
VOLUME 6 ROAD GEOMETRY
SECTION 1 LINKS

PART 2

TD 27/05

CROSS-SECTIONS AND HEADROOMS

SUMMARY

This Standard sets out the dimensional requirements for the highway cross-sections for all-purpose and motorway trunk roads, both at and away from structures. It also gives requirements for headroom at structures.

INSTRUCTIONS FOR USE

1. Remove Contents pages from Volume 6 and insert new Contents page for Volume 6 dated February 2005.
2. Remove TD 27/96 from Volume 6, Section 1 which is superseded by this Standard and archive as appropriate.
3. Insert TD 27/05 into Volume 5, Section 1.
4. Please archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from The Stationery Office Ltd.



THE HIGHWAYS AGENCY



SCOTTISH EXECUTIVE



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**THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND**

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Contents

Chapter

1. Introduction
2. Design Principles
3. Design Process
4. Highway Cross-Sections
5. Highway Cross-Sections at Structures
6. Headrooms at Structures
7. References
8. Enquiries

Annex A Features Commonly Occurring in the
 Highway Cross-Section

Annex B Rural Motorway Widening, Cross-Section
 and Layout at Physical Restraints

1. INTRODUCTION

1.1 General

1.1.1 This Standard sets out the design principles and factors that should be considered by Design Organisations in selecting highway cross-sections and headrooms. The process of design is described together with an approach to developing options.

1.1.2 This Standard supersedes TD 27/96. The major changes are:

- i. the use of a modular system to describe the individual components of the cross-section;
- ii. the acknowledgement that society demands measures to permit better use of existing roads;
- iii. further guidance to encourage consideration of future maintenance operations;
- iv. a widening of the road pavement in certain circumstances for reasons of buildability and to accommodate future traffic management layouts;
- v. emphasis on the need to fully consider and promote facilities for non-motorised road users;
- vi. the way in which certain components of the cross-section are measured;
- vii. the presentation of information has been clarified and improved, with new Tables and additional Figures; and
- viii. definitions have been updated and extended:
 - guidance associated with reduced width hardshoulders, central reserve and lane widths to assist in the widening of rural motorways at short obstructions. See Annex B; and
 - advice given on the provision of off-side hardstrips.

1.2 Scope

1.2.1 This Standard gives details of the cross-sections and headrooms to be used for all-purpose and motorway trunk roads, both at and away from structures.

1.2.2 The information covers trunk roads of all types: rural motorways, rural all-purpose roads, urban motorways and urban all-purpose roads, together with associated connector roads.

1.2.3 The cross-section of side roads that are not part of the Overseeing Organisation's network should be agreed with the relevant Highway Authority. Further details are given in Chapter 5.

1.2.4 This Standard is not applicable to road tunnels. For guidance see **BD 78 (DMRB 2.2.9)**.

1.2.5 For details of pedestrian, cycle and equestrian subway dimensions see **TD 36 (DMRB 6.3.1)** and **TA 91 (DMRB 5.2.4)**, for footbridges see **BD 29 (DMRB 2.2.8)**, and for agricultural crossings see **TA 57 (DMRB 6.3)** and **TA 56 (DMRB 8.2)**.

1.2.6 This standard does not give mandatory requirements for headroom near airports or at power lines, but Annex A provides details of sources of information.

1.3 Implementation

1.3.1 This Standard must be used forthwith for the design of all schemes for the construction and improvement of all-purpose and motorway trunk roads currently being prepared, provided that in the opinion of the Overseeing Organisation, this would not result in any significant additional expense or delay. The Design Organisation must confirm its application to particular schemes with the Overseeing Organisation.

1.4 Definitions

1.4.1 For the definitions of the general highway terms used in this Standard, such as "highway types" (trunk roads, motorway and all-purpose roads etc) and

“components of the highway” (hardshoulders, hardstrips and climbing lanes etc.), see **BS 6100: Subsection 2.4.1**.

1.4.2 Particular terms used in this Standard are defined as:

Bridleway: Highway for use on foot or horseback (unless specifically prohibited, cyclists can also use a bridleway but are required to give way to other users).

Berm: Any nominally flat area between the back of the verge and the highway boundary at the top of a cutting or the bottom of an embankment.

Central Reserve: The area that separates the carriageways of a dual carriageway exclusive of any hardstrips.

Connector Road: Refer to **TD 22 (DMRB 6.2.1)**.

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. The cross-section includes carriageways, central reserve, separator zones, hardshoulders, hardstrips, verges including any footway, cycle track or bridleway, cutting or embankment slopes and berms. (See Figure 4-1a to Figure 4-4b).

CSRRS (Current Standard for Road Restraint Systems): Please refer to the Overseeing Organisations' current standard for road restraint systems. Note: Where diagrams within TD 27 show vehicle restraint systems, these are for illustrative purposes only and the CSRRS must be consulted to determine the appropriateness of any provision.

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 commissioned to undertake the various phases of scheme preparation.

Designated Lanes: A lane reserved exclusively for use by designated vehicles such as cycles, buses, taxis, large goods vehicles and high occupancy vehicles.

Downstream: That part of the carriageway(s) where the traffic is flowing away from the cross-section in question.

Headroom: The minimum distance between the surface of the highway cross-section and the deflected structure (including any temporary or permanent attachments) measured at right angles to the surface of the cross-section.

Interchange: Refer to **TD 22 (DMRB 6.2.1)**.

Interchange Link: Refer to **TD 22 (DMRB 6.2.1)**.

Loops: Refer to **TD 22 (DMRB 6.2.1)**.

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

Maintained Headroom: The minimum value of Headroom that must be preserved at all times.

Margin: EITHER the area between the Paved Width and an NMU route OR an area between two parallel NMU routes OR an area between an NMU route and a physical boundary.

New Construction Headroom: The value of Headroom for new structures that includes an additional allowance for future road realignment and resurfacing.

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

Non-Motorised Users (NMUs): Pedestrians, cyclists and equestrians including mobility impaired users as defined in **HD 42 (DMRB 5.2.5)**.

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

Overbridge: A bridge that spans the road under consideration.

Overseeing Organisation: The Highway Authority for the road construction or improvement scheme.

Paved Width: A collective term for the surface of the road cross-section that comprises the carriageway, hardshoulder and hardstrips.

Paved Width Headroom: The value of Headroom over the Paved Width.

Road Tunnel: Refer to **BD 2 (DMRB 1.1)**.

Rural Roads: All-purpose roads and motorways that are generally not subject to a local speed limit. Refer to TA 46 (DMRB 5.1.3).

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

Slip Road: Refer to TD 22 (DMRB 6.2.1).

Standard Headroom: Either Maintained Headroom or New Construction Headroom, as appropriate.

Structure: Any object with the primary purpose of bearing loads. This includes bridges, footbridges, retaining walls and sign or signal gantries, but excludes more frangible items such as deformable vehicle restraint systems and small span drains.

Structure Free Zone (SFZ): A buffer zone adjacent to the Paved Width and beneath a Structure 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 under consideration.

Urban Roads: Refer to TA 79 (DMRB 5.1.3).

Urban Motorway: A motorway with a speed limit of 60 mph or less within a built-up area.

Urban All-Purpose Road (UAP): 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.

Upstream: That part of the carriageway(s) where traffic is flowing towards the cross-section in question.

Vehicle Restraint System (VRS): Refer to CSRRS.

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 highway with five or more lanes in any one direction.

Working Width: Refer to CSRRS.

1.5 Mandatory Sections

1.5.1 Mandatory sections of this document are contained in boxes. The Design Organisation must comply with these sections or obtain agreement to a Departure from Standard from the Overseeing Organisation. The remainder of the document contains advice and explanation, which is commended to users for consideration.

1.6 Departures From Standard

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

1.7 Relaxations

1.7.1 In difficult circumstances Relaxations may be introduced at the discretion of the Design Organisation, having regard to all relevant local factors, but only where specifically permitted by this Standard. Careful consideration must be given to layout options incorporating Relaxations, having weighed the benefits and any potential disbenefits. Particular attention must be given to the safety aspects (including operation, maintenance, construction and demolition) and the environmental and monetary benefits/disbenefits that would result from the use of Relaxations. The consideration process must be recorded. The preferred option must be compared against options that would meet full Standards.

2. DESIGN PRINCIPLES

2.1 General

2.1.1 This chapter describes the principles to be followed when designing highway cross-sections for new and improved all-purpose trunk roads and motorways.

2.1.2 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. Some decisions relating to the cross-section are made during project development, such as the capacity and number of lanes. Other decisions, such as the type of road, are made earlier in the process.

2.1.3 This Standard defines and describes the components and presents guidance on details of their design. The basic components are identified separately to simplify definition and interpretation as an aid to design consistency and application. Different arrangements of the components are to be used depending on the functional classification of the highway. The Design Organisation's role is to decide

which of the components to include and the selection of the appropriate dimensions.

2.2 Co-ordinated Design

2.2.1 There are many components in a highway provided for specific purposes and each involves a number of interrelated design decisions. Integrating all these components to satisfy the numerous competing demands for highway space and functionality requires carefully balanced decisions. Plate 2-1 provides an illustration to emphasize this point.

2.2.2 Features included in the cross-section can affect the overall width and their relationship and interaction is often complex. The preferred locations for features in verges and the central reserve may often coincide or overlap and the Design Organisation should be aware of the potential for such conflicts. Generally, there is far more equipment below the surface of verges and central reserves than is apparent on the surface and some underground features must be readily accessible for routine maintenance.



Plate 2-1: Sharing Space in the Cross-section

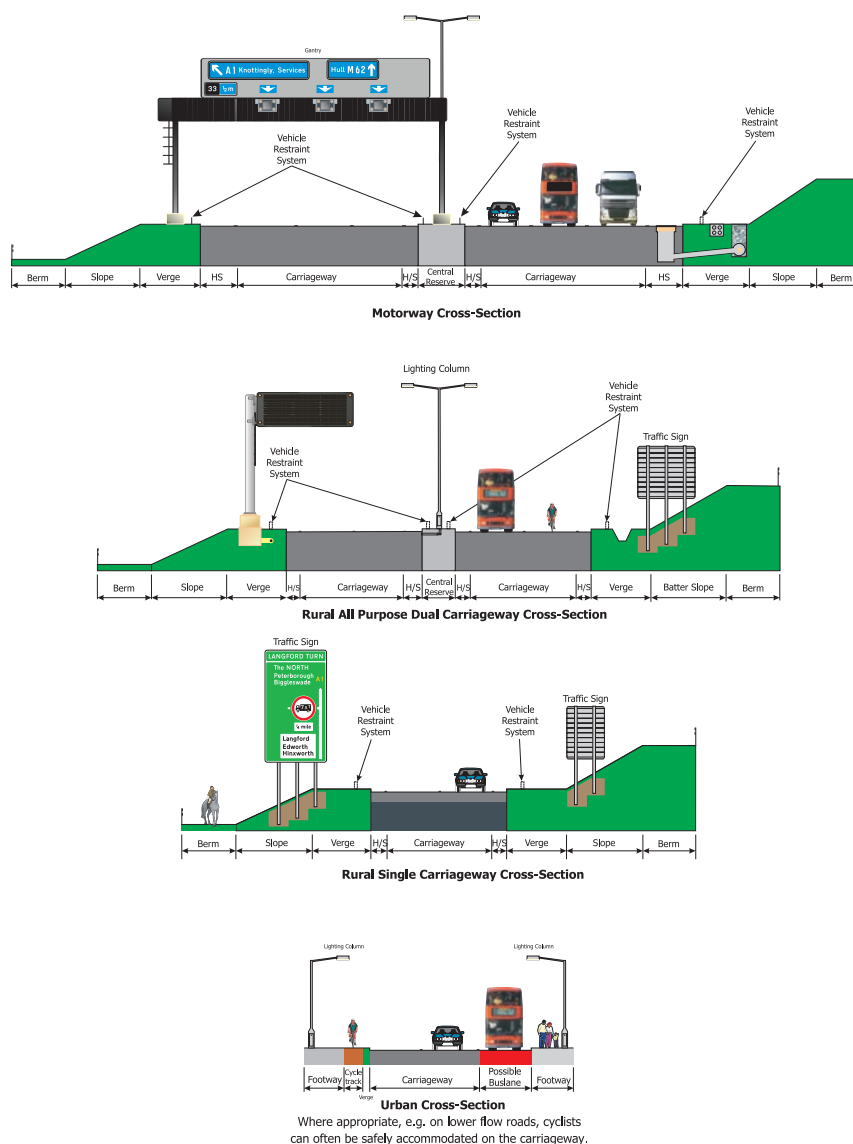
2.2.3 Towards the end of the design process, Design Organisations are occasionally faced with fitting additional detailed design features into the available highway. Problems can be avoided by ensuring that the approximate sizes and locations of detailed design features are identified during the very early stages of the design so that the required space can be determined.

2.2.4 Design Organisations may need to consider the possibility of future widening, particularly at structures. See paragraph 5.1.5 for guidance.

2.2.5 Figure 2-1 illustrates the size and extent of typical features above and below ground that may need to be accommodated in the verge and central reserve of roads. With the wide range of features that actually occur, details are best designed individually for each

situation. Plate 2-2 and Plate 2-3 show general examples of rural and urban road situations to highlight the differing road environments.

2.2.6 The Design Organisation should ensure that the blend of the various components within the available space balances considerations of safety, environmental impact, cost, buildability, operation and maintenance. Where there are options for dimensions, the decision making process should include due consideration of the often complex interaction between these factors and any other design constraints. Proper consideration of the basic design will help ensure that both new roads and improvements to existing highways fit harmoniously into their surroundings.



Note:
HS - Hardshoulder
H/S - Hardstrip

Figure 2-1: Typical Features to be Accommodated in the Cross-Section



Plate 2-2: Typical Rural All Purpose Dual Carriageway Cross-section



Plate 2-3: Typical Urban Cross-section

2.3 Classification of Highways

2.3.1 Two broad divisions are used in this Standard for defining the cross-section in association with the environment through which the highway passes; namely Rural Roads and Urban Roads. These are further subdivided into Motorways and All-Purpose roads with a further category to distinguish between Mainline and Connector roads.

2.4 Variations between Rural and Urban Roads

2.4.1 In urban areas there will usually be less scope for co-ordinating features than in rural areas, although wherever economically and environmentally practicable every effort should be made to do so. The Design Organisation will need to ensure a careful balance between the many competing demands.

2.4.2 In urban areas there are likely to be numerous items of street furniture and underground equipment within the highway cross-section. See **TD 9 (DMRB 6.1.1) and Transport in the Urban Environment** for further advice on designing urban single and dual carriageway roads.

2.4.3 While there may be fewer items of underground equipment in rural areas, those that do exist are likely to be high capacity services, which could have a bearing on the economical and effective delivery of subsequent maintenance and operation of the network.

2.5 Network Objectives

2.5.1 The aim is to deliver an economic, accessible, integrated, safe, reliable, 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 highways for the benefit of non-motorised users. The Design Organisation should take these factors into account throughout the design process.

2.6 Designated Lanes

2.6.1 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 highway space to buses and other designated vehicles can greatly improve journey times and reliability thereby encouraging modal shift.

2.6.2 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 Overseeing Organisation 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.

2.6.3 The Design Organisation must ensure that the proposed cross-section and lane widths are adequate to enable maintenance to be undertaken safely. Care must be taken to ensure that where cyclists are permitted to use the designated lane, the width is adequate for this purpose.

2.6.4 Any proposal to install a designated lane on a trunk road carriageway is a Departure from Standard.

2.6.5 For further design considerations associated with designing in an urban environment see **TD 9 (DMRB 6.1.1)**. See **Traffic Advisory Leaflets, Local Transport Notes and Transport in the Urban Environment** for further advice on designing facilities for bus lanes and other designated lanes.

2.7 Non-Motorised Users

2.7.1 It is essential that Design Organisations integrate facilities for NMUs in the design at an early stage so that they are not overlooked when allocating space. To do this effectively, Design Organisations must be able to understand the highway environment from an NMU's perspective and its relationship to the various road design components.

2.7.2 During project appraisal involving new construction or improvement of an existing road, Design Organisations must determine and make adequate provision for any NMU requirements. See **TA 90 (DMRB 6.3.5)**, **TA 91 (DMRB 5.2.4)**, **HD 42 (DMRB 5.2.5)** and **IHT Guidelines For Providing For Journeys On Foot**.

2.7.3 The Design Organisation's attention is drawn to the statutory duty to provide proper and sufficient footways for pedestrians and adequate margins for ridden horses and driven livestock where it is

considered necessary, or desirable, for the safety or accommodation of these road users.

2.8 Persons with Disabilities

2.8.1 Persons 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 because it allows greater independence for persons with disabilities.

2.8.2 Legislation prohibits discrimination on the basis of disability, and the Design Organisation must take into account any implications of statute when considering the design of highway features.

2.8.3 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 Overseeing Organisation as part of the reporting procedure outlined in paragraph 2.7.2 above.

2.8.4 For further advice on designing for the needs of persons with disabilities, see **Department for Transport guidelines**, on **Inclusive Mobility**.

2.9 Environmental Design

2.9.1 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 highway. **The Good Roads Guide (DMRB 10.1 and 10.2)**, **HA 67 (DMRB 10.4.1)** and **DMRB Vol 11** describe the approach to be taken.

2.9.2 **HA 56 (DMRB 10.1.2 Chapter 12)** gives advice for planting distances between the Paved Width and trees and shrubs. Design Organisations should be aware that only grass is likely to survive in narrow areas and that a significant width is required to develop and maintain trees and shrubs. Thin strips of grass are undesirable as they often fail to prosper and are difficult to maintain. Paragraphs 4.6.6 and 4.6.7 provide further advice on the choice between hard and soft features.

2.9.3 Existing road corridors may contain significant biodiversity interest which may be required to be conserved, enhanced or reinstated when road improvements are being considered.

3. DESIGN PROCESS

3.1 General

3.1.1 For the purposes of developing initial layouts, the Design Organisation should determine the appropriate typical width for the highway cross-section and any variation in width required. The type of highway and number of lanes needed for a facility is usually determined during the concept stage of project development. Figure 3-1 provides a flow chart as simplified guidance on the design process.

3.2 Health and Safety Responsibilities

3.2.1 When selecting the most appropriate carriageway type, including connector roads, for a new or improved road using **TA 46 (DMRB 5.1.3)** there is a requirement to consider the future maintenance and operation of the road. Health and Safety legislation also requires that consideration be given at the design stage to the safety of maintenance operations and the safety of all who may be required to work on or near the highway in the course of their duties, e.g. emergency service personnel. In certain circumstances, when selecting the cross-section, the Design Organisation may need to:

- i. enhance particular cross-sectional components along a whole route or link;
- ii. provide localised widening of standard cross-sections;
- iii. select a higher standard carriageway than suggested on traffic grounds alone by **TA 46 (DMRB 5.1.3)**.

3.2.2 Design Organisations must consider maintenance issues on a scheme-by-scheme basis and the selection of standard cross-sections in **TA 46 (DMRB 5.1.3)** and TD 27 does not obviate the need for such considerations. The Design Organisation must compile a statement of scheme specific maintenance and health and safety issues ensuring that all maintenance activities are considered. The Design Organisation must consult with the Maintaining Organisation when compiling this statement. The Design Organisation must

recommend the most appropriate cross-section to the Overseeing Organisation and must agree the timing of such recommendations at the outset of the scheme. This paragraph does not relieve Design Organisations of their statutory health and safety responsibilities.

3.3 Range of Choice

3.3.1 The Paved Width of the cross-section varies according to the type of road. Standard dimensions have been selected on the basis of operational experience in the United Kingdom and elsewhere, including the requirements of current and predicted vehicle construction and use.

3.3.2 The widths of traffic lanes, hardshoulders and hardstrips are mandatory for a particular type of road. Some flexibility, as described in this Standard, is available on the width of berms, side slopes, verges and central reserves.

3.3.3 The required standard of provision and actual position of features for NMUs should be considered in accordance with paragraph 2.7.2.

3.4 Visibility

3.4.1 On curved alignments and approaches to junctions, it may be necessary to widen the cross-section, particularly verges and central reserves, to ensure that the layout meets visibility requirements. Refer to **TD 9 (DMRB 6.1.1)**.

3.5 Features Within the Highway

3.5.1 Annex A provides an indication of the features that commonly occur within the highway cross-section as a preliminary checklist. Where applicable, Annex A refers to other Standards, Advice Notes and documents that contain further details.

3.5.2 The guidance provided by Annex A emphasizes the wide range and often complex interaction of features that the Design Organisation may have to take into account when devising a suitable cross-section.

3.5.3 The scheme design should make adequate provision for the accommodation of roadside equipment and allow for safe installation and maintenance access.

Allowances should also be made within the cross-section for the future installation of additional equipment as more sophisticated control systems are developed for the network.

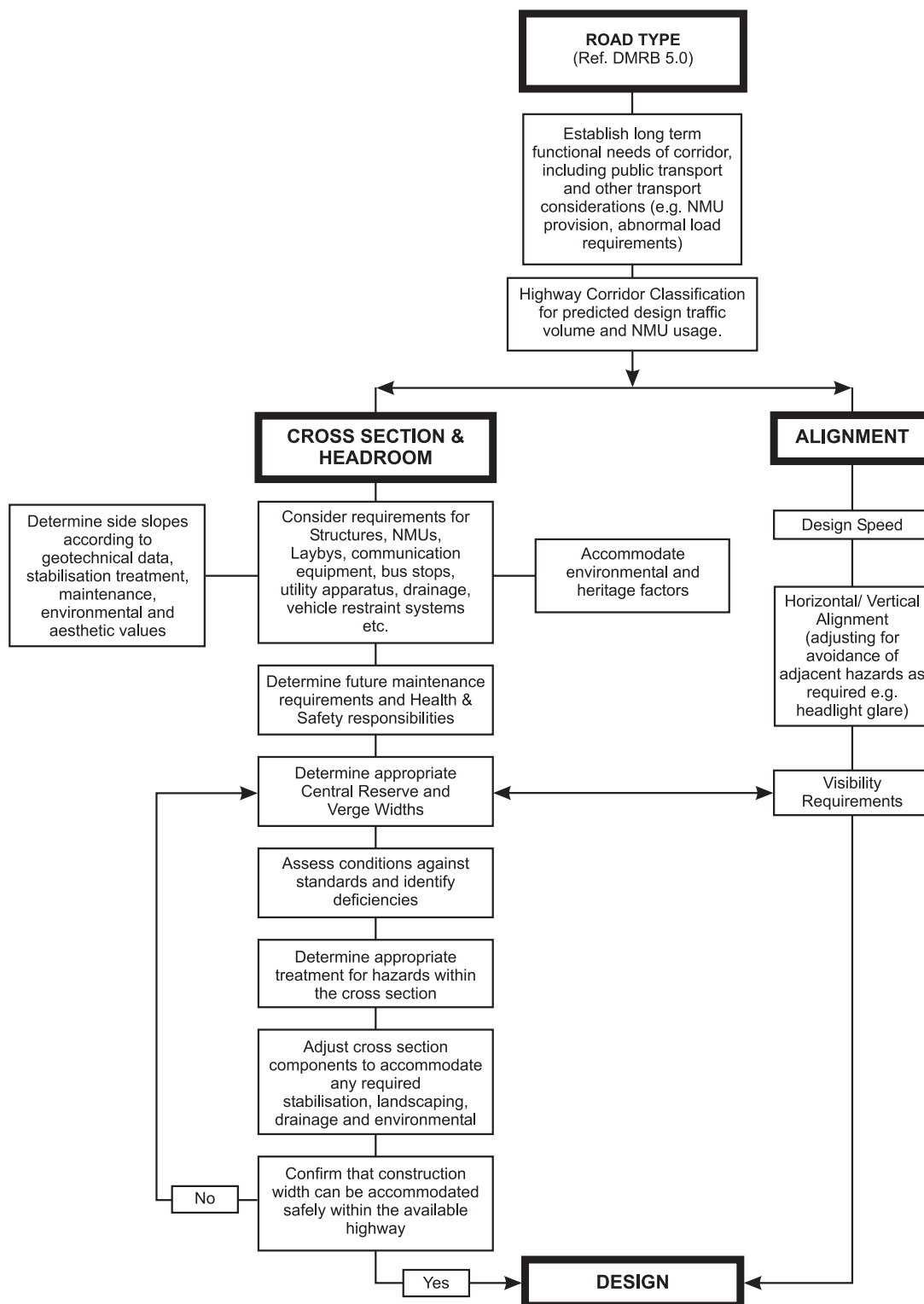


Figure 3-1: Cross-Section Design Flow Chart

4. HIGHWAY CROSS-SECTIONS

4.1 General

4.1.1 This chapter identifies the components of the cross-section and presents guidance on details of their design. It applies to all cross-sections other than those through or across structures for which specific requirements are given in Chapter 5. Figure 4-1a to Figure 4-4b show sections with detailed dimensions to indicate how the various components should be brought together to form the cross-section of different types of road.

