
**Technical Note 67**

# VMS Gantry Repair Procedure

**August 2015**

Queensland Government

## Copyright



**Feedback:** Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

## Contents

# 1 Scope

The purpose of this document is to provide a repair procedure for the various defects found during Bridge Information System Level 2 inspections of VMS gantry structures.

# 2 Defect identification and repair procedure

This section will detail the various type of defects found and also provide a repair procedure which can be used.

If a defect is found which is not covered by this document, please contact TMR Structures for clarification of the correct method before proceeding with a repair process.

# 3 Base plates

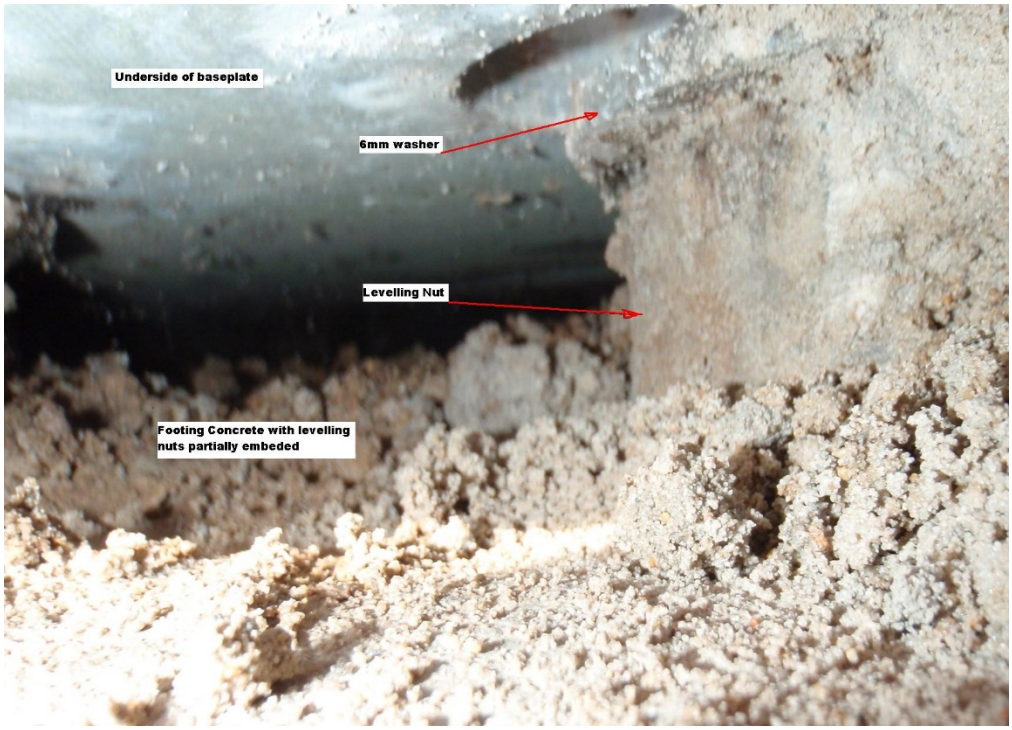
## *3.1 No mortar or inadequate mortar under the base plate*

The design drawings state that mortar should be placed under the base plate and the base plate shall be fully supported on the mortar. The majority of the gantries have been placed on Levelling nuts. If the mortar has reflective cracking then the generally suggests that the mortar has only been placed around the perimeter. Refer to Figure 1. If the area is struck with a hammer, this will often verify if the mortar is sound. If the mortar is not sound then the effect shown in Figure 2 will occur. Figure 3 shows that the gantry has been landed on levelling nuts.

***Figure 1 – Reflective cracking indicates the mortar is not sound***

***Figure 2 – Mortar only placed around the perimeter***

***Figure 3 – View under the base plate***




### *3.2 Incorrectly installed holding down bolts*

The next most common defect we find this the holding down bolt washers are starting to pull through the slotted holes in the base plate. Refer to Figure 4. The Australian Design Codes state that a plate shall be placed over the slotted holes to prevent the nut or bolt pulling through the slotted hole.

The other concern is in relation to the bolt tension. We have found some hold bolt nuts are loose. Refer to Figure 5. The way to identify if a nut is correctly installed is tap the hold down bolt with a hammer. The bolt should have a ringing sound.

***Figure 4 – Washer is pulling through the slotted hole***

***Figure 5 – Hold down nut was loose***

### *3.3 Repair process for base plate problems*

The following checks must be carried out.

- Determine if the gantry is supported on levelling nuts;
- Determine if the mortar has been placed under the complete gantry base plate and the mortar in in contact with the base plate;
- Are any slotted holes clearly visible.

If either of these defects are found then follow the procedure below.

### *3.4 Gantry supported on levelling nuts – repair using wedges*

The process outlined below is to be used for gantry structures which span across a road and there are supports each side of the road.

