Presentation Outline

• Drivers of Change

• Structures Specification – NRA Manual Contract Documents Road Works (NRA MCDRW)

• Structures Standards – NRA Design Manual for Roads & Bridges (NRA DMRB)

• The Evolving EuroCodes

• NRA Weigh-In-Motion (WIM)
Drivers of Change

What’s Driving Change?

- No more Addendums
- EuroCodes
- EuroNorms
- Construction Products Regulations (CPR)
- Outdated or Unclear Standards / Specifications
- New Materials
- Formatting
- Poor Construction practice + Lessons learnt
- Background Reading / Advice Notes – No contractual relevance
### NRA SD 02 Volume Contents

5 new documents have been published recently

Working on updating 3 others – available 2015

<table>
<thead>
<tr>
<th>NRA MCDRW Part</th>
<th>Document or Series Number</th>
<th>Document or Series Title</th>
<th>Document or Series Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume 1</td>
<td>1600</td>
<td>Piling and Diaphragm Walling <em>(including Erratum No. 1, March 2011)</em></td>
<td>December 2010</td>
</tr>
<tr>
<td>Volume 1</td>
<td>1700</td>
<td>Structural Concrete</td>
<td>December 2013</td>
</tr>
<tr>
<td>Volume 1</td>
<td>1800</td>
<td>Structural Steelwork</td>
<td>June 2014</td>
</tr>
<tr>
<td>Volume 1</td>
<td>1900</td>
<td>Protection of Steelwork Against Corrosion</td>
<td>June 2014</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2000</td>
<td>Waterproofing for Concrete Structures</td>
<td>December 2010</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2100</td>
<td>Bridge Bearings</td>
<td>March 2011</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2200</td>
<td>Parapets (Not Used)</td>
<td>March 2013</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2300</td>
<td>Bridge Expansion Joints and Sealing of Gaps</td>
<td>December 2010</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2400</td>
<td>Brickwork, Blockwork and Stonework</td>
<td>December 2013</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2500</td>
<td>Special Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>Volume 1</td>
<td>2600</td>
<td>Miscellaneous</td>
<td>December 2010</td>
</tr>
</tbody>
</table>
Series 1700 *(December 2013)* - *Structural Concrete*

**Overview**

- EuroCodes *(IS EN 1992)* based on assumption of construction and workmanship (execution) to **IS EN 13670** *(Construction Management; Falsework & Formwork; Reinforcement; Prestressing; Concreting; Precast Elements; and Geometrical Tolerances)*

- New Series 1700 now aligned with IS EN 13670 *(Concrete Execution Code)*

- New Series 1700 is based on new HA Series 1700 *(rewritten for Ireland)*

- Full review and update of all product standards referenced within Series 1700 to ensure compliance with the latest EuroNorms

- Provides general requirements to Designers compiling contract specific structural concrete specifications on NRA schemes
Series 1700 - *Structural Concrete*

**Items of Note:**

- **Execution Specification (1701.3)**
  - Before commencement of construction of any works the execution specification relevant to that works must be complete and available (Table NG 17/1)

- **Execution Class (1701.4)**
  - All works shall be built in accordance with Execution Class 3
  - A set of requirements specifying quality levels for construction of the works (Inspection of Material & Products; Inspection of Execution; Documentation of Inspection)

- **Self Compacting Concrete (1706.3)**
  - Not permitted for any insitu works
  - If proposed in factory produced precast elements - prior approval of ER required
  - If approved by ER – Shall conform to IS EN 206-9 & Testing to IS EN 12350-8 to 12
Series 1700 -

**Structural Concrete**

**Items of Note:**

- **Trial Panels** (1708.1)
  - This is not new! But we don’t get them on-site?
  - Required (prior to works) for all exposed concrete
  - To demonstrate surface finish can be achieved by the methods proposed

- **Curing of Concrete** (1710.5)
  - Curing Class 3 (Cl 8.5 of IS EN 13670 & Annex F) required
  - Duration – function of the development of 28 days compressive strength (50%)
  - Concrete must be protected against harmful effects of weather (rain, temperature etc)

- **Geometrical Tolerances** (1728)
  - Tolerances have been provided for road structures
  - Irrespective of geometrical tolerances used - Modified partial safety factors (IS EN 1992-1-1 / IS EN 13369) not permitted
Series 1700 - *Structural Concrete*

**Items of Note:**

- CE Marking of Precast Products
  - IS EN 13670 considers precast elements to be products. The key standards are:
    - IS EN 15050 – Bridge Elements
    - IS EN 14844 – Box Culverts
Series 1800 (June 2014) -

**Structural Steelwork**

**Overview**

- Old Series 1800 based on BS 5400 Part 6 - now obsolete
- EuroCodes (IS EN 1993) based on assumption of executing to IS EN 1090-2
- New Series 1800 based on IS EN 1090-2 (Steel Execution Code)
- Based on new Highways Agency Series 1800 (rewritten for Ireland) which in turn is based on BSi PD 6705 (Recommendations for the execution of steel bridges to EN 1090-2)
- Provides general requirements to Designers compiling contract specific structural steelwork specifications in accordance with IS EN 1090-2
- Aim is to ensure technically sound choices are made, resulting in bridges being executed as economical as possible, whilst maintaining the level of reliability implicit of IS EN 1990 & IS EN 1993
Main Differences between IS EN 1090-2 & BS 5400-6

- **User Decision:**
  - 200 NDPs within IS EN 1090-2 compared to 39 within BS 5400-6

- **Scope of Application:**
  - IS EN 1090-2 applies to all types of structural steelwork (BS 5400-6 specific to bridges)

- **Reference Standards:**
  - IS EN 1090-2 references over 100 new European standards many of which replace British Standards (referenced within BS 5400-6)

- **Material Grades:**
  - Range for plates & sections has increased from S460 (BS 5400-6) to S690 (IS EN 1090-2)
Main Differences between IS EN 1090-2 & BS 5400-6

- **Product Forms:**
  - IS EN 1090-2 covers high strength cables (BS 5400-6 did not)

- **Execution Methods:**
  - IS EN 1090-2 allows laser & plasma cut holes (not covered in BS 5400-6)

- **Personnel Qualification:**
  - IS EN 1090-2 has qualification requirements for welding co-ordinators, welders & weld inspectors. BS 5400-6 did not address this.