4.1.2 Numerous changes in the cross-section are not desirable and a consistent width is to be preferred whenever practicable along a route.

4.2 Paved Width

4.2.1 The dimensions of the components of the Paved Width must be as given in Figure 4-1a to Figure 4-4b. Any reduction or increase in these dimensions is a Departure from Standard, with the exception that:

- i. 6.0m single carriageway all-purpose roads are permitted in Scotland and Northern Ireland for design year flows of 5000 AADT or less;
- ii. for dual carriageway pinch points, refer to paragraph 4.3.3;
- iii. for off-side hardstrips refer to paragraph 4.4.3;
- iv. for swept paths refer to paragraph 4.3.2.

4.3 Traffic Lane Width

4.3.1 This Standard adopts a single method to define lane widths. Lane widths are measured between the trafficked side of carriageway edge lines and the centre line of lane lines.

4.3.2 Traffic lanes must be widened on curves of low radius to allow for the swept path of long vehicles. See **TD 9 (DMRB 6.1.1)** and **TD 42 (DMRB 6.2.6)**.

4.3.3 **TD 9 (DMRB 6.1.1)** allows lane widths narrower than those given in TD 27 at new dual carriageways through pinch points. A Departure from Standard is therefore not required for lane widths that comply with TD 9 under these conditions. See **TD 9 (DMRB 6.1.1)**.

4.4 Hardstrips

4.4.1 A hardstrip provides a surfaced strip that abuts on the carriageway. The key reasons for the provision of hardstrips include:

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

4.4.2 The hardstrip 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.

4.4.3 **DMRB 4.2** requires the Design Organisation to carefully consider the removal of surface water from off-side lanes. It is not within the scope of TD 27 to predict the precipitation and drainage requirements of a particular road and the values of dimension 'F' in Figure 4-1a to Figure 4-4b do not include any allowance for flooded width. Dimension 'F' may be increased to a maximum of 1.00m where appropriate, e.g. when the road falls to the right.

4.4.4 Hardstrips on urban roads are not normally provided due to the associated constraints on land-take and land costs. Urban roads have lower design speeds and are often more congested than those in rural areas. Generally drivers do not expect rural standards in urban areas and the restriction of width can assist with encouragement of low speeds, which is of safety benefit due to the large number of accesses and NMUs, particularly those crossing the road. On urban roads the carriageway edge treatment will generally include positive drainage and kerbs, which provides additional edge restraint and support for raised footways and verges.

4.5 Hardshoulders

4.5.1 The hardshoulder 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.

4.5.2 Offside hardshoulders are not permitted.

4.6 Central Reserves

4.6.1 Central reserves provide physical separation between carriageways thereby providing freedom from interference from opposing traffic, particularly where space is allowed for the construction of a VRS, if appropriate.

4.6.2 Minimum central reserve widths are given in Figure 4-1a to Figure 4-4b. A central reserve width less than the minimum is a Departure from Standard.

Greater dimensions may be used in circumstances where this would be preferable. 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. The Design Organisation should consider whether it is necessary to widen the central reserve in order to:

- i. provide the requisite stopping sight distances in accordance with **TD 9 (DMRB 6.1.1)**;
- ii. accommodate any street furniture, utility or drainage features and equipment (**DMRB 4.2**);
- iii. meet the requirements of CSRRS for road restraint systems;
- iv. accommodate any permanent signs required with particular attention to the provision of adequate working width and set-back for VRSs relative to the complete sign assembly;
- v. accommodate significant difference in levels of adjacent carriageways;
- vi. accommodate temporary traffic management layouts for the envisaged maintenance regime;
- vii. accommodate matrix signs and signals;
- viii. accommodate any parts of structures or complete structures;
- ix. provide sufficient space for maintenance operations;
- x. fulfil landscape and environmental objectives;
- xi. accommodate NMUs.

4.6.3 The Design Organisation should consider other features that may have to be accommodated in the central reserve, some of which are listed in Annex A and also the Health and Safety responsibilities highlighted in Section 3.2. During project appraisal the Design Organisation should also ensure that future network plans for traffic control (e.g. gantries) are taken into account.

4.6.4 Reference should be made to **TD 42 (DMRB 6.2.6)** for guidance on widening the central reserve at priority junctions on dual-carriageway all-purpose roads. Away from junctions, crossing places for NMUs, both controlled and uncontrolled, may require significant space, particularly where equestrians and cyclists are expected.

Maintenance Crossovers

4.6.5 **TA 92 (DMRB 8.4.6)** provides advice on the design of central reserve crossovers used during temporary traffic management situations, including advice for the planning of new roads. **BD 78 (DMRB 2.2.9)** provides requirements on crossovers at tunnels.

Hardening of Central Reserves

4.6.6 Techniques for reducing maintenance liabilities within central reserves should be considered during the preparation of new roads and improvements and also for major maintenance operations on existing roads to reduce risks to both operatives and other highway users. Such techniques may include hardening or the planting of low growth species of grass.

4.6.7 When deciding whether to harden central reserves, Design Organisations should:

- i. check the adequacy of the surface water drainage system;
- ii. 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. The environmental database for the route should therefore be consulted;
- iii. determine the area to be hardened, based on what areas of vegetation may be left uncut without affecting visibility or sign conspicuity;
- iv. consider the appearance (see paragraph 4.6.9);
- v. take account of whole-life costs and safety considerations.

4.6.8 **TA 92 (DMRB 8.4.6)** gives advice on pavement designs at maintenance crossovers. Away from crossovers, any general hardening of the central reserve should be designed to be capable of withstanding light vehicle over-run and prevent weed growth. The Overseeing Organisation should be consulted for advice on the pavement specification.

4.6.9 Consideration should be given to the provision of coloured surfacing that contrasts with the main carriageway where the hardened area may be perceived as a stopping facility. This is only likely where the VRS set-back is 1.5m or above. The overall width of any colouring will depend on individual circumstances. In some situations it may be appropriate to continue the coloured surface across the whole central reserve, while in others, for reasons of cost or aesthetics, the width may be limited to the traffic side of the VRS.

Earthworks and Landscaping

4.6.10 It is generally undesirable to provide earthworks and landscaping within the central reserve, as they can be difficult and expensive to maintain.

4.7 Verges

4.7.1 The verge is important from a number of perspectives, including safety, the environment and when considering the initial cost and ongoing maintenance and operating costs. It can provide a separate route for NMUs on all-purpose roads and also offers an area to accommodate footways 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.

4.7.2 Minimum verge widths are given in Figure 4-1a to Figure 4-4b. A verge width less than the minimum is a Departure from Standard. Note: Where the Figures denote 'varies', the decision rests with Design Organisations, taking into account the advice in this Standard.

Advice concerning choice of verge width corresponds with that provided for central reserves in Section 4.6. Additional advice solely for verges is given below.

4.7.3 **CSRRS** provides requirements to ensure safety if a VRS is struck and deflected near the edge of an embankment slope. Design Organisations must comply with **CSRRS** and where necessary, for example on the approach to underbridges, additional verge width must be provided.

4.7.4 Motorists often prefer to use the nearside verge in preference to the hardshoulder as a place to stop in the event of emergencies. This practice can also assist the passage of emergency vehicles. The provision of continuous nearside VRS, or systems with very few breaks, could prejudice this practice. Refer to Section 4.11 for advice on increasing a set-back.

4.7.5 For verges on urban roads, in particular motorways, environmental fencing is becoming a regular feature of the cross-section and the Design Organisation should establish the requirements as early as practicable.

4.7.6 Where it is necessary to accommodate communications ducting and chambers, a minimum verge width of 2.0m must be provided.

4.7.7 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.

4.7.8 The concept of providing wide verges to slow and contain errant vehicles has significant land take implications. Research has indicated that only a small proportion of injury accidents would be avoided if verges were doubled in width. Consequently, vehicular safety aspects will not normally be a factor when choosing a verge width greater than the minimum width, provided visibility requirements are met and space exists for any VRS that may be required.

4.7.9 Verges should be sufficiently level and free from hazards to permit their occasional use by NMUs in the absence of dedicated facilities. Footways, cycle tracks and other NMU facilities are usually provided within highways in urban areas, but are less frequent in rural areas.

4.7.10 Provision for NMUs on all-purpose roads must be made where a local need has been identified and agreed with the Overseeing Organisation in accordance with **TA 90 (DMRB 6.3.5)**, **TA 91 (DMRB 5.2.4)**, **HD 42 (DMRB 5.2.5)** and **Environmental Assessment (DMRB 11.0)**.

4.7.11 Where footways are provided, the widths must be in accordance with **HD 39 (DMRB 7.2.5)**.

4.8 Berms and Side Slopes

4.8.1 Berm and side slope widths should be chosen to suit the local situation. The width of berm will depend upon:

- i. terrain;
- ii. environmental design features;

- iii. engineering and geotechnical measures used to accommodate changes in ground levels;
- iv. the need to accommodate various types and widths of drain and other services in any berm;
- v. maintenance requirements.

4.8.2 A degree of flexibility is available to the Design Organisation when selecting the berm width although a desirable width of 3.0m is recommended. The berm may however provide a reasonable route for NMUs and Design Organisations should consider their needs to determine if the chosen width is adequate.

4.8.3 Whenever practicable, side slopes adjacent to emergency roadside telephones should be kept to a minimum angle to assist motorists in waiting at the highway boundary in the event of an emergency or breakdown. See **TA 73 (DMRB 9.4.2)** for further advice on location of emergency telephones.

4.8.4 At all sites where cattle or horses will be expected to cross the road, any side slope angles will have an impact on highway safety. Alternative means of crossing are described in **TA 56 (DMRB 8.2)** and **TA 57 (DMRB 6.3)**.

4.9 Wide Highway Corridors

Motorway Lane Provision

4.9.1 Dual 4-lane Motorway remains the maximum standard of provision in the UK. In exceptional circumstances it may be necessary to provide wider carriageways to link closely spaced junctions in order to provide reasonable lane continuity and sufficient capacity. Where weaving flows are high it may be more desirable to provide link roads. For further guidance see **TD 22 (DMRB 6.2.1)**.

4.9.2 Design Organisations should be aware that for wide carriageways, the size of items such as storage tanks and gantry substructures can be considerable and adequate width should be allowed in verges and central reserves. Drainage on wide carriageways should also be considered at an early stage in the design process with reference to **TA 80 (DMRB 4.2.2)**.

4.9.3 Wide carriageways may also create difficulties for maintenance (including provision of a winter service) and incident management. Also see Section 3.2.

4.9.4 Any proposal for dual 5-lane motorway (D5M) or greater width is a Departure from Standard.

Auxiliary Lane Provision

4.9.5 Where auxiliary lanes are provided in accordance with general arrangement layouts given in **TD 22 (DMRB 6.2.1)**, the width of the auxiliary lane(s) must be equal to the width of the adjacent nearside mainline lane as shown in Figure 4-1a, Figure 4-2a, Figure 4-3a and Figure 4-4a, as appropriate. Any proposal that includes auxiliary lanes, and creates a carriageway of more than five lanes in one direction is a Departure from Standard.

4.9.6 The provision of either a hardshoulder or hardstrip adjacent to an auxiliary lane must be consistent with the provision on the mainline.

4.10 Connector Road Lane Provision

4.10.1 For guidance on determining the required number of lanes, hardshoulder and hardstrip provision on connector roads, see **TD 22 (DMRB 6.2.1)**.

4.10.2 Where connector roads approach junctions, those dimensions given in the relevant Standards (**See DMRB 6.2**) 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.

At such connector roads the requirements shown in Figure 4-5 to Figure 4-7 must apply.

4.10.3 Widths of single lane connector roads have been determined to allow routine maintenance activities to be undertaken. Full resurfacing within such widths may not be possible without closing the connector road. Where this is likely to cause significant safety or journey time disbenefits Design Organisations should increase the width. Consistent with paragraph 4.2.1 above, this is a Departure from Standard.

4.10.4 Widths of two lane connector roads have been determined to allow all maintenance activities to be undertaken, including full resurfacing. Where significant constraints exist, Design Organisations may consider a reduction in width via a Departure from Standard application, taking into account any safety and delay disbenefits of the diversion route if a connector road has to be closed. Applications that do not allow routine maintenance to be carried out in safety whilst keeping the connector road open are unlikely to be approved.

4.10.5 For slip roads that carry two-way traffic for some of their length, the width of central reserve must be consistent with those given in Figure 4-1a, Figure 4-2a, Figure 4-3a and Figure 4-4a. Tight radii will often require greater widths to allow for sight lines.

4.11 Miscellaneous Features

Separator Zones

4.11.1 The widths of separator zones should generally follow the decision-making process used to determine central reserve widths discussed in Section 4.6 above. Design Organisations 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.

4.11.2. Where traffic on any lane of a parallel road runs counter to the mainline traffic flow then the risks associated with headlight glare must be assessed and the need for mitigation measures must be considered.

Methods include:

- i. designing the alignments of the roads so as to provide significant level differences;
- ii. screening fences or earth bunds;
- iii. appropriately designed soft planting that provides foliage all year round at the correct heights;
- iv. where the use of a VRS is recommended by CSRRS, it may be practicable to provide a system that is designed to cut-off glare.

4.11.3 These items should be considered alongside the advice given in Section 4.6 above when selecting the width required for separator zones.

Chambers and Gullies

4.11.4 Advice on the location of drainage features, including access chambers, is given in **DMRB 4.2**. Design Organisations should be aware that siting access chambers and gullies within hardshoulders may affect the adequacy of temporary traffic management layouts and may also create additional maintenance liabilities. On all-purpose roads used by cyclists, access chambers and gullies within the hardstrip may also cause problems.

Maintenance Hardstandings

4.11.5 Consistent with Section 3.2 above, areas of hardstanding for maintenance activities provide a safety benefit to the highway and those working on it. Consideration should therefore be given to their provision along the route. Hardstandings are most needed where only hardstrips are provided and where hardshoulders are less than 3.0m wide. In the latter case, this includes most urban motorways.

4.11.6 In all cases, the Design Organisation must consult with the Maintaining Organisation, carry out a risk assessment and determine the need for hardstandings.

4.11.7 When selecting locations for any hardstandings, Design Organisations should follow the advice given in **TA 69 (DMRB 6.3.3)** to minimise risk. The width and length of maintenance hardstandings should be designed individually for the vehicle types likely to use them. For example, at communication cabinet locations the use will generally be cars or light vans, but at general purpose locations large goods vehicles may be expected to deposit equipment.

4.11.8 The frequency of any hardstandings should be determined by the Design Organisation, taking into account routine and capital maintenance regimes. Safety benefits will be maximised and cost savings may be gained by rationalising the locations of equipment that requires regular maintenance.

4.11.9 Design Organisations should ensure that hardstandings contrast in appearance with the main carriageway to dissuade general use. Signing should also be provided to inform the general public of their

specific purpose. Advice should be sought from the Overseeing Organisation on signing issues. Entry and exit tapers should be minimised to discourage public use but without compromising safety. Research is being undertaken to provide further advice on this matter.

Raised Rib Edgelines

4.11.10 Nearside and Offside edge lines must be raised rib on motorway mainline and connector roads.

4.11.11 For advice on the use of raised rib road markings on all-purpose roads refer to **Traffic Signs Manual Chapter 5**.

VRS Set-back

4.11.12 Obstructions immediately adjacent to the edge of the paved carriageway 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 and driver shyness. Any proposals for departures or relaxations must consider:

- i. In central reserves: the effects on vehicle positioning within traffic lanes, particularly where non-standard lane widths are proposed.
- ii. In verges with a hardstrip or hardshoulder: 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.
- iii. In verges without a hardstrip or hardshoulder: the effects on vehicle positioning within traffic lanes, particularly where non-standard lane widths are proposed.
- iv. In all cases the effects on future temporary traffic management systems, e.g. a low set-back, may preclude utilisation of paved areas for trafficking.

4.11.13 The set-back is the lateral distance between the traffic face of a safety barrier and as appropriate:

- i. Nearside: the back of the nearside hardstrip or hardshoulder
- ii. Nearside: the kerb face for roads without a nearside hardstrip or hardshoulder
- iii. Offside: the trafficked edge of the edge line or the kerb face where there is no edge line

The minimum dimensions to be used are given in Table 4-1.

Location	Desirable minimum set-back value (mm)	Available relaxations at sites described in footnotes
In verges with no adjacent hardstrip or hardshoulder	1200	Note (i), (ii)
In verges with an adjacent hardstrip or hardshoulder	600	(iii)
Central reserves	1200	Note (i), (ii)

Table 4-1: Set-back

Notes

Design Organisations may, where justified, consider Relaxations to set-back as follows:

- i. Relaxation to 600mm for roads of speed limit 50mph or less (including temporary mandatory speed limits).
- ii. Relaxation to 1000mm at existing roads with physical constraints (e.g. a structure) where it would be difficult to provide the desirable value.
- iii. Relaxation to 450mm will be 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.

4.11.14 On central reserves where there are no obstructions and there is only one double sided deformable safety barrier between carriageways, the set-back on both sides of the safety barrier must be as stipulated in paragraph 4.11.13 but they must not be less than the Working Width of the safety barrier minus the actual width of the safety barrier.

4.11.15 Set-back greater than the minimum values should be provided where space allows, particularly in the following circumstances:

- i. At verges for roads where continuous or near continuous VRS is proposed over a long length where the VRS may prevent a driver from mounting the verge in an emergency.
- ii. Where use of the minimum set-back in central reserves would result in the Paved Width being closer than 600mm to the VRS and where future temporary traffic management and maintenance regimes would require full utilisation of the pavement, e.g. on D2AP rural roads where a minimum set-back for normal operation (1200mm) could create a problem during certain temporary traffic management layouts if the 1.0m offside hardstrip was to be fully trafficked.
- iii. To achieve a smooth alignment with a parapet.

4.12 Rate of Change of Cross-Section Width

4.12.1 Notwithstanding the advice in paragraph 4.1.2, over the length of a route variations in the cross-section are likely to be required. Guidance on suitable sources of reference to determine the appropriate transitional arrangement is provided in Table 4-2.

4.12.2 Table 4-3 shows the required mainline rate of change in width based on a standard 3.65m lane. In all cases where Table 4-3 is used, the transition taper should correspond with the higher design speed of the two adjoining links under consideration. See **TD 22 (DMRB 6.2.1)** for the layout of Merges and Diverges.

