

Plan Check / PCIS Application Number: \_\_\_\_\_

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

**References:**

- ASCE 7-10 -The Minimum Design Loads for Buildings and other structures ASCE 7-10 by American Society of Civil Engineers. Including Supplemental No.1 and 2, excluding Chapter 14 and Appendix 11A
- ACI 530-11 - Building Code Requirements for Masonry Structures
- ACI 530.1-11- Specification for Masonry Structures
- LABC - 2014 City of Los Angeles Building Code, Jan 2014

(Note: unless noted otherwise, all sections of code referenced within this article shall refer to ACI 530-11)

**PLAN DETAILS**

1. Masonry Shear walls in seismic design category D, E, or F shall be designed for the requirements of special reinforced masonry shear walls as per 1.18.3.2.6 and Table 12.2-1 of ASCE-7.
2. Vertical reinforcement in masonry walls shall comply with the following:
  - a. At least 0.20-in<sup>2</sup> in cross sectional area shall be provided (1.18.3.2.3.1):
    - i. at corners,
    - ii. within 16-in. of each side of an opening,
    - iii. within 8-in. of the ends of walls or movement joints,
    - iv. at a maximum spacing of 120 inch on center.
  - b. Maximum spacing shall not exceed 1/3 the length of the shear wall, 1/3 the height of the shear wall, or 48 inch for masonry laid in running bond and 24 inch for masonry in other than running bond. (1.18.3.2.6 (a))
  - c. The minimum cross sectional area shall be of 1/3 of the required shear reinforcement. (1.18.3.2.6 (c))
3. Horizontal reinforcement in masonry walls shall comply with the following:
  - a. Spacing of horizontal reinforcement shall not exceed 1/3 the length of the shear wall, 1/3 the height of the shear wall, 48-in for masonry laid in running bond, nor 24-in for masonry laid in other than running bond. (1.18.3.2.6 (b))
  - b. Located at the bottom and top of wall openings and shall extend minimum 24-in., or 40 bar diameter past the opening, whichever is greater. (1.18.3.2.3.1)
  - c. Continuous horizontal reinforcement shall be provided at structurally connected roof and floor levels and be provided within 16-in. of the top of walls. (1.18.3.2.3.1)
4. Shear reinforcement shall be anchored around vertical reinforcing bars with a standard hook (1.18.3.2.6(d))

5. Provide minimum reinforcement for masonry walls as follows:
  - a. The sum of horizontal and vertical reinforcement shall not be less than 0.002 times the gross cross sectional area of the wall. (1.18.3.2.6 (c))
  - b. For masonry laid in running bond, both of the horizontal and vertical reinforcement shall not be less than 0.0007 times the gross cross sectional area of the wall. (1.18.3.2.6 (c) 1)
  - c. For masonry laid in other than running bond, vertical reinforcement shall not be less than 0.0007 times the gross cross sectional area of the wall, and horizontal reinforcement shall not be less than 0.0015 times the gross cross-sectional area of the wall. (1.18.3.2.6 (c) 2)
6. Only Type S or type M cement-lime mortar or masonry cement shall be used as part of the lateral force resisting system. (1.18.4.4.2.2)
7. Masonry partition walls, screen walls and other elements that are not designed to resist vertical or lateral loads shall be isolated from the structure in accordance with 1.18.3.1. Isolation joints and connectors between these elements and the structure shall be designed to accommodate the design story drift. (1.18.3.1)
8. Masonry columns shall comply with the following:
  - a. The distance between lateral supports a column shall not exceed 99 multiplied by the least radius of gyration  $r$  (1.14.1.1(a))
  - b. Columns shall have a minimum side dimension of 8-in. nominal. (1.14.1.1 (b))
  - c. Columns shall be designed to resist loads with a minimum eccentricity equal to 0.1 times each side dimension, considering each axis independently. (2.3.4.3)
  - d. Vertical column reinforcement shall not be less than  $0.0025A_n$  nor exceed  $0.04A_n$ . Minimum number of vertical bars shall be four. (1.14.1.3)
  - e. Vertical reinforcement shall be enclosed by lateral ties at least 1/4-in. diameter with spacing not exceeding, 16 longitudinal bar diameters, 48 lateral tie diameters, least cross-sectional dimension of the member, (1.14.1.4 (a)& (b))
  - f. Lateral ties shall be arranged so that every corner and alternate longitudinal bar shall have lateral support provided by the corner of a lateral tie with an included angle of not more than 135 degrees. (1.14.1.4 (c))
  - g. Lateral ties shall be located vertically not more than one-half lateral tie spacing above the top of footing or slab in any story and not more than one-half lateral tie spacing below the lowest horizontal reinforcement in beam, girder, slab, or drop panel above. (1.14.1.4 (d))
9. Additional ties shall be provided around anchor bolts which are set in the top of columns. Such ties shall enclose both the vertical bars in the column and the anchor bolts. There shall be a minimum of two No. 4 lateral ties provided in the top 5 in. of the column. (1.18.4.3.2.1)