- **Quality Management:**
  - IS EN 1090-2 addresses the subject of quality documentation & quality plans in a more explicit manner.
Main Differences between IS EN 1090-2 & BS 5400-6

- **Quality Control:**
  - IS EN 1090-2 is based on Factory Production Control (FPC) which is on-going and testing is not specific to any particular contract or structure. BS 5400-6 does not address FPC.

- **Acceptance Levels:**
  - As a result of FPC, target quality levels must be high enough to cover the most quality sensitive design situations. BS 5400-6 quality based on fitness for purpose.

- **Geometrical Tolerances:**
  - IS EN 1090-2 has more comprehensive requirements than BS 5400-6.

- **Surface Treatment:**
  - IS EN 1090-2 covers the application of surface coatings (BS 5400-6 did not)
Series 1800 - *Structural Steelwork*

**Items of Note:**

- **CE Marking of Products**
  - Open Sections – IS EN 10025-1
  - Hollow Sections – IS EN 10210-1
  - Plates – IS EN 10025-1

- **CE Marking of fabricated structural steelwork**
  - Fabricated structural steelwork – IS EN 1090-1

- **Execution Class**
  - Consequence Class (CC) + Service Category (SC) + Production Category (PC) = Execution Class (EXC1, EXC2, EXC3 or EXC4)
  - For bridges **EXC3** shall generally (Cl. 1804.1.2) – i.e. EXC4 for long span bridges
Series 1800 - 
*Structural Steelwork*

**Items of Note:**

- Responsibility of Main Contractor to carry out due diligence of Steelwork Contractor
- Steelwork Contractor appointed must have an Execution Class equal to that required for the project (EXC3 typically)
- Compliance with IS EN 1090-1 is no small task and places obligations on the steelwork contractor that are onerous and take significant time to put in place
- Steelwork Contractor must demonstrate compliance with the CPR and CE Marking:
  - Factory Production Control (FPC) Certificate – issued by a notified body
  - Welding Certificate – issued by a notified body
  - Declaration of Performance (DoP) – issued by steelwork contractor
Thompson Project Manager

Newcastle, Ally Road Car

and produced in the 15th

placed on the market

Thompson - CPR -

Factory Production Certificate

Structural Components for use

2273-CPR -

EC Certificate

Welded steel components in accordance with drawings

Ks G1-C5 FT-1 M3 and Volume A Works Requirement

Declaration of Performance

Job No. 8003 Newcastle Footbridge

Thompson

Type:

Steel structures or composite steel and concrete

Welded steel components are made from hot

rolled, cold-formed steel. Steel material from which

components are made can be in various shapes/profiles

e.g. plates, sheet, strip, bars, castings or forgings.

Steel Construction Certification Scheme Limited

2273

Notified Body: 4 Whitehall Court, Westminster

London SW1A 2LS

Thompson Project Management Ltd.

Newcastle, Ally Road, CQC245

Steel Construction Certification Scheme has performed (1) initial inspection of the

manufacturing plant and factory product control and (2) continuous surveillance,

assessment and evaluation of factory production control and issued Factory

production control certificate. Certification certificate 2273-CPR-4225 and Welding certificate 2273-CPR-4225/01.

System 2+
Overview

- RCDs updated to reflect a revised sign clamping detail for each of the groups – ensures future versatility
- RCDs updated to take account of the EuroCodes (all BS references removed)
- RCDs updated to take account of the EuroNorms
- The purpose of the Family Groups is to ensure a consistency of structural form across the network
Series 1800 –
*Road Construction Details – Steelwork for Structures* *(RCD/1800/1 to RCD/1800/9)*

**Items of Note**

- All Gantry’s require an independent Design & Check to be undertaken
- All Gantry legs < 4.5m from edge of carriageway shall be designed for impact (regardless of presence of vehicle restraint system)
- All section sizes and details are minimum indicative sizes only
- It is the responsibility of the Designer to avoid clashes of the clamps and steelwork
- A 750mm concrete plinth has been introduced for all Family Groups
- All splices and connections to be fully top coated after assembly - All gaps to be sealed
Series 1800 –
Road Construction Details – Steelwork for Structures (RCD/1800/1 to RCD/1800/9)

Structures Specifications – NRA MCDRW
Series 1900 *(June 2014)* - *Protection of Steelwork against Corrosion*

**Overview**

- Based on new Highways Agency Series 1900 (rewritten for Ireland)
- Takes account of updates made to NRA BD 35/14 *(Quality Assurance Scheme for Paints)*
- No changes to maintenance painting clauses *(1970 to 1984)*
- Compatible with IS EN 1090-2 – Execution of Steel Structures
- Provides guidance to Designers compiling contract specific specifications pertaining to surface preparation and corrosion protection
- Provides guidance to those undertaking the works
- Aim to provide economic safe working life from steel assets
Series 1900 -  
**Protection of Steelwork against Corrosion**

