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STRUCTURAL ENGINEERING REPORT

Prepared For

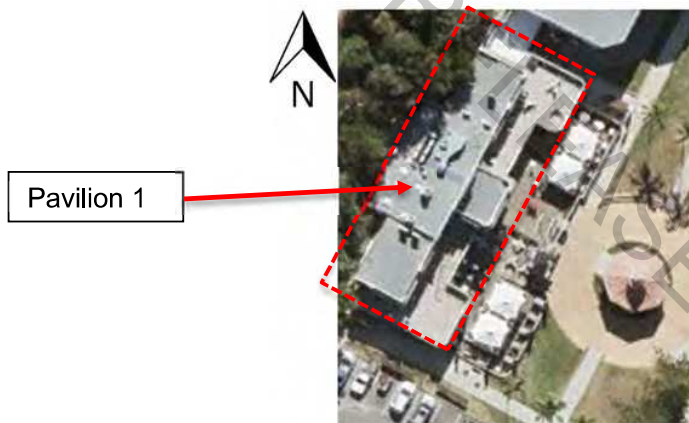
Moreton Bay Regional Council

Relating to

Structural Condition Audit

At

**Sutton Beach Pavilion 1
Marine Parade, Redcliffe QLD 4020**



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2		29/05/2020		29/05/2020	Amendments to Section 6 and Executive Summary
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1. Executive Summary

The scope of this structural engineering report is to provide an overall summary of the structural condition of building elements via undertaking an up to date invasive investigation and correlating the results against all recent relevant available previous building investigative works.

The most recent inspections were undertaken to enable a full picture to be generated with regards to aspects of the structure that until this point had been assumed knowledge, this has subsequently enabled more accurate correlation of data across the various rounds of previous reporting.

Generally, it can be stated that there are:

- Regular reporting of failures in the external cladding system primarily in relation to waterproofing;
- Regular and consistent statements around leaking roof and wall cladding are noted to have occurred for at least the past 10 years.
- Evidence of prolonged water ingress into internal spaces which is often a clear indicator that damage to the structure is likely to have occurred, either via corrosion of reinforcement, corrosion of structural steelwork or fungal rot of timber framing members.

When considering the proposed building remedial works projects that are currently tabled to be undertaken (rear water surface and subsurface water handling works), it is recommended that the following remedial building requirements should also be considered. Note that to facilitate continued use as a leased occupancy all items listed below would be deemed as necessary works to be undertaken:

- Ground floor requires remedial works in regards to significant and ongoing water ingress, rear subsurface water mitigation strategies (rear subsurface drilled / bored drainage system);
- Ground floor area requires remedial works to concrete beams, concrete slab, internal rear wall linings and framing, steel beam connections and ceiling support system;
- Link structure requires remedial works to mitigate water ingress and concrete repairs;
- Upper level area requires remedial works to mitigate water ingress (roof / walls / windows), remedial repairs to wall framing and roof framing;
- Exterior remediation includes replacement of foam awnings and general waterproofing repairs.

It is recommended that the above points be considered in context with the additional notes below:

- It has been noted that the original concrete structure is at or approaching end of life which will result in accelerated degradation;
- It should be noted that the currently proposed rear subsurface water mitigation strategy (rear subsurface drilled drainage system) cannot be guaranteed due to building configuration and inability to properly assess rear sub surface conditions (supplementary positive side (injection) and negative side membrane installation has been recommended but should not be read as a method that would enable the guarantee);

2. Introduction

As requested by [REDACTED] of MBRC in correspondence dated 29 January 2020, ^{Personal Information} of FSA Consulting Engineers (FSACE) undertook a number of inspections of the commercial premises known as Sutton Beach Pavilion 1, located at Marine Parade, Redcliffe QLD 4020.

In accordance with these instructions, the purpose of this structural condition audit was to undertake:

- An initial inspection to finalise scope and invasive investigation locations;
- A follow up inspection to inspect structure post provision of access as defined in initial inspection;
- Provision of a structural condition audit report covering the findings including cross referencing / collating previous relevant investigations and reporting.

Previous investigation and reporting is to be correlated with these inspection works to enable a global assessment of required works for the structure.

The Suttons Beach Pavilion facility consisted of a number of structures, for the purposes of this report they will be referenced as Pavilion 1, Pavilion 2 and link structure (refer Figure 1 below).

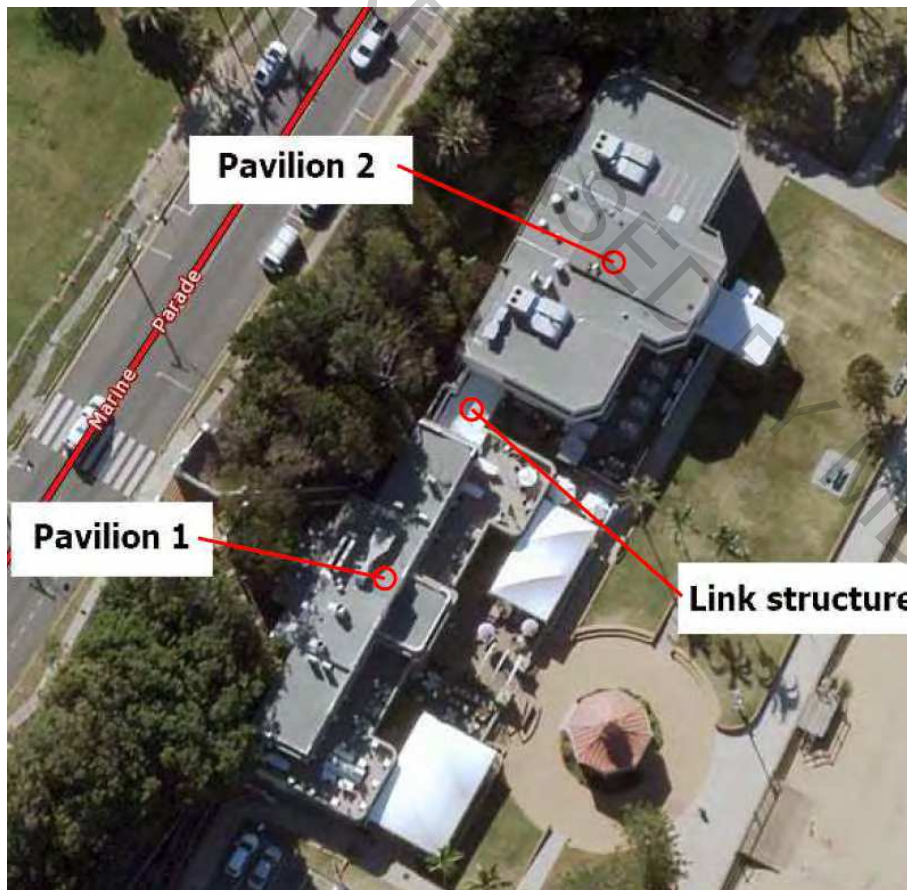


Figure 1: Facility structure identification

Records from 1937 indicate that a reinforced concrete framed structure was built on the site as a Beach Pavilion. Various alterations, extensions and renovations to the structure have occurred to the site since that time as well as a number of changes in use. Pavilion 1 is identified as typically double storey with the link structure being single storey.

Major redevelopment of the site occurred around the year 2000 with the construction of a new function center building (Pavilion 2) to the north and a 'link structure' between the two pavilions. A plant room / services building was added to the rear of Pavilion 1 upper level at this time as well. In 2007 major renovations to Pavilion 1 were undertaken with additional structures added to either side of the original entrance as well as major renovations to the interior.

By 2020 the site consisted of Pavilion 1 (built over the original Beach Pavilion) used as a restaurant, Pavilion 2 (outside the scope of this report) used as a conference center and a 'Link Section' between the two. The structural condition of Pavilion 1 and its link to Pavilion 2 (Link structure) is the focus of this report.

Detailed information, including photos, on the defect related investigations completed by FSACE and details of investigations by others are given in Section 3 of this report. The 22 noted defects are referenced and summarised to give an overall audit of the structural condition of Pavilion 1 within the context of its history.

For consistency through this report, 'Ground Level' was taken as the lower level of Pavilion 1, and 'Level 1' as the upper level.



