Varley and Gulliver Ltd.

Aluminium VGAN 500 Series Vehicle Restraint System Specification Manual.

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SECTION A – Specification Manual.

CONTENTS

SECTION ‘A’ – SPECIFICATION MANUAL.

1.0 List of Drawings.

1.1 System Drawings.

DRAWING NUMBER	DRAWING TITLE.
VGAN 500-01.C:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **VGAN 501 AND VGAN 502.**
VGAN 500-02.C:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **VGAN 503 AND VGAN 504.**
VGAN 500-03.C:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **VGAN 505 AND VGAN 506.**
VGAN 500-04.C:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **VGAN 507 AND VGAN 508.**
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VGAN 500-07:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **PARAPET POST DETAILS.**
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VGAN 500-11.B:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **CONNECTION DETAILS TO TRANZFLEX 130 TRANSITION.** (SHEET 1 OF 2.)
VGAN 500-12.A:	STANDARD ARRANGEMENT DRAWINGS OF VGAN 500 SERIES ALUMINIUM PARAPET SYSTEM. **CONNECTION DETAILS TO TRANZFLEX 130 TRANSITION.** (SHEET 2 OF 2.)

2.0 List of Varley and Gulliver Limited Company Procedures for Production.

All procedure references relate to Varley and Gulliver Limited Quality Assurance manual in accordance with **ISO 9001:2008** approved procedures.

Name of procedure:	**Procedure Reference Number:**
Product Realisation (Inspection of Raw Materials):	7.1
Inspection of Components and Fasteners:	7.1
Routine inspections carried out during manufacture:	7.1
Handling and Storage of Materials:	7.1
Control of measuring equipment:	4.2.4 and 7.1
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Table 1.

3.0 Product Description:

The VGAN 500 series aluminium parapet is a **modular system** providing supporting posts are spaced at **4.0m centres**. Exceptions are at Type 3 expansion joint locations where posts spanning the joint should not exceed 1.5m and the penultimate bays either side of the joint should not exceed 1.0m centres. End bays should also have post centres not exceeding 1.0m with penultimate bays not less than **3.2m** centres.

The system consists of 3, 4 or 5 horizontal extruded aluminium rail sections 114mm x 70mm located to supporting posts at heights specified on system drawings. The rails are nominally 12.0m long with ends punched with 10.5mm diameter holes to receive bolted rail to rail connection joints. Shorter rail lengths are utilised at expansion joints and ends of runs.
Rails are joined together with internal extruded aluminium rail joint sleeves 95.8mm x 61.5mm which are slotted in the top and bottom faces to accept 5No. M10x80mm long stainless steel bolts which pass through the rail and joint and are secured with M10 nyloc nuts.

There are three types of rail joint to accommodate varying degrees of expansion or contraction.
Type 1 joint (Standard) accommodates movement range upto +/- 9mm.
Type 2 joint (Expansion) accommodates movement range upto +/- 25mm.
Type 3 joint (No-Tension Expansion) accommodates movement range upto +/- 150mm.

The rails are attached to the supporting posts with 4no. M12 stainless steel captive fixings located and secured in the rear of the rail with a sliding clamp bar.

The supporting posts are fabricated from the following components:

- 19mm thick extruded aluminium baseplate 204mm wide x 343mm long with 4No. 27mm diameter holes punched to suit 127mm x 203mm centres for M20 holding down bolts.
- Extruded aluminium double box section 219mm x 68mm with traffic face and rear webs 6mm thick and side flange and centre web 4.5mm thick. The section is diagonally split 20mm above the bottom of the post at the rear to the full height of the post to produce a 60mm set back from the traffic face at the top of post.
- Extruded aluminium front gusset 60mm x 30mm x 10mm thick and 45mm long.
- 3, 4 or 5No. Extruded aluminium post to rail cleats 22mm thick x 66mm wide x 210mm long punched with 4No. 13mm wide x 20mm long vertical slots to accept rail fixing bolts to suit post height.
- Extruded aluminium post cover strip channel 72mm wide x 2mm thick x length to suit post height.
- Extruded aluminium post cap.

