Design Manual for Roads and Bridges

Road Layout
Design

CD 127
Cross-sections and headrooms

(formerly TD 27/05, TD 70/08)

Revision 1

Summary
This document provides requirements for the highway cross-sections and headroom at structures for motorway and all-purpose trunk roads.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
1	Mar 2020	Revision 1 (March 2020) Revision to update references only. Revision 0 (November 2019) CD 127 replaces TD 27/05 and TD 70/08. This full document has been re-written to make it compliant with the new Highways England drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes TD 27/05 Cross-sections and Headrooms and the wide single 2+1 road cross-section element from TD 70/08 Design of wide single 2+1 roads, which are withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This document sets out the design requirements and advice to be followed in selecting highway cross-sections and headrooms on motorways and all-purpose trunk roads.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 19.N] apply to this document.

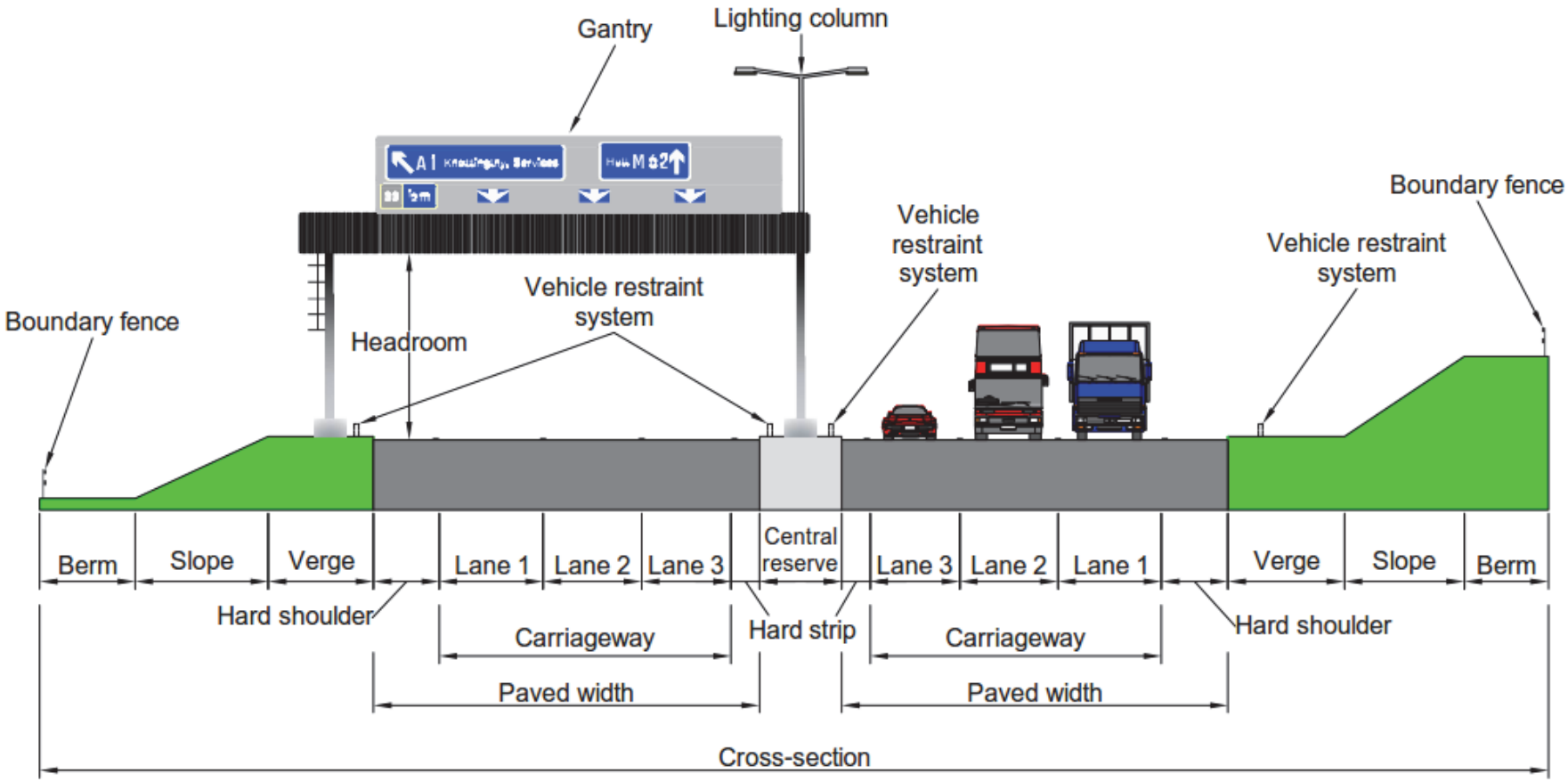
Cross-section components

Range of choice

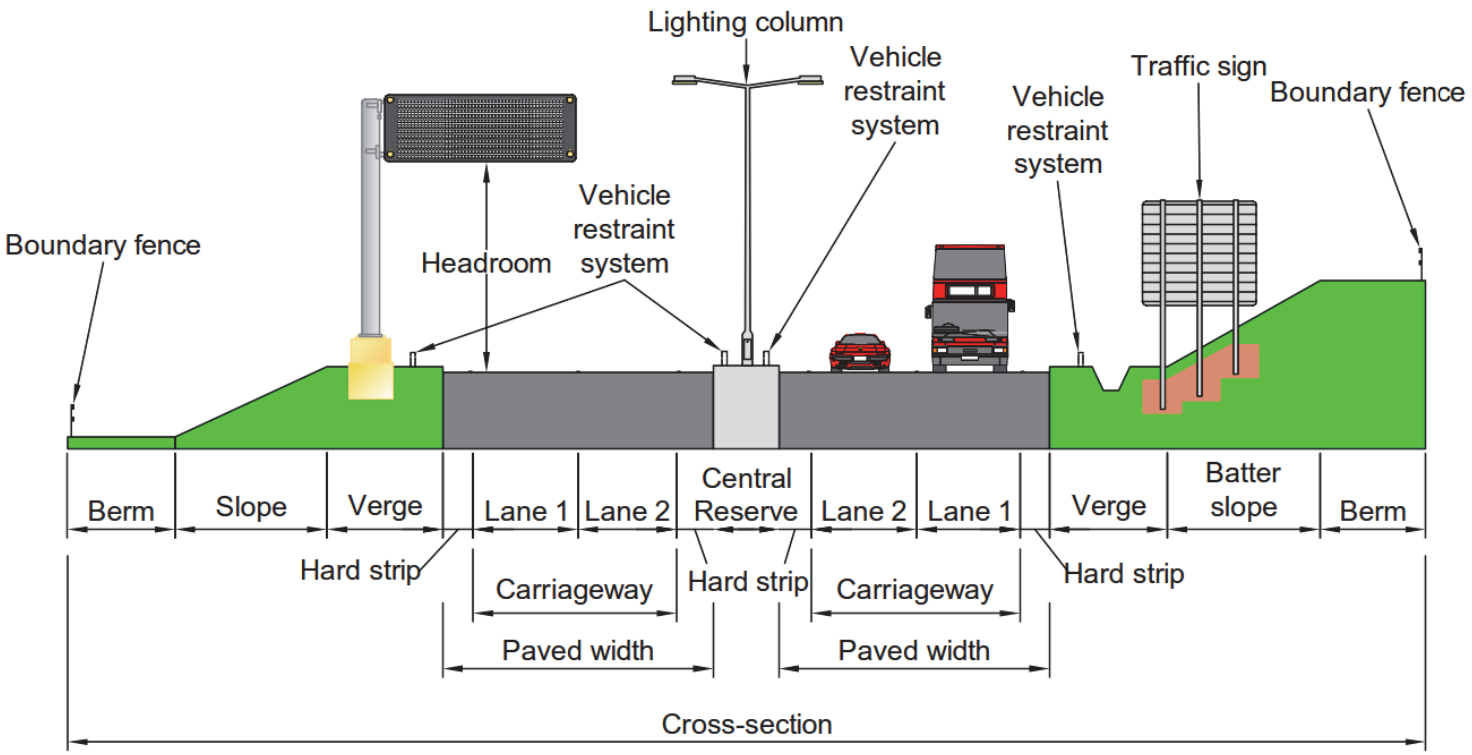
The cross-section is made up from a combination of distinct components that vary depending upon the type of highway and the facilities provided for the various users of the route. The components which make up a typical cross-section are shown in the diagrams below.

Where this document permits options for the dimensions of components, the decision making process needs to assess the impact on safety, environment, cost, buildability, operation, maintenance and other design constraints.

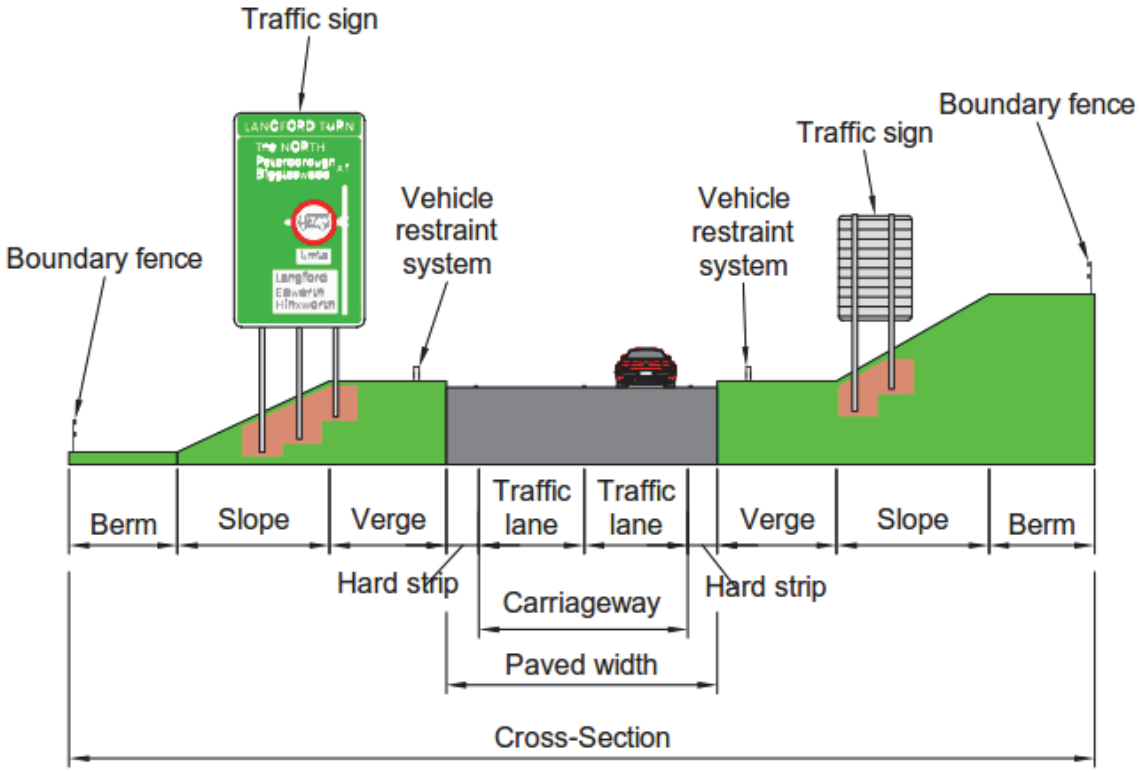
Typical rural motorway cross-section components



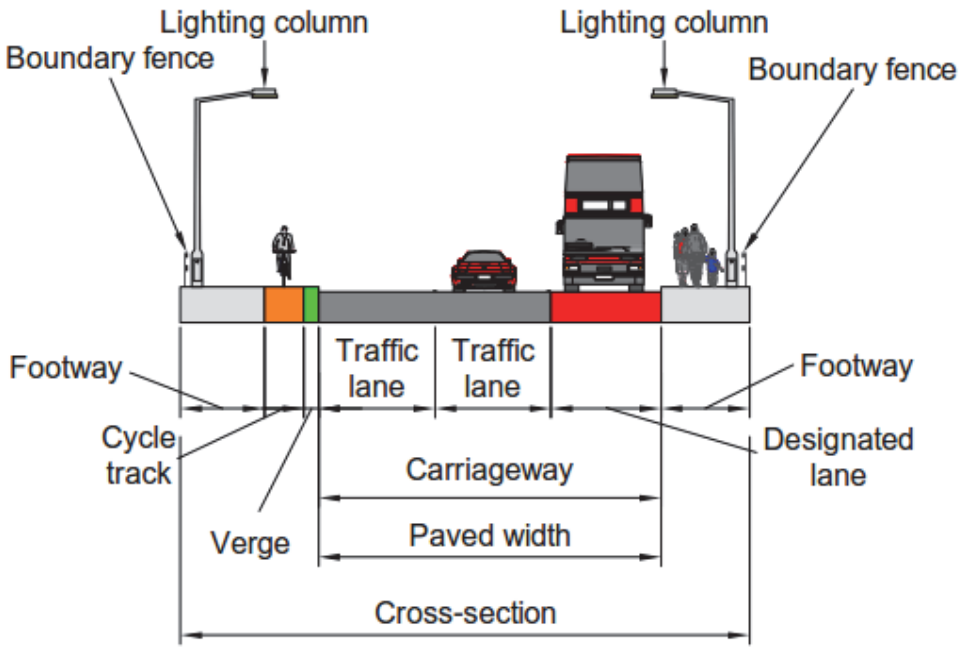
Typical rural dual carriageway cross-section components



Typical rural single carriageway cross-section components



Typical urban single carriageway cross-section components



Abbreviations and symbols

Abbreviations

Abbreviation	Definition
mm	Millimetres
mph	Miles per hour
SFZ	Structure free zone
TSRGD	Traffic Sign Regulations and General Directions
VRS	Vehicle restraint system

Symbols

Symbol	Definition
S	Added headroom clearance at sag curves

Terms and definitions

Terms and definitions

Term	Definition
Bridleway	Highway for use by pedestrians, horse-riders and cyclists (unless specifically prohibited). NOTE: Cyclists are expected to give way to other users.
Berm	Any nominally flat area between the back of the verge and the highway boundary on a cutting or embankment.
Carriageway	The area of the paved width which is trafficked by road users under normal operation. NOTE 1: This includes designated lanes such as bus lanes and cycle lanes. NOTE 2: The carriageway excludes hard shoulders and hard strips. NOTE 3: This definition of carriageway can differ from those used in the Highways Act 1980 [Ref 15.N] and the TSRGD 2016 2016 [Ref 28.N].
Central reserve	The area that separates the carriageways of a dual carriageway exclusive of any hard strips.
Connector road	A collective term for interchange links, link roads, slip roads and loops designed as part of a full grade separated junction.
Cross-section	The assembly of the various components of the highway between the highway boundaries, measured at right angles to the line of the highway. NOTE: Cross-section components include: 1) carriageways; 2) central reserve; 3) separator zones; 4) hard shoulders; 5) hard strips; 6) verges including any footway; 7) cycle track or bridleway; 8) cutting or embankment slopes; and 9) berms.
Cycle lane	A lane in the carriageway for use by cyclists.
Cycle track	A track separate from the main carriageway for use by cyclists.
Design organisation	The organisation undertaking the scheme preparation.
Designated lanes	A lane exclusively for use by designated vehicles such as bicycles, buses, taxis, large goods vehicles and high occupancy vehicles.

Terms and definitions (continued)

Term	Definition
Headroom	The minimum distance between the surface of the carriageway and a structure (accounting for any deflection due to temporary or permanent attachments) measured at right angles to the surface of the carriageway.
Mainline	The major carriageway. At a junction the mainline typically has a higher road classification and / or carries greater traffic volumes.
Maintained headroom	The minimum value of headroom to be preserved at all times.
Maintaining organisation	The organisation commissioned to undertake the maintenance of an asset.
New construction headroom	The value of headroom for new structures that includes an additional allowance for deflection of the structure and future road realignment and resurfacing.
Overbridge	A bridge that spans above the road being considered.
Paved width	A collective term for the surface of the cross-section that comprises the carriageway, hard shoulder and hard strips (including designated lanes and cycle lanes).
Paved width headroom	The value of headroom over the paved width.
Rural roads	An all-purpose road or motorway that is generally not subjected to a local speed limit.
Separator zone	An area that separates traffic flows on the mainline from an adjacent parallel road, e.g. link road.
Slip road	A connector road between a mainline carriageway and another road. NOTE: At the end of a slip road, traffic can encounter a priority junction, a roundabout or traffic signals.
Standard headroom	Either maintained headroom or new construction headroom, as appropriate.
Structure	Any object with the primary purpose of bearing loads. NOTE: This includes bridges, footbridges, retaining walls and sign or signal gantries, but excludes more frangible items such as deformable vehicle restraint systems.
Structure free zone	A buffer zone beneath a structure located at the central reserve and at the verges adjacent to the paved width, that reduces the risk of errant vehicle impacts by providing an appropriate value of headroom.
Subway	Underground passageway or tunnel for use by pedestrians, cyclists, and sometimes equestrians.
Underbridge	A bridge that carries the road being considered over another road, railway or watercourse.
Urban roads - motorway	A motorway with a speed limit of 60 mph or less within a built-up area.

Terms and definitions (continued)

Term	Definition
Urban roads - all purpose roads	An all-purpose road within a built-up area, either a single carriageway with a speed limit of 40mph or less or a dual-carriageway with a speed limit of 60mph or less.
Vehicle restraint system	A safety system installed at the edges of the carriageway to provide vehicle restraint.
Verge	Any nominally flat area between the edge of the paved width and either the start of an adjacent side slope or, in the absence of a side slope, the highway boundary or bridge parapet.
Wide highway corridor	Any all-purpose dual carriageway with more than 3 mainline lanes or motorway with more than 4 mainline lanes in any one direction.
Working width	The distance between the traffic side of the barrier before impact and the maximum dynamic lateral position of the system after impact.

1. Scope

Aspects covered

1.1 This document provides requirements and advice for the cross-sections and headrooms that shall be used for both new and improved motorways and all-purpose trunk roads including connector roads.

NOTE 1 *This document does not give mandatory requirements for headroom near airports or additional headroom requirements at power lines.*

NOTE 2 *International Civil Aviation Organisation document ICAO Vol 1 [Ref 17.N] provides requirements and advice for headrooms near airports.*

1.2 The distribution network operator shall be contacted to establish whether additional clearance is required beneath overhead power lines.

