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Cross-Sections and Headroom

November 2011

Summary:

This Standard sets out the dimensional requirements for road cross-sections for all-purpose roads and motorways. It covers the requirements on the open road and at structures, but not in tunnels. It also gives requirements for headroom at structures.

VOLUME 6 ROAD GEOMETRY
SECTION 1 LINKS

PART 2

NRA TD 27/11

CROSS-SECTIONS AND HEADROOM

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1. INTRODUCTION

General

1.1 This Standard outlines the design principles and factors which should be considered by Design Organisations in selecting road cross-sections and headroom. The process of design is described together with an approach to developing options.

1.2 This standard supersedes the December 2007 version of NRA TD 27. This standard is a general revision including the introduction of:

- a) The terms Standard Single and Reduced Single in Table 3 have been removed and replaced with the terms Type 1 and Type 2 single.
- b) A new single carriageway cross section has been introduced to Table 3, namely the Type 3 Single (S2).
- c) Urban Single Carriageway relief road and Dual Carriageway relief road cross sections have been introduced to Table 5 of section 3.
- d) Guidance on the provision of footways for mobility impaired users.
- e) Amended definitions included.
- f) Sustainability requirements incorporated into document.
- g) The term hardstanding has been replaced by the term Hardened Verge.
- h) The definition of a cycle lane in paragraph 1.10 has been removed and replaced by the term cycle track; the definition of the term cycle track has been expanded.
- i) Paragraphs 3.55, 3.56 and 3.57 in conjunction with Table 1 of section 3 expand on the information provided in previous revisions of NRA TD 27 and provide information regarding footway, cycle track and raised verge combinations in urban areas.
- j) The term D2AP has been omitted in this revision of NRA TD27.
- k) The needs of mobility impaired persons at structures have been considered in section 4 and provisions have been introduced to Table 6 of Section 4.
- l) Table 8 of section 5 which details sag radius compensation has been expanded to provide details of curvature which may

be encountered/utilised on local routes or routes with a low design speed

Scope

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

1.4 The information covers roads of all types: rural motorways, rural all purpose roads, urban motorways, urban all purpose roads together with associated connector roads.

1.5 This Standard is not applicable to road tunnels.

1.6 For details of pedestrian and cycle subway dimensions see TD 36, and for footbridges see BD 29. Advice on equestrian subways and for agricultural crossings is given in TA 57.

Implementation

1.7 This Standard should be used forthwith for all schemes for the construction and/or improvement of all-purpose roads and motorways. The Standard should be applied to the design of schemes already being prepared unless, in the opinion of the National Roads Authority, application would result in significant additional expense or delay progress. In such cases, Design Organisations should confirm the application of this Standard to particular schemes with the National Roads Authority. For minor improvements to existing roads refer to NRA TA 85/11.

1.8 For the application of this Standard to regional and local roads diverted or improved on-line as part of a national road scheme, see Paragraphs 3.3 and 4.4.

Definitions

1.9 For the definitions of the general road terms used in this Standard such as components of the road (central reserve, verge, hard shoulder, and hard strip, etc.) see BS 6100-1 and BS 6100-4.

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

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

Bridge Length: - is the length of bridge parapet. Long underbridges are those exceeding 100m.

Bridleway: - Road (surfaced or unsurfaced) for use on foot or horseback.

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

Connector Road: - A collective term for slip roads, interchange links and loop roads.

Cross-section: - The road cross-section incorporates all elements between the boundaries including carriageways, the central reserve, separation zones, hard shoulders, hard strips, verges including any footway, cycle track or bridleway, cutting or embankment slopes, berms and work space. All dimensions are measured square to the line of the road (see Tables 2 to 5).

Cycle Track: - Part of a road, including part of a footway or part of a roadway, which is reserved for the use of pedal cycles and from which all mechanically propelled vehicles, other than mechanically propelled wheelchairs, are prohibited from entering except for the purpose of access.

D2M: - Dual two-lane motorway.

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

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

Disabled People: - Includes individuals with mobility, sight, comprehension or hearing impairment, the ageing population and people with temporary injuries. Includes users of wheelchairs (manual and electric) as well as users of motorised mobility scooters.

Footway:- that portion of any road associated with a roadway which is provided primarily for use by pedestrians;

Hardened Verge:- An area of the verge set aside for emergency situations for vehicles to stand or park. The surface should be sufficiently strengthened to support vehicles safely without sinking into the surface.

Headroom: - The minimum distance between surface and structure as defined in Paragraph 5.5.

Interchange: - A grade separated junction that provides free flow of traffic from one mainline carriageway to another. Refer to TD 22.

Interchange Link: - Refer to TD 22.

Loops: - Refer to TD 22.

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

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

Maintained Headroom: - The minimum headroom which shall be preserved at all times.

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

New Construction Headroom: - The headroom which includes an allowance for resurfacing.

Non-motorised Users (NMUs): - Pedestrians, cyclists and equestrians, including disabled people (see definition of 'Disabled People') and other mobility impaired users (e.g. people with luggage, with children, or pregnant women).

