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Transport Infrastructure Ireland

TII Publications

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Cross Sections and Headroom

DN-GEO-03036
May 2023

DN Design

Standards

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TII Publications

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Contents

Updates to TII Publications resulting in changes to

Cross Sections and Headroom DN-GEO-03036

Date: May 2019

Amendment Details:

This document supersedes DN-GEO-03036 published in June 2017. The principle changes in this revised document are as follows:

a) Additional content has been added to Sections 2 and 3 detailing the requirements for applying the Principles of Forgiving Roadsides when designing the road cross section. This includes details of the required Clear Zones to be achieved and methods for achieving these through various approaches.

b) Clear Zone requirements for roads with Design Speeds less than 85kph are included in Section 3.4.

c) Section 4.7 has been updated to include the requirement that piers for overbridges are not permitted within the central reserve of Type 2 or Type 3 Dual Carriageways.

Date: May 2023

Amendment Details:

This document supersedes DN-GEO-03036 published in May 2019. The principal changes in this revised document are as follows:

a) General review and update of definitions undertaken.

b) Type 2 and Type 3 Dual Carriageways have been renamed as Type 2 and Type 3 Divided Roads.

c) Section 3.8 Active Travel Users – includes additional guidance and reference to PE-PMG-02045 outlining the appraisal process to be carried out to define the most appropriate type of active travel facility for a particular road scheme.

d) Express Roads – details have been removed form DN-GEO-03031 and included in this document.

e) Section 4.7 Central Reserves – reference to DN-GEO-03060 for guidance on widening of central reserve for Type 3 Divided Roads and for active travel crossing treatments.

f) Section 4.10 Verges – additional guidance included for verge widening to accommodate features and services including providing for active travel facilities.

g) Table 4.1 to Table 4.4 – updated to include parallel roads. Updated notes to align with changes in the standards regarding verge width considerations, requirements for cross-section type.

Date: May 2023

Amendment Details:

h) Section 4.17 includes additional general principles and requirements for rural active travel facility layouts, including widths of facilities, guidance on shared use facilities, separation distance from road pavement. Reference made to PE-PMG-02045 and other relevant standards.

i) Section 5.6 – additional requirements for nearside verge width at underbridges and overbridges where Active Travel Facilities are proposed.

j) Headroom standards for rural active travel facilities previously included in DN-GEO-03040 have been moved to this document.

Contents Table

1. Introduction

1.1 General

This Standard outlines the design principles and factors which shall be considered by Designers in selecting road cross-sections and headroom clearances. The process of design is described together with an approach to developing options. It highlights the Principles of Forgiving Roadsides as a key component for designing a cross-section.

1.2 Scope

This Standard gives details of the cross-sections and headroom clearances to be used for all-purpose roads, and motorways, both on open roads and at structures and pedestrian and cycle subways.

In the case of rural all-purpose roads, details are also provided for on-line off-road active travel facilities which form part of the road cross-section. Specific requirements related to Active Travel are highlighted by the inclusion of the icons above and below this paragraph.

The information covers rural motorways, rural all-purpose dual carriageways and divided roads, urban motorways, urban all-purpose dual carriageways and urban relief roads, together with associated connector roads. Urban Street cross-sections should be designed in accordance with the Design Manual for Urban Roads and Streets. The approaches to urban areas on national roads shall be designed in accordance with DN-GEO-03084 The Treatment of Transition Zones to Towns and Villages on National Roads.

This Standard is not applicable to road tunnels.

For details of footbridge design criteria see DN-STR-03005.

1.3 Implementation

This Standard shall be used forthwith on all schemes for the construction and/or improvement of National Roads. Where the scheme has received, prior to publication of this Standard, its statutory approvals to allow it to proceed, and the implementation of this Standard would lead to additional land take requirements, a Departure from Standards may be sought for the use of the previous version of the Standard.

In support of this Standard, where minor improvements are proposed to existing roads, Designers are directed to DN-GEO-03030 Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes.

Information is also provided in this Standard on its application to regional and local roads diverted or improved on-line as part of a National Road scheme.

1.4 Cross Sectional Components

The road cross-section is made up several components that will vary depending on the type of road / highway and the facilities provided for users of the route. The components which make up some of the typical rural road cross sections are illustrated within the diagrams below. These elements making up the road cross-section, are defined below and the requirements are covered within the following sections of this Standard.

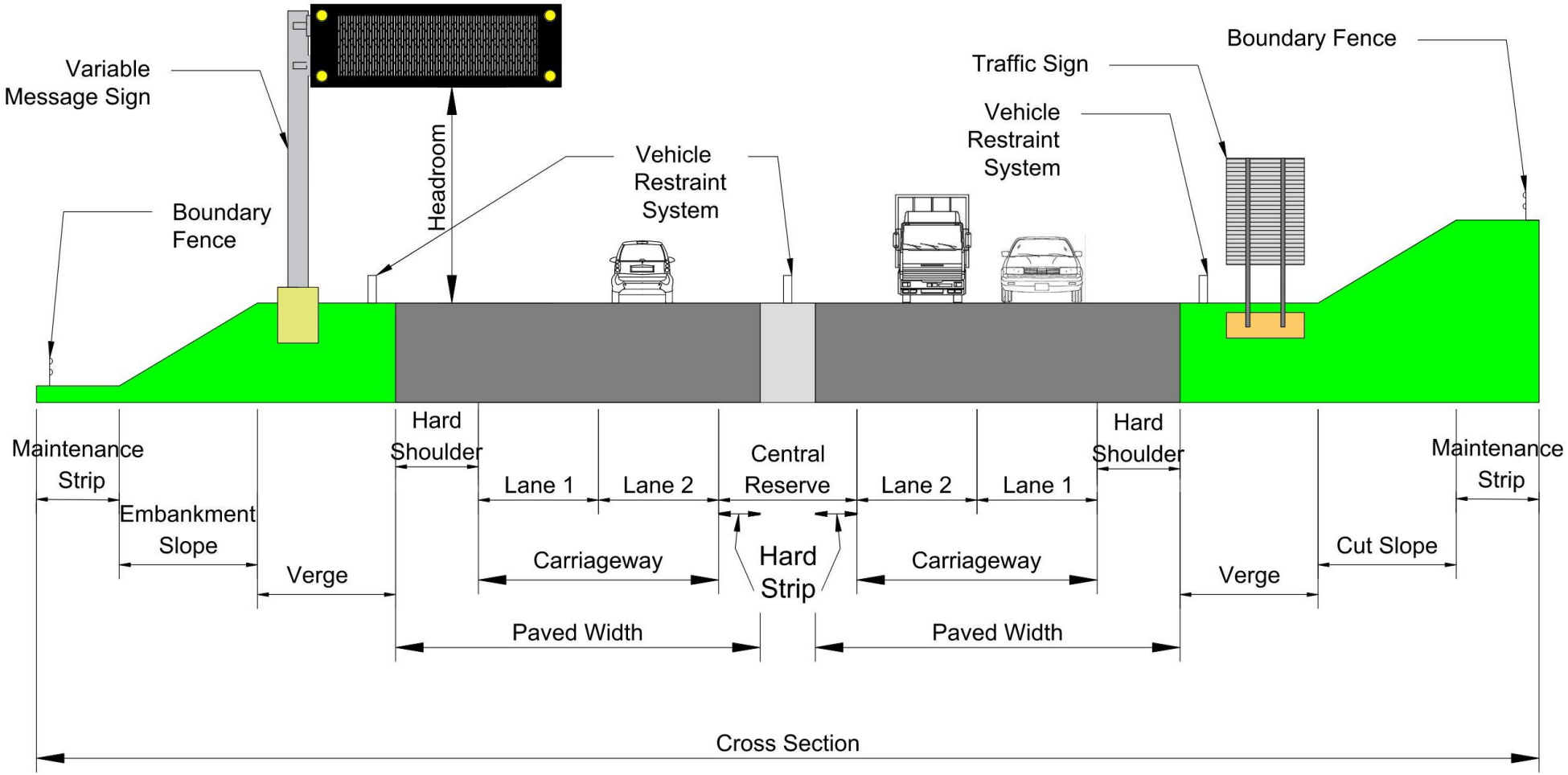


Figure 1.1 Typical Rural Motorway / Type 1 Dual Carriageway Cross Section Components

