NRA IAN 03/12

National Roads Authority
An tÚdarás um Bóithre Náisiúnta

Provisions for Cyclists and Pedestrians on Type 2 and Type 3 single carriageway National Roads in rural areas

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Summary:

This Interim Advice Note relates to the provisions for, and design of, cyclist and pedestrian facilities on Type 2 and Type 3 single carriageway National Roads in rural areas.

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Provisions for Cyclists and Pedestrians on Type 2 and Type 3 single carriageway National Roads in rural areas

Contents

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1. INTRODUCTION

General

1.1 The purpose of this Interim Advice Note is to outline design principles and factors that should be considered by Design Organisations when providing cyclist and pedestrian facilities on new Type 2 and Type 3 single carriageway National Roads in rural areas.

1.2 This Interim Advice Note includes some design information for elements of the road cross-section. For more detailed information on road cross-sections reference should be made to NRA standard NRA TD 27.

Scope

1.3 This Interim Advice Note gives details on the road cross-section, geometric design, junction design, construction, drainage and signage and road markings for cyclist and pedestrian facilities on Type 2 and Type 3 single carriageway projects.

Implementation

1.4 This Interim Advice Note shall be used as directed by the NRA for the design of new or improved cyclist and pedestrian facilities on Type 2 and Type 3 single carriageway National Roads in rural areas.

1.5 If this Interim Advice Note is to be used for the design of local or regional road schemes, the Design Organisation should agree with the relevant Road Authority the extent to which the document is appropriate in any particular situation.

Definitions

1.6 For definitions of the general road terms used in this Standard such as components of the road (central reserve, verge, hard shoulder, and hard strip, etc.) see NRA TD 27.

1.7 Particular terms used in this Standard are defined as follows:

All-purpose road:- A road for the use of all classes of traffic e.g. not a motorway.

Cross-section:- The road cross-section incorporates all elements between the boundaries including carriageways, the central reserve, separation zones, hard shoulders, hard strips, verges including any footway, cycle track or bridleway, cutting or embankment slopes, berms and work space. All dimensions are measured square to the line of the road.

Cycle Lane:- A separate part of the carriageway for use by cyclists. The cycle lane forms part of the roadway and it is located within the contiguous road surface. It is not a cycleway and therefore generally not for the exclusive use of cyclists. These facilities do not cater for pedestrians.

Cycleway - A facility dedicated for the sole use of cyclists and, if permitted, pedestrians located within the road corridor.

Cycle Trail:- A facility dedicated for the sole use of cyclists and, if permitted, pedestrians located outside of the road corridor.

Design Organisation:– The organisation responsible for undertaking and/or certifying the design.

Mainline:- The carriageway carrying the main flow of traffic (generally traffic passing straight through a junction or interchange).

Non-motorised Users (NMUs):- Pedestrians, cyclists and equestrians, including mobility impaired users.

Road Authority:- The authority responsible for the road construction or improvement scheme.

Roads: Urban and Rural:- An Urban Road is a road which is in a built-up area and has either a single carriageway with a speed limit of 60km/h or less, or has a dual carriageway (including motorways) with a speed limit of 80km/h or less. All other roads are Rural Roads. See also NRA TD 9.

Mandatory Sections

1.8 Sections of this document which form part of the standards the National Roads Authority expects in design are highlighted by being contained in boxes. These are the sections with which the Design Organisation must comply or must have agreed a suitable Departure from Standards with the National Roads Authority. The remainder of the document contains advice and enlargement which is commended to Design Organisations for their consideration.

Relaxations within Standard and Departures from Standards

1.9 In difficult circumstances, the Design Organisation may relax some elements of these design standards, as specifically provided for within this document, and in accordance with **NRA TD 9**. The Design Organisation shall record the fact that a Relaxation has been used in the design and the corresponding reasons for its use. The record shall be endorsed by the Design Organisation responsible for the scheme. The Design Organisation shall report all Relaxations incorporated into the design as part of the project report at the end of each project management phase

1.10 In exceptional situations, the National Roads Authority may be prepared to agree to a Departure from Standards where the Standard, including permitted Relaxations, is not realistically achievable. Design Organisations faced by such situations and wishing to consider pursuing this course shall discuss any such option at an early stage in design with the National Roads Authority. Proposals to adopt Departures from Standard must be submitted by the Design Organisation to the National Roads Authority and formal approval received before incorporation into a design layout.

Road Markings

1.11 Please note that all drawings in this standard are diagrammatic only. No reliance should be placed upon them for road marking layouts for which reference should be made to the Traffic Signs Manual.

2. OVERVIEW

General

2.1 This interim advice note has been developed to give Design Organisations guidance on the provision of cycling and pedestrian facilities, on Type 2 and Type 3 National Roads in rural areas, so as to achieve a consistent quality of layout and coordinated design appropriate to the anticipated usage and demand in a range of circumstances.

2.2 This Interim Advice Note is based on international design standards and best practice. A list of these references is given in Section 11. The advice note also incorporates lessons learnt from a number of trial cycleway projects undertaken in Ireland.

2.3 Apart from cycle lanes, all other facilities in this document are considered to be shared use facilities for both pedestrians and cyclists, which is appropriate in the context of a rural setting and expected low number of users.

2.4 References within this document to cycling facilities should be generally taken to include for shared use with pedestrians.

National Cycle Policy

2.5 Current Government policy is set out in the *National Cycle Policy Framework (2008-2020)* with the aim to develop "a culture of cycling in Ireland to the extent that by 2020, 10% of all trips will be by bike". One practical measure to support this objective is to provide a National Cycle Route Network which encourages cycling as a transport mode, leisure activity and tourist activity in Ireland. The National Roads Authority published the *National Cycle Network Scoping Study* in August 2010, which identified a core network of high-quality routes between the larger towns and cities, and through the regions of greatest interest for tourist and recreational cycling.

2.6 The National Cycle Network will be approximately 2000km in length. The network will consist of on-road cycleways, off-road cycleways and cycle trails which make use of existing dedicated cycle paths, canal tow paths and disused railway lines. All of these routes will be free from motorised traffic.

2.7 Other cycling and pedestrian facilities along new and improved Type 2 and Type 3 National Roads will complement the *National Cycle Network* by providing additional links to connect to the adjoining hinterland in each region.

2.8 It is intended that the rural cycle route network will be a safe, attractive, high quality set of facilities catering for all non-motorised users. This will promote cycling and walking to the benefit of local communities and the general public as a whole.

Facilities for Cyclists and Pedestrians

2.9 For the purposes of this document the following non-statutory definition of cyclist and pedestrian facilities applies:

- Cycle Lane
- Cycleway
- Cycle Trail

2.10 Within the rural environment pedestrians and cyclists have tended to use the same facilities, including footpaths, hard shoulders and carriageways, with minimal conflict. This is mostly due to the relatively low number of walkers in the rural environment. It is recognised that any new facilities provided would continue to be shared and as such the facilities described in this document will be suitable for the combined use of both cyclists and pedestrians.

Cycle Lane

The cycle lane forms part of the roadway, it is located within the contiguous road surface and is delineated by a single white edge line on the right as defined in the Traffic Signs Manual and in S.I. No. 181/1997: Road Traffic (SIGNS) Regulations, 1997. These facilities do not cater for pedestrians. On all-purpose rural roads without footpaths, the provision of a cycle lane will give rise to difficulties for pedestrians who would normally

walk on the road carriageway. If a cycle lane is to be provided, it should be only in conjunction with an adjoining footpath for pedestrians.

Photo 2.1: Cycle lane in a rural environment (Denmark)

Cycleway

2.11 The cycleway is dedicated for the use of cyclists and pedestrians and it is an offence for motorised traffic to use it. There are two types of cycleway:

- On-road cycleway
- Off-road cycleway

2.12 The on-road cycleway is located within the contiguous road surface and is separated from motorised traffic by a segregation strip at least 0.5m wide and delineated by road markings. In some cases other physical markers may be used to clearly define the segregation.

Photo 2.3: On-road cycleway with road making delineation

2.13 The off-road cycleway is physically separated from the road carriageway by a verge or some other form of physical segregation; however it remains within the road corridor.

Photo 2.5: Off-road cycleway with 2.0m segregation verge (Denmark)

Photo 2.6: Off-road two-way shared cycleway and footway (Denmark)

Photo 2.7: Off-road cycleway with 1.0m segregation verge (N59 near Clifden, County Galway)

Cycle Trail

2.14 The cycle trail is a facility which is distinct from the road corridor and comprised of elements such as canal tow paths, disused railways and other such paths. The cycle trail is primarily used for recreational purposes and may consist of lower quality construction materials.

Photo 2.8: Cycle trail (Great Western Greenway, Mayo along a former railway line)

Photo 2.9: Cycle trail (New Zealand)

3. PLANNING

General

3.1 There is a statutory requirement for all-purpose roads to cater for cyclists and pedestrians as well as for motorised vehicles. New road projects should therefore include provisions for cyclists and pedestrians. There a number of ways to do this ranging from shared use of the carriageway to cycle lanes and dedicated cycleways within the road corridor. In some circumstances cyclists and pedestrians may be better accommodated away from the main traffic route, such as where an older section of road has been bypassed. In such circumstances clear directional signs will be required to ensure that cyclists and pedestrians are aware of the correct route to follow.

Photograph No.3.1 – Cycleway along a section of old road that has been bypassed

Photograph No.3.2 – Cycleway along an improved section of road, but not paralell

3.2 A successful cycling and walking facility is dependent on the following factors;

- Segregation from high-speed motorised traffic
- route continuity, particularly at road crossings;
- riding surface comfort, including maintenance;
- convenience;
- route attractiveness
- safety

3.3 At the earliest stage of a project consideration must be given to the needs and requirements of cyclists and pedestrians. This consideration should follow a design planning process which includes the following stages:

- Objectives Definition
- Constraints and Opportunities Assessment
- Demand Assessment
- Cycle and Walking Network Plan

Objectives Definition

3.4 The first stage of planning cycling and walking facilities for inclusion within a road project is to identify the objectives for the facility.

3.5 Planning should commence with a defined set of objectives such as:

- Create a facility that forms part of the National Cycle Route Network and of local recreational walking routes network.
- Connect rural settlements which are in close proximity to each other
- Provide a cycle network which passes as close as possible to centres of population
- Provide a cycle and walking route that connects to local amenities such as a beach, lake, historic site, woodland, mountains, etc

Opportunities and Constraints

3.6 The next stage before developing the cycle and walking route network plan is to identify any opportunities and constraints which may have an effect on the demand for cycling within the project area.

3.7 Opportunities to increase demand should be identified and include, but not be limited to, the following:

- Existing cycle and pedestrian facilities which could be linked to provide contiguous routes
- Tourist destinations within the local area which can be readily accessed
- Leisure facilities which can be readily accessed.
- Residential areas which can be serviced
- Commercial development areas which can be serviced
- Public transport interchanges to provide access to and from the cycle facilities
- Areas of natural beauty through which the cycle facility can be routed to enhance the user experience
- Disused railway lines and towpaths which can keep costs down and give the cycleway a more natural feel.
- Future planning proposals and local development plans.

3.8 Constraints which may limit demand should be identified. These include, but are not limited to, the following:

- Steep hills which may cause excessive exertion should be avoided
- Localities within which personal safety, either perceived or real, may be an issue should be avoided such as places hidden from view or where there is a risk of anti-social activity.
- Vehicle entrance crossings
- Junction crossings

Demand Assessment

3.9 Demand assessment will determine the requirement for pedestrian and cycling facilities for Type 2 and Type 3 single carriageway road projects.

3.10 Determining demand for a cycling and walking facility within the rural environment can be challenging. However undertaking a demand assessment will give Design Organisations a better understanding of the local conditions and environment which will enable them to design facilities that will better satisfy the objectives and ultimately encourage new users to take up cycling and walking.

3.11 Assessing demand for each project may require a mixture of different techniques including:

- Estimate use of a facility by comparing it to usage levels of existing facilities elsewhere with similar surrounding population, land use characteristics etc.
- Predict usage on a facility or in an area based on simple calculations and rules of thumb about trip lengths, mode shares and other aspects of travel behaviour.
- Relate usage in an area to its local population, land use, tourism potential and other characteristics.

- Predict an individual's travel decisions based on characteristics of the alternatives available to them.

3.12 The demand assessment should be used to develop a map which shows existing and potential demand patterns. The mapping should include locations of trip generators and attractors such as residential areas, leisure facilities, recreational areas and tourist spots.

3.13 For more information on modelling techniques and quantitative methods refer to the NRA Project Appraisal Guidelines.

Route Network Plan

3.14 The cycling and walking route network plan should be developed from the information compiled from the objectives, opportunities and constraints, and demand assessment exercises.

3.15 The network plan may result in the requirement for facilities which are not adjacent to the main traffic route and are in fact completely distinct from the road.

3.16 . To have the most benefit for cyclists and pedestrians, a scheme should seek to complete a section of route in full between significant terminal destinations, which will enable incremental delivery of an overall route network over time.

4. GENERAL DESIGN PRINCIPLES

General

4.1 Once the cycling and walking network plan has been developed and a route has been identified the appropriate facility must be determined.

4.2 When considering the final configuration of the cycle facility the Design Organisation should always keep in mind that a successful cycling facility must have the following qualities:

- route continuity, particularly through road crossings
- a high quality of ride
- convenience
- attractiveness
- safety

4.3 The cycling and walking network may comprise of any or all of the following:

- on carriageway shared use of roads including the use of hard shoulders
- cycle lanes and footpaths
- on-road cycleways / footways
- off-road cycleways / footways
- cycle & walking trails

The mix of facility will be determined by assessing the existing facilities, local road types, traffic flows on the local road network, the number of vehicle entrances, the number of junctions and other road crossings and comparing this with the cycle network plan.

Selection of Facility Type

4.4 The appropriate cycling and walking facility will primarily be dependent on the speed and volume of motorised vehicles. However it will also depend on the function of the route for cyclists and walkers and the physical constraints/opportunities present. Other considerations include the number of Heavy Commercial Vehicles, sight distances, potential for parked vehicles, the number and type of junctions, property accesses, and other local factors.

4.5 The suitability of a road to accommodate a cycling facility is assessed by quantifying vehicle speeds and flows, both at peak and off-peak times. Figure 4.1 sets out the motor vehicle speed and flow criteria which are relevant in determining if the cycling facility should be a cycle lane or an off-road or on-road cycleway.

4.6 Figure 4.1 shows that if the 85th percentile traffic speed is greater than 65 km/h and the mainline traffic volumes are over 1000 vehicles per day then an off-road cycleway or cycle trail is appropriate. Below 65 km/h an on-road cycleway, cycle lane or shared carriageway can be considered relative to the traffic flows and local conditions.

4.7 If, due to a low 85th percentile traffic speed, an on-road cycleway or cycle lane were to be considered then the effect of the resulting carriageway widening on the traffic speed needs to be evaluated. The traffic speed would be expected to rise due to the reduced traffic calming effect of the wider carriageway.

