PRACTICE EXAM 16: CALIFORNIA SEISMIC PRINCIPLES (100 QUESTIONS)

This practice examination contains 100 multiple-choice questions. Allow 2.5 hours for a timed simulation. Select the single best answer for each question. The 2026 study basis used for this practice set is the 2022 California Building Code and ASCE/SEI 7-16. This is independent study material, not an official BPELSG examination.

1. A site has mapped short-period spectral acceleration Ss = 1.20 g and site coefficient Fa = 1.10. Using SMS = FaSs and SDS = (2/3)SMS, what is SDS?

A. 0.73 g
B. 1.10 g
C. 1.32 g
D. 0.88 g

2. For a preliminary comparison, Site A has SDS = 0.55 g and Site B has SDS = 0.82 g. If all other building characteristics are unchanged and base shear is proportional to SDS, what is the ratio VB/VA?

A. 0.67
B. 1.49
C. 1.27
D. 1.82

3. A geotechnical boring log reports several soil profiles. Which profile should trigger the strongest liquefaction screening concern under strong cyclic shaking?

A. Loose saturated granular soil with a shallow groundwater table
B. Dense dry gravel above deep groundwater
C. Competent rock with little weathering

D. Stiff unsaturated clay on a slope

4. A project team changes a building from an ordinary office occupancy to a facility whose post-earthquake operation is essential. Which seismic-design input is most directly affected by that occupancy change?

A. Mapped fault location at the site
B. Site-class soil profile definition
C. Risk category and the associated importance treatment
D. Fundamental period equation exponent

5. Using SMS = FaSs, what value of Fa is implied by SMS = 1.44 g and Ss = 1.20 g?

A. 1.20
B. 0.83
C. 1.44
D. 1.73

6. Why is site class established before finalizing design spectral response parameters?

A. Because site class directly selects the structural material
B. Because soil stiffness modifies the mapped ground-motion values used for design
C. Because site class fixes the building's occupancy group
D. Because site class replaces the need for seismic mass

7. The one-second site-modified spectrum ordinate is being computed from Fv = 1.60 and S1 = 0.50 g. Using SM1 = FvS1, select the resulting value.

A. 0.31 g
B. 1.10 g
C. 2.10 g

D. 0.80 g

8. Which information belongs most appropriately on construction documents as seismic design data?

A. Only the architect's room-finish schedule
B. Only the contractor's concrete delivery tickets
C. Design spectral parameters, seismic design category, and selected force-resisting system
D. Only the owner's equipment maintenance log

9. Two lateral systems carry the same design story shear. System X has lateral stiffness 900 kip/in and System Y has 600 kip/in. Assuming elastic response, what is the ratio of drift in Y to drift in X?

A. 0.67
B. 1.20
C. 1.50
D. 1.80

10. Which condition is most characteristic of a soft-story vertical irregularity?

A. One story has substantially lower lateral stiffness than adjacent stories
B. The roof diaphragm has a rectangular plan
C. Column sizes repeat uniformly over height
D. The center of mass lies near the plan center

11. A story shear is 720 kips and the elastic story stiffness is 240 kip/in. What is the elastic story drift before any amplification factor is applied?

A. 0.33 in.
B. 1.50 in.
C. 6.00 in.
D. 3.00 in.

12. What is the principal seismic concern created by a large offset between the center of mass and center of rigidity?

A. Uniform reduction of all story shears
B. Torsional response that increases demand on some vertical resisting elements
C. Elimination of diaphragm in-plane forces
D. Automatic increase in foundation bearing capacity

13. A building requires 3.0 inches of calculated seismic movement toward an adjacent structure, while the neighbor can move 2.0 inches toward it. Using the conservative sum-of-movements approach, what minimum clear separation is required?

A. 1.0 in.
B. 5.0 in.
C. 2.5 in.
D. 6.0 in.

14. Why can P-Delta effects become important in a flexible multistory building?

A. Gravity loads cancel all lateral story shear
B. Lateral displacement removes axial load from columns
C. Flexibility prevents any second-order response
D. Gravity loads acting through lateral displacement create additional overturning effects

15. A dual lateral system has two components with elastic story stiffnesses of 500 kip/in and 300 kip/in acting in parallel. What is their combined elastic story stiffness?

A. 187.5 kip/in
B. 500 kip/in
C. 800 kip/in

D. 1,500 kip/in

16. What structural attribute most directly improves the ability of a seismic force-resisting system to undergo repeated inelastic deformation without sudden loss of strength?

A. Ductility
B. Mass concentration
C. Plan eccentricity
D. Brittle connection strength

17. In an older unreinforced masonry bearing-wall building, which deficiency most directly threatens out-of-plane wall stability during earthquake shaking?

A. Excessive interior paint thickness
B. Uniform ceiling tile spacing
C. Missing positive anchorage between masonry wall and diaphragm
D. Oversized plumbing cleanouts

18. A tilt-up building retrofit adds positive roof-to-wall anchors at exterior panels. Which failure mechanism is the retrofit primarily intended to reduce?

A. Out-of-plane wall separation from the roof diaphragm
B. Uniform shortening of interior columns
C. Soil liquefaction below the entire site
D. Yielding of all roof joists in flexure

19. After an earthquake, a concrete flat-plate building shows severe punching distress around several slab-column connections. Why is this finding especially significant?

A. It proves the foundation soil has liquefied
B. It automatically increases slab ductility

C. It shows the roof diaphragm is perfectly rigid
D. Loss of punching capacity can compromise gravity-load support at the column connection

20. Which retrofit most directly addresses a discontinuous diaphragm load path in an existing building?

A. Increase nonstructural ceiling weight
B. Strengthen collectors and connections into the lateral system
C. Remove accessible inspection openings
D. Reduce the number of wall anchors

21. An existing steel braced frame contains slender braces that buckle early and lose cyclic strength. Which retrofit objective is most appropriate?

