Road Geometry

NRA TD 9

NRA TD 301

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Road Geometry Updates

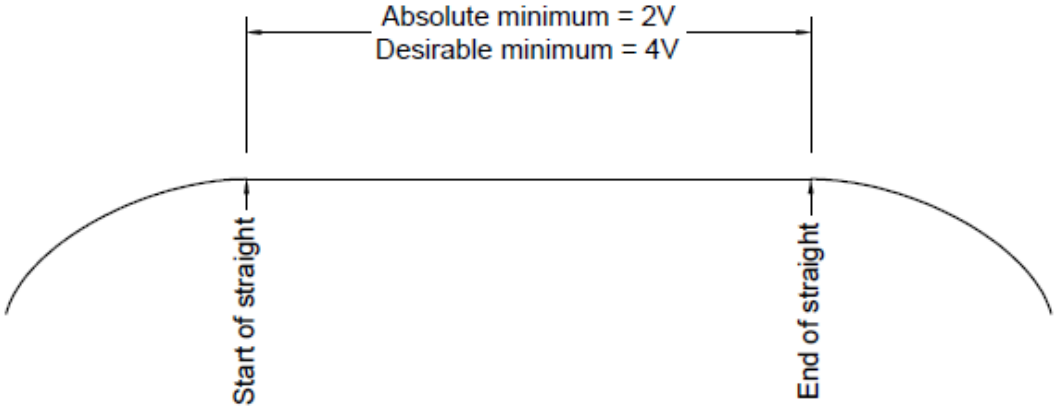
- NRA TD 9 – Road Link Design
  - Updates to Existing Standard
- NRA TD 301 – Geometric Design Of Junctions
  - New Junction Standard

Publication in **June 2015**

NRA TD 9 Road Link Design

Principal Updates:

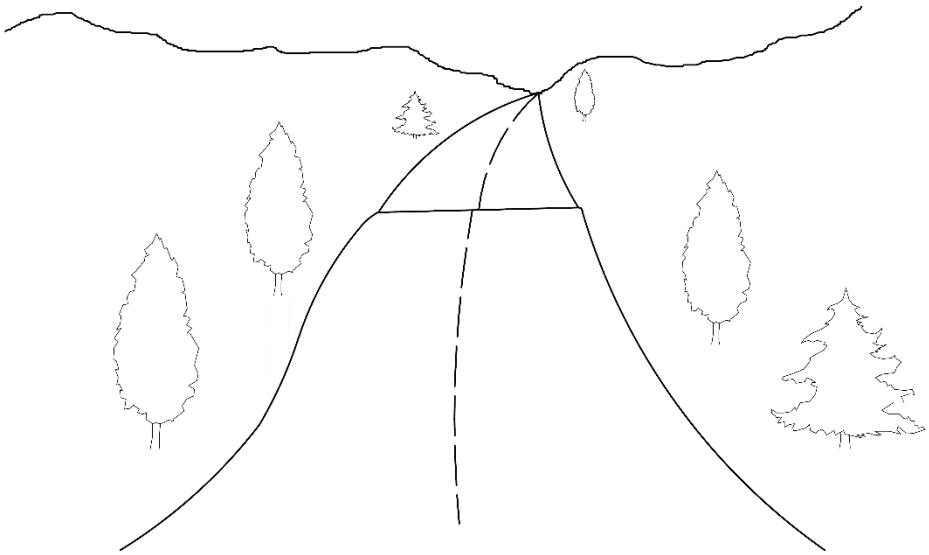
- NRA TD 10 has been amalgamated into NRA TD 9
- Type 2 & 3 DC added to Rural Road Layouts in Table 6/1
- Distinction between **Bands A and B Design Speed** removed
- Definitions for Urban Street and Urban Relief Road included
- Broken Back Curves defined