**Items of Note:**

- Update of Table 19/1 (Permissible Paint Item Numbers)
  - 2 added / 16 deleted
- Update of Table 19/2B (System Requirements for Bridges)
  - Minimum dft for the system increased from 475 to 525 microns
- Paint Testing **is** Required - CREST is Testing Authority
  - has always been required but not typically undertaken!!
  - ‘A’ samples (quality assurance) – if >500 litres (previously 1000 litres)
  - ‘B’ samples (application control) – required in all cases
Series 1900 - Protection of Steelwork against Corrosion

Items of Note:

- Independent Painting Inspection Firm Required
  - Shall be employed by the Contractor
  - Inspect & Test all corrosion protection systems in-shop and on-site
  - Personnel – shall be certified painting inspectors (Level 2 Icorr Cert / CIP Level 2)
  - ER must review and approve CVs
  - Inspectors Report required to be submitted to ER within 5 days of inspection

- Thermally sprayed metal coating – excluded from general protection of bridges
- Aluminium – preferred thermally sprayed metal coating (where appropriate – bearings, CCTV masts, lighting columns)
- Zinc metal spray no longer permissible
### Series 1900 - Structures Specifications

**Protection of Steelwork against Corrosion**

- **Steelwork Except** Bearings, CCTV Masts, Cantilever Masts, Steel Lighting Columns and Bracket Arms
- **Difficult Access**

#### Table:

<table>
<thead>
<tr>
<th>Item No</th>
<th>Min dry film thickness per coat (µm)</th>
<th>Min dry film thickness (µm)</th>
<th>Item No</th>
<th>Min dry film thickness per coat (µm)</th>
<th>Min dry film thickness (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>109, 112, 167, 168, 169 or 185</td>
<td>50, 125, 25, 50 or 100</td>
<td>400</td>
<td>450 if Item 185 finish is specified</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50, 125, 25, 50 or 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Finishes are specified according to conditions.*
## Series 1900
**Protection of Steelwork against Corrosion**

### Structures Specifications

**APPENDIX 19/1**
(SPECIFICATION FOR HIGHWAY WORKS)

**FORM HA/P1 (NEW WORKS) PAINT SYSTEM SHEET**

<table>
<thead>
<tr>
<th>1. <strong>CONTRACT TITLE:</strong></th>
<th>M9 Kilcullen Services Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STRUCT Ref. ST02 and ST03</td>
</tr>
</tbody>
</table>

**GRID REF:** Refer to Drawings

**DATE OF ISSUE OF DOCUMENTS TO TENDERERS:** November 2014

**ENVIRONMENT AND ACCESSIBILITY:** INLAND - DIFFICULT ACCESS

**REQUIRED DURABILITY OF SYSTEM**

<table>
<thead>
<tr>
<th>NO MAINTENANCE</th>
<th>up to 12 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINOR MAINTENANCE</td>
<td>from 12 years</td>
</tr>
<tr>
<td>MAJOR MAINTENANCE</td>
<td>after 20 years</td>
</tr>
</tbody>
</table>

**COLOUR OF FINISH:**

| Grey BS 4800 00A09 |

**PAINT SYSTEM TO BE APPLIED OVER:**

**AREA REF:** A, D, E

**AREA DESCRIPTION:** Structural Steelwork (for Contract Surface of HSFG. Bolted Joints see Area C)

**PROTECTIVE SYSTEM TYPE:** II

### DETAILS

<table>
<thead>
<tr>
<th>Item No. &amp; Colour</th>
<th>1(^{st}) Coat</th>
<th>2(^{nd}) Coat</th>
<th>3(^{rd}) Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 - 08 C 35</td>
<td>Zinc Phosphate Blast Primer 2 pack</td>
<td>2 Pack Glass Flake Epoxy</td>
<td>2 Pack Polyurethane Finish</td>
</tr>
<tr>
<td>123 - 11480 (Grey)</td>
<td>169 - 55610</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Date Registered by DTP and BBA Cert No.:**

| 27/03/2014 | 27/03/2014 | 27/03/2014 |
| 08/H135 (PS5) | 08/H135 (PS1) | 08/H135 (PS13) |

**Brand Name and Manufacturers Ref No.:**

| HEMPADUR 1555E | HEMPADUR MULTI-STRENGTH GF 35870 | HEMPATHANE 55610 |

**Data Sheet Ref No.:**

| 1555E | 35870 | 55610 |

**Where applied:**

| Shop | Shop | Shop |
Items of Note

- New Clauses pertaining to the Masonry Repointing of Historic Structures have been added
  - (17) Clauses 2401 to 2416 pertain to brickwork, blockwork & stonework within new construction
  - (16) Clauses 2450 to 2465 pertain to historic structures

- A Lime Mortar shall be used for the repointing of all Historic Structures (and any other structure originally constructed using a lime mortar)

- Series 2400 has been updated to reflect the latest EuroNorms – All outdated British Standards have been removed (e.g. BS 4027 ~ IS EN 197-1)

- A new RCD (RCD/2400/7) pertaining to the Principles of Stonemasonry has been created
Structures Specifications – NRA MCDRW

Series 2400 (December 2013) - Road Construction Details – Walls (RCD/2400/7)

Natural Bedding and Lengths
Laid Into Wall - Correct

Face Bedding - Wrong
Overview

- Concern about poor quality agricultural underpasses being constructed beneath the national road network
- These were typically one off developments and were constructed with little or no consideration to NRA standards (sub-standard)
- Aim to produce a set of RCDs that would inform all parties of keys issues to be addressed (prior to any works being undertaken)
- Pulls together all NRA requirements into one location
- An extensive set of drawing notes have been included (RCD/2500/3)
Series 2500 -

*Road Construction Details – Special Structures* *(RCD/2500/1 to RCD/2500/3)*

Items of Note

- **Design:**
  - Chartered Engineer with previous National Road Design Experience required
  - Prior to Planning Application a TAR must be submitted to the NRA for approval
  - No gabions permitted as part of any earth retention system
  - Eurocodes / EuroNorms & NRA DMRB & NRA MCDRW

