MOTT MACDONALD

Queen Victoria Building Condition Assessment

23 July 2018

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
1	18/07/18	BGS	AN	AN	For CMP

Document reference: 399302 | 1 | A

Information class: Standard

Contents

1 Introduction

Mott MacDonald has been commissioned by Urbis to carry out a condition assessment of the Queen Victoria Building, Sydney CBD for inclusion in a new CMP being written for the building.

The purpose of this report is to document the current state of the building, noting any areas which may require further attention and regular maintenance.

1.1 Inspection

Structural engineers Alison Naimo and Benjamin Sutton inspected the building on the 4th of July 2018. The weather was clear at the time of inspection, however, there had been some rain in the previous days.

The inspection was visual only and no access was provided to the main dome roof structure, ceilings or floor spaces. The retail areas, basements, service corridors, storage areas, and loading zones were inspected on a spot check basis only.

Fixtures and finishes in retail and publicly accessible spaces meant that structure was generally not visible in these areas. The majority of structure that was able to be inspected was in back of house locations.

No base building plans were available at the time of inspection.

1.2 Limitations of this Report

Given the size of the building and the limited time and access to inspect and report on the structure the following report is not an exhaustive record of the condition of the building. It does however highlight areas and elements of the building that may require closer inspection or that may carry a higher risk of failure or degradation in the future.

1.3 Building Structure

Originally opened in 1898, the 30-metre-wide by 190-metre-long Queen Victoria Building (QVB) has undergone many alterations including major works in 1917, 1935, 1986, and 2009. The most recent works focused on the conservation of facades and internal refurbishment including new escalators and balustrades.

The QVB comprises of four retail storeys, additional levels in the end pavilions, and a basement carpark. The structure is a sandstone façade which fronts concrete floors and a mixture of original brick-masonry and concrete supports. A steel and glass roof structure runs down the middle of the building between twenty copper domes. In the centre of the building is a large dome, twenty metres in diameter.

At the time of inspection, the building was overall in very good condition with some minor cracking, water ingress, and corroded steel connections. The retail areas, where inspection was possible, were well maintained. The majority of defects found during our inspections were located on the roof, fire escapes, and lower ground service corridors. We do note however, that these areas where also the areas where inspection of the structure was not prevented by finishes.

Specific areas of the structure which have been identified as requiring attention are detailed on pages 2 to 4 with relevant photos depicted in the Appendix A-C.

2 Areas of Attention

2.1 Perimeter Flag Poles

Several flag poles are located around the perimeter of the QVB roof between the dome structures. These tall structures are susceptible to wind forces and can undergo large movements. Dues to the transient nature of wind loading, these structures are also subjected to vibration.

The nature and location of flag poles in general make them an element with a relatively high risk profile. The risk of a pole becoming unstable and potentially falling off the building or onto the roof needs to be considered in the maintenance schedule.

Figures 1 through 5 show a number of the flag poles on the western (Figure 1), Northern (Figure 2), and Southern ends (Figures 3-5) of the building. Where possible fixings between the flagpoles and the building substrate were inspected. The following defects were noted:

- The side connection to the flag pole in Figure 1 was found to be loose.
- The flag poles at the southern end looked to have potentially corroded bolts with insufficient threads.

We recommend the following:

- All flag poles to be inspected and checked on a regular basis.
- Where defective fixings are identified they should be rectified as soon as possible.

2.2 Roof Access Structures

A full survey of roof access structures was not carried out during our inspection, however in areas where access was made roof access structures were visually inspected.

Roof access structures on the building comprise of a mix between new and original walkways, stairs and balustrades.

Figures 6-12 show example photos of the access structures found on the building's roof. Figures 7 and 8 show an original railing having broken off from the embedded end. Figure 12 shows an unbolted end to a railing on one of the new lightweight walkways.

Although in the areas accessed during our inspection few defects (not including dimensional code non- compliances) were noted we recommend the following:

- A survey of roof access structures be made and a risk assessment carried out. And where necessary access should be upgraded to meet new codes.
- All fixings be checked during routine maintenance and replaced if necessary.