1. Obtain the steel wedges which will be used support the gantry column. Refer to Figure 6, Figure 7 and Figure 8;

***Figure 6 – Steel Wedge***

***Figure 7 – Steel Wedge Certified Drawing***

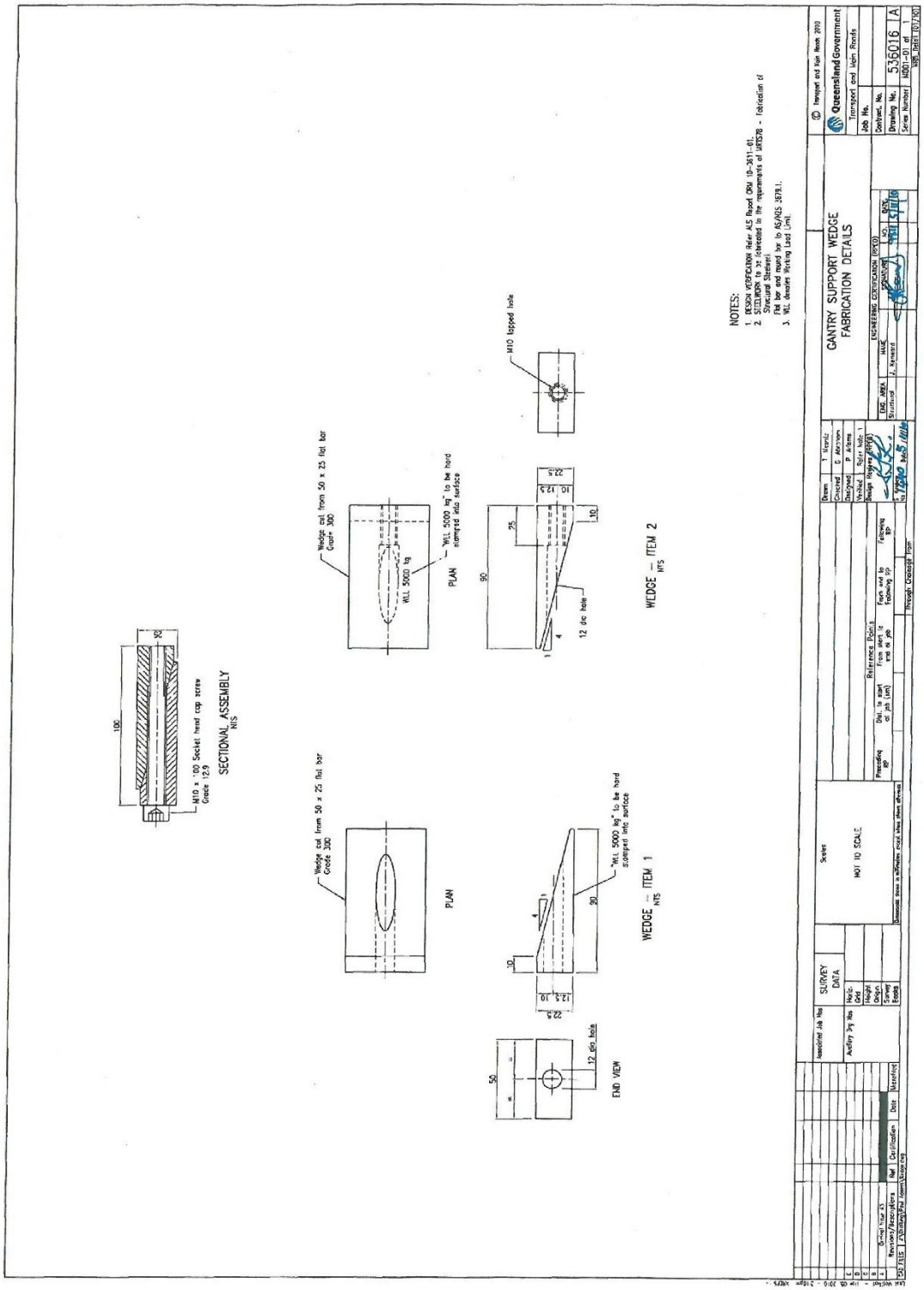
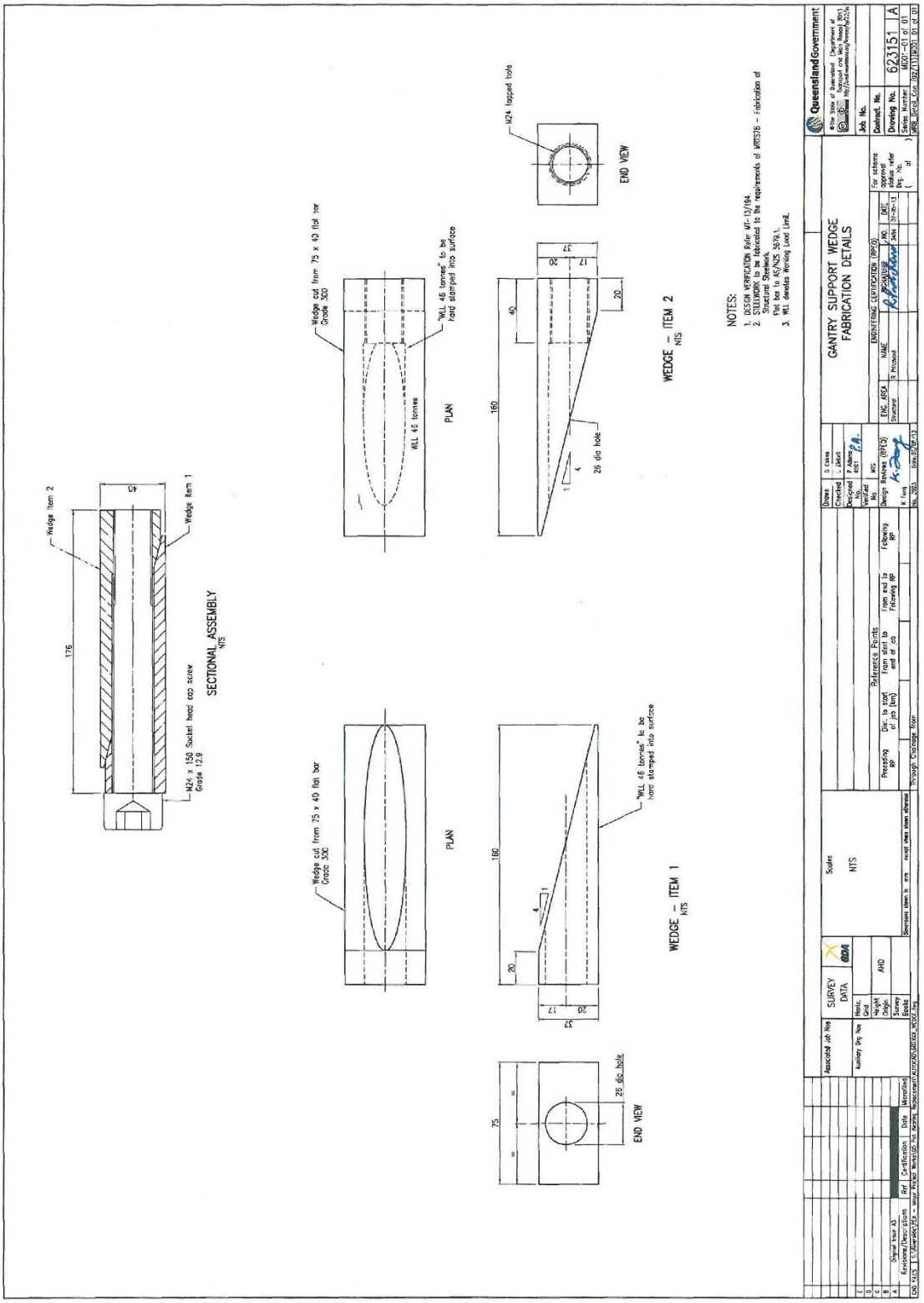


***Figure 8 – Steel Wedge Certified Drawing***



2. Remove all the existing unsound mortar, refer to Figure 9;

***Figure 9 – View of the mortar removed from under the gantry***

3. Measure the distance from the underside of the base plate to the top of the foundation concrete.

Note: The underside of the gantry base plate should be positioned between 25mm and 50mm above the concrete foundation. If the distance from the underside of the base plate and the concrete footing is greater then 50mm, then the whole gantry will need to be lowered

4. Place a thin layer of foam around the wedge.
5. Position 4 - steel wedges at 90o to one another. If extra packing is required, place the packers on top of the steel wedge.
6. Back off each levelling nut evenly until the gantry is supported on the steel wedges (Note: This process will need to be carried out slowly);
7. Glue 4mm timber dowels to the underside of the base plate. These dowels will ensure the gantry will effectively drain;
8. Place formwork around the base and ensure that formwork is water tight. Refer to Figure 10;

***Figure 10 – View of the formwork placed around the footing***


9. Mix up Conbextra GP mortar (or approved equivalent) to a flowable consistency;
10. Place the mortar so the mortar comes to the underside of the base plate;
11. Wait 24 hours for the mortar to achieve the required strength of 32MPa;
12. Remove the formwork, timber dowels and steel wedges from under the gantry, refer to Figure 11 and Figure 12;

***Figure 11 – View of the mortar and installed wedge***

***Figure 12 – View of the pocket created by the removed wedge***

13. Repair the mortar where the wedges were placed with Conbextra GP mortar (or approved equivalent) to a trowable consistency;

14. Tension the hold down bolts until they are snug tight;

### *3.5 Gantry supported on levelling nuts – backing of levelling nuts*

Another option available is to use the levelling nuts as a means of supporting the gantry. The process outlined below can only be used for gantry structures which span across a road and there are supports each side of the road.