- **Vehicle Restraint System:**
  - In accordance with NRA TD 19 for approach / departure lengths, working widths

- **Execution:**
  - Road opening licence required from the relevant LA
  - Construction Sequence & Traffic Management to be agreed with LA (and addressed within TAR)
Structures Specifications – NRA MCDRW

Series 2500 -
Road Construction Details – Special Structures (RCD/2500/1 to RCD/2500/3)

Items of Note

➤ Road Safety Audit:
  ➤ Stage 2 & Stage 3 Road Safety Audits required (NRA HD 19)

➤ Road Reinstatement:
  ➤ Proposals must be approved by the LA prior to any works taking place (condition of the road opening licence)

➤ Health and Safety:
  ➤ PSDP, PSCS & Risk Assessments required in accordance with Safety, Health & Welfare (Construction) Regulations
Look Ahead (Future Work 2015) – 4 new documents planned for 2015

- **NRA Series 2000 Waterproofing for Concrete Structures**:  
  - To be rewritten from scratch to suit the Irish market  
  - To be reviewed in conjunction with planned update of BD47 & BA47

- **NRA Series 2100 Bridge Bearings**:  
  - To be rewritten from scratch to suit the Irish market  
  - To be reviewed in conjunction with planned update of BD20

- **NRA Series 2300 Bridge Expansion Joints & Sealing of Gaps**:  
  - To be rewritten from scratch to suit the Irish market  
  - To be reviewed in conjunction with planned update of BD33 & BA26

- **NRA Series 5500 Structural Concrete Repairs**:  
  - No NRA specification pertaining to concrete repair to date  
  - To be based upon draft HA Concrete Repair Specification  
  - IS EN 1504 Products & Systems for the Protection/Repair of Concrete Structures
Structures Standards – NRA DMRB

NRA Design Manual for Roads and Bridges

The Volume Contents and Alphanumeric Index document (Volume 0, Section 1, Part 1 of the NRA DMRB) provides a list, volume by volume, of the current documents of the Design and Construction for Roads and Bridges, as implemented in Ireland. It also provides an index in alpha-numeric order. This document is updated regularly and may be used as a check of the current status of the NRA DMRB and the implementation documents.

Title | Folders/Files
--- | ---
Volume 0: Introduction and Contents | (0/5)
Volume 1: Highway Structures: Approval procedures and general design | (0/15)
Volume 2: Highway Structures: Design (Substructures and Special Structures) Materials | (0/37)
Volume 3: Highway Structures: Inspection and Maintenance | (0/50)

http://nrastandards.nra.ie
<table>
<thead>
<tr>
<th>Section</th>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1</td>
<td>BD 36</td>
<td>Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures</td>
</tr>
<tr>
<td>1.2.2</td>
<td>BA 28</td>
<td>Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures</td>
</tr>
<tr>
<td>1.3.4</td>
<td>BA 40</td>
<td>Tack Welding of Reinforcing Bars</td>
</tr>
<tr>
<td>1.3.13</td>
<td>BA 53</td>
<td>Bracing Systems and the Use of U-Frames in Steel Highway Bridges</td>
</tr>
<tr>
<td>1.3.14</td>
<td>BD 10</td>
<td>Design of Highway Structures in Areas of Mining Subsidence</td>
</tr>
<tr>
<td>1.3</td>
<td>BA 19</td>
<td>The Use of BS 5400: Part 3</td>
</tr>
<tr>
<td>1.3</td>
<td>BA 24</td>
<td>Early Thermal Cracking of Concrete</td>
</tr>
<tr>
<td>1.3.15</td>
<td>BA 84</td>
<td>Use of Stainless Steel Reinforcement in Highway Structures</td>
</tr>
<tr>
<td>1.3</td>
<td>BE 23</td>
<td>Shear Key Decks</td>
</tr>
<tr>
<td>1.3</td>
<td>BE 5</td>
<td>Rules for the Design and Use of Freyssinet Concrete Hinges in Highway Structures.</td>
</tr>
<tr>
<td>1.3.8</td>
<td>BA 57</td>
<td>Design for Durability</td>
</tr>
</tbody>
</table>
# Structures Standards – NRA DMRB

**NRA GD 02**  
**Volume 1**

<table>
<thead>
<tr>
<th>DMRB Part</th>
<th>Number</th>
<th>Title</th>
<th>NRA Addendum or Standard Dated</th>
<th>UK DMRB Reference Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1: Approval Procedures</td>
<td>1.1.1A</td>
<td>NRA BD 2* Technical Approval of Road Structures on Motorways and Other National Roads</td>
<td>January 2009</td>
<td>N/A</td>
</tr>
<tr>
<td>Section 2: Other Procedural Documents</td>
<td>1.2.3</td>
<td>NRA BD 95* Treatment of Existing Structures on Highway Widening Schemes</td>
<td>December 2014</td>
<td>N/A</td>
</tr>
<tr>
<td>Section 3: General Design</td>
<td>1.3.5</td>
<td>NRA BD 60* Use of I.S. EN 1991-1-7 for the Design of Accidental Actions</td>
<td>December 2010</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>1.3.6</td>
<td>BA 59 Design of Highway Bridges for Hydraulic Action</td>
<td>-</td>
<td>May 1994</td>
</tr>
<tr>
<td></td>
<td>1.3.7</td>
<td>NRA BD 57* Design for Durability</td>
<td>December 2010</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>1.3.11</td>
<td>BA 41 The Design and Appearance of Bridges</td>
<td>-</td>
<td>February 1998</td>
</tr>
<tr>
<td></td>
<td>1.3.16</td>
<td>BD 84 Strengthening of Concrete Bridge Supports Using Fibre Reinforced Polymers</td>
<td>December 2002</td>
<td>August 2002</td>
</tr>
<tr>
<td></td>
<td>1.3.17</td>
<td>BD 90 Design of FRP Bridges and Highways Structures</td>
<td>-</td>
<td>May 2005</td>
</tr>
<tr>
<td></td>
<td>1.3.18</td>
<td>BD 85 Strengthened Highway Structures Using Externally Bonded Fibre Reinforced Polymer</td>
<td>-</td>
<td>November 2008</td>
</tr>
</tbody>
</table>

