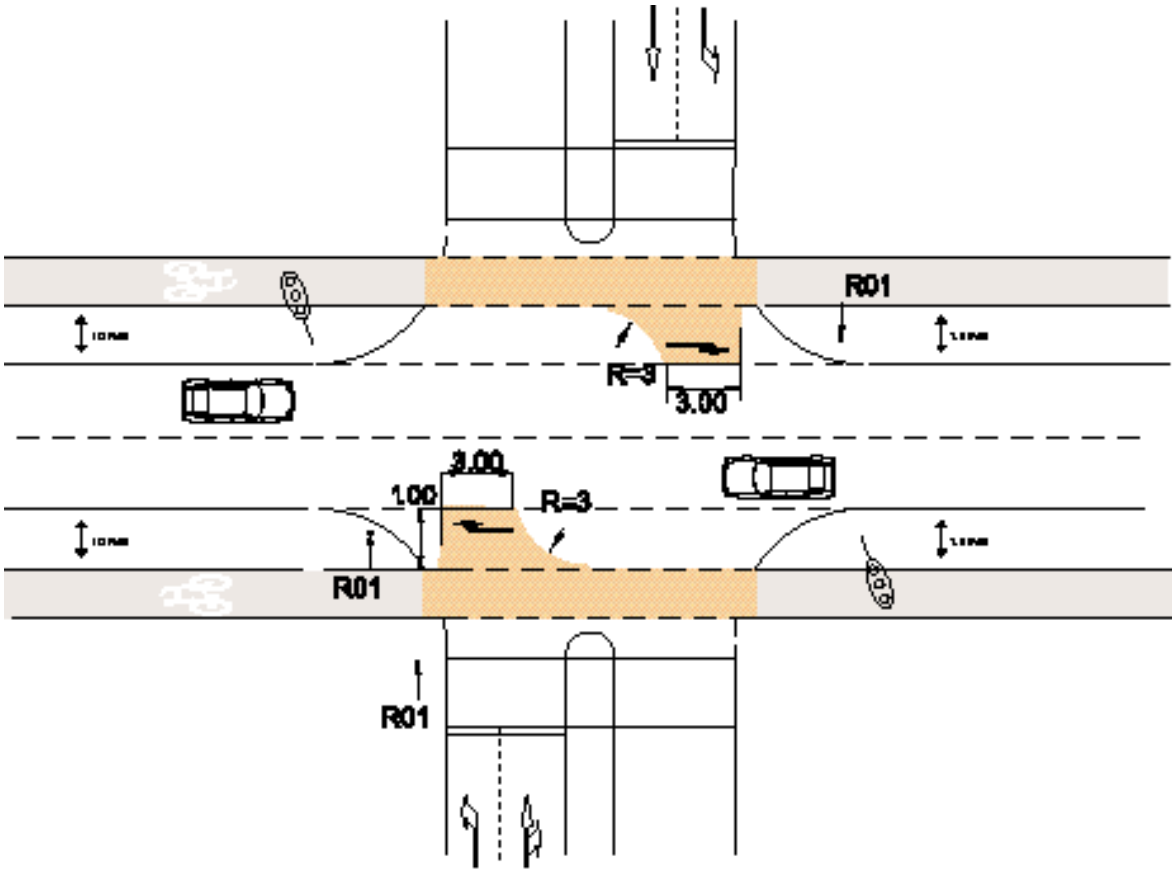
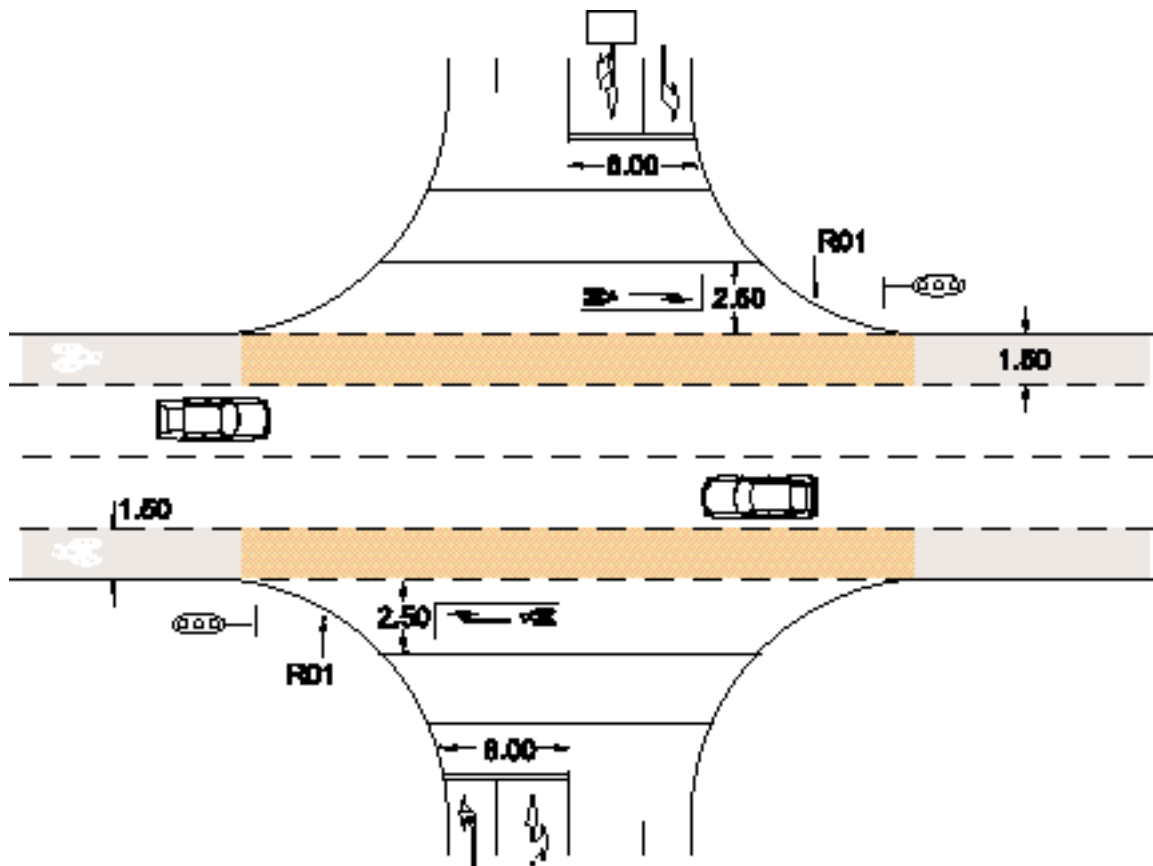