Figure 2: Eastern elevation of Pavilion 1



3. Findings

FSACE have completed a number of structural inspections to Pavilion 1 on behalf of MBRC from circa 2016, including additional structural inspections in 2020. The findings of these inspections are documented in section 3.1 to 3.5 with relevant documents in Appendix's A, B, C, D and E.

Other consultants have also been engaged to undertake assessment and reporting including maintenance cost forecasts, reporting that has been made available to FSACE is from 2007. A summary of the findings of this documentation is included in section 3.6 to 3.7 below with supporting documents in Appendix's F, G, H and I.

The above suite of documented information has been compiled into a Structural Audit Assessment as summarised in the conclusion.

For the purposes of consistency classification of primary structural defects (steel and concrete defects) has been made. Table 3.1 and 3.2 below contain a list of descriptors used for the assessment of defects to structural steel and structural concrete. These classification descriptors are referenced through this report to record the severity of the defects identified.

Corrosion description	Classification	% loss widespread for length of member	% loss localized in one section of member
No Corrosion	S1	0%	0%
Early/minor corrosion	S2	0-2%	0-5%
Moderate corrosion	S3	2-10%	5-15%
Advanced corrosion	S4	10-20%	15-30%
Severe corrosion	S5	20-50%	30-80%
Extreme corrosion / structural failure	S6	>50%	>80%

Table 3.1: Descriptors for Steelwork Corrosion



Defect description	Classification	Notes
No damage	C1	As built condition
Stained surfaces / grout cracking	C2	Staining due to corrosion of baseplates or other steel structures
Cracking or damage to minor structures (non-structural)	C3	To concrete bunds, plinths, fire proofing and the like





Minor concrete deterioration	C4	Cover has been compromised; shrinkage cracks; cracks less than 1mm
Moderate concrete deterioration	C5	Cracks greater than 1mm, evidence of corroded reinforcement (steel section loss likely less than 30% steel)
Severe concrete deterioration	C6	Spalling concrete, missing or corroded reinforcement (greater than 30% steel sectional loss)





Table 3.2: Descriptors for Concrete Defects





3.1. Engineering Inspection 12 February 2020 – Pavilion 1





Defects identified have been given an ID (D1 etc) and were categorised and noted below with example photos. Location of identified defects are given on annotated layout plans, refer Appendix A. Following the inspection, a summary email was issued to [REDACTED] of MBRC and a copy of this information is also attached as Appendix A.





Location	Photo	Defect Noted	Implications of remedial works
Ground Floor Grid F-G		Defect D1 C5 Spalling concrete to soffit of Level 1 slab; evidence of past repairs, evidence of corroded reinforcement in local patches.	Removal of all finishes, framing and services to enable access to slab for full inspection and repair.
Ground Floor Grid D-E		Defect D1 C5 Spalling concrete to soffit of Level 1 slab; evidence of past repairs, evidence of corroded reinforcement in local patches.	Removal of all finishes, framing and services to enable access to slab for full inspection and repair.





Location	Photo	Defect Noted	Implications of remedial works
Ground Floor Grid D-E		Defect D1 C5 Spalling concrete to soffit of Level 1 slab; evidence of past repairs, evidence of corroded reinforcement in local patches.	Removal of all finishes, framing and services to enable access to slab for full inspection and repair.
Ground Floor Grid B-C		Defect D1 C5 Spalling concrete to soffit of Level 1 slab; evidence of past repairs, evidence of corroded reinforcement in local patches.	Removal of all finishes, framing and services to enable access to slab for full inspection and repair.
Ground Floor Grid B		Defect D1 C5 Spalling concrete to soffit of Level 1 slab; evidence of past repairs, evidence of corroded reinforcement in local patches.	Removal of all finishes, framing and services to enable access to slab for full inspection and repair.
Ground Floor Grid H		Defect D2 Exposed corroded reinforcement.	Access to area challenging due to new structures.

Location	Photo	Defect Noted	Implications of remedial works
Ground Floor Grid E-F		Defect D2 C5 Cracking in rear wall infill (or previous repair) section.	Removal of all finishes, framing and fit out to allow access for repair.
Ground Floor Grid E-F		Enlarged photo of defect described above	As noted above
Ground Floor Grid B-C		Defect D3 Connection supplementary floor beam to wall appeared unfit for purpose. Minor corrosion (S2) to unprotected steelwork	Removal of all finishes, framing and services to enable access to connection for design and installation of upgraded connection
Ground Floor Grid E		Defect D4 C6 Spalling concrete	Exclusion zone beneath affected area, remove spalling to mitigate the risk of spalling concrete dropping and resulting in injury, undertake concrete repair works

Location	Photo	Defect Noted	Implications of remedial works
Ground Floor Grid E		Defect D4 Enlarged photo of defect shown above	Refer above
Ground Floor Grid D-E		Defect D4 C6 Spalling concrete	Exclusion zone beneath affected area, remove spalling to mitigate the risk of spalling concrete dropping and resulting in injury, undertake concrete repair works
Ground Floor Grid A-B		Defect D5 Water damage along full extent of western wall resulting in severe dry rot of timber. Evidence of termite damage.	Complete removal of kitchen fitout and all framing members. Resolution of water ingress through western wall problematic.
Ground Floor Grid A-B		Defect D5 Water damage along full extent of western wall resulting in severe dry rot of timber. Evidence of termite damage.	Complete removal of kitchen fitout and all framing members. Resolution of water ingress through western wall problematic.

Location	Photo	Defect Noted	Implications of remedial works
Ground Level Grid D-E		Defect D6 Ceiling failure due to weight of services cables	Removal of existing ceiling sheeting, installation of new system to support required cables
Ground Level Grid D-E		Defect D7 Noted condensation on existing refrigeration lines; likely resulting in water ingress to structural members and finishes	Removal of existing ceiling to enable make good works to refrigeration lines
Level 1 Grid A		Defect D8 C5 cracking in reinforced concrete stair wall southern access stairs	Access available for repairs
Level 1 Grid A		Defect D8 C5 cracking in reinforced concrete stair wall southern access stairs	Access available for repairs

Location	Photo	Defect Noted	Implications of remedial works
Level 1 Grid H		Defect D9 Failure of external lining water ingress into frame likely	Access up to external area of Level 1: strip linings and undertake repair works as required.
Level 1 Grid B		Defect D10 Water damage to full extent (assumed) of upper level wall framing – image adjacent shows repaired framing install. Resulting bottom plate and lower portion of studs suffering initial to severe dry rot of timber.	To undertake repairs to achieve a current best practice outcome full removal of all external cladding would be required, repair works would be required framing repairs as required (assumed as minimum all bottom plate and a majority of studs), install external wall membrane and windows and a new external cladding system, undertake internal wall lining repairs as necessary.
Level 1 Grid D		Defect D10 Water damage to full extent (assumed) of upper level wall framing. Resulting bottom plate and lower portion of studs suffering initial to severe dry rot of timber.	As above
Level 1 Grid D		Defect D10 Water damage to full extent (assumed) of upper level wall framing. Resulting bottom plate and lower portion of studs suffering initial to severe dry rot of timber.	As above

Location	Photo	Defect Noted	Implications of remedial works
Level 1 Grid E-F		Defect D10 Water damage to full extent (assumed) of upper level wall framing. Resulting bottom plate and lower portion of studs suffering initial to severe dry rot of timber.	As above
Level 1 Grid H		Defect D10 Water damage to full extent (assumed) of upper level wall framing. Resulting bottom plate and lower portion of studs suffering initial to severe dry rot of timber; studs, bottom plate and tie down have failed	As above
Level 1 Grid E		Defect D10 Water damage resulting in severe dry rot of timber; failed brick/timber interface	As above
Level 1 Grid D		Defect D11 Severe corrosion S5 to handrail and bolted connection	Remove existing including any corroded fixings prior to replacement. Access to Level 1 area.