4.8 Off-road cycleways remove cyclists from busy traffic conditions and provide a higher degree of comfort when compared to on-road cycleways. They are particularly appropriate in the rural environment where there are few interruptions due to accesses and junctions. However they require slightly more land and may require additional road sweeping. However provision of route continuity at side road junctions can be problematic where turning movements are fairly high.

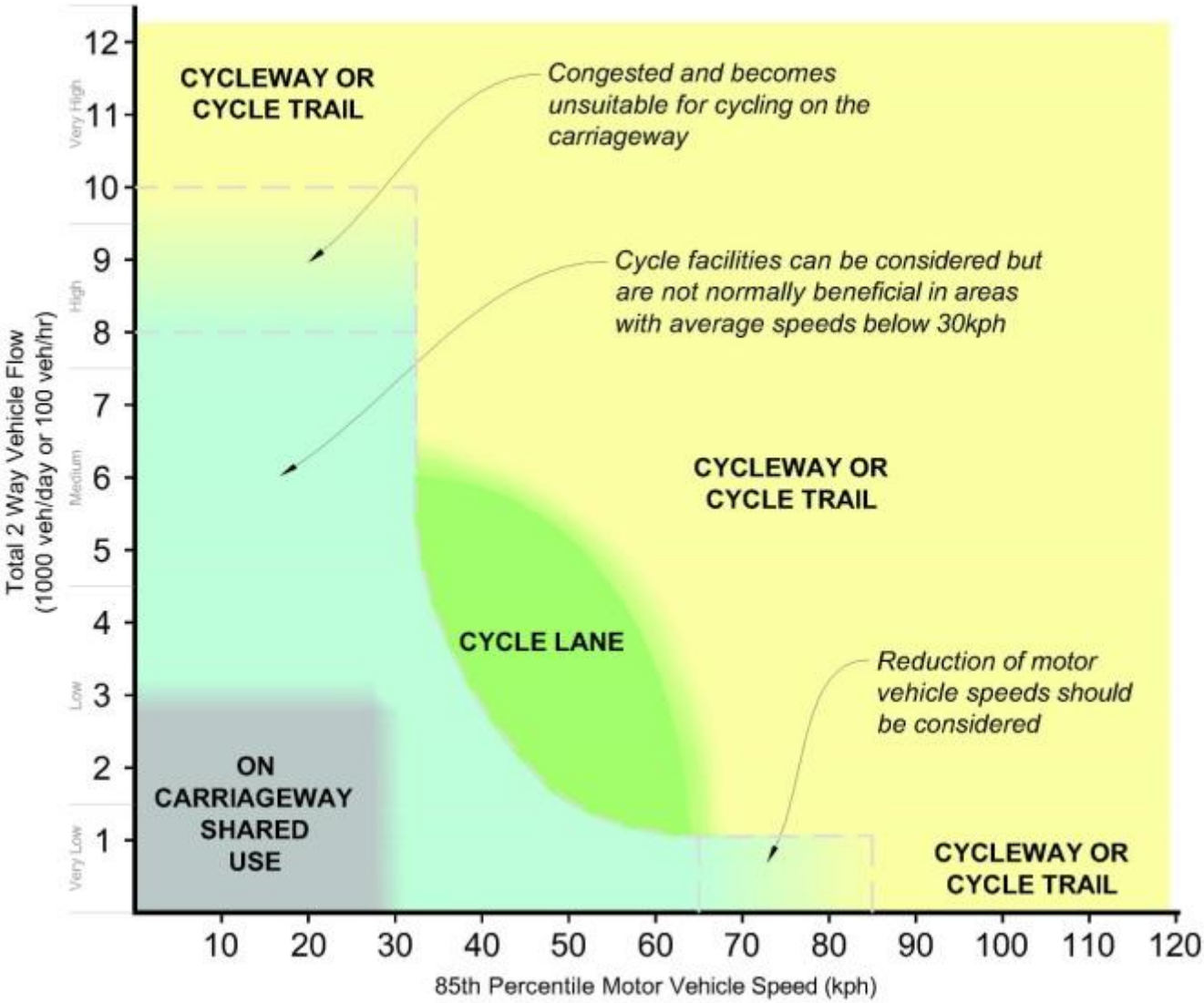


Figure 4.1: Selection Chart for Cycleway Type

4.9 On-road cycleways are useful where the physical road corridor width is restricted, such as beside water bodies or steep slopes. They can also be useful in situations where the current road cross section has a sufficiently wide hard shoulder to accommodate a cycleway and segregation width, such as a recently downgraded national road. The disadvantage for on-road cycleways include the lack security of physical separation from motorised traffic for the cyclist, motorised vehicles could misuse the cycleway, and a reduced traffic calming effect due to the apparent width of the overall road surface.

4.10 Where possible, off-road cycleways should be provided due to the perceived and real safety benefits gained by physically separating cyclists from motorised vehicles, so long as junctions are treated suitably to maintain priority for cyclists as discussed later in this report. The use of on-road cycleways should be limited to especially difficult circumstances; and in such cases a Departure from Standards will be required for its use.

One-way Versus Two-way Cycle Facilities

4.11 The one-way cycle facility comprises a cycle facility on each side of the road with the direction of flow matching that of the adjacent carriageway. Where space permits, this should be the normal provision as it will meet the natural expectations of road users for uni-directional cycle movements at junctions.

4.12 The two-way option has a cycle facility on one side of the road only with adequate width for

approaching cyclists to pass each other as well as accommodating pedestrians.

4.13 The choice of one-way versus two-way cycle facilities must be considered in terms of the local context, particularly the number of junctions, private entrances, mainline geometry, sightlines (at bends), vehicle turning movements, and track continuity.

4.14 Generally one-way cycle facilities, located on each side of the road, minimise the need for cyclists to cross the road. They also create a more conventional arrangement at junctions than two-way scenarios do. In the one-way situation cyclists will be approaching junctions on the same side of the road and in the same direction as motorised vehicles. This places cyclists in the line of sight of drivers approaching junctions enabling them to give way where necessary. In certain situations there may be natural tendency for contra-flow cycle movements such as where a cycle facility provides a convenient route between destinations without the need for cyclists to cross the road. See Section 7 for more details.

4.15 One-way cycle facilities may be preferable where steep longitudinal gradients are expected. Cyclists travelling slowly uphill have a tendency to wobble which increases the overall track width required. Cyclists travelling downhill have an increased speed and lose some of their ability to manoeuvre. This combination leads to an increased risk of conflict between cyclists travelling in opposite directions and is best avoided by utilising one-way cycle facilities.

4.16 A two-way cycle facility, located on one side of the road, may minimise the number of conflicts with vehicle entrances and junctions by locating the cycle facility on the side of the road with the least number of side roads and vehicle entrances. This may be particularly relevant for example on a coastal route where the cycle track may be placed on the seaward side of the road. It also provides a wider facility which gives a higher degree of comfort to the cyclist. If widening of an existing road corridor is required then widening on one side will reduce the number of properties affected.

4.17 A two-way cycle facility has the disadvantage that it can increase the need for cyclists to cross the road. It also increases the risk to cyclists at junctions and entrances due to vehicles not expecting contra-flow cyclists approaching from the left, but this concern may diminish in time as drivers become more used to the presence of such cycle tracks on the road network. Suitable signage and visibility will also reduce the risk of collision between vehicles and cyclists at such junctions.

5. CROSS-SECTIONS

General

5.1 The width of each of cycle and walking facility elements, including the segregation hard strip, segregation verge, and outside verge, will define its functionality, safety and attractiveness.

5.2 When deciding on cross-section widths for different elements of cycling and walking facilities the following points should be considered:

- the further a facility is from the road carriageway the safer the cyclists and walkers will feel
- the wider the facility the higher the capacity
- the more overall width available the more attractive the facility becomes with the possibility of landscaping

However these greater widths come at the expense of land and additional construction costs, and therefore a balance must be struck.

5.3 The following sections define desirable and absolute minimum dimensions for the various elements of a cycle facility under typical usage within the rural environment. Where possible these should be enlarged, particularly where increased usage may be expected such as close to densely populated areas or areas of particular natural beauty where users may wish to stop to enjoy the view.

5.4 Absolute minimum dimensions should only be used in very limited situations such as at pinch points or avoiding hazards and shall be treated as a Departure from standard.

5.5 Typical cross-section arrangements are shown on Figures 5.2 through 5.4.

Cycle Facility Width

5.6 Rural cycle facilities are shared use facilities and as such accommodate both cyclists and pedestrians at the same time. When defining the cross-section widths consideration needs to be given to the likely level of pedestrian and cyclist usage, the anticipated speed of the cyclist given the vertical profile, and the space that each user will occupy when using the facility.

5.7 Experience has shown that pedestrian and cycle flows can be catered for safely on shared facilities of restricted width. However this may inhibit the speed of cyclists and result in some faster cyclists choosing to remain within the road carriageway rather than using the dedicated facility. This could undermine the effectiveness of the road improvement scheme for the non motorised user. Care is required to ensure that a false economy does not arise through the provision of a minimalist facility where a wider cycle facility may have succeeded in attracting greater use.

5.8 The space needed for a cyclist to feel safe and comfortable depends on:

- the cyclist's dynamic envelope; i.e. the space needed in motion;
- the clearance when passing fixed objects; and
- the distance from, and speed of other traffic.

5.9 At low speeds, cyclists are prone to wobble and deviate from a straight line. For most cyclists a speed of 11km/h is required to ride comfortably in a straight line without a conscious effort to maintain balance. Above this speed the additional width needed when moving is 0.2m. Below this speed it is 0.8m.

5.10 The dynamic width of a cyclist, including deviation, as 1.0m. The clear space for one person walking is 0.6m.

5.11 On two-way cycleways where cyclists need to pass each other 0.5m should ideally be allowed between the dynamic envelope of each cyclist. This gives a desirable minimum width of 2.5m for two-way cycleways as shown in Figure 5.1.

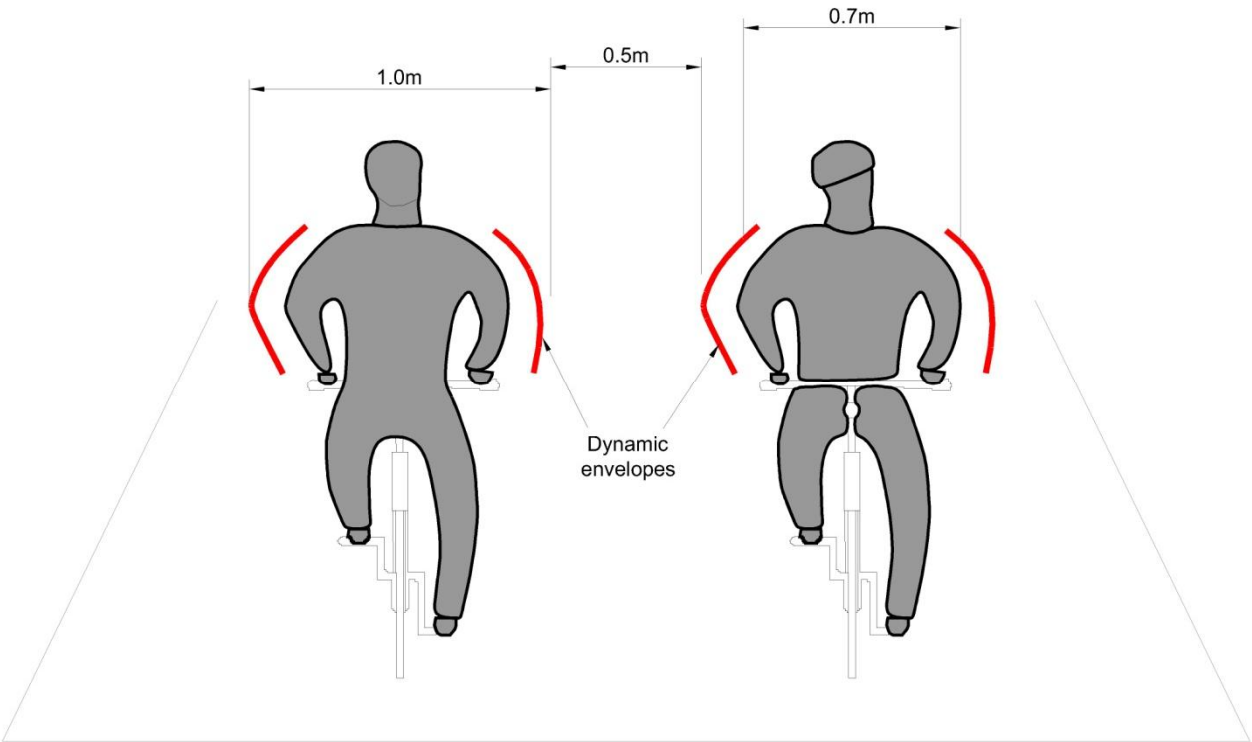


Figure 5.1: Width Requirements for Passing Cyclists

5.12 An absolute minimum width for a two-way cycle facility is 1.75m in very limited circumstances over short sections. When approaching such a pinch-point cyclists may moderate their speed to allow passing to take place before or after the restricted section, so long as it is short enough.

5.13 The desirable minimum width for a one-way cycle facility is 2.0m. This allows clear space for a cyclist to pass a pedestrian. It also allows cyclists to overtake another cyclist without leaving the cycleway. Compacted grass verges should be provided alongside the facility to enable evasive action by cyclists or walkers if necessary during a passing manoeuvre.

5.14 An absolute minimum of 1.5m may be appropriate for a one-way facility in situations of very low pedestrian and cyclist movements. This assumes pedestrians walking alone or in single file, otherwise two people walking together will block the route for a cyclist who may be approaching unseen from behind. Such a narrow facility is only suitable for use in locations remote from housing and attractions where pedestrians will be rarely encountered.

5.15 If vertical objects such as a wall, a fence or a safety barrier are located immediately adjacent to a cycleway the effective width of the cycleway will be reduced. It may therefore be necessary to increase the overall width, relative to the height of the object, to avoid limiting the effective capacity of the cycle facility. Table 5.1 gives guidance on additional widths required where vertical objects are located adjacent to the cycle facility.

Type of Edge Constraint	Additional Width (m)
Flush or near flush surface	**Nil**
Low up-stand up to 0.15m	**0.20**
Vertical features from 0.15m to 1.2m*	**0.25**
Vertical feature above 1.2m	**0.50**

* Including bridge parapets etc. over 1.2m for short distances

Table 5.1: Lateral Clearances for Cycleways

5.16 Where the vertical and horizontal alignments allow for higher cyclist speeds, additional width may be required to give a greater degree of separation between the fast moving cyclist, the pedestrian, and the slow moving cyclist travelling in the opposite direction.

5.17 The required cycle facility widths are as follows:

Facility Type	Desirable Minimum (m)	Absolute Minimum* (m)
One-way	**2.0**	**1.5**
Two-way	**2.5**	**1.75**

* Requires Departure from Standards

Table 5.2: Cycle Facility Widths

Segregation Width from Carriageway

5.18 Adequate separation width for cyclists and walkers from motorised vehicles is essential in providing a safe and comfortable environment for non-motorised road users.

