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Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads

DN-GEO-03043

November 2011

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Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads

November 2011

Summary:

This Standard sets out the design requirements for major/minor priority junctions, and direct access onto national roads.

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SECTION 2 JUNCTIONS

PART 6

NRA TD 41-42/11

**GEOMETRIC DESIGN OF
MAJOR/MINOR PRIORITY
JUNCTIONS AND VEHICULAR
ACCESS TO NATIONAL ROADS**

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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 preparing layouts of major/minor priority junctions and vehicular access onto national roads. It also includes the aspects of compact grade separation immediately adjacent to the major road carriageway.

1.2 This Standard supersedes the July 2004 version of the NRA Addendum to TD 42/95 “Geometric Design of Major/Minor Priority Junctions” and the July 2004 version of the NRA Addendum to TD 41/95 “Vehicular Access to All-purpose Trunk Roads. This standard also supersedes those aspects of TD40 “Layout of Compact Grade Separated Junctions” relating to joining and leaving the major road carriageway.

1.3 The advice on treatment of major/minor priority junctions contained within TD 42/95, was based upon a review of Advice Note TA 20/84. This advice has been further reviewed for this standard in light of a study commissioned by the Highways Agency “Safety Review of Priority Junctions and Accesses – Review of TD 40, 41 & 42” published in July 2007.

1.4 The National Roads Authority supports a strategy aimed at maintaining the capacity, efficiency and safety of the national roads network which seeks to prevent a proliferation of roadside developments along national roads to which high speed limits apply, i.e. greater than 50km/h in accordance with national policy.

1.5 The principal changes from the previous Standards are:

a. Incorporation of TD 41 Vehicular Access to All-Purpose Trunk Roads and TD 42 Geometric Design of Major/Minor Priority Junctions into a single document and associated NRA addendums.

b. Inclusion of three types of direct access into the document, with all other accesses to be

designed to the same standard as major/minor priority junctions.

c. Change in the way that relaxations are identified within this standard.

d. Prohibiting new junctions and direct accesses on climbing lanes.

e. Central reserve crossings prohibited on Type 1 & 2 Dual Carriageways.

f. The provision of rural crossroads requires granting of a Departure from Standards by the National Roads Authority.

g. Position of Stop lines on roads with hard shoulders revised to be consistent with the Traffic Signs Manual.

h. Detail of Hard Shoulder Hatching at junctions revised.

i. Allowable relaxation to the object height to be considered at junctions.

j. Desirable minimum sight distance “x” for junctions with “Stop” signs is reduced to 3.0m from 9m.

k. Absolute minimum sight distance “x” for junctions and direct accesses is standardised at 2.4m on national roads.

l. New guidance on relaxations to “x” and “y” distances on regional and local roads.

m. Revised requirements for dwell areas on the approach to a junction.

n. The desirable width of a channelising island acting as a pedestrian refuge is 2.1m. An absolute minimum width of 1.5m is allowable.

o. Diverge Tapers not permitted at Simple Junctions.

p. Diverge auxiliary lanes only allowable on dual carriageway roads.

Scope

1.6 This Standard defines the main types of major/minor priority junctions and accesses to be used on new and improved national roads.

1.7 Advice is given on the choice between the different types of major/minor priority junction and vehicular accesses and the siting of such junctions

1.8 Key safety issues are identified, as are particular design issues relating to the specific requirements of road users both motorised and non-motorised. Landscaping aspects that can give rise to safety issues are identified and specific recommendations and requirements are stated.

1.9 Recommendations are given on the geometric design of the important elements of the major/minor priority junction or access, and the way that the individual elements can be brought together to produce a good overall scheme.

1.10 The requirements to be met in providing or improving both minor/major priority junctions and accesses are given in this standard, including geometric and visibility standards. It covers all purpose national roads, both dual and single carriageways, in urban and rural areas. It also provides non-mandatory guidance for accesses onto regional and local roads in urban areas.

Implementation

1.11 This Standard shall be used for the design of all new or improved national roads. Unless otherwise agreed with the relevant Road Authority, all roads affected by national roads projects shall be designed in accordance with this Standard. The design of regional and local roads which are constructed or improved as part of a national road scheme shall be designed in accordance with this standard. 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.

1.12 If this Standard is to be used for the design of regional and local road schemes, the Design Organisations should agree with the relevant Road Authority the extent to which the document is appropriate in any particular situation.

Definitions

1.13 The terminology follows where possible the definitions contained in BS 6100: Subsection 2.4.1 1990.

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

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

Channelising Island: - An island constructed within the bellmouth of a major/minor junction to guide traffic movements in and out of the minor road. Specifically used for ghost island junctions and single lane dualling.

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

Crossroads: - An at-grade junction of two roads that cross approximately at right angles (Figure 1/4).

Cycle Lane: - A part of the carriageway marked for use by pedal cycles.

Cycle Track: - A track separated from a road for use only by pedal cycles and by pedestrians where permitted.

D2M: - Dual two-lane motorway.

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

Direct Access Layout 1: - A field access that connects directly onto the public road (shown as Direct Access Layout 1 in Chapters 7&8).

Direct Access Layout 2: - A connection to an all-purpose national road for the use of road vehicles, serving or intended to serve, one or more properties, and linking directly to the national road (shown as a Direct Access Layout 2 in Chapter 7). The level of use of such an access shall be less than 150 vehicle movements in a week. All accesses with a vehicular flow greater than this level shall be designed as a junction.

Direct Access Layout 3: - Specific form of left in / left out direct access for use on dual carriageways without the facility of a gap in the central reserve (shown as a Direct Access Layout 3 in Chapter 8).

Ghost Island Junction: - An at-grade junction, usually a T- or staggered junction, within which an area is marked on the

carriageway, shaped and located so as to direct traffic movement (Figure 1/2).

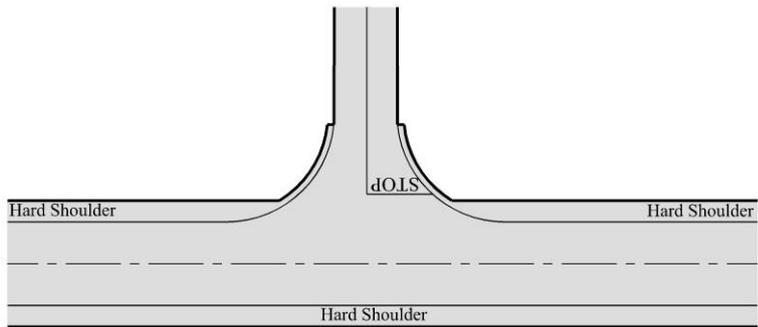


Figure 1/1: Simple T-Junction

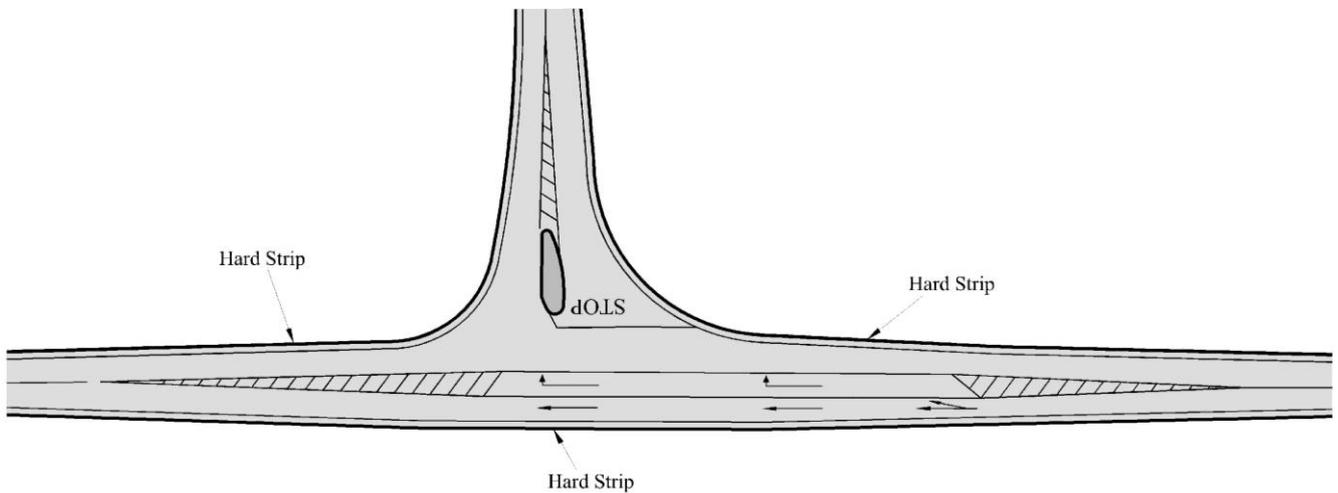


Figure 1/ 2: Ghost Island Junction

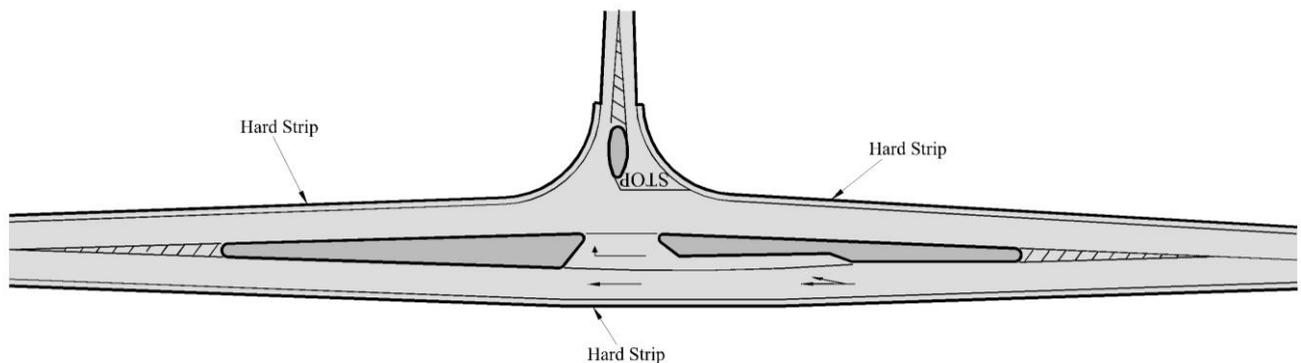


Figure 1/3: Single Lane Dualling

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

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

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

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

Roads, Urban and Rural: - an **Urban Road** is a road which is in a built up area and has either a single carriageway with a speed limit of 60 km/h or less, or has a dual carriageway (excluding motorways) with a speed limit of 80 km/h or less, or a motorway with a speed limit of 100 km/h or less. All other roads are **Rural Roads**.

S2: - Two-lane single carriageway road with lane widths of up to 3.75m.

Simple Junction: - A “T” or staggered junction without a ghost or physical islands in

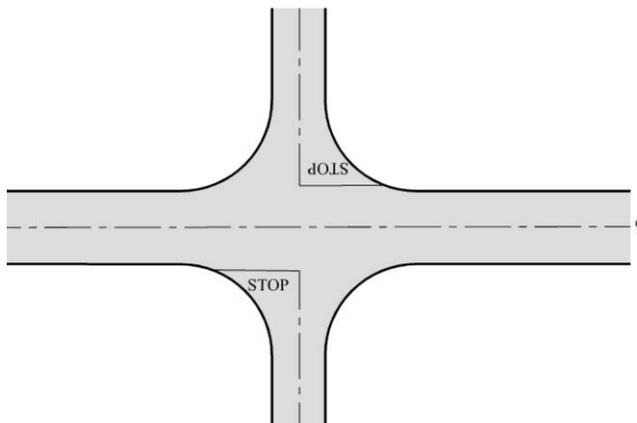


Figure 1/4: Crossroads

the major road and without channelising islands in the minor road approach (Figure 1/1).

Skew or Y-Junction: - An at-grade junction of two roads, at which the minor road approaches the major road at an oblique angle and terminates at the junction (Figure 1/5).

Staggered Junction; - An at-grade junction of three roads, at which the major road is continuous through the junction, and the minor roads connect with the major road so as to form two opposed T-junctions (Figure 1/6).

T-Junction: - An at-grade junction of two roads, at which the minor road joins the major road approximately at right angles (Figure 1/1).

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**.

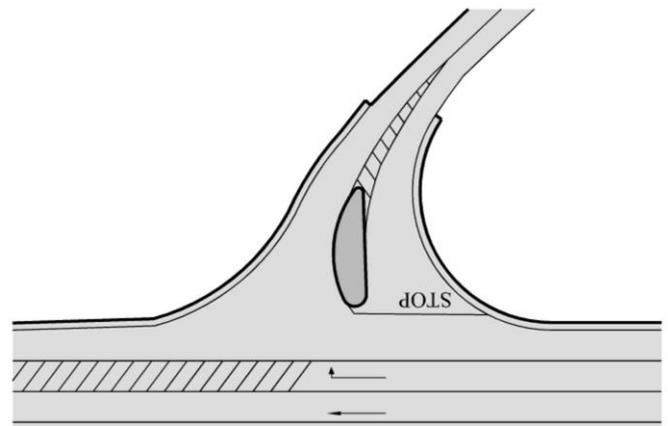


Figure 1/5: Left Hand Skew Junction

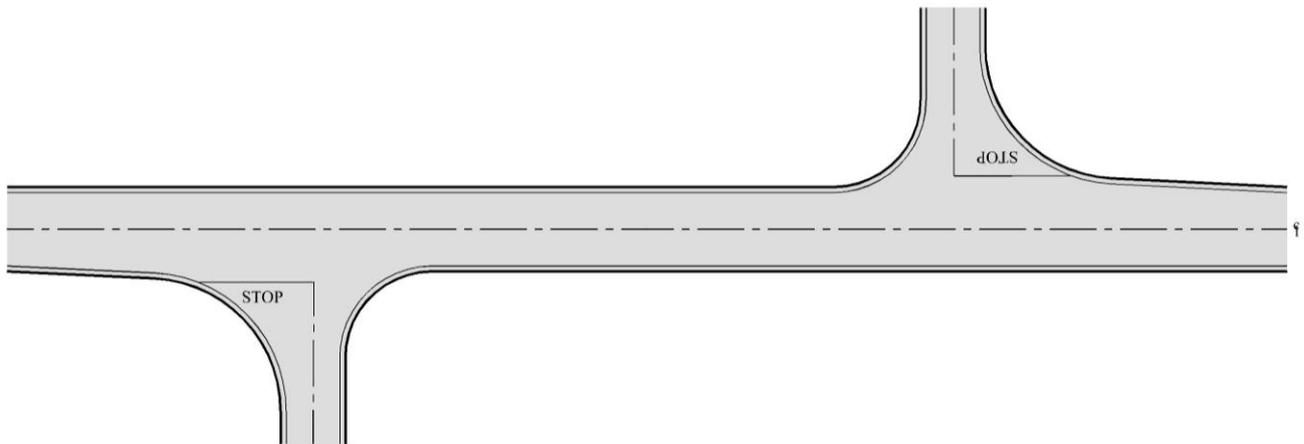


Figure 1/6: Simple Right/Left Stagger

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.

Mandatory Sections

1.15 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

1.16 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 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

1.17 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.

Disclaimer

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

2. Layout Options of Major/Minor Priority Junctions and Direct Access

General

Junctions

2.1 Major/minor priority junctions are the most common form of junction control. Traditionally, these junctions have been controlled by 'Yield' signs and road markings, with the traffic on the minor road giving way to the traffic on the major road.

However, new junctions onto national roads shall be designed with 'Stop' signs and road markings in place of the 'Yield' signs.

2.2 At new junctions onto regional and local roads, 'Yield' signs and road markings may be used in appropriate circumstances (as opposed to 'Stop' signs), provided there is full visibility from an 'x' distance of 9m (see Paragraph 7.7) and there are no Relaxations associated with the junction layout. Refer to the Traffic Signs Manual.

2.3 The advantage of all major/minor priority junctions is that through traffic on the major road is not delayed. However, high major road speeds or the possibility of major road overtaking traffic manoeuvres should not be encouraged at major/minor priority junctions.

2.4 For more heavily used junctions, more complex forms of junction layout are required. Due to the uncertainty of traffic forecasting, designers should always consider whether the layout they are designing could be upgraded to provide more capacity, if this should prove necessary in the future.

Direct Accesses

2.5 There is a potential saving in collisions where there is a reduction in the number of lightly trafficked direct accesses and minor junctions made directly on to each national road. Such accesses can be joined together with a link or service road before they join the main carriageway of the national road. Options for such indirect connections should always be explored,

as should providing the access from the local road network.

2.6 It is inadvisable to agree to a new access facing an existing one across a single carriageway road as this may lead to vehicles crossing the national road. Cross road situations are equally undesirable and therefore in such cases accesses should be staggered. The implications and collision risk for right turning traffic into and out of the access shall always be taken into account. This may indicate that it would be desirable to prevent the right turning movements. If preventing right turning is not a practical option, vehicles waiting in the centre of the road to turn right can sometimes be protected by islands.

Accesses therefore shall not be situated opposite to another access or a minor road, a minimum stagger distance as given in Paragraph 7.72 shall be used on national roads.

2.7 The overriding principle is that direct vehicular access onto national roads should be avoided as far as practicable. However, where a direct access exists or is to be provided, the requirements will depend on whether the access is existing, altered or new, and whether the road is existing, to be improved on-line, or is new or improved on a new alignment. An altered access is an existing one for which the NRA consider a significant change in layout, location or usage is proposed.

Existing Direct Access

2.8 Where an existing national road is to be improved on-line, there are likely to be existing accesses. Where possible these should be relocated on another road or to a better location onto the national road (such relocation would be regarded as a new or altered access – see Paragraphs 7.18 to 7.22 or 8.20 to 8.24 as appropriate). Where this is not practicable, the layout of the access onto the new road should be designed in accordance with the geometric standards for a new or altered access (see Paragraphs 7.18 to 7.22 or 8.20 to 8.24 as appropriate).

Any such layout which does not achieve the geometric standards for a new or altered access shall require a Departure.

New or Altered Accesses

2.9 The type of new and altered direct vehicular accesses on to all-purpose national roads shall be determined from **NRA TD 9** and the size of vehicles using the access. The access shall be designed for the largest vehicle expected to use it. The selection of the access layout will be dependent upon carriageway widths, geometric constraints, local traffic flows, other site specific features, and environmental considerations.

2.10 Any application which results in a material increase in the volume of traffic or a material change in the type of traffic entering or leaving a national road shall be carefully considered. Generally, a material increase is considered to be if the turning traffic flows, as a result of the new development, would increase by 5% or more, although there may be cases when it is important to consider smaller increases.

2.11 On Type 1 and 2 Dual Carriageways no permanent crossings of the central reserve are allowed. With Type 3 Dual Carriageway roads, it is important to keep crossings in the central reserve to an absolute minimum to maintain safety, and hence to confine traffic to more major road junctions. Only in exceptional circumstances should movements across the central reserve be permitted to and from direct vehicular accesses. Any provision of central reserve gap for an access will be a Departure from Standards.

Design Procedure

2.12 Junction design is a key element of the overall design process for national road schemes. The flow chart shown in Figure 2/1 outlines the design process for major/minor priority junctions in a series of interrelated design steps.

2.13 The decision to provide a major/minor priority junction rather than some other form of junction should be based on operational, economic and environmental considerations. *[Step 1]* The most appropriate type of junction should be chosen. However, sequences of junctions should not involve many different layout types. A length of route or bypass containing roundabouts,

single lane dualling, ghost islands, simple priority junctions and grade separation would inevitably create confusion and uncertainty for drivers and may result in collisions. Safe road schemes are usually straightforward, containing no surprises for the driver.

2.14 The most appropriate type of major/minor priority junction to be used can be chosen from those described in Chapter 1. This decision should be based on a wide range of factors, taking into account design year traffic flow, the nature and proportions of large goods and passenger carrying vehicles, geometry and traffic delays, an initial estimate of entry and turning stream capacities, and collision costs. It should also be based on a consideration of the particular site characteristics such as development and topography. *[Step 2]*

2.15 The next step is to address all of the relevant safety issues to ensure as safe a design as possible, to take account of road users' specific requirements and to incorporate a preliminary signing, street furniture and landscape design within the junction. At this point, the key geometric parameters of the junction design should be assessed. *[Steps 3a-3d]*

2.16 Having established the various components of the junction design, the Design Organisation should check that the capacity of the junction is still adequate. This includes examining if the junction is located on a route with a wide variation in flow and turning movements, particularly those having prolonged daily peak periods. The check should be undertaken prior to assembling the component parts to form a complete junction. *[Step 4]*

2.17 Before proceeding to final design *[Step 5]*, a "driveability" check should be performed, to assess first the smooth assembly of the components of the junction design. This should include a visual assessment of the junction on all approaches from the driver's eye view. Secondly, the junction should be considered within the context of its adjacent links and those adjacent junctions on the particular route. As a whole, the layout should be designed to suit the traffic pattern, with the principal movements following smooth vehicular paths. This improves the smoothness of operation and makes it more readily understood by drivers.

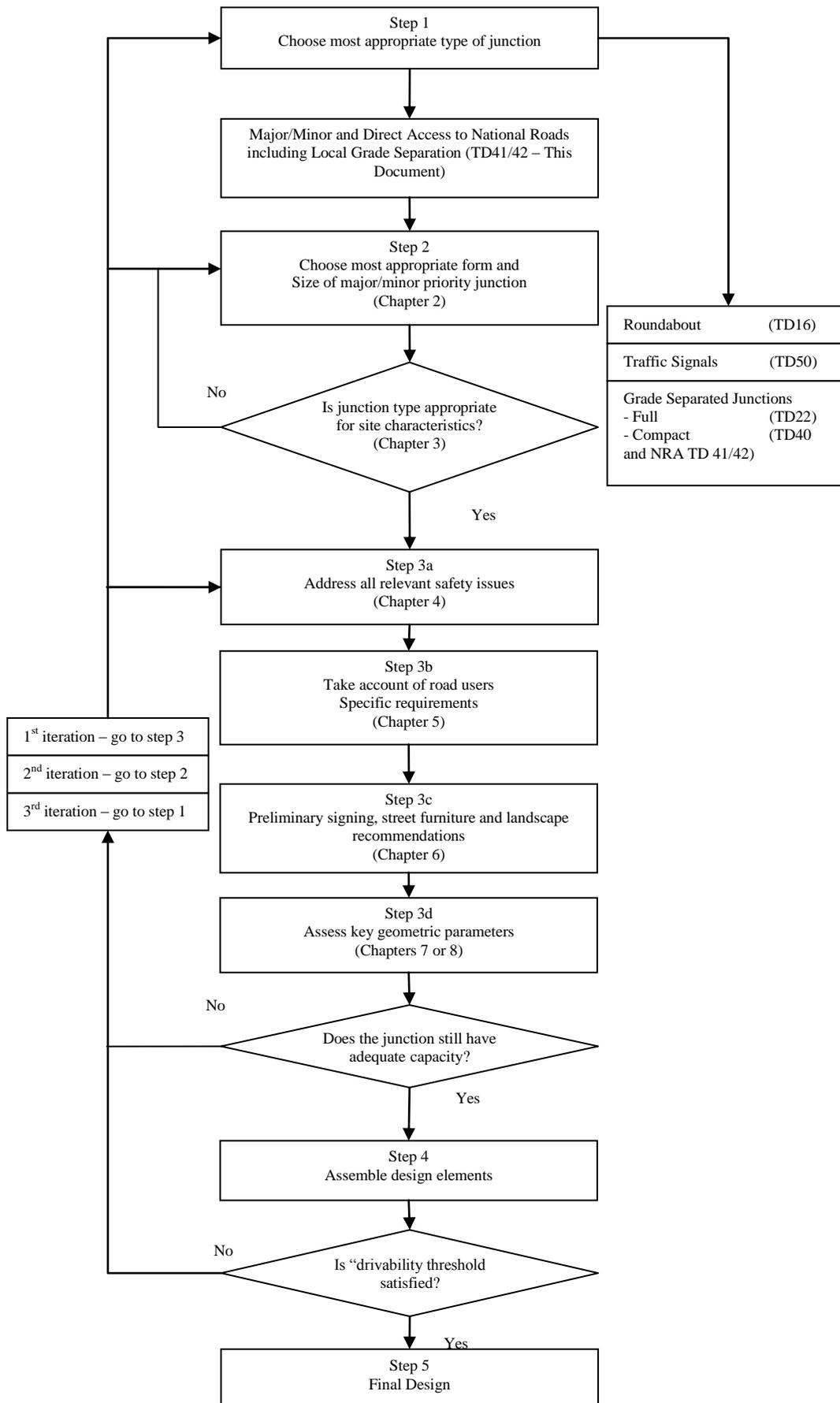


Figure 2/1: Flow Chart Outlining Design Procedure (Para 2.12 to 2.18)

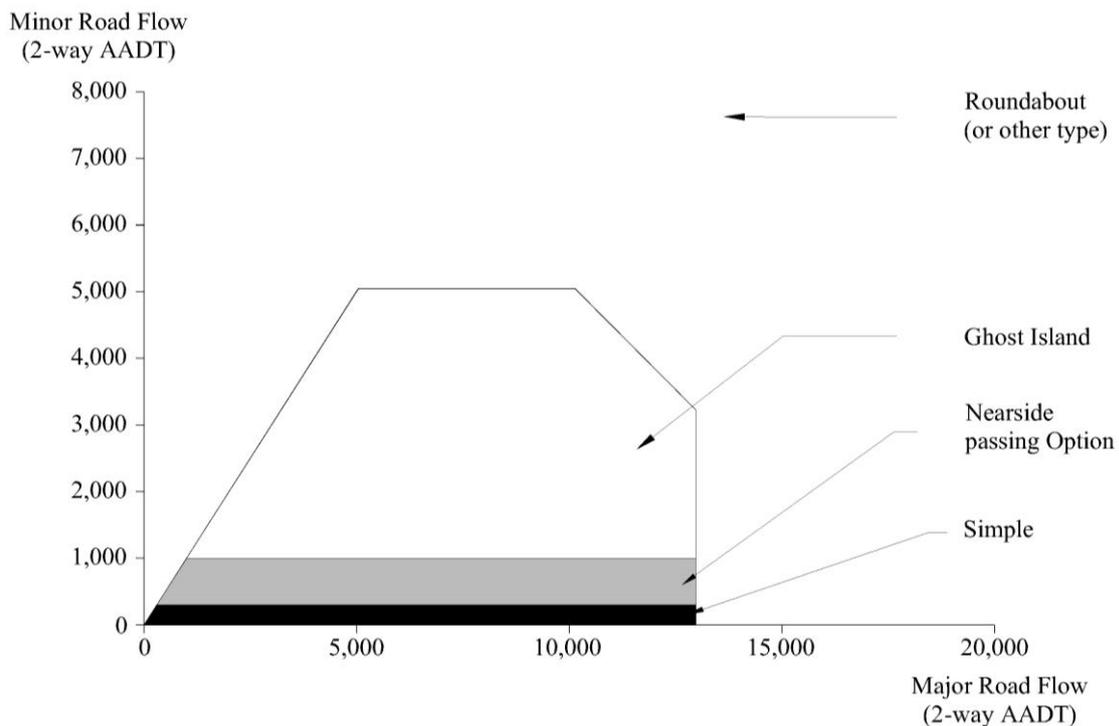


Figure 2/2 : Approximate Level of Provision of T-junctions on New Single Carriageway Roads for Various Major and Minor Road Design Year Traffic Flows (Paras 2.20, 2.22)

2.22 The following principles for each of the different junction layout types can be identified from Table 2/1 and Figure 2/2.