NRA TD 9 Road Link Design

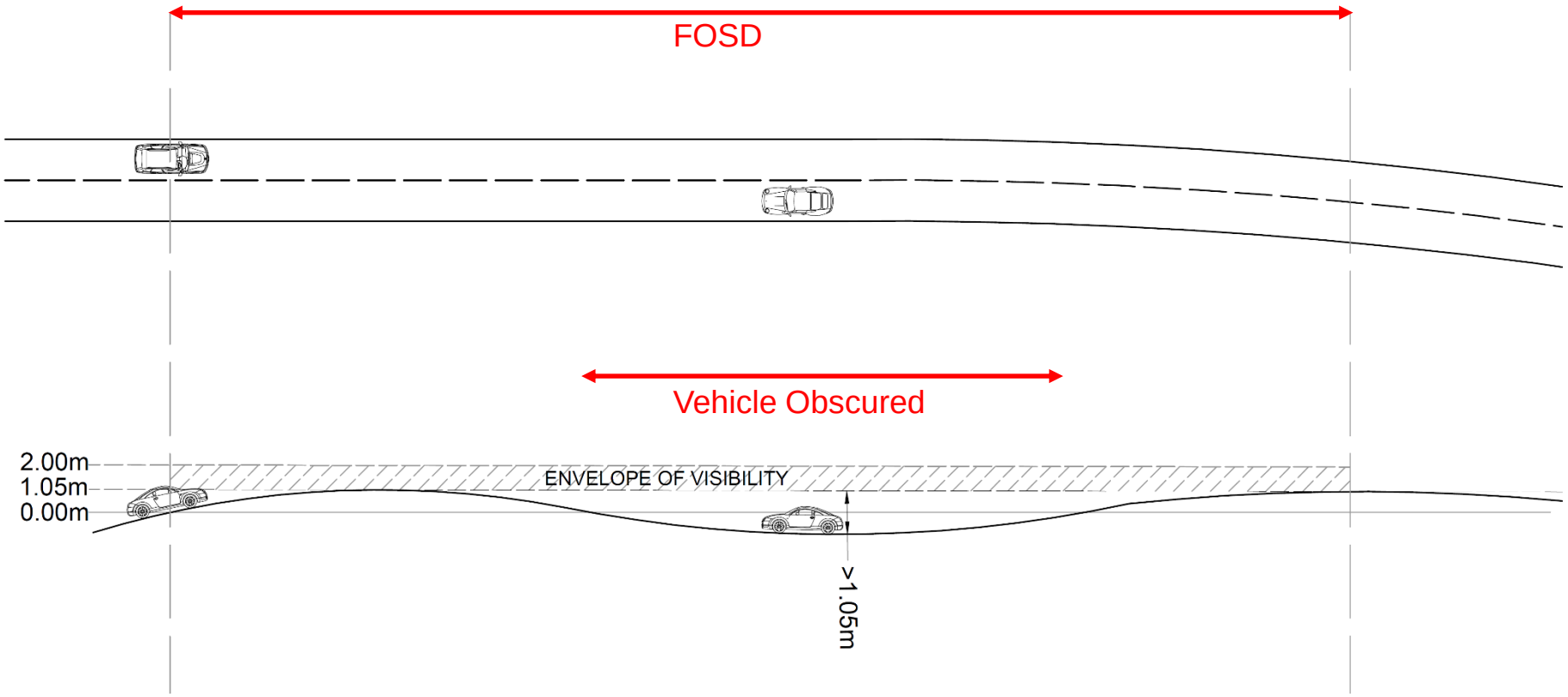
Hidden Dips

- An amended definition for a hidden dip / FOSD along with diagrams to illustrate is now included (Clause 7.33).



NRA TD 9 Road Link Design

Hidden Dips



Problem: Vertical height between the underside of 1.05m sight line and the road surface too great to provide FOSD in the vertical plane.

NRA TD 9 Road Link Design

Sight Distance Updates

- Tables 2/1 and 2/2 showing the permitted relaxation in Stopping sight distance remote from and in the vicinity of a junction are included. (Previously included in Annex B).

- Motorways and Dual Carriageways a **one step** Relaxation below the Desirable Minimum Stopping SSD to the **high object** in combination with an uphill gradient relaxation is now permitted (remote from junction only).

	Associated Relaxation	Motorways		Type 1, 2 and 3 Dual Carriageways		Type 1, 2 and 3 Single Carriageways	
		High Object	Low Object[1]	High Object	Low Object[1]	High Object	Low Object[1]
1	No relaxation in horizontal curvature, vertical curvature, gradient or superelevation.	1 Step[2,3]	2 Steps [3]	2 Steps [3]	2 Steps [3]	2 Steps [5]	2 Steps [5]
2	1 Step relaxation in horizontal curvature.	1 Step[2,3]	2 Steps [3]	1 Step[2,3]	2 Steps [3]	1 Step [2,4,5]	2 Steps [5]
3	2 Step relaxation in horizontal curvature.	None [2]	1 Step	None [2]	1 Step	None [2,4]	1 Step [4,5]
4	3 Step relaxation in horizontal curvature.	None [2]	None [2]	None [2]	None	None [2,4]	None [2,4]
5	4 Step relaxation in horizontal curvature.	None [2]	None [2]	None [2]	None	None [2,4]	None [2,4]
6	Relaxation in vertical curvature.	None [2]	1 Step	None [2]	1 Step	None [4,5,6]	1 Step [4,5]
7	Uphill Gradient relaxation	1 Step [2]	2 Steps	1 Step [2]	2 Steps	None [2,4]	1 Step [4,5]
8	Downhill Gradient relaxation	None [2]	1 Step	None [2]	1 Step	None [2,4]	1 Step [4,5]
9	Crossfall relaxation.	None [2]	1 Step	None [2]	1 Step	None [2,4]	1 Step [4,5]

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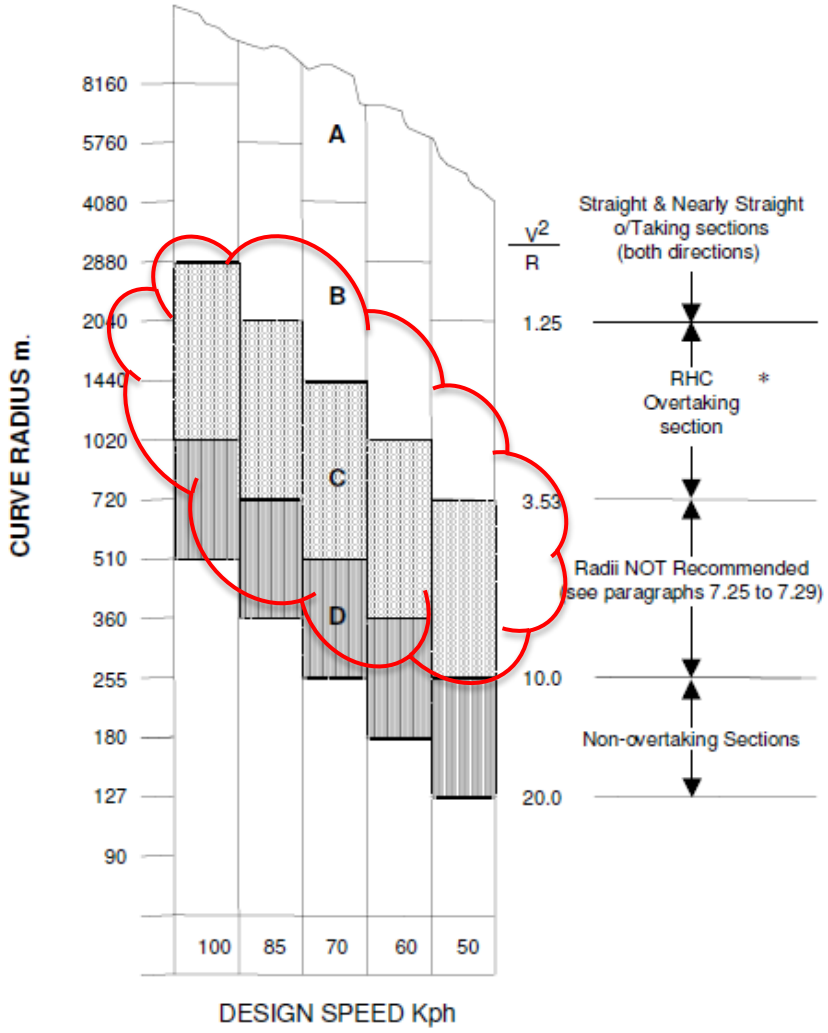
Band C Curvature

