



**COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
BUILDING AND SAFETY DIVISION**

**RETAINING WALL
PLAN REVIEW LIST**

GENERAL PROJECT INFORMATION

PLAN CHECK NO. _____ DISTRICT NO _____
JOB ADDRESS _____ CITY _____ ZIP _____

NOTE: Numbers in the parenthesis () refer to sections of the 2017 edition of the Los Angeles County Building Code (LACBC), Table (T), Building Code Manual (BCM), Residential Code Manual (RCM), 2010 Minimum Design Loads for Buildings and Other Structures (3rd Printing) including Supplement No.1 (ASCE7), 2015 Special Design Provisions for Wind and Seismic (SDPWS), 2013 Building Code Requirements and Specification for Masonry Structures TMS 402-13/ACI 530-13 & TMS 602-13/ ACI 530.1-13, 2014 Building Code Requirements for Structural Concrete (ACI 318-14)

INSTRUCTIONS

- Corrections with circled item numbers apply to this plan check.
- In the left-hand margin of the circled corrections, please indicate the sheet number and detail or note number on the plans where the corrections are made. Resubmit marked original plans and two corrected sets of plans, calculations and this plan review list.
- Incomplete, unclear, or faded drawings or calculations will not be accepted.
- Incorporate all comments as marked on checked set of plans and calculations and these correction sheets.

STRUCTURAL CALCULATION

APPLICATION AND PERMITS

1. Valuation is low. It should be \$ _____. Correct the application and pay a supplemental plan check fee of \$ _____ at the time resubmittal. (107.2)
2. Complete the permit application form to show the legal description, street address, owner, designer, _____.
3. A separate permit is required for each retaining wall. (106.1)
4. A Certificate of Workers' Compensation Insurance must be presented to Building and Safety before a permit can be issued.

REFERRALS

5. See Agency Referral sheet for additional requirements. Obtain all agency approvals prior to permit issuance.
6. Refer to the attached Building Code Manual (BCM) or Residential Code Manual (RCM) for additional information and policy on retaining wall design:
 - a. BCM 1807.2 Article 1
 - b. RCM R404.4 Article 1
7. The following information or documents shall be submitted for review and approval:
 - a. Soils Report
 - b. Geology Report

- c. Structural Calculations
8. Obtain clearance from the Geotechnical and Materials Engineering Division (GMED) for review of the soils report prior to final plan approvals. All notes, corrections, or revisions from GMED review shall be incorporated on the final building plans. (See Agency Referral sheet).
 9. A grading permit is required in accordance with Appendix J103.
 10. Rough grading approval is required before a building permit can be issued.
 11. Parcel/Tract Map _____ must be recorded before a permit can be issued. Submit a copy of the recorded map.

SITE REQUIREMENTS

12. Show the building or structure setback from the top or bottom of the slope. Building/structure located at the top or bottom of the slope shall be set back _____ feet from the retaining wall. Edge of retaining wall footing at the top of the slope, shall be setback _____ feet from face of descending slope. (1808.7)
13. The maximum slope of cuts and fills is two horizontal to one vertical for buildings, structures, foundations, and retaining walls, unless justified by a soils report. (J107.6)

