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**Steel VGSN 800 Series Vehicle Restraint System  
Specification Manual.**

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## CONTENTS

### SECTION A – Specification Manual.

<b>1.0 List of Drawings:</b> .....	<b>5</b>
<b>1.1 System Drawings</b> .....	<b>5</b>
<b>2.0 List of Varley and Gulliver Limited Company Procedures for Production:</b> .....	<b>8</b>
<b>2.1 Table 1</b> .....	<b>8</b>
<b>3.0 Product Description</b> .....	<b>9</b>
<b>4.0 Durability</b> .....	<b>15</b>
<b>5.0 Compliance with EN.1317:</b> .....	<b>16</b>
<b>5.1 EN.1317-1:2010 and EN.1317-2:2010</b> .....	<b>16</b>
<b>5.2 EN.1317-5:2007+A1:2008:</b> .....	<b>16</b>
<b>6.0 Recommendations for Use:</b> .....	<b>17</b>
<b>6.1 Minimum plinth dimensions</b> .....	<b>17</b>
<b>6.2 Working width restraints</b> .....	<b>17</b>
<b>6.3 Minimum length of parapet</b> .....	<b>17</b>
<b>6.4 Horizontal and Vertical alignment</b> .....	<b>17</b>
<b>7.0 Technical Information:</b> .....	<b>18</b>
<b>7.1 Post Capacity:</b> .....	<b>18</b>
<b>7.1.1 Unfactored Moment of Resistance of Post.</b> .....	<b>18</b>
<b>7.1.2 Shear Force Resistance of Post.</b> .....	<b>18</b>
<b>7.2 Anchorage Capacity:</b> .....	<b>18</b>
<b>7.2.1 Characteristic Load Values.</b> .....	<b>18</b>
<b>7.2.2 Serviceability Limit State Value.</b> .....	<b>18</b>
<b>7.2.3 Ultimate Limit State Value.</b> .....	<b>18</b>
<b>7.3 System Weights:</b> .....	<b>18</b>
<b>7.3.1 VGSN 801</b> .....	<b>18</b>
<b>7.3.2 VGSN 802</b> .....	<b>18</b>
<b>7.3.3 VGSN 803</b> .....	<b>18</b>
<b>7.3.4 VGSN 804 TP1</b> .....	<b>18</b>
<b>7.3.5 VGSN 804 TP2</b> .....	<b>18</b>
<b>7.3.6 VGSN 805</b> .....	<b>18</b>

## CONTENTS

<b>8.0 Certification:</b> .....	<b>19</b>
<b>8.1 BS.EN.ISO 9001:2008 Quality Management Certificate</b> .....	<b>19</b>
<b>9.0 Design of Parapet system:</b> .....	<b>21</b>

### SECTION B – INSTALLATION MANUAL.

<b>1.0 Scope:</b> .....	<b>23</b>
<b>1.1 Scope of Work</b> .....	<b>23</b>
<b>2.0 Safety:</b> .....	<b>24</b>
<b>2.1 Compliance</b> .....	<b>24</b>
<b>2.2 Management</b> .....	<b>24</b>
<b>2.3 Training</b> .....	<b>24</b>
<b>2.4 Personal Protective Equipment</b> .....	<b>24</b>
<b>2.5 Site</b> .....	<b>24</b>
<b>2.6 Access</b> .....	<b>24</b>
<b>2.7 Other operatives</b> .....	<b>24</b>
<b>3.0 Sequence of Operations:</b> .....	<b>25</b>
<b>3.1 Erection of Posts and Panels</b> .....	<b>25</b>
<b>3.2 Grouting under Baseplates</b> .....	<b>26</b>
<b>3.3 Fixings of Additional Rail</b> .....	<b>27</b>
<b>4.0 Routine Inspection:</b> .....	<b>29</b>
<b>4.1 Guidance for Inspection</b> .....	<b>29</b>
<b>4.2 Accident Damage Inspection</b> .....	<b>29</b>

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## **SECTION 'A' – SPECIFICATION MANUAL.**