Layout	Reference
Mainline Transition in number of lanes	TD 9 (DMRB 6.1.1), TD 22 (DMRB 6.2.1), TD 39 (DMRB 6.2.4) and Volume 3 of the Manual of Contract Documents for Highway Works
Mainline Transition for lane width variations	See Table 4-3
Slip Road change in number of lanes	TD 39 (DMRB 6.2.4) and Traffic Signs Manual
Transitions from hardshoulder to hardstrip	See Figure 4-8 and Figure 4-9
Gain and Loss of Hardstrip on Connector Roads with superelevation	See Figure 4-10
Reduction in hardshoulder widths	See Annex B . Figure 2 and Figure 3
Change from dual carriageway to single carriageway	TD 9 (DMRB 6.1.1) and Traffic Signs Manual

Table 4-2: Transition Reference Table

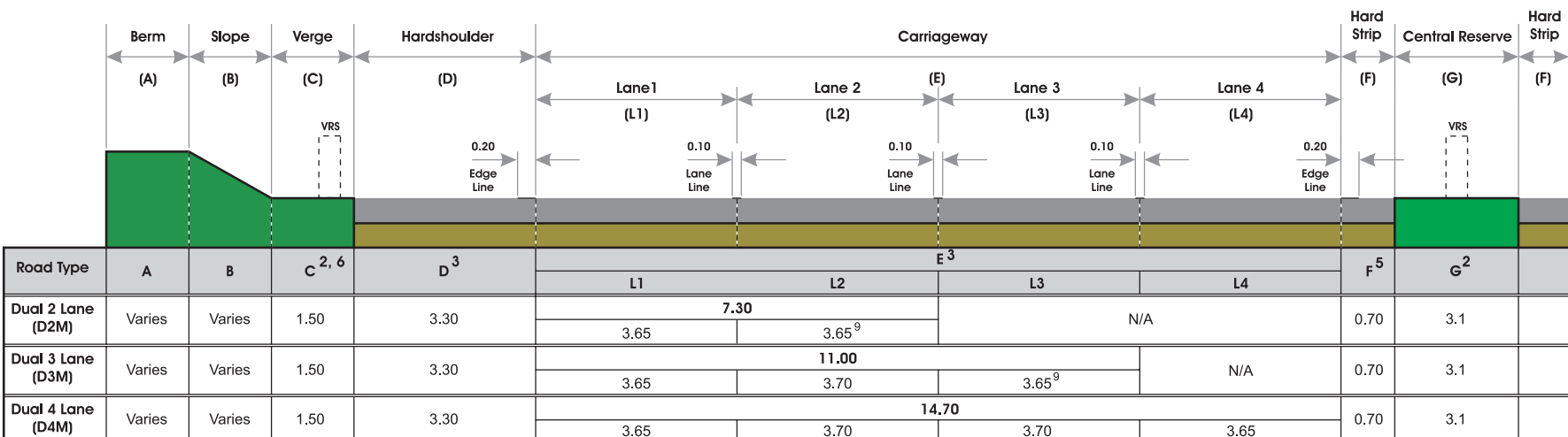
Design Speed KPH	Transition Taper
50	1:25
60	1:30
70	1:35
85	1:45
100	1:50
120	1:55

Table 4-3: Mainline Rate of Change in Width Based on a Standard 3.65m Lane

4.13 Highway Cross-section Drawings

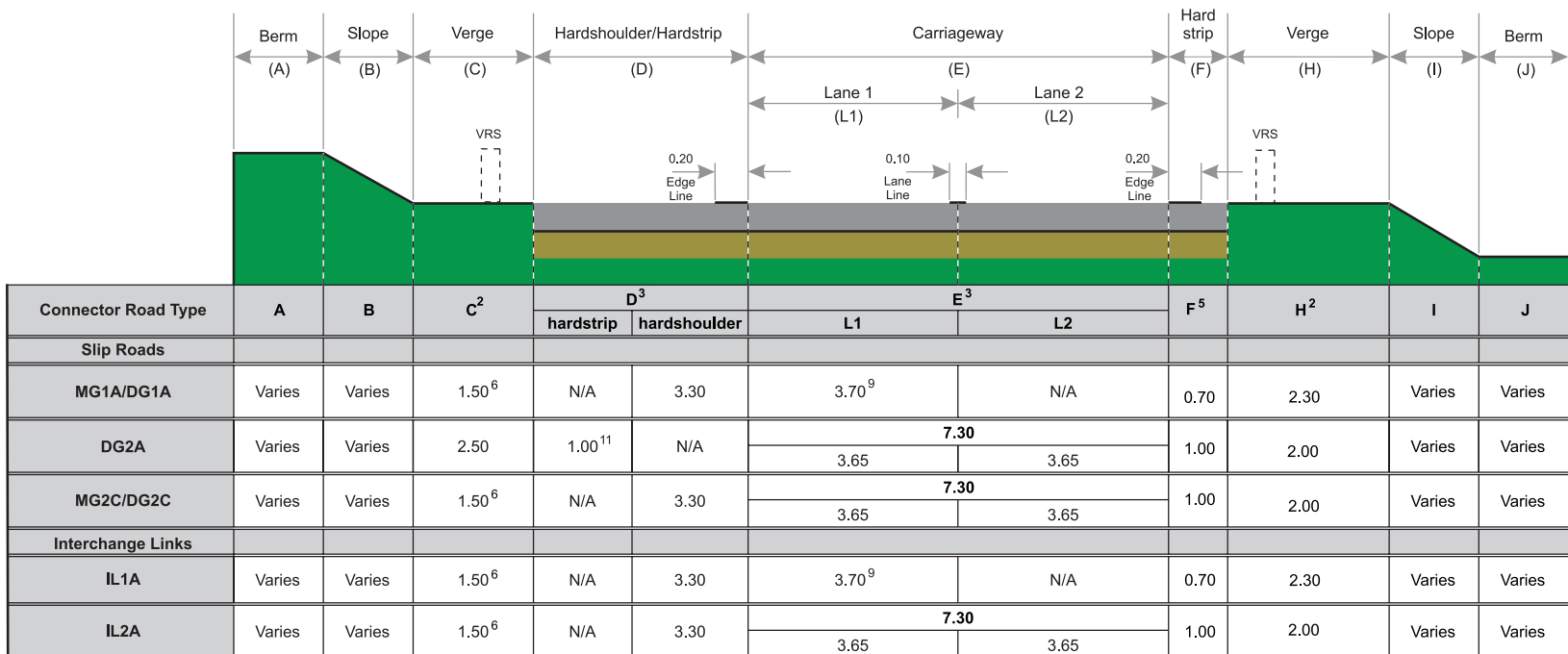
4.13.1 The following notes should be read in conjunction with Figure 4-1a to Figure 4-4b. Where superscript reference numbers are given in the Figures, these refer to the respective note numbers below:

1. All dimensions are in metres.
2. Verge and central reserve dimensions are minimum values that may need to be increased to suit particular circumstances (see Section 4.6 and 4.7 above). Any value less than the minimum is a Departure from Standard.
3. Carriageway, hardshoulder and nearside hardstrip dimensions are fixed values; any alternative proposal is a Departure from Standard.
4. For guidance on selection of slip roads, interchange links and loops (i.e. MG1A, DG1A etc.) refer to **TD 22 (DMRB 6.2.1)**.
5. Offside Hardstrips and Verges (See paragraph 4.4.3). Where drainage considerations require an increase in dimension 'F' then dimension 'G' or 'H' as appropriate may be reduced by a similar amount.
6. Refer to paragraph 4.7.6 for details of the minimum verge width required to accommodate communications equipment.
7. This dimension to be increased by 0.5m when adjacent to Highway Boundary.
8. Where the Figures denote 'varies', the decision rests with Design Organisations, taking into account the advice in this standard. (See paragraph 4.7.2)
9. Measured to the trafficked side of offside edgeline (rural) or face of offside kerb (urban).
10. Details provided for dual-carriageways are applicable for both sides of the road.
11. Where noted, some cross-sections may need local enhancement by provision of maintenance hardstandings. (See paragraph 4.11.5).
12. On rural motorways and dual carriageways (including connector roads) **Traffic Signs Manual Chapter 5** recommends increasing lane lines to 150mm. Such increases may also be warranted on roads with lower speed limits with concrete surfaces.



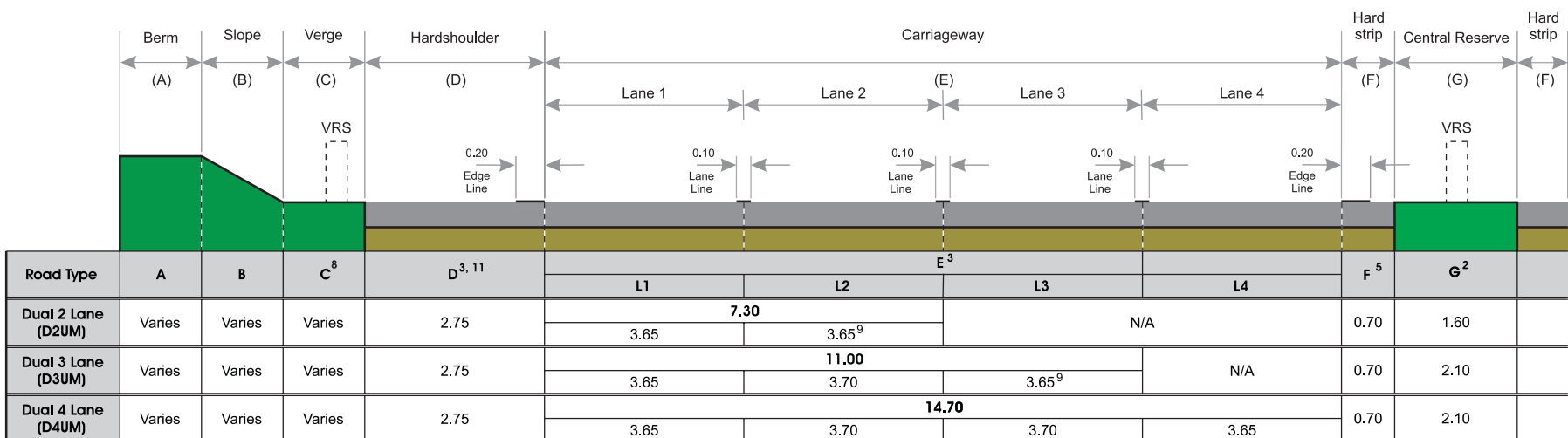
Note: Refer to notes in paragraph 4.13.1

Figure 4-1a: Dimensions of Cross-Section Components for Rural Motorway Mainline



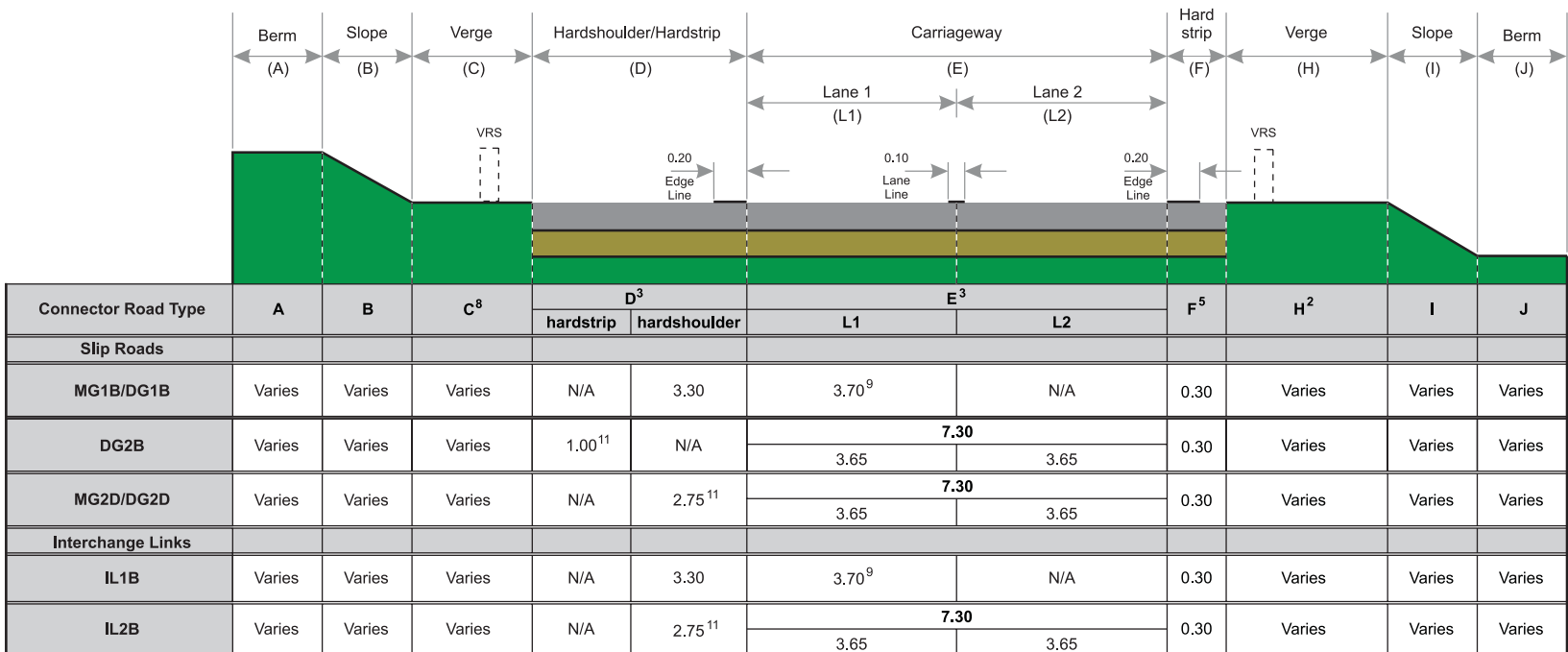
Note: Refer to notes in paragraph 4.13.1

Figure 4-1b: Dimensions of Cross-Section Components for Rural Motorway Connector Roads



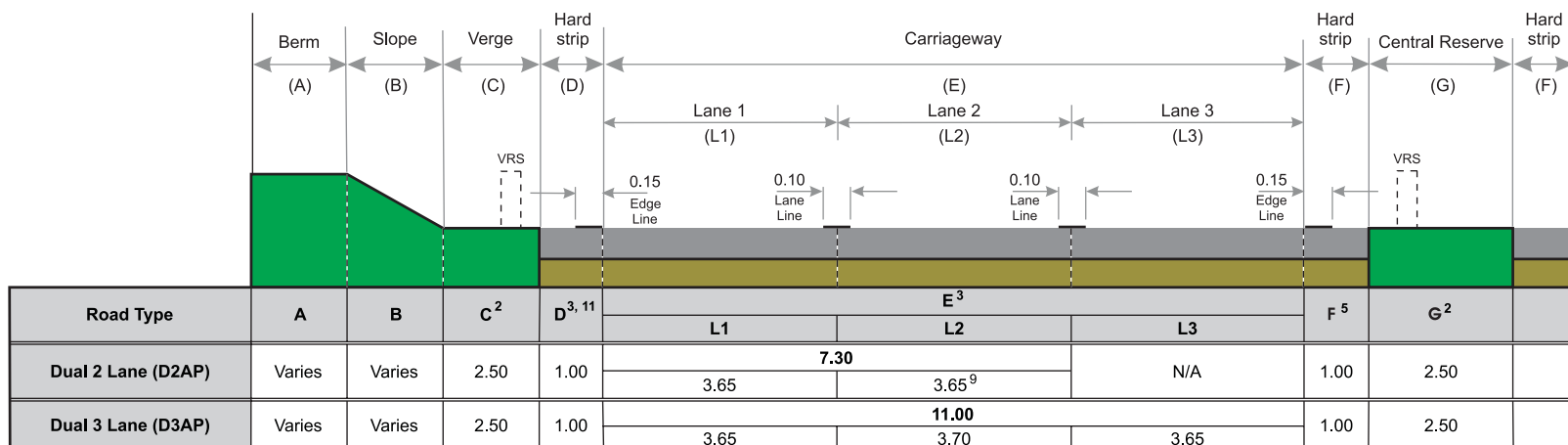
Note: Refer to notes in paragraph 4.13.1

Figure 4-2a: Dimensions of Cross-Section Components for Urban Motorway Mainline

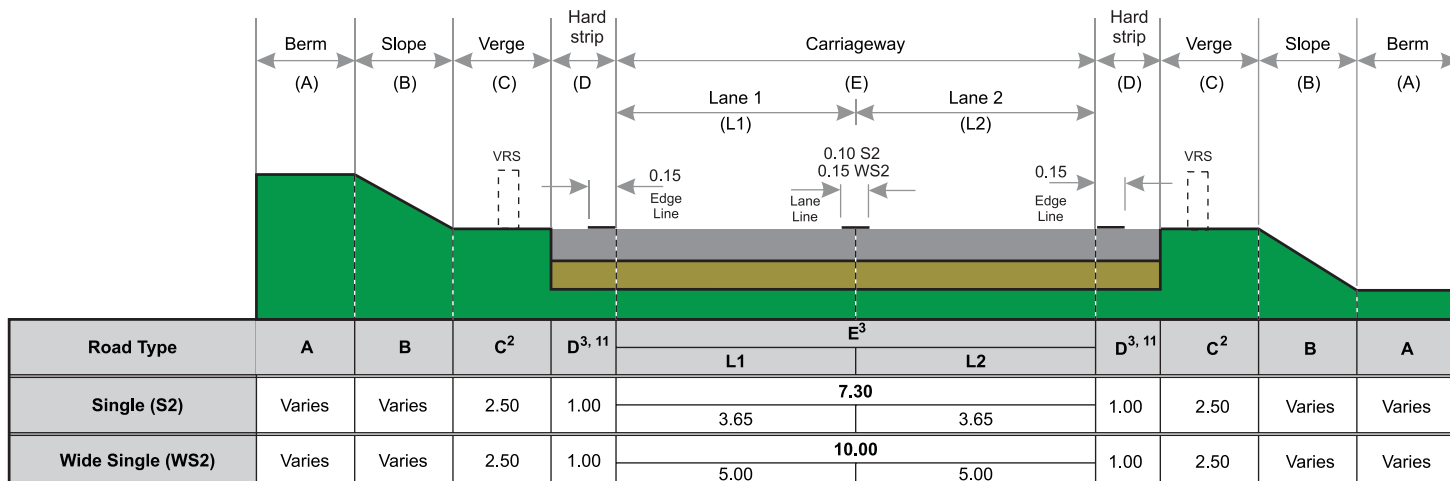


Note: Refer to notes in paragraph 4.13.1

Figure 4-2b: Dimensions of Cross-Section Components for Urban Motorway Connector Roads



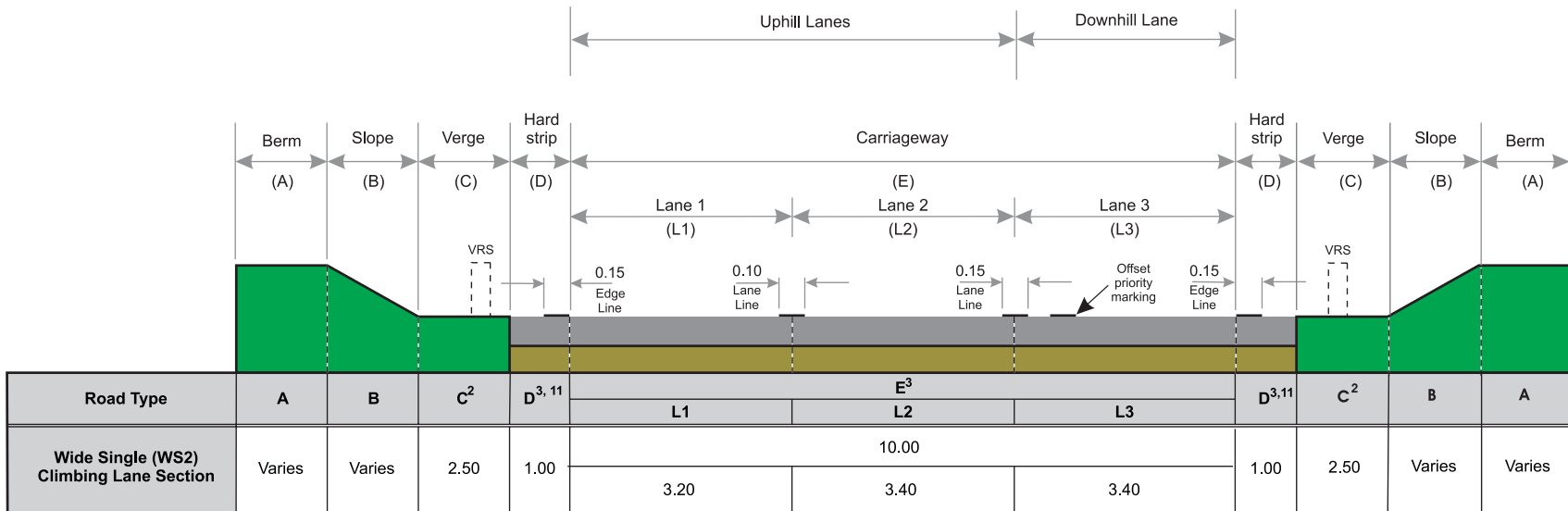
Dual Carriageway



Single Carriageway

Note: Refer to notes in paragraph 4.13.1

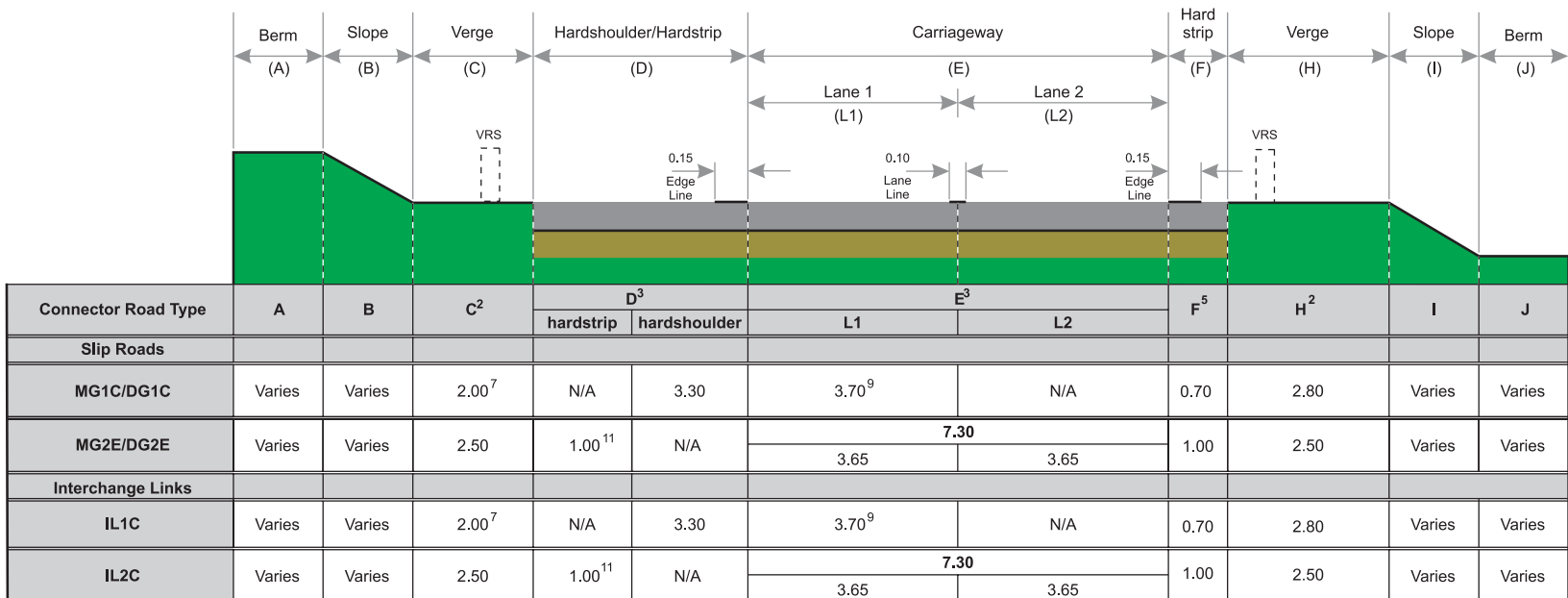
Figure 4-3a: Dimensions of Cross-Section Components for Rural All-Purpose Roads Mainline



**Wide Single Carriageway
Climbing Lane Section**

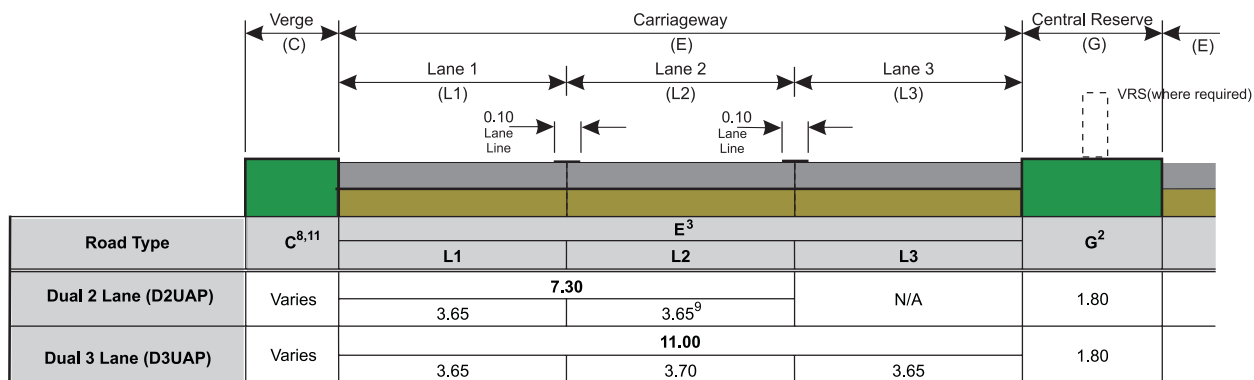
Note: Refer to notes in paragraph 4.13.1

