Town of Port Hedland Observation Tower

Tower Condition Assessment Report

Prepared for the Town of Port Hedland
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aie.engineering

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1. Executive Summary

AIE were engaged by the Town of Port Hedland (ToPH) to undertake a structural condition inspection of the public Observation Tower located at 13 Wedge St, Port Hedland WA. The objective of the inspection was to assess the structural condition of the tower and identify any defects or deterioration that may affect the safety, serviceability and integrity of the structure. A summary of the breakdown of the defects Priority Rankings assigned from the inspection results of the subject property is presented in Table 1.

Table 1: Summary of Priority Ranking Breakdown.

Risk Rating	Description	Priority Ranking	No. of Priority Rankings*
0	Extremely Severe	P0	0
1	Severe	P1	3
2	High	P2	2
3	Moderate	P3	4
4	Low	P4	1
Total			**10**

*Represents grouped elements.

The inspected public Observation Tower was assessed to be of a **Severe Risk to Safety** at the time of inspection, **based on a generally deteriorated structural system**, and intervention is recommended as summarised below:

- The Risk **Priority Ranking P1** defects need to be addressed within 3 months from the date of this report, and include:
    - A horizontal bracing at ground level that has Level 5 corrosion at an isolated area, which has led to disconnection at one of the joints. This bracing need to be replaced like-for-like.
    - An isolated area on one of the columns at Tower Level 4 has Level 5 corrosion (with holing). Remediation of this defect by overplating is recommended. **Further structural analysis and design is required in order to provide detailed remediation details for this defect**.
    - Handrails and kick plates have Level 5 corrosion (with holing) in multiple locations on all Tower Levels, and these need to be replaced like-for-like.

- The Risk **Priority Ranking P2** defects need to be addressed within 6 months from the date of this report, and include:
    - The ladder on Tower Level 5 – 6 has Level 5 corrosion in multiple locations and need to be replaced like-for-like.
    - The platform floor on Tower Level 5 has Level 5 corrosion (with holing) in multiple locations, and the steel floor plate need to be replaced like-for-like.

- The Risk **Priority Ranking P3** defects need to be addressed within 12 months from the date of this report, and include:
    - All fasteners and connections on the Tower have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.
    - Multiple diagonal bracings have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating

re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.

- Multiple welds have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned using a wire brush (or similar), and further assessment be undertaken to determine the extent of corrosion per location prior to remediation by either,
  - Grinding the weld connection and re-welding following AS/NZS 1554.1
  - Preparing surfaces and re-applying protective coating following manufacturer's recommendations and to AS 2312.1.
- Multiple stairs have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.

- The Risk **Priority Ranking P4** defects need to be addressed within 24 months from the date of this report, and include:
  - Multiple columns have widespread protective coating breach and Level 2 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1.

In addition to the inspection results and recommended intervention above, a high-level cost estimate has been developed, including a 20% contingency, and **a budget of $672,000 (excl. GST) is recommended for the remediation work**.

Furthermore, an estimate for professional and engineering services is also given based on certain findings that need engineering input, and quality assurance and verification exercises that may be required during remediation. This budget estimate, at **12%** of the recommended remediation budget has been applied to the contractor's estimate. Therefore, a further budget estimate of **$80,640 (excl. GST) is recommended for professional and engineering services**.

In summary, the total budget estimate recommended for structural remediation of the ToPH public Observation Tower, including professional and engineering services is **$752,640 (excl. GST)**.

2. Introduction

2.1. General

AIE Engineering and Construction Management Pty Ltd (AIE) is a specialist engineering consultancy servicing the needs of clients throughout Australia and New Zealand. Our expertise lies in Asset Integrity Management (AIM), particularly within the diverse sectors of resources, mining, local government, marine, ports, transportation, and oil and gas industries. We specialise in condition assessments and inspection, as well as the design and project management of structural engineering works, encompassing concrete, steel corrosion, and cathodic protection technologies. This breadth of experience uniquely positions AIE to address the multifaceted needs of our clients in these sectors.