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

Overbridge: - A bridge that spans the road under consideration.

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

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

Road Tunnel: - A road tunnel enclosed for a length of 150m or more. A shorter enclosed length is an overbridge. Refer to NRA BD 2.

Rural Road:- A road outside of built-up areas including i) a single carriageway with a mandatory speed limit of at least 80km/h; or ii) a single carriageway within a speed transition zone and with a mandatory speed limit of 60km/h; or iii) a dual carriageway with a mandatory speed limit of at least 100km/h; or iv) a Motorway with a mandatory speed limit of 120km/h.

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

S2: - Two-lane single carriageway road with lane widths of up to 3.65m).

Slip Road: - Refer to TD 22.

Subway: - Underground passageway or tunnel for use by pedestrians, cyclists and sometimes equestrians.

Type 1 Dual Carriageway: - A divided all-purpose road with two lanes in each direction constructed to the geometric standards of NRA TD 9 and TD 22.

Type 2 Dual Carriageway: - A divided all-purpose road with two lanes in each direction constructed to the geometric standards of NRA TD 10.

Type 3 Dual Carriageway: - A divided all-purpose road with two lanes in one direction of travel and one lane in the other direction, constructed to the geometric standards of NRA TD 10. The two-lane section alternates with a one-lane section at intervals of 2km approximately.

Type 1 Single Carriageway:- An all purpose road with a 3.65m lane in each direction constructed to the geometric standards of NRA TD 9.

Type 2 Single Carriageway:- An all purpose road with a 3.50m lane in each direction

constructed to the geometric standards of NRA TD 9.

Type 3 Single Carriageway:- An all purpose road with a 3.00m lane in each direction constructed to the geometric standards of NRA TD 9.

Underbridge: - A bridge that carries the road under consideration.

Urban Road:- A road within a built-up area including i) a single carriageway urban relief road with a mandatory speed limit of 60km/h; or ii) a dual carriageway with a mandatory speed limit of 80km/h or less; or iii) a Motorway with a mandatory speed limit of 100km/h or less.

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

Urban Street:- A road within a built-up area with a mandatory speed limit of 50km/h or less; or a road within a built-up area with a mandatory speed limit of 60km/h and where the primary purpose of the road is to provide direct access to premises.

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

Work Space: -The strip of land between the top of cutting or toe of embankment and the road boundary.

Mandatory Sections

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

Relaxations within Standard

1.12 In difficult circumstances, the Design

Organisation may relax a standard set out in this document, where specifically provided for within the text. Refer to NRA TD 9. The Design Organisation shall record the fact that a Relaxation has been used in the design and the corresponding reasons for its use. The record shall be endorsed by the Design Organisation's senior engineer responsible for the scheme. The Design Organisation shall report all Relaxations incorporated into the design as part of the project report at the end of each project management phase (refer to the National Roads Project Management Guidelines).

Departures from Standards

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

2. DESIGN PRINCIPLES

General

2.1 This section describes the principles to be followed when designing road cross-sections for new and improved all-purpose roads and motorways. The underlying principle is that Design Organisations are given the maximum choice, so that there is flexibility to develop layout options that will meet the National Roads Authority's objectives.

2.2 Design Organisations should balance considerations of safety, environmental impact, sustainability, cost, buildability of the road elements, operation and maintenance. Where there are options for heights or widths, the selection process should include due consideration of these factors and any other design constraints.

Health & Safety Responsibilities

2.3 When selecting the most appropriate carriageway type, including connector roads, for a new or improved road, consideration should be given to the construction of and future maintenance and operation of the road. Health and Safety legislation requires that consideration is taken to ensure that the scheme can be constructed safely. The 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 road 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; or
- iii. select a higher standard of carriageway than suggested on traffic grounds.

2.4 Design Organisations must consider maintenance issues on a scheme-by-scheme basis and the selection of standard cross-sections in this Standard 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 Road Authority 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.

Range of Choice

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

2.6 The Design Organisation does, however, have some flexibility over the width of work space, berms, side slopes, verges and central reserves, although a reduction of verge or central reserve width below desirable minimum will require a Departure.

2.7 The verge width on either side of the paved area may be a factor affecting the severity of accidents where vehicles run off the carriageway. Research has indicated that only a small proportion of injury accidents, perhaps 2% or 3% in open country, would be avoided if verges were to be doubled in width. Consequently, safety aspects will not normally be a factor when choosing a verge width greater than the desirable width, provided visibility requirements are met. Details of when to provide safety barriers in verges and central reserves to protect against collisions between vehicles and roadside objects or features are given in NRA TD 19.

2.8 The width between the back of the verge and the road boundary will depend on the terrain, the need to accommodate environmental mitigation measures, the engineering or geotechnical measures used to accommodate changes in ground levels, and any need to include differing types and widths of drain and other services in the work space.

Environmental Design

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

Network Objectives

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

Designated Lanes

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

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

2.13 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.

