Durability Requirements for Civil Infrastructure

T HR CI 12002 ST

Richard Hitch, Lead Civil Engineer

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1. Introduction

- Access to carry out maintenance activities limited – set to further reduce in future
- Restrictions on access significantly increase costs and reduce the effectiveness.
- Clarification should be sought from the ASA

The purpose of the standard is to specify requirements to increase the durability and reduce maintenance of new railway civil infrastructure.

- Scope
  - bridges and culverts
  - tunnels and associated underground station structures
  - retaining walls
  - overhead wiring structures
2. Application

The requirements of this standard apply to:

• TfNSW
• TfNSW agencies
• external third party organisations (where the third party organisation is involved with civil infrastructure that will be owned by TfNSW)

- Reference documents
- Terms and definitions
3. **General**

- The relevant AEO is responsible for ensuring that the selected design, materials, construction and associated maintenance will achieve the durability objectives and requirements for each civil infrastructure asset and asset component.
- In such cases this document shall take precedence.
4. Design life

- For concrete structures, the onset of active corrosion of the steel reinforcing and prestressing tendons shall not have commenced within the specified design life.
- Active corrosion is defined as corrosion with an ongoing current density > 0.2 µA/cm².
- When designing for fatigue, the effective number of stress cycles specified in the relevant standard shall be adjusted proportionally to reflect the design life specified in this standard, where appropriate.

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<tr>
<th>Bridges*</th>
<th>Structural elements</th>
<th>Concrete</th>
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<tr>
<td>Bridges*</td>
<td>Structural elements</td>
<td>Steel</td>
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<td>Bridges*</td>
<td>Bearings – replaceable elements</td>
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<td>Bridges*</td>
<td>Bearings – non-replaceable elements</td>
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5. Site investigation

Early design phase investigations

- Project durability investigations are required in the early design phase and they are also recommended in the operational phase of the asset.
- Early design phase investigations shall be undertaken to classify the corrosivity and aggressivity of the exposure conditions to enable the minimum durability requirements to be determined for an asset and sub-asset items.
6. Operational phase investigation

• During the period in which the asset is operational and exposed to the environment, it is recommended to ascertain that the durability measures designed into the assets are adequately resisting the exposure conditions.

• Requirements for operational phase investigation shall be included in the technical maintenance plan (TMP) for the asset.
7. Durability strategy and criticality

- The durability strategy for a new design should address criticality and risk.
- Accessibility for inspection and maintenance is a key concern in the rail environment.
- The consequences of failure should take into account whether an asset is available for maintenance and whether maintenance, either planned or unplanned, has an impact on the operability of the rail asset.
- For the purposes of determining durability requirements of these assets, it shall be assumed that maintenance will be limited to periodic examinations, cleaning and flushing as well as replacement of sub-items that have specifically been designed to be replaced.
- All assets and asset sub-items covered by this standard, however, shall be designed to be effectively maintenance free with the exception of maintenance as defined above (that is, Maintenance Class 5), unless approved otherwise by the Lead Civil Engineer, ASA.
8. Durability plan

- The AEO shall prepare a durability plan for all civil infrastructure projects with an estimated construction cost greater than $2 million or where the project is such that its early failure due to inadequate durability would have disproportionate operational or cost implications.
- The durability plan shall be prepared in accordance with the requirements of RMS publication *Guide for Preparation of a Durability Plan*.
- The results of the durability plan shall be included in the TMP and applied during all lifecycle stages of the project.
9. **Specific durability actions for concrete**

The specific durability measures taken to achieve the required durability will include a combination of the following:

- penetrability performance requirement such as carbonation coefficient, chloride diffusion or migration coefficient
- composition of cementitious binder system
- cover to reinforcement
- cathodic protection (only for atmospheric or immersed sub-asset items)
- avoidance of deterioration/maintenance prone detailing
- substitution with corrosion resistant reinforcement
10 Exposure conditions

10.1 Atmospheric exposure
10.2 Maritime exposure
10.3 Massive sections
10.4 Acid or soft water
10.5 Sulfate attack
11 Construction considerations

11.1  Reinforcement fixing
11.2  Concrete placement
11.3  Early concrete protection
11.4  Curing
11.5  Joints
11.6  Concrete crack control and crack limits
11.7  Cathodic protection
11.8  Stainless steel reinforcement
12. Specific durability actions for steel

12.1 Design detailing
   12.1.1 Maintainability of structures

12.2 Corrosion allowance
   It shall be assumed that there will be no protective coating applied within the specified design life other than the initial protective coating. Additional steel thickness shall be provided to allow for any resulting section loss to ensure that the structure design capacity is maintained over the design life.
   Weathering steel may be considered subject to maintenance and urban design considerations.

12.3 Cathodic protection

12.4 Substitution with corrosion resistant materials

12.5 Selection of durability measures for steel structures
12. Additional requirements

- The potential effects of climate change shall be considered when assessing durability requirements.
- The cover sheet of the project drawings shall reference the durability plan and associated TMP (Refer to Section 9).
- Fracture critical components should be avoided. Where incorporated in a structure, fracture critical components shall be clearly identified in the design documentation and associated TMP.
- Where an item is not readily accessible for maintenance or replacement, it shall be designed so that it will function for the specified life of the structure without maintenance or replacement.
- Design documentation and associated TMP shall specify which elements of the structure are intended to be replaceable and shall provide a detailed methodology for the replacement process.
- Dowels and embedded fitments shall be stainless steel grade 304L (UNS S30403) or 316L (UNS S31603). Higher strength stainless steels may be selected provided that corrosion resistance is adequate.
Additional requirements (contd.)

• Reinforced soil structures shall incorporate removable test straps.
• To prevent stormwater infiltration of the reinforced soil block, reinforced soil structures shall incorporate an impermeable HDPE membrane layer.

• Appendix A Concrete Degradation
• Appendix B Maintenance Class Classification