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## **1.0 List of Drawings.**

### **1.1 System Drawings. (Attached.)**

<b><u>DRAWING NUMBER</u></b>	<b><u>DRAWING TITLE.</u></b>
<b>VGSN 800-01:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>VGSN 801.</b>
<b>VGSN 800-02:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>VGSN 802.</b>
<b>VGSN 800-03:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>VGSN 803.</b>
<b>VGSN 800-04:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>VGSN 804.</b>
<b>VGSN 800-05:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>VGSN 805.</b>
<b>VGSN 800-06:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>PANEL AND RAIL CONNECTION DETAILS. (1 of 3.)</b>
<b>VGSN 800-07:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>PANEL AND RAIL CONNECTION DETAILS. (2 of 3.)</b>
<b>VGSN 800-08:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>PANEL AND RAIL CONNECTION DETAILS. (3 of 3.)</b>
<b>VGSN 800-09:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>PARAPET POST DETAILS.</b>
<b>VGSN 800-10:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>TOP PANEL INFILL DETAILS.</b>
<b>VGSN 800-11:</b>	STANDARD ARRANGEMENT DRAWINGS OF VGSN 800 SERIES STEEL PARAPET SYSTEM. <b>TRANZFLEX 80 SAFETY FENCE CONNECTOR DETAILS.</b>

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## **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.

<b>Name of procedure:</b>	<b>Procedure Reference Number:</b>
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
Assessment of Personnel:	6.2
Control of Specification Manual:	4.2.4
Control on incoming Materials:	7.1 and 7.4.2
Traceability of Materials:	7.1
Corrective and preventive actions to be taken:	8.5.2 and 8.5.3
Continuous surveillance via Internal Audits:	8.2.2
Appointment and control of suppliers and subcontractors:	7.4.1

**Table 1.**

### **3.0 Product Description:**

The VGSN 800 series Steel parapet is a **modular system** providing supporting posts are spaced at upto **3.750m centres**. Exceptions are at Type 3 expansion joint locations where posts spanning the joint should not exceed 1.5m. Closer post centres may be used for single bays where this cannot be avoided at movement joints and end bays of parapet runs.

The system consists of panels with kicker rails and optional additional top rail located to supporting posts at heights specified on system drawings. The panels consist of 90mm x 90mm top and bottom rails with 48.3mm diameter infill bars welded in between at nominal 150mm centres. The panels are nominally 7.490m long with ends punched with 24mm diameter holes to receive bolted rail to rail connection joints. Shorter panels are utilised at expansion joints and ends of runs.

Rails are joined together with internal rail joint sleeves 78mm x 78mm x 5mm, which are slotted in the top and bottom faces to accept 2No. M20x120mm long galvanised steel bolts which pass through the rail and joint and are secured with M20 galvanised nuts.

There are three types of rail panel joints to accommodate varying degrees of expansion or contraction.

Type 1 joint (Standard) accommodates movement range upto +/- 5mm.

Type 2 joint (Expansion) accommodates movement range upto +/- 25mm.

Type 3 joint (No-Tension Expansion) accommodates movement range upto +/- 80mm.

The lower 70mm x 8mm thick kicker rail is attached to the lower section of the panels via 50mm x 8mm thick connection lugs welded to the panel bottom rail. The kicker rail is attached using M12x40mm long galvanised steel bolts and nuts. The length of the kicker rails is nominally the same as the panels.

The kicker rails are joined together with 70mm x 8mm thick joint plates attached with M16x40mm long galvanised steel bolts and nuts.

The 90mm x 90mm independent top rails are nominally the same length as the panels. The ends of the rails are punched with 24mm diameter holes to receive bolted rail to rail connection joints. Rails are joined together with internal rail joint sleeves 78mm x 78mm x 6mm, which are slotted in the top and bottom faces to accept 2No. M20x120mm long galvanised steel bolts which pass through the rail and joint and are secured with M20 galvanised nuts.