1. Remove all the existing unsound mortar, refer to Figure 9;

***Figure 13 – View of the mortar removed from under the gantry***

2. Measure the distance from the underside of the base plate to the top of the foundation concrete.

Note: The underside of the gantry base plate should be positioned between 25mm and 50mm above the concrete foundation. If the distance from the underside of the base plate and the concrete footing is greater then 50mm, then the whole gantry will need to be lowered

***Figure 14 – View of the foam around the levelling nut***

3. Place foam around the 4 of the levelling nuts, refer to Figure 14;
4. Back off each levelling nut evenly until the gantry is supported at the correct height (Note: This process will need to be carried out slowly);
5. Glue 4mm timber dowels to the underside of the base plate. These dowels will ensure the gantry will effectively drain.
6. Back off all the other nuts which are not encapsulated within the foam;
7. Place formwork around the base and ensure that formwork is water tight;
8. Mix up Conbextra GP mortar (or approved equivalent) to a flowable consistency;
9. Place the mortar so the mortar comes to the underside of the base plate;
10. Wait 24 hours for the mortar to achieve the required strength of 32MPa;
11. Remove the formwork and timber dowels;

***Figure 15 – View of the mortar and installed wedge***

***Figure 16 – View of the pocket created by the removed wedge***


12. Back of the levelling nuts, so the gantry is supported on the mortar, refer to Figure 15;
13. Place formwork around the base and ensure that formwork is water tight;
14. Mix up Conbextra GP mortar (or approved equivalent) to a flowable consistency;
15. Place the mortar in the area where the levelling nuts were backed off. Ensure the mortar comes to the underside of the base plate, refer to Figure 16;
16. Tension the hold down bolts until they are snug tight;

### *3.6 Cantilever gantry supported on levelling nuts*

The process outlined below shall be used for cantilever gantry structures.

1. Obtain the steel wedges which will be used support the gantry column;
2. Remove all the existing unsound mortar;
3. Measure the distance from the underside of the base plate to the top of the foundation concrete.

Note: The underside of the gantry base plate should be positioned between 25mm and 50mm above the concrete foundation. If the distance from the underside of the base plate and the concrete footing is greater then 50mm, then the whole gantry will need to be lowered

4. Place a thin layer of foam around the wedge.
5. Position 4 - steel wedges at 90o to one another. If extra packing is required, place the packers on top of the steel wedge.
6. Back off each levelling nut evenly until the gantry is supported on the steel wedges (Note: This process will need to be carried out slowly);

Ensure a crane is connected to the end of the cantilever section of the gantry during the lowering process onto the steel wedges. This is recommended from a safety perspective particularly when carrying out repairs when there is only one lane of traffic closed.

7. Glue 4mm timber dowels to the underside of the base plate. These dowels will ensure the gantry will effectively drain.
8. Place formwork around the base and ensure that formwork is water tight;
9. Mix up Conbextra GP mortar (or approved equivalent) to a flowable consistency;
10. Place the mortar so the mortar comes to the underside of the base plate;
11. Wait 24 hours for the mortar to achieve the required strength of 32MPa;
12. Remove the formwork, timber dowels and steel wedges from under the gantry;
13. Repair the mortar where the wedges were placed with Conbextra GP mortar (or approved equivalent) to a trowable consistency;
14. Tension the hold down bolts until they are snug tight;

## 4 Slotted holes

1. For the slotted holes, a steel plate will need to be installed which spans across the slotted holes;
2. Before installing the washers, ensure that there will still be a minimum of 3mm of thread above the top of the nut once the washer has been installed.
3. Remove holding down nut and install the plate washer as shown in Figure 17 and Figure 18. Re-install the normal washer and nut. Note: Only one nut is removed at any one time.

***Figure 17 – Plate washer for slotted holes***

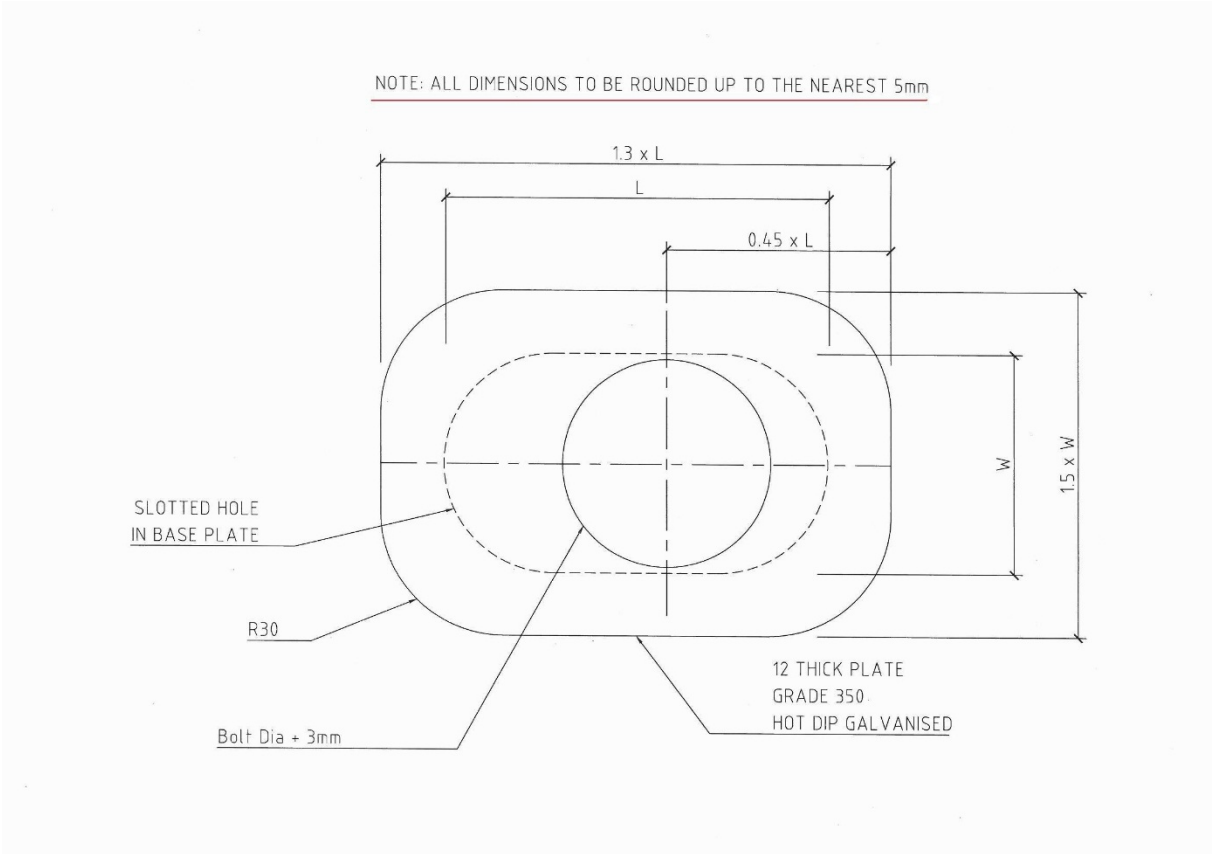


***Figure 18 – View of an installed plate washer***

## 5 Splice bolts

### *5.1 Splice joint defects*

During routine Level 2 LTMS inspections, a number of splice joints were identified with gaps between the splice plates. Figure 19 shows the location of the splice joint and Figure 20 shows the state of some of the splice bolts. Some of the splice joints have not been pulled together, as there is clear gaps between the splice plates. Refer to Figure 21.

In the majority of cases a 1mm thick steel ruler can be slide between the splice joints. The joints were originally designed as a T/B connection, which AS 4100 requires the splice joints to have minimum contact surface of 67% of the splice area.

During the inspection of the VMS gantries we have found that the splice joints bolts have not been tensioned correctly.

***Figure 19 – View of the splice joint location***

***Figure 20 – Some of the bolts have not been tensioned correctly***

***Figure 21 – Splice joint not pulled together***

### *5.2 Splice joint repairs*

Outlined below is the process to be used for the repair of splice joints where the bolts are to be fully tensioned.

Note: Once a fully tensioned bolts has correctly tensioned it cannot be re-tensioned.