5.19 As the speed differential between cyclists and motor traffic increases, so the greater the separation required. The separation provides protection to the cyclist from the vacuum effect of passing vehicles, particularly large trucks. It also provides protection from cyclists accidentally weaving onto the carriageway due to inexperience or during a passing manoeuvre.

5.20 A cycle lane provides no segregation between cyclists and motorised vehicles and should be used infrequently within the rural environment. A 0.5m wide contra-flow hard strip must be provided where a two-way cycle lane is required.

5.21 Where an on-road cycleway is utilised, the segregation width is defined by the width of the hard strip. The segregation hard strip has a desirable minimum width of 1.0m; however this can be reduced to 0.5m as an absolute minimum.

5.22 The hard strip will be delineated by edge markings and enhanced through the use of groups of yellow hatch markings at intervals as shown on Figure 10.1 in Section10.

5.23 For an off-road cycleway the segregation width includes the hard strip along the edge of the road carriageway and the unpaved verge and is measured between the carriageway edge marking and the edge of the cycleway as shown in **Figure YY**.

5.24 For maintenance purposes the absolute minimum width of an unpaved verge is 0.5m for a two-way cycleway, however 0.75m is the absolute minimum for a one-way off-road due to the lesser overall width of the one-way facility. The absolute minimum passing width between cyclists and motorised vehicles is 1.25m which provides a safe passing distance.

5.25 At a sufficient width the dividing verge can be utilised to accommodate roadside features such as traffic signs and safety barriers (or drainage in limited circumstances). It can also be landscaped with suitable plants which may enhance the attractiveness of the cycleway while not compromising visibility. Maintenance in the verge can be reduced through the use of poor soils which inhibit the growth of grasses or planting of low-growth ground creepers.

5.26 Where it is likely that vehicles may cross the segregation verge or an absolute minimum verge width is utilised, the inclusion of delineator posts at 24m centres should be considered.

5.27 The required segregation verge widths are as follows:

Facility Type	Desirable Minimum (m)	Absolute Minimum *(m)
On-road Cycleway	**1.0**	**0.5**
One-way Off-road Cycleway	**2.0**	**1.25**
Two-way Off-road Cycleway	**2.0**	**1.0**

* Requires Departure from Standards

Table 5.3: Segregation Verge Widths

Outside Verge Width

5.28 The outside verge width gives separation from the adjacent boundary treatment for the cyclist, particularly if the boundary is a high object such as a fence or a wall. It supports the edge of the pavement and if not provided will require an edging kerb instead for this purpose. The outside verge will enhance the overall appearance of the cycling facility through adding to the sense of space along the cycle and walking route.

5.29 The required outer verge width is generally a function of the cycleway width and the boundary treatment. Where possible a verge width of 1.0m is desirable as it allows for ease of maintenance. If a sufficiently wide cycleway has been provided then a verge may not be necessary.

5.30 Where the adjacent cycleway is of limited width the outside verge must consist of compacted soil with grass over the first 300mm to allow cyclists to take evasive action when passing or overtaking. Where sufficient width has been provided in the cycleway and it is not anticipated that cyclists will veer out onto the verge then the verge may be surfaced with softer materials. In all cases the verge should have poor soils that will inhibit the growth of grasses and will reduce the maintenance requirement. If a hedge forms the boundary delineation the verge width must accommodate expected growth between maintenance periods.

5.31 The outside verge widths are as follows:

	Desirable Minimum (m)	Absolute Minimum (m)
Outside Verge	**2.0**	**1.5**

Table 5.4: Outside Verge Widths

Safety Barriers

5.32 Safety barriers are not required to protect cyclists and pedestrians from motorised traffic on the adjoining the road. Unless required to protect traffic from other hazards as defined in NRA TD19, safety barriers should not be provided adjacent to a shared cycleway and footway.

5.33 If a safety barrier is necessary, then careful consideration must be given to the positioning and construction. Cyclists and pedestrians need to be protected from the hazard posed by safety barrier posts and rails. A safety barrier within a segregation verge can significantly diminish the effective width of the cycleway if located too close to the edge of the facility.

5.34 Where safety barriers are required for road traffic they must be located within the segregation verge between the mainline carriageway and the cycleway. If a safety barrier were located on the outside of the cycleway, the impact zone of an errant vehicle within the cycleway would be extended from a single point to the full distance it would take for the vehicle to come to a complete standstill, thereby amplifying the risk of cyclists and pedestrians of being struck by the errant vehicle.

5.35 The width of the segregation verge, where a safety barrier is to be installed, must include the hard strip or hard shoulder, the set-back, the physical width of the safety barrier, and another 0.5m setback from the rear of the posts to allow for separation between the barrier and the cycleway.

5.36 Where a cycleway is located behind a safety barrier then a system must be implemented which covers safety barrier posts to make them safe if a cyclist were to fall on one. This may be in the form of a plastic cap, check rail, or some other device to protect sharp edges.

Example of safety barrier with check rail across rear of posts at pinch-point along a two-way cycleway in Denmark.

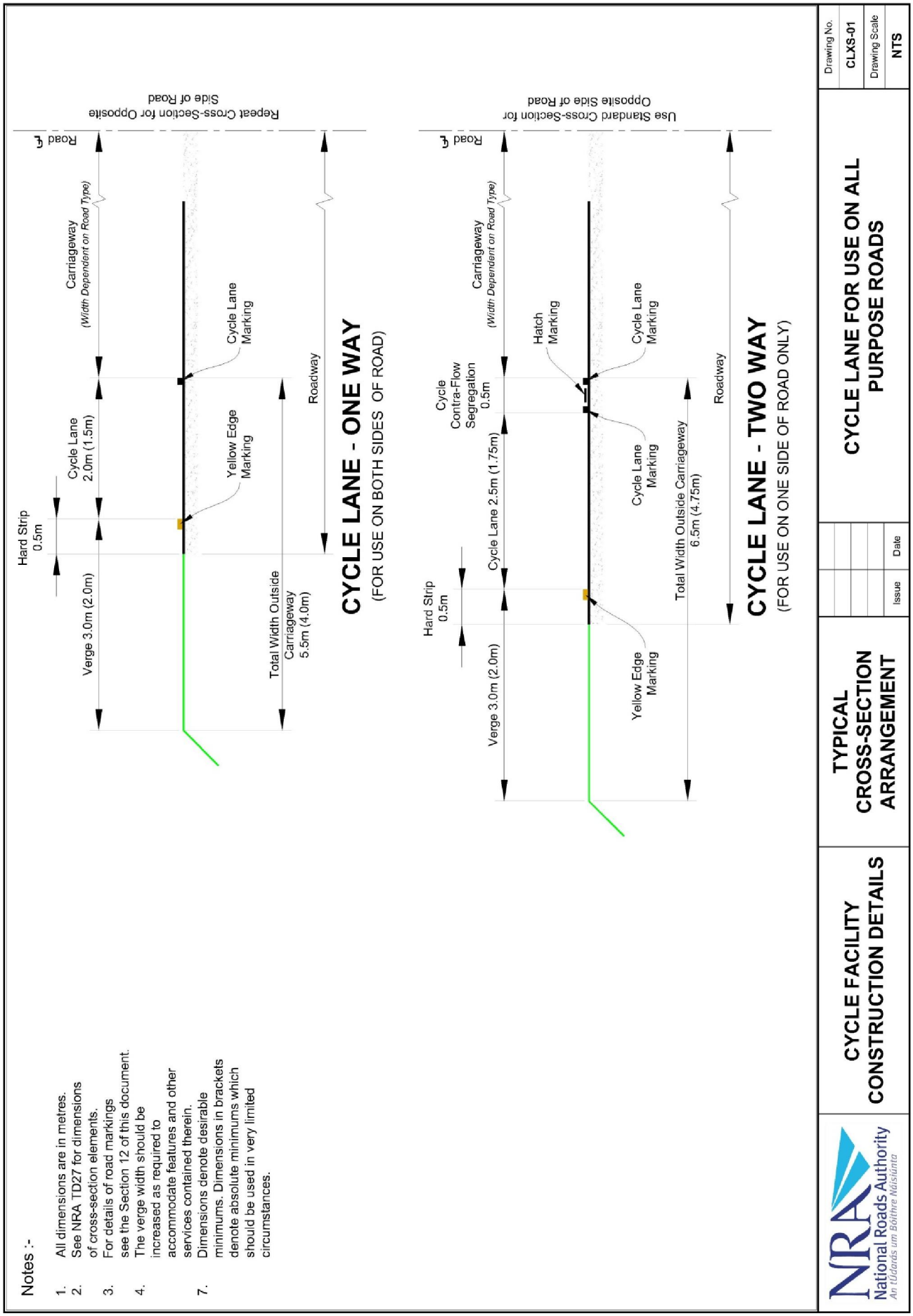


Figure 5.2: Typical cross-section arrangements

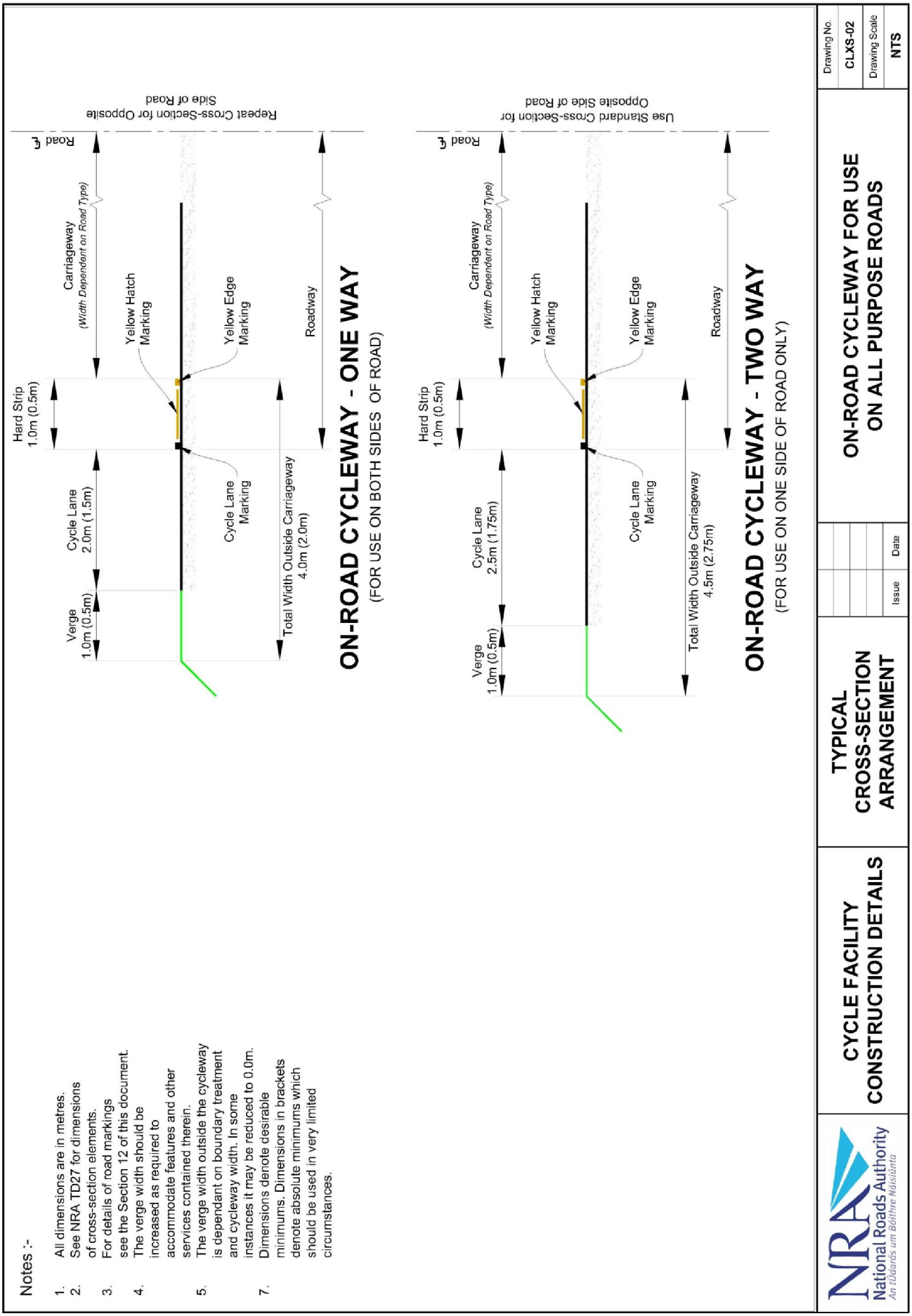


Figure 5.3: Typical cross-section arrangements

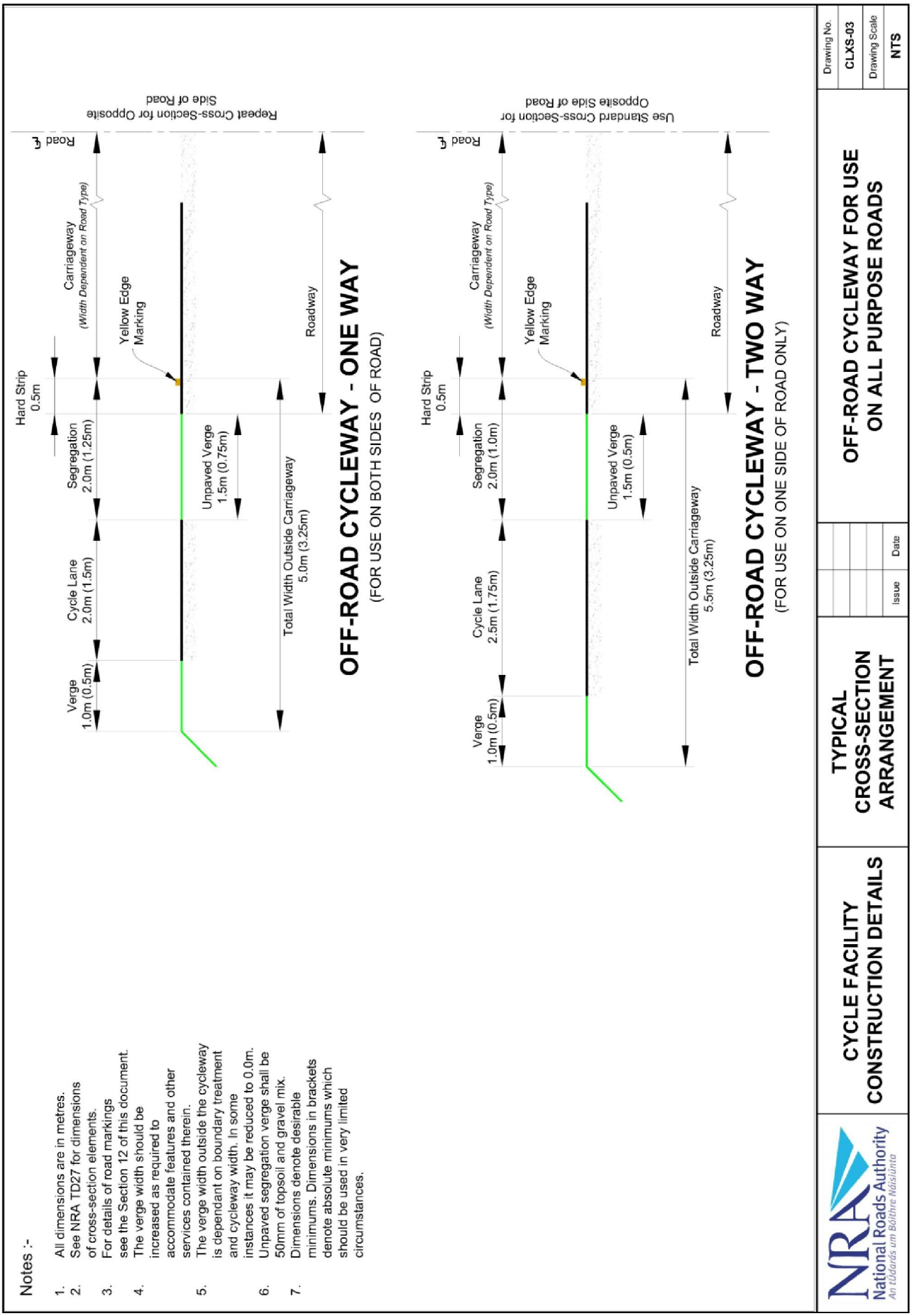


Figure 5.4: Typical cross-section arrangements

6. GEOMETRIC DESIGN

General

6.1 On-road cycleways and cycle lanes will have a geometric design contiguous with that of the adjacent carriageway and as such the geometric design criteria of the road carriageway will apply.