Note that Mott MacDonald are not aware of any existing maintenance programmes that already exist for the building. It may be that the building owner already has management processes in place to address some of these issues.

2.3 Cracking in Dome Structure Sandstone

Twenty small copper clad domes run the perimeter of the QVB roof. Each roof is supported by original sandstone walls. Typically, the sandstone itself appeared to be in very good condition, however, some typical defects were noted in several of the domes that were accessed during our inspection.

Minor cracking was evident between the joints of the sandstone. Diagonal cracks running from the concrete lintels above the thin windows were common among the small dome structures. Examples photos are shown in Figures 13 to 16.

The crack patterns suggest movement has occurred in the life of the structure, this is not uncommon in buildings of this age and size. The size and pattern of cracking seen does not pose a risk to the structure at this time.

We recommend the following:

- Cracks in the stone walls below the small domes should be documented and monitored to determine whether or not further movement is occurring.
- Repair may be necessary if the stone itself starts cracking or the existing cracks continue to creep or widen.

2.4 Cracking in Structural Masonry and Concrete

Evidence of minor cracking was observed in the building's masonry and concrete walls. Such cracks are shown in Figures 17 to 28, the cause of cracking varies and instances relating to the following were noted during our inspection:

- Redundant fixings in to masonry walls appear to have led to cracks such as those shown in Figures 17 and 20.
- Other cracks appear to be due to minor building movement as the sandstone in Figure 18.
- Several concrete elements suffering spalling and cracking were noted in the roof access area on the west side of the building (just north of the main dome). Refer Figures 21, 24, 25, and 28.

We recommend the following:

- As with the sandstone cracking in Section 2.3, cracks throughout the building should be documented and monitored to determine if further movement is occurring. Cracks continuing to grow should be assessed and repaired if necessary.
- The crack in the column in the roof access area on the west side of the building, just north of the main dome (Figure 24) should be assessed by a structural engineer
- Spalling concrete elements in this area (including figure 25) should be repaired and the area should be assessed for leaks which may be causing damage to structure.

2.5 Water Ingress from Roof

Evidence of water entering through the roof was discovered around the upper levels of the building. Figures 29-42 show examples of such water ingress.

Figure 33 shows ponding in a section of flat roof on the Southern end of the building. It is likely this has led to the damp walls shown in Figures 32 and 34 which lie directly below the roof.

We recommend the following:

- If left unchecked leaks can lead to damp, corrosion, and spalling. Regular building maintenance should be carried out to prevent leaking.
- Checking the drainage in the area of the flat roof at the southern end of the building for leaks (Figure 33).

2.6 Water Ingress Sub-Ground

Evidence of water entering through the rock in basement areas was noted. Water can easily move through porous rock such as sandstone. Any contact with the ground without seamless waterproofing can cause leaking. Areas where sub-ground leaking is occurring is shown in Figures 43-46.

Depending on the use of the area a level of water ingress may not be problematic. However, where water ingress is at risk of causing damage to the building structure it needs to be managed.

We recommend:

- A survey of basement areas be carried out by building maintenance to identify areas of water ingress and areas where such ingress poses a risk to structure (damp, corrosion etc)

2.7 Awnings at Ground Level

Large awnings cover the footpaths around the outer perimeter of the building (Figures 47-48). Due to the nature and location of awning structures they have in the past tended to be items of increased risk on buildings. This is largely since awning structures are often not visible and are difficult to access for maintenance. Although no defects were noted during our inspection we would recommend the following:

- Inspection of awning structures and fixings to building be inspected as part of a regular maintenance schedule

2.8 Sandstone Façade

Between 2006 and 2009, the sandstone façade of the QVB underwent restoration. Typically, visible sandstone was in very good condition at the time of inspection. No major deterioration or cracking was visible.

Due to the significance of the stone facade, we suggest monitoring the sandstone every 5 years.

