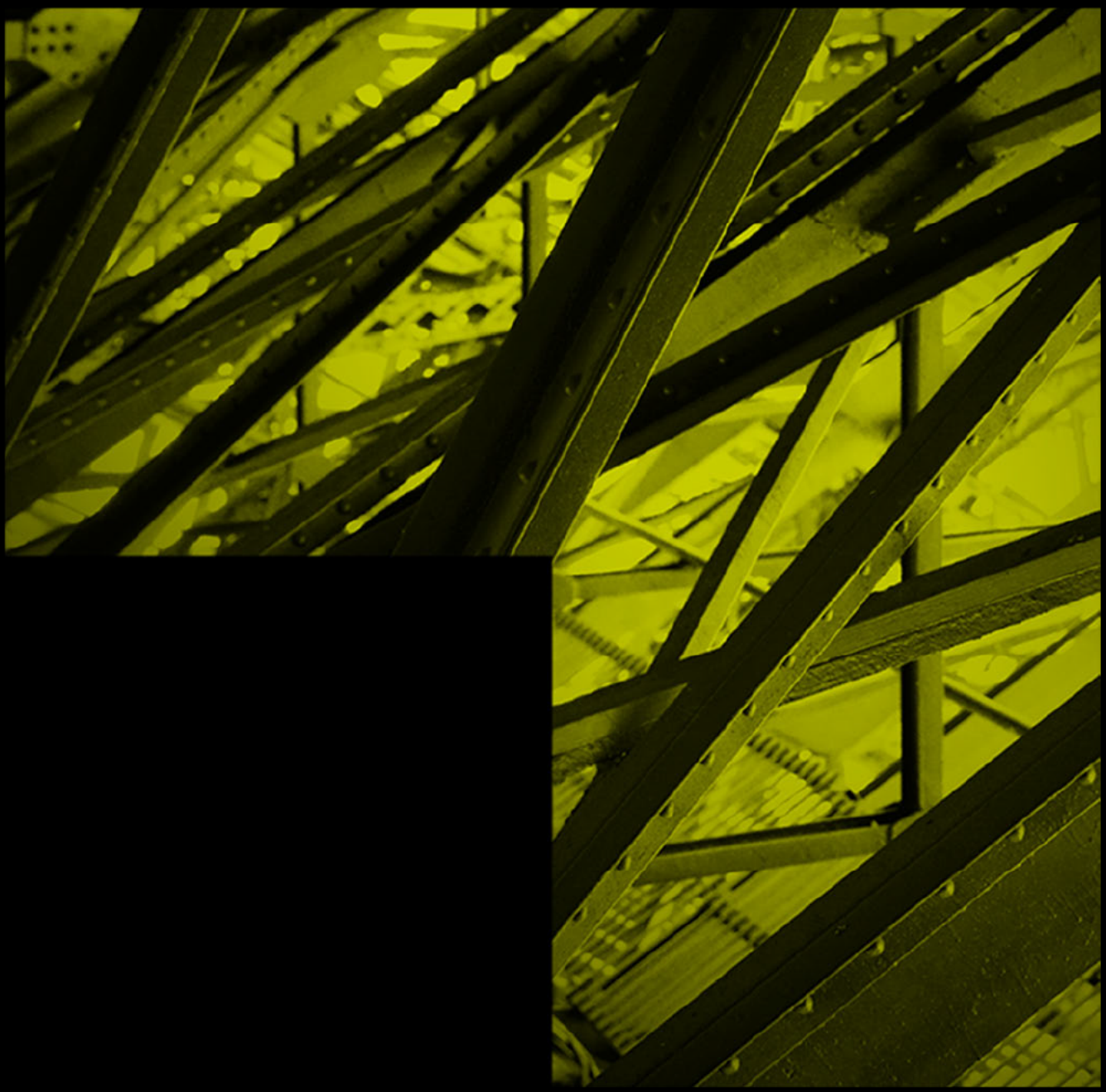
# WATERLOO TRAIN STATION CANOPY REASSESSMENT

Greater Wellington Regional Council



# DOCUMENT CONTROL RECORD

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|---|---|
| **CLIENT** | Greater Wellington Regional Council |
| **PROJECT** | Waterloo Train Station Canopy Reassessment |
| **HG PROJECT NO.** | A2414842.00 |
| **HG DOCUMENT NO.** | REP001-A2414842.00-AOK |
| **DOCUMENT** | Canopy Reassessment Report |

# ISSUE AND REVISION RECORD

| | |
|---|---|
| **DATE OF ISSUE** | 20/05/2024 |
| **STATUS** | Issued to Client |
| **ORIGINATOR** | s7(2)(a) Senior Structural Engineer |
| **REVIEWED** | s7(2)(a) – Senior Structural Engineer |
| **APPROVED FOR ISSUE** | s7(2)(a) – Structures Manager – Christchurch & Wellington |


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|---|---|
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# EXECUTIVE SUMMARY

Harrison Grierson has been engaged by the Greater Wellington Regional Council (GWRC) to carry out a condition reassessment of the canopy and roof structure at Waterloo Train Station, Lower Hutt. This reinspection has been performed in line with the recommendations provided by Harrison Grierson in their previous assessment report for this canopy performed in November 2021.

