VARLEY & GULLIVER PARAPETS

HSM1107

VGAN 400 Aluminium Parapet Manual

@1.829m [72 inch] Post Centres

Normalised Performance:

Containment	Working Width	Dynamic Deflection
TL4	1.16m	0.5m

Contents

Document Control

Revision Table				
Revision	Description	Written By	Approved By	Date
1	TCF release	W.J.Butler	A.Pardoe	Aug 2023
A	Full Release	W.J.Butler	A.Pardoe	Sept 2023

Section ‘A’ – Specification Manual.

1.0 List of Drawings.

1.1 System Drawings.

DRAWING NUMBER	DRAWING TITLE.
PD-VGAN400: (Sheets 1-3)	STANDARD ARRANGEMENT DRAWINGS OF VGAN 400 SERIES ALUMINIUM PARAPET SYSTEM.
HS-ES016	VGAN400 to Thrie Beam Connection

2.0 Varley and Gulliver Parapets Company Procedures for Production.

Varley and Gulliver Parapets Integrated Management System (IMS) which has been certified to **ISO 9001:2015**.

Varley and Gulliver are dedicated to quality and continuous process improvement. Our aim is to ensure that through established standards and procedures complying with the requirements of ISO 9001 and current legislation, the level of quality matches or exceeds our customers' expectations. We believe employees at all levels are responsible for meeting high quality standards and encourage their involvement in the quality process.

Our quality objectives have been established by senior management to reflect our customer focus. To assess our performance, we operate a process of monitor, measure and act to realize our ultimate goal "Total Customer Satisfaction". The company's quality objectives undergo a formal assessment by top management every 6 months to ensure the continuing effectiveness of its policies.

3.0 Product Description:

The VGAN 400 series aluminium parapet is a **modular system** providing supporting posts spaced at **1.829m [72inches] centres**. Exceptions are at Type 3 expansion joint locations where posts spanning the joint should not exceed **1.5m [59inches]** and the penultimate bays either side of the joint should not exceed **1.0m [39.37inches]** centres.

The system consists of 3 horizontal extruded aluminium rail sections.
The lower two main traffic rails are 152mm [5.984inches] x 98mm [3.858inches] located to supporting posts at heights 328mm [12.913inches] and 633mm [24.921inches] as specified on system drawing.
The rails are nominally 8.975m [353.35inches] long with square cut ends to receive sliding 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 139mm [5.472inches] x 86mm [3.366inches] which are fitted with a standard 8mm [0.31inches] diameter coiled spring pin.

The top pedestrian rail is 114mm [4.488inches] x 72mm [2.834inches] located to supporting posts at height 939mm [36.850inches] as specified on system drawing.
The rails are nominally 8.975m [353.35inches] long with square cut ends to receive sliding 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 104mm [4.09inches] x 64mm [2.52inches] which are fitted with a standard 8mm [0.31inches] diameter coiled spring pin.

There are three types of rail joint to accommodate varying degrees of expansion or contraction.
Type 1 joint (Standard) accommodates movement range upto +/- 9mm [0.35inches].
Type 2 joint (Expansion) accommodates movement range upto +/- 25mm [1.02inches].
Type 3 joint (No-Tension Expansion) accommodates movement range upto +/- 150mm [5.9inches].

The rails are attached to the supporting posts with 2no. M16 stainless steel setpin fixings located and secured into the rear of the rail with a sliding rail nut.

The supporting posts are a single cast aluminium alloy:

Posts are usually attached to the bridge structure or retaining wall using 7/8” galvanised anchorage bolts cast-in or resin fixed, along with a 7/8” galvanised flat washer and heavy hex nut to secure the post in position. (Supplied by others).

Socketed cradle and drilled chemical anchors are available upon request.

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**.

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, lifeboats 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 Connections

The VGAN400 drawing pack accounts for connections to Thrie beam guardrail.
The connection plate is a designed connection for use in approach and depart of the VGAN400 system, accounting for the reduction in height back to the road for the Thrie beam.

Please see drawing **HS-ES016** for full details.

6.0 Compliance:

6.1 MASH TL4

The **VGAN 400** series aluminium vehicle restraint system as shown on drawing **PD-VGAN400** has been crash tested and certified reports prepared in compliance with the M.A.S.H Recommended Procedures for the Safety Performance Evaluation of Highway Features. Report number **TRNo690902-VGL1-4**.