A. Increase floor mass without changing the braces
B. Improve brace and connection ductility while controlling the intended inelastic mechanism
C. Create a larger accidental torsional eccentricity
D. Eliminate all connection inspection

22. During a rapid post-earthquake safety evaluation, which observation most strongly supports restricting occupancy pending detailed evaluation?

A. A few ceiling tiles have shifted
B. Several desk drawers are open
C. Minor cosmetic paint cracking appears
D. Major damage to a primary lateral-force-resisting element

23. For this exercise use Cs = SDS/(R/Ie) and V = CsW. If SDS = 0.78, R = 8.0, Ie = 1.00, and W = 2,200 kips, what is the seismic base shear V?

A. 214.5 kips
B. 160.9 kips

C. 268.1 kips
D. 1,716.0 kips

24. For this exercise use Cs = SDS/(R/Ie) and V = CsW. If SDS = 0.64, R = 6.5, Ie = 1.00, and W = 3,100 kips, what is the seismic base shear V?

A. 228.9 kips
B. 381.5 kips
C. 305.2 kips
D. 1,984.0 kips

25. For this exercise use Cs = SDS/(R/Ie) and V = CsW. If SDS = 0.92, R = 7.0, Ie = 1.25, and W = 1,800 kips, what is the seismic base shear V?

A. 295.7 kips
B. 221.8 kips
C. 369.6 kips
D. 1,656.0 kips

26. For this exercise use Cs = SDS/(R/Ie) and V = CsW. If SDS = 0.70, R = 5.5, Ie = 1.00, and W = 2,650 kips, what is the seismic base shear V?

A. 253.0 kips
B. 421.6 kips
C. 337.3 kips
D. 1,855.0 kips

27. Use the approximate-period expression Ta = Ct h^x. For Ct = 0.03, h = 55 ft, and x = 0.75, what is Ta?

A. 0.43 sec

B. 0.61 sec
C. 0.79 sec
D. 1.11 sec

28. Use the approximate-period expression Ta = Ct h^x. For Ct = 0.028, h = 72 ft, and x = 0.80, what is Ta?

A. 0.60 sec
B. 1.12 sec
C. 1.36 sec
D. 0.86 sec

29. Use the approximate-period expression Ta = Ct h^x. For Ct = 0.02, h = 90 ft, and x = 0.75, what is Ta?

A. 0.41 sec
B. 0.75 sec
C. 0.58 sec
D. 1.08 sec

30. Use the approximate-period expression Ta = Ct h^x. For Ct = 0.035, h = 48 ft, and x = 0.70, what is Ta?

A. 0.37 sec
B. 0.69 sec
C. 1.03 sec
D. 0.53 sec

31. A three-level building uses Cvx = wx hx / Σ(wi hi), with k = 1. Level weights are 400, 400, and 400 kips at heights 12, 24, and 36 ft. What fraction of base shear is assigned to the roof level?

A. 0.500
B. 0.380
C. 0.600
D. 0.333

32. A three-level building uses Cvx = wx hx / Σ(wi hi), with k = 1. Level weights are 300, 450, and 600 kips at heights 15, 30, and 45 ft. What fraction of base shear is assigned to the middle level?

A. 0.180
B. 0.300
C. 0.400
D. 0.333

33. A three-level building uses Cvx = wx hx / Σ(wi hi), with k = 1. Level weights are 500, 450, and 350 kips at heights 14, 28, and 42 ft. What fraction of base shear is assigned to the lowest level?

A. 0.204
B. 0.084
C. 0.304
D. 0.333

34. A three-level building uses Cvx = wx hx / Σ(wi hi), with k = 1. Level weights are 250, 350, and 450 kips at heights 10, 20, and 30 ft. What fraction of base shear is assigned to the roof level?

A. 0.467
B. 0.687
C. 0.333
D. 0.587

35. A three-level building uses Cvx = wx hx / Σ(wi hi), with k = 1. Level weights are 600, 500, and 400 kips at heights 13, 26, and 39 ft. What fraction of base shear is assigned to the middle level?

A. 0.237
B. 0.457
C. 0.357
D. 0.333

36. For this practice problem, a diaphragm design force is specified as Fpx = 0.65Fx. If the story force Fx = 420 kips, what diaphragm force is required?

A. 147.0 kips
B. 273.0 kips
C. 341.2 kips
D. 420.0 kips

37. For this practice problem, a diaphragm design force is specified as Fpx = 0.75Fx. If the story force Fx = 360 kips, what diaphragm force is required?

A. 90.0 kips
B. 337.5 kips
C. 270.0 kips
D. 360.0 kips

38. For this practice problem, a diaphragm design force is specified as Fpx = 0.60Fx. If the story force Fx = 510 kips, what diaphragm force is required?

A. 204.0 kips
B. 306.0 kips
C. 382.5 kips
D. 510.0 kips

39. For this practice problem, a diaphragm design force is specified as Fpx = 0.80Fx. If the story force Fx = 290 kips, what diaphragm force is required?

A. 232.0 kips
B. 58.0 kips
C. 290.0 kips
D. 348.0 kips

40. An exterior wall panel is designed for a uniform out-of-plane seismic pressure of 0.42 kip/ft² over a tributary panel 24 ft wide by 14 ft high. What resultant force acts on the panel?

A. 84.7 kips
B. 197.5 kips
C. 16.0 kips
D. 141.1 kips

41. An exterior wall panel is designed for a uniform out-of-plane seismic pressure of 0.36 kip/ft² over a tributary panel 30 ft wide by 12 ft high. What resultant force acts on the panel?