1.3 The cross-section and headrooms of roads that are not motorways or all-purpose trunk roads and are diverted or improved as part of a trunk road scheme shall be agreed with the highway authority for that road.

1.4 This document shall not be applied to the design of road tunnels or the crossovers at tunnels.

NOTE *For requirements and advice for the design of tunnels refer to CD 352 [Ref 4.N].*

1.5 This document shall not apply to the design of central reserve crossovers used during temporary traffic management situations.

NOTE *For requirements and advice for the design of central reserve crossovers refer to CD 192 [Ref 27.N].*

1.6 This document shall not be applied to the design of pedestrian, cycle and equestrian subways and underpasses.

NOTE 1 *For requirements and advice for the design of subways and underpasses refer to CD 143 [Ref 6.N] and CD 195 [Ref 5.N]. In Scotland, further details are also given in Roads for All [Ref 24.N].*

NOTE 2 *Requirements and advice for the design of footbridges is given in CD 353 [Ref 3.N].*

1.7 This document shall not be used for the design of designated lanes for specific vehicle types, e.g. bus lanes or cycle lanes.

NOTE 1 *For advice on the design of bus lanes refer to TSM Chapter 5 [Ref 29.N].*

NOTE 2 *For requirements and advice for the design of cycle lanes refer to CD 195 [Ref 5.N].*

Implementation

1.8 This document shall be implemented forthwith on all schemes involving the design of highway cross-sections and headrooms on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 19.N].

1.9 Proposals to adopt departures from this document shall be submitted in accordance with GG 101 [Ref 19.N].

Use of GG 101

1.10 The requirements of GG 101 [Ref 19.N] shall be followed in respect of activities covered by this document.

2. Highway cross-sections

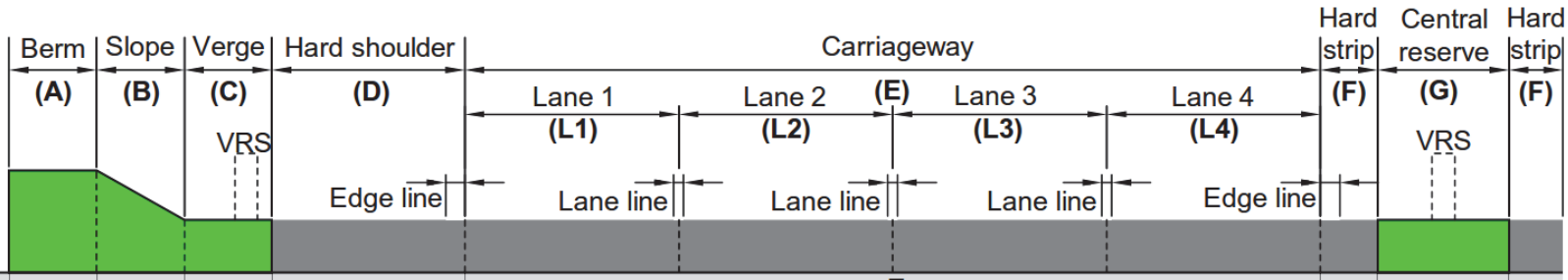
General

2.1 The requirements in this section shall apply to all cross-sections other than those through or across structures for which the requirements are given in Section 3 of this document.

2.1.1 Numerous changes in the cross-section and its components are not desirable along a route and a consistent width should be provided.

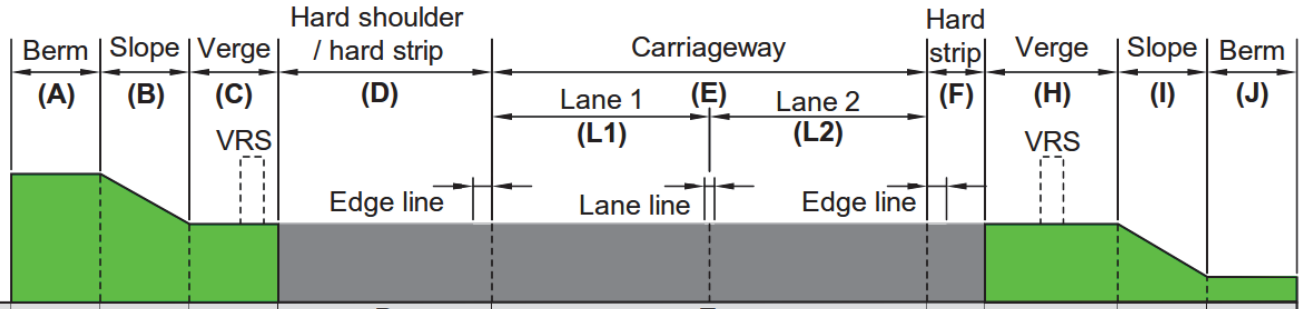
NOTE 1 Typical cross-sections are provided in Figures 2.1.1N1a to 2.1.1N1h.

Figure 2.1.1N1a Dimensions of cross-section components for rural motorway mainline



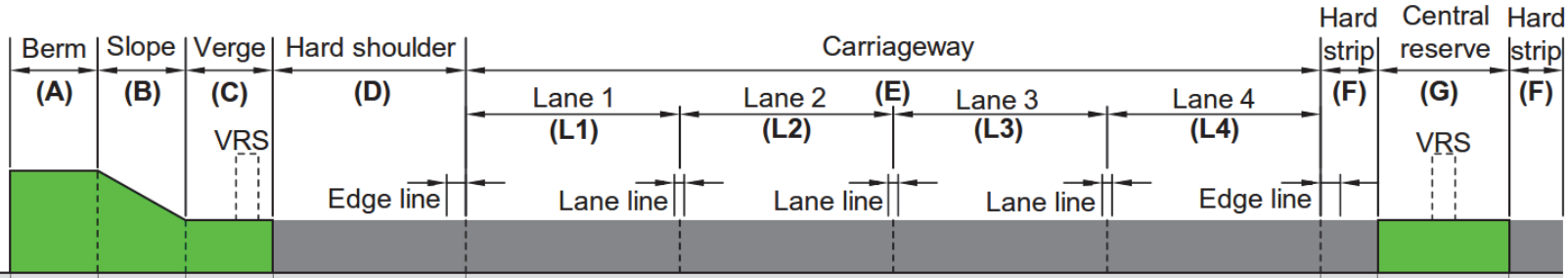
Road type	A	B	C	D	E				F	G	
					L1	L2	L3	L4			
Dual 2 lane (D2M)	Varies	Varies	1.50	3.30	**7.30**		N/A		0.70	3.10	
					3.65	3.65					
Dual 3 lane (D3M)	Varies	Varies	1.50	3.30	**11.00**			N/A	0.70	3.10	
					3.65	3.70	3.65				
Dual 4 lane (D4M)	Varies	Varies	1.50	3.30	**14.70**				0.70	3.10	
					3.65	3.70	3.70	3.65			

Figure 2.1.1N1b Dimensions of cross-section components for rural motorway connector roads



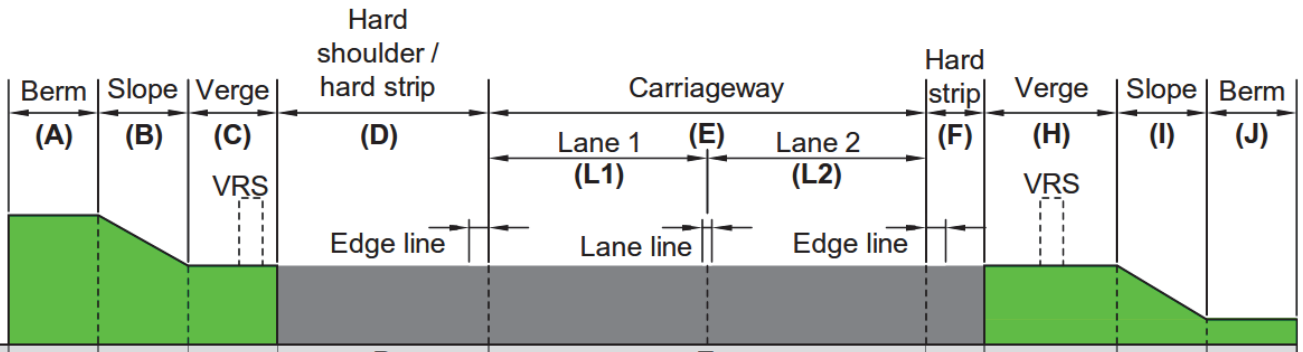
Connector road type	A	B	C	D		E		F	H	I	J
				hard strip	hard shoulder	L1	L2				
Slip roads											
MG1A/DG1A	Varies	Varies	1.50	N/A	3.30	3.70	N/A	0.70	2.30	Varies	Varies
DG2A	Varies	Varies	2.50	1.00	N/A	**7.30**		1.00	2.00	Varies	Varies
						3.65	3.65				
MG2C/DG2C	Varies	Varies	1.50	N/A	3.30	**7.30**		1.00	2.00	Varies	Varies
						3.65	3.65				
Interchange links											
IL1B	Varies	Varies	1.50	N/A	3.30	3.70	N/A	0.70	2.30	Varies	Varies
IL2B	Varies	Varies	1.50	N/A	3.30	**7.30**		1.00	2.00	Varies	Varies
						3.65	3.65				

Figure 2.1.1N1c Dimensions of cross-section components for urban motorway mainline



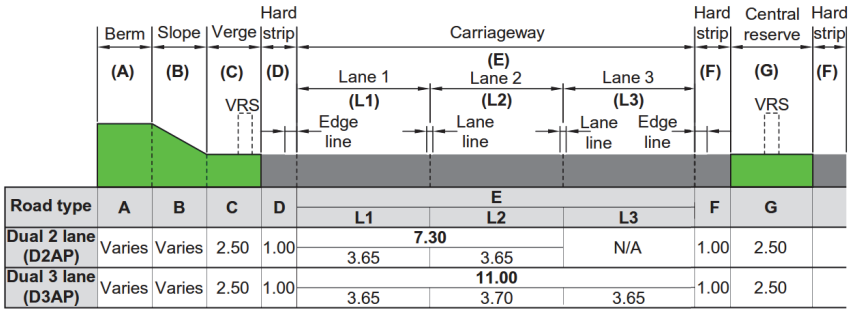
Road type	A	B	C	D	E				F	G	
					L1	L2	L3	L4			
Dual 2 lane (D2UM)	Varies	Varies	Varies	2.75	**7.30**		N/A		0.70	1.60	
					3.65	3.65					
Dual 3 lane (D3UM)	Varies	Varies	Varies	2.75	**11.00**			N/A	0.70	2.10	
					3.65	3.70	3.65				
Dual 4 lane (D4UM)	Varies	Varies	Varies	2.75	**14.70**				0.70	2.10	
					3.65	3.70	3.70	3.65			

Figure 2.1.1N1d Dimensions of cross-section components for urban motorway connector roads



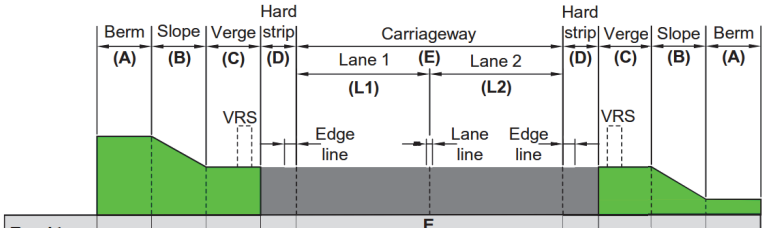
Connector road type	A	B	C	D		E		F	H	I	J
				hard strip	hard shoulder	L1	L2				
Slip roads											
MG1B/DG1B	Varies	Varies	Varies	N/A	3.30	3.70	N/A	0.30	Varies	Varies	Varies
DG2B	Varies	Varies	Varies	1.00	N/A	**7.30** 3.65	3.65	0.30	Varies	Varies	Varies
MG2D/DG2D	Varies	Varies	Varies	N/A	2.75	**7.30** 3.65	3.65	0.30	Varies	Varies	Varies
Interchange links											
IL1B	Varies	Varies	Varies	N/A	3.30	3.70	N/A	0.30	Varies	Varies	Varies
IL2B	Varies	Varies	Varies	N/A	2.75	**7.30** 3.65	3.65	0.30	Varies	Varies	Varies

Figure 2.1.1N1e Dimensions of cross-section components for rural all-purpose roads mainline



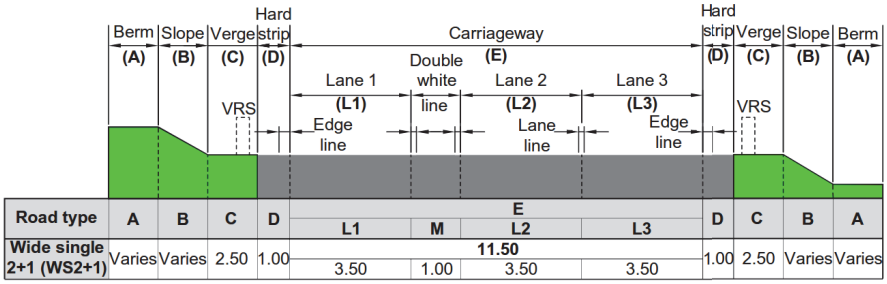
Road type	A	B	C	D	E			F	G
					L1	L2	L3		
Dual 2 lane (D2AP)	Varies	Varies	2.50	1.00	7.30		N/A	1.00	2.50
					3.65	3.65			
Dual 3 lane (D3AP)	Varies	Varies	2.50	1.00	11.00			1.00	2.50
					3.65	3.70	3.65		

Dual carriageway



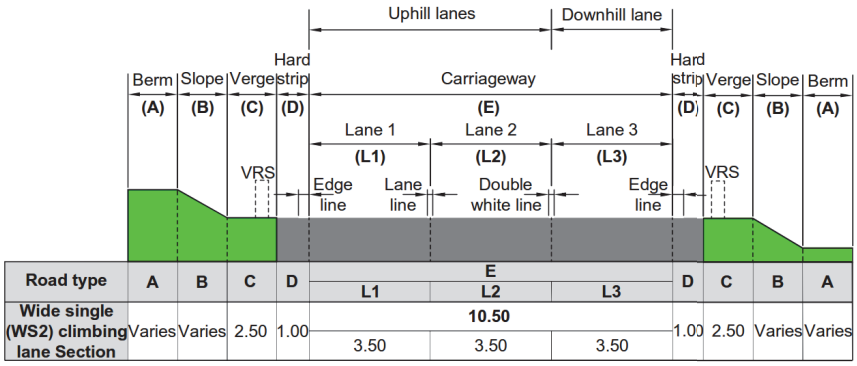
Road type	A	B	C	D	E		D	C	B	A
					L1	L2				
Single (S2)	Varies	Varies	2.50	1.00	7.30		1.00	2.50	Varies	Varies
					3.65	3.65				
Wide single (WS2)	Varies	Varies	2.50	1.00	10.00		1.00	2.50	Varies	Varies
					5.00	5.00				

Single carriageway



Road type	A	B	C	D	E				D	C	B	A
					L1	M	L2	L3				
Wide single 2+1 (WS2+1)	Varies	Varies	2.50	1.00	11.50				1.00	2.50	Varies	Varies
					3.50	1.00	3.50	3.50				

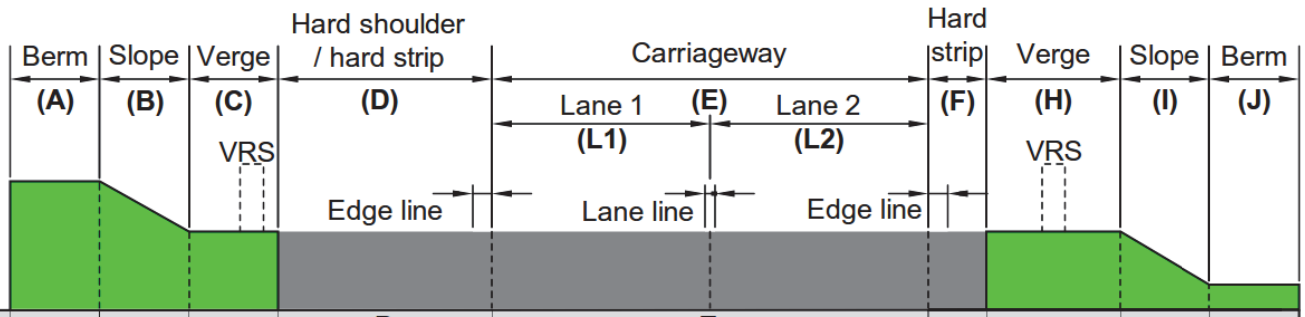
Wide single 2+1 carriageway



Road type	A	B	C	D	E			D	C	B	A
					L1	L2	L3				
Wide single (WS2) climbing lane Section	Varies	Varies	2.50	1.00	10.50			1.00	2.50	Varies	Varies
					3.50	3.50	3.50				

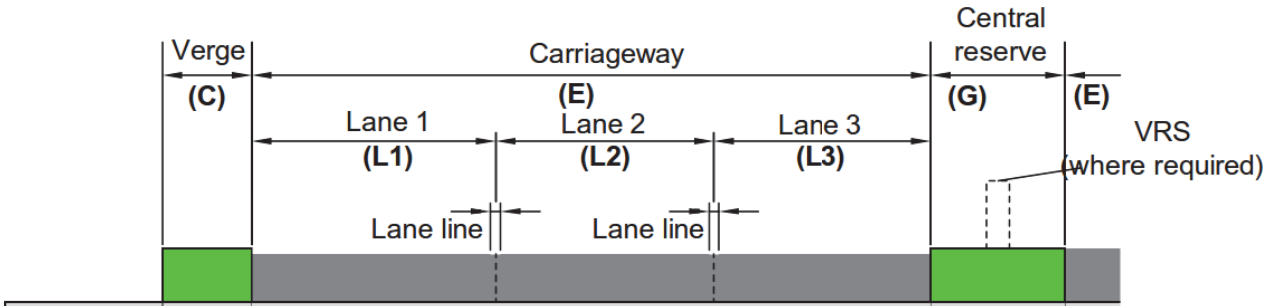
Wide single (WS2) climbing lane section

Figure 2.1.1N1f Dimensions of cross-section components for rural all-purpose connector roads