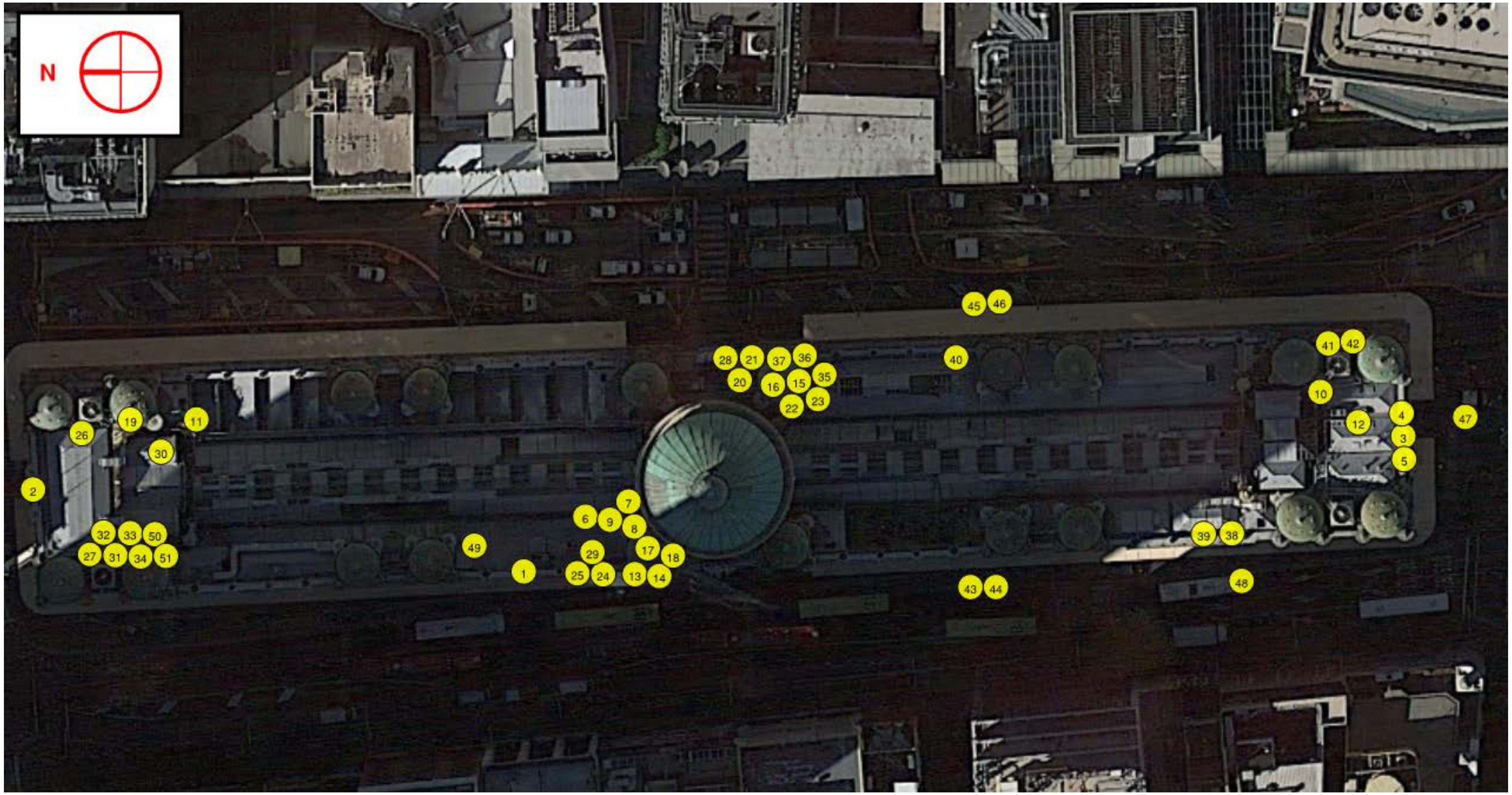
2.9 Additional recommended guidelines for inclusion in CMP

Due to the age, history, and significance of the building any changes to the building structure, including changes to loading should be assessed by a structural engineer familiar with buildings of this type.