A. 77.8 kips
B. 181.4 kips
C. 15.1 kips
D. 129.6 kips

42. An exterior wall panel is designed for a uniform out-of-plane seismic pressure of 0.48 kip/ft² over a tributary panel 20 ft wide by 16 ft high. What resultant force acts on the panel?

A. 92.2 kips
B. 215.0 kips
C. 153.6 kips
D. 17.3 kips

43. An exterior wall panel is designed for a uniform out-of-plane seismic pressure of 0.40 kip/ft² over a tributary panel 28 ft wide by 15 ft high. What resultant force acts on the panel?

A. 168.0 kips
B. 100.8 kips
C. 235.2 kips
D. 17.2 kips

44. A wall-to-diaphragm anchorage line must transfer 144 kips through 12 equally loaded anchors. Neglecting eccentricity, what force is assigned to each anchor?

A. 6.0 kips
B. 12.0 kips
C. 18.0 kips
D. 14.4 kips

45. A wall-to-diaphragm anchorage line must transfer 195 kips through 15 equally loaded anchors. Neglecting eccentricity, what force is assigned to each anchor?

A. 6.5 kips
B. 19.5 kips
C. 13.0 kips
D. 15.0 kips

46. A wall-to-diaphragm anchorage line must transfer 168 kips through 14 equally loaded anchors. Neglecting eccentricity, what force is assigned to each anchor?

A. 12.0 kips
B. 6.0 kips
C. 18.0 kips
D. 14.0 kips

47. When seismic base shear is distributed vertically using a weight-height relationship, what generally causes an upper level to receive a larger fraction of the total?

A. Lower elevation with unchanged weight
B. Greater participating weight and/or greater elevation above the base
C. Smaller weight at the same elevation
D. Removal of the building's lateral system

48. Why must diaphragm forces be transferred through collectors or drag elements where the vertical lateral system is discontinuous in plan?

A. To increase architectural ceiling height
B. To eliminate all in-plane diaphragm stress
C. To prevent gravity loads from reaching columns
D. Provide a load path from diaphragm shear into resisting elements

49. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 1.0, SDS = 0.75, Wp = 18 kips, z/h = 0.2, Rp = 2.5, and Ip = 1.0, what is Fp?

A. 1.81 kips
B. 4.23 kips
C. 3.02 kips
D. 2.16 kips

50. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 2.5, SDS = 0.62, Wp = 6 kips, z/h = 0.8, Rp = 3.5, and Ip = 1.0, what is Fp?

A. 2.76 kips
B. 1.66 kips
C. 3.86 kips
D. 1.06 kips

51. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 1.0, SDS = 0.85, Wp = 22 kips, z/h = 0.5, Rp = 2.0, and Ip = 1.0, what is Fp?

A. 4.49 kips
B. 7.48 kips
C. 10.47 kips
D. 3.74 kips

52. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 2.5, SDS = 0.7, Wp = 4.5 kips, z/h = 1.0, Rp = 2.5, and Ip = 1.0, what is Fp?

A. 2.27 kips
B. 3.78 kips
C. 5.29 kips
D. 1.26 kips

53. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 1.0, SDS = 0.58, Wp = 30 kips, z/h = 0.3, Rp = 2.5, and Ip = 1.0, what is Fp?

A. 2.67 kips
B. 6.23 kips
C. 2.78 kips
D. 4.45 kips

54. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 2.5, SDS = 0.66, Wp = 8 kips, z/h = 0.6, Rp = 3.0, and Ip = 1.0, what is Fp?

A. 2.32 kips
B. 5.42 kips
C. 1.76 kips
D. 3.87 kips

55. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 1.0, SDS = 0.9, Wp = 12 kips, z/h = 0.9, Rp = 2.0, and Ip = 1.0, what is Fp?

A. 3.63 kips
B. 8.47 kips
C. 6.05 kips
D. 2.16 kips

56. For this exercise use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), with no cap or minimum check. Given ap = 2.5, SDS = 0.55, Wp = 10 kips, z/h = 0.4, Rp = 3.5, and Ip = 1.0, what is Fp?

A. 2.83 kips
B. 1.70 kips
C. 3.96 kips
D. 1.57 kips

57. A rigid nonbuilding structure is assigned a seismic coefficient Cs = 0.18 for this problem. If its effective seismic weight is 420 kips, what base shear V = CsW is used?

A. 37.8 kips
B. 75.6 kips
C. 113.4 kips
D. 2333.3 kips

58. A rigid nonbuilding structure is assigned a seismic coefficient Cs = 0.22 for this problem. If its effective seismic weight is 310 kips, what base shear V = CsW is used?

A. 34.1 kips
B. 102.3 kips
C. 1409.1 kips
D. 68.2 kips

59. A rigid nonbuilding structure is assigned a seismic coefficient Cs = 0.16 for this problem. If its effective seismic weight is 550 kips, what base shear V = CsW is used?

A. 88.0 kips
B. 44.0 kips
C. 132.0 kips
D. 3437.5 kips

60. A rigid nonbuilding structure is assigned a seismic coefficient Cs = 0.25 for this problem. If its effective seismic weight is 260 kips, what base shear V = CsW is used?

A. 32.5 kips
B. 97.5 kips
C. 65.0 kips
D. 1040.0 kips

61. For a rooftop mechanical unit, why must seismic attachment design consider the supporting curb and its connection to the roof framing, not only the equipment anchor bolts?

A. Because roof framing never carries gravity load
B. Because anchor bolts eliminate component acceleration
C. Because curbs are architectural finishes only
D. Complete the component force path into the building structure

62. Which change most directly increases the inertial force demand on a component when its acceleration response is otherwise unchanged?

A. Reducing its mass
B. Removing its support connection
C. Increasing the component's seismic weight
D. Lowering its weight while holding acceleration constant

63. A rigid diaphragm distributes 420 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 120, 180, and 300 kip/in. What direct shear goes to element 3?

