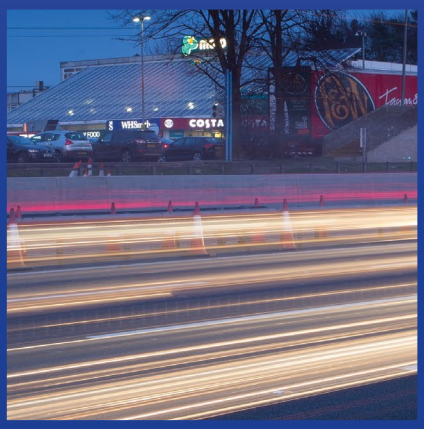
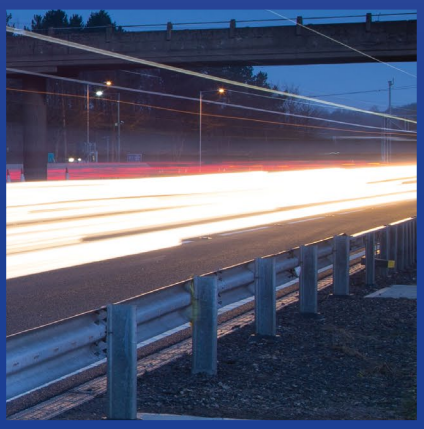
HSM001 (Issue B)

Hill & Smith Ltd Guardrail Installation Manual




Contents

Please note that this manual supersedes all previous information / manuals issued by Hill & Smith Ltd. It is the responsibility of the user to ensure that the most up to date information is downloaded / viewed from our Xtratech technical support website – xtratech.hill-smith.co.uk. We reserve the right to continually improve and update our systems and information.

1. General

1.1 General description

This Manual is for use with Hill & Smith Ltd guardrail vehicle restraint systems (VRS) and must be read in conjunction with the relevant system drawings. Compliance with national / international performance criteria is as detailed within the system drawings.

1.2 Systems Documentation

Our Xtratech site contains our VRS drawings / manuals / documents, etc. for viewing / download and can be accessed by following the Technical Support link at the bottom of our website home page http://www.hill-smith.co.uk via the 'Xtratech' button. Please click on 'create an account', input your email address and your chosen password and you will have access to our full product range.

1.3 Training

Training on the installation, inspection, repair and maintenance of Hill & Smith Ltd VRS's is available in the UK through Lantra Awards Approved Training Centres (www.lantra-awards.co.uk), or contact Hill & Smith Ltd on barriertechnical@hill-smith.co.uk

Where training of operatives is not a mandatory requirement we strongly recommend that training is carried out to ensure the performance of Hill & Smith Ltd VRS's are maintained for the design life of the system.

1.4 Durability / Design Warranty

Hill & Smith Ltd VRS's have a typically designed / manufactured serviceable life of not less than 20 years. Steel VRS components are hot dipped galvanised to the requirements of EN ISO 1461 (or when requested to the thicker coating requirements of its National Annexes). Fasteners are hot dip spun galvanised to the requirements of EN ISO 10684. The presence of high levels of winter salts, coastal salts and aggressive atmospheric pollutants can all reduce the life expectancy of the protective coatings of VRS components. Installations in tunnels where corrosive salts are not washed by rainfall have historically reduced the life expectancy of the VRS. Other coating options are available on request.

Hot dipped galvanised coatings with a thickness in excess of the requirements detailed in EN ISO 1461 – table 3, are available on request. For example, for the Swedish Standard, SS-EN ISO 1461 National Annex, table NA.1. the coating Zn115 is designated within the item name, e.g. CM011B-Zn115.

Where accelerated corrosion is deemed to be a concern, it is recommended that suitable periodic inspection / maintenance is undertaken to ensure the performance of the VRS is not compromised.

The Product / Design Warranty and Liability assurance given by Hill & Smith Ltd for VRS's will be invalidated if it is shown that components from an unapproved supply / site modified, have been used in the installation, maintenance or repair of the system and / or that the installation does not conform to Hill & Smith Ltd requirements.

1.5 Technical Data / Enquiries

Additional technical information not covered within this manual is available on our Xtratech site.

Other technical enquiries should be addressed to barriertechnical@hill-smith.co.uk

1.6 Quality Assurance

Hill & Smith Ltd has in-house procedures for ensuring full compliance with the Quality Assurance certificate requirements of EN ISO 9001 and the Factory Production Control requirements of EN1317-5. It is the policy of Hill & Smith Ltd to give customer satisfaction by supplying products and services which are fit for purpose and conform to all aspects of their specification.

1.7 Environmental

Hill & Smith Ltd recognise the need to operate the business in a manner that reflects good environmental management. The company is aware of the environmental impacts of its operations and will balance its business aims with the need to protect both the local community and global environment. Hill & Smith Ltd operates an Environmental Management System to the certification requirements of EN ISO 14001.

1.8 Health and safety

Hill & Smith Ltd is committed to preventing injury and ill health by operating its business in accordance with and the Health and Safety at Work Act 1974 including all applicable regulations made under the Act. Hill & Smith Ltd is committed to ensuring the health, safety and welfare of all its employees and any other person not employed by the Company who may be affected by the way in which we conduct our business, both on and off this Site. Hill & Smith Ltd has an Occupational Health & Safety Management System certified to OHSAS 18001 which is applied to all operations within our business operation.

1.9 Integrated management system

Hill & Smith Ltd have an integrated common management system which cover the requirements of ISO 9001, ISO 14001 & OHSAS 18001 in one management framework, this Management System is certified to PAS99. The adoption of this PAS standard simplifies the management of multiple system standards and any associated conformity assessment together with introducing some of the newer principles of management systems outlined in ISO Annex SL.

1.10 Recycling / COSHH requirements

System components have a high recyclability.

COSHH sheets for system components (where relevant) are available for download from our Xtratech site.

2. Layout Design

2.1 General

VRS layout designs must be carried out by competent engineers / designers to comply with national or state requirements. It is important to note that this manual contains guidance, which may differ from specific state requirements. In these cases it is recommended that the most onerous requirement should be followed.

Consideration must be given to the form and design of the infrastructure to ensure the satisfactory performance of the VRS over its installed life.

The ground below and to each side of the VRS shall be generally level with a maximum slope of 1 in 20 (5 %) and be free of hazards within the set back and working width zones.

2.2 Layout terminology

The following is taken from the requirements set out in the European road restraint systems test / specification standards, EN 1317-2 and ENV 1317-4. For other National standards please refer to the relevant documents for guidance.

VRS
Vehicle restraint system protecting a hazard that has been designated as such by the competent Layout Designer by a risk assessment process

Length of Need
Minimum length of full height VRS

Traffic Face
Line of un-deformed VRS nearest to traffic

Hazard
A feature or object that is deemed to require VRS protection by the process of risk assessment

Set-back
See 2.5

Approach
Vehicle direction towards a hazard

Depart
Vehicle direction away from a hazard

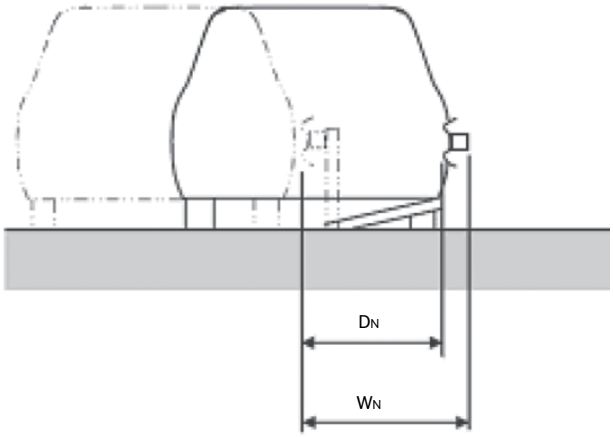
Containment Level
VRS Containment Class for specific vehicle type / speed / angle of impact (see EN 1317-2 for details)

ASI
Accident Severity Index (see EN 1317-2 for details)

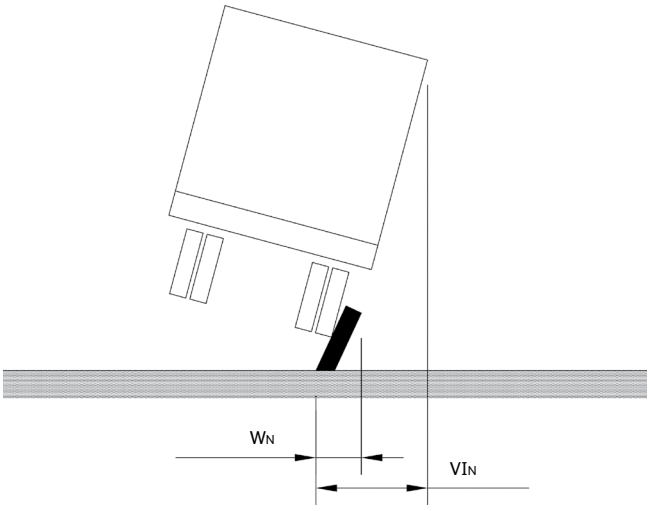
Impact Severity Level, ISL
VRS and terminal Impact severity level class A, B or C based on the tested vehicle ASI value (see EN 1317-2 for details)

Working Width, W_N
Maximum lateral dynamic displacement of any part of the VRS from the un-deformed traffic face of the VRS (see EN 1317-2 and below for details)

Dynamic Deflection, D_N
Maximum lateral dynamic displacement of the traffic face of the VRS (see EN 1317-2 and below for details)



Vehicle Intrusion, VI_N
Maximum lateral dynamic displacement of any part of the vehicle from the traffic face of the VRS (see EN 1317-2 and below for details)

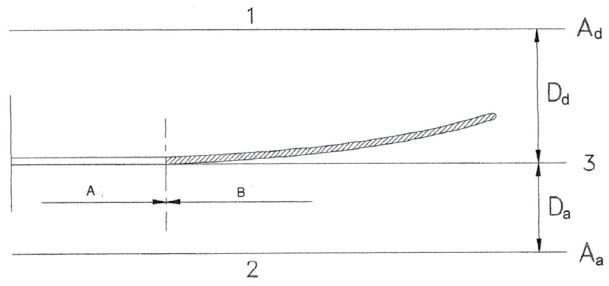


Performance Class
Terminal Performance Class for specific vehicle type / speed / direction of impact

Permanent Lateral Displacement Zone
Terminal defined as a Class D.x.y (see Da and Dd below and ENV 1317-4 for details)

Da
Maximum terminal deflection on traffic side from the traffic face of the connecting VRS. Converted to Class ref. x (1-3)