Texas A&M Transport institute (TTI) undertook a Test Designation **4-10** crash test on the **16th November 2020** and subsequently prepared report number **690902-VGL3** dated **November 2020**.

Texas A&M Transport institute (TTI) undertook a Test Designation **4-11** crash test on the **12th August 2021** and subsequently prepared report number **690902-VGL4** dated **November 2022** which certifies the Containment level **TL4**.

Texas A&M Transport institute (TTI) undertook a Test Designation **4-12** crash test on the **09th June 2022** and subsequently prepared report number **690902-VGL1** dated **November 2022** (revised) which certifies the Containment level **TL4**.

7.0 Recommendations for Use.

This vehicle restraint system is suitable for use on highways with a speed limit of **less than 62.2 mph (100 kmph)** where the following provisions can be met:-

7.1 Minimum Plinth Dimensions.

The minimum width of the bridge or retaining wall stringcourse (plinth) shall be **438mm [17.244inches]** wide.
The upstand at the traffic face adjacent to the paved surface shall be a minimum of **229mm [11.771inches]**.

7.2 Minimum Length of Parapet.

The minimum recommended length for the product installation to **TL4** is **30m [98.43Foot].**

7.3 Horizontal and Vertical Alignment.

The minimum horizontal curvature without pre-curving of main rails is **150m [492.13Foot]**.

Smaller radii can be accommodated by special arrangement with pre-curving. The next tightest radius on this system would be approx. 10m. **[32.8Foot]**

Posts can accommodate vertical alignments of upto **+/-2.5º**.

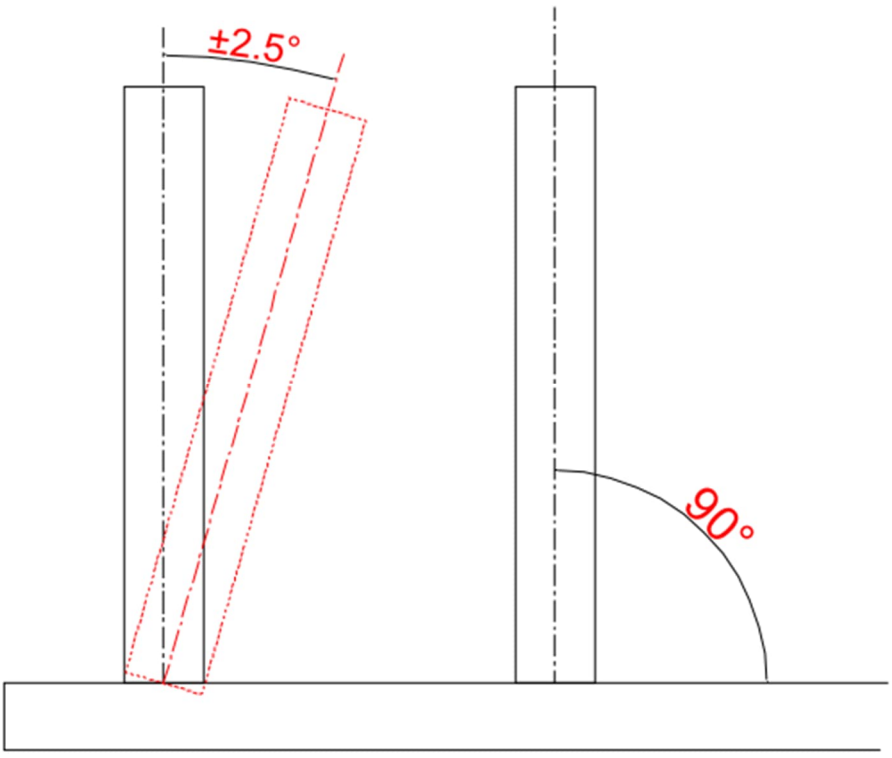

Figure 1: Longitudinal Vertical alignments

However, when the vertical alignment results in a longitudinal fall in excess of 2.5° the posts should be fixed square to the concrete plinth transversely and perpendicular to the concrete longitudinally.