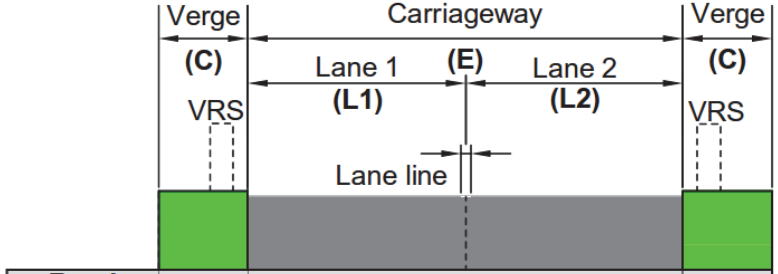
Connector road type	A	B	C	D		E		F	H	I	J
				hard strip	hard shoulder	L1	L2				
Slip roads											
MG1C/ DG1C	Varies	Varies	2.00	N/A	3.30	3.70	N/A	0.70	2.80	Varies	Varies
MG2E/ DG2E	Varies	Varies	2.50	1.00	N/A	**7.30** 3.65	3.65	1.00	2.50	Varies	Varies
Interchange links											
IL1C	Varies	Varies	2.00	N/A	3.30	3.70	N/A	0.70	2.80	Varies	Varies
IL2C	Varies	Varies	2.50	1.00	N/A	**7.30** 3.65	3.65	1.00	2.50	Varies	Varies

Figure 2.1.1N1g Dimensions of cross-section components for urban all-purpose roads mainline



Road type	C	E			G
		L1	L2	L3	
Dual 2 lane (D2UAP)	Varies	7.30		N/A	1.80
		3.65	3.65		
Dual 3 lane (D3UAP)	Varies	11.00			1.80
		3.65	3.70	3.65	

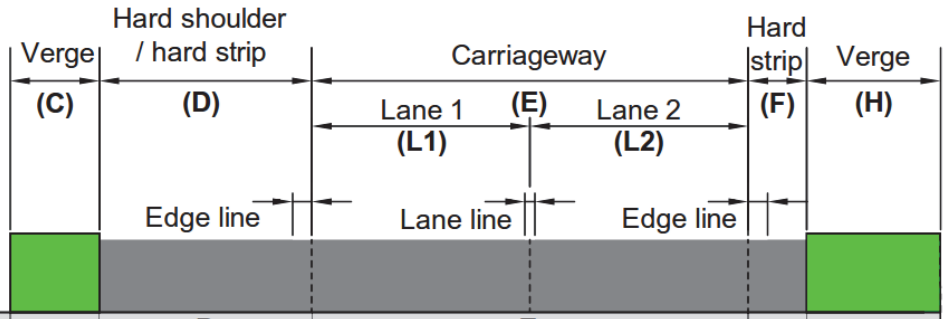
Dual carriageway



Road type	C	E		C
		L1	L2	
Single (SU2)	Varies	7.30		Varies
		3.65	3.65	

Single carriageway

Figure 2.1.1N1h Dimensions of cross-section components for urban all-purpose connector roads



Connector road type	C	D		E		F	H
		hard strip	hard shoulder	L1	L2		
Slip roads							
MG1D/ DG1D	Varies	N/A	3.30	3.70	N/A	0.30	Varies
MG2F/ DG2F	Varies	1.00	N/A	**7.30** 3.65	3.65	0.30	Varies
Interchange links							
IL1D	Varies	N/A	3.30	3.70	N/A	0.30	Varies
IL2D	Varies	1.00	N/A	**7.30** 3.65	3.65	0.30	Varies

NOTE 2 All dimensions in Figures 2.1.1N1a to 2.1.1N1h are in metres.

NOTE 3 Offside lane widths are measured to the trafficked side of the offside edge line (rural) or face of offside kerb (urban).

NOTE 4 Details provided for dual carriageways are applicable for both sides of the road.

NOTE 5 The TSM Chapter 5 [Ref 29.N] provides guidance on the widths of road markings.

Traffic lane width

2.2 Traffic lane widths for horizontal curvature greater than 400 metres radii shall be in accordance with Figures 2.1.1N1a to 2.1.1N1h.

NOTE 1 Traffic lane widths for carriageways with horizontal curve radii of greater than 90 metres but below 400 metres are given in CD 109 [Ref 14.N].

NOTE 2 Traffic lane widths at junctions where the horizontal curve radii are 90 metres or less are given in CD 123 [Ref 11.N].

2.3 Traffic lane widths shall be measured between the trafficked side of carriageway edge lines and the centre of lane lines.

Hard strips

2.4 Nearside hard strips shall be provided as shown in Figures 2.1.1N1a to 2.1.1N1h.

2.5 The minimum width of offside hard strips (dimension F) shall be as shown in Figures 2.1.1N1a to 2.1.1N1h.

2.6 The maximum width of offside hard strips (dimension F) shall be 1.00 metre.

NOTE 1 Offside hard strip widths up to 1.00 metre can be appropriate where the road falls to the offside and additional drainage surface area is required.

NOTE 2 A hard strip provides a surfaced strip that abuts the carriageway. The key reasons for the provision of hard strips include:

1) pavement integrity/stability;
2) partial provision for stopped vehicles;
3) snow and water collection;
4) overrun facility for driver error or evasive action;
5) improved level of service and driver comfort;
6) supports edge lines;
7) reduces the risk of vegetation encroachment over edge lines; and
8) allows for the placement of road studs outside vehicle wheel paths, where appropriate.

Hard shoulders

2.7 Nearside hard shoulders shall be provided as shown in Figures 2.1.1N1a to 2.1.1N1h.

NOTE The hard shoulder is provided adjacent to the nearside of the carriageway 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.

2.8 Offside hard shoulders shall not be permitted.

Central reserves

2.9 Minimum central reserve widths shall be as shown in Figures 2.1.1N1a to Figure 2.1.1N1h except where the offside hard strip has been widened for drainage.

NOTE *Where the offside hard strip has been widened for drainage, the central reserve can be reduced by up to the same value as the increase in the offside hard strip.*

2.9.1 The central reserve may be widened in order to:

1) provide the requisite stopping sight distances in accordance with CD 109 [Ref 14.N];
2) accommodate any street furniture, utility, drainage features or equipment;
3) meet the requirements for vehicle restraint systems (VRS);
4) accommodate any permanent signs required with particular attention to the provision of the required working width and set-back for VRSs relative to the complete sign assembly;
5) accommodate significant difference in levels of adjacent carriageways;
6) accommodate temporary traffic management layouts for the envisaged maintenance regime;
7) accommodate matrix signs and signals;
8) accommodate any parts of structures or complete structures;
9) provide sufficient space for maintenance operations;
10) fulfil landscape and environmental objectives; and
11) accommodate walking, cycling and horse-riding routes.

NOTE *Requirements and advice for the widening of central reserves at priority junctions are given in CD 123 [Ref 11.N].*

2.9.2 The central reserve should be hardened or have low growth species of grass to minimise the need for maintenance.

2.9.3 When deciding whether to harden central reserves, the design should:

1) check the adequacy of the surface water drainage system to accommodate any additional surface water run-off;
2) 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 potential habitat;
3) determine the area to be hardened, based on what areas of vegetation can be left uncut without affecting visibility or sign conspicuity; and
4) take account of whole-life costs and safety considerations.

2.9.4 Away from crossovers, any hardening of the central reserve should be designed to be capable of withstanding vehicle over-run and prevent vegetation growth.

NOTE *For further requirements and advice on landscape design see LA 101 [Ref 18.N], LA 102 [Ref 26.N], LA 103 [Ref 25.N], LA 104 [Ref 8.N], LA 107 [Ref 20.N] and LD 117 [Ref 21.N].*

2.9.5 Where the hardened area could be misused by road users, contrasting coloured surfacing may be used in the central reserve, although this is only likely to be necessary where the VRS set-back is 1.50 metres or greater.

NOTE 1 *In some situations it can be appropriate to continue the coloured surface across the whole central reserve.*

NOTE 2 *In other situations, for reasons of cost or aesthetics, the width of the coloured surfacing can be limited to the traffic side of the VRS.*

Verges

2.10 Minimum verge widths shall be as shown in Figures 2.1.1.N1a to 2.1.1.N1h, except where:

1) there is a need for increased width to accommodate communication ducts and chambers;
2) the offside hard strip is being widened for drainage; or

3) the nearside verge on a single lane rural all-purpose connector road is located immediately adjacent to the highway boundary.

2.11 Where the offside hard strip has been widened for drainage, the reduction of the offside verge shall be no more than the increase in the offside hard strip.

2.11.1 Thin strips of grass or other vegetation within the highway cross-section should be avoided as they can result in safety issues related to maintenance.

NOTE 1 The verge offers an important component in highway drainage systems, including the storage of snow displaced from the carriageway. It offers an area to support utility plant and to house highway equipment. Congested verges with insufficient room for necessary roadside components present both safety and engineering difficulties.

NOTE 2 Documents CD 143 [Ref 6.N] and CD 195 [Ref 5.N] provide requirements and advice on the appropriate widths of facilities for walking, cycling and horse-riding and the horizontal separation (verge) from the carriageway.

2.12 Where the nearside verge on a single lane rural all-purpose connector road is located immediately adjacent to the highway boundary, the verge shall be increased by a minimum of 0.50 metres over the values given in Figure 2.1.1.N1f.

2.13 Where Figures 2.1.1.N1a to 2.1.1.N1h indicate the verge width "varies" and it is necessary to accommodate communications ducting and chambers, a minimum verge width of 2.00 metres shall be provided.

2.13.1 Where Figures 2.1.1.N1a to 2.1.1.N1h indicate verge width "varies" or where the verge width needs to be increased over the minimum value, the verge should be designed where applicable to:

1) accommodate the requisite stopping sight distances in accordance with CD 109 [Ref 14.N];
2) accommodate any street furniture, utility, drainage features or equipment;
3) meet the requirements for VRS (CD 377 [Ref 23.N]);
4) accommodate any permanent signs required with particular attention to the provision of the required working width and set-back for VRSs relative to the complete sign assembly;
5) accommodate significant level differences;
6) accommodate temporary traffic management layouts for the envisaged maintenance regime;
7) accommodate matrix signs and signals;
8) accommodate any parts of structures or complete structures;
9) provide sufficient space for maintenance operations;
10) fulfil landscape and environmental objectives including environmental fencing;
11) accommodate walking, cycling and horse-riding routes; and/or
12) provide for access to emergency telephones or provide a safe location for stranded motorists.

Wide carriageways

Mainline lane provision

2.14 All-purpose dual carriageways shall not have more than three mainline lanes in one direction.

2.15 Motorways shall not have more than four mainline lanes in one direction.

NOTE Auxiliary lanes are not included when determining the number of mainline lanes on all-purpose dual carriageways and motorways.

Auxiliary lane provision

2.16 Where auxiliary lanes are provided, the width of the auxiliary lane(s) shall be equal to the width of the adjacent nearside mainline lane.

2.17 The provision of either a hard shoulder or a hard strip adjacent to an auxiliary lane shall be consistent with the provision on the mainline.

Connector road lane provision

2.18 Where a junction capacity assessment has identified additional connector road lanes are required at the junction at the end of the slip road, the lane width requirements for additional lanes shall be:

1) where the additional lane(s) is 100 metres or less in length, the lane width is derived from the junction document (CD 122 [Ref 12.N] or CD 123 [Ref 11.N]) for the type of junction at the end of the slip road, see Figure 2.18a;
2) where the additional lane(s) is greater than 100 metres in length, the lane width is 3.65 metres wide plus any allowance for widening at tight radii, see Figures 2.18b and 2.19 (see section on "Traffic lane width").

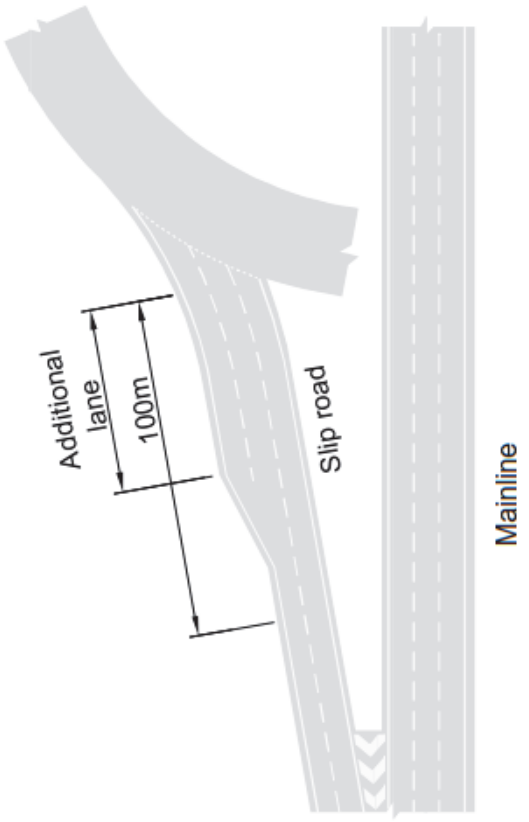


Figure 2.18a Partial additional lane(s) slip road provision - additional lane 100m or less in length

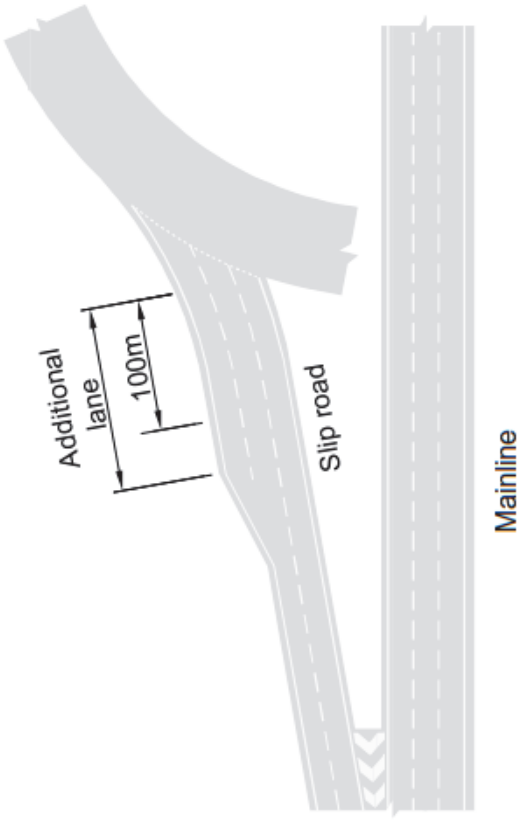


Figure 2.18b Partial additional lanes(s) slip road provision - additional lane greater than 100m in length

2.19 Where the additional lane(s) extend upstream beyond a point level with the back of diverge nose the additional lane(s) provided shall extend at least as far upstream as the tip of the diverge nose (see Figure 2.19).

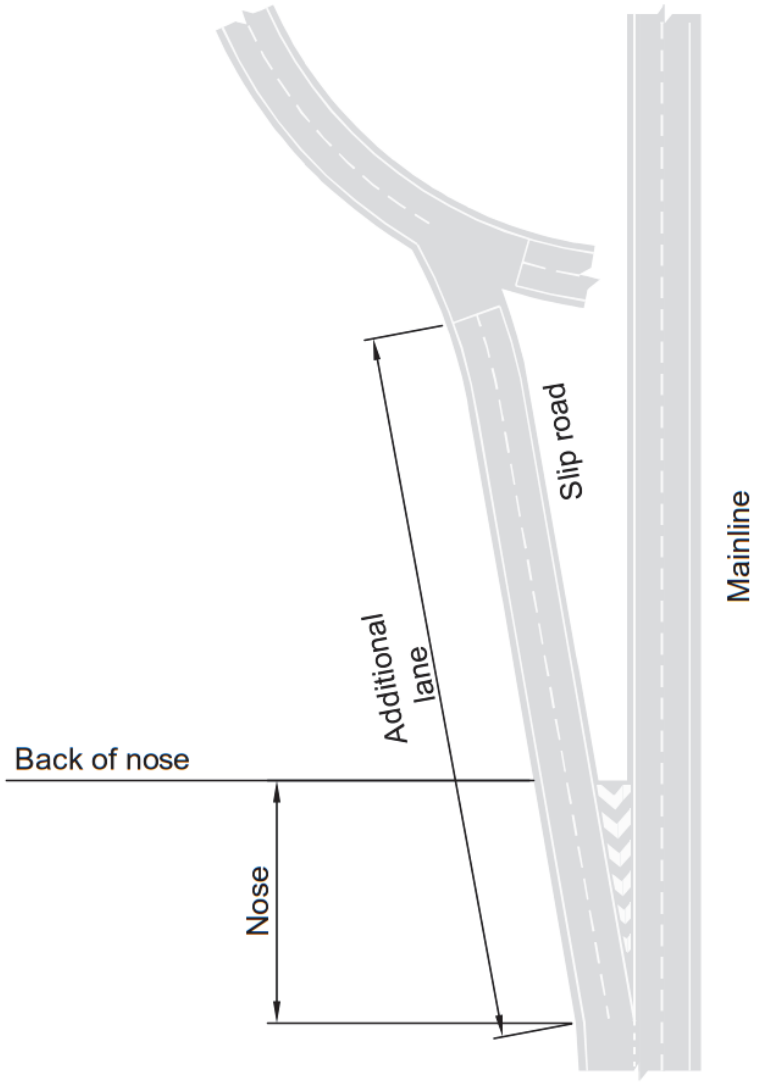


Figure 2.19 Partial additional lane(s) slip road provision - additional lane extends upstream beyond a point level with the back of diverge nose

2.20 Hard shoulder and hard strip widths adjacent to the additional connector road lanes shall be consistent with the upstream connector road provision.

NOTE 1 For further requirements and advice on determining the required number of lanes, hard shoulder and hard strip provision on connector roads, see CD 122 [Ref 12.N].

NOTE 2 Compliant widths of single lane connector roads allow routine maintenance activities to be undertaken. Full resurfacing within such widths is unlikely to be possible without closing the connector road.

NOTE 3 Compliant widths of two lane connector roads allow all maintenance activities to be undertaken, including full resurfacing, without having to close the connector road.

2.21 For connector roads that carry two-way traffic for some of their length, the minimum width of central reserve shall be as shown in Figure 2.1.1N1a, Figure 2.1.1N1c, Figure 2.1.1N1e and Figure 2.1.1N1g.