Table 1: Standards and Advice Notes Available for Use in Ireland
NRA BD 95/14 (Dec 2014) - Treatment of Existing Structures on Road Widening Schemes

Overview

- Provides requirements for the treatment of existing structures affected by road widening schemes
- Based on HA BD 95/07 (rewritten for Ireland)
- Describes the process to be applied through preliminary & detailed design
- Provides advice to commonly encountered situations (typical current design standard requirements not met by existing structures) – Appendix B
- Reuse as much existing infrastructure as possible where economical to do so (e.g. Departures for existing non-compliances?)
- Clarifies the requirements for Assessment of Existing structures (Review of Existing Assessment Form – REAF – Appendix A)
The Procedure for Dealing with Existing Structures - Process Flow Chart

Everything should combine to form the Preliminary Design Report (PDR) – this occurs within Phase 1 to 4 of a scheme.
### A.1. Review of Existing Assessment Form (REAF)

<table>
<thead>
<tr>
<th>Structure Details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure Name</strong></td>
<td><code>&lt;Structure Name&gt;</code></td>
</tr>
<tr>
<td><strong>Eirspan Structure Number</strong></td>
<td><code>&lt;e.g. KY-N86-021.00&gt;</code></td>
</tr>
<tr>
<td><strong>Northing : Easting</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Date Commissioned</strong></td>
<td><code>&lt;Date that the structure came into service&gt;</code></td>
</tr>
<tr>
<td><strong>Bridge Spans</strong></td>
<td><code>&lt;Name of road, railway, river etc.&gt;</code></td>
</tr>
<tr>
<td><strong>Minimum Headroom</strong></td>
<td><code>&lt;Minimum headroom&gt;</code></td>
</tr>
<tr>
<td><strong>Bridge Carries</strong></td>
<td><code>&lt;Name of road, railway etc&gt;</code></td>
</tr>
</tbody>
</table>

**Brief Description of Structure**

*Give a brief description of the structure including structural type (deck, substructure and foundations). Identify any unusual features or modifications since first constructed.*

<table>
<thead>
<tr>
<th>Existing Assessment Details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspection for Assessment Date</strong></td>
<td><code>&lt;Date&gt;</code></td>
</tr>
<tr>
<td><strong>Recorded Condition</strong></td>
<td><code>&lt;Condition Factor&gt;</code></td>
</tr>
<tr>
<td><strong>Assessment Date</strong></td>
<td><code>&lt;Date&gt;</code></td>
</tr>
<tr>
<td><strong>Report Number</strong></td>
<td><code>&lt;Report Number&gt;</code></td>
</tr>
<tr>
<td><strong>Assessing Engineer</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Company</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Current Assessed Capacity</strong></td>
<td></td>
</tr>
<tr>
<td><strong>HA</strong></td>
<td><code>&lt;eg 40te&gt;</code></td>
</tr>
<tr>
<td><strong>HB</strong></td>
<td><code>&lt;eg 30HB&gt;</code></td>
</tr>
<tr>
<td><strong>Parapet</strong></td>
<td><code>&lt;eg N2 with mesh infill assessed as satisfactory&gt;</code></td>
</tr>
<tr>
<td><strong>Pier Impact</strong></td>
<td><code>&lt;eg Passes to NRA BD 48&gt;</code></td>
</tr>
<tr>
<td><strong>Certification</strong></td>
<td><code>&lt;Record if certificates exist&gt;</code></td>
</tr>
<tr>
<td><strong>Calculations</strong></td>
<td><code>&lt;Record if calculations exist&gt;</code></td>
</tr>
<tr>
<td><strong>As built drawings</strong></td>
<td><code>&lt;Record if as built drawings exist&gt;</code></td>
</tr>
<tr>
<td><strong>Comments on Assessment</strong></td>
<td><code>&lt;A brief summary of the assessment method and findings.&gt;</code></td>
</tr>
</tbody>
</table>
## NRA GD 02 – Volume Contents