Simple

2.23 Simple junctions are appropriate for most minor junctions on single carriageway roads, on dual carriageways simple junctions must be restricted to left in/left out only. For new rural junctions they shall only be used when the design flow in the minor road is not expected to exceed about 300 vehicles 2-way AADT, and that on the major road is not expected to exceed 13,000 vehicles 2-way AADT.

2.24 At existing rural and urban junctions the cost of upgrading a simple junction to provide a right turning facility will vary from site to site. However, upgrading should always be considered where the minor road flow exceeds 500 vehicles 2-way AADT, a right turning collision problem is evident, or where vehicles waiting on the major road to turn right inhibit the through flow and create a hazard.

Nearside Passing/ Left Diverge Loops

2.25 For existing roads where the flow levels are not great enough to justify the provision of a ghost

island or roundabout as shown on Figure 2/2, and a right turning problem remains, consideration may be given to the use of a low cost remedial measure. Two such measures include a nearside passing bay, to allow through vehicles to pass those right turners waiting in the centre of the major road, albeit at a reduced speed, or a left hand diverging lane loop, which allows right turners to wait off the major road, and to make the crossing movement at right angles and has the advantage of not compromising overtaking on the major road.

These are shown in Figures 2/3, 2/4 and 2/5.

2.26 The decision to provide a right turning facility shall be made in accordance with the warrants given in Paras 2.23 and 2.24. The choice of type of right turn facility to be used, however, will depend on the particular site characteristics. The nearside passing option shall not be used on new roads as ghost islands are preferred.

Ghost Island

2.27 Ghost islands may be used on new single carriageway roads, or in the upgrading of existing junctions to provide right turning vehicles with a degree of shelter from the through flow. They are

highly effective in improving safety, for turning traffic on the major road.

2.28 The use of ghost islands on unrestricted rural single carriageway roads can, in certain circumstances, pose safety problems. In situations where overtaking opportunity on the major road on either side of the junction is restricted, the presence of a widened carriageway, albeit with hatch markings, could result in overtaking

manoeuvres which may conflict with right turns into and out of the minor road.

2.29 Prior to installing ghost islands consideration should be given to overtaking opportunities on adjacent links. Ghost islands shall be installed on non-overtaking sections of the road.

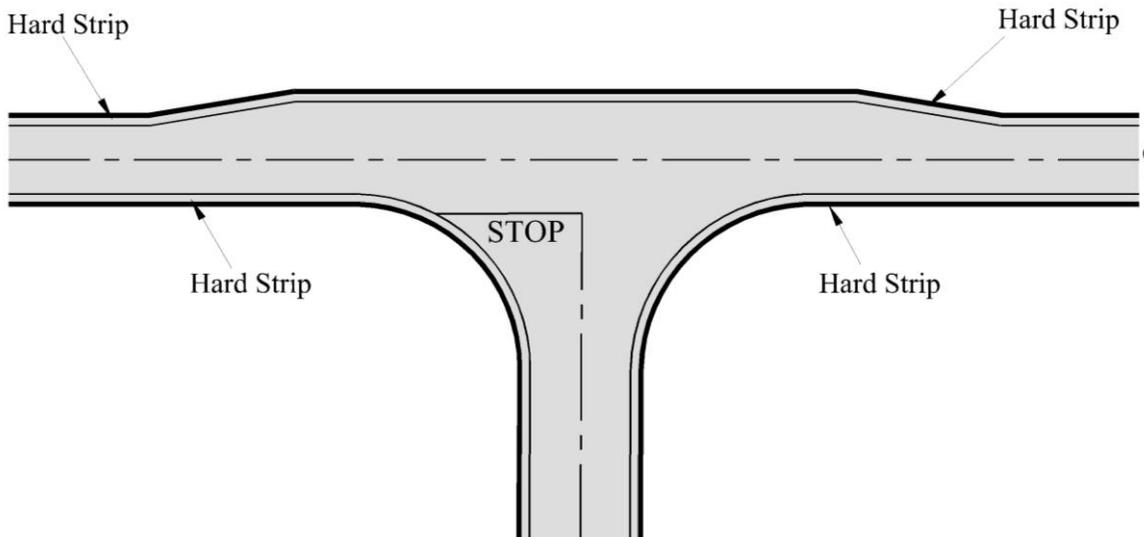


Figure 2/3: Major/Minor Priority Junction with Nearside Passing Bay for Roads without Hard Shoulders (Para 2.25)

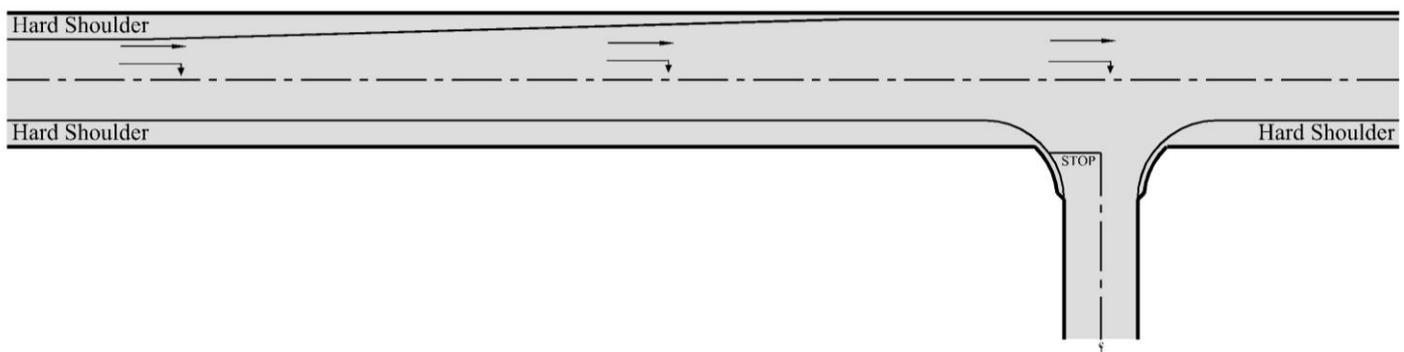


Figure 2/4: Major/Minor Priority Junction with Nearside Passing Bay Option for Roads with Hard Shoulders (Para 2.25)

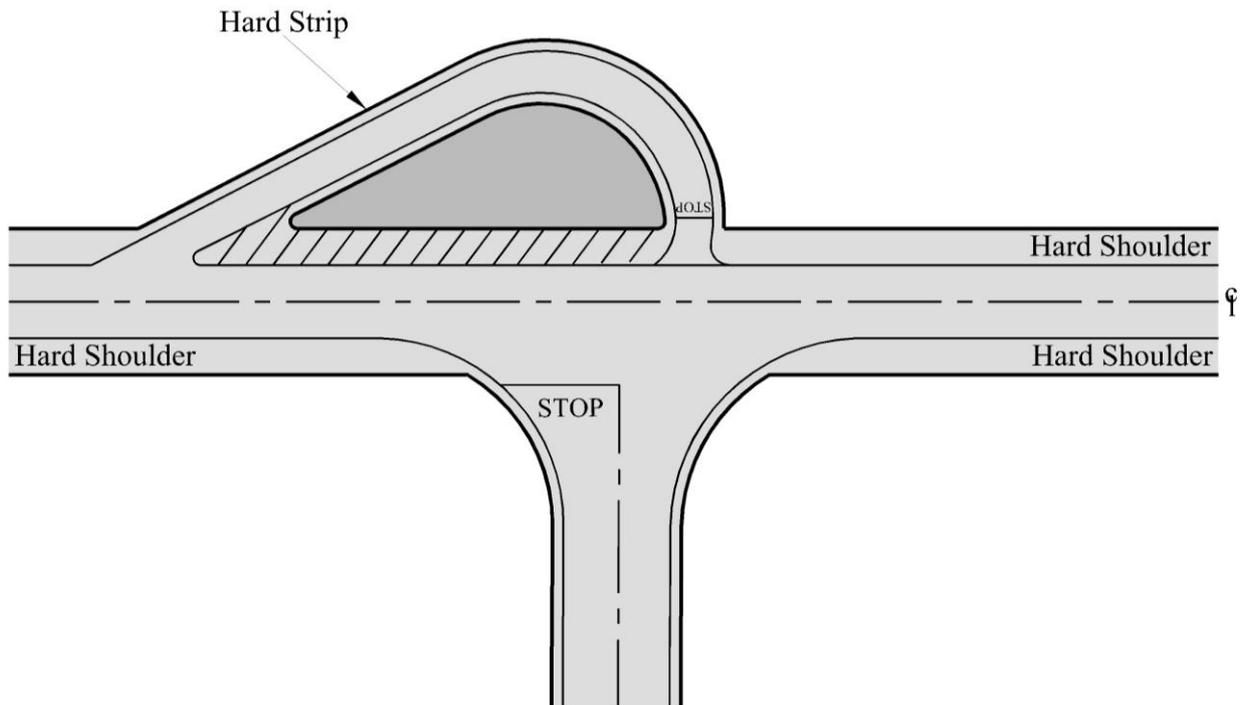


Figure 2/5: Major/Minor Priority Junction with Left Hand Diverging Lane Loop for Right Turns (Para 2.25)

Single Lane Dualling

2.30 Single lane dualling is formed by widening the major road to provide a central reservation, a right turning lane and space for vehicles waiting to turn right from the major road into the minor road (Fig 1/3). An important feature of this type of junction is that there is only one through lane in each direction on the major road preventing overtaking and excessive speeds.

Single lane dualling may offer benefits compared to ghost islands when overtaking opportunities on adjacent links are restricted and where traffic turning right out of the minor road would need to make this manoeuvre in two stages.

There are certain conditions under which a single lane dualling layout may be misinterpreted by drivers.

- Where a road contains alternating single and dual carriageway sections, drivers could mistake the width of the divided carriageway at the junction as a fully dualled section with overtaking opportunities.
- Where a single lane dualled junction is proposed on a single carriageway road within approximately 3 kilometres from a long length of dual carriageway, there may also be confusion.

The use of single lane dualling on national roads will be subject to the granting of a Departure from Standard by the NRA.

Dual Carriageway Junctions

2.31 Major/minor priority junctions may also be used on Type 1, 2 and 3 Dual Carriageways. The upper limit for minor road flows should be taken as about 3,000 vehicles AADT 2-way when considering providing a major/minor priority junction on continuous Type 1, 2 or 3 Dual Carriageway roads in rural areas.

The provision of short lengths of full dualling just to incorporate a junction on an otherwise single carriageway road is prohibited.

2.32 Where there is a change in road type from a motorway or Type 1 Dual Carriageway with full grade separation to a Type 2 or 3 Dual Carriageway with at-grade junctions, a roundabout should always be used at the first major junction in order to emphasise to drivers the changed character of the road. This has been found to reduce collisions.

2.33 On Type 3 Dual Carriageways priority junctions permitting right turns can be provided at changeovers where the passing lane changes from use by traffic travelling in one direction to the other. The typical layouts for these for both critical and non-critical changeovers are shown in **NRA TD10**. Aspects of these junctions are given in Chapter 3 of **NRA TD 10**. Details of the minor road alignment design are given in Chapter 7 of this document

realistic to calculate queue lengths and delays manually.

Crossroads

2.34 Crossroads are considered unsuitable for all rural road junction types. The use of a rural crossroads shall be considered as a Departure from Standard on all new and improved roads.

Staggered Junctions

2.35 Staggered junctions comprise of a major road with opposed T-junctions on either side. Right/left staggers (where minor road traffic crossing the major road first turns right, proceeds along the major road and then turns left) are preferred to left/right staggers because traffic turning between the minor roads is less likely to have to wait in the centre of the major road.

The use of left/right staggered junctions without ghost islands shall be a Departure from Standard.

Capacity Assessment

2.36 For design involving flows greater than the low flows described in the preceding paragraphs, use should be made of the equations which are available for the prediction of possible minor road entry flows into a major/minor priority junction as a function of the flow/geometry at the junction. These equations are applicable to all types of major/minor priority junctions including staggered junctions.

2.37 The range of reference flows developed should be used to produce trial designs for assessment. A flow to capacity ratio (RFC) of not greater than 75% is required when considering single carriageways with design speeds of 100 kph and above or high speed dual carriageways. This is because formulae have not been developed for these latter types of road.

2.38 Manual or computerised methods such as PICADY may be used to assess capacity. It is not

3. Siting Of Major/Minor Priority Junctions and Direct Access to National Roads

General

3.1 On new single carriageways where overtaking opportunity is limited, ghost island and single lane dualling junctions should be sited on non-overtaking sections, as defined in **NRA TD 9**. On existing single carriageway roads along which overtaking opportunity is very limited, the isolated local improvement of a junction to a ghost island could induce unsafe driver behaviour, since the short length of wider road thus created may be used by some frustrated drivers for overtaking with inadequate visibility.

3.2 Where visibility is limited and it is considered important to prevent overtaking, a measure that has been found to reduce the number of such manoeuvres at existing ghost island or single lane dualling junctions is the application of diagonal hatched road markings in the hard strips, which gives a more confined impression to approaching drivers, as shown in Figure 3/1.

3.3 A saving in collisions may be achieved, and an improvement made in operational performance, by reducing the number of lightly trafficked minor road connections onto major roads. The cost effectiveness of connecting such routes together with a link road before they join a new major road should always be investigated.

Horizontal Alignment

3.4 Ideally, major/minor priority junctions and direct accesses on to national roads should not be sited where the major road is on a sharp curve. However, where the siting of a major/minor

priority junction or access on a curve is unavoidable, the preferred alignment is where T-junctions are sited with the minor road on the outside of the curve and desirable minimum Stopping Sight Distance (SSD) from **NRA TD 9** can be achieved. This is especially important for junctions on dual carriageways, to ensure that minor road traffic has a clear view of vehicles on the major road that may be overtaking through the junction. Junctions on the inside of sharp curves are most undesirable.

3.5 The provision of new major/minor junctions or direct accesses shall not be permitted within 90m of the roundabout on rural roads; this may be reduced to 50m as a relaxation on urban roads. This requirement is due to the reduced visibility to and from the minor road.

3.6 New or altered direct accesses shall not be sited at any location where the desirable minimum SSD envelope of the national road falls outside the paved surface of the road. The paved surface includes hard strips if present. It also includes the hard shoulder at accesses where the stop line is set at the back of the hard shoulder. This means that accesses cannot be sited on the inside of bends where the minimum stopping sight distance cannot be achieved. Direct accesses shall also not be sited within overtaking sections of single carriageway roads as defined in **NRA TD 9**.

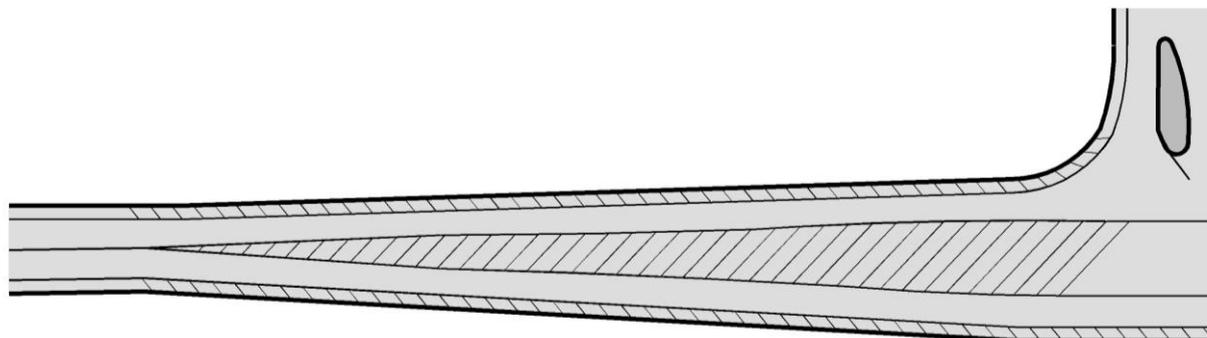


Figure 3/1: Use of Hatching in Hard Strips to Eliminate Overtaking Manoeuvres (Para 3.2)

3.7 Problems have been experienced with major/minor priority junctions containing a skew minor road at the end of some town bypasses where the alignment is such that some drivers perceive that the minor road retains priority. In such circumstances, the minor road approach should be aligned so as to join the major road as near to right angles as possible in order to eliminate any driver confusion as to which route has priority.

Vertical Alignment

3.8 The best locations for new or altered junctions and accesses onto national roads will be on level ground or within sags where there is visibility as set out in Para 7.3 to 7.15 The gradient of major road approaches to the junction or access should not exceed 2% either uphill or downhill. Downhill approaches in excess of this figure, particularly on high speed roads, can induce traffic speeds above those desirable through the junction, and lead to a misjudgement of the approach speed by drivers entering from the minor road. Uphill approaches are also undesirable since it is difficult for drivers to appreciate the layout of a junction when they are approaching it on an up gradient. They cannot see the full layout from the lengths immediately on either side of the crest.

3.9 New or altered junctions and accesses shall not be at or near crests where the shape of the junction or access would not be immediately apparent to the driver on the national road, or where there are double white lines (indicating restricted forward visibility).

Visibility

3.10 At driver's eye level there shall be a clear view from the junction or access over the

immediate area of the junction or access and its connection to the national road.

3.11 Direct accesses shall only be sited where they do not encroach on the visibility requirements of adjoining direct accesses or junctions in regular use. This will determine the minimum spacing of new accesses. Where the all-purpose national road is an Urban Road as defined in Para 1.14 the spacing of accesses shall comply with the provisions contained within the "NRA Policy Statement on Development Management and Access to National Roads".

Crossfall/Superelevation

3.12 At ghost island junctions on Type 3 Dual Carriageways, or single lane dualling, the mainline right turn lane should fall, for drainage purposes, towards rather than away from, the minor road. If this is not the case drivers waiting at the minor road stop line may not be able to see the width of the mainline far carriageway, particularly where there is superelevation across the main carriageway. They may not immediately appreciate that the road they are joining is a dual carriageway, particularly with single lane dualling. A form of optical illusion may also be created, whereby the width available in the central reserve, to make the right turn out of the minor road in two stages, appears insufficient to accommodate waiting vehicles. In this situation the minor road driver may attempt to perform the manoeuvre in one stage.

Junctions and Direct Accesses on Climbing Lanes

3.13 Major/minor junctions and direct accesses on to national roads shall not be located on climbing lane sections.

4. Safety

Junctions

4.1 The National Roads Authority is responsible for securing a safe and efficient national road network. The performance and safety record roads are strongly influenced by the layout and frequency of junctions and accesses.

4.2 An analysis of road collision data for 1996 to 2006 shows that just over 50% (38,853) of all collisions involving personal injury or death occur at junctions or involved turning movements either onto or off roads. The fatalities in these collisions totalled 1126, or 28% of overall road collision fatalities for the period.

4.3 For the same flows a major/minor priority junction will usually have a higher collision rate than other junction types. These collisions will in themselves be more serious than at other forms of control. Collisions are mainly associated with right turns and are exacerbated in number and severity by high major road speeds or the possibility of incautious overtaking traffic manoeuvres occurring on the major road. Collisions involving the right turn from the major road (22%) and the right turn out of the minor road (27%) are the most frequent at major/minor priority junctions (Figures taken from UK research).

4.4 Various methods which have been shown to enhance safety at these junctions in the past include:-

a. The installation of a ghost island on single carriageway roads to shelter right turning traffic and discourage overtaking. The study on rural T-junctions, summarised in UK TRL RR 65, demonstrated that the frequency of collisions involving a right turn from the major road is some 70% less at junctions with a ghost island, than at simple junctions. It should however be noted that more recent research by the Highways Agency in the UK has shown that the minimal extent of some ghost island junctions was a feature of some of the worst performing ghost island sites studied.

b. The use of double white line markings or raised rib markings along the hatching boundary, or the application of differential coloured surfacing within the hatched area at ghost islands

to discourage dangerous overtaking manoeuvres at the junction.

c. The application of hatching in the hard strips at single lane dualling junctions has been shown to give a more confined impression to approaching drivers and hence reduce speeds.

d. The replacement of a rural crossroads by a staggered junction. This has been shown to reduce collisions by some 60%.

e. The installation of channelising islands on the minor road approaches at rural crossroads. This has been shown to reduce collisions (mainly minor road overrun) by about 50%.

f. The improvement of visibility. However, care should be taken not to provide visibility to the right on the minor road approach much in excess of the desirable minimum as this can divert the driver's attention away from road users on the major road in the immediate vicinity towards those approaching in the far distance.

g. The provision and maintenance of good skid resistant surfaces.

h. The conversion of urban major/minor priority junctions to traffic signal or roundabout control. The latter has been shown to reduce collisions by 30% or more.

i. The installation of pedestrian guard rails, central refuges and pedestrian crossings in urban areas.

j. On high speed dual carriageways, the prevention of right turn crossing manoeuvres at the junction and use of a roundabout or a grade separated crossing close to the major/minor priority junction for the purpose of U-turns by the diverted traffic. Such a method of local grade separation eliminates the two manoeuvres contributing most to collisions at major/minor priority junctions. The design of such layouts is covered more fully in Chapter 8 and in **TD 40** "Layout of Compact Grade Separated Junctions".

Direct Access to National Roads

4.5 The National Roads Authority supports a strategy aimed at maintaining the capacity, efficiency and safety of the national roads

network which seeks to prevent a proliferation of roadside developments along national roads to which high speed limits apply, i.e. greater than 50km/h in accordance with national policy.

Detailing of Severed Roads

4.6 Where an existing road is severed by a new road scheme, resulting in the creation of a cul-de-sac, the approach to the cul-de-sac should be detailed to direct through traffic on to the through road. The access to the cul-de-sac therefore, shall be detailed so as to require a deliberate turning manoeuvre to prevent drivers assuming the previous road layout still applied.

