



BRIDGE TECHNICAL DIRECTION BTD2007/11

HORIZONTAL REINFORCEMENT FOR CRACK CONTROL IN WALLS AND WALL TYPE PIERS

Background

It has been a long standing RTA Bridge Engineering practice to specify an increased area of horizontal reinforcement in the lower parts of abutment walls and wall type piers where the wall is rigidly connected to (and restrained by) a footing or a pile cap. Whilst Clause 11.6 of AS 5100.5 specifies minimum requirements for horizontal (shrinkage) reinforcement, using a uniform distribution of the horizontal reinforcement in the vertical direction does not fully recognise the need for better crack control at the connection to the footings, pile caps or other members, particularly for long walls where the effects of the differential shrinkage can be substantial.

Information

The minimum reinforcement for crack control in walls that are restrained by other members is specified in AS 5100.5 Clause 11.6. Depending on the exposure classification and diameter of the horizontal reinforcing bars, the specified horizontal reinforcement ratio A_s/bD varies from 0.0035 to 0.008 where b is the height and D is the thickness of the wall. D need not be taken as greater than 500 mm.

RTA experience indicates that, for good control of vertical cracks in the wall that originate at its base (where it is rigidly connected to the footing or pile cap or where the curtain wall at the top of an abutment is restrained by the headstock), a higher ratio of the horizontal reinforcement in the lower part of the wall compared to that provided in the upper parts of the wall is required.

The forces developed by thermal cracking during cement hydration and by differential shrinkage are related to the length of the wall. Clause 11.6 of AS 5100.5 does not change the horizontal reinforcement ratio in relation to the length of the wall, and the following the following should be noted:

- Clause 13.4.2 of AS 5100.3 specifies that vertical contraction joints shall be provided in long concrete walls and abutments to control shrinkage cracking. The Clause does not specify mandatory limits on lengths of wall between contraction joints, but spacings of 8 to 10 m are recommended for walls founded on other than rock and 5 m for walls founded on rock. Expansion joints are recommended at 30 m maximum spacings.
- The provisions of AS 5100.5 for horizontal reinforcement in walls are based on AS 3600, modified for bridge structures. AS 3600 is being revised and in the current draft the following note relates to the ratio of horizontal reinforcement: *"For walls longer than 8 m additional horizontal crack control reinforcement may be needed at the base of the wall to control thermal cracking during hydration"*.

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Bridge Technical Direction

The area of horizontal reinforcement for crack control additional to that specified by Clause 11.6 of AS 5100.5 shall be determined by the designer. However, in walls and wall type piers where the spacing of vertical contraction or expansion joints exceeds 8.0 m, the area of horizontal reinforcement for crack control shall be increased near the base of the wall.

As a minimum, the ratio of the reinforcement near the base of the wall up to a height equal to the thickness of the wall shall not be less than 1.33 times the ratio calculated from the formulae in Clause 11.6.2 of AS 5100.5. The vertical spacing of the horizontal reinforcement shall not exceed 150 mm.

Where vertical contraction or expansion joints are provided in the footing of the wall or in the pile cap in accordance with Clause 13.4.2 of AS 5100.3, matching vertical contraction joints or expansion joints at the same location shall also be provided in the wall.

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