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Transport Infrastructure Ireland

## TII Publications



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# Notes for Guidance to the Specification for Road Restraint Systems (Vehicle and Pedestrian)

**CC-GSW-00400**  
June 2020

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Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

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<b>TII Publication Title</b>	<i>Notes for Guidance to the Specification for Road Restraint Systems (Vehicle and Pedestrian)</i>
<b>TII Publication Number</b>	CC-GSW-00400

<b>Activity</b>	<i>Construction &amp; Commissioning (CC)</i>	<b>Document Set</b>	<i>Standards</i>
<b>Stream</b>	<i>Guidance on Specification for Works (GSW)</i>	<b>Publication Date</b>	<i>June 2020</i>
<b>Document Number</b>	<i>00400</i>	<b>Historical Reference</b>	<b>Series NG 400</b>

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## TII Publications




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<b>Set:</b>	Standards

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**Updates to TII Publications resulting in changes to  
Notes for Guidance to the Specification for Road Restraint Systems (Vehicle and Pedestrian)  
CC-GSW-00400**

**Date:** June 2020

**Page No:** General

**Section No:** General

**Amendment Details:**

This document supersedes the November 2015 version of CC-GSW-00400. Amendments have been made as per the following:

- a) Document heading numbers have been revised to reflect the changes to CC-SPW-00400.
- b) Guidance relating to the Independent VRS Chartered Engineer has been revised and reference to CC-REQ-04009 added.
- c) Guidance relating to corrosion protection of reinforcement strands within in-situ concrete barriers added.
- d) Guidance relating to terminals and transitions revised with reference to DN-REQ 03080 and DN-REQ-03081 respectively.
- e) Guidance relating to evidence of installation training for VRS products added.
- f) Guidance relating to push testing added.
- g) A criterion relating to Vehicle Intrusion has been added to the schedule of safety barriers in sample Appendix 4/1.
- h) A new schedule for transitions has been added to sample Appendix 4/1.
- i) Exit Box Classes Za and Zd have replaced Exit Box Class Z (1,2,3,4) in the schedule of safety barrier terminals in sample Appendix 4/3.
- j) A new schedule for crash cushions has been added to sample Appendix 4/3.

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## NG 1. General

The specialist responsible for the design of the road restraint systems should identify the performance characteristics required to protect each hazard within the scheme. A schedule of these factors should be placed on the Drawings or within Appendices 4/1 to 4/7 as appropriate.

In accordance with the requirements of I.S. EN 1317-5, manufacturers must incorporate CE marking on their products, defining the performance characteristics for which the product has been certified. Reference should be made to I.S. EN 1317-5 to establish the full requirements of the submission, which include details of the system, its components, constituent materials, performance testing, production controls, product traceability, durability assessment, applicable site conditions, installation and site testing requirements.

Certification is granted to a particular manufacturer for a specific product. If a supplier sources the same product from more than one manufacturer, then separate certification is required for each source.

In many cases there will not be an optimum position for the road restraint system and a wide range of Set-backs could be used. The specialist responsible for the design of the road restraint system, however, should always identify one location for the system and state this in Appendix 4/1. Care should be taken to ensure that the Set-back identified does not unduly restrict the selection of road restraint system. If the Contractor proposes a road restraint system which requires a different Set-back, the Contractor's specialists must undertake any redesign required in order that this system can be installed satisfactorily.

## **NG 2. Road Restraint Systems – General Requirements**

### **NG 2.1 Durability**

One of the requirements for certification under I.S. EN 1317-5 is that the manufacturer submits a formal assessment of the anticipated durability of the product. A copy of this assessment should be provided with the product and should be reviewed by the Employer's Representative relative to the stated durability requirements.

### **NG 2.2 Corrosion**

The construction of permanent in-situ concrete restraint systems requires exposed vertical and horizontal faces to be saw cut to act as crack inducers. Water ingress to the reinforcement strands, including water containing chloride from de-icing salts, may therefore occur. The reinforcement strands within these systems are therefore to be protected against corrosion due to water ingress at the saw cuts.

### **NG 2.4 Handling and Storage**

Handling and storage arrangements should be appropriate to the materials concerned. Requirements for the most common materials, coated steel and precast concrete are referenced specifically, but the general requirement applies equally to other materials.

