

DESIGN SPECIFICATION

D3

**BRIDGE AND
CIVIL STRUCTURES DESIGN**

SPECIFICATION D3 – BRIDGE AND STRUCTURES DESIGN

CLAUSE	CONTENTS	PAGE
CITATION	3	
ORIGIN OF DOCUMENT, COPYRIGHT		3
VERSIONS, D3 – Bridges and Civil Structures Design		3
GENERAL		4
D3.01 SCOPE		4
D3.02 OBJECTIVE		4
D3.03 BASIS OF DESIGN		4
D3.04 REFERENCE AND SOURCE DOCUMENTS		5
D3.05 INVESTIGATIONS		6
D3.06 BRIDGE DESIGN CRITERIA		7
D3.07 CONCEPT DESIGN		10
D3.08 DETAILED DESIGN		10
D3.09 STRUCTURES OTHER THAN BRIDGES, ASSOCIATED WITH ROADS		11
D3.10 SMALL EARTH DAMS & DETENTION BASINS		11
D3.11 STRUCTURES USED FOR PUBLIC SAFETY		12
D3.12 MARITIME STRUCTURES		12
D3.13 TEMPORARY WORKS		13
SPECIAL REQUIREMENTS		13
D3.14 CERTIFICATION		13
D3.15 RESERVED		13
D3.16 RESERVED		13

CITATION

This document is named “Kempsey Shire Council, Design Specification D3 – Bridge and Civil Structures Design”.

ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on PMHC AUS-SPEC. Parts of the AUS-SPEC document that remain are still subject to the original copyright.

VERSIONS, D3 – Bridges and Civil Structures Design

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Infrastructure
1.0	Version 1 – First Draft Version		March 2025	

DESIGN SPECIFICATION D3**BRIDGE AND CIVIL STRUCTURES DESIGN****GENERAL****D3.01 SCOPE**

1. This section sets out design considerations to be adopted in the design of structural engineering elements for public works. Such elements will include:
- (a) Road traffic bridges
 - (b) Pedestrian and shared path bridges
 - (c) Civil structures other than bridges, but associated with roads and reserves (eg culverts, underpasses, noisewalls etc..)
 - (d) Retaining walls
 - (e) Small earth dams, detention basins
 - (f) Structures used for public safety (traffic barriers, pedestrian barriers, street lighting)
 - (g) Sign support structures
 - (h) Temporary works
 - (i) Revetment works

D3.02 OBJECTIVE

- | | |
|--|------------------------------|
| 1. The objective of design shall be to ensure that as far as reasonably practical that structures are safe and serviceable in use, economic to build and maintain, sustainable with minimal impact on the environment, and which perform their intended functions. | Objective |
| 2. The design life of structures covered by this Specification shall be 100 years (Bridges and other structures associated with public road works), and 50 years for other minor structures. Ancillary elements may have a reduced design life as specified by Council provided provision for inspection, maintenance, removal and replacement of such elements has been detailed. | Design Life |
| 3. Design considerations shall, in addition to Objective 1, include but not be limited to: economic; engineering; physical; aesthetic; environmental; community; safety; durability; maintenance and other relevant constraints. | Design Considerations |

D3.03 BASIS OF DESIGN

- | | |
|--|----------------------------|
| 1. The design shall be based on current Australian standards; best practice and provide for innovative solutions. Management control and supervision by experienced and qualified engineers shall be required at all stages of the design. | Quality |
| 2. The Australian Standard AS5100 Bridge Design shall be adopted for all bridge designs in the Kempsey Shire Council Local Government Area. | Australian Standard |

3. The Design Engineer must be an experienced and qualified engineer in accordance with Aus-Spec DQS-Quality Assurance of Engineering Design, Section DQS.06.

**Qualified
Engineer**

4. Independent verification of the design must be completed by experienced and qualified engineers either from the same organisation separate to the original design team, or a separate organisation as directed by council.

5. Specifications shall be cross referenced on the design plans. The safety and service performance of a structure depends also on the quality control exercised in fabrication, supervision on site, the control of unavoidable imperfections and the qualifications, experience and skill of all personnel involved. Adequate attention shall therefore be given to these factors in the design.

