Safety Barriers - Design and Installation Developments and Pitfalls

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NRA APPROVAL LIST WITHDRAWN

All Safety Barriers to be **CE Marked!!!!!!**

CE Marking for a barrier kit does NOT mean that the barrier system is a fully compliant installation.

NRA will maintain a list of CE marked barriers for designers to obtain information on available systems
Pre-Construction Checklist

Tender Document
Checklist – Pre-Construction

• Do you need a barrier (could the obstruction be removed or made passively safe)

3.9 Hazard mitigation measures shall be considered by the Designer prior to designing a safety barrier. A safety barrier shall only be introduced if the hazard cannot be mitigated. The mitigation measures for hazards within the Clear Zone are listed below in order of preference:

a) Remove;
b) Relocate;
c) Re-design the hazard to reduce the risk to road users e.g. introducing a passively safe sign post;
d) Revise the road layout or cross-section to lower the risk, e.g. increase the width of the hard shoulder, improve the road alignment, etc.;
e) Reduce impact severity (e.g. by using a breakaway feature or by setting a culvert flush with the existing ground);
f) Provide a suitable safety barrier.
A new Chapter 8 has been added to NRA TD 19 to include a risk assessment procedure for schemes involving online realignment on National Roads.
Purpose of Safety Barrier
Risk Assessment Procedure

To assess the need for a safety barrier on a scheme involving online realignment.
Risk Assessment Procedure

Steps

The Designer shall undertake the following risk assessment procedure for all hazards and record it in the risk assessment sheet:

- Establish if hazard within the clear zone and can be mitigated;
- Rank the hazard - new Appendix D of NRA TD19;
- Calculate the sinuosity of that section of road;
Risk Assessment Procedure

Steps

- Assess the collision rate threshold for that section of road;
- Assess the risk of a vehicle leaving the road based on sinuosity ranking and collision rate ranking;
- Assess the overall risk rating;
- Undertake a site survey to confirm the need for a safety barrier.
The Designer shall complete a risk assessment sheet using the new layout included in Appendix C of NRA TD 19.
A hazard is any physical obstruction which may, in the event of an errant vehicle leaving the carriageway, result in significant injury to the occupants of the vehicle.
Chapter 3 of NRA TD 19 gives the types of hazard which present a significant risk to an errant vehicle.

Categories of hazards include side slopes, fixed objects, water and linear hazards e.g. roads, railways.
Hazard Categories

- New/Updated fixed objects within the Clear Zone considered as hazards requiring mitigation (par 3.17):
  - Wooden poles/posts with **cross-sectional area > 25,000mm²** that do not have breakaway features
  - Timber posts and rail fences if not being used as a road boundary
  - Drainage items, such as culvert headwalls and transverse ditches that are not detailed to be traversed safely
Hazard mitigation measures shall be considered by the Designer prior to designing a safety barrier.

A safety barrier shall only be introduced if the hazard cannot be mitigated.
Hazard Mitigation

Where possible hazards shall be mitigated as follows in accordance with Par 3.9:

- Remove;
- Relocate;
- Re-design the hazard to reduce the risk to road users e.g. introducing a passively safe sign post;
Hazard Mitigation

- Revise the road layout or cross-section to lower the risk, e.g. increase the width of the hard shoulder, improve the road alignment, etc;
- Reduce impact severity e.g. by setting a culvert flush with the existing ground;
- Provide a suitable safety barrier.
If the hazard cannot be mitigated the Designer shall assess if the hazard ranking is:

- **High**
- **Medium**
- **Low**

using the new suggested hazard ranking system included in the new Appendix D and record it in the risk assessment sheet.
Sinuosity

Sinuosity Index (SI) = \frac{\text{Actual section length between A and B}}{\text{Shortest Path between A and B}}
Sinuosity

- The sinuosity index shall be calculated by the Designer **on the approach** to a hazard

- Minimum length over which the sinuosity shall be assessed = \textbf{200m}
Sinuosity

Hazard Located within or at the end of a Horizontal Curve
Sinuosity

Hazard located on a straight or nearly straight section beyond a horizontal curve

Desirable minimum SSD length for the Design Speed
Hazard located on a straight or nearly straight section of road beyond the horizontal curve and the Desirable Minimum SSD length.
The Desirable Minimum SSD length shall be as per Table 1/3 of NRA TD 9 for the particular Design Speed.