5. Provision for Non-motorised Users

General

5.1 In designing major/minor priority junctions, it is important to take account of the specific requirements of road users. The high speed nature of rural national roads is such that specific facilities may be required at some locations in order to ensure the safe passage of specific road users through the junction. This is equally true at some urban sites where some junctions may be used intensively by all types of road user.

Cyclists' Facilities

5.2 Major/minor priority junctions present a hazard for pedal cyclists, 73% of cyclist collisions at junctions occur at major/minor priority junctions. It is therefore important that a cyclist is provided with a safe passage through the junction, and that the design of any cyclist facilities should take into account both their vehicular rights and their particular vulnerability, as suggested by the collision statistics.

5.3 Consideration should be given to cyclists where an existing cycle lane crosses the minor road. In this instance, the greatest danger has been found to be a collision with vehicles emerging from the minor road, and from motor vehicles turning right or left from the major road and thus cutting across the path of the cyclist.

5.4 Advice on cycle facilities is provided in "Guidelines on Traffic Calming for Towns and Villages on National Routes" (NRA Guidelines) and "The National Manual for the Design of Cycle Facilities" (Department of Transport).

5.5 Bearing in mind the practicalities and economics, it is important to consider the provision of facilities that take cyclists away from the mouth of the junction on rural roads. This will minimise the interaction between cyclists and motor vehicles and provide safe crossing points.

5.6 Such facilities may include the following:-

a. Shared use by pedestrians and cyclists of a displaced cycle track/footway with a controlled or uncontrolled crossing.

b. A signposted alternative cycle route away from the junction.

c. Full grade separation, for example by means of a combined pedestrian/cyclist subway system.

If provision of any of these is not possible, then greater emphasis should be placed on the safety aspects of the design of the major/minor priority junction layout, by careful attention to the provision of crossing places.

5.7 In urban areas, if the volume of cyclists is significant, but not high enough to justify economically a grade separated crossing, then consideration may be given to signalling the whole junction.

Equestrians' Facilities

5.8 Where it is expected that there will be regular use of the junction approaches by ridden horses, of the order of more than 20 passages a week, consideration should be given to the provision of dedicated crossing places. Horses require longer headway between vehicles than cyclists and pedestrians, to allow an adequate margin of safety for crossing. Therefore, the location of such crossings should preferably be at some distance from the junction to permit suitable visibility by the rider. The visibility distances recommended for equestrians in **TA 57** are considerably greater than those set out in Chapters 7 and 8 of this standard.

5.9 It is recommended that the grass verge be extended at the crossing point to provide a "holding area" for the horses.

5.10 Displaced routes at major/minor priority junctions are to be preferred, although the use of grass verges by ridden horses may have an indirect effect on road safety, in that the drainage system may be damaged, causing the carriageway to flood, or damaged verges may force pedestrians to walk on the carriageway. In such circumstances, strengthening of the verges may be required.

5.11 Alternatively, ridden horses could share cycle tracks where these are remote from the mouth of the junction, but should not be expected to use pedestrian facilities.

Pedestrians' Facilities

5.12 The requirements of pedestrians should be carefully considered in the design and choice of major/minor priority junctions. Although it is preferable to provide separate pedestrian routes away from the junction, where road widths are less and traffic movements more predictable, this is rarely practical, in which case the following facilities should be considered:-

- a. A minor road central refuge at an unmarked crossing place (Figure 5/1).
- b. Subway or footbridge (footbridge preferred).

5.13 The type of facility selected will depend upon the volumes and movements expected of both pedestrians and traffic, and should be designed in accordance with current recommendations and requirements - **BD 29; TD 36**. The use of different types of pedestrian facility at the same junction is not recommended as this could lead to confusion by pedestrians and drivers.

5.14 At-grade pedestrian crossing points should not be placed in the mouth of the junction. Instead they should be located away from the mouth where the carriageway is relatively narrow. In urban areas, where pedestrian flows are relatively low, it is possible to provide a central refuge in the hatched area of a ghost island junction; to enable pedestrians to make the crossing manoeuvre in two stages, and have a safe central waiting area. The use of tactile surfaces should be considered in the normal way.

5.15 Defined at-grade pedestrian crossing points on the minor road should be a minimum of 15m back from the "Yield or Stop" line, and should be sited so as to reduce to a minimum the width to be crossed by pedestrians provided they are not involved in excessive detours from their desired paths.

5.16 In urban areas, where large numbers of pedestrians are present, guard rails or other deterrents may be used where there is a requirement to prevent indiscriminate crossing of the carriageway. The design of guard railing should not obstruct drivers' visibility requirements. Guard rails which are designed to maintain drivers' visibility of pedestrians through them, and vice versa, are available, but should be checked in case blind spots occur.

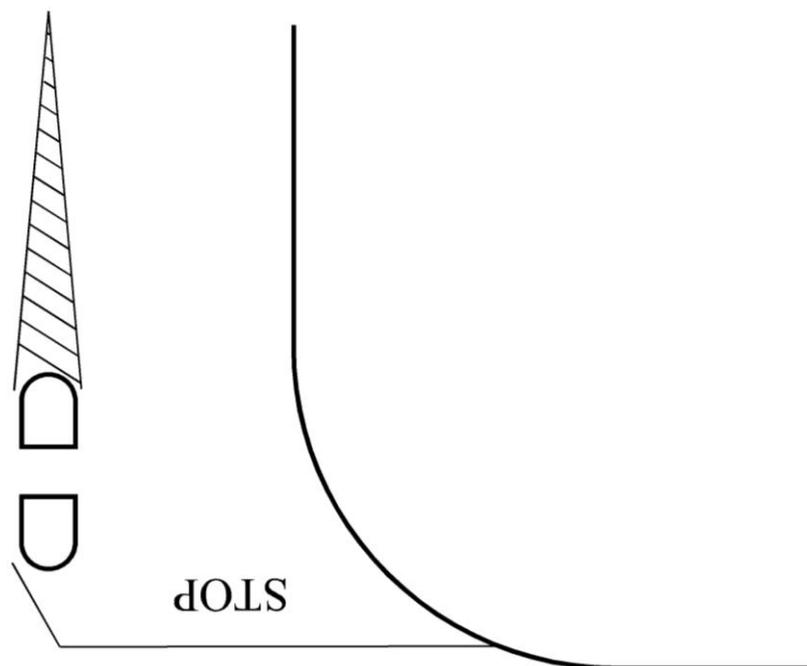


Figure 5/1: Typical Urban Separation Island (Para 5.12)

6. Landscaping and Roadside Features

6.1 The design of landscaping and street furniture within the road boundaries shall be carried out in consultation with appropriate specialists. The Design Organisation shall consider the maintenance implications and where the responsibility for maintenance is passed to a third party, maintenance standards must be agreed. If third parties wish to enhance the standard of planting or landscaping at major/minor priority junctions, for example with special floral displays, this shall be with the agreement of the National Roads Authority, and shall not compromise visibility or safety.

6.2 Apart from the amenity benefits, the landscape treatment of major/minor priority junctions can have practical advantages from a traffic engineering point of view. These can be:

- To make the layout of a major/minor priority junction more obvious to approaching traffic.
- To provide reference points or features for drivers waiting to exit the minor road, aiding them in judging the speed of drivers approaching on the major road. This can be useful where a junction is located in an open landscape, where there is a lack of natural reference points.
- To provide a positive background to the road signs around the junction.

6.3 It is essential that visibility within the required splay remains unobstructed by vegetation and street furniture. Trees and shrubs shall not be planted within 3 m back from the edge of the visibility splay. This is to allow for future growth to take place which will not impede the required standards of visibility. Exceptionally and providing visibility standards are not infringed, plants maintained as ground cover could be planted within the visibility splay but normally the splay should be grassed or paved.

6.4 Too much visibility can be as problematic as too little and this can sometimes also be redressed by careful landscape treatment.

6.5 A well-defined maintenance programme should be developed if extensive planting is used to ensure that such planting does not obscure

either approaching traffic or direction signs at any time.

6.6 The overall design of landscaping and positioning of signs and other street furniture should be considered with the aim of reducing roadside clutter.

7. Geometric Design Features for Single Carriageway Roads

General

7.1 This chapter outlines the geometric design features to be considered in the design of major/minor priority junctions and accesses associated with single carriageway roads. Many of the features are dealt with separately, and a designer should work systematically through the design procedure prior to assembling the component parts. This is an iterative process, as illustrated in Figure 2/1.

Design Speed

7.2 Geometric standards for junctions are related to the traffic speed of the major road, and for new roads this is the design speed as defined in **NRA TD 9**. Reference should be made to **NRA TD 9** in order to determine the appropriate design speed.

Visibility

7.3 Traffic from either a minor road or direct access has to join or cross the major road when there are gaps in the major road traffic streams. It is therefore essential that drivers emerging from a minor road or direct access shall have adequate visibility in each direction to see the oncoming major road traffic in sufficient time to permit them to make their manoeuvres safely. This concept also applies to major road traffic turning right into the minor road or direct access. As well as having adverse safety implications, poor visibility reduces the capacity of turning movements. Visibility shall however, not be excessive as this can provide a distraction away from nearer opposing traffic.

7.4 For safety, drivers both on the major road and on the minor road or direct access shall be able to see any potential hazard in time to slow down or stop comfortably before reaching it. It is necessary therefore to consider the driver's line of vision in both the vertical and horizontal planes and the stopping sight distance for the vehicle at the relevant design speed. It is also essential that other road users can equally see oncoming vehicles; particularly where vehicles cross the footway in front of pedestrians at the same level and the crossing may not be so obvious.

7.5 Drivers approaching a major/minor priority junction from both the major road and the minor road shall have unobstructed visibility as indicated in the following sections. The envelope of visibility for driver's eye height is as set out in **NRA TD 9**.

Major Road

7.6 Drivers approaching a major/minor priority junction or direct access along the major road approaches shall be able to see the minor road or direct access entry from a distance corresponding to the desirable minimum SSD for the design speed of the major road, as described in **NRA TD 9**. It should be noted that **NRA TD 9** does not allow relaxations in SSD on the immediate approach to junctions with the exception of an individual field access. This visibility allows drivers on the major road to be aware of traffic entering from the minor road or direct access in time for them to be able to slow down and stop safely if necessary.

Minor Road/Direct Access

7.7 The principle of providing the required visibility for drivers approaching the junction from the minor road or direct access has three distinct features.

a. Approaching drivers shall have unobstructed visibility of the junction from a distance corresponding to the desirable minimum SSD for the design speed of the minor road, as described in **NRA TD 9**. This allows drivers time to slow down safely at the junction, or stop, if this is necessary. Where a "Yield or Stop" sign is proposed the visibility envelope shall be widened to include the sign.

b. From a point measured 15m along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the surfaced carriageway (including hard strip or hard shoulder) of the major road, an approaching driver shall be able to see clearly the junction form, and those peripheral elements of the junction layout as shown in Figure 7/1. This

provides the driver with an idea of the junction form, possible movements and conflicts, and possible required action before reaching the major road.

c. The distance back along the minor road or direct access from which the full visibility is measured is known as the ‘x’ distance. It is measured back along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the surfaced road (including hard strip or hard shoulder) of the major road. The desirable minimum ‘x’ distance shall be 3.0m for all junctions and direct accesses except those with a “Yield” sign. Junctions and direct accesses with a “Yield” sign will require an ‘x’ distance of 9m. In difficult circumstances, the ‘x’ distance may be taken as a Relaxation from 3.0m to 2.4m for simple junctions in a stop controlled situation (see paragraph 2.23 for restrictions on the use of simple junctions). On regional and local roads a further relaxation of the ‘x’ distance to 2.0m may be considered in difficult circumstances. This further relaxation may only be permitted for lightly used accesses, excluding field accesses and other accesses where agricultural vehicles can be expected such as farm houses. On national roads any reduction of the ‘x’ distance below 2.4m shall be considered to be a Departure from Standard.

From the point “x” metres back from the major road a driver approaching the junction along the minor road shall be able to see clearly points to the left and right on the nearer edge of the major road running carriageway at a distance given in Table 7/1, measured from its intersection with the centreline of the minor road. This is called the ‘y’ distance and is defined in Figure 7/1.

d. On national roads the full ‘y’ distance must be achieved, however in difficult circumstances the low object height may be taken as 0.6m instead of 0.26m as a Relaxation.

e. For urban, regional and local roads with a demonstrably effective speed limit of 60kph or less, the ‘y’ distance may be relaxed by one design speed step in difficult circumstances, see also Para 7.11.

7.8 If the line of vision lies partially within the major road paved area, it shall be made tangential to the nearer edge of the major road paved carriageway (including hard shoulder or hard strip), as shown in Figure 7/2.

Design Speed of Major Road (kph)	‘y’ Distance (m)
42	50
50	70
60	90
70	120
85	160
100	215

Table 7/1: ‘y’ Visibility Distances from the Minor Road (Para 7.7c)

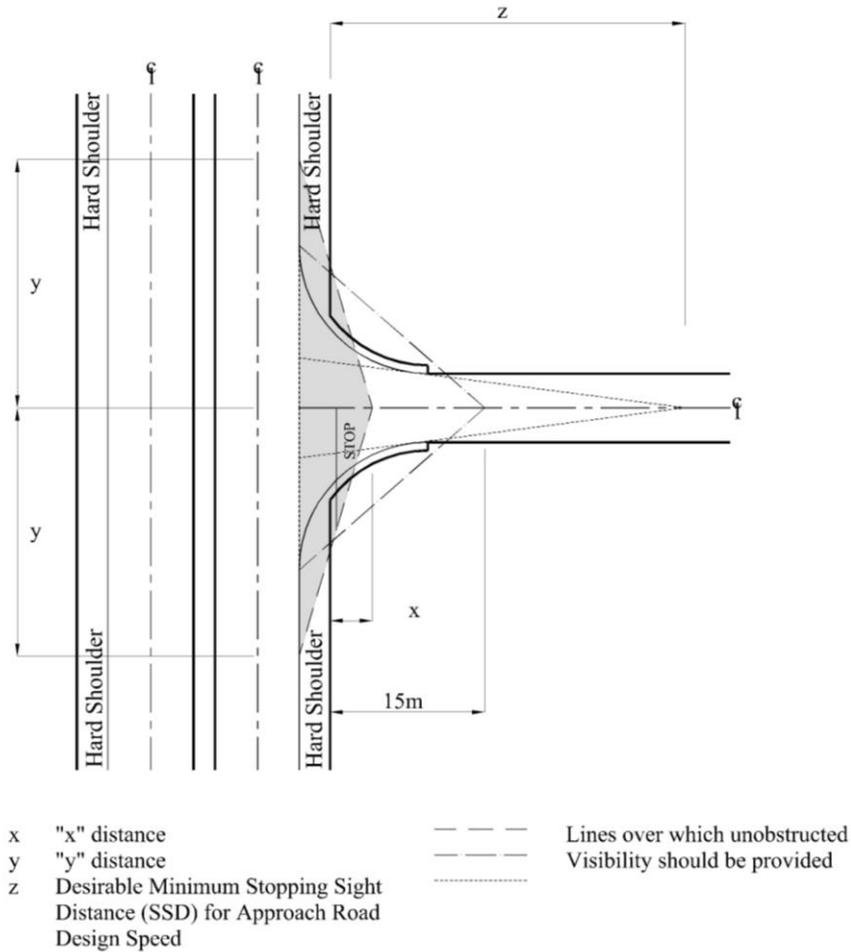


Figure 7/1: Visibility Standards (Para 7.7)

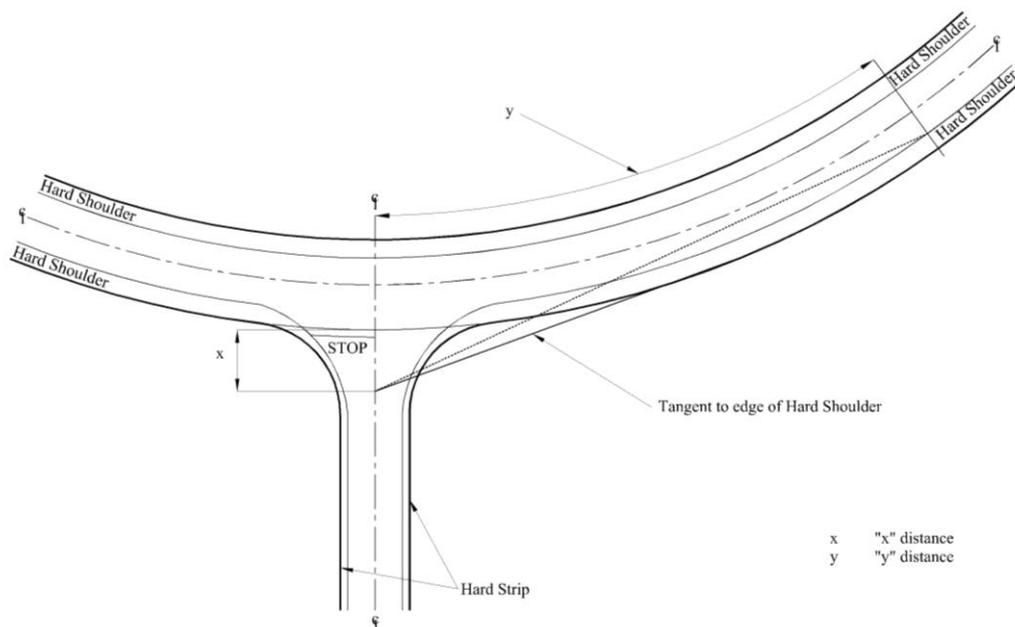


Figure 7/2: Visibility Standards with a Curved Major Road (Para 7.8)

7.9 The 'x' distance, from which full 'y' distance visibility is provided, should not be more than 9m, as this induces high minor road approach speeds into the junction, and leads to excessive land take.

7.10 Similarly, although the 'y' distance shall always be provided, there is little advantage in increasing it, as this too can induce high approach speeds and take the attention of the minor road or direct access driver away from the immediate junction conditions. Increased visibility should not be provided to increase the capacities of various turning movements.

7.11 At junctions onto regional and local urban roads where there is a constraint on overtaking on the approach from the left to the junction, the visibility splay to the left may, as a Relaxation, be taken to the nearside edge of the lane for oncoming traffic rather than to the nearside edge of the road: see Figure 7/3. A constraint on overtaking occurs where the layout or visibility on the approach is such that a continuous white line is required to prevent overtaking.

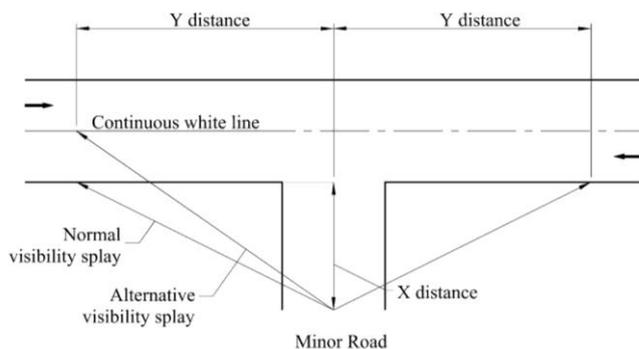


Figure 7/3: Alternative Visibility Splay for Urban Regional and Local Roads

7.12 If the major road is one way, a single visibility splay in the direction of approaching traffic will suffice. If the minor road serves as a one way exit from the major road, no visibility splays will be required, provided that forward visibility for turning vehicles is adequate.

7.13 Dangerous conditions arise if vehicles obstruct visibility by parking within visibility splays. Where necessary, parking and access shall be controlled to prevent this. The Design Organisation shall ensure that the positioning of lay-bys, bus stops, traffic signs, environmental barriers and other street furniture does not interfere with the drivers' visibility requirements and that the obstructive effect for all road users is minimised.

7.14 It is important to ensure that developments serviced by a new direct access do not lead to parking on the major road in the vicinity of the access, to the detriment of the safe passage of vehicles on both the access and the national road. On certain types of development where this is likely to be an issue the design should be such as to prevent such parking.

7.15 Where an emerging vehicle crosses a footway at a lightly used direct access - for example from the driveway of a single dwelling - pedestrians may not have sufficient warning of its approach. This relates to the situation where the vehicle crosses at the footway level and there is no clearly formed differentiation in the level between the footway and the crossing. Under these conditions, visibility splays to the back of the footway, 2m on either side of the centre of the access, shall be provided from 2m back from the back edge of the footway along the centreline of the access. The driver's eye height shall be taken as 1.05m and the object height at the back of footway shall be taken as 0.6m to make clear the presence of a small child. This is shown in Figure 7/4.

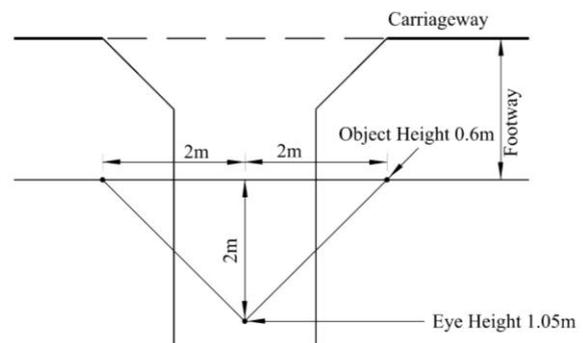


Figure 7/4: Visibility at Back of Footway Crossing

Approach Gradients

7.16 The gradient on minor roads shall be in accordance with **NRA TD 9**. On direct accesses, gradients greater than 10% approaching the major road shall not be permitted other than in exceptional circumstances. The gradient on the minor road immediately next to the major road should be considerably less, and a "dwell" area of at least 15m shall be provided immediately adjacent to the major road carriageway. Where site conditions are particularly difficult this area may be 10m as a Relaxation. In the case of a direct access to a single dwelling, it may be reduced to 5m as a Relaxation.

7.17 The gradient for the dwell area shall lie between plus and minus 2.5%. In difficult situations this may be increased to between plus and minus 4%. The intention here is to avoid the risk of vehicles stalling on a mild hill start when attempting to accept a gap in the major road traffic or inadvertently rolling out into the major road carriageway. The visibility requirement set out in the above paragraphs shall be met in full at locations with steep gradients.

7.18 In order to facilitate dwell areas in accordance with Paragraph 7.17, the maximum vertical gradient of the local road or access may be increased to 10% on the approach to a dwell area.

Geometric Layouts of Small Direct Accesses

7.19 Table 7/2 gives a number of basic direct access layout types which should form the basis of local designs.

7.20 Two layouts are proposed for the following circumstances:

- Layout 1: Field access
- Layout 2: Single dwelling

7.21 These layouts have approximate levels of use as indicated in Table 7/2. All other direct accesses shall be designed to the same standard as

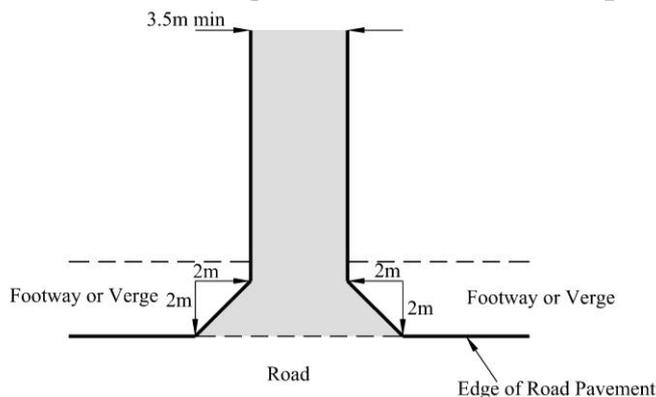


Figure 7/5: Direct Access Layout 1 – Field Access

a road junction as detailed elsewhere within this Chapter.

	Field Access	Single Dwelling
Direct Access Layout	1	2
Traffic using the access AADT	Less than 10 movements a week	Less than 150 movements a week
Layout suitable for carriageway configuration	Single & Dual	Single & Dual

Note: These figures are recommendations and indicate the approximate level at which alternatives for connections should be considered. Design Organisations should look carefully at the safety implications involved in providing the alternative connection.

Table 7/2: Recommended Standard Access layouts

7.22 Other than the layout details as shown in Figures 7/5 and 7/6 all other geometric design details will be as detailed within the rest of this Chapter.