D3.04 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

DQS	-	Quality Assurance Requirements for Design
D1	-	Road Design
D2	-	Pavement Design
D5	-	Stormwater Drainage Design
D7	-	Stormwater Quality Management
D8	-	Waterfront Development
D9	-	Cycleway and Pathway Design
D14	-	Work-As-Executed Plans
D15	-	Drafting Specifications
C	-	Council Construction Specifications (All)

(b) Australian Standards

AS1158	-	Lighting for roads and public spaces
AS1428	-	Design for access and mobility
AS1170	-	Minimum design loads on structures
AS1576	-	Scaffolding
AS1597	-	Precast reinforced concrete box culverts
AS1720	-	Timber structures
AS1726	-	Geotechnical site investigations
AS2041	-	Buried corrugated metal structures
AS2159	-	Piling – Design and installation
AS2601	-	The demolition of structures
AS3600	-	Concrete structures
AS3610	-	Formwork for concrete
AS3700	-	Masonry structures
AS3845	-	Road Safety Barrier Systems
AS4100	-	Steel structures
AS4671	-	Steel reinforcing materials
AS5100	-	Bridge design
AS4678	-	Earth-retaining structures
AS4997	-	Guidelines for the design of maritime structures
Other relevant codes and guidelines with the above.		

(c) State Authorities

RMS	Roads and Maritime Authority of NSW
DLWC	NSW Department and Land and Water Conservation
NSW Fisheries	NSW Department of Fisheries

(d) Other

AUSTROADS	-	Guide to Traffic Engineering Practice: Pedestrians
AUSTROADS	-	Guide to Bridge Technology (Set)
AUSTROADS	-	Guide to Road design (Set)
AUSTROADS	-	Waterway Design
RMS	-	Aesthetics of Bridges – Design Guidelines to Improve the Appearance of Bridges in NSW, 2004
Inst. of Eng.	-	Australian Rainfall and Runoff
KD Nelson	-	Design and Construction of Small Earth Dams
DLWC	-	NSW Flood Plain Manual
Dept. Housing	-	Managing Urban Stormwater: Soils and Construction
RMS	-	Road Design Guide Stormwater Management and Drainage Design
US Army	-	US Army Waterways Experiment Station Streambank Protection Guidelines.
QLD Govt.	-	QLD Urban Drainage Manual

D3.05 INVESTIGATIONS

1. A geotechnical investigation and foundation assessment must be undertaken for each new proposed structure. The investigation must be sufficient to identify and provide all the information required to design, construct and maintain each new structure, and to preserve and protect existing structures. The assessment shall recommend requirements and scope for foundation testing including integrity and geotechnical strength testing as required.

Geotechnical investigation

2. The geotechnical investigation scope of work shall be in accordance the requirements of AS1726 and AS2159.

3. A waterway investigation must be undertaken for each new proposed waterway structure including hydrology and hydraulic assessments at the site. The investigation should include a clear description of the waterway and hydraulic regime, a detailed investigation and analysis, recommendation of the relevant design parameters to be adopted for the proposed structure, recommended mitigation or management measures to ensure hydrological and hydraulic impacts are minimised, and liaison with key stakeholders.

Waterway investigation

4. The waterway investigation must include the comparison of existing and proposed conditions of flood level, stream velocity and change in flow distribution for the 5% AEP, 1% AEP, 0.05% and the Probable Maximum Flood (PMF). An estimation of scour depth for the 0.05% AEP flood event must be included in the assessment.

5. Reference is made to D5 – Stormwater Drainage Design relating to the waterway investigation.

6. Where existing structures are to be retained or modified to be incorporated into the proposed works, a structural assessment shall be completed to ensure the adequacy of these structures for their proposed purpose. Any modifications, strengthening or upgrading works shall be in accordance with current design standards.

Existing structure assessment

7. Where existing structures are proposed to be demolished as part of the works, a demolition report is required to document method statements,

Demolition

environmental mitigation measures, safety requirements, waste management and disposal requirements, and a demolition works staging program.