AIE were engaged by the Town of Port Hedland (ToPH) to undertake a structural condition inspection of the public Observation Tower located at 13 Wedge St, Port Hedland WA. The objective of the inspection was to assess the structural condition of the tower and identify any defects or deterioration that may affect the safety, serviceability and integrity of the structure.

The inspection comprised a detailed visual assessment of safely accessible structural members, connections, bracing, platforms, ladders, stairs, and safety barriers. Observations were recorded for defects including protective coating breach (PCB), corrosion of structural steel elements, deterioration to welds and connections, and localised corrosion-related section loss. Findings from the inspection have been used to inform recommended remediation and maintenance actions to support safe ongoing use of the structure.

The inspection was completed using existing access stairs and a pole-mounted high-resolution camera to capture high quality photographs of structural members, connections, and corrosion-affected areas. Where closer access was required for specific areas of concern, inspection was undertaken by Working-at-Heights trained personnel using full harness and 100% tie-off. Access to the first landing was by portable ladder. It should be note that reinstatement of a permanent access to the first landing (Level 1) is not included in this report.

2.2. Previous Inspections

According to documentation availed to AIE's engineers prior to the current inspection, it was noted that a previous structural review of the Observation Tower was completed on 28 July 2015 and documented in a report.

Based on the review of the previous inspection report, it was noted that matters relating to environmental/climatic exposure considerations and stair access compliance with relevant Australian Standards had already been assessed and addressed as part of the earlier review.

Accordingly, the scope of the current engagement was limited to a structural condition assessment only, comprising a visual inspection supplemented by limited non-destructive testing (NDT) in the form of hammer tapping to identify potential deterioration. No structural design, certification, or compliance assessment was undertaken as part of this inspection.

2.3. Conflict of Interest

AIE's recommendations are independent, without any conflicts of interest associated with the supply of materials, equipment, or laboratory testing services. AIE is also not a consultant that is conflicted by any commercial relationships with suppliers, technology providers or contractors.

The Partners and Directors of AIE are also not Directors of other companies that supply repair materials which would then be conflicted by this project consultancy.

3. Scope

The scope of this inspection comprised a structural condition assessment of the public Observation Tower located at 13 Wedge St, Port Hedland WA, based on a visual inspection of safely accessible structural elements.

The scope included identification of observable defects and deterioration, photographic documentation, and provision of high-level remedial and maintenance recommendations to support continued safe use of the structure.

Limited non-destructive testing (NDT) was also undertaken in the form of hammer tapping to assist in identifying areas of potential corrosion, section loss, or delamination where deterioration was suspected. No intrusive investigations, material sampling, structural design verification, or compliance certification were undertaken as part of this assessment.

The site location of the public Observation Tower is shown in Figure 1.

Figure 1: Location of public Observation Tower at 13 Wedge St, Port Hedland WA

4. Background Information

The public Observation Tower is located in Port Hedland, Western Australia, within **Wind Region D (Severe Cyclonic).** The structure comprises of a steel frame, including supporting steel members, bracing, elevated platforms, access stairways and landings, and associated safety barriers and handrails.

5. Methodology

The inspection and assessment were carried out in general accordance with the methodology outlined in AS ISO 13822-2005 (R2016), Section 4.5 Preliminary Assessment. The objective of the inspection was to identify the structural system and any observable deterioration or damage by means of a visual inspection and simple inspection tools. The condition assessment was undertaken in qualitative terms, based on the observed extent and severity of deterioration, and used to inform defect prioritisation and high-level remedial recommendations.

The inspection comprised a visual assessment of safely accessible structural components, including primary members, bracing, platforms, access stairs, and safety barriers. Non-Destructive Testing (NDT) was also undertaken in the form of hammer tapping, where required, to assist in identifying potential corrosion, section loss, delamination, or other localised defects that may not be readily apparent by visual inspection alone.