Posts are usually attached to the bridge structure or retaining wall with 4No. M20 stainless steel holding down bolts into approved cast-in anchorage units or resin fixed drilled anchorages. The holding down bolts and washers are isolated from the aluminium baseplate with a nylon top hat washer.

4.0 Durability:

The durability of a product is dependent upon numerous factors such as weather conditions, air pollution, location, handling, repair and routine maintenance.

Aluminium weathers to a dull grey finish due to the formation of an impervious oxide layer which is integral with the base metal on exposed surfaces, which is highly resistant to atmospheric corrosion. The rapid forming of the oxide layer and reforming of the layer when scratched is a main reason for the good corrosion characteristics of aluminium and an **almost unlimited life expectancy**.

The use of stainless steel fixings in aluminium can raise concern of bi-metallic corrosion (Galvanic corrosion).
Galvanic corrosion takes place when two different metals have contact with each other in the presence of an electrolyte and is also dependent upon the relative masses of the two materials and the level of current density in the sacrificial anode which would be the aluminium extrusions. The high relative mass of the aluminium compared with the stainless steel fixings would result in a low current density. The extent of isolation between stainless steel fixings in aluminium components, in our opinion, is over specified and the use of stainless steel in contact with aluminium in several existing parapet systems used for over 30 years in the UK would verify.
The main area of concern would be the holding down bolts and the baseplate which would be prone to standing water and road salts and for this reason a nylon isolation washer is utilised.

Splashes of alkaline building materials like grout and concrete cause visible spots on the surface of the Aluminium. These are difficult to remove and for this reason Aluminium should be protected on site. The underside of the Aluminium baseplate is painted with two coats of bitumastic paint to prevent alkaline contact during the grouting process. After the cementation of the grout corrosion cannot happen.

Pitting corrosion can occur on aluminium surfaces frequently in contact with a humid environment. In general, the consequence is only aesthetical.
Accumulation of dirt and debris on surfaces can cause a reduced durability due to the consequence of long-term moisture. Dirt and debris should be removed during routine inspections.

In 1998 Mouchel Consulting Limited produced a report for The Highway Agency on the Opportunities for Use of Aluminium in Highway Structures, and we have listed below several relevant extracts regarding durability from this report.

- “If the Skin is broken by actions such as scraping, a new oxide layer will form on the exposed aluminium so it is considered to be **self healing**.”
- “Aluminium Alloys are **highly resistant to corrosion**. For this reason they are often used in marine structures such as navigation buoys, life boats and general shipping.”
- “It is the experience of military equipment that any aluminium alloy surface which is free draining and exposed to the full force of the weather will not corrode and will not noticeably deteriorate over very long periods. The military experience covers 20 to 30 years and if this is extrapolated it shows that the **120 year life of a civil bridge is**

easily met, and the infinite life predicted by some manufacturers is only a modest exaggeration."

- "The greatest long term advantage of aluminium alloys is their durability and the consequent reduction in maintenance costs."
- "Aluminium alloys will suffer from pitting corrosion and this is increased in a marine environment. However the rate of such pitting is so slow that it will not have a significant effect on the life of structural sections. This is supported by the experience of a long life of structures in ships, buoys, and other marine structures in extremely aggressive environments."
- "Aluminium alloys without coatings are less susceptible to the consequences than painted steel structures, where local damage by vandals can initiate unsightly breakdown of the protective system and subsequent corrosion."
- "Reduced maintenance can be confidently anticipated as a consequence of the use of aluminium alloy, with a significant reduction in access and delay costs."

For additional information we have also listed extracts regarding the environment.

- "The environmental advantages of aluminium alloys are particularly applicable to structural applications. The reduction in maintenance will have a greater effect when applied to long life structures, and highway bridges have a much longer design life than building or the more usual applications for the material. In addition, the traffic delay cost savings are a particularly significant factor in this application."
- "Materials themselves must be sustainable, and of low energy content when recycled. The highway network must not be burdened with a rate of replacement and maintenance in the future that imposes unacceptable delays on traffic."
- "There is very strong case to make for aluminium alloy on environmental and sustainability grounds. The material is plentiful, but more importantly can be easily recycled using only 5% of its original energy consumption. Reduced need for maintenance also has significant environmental and sustainability advantages."