### **NG 2.5 Installation**

It is a requirement of I.S. EN 1317-5 that detailed descriptions of the installation requirements are provided by the manufacturer, and it is very important that these are readily available to all relevant parties on site. These must be carefully adhered to, to ensure that the system is installed on site in the same manner as when it was certified.

As the requirements for each road restraint system differ, it is vital, to ensure that the system will perform as specified, that those installing the system have been provided with adequate installation training particular to the specific system. This training shall be provided by the specific system manufacturer.

### **NG 2.6 Terminals**

There is currently no harmonised European Standard for the testing and approval of terminals for use with VRS and therefore terminals are not a CE marked product. TII has therefore implemented the testing requirements contained in the Draft standard prEN 1317- 7:2014 Test methods for the terminals of safety barriers within DN-REQ-03034. To ensure that a standardised approach is applied to the evaluation of terminal arrangements proposed for use on the Irish national road network, TII has also established DN-REQ-03080 – Terminal Assessment Procedure has been developed to ensure a standardised approach is applied to the evaluation of terminal arrangements proposed for use on the Irish National Road Network. Terminal systems deemed suitable for use on Irish national roads following assessment under this Standard are added to the Compliant Terminal Systems list accessible through the Downloads section of the TII Publications website. The specialist responsible for the design of the system should identify the performance characteristics required for each specific safety barrier end terminal location, whilst being cognisant of the available products on the TII Compliant Terminals List. A schedule of these factors should be placed on the Drawings and within Appendix 4/3.

## NG 2.7 Transitions

There is currently no harmonised European Standard for the testing and approval of transitions and therefore transitions are not CE marked products. To ensure that a standardised approach is applied to the evaluation of transitions proposed for use on the Irish national road network, TII has established DN-REQ-03081 – Transition Assessment Procedure to ensure a standardised approach is applied to the evaluation of transitions proposed for use on the Irish National Road Network. The specialist responsible for the design of the system should identify the performance characteristics required for each specific safety barrier transition location, whilst being cognisant of the available products on the TII Compliant Transitions List. A schedule of these factors should be placed on the Drawings and within Appendix 4/1.

## NG 2.9 Training

Training for a family of VRS products is acceptable once the certificate for such training clearly indicates what specific products are covered within such training. The training shall include for all foundation options available for the product (driven, socketed, surface mounted, cast in concrete or other) as per the installation manual.

Evidence of training shall include the following:

- Installer name
- Product
- Date of training

## NG 2.10 Modifications

A non-exhaustive list of cases of possible modifications to the requirements of Clauses 4, 5 and 6 of I.S. EN 1317-5 is presented below;

### Category A

- Barrier undergoes repainting.
- Pre-cast concrete barrier has additional reinforcement for production reasons.

### Category B

- Metal barrier was originally tested with sloped end terminals and a revised end treatment is provided, maintaining the same anchorage.
- Change of type of anchoring bolts in a metal barrier, where they are not designed to yield.
- Metal barrier, where component rail length is increased.
- Rope barrier, where section length between anchorages is reduced.

### Category C

- Precast concrete barrier with jointed elements, which need to be replaced with revised joints.
- Metal barrier where type or grade of metal is changed.
- Change of type of bolts in a metal barrier where they are designed to yield.



## **NG 3. Installation of safety barriers, terminals, transitions, crash cushions and removable barriers**

### **NG 3.1 Installation**

#### **NG 3.1.1 Layout**

The intended location of road restraint systems shall be defined by the specialists responsible for the design of the system in accordance with the requirements and guidance contained in TII Publications. The specification permits a maximum deviation from the designed location in order to achieve satisfactory performance and appearance.

#### **NG 3.1.2 In-situ Concrete Safety Barriers**

In-situ concrete barriers are required to be CE Marked products and as such are subject to the manufacturer's installation requirements. Minimum requirements for the specification of concrete in terms of grade, cement content, W/C ratio, exposure class, GGBS requirements etc. for example in line with TII standards may be added and where these are greater than the manufacturers requirements they shall be complied with.

