

CITY OF MILPITAS

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STRUCTURAL PLAN REVIEW CHECKLIST

SHELL BUILDING (CONCRETE)

The intent of this checklist is to provide a general guideline for the structural plan review. This checklist may not include items related to all possible projects. This checklist may include more items than specific set of structural plans may encompass.

Referenced Codes:

- 2013 California Building Code (CBC)
- 2014 Milpitas Municipal Code (MMC)
- ASCE 7-10
- ACI 318-11

* Code section referenced is CBC unless noted otherwise.

| | Code Requirements | Code section | Req'd |
|-------------------|---|---------------|-------|
| A. GENERAL | | | |
| 1. | The design loads and other information pertinent to the structural design required by section 1603 shall be indicated on the construction documents. As a minimum they shall include: <ul style="list-style-type: none"> a. ROOF : _____ PSF DEAD LOAD _____ PSF LIVE LOAD FLOOR : _____ PSF DEAD LOAD _____ PSF LIVE LOAD b. WIND PER Sec.1609: c. BASIC WIND SPEED (V_{asd}) _____ MPH WIND IMPORTANT FACTOR, I, _____ EXPOSURE CATEGORY _____ d. SEISMIC PER Sec.1613: RISK CATEGORY _____ SEISMIC IMPORTANT FACTOR, I, _____ SITE CLASS _____ _____ S_s _____ S1 _____ SEISMIC DESIGN CATEGORY _____ _____ S_{ds} _____ S_{d1} _____ R, RESPONSE COEFFICIENT FACTOR _____ | 1603 | |
| 2. | Structural plans must be designed by an Engineer or Architect licensed by the State of California and the final plans for permit issuance shall be stamped and signed by the design Engineer or Architect. | | |
| 3. | Plans and details for elements of the structure designed by others shall be reviewed and approved by the Engineer or Architect of record prior to submitting to the City for review and approval. | | |
| 4. | The concentrated load given in Table 1607.1 shall be assumed to be uniformly distributed over an area 2.5' square on floor and other similar surfaces and shall be located so as to produce the maximum load effects in the structural members. | 1607.4 | |
| 5. | The minimum uniformly distributed live loads and concentrated live loads shall be per Table 1607.1. | Table 1607.1 | |
| 6. | In structures assigned to seismic design category D through F, horizontal cantilever structural components shall be designed for a minimum net upward force of 0.2 times the dead load in addition to the applicable load combination of section 12.4.4 of ASCE 7. | ASCE 7 12.4.4 | |

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| Code Requirements | | Code section | Req'd |
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| 7. | Partition load not less than 15psf shall be included as live load in office buildings and in other buildings where partition locations are subjected to change whether or not partitions are shown on the construction documents, unless the specified live load exceeds 80psf. | 1607.5 | |
| 8. | Handrail assemblies and guards shall be designed to resist a uniform load of 50 plf applied in any direction at the top and to transfer this load through the supports to the structure. Handrail assemblies and guards shall be able to resist a single concentrated load of 200 pounds applied in any direction at any point along the top and have attachment devices and supporting structure to transfer this loading to appropriate structural elements of the building. The concentrated load need not be assumed to act concurrently with the uniform load. | 1607.8 | |
| 9. | Interior walls and partitions that exceed 6' in height, including their finish materials, shall have adequate strength to resist the loads to which they are subjected but not less than a horizontal load of 5psf. | 1607.14 | |
| 10. | | | |
| 11. | | | |
| 12. | The deflections of structural members shall not exceed the more restrictive of the limitations of the material chapters and Table 1604.3. | | |
| 13. | Indicate special inspections and testing required per sections 1705 on drawings. | 1705 | |
| 14. | Indicate requirement for structural observation on the drawings. | 1704.5 | |
| 15. | Indicate on the drawing that each contractor responsible for the construction of a main wind or seismic force resisting system, designated seismic system or wind or seismic resisting component shall submit a written statement of responsibility to the Building Official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall be as per section 1704.4 | 1704.4 | |
| B. FRAMING | | | |
| 16. | The design and construction of structural concrete elements shall meet the minimum requirements of ACI 318 for Structural Concrete as per California Building Code. | | |
| 17. | Indicate sizes and locations of all structural members on plans. Framing details shall be referenced on plans. | | |
| 18. | Specify the type of concrete, normal weight or light weight, compressive strength of concrete and the grade of reinforcement on the drawings. | | |
| 19. | Concrete exposed to sulfate-containing solutions or soil shall conform to requirements of ACI 318 Table 4.3.1. For moderate sulfate exposure, cement type II and minimum compressive strength of 4,000 psi concrete shall be used. Type V cement and minimum compressive strength of 4,500 psi concrete shall be used for severe sulfate exposure. | ACI 318 4.3 | |
| 20. | Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel. | ACI 318 6.3 | |
| 21. | The minimum clear spacing between parallel bars in a layer shall be one bar diameter but not less than 1". | ACI 318 7.6 | |
| 22. | Where parallel reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers not less than 1". | ACI 318 7.6 | |
| 23. | In walls and slabs other than concrete joist construction, primary flexural reinforcement shall not be spaced farther apart than 3 times the wall or slab thickness nor farther apart than 18". | ACI 318 7.6.5 | |
| 24. | The slope of inclined portion of an offset bar in column shall not exceed 1 in 6 with axis of column. | ACI 318 7.8.1.1 | |
| 25. | Horizontal support at offset bends in column shall be provided by lateral ties, spirals or parts of the floor construction. Lateral ties or spirals, if used, shall be placed not more than 6" from points of bend. | ACI 318 7.8.1.3 | |