A. 0.7 kips
B. 210.0 kips
C. 227.0 kips
D. 140.0 kips

64. A rigid diaphragm distributes 360 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 250, 150, and 100 kip/in. What direct shear goes to element 1?

A. 180.0 kips
B. 0.7 kips
C. 197.0 kips
D. 120.0 kips

65. A rigid diaphragm distributes 480 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 90, 210, and 300 kip/in. What direct shear goes to element 2?

A. 168.0 kips
B. 0.8 kips
C. 312.0 kips
D. 160.0 kips

66. A rigid diaphragm distributes 390 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 160, 240, and 200 kip/in. What direct shear goes to element 2?

A. 0.7 kips
B. 234.0 kips
C. 130.0 kips
D. 156.0 kips

67. A rigid diaphragm distributes 350 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 140, 260, and 100 kip/in. What direct shear goes to element 1?

A. 0.7 kips
B. 252.0 kips
C. 98.0 kips
D. 116.7 kips

68. A rigid diaphragm distributes 520 kips of direct shear to three parallel lateral elements in proportion to stiffness. Their stiffnesses are 200, 320, and 280 kip/in. What direct shear goes to element 3?

A. 0.7 kips
B. 182.0 kips
C. 338.0 kips
D. 173.3 kips

69. Three parallel lateral elements lie at x = 0, 20, and 40 ft and have stiffnesses 100, 200, and 300 kip/in. Using xCR = Σ(kixi)/Σki, where is the center of rigidity?

A. x = 26.7 ft
B. x = 20.0 ft
C. x = 34.7 ft
D. x = 19.7 ft

70. Three parallel lateral elements lie at x = 0, 30, and 60 ft and have stiffnesses 250, 150, and 100 kip/in. Using xCR = Σ(kixi)/Σki, where is the center of rigidity?

A. x = 30.0 ft
B. x = 29.0 ft
C. x = 14.0 ft
D. x = 21.0 ft

71. Three parallel lateral elements lie at x = 5, 25, and 55 ft and have stiffnesses 180, 220, and 200 kip/in. Using xCR = Σ(kixi)/Σki, where is the center of rigidity?

A. x = 28.3 ft
B. x = 37.0 ft
C. x = 29.0 ft
D. x = 22.0 ft

72. Three parallel lateral elements lie at x = 0, 18, and 42 ft and have stiffnesses 150, 300, and 150 kip/in. Using xCR = Σ(kixi)/Σki, where is the center of rigidity?

A. x = 20.0 ft
B. x = 27.5 ft
C. x = 12.5 ft
D. x = 19.5 ft

73. A diaphragm story shear of 420 kips acts with a total design eccentricity of 3.5 ft between the force line and center of rigidity. What torsional moment is produced?

A. 735.0 kip-ft
B. 1,470.0 kip-ft
C. 2,205.0 kip-ft
D. 120.0 kip-ft

74. A diaphragm story shear of 360 kips acts with a total design eccentricity of 4.2 ft between the force line and center of rigidity. What torsional moment is produced?

A. 1,512.0 kip-ft
B. 756.0 kip-ft
C. 2,268.0 kip-ft
D. 85.7 kip-ft

75. A diaphragm story shear of 510 kips acts with a total design eccentricity of 2.8 ft between the force line and center of rigidity. What torsional moment is produced?

A. 714.0 kip-ft
B. 2,142.0 kip-ft
C. 1,428.0 kip-ft
D. 182.1 kip-ft

76. A diaphragm story shear of 300 kips acts with a total design eccentricity of 5.0 ft between the force line and center of rigidity. What torsional moment is produced?

A. 750.0 kip-ft
B. 1,500.0 kip-ft
C. 2,250.0 kip-ft
D. 60.0 kip-ft

77. A flexible diaphragm carries an in-plane shear of 300 kips across a resisting length of 75 ft. Using average unit shear v = V/L, what is v?

A. 2.00 kip/ft
B. 6.00 kip/ft
C. 4.00 kip/ft
D. 8.00 kip/ft

78. A flexible diaphragm carries an in-plane shear of 420 kips across a resisting length of 84 ft. Using average unit shear v = V/L, what is v?

A. 2.50 kip/ft
B. 5.00 kip/ft
C. 7.50 kip/ft
D. 10.00 kip/ft

79. A flexible diaphragm carries an in-plane shear of 360 kips across a resisting length of 60 ft. Using average unit shear v = V/L, what is v?

A. 6.00 kip/ft
B. 3.00 kip/ft
C. 9.00 kip/ft
D. 12.00 kip/ft

80. A flexible diaphragm carries an in-plane shear of 525 kips across a resisting length of 105 ft. Using average unit shear v = V/L, what is v?

A. 2.50 kip/ft
B. 7.50 kip/ft
C. 10.00 kip/ft
D. 5.00 kip/ft

81. A floor diaphragm acts as a deep horizontal beam with an in-plane moment of 1,800 kip-ft. Chord resultants are 40 ft apart. What axial chord force is required by that force couple?

A. 22.5 kips
B. 67.5 kips
C. 90.0 kips
D. 45.0 kips

82. A diaphragm develops an in-plane bending moment of 2,400 kip-ft. If the effective distance between chord force resultants is 48 ft, what chord force magnitude F = M/d is required?

A. 25.0 kips
B. 75.0 kips
C. 50.0 kips
D. 100.0 kips

83. A diaphragm develops an in-plane bending moment of 1,650 kip-ft. If the effective distance between chord force resultants is 33 ft, what chord force magnitude F = M/d is required?

A. 25.0 kips
B. 50.0 kips
C. 75.0 kips
D. 100.0 kips

84. A diaphragm develops an in-plane bending moment of 3,150 kip-ft. If the effective distance between chord force resultants is 45 ft, what chord force magnitude F = M/d is required?