Figure 4-3b: Dimensions of Cross-Section Components for Rural Wide Single All-Purpose Climbing Lanes

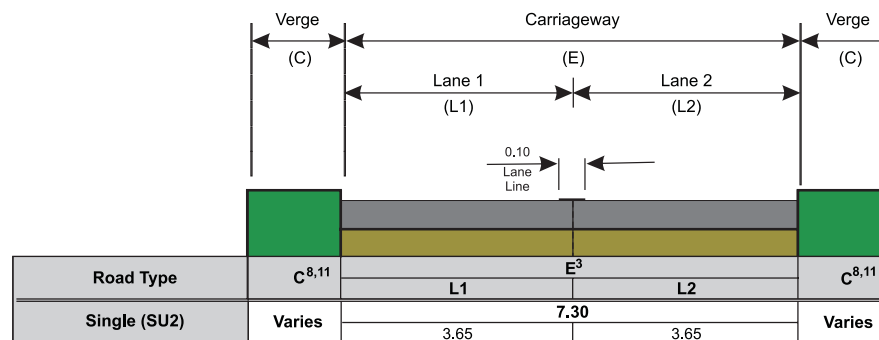


Note: Refer to notes in paragraph 4.13.1

Figure 4-3c: Dimensions of Cross-Section Components for Rural All-Purpose Connector Roads



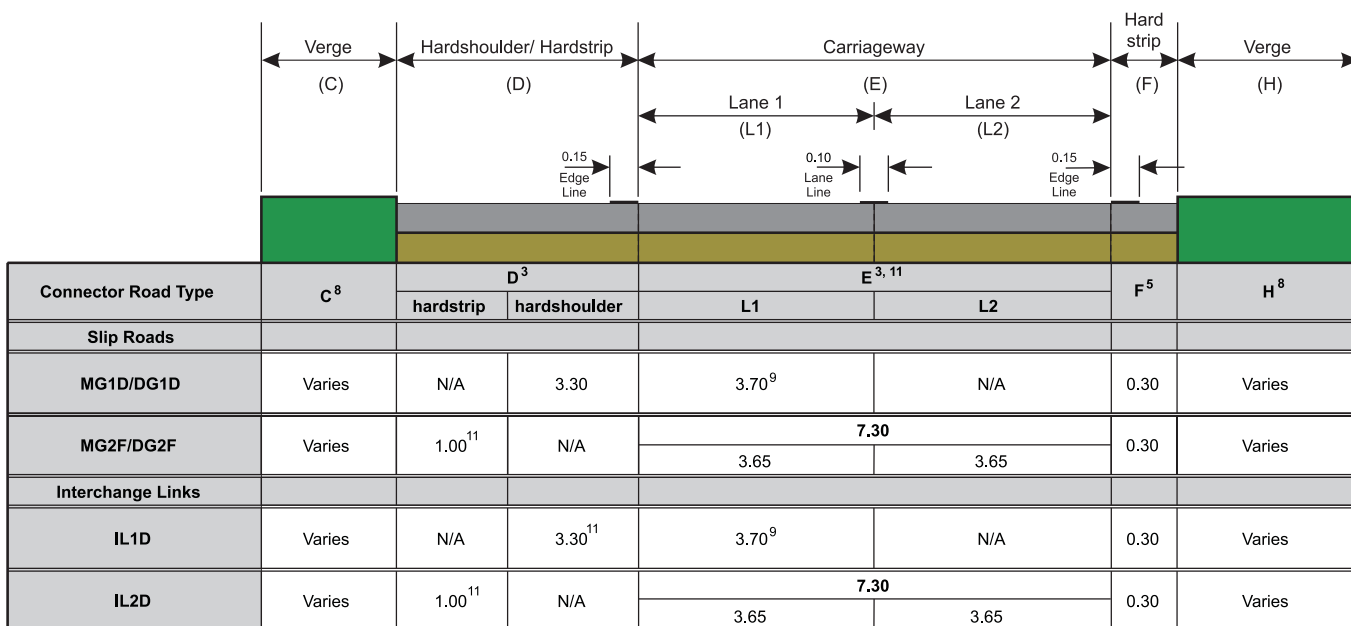
Dual Carriageway



Single Carriageway

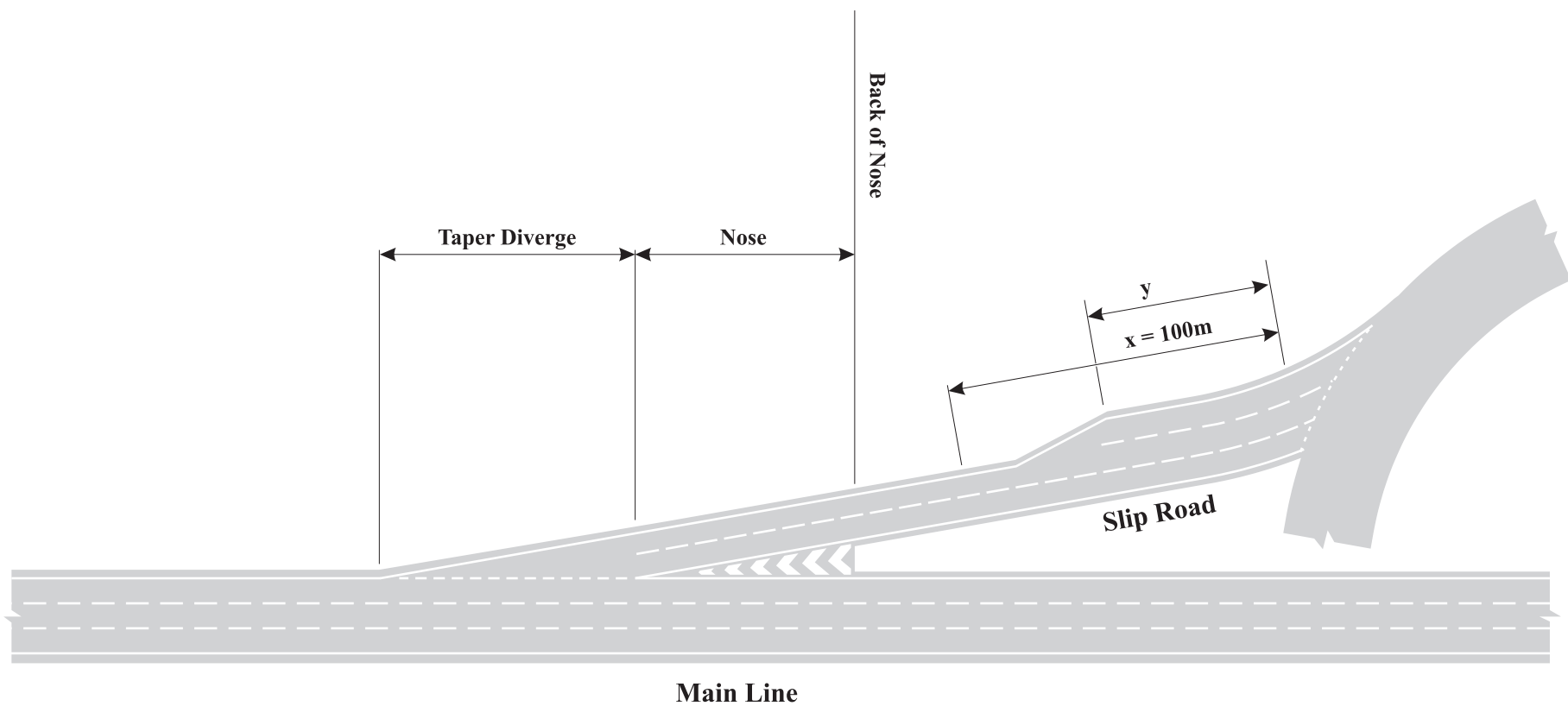
Note: Refer to notes in paragraph 4.13.1

Figure 4-4a: Dimensions of Cross-Section Components for Urban All-Purpose Roads Mainline



Note: Refer to notes in paragraph 4.13.1

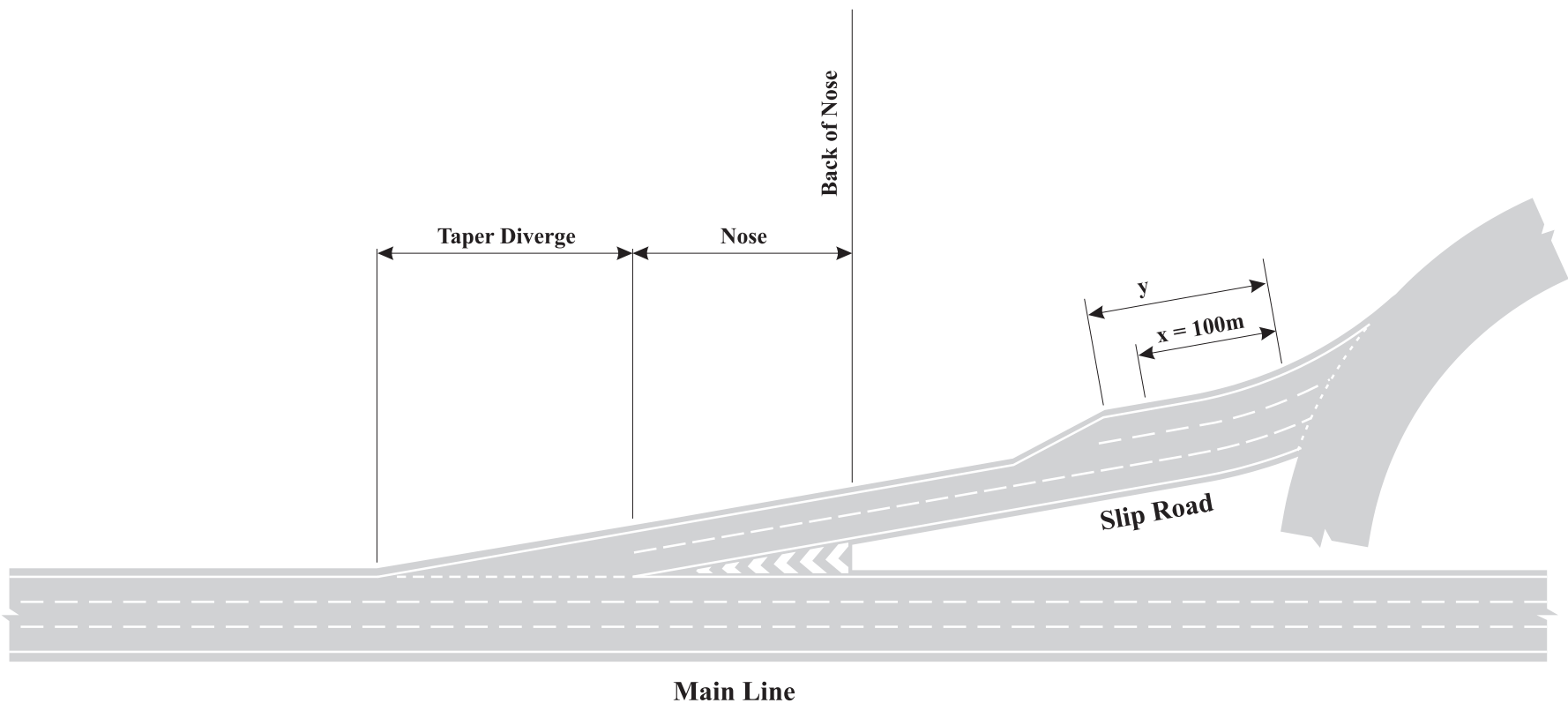
Figure 4-4b: Dimensions of Cross-Section Components for Urban All-Purpose Connector Roads



Notes

1. 'y' = Length of additional lane determined from junction and queue capacity assessment.
2. Where 'y' < 'x' Lane widths along length 'y' to be derived from requirements of junction design standards.
3. Hardshoulder and hardstrip widths over length 'y' to be as per upstream provision.

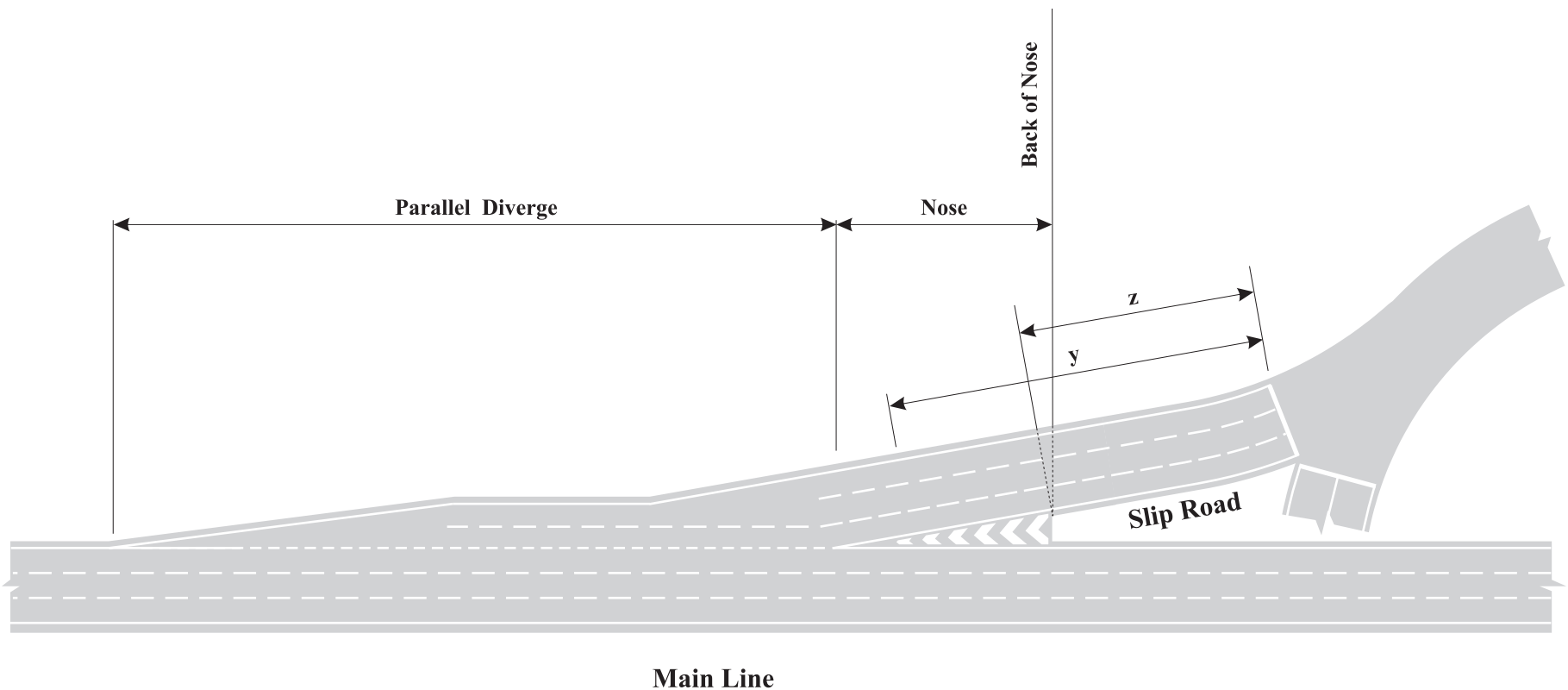
Figure 4-5: Partial 3-Lane Slip Road Provision - Type 1



Notes

1. 'y' = Length of additional lane determined from junction and queue capacity assessment.
2. Where 'y' \geq 'x' width of additional lane must be 3.65 m plus any allowance for lane widening at tight radii
3. Hardshoulder and hardstrip widths over length 'y' to be as per upstream provision.

Figure 4-6: Partial 3-Lane Slip Road Provision - Type 2

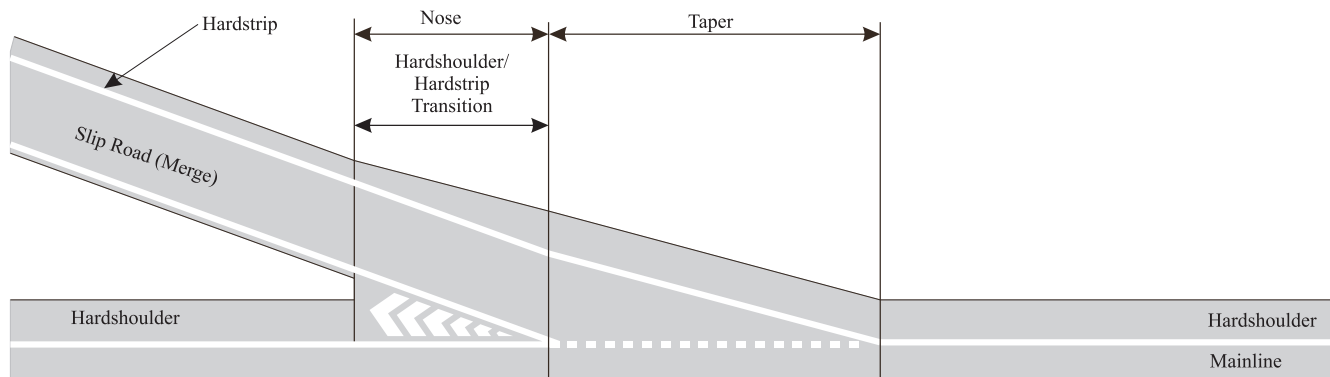


Notes

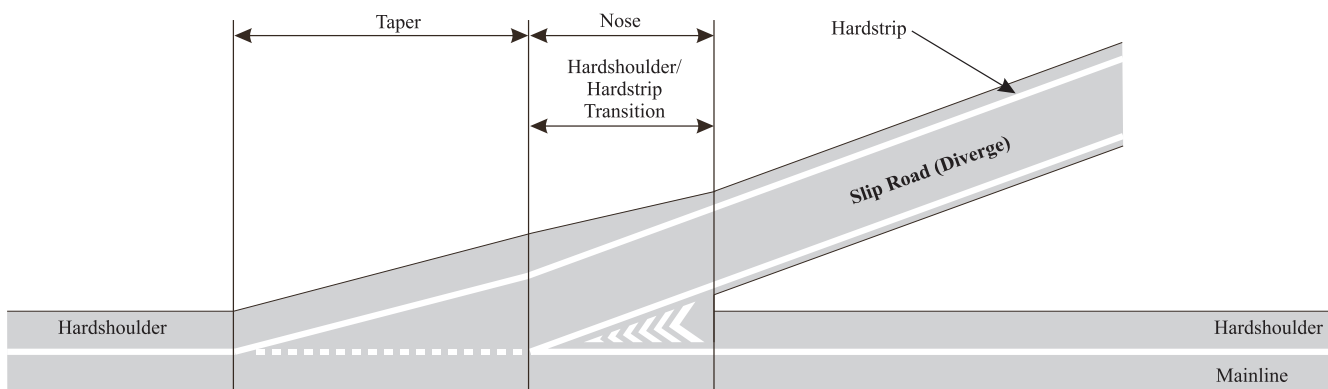
1. 'y' = Length of additional lane determined from junction and queue capacity assessment.
2. Where 'y' > 'z' a three lane slip road carriageway must be provided at least as far upstream as the tip of the nose.
3. Width of additional lane shall be 3.65m plus any allowance for lane widening at tight radii
4. Hardshoulder and hardstrip widths to be as per upstream provision and paragraph 4.9.6

Figure 4-7: Partial 3-Lane Slip Road Provision - Type3

Slip Road Merge



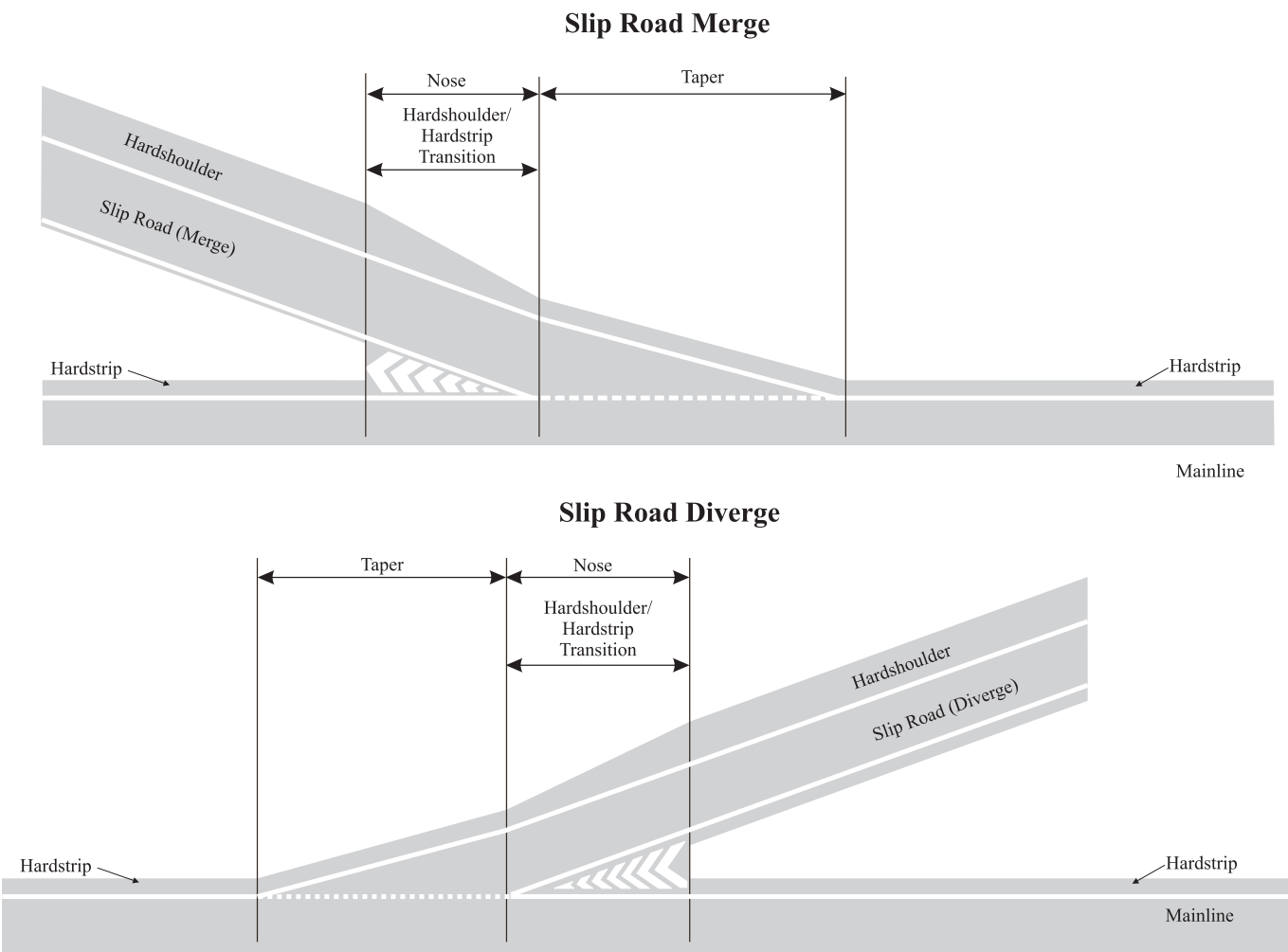
Slip Road Diverge



Note:

1. The actual provision of hardshoulder and hardstrips is defined in TD 22 and this figure illustrates a single example but not all cases.
2. For parallel merges and diverges and for lane gain and lane drop layouts, any transition between a hardstrip and a hardshoulder or between hardshoulders of different widths must also be effected over the length of the nose.