Separator zones

2.22 Headlight glare from any lane of a parallel road that runs counter to the mainline traffic flow shall not affect main line traffic.

NOTE Headlight glare can be managed through the use of a separator zone.

2.22.1 Where a separator zone is used to manage headlight glare from a parallel road, it should be wide enough to accommodate the following features (where applicable):

1) the requisite stopping sight distances in accordance with CD 109 [Ref 14.N];
2) any street furniture, utility or drainage features and equipment;
3) the working width and set-back requirements for VRS;
4) any permanent signs required with particular attention to the provision of the required working width and set-back for VRSs relative to the complete sign assembly;
5) any difference in levels of adjacent carriageways;
6) temporary traffic management layouts for the envisaged maintenance regime;
7) matrix signs and signals;
8) any parts of structures or complete structures;
9) space for maintenance operations;
10) landscaping and environmental provision;
11) walking, cycling and horse-riding routes; and
12) the occupants of broken down vehicles.

2.22.2 Methods to eliminate headlight glare may include:

1) designing the alignments of the roads to provide level differences;
2) screening fences or earthbunds;
3) soft planting that provides foliage all year round at the correct heights; and
4) a VRS system that is designed to cut off glare where a VRS system is to be installed.

Raised rib edge lines

2.23 Nearside and offside edge line road markings on motorway mainline and connector roads shall have raised ribs in accordance with diagram 1012.2 (schedule 11, part 4, item 12) of the TSRGD 2016 2016 [Ref 28.N].

NOTE Raised rib road markings can be used on all-purpose trunk roads in accordance with diagram 1012.3 (schedule 11, Part 4, item 13) of the TSRGD 2016 2016 [Ref 28.N].

VRS set-back

2.24 The minimum dimensions for VRS set-back shall be as shown in Table 2.24 and are illustrated in Figures 2.25a to 2.25d.

Table 2.24 Set-back

Location	Desirable minimum set-back value (mm)	Available relaxations described in notes
In verges with no adjacent hard strip or hard shoulder	1200	Notes 1) and 2)
In verges with an adjacent hard strip or hard shoulder	600	Note (3)
Central reserves	1200	Notes 1) and 2)

Notes:
Relaxations to set-back are permitted as follows:

1) Relaxation to 600mm for roads of speed limit 50mph or less (including temporary mandatory speed limits).
2) Relaxation to 1000mm at existing roads with physical constraints (e.g. a structure) where it could be difficult to provide the desirable value.
3) Relaxation to 450mm where it is considered necessary to position the VRS away from the edge of an existing embankment in order to provide support to the foundation.

2.25 The set-back shall be the lateral distance between the traffic face of a safety barrier and:

1) nearside: the back of the nearside hard strip or hard shoulder;
2) nearside: the kerb face for roads without a nearside hard strip or hard shoulder;
3) offside: the trafficked edge of the edge line;
4) offside: the kerb face where there is no edge line.

Figure 2.25a Nearside - no hard shoulder or hard strip

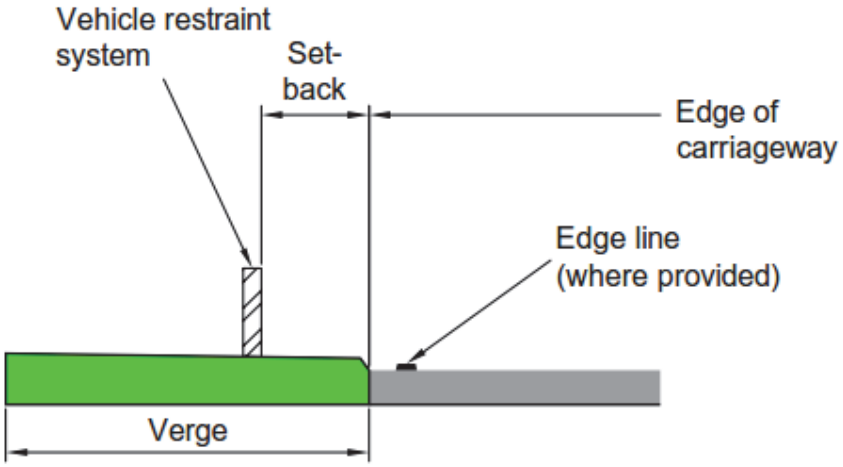


Figure 2.25b Nearside - with hard shoulder or hard strip

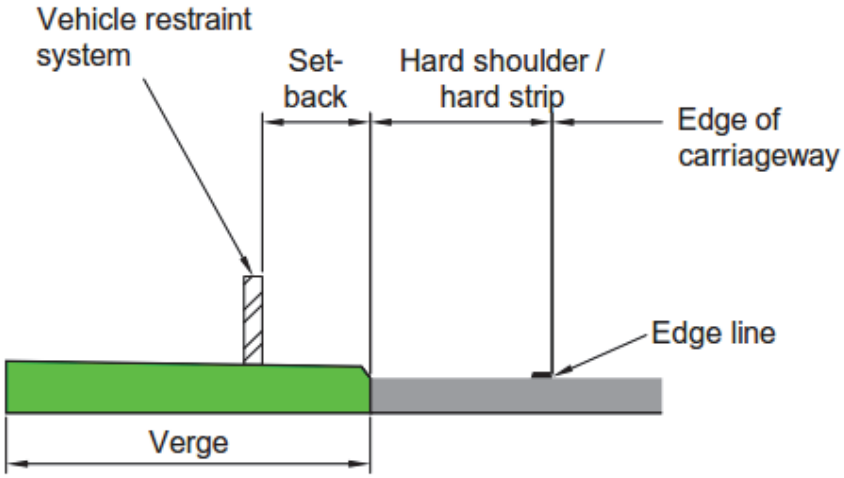


Figure 2.25c Offside - with hard strip

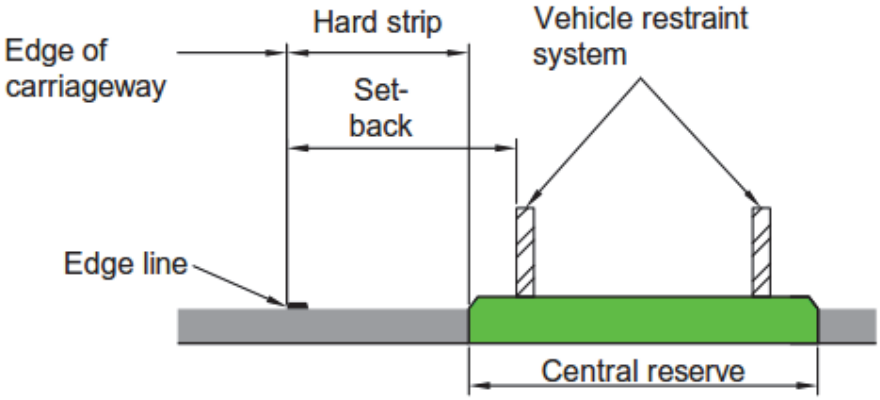
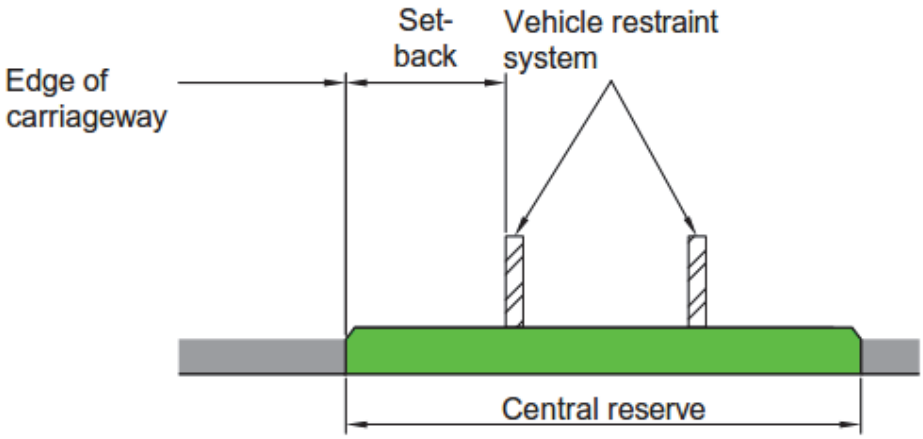


Figure 2.25d Offside - no hard strip



NOTE 1 For further VRS design requirements see CD 377 [Ref 23.N].

NOTE 2 The following factors can influence the decision to use a relaxation in Table 2.24:

1) in central reserves: the effects on vehicle positioning within traffic lanes, particularly where

non-standard lane widths are proposed;

2) *in verges with a hard strip or hard shoulder: the effects on the ability of occupants of parked vehicles to leave via the nearside doors and the possibility of increased risk due to parking closer to live traffic;*

3) *in verges without a hard strip or hard shoulder: the effects on vehicle positioning within traffic lanes, particularly where non-standard lane widths are proposed; and*

4) *in all cases: the effects on future temporary traffic management systems, e.g. a reduced set-back, can limit the width available for temporary traffic management.*

NOTE 3 Physical objects such as VRS immediately adjacent to the edge of the carriageway can result in drivers reducing speed and positioning their vehicles away from the obstruction. The purpose of the set-back is to provide a lateral distance between the VRS and the carriageway which reduces the effect of the safety barrier on driver behaviour.

2.25.1 Set-back greater than the minimum values should be provided in the following circumstances:

1) at verges for roads where continuous or near continuous VRS is proposed to prevent a driver from mounting the verge in an emergency;

2) where use of the minimum set-back in central reserves can result in the paved width being closer than 600mm to the VRS; and

3) to achieve a smooth alignment with a parapet.

2.26 On central reserves where there are no obstructions and there is only one double sided deformable safety barrier between carriageways, the minimum set-back on both sides of the safety barrier shall be as stipulated in Table 2.24 but also no less than the working width of the safety barrier minus the actual width of the safety barrier.

Kerbs (away from bridge decks)

2.27 Kerbs shall be specified in accordance with BS EN 1340 [Ref 2.N]: Concrete Kerb Units - Requirements and Test Methods and the minimum requirements of Series 1100.

NOTE 1 Kerbs are used to:

1) provide physical or visual delineation and minor restraint, particularly between surfaces intended for different users such as footways and carriageways; and/or

2) create drainage channels.

NOTE 2 Further requirements and advice relating to the use of kerbs as a drainage feature are given in CD 524 [Ref 7.N].

2.27.1 In urban areas where footways are present adjacent to the carriageway, bullnose or half battered kerbs with an upstand of at least 100mm should be provided.

2.27.2 In rural areas where a footway is less than 1.30 metres from the carriageway edge, half battered kerbs with an upstand of 100mm should be provided.

NOTE Half battered or bullnose kerbs with an upstand of 100mm or more can act as a form of minor restraint to light traffic, thereby reducing the risk of vehicles overrunning the edge of the carriageway. This is particularly important at junctions where vehicles are undertaking sharper turns.

2.27.3 In rural areas where a footway is more than 1.30 metres from the carriageway edge, full battered kerbs with an upstand of 75mm should be provided.

NOTE Full battered kerbs with an upstand of 75mm are used in rural areas where it is considered safer for an errant vehicle travelling at high speed to be able to mount the kerb with a reduced risk of overturning e.g. at features such as traffic islands and roundabouts.

2.27.4 Where there are no adjacent footways, kerbs should not be provided except where they are necessary for drainage purposes or to act as a minor restraint, e.g. at traffic islands and in structures or tunnels.

NOTE *At rural junctions with corner radii of 10 metres or less and where there is no adjacent footway, upstand kerbs can be provided to reduce the risk of vehicles overrunning the verge.*

2.27.5 Where it is necessary to lower kerbs they should be laid flush with the carriageway or with a maximum upstand of 6mm using bullnose kerbs for the purpose of retaining water where the carriageway falls towards the kerb.

NOTE 1 *It can be necessary to lower kerbs at private accesses, pedestrian crossings and the start / end of cycle tracks.*

NOTE 2 *For requirements and advice for kerbs at bridge decks see Section 3 of this document.*

Rate of change of cross-section width

2.28 The minimum transition tapers for the rate of change in the cross-section width of mainline lanes, connector road lanes and hard shoulder width shall be in accordance with Table 2.28.

Table 2.28 Mainline and connector road rate of change in lane width

Design speed (km/h)	Minimum transition taper
50	1:25
60	1:30
70	1:35
85	1:45
100	1:50
120	1:55

NOTE *The values in Table 2.28 are not applicable to the widening of central reserves, for example around bridge piers. In such cases, a smooth alignment of the carriageway edge lines is to be maintained.*

2.29 Where a transition taper is used to change cross-section between two adjoining links with differing design speeds, the higher design speed of the two links shall be used.

NOTE *For requirements and advice on the layout of grade separated junction merges and diverges see CD 122 [Ref 12.N].*

2.30 Transitions between hard shoulders and hard strips shall be undertaken over the length of the nose, as shown in Figures 2.30a and 2.30b.

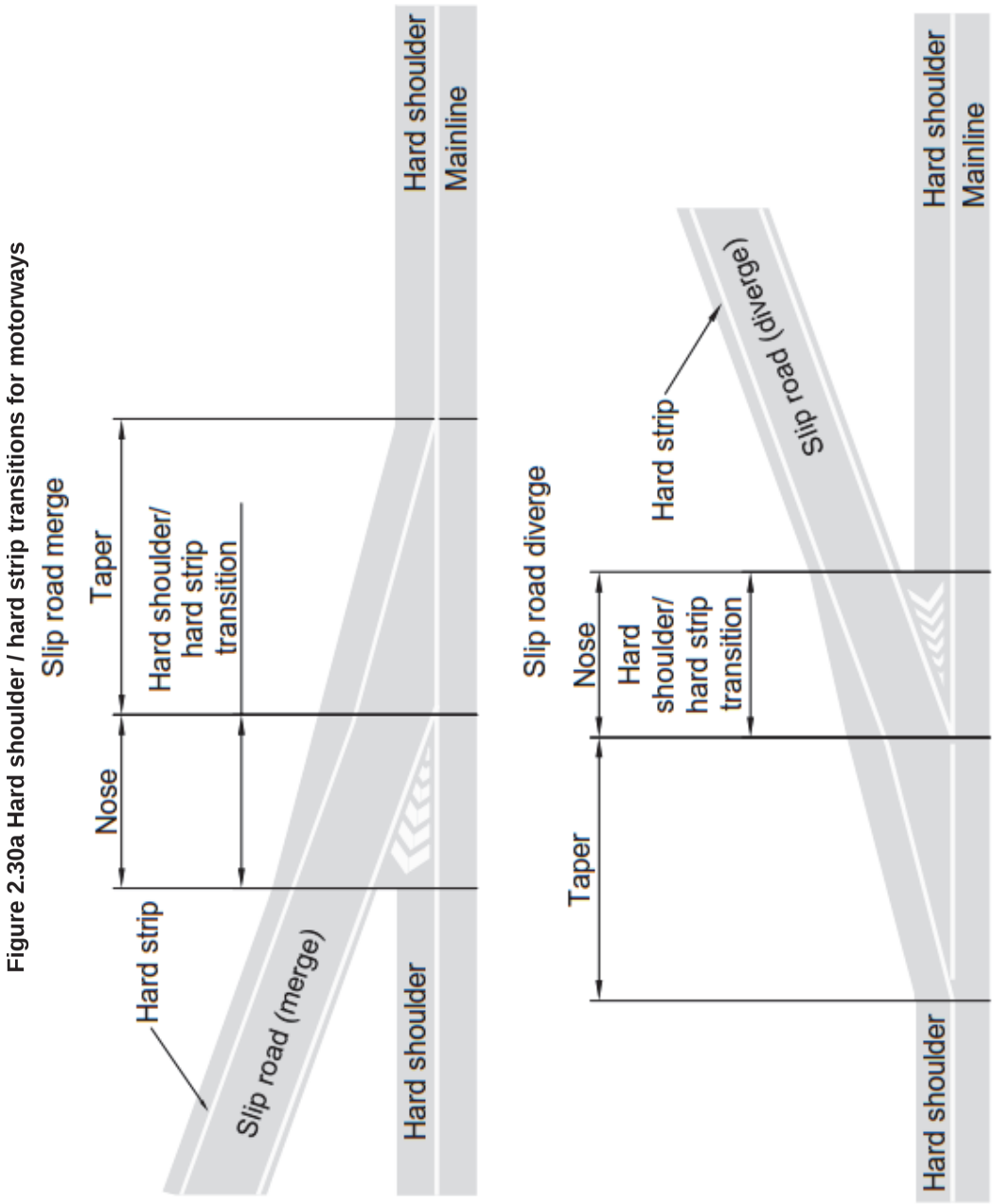
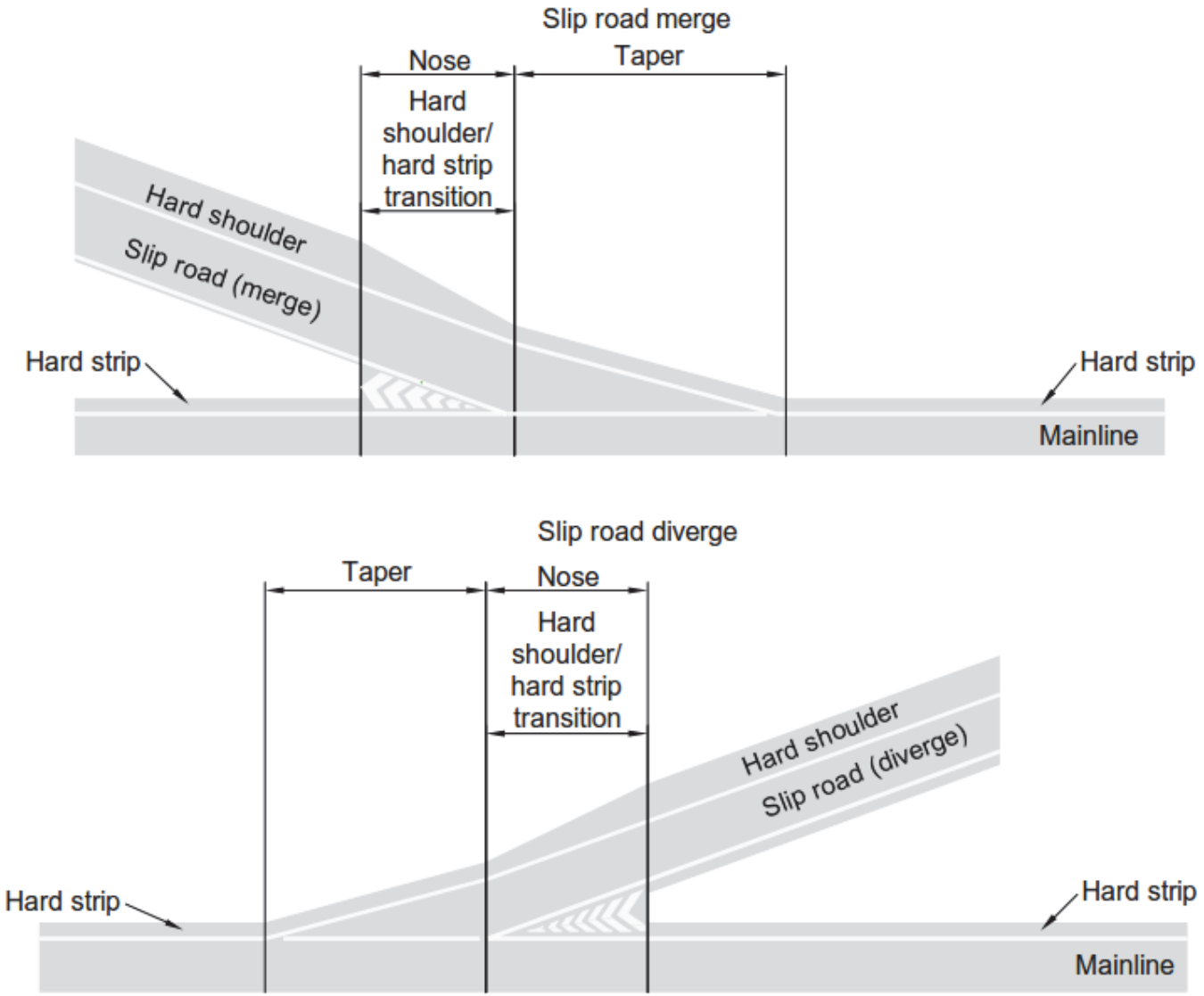