Location	Photo	Defect Noted	Implications of remedial works
Level 1 Grid D		Defect D11 Severe corrosion S5 to handrail and bolted connection	Remove existing including any corroded fixings prior to replacement. Access to Level 1 area.
Level 1		Defect D19 Foam awnings (fiberglass lined) are degraded / delaminating - may contribute to water ingress to structural frame	Removal and / or repair of all foam awnings
Level 1		Defect D19 Foam awnings (fiberglass lined) are degraded / delaminating - may contribute to water ingress to structural frame	Removal and / or repair of all foam awnings
Level 1		Defect D19 Foam awnings (fiberglass lined) are degraded / delaminating - may contribute to water ingress to structural frame	Removal and / or repair of all foam awnings





3.2. Engineering Inspection 05 February 2020 – Drainage Void area




An inaccessible void identified as the 'drainage void' was constructed behind the western wall of the link structure as part of the refurbishment works. Defects identified in this area were categorised and noted below with example photos. Following the inspection, a summary email was issued to [REDACTED] of MBRC and a copy of this information is given in Appendix B.

The 'drainage void' appeared to have been created by the construction of the link structure between the original Pavilion 1 and the newer Pavilion 2. A remaining part of the original western stair wall (rear of the site) was identified as well as a newer block wall (rear / western wall of link structure) was noted which did not appear to be waterproofed. The void was noted to be approximately 3.5m deep with 550mm clear width narrowing to 300mm in some places. Safe access to the rear of the block wall for rectification works is therefore not possible. Remaining original path sections and erosion were also noted.

Failure of the structural support for an existing electrical cable tray was notified to MBRC as requiring immediate rectification (refer Appendix B).

Location	Photo	Defect Noted	Implications of remedial works
Level 1 rear of 'link structure' – drainage void (from rear boardwalk)		Defect D11 Location of block wall that does not appear to be waterproofed resulting in water ingress to Ground Level	Safe access to undertake repairs appears to be not possible due to the narrow access between original western wall and newer block wall. Repairs would require construction of a second retaining wall to the west.
Level 1 rear of 'link structure' – drainage void (from rear boardwalk)		Defect D11 Location of block wall that does not appear to be waterproofed. Corrosion of exposed reinforcement to original wall.	Safe access to undertake repairs appears to be not possible due to the narrow access between original western wall and newer block wall. Repairs would require construction of a second

Location	Photo	Defect Noted	Implications of remedial works
			retaining wall to the west.
Rear of 'link structure' – drainage void		Defect D12 Failed structural support of electrical cable tray	Access via under boardwalk
Rear of 'link structure' – drainage void		Defect D12 Failed structural support of electrical cable tray	Access via under boardwalk
Rear of 'link structure' – drainage void		Defect D14 Local support of bearer has been compromised	Removal of boardwalk
Rear of 'link structure' – drainage void		Defect D11 Corrosion of reinforcement in original structure	Safe access is impossible to achieve due to the narrow gap between original western wall and newer block wall



Location	Photo	Defect Noted	Implications of remedial works
Rear of 'link structure' – drainage void		Defect D13 Undermining of original concrete approximately 1.5m above drainage void floor level	Removal of boardwalk and demolition of remaining pathway. Likely need to undertake batter stability or retaining works
Ground Level link structure - Internal rear wall		Defect D11 Water ingress evident	Repairs to internal wall linings will require waterproofing to both box gutter and external wall
Ground Level link structure - Internal rear wall		Defect D11 Water ingress evident	Repairs to internal wall linings will require waterproofing to both box gutter and external wall

3.3. Engineering Inspection 30 January 2020 – Pavilion 1 south west corner (PWD)

Defects identified were categorised and noted below with example photos. Following the inspection, a summary email was issued to [REDACTED] of MBRC and a copy of this information is given in Appendix C.

The beam in question was noted to be located in the ceiling of the PWD toilet in the south west corner of Pavilion 1, spanning north south. The original intent of the structure was to support the eastern edge of the southern stairs to the rear of the original pavilion. Following more recent refurbishment works it appears possible new level 1 slab and wall loads may also be supported by this beam.

Significant concrete spalling and corroded reinforcement (C6) were identified to the beam and to the soffit of the Level 1 slab. A technical specification for the recommended remedial works to the beam and slab soffit was issued to MBRC by FSACE on 4 February 2020 (reference FS1499FL-SP01). This specification is not appended to this report.

Location	Photo	Defect Noted	Implications of remedial works
Ground Level Southern corner		Defect D15 C6 concrete spalling and corroded reinforcement of original beam	Removal of internal fittings and fixtures; temporary propping
Ground Level Southern corner		Defect D15 C6 concrete spalling and corroded reinforcement or Level 1 slab soffit	Removal of internal fittings and fixtures; temporary propping



3.4. Engineering Inspection 8 November 2017 – Primary maintenance works

Following an inspection on 8 November 2017, FSACE issued Structural Engineering Report **FS1499BB-SER02** dated 9 November 2017 (refer Appendix D) which summarised the identified recommendations for remedial works for Pavilion 1 as follows. Refer to Appendix D for additional information including photos.

- **Defect D16: Roof Level**
Likely compromise of structural integrity of roof framing members due to continued water ingress through failed roof sheeting and services penetrations or fixings.
Access required for remedial works would involve removal of all mechanical plant and roof sheeting.
- **Defect D10: Level 1 Eastern wall**
Installation of new waterproofing system to the balcony including tiles, supporting walls and glazing, reconstruction of lightweight cladding and waterproof masonry/concrete façade elements. Remove and replace all Level 1 windows.
- **Defect D5: Ground Level Western wall, southern end**
In addition to resolution of waterproofing works to the western wall, complete strip out of entire kitchen and disabled toilet including wall linings, ceiling linings, services and all fixtures and fittings to enable structural repairs to be completed.
- **Defect D17: Top of Level 1 slab in Upper Kitchen area**
Removal of floor, fixtures and fittings around original internal services lift to enable structural inspection and remedial works to Level 1 slab
- **Defect D18: Top of Level 1 slab in upper amenities area**
Removal of floor, fixtures and fittings around likely construction joint to enable structural inspection and remedial works to Level 1 slab



3.5. Engineering Inspections July/August 2016 – Defects to Ground Floor Kitchen

Following multiple inspections in July/August 2016, FSACE issued Structural Engineering Report **FS1499BB-SER01** dated 8 September 2016 (refer Appendix E) which confirmed evidence of significant water ingress through the original western wall of Pavilion 1 and the implications for the integrity of the original structural members as well as the integrity of secondary framing and finishing that formed the refurbishment of Pavilion 1.

As we understand at the writing of this report, no remedial works to address water ingress through the original western wall had been undertaken and defects to the timber framing members were still evident (refer Section 4.1, Defect D5). Continued water ingress is also noted to contribute to the continued defects to the original concrete wall (refer Section 4.1, Defect D2) and possibly also to concrete spalling of the soffit of Level 1 original concrete slab (refer Section 4.1, Defect D1).

Following submission of various engineering options to mitigate against water ingress through the western wall, various risk assessments were undertaken including FSACE submitted 'Dewatering Options Analysis Report FS1499BB-CAR-01' dated 27th September 2019. This report analysed six different engineering options against the following categories:

- Effectiveness of mitigation of water ingress
- Construction cost
- Recurrent cost
- Constructability
- Reliability on power source
- Impact of planning approvals

Option 2B was identified as having the highest rating against these categories and consisted of the construction of directional drilled sub surface (horizontal dewatering), gravity fed drainage system behind the western wall which aims to drain excess water to the existing storm water infrastructure. This system scored highly for its relatively low construction and recurrent costs, but only scored 8/10 for its effectiveness of mitigation of water ingress.

It is therefore worth noting that the implementation of this engineering solution is not a guaranteed solution to mitigating water ingress.



3.6. 2012 Façade engineering assessment: **Personal Information** Consulting

In 2012, Façade Engineer **Personal Information** conducted visual inspections and water testing investigations of Pavilion 1 and Pavilion 2. The defects for Pavilion 1 identified in this resultant report (refer Appendix F) and the subsequent technical specification of works (refer Appendix F) generally align with the defects identified through FSACE inspections (refer Sections 3.1 to 3.5) as follows:

- Defects D2 and D5: Below-ground water penetration occurrences
- Defect D9: Water penetration through façade cracks
- Defect D10: Water penetration through eastern façade, window frames and balconies
- Defect D16: Corroded roof elements
- Defect D18: Water penetration through Level 1 slab in amenities area
- Defect D19: Deteriorated foam façade embellishments

The report also noted the possibility of cracks in the structural ground slab of Pavilion 1 although this risk was assessed as Low. FSACE have not conducted inspections of the top of the ground slab as this was covered with internal finishes.