Appendix A: Photo Schedule

No.	***Photo Reference***	***Location***	***Description***
1	Figures 1 -5	Roof Perimeter	Flag Poles
2	Figures 6-12	Roof	Roof Access Structures including walkways and balustrades
3	Figures 13-16	Roof Dome Structures	Cracking in Sandstone
4	Figures 17-28	Structural Walls	Cracking in Masonry and Concrete
6	Figures 29-42	Various Locations Around Upper Levels	Water Ingress from Roof
7	Figures 43-45	Various Sub-Ground Levels	Water Ingress Sub-Ground
8	Figures 47-48	Ground Level External Perimeter	Awnings
9	Figures 47-49	Building Façade	Sandstone
10	Figures 50-51	Various locations	Other Maintenance

Appendix B: Photo Reference Plan



Appendix C: Photos

Figure 1: Typical Connection for East and West Flag Poles

Source: Mott MacDonald 2018

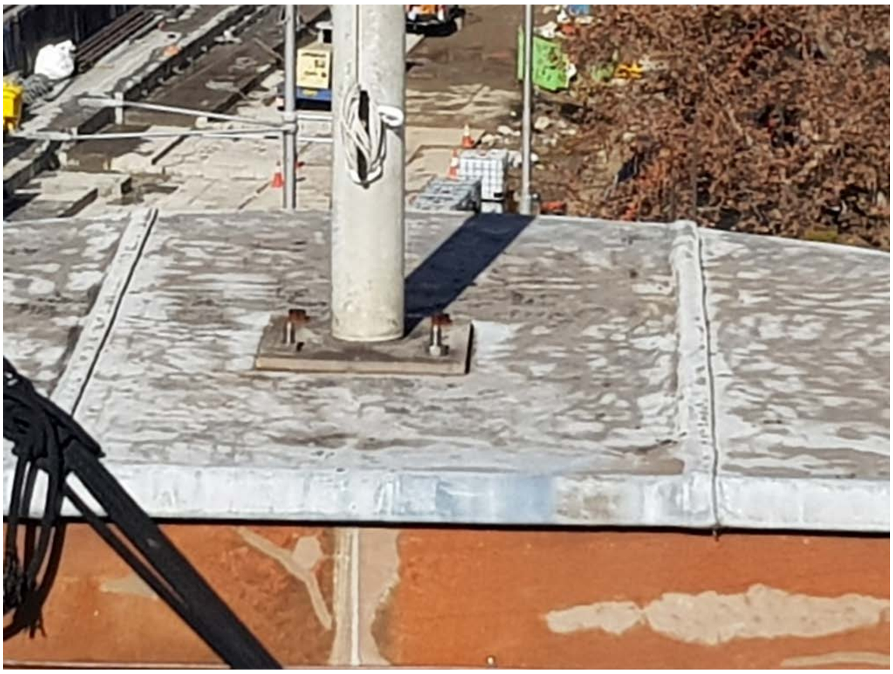
Figure 2: Flag Poles North End

Source: Mott MacDonald 2018

Figure 3: Flag Poles South End

Source: Mott MacDonald 2018

Figure 4: Corroded Flag Pole Connections South End



Source: Mott MacDonald 2018

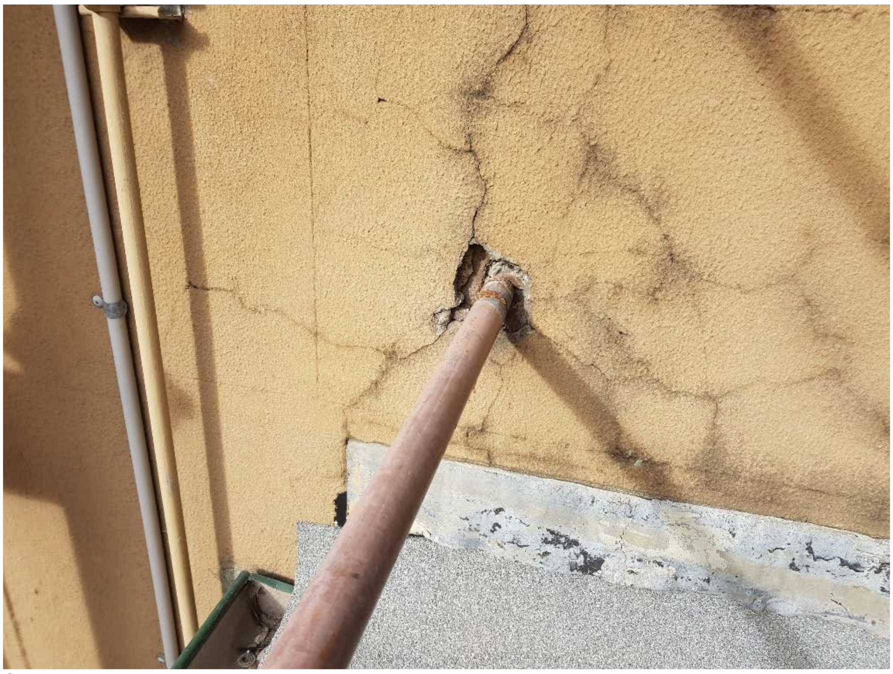
Figure 5: Corroded Flag Pole Connections South End

Source: Mott MacDonald 2018

Figure 6: Balustrade North West

Source: Mott MacDonald 2018

Figure 7: North West Balustrade Closest to Central Dome Fixing



Source: Mott MacDonald 2018

Figure 8: Original Railing Broken Off from Wall

Source: Mott MacDonald 2018

Figure 9: Cracking Around Embedded Railing

Source: Mott MacDonald 2018

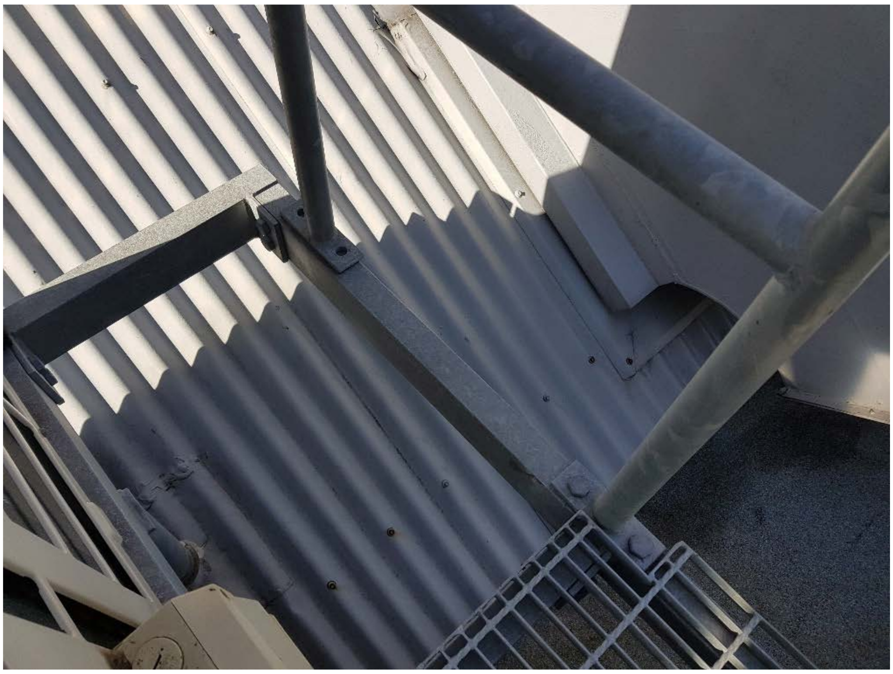
Figure 10: Corroded Connection of Access Structure South End

