BUILDING ASSESSMENT AND DEVELOPMENT OF REMEDIAL STRATEGIES FOR SOUTH MELBOURNE TOWN HALL

Prepared for City of Port Phillip

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INFRACORR CONSULTING PTY LTD
p: 1300 805 089
e: info@infracorr.com
www.infracorr.com
20 Business Park Dve
Notting Hill, Victoria
Australia, 3168
MELBOURNE | SYDNEY | MACKAY
ABN 61 107 906 678

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Author(s):	Nathan Way Materials Technologist Bradley Little Principal Engineer (ASSE)	Signature: Date:	NW, BL 07/05/2020
Reviewer(s):	Andrew Czerwinski Senior Engineer	Signature: Date:	AC 07/05/2020
Approver(s):	Andrew Czerwinski Senior Engineer	Signature: Date:	AC 07/05/2020

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EXECUTIVE SUMMARY

Infracorr carried out an investigation of the South Melbourne Town Hall between 16 and 26 March 2020. The inspection included accessible critical elements including brickwork, timber roof framing and structural concrete elements as well as decorative concrete external features at risk of spalling.

This report provides City of Port Phillip with a general building condition report for the South Melbourne Town Hall, including major issues identified during the investigation that pose a risk to the short-term structural integrity or long-term durability of the structure. The report includes general recommendations for remediation strategies and for further investigation where required and outlines indicative budget estimates to address the major issues that have been identified.

The major areas of deterioration and structural concern identified in the report, and their proposed remedial actions can be summarised as follows:

- The roof structure within the main hall and south wing of the Town Hall were found to have a number of issues which have reduced the capacity of the trusses to support the roof loads and provide stability to the walls. Access to the roof structure of the east and west wings could not be performed as they could not be accessed safely. Based on the condition of the inspected area, it is believed that the roof structure in inaccessible areas are in a similar condition. The recommended remedial works should address the following issues throughout all areas of the Town Hall roof structure:

    a) Anchorage between the timber trusses and the brick walls should be undertaken on all trusses including remediation of all bearing plates.

    b) Strengthening of timber trusses and straining beams using bolted steel frames, similar to that previously performed to selected trusses, should be undertaken on all the trusses.

    c) Review connections between framing and trusses, including underpurlins and rafters and rafters and battens. These should be adequately tied down to the roof trusses and assess the adequacy of packers noted throughout the roof structure.

    d) Connections of joists to trusses, particularly where joists have been notched or spacers implemented, should be reviewed for structural adequacy and strengthened wherever compromised.

    It is anticipated that the above repairs would be largely performed by lifting existing roofing (colourbond sheeting or slate) to gain access to the repair areas. The access throughout the roof, particularly the wing buildings, is not adequate and should be upgraded to enable safe access for maintenance and inspection. This should coincide with the above repair works. Access upgrades could be achieved using aluminium or timber gantries incorporating

handrails. This is generally preferable to the use of static lines as currently in place above the Main Hall.

- *As part of the present investigation, the support of the roof trusses in room F2 (south wing) were found to have deteriorated to the point that possible collapse of the roof was a considerable risk. Emergency propping works were undertaken during the investigation by a contractor engaged by the council to mitigate the risk as a temporary measure. Details of these works can be found in an Inspection Report issued on the 9th April 2020 (Appendix D).*

- The main hall backstage area has subsided with cracking of brickwork walls and rising damp present throughout the rooms on the ground level. Deterioration has resulted in mould growth, paint and render damage throughout the area. Cracking may have resulted from suspended floor beam deflection or the result of moisture ingress causing rot and footing settlement. Survey of the subfloor structure and investigation of a suspected water leak from services noted in the area, should be conducted. Based on the outcomes of this investigation, it is expected that installation of subfloor ventilation will address the rising damp deterioration.

- The external council building deck was found to be in poor condition with concrete spalling and reinforcement section loss on the soffit. Associated cracking, damp and efflorescence deterioration was observed within the main hall at column 5 west (W5). This landing is likely in similar poor condition to the external stairs (see below). It is recommended that the following remediation be undertaken in conjunction with remediation of the stairs:

    a) Concrete patch repair remediation to the walkway soffit.

    b) Removal and reinstatement of the waterproofing membrane across the landing, including at the air conditioner bund area located on the landing.

- The external stair access condition was assessed by Infracorr in 2018 (refer report CPPMT-REP1) and identified widespread deterioration. The report outlined recommendations for remediation including significant concrete repairs, protective coating application and repairs to steelwork.

A general discussion of the main deterioration concerns are included in Section 11. In addition to the above, general defects and issues including waterproofing failures, compliance and safety concerns, damp rising, render cracking and reinforcement corrosion are detailed throughout Sections 3 to 10 of the report. Recommendations to further investigate or remediate areas of concern have been organised into a Remedial Strategy in Section 12. Many of the lower priority concerns are considered to be best addressed through regular maintenance by a property maintenance contractor rather than individual scoped items. Preliminary budgets estimates have been provided to address the high priority issues identified by the investigation.

1 INTRODUCTION

1.1 General

Infracorr Consulting Pty Ltd (Infracorr) were engaged by the City of Port Phillip (CPP) to carry out an inspection of the South Melbourne Town Hall in order to document the overall general building condition and provide recommendations for appropriate remedial measures to ensure the ongoing serviceability of the building. ASSE Consultants Pty Ltd (ASSE) were engaged by Infracorr to provide structural assessment and advice as part of the inspection scope.

1.2 Background

The South Melbourne Town Hall is an iconic structure of state heritage significance situated on Bank Street, South Melbourne, within the City of Port Phillip (CPP). The Town Hall was built between 1879-80 and has been occupied by various state and federal administrative bodies since that time. In 2004, major renovation works reinstated the decorative roof and iron crest and restored the original external colourings. The Town Hall has a long-standing commercial tenant, The Australian National Academy of Music (ANAM), who use the facilities for performances, rehearsals and teaching facilities. The ANAM facilities are concentrated on the East Side of the Town Hall with City of Port Phillip occupying predominantly the West Side.

In 2018 a section of ceiling on a first-floor hall and adjacent rooms facing Bank Street collapsed due to what is understood to have been leaking fire services piping. A series of structural assessments have subsequently been performed on the timber truss roof structure in this area. A structural report supplied by CPP outlines deterioration identified in the roof structure in the South Wing areas, as well as proposed strengthening to trusses where substantial decay has occurred. The report also recommended that ceiling battens and ceiling joists be re-installed or reinforced with metal straps. The Ultum survey conducted in 2015 identified deterioration of the concrete lift shaft and deterioration to the upper level brick walls. Remedial works have since been performed by others, including construction of a new lift shaft. The extent of remediation was not known at the time of investigation.

CPP is currently remediating areas of the South and West Wings in conjunction with the ceiling collapse from 2018. It is understood that CPP is developing a remediation strategy for management of the Town Hall into the future.

1.3 Aims

Infracorr's scope of investigation addresses the following CPP aims:

- Undertake an audit of the overall condition of the structure;
- Identify any major issues that pose a risk to the short-term structural integrity or long-term durability of the Town Hall; and
- Develop potential remedial strategies that can be employed to ensure the long-term durability of the Town Hall and provide preliminary budget estimates for these options.

2 SCOPE OF INVESTIGATION

2.1 Overview

To achieve the project aims, Infracorr's scope of investigation included inspection of accessible critical elements including brickwork, timber roof framing and structural concrete elements as well as decorative concrete external features at risk of spalling. The inspection provided a general, overall understanding of the condition of Town Hall and included development of remediation strategies and identification of issues for which further investigation is required.

Infracorr conducted a review of previous structural reports provided by CPP prior to the investigation in order to understand the current condition of the structure and remedial actions taken to date. Defects identified within the reports have been summarised and tabulated in Appendix B.

2.2 Restrictions

Assessment of the structure was limited to areas that could be accessed and inspected over four days and was limited to visual inspection and non-destructive sounding and delamination testing. The inspection did not include destructive removal of render or other coverings to inspect the condition of internal construction materials, however commentary has been provided where this was visible within defects. Certain areas of the Town Hall could not be accessed safely or were inaccessible due to security (i.e. locked rooms). Due to the extensive area of the survey, all efforts were made to identify defects requiring urgent attention and detailed analysis of defects was not performed. Further investigation has been recommended in some instances to determine appropriate remedial actions required. Within the available time every effort was made to identify defects that needed to be documented for further investigation and where possible preliminary advice provided.

As it is not possible to inspect the foundations, the review of the foundations was limited to movement in the walls that would have been the result of foundation movement. Walls were inspected internally and externally wherever possible.

Access under the floor at the time of the inspection was generally not possible. The inspection was therefore limited to walking over the extent of the floor to locate any areas of floor are springy under foot. A springy floor would indicate that there has been a loss of support of the joist and/or bearers.

As noted above, inspection work was carried out for areas where safe access is available. Some of the roof areas were not inspected as there was no safe access to these areas. However, a reasonable assumption of the condition of these areas can be made based on the condition of areas where there was access.

Damage noted in the masonry may have only appeared slight at the time of the inspection, however there may be some history to the damage which have previously been repaired and rendered over.

Therefore, cracks may be a manifestation of a long-term problem and should continue to be monitored and if the crack width increases, professional advice engaged.

The buildings have not been investigated for termite damage as this is outside our area of expertise. Consideration should be given to having the building investigated for termites. Moisture allowed to perpetuate in subfloor areas can provide the preferred environment for termites.

2.3 Site Plan Arrangement

Due to the size the complexity of the South Melbourne Town Hall, the findings and recommendations of the investigation have been divided into eight regions outlined in Figure 1 below.

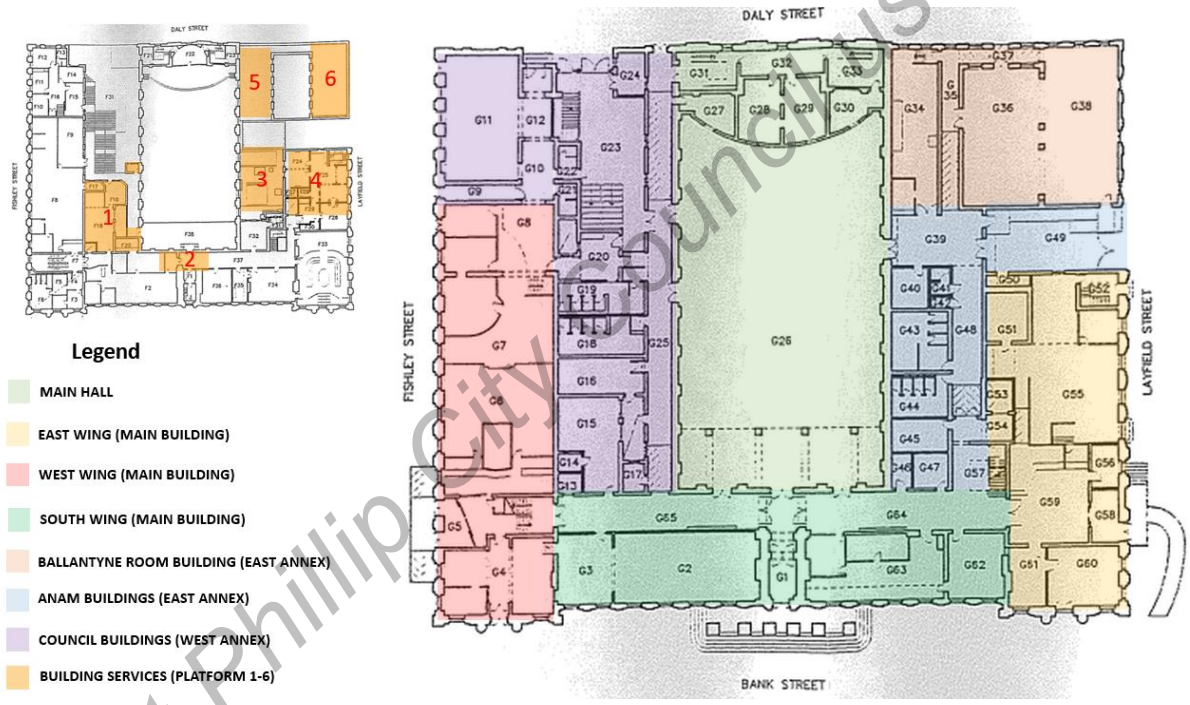

Figure 1 - South Melbourne Town Hall site plan arrangement (All arrangements are further elaborated upon in the respective report sections below).

3 MAIN HALL

3.1 Plan Arrangement

The plan arrangement for the Main Hall is provided in Figure 2. This plan has been developed to reference columns of the structure, associated roof trusses and connections.

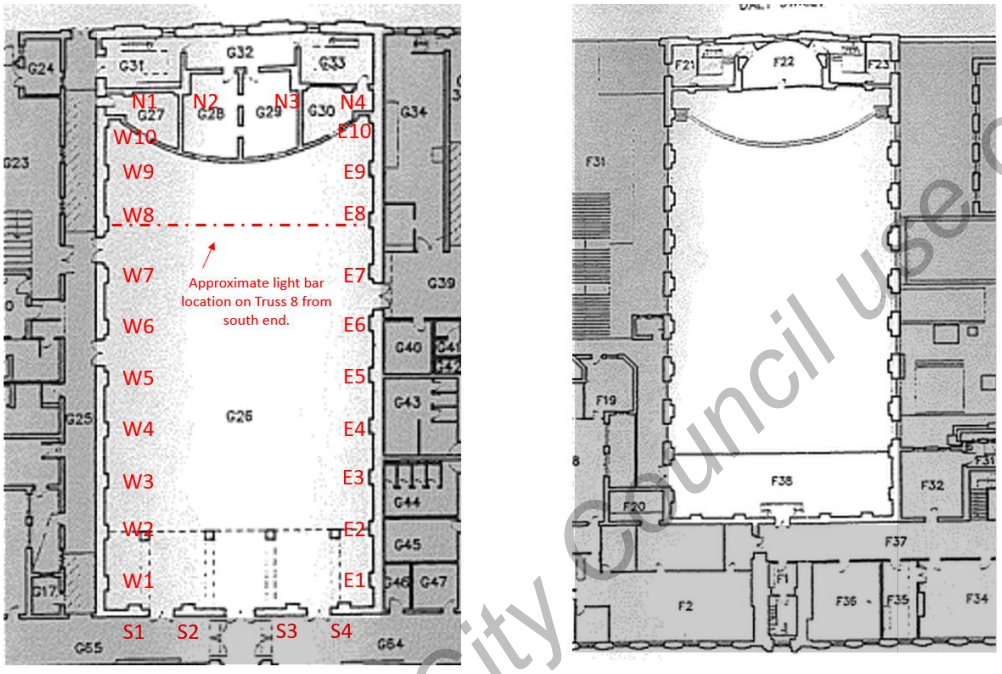

Figure 2 - Main Hall plan arrangement (Ground floor – left; First floor – right).

3.2 Foundations

No movement was observed in walls to indicate that there is an issue with the foundations of the building.

3.3 Floors

3.3.1 Main Hall

Refer to photograph MH-G26-F-9001.

The flooring of the Main Hall (G26) was visually inspected from above and found to be in sound overall condition throughout the hall. No substantial movement was identified except for a section of floor located adjacent to the access stairs to the stage outlined in Figure 3.

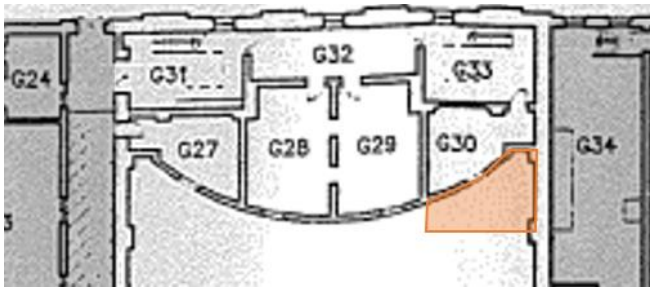

Figure 3 – Highlighted area of floor plan with subfloor deterioration.

Inspection of this area found the floor to be springy and to shift when loaded. Refer to the discussion on the dampness in rooms G27 to G33 in Section under the heading of "Walls" (Section 3.4.4).

3.3.2 Stage

Walking across the stage and room F22 no movement was observed that raised concern.

3.3.3 Rooms G27 to G33

Walking across the floors to these rooms indicated that there is some spring in the floors of rooms G28 and G29. Refer to comments under "Walls" regarding damp in this area (Section 3.4.4). There is moisture and a dank smell in this area. With the dampness under the floor there may be some rot in the timber. This requires further investigation.

3.3.4 Rooms F21 and F23

There is a sag in the floor under the wall between the rooms and the stairway. It does not appear to be causing an issue for the floors but has led to some cracking in the walls. Refer to the discussion under the heading of "Walls"(Section 3.4.4).

3.4 Walls

3.4.1 Overview

Several defective regions were observed during the investigation as follows:

a) Cracking and associated water damage observed on the West side of the hall at columns W3, W4 and most notably W5 (refer photo MH-G26-W-002). Columns along the elevated external walkway were found to have various levels of cracking and water damage, the deterioration was observed to be associated with
   - Cracking and damage around the ornamental façade window lintel; and
   - Ingress of moisture through the council building deck air conditioner bund area. This bund area is discussed further in Section 3.4.2, 9.5.1 and 10.2.1.

b) Cracking with associated water damage was observed on walls throughout the backstage area of the hall (refer photos MH-G31-W-001; MH-F23-C-001; MH-G31-F-001; MH-F23-W-001).

Inspection of the back-stage rooms found that the suspended slab between the ground floor and first floor has subsided with cracking reflecting through the brickwork walls. The external wall remains plumb however the stage appears to have subsided, this is likely due movement of the building over time. This movement has resulted in numerous areas of water ingress and damage. This is evident in the form of mould growth in G30 and paint and render damage throughout the area.

Access to the area was limited as it is presently being used for storage. The presence of asbestos within the water damaged ceiling and mould growth prevented excavation to determine the extent of deterioration. Safety implications are further discussed in Section 3.6.

A systematic discussion of the walls throughout the entire Main Hall area follows.

3.4.2 Main Hall

Refer to photos MH-G26-C-001; MH-G26-W-9001 to 9003.

Generally inspecting the hall wall from inside at floor level there was no cracking that raised concern with the structure. At pier west 5 there was some cracking, damp and efflorescence at approximately mid height. After inspecting the external concrete deck adjacent to this location, it was found the damage was most likely due to inadequate waterproofing in this location. Refer to the comments on the Council Building Deck.(Section 3.4.1, 9.5.1 and 10.2.1).

3.4.3 External

Refer to photos MH-G26-W-9101 to 9224

Both the east and west walls have diagonal cracks at both the north and south ends. The cracks extend from the north and south walls at mid height diagonally up towards the parapets. Refer to the general discussion on brick growth in Section 11.1.

3.4.4 Rooms G27 to G33

Refer to photos MH-G28-W-9001 to 9004

In this area of the building there is a distinct dank, musty smell indicating moisture. Much of the lower section of the walls has rising damp. Finding damp in this area appears to be quite unusual. The building is on top of a small hill and therefore unlikely to have a water table close to ground level. The stormwater all discharges outside the building. The remaining sources of water are sewers and water supplies. This should be inspected to determine the source of water. In room G31 there is a water meter. It is possible that there is a leak near the meter. The floors in this area are a little springy. It is possible that there is some rot in the subfloor structure. Noted under the section “rooms F21 and F23” it has been suggested that the cracking in the walls of rooms F21 and F23 was due to the floor beam deflecting. However, it is also possible that the damp under the floor in this area has led to some footing settlement. This should also be investigated.

The wet rooms for the ANAM Building are located between the hall and the East Wing. It is possible that the water supply runs under the north/east corner of the Main Hall and is leaking under the floor in this area leading to the springy floor as noted under “Floors” above (Section 3.3.3).

3.4.5 Walls between rooms F21 and F23 and the stair

Refer to photos MH-F21/F23-W-9001 to 9007

There is some diagonal cracking in this wall, leading diagonally up from the north external wall indicating to us that there had been a loss of support of the wall at mid span. Measurement across the floor indicated that there is approximately 30 mm fall on the west side and 20mm fall on the east side from the north wall to the mid-span of the floor. As suggested in the comments on Rooms G23 to G33 there may be some settlement due to the presence of water under the floor.

3.4.6 Parapets East and West Side

Refer to photos MH-G26-W-9201 to 9204 and 9221 to 9222.

A string line was pulled along the inside face of the east parapet and the bow in the wall measured as 60 mm toward the west i.e. into the building rather than out from the building, which would be more common. There is also a bow in the west parapet which by eye is of similar magnitude. The bow however could not be measured as there was no safe access available. What has caused the bowing of the parapets is unclear and further investigation is required. The bowing of the wall is possibly due to brick growth. See discussion on brick growth in Section 11.1.

3.4.7 Gable ends North and South

Refer to photograph MW-G26-W-9403.

The north gable shown in the photograph appears to be tied into the roof structure by the ends of the under purlins only. Refer to the discussion regarding the condition of the timber built into the brickwork under the heading “Roof Structure”. The stability of the north gable is provided by the ties between the underpurlins and the brickwork. If the timber has rotted and the ties, if any, corroded away the parapet is effectively unrestrained against wind and seismic loads as specified in AS1170.

The southern gable is of similar construct, but the clear wall height is considerably less due to the connection to the South Wing and therefore the loads on the connections between the under purlins and the gable will be reduced.

The lateral support of both gable walls should be investigated.

3.5 Roof Structure

3.5.1 Overview

The roof structure of the Main Hall and wings have been investigated by a number of consultancies over the last 10 years with various findings reported. As the extent of previously identified deterioration and associated remediation actions are not fully known, Infracorr has assumed that all defects identified in the present inspection of the roof system are cause for consideration.

The ceiling within the Main Hall appears to be in good condition given the age of the structure with some isolated areas of decorative cornice damage. Evidence of water staining and associated cracking can be observed along the west side of the structure. This deterioration is associated with the rotting of trusses and is addressed under truss remediation. Notably staining and cracking appears to be most severe in the north west corner.

3.5.2 Main Trusses

Refer to photos MH-G26-R9202, MH-G26-R-014 to 045 and the general arrangement drawings provided in Section 11.4.

The main roof trusses span approximately 18 m from the east to west walls of the hall and are located at approximately 3.5 m centres. The physical inspection of the roof trusses was limited to that which could be safely accessed off the walkway while tethered to the static line. The following comments are therefore based on what could be seen from the walkway and from reviewing the photos while writing the report.

With all trusses the connection of primary concern is where the diagonal meets the bottom chord as this is the most highly stressed connection and most susceptible to water damage from leaking gutters. Refer to the report of the trusses in the South Wing where it was possible to access this connection.

From the photos it can be seen that there has been some water damage at the ends of the trusses where the bottom chord is built into the wall. Either the bearing plate has rotted, or the end of the bottom chord has rotted, or most likely a combination of the two. This has meant that the bottom chord has dropped away from the underside of the rafter bearing plate. For more discussion on the impact of rot at the end of the bottom chord refer to Section 11.4.

During inspection of the trusses for rot, longitudinal cracking within the straining beams and bottom chords was noted on several trusses within the main roof. (Refer photos MH-G26-R-017 to (E1) MH-G26-R-019 (E1); MH-G26-R-020 (W1); MH-G26-R-009 (W6); MH-G26-R-010; MH-G26-R-011 (W8); MH-G26-R-015 (E4)).This cracking may impact the performance of roof elements and should be investigated in conjunction with review of other roof element deterioration.

3.5.3 Rafters

Refer to photos MH-G26-R-9402

The roof sheeting on the roof appears to have been replaced with Colorbond roof sheeting. Colorbond roof sheeting has been available since 1966, and therefore it is assumed that the sheeting has been replaced within the last 50 years. From within the ceiling void it can be seen that the rafters were straightened by packing between the rafters and the under purlins. The packing consists of a variety of different thickness timber packers combined to provide the required packing thickness. From the safe access way, it was impossible to confirm how the rafters are tied to the underpurlin. It is expected that the rafters are tie down with some metal strapping nailed to both the rafters and the underpurlin. From the photos no such tie down can be observed. From the photos the rafters are at approximately 450mm centres and the roofing battens at closer centres, possibly 300ctrs. This is consistent with the roofing being slate or tiles when the building was constructed. If this is the cast when the roof was constructed, tie down of the rafters and underpurlins would not have been a concern due to the weight of the roof.

The tie down between the rafters and the underpurlins should be investigated.

3.5.4 Underpurlins

Refer to photos MH-G26-R-9401 to 9405

At the northern end of the hall the underpurlins, halfway between the top of the queen post and the eave are supported on the gable wall, a brick wall between room G26 and rooms F21 to F23, and the last of the roof trusses. It would appear that the last truss has dropped by approximately 40mm and the underpurlin has come free from the truss and appears to be supported by the gable wall and the internal wall only. This causes a problem, as the restraint of the gable wall relies on the wall being tied into the roof structure through the underpurlin built into the gable wall. Due to access restriction it was not possible to visually inspect this connection, but the photos clearly show the underpurlin raised above the diagonal chord of the truss. As noted above with the roof rafters it is most likely that when the building was constructed it had a tiled roof and tie down of the underpurlins was not an issue. Now that the roof has been replaced with a metal deck roof the connection between the underpurlin and the rafter should be reviewed.

3.5.5 Ceiling Joists

Refer to photos MH-G26-R-013; MH-G26-R-016; MH-G26-R-9201 to 9212.

The ceiling joists are skew nailed to the truss bottom chord at each end. Due to access difficulties it was not possible to determine how many nails had been provided in the connection. As a typical example, in soft woods, a 3.1mm dia nail will have a safe working load shear capacity in the order of 40kg to 50kg in accordance with the current AS1720. If only 2 nails have been provided between the ceiling joists and the roof trusses the maximum working load capacity of the connection would be in the order of 100kg. Subtracting the weight of the ceiling from this load does not leave sufficient

capacity in the joint to support safe work access on the ceiling joists. The above indicative joint capacities are based on the two members being in close contact. But, as can be seen in the photos, in some instances there is a gap between the ceiling joist and the truss and in some cases, packers have been introduced into the joint. In both cases the capacity of the joint will be reduced.

3.5.6 Access ways

Refer to photos MH-G26-R-003; MH-G26-S-004 to MH-G26-S-006 and MH-G26-R-9301 to 9308.

There is the primary access way down the centre of the roof consisting of 2 planks, side by side, spanning the 3.5m between the roof trusses. Referring to the HyPlank laminated pine span tables a 230x40 LVL plank has an allowable span of 2.4m for light duty loading in accordance with AS1576. On this basis it is likely that the current planks do not comply with AS1576. It was noted that the current planks are also not tied together with battens, at say third points. Blocking the planks together, might assist with them complying with AS1576. Adding to the complexity of complying with AS1576, is the fact that with the current safety line rigging arrangement, with only one traveller, ensures that there can/will be two men on a single plank at the same time. Light duty loading to AS1576 has a point load of 1.7kN i.e. approximately 170kg.

Either side of the main walkway, aluminium mesh has been laid. From previous correspondence with regards the safe access into the ceiling space, it is concluded that the mesh was added, along with the static line, to prevent a workman falling through the ceiling. The mesh is supported on the ceiling joists and based on the discussion above it is unlikely that the connection of the ceiling joists to the roof trusses has sufficient capacity to support a workman in accordance with AS1720.

Leading out from the main walkway, are access walkways to the lighting grid winch motors. It is understood that the motors are required to be removed for maintenance and for changing the motors. The walkway consists of yellow-tongue flooring laid over the ceiling joists and aluminium mesh placed either side. As stated under the discussion on the ceiling joist it is unlikely that the ceiling joists have sufficient capacity to safely support one workman, not to mention two workmen and the winch while it is being replaced.

It is understood that the walkway arrangement has recently been reviewed and the current system installed. How the current system was procured and if it was reviewed by an Engineer (Structural) is unknown. It is recommended that the installed roof access system be reviewed by a structural Engineer to assess its adequacy.

3.6 Safety

Deterioration of the backstage area was found to include mould growth in conjunction with water damage including to areas with asbestos marked materials. Due to the conditions at the time of inspection a detailed survey of this area was not performed. As this area houses musical equipment it is anticipated that entry and exit by occupants occurs and is considered a safety risk due to possible disturbance. Should a disturbance occur to the walls or ceiling, occupants may be exposed to mould spores and/or asbestos fibres. Presence of moisture as indicated in Sections 3.3.3 and 3.4.4 increase this risk due to potentially weakening construction materials.

Although no immediate safety risks associated with the walls and ceiling were identified during the investigation, Infracorr noted some cornice details had spalled from the roofline within the Main Hall,

this poses a risk to people below should further deterioration occur. As these elements are not easily accessible further investigation is required.

Infracorr identified the following safety considerations when surveying the Main Hall roof:

- Roof access safety are noted in Section 3.5.6 above.
- Risks when performing maintenance works to equipment:
  - Pendant lights require manual operation of existing ratcheting equipment with no apparent brake mechanism (refer photos MH-G26-S-002; MH-G26-S-003);
  - Light bar maintenance and electric motors including roof suspension requires entry to platforms suspended by ceiling joists not adequate for loading;
  - Future inspection of ceiling trusses requires improved lighting to the east side of the hall and recommended access to reach the ends of trusses for inspection of wall connections; and
  - Loose electrical cables were identified in the backstage area of the Main Hall on the F22 landing, these services should be isolated and or removed to prevent safety risk (Refer photo MH-G33-S-001).

4 EAST WING (MAIN BUILDING)

4.1 Plan Arrangement

The plan arrangement for the East Wing is provided in Figure 4.