Depending on the outcome of the preliminary inspection, preliminary analysis may be carried out to identify future deficiencies that relate to the safety and serviceability of the property, with reference to the relevant Australian Standards and Codes. Results from these checks dictate as to whether further investigations are to be instigated.

Where preliminary inspections and checks indicate that the property's structural integrity is at a Risk Level above 'High' (refer to Figure 2), engineering intervention shall be immediately taken to reduce the danger with respect to public safety. Where uncertainties exist, critical deficiencies shall be immediately assessed, and any necessary actions implemented. Where preliminary checks identify there is uncertainty in actions, action effects or properties of the structure, detailed assessment in accordance with AS ISO 13822-2005(2016) Section 4.6 shall be initiated.

No intrusive investigations, detailed structural calculations, nor compliance certification were undertaken. The assessment is predicated on the assumption that the structure was originally designed and constructed in accordance with relevant Australian Standards, building codes, and accepted engineering practice. Accordingly, this report must not be interpreted as providing certification, approval, or verification of compliance for the structure or any of its components.

5.1. Access and Visual Inspections

Access to the Observation Tower for inspection was undertaken on foot using the existing access stairs and platforms. A visual inspection of all safely accessible structural components was completed from ground level and from various platform levels, utilising a tape measure and callipers for basic dimensional checks, and digital camera for photographic documentation. Where required, a pole-mounted high-resolution camera was used to capture images of elevated or inaccessible areas without the need for an elevated work platform (EWP).

It is important to note that for public safety reasons, the first flight of stairs from ground level to Level 1 (see Figure 3) has been removed to limit access to the tower. Therefore, for the current scope, a portable ladder was temporarily installed to enable safe access to the first platform for inspection purposes. It should be noted that reinstatement of a permanent access to the first landing is not included in this report.

Areas of note for steel elements included the protective coating, connections & fasteners, and components exhibiting various levels of deterioration. Generally, AIE's Corrosion Condition Rating Guideline given in Table 2 was used when identifying defects on the steel elements during the condition assessment.

Table 2: AIE's Steel Corrosion Condition Rating Guideline

Corrosion Level	Corrosion Condition Description	Section Loss Estimate
1	Surface Corrosion / Protective Coating Breakdown (PCB)	No metal thickness loss greater than 0.1 mm
2	Minor Corrosion	Metal thickness loss between 0.1 mm – 0.5 mm
3	Medium Corrosion	Metal thickness loss between 0.5 mm – 2 mm
4	Major Corrosion	Metal thickness loss up to 2 mm – 50% of total component thickness
5	Severe Corrosion	Metal thickness loss between 50% – 100% of total component thickness

5.2. Priority and Risk Assessment Definitions

Priority ranking is chosen based on the risk level determined from the Qualitative Risk Assessment as defined in Figure 2. The corresponding action is given for guidance only to assist ToPH in performing the recommended maintenance work. AIE takes no responsibility for incidents or system failures that occur prior to the recommended action durations.

Risk Ranking	Risk Level	Action	Priority Ranking
0	Extremely Severe	Address without delay, notify all personnel accessing the site, restrict access as required, & undertake make-safe works if required, etc.	P0
1	Severe	Address within 3 months	P1
2	High	Address within 6 months	P2
3	Moderate	Address within 12 months. Possibly assign to maintenance, monitor or further review	P3
4	Low	Review again after 2 years	P4

Qualitative Consequence:

Catastrophic – Death, loss of asset, release to environment such that significant public interest or regulatory intervention occurs or reasonably could occur.

Critical – Severe injury, major asset damage or event which causes some loss of performance, unplanned localised damage to environment, or could have resulted in catastrophic consequences under different circumstances.

Marginal – Minor injury, minor asset damage, minor confined and non-damaging environmental exposure.

Negligible – General acceptable condition.