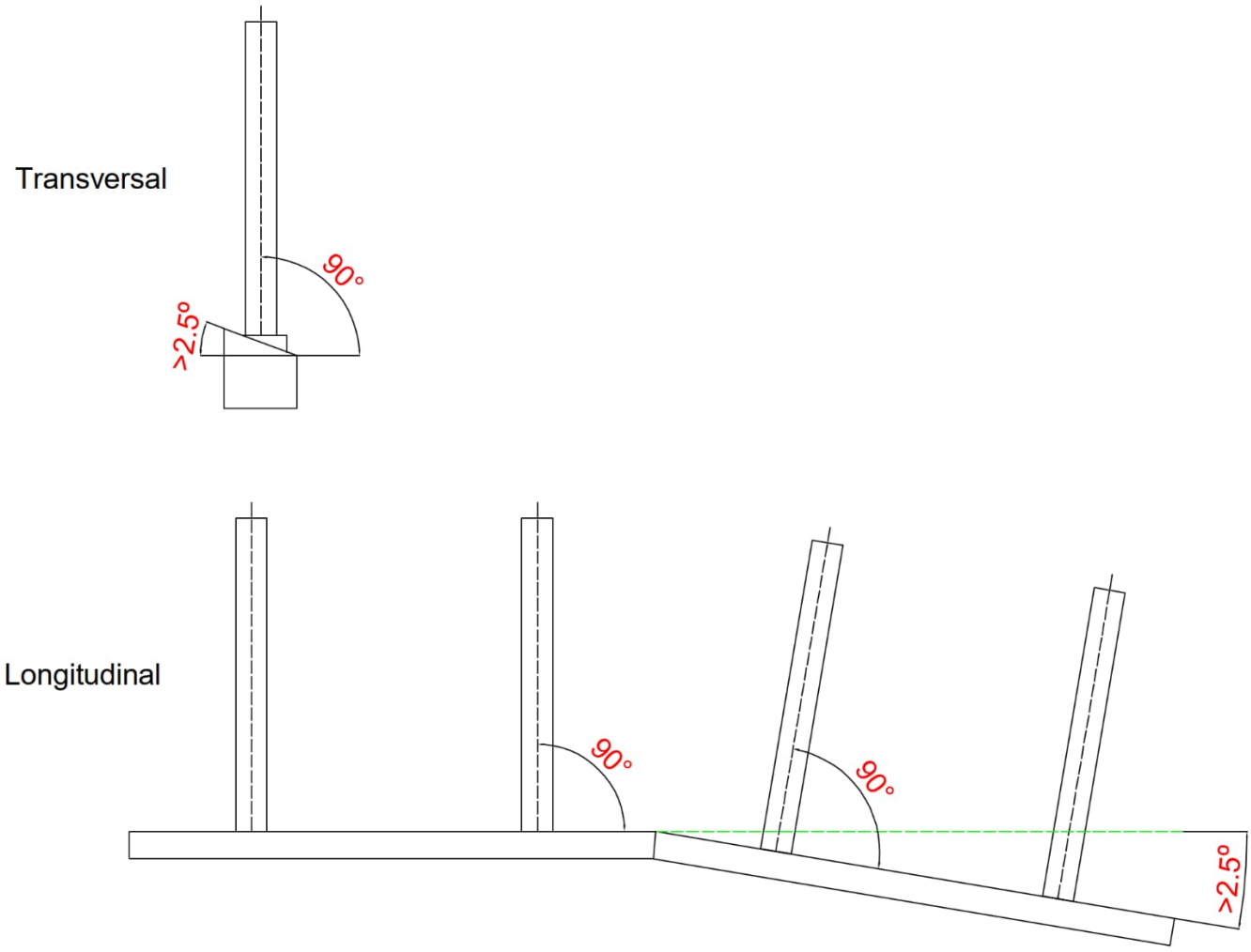

Figure 2: Alignment in excess of 2.5°

7.4 Baseplate Grout

The system is not designed for use with grout, if required bedding grout must be a non-shrink cementitious grout with a minimum compressive strength of 50N/mm2 [7.25kips].
We recommend using 10-30mm [0.39-1.18inches].

The anchorage must also be reviewed to ensure the sizes are suitable for the additional height from the grout.