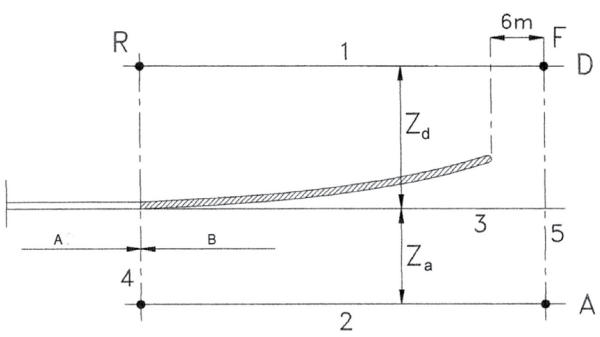
Dd
Maximum terminal deflection to rear of terminal from the traffic face of the connecting VRS. Converted to Class ref. y (1-4)



Vehicle Redirection Zone
Terminal defined as Class Z (1-4) (see Za and Zd below and ENV 1317-4 for details)

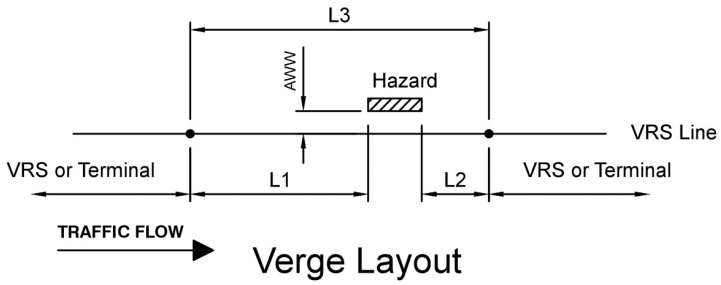
Za
Maximum vehicle redirection on traffic side of terminal from the traffic face of the connecting barrier

Zd
Maximum vehicle redirection to rear of terminal from the traffic face of the connecting barrier

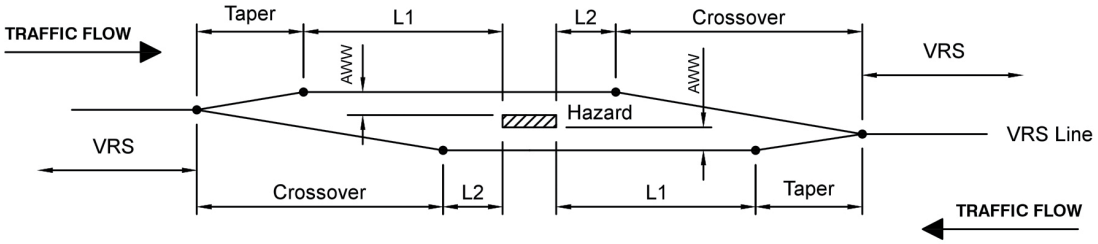


2.3 Adjacent to Hazard

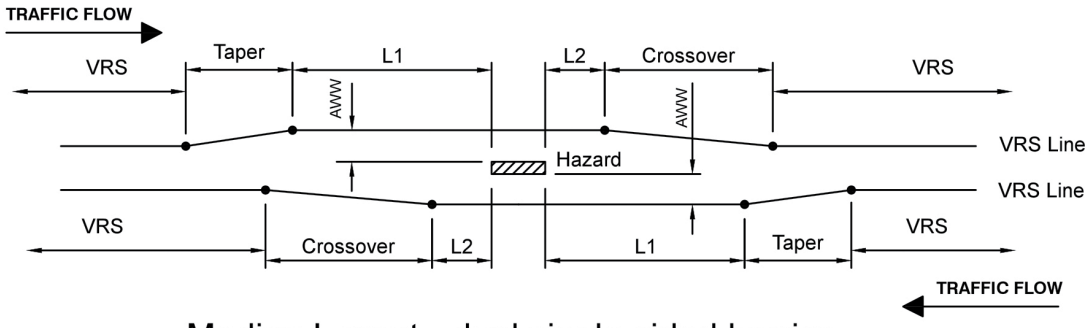
The following details the layout of Hill & Smith VRS's adjacent to verge and median hazards.



Verge Layout



Median Layout - double sided barrier



Median Layout - dual single sided barrier

L1 - VRS length on approach to hazard
L2 - VRS length on depart from hazard
L3 - VRS length of Need
AWW - Available Working Width (traffic face of VRS to traffic face of hazard)
Length of Need - minimum length of full height, full containment VRS (can include transitions and parapets)
Taper - Rate of change of set-back of VRS on approach to hazard
Crossover - Rate of change of set-back of VRS on depart from hazard

Note: Layouts shown for vehicles driving on the Left Hand side of the highway. For vehicles driving on the Right Hand side of the highway, please adjust traffic flow direction accordingly.

2.4 Min lengths of VRS

The following are the minimum length of need of Hill & Smith Ltd full height VRS's to be used on the approach to, and on the depart of, the hazard.

Minimum permissible length of need of full height VRS			
Containment Level	Overall Length	Approach to Hazard	Depart from Hazard
N2	40m min.	30m*	7.5m
H1/H2	44m min.	30m	10.5m

* Minimum 10m at hazard WW in advance of hazard – for N2 containment ONLY (can also be adjacent to a transition, parapet or higher containment VRS)

2.5 Set-Back / height of VRS

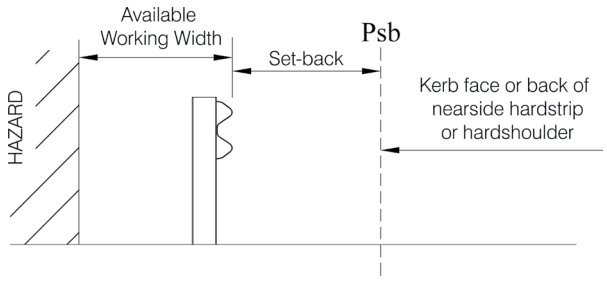
Where the horizontal distance from the traffic face of the VRS to the point of setback (Psb) is less than, or equal to 1.5m, the specified VRS height to the centre of the beam shall be measured from the level of the adjacent paved surface. Over 1.5m and, the height will be measured from the general ground level below the VRS.

*Psb is the point from which the set-back of the VRS traffic face is measured.

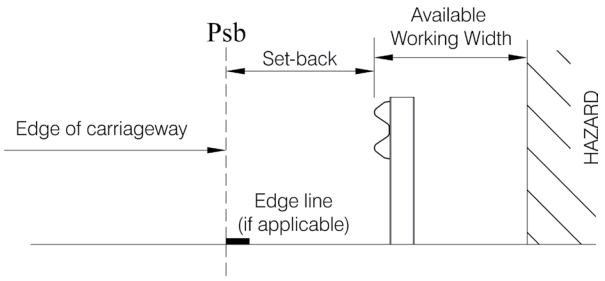
The set-back is the lateral distance between the traffic face of a VRS and, as appropriate,

a) Nearside: the back of the hard-strip or hard-shoulder

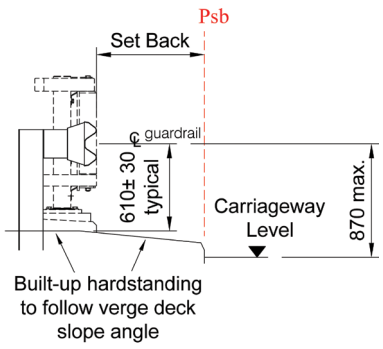
b) Nearside: the kerb face for roads without a nearside hardstrip or hardshoulder



c) Offside: the trafficked edge of the edge line or the kerb face where there is no edge line



Note: Set-back requirements for VRS transitions adjacent to parapets need to be addressed to suit the specific parapet arrangement on site. Where the VRS transition set back is unable to follow the set back/height of beam requirements as 2.5 above, due to the set back requirements of the parapet, then built–up hard-standing to the ground adjacent to the VRS would be necessary to ensure the specified VRS height from the adjacent ground level is maintained, (maximum allowable longitudinal slope of the ground under the VRS is 1 in 50). **Hill & Smith strongly recommend that the layout design of the transition is taken into consideration WITH the parapet layout to ensure the ground levels adjacent to the transition are in compliance with the above.** Please see below and relevant transition drawings for further details.



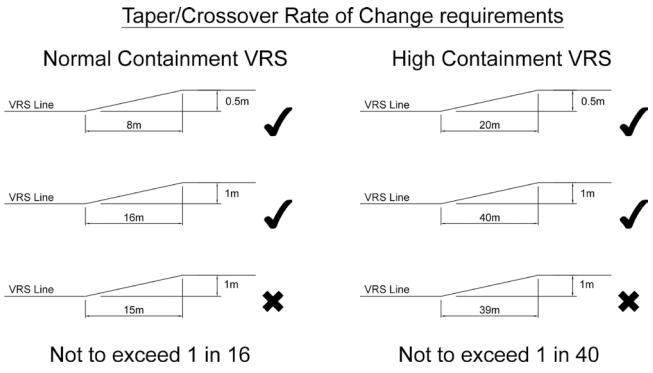
Set back
TranZFlex to parapet transition

2.6 Change in horizontal plan alignment – Curves

Where VRS's are set out on curves, the competent Layout Designer must evaluate the safety aspect of the potential for a vehicle to impact the VRS at a greater angle and possibly lower speed than that specified in the EN1317-2 performance testing standard. Hill & Smith Ltd recommend that a risk assessment is carried out to the satisfaction of the overseeing organisation to address the risk of variances to the tested/approved VRS. (Please see 3.8 for further details)

2.7 Change in horizontal plan alignment – Taper

Change of horizontal plan alignment to take place over the taper length. Taper angle / ratio must not exceed the values given below. It is recommended that transitions are not installed on the taper length.



For normal containment VRS within the taper length, the working width (W) is to be 1 class lower than the adjacent connected VRS, e.g. W4 on VRS parallel to the point of set-back and W3 on taper. Where the working width of the VRS parallel to the set-back is W1, then wherever possible, it is recommended to position the taper where the adjacent connected VRS is W2 and above, parallel to the point of set-back.

2.8.1 Adjacent to drainage channels and kerbs

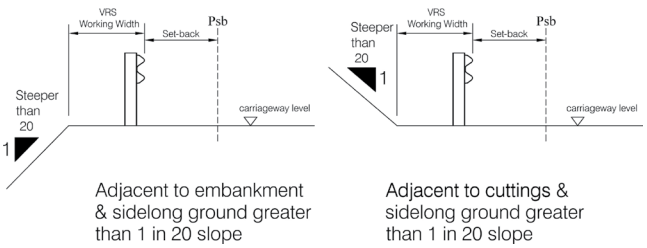
When considering the use of surface water drainage channels and or kerbing, the competent Layout Designer must evaluate the safety aspect in relation to the position of any VRS and the relevant set-back distance. The placement of kerbs / drainage may affect the performance of the VRS by destabilising the impacting vehicle. Hill & Smith Ltd recommend that a risk assessment is carried out to the satisfaction of the overseeing organisation to address the risk of variances to the tested / approved VRS.

2.8.2 Adjacent to cuttings and embankments / sidelong slopes in excess of a 1 in 20 gradient

To ensure the performance of the VRS, it is important to consider the minimum distance that it can be installed adjacent to a cutting / embankment.