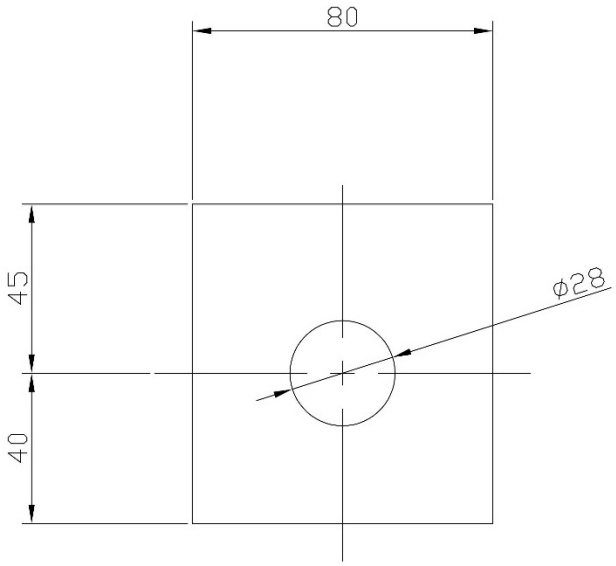
#### 5.2.1 Equipment for repair

The following equipment will be required to carrying out any repair works.

1. Purchase 30 - Class 8.8 - M24x150 Bolts in accordance with MRTS78;
2. Purchase 30- M24 DTI Load indicating washers;

3. Fabricate the Spacer Washers as per Figure 22
4. Hire a tension wrench which has a maximum torque of 2000Nm. Ensure the tension wrench has an overall length of 300mm, refer to Figure 23;

***Figure 22 – Spacer Washer Detail***




Notes

1. Plate to be Grade 350 to AS/NZS 3678;
2. Plate to be 2mm or 6mm thick;
3. Plate to be water cut to minimise distortion of the plate;
4. Plate to be hot dip galvanised to the requirements of AS/NZS 4680.

***Figure 23 – View of the distance available from the first vertical member to the splice joint***

### 5.2.2 Repair procedure – splice joints

NOTE: The repair outlined below shall not be undertaken when the wind speed is above 10km/h.

The following process will need to be used for the instalment of the shims at the splice joints.

1. Measure the gap between the splice joint plates;
2. Place an 800mm long breaker bar on the existing splice bolts and determine if the bolts can still be tightened. (If the bolt moves the splice bolts were never tensioned correctly in the first instance);
3. If the measured gap is less than 4mm, then following Option A. If the measured gap is greater than 4mm, then follow Option B.

#### 5.2.2.1 Splice joint – option a

For this option, no shim plates will be installed. The correct tensioning of the bolts should close the gap between the splice plates.

Note: Only carry out works on one splice joint at a time.

1. Using the bolt replacement sequence shown in Figure 25, remove the existing bolt and install a new bolt assembly. Ensure the load indicating washer flat surface is placed against the steelwork and there a washer between the nut and the load indicating washer. Ensure the bolt assembly is snug tight before moving to the next bolt;
2. Repeat Steps 1 until all the new bolts have been installed and the bolts are snug tight.
3. Once all the bolts have been replaced, then tension the bolts with a calibrated wrench as per TMR technical note TN62A;
4. Once all the bolt tensioning is complete, measure the gap between the splice joints with a 0.5mm feeler gauge to confirm the gap between the splice plates has closed up;
5. Ensure the first bolts have not lost any tension. (Bolt is loose or there is a gap between the load indicating washer);
6. Repeat the same process for the second splice joint.

Note: If the gap does not close option B shall be used.

#### 5.2.2.2 Splice joint – option b

For this option, shim plates will be installed as the gaps between the place joint is greater than 2mm wide.

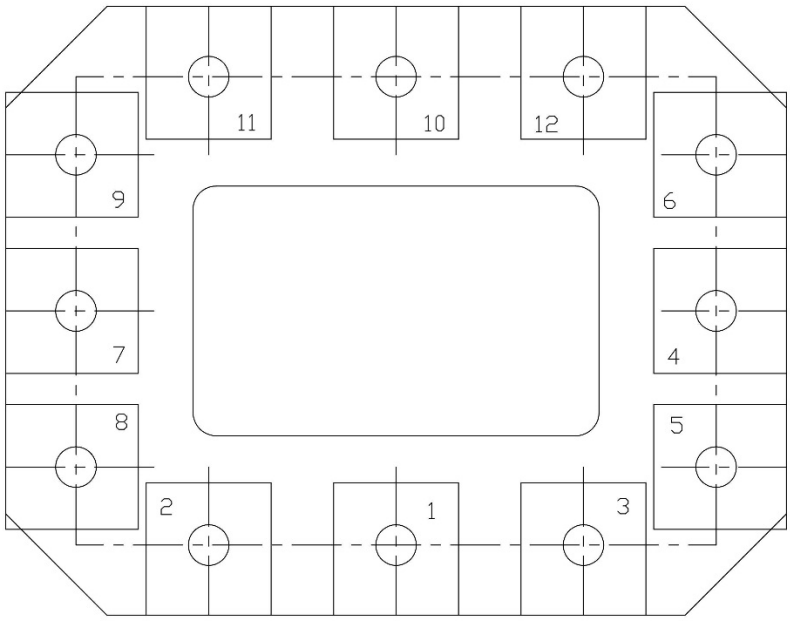
Note: Only carry out works on one splice joint at a time.

1. Measure the gap between the splice joint at each bolt location. This will determine the thickness of shim that should be installed. The largest gap will determine the thickness shim required for the joint;
2. The load of the cantilever section will need to be taken up with a 20 tonne Franner crane, so the shims can be installed;
3. Loosen all the splice bolts so the appropriate shims can be installed;

4. Using the bolt replacement sequence shown in Figure 25, remove the first bolt and install the Spacer Shim between the splice plates. If the shim washer is tight then tap the washer in between the splice plates with a plastic head hammer.
5. Install a new bolt assembly with a load indicating washer. Ensure the load indicating washer flat surface is placed against the steelwork and there a washer between the nut and the load indicating washer. Ensure the bolt assembly is snug tight before moving to the next bolt;
6. Repeat Steps 4 and 5 until all the shims and new bolts have been installed and the bolts are snug tight.
7. Once all the bolts have been replaced, then the bolts will need to be tensioned with a tension wrench as per TMR technical note TN62A;
8. Once all the bolt tensioning is complete, measure the gap between the splice joints with a 0.5mm feeler gauge to confirm the gap between the splice plates has closed up;
9. Ensure the first bolts have not lost any tension. (Bolt is loose or there is a gap between the load indicating washer);
10. Repeat the same process for the second splice joint.