- TD 9/12 recommends that use of horizontal curvature within Band C is avoided but does not require a departure.



NRA TD 9 Road Link Design

Band C Curvature

New Road Design:

- The use of radii in Band C is now regarded as a departure from standard for new road schemes (Clause 7.28)

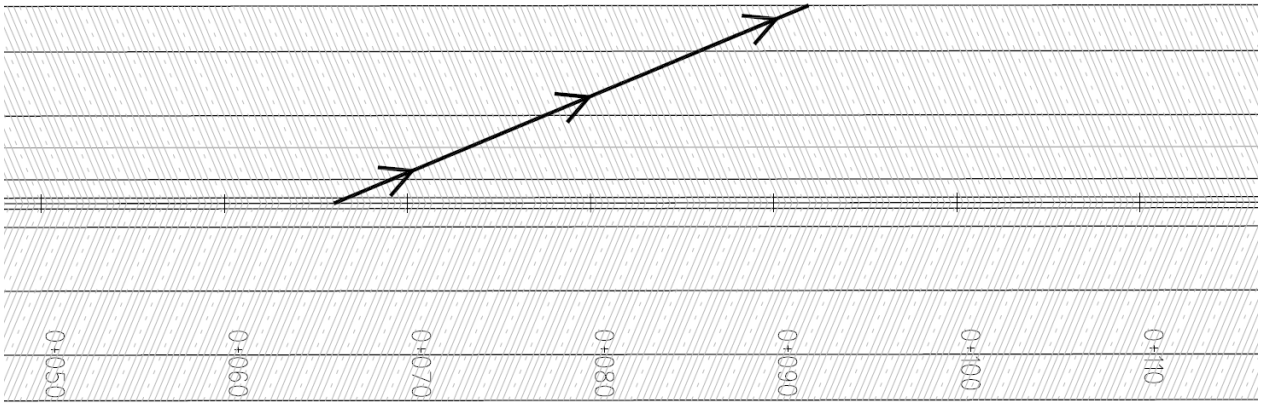
Existing Online Improvement:

- Use of Band C curves permitted as a relaxation from standard for online improvements to existing roads (Clause 7.29) and on regional and local roads (Clause 9.19)

NRA TD 9 Road Link Design

Road Camber

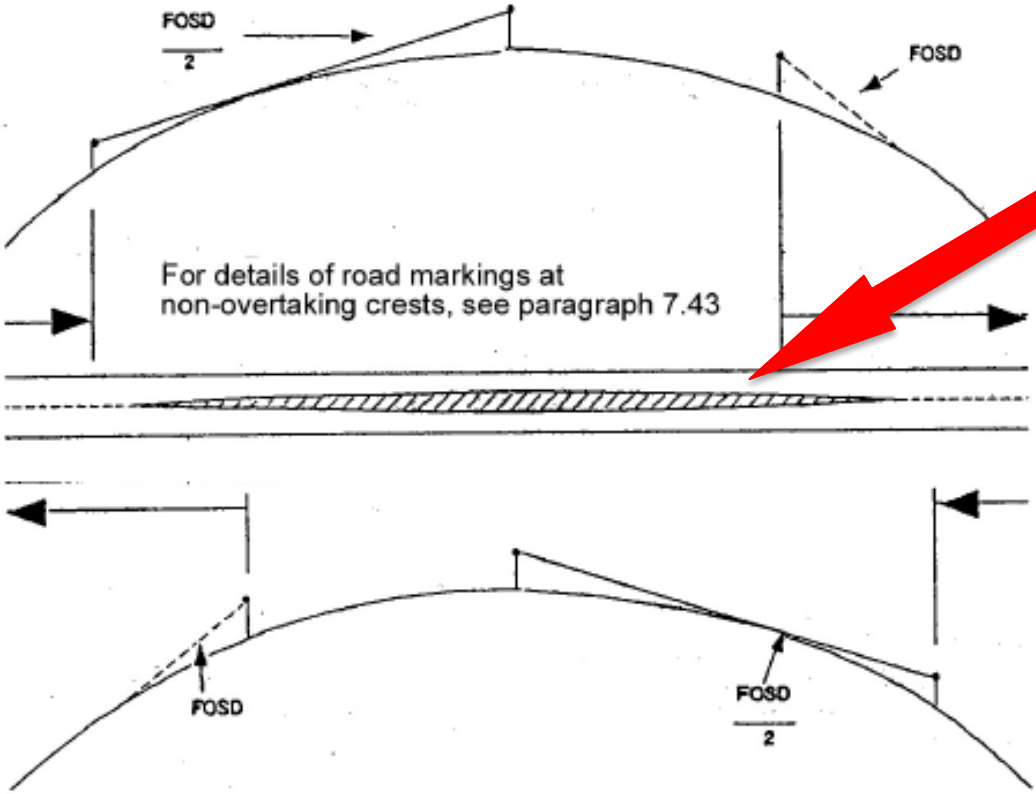
- Clause 3.1 – As a relaxation, a camber of 3% may be appropriate on steep sections of wider carriageway to reduce drainage path lengths.



