1. Scope and introduction
BTN014 Sign gantries and lighting masts states VicRoads’ requirements for the design and construction of the structures listed in AS5100.1 Cl 23.1.

Bridge Technical Notes are a Code of Practice. Compliance with Bridge Technical Notes is mandatory.
BTN014 is to be read in conjunction with:

- Standard Specification 760

Other than as stated in this document and relevant VicRoads standard specifications, the provisions of AS5100:2017 shall apply. Where this document differs from AS5100:2017, its requirements override those of AS5100:2017.

This document also provides additional requirements for construction which are intended to reduce the risk of fatigue failure of the listed structures.

2. Geometry
The maximum horizontal length of the cantilever arm of sign structures shall not exceed 9m. Further recommendations for the treatment of cantilever arms of horizontal length greater than 9m are given in the Appendix.

3. Foundations

3.1. Foundations
Cantilever and gantry sign structures shall be supported on a piled foundation. The maximum permitted settlement of piled foundations shall be determined on the basis of a geotechnical investigation and in any event, shall not exceed 5mm.

3.2. Mounting
Sign gantries shall not be mounted on bridge barriers. If it is necessary to mount a cantilever or gantry sign structure on a bridge, the mounting point shall be independent of the bridge barrier.

4. Fatigue limit state design
Fatigue limit state design shall be in accordance with the current edition of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All aspects of fatigue design shall be based upon the AASHTO publication, including drag coefficients, fatigue importance factors, fatigue stress categories and constant amplitude fatigue limits.

Sign structures or high-mast light poles that could fall onto marked traffic lanes shall be treated in accordance with AASHTO requirements for Fatigue Category I.

VicRoads permits the use of square and rectangular sections subject to the rigorous design approach for fatigue outlined in Appendix C of AASHTO LRFD Specification (2015) and fabricated in accordance with VicRoads Standard Specification 630. The AASHTO publication provides values of equivalent fatigue-limit-state static wind pressure ranges without requiring consideration of the site-specific wind loading. The wind pressure ranges used in the AASHTO formulae were obtained following consideration of a range of installation sites across the USA. For high-mast light poles AASHTO requires the equivalent fatigue-limit-state static wind pressure range to be selected based upon the yearly mean wind velocity. For these structures, the maximum value of equivalent fatigue-limit-state static wind pressure range shall be used, unless a lesser value is justified based upon detailed wind records taken over a period of at least 50 years. Adjustment may be required for differences in the averaging interval used for wind speed data in Australia and in the USA.

The potential for a resonant response of the cantilever arm of cantilever sign structures to vortex shedding originating from the column shall be assessed, including designs in which steel box sections are used for the principal members. If a resonant response is possible, this shall be mitigated in the design (for example by the installation of impact dampers or wind-flow spoilers).

5. Materials

5.1. Grout
Grout shall be proprietary pre-mixed, free-flowing, non-shrink material with a minimum strength of 50MPa in accordance with Standard Specification 760.

Dry-packed mortar shall not be used.
5.2. Steel
Further to AS/NZS5100.6 Cl.14.4, for the purpose of selecting the grade of steel, the design service temperature shall be taken as LOMAT – 5ºC.

6. Preparation of designs
Designs for sign structures shall be prepared by a designer that is prequalified at Structures Complex level in accordance with the VicRoads scheme for prequalification of consulting engineers.

7. Proof engineering of designs
Designs for sign structures shall be subjected to proof-engineering by an engineer that is prequalified at Proof Engineering level in accordance with the VicRoads scheme for prequalification of consulting engineers.

8. Additional requirements for cantilever sign structures with cantilever arms of horizontal length greater than 9m
In order to ensure that cantilever arms of length exceeding 9m will have an adequate fatigue performance, it is advised that they should be subjected to vibration monitoring for a period of 12 months. As a minimum, vibration monitoring shall be achieved by measuring variations in strain at the base-plate weld in order to establish that the strain range is less than the relevant constant-amplitude fatigue limit defined in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

Proposals for vibration monitoring together with the collection and interpretation of data shall be subjected to proof-engineering by a company that is prequalified at Proof Engineering level under the VicRoads scheme for prequalification of consulting engineers.

Principal Bridge Engineer
VicRoads

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Bridge Technical Notes are subject to periodic review and may be superseded.
Appendix A

Construction

Installation of anchor-bolts
Following erection of the column, all levelling nuts in double-nut moment connections should be tightened to snug-tight to capture the base-plate with nuts effectively tensioned against both sides of the baseplate.

Top-nuts shall be tensioned by the part-turn method as follows:

- Anchor-bolt diameter B 37.5 mm 1/6 turn beyond snug tight
- Anchor-bolt diameter > 37.5 mm 1/12 turn beyond snug tight

Anchor-bolt template
In order to maximise the fatigue performance of the base-plate connection, it is recommended that a double template is used in order to achieve correct positioning and alignment of the cast-in anchor-bolts and the bolt holes in the base-plate. A suitable arrangement is described in NCHRP469 Fatigue-Resistance Design of Cantilevered Signal, Sign and Light Supports, Figure C-5.1 and comprises a pair of steel ring with nuts on both sides - one ring cast in at the lower end of the anchor-bolts, and one removable ring at the upper end of the anchor-bolts.

Grout
Grout must be mixed in accordance with the manufacturer’s recommendations using a mechanical mixer which has sufficient volume to mix all of the grout required for one base-plate in a single mix. Grout must be placed within the maximum time limit recommended by the manufacturer.

Formwork
If formwork is not properly sealed, grout leaks may occur leading to the formation of voids under the base-plate and potentially to a heightened risk of corrosion of steel components. The following procedure is recommended in order to avoid the possibility of grout leakage.

Suggested Formwork Procedure
Formwork on three sides of the base-plate should be set at to a minimum height of 50mm above the top of the base-plate. Formwork on the fourth side is then set to a level 10mm higher than the underside of the base-plate.

The grout should then be poured into the side opposite the low side in a continuous operation such that the grout flows freely over the formwork on the low side.

Neither the formwork, base-plate or grout should be vibrated or tapped. Grout must then be cured in accordance with the manufacturer’s instructions.

Grout-testing
Cube tests shall be taken at a minimum rate of 1 set of four per day. The set of cubes shall represent the whole of the day’s production of grout. Two cubes shall be tested at 7 and 28 days respectively. The results of the cube tests shall be reported to the Superintendent within 7 days of the test.