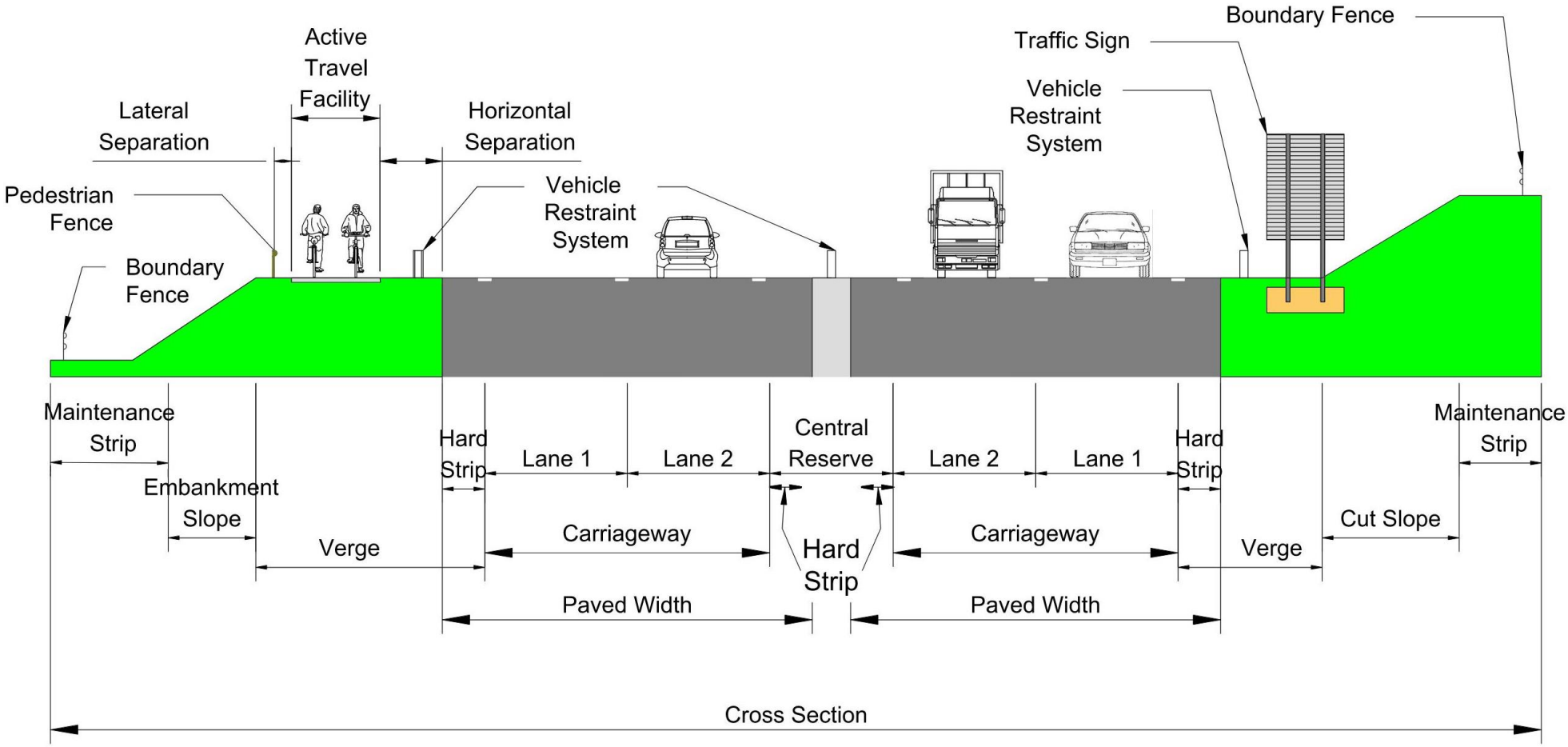


Figure 1.2 Typical Type 2 Divided Road Cross Section Components

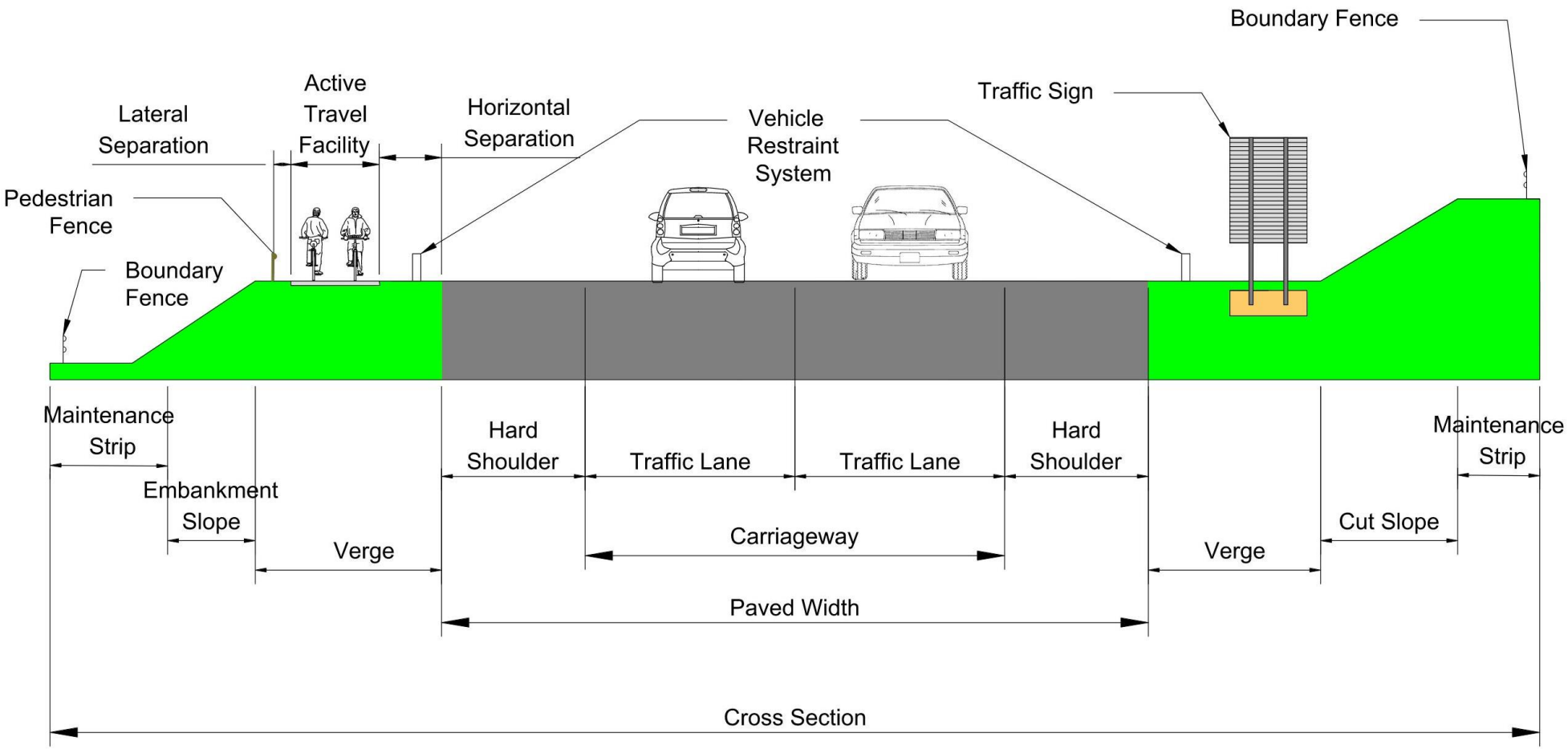


Figure 1.3 Typical Rural Type 1 Single Carriageway Cross Section Components

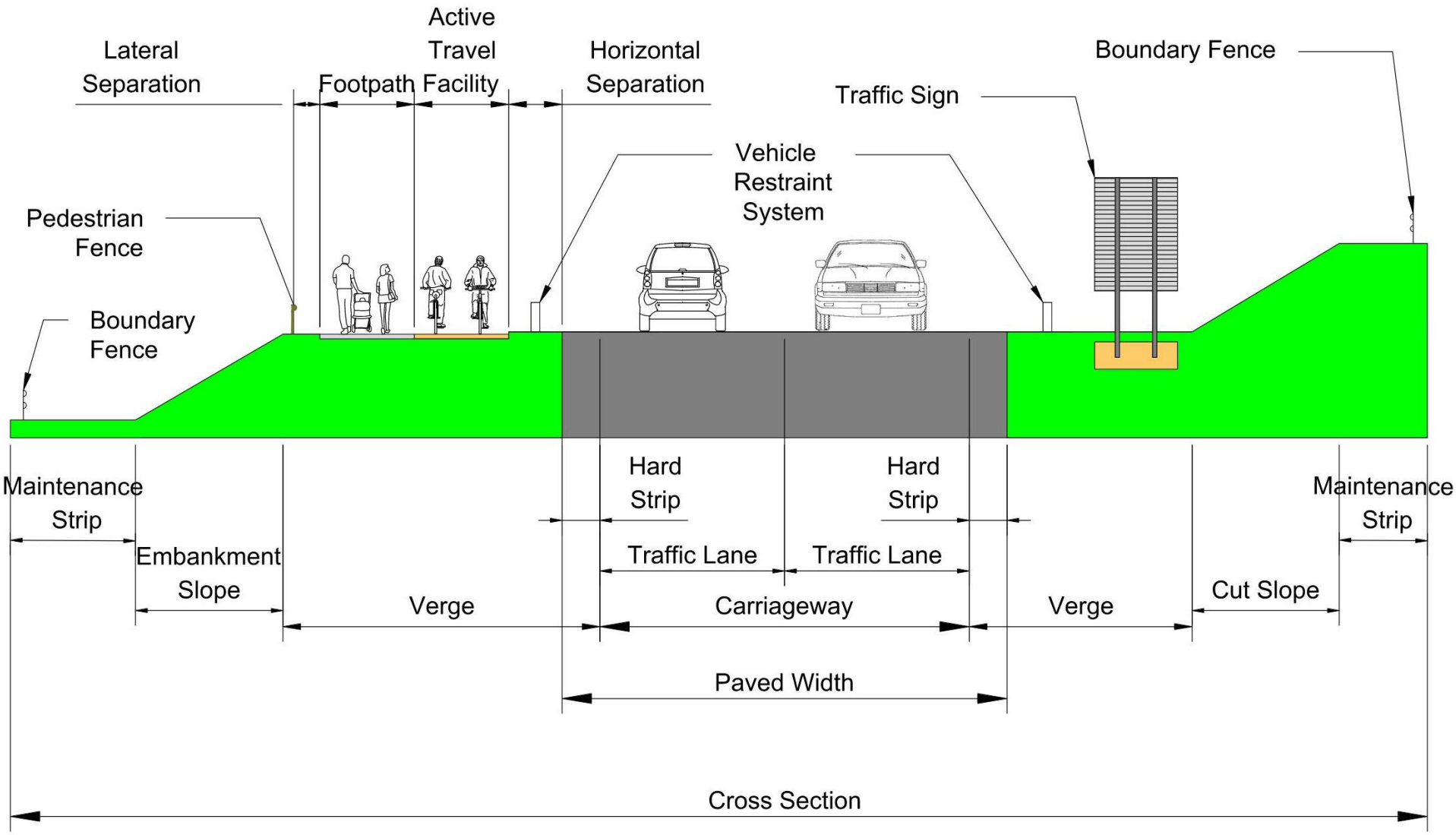


Figure 1.4 Typical Rural Type 2 / Type 3 Single Carriageway Cross Section Components

1.5 Definitions

Particular terms used in this Standard are defined as follows:

a) **Active Travel:** Walking, wheeling, and cycling for all users for all trip purposes where walking, wheeling, and cycling mean[1]:

   i) **Walking and Wheeling**: Engaging in the typical act of walking plus jogging, using mobility aids (i.e., manual and electric wheelchairs as well as motorised mobility scooters), and using non-motorised scooters.

   ii) **Cycling**: Cycling using any type of cycle, such as bicycles, electric cycles, adapted cycles and cargo cycles. Cycles must, except for specific situations, be treated as 'vehicles', not as 'pedestrians'.

   iii) **Active Travel Infrastructure:** All types of pedestrian and cycle facilities which improve conditions for people walking, wheeling, and cycling.

   iv) **Ancillary Infrastructure:** Constructed features that provide added value to the cycle route and enhance the user's experience.

   v) **Off-line facility:** Element of active travel network or rural off-line cycleway catering for people walking, wheeling, and cycling that is not part of the road cross-section (notwithstanding, potential sole designation as cycleway).

   vi) **On-line facility:** Element of active travel network catering for people walking, wheeling, and cycling that is part of the road cross-section. On-line active travel facilities may be provided as on-road pavement or off-road pavement facilities:

      a) **Off-road Facility:** Facility that is physically segregated from the road pavement by, for example, a verge;

      b) **On-road Facility:** Facility that forms part of the road pavement without physical separation or demarcation from the road / vehicular carriageway.

b) **Active Travel Users (ATUs)**: All users of an Active Travel Facility.

c) **All-purpose road**: A road for the use of all classes of traffic (e.g. not a Motorway).

d) **Bridge Length**: Is the length of bridge parapet.

e) **Carriageway**: The area of the paved width which is trafficked by road users under normal operation. Notes:

   i) This includes designated lanes such as bus lanes and cycle lanes; and

   ii) The carriageway excludes hard shoulders and hard strips.

f) **Central reserve**: The area which separates the carriageways of a dual carriageway or Motorway. Note that this includes any offside hard strips.

g) **Clear Zone**: The Clear Zone is the total width of traversable land on the nearside or offside which is to be kept clear of unprotected hazards. This width is available for use by errant vehicles. The zone is measured from the nearest edge of the trafficked lane: i.e. the hard shoulder or hard strip forms part of the Clear Zone.

[1] Walking and wheeling are of equal importance to cycling as they are much more commonly utilised modes; they form part of all trips, even those where the primary mode is the private vehicle or public transport.

h) **Connector Road**: A collective term for slip roads, link roads, interchange links and loop roads.

i) **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, on-line active travel facilities or bridleways, fences, barriers, cutting or embankment slopes, berms and maintenance strip. All dimensions are measured square to the line of the road (see Tables 4.1 to 4.5).

j) **Cycle Facilities**: Refers to all types of measures which improve conditions for cyclists and include:

   i) **Cycleways:** an off-line public road reserved for the exclusive use of people cycling or people walking, wheeling, and cycling (see also definitions of 'Greenway' and 'Shared Use Active Travel Facility'). All mechanically propelled vehicles, other than mechanically propelled wheelchairs and electric bikes, are prohibited from entering except for the purpose of maintenance and access.

   ii) **Greenway:** A cycleway that caters for people walking, wheeling and cycling in a mainly recreational environment.

   iii) **Cycle Track:** A part of a road cross-section, separated from the road / vehicular carriageway by a verge, which is reserved for the use of cycles and from which all mechanically propelled vehicles, other than mechanically propelled wheelchairs and electric bikes, are prohibited from entering except for the purpose of maintenance and access. A cycle track can be off-road, on-road (see definition of 'Cycle Lane') or shared (see definition of 'Shared Sue Active Travel Facility').

   iv) **Shared Use Active Travel Facility:** A Cycle Track or Cycleway that is provided for people walking, wheeling and cycling.

   v) **Cycle Lane:** Part of the road pavement reserved for use by cycles. The cycle lane forms part of the road pavement, and it is thus located within the contiguous road surface. It is not a cycleway nor cycle track and therefore, generally not for the exclusive use of cycles.

   vi) **Cycle Network:** A defined collection of routes which connect key origins and destinations in a specified area for cyclists.

k) **Cycle Friendly:** Cycle Friendly refers to situations where dedicated cycle infrastructure has not been provided, but road space is nonetheless designed such that competent cyclists feel comfortable travelling alongside other traffic. A cycle friendly road should not result in cyclists having to behave unpredictably, i.e., changing their position on the carriageway to avoid an obstacle or a sudden change in width of the hard shoulder. It is considered the most basic level of cycle provision to be implemented on all-purpose roads.

l) **Designated Lane:** A lane reserved exclusively for the use by designated vehicles such as cycles, buses and taxis.

m) **Designer:** The organisation responsible for undertaking and/or certifying the design.

n) **Express Road**: An Express Road is a legal category of road designed for motor traffic, which is accessible primarily from interchanges or controlled junctions and which:

   i) Prohibits stopping and parking on the running carriageway; and

   ii) Does not cross at grade with any railway or tramway track.

o) **Hardened Verge**: An area of the verge set aside for emergency or maintenance situations for vehicles to stand or park. The surface should be sufficiently strengthened to support vehicles.

p) **Headroom**: The minimum distance between surface and structure as defined in Paragraph 6.1.

q) **Interchange**: A grade separated junction that provides free flow of traffic from one mainline carriageway to another. Refer to DN-GEO-03060.

r) **Interchange Link**: A connector road, one or two-way, carrying free flowing traffic within an interchange.

s) **Loops**: A connector road, one or two-way, which is made up of the elements of the loops shown in DN-GEO-03060 and which passes through an angle in the range of approximately 180 to 270 degrees. The loop is considered to extend to the end of the near straight length of road contiguous with the back of the diverge or merge nose.