The panels / independent rail are attached to the supporting posts via specially fabricated post to rail bracket Type 2. Panels are attached to brackets with a type C washer plate and 2No. M12x35mm long stainless steel setpins fitted horizontally into the thermally drilled and tapped holes in the panels to clamp the bracket and panels together.

Brackets Type 2 are attached to posts with a type C washer plate and 2No. M12x35mm long stainless steel setpins fastened into thermally drilled and tapped holes in the post.

The supporting posts are fabricated from 260x240x25mm thick steel baseplates with 90x90x3.6mm thick steel SHS posts welded off centre with an 8mm fillet weld all round. Posts are usually attached to the bridge structure or retaining wall with 4No. M16 stainless steel holding down bolts into approved cast-in anchorage units or resin fixed drilled anchorages. The holding down bolts are isolated from the galvanised washers and 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. In the case of steel product protected by Hot dip galvanising durability is also dependent upon the thickness of the protective coating.

The main panels / rails, posts, brackets and joints are Hot Dipped Galvanised in accordance with BS.EN.ISO.1461:2009.

After galvanising an extremely thin protective film of zinc oxide forms on the surface which is impervious and tightly adherent to the zinc. With time the zinc oxide thickness increases and the original bright shiny surface of the zinc changes to a dull light grey colour.

The use of stainless steel fixings in contact with galvanised surfaces can raise concern of bi-metallic corrosion (Galvanic corrosion).

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 top hat isolation washer is utilised between the stainless holding down bolt and the galvanised washer.

Splashes of alkaline building materials like grout and concrete, cement cause visible spots on the surface of the galvanising caused by slight etching when drying or setting. The etching will stop once dry or set.

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.

The most important contaminant for zinc is sulphur dioxide and its presence largely controls the atmospheric corrosion of zinc. Specific corrosion values in the UK have been mapped by the Agricultural Development Advisory Service. The Zinc Millennium map is available on the Galvanisers Association website ([www.hdg.org.uk](http://www.hdg.org.uk)). The map gives the corrosion rate of galvanising in 10km areas throughout the UK. As the rate of corrosion for zinc is generally linear for a given environment the map can be utilised to establish the life expectancy of a galvanised product.

The average thickness of the galvanised product divided by the corrosion rate for a specified location will determine the expected minimum life of the galvanised coating in years.

Therefore to specify an exact working life duration is virtually impossible but would predict a durability of the product with an average thickness of coating of 85 microns in an industrial environment to be over 30 years dependent upon routine inspection, repair and maintenance.

A supplementary paint system may be applied for enhanced durability and aesthetics.



## **5.0 Compliance with EN.1317.**

### **5.1 EN.1317-1:2010 and EN.1317-2:2010.**

The **VGSN 800** series Steel vehicle restraint system as shown on drawing **VGSN 800-01** has been crash tested and a certified report prepared in compliance with **EN.1317-1: 2010** and **EN.1317-2: 2010**.

MIRA Limited undertook a **TB31** crash test on **26 September 2013** and subsequently prepared report number **1203340-001** 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-0222-2013**.

## **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 from 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 **18.75m**.

### **6.4 Horizontal and Vertical Alignment.**

The minimum horizontal curvature without pre-curving of main panels is **450m**. Smaller radii can be accommodated by special arrangement with pre-curving.

Post cleats can accommodate vertical alignments of upto  $\pm 15^\circ$ .

Posts are usually welded perpendicular to baseplates.

