

Memorandum

TO: All Design Section Staff
FROM: Bijan Khaleghi
DATE: February 10, 2009
SUBJECT: Skin Reinforcement Requirement

This design memorandum provides guidance on skin reinforcement requirement for flexural members. These modifications will be integrated in the next revision to the BDM.

The requirement of the LRFD Section 5.7.3.4 “Control of Cracking by Distribution of Reinforcement” for skin reinforcement shall be modified as follows:

If the depth, h , of non-prestressed or partially prestressed members exceeds 3.0 ft., longitudinal skin reinforcement shall be provided on both side faces of the component. Such reinforcement shall be uniformly distributed along both side faces for a distance $h/2$ nearest the flexural tensile reinforcement. The spacing, s , in inches shall satisfy:

$$s \leq 15(40/f_s) - 2.5C_c \leq (h/6) \leq 12 \quad (1)$$

where:

C_c = is the clear cover to the side face of the member (in.)

h = overall thickness or depth of the component (in.)

f_s = tensile stress in steel reinforcement at the service limit state (ksi). f_s may be assumed to be $(2/3)f_y$ (ksi)

f_y = yield strength of reinforcement (ksi)

The maximum spacing of the skin reinforcement shall not exceed either $h/6$ or 12.0 in. Such reinforcement may be included in strength computations if a strain compatibility analysis is made to determine stresses in the individual bars or wires. The skin reinforcement shall not be less than #4 at 12 in. in both side faces.

The total area of skin reinforcement A_{sk} in both side faces need not exceed 10% of the flexural tensile reinforcement.

BACKGROUND

The above modifications for skin reinforcement are based on the ACI 318-2005. For relatively deep flexural members, some reinforcement should be placed near the vertical faces in the tension zone to control cracking in the web. Without such auxiliary steel, the width of the cracks in the web may greatly exceed the crack widths at the level of the flexural tension reinforcement. The bar spacing, rather than size, is the important issue. Bar sizes #4 or #5 (or welded wire reinforcement) with a minimum area of $0.2 \text{ in}^2/\text{ft}$ of depth is typically provided.

The above modifications also conform to the AASHTO Guide Specifications for LRFD Seismic Bridge Design section 8.13.4.2.3 for Horizontal Side Reinforcement for bent caps in seismic design categories C and D. The total longitudinal side face reinforcement in the bent cap shall be at least equal to $0.1A_{\text{top}}^{\text{cap}}$ or $0.1A_{\text{bot}}^{\text{cap}}$ longitudinal reinforcement, and shall be placed near the side faces of the bent cap with a maximum spacing of 12 in.

If you have any questions regarding this issue, please contact Bijan Khaleghi at 705-7181.

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