Figure 4-8: Hardshoulder/Hardstrip Transitions for Motorways



Note:

1. The actual provision of hardshoulder and hardstrips is defined in TD 22 and this figure illustrates a single example but not all cases.
2. For parallel merges and diverges and for lane gain and lane drop layouts, any transition between a hardstrip and a hardshoulder must also be effected over the length of the nose.

Figure 4-9: Hardshoulder/Hardstrip/Transitions for All-Purpose Roads

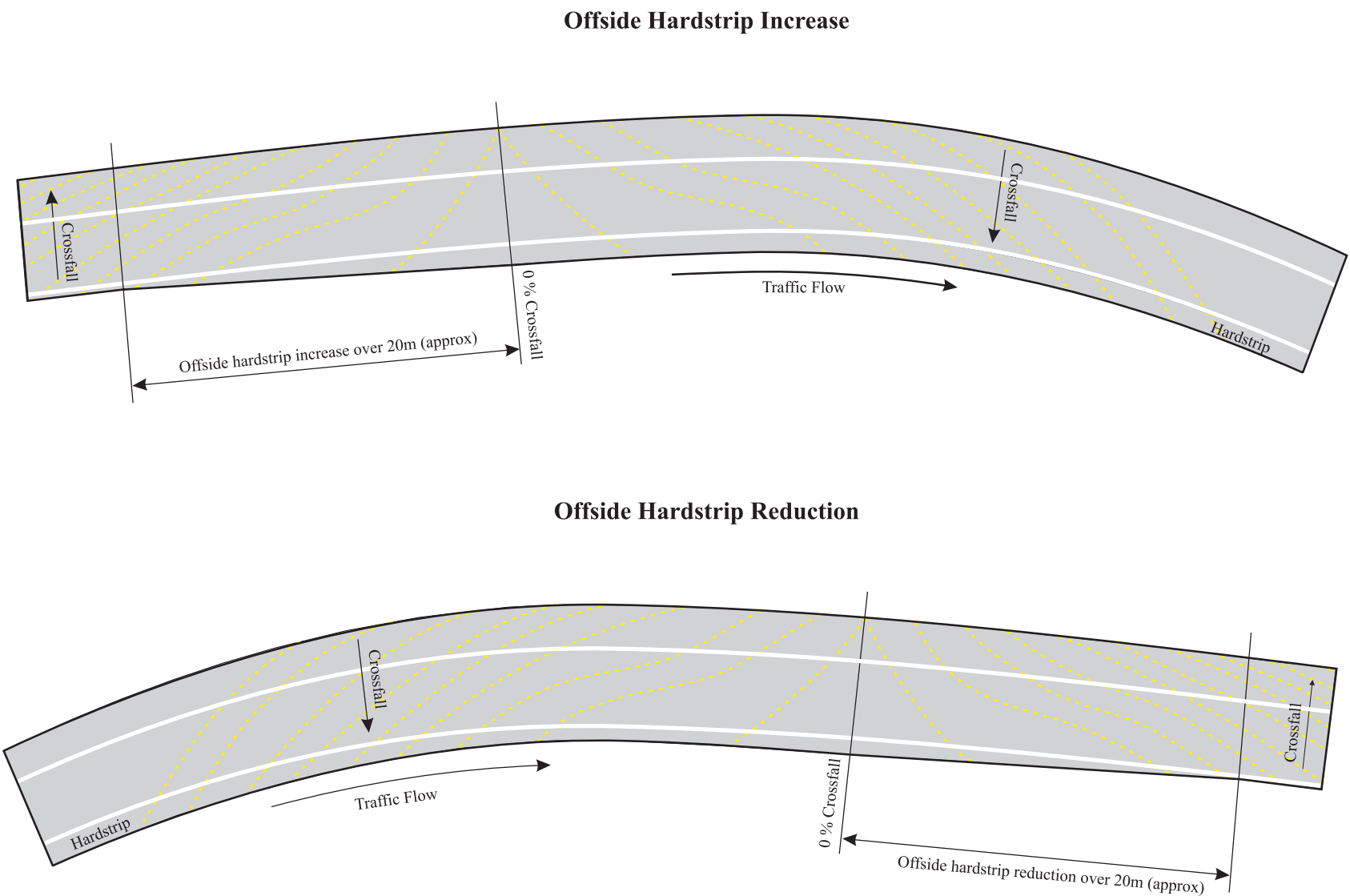


Figure 4-10: Offside Hardstrip Width Changes

5. HIGHWAY CROSS-SECTIONS AT STRUCTURES

5.1 General

5.1.1 Cross-sections at structures are detailed in Figure 5-1 to Figure 5-6.

5.1.2 Design Organisations should note that the definitions in Section 1.4 may differ from definitions used elsewhere in DMRB and particularly from those in Volumes 1, 2 and 3.

5.1.3 Variations of Cross-section provision at structures in close succession should be avoided, except where necessary to meet the mandatory requirements of this or other Standards, e.g. stopping sight distances in **TD 9 (DMRB 6.1.1)**.

5.1.4 The Cross-section of a side road, which is not a trunk road and is diverted or improved as part of a trunk road scheme must be agreed with the relevant highway, planning and Technical Approval Authorities.

5.1.5 Design Organisations should refer to the Overseeing Organisation for advice on the need to consider future provision at structures. Refer also to **BD 2 (DMRB 1.1)**.

5.1.6 Major roads have the potential to divide existing habitats and consequently threaten biodiversity. Design Organisations should therefore consider measures that allow the continued passage of flora and fauna across such roads. These may take the form of 'Green Structures' that are dedicated to particular flora and fauna, or the inclusion of green components on structures shared by human users. Examples of the latter include mammal ledges and soft verges. Green Structures can also play a significant role in minimising community severance for NMUs. For further details refer to **DMRB 10.4**.

5.1.7 Design Organisations should refer to the 'I' Series of Volume 3 of the Manual of Contract Documents for Highway Works for the provision of ducts at bridges.

5.2 Non-Motorised User Provision at Structures

5.2.1 The standard of the route for NMUs including margins at a structure must be at least equivalent to that determined for the approaches.

5.3 Paved Width Requirements

5.3.1 The paved widths shown in Figure 4-1a to Figure 4-4b must be continued through the structure.

5.4 Side Road Structures

5.4.1 The Cross-section of local roads must be agreed with the relevant highway, planning and Technical Approval Authorities, based on the advice contained below in paragraphs 5.4.2 to 5.4.4

5.4.2 If a structure is required under or over an existing single lane rural side road of carriageway width less than 6.0m, the carriageway width of that side road should be retained where all the following requirements are met:

- i. Traffic flows are not expected to exceed 200 vehicles per day.
- ii. The carriageway width is not less than 3.60m and the lateral width of Cross-section, over which the minimum Headroom is provided in accordance with paragraphs 6.1.3 and 6.3.1, is not less than 6.60m.
- iii. Passing bays, which must be inter-visible, are provided at each side of the structure.
- iv. Stopping Sight Distance to the requirements of **TD 9 (DMRB 6.1.1)** is provided.

5.4.3 For local roads with a carriageway wider than 6.0m, there is potential for driver confusion, inappropriate speeds and poor visual appeal being generated by very localised widening. Possible solutions to this problem include:

- i. providing appropriate transition lengths between the existing and widened sections; and
- ii. where provision for possible future widening is the key criterion – specifying an additional verge width, such that the road can be brought up to the required Standard in future, without impinging on structure clearances.

5.4.4 For local roads crossed over by bridges, the Cross-section width should also be chosen with due consideration to the risk and consequences associated with errant vehicle impact. In most cases this can be achieved by complying with the recommendations contained within this Standard with respect to verges, those within **CSRRS** with respect to the provision of VRS and those within **BD 60 (DMRB 1.3.5)** with respect to design for vehicle impact.

5.5 Central Reserves

5.5.1 At structures the central reserve width derived from Chapter 4 must be continued through or across the structure. However the Design Organisation must also consider whether an increase in width is required for the reasons discussed in Section 4.6.

5.6 Verges

5.6.1 For Overbridges the verge width derived from Chapter 4 must be continued through the structure. For Underbridges the verge width must be as derived from Chapter 4 less any local widening provided solely for the purpose of locating a VRS away from the edge of an embankment as described in paragraph 4.7.3. However in either case the Design Organisation must also consider whether an increase in verge width is required for the reasons discussed in Section 4.7.

5.7 Raised Verges and Central Reserves at Underbridges

5.7.1 The provision of raised verges and central reserves at underbridges can create a number of problems. These include:

- i. the restrictions they impose on the available width for running lanes during maintenance;
- ii. the need to raise their level when the adjacent carriageway is overlaid (although it is not always practicable to raise verges on bridge decks because of the height of the parapets and parapet upstands); and
- iii. providing suitable movement joint and waterproof details.

5.7.2 These problems however, are usually outweighed by their many benefits. These include:

- i. improving safety by dissuading the majority of moving vehicles from straying dangerously close to the parapet;
- ii. if a suitable width is provided, performing the function of an NMU route;
- iii. accommodation of VRS footings;
- iv. forming part of the deck drainage system;
- v. if an appropriate verge width is provided, parked vehicles may benefit, as nearside doors can be opened for safer egress and the adjacent parapet will be more obvious to drivers stepping out from high cab units;
- vi. accommodation of services;
- vii. if appropriately detailed, they can be used as a structural component.

5.7.3 For central reserves, the raised width must be limited to the minimum required to accommodate any required NMU route, VRS or services. The maximum kerb height provided must be 75mm.

5.7.4 For Cross-sections above bridge decks where the VRS is a parapet, a raised verge 0.6m minimum width and with a desirable maximum kerb height of 75mm must be provided between the Paved Width and adjacent parapets. This applies to the nearside or offside. The maximum kerb height can be raised to a height not exceeding 100mm where it can be shown that significant benefits result.

This is because dynamic testing has shown that limiting the height of the kerb upstand to 75mm minimises the risk of an errant vehicle being projected upwards upon impact. As parapets are designed to restrain vehicles in contact with the adjacent verge surface, minimising this risk is critical. A raised verge height of not more than 75mm is therefore usually preferable. Where a significant monetary benefit can be obtained by raising the verge slightly, a maximum kerb height of 100mm is however acceptable where the adjacent restraint system is a vehicle parapet. For determining the required verge width, also refer to Sections 5.5 and 5.6 which give requirements that in most cases will necessitate greater overall verge widths than the minimum dimension specified in this paragraph.

5.8 Vehicle Restraint Systems and Parapets

5.8.1 VRS and parapets must be positioned in accordance with the requirements of CSRRS.

5.9 Divided Structures on Single Carriageway Routes

5.9.1 Occasionally it is necessary to provide a single lane in each direction separated by a central reserve. For instance, certain landmark bridges feature a central cable stay with a single traffic lane either side. In such cases single-lane dualling results.

5.9.2 Where single-lane dualling is necessary at divided structures, the dimensions should be determined by following the principles established for single lane dualling on all-purpose roads in **TD 42 (DMRB 6.2.6)**. An important feature of the Cross-section in these situations is that only one through lane in each direction is available. There is a need to allow motorists to pass a stopped vehicle without leaving the Paved Width. To achieve this, the

through lane in each direction should be 4.0m wide, exclusive of hardstrips and the overall Paved Width of each carriageway should be at least 6.0m. See Figure 5-6.

5.10 Improving Existing Roads

5.10.1 When existing roads are being improved to provide additional lanes or other features the cost implication of widening a structure may be significant. In these cases, the Overseeing Organisation should be consulted for advice and it may be practicable to consider Departures from Standard in accordance with Annex B.

5.11 Accommodation Bridges

5.11.1 The widths of accommodation bridges should be agreed with the Overseeing Organisation after considering the following criteria:

- i. the agreed reasonable needs of the respective private landowner;
- ii. the size of vehicles, particularly agricultural vehicles, that may reasonably be expected to use the bridge;
- iii. maintenance requirements; and
- iv. the needs of NMUs enjoying a legal right of way.

5.11.2 At the completion of negotiations with landowners, the agreed provision must be recorded in a formal agreement.

5.11.3 For further guidance refer to '**Provision of Farm Crossings**' published jointly by the Department for Transport and National Farmers Union, and the '**Report of the Study Group on Dimensions of Agricultural Bridges and Underpasses**' published by MAFF and the Department for Transport.

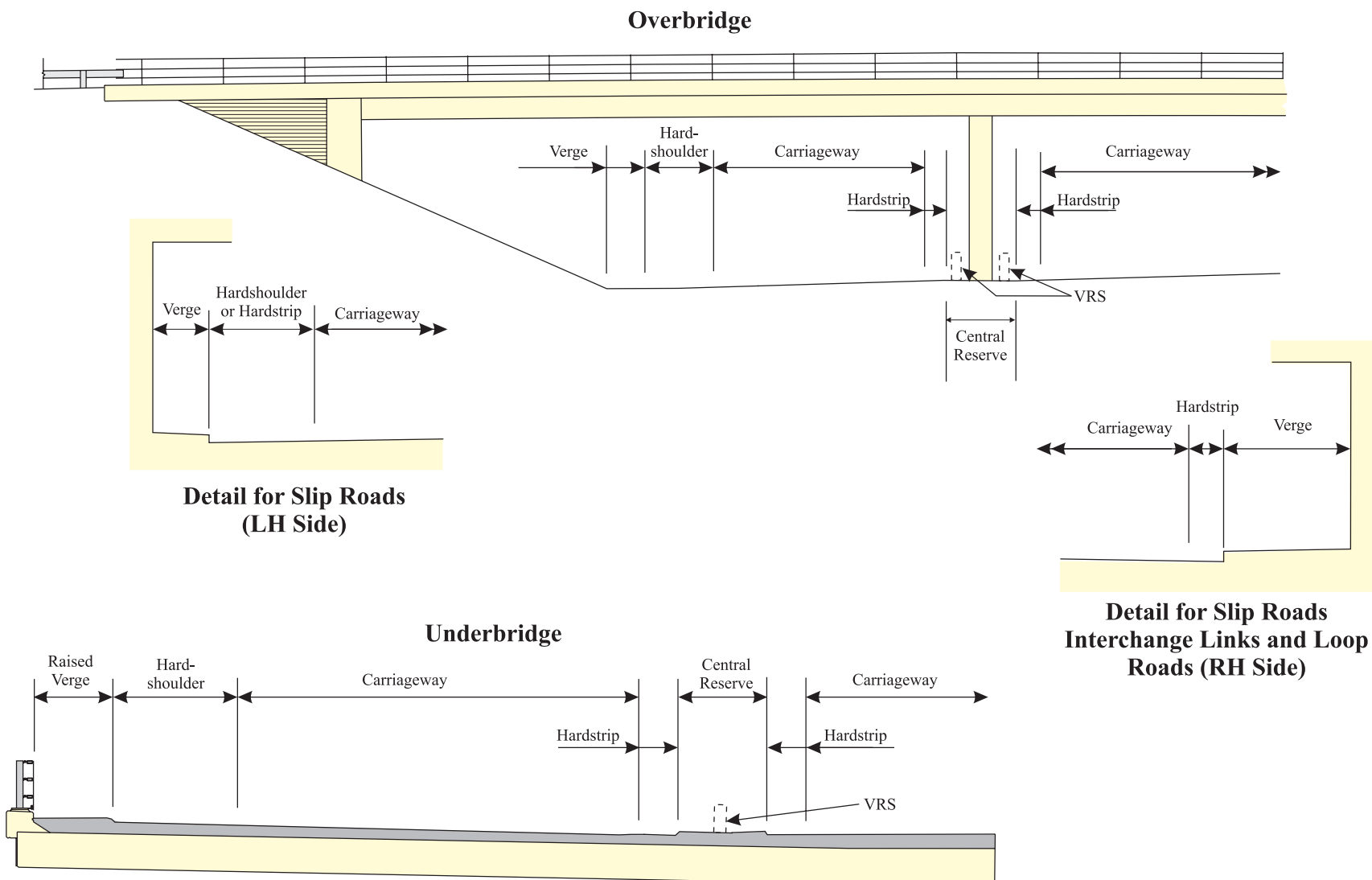


Figure 5-1: Cross-Section Components for Rural and Urban Motorways

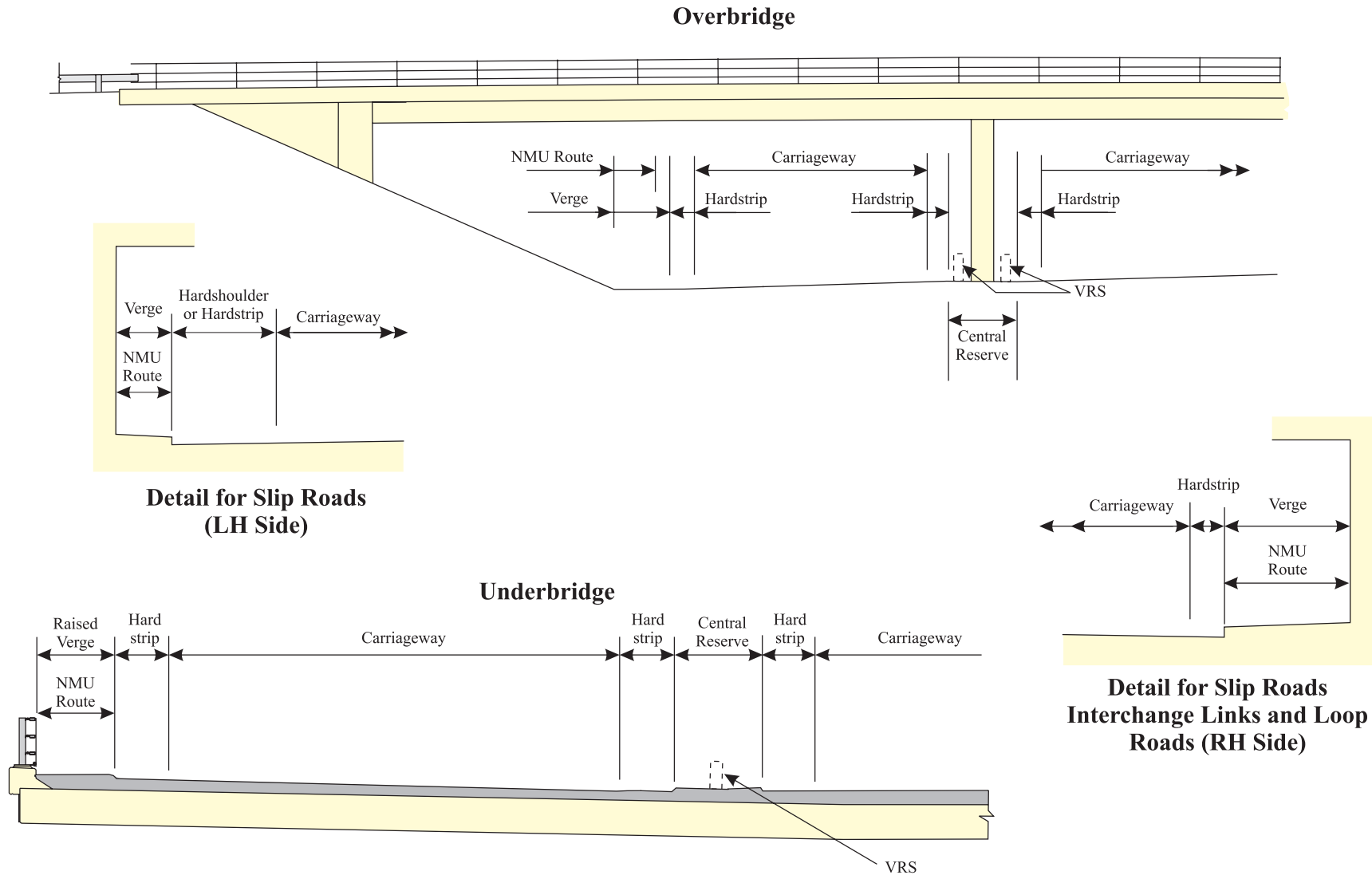


Figure 5-2: Cross-Section Components for Rural All-Purpose Dual Carriageway Roads