***Durability
assessment***

8. Durability investigations and assessment applicable to the proposed structure shall be completed to achieve a lowest whole-life cost design philosophy. The durability assessment shall define the design life requirements for each element and consider the end of life criteria, or service life where an element is expected to perform its function without major maintenance or structural repair.

9. The durability assessment shall address for each element, the severity of exposures and details of the environment including air / atmosphere, ground, fresh water, and sea water as applicable, and provide classification of exposures. The assessment shall provide recommendations for materials and protective measures as required to achieve the lowest whole-life cost design philosophy, along with required maintenance requirements and responsibilities to ensure the design life of the various structural elements are met.

Materials

10. Structures shall be of a durable nature sufficient to achieve the intended design life. Material selection may consider concrete, timber, steel or other materials as approved by Council, but with emphasis placed on low maintenance and design life.

11. Council requires bridges to have low maintenance finishes; therefore timber and steel are not usually acceptable construction materials, unless suitable precautions are adopted.

D3.06 BRIDGE DESIGN CRITERIA

1. Road alignment, carriageway widths, clearances and other geometric requirements shall comply with the requirements of Specification D1 ROAD DESIGN, AS5100 and Austroads – Guide to Road Design, as a minimum. Where there is a conflict between the Austroads guides and the governing Australian Standard, the Australian Standard shall have precedence.

Geometry

2. Provision for pedestrians on bridges is required in rural residential and urban areas, and as required by Council. The minimum provision shall be a 2.0 m footpath (or as required by the governing Australian Standard) with kerb at the road traffic edge and handrail. Traffic separation barrier may be required where traffic speeds or volumes warrant.

***Pedestrian
facilities***

3. Council may require the provision of separate pedestrian carriageways in other situations should the anticipated traffic warrant it.

4. Pedestrian access and shared path bridges shall be designed in accordance with Austroads and the governing Australian Standard. Where there is a conflict between the Austroads guides and the governing Australian Standard the Australian Standard shall have precedence.

5. Designs for separate pedestrian bridges shall be based on current standards; best practice and provide for innovative solutions. Pedestrian bridge width shall be in accordance with pathway requirements of Austroads and the governing Australian Standard. Where there is a conflict between the Austroads guides and the governing Australian Standard the Australian Standard shall have precedence.

6. At navigable waterways, the structure shall provide minimum dimensional clearance as specified by the waterway authority.

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| <p>7. For road structures, the average recurrence interval for flood immunity and SLS shall be in accordance with AS5100.1 2017 Table 11.1. For pedestrian and shared path bridges, the average recurrence interval for flood immunity and SLS shall be between 10 and 50 years, as defined by Council. The soffit level of the structure shall not be less than the flood immunity level, unless otherwise specified by Council. The structure shall be designed to sustain the SLS flood event without damage.</p> | <p><i>Navigable waterways</i></p> <p><i>SLS and flood immunity</i></p> |
| <p>8. The bridge shall not collapse under any flood up to and including the ultimate limit state (2000 year ARI), including the effects of debris and scour. Any scour protection measures provided for the SLS event, shall not be relied upon at the ULS.</p> | <p><i>Design Storm Event</i></p> |
| <p>9. Piers and abutments shall be protected adequately to prevent scour for floods up to the SLS flood event. Determination of scour depths and scour protection shall be completed for the adopted SLS flood event using methods defined in the Hydraulic Engineering Circular No 18 – Evaluating Scour at Bridges, Fifth Edition, April 2012 (FHWA HIF-12-003) assuming any soil is granular (i.e non-cohesive).</p> | <p><i>Scour</i></p> |
| <p>10. Heavy debris and bed loads may be characteristic of some streams so that span lengths and pier location is to be assessed. Debris loading, including the amount, type and size of debris shall be assessed. Depths of debris shall be adopted per AS5100 considering the above assessment.</p> | <p><i>Debris</i></p> |
| <p>11. If overtopping is permitted, handrails and guardrails may be omitted in consultation with council following an appropriate risk assessment. Flood depth indicators and delineation kerbs will be required in such cases.</p> | <p><i>Overtopping</i></p> |
| <p>12. Unless otherwise indicated on the Development Consent, where inundation of small bridges (less than 6m overall length) is permitted by Council, the bridge shall be designed to convey at least the 20 year ARI storm event without damage to bridge, channel bed, banks and road embankments. Certification stating that the bridge is capable of withstanding the inundation loadings for up to the 100 year ARI storm event will be required. If in the opinion of the Principal Consultant, such certification is impractical, the structure shall be designed to convey the 100 year ARI storm event without inundation.</p> | <p><i>Small bridges</i></p> |
| <p>13. Where a bridge is partially or fully submerged in events more frequent than the 2% AEP flood event, the superstructure must not have hollowed closed cells or voids.</p> | |
| <p>14. Where structures are designed to be inundated, the degree hazard, as specified in the NSW Governments Flood Plain development manual 2000 shall not be exceeded. For the stability and safety of pedestrians and vehicles the effect of the backwater gradient on upstream property shall be identified on the design plans.</p> | <p><i>Backwater Gradient</i></p> |
| <p>15. Bridges located in roadways, which are to be dedicated as public roads, shall be designed to convey the stormwater event identified as above, and in accordance with D5 – Stormwater Drainage Design. Where no inundation is permitted, appropriate afflux shall be adopted together with a 300 mm freeboard to the bridge or structure soffit.</p> | <p><i>Freeboard</i></p> |
| <p>16. All bridges, culverts, underpasses and retaining walls supporting traffic must be designed in accordance with AS5100 for SM1600 loadings. Heavy load platform loads (HLP320/400) in accordance with AS5100 shall be considered, if required by Council. All other imposed loads shall be as defined in AS5100.</p> | |