FIGURE 4.19B | AN EXAMPLE OF FACILITIES FOR CYCLISTS TURNING RIGHT



(ONLY CYCLE LIGHTS SHOWN)

FIGURE 4.19C | AN EXAMPLE OF FACILITIES FOR CYCLISTS TURNING RIGHT



4.9 Road crossings

(Table 4.7; figs 4.20 - 22)

Where to apply

Facilities for cyclists to cross the road are necessary at:

- the end of a segregated one or two-way cycle track;
- locations where a cycle route crosses a main road.

Measures

- At the point of crossing, the length of the (possible) waiting area is 2.00m.
- The width of the crossing cycle track is between 2.50 and 3.50.
- The central barrier must have a minimum width of 2.00m, and preferably be between 3.00m and 5.00m. In particular this is needed at two-way crossings.

General comments

- The safest solution is where all road-users can clearly judge the situation, and correspondingly adjust to a lower speed.
- Vulnerable cyclists, who have difficulty in looking over their shoulder while riding, can

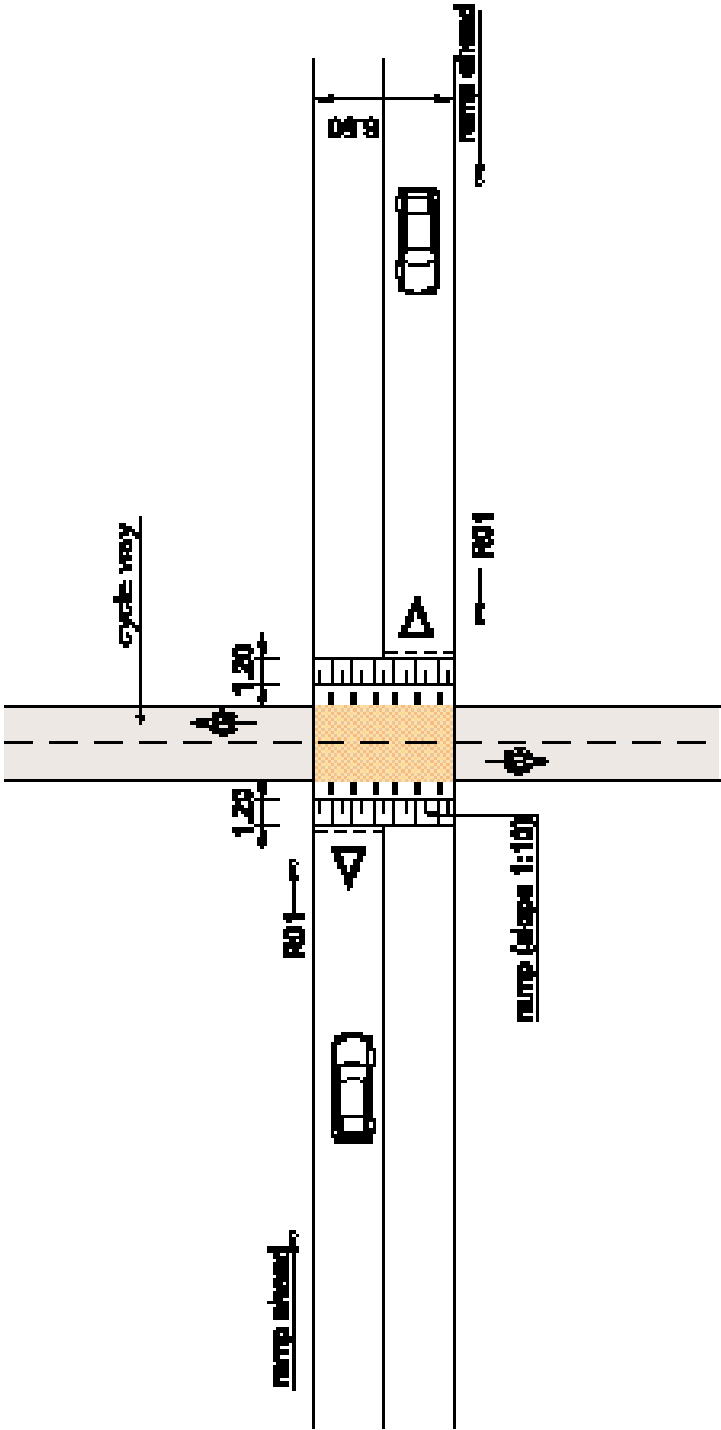
use the extra room at the point just before crossing the road, to check whether or not traffic is approaching. More mobile cyclists, who can look over their shoulder, only need the manoeuvring space, to judge approaching traffic.