3.7. 2012 and 2017 Quantity surveyors' reports: Proactive Quantity Surveyors

Proactive Quantity Surveying (PQS) have submitted a number of cost estimation reports to MBRC based on SWC reports (Section 3.6 above), site visits and discussions with MBRC. There reports are including in Appendix G.

The structural items identified in their 2017 report are:

- Defects D2 and D5: Water leaks into the rear of the Pavilion Building from the steep rock embankment
- Defect D10: Water leaks around windows and stud wall framing; water leaks from open balconies
- Defect D16: Water leaks around penetrations on flat roof
- Defect D19: Removal of polystyrene foam ledges around building

In addition, PQS identified a number of non-structural 'key issues' as follows:

- Defect D20: Sewerage smells throughout, particularly in the kitchen areas
- Defect D21: Replacement of PWD ground floor toilet to comply with current PWD codes
- Defect D22: Electrical items past due date for testing and tagging plus Fire Exit signs not illuminated

3.8. 2007 and 2017 Geotechnical assessment reports:

- Morrison Geotechnic
- Apod soil testing

Geotechnical investigation reports from 2017 and 2007 have been included in Appendix H for completeness. These reports do not identify defects to the existing structure. They contain information that would be useful for the design and specification of works to the existing structure.

3.9. 2018 Heritage assessment: Converge Heritage + Community

A recent Heritage Report commissioned by MBRC has been included in Appendix I. In this report, the elements of the structure have been rated against criteria for significance hierarchy (Table 5) and in Figures 54, 55 and 56 (extracts shown below).

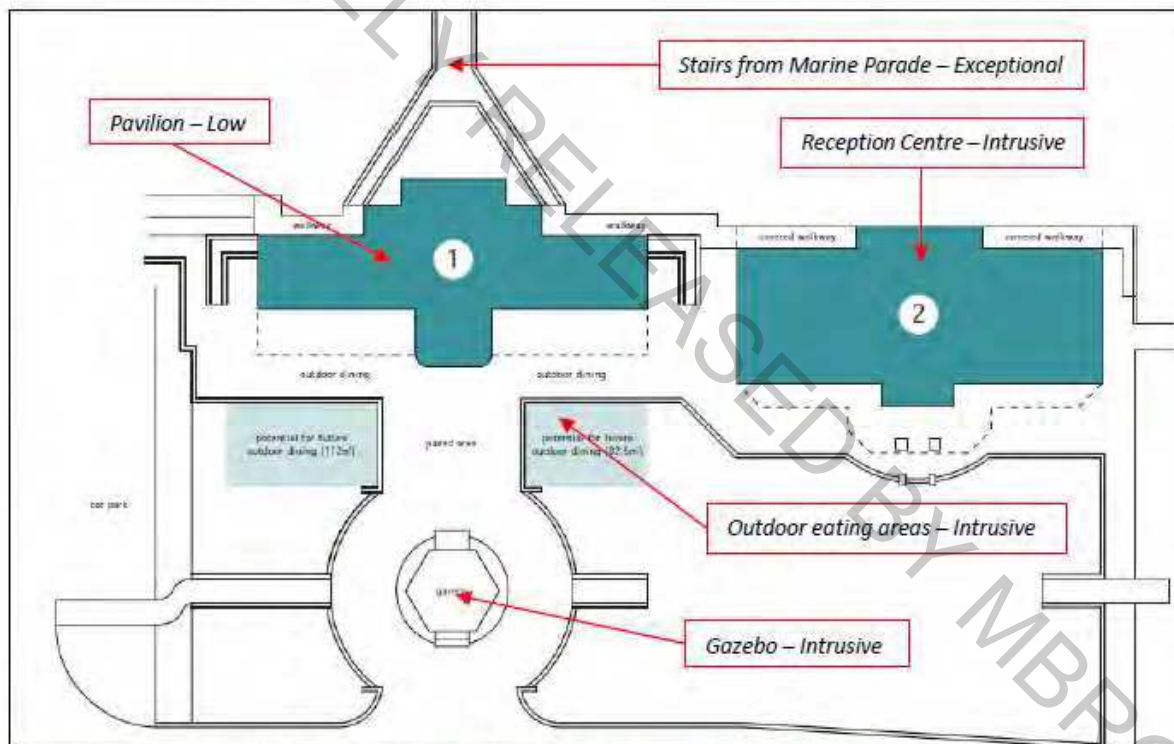


Figure 54: Location significant elements around the setting of the pavilion (MBRC 2006: 8).

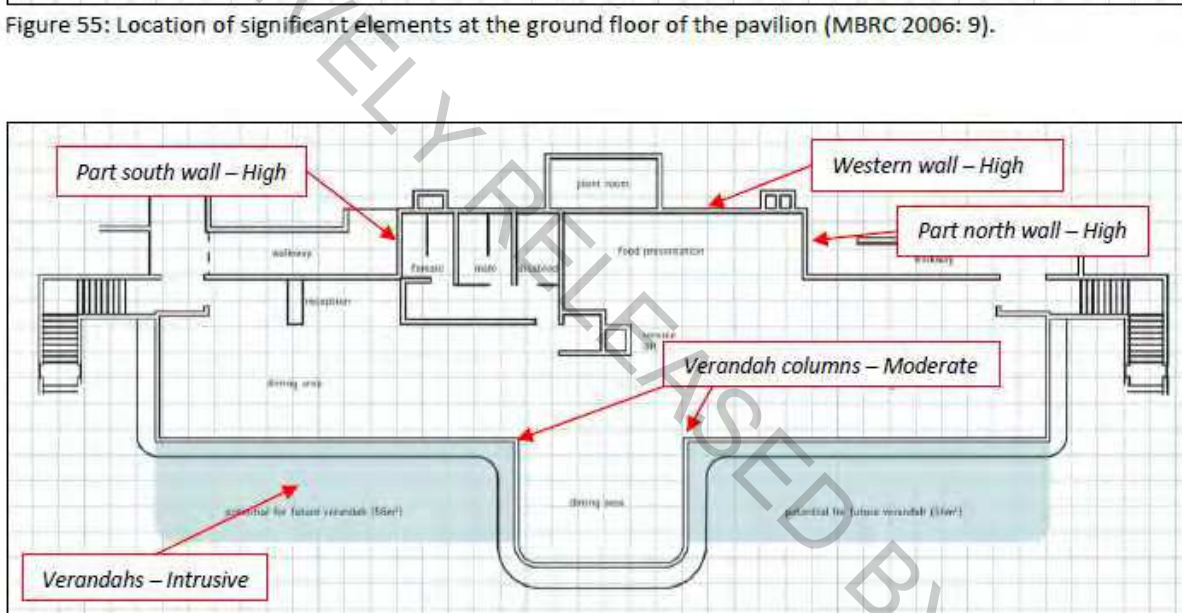


Figure 56: Location of significant elements at the second floor of the pavilion (MBRC 2006: 9).

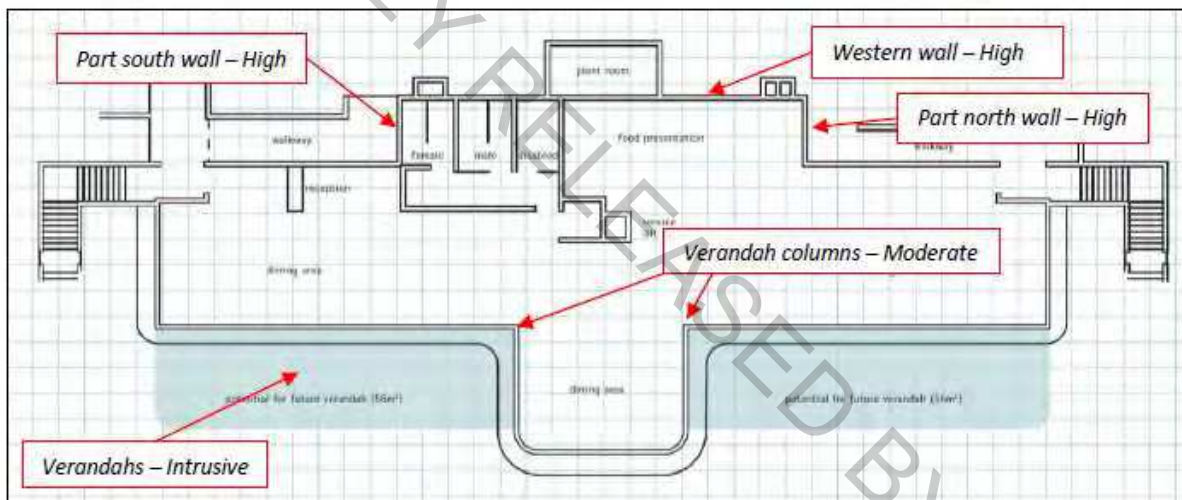


Figure 56: Location of significant elements at the second floor of the pavilion (MBRC 2006: 9).