Adjacent to cuttings – so that the errant vehicle / VRS is not affected by the cutting slope during impact, the start ('toe') of the upward slope must not be positioned within the working width zone of the VRS.

Adjacent to embankments/sidelong slopes in excess of a 1 in 20 gradient – the stability of the ground adjacent to an embankment and the affect of the stability of the colliding vehicle within the VRS working width zone are factors that must be considered in the positioning of the VRS. Unless deemed suitable by the site Engineer, the start ('top') of the downward slope must be at a minimum distance away from the traffic face of the VRS not less than the VRS working width class installed, e.g. 1000mm for a W3 VRS. The stability of the ground being determined by the requirements set out in the Hill & Smith Site Soil Testing manual – HSD002 (please see 3.2 and manual HSD002 for further details)



2.8.3 Adjacent to roadside furniture

Road furniture and equipment must not be positioned in front of, immediately in advance of, or within the available working width of the VRS as it may affect the performance of the VRS.

Where passively safe furniture is considered, then its location in relation to the VRS must be risk assessed to the satisfaction of the overseeing organisation.

3. Installation

The installation, inspection, repair and maintenance of VRS's require personnel to work on the highway. It is the responsibility of the installer to ensure that safe working practices are adopted, as required by law. No operation should cause danger to employer, employee, contractor, sub-contractor or any member of the public. Personal Protection Equipment (PPE) must be used as required.

3.1 Hand Tools required (Minimum)

Measuring equipment e.g. tape, line etc.
Level
Spanners / sockets
Podger bar / spanner
Suitable calibrated torque wrench

3.2 Soil conditions

For the VRS to perform as tested, the soil / ground surrounding the post / individual post foundation must be capable of achieving a minimum stiffness that must be maintained over the service life of the VRS.

3.2.1 For all Hill & Smith VRS posts excluding SVV2 VRS

To ascertain the soil conditions, site specific static push tests are carried out by the installer / client on sacrificial posts / individual post foundations installed in the soil / ground immediately adjacent to the proposed VRS installation. The static push test applies load to the VRS post horizontally at a specified height with the deflection recorded at a set height on the post. If the driven post or sample individual post foundation complies with the requirements set out in our Site Soil Testing Requirements manual - HSD002 and the table below, then the length (if a driven post / socket) or size of individual post foundation (socketed or cast-in post) is deemed suitable to be used at that location. The frequency of the test would be determined by the Site Engineer, as it is dependent on any varying soil / ground conditions being present where the VRS is to be installed. The tests should be carried out when the soil / ground is likely to be in its weakest state, e.g. due to changing environmental conditions.

* Please note that the maximum permissible deflection values for the testing of the ground conditions adjacent to some transition arrangements are reduced in value the nearer the posts are positioned to one another. Please see the relevant VRS drawings for details.

On VRS installations where individual post foundation movement must not occur under any circumstances, e.g at positions adjacent to fibre-optic cable ducts, the destructive post test would be used. This test is based on the same arrangement as the above static push tests but requires a greater load to plastically fail the post without moving the foundation. For details please refer to our Site Soil Testing Requirements manual – HSD002.

All testing data to be recorded / maintained to the specific requirements of the contract.

Static Push Test Pass / Fail Requirements		
Post Type	Bending Moment	Permissible Deflection
FlexBeam 125x44x5 'Z'	6 kNm / 6000Nm	100mm
FlexBeam PLUS 170x47.5x6 'Z"	9 kNm / 9000Nm	150mm *see above
FlexBeam PLUS 125x90x6 'Z"	9 kNm / 9000Nm	150mm
OBB / TCB 110x49x5 'Z'	6 kNm / 6000Nm	100mm
DROBB 125x90x6 'Z"	9 kNm / 9000Nm	150mm

3.2.2 For Hill & Smith SVV2 VRS posts

The permissible post type options for the SVV2 VRS are socketed, cast-in or surface mounted. Due to the stiffness of the I section post used, the push test is not a viable method of testing the ground. The foundations for the SVV2 VRS are to be designed by the site engineers to suitably resist the post loading criteria as detailed on the SVV2 VRS drawing, to the requirements of the contract.

Special concrete foundations, e.g. continuous ground beams / pile caps are to be designed by competent third party Engineers to resist the plastic failure moment of the VRS post in its worst case direction (this is generally perpendicular to the traffic face line of the VRS). The post properties / moment capacities etc, can be found on the relevant VRS drawing available from our Xtratech site. The design and construction of VRS post foundations to be carried out to the satisfaction of the overseeing organisation / specific contract requirements.

3.3 Posts

There are various types of and installation methods for VRS posts (please refer to specific VRS drawings and Appendix A, for permitted options),

1. Directly driven into ground,
2. Set into a punched hole and backfilled with a specific aggregate,
3. Set into a precast foundation within a punched hole,
4. Cast directly into an in-situ individual/continuous concrete foundation or cored hole,
5. Set into a socket (steel or plastic) which is cast into an in-situ concrete foundation or cored hole,
6. Set into a driven socket,
7. Surface mounted (using anchors),
8. Bridge plate (surface mounted without anchors).

When setting out the post positions it is important that an accumulation of tolerance errors is avoided. This is to ensure that the post positions remain within the overall system tolerances.

From the setting-out datum check the pitch to the first system post and ensure that it is within the system tolerances as shown on the relevant system drawings. (Subsequent posts are to be measured from the setting out datum). Continue this method for all posts and then, if necessary, re-datum and repeat as above.

Ensure a check has been made regarding the proximity of underground services / ducts, etc, that may potentially be damaged during the installation and performance life of the VRS.

Ensure the post is the correct type for the VRS specified.

Ensure the post is in the correct orientation. The radiused edge of the Z post on the guardrail side, must be installed facing the approaching traffic (see relevant drawing for further clarification). NOTE: The majority of cast-in / socketed or driven Z posts can either be used in the S or Z orientation when viewed from above. Where this is not possible, especially with the surface mounted post option, then the post type item name will include either an S or Z.

Ensure the post is set to the specified height.

Ensure the system is within the tolerances for height, spacing and verticality.

3.3.1 Driven option

If the ground is too hard, unacceptable damage to the top of the post will result. In these circumstances other options should be used, e.g. cored concrete foundations.

3.3.2 Concrete foundation option

The size of concrete foundations are dictated by the surrounding soil conditions (see 3.2), and the minimum cover requirements to the socket / post as specified on the relevant VRS drawing.

In the vast majority of cases, increasing the depth of the foundation is likely to result in a more economic foundation size than increasing its plan dimension.

It is important that foundations are constructed with vertical sides to ensure their optimum performance over the life of the VRS.

Concrete to have a minimum 28 day characteristic strength of 20MPa for Ø150x300mm cylinder or 25MPa for 150mm cube test, prior to the VRS being commissioned. Specification of concrete mix and use of is determined by the specific contract requirements.

Positioning of the posts/sockets is critical when setting components in concrete. Check that the sockets are at the correct height to ensure the embedment depth of the post below the adjacent ground level is compliant with the VRS being installed (please refer to Appendix A of this document). It is recommended to install sockets slightly higher than the adjacent ground level and slope the top surface of the foundation up towards the top of the socket. This has the effect of reducing the amount of material building up in the bottom of the socket over a period of time, effectively making post replacement easier. The maximum height permitted for the socket to extend above the top of adjacent foundation level is 30mm. The 'standard' socket in the range allows for this sloping of the foundation assuming the reference and adjacent ground level are the same (Please refer to Appendix A for more details).

When setting components in wet concrete, ensure that during curing they remain in their set position, using temporary support framework where necessary.

The use of a steel reinforcement ring around the socket/post within the concrete foundation is recommended. Generally they are positioned evenly around the vertical axis of the post / socket at a distance down from the top of the foundation, which is determined by the minimum cover requirements of the contract/site. Dependent on the adjacent ground conditions, they may be deemed unnecessary by the overseeing Engineer,

If required, fit socket excluder prior to installation of guardrail.

3.3.3 Surface-mounted option

It is usually necessary to use a suitable grout / mortar bed of between 10mm and 30mm thickness underneath the surface mounted post feet to achieve the required horizontal alignment of the adjacent posts of the VRS.

Any voids in anchorages, attachment systems and base plates should be filled with a non-setting passive filler to prevent the collection of water.

Base plate fixings / anchors should be M20 and are designed and supplied by third parties to the loading requirements shown on the relevant system drawings and in the Hill & Smith Ltd HSD002 Site Testing Requirements manual. No part of the fixing should protrude more than 40mm above the underside of the foot.

Some contracts may specify stainless steel anchorage systems to be used. This is commonly the case when attaching to structures, e.g. bridges.

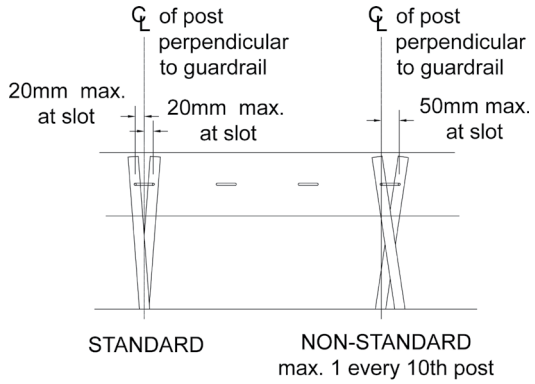
Hill & Smith Ltd no longer supply adjustable surface

mounted posts. They have been superseded by fixed height versions, available in 5mm incremental heights between the minimum and maximum height range detailed on the relevant VRS drawing.

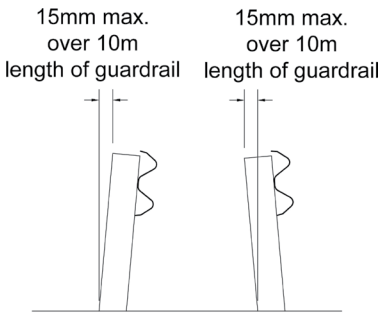
3.4 Installation tolerances

Hill & Smith Ltd VRS's must be installed with the guardrail running parallel to the carriageway surface level, at a tolerance of + / - 30mm applying to the specified guardrail heights at any point in the system. It must present a flowing alignment, i.e. the overall alignment on plan must not depart from the prescribed alignment by more than + / - 30mm, nor deviate in any 10m length from the straight or required radius by more than + / - 15mm.

Posts to be installed perpendicular to the guardrail, to the tolerances as detailed below,



POST ALIGNMENT ON ELEVATION



POST ALIGNMENT ON SECTION

Please note that when installing the SVV2 VRS the layout centres of the posts is more critical than a barrier VRS as it is derived from a parapet system. It is important that the tolerance between posts is maintained at 2000mm ± 2mm.

3.5 Post Deviation

In general post positions must not be varied from those that are detailed on the relevant VRS drawings. Wherever possible, it is always good practice to avoid repositioning of the posts by adjusting the working width class, (i.e. post centres) of the adjacent VRS. (Please see 3.6 for details).