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

u) **Maintained Headroom**: The minimum headroom which shall be available at all times during the road's operation.

v) **Maintaining Organisation**: The organisation which will be responsible for the maintenance of the road after construction.

w) **Maintenance strip**: The strip of land between the top of cutting or toe of embankment and the road boundary, also known as the work space or work space strip.

x) **Minor Road**: A minor road is a road which has to give priority to the major road.

y) **Motorway**: A divided multi-lane road as defined in Section 43 of the Roads Act.

z) **National, Regional, Local & Public Roads:**

  i) A National Road is a public road or a proposed public road which is classified or is intended to be classified as a national road under Section 10 of the Road Act (1993).

  ii) A Regional Road is a public road or a proposed public road which is classified or is intended to be classified as a regional road under Section 10 of the Road Act (1993).

  iii) A Local Road is a public road or a proposed public road other than a national road or a regional road.

  iv) A Public Road is a road over which a public right of way exists (or will exist in the case of a proposed public road) and the responsibility for the maintenance of which lies with the Road Authority.

aa) **Nearside**: Left-hand side of vehicle when viewing a forward moving vehicle from behind: typically, the front-seat passenger side of the vehicle in Ireland.

bb) **New Construction Headroom**: The headroom which includes an allowance for resurfacing that is available at the commencement of the road's operation.

cc) **Offside**: Right-hand side of vehicle when viewing a forward moving vehicle from behind: typically, the driver's side of the vehicle in Ireland.

dd) **Overbridge:** A bridge that spans the road under consideration.

ee) **Pedestrian Access Provision**: That part of the verge on all-purpose roads provided to enable pedestrian movement through or over a structure.

ff) **Pedestrian Facilities:** All types of measures which improve conditions for people walking and wheeling, and include:

i) **Footpath:** A path, separated from the road / vehicular carriageway by a kerb, for use by pedestrians which does not form part of the road pavement.

ii) **Footway:** A path for use by pedestrians, separated from the road / vehicular carriageway by a verge, which does not form part of the road pavement.

iii) **Bridleway:** A road (surfaced or unsurfaced) for use on foot or horseback.

gg) **People with Disabilities**: Includes individuals with mobility, sight, comprehension or hearing impairment, the ageing population and people with temporary injuries. Includes users of wheelchairs (manual and electric).

hh) **Road Authority**: The authority responsible for the road construction or improvement scheme.

ii) **Road Tunnel**: A road enclosed for a length of 150m or more. A shorter enclosed length is an overbridge. Refer to DN-STR-03001.

jj) **Rural Area:** an area outside of a built-up area which is generally controlled by speed limits greater than 60 km/h.

kk) **Rural Cycle Scheme Design:** The design associated with the construction of cycle facilities in a rural area.

ll) **Rural National Road:** A road outside of built-up areas with a speed limit of greater than 60km/h, including:

i) Single Carriageway roads;

ii) All-purpose Dual Carriageway roads; or

iii) Motorways.

mm) **Separator Zone**: An area that separates traffic flows on the mainline from an adjacent parallel road, e.g. link road.

nn) **Slip Road**: A connector road within a junction between a mainline carriageway and the local road network, or vice versa, which meets the local road network at-grade. Traffic using a slip road usually has to yield to traffic already on the mainline or on the local road network.

oo) **Subway**: Underground passageway or tunnel for use by pedestrians, cyclists and equestrians.

pp) **Transition Zone**: A 50 to 60 km/h posted speed limit zone passing through areas of low density residential and commercial development and/or industrial areas.

qq) **Type 1 Dual Carriageway**: A divided all-purpose road with a minimum of two lanes and hard shoulder in each direction constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00006.

rr) **Type 2 Divided Road**: A divided all-purpose road with two lanes and hard strip in each direction constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00005.

ss) **Type 3 Divided Road**: A divided all-purpose road with two lanes in one direction of travel and one lane in the other direction, constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00004. The two-lane section alternates with a one-lane section at intervals of 2km approximately.

tt) **Type 1 Single Carriageway**: An all-purpose road with a 3.65m lane in each direction constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00001.

uu) **Type 2 Single Carriageway**: An all-purpose road with a 3.50m lane in each direction constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00002.

k) **Type 3 Single Carriageway**: An all-purpose road with a 3.00m lane in each direction constructed to the geometric standards of DN-GEO-03031 and CC-SCD-00003.

vv) **Underbridge**: A bridge that carries the road under consideration.

ww) **Urban All-Purpose Road**: An all-purpose road within a built-up area.

xx) **Urban Motorway**: A motorway constructed in a built-up area.

yy) **Urban Relief Road**: An urban road where the primary purpose of the road is to facilitate the movement of traffic and avoid congestion or other obstacles to movement.

zz) **Urban Street**: A road within a built-up area where the primary purpose of the road is to provide direct access to premises.

aaa) **Verge**: The part of a road cross-section alongside a carriageway but not including embankment or cutting slopes. Note that this includes hard strips but not hard shoulders.

bbb) **Vehicle Restraint System (VRS):** A system installed on the road to provide a level of containment for an errant vehicle.

ccc) **Wide Motorway:** A motorway with two 3.75m lanes in each direction and a central reserve of 9m to 16m constructed to the geometric standards of CC-SCD-00008.

1.6 Relaxations and Departures

The standards contained in this document represent the cross-sections and headroom whose incorporation in the design would achieve a desirable level of performance in average conditions in terms of traffic safety, operation, economic and environmental effects and sustainability. At some locations on new roads or major improvements, however, it may not be possible to justify even the lowest levels of design parameters in economic or environmental terms, due to high costs, low traffic levels, and environmental damage, etc. In such cases, sufficient advantages might justify either a Relaxation within the standards or, in more constrained locations, a Departure from the standards. Relaxations and Departures should be assessed in terms of their effects on the economic worth of the scheme, the environment, and the safety of the road user. Further information in relation to Departures and Relaxations, including the process for submitting an application for a Departure from Standard can be found in GE-GEN-01005.

1.6.1 Relaxations within Standard

In difficult circumstances, the Designer may relax a standard set out in this document, where specifically provided for within the text. Refer to DN-GEO-03031 for permitted Relaxations and combinations of Relaxations. The Designer 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 Designer's Senior Engineer responsible for the scheme. The Designer shall report all Relaxations incorporated into the design as part of the project report at the end of each project management phase (refer to the TII Project Management Guidelines, PE-PMG-02041).

1.6.2 Departures from Standard

In exceptional situations, TII may be prepared to agree to a Departure from Standard where the standard, including permitted Relaxations, is not realistically achievable. Designers faced by such situations and wishing to consider pursuing this course shall discuss any such option at an early stage in design with TII. Proposals to adopt Departures from Standards must be submitted by the Designer to TII and formal approval received BEFORE incorporation into a design layout. Acceptance of a Departure application will not be given retrospectively.

2. Forgiving Roadsides

2.1 General

This chapter provides details on the application of Forgiving Roadsides, the principles of which may have a significant impact on the road cross-section to be adopted and on the safety and operation of the proposed road in service. It shall be read in conjunction Chapter 3 Design Principles.

2.2 Principles of Forgiving Roadsides

The verge width on either side of the paved area may be a factor affecting the severity of collisions where errant vehicles run off the carriageway. With the implementation of appropriate treatment measures to mitigate against hazards, roadsides can be made more forgiving in the event of loss of control incidents, thereby reducing the number of fatalities and serious injuries. Consideration shall be given to roadside hazards and the provision of a Clear Zone as discussed in Section 3.4 at an early stage in the scheme development to decrease the need for VRS and create a more Forgiving Roadside.

Designers shall therefore endeavour to provide a hazard free verge and roadside area which can allow errant drivers to regain control of their vehicles and safely bring their vehicle to a halt within the Clear Zone or to safely re-join the carriageway.

It is key that proper consideration be given to providing a Forgiving Roadside from the initial stages of any road scheme. In doing so, the need for the installation of Vehicle Restraint Systems (VRS) to protect form roadside hazards can be reduced. This is beneficial from a road safety point of view as although VRS are tested to achieve particular performance criteria, they can still be hazardous to errant road users.

The range of possible treatments to provide a more Forgiving Roadside has been categorised and should be implemented in order of preference as follows:

1. Mitigation of hazards through the removal or relocation of any obstacle to provide an adequate Clear Zone width;
2. Modifying road layout or roadside elements to provide a passive roadside where the removal or relocation of hazards cannot be reasonably achieved;
3. Shielding obstacles through the use of a VRS where mitigation or modification measures cannot be reasonably implemented.

In situations where hazard mitigation or modification cannot be reasonably achieved when considered in conjunction with economic, environmental and engineering constraints, through techniques such as those described in Sections 2.4 and 2.5, the provision of a VRS can be warranted. The Designer shall consider the lifetime cost of providing a VRS versus the cost of mitigation/ modification measures. While the initial cost of such measures may be higher than the installation of a VRS, the whole life costing of a VRS solution should be taken into account. To assist with this process, the SAVeRS tool can be used to provide an estimate of the whole life costing of a VRS including construction, maintenance and repair costs of the system, plus potential injury costs based on the predicted crash rate calculated. The SAVeRS tool, guideline document and user manual can be downloaded from the Downloads section of the TII Publications website.

2.3 Roadside Hazards

A roadside hazard is any physical obstruction which may, in the event of an errant vehicle leaving the carriageway, cause harm to the occupants of the vehicle in the event of a collision.

Full details and guidance on what constitutes a hazard, along with the ranking of hazards is provided in DN-REQ-03034 The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges.

2.3.1 Categories of Roadside Hazards

The general categories of roadside hazards include but are not limited to the type and examples included in the following sub-sections. When reviewing all potential hazards in a design, the Designer shall consider the long-term implications of the hazard e.g. for planting of trees, the mature tree size shall be considered rather than the planted tree size.

2.3.1.1 Single Fixed Objects / Point Hazard

- Sign supports
- Lighting columns
- Trees
- Culvert ends / headwalls
- Substandard VRS ends
- Bridge abutments
- Bridge piers

2.3.1.2 Continuous / Linear Hazards

- Embankments and slopes
- Rock cuts / retaining walls
- Other roads
- Railway lines
- Central reserves
- Water hazards / ditches
- Rows of trees
- All fences and linear boundary delineations with horizontal rails, including knee rails, (but excluding those to CC-SCD-00320, CC-SCD-00321 or CC-SCD-00324);
- Non-conforming VRS

2.3.1.3 Special Considerations

In addition to those listed above, several other conditions may require special consideration:

- Locations with high collision histories
- Locations with regular pedestrian and bicycle usage
- Playgrounds, monuments, and other locations with high social or economic value

2.3.2 Earthworks Slopes

A cut slope steeper than 1:2 as shown in Figure 2.1 is considered a hazard. Embankment Slopes where the slope is steeper than 1:3 and the height of the embankment is greater than 0.5m, or where slopes are within the range of 1:3 to 1:5 but the embankment height is ≥ 6m as shown in Figure 2.2 are also considered hazards.

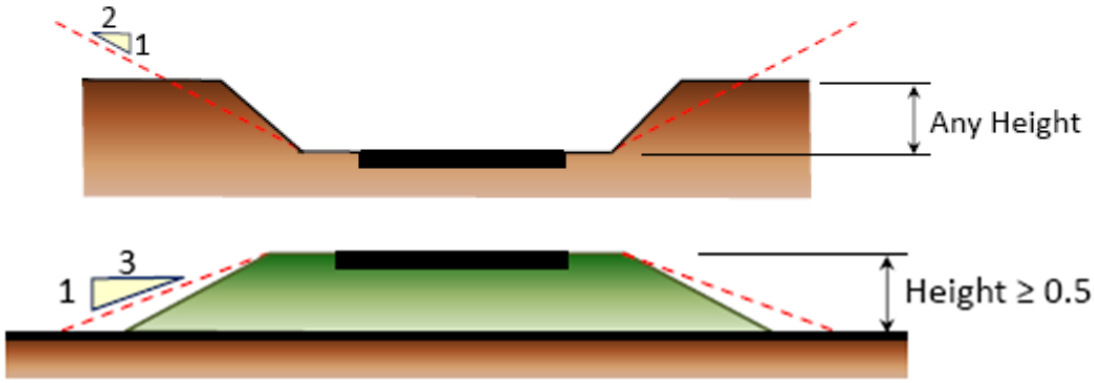


Figure 2.1 Cut Slopes

Figure 2.2 Embankment Slopes

2.4 Mitigation of Hazards

Hazards located within the Clear Zone, as described in Section 3.4, should be mitigated where it is deemed practical to do so when assessed in conjunction with economic, environmental and engineering considerations. Where this is not deemed practical, provision of a VRS to protect from hazards within the Clear Zone may be necessary. In some situations, it may be necessary to provide a VRS to protect a particularly high-risk hazard outside the Clear Zone.

Hazard mitigation measures shall be considered by the Designer prior to designing a VRS. A VRS shall only be introduced if the hazard cannot be mitigated as it will itself present a hazard to errant vehicles and occupants. The mitigation measures for hazards within the Clear Zone are listed below in order of preference:

1. Remove;
2. Relocate;
3. Re-design the hazard to reduce the risk to road users (e.g. introducing a passively safe sign post);
4. Revise the road layout or cross-section to lower the risk (e.g. verge widening, improve the road alignment, etc.);
5. Reduce impact severity (e.g. by using a forgiving feature or by setting a culvert flush with the existing ground);
6. Provide a suitable VRS.

Delineation and signage may be considered as treatments if the mitigation measures listed above are deemed inappropriate for a particular location. Whilst these treatments can alert a driver to roadside hazards, they will not protect an errant vehicle from a roadside hazard and hence should be used with caution. They may be appropriate solutions for urban scenarios, low speed environments or where limited space is an issue. Further guidance is included within DN-REQ-03079, Design of Road Restraint Systems for Constrained Locations (On-line Improvements, Retrofitting and Urban Settings).