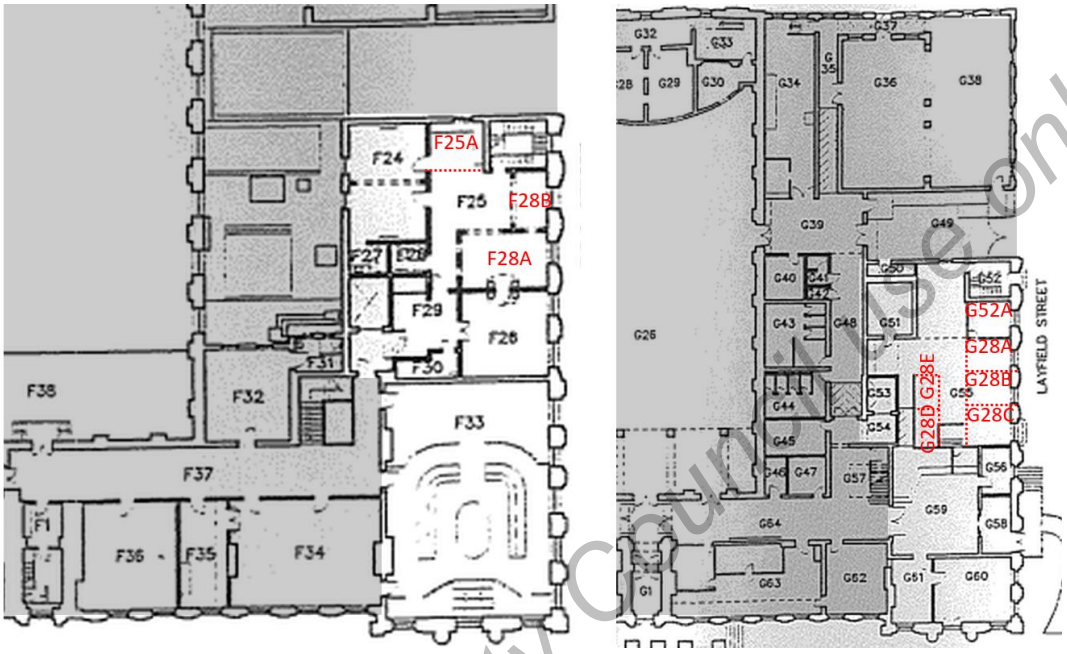

Figure 4 - East wing plan arrangement (Ground floor – right; First floor – left).

4.2 Foundations

The walls were inspected internally and externally and only some cracking was noted in the north wall and north/east corner of the building. Deterioration of this area is likely resultant from deterioration of underground services. Access holes to service pits were identified in G49 and the proximity is likely responsible.

Refer to the discussion under the Heading of “Walls” (Section 4.4) and the discussed in Section 8.6.

4.3 Floors

4.3.1 General

Refer to photograph EW-G26-F-9001.

Minor movement was found within the floor of F33 council chambers near the doors however no floor movement was observed that indicated an issue.

4.4 Walls

Several defective regions were observed during the investigation, these are summarised below and discussed in the subsections under this heading.

a) Cracking is present internally along the north wall of room F25A. External inspection of the north east corner of the building indicates previous remedial works have been performed above the first floor mid height level (refer photos EW-F25-W-001; EW-F25-F-001), however no records were provided at the time of the investigation. This cracking is further discussed further in section 4.4.1.
b) Cracking reflecting through brickwork along first floor rooms along eastern wall (F28A and F28B) (refer photos EW-F28A-W-001; EW-F28A-F-001);
c) Cracking present within Room F24 on the southern wall on a brickwork chimney. Deterioration extends into F27 with water damage evident within room resulting in a subsided ceiling (refer photos EW-F27-W-001; EW-F27-F-001).
d) Cracking and associated water staining was observed within rooms G60 and G61 located beneath the council chambers. Cracking appeared concentrated around the perimeter of the structure.

4.4.1 Room F25a

Refer to photos EW-F25-W-001, ME-F25-W-9001 to 9006.

From inside this room some cracking was observed in the masonry wall under the window. Referring to the structural drawings produced by Tattersall Engineering consultants in 1996 an opening was made in the north wall directly below this room. The drawings indicate that 2 no. 100 x 10 equal angle lintels are to be provided. The wall appears to consist of 3 skins of brickwork in which case it would be reasonable to infer that one lintel would have been provided per skin. There have been repairs to the external face of the wall and there is some cracking in the external brickwork leading down towards the ground in the North/east corner. Adjacent to the wall, in the loading bay, is a stormwater pit and what appears to be a grease trap. The likely causes of the cracks in this wall are a combination of water seeping from the pits and the installation of the lintel above the ground floor opening. Both should be investigated to identify the cause of the cracking before it is made good.

4.4.2 Room F24 and F27

Refer to photos ME-F24-W-9001 to 9004.

Located on the south wall of this room is a fireplace. The fireplace and short sections of masonry walls separate room F24 from rooms F27 and F28. There are some cracks in the walls to the side of the fireplace with associated water damage found within F27. Reviewing the room plans for this area indicates that these walls and fireplace are located over the ground floor kitchen between the lift shaft and the strong room. An attempt was made to inspect the structure under the wall through an inspection opening in the kitchen. Unfortunately, the ceiling space above the kitchen was occupied by a number of large air-conditioning ducts and an older ceiling above the ducts making it impossible to

inspect the structure supporting the walls. The removal of some of the ducting and ceiling is required to allow for the inspection of this structure.

Discussions with the building occupiers indicated that the water damage in F27 is known and was addressed when remediation was done to the lift shaft adjacent, however cracking may not have been adequately addressed. Inspection of the façade identified a large gap in the construction between the brick wall of the room and the lift shaft. Previous remediation has been attempted to address this by using steel channel to partially cover the construction joint but is not sufficient. It is recommended that the construction joint be injected with sealant or channel extended to encapsulate the area.

4.5 Roof Structure

Infracorr did not internally inspect the roof structure of the East Wing of the building. Access to this area was roped off with signage preventing entry. As this wing did not have lifelines installed, access could not be safely performed. As such, survey of the roof of this wing was limited to external survey via street access and access provided by rooftop walkways.

4.5.1 Rooms F24 to F30

Refer to photos ME-F25B-W-9006 to 9010.

4.5.2 Room F33

Refer to photos ME-F33-R-9001 to 9005.

From the photos it can be seen that the roof has been previously reinforced with steel frames bolted to the trusses. Refer to the Section 11.4 for a discussion on the Timber Roof Trusses.

No deterioration of the roof structure has been confirmed, however further inspection is recommended based on findings identified in the South Wing, discussed in Section 6.5.

5 WEST WING (MAIN BUILDING)

5.1 Plan Arrangement

The plan arrangement for the West Wing is provided in Figure 5.

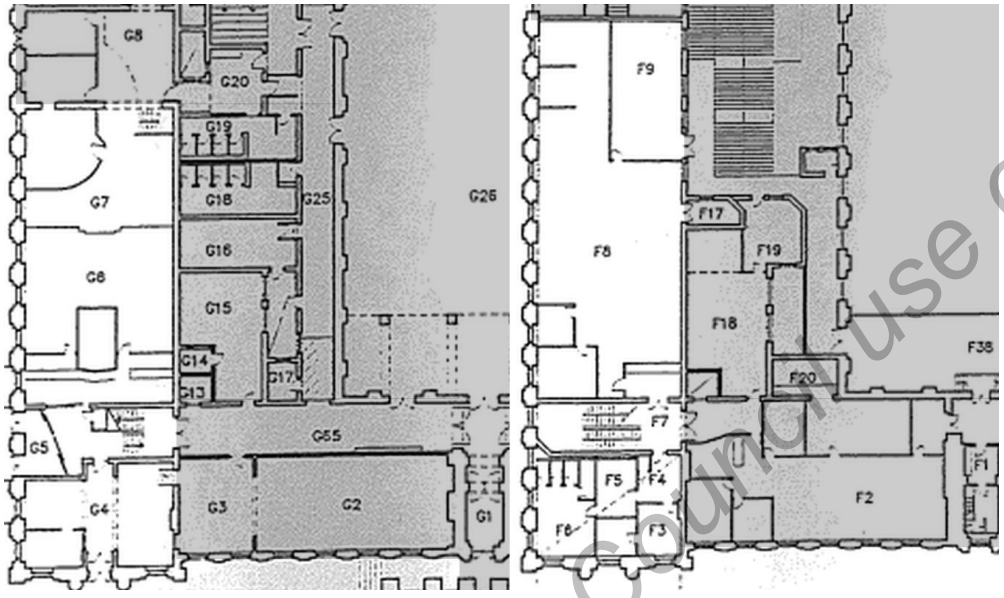

Figure 5 - West wing plan arrangement (Ground floor – left; First floor – right).

5.2 Foundations

No movement was observed in the walls to indicate that there is an issue with the foundations of the building.

5.3 Floors

5.3.1 General

Access under the floor at the time of the inspection was not possible however the majority of the floor was solid under foot.

5.3.2 Room G04

Refer to photos EW-G04-F-9001 to 9002.

Performing a heal drop test in this room it was noted that there is some bounce in the floor. Leading from the south elevation and running through the centre of the room is a corridor which appears to have a concrete floor. Inspecting from outside there are limited air vent grills. It is possible that the subfloor is not receiving a change of fresh air. Solar power fans can be used to force air into confined

subfloors to ensure a regular changing of the air and removal of moisture. Refer to the discussion in the Section 11.3 regarding subfloor ventilation.

5.4 Walls

Defective regions observed in the West Wing during the investigation include:

a) Water damage within G8 along the east wall. Damage is not present above wall storage indicating that the damage may have been repaired in easily accessible areas only. It is unknown when this damage occurred, however, discussions with staff within the office space indicate the wall has been in this condition for the last two years without change. No inspection could be conducted on the reverse face of the wall due to lack of access to the room.
b) Water damage was observed in the south east corner of F8 between the original ceiling and the removed suspended ceiling.
c) No waterproofing was observed on the external landing adjacent to F8 positioned around air conditioner ducting and service pipes, this provides a location to track rain into the brickwork and into the rooms below.

5.4.1 Rooms F8 and F9

Some plumb measurements were taken around these walls while an ELV (Elevated Work Platform) was available. The east wall was plumb halfway along the room. This was to be expected as there are rooms on the other side of the wall. On the west side of the room at the midpoint the wall was 25mm out of plumb.

5.5 Roof Structure

Infracorr was unable to inspect the roof of this wing internally due to deterioration of the South Wing. Inspection was performed in multiple spot locations using scissor lift access however due to the suspended ceiling joists, inspection of some elements could not be performed.

Some water staining was present at the bottom ends of the rafters and at truss wall connections. Although there is presence of moisture, the level of wood deterioration was observed to be less than observed in the South Wing and Main Hall.

Inspection of G4 identified water damage to ceiling panels corresponding to the location of water services within the men's bathrooms, further inspection was not conducted.

5.5.1 Room F7

Refer to photos WW-F07-R-9001 to 9002.

It was not possible to gain safe access into the roof at the southern end of the West Wing. However, some photos were taken off the EWP located in room F2 of the South Wing. It can be seen in the photos that this roof has been strengthened. Presumably this has been done to make good any rot in

the timber as noted in other roofs and, with the bracing added, to stabilize the tower over this area. Refer to the discussion in Section 11.4.

5.5.2 Room F8

Refer to photos WW-F08-R-9001 to 9399.

Critical areas of the roof framing were inspected off an EWP. As the ELP was only available for a day only select areas of the roof could be inspected. The critical areas are the support on the brick walls, the connection between the diagonal chord and the queen post to the bottom chord. There are exposed trusses with a vaulted ceiling in the centre of the room. At the north and south ends of the room the ceiling drops down to a flat ceiling under the trusses. At some point in time flat ceiling was run through the whole room by the addition of ceiling joists suspended of the bottom chords of the trusses. This has added additional load to the bottom chord of the trusses and the connection between the bottom chord and the queen posts. Refer to the discussion in Section 11.4.

A number of the original ceiling joists in the flat area have split where they are cut around a batten fixed to the side of the truss bottom chord. Refer to the discussion under ceiling joists in the South Wing.

The west end of the second roof truss has rotted where built into the brick wall. Refer to the discussion in Section 11.4.

6 SOUTH WING (MAIN BUILDING)

6.1 Plan Arrangement

The plan arrangement for the South Wing is provided in Figure 6.

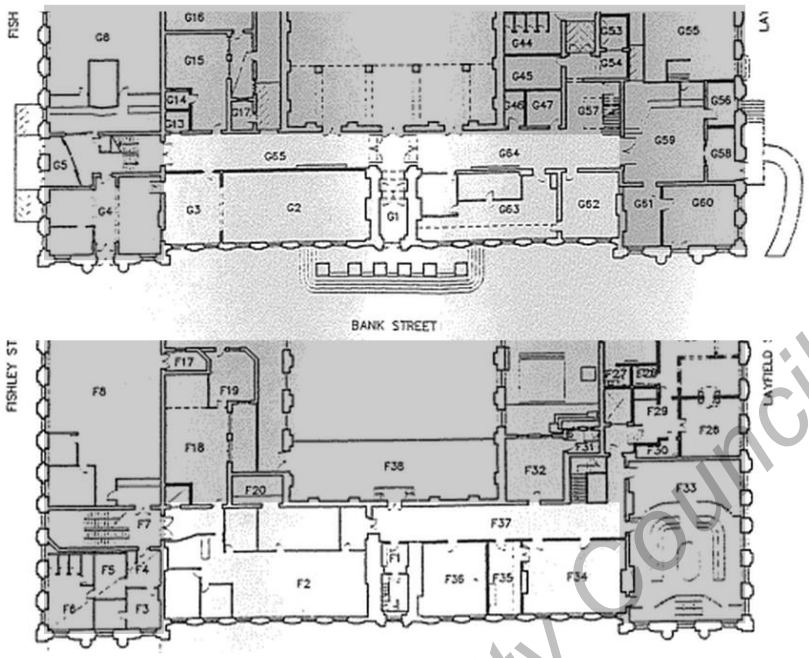

Figure 6 - South wing plan arrangement (Ground floor – top; First floor – bottom).

6.2 Foundations

No movement was observed in the walls to indicate that there is an issue with the foundations of the building.

6.3 Floors

6.3.1 General

Access under the floor at the time of the inspection was not possible however the majority of the floor was solid under foot.

6.3.2 Room F2

Refer to photos SW-G2-F-9001 to 9008.

The floor under room F2 has been strengthened /reinforced since originally constructed. Over the corridor G55 the floor has been strengthened with steel channels adjacent to the floor joists. This may have been done to support a compactus unit.

Over G2 steel beams have been added in two directions to halve the span of the floor joists.

6.4 Walls

Water damage and cracking was observed along the south wall of the East Wing in first floor rooms as follows and as discussed further in Section 6.5.

a) F2/G2 – the location of 2018 ceiling collapse and observed considerable deterioration of lower chords where crushing and rotting of wood has occurred (refer photos SW-G02-C-001 to SW-G02-C-003).
b) F36 / F35 where roof trusses have been strengthened using steel channels to supplement deteriorated timber lower chords.
c) F34 where trusses have not been strengthened and appear to be in deteriorating condition with crushing and likely rotting wood present at the end of the lower chords. These trusses could not be further inspected as access was limited to access walkways.

Inspecting the walls from outside and inside the building did not reveal any cracking that raised structural concern.

6.5 Roof Structure

6.5.1 General Comments

Inspection of the roof over rooms G62 to G64 was possible off a walkway and static line attached to the roof trusses. This provided for a visual inspection but limited access to critical connections.

Inspection of the roof space over F2 was limited due to safe access. An EWP was incorporated to supplement access allowing inspection of four locations. One connection between a Queen post and bottom chord, in addition to the ceiling joists and three locations at the joint between the bottom chord and the brick wall.

According to an article on the Australian Broadcasting Corporation (ABC) website on the 31st of October 2018 the roof collapsed in the South Wing on the 18th of October 2018 flooding the building with over 12,000 litres of water. From a report produced by Mr. Geoffrey Nixon of GC Nixon & Associates on the 29th of October 2018 a section of ceiling collapsed at the eastern end of room F2, i.e. adjacent to the central tower. The report indicates that the ceiling collapse was most likely due to a ceiling joist failing. It is understood from the Council project manager that the majority of the water came from a damaged fire service and that there may have been a water leak in the roof that initiated the collapse. Reviewing the photos of the roof where the ceiling collapsed it is noted that the batten which the ceiling joists are notched around is missing. It is possible that the batten failed causing the ceiling to collapse.

The Nixon report also identified the failure of a bottom chord to king post connection and recommended the full inspection of the roof and back propping the truss with the failed connection.

6.5.2 Ceiling Joists

Refer to photos SW-F02-R-9201 to 9211.

The first-floor ceiling joists are 132x40 Oregon at 420 centres. Support for the ceiling joists is provided by notching the end of the rafter over a batten nailed to the side of the bottom chord of the roof truss. The batten is 45 deep by 30 wide and appears to be nailed to the truss bottom chord with a single nail at 420 centres. The spacing of the nails was measured across nail rust stains where a section of batten had previously been removed. The nail size could not be determined, however assuming a 3.3 dia nail was used, the shear capacity of the nailed joint is in the order of 50 kg working in accordance with AS1720. Note; a 3.3 dia nail would be at the upper limit of the size of nail used for this type of joint. The centre of the joists, at the ends, have been notched out to allow the joists to encapsulate the batten i.e. a tongue and grove joint. Where the ceiling joists are notched over the batten the shear capacity of the remaining joist is not sufficient to support a workman on the joist when assessed in accordance with AS1720. In the photos a knot can be seen adjacent to the notch at the critical location. With this knot it is impossible for us to know the load capacity of this joist. In the photos a joist has also split along the grain out from the notch. This splitting of the rafters is common throughout the South Wing of the main building.

Walkways have been provided over the ceiling joists at a number of locations. In our opinion the ceiling joists connections to the main roof trusses do not comply with AS1720 and are not sufficient to safely support the weight of a workman.

6.5.3 Main roof trusses

Refer to photos SW-F02-R-9001 to 9013, SW-F37-R-9001 to 9021

Refer to Section 11.4 for a discussion on the roof trusses and the critical connections.

The main roof trusses span approximately 9.4m between the south wall of the Main Hall and the southern wall of the building and are located at approximately 2.85m centres. Judging by the number of roof battens on both sides of the roof it is suggested that when the roof was constructed there were slate tiles on both sides of the roof. The roof currently has slate tiles on the street face and corrugated iron roof sheeting on the north side.

Queen Post to Bottom Chord – The northern queen post in the second truss from the west end of room F02 has failed. The bolt in the connection has pulled a plug of timber out of the queen post.

Truss Bearing on wall - The southern end of the bottom chords, where bearing in the brick wall, has rotted. The rot has reduced the bearing length of the truss on the brick wall. This has increased the bearing stress in the bottom chord to the point where the fibres in the timber adjacent to the bearing have fractured. The bearing plate under the trusses has also rotted and directly under the trusses the bearing plate has been replaced by a number of Jarrah packers.

Along the North side one bottom chord bearing was inspected and no rot was observed.

A number of the roof trusses have been reinforced with steel channel frames bolted to the trusses primarily along the south side. This would appear to have been the solution to stabilizing the roof where the bottom chord had rotted in the wall.

6.5.4 Safety

Infracorr identified the following building security risks with associated safety risks when surveying the South Wing:

a) The external door providing ceiling access between the south and East Wings of the building does not have a lock and cannot be secured.
b) A roof hatch located beneath building service platform 2 was found to both freely accessible with no locking mechanism nor mechanism to hold the hatch open for access (refer photo SW-F35-S-001).

7 BALLANTYNE ROOM BUILDING (EAST ANNEX)

7.1 Plan Arrangement

The plan arrangement for the Ballantyne Room Building is provided in Figure 7.

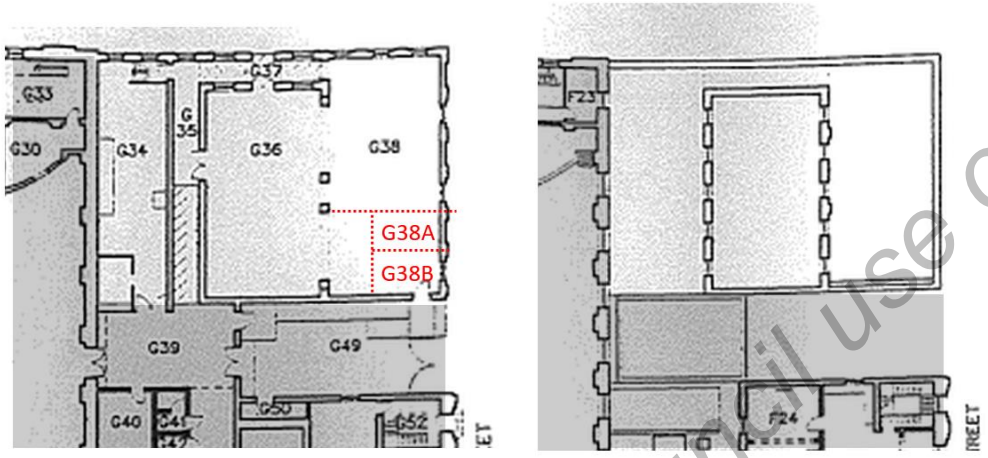

Figure 7 - Ballantyne Room Building plan arrangement (Ground floor – left; First floor – right).

7.2 Foundations

No movement was observed in the walls to indicate that there is an issue with the foundations of the building.

7.3 Floors

As there is not access under the floor it was not possible to inspect the subfloor structure. Having walked over the floors and tested it with a heal drop the only area that showed any noticeable deflection was the middle of the room G36. This area of the floor is in the middle of this group of building and may not be getting adequate ventilation. Refer to Section 11.3 for a discussion on subfloor ventilation.

7.4 Walls

Deterioration of the walls was found to be present within the south end of the building with cracking evident within the Ballantyne Room (G36) and room G38 (refer photo BB-G36-W-001). Evidence of water damage was also present within the suspended ceiling of G36 extending through to G38. This is further discussed in Section 7.5 below.

7.4.1 Rooms

Refer to photos BB-G38-W-9001 and BB-G26-W-0021 & 0022.

There is some minor cracking in the north wall of room G36 and the east wall of rooms G38A and G38B. The cracking is minor with cracks less than 5mm and classified as Damage Category 2 in accordance with AS2870 (i.e. crack width limit < 5mm, cracks noticeable but easily filled).

7.5 Roof Structure, Gable Ends and Chimneys

Refer to photos BB-G38-W-001 to 0017

Inspection of the roof structure could not be performed internally and was limited to assessment of the façade, gable ends and chimneys of the building (refer photos BB-G36-F-001 to BB-G36-F-006; BB-G38-R-001 to BB-G38-R-002).

Access into the ceiling space of the Ballantine Room is through an access door in the south elevation which could not be accessed. Based on the inspection of the other building it would have to be assumed that this building also has a trussed roof. It is also likely that the bottom chord is built into the brickwork with some rot in the wood.

The gable at the north end of the building has a significant lean out at the top and some cracking in the ornamental detail. The southern gable wall has the anchor plates at what appears to be ceiling level. To secure this gable the tie rods possibly should have been located closer to the ridge line, however this would require more detailed analysis to confirm. Previous work has been done on both the north and south gables to secure them by the addition of tie rods and anchor plates. The tie rods were found to have minimal thread with approximately 5 mm and 10 mm on the north end. Typically, tie rods are installed with additional thread or a second nut to prevent loosening of the fixing. Inspection of the brickwork beneath the anchor plates suggested an absence of waterproofing membrane or sealant. Exposed bricks in this arrangement is avoided and can result in water ingress resulting in further deterioration of the wall and installed rods and plates.

Two of three chimneys located on the roof of this structure were found to be in deteriorated condition with substantial cracking (refer photos BB-G38-F-001 to BB-G38-F-006). The remaining chimney was found to have a metal collar and could not be further inspected. The south eastern chimney is the most deteriorated with grout loss and extensive cracking of the upper half of the chimney.

It might be possible to obtain the documents for the repair of the gable ends and these documents could hopefully outline any works done to the trusses and the extent of remediation to the chimney with the metal collar. If the trusses have not been inspected for deterioration, some additional investigation work should be undertaken (Refer to Section 11.4 for discussion of roof trusses and framing).

In order to assess the efficacy of the previous gable end repairs and need for further repair work, it is recommended that existing cracking in render and façade be patched and monitored for movement/crack growth. If available, documentation and photos taken following previous repairs should be reviewed and compared against the current condition. Application of a sealant around anchor plates should be performed to prevent moisture ingress and corrosion of steelwork. Remediation to the chimneys is recommended by removal of minimal render, raking out of mortar and reinstatement in situ. Should the deterioration of the brickwork and mortar be extensive reconstruction may be required.

8 ANAM BUILDINGS (EAST ANNEX)

8.1 Plan Arrangement

The plan arrangement for the ANAM Buildings (East Annex) is provided in Figure 8.

Figure 8 - ANAM Buildings (East Annex) site arrangement (Ground floor – right; First floor – left).

8.2 Foundations

No movement was observed in the walls to indicate that there is an issue with the foundations of the building.

8.3 Floors

Access under the floor at the time of the inspection was not possible however the majority of the floor was solid under foot.

8.4 Walls

Water staining was identified on the ceiling and east wall of F32 (refer photos AB-F32-W-001; AB-F32-W-002). Deterioration is likely the result of damage to the flashing on the roof above. Sealant was observed to have been previously applied to the roof flashing. Due to the extent of deterioration observed internally, and its current unrepaired condition, it is unknown if remediation works have been successful in addressing the waterproofing issue.

The walls were inspected from the corridor and from with the bathrooms and no issues were observed that raised structural concern.

8.5 Roof Structure

8.5.1 General

No Access was available to inspect the roof framing. Inspection from roof access did not indicate deterioration of note at the time of inspection.

8.6 Loading Bay

Inspection of the ANAM Buildings identified the loading bay as a safety risk, this area is subject to a live edge with no handrail present (refer photos AB-G49-S-001; AB-G49-S-002). Furthermore, doors open outward and are not permanently secured to prevent use. Understandably railings are not desired for a loading bay however removable balcony railings should be installed to prevent fall risk or the area restricted from general access.

9 COUNCIL BUILDINGS (WEST ANNEX)

9.1 Plan Arrangement

The plan arrangement for the Council Buildings (East Annex) is provided in Figure 9.

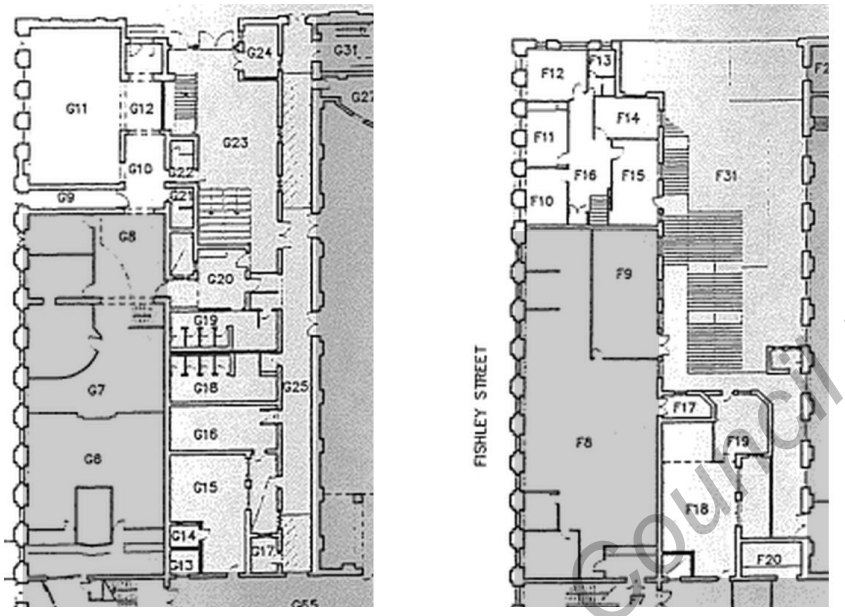

Figure 9 - Council Buildings (West Annex) plan arrangement (Ground floor – left; First floor – right).

9.2 Foundations

No movement was observed in the walls to indicate that there is an issue with the foundations of the building.

9.3 Floors

As there is not access under the floor it was not possible to inspect the subfloor structure. Having walked over the floors and testing with a heal drop no noticeable deflection was observed.

9.4 Walls

9.4.1 Apartment Studios

Refer to photos CB-F11- W-0001 to CB-F14-W-0002.

Water staining was identified in F12 around all cornices and across ceiling of the room. Water damage may be due to slate roof pointing deterioration (refer photos CB-F12-C-001, CB-F12-C-002). Inspection was not performed. Embedded external drain arrangement may also contribute to deterioration to

the north west corner of the building (refer photos CB-F10-F-001 to CB-F12-F005). There is some minor cracking in the wall at the north end of the building.

9.4.2 Room F17

Refer to photos CB-F17-W-9001.

There is some minor cracking either side of the window lintel. There are legs supporting a plant platform over the window. This should be reviewed.

9.5 Stairs

Refer to photos CB-EXTERNAL-0001 TO 0005.