6.2 Off-road cycleways will generally be governed by the road geometry, but in some instances will require to deviate from the road alignment such as at junctions, steep longitudinal sections, and areas with land constraints.

6.3 Cycle trails will generally follow the natural features of the surrounding topography or the alignment of any disused rail line or tow path. However the following design criteria should still be used as guidance where possible.

6.4 Cyclists often go out of their way to avoid climbing a hill, especially where the gradient is steep. They may also try to avoid losing height once it has been gained. In some cases it may be necessary to consider an indirect alignment which avoids steep gradients. If space permits, steep gradients may be mitigated by introducing braided (zig-zag) sections for the uphill sections. However in some situations it may be better to have a steep route rather than none at all.

6.5 Speed differential between cyclists is likely to be greater on uphill sections of a hilly route rather than downhill sections and should therefore be treated in a different way. On the uphill section cyclists are likely to be travelling slowly or walking therefore it may be beneficial to segregate uphill and downhill cyclists.

Design Speed

6.6 Frequent road crossings, tight corner radii, the presence of other users, restricted width and forward visibility all affect the speed with which cyclists can travel and the effort required. Cyclists tend not to favour cycle routes that frequently require them to adjust their speed or to stop.

6.7 Cyclists generally travel at speeds between 20km/h and 30km/h on the flat and desire to maintain speed this speed without losing momentum due to interruptions such as giving way at junctions. Cycle speeds will vary to a greater degree than motorised traffic according to the vertical alignment. On steep uphill sections speeds can drop as low as 7km/h, whereas on downhill sections they can exceed 70km/h. These variations need to be considered carefully during the cycle network design as described in Section 3.

6.8 A consistent design speed of 30km/h for most off-road cycleways will provide a margin of safety for the majority of cyclists. However, where a cyclist would expect to slow down such as on an approach to a road crossing, the design speed may be reduced down to 10km/h over short distances. In these situations it may be useful to include a road marking of 'SLOW' if the forward visibility is limited.

6.9 The stopping sights distance parameters are as follows:

	Design Speed (km/h)
General Provision	**30**
Acceptable Minimum (over short distances)	**10**

Table 6.1: Design Speed for Cycleways

Visibility

6.10 The distance over which the cyclist has visibility of potential hazards is a critical design feature.

6.11 When assessing visibility for cyclists two parameters must be assessed:

- Dynamic Sight Distance (DSD)
- Stopping Sight Distance (SSD)

The dynamic sight distance and stopping sight distance parameters are as follows:

	Distance (m)
Minimum Dynamic Sight Distance (DSD)	**65**
Minimum Stopping Sight Distance (SSD)	**35**

Table 6.2: Dynamic Sight Distance and Stopping Sight Distance

6.12 The DSD is the distance a cyclist requires to see ahead in order to pass slower cyclists and pedestrians whilst still feeling safe and comfortable riding. The distance specified in Table 6.2 is the distance covered by a cyclist travelling at 30km/h in 8 seconds. See Figure 6.1 for a diagrammatic representation of DSD.

6.13 The SSD is the distance a cyclist requires to perceive, react and stop safely in adverse conditions. The distance includes a reaction time of 2 seconds plus the braking distance (deceleration rate of 0.15g).

6.14 The minimum SSD should be increased by 50% on loose surface tracks and gradients of greater than 5%.

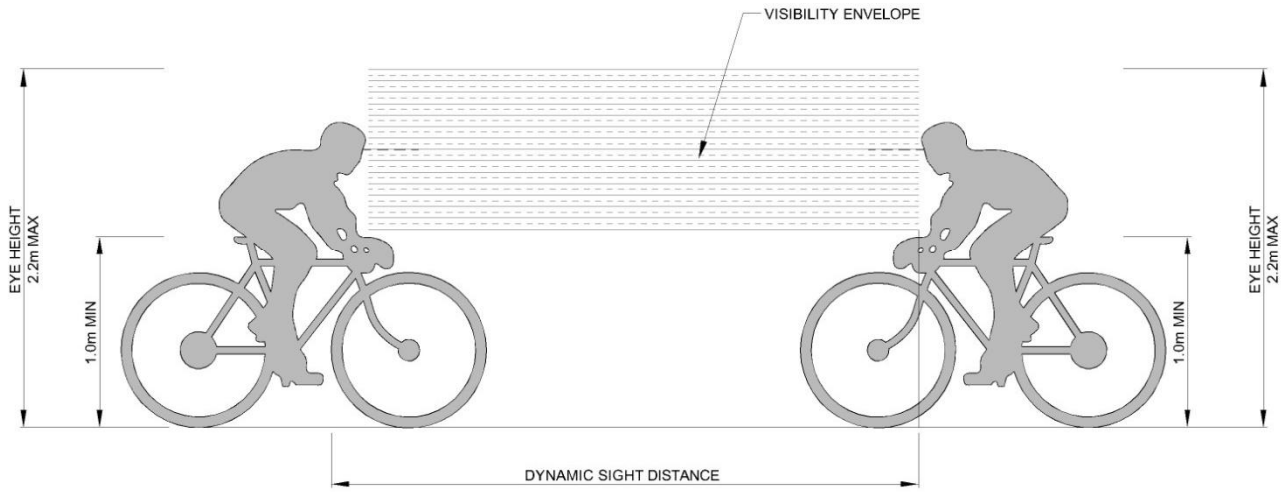


Figure 6.1: Dynamic Sight Distance

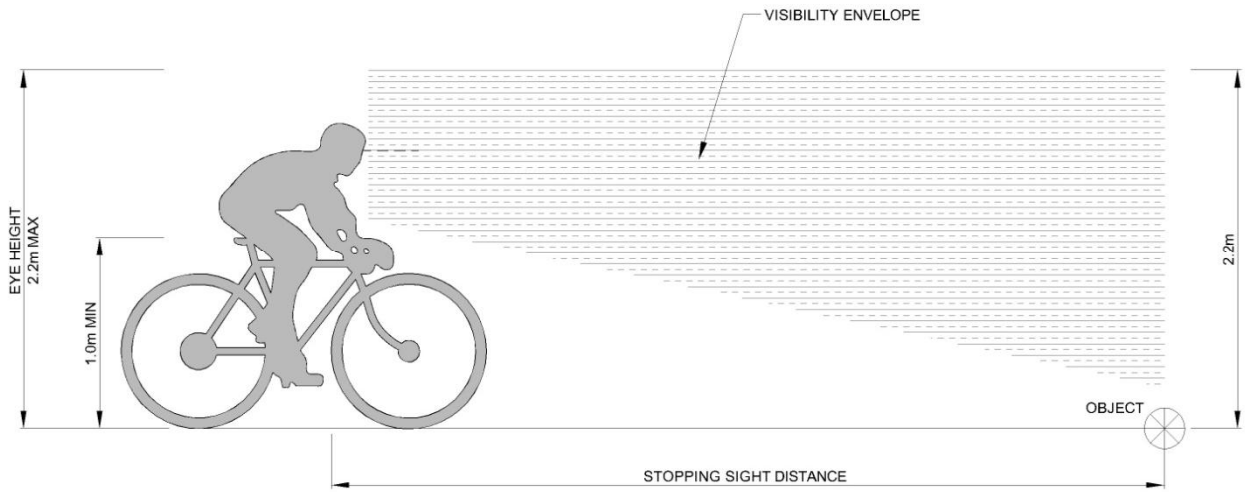


Figure 6.2: Stopping Sight Distance

6.15 Designers should ensure that an object at the minimum SSD is visible from a range of eye heights. For cyclists, an eye height range of 1.0m to 2.2m should be used, which accommodates a range of cyclists from children and recumbent users to adults. The object height should be taken as a range from ground level to 2.2m, as cyclists need to be able to observe deformations, holes and objects which could interfere with safe progress. See Figure 6.2 for a diagrammatic representation of SSD.

6.16 Street furniture, trees and shrubs should be located outside of the envelope of SSD where practical. In particular trees can obscure pedestrians from approaching cyclists. Isolated objects with widths of less than 300mm are unlikely to have a significant effect on visibility and may be ignored if removal is not practicable. For unmovable obstructions wider than 300mm it may be necessary to provide markings to guide cyclists.

Horizontal Alignment

6.17 To achieve a comfortable ride for cyclists, horizontal radii must allow a cyclist to negotiate them without a loss of speed.

6.18 The absolute minimum horizontal curvature for use on cycleways is as follows:

Design Speed (km/h)	Absolute Minimum (m)
30	**25**
10	**4**

6.19 In situations where the speed of cyclists needs to be controlled, alignments with a low radius can be used as a speed inhibitor. An absolute minimum is 4.0m. Any lower and the speed will drop below 12km/hr which makes it difficult for cyclists to keep their balance. Such situations may include vehicle priority junctions and areas of anticipated high pedestrian usage. It is important that cycling speeds do not cause inconvenience or danger to pedestrians.

Vertical Alignment

6.20 Care should be taken in designing cycleways to ensure gradients are kept to a minimum. The type of surface is important on slopes as the ability of tyres to grip the surface will depend upon frictional resistance of the surface coupled with its gradient.

6.21 The speed of travel is another important factor to consider, as well as the length of gradient. Steep gradients can lead to relatively high speeds for descending cyclists or very low speeds for climbing cyclists, which cab create hazards for all users of the route. Stopping distances also increase significantly on gradients in excess of 5%. Obstacles and sharp bends at the top and bottom of steep and/or long gradients should be avoided.

6.22 The preferred maximum gradient is 3% for cycleways, but this can rise to 5% over distances of up to 100m. Where steeper slopes are unavoidable, the limiting gradient is 7% over a distance of up to 30m. Steeper gradients are not recommended except over short distances. In mountainous terrain these gradient guidelines may not be practicably applied and with modern bicycle gearing long steep gradients can be managed at low speeds with suitable width provision for the wobble factor. On the approach to junctions the gradient would ideally not exceed 3%, which is similar to the design rules for roads. Where cyclists have to stop such as at junctions, a short locally levelled section will be of benefit.

Crossfall and Superelevation

6.23 Crossfalls should range between 1.0% and 2.5% to ensure adequate drainage.

6.24 While it is desirable that a cycleway should fall from its outer edge to the inside on bends, superelevation is unnecessary because of the way cyclists lean in turns and excessive superelevation should be avoided due to the potential dangers of icy weather difficulty manoeuvring at slow speeds.

6.25 These considerations will simplify the cross-section design in terms of level variation across the overall reservation and associated road grading.

7. JUNCTIONS AND CROSSINGS

General

7.1 A cycle network is only as good as its weakest feature. Research has shown that around three-quarters of cyclist casualties occur at or near junctions (London Research Centre 1994). Any benefits of providing a cycling facility may be negated if it terminates at or before a junction, without providing safe passage through.

7.2 It is most important that drivers know where to expect cyclists within a junction arrangement. Layouts that place a cyclist outside the driver's normal field of view are likely to be hazardous. Designs that place cyclists in front of and reasonably close to the driver tend to be safer. Simple layouts are preferred, complex layouts are to be avoided.

7.3 Approaches to crossings should normally be at right angles to the carriageway. Where cycle routes are located adjacent to the carriageway and lead to crossing points then 'jug handle' layouts should be used to place cyclists at right angles to the traffic flows.

7.4 When designing junctions and crossings consideration should be given to the fact that these facilities are for use by both pedestrians and cyclists.

Major / Minor Priority Junctions

7.5 The treatment of a major / minor priority junction for cyclists is applicable to on-road and off-road cycleways only. Cyclists on a cycle lane will be considered as mainline traffic. A cycle trail will cross a minor road using a perpendicular vehicle priority crossing.

7.6 Familiarity to both the driver and cyclist within a major / minor priority junction is of primary importance, therefore design options should be limited to the following options:

- bending in – cycle priority, which should be the norm for one-way cycle routes.
- bending out - cycle priority, which suits two-way cycle routes (usually with a raised platform to bring the cycle track across the road);
- bending out – vehicle priority (to be avoided except where major traffic flows warrant)

Bending In – Cycle Priority

7.7 The bending in junction treatment for major / minor priority junctions should only be used for one-way cycle facilities. Vehicles approaching a junction from the minor road would not be expecting to give way to cyclists approaching from the left. A two-way facility using a bending in junction treatment would result in cyclists approaching minor road from the left and could likely put cyclists in an unsafe situation.

7.8 A typical bending in junction treatment for a cycleway will reduce the segregation verge down to 0.5m at least 30m in advance of the junction. The cyclist is then given priority through the junction with appropriate road markings and traffic signs. 30m after the junction the standard segregation verge is restored.

7.9 The bending in junction treatment places the cyclist in a highly visibly location relative to the motorist on the mainline. The left turning motorist will be in a better position to judge if a cyclist will be travelling straight through the junction, and if so, give them priority.

7.10 Visibility requirements for vehicles at major / minor priority junctions shall be in accordance with NRA TD 41-42. However where a bending in cycle facility is provided the 'x' distance must be measured from the outside edge of the cycle facility.

7.11 The "dwell" area, in accordance with NRA TD 41-42, shall be provided immediately adjacent to the carriageway as defined by the nearside edge of the carriageway. However, where a bending in cycle facility is provided, a dwell area behind the stop line must be at least 5m long sufficient to store one vehicle.