#### **NG 3.1.4 Concrete in Foundations and Anchor Blocks**

Concrete foundations and anchor blocks perform a vital component of safety barrier systems and must be constructed appropriately in accordance with the system manufacturer's requirements. In particular if concrete foundations are placed within filter material it is essential for the correct function of both the drain and the foundation that concrete grout loss is prevented.

#### **NG 3.1.8 Cutting and Drilling of Components**

The layout of road restraint systems needs to be considered in the full knowledge of both the hazards to be protected and other obstacles to the correct installation of the system. It is not acceptable simply to select a system and then make site adjustments to fit the particular circumstances encountered on site. Such an approach will almost certainly compromise the performance of the system. Where special, non-standard components are required these should be identified prior to ordering of the system, appropriate details agreed with the manufacturer and special components prepared in the factory.

#### **NG 3.1.13 Anchorages**

Many safety barrier systems rely on anchorage details, be it of tensioned beams, tensioned ropes or attachment systems for surface mounted posts. Where the safety barrier system relies on a tensioned beam or rope, which will inevitably lose tension following an impact, it is essential that the length of barrier which is temporarily unserviceable is kept to a reasonable minimum. The specified intermediate anchorage requirements are intended to set a minimum criterion in this regard.

#### **NG 3.1.14 Attachment Systems for Surface Mounted Posts**

In most cases the anchorage details will form part of the certified safety barrier system, while in others, particularly in the case of surface mounted posts, alternative anchorage details may be permissible provided they meet certain performance criteria. Anchorages for securing surface mounted posts which utilise drilled holes have been known to fail due to either a lack of cleanliness of the hole or the excess tolerance in the size of the hole. The manufacturer of the anchorages should provide details of the maximum tolerances permitted and the evidence should be submitted to the Employer's Representative.

Such evidence should show that the anchorages perform satisfactorily when installed in holes having these tolerances. With the introduction of bonded anchorage details it is especially important that the manufacture provides full details of the system and its correct installation and testing.

## **NG 3.2 Testing**

### **NG 3.2.1 Anchorages in Drilled Holes for Safety Barriers, Terminals, Transitions and Crash Cushions**

The Contractor is responsible for carrying out the site tests at the frequency of the more onerous of either the values given in the accepted manufacturer's installation manual or as given in contract specific Appendix 1/5. Any particular requirements should be included in contract specific Appendix 4/1 or 4/3. The rate of testing will need to be determined for each location where anchorages in drilled holes are to be used. As a guide where the anchorages are to be installed on bridges or other structures, the rate of testing should normally be not less than 1 No. anchorage per post anchorage group for safety barrier, terminal and transition for each of the first 5 No. anchorage groups installed and 1 No. anchorage per 5 No. anchorage groups installed thereafter. For crash cushions, the rate of testing will need to be determined on an individual basis and in accordance with the design of the crash cushion to be installed. If failures are recorded the rate of testing should be increased until the suitability of the anchorages can be established. Any anchorage which fails the testing should be replaced and retested. The testing programme should consider variations in the locations of the anchorages.

### **NG 3.2.2 Ground Testing Requirements for Posts**

All safety barrier systems inclusive of transitions ultimately transfer the impact force into the ground and as such rely on ground conditions being compatible with the system design in order to perform to their designed criteria. It is vital that the performance of a safety barrier is not compromised in service through the provision of inadequate ground conditions. I.S. EN 1317-5 requires that the manufacturer provides a description of the ground conditions required for the system to perform as certified. Consequently, testing shall be undertaken to demonstrate that the ground conditions are compatible with the selected barrier system. The nature of the testing will obviously depend on the type and form of the barrier and it is therefore important that the safety barrier manufacturer specifies the testing.

Push tests shall be undertaken in accordance with BS 7669 Part 3 Annex B to demonstrate that the finished ground provides sufficient resistance. The forces to be applied and the permitted displacement of the post shall be as per the manufacturer's requirements for the specific product to be installed.

Some barrier systems include knock down posts which are held in post sockets, with the intention that the posts be replaced within the same socket following impact. Experience has shown that the most common ground conditions related failure is for these sockets to become dislodged or mis-aligned during impact, such that they are no longer suitable to receive the replacement post. To overcome this, a requirement has been included to demonstrate that the sockets remain serviceable following collapse of the post.