8.0 Technical Information.

8.1 Post Capacity:

8.1.1 Unfactored Moment of Resistance of Post.
The unfactored moment of resistance of the posts at the underside of the post baseplate = **71.7 kNm. [52.9kips]**

8.1.2 Shear Force Resistance of post.
The shear for resistance of the post = **152.6 kN. [34.3kips]**

8.2 Anchorage Capacity:

8.2.1 Characteristic Load Value.
The characteristic value of actions due to loads = **64.08 kN. [14.4kips]**

8.2.2 Serviceability Limit State Value.
The serviceability limit state value = **70.49 kN. [15.8kips]**

8.2.3 Ultimate Limit State Value.
The ultimate limit state value = **115.34 kN. [25.9kips]**

8.3 System Weights:

Weights are based on 1.829m [72inches] centres, NOT including anchorage.

8.3.1 **VGAN 400** (1.20m high.)
Weight per metre = **29 kg/m. [19.49 lb/ft]**

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

9.0 Certification.

9.1 BS.EN.ISO 9001:2015 Quality Management Certificate.

For up to date certificates please see details on our Xtratech website:
https://xtratech.hill-smith.co.uk/documents/certifications/

10.0 Design of Parapet System.

The parapet system has been designed following the general principles defined in the following standards:

- **BS.EN.ISO 9606-2:2004** – Qualification test of welders. Fusion welding. Aluminium and aluminium alloys.
- **BS.EN.ISO 15614-2:2005** - Specification and qualification of welding procedures for metallic materials. Welding procedure test. Arc welding of aluminium and its alloys.
- **American Association of State Highway and Transportation Officials** – Standard Specifications for Highway Bridges 17th Edition.
- **The Aluminium Association** – Design Manual 8th Edition for Allowable Stress Design in Aluminium Structures.
- **Manual for Assessing Safety Hardware (MASH) 2016** - Crash standards for roadside safety hardware and sunset dates for non-MASH compliant devices.

Section ‘B’ – Installation Manual.

11.0 Scope:

This Method Statement encompasses the work involved to erect VGAN 400 Series Aluminium Vehicle parapet.

12.0 Safety:

12.1 All work will comply with the following:

12.1.1 The Health and Safety at Work Act.

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

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

12.2 All Site operatives should be experienced tradesmen. The nominated Contract Manager and Installation Supervisor will ensure safe working practices are adhered to.

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

12.4 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.

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

12.6 Clear vehicular access must be provided for lorries to load/unload materials.

12.7 Care to be taken when other trades are operating whilst the parapet is being erected.

12.8 Appropriate temporary edge protection should be installed to the rear of the parapet edge beam and independent of the VGAN 400 parapet system.

13.0 Sequence of Operations:

13.1 Installation of Posts and Rails:

13.1.1 No work will commence until items 11.1 & 11.8 have been met.

13.1.2 Identify positions from the General Arrangement (GA) drawings and place all posts and rails in the required locations. To adequately identify parapet components please refer to drawing PD-VGAN400.

13.1.3 Layout in front of each post location the steel holding down nut's c/w steel washer.

13.1.4 Ensure that the threads of all bolts have a thin coat of grease applied (copper slip or similar – not supplied) prior to fitting.

13.1.5 Check that anchorage studs are clean and free of debris.

13.1.6 Lift post and place solid inert packer(s) in the centre of the anchor cluster along the stringcourse. Refer to drawing PD-VGAN400 to ensure **1200mm [47.24inches] MINIMUM height** above datum is achieved.

13.1.7 Plumb posts in both elevations using the central packer, and by rocking front to side. Do not apply final torque to the anchorage hex bolts at this stage, bolts should be tightened no more than approximately hand tight turn at this stage.

13.1.8 Repeat items **12.1.3** – **12.1.7** along length of work area.

13.1.9 Starting at one end of the structure begin erecting the rails by laying them on battens/packers, to avoid damage, on the structure. Insert the rail connection nuts and slide along the back of the rails. The quantity of rail connection nut clamp bars required is dependent upon the number of posts the rail is fixed too. Two rail connection nuts per post to rail location are required. Therefore, if the rail is connected to three posts then six rail connection nuts are required.

13.1.10 Offer the rails up into position (starting with the bottom rail) and fit the post/rail fixings. M16x45 long for the bottom two rails and M16x35 long for the top rail along with M16 spring washer and flat washers. We would advise that bolts are kept separate to ensure bolts are not fitted at the wrong locations.

