Woolacotts.
CONSULTING ENGINEERS

Structural Assessment of Christmas Island Skate Park

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March 2015 | 15-34

Contents

Document control

Rev No	Date	Revision details	Approved	Verified	Prepared
A	27/3/15	Approved Issue	SDC	SETB	SDC

1.0 Introduction

Woolacotts Consulting Engineers were engaged by the Department of Infrastructure and Regional Development to undertake a structural assessment of the enclosing structure of the Christmas Island Skate Park, located on Gaze Road.

The scope of works included:

- Visual inspection of the building fabric and structure.
- Preparation of a report regarding the condition of the cladding and structure, inclusive of recommendations and methodologies for maintenance and/or remedial works to ensure ongoing safe operation of the facility, with budget estimates, inclusive of an option to demolish the structure.

This report is based on our inspection of the facility, undertaken on Friday 20 February 2015.

2.0 Building Description

The building enclosing the Christmas Island Skate Park is a large single storey steel framed structure, approximately 21 metres wide by 34m long. Plans and sections of the structural framing are presented in Appendix B. The building was originally constructed as a sports hall with a single basketball court but now has various skate ramps installed over the court surface.

The structure consists of 10 structural steel portal frames and associated bracing elements, supporting timber roof purlins and wall girts and clad in corrugated metal sheeting. Four stepped concrete tiers, supporting plastic seating are located along the western edge of the building, built against the line o a concrete retaining wall supporting the raised carpark area adjacent to the building.

Timber framed store rooms are located at the building corners either end of the tiered seating. A toilet block, which based on the age of the cladding, appears to have been constructed as a later addition, is connected to the Southeast corner of the building.

Roller shutter entries into the building are located at the Northern and Southern end walls. High level operable windows are located in every second bay between columns along the Eastern wall of the building. The internal face of the Eastern, Southern and Northern walls are clad at low level with plasterboard, with the Eastern and Northern panels are decorated with spray painted murals.

3.0 Observations and Recommendations for Repair

Our observations are based on inspections undertaken on 20 February 2015. The inspections were of a visual nature only with no testing of materials undertaken.

We note that our inspection was limited to the exposed structural steel framing and roof and wall cladding only. No other parts of the structure or building fabric were inspected in detail.

The table presented in Appendix A records the observed damage to the building fabric and structure described below and makes recommendations for maintenance or repairs required to ensure continued safe operation and to prevent further damage from occurring.

The location of the observed damage recorded in the table is indicated on the building drawings presented in Appendix B of this report. A photographic record of the damage is also included in Appendix C.

The identified risk posed by the damage observed to the existing building fabric and structure has been categorised within the table as Low, Medium, High or Extreme based on both the consequence and likelihood of occurrence. We recommend that the risks be addressed within the following time frames:

- Extreme – Immediately
- High – Within three months
- Medium – Within six months
- Low – Within twelve months

The various types of damage observed and our recommendations for remedial works are discussed below.

3.1 Corrosion of Structural Steelwork

The exposed structural steel brackets fixed to the top of the portal frame columns to support the roof eaves are in very poor condition. Several are missing and others are substantially corroded to the point where their structural adequacy has been compromised. These brackets are in need of removal and replacement.

The existing paint finish to the internal structural steel portal frames and angle roof and wall bracing has deteriorated and there is minor surface corrosion throughout. Heavier corrosion was observed along the top of the western wall (where the wall sheeting does not extend full height), at the top corner connections and at the base of all columns.

In our opinion the extent of corrosion observed at most locations will not yet have compromised the structural adequacy of the members. If left untreated however, the corrosion will continue to propagate, leading to loss of section capacity and eventual failure of structural steel members.

We recommend that the building cladding be temporarily removed to allow all structural steel elements to be abrasive blast cleaned to remove all corrosion back to shiny metal. A structural engineer should then be involved to inspect the identify areas where the steel sections have been significantly reduced in thickness and a boilermaker engaged to site weld additional steel strengthening plates in place where required.

Corrosion is present at the base of all columns and we recommend that further concrete encasement be provided at all column bases to prevent water from ponding at the base of the steel.

Upon the completion of cleaning and strengthening works, all steelwork should be repainted with a zinc rich epoxy primer to protect against further corrosion, prior to application of a top coat.

3.2 Condition of Girts, Purlins and Sheeting

The roof sheeting is missing at the Northern end of the building and at various locations along the Eastern eaves. The failure of the roof sheeting is due to the corrosion or pull-out failure of the fixings from the supporting timber purlins.