Figure 2.30a Hard shoulder / hard strip transitions for motorways

Figure 2.30b Hard shoulder / hard strip transitions for all-purpose roads



2.30.1 Gain and loss of the offside hard strip on connector roads with superelevation should be as shown in Figure 2.30.1

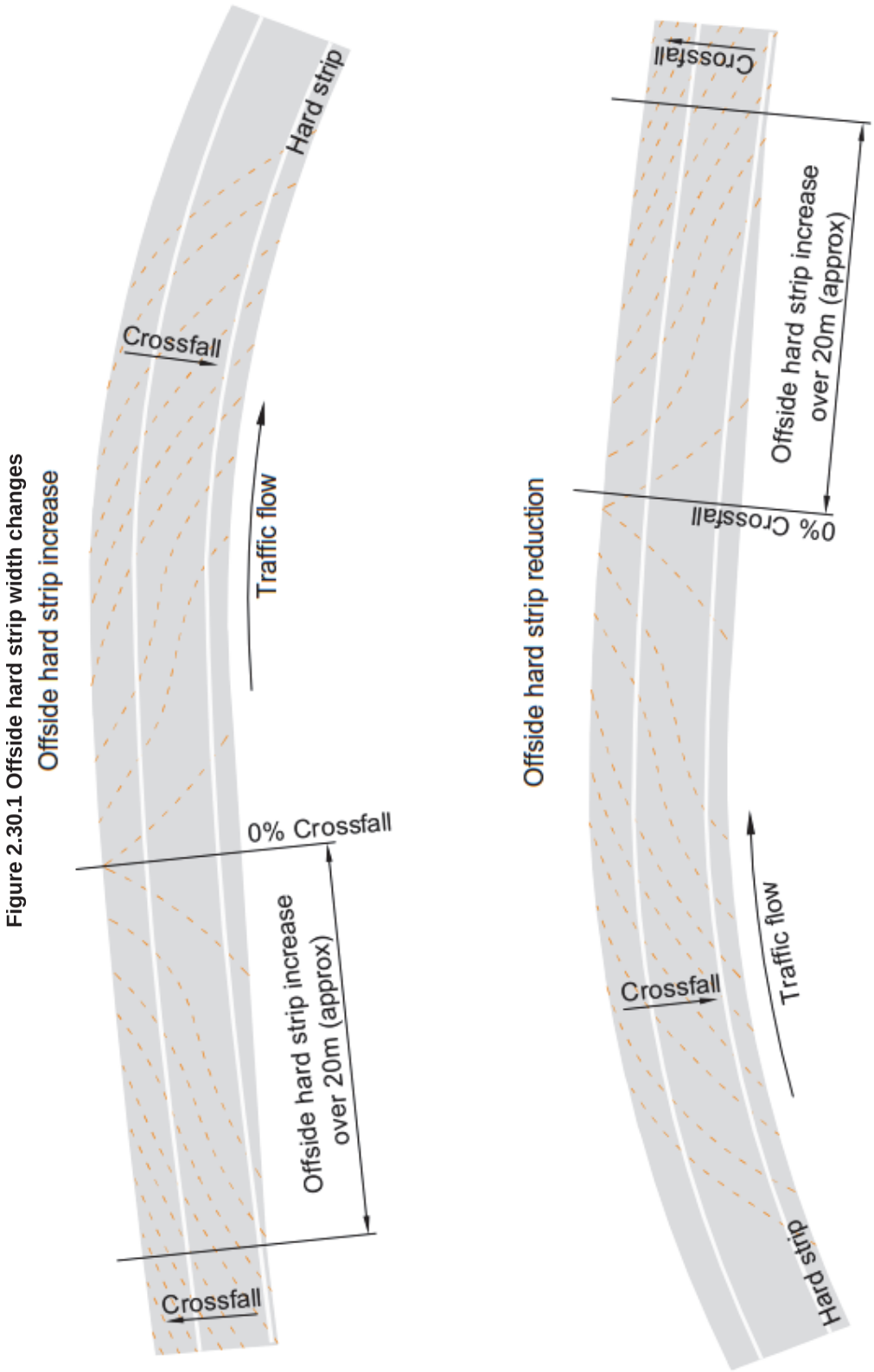


Figure 2.30.1 Offside hard strip width changes

NOTE 1 For further information on determining transitions in the number of mainline lanes see CD 109 [Ref 14.N] , CD 122 [Ref 12.N] and MCHW HCD Drawings [Ref 22.N] .

NOTE 2 For further information on determining transitions in the number of connector road lanes see CD 122 [Ref 12.N] and TSM (Guidance) [Ref 13.N].

NOTE 3 For further information on transitions from dual carriageway to single carriageway see CD 109 [Ref 14.N] and TSM Chapter 5 [Ref 29.N].

3. Highway cross-sections at structures

General

3.1 The paved widths as determined by Section 2 of this document shall be continued through the structure.

3.1.1 The design should include an assessment of the need to provide additional widening at structures to allow for future widening of the cross-section.

NOTE *Additional information on the cross-section components that are found at structures are detailed below in Figures 3.1.1Na to 3.1.1Ne.*

Figure 3.1.1Na Cross-section components for rural and urban motorways at structures

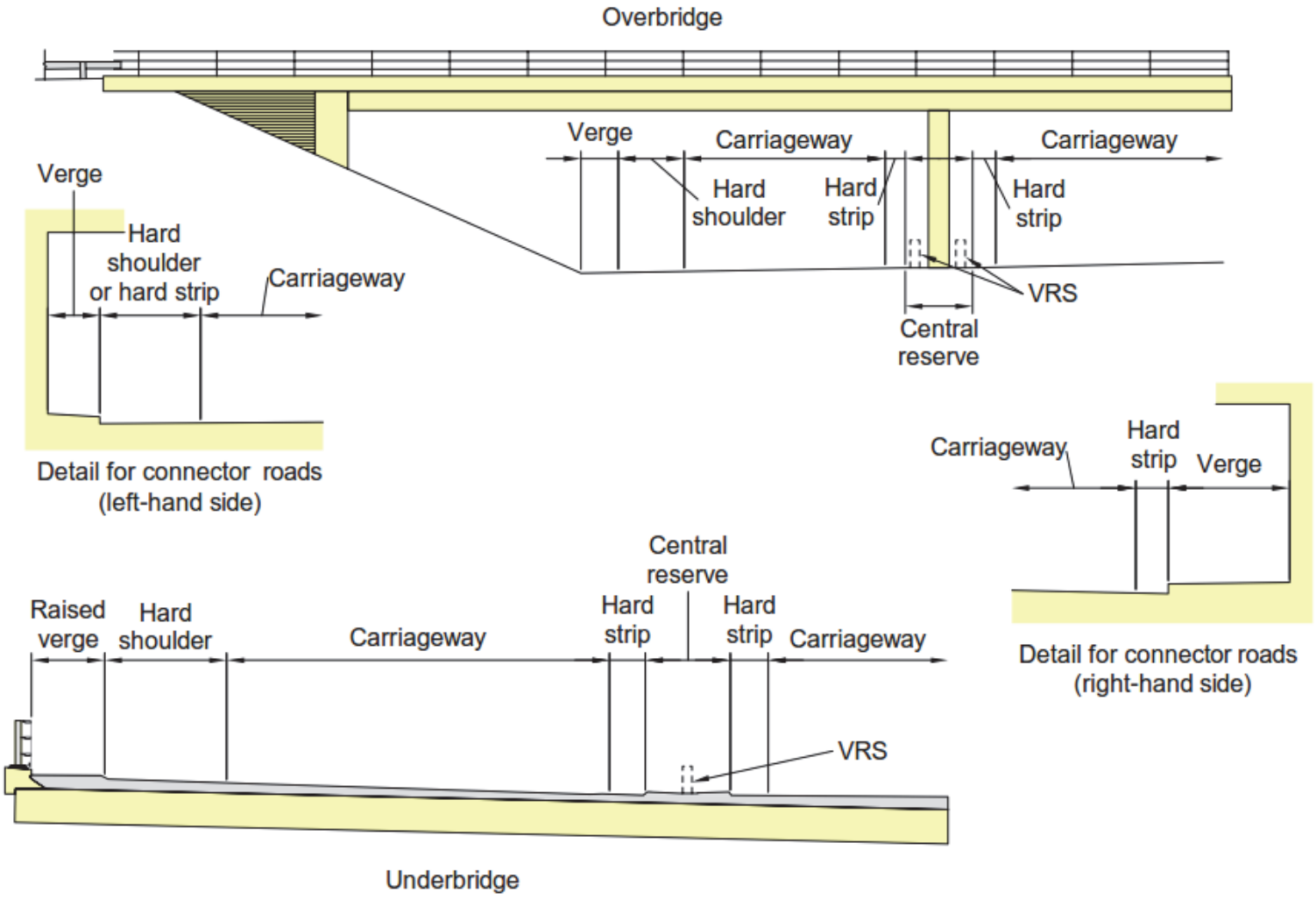


Figure 3.1.1Nb Cross-section components for rural all-purpose dual carriageway roads at structures

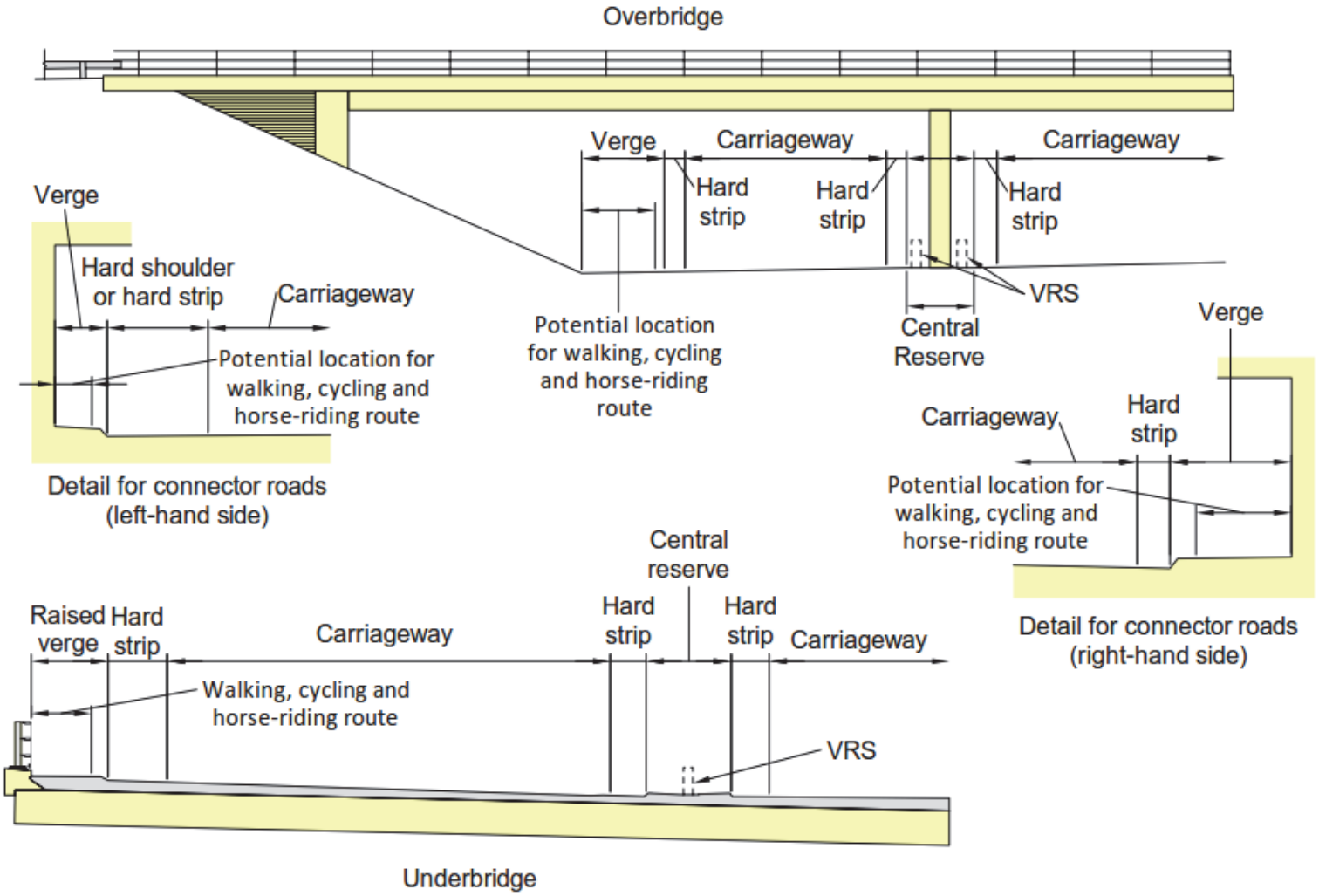


Figure 3.1.1Nc Cross-section components for rural all-purpose single carriageway roads at structures

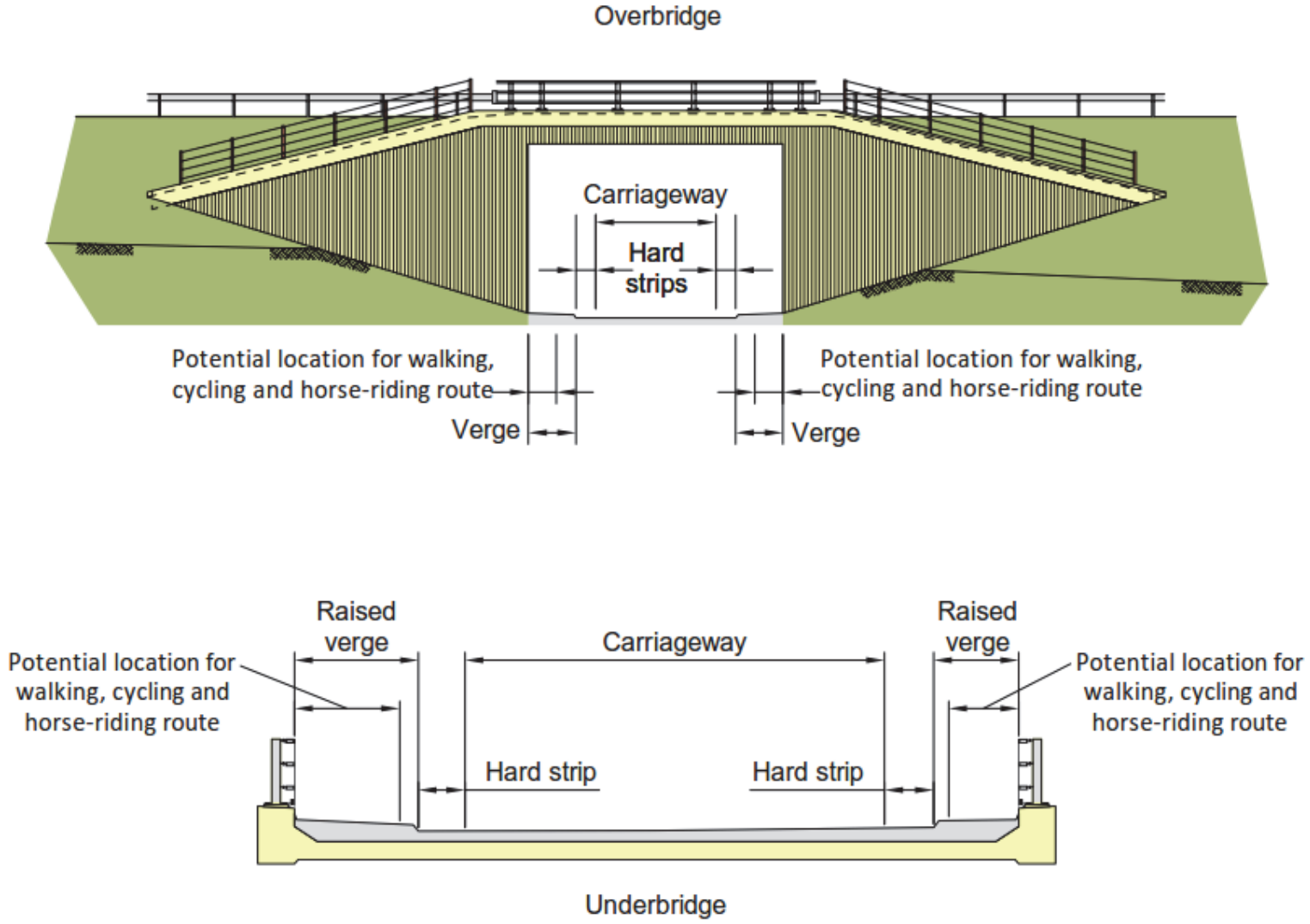


Figure 3.1.1Nd Cross-section components for urban all-purpose dual carriageway roads at structure