PLAN REQUIREMENTS

14. The address of the site, the name of the legal owner(s), and the name address of the person(s) preparing the plans are required on the first sheet of the plans. (106.4.3)
 15. A complete plot plan showing:
Lot dimensions/ yard setbacks/ street name(s)/ north arrow/ existing building to remain/ distance between buildings/ location of private sewage disposal system including expansion areas/ utilities/ easements/ _____ is required. (106.4.3)
 16. Provide contours and/or elevations to define existing and proposed drainage patterns. Provide details of proposed drainage devices for contributory surface drainage including inlets, weep holes, and outlet details. Hydrology and hydraulic analysis (as applicable) is required for sizing of necessary drainage devices.
 17. Show all detail and section references at their appropriate location on the plan views.
 18. Provide an elevation profile showing the various wall heights and lengths or clearly show on the plot plan where each wall of each height is to be built.
 19. Clearly show the location of the property line on the wall cross section. Neither the footing nor the drainage system for the wall is permitted to lie on adjacent property without written permission of the property owner.
 20. Each sheet of the plans must bear the signature, registration number, and expiration date of an Architect or Engineer registered in the State of California.
 21. The geotechnical engineer of record shall review, stamp, and sign the foundation plans and details for final approval when a soils investigation and report is required or provided.
 22. Note on the plan: "The soils or geotechnical engineer shall inspect and approve the foundation excavations prior to requesting Building and Safety foundation inspection".
- GENERAL DESIGN REQUIREMENTS**
23. Specify on the plans the design compressive strength of concrete and masonry units, mixes and types of mortar and grout, yield strength of steel reinforcement and ASTM designations, and design soil pressure. Reference any soils report used or provided. (106.4.3)
 24. Hydrostatic pressure shall be included in the design unless subsurface water is properly diverted away from the wall. Subsurface water will need to be diverted to an adequate outlet. (106.4.3)
 25. Special inspection for masonry is required as specified by Chapter 17 and TMS 402/ACI 530, Code Section 3.1, and TMS 602/ACI 530.1 Specification Section 1.6 – Quality Assurance Program.
 26. Specify the compressive strength of the masonry by either the Unit strength method or the Prism test method in accordance with TMS 602/ACI 530.1, Article 1.4B.
 27. Specify on the cross section the design dimensions of wall, footing, keyway, reinforcing steel size and spacing, location of steel and clear cover, and _____ . For masonry wall, indicate on the cross section if the wall is either fully or partially grouted.
 28. Provide detail and spacing of construction/contraction joints and specify filler material.
 29. Per soils report, provide _____ feet of freeboard and/or swale behind the retaining wall.
 30. Retaining walls that are unrestrained and free to move at the top shall be permitted to be designed for active pressure. (1610.1)
 31. Foundation walls or basement walls where the top is restrained against horizontal movement shall be designed for at-rest pressure, except where walls that do not extend more than 8 feet below grade and are laterally supported at the top by flexible diaphragms shall be permitted to be designed for active pressure. (1610.1)
 32. Note on the plans: The use of expansive soils as backfill materials behind the retaining walls or basement walls shall not be permitted. (T1610.1, Footnote b)
 33. Provide calculations and analyses for the following:
 - a. Calculate all applied load demands on the walls and footings, including lateral soil pressures, surcharges, and seismic pressures (for retained backfill height greater than 6 feet).
 - b. Design the stem wall and determine the required thickness, principal flexural reinforcements, dowel lengths.
 - c. Calculate the overturning moment and resisting moment.
 - d. Determine the factor of safety for overturning and sliding.
 - e. Calculate the factored soil pressures under the footing at the toe and heel.
 - f. Determine the eccentricity (e) of the resultant of all applied loads about the midpoint of the footing. Eccentricity must be within the middle third of the footing with $e \leq L/6$, where L = width of footing.
 - g. Design the footing for flexure and shear, and determine the required flexural reinforcements, dowels, etc.
 34. Where a soil investigation report is not provided, the minimum equivalent fluid pressure values for active and at-rest lateral pressures shall conform to the prescriptive requirements of BCM 1807.2 Article 1, or RCM R404.4 Article 1, with applicable design restrictions and height limitations as indicated therein.

35. Where design does not conform to the prescriptive requirements of BCM 1807.2 Article 1, or RCM R404.4 Article 1, a soils report must be provided.
36. Where a soils report is required, in addition to the lateral earth pressures and surcharges, it must also address seismic lateral earth pressures on walls with retained backfill height greater than 6 feet, specify the seismic design parameters, and provide recommendations for earthquake load computations and structural design. (1803.5.12)

LOADS AND SURCHARGES

37. For retaining walls and basement walls supporting a retained backfill height greater than 6 feet, structural calculations and analysis shall include seismic forces on the walls in addition to other lateral and vertical loads. (1803.5.12)
38. Retaining walls, basement walls, and footings shall be designed using the appropriate governing load combinations that will provide the most critical load effects in accordance with Building Code Section 1605.
39. The slope backfill as shown on Sheet _____ creates an additional surcharge on the wall. Use an equivalent fluid soil pressure of _____ pcf instead of _____ pcf used in the calculations.
40. A concentrated or uniform load adjacent to the wall causes a surcharge. Design lateral pressure from the surcharge load shall be added to the lateral earth pressure load. The structure or load shown on Sheet _____ creates an additional surcharge on the retaining wall. Revise the calculations and design on the plans as needed. (1610.1)