Variances are however allowed where ground obstructions are present that cannot be re-sited - these variations are limited in distance and repeatability; please see relevant VRS drawing for details. Re-adjustment of the working width class of the VRS (see above) may also be necessary to avoid larger obstructions.

3.6 Progression through VRS working width

The minimum length of progression through the working widths of the Hill & Smith VRS's are detailed in the following table,

For further details of the progression through the working widths of Hill & Smith Ltd VRS's, please see Appendix C in this document.

Minimum progression lengths between VRS working widths					
	W1	W2	W3	W4	W5
FlexBeam single sided	3.6m (3 posts crs)	4m (2 post crs)	5.6m (2 post crs)	8m (2 post crs)	10m (2 post crs)
FlexBeam double sided		4.8m (3 posts crs)	8m (2 post crs)	9.6m (2 post crs)	
SPR4 single sided	2m (2 posts crs)	5m (2 posts crs)	8m (2 posts crs)	10m (2 posts crs)	

3.7 Guardrail installation

Hang guardrails onto the posts at the designated positions using the correct fasteners as shown on the relevant system drawing – hand tighten only.

3.7.1 Guardrail joint with podger hole

Connect the guardrails together using the fasteners as shown on the relevant system drawing. If the guardrail has a 20mm dia. podger hole adjacent to the joint slot arrangement, all these fasteners are hand tightened only before using a podger bar tool to remove slack. Whilst holding this tension, tighten at least 2 no fasteners to their allotted torque. Tighten the remaining joint assembly fasteners to their allotted torque, before moving onto the next adjacent guardrail joint. (please see below for details).

3.7.2 Guardrail joint without podger hole

Connect the guardrails together using the fasteners as shown on the relevant system drawing. Tighten all joint assembly fasteners to their allotted torque, before moving onto the next adjacent guardrail joint.

Guardrail lap joint fasteners must be tightened to their correct torque setting before the hand-tightened post fasteners are torqued to their final setting.

3.8 Installation on curves

To offset the increased angle / energy of impact on curved VRS layouts, Hill & Smith Ltd recommend that post centres progressively reduce when used on installations with a guardrail traffic face radii from 49m down to 6m. For details, please refer to the relevant VRS drawing.

Please note – Due to the stiffness of the rear guardrail (CM350) used on the SVV2 VRS, traffic face radii less than 500m is not possible.

Guardrails installed on a traffic face radii of less than 50m are factory curved to a single radius only, i.e compound radii on the same beam is not possible. They are available, by request, in 1m radii increments from 49m to 12m and 0.5m increments from 12m to 6m. Please note that guardrails with a convex traffic face curved below a 10m radii will exhibit a 'wavy' edge on the outer edges of the guardrail profile.

The minimum Radii that straight rubbing rails can be used with FlexBeam N2W1 (CEFB021R) VRS are as follows,

- 4.8m rubbing rail using RHS47/1/8 connection plates – 90m min
- 4.8m rubbing rail using B135A connection plates on radius – 65m min
- 2.4m rubbing rail using RHS47/1/8 connection plates – 50m min
- 2.4m rubbing rail using B135A connection plates on radius – 35m min

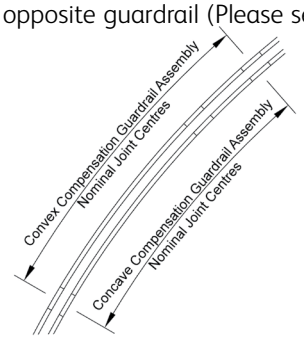
Rubbing rails with radii less than the above must be factory curved.

Please note that rubbing rails can only be curved to a single radii and approx. 300mm at either end of the rubbing rail will remain straight after radiusing to ensure the correct fitting of joint plates.

To ensure guardrails / rubbing rails are correctly radiused to our customers requirements a 'Radiused Guardrail / Rubbing Rail' template sheet is available for download from our Xtratech site. This template sheet has been designed to guide the end user / purchaser in providing the critical dimensions required for the correct manufacture of a radiused guardrail / rubbing rail.

For the assembly of double sided FlexBeam VRS on long sweeping curves it may be necessary for 'compensation' assemblies to be used to prevent 'slotting out', i.e. where the guardrail slot on one side falls longitudinally out of line with the post attached to the opposite guardrail (Please see the detail below).

Compensation Guardrail Fitted At Every...Guardrails		
Radius of Curve (m)	CM001 3.2m nom. Guardrail	CM023 4m nom. Guardrail
120	9	7
150	14	11
200	26	20
250	42	33
300	60	48
350	83	66
400	108	86
450	137	109
500	169	135
550	205	164
600	244	195
650	287	229
700	333	266
750	383	306



Compensation Guardrail Assembly Table		
Radii	Guardrail + Compensation	Nominal Ctrs
Concave	CM001 + CM025 (750mm)	3.150m
Convex	CM001 + CM027(850mm)	3.250m
Concave	CM023 + CM025(750mm)	3.950m
Convex	CM023 + CM027(850mm)	4.050m

3.9 Attachment of Accessories

The addition of components to Hill & Smith Ltd VRS's may affect their tested performance and would not be compliant with the VRS's CE mark / Approval. Any proposed additions would need to be risk assessed to the satisfaction of the overseeing organisation. Hill & Smith Ltd cannot accept any liability for the performance of third party modified VRS's.

3.10 Closure beams for guardrails

Closure beams (if required) are installed at the end of the length of need VRS, prior to the connection to other VRS types/terminals. They are reduced length versions of the relevant VRS guardrail and are restricted to a minimum of half of the standard relevant VRS guardrail length, Where the required closure beam length is less than the specified minimum length then add this length to the adjacent beam length and divide equally to give 2 closure beams of the same length. These shall be installed adjacent to each other. Closure beams must be factory manufactured to the customer's specific length requirements

Closure beam (CB) template sheets are available for download from our Xtratech site. These sheets (available in PDF format) have been designed to guide the end user / purchaser in providing the critical dimensions required for the correct manufacture of the component. Each CB template sheet is required to be signed off by the customer for dimensional confirmation prior to manufacture.

Please note: closure beams are supplied in 5mm increments.

3.11 Modifications to components

VRS components are tested to the requirements of EN1317 and to ensure compliance with the CE mark approval must not deviate from the components detailed on the relevant VRS drawing. Hill & Smith Ltd strongly recommend that components are NOT modified. Where this is absolutely unavoidable, a risk assessment would need to be carried out to the satisfaction of the overseeing organisation.
Hill & Smith Ltd are able to manufacture non-standard (NS) components if requested – i.e. overall length/height outside of those detailed on the relevant VRS drawings. Hill & Smith Ltd are unable to accept design liability for NS components as they are not in compliance with the relevant VRS CE mark approval and each NS item is required to be signed off by the customer for dimensional and liability confirmation prior to manufacture. Materials and manufacturing details will be based on the standard component. Non-standard (NS) component template sign off drawing sheets are available for download from our Xtratech site. These sheets (available in PDF format) have been designed to guide the end user / purchaser in providing the critical dimensions required for the correct manufacture of the component.

Special components, i.e. with modifications outside of the length/height requirements of an NS component, would also require to be signed off by the customer for dimensional and liability confirmation prior to manufacture. These would be treated as one-off components made to order and would require manufacturing details to be provided by the customer.

VRS components must not be site modified.

3.12 Connections, transitions and terminals

For details of connections / transitions relating to the following, please refer to the relevant section of our Xtratech technical website.

- Connections / transitions to other Hill & Smith Ltd VRS's
- Connection / transitions to non-Hill & Smith Ltd VRS's
- Connection / transitions to concrete VRS / plinths etc.
- Connection / transitions to terminals
- Connection / transitions to parapets
- Connection / transitions to expansion joints at structures

These details must be adhered to at all times. Hill & Smith Ltd recommend that a risk assessment is carried out to the satisfaction of the overseeing organisation if variances to these layout details are absolutely unavoidable.

4. Repair

Like for like repair of Hill & Smith Ltd VRS's must be carried out to the drawings/specification current at the time of the initial VRS installation. The site contract file will hold these documents. Relevant documents can also be supplied by Hill & Smith Ltd when requested via email to barriertechnical@hill-smith.co.uk

Guardrails, posts and other VRS components that are visually seen to be distorted, split, buckled or otherwise damaged shall be replaced. Due to work hardening effects, it is not acceptable to straighten damaged components. All fasteners in the impact zone shall be replaced with new, correctly specified fasteners irrespective of whether they are damaged or not. Guardrail lap holes either side of the damaged VRS area shall be examined closely for splitting or malformed shape (hole ovality, etc) and such guardrails will be unacceptable for re-use.

If a post is leaning but with no evidence of bending in the post at or near ground level, then it is likely that the foundation has moved. Movement of driven or socketed posts in individual concrete foundations (whether affected directly by impact or not) will require that the posts / foundations are removed and the ground locally dynamically compacted to the satisfaction of the overseeing Engineer before posts are re-driven or replaced.

Where posts are in socketed foundations and there is no damage to the foundation, a new post can be refitted into the socket. Prior to the replacement of a surface mounted post, the holding down anchors should be inspected for any visible movement. Any movement or adjacent structural damage to the concrete will render the fixings unsuitable for re-use and they should be replaced with suitable fixings which are capable of withstanding the loads generated by the deforming of the post section (as specified by the overseeing Engineer with reference to the surface mounted anchor loading table on the relevant system drawing).

Breakage or movement of any concreted foundations of posts or End Anchorages will necessitate replacement. If the impact is within 50 m of a terminal then the anchor foundation/anchor bolt arrangement should be inspected for damage/movement. Reconstruction using a larger concrete anchor block to the design/installation requirements of the overseeing Engineer, may be needed if any movement has occurred.

Hill & Smith Ltd recommend, that where it is deemed viable and at every opportunity, consideration is given to bring existing VRS's up to the latest standards.

4.1 Damaged coatings

Damaged coatings can be repaired by the application of a 150 micron coat of high (> 89%) Zinc solids paint (as specified in EN ISO 1461 – Clause 3.1), to the manufacturers application procedure.

4.2 Component replacement

Any damaged guardrail, fixings, brackets or posts must be replaced with new components conforming to the Hill & Smith Ltd installed VRS specification.

Before any driving of posts in new positions is undertaken a check should be made for any underground services or cable positions that may be damaged by the post.

5. Maintenance and Inspection

Like for like maintenance of Hill & Smith Ltd VRS's must be carried out to the drawings / specification current at the time of the initial VRS installation. The site contract file will hold these documents. Relevant documents can also be supplied by Hill & Smith Ltd via email request to barriertechnical@hill-smith.co.uk

The frequency of drive-by / walk-up inspections and maintenance works would be specifically determined by the appropriate highway maintenance authority contract based upon, e.g. volume of traffic, impact history, vandalism, etc..

5.1 Historical Data

Hill & Smith Ltd have a policy of continual improvement and updates to products and their installation manuals / drawings. Current information/documents available on our Xtratech may not reflect what has been historically installed and therefore it is recommended that reference is made to the job specific contract file for any system details at that time or deviations used.