The requirement for an Independent VRS Chartered Engineer to certify the appropriateness of the proposed site testing regime for the particular barrier system in the particular ground conditions has been added to CC-SPW-00400. Further information regarding the role of the Independent VRS Chartered Engineer is included in CC-REQ-04009 Independent Vehicle Restraint Systems Chartered Engineer Requirements.

## **NG 4. Vehicle parapets**

### **NG 4.1 I.S. EN 1317 Compliant parapets**

#### **NG 4.1.3 Maintenance and Repair**

The Employer or other body which will be responsible for the maintenance of the vehicle parapet may require the provision of user installation/maintenance manuals and a stock of materials and equipment to be retained in store for maintenance purposes. Training of maintenance staff may also be required for vehicle parapets which have not previously been installed on the road network. Where this is the case, the compiler should provide a schedule in Appendix 4/4 indicating which materials are required as well as the system types for which manuals and training are required.

### **NG 4.2 Testing**

#### **NG 4.2.1 Site Tests on Anchorages in Drilled Holes for Vehicle Parapets**

The Contractor is responsible for designing the anchorages and carrying out site tests at the frequency given in contract specific Appendix 1/5. Any particular requirements should be included in contract specific Appendix 4/1. The rate of testing will need to be determined for each location where anchorages in drilled holes are to be used. As a guide the rate of testing should normally be not less than 1 No. anchorage per vehicle parapet post anchorage group for each of the first 5 No. vehicle parapet post anchorage groups installed and 1 No. anchorage per 5 No. vehicle parapet post anchorage groups installed thereafter. If failures are recorded the rate of testing should be increased until the suitability of the anchorages can be established. Any anchorage which fails the testing should be replaced and retested. The testing programme should consider variations in the locations of the anchorages.

### **NG 4.3 Bespoke Vehicle Parapets**

The need for bespoke vehicle parapets may arise, inter alia, for bridges over the railway, where particular safety criteria apply, for heritage structures where particular aesthetic criteria may apply or in urban areas where traffic speeds are low and aesthetic criteria may apply. Wherever possible, vehicle parapets tested in accordance with I.S. EN 1317 should be used in these circumstances and only as the last resort should a bespoke vehicle parapet be provided.

## **NG 5. Pedestrian Restraint Systems**

The type and the location of pedestrian restraint systems should be described in Appendix 4/2.

## **NG 6. Temporary Restraint Systems**

Temporary restraint systems can be provided by:

- i. The Contractor as part of Temporary Works and remaining their property.
- ii. The Contractor but becoming the property of the Road Authority on completion of the Works.
- iii. The Road Authority for the Contractor's use during the Works.

Appendix 4/1 should state which of the above applies, and where appropriate, details of locations from which the temporary restraint systems can be collected and/or returned.

## **NG 7. Anti-Glare Screens**

See Appendix 4/5.

## **NG 8. Maintenance of Legacy Vehicle Restraint Systems**

Since all new VRS are required to be in accordance with EN 1317 and be CE marked, the traditional forms of barrier such as tensioned corrugated beam and open box beam could only be used for new construction if they were CE marked. Hence the specification requirements given for 'legacy' systems are with respect to the provision and installation of components for repair and maintenance of existing non CE marked VRS only.

## NG Sample Appendix 4/1: Safety Barriers

*[Notes to compiler]*

1. The locations of safety barriers are shown on Drawing Nos .....  
*[generally the 1:500 or 1:1000 Site Plans].*
2. The performance criteria for the safety barriers are shown on the above drawings/  
scheduled in the following table. *[Delete as appropriate.]*



### 3. Schedule of Safety Barriers

Barrier Ref No	Start Chainage of LoN	End Chainage of LoN	Hazard Information				Barrier Type	Single/Double Sided	Minimum Safety Barrier Performance Criteria				
			Hazard Description	Hazard Chainage	Location	Drawing Reference			Containment Level	Impact Severity Level	Working Width	Vehicle Intrusion*	Set-Back

\* VI specified is in accordance with EN1317-2:2010. The procedure for measuring VI within EN1317-2:1998 + A1 2006 is different than EN1317:2010. If a VRS tested to EN1317-2:1998 + A1 2006 is proposed for use, it must be shown to achieve the required VI value as assessed under the EN1317:2010 through simulation or some other means.