MASONRY STEM WALL

41. The design of masonry structures using allowable stress design (ASD) shall comply with Sections 2106 and 2107.1.
42. The design of masonry structures using strength design (SD) shall comply with Sections 2106 and 2108.1.
43. Show the minimum lap length for straight reinforcing bars in tension or compression extending from the top of footing into the CMU stem wall. Minimum lap length shall be the development length l_d but not less than 12 inches, per TMS 402/ACI 530 Section 8.1.6.3, 8.1.6.7.1.1 (ASD) or 9.3.3.3, 9.3.3.4 (SD).
(TMS 402 Sections 8.1.6.7.1.1 or 9.3.3.4)
44. When design is based on ASD, alternative minimum lap length per the Building Code may be used. The minimum length of lap splices for straight reinforcing bars in tension or compression shall be $l_d = 0.002d_b f_s$ but not less than 12". In no case shall the length of the lapped splice be less than 40 bar diameters. When epoxy coated bars are used, lap length shall be increased by 50 percent. (2107.2.1)

45. In regions of moment where the design tensile stresses in the reinforcement f_s are more than 80 percent of the allowable steel tension stress, F_s , the lap length of splices shall be increased by 50 percent of the minimum required length. (2107.2.1)
46. The bar diameter shall not exceed one-eighth of the nominal wall thickness and shall not exceed one-quarter of the least dimension of the cell, course, or collar joint in which it is placed. (2107.4)
47. If fence wall is located at top of the retaining wall, justify by calculations the effect of the wind load to the fence and retaining wall.
48. Minimum masonry wall cover is ≥ 2 inches for bars larger than #5, and ≥ 1.5 inches for #5 bars or smaller. Show minimum clear covers (measured from the exterior surface of masonry wall to the outermost surface of the reinforcement) on the wall sections and details. (TMS 402 Section 6.1.4)
49. Minimum horizontal reinforcement in the masonry stem wall shall be No. 4 bar, with spacing not more than 48 inches on center. (TMS 402/ACI 530 Section 7.4.4.1)
50. Minimum vertical reinforcement in the masonry stem wall shall be No. 4 bar, with spacing not more than 48 inches on center. (TMS 402/ACI 530 Section 7.4.4.1)
51. Vertical reinforcement shall be located within 16 inches of the ends of masonry walls. (TMS 402/ACI 530 Section 7.4.4.1)
52. For masonry basement wall or foundation wall subjected to combined flexure and axial compression, show calculations and check the adequacy of the masonry stem wall for combined stresses. The allowable compressive stress due to axial load (F_a) or nominal axial strength (P_n) shall be determined for unreinforced masonry without the contribution of longitudinal steel. (TMS 402/ACI 530 Sections 8.2.4 and 8.3.4, or 9.2.4)
53. For ASD, the calculated compressive stress in masonry due to flexure (f_b) or due to flexure in combination with axial load ($f_a \pm f_b$) shall not exceed the allowable compressive stress (F_b), that is $f_a \pm f_b \leq F_b$, where $F_b \leq 0.45f'_m$. The calculated compressive stress due to axial load (f_a) shall not exceed the allowable axial compressive stress (F_a) in accordance with TMS 402/ACI 530 Section 8.2.4.1. (TMS 402/ACI 530 Section 8.3.4.2.2)

CONCRETE STEM WALL

54. Design of concrete cantilever retaining walls shall be in accordance with ACI 318 Section 22.2 through 22.4.
(ACI 11.1.4)
55. Minimum horizontal reinforcement in cast-in-place stem wall shall be in accordance with ACI 318 Table 11.6.1. Maximum spacing shall be the lesser of 3h or 18 inches, where h = wall thickness. Show horizontal reinforcement in the stem wall on the sections and/or details. (ACI 11.1.4 and 11.7.2.1)