13.1.11 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.

13.1.12 Insert the rail-to-rail joints pieces Type 1, 2 or 3 as determined from the GA layout and set the appropriate joint gap.

13.1.13 Repeat steps **12.1.10** – **12.1.12** along entire length of the work area, ensuring the correct rail joint gaps are set (see PD-VGAN400 drawing).

13.1.14 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. Refer to standard detail drawings to ensure **1200mm [47.24inches] MINIMUM height** above datum is achieved.

13.1.15 Check and tighten down all holding down bolts (approximately hand tight plus half a turn), apply the correct torque of **40Nm [29.5ft-lb]** to the lower two main rail post / rail bolts only. The top rail fixings are to be tightened until the spring washer is flat.

13.1.16 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.

13.2 Grouting under Baseplates (if required):

When grouting please account for the system height as this will be affected by the grout thickness. Grouting is not required by default for this system.

13.2.1 When extreme weather temperatures prevail, please follow the grout manufacture's recommendations.

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

13.2.3 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.

13.2.4 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.

13.2.5 Leave the grout to set. (as per manufacturers' recommendations).

13.2.6 Once set remove the frame.

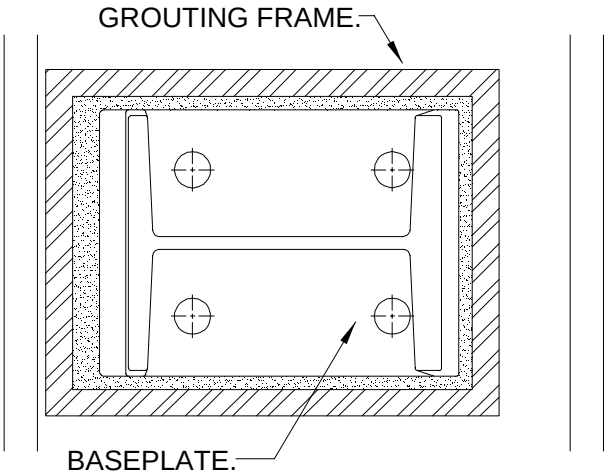

Figure 1.

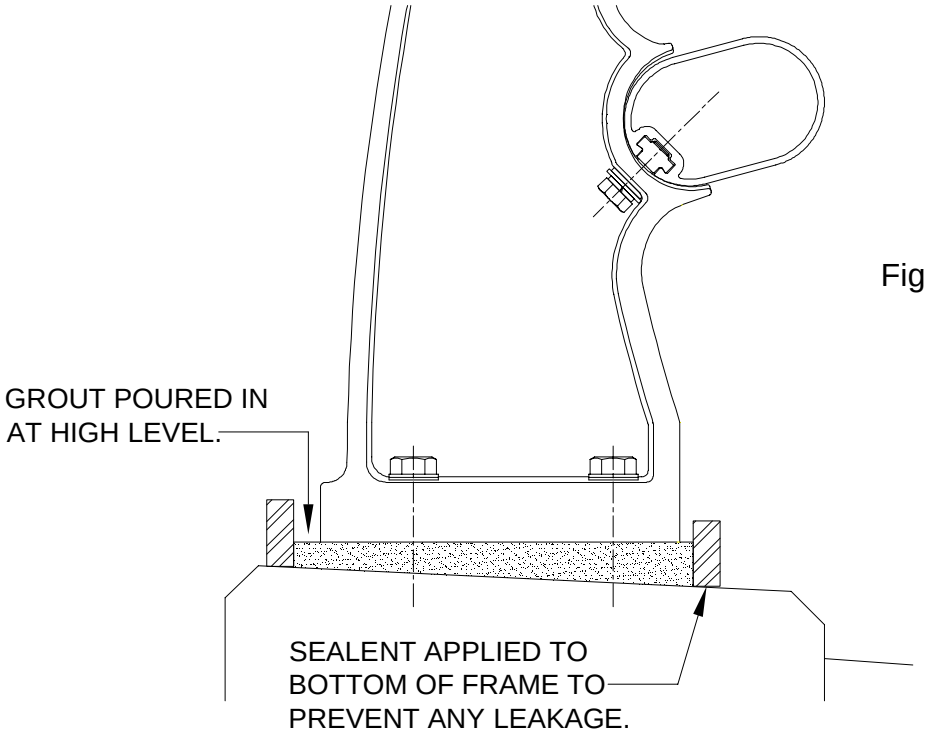

Figure 2.