We understand that various renovations of the structure have occurred over its lifetime as the use of the building has changed. In 2000, with the construction of Pavilion 2 on the site, the 'Link' section between the two buildings was established. In 2007, Pavilion 1 was extended at ground level towards the beach and major internal renovations were undertaken.

As is common with buildings that have been developed and re-configured over significant time periods (eighty-years), detection of the extent of suspected defects is problematic; original structure is often hidden behind layers of internal fixtures and fittings or covered as earth retaining walls or similar.

Significant investigations and assessments of the structure in its current as built configuration have been made over the past 9 years. The results of these investigations have been provided in detail within previous sections and the appendices of this report.

4. Conclusion

The following summarises the defects that have been found through the various investigative processes, generally it should be noted that:

- There is regular reporting of failures in the external cladding system primarily in relation to waterproofing.
- Regular and consistent statements around leaking roof and wall cladding are noted to have occurred for at least the past 10 years.
- Evidence of prolonged water ingress into internal spaces which is often a clear indicator that damage to the structure is likely to have occurred, either via corrosion of reinforcement, corrosion of structural steelwork or fungal rot of timber framing members. Where regular water ingress occurs and results in either wet / moist / dry cycling or areas remaining moist / damp significantly accelerated deterioration can be expected, this is clearly evident throughout the structure.

4.1. Defects to reinforced concrete frame

Significant concrete defects were noted to the ceiling area of the Pavilion PWD facility (south west corner of building - D15 – see image below). Significant spalling and deterioration of the reinforcement through the support beam and ceiling of the PWD facility was noted.



Whilst access for a full inspection was problematic, through limited access areas the following concrete spalling / cracking defects were noted:

- Soffit of Level 1 slab (D1) on the west of Pavilion 1;
- Soffit of Level 1 slab (D4 – see image below) to the eastern original entry;
- Ground level western wall (D2);
- Northern wall in the Link section (D11).
- External concrete stairs to the south west of Pavilion 1 (D8 - noted as part of the original structure).



Investigations have shown that there is evidence of spalling and reinforcement corrosion at various stages of degradation throughout the structure. Additionally, further consideration should be given to the following:

- Full investigation of the original ground floor rear wall in this regard is not possible due to the implications of fit out and retained soil;
- Significant water ingress over a long time period is noted as having occurred, this is noted as a potential root cause of corrosion to reinforcement. As such it could be reasonably assumed that once fully exposed there would be additional instances of reinforcement corrosion through this area;
- Concrete is naturally subject to chloride and carbonation ingress over time. When the ingress depth reaches the reinforcement, the onset of reinforcement corrosion is expected to accelerate, this is nominated as structure design service life. When considering the original reinforced concrete structure in our opinion it would be a fair assumption that the original structure is at or approaching the end of its original design service life.

Remedial concrete works can be undertaken via traditional concrete repair systems including breaking out spalling, replacement of corroded reinforcement and reinstatement of concrete repair mortar. Access to affect remedial works without full removal of fixtures, finishes and other surface coverings (including retained soil) is likely to be problematic complicating the repair process.

Note that evidence of spalling concrete was identified in a public location to the soffit of a suspended slab overhang on the eastern elevation of the original building (defect D4). Where overhead public space spalling concrete is identified it poses a risk of injury to the public and facility operators, this defect should be immediately made safe by removal and repair. A concrete repair specification for the soffit repairs of the PWD (D15) has already been provided, this repair system can be employed in the D4 location.

4.2. Defects to floor, wall and roof framing members

Evidence of water damage was identified to both ground floor and level one wall and roof framing. Locations that were either evident or uncovered through invasive investigation are noted as:

- Ground floor western wall internal lining framing (D5 - non-structural – first image below);
- Level 1 wall framing to perimeter of structure (D9 and D10 - assumed as a common defect to all upper level wall framing – second and third image below);
- Level 1 roof framing – corrosion noted generally to roof framing members with assumed water damage to roof framing where continued ingress has been occurring (assumptive based upon roof condition).





Further, partial invasive investigation into the ground floor ceiling space identified member surface corrosion and defective floor beam connections (D3 – refer image below).



The following comments are made regarding these defects:

- Repairs to floor framing connections is problematic without the removal of internal ceiling linings and services.
- Whilst ground floor framing is non-structural, repairs will be required at some point to mitigate local failure of the partition and its lining:
 - Repairs will require full stripping of all fit out along the back wall and replacement of same, which will be a significant undertaking considering the majority is kitchen equipment.
- Upper level wall framing to the full perimeter is deemed to be degraded, in several cases the bottom plate has completely collapsed rendering roof framing support compromised:

- Repairs to upper level wall framing will be significant in nature and require full stripping of wall cladding to enable the works.
- Root cause analysis of the leaks has led to identifying the failure of the external fabric including window waterproofing. Long term repairs will require the complete replacement of the external cladding system.
- Roof framing where noted as deficient will require removal of roof cladding to undertake repairs:
 - Inspection and reporting of roof cladding and mechanical equipment condition has been undertaken previously with both noted as being in very poor condition. MBRC advised FSACE in 2017 that water leaks into the upper level of Pavilion 1 were on-going despite regular repairs by MBRC and others. Continued water ingress would increase the risk of timber wet rot and steel corrosion to roof framing members;
 - Structural wall and roof framing repairs would trigger the need to remove and therefore replace the roof cladding system, this will be significantly impacted by the mechanical equipment on the roof.

When assessing the implications of this defect the health issues relating to continued and ongoing mould presence should also be considered.

4.3. General defects to Pavilion 1 and Link Section

The following additional defects have been reported through the investigative process:

- Water ingress – ground floor pavilion 1:
 - Water ingress through the ground floor west wall has been regularly reported;
 - Significant assessment work has been undertaken to determine the root cause of water ingress and methods of mitigation;
 - Due to the building configuration guaranteed mitigation measures are problematic, the opportunity to achieve this is limited to excavation behind and creation of a secondary wet wall. All other solutions as documented will not guarantee 100% mitigation of ingress;
 - Secondary issues resulting from this ingress is the degradation of internal wall partitions between the working area and the structural wall, repairs of same will require significant demolition and reconstruction of the kitchen area;
 - There is a high likelihood that covered structural components (specifically the rear structural wall) are impacted by this ongoing ingress.
- Water ingress – ground floor link structure:
 - Poor initial construction methodology has resulted in a lack of waterproofing and drainage to the west side of this structure (D11);
 - Poor access has complicated the possibility for repair with significant invasive works required to rectify the defect;
 - Failure of unretained soil has resulted in collapse of boardwalk bearers (D13 / D14) and joists and impacted on drainage pipework and services (D12).
- Water ingress upper level:
 - Failure of both wall and roof cladding systems, original window installation not fit for purpose from a waterproofing perspective
 - Significant roof penetrations and local failures to roof cladding system
- Degraded / delaminating existing foam awnings (D19);

- Local ceiling sheeting failure in Pavilion 1 due to weight of services cables (D6);
- Previously reported poor mechanical and electrical services installation, reported condensation build up and dripping into ceiling space from incorrectly installed refrigeration pipework;
- Potential member damage from washing of the upper level kitchen floor and resultant water ingress into the ceiling cavity (D17);
- Potential member damage from washing of the upper level amenities floor and water ingress into the ceiling cavity (D18).