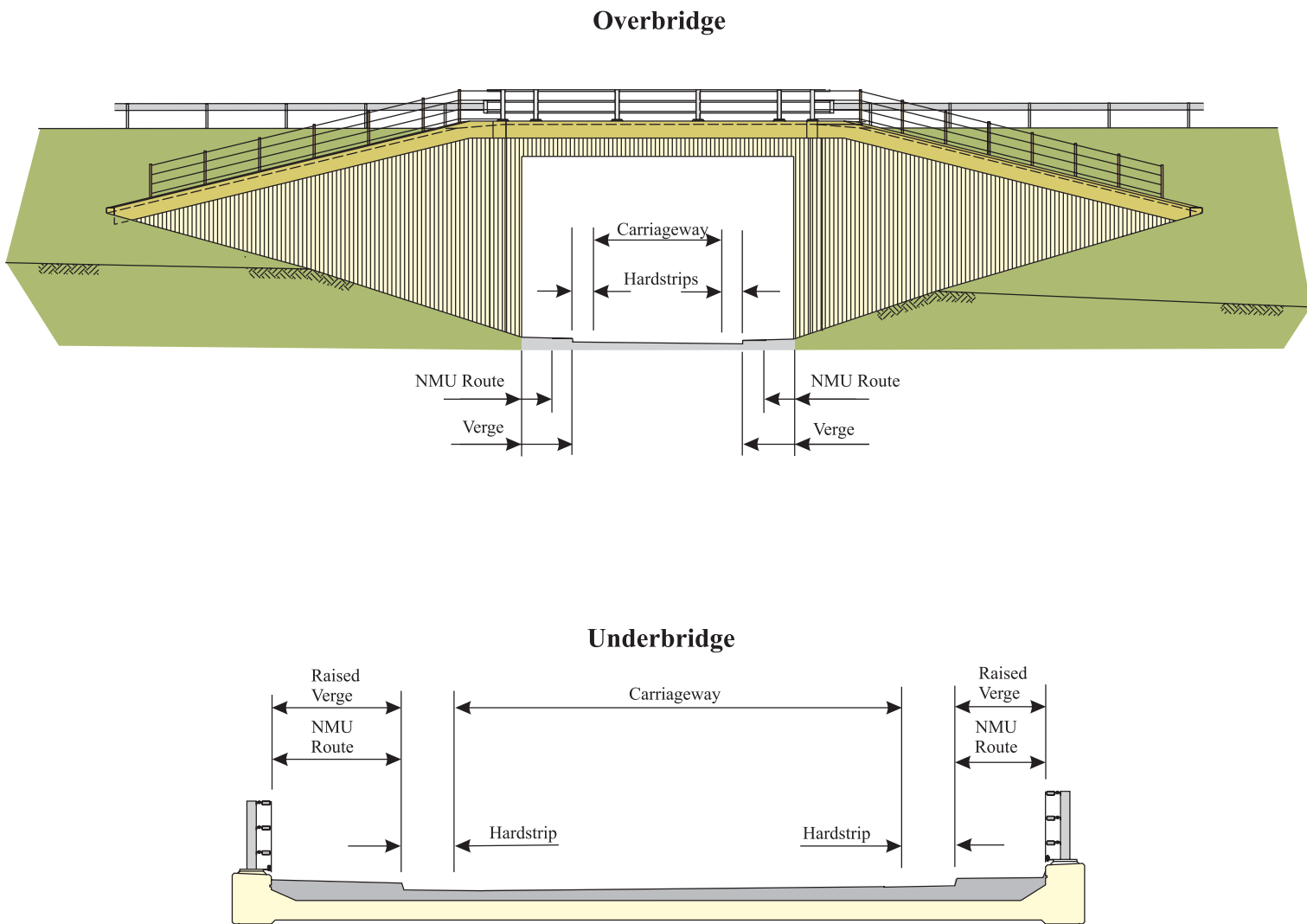


Figure 5-3: Cross-Section Components for Rural All-Purpose Single Carriageway Roads

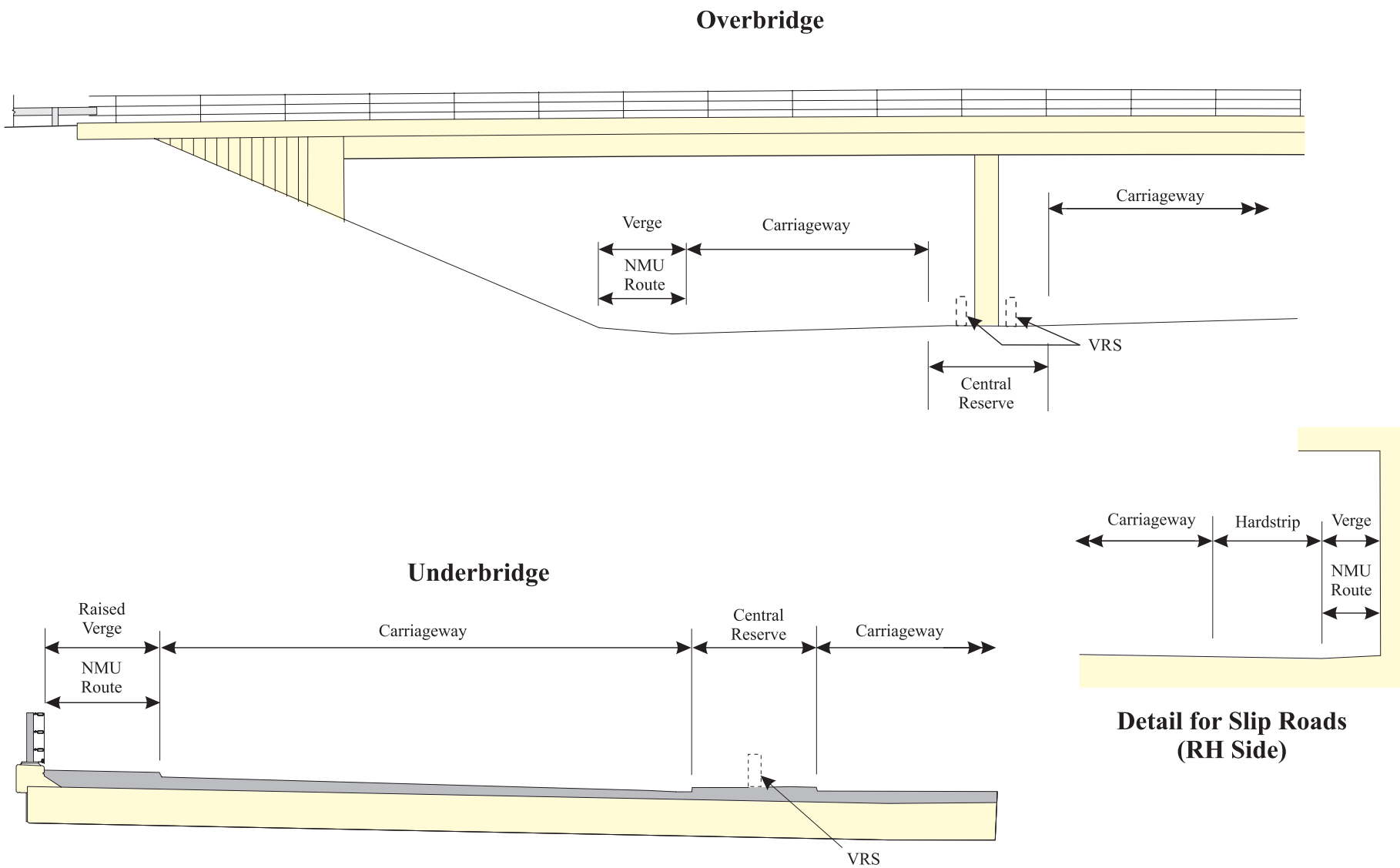


Figure 5-4: Cross-Section Components for Urban All-Purpose Dual Carriageway Roads

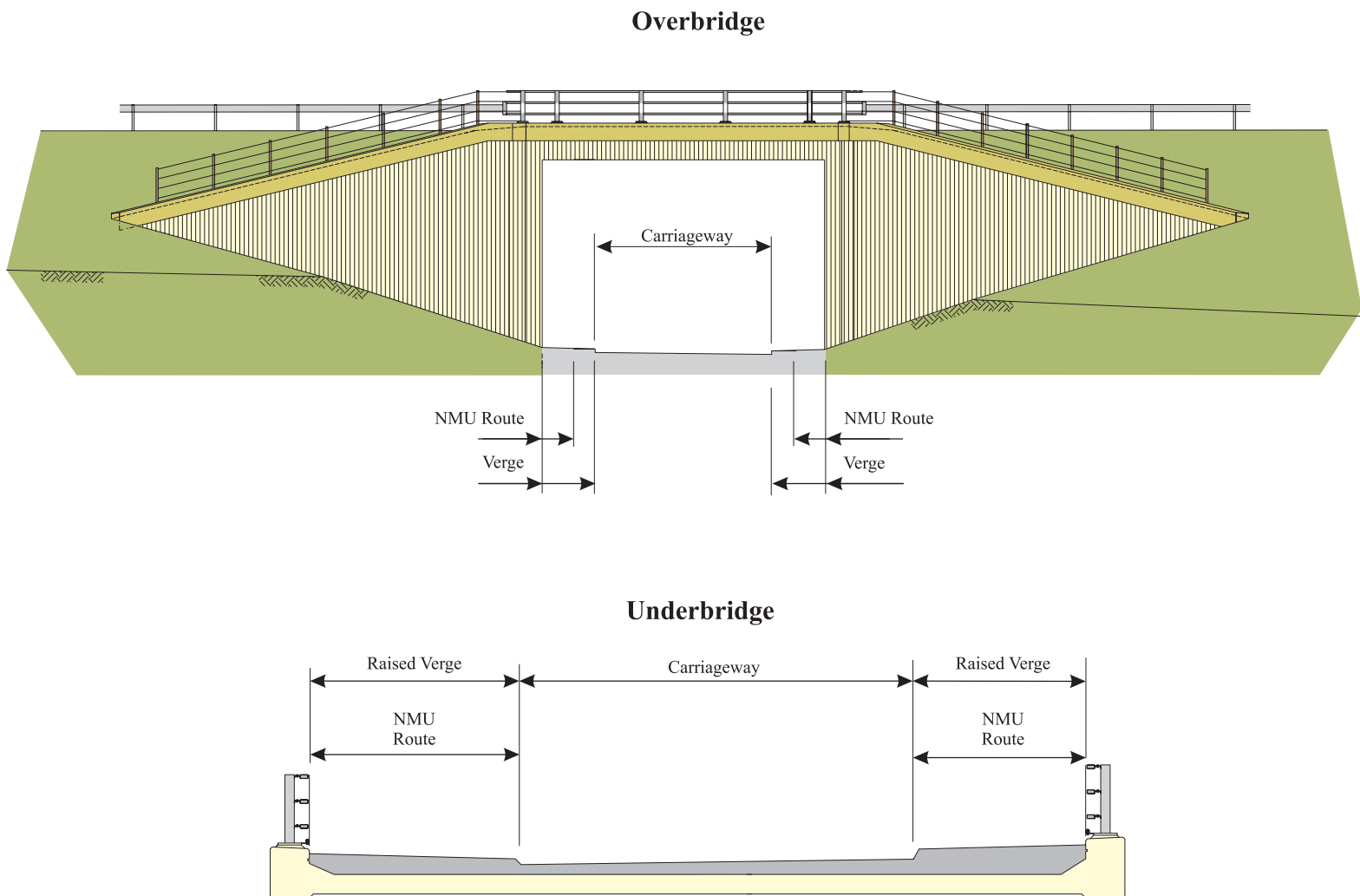
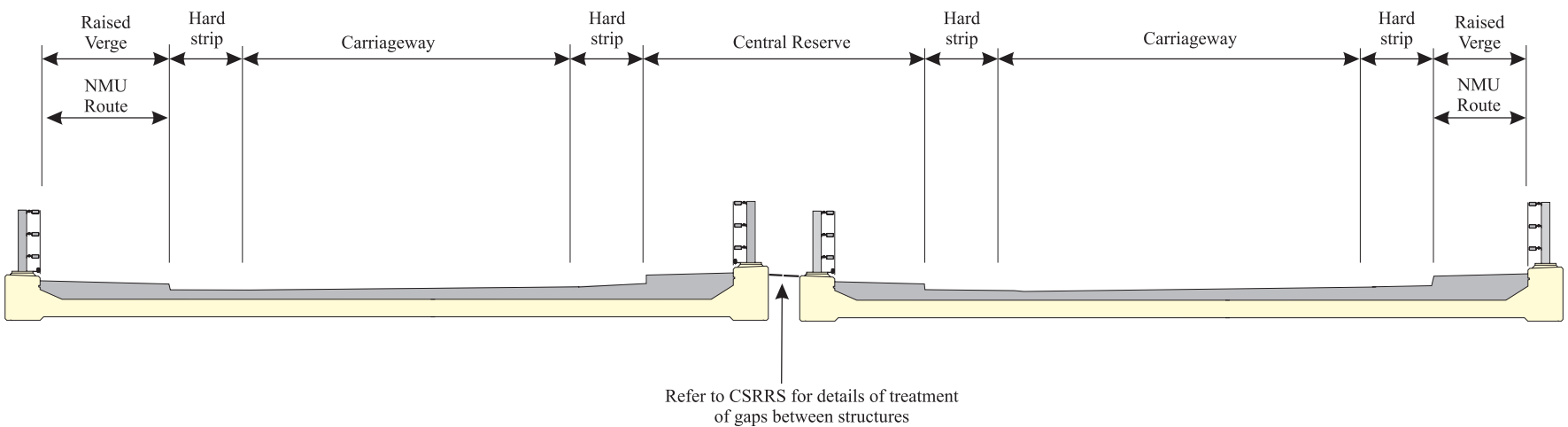


Figure 5-5: Cross-Section Components for Urban All-Purpose Single Carriageway Roads



Note: For the width of Paved Width components refer to paragraph 5.9.2

Figure 5-6: Cross-Section Components for Dual One Lane All-Purpose Roads at Divided Structures

6. HEADROOMS AT STRUCTURES

6.1. General

6.1.1 Dimensional Standards are given in Table 6-1 for New Construction Headroom and Maintained Headroom at overbridges and at other structures over a highway.

6.1.2 For definitions of Headroom, Maintained Headroom, New Construction Headroom, Paved Width Headroom, Standard Headroom and Structure Free Zone, refer to paragraph 1.4.2.

6.1.3 All new structures must be designed and constructed to provide a Paved Width Headroom equal to or greater than the New Construction Headroom given in Table 6-1. In addition New Construction Headroom must be provided over the extent of the Structure Free Zones in accordance with paragraph 6.3.1.

6.1.4 Where the Paved Width Headroom beneath an existing structure is reduced as a consequence of resurfacing, the residual Paved Width Headroom must not be less than the appropriate Maintained Headroom given in Table 6-1.

6.1.5 Where the Paved Width Headroom beneath an existing structure is proposed to be reduced as a consequence of bridge strengthening or road widening, the Design Organisation must consider all the issues that may influence the choice of structure headroom, including those described in paragraphs 6.1.10 and 6.1.11.

6.1.6 The Paved Width Headroom proposed by the Design Organisation must be subject to the agreement of the Overseeing Organisation. In the case of existing structures, Design Organisations must ensure that any change to the Paved Width Headroom as given in paragraphs 6.1.4 and 6.1.5 above are documented in the Overseeing Organisation's bridge records and planning systems for the movement of high loads on a route.

6.1.7 Where a Maintaining Organisation has identified an existing structure with Headroom less than Maintained Headroom over the Paved Width, the Overseeing Organisation must be advised immediately and a risk assessment carried out as soon as is practicable and the structure managed in accordance with the outcome of that risk assessment.

6.1.8 The Headroom provision at Underbridges for trunk roads passing over other authorities' facilities must be agreed with the relevant highway, railway or water authority (road, rail, navigation or river authority in Scotland). However, where a trunk road passes over another highway, the Headroom provision must not be less than the corresponding Standard Headroom given in Table 6-1.

6.1.9 The Standard Headrooms given in Table 6-1 are the minima. Even when Headroom in excess of these values has been provided, the Design Organisation may still need to consider the effects of vehicle collisions on bridge superstructures. For new structures the Design Organisation must refer to **BD 60 (DMRB 1.3.5)** for details of design requirements relating to vehicle collision loads on bridge superstructures.

6.1.10 Headroom greater than the minimum may be needed when considering the following issues:

- i. risk of vehicular impact with the superstructure, taking into account records of vehicle impact and any indicators of previous impacts on the superstructure;
- ii. provision for adequate forward visibility in sags (see paragraph 6.2.1);
- iii. forward visibility to overhead signs and signals;
- iv. future implications for maintenance of structure and pavement;
- v. whole life costs of structure and pavement;

- vi. accommodation of services or apparatus;
- vii. compliances with the Design Organisation's health and safety responsibilities (see paragraph 3.2.2);
- viii. other site specific issues; and
- ix. to provide uniformity of headroom (see paragraph 6.5.1).

6.1.11 Where it is economical and/or environmentally acceptable, Headroom greater than the minimum should be provided.

6.1.12 Confirmation of the Paved Width Headroom actually provided based on site measurement alone can be prone to error as Headroom can seldom be obtained directly by vertical measurement alone. A desk study based on as-built records is recommended prior to actual on-site measurement, to determine an accurate method that will provide the correct perpendicular Headroom dimension.

6.2 Compensation for Vertical Sag Curvature and Deflection

6.2.1 Where the road passing under a structure is on a sag curve, the Standard Headrooms in Table 6-1 must be increased in accordance with Table 6-2. The sag radius must be measured along the carriageway over a 25m chord.

6.2.2 Allowances must be made for the deflection of structures. The relevant Standard Headroom must be provided for the serviceability limit state under the action of the maximum design deflection. The maximum design deflection must be obtained by reference to the relevant loading standard.

Type of structure	New Construction Headroom (m)	Maintained Headroom (m)
Overbridges	5.30 + S	5.03 + S
Footbridges, Sign/Signal Gantries and other structures vulnerable to vehicular impact	5.7 + S	5.41 + S
Free Standing Temporary Structures	N/A	5.41¹ + S
All Permanent Structures over High Load Routes ²	6.45 + S	6.18¹ + S

Where S = Sag Curve Compensation in accordance with Table 6-2

Table 6-1: Standard Headroom at Structures

1 For Free Standing Temporary Structures and also for a Temporary Structure attached to a Permanent Structure refer also to paragraph 2.5.4 of the **Traffic Signs Manual, Chapter 8**.
2 Not applicable in Northern Ireland.

Sag Radius (m)	Additional Clearance S (mm)
1000	80
1200	70
1500	55
2000	45
3000	25
6000	15
>6000	Nil

Table 6-2: Sag Curve Compensation

6.3 Structure Free Zone (SFZ)

6.3.1 Errant vehicles may leave the road pavement leading to a risk of collision with components of the structure. In addition, it may become necessary in the future to increase the width of the pavement (either permanently or temporarily) at the expense of the adjacent verge and central reserve. In order to ensure that adequate provision is made for these circumstances, SFZ must be included beneath all new structures, by providing the appropriate value of New Construction Headroom given in Table 6-1 over the lesser of the following widths:

- i. the full verge width derived from paragraph 5.6.1 or central reserve width derived from paragraph 5.5.1 (deemed to include any side slopes shallower than 1:4 - vertical:horizontal); and
- ii. from the edge of the Paved Width to the face of any vertical support.

6.3.2 Examples of the Paved Width Headroom and the SFZ for typical Cross-sections are given in Figure 6-1, Figure 6-2 and Figure 6-3.

6.3.3 Where a Maintaining Organisation has identified an existing structure with an SFZ providing less than Maintained Headroom, a risk assessment should be carried to determine if measures to safeguard

the structure are required, e.g. the introduction of a VRS.

6.3.4 The SFZ defined in paragraph 6.3.1 above should be marked on the design and as-built drawings in combination with the Paved Width Headroom and the corresponding Maximum Live Load Deflection (as shown on Figure 6-1, Figure 6-2 and Figure 6-3) for the purposes of maintaining accurate bridge records.

6.3.5 Even when an SFZ has been provided, the Design Organisation may still need to consider the effects of vehicle collisions. For new structures, the Design Organisation must refer to **BD 60 (DMRB 1.3.5)** for details of design requirements relating to vehicle collision loads.

6.4 Non-Motorised User Headrooms

6.4.1 Requirements for Headroom at subways dedicated to NMUs are contained in **TD 36 (DMRB 6.3.1)**.

6.4.2 For structures outside the scope of **TD 36 (DMRB 6.3.1)**, Design Organisations must adopt the Headrooms given in **TD 36 (DMRB 6.3.1)** where an NMU route is present. Where more than one Headroom value is quoted in **TD 36 (DMRB 6.3.1)** Design Organisations must adopt the higher value unless the NMU route is short as defined in **TD 36 (DMRB 6.3.1)**. The initial selection of NMU Headroom to be provided must be increased by 300mm where any future overlay of road pavement could subsequently reduce the adjacent NMU headroom to a value below the required minimum.

6.5 Uniformity of Headroom Along an Existing Route

6.5.1 Where a new overbridge is proposed on an existing route that has overbridges with Headroom greater than New Construction Headroom, consideration should be given to providing the same Paved Width Headroom as the existing bridges. This uniformity of Headroom can lead to a marked reduction in the risk of superstructure impacts along that route. The Headroom for new Overbridges on an existing

route should therefore be increased where this will allow uniformity of Headroom to be provided without significantly adding to cost. However, consideration should be given to the vulnerability of footbridges or other lightweight structures that may have lower Headrooms than other more robust structures on the same route.

6.6 Utilities Companies and Other Authorities Apparatus

6.6.1 Greater Headroom than that determined from paragraphs 6.1.1 to 6.2.2 and 6.3.1, may be required by a utility company, or other authority. Any such increase in the Headroom dimension must be agreed with the Overseeing Organisation.