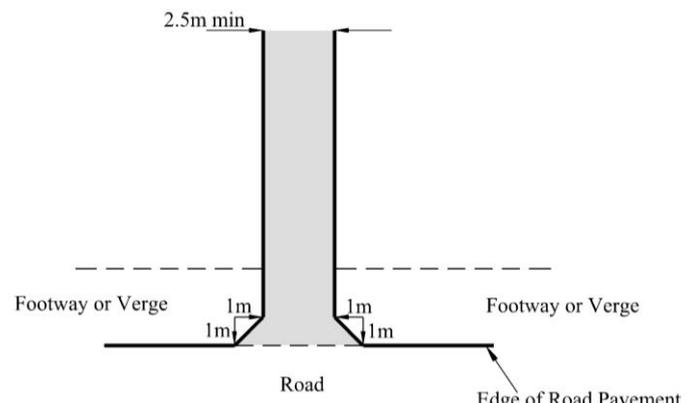


Figure 7/6: Direct Access Layout 2 – Single Dwelling

Entrance Gates Across Direct Access

7.23 Entrance gates across a direct access shall be set back to accommodate one vehicle in the access, clear of the main running lane and preferably clear of the footway. The vehicle to be accommodated should be of the largest type to use the access on a regular basis, (which in the case of farm vehicles may include a trailer). Wherever possible, gates should open away from the highway and where this is not possible, the set back should be increased to allow for this. As a Relaxation, where entrance gates are permanently open while the development is in use and during the working day, the requirement for the set back may be omitted.

Factors Common to all Junction Types

Design Vehicle

7.24 Allowance shall be made for the swept turning paths of long vehicles where they can reasonably be expected to use a junction. Consideration shall also be given to the manoeuvring characteristics of these vehicles in the design of staggered junctions.

7.25 All of the geometric parameters used in the design of a major/minor priority junction have been developed to cater for a 16.5m long articulated vehicle, whose turning width is greater than for most other vehicles within the normal dimensions permitted in the existing Road Traffic (Construction, Equipment and Use of Vehicles) Regulations, or likely to be permitted in the near future. The turning requirements of an 18.35m long drawbar trailer combination are less onerous regarding road width. In cases where hard strips are present, the design vehicle is assumed to use these on some turns, and at some simple junctions, it may encroach into opposing traffic lanes.

7.26 The use of computer software to predict the swept path of large vehicles is recommended. The vehicle type used shall be appropriate to the predicted use of the junction or direct access.

Corner Radii

7.27 Where no provision is made for large commercial vehicles, it is recommended that the minimum circular corner radius at simple junctions should be 6m in urban areas and 10m in rural areas. Where provision is to be made for

large commercial vehicles, the recommended circular corner radius is:-

- a. 10m at urban simple junctions, followed by a taper of 1:5 over a distance of 30m, measured from the edge of the major road carriageway up the minor road in the case of the entry to the minor road, and followed by a similar taper measured from the centreline of the minor road along the major road for the entry to the major road. As shown in Figure 7/7.
- b. 15m at rural simple junctions, with tapers of 1:10 over a distance of 25m.
- c. 15m at ghost island junctions, with tapers of 1:6 over a distance of 30m.
- d. 15m at simple staggered junctions, with tapers of 1:8 over a distance of 32m.
- e. 20m radius in all other circumstances.

These radii only apply where there are no nearside diverge tapers or lanes. Figures for these are given in Para 7.67

7.28 Where large commercial vehicles comprise a significant proportion of the turning movements, use of the compound curve shown in Figure 7/8 is recommended.

Carriageway Widths

7.29 A minimum 0.5 metre hard strip shall be provided throughout all junction layouts, corner radii and associated tapers.

Through Lanes

7.30 At ghost island junctions, the through lane in each direction shall not be greater than 3.65m wide, exclusive of hard strips, but shall not be less than 3.0m wide on rural roads.

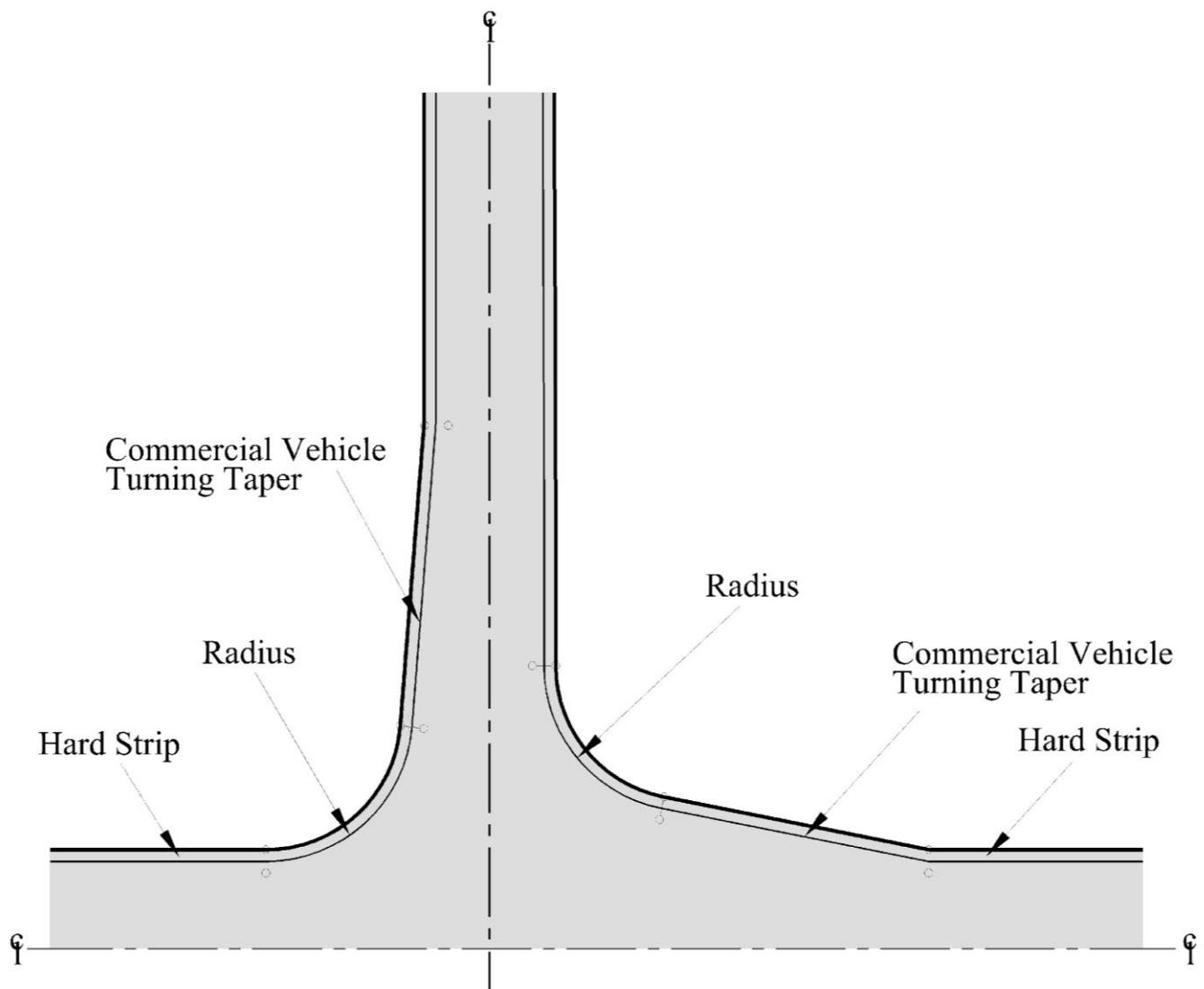


Figure 7/7: Design of Corner Radii for Rural Simple Junctions, Ghost Island Junctions & Simple Staggered Junctions (Para 7.26)

Minor Road Approaches

7.31 On a minor road approach of nominal width 7.5m or less, where a channelising island, as described in paragraphs 7.51 to 7.61, is provided both lanes shall be 4.0m wide at the point where the hatched markings surrounding the channelising island begin. At the point where the channelising island commences, the widths on either side shall be as follows:-

- a. On the approach to the major road, 4.0m wide for a ghost island exclusive of hard strips. If the approach on the minor road consists of two lanes, this dimension shall be 5.5m.
 - b. On the exit from the major road, 4.5m wide for a ghost island exclusive of hard strips.
- These dimensions are shown on Figure 7/10.

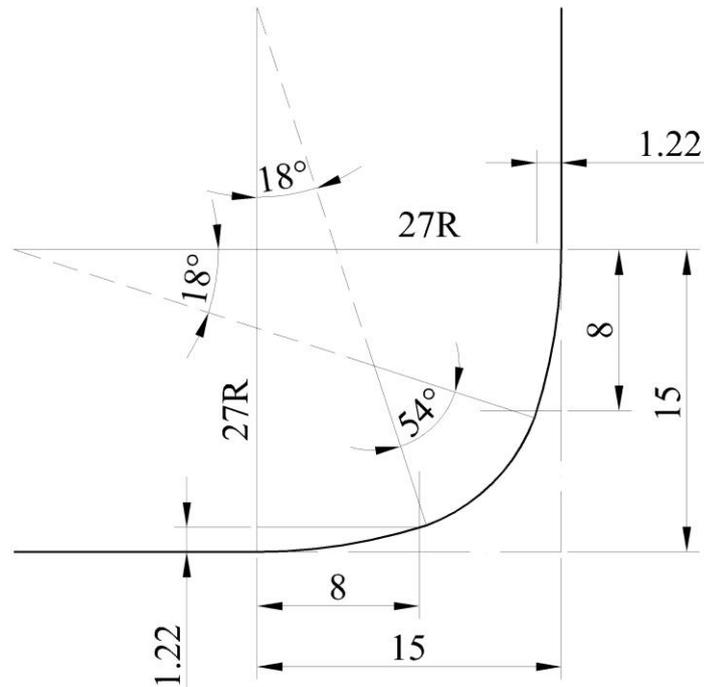
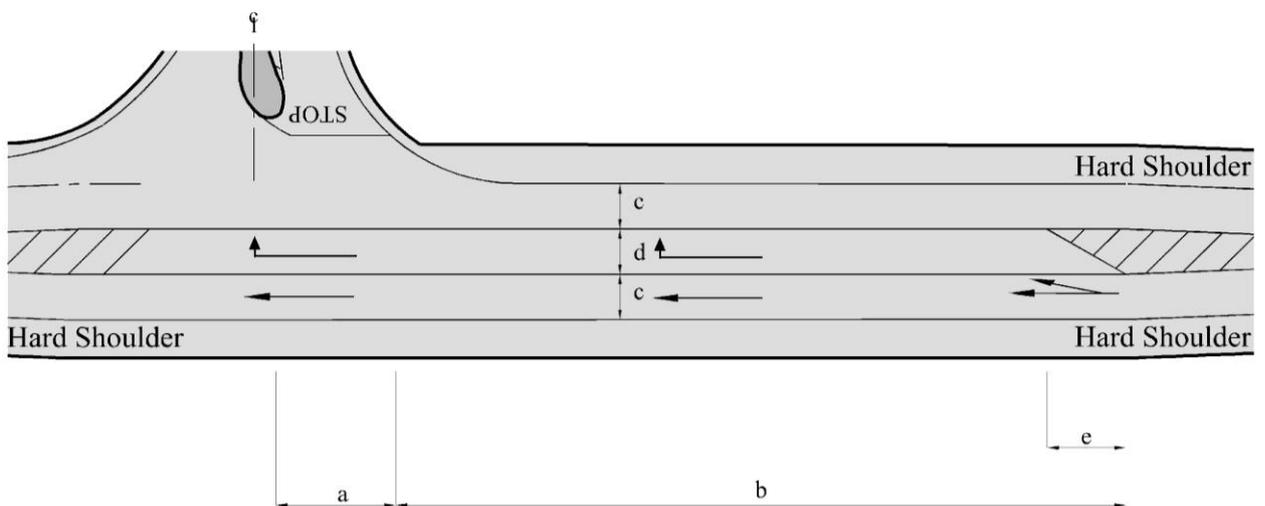
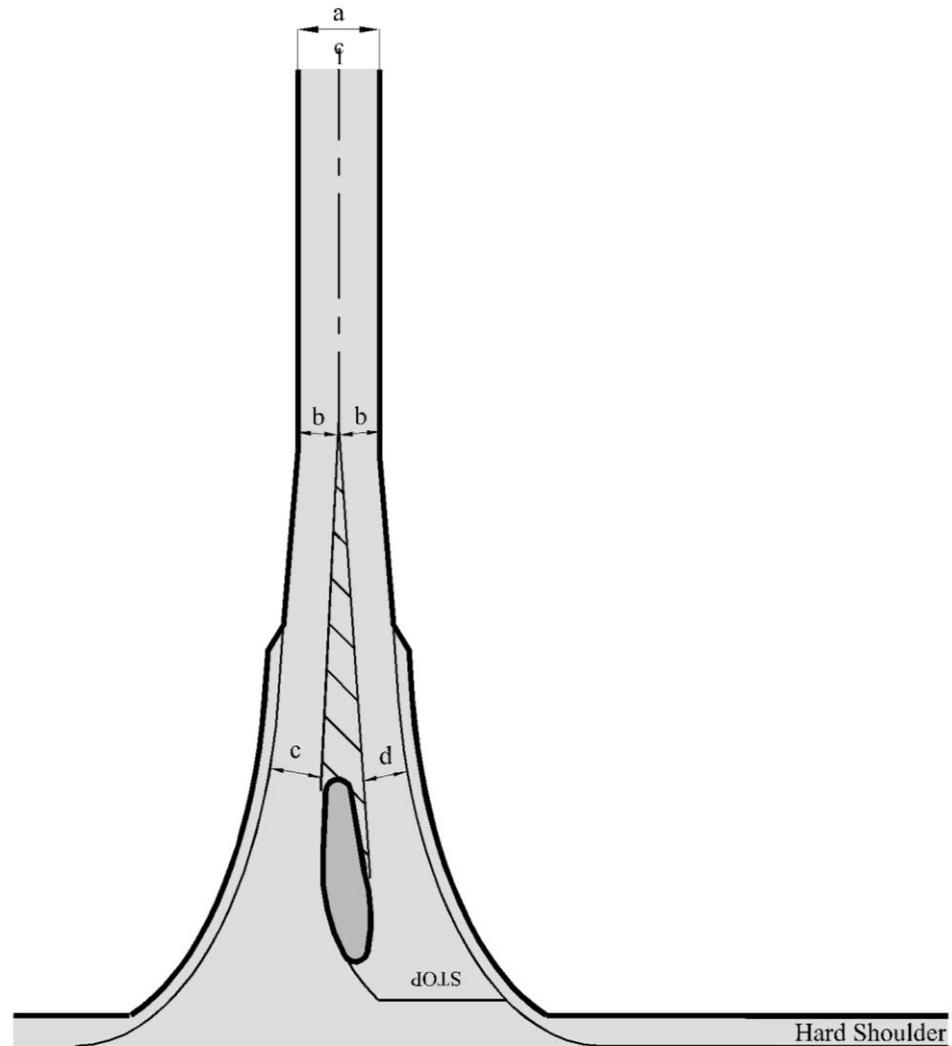


Figure 7/8: Design of a Compound Curve (Para 7.27)



- | | | | |
|---|---|---|---------------------|
| a | Turning Length (+ Queuing length, if required, but see para 7.41) | c | Through Lane Width |
| b | Deceleration Length | d | Turning Lane Width |
| | | e | Direct Taper Length |

Figure 7/9: Major/Minor Priority Junction with a Ghost Island (Paras 7.29 – 7.60)



- | | | | |
|---|---|---|--|
| a | 7.0m nominal width | d | 4.0m for ghost island |
| b | 4.0m in all cases | | 4.5m for single lane dualling,
dual carriageway |
| c | 4.5m for ghost island
5.0m for single lane dualling,
dual carriageway | | 5.5m if two lane approach |

Figure 7/10: Minor Road Approaches (Para 7.30)

7.32 If there are no channelising islands in the minor road, the nominal approach width should continue up until the tangent point of the curve to join the edge of the major road running carriageway.

7.33 At skew junctions the centreline of the minor road shall have a minimum radius of 50m that meets the major road nearside channel at right angles. Prior to the 50m radius, the minor road centreline shall be designed in full accordance with **NRA TD 9** and shall be at an angle of between 30 and 150 degrees to the major road channel (see Figure 7/11).

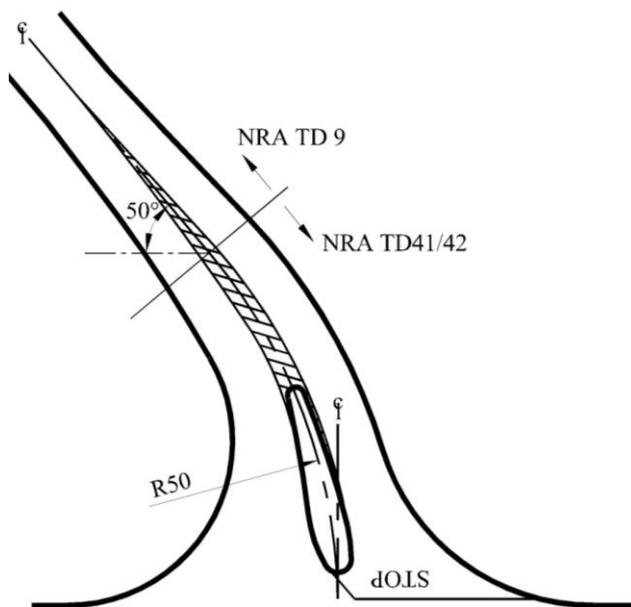


Figure 7/11: Skew Junctions (Para 7.32)

Carriageway Widths around Curves

7.34 Where carriageways are taken around tight radius corners, added width shall be provided to cater for the swept area of larger commercial vehicles and the "cut in" of trailer units. Table 7/3 shows the recommended minimum widths for various nearside corner radii based on the design vehicle. For radii above 100m, the standards set out in **NRA TD 9** shall be used. The carriageway widths in Table 7/3 are not normally required where channelising islands, as described below in Paragraphs 7.51 to 7.61 are provided.

7.35 Where 16.5m long vehicles are anticipated, but are likely to form only a very small percentage of the total number of vehicles and where

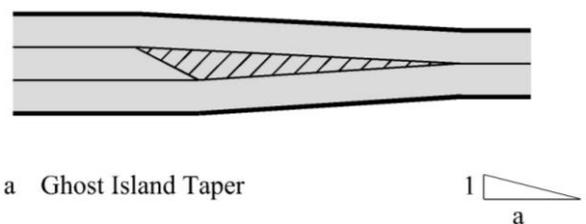
conflicts will not occur on bends, the carriageway widths should be designed to cater for those vehicles with a less onerous turning requirement that will use the junction. The width should be adequate to accommodate the swept paths of the vehicles being considered with an additional 1m allowance for variation in their position. Alternatively, figures from Table 7/3 could still be used.

7.36 An articulated car transporter will turn in the widths shown, but where provision is to be made for this type of vehicle, street furniture above 2.5m high should be set back at least 1m from the edge of the minor road carriageway at the bellmouth (this does not apply for channelising islands) to allow for the projection of the trailer over the tractor cab.

7.37 Preventing or minimising conflicts by separation means that drivers are only faced with simple decisions on their choices of movement at any one time. This can lead to greater safety. For the separation to be effective, the junction must be large enough for drivers to identify in adequate time those vehicles which will conflict with their intended path and those that will not. If this is not so, gaps in the flow cannot be used effectively by traffic entering the junction.

Tapers

7.38 Central islands, for ghost islands (Figure 7/12) should normally be developed symmetrically about the centreline of the major road to their maximum width at the tapers shown in Table 7/4. The maximum island width should continue through the junction to the tangent point of the minor road radius and the edge of the major road carriageway. In difficult circumstances, the Design Organisation may relax the taper value by one design speed step as a relaxation.



a Ghost Island Taper

Figure 7/12: Ghost Island Development and Taper (Para 7.37)

Inside Radius or Curve Radius (m)	Corner or Curve	Single Lane Width (excluding hard strip provision) (m)	Single Lane Width with space to pass Stationary Vehicle (including hard strip provision) (m)	Two Lane Width for One Way or Two Way Traffic (excluding hard strip provision) (m)		
				Inside Lane	Outside Lane	Total
10		8.4	10.9	8.4	6.5	14.9
15		7.1	9.6	7.1	6.0	13.1
20		6.2	8.7	6.2	5.6	11.8
25		5.7	8.2	5.7	5.2	10.9
30		5.3	7.8	5.3	5.0	10.3
40		4.7	7.2	4.7	4.6	9.3
50		4.4	6.9	4.4	4.3	8.7
75		4.0	6.5	4.0	4.0	8.0
100		3.8	6.3	3.8	3.8	7.6

Table 7/3: Minimum Corner and Curve Radii and Carriageway Widths (Para 7.33)

7.39 Where junctions are located on sharp curves, islands should be introduced asymmetrically to suit the circumstances (as indicated in Figures 7/17). Notwithstanding the requirement for a Departure from Standard for a junction on a climbing lane where necessary the same principles would apply. It is also appropriate to introduce islands asymmetrically in other circumstances. This can have the benefit of avoiding expense (for example Statutory Undertakers' works). If the widening is biased to the minor road side, through traffic will be deflected where crossing movements at the minor road take place, which may be a benefit.

7.40 It should be noted that with asymmetrical islands that the taper ratio will be the same as for a symmetrical island but the taper length will be considerably greater. Design Organisations shall ensure that any design whether with symmetrical or asymmetrical central islands; a smooth flowing alignment is achieved.

Turning Length

7.41 The turning length is provided to allow long vehicles to position themselves correctly for the right turn. The turning length shall be 10m long irrespective of the type of junction, design speed or gradient, measured from the centreline of the minor road. It is shown on Figures 7/9.

7.42 Where capacity calculations indicate that for significant periods of time there will be vehicles queuing to turn right from the major road, the turning length shall have a queuing length added to it as a reservoir to accommodate queuing vehicles.

Direct Taper Length

7.43 The direct taper length is the length over which the width of a right turning lane is developed. For ghost island junctions right turning lanes shall be introduced by means of a direct taper whose length is part of the deceleration length, and depends on the design speed. This taper length is given in Table 7/5. In difficult circumstances, the Design Organisation may relax the taper value by one design speed step as a relaxation.

Design Speed (Kph)	Taper for Ghost Island
50	1:20
60	1:20
70	1:20
85	1:25
100	1:30

Note: In difficult circumstances, the Design Organisation may relax the taper value by one design speed step as a relaxation.

Table 7/4: Tapers for Central Islands

Design Speed (kph)	Direct Taper Length (m)
50	5
60	5
70	15
85	15
100	25

Note: In difficult circumstances, the Design Organisation may relax the taper value by one design speed step as a relaxation.

Table 7/5: Direct Taper Length (Para 7.42)

Ghost Islands

7.44 For new junctions, the desirable width of a ghost island turning lane shall be 3.5m, but a Relaxation to 3.0m is permissible. On rural roads, with design speeds above 85kph or where hard strips are present, widths greater than 3.65m are inadvisable because wide ghost islands in these situations create a sense of space that could encourage hazardous overtaking at junctions.

7.45 At left/right staggered junctions, the deceleration lengths would overlap but the width of the ghost island shall not be increased to make them lie side by side. The starting points of the right turning section shall be joined by a straight line, which will mean at higher design speeds, the

full width of the turning lane will not be developed until the end of the diverging section (as shown in Figure 9/3). The width of the turning lane shall be the full width of the ghost island.

Right Turning Lanes

7.46 The overall length of a right turning lane provided at ghost island junctions, will depend on the major road design speed and the gradient. It consists of a turning length, as described in Paras 7.40 and 7.41, and a deceleration length. This component shall be provided in accordance with Table 7/6, in which the gradient is the average for the 500m length before the minor road. In difficult circumstances, the Design Organisation may relax the deceleration length by one design speed step as a relaxation.

Design Speed (kph)	Up Gradient		Down Gradient	
	0-4%	Above 4%	0-4%	Above 4%
50	25	25	25	25
60	25	25	25	25
70	40	25	40	40
85	55	40	55	55
100	80	55	80	80

Note: In difficult circumstances, the Design Organisation may relax the deceleration length by one design speed step as a relaxation.

Table 7/6: Deceleration Length (m) for Ghost Island (Paras 7.45 and 7.68)

7.47 The deceleration length can be seen on Figures 7/9. The deceleration lengths are based on the assumption that vehicles will slow by one design speed step on the major road before entering the length. The deceleration rate on the level is assumed to be 0.375g. There is no reaction time as this is a planned manoeuvre.

Traffic Islands and Refuges

7.48 Traffic islands should be provided in the mouth of the minor road at major/minor priority junctions, except simple junctions, to:-

- a. Give guidance to long vehicles carrying out turning movements.
- b. Channelise intersecting or merging traffic streams.
- c. Warn drivers on the minor road that a junction is ahead.
- d. Provide shelter for vehicles waiting to carry out manoeuvres such as waiting to turn right.
- e. Assist pedestrians.