Relevant documents can be supplied by Hill & Smith Ltd via email request to barriertechnical@hill-smith.co.uk

For further information please visit the Hill & Smith Xtratech.

An information portal designed for quick access to drawings & technical documents.

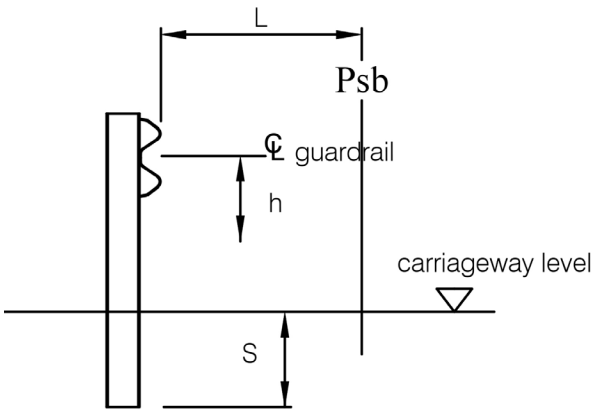
Appendix A: VRS components – Guardrail post type options

				Assumed 'level' ground								(S and Z designates the Z post shape when viewed from above after install)					
				Beam								Socketed / cast-in post		Driven post		Surface mounted post	
CE marked Guardrail VRS	Product reference	Post Crs mm	Drawing reference	Nominal 'installed' length mm	Item no.	* Height to centre of beam mm	Beam to post fixing item no.	Height to top of post mm	Depth of socket in ground mm	Std socket height mm	Level socket height mm	Length mm	Item no.	Length mm	Item no.	Height mm	Item no.
SS N2 W1 FlexBeam PLUS	CEFB21	1200	PD-CEGRSB100	4000	CM023	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS N2 W1 FlexBeam PLUS	CEFB21R	1600	PD-CEGRSB101	4000	CM023	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
With Rubbing Rail														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS N2 W2 FlexBeam PLUS	CEFB22	2000	PD-CEGRSB102	4000	CM023	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS N2 W3 FlexBeam PLUS	CEFB23	2800	PD-CEGRSB103	4000	CM023	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS N2 W4 FlexBeam	CEFB04	4000	PD-CEGRSB104	4000	CM023	610	CM031	710	450	470	450	1160	CM011A	1700	CM011B	710	CM077AS
														1900	CM011C	710	CM077AZ
														2100	CM011D	610	CM077BS
																610	CM077BZ
SS N2 W5 FlexBeam	CEFB05	5000	PD-CEGRSB105	5000	CM059	610	CM031	710	450	470	450	1160	CM011A	1700	CM011B	710	CM077AS
														1900	CM011C	710	CM077AZ
														2100	CM011D	610	CM077BS
SS N2 W1 SPR4	CESPR4-002	2000	PD-CEGRSB111	4000	CM600	550	CM048	675	510	520	N/A	1185	CM301A	1650	CM301B	675	CM610AS
														1850	CM301C	675	CM610AZ
														2050	CM301D		

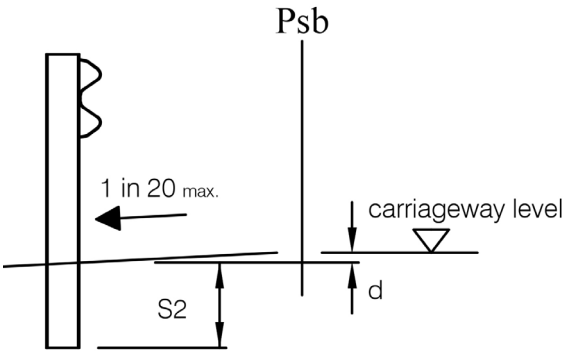
								Assumed 'level' ground				(S and Z designates the Z post shape when viewed from above after install)					
CE marked Guardrail VRS	Product reference	Post Crs mm	Drawing reference	Beam			Beam to post fixing item no.	Height to top of post mm	Depth of socket in ground mm	Std socket height mm	Level socket height mm	Socketed / cast-in post		Driven post		Surface mounted post	
				Nominal 'installed' length mm	Item no.	* Height to centre of beam mm						Length mm	Item no.	Length mm	Item no.	Height mm	Item no.
SS N2 W2 SPR4	CESPR4-004	2500	PD-CEGRSB112	4000	CM600	550	CM048	675	510	520	N/A	1185	CM301A	1650	CM301B	675	CM610AS
														1850	CM301C	675	CM610AZ
														2050	CM301D		
SS N2 W3 SPR4	CESPR4-003	4000	PD-CEGRSB113	4000	CM600	550	CM048	675	510	520	N/A	1185	CM301A	1650	CM301B	675	CM610AS
														1850	CM301C	675	CM610AZ
														2050	CM301D		
SS N2 W4 SPR4	CESPR4-005	5000	PD-CEGRSB114	4000	CM600	550	CM048	675	510	520	N/A	1185	CM301A	1650	CM301B	675	CM610AS
														1850	CM301C	675	CM610AZ
														2050	CM301D		
DS N2 W2 FlexBeam	CEFB12	1600	PD-CEGRSB150	4000	CM023	610	CM031	785	375	400	380	1160	CM011A	1700	CM011B	785	CM058AS
														1900	CM011C	785	CM058AZ
														2100	CM011D	685	CM058BS
																685	CM058BZ
DS N2 W3 FlexBeam	CEFB13	4000	PD-CEGRSB151	4000	CM023	610	CM031	785	375	400	380	1160	CM011A	1700	CM011B	785	CM058AS
														1900	CM011C	785	CM058AZ
														2100	CM011D	685	CM058BS
																685	CM058BZ
DS N2 W4 FlexBeam	CEFB14	4800	PD-CEGRSB152	4000	CM023	610	CM031	785	375	400	380	1160	CM011A	1700	CM011B	785	CM058AS
														1900	CM011C	785	CM058AZ
														2100	CM011D	685	CM058BS
																685	CM058BZ
DS N2 W4 SPR4	CESPR4-001	4000	PD-CEGRSB160	4000	CM023	610	CM031	710	450	470	450	1160	CM011A	1700	CM011B	710	CM077AS
														1900	CM011C	710	CM077AZ
														2100	CM011D	610	CM077BS
																610	CM077BZ

								Assumed 'level' ground				(S and Z designates the Z post shape when viewed from above after install)					
CE marked Guardrail VRS	Product reference	Post Crs mm	Drawing reference	Beam			Beam to post fixing item no.	Height to top of post mm	Depth of socket in ground mm	Std socket height mm	Level socket height mm	Socketed / cast-in post		Driven post		Surface mounted post	
				Nominal 'installed' length mm	Item no.	* Height to centre of beam mm						Length mm	Item no.	Length mm	Item no.	Height mm	Item no.
SS H1 W4 FlexBeam PLUS	CEFB63	1600	PD-CEGRSB200	3200	CM001	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS H1 W3 VI6 FlexBeam PLUS	CEFB63	1600	PD-CEGRSB201	3200	CM001	610	CM047	735	450	470	450	1185	CM301A	1650	CM301B	735	CM302AS
														1850	CM301C	735	CM302AZ
														2050	CM301D	635	CM302BS
																635	CM302BZ
SS H1 W4 FlexBeam PLUS	CEFB64	2000	PD-CEGRSB202	4000	CM023	610/1000	CM048	1075	450	470	450	1525	CM043AS	2120	CM043B	1075	CM049AS
														1525	CM043AZ	1075	CM049AZ
																975	CM049BS
																975	CM049BZ
SS H2 W5 FlexBeam PLUS	CEFB85	2000	PD-CEGRSB300	4000	CM023	610/1000	CM048	1075	450	470	450	1525	CM043AS	2120	CM043B	1075	CM049AS
														1525	CM043AZ	1075	CM049AZ
																975	CM049BS
																975	CM049BZ
SS H2 W1 VI2 SVV2	CESVV2	2000	PD-CEGRSB310	Front - 4000/2725	CM351/352	610	F07SH & CM361	1255	500	520	N/A	1755	CM363	N/A	N/A	1115	CM357A
				Rear - 4000	CM350											1235	CM357B
DS H2 W4 VI5 Briflex	CEFB95	1600	PD-CEGRSB350	3200	CM001	610	CM053	1075	450	470	450	1525	CM043AS	2120	CM043B	1075	CM049AS
														1525	CM043AZ	1075	CM049AZ
																975	CM049BS
																975	CM049BZ
SS H1 W4 VI9 DROBB	CEDROBB	2400	PD-CEGRSB249	4800	B03	610/1020	F02 & B17	1120	450	470	450	1570	B80A (S)	2020	B81A (S)	1120	B83A (S)
												1570	B80B (Z)	2020	B81 (Z)	1120	B83B (Z)
														2270	B82A (S)	1020	B83C (S)
														2270	B82 (Z)	1020	B83D (Z)

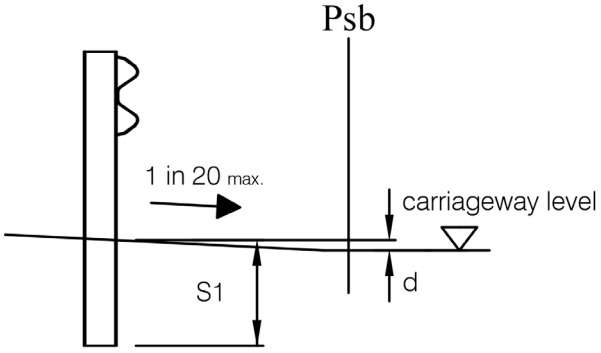
Appendix A: VRS components – Determination of socket heights