Mitigation of water ingress will be problematic due to the nature of construction. It should be noted that significant invasive works will be required to remediate building water ingress.

Other items noted, whilst relatively minor in nature, lead to an assumption around the poor quality of workmanship that was employed through the more recent renovation works. Whilst the investigations and reporting to date would be considered thorough, by nature there is a limit to what could be reasonably expected to be able to be seen. As such, workmanship should be taken into account when assessing the full extent of works that will be required to render the building fit for purpose, through the balance of its life expectancy.

4.4. Additional defects of note

The following defects have been reported previously and are relevant to the current considerations so are included for completeness:

- Reported sewage smells (D20);
- Existing ground floor toilet non-compliance with current PWD codes (D21);
- Level 1 access non-compliance;
- Non-compliance of electrical items (out of date tagging) and fire signs (D22).

In an effort to rank defects for priority of repair the following list has been provided. It is noted that this ranking is based purely on potential outcomes relating from potential structural failure when considering the risk to health and safety. This ranking has not been assessed against a likelihood / consequences table so should be read purely as statements of what we would consider structural repair priorities. Further, we have only listed items would result in a structural failure outcome if not remediated:

Listed in priority with highest priority at the top:

1. Spalling concrete to PWD (D15)
2. Spalling concrete to entry soffit area (D4)
3. Failing upper level wall framing
4. Defects to roof framing
5. Defects to level 1 floor beam connections

Note that other non-structural risks such as electrical, slips and falls etc. have not been considered.

When considering the proposed building remedial works projects that are currently tabled to be undertaken (rear water surface and subsurface water handling works), the following remedial building requirements should be considered. Note that to facilitate continued use as a leased occupancy all items listed below would be deemed as necessary works to be undertaken:

- Ground floor requires remedial works in regards to significant and ongoing water ingress, rear subsurface water mitigation strategies (rear subsurface drilled / bored drainage system);
- Ground floor area requires remedial works to concrete beams, concrete slab, internal rear wall linings and framing, steel beam connections and ceiling support system;
- Link structure requires remedial works to mitigate water ingress and concrete repairs;
- Upper level area requires remedial works to mitigate water ingress (roof / walls / windows), remedial repairs to wall framing and roof framing;
- Exterior remediation includes replacement of foam awnings and general waterproofing repairs.

The above should be read in conjunction with the following comments:

- The original concrete structure is at or approaching end of life which will result in accelerated degradation;
- Currently proposed rear subsurface water mitigation strategy (rear subsurface drilled drainage system) cannot be guaranteed due to building configuration and inability to properly assess rear sub surface conditions (supplementary positive side (injection) and negative side membrane installation has been recommended but should not be read as a method that would enable the guarantee);

Significant cost estimation works have been undertaken for the purposes of planning. Cost information has been generated over a relatively long time period across a number of differing options, as such the following data extracted from the attached cost estimates (refer appendix G) in conjunction with other reference data reflects what could reasonably be expected as the costs associated with remedial rectification works. Note that the cost for membrane injection or structural and cladding remediation for the upper level framing has not been assessed to date and as such is not noted, it should be expected these values will be significant in nature.

Construction Cost Estimate Summary Table: Identified key remedial works requirements

Item	Value	Comment
2017 Maintenance items	\$447,000	Less rear wet wall construction allowance
Proposed rear horizontal dewatering system	\$500,000	
Internal kitchen stripout, and reinstallation	\$215,000	
Installation of both positive (injection) and negative side membrane to rear wall – supplementary to rear horizontal dewatering system	Unknown	Unknown but expected to be significant in value
2018 Maintenance works items	\$165,000	Note there will be some redundancy / overlap due to limited maintenance through the period 2017 – 2020 but these will not be values of significance
2019 Maintenance works items	\$157,000	
2020 Maintenance works items	\$100,000	
Pavilion roof level works	\$397,000	
Replacement of windows (L1), façade and balcony waterproofing	\$335,000	
Structural repairs to upper level wall and roof framing	Unknown	Unknown but expected to be significant in value
Total Estimated:	\$2,316,000 +	Membrane injection and upper level framing to be added

Note that the above should be seen as cost estimates only. Should MBRC wish to further explore remediation, revisiting and updating of cost estimates will be required.



5. Limitations to Report

Personal Information inspections on the dates noted in the various relevant reports were limited to a visual and walkover examination of the site. This report has been prepared within the limitations imposed by visual access and walkover around Suttons Beach Pavilion 1, and the findings noted are relevant to the noted dates of the inspection.

This report refers to specific structural engineering matters only and the following matters are specifically excluded from assessment:

- Safety and condition of electrical wiring;
- Plumbing work, including water services, sewers, roof gutter and gas plumbing;
- Any subsurface or otherwise hidden aspects;
- Fire and health regulations and requirements; and
- Review of drawings showing the structural configuration or member sizes of the existing structure.

Interpretations of this report beyond the above-mentioned limits should not be made.

This report represents the findings of FSA Consulting Engineers in relation to the specific matters defined in this report only and is not to be construed to represent a comment on the structural integrity or otherwise of any other area(s) of the property that is/are not directly commented on in respect to adequacy of condition.

6. Indemnity

This audit has been undertaken by FSA Consulting Engineers at the request of Moreton Bay Regional Council. No responsibility to third parties under the law of contract, tort or otherwise for any loss or damage is accepted.



7. Declaration

I declare the following:

- The factual matters stated within this report are, to the best of my knowledge, true and correct.
- I have completed all enquiries that I consider appropriate in formulating my conclusions.
- The opinions stated by me within this report are genuinely held by me.
- The report contains reference to all matters which I regard as significant.

Should you have any further enquiries regarding this matter, do not hesitate to contact me.

Yours faithfully,

Personal Information

FSA Consulting Engineers P/L
as trustee for FSACE Trust
Unit 12, Tingalpa Central, 1631 Wynnum Road, Tingalpa Q 4173
Tel: **Personal Information**
Mob: **Personal Information**
Email: **Personal Information**
Web: www.fsace.com.au



Appendix A: FSACE inspection 12-02-2020 – Pavilion 1

ADMINISTRATIVELY RELEASED BY MBRC 2-2-22



APPROX. CURRENT
BUILDING GROUND
LEVEL PROFILE

EXISTING BUILDING REAR WALL
SUBJECT TO WATER INGRESS

APPROX. OUTLINE
OF LEVEL 1 OVER

F.F.L 3.55m

DRAINAGE VOID (E)

1 PAVILION 1 - GROUND FLOOR (EXISTING)
SCALE: 1 : 150

NOTES
REFER TO SHEET 17-545-003 &
17-545-004 FOR GENERAL NOTES.

DRAWING USED TO ANNOTATE LOCATION
OF IDENTIFIED DEFECTS: Ground Level
INSPECTION 12-02-2020

Personal Information

PRINT IN COLOUR



ENGINEERING,
CONSTRUCTION &
MAINTENANCE
AUTHORISATION

Director Date

Message Date

PROJECT INFORMATION

Project Number

Coordinator

Design

Surveyor

Survey Date

Checked

Horizontal

Vertical

Scale

ISSUE

Revisions

D Appr. Date:

C Appr. Date:

B Appr. Date:

A Appr. Date:

Original Issue Date:

PROJECT DESCRIPTION

SUTTONS BEACH

PAVILION

50 MARINE PARADE,

REDFCLIFFE

PAVILION 1 FIRST

FLOOR WATER

INGRESS REPAIRS

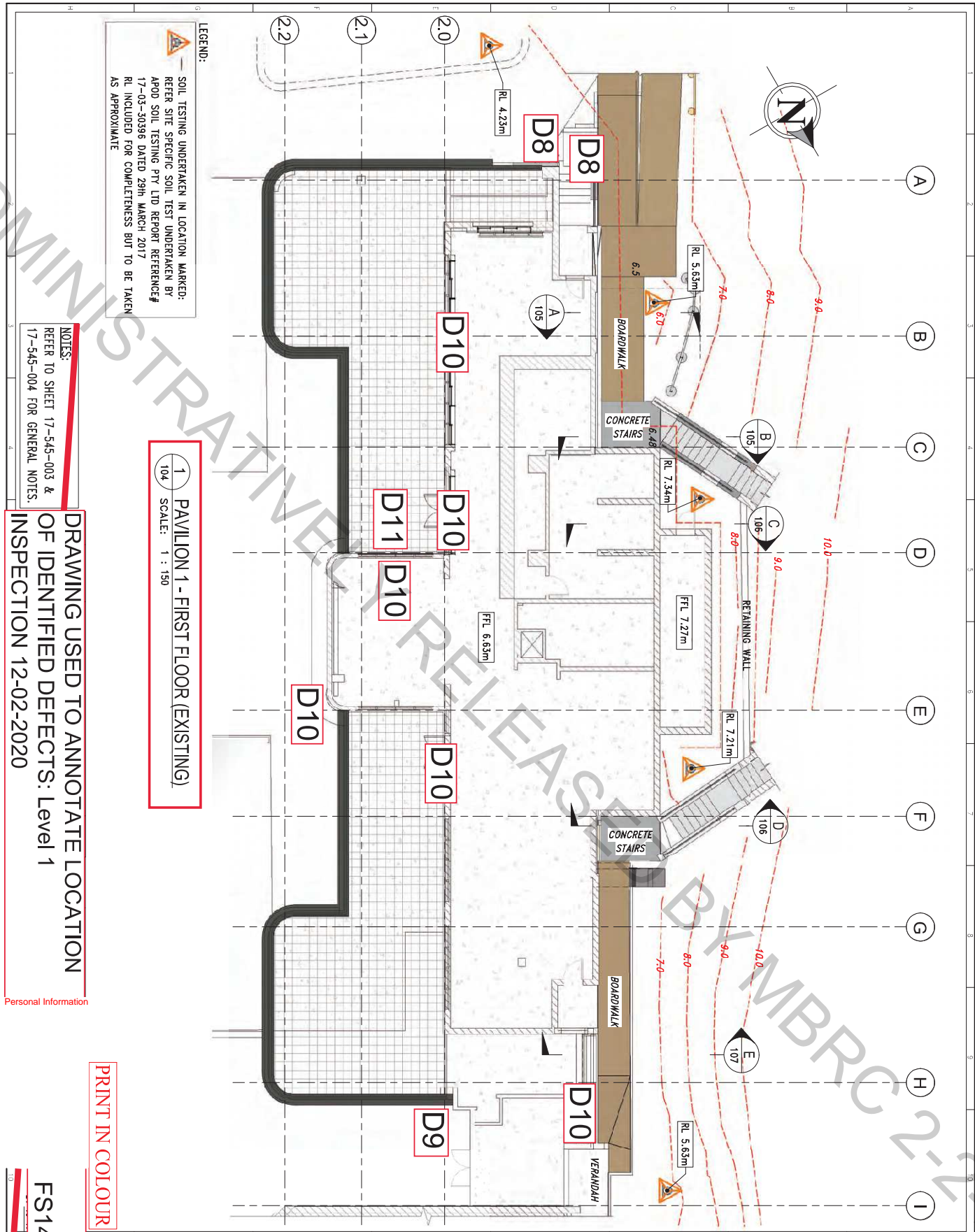
PAVILION 1 - GROUND FLOOR

EXISTING

APPENDIX A

FS1499FL-SER01

Original Plan Size A3



LEGEND:

SOIL TESTING UNDERTAKEN IN LOCATION MARKED:
REFER SITE SPECIFIC SOIL TEST UNDERTAKEN BY
AP0D SOIL TESTING PTY LTD REPORT REFERENCE#
17-03-30396 DATED 29th MARCH 2017
RL INCLUDED FOR COMPLETENESS BUT TO BE TAKEN
AS APPROXIMATE

1 PAVILION 1 - FIRST FLOOR (EXISTING)
104 SCALE: 1 : 150

NOTES:
REFER TO SHEET 17-545-003 &
17-545-004 FOR GENERAL NOTES.

**DRAWING USED TO ANNOTATE LOCATION
OF IDENTIFIED DEFECTS: Level 1
INSPECTION 12-02-2020**

Personal Information

PRINT IN COLOUR

APPENDIX A
FS1499FL-SER01
Original Plan Size A3

Moreton Bay Regional Council	
ENGINEERING, CONSTRUCTION & MAINTENANCE AUTHORISATION	
Director	Date
PROJECT INFORMATION	
Message	Date
Budget Number	
Coordinator	Drawn/Labelled
Design	Checked
Surveyor	Survey Date
Horizontal	Vertical
IS USE	
Revisions	
D	Appr. Date:
C	Appr. Date:
B	Appr. Date:
A	Appr. Date:
Original Issue	Date:
PROJECT DESCRIPTION SUTTONS BEACH PAVILION 50 MARINE PARADE, REDCLIFFE PAVILION 1 FIRST FLOOR WATER INGRESS REPAIRS	
PAVILION 1, FIRST FLOOR EXISTING	

Personal Information

From: Personal Information
Sent: Wednesday, 12 February 2020 4:08 PM
To: Personal Information
Cc: Personal Information
Subject: RE: Suttons Beach engineering inspection

Hi, ^{Personal Information}

Confirming our attendance on the Suttons Beach Pavilion this morning to undertake an invasive investigation as planned, the works were completed without significant affect on ^{Personal Information}. Note that whilst this was invasive there were still some limitations to what could be seen without significant removal of linings and within the boundaries of access limits, the intent was to get an overall picture of the building structural item current condition. A brief summary of our findings is:

- Lower level:
 - Wall framing to the south end of the rear (western) basement wall was noted as having severe dry rot / termite damage to the bottom plate and lower stud level. Previous investigations at the north end of this wall identified similar defects, cabinetry was also identified as having significant levels of deterioration, this leads to the assumption that a significant extent of the lower portion of the wall framing and any lower level timber based cabinetry is likely affected by the same defect. Whilst it is a non structural wall probable future repairs which would include a complete demolition of the kitchen need to be factored in to the long term decision making
 - Local areas of spalling and previous concrete repairs were noted sporadically through the soffit of the level one slab
 - Spalling was identified to the north end wall where the original stair had been demolished
 - Corrosion and anchor bolt sizing issues was identified to steel beams that had been added in as supplementary support for post original construction modifications
 - Some local spalling was noted to the soffit of the external façade outstand (needs to be removed for safety reasons – see images below)
 - Cracking was noted to a reinforced concrete beam over the original entry portal
- Upper level:
 - Spalling and cracks were noted to the south end access stair walls
 - Wall framing water damage was noted at every invasive investigation point (5 total) with degradation ranging from initial (although framing in this area appeared to have been a more recent repair not original construction) to failed (see image below), this leads us to the conclusion that the entirety of the wall framing is degraded to some level with the potential that anything that has not been replaced already is failing or has failed:
 - The main culprit appears to be the windows but there is potential that the external cladding system is not entirely water tight
 - Continued repairs and patch ups will not eliminate the root source from what we can see
 - In our opinion the entire upper level needs to be demolished and reconstructed in a fit for purpose manner (as a minimum stripped back to frame, repairs to frame then new linings, waterproofing and windows) to mitigate the ongoing repairs

There are some other items that we will add in to the report.

Let me know if you need any further clarification at this point.

Thanks,
^{Personal Information}



Appendix B: FSACE inspection 05-02-2020 – Northern drainage void

ADMINISTRATIVELY RELEASED BY MBRC 2-2-22

[REDACTED]

From:

Personal Information

Sent:

Wednesday, 5 February 2020 3:36 PM

To:

Cc:

Subject:

FS1499FL - MBRC - Suttons Beach Pav 1 - drainage void investigations

Hi [REDACTED],

As part of a project we have under [REDACTED] at Suttons beach pavilion there was a need to further investigate a void between Pavilion 1 and Pavilion 2, to the west of the interface structure (see mark up GIS below) to enable a clearer understanding of its initial design / construction intent. This area has not been previously fully explored due to the nature of accessibility and the intent of previously documented mitigation measures.