7.49 At rural major/minor junctions of the ghost island type, the rural channelising island as described in paragraphs 7.51 to 7.61 shall be used.

7.50 Physical islands shall have an area of at least 4.5 square metres, and shall be treated to be conspicuous in poor lighting conditions. Smaller

areas should be defined by road markings. The risk of overriding the islands can be reduced by offsetting the approach nose from the edge of the vehicle paths.

7.51 Where a traffic island serves as a refuge for pedestrians it shall be at least 2.1m wide and have openings in the centre at carriageway level to make the crossing easier for pedestrians (see Figure 5/1). Opposite the refuge openings, dropped kerbs shall be installed for the same reason. Care shall be taken that street furniture does not obstruct the drivers' view of pedestrians.

7.52 The recommended layout and details of the design of rural channelising islands can be found below.

Design of Channelising Islands

T-Junctions or Staggered Junctions

7.53 The recommended layout for T-junctions or staggered junctions, where the minor road centreline is inclined to the major road at an angle of between 70° and 110°, is shown in Figure 7/14. This should be read in conjunction with Tables 7/7 and 7/8.

7.54 The following points should also be noted:-

- a) The circular arc R₁ is tangential to the offset, d, from the minor road centreline and the offside edge of the through traffic lane on the major road into which right turning traffic from the minor road will turn.

c) The offset, d , for left hand splay junctions is 4.5 metres.

d) For right hand splay junctions, the circular arc R_1 touches the curved minor road centreline and is tangential to the offside edge of the through traffic lane on the major road into which right turning traffic from the minor road will turn.

e) The island should be about 15 metres long. The tail is offset about 1m to the right of the curved minor road centreline (viewed from the minor road approach) and rounded off with a radius of 0.75m to 1.00m.

Crossroads

7.56 The use of rural crossroads is regarded as a Departure from Standard. However for upgrading of rural cross-roads the following details may be used.

7.57 The recommended layout for rural crossroads where long vehicles are predicted, and where the minor road centreline is inclined to the major road at an angle between 70° and 110° , is shown in Figure 7/14.

7.58 There are similarities in the design to that outlined previously, but the following points should be noted:-

a) The long axis of the island is inclined at 5° to the minor road centreline and the island is always 3m wide.

b) The circular arc R_1 has a radius of 11m and is tangential to the left hand side of the island (viewed from the minor road approach) and the centreline of the major road. (In some cases where the minor road is inclined to the major road at angles between 100° and 110° , R_1 will have to be reduced to 8m to create a suitable island.)

c) The circular arc R_2 has a radius of 11m and is tangential to the major road centreline and the minor road centreline.

7.59 Where the minor road centreline is inclined to the major road at angles less than 70° , R_1 will normally be 12m and R_2 8m.

7.60 Where the minor road centreline is inclined to the major road at angles greater than 110° , R_1 will normally be 8m and R_2 12m.

7.61 Where two splay minor roads meet at a crossroads, the minor road centrelines should be offset relative to one another by approximately the width of one island.

Swept Path Analysis

7.62 The swept path of large vehicles likely to use the junction shall be checked using a computer based swept path analysis programme.

Minor Road Inclination ($^\circ$)	Offset d (m)
70	1.5
80	2.0
90	2.5
100	2.0
110	1.5

Table 7/7: Channelising Island Offset

Width of Major Road Carriageway at Junction (m)	Radius R_1 (m)
9.5	12
10.0	12
11.0	14

Note: Radius R_2 is normally the same value as R_1 but should be designed to ensure that the island nose is positioned between 2 - 4 metres from the edge of the main carriageway and that the width of the island lies between 2 - 5 metres.

Table 7/8: Design of Radius R_1

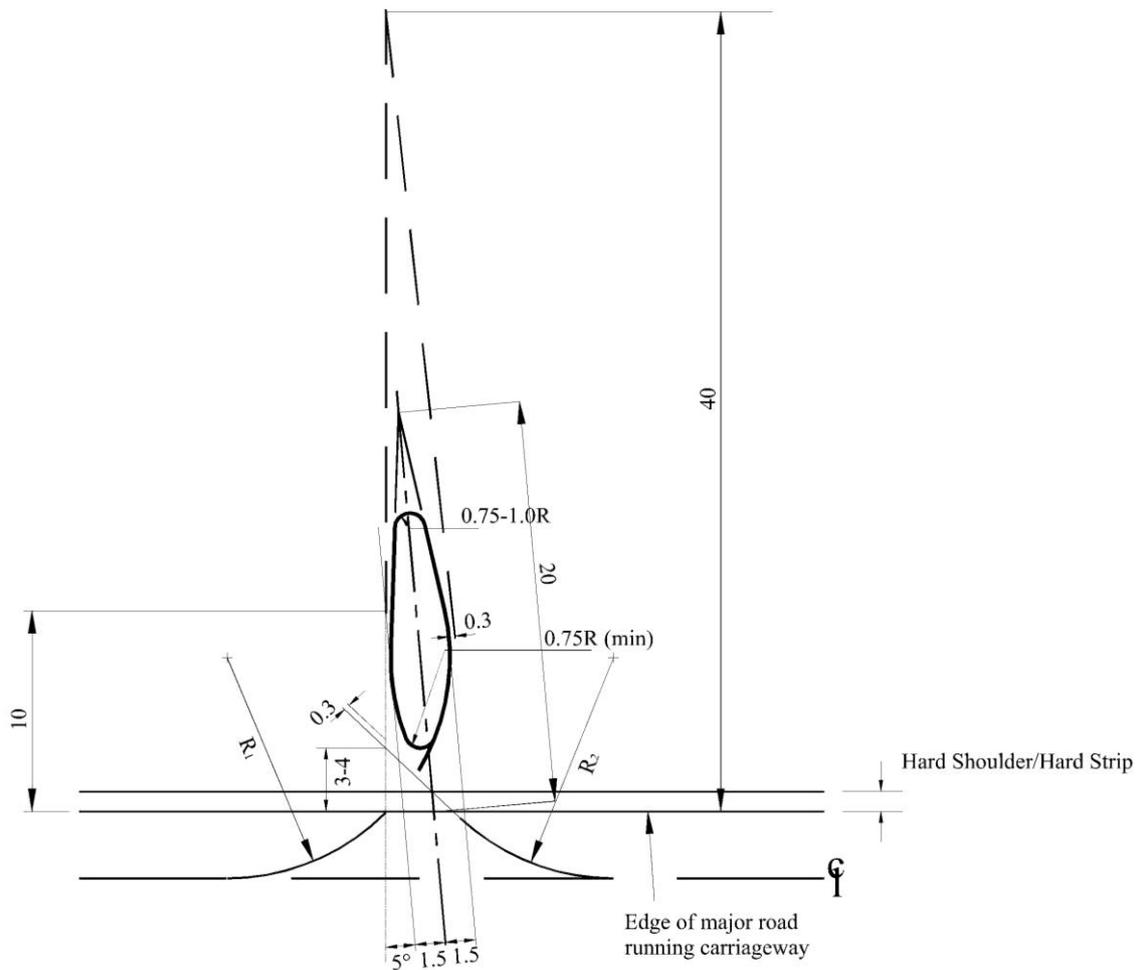


Figure 7/14: Design of Rural Crossroads Channelising Island (Dimensions in metres)

Diverging Tapers and Lanes at Junctions

7.63 Major road traffic, when slowing down on the approach to a junction in order to turn into a minor road, may impede the following vehicles that are not turning. It is helpful therefore to permit the divergence of the two streams at a small angle and approximately equal speed by the provision of a diverging taper.

7.64 Right turning tapers and lanes in the centre of ghost islands on single carriageways, are especially useful as they provide a convenient space for vehicles to slow down and wait before turning off the major road, and assist the right turn out of the minor road. Details of the design of such facilities are covered in Para 7.45.

7.65 Nearside diverging tapers allow left turning major road traffic to slow down and leave the major road without impeding the following through traffic, but they are of less benefit in terms of operation and safety than right turning lanes, possibly because the left turn from the major road does not cross an opposing traffic stream and is rarely impeded. However, nearside diverging tapers should always be considered for higher speed roads or on gradients.

7.66 Nearside diverging tapers shall not be provided at simple junctions (Figure 1/1). They shall be provided at other junctions including compact grade separation in the following circumstances for traffic in the design year:-

- a) Where the volume of left turning traffic is greater than 600 vehicles AADT, or
- b) Where the percentage of heavy commercial vehicles is greater than 20% and the volume of left turning traffic is greater than 450 vehicles AADT, or
- c) Where the junction is located on an up or down gradient of greater than 4% on the major road at any design speed and the volume of left turning traffic is greater than 450 vehicles AADT.

Where the major road flow is greater than 4000 AADT then the above figures for turning traffic shall be halved. At some junctions there may be safety benefits in providing nearside diverging tapers at lower flows.

7.67 They shall not be provided where the minor road is on the inside of a curve where traffic on

the diverging taper could adversely affect visibility for drivers emerging from the minor road. They shall generally not be provided where the design speed for the major road is less than 85kph nor where the cost of provision is excessive. In that case adequate warning of the junction ahead must be provided.

7.68 For a minor road junction with a nearside diverging taper, tapers shall be formed by a direct increase to a width of 3.5m at its tangent point with the corner into the minor road. The radius of this corner should be at least 20m where the main road design speed is 85kph and at least 40m above this speed. For direct accesses this radius preferably will be 20m. The width around this corner will depend on the radius selected (see Table 7/3). The length of this lane is defined as being from the beginning of the taper up to the tangent point between the diverge taper and the radius of the junction as shown in Figure 7/15.

7.69 The desirable length of a nearside diverging taper shall be that of the relevant deceleration length given in Table 7/6. Where there are severe site constraints and the design speed is 85km/h, the length may be reduced to a minimum of 35m as a Relaxation.

7.70 In certain circumstances it may be necessary to consider an auxiliary lane. In the case of an auxiliary lane on a single carriageway road this will be a Departure from Standard.

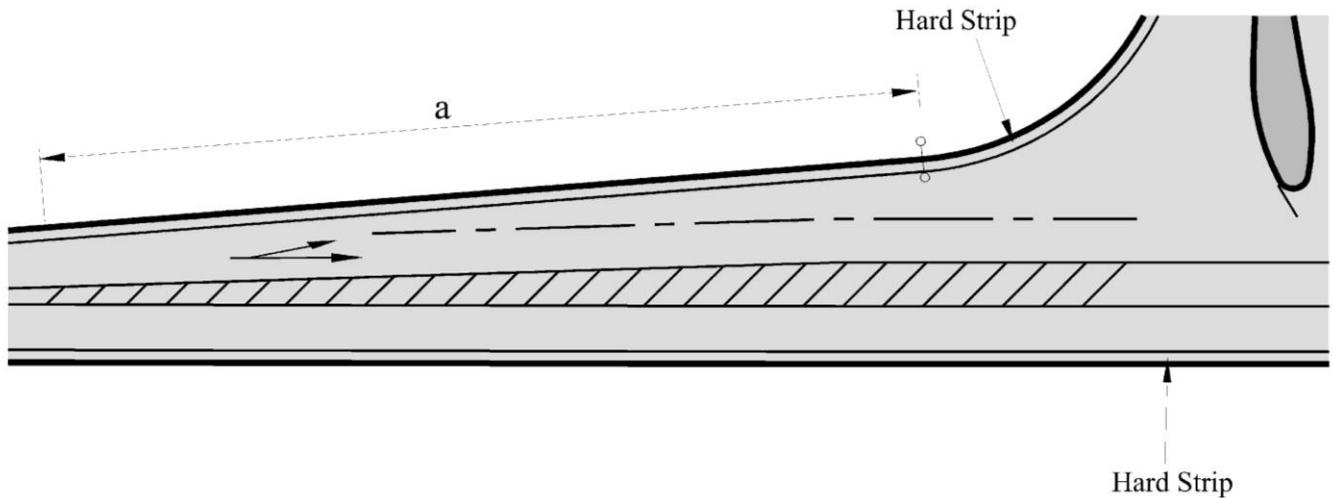
Merging Tapers.

7.71 Merging Tapers shall not be used at single lane carriageways.

Stagger Distances

7.72 The stagger distance of a junction is the distance along the major road between the centrelines of the two minor roads.

7.73 For simple major/minor priority junctions with a right/left stagger, the minimum stagger distance shall be 50m. For a ghost island junction it shall also be 50m. These are based on the distance required for manoeuvring the 18.35m drawbar trailer combination design vehicle between the two minor roads, and shall be provided on all new staggered junctions, including the upgrading of rural crossroads.



a Deceleration Length (Refer to table 7/ 6)

Figure 7/15: Major Minor Priority Junctions with Nearside Diverging Taper (Para 7.67)

7.74 For simple left/right staggers, the minimum stagger distance shall be 50m. The minimum values for the other types of staggered major/minor priority junction are given in Table 7/9. For higher design speeds, this distance is based on the sum of the two deceleration lengths lying side by side plus the turning lengths (and queuing lengths, if appropriate) at each end, as indicated in the Table 7/9, otherwise it is based on the manoeuvring requirements of the design vehicle. In difficult circumstances the Design Organisation may relax the stagger distance by one design speed step as a relaxation.

Skew Junctions

7.75 The design parameters where the minor road approaches at an angle other than 90°, for both left hand and right hand splay junctions, are shown in Figure 7/16. The parameters are set out in Paras 7.29 - 7.50. For those locations where the major road is on a curve at the junction, the relevant design parameters are indicated in Figure 7/17. Also see Paragraph 7.38.

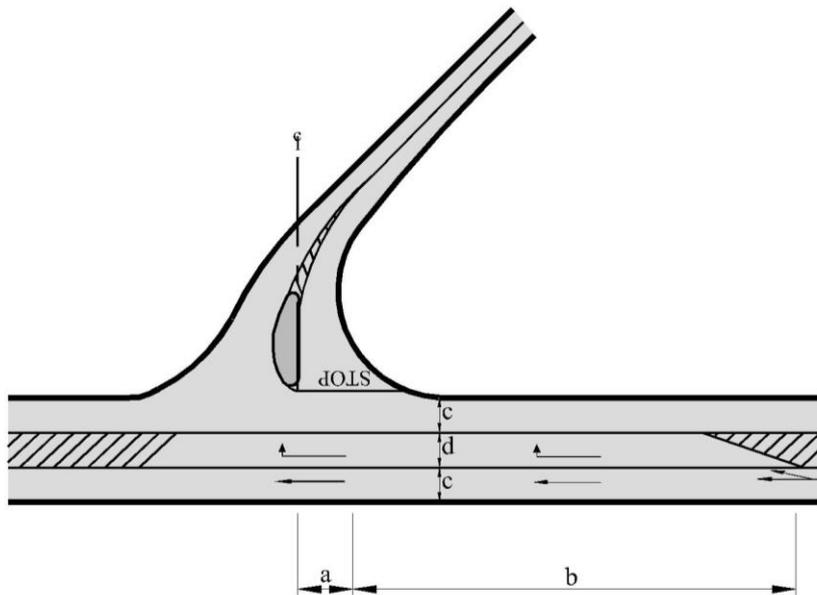
Junctions on Climbing Lanes

7.76 For major/minor priority T-junctions located on a climbing lane, the key dimensions are shown in Figure 7/18. However as stated in Para 3.13 the provision of a junction on a climbing lane is a Departure from Standard.

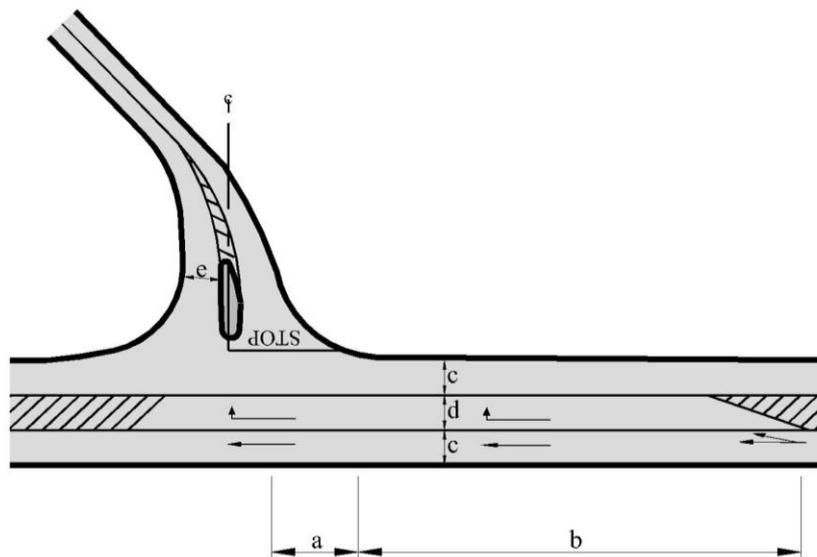
7.77 Simple major/minor priority junctions shall not be used within climbing lane sections, since problems of safety may arise.

Design Speed (kph)	Stagger Distance (m)
50	50 (manoeuvring)
60	50 (manoeuvring)
70	60 (10+40+10)
85	75 (10+55+10)
100	100 (10+80+10)

Table 7/9: Minimum Stagger Distances for Left/Right Staggered Ghost Island Junctions



- | | | | |
|---|---------------------|---|------------------------|
| a | Turning Length | c | Through Lane Width |
| b | Deceleration Length | d | Turning Lane Width |
| | | e | Minor Road Entry Width |



- | | | | |
|---|---------------------|---|------------------------|
| a | Turning Length | c | Through Lane Width |
| b | Deceleration Length | d | Turning Lane Width |
| | | e | Minor Road Entry Width |

Figure 7/16: Major/Minor Priority Junction with Skew Minor Road (Para 7.74)

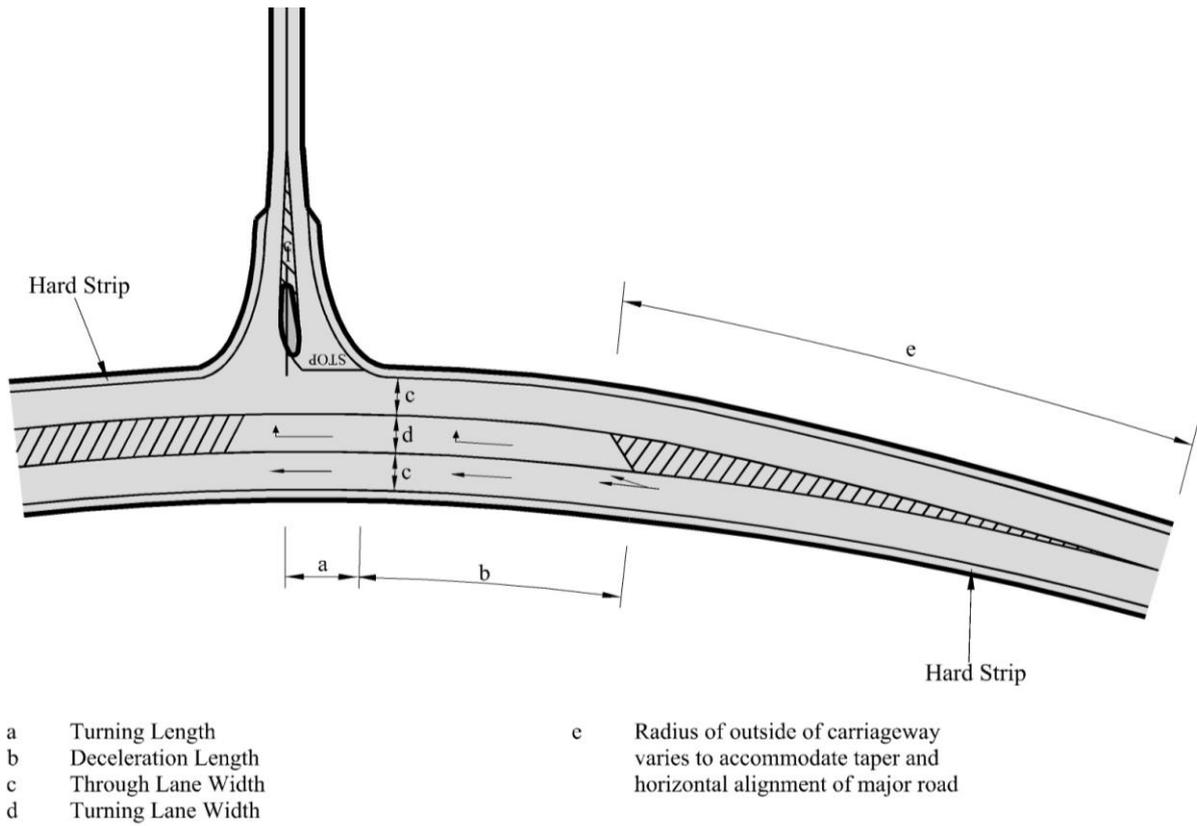


Figure 7/17: Major/Minor Priority Junction with Curve on Major Road (Paras 7.38, 7.74)

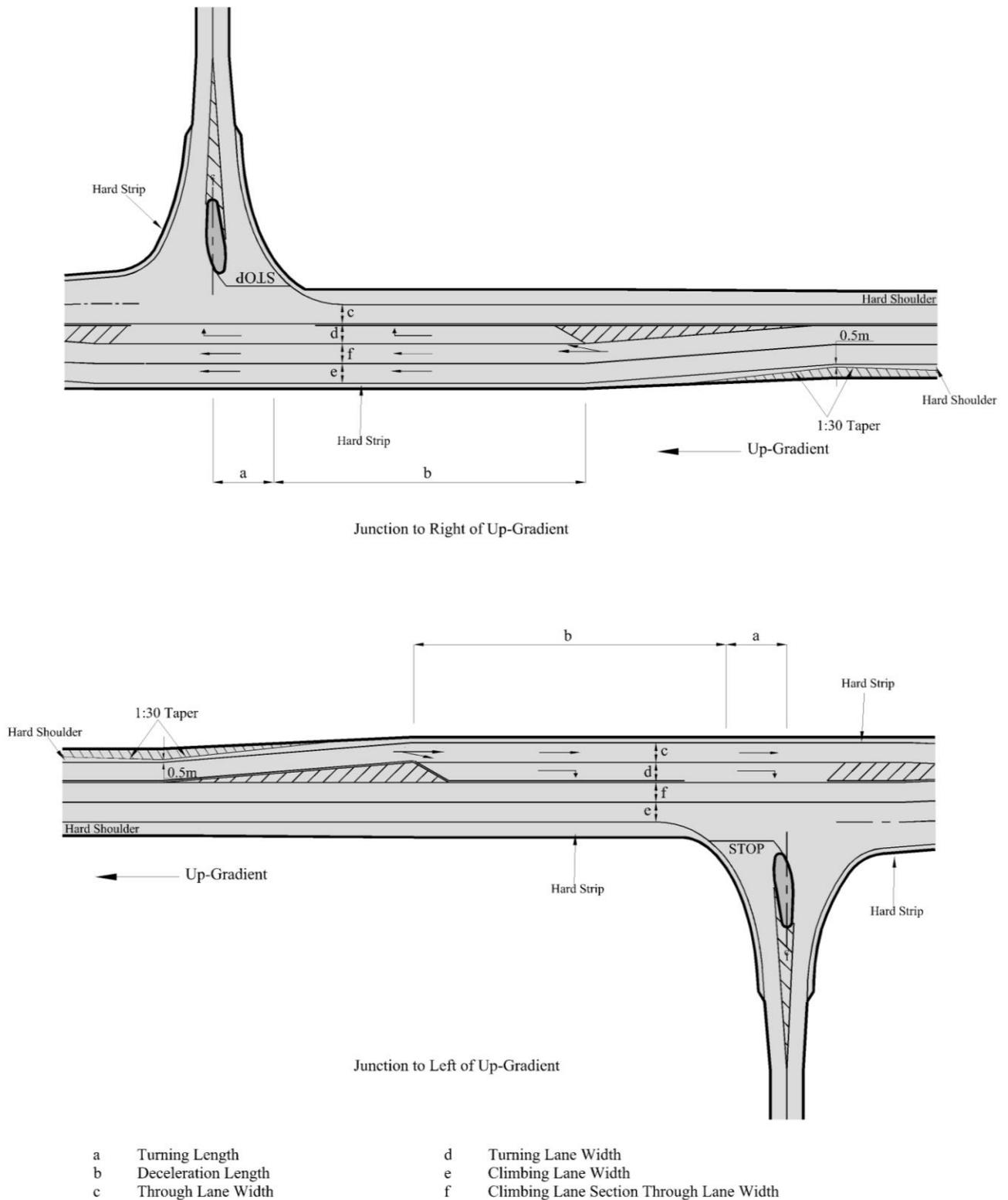


Figure 7/18: Major/Minor Priority Junction on Climbing Lane (Paras 7.38, 7.75)

Drainage and Crossfall

7.78 From considerations of surface water drainage and driver comfort, the road camber on the major road shall be retained through the junction and the minor road graded into the channel line of the major road. Checks shall be made for flat areas at all changes of gradient, superelevation or crossfall.