As per Section 3.1, in order to adequately treat, repair and repaint the existing the corroding structural steel framing to the building it will be necessary to temporarily remove all cladding. In our opinion the corrugated metal roof and wall cladding and the supporting timber wall girts and roof purlins are at the end of their usable life and in need of replacement.

We recommend that the replacement girts and purlins be galvanized steel in lieu of timber to provide better durability. Given the very aggressive atmospheric conditions for corrosion adjacent to the coast-line, we recommend that the replacement sheeting be galvanized steel sheeting such as Colorbond Ultra, which is specifically designed for durability in this type of environment.

4.0 Cost Estimates

The following cost estimates have been based on the price of building materials, plant hire and labour as at March 2015. We note that the costs may vary considerably based on the availability of local labour, plant and materials.

4.1 Remedial Works

Our recommended scope for the remedial works to the building fabric and structure to ensure the ongoing safe operation has been itemised in the below table.

Item	Scope of Work	Cost Estimate
1.	Remove existing roof and wall sheeting and cladding and dispose of locally	$37,500
2.	Abrasive blast clean all exposed structural steel to remove all corrosion, inspection by engineer and site welding of stiffener plates as necessary by boilermaker.	$60,000
3.	Concrete encasement of column bases and painting of all steelwork with a zinc rich epoxy coating	$15,000
4.	Install new steel purlins and girts to replace existing timber members and new structural steel eaves support brackets	$90,000
5.	Install new galvanized steel roof and wall sheeting	$175,000
	TOTAL	$377,500

4.2 Demolition of Structure

As an alternative to repair, we estimate the demolition costs for the structure to be:

1. Removal of cladding and demolition of all structural steel framing only $100,000
2. Break-up slab on ground and foundations, cap all services. $150,000