2.14 Any proposal to install a designated lane on a national road is a Departure from Standard.

Non-Motorised Users

2.15 It is essential that Design Organisations integrate facilities for non-motorised users (NMUs) in the design at an early stage so that they are not overlooked when allocating space. This will help to ensure the most sustainable cross-section is selected. To do this effectively, Design Organisations must be able to understand the road environment from the NMUs' perspective and the relationship of NMUs to the various road design components.

2.16 During project appraisal involving new construction or improvement of an existing road, Design Organisations must determine and make adequate provision for any NMu requirements. An effective way of achieving this is through consultation with user groups.

2.17 The Design Organisation's attention is drawn to the requirement to provide proper and sufficient footways for pedestrians, cycle tracks 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.

2.18 In general, this will be the case for online improvements of national roads where no safer alternative route is available. However NMUs should be discouraged from using new offline high-speed roads where the existing route remains available and provides a safer alternative.

Disabled Persons

2.19 Disabled persons 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 disabled persons.

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

2.21 The required standard of provision for persons with disabilities must be considered at the early stages of scheme preparation and the level of facilities must be agreed with the Road Authority (Refer to paragraph 3.59).

Design Process

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

Agricultural cattle/horse crossings;
Animal tunnels;
Anti-dazzle fences;
Apparatus of utility companies and other authorities;
Bridleways;
Communication equipment;
Cycle Tracks;
Culverts;
Drains;
Emergency telephones;
Fencing;
Footbridges;
Footways;
Foundations;
Garda observation platforms;
Geotechnical monitoring equipment;
Geotextiles;
Hardened Verge;
Landscaping;
Lay-bys;
Lighting columns;
Loop detectors;
Noise barriers / bunding;
Overbridges;
Parapets;
Pedestrian guardrails;
Retaining walls;
Safety barriers;

Sign/signal gantries;
Subways;
Tracks for equestrians;
Traffic signals and control and equipment;
Traffic signs;
Underbridges;
Vehicle arrester beds;
Visual barriers / bunding; and
Weather monitoring equipment.

2.23 Details and design requirements for many of these features are contained in the Standards and Advice Notes of the NRA Design Manual for Roads and Bridges and in various other documents. Some features, safety barriers and large traffic signs for example, can have a significant effect on the cross-section width whilst other features, sign gantries for example, are usually accommodated within the side slopes and work space.

2.24 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 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 purposes. Engineering solutions can usually be designed to overcome conflicts where space is limited, but these may increase costs. The sizes and extents of features above and below ground in the verge and central reserve of rural roads can vary widely. Therefore, details are best designed individually for each situation.

Visibility

2.25 On curved alignments and approaches to junctions, it may be necessary to widen the cross-section, particularly verges and central reserves, to ensure that drivers and other road users can see the appropriate distances, and that the layout meets the visibility requirements. Refer to NRA TD 9.

3. CROSS-SECTIONS ON OPEN ROADS

General

3.1 Tables 2 to 5 give detailed dimensions for each element. The information covers most types of road, including rural motorways, rural all-purpose roads, urban motorways and urban all-purpose dual carriageway roads, together with associated interchange links, loops and on and off slip roads. For graphic representations of these cross-sections, refer to NRA Road Construction Details Series 000.

3.2 Wide Motorway cross-sections will normally be used only where adjacent lengths of road are of equivalent cross-section. The use of these cross-sections shall be agreed with the National Roads Authority in each case.

3.3 Table 3 gives detailed dimensions for each element of the cross-sections for regional and local roads diverted or improved on-line as part of a national road scheme. The particular type of cross-section to be adopted shall be a Type 1, 2 or 3 depending on the predicted traffic flows and the resulting capacity level to be provided in accordance with NRA TD 9 Table 6/1.

For graphic representations of these cross-sections, refer to NRA Road Construction Details Series 000.

Pavement Width

3.4 The width of the paved elements of the cross-section, i.e. carriageways, hard shoulders and hard strips, shall normally be in accordance with the requirements of this Standard. Any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements of Paragraph 3.8 or NRA TD 9.

Traffic Lane Widths

3.5 Traffic lane widths are measured between the trafficked side of carriageway edge lines and the centre line of lane lines and shall be as detailed in Tables 2 to 5.

3.6 Where kerbs are used on roads with a speed limit above 80km/h they shall be a maximum height of 80mm and shall be splayed over the full height, by at least 45° to the vertical.

3.7 Information on the provision, start and finish of climbing lanes incorporated into single and dual carriageway roads can be found in NRA TD 9.

3.8 Traffic lanes shall be widened on curves of low radius to allow for the swept path of long vehicles. See NRA TD 9..

Changes of Carriageway Edge Treatment

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

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

3.11 See NRA TD 10, TD 22, TD 40 and NRA TD 41-42 for the layouts of merges and diverges at junctions and accesses.

Hard Strips

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

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

3.14 Hard strips 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 - the restriction of width of the road makes drivers more aware of NMUs and can assist with encouragement of low speeds, which is of safety benefit due to the large number of accesses and NMUs. 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.