<table>
<thead>
<tr>
<th>DESIGN SPEED (km/h)</th>
<th>120</th>
<th>100</th>
<th>85</th>
<th>70</th>
<th>60</th>
<th>50</th>
<th>( V^2/R )</th>
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<tbody>
<tr>
<td>STOPPING SIGHT DISTANCE m</td>
<td></td>
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<td></td>
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<tr>
<td>Desirable Minimum Stopping Sight Distance</td>
<td>295</td>
<td>215</td>
<td>160</td>
<td>120</td>
<td>90</td>
<td>70</td>
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<tr>
<td>One Step below Desirable Minimum</td>
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<td>160</td>
<td>120</td>
<td>90</td>
<td>70</td>
<td>50</td>
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<td>Two Steps below Desirable Minimum</td>
<td>160</td>
<td>120</td>
<td>90</td>
<td>70</td>
<td>50</td>
<td>50</td>
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<table>
<thead>
<tr>
<th>HORIZONTAL CURVATURE m</th>
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<tbody>
<tr>
<td>Minimum R without elimination of Adverse Camber and Transitions</td>
<td>2880</td>
<td>2040</td>
<td>1440</td>
<td>1020</td>
<td>720</td>
<td>510</td>
<td>5</td>
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<tr>
<td>Minimum R with Super elevation of 2.5%</td>
<td>2040</td>
<td>1440</td>
<td>1020</td>
<td>720</td>
<td>510</td>
<td>360</td>
<td>7.07</td>
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<td>Minimum R with Super elevation of 3.5%</td>
<td>1440</td>
<td>1020</td>
<td>720</td>
<td>510</td>
<td>360</td>
<td>255*</td>
<td>10</td>
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<tr>
<td>Desirable Minimum R with Super elevation of 5%</td>
<td>1020</td>
<td>720</td>
<td>510</td>
<td>360</td>
<td>255*</td>
<td>180*</td>
<td>14.14</td>
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<tr>
<td>One Step below Desirable Min R with Super elevation of 7%</td>
<td>720</td>
<td>510</td>
<td>360</td>
<td>255*</td>
<td>180*</td>
<td>127*</td>
<td>20</td>
</tr>
<tr>
<td>Two Steps below Desirable Min R with Super elevation of 7%</td>
<td>510</td>
<td>360</td>
<td>255*</td>
<td>180*</td>
<td>127*</td>
<td>90*</td>
<td>28.28</td>
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<tr>
<td>Three Steps below Desirable Min R with Super elevation of 7%</td>
<td>180</td>
<td>127*</td>
<td>90*</td>
<td>65*</td>
<td>40</td>
<td></td>
<td></td>
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<tr>
<td>Four Steps below Desirable Min R with Super elevation of 7%</td>
<td>127</td>
<td>90*</td>
<td>65*</td>
<td>44*</td>
<td>56.56</td>
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<table>
<thead>
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<td>100</td>
<td>55</td>
<td>30</td>
<td>17</td>
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<tr>
<td>One Step below Desirable Min Crest K Value</td>
<td>100</td>
<td>55</td>
<td>30</td>
<td>17</td>
<td>10</td>
<td>6.5</td>
<td>6.5</td>
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<tr>
<td>Two Steps below Desirable Min Crest K Value</td>
<td>55</td>
<td>30</td>
<td>17</td>
<td>10</td>
<td>6.5</td>
<td>6.5</td>
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<table>
<thead>
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<th>VERTICAL CURVATURE – SAG</th>
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<td>Desirable Minimum Sag K Value</td>
<td>53</td>
<td>37</td>
<td>26</td>
<td>20</td>
<td>13</td>
<td>9</td>
<td>6.5</td>
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<tr>
<td>One Step below Desirable Min Sag K Value</td>
<td>37</td>
<td>26</td>
<td>20</td>
<td>13</td>
<td>9</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Two Steps below Desirable Min Sag K Value</td>
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<td>20</td>
<td>13</td>
<td>9</td>
<td>6.5</td>
<td>6.5</td>
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<table>
<thead>
<tr>
<th>*** Absolute Minimum Vertical Curve Length to be used on Dual Carriageways</th>
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<tr>
<td></td>
<td>240</td>
<td>200</td>
<td>-</td>
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<table>
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<tr>
<th>OVERTAKING SIGHT DISTANCES</th>
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<tr>
<td>Full Overtaking Sight Distance FOSD m</td>
<td>N/A</td>
<td>580</td>
<td>490</td>
<td>410</td>
<td>345</td>
<td>290</td>
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<tr>
<td>Overtaking Crest K Value</td>
<td>N/A</td>
<td>400</td>
<td>285</td>
<td>200</td>
<td>142</td>
<td>100</td>
<td></td>
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</tbody>
</table>
Sinuosity