Inspection and assessment of the external stair access was previously performed by Infracorr in 2018. Further inspection was not performed as part of this investigation. Findings from the previous investigation are summarised in CPPMT-REP1 (November 2018), an excerpt has been provided below:

The reinforced concrete stairs are in poor condition and are at a risk of continued carbonation induced reinforcement corrosion, accelerated through the presence of cast-in chlorides in some areas. Widespread delamination was identified along steps; however, the majority is likely to be isolated to the render/fairing coat only. Significant repairs are required to all stringers and to the columns supporting stairs. Carbonation of the walls beneath the stairs require protective coating application to prevent future corrosion and spalling. Coating deterioration on the railing requires repair to prevent further corrosion, and repairs to railing base posts will be required as part of the recommended repairs to stringers.

The handrails on the stairs and landing are not believed to comply with Building Code height requirements and should be upgraded at the time of stair repairs.

9.5.1 Landing

Refer to photos CB-EXTERNAL- 0004 to 0013.

The external landing is a reinforced concrete structure supported on the Main Hall walls on the east side and on concrete column on the west side. At the north end of the landing is a tanked bunded area containing air conditioning units. The tanking is leaking allowing water to seep into the masonry of the Main Hall at the 5th pier location. Refer to the discussion under walls in the Main Hall section of this report (Section 3.4).

On the soffit of the slab and across one of the windows on the hall side there is some spalling of the concrete, the spalling of the concrete should be investigated and repaired.

Water ingress from this leaking tank bund has resulted in visual deterioration attributed to the following:

a) Incomplete or deteriorated waterproofing installed in the council building deck bund.
b) Air conditioner services below the deck walkway indicate water staining and associated fungal growth in proximity to an installed drain within the bund. This drain is ineffective in redirecting water from this area into the guttering system.

During inspection of this area Infracorr noted installation of a piece of corrugated roofing installed on top of flashing, instead of under it (refer photo CB-G23-R-001). This installation does not provide overlap of the adjacent corrugated roofing resulting in a gap in the roof line. This can provide a direct pathway for water to enter the roof.

10 BUILDING SERVICES (EXTERNAL PLATFORMS 1-6)

10.1 Plan Arrangement

Infracorr has developed the indicative plan arrangement for the Building Services (External Platforms) provided in Figure 10.

Figure 10 - Building Services (External Platforms) plan arrangement (located at and above first floor plan).

10.2 Platforms

10.2.1 Flooring

Located north of the main building services platform 1 includes a small bund area built into a steel reinforced concrete council building deck walkway. This bund area has poor waterproofing for air conditioners resulting in spalling of soffit concrete and water ingress and deterioration within the Main Hall columns and the corridor located below. This is discussed in detail in Section 9.5.1.

Platform 1 with the exception of the small bund area incorporates several extensions with varying services throughout. Constructed primarily of steel gantries, this platform is in fair condition with the exception of the original platform on the lower tier. This platform is constructed of a steel frame with timber slats displaying light to moderate deterioration. It is understood that major upgrades to the air-conditioning system are planned.

No deterioration nor structural concerns were observed with platforms 2-6, beyond those mentioned in Section 10.2.2 below.

10.2.2 Safety

Review of the external building platforms revealed the following safety concerns with the construction and access to these service platforms:

- Platform 1
    a) The upper platform level has been constructed to act as a walkway between platform 1 and 2. Access to this area wraps around the corner of the Main Hall. The corner platform is suspended by a welded hook on the western end and on the eastern end a welded handrail connects the platform to the main platform 2 assembly (refer photos BS2-F02-S-001 to BS2-F02-S-004). This should not be used as a permanent support solution.
- Platform 2
    a) Access to the Main Hall roof is currently not adequate and requires descent beneath platform 2 without assistance from a walkway. This access does not provide stable footing nor handrail support. It is recommended that the walkways be redesigned to include stepped access to the main hall by extension of the gantries possibly from the east side of platform 2.
- Platforms 3 - 5
    a) No Safety concerns identified during inspection.

11 DISCUSSION OF DETERIORATION AND CONSTRUCTION CONCERNS

11.1 Brick Growth - Moisture Expansion of Bricks

The moisture expansion of bricks is commonly referred to as brick growth. The expansion of the bricks occurs when the clay materials in the brick absorb moisture and expand after being fired in a kiln. Studies suggest that for Australian bricks the majority of the expansion occurs over 15 years and can range from 0.6 to 2.2 mm/m. The research papers below suggest that the restrained brick growth can be half that of the unrestrained brick growth.

The differential expansion of the masonry can lead to walls bulging out if constrained at each end, diagonal cracks in the wall where the lower elevation of the wall is not expanding at the same rate and therefore provide restrain against the section of wall expanding leading to diagonal tension cracking in the masonry and rotation and vertical cracking at the ends of the walls. This can be seen in the Easy and West walls of the Main Hall building.

- CBPI (Clay Brick and Paver Institute) – Research Paper 9 – Moisture Expansion of Clay Bricks: An Appraisal of Past Experience and Current Knowledge.
- CBPI (Clay Brick and Paver Institute) – Research Paper 16 – The Moisture Expansion of Bricks and Walls.
- CBPI (Clay Brick and Paver Institute) – Research Paper 17 – The Expansion of Clay Bricks After 30 Years and a Method for its Prediction.

11.2 Seismic/Wind Bracing

After the 1989 Newcastle Earthquake AS1170.4 (Earthquake actions in Australia) were incorporated into the Building Code of Australia. Prior to this, as Australia was not perceived to be seismically active, masonry structures were designed for a combination of dead loads, live loads and wind loads. Section 5.2 of AS1170.4 requires that all structures be configured with a seismic-force-resisting system that has a clearly defined load path, or paths, that will transfer the earthquake actions generated in an earthquake to the supporting foundation soil. Similarly, to resist wind loads on the walls and roof, the bottom chord of the roof trusses need to be tied into the masonry wall and a load path provided back to the shear walls and foundations.

From the inspection it was not possible to determine how the roof trusses are tied to the masonry. Most likely the trusses were nailed to the timber bearing plate built into the masonry and the lateral restraint of the walls was provided by either metal ties built into the masonry and fix to the timber plate or just on the friction/bond between the timber plate and the masonry. The end of many of the roof trusses though-out the builds, and the timber bearing plates have various amounts of rot in them. If there were metal ties, they will have either corroded away or the fixing into the timber diminished.

The gable walls of the Main Hall and the room F8/F9 rely on the under purlins being built into the walls for their lateral restraint. It was not possible to access these points in either building. However, based on the condition of the ends of the main roof trusses, it would have to be assumed that the ties between the masonry and the underpurlins has deteriorated to the point that there no longer provides a serviceable connection between the two. With the loss of timber from the bottom chord of the roof trusses in room F2 there is no remaining tie between the masonry and the roof trusses in this area.

The connection between the timber framing, i.e. roof trusses and underpurlin, should be investigated and if necessary new ties added between the masonry and the timber framing. Additional roof bracing may be required to transfer the seismic and wind loads back to the shear walls.

- CBPI – Research Paper 15 – Unreinforced Masonry Structures – An Australian Overview.

11.3 Subfloor Ventilation and Rising Damp

Referring to the 1945 aerial photograph of the South Melbourne Town Hall it appears that the Ballantine Room was separate from the outer buildings and the Main Hall was only connected to the South Wing at the southern end.

Having subfloor vents around each of the building would have provided ventilation of the sub-floor though cross ventilation.

Sub-floor ventilation is required for buildings with timber sub-floors as it reduces the humidity within the subfloor crawl space. Moisture within the crawl space can make the subfloor damp, musty, mouldy and promote fungi growth. Damp in the subfloor space also assist termites in establishing a colony. Termites can be attracted to the odour of the fungi growing in or on timber that remains damp for extended periods of time. Douglas fir (Oregon) is particularly susceptible to termites.

With regards to termites, the City of Port Phillip is a designated termite prone area. The Council Web site under Planning and Building contains information with regards the management of termites. http://www.portphillip.vic.gov.au/termites.htm

Where subfloor vents have been closed off preventing cross ventilation, forced ventilation can be adopted. Subfloor ventilation consists of fans and ducts to draw fresh dry air in from outside the building forcing the damp air out and reducing the humidity.

Rising damp is the term used to describe the dampness occurring in porous masonry walls as a result of moisture rising from the ground by capillary action. This can be seen in room G27 to G33 of the Main Hall. If there is no moisture barrier between the masonry and the timber subfloor structure, this can lead to rot in the timber structure.

Consideration should be given to:

- The level of subfloor ventilation and the addition of forced ventilation if required.

- Inspecting the subfloor for termites.
- Water leaks under the floor.
- Damp courses in the brickwork.

Figure 11**.** Part of The University of Melbourne 1945 archived aerial photomap (848-b4)

11.4 Timber Roof Trusses and Framing

11.4.1 General

The trusses are queen post trusses, where the angled outer chord stops at the queen post rather than extending through to the ridge as per a King Post truss. Unlike most trusses there are no diagonal members through the centre third of the truss and therefore rely on the stiffness of the bottom chord acting like a beam to balance any out of balance roof loads. Refer to Figure 12 - 13 for the general arrangement of the trusses. Figure 12 is the general arrangement over the Main Hall and Figure 13 is the general arrangement over the South, East and West Wings.

Judging by the number of roof battens on both sides of the roof it is suggested that when the roofs were constructed there were slate tiles on both sides of the roof. The roofs on the South, East and

West Wings currently have slate tiles on the street face and corrugated roof sheeting on the internal side of the roof.

11.4.2 Connection between the Queen Post and the Bottom Chord.

The connection between the queen post and the bottom chord is primarily to support the weight of the bottom chord and the attached ceiling, if any. In the wing buildings the connection also resists lateral loads from the strut. In the Main Hall the strainer beam resists the lateral loads from the strut.

In the Main building a steel 'U' bracket is provided under the bottom chord and bolted though the sides of the Queen Post. This is presumably done to support the additional weight of the bottom chord and ceiling due to the greater truss span. In the wing buildings a single bolt has been provided through the bottom chord and is anchored into the Queen Post with a captive nut checked into the Queen Post.

Any out-of-balance loads place additional loads on the connection as the bottom chord transfers the out of balance shear forces back to the Queen Post with the lessor load. See Figure 14.

In the South Wing one of these connections has failed. Refer to photos SW-F02-R-9101 to 9105. In this case the load on the connection has been sufficient to pull out a plug of timber. This type of failure is possible in any one of the trusses in the wing building particularly where additional ceiling layers have been added.

11.4.3 Connection between the Diagonal Chord and the Bottom Chord

The Diagonal Chord member transfers all the vertical loads back to the brick walls at either end. As the chord is on an angle the horizontal component of the chord force is transferred into tension in the bottom chord. In effect the bottom chord acts like a tie in an arch preventing it from spreading. To transfer this force, the diagonal tie is cut into the bottom chord where it can press into a shoulder. The lateral load on the shoulder is then transferred through shear into the balance of the bottom chord. Refer to Figure 15 which indicates the location of the shear plane. The required area of the shear plane is calculated based on the tie force required and the shear capacity of the timber. The anchor bolt in this connection is typically there just to keep the two members together.

Many of the trusses have lost timber, through rot, from this shear plane. If enough timber is lost, eventually the timber will shear along this shear plane. In photograph SW-F02-R-9306 it can be seen that a crack has started to form along this shear plane and there is also some local bearing failure of the end grains at the shoulder.

It was possible to observe this in room F02 and it is likely that this is occurring in other trusses including the Main Hall.

11.4.4 Bottom Chord Bearing on the wall

In the South Wing it was possible to measure the depth of the bearing on the brick wall as the timber rotted giving access for a tap measure. The bearing length was measured as 250 mm. Where the

timber had rotted away only 50mm of end bearing remained. With only 50 mm of end bearing the timber fibres have crushed locally and some of the fibres have fractured.

Running over the top of the bottom chord and seated on the brickwork is a timber rafter fixing plate. Presumably when the building was constructed the seating plate sat on top of the bottom chord. In all the buildings there is now between 20 mm and 40 mm gap between the two. Assuming that the shrinkage in the bottom chord accounts for 5 to 10 mm that leaves 10 to 20 mm of bearing displacement due to rot in the bottom chord.

The bottom chord also sits on a 100 mm wide continuous bearing plate. At many of the truss locations this plate has rotted away. Presumably this plate was there to tie the brickwork back to the timber framing to resist wind loads. With the end of the truss rotted and the bearing plate rotted there is very little left to tie the brickwork back to the timber framing and provide stability to the wall.

11.4.5 Ceiling Joists

Three methods for attaching the ceiling joist to the roof trusses have been adopted in the Main Hall and the wing buildings. Firstly, in the Main Hall the rafters have been butted up to the truss bottom chord and skew nailed. Secondly, in the wing buildings the ceiling joists have been notched over a batten nailed to the side of the truss bottom chord. Thirdly, in the West Wing a ceiling has been added during a renovation, which is attached to hanging beams siting on the bottom chord of the trusses. For further discussion on each of the ceiling systems refer to the relevant building section discussions. Each of these ceiling systems should be reviewed for structural adequacy.

11.4.6 Roof Rafters and Battens

Over the Mail Hall and the internal elevations of the wing buildings the slate roof has been replaced with a corrugated metal deck roof. This change typically reduces the weight of the cladding from around 60kg/m^2 for a slate roof to 5kg/m^2 for a metal deck roof. With the lighter weight roof wind is more likely to lift the roof off the building. Current Australian codes require the roof to be tied down to a suitable anchorage point. This starts with the fixing of the roof sheet to the battens, then the battens to the rafters and the rafters to the underpurlins. Presumably when the roof sheeting was installed it was screwed down in accordance with the manufacturers' recommendations. From the inspection it was not possible to determine if the battens, to which the roof sheeting is fixed, were provided with the required additional fixings to comply with AS1684/AS1720. From the photograph, Figure 19, it can be seen that packers have been provided between the rafters and the underpurlin with no obvious tie downs provided between the two.

11.4.7 Underpurlins

To prevent the roofing lifting off the building in high winds the underpurlins should be tied down to the roof trusses. As can be seen in the photograph Figure 20, the underpurlin has lifted off the roof truss. In the Main Hall roof there was no safe access to inspect this connection. The connection between the underpurlins and the trusses should be inspected to confirm that it is adequate to resist wind up lift. The inspection and assessment is required for all the underpurlin inspection.

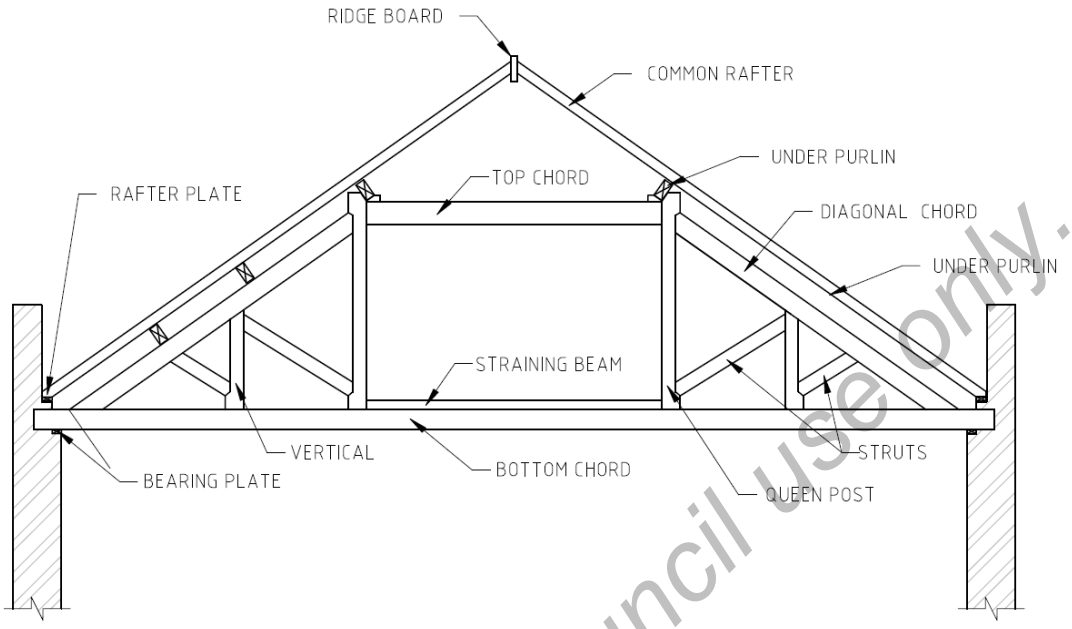

Figure 12. Main Hall truss general arrangement

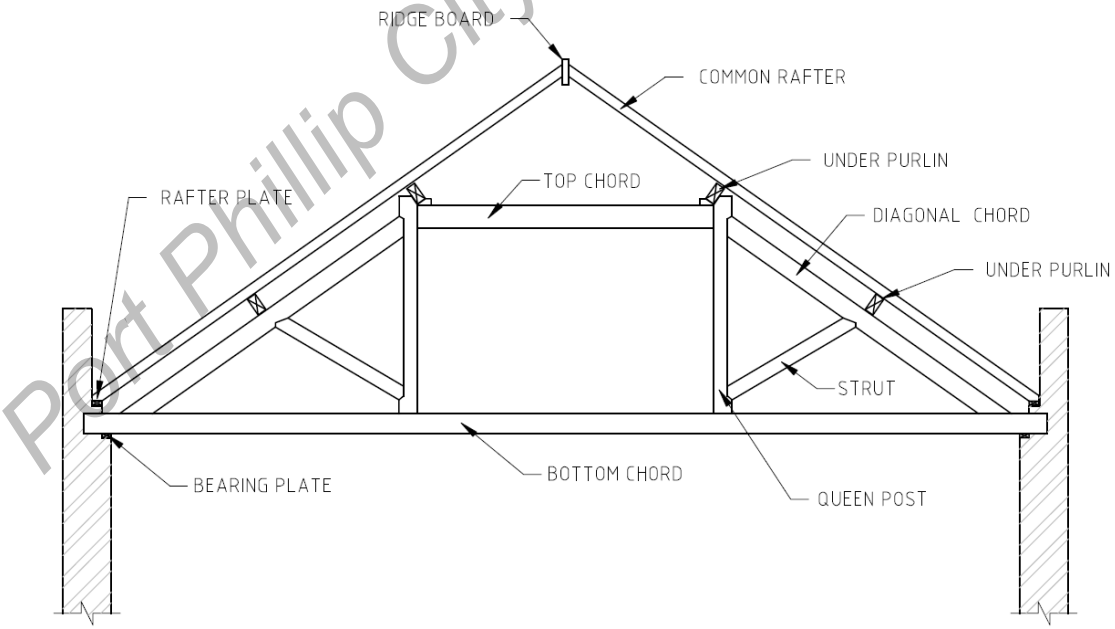

Figure 13. South and West Wing truss general arrangement

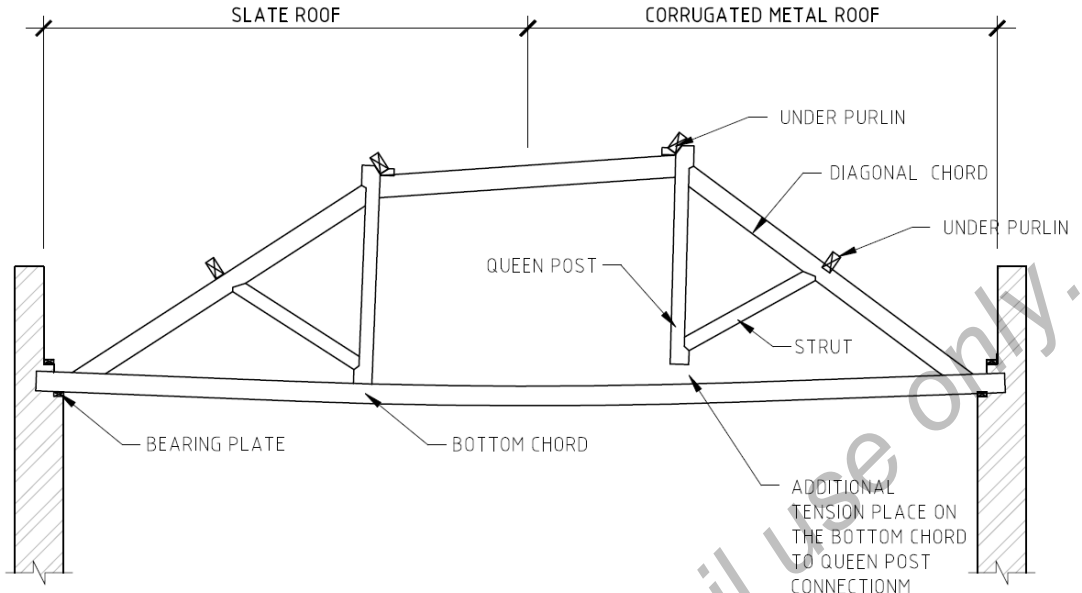

Figure 14. South and West Wing truss displaced shape with out of balance loads

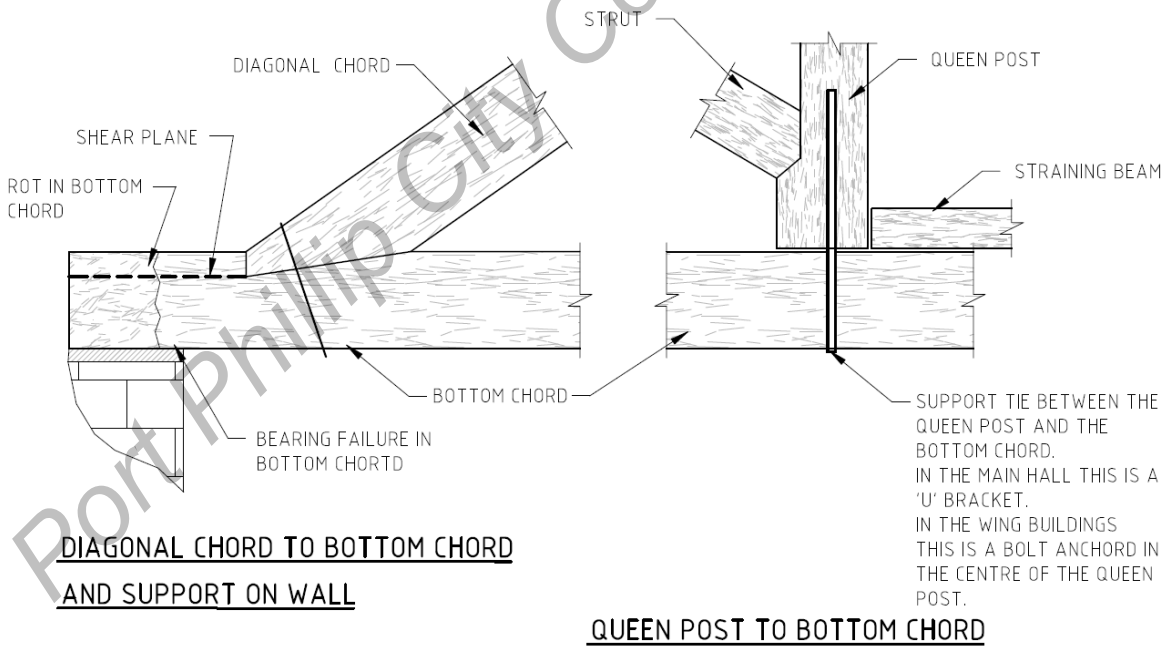

Figure 15. Bottom chord connection detail

Main Hall.

Ceiling joists with a packer between the end of the joist and the truss bottom chord.

Figure 16. Ceiling joists with a packer between the end of the joist and the truss bottom chord

South Wing

The notch in the end of the ceiling joist reduces the shear capacity of the joist at the support. This has led to cracks in many of the ceiling joists.

A similar detail has been provided in the east and west wings.

Figure 17. Notch in ceiling joist

West Wing

Added ceiling framing hanging off the bottom chord of the truss via a hanging beam.

Figure 18. Added ceiling framing

Main Hall.

Rafters packed up off underpurlins.

No obvious tie down provided.

Figure 19. Rafters packed up off underpurlins without evident tie down.

Figure 20. Underpurlin raised off top chord, possibly not tied down.

11.5 Referenced Codes

- AS1170 – Structural design actions
- AS1720 – Timber Structures
- AS1576 - Scaffolding General Requirements
- AS1577 - Scaffold Decking Components
- AS3700 - Masonry Structures
- AS2870 – Residential Slabs and Footings

12 REMEDIAL STRATEGY

As the South Melbourne Town Hall has significant heritage and seen upgrades and repairs accumulate over the lifetime of the structure, it is understandable that there are a variety of deterioration mechanisms both current and pre-existing within the Town Hall structure and annexes. Infracorr has developed recommendations for all issues identified as part of the investigation and summarised these in Tables 1 to 9 below. Due to the size and complexity of the Town Hall, and the extensive number of issues identified, only general remediation options have been provided to assist in managing the durability and serviceability of the structure into the future.

Recommendations for the major areas of deterioration, structural or compliance concern have been summarised in Table 1. Budget estimates have been provided for these items. The estimates have been developed for the purposes of preliminary budget allocation planning and are not intended for any other purpose. Cost estimates have been prepared using reasonably available information, limited site inspection and experienced assumptions and judgements that Infracorr considered to be appropriate, and which will be subject to revision when works are undertaken. Rates provided, or used to develop cost estimates, should be treated as indicative only. No detailed quotation has been obtained in preparing the estimates, and Infracorr does not guarantee their accuracy, or that the works can or may be undertaken at a cost which is the same or lower than the cost estimates.

Recommendations for all remaining areas of concern have been organised by area, as per the body of the report in Tables 2 to 9. The majority of these items can be addressed via regular maintenance or require further investigation to properly assess and assign remedial actions. Many of these lower priority concerns are expected to be addressed through regular maintenance by a property maintenance contractor rather than individual scoped items and budget estimates have not been provided for the items in these tables.

To help guide and prioritise the remediation activities, a priority rating has been assigned to the recommendations for all issues identified during the inspection. The following general ratings are used throughout this section:

High – impacts structural integrity or safety of occupants.

Moderate – currently not critical to structural performance but if left unattended may lead to structural or safety issues.

Low – minor concerns or those that are expected to take a number of years to result in more significant issues if left unattended.

Defects rated Moderate and Low, whilst not believed to be critically urgent to the structural integrity of the building, should nevertheless be addressed at the earliest opportunity to prevent further damage to the structure and minimise cost to remediate.

Table 1 - Major remedial recommendations identified in the investigation.

Issue	Element	Details	Recommendation	Priority	Timeframe	Preliminary Budget
Timber roof trusses and framing deterioration	Roof	A number of issues were identified within the roof structure of the main hall and wings of the complex. It is anticipated that the following recommended works are required for all wooden roof structures of the Town Hall. The nature of repairs will largely be repeated throughout the roof of the buildings however the extent and types of repair for each truss and for framing in each area will need to be determined as part of the repairs. There is a very large uncertainty as to the extent and cost of works required.	Types of repair will include the following, as required for all areas of the roof structure: Anchorage between the timber trusses and the brick wall and remediation of the bearing plates should be undertaken for all trusses. Strengthening of trusses and restraining beams should be undertaken on all trusses using bolted steel frames similar to previous strengthening works to address deterioration in truss ends. Inspection and review of all roof connections should be made between the framing and trusses, including underpurlins and rafter and rafters and battens. These should be repaired to ensure adequate tie down of these elements to the roof trusses. Review of the connection between ceiling joists and trusses should be performed for structural adequacy due to the use of notching and spacers throughout the roof structure.	High	Urgent works that should be commenced as soon as practical and completed within 3 years	$4,000,000
Roof access	Walkway	Sections of the walkways are installed on ceiling joists and not suspended from trusses. This is particularly concerning where walkways have been constructed to reach and remove electric motors used for performances with two people and the weight of the motor to be suspended by the ceiling joists. In other wings, access is via walkways without handrails and in some cases static lines.	Review the load capacity of the installed walkways by a Structural Engineer. Due to deteriorating condition of the roof structure, upgrades to the roof access should be performed in conjunction with the roof works. Use of aluminium or timber gantries incorporating handrails should be incorporated into the upgrade works. This is generally preferable to the exclusive reliance on static lines as currently in place above the Main Hall.	High	Urgent works to be performed in conjunction with roof remediation works	Included in the above sum.