The purpose of the assessment is to provide corrosion scores and maps based on the following criteria to ascertain the expected residual life span of the canopy in years.

### CORROSION SCORING SYSTEM

The corrosion scoring system incorporated for each of the members is as follows:

| | |
|---|---|
| 1 | No Corrosion Evident |
| 2 | Light Corrosion Evident |
| 3 | Medium Corrosion Evident |
| 4 | Heavy Corrosion (Partial Repair/ Maintenance Required) |
| 5 | Heavy Corrosion (Full Repair) |

### ESTIMATED LIFESPAN OF INDIVIDUAL CANOPY ELEMENTS

#### ROOF

The top roof sheeting is showing signs of corrosion at the interfaces with the internal gutters as well as lifting of the flashings around the seismic gap with the adjacent building. The Clearlite panels are brittle and in poor condition with the seams being lifted due to the ingress of moss.

The internal gutters to both the upper and lower levels are showing signs of heavy corrosion in isolated areas.

Most of the hold-down screws connecting roof sheeting to purlin are showing heavy corrosion.

The bottom roof sheeting is also showing heavy corrosion under the ridgeline location.

We estimate that the current roof has an estimated lifespan of 2 to 3 years if no maintenance is carried out.

#### PURLIN VERTICAL SUPPORT POSTS

The purlin support posts are short lengths of SHS steel of varying depths which support the purlins off the top chord of the spaceframe truss enabling the pitch of the roof to be formed. The purlin support members display the heaviest corrosion of all the canopy elements.

We estimate that maintenance to some of these elements will be required in the next 6 to 12 months to prevent more extensive repairs (possibly even member replacement) being required. The area of most concern is highlighted in the corrosion map where the supports have a corrosion score of 4.

#### STEEL PURLINS

The steel purlins supporting the roof sheeting appear to be DHS elements that run longitudinally along the length of the canopy supported off the vertical SHS purlin support posts.

These purlins are generally in good condition with a corrosion score of 2. With only isolated cases requiring remediation in the next 18 to 24 months due to them having a corrosion score of 4.

**SPACE FRAME TOP CHORDS**

The truss top chords are “C” channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The top chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

Most of the bolts connecting the top chord members display medium-level corrosion. The recommended corrective measures must be actioned within 12 to 24 months before there is a need to replace these bolts and nuts.

**SPACE FRAME DIAGONALS**

The truss diagonals are CHS tubes in groups of 4 spanning between the top and bottom chords.

The diagonals are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

**SPACE FRAME BOTTOM CHORDS**

The truss bottom chords are “C” channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The bottom chords are generally in good condition with a corrosion score of 1 or 2 however there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

Also, at isolated locations, connecting bolts that showed no corrosion on the previous inspection, are now starting to display light corrosion.

**PIGEONS PRESENCE**

On the northeast side, most of the bottom roof sheeting and walls are covered by Pigeon droppings, accelerating the corrosion process.

All pigeon access holes to the roof cavity must be blocked and the affected areas cleaned up.

# 1.0 INTRODUCTION

Harrison Grierson has been engaged by the Greater Wellington Regional Council (GWRC) to carry out a condition assessment of the Waterloo Train Station Canopy located at Waterloo Train Station Lower Hutt, Wellington.

The station is located between Oxford and Cambridge Terraces as per the below screenshot. The two sides of the station are connected by a subway.

