

Supplemental Plan Check List for Concrete Shear Wall (2017)

Plan Check/PCIS Application No.:

Date:

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For instruction and other information, read the master plan check list attached.

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Reference code is Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary unless otherwise noted in plan check list.

PLAN DETAILS

1. Longitudinal and Transverse reinforcement ratio, ρ_l and ρ_t for shear wall exceeding $A_{CV} \lambda \sqrt{f'_c}$ shall not be less than 0.0025 (ACI 318-14, §18.10.2.1)
2. Reinforcement spacing each way in shear walls shall not exceed 18" (ACI 318-14, §18.10.2.1)
3. At least two curtains of reinforcement shall be used in a wall if $V_u > 2 A_{CV} \lambda \sqrt{f'_c}$ or $h_w/l_w \geq 2.0$ in which h_w and l_w refer to height and length of entire wall, respectively (ACI 318-14 18.10.2.2)
4. Reinforcement in structural walls shall be developed or spliced for f_y in tension in accordance with Sections 25.4, 25.5, and (a) through (c):
 - a. Longitudinal reinforcement shall extend beyond the point at which it is no longer required to resist flexure by least $0.8l_w$ except at the top of a wall.
 - b. At locations where yielding of longitudinal reinforcement is likely to occur as a result of lateral displacements, development lengths of longitudinal reinforcement shall be 1.25 times the values calculated for f_y in tension.
 - c. Mechanical splices of reinforcement shall conform to 18.2.7 and welded splices of reinforcement shall conform to 18.2.8.
5. If in-plane $V_u \leq 0.5V_c$, minimum ρ_l and minimum ρ_t shall be in accordance with Table 11.6.1. These limits need not be satisfied if adequate strength and stability can be demonstrated by structural analysis. (ACI 318-14 §11.6.1)
6. If in-plane $V_u \geq 0.5V_c$ (a) and (b) shall satisfied:
 - a. ρ_l shall be at least the greater of the value calculated by Eq. (11.6.2) and 0.0025, but need not exceed required by 11.5.4.8 $\rho_l \geq 0.0025 + 0.5(2.5 - h_w/l_w)(\rho_t - 0.0025)$
 - b. ρ_t shall be at least 0.0025 (ACI 318-14 §11.6.2)
7. Walls or wall piers with $h_w/l_w \geq 2.0$ that are effectively continuous from the base of structure to top of wall and are designed to have a single critical section for flexure and axial loads shall satisfy (a) and (b) or shall be designed by 18.10.6.3:
 - a. Compression zones shall be reinforced with special boundary elements where

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$$c \geq \frac{\ell_w}{600 (\delta_u / h_w)}$$

and c corresponds to the largest neutral axis depth calculated for the factored axial force and nominal moment strength consistent with the direction of the design displacement δ_u . Ratio δ_u/h_w shall not be taken less than 0.005.

- b. Where special boundary elements are required by (a), the special boundary element transverse reinforcement shall extend vertically above and below the critical section at least the greater of l_w and $M_u/4V_u$ except as permitted in 18.10.6.4(g). (ACI 318-14 §18.10.6.2)
8. Where special boundary elements are required, the following shall be satisfied
(ACI 318-14 §18.10.6.4):
- The boundary elements shall extend horizontally from the extreme compression fiber minimum ($c-0.1 l_w$) or $c/2$, whichever is larger.
 - Width of the flexural compression zone, b , over the horizontal distance calculated by 18.10.6.4(a), including flange if present, shall be at least $h_u/16$.
 - For walls or wall piers with $h_w/l_w \geq 2.0$ that are effectively continuous from the base of structure to top of wall, designed to have a single critical section for flexure and axial loads, and with $c/l_w \geq 3/8$, width of the flexural compression zone b over the length calculated in 18.10.6.4(a) shall be greater than or equal to 12 in.
 - In flanged sections, the boundary element shall include the effective flange width in compression and shall extend at least 12 in. into the web.
 - The boundary element transverse reinforcement shall satisfy 18.7.5.2(a) through (e) and 18.7.5.3, except the value h_x in 18.7.5.2 shall not exceed the lesser of 14 in. and two-thirds of the boundary element thickness, and the transverse reinforcement spacing limit of 18.7.5.3(a) shall be one-third of the least dimension of the boundary element.
 - The amount transverse reinforcement shall be in accordance with Table 18.10.6.4(f)
 - Where the critical section occurs at the wall base, the boundary element transverse reinforcement at the wall base shall extend into the support at least l_d in accordance with 18.10.2.3, of the largest longitudinal reinforcement in the special boundary element. Where the special boundary element transverse reinforcement shall extend at least 12 in. into the footing, mat, or pile cap, unless a greater extension is required by 18.13.2.3.
 - Horizontal reinforcement in the wall web shall extend to within 6 in. of the end of wall. Reinforcement shall be anchored to develop f_y within the confined core of the boundary element using standard hooks or heads. Where the confined boundary element has sufficient length to develop the horizontal web reinforcement, and $A_s f_y / s$ of the horizontal web reinforcement, it shall be permitted to terminate the horizontal web reinforcement without a standard hook or head.
9. Where boundary zone detail is not required by ACI 318-14, §18.10.6.2 or §18.10.6.3, the following shall be satisfied:
- If $\rho_l < 400/f_y$, the boundary transverse reinforcement shall satisfy §18.7.5.2(a) and 18.10.6.4(a). The longitudinal spacing of transverse reinforcement in the boundary shall not exceed the lesser of 8 in. and $8 d_b$ of the smallest primary flexural reinforcing bars, except the spacing shall not exceed the lesser of 6 in. and $6 d_b$ within a distance equal to the greater of l_w and $M_u/4V_u$ above and below critical sections where yielding of longitudinal reinforcement is likely to occur as a result of inelastic lateral displacements. (ACI 318-14 §18.10.6.5)
 - V_u exceeding $A_{CV} \lambda \sqrt{f'_c}$ shall have horizontal reinforcement terminating at the edges of shear wall with the a standard hook or "U" stirrup of the same size and spacing as, and spliced to, the horizontal reinforcement. (ACI 318-14, §18.10.6.5)