10. Beams supporting reactions from discontinuous walls or frames shall have transverse reinforcement spaced no more than one-half of the nominal depth of the beam. Transverse reinforcement ratio shall not be less than 0.0015. (1.18.4.3.2.5)
11. Columns and Piers used to resist seismic load and to support reactions from discontinuous stiff elements shall comply with:
  - a. Seismic response modification factor , R, is no greater than 1.5, (1.18.4.3.2.4)
  - b. Transverse reinforcement shall meet the requirements of 1.18.4.3.2.5.
12. For ASD, the bar diameter shall not exceed 1/8 of the nominal wall thickness and shall not exceed 1/4 of the least dimension of the cell, course or collar joint in which is placed. (2107.4 of 2014 LABC)

## **CALCULATIONS**

1. Provide structural calculations and details of reinforcement for piers, columns, beams, and for the distribution of concentrated vertical loads at walls.
2. The design of masonry structures shall comply with the allowable stress design provisions of Section 2107, or the strength design provisions of Section 2108, and with the General Design and Construction Requirements of Section 2101 through 2104, and 2106. All design calculations shall be based on specified dimensions. (2014 LABC)
3. Special reinforced masonry shear walls shall be designed with increased design value in accordance with 1.18.3.2.6.1.1 for strength design or 1.18.3.2.6.1.2 for allowable stress design.
4. Only the net area of hollow masonry units shall be used in design of shear walls. (1.9.1.1)
5. Provide structural calculations for the design of masonry columns and walls considering the effects of combined axial and bending stresses due to eccentricity and lateral loading. (2.3.4, 2.3.5 and 2.3.6)
6. **For working stress design:**
  - a. Allowable compressive force due to axial load shall be in accordance with the formulas in Sec. 2.3.4.2.1;
  - b. Allowable flexural compressive stresses or flexural compressive stresses with axial load shall not exceed  $F_b = 0.45 f'_m$ , per Sec. 2.3.4.2.2;
  - c. Allowable shear stress in **shear walls** ( $F_v$ ) shall not exceed values specified in Sec. 2.3.6.1.2:

$$F_v = F_{vn} + F_{vs} \quad (\text{Eq. 2-25})$$

$$F_v \leq 3 \sqrt{f'_m} \quad \text{for} \quad M/V_d \leq 0.25 \quad (\text{Eq. 2-26})$$

$$F_v \leq 2 \sqrt{f'_m} \quad \text{for} \quad M/V_d \geq 1 \quad (\text{Eq. 2-27})$$

Where allowable shear stress resisted by masonry only:

$$F_v = (1/2)[4 - 1.75(M/V_d)](f'_m) + 0.25(P)/A_n \quad (\text{Eq. 2-28})$$

Where allowable shear stress resisted by both masonry and reinforcement:

$$F_v = (1/4)[4 - 1.75(M/V_d)](f'_m) + 0.25(P)/A_n \quad (\text{Eq. 2-29})$$

where  $M/V_d \leq 1$

$$F_{vs} = 0.5(A_v F_s d) / (A_n s)$$

- d. Allowable stresses in reinforcement shall conform to Sec. 2.3.3.1.
- e. Reinforcement in shear walls with  $M/V_d$  equal to or greater than one and having an axial load greater than  $0.05(f'_m)(A_n)$  shall not exceed the maximum reinforcement ratio determined by equation 2-23. The reinforcement ratio is not applicable for the out-of-plane direction. (2.3.4.4)
- f. Development length of reinforcing bars in tension or compression shall be determined in accordance with equation 2-12, but not less than 12". (2.1.7.3)
- g. Lap splices of reinforcing steel shall be determined in accordance with equation 21-1. Reinforcement larger than No. 9 bar shall be by approved mechanical connections in accordance with 2.1.7.7.3. (2107.2.1 and 2107.3 of 2014 LABC)

## 7. For strength design:

- a. The design strength is the nominal strength multiplied by the strength reduction factor  $\phi$  as specified in Section 3.1.4;
- b. Walls shall be designed for out of plane loads in accordance with Sec. 3.3.5:
  - i. Factored axial stress shall not exceed  $0.20(f'_m)$ . (3.3.5.3)
  - ii. When slenderness ratio exceeds 30, factored axial stress shall not exceed  $0.05(f'_m)$ . (3.3.5.3)
  - iii. Calculate the mid-height, out-of-plane wall deflection for service lateral and vertical load (without load factors) and limit it to  $0.007h$ . (3.3.5.5).
  - iv. Check stress at mid height of wall in accordance with Section 3.3.5.3.
- c. Wall shall be design for in-plane loads in accordance with Sec. 3.3.6:
  - i. Reinforcement shall be provided perpendicular to the shear reinforcement and shall be at least equal to one-third of the cross sectional area of shear reinforcement,  $A_v$ ;
  - ii. Nominal flexural and axial strength shall be determined in accordance with Sec. 3.3.4.1.1;
  - iii. Nominal shear strength shall be determined in accordance with Sec. 3.3.4.1.2;
  - iv. The maximum reinforcement shall meet the requirements of Section 3.3.3.5 or Section 3.3.6.5.1 through Section 3.3.6.5.5; (3.3.6.5)
- d. Development length of reinforcing bars in tension or compression shall be determined in accordance with equation 2-12 of ACI 530, but not less than 12"; (2.1.7.3)
- e. Splices of reinforcement shall be determined by equation 3-16, but shall not be less than 12-in.

and need not be greater than  $72 d_b$ . (3.3.3.3 and 2108.2 of 2014 LABC)

9. Provide calculations for design of anchor bolts in masonry considering edge distance and effective embedment depth in accordance with 2.1.4 for allowable stress design or 3.1.6 for strength design.

## **NOTES ON PLANS**

1. Provide material specification for ( ) block, ( ) grout, ( ) mortar, and ( ) reinforcing steel per section 2103 of 2014 LABC.
2. Construction shall comply with Section 3 of ACI 530.1-11.
  - a. Reinforcement shall be supported to prevent displacements beyond the tolerances allowed by 3.4 of ACI 530.1. prior to grouting; (3.4 B of ACI 530.1-11)
  - b. Cleanouts shall be provided for all grout pours over 5'-4"; (3.2 F of ACI 530.1-11)
  - c. Grout lift height shall not exceed 12.67 ft when the masonry has cured for 4-hrs., the grout slump is maintained between 10 and 11 in., and no intermediate reinforced bond beams are placed between the top and bottom of the pour height. Otherwise grout lift height shall not exceed 5'-4". (3.5 D of ACI 530.1-11)
  - d. All cells and spaces containing reinforcement shall be filled with grout.
3. Quality assurance measures shall comply with Sec. 2105 of 2014 LABC and Tables 1.19.1 and 1.19.2 and 1.19.3 of ACI 530 and shall be included in the statement of special inspections required by 1705 of 2014 LABC.
4. Pipes and conduits embedded in masonry shall not reduce the required strength. (1.20.2)
5. Joint reinforcement used in masonry exposed to earth or weather shall be stainless steel or protected from corrosion by mill galvanized, hot-dip galvanized, or epoxy coating. (1.16.4.2 & 1.16.4.3)
6. Deputy inspection is required for masonry construction. (1704 of 2014 LABC)