Qualitative Risk Assessment				
Probability	**Consequence**			
	Catastrophic	Critical	Marginal	Negligible
Frequent	0	1	1	3
Probable	1	1	2	3
Occasional	1	2	3	4
Remote	2	2	3	4
Improbable	3	3	3	4

Severe	High	Moderate	Low

Qualitative Probability:

Frequent – Likely to occur in the next 6 months.
Probable – Likely to occur in the next 12 months.
Occasional – Likely to occur in the next 24 months.
Remote – Likely to occur in the next 5 years.
Improbable – Unlikely but possible to occur in the remaining life of the asset.

Figure 2: Qualitative Risk Assessment Definitions.

6. Results

6.1. Summary of Results

A breakdown of the defects Priority Rankings assigned from the inspection results of the subject property is presented in Table 3. It is important to note that the number of Priority Rankings given represent grouped elements.

Table 3: Priority Ranking Breakdown.

Risk Rating	Description	Priority Ranking	No. of Priority Rankings*
0	Extremely Severe	P0	0
1	Severe	P1	3
2	High	P2	2
3	Moderate	P3	4
4	Low	P4	1
Total			**10**

*Represents grouped elements.

The inspected public Observation Tower was assessed to be of a **Severe Risk to Safety** at the time of inspection, **based on a generally deteriorated structural system.**

- The Risk **Priority Ranking P1** defects need to be addressed within 3 months from the date of this report, and include:
  - A horizontal bracing at ground level that has Level 5 corrosion at an isolated area, which has led to disconnection at one of the joints.
  - An isolated area on one of the columns at Tower Level 4 has Level 5 corrosion (with holing). **Further structural analysis and design is required in order to provide detailed remediation details for this defect**.
  - Handrails and kick plates have Level 5 corrosion (with holing) in multiple locations on all Tower Levels.

- The Risk **Priority Ranking P2** defects need to be addressed within 6 months from the date of this report, and include:
  - The ladder on Tower Level 5 – 6 has Level 5 corrosion in multiple locations.
  - The platform floor on Tower Level 5 has Level 5 corrosion (with holing) in multiple locations.

- The Risk **Priority Ranking P3** defects need to be addressed within 12 months from the date of this report, and include:
  - All fasteners and connections on the Tower have widespread protective coating breach and Level 3 corrosion.
  - Multiple diagonal bracings have widespread protective coating breach and Level 3 corrosion.
  - Multiple welds have widespread protective coating breach and Level 3 corrosion.
  - Multiple stairs have widespread protective coating breach and Level 3 corrosion.

- The Risk **Priority Ranking P4** defects need to be addressed within 24 months from the date of this report, and include:
  - Multiple columns have widespread protective coating breach and Level 2 corrosion.

6.2. Inspection Results

All results have been summarised in Table 4 and Figure 3 with general descriptive notes. The table is sorted by Element IDs, and photographs of observations have been given in Appendix A – Selected Photographic Record. The inspection results provide ToPH with the required information for planning and remediation purposes.

Table 4: Results from Visual Inspection.

Defect ID	Location#	Element Description	Defect Description	Possible Cause/Recommended Action*	Priority Ranking	Photo Nr's
1	Connections	Fasteners and connection plates	Protective coating breach (PCB) and Level 3 corrosion in multiple locations (all connections).	Clean areas of deterioration, prepare surfaces and re-apply protective coating as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.	P3	9205-9207 9210, 9213 9270-9273
2	Bracing	Horizontal bracing	Level 5 corrosion at an isolated area/connection of ground level bracing. Bracing disconnected from connection.	Replace bracing like-for-like.	P1	9214-9220
3	Bracing	Diagonal bracing	PCB and Level 3 corrosion in multiple locations.	Prepare surface and re-apply protective coating as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.	P3	9276-9277 9297-9302 9561-9563
4	Connections	Welds	PCB and Level 3 corrosion in multiple locations.	Clean areas of deterioration using a wire brush and further determine extent of corrosion per location, prior to remediation by either: • Grinding the weld connection and re-welding following AS/NZS 1554.1 • Preparing surfaces and re-applying protective coating following manufacturer's recommendations and to AS 2312.1.	P3	9239-9244 9265-9268 9406-9410