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| Code Requirements | | Code section | Req'd |
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| 26. | Where a column face is offset 3" or greater, longitudinal bars shall not be offset bent. | ACI 318 7.8.1.5 | |
| 27. | For cast-in-place column construction, size of spirals shall not be less than 3/8" in diameter. | ACI 318 7.10.4.2 | |
| 28. | Clear spacing between spirals in column shall not exceed 3" nor be less than 1". | ACI 318 7.10.4.3 | |
| 29. | All nonprestressed bars in column shall be enclosed by lateral ties, at least No.3 in size for longitudinal bars No. 10 and smaller, and at least No. 4 in size for No.11, 14, 18 and bundled bars. | 7.10.5.1 | |
| 30. | Vertical spacing of ties spacing in column shall not exceed 16 longitudinal bar diameters, 48 tie bar diameter, or least dimension of the compression member. | ACI 318 7.10.5.2 | |
| 31. | Ties in column shall be arranged such that every corner and alternate longitudinal bar shall have lateral support provided by the corner of a tie with an included angle of not more than 135 degree and no bar shall be farther than 6" clear on each side along the tie from such a laterally supported bar. | ACI 318 7.10.5.3 | |
| 32. | Ties in column shall be located vertically not more than one-half a tie spacing above the top of footing or slab in any story, and not more than one-half a tie spacing below the lowest horizontal reinforcement in slab or drop panel above. | ACI 318 7.10.5.5 | |
| 33. | Where anchor bolts are placed in the top of columns or pedestals, the bolts shall be enclosed by lateral reinforcement that also surrounds at least four vertical bars of the column or pedestal. The lateral reinforcement shall be distributed within 5" of the top of the column or pedestal, and shall consist of at least 2 No. 4 or 3 No. 3 bars. | ACI 318 7.10.5.7 | |
| 34. | Area of longitudinal reinforcement for non-composite compression members shall be not less than 0.01Ag or more than 0.08Ag. | ACI 318 10.9.1 | |
| 35. | Minimum number of longitudinal bars in compression members shall be 4 bars within rectangular or circular ties, 3 for bars within triangular ties, and 6 for bars enclosed by spirals. | ACI 318 10.9.2 | |
| 36. | For compression member built monolithically with wall: outer limits of the effective cross section of a spirally reinforced or tied reinforced compression member built monolithically with a concrete wall or pier shall be taken not greater than 1.5" outside the spiral or tie reinforcement. | ACI 318 10.8.2 | |
| 37. | | | |
| 38. | The unsupported length of a compression member, l_u , shall be taken as the clear distance between floor slabs, beams, or other members capable of providing lateral support in the direction being considered. | 10.10.1.1 | |
| 39. | In nonsway frames it shall be permitted to ignore slenderness effects for compression members when Kl_u/r is less or equal to 34-12(M1/M2). The term M1/M2 is positive if the member is bent in single curvature, and negative if the member is bent in double curvature. | ACI 318 10.10.1 | |
| 40. | Radius of gyration, r , shall be permitted to be 0.3 times the overall dimension in the direction stability is being considered for rectangular compression members and 0.25 times the diameter for circular compression members. | ACI 318 10.10.1.2 | |
| 41. | Reinforcement for shrinkage and temperature stresses normal to flexural reinforcement shall be provided in structural slabs where the flexural reinforcement extends in one direction only. For slabs where grade 40 and 60 deformed bars are used the minimum ratio of reinforcement area to gross concrete area shall be 0.002 and 0.0018 respectively. | ACI 318 7.12.2.1 | |
| 42. | At every section of a flexural member where tensile reinforcement is required by analysis, area of reinforcement shall not be less than 3 times square root of f'_c times b_w times d divided by f_y (equation 10-3) and not less than 200 times b_w times d divided by f_y . | ACI 318 10.5.1 | |
| 43. | Where h of a beam or joist exceeds 36", longitudinal skin reinforcement shall be uniformly distributed along both side faces of the member. | ACI 318 10.6.7 | |
| 44. | The spacing of lateral supports for a beam shall not exceed 50 times b , the least width of compression flange face. | ACI 318 10.4.1 | |