Backstage cracking and rising damp	Floors	Deterioration resulting from rising damp in multiple areas of the town hall, including throughout the backstage area. Manifested as water staining, mould growth, cracking in walls and subsidence of backstage area suspended slab.	A survey of the subfloor structure should be performed to investigate a suspected water leak, based on the outcome of the investigation remedial works may be required. Subject to the cause of the water presence it is expected that installation of subfloor ventilation with address rising damp deterioration observed within the backstage area and main hall and other sealed off areas found to have insufficient subfloor ventilation. If found to be more severe, repairs to the damp proof course or electrochemical damp course treatment may be required.	Moderate	Inspect within the next 12 months.	$250,000
Waterproofing and Concrete Repairs to Council Building Deck	Landing (External above stairs)	Cracking, moisture staining and efflorescence was observed in the main hall column W5. External inspection of the soffit of this walkway identified concrete spalling and reinforcement corrosion. This deterioration is due to inadequate waterproofing.	Concrete patch repairs are required to remediate to the walkway soffit. Removal and reinstatement of the waterproofing membrane across the landing including the air conditioner bund area should be performed to prevent further deterioration. It is recommended that remediation to the council building be performed in conjunction with the external staircase works.	Moderate	12 months	$175,000
External Staircase Concrete Reinforcement Corrosion	Stairs (External)	The reinforced concrete stairs are in poor condition and are at a risk of continued carbonation induced reinforcement corrosion, resulting in further delamination and spalling.	Significant concrete repairs are required to all stringers and to the columns supporting stairs. Remediation of the railing base posts should be conducted in conjunction with these works. Protective concrete coating application is required to the walls beneath the stairs to prevent future corrosion and spalling. Application of a protective coating is required on the railings to prevent further corrosion.	Moderate	12 months	$230,000

Table 2 – Recommendations identified for the Main Hall

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Render cracking	Wall - Column W3 Column W4	G26	Cracking Present in render reflecting brickwork.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Spalling of render around lintel and column cornice.	Wall - Window b/w Column W4-5	G26	Spalling of render material.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Spalled cornice detail	Wall - Column S1	F38	Spalling of ornamental plasterwork.	Inspection should be undertaken as part of scheduled maintenance.	Low	Address as part of regular maintenance works.
Spalled cornice details	Column E6; Column W8-9; Column W5-6	G26	Spalling of ornamental plasterwork.	Inspection should be undertaken as part of scheduled maintenance.	Low	Address as part of regular maintenance works.
Electrical services	Compliance	F22	Electrical services exposed and dangling from wall in front of entrance between F22 and F23.	Assessment of redundancy of electrical services and either removal or enclosure within electrical box.	High	Immediate.
Water damage / Ingress	Roof	G26	Gaps in screed along roof line located to the west of the eastern ladder access to the roof of the Main Hall.	Seal to prevent moisture ingress.	Moderate	Address as part of regular maintenance works.
Remaining recommendations for the Main Hall relate to the roof works summarised in Table 1.						
Water damage / Ingress	Roof	G26	Moisture ingress along rafters of the Main Hall pooling around connections at the end of each truss.	Address moisture ingress as part of roof works.	High	Refer to “Timber roof trusses and framing deterioration” in Table 1.
Ceiling cracking from water damage	Wall – Column W1-W10	G26	Cracking resulting from water damage present along west roofline in curved ceiling. Most severe between Column W9 - W10. Damp Patch North of Column W10	Inspection should be undertaken in conjunction with remediation of roof structure.	Moderate	Refer to “Timber roof trusses and framing deterioration” in Table 1.

Pendant light assemblies	Light Assemblies	G26	Construction of the mechanisms used to support the pendant lights within the Main Hall are based on a ratcheting crank handle-based system with a steel bar used to retain the height of the light using wood chocks. This has been mounted through the lower chord and includes cutting away of the chord and ceiling joists to accommodate the handle. This has occurred in truss chords with cracking present, reducing the cross section.	Inspection of the implications of reduced section should be reviewed by a structural engineer. To be conducted in conjunction with roof structure inspection and remedial works.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.
Truss structural cracking	Roof	G26	Splitting was identified in the lower chords on a number of trusses throughout the Main Hall. This includes Truss 8 used to suspend the light assembly.	Structural assessment required in conjunction with strengthening works.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.
Truss structural splitting	Roof	G26	Splitting was identified in the lower chord restraint beams along the full length of the beams. Trusses impacted include 1 (cracking partially obscured by electrical wiring installed for ceiling lighting assembly)	Assessment required in conjunction with remediation works.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.
Gable Ends	Wall / Roof	G26	The stability of the north gable is provided by the ties between the underpurlins and the brickwork if the timber has rotted and the ties, if any, corroded away the parapet is effectively unrestrained against wind and seismic loads as specified in AS1170.	The lateral support of gable walls should be assessed in detail in conjunction with remediation works.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.
Truss structural crushing	Roof	G26	The lower chord restraining beam has moved within truss 1 and is no longer seated correctly on the east side. Concurrently the beam is being crushed into the connection on the west side.	Assessment required in conjunction with remediation works.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.
Rigging access	Safety	G26	Only one connection point on static lines, this assumes that two people will be clipped together on the same point and moving through the roof access at the same point. Structural commentary in this report indicates that the planks used for accessing the roof are not suitable for two persons as is required with the current access system. Furthermore, if an incident occurs there is no safe location to clip onto to rescue the fallen	Installation of suitable access system should be reviewed and upgraded in conjunction with remediation works.	High	Refer to "Roof access" in Table 1.

			person as the lifeline is above the reach of people to clip on and off without the use of a second anchor.			

Table 3 - Recommendations identified for the East Wing.

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Cracking	Ceiling	F28	Cracking on ceiling near east wall	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking	Wall	F28A	Cracking around lintel on the east wall.	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking	Wall	F25A	Cracking along north wall mid height.	An investigation is recommended to review likely causes of cracking before cracking is sealed.	Low	Address as part of regular maintenance works.
Cracking	Wall	F27	Cracking present against south chimney wall.	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Ceiling	F27	Inspection of the façade identified a gap between the original wall line and concrete lift construction. A metal angle was installed partially covering this gap. As it is unsealed, water ingress and further water damage on wall joining lift shaft and to rooms below will likely occur.	It is recommended that the construction joint be injected with sealant or channel extended to encapsulate the area.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Wall	F29	Water ingress above switchboard adjoining elevator shaft / F27 room.	As per above item.	Low	Address as part of regular maintenance works.
Cracking	Wall	G64	Cracking in cornice above entry to G63	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.

Cracking	Wall	G61	Cracking present on south and west walls	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking	Wall	G60	Cracking in north west, north east corner and cracking in south east corner. Damage to wall and ceiling cornices in south west corner	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Wall	G59	Paint blistering along cornice of south wall adjoining G61	Remediate during scheduled maintenance.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Wall	G55A	Cracking along frame of east wall and associated water damage	Inspection of water ingress location and sealing during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking	Wall	G55B	Cracking along east wall and south wall	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.

Table 4 - Recommendations identified for the West Wing.

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Structural / Water Damage ingress	Ceiling	F8/F9	Water damage present at connections from rafters to wall line. West wall is out of plumb by 20 mm over 2 metres. Cracking present on west wall.	Investigation of roof condition advised to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.
Compliance	Compliance	F3	Full height windows present at this level. Handrails at 1050 mm height to prevent falls however when considering hobs 250 mm, effective height reduced to 800 mm. Rails do not appear compliant.	Review use of room and recommend replacement of handrails with compliant alternative or isolate area.	Moderate	6 months.
Water damage / Ingress	Ceiling	F8	Water damage on south east corner of room.	Investigation of roof condition advised to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.
Water damage / Ingress	Ceiling	G4	Water damage to ceiling. Damage corresponds to approximate location of male bathroom on level	Inspection of water ingress location and address leaking.	Moderate	Address in the next 3 – 12 months.

			above. Both in south west corner corresponding to toilets and north east corner corresponding to sink.			
Water damage / Ingress	Wall	G7	Lower half of east wall has plaster deterioration and flaking. Deterioration not present above wall mounted shelving. This suggests the damage is pre-existing and not a result of ongoing damage from above waterproofing issues. Unclear if damage is resultant from damp rise within brickwork. Access to server room behind wall was not possible.	Inspection of water ingress location and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Ceiling	G8	Water damage and associated delamination of render exhibiting paint blistering. Water damage also present below windowsill on west side.	Inspection of water ingress location and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.

Table 5 - Recommendations identified for the South Wing.

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Handrail height	Safety	F37	Inadequate handrail heights due to outdated safety requirements. 750mm on stairs, 800mm on landings.	Review safety requirements with consideration made to heritage.	Moderate	12 months.
Water damage / Ingress	Ceiling	G2	Water damage to ceiling resulting in collapse, appears roof had been previously re-plastered with pre-existing plasterwork chocked above new ceiling removed by water damage. No further damage observed. Structural strengthening has occurred within this roof in the form of steel beams being lowered into place from the ceiling above. Each joist has been connected by flanges to the beams located exclusively across G2 and do not extent into G3.	Structural strengthening has been performed. Assessment of design and should be reviewed and confirmed to be appropriate by a structural engineer prior to completion of refurbishment works in G2.	Moderate	Address as part of current G2 refurbishment works.
Manhole access	Safety	F1	Roof access manhole is not secured and does not have a lock out in open position.	Secure the roof hatch or install a lock. Upgrade hinge to one with a lock out.	Low	Address as part of regular maintenance works.

Water damage / Ingress	Ceiling	G1	Water damage resulting in paint flaking and cracking of cornices on ceiling likely due to door being open over extended periods of time.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Remaining recommendations for the South Wing relate to the roof works summarised in Table 1.						
Water damage / Ingress	Wall / Ceiling	F34	Water staining on south wall	Investigation of roof condition to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.
Water damage / Ingress	Wall / Ceiling	F34	Water staining on North wall	Investigation of roof condition to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.
Cracking	Wall	F35	South wall cracking, cracking also present on walls adjoining east to F34.	Investigation of roof condition to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.
Water damage / Ingress	Wall / Ceiling	F36	Water staining on south wall. Water staining to western wall with damp spots on ceiling and below cornice towards south west corner.	Inspection of water ingress location.	High	Address in conjunction with roof works in Table 1.
Movement	Ceiling	F33	Sagging in the ceiling present in the north east corner. Cracking present along west wall. Roof could not be safely accessed. No other damage observed (note that Infracorr was informed that this room had been recently refreshed with deterioration no longer visible).	Investigation of roof condition to prevent further deterioration.	High	Address in conjunction with roof works in Table 1.

Table 6 - Recommendations identified for the Ballantyne Room Building.

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Tie Rod Condition and Waterproofing	Roof	G36	The tie rods were found to have minimal thread. Furthermore, anchor plates do not have apparent membrane or sealant to prevent crevice corrosion. Extensive cracking is present on the façade around the gable end walls with cracking reflecting through brickwork likely the cause of the tie rod fixing works.	Application of a sealant around the anchor plates is recommended to prevent corrosion. Existing cracking in render and façade should be patched and monitored for movement/crack growth.	Moderate	12 months
Cracking	Wall	G36	Vertical cracking on south wall focussed on west corner. Cornice joint dislodged, cracking also present within cornice in centre of wall. Minor cracking on east wall.	As item above.	Moderate	12 months
Deteriorated to chimneys and roof slates	Roof / Façade	G36	Deteriorated roof elements including chimney and missing / damaged slates on roof.	Remediation works to roof elements including waterproofing and reinstatement of chimney grout and render, reconstruct if required.	Moderate	Address in the next 2 years.
Water damage / Ingress	Wall / Ceiling	G38	North end of room experiencing water ingress, staining present on walls and through light fittings. Cracking present along window frame and north end wall.	Inspection of water ingress location, remediate in conjunction with roof remediation works.	Low	Address as part of regular maintenance works.
Cracking	Wall / Ceiling	G38A	Cracking along east wall, adjoining G38B.	Investigation of roof condition to prevent further deterioration.	Low	Address as part of regular maintenance works.
Cracking	Wall	G38B	South wall cracking, likely the same mechanism as found in the Ballantyne Room G26.	Investigation of roof condition to prevent further deterioration.	Low	Address as part of regular maintenance works.

Remaining recommendations for the Ballantyne Room Building relate to the roof works summarised in Table 1.						
Water damage / Ingress	Roof, Wall and Ceiling	G36	North end of room experiencing water ingress, staining present on walls and through light fittings. Cracking present around window frame in north west corner with water damage present internally on cornice along west wall.	Inspection of the roof structure for deterioration of trusses and the tie rods should be performed.	High	Refer to "Timber roof trusses and framing deterioration" in Table 1.

Table 7 - Recommendations identified for the ANAM Buildings (East Annex).

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
No handrails on service entrance platform.	Safety	G49	No handrails are present along loading facility. Doorways are accessible and open. This is not safe.	Install removable handrail or restrict access through area.	High	Immediate.
Water damage / Ingress	Ceiling	F32	Water damage to east wall in southern end of room. Also present along ceiling.	Inspection of water ingress location, remediate in conjunction with roof inspection works.	Low	Address as part of regular maintenance works.

Table 8 - Recommendations identified for the Council Buildings (West Annex).

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Water damage / Ingress	Walls	G15	Water damage to east wall in southern end of room. Also present along ceiling.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking	Wall	F17	Cracking around lintel and along north cornice of room, likely resultant from air conditioner services positioned off centre from northern wall line.	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.

Cracking	Wall	F19	External cracking around north eastern corner of façade	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking with water damage	Wall	F18	Horizontal wall cracking to east wall reflecting through to external façade.	Condition to be monitored and patched during scheduled maintenance.	Low	Address as part of regular maintenance works.
Waterproofing on external landing.	Landing / Roof	F8/F9	Waterproofing membrane is not present behind pipes and vents installed adjoining F8 and along upstand of F17 likely acting as a location for water ingress below waterproofing membrane.	Issue to be addressed when applying new waterproofing to Council Building Deck.	Low	Refer to "Waterproofing and Concrete Repairs to Council Building Deck" in Table 1.
Water damage / Ingress	Ceiling	G16	Bathroom ceiling exhibiting water damage along east edge of roof line.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Cracking with water damage	Wall	G20	Cracking on wall around window lintel.	Condition to be monitored and remediated during scheduled maintenance.	Low	Address as part of regular maintenance works.
Water damage / Ingress	Ceiling	F12	Water staining in room around all cornices and across ceiling of the room. Water damage likely due to slate roof pointing deterioration. Water damage to façade likely leading to water damage internally due to embedded external drain arrangement.	Inspection or the roof is recommended to determine source of water ingress, condition expected to deteriorate further if left unattended.	Moderate	Address in the next 3 – 12 months.
Water damage / Ingress	Wall	F14	Cracking on north wall adjacent to window lintel, cracking appears to have been repaired and cracked again. Water staining on wall adjacent	Inspection of water ingress location, remediate in conjunction with roof inspection works.	Low	Address as part of regular maintenance works.

Table 9 - Recommendations identified for Building Services (External Platforms)

Defect	Element	Room	Details	Recommendation	Priority	Timeframe
Unsafe welding practices	Compliance	F2	A Hook and rod were used as a bracket to support the roof access above F2.	Remove unsafe fixing arrangement and install appropriate bracket.	High	Urgent works
Unsafe welding practices	Compliance	F2	A handrail has been used to provide a weld connection to support the roof access above F1/F2.	Remove unsafe fixing arrangement and install appropriate bracket.	High	Urgent works

13 SUMMARY

Of primary concern is the roof structure across all buildings. Rot in the ends of the roof trusses, where they are built into the wall, has reduced the capacity of the trusses to support the roof loads, and provide stability to the brick walls. It appears that there has been previous attempt to strengthen the timber trusses with the addition of steel frames bolted to the sides of some of the trusses. Unfortunately, this work should have been undertaken on all the trusses.

Changing roofing from tiles to colorbond roof sheeting has in some cases caused the roof loads to be out of balance putting additional stress on the connections between the bottom chords and the Queen Posts. This connection has been further stressed by the addition of ceilings to the bottom chord or the addition of extra layers of ceiling. The reduction in the weight of the roofing material requires the rafters and underpurlins to be tied down to the trusses and eventually the walls. From the inspection it appears that the tie down of the roof has not been accounted for in previous works.

Previous repairs performed to the gable walls of the Ballantyne room building should be regularly monitored by periodically recording crack width to confirm that repairs have been effective. A similar monitoring program should be employed for significant cracks throughout outer walls of buildings once repairs to the roof structure and completed.

Damp under the floor in rooms G27 to G33 need to be investigated as it is potentially leading to rot in the subfloor structure and potential foundation movement causing cracking in the walls over. In general, subfloor ventilation should be reviewed to ensure high levels of humidity do not lead to termite, rot or fungal issues with the timber framing.

Water on the concrete landing between the Main Hall and the West Wing has been seeping into the Main Hall and causing concrete cancer on the soffit of the deck needs to be attended to.

Deterioration of the external staircase should be addressed to ensure further accelerated deterioration is prevented.

APPENDICES

APPENDIX A: INVESTIGATION PHOTOS

Figure 1 AB-F32-W-001 P1040090

Figure 2 AB-F32-W-002 P1040094

Figure 3 AB-G49-S-001 P1050373

Figure 4 AB-G49-S-002 P1050748

Figure 5 BB-G36-F-001 P1040432

Figure 7 BB-G36-F-003 P1040454

Figure 6 BB-G36-F-002 P1040318

Figure 8 BB-G36-F-004 P1040471

Figure 9 BB-G36-F-005 P1040474

Figure 11 BB-G36-W-0002-20200316 (2)

Figure 10 BB-G36-W-0001-20200316 (1)

Figure 12 BB-G36-W-0003-20200316 (3)

Figure 13 BB-G36-W-0004-20200316 (8)

Figure 15 BB-G36-W-0006-20200316 (14)

Figure 14 BB-G36-W-0005-20200316 (13)

Figure 16 BB-G36-W-0007-20200316 (4)

Figure 17 BB-G36-W-0008-20200316 (7)

Figure 18 BB-G36-W-0009-20200316 (6)

Figure 19 BB-G36-W-001 P1030980

Figure 20 BB-G36-W-0010-20200316 (9)

Figure 21 BB-G36-W-0011-20200316 (1)

Figure 23 BB-G36-W-0013

Figure 22 BB-G36-W-0012-20200316 (10)

Figure 24 BB-G36-W-0014-20200316 (11)

Figure 25 BB-G36-W-0015-20200316 (12)

Figure 27 BB-G36-W-0017

Figure 26 BB-G36-W-0016-20200316 (5)

Figure 28 BB-G36-W-002 P1030996

Figure 29 BB-G36-W-0021

Figure 30 BB-G36-W-0022

Figure 31 BB-G38B-W-001 P1040032

Figure 32 BB-G38D-W-0001

Figure 33 BB-G38-F-001 P1050593

Figure 34 BB-G38-F-002 P1050615

Figure 35 BB-G38-F-004 P1050625

Figure 36 BB-G38-F-005 P1050628

Figure 37 BB-G38-F-006 P1040441

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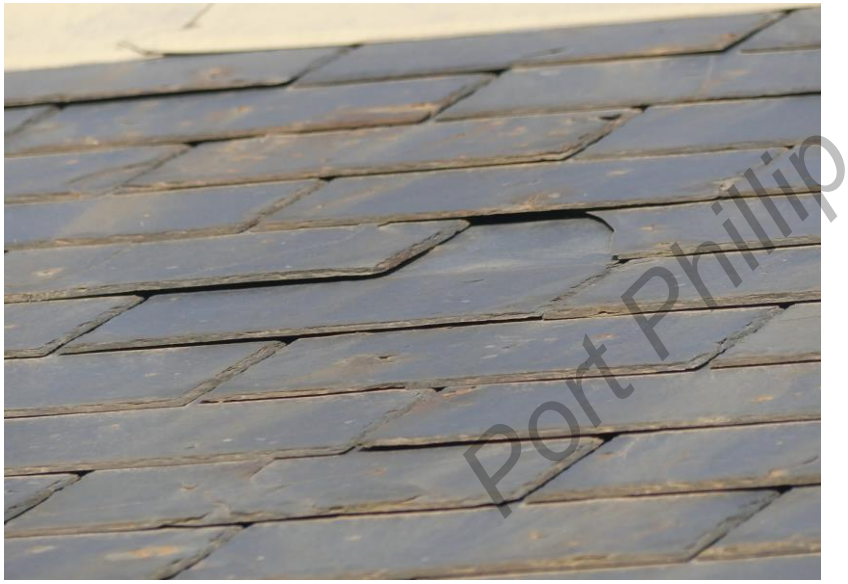

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Figure 40 BB-G38-W-001 P1040018

Figure 41 BB-G38-W-002 P1040013

Figure 43 BS1-G25-W-003 P1050634

Figure 42 BS1-G25-S-001 P1040660

Figure 44 BS1-G26-W-001 P1050554

Figure 45 BS1-G26-W-002 P1050557

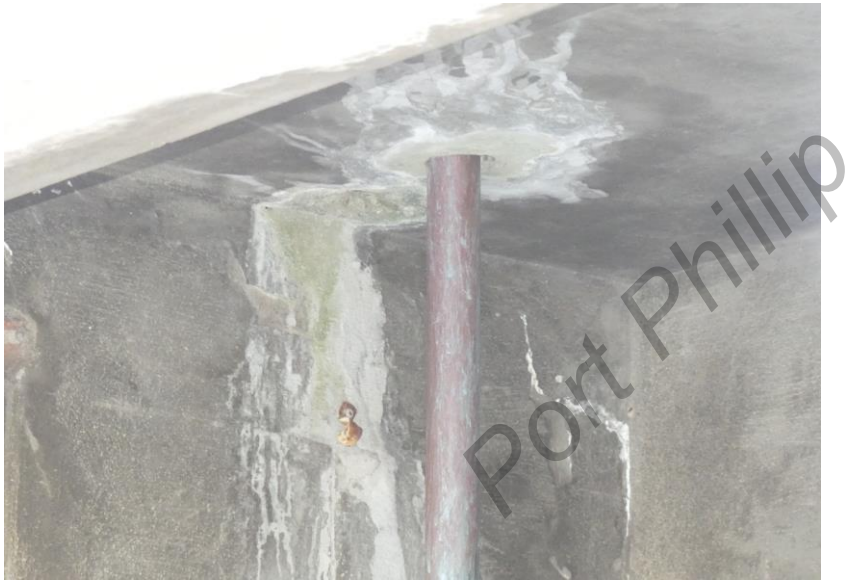

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Figure 48 BS2-F02-S-001 P1050516

Figure 49 BS2-F02-S-002 P1050513

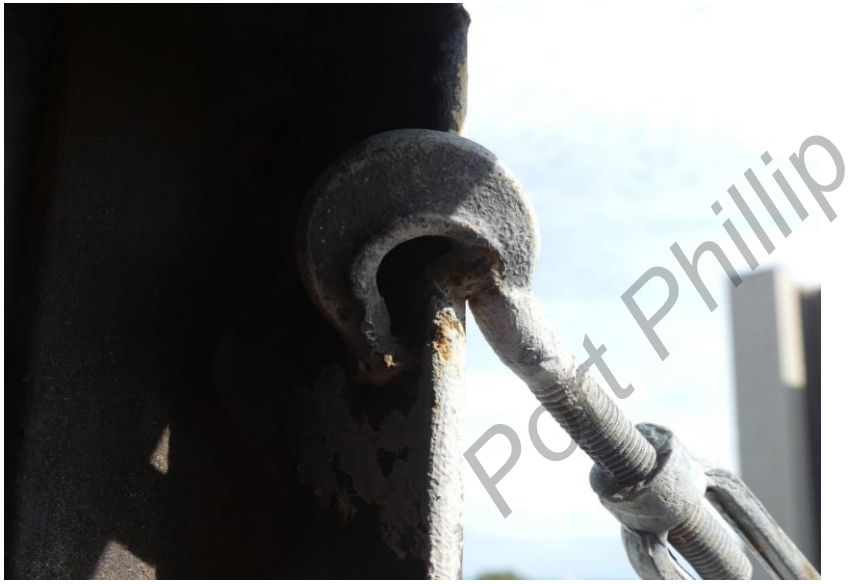

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Figure 51 BS2-F02-S-004 P1050514

Figure 52 CB-EXTERNAL-0001-20200326 (11)

Figure 53 CB-EXTERNAL-0002-20200326 (1)

Figure 54 CB-EXTERNAL-0003-20200326 (14)

Figure 55 CB-EXTERNAL-0004-20200326 (13)

Figure 56 CB-EXTERNAL-0005-20200326 (12)

Figure 57 CB-EXTERNAL-0006-20200326 (2)

Figure 59 CB-EXTERNAL-0008-20200326 (4)

Figure 58 CB-EXTERNAL-0007-20200326 (3)

Figure 60 CB-EXTERNAL-0009-20200326 (5)

Figure 61 CB-EXTERNAL-0010 (2)

Figure 62 CB-EXTERNAL-0011 (3)

Figure 63 CB-EXTERNAL-0012 (8)

Figure 64 CB-EXTERNAL-0013 (1)

Figure 65 CB-F08-F-001 P1050574

Figure 66 CB-F08-F-002 P1050577

Figure 67 CB-F08-F-003 P1050545

Figure 68 CB-F08-W-9001 (34)

Figure 69 CB-F11-W-0001 (7)

Figure 71 CB-F12-C-002 P1050468

Figure 70 CB-F12-C-001 P1050463

Figure 72 CB-F12-F-001 P1050692(2)

Figure 73 CB-F12-F-002 P1050693(2)

Figure 75 CB-F12-F-004 P1050709

Figure 74 CB-F12-F-003 P1050697

Figure 76 CB-F12-F-005 P1050706

Figure 77 CB-F12-W-0001 (6)

Figure 79 CB-F14-W-0001 (4)

Figure 78 CB-F12-W-0002 (5)

Figure 80 CB-F14-W-0002

Figure 81 CB-F17-F-001 P1040661

Figure 83 CB-G15-F-001 P1040623

Figure 82 CB-F18-F-001 P1040595

Figure 84 CB-G15-W-001 P1040559

Figure 85 CB-G23-R-001 P1050775

Figure 87 CB-G23-S-001 P1050649

Figure 86 CB-G23-R-002 20200326_114308

Figure 88 CB-G25-C-001 P1040640

Figure 89 EW-F24-W-9001 (7)

Figure 91 EW-F24-W-9002 (8)

Figure 90 EW-F24-W-9001

Figure 92 EW-F24-W-9002

Figure 93 EW-F24-W-9003 (9)

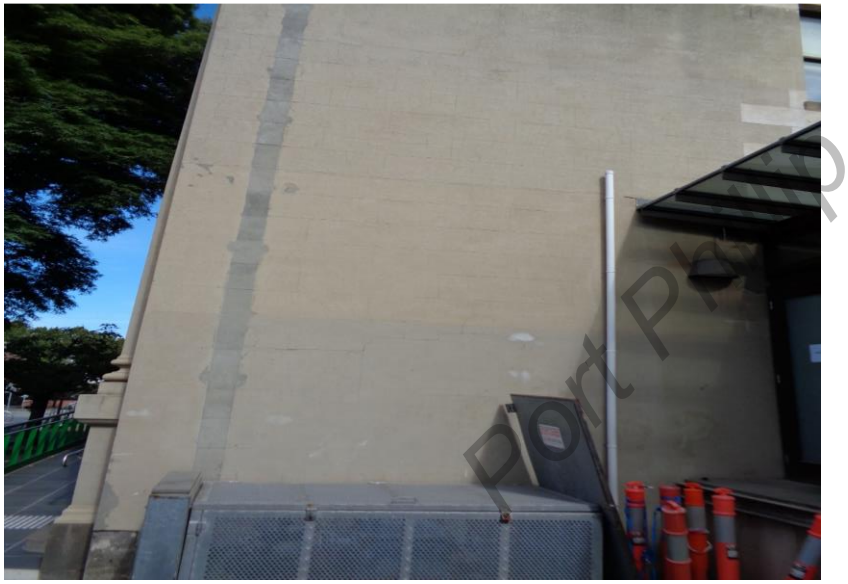
Figure 95 EW-F24-W-9005 (11)

Figure 94 EW-F24-W-9004 (10)

Figure 96 EW-F25B-W-9001 (3)

Figure 97 EW-F25B-W-9002 (7)

Figure 99 EW-F25B-W-9004 (6)



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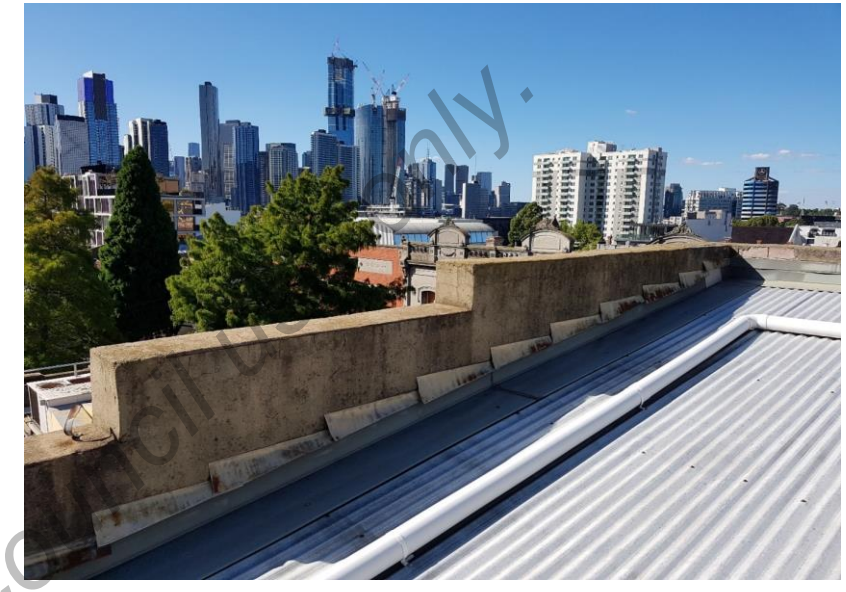

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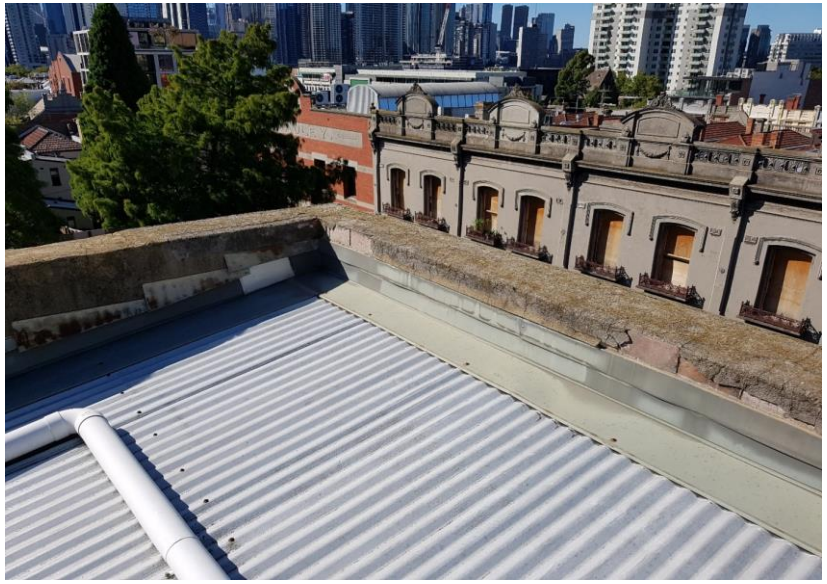