Appendix A

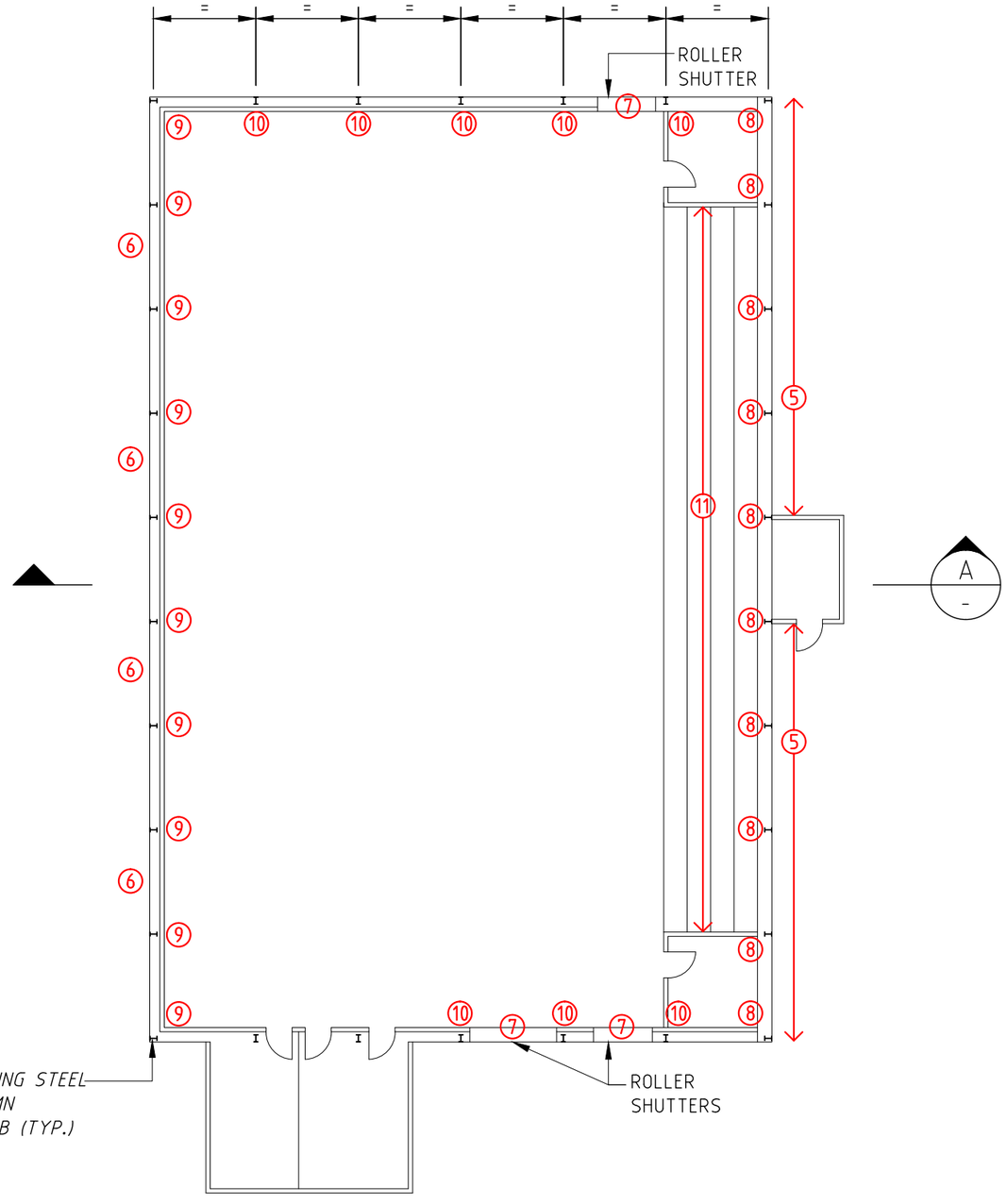
Table of Observed Damage/Defects

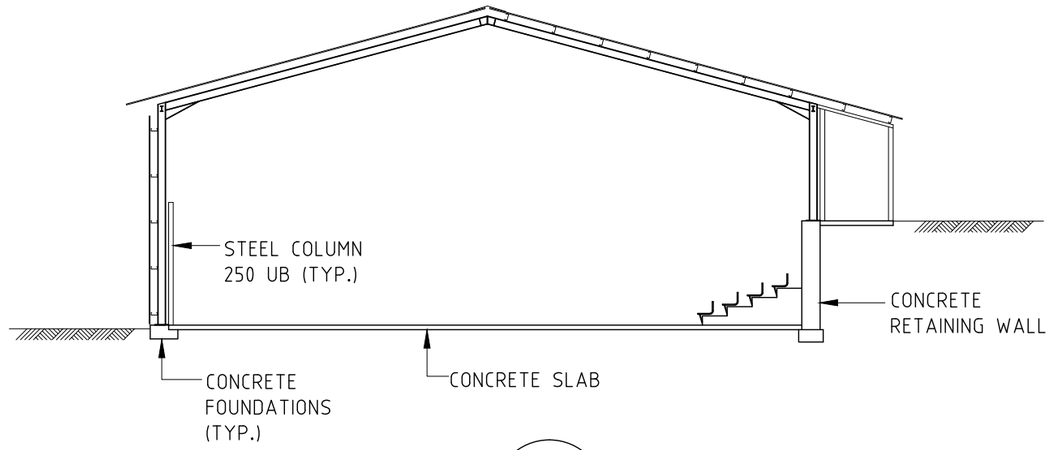
Dwg Ref. (Apdx B)	Observations	Photos (Apdx C)	Risk	Risk Category	Recommendations
Roof Cladding					
S101, item 1	Missing areas of roof sheeting	1, 2	Water ingress into building causing internal damage. Further roof sheeting failure due to failure of screw fixings and/or timber purlins. Accelerated corrosion of internal steelwork exposed to aggressive atmospheric conditions	**Medium**	Schedule all roof and wall sheeting and supporting purlin and girt framing for removal and replacement, refer section 3.2
S101, item 2	Missing sections of eaves cladding and structural support framing	3, 4 Typical	Water ingress into building causing internal damage. Further failure of support framing and localised collapse of eaves sheeting.	**Medium**	Replace missing support framing and sheeting as part of overall sheeting replacement
S101 item 3	Deterioration of roof eaves inclusive of: -Corrosion of structural steel supports -Warping of timber edge board -Corrosion of screw and bolt fixings	5,6 Typical	Water ingress into building causing internal damage. Further failure of support framing and localised collapse of eaves sheeting.	**Medium**	Schedule all eaves support framing for replacement as part of overall re-sheeting of building
S101 item 4	Corrosion at Roof Ventilators	-	Ongoing corrosion resulting in failure	**Low**	Replace ventilators as part of re-sheeting of building
Wall Cladding					
S100, item 5	Corrugated wall sheeting along Western wall does not extend to underside of eaves, allowing weather ingress into building	6	The internal structural steel along the top of the wall is exposed to the aggressive atmospheric conditions and will continue to corrode more rapidly	**Low**	Extend wall sheeting to underside of eaves to prevent weather ingress into building
S100, item 6	Broken window panes at high level in Eastern wall	7 Typical	Collapse of damaged panes resulting in severe injury/death. Weather ingress into building resulting in property damage	**Low**	Replace all window panes with toughened safety glass
S100, item 7	Corrosion of exposed structural steel framing around roller shutter openings	8 Typical	Long term corrosion failure if corrosion allowed to continue to propagate unchecked	**Low**	Abrasive blast clean steelwork to remove all corrosion and repaint with a rust inhibitor. Provide external cladding over steel to prevent exposure to aggressive atmospheric conditions