Based on an EAA report on the average depth of weathering of a 0.91mm aluminium sheet exposed for 20 years in a tropical, industrial and marine environment resulted in a loss of thickness of 0.02mm, 0.05mm and 0.08mm respectively with 85% of reduction occurring within the first 3 years of exposure.

Therefore to specify exact working life duration is virtually impossible but based on the above would predict durability in accordance with the requirements of Manual of Contract Documents for Highway Works Volume 1 for parapets of 60 years or more dependent upon routine inspection, repair and maintenance.

5.0 Compliance with EN.1317.

5.1 EN.1317-1:1998 and EN.1317-2:1998.

The **VGAN 500** series aluminium vehicle restraint system as shown on drawing **VGAN 500-01** has been crash tested and certified reports prepared in compliance with **EN.1317-1: 1998** and **EN.1317-2: 1998**.

MIRA Limited undertook a **TB31** crash test on **17 August 2006** and subsequently prepared report number **MIRA-06-1012661-012** which certifies the Containment Level as **N1** with a working width class of **W2**.

Severity Class level = **A**.

5.2 EN 1317-5:2007+A1:2008

The above proposed standard does not incorporate additional requirements over and above the current ISO 9001:2008 quality management system.
Varley & Gulliver Limited have been assessed for Factory Production Control against FPC Certificate of Compliance 0888-FPC-0222-2012.

6.0 Recommendations for Use.

This vehicle restraint system is suitable for use on highways with a speed limit of **less than 50mph** where the following provisions can be met:-

6.1 Minimum plinth dimensions.

The minimum width of the bridge or retaining wall stringcourse (plinth) shall be **450mm** wide.

The upstand at the traffic face adjacent to the paved surface shall be a minimum of 50mm and the maximum cross sectional profile of the plinth shall not exceed 100mm.

6.2 Working Width restraints.

The distance form the traffic face of the restraint system to any obstruction behind the restraint system (lighting column, sign post etc.) shall be a minimum of **0.8m**.

6.3 Minimum Length of parapet.

The minimum recommended length for the product installation is **14m**.

6.4 Horizontal and Vertical Alignment.

The minimum horizontal curvature without pre-curving of main rails is 50m.
Smaller radii can be accommodated by special arrangement with pre-curving.

Posts with cleats set level can accommodate vertical alignments of upto +/-2º.

Posts with cleats set at +2º can accommodate vertical alignment upto +4º.
Posts with cleats set at +4º can accommodate vertical alignment upto +6º.

Posts with cleats set at -2º can accommodate vertical alignment upto -4º.
Posts with cleats set at -4º can accommodate vertical alignment upto -6º.

Posts are usually welded perpendicular to baseplates.
However, when the vertical alignment results in a longitudinal fall in excess of 5° the baseplates should be raked to follow the alignment while the posts remain vertical.

7.0 Technical Information.

7.1 Post Capacity:

7.1.1 Unfactored Moment of Resistance of Post.
The unfactored moment of resistance of the posts at the underside of the post baseplate = **32.51 kNm.**