Hard Shoulders

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

3.16 Offside hard shoulders are not permitted.

Central Reserves

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

3.18 Minimum central reserve widths are given in Tables 2 to 5. A central reserve width less than the minimum is a Departure from Standard.

3.19 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 NRA TD 9;
- ii. accommodate any street furniture, utility or drainage features and equipment;
- iii. meet the requirements of NRA TD 19 for safety barriers;
- iv. accommodate any permanent signs required, with particular attention to the provision of adequate working width and set-back for safety barriers relative to the complete sign assembly;
- v. accommodate significant difference in levels of adjacent carriageways;
- vi. accommodate temporary traffic management layouts for the envisaged maintenance regime;
- vii. accommodate variable message 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; and
- xi. accommodate NMUs.

3.20 The Design Organisation should consider other features that may have to be accommodated in the central reserve, some of which are listed in Paragraph 2.22 and also the health and safety responsibilities highlighted in Paragraphs 2.3 and 2.4. During project appraisal the Design Organisation should also ensure that future network plans for traffic control (e.g. gantries) are taken into account.

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

3.22 Where the central reserve width varies, raised profile markings should be used to define the edge of the running lane clearly. Particular

care should be taken to avoid creating the illusion of a lane gain, for example, by the use of coloured surfacing to distinguish the widened area and maintain a constant width of hard strip. Furthermore, variations in safety barrier set back should be carefully considered in this regard to provide a flowing appearance.

3.23 Reference should be made to NRA TD 41-42 and NRA TD 10 for guidance on widening the central reserve at priority junctions on Type 3 Dual-Carriageway all-purpose roads. Away from junctions, crossing places for NMUs should be avoided on dual carriageway all-purpose roads. Where there is sufficient demand for a crossing point, provision of an underpass or pedestrian overbridge should be considered. A flow of about 10 pedestrians in any hour may warrant such a provision, and this will need to consider step-free access options to accommodate all NMUs.

Emergency Crossing Points

3.24 NRA TD 9 provides advice on the design of Emergency Crossing Points.

Hardening of Central Reserves

3.25 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.

3.26 For new construction schemes, central reserves shall be paved.

3.27 When deciding whether to harden existing central reserves as part of a road improvement / maintenance scheme, 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 a 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. take account of whole-life costs and safety considerations.

3.28 Any general hardening of the central reserve should be designed to be capable of withstanding light vehicle over-run and prevent weed growth. The Road Authority should be consulted for advice on the pavement specification.

Verges

3.29 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. The design of the verge, as well as the location of the emergency telephone, should consider the access requirements that may be required for some NMUs.

3.30 Minimum verge widths are given in Tables 2 to 5. A verge width less than the minimum is a Departure from Standard. Note: Where the Tables denote 'varies', the decision rests with Design Organisations, taking into account the advice in this Standard.

3.31 Advice concerning choice of verge width corresponds with that provided for central reserves in Paragraphs 3.17 to 3.23. Additional advice solely for verges is given below.

3.32 NRA TD 19 provides requirements to ensure safety if a Safety Barrier is struck and deflected near the edge of an embankment slope. Design Organisations must comply with NRA TD 19 and, where necessary, for example on the

approach to underbridges, additional verge width may need to be provided.

3.33 Environmental fencing is becoming a regular feature of the cross-section and the Design Organisation should establish the requirements as early as practicable in order to make appropriate provision of road width.

3.34 Where it is necessary to accommodate communications ducting and chambers, a minimum verge width of 2.0m shall be provided. On a Type 2 Dual Carriageway, a minimum verge width of 3.0m shall be provided.

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

3.36 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 safety barriers that may be required.

3.37 Verges should be sufficiently firm, 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 on roads in urban areas, but are less frequent in rural areas.

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

3.39 Provision for NMUs on all-purpose roads must be made where a local need has been identified and agreed with the Road Authority.

3.40 Where footways are provided, the widths shall be in accordance with HD 39.

3.41 Hardened Verges with a minimum width of

1.20m shall be provided within the verges of Type 2 and Type 3 Dual Carriageways. These shall be located beyond the edge of carriageway. Where only emergency use is anticipated the hardened verges may be of light construction, e.g. Clause 804 or similar compacted granular material (see the NRA Specification for Roadworks.) Where a filter drain is positioned beneath the hardened verge, the surface material shall be selected and compacted to be both free draining and provide a stable surface. For graphic representation of the above, refer to NRA Road Construction Details Series 000.

Work Space and Side Slope Widths

3.42 Work space and side slope widths should be chosen to suit the local situation. The width of work space 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 work space;
- v. maintenance requirements.

3.43 The width of work space shall be determined by the Design Organisation. A typical width of 3.0m is recommended.

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

Auxiliary Lane Provision

3.45 Where auxiliary lanes are provided in accordance with general arrangement layouts given in TD 22 and NRA TD 41-42, the width of the auxiliary lane(s) shall be equal to the width of the adjacent nearside mainline lane.

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

Connector Road Lane Provision

3.47 For guidance on determining the required number of lanes, hard shoulder and hard strip provision on connector roads, see TD 22.