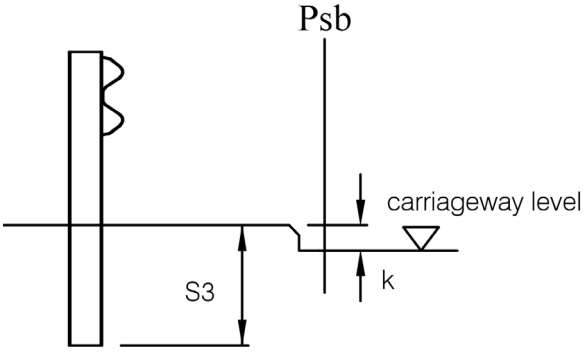
No slope - Level with carriageway



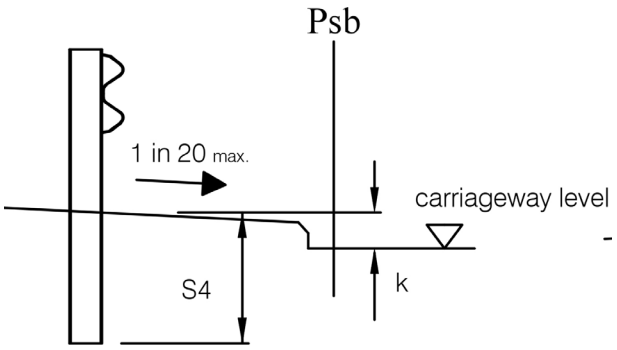
Slope away from carriageway



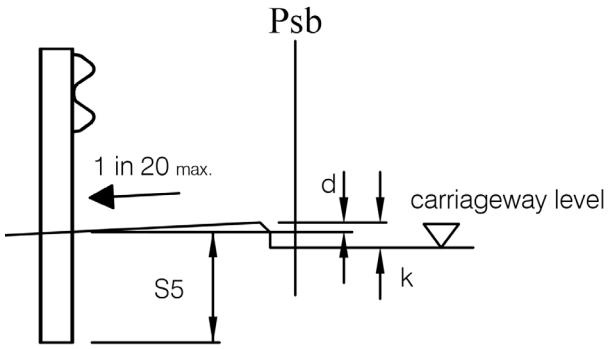
Slope towards carriageway



No slope - with kerb



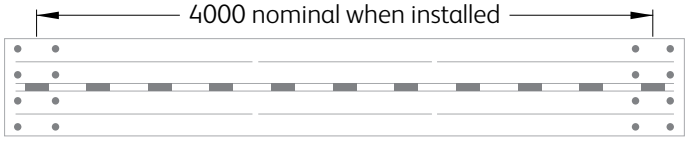
Slope towards carriageway - with kerb



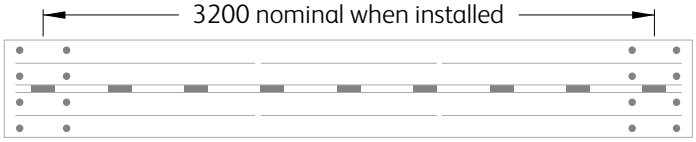
Slope away from carriageway - with kerb

Key
Psb - Point of set-back
L - Set-back distance from Psb to traffic face of VRS.
If 1500mm or less, h is taken from carriageway level
If over 1500mm, h is taken from ground level at centreline of post.
h - Height to centreline of guardrail from carriageway or adjacent ground level.
d - 75mm max. - Height of 1 in 20 maximum slope of ground to/from carriageway level.
k - Height of kerb (see 2.7), including slope if applicable.
S - Height of socket as standard system socket height if L is greater than 1500mm
Where L is 1500mm or less, height of sockets as below,
S1 - standard system socket height + d
S2 - standard system socket height - d
S3 - standard system socket height + k
S4 - standard system socket height + k
S5 - standard system socket height + k - d

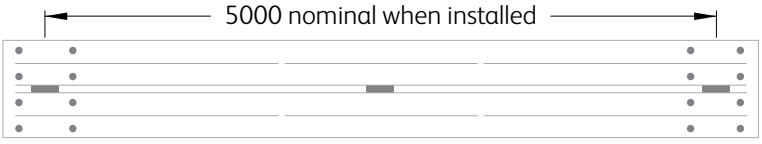
Appendix B: Permissible VRS post positions (See also Appendix C)
For post deviation rules please see relevant VRS drawings



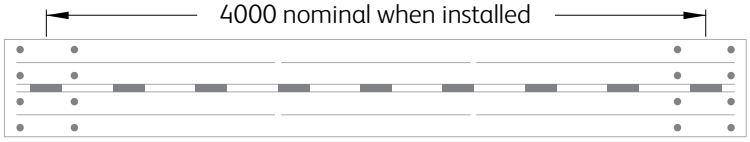
4.0m Guardrail - CM023	System ref.	Post Crs (mm)	1	2	3	4	5	6	7	8	9	10	1
S/S FlexBeam PLUS N2 W1	CEFB21	1200	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
S/S FlexBeam PLUS R N2 W1	CEFB21R	1600	✘	✔	✘	✔	✘	✔	✘	✔	✘	✔	✘
S/S FlexBeam PLUS N2 W2	CEFB22	2000	✔	✘	✘	✘	✘	✔	✘	✘	✘	✘	✔
S/S FlexBeam PLUS N2 W3	CEFB23	2800	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
S/S FlexBeam PLUS N2 W4	CEFB04	4000	✘	✘	✘	✘	✘	✔	✘	✘	✘	✘	✘
D/S FlexBeam PLUS N2 W2	CEFB12	1600	✘	✔	✘	✔	✘	✔	✘	✔	✘	✔	✘
D/S FlexBeam PLUS N2 W3	CEFB13	4000	✘	✘	✘	✘	✘	✔	✘	✘	✘	✘	✘
D/S FlexBeam PLUS N2 W4	CEFB14	4800	✘	✔	✘	✔	✘	✔	✘	✔	✘	✔	✘
S/S FlexBeam PLUS H1 W4 VI6	CEFB64	2000	✔	✘	✘	✘	✘	✔	✘	✘	✘	✘	✔
S/S FlexBeam PLUS H2 W4 VI5	CEFB85	2000	✔	✘	✘	✘	✘	✔	✘	✘	✘	✘	✔



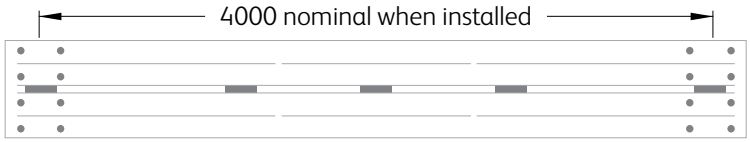
3.2m Guardrail - CM001	System Ref.	Post Crs (mm)	1	2	3	4	5	6	7	8	1
S/S FlexBeam PLUS H1 W4	CEFB63	1600	✔	✘	✘	✘	✔	✘	✘	✘	✔
S/S FlexBeam PLUS H1 W3 VI6	CEFB63	1600	✔	✘	✘	✘	✔	✘	✘	✘	✔
BriFlex H2 W5 D/S	CEFB65	1600	✔	✘	✘	✘	✔	✘	✘	✘	✔



5.0m Guardrail - CM059	System Ref.	Post Crs (mm)	1		2		1
S/S FlexBeam N2 W5	CEFB05	5000	✘		✔		✘



4.0m Guardrail – CM600	System Ref.	Post Crs (mm)	1	2	3	4	5	6	7	8	1
S/S SPR4 N2 W1	CESPR4-002	2000	✔	✘	✘	✘	✔	✘	✘	✘	✔
S/S SPR4 N2 W2	CESPR4-004	2500	✔	✔	✔	✔	✔	✔	✔	✔	✔
S/S SPR4 N2 W3	CESPR4-003	4000	✔	✘	✘	✘	✘	✘	✘	✘	✔
S/S SPR4 N2 W4	CESPR4-005	5000	✔	✘	✔	✘	✔	✘	✔	✘	✔
D/S SPR4 N2 W4	CESPR4-001	4000	✔	✘	✘	✘	✘	✘	✘	✘	✔



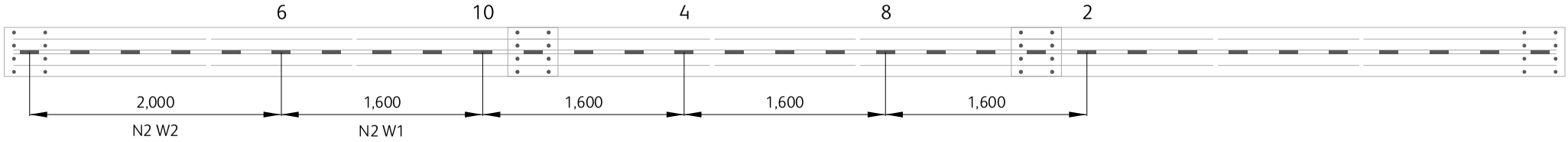
4.0m Guardrail – CM351	System Ref.	Post Crs (mm)	1		2		3		4		1
S/S SVV2 H2 W1 VI2	CESVV2	2000	✔		✘		✔		✘		✔

For further information please visit the Hill & Smith Xtratech.

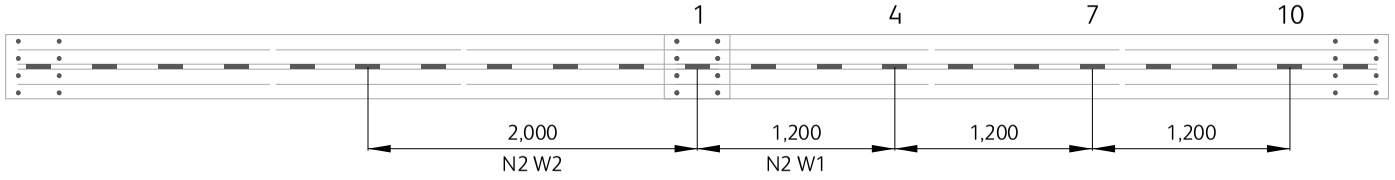
An information portal designed for quick access to drawings & technical documents.

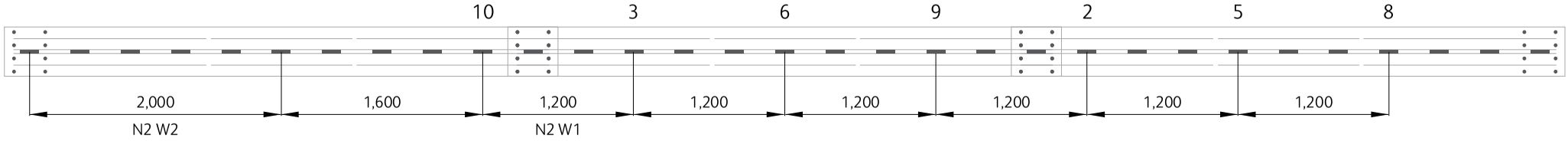
Appendix C: VRS working width progression details showing permissible post positions on guardrails (see also 3.6 & Appendix B)

SS N2 W2 (2m) FlexBeam PLUS to N2 W1-R (1.6m) FlexBeam PLUS

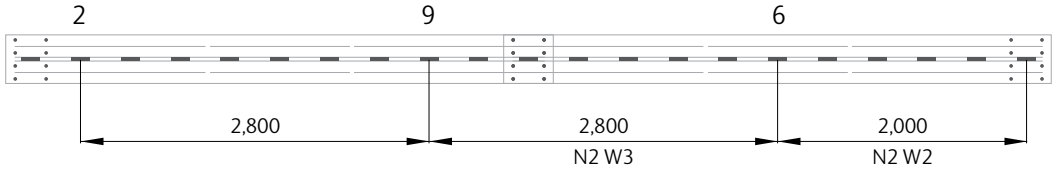


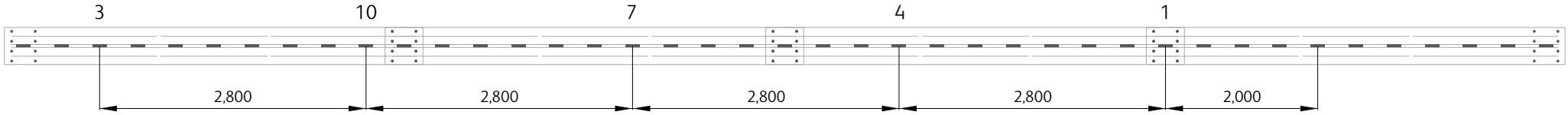
SS N2 W2 (2m) FlexBeam PLUS to N2 W1 (1.2m) FlexBeam PLUS