### Volume 2 – Structures – Design & Materials

16 Documents Withdrawn

<table>
<thead>
<tr>
<th>Section</th>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>BD 41</td>
<td>Reinforced Clay Brickwork Retaining Walls of Pocket-Type and Grouted-Cavity Type Construction</td>
</tr>
<tr>
<td>2.1.2</td>
<td>BD 42</td>
<td>Design of Embedded Retaining Walls and Bridge Abutments</td>
</tr>
<tr>
<td>2.1.3</td>
<td>BD 68</td>
<td>Crib Retaining Walls</td>
</tr>
<tr>
<td>2.1.4</td>
<td>BA 68</td>
<td>Crib Retaining Walls</td>
</tr>
<tr>
<td>2.1.5</td>
<td>BD 70</td>
<td>Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments</td>
</tr>
<tr>
<td>2.1</td>
<td>BD 30</td>
<td>Backfilled Retaining Walls and Bridge Abutments</td>
</tr>
<tr>
<td>2.1.7</td>
<td>BA 80</td>
<td>Use of Rockbolts</td>
</tr>
<tr>
<td>2.2.1</td>
<td>BD 26</td>
<td>Design of Lighting Columns</td>
</tr>
<tr>
<td>2.2.2</td>
<td>BA 48</td>
<td>Pedestrian Protection at Head Walls, Wing Walls and Retaining Walls</td>
</tr>
<tr>
<td>2.2.11</td>
<td>BD 83</td>
<td>Design of CCTV Masts</td>
</tr>
<tr>
<td>2.2.13</td>
<td>BD 88</td>
<td>Design of Cantilever Masts for Traffic Signals and/or Speed Cameras</td>
</tr>
<tr>
<td>2.3.2</td>
<td>BA 37</td>
<td>Priority Ranking of Existing Parapets</td>
</tr>
<tr>
<td>2.3.7</td>
<td>BA 82</td>
<td>Formation of Continuity Joints for Use in Bridge Decks</td>
</tr>
<tr>
<td>2.3.9</td>
<td>BA 92</td>
<td>The use of recycled Aggregates in Structural Concrete</td>
</tr>
<tr>
<td>2.4.2</td>
<td>BA 27</td>
<td>Quality Assurance Scheme for Paints and Similar Protective Coatings</td>
</tr>
<tr>
<td>2.2</td>
<td>BE 7</td>
<td>Departmental Standard (Interim) Motorway Sign/Signal Gantries</td>
</tr>
</tbody>
</table>
Structures Standards – NRA DMRB

**NRA GD 02**
Volume 2

19 documents retained
3 new documents added
Overview

- Replaces NRA Addendums to BD26 (Design of Lighting Columns); BD83 (Design of CCTV Masts); & BD88 (Design of Cantilever Masts for Traffic Signals and/or Speed Cameras)

- Standalone NRA BD - Covers the design of support structures for roadside furniture (Lighting Columns; Masts to support CCTV, Traffic Signals, Speed Cameras; Traffic Signs)

- It incorporates the provisions of IS EN 40 (Lighting Columns) & IS EN 12899 (Fixed Vertical Road Traffic Signs)

- To be used when designing a support structure from first principles (typically these support structures are supplied as proprietary products – off the shelf)

- All proprietary products should be checked for compliance with this standard
NRA BD 94/14 (Dec 2014) - *Design of Support Structures for Roadside Furniture*

Items of Note:

- **Foundations (Chapter 11)** – Support Structures typically off the shelf but foundations responsibility of Design Engineer

- A TAR is required for certain minor structures (e.g. High Masts for lighting or cameras) in accordance with NRA BD2 (CAT 1)

- All design shall be in accordance with the Eurocodes

- Design Working Life (Cl 5.2) shall be in compliance with IS EN 1990 – Working Life Category 3 (up to 50 years for masts supporting lighting columns / traffic signals) & Working Life Category 4 (50-120 years for high mast lighting)

- Fatigue Criteria (Cl 5.10 – 5.16) – dependent on geometrical configuration & fabrication
Overview

- Replaces NRA Addendum to HA BD51/98 (17 years old)
- Based on new Highways Agency BD51/14 (rewritten for Ireland)
- Sets out the structural design requirements for Gantries (in terms of the EuroCodes)
- Updated to comply with the EuroCodes & EuroNorms (removal of obsolete references)
- Linked to the Series 1800 RCDs (Gantry groups 1 to 5) – all plate sizes are minimum sizes (prohibited to reduce plate / weld sizes)
- Relevant to any sign structure that cantilevers out over the carriageway / hard shoulder
- Identification Plates shall be attached to each new structure
Items of Note

- 60 year design life for gantry structures
- 5.8m vertical clearance required
- The limiting Structural Deformations (serviceability limit state) for gantries (Table 3.1) specified within BD51/98 have been retained
- Vehicle impact loading specified is similar to that stated within the NA to IS EN 1991-1-7
- The combined effects of axial compression / tension; torsion & biaxial bending must be checked
- Must check if a gantry is dynamically sensitive
- Supports within 4.5m of carriageway – must design for impact (regardless of VRS)
NRA BD 35/14 (June 2014) -
Quality Assurance Scheme for Paints and similar Protective Coatings

- Provides details of the quality assurance scheme for paints
- Provides Specifiers; Designers; & Supervisors of works guidance on the operation of the quality assurance scheme for paints
- Provides Manufacturers; Certifiers; & Testers of paints with paint material requirements
NRA BD 35/14 -

Quality Assurance Scheme for Paints and similar Protective Coatings

- Replaces NRA addendum to BD 35/99 – completely outdated (16 years old)
- Based on Highways Agency BD35/14 (rewritten for Ireland)
- Updated Appendix A – Manual of Paints for Structural Steelwork
- Provides data on paints permitted for use on NRA painting contracts
- 2 items added (Item No. 109, 167)
- 16 items deleted (Item No. 14, 32, 35, 47, 50, 70, 74, 124, 132, 133, 134, 135, 141, 150, 151, 156)
- Changes based on extensive research programme conducted in UK
- Developed in conjunction with industry
- Balance of performance v cost v traffic disruption on national roads
- For maintenance painting – refer to NRA BD 87 & contract specific requirements
NRA BD 35/14 - 
Quality Assurance Scheme for Paints and similar Protective Coatings

Quality Assurance Scheme

1. Certification of Paints
   - BBA HAPAS (or equivalent) required for all paint systems ([www.bbacerts.co.uk](http://www.bbacerts.co.uk))
   - Ensures required level of corrosion protection
   - Certification must be submitted to ER for approval

2. Testing of ‘A’ and ‘B’ samples
   - Requirements specified in Series 1900
   - Independent Testing Authority – CREST (or equivalent)
### Item No. 167

**GISTERED DESCRIPTION:** Epoxy Acrylic Finish (two-pack)

**LOURS:** As the manufacturer’s declared colour given with reference to BS 4800 and/or BS 381C where appropriate

**E:** As a decorative semi-gloss finish for new works or maintenance

**BULD AND METHOD OF APPLICATION:** NB / AS or B*

**TLINE COMPOSITION:**

- **Pigment Volume Concentration (%):** As described in manufacturer’s declared formulation
- **Pigment:** Rutile Titanium Dioxide (IS EN ISO 591-1:2000) and tinting pigments as described in the manufacturer’s declared formulation
- **Medium:** Carboxy functional styrene acrylic with separately packed liquid epoxy resin cure agent, as described in the manufacturer’s declared formulation
- **Volatile:** As described in manufacturer’s declared formulation.
- **Mixing Properties:** As described in manufacturer’s declared formulation.