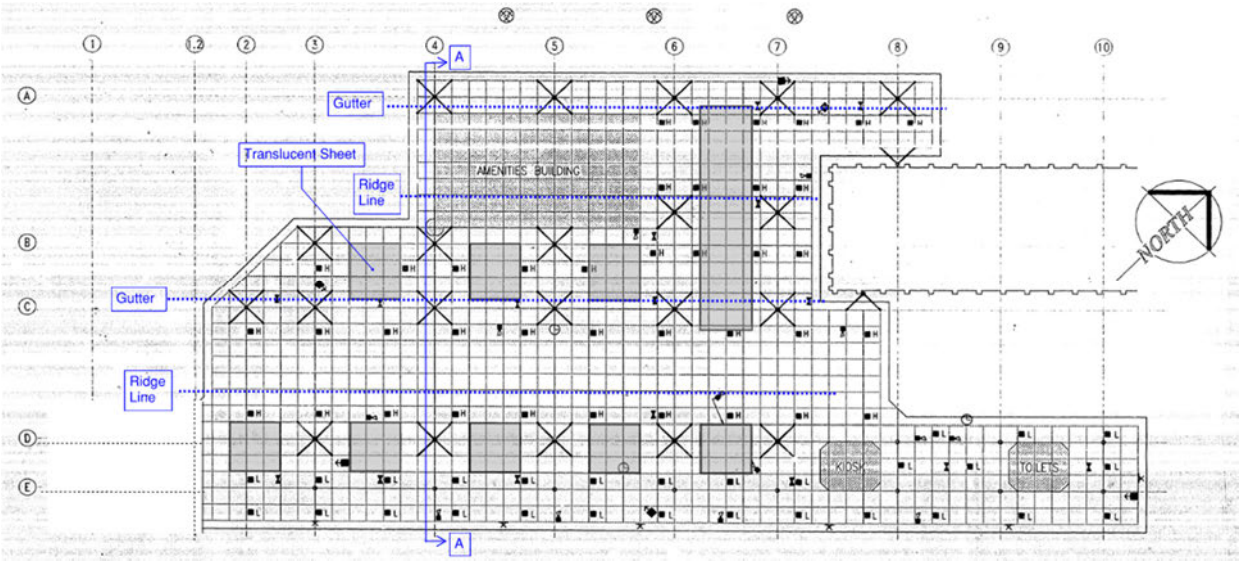

**Site Location (Image from Google Maps)**

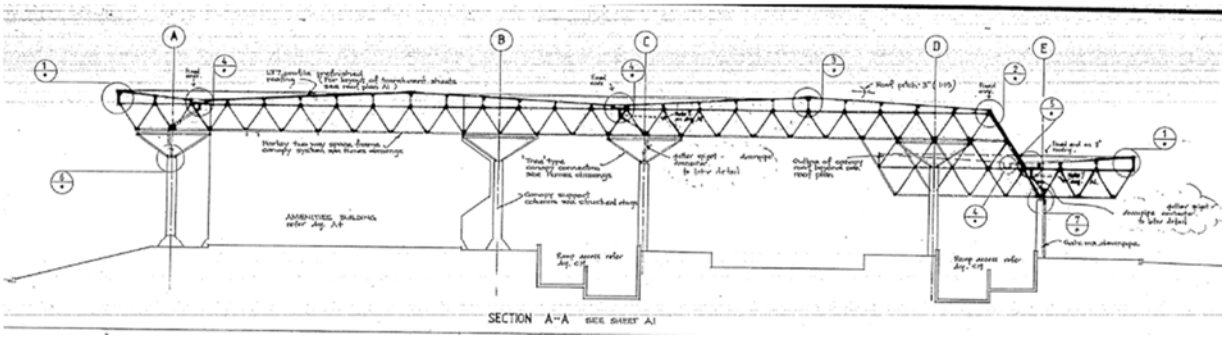
# 2.0 CANOPY DESCRIPTION

The canopy is split over two levels and features steel long-run roofing with Clearlite panels supported on steel DHS purlins which span longitudinally along the length of the structure.

There are 3 internal gutters all running along the length of the roof and a seismic joint to the adjoining building. The purlins are supported on small square hollow section (SHS) upstands of varying heights which enable the roof pitch to be formed. The SHS purlin supports are then supported on a steel spaceframe structure featuring longitudinal and transverse channel sections as top and bottom chords with diagonal circular hollow section members spanning between them. The spaceframe spans between concrete circular columns with 4 diagonal members located on the top which support the bottom chords of the spaceframe structure.

The canopy has a 2-degree telecommunications installation on the roof which relies on elements of the spaceframe for structural support.



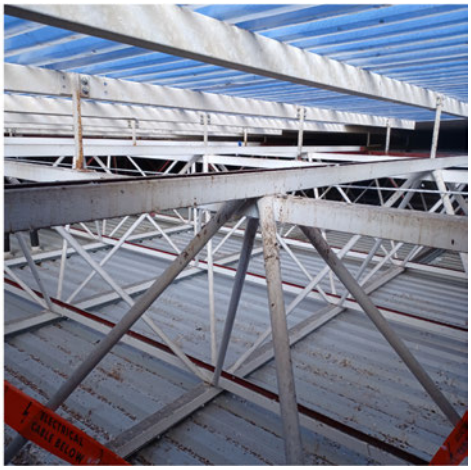
Upper-Level Roof

Lower-Level Roof

Internal Box Gutter

Translucent sheet

Purlin and SHS Support onto Top Chord



Top Chord and Diagonals

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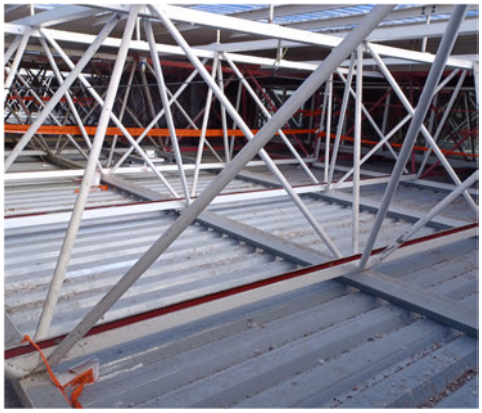
|  |  |
| Bottom Chords and Diagonals | Canopy Support Columns |

# 3.0 CANOPY CONDITION

## 3.1 INSPECTION METHODOLOGY

The canopy was inspected by Senior Structural Engineer s7(2)(a) from Harrison Grierson on 29 and 30 April 2024. Abseil Access Ltd provided fall protection services and accompanied HG personnel whilst the inspection was being conducted.

The roof space was accessed through the access hatch located in the former bus terminal building situated on the North of the railway lines.

A corrosion score consistent with the previous HG inspection in November 2021 was used for the inspection to provide a consistent comparison. The scoring system is described in the table below.

| Score | Corrosion Level |
|---|---|
| 1 | No Corrosion Evident |
| 2 | Light Corrosion Evident |
| 3 | Medium Corrosion Evident |
| 4 | Heavy Corrosion (Partial Repair/ Maintenance Required) |
| 5 | Heavy Corrosion (Full Repair) |

## 3.2 INSPECTION RESULTS

Condition maps have been produced to show the condition of each of the structural members. These can be found in Appendix A as well as in the sections below.