Defect ID	Location#	Element Description	Defect Description	Possible Cause/Recommended Action*	Priority Ranking	Photo Nr's
5a	Columns	Columns	PCB and Level 2 corrosion in multiple locations.	Prepare surfaces and re-apply protective coating following manufacturer's recommendations and to AS 2312.1.	P4	9206-9208 9276 9278-9279
5b	Columns	Columns	Level 5 corrosion (with holing) identified in an isolated area.	Remediate defect by overplating. Contact AIE for further structural analysis/remediation details.	P1	9418-9420
6	Handrails	Handrails, incl. kick plates	PCB and Level 5 corrosion (with holing) in multiple locations.	Replace handrails and kick plates like-for-like.	P1	9335-9336 9382-9385 9476-9478 9483-9486 9497-9501 9518-9519 9521 9603-9606 9617-9619 9632-9634 9672-9675 9696-9700
7	Stairs	Stairs on all levels	PCB and Level 3 corrosion in multiple locations.	Prepare surfaces and re-apply protective coating following manufacturer's recommendations and to AS 2312.1.	P3	9258-9260 9269-9272 9347-9349 9394 9400-9402 9558-9560
8	Ladder	Ladder on level 5 – 6	PCB and Level 5 corrosion in multiple locations.	Replace ladder like-for-like.	P2	9645-9651

Defect ID	Location[#]	Element Description	Defect Description	Possible Cause/Recommended Action*	Priority Ranking	Photo Nr's
9	Platforms	Platform floor on Tower Level 5	PCB and level 5 corrosion (with holing) in multiple locations.	Replace platform floor plate sheeting like-for-like.	P2	9435 9442-9443 9448-9449 9538-9542 9574-9580

[#]Refer to Figure 3 for typical defect locations
*Rating subject to change on further investigation and/or findings during remediation