17. For existing structures loads and rating factors shall be determined for design vehicles in accordance with AS5100, and in consultation with council. Rating factors for current General Access Vehicles (GAV) including semi-trailer (ST42.5), and also Restricted Access Vehicles (RAV) including semi-trailer (ST45.5) and B-double (BD68) vehicles shall also be determined.

Vehicle loads

18. A positive lateral (and vertical) restraint system between the superstructure and the substructure shall be provided at piers and abutments to resist the Minimum Lateral Restraint force as defined in AS5100.

19. Earthquake loads shall be considered in accordance AS5100. The bridge earthquake design category (BEDC) shall be defined in accordance with AS5100, and as required by Council.

20. Road traffic barriers shall be provided along the edge of new structures for the containment of errant vehicles in accordance with AS5100. The appropriate barrier performance level shall be selected via the risk assessment process defined in AS5100.

**Lateral
restraint**

21. For bridge rehabilitation, the appropriate barrier performance level to be adopted in consultation with Council should consider the expected remaining life of the structure, history of traffic accidents and the costs and benefits of upgrading the barrier. A reduction to be barrier performance level may be considered in consultation with council following an appropriate risk assessment.

Earthquake

Traffic barriers

22. For bridge approaches, a transition barrier shall be provided between any flexible roadside barrier and the rigid or semi-rigid traffic barrier in accordance with the requirements of AS5100 and Austroads Road Design Guide.

23. Long term maintenance of bridge joints must be considered in the design and the number of joints minimised where practical. Finger plate joints are not permitted where there is provision for on-road cyclists.

24. Bearings, other than elastomeric strip bearings shall be designed with sufficient provision for replacement within the design life of the structure.

Bridge joints

25. Where a precast girder or steel girder bridge is proposed to be integral with the substructure, it must be designed for full continuity and not partial continuity, the number and type of girders must be the same on either side of piers, and the bridge must not have a skew greater than 5 degrees.

Bearings

Integral bridges

26. Drainage provisions from the bridge deck shall be in accordance with the requirements of AS5100, Austroads. Drainage provisions shall be designed to ensure gutter flow width does not extend into the marked traffic lanes for the 5% AEP storm event.

27. Appropriate access provisions to satisfy safe work practices, shall be incorporated into the design to facilitate inspection and maintenance and component replacement.

Deck drainage

28. Preventative maintenance is a key issue affecting the design life of the structure. The design plans shall specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design shall also be shown on the design plans.