6.7 Accommodation Underbridges

6.7.1 The Headroom for accommodation Underbridges should be selected using the criteria given in Section 5.11.

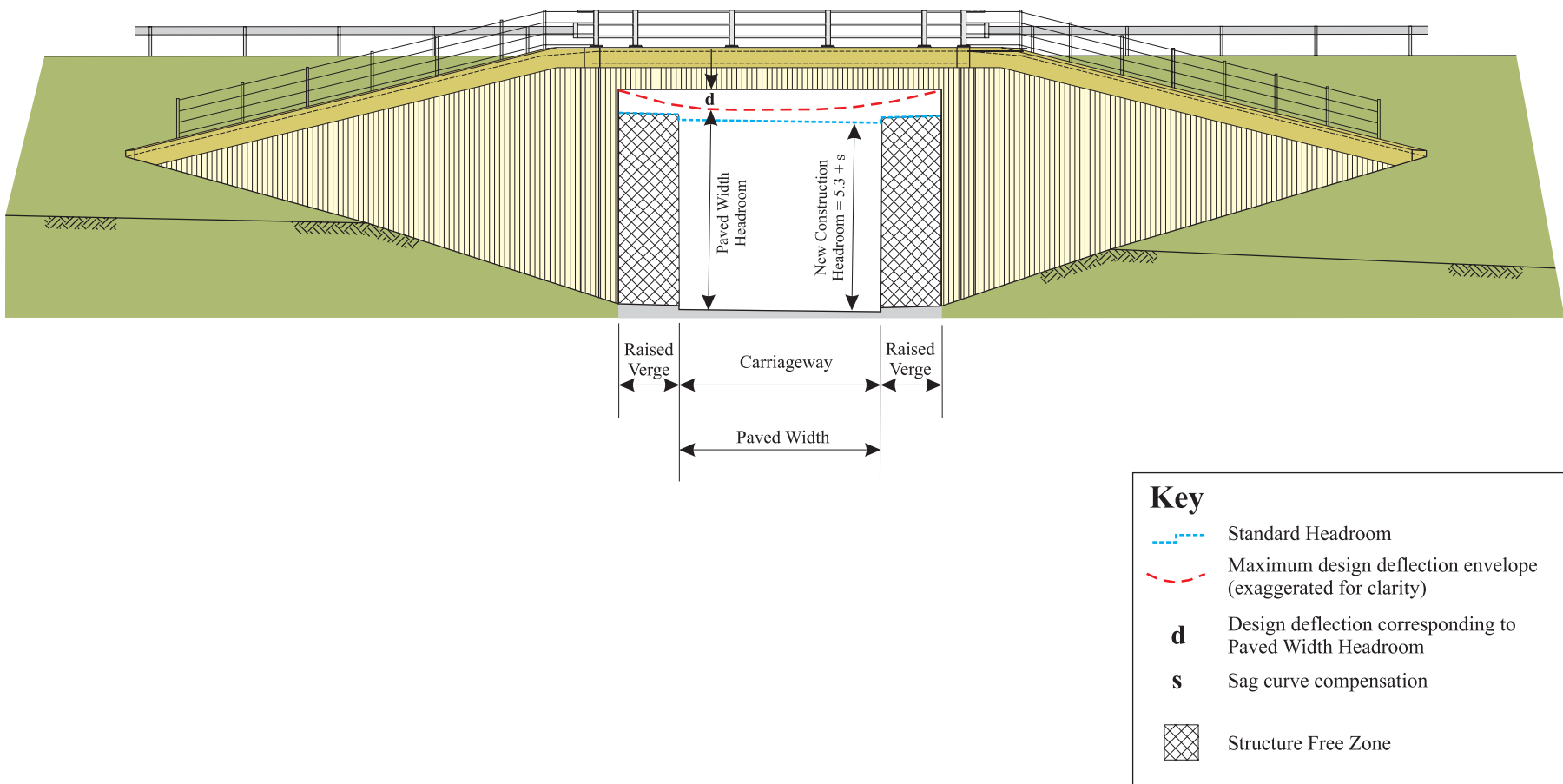


Figure 6-1: Headroom and Structure Free Zone for a Single Carriageway Road with Footways

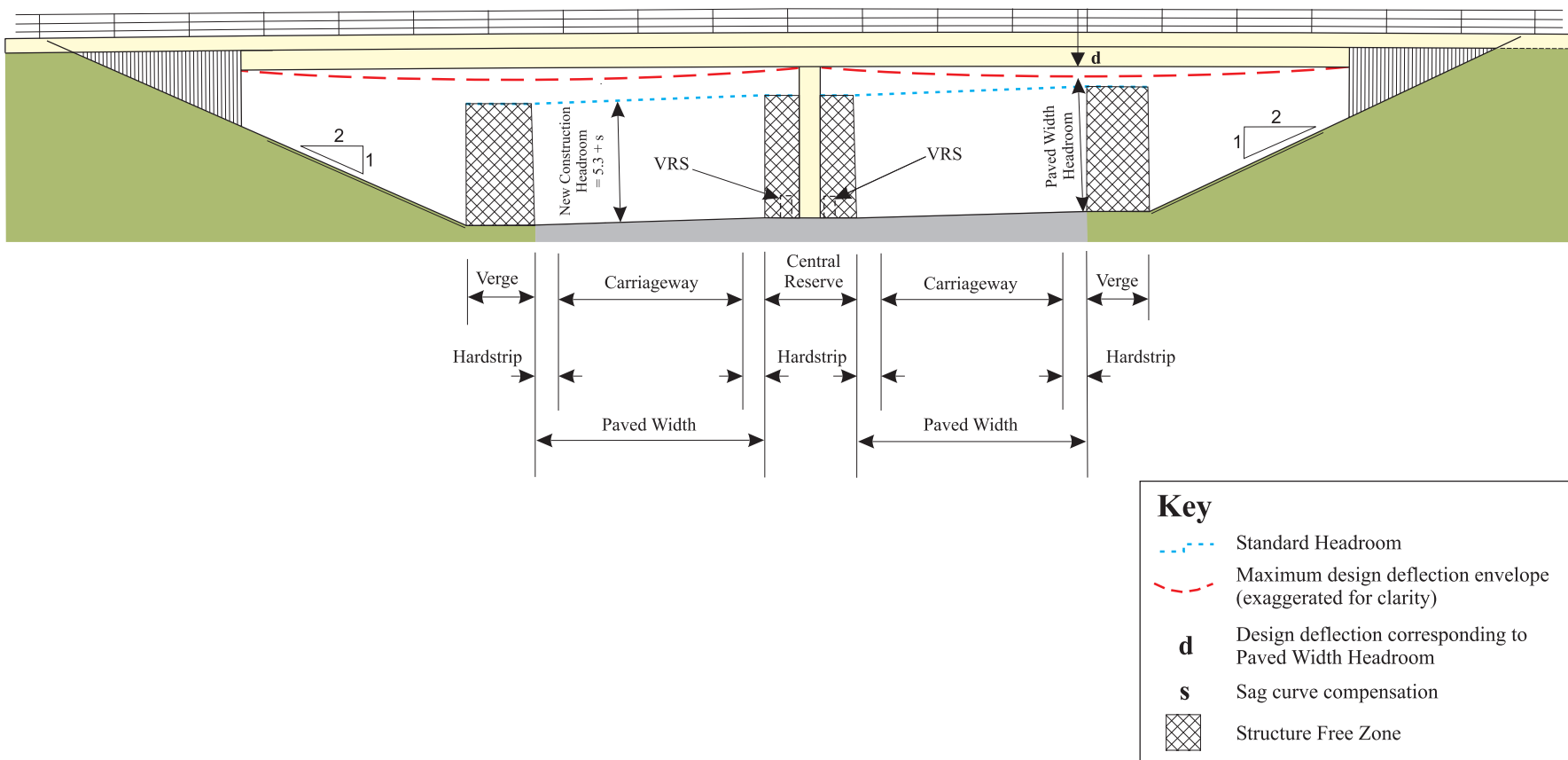


Figure 6-2: Headroom and Structure Free Zone for a Two Span Structure Crossing a Dual Carriageway

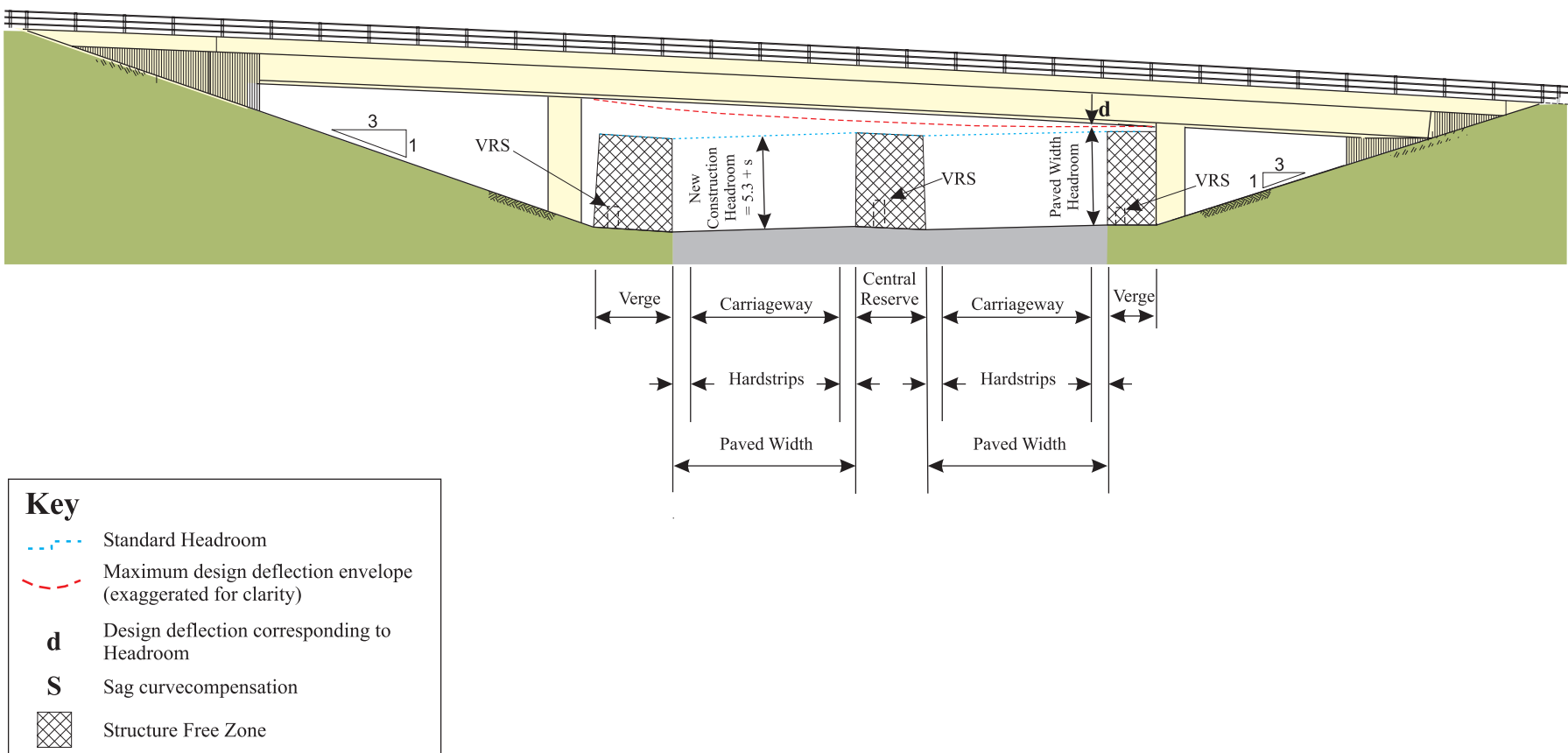


Figure 6-3: Headroom and Structure for a Three Span Structure Crossing a Dual Carriageway

7. REFERENCES

Department for Transport

Design Manual For Roads and Bridges

BD 2 (DMRB 1.1)	Technical Approval of Highway Structures
BD 60 (DMRB 1.3.5)	Design of Highway Bridges for Vehicle Collision Loads
BD 29 (DMRB 2.2.8)	Design Criteria for Footbridges
BD 78 (DMRB 2.2.9)	Design of Road Tunnels
TA 80 (DMRB 4.2.2)	Surface Drainage of Wide Carriageways
TA 46 (DMRB 5.1.3)	Traffic Flow Ranges for Use in the Assessment of New Rural Roads
TA 79 (DMRB 5.1.3)	Traffic Capacity of Urban Roads
TA 91 (DMRB 5.2.4)	Provision for Non-Motorised Users
HD 42 (DMRB 5.2.5)	Non-Motorised User Audits
TA 57 (DMRB 6.3)	Roadside Features
TD 9 (DMRB 6.1.1)	Highway Link Design
TD 22 (DMRB 6.2.1)	Layout of Grade Separated Junctions
TD 39 (DMRB 6.2.4)	The Design of Major Interchanges
TD 42 (DMRB 6.2.6)	Geometric Design for Major/Minor Priority Junctions
TD 36 (DMRB 6.3.1)	Subways for Pedestrians and Pedal Cyclists. Layout and Dimensions
TA 69 (DMRB 6.3.3)	The Location and Layout of Lay-bys

TA 90 (DMRB 6.3.5)	The Geometric Design of Pedestrian, Cycle and Equestrian Routes
HD 39 (DMRB 7.2.5)	Footway Design
TA 56 (DMRB 8.2)	Hazardous Cattle Crossing: Use of Flashing Amber Lamps
TA 92 (DMRB 8.4.6)	Crossover and Changeover Design
TA 73 (DMRB 9.4.2)	Motorway Emergency Telephones
DMRB 10.1 and 10.2	The Good Roads Guide
DMRB Volume 11	Environmental Assessment

Other Department for Transport Documents

Inclusive Mobility (DfT 2003) http://www.dft.gov.uk/stellent/groups/dft_mobility/documents/page/dft_mobility_503282.hcsp

Provision of Farm Crossings (DfT/NFU)

Report of the Study Group on Dimensions of Agricultural Bridges and Underpasses (DfT/MAFF)

The Traffic Signs Manual

Manual of Contract Documents for Highway Works

Manual of Contract Documents for Highway Works (MCDHW)

Transport Research Laboratory (TRL)

Accidents at Hard Shoulder Discontinuities on Dual 2-Lane and 3-Lane Motorways - Unpublished Report PR/TT/025/98 (available on request from Overseeing Organisation)

**The Institution of Highways & Transportation
(IHT)**

Transport in the Urban Environment (TUE) (IHT 1997)

Guidelines for Providing for Journeys on Foot (IHT
2000)

Note: The above list does not generally include those
references in Annex A.

8. ENQUIRIES

All technical enquiries or comments on this Standard should be sent in writing as appropriate to:

Chief Highway Engineer
The Highways Agency
123 Buckingham Palace Road
London
SW1W 9HA

G CLARKE
Chief Highway Engineer

Chief Road Engineer
Scottish Executive
Victoria Quay
Edinburgh
EH6 6QQ

J HOWISON
Chief Road Engineer

Chief Highway Engineer
Transport Directorate
Welsh Assembly Government
Llywodraeth Cynulliad Cymru
Crown Buildings
Cardiff
CF10 3NQ

M J A PARKER
Chief Highway Engineer
Transport Directorate

Director of Engineering
The Department for Regional Development
Roads Service
Clarence Court
10-18 Adelaide Street
Belfast BT2 8GB

G W ALLISTER
Director of Engineering

ANNEX A: FEATURES COMMONLY OCCURRING IN THE HIGHWAY CROSS-SECTION

Feature	Standard Advice or Guidance	Title
Abnormal load lay-bys		No specific reference documents identified
Agricultural/Animal Crossings	TA 56 (DMRB 8.2) TA 57 (DMRB 6.3.3)	Hazardous Cattle Crossings: Use of Flashing Amber Lights Roadside Features
Airspace headroom for airstrips near roads	International Civil Aviation Organisation Annex 14, Aerodromes	Specification for the design and equipment for aerodromes
Animal bridges	DMRB 10.4	
Animal Tunnels	DMRB 10.4	
Anti-Glare Screens	CSRRS	
Arrester Beds	CSRRS	
At-grade crossings	TA 68 (DMRB 8.5.1) TA 15 (DMRB 8.1) TA 57 (DMRB 6.3.3) Local Transport Note 2/95	The Assessment and Design of Pedestrian Crossings Pedestrian Facilities at Traffic Signal Installations Roadside Features The Design of Pedestrian Crossings
Camera installations	TD 17 (DMRB 9.3)	Criteria for the Provision of Close Circuit Television on Motorways
CCTV Masts	BD 83 (DMRB 2.2.11)	Design of CCTV Masts
Culverts	DMRB 4.2	
Cycle facilities	TD 36 (DMRB 6.3.1) Local Transport Note 4/00 TA 90 (DMRB 6.3.5) TA 91 (DMRB 5.2.4)	Subways for Pedestrians and Pedal Cyclists Layout and Dimensions Cycling Bibliography The Geometric Design of Pedestrian, Cycle and Equestrian Routes Provision for Non-Motorised Users
Designated lanes including bus lanes, high-occupancy vehicle lanes, non-car lanes	SH 5 (DMRB 8.2) Local Transport Note 1/97 Traffic Advisory Leaflet 6/01	Implementation of Bus Priorities Keeping Buses Moving Bus Priorities
Drainage channels	DMRB 4.2	

Feature	Standard Advice or Guidance	Title
Drains	MCDHW 3.1 HA 37 (DMRB 4.2.4) HA39 (DMRB 4.2.1)	Highway Construction Details Hydraulic Design of Road Edge Surface Water Channels Edge of Pavement Details
Emergency telephones	TA 73 (DMRB 9.4.2)	Motorway Emergency Telephones
Environmental barriers including screening fencing and noise fencing/bunds	HA 65 (DMRB 10.5.1) HA 66 (DMRB 10.5.2)	Design Guide for Environmental Barriers Environmental Barriers Technical Requirements
Equestrian facilities	TA 90 (DMRB 6.3.5) TA 91 (DMRB 5.2.4)	The Geometric Design of Pedestrian, Cycle and Equestrian Routes Provision for Non-Motorised Users
Footbridges	BD 29 (DMRB 2.2.8)	Design Criteria for Footbridges
Foundations	BD 74 (DMRB 2.1.8)	Foundations
Geotechnical Monitoring Equipment		No specific reference documents identified
Geotextiles		No specific reference documents identified
Gullies	DMRB 4.2	
Hardstandings		No specific reference documents identified
High mast lighting columns	CSRRS	
Highway boundary fencing	MCDHW 3.1	Highway Construction Details
Ice prediction and Weather Stations	TRMM	Trunk Road Maintenance Manual
Kerbing including combined kerb and drainage systems	HA 39 (DMRB 4.2) TA 57 (DMRB 6.3.3) MCDHW 3.1	Edge of Pavement Details Roadside Features Highway Construction Details
Landscaping	DMRB Vol. 10	No specific reference documents identified
Lay-bys	TA 69 (DMRB 6.3.3)	Location and Layout of Lay-bys
Lighting Columns	BS 5489 BD 26 (DMRB 2.2.1) TD 30 (DMRB 8.3) BS 5649/EN40 TD 34 (DMRB 8.3)	Road Lighting: Guide to General Principles Design of Lighting Columns Design of Road Lighting for All-Purpose Trunk Roads Lighting Columns Design of Road Lighting for Motorway Trunk Roads
Loop Detectors	HD 20 (DMRB 9.3.1)	Loop Detectors for Motorways
Maintenance crossovers	TA 92 (DMRB 8.4.6)	Crossover and Changeover Design

Feature	Standard Advice or Guidance	Title
Mobile telephone masts		No specific reference documents identified
Motorway Communications including VMS and infrastructure	DMRB Volume 9, 9a, and 9b MCDHW 3.3	Network Traffic Control and Communications Highway Construction Details
Motorway Markers	MCDHW 3.1	Highway Construction Details
Overbridges	DMRB Volumes 1 and 2	
Overhead Electricity Power Lines	Electricity Association Services Limited Standard 43-8	Overhead Line Clearances
Pedestrian facilities	HD 39 (DMRB 7.2.5) TD 36 (DMRB 6.3.1) TRL: Application Guide 26 Local Transport Note 2/86 Institute of Highways and Transportation Guidance Traffic Advisory Leaflet 3/00 TA 90 (DMRB 6.3.5) TA 91 (DMRB 5.2.4)	Footway Design Subways for Pedestrians and Pedal Cyclists Layout and Dimensions Footways – Design and Maintenance Guide Shared use by cyclists and pedestrians Guidelines for Providing for Journeys on Foot Walking Bibliography The Geometric Design of Pedestrian, Cycle and Equestrian Routes Provision for Non-Motorised Users
Pedestrian Guardrails	CSRRS	
Picnic areas	TA 57 (DMRB 6.3.3)	Roadside Features
Pipeline structures		No specific reference documents identified
Police/Observation Platforms on Motorways	TA 66 (DMRB 6.3.2)	Police Observation Platforms on Motorways
Ponds	HA 87 (DMRB 10.0) HA 89 (DMRB 10.0)	Environmental Functions Environmental Elements
Reinforced earth walls	BD 70 (DMRB 2.1.5)	Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments
Retaining walls	BD 41 (DMRB 2.1.1) BD 42 (DMRB 2.1.2) BD 68 (DMRB 2.1.3) BA 68 (DMRB 2.1.4) BD 70 (DMRB 2.1.5)	Reinforced Clay Brickwork Retaining Walls of Pocket Type and Grouted Cavity Type Construction Design of Embedded Retaining Walls and Bridge Abutments Crib Retaining Walls Crib Retaining Walls Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments

Feature	Standard Advice or Guidance	Title
Rock fences		No specific reference documents identified
Sign/Signal Gantries	BD 51 (DMRB 2.2.4)	Portal and Cantilever Sign/Signal Gantries
Signs	TSM TSR&GD DMRB Volume 8	Traffic Signs Manual Traffic Signs Regulations and General Directions
Sky cradle areas for HV cables	National Grid Co. Ltd Technical Doc. TGN [T] 47	Design and use of sky cradles at line crossings of motorways, other major roads and railways
Storage tanks/interceptors		No specific reference documents identified
Subways	TD 36 (DMRB 6.3.1)	Subways for Pedestrian and Pedal Cyclists Layout and Dimensions
Traffic calming	Traffic Advisory Leaflet 5/00	Traffic Calming Bibliography
Traffic Signals	TD 50 (DMRB 6.2.3) DMRB 8.1 Local Transport Note 1/98	The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts Traffic Signals and Control Equipment The Installation of Traffic Signals and Associated Equipment
Transmission substations		No specific reference documents identified
Tree planting	HA 13 (DMRB 5.2) DMRB Volume 10	The Planting of Trees and Shrubs
Underbridges	DMRB Volumes 1 and 2	
Utility and Statutory Undertakers Plant including both above ground apparatus (e.g. cabinets, governors, telegraph poles, etc.) and underground apparatus (e.g. buried cables, pipelines, etc.)	MCDHW 3.1	Highway Construction Details
Vehicle Restraint Systems	CSRRS	
VMS Signs	TA 60 (DMRB 8.2) TD 33 (DMRB 8.2)	The Use of Variable Message Signs on All-Purpose and Motorway Trunk Roads The Use of Variable Message Signs on All-Purpose and Motorway Trunk Roads

NOTE: Design Organisations must satisfy themselves of the currency of the details contained within this table.

MCDHW is The Manual of Contract Documents for Highway Works

ANNEX B: RURAL MOTORWAY WIDENING, CROSS-SECTION AND LAYOUT AT PHYSICAL RESTRAINTS

1. INTRODUCTION

1.1 General

1.1.1 This Annex is based upon guidance developed by the Overseeing Organisations to assist the development of options at constrained locations for the first sections of M25 to be widened. These sections are now open to traffic and the experience gained has been incorporated into this document. The results of completed research into the effects of long-standing discontinuous hardshoulders and reduced width lanes elsewhere on the UK motorway network have also been incorporated. See **TRL unpublished report** 'Accidents at Hard Shoulder Discontinuities on Dual 2-Lane and 3-Lane Motorways'.

1.2 Scope

1.2.1 This Annex gives advice for the preparation of rural dual four-lane motorway (D4M) improvement schemes that will add or relocate lanes within a carriageway, often within existing highway land and often at existing structures. Its application is not intended for use on new routes or 'green field' sites. The document describes the options for modification of the cross-section at physical constraints that occur where existing structures cannot readily be widened. A constrained location could also occur away from structures where the existing highway boundary is close to the edge of the paved width or a proposed boundary fence is close to a sensitive location (e.g. Site of Special Scientific Interest).

1.2.2 Although this Annex has been worded for proposed D4M projects, this advice may also be applicable for other motorway or dual carriageway projects. However in the case of the latter, the needs of NMUs may preclude the use of narrow verges.

1.3 General Principles

1.3.1 The primary objective is to provide a Cross-section that complies with the mandatory sections of TD27. Designs developed using this Annex may not comply (see Table 1 notes) and in such cases must be submitted to the Overseeing Organisation for consideration as Departures from Standard.

1.3.2 Small changes in cost or other small effects are not sufficient justification for Departures from Standards. Design Organisations must demonstrate that significant and disproportionate costs or other effects would result from adoption of full standards, before considering non-standard designs.

1.3.3 Making the best use of the available width involves firstly using all spare space. The second principle is to maintain the width of running lanes, particularly those carrying heavy vehicles, as far as practicable because these are in use all the time. Research and experience, both from the UK and abroad, has shown that short discontinuities in the hardshoulder do not materially affect the good safety record of motorways.

1.3.4 Where traffic is moved closer to existing structures, the Design Organisation must consider the risk of collision with the structure. Reference must be made to **BD 48 (DMRB 3.4.7)** for guidance on assessing the susceptibility of the supports to vehicle impact.