### 3.2.1 ROOF

The top roof sheeting is showing signs of corrosion at the interfaces with the internal gutters as well as lifting of the flashings around the seismic gap with the adjacent building.

Some of the Clearlite panels were replaced recently and are in good condition. However, the old Clearlite panels are brittle and are in poor condition with the seams being lifted due to the ingress of moss.

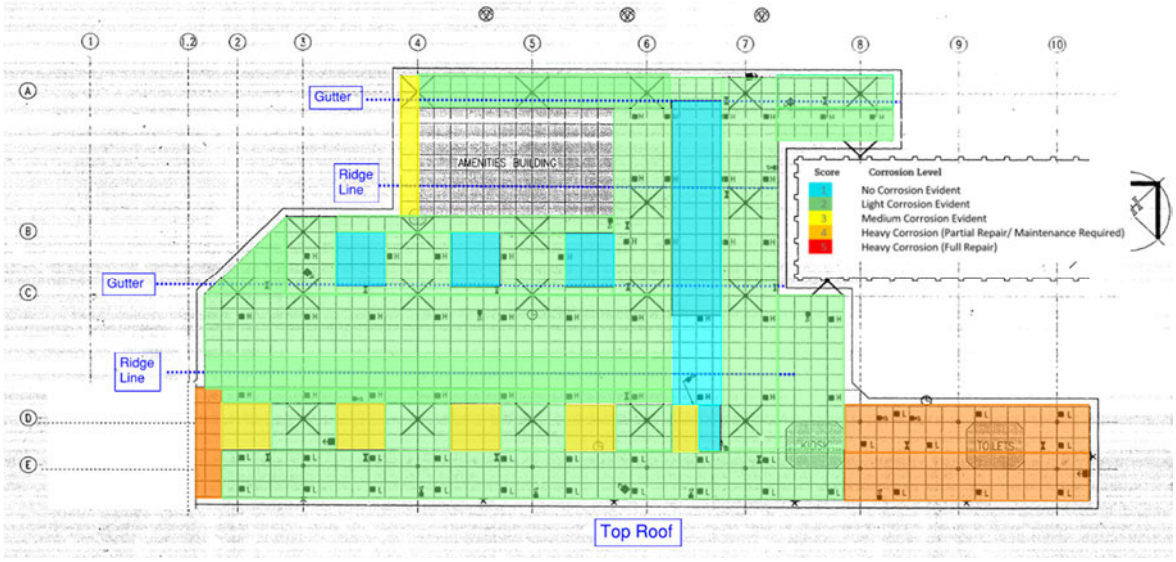
The internal gutters to both the upper and lower levels are showing signs of heavy corrosion in isolated areas.

Most of the hold-down screws connecting roof sheeting to purlin are showing heavy corrosion.

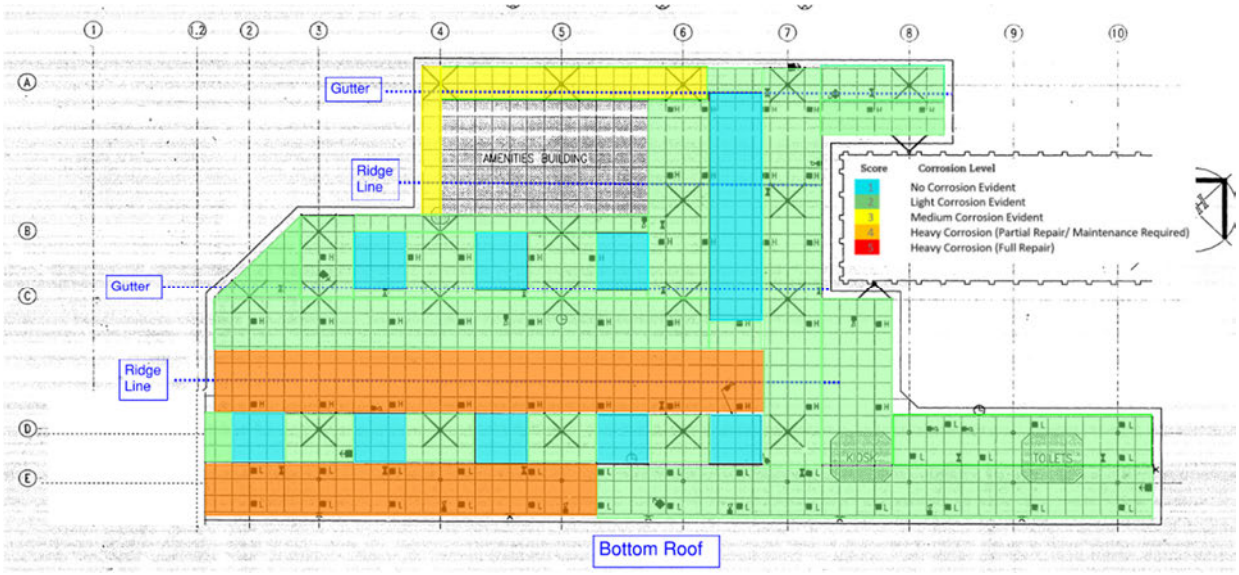
The bottom roof sheeting is also showing heavy corrosion under the ridgeline location.