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| Code Requirements | | Code section | Req'd |
|--------------------------|---|-------------------------------|-------|
| 45. | A minimum area of shear reinforcement shall be provided in all reinforced concrete flexural members (prestressed and nonprestressed) where V_u exceeds 0.5 phi times V_c except slabs and footings, concrete joist construction and beam with h not greater than the largest of 10", 2.5 times thickness of flange, or 0.5 the width of web. | ACI 318 11.4.6.1 | |
| 46. | For design for horizontal shear forces in plane of wall, d shall be taken equal to 0.8 times wall length. | ACI 318 11.9.4 | |
| 47. | The ratio of horizontal shear reinforcement area to gross concrete area of vertical section in wall shall not be less than 0.0025. | ACI 318 11.9.9.2 | |
| 48. | The spacing of horizontal shear reinforcement in wall shall not exceed the smallest of $l_w/5$, $3h$ and 18", where l_w is the overall length of the wall. | ACI 318 11.9.9.3 | |
| 49. | Spacing of vertical shear reinforcement in wall shall not exceed the smallest of $l_w/3$, $3h$ and 18". | ACI 318 11.9.9.5 | |
| 50. | At least two curtains of reinforcement shall be used in a wall if V_u exceeds $2A_{cv}\lambda$ times the square root of f'_c . | ACI 318 21.9.2.2 | |
| 51. | Walls more than 10" thick, except basement walls, shall have reinforcement in each direction placed in 2 layers parallel with faces of wall. | ACI 318 14.3.4 | |
| 52. | Lateral ties for the vertical reinforcement in wall shall be required when the vertical reinforcement area is greater 0.01 times gross concrete area. | ACI 318 14.3.6 | |
| 53. | Not less than 2 No. 5 bars in walls having two layers of reinforcement in both directions and one No 5 bar in walls having a single layer of reinforcement in both directions shall be provided around all window and door openings. Such bars shall be anchored to develop f_y in tension at the corners of the openings. | ACI 318 14.3.7 | |
| C. LATERAL SYSTEM | | | |
| 54. | Buildings, structures and parts thereof shall be designed to withstand the minimum wind loads. Wind loads shall be determined in accordance with chapter 6 of ASCE 7. | 1609 | |
| 55. | Every structure and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motion in accordance with ASCE 7. | 1613 | |
| 56. | When the soil properties are not known in sufficient detail to determine the site class, site class D shall be used. | 1613.3.2, ASCE 7 11.4.2 | |
| 57. | The effective seismic weight of a structure shall include the total dead load, 25% of the floor live load in storage areas, the actual partition weight or a minimum of 10 psf of floor area whichever is greater when provision for partitions is required by ASCE 7 sec. 4.3.2 and total operating weight of permanent equipment per ASCE 7 sec. 12.7.2. | ASCE 7 12.7.2 | |
| 58. | The basic lateral and vertical seismic force-resisting system shall conform to one of the types as indicated in ASCE 7 Table 12.2-1. The structural system used shall be in accordance with the seismic design category and height limitations indicated in ASCE 7 Table 12.2-1. The appropriate response modification coefficient, R , system overstrength factor, ω , and deflection amplification factor, C_d , indicated in ASCE 7 Table 12.2-1 shall be used in determining the base shear, element design forces and design story drift. | | |
| 59. | Structures that have horizontal structural irregularity type 1a, 1b, 4 or 5 of Table 12.3-1 in ASCE 7 shall be analyzed using a 3-D representation. | ASCE 7 12.7.3 | |
| 60. | All structures shall be separated from adjoining structures. Separation shall allow for the maximum inelastic response displacement. Adjacent buildings on the same property shall be separated by at least a distance specified in 12.12.3 of ASCE 7 | ASCE 7 12.12.3 | |
| 61. | The design story drift shall be determined per ASCE 7 sections 12.12 and shall not exceed the allowable story drift as obtained from Table 12.12-1 of ASCE 7. | | |
| 62. | Indicate type of shear walls and their minimum length on plans to match the design calculations. | | |
| 63. | Indicate the type/size and locations of hold-down on plans. | | |