Source: Mott MacDonald 2018

Figure 11: Typical New Access Walkways

Source: Mott MacDonald 2018

Figure 12: Missing Bolts on Balustrade South End



Source: Mott MacDonald 2018

Figure 13: Diagonal Cracking Through Bed Joints Above Windows

Source: Mott MacDonald 2018

Figure 14: Diagonal Cracking Through Bed Joints Above Windows

Source: Mott MacDonald 2018

Figure 15: Diagonal Cracking Through Bed Joints Above Windows

Source: Mott MacDonald 2018

Figure 16: Diagonal Cracking Through Bed Joints Above Windows

Source: Mott MacDonald 2018

Figure 17: Cracking Around Old Embedded Fixings

Source: Mott MacDonald 2018

Figure 18: Vertical Cracking at Sandstone Brick Interface

Source: Mott MacDonald 2018

Figure 19: Cracking in Northern Fire Escape Walls

Source: Mott MacDonald 2018

Figure 20: Cracking Around Railing Fixings

Source: Mott MacDonald 2018

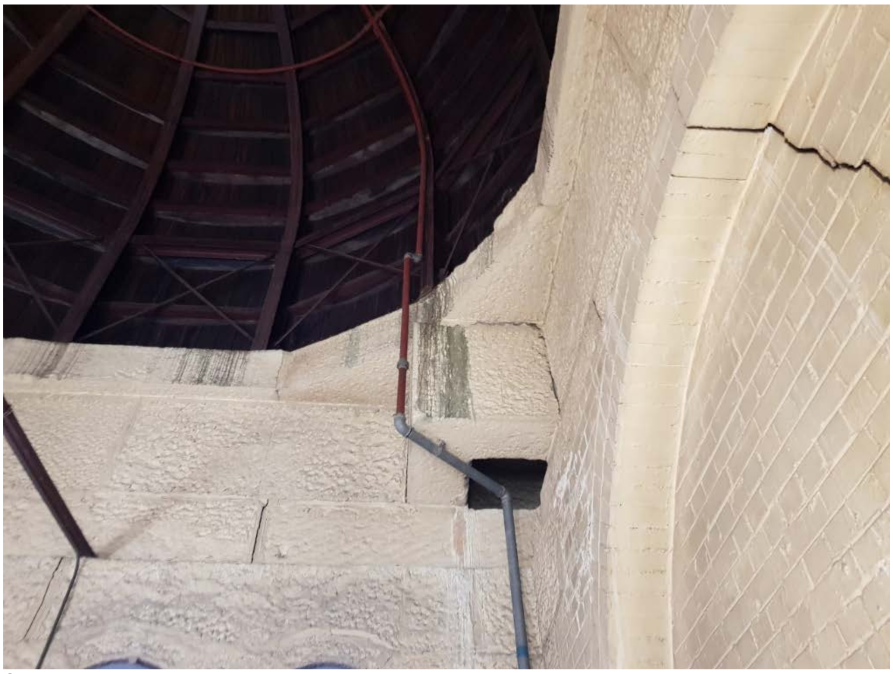
Figure 21: Vertical Cracking in Masonry

Source: Mott MacDonald 2018

Figure 22: Vertical Cracking in Masonry

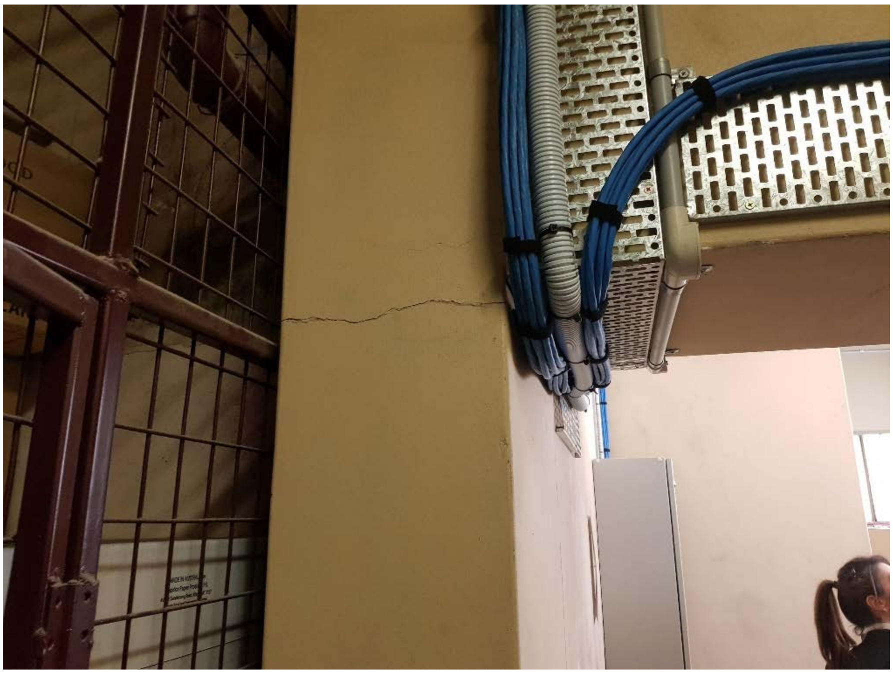
Source: Mott MacDonald 2018

Figure 23: Vertical Cracking in Dome Masonry



Source: Mott MacDonald 2018

Figure 24: Horizontal Crack in Column



Source: Mott MacDonald 2018

Figure 25: Cracking in Lintel

Source: Mott MacDonald 2018

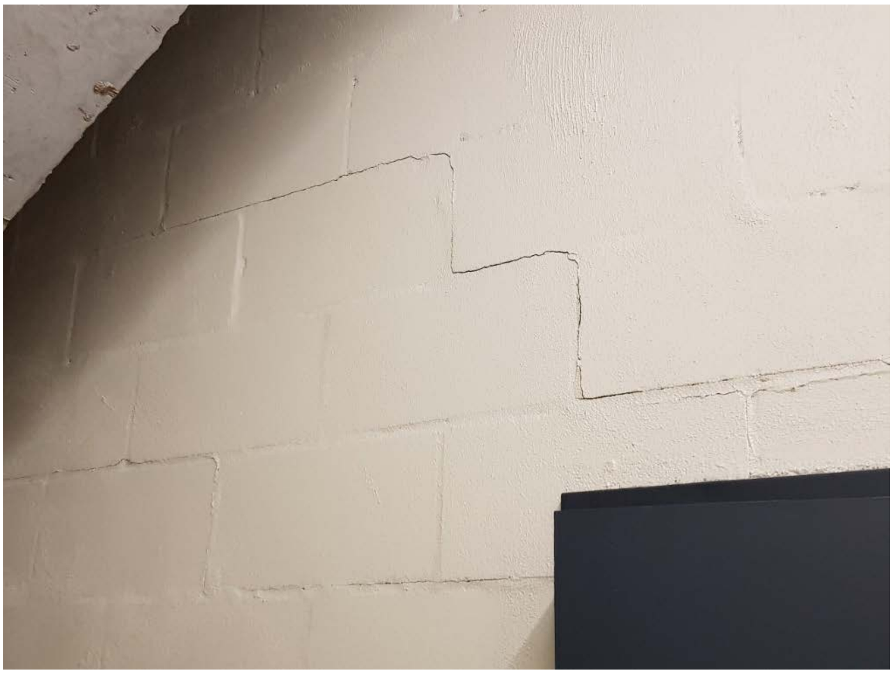
Figure 26: Diagonal Cracking in Tea Room Lintel