- For narrow local roads, a continuous crossfall between the edges of the road is a permitted relaxation.

NRA TD 9 Road Link Design

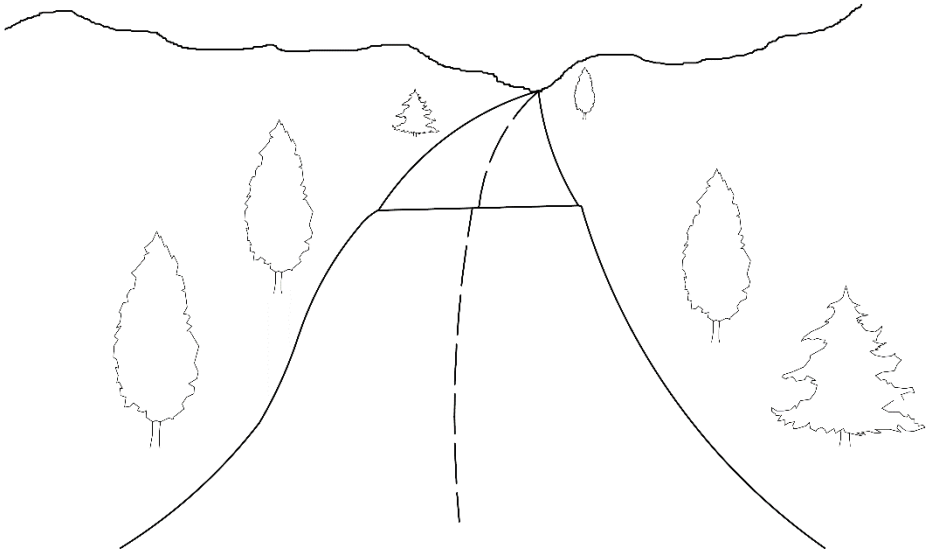
Two-way Single Carriageways (Vertical Curve Design)



Crest K <u>one step below</u> Desirable Minimum

NRA TD 9 Road Link Design

Two-way Single Carriageways (Vertical Curve Design)



NRA TD 9 Road Link Design

Two-way Single Carriageways (Vertical Curve Design)

- Unless FOSD is provided, the crest K value should not be greater than Desirable Minimum
- Definition of Overtaking Section
- Approach to Line-Marking

NRA TD 9 Road Link Design

New Chapter 10

'Geometric Design to Improve Surface Drainage of Carriageways'

- Incorporates IAN 09/13 into standard
  - Issue of Aquaplaning not given sufficient prominence in existing geometric standards (TD 9/12)
  - Road surface geometry has the most direct influence on the surface flow and the build-up of storm water runoff
  - Places avoidance of aquaplaning as a geometric design issue

NRA TD 9 Road Link Design

New Chapter 10

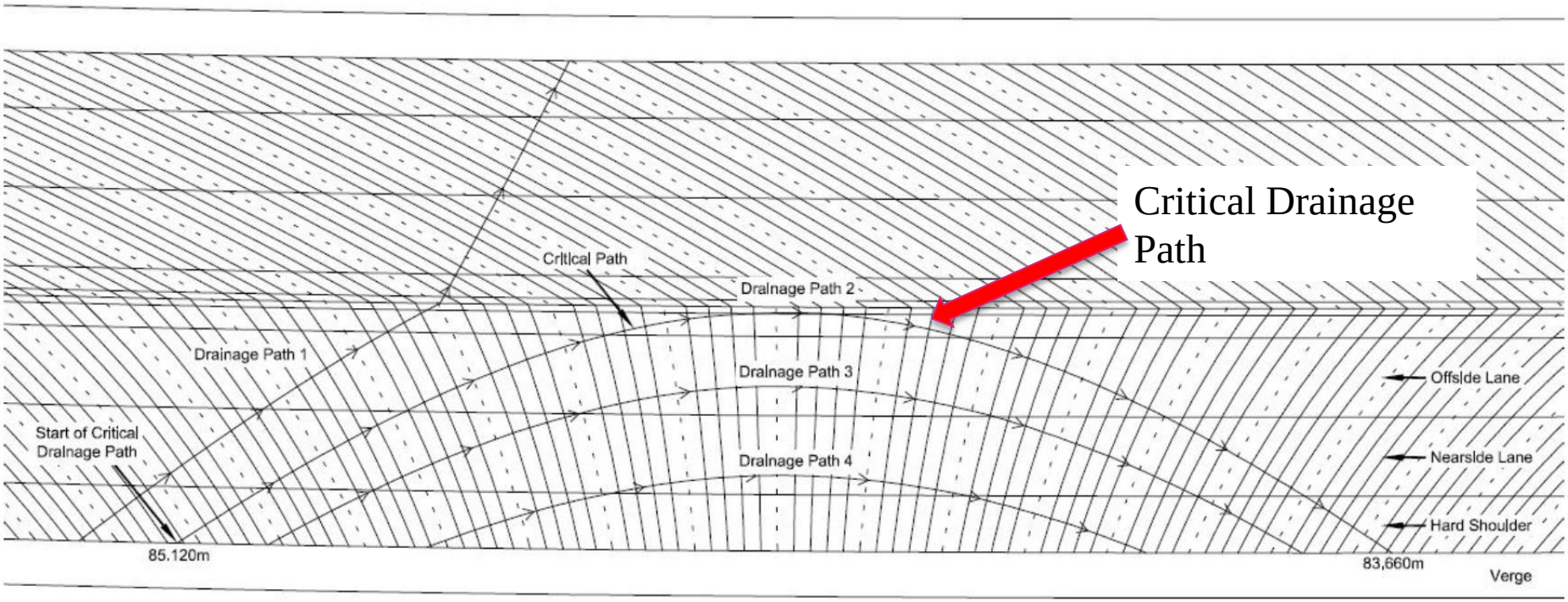
- Introduces mandatory design requirements to limit water film depths and minimise aquaplaning risk

