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 May 2016
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
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Hidden Dips

Figure 2/2: Measurement of FOSD
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Hidden Dips

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

<table>
<thead>
<tr>
<th>Associated Relaxation</th>
<th>Motorways</th>
<th>Type 1, 2 and 3 Dual Carriageways</th>
<th>Type 1, 2 and 3 Single Carriageways</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Object</td>
<td>Low Object&lt;sup&gt;1&lt;/sup&gt;</td>
<td>High Object</td>
</tr>
<tr>
<td>1 No relaxation in horizontal curvature, vertical curvature, gradient or superelevation.</td>
<td>1 Step&lt;sup&gt;(2,3)&lt;/sup&gt;</td>
<td>2 Steps&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>2 Steps&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 1 Step relaxation in horizontal curvature.</td>
<td>1 Step&lt;sup&gt;(2,3)&lt;/sup&gt;</td>
<td>2 Steps&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>1 Step&lt;sup&gt;(2,3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 2 Step relaxation in horizontal curvature.</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>1 Step</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 3 Step relaxation in horizontal curvature.</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 4 Step relaxation in horizontal curvature.</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 Relaxation in vertical curvature.</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>1 Step</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 Uphill Gradient relaxation</td>
<td>1 Step&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>2 Steps</td>
<td>1 Step&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>8 Downhill Gradient relaxation</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>1 Step</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>9 Crossfall relaxation.</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>1 Step</td>
<td>None&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
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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 (Obstructions to Overtaking)

Note: A simple priority junction with no ghost island layout can be ignored for the purposes of determining Overtaking Sections.

(a) Approach to Priority Junction (with ghost or solid island).

(b) Approach to Roundabout.
Two-way Single Carriageways (Obstructions to Overtaking)

- On **New Schemes**, FOSD will terminate FOSD/4 in advance of a Simple Junction.

- Simple Junctions can be ignored in FOSD measurement on Online Realignments.
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
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 Critical Drainage Path

- 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

![Diagram of crown lines with 2.5% superelevation applied across lanes]

- 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 40/94

TD 16/07 → TD 10/07

TD 22/06 → TD 51/03
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)
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.
Geometric Design of Roundabouts

- Recommended Minimum/Maximum ICD introduced for various roundabout types:
  - Single Lane (28m – 36m)
  - Multi-Lane (45m – 55m, 65m max.)
  - Five arm roundabout (55m minimum)
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
Layout of Grade Separated Junctions – Principal Changes:

- Layout Options revised for Grade Separation on Motorway / Type 1 DC
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
Layout of Grade Separated Junctions – Principal Changes:

- Merge layout options amended to remove direct tapers

**Option 1 Preferred**

**Option 2 Alternative**
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

Adverse Camber at Junction Entry/Exit
Thank You

Any questions?