We estimate that the current roof has an estimated lifespan of 2 to 3 years if no maintenance is carried out.

**Top Roof Corrosion Score Map**



**Bottom Roof Corrosion Score Map**



**ROOF PHOTOGRAPHS**

Roof Clearlite Panel corrosion score 3

Orange Lyceum on lower roof corrosion score 4

Internal Gutter corrosion score 2

Ridge Capping corrosion score 2

Roof seismic joint corrosion score 3

Roof walkway

Corrosion at lower internal gutter corrosion score 4

Corrosion at lower internal gutter corrosion score 4

Paint flaked off

Corrosion at hold-down screws corrosion score 4

Orange Lyceum on lower roof corrosion score 4

Corrosion at bottom roof sheeting corrosion score 3

Corrosion at bottom roof sheeting corrosion score 3

Corrosion at the intersection of upper and lower roofs due to flashing at the corner, corrosion score of 4

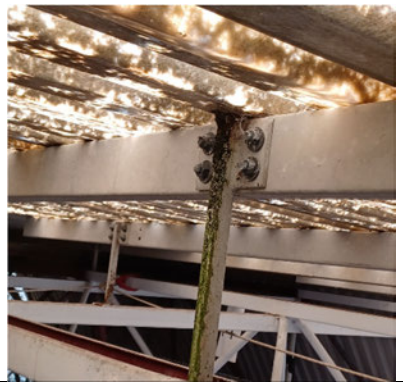
Damage to the sheeting wall on the Southside

Damage to the sheeting wall on Southside

Corrosion at hold-down screws corrosion score 4

Corrosion at bottom roof sheeting corrosion score 4

| | |
|---|---|
|  |  |
| Moss at the top of translucent sheeting | Corrosion at bottom roof sheeting corrosion score 4 |
|  |  |
| Accumulated Pigeon droppings | Accumulated Pigeon droppings |
|  |  |
| Accumulated Pigeon droppings | Corrosion spreading due to light fixings |



Leakage due to cracks in sheet

Holes in top roof sheeting

Corrosion spreading due to pipe fixings

Corrosion spreading due to spare member

Missing bolts to purlin

Opening for birds' entry

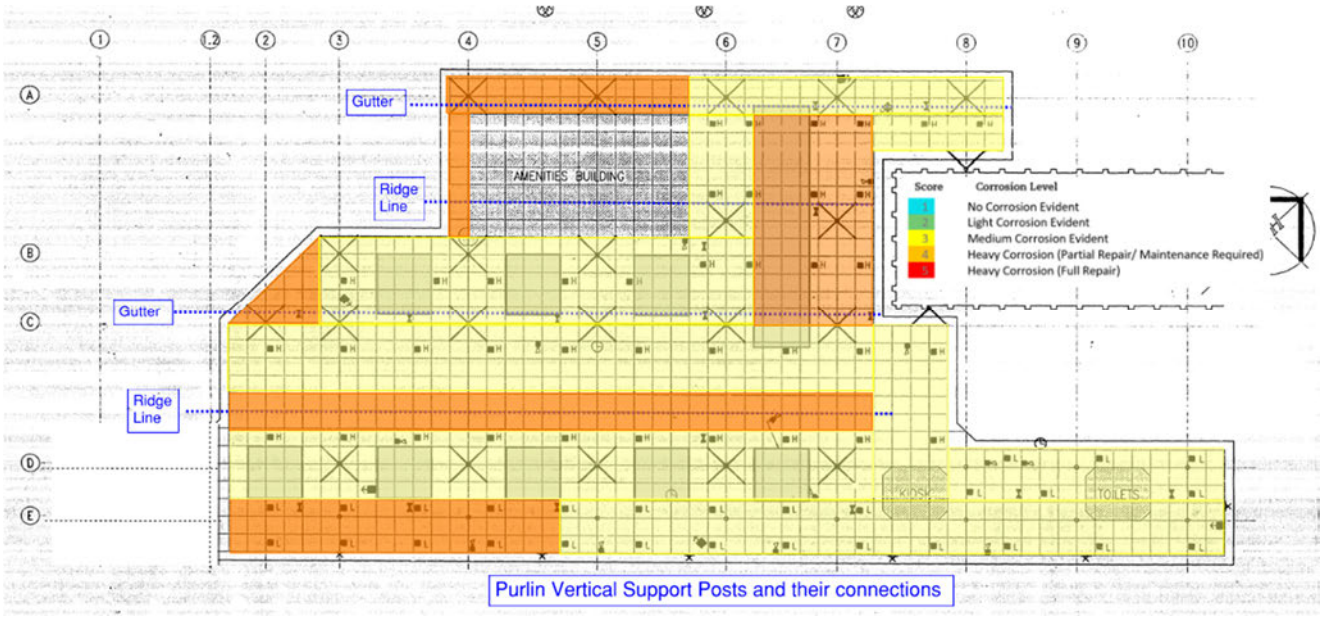
### 3.2.2 PURLIN VERTICAL SUPPORT POSTS

The purlin support posts are short lengths of SHS steel of varying depths which support the purlins off the top chord of the spaceframe truss enabling the pitch of the roof to be formed.