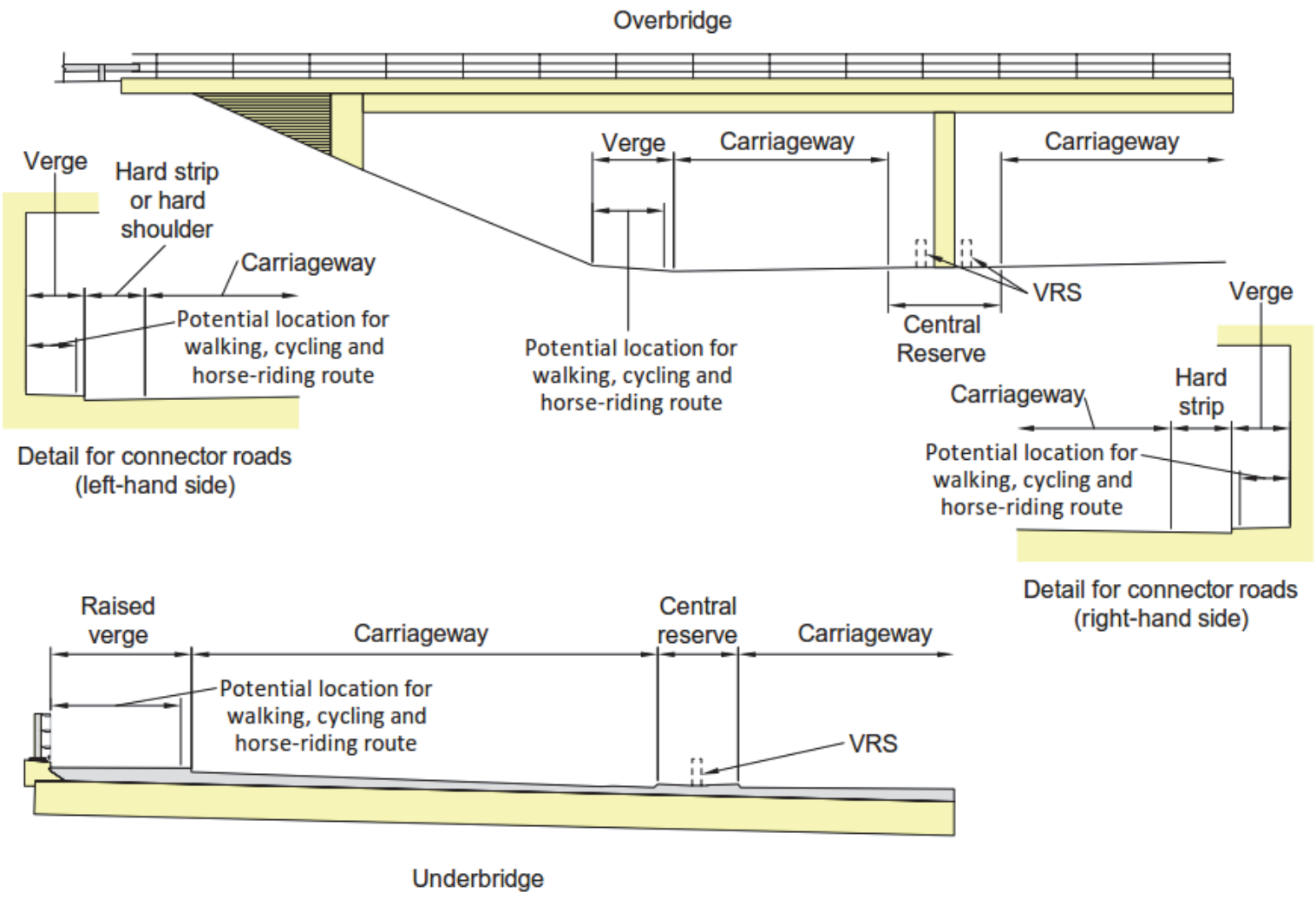
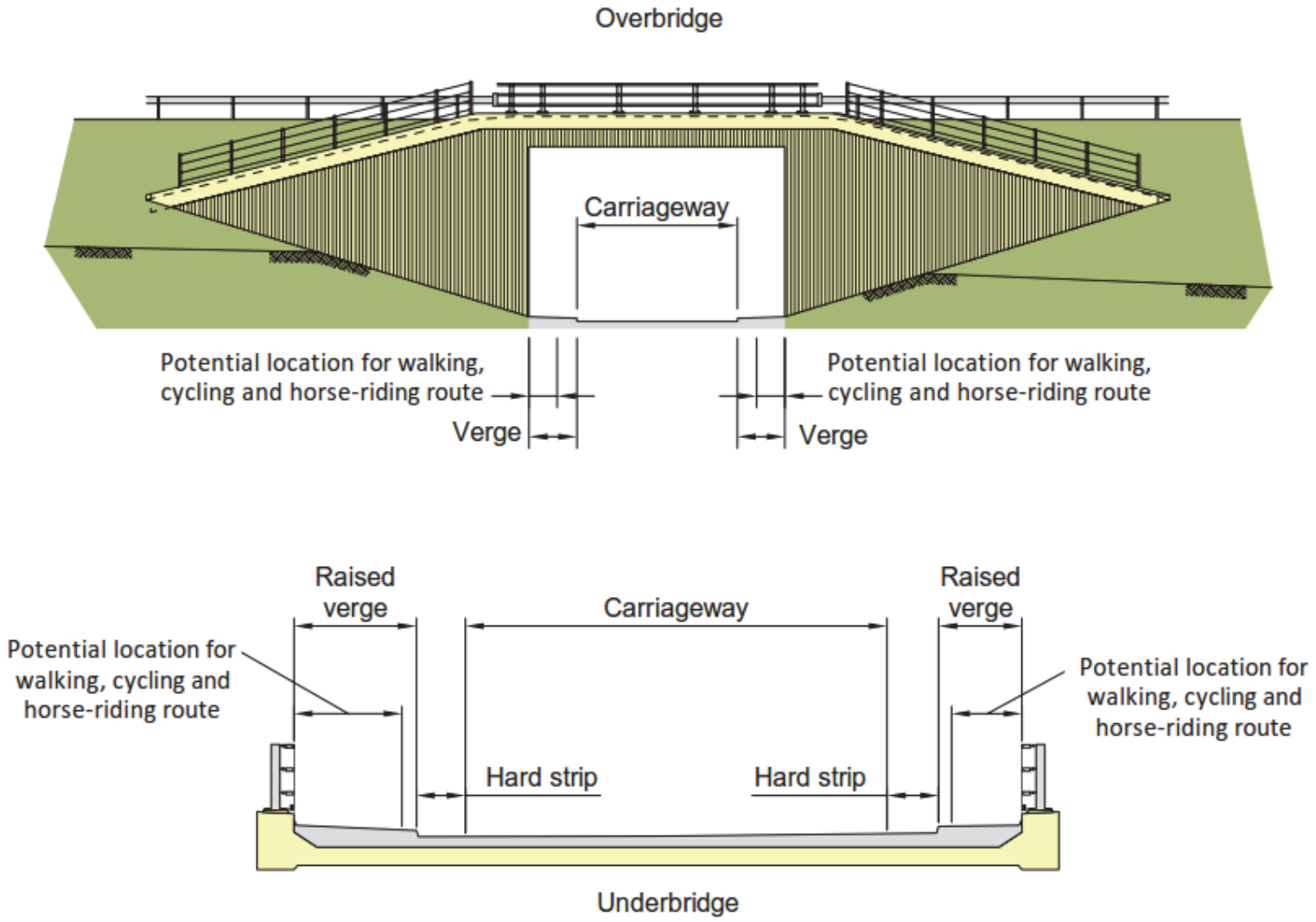


Figure 3.1.1Ne Cross-section components for urban all-purpose single carriageway roads at structures



3.1.2 Where it is necessary to divide lanes of a single carriageway at divided structures (see Figure 3.1.2), the carriageway dimensions should be in accordance with those identified for single-lane dualling on single carriageway roads in CD 123 [Ref 11.N].

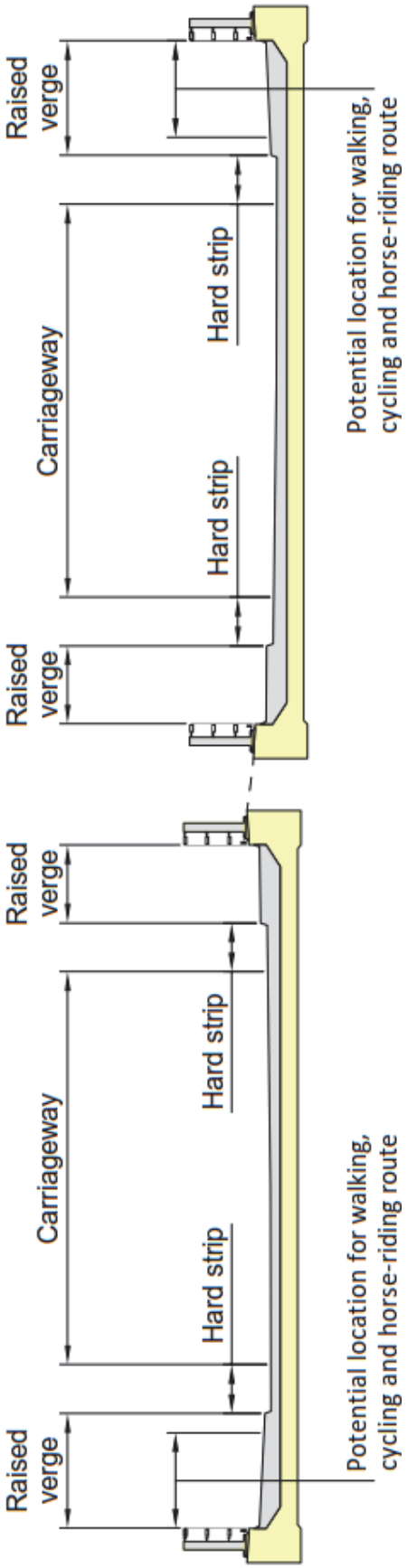


Figure 3.1.2 Cross-section components for dual one lane all-purpose roads at divided structures

NOTE *Occasionally it is necessary to provide a single lane in each direction separated by a central reserve. For instance, certain landmark bridges featuring a central cable stay with a single traffic lane either side.*

Walking, cycling and horse-riding provision at structures

3.2 The provision for walking, cycling and horse-riding, including horizontal separation from the carriageway, at a structure shall be at least equivalent to any provision immediately upstream and downstream of the structure.

Central reserves

3.3 Minimum central reserve widths derived from Section 2 of this document shall be continued through or across the structure.

NOTE *Central reserve widening can be necessary through a structure where a central pier is located in the central reserve.*

Verges

3.4 For overbridges and underbridges the verge width derived from Section 2 of this document shall be continued through the structure.

Raised verges and central reserves on bridge decks

3.5 The maximum kerb height of raised central reserves shall be 75mm.

3.6 For cross-sections above bridge decks where the VRS is a parapet, a raised verge of 600mm minimum width and with a maximum kerb height of 75mm shall be provided between the paved width and adjacent parapets, and this applies to both the nearside or offside.

NOTE *Limiting the height of the kerb upstand to 75mm minimises the risk of an errant vehicle being projected upwards upon impact.*

Accommodation bridges

3.7 Any discussions with landowners with respect to accommodation bridges and the resulting agreed provision shall be recorded in a formal agreement.

3.7.1 When deriving the widths of accommodation bridges the following criteria should be assessed:

1) the agreed reasonable needs of the respective private landowner;
2) the size of vehicles, particularly agricultural vehicles, that can reasonably be expected to use the bridge;
3) maintenance requirements; and
4) the needs of walkers, cyclists and horse-riders in locations where they have legal right of way.

4. Headrooms at structures

General

4.1 Bridges and highway structures shall be designed, constructed, and maintained to provide a minimum standard headroom above the paved width, verges and central reserve in accordance with Table 4.1 and Table 4.3.

Table 4.1 Minimum standard headroom at structures

Type of structure	New construction headroom (metres)	Maintained headroom (metres)
Overbridges	5.30 + S	5.03 + S
Footbridges, sign and signal gantries, and other structures vulnerable to vehicular impact	5.70 + S	5.41 + S
Free-standing temporary structures	N/A	5.41 + S
All permanent structures over high load routes (not applicable in NI)	6.45 + S	6.18 + S
Where S is the additional clearance in accordance with Table 4.3		

4.2 The headroom after the maximum deflection of the superstructure at the serviceability limit state shall be greater than the minimum standard headroom given in Table 4.1 as shown in Figures 4.6N1, 4.8a, 4.8b, and 4.8c.

NOTE 1 For new bridges, provision for any additional self-weight due to waterproofing, surfacing, and other coatings are in accordance with BS EN 1991-1-1 [Ref 9.N] and NA to BS EN 1991 [Ref 30.N].

NOTE 2 For existing bridges, the provision for any additional self-weight due to waterproofing, surfacing, and other coatings is made in accordance with CS 454 [Ref 1.N].

NOTE 3 Where required, bridges and highway structures are designed to withstand vehicular impact in accordance with BS EN 1991-1-7 [Ref 10.N] and NA to BS EN 1991 [Ref 30.N].

Sag curve compensation

4.3 Where the road passing under the superstructure is on a sag curve, the minimum standard headroom given in Table 4.1 shall be increased by the additional clearance S in accordance with Table 4.3:

Table 4.3 Sag curve compensation

Sag radius (metres)	Additional clearance S (mm)
$\leq$ 1000	80
1200	70
1500	55
2000	45
3000	25
6000	15
$>$ 6000	0

4.4 Sag curve radius shall be measured along the carriageway over a 25 metres chord.

Structure free zones (SFZ)

4.5 SFZs shall include central reserves and verges adjacent to the carriageway.

NOTE 1 *SFZs can reduce the risk of a vehicular impact at the superstructure during an accidental situation where an errant vehicle could leave the paved width.*

NOTE 2 *SFZs can be used in the future to increase the width of the pavement either permanently or temporarily.*

4.6 Minimum width of the SFZ for all new structures shall be the lesser of either:

1) the full verge width or the central reserve width (including any slopes shallower than 1:4 (vertical:horizontal);
2) the width from the edge of the paved width to the outermost face of any vertical support.

NOTE 1 *Vertical supports can include:*

1) vertical or inclined columns or piers as shown in Figure 4.6N1;
2) columns or piers with a varying cross-section;
3) columns or piers with or without crossheads.

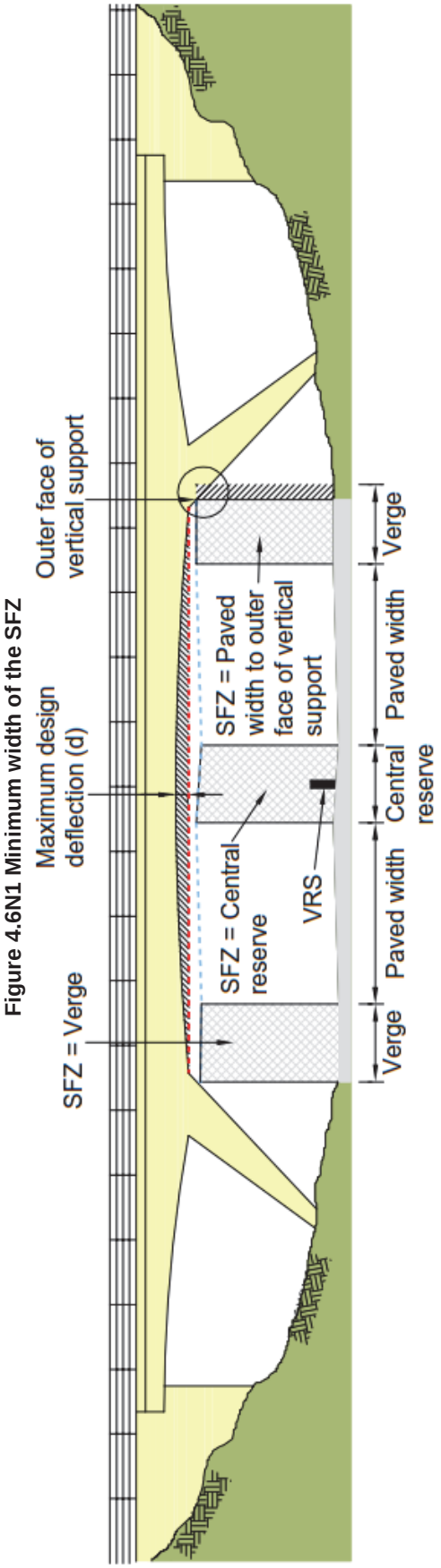


Figure 4.6N1 Minimum width of the SFZ

NOTE 2 *The lowest point of the slope adjacent to the verges can be used as a reference point to measure the inclination of the slopes.*

4.7 Where the existing headroom within the SFZ is found to be less than the minimum maintained headroom, the maintaining organisation shall:

1) carry out a risk assessment;
2) manage the structure in accordance with the output of the risk assessment.

NOTE *The installation of a VRS at the interface between the paved width and the verge can reduce the risk of a vehicular impact at the superstructure within the SFZ.*

Design and as-built drawings

4.8 In the design and as-built drawings the following information shall be included in a similar manner as shown in Figures 4.8a, 4.8b, 4.8c:

1) the SFZ;
2) the paved width headroom;
3) the maximum deflection of the superstructure in the serviceability limit state obtained from the structural analysis;
4) the sag curve (where applicable).