3.48 Where connector roads approach junctions, those dimensions given in the relevant Standards 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.

Separator Zones

3.49 The widths of separator zones should generally follow the decision-making process used to determine central reserve widths discussed in Paragraphs 3.17 to 3.23 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.

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

3.51 Methods of avoiding headlight glare include:

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

Design Organisations should take into consideration which mitigation method provides the most sustainable solution.

3.52 Sightline requirements must not be compromised by the above measures.

Provision of Lay-bys

3.53 For guidance on determining the requirements for the provision of lay-bys, see NRA TA 69.

Road Markings

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

Urban Areas

3.55 Footways and off road cycle tracks provided on all purpose roads in urban areas shall meet with the width requirements given in Table 1.

3.56 Where it is anticipated that mobility impaired users will be regular users of a footway, consideration shall be given to increasing the footway width to 1.80m

3.57 A kerbed raised verge width shall be provided which shall include the footway, off road cycle track or shared facility widths in Table 1. This raised verge width shall also include a minimum segregation width between the edge of carriageway and edge of footway, off road cycle track or shared facility of 0.5m for Single Carriageway Roads and 1.5m for Dual Carriageway Roads. See Road Construction Details Series 000 for a graphic representation.

3.58 In urban areas there may be numerous items of street furniture within the highway cross-section.

Table 1: Minimum Verge, Footway and Off Road Cycle Track Widths on Urban Roads

Usage	Minimum Footway/ Off Road Cycle Track Width (m)	Minimum Kerbed Raised Verge Width (m)
Footway Regular usage ¹	1.65	Single Carriageway 2.15 Dual Carriageway 3.15
Footway Occasional usage ¹	1.50	Single Carriageway 2.00 Dual Carriageway 3.00
Footway Mobility Impaired Users	1.80	Single Carriageway 2.30 Dual Carriageway 3.30
Off Road Cycle Track	Width shall be as per the National Cycle Manual	Minimum raised verge width shall include the Segregation width and Cycle Track Width
Shared Pedestrian and Cyclist Facilities	Width shall be as per the National Cycle Manual	Minimum raised verge width shall include the Segregation width and Cycle Track Width

Notes: 1. Regular usage occurs where there is a clearly defined local need with a predicted maximum flow of 25 or more pedestrians per hour, or footways are provided on contiguous sections.

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

	Nearside			Carriageway ²	Offside		Central Reserve ^{1,4}
	Verge ^{1,4}	Hard Strip ²	Hard Shoulder ²		Hard Strip ²	Verge ^{1,4}	
MAINLINES							
Standard Motorway (D2M)	2.00		2.50	7.00	1.00	-	2.60 ⁵
Wide Motorway (D2M)	3.00	-	3.00	7.50	1.00	- ³	9.00
Wide Motorway (D2M) (with provision for extra lane)	3.00	-	3.00	7.50	1.00	- ³	16.00
SLIP ROADS, INTERCHANGE LINKS AND LOOPS: MERGES AND DIVERGES							
1 Lane	4.50	1.50	-	4.00	0.50	3.50	-
2 Lane	4.00	1.00	-	7.30	0.50	3.50	-
SLIP ROADS: DIVERGE ONLY							
2 Lane	4.00	1.00	-	6.00	0.50	3.50	-

- Notes:
1. Verge and central reserve dimensions are minimum values: any reduction is a Departure.
 2. Carriageway, hard shoulder and hard strip dimensions are fixed values: Any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements of Paragraph 3.8 of NRA TD 9.
 3. For details of offside verges at divided structures, see Table 6.
 4. Where a hard strip is present, the corresponding verge or central reserve dimension includes the hard strip. However, where a hard shoulder is present, the corresponding verge dimension does not include the hard shoulder.
 5. Width of central reserve on Standard Motorway is determined by the type of safety barrier. See NRA TD 19.
 6. For guidance on selection of slip roads and interchange link and loop roads, see TD 22.
 7. All dimensions are in metres.
 8. For graphic representation of these cross-sections, refer to NRA Road Construction Details Series 000.

Table 2

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

	Nearside			Carriageway ²	Offside		Central Reserve ^{1,4}
	Verge ^{1,4}	Hard Strip ²	Hard Shoulder ²		Hard Strip ²	Verge ^{1,4}	
MAINLINES							
Type 3 Single (S2)	3.00	0.50	-	6.00	-	-	-
Type 2 Single (S2)	3.00	0.50	-	7.00	-	-	-
Type 1 Single (S2)	3.00	-	2.50	7.30	-	-	-
Type 3 Dual Carriageway	3.00 ⁶	0.50 min	-	7.00 (2 Lane) 3.50 (1 Lane)	0.50	- ³	1.50
Type 2 Dual Carriageway	3.00 ⁶	0.50	-	7.00	0.50	- ³	1.50
Type 1 Dual Carriageway	2.00	-	2.50	7.00	1.00	- ³	2.60 ⁵
SLIP ROADS, INTERCHANGE LINKS AND LOOPS: MERGES AND DIVERGES							
1 Lane	4.50	1.50	-	4.00	0.50	3.50	-
2 Lane	4.00	1.00	-	7.30	0.50	3.50	-
SLIP ROADS: DIVERGE ONLY							
2 Lane	4.00	1.00	-	6.00	0.50	3.50	-