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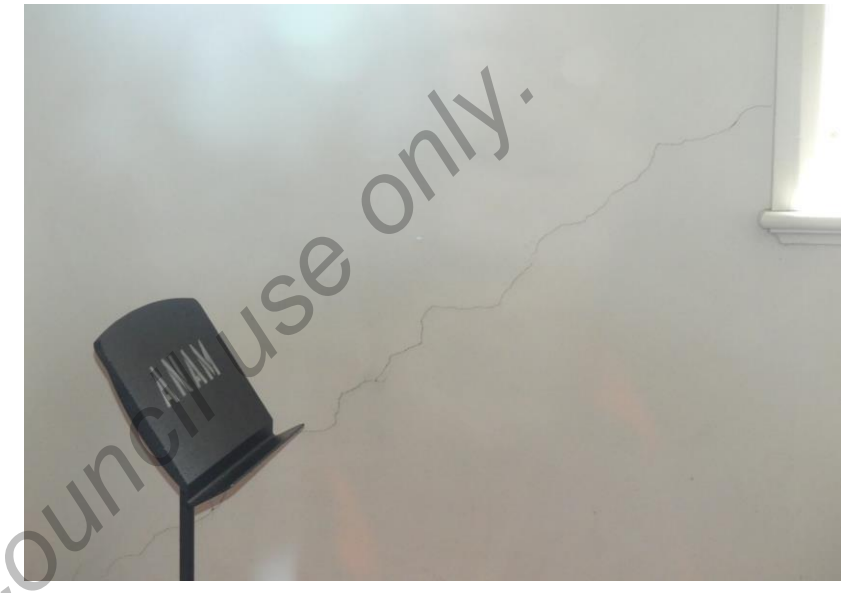

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Figure 106 EW-F25-F-001 P1050750

Figure 108 EW-F27-C-9001

Figure 109 EW-F27-F-001 P1050618

Figure 111 EW-F28A-F-001 P1050744

Figure 110 EW-F27-W-001 P1040129

Figure 112 EW-F28A-W-001 P1040119

Figure 113 EW-F33-R-9001 (23)

Figure 115 EW-F33-R-9003 (21)

Figure 114 EW-F33-R-9002 (22)

Figure 116 MH-F21-W-9001-20200316

Figure 117 MH-F21-W-9002-20200316

Figure 118 MH-F21-W-9003-20200316

Figure 119 MH-F21-W-9004 (6)

Figure 120 MH-F21-W-9005 (7)

Figure 121 MH-F23-C-001 P1040410

Figure 123 MH-F23-W-9001-20200316

Figure 122 MH-F23-W-001 P1040421

Figure 124 MH-F23-W-9002-20200316

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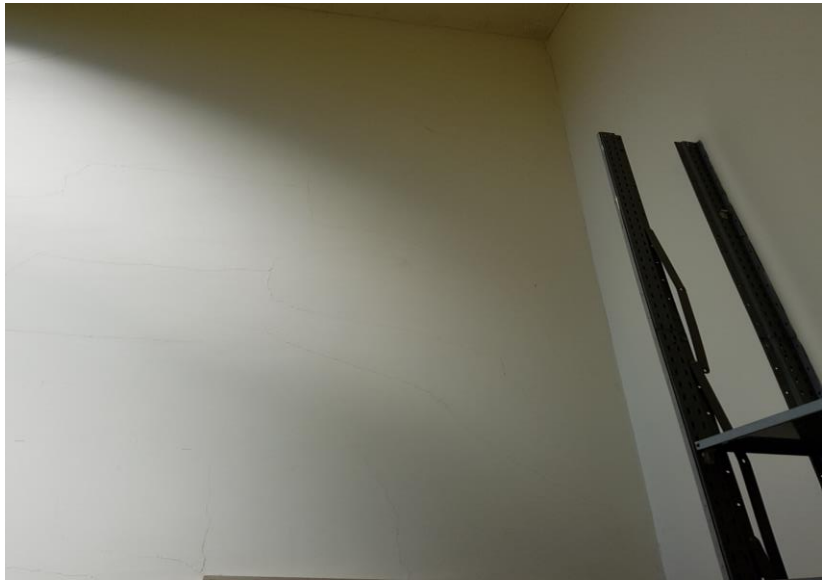

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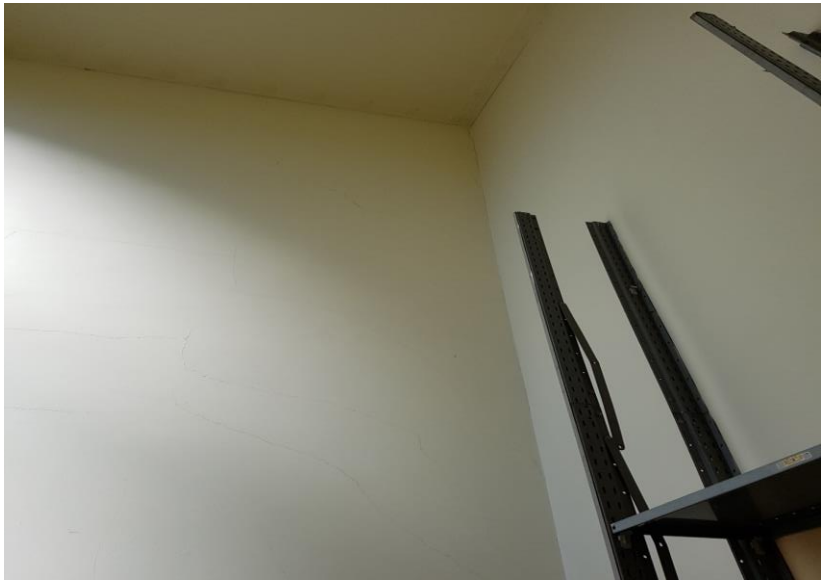

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Figure 132 MH-G26-F-001 (E) P1040305

Figure 133 MH-G26-F-002 (W) P1040325

Figure 134 MH-G26-F-9001-20200316 (28)

Figure 135 MH-G26-R-001 P1030975

Figure 136 MH-G26-R-002 (W1) P1040167

Figure 137 MH-G26-R-003 P1040169

Figure 139 MH-G26-R-005 (W2) P1040178

Figure 138 MH-G26-R-004 (W2) P1040174

Figure 140 MH-G26-R-006 (W10) P1040243

Figure 141 MH-G26-R-007 (W10) P1040245

Figure 142 MH-G26-R-008 (E6) P1040253

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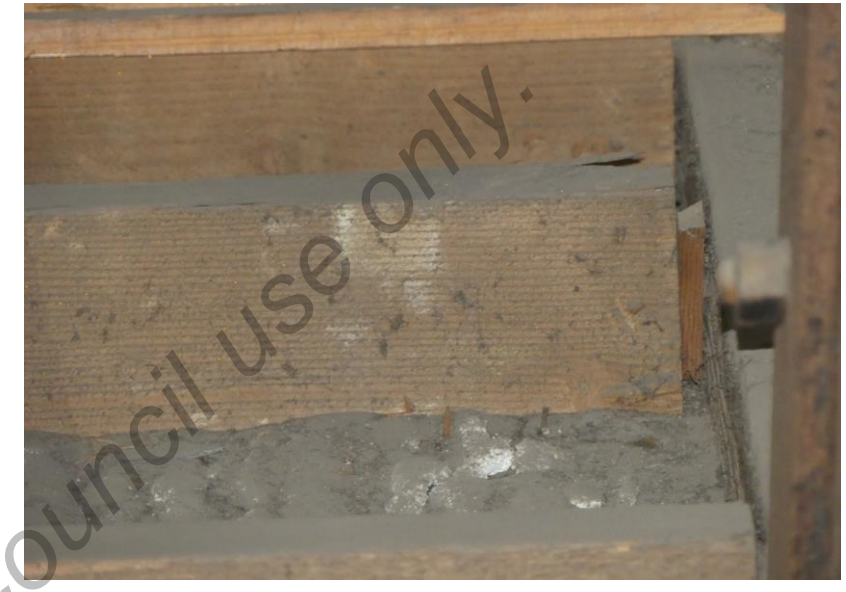

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Figure 148 MH-G26-R-014 P1040292

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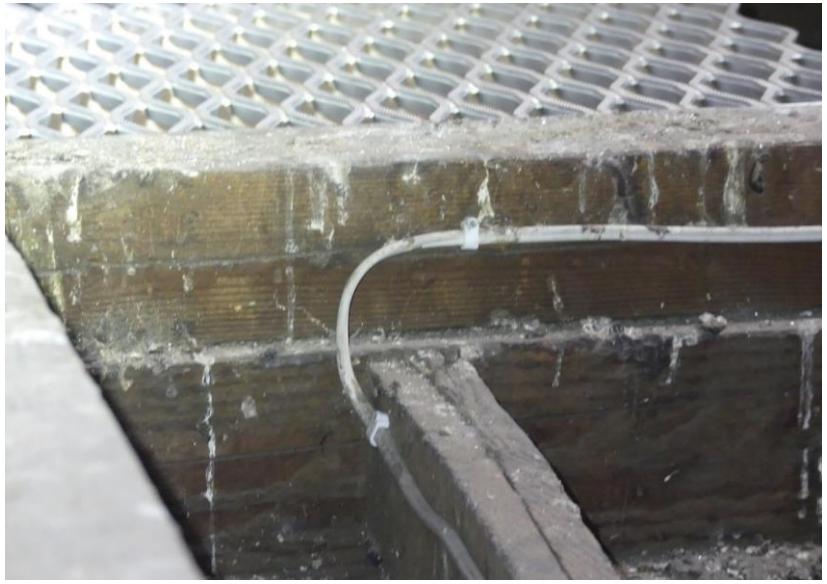

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Figure 153 MH-G26-R-019 (W1) P1040689

Figure 155 MH-G26-R-021 (E1) P1040711

Figure 154 MH-G26-R-020 (W1) P1040695

Figure 156 MH-G26-R-022 (E2) P1040716

Figure 157 MH-G26-R-023 (E3) P1040719

Figure 158 MH-G26-R-024 (E4) P1040721

Figure 159 MH-G26-R-025 (E5) P1040725

Figure 160 MH-G26-R-026 (E6) P1040728

Figure 161 MH-G26-R-027 (E7) P1040730

Figure 163 MH-G26-R-029 (E9) P1040736

Figure 162 MH-G26-R-028 (E8) P1040733

Figure 164 MH-G26-R-030 (E10) P1040742

Figure 165 MH-G26-R-031 (W10) P1040746

Figure 167 MH-G26-R-033 (W8) P1040751

Figure 166 MH-G26-R-032 (W9) P1040749

Figure 168 MH-G26-R-034 (W7) P1040755

Figure 169 MH-G26-R-035 (W6) P1040758

Figure 171 MH-G26-R-037 (W4) P1040763

Figure 170 MH-G26-R-036 (W5) P1040760 NEED A NON BLURRY PHOTO

Figure 172 MH-G26-R-038 (W3) P1040766

Figure 173 MH-G26-R-039 (W2) P1040770

Figure 175 MH-G26-R-041 P1040775

Figure 174 MH-G26-R-040 (W1) P1040774

Figure 176 MH-G26-R-042 P1040776

Figure 177 MH-G26-R-043 P1040777

Figure 179 MH-G26-R-045 P1040779

Figure 178 MH-G26-R-044 P1040778

Figure 180 MH-G26-R-9001-20200316 (63)

Figure 181 MH-G26-R-9002-20200316 (64)

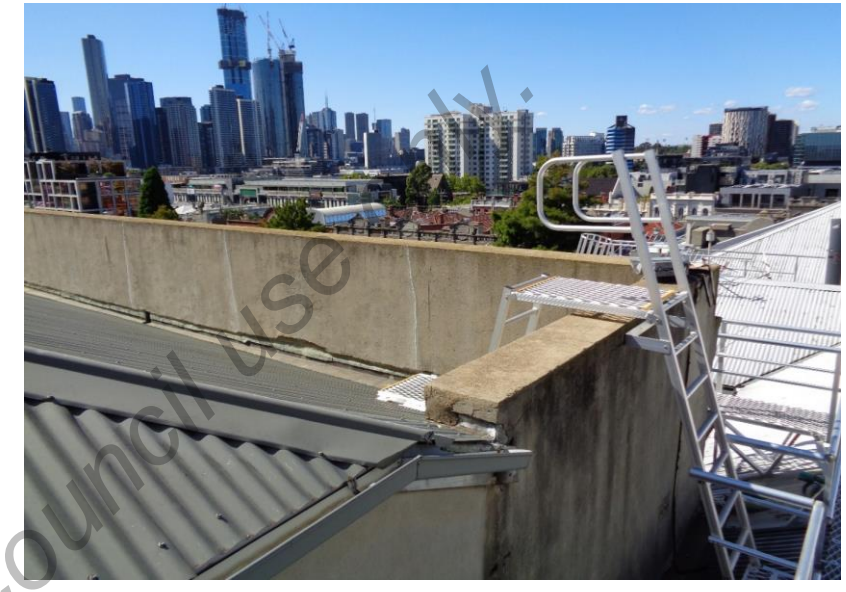

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Figure 185 MH-G26-R-9202-20200316 (54)

Figure 187 MH-G26-R-9204-20200316 (46)

Figure 186 MH-G26-R-9203-20200316 (45)

Figure 188 MH-G26-R-9205-20200316 (43)

Figure 189 MH-G26-R-9206-20200316 (44)

Figure 191 MH-G26-R-9208-20200316 (48)

Figure 190 MH-G26-R-9207-20200316 (47)

Figure 192 MH-G26-R-9209-20200316 (49)

Figure 193 MH-G26-R-9210-20200316 (50)

Figure 195 MH-G26-R-9212-20200316 (12)

Figure 194 MH-G26-R-9211-20200316 (51)

Figure 196 MH-G26-R-9221-20200316 (9)

Figure 197 MH-G26-R-9222-20200316 (10)

Figure 199 MH-G26-R-9301-20200316 (52)

Figure 198 MH-G26-R-9223-20200316 (11)

Figure 200 MH-G26-R-9302-20200316 (36)

Figure 201 MH-G26-R-9303-20200316 (34)

Figure 202 MH-G26-R-9303-20200316 (35)

Figure 203 MH-G26-R-9304-20200316 (42)

Figure 204 MH-G26-R-9305-20200316 (41)

Figure 205 MH-G26-R-9306-20200316 (40)

Figure 207 MH-G26-R-9308-20200316 (38)

Figure 206 MH-G26-R-9307-20200316 (39)

Figure 208 MH-G26-R-9401-20200316 (37)

Figure 209 MH-G26-R-9402

Figure 211 MH-G26-R-9404-20200316 (32)

Figure 210 MH-G26-R-9403-20200316 (33)

Figure 212 MH-G26-R-9405-20200316 (31)

Figure 213 MH-G26-R-9431-20200316 (5)

Figure 214 MH-G26-R-9432-20200316 (4)

Figure 215 MH-G26-R-9433-20200316 (6)

Figure 216 MH-G26-R-9434-20200316 (7)

Figure 217 MH-G26-R-9435-20200316 (8)

Figure 219 MH-G26-S-002 P1040184

Figure 218 MH-G26-S-001 P1040181

Figure 220 MH-G26-S-003 P1040189

Figure 221 MH-G26-S-004 P1040208

Figure 223 MH-G26-S-006 (W10) P1040230

Figure 222 MH-G26-S-005 (W8) P1040222

Figure 224 MH-G26-W-001 P1030919

Figure 225 MH-G26-W-002 P1030924

Figure 227 MH-G26-W-9001-20200316

Figure 226 MH-G26-W-003 P1050563

Figure 228 MH-G26-W-9002-20200316

Figure 229 MH-G26-W-9003

Figure 230 MH-G26-W-9101 (1)

Figure 231 MH-G26-W-9102 (2)

Figure 232 MH-G26-W-9103 (3)

Figure 233 MH-G26-W-9104 (4)

Figure 235 MH-G26-W-9106-20200316

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Figure 236 MH-G26-W-9201

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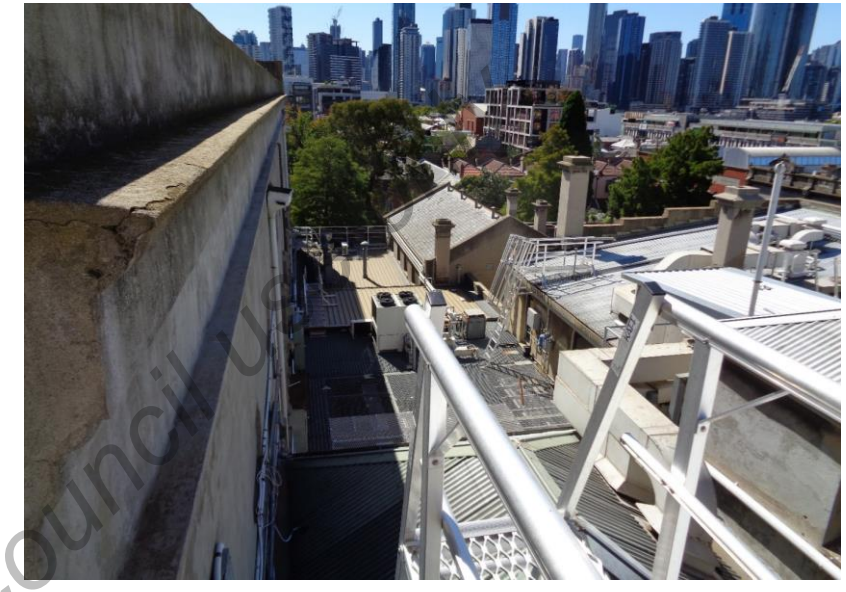

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Figure 243 MH-G26-W-9223-20200316 (61)

Figure 242 MH-G26-W-9222-20200316 (60)

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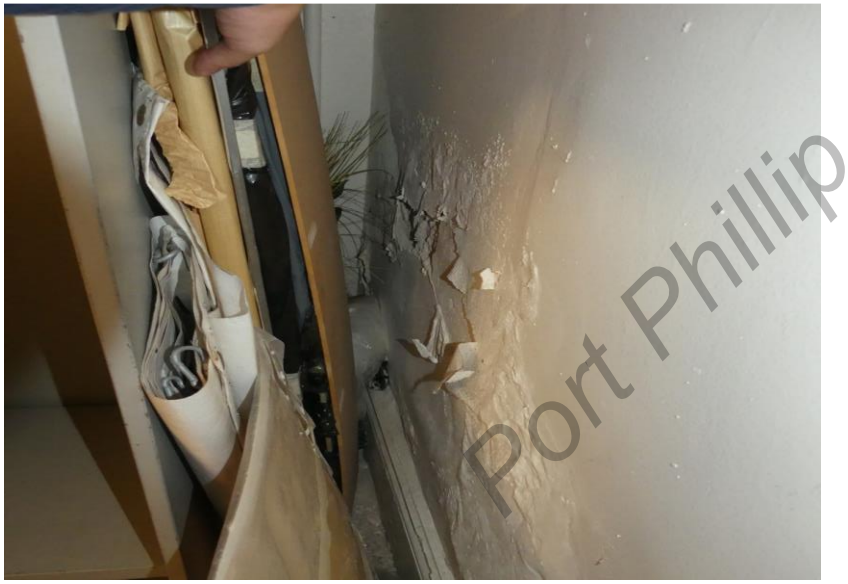

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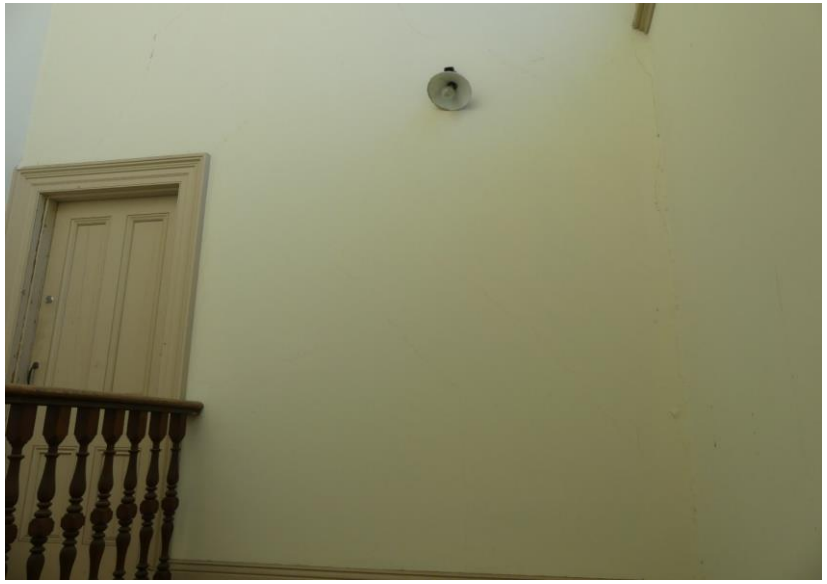

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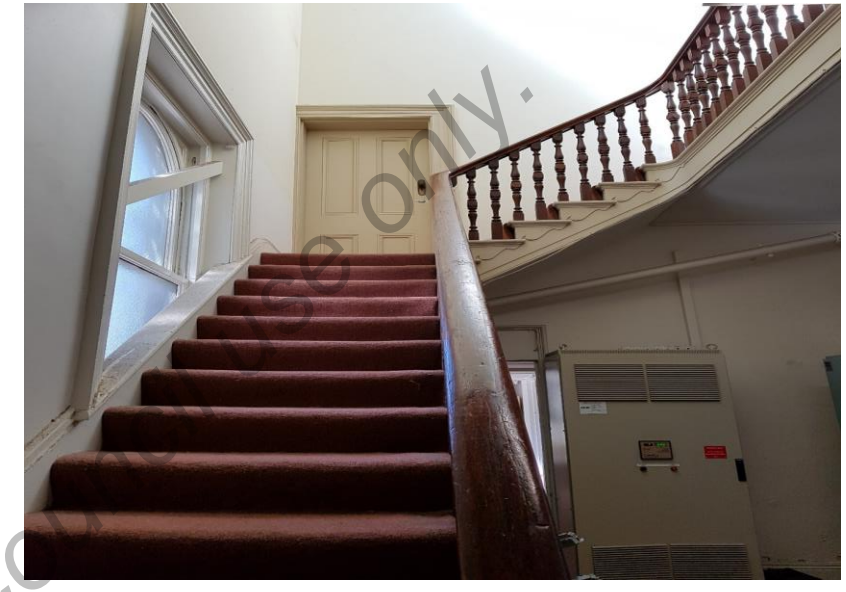

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Figure 263 SW-F02-R-006 P1050191

Figure 262 SW-F02-R-005 P1050200

Figure 264 SW-F02-R-007 P1050224

Figure 265 SW-F02-R-9001 (53)

Figure 267 SW-F02-R-9003 (51)

Figure 266 SW-F02-R-9002 (52)

Figure 268 SW-F02-R-9004 (50)

Figure 269 SW-F02-R-9005 (17)

Figure 271 SW-F02-R-9101 (22)

Figure 270 SW-F02-R-9006 (22)

Figure 272 SW-F02-R-9102 (31)

Figure 273 SW-F02-R-9103 (23)

Figure 274 SW-F02-R-9104 (37)

Figure 275 SW-F02-R-9105 (38)

Figure 276 SW-F02-R-9106 (24)

Figure 277 SW-F02-R-9107 (36)

Figure 279 SW-F02-R-9202 (26)

Figure 278 SW-F02-R-9201 (25)

Figure 280 SW-F02-R-9203 (27)

Figure 281 SW-F02-R-9204 (28)

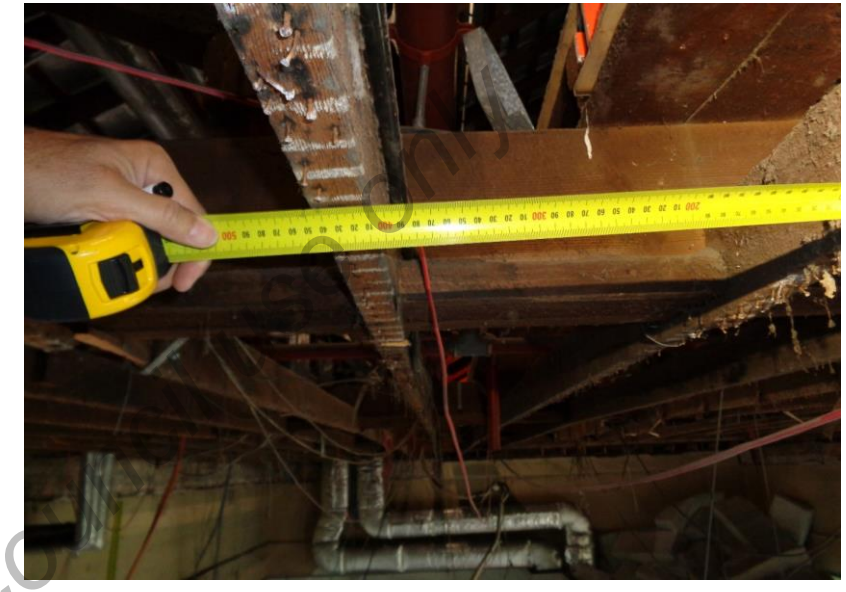


Figure 283 SW-F02-R-9206 (30)

Figure 282 SW-F02-R-9205 (29)

Figure 284 SW-F02-R-9207 (32)

Figure 285 SW-F02-R-9208 (33)

Figure 287 SW-F02-R-9210 (35)

Figure 286 SW-F02-R-9209 (34)

Figure 288 SW-F02-R-9211 (39)

Figure 289 SW-F02-R-9301 (40)

Figure 291 SW-F02-R-9303 (42)

Figure 290 SW-F02-R-9302 (41)

Figure 292 SW-F02-R-9304 (44)

Figure 293 SW-F02-R-9305 (45)

Figure 295 SW-F02-R-9307 (2)

Figure 294 SW-F02-R-9306 (46)

Figure 296 SW-F02-R-9307 (43)

Figure 297 SW-F02-R-9308 (3)

Figure 299 SW-F02-R-9310 (47)

Figure 298 SW-F02-R-9309 (4)

Figure 300 SW-F02-R-9311 (48)

Figure 301 SW-F02-R-9312 (49)

Figure 303 SW-F02-R-9402 (11)

Figure 302 SW-F02-R-9401 (12)

Figure 304 SW-F02-R-9403 (13)

Figure 305 SW-F02-R-9404 (5)

Figure 307 SW-F02-R-9406 (7)

Figure 306 SW-F02-R-9405 (6)

Figure 308 SW-F02-R-9407 (16)

Figure 309 SW-F02-R-9408 (17)

Figure 311 SW-F02-R-9410 (14)

Figure 310 SW-F02-R-9409 (15)

Figure 312 SW-F02-R-9411 (9)

Figure 313 SW-F02-R-9412 (10)

Figure 315 SW-F02-R-9501 (18)

Figure 314 SW-F02-R-9413 (8)

Figure 316 SW-F02-R-9502 (19)

Figure 317 SW-F02-R-9503 (20)

Figure 319 SW-F32-S-001 P1050675

Figure 318 SW-F02-R-9601 (21)

Figure 320 SW-F34-R-001 P1050664

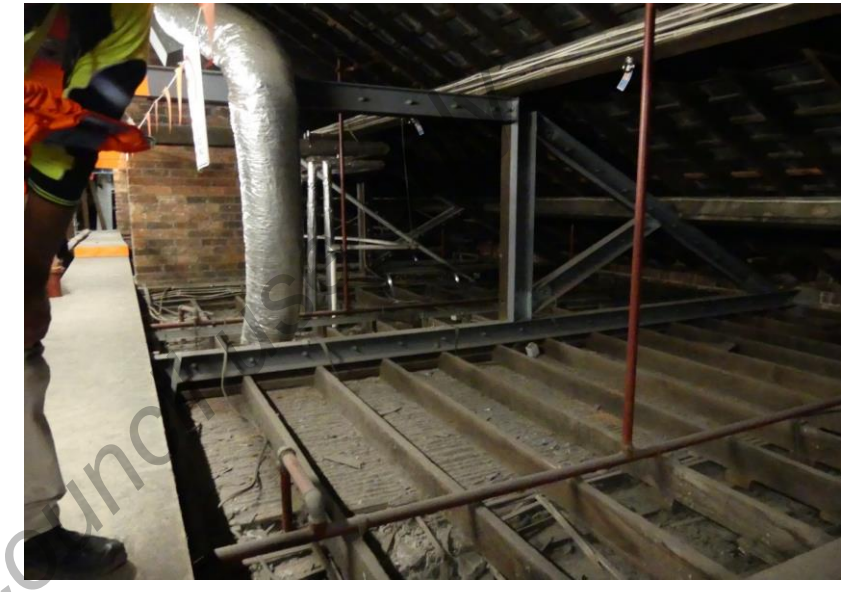
Figure 321 SW-F34-R-002 P1050050

Figure 323 SW-F34-W-001 P1040059

Figure 322 SW-F34-R-003 P1050058

Figure 324 SW-F34-W-002 P1040061

Figure 325 SW-F35-R-001 P1050661



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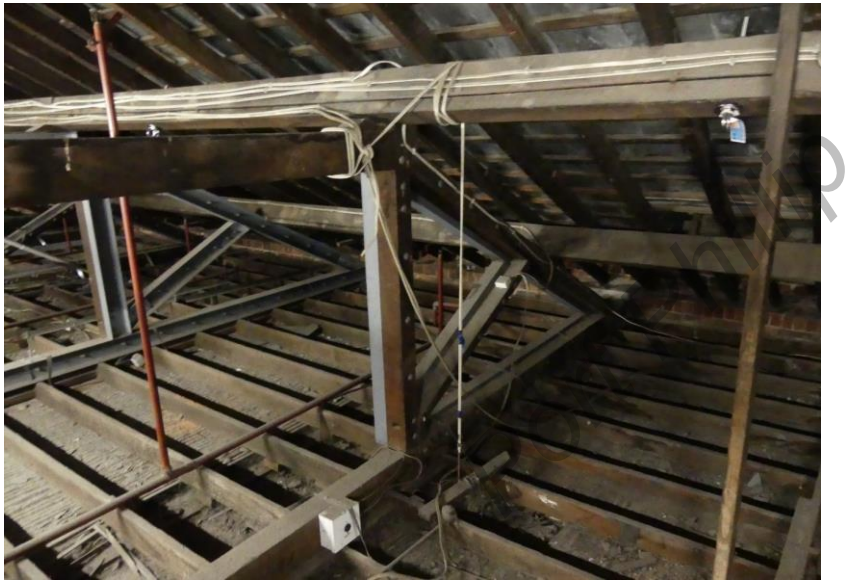