7.1.2 Shear Force Resistance of post.
The shear force resistance of the post = **116.4 kN.**

7.2 Anchorage Capacity:

7.2.1 Characteristic Load Value.
The characteristic value of actions due to loads = **67.70 kN.**

7.2.2 Serviceability Limit State Value.
The serviceability limit state value = **74.47 kN.**

7.2.3 Ultimate Limit State Value.
The ultimate limit state value = **121.86 kN.**

7.3 System Weights:

Weights are based on 4.0m centres and anchorage units type VGAS/1

7.3.1 **VGAN 501** (1.00m high without mesh.)
Weight per metre = **15.50 kg/m.**

7.3.2 **VGAN 502** (1.00m high with mesh.)
Weight per metre = **19.00 kg/m.**

7.3.3 **VGAN 503** (1.25m high without mesh.)
Weight per metre = **19.85 kg/m.**

7.3.4 **VGAN 504** (1.25m high with mesh.)
Weight per metre = **24.25 kg/m.**

7.3.5 **VGAN 505** (1.40m high without mesh.)
Weight per metre = **20.20 kg/m.**

7.3.6 **VGAN 506** (1.40m high with mesh.)
Weight per metre = **25.10 kg/m.**

7.3.7 **VGAN 507** (1.50m high without mesh.)
Weight per metre = **20.40 kg/m.**

7.3.8 **VGAN 508** (1.50m high with mesh.)
Weight per metre = **25.65 kg/m.**

7.3.9 **VGAN 509** (1.80m high without mesh.)
Weight per metre = **23.3 kg/m.**

7.3.10 **VGAN 510** (1.80m high with part height solid and part height mesh infill.)
Weight per metre = **31.65 kg/m.**

The stated values could vary due to material, fabrication and installation tolerances, however, these values should be utilised for any design purposes.

8.0 Certification.

8.1 BS.EN.ISO 9001:2008 Quality Management Certificate.

LRQA
Business Assurance

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Varley & Gulliver Ltd
57-70 Alfred Street, Sparkbrook, Birmingham, West Midlands
United Kingdom

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:

ISO 9001:2008
and National Highway Sector Schemes –
2B – for the supply, installation, maintenance and repair of Vehicle Restraint Systems
5A – for the Manufacture of Parapets for Road Restraint Systems
5B – for the Installation of Parapets for Road Restraint Systems

The Quality Management System is applicable to:

The manufacture, supply and installation of aluminium and steel parapets including collision damage repairs and refurbishment. The management of installation of parapets for road restraint systems:
a) Vehicle parapets for bridges and other highway structures
b) Pedestrian parapets for bridges and other highway structures.
The manufacture and supply of passively safe sign support posts.
The manufacture, supply and installation of signal/sign gantries.
The manufacture, supply and installation of aluminium and steel guard rails.
The manufacture of cradle anchorages.
Contract management of supply and installation of safety fences (Flex Beam, TCB, DROBB and OBB) and crash cushions.
The manufacture and supply of aluminium scaffolding, roof trusses and stage lighting.
The manufacture and supply of general engineering products.

Approval
Certificate No: LRQ 0860500

Original Approval: 14 February 1989
Current Certificate: 1 February 2013
Certificate Expiry: 31 January 2016

Issued by: Lloyd's Register Quality Assurance Limited
Name of Signatory: Andrea Gibbons
Job Title: Administration Manager

UKAS MANAGEMENT SYSTEMS
001

NHS
national highway sector schemes

This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom.
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001
Macro Revision 13

9.0 Approved Anchorage Units.

9.1 VGAS/1 Anchorage unit.

9.1.1 Drawing Number VGAS/1.

9.2 VGAS/2 Anchorage unit.

9.2.1 Drawing Number VGAS/2.

9.3 VGAS/3 Anchorage Unit.

9.3.1 Drawing Number VGAS/3.

9.4 FCL Anchorage Unit.

Drawing Number 231/2.

SECTION ‘B’ – INSTALLATION MANUAL.

1. Scope:

1.1 This Method Statement encompasses the work involved to erect **VGAN 500 Series** Aluminium Vehicle / Pedestrian parapet.

2.0 Safety:

2.1 All work will comply with the following:

2.1.1 The Health and Safety at Work Act.

2.1.2 Varley and Gulliver's Safety Handbook.

2.1.3 Varley and Gulliver associated Method Statement(s) & Risk Assessment(s).

2.1.4 Any Site Inductions given by the Main Contractor**.**

2.2 All Varley & Gulliver Limited Site operatives will be experienced tradesmen. The nominated Contract Manager and Installation Supervisor will ensure safe working practices are adhered to by Varley & Gulliver Limited employees during the duration of on site work. Any other matters are to be directed to Varley & Gulliver Limited Contracts Division.

2.3 All operatives will comply with Site Safety Procedures as specified by Varley & Gulliver & the Main Contractor. All Plant operators will be trained and certified in the safe operation and use of the equipment they are utilising.