Nearly Straight sections shall be as per Figure 7/6 of NRA TD 9.
Sinuosity is divided into three sinuosity rankings as follows:

- High (H) - Sinuosity Index > 1.02;
- Medium (M) - 1.004 ≤ Sinuosity Index ≤ 1.02;
- Low (L) - Sinuosity Index < 1.004

The Designer shall record the calculated Sinuosity Index and the Sinuosity Ranking in the risk assessment sheet.
Collision Rate Thresholds as per NRA HD 15

Collision Rate Threshold Data can be requested from the NRA by the Designer at infosafety@NRA.ie
Collision Rate Ranking

The Designer shall assign a Collision Rate Ranking to the Collision Rate Threshold for the section of road and record it in the risk assessment sheet:

- High (H) - Twice Above Expected Collision Rate;
- Medium (M) - Above Expected Collision Rate;
- Low (L) - Below Expected Collision Rate and Twice Below Expected Collision Rate.
## Risk of a Vehicle Leaving the Road

### Collision Rate Ranking

<table>
<thead>
<tr>
<th>Risk of a Vehicle Leaving the Road</th>
<th>Collision Rate Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinuosity Ranking</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

*Where H=High, M=Medium, L=Low*
## Overall Risk Rating

*Where H=High, M=Medium, L=Low*

<table>
<thead>
<tr>
<th>Overall Risk Rating</th>
<th>Hazard Ranking</th>
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</thead>
<tbody>
<tr>
<td>Risk of a vehicle leaving the road</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>
Overall Risk Rating

For each hazard location a determination shall be made as follows:

**Overall risk rating – High**

- Safety barrier shall be installed or the hazard shall be mitigated.
Overall Risk Rating

Overall risk rating – Medium

- Safety barrier shall be installed or the hazard shall be mitigated if within 2m of carriageway edge.

- If the hazard is ≥ 2m from the carriageway edge, the Designer shall assess the hazard level and the risk of a vehicle leaving the road on site and determine if a safety barrier is required.
Overall Risk Rating

Overall risk rating - Low

- A safety barrier is not required.

Each determination shall be recorded in the risk assessment sheet along with the reason for providing or not providing the safety barrier.
A site survey shall be carried out by the Designer as part of the risk assessment procedure to confirm the need or otherwise for a safety barrier at all locations.
The Design Organisation shall follow the risk assessment procedure outlined in Chap 8 of NRA TD 19 and include the risk assessment sheet in the Preliminary Design Report.

The Design Organisation shall review the operational characteristics of any existing safety barriers for compliance with NRA TD 19 and replace those which do not satisfy the requirements of the standard.
Checklist - Preconstruction

- Specify barrier in accordance with NRA TD 19?
  - This includes Containment (N2, H2 or H4a for rail)
  - Impact Severity (A or B, now also C)
  - Working Width (Is there anything within the working width, including passively safe products)
  - Set-back (How far the barrier should be from the road)
Construction Checklist
Clause 401.2: The person responsible for the design shall ensure:

(i) comply with this Series, Appendices 4/1, 4/3 and 4/7 and the requirements of standards NRA TD19 and NRA BD52 (as appropriate);

(ii) are certified in accordance with IS EN 1317-5 to conform to the parameters of containment level, impact severity level and working width identified in Appendices 4/1 and 4/7; and

(iii) are installed in accordance with the manufacturers’ installation manual, attached to the relevant CE Certificate.
Construction Checklist

- Is the barrier CE marked to EN 1317
- Has it been installed in accordance with the test report (Installation Manual)?

Ask for it!!!
Construction Checklist

- Has the barrier been modified?
- Have the Ground Conditions been certified by an independent Chartered Engineer?
Compatibility

- Can the terminal function adequately in combination with the type of safety barrier it is attached to.
- Contractor must check with the Safety Barrier manufacturer(s) and ensure that the proposed Safety Barrier and Terminal will act together and meet the Performance criteria.
Finally: Please check that it has been installed properly!!!
Safety Barrier Site Info

THANK YOU

ANY QUESTIONS??

National Roads Authority - Standards Section
Training for New Developments
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