---

* May be brush applied to small areas only
NRA DMRB Volume 2 – Structures: Design & Materials
Look Ahead (Future Work 2015) – 4 new documents planned

1. New NRA BD - Expansion Joints
   - BD33 Expansion Joints for Use in Highway Bridge Decks + BA47 Expansion Joints for Use in Highway Bridge Decks

2. New NRA BD – Hydrophobic Pore Liner / Coatings
   - BD43 Criteria and Materials for the Impregnation of Concrete Highway Structures + BA 85 Coatings for Concrete Highways Structures & Ancillary Structures

3. New NRA BD – Waterproofing & Surfacing
   - BD47 Waterproofing & Surfacing of Concrete Bridge Decks + BA47 Waterproofing & Surfacing of Concrete Bridge Decks

4. New NRA BD – Bridge Bearings
   - BD20 Bridge Bearings: Use of BS 5400 Part 9 (1983)
NRA GD 02 Volume Contents
Volume 3
Structures – Inspection & Maintenance

Until recently Volume 3 was not formally implemented – background reading only

41 Documents Added:
• Section 1 Inspection – 4
• Section 3 Repair - 5
## Structures Standards – NRA DMRB

### NRA GD 02 Volume Contents

#### Volume 3

**Structures – Inspection & Maintenance**

#### 41 Documents Added:
- Section 4 Assessment – 16

### Table 3 Continued: Standards and Advice Notes Available for Use in Ireland

<table>
<thead>
<tr>
<th>DMRB Part</th>
<th>Number</th>
<th>Title</th>
<th>NRA Addendum or Standard Dated</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>NRA BD 21*</td>
<td>The Assessment of Road Bridges and Structures (including Erratum No. 1, dated December 2014)</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.2</td>
<td>NRA BA 16*</td>
<td>The Assessment of Road Bridges and Structures.</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.3</td>
<td>NRA BA 38*</td>
<td>Assessment of the Fatigue Life of Corroded or Damaged Reinforcing Bars</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.4</td>
<td>NRA BA 39*</td>
<td>Assessment of Reinforced Concrete Half-joints</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.5</td>
<td>NRA BD 48*</td>
<td>The Assessment and Strengthening of Road Bridge Supports</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.6</td>
<td>NRA BA 54*</td>
<td>Load Testing for Bridge Assessment</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.7</td>
<td>NRA BA 55*</td>
<td>The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.8</td>
<td>NRA BA 52*</td>
<td>The Assessment of Concrete Road Structures Affected by Alkali Silica Reaction</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.9</td>
<td>NRA BD 56*</td>
<td>The Assessment of Steel Road Bridges and Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.10</td>
<td>NRA BA 51*</td>
<td>The Assessment of Concrete Structures Affected by Steel Corrosion</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.11</td>
<td>NRA BD 44*</td>
<td>The Assessment of Concrete Road Bridges and Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.12</td>
<td>NRA BA 44*</td>
<td>The Assessment of Concrete Road Bridges and Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.13</td>
<td>NRA BD 61*</td>
<td>The Assessment of Composite Road Bridges and Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.14</td>
<td>NRA BD 79*</td>
<td>The Management of Sub-standard Road Structures</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.15</td>
<td>NRA BD 81*</td>
<td>Use of Compressive Membrane Action in Bridge Decks</td>
<td>June 2014</td>
</tr>
<tr>
<td>3.4.16</td>
<td>NRA BD 101*</td>
<td>Structural Review and Assessment of Road Structures</td>
<td>June 2014</td>
</tr>
</tbody>
</table>
Structures Standards – NRA DMRB

NRA GD 02 Volume Contents
Volume 3
Structures – Inspection & Maintenance

41 Documents Added:
• Section 5 Standards & Advice Notes superseded by Eurocodes but required for assessment – 16
NRA DMRB Volume 3 – Structures: Inspection & Maintenance

Look Ahead (Future Work 2015) – 9 new documents planned

1. NRA BD 300 *EIRSPAN – Inventory Manual*
2. NRA BD 301 *EIRSPAN – Principle Inspection*
3. NRA BD 302 *EIRSPAN – Routine Inspection*
4. NRA BD 303 *The Stage I Structural Assessment of Road Structures*
5. NRA BD 304 *The Stage II Structural Assessment of Road Structures*
6. NRA BD 89 *The Conservation of Road Structures*
7. NRA BD 27 *The Protection and Repair of Concrete Road Structures*
8. NRA BD 97 *The Assessment of Scour and other Hydraulic Actions at Road Structures*
9. NRA BD 86 *The Assessment of Road Bridges & Structures for the Effects of Abnormal & Exceptional Abnormal Load Vehicles using SV & SOV Load Models*
NRA BD 86/15 (March 2015) -
The Assessment of Road Bridges & Structures for the Effects of Abnormal & Exceptional Abnormal Load Vehicles using SV & SOV Load Models

**What is it?:**
- A standard to assess bridges for the effects of abnormal vehicles (in combination with the effects of C&U vehicles and permanent loads)
- Provides requirements on how to determine the “Vehicle Rating” and “Reserve Factor” for a particular structure

**When would you use it?:**
- As directed by NRA BD 101 (significant deterioration)
- In the management of Abnormal Vehicle movements
- And as agreed with the structures section of the NRA
What benefits does it provide?