A. 70.0 kips
B. 35.0 kips
C. 105.0 kips
D. 140.0 kips

85. Two floor levels have lateral displacements of 2.8 inches and 1.6 inches in the same direction. What is the story drift between those levels?

A. 1.2 in.
B. 0.6 in.
C. 2.2 in.
D. 4.4 in.

86. For a simplified load-combination exercise, use U = 1.2D + 1.0E + 0.5L. If D = 520 kips, E = 180 kips, and L = 160 kips, what is U?

A. 704 kips
B. 884 kips
C. 804 kips
D. 964 kips

87. When is modeling a diaphragm as rigid most defensible for lateral-force distribution?

A. Whenever the diaphragm contains any opening
B. Whenever all vertical elements have identical strength
C. Whenever the building has only one story
D. When diaphragm deformation is small relative to vertical-system deformation

88. Within a diaphragm load path, what task is performed by a drag or collector member?

A. To carry only architectural ceiling loads
B. To remove torsional demand from the building
C. Transfer gathered diaphragm force into a vertical resisting element
D. To replace every diaphragm chord

89. At a reinforced-concrete plastic-hinge region, what performance benefit is sought by using closely spaced transverse reinforcement around the core?

A. They eliminate all flexural cracking
B. They help confine concrete and restrain longitudinal bars during cyclic inelastic deformation
C. They replace the need for longitudinal steel
D. They reduce the building's seismic mass to zero

90. Why are protected zones and connection detailing important in steel moment-frame seismic systems?

A. Preserve intended ductile yielding and avoid brittle connection failure
B. They make beam yielding impossible
C. They eliminate weld quality requirements
D. They force all columns to remain unstressed

91. What is the seismic purpose of continuous ties across a structure?

A. They increase nonstructural dead load

B. They permit walls to separate freely
C. They remove the need for collectors
D. Maintain integrity and a continuous earthquake-force transfer path

92. A masonry shear wall requires boundary and connection detailing for cyclic lateral loading. Which field activity most directly supports conformance with the structural design?

A. Check only the final paint color
B. Measure office furniture spacing
C. Verify reinforcement, grout, and critical anchorage before concealment
D. Review landscaping irrigation zones

93. Why is special inspection of critical structural welding important on seismic projects?

A. It guarantees no earthquake damage can occur
B. It removes the engineer's design responsibility
C. It provides independent verification that specified welding procedures and acceptance criteria are followed
D. It converts all welded joints into pinned joints

94. During seismic construction, structural observation is intended primarily to accomplish which of the following?

A. To replace all contractor quality control
B. Observe general conformance of significant structural construction with design intent
C. To perform every material test personally
D. To waive required special inspections

95. Why should chord and collector splices be detailed to transfer the required seismic force through the splice region?

A. Prevent a splice discontinuity from breaking the diaphragm force path
B. Because splices eliminate diaphragm bending
C. Because only gravity load crosses a splice
D. Because collectors never carry tension

96. Why are anchor edge distance, embedment, and installation quality important for wall anchorage?

A. They determine the building's occupancy group
B. They set the mapped spectral acceleration
C. They control the architectural paint system
D. They control whether the anchor develops required tension and shear resistance

97. A wood shear wall relies on sheathing fasteners around panel edges. Why is specified fastener spacing important?

A. It determines the concrete compressive strength
B. It controls the distributed shear-transfer mechanism between sheathing and framing
C. It eliminates hold-down demand
D. It fixes the site's seismic design category

98. Why must nonstructural elements accommodate expected story drift where they cross seismic joints or attach between floors?

A. To increase the building's seismic weight
B. To lock adjacent floors together rigidly
C. Avoid brittle damage from differential movement
D. To replace structural separation joints

99. What is the primary quality-control concern when high-strength bolts form part of a seismic steel connection?

A. Confirm only the beam paint gloss
B. Ignore faying surfaces and bolt condition
C. Replace inspection with a visual floor survey
D. Confirm the specified bolt installation, pretension where required, and connection configuration

100. Why should field changes to a critical seismic connection be reviewed before acceptance?

A. Because small changes can alter strength, ductility, stiffness, or load path
B. Because field changes always reduce dead load
C. Because drawings prohibit all construction tolerances
D. Because any change automatically increases damping

Practice Exam 16: Answer Key and Explanations

1. D — First compute SMS = 1.10(1.20) = 1.32 g. The design short-period value is two-thirds of that, so SDS = 0.88 g. The other values correspond to skipping one step, using the site coefficient alone, or reporting the maximum considered value instead of the design value. The design-data step matters because site conditions and occupancy choices feed directly into.

2. B — With every other factor held constant, the base-shear ratio equals the SDS ratio. Dividing 0.82 by 0.55 gives about 1.49. A ratio below one reverses the sites, while 1.27 and 1.82 do not follow from the stated proportional relationship between spectral acceleration and base shear. The design-data step matters because site conditions and occupancy choices feed directly into.

3. A — Liquefaction susceptibility is greatest where loose, saturated, cohesionless soils can build excess pore-water pressure during cyclic shaking. Dense dry gravel lacks saturation, competent rock is not a liquefiable soil deposit, and stiff unsaturated clay does not match the classic mechanism. Site characterization therefore focuses on density, gradation, saturation, and groundwater conditions.

4. C — Occupancy and consequence of failure are used to establish the building's risk category and related importance treatment. The mapped hazard and site soil profile are properties of the location, not the tenant use, while the form of a period equation does not change merely because the occupancy becomes essential. The design-data step matters because site conditions and occupancy.