Our investigation this morning has uncovered some problematic outcomes as follows:

1. The void was created by the construction of the pavilion 1 and pavilion 2 link section, a new block wall has been built offset approximately 750mm inside the original back wall alignment to basement ground level with some pipework and services through
2. The void is approximately 3.5m deep from boardwalk level and approximately 550 clear width narrowing to 450 / 300 in some places (hence access is problematic):
3. There is a remaining section of original stair stringer and what appears to be a section of redundant pathway, the pathway is acting as a roof slab over a section of backfill approximately 2m above excavation level:
 - a. The backfill has undermined the slab by approximately 300mm currently (see images below)
4. There are a number of services under the boardwalk that we were unaware of:
 - a. Specifically there is a cable tray that appears to have had its supports removed and is spanning approximately 3m whereby the cables at the north end as the exit the P2 core are supporting the cable duct lid which in turn is hanging the balance of the duct (see images below)
 - i. Both [REDACTED] and myself saw this as a significant electrical safety hazard that requires immediate rectification
5. No attempt at waterproofing the recent block wall was made hence any water that enters this area will relatively easily migrate through the wall
6. Local support of a bearer has been compromised (although the joist appears to be robust enough and is not spliced through the remaining span that it is not at imminent risk of collapse

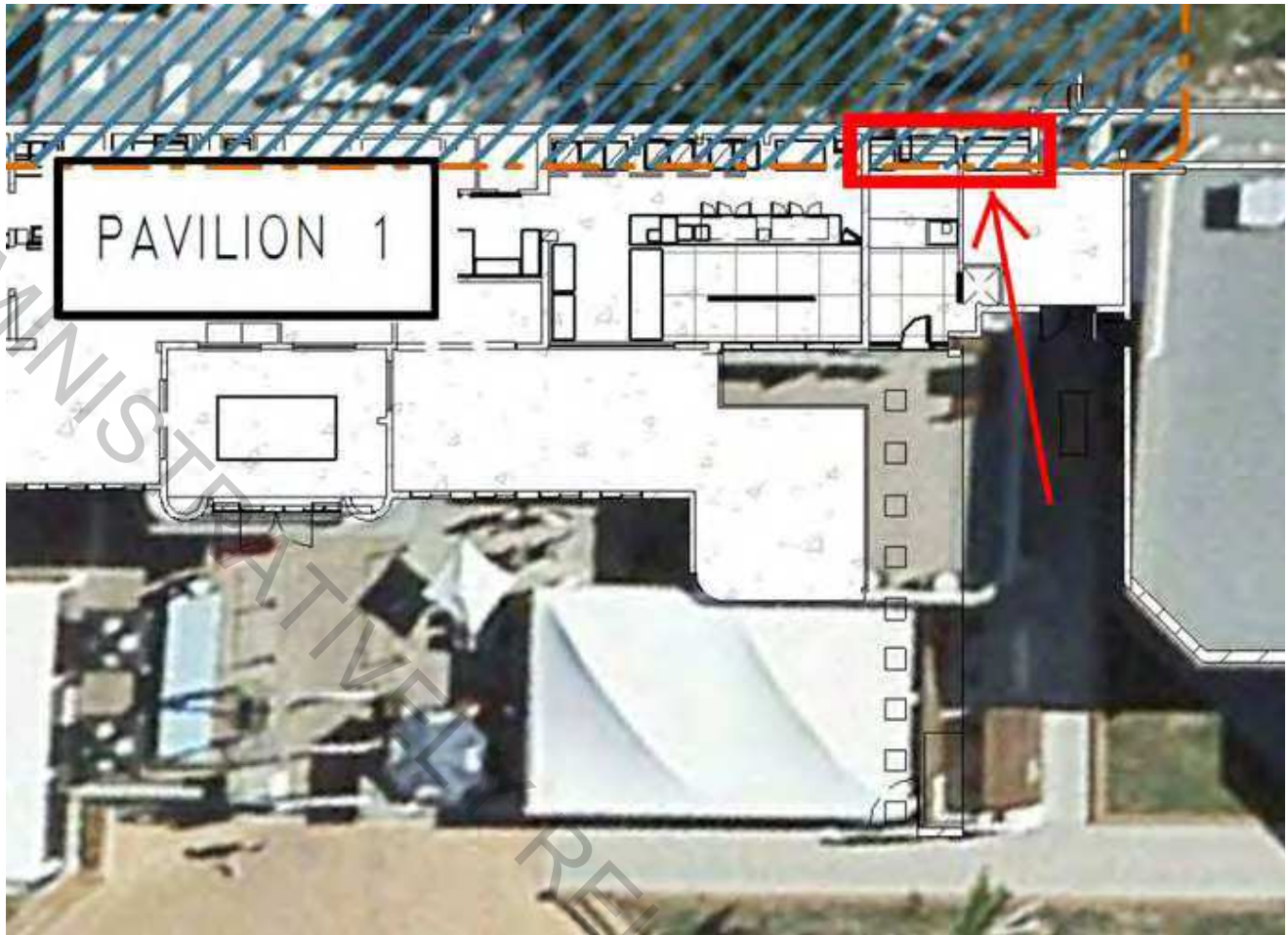
[REDACTED], item 4a needs immediate attention in our opinion to mitigate a potential electrical hazard / risk. Temporary propping of the cable tray would be a good immediate risk mitigation method, the cabling should be assessed for fitness for purpose.

In reality the entire area needs various levels of repair, from what I have seen any water ingress mitigation that does not involve creation of a secondary retaining wall such that we can keep water away from the recent wall construction is very unlikely to be 100% successful.

I will send a further email with images taken today FYI. We will continue with our investigations as planned. Let me know if you need any further clarification re the above.

Thanks,

Personal Information









**Under this slab south
end at interface with
original stair stringer**

Personal Information

Structural Engineer

Mob: Personal Information

E-mail: Personal Information



Appendix C: FSACE inspection 30-01-2020 – Pavilion 1 south west corner (PWD)

ADMINISTRATIVELY RELEASED BY MBRC 2-2-22

[REDACTED]

From:

Personal Information

Sent: Thursday, 23 January 2020 4:44 PM

To: [REDACTED]

Cc: [REDACTED]

Subject: FS1499FL - MBRC - Suttons Beach Pav - Concrete Beam Defect - Inspection advice

Hi [REDACTED],

As instructed I have attended site to assess an apparently defective reinforced concrete beam located in the ceiling of the PWD toilet – south west corner of pavilion 1. The beam spans north south with its original intent to support the east edge of the rear stairs. The location is as shown in extracts of the original design drawing and what appears to be the most recent architectural refurbishment drawings (see below).

In regards to the beam in question it is noted that:

- The original intent was for support of the stairs, subsequent works include a new slab over what was an original void and a new block wall over, we are unable to comment if the more recent structural works have utilised this beam (i.e. added more load to it) or have been designed as independent
- The beam was noted as having significant corrosion to the bottom reinforcing and spalling of concrete, it appeared that spalling of the soffit of the beam had reduced it in the order of 50mm in section depth
- The bottom reinforcing is ineffective with significant section loss
- Vertical cracking (see below) indicates the bottom of the beam is under tension – indicating it is bending downwards in the middle (as would be expected – in a traditional reinforced concrete design the bottom steel would work in tension to counter this stress)
- At some point in the past there has been an effort to coat the defect as can be seen by the apparent bitumen coating.

We would consider this beam structurally failed and without the benefit of knowledge of the structural implications of post original construction refurbishments assume it is supporting both the stairs in combination with the more recently added upper level floor, wall and roof loads.

In this case we recommend immediate temporary propping approximately midspan via installation of an acrow prop centred on the beam:

- Installed over sole board on floor – 2 x 200 x 400 base layer (400x400) w/ 200 x 400 perpendicular top board
- Head board should be between the beam and reinforcing
- Acrow prop should be secured at the head against potential dislodgement.

In our opinion the most effective permanent repair system would be carbon fibre strengthening, the following would need to be considered:

- Rebuilding the beam back to original depth with repair mortar system
- Installation of a carbon fibre bandage through full length
- Consideration of fire rating if deemed necessary.

The box out / linings will need to be removed to enable access to the full length of the beam for finalisation of repair detailing.

Note this beam was part of the original structure hence repairs may have heritage implications.

Let me know how you wish to proceed.

Thanks,



Appendix D: FSACE Report Primary Maintenance Works 09-11-2017

ADMINISTRATIVELY RELEASED BY MBRC 2-2-22