Figure 3: Grouting Detail

13.2.7 When grout boxes are removed the holding down nuts are to be torqued to between **50Nm [36.87ft-lb]** and **70Nm [51.62ft-lb].**

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

14.0 Routine Inspections

14.1 General Inspection

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

14.2 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.)

14.3 Accident Damage Inspection:

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

- Any damage to posts and rail sections.
- Absence or looseness of bolts or nuts.
- Absence of or damage to grout pad.
- Build-up of debris and dirt.

If in any doubt, contact Varley & Gulliver Parapets who can offer advice.

15.0 Annex

15.1 Annex A - Inspection Form

*Recommended criteria, but not exhaustive. Must be checked against relevant contract requirements.

Inspection report Reference:	
Inspection Date:	
Date of previous Inspection:	
Date of next Inspection:	
Client:	
Location / Project Reference:	
System Reference:	
Name of Inspector:	
Inspector trained by a Hill & Smith Infrastructure Ltd Approved Training centre:	□ Yes □ No If yes, Precise the Training Centre below: Training Centre:
Company:	

Posts		
	Description	Comments
□Yes □ No	The Posts are spaced as per the System specifications.	
□Yes □ No	The Posts are at the correct height	
□Yes □ No	The Posts are NOT damaged	
□Yes □ No	The Posts do NOT need repair	
□Yes □ No	The coating of Post is NOT damaged	
□Yes □ No		
□Yes □ No		

Socketed Foundation		
	Description	Comments
□Yes □ No	Post foundation secure	
□Yes □ No	No standing water / pooling water areas	

□Yes □ No	Concrete is NOT cracked	
□Yes □ No	Concrete slab/foundation did NOT sink	
□Yes □ No		
Rails		
	Description	Comments
□Yes □ No	2x VFX099 fastener per upper rail	
□Yes □ No	2x VFX012 fastener per lower rail	
□Yes □ No	No evidence of corrosion	
□Yes □ No	Fasteners are torqued to the relevant value	
□Yes □ No	Fasteners are sitting normal to Their mating surfaces.	
□Yes □ No		
Additional requirements		
	Description	Comments
□Yes □ No		
□Yes □ No		
□Yes □ No		
□Yes □ No		
General Comments		
□Yes □ No		
□Yes □ No		
□Yes □ No		
□Yes □ No		

Signed by:..... Signature: ..... Date:.....

15.2 Annex B: VRS Components Table

Table 1: Components table

Components for the VGAN 400 VRS System		
Item Number	Item Name	Weight (Kgs)
VA417	VGAN 300/400 Post Casting Aluminium	20
VE072-7290	VGAN 300/400 Main Rail 7290lg (110931)	45.47
VA486	VGAN 400 Main Rail Joint (VGAN400/AD-09) (Type 1 and 2)	8.38
VA488	VGAN 400 Main Rail Joint (Type 3)	14.38
VE075-7290	VGAN 300/400 Pedestrian Rail 7290lg (110934)	22.12
VA489	VGAN 400 Top Pedestrian Rail Joint (VGAN400/AD-11) (Type 1 and 2)	5.07
VA491	VGAN 400 Top Pedestrian Rail Joint (Type 3)	8.45
VA428	VGAN 300/400 Rail Connection Nut	0.41
VFX099	M16 x 35 Hex Setpin	0.05
VFX012	M16 x 45 Hex Setpin (VG001086)	0.06
VFX230	M16 Spring Washer Type 'B' Stainless Steel (VG000771)	0.01
VFX164	M16 Flat Washer Form 'C' (Ø34 O/D x 3mm Thick) (VG001166)	0.01
VFX166	M16 Flat Nylon Washer (VG000840)	0.01
VFX452	M8x20 Coiled Spring Pin	0.002
VFX063	M8x30 Hex Setpin (VG001128)	0.001
VFX060	M8 Flat Washer Form 'A' 17 O/D x 1.6 (VG001189)	0.002
VFX061	M8 Spring Washer Type 'B' (VG001192)	0.002
VFX122	M8 Flat Nylon Washer (VG000854)	0.001

Table Of Figures