5. A — Rearrange SMS = FaSs to Fa = SMS/Ss. Dividing 1.44 g by 1.20 g gives 1.20. The units cancel because Fa is dimensionless. The other choices arise from reversing the ratio, copying SMS directly, or multiplying values that should instead be divided. The design-data step matters because site conditions and occupancy choices feed directly into the seismic demand.

6. B — Site class represents subsurface stiffness and related response characteristics, so it is used with mapped hazard values to establish site-modified spectral parameters. It does not dictate the structural material, determine occupancy, or eliminate seismic mass. The sequence matters because the design spectrum should reflect both regional hazard and local ground response.

7. D — The one-second maximum considered spectral value is obtained by direct multiplication: SM1 = 1.60(0.50 g) = 0.80 g. Dividing produces 0.31, while adding or otherwise combining the inputs produces the larger distractors. The coefficient modifies the mapped motion rather than replacing it. The design-data step matters because site conditions and occupancy choices feed directly into the seismic demand.

8. C — Seismic construction documents should communicate the design basis needed to understand and execute the lateral system, including key spectral parameters, seismic design category, and the selected resisting system. Finish schedules, delivery tickets, and maintenance logs may be useful project records, but they do not define the structural seismic design basis.

9. C — For the same shear, elastic displacement is inversely proportional to stiffness. Thus driftY/driftX = kX/kY = 900/600 = 1.50. The 0.67 choice reverses the ratio; the other values do not follow from force divided by stiffness. The more flexible system develops the larger displacement demand. The key is to relate stiffness, strength, ductility, and geometry to expected response.

10. A — A soft story is a vertical stiffness discontinuity: one level deforms much more because its lateral stiffness is substantially lower than neighboring stories. A regular rectangular diaphragm, repeating column sizes, and near-centered mass do not themselves create that condition. Concentrated drift can amplify damage in columns, walls, partitions, and connections at the weak level.

11. D — Elastic story drift under the stated linear model is shear divided by stiffness: 720/240 = 3.00 inches. The 0.33-inch choice inverts the calculation, 1.50 inches halves the demand without justification, and 6.00 inches doubles it. This relationship is a basic force-deflection check for a story model. The key is to relate stiffness, strength, ductility, and geometry to expected.

12. B — An offset between mass and rigidity creates a torsional moment when lateral inertia forces act through the mass center. That rotation increases demand on some perimeter elements while reducing it on others. It does not uniformly reduce story shear, eliminate diaphragm action, or improve soil bearing capacity. The effect must be represented in analysis and detailing.

13. B — Under the stated conservative approach, possible closing movements are added because the two structures can move toward one another. The required separation is therefore 3.0 + 2.0 = 5.0 inches. Subtracting, averaging, or adding an arbitrary extra inch does not match the assumed method for preventing seismic pounding. The key is to relate stiffness, strength, ductility, and geometry.

14. D — P-Delta behavior is a second-order effect: gravity loads act through a laterally displaced geometry and create additional moments and story demands. The effect becomes more significant as axial load and drift increase. Gravity does not cancel seismic shear, columns do not lose axial load simply because they drift, and flexibility can increase rather than suppress the response.

15. C — Parallel lateral elements experience compatible story displacement, so their resisting forces add. The equivalent stiffness is therefore 500 + 300 = 800 kip/in. The reciprocal-style result applies to a different arrangement, 500 ignores one component, and 1,500 is not obtained from the stated parallel stiffness relationship. The key is to relate stiffness, strength, ductility, and geometry to expected.

16. A — Ductility is the capacity to sustain substantial inelastic deformation while maintaining useful strength and energy-dissipation capability. Extra mass generally increases inertial force, plan eccentricity can increase torsion, and brittle strength without deformation capacity can lead to sudden failure. Seismic systems rely on appropriately detailed ductile mechanisms rather than uncontrolled brittle response.

17. C — URM walls are vulnerable when diaphragms cannot provide reliable out-of-plane support and transfer inertia forces through positive anchorage. Missing or weak wall-to-diaphragm connections can allow wall separation and collapse. Paint thickness, ceiling layout, and plumbing cleanouts do not provide the critical structural restraint needed to stabilize heavy masonry walls during strong shaking.

18. A — Positive wall-to-roof anchorage provides a direct path for out-of-plane panel inertia forces into the diaphragm. That specifically reduces the risk of panels separating from roof support. It does not prevent liquefaction, shorten columns, or force joists to yield. The retrofit targets a historically important connection and load-path weakness in tilt-up construction.

19. D — Punching shear distress at a flat-plate slab-column connection is critical because that connection carries gravity load as well as participating in building deformation. Severe damage can threaten local or progressive gravity-support failure. The observation does not prove liquefaction, create ductility, or establish diaphragm rigidity. Post-earthquake evaluation should therefore treat such distress seriously.

20. B — Collectors and their connections gather diaphragm shear and transfer it into walls, frames, or other vertical resisting elements. Strengthening that path directly addresses a discontinuity. Adding ceiling weight increases seismic mass, closing inspection access does not improve structural transfer, and removing wall anchors weakens rather than strengthens the earthquake load path.

21. B — A retrofit should address the controlling brittle or unstable response by improving cyclic deformation capacity and connection performance, while directing yielding into a deliberate mechanism. Increasing mass raises inertia forces, larger torsional eccentricity worsens uneven demand, and eliminating inspection reduces confidence in critical work. The goal is dependable ductile behavior, not simply added strength in unrelated components.

22. D — Major new damage to a primary lateral element can indicate reduced strength, stiffness, or stability and therefore warrants conservative occupancy restriction until the condition is evaluated. Shifted ceiling tiles, open drawers, and cosmetic paint cracking may document shaking but do not by themselves demonstrate comparable structural danger. Post-earthquake decisions focus on life-safety implications of observed damage.