2.4.1 Hazard Mitigation at Junctions

Specific consideration shall be given early in the design to hazards located in close proximity to a junction.

The Designer shall consider relocation of introduced hazards such as signs or lighting columns, away from junctions or slip roads if deemed practical to avoid the need for VRS. Provision of a suitable VRS at a hazard located close to a junction can be problematic. The barrier's performance can be influenced by the constraints presented by the junction e.g. a tight radius barrier around a bend at the junction may not perform as tested or a lack of space for suitable termination of a barrier at a diverge slip road. If mitigation or modification cannot be achieved when considered in line with economic, environmental and engineering constraints, the Designer shall endeavor to design a road layout, and ensure there is sufficient land take, that can facilitate a fully compliant VRS.

2.5 Modification of Roadside Elements

In some cases, it is not possible to remove hazardous obstacles from the Clear Zone. In such circumstances, the designer shall consider modifying single and continuous hazards to minimise the risk of personal injury and property damage in the event of a collision. Examples of suitable modifications may include:

- Forgiving devices;
- Suitable drainage ditch and embankment/ cutting slope treatments;
- Forgiving masonry structures;
- Shoulder modifications;
- Modification of retaining walls and rock cuts.

In modifying road elements, the Designer shall consider whether any such proposed mitigations require a Departure from Standard.

2.6 Shielding of Roadside Hazards through Installation of VRS

Where mitigation or modification measures are not deemed feasible for the treatment of hazards in the Clear Zone when considered in line with economic, environmental and engineering constraints, and the risk to road users remains, it will be necessary to provide a VRS in accordance with DN-REQ-03034 The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridge or DN-REQ-03079 Design of Road Restraint Systems for Constrained Locations (On-line Improvements, Retrofitting and Urban Settings). Justification for the installation of a VRS shall be recorded by the Designer in accordance with the VRS Justification template included in Appendix C of DN-REQ-03034.

2.7 Life Cycle Cost Analysis

When assessing measures required to implement a forgiving roadside it is important to consider the whole life cycle cost analysis of the scheme. While the initial cost of mitigation measures may be higher than shielding a hazard through the installation of a VRS, e.g. purchasing additional land to allow removal of the hazard from the Clear Zone, the whole life costing of a VRS solution should be considered when carrying out the cost benefit analysis.

The SAVeRS (Selection of Appropriate Vehicle Restraint System) tool can be used as part of this justification process. The tool was developed as part of the CEDR Call 2012 (Refer to DN-REQ-03079 for a worked example). It is a spreadsheet-based tool which allows the Designer to:

- Assess the lifetime cost of VRS on a scheme.
- Select the most appropriate VRS to be installed.
- Justify up front mitigation costs which would allow for the removal of the need for a VRS.

The SAVeRS tool, guideline document and user manual are available for download from the 'Downloads' Section of the TII publications website.

3. Design Principles

3.1 General

This chapter describes the principles to be followed when designing the road cross-section and headroom for new and improved all-purpose roads and motorways. The underlying principle is that Designers are given the maximum choice, so that there is flexibility to develop layout options that will meet TII requirements.

When choosing the appropriate cross-section and headroom, the Designer should balance considerations of safety, environmental impact, sustainability, economic impacts, buildability of the road elements, operation and maintenance.

Recent studies have shown that approximately 30 per cent of fatal road crashes in the European Union are single vehicle incidents. These incidents are generally classified as run-off-road crashes, where the vehicle leaves the road and collides with a roadside hazard. Mitigation of roadside hazards at an early stage in the design process can have a significant positive effect on road safety. Designers shall consider the principles of providing a Forgiving Roadside environment for errant vehicles when choosing cross-sections as discussed in Section 4.10 hereafter.

3.2 Range of Choice

The widths of paved elements of the cross-section, i.e. running lanes, hard shoulders and hard strips, vary between different types of road. Dimensions have been selected on the basis of research, experience in Ireland, and comparison with other countries' standards in order to provide new and improved roads that maximise safety and are operationally efficient and cost effective. The Designer is not given choices over the widths of running lanes, hard shoulders and hard strips for a particular type of road.

The Designer does, however, have some flexibility over the width of maintenance strip, berms, side slopes, verges and central reserves, although a reduction of verge or central reserve width below the minimum requirements outlined in Chapter 4 will require a Departure from Standard. The width between the back of the verge and the road boundary will depend on the terrain, the need to accommodate environmental mitigation measures, the engineering or geotechnical measures used to accommodate changes in ground levels, and any need to include differing types and widths of drainage features and other services in the maintenance strip. The Designer shall consider the Principles of Forgiving Roadsides when determining the width of these elements.

3.3 Design Process

For the purposes of developing initial layouts, the Designer's objective should be to determine the appropriate width for the road cross-section, and any variation in width required. Features included in the cross-section can affect the choice of width. Features that commonly occur within the road may include:

- Agricultural cattle/horse crossings;
- Animal tunnels;
- Anti-dazzle fences;
- Apparatus of utility companies and other authorities;
- Bridleways;

- Communication equipment;
- On-line, Off-Road Active Travel Facilities;
- Culverts;
- Drains;
- Emergency telephones;
- Fencing;
- Footbridges;
- Footways;
- Foundations;
- Garda observation platforms;
- Geotechnical monitoring equipment;
- Geotextiles;
- Hardened Verge;
- Kerbing;
- Landscaping;
- Lay-bys;
- Lighting columns;
- Loop detectors;
- Noise barriers / bunding;
- Overbridges;
- Parapets;
- Pedestrian guardrails;
- Retaining walls;
- VRS;
- Sign/signal gantries;
- Subways;
- Tracks for equestrians;
- Traffic signals and control and equipment;
- Traffic signs including posts;
- Underbridges;
- Vehicle arrester beds;
- Visual barriers / bunding; and
- Weather monitoring equipment.

Details and design requirements for many of these features are contained in other TII Publications (Standards) and in various other technical guidance documents. Some features, VRS and large traffic signs for example, can have a significant effect on the cross-section width whilst other features, sign gantries for example, are usually accommodated within the side slopes and maintenance strip.

The preferred locations for features in verges and the central reserve may often coincide or overlap, and the Designer should be aware of the potential for such conflicts.

Generally, there is far more below the surface of verges and central reserves than is apparent on the surface, and some underground features must be readily accessible for maintenance purposes. Engineering solutions can usually be designed to overcome conflicts where space is limited, but these may increase costs. The sizes and extents of features above and below ground in the verge and central reserve of rural roads can vary widely. Therefore, details should be designed individually for each situation.

3.4 Clear Zone

3.4.1 Clear Zone Concept

The Clear Zone is a vital component of a Forgiving Roadside. The Clear Zone is the total width of traversable land on the nearside or offside which is to be kept clear of unprotected hazards. This width is available for use by errant vehicles. The zone is measured from the nearest edge of the trafficked lane: i.e. the hard shoulder or hard strip forms part of the Clear Zone.

In some circumstances, the Clear Zone extends beyond the extents of the road works boundary or fence line. Where hazards occur in this area, the Designer shall assess the hazards for VRS provision.

Where provision of a hazard free Clear Zone cannot be fully achieved through measures as described in Sections 2.4 and 2.5, a VRS designed in accordance with DN-REQ-03034 may be provided.

3.4.2 Clear Zone Width

Several factors influence the path of an errant vehicle which leaves the carriageway. The most notable of these are the vehicle speed, the horizontal curvature of the road and the terrain over which the vehicle passes. Table 3.1 indicates the Clear Zone width required for various design speeds and curvatures on National Roads.

Table 3.1 Clear Zone Widths

Horizontal radius (m)	Design Speed (km/h)							
	40	50	60	70	80	85	100	120
	Required width of Clear Zone (m)							
Inside of bend or Straight	**2.2**	**3.0**	**4.5**	**5.2**	**6.1**	**6.5**	**8.0**	**10.0**
Outside of bend ≥ 1,000m	2.2	3.0	4.5	5.2	6.1	6.5	8.0	10.0
Outside of bend ≥ 900m	2.4	3.3	4.9	5.6	6.9	7.1	8.8	12.4
Outside of bend ≥ 800m	2.6	3.4	4.9	5.8	7.1	7.7	9.6	14.9
Outside of bend ≥ 700m	2.6	3.4	5.0	6.1	7.7	8.3	10.4	17.5
Outside of bend ≥ 600m	2.6	3.5	5.2	6.3	7.9	8.8	11.2	20.0
Outside of bend ≥ 500m	2.6	3.5	5.3	6.6	8.5	9.4	12.0	
Outside of bend ≥ 400m	2.8	3.8	5.6	6.7	9.0	10.0	12.8	
Outside of bend ≥ 300m	2.9	3.9	6.0	7.4	9.6	10.6		
Outside of bend ≥ 200m	3.4	5.1	7.2					
Outside of bend ≥ 100m	4.8	7.5						

Notes:

1. *The Clear Zone widths indicated in Table 3.1 are intended for use on rural sections of national roads or local and regional roads being upgraded as part of a national road scheme and are not intended for application to typical urban scenarios. The installation of a VRS on national roads in urban locations should be avoided, see DN-REQ-03079 for guidance in relation to VRS in urban settings.*

2. *Slip roads forming part of a major road scheme shall adopt the Clear Zone widths for an 85 km/h section of road listed in Table 3.1.*

3. *The Clear Zone widths in Table 3.1 can be applied to the Operational Speed of legacy national roads where retrofitting new or replacement VRS, and the existing road cross-section is not being changed i.e. VRS works only. See DN-REQ-03079, Design of Road Restraint Systems for Constrained Locations (On-line Improvements, Retrofitting and Urban Settings).*

3.4.2.1 Terrain Classes

Figure 3.1 and Figure 3.2 indicate how to determine the Clear Zone width available where different classes of terrain exist within the roadside cross-section. Where the ground is reasonably flat (Terrain Class 1), the width of the embankment or cutting slope can be included in the available Clear Zone. Where there is a medium embankment slope (Terrain Class 2), it is considered that a vehicle can cross the slope without overturning but cannot slow down. In such terrain, therefore, the available Clear Zone does not include the width of the slope. Where the slope is steep enough to form a hazard in itself (Terrain Class 3), the available Clear Zone does not extend onto or across the slope.

The Terrain Classes are defined as:

Class 1: Slope is equal to or less steep than 1:5 (falling) or 1:2 (rising).

The area is considered as level terrain.

If the total change in level is less than 0.5m the area can be judged as level terrain regardless of the angle of the slope.

Class 2: Slope is between 1:3 and 1:5 (falling).

It is possible to drive on such a slope without overturning, provided the transition to the slope is rounded off, but vehicles cannot decelerate on the slope. The slope width can be part of the Clear Zone but cannot be included in the determination of the necessary width of the Clear Zone.

Class 3: Slope rises sharply (steeper than 1:2) or falls sharply (steeper than 1:3).

These inclinations present a danger of overturning or sudden halting of the vehicle. These areas are considered hazards if it is not possible to remove the risk in some way.

A fundamental concept in the design of embankments is to round the top and bottom of the slope such that vehicles do not become unstable or prone to overturning as they traverse the embankment or cutting. The slope rounding should generally have a radius of at least 4m.

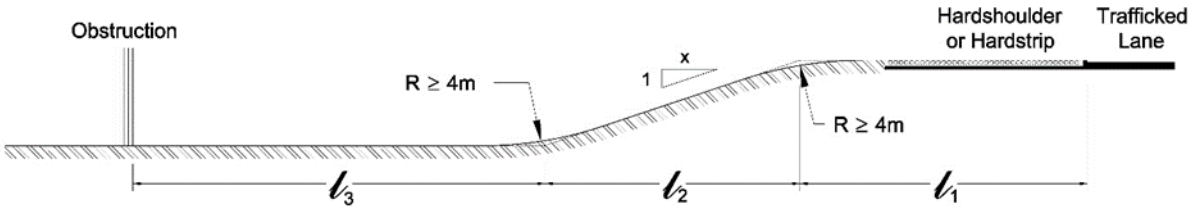


Figure 3.1 Land Included in Clear Zone: Embankments

Embankment or Falling Terrain	Terrain Class	Clear Zone Width
Slope flatter or equal to 1:5	1	$\ell_1 + \ell_2 + \ell_3$
Slope between 1:5 and 1:3	2	$\ell_1 + \ell_3$
Slope steeper than 1:3	3	ℓ_1

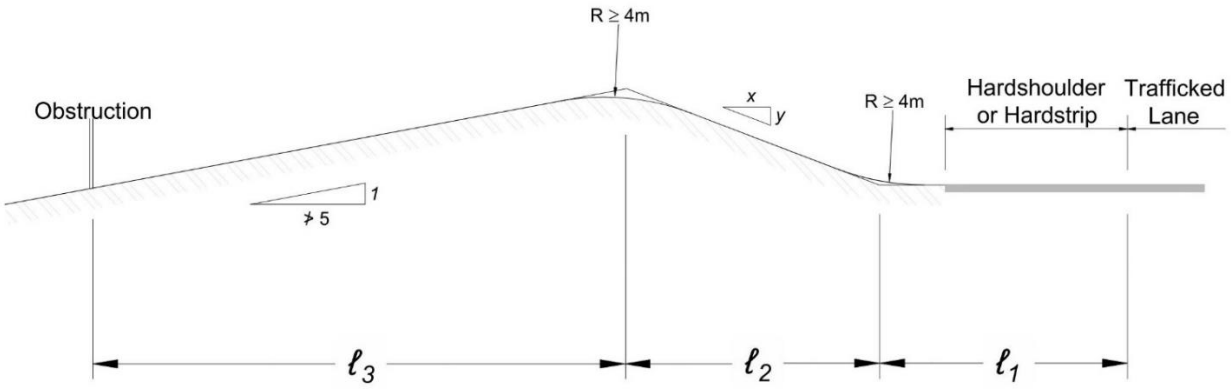


Figure 3.2 Land Included in Clear Zone: Cuttings

Cutting or Raising Terrain	Terrain Class	Clear Zone Width
Slope flatter or equal to 1:2	1	$\ell_1 + \ell_2 + \ell_3$
Slope steeper than 1:2	3	ℓ_1

3.5 Environmental Design

Environmental design features are an integral aspect of the design of any road and many features can have a significant effect on the required overall width of the road.