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Figure 329 SW-F36-W-001 P1040076

Figure 331 SW-F37-R-9002 (14)

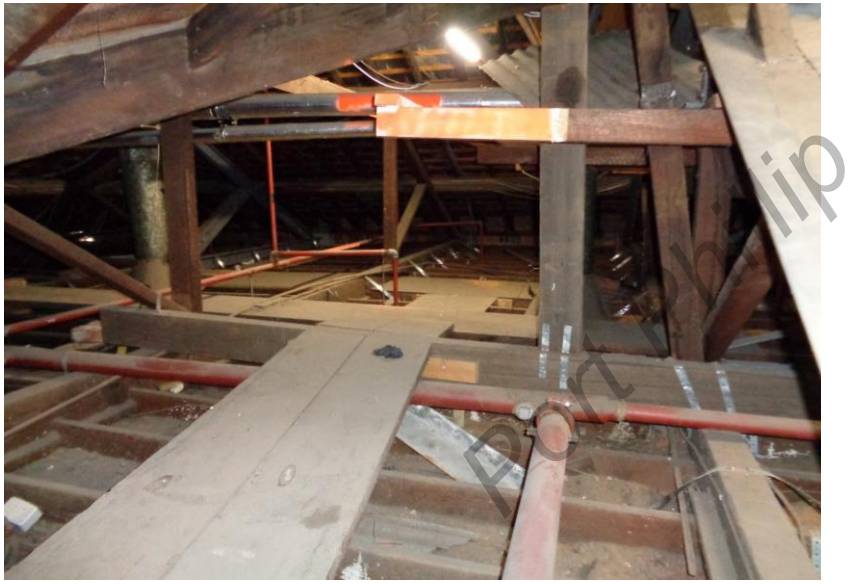

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Figure 332 SW-F37-R-9003 (13)

Figure 333 SW-F37-R-9004 (12)

Figure 335 SW-F37-R-9006 (10)

Figure 334 SW-F37-R-9005 (11)

Figure 336 SW-F37-R-9007 (9)

Figure 337 SW-F37-R-9008 (8)

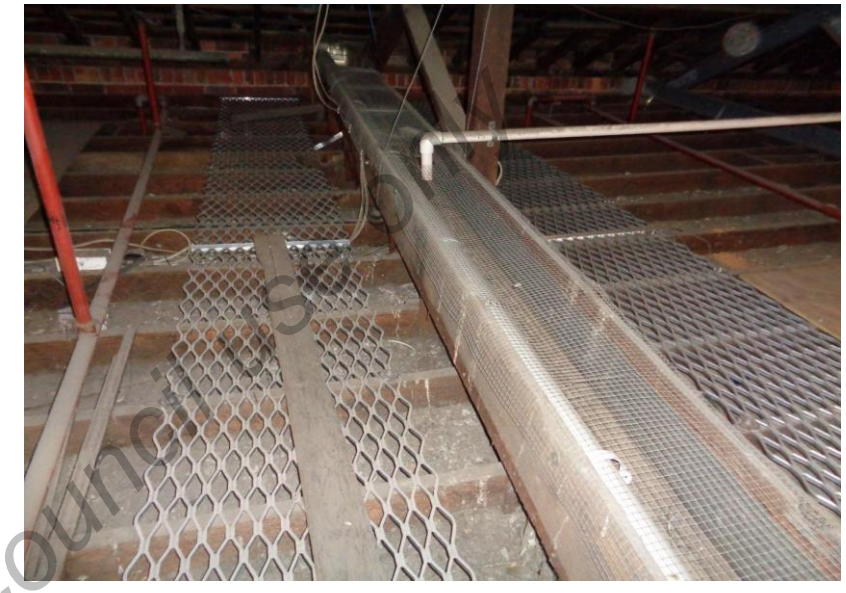

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Figure 341 SW-F37-R-9012 (4)

Figure 343 SW-F37-R-9014 (2)

Figure 342 SW-F37-R-9013 (3)

Figure 344 SW-F37-R-9015 (1)

Figure 345 SW-F37-R-9016 (25)

Figure 347 SW-F37-R-9018 (16)

Figure 346 SW-F37-R-9017 (24)

Figure 348 SW-F37-R-9019 (18)

Figure 349 SW-F37-R-9020 (19)

Figure 350 SW-F37-R-9021 (20)

Figure 351 SW-FACADE-W-9001 (37)

Figure 352 SW-FACADE-W-9002 (36)

Figure 353 SW-FACADE-W-9003 35)

Figure 354 SW-FACADE-W-9004 (34)

Figure 355 SW-FACADE-W-9005 (33)

Figure 356 SW-FACADE-W-9006 (19)

Figure 357 SW-FACADE-W-9006

Figure 359 SW-G02-C-001 P1050301

Figure 358 SW-FACADE-W-9007 (20)

Figure 360 SW-G02-C-002 P1050289

Figure 361 SW-G02-C-003 P1050311

Figure 363 SW-G2-F-9002 (2)

Figure 362 SW-G2-F-9001 (3)

Figure 364 SW-G2-F-9003 (4)

Figure 365 SW-G2-F-9004 (21)

Figure 367 SW-G2-F-9005 (6)

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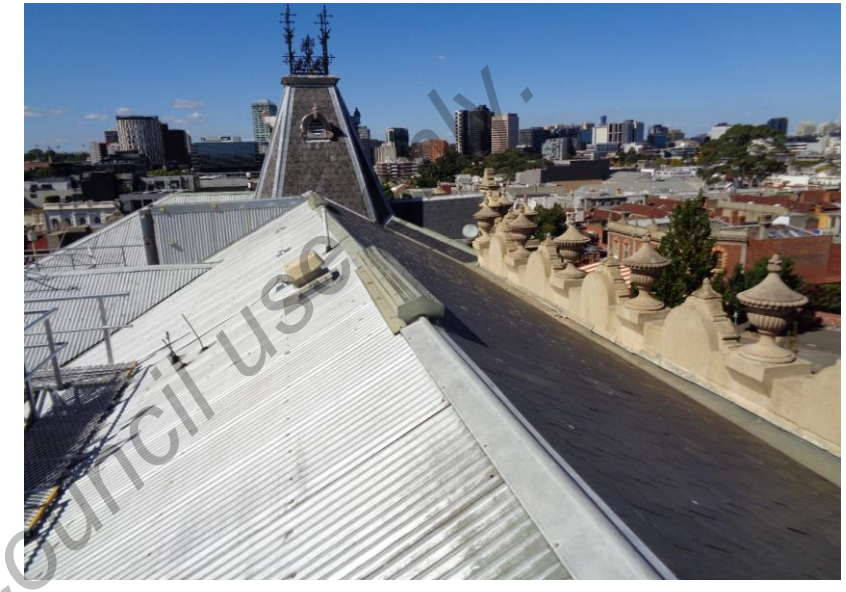

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Figure 370 SW-G2-F-9008 (1)

Figure 372 SW-ROOF-02

Figure 373 WW-EXTERNAL-W-9001 (53)

Figure 374 WW-EXTERNAL-W-9002 (54)

Figure 375 WW-EXTERNAL-W-9003 (19)

Figure 376 WW-F03-R-9001 (40)

Figure 377 WW-F03-S-001 P1040541

Figure 379 WW-F06-F-9002 (43)

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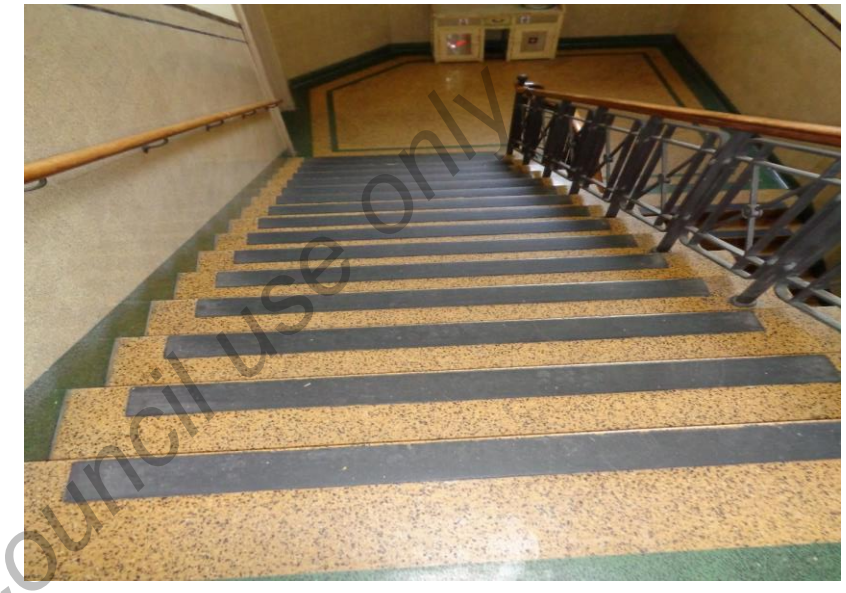
Figure 380 WW-F06-R-9001 (41)

Figure 381 WW-F06-R-9002 (42)



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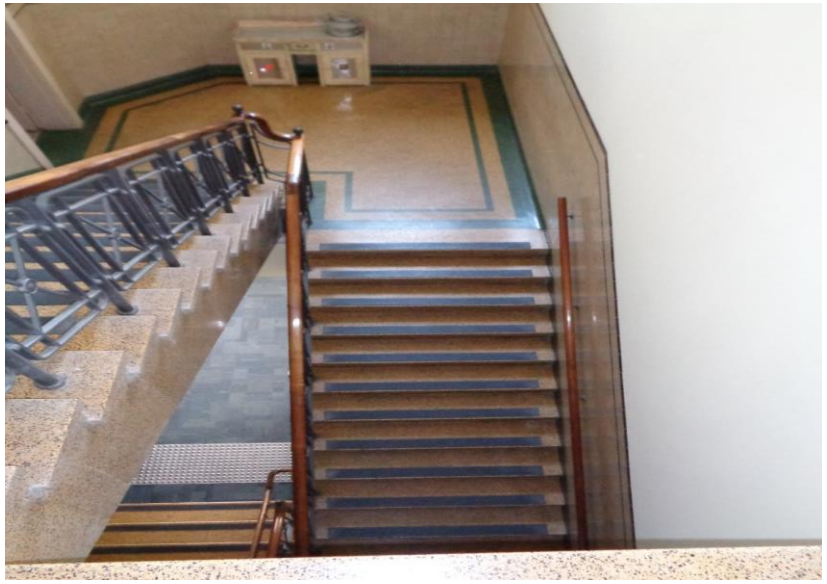

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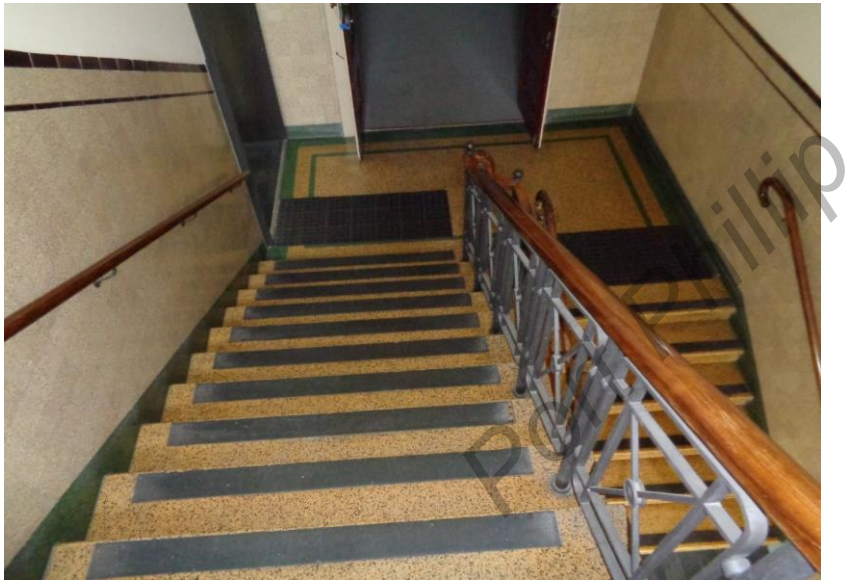

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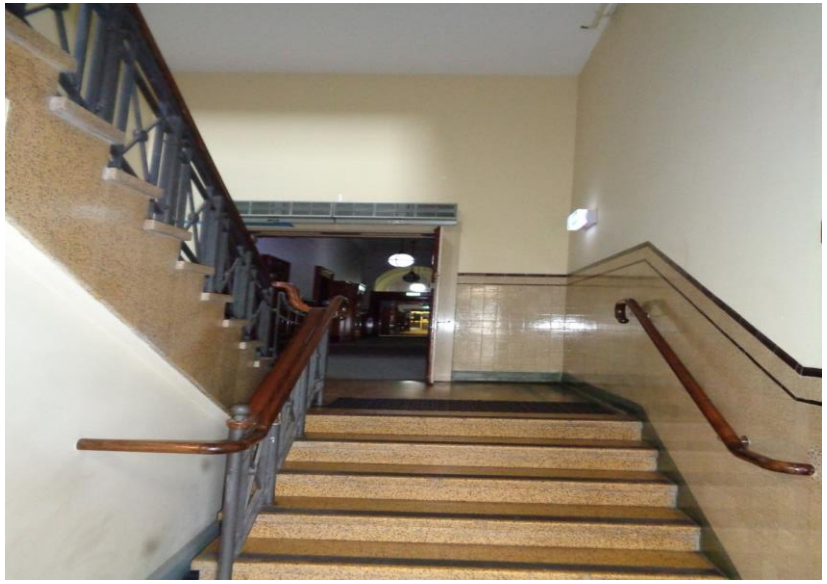

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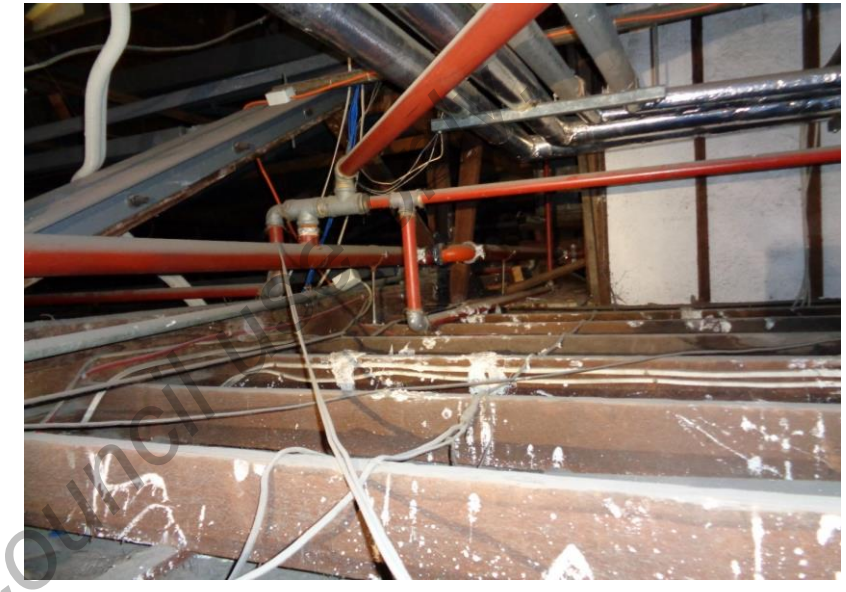

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Figure 390 WW-F07-R-9002 (12)

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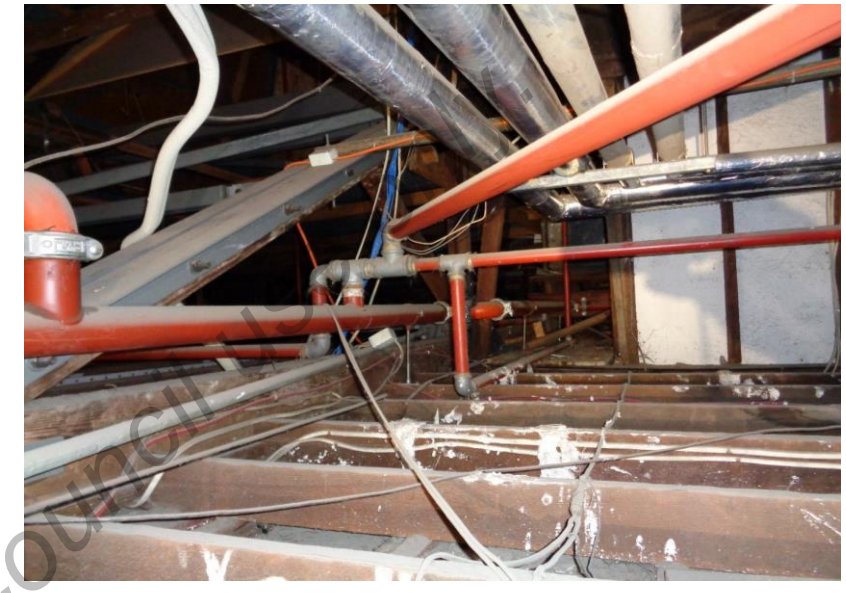
Figure 393 WW-F07-R-9005 (15)

Figure 394 WW-F07-R-9006 (16)



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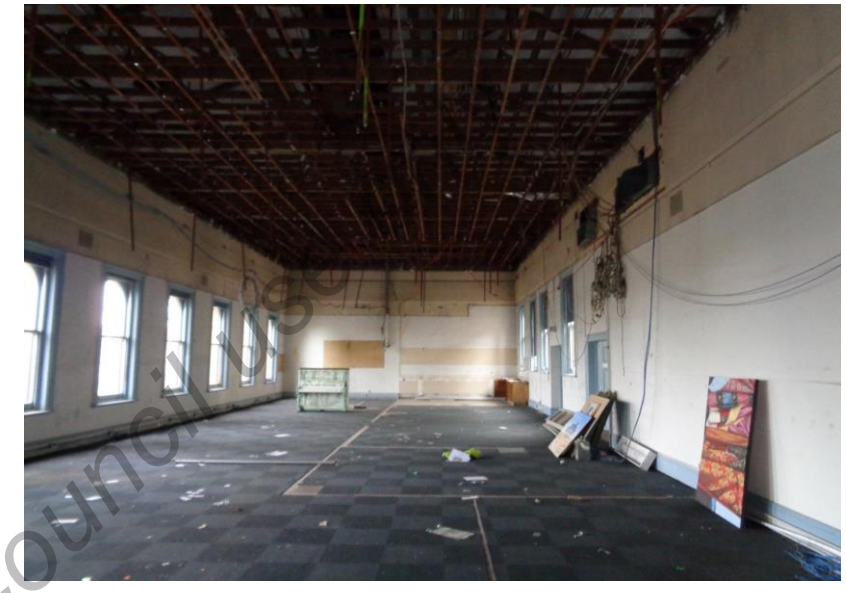

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Figure 398 WW-F08-F-9001 (31)

Figure 400 WW-F08-R-9002 (23)

Figure 401 WW-F08-R-9003 (24)

Figure 403 WW-F08-R-9005 (26)

Figure 402 WW-F08-R-9004 (25)

Figure 404 WW-F08-R-9005 (27)

Figure 405 WW-F08-R-9006 (28)

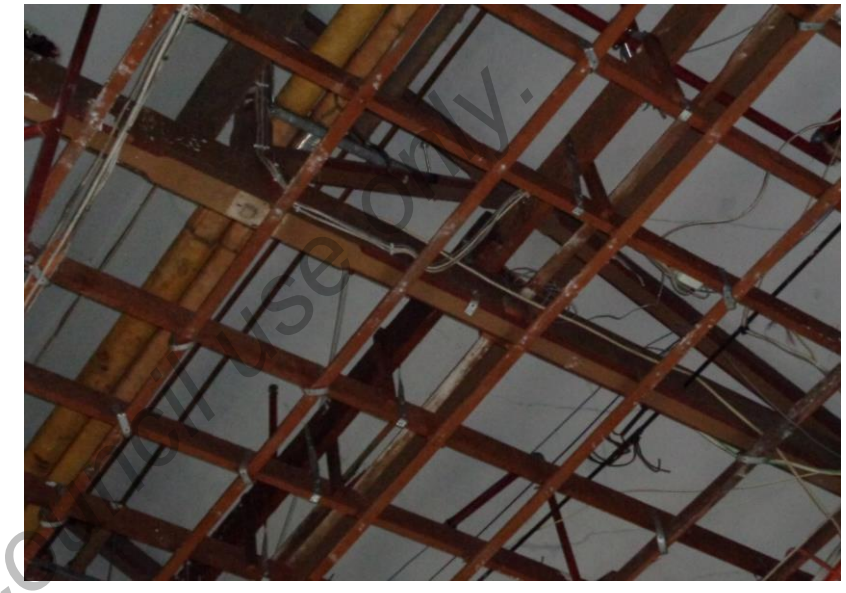

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Figure 406 WW-F08-R-9007 (29)

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Figure 409 WW-F08-R-9010 (3)

Figure 411 WW-F08-R-9102 (56)

Figure 410 WW-F08-R-9101 (55)

Figure 412 WW-F08-R-9103 (57)

Figure 413 WW-F08-R-9104 (58)

Figure 415 WW-F08-R-9106 (60)

Figure 414 WW-F08-R-9105 (59)

Figure 416 WW-F08-R-9107 (61)

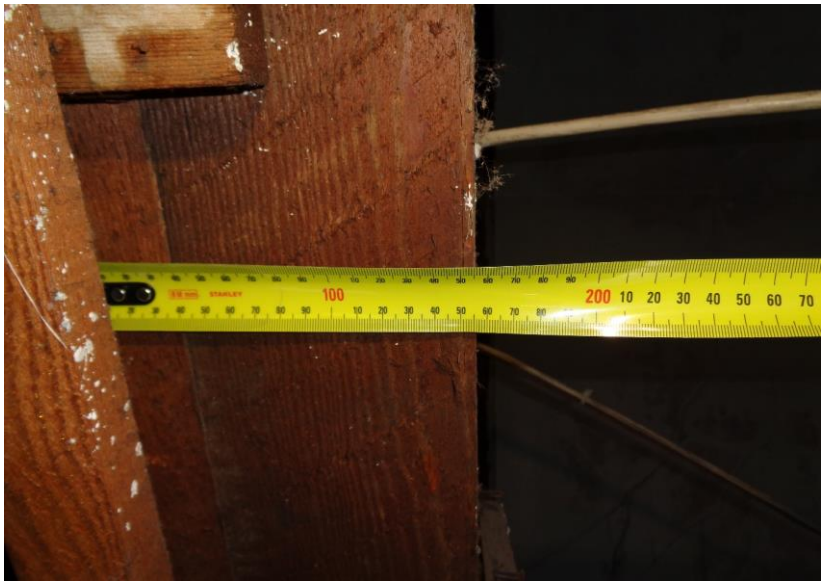

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Figure 418 WW-F08-R-9109 (63)

Figure 420 WW-F08-R-9111 (65)

Figure 421 WW-F08-R-9112 (66)

Figure 423 WW-F08-R-9114 (68)

Figure 422 WW-F08-R-9113 (67)

Figure 424 WW-F08-R-9115 (69)

Figure 425 WW-F08-R-9201 (71)

Figure 427 WW-F08-R-9203 (73)

Figure 426 WW-F08-R-9202 (72)

Figure 428 WW-F08-R-9204 (74)

Figure 429 WW-F08-R-9205 (75)

Figure 431 WW-F08-R-9207 (77)

Figure 430 WW-F08-R-9206 (76)

Figure 432 WW-F08-R-9208 (78)

Figure 433 WW-F08-R-9209 (79)

Figure 434 WW-F08-R-9210 (1)

Figure 435 WW-F08-R-9301 (4)

Figure 436 WW-F08-R-9302 (5)

Figure 437 WW-F08-R-9303 (6)

Figure 439 WW-F08-R-9305 (8)

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Figure 440 WW-F08-R-9306 (9)

Figure 441 WW-F08-R-9307 (10)

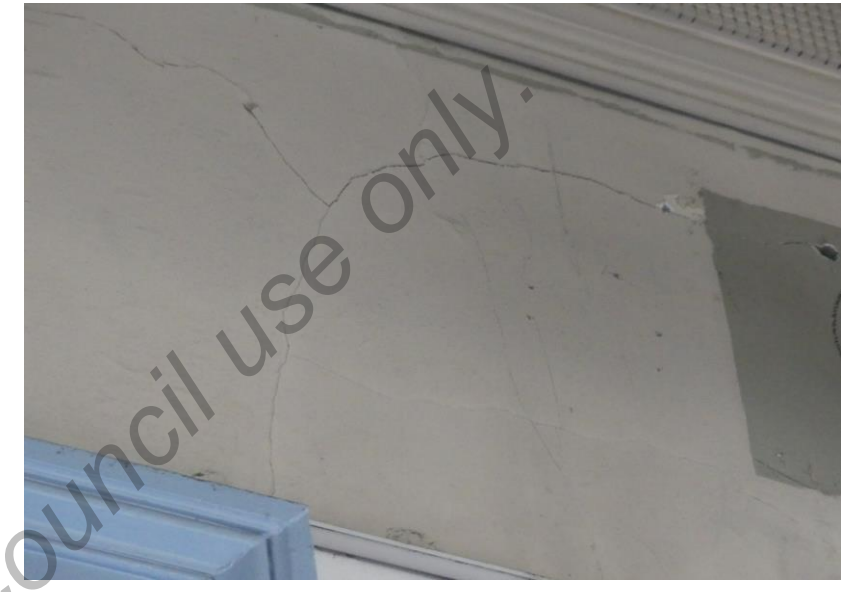


Figure 443 WW-F08-W-002 P1050248

Figure 442 WW-F08-W-001 P1040528

Figure 444 WW-F08-W-9001 (35)

Figure 445 WW-F08-W-9002 (36)

Figure 447 WW-F08-W-9004 (33)

Figure 446 WW-F08-W-9003 (32)

Figure 448 WW-F08-W-9005 (21)

Figure 449 WW-F08-W-9006 (20)

Figure 451 WW-FMAIL-R-9002 (47)

Figure 450 WW-FMAIL-R-9001 (46)

Figure 452 WW-G04-C-001 P1040553

Figure 453 WW-G04-F-9001 (51)

Figure 454 WW-G04-F-9002 (52)

Figure 455 WW-G07-W-001 P1040908

APPENDIX B: RECOMMENDATIONS FROM PREVIOUS CONDITION REPORTS

RECOMMENDATIONS FROM PREVIOUS CONDITION REPORTS

The following issues and recommendations have been noted in previous condition assessment reports. Where possible these have been included in the general recommendations in Section 12. The table below catalogues defects regardless of their remediation status.

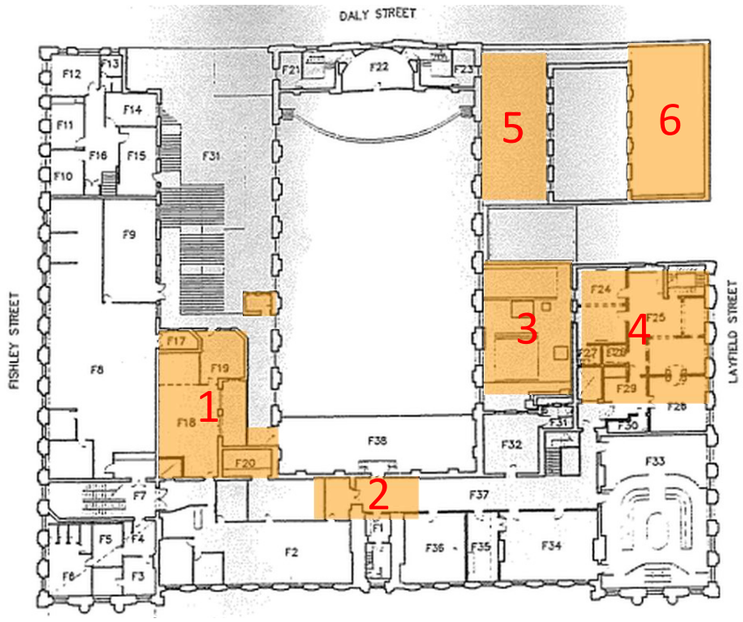
Table 10 - Recommendations from previous condition reports.