2.4 All personnel will wear the correct PPE for the task in hand. High Visibility clothing, Safety Footwear and Hard Hats will be worn as a matter of course.

2.5 All personnel will be given a copy of this Method Statement and associated Risk Assessments prior to commencement of work.

2.6 Clear vehicular access must be provided for our lorries to load/unload and for our vans whilst work is ongoing.

2.7 No other trades to have access to work areas whilst Varley & Gulliver's operations are ongoing unless otherwise agreed.

3.0 Sequence of Operations:

3.1 Installation of Posts and Rails:

3.1.1 No work will commence until items 2.6 & 2.7 have been met.

3.1.2 Identify positions from the General Arrangement (GA) drawings and place all posts and rails in the required locations.

3.1.3 Place solid inert packer(s) in the centre of the anchor cluster along the stringcourse.

3.1.4 Layout in front of each post location the M20 stainless steel holding down bolts c/w stainless steel washers and plastic top hats as required. Place washers onto holding down bolts to ensure that the plastic top hat washer is in contact with the baseplate upon installation.

3.1.5 Ensure that the threads of all bolts have a thin coat of grease applied (copper slip or similar) prior to fitting.

3.1.6 Check that anchorage sockets are clean and free of debris.

3.1.7 Locate post over anchor cluster and insert the M20 bolts with washers through the baseplate into the anchorage sockets.

3.1.8 Plumb posts in both elevations using the central packer, and by rocking front to side. Do not apply final torque to the M20 bolts at this stage, bolts should be tightened no more than finger tight at this stage.

3.1.9 Repeat items **3.1.3** – **3.1.8** along length of work area.

3.1.10 Starting at one end of the structure (preferably the left) begin erecting the rails by laying them on battens/packers, to avoid damage, on the structure. Insert the M12 Stainless Steel bolts into the clamp bars and slide along the back of the rails. The quantity of clamp bars required is dependant upon the number of posts the rail is fixed too. The lower two rails are also to have the rail retaining strap clamp bar inserted in between the standard clamp bars.

3.1.11 Offer the rails up into position (starting with the bottom rail) and fit the post/rail fixings.

3.1.12 Once the first set of rails are installed, plumb the end of the rails and tighten post/rail bolts. Do not apply the required torque to the post/rail bolts at this stage.

3.1.13 Determine from the GA layout drawing if safety fence connectors are to be installed at the ends of the rails and proceed to fit (if required).

3.1.14 Insert the rail to rail joints pieces and fix with M10x80 long stainless steel bolts, M10 nyloc nuts and washer bars.

3.1.15 Repeat steps **3.1.11** – **3.1.13** and step **3.1.15** along entire length of the work area, ensuring the correct rail joint gaps are set (see GA drawing).

3.1.16 Repeat step 3.14 at the other end (if required).

3.1.17 Line and level by means of eying in the top rail, lifting and lowering posts using thin shims for level and using rocking action for alignment.

3.1.18 Check and tighten down all holding down bolts (still no more than finger tight), apply the correct torque of **80Nm** to the post / rail bolts.

3.1.19 When parapets are attached to Varley and Gulliver Limited anchorage units the length of bolt engagement needs to be a minimum of 25mm.
When parapets are attached to anchorage provided by other the following equation should be followed:

$$\textbf{LE} = 0.7 \times \frac{\textbf{Ultimate Tensile Strength of Fixings}}{\textbf{0.2\% Proof Stress of Anchorage Socket}} \times \textbf{D}$$

Where:
LE = Length of Engagement
D = Bolt Diameter.

3.1.20 Line and Level to be passed off and Job Instruction Sheets to be completed and passed to the relevant representative from the client for approval and signature.

3.2 Grouting under Baseplates:

3.2.1 If the temperature is likely to fall below 5 degrees Centigrade for 24 hours either side of pouring the grout either:

a) Cover area with hessian, providing temperature is not likely to fall to freezing point.

b) DO NOT grout.

3.2.2 Using 2” x 1” wood, construct a grouting frame slightly bigger than the baseplate. (See Figure 1.)

3.2.3 Nail the frame together and apply silicone sealant (where appropriate) to the outside of the frame when positioning, to stop any grout from seeping out.