7.12 The disadvantage of the bending in layout is that vehicles on the road, proceeding to turn left, may do so without giving way to cyclists in situations of marginal timing. This is due to the perceived pressures of vehicles following them on the road behind. However, over the past number of years, bending in layouts have become more common in urban areas and many drivers are now familiar with their operational requirements. Where traffic flows are significant a deceleration lane can be provided to enable a turning vehicle to slow down appropriately.

7.13 The bending in junction treatment is not recommended at junctions with a large number of left turning vehicles from the minor road.

7.14 See drawing JC-01 for a typical example of a bending in cycle priority junction on a single carriageway. The cycle and walking facility should be marked across the junction mouth with edge lines and symbols on the carriageway to highlight the crossing to drivers. (Refer to the example from Denmark in Photograph No.7.2)

Photograph No.7.1 – Bending-in of Cycleway on approach to a Junction (Denmark)

Photograph No.7.2 – Cycle Markings at Junction (Denmark)

Bending Out

7.15 The bending out junction treatment for major / minor priority junctions can be used for either one-way or two-way cycle facilities.

7.16 The bending out junction treatment is utilised to develop space between the cyclist crossing the junction and vehicles turning off the mainline onto the side road. They take the form of either a cycle priority or vehicle priority junction.

7.17 An advantage that the bending out junction treatment has over the bending in junction treatment is that it gives space for vehicles turning left off the major road before they encounter the cycle crossing thereby minimising any effect on the mainline capacity. Also a single vehicle waiting at the junction can stop closer to the carriageway thereby reducing the visibility requirements.

7.18 Junction priority within a bending out scenario must be assessed in terms of the following criteria:

- The general objective to allow cyclists to maintain speed without being required to give way to turning traffic
- Volumes and speed of turning traffic (as defined in Section 7.20)
- Volumes of bicycle traffic
- Traffic speed on the main road
- any other site specific conditions which may affect visibility and safety

7.19 Both forms of priority junction are set back from the mainline carriageway allowing cyclists to pass through the junction offset from the junction interface. It is important for safety that the 'bend out' is designed so as to provide the cyclist with a straight approach to the crossing. It must be introduced such that it does not give a cyclist the feeling of a detour and motorists do not get the impression that the cyclist is turning left.

Bending Out – Cycle Priority

7.20 Generally cycle priority junctions should only be used where the mainline traffic flow is less than 4,000 vehicles per day and the average vehicle speed is less than 50km/h. Consideration should also be given to the traffic flows on the side road.

7.21 For a cycle priority junction the bend out should be introduced gradually to minimise the inconvenience for the cyclist and to allow them to maintain a reasonable speed through the junction. A minimum radius of 30m should be used.

7.22 Coloured surfacing should be considered to emphasise the existence of the cycle priority crossing. The cycle and walking facility should be marked across the minor road with edge lines on the carriageway to highlight the crossing to drivers.

Bending Out – Vehicle Priority

7.23 For a vehicle priority junction the bend out should be introduced a little quicker than the cycle priority scenario. Using a minimum 10m radius a traffic calming affect can be developed to limit the cyclist speed approaching the cyclist give way line.

7.24 See drawing JC-01 for a typical example of a bending in cycle priority junction on a single carriageway. The cycle and walking facility should be marked across the minor road with edge lines and symbols on the carriageway to highlight the crossing to drivers.

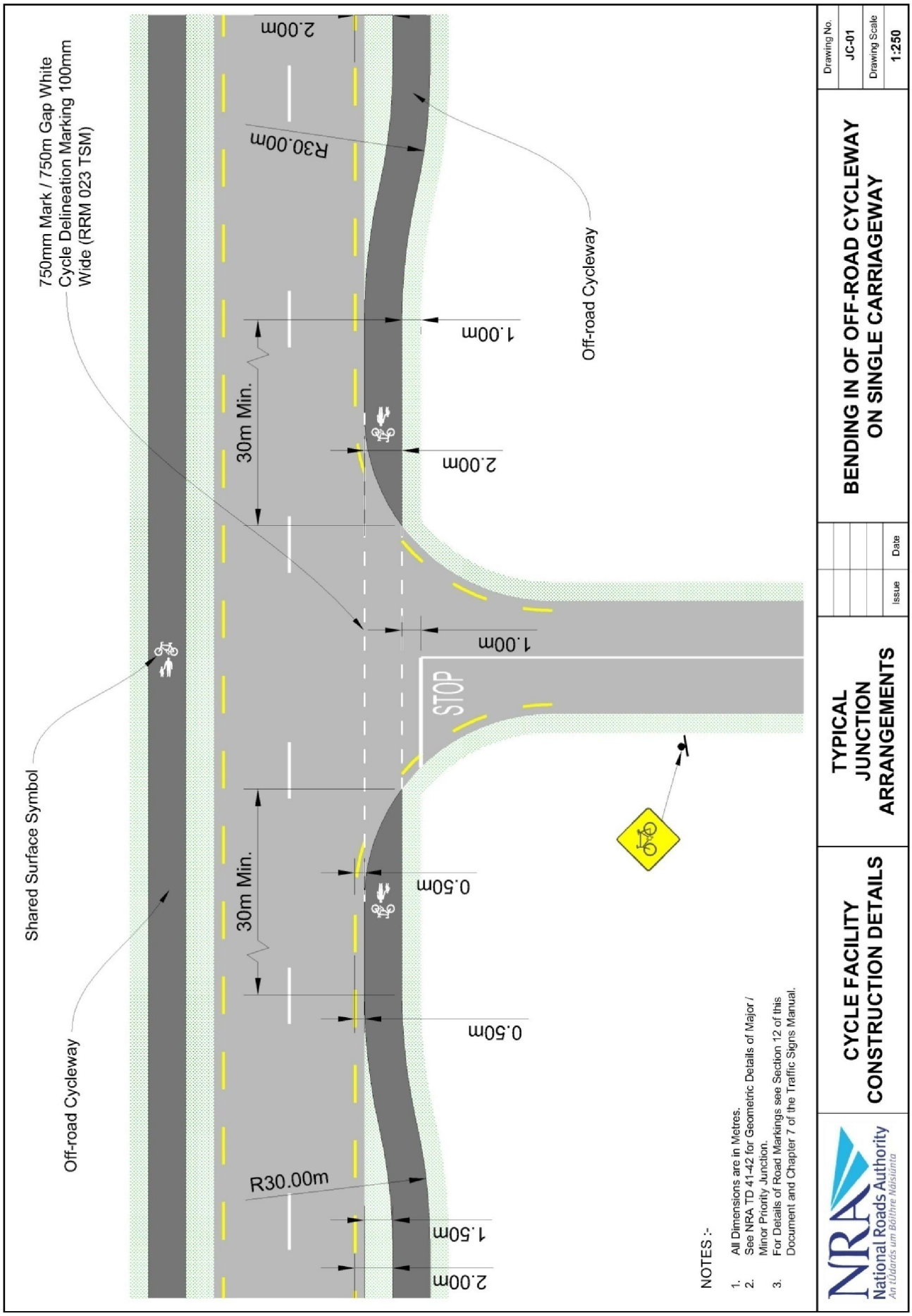


Figure 7.1: Typical junction arrangements

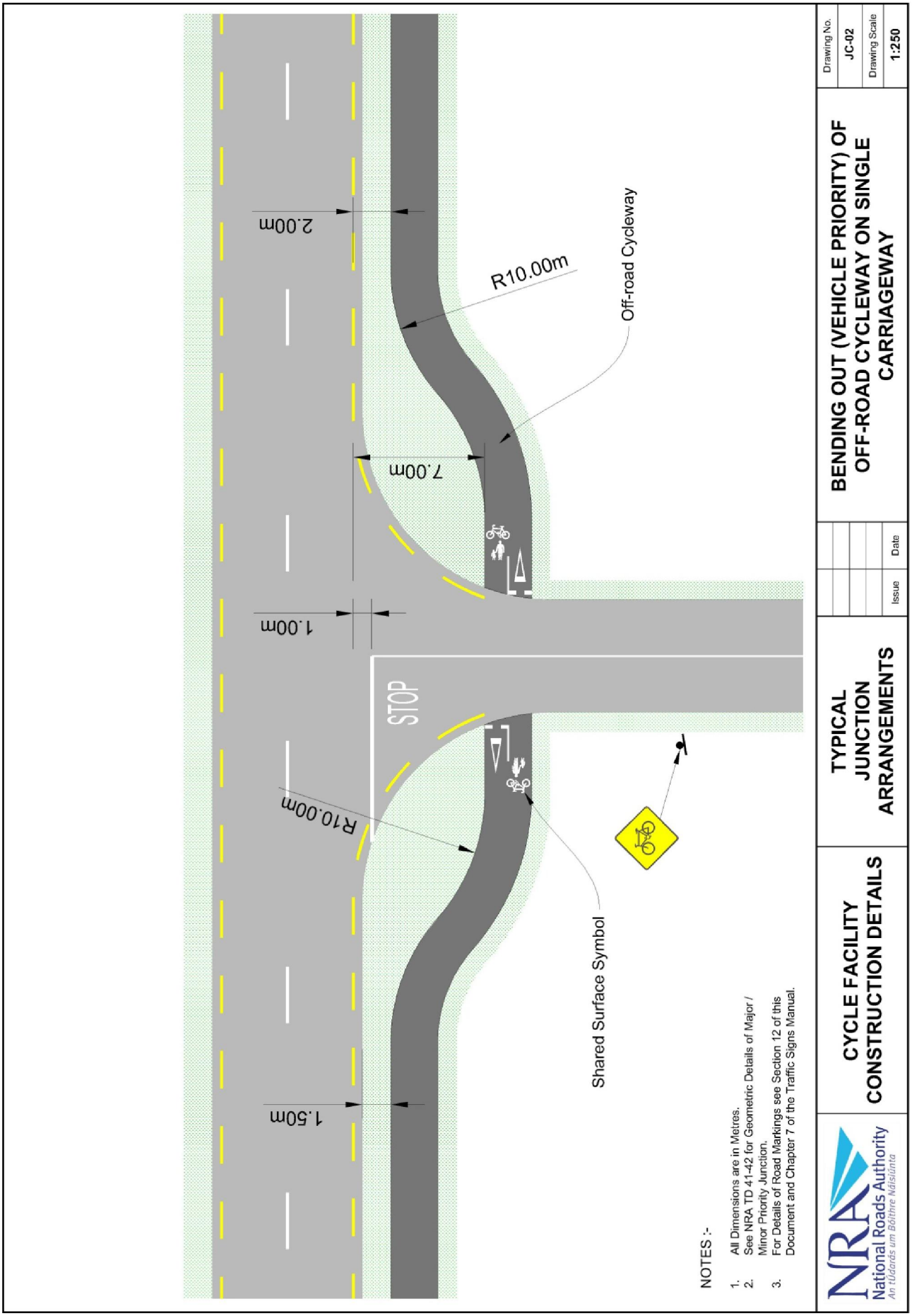


Figure 7.2: Typical junction arrangements

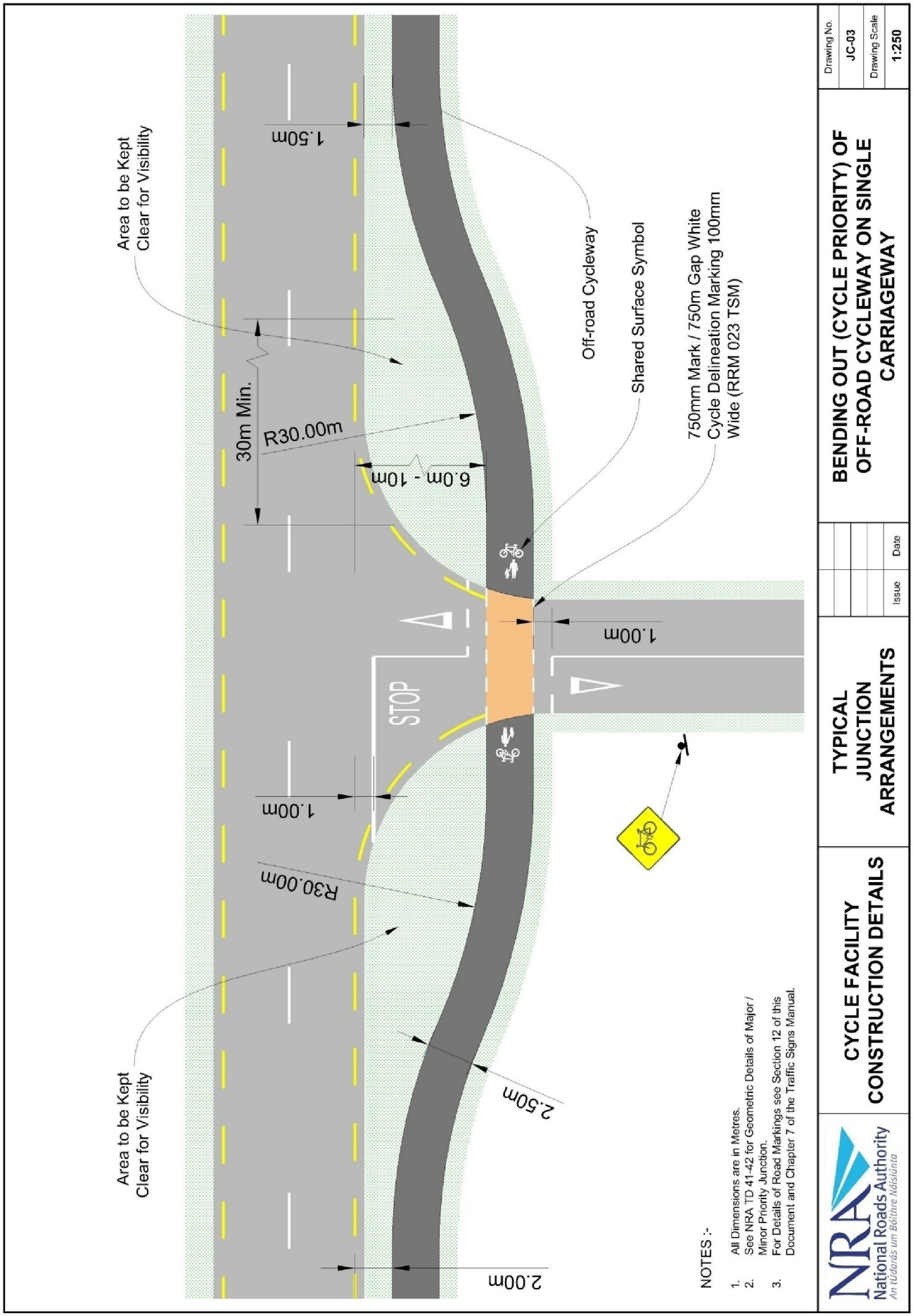


Figure 7.3: Typical junction arrangements

Grade Separated Junctions

7.25 Grade separated junctions are commonly found on highly trafficked all purpose dual carriageways with traffic speeds in excess of 85kph and relatively fast entry and exit speeds on slip ramps. For on-road cyclists conflicts occur over the whole length of merge and diverge areas between a relatively slow moving cyclist wishing to continue on the mainline and fast moving entry and exit traffic.