The purlin support members display the heaviest corrosion of all the canopy elements. We estimate that maintenance to some of these elements will be required in approximately the next 6 to 12 months to prevent more extensive repairs (possibly even member replacement) being required.

The area of most concern is highlighted in the corrosion map, where the supports have a corrosion score of 4.

**Purlin Supports Corrosion Score Map**



**PURLIN VERTICAL SUPPORT POST PHOTOGRAPHS**

Purlin support corrosion score 4

Purlin support corrosion score 3

Purlin support corrosion score 4

Purlin support corrosion score 3

Purlin support corrosion score 4

Purlin support corrosion score 4

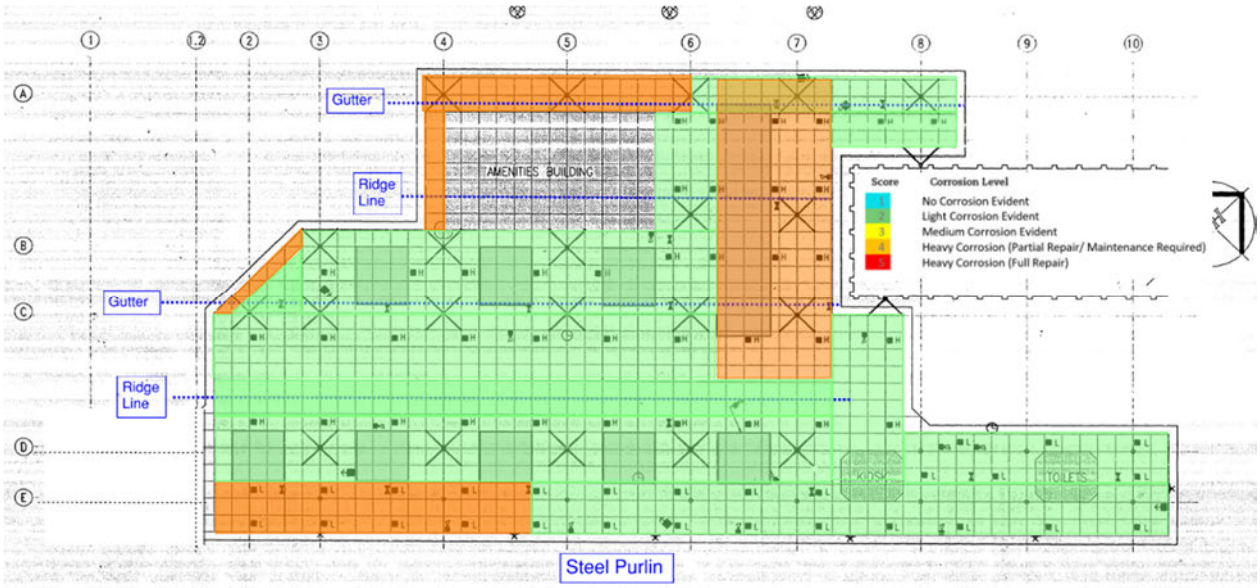
### 3.2.3 STEEL PURLINS

The steel purlins supporting the roof sheeting appear to be DHS elements that run longitudinally along the length of the canopy supported off the vertical SHS purlin support posts.

The purlins are generally in good condition with a corrosion score of 2.

Only isolated cases require remediation in the next 18 to 24 months due to them being corrosion level 4.

**Purlin Corrosion Score Map**



**STEEL PURLIN PHOTOGRAPHS**

Purlin corrosion score 4

Purlin corrosion score 4

Purlin corrosion score 4

Purlin corrosion score 2

Purlin corrosion score 2

Purlin corrosion score 2

### 3.2.4 SPACE FRAME TOP CHORDS

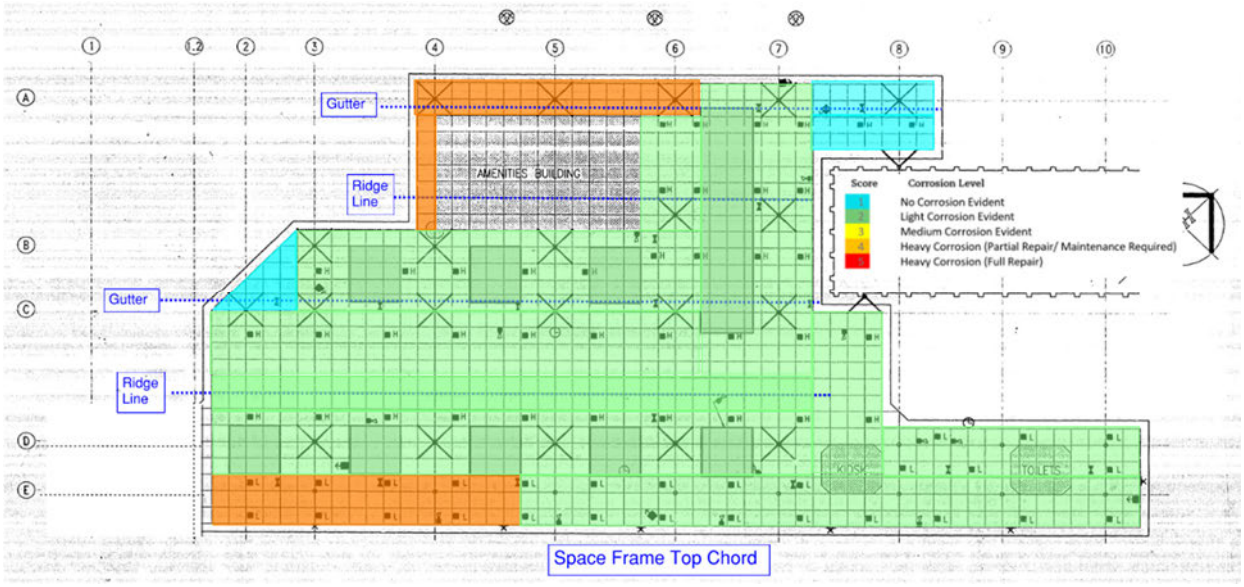
The truss top chords are “C” channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The top chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the top chord members, which can accelerate the corrosion process.

