Supplemental Plan Check List
for
Concrete Shear Wall (2023)

Plan Check Number : _____

PCIS Application number: _____

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If you have any questions or need clarification on any plan check matters, please contact your plan check engineer and/or his or her supervisor.

For instructions and other information, reference the project general correction sheet.

Reference code is Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary unless otherwise noted in plan check list.

Obtain Information Bulletins, Affidavits or Forms from our web site at www.ladbs.org.

PLAN DETAILS

1. Reinforcing bars used in shear wall shall comply with 18.2.6.1 and 20.2.2.

2. Minimum compressive strength for concrete shear wall is f'c = 3000 psi with Grade 60, Grade 80 reinforcement. Minimum f'c = 5000 psi with Grade 100 reinforcements. (18.2.5.1 and Table 19.2.1.1)

3. Longitudinal and Transverse reinforcement ratios, ρ_l and ρ_t for V_u exceeding $A_{CV}\,\lambda\sqrt{f'_c}$ shall not be less than 0.0025. (18.10.2.1)

4. Reinforcement spacing each way in shear walls shall not exceed 18" (18.10.2.1)

5. 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 (18.10.2.2)

6. Reinforcement ratio ***ρl*** shall be at least the reinforcement ratio ***ρt*** , if height to length ratio < 2.0. (18.10.4.3)

7. 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 (d): (18.10.2.3)
   (a) Except at the top of a wall, longitudinal reinforcement shall extend at least 12 ft above the point at which it is no longer required to resist flexure but need not extend more than ***ld*** above the next floor level.

(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) Lap splices of longitudinal reinforcement within boundary regions shall not be permitted over a height equal to ***hsx*** above, and ***ld*** below, critical sections where yielding of longitudinal reinforcement is likely to occur as a result of lateral displacements. The value of ***hsx*** need not exceed 20 ft. Boundary regions including those within lengths specified in 18.10.6.4(a) and within a length equal to the wall thickness measured beyond the intersecting region(s) of connected walls.

(d) Mechanical splices of reinforcement shall conform to 18.2.7 and welded splices of reinforcement shall conform to 18.2.8.

8. 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 have longitudinal reinforcement at the ends of a vertical wall segment that satisfies (a) through (c). (18.10.2.4)
   (a) Longitudinal reinforcement ratio within ***0.15lw*** from the end of a vertical wall segment, and over a width equal to the wall thickness, shall be at least $6\sqrt{f'_c}/f_y$.
   (b) The longitudinal reinforcement required by 18.10.2.4(a) shall extend vertically above and below the critical section at least the greater of ***lw*** and ***Mu/3Vu***.
   (c) No more than 50 percent of the reinforcement required by 18.10.2.4(a) shall be terminated at any one section.

9. Reinforcement in coupling beams shall be developed for fy in tension in accordance with 25.4, 25.5, and (a) and (b): (18.10.2.5)
   (a) If coupling beams are reinforced according to 18.6.3.1, the development length of longitudinal reinforcement shall be 1.25 times the values calculated for fy in tension.
   (b) If coupling beams are reinforced according to 18.10.7.4, the development length of diagonal reinforcement shall be 1.25 times the values calculated for fy in tension.

10. If in-plane $\mathbf{V_u \leq 0.5\phi\alpha_c\lambda\sqrt{f'_c}A_{cv}}$, 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. (11.6.1)

11. If in-plane $\mathbf{V_u \geq 0.5\phi\alpha_c\lambda\sqrt{f'_c}A_{cv}}$, (a) and (b) shall satisfied: (11.6.2)
   (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 ρ_t required for strength by 11.5.4.3 $\rho_l \geq 0.0025 + 0.5(2.5 - h_w / l_w)(\rho_t - 0.0025)$
   (b) ρ_t shall be at least 0.0025

12. 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: (18.10.6.2)

(a) Compression zones shall be reinforced with special boundary elements where

$$\frac{1.5\delta_u}{h_{wcs}} \geq \frac{\ell_w}{600c} \qquad (18.10.6.2a)$$

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_{wcs} shall not be taken less than 0.005.

(b) If special boundary elements are required by (a), then (i) and either (ii) or (iii) shall be satisfied.

(i) Special boundary element transverse reinforcement shall extend vertically above and below the critical section a least the greater of ℓ_w and $M_u/4V_u$, except as permitted in 18.10.6.4(i).