7.26 The Design Organisation should include off-road cycle facilities to manage these conflicts effectively. Careful consideration must be given to the design of appropriate crossings including 'jug handle' crossings on the slip roads as shown in Photograph No.7.3.

Photograph No.7.3 – "Jug-Handle" Crossing for Cycleway at Grade-Separated Junction

7.27 Consideration should be given to directing cyclists up the diverge slip road, crossing the minor road and rejoining the mainline via the merge slip road. However the vertical gradients will determine the amount of use by cyclists. If it is likely that cyclists will continue to use the mainline then a facility at grade will still be preferable.

7.28 At major junctions with high flows on the slip ramps in excess of 1,000 vehicles per hour, it will be preferable to provide grade-separation for cyclists through separate underpasses or overbridges to suit the overall junction geometry. The minimum width of the cycleway at these structures shall be 3m to allow for adequate clearance to parapets or side walls.

Photograph No.7.4 –Bridge Crossing for Cycleway at Grade-Separated Junction

Side Roads at Bridges

7.29 For the purpose of maximum permeability within the overall road network, it is desirable to provide connections from a cycleway along a dual carriageway to all local roads that are carried over or under the main road on a bridge.

7.30 Where a connection is provided between a cycle facility on the mainline and a minor road bridge or underpass crossing it should comply with the geometric design requirements as described in Section 6. So as to limit the gradient for cyclists, a spur link may be required between suitable points where both roads are close to natural ground level. This spur will most likely run along the toe of an embankment or the lip of a cutting as the case may require.

Roundabouts

7.31 Roundabouts on rural roads will usually be bypassed by a cycleway, with side road crossings provided on the arms of the junction as appropriate to provide connections for cyclists and pedestrians. Such road crossings will typically be located 10m to 15m from the edge of the circulatory carriageway so as to enable exiting traffic to appreciate the presence of a cyclist or pedestrian crossing the road.

7.32 Approaches to crossing points should be laid out to suit smooth cycling with splayed corners and minimum 4m radius curves.

7.33 Refuge islands at roundabout crossings should be at least 3m wide to enable cyclists and pedestrians to make a staged crossing if necessary and to await a gap in traffic.

7.34 Controlled crossings at roundabouts for pedestrians and cyclists, such as a zebra crossing, will rarely be appropriate in a rural area with low frequency usage. However, a controlled crossing may be worth considering at locations where large numbers of users may be expected such as at a busy amenity site.

Road Crossings for Cyclists and Pedestrians

7.35 When a cycle facility crosses a road, selection of the most appropriate location and form of crossing requires careful assessment. The selection process depends on the interaction and resolution of site-specific factors, (such as proximity to a school), with the safety of the vulnerable road user being of paramount importance. Depending on the relative volumes of traffic, a crossing may be either at grade or through an underpass or bridge.

7.36 Approaches to at-grade road crossings should normally be at right angles to the carriageway. Where cycle routes are located adjacent to the carriageway and lead to crossing points then 'jug handle' layouts should be used to place cyclists at right angles to the traffic flows.

Photograph No.7.5 –At-grade Road Crossing with Bending for Cycleway (N59 at Newport, Co. Mayo)

Photograph No.7.6 –At-grade Road Crossing without Bending for Cycleway (N59 at Derrylea, Co. Galway)

Photograph No.7.7 –Underpass Crossing for Cycleway at Main Road (Denmark)

At-grade Road Crossings – All Purpose Dual Carriageways

7.37 The crossing of an all purpose dual carriageway may be used to connect two cycle facilities on opposite sides of the road or to provide access to an area of interest.

7.38 The crossing requires a minimum median width of 5.0m for staging.

7.39 A left-right stagger within the median should be provided with a minimum length of 10m. The left stagger ensures that users turn left to face oncoming traffic.

7.40 The cycleway width within the median should be maximised for comfort of slow-speed cycling and storage. A desirable minimum width of 3.0m is required with additional clearances to fixed objects as necessary.

7.41 Cyclists approaching the crossing need not be forced to dismount however they should be slowed on the approach in preparation of giving way at the crossing point.

Crossings at Direct Accesses

7.42 Cyclists should be afforded priority at all footpath crossings and vehicle entrances so as to maintain momentum and to respect the natural expectation of priority for the through movement.

7.43 Visibility requirements for vehicles at direct accesses shall be in accordance with NRA TD 41-42. The 'x' distance shall be measured from the nearside edge of the carriageway without the need to accommodate the cycle facility.

7.44 Additionally a direct access crossing a cycleway will require a visibility splay setback 2.0m ('x' distance) from the cycleway with a stopping sight distance of 35.0m ('y' distance).

7.45 The "dwell" area, in accordance with NRA TD 41-42, shall be provided immediately adjacent to the carriageway as defined by the nearside edge of the carriageway. However, a dwell area is better provided behind the cycleway with sufficient space to store one vehicle.

7.46 The cycleway pavement construction must be carried across an access to a property so as to clearly indicate the priority for the through cycle traffic. Cycle symbol road markings should be provided at the crossing to reinforce the arrangement.

7.47 The vertical alignment of the cycleway must carry across an entrance without interruption or dishing.

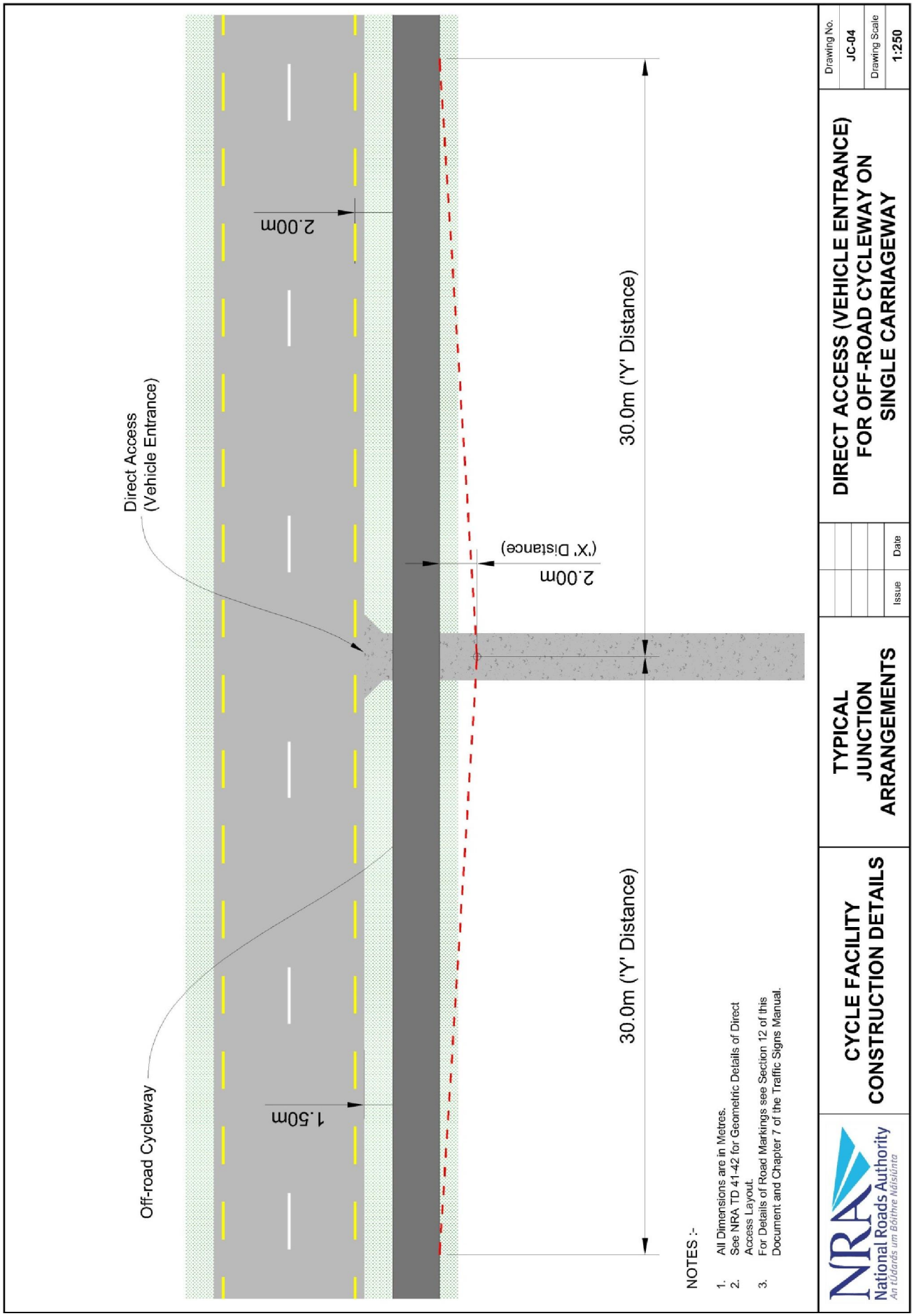


Figure 7.4: Typical junction arrangements

8. CONSTRUCTION DETAILS

General

8.1 The type and quality of the cycleway surface and construction affects the comfort and attractiveness of a route and the whole-life costs of the project. A good quality specification will minimise maintenance and repair costs over the long term.

8.2 Cycle lanes will generally have the same pavement construction as the mainline carriageway.

8.3 Cycleways do not suffer from the same degree of wear as motor vehicle routes and may be of much lighter construction than a road pavement. These light pavements are not specifically covered in the general guidance for road pavements elsewhere in the NRA DMRB. However, the materials specifications and construction techniques used will be consistent with the relevant requirements of the NRA DMRB and the Manual of Contract Documents for Road Works (NRA MCD).

8.4 This advice note provides guidance on best practice pavement construction for cycleways based on trials in a pilot scheme. Typical construction details are included in Figures 8.1 and 8.2.

Pavement Construction to Formation Level

8.5 Cycleway pavements will generally be constructed of bituminous macadam. However there may be some instances where the bituminous surface is not suitable or desirable. Some cycle trails have been constructed with an unbound grit surface, which has merit in terms of low-energy construction and aesthetic quality in a rural environment. Such grit surfaces may not suit all cyclists, especially for bicycles with narrow wheels and high pressure tyres that would be more vulnerable to puncture on an unbound surface. The selected pavement construction material will depend on the purpose and expected level of use of the cycleway, the construction methods available, stability of the sub-grade, drainage, frost susceptibility, aesthetics, and design life required. Typical pavement options are included in Table 8.1.

8.6 Bicycles are more sensitive to ride quality than motor vehicles due to their lack of suspension and narrow wheels. Some older cycleways are poor in terms of ride quality and surface level tolerance, which is probably due to the lack of appropriate construction details and specified level tolerances. It is desirable to provide a finished surface quality for a cycleway that meets the minimum requirements of Series 700 of the Specification for Roadworks.

8.7 In the absence of specific construction details for cycleways, the footway detail as shown on NRA RCD/1100/4 of the NRA MCD Road Construction Details has been used in the past. This form of construction is not suited to achieve tolerances specified in Series 700 of the Specification for Roadworks. The thin footway pavement design is vulnerable to ridging of the sub-base due to the use of vibrating rollers for compaction. The sudden transition from sub-base level tolerances to surface tolerances through a single 50mm thick layer of bituminous macadam is not sufficient to compensate for ridging in the sub-base which is then reflected in the surface layer.

8.8 The recommended pavement construction detail that will limit problems of ride quality for cycleways is as follows:

- 20mm thin surface course macadam;
- 40mm to 55mm base or binder course;
- 150mm 804 sub-base (machine laid).

Typical Cycleway Surfacing Options	
Surface	Comment
Asphalt or Bituminous	Preferred surface, suitable for high flow routes Lower long term maintenance costs.
Surface dressed base course	More suitable in rural environments. Preferred to unbound surfacing. Allows for colour variation through choice of chippings. Fibre-reinforced surfaces add strength
Unbound	Not generally recommended except on very quiet routes or in mountain areas where most bikes are of a suitable type. Can be dusty when dry and can result in unpleasant spray when wet. Prone to erosion by poor drainage. Can have higher long term maintenance costs, and is prone to damage by horses and farm vehicles.

Table 8.1: Typical Cycleway Surfacing Options

Photograph No.8.1 – Cycleway with Grit Surface (Great Western Greenway, Co.Mayo)

Construction - General

8.9 Most damage to a cycleway pavement is likely to occur during the construction process due to the use of heavy weight machinery. It is essential that suitable lightweight equipment is used to avoid deformation of the pavement and foundation. Such equipment is readily available and should be specified in the Construction Contract using current guidance from the NRA.

8.10 Direct delivery of materials, such as stone and macadam using normal trucks travelling on the cycleway should be avoided. It will probably be necessary to deliver such materials from the side if adjacent to the road, or by transfer with smaller equipment.

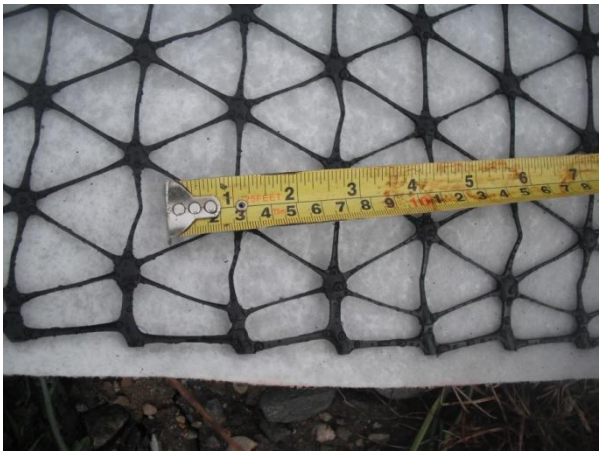
Photograph No.8.2 – Lightweight Construction Equipment on a Cycleway Scheme (Note the rubber tracks to prevent damage to pavement)

Foundations for Cycleway Pavements

8.11 Many cycleways will be constructed on poor ground. For reasons of economy it is desirable to avoid the need to excavate soft ground beneath a lightweight cycleway, which will not give rise to significant settlement in operation. The critical design factor will therefore be the weight of construction plant during construction, which should be as light as possible.

8.12 Trials have shown that it is possible to construct a floating cycleway to a high quality standard across very soft ground using a suitable foundation layer with geotextile and stone fill sandwich construction as shown in Photographs No.8.3 to 8.6.

Photograph No.8.3 – Geotextile base for Floating Lightweight Construction



Photograph No.8.4 – Detail of Typical Geotextile Base Layer

Photograph No.8.5 – Lightweight Roller Compacting Foundation for Cycleway

Photograph No.8.6 – Completed Floating Lightweight Construction for Cycleway

8.13 The cycleway pavement foundation should be designed to the road design standards in Volume 4 of the NRA DMRB.

8.14 Where necessary due to soft ground conditions, capping should be placed in accordance with Series 600 of the Specification for Roadworks. Typically a minimum of 350mm of capping material will be required, possibly with a geotextile membrane at sub-formation.