**STRUCTURAL PLAN REVIEW CHECKLIST
SHELL BUILDING (CONCRETE)(Cont'd)**

| Code Requirements | | Code section | Req'd |
|-------------------|--|-----------------------|-------|
| 64. | When using alternative basic load combinations in allowable stress design that includes wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. | 1605.3.2 | |
| 65. | | | |
| 66. | R, Cd, and Ω values for vertical combinations: The value of the response modification coefficient, R, used for design at any story shall not exceed the lowest value of R that is used in the same direction at any story above that story. The deflection amplification factor, Cd, and the system over strength factor, Ω , used for the design at any story shall not be less than the largest value of this factor that is used in the same direction at any story above that story, except for rooftop structures not exceeding two stories in height and 10% of the total structure weight, other supported structural systems with a weight equal to or less 10% of the weight of the structure and detached one- and two family dwellings of light-frame construction. | ASCE 7 12.2.3.1 | |
| 67. | Redundancy factor for structures assigned to seismic design category D through F shall equal to 1.3 unless one of the two conditions in sec. 12.3.4.2 of ASCE 7 are met, whereby the redundancy factor is permitted to be taken as 1.0. | | |
| 68. | Columns, beams, trusses, or slabs supporting discontinuous walls or frames of structures having horizontal irregularity type 4 as per ASCE 7 Table 12.3-1 or vertical irregularity type 4 as per ASCE 7 Table 12.3-2 shall be designed to resist the seismic load effects including overstrength factor of section 12.4.3. | ASCE 7 12.3.3.3 | |
| 69. | Where allowable stress design is used for load combinations with over strength factor, allowable stresses are permitted to be determined using allowable stress increase of 1.2. This increase shall not be combined with increases in allowable stresses or load combination reductions otherwise permitted by this standard or the material reference. | ASCE 7 12.4.3.3 | |
| 70. | In structures assigned to seismic design category C, D, E or F, collector elements, splices, and their connections to resisting elements shall resist the load combinations with overstrength factor of section 12.4.3 except in structures or portions thereof braced entirely by light-frame shear walls. | ASCE 7 12.10.2.1 | |
| 71. | Structural walls and their anchorage shall be designed for a force normal to the surface equal to 0.4Sds times the weight of the structural wall with a minimum force of 10% of the weight of the structural wall. | ASCE 7 12.11.1 | |
| 72. | The anchorage of concrete or masonry structural walls to supporting construction shall provide a direct connection capable of resisting the force per 12.11.2.1 | ASCE 7 12.11.2 | |
| 73. | Diaphragm shall be provided with continuous ties or struts between diaphragm chords to distribute these anchorage forces into the diaphragm. Added chords are permitted to be used to form sub-diaphragm to transmit the anchorage forces to the main continuous cross-ties. The maximum length-to-width ratio of the structural sub-diaphragm shall be 2.5 to 1. | ASCE 7 12.11.2.2.1 | |
| 74. | The strength design forces for steel elements of the structural wall anchorage system, with the exception of anchor bolts and reinforcing steel, shall be increased by 1.4 times the forces otherwise required. | ASCE 7 12.11.2.2.2 | |
| 75. | In wood diaphragms, the continuous ties shall be in addition to the diaphragm sheathing. Anchorage shall not be accomplished by use of toe nails or nails subject to withdrawal nor shall wood ledgers or framing be used in cross-grain bending or cross-gain tension. | ASCE 7 12.11.2.2.3 | |
| 76. | In metal deck diaphragms, the metal deck shall not be used as the continuous ties required in the direction perpendicular to the deck span. | ASCE 7 12.11.2.2.4 | |
| 77. | Diaphragm to structural wall anchorage using embedded straps shall be attached to or hooked around the reinforcing steel or otherwise terminated so as to effectively transfer forces to the reinforcing steel. | ASCE 7 12.11.2.2.5 | |