Source: Mott MacDonald 2018

Figure 27: Fire Escape Cracking

Source: Mott MacDonald 2018

Figure 28: Diagonal Cracking Above Fire Escape Door Opening



Source: Mott MacDonald 2018

Figure 29: Spalling Concrete

Source: Mott MacDonald 2018

Figure 30: Signs of Water Ingress On Tea Room Extrance Roof

Source: Mott MacDonald 2018

Figure 31: Damp Walls in Fire Escape

Source: Mott MacDonald 2018

Figure 32: Damp Fire Escape Walls Under North West Flat Roof

Source: Mott MacDonald 2018

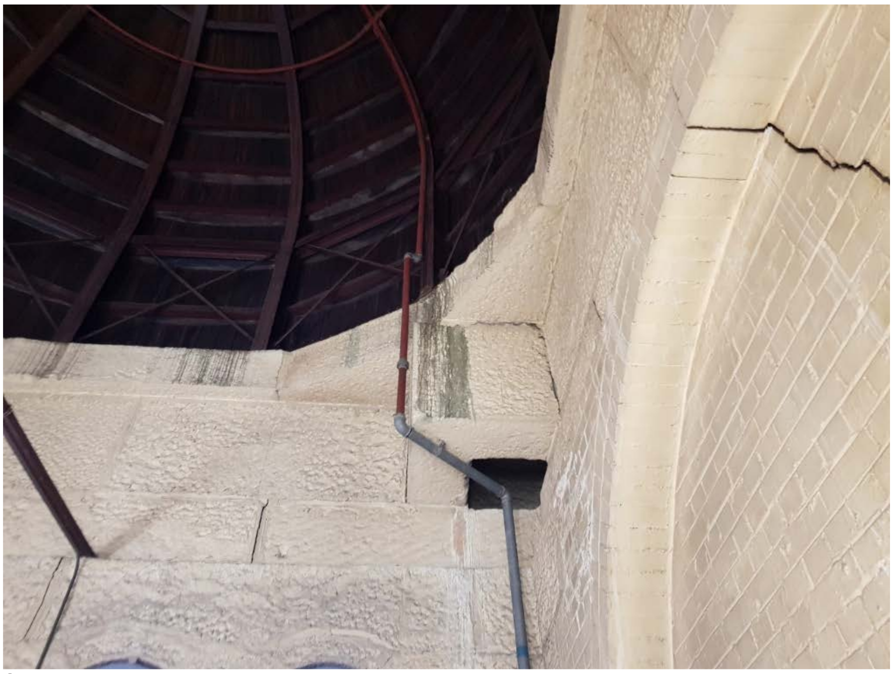
Figure 33: Ponding Water on North East Flat Roof

Source: Mott MacDonald 2018

Figure 34: Damp Fire Escape Walls Under North West Flat Roof

Source: Mott MacDonald 2018

Figure 35: Water Staining From Dome Roof



Source: Mott MacDonald 2018

Figure 36: Water Staining From Dome Roof

Source: Mott MacDonald 2018

Figure 37: Water Staining From Dome Roof

Source: Mott MacDonald 2018

Figure 38: Signs of Water Ingress From The Victoria Room Roof

Source: Mott MacDonald 2018

Figure 39: Signs of Water Ingress From The Victoria Room Roof

Source: Mott MacDonald 2018

Figure 40: South East Meeting Room Water Staining

Source: Mott MacDonald 2018

Figure 41: South Fire Escape Damp and Spalling Concrete

Source: Mott MacDonald 2018

Figure 42: South Fire Escape Damp and Spalling Concrete

Source: Mott MacDonald 2018

Figure 43: Water Staining Around Lower Ground Gutter in Service Corridor

Source: Mott MacDonald 2018

Figure 44: Ponding Water in Lower Ground Service Corridor

Source: Mott MacDonald 2018

Figure 45: Damp Wall in Lower Ground Fire Escape

Source: Mott MacDonald 2018

Figure 46: Signs of Water Ingress in Lower Ground Fire Escape

Source: Mott MacDonald 2018

Figure 47: South Facade

Source: Mott MacDonald 2018

Figure 48: West Façade

Source: Mott MacDonald 2018

Figure 49: Western Sandstone Dome

Source: Mott MacDonald 2018

Figure 50: Bowing Gutter Above North West Flat Roof

Source: Mott MacDonald 2018

Figure 51: Broken Fixing on Gutter Above North West Flat Roof

Source: Mott MacDonald 2018

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