8.15 The Designer may choose to strip the topsoil, in which case the top of the capping layer is likely to correspond to original ground level, and the finished cycleway surface will be above ground level to suit over-the-edge drainage.

8.16 It may be preferable not to strip the topsoil layer so as to avail of the natural load-spreading capacity of the "scraw" (vegetation and root layer) on soft soils such as peat. Overall settlement of the cycleway under its own self-weight is of little concern for the final vertical alignment of the route, and therefore it would be acceptable to leave the original ground undisturbed in the construction.

Sub-Base Construction

8.17 A minimum of 150mm of sub-base must be laid in accordance with Series 800 of the Specification for Roadworks.

8.18 So as to achieve the desired level tolerance and associated ride quality, trials have shown that the sub-base should be laid with a paver as shown in Photograph No.8.6. Mini-pavers are available that can lay to the narrow widths required for a cycleway.

Photograph No.8.7 – Paving machine laying sub-base for a Cycleway

Bound Pavement and Surfacing

8.19 The bituminous pavement must be laid and compacted with suitable lightweight machinery as shown in Photograph No.8.7.

Photograph No.8.8 – Lightweight roller compacting Cycleway pavement

8.20 The recommended thickness of the bituminous pavement is 60mm to 75mm in two layers with a fine-aggregate surface course 20mm thick. However, trials have shown that with suitable quality control during construction to achieve the required level tolerances and ride quality, the surface course layer may be omitted and that a single 55mm thick layer of binder course should suffice.

Pavement Edge Detail

8.21 A stepped edge detail, as per NRA RCD 700/1, shall be formed on the low edge of cycleway pavement to suit over-the-edge drainage and to prevent surface water runoff from blocking back onto the paved surface due to accumulation of grass and soil in the verge.

Verge Detail

8.22 It is desirable to inhibit grass growth on the segregation verge between the road and the cycleway so as to minimise or eliminate the need for maintenance. Initial trials have used a thin and stony soil in the verge to restrain the rate of grass growth, as shown in Photograph No.8.9.

Photograph No.8.9 – Stony Soil in Segregation Verge to inhibit grass growth

8.23 Ideally the verges should be left to self-seed with local plant types from the surrounding terrain, in line with best practice for sustainability. Some cycleways will traverse through Special Areas of Conservation and Natural Heritage Areas, in which case it is especially important not to introduce native grass species in the grass verges.

8.24 Trials are ongoing on a pilot scheme on the N59 at Derrylea near Clifden, Co.Galway, where the initial growth of grass in the verge appears to be appropriately slow as shown in Photograph No.8.10 taken about 5 months after construction. This trial will be monitored to confirm the success or otherwise of the verge construction details. If necessary, the construction detail will be adapted further on other planned cycleway schemes in Donegal, Mayo and Kerry from which additional lessons may be learnt

Photograph No.8.10 – Pilot scheme with Trial Grass Verge Detail (N59 at Derrylea)

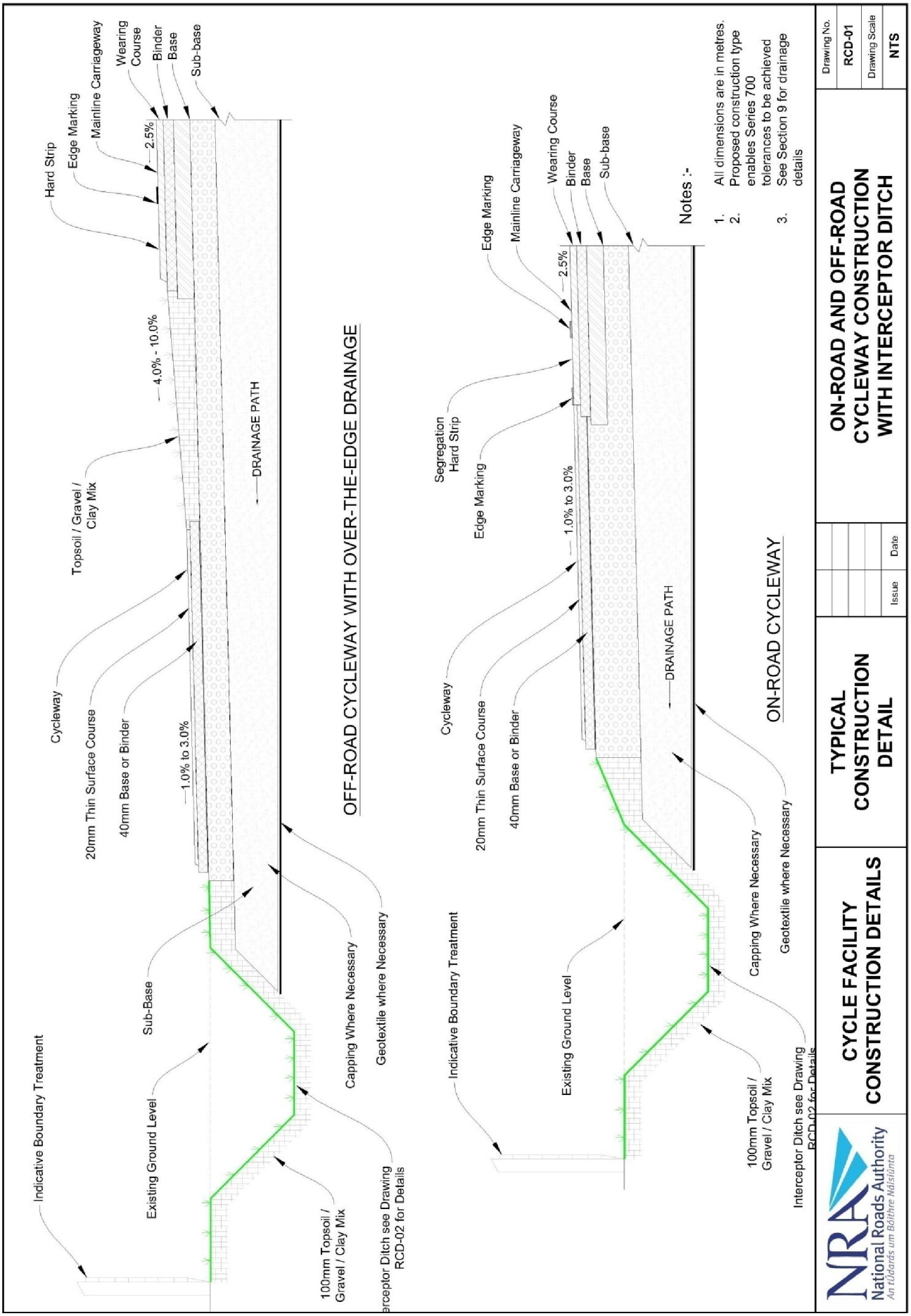


Figure 8.1: Typical cycleway construction detail (Part 1)

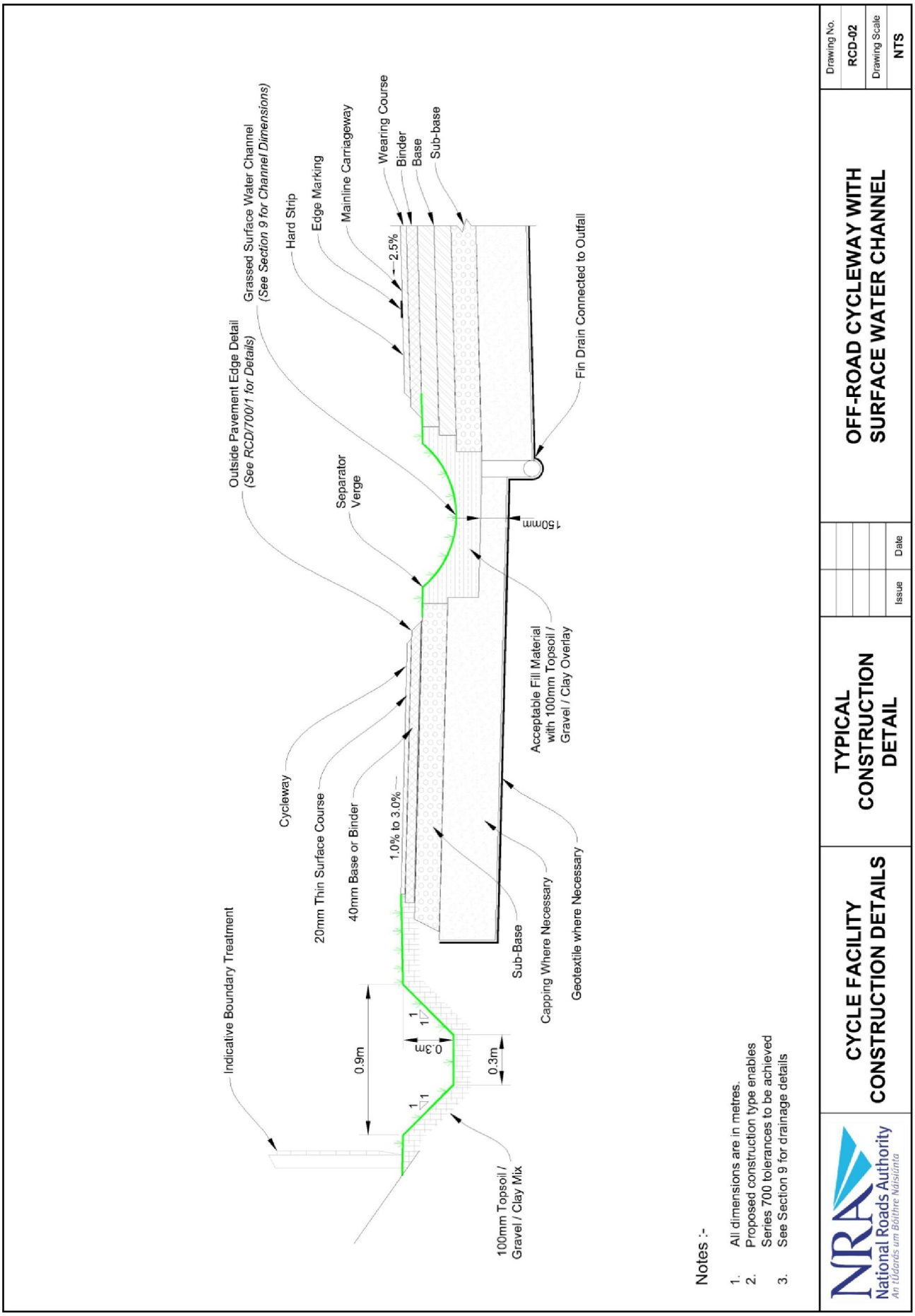


Figure 8.2: Typical cycleway construction detail (Part 2)

9. DRAINAGE

Surface Crossfall

9.1 Cycle facility surfaces need to be adequately drained to avoid the difficulties that standing water and ice can create for cyclists. A cycle facility should be constructed with a crossfall generally between 1.0% and 3.0%, with a maximum of 5.0% over short sections.

9.2 Where a cycle facility forms part of the contiguous road surface then the road crossfall should be continued across its extent. However within superelevated curves the crossfall can be reduced across the width of the cycle facility so as not to exceed 5%.

Surface Water Collection

9.3 Surface water runoff from rural all purpose roads is preferably collected from over-the-edge by drainage ditches or by direct runoff into combined surface water and ground water filter drains. In some limited areas runoff may be collected by a kerb and gully system, but this should be avoided if possible as it is not really suitable in a rural area.

9.4 Where a cycle lane or on-road cycleway is proposed, as either a new construction or an improvement to an existing road, a surface water collection system should be provided in accordance with Standard HD 33 of the NRA DMRB.

9.5 Where an off-road cycleway is proposed running parallel to the mainline, surface water runoff can be collected either within the segregation verge or may be allowed to flow across the cycleway and over-the-edge into a drainage ditch.

9.6 Cycle trails should, where possible, use natural drainage or small drainage ditches connected into existing watercourses as shown in Photograph No.9.1.

Over-the-edge Drainage

9.7 Section 3.18 of NRA DMRB Standard HD 33 states that over the edge drainage is 'inappropriate for usage in locations where footways or segregated cycleways abut carriageways'. However a recent trial project which has utilised over-the-edge drainage across a cycleway, in both cutting and fill situations, has proved successful, which indicates that HD33 should be revised to remove the above limitation on the drainage system. On all but very wide multi-lane roads, the transverse surface water flow on the pavement will be very shallow in normal rainfall events when cyclists and pedestrians might be present on the route. Such water on the cycleway surface will not be of concern in terms of safety or comfort. In addition, with a segregation grass verge there should be a degree of infiltration of surface water to diminish the residual surface flow that could cross onto the cycleway.

Photograph No.9.1 – Small Drainage Ditch for a Cycle Trail

9.8 Over-the-edge drainage is the preferred arrangement for a rural road with a cycleway adjoining, as this will greatly simplify the construction detailing and scheme cost as well as adding to the overall sustainability and environmental fit of the new or improved road.

9.9 Where over-the-edge drainage is used it is important to ensure that the surface water runoff

flows off the cycleway towards the drainage ditch and does not pond. Suitable crossfall of minimum 1% and maximum 3% should be provided on the cycleway pavement.

9.10 The separator verge must be constructed with a crossfall of no more than 10% so as not to destabilise an errant cyclist. No minimum crossfall is specified for the verge as water infiltration is desirable to limit and attenuate the overall runoff to the receiving watercourse.

9.11 The outside pavement edge detail (RCD/700/1) of both the carriageway and cycleway should be higher than the proposed ground level by the depth of the pavement wearing course to stop back flow of the surface water runoff from a flat verge.

9.12 The typical construction details shown in Figures 8.1 and 8.2 assume a road formation profiled with a 2.5% camber which provides a drainage path to the road edge underneath the verge and cycleway through extension of the capping layer or sub-base laterally. This also provides a drainage path for any surface water that permeates through the separator verge into the sub-base.

9.13 The separator verge should constructed from suitable fill material with a 50mm thick stony topsoil layer at the surface.

Open Drainage Systems

9.14 Drainage ditches, grassed surface water channels and swales have an advantage over a filter drain in that they better satisfy sustainable drainage principles including flood attenuation and pollution control by slowing water flow and allowing settlement of suspended solids and absorption of pollutants by vegetation. Open drainage systems are therefore preferable to piped systems on both an environmental and a cost basis.

Drainage Ditch

9.15 The details for a suitable drainage ditch are shown in Figures 8.1 and 8.2. It has 45 degree side-slopes and a 300mm base width. The depth will be determined by the road sub-formation level, but will typically be 0.6m so as to reach a depth of 100mm below the capping layer if present. On this basis the typical width of the ditch will be 1.5m at the ground surface.

9.16 A drainage ditch should be located outside of the outer verge along the cycleway so as to protect an errant cyclist from toppling into the ditch.