CALCULATIONS

A. General

1. Design forces shall be in accordance with the Factored Load and Combinations specified in §91.1605.2 of LABC and §12.4.2.3 of ASCE 7-10 §18.10.3 of ACI318-14.
2. The R value used in determining the base shear shall not exceed 5.0 for special reinforced concrete shear walls and 4.0 for ordinary concrete shear walls. per T12.2-1 of ASCE 7-10.
3. In storage and warehouse occupancies, include a minimum 25% of the floor live load for the seismic dead load, W. (ASCE 7-10, §12.7.2.1)
- 4 The shear strength reduction factor, "φ" shall be per §21.2.4 of ACI 318-14.

B. Shear

1. Wall shall have a nominal shear strength per following formula:

$$V_n = A_{CV} [\alpha_c \lambda \sqrt{f'_c} + \rho_t f_y]. \quad (ACI318-14 Eq18.10.4.1)$$

Where : $\alpha_c = 3.0$ for $h_w / l_w \leq 1.5$,

$\alpha_c = 2.0$ for $h_w / l_w \geq 2.0$

$\alpha_c =$ Varies linearly between 3.0 and 2.0 for h_w / l_w between 1.5 and 2.0
(ACI 318-14, §18.10.4.1)

2. h_w / l_w used in determining V_n for segments of a wall shall be the larger of the ratios for the entire wall and the segment of wall considered. (ACI 318-14, §18.10.4.2)
3. Reinforcement ratio $\rho_l \geq \rho_t$, if height to length ratio < 2.0, (ACI 318-14, §18.10.4.3)
4. Nominal shear strength, V_n , of all wall shall not exceed $8 A_{CV} \sqrt{f'_c}$ for the entire building and $10 A_{CV} \sqrt{f'_c}$ for individual wall pier. (ACI 318-14, §18.10.4.4)

C. Flexure and axial loads

1. Shear walls subject to combined flexural and axial loads shall be designed in accordance with ACI 318-14, §22.4. The effects of openings shall be considered. (ACI 318-14, §18.10.5.1)
2. Effective flange widths of flanged sections shall extend from the face of the web a distance equal to the smaller of $\frac{1}{2}$ the distance to an adjacent wall web and 25% of the total wall height (ACI 318-14, §18.10.5.2)

D. Boundary elements

1. Special boundary elements at the edges of structural walls are required per §18.10.5.2 and §18.10.5.3 of ACI 318-14.
2. Walls that are effectively continuous from the base of the structure to top of wall and designed to have a single critical section for flexure and axial loads shall meet the following (ACI 318-14 §18.10.6.2):
 - a. Compression zones shall be reinforced with special boundary elements per
(Eq 18.10.6.2)

$$C \geq \frac{\ell_w}{600 (\delta_u / h_w)}$$

Where δ_u/h_w shall not be taken less than 0.007

- b. Reinforcement shall extend vertically a maximum distance not less than the larger of ℓ_w or $M_u / 4V_u$.
3. Structural walls not designed to the provisions of 18.10.6.2 shall have special boundary elements at boundaries and edges around the openings of the wall where the maximum extreme fiber compressive stress exceeds $0.2 f'_c$. (ACI 318-14 §18.10.6.3)

E. NOTES ON PLANS

1. Minimum compressive strength for concrete shear wall is $f'_c = 3000$ psi.
(ACI 318-14, §18.2.5.1, Table 19.2.1.1)
2. Continuous inspection by a deputy inspector shall be required.
(LABC §91.1705.3)
3. Reinforcing bars used in shear wall shall comply with
(ACI 318-14, §18.2.6.1 and 20.2.2)

Additional Corrections	Code Section	