*[Safety barriers with different performance criteria within a continuous length should be split into sections such that the performance criteria for each section are unique. Alternatively, the safety barriers on a scheme may be assigned categories each of which defines the performance criteria for that type of system. The table should identify the performance criteria for each section of safety barrier at each barrier location or of each barrier type.]*

*Where a Length of Need comprises many short lengths of barrier with different performance criteria standard details should be provided on the Drawings and each combination of barriers given a reference. This barrier reference should then be entered in the table once only for each length of combined barrier. There is no need to indicate each length of each type of safety barrier, but performance criteria should be stated for all barriers in the combination (e.g. W6/W4/W3, H2/N2 etc.).*

*Barrier types will normally be indicated where:*

- *the In-situ Concrete Barrier is to be used; or*
- *there are exceptional and overriding reasons for specifying a particular barrier type.*

*In the latter case, the agreement of Transport Infrastructure Ireland is required before particular barrier types are included in the Schedule of Safety Barriers.*

*The Compiler should indicate the Working Width required as an absolute value (e.g. W6) and not as a range of acceptable values.*

*The Start and Finish Chainages shall be derived from the Approach and Departure Lengths which have been determined in accordance with DN-REQ-03034 and the Designer's risk assessment of the level of protection required.]*

4. Temporary Safety Barriers

*[Note to compiler: State here:]*

- i. Who is to provide temporary safety barriers.
- ii. Location for removal of temporary safety barriers on completion of the Works.
- iii. Location(s) from which temporary safety barriers are to be collected and returned by the Contractor if provided by the Employer.
- iv. Who is to own the temporary safety barriers on completion of the Works.

5. Other Details *[to be included as required]*

- a) Any special details which are shown on the Drawings and have been designed by the specialist with responsibility for the design of the road furniture.
- b) Any special requirements for setting out details.
- c) Details of testing requirements and frequency of testing not covered already within the Specification.
- d) Any special testing requirements for anchorages in drilled holes.
- e) Any other relevant details.

6. Schedule of Transitions

Transition Requirements				Upstream Connection				Downstream Connection			
Performance Criteria											
Transition Ref No.	Performance Class	Impact Severity Level	Working Width	Barrier/ Terminal/ Parapet Ref No	Performance Class	Impact Severity Level	Working Width	Barrier/ Terminal/ Parapet Ref No	Performance Class	Impact Severity Level	Working Width

## NG Sample Appendix 4/2: Pedestrian Restraint Systems

*[Note to compiler: Details should be given here of locations and type of pedestrian restraint systems required. Cross-reference may be made to the drawings where appropriate.]*

## NG Sample Appendix 4/3: Safety Barrier Terminals

*[Note to compiler: Include here:]*

1. The locations of safety barrier terminals are shown on Drawing Nos ..... *[generally the 1:500 or 1:1000 Site Plans].*
2. The performance criteria for the safety barrier terminals are shown on the above drawings/scheduled in the following table. *[Delete as appropriate.]*

3. Schedule of Safety Barrier Terminals

Barrier Ref No	Upstream Terminal						Downstream Terminal									
	Minimum Performance Criteria						Minimum Performance Criteria									
	Performance Class	Impact Severity Level	Permanent Lateral Displacement Class		Exit Box Class*		Directions Class	Performance Class	Impact Severity Level	Permanent Lateral Displacement Class		Exit Box Class*		Directions Class	Ramp Down	Flared
X (1,2,3)			Y (1,2,3,4)	Za	Zd	BDT, UDTA, UDTD				X (1,2,3)	Y (1,2,3,4)	Za	Zd			

\* The Exit Box Class specified is the minimum Exit Box Class requirement e.g. if Z<sub>d3</sub> is specified, products with a Z<sub>d</sub> value of Z<sub>d1</sub>, Z<sub>d2</sub> or Z<sub>d3</sub> are permitted.

Each length of permanent safety barrier listed in Appendix 4/1 should be cross referenced here providing details of both the upstream and downstream terminal performance requirements.