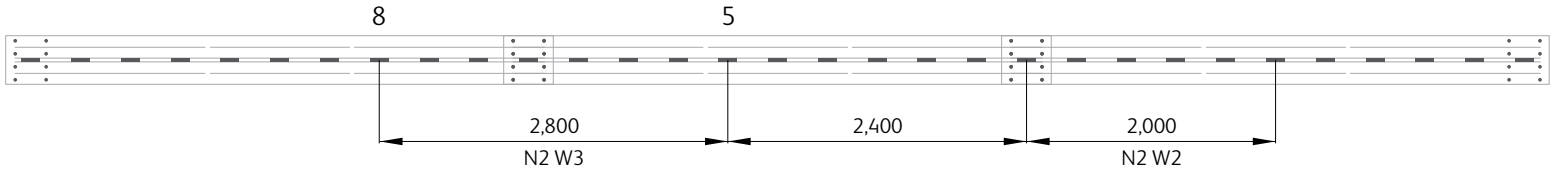




SS N2 W3 (2.8m) FlexBeam PLUS to N2 W2 (2m) FlexBeam PLUS

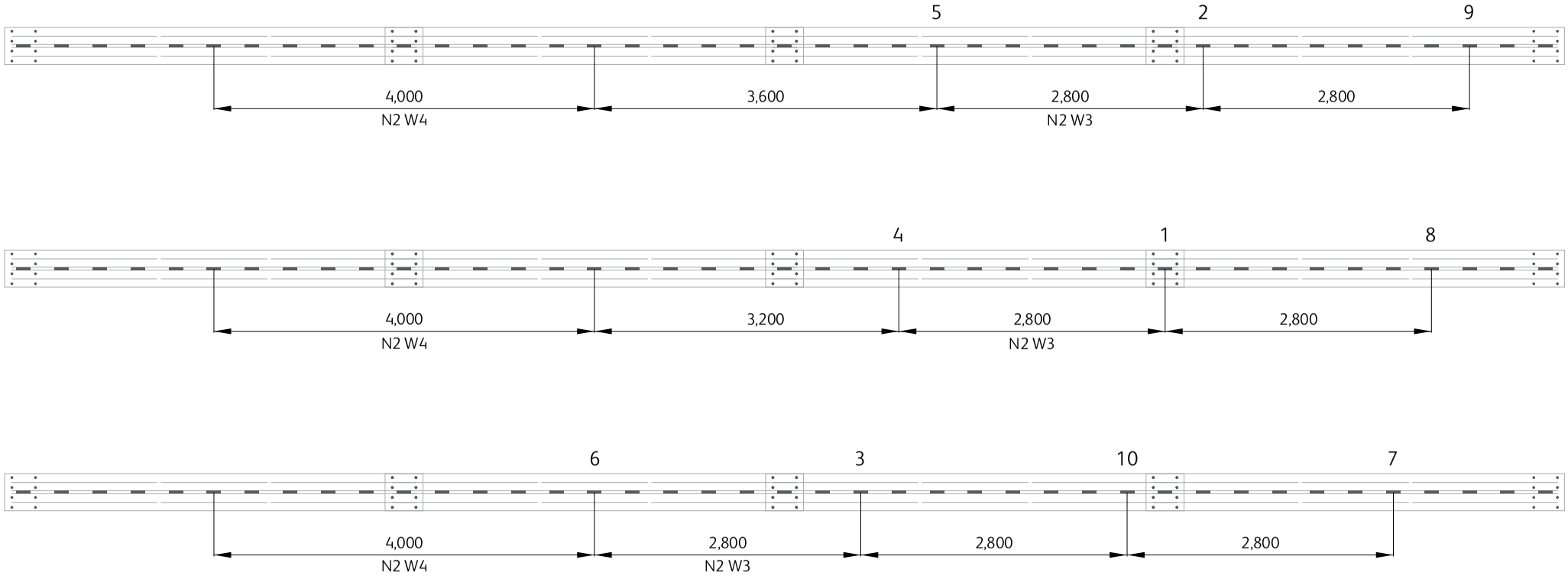




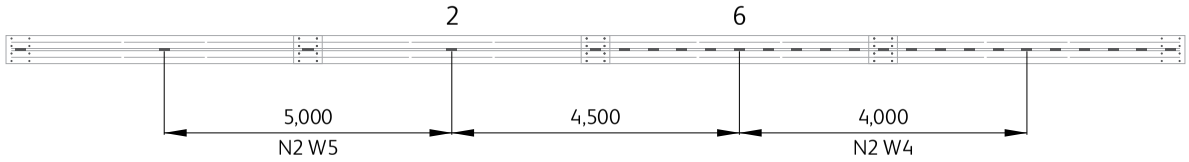


Appendix C: VRS working width progression details showing permissible post positions on guardrails (see also 3.6 & Appendix B)

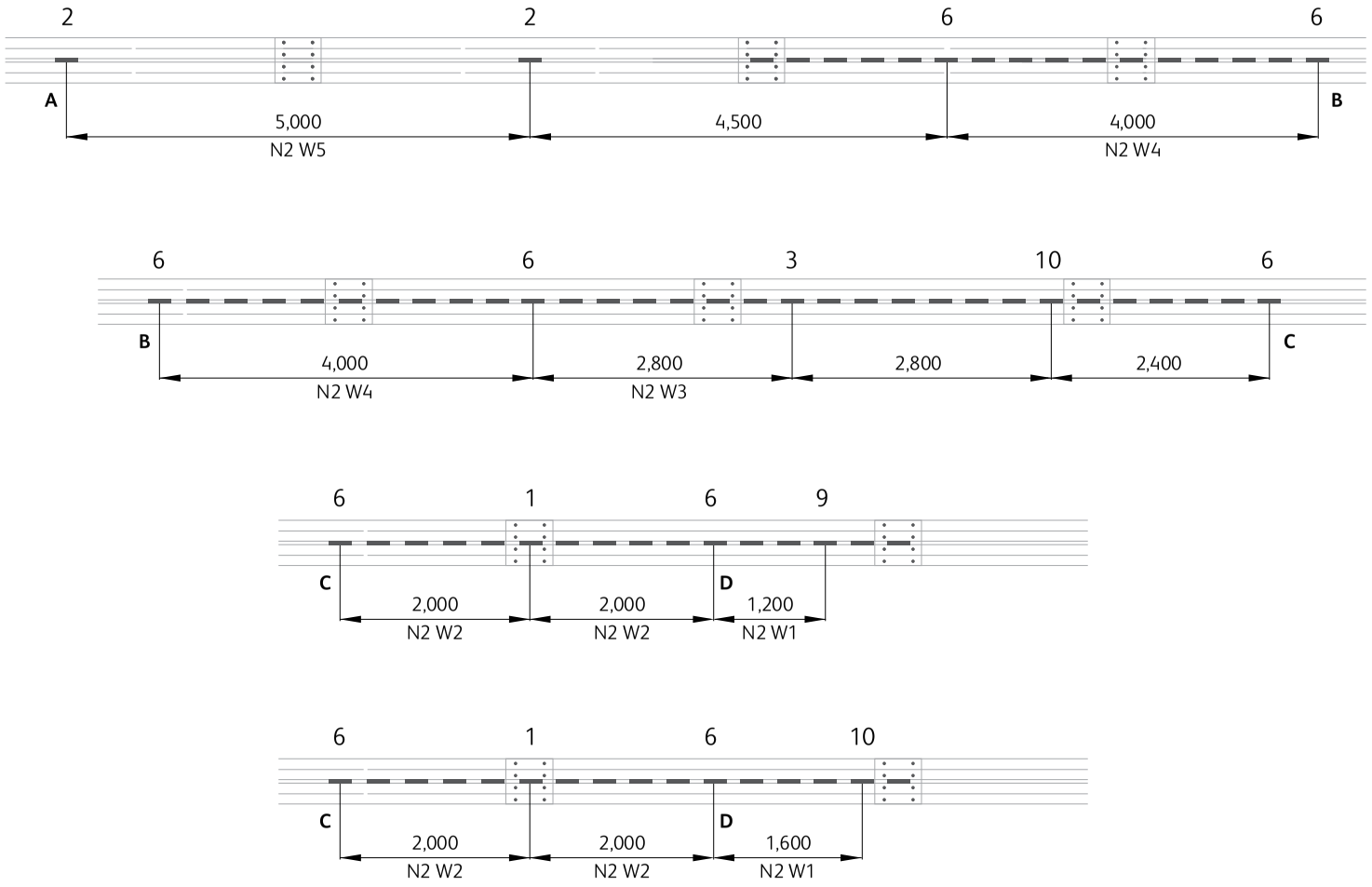
SS N2 W4 (4m) FlexBeam to N2 W3 (2.8m) FlexBeam PLUS