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SHELL BUILDING (CONCRETE)(Cont'd)**

| Code Requirements | | Code section | Req'd |
|----------------------|---|--|-------|
| 78. | Any smaller portion of the structure shall be tied to the remainder of the structure with elements having a design strength capable of transmitting a seismic force of 0.133 times Sds, times the weight of the smaller portion or 5 percent of the portion's weight, whichever is greater. | ASCE 7 12.1.3 | |
| 79. | In structures assigned to seismic design category D, E & F, horizontal cantilever structural components shall be designed for a minimum net upward force of 0.2 times the dead load in addition to applicable load combinations of ASCE 7 section 12.4. | ASCE 7 12.4.4 | |
| D. FOUNDATION | | | |
| 80. | Soil investigation is required for foundation design. | 1802 | |
| 81. | Pier and pile foundations shall be designed and installed on the basis of a foundation investigation unless sufficient data upon which to base the design and installation is available. | | |
| 82. | Longitudinal reinforcement of columns and structural walls resisting forces induced by earthquake effects shall extend into the footing, mat or pile cap, and shall be fully developed for tension at the interface. | ACI 318 21.12.2.1 | |
| 83. | Columns or boundary elements of special reinforced concrete structural walls that have an edge within one-half the footing depth from an edge of the footing shall have transverse reinforcement in accordance with ACI 318 sec. 21.6.4.2 through 21.6.4.4 provided below the top of the footing. This reinforcement shall extend into the footing a distance no less than the smaller of the depth of the footing, mat, or pile cap, or the development length in tension of the longitudinal reinforcement. | ACI 318 21.12.2.3 | |
| 84. | Where earthquake effects create uplift forces in boundary elements of special reinforced concrete structural walls or columns, flexural reinforcement shall be provided in the top of the footing, mat, or pile cap to resist the design load combinations, and shall not be less than required by ACI 318 sec. 10.5. | ACI 318 21.12.2.4 | |
| 85. | Grade beams designed to act as horizontal ties between pile caps or footings shall be proportioned such that the smallest cross sectional dimension shall be equal to or greater than the clear spacing between connected columns divided by 20, but need not be greater than 18" and reinforced with continuous longitudinal bars that shall be developed within or beyond the supported column or anchored within pile cap or footing at all discontinuities and with closed ties at a spacing not to exceed the lesser of one-half the smallest orthogonal cross sectional dimension or 12". | ACI 318 21.12.3.1 & 21.12.3.2 | |
| 86. | Individual pile caps, piers or piles shall be interconnected by ties. Ties shall be capable of carrying, in tension and compression, a force equal to the product of the larger pile cap or column load times the seismic coefficient, Sds divided by 10 and 25% of the smaller pile or column design gravity load. The pier, pile, pile cap & tie beam shall have a minimum compressive strength of 3000 psi at 28 days. | 1810.3.13 & 1808.8.1 | |
| 87. | The concrete for precast nonprestressed piles shall have a 28-day specified compressive strength, f'c, of not less than 4,000 psi per Table 1808.8.1 | 1808.8.1 | |
| 88. | The minimum amount of longitudinal reinforcement shall be 0.5% of the concrete section and shall consist of at least 4 bars for cast-in-place concrete | 1810.3.9. 4.2 | |
| 89. | Concrete for precast prestressed piles shall have a 28-day specified compressive strength, f'c, of not less than 5,000 psi per Table 1808.8.1 | 1808.8.1 | |
| 90. | Concrete for cast-in-place concrete pile foundation shall have a 28-day specified compressive strength of not less than 3000 psi per Table 1808.8.1 | 1808.8.1 | |
| 91. | Reinforcement where required in cast-in-place concrete pile shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete except in augered uncased cast-in-place piles where the tied reinforcement shall be placed after piles are concreted, while the concrete is still in a semifluid state. | 1810.3.9. 3 | |

**STRUCTURAL PLAN REVIEW CHECKLIST
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| Code Requirements | | Code section | Req'd |
|--------------------------|---|--------------------------------------|--------------|
| 92. | The allowable design stresses of materials used in deep foundation shall be per Table 1810.3.2.6. Uncased cast-in-place deep foundation elements shall have a minimum diameter 12" and the length shall not exceed 30 times the average diameter. | 1810.3.2. 6 & 1810.3.5. 2.2 | |