Roads with Hard Shoulders

7.79 Where hard shoulders are provided on roads with major/minor priority junctions, particular care should be taken to ensure safe designs for the junctions. The layouts should be in accordance with the geometric requirements described in the preceding paragraphs of this Chapter, together with the following additional requirements.

Approach to a Junction

7.80 On the major road approach to a junction on the left with a direct taper diverging lane, the hard shoulder width may be reduced as the taper develops subject to the requirement to maintain a minimum 0.5m wide hard strip, as shown in Figure 7/21.

Opposite a Junction

7.81 On the side of the major road opposite a simple T junction, the hard shoulder shall be maintained through the junction.

7.82 On the side of the major road opposite a ghost island junction the hard shoulder shall be tapered to form a 0.5m hard strip as illustrated in Figure 7/21. On the approach side the taper shall be at an angle of 1:30 and shall be introduced by means of hatched road markings. This taper shall terminate at the start of the central island road markings. On the departure side, the hard shoulder may be reintroduced over the length of the central island taper. The running lane should be a constant width through the junction. Where the required paved width is less than the full paved

width away from the junction, the full paved width should be continued through the junction, with any excess area hatched.

Hard Shoulders on the Minor Road

7.83 Where the minor road approach to a junction has a hard shoulder, the hard shoulder should be terminated by tapering to a width of 0.5m to form a hard strip. The taper angle should be 1:30 and the taper should terminate not less than 15m before the start of the entry widening.

7.84 Where the minor road departure from a junction has a hard shoulder, the hard shoulder should not start before the end of the exit widening.

Stop or Yield Line

7.85 In accordance with the Traffic Signs Manual, the edge of the stopline nearest to the major road shall not be closer than 600mm to the line of the back of the paved area of the major road (see Figures 7/19 and 7/20). Where the major road is not a national road, a 'Yield' line may be provided as an alternative in appropriate circumstances, provided there is full visibility from an 'x' distance of 9m (see Paragraph 7.7) and there are no Relaxations associated with the junction layout.

7.86 Some existing major/minor priority junctions have the 'Stop' or 'Yield' line set at the back of the major road running carriageway. Where such junctions occur near proposed new or improved priority junctions with the 'Stop' or 'Yield' line set back, the layouts should be reviewed to ensure that drivers are not confused by encountering different junction arrangements in succession. Where appropriate, the markings of the existing junctions should be revised in accordance with this Standard.

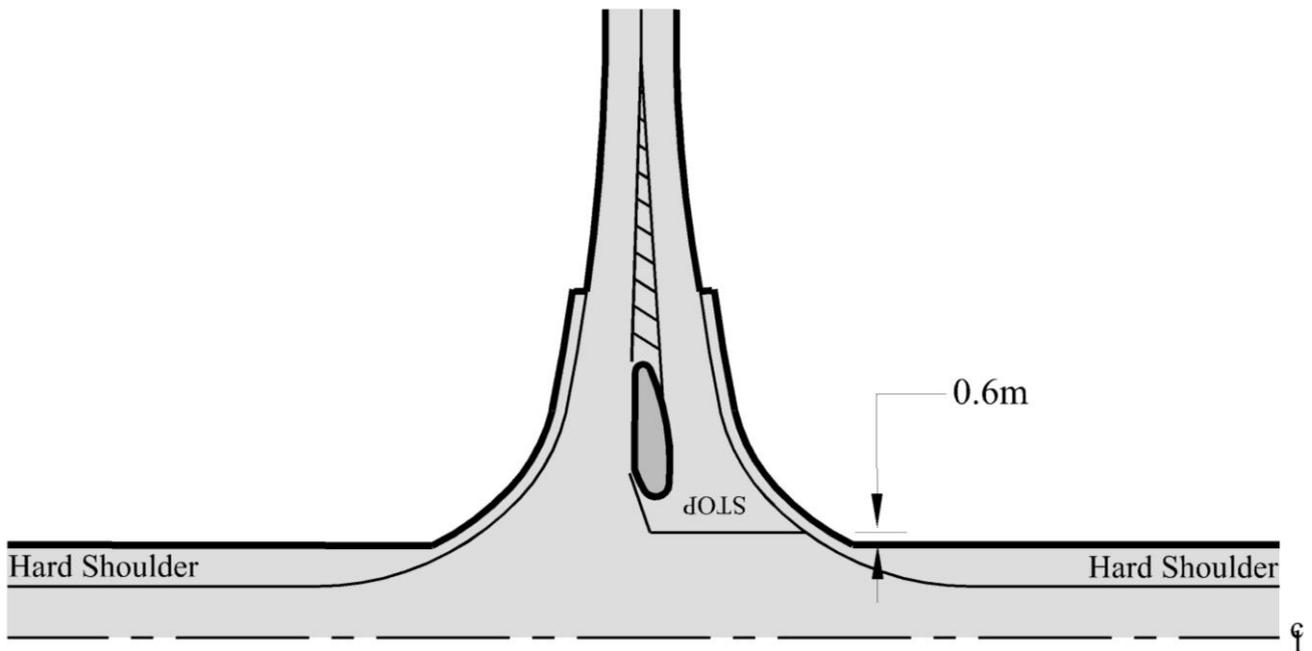


Figure 7/19: Major/Minor Priority Junction Stop Line with Hard Shoulder or Hard Strips (Para 7.84)

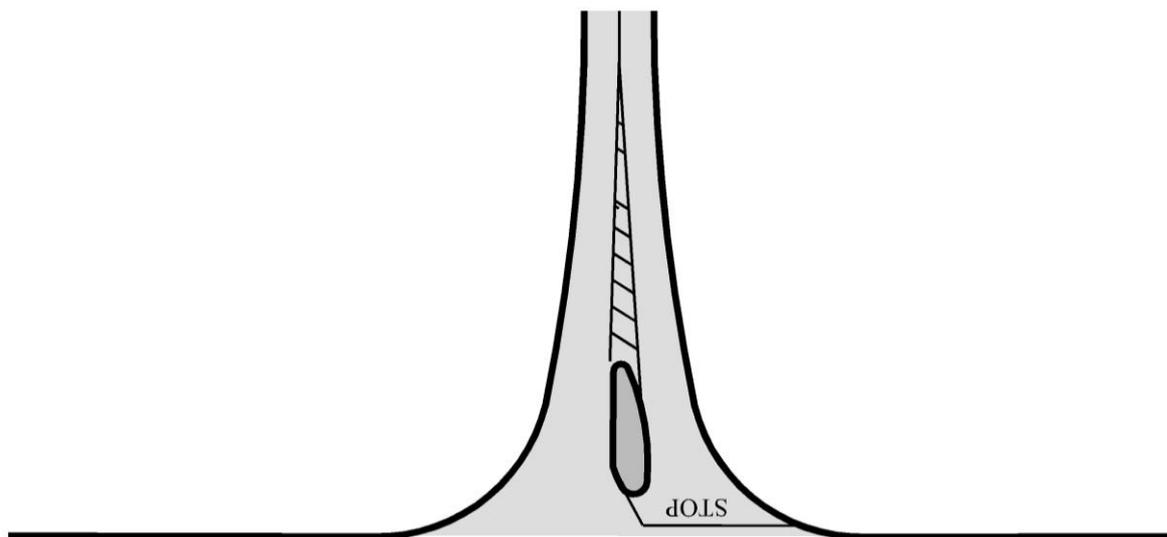
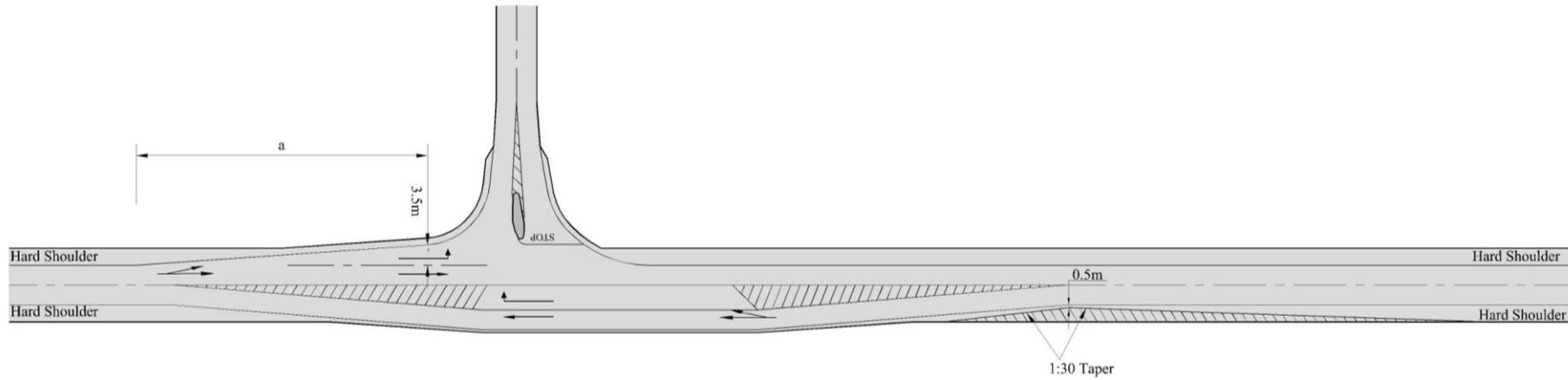
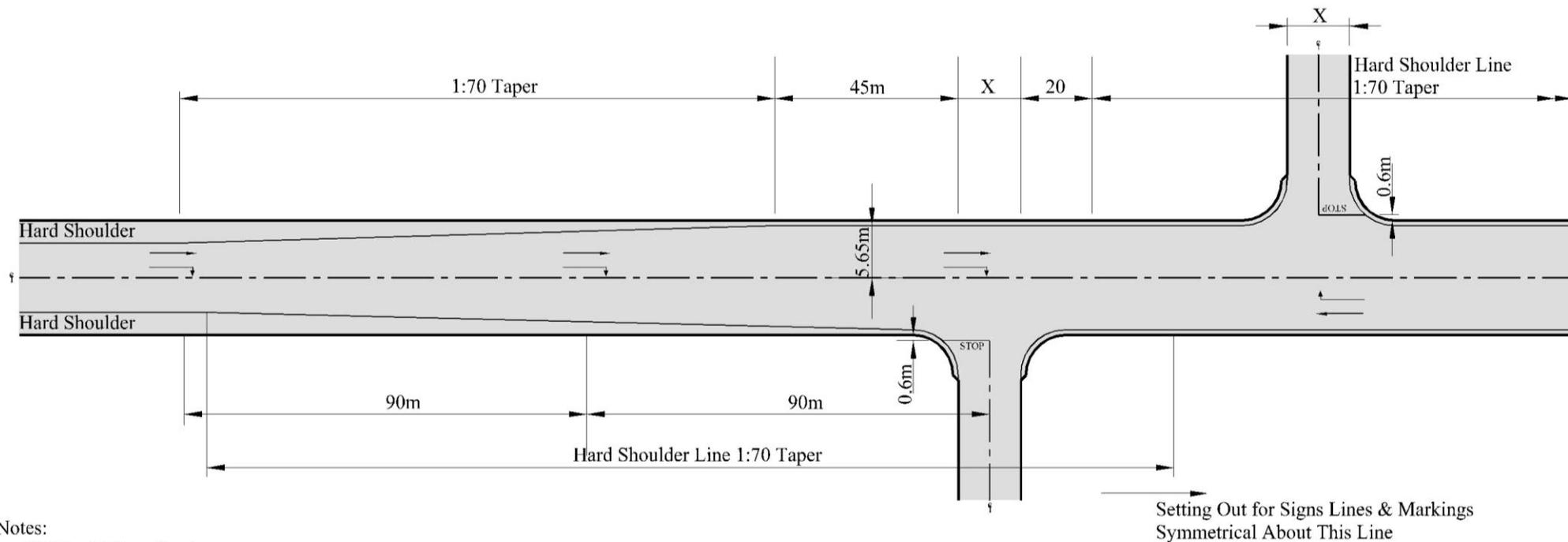


Figure 7/20: Major/Minor Priority Junction Stop Line with no Hard Shoulder or Hard Strips (Para 7.84)



a = Deceleration Length (Refer to Table 7/6)

Figure 7/21: Treatment of Hard Shoulders at a Ghost Island Junction



**Figure 7/22: Treatment of Hard Shoulders at Staggered Junctions without Ghost Island
 (Nearside passing option)**

8. Geometric Design Features for Dual Carriageways

General

8.1 This chapter outlines the geometric design features to be considered in the design of major/minor priority junctions and accesses associated with dual carriageways. Many of the features are dealt with separately, and a designer should work systematically through the design procedure prior to assembling the component parts. This is an iterative process, as illustrated in Figure 2/1.

8.2 In principal the differences between single and dual carriageway roads are as follows:

- Merge tapers are only permitted for use on dual carriageway roads;
- Nearside diverge auxiliary deceleration lanes are generally for use on dual carriageway roads. However if the circumstances demonstrate that such a facility is necessary for a single carriageway road, this shall be classed as a Departure from Standard;
- No gaps and hence no traffic right turn manoeuvres are permitted in the central reserve on all types of dual carriageway roads, except for Type 3 Dual Carriageways;
- For further details on the junction treatment of minor and major roads refer to Table 4 of **NRA TD 9**.

Design Speed

8.3 Geometric standards for junctions are related to the traffic speed of the major road, and for new roads this is the design speed as defined in **NRA TD 9**. Reference should be made to **NRA TD 9** in order to determine the appropriate design speed.

Visibility

8.4 Traffic from either a minor road or direct access has to join or cross the major road when there are gaps in the major road traffic streams. It is therefore essential on a Type 3 Dual Carriageway that drivers emerging from a minor road or direct access shall have adequate visibility in each direction to see the oncoming major road traffic in sufficient time to permit them to make their manoeuvres safely. This concept also applies

to major road traffic turning right into the minor road or direct access on a Type 3 Dual Carriageway. For Type 1 and Type 2 Dual Carriageways, visibility to the right is only required for egress out of left in/left out junctions and accesses. As well as having adverse safety implications, poor visibility reduces the capacity of turning movements.

8.5 For safety, drivers both on the major road and on the minor road or direct access shall be able to see any potential hazard in time to slow down or stop comfortably before reaching it. It is necessary therefore to consider the driver's line of vision in both the vertical and horizontal planes and the stopping sight distance for the vehicle at the relevant design speed. It is also essential that other road users can equally see oncoming vehicles; particularly where vehicles cross the footway in front of pedestrians at the same level and the crossing may not be so obvious.

8.6 Drivers approaching a major/minor priority junction from both the major road and the minor road shall have unobstructed visibility as indicated in the following sections. The envelope of visibility for driver's eye height is as set out in **NRA TD 9**.

Major Road

8.7 Drivers approaching a major/minor priority junction or direct access along the major road approaches shall be able to see the minor road or direct access entry from a distance corresponding to the desirable minimum SSD for the design speed of the major road, as described in **NRA TD 9**. It should be noted that **NRA TD 9** does not allow relaxations in SSD on the immediate approach to junctions with the exception of an individual field access. This visibility allows drivers on the major road to be aware of traffic entering from the minor road or direct access in time for them to be able to slow down and stop safely if necessary.

Minor Road/Direct Access

8.8 The principle of providing the required visibility for drivers approaching the junction from the minor road or direct access has three distinct features:

a. Approaching drivers shall have unobstructed visibility of the junction from a distance corresponding to the desirable minimum SSD for the design speed of the minor road, as described in **NRA TD 9**. This allows drivers time to slow down safely at the junction, or stop, if this is necessary. Where a "Yield or Stop" sign is proposed the visibility envelope shall be widened to include the sign.

b. From a point measured 15m back along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the surfaced carriageway (including hard strip or hard shoulder if this is present) of the major road, an approaching driver shall be able to see clearly the junction form, and those peripheral elements of the junction layout. This provides the driver with an idea of the junction form, possible movements and conflicts, and possible required action before reaching the major road.

c. The distance back along the minor road or direct access from which the full visibility is measured is known as the 'x' distance. It is measured back along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the surfaced carriageway (including hard strip or hard shoulder) of the major road. The desirable minimum 'x' distance shall be 3.0m for all junctions and direct accesses except those with a "Yield" sign. Junctions and direct accesses with a "Yield" sign will require an 'x' distance of 9m. In difficult circumstances, the 'x' distance may be taken as a relaxation from 3.0m to 2.4m for lightly trafficked simple junctions in a stop controlled situation. Any reduction of the 'x' distance below 2.4m shall be considered to be a Departure from Standard. From the point "x" metres back from the major road a driver approaching the junction along the minor road shall be able to see clearly a point to the right on the nearer edge of the major road running carriageway at a distance given in Table 8/1, measured from its intersection with the centreline of the minor road. This is called the 'y' distance and is defined in Figure 8/1.

d. On national roads the full 'y' distance must be achieved, however in difficult circumstances the low object height may be taken as 0.6m instead of 0.26m as a Relaxation.

8.9 If the line of vision lies partially within the major road carriageway, it shall be made tangential to the nearer edge of the major road running carriageway, as shown in Figure 8/2.

8.10 These visibility standards apply to new junctions and direct accesses and to improvements to existing junctions and direct accesses.

8.11 The 'x' distance, from which full 'y' distance visibility is provided, should not be more than 9m, as this induces high minor road approach speeds into the junction, and leads to excessive land take.

8.12 Similarly, although the 'y' distance shall always be provided, there is little advantage in increasing it, as this too can induce high approach speeds and take the attention of the minor road or direct access driver away from the immediate junction conditions. Increased visibility should not be provided to increase the capacities of various turning movements.

8.13 For details of visibility requirements for Type 3 Dual Carriageway central reserve gaps see **NRA TD 10**.

8.14 For all dual carriageways, a single visibility splay in the direction of approaching traffic will suffice. If the minor road serves as a one way exit from the dual carriageway, no visibility splays will be required, provided that forward visibility for turning vehicles is adequate.

8.15 Dangerous conditions arise if vehicles obstruct visibility by parking within visibility splays. Where necessary, parking and access shall be controlled to prevent this. The Design Organisation shall ensure that the positioning of lay-bys, bus stops, traffic signs, environmental barriers and other street furniture does not interfere with the drivers' visibility requirements and that the obstructive effect for all road users is minimised.

8.16 It is important to ensure that developments serviced by a new direct access do not lead to parking on the major road in the vicinity of the access, to the detriment of the safe passage of vehicles on both the access and the national road. On certain types of development where this is likely to be an issue the design should be such as to prevent such parking.

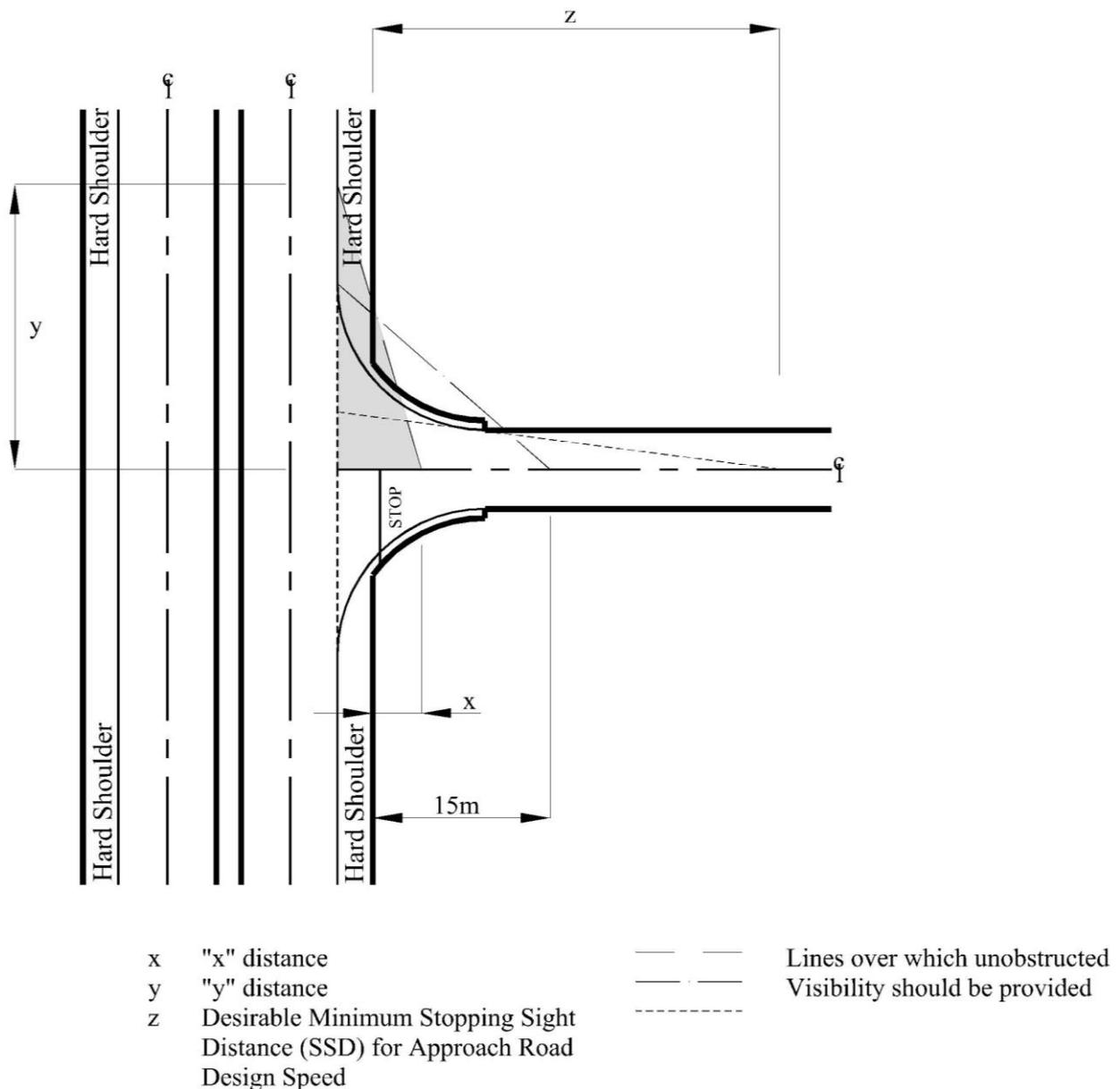


Figure 8/1: Visibility Standards (Para 8.8)

Design Speed of Major Road (kph)	'y' Distance (m)
70	120
85	160
100	215
120	295

Table 8/1: 'y' Visibility Distances from the Minor Road (Para 8.8c)

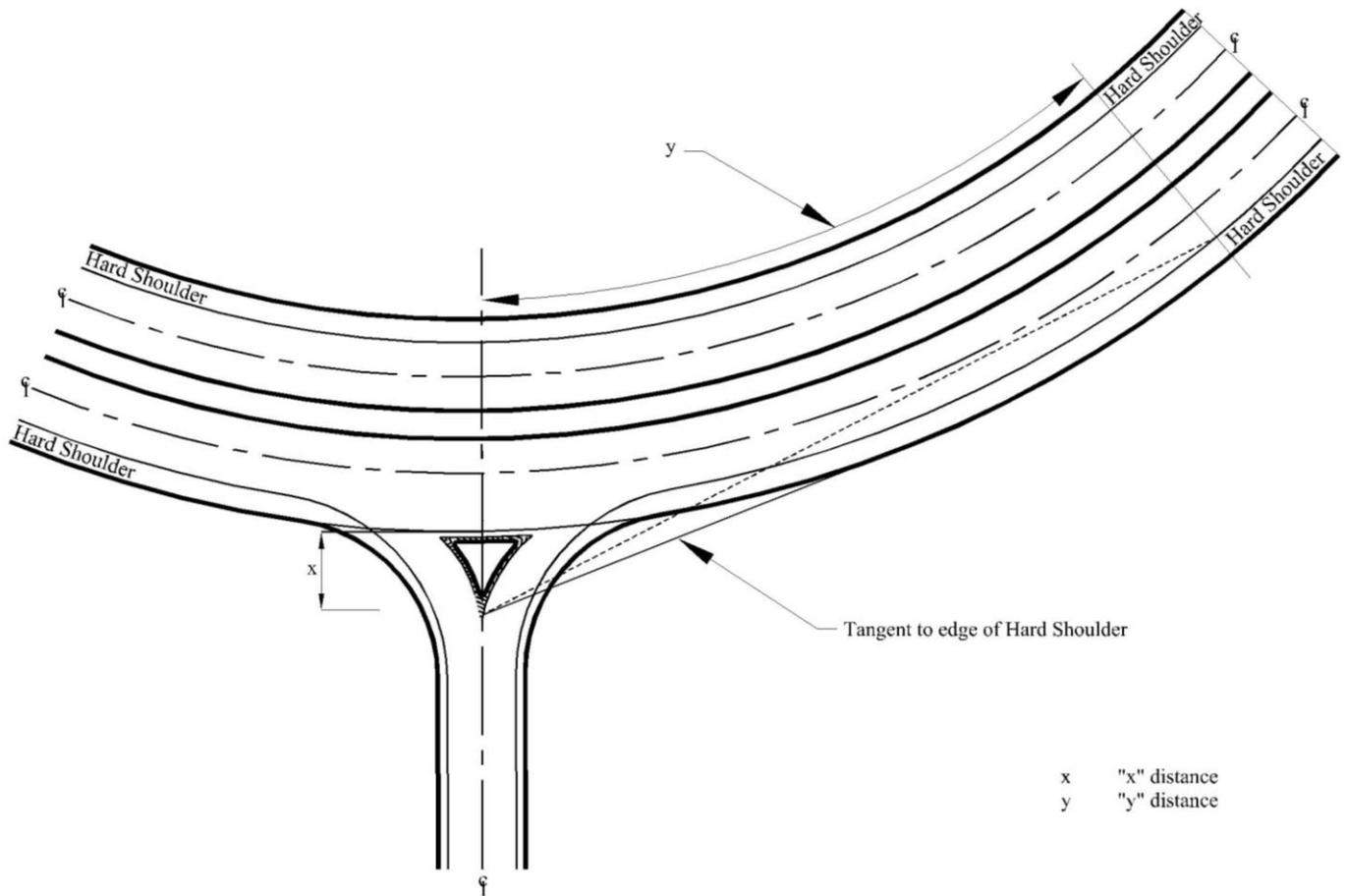


Figure 8/2: Visibility Standards with a Curved Major Road (Para 8.9)

8.17 Where an emerging vehicle crosses a footway at a lightly used direct access - for example from the driveway of a single dwelling - pedestrians may not have sufficient warning of its approach. This relates to the situation where the vehicle crosses at the footway level and there is no clearly formed differentiation in the level between the footway and the crossing. Under these conditions, visibility splays to the back of the footway, 2m on either side of the centre of the access, shall be provided from 2m back from the back edge of the footway along the centreline of the access. The driver's eye height shall be taken as 1.05m and the object height at the back of footway shall be taken as 0.6m to make clear the presence of a small child. This is shown in Figure 8/3.