4. Schedule of Crash Cushions

Crash Cushion Ref No	Performance Class	Impact Severity Level	Permanent Lateral Displacement Class	Exit Box Class	Redirective (R)/ Non-Redirective (NR)

## NG Sample Appendix 4/4: Safety Barrier Maintenance

*[Note to compiler: Where required by the Employer, the compiler should include a schedule of:*

- i. Installation and/or maintenance manuals for each barrier and terminal type;*
- ii. Any materials which are to be provided for maintenance purposes;*
- iii. Special items of equipment etc required for the installation, testing, maintenance and demolition of the safety barriers and terminals.*

*The schedule should take account of the barrier and terminal types specified (if any) and the overall length of each barrier type. The schedule should generally include sufficient length of safety barrier (and components) to allow for the replacement of at least 50m of each safety barrier type or 5% of the overall length of each barrier type installed on that contract. At least one terminal and transition of each type should also be provided. However, reference should be made to Transport Infrastructure Ireland and the body responsible for maintaining the barriers for replacement materials requirements. Manuals and training shall be provided for all safety barriers.*

*Where a scheme is anticipated to be maintained by more than one maintenance body, the schedule should identify which barriers and terminals are provided to the individual maintenance depots. The schedule should also state where the barriers, terminals and components should be delivered to. Entries in the schedule for a safety barrier and a terminal to be provided to a particular maintenance depot may be as follows:]*

1. Schedule of Barrier Materials for Maintenance

Barrier Information				Barrier Quantity to be Supplied for Maintenance			Provision of Information, Training etc.		Address for Delivery
Barrier Type	Containment Rating	Impact Severity	Working Width	Barrier Length	Transitions	Other Items	Manuals	Training	
N/A	N2	A	W6	55m	1 No. (N2-H2)	1 No. set of tools for installation	2 No.	1 No. course for 5 operatives	XXX Depot XXX

2. Schedule of Terminal Materials for Maintenance

Terminal Information						Terminals Quantity to be Supplied for Maintenance		Provision of Information, Training etc.		Address for Delivery	
Terminal Type	Performance Class	Impact Severity Level	Permanent Lateral Displacement Class		Exit Box Class		Number	Other Items	Manuals	Training	
			X (1,2,3)	Y (1,2,3,4)	Za	Zd					
N/A	T110	A	X2	Y2	Z1	Z3	5	1 No. set of tools for installation	2 No.	1 No. course for 5 operatives	XXX Depot XXX

## **NG Sample Appendix 4/5: Anti-Glare Screens**

*[Note to compiler: Include here:]*

The locations of anti-glare screens are shown on Drawing Nos ..... *[generally the 1:500 or 1:1000 Site Plans].*

*[Include location details, preferably by chainage reference together with any specific performance requirements here.]*



## **NG Sample Appendix 4/6: Not Used**

## NG Sample Appendix 4/7: Vehicle Parapet Systems

[Note to compiler: This should list the following and cross-refer to Appendix 1/5 and Appendix 1/11 as necessary:]

1. The locations of Vehicle Parapet Systems are shown on Drawings Nos ..... [generally the 1:500 or 1:1000 Site Plans].
2. The performance classes for the Vehicle Parapet Systems are shown on the above drawings/scheduled in the following table. [Delete as appropriate]
3. Schedule of Vehicle Parapet Systems

Structure Ref No	Length of Vehicle Parapet	Height of Vehicle Parapet	Vehicle Parapet Type	Vehicle Parapet Performance Criteria		
				Containment Level	Impact Severity Level	Working Width

[Vehicle Parapet type will normally be indicated where:

1. A bespoke vehicle parapet system is to be used; or
2. there are exceptional and overriding reasons for specifying a particular vehicle parapet type.


In the latter case, the agreement of Transport Infrastructure Ireland is required before particular vehicle parapet types are included in the Schedule of Vehicle Parapet Systems.

The Compiler should indicate the Working Width required as an absolute value (e.g. W6) and not as a range of acceptable values.]

4. Other Details [to be included as required]
  - a) Any special details which are shown on the Drawings and have been designed by the specialist with responsibility for the design of the road furniture.
  - b) Any special requirements for setting out details.
  - c) Details of testing requirements and frequency of testing not covered already within the Specification.
  - d) Any special testing requirements for anchorages in drilled holes.
  - e) Any other relevant details.





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