- Increases the minimum resultant gradient from 0.5% to 1%

- Requires the designer to compile and Aquaplaning Assessment Report for submission to the NRA at Preliminary Design Stage

Drainage Flow Path - Length

- WFD analysis to be carried out on <u>Critical Drainage Path</u>
  - Contour plot at typical Rollover Location:



Calculation of WFD (Gallaway Method)

- Empirical equation developed by Gallaway et al. to determine Water Film Depth:

$$D = \frac{0.103 \times T^{0.11} \times L^{0.43} \times I^{0.59}}{S^{0.42}} - T$$

Where,

D	=	Water film depth above pavement texture (mm)
T	=	Average pavement texture depth (mm)
L	=	Length of drainage path (m)
I	=	Rainfall Intensity (mm/hr)
S	=	Slope of drainage path (%)

Assessment Criteria

- To minimise aquaplaning potential, geometric design must ensure:

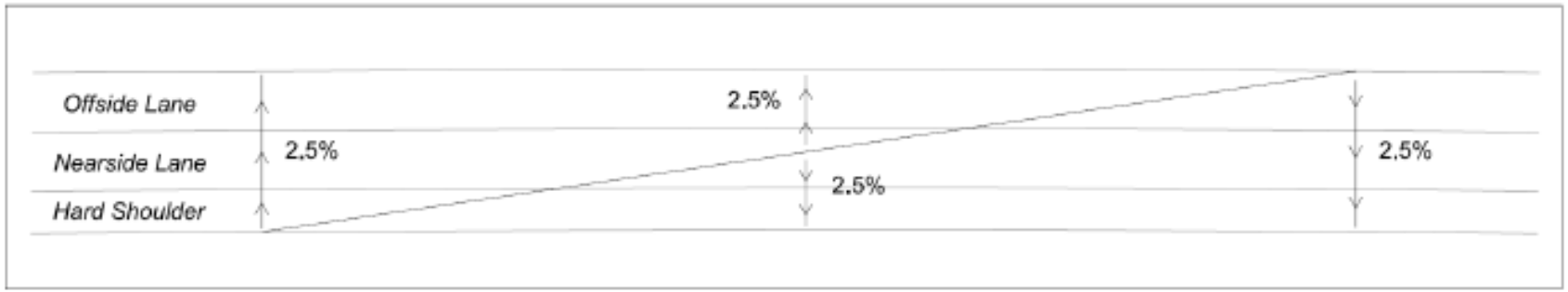
  - Water film depths must not exceed 2.5mm on single carriageways

  - On Motorways & Dual Carriageways, a maximum value of 3.3mm will apply

  - Road surface geometry shall be such that flow paths are limited to about 60m in length

Rolling Crowns

- Superelevation applied along diagonal crown line across carriageway



- Instantaneous change in crossfall (must not exceed 5%)
- Crown lines must be sufficiently long to achieve satisfactory ride quality
- A Departure from Standards on high speed roads

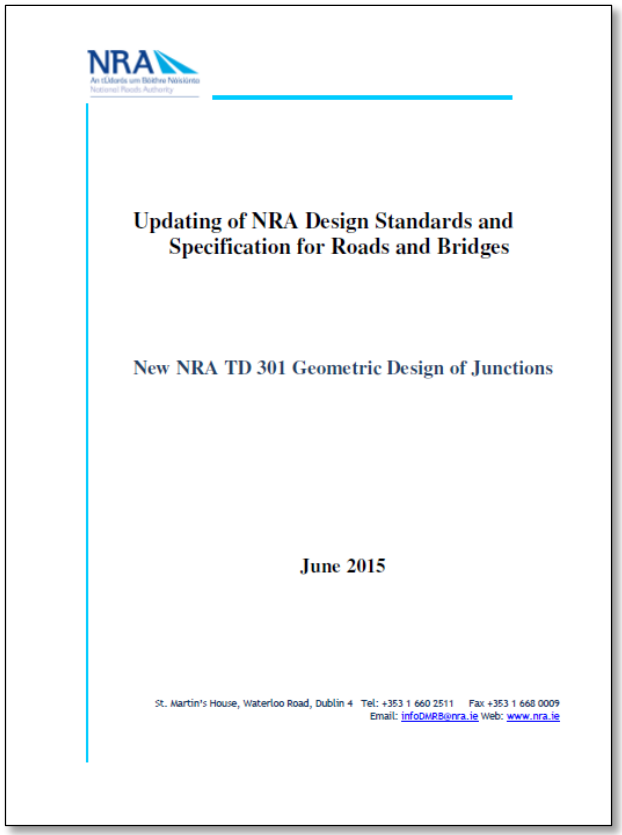
NRA TD 301 Geometric Design of Junctions

- New NRA standards which **combines existing junction standards** into a single comprehensive document