Exposed Structural Framing					
-	General deterioration of paint finish and corrosion of structural steel portal frames	9,10 Typical	Long term corrosion failure if corrosion allowed to continue to propagate unchecked	**Low**	Schedule all structural steelwork to be abrasive blast clean to remove all corrosion. Re-paint with a zinc rich epoxy primer, refer section 3.1
S100, item 8	Heavy corrosion at base of portal frame columns at Western wall	11,12 Typical	Corrosion failure if corrosion allowed to continue to propagate unchecked	**Medium**	Upon completion of abrasive blast cleaning, site weld additional steel plates as necessary to strengthen reduced steel profile prior to re-painting. Consider additional concrete encasement at column base to prevent ponding water ponding
S100, item 9	Corrosion at base of columns and floor plates along Eastern wall. Corrosion of base of columns at Northern wall	13 Typical	Corrosion failure if corrosion allowed to continue to propagate unchecked	**Medium**	Upon completion of abrasive blast cleaning, site weld additional steel plates as necessary to strengthen reduced steel profile prior to re-painting. Consider additional concrete encasement at column base to prevent ponding water ponding
S100, item 10	Corrosion at base of columns at Northern and Southern walls.	14, 15 Typical	Corrosion failure if corrosion allowed to continue to propagate unchecked	**Medium**	Upon completion of abrasive blast cleaning, site weld additional steel plates as necessary to strengthen reduced steel profile prior to re-painting. Consider additional concrete encasement at column base to prevent ponding water ponding
Miscellaneous					
S100, item 11	Corrosion of plastic seat support framing, damaged and loose seats	16 Typical	Sharp exposed metal edge causing injury. Failure of further seating	**Low**	Remove all corroded seat framing as necessary

Appendix B

Building Plans and Sections





SECTION A -

MAIN STRUCTURE FLOOR PLAN

LEGEND

(1) DENOTES LOCATION OF OBSERVED DAMAGE, REFER TABLE IN APPENDIX A.

No.	Date	Description	Ver.	Appr.