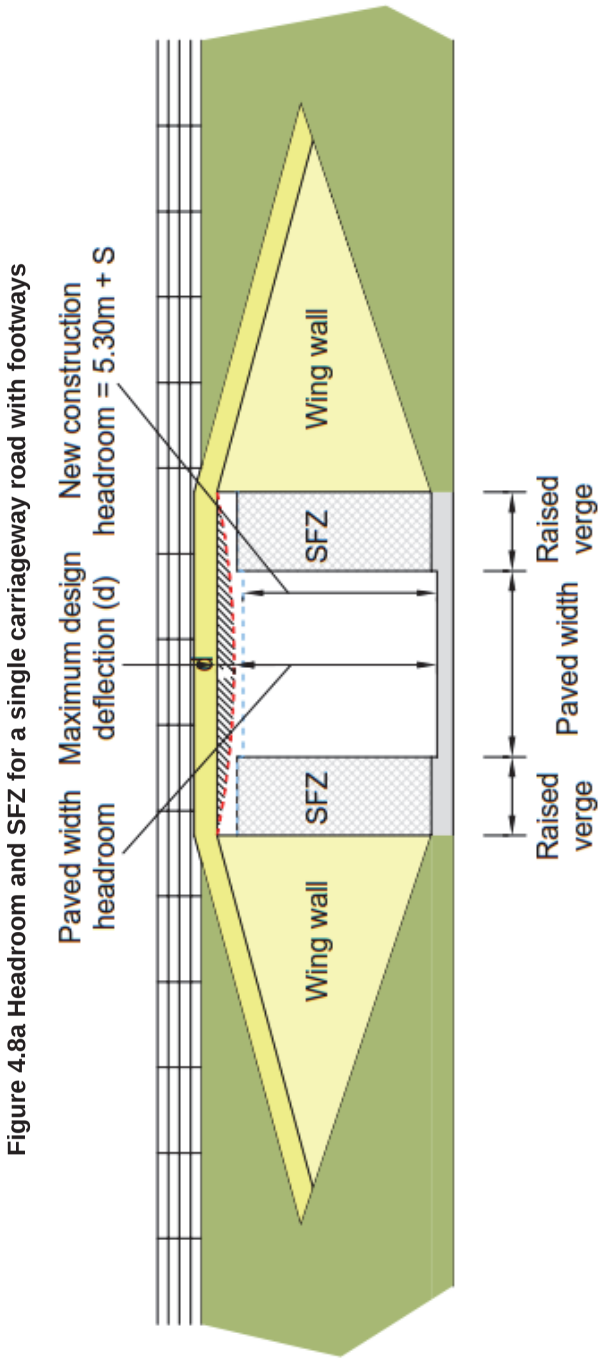


Figure 4.8a Headroom and SFZ for a single carriageway road with footways

Figure 4.8b Headroom and SFZ for a 2 No. span structure crossing a dual carriagway

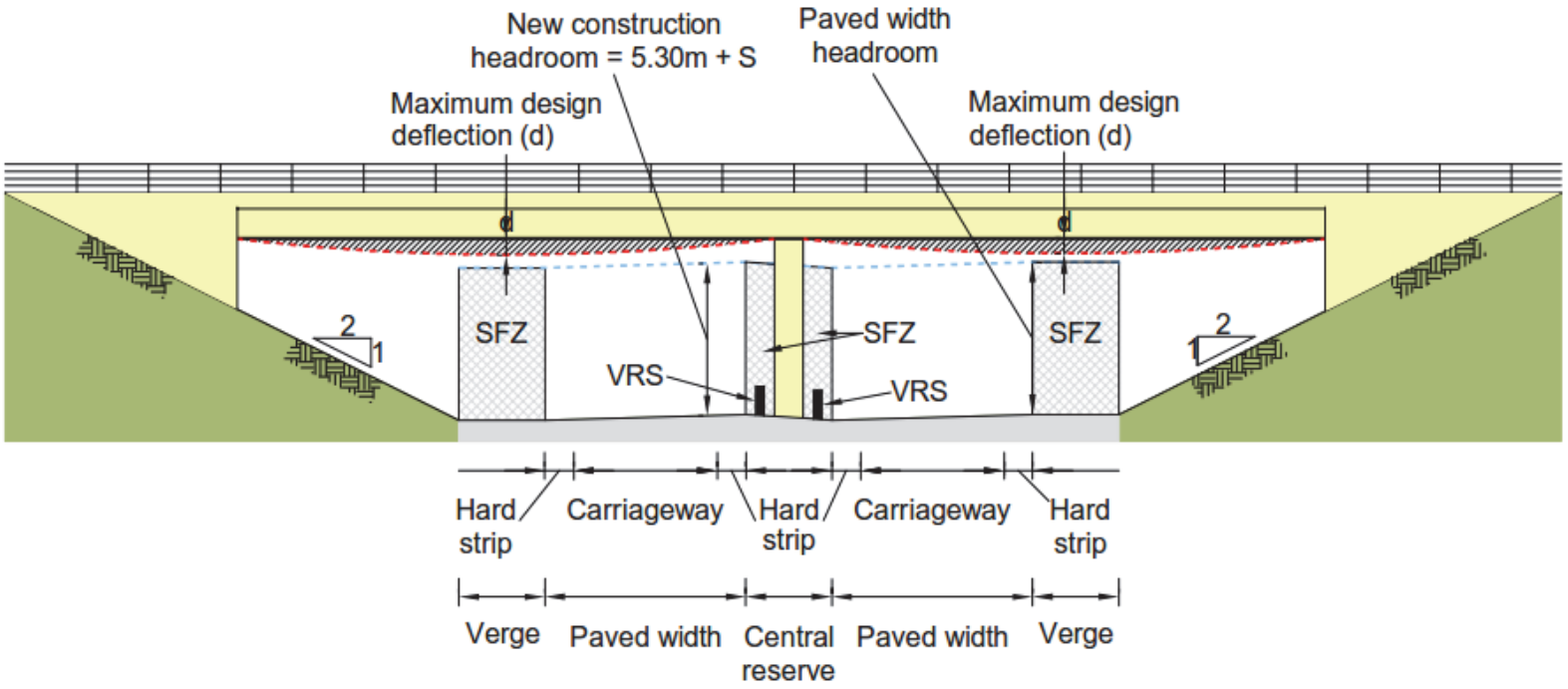
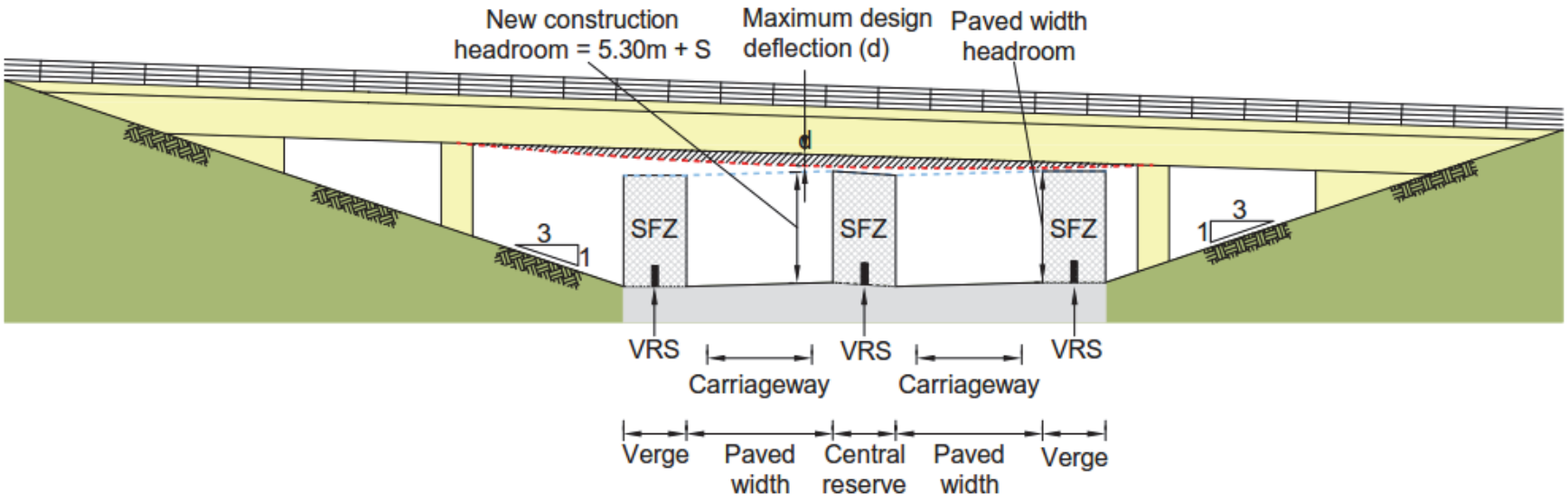


Figure 4.8c Headroom and SFZ for a 3 No. span structure crossing a dual carriagway



New structures

4.9 New bridges and highway structures shall be designed to have a minimum new construction headroom and a minimum paved width headroom equal to or greater than the new construction headroom given in Table 4.1.

NOTE Paved width includes the width of the carriageway plus any hard shoulders and hard strips.

4.9.1 Headroom should be greater than the minimum given in Table 4.1 where:

1) the location presents a high risk of vehicle impact based on previous records;
2) forward visibility is affected due to sags (comfort criteria for sag curves can be obtained from CD 109 [Ref 14.N];
3) forward visibility is affected due to overhead signs and signals;
4) future maintenance of the bridge and pavement can result in a reduction of the headroom;
5) it is economical with regards to the whole life costs of the structure and pavement;
6) accommodation of services or apparatus is required;
7) there are other site specific constraints (such as access limitations);
8) lightweight structures (such as footbridges) are passing above the road;
9) it is environmentally sustainable.

4.9.2 Where the headroom of existing structures on a route is greater than the new construction headroom given in Table 4.1, and where an increase of the new construction headroom for new structures does not have a significant impact to the overall construction cost, new structures should have the same headroom as the existing structures.

NOTE 1 Providing headroom uniformity along an existing route can reduce the probability of vehicular impact.

NOTE 2 Existing robust structures along a route with a greater headroom than the new construction headroom, can provide protection to new lightweight structures (such as footbridges) against vehicular impacts, only if the new structures have an equal or greater headroom than the headroom of the existing robust structures.

4.10 Where a trunk road passes over other authorities infrastructure or third party land, the headroom provision shall be agreed with the relevant authority or landowner.

4.10.1 Where a trunk road passes over other authorities infrastructure or third party land, the minimum headroom at under-bridges should be subject to the minimums quoted in this document.

NOTE Infrastructure can include rail and navigable canals.

Existing structures

4.11 Existing bridges and highway structures shall have a minimum maintained headroom and a minimum paved width headroom preserved at all times in accordance with Table 4.1.

NOTE Re-surfacing of the paved width can result to an increase of the pavement's level which can lead to a reduction of the headroom.

4.11.1 Where structural strengthening is required beneath a superstructure, the adopted strengthening techniques should have a minimum impact on headroom.

4.12 The design organisation shall inform the Overseeing Organisation of any change of the headroom.

NOTE Up to date bridge records for the maintained headroom can facilitate the implementation of accurate planning systems for the movement of high loads on a route.

4.13 Where a headroom is found to be less than the minimum maintained headroom over the paved width in accordance with Table 4.1, the maintaining organisation shall:

1) immediately notify the Overseeing Organisation;

2) carry out a risk assessment and manage the structure in accordance with the outcome of the risk assessment.

4.14 Where as-built records of the structure are available, verification of the headroom on site shall be made after a review of the available information.

NOTE 1 A review of the available information and as-built records can:

1) reduce the risk of a measurement error;

2) contribute towards identifying health and safety risks and hazards and implementing the appropriate health and safety measures during the site visit.

NOTE 2 Vertical measurements to verify and record the minimum headroom are made in accordance with CS 450 [Ref 16.N].

4.14.1 Vertical measurements should be taken at different locations along the paved width area and within the SFZ such as:

1) from the top of the raised verges and central reserve;
2) where a sag curve is present, from the outermost point of the curve;
3) below both edges of the superstructure in the transverse direction to assess the minimum headroom against any cross-sectional deck inclination.

Utilities companies and other authorities apparatus

4.15 Where utility companies or other authorities (such as rail or legislative bodies) require greater headroom, any such increase shall be agreed with the Overseeing Organisation.

NOTE Utility companies or other authorities can require an increased headroom to achieve sufficient vertical clearance to pass their services above the pavement.

Accommodation underbridges

4.16 Headroom for accommodation underbridges shall be agreed with the landowners and expected users of the structure and recorded in a legally enforceable agreement.

4.16.1 The headroom at accommodation bridges should be derived from the following criteria:

1) the likely methods of farming in the area;
2) the size of the agricultural and maintenance vehicles expected to use the bridge;
3) the use of the bridge by walking, cycling, and horse-riding users;
4) the use of the bridge for animal access.

NOTE The maximum height of an agricultural vehicle can be up to 4.65 metres except those transporting agricultural baled produce (i.e. hay, silage straw, or animal fodder) which have no height limit.

Walking, cycling, and horse-riding users

4.17 For new structures the minimum headroom given in CD 143 [Ref 6.N] shall be increased by 300mm where there is a risk for a reduction of the headroom.

NOTE 1 A future overlay of the road pavement can result in a reduction of the subway's headroom.

NOTE 2 Minimum headroom for subways and structures that are used by walkers, cyclists and horse-riders is in accordance with the requirements of CD 143 [Ref 6.N].

4.18 Headrooms for structures outside the scope of CD 143 [Ref 6.N] shall adopt the headroom requirements in CD 143 [Ref 6.N] where facilities for walking, cycling or horse-riding are provided.

4.18.1 Where more than one headroom is quoted in CD 143 [Ref 6.N] due to different widths along the length of the structure, the maximum headroom should be adopted.

5. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CS 454, 'Assessment of highway bridges and structures'
Ref 2.N	BSI. BS EN 1340, 'Concrete kerb units. Requirements and test methods.'
Ref 3.N	Highways England. CD 353, 'Design criteria for footbridges'
Ref 4.N	Highways England. CD 352, 'Design of road tunnels'
Ref 5.N	Highways England. CD 195, 'Designing for cycle traffic'
Ref 6.N	Highways England. CD 143, 'Designing for walking, cycling and horse riding (vulnerable users)'
Ref 7.N	Highways England. CD 524, 'Edge of pavement details'
Ref 8.N	Highways England. LA 104, 'Environmental assessment and monitoring'
Ref 9.N	BSI. BS EN 1991-1-1, 'Eurocode 1 - Actions on Structures - Part 1-1: General actions- Densities, self weight, imposed loads for buildings'
Ref 10.N	BSI. BS EN 1991-1-7, 'Eurocode 1 - Actions on structures - Part 1-7 General actions - Accidental actions'
Ref 11.N	Highways England. CD 123, 'Geometric design of at-grade priority and signal-controlled junctions'
Ref 12.N	Highways England. CD 122, 'Geometric design of grade separated junctions'
Ref 13.N	The National Archives. Department for Transport. TSM (Guidance), 'Guidance. The Traffic Signs Manual'
Ref 14.N	Highways England. CD 109, 'Highway link design'
Ref 15.N	The National Archives. legislation.gov.uk. Highways Act 1980, 'Highways Act 1980'
Ref 16.N	Highways England. CS 450, 'Inspection of highway structures'
Ref 17.N	International Civil Aviation Organization. ICAO Vol 1, 'International Standards and Recommended Practices, Annex 14 to the Convention on International Civil Aviation, Volume 1 Aerodrome Design and Operations'
Ref 18.N	Highways England. LA 101, 'Introduction to environmental assessment'
Ref 19.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 20.N	Highways England. LA 107, 'Landscape and visual effects'
Ref 21.N	Highways England. LD 117, 'Landscape design'
Ref 22.N	Highways England. MCHW HCD Drawings, 'Manual of Contract Documents for Highway Works Volume 3: Highway Construction Details'
Ref 23.N	Highways England. CD 377, 'Requirements for road restraint systems'
Ref 24.N	Transport Scotland. 'Roads for All - Good Practice Guide for Roads'
Ref 25.N	Highways England. LA 103, 'Scoping projects for environmental assessment'
Ref 26.N	Highways England. LA 102, 'Screening projects for Environmental Impact Assessment'

Ref 27.N	Highways England. CD 192, 'The design of crossovers and changeovers'
Ref 28.N	The Stationery Office. TSRGD 2016, 'The Traffic Signs Regulations and General Directions 2016' , 2016
Ref 29.N	The Stationery Office. TSM Chapter 5, 'Traffic Signs Manual Chapter 5 - Road Markings'
Ref 30.N	BSI. NA to BS EN 1991, 'UK National Annex for Eurocode 1: Actions on structures'

Road Layout
Design

CD 127
England National Application Annex to CD 127
Cross-sections and headrooms

(formerly IAN 149/17, IAN 161/15 and IAN 198/17)

Revision 1

Summary
This National Application Annex sets out the Highways England specific requirements for highway cross-sections and headrooms on existing roads.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
1	Mar 2020	Revision 1 (March 2020) Update to references only. Revision 0 (November 2019) Highways England National Application Annex to CD 127.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes those parts of IAN 149/17, IAN 161/15 and IAN 198/17 relating to the geometric design of highway cross-section and headrooms which are withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex (NAA) gives the Highways England specific requirements and additional relaxations relating to cross sections and headrooms for:

1) modifying existing motorways where motorway regulations apply (herein referred to as 'existing motorways');
2) modifying existing all-purpose dual carriageways; and
3) smart motorways

The additional relaxations included in this NAA allow greater flexibility when dealing with the constraints associated with enhancing elements of existing motorways and all-purpose trunk roads.

This NAA is to be used in conjunction with CD 127 [Ref 1.N], GD 300 [Ref 6.N] and IAN 161 [Ref 9.N] where appropriate.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 5.N] apply to this document.

Abbreviations

Abbreviations

Abbreviation	Definition
ALR	All lane running
IAN	Interim Advice Note
m	Metres
SCRG	Safety Control Review Group
VRS	Vehicle restraint system

Terms and definitions

Terms and definitions

Term	Definition
All lane running	A smart motorway scheme with the permanent conversion of the hard shoulder to a running lane.
Expressway	A high speed dual carriageway that has at least two lanes in each direction, grade separated junctions and uses technology to support operational regimes (see GD 300 [Ref 6.N]).
Maintaining organisation	The organisation commissioned to undertake the maintenance of a structure.

E/1. Modifying existing motorways

Scope

E/1.1 The requirements and advice in Section E/1 shall only be used when modifying existing motorways, with the exception of smart motorway and expressway schemes.

E/1.1.1 The parameters in Section E/1 should only be used where it is not practicable to comply with the requirements of CD 127 [Ref 1.N].