- Notes: 1. Verge and central reserve dimensions are minimum values: any reduction is a Departure.
2. Carriageway, hard shoulder and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements of Paragraph 3.8 of NRA TD 9.
3. For details of offside verges at divided structures, see Table 6.
4. Where a hard strip is present, the corresponding verge or central reserve dimension includes the hard strip. However, where a hard shoulder is present, the corresponding verge dimension does not include the hard shoulder.
5. Width of central reserve on Type 1 Dual Carriageway is determined by the type of safety barrier. See NRA TD 19.
6. The nearside verges on a Type 2 and Type 3 Dual Carriageways shall include hardened verges with a minimum width of 1.2 m.

7. For guidance on selection of slip roads and interchange link and loop roads, see TD 22.
8. All dimensions are in metres.
9. For graphic representation of these cross-sections, refer to NRA Road Construction Details Series 000.
10. The type of cross-section to be adopted shall depend on the capacity level to be provided in accordance with NRA TD9 Table 6/1.

Table 3

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

Motorways up to 100km/h Design Speed	Nearside			Carriageway ²	Offside		Central Reserve ^{1,4}
	Verge	Hard Strip ²	Hard Shoulder ²		Hard Strip ²	Verge	
MAINLINES Standard Motorway (D2UM)	Varies	-	2.50	7.00	1.00	- ⁶	2.60 ⁵
SLIP ROADS, INTERCHANGE LINKS AND LOOPS: MERGES AND DIVERGES							
1 Lane	Varies	1.50	-	4.00	0.50	Varies	-
2 Lane	Varies	1.00	-	7.30	0.50	Varies	-
SLIP ROADS: DIVERGE ONLY							
2 Lane	Varies	1.00	-	6.00	0.50	Varies	-

- Notes:
1. Central reserve dimensions are minimum values: any reduction is a Departure.
 2. Carriageway and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements of Paragraph 3.8 of NRA TD 9.
 3. Table 6/1 of NRA TD 9 does not apply to Urban Roads. Refer to TA 79 for guidance on assessing the Traffic Capacity of Urban Roads.
 3. The central reserve dimension includes the offside hard strip.
 4. Width of central reserve is determined by the type of safety barrier. See NRA TD 19.
 5. For details of offside verges at divided structures, see Table 6.
 6. For guidance on selection of slip roads and interchange link and loop roads, see TD 22.
 7. All dimensions are in metres.
 8. For graphic representation of these cross-sections, refer to NRA Road Construction Details Series 000.

Table 4

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

All-Purpose Roads Up to 100km/h	Nearside		Carriageway ²	Offside		Central Reserve ¹
	Verge ³	Hard Strip ²		Hard Strip ²	Verge ³	
MAINLINES						
Single Carriageway Relief Road	Varies	-	6.00 to 7.00	-	-	-
Dual Carriageway Relief Road	Varies	-	7.00	-	-	1.80
Dual 2 Lane	Varies	-	7.30	-	- ⁴	1.80
Dual 3 Lane (D3AP)	Varies	-	11.00	-	- ⁴	1.80
SLIP ROADS, INTERCHANGE LINKS AND LOOPS: MERGES AND DIVERGES						
1 Lane	Varies	1.50	4.00	0.50	Varies	-
2 Lane	Varies	1.00	7.30	-	Varies	-
SLIP ROADS: DIVERGE ONLY						
2 Lane	Varies	1.00	6.00	-	Varies	-

- Notes:
1. Central reserve dimensions are minimum values: any reduction is a Departure.
 2. Carriageway and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements of Paragraph 3.8 of NRA TD 9.
 3. Verge width shall be determined to take account of the uses and clearances required. See Table 1 for the minimum verge widths to be provided where a footway, cycle track or shared pedestrian/cyclist facility is required.
 4. For details of offside verges at divided structures, see Table 6.
 5. For guidance on selection of slip roads and interchange link and loop roads, see TD 22.
 6. All dimensions are in metres.
 7. For graphic representation of these cross-sections, refer to NRA Road Construction Details Series 000.
 8. Table 6/1 of NRA TD 9 does not apply to Urban Roads. Refer to TA 79 for guidance on assessing the Traffic Capacity of Urban Roads.

Table 5

4. CROSS-SECTIONS AT STRUCTURES

General

4.1 The cross-sections detailed below assume a straight horizontal alignment of the carriageway. If this is not the case the verges and central reserve may require widening to give the stopping sight distances required in accordance with NRA TD 9. For a graphic representation of the following requirements, refer to NRA Road Construction Details Series 000.

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

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

Roads diverted or improved on-line as part of a national road scheme

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

Traffic Lane Widths

4.5 Lane widths shall be maintained through or over a structure.

Hard Shoulders and Hard Strips

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

Central Reserves

4.7 The width of central reserve applicable to the adjacent open road section should be continued through or over the structure.