3.6 Network Objectives

The aim is to deliver an economic, accessible, integrated, safe, reliable, sustainable, efficient and environmentally acceptable network for all users. This includes the need for safe, efficient and effective maintenance as well as the necessity to adapt and improve some roads for the benefit of active travel users. The Designer shall take these factors into account throughout the design process.

3.7 Designated Lanes

With integrated and sustainable transport policy now guiding transport planning, the need to consider and accommodate bus facilities and other designated lanes within the cross-section is likely to increase. The reallocation of road space to buses and other designated vehicles can greatly improve journey times and reliability, thereby encouraging modal shift.

In many instances, the provision of a designated lane will be achieved through the adaptation of the existing carriageway, especially in urban areas. This will often result in a lane being lost for general-purpose traffic. The Road Authority should therefore be fully satisfied of the net benefits to be derived from any proposed alterations. It is important to consider these aspects at an early stage in the project appraisal so as to ensure the most sustainable use of the road network.

Any proposal to install a designated lane on a National Road is a Departure from Standard.

3.8 Active Travel Users

The provision of all active travel infrastructure, or interventions on National Roads Schemes shall be plan-led, so as to maximise opportunities for potential benefits and usage. The Designer shall assess the appropriateness of providing active travel infrastructure taking into consideration the planning and design principles as outlined in PE-PMG-02045.

This approach requires the Designer to appraise and define the most appropriate Active Travel facility to be provided based on the needs for their particular scheme.

Where an on-line off-road facility is proposed, such facilities represent an integral element of the road cross-section. It is therefore essential that Designers integrate the facility into the design at an early stage so that all features required within the cross-section are appropriately space proofed.

3.9 People with Disabilities

People with disabilities are better able to participate in the community if suitable and accessible facilities are available that make it easier for them to reach their desired destinations, especially for those that do not drive. Suitable provision is therefore an essential component of the cross-section.

Designers are required to take necessary measures to ensure no discrimination on the basis of disability when considering the design of roadside features.

The required standard of provision for persons with disabilities must be considered at the early stages of scheme preparation and the level of facilities must be agreed with the Road Authority.

3.10 Visibility

On curved alignments and approaches to junctions, it may be necessary to widen the cross-section, particularly verges and central reserves, to ensure that drivers and other road users can see the appropriate distances, and that the layout meets the visibility requirements. Refer to DN-GEO-03031 for visibility requirements and verge widening.

3.11 Express Roads

3.11.1 General Principles

An Express Road is a category of road that shall be Type 1 Single / Type 1 Dual Carriageway or Type 2 Divided Road type incorporating access control as outlined in Section 3.11.2.

Where facilities for active travel users are required, provision shall be made beyond the fence line of the Express Road cross-section. Where a roundabout junction is used on an Express Road, active travel user facilities may cross the Express Road while passing through the junction on the intersecting road subject to the requirements of DN-GEO-03060.

An Express Road shall not cross at grade with any railway or tramway track

3.11.2 Junction Strategy

An Express Road shall be designed so as to minimise the number of junctions and to provide drivers with straightforward junction layouts which shall be controlled.

Only the following junction types are permitted for use on Express Roads.

a) Roundabouts;

b) Grade Separated Junctions (including Compact Grade Separated Junctions);

c) Left-in/Left-out Junctions.

4. Cross-Sections on Open Roads

4.1 General

Tables 4.1 to 4.4 give detailed dimensions for cross-sectional elements. The information covers rural motorways and rural all-purpose dual carriageways and divided roads, urban motorways, urban all-purpose dual carriageway roads and single carriageway urban relief roads, together with associated interchange links, loops and on and off slip roads. For graphic representations of these cross-sections, refer to the Road Type and Cross-section set of Standard Construction Details (CC-SCD-00001 to CC-SCD-00016) on the TII Publications website.

Wide Motorway cross-sections will normally be used only where adjacent lengths of road are of equivalent cross-section.

Table 4.2 gives detailed dimensions for each element of the cross-sections for regional and local roads diverted or improved on-line as part of a National Road scheme.

4.2 Paved Width

The width of the paved elements of the cross-section, i.e. carriageways, hard shoulders and hard strips, shall be in accordance with the requirements of this Standard. Any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements for pavement widening on curves as detailed in DN-GEO-03031.

4.3 Traffic Lane Widths

Traffic lane widths as detailed in Tables 4.1 to 4.4 are measured between the trafficked side of carriageway edge lines and the centre line of lane lines.

Where more than two traffic lanes are required in either direction, the middle traffic lane(s) widths are measured between the centre line of the adjacent lane lines.

Where kerbs are used, they shall be a maximum height of 80mm above the adjacent pavement and shall be splayed over the full height, by at least 45° to the vertical.

Information on the provision, start and finish of climbing lanes incorporated into single and dual carriageways and divided roads can be found in DN-GEO-03031.

Traffic lanes shall be widened on curves of low radius to allow for the swept path of long vehicles. See DN-GEO-03031 for details of curve widening.

4.4 Changes of Carriageway Edge Treatment

Where slip roads, interchange links and loop roads join or leave main carriageways, the edge detail may change from hard shoulder to hard strip or carriageway edge.

Transitions between different edge details should take place over the length of the taper.

See DN-GEO-03060 for the layouts of merges and diverges at junctions.

4.5 Hard Strips

A hard strip provides a surfaced strip that abuts on the traffic lanes. The key reasons for the provision of hard strips include:

- pavement integrity/stability;
- partial, cost-effective provision for stopped vehicles;
- provision of valuable additional width to accommodate temporary traffic management layouts;
- snow and water collection;
- overrun facility for driver error or evasive action; and
- improved level of service and driver comfort.

The hard strip also supports edge lines, reduces the risk of vegetation encroachment over edge lines and allows for the placement of road studs outside vehicle wheel paths, where appropriate.

4.6 Hard Shoulders

The hard shoulder is provided adjacent to the nearside of the traffic lanes to offer a place to stop in emergencies, clear of mainline traffic. It also provides access for emergency vehicles and additional road space during temporary traffic management operations. On all-purpose single carriageways, the hard shoulder also provides room for slow moving vehicles to temporarily pull over to allow other traffic to overtake.

While the presence of hard shoulders can also provide a degree of refuge for cyclists and pedestrians, they shall be not considered to provide a dedicated active travel facility, which shall instead follow the requirements outlined in Section 4.17 of this Standard. Notwithstanding, on roads with hard shoulders where dedicated active travel facilities are not provided along the route, it is important that cycle friendly principles are adopted. In such cases, localised narrowing of the hard shoulder to accommodate ghost island junctions, climbing lanes etc. must consider the position of any cyclists who may be using the route.

Offside hard shoulders are not permitted.

4.7 Central Reserves

Central reserves provide physical separation between carriageways thereby providing freedom from interference from opposing traffic, particularly where a VRS is provided.

Minimum central reserve widths are given in Tables 4.1 to 4.4. A central reserve width less than the minimum is a Departure from Standard.

The standard widths are based on the assumption that the road alignment is straight and level between carriageways and that only a minimal amount of equipment or street furniture needs to be accommodated, either permanently or during temporary maintenance activities. Dimensions in excess of those listed in Tables 4.1 to 4.4 may be used in circumstances where deemed appropriate, subject to the approval of TII. The Designer shall consider whether it is necessary to widen the central reserve in order to:

- provide the requisite stopping sight distances in accordance with DN-GEO-03031;
- accommodate any street furniture, utility or drainage features and equipment;

- meet the requirements of DN-REQ-03034 for Vehicle Restraint Systems;
- accommodate any permanent signs required, with particular attention to the provision of adequate working width and set-back for safety barriers relative to the complete sign assembly;
- accommodate significant difference in levels of adjacent carriageways;
- accommodate temporary traffic management layouts for the envisaged maintenance regime subject to adequate pavement provision;
- accommodate variable message signs and signals;
- accommodate any parts of structures or complete structures;
- provide sufficient space for maintenance operations;
- fulfil landscape and environmental objectives;
- accommodate ATUs when crossing; and
- accommodate snow and water collection.

The Designer shall consider other features that may have to be accommodated in the central reserve as well as the safety of maintenance operations and the safety of all who may be required to work on or near the road in the course of their duties, e.g. emergency service personnel. During project appraisal, the Designer shall also ensure that future network plans for traffic control (e.g. gantries) are taken into account.

Piers for overbridges are not permitted within the central reserve of Type 2 or 3 Divided Roads.

Variations of central reserve widths in close succession should be avoided. The Designer shall consider how the scheme will integrate with adjacent highway sections and the route as a whole.

Where the central reserve width varies, raised profile markings should be used to define the edge of the running lane clearly. Particular care should be taken to avoid creating the illusion of a lane gain, for example, by the use of hatching as per the Traffic Signs Manual Chapter 7 in the widened area. Furthermore, variations in safety barrier set back should be carefully considered in this regard to provide a flowing appearance.

Reference should be made to DN-GEO-03060 for guidance on widening the central reserve at priority junctions on Type 3 Divided Roads.

Reference should be made to DN-GEO-03060 for the requirements for crossing treatments for On-line off-road active travel facilities.

4.8 Emergency Crossing Points

DN-GEO-03031 provides advice on the design of Emergency Crossing Points.

4.9 Hardening of Central Reserves

Techniques for reducing maintenance liabilities within central reserves should be considered during the preparation of new roads, road improvement schemes and also for major maintenance operations on existing roads, to reduce risks to both operatives and other highway users.

For new construction schemes, central reserves shall be paved.

When deciding whether to harden existing central reserves as part of a road improvement / maintenance scheme, the Designer shall:

- check the adequacy of the surface water drainage system;
- make an assessment of environmental factors, such as the landscape character of the setting and location of the road, the environmental consequences of weed control and the function of the central reserve as a potential habitat. The environmental database for the route should therefore be consulted;
- determine the area to be hardened, based on what areas of vegetation may be left uncut without affecting visibility or sign conspicuity;
- take account of whole-life costs and safety considerations;
- determine if the central reserve is to be used to accommodate temporary traffic management layouts for the envisaged maintenance regime.

As a minimum, any general hardening of the central reserve should be designed to be capable of withstanding light vehicle over-run and prevent weed growth. The design shall be in accordance with DN-PAV-03074 Design of Bituminous Mixtures, Surface Treatments, and Miscellaneous Products and Processes.

4.10 Verges

The verge is important from a number of perspectives, including safety, the environment, when considering the initial cost and ongoing maintenance and operating costs. It can provide a separate route for ATUs on all-purpose roads and also offers an area to accommodate footways, active travel facilities and other dedicated facilities to improve safety and convenience for these groups. On motorways, stranded motorists may use the verge on foot to reach the emergency telephones or await the arrival of a rescue vehicle. The design of the verge, as well as the location of the emergency telephone, should consider the access requirements that may be required for some ATUs.

Minimum verge widths are given in Tables 4.1 to 4.4. A verge width less than the minimum requires a Departure from Standard. Where the Tables denote ‘Varies’, the decision rests with Designers, taking into account the advice in this Standard. The verge width should be increased as necessary to accommodate the features and services contained therein, including allowance for active travel facilities. The additional verge width for these facilities shall be calculated in accordance with this Standard to account for required separation distances, minimum facility width and lateral clearance requirements discussed later in this document.

Advice concerning choice of verge width corresponds with that provided for central reserves. Additional advice solely for verges is given below.

The verge offers an important component in road drainage systems, including the storage of snow displaced from the carriageway. It offers an area to support ancillary roadside equipment such as VRS, ITS equipment, traffic counters, lighting and other highway features such as laybys and landscaping. Environmental fencing is a regular feature of the cross-section and the Designer shall establish the requirements as early as practicable to make appropriate provision of road width. Congested verges with insufficient room for necessary roadside components present both safety and engineering difficulties.