TD 41-42

TD 16/07

TD 40/94



TD 22/06

TD 51/03

TD 10/07

NRA TD 301 Geometric Design of Junctions

Geometric Design of Priority Junctions and Vehicular Accesses to National Roads – Principal Changes:

- **Junction Siting:**
  - Junctions located on the inside of sharp curves (below Desirable Minimum R as per NRA TD 9) now regarded as a Departure.
- **Vertical Alignment:**
  - Maximum 2% gradient on **major road** approaches to junctions now mandatory
- **Level of Provision – Simple Junction**
  - Simple junctions shall only be used for new rural junctions when design flow for right turns does not exceed **120 vehicles AADT** (Major road not exceeding 13,000 AADT)

NRA TD 301 Geometric Design of Junctions

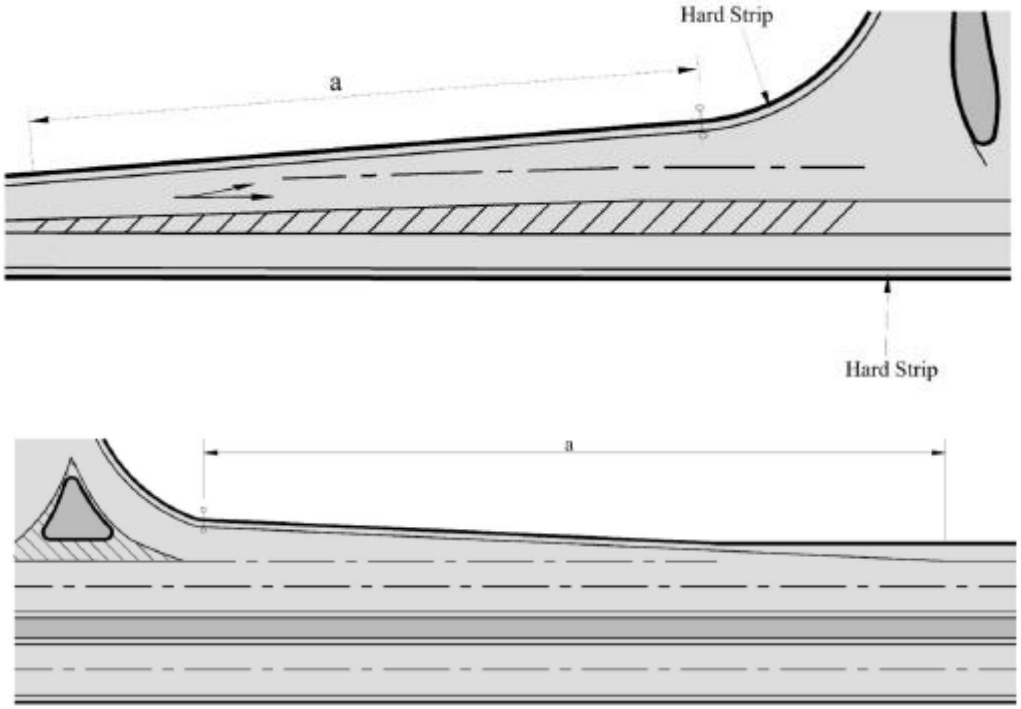
Geometric Design of Priority Junctions and Vehicular Accesses to National Roads – Principal Changes:

- **Dwell Area / Gradient**
  - In the case of a dwelling access, a combined relaxation in dwell area and approach gradient is not regarded as a departure
- **Channelising Islands**
  - Rural channelising islands shall be raised and kerbed and constructed in accordance with RCD/1100/09
- **Junction Corner Radii**
  - 13m at Rural Simple Junctions (verify by swept path analysis)

NRA TD 301 Geometric Design of Junctions

Geometric Design of Priority Junctions and Vehicular Accesses to National Roads – Principal Changes:

- **Merge / Diverge Tapers**



NRA TD 301 Geometric Design of Junctions

Geometric Design of Priority Junctions and Vehicular Accesses to National Roads – Principal Changes:

- **Merge / Diverge Tapers**

  - Merge / Diverge **auxiliary lanes & tapers** not permitted on Single Carriageways

  - Merge / Diverge **tapers** not permitted on Dual Carriageways

  - Auxiliary lane merge / diverge layouts on Dual Carriageways designed to Chapter 7 (i.e. TD 22 standards)

NRA TD 301 Geometric Design of Junctions

Geometric Design of Roundabouts – Principal Changes:

- Roundabout type terminology amended to:

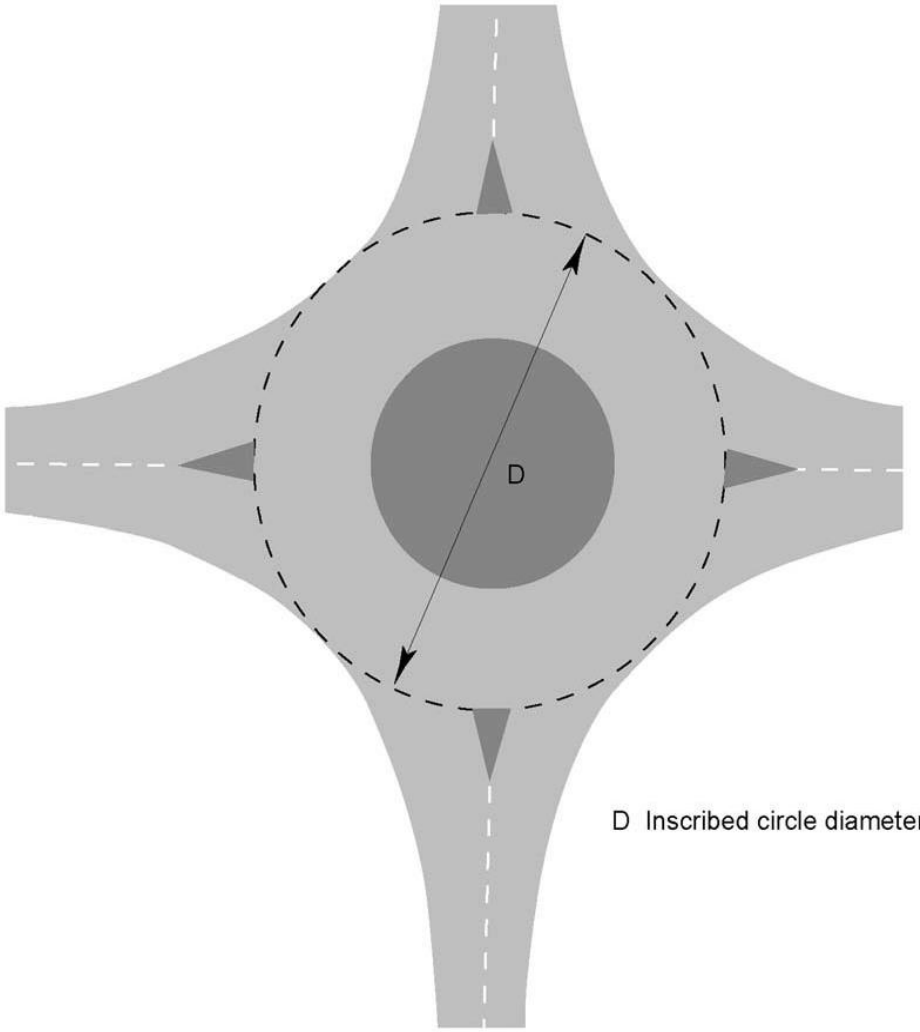
  Single Lane and ***Multi-Lane*** only

- Minimum standard defined for all rural roundabouts, i.e. references to Mini, Compact, Double, Grade Separated, Signalised roundabouts removed.

NRA TD 301 Geometric Design of Junctions

Geometric Design of Roundabouts

- Minimum/Maximum ICD introduced for various roundabout types:
  - Single Lane (28m – 36m)
  - Multi-Lane (45m – 55m, 65m max.)
  - Five arm roundabout (55m minimum)



NRA TD 301 Geometric Design of Junctions

Geometric Design of Roundabouts – Principal Changes:

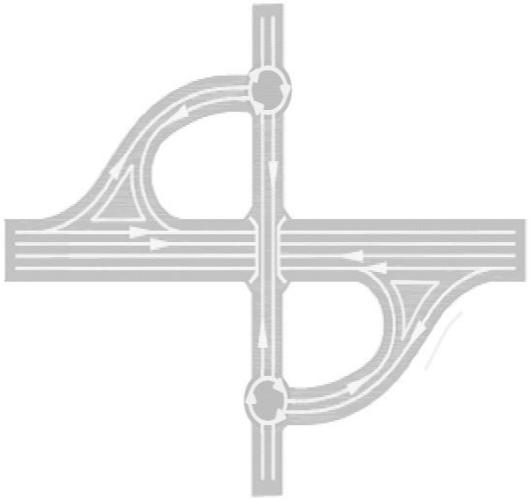
- Introduction of cut-off point between roundabout and link design 50m from yield line.
- Five arm roundabout now a departure from standards
- Maximum longitudinal gradient of the circulatory carriageway of 2.5%
- Minimum resultant gradient of 1% within 50m of roundabout (may be reduced locally to 0.5% at interface)
- Design of Segregated Left Turn Lanes now included (previously TD 51/03)
- Overrun Areas

NRA TD 301 Geometric Design of Junctions

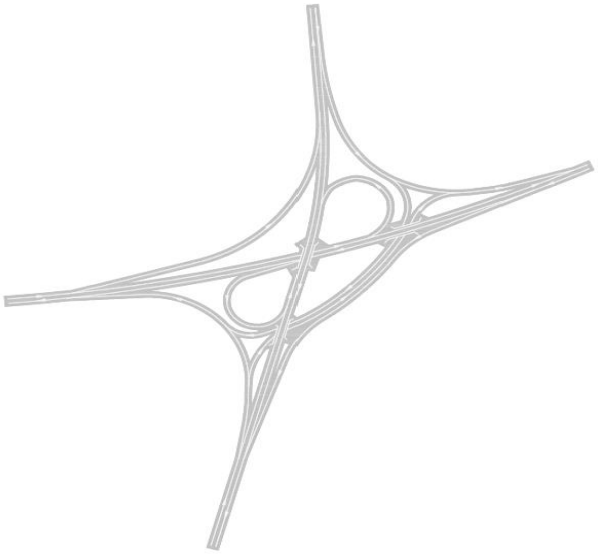
Layout of Grade Separated Junctions – Principal Changes:

- Layout Options revised for Grade Separation on Motorway / Type 1 DC

Dumb-bell



Half Cloverleaf



Interchange

NRA TD 301 Geometric Design of Junctions

Layout of Grade Separated Junctions – Principal Changes:

- Layout Options **removed** from standard:

Diamond

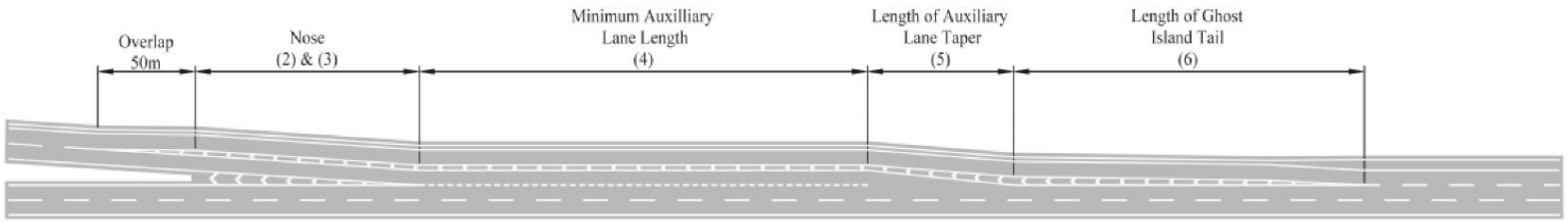
2 Bridge Roundabout

3 Level Roundabout

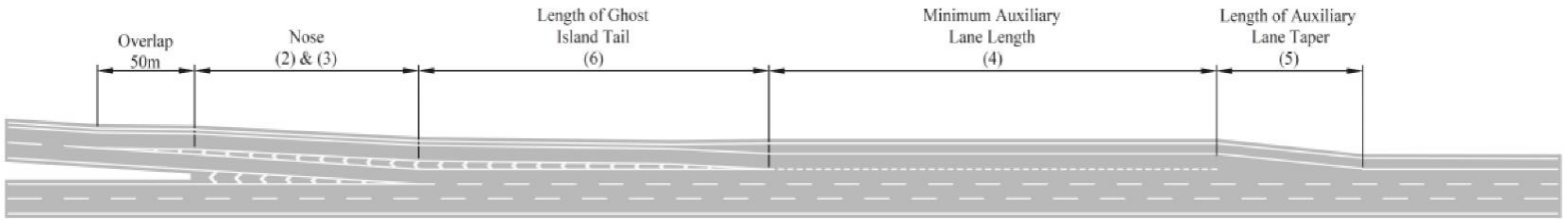
NRA TD 301 Geometric Design of Junctions

Layout of Grade Separated Junctions – Principal Changes:

- Merge layout options amended to remove direct tapers



F – Lane Gain With Ghost Island Merge (Option 1 Preferred)

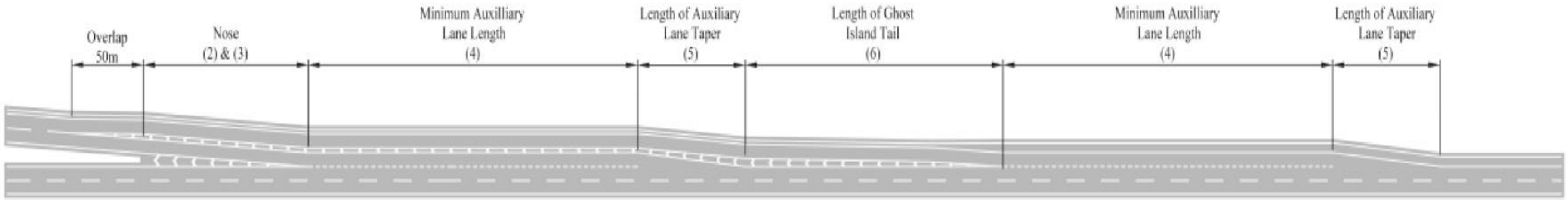


F – Lane Gain With Ghost Island Merge (Option 2 Alternative)

NRA TD 301 Geometric Design of Junctions

Layout of Grade Separated Junctions – Principal Changes:

- Merge layout options amended to remove direct tapers



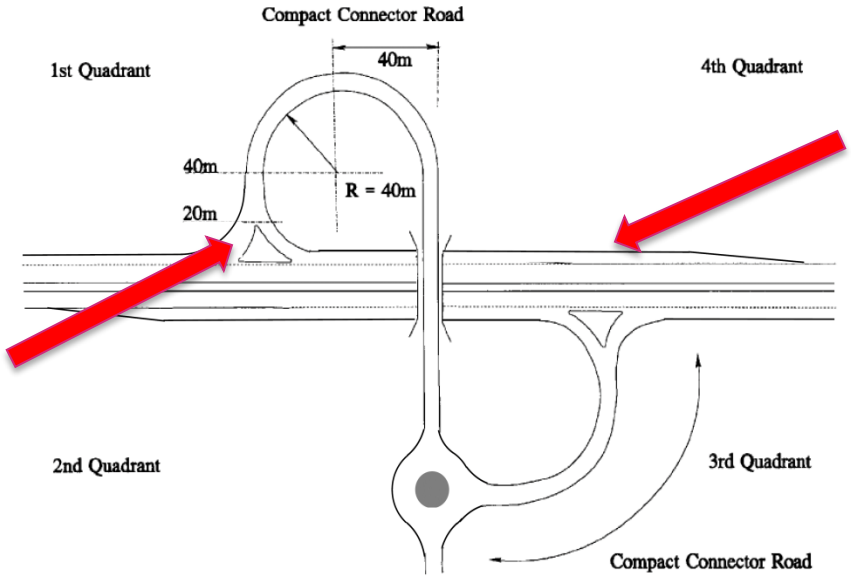
H – Alternative Ghost Island Merge With Auxiliary Lane (Departure Required)

NRA TD 301 Geometric Design of Junctions

Layout of Compact Grade Separated Junctions – Principal Changes:

- Update to Visibility Requirements for low radius compact connector roads

  - Permissible relaxation to low object (0.26m) visibility restricted by safety barrier



Merge / Diverge Auxiliary Lanes

Adverse Camber at Junction Entry/Exit

Thank You

Any questions?

NRA
An tÚdarás um Bóithre Náisiúnta
National Roads Authority

ARUP