- More realistic abnormal load models (v HB Load Model)
- Attainment of higher load capacity ratings (particularly for spans < 10m)
- Flexibility to modify Overload Factor & Dynamic Amplification Factor
Abnormal Loads ~ SV 80 to 196

Exceptional Abnormal Loads ~ SOV 250 to SOV 600
NRA BD 86/15
Abnormal & Exceptional Abnormal Load Models

(a) SOV-250 Load Model
(b) SOV-350 Load Model
(c) SOV-450 Load Model
(d) SOV-600 Load Model

SOV Load Models
SV196 Load Model
NRA BD 86/15 -
The Assessment of Road Bridges & Structures for the Effects of Abnormal & Exceptional Abnormal Load Vehicles using SV & SOV Load Models
NRA BD 86/15

- Reserve Factors – ability of a bridge to carry an abnormal load model

- Capacity/Demand Ratio > 1.0

\[
\psi_{SV} \text{ or } \psi_{SOV} = \frac{R^*_A - (S^*_D + S^*_HA)}{S^*}
\]
The Evolving EuroCodes

History

• 10 EuroCode standards (58 individual parts)
  ➢ developed between late 1970s and 2010
  ➢ so took about 30 years to develop

• Introduced in 31st March 2010
  ➢ design to Eurocodes becomes mandatory (CEN)
  ➢ withdrawal of conflicting national codes

• Now 2015 (5 year review) - need to evolution to ensure:
  ➢ remain current
  ➢ fit for purpose
The Evolving EuroCodes

History

• European Commission (Dec 2012) – Mandate M/515
  ➢ request CEN to develop a detailed work programme for the future activities of CEN/TC250

• CEN/TC250 respond to EC:
  ➢ May 2013 – 138 page document
  ➢ Over 1000 experts across Europe involved in response
  ➢ 77 discrete tasks (evolving)
  ➢ “Towards a second generation of EN Eurocodes”
  ➢ 5 year Programme (2015 – 2020)
  ➢ €10 Million Budget
Towards a second generation of EN EuroCodes

1. Improve the existing codes (make them easier to use)
   - Feedback from practitioners – systematic reviews
   - Improve the clarity - Enhance User friendliness
   - Simply routes through the codes
   - Reduce the amount of national variation (NDPs)
   - Reduce number of alternate design methods
   - Remove rules of little practical use
   - Substantial additions required
   - Incorporate new state of the art
   - Needs of the market
Towards a second generation of EN EuroCodes

2. Develop new codes

- **Existing Structures & Assessment (WG2)**
  - Purpose is to stimulate debate – NOT for use
  - Comments required by 9th September 2015

- **Structural Glass (WG3)**

- **Fibre Reinforced Polymers (WG4)**

- **Membrane Structures (WG5)**

- **Robustness (WG6)**
NSAI EuroCodes Consultative Committee
- ECC Replaces NEAC (Oct 2013)
- NSAI TC 015 – mirrors CEN/TC250
- ECC Advises NSAI on all things EuroCodes
NRA Weigh-In-Motion (WIM)

Site #1
Donabate, Dublin

Site #2
Black Bull, Meath

Site #3
Maynooth, Kildare

Site #4
Lewistown, Kildare

Site #5
Gorey, Wexford

Site #6
Citywest South, Dublin
NRA Weigh-In-Motion (WIM)

- Camera’s
- Traffic Loops
- WIM Sensors
- Control Cabinet
NRA Weigh-In-Motion (WIM)
NRA Weigh-In-Motion (WIM)

- **We’re blind** – The NRA have no HCV loading / overload Network Indicators
- Overloaded Trucks / Axles cause a lot of damage to Roads & Bridges
- The relationship between axle weight & pavement damage is not linear
- 4th Power Law - Overloaded Axles cause exponential damage to pavements
- Initial NRA focus – determine the state of truck loading on National Primary’s
- Knowledge facilitates more efficient management & maintenance
- Need a couple of years of good data prior to any detailed analysis being conducted (............12 months so far)
NRA Weigh-In-Motion (WIM)

- Bridge Design & Assessment
- Road Pavement Design & Assessment
- Research & Development
- Level of illegal Overloading
- No. Permit Trucks
- Road Safety

WIM STATISTICS
SECTION 3 - Cumulative GVW Histogram
One Year of Data (2014) - Across all 6 Sites

NRA Weigh-In-Motion (WIM)

Cumulative gross vehicle weight by site (main section)

- 46T Limit
- 50T to 70T - Probably overloaded HCVs

Cumulative gross vehicle weight by site (upper tail)

- Tail - 76T to 190T – you would hope these are all permit trucks!
- 190T

Network Management
NRA Weigh-In-Motion (WIM)

8 Axle – 137T

10 Axle – 123T

3 Axle – 48T
11T - 17T - 18T
3 Axle Limit – 26T
85% Overloaded

5 Axle – 72T
5 Axle Limit – 42T
71% Overloaded

6 Axle – 78T
6 Axle Limit – 46T
70% Overloaded
NRA Weigh-In-Motion (WIM)

Engineers Ireland Presentation

- http://www.engineersireland.ie/Communications/Engineer-TV-Archive.aspx
- Communications / Engineers TV Archive
- “Traffic Monitoring Systems across the National Road Network” - (11/02/15)
Many Thanks for your Attention

Any queries, contact:
Fergal Cahill *(NRA)*

fcahill@nra.ie