(ii) $b \geq \sqrt{0.025\ell c_w}$

(iii) $\delta_c/h_{wcs} \geq 1.5\delta_u/h_{wcs}$, where:

$$\frac{\delta_c}{h_{wcs}} = \frac{1}{100}\left(4 - \frac{1}{50}\left(\frac{\ell_w}{b}\right)\left(\frac{c}{b}\right) - \frac{V_e}{8\sqrt{f'_c}A_{cv}}\right) \qquad (18.10.6.2b)$$

The value of δ_c/h_{wcs} in Eq. (18.10.6.2b) need not be taken less than 0.015.

13. Where special boundary elements are required, the following per 18.10.6.4 shall be satisfied:

(a) The boundary elements shall extend horizontally from the extreme compression fiber a minimum of (c-0.1 l_w) or c/2, whichever is larger.

(b) 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 $h_u/16$.

(c) 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.

(d) In flanged sections, the boundary element shall include the effective flange width in compression and shall extend at least 12 in. into the web.

(e) The boundary element transverse reinforcement shall satisfy 18.7.5.2(a) through (d) and 18.7.5.3, except the transverse reinforcement spacing limit of 18.7.5.3(a) shall be one-third of the least dimension of the boundary element. The maximum vertical spacing of transverse reinforcement in the boundary element shall also not exceed that in Table 18.10.6.5(b).

(f) Transverse reinforcement shall be arranged such that the spacing hx between laterally supported longitudinal bars around the perimeter of the boundary element shall not exceed the lesser of 14 in. and two-thirds of the boundary element thickness. Lateral support shall be provided by a seismic hook of a crosstie or corner of a hoop. The length

of a hoop leg shall not exceed two times the boundary element thickness, and adjacent hoops shall overlap at least the lesser of 6 in. and two-thirds the boundary element thickness.

(g) The amount transverse reinforcement shall be in accordance with Table 18.10.6.4(g).

(h) Concrete within the thickness of the floor system at the special boundary element location sha;; have specified compressive strength at least .7 times ***f'c*** of the wall.

(i) For a distance above and below the critical section specified in 18.10.6.2(b), web vertical reinforcement shall have lateral support provided by the corner of a hoop or by a crosstie with seismic hooks at each end. Transverse reinforcement shall have a vertical spacing not to exceed 12 in. and diameter satisfying 25.7.2.2.

(j) 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 Ɛd, in accordance with 18.10.2.3, of the largest longitudinal reinforcement in the special boundary element. Where the special boundary element terminates on a footing, mat, or pile cap, 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 18.13.2.4.

(k) Horizontal reinforcement in the wall web shall extend to within 6 in. of the end of the wall. Reinforcementshall be anchored to develop fy within the confined core of the boundary element using standard hooks or heads. Wherethe confined boundary element has sufficient length to develop the horizontal web reinforcement, and ***Asfy/s*** of the horizontal web reinforcement does not exceed ***Asfyt/s*** of the boundary element transverse reinforcement parallel to the horizontal web reinforcement, it shall be permitted to terminate the horizontal web reinforcement without a standard hook or head.

9. Where boundary zone details are not required by 18.10.6.2 or 18.10.6.3, (a) and (b) shall be satisfied: (18.10.6.5)

   (a) Except where ***Vu*** in the plane of the wall is less than ***λ√f'cAcv***, horizontal reinforcement terminating at the edges of structural walls without boundary elements shall have a standard hook engaging the edge reinforcement or the edge reinforcement shall be enclosed in U-stirrups having the same size and spacing as, and spliced to, the horizontal reinforcement.

   (b) If the maximum longitudinal reinforcement ratio at the wall boundary exceeds ***400/fy***, boundary transverse reinforcement shall satisfy 18.7.5.2(a) through (e) over the distance calculated in accordance with 18.10.6.4(a). The vertical spacing of transverse reinforcement at the wall boundary shall be in accordance with Table 18.10.6.5(b).

CALCULATIONS

General

1. Design forces shall be in accordance with the Factored Load and Combinations specified in 1605.1 of the 2023 LABC, 2.3 of ASCE 7-16, and 18.10.3 of ACI318-19.