**Maintenance
access**

29. The Principal Consultant shall provide for public utilities as required, including the provision of conduits in bridges. A single 100 mm diameter uPVC conduit shall be provided in concrete barrier parapets for provision of future utilities, as specified by the Council.

Maintenance

30. Road signs and lighting structures must be designed in accordance with RMS Bridge Technical Direction BTD 2009/01.

Utilities

*Signs and
lighting
structures*

D3.07 CONCEPT DESIGN

1. The purpose of the structural concept design is to demonstrate that the preferred design has addressed all key constraints relating construction, maintenance and operation of the structure, and achieves the intended lowest whole-life cost design philosophy. The design must consider sustainability, environment, aesthetics, build ability, structure robustness, durability, maintenance and operational commitments, and provision of access for periodic inspections.

Concept design

2. Any departures from current design standards and specifications shall be identified for approval by the Council.

3. The Concept Design Drawings are to show the plan layout, vertical alignment, superstructure details including typical cross-sections and substructure details including proposed foundation type.

4. The Concept Design Report must include a list of the site and design constraints that apply at each site, a list and summary of the investigations and findings to date, general arrangement sketches, discussions of the relative merits of each option considered and finally a recommended preferred concept design option for each site with clear justification.

D3.08 DETAILED DESIGN

1. The purpose of the structural detailed design and documentation is to progress the concept design to sufficient level to allow tender and construction, while meeting the requirements of the design brief, current designs standards and specification.

Detailed design

2. The Detailed Design Drawings shall include as a minimum; cover page including bridge name and location, drawing index, design criteria and loading assumptions; general arrangement including plans elevations and sections with setout; foundation drawings including set-out and details; substructure drawings; superstructure general arrangement and detail drawings; precast element fabrication drawings; traffic barrier set-out and detailed fabrication drawings; joint and bearing set-out and detail drawings; scour protection drawings; and other details as required.

3. The Detailed Design Report shall include as a minimum; design criteria; description of design and all elements; methods of analysis and results including capacity and design actions for each element; materials selection and durability; maintenance provisions; constructability; safety in design; and verification of design records.

D3.09 STRUCTURES OTHER THAN BRIDGES, ASSOCIATED WITH ROADS

1. Public utility structures, retaining walls, and the like will be designed by a competent, practicing engineer, experienced in the design of such structures. The Principal Consultant shall refer to the relevant Australian standards to execute the design.

Retaining Walls

2. Retaining walls, reinforced soil structures, and reinforced rock structures are to be designed in accordance with AS 4678 Earth Retaining Structures, AS5100, and any other relevant Australian Standards. The Principal Consultant shall adopt the recommendations in AS 4678 where no other Standard governs.

3. Revetment works shall be designed in accordance with all relevant Australian standards. Factors to be designed for, include, but are not limited to, the following:

Revetment Works

- (a) scour protection, designed in accordance with “RTA Road Design Guide: Stormwater Management and Drainage Design” Section 7, Chapter 24 Other Drainage Elements, “US Army Streambank Protection Guidelines”, “AUSTROADS Waterway Design”, and any other relevant Australian standards
- (b) rapid drawdown effects;
- (c) piping or material loss;
- (d) wave action and over topping; and
- (e) durability.

4. In the absence of a governing Australian standard, the structure classification and performance monitoring shall be in accordance with AS 4678 Sections 1 and 7 respectively.

D3.10 SMALL EARTH DAMS & DETENTION BASINS

1. A small earth dam or wet retention basin is classified as being:
- (a) less than 10 metres in height with a storage capacity of less than 20 megalitres; or
 - (b) less than 5 metres in height with a storage capacity of less than 50 megalitres.

Small Earth Dam - Definition

2. Small earth dams may be designed following the guidelines in “Design and Construction of Small Earth Dams” by K D Nelson together with relevant geotechnical recommendations. The structural design of weir outlets to resist failure shall be considered in design. Refer also to the Retarding Basin, Stormwater Detention and Wetland sections in Aus-spec D5.15, D7.19, and D7.22 respectively.