3.2.4 Place the frame around the baseplate and pour in an approved non-shrink grout at the high end (See Figure 2.) Ensure that the grout runs through to all sides.

3.2.5 Leave the grout to set. (as per manufacturers’ recommendations).

3.2.6 Once set remove the frame.

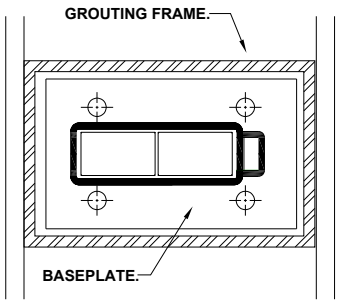

Figure 1.

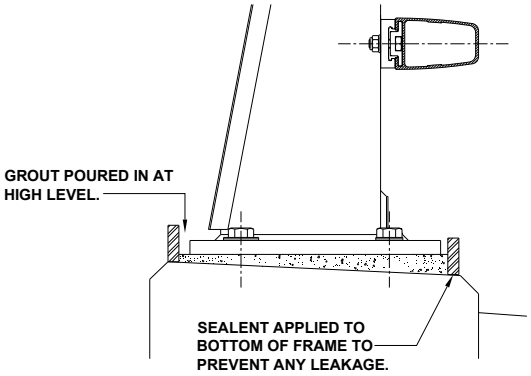

Figure 2.

3.2.7 When grout boxes are removed the holding down bolts are to be torqued to between **50Nm** and **70Nm.**

3.2.8 Job Instruction Sheets to be completed and passed to relevant representative from the client for approval and signature.

3.3 Mesh Infilling:

3.3.1 Starting from one end (preferably the left corner) proceed to layout the bottom mesh rail along entire length of work area.

3.3.2 Mark bottom mesh rail and drill a 10mm hole at post baseplate positions. Drill 10mm holes at ends of mesh rail for spice plates. Cut and gap bottom mesh rail at expansion joints as per drawing.

3.3.3 Using associated bolts, nuts and washers identified from GA layout drawing proceed to fix bottom mesh rail along length of work area.

3.3.4 Starting from one end (preferably the left corner) proceed to layout the mesh panels along length of work area, along with top flashing and mesh retaining clips.

3.3.5 Secure mesh panels to front face of rails by means of drilling a 4.8mm hole, mesh retaining clip and Amfast drive rivet (extra short) code: HSBN 48100 or equivalent. Cut panels at expansion joints and fit plastic caps.

3.3.6 Proceed along entire length of work area repeating step **3.3.5**.

3.3.7 Fix vertical end flashings at ends of runs and at expansion joint locations. Proceed to fix top flashing to top rail along entire run, drilling 4.8mm holes at centres not exceeding 203mm, fixed with Amfast drive rivets (extra long) code: HSBN 48180 or equivalent. Top flashing to stop / start at all rail joint locations.

3.3.8 After steps **3.3.2** – **3.3.7** remove all swarf from rails and posts using a soft hand brush. Collect up all off cuts and dispose of off site.

Job Instruction Sheets to be completed and passed to relevant representative from the client for approval and signature.

4.0 Routine Inspections:

4.1 It is recommended that a general inspection of the aluminium parapet is carried out during routine and principle inspections of the main structure.

4.2 Guidance for Inspection:

The following items should be reviewed as part of the inspection:

- Absence or looseness of bolts or nuts.
- Absence of or damage to grout pad.
- Build up of debris and dirt.
- Adequate attachment of mesh infill. (where applicable.)

4.3 Accident Damage Inspection:

The following items should be reviewed as part of the inspection:

- Any cracks in or adjacent to welds. Particular attention to be paid to the post to baseplate weld and post to cleat welds.
- Absence or looseness of bolts or nuts.
- Absence of or damage to grout pad.
- Build up of debris and dirt.
- Adequate attachment of mesh infill. (where applicable.)

If in any doubt contact Varley and Gulliver Limited who can offer advice or arrange a site visit.