NOTE 1 *Document IAN 161 [Ref 9.N] provides requirements and advice for the design of smart motorways.*

NOTE 2 *Document GD 300 [Ref 6.N] provides requirements and advice for the design of expressways.*

E/1.2 The parameters in Section E/1 shall not be used for new motorway elements e.g. the construction of a new slip road.

Geometric parameters

Highway cross-section (CD 127 clauses 2.1, 2.2, 2.4, 2.5, 2.7, 2.8, 2.9, 2.12, 2.23, 2.26, 3.3 and 3.4)

E/1.3 Where the cross-section component dimensions specified in CD 127 [Ref 1.N] cannot be achieved for mainline carriageways, the appropriate cross-section component dimensions shall be derived from Table E/1.4.

E/1.4 Any relaxations applied to the motorway mainline cross-sections as shown in Figure E/1.4 shall follow the hierarchy shown in Table E/1.4 and be applied in sequence starting at 'priority 1', with the exception that priority 3 can be used before priority 2 over lengths of less than 100 metres.

Figure E/1.4 Layout of the components detailed in Table E/1.4

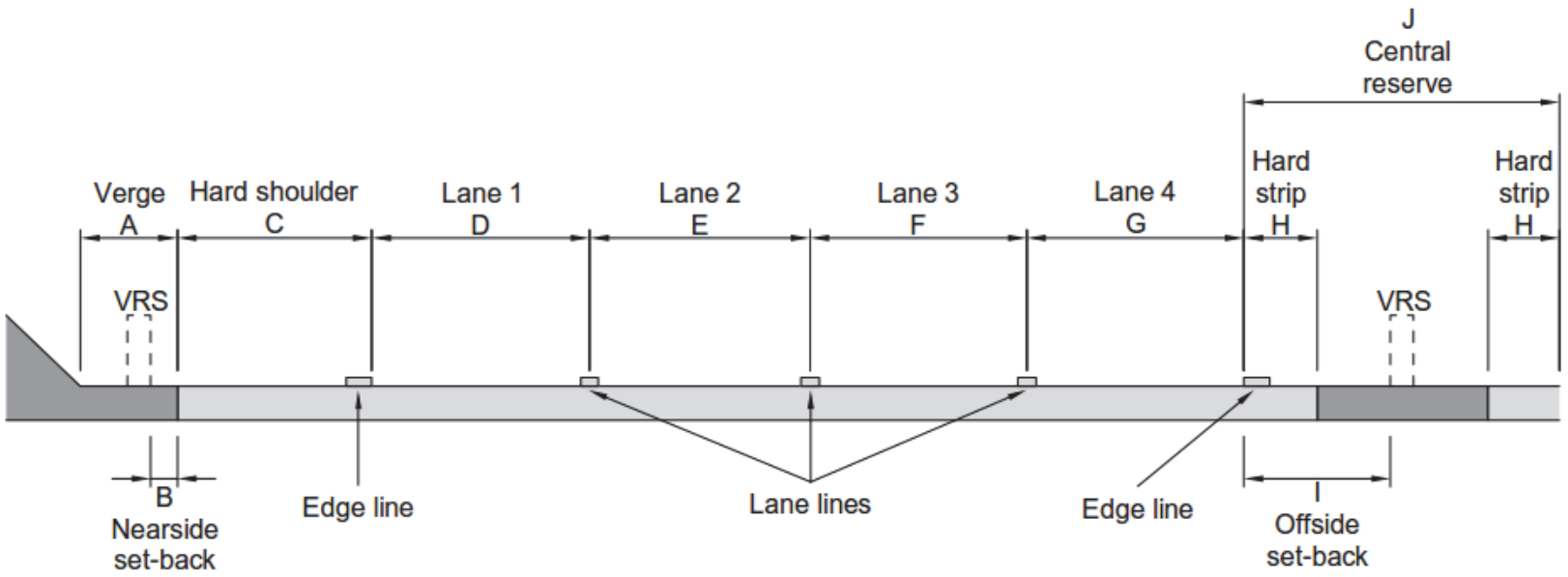


Table E/1.4 Reduced cross-sections hierarchy for widening on existing motorway mainline carriageways

					Lane widths (metres)											
					D2M		D3M			D4M						
Reference to Figure E/1.4		**A**	**B**	**C**	**D**	**E**	**D**	**E**	**F**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Priority order	Reduced element	Nearside verge (m)	Nearside set-back (m)	Hard shoulder/ emergency access width (m)	Lane 1	Lane 2	Lane 1	Lane 2	Lane 3	Lane1	Lane 2	Lane3	Lane4	Off-side hard strip (m)	Off-side set-back (m)	Central reserve inc. hard strip (m)
1	Nearside verge (metres)	See note 1	0.60	3.30	3.65	3.65	3.65	3.70	3.65	3.65	3.70	3.70	3.65	0.70	1.20	4.50
2	Central reserve	See note 1	0.60	3.30	3.65	3.65	3.65	3.70	3.65	3.65	3.70	3.70	3.65	0.70	1.00	3.40
3	Set-back to nearside VRS	See note 1	0.00	3.30	3.65	3.65	3.65	3.70	3.65	3.65	3.70	3.70	3.65	0.70	1.00	3.40
4	Lane widths	See note 1	0.00	3.30	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	3.40
5	Lane widths and central reserve	See note 1	0.00	3.30	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	3.00
6	Hard shoulder	See note 1	0.00	3.00	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	3.00
7	Central reserve	See note 1	0.00	3.00	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	2.60
8	Emergency access	See note 1	0.00	2.50	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	2.60
9	Emergency access	See note 1	0.00	2.00	3.65	3.55	3.65	3.55	3.30	3.65	3.60	3.40	3.30	0.70	1.00	2.60

NOTE 1 *The width of the nearside verge can be reduced as required as long as the resultant width can accommodate both underground and over-ground equipment, including emergency roadside telephones.*

NOTE 2 *Document TD 131 [Ref 8.N] provides further requirements and advice for situations where the verge width is reduced in accordance with Table E/1.4 and emergency roadside telephones are provided.*

E/1.5 Where a 600mm raised verge is provided on an underbridge, the raised verge width shall be excluded from the measurement of the hard shoulder.

E/1.5.1 The 600mm raised verge provided on an underbridge may be included in the measurement of an emergency access width.

E/1.6 Where it is proposed to reduce the central reserve (including hard strips) to 3.40 metres or less, the Overseeing Organisation shall be consulted to ensure that any implications on maintenance activities have been considered and any potential issues resolved.

E/1.7 Where resultant wheel tracks from altered lane widths are within 100mm of existing pavement joints, the maintaining organisation shall be consulted to ensure that any implications on maintenance have been considered and any potential issues resolved.

E/1.8 Where it is proposed to reduce the hard shoulder below 3.00 metres the emergency services shall be consulted to ensure that any implications on their activities have been considered and any potential issues resolved.

E/1.9 Where verge widths at structures are reduced to zero the maintaining organisation and emergency services shall be consulted to ensure that any implications on maintenance activities and the potential impact on the occupants of stricken vehicles have been considered and any potential issues resolved.

E/1.10 When applying the cross-section relaxations identified in Table E/1.4, no lane lines shall taper at gradients steeper than 1:100 when transitioning from one cross-section to another.

E/1.11 The central reserve width as identified in Table E/1.4 shall accommodate the working widths of the vehicle restraint system (VRS) and any equipment that is present or proposed.

E/1.12 Where the hard shoulder width is reduced to 3.00 metres or less for a distance of over 100 metres, a safety risk assessment shall be undertaken in accordance with GG 104 [Ref 7.N] 'Requirements for safety risk assessment', to determine if mitigation such as CCTV or an alternative monitoring / verification system is required.

E/1.13 Where lengths of hard shoulder less than 3.00 metres wide are proposed in accordance with Table E/1.4 these shall be limited to 30% of the overall length of a link.

E/1.14 Hard shoulders shall be at least 3.00 metres wide for a distance of 300 metres downstream from the merge datum points.

E/1.15 Where hard shoulders less than 3.00 metres wide are proposed these shall be hatched out as illustrated in Figure E/1.15.

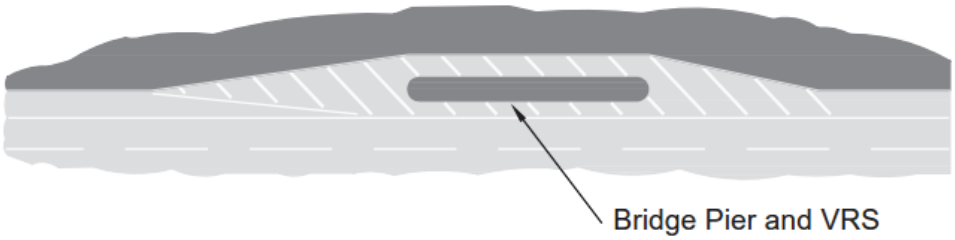
Figure E/1.15 Layout of hatching for hard shoulders less than 3.00 metres wide

E/1.16 The taper at the start of the hatching in a hard shoulder less that 3.00 metres wide shall have a ratio of 1:15.

E/1.17 Where an access route for emergency vehicles is to be provided behind a bridge pier, the dimensions shall be derived from a swept path analysis using the largest emergency vehicle likely to use the link.

E/1.18 Where an access route for emergency vehicles is to be provided behind a bridge pier the hard shoulder shall be hatched out as illustrated in Figure E/1.18.

Figure E/1.18 Layout of hatching at an emergency access route behind a bridge pier



E/1.19 The taper at the start of the hatching in the hard shoulder where an emergency access route is provided behind a bridge pier shall have a ratio of 1:15.

E/2. Modifying existing all-purpose dual carriageways

Scope

E/2.1 The requirements and advice in Section E/2 shall only be used when modifying existing all-purpose dual carriageways, with the exception of expressways.

E/2.1.1 The parameters in Section E/2 should only be used where it is not practicable to comply with the requirements of CD 127 [Ref 1.N].

NOTE *Document GD 300 [Ref 6.N] provides requirements and advice for the design of expressways.*

E/2.2 The parameters in Section E/2 shall not be used for new all-purpose dual carriageway elements e.g. the construction of a new slip road.

Geometric parameters

Highway cross-section (CD 127 clauses 2.1, 2.4, 2.5, 2.6, 2.16 and 2.23)

E/2.3 Where hard strips with the dimensions specified in CD 127 [Ref 1.N] cannot be achieved, hard strips with dimensions equivalent to or greater than the existing hard strip provision shall be retained.

E/2.4 Where the VRS set-back dimensions specified in CD 127 [Ref 1.N] cannot be achieved, VRS set-back equivalent to or greater than the existing VRS set-back on the mainline carriageway at overbridges shall be retained.

E/2.5 Where the paved width dimensions of a slip road specified in CD 127 [Ref 1.N] cannot be achieved, paved width dimensions (including lane widths and hard strip widths) equivalent or greater than the existing paved width dimensions shall be retained when the slip road meets the requirements for the design flow ranges and connector road type as required by CD 122 [Ref 3.N].

E/3. Smart motorways

Scope

E/3.1 The requirements and advice contained in Section E/3 shall only be used to upgrade an existing motorway to a smart motorway.

E/3.2 Where a new junction is proposed as part of a smart motorway, the parameters given in Section E/3 shall not be used to design the new elements of that junction e.g. the slip roads.

Geometric parameters

Verges, edge detail and omission of hard shoulder (CD 127 clauses 2.1, 2.2, 2.4, 2.5, 2.7, 2.8, and 2.23)

E/3.3 Where there is no nearside edge restraint, such as a kerb or drainage channel, nearside hard strips shall be provided in accordance with Table E/3.3.

Table E/3.3 Minimum hard strip width provision

	Minimum hard strip width	Minimum hard strip width when endorsed by the safety control review group (SCRG).
Minimum hard strip width	500mm	300mm

E/3.4 Where there is no offside edge restraint, such as a kerb or drainage channel, an offside hard strip with a width of at least 300mm shall be provided.

NOTE *Where an edge restraint is provided, such as a kerb or drainage channel for example, there is no requirement for a nearside or offside hard strip.*

E/3.5 If a drainage channel is provided adjacent to a concrete carriageway the drainage channel shall be tied to the carriageway pavement.

E/3.5.1 Any additional pavement width available should be allocated to the provision of a nearside hard strip (where it is sub-standard or where one is not provided) rather than increasing the all lane running (ALR) lane widths above the dimensions given in Table E/3.10.

E/3.5.2 Mainline hard shoulders may be omitted on smart motorways.

E/3.5.3 The design should avoid paved areas in the verge that encourage road users to stop illegally.

E/3.5.4 Where the proposed emergency access / hard strip adjacent to the mainline carriageway is greater than 1.50 metres and less than 3.00 metres wide it should be marked with a hatched road marking.

E/3.6 Hatched road markings in the emergency access / hard strip shall only be used when endorsed by the SCRG.

NOTE *Where ALR is utilised, the requirement to hatch an emergency access width / hard strip does not apply where a hard shoulder has been converted into a running lane and a hard strip is also provided due to the available cross section.*

E/3.7 Where a hard shoulder is present on a merge connector road, this shall be hatched where the width drops below 3.00 metres.

E/3.7.1 The hatching on hard shoulders below 3.00 metres wide on merge connector roads should terminate at the entry datum point in accordance with CD 122 [Ref 3.N].

E/3.8 Where a hard shoulder is present on a diverge connector road, the hard shoulder shall be hatched where the width drops below 3.00 metres.

E/3.8.1 On diverge connector roads the hatching in hard shoulders below 3.00 metres wide should commence at the exit datum point in accordance with CD 122 [Ref 3.N].

E/3.9 There shall be no loose stone, or filter drain material within 1.00 metre of the trafficked edge of the carriageway edge line.

NOTE *For requirements and advice on the stabilisation of filter drain material at the edge of the carriageway see CD 525 [Ref 2.N] .*

Traffic lane widths

E/3.10 The minimum dimensions for smart motorway traffic lane widths shall be as shown in Table E/3.10.

Table E/3.10 Minimum dimensions for smart motroway traffic lane widths

Lane 1 (metres)	Lane 2 (metres)	Lane 3 (metres)	Lane 4 (metres)
3.65	3.50	3.40	3.20

NOTE *The dimensions given in Table E/3.10 are for converting a 3 lane motorway with a hard shoulder to a 4 lane ALR motorway and lanes are to be measured in accordance with CD 127 [Ref 1.N].*

E/3.11 Where compliant hard strips are provided in accordance with CD 127 [Ref 1.N], the hierarchy for increasing lane widths above the dimensions shown in Table E/3.10 shall be to allocate additional width to lane 2, then lane 3 and finally lane 4.

E/3.11.1 The impact on the joints in both the surface and the binder course from the movement of wheel tracks should be addressed in the design.

NOTE 1 *Relocating the lane lines (without carriageway resurfacing) can result in the proposed wheel tracks moving over the existing longitudinal joints in the final solution.*

NOTE 2 *When considering the impact of wheel tracks on longitudinal joints for lane widths below 3.65 metres, wheel track zones can be assumed to be 600mm wide at 2050mm centres, centred in the lane.*

Central reserves

E/3.12 Where it is proposed to reduce the central reserve (including hard strips) to 3.40 metres or less, the maintaining organisation shall be consulted to ensure that any implications on maintenance activities have been considered and any potential issues resolved.

E/3.13 Central reserve widths shall be wide enough to accommodate any relevant equipment, the working widths for the VRS and be no less that 2.60 metres wide including hard strips.

E/3.14 The use of unbound materials in the central reserve shall only be proposed when it has been endorsed by the SCRG.

E/3.14.1 Where works are undertaken in the central reserve, the use of unbound material as the surface treatment should be avoided.

E/3.14.2 Where unbound material is used in the central reserve, the material should be stabilised in accordance with CD 525 [Ref 2.N].

Vehicle restraint system set back

E/3.15 The set-back to a VRS shall be measured as the lateral distance between the traffic face of a safety barrier and:

1) nearside:
   a) the back of the nearside hard strip (when it is greater than 600mm) or hard shoulder;
   b) the kerb face for roads without a nearside hard strip (or hard strip less than 600mm) or without hard shoulder;
   c) the trafficked edge of the edge line for roads without a hard strip (or hard strip less than 600mm), or without hard shoulder or kerb;
2) offside:

a) the trafficked edge of the edge line or the kerb face where there is no edge line.

E/3.16 The minimum set-back dimensions that shall be used for smart motorways are as given in Table E/3.16.

Table E/3.16 Smart motorway set-back

Location	Minimum set-back value (mm)	Available relaxations at sites described in footnotes
In verges with no adjacent hard strip or hard shoulder (i.e. <than 600mm width hard strip)	1200	Notes 1, 2, 4
In verges with an adjacent hard strip or hard shoulder (i.e. ≥ 600mm width hard strip)	600	Note 3
Central reserves	1200	Notes 1, 2, 4
Note 1. Relaxation to 600mm for roads of speed limit 50mph or less (including temporary mandatory speed limits). Note 2. Relaxation to 600mm at existing roads with physical constraints (e.g. a structure) where it could be difficult to provide the minimum set-back value. Note 3. Relaxation to 450mm is permitted where it is considered necessary to position the VRS away from the edge of an existing embankment in order to provide support to the foundation. Note 4. Relaxation to 1.00 metre is permitted where space is limited for extended lengths.		

E/3.16.1 Set-back dimensions greater than the minimum values given in Table E/3.16 should be provided wherever practicable on smart motorways.

E/3.17 The relaxations in set-back identified in Table E/3.16 shall not be applied if they create non-compliant stopping sight distance in accordance with CD 109 [Ref 4.N].

E/3.18 For the purposes of measurement of set-back, an emergency area shall be treated as a hard shoulder.

E/4. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CD 127, 'Cross-sections and headrooms'
Ref 2.N	Highways England. CD 525, 'Design of combined surface and sub-surface drains and management of stone scatter'
Ref 3.N	Highways England. CD 122, 'Geometric design of grade separated junctions'
Ref 4.N	Highways England. CD 109, 'Highway link design'
Ref 5.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 6.N	Highways England. GD 300, 'Requirements for new and upgraded all-purpose trunk roads (expressways)'
Ref 7.N	Highways England. GG 104, 'Requirements for safety risk assessment'
Ref 8.N	Highways England. TD 131, 'Roadside technology and communications'
Ref 9.N	IAN 161, 'Smart Motorways'