Small Earth Dams - Design

The following design criterion shall apply in addition to those specified in “Design and Construction of Small Earth Dams” by K D Nelson, and in Aus-spec D5.15, D7.19, and D7.22:

- (a) freeboard – 1 metre minimum;
- (b) design height – construction height shall exceed design height by 5% for settlement;
- (c) wall slopes shall be a maximum of 6H:1V; and
- (d) crest width – 2.5 metre minimum.

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| <p>3. Small detention basins for the purpose of this Specification are defined by “QLD Urban Drainage Manual” Section 6.02 as:</p> <ul style="list-style-type: none">(a) Small basins placed at the lowest points of individual development sites, and which can also serve as sediment traps and possibly assist in pollution reduction;(b) Ponds and low-points located within larger development areas;(c) Playing-fields and car-parks, either excavated into natural surface or surrounded by a low bund or kerb;(d) Underground tanks in highly built-up areas; and(e) Devices such as soakage pits, trenches and basins. | <p><i>Small
Detention
Basin -
Definition</i></p> |
| <p>4. Small detention basins shall be designed in accordance with ANCOLD “Guidelines on Design Floods for Dams”, the recommendations outlined in “Managing Urban Stormwater Soils and Construction” by the NSW Department of Housing, “QLD Urban Drainage Manual”, Aus-Spec D5.15, D7.19, and D7.22 specifications, and any other relevant Australian standards or guidelines.</p> | <p><i>Small
Detention
Basin - Design</i></p> |
| <p>5. The Principal Consultant shall carry out the design with recognition of the potential risk on existing and planned infrastructure downstream, assuming the probability of dam/basin failure.</p> | <p><i>Risk Analysis
Assessment</i></p> |
| <p>6. The Principal Consultant shall be qualified in accordance with Aus-Spec DQS.</p> | <p><i>Qualification</i></p> |

D3.11 STRUCTURES USED FOR PUBLIC SAFETY

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| <p>1. The requirement of traffic barriers and pedestrian safety rails on bridges is to be determined by the Design Engineer who shall consider whether separate traffic and pedestrian barriers are required. AS5100 – Bridge design and AUSTRROADS may be used as guides. If a barrier system is adopted, it should be designed in accordance with AS 3845 Road Safety Barrier Systems, AS5100, RTA Road Design Guide and any other relevant Australian guides and standards.</p> | <p><i>Barriers</i></p> |
| <p>2. It is essential that all barriers have been fully certified for each design and accredited for the intended use under quality assurance provisions.</p> | |
| <p>3. Urban bridges shall be provided with adequate street lighting to comply with AS 1158 and any other relevant Australian Standards. Such requirements will be noted accordingly on the design plans.</p> | <p><i>Lighting</i></p> |

D3.12 MARITIME STRUCTURES

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| <p>1. Jettys, wharves, boat ramps, and the like will be designed by a competent, practicing engineer, experienced in the design of such structures. The Design Engineer must be an experienced and qualified engineer in accordance with Aus-Spec DQS-Quality Assurance of Engineering Design, Section DQS.06.</p> | <p><i>Maritime
structures</i></p> |
| <p>2. Maritime structures are to be designed in accordance with AS1170, AS4997 Guidelines for the design of maritime structures, and any other relevant Australian Standards and relevant building regulations. The Principal Consultant shall adopt the recommendations in AS 4997 where no other Standard governs.</p> | |

D3.13 TEMPORARY WORKS

1. Temporary works are the parts of a construction project that are needed to enable construction of, protect, support or provide access to the permanent works. Usually the temporary works are removed after use and can include access scaffolds, props, shoring, excavation support, falsework and formwork.

Temporary Works

2. Structures which are proposed for the temporary support of roads, services and the like shall be designed by an engineer who is qualified in accordance with Aus-Spec DQS.

Qualification

3. Temporary works design must be coordinated and staged with the permanent works design and the Principal Contractor to ensure safety throughout the construction phase. Temporary works design must be completed considering all relevant regulations and codes of practice.

Safety

Codes of Practice

SPECIAL REQUIREMENTS**D3.14 CERTIFICATION**

1. The Principal Consultant shall be required to certify the design in accordance with the requirements of DQS – Quality Assurance Requirements for Design and this specification.

D3.15 RESERVED**D3.16 RESERVED**