56. Maximum spacing of the required vertical flexural reinforcement in cast-in-place stem wall shall be the lesser of $3h$ or 18 inches, where h = wall thickness.
(ACI 11.7.3.1)
57. Minimum shrinkage and temperature reinforcement in concrete walls shall comply with ACI 318 Section 24.4.3.2. Maximum spacing shall be the lesser of $5h$ or 18 inches, where h = wall thickness. (ACI 24.4.3.3)
58. Clearly show the minimum concrete covers on the sections and/or details. For formed cast in place concrete exposed to earth or weather, concrete cover $c_c \geq 2$ inches for #6 bars or larger, and $c_c \geq 1.5$ inches for #5 bars or smaller. For concrete cast against and permanently exposed to earth (i.e. footing), cover $c_c \geq 3$ inches. (ACI 20.6.1.3.1)
59. For connections between a cast-in-place wall and foundation, minimum area of vertical reinforcement crossing the interface shall satisfy ACI 318 Section 11.6.1. (ACI 16.3.4.2)
60. Show calculations and determine the development length l_d of straight bars in tension, where minimum $l_d \geq 12$ inches. (ACI 25.4.2.1)
61. Specify the minimum lap length of reinforcement where splices are used. Provide Class B lap splice length $l_{st} \geq 1.3l_d$ but not less than 12 inches for deformed bars in tension. Show on the cross sections and/or provide a lap splice schedule. (ACI 25.5.2.1)
62. Specify the length of flexural dowel bars in tension extending from the top of footing into the stem wall. Minimum dowel length shall be the required Class B lap splice length $l_{st} \geq 1.3l_d$ for continuous bars in tension. (ACI 25.5.2.1)
63. Where bars of different size are lap spliced in tension, the tension lap splice length l_{st} shall be the greater of the following: (ACI 25.5.2.2)
- Development length l_d of the larger bar.
 - Tension Lap splice length l_{st} of the smaller bar.
64. Concrete wall shall not be backfilled and compacted until the minimum compressive design strength has been attained. Provide note on the plans.
68. Where a keyway is provided below the footing base to resist sliding, lateral soil pressures on both sides of the keyway shall be considered in the sliding analysis. (1807.2.1)
69. Minimum flexural reinforcement required in footings shall comply with ACI 318 Sec. 7.6.1.1. Maximum spacing of reinforcement shall be the lesser of $3h$ or 18 inches, where h = overall footing depth.
(ACI 13.3.2.1 and 7.7.2.3)
70. Provide calculations and design the required flexural reinforcements for the toe and/or heel portions of the footing.
71. Minimum shrinkage and temperature reinforcement in footings shall comply with ACI 318 Table 7.6.1.1. Maximum spacing shall be the lesser of $5h$ or 18 inches, where h = overall footing depth. (ACI 13.3.2.1 and 7.7.6.2.1)
72. Development of reinforcement in footings shall be in accordance with ACI 318 Chapter 25. (ACI 13.2.8.1)
73. Check the embedment of required flexural reinforcement into the footing. Show calculations and determine the development length. (ACI 25.4)

TORSION BEAMS AND PILE CAPS

74. The concrete grade beam supporting the retaining wall is subjected to combined torsion and biaxial bending. Provide a structural analysis and design of the beam to verify the adequacy of the stirrups, longitudinal steel, and concrete stresses. (ACI 22.7 and 22.3)
75. Provide connection details that transfer lateral forces from the wall through the grade beam or pile cap to the pile foundations.
76. Specify the concrete compressive strength f'_c for the stem wall, grade beam, pile cap, or deep foundations on the plans.
77. Design of pile caps (footings over piles) shall be in accordance with ACI 318 Section 13.4.2. Provide calculations for the following:
- Determine pile reactions of the individual piles.
 - Determine the required pile cap thickness. Check one-way and two-way shear requirements at the critical sections in the pile cap.
 - Determine the required flexural reinforcements at the critical sections, including required development lengths of straight bars and hooked bars in tension.
 - Check transfer of forces between the stem wall and the pile cap.
78. Provide plan layout of the pile cap and pile group. Show plan dimensions of pile cap length and width, pile dimension, pile spacing, and stem wall location.
79. Show the pile cap cross section and specify the following:

WALL FOOTINGS

65. The soil bearing pressure used in the structural calculations exceeds the maximum code allowable of 1500 psf without a soils report. Provide a soils report to substantiate the design load or redesign using 1500 psf. (T-1806.2)
66. Clearly show by calculations that the minimum factor of safety (FS) against sliding and overturning is 1.5. Where seismic loads are included, minimum $FS \geq 1.1$ for both sliding and overturning. (1807.2.3)
67. The combined formula used to determine the soil bearing pressure ($P/A \pm M/S$) is not appropriate when the least pressure is negative and where the eccentricity $e > L/6$, with L = width of footing. This means that the soil is not in contact with the base of the retaining wall. Submit revised design and calculations, and show that $e \leq L/6$.