1.3.5 Narrow Cross-sections may affect the viability, efficiency or safety of maintenance operations. Design Organisations, in accordance with Health and Safety legislation, must consider such effects in all designs. The Maintaining Organisation must always be consulted.

1.3.6 Narrow Cross-sections may affect the performance of the emergency services. The emergency services must always be consulted.

1.3.7 The Design Organisation must determine the likely risks and report its findings with Departure from Standard submissions.

2. DEVELOPMENT OF OPTIONS AT CONSTRAINTS

2.1 Application of Departures

2.1.1 The priority order in which departures and relaxations must be applied when apportioning the available space to the various components is given in Table 1, which should be read in conjunction with Figure 1. The hierarchy should be applied in sequence, with the appropriate adjustment made to the related cross-sectional element whenever practicable, before proceeding to the next level.

2.1.2 The following paragraphs deal with the provision and width of components, the choice of VRSs and the set-back to them, hardshoulder width and discontinuities, emergency access routes, and traffic lane widths.

2.2 Verge and Central Reserve (1 and 2 in Table 1)

2.2.1 Design Organisations should consider reducing the width of verges and the central reserve to the minimum required to accommodate equipment (see Sections 4.6 and 4.7 of the main document).

2.2.2 At Underbridges, the Design Organisation should be aware of paragraph 5.7.4 in the main document with respect to raised verges adjacent to a parapet.

2.3 Clearance to Structures (3 in Table 1)

2.3.1 Limiting the space devoted to VRSs may be achieved by the use of types that maximise the space for traffic. Further space savings can be achieved by the use of smooth, non-snagging concrete faces to existing piers, abutments and retaining walls, in conjunction with flush-fitted VRSs on both approach and departing ends of the structure face. The structure must be able to resist the appropriate impact loading if it is to perform the dual function of a structure and a VRS. Even where VRSs are provided, it may still be necessary for structures to resist residual impact loading. New points of impact loading from any new access routes behind piers should also be considered.

2.3.2 Emergency access routes are contained within the Paved Width defined in the main document.

2.3.3 Headroom requirements are given in Section 6 of the main document.

2.4 Set-back to Vehicle Restraint Systems (4 to 11 in Table 1)

2.4.1 Desirable minimum set-back values are given in Section 4.11 of the main document.

2.4.2 At constraints the set-back to the hardshoulder could be reduced to zero and to a traffic lane to 1.0m. The set-back on the offside of a traffic lane from a deformable VRS could be reduced to 0.80m. Rigid VRSs are more noticeable to drivers and consequently it is recommended that set-backs to them are not less than 1.0m. The Working Width behind the VRS allows for deflection of the barrier on impact and Departures from Standard on working width are not usually permitted.

2.5 Motorway Hard Shoulder Provision (4 to 6 in Table 1)

2.5.1 The standard rural hardshoulder width of 3.30m is desirable. Its function is described in Section 4.5 of the main document.

2.5.2 Hard shoulder width may be reduced to 3.0m without significantly reducing effectiveness and safety for breakdown and emergency use. Widths of less than 3.0m should be regarded as discontinuities of the hardshoulder and therefore not for public use.

2.5.3 Where the Design Organisation requires the hardshoulder to be discontinued, the space should be used to provide an emergency access route. Any local discontinuity of the hardshoulder should be as short as practicable and marked as shown in Figure 2. In addition to markings, appropriate signs must be provided advising of loss of hardshoulders. See paragraph 2.13.4 below.

2.5.4 Between local discontinuities the minimum length of hardshoulder for public use (3.0m minimum width) should be 100m between the tips of taper markings to allow for safe stopping and rejoining. Where widths of greater than 3.0m are provided between two discontinuities, but the length is less than 100m, the hatching must be continued.

2.5.5 The retention of a hardshoulder on the 300m before a diverge is less important than at other points because drivers of vehicles with mechanical difficulties can usually manage to reach the off-slip. Conversely, a discontinuity of the hardshoulder immediately after a merge should be avoided because drivers who have difficulty merging tend to overrun the hardshoulder. Nearside lane-gain junctions do not normally present this risk.

2.6 Motorway Emergency Access (7 to 11 in Table 1)

2.6.1 Emergency services make use of the hardshoulder to reach incidents. The level of severity of accidents often depends on the time taken for emergency services to reach an incident. At discontinuities of the hardshoulder, emergency services can make use of widths of 2.50m or less (absolute minimum 1.0m) for access purposes, provided Lane 1 is standard width. This is particularly desirable where the alternative route would be time consuming, such as at viaducts. Any emergency access width adjacent to the left-hand lane should be hatched and signed as a discontinuous hardshoulder to discourage public use.

2.6.2 Bridges with open side-spans may permit construction of a continuous access roadway for emergency vehicles behind the pier at a hardshoulder discontinuity. Figure 3 shows a typical layout.

2.6.3 Where it is proposed to create discontinuities of the hardshoulder that would cause significant difficulties for the emergency services in reaching incidents, the Design Organisation should consider the provision of alternative access roadways separate from the motorway. These might start from interchanges, maintenance compounds, or special accesses from local roads or other access points at the motorway boundary. It is highly desirable that the presence and destination of access roadways is not readily apparent to the public to minimise the possibility of unauthorised use. Signs, markings and often physical barriers will be necessary.

2.6.4 The Design Organisation must consult with the emergency services in writing on the access provision for rural motorway schemes with hardshoulders less than 3.0m in width. This must be included in a site specific risk assessment undertaken by the Design Organisation that takes into account local factors, e.g. some sites may have higher risks due to the length of alternative routes and/or proximity of major venues, hospitals, airports or major industrial works.

2.6.5 For layouts such as those shown in Figure 3, the risk of impact with bridge piers may be higher than the layout given in Figure 2. In addition, the risk of vehicles being launched from the ramped-ends of VRSs is higher. Therefore it is recommended that Design Organisations consult CSRRS with a view to considering the use of crash cushions for such layouts. A warning bollard with reflective materials should also be provided. Also refer to paragraph 1.3.4 for guidance on the requirements to check bridge piers for impact.

2.7 Width of Traffic Lanes (10 to 11 in Table 1)

2.7.1 The standard lane widths in TD 27 for a four lane rural motorway are shown at A1 in Figure 1. The lane dimensions are measured between the trafficked side of carriageway edge lines and the centre line of lane lines and this convention is followed in this Annex. Design Organisations should, however, take care to state the points on the lane markings that any dimensions are measured between when specifying narrower lanes.

2.7.2 Traffic lane widths less than standard may be considered for lanes 1, 2, 3 and 4. Lane 1 may be reduced to 3.60m, lane 2 to 3.50m, lane 3 to 3.35m, and lane 4 to 3.35m. Section A2 in Figure 1 shows these widths. The pavement construction should be extended into the set-back area on the offside where the width of lane 4 is reduced. However, as described in paragraph 4.11.15 of the main document, extension of the pavement within a 600mm zone from the VRS would not normally be warranted. It is recommended that the central reserve is hardened as described in Section 4.6 of the main document so that accidental overrun is accommodated safely.

2.7.3 Where the space available for traffic lanes is less than the standard section, but more than in Section A2 in Figure 1, the additional space should be allocated first to lane 1, then to offside lanes, up to the standard width of section in Section A1 in Figure 1.

2.7.4 Exceptionally, lane widths less than in Section A2 in Figure 1 may be necessary over short lengths and complementary signing is likely to be required in such cases. Such signing will require special authorisation. Speed limit and/or width prohibition traffic orders may be required.

2.8 Transitions Between Sections of Different Width

2.8.1 The length of transition from one Cross-section to another should be sufficient for drivers to follow naturally the alignment of the lane lines and edge lines ahead and to negotiate and adjust position relative to vehicles in adjacent lanes. Changes in direction of road markings should be smooth and curved. Table 4-2 of the main document provides minimum requirements but, because variations of standards on motorways are rare, it is recommended that taper angles of 1:100 or shallower are adopted.

2.9 Length

2.9.1 Adoption of the options contained within this Annex for modifying the hardshoulder and carriageway Cross-section and layout at physical constraints is only considered appropriate at short obstructions (i.e. less than 100m in length, exclusive of tapers). Approval for longer sections (i.e. greater than 100m) will not be considered unless there is very strong justification in terms of safety, reliability, efficiency and environmental impact.

2.9.2 For schemes where more than one discontinuity is proposed, Design Organisations should be aware that numerous discontinuities can:

- i. increase response times for emergency vehicles when queuing traffic is present;
- ii. increase risk to the travelling public;
- iii. affect the safety of maintenance; and
- iv. increase delays during maintenance operations and incident management as sufficient width may not be available to provide the required number of traffic lanes.

[Note: The adverse effects described above will be aggravated where a discontinuity coincides with reduced lane widths.]

2.9.3 Driving on narrow lanes for long distances requires considerable levels of concentration, as there is very little margin for error when steering a vehicle, particularly where numbers of Large Goods Vehicles are high. Driving for long distances through this type of layout would increase driver stress, possibly resulting in judgement errors and an increase in the risk of accidents. It is not envisaged that reduced lane widths would be continued over long lengths.

2.10 Emergency Telephones at Discontinuities

2.10.1 Where currently installed on a route, emergency telephones should be provided at either side of discontinuities, so that drivers in difficulty will be encouraged to stop before the discontinuity, and all drivers seeking assistance can walk to a telephone without crossing the discontinuity. Emergency telephones should be located in positions where it is safe for both a vehicle to stop and subsequently rejoin the carriageway and for pedestrians, including those with mobility impairments, to travel between the phone and vehicle. Emergency telephones should be located on lengths with full width hardshoulders in preference to lengths without hardshoulders, or with emergency access routes.

2.10.2 In situations where verge width is very limited over a long length, such as at retaining walls, consideration should be given to local verge widening at the telephone site, reached through an overlap in the VRS where these are required, to improve the safety of those using the telephone.

2.10.3 It may be feasible to route pedestrians through side spans if the verge is hardened and signing is provided.

2.11 Cross-section Departures in Combination with Other Relaxations

2.11.1 In many cases, Relaxations permitted by **TD 9 (DMRB 6.1.1)**, in visibility, horizontal curvature, and vertical curvature will be acceptable in combination with cross-section departures. However, these aspects, as with any other local features at a constrained location should be considered in the development of options and reported in any submission for Departures from Standard.

2.12 Maintenance Implications

2.12.1 Reductions of the surfaced width can be expected to have implications for future maintenance and the Maintaining Organisation must be consulted on this aspect. Checks should be made that layouts are capable of safe and satisfactory operation during closures by considering the necessary traffic management measures, including temporary signing. Consideration should be given to ploughed snow storage, salting routes and diversion routes. Maintenance activities also require access to structures and ancillary items such as drainage, signs, lighting, signalling equipment, planting and mown areas.

2.12.2 Where the hardshoulder is less than 3.0m maintenance hardstandings must be considered in accordance with the guidance provided by paragraph 4.11.5 of the main document.

2.13 Mitigation

2.13.1 As with any non-standard situation, Design Organisations must consider suitable mitigation measures to reduce any identified risks.

2.13.2 Signing to warn drivers of width reductions is discussed at paragraph 2.7.4 above.

2.13.3 Typical road marking layouts for locations where the width of hardshoulder would be less than 3.0m are shown in Figures 2 and 3.

2.13.4 Statutory Requirements for signing and marking are contained in the Traffic Signs Regulations and General Directions, which in many cases will indicate hatched markings to diagram 1040.5, in conjunction with a sign to diagram 820.1. Where breaks in the hardshoulder are intermittent, a single sign advising of the total length of discontinuous hardshoulder may be preferable to signing each break separately. Variants of diagram 820.1 have been used, although this case requires signs authorisation by the Overseeing Organisation.

2.13.5 **Chapter 4** of the **Traffic Signs Manual** gives advice about the siting of warning signs. Diagram 820.1 is considered to be a warning sign. The **Traffic Signs Manual** gives advice about the distance between warning signs and the hazard. The hazard must be taken to be the first physical incursion into the normal 3.30m hardshoulder.

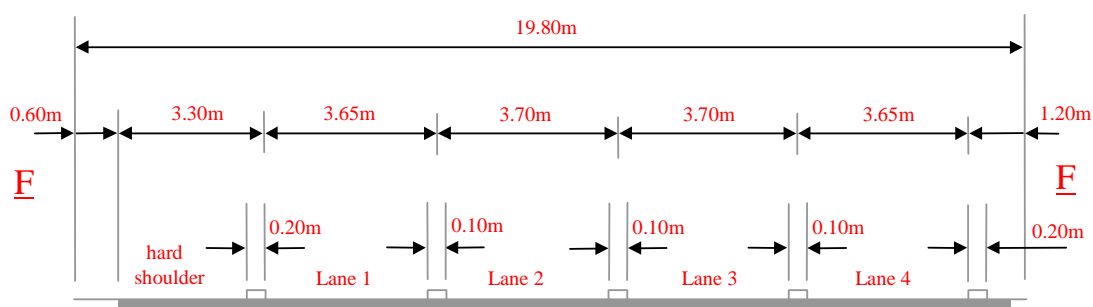
2.13.6 Recent advances in technology allow network operators to be alerted to vehicles stopped on the carriageway. This could be via use of inductive loops, CCTV or intelligent video systems. Where risks are considered to be high (e.g. where hardshoulder discontinuities are long) the Design Organisation should consider such mitigation measures.

Priority Order (see Note 1)	Comments	Left-hand Set-back	Hard Shoulder or Emergency Access Width	Running Lane Widths	Right-Hand Set-back	Overall Width Between “F” Points in Fig.1
1	(Paragraph 2.2)	Reduce verge widths				
2	(Paragraph 2.2)	Reduce central reserve width				
3	(Paragraph 2.3)	Limit space devoted to VRs (See Note 2)				
4	Minimum standard section (Figure 1; A1)	0.60m to back of hardshoulder	3.30m hardshoulder	14.70m standard lane widths	1.20m	19.80m
5	Reduce: Set-back adjacent to the hardshoulder to a minimum of zero, and adjacent to a traffic lane to a minimum of 0.80m (See Note 3)	Zero The minimum set-back of 1.0m to the nearside traffic lane is included within the emergency access width			0.80m (See Note 3)	18.80m
6	Reduce: Hardshoulder width, to a minimum of 3.0m hardshoulder	3.0m				18.50m
7	Provide: 2.50m emergency access route for emergency vehicles only	2.50m emergency access (hatched & signed)	18.00m			
8	Provide: 2.0m emergency access route for emergency vehicles only	Zero The minimum set-back of 1.0m to the nearside traffic lane is included within the emergency access width	2.0m emergency access (hatched & signed)		17.50m	
9	Reduce: Emergency access route to 1.0m		1.0m emergency access (hatched & signed)		16.50m	
10	Reduce Lane 4 to 3.55m Lane 3 to 3.60m Lane 2 to 3.60m			14.40m reduced width of lane 4	16.20m	
11	Reduce Lane 4 to 3.35m Lane 3 to 3.35m Lane 2 to 3.50m Lane 1 to 3.60m (Figure 1; A2)			13.80m Figure 1; A2-reduced width lanes 2, 3 & 4	15.60m	

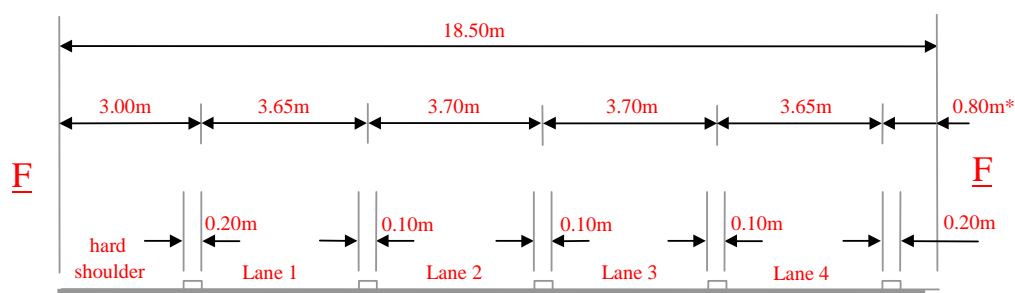
Note:

- For schemes within the Scope defined in paragraphs 1.2.1 and 1.2.2 of this Annex, it is permitted to adopt steps 1 to 6 as Relaxations (with the exception of Working Width as described in paragraph 2.4.2). Steps 7 to 11 are Departures from Standard.
- Refer to paragraph 2.4.2 of this Annex for advice on allowable relaxations in set-back.
- For double sided deformable barriers this dimension must be checked to ensure that the deflected system does not encroach into the opposite live traffic lane. Also for rigid VRs the 0.80m set-back must be increased to 1.0m.
- For interpolation between steps refer to paragraph 2.7.3.

Table 1: Priority Order For Cross-section Reductions At Physical Constraints

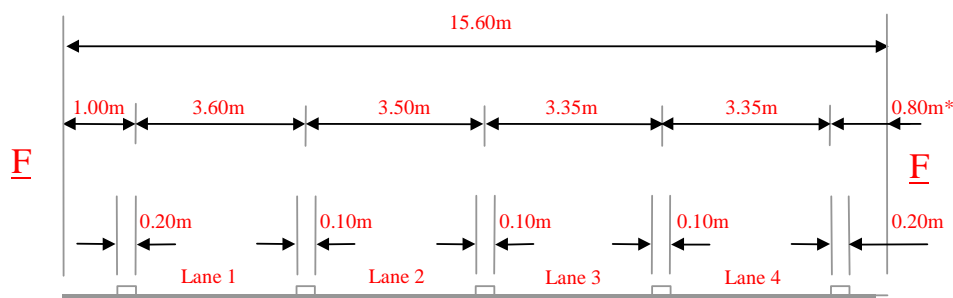


A1 – STANDARD 4 LANE SECTION
No.4 in Table 1



Note: Refer to para. 2.7.2 of this Annex B for details on edge treatment.

REDUCED WIDTH HARD SHOULDER & SET BACK
No.6 in Table 1



Note: Refer to para. 2.7.2 of this Annex B for details on edge treatment.

A2 – REDUCED WIDTH LANES AND SET-BACK AND
MINIMUM EMERGENCY ACCESS
No.11 in Table 1

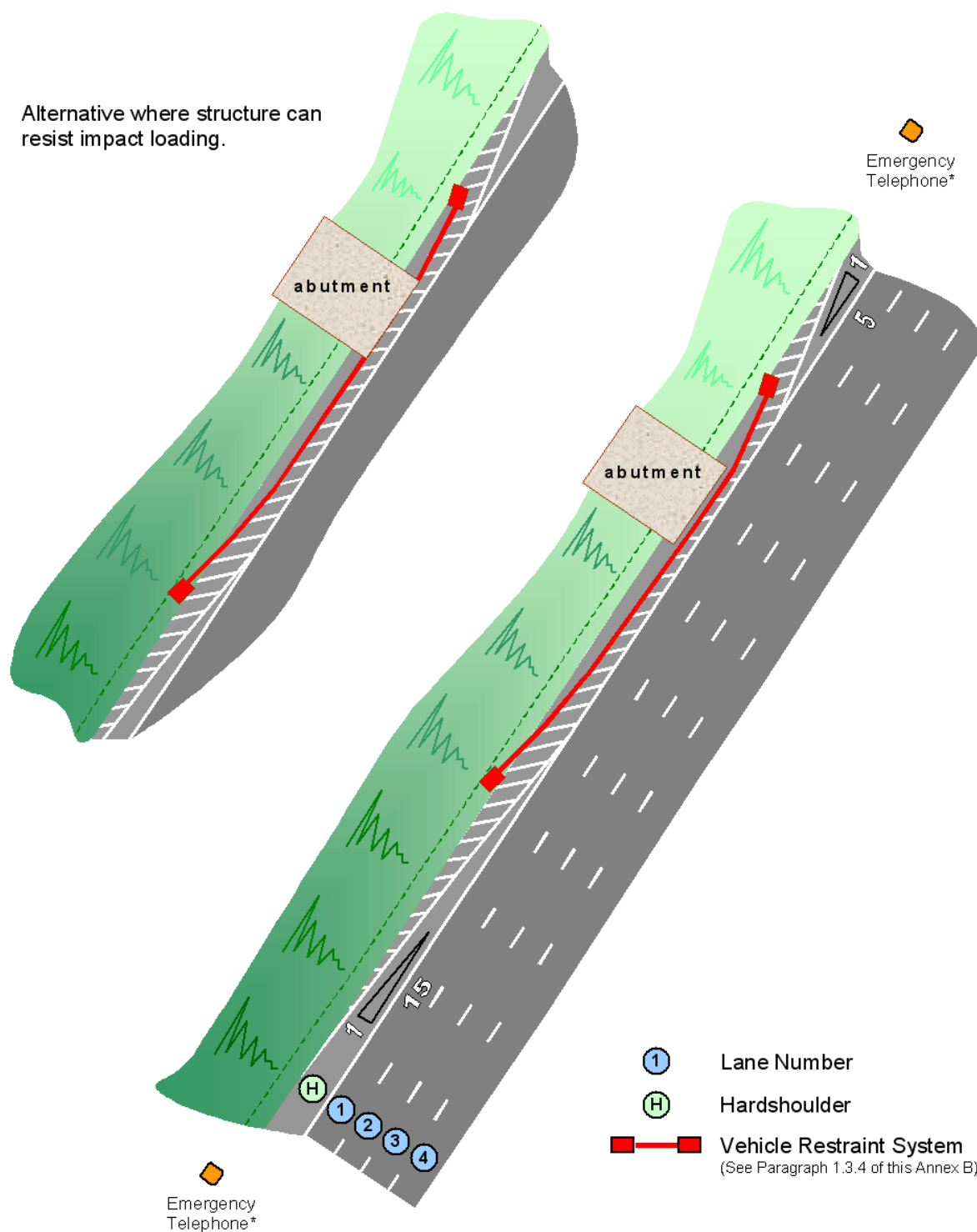
Note:

F Face of physical constraint. Note that for parapets paragraph 2.2.2 of this Annex refers.

* 1.00m minimum to rigid VRSSs.

Refer to paragraph 4.13.1(12) of the main document with regard to lane line widths.

Figure 1 - Cross-section Examples At Physical Constraints



Notes

* Emergency telephones 100m from ends of the tapers.

The tapers start at the points where the hard shoulder width reduces below 3.3m

Figure 2 - Layout at a Discontinuity of the Hardshoulder



1. 2.50m minimum paved width with widening on curves
2. 3.00m minimum clear width between vehicle restraints system faces (4.00m minimum where snow ploughs must pass)
3. Headroom must be equal to the appropriate value of Maintained Headroom (see para. 6.1.4. of the main document), unless vehicle restrictions permit a lower value
4. Horizontal alignment, vertical alignment and visibility for a design speed of 50 kph
5. Construction to be designed to carry minimum of 100 cv/d

The tapers start at the points where the hard shoulder width reduces below 3.3m

Figure 3 - Access Roadway for Emergency Vehicles