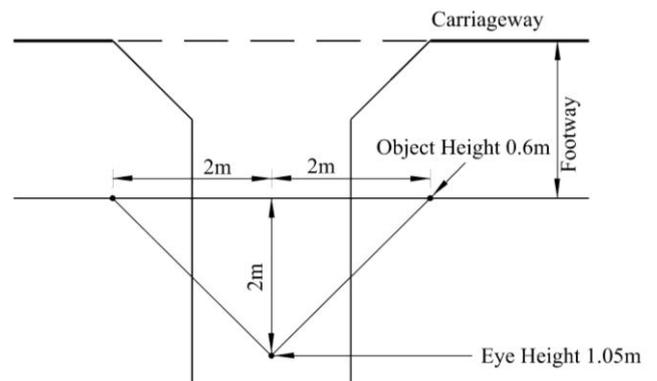


Figure 8/3: Visibility at Back of Footway Crossing

Approach Gradients

8.18 The gradient on minor roads shall be in accordance with **NRA TD 9**. On direct accesses, gradients greater than 10% approaching the major road shall not be permitted other than in exceptional circumstances. The gradient on the minor road immediately next to the major road should be considerably less, and a "dwell" area of at least 15m shall be provided immediately

adjacent to the major road carriageway. Where site conditions are particularly difficult this area may be 10m as a Relaxation. In the case of direct access to a single dwelling, it may be reduced to 5m as a Relaxation.

8.19 The gradient for the dwell area shall lie between plus and minus 2.5%. In difficult situations this may be increased to between plus and minus 4%. The intention here is to avoid the risk of vehicles stalling on a mild hill start when attempting to accept a gap in the major road traffic or inadvertently rolling out into the major road carriageway. The visibility requirement set out in the above paragraphs shall be met in full at locations with steep gradients.

Geometric Layouts of Small Direct Accesses

8.20 Table 8/2 gives a number of basic direct access layout types which should form the basis of local designs.

8.21 Layouts for small individual direct accesses are detailed in Table 8/2 these are for the following circumstances:

- Layout 1: Field access
- Layout 3: Left in/Left Out for all other accesses including single dwellings.

8.22 These layouts have approximate levels of use as indicated in Table 8/2, all other direct accesses shall be designed to the same standard as a road junction as detailed elsewhere within this Chapter.

	Field Access	Left in/Left Out
Direct Access Layout	1	3
Traffic using the access AADT	Less than 10 movements a week	Less than 150 movements a week
Layout suitable for carriageway configuration	Dual	Dual

Note: These figures are recommendations and indicate the approximate level at which alternatives for connections should be considered. Design Organisations should look carefully at the safety implications involved in providing the alternative connection.

Table 8/2: Recommended Standard Access layouts

8.23 Other than the layout details as shown in Figures 8/4 and 8/5 all other geometric design details will be as detailed within the rest of this Chapter.

Entrance Gates Across Direct Access

8.24 Entrance gates across a direct access shall be set back to accommodate one vehicle in the access, clear of the main running lane and preferably clear of the footway. The vehicle to be accommodated should be of the largest type to use the access on a regular basis, (which in the case of farm vehicles may include a trailer). Wherever possible, gates should open away from the highway and where this is not possible, the set back should be increased to allow for this. As a Relaxation, where entrance gates are permanently open while the development is in use and during the working day, the requirement for the set back may be omitted.

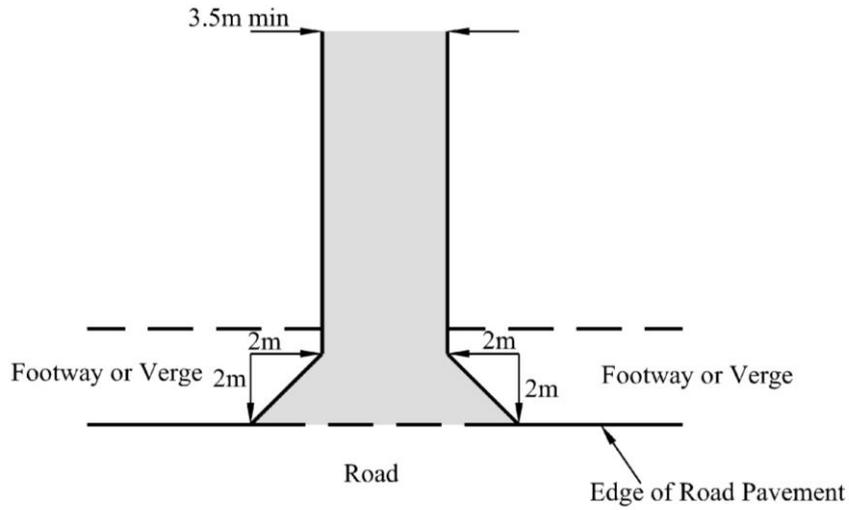


Figure 8/4: Direct Access Layout 1 – Field Access

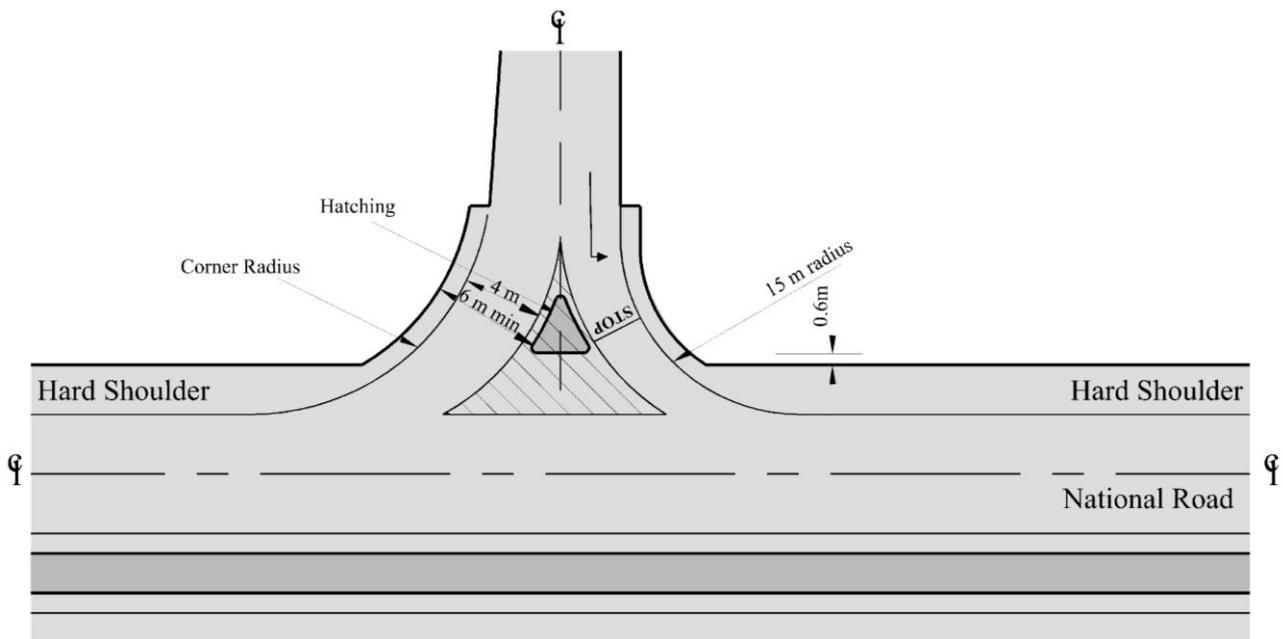


Figure 8/5: Direct Access Layout 3 – Left In/Left Out

Factors Common to all Junction Types

Design Vehicle

8.25 Allowance shall be made for the swept turning paths of long vehicles where they can reasonably be expected to use a junction. Consideration shall also be given to the manoeuvring characteristics of these vehicles in the design of staggered junctions for Type 3 Dual Carriageways and shall be designed in accordance with **NRA TD10**.

8.26 All of the geometric parameters used in the design of a major/minor priority junction have been developed to cater for a 16.5m long articulated vehicle, whose turning width is greater than for most other vehicles within the normal dimensions permitted in the existing Road Traffic (Construction, Equipment and Use of Vehicles) Regulations, or likely to be permitted in the near future. The turning requirements of an 18.35m long drawbar trailer combination are less onerous regarding road width. In cases where hard strips are present, the design vehicle is assumed to use these on some turns.

8.27 The use of computer software to predict the swept path of large vehicles is recommended. The vehicle type used shall be appropriate to the predicted use of the junction or direct access.

Corner Radii for Type 3 Dual Carriageway Priority Junctions

8.28 Where no provision is made for large commercial vehicles, it is recommended that the minimum circular corner radius at Type 3 Dual Carriageway priority junctions should be 6m in urban areas and 10m in rural areas. Where provision is to be made for large commercial vehicles, the recommended circular corner radii are 15m with tapers of 1:6 over a distance of 30m (see Figure 8/6).

These radii only apply where there are no nearside diverge tapers or lanes, or nearside merge tapers as detailed in paragraph 8.47 to 8.65.

For details of the splitter island for these junctions see paragraphs 7.51 to 7.54 and **NRA TD10**.

Where large commercial vehicles comprise a significant proportion of the turning movements, use of the compound curve shown in Figure 8/7 is recommended.

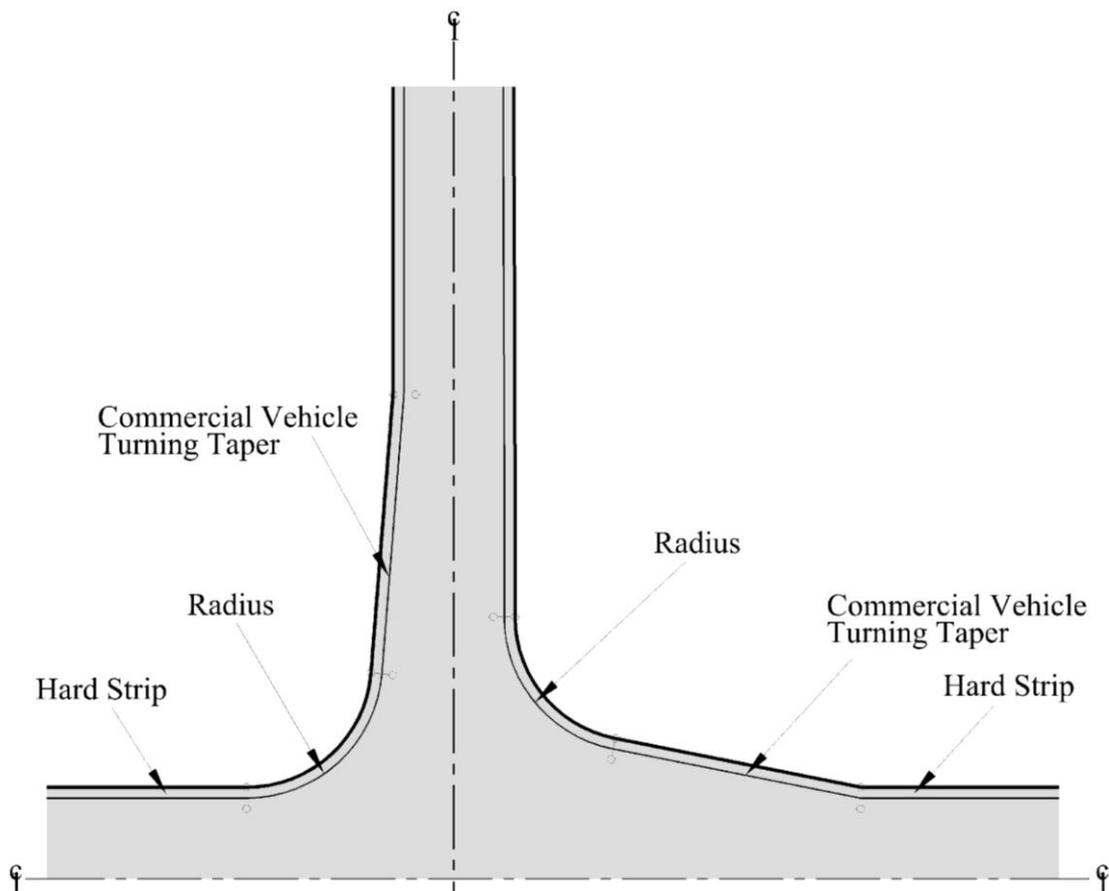


Figure 8/6: Design of Corner Radii for Rural Type 3 Dual Carriageway Priority Junctions (Para 8.28)

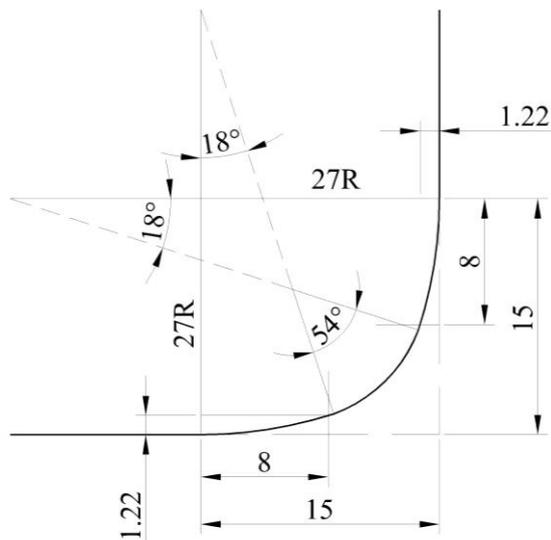


Figure 8/7: Design of a Compound Curve (Para 8.28)

Carriageway Widths

8.29 A minimum 0.5 metre hard strip shall be provided throughout all junction layouts, corner radii and associated tapers.

Through Lanes

8.30 At ghost island junctions, which are permitted at Critical and Non-Critical Changeovers on Type 3 Dual Carriageways, refer to **NRA TD10**.

8.31 At dual carriageway junctions the through lane widths remote from the junction shall be continued through the junction.

Minor Road Approaches

8.32 On a minor road approach where left turn only traffic deflection islands are provided these should be set back 1metre from the stop line at the junction with the mainline as shown in Figure 8/8.

8.33 On a minor road approach of nominal width 7.5m or less, where a channelising island is provided on a Type 3 Dual Carriageway, both lanes shall be 4.0m wide at the point where the hatched markings surrounding the channelising island begin. At the point where the channelising island commences, the widths on either side shall be as follows:-

a. On the approach to the major road, 4.0m wide for a ghost island on a Type 3 Dual Carriageway exclusive of hard strips. If the

approach on the minor road consists of two lanes, this dimension shall be 5.5m.

b. On the exit from the major road, 4.5m wide for a ghost island on a Type 3 Dual Carriageway, exclusive of hard strips.

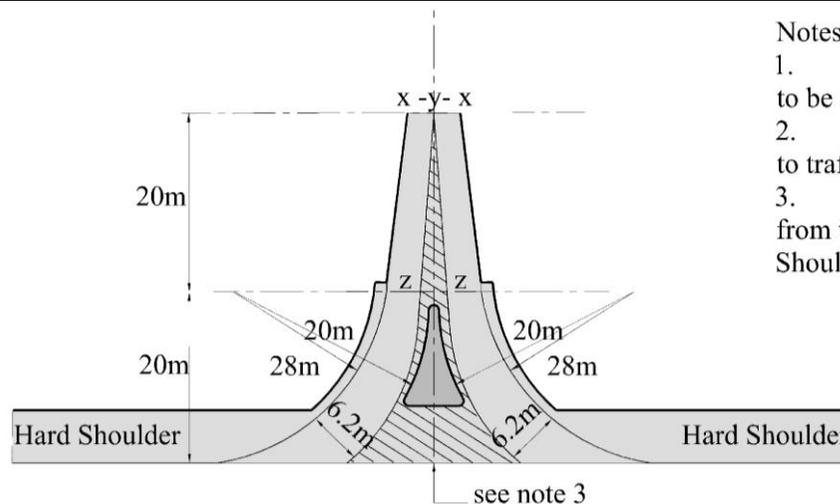
These dimensions are shown in Chapter 7, Geometric Design Features for Single Carriageway Roads, Figure 7/10.

Details for Compact Grade Separation

Minor Road Width (m)	x (m)	y (m)	z (m)
< 3.0	3.0	0.6	4.7
3.0 to 3.65	3.3	0.6	4.7
3.65	3.65	0.6	4.7

Details for Minor Roads

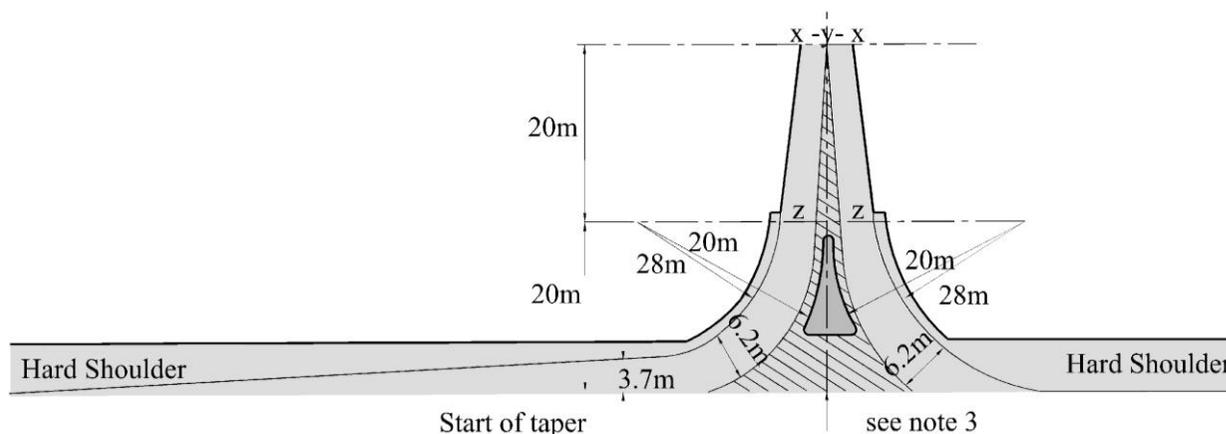
Minor Road Width (m)	x (m)	y (m)	z (m)
< 3.0	3.3	0	4.7
3.0 to 3.65	3.65	0	4.7
3.65	3.65	0	4.7



Notes:

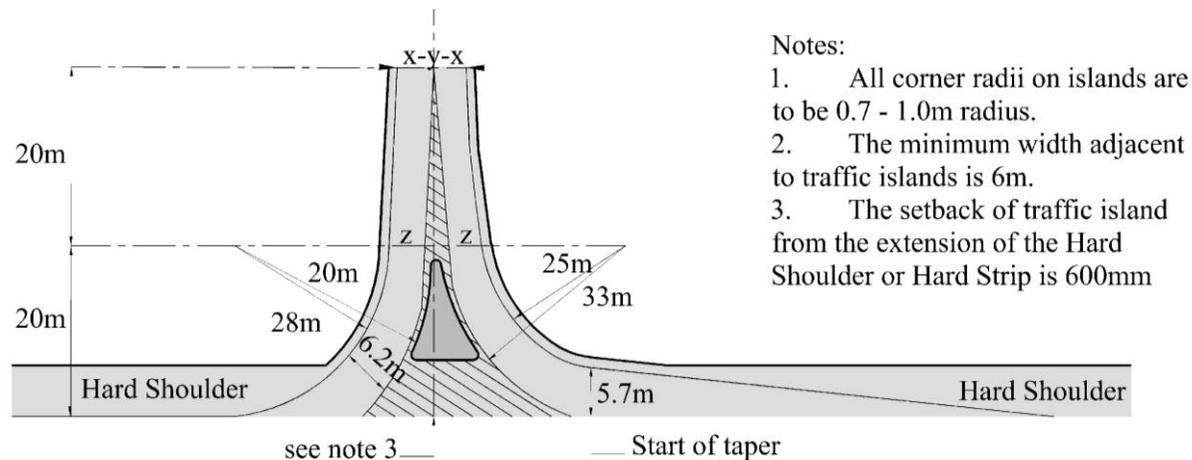
1. All corner radii on islands are to be 0.7 - 1.0m radius.
2. The minimum width adjacent to traffic islands is 6m.
3. The setback of traffic island from the extension of the Hard Shoulder or Hard Strip is 600mm

a) Simple Mainline Junction

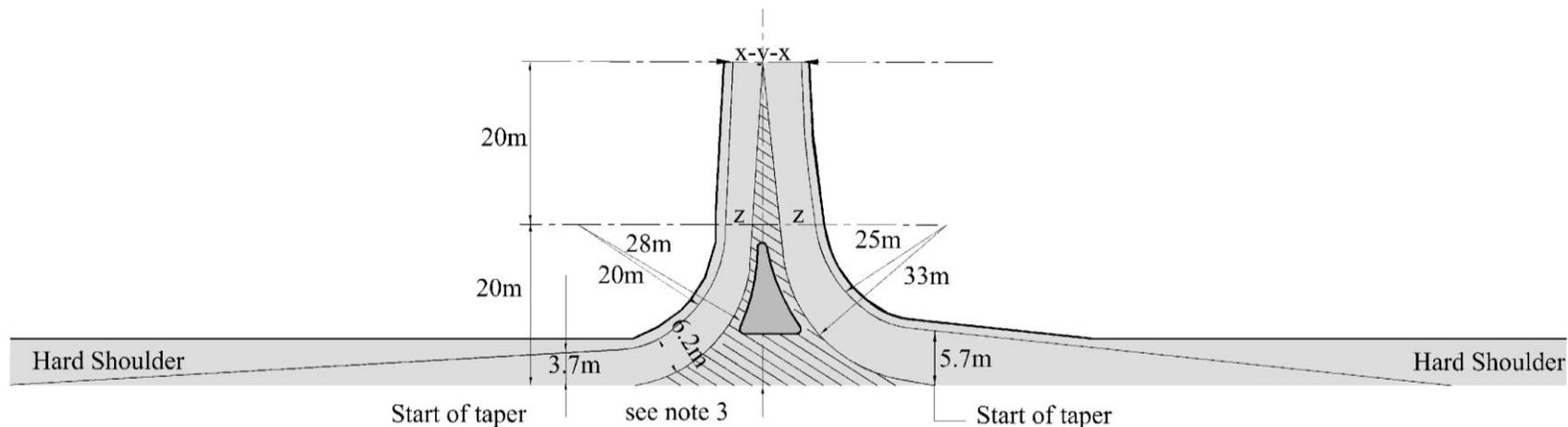


b) Mainline Junction with Nearside Diverge Taper

Figure 8/8: Major/Minor Road Junction for Left Turn Only Manoeuvres (Para 8.32)



c) Mainline Junction with Nearside Merging Taper



d) Mainline Junction with Nearside Diverge Taper and Merging Taper

Figure 8/8(Cont): Major/Minor Road Junction for Left Turn Only Manoeuvres (Para 8.32)

8.34 At skew junctions the centreline of the minor road shall have a minimum radius of 50m that meets the major road nearside channel at right angles. Prior to the 50m radius, the minor road centreline shall be designed in full accordance with **NRA TD 9** and shall be at an angle of between 50 and 130 degrees to the major road channel.