Defect	Element	Area	Details	Recommendation	Source
Roof Access Upgrade	Internal Roof Access	Main Hall	Access to the roof and ceiling cavity was deemed to be unsafe requiring investigation and remediation of deteriorated beams.	• Provide additional fixings between existing platform walkway to the existing platform. • A timber handrail is to be installed to ensure access is limited to walkways. • New walkways are to be installed running east-west to safely access the winches. • A new timber beam to be provided adjacent to the existing notched beam to the north.	Wood and Grieve Engineers 15/12/2015
Brick Cracking and moisture ingress	Ceiling Brickwork	East Wing	Minor cracking in some of the masonry walls and there are some stains indicating water ingress.	• Further investigation required to determine route of ingress.	G Nixon Report 31/10/2018
Notching and splitting of ceiling joists / propping of joists with timber spacers	Roof and Ceilings	South Wing	The ceiling joists have been notched over a timber plate along the sides of the truss bottom chords, however there were no split joists visible.	• Truss end connection shall be propped and reinforced.	G Nixon Report 12/11/2018
Decayed rafters	Roof and Ceilings	South Wing	One of the rafters contained significant decay and will need to be laminated or replaced.	• Replace or laminate.	G Nixon Report 12/11/2018

Splitting of Timber web members and poor connection	Roof Trusses	South Wing - Truss 1 – 2 West Wing – Truss 3,6	The base of one of the vertical web members in a truss in the South Wing, has split and pulled out of the connection to the truss bottom chord.	• The truss with the displaced post shall remain propped until the truss to post connection is rectified (Detail B in G Nixon Report).	G Nixon Report 29/01/2019
Loose Bolt Connection and crushing of chords	Roof Trusses	South Wing - Truss 1,3-5 West Wing - Truss 1,5-8	Many of the bolts in the connections of the top chords to the bottom chords, have become loose, and have caused the top of the bottom chord to either split or crush.	• Truss end connections which have substantial decay shall be propped and reinforced (Detail A in G Nixon Report). • The bolts in the ends of all trusses shall be checked and tightened.	G Nixon Report 29/01/2019
Moisture ingress to ceiling	Roof Trusses	West Wing - Truss 1,6	Water staining in the top chord adjacent to vertical post.	• Further investigation required to determine route of ingress.	G Nixon Report 29/01/2019
Defective timber used in construction	Roof Trusses	South Wing - Truss 4,5	There is a large knot in the north end of the bottom chord of a South Wing truss.	• Truss end connection shall be propped and reinforced (Detail A in G Nixon Report).	G Nixon Report 29/01/2019
Saw cutting of bottom chords	Roof Trusses	South Wing - Truss 4	There is a saw cut across the bottom of the bottom chord of a South Wing truss.	• Truss end connection shall be propped and reinforced (Detail A in G Nixon Report).	G Nixon Report 29/01/2019
Inadequate connection of ceiling joists	Roof and Ceilings	Main Hall	The ceiling joists have shifted and no longer make adequate connection to trusses.	• Ends of ceiling joists require rectification by means of steel straps or nail plate connections.	G Nixon Report 03/02/2019
Concrete Reinforcement Corrosion	External Staircase	Stringers and Columns	Carbonation induced reinforcement corrosion leading to delamination and spalling.	• Installation of a Galvanic corrosion protection as part of concrete patch repairs.	Infracorr Report 22/11/2018
Concrete Step Delamination	External Staircase	Steps	Large areas of delamination were identified on the stairs; however, this is believed to be a render/ fairing	• Removal of the render /fairing coat to allow access for full delamination survey leading to full depth patch repairs	Infracorr Report 22/11/2018

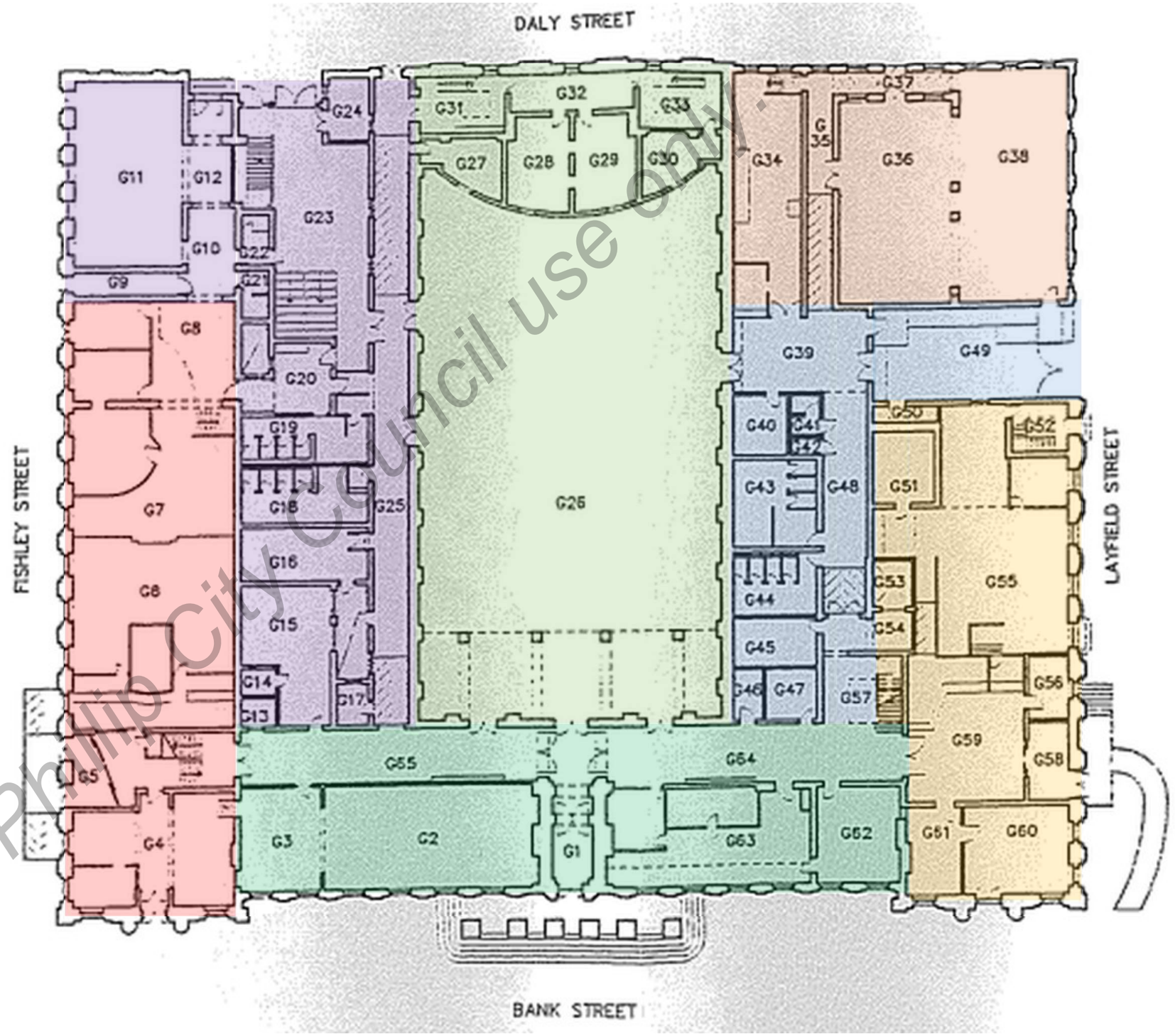
			coating requiring further investigation.	incorporating galvanic anodes.	
Coating failure and steel corrosion	External Staircase	Railing	Handrails are exhibiting coating failure and corrosion around exposed unprotected railings.	• Removal of existing coatings and application of a colour matched protective coating.	Infracorr Report 22/11/2018
Coating failure and steel corrosion	External Staircase	Railing Posts	Handrails posts are unprotected with corrosion extending below the original height of the stringers.	• The base of the posts should be exposed, cleaned and coated with a waterproof protective coating and re-embedded in mortar in conjunction with the stringer repairs.	Infracorr Report 22/11/2018

APPENDIX C: INVESTIGATION PLAN ARRANGEMENTS - SOUTH MELBOURNE TOWN HALL

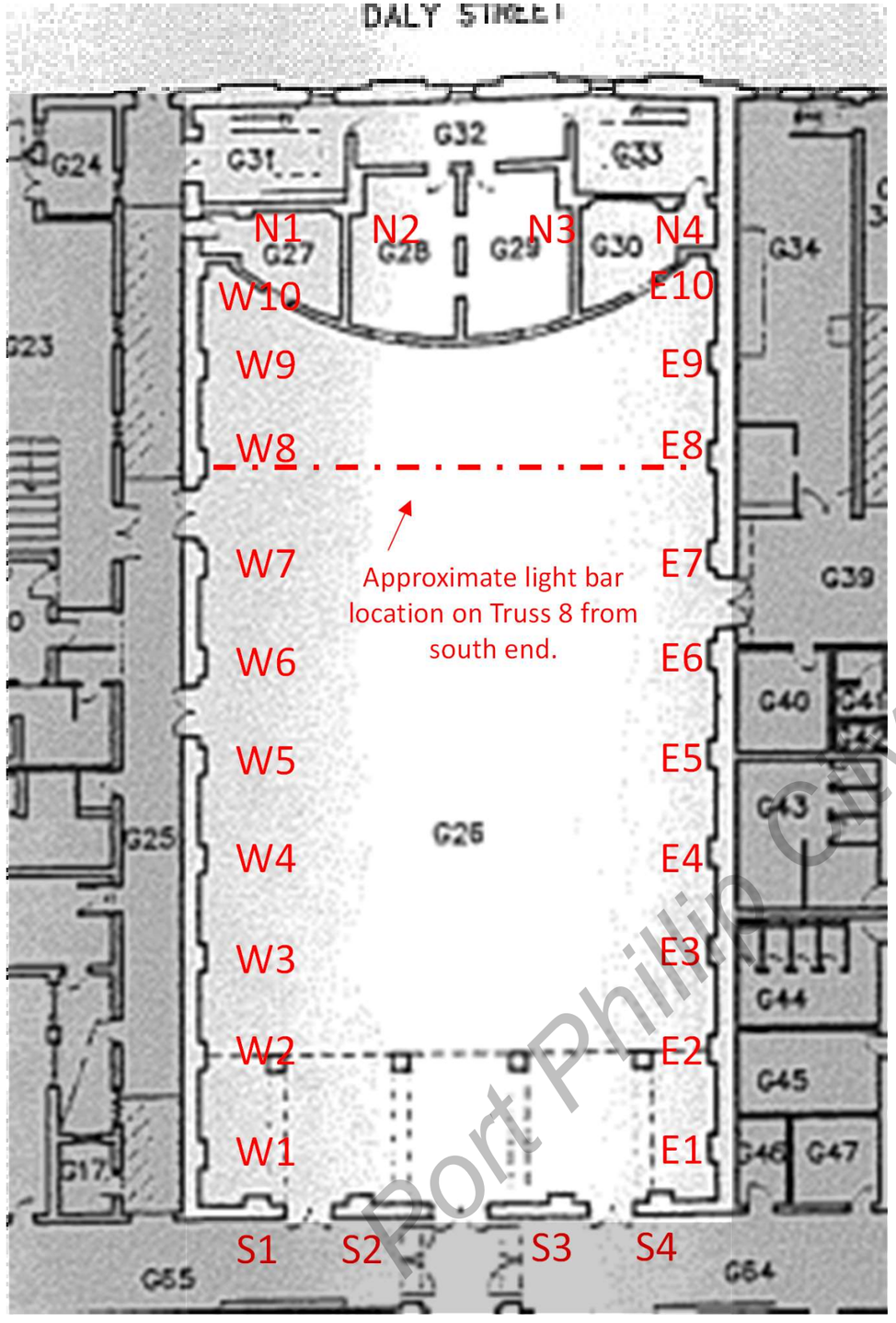


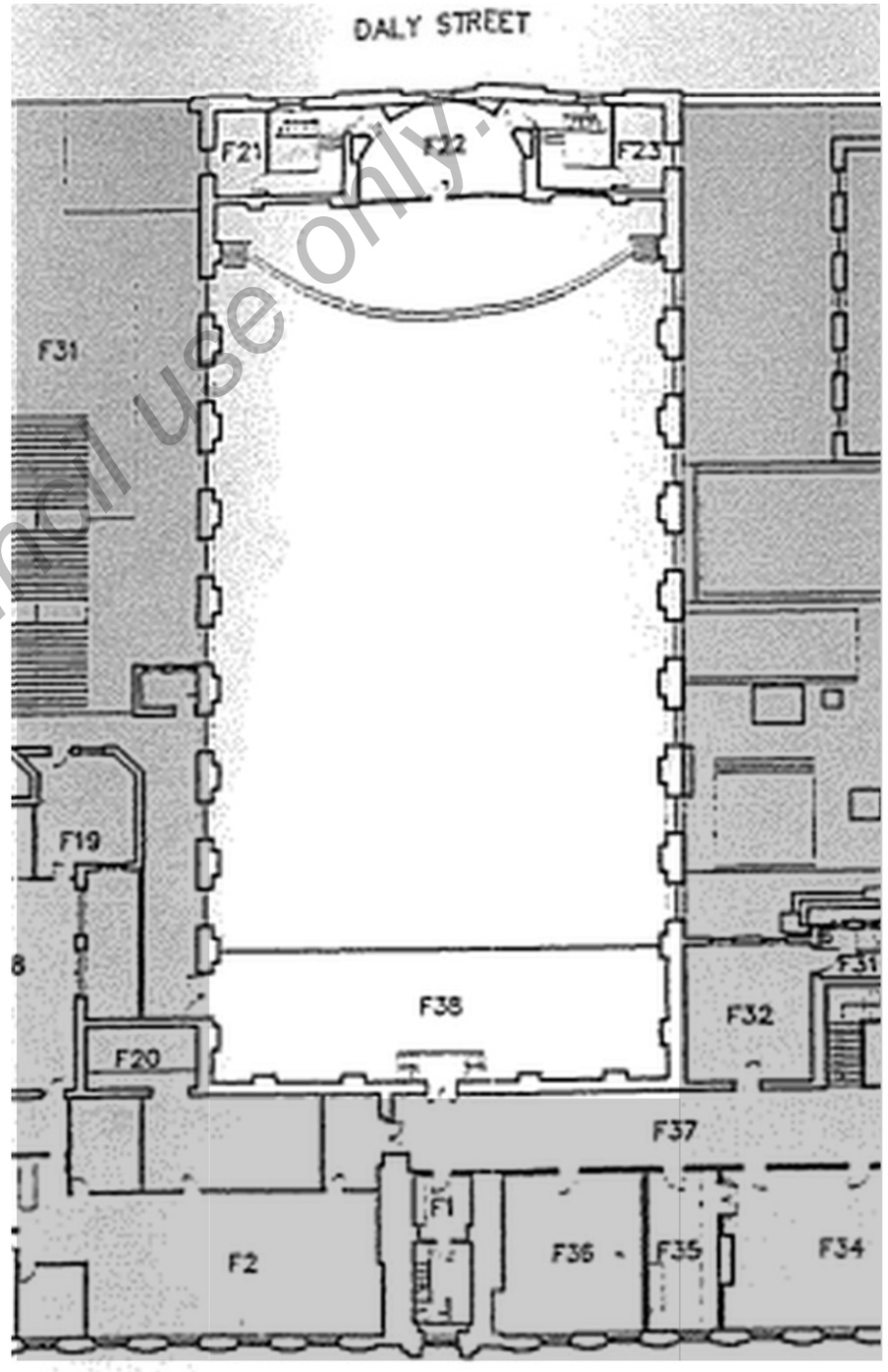
Legend

- MAIN HALL
- EAST WING (MAIN BUILDING)
- WEST WING (MAIN BUILDING)
- SOUTH WING (MAIN BUILDING)
- BALLANTYNE ROOM BUILDING (EAST ANNEX)
- ANAM BUILDINGS (EAST ANNEX)
- COUNCIL BUILDINGS (WEST ANNEX)
- BUILDING SERVICES (PLATFORM 1-6)

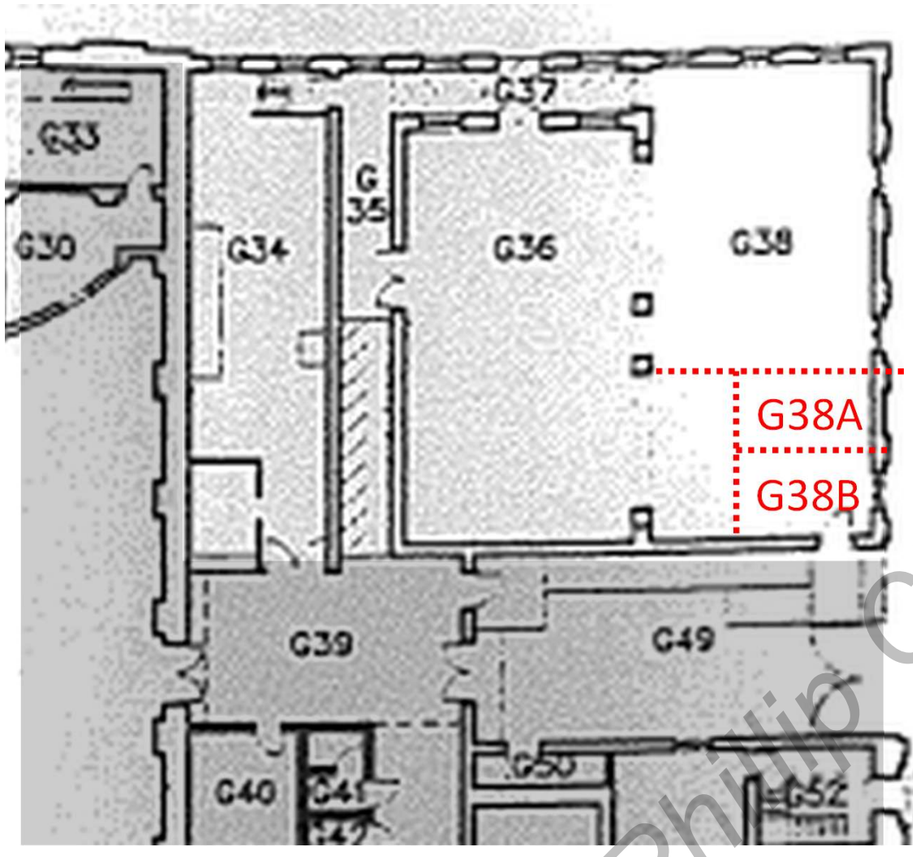


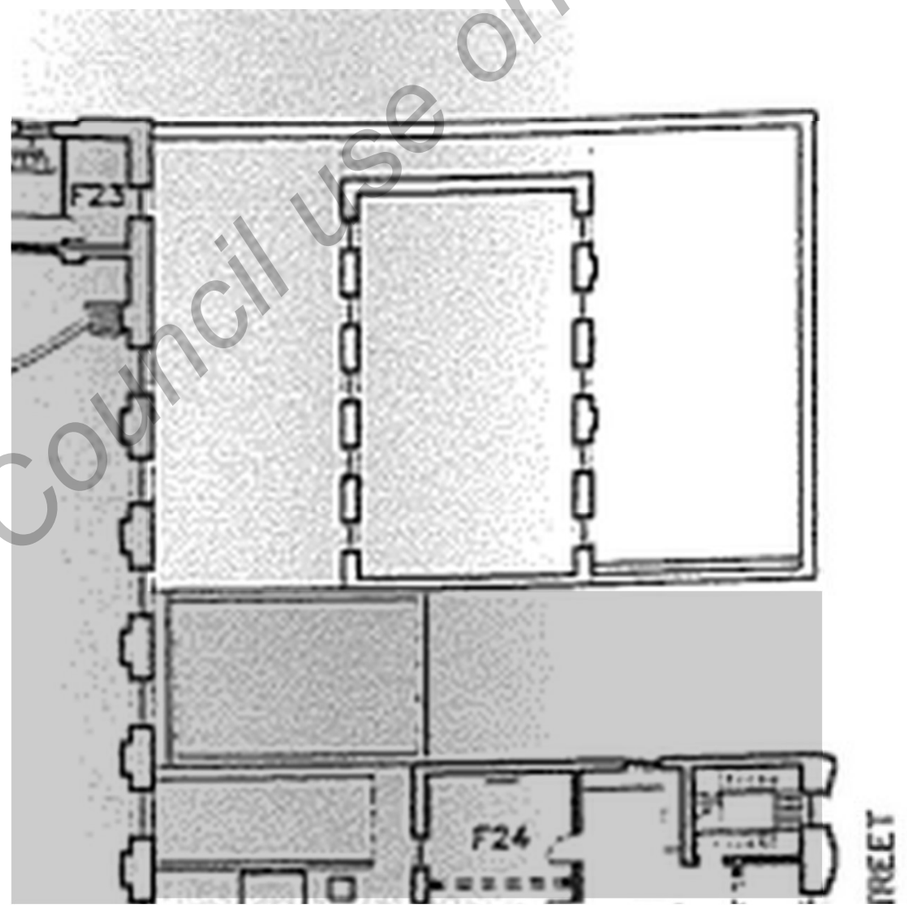
Main Hall



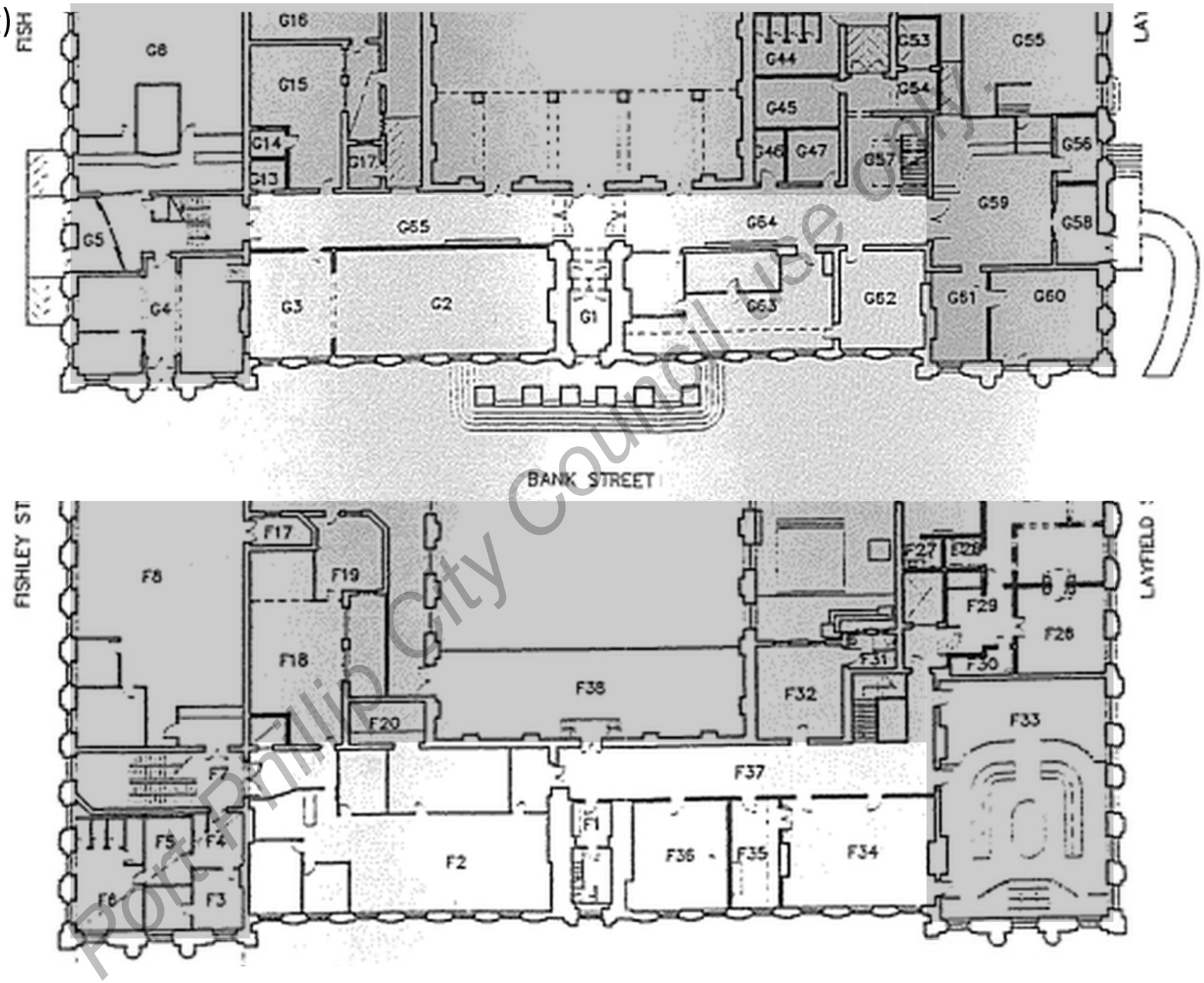


Ballantyne
Room
Building

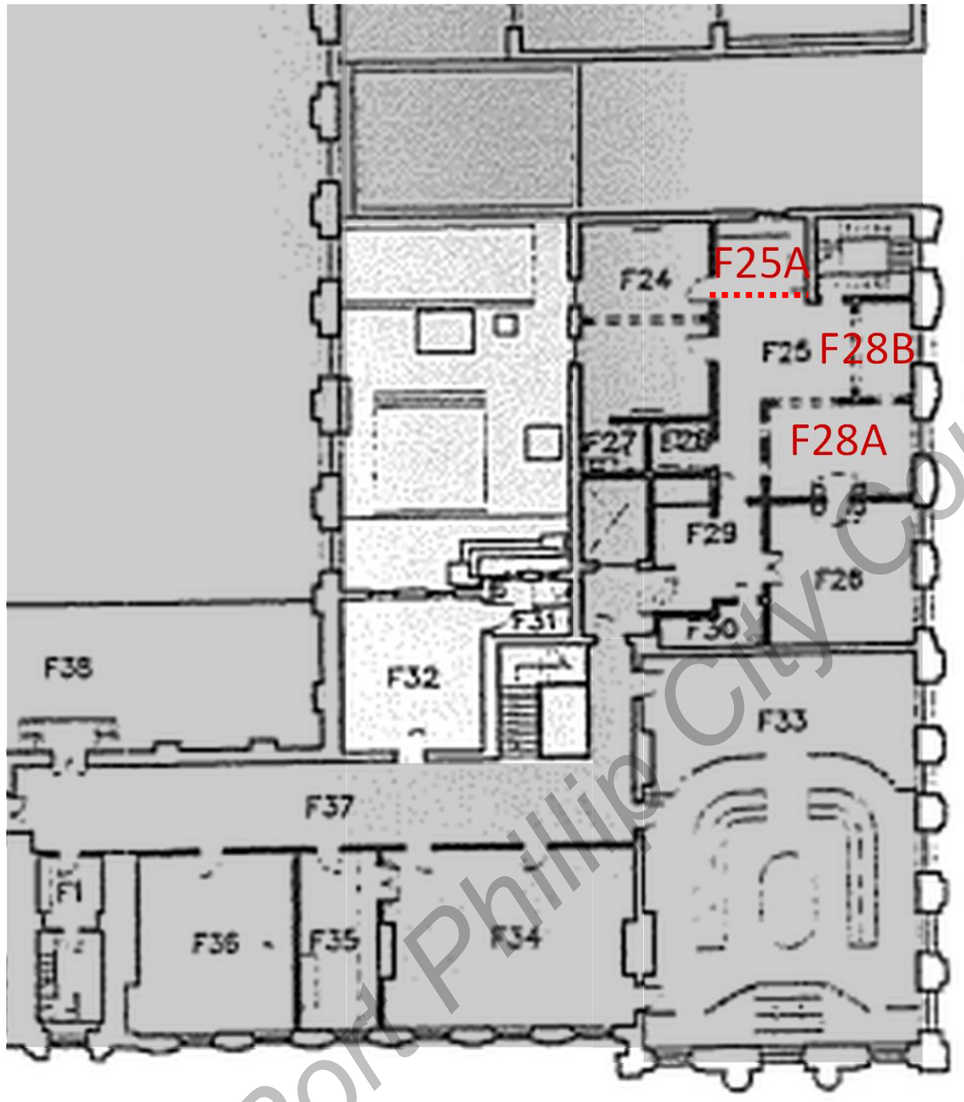


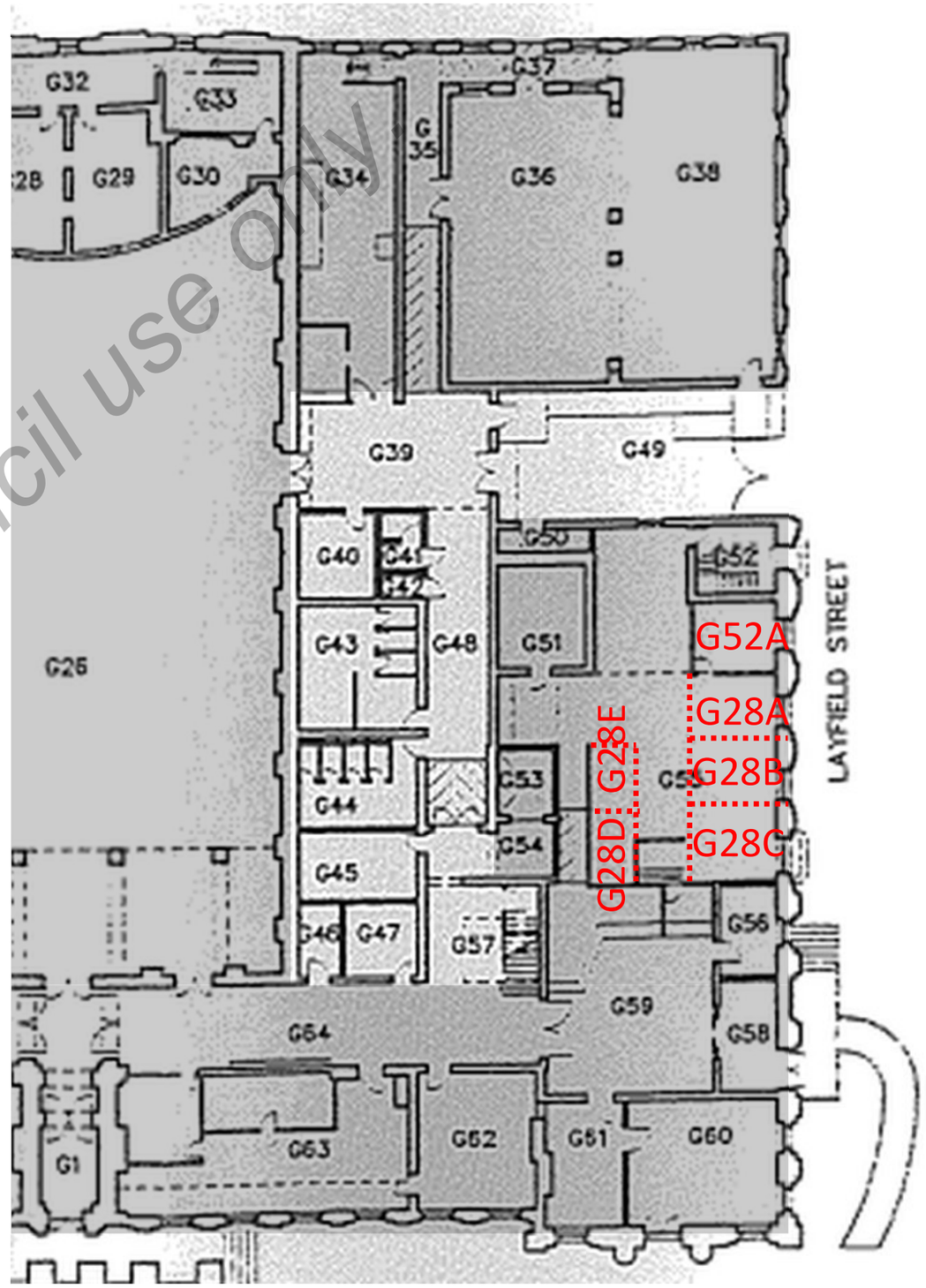


South Wing (Main Building)