However, when the vertical alignment results in a longitudinal fall in excess of  $5^\circ$  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 = **14.09 kNm.**

#### **7.1.2 Shear Force Resistance of post.**

The shear force resistance of the post = **132.84 kN.**

### **7.2 Anchorage Capacity:**

#### **7.2.1 Characteristic Load Value.**

The characteristic value of actions due to loads = **37.68 kN.**

#### **7.2.2 Serviceability Limit State Value.**

The serviceability limit state value = **41.45 kN.**

#### **7.2.3 Ultimate Limit State Value.**

The ultimate limit state value = **67.82 kN.**

### **7.3 System Weights:**

Weights are based on 3.750m centres and anchorage units type **VGAS/7.**

#### **7.3.1 VGSN 801 (1.15m high panel.)**

Weight per metre = **61.40 kg/m.**

#### **7.3.2 VGSN 802 (1.35m high panel.)**

Weight per metre = **79.50 kg/m.**

#### **7.3.3 VGSN 803 (1.40m high with top rail.)**

Weight per metre = **75.30 kg/m.**

#### **7.3.4 VGSN 804 TP1 (1.40m high panel.)**

Weight per metre = **80.80 kg/m.**

#### **7.3.5 VGSN 804 TP2 (1.40m high panel)**

Weight per metre = **78.60 kg/m.**

#### **7.3.6 VGSN 805 (1.50m high with top rail.)**

Weight per metre = **81.00 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.



#### 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



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 Design of Parapet System.**

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

- **BS.EN.1011-1:2009** – Recommendations for welding of metallic materials. General guidance for arc welding.
- **BS.EN.1011-2:2001** – Recommendations for welding of metallic materials. Arc welding of ferretic steels.
- **BS.EN.287-1:2011** – Qualification test of welders. Fusion welding. Steels.
- **BS.EN.ISO.15607:2003** – Specification and qualification of welding procedures for metallic materials.
- **BS.EN.1317-1:2010** – Road restraint systems. Terminology and general criteria for test methods.
- **BS.EN.1317-2:2010** – Road restraint systems. Performance classes, impact test acceptance criteria and test methods for safety barriers.
- **BS.6779-1:1998** – Highway parapets for bridges and other structures. Specification for vehicle containment parapets of metal construction.
- **BS.7818:1995** - Pedestrian restraint systems in metal.
- **BS.EN.ISO.1461:2009** – Hot dip galvanized coatings on fabricated iron and steel articles. Specification and test methods.



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**Steel VGSN 800 Series Vehicle Restraint System.  
SECTION 'B' – Installation Manual.**

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**1. Scope:**

**1.1** This Method Statement encompasses the work involved to erect **VGSN 800 Series** Steel 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** The contents of the Method Statement and associated Risk Assessments shall be communicated to ALL erection teams 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.



### **3.0 Sequence of Operations:**

#### **3.1 Installation of Posts and Panels:**

- 3.1.1** No work will commence until items 2.6 & 2.7 have been met.
- 3.1.2** Check that anchorage sockets are clean and free of debris. Clean out as necessary.
- 3.1.3** Layout in front of each post location the M16 stainless steel holding down setpins c/w M16 stainless steel washer form 'A', M20 form 'E' galvanised steel washers and M16 nylon top hats as required. Place washers onto holding down bolts and ensure that the nylon top hat washer is in contact with the underside of the stainless washer and the galvanised washer upon installation.
- 3.1.4** Identify positions from the General Arrangement (GA) drawings and place all posts and panels in the required locations. Locate post over anchor cluster and insert the M16 setpins with washers through the baseplate into the anchorage sockets. Ensure that the threads of all bolts have a thin coat of grease applied (copper slip or similar) prior to fitting.
- 3.1.5** Lean post and place 20mm solid inert packer(s) as close to the centre of the baseplate as possible. Ensure that the threads of all bolts have a thin coat of grease applied (copper slip or similar) prior to fitting.
- 3.1.6** Plumb posts in both elevations using the central packer, and by rocking front to side. Do not tighten the M16 bolts at this stage, bolts should be no more than finger tight.
- 3.1.7** Repeat items **3.1.3** – **3.1.6** along length of work area.
- 3.1.8** Fix the post to panel / rail brackets type 2 to posts using M12x35 long stainless steel setpins c/w M12 stainless steel spring washer and galvanised steel washer plate type C. Fixings to be finger tight only at this stage.
- 3.1.9** Starting at one end of the structure begin erecting the panels by laying them on battens/packers, to avoid damage, on the structure. Offer the panels up into position and fit the bracket type 2 to panels using M12x35 long stainless steel setpins c/w M12 stainless steel spring washer and galvanised steel washer plate type C. Fixings to be finger tight only at this stage.
- 3.1.10** Once the first panel is installed, plumb the end of the panel and tighten post and panel fixings. Do not fully tighten at this stage.
- 3.1.11** Determine from the GA layout drawing if safety fence connectors are to be installed at the ends of the panels and proceed to fit (if required).
- 3.1.12** For the panel rails insert the 78x78 rail to rail joints pieces (type to be determined from layout drawing) and fix with M20x120 long galvanised steel bolts, M20 galvanised nuts and washers.