Client: INDIAN OCEAN TERRITORIES ADMINISTRATION

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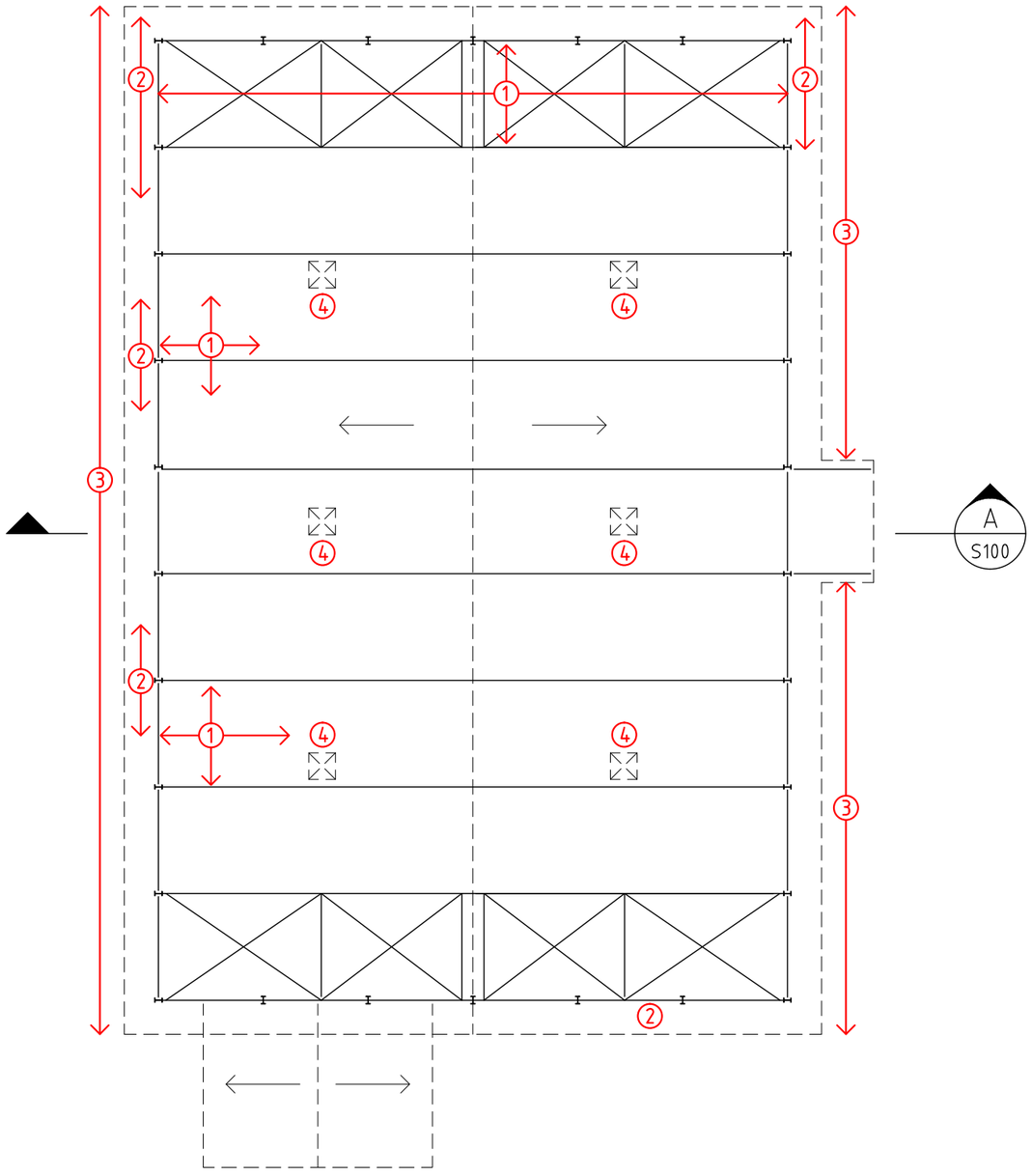
CHRISTMAS ISLAND
SKATE PARK

MAIN STRUCTURE FLOOR LAYOUT

Date	Approved	Verified	Prepared
MARCH 2015			
Scale @ A1: 1:100			
Job number: 15-34	Drawing number: S100		Amendment



MAIN STRUCTURE ROOF LAYOUT

LEGEND

(1) DENOTES LOCATION OF OBSERVED DAMAGE, REFER TABLE IN APPENDIX A.

No.	Date	Description	Ver.	Appr.