As noted previously, new roads shall be designed to provide a more forgiving environment for errant vehicles. This can be achieved through the provision of a Clear Zone to the side of the carriageway as per Section 3.4. The concept of providing wide verges to slow and contain errant vehicles, and accommodating shallower side slopes for example, may have significant land take implications and needs to be considered early in the design process.

If properly incorporated during the early stages of planning and design, the Forgiving Roadsides principles, as outlined in Chapter 2, can be used to avoid such issues. Examples of this could include incorporating the maintenance strip into shallow embankments or combining swale drains and the maintenance strip.

DN-REQ-03034 provides requirements to ensure the safety of road users if a VRS is struck and deflected near the road edge or central reserve.

Designers shall comply with DN-REQ-03034 when designing VRS in situations where hazards cannot be mitigated or modified. Where necessary, additional verge width may need to be provided, for example on the approach to underbridges to allow sufficient embankment width behind the VRS to ensure the VRS and associated foundation can perform adequately.

Verges should be sufficiently firm, level and free from hazards to permit their occasional use by ATUs in the absence of dedicated facilities.

Where footways are provided, the widths shall be in accordance with Section 4.17.2 of this standard.

Variations of verge widths in close succession should be avoided. The Designer shall consider how the scheme will integrate with adjacent highway sections and the route as a whole.

4.11 Maintenance Strip and Side Slope Widths

Maintenance strip and side slope widths should be chosen to suit the local situation. The width of maintenance strip will depend upon:

- terrain;
- environmental design features;
- engineering and geotechnical measures used to accommodate changes in ground levels;
- the need to accommodate various types and widths of drainage features and other services in any maintenance strip;
- maintenance requirements;
- Clear Zone requirements.

The width of maintenance strip shall be determined by the Designer. A typical minimum width of 3.0m is recommended.

To provide a more forgiving environment for errant vehicles, the provision of a Clear Zone in accordance with DN-REQ-03034 shall also be considered when choosing the appropriate maintenance strip and side slope widths, refer Figure 3.1 and Figure 3.2.

Whenever practicable, side slopes adjacent to emergency roadside telephones should be kept to a minimum angle to assist motorists in waiting at the road boundary in the event of an emergency or breakdown.

4.12 Auxiliary Lane Provision

Where auxiliary lanes are provided in accordance with the general arrangement layouts given in DN-GEO-03060, the width of the auxiliary lane(s) shall be equal to the width of the adjacent nearside mainline lane.

Changes in lane width between connector roads and auxiliary lanes shall be carried out over the full length of the nose.

Table 4.1 Rural Motorways - Dimensions of Cross-Section Elements Including: Slip Roads, Interchange Links and Loops

	Nearside				Offside		
	Verge [1,4]	**Hard Strip[2]**	**Hard Shoulder[2]**	**Carriage-way [2,8]**	**Hard Strip[2]**	**Verge [1,4]**	**Central Reserve[1,4]**
Mainline							
Motorway[8]	**2.00**		2.50	7.00 (2 Lane)	1.00	-	2.60
Wide Motorway	**3.00**	-	3.00	7.50	1.00	-[3]	9.00
Wide Motorway with provision for extra lane	**3.00**	-	3.00	7.50	1.00	-[3]	16.00
Slip Roads, Interchange Links, Parallel Link Roads, and Loops: Merges and Diverges							
1 Lane	4.50	1.50	-	4.00	0.50	3.50	-
2 Lane	4.00	1.00	-	7.30	0.50	3.50	-
Slip Roads: Diverge Only							
2 Lane	4.00	1.00	-	6.00	0.50	3.50	-

Notes:

1. *Verge and central reserve dimensions are minimum values: any reduction shall require a Departure from Standard.*
2. *Carriageway, hard shoulder and hard strip dimensions are fixed values: Any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements or pavement widening on curves as detailed in DN-GEO-03031.*
3. *Refer to Clause 5.6 for details of offside verges at divided structures.*
4. *Where a hard strip is present, the corresponding verge or central reserve dimension includes the hard strip. However, where a hard shoulder is present, the corresponding verge dimension does not include the hard shoulder.*
5. *For guidance on selection of slip roads and interchange link and loop roads, see DN-GEO-03060 for the design of Grade Separated Junctions.*
6. *All dimensions are in metres.*
7. *For graphic representation of these cross-sections, refer to the appropriate Standard Construction Detail for road type and cross-section on the TII Publications website.*
8. *Where the traffic assessment indicates more than 2 lanes are required in each direction, any additional lanes shall be 3.5m in width for Motorways. Details of verges, hard shoulders and the central reserve shall be the same as for a Motorway with 2 lanes in each direction.*

Table 4.2 Rural All-Purpose Roads - Dimensions of Cross-Section Elements Including: Slip Roads, Interchange Links and Loops

	Nearside			Offside			
	Verge [1,4,8,9]	**Hard Strip**[2]	**Hard Shoulder**[2]	**Carriage-way** [2,11]	**Hard Strip**[2]	**Verge** [1,4]	**Central Reserve** [1,4]
Mainline							
Type 3 Single	**3.00**	0.50	-	6.00	-	-	-
Type 2 Single	**3.00**	0.50	-	7.00	-	-	-
Type 1 Single	**3.00**	-	2.50	7.30	-	-	-
Type 3 Divided Road	**3.00**	0.50 min	-	7.00 (2 Lane) 3.50 (1 Lane)	0.50	- [3]	1.50
Type 2 Divided Road	**3.00**	0.50	-	7.00	0.50	- [3]	1.50
Type 1 Dual Carriageway[10]	**2.00**	-	2.50	7.00 (2 Lane)	1.00	- [3]	2.60
Slip Roads, Interchange Links, Parallel Link Roads and Loops: Merges and Diverges							
1 Lane	4.50	1.50	-	4.00	0.50	3.50	-
2 Lane	4.00	1.00 (Type 2/3) 1.50 (Type 1)	-	7.30	0.50	3.50	-
Slip Roads: Diverge Only							
2 Lane	4.00	1.00 (Type 2/3) 1.50 (Type 1)	-	6.00	0.50	3.50	-

Notes:

1. *Verge and central reserve dimensions are minimum values: any reduction is a Departure from Standard.*
2. *Carriageway, hard shoulder and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements for pavement widening on curves as detailed in DN-GEO-03031.*
3. *Refer to Clause 5.6 for details of offside verges at divided structures.*
4. *Where a hard strip is present, the corresponding verge or central reserve dimension includes the hard strip. However, where a hard shoulder is present, the corresponding verge dimension does not include the hard shoulder.*
5. *For guidance on selection of slip roads and interchange link and loop roads, see DN-GEO-03060 for the design of Grade Separated Junctions.*
6. *All dimensions are in metres.*
7. *For graphic representation of these cross-sections, refer to the appropriate Standard Construction Detail for road type and cross-section on the TII Publications website.*
8. *Verge width shall be determined to take into account the uses and clearances required.*
9. *The verge width should be increased as necessary to accommodate the features and services contained therein, including allowance for active travel facilities. The additional verge width for pedestrian/cycle facilities shall be calculated in accordance with this Standard to account for required separation distances, minimum facility width and lateral clearance requirements. Where an Active Travel facility is provided, a minimum outer verge width of 0.5m shall be provided.*
10. *Where the traffic assessment indicates more than 2 lanes are required in each direction, any additional lanes shall be 3.5m in width for Type 1 Dual Carriageways. Details of verges, hard shoulders and the central reserve shall be the same as for a Type 1 Dual Carriageways with 2 lanes in each direction.*

Table 4.3 Urban Motorways - Dimensions of Cross-Section Elements Including: Slip Roads, Interchange Links and Loops

	Nearside				Offside		
	Verge[9]	**Hard Strip[2]**	**Hard Shoulder[2]**	**Carriageway[2]**	**Hard Strip[2]**	**Verge**	**Central Reserve[1]**
Mainlines							
Standard Motorway[8]	2.0	-	2.50	7.00	1.00	- [4]	2.60
Slip Roads, Interchange Links, Parallel Link Roads and Loops: Merges and Diverges							
1 Lane	Varies	1.50	-	4.00	0.50	Varies	-
2 Lane	Varies	1.00	-	7.30	0.50	Varies	-
Slip Roads: Diverge only							
1 Lane	Varies	1.00	-	6.00	0.50	Varies	-

Notes:

1. *Central reserve dimensions are minimum values: any reduction is a Departure from Standard.*
2. *Carriageway, hard shoulder and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements for pavement widening on curves as detailed in DN-GEO-03031.*
3. *The central reserve dimension includes the offside hard strip.*
4. *Refer to Clause 5.6 for details of offside verges at divided structures.*
5. *For guidance on selection of slip roads and interchange link and loop roads, see DN-GEO-03060 for the design of Grade Separated Junctions.*
6. *All dimensions are in metres.*
7. *For graphic representation of these cross-sections, refer to the appropriate Standard Construction Detail for road type and cross-section on the TII Publications website.*
8. *Where the traffic assessment indicates more than 2 lanes are required in each direction, any additional lanes shall be 3.5m in width for Urban Motorways. Details of verges, hard shoulders and the central reserve shall be the same as for an Urban Motorway with 2 lanes in each direction.*
9. *Where necessary to accommodate communication ducting and chambers a minimum verge width of 2.0m shall be provided*

Table 4.4 Urban All-Purpose Roads - Dimensions of Cross-Section Elements Including: Slip Roads, Interchange Links and Loops

	Nearside			Offside		
	Verge[3,8]	**Hard Strip[2]**	**Carriageway[2]**	**Hard Strip[2]**	**Verge[1,4]**	**Central Reserve[1,4]**
Mainlines						
Single Carriageway Relief Road	Varies	-	6.00 to 7.00	-	-	-
Dual Carriageway Relief Road	Varies	-	7.00	-	-	1.80
Dual 2 Lane	Varies	-	7.30	-	- [4]	1.80
Dual 3 Lane	Varies	-	11.00	-	- [4]	1.80
Slip Roads, Interchange Links, Parallel Link Roads and Loops: Merges and Diverges						
1 Lane	Varies	1.50	4.00	0.50	Varies	-
2 Lane	Varies	1.00 (Type 2/3) 1.50 (Type 1)	7.30	-	Varies	-
Slip Roads: Diverge Only						
2 Lane	Varies	1.00 (Type 2/3) 1.50 (Type 1)	6.00	-	Varies	-

Notes:

1. *Central reserve dimensions are minimum values: any reduction is a Departure from Standard.*
2. *Carriageway and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements for pavement widening on curves as detailed in DN-GEO-03031.*
3. *Verge width shall be determined to take account of the uses and clearances required.*
4. *Refer to Clause 5.6 for details of offside verges at divided structures.*
5. *For guidance on selection of slip roads and interchange link and loop roads, see DN-GEO-03060 for the design of Grade Separated Junctions.*
6. *All dimensions are in metres.*
7. *For graphic representation of these cross-sections, refer to the appropriate Standard Construction Detail for road type and cross-section on the TII Publications website.*
8. *The verge width should be increased as necessary to accommodate the features and services contained therein, including allowance for active travel facilities. The additional verge width for pedestrian/cycle facilities shall be calculated in accordance with this Standard to account for required separation distances, minimum facility width and lateral clearance requirements. Where an Active Travel facility is provided, a minimum outer verge width of 0.5m shall be provided.*

4.13 Connector Road Lane Provision

For guidance on determining the required number of lanes, hard shoulder and hard strip provision on connector roads, see DN-GEO-03060.

Where connector roads approach junctions, those dimensions given in the relevant sections of DN-GEO-03060 that prescribe safe and efficient junction designs may take precedence over the cross-section dimensions given in this Standard. Traffic movements at the junction may demand the development of additional lanes to provide capacity for separate traffic streams.

4.14 Separator Zones

The widths of separator zones should generally follow the decision-making process used to determine central reserve widths discussed previously. Designers should be aware that minimal width separator zones could lead to problems due to a lack of refuge area for occupants of broken down vehicles and also for maintenance.

Where traffic on any lane of a parallel road runs counter to the mainline traffic flow, the risks associated with headlight glare shall be assessed and the need for and the type of mitigation measures shall be considered when determining the required width of separator zones.

Methods of avoiding headlight glare include:

- designing the alignments of the roads so as to provide significant level differences;
- providing anti-dazzle screening fences or earth bunds (taking consideration of any clear zone requirements);
- providing appropriately designed soft planting that provides foliage all year round at the correct heights;

Designers should take into consideration which mitigation method provides the most sustainable solution. Sightline requirements must not be compromised by the above measures.

4.15 Provision of Emergency Refuge Areas (ERAs) and Lay-bys

For guidance on determining the requirements for the provision of Emergency Refuge Areas (ERAs) and Lay-bys, see DN-GEO-03031 and DN-GEO-03046.

4.16 Road Markings

For details of the road markings required to define lanes, hard shoulders, etc. on the various types of road cross-section, see the Traffic Signs Manual.

4.17 Rural Active Travel Facility Layouts

4.17.1 General Principles

The provision of all active travel infrastructure, or interventions on National Roads Schemes shall be plan-led, so as to maximise opportunities for potential benefits and usage. The Designer shall assess the appropriateness of providing active travel infrastructure taking into consideration the planning and design principles as outlined in PE-PMG-02045.