23. A — The stated coefficient is Cs = 0.78/(8.0/1.00) = 0.0975. Multiplying by W = 2,200 kips gives V = 214.5 kips. The distractors represent scaling errors or using SDS directly without the response-modification denominator. The arithmetic is only one step; the result must still be carried through the building load path to the diaphragm, collectors, and vertical resisting elements.

24. C — The stated coefficient is Cs = 0.64/(6.5/1.00) = 0.0985. Multiplying by W = 3,100 kips gives V = 305.2 kips. The distractors represent scaling errors or using SDS directly without the response-modification denominator. The arithmetic is only one step; the result must still be carried through the building load path to the diaphragm, collectors, and vertical resisting elements.

25. A — The stated coefficient is Cs = 0.92/(7.0/1.25) = 0.1643. Multiplying by W = 1,800 kips gives V = 295.7 kips. The distractors represent scaling errors or using SDS directly without the response-modification denominator. The arithmetic is only one step; the result must still be carried through the building load path to the diaphragm, collectors, and vertical resisting elements.

26. C — The stated coefficient is Cs = 0.70/(5.5/1.00) = 0.1273. Multiplying by W = 2,650 kips gives V = 337.3 kips. The distractors represent scaling errors or using SDS directly without the response-modification denominator. The arithmetic is only one step; the result must still be carried through the building load path to the diaphragm, collectors, and vertical resisting elements.

27. B — Substituting the stated values gives Ta = 0.03(55^0.75) = approximately 0.61 seconds. The other choices are intentionally scaled away from that result and do not satisfy the given power-law relationship. Period should be calculated from the specified equation before it is used in any subsequent force coefficient. The arithmetic is only one step; the result must still be.

28. D — Substituting the stated values gives Ta = 0.028(72^0.80) = approximately 0.86 seconds. The other choices are intentionally scaled away from that result and do not satisfy the given power-law relationship. Period should be calculated from the specified equation before it is used in any subsequent force coefficient. The arithmetic is only one step; the result must still be.

29. C — Substituting the stated values gives Ta = 0.02(90^0.75) = approximately 0.58 seconds. The other choices are intentionally scaled away from that result and do not satisfy the given power-law relationship. Period should be calculated from the specified equation before it is used in any subsequent force coefficient. The arithmetic is only one step; the result must still be.

30. D — Substituting the stated values gives Ta = 0.035(48^0.70) = approximately 0.53 seconds. The other choices are intentionally scaled away from that result and do not satisfy the given power-law relationship. Period should be calculated from the specified equation before it is used in any subsequent force coefficient. The arithmetic is only one step; the result must still be.

31. A — With k = 1, each level contribution is wxhx. The products are 4,800, 9,600, and 14,400; their sum is 28,800. Dividing the roof-level product by the total gives 0.500. The other fractions do not preserve the required normalized weight-height distribution. The arithmetic is only one step; the result must still be carried through the building load path to.

32. B — With k = 1, each level contribution is wxhx. The products are 4,500, 13,500, and 27,000; their sum is 45,000. Dividing the middle-level product by the total gives 0.300. The other fractions do not preserve the required normalized weight-height distribution. The arithmetic is only one step; the result must still be carried through the building load path to.

33. A — With k = 1, each level contribution is wxhx. The products are 7,000, 12,600, and 14,700; their sum is 34,300. Dividing the lowest-level product by the total gives 0.204. The other fractions do not preserve the required normalized weight-height distribution. The arithmetic is only one step; the result must still be carried through the building load path to.

34. D — With k = 1, each level contribution is wxhx. The products are 2,500, 7,000, and 13,500; their sum is 23,000. Dividing the roof-level product by the total gives 0.587. The other fractions do not preserve the required normalized weight-height distribution. The arithmetic is only one step; the result must still be carried through the building load path to.

35. C — With k = 1, each level contribution is wxhx. The products are 7,800, 13,000, and 15,600; their sum is 36,400. Dividing the middle-level product by the total gives 0.357. The other fractions do not preserve the required normalized weight-height distribution. The arithmetic is only one step; the result must still be carried through the building load path to.

36. B — The problem directly defines the diaphragm force as 0.65 times the story force. Multiplying 0.65 by 420 kips gives 273.0 kips. Using the complementary fraction, increasing the result arbitrarily, or taking the full story force ignores the stated relationship for this exercise. The arithmetic is only one step; the result must still be carried through the building load.

37. C — The problem directly defines the diaphragm force as 0.75 times the story force. Multiplying 0.75 by 360 kips gives 270.0 kips. Using the complementary fraction, increasing the result arbitrarily, or taking the full story force ignores the stated relationship for this exercise. The arithmetic is only one step; the result must still be carried through the building load.

38. B — The problem directly defines the diaphragm force as 0.60 times the story force. Multiplying 0.60 by 510 kips gives 306.0 kips. Using the complementary fraction, increasing the result arbitrarily, or taking the full story force ignores the stated relationship for this exercise. The arithmetic is only one step; the result must still be carried through the building load.

39. A — The problem directly defines the diaphragm force as 0.80 times the story force. Multiplying 0.80 by 290 kips gives 232.0 kips. Using the complementary fraction, increasing the result arbitrarily, or taking the full story force ignores the stated relationship for this exercise. The arithmetic is only one step; the result must still be carried through the building load.

40. D — A uniform pressure produces resultant force equal to pressure times tributary area. The panel area is 24(14) = 336 ft^2, and 0.42(336) = 141.1 kips. The distractors use incomplete area, arbitrary scaling, or perimeter-like arithmetic instead of the stated pressure-area relationship. The arithmetic is only one step; the result must still be carried through the building load path.