Most of the connection bolts display medium-level corrosion.

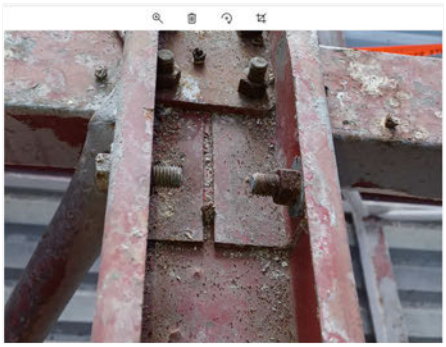
**Top Chord Corrosion Score Map**



**SPACE FRAME TOP CHORD PHOTOGRAPHS**

Truss top chord corrosion score 2

Truss top chord corrosion score 4



Truss top chord connection corrosion score 3

Truss top chord corrosion score 1

Truss top chord corrosion score 3

Truss top chord corrosion score 3

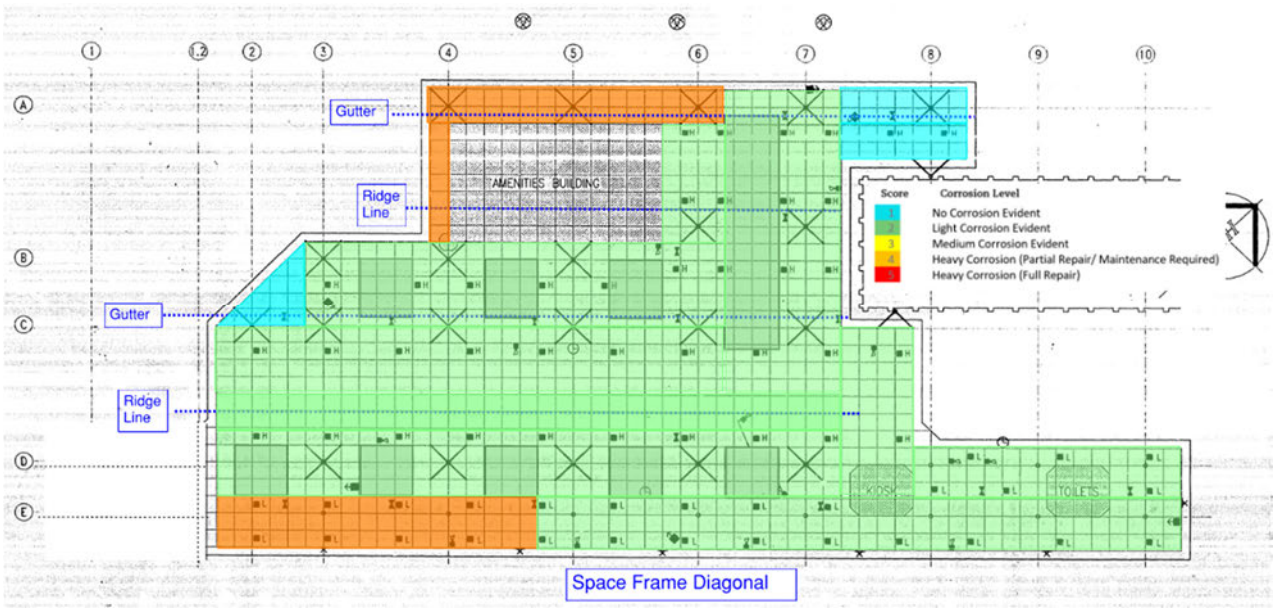
### 3.2.5 SPACE FRAME DIAGONALS

The truss diagonals are CHS tubes in groups of 4 spanning between the top and bottom chords.

The diagonals are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the diagonal members, which can accelerate the corrosion process.