2. The R value used in determining the base shear shall not exceed 5.0 for special reinforced concrete shear walls for bearing wall systems, 6.0 for special reinforced concrete shear walls for building frame systems, and 4.0 for ordinary reinforced concrete shear walls per T12.2-1 of ASCE 7-16.

3. The shear strength reduction factor for special structural walls, "ϕ" shall be modified in accordance with 21.2.4.1 through 21.2.4.4 (21.2.4.)

4. For any member designed to resist E, ϕ for shear shall be 0.60 if the nominal shear strength of the member is less than the shear corresponding to the development of the nominal moment strength of the member. The nominal moment strength shall be the maximum value calculated considering factored axial loads from load combinations that include E. (21.2.4.1)

Shear

1. The design shear force ***Ve*** shall be calculated by:

$$V_e = \Omega_v \omega_v V_u \leq 3V_u \qquad (18.10.3.1)$$

where V_u, Ω_v, and ω_v are defined in 18.10.3.1.1, 18.10.3.1.2, and 18.10.3.1.3, respectively.

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

$V_n = A_{CV} [\alpha_c \lambda \sqrt{f'_C} + p_t f_y]$ (Eq 18.10.4.1)

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

α_c= 2.0 for $h_w / l_w \geq 2.0$

α_c= Varies linearly between 3.0 and 2.0 for h_w / l_w between 1.5 and 2.0 (18.10.4.1)

3. h_w / ℓ_w used in determining V_n for segments of a wall shall be the greater of the ratios for the entire wall and the segment of wall considered. (18.10.4.2)

4. Reinforcement ratio ρ_l shall be at least the reinforcement ratio ρ_t , if height to length ratio < 2.0. (18.10.4.3)

5. Nominal shear strength, V_n, of all wall segments sharing a common lateral force, shall not exceed $\mathbf{8A_{cv}\sqrt{f'_c}}$, and for any individual wall segments, shall not exceed $\mathbf{10A_{cw}\sqrt{f'_c}}$, where $\mathbf{A_{cw}}$ is the area of concrete section of a horizontal wall segment or coupling beam. (18.10.4.4)

Flexure and axial loads

1. Shear walls subject to combined flexural and axial loads shall be designed in accordance with 22.4. The effects of openings shall be considered. (18.10.5.1)

2. Effective flange widths of flanged sections shall extend from the face of the web a distance equal to the lesser of 1/2 the distance to an adjacent wall web and 25% of the total wall height above the section under consideration. (18.10.5.2)

Boundary elements

1. Special boundary elements at the edges of structural walls are required per 18.10.6.2 and 18.10.6.3.

2. Walls or wall piers with $h_w / l_w \geq 2.0$ 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: (18.10.6.2)

(a) Compression zones shall be reinforced with special boundary elements where

$$\frac{1.5\delta_u}{h_{wcs}} \geq \frac{\ell_w}{600c} \qquad (18.10.6.2a)$$

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_{wcs} shall not be taken less than 0.005.

(b) If special boundary elements are required by (a), then (i) and either (ii) or (iii) shall be satisfied.

(i) Special boundary element transverse reinforcement shall extend vertically above and below the critical section a least the greater of ℓ_w and $M_u/4V_u$, except as permitted in 18.10.6.4(i).

(ii) $b \geq \sqrt{0.025\ell c_w}$

(iii) $\delta_c/h_{wcs} \geq 1.5\delta_u/h_{wcs}$, where:

$$\frac{\delta_c}{h_{wcs}} = \frac{1}{100}\left(4 - \frac{1}{50}\left(\frac{\ell_w}{b}\right)\left(\frac{c}{b}\right) - \frac{V_e}{8\sqrt{f'_c}A_{cv}}\right) \qquad (18.10.6.2b)$$

The value of δ_c/h_{wcs} in Eq. (18.10.6.2b) need not be taken less than 0.015.

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. (18.10.6.3)

NOTES ON PLANS

1. Minimum compressive strength for concrete shear wall is f'C = 3000 psi with Grade 60, Grade

80 reinforcement. Minimum f'c =5000 psi with Grade 100 reinforcements. (18.2.5.1 and Table 19.2.1.1)

2. Continuous inspection by a deputy inspector shall be required. (LABC 1705.3)

3. Reinforcing bars used in shear wall shall comply with 18.2.6.1 and 20.2.2.

ADDITIONAL CORRECTIONS	**Code Sec. No.**

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