Client: INDIAN OCEAN TERRITORIES ADMINISTRATION

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CHRISTMAS ISLAND
SKATE PARK

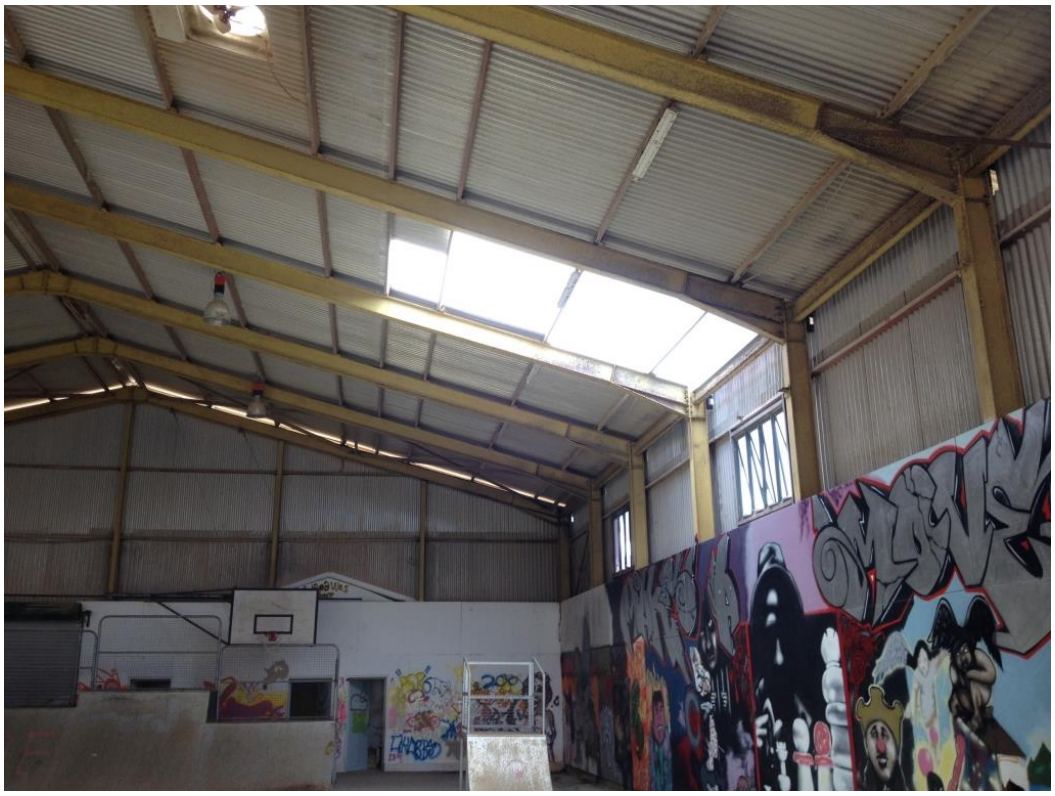
MAIN STRUCTURE
ROOF LAYOUT

Date	Approved	Verified	Prepared
MARCH 2015			
Scale @ A1: 1:100			
Job number: 15-34	Drawing number: S101		Amendment

Appendix C

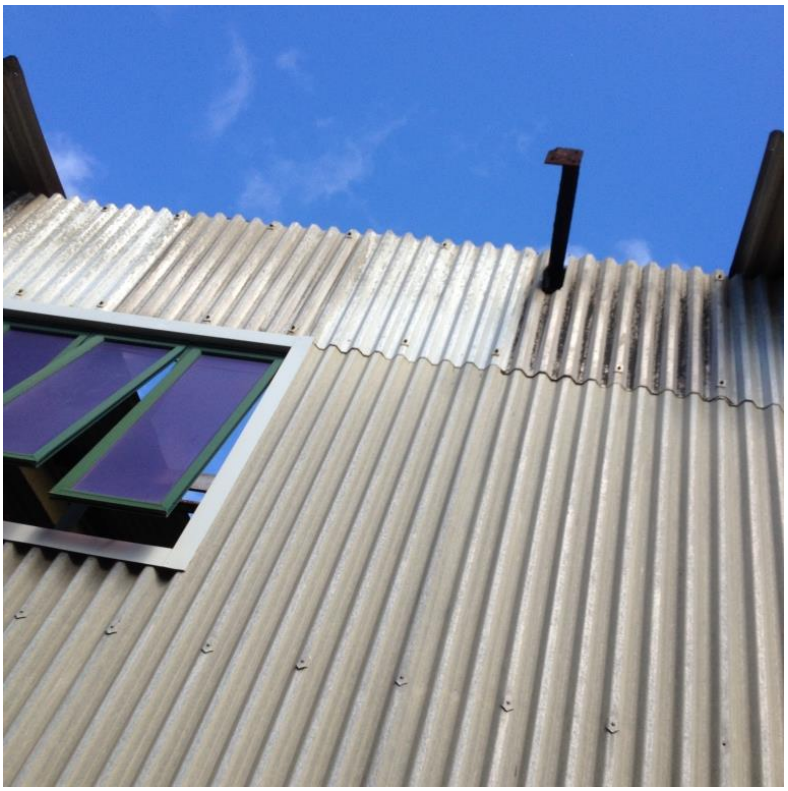
Photographs

Photograph 1: Missing roof sheeting at Northern end bay of building



Photograph 2: Missing roof sheeting near centre of eastern side of roof

Photograph 3: Sections of missing eaves cladding and structure along Eastern wall



Photograph 4: Missing eaves support framing and cladding at Eastern wall

Photograph 5: Typical corrosion of structural steel eaves support framing

Photograph 6: Typical weathering and corrosion at eaves support framing

Photograph 7: Typical broken window panes at high level in Eastern wall

Photograph 8: Typical corrosion of exposed structural steel framing at roller shutter doors

Photograph 9: Typical deterioration of paint finish and corrosion of exposed structural steel framing

Photograph 10: Typical deterioration of paint finish and corrosion of exposed structural steel framing

Photograph 11: Typical corrosion of at base of columns at Western wall

Photograph 12: Typical corrosion of at base of columns at Western wall

Photograph 13: Typical corrosion at base of columns in Eastern wall

Photograph 14: Typical corrosion at base of columns in Northern and Southern walls

Photograph 15: Typical corrosion at base of columns in Northern and Southern walls

Photograph 16: Damage to plastic seats and corrosion of support framing