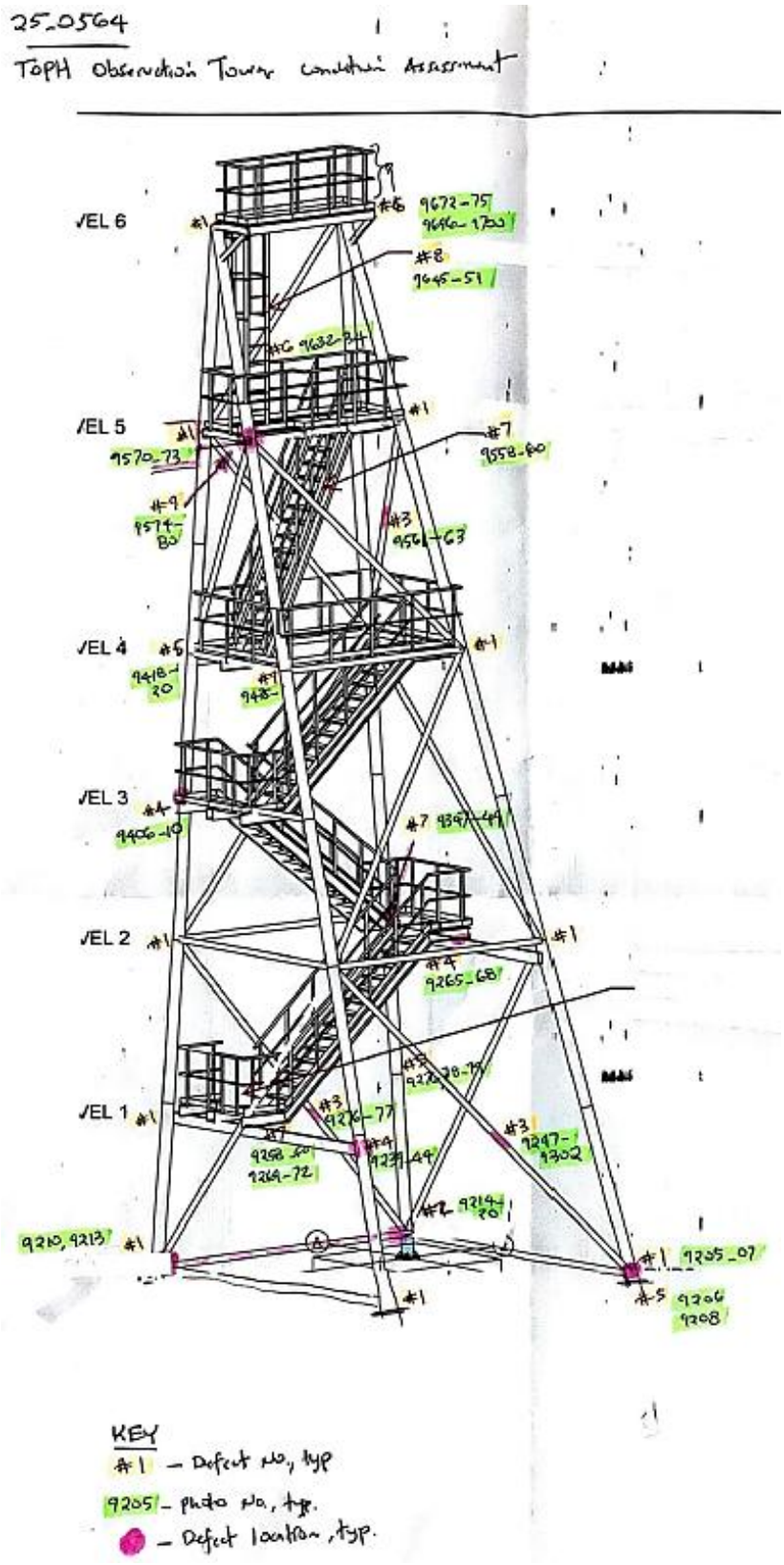

Figure 3 Defect locations

7. Conclusions and Recommendations

7.1. General

The inspected public Observation Tower was assessed to be of a **Severe Risk to Safety** at the time of inspection, **based on a generally deteriorated structural system**, and intervention is recommended as summarised below:

- The Risk **Priority Ranking P1** defects need to be addressed within 3 months from the date of this report, and include:
    - A horizontal bracing at ground level that has Level 5 corrosion at an isolated area, which has led to disconnection at one of the joints. This bracing need to be replaced like-for-like.
    - An isolated area on one of the columns at Tower Level 4 has Level 5 corrosion (with holing). Remediation of this defect by overplating is recommended. **Further structural analysis and design is required in order to provide detailed remediation details for this defect**.
    - Handrails and kick plates have Level 5 corrosion (with holing) in multiple locations on all Tower Levels, and these need to be replaced like-for-like.

- The Risk **Priority Ranking P2** defects need to be addressed within 6 months from the date of this report, and include:
    - The ladder on Tower Level 5 – 6 has Level 5 corrosion in multiple locations and need to be replaced like-for-like.
    - The platform floor on Tower Level 5 has Level 5 corrosion (with holing) in multiple locations, and the steel floor plate need to be replaced like-for-like.

- The Risk **Priority Ranking P3** defects need to be addressed within 12 months from the date of this report, and include:
    - All fasteners and connections on the Tower have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.
    - Multiple diagonal bracings have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.
    - Multiple welds have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned using a wire brush (or similar), and further assessment be undertaken to determine the extent of corrosion per location prior to remediation by either,
        - Grinding the weld connection and re-welding following AS/NZS 1554.1
        - Preparing surfaces and re-applying protective coating following manufacturer's recommendations and to AS 2312.1.
    - Multiple stairs have widespread protective coating breach and Level 3 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1. If more defects or severe deterioration is found during remediation, contact AIE for further direction.