SS N2 W5 (5m) FlexBeam to N2 W4 (4m) FlexBeam

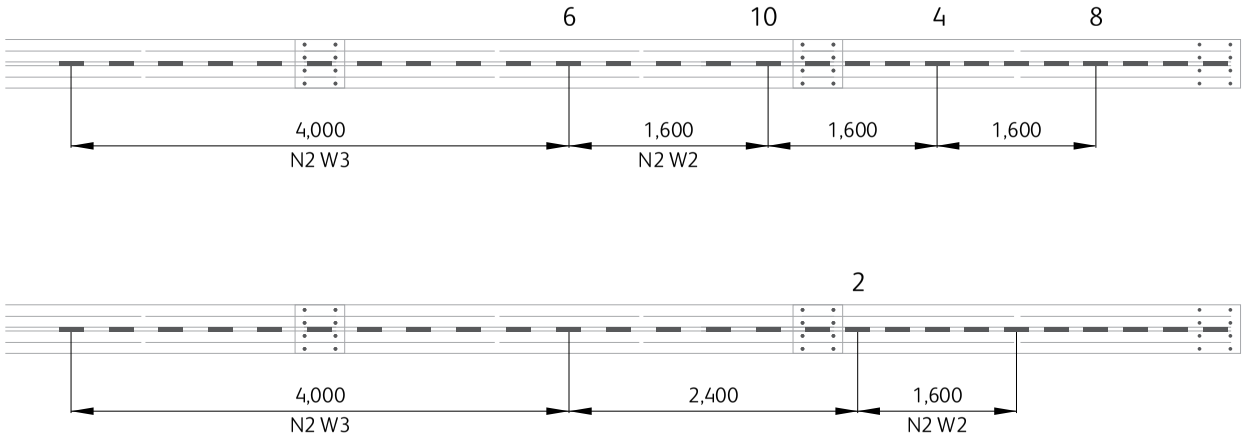


SS N2 W5 (5m) FlexBeam to N2 W1 FlexBeam PLUS minimum progression length

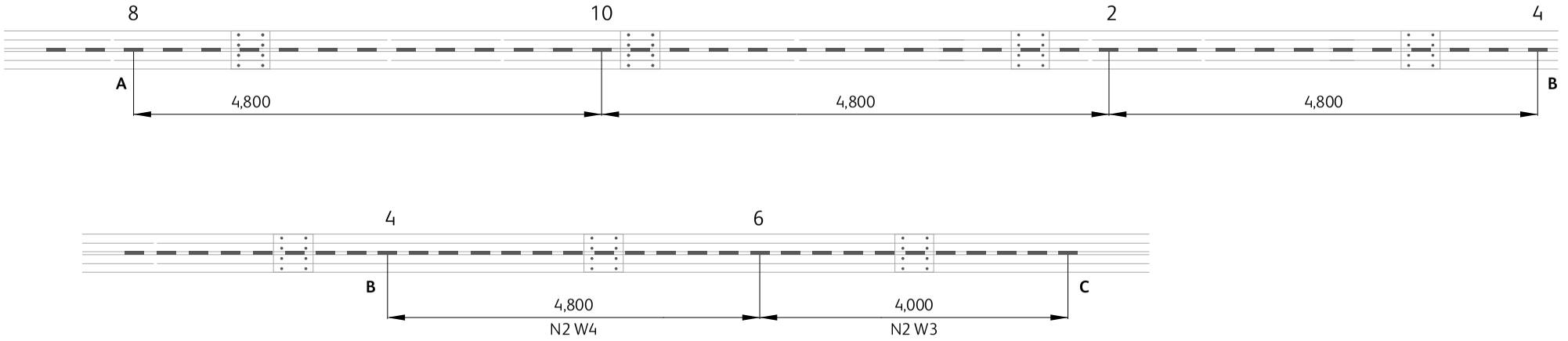


Appendix C: VRS working width progression details showing permissible post positions on guardrails (see also 3.6 & Appendix B)

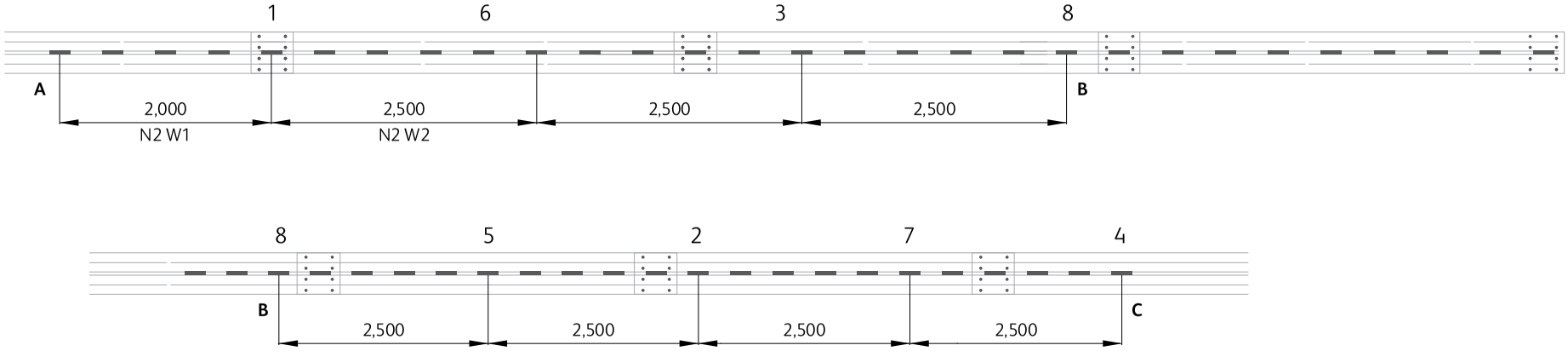
DS N2 W3 (4m) FlexBeam to N2 W2 (1.6m) FlexBeam



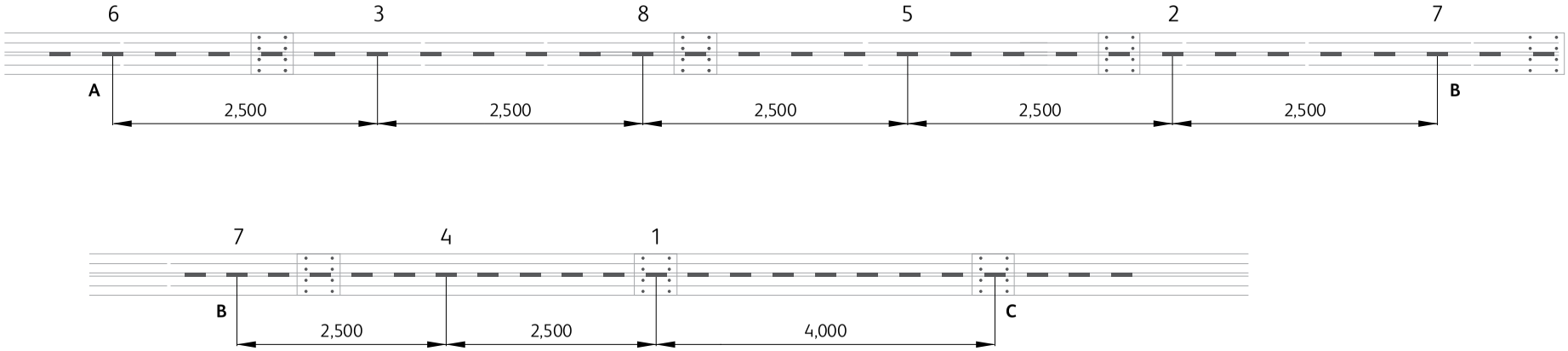
DS N2 W4 (4.8m) FlexBeam to N2 W3 (4m) FlexBeam



SS N2 W1 (2m) SPR4 to N2 W2 (2.5m) SPR4

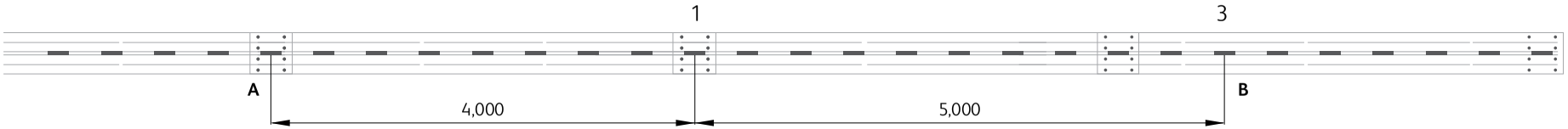


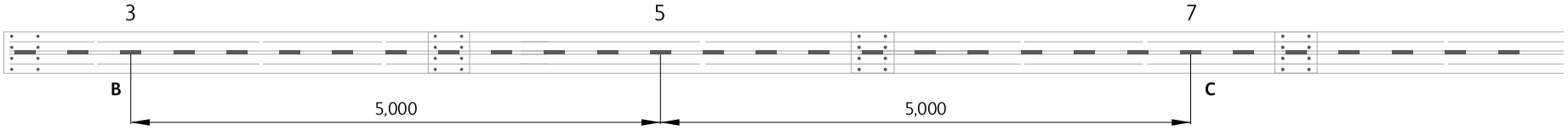
SS N2 W2 (2.5m) SPR4 to N2 W3 (4m) SPR4



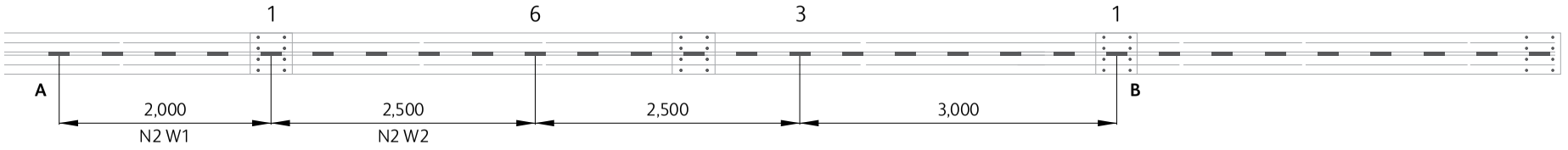
Appendix C: VRS working width progression details showing permissible post positions on guardrails (see also 3.6 & Appendix B)

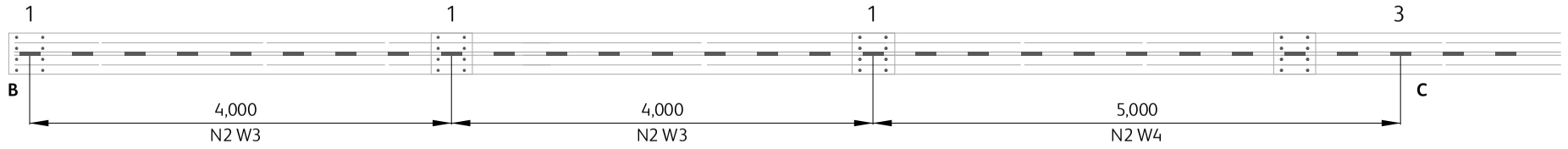
SS N2 W3 (4m) SPR4 to N2 W4 (5m) SPR4



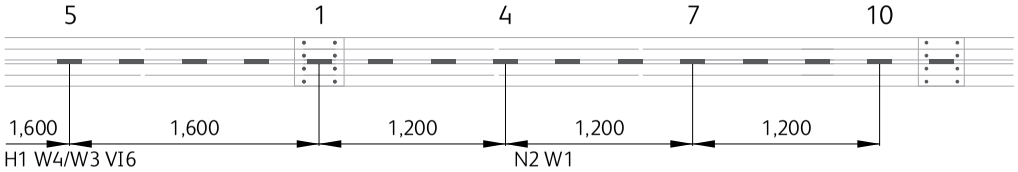


SS N2 W1 (2m) SPR4 to N2 W4 (4m) SPR4 minimum progression length

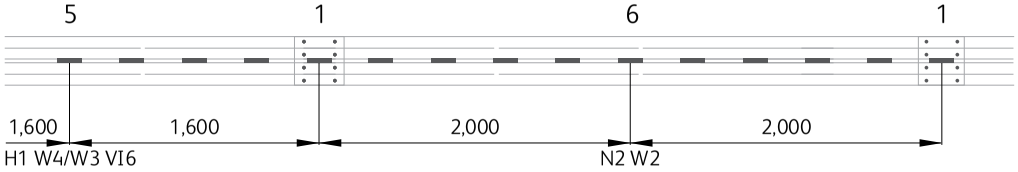




SS H1 W4/W3 VI6 (1.6m) FlexBeam PLUS to SS N2 W1 (1.2m) FlexBeam PLUS



SS H1 W4/W3 VI6 (1.6m) FlexBeam PLUS to SS N2 W2 (2m) FlexBeam PLUS



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