***Figure 24 – Correct Installation***

***Figure 25 – View of the installed washers between the splice plates***




## 6 Repair procedure – Clevis bracket

### *6.1 Clevis bracket defects*

The clevis brackets are used support the VMS sign. In many cases the bracket has been poorly fabricated, as the welding around plate to the threaded rod is poorly executed, refer to Figure 26, Figure 27 and Figure 28

***Figure 26 – View of the poorly fabricated clevis bracket***

***Figure 27 – View of the typical clevis bracket***

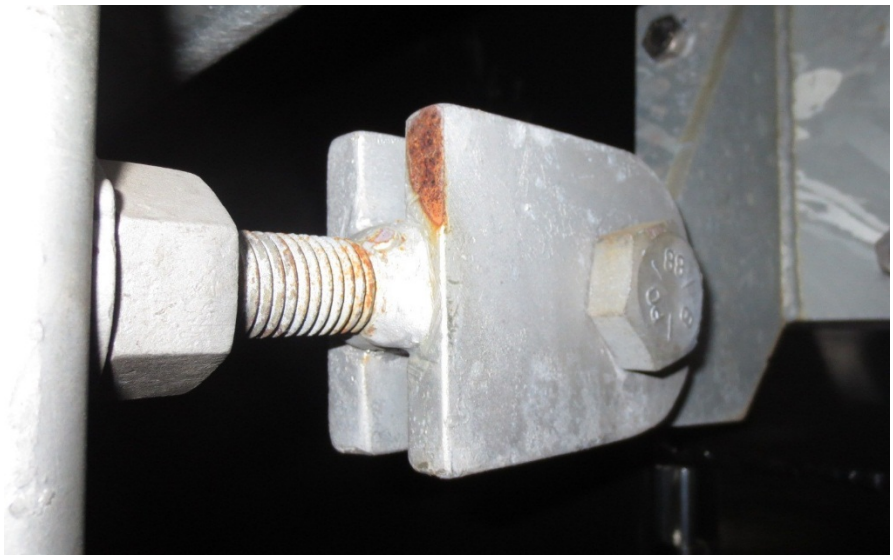
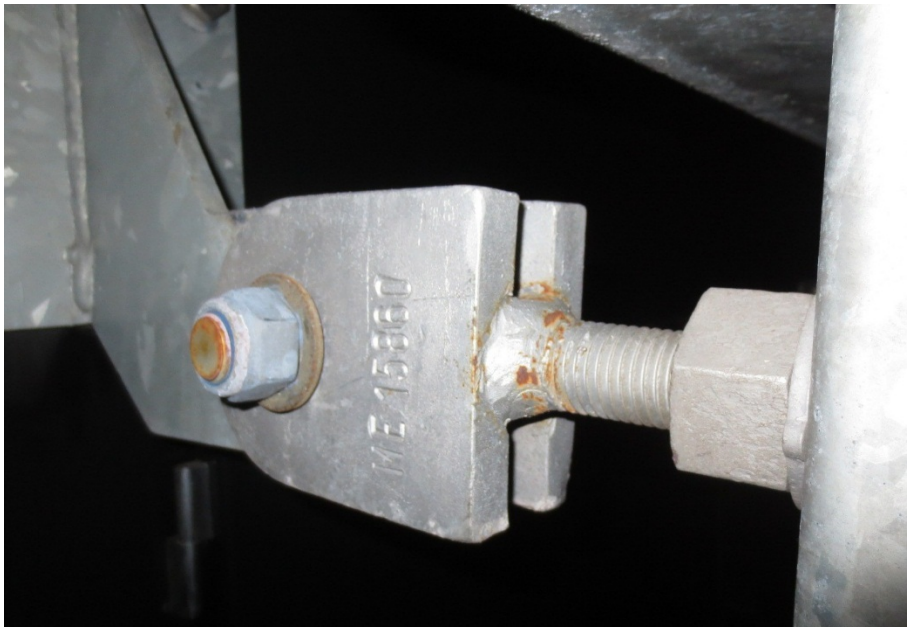


***Figure 28 – View of the typical clevis bracket***



### *6.2 Repair process for Clevis bracket*

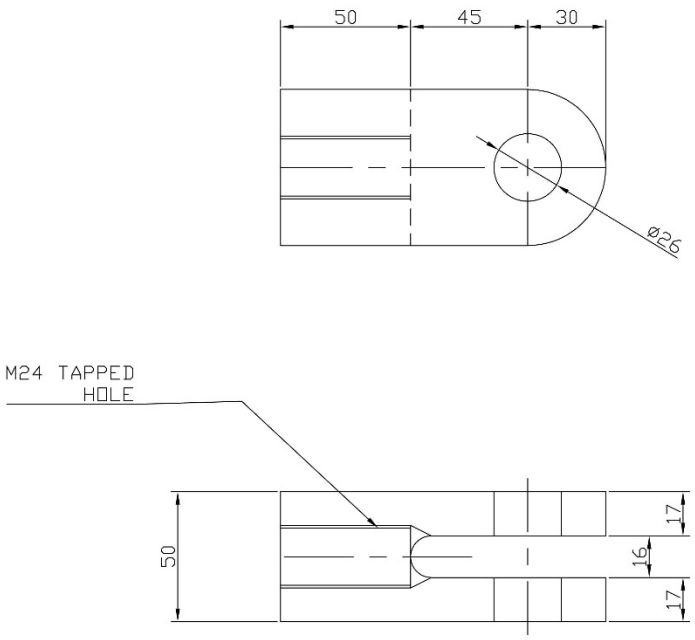
The following process will need to be used for the replacement of the clevis brackets.

#### 6.2.1 Equipment for repair

The following equipment will be required to carrying out any repair works.

1. Fabricate the clevis bracket as per Figure 29 or Figure 30 and Figure 31 depending on the type of sign connection;
2. Purchase the Class 8.8 threaded rod, with all the nuts in accordance with MRTS78.

***Figure 29 – Clevis Bracket Fabrication for single sign connections***




Clevis Notes

1. All items to be fabricated in accordance with MRTS78.
2. Threaded rod and nuts to be purchased in accordance with MRTS78
3. Machine Clevis from 4140-U bar.
4. All items to be hot dip galvanised to the requirements of AS/NZS 4680.

***Figure 30 – Alternative Clevis adjustment rod***

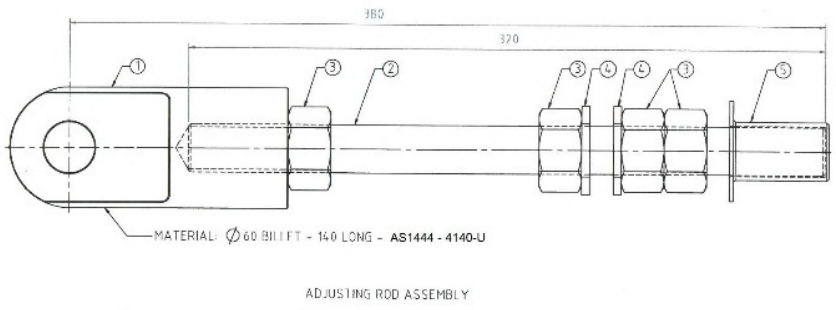
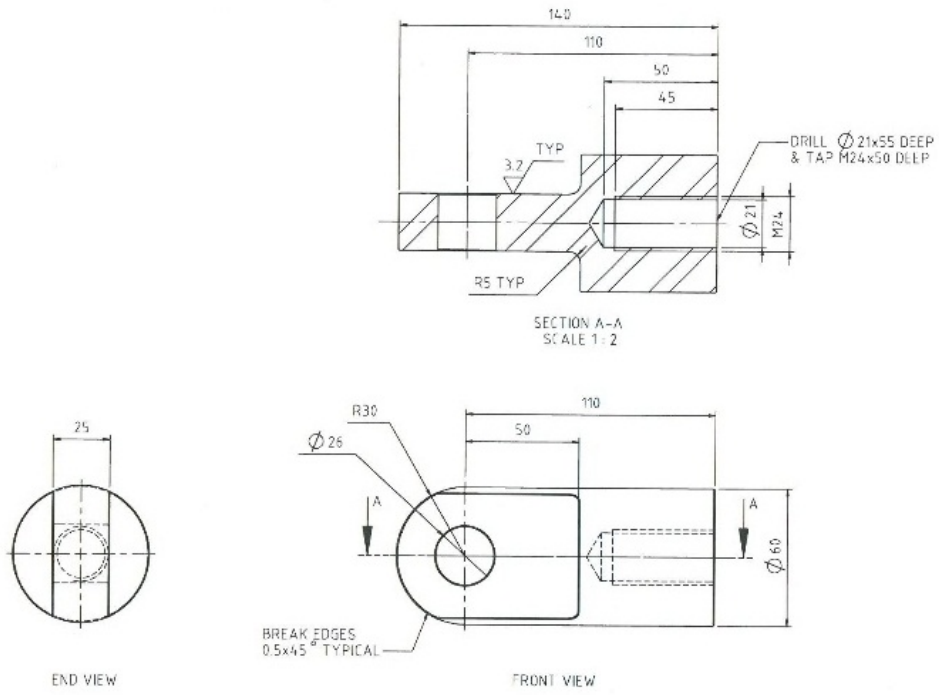


***Figure 31 – View of the clevis bracket for double plate sign connections***




Clevis Notes

1. All items to be fabricated in accordance with MRTS78.
2. Threaded rod and nuts to be purchased in accordance with MRTS78
3. Machine Clevis from 4140-U bar.
4. All items to be hot dip galvanised to the requirements of AS/NZS 4680.