Verges at Underbridges and Overbridges

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

4.9 On all-purpose road overbridges, underbridges, elevated roads and viaducts, the nearside verge will need to provide a clear width for pedestrian access. The width can be varied depending upon the overall length of the structure and the likely pedestrian flows as indicated in Paragraphs 4.11 to 4.17 and Table 6. Provision may also need to be made for pedal cyclists. Where it is anticipated that mobility impaired users will be regular users of the structure, consideration shall be given to providing a width of 1.80m – this allows for two wheelchair users to pass one another in opposite directions. Where regular use is not envisaged, a minimum width of 1.5m is permissible, although passing places will be required at regular intervals.

4.10 **Regular** pedestrian usage on an all-purpose road occurs where there is a clearly defined local need with a predicted maximum flow of more than 25 pedestrians per hour and/or footways are provided, or are to be provided, on contiguous sections of road. **Occasional** pedestrian usage occurs at other locations.

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

Table 6: Verge Widths on Underbridges

Road Type	Location	Pedestrian Usage (see Paragraph 4.11)	Bridge Length M	Raised Verge Width m
Motorway	Nearside	-	All	0.60
	Offside	-	All	0.60
All-Purpose Road	Nearside	Regular	≤ 100	2.00
		Regular	> 100	1.50
		Occasional	All	1.50
		Mobility Impaired Users	All	1.80
	Offside*	All	All	0.60

Note: * For bridges carrying Regional and Local Roads it may be appropriate to treat one side as the offside despite the road carrying two-way traffic.

Verges at Underbridges

4.12 On underbridges the verge adjacent to the bridge parapet shall be raised with a maximum kerb height of 80mm. Kerbs shall be splayed for its full height, by at least 45° to the vertical. Any reduction in width shall be regarded as a Departure.

Verges beneath Overbridges

4.13 Beneath overbridges the verge width shall be not less than 2.0m and shall also comply with the following arrangements where applicable.

4.14 At overbridges where an abutment is adjacent to the carriageway:

- a) the distance from the edge of road pavement to the face of the abutment shall be not less than 4.50m.
- b) where there is regular pedestrian usage, a paved footway of 1.65m minimum clear width shall be provided on the nearside verge behind any safety barrier. Consideration shall be given to increasing this width to 1.80m where it is anticipated that there will be

regular use by mobility impaired users.

4.15 At overbridges where a pier is adjacent to the carriageway:

- a) The distance from the edge of the traffic lane to the face of the pier shall be not less than 4.5m.
- b) the minimum distance from the edge of road pavement to the face of the pier shall be determined to suit the safety barrier set-back and working width. Working width is the distance from the traffic face of the safety barrier to the maximum dynamic deflected position of the barrier after impact (see NRA TD 19).
- c) where there is regular pedestrian usage, a paved footway of 1.65m minimum clear width shall be provided on the nearside through the span separate from the main carriageway. Consideration shall be given to increase this width to 1.80m where it is anticipated that there will be regular use by mobility impaired users.

4.16 Provision may also be needed for pedal cyclists, in which case this should normally be located alongside the footway.

Safety Barriers and Bridge Parapets

4.17 Safety barriers and bridge parapets shall be positioned in accordance with the requirements of NRA TD 19 and NRA BD 52.

5. HEADROOM AT STRUCTURES

General

Dimensional standards are given in Table 7 for “new construction headroom” and “maintained headroom” at overbridges and at other structures over a road.

**Table 7:
Standard Headroom at Structures**

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

5.1 The headroom provision at underbridges shall be in accordance with Table 7 unless otherwise agreed with the relevant Road, Railway or Water Authority.

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

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

Dimensional Requirements

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

5.5 The relevant standard headroom in Table 7 shall be provided:

- Over the paved carriageway, hard shoulder or hard strip plus any provision for future widening;
- Over the full verge width, except where (e) applies, and even then for a minimum of 4.5m from the edge of the traffic lane;
- Over the central reserve of a dual carriageway, except where (e) applies;
- Between the carriageway and the pier or abutment face where such a support is located within 4.5m of the edge of the road pavement, except where (e) applies;
- Up to the back of the working width of a safety fence, when installed (see Figure 1). The working width is the distance from the traffic face of the safety fence to the maximum deflected position of the fence or vehicle after impact.

5.6 The headroom standards for pedestrian subways and combined pedestrian/cycle subways are contained in TD 36. Guidance on the headroom requirement for equestrian usage is contained in TA 57.

Compensation for Vertical Sag Curvature and Deflection

5.7 Where the road passing underneath a structure is on a sag curve, the headrooms in Table 7 shall be increased in accordance with Table 8. The sag radius is measured along the carriageway over a 25m chord.

**Table 8:
Sag Radius Compensation**

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

5.8 Allowances shall be made for the deflection of structures. The minimum headroom shall be maintained for the serviceability limit state under the action of load combination 1 specified in the current appropriate loading standard.