41. D — A uniform pressure produces resultant force equal to pressure times tributary area. The panel area is 30(12) = 360 ft², and 0.36(360) = 129.6 kips. The distractors use incomplete area, arbitrary scaling, or perimeter-like arithmetic instead of the stated pressure-area relationship. The arithmetic is only one step; the result must still be carried through the building load path.

42. C — A uniform pressure produces resultant force equal to pressure times tributary area. The panel area is 20(16) = 320 ft², and 0.48(320) = 153.6 kips. The distractors use incomplete area, arbitrary scaling, or perimeter-like arithmetic instead of the stated pressure-area relationship. The arithmetic is only one step; the result must still be carried through the building load path.

43. A — A uniform pressure produces resultant force equal to pressure times tributary area. The panel area is 28(15) = 420 ft², and 0.40(420) = 168.0 kips. The distractors use incomplete area, arbitrary scaling, or perimeter-like arithmetic instead of the stated pressure-area relationship. The arithmetic is only one step; the result must still be carried through the building load path.

44. B — With equal load sharing and no eccentricity, the anchor demand is total anchorage force divided by the number of anchors: 144/12 = 12.0 kips. The other values either halve or increase the demand without basis, or incorrectly assume fewer anchors than the problem provides. The arithmetic is only one step; the result must still be carried through the.

45. C — With equal load sharing and no eccentricity, the anchor demand is total anchorage force divided by the number of anchors: 195/15 = 13.0 kips. The other values either halve or increase the demand without basis, or incorrectly assume fewer anchors than the problem provides. The arithmetic is only one step; the result must still be carried through the.

46. A — With equal load sharing and no eccentricity, the anchor demand is total anchorage force divided by the number of anchors: 168/14 = 12.0 kips. The other values either halve or increase the demand without basis, or incorrectly assume fewer anchors than the problem provides. The arithmetic is only one step; the result must still be carried through the.

47. B — Vertical force distribution weights each level by its seismic weight and an elevation term. Increasing either contribution generally increases that level's share, all else equal. Lowering elevation or reducing weight has the opposite effect, while removing the lateral system is not a valid way to redistribute a prescribed building base shear.

48. D — Collectors gather distributed diaphragm forces and deliver them to walls, frames, or braces when geometry does not permit direct transfer. They preserve a continuous in-plane load path across openings and offsets. They do not raise ceilings, eliminate diaphragm stress, or prevent gravity load transfer. Their role is specifically seismic force collection and continuity.

49. C — Substitution into the stated component-force equation gives Fp = 0.4(1.0)(0.75)(18)(1 + 2(0.2))/(2.5/1.0) = 3.02 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

50. A — Substitution into the stated component-force equation gives Fp = 0.4(2.5)(0.62)(6)(1 + 2(0.8))/(3.5/1.0) = 2.76 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

51. B — Substitution into the stated component-force equation gives Fp = 0.4(1.0)(0.85)(22)(1 + 2(0.5))/(2.0/1.0) = 7.48 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

52. B — Substitution into the stated component-force equation gives Fp = 0.4(2.5)(0.7)(4.5)(1 + 2(1.0))/(2.5/1.0) = 3.78 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

53. D — Substitution into the stated component-force equation gives Fp = 0.4(1.0)(0.58)(30)(1 + 2(0.3))/(2.5/1.0) = 4.45 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

54. D — Substitution into the stated component-force equation gives Fp = 0.4(2.5)(0.66)(8)(1 + 2(0.6))/(3.0/1.0) = 3.87 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

55. C — Substitution into the stated component-force equation gives Fp = 0.4(1.0)(0.9)(12)(1 + 2(0.9))/(2.0/1.0) = 6.05 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

56. A — Substitution into the stated component-force equation gives Fp = 0.4(2.5)(0.55)(10)(1 + 2(0.4))/(3.5/1.0) = 2.83 kips. The alternatives represent omitted height amplification or arbitrary scaling. Because the stem explicitly excludes cap and minimum checks, only the given equation is evaluated. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path detailing are inseparable.

57. B — The problem defines the base shear directly as V = CsW. Multiplying 0.18 by 420 kips gives 75.6 kips. Halving or increasing that product is unsupported, and dividing weight by the coefficient produces a quantity inconsistent with the specified seismic-force relationship. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path.

58. D — The problem defines the base shear directly as V = CsW. Multiplying 0.22 by 310 kips gives 68.2 kips. Halving or increasing that product is unsupported, and dividing weight by the coefficient produces a quantity inconsistent with the specified seismic-force relationship. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path.

59. A — The problem defines the base shear directly as V = CsW. Multiplying 0.16 by 550 kips gives 88.0 kips. Halving or increasing that product is unsupported, and dividing weight by the coefficient produces a quantity inconsistent with the specified seismic-force relationship. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path.

60. C — The problem defines the base shear directly as V = CsW. Multiplying 0.25 by 260 kips gives 65.0 kips. Halving or increasing that product is unsupported, and dividing weight by the coefficient produces a quantity inconsistent with the specified seismic-force relationship. Component and nonbuilding-structure forces must ultimately reach adequately designed attachments and supports, so force calculation and load-path.

61. D — Component anchorage is only as strong as the complete load path. Inertia force must pass from the equipment through anchors, curb or support, local roof elements, and into the building structure. Roof framing still carries gravity, anchors do not eliminate acceleration, and curbs can be structural parts of the seismic attachment system rather than mere finishes.

62. C — Inertial force follows mass times acceleration, so greater seismic weight increases force when response acceleration is unchanged. Reducing mass or weight decreases the inertial term. Removing support does not make force vanish; it instead creates a dangerous load-path failure. Component design therefore considers both expected acceleration and the weight that must be restrained.

63. B — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 3 receives 300/600 of 420 kips, which is 210.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

64. A — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 1 receives 250/500 of 360 kips, which is 180.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

65. A — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 2 receives 210/600 of 480 kips, which is