Note: Only carry out works on one clevis bracket at a time.

1. Remove the bolt connecting the existing clevis bracket to the gantry;
2. Cut the threaded section between the gantry vertical member and the clevis bracket;
3. Remove the threaded rod from the vertical member and the existing clevis bracket;
4. Bolt the new clevis bracket to the sign face, refer to Figure 32, Figure 33 and Figure 34;
5. Slide the new threaded rod through the hole in the gantry vertical member, ensuring the two locking nuts are installed;
6. Screw the threaded rod into the clevis bracket and ensure the threaded rod is screwed all the way into the clevis bracket;
7. Tighten the lock nut against the clevis bracket;
8. Tighten the nut on the back of the clevis assembly, so the clevis assembly is tight;
9. Tighten both lock nuts;
10. Repeat for the other clevis bracket.

***Figure 32 – View of the clevis bracket assembly to be replaced***

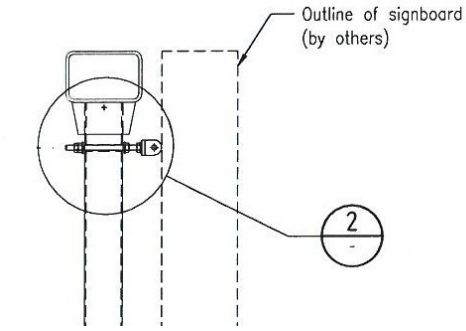



***Figure 33 – View of the clevis bracket assembly***

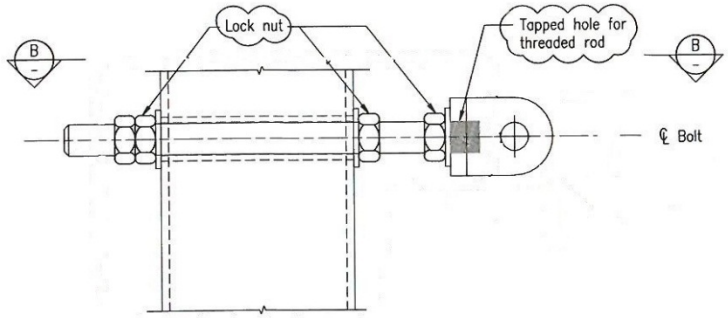
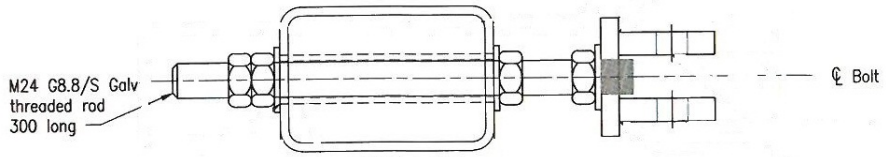



***Figure 34 – View of the clevis bracket assembly***




## 7 Corrosion

During the various inspections undertaken, the most common defect found is corrosion. Outlined below are the common corrosion defects.