- When priority is in favour of the cycle traffic, a raised crossing should be constructed in order to reduce the speed of motorised traffic to less than 30 km/h at the crossing. If priority is in favour of motorised traffic, but there is still a need to reduce its speed (for instance near a school or shopping area), then speed humps should be installed some distance before and after the crossing.
- The speed of motorised traffic can be reduced by bending out ($r=30m$) both lanes of the carriageway where a central barrier starts.
- A central barrier is preferable where there is enough room for its provision. It will warn road-users of the crossing, and make it easier for cyclists to cross.
- If a central barrier (and no speed humps) is used, the total length of the central barrier should be long enough (approx. 50m) to prevent cyclists from crossing the road at other points before or after it. Although this limits the freedom of movement for cyclists, it will increase safety.

TABLE 4.7 | WARRANTS TO INDICATE WHAT KIND OF CROSSING FACILITY IS NEEDED

Shape	Criteria	Speed of motorised traffic	Two-way volumes (pcu) per day	Right of way
	With road markings only see figure	< 30 km/h	<5000	cyclists give way
	With road narrowing see figure 4.21	Approx. 30 km/h	5,000 - 8,000	cyclists give way
	With raised crossing see figure 4.22	to be slowed down to 30 km/h	< 5.000	cyclists should get the priority
	With central barrier see figure 4.23	to be no more than 50 km/h	8.000	motorised traffic should get the priority

FIGURE 4.21 | CYCLE WAY CROSSING A CARRIAGEWAY BY MEANS OF A RAISED CROSSING



This technical drawing illustrates a plan view of a drainage system. It features two main parallel channels connected by cross-connections. Key elements include:

- Main Channels:** Two long, narrow rectangular channels running vertically.
- Cross-Connections:** Several horizontal connections between the main channels, some labeled with dimensions like 3.10, 3.50, and 2.00.
- Inlets/Outlets:** Various openings along the channels, some labeled with numbers like 100, 200, and 300.
- Flow Direction:** Indicated by arrows pointing downwards throughout the system.
- Dimensions:** Numerous numerical values are provided, such as 1.60-2.50 at the top, 25.00 for channel lengths, and 10.00-20.00 at the bottom right.
- Slopes:** Some areas are marked with slope indicators like 1:10.

4.9.1 Toucan crossing

Where to apply

- At road crossings where the motorised traffic volume exceeds 10,000 (pcu/day) and when the driving speed of motorised traffic cannot be reduced.

Specification

- A Toucan is a signalised crossing facility shared by pedestrians and cyclists and regulated with traffic lights.
- Pedestrians and cyclists have to push a button or cross a loop before getting a green phase.

Dimensions

- The width of the crossing facility should preferably be 4.00m (minimum 3.00m).
- The cycle crossing facility should be sited at the most convenient waiting spot.

Legal status

- Priority is decided by the traffic lights.

General comments

- The Toucan crossing can be installed near schools and shopping areas.
- The traffic signal phasing should be adjusted to the walking speed of crossing pedestrians and also give short waiting times for crossing pedestrians and cyclists.
- The width of the middle island should be a minimum of 2.0m and preferably 2.5m or more.



Cycle facilities (Department of Transport, England)