- The Risk **Priority Ranking P4** defects need to be addressed within 24 months from the date of this report, and include:
    - Multiple columns have widespread protective coating breach and Level 2 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1.
    - Other areas on the Tower have widespread protective coating breach and Level 1 corrosion. It is recommended that the deteriorated areas be cleaned, surfaces prepared and protective coating re-applied as per manufacturer's recommendations and to AS 2312.1 in order to prolong the service life of the structure.

7.2. Budget Estimate

7.2.1. Contractor's Estimate

In addition to the inspection results and recommended intervention above, a breakdown of high-level cost estimates (+-20%) of all the elements inspected have been given below to provide the ToPH with budgeting and forward planning for the remediation works.

- Breakdown, **excl GST**:
    - Labour costs total $405,888.00
    - Material costs total $114,950.00
    - Equipment costs total $38,400.00

Total	**$559,238.00**

The contractor's execution scope is inclusive of the following:

- Mobilisation of equipment to site
- Scaffolding and access installation
- Transport and cranage
- Repairs and modifications
- Surface preparation, blast cleaning, and painting
- Demobilisation

Noting the above and allowing for a 20% contingency, **a budget of $672,000 (excl. GST) is recommended for the remediation work**.

7.2.2. Professional and Engineering Services Estimate

In addition to the contractor's budget estimates given above, an estimate for professional and engineering services is also recommended based on certain findings that need engineering input, and quality assurance and verification exercises that may be required during remediation. This budget estimate, at **12%** of the recommended remediation budget has been applied to the contractor's estimate. Therefore, a further budget estimate of **$80,640 (excl. GST) is recommended for professional and engineering services**. These services include independent engineering and quality assurance roles.

The professional and engineering services are inclusive of the following:

- Engineering and professional services:
  - Detailed engineering assessment of defective structural elements
  - Structural design of compliant remedial solutions
  - Preparation of construction documentation and technical specifications
  - Engineering oversight and technical support during execution

- Quality assurance and independent verification:
  - Development and implementation of inspection and test plans (ITPs)
  - Independent QA/QC inspections at critical hold points
  - Review of contractor quality records and certifications
  - Engineering verification and certification of completed works

In summary, the total budget estimate recommended for structural remediation of the ToPH public Observation Tower, including professional and engineering services is **$752,640 (excl. GST)**.

Thank you for the opportunity and for considering our services towards your project. If you require any further information regarding specific or any other aspects of this report, please do not hesitate to contact us.

Yours Sincerely,

Tim Vos B.Eng
Project Engineer

Moses Kiliswa PhD CPEng RPEQ
Principal Engineer

Appendix A – Selected Photo Record

Defect ID 1

DSCN9205

DSCN9206

DSCN9207

DSCN9210

DSCN9213

DSCN9270

DSCN9271

DSCN9272

DSCN9273

Defect ID 2

DSCN9214

DSCN9215

DSCN9216

DSCN9217

DSCN9218

DSCN9219

DSCN9220

Defect ID 3

DSCN9276

DSCN9277

DSCN9297

DSCN9298

DSCN9299

DSCN9297

DSCN9298

DSCN9299

DSCN9300

DSCN9301

DSCN9302

Defect ID 4

DSCN9239

DSCN9240

DSCN9241

DSCN9242

DSCN9243

DSCN9244

DSCN9265

DSCN9266

DSCN9267

DSC9268

DSC9406

DSC9407

DSC9408

DSC9409

DSC9410

Defect ID 5a

DSCN9206

DSCN9207

DSCN9208

DSCN9276

DSCN9278

DSCN9279

Defect ID 5b

DSCN9418

DSCN9419

DSCN9420

Defect ID 6

DSCN9335

DSCN9336

DSCN9382

DSCN9383

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DSCN9675

DSCN9696

DSCN9697

DSCN9698

DSCN9699

DSCN9700

Defect ID 7

DSCN9258

DSCN9259

DSCN9260

DSCN9269

DSCN9270

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