***Figure 35 – Corrosion around the sign bracket***

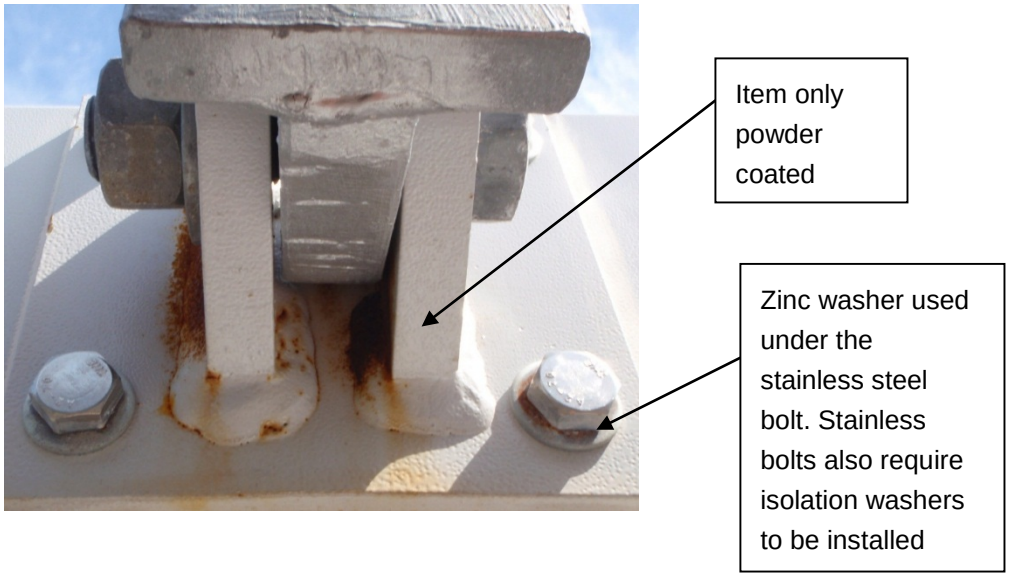


***Figure 36 – View of the corrosion on the inside of the member***

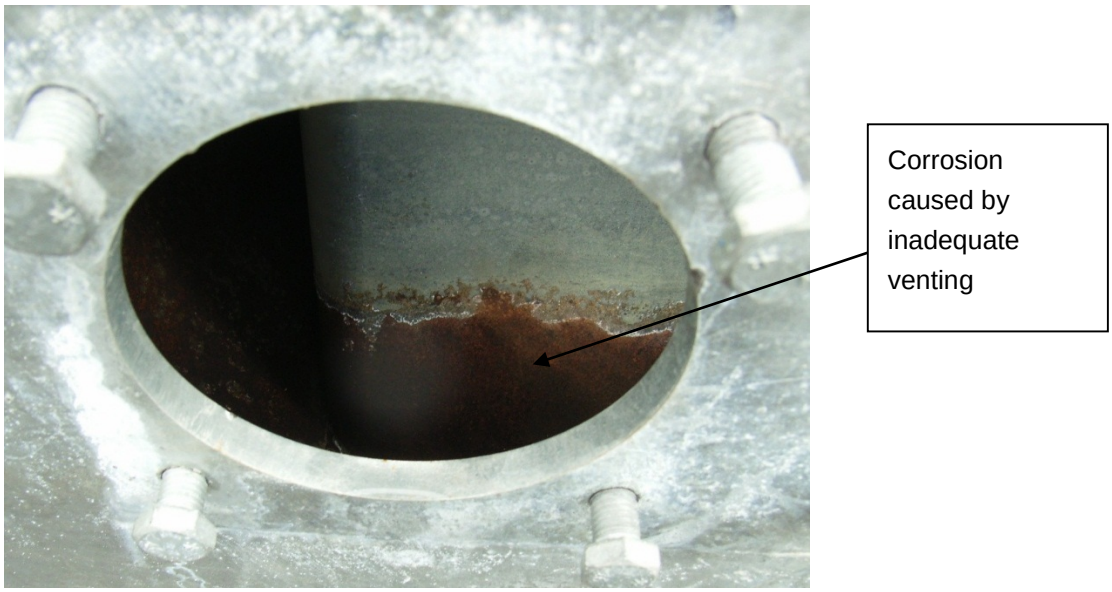



***Figure 37 – Close up view of the corrosion***

***Figure 38 – Corrosion leaching out of vent hole***

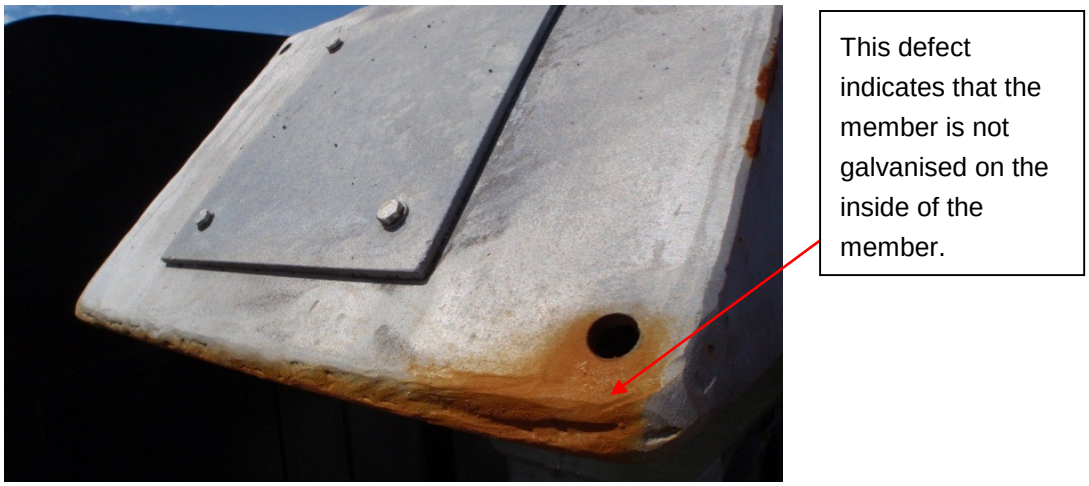


***Figure 39 – View of the lack of zinc coating on the inside of the top member***

***Figure 40 – View of the lack of zinc coating on the inside of the top member***

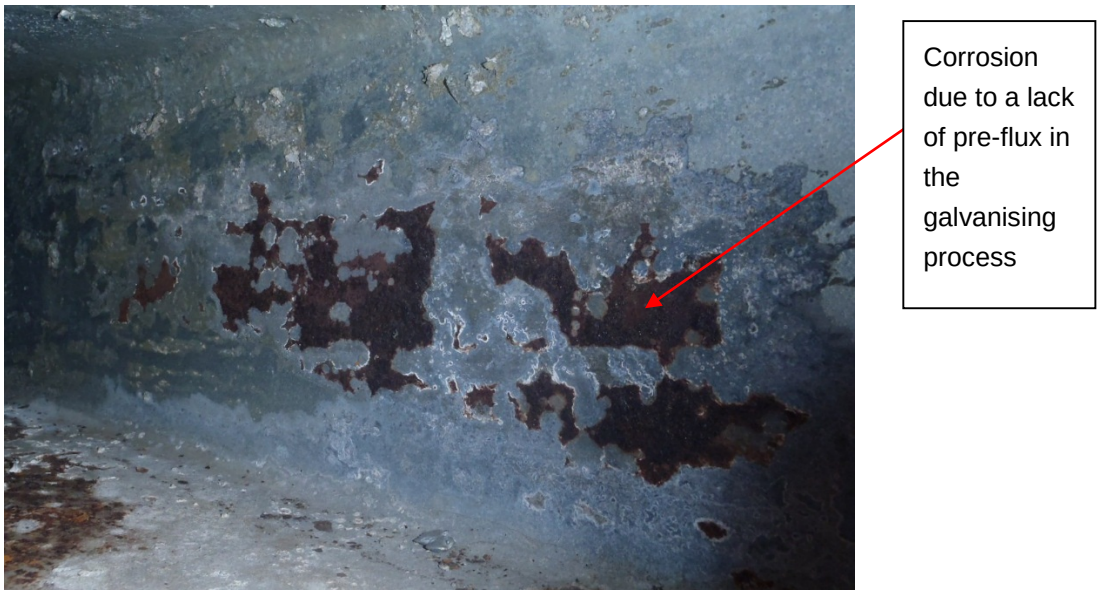
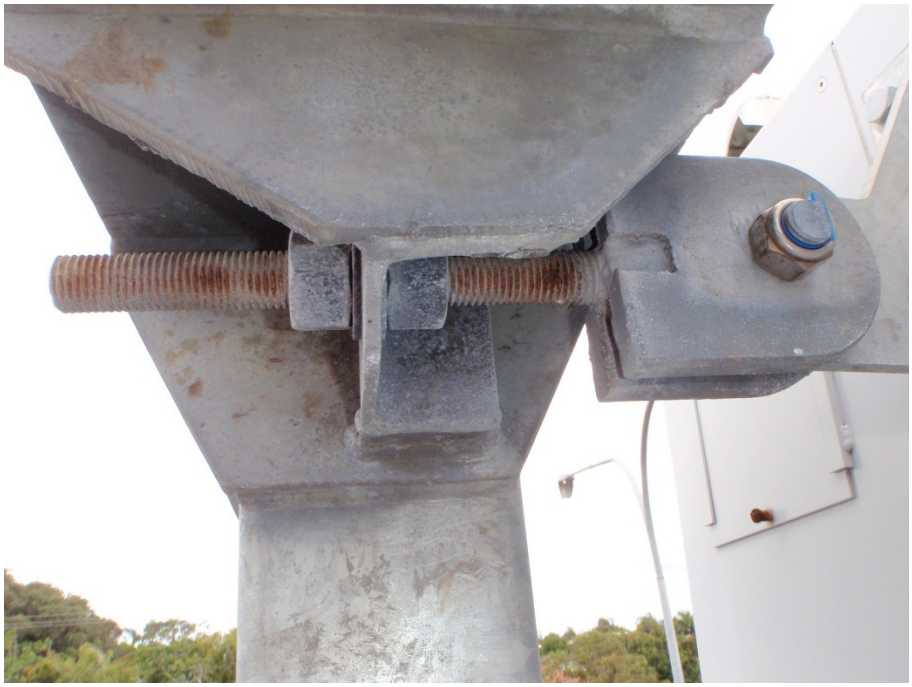



***Figure 41 – Corrosion from the vent hole***

***Figure 42 – General corrosion***

***Figure 43 – General corrosion on the threads***



### *7.1 Repairs to corrosion defects*

Outlined below are the recommended repairs for corrosion defects.

### *7.2 Corrosion inside a member*

If corrosion is found on the inside a member as shown in Figure 36, Figure 37, Figure 38, Figure 39 and Figure 40, then the following process will need to be used.

1. Remove the gantry structure;

2. Remove the sign face, wiring and items which can be unbolted;
3. Ensure the structure is modified so the gantry members have adequate venting before the full structure is re- galvanised to the requirements of AS/NZS 4680. The best way to rectify the problem is to place a vent hole in the cap plate. Refer to Figure 44 or Figure 45.
4. Once the galvanising has been completed and inspect the gantry to ensure that the galvanising complies with the requirements of AS/NZS 4680;
5. Re-install the unbolted items, sign face and wiring;
6. Re-install the member.