- 3.1.13** Layout the lower kicker rail onto battens / packers, to avoid damage, onto the structure. Offer the rails up into position and fit to the lower hanging lugs and fit M12x40 long galvanised steel setpins with nuts and washers.
- 3.1.14** Attached the lower kicker rail joint plate (type to be determined from layout drawing) and fix with M16 bolts, nuts and washers (type of fixings dependent upon type of joint.)
- 3.1.15** Repeat steps **3.1.9** to **3.1.14** along entire length of the work area, ensuring the correct rail joints are fitted and the correct gaps are set (see GA drawing).
- 3.1.16** Repeat step **3.11** 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 **ALL** bolts to the specified torque settings.
- 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 20mm.  
When parapets are attached to anchorage provided by other the following equation should be followed:
- $$LE = 0.7 \times \frac{\text{Ultimate Tensile Strength of Fixings}}{0.2\% \text{ Proof Stress of Anchorage Socket}} \times D$$
- 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.

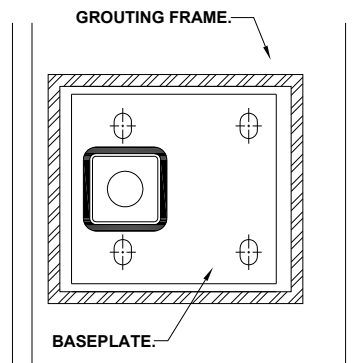


Figure 1.

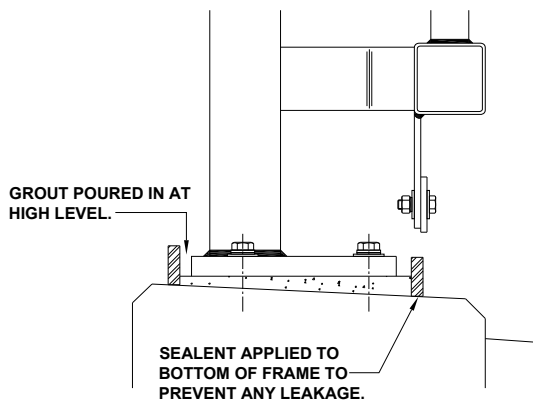


Figure 2.

**3.2.7** When grout boxes are removed the holding down bolts are to be re-tightened.

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

### **3.3** Top Rail: (if required.)

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

**3.3.2** Fix the post to panel / rail brackets type 2 to posts using M12x35 long stainless steel setpins c/w M12 stainless steel spring washer and galvanised steel washer plate type C. Fixings to be finger tight only at this stage.

**3.3.3** Offer the rails up into position and fit the bracket type 2 to rails using M12x35 long stainless steel setpins c/w M12 stainless steel spring washer and galvanised steel washer plate type C. Fixings to be finger tight only at this stage.

**3.3.4** For the rails insert the 78x78 rail to rail joints pieces and fix with M20x120 long galvanised steel bolts, M20 galvanised nuts and washers.

**3.3.5** Repeat steps **3.3.2** to **3.3.4** along entire length of the work area, ensuring the correct rail joints are fitted and the correct gaps are set (see GA drawing).

**3.3.6** Check and tighten **ALL** bolts to the specified torque settings.

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 steel 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.

### **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.
- Damage to attachment cleats.
- 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 and Gulliver Limited who can offer advice or arrange a site visit.