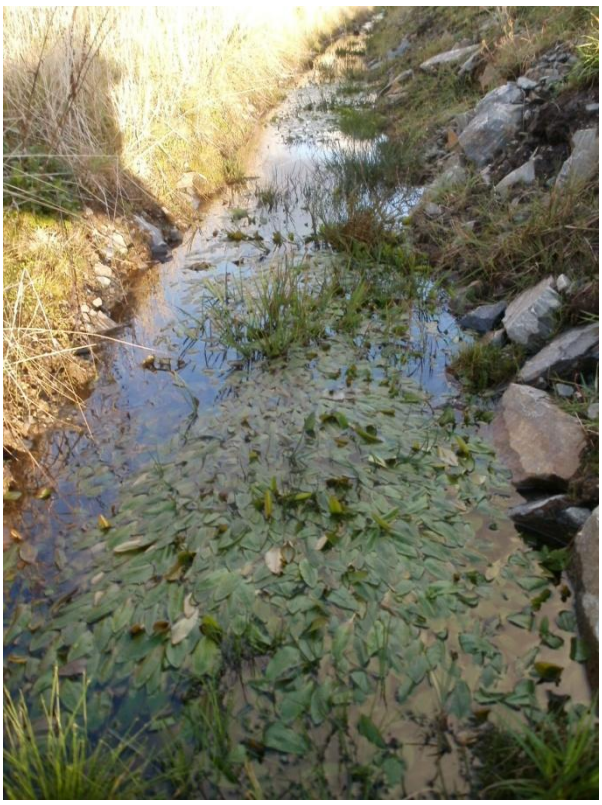
Photo 9.3: Off-road cycleway with over-the-edge drainage and ditch

9.17 Normally the longitudinal profile of a drainage ditch will generally follow the road vertical alignment, which will limit the gradient and lower risk of erosion due to fast water flow. This is desirable to slow the water runoff speed for attenuation reasons and to allow for settlement of any water borne pollutants from the road. Trials have indicated that ditches do not normally require to be lined with topsoil. The subsoil (and possibly rock) in the excavation will usually become vegetated in a short time with suitable local plant varieties as shown in Photograph 9.4.

9.18 Where there is a risk of high velocity flow in a ditch that would lead to erosion, such as on the final link to an outlet, it may be necessary to place small rocks in the ditch to absorb the flow energy and reduce the risk of erosion of clay.

9.19 Where a drainage ditch is less than 1.2m deep and has no more than 600mm of standing water, in accordance with NRA Standard TD19 it is not considered a hazard for traffic that might stray off the road. Therefore a safety barrier will not be necessary due to the inclusion of a drainage ditch within the clear zone from the road edge.

9.20 See NRA TD 19 and Section 5 for all other safety barrier requirements.



Photograph No.9.4 – Natural vegetation in a drainage ditch: self-seeded

Grassed Surface Water Channel

9.21 Within the segregation verge a grassed surface water channel can be used to collect surface water runoff from both the carriageway and the cycleway when located within a cutting or at grade. See Figure 8.2 for details.

9.22 This channel would be located within a suitably wide segregation verge. The channel should be a rounded dished shape that is approximately ¾ of the segregation verge width and has a depth of approximately ¼ of the width of the dish.

9.23 The channel should be constructed from suitable fill material which will allow for some growth of local vegetation but be robust enough to resist being eroded prior to growth taking hold.

9.24 The grassed channel surface water flow can be collected within catch-pits that sit in concrete surrounds. These in turn can either connect into existing road drainage or discharge into existing watercourses.

9.25 Where a shallow grassed surface water channel is used due to limitations of space it can be complemented by a fin drain for sub-surface drainage as necessary.

Photo 9.5: Off-road cycleway with grassed drainage channel in segregation verge

Swales

9.26 A Swale is similar in function to a grassed surface water channel but has very shallow side slopes of about 1 vertical to 3 or 4 horizontal. The wide shallow shape provides greater delay to surface water flow and increases the degree of both attenuation and pollution control. It should be used in preference where there is sufficient space available. However, the acquisition of additional land would not usually be justified to accommodate swales in all locations as the additional benefits are only marginal compared to other open drainage systems.

9.27 A typical example of a swale is shown in Photograph No.9.6 at the construction stage and before vegetation has grown.

Photograph No.9.6 – Swale before grass growth

9.28 The same swale is shown in Photograph No.9.7 about a year later when it is fully vegetated.

Photograph No.9.7 – Swale after grass growth

Filter Drains

9.29 Filter drains involve the use of costly artificial materials such as pipes, graded stone trench fill, geotextiles and Blockwork catchpits. Open drainage systems are much cheaper by comparison.

9.30 Filter drains are also poorly suited to sustainable design principles for a scheme in a natural environment. They should be avoided as much as possible, with the preference for open drainage ditches.

9.31 Where space is tight, filter drains may be used on off-road cycleways can be used to collect surface water runoff within the segregation verge before it crosses onto the cycleway surface.

9.32 When using filter drains consideration needs to be given to stone scatter and the location of safety barriers.

10. SIGNAGE AND ROAD MARKINGS

General

10.1 All signage and road marking used on a public road must comply with the current Traffic Signs Manual. Where a cycle trail is provided outside of a road corridor it may contain other types of signs and markings that are not included in the Traffic Signs Manual.

Signage

10.2 The basic shared facility traffic sign (RUS 058), as shown in Photograph No.10.2, should be used at all intersection points where cyclists or pedestrians may gain access to the cycleway. This sign will give legal definition to the facility as for the exclusive use of cyclists and pedestrians. Other variant signs may be used where there is segregation between the cycle lane and footpath.

10.3 A coherent route direction signage strategy must be developed which gives users clear direction when using the facility. For a cycling facility to be successful, users should be made aware of the facility so that they can avail of it. The signage strategy is not limited to the route itself but must also advise potential users within the wider area of the presence of the route.

Photo 10.1: Sign indicating the presence of a greenway

Photo 10.2: Direction Signs at a junction of greenways

10.4 Signs should not be too intrusive in the rural environment. Rather they should be in keeping with the surroundings as much as possible by for instance using natural materials such as timber rather than steel posts as shown in the example in Photograph No.10.3.

Photo 10.3: Cycleway sign using a wooden post

Cycleway Road Markings

10.5 Minimal road markings are required for a cycleway. The upright sign will normally suffice to define the starts and ends of sections between access points. Shared surfaces need no delineation as both pedestrians and cyclists naturally avoid each other within a shared facility.

10.6 Off-road cycleways may be identified by painting a combined cycle and pedestrian symbol on the surface at the beginning and end as well as major road crossings.

10.7 Cycle symbols (M116 TSM) and Pedestrian symbols (M111 TSM) may be used intermittently to identify the cycleway as shown in Photograph No. 10.4. These symbols are most useful at access points and junctions as highlighted in Section 7 and as shown in Photograph No.10.5

Photograph No.10.4 – Intermittent Road markings on a Greenway

Photograph No.10.5 – Cycleway Road markings at a Junction

Cycle Lane Road Marking

10.8 Road markings are essential to delineate cycle lanes that are on the road. These markings define the cycle lane in both legal and physical terms.

10.9 In accordance with the relevant Regulations and Chapter 7 of the Traffic Signs Manual the edge of the cycle lane on the side nearest road traffic should be indicated by a continuous 100mm or 150mm white line. A broken 150mm white line should be used where general traffic may cross the boundary of the cycle lane for example at a junction. Access to a property is permitted across a continuous cycle lane edge line and so breaks in the line are not necessary at entrances.

10.10 Where a contra-flow cycle lane is provided additional hatched separation is required.

10.11 The nearside edge of the cycle lane should be indicated by a broken 150mm yellow line.

10.12 Cycle symbols (M116 TSM) should be used intermittently at typically 100m intervals to identify the cycle lane.

On-road Cycleway

10.13 A typical one-way on-road cycleway should be delineated as shown in Figure RM-01.

10.14 The nearside edge of the carriageway should be indicated by a broken 150mm yellow line as normal for any all-purpose road. The edge of the cycle lane nearest the road should be indicated by a continuous 150mm white line.

10.15 The separation strip should be identified by diagonal yellow hatching. This hatching should consist of a group of 4 hatch markings at 45 degrees repeated at least every 96m down to every 24 metres as necessary.

10.16 Each hatch line may include a raised profile rib in running longitudinally along each hatch to a height of 8mm above the hatch paint. This provides a tactile feedback to motorised vehicles that may cross into the hatched area. Alternatively the hatch painting may be laid to a thickness of 11mm.

Photo 10.3:

Cycle Trail Signs and Markings

10.17 Cycle trails require no road markings and should be identified solely by signs.

Delineator Posts in Segregation Verges

10.18 Delineator posts may be provided at 24m centres to discourage vehicles crossing the segregation grass verge and to highlight the separation between the road and the cycleway where they are closely aligned.

Photo 10.3: Delineator Posts in Verge

Bollards

10.19 Bollards may be useful to restrict access to a cycleway by motorised vehicles. Such bollards can also support suitable signs.

Photograph No.10.6 – Bollard at Access Point to Greenway

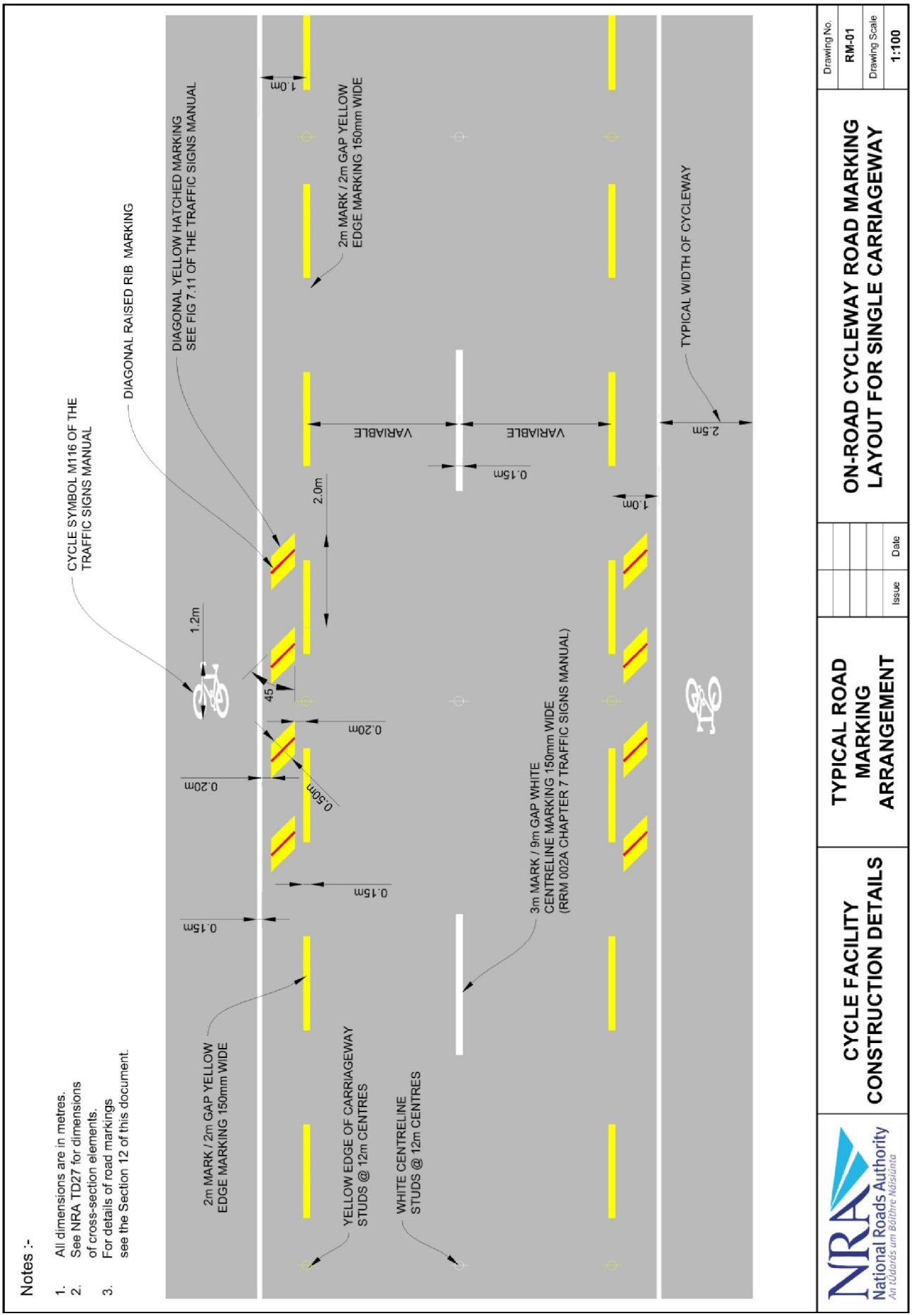


Figure 10.1: On-road cycleway road marking

11. REFERENCES

Design manual for Roads and Bridges (DMRB)

11.1 NRA TD 19 (NRA DMRB 2.2.8A) – Safety Barriers.

11.2 HD 33 (NRA DMRB 4.2.3) – Surface and Sub-surface Drainage Systems for Highways.

11.3 NRA TD 9 (NRA DMRB 6.1.1) – Road Link Design.

11.4 NRA TD 10 (NRA DMRB 6.1.1B) – Road Link Design for Type 2 and Type 3 Dual Carriageways.

11.5 NRA TD 27 (NRA DMRB 6.1.2) – Cross Sections and Headroom.

11.6 TD 22 (DMRB 6.2.1) – Layout of Grade Separated Junctions.

11.7 TD 16 (DMRB 6.2.3) – Geometric Design of Roundabouts.

11.8 TD 40 (DMRB 6.2.5) – Layout of Compact Grade Separated Junctions.

11.9 NRA TD 41-42 (DMRB 6.2.6) – Geometric Design of Major/Minor Priority Junctions and Vehicle Access to National Roads.

11.10 TA 90 (DMRB 6.3.5) – The Geometric Design of Pedestrian, Cycle and Equestrian Routes.

Other References

11.11 Classification and Grading for Recreational Trails (ISC, Dublin, 2008).

11.12 Connect2 and Greenway Design Guide (SUSTRANS, Bristol, 2009).

11.13 Cycle by Design 2010 (TS, Scotland, 2010).

11.14 Cycle Infrastructure Design – Local Transport Note 2/08 (TSO, Norwich, 2008).

11.15 Cycle-friendly Infrastructure – Guidelines for Planning and Design (CTC, Godalming, 1996).

11.16 Design Manual for Bicycle Traffic (CROW, Netherlands, 2006).

11.17 Ireland's First National Cycle Policy Framework (DTTAS, Dublin, 2009).

11.18 Making Way for the Bicycle (SUSTRANS, Bristol, 1994).

11.19 Provision of Cycling Facilities – National Manual for Urban Areas (DoELG, Dublin, 2006).

11.20 The National Cycle Network – Guidelines and Practical Details (SUSTRANS, Bristol, 1997).

11.21 Traffic Signs Manual (DTTAS, Dublin, 2010)

11.22 National Cycle Manual (NTA June 2011)

12. ENQUIRIES

12.1 All technical enquiries or comments on these guidelines should be sent in writing to:

Head of Engineering
National Roads Authority
St Martin's House
Waterloo Road
Dublin 4

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Tim Ahern
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