Note: New splice bolts are required for the above repair.

***Figure 44 – Provide a means for the air to escape***

Another option is to bolt the cap plate onto the top of the column. Refer to Figure 45. Note: If the bolt on cap plate is used the gantry designers will need to confirm the can be undertaken.

***Figure 45 – One way to provide adequate venting is to bolt on the cap plate***

### *7.3 General spot corrosion*

For general spot corrosion as shown in Figure 42 and Figure 43, the following process shall be used.

1. Remove the surface corrosion with a wire brush;
2. Apply two coats of Jotun Galvanite (or approved equivalent) by brush.

### *7.4 Corrosion on sign face bracket*

For the corrosion on a sign face bracket the following process will need to be used.

1. Remove the sign face;
2. Remove the sign face brackets and have the brackets be hot dip galvanised in accordance with AS/NZS 4680;
3. Re-install the bracket ensure a fibre isolation washer is installed between the stainless steel washer and the hot dip galvanised bracket;
4. Re-install the sign face.

### *7.5 Corrosion from small venting hole*

When corrosion is leaching from a venting hole on a stiffening plate the following process shall be used.

1. Remove the surface corrosion with a wire brush;
2. Plug the venting hole with a lead sinker to seal off the vent hole;
3. Apply two coats of Jotun Galvanite (or approved equivalent) by brush.

## 8 Defects and cracks in welds

During routine inspections we have found some welds have weld defect or cracks. Refer to Figure 47 and Figure 48. When this defect is found Structural Engineering advice may be required to provide a method of repairing the structure.

***Figure 46 – Typical view of the weld defect and crack locations***

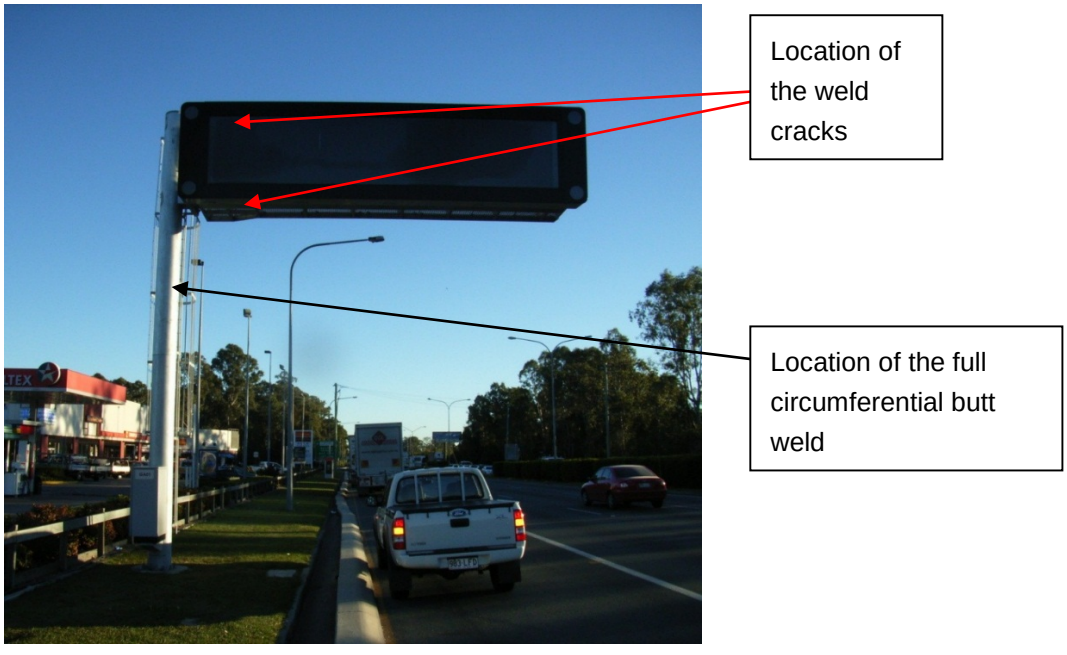


***Figure 47 – View of the column member inspected***

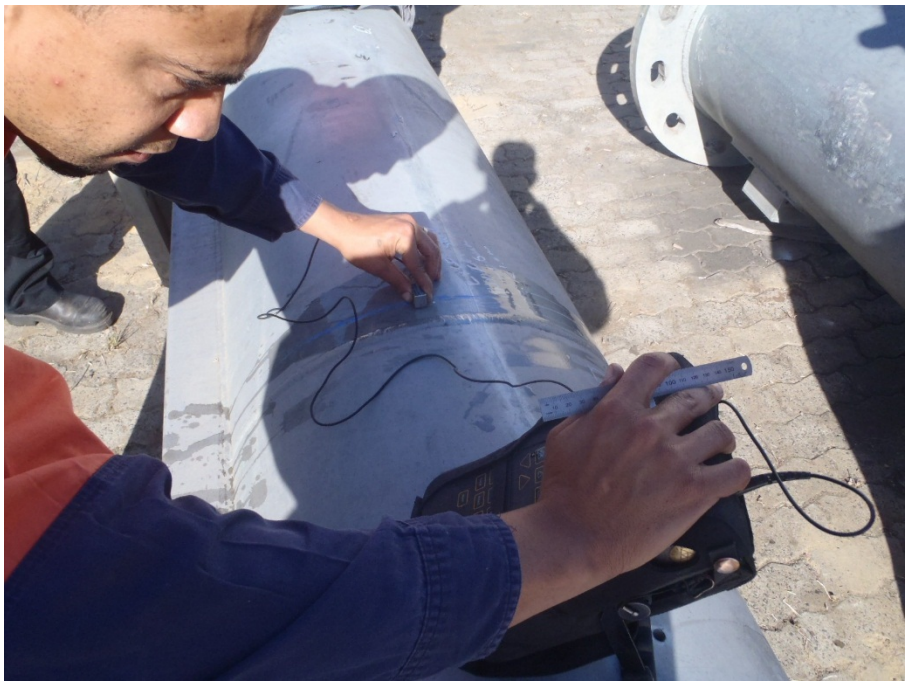
***Figure 48 – View of the visual cracks in the butt weld on the back side of the column member***

### *8.1 Further inspection weld defects*

Outlined below are the general works which can be undertaken to identify the extent of the welding defect.

1. Carry out 100% Ultrasonic testing of the member to determine the extent of the defect. This work is performed by specialist Non Destructive Testing (NDT) companies. Refer to Figure 49. (Note: NDT of galvanised steelwork is usually not permitted. However the testing will give an indication of the defects that may exist in a structure.)

***Figure 49 – View of the method of testing the welds***



2. If the NDT detects any defects which are not visible, they will be marked out on the member. Refer to Figure 50, Figure 51 and Figure 52.

***Figure 50 – View of the marked out area***

***Figure 51 – View of the full circumferential weld in the column member***


***Figure 52 – View of the level of undercut in the butt weld***


### *8.2 Repair of the weld defects and weld cracks*

The following process should be used for the repair the weld defects or crack found during the initial NDT investigation.

1. The gantry structure will need to be taken down and sent to a TMR approved fabricator for repair;
2. The galvanising coating will need to be stripped off the gantry member before the defect can be repair;
3. Grind out the weld defect and replace the weld to the requirement of MRTS78;
4. Carry out 100% ultrasonic testing to determine if the weld defect has been rectified;
5. Once welding is complete, the gantry structure will be sent for galvanising;
6. Re-install the gantry structure.