ANAM
Buildings
(East Annex)





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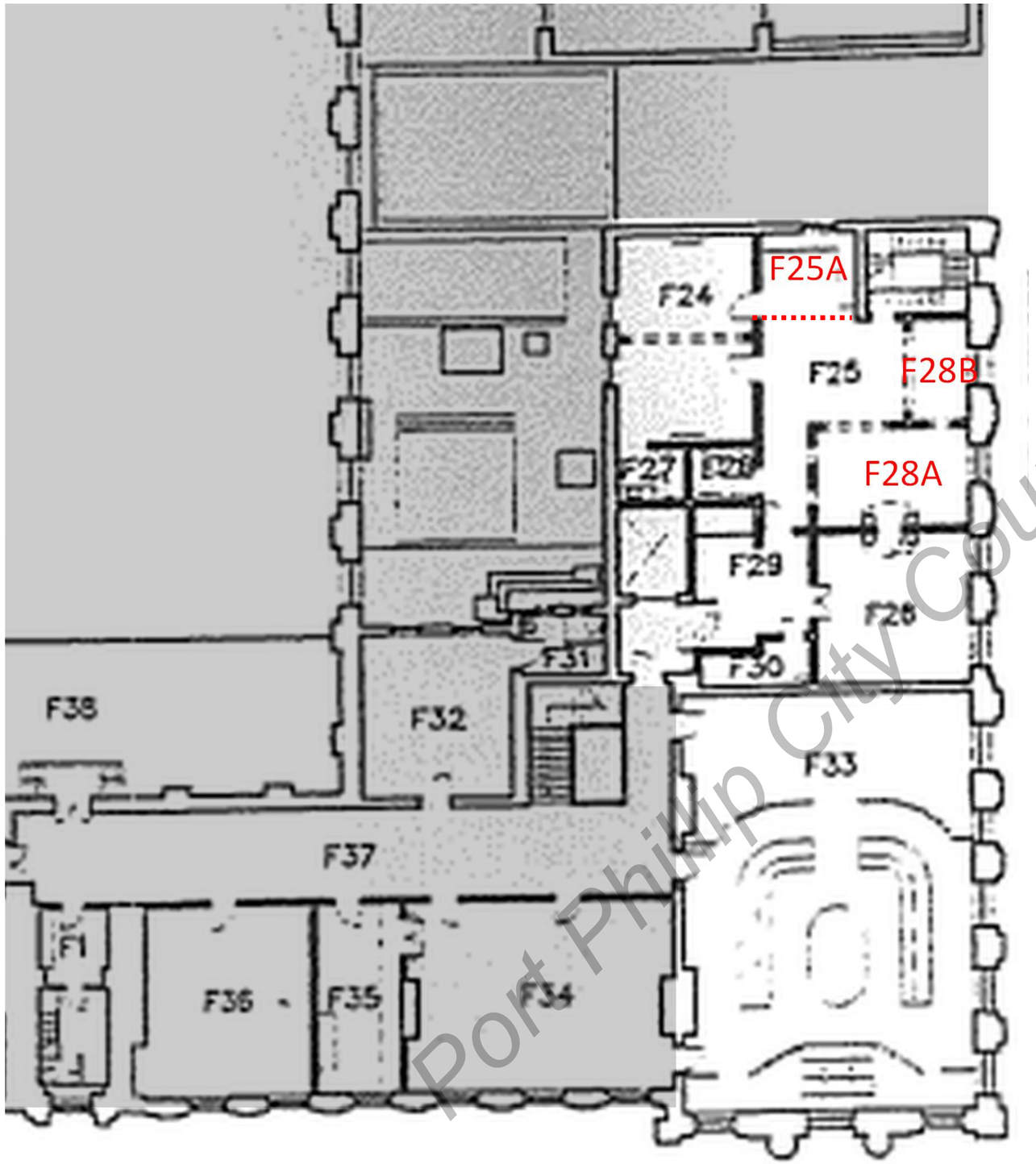
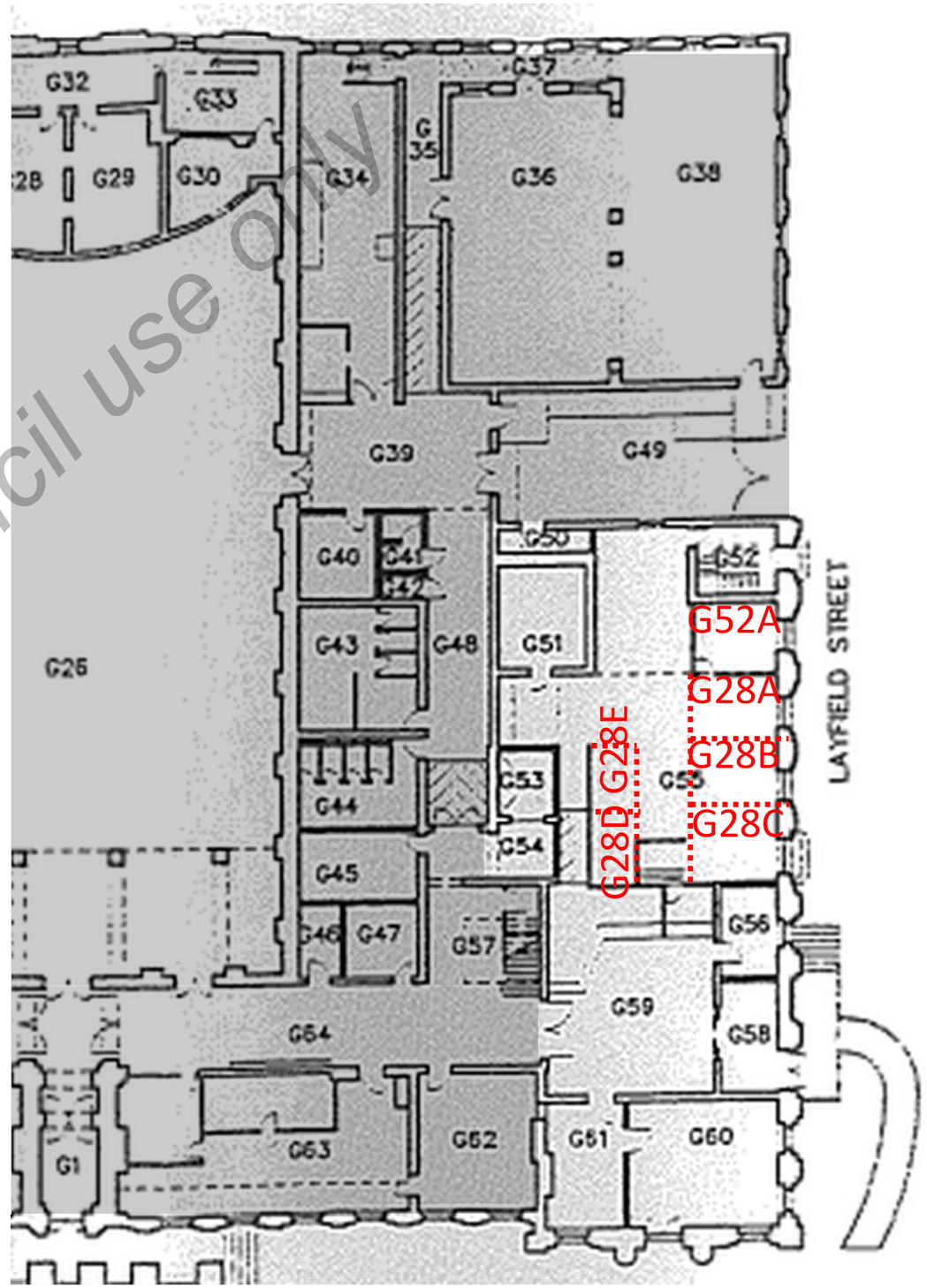
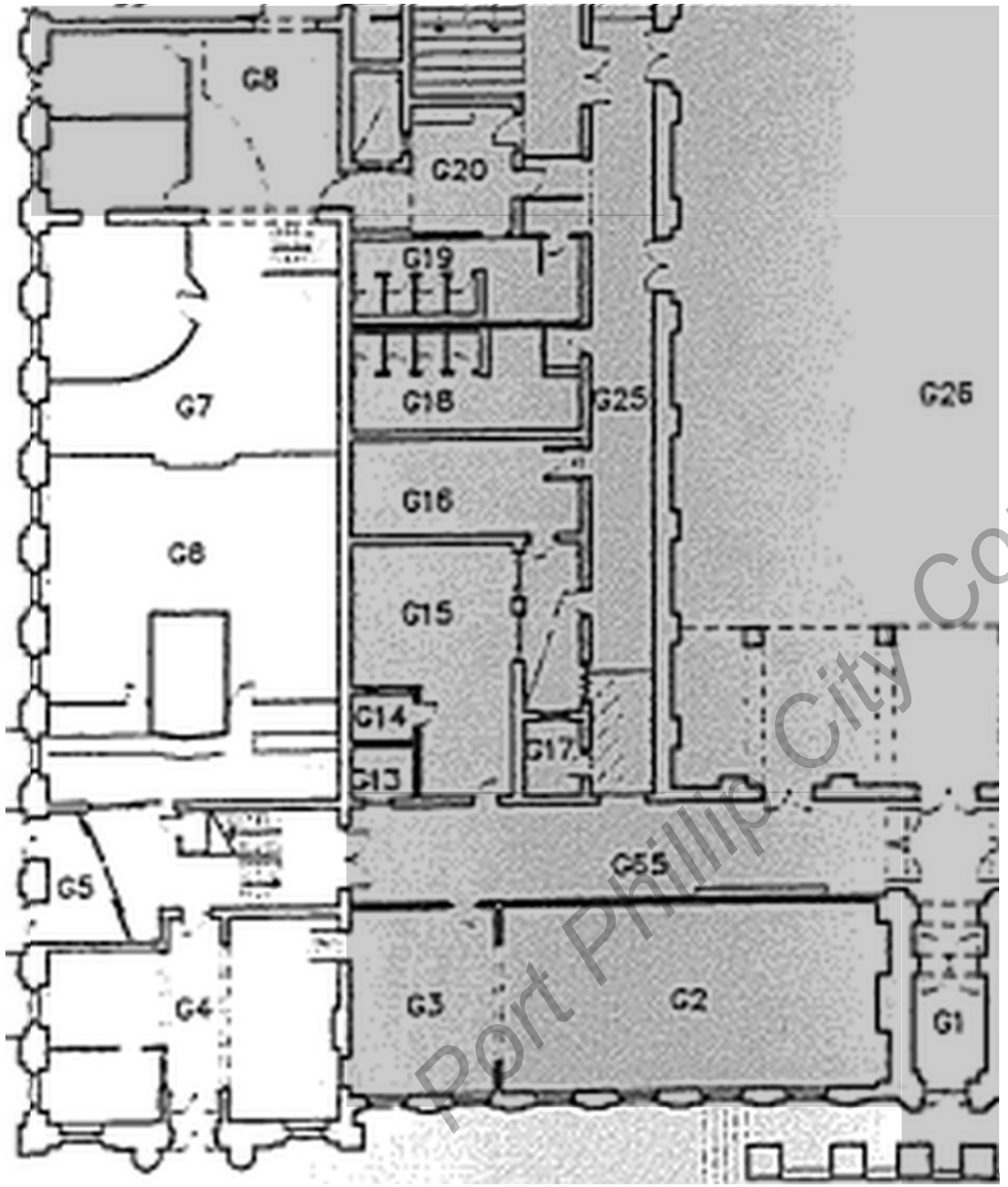
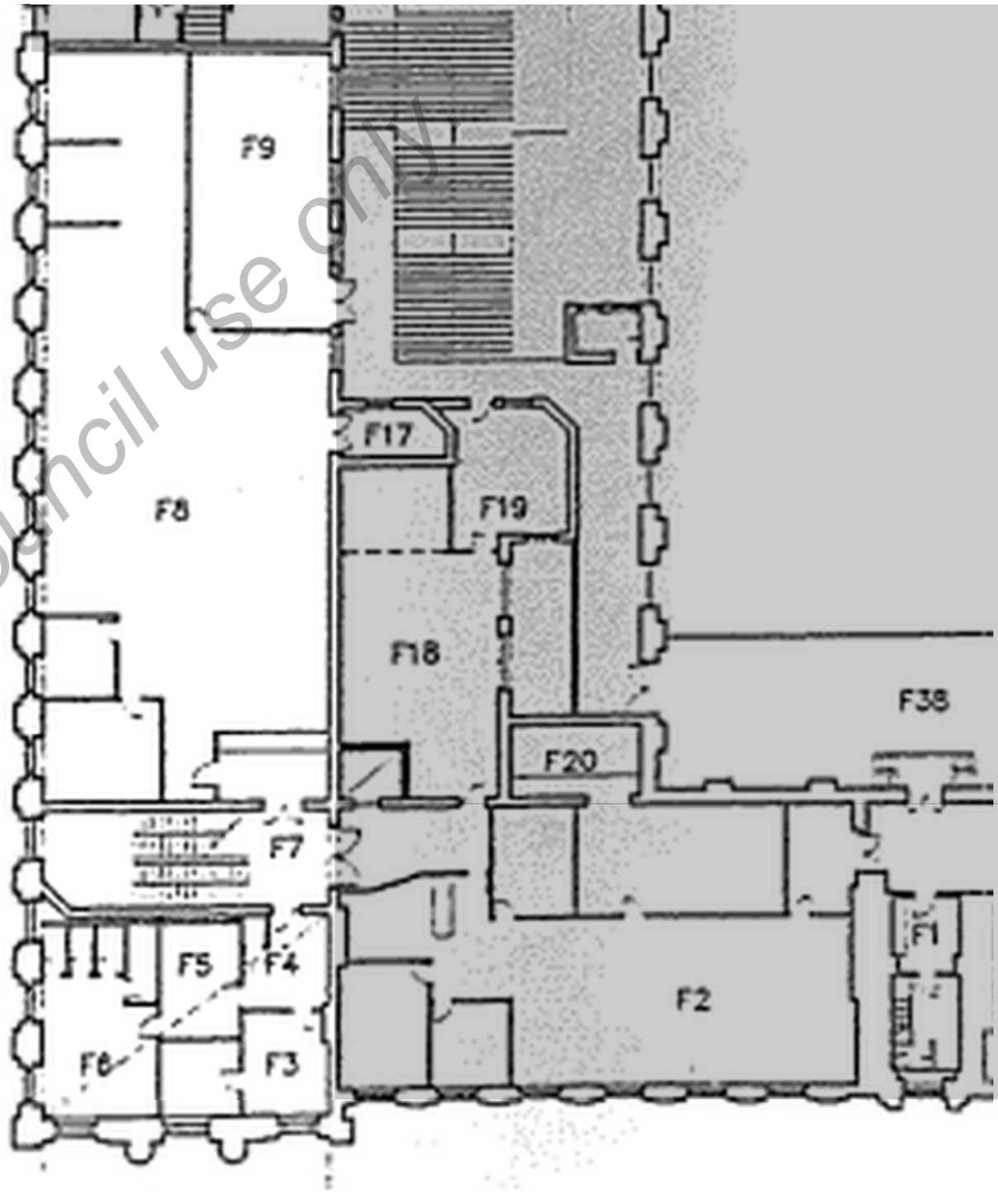


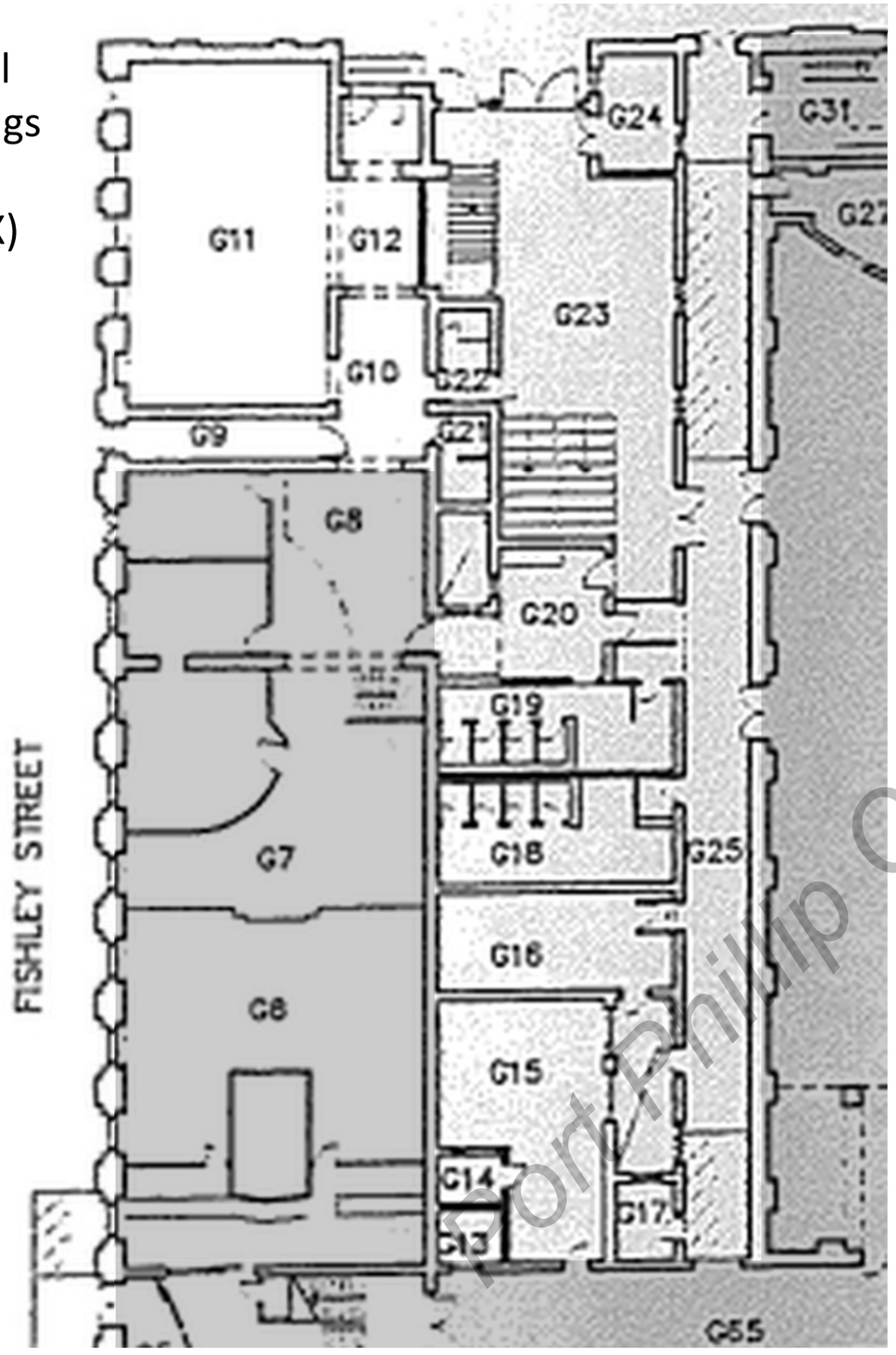


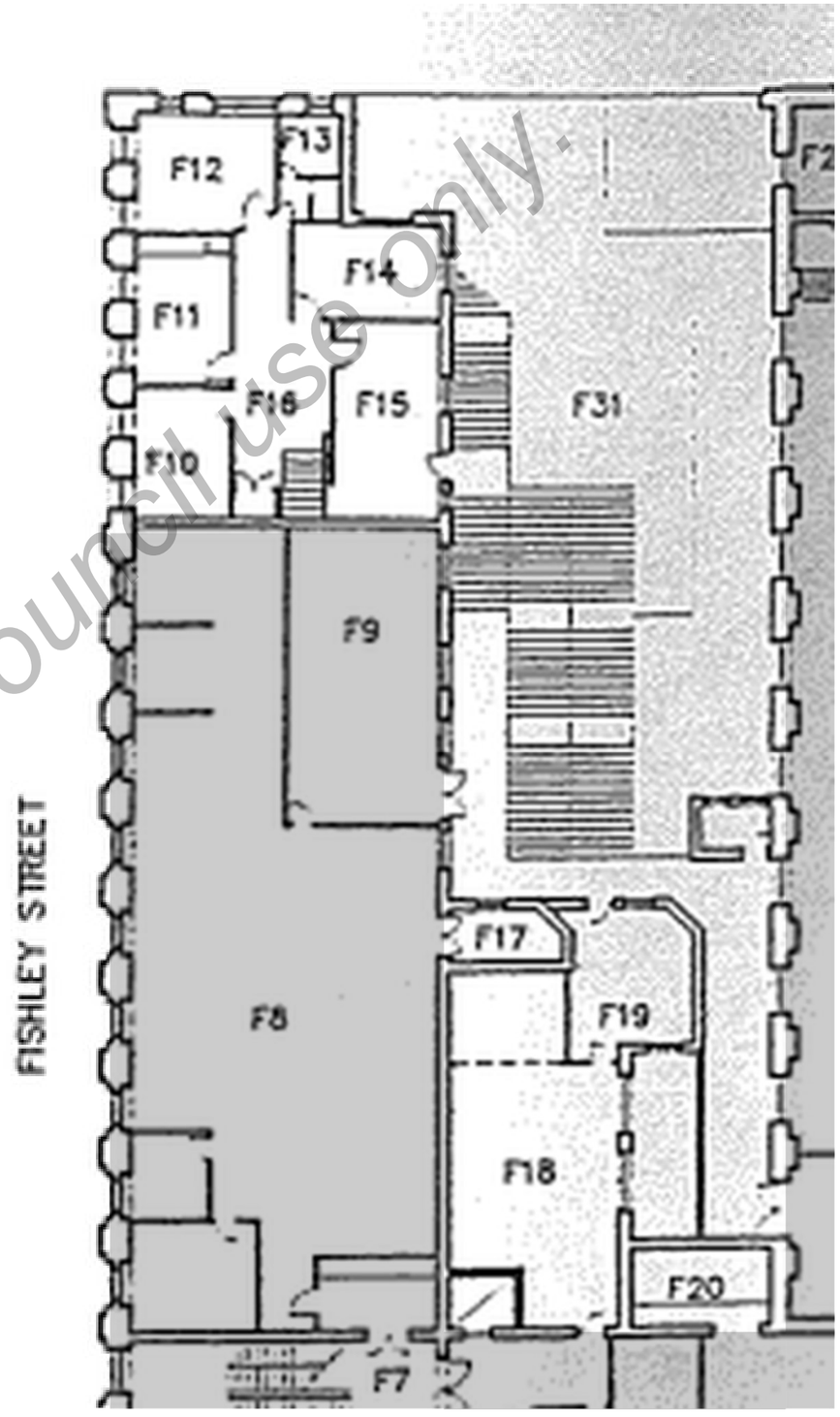
West Wing





Council Buildings (WEST ANNEX)





APPENDIX D: INSPECTION REPORT

(DATED 9/4/2020)

infracorr
INFRACORR CONSULTING PTY LTD
p: 1300 805 089
e: info@infracorr.com
www.infracorr.com
20 Business Park Dve
Notting Hill, Victoria
Australia, 3168
ABN 61 107 906 678

ASSE Consultants Pty Ltd
ABN 83 085 563 748
197a High Street
Ashburton, VICTORIA. 3147
Ph : 0439 352 184
Email : asse@asse.com.au

9/4/2020

Dear Joe Gangi of City of Port Phillip Council,

Re: Temporary Roof propping along the south wall of Room F2 – South Melbourne Town Hall

On the 24th of March, during our global inspection of the South Melbourne Town hall, along with Infracorr Consulting P/L, it was observed that the support of the roof trusses along the south wall of room F2 had deteriorated to the point that we were concerned about the possible collapse of the roof.

The western most truss has been strengthened by bolting a steel channel frame to the side of the truss and supporting the frame in the brick wall. When this work was done is unknown to us. It would appear that at the same time the remaining four trusses had the original timber spreader support plate removed from under the trusses and what appears to be Jarrah packers placed between the bottom chord of the trusses and the brickwork. From our measurements the bottom chords of the trusses were pocketed 250mm into the brickwork. For the eastern most truss, the end of the bottom chord has rotted leaving 50mm of the original 250mm bearing on the jarrah packers. With the reduced bearing length the timber in the bottom chord has begun to crush locally causing the timber fibres to fracture adjacent to the jarrah packers. Similar crushing and fracture of the timber fibres adjacent to the packers was observed in the remaining 3 trusses.

Note: A full review of the trusses with photographs will be included in our Global report on the buildings.

The City of Port Philip Council, Mr Joe Gangi, were advised of our concerns and they engaged a contractor to install props under the 4 remaining trusses in this room.

The Council asked us to review the propping installed to ensure the propping is adequate until a permanent solution can be installed.

Observations and discussion

A single Multiprop MP625 has been installed under the southern end of each of the 4 remaining timber roof trusses. The base of the props are supported on 2 no. 240 x 45 f17 SHW beams, on the flat, running the length of the four trusses plus approximately 900mm past each end. An additional 240 x 45 plate by 1800 long has been provided under each of the props.

From our calculations, allowing for a dead load of 110kg per square meter for the slate roof and a live load of 30kg per square meter for roof access, the reaction at the southern support of the roof truss is 18kN (i.e. 1.8 tonnes).

Reviewing the load table for the props they have a load capacity of 31kN at a length of 5.5m and therefore the props have sufficient capacity.

Assuming the F17 SHW spreaders span across 4 number floor joist and the joist are equally loaded the maximum ultimate bending moment is 5.67kNm. The capacity of the three thicknesses of 240 x 45 F17 SHW is 6.93kNm. This is greater than the applied load and therefore adequate.

To assess the floor joist we have assumed that the prop load will only be shared across 2 number joists of 266 deep by 45 wide. We have assumed that the two joist will support the 18kN point load and a floor live load of 1.5kN/m^2. From our observations of the joist we believe that they could be rated as Grade F11 and seasoned. Based on the above loads, size and grade of timber we find that the joist are working to approximately ¼ of their capacity in bending, 14% over stressed for long term dead load and 10 percent under stressed for short term dead plus live load. As the propping is a temporary solution and the trusses will always maintain some loading on the brickwork reducing the calculated load in the props we consider the above results to be acceptable.

Conclusions
The propping installed will be sufficient in the short term to prevent the roof collapsing. We would expect that a permanent engineered solution should be installed within the next 12 months. Once an Engineer is engaged, in say the next 6 month, to design the strengthening works the current propping should be inspected to ensure that propping is still performing adequately and can remain in place until the permanent works are completed.

Attached - Photographs of propping.

Yours faithfully,

B.Little

Bradley J Little BE (Civil) RBP(EC13875)
ASSE Consultants Pty Ltd

1-DSC02104.JPG

2-DSC02103.JPG

3-DSC02100.JPG

4-DSC02094.JPG

5-DSC02095.JPG

6-DSC02093.JPG

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