This approach requires the Designer to appraise and define the most appropriate Active Travel facility to be provided based on the needs for their particular scheme.

The most appropriate facility may be provided in the following ways, or through a combination of same:

- On-line, off-road facilities adjacent to a proposed road upgrade in compliance with this standard, DN-GEO-03031 and DN-GEO-03060;
- Off-line facilities in compliance with DN-GEO-03047;
- Links to an existing or proposed active travel network. In this case, the Designer should verify that the existing/proposed active travel network is compliant with the requirements for on-line, off-road facilities, or off-line facilities as outlined above. Upgrades shall be proposed to bring the facilities into compliance, where required. A Departure from Standard shall be required where an existing/proposed facility is not compliant and / or upgraded as outlined.

Where active travel facilities are provided within the verge, the Designer should position the facility as far from the edge of the carriageway as possible to increase the safety/comfort of users, provided the clearances to objects as specified later in this section can be achieved. The separation distances from the carriageway detailed later in this section are the minimum requirements.

4.17.2 Cross-Section

Generally, rural active travel facilities will also provide for pedestrians, unless a separate pedestrian footway or footpath is provided. When determining the cross-section widths, the level of pedestrian and cyclist usage shall be considered. The anticipated speed of the cyclist given the vertical profile, and the space that each user will occupy when using the active travel facility should also be assessed.

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

- the space needed for a cyclist in motion known as the cyclist's dynamic envelope, particularly at low speeds;
- the clearance when passing fixed objects;
- the distance from, and speed of other traffic;

Other considerations in determining active travel facility width are:

- Cycling in a rural environment is a social activity and therefore sufficient width is required to allow cyclists to pair up or travel in groups;
- Not all cyclists travel at the same speed therefore room to overtake needs to be provided;
- When families travel together sufficient width for an adult to cycle parallel with young children for safety and reassurance reasons;
- The volume of cyclists;
- Cyclists with trailers/panniers;
- Trikes and recumbents;
- Whether the cross-section is shared with other users (pedestrians, motorised vehicles);
- Whether the facilities are one-way or two-way operation;
- Lateral clearance when positioning obstacles such as kerbstones, lamp posts, bollards, trees and walls.

Table 4.5 and Table 4.6 present the mandatory requirements for active travel facilities. Table 4.5 demonstrates the required widths based on whether the active travel facility is a segregated two-way cycle facility or a shared facility with pedestrians. Low volume facilities are those considered to attract less than 300 users an hour and high-volume facilities are those expected to attract greater than 300 users an hour. The mandatory minimum values outlined will provide a reasonable quality of service and will satisfy all of the core design principles.

The use of values less than the minimum values outlined in Table 4.5 and Table 4.6 shall require a Departure from Standard.

Table 4.5 Mandatory Minimum Widths for Active Travel Facilities

Active Travel Facility Types	Volume	Minimum Width of Cycle Facility (m)	Minimum Width of Pedestrian Only Facility (m)
Segregated Pedestrian and Two-Way Cycle Facility	Low Volume	3.0	2.0
	High Volume	4.0	2.0
Shared Use Two-Way Pedestrian and Cycle Facility	Low Volume	3.0 (Shared with Pedestrians)	N/A
	High Volume	5.0 (Shared with Pedestrians)	N/A

Shared use facilities will be provided as the default when new active travel intervention need is identified - in particular where the volumes of pedestrians will be low (less than 100 people per hour per metre width of unsegregated shared facility) and or where spatial constraints constrain provision.

4.17.2.1 Segregation of Pedestrians and Cyclists

As part of the design process, it is important to define whether the facility will attract low or high volumes of cyclist/pedestrian traffic to give the Designer the choice to make an informed decision on cross-section dimensions and whether or not segregation of cyclists and pedestrians is necessary.

Consideration will be afforded to segregating pedestrian and cyclist flows where flow volumes warrant same (greater than 100 pedestrians per hour per metre width of unsegregated shared facility). Additional guidance in relation to flow volumes is available within the Design Manual for Roads and Streets and the National Cycle Manual. Refer to Table 4.6 below which indicates the type of arrangement that may be suitable on the basis of density of pedestrian activity.

Table 4.6 Pedestrian flow density

Density of Pedestrians (users/hr/m) *	**Recommended Arrangement**
< 100	Shared use is usually appropriate (cycles give way)
101 – 199	Segregation may be considered
> 200	Segregation should be considered

**Based on CROW, Design Manual for Bicycle Traffic, 2016.*

On rural Active Travel facilities, it is likely that the density of volumes warranting segregation would not be present. Consideration should also be given to segregation of cyclists and pedestrians in areas where there is a likelihood for increased pedestrian activity and a higher likelihood for increased conflicts, such as areas where access to adjacent properties / shops / destinations in close proximity to the active travel facility would be higher.

Where segregation of pedestrian and cyclist flows is deemed necessary and appropriate, a minimum level of separation should be provided through one of the following means:

- A level difference of at least 60mm (cycleways raised);
- A raised, bevelled kerb (cycleway raised); or
- A grassed verge of minimum width 500mm (incorporating landscaping treatment as necessary)

Interaction of pedestrian and cyclist flows should be considered on links and at crossings. Where a route for pedestrians must cross a route for cycles, this crossing should be examined carefully to ensure that interfacing is safe for all users. Reference should be made to the requirements of the National Cycle Manual in this regard.

4.17.3 Horizontal Separation Distances

For on-line off-road active travel facilities, a separation distance is to be provided between the road and the cycle track through the provision of a grassed verge. This separation helps protect users from passing motor traffic and also provides a clear visual separation between the road and active travel facility.

The horizontal separation distance is measured from the edge of the road pavement, with minimum separation distances presented in Table 4.7. In all cases, the separation distance must include a 1.5m grassed strip to provide a clear visual separation. This may require extension of the separation distances noted in Table 4.7 where non-grassed features (e.g. filter drains, concrete surface water channels) are accommodated within. The active travel facility should however be located as far from the edge of the carriageway as possible, as described earlier in this section.

Additionally, if screening fencing, barriers or any other road furniture is proposed between the road pavement and Active Travel facility, the separation distance shall be increased to accommodate the features and geometric considerations (such as sight distance, working widths etc.) as required.

Any values below those outlined in Table 4.7 require a Departure from Standard.

Table 4.7 Horizontal Separation Distances

Speed Limit (km/h)	Desirable Min Horizontal Separation – Rural (m)
80	1.5
100	2.0

4.17.4 Lateral Clearance

If vertical objects such as a wall, a pedestrian / cyclist fence or a VRS are located immediately adjacent to an active travel facility, the effective width of the active travel facility will be reduced. A minimum lateral clearance of 1m shall be provided to vertical objects where they are located adjacent to active travel facilities. Where a VRS is proposed adjacent to an active travel facility, it shall be provided as per Clause 4.17.6 of this standard.

4.17.5 Typical Details

Figure 4.1 and Figure 4.2 illustrate the cross-section requirements of the different active travel facility options which may or may not be shared with pedestrians. See Table 4.5 and Table 4.7 for the required dimensions.

4.17.6 Safety Barriers

The provision of safety barriers shall be made in accordance with DN-REQ-03034. Any safety barrier required shall be positioned between the carriageway and the active travel facility. The minimum distance between the active travel facility and the safety barrier shall be equal to the working width of the safety barrier and comply with the minimum lateral clearance requirements outlined earlier. In addition, safety barriers adjacent to the active travel track should be of an enclosed double-sided beam type or similar, as described in DN-REQ-03034.

4.17.7 Pavement and Foundation Construction Details

Construction details for active travel facilities developed as part of a National Road scheme shall as per Chapter 7 of DN-GEO-03047.

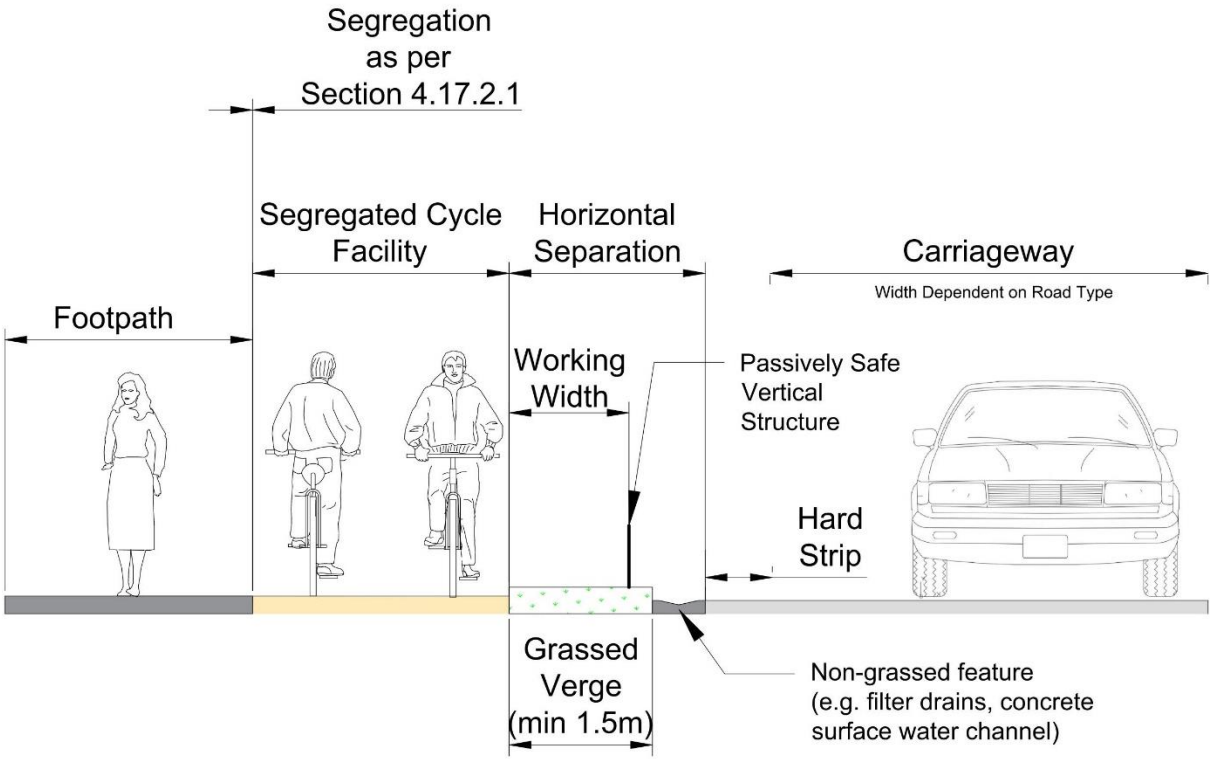


Figure 4.1 Segregated Pedestrian and Two-way Cycle Facility

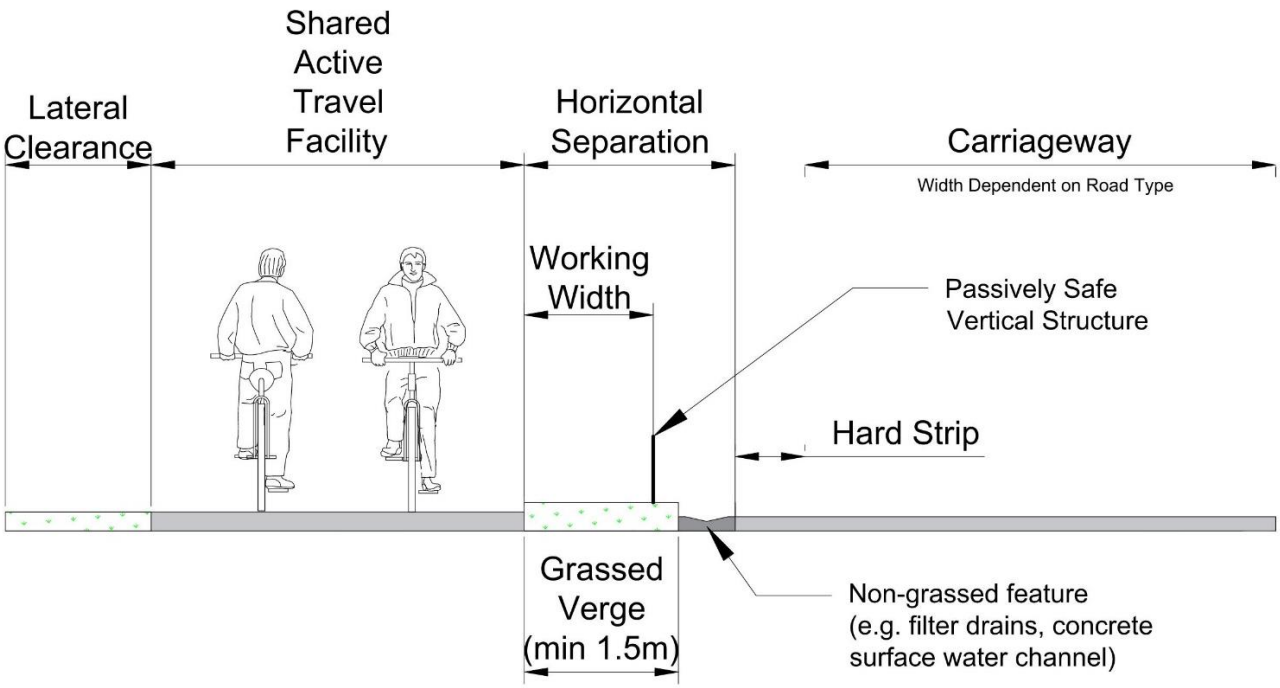


Figure 4.2 Shared Use Active Travel Facility

5. Cross-Sections at Structures

5.1 General

The cross-section requirements detailed below for structures assume a straight horizontal alignment of the carriageway. If this is not the case the verges and central reserve may require widening to give the stopping sight distances required in accordance with DN-GEO-03031. For graphic representations of these cross-sections, refer to the Road Type and Cross-section set of Standard Construction Details (CC-SCD-00001 to CC-SCD-00016) on the TII Publications website.