Utilities Companies' and Other Authorities' Apparatus

5.9 Greater headroom than that determined from Paragraphs 5.1 to 5.9 may be required by a Utility Company or other authority. Any increase in the headroom dimension shall be agreed with the National Roads Authority.

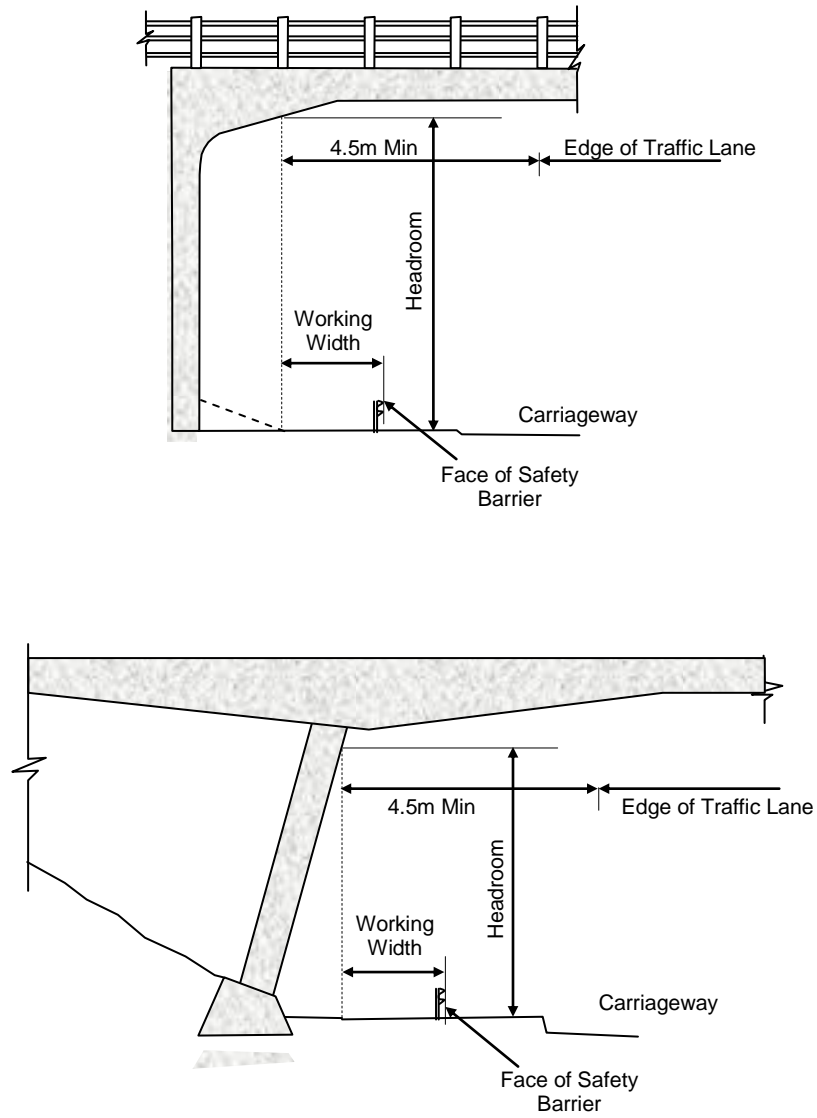


Figure 1:
Headroom at Structures

6. REFERENCES

6.1 Design Manual for Roads and Bridges (DMRB):

NRA BD 2 (DMRB 1.1.1A) – Technical Approval of Structures on Motorways and Other National Roads

BD 29 (DMRB 2.2.8) – Design Criteria for Footbridges.

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

NRA BD 52 (DMRB 2.3.3) – The Design of Highway Bridge Parapets.

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

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

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

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

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

TD 36 (DMRB 6.3.1) – Subways for Pedestrians and Pedal Cyclists. Layout and Dimensions.

NRA TA 69 (DMRB 6.3.3) – The Location and Layout of Lay-bys.

TA 57 (DMRB 6.3) – Roadside Features.

HD 39 (DMRB 7.2.5) – Footway Design.

6.2 Other References

BS 6100-1 Building and Civil Engineering – Vocabulary – Part 1: General Items. British Standards Institution, 389 Chiswick High Road, London W4 4AL.

BS 6100-4 Building and Civil Engineering – Vocabulary – Part 4: Transport. British Standards Institution, 389 Chiswick High Road, London W4 4AL.

National Roads Project Management Guidelines. National Roads Authority.

NRA Manual of Contract Documents for Road Works Volume 2: Specification for Roadworks. National Roads Authority.

NRA Manual of Contract Documents for Road Works Volume 4: Road Construction Details. National Roads Authority.

Transport in the Urban Environment, Part V. The Institution of Highway Engineers and Transportation.

Traffic Signs Manual. Department of Transport.

National Cycle Manual. National Transportation Authority.

7. ENQUIRIES

7.1 All technical enquiries or comments on this Interim Advice Note should be sent in writing to:

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Tim Ahern
Head of Engineering