Carriageway Widths around Curves

8.35 Where carriageways are taken around tight radius corners, added width shall be provided to cater for the swept area of larger commercial vehicles and the "cut in" of trailer units. Table 8/3 shows the recommended minimum widths for various nearside corner radii based on the design vehicle. For radii above 100m, the standards set out in **NRA TD 9** shall be used. The carriageway widths in Table 8/3 are not normally required where channelising islands, as described below in Paragraphs 8.38 and 8.39 are provided.

8.36 Where 16.5m long vehicles are anticipated, but are likely to form only a very small percentage of the total number of vehicles and where conflicts will not occur on bends, the carriageway widths should be designed to cater for those vehicles with a less onerous turning requirement that will use the junction. The width should be adequate to accommodate the swept paths of the vehicles being considered with an additional 1m allowance for variation in their position. Alternatively, figures from Table 8/3 could still be used.

8.37 An articulated car transporter will turn in the widths shown, but where provision is to be made for this type of vehicle, street furniture above 2.5m high should be set back at least 1m from the edge of the minor road carriageway at the bellmouth (this does not apply for channelising islands) to allow for the projection of the trailer over the tractor cab.

Central Islands

8.38 Cutting, merging and diverging movements can usefully be separated by physical or painted guide islands set out with road markings so that the number of traffic conflicts at any point is reduced (as indicated in Figure 8/8). Painted guide islands can be enhanced by the use of coloured surfacing or textures within them. However, designs which have numerous small traffic islands should be avoided as they are confusing and tend to be ignored.

8.39 Preventing or minimising conflicts by separation means that drivers are only faced with simple decisions on their choices of movement at any one time. This can lead to greater safety. For the separation to be effective, the junction must be large enough for drivers to identify in adequate time those vehicles which will conflict with their intended path and those that will not. If this is not so, gaps in the flow cannot be used effectively by traffic entering the junction.

Tapers

8.40 Central islands, for ghost islands on Type 3 Dual Carriageways (see **NRA TD10**).

Direct Taper Length

8.41 The direct taper length is the length over which the width of a nearside auxiliary lane is developed. This taper length is given in Table 8/4.

Inside Radius (m)	Corner or Curve Radius (m)	Single Lane Width (excluding hard strip provision) (m)	Single Lane Width with space to pass Stationary Vehicle (including hard strip provision) (m)	Two Lane Width for One Way or Two Way Traffic (excluding hard strip provision) (m)		
				Inside Lane	Outside Lane	Total
10		8.4	10.9	8.4	6.5	14.9
15		7.1	9.6	7.1	6.0	13.1
20		6.2	8.7	6.2	5.6	11.8
25		5.7	8.2	5.7	5.2	10.9
30		5.3	7.8	5.3	5.0	10.3
40		4.7	7.2	4.7	4.6	9.3
50		4.4	6.9	4.4	4.3	8.7
75		4.0	6.5	4.0	4.0	8.0
100		3.8	6.3	3.8	3.8	7.6

Table 8/3: Minimum Corner and Curve Radii and Carriageway Widths (Para 8.35)

Design Speed (kph)	Direct Taper Length (m)
50	5
60	5
70	15
85	15
100	25
120	30

Table 8/4: Direct Taper Length (Para 8.41)

Design Speed (kph)	Deceleration Length (m)
70	55
85	80
100	110
120	150

Note: In difficult circumstances, the Design Organisation may relax the deceleration length by one design speed step as a relaxation.

Table 8/5: Deceleration Length (m) for Dual Carriageways (Para 8.55)

Traffic Islands and Refuges

8.42 Traffic islands should be provided in the mouth of the minor road at major/minor priority junctions, except simple junctions, to:-

- a. Give guidance to long vehicles carrying out turning movements.
- b. Channelise intersecting or merging traffic streams.
- c. Warn drivers on the minor road that a junction is ahead.
- d. Provide shelter for vehicles waiting to carry out manoeuvres such as waiting to turn right.
- e. Assist pedestrians.

8.43 At rural major/minor junctions of the ghost island for Type 3 Dual Carriageway type, the rural channelising island as described in paragraphs 7.51 to 7.61 shall be used.

8.44 Physical islands shall have an area of at least 4.5 square metres, and shall be treated to be conspicuous in poor lighting conditions. Smaller areas should be defined by road markings. The risk of overriding the islands can be reduced by offsetting the approach nose from the edge of the vehicle paths.

8.45 Where a traffic island serves as a refuge for pedestrians it shall be at least 2.1m wide and have openings in the centre at carriageway level to make the crossing easier for pedestrians (see Figure 5/1). Opposite the refuge openings,

dropped kerbs shall be installed for the same reason. Care shall be taken that street furniture does not obstruct the drivers' view of pedestrians.

Swept Path Analysis

8.46 The swept path of large vehicles likely to use the junction shall be checked using a computer based swept path analysis programme.

Diverging Tapers and Lanes

8.47 Major road traffic, when slowing down on the approach to a junction in order to turn into a minor road, may impede the following vehicles that are not turning. It is helpful therefore to permit the divergence of the two streams at a small angle and approximately equal speed by the provision of a diverging taper.

8.48 Right turning tapers and lanes in the centre of ghost islands for Type 3 Dual Carriageways are especially useful as they provide a convenient space for vehicles to slow down and wait before turning off the major road, and assist the right turn out of the minor road. Details of the design of such facilities are covered in **NRA TD10**.

8.49 Nearside diverging tapers allow left turning major road traffic to slow down and leave the major road without impeding the following through traffic, but they are of less benefit in terms of operation and safety than right turning lanes, possibly because the left turn from the major road does not cross an opposing traffic stream and is rarely impeded. However, nearside diverging tapers should always be considered for higher speed roads or on gradients.

Diverge Tapers

8.50 Nearside diverging tapers shall be provided at junctions in the following circumstances for traffic in the design year:-

- a) Where the volume of left turning traffic is greater than 300 vehicles AADT, or
- b) Where the percentage of heavy commercial vehicles is greater than 20% and the volume of left turning traffic is greater than 225 vehicles AADT, or
- c) Where the junction is on an up or down gradient of greater than 4% at any design speed
- d) and the volume of left turning traffic is greater than 225 vehicles AADT.

8.51 They shall not be provided where the minor road is on the inside of a curve where traffic on the diverging taper could adversely affect visibility for drivers emerging from the minor road. They shall generally not be provided where the design speed for the major road is less than 85kph nor where the cost of provision is excessive.

8.52 Where a diverge taper is not provided adequate warning of the junction ahead must be provided. In such circumstances the detail for a Direct Access Layout 3 should apply (see Figure 8/5).

8.53 Nearside diverging tapers shall not be provided for direct accesses.

8.54 For minor road junctions with a nearside diverging taper, tapers shall be formed by a direct increase to a width of 3.5m at its tangent point with the corner into the minor road. The radius of this corner should be at least 20m where the main road design speed is 85kph and at least 40m above this speed. The lane width around this corner will depend on the radius selected (see Table 8/3). The length of this lane is defined as being from the beginning of the taper up to the tangent between the taper and the radii of the junction, as shown in Figure 8/9.

8.55 The desirable length of a nearside diverging taper shall be that of the relevant deceleration length given in Table 8/5. Where there are severe site constraints and the design speed is 85km/h, the length may be reduced to a minimum of 35m as a Relaxation.

Diverge Auxiliary Lanes

8.56 Where there are high traffic flows on the major road vehicles decelerating on the main carriageway and moving into the diverging taper could, until they reach a point where there is a full lane width available in the diverging taper, have a significant effect on the capacity of the through carriageway by impeding following drivers. The provision of an auxiliary diverge lane, as shown in Figure 8/10, allows turning traffic to move off the major road prior to any deceleration.

8.57 Junctions that require the provision of a diverge taper in accordance with the circumstances given in paragraph 8.51 shall, if traffic flows for the mainline exceed those given in Table 8/6, have an auxiliary diverge lane (Figure 8/10) provided instead of the diverge taper. Auxiliary lanes shall be 3.5 metres wide.

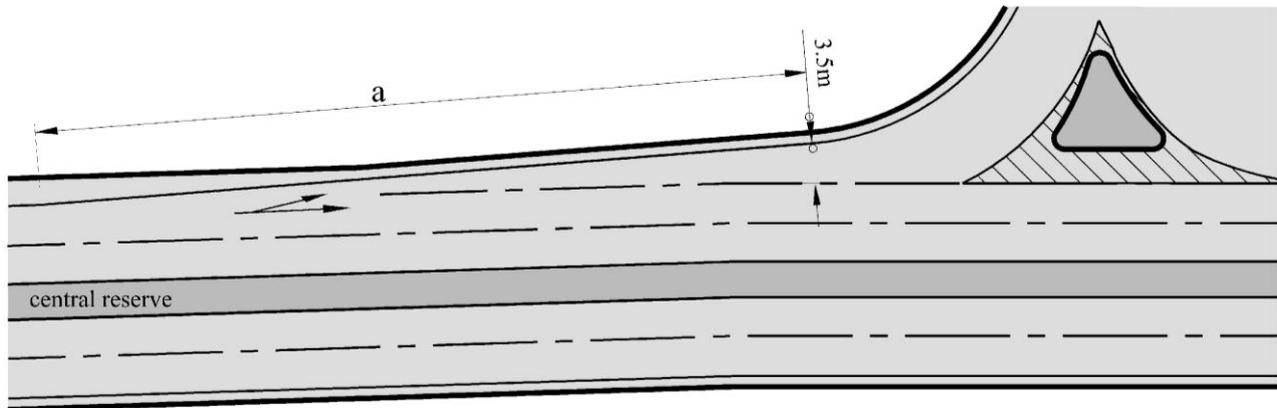
Type of Dual Carriageway	AADT (Two Way)
Type 1 & 2	16,000
Type 3 (two lane carriageway)	16,000
Type 3 (single lane carriageway)	8,000

Table 8/6: Auxiliary Lane Requirement (Para 8.57)

8.58 The auxiliary diverge lane should be of sufficient length to allow a vehicle to decelerate from major road speeds sufficiently to be able to safely negotiate the turn into the minor road. Such an auxiliary diverge lane would not normally be less than 80m in length. Its length may also depend on any need for reservoir space for turning traffic. The auxiliary diverge lane should commence with a direct taper (Figure 8/10) the length of which shall be determined from Table 8/4. The relevant deceleration length (Figure 8/10) is given in Table 8/5. In difficult circumstances the Design Organisation may reduce this deceleration length by one design speed step as a relaxation.

8.59 The provision of major minor junctions with auxiliary diverge lanes onto Type 3 Dual Carriageways is limited to the left in/left out type.

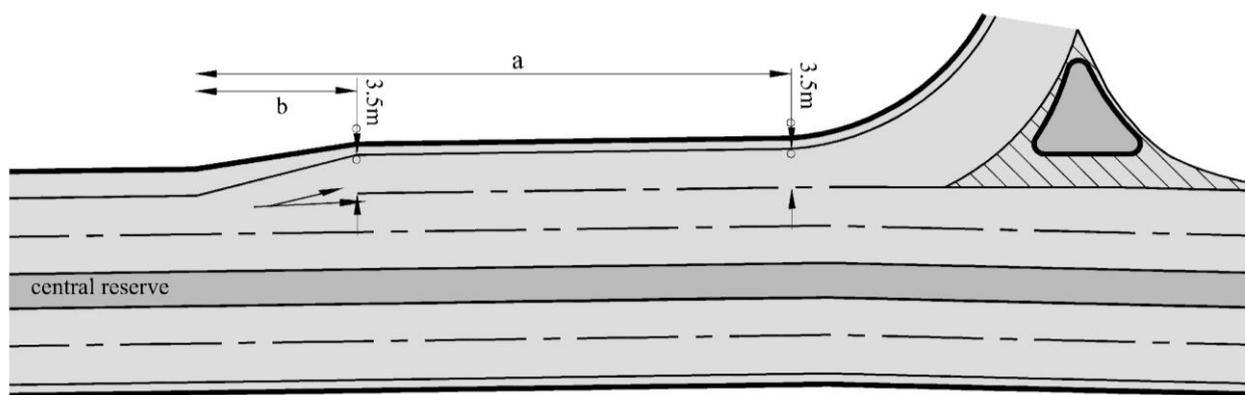
For other junction types onto Type 3 Dual Carriageways refer to **NRA TD10**.



a Deceleration Length (Refer to table 8/5)

a Deceleration Length (Refer to Table 8/5)

Figure 8/9: Major Minor Priority Junctions with Nearside Diverging Taper (Para 8.54)



a Deceleration Length (Refer to Table 8/5)

b Direct Taper Length (Refer to Table 8/4)

a Deceleration Length (Refer to Table 8/5)

b Direct Taper Length (Refer to Table 8/4)

Figure 8/10: Major Minor Priority Junctions with Nearside Auxiliary Lane (Para 8.57)

Merging Tapers

8.60 Merging tapers permit minor road traffic to accelerate fully whilst joining the faster traffic streams on the major road, where the joining traffic may otherwise impede flow and be a source of hazard.

8.61 Merging tapers shall only be used at dual carriageway junctions. They shall be provided on Type 1 and Type 2 Dual Carriageways and the two lane carriageway of a Type 3 Dual Carriageway with the following criteria for junctions with minor roads:

- a) 85km/h or greater design speed with left turning traffic flow greater than 600 AADT or;
- b) 85km/h or greater design speed with merging traffic on a greater than 4% up gradient and left turning traffic flow greater than 450 AADT or;
- c) 85km/h or greater design speed with percentage of Large Commercial Vehicles more than 20% and left turning traffic flow greater than 450 AADT.

Merge tapers may also be applicable where there is a high seasonal use by large or slow moving vehicles.

They shall never be used at junctions onto the single lane carriageway of a Type 3 Dual Carriageway. They shall not be provided where the cost of provision would be excessive.

8.62 At some junctions on dual carriageways there may be safety benefits in providing merging tapers at lower flows.

8.63 The merging taper shall be designed as shown in Figure 8/8 (c) with a radius out of the minor road of at least 25m with a lane width of 5.7m for a design speed of 85 kph, and of at least 30m radius with a lane width of 5.3m for design speed greater than 85 kph. The merging length as shown in Figure 8/11 shall be obtained from Table 8/7.

8.64 In difficult circumstances, the Design Organisation may relax the taper length by one design speed step as a relaxation.

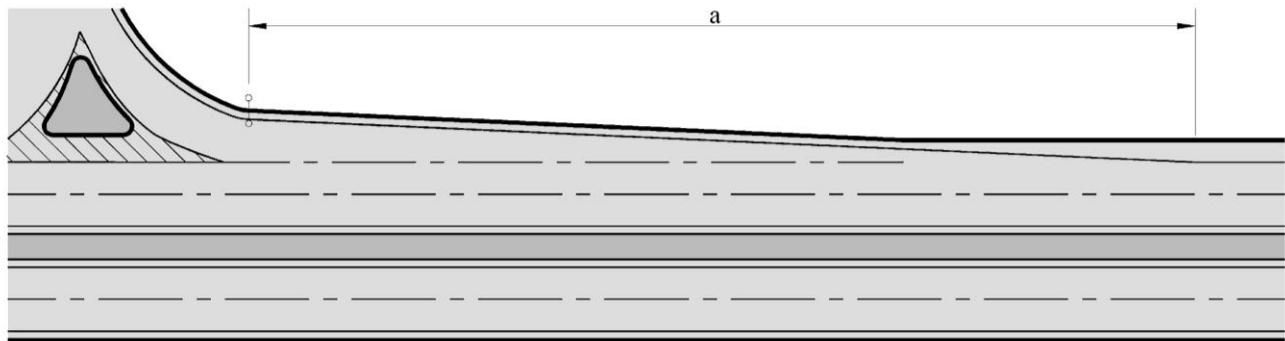
Auxiliary Merge Lanes

8.65 Auxiliary merging lanes shall not be provided on all-purpose dual carriageways with a design speed of 100 kph or less. On dual carriageways with a design speed of 120kph the merge shall be detailed in accordance with TD22.

Design Speed (kph)	Merging Length (m)
85	90
100	110
120	130

Note: In difficult circumstances, the Design Organisation may relax the merging length by one design speed step as a relaxation.

Table 8/7: Merging Length



a Merging Length (Refer to Table 8/7)

Figure 8/11: Major/Minor Priority Junction with Nearside Merging Taper (Para 8.63)

Drainage and Crossfall

8.66 From considerations of surface water drainage and driver comfort, the road camber on the major road shall be retained through the junction and the minor road graded into the channel line of the major road. Checks shall be made for flat areas at all changes of gradient, superelevation or crossfall.

Roads with Hard Shoulders

8.67 Where hard shoulders are provided on roads with major/minor priority junctions, particular care should be taken to ensure safe designs for the junctions. The layouts should be in accordance with the geometric requirements described in the preceding paragraphs of this Chapter, together with the following additional requirements.

Approach to a Junction

8.68 On the major road approach to a junction on the left with a direct taper diverging lane or auxiliary diverge lane, the hard shoulder width may be reduced as the taper develops subject to the requirement to maintain a minimum 0.5m wide hard strip, as shown in Figure 8/9 or 8/10.

Departure from a Junction

8.69 On the major road departure from a ghost island junction for Type 3 Dual Carriageway, the hard shoulder may be introduced over the length of the taper of the central island road markings.

8.70 On the major road departure from a junction with a direct taper merge the hard shoulder should be developed at the end of the taper as shown in Figure 8/11.

Hard Shoulders on the Minor Road

8.71 Where the minor road approach to a junction has a hard shoulder, the hard shoulder should be terminated by tapering to a width of 0.5m to form a hard strip. The taper angle should be 1:30 and the taper should terminate not less than 15m before the start of the entry widening.

8.72 Where the minor road departure from a junction has a hard shoulder, the hard shoulder should not start before the end of the exit widening.

9. References

Design Manual for Roads and Bridges (DMRB)

Volume 2: Highway Structures: Design (Substructures and Special Structures) Materials:

BD 29, Design Criteria for Footbridges (DMRB 2.2).

Volume 5: Assessment and Preparation of Road Schemes:

TA 44 Capabilities, Queues, Delays and Accidents at Road Junctions – Computer Programs ARCADY/3 and PICARDY/3 (TRRL) (DMRB 5.1.1).

Volume 6: Road Geometry:

NRA TD 9, Road Link Design;

NRA TD 10 Road Link Design for Type 2 and Type 3 Dual Carriageways;

TD 22, Layout of Grade Separated Junctions (DMRB 6.2.1);

TA 48 Layout of Grade Separated Junctions (DMRB 6.2.2)

TD 16 Geometric Design of Roundabouts (DMRB 6.2.3)

TD 50, The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts (DMRB 6.2.3);

TD 40, Layout of Compact Grade Separated Junctions (DMRB 6.2.5);

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

TA 18 Junction Layout for Control by Traffic Signals (DMRB 6.2)

TA 57 Roadside Features (DMRB 6.3)

TD 20 Traffic Flows and Carriageway Width Assessment. (DMRB 5.1)

Volume 12: Traffic Appraisal of Road Schemes (TAM).

Volume 13: Economic Assessment of Road Schemes (COBA).

National Roads Authority Publications

Guidelines on Traffic Calming for Towns and Villages on National Routes; 1999

Road Collision Facts; Ireland; 2004

Highways Agency Reports

Safety Review of Priority Junctions and Accesses: July 2007

British Standards

BS 6100 Subsection 2.4.1 1990 - The British Standard Glossary of Building and Civil Engineering Terms - Part 2 Civil Engineering Terms - Section 2.4 Highway and Railway Engineering: British Standards Institution 1990 (UDC 001.4: (624+697))

Traffic Sign Regulations

Road Traffic (Signs) Regulations 1997 to date.

Traffic Signs Manual. Department of Transport.

Transport Research Laboratory (TRL) Research Reports

RR 65, Accidents at Rural T Junctions. Transport Research Laboratory, Crowthorne, UK.

LR 762 (Berkshire Study) Methodology of an In-Depth Accident Investigation Survey 1977.

LF779 A Study of Speed/Flow Relations on Rural Motorways and All-Purpose Dual Carriageways 1979.

LF780 Speed/Flow Formulae for Rural Motorway and All-Purpose Dual Carriageways 1979.

LF923 A Study of Speed/Flow/Geometry Relations on Rural Single Carriageways 1980.

LF925 Changes on Speeds on Rural Roads 1980.

TRL Junction Assessment Programs

ARCADY/3 Application Guide 17: 1990 (Assessment of Roundabout Capacity and Delay Version 3).

OSCADY/3 Application Guide 22: 1993. (Optimised Signal Capacity and Delay)

PICADY/3 Application Guide 18: 1990 (Priority Intersection Capacity and Delay Version 3).

Other Research Reports

Interstate System Accident Research Study - 1: USA Federal Highway Administration Washington DC: 1970.

Effects of Road and Traffic Characteristics on Accidents on Main Rural Roads in Ireland: An Foras Forbatha: Dublin, Ireland: 1976.

Relationship of Private Entrances to Highway Efficiency: Ontario Ministry of Transportation 1988.

Road Traffic (Construction, Equipment and Use of Vehicles) Regulations 1963 to 1997.

Other United Kingdom Government Publications

The Casualty Report: Road Accidents in Great Britain 1992 HMSO.

Road Accidents in Great Britain 1980: HMSO.

Tactile Surfaces Disability Unit Circular 1/92.

Cyclists at Road Crossings and Junctions - Local Transport Note 1/86 Traffic Advisory Unit 1986.

Shared use by Cyclists and Pedestrians LTN 2/88 Traffic Advisory Unit 1988.

Making way for Cyclists LTN 1/89 Traffic Advisory Unit 1989.

Providing for the Cyclist - Cycling Advice Note 1/89, Scottish Office 1989.

Making way for Cyclists - Cycling Advice Note 1/90: Scottish Office 1990.

Entry Treatments - Traffic Advisory Leaflet 2/94. Traffic Advisory Unit 1994.

Transport - Planning Policy Guidance Note 13 (PPG13) - Department of the Environment/Department of Transport: March 1994 (England) HMSO 1994.

Highways Considerations in Development Control Planning Policy Guidance Note 13 (PPG13) - Department of the Environment/Welsh Office: November 1988 (Wales). HMSO 1988.

The General Policy of the Department of Transport and the Welsh Office on the Control of Development on trunk roads – Guidance Note. Issued under cover of Circular Roads 4/88; Welsh Office Circular 42/88. (1988).

Miscellaneous

Accident Investigation and Prevention Manual.

Guidelines on Traffic Calming for Towns and Villages on National Routes. National Roads Authority.

The National Manual for the Design of Cycle Facilities. Department of Transport (due to be published in 2009).

National Roads Project Management Guidelines. National Roads Authority.

Road Accidents in Great Britain 1991. HMSO, London.

10. Enquiries

- 10.1 All technical enquiries or comments on this document or any of the documents listed as forming part of the NRA DMRB should be sent in writing to:

Head of Engineering
National Roads Authority
St Martins House
Waterloo Road
Dublin 4



.....
T. AHERN
Head of Engineering



Bonneagar Iompair Éireann
Transport Infrastructure Ireland



Ionad Ghnó Gheata na
Páirce,

Stráid Gheata na Páirce,
Baile Átha Cliath 8, Éire



Parkgate Business Centre,
Parkgate Street,
Dublin 8, Ireland



www.tii.ie



info@tii.ie



+353 (01) 646 3600



+353 (01) 646 3601