Variations of cross-section provision at bridges in close succession shall be avoided except where sight distance requirements dictate otherwise. The verge and central reserve widths appropriate for the longest structure shall be used. Individual cases shall be treated on their merits.

The requirements of this Standard are not applicable to road tunnels.

5.2 Roads Diverted or Improved on-line as Part of a National Road Scheme

The cross-section at a structure of a road diverted or improved on-line as part of a National Road scheme shall have a minimum width of 5.5m.

5.3 Traffic Lane Widths

Lane widths shall be maintained through or over a structure.

5.4 Hard Shoulders and Hard Strips

Where hard shoulders or hard strips are provided adjacent to the edges of the carriageway they shall be continued at the same width through or over the structure.

5.5 Central Reserves

The width of central reserve applicable to the adjacent open road section should be continued through or over the structure. Reference is brought to the restrictions on piers within the central reserve within Section 4.7 of this document.

5.6 Verges on Underbridges and Overbridges

In planning the overall width required, consideration should be given to the space necessary for structural elements of the bridge, including: foundations, items such as bridge joints, drainage runs, electrical equipment and services, and VRS. Consideration should also be given to maintenance operation needs.

On motorways, a minimum 0.6m nearside raised verge width shall be provided over the full length of the bridge. In cases where the opposing carriageways are on two separate bridge structures, a minimum offside raised verge width is also required.

Where an Active Travel facility is proposed on approach to road overbridges, underbridges, elevated roads and viaducts, the nearside verge shall accommodate ATUs.

Widths shall be provided as per the requirements of Section 4.17.2 and maintained across under/overbridges where ATU facilities are proposed on the approaches. The horizontal separation distance can be reduced to a minimum of 1.5m on the bridge. The use of different coloured surfacing for the separation area should be considered, in order to deter cyclists from encroaching into the area.

Verge widths may need to be increased to allow adequate visibility, particularly where a bridge is located on a horizontal curve.

5.6.1 Verges on Underbridges

On underbridges, the verge adjacent to the bridge parapet shall be raised with a maximum kerb height of 80mm above the adjacent pavement. Kerbs shall be splayed for their full height, by at least 45° to the vertical.

5.6.2 Verges beneath Overbridges

Beneath overbridges, the verge adjacent to the bridge abutment / pier shall be raised with a maximum kerb height of 80mm above the adjacent pavement. Kerbs shall be splayed for their full height, by at least 45° to the vertical.

Additionally, the verge width shall be not less than 2.0m and shall also comply with the following arrangements where applicable.

At overbridges where an abutment is adjacent to the carriageway:

a) The distance from the edge of road pavement to the face of the abutment shall be not less than 4.5m.

b) Where an on-line, off-road active travel facility is required, a minimum raised verge width which caters for the lateral clearance and separation distances outlined in this standard shall be provided.

At overbridges where a pier is adjacent to the carriageway:

a) The distance from the edge of the traffic lane to the face of the pier shall be not less than 4.5m.

b) The minimum distance from the edge of road pavement to the face of the pier shall be determined to suit the safety barrier set-back and working width as defined in DN-REQ-03034.

c) Where an on-line, off-road active travel facility is required, a minimum raised verge width which caters for the lateral clearance and separation distances outlined in this standard shall be provided.

5.7 Safety Barriers and Bridge Parapets

Safety barriers and bridge parapets shall be positioned in accordance with the requirements of DN-REQ-03034.

6. Headroom at Structures

6.1 General

Dimensional standards are given in Table 6.1 for New Construction Headroom and Maintained Headroom at overbridges and at other structures over a road.

The headroom provision at underbridges shall be in accordance with Table 6.1 unless otherwise agreed with the relevant Road, Railway or Water Authority.

The headroom values given are the minimum; where it is economical and/or environmentally acceptable, greater headroom should be provided.

The requirements of this Standard are not applicable to road tunnels.

Table 6.1 Standard Headroom at Structures

Type of Structure	New Construction Headroom (m)	Maintained Headroom (m)
Overbridges	**5.30**	**5.03**
Footbridges and Sign/Signal Gantries	**5.70**	**5.41**
Free Standing Temporary Structures	**N/A**	**5.41**

6.2 Dimensional Requirements

Headroom shall be measured at right-angles to the surfaces of the carriageway, hard shoulder, hard strip, verge or central reserve, at the point where it is a minimum.

The relevant standard headroom in Table 6.1 shall be provided:

a) Over the paved carriageway, hard shoulder or hard strip plus any provision for future widening;

b) Over the full verge width, except where (e) applies, and even then, for a minimum of 4.5m from the edge of the traffic lane;

c) Over the central reserve of a dual carriageway / divided road, except where (e) applies;

d) Between the carriageway and the pier or abutment face where such a support is located within 4.5m of the edge of the road pavement, except where (e) applies;

e) To the back of the working width or vehicle intrusion width, whichever is greater, of any VRS as defined in DN-REQ-03034, where installed (see Figure 6.1).

Headroom standards for rural active travel facilities are included in this document.

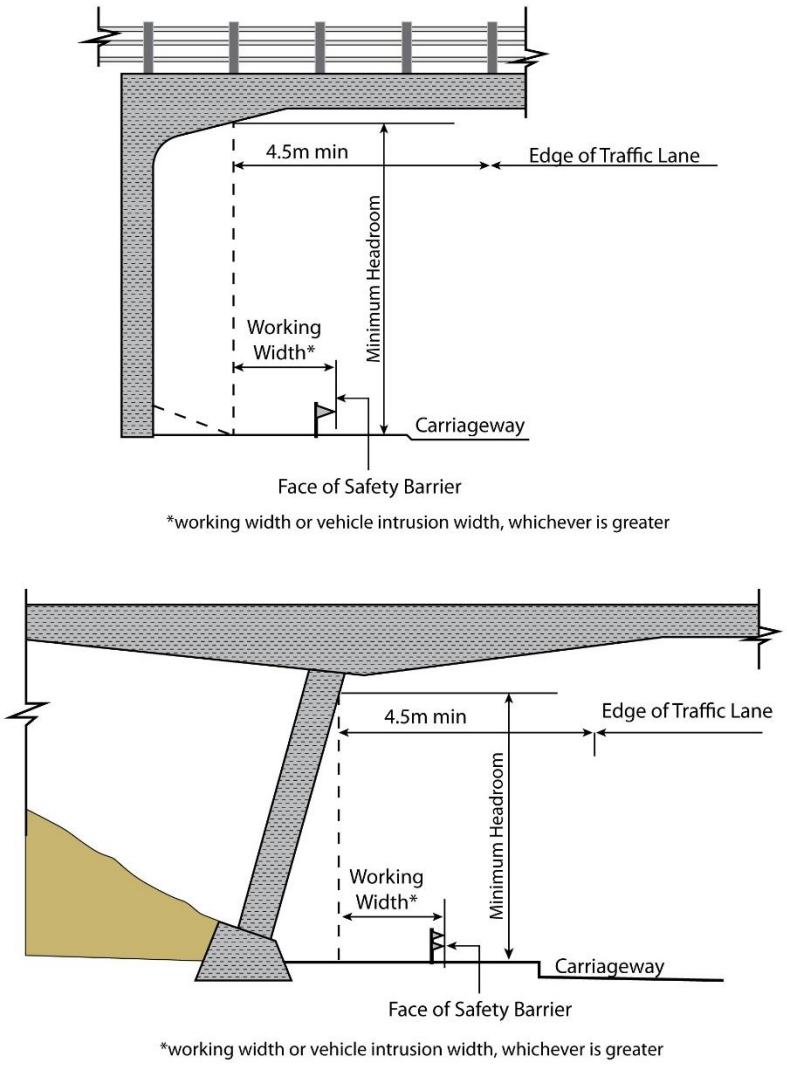


Figure 6.1 Headroom at Structures

6.3 Compensation for Vertical Sag Curvature and Deflection

Where the road passing underneath a structure is on a sag curve, the headroom values in Table 6.1 shall be increased in accordance with Table 6.2. For sag radii between the values listed in Table 6.2, the additional clearance shall be linearly interpolated. The sag radius is measured along the carriageway over a 25m chord.

Allowances shall be made for the deflection of structures. The minimum headroom shall be provided for the total deflection of the structure under the appropriate serviceability limit state design combinations in accordance with I.S. EN 1990 and the Irish National Annex.

Table 6.2 Sag Radius Compensation

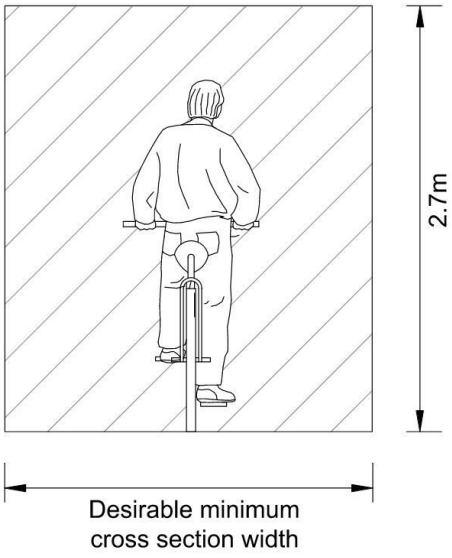
Sag Radius (m)	Additional Clearance (mm)
<650	160
650	130
900	100
1000	80
1200	70
1500	55
2000	45
3000	25
6000	15
>6000	Nil

6.4 Utility Companies' and Other Authorities' Apparatus

Greater headroom than that determined from this Standard may be required by a Utility Company or other authority. The Designer shall consider the impact of this requirement in the development of the designs.

6.5 Headroom at Structures for Cyclists and Pedestrians

It is important that clear headroom is available throughout the active travel facility. The desirable minimum headroom along active travel facilities shall be provided as an envelope across the full width of the cross-section, as illustrated in Figure 6.2. The Designer also needs to take into account headroom issues associated with gateway entrances, sign heights, overhanging trees, lighting and car/van/truck restriction devices and underpasses. A desirable minimum clearance / headroom shall be provided for cycleway facilities at structures – refer to Table 6.2. Further guidance is available in DN-STR-03005.



Note: Desirable minimum cross section width is given by Table 4.5 and varies depending on facility type and expected usage volumes.

Figure 6.2 Headroom at Structures for Cyclists

Table 6.3 Minimum Headroom for Subways and Enclosed Footbridges

	Minimum Headroom (m)
Pedestrian Only	2.3
Pedestrian and Cyclist	2.4
Equestrian (dismounting provisions in accordance with DN-STR-03005 Section 12.14)	2.7
Equestrian (Mounted)	3.7

7. References

7.1 TII Publications (Standards)

- DN-STR-03001 – Technical Approval of Structures on Motorways and Other National Roads.
- DN-STR-03005 – Design Criteria for Footbridges.
- DN-REQ-03034 – The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges.
- DN-REQ-03079 – The Design of Road Restraint Systems for Constrained Locations (On-line Improvements, Retrofitting and Urban Settings).
- DN-GEO-03030 – Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes
- DN-GEO-03031 – Road Link Design.
- DN-GEO-03060 – Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)
- DN-GEO-03040 – Subways for Pedestrians and Pedal Cyclists. Layout and Dimensions.
- DN-GEO-03046 – The Location and Layout of Lay-bys.
- DN-GEO-03047 – Rural Cycleway Design (Off-line).
- DN-GEO-03087 – Hard Shoulder Bus Priority Measures on Motorways and Type 1 Dual Carriageways
- PE-PMG-02041 – Project Management Guidelines
- PE-PMG-02042 – Project Manager’s Manual for Major National Projects.
- PE-PMG-02043 – Project Manager’s Manual for Minor National Projects.

7.2 Other References

- TII Publications (Standards) Specification for Works. Transport Infrastructure Ireland.
- TII Publications (Standards) Standard Construction Details. Transport Infrastructure Ireland.
- Transport in the Urban Environment, Part V. The Institution of Highways and Transportation.
- Traffic Signs Manual. Department of Transport, Tourism and Sport.
- National Cycle Manual. National Transport Authority.
- A Guidance Document for the Implementation of the CEDR Forgiving Roadsides Report, Transport Infrastructure Ireland.

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