**Diagonals Corrosion Score Map**



**SPACE FRAME DIAGONAL PHOTOGRAPHS**

Diagonal corrosion score 3

Diagonal corrosion score 2

Diagonal corrosion score 3

Diagonal corrosion score 1

### 3.2.6 SPACE FRAME BOTTOM CHORDS

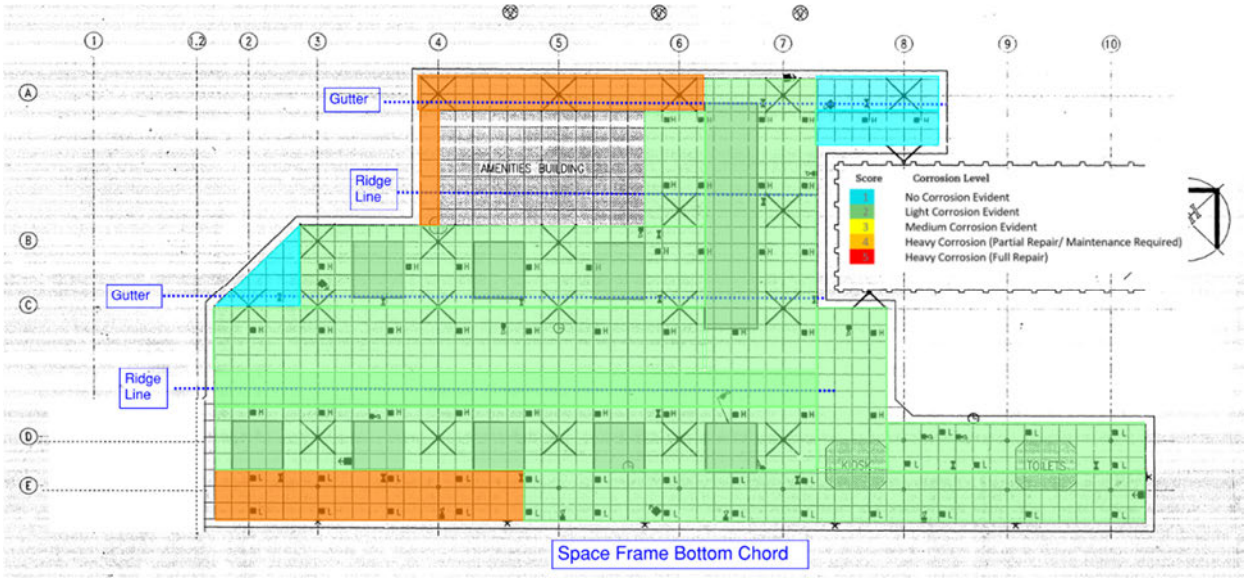
The truss top chords are "C" channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The bottom chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the southwest corner with a corrosion score of 4.

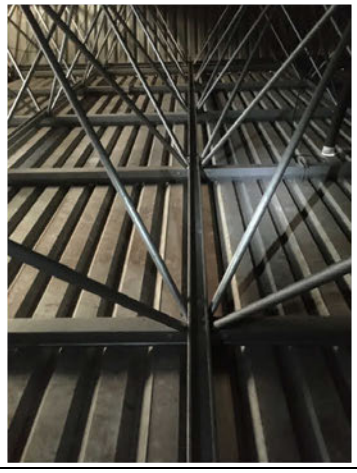
The paint in some areas was observed to have flaked off the bottom chord members, which can accelerate the corrosion process.

Some of the connection bolts display medium-level corrosion.

**Bottom Chord Corrosion Score Map**



**SPACE FRAME BOTTOM CHORD PHOTOGRAPHS**

| | |
|---|---|
|  |  |
| Bottom chord corrosion score 2 | Bottom chord corrosion score 3 |
|  |  |
| Bottom chord corrosion score 1 | Bottom chord corrosion score 2 |
|  |  |
| Bottom chord corrosion score 4 | Bottom chord corrosion score 3 |

| | |
|---|---|
|  |  |
| Plate between column and bottom chord corrosion score 4 | Plate between column and bottom chord corrosion score 4 |

# 4.0 CONCLUSION AND RECOMMENDATIONS

Overall, the canopy structure is in reasonable condition apart from the following locations.

We recommend that the following remedial works be carried out within the next 12 months to prevent further deterioration of the structure.

## 4.1 ROOF

- Power wash the entire roof
- Touch up the areas of corroded sheeting around the internal gutters.
- Replace the corroded areas of internal gutters at the upper and lower levels.
- Replaced the corroded hold-down screws between sheeting and purlin.
- Block all pigeon/vermin entry points.
- Power wash pigeon droppings.
- Fix the ridge overlapping and flashing details at joints/corners.
- Paint touch up required in the areas of corroded bottom roof sheeting below the ridge line.

## 4.2 PURLIN SUPPORTS

- Abrasive blast and re-paint the square hollow section supports and connections in the upper and lower-level portions of the roof.

## 4.3 TOP CHORDS

- Abrasive blast and re-paint the top chord connection bolts. Also, repaint the chord members to prevent corrosion as most paint has already flaked off.

## 4.4 DIAGONALS

- Repaint the diagonal member to prevent the start of the corrosion as most of the paint has been flaked off.

## 4.5 BOTTOM CHORDS

- Repaint the bottom chord members to prevent corrosion as most paint has already flaked off.

## 4.6 GENERAL

- Inspect the structure every 2 years to assess for further corrosion and degradation.

# 5.0 LIMITATIONS

## 5.1 GENERAL

This report is for the use by Greater Wellington Regional Council only and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed upon between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff, or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

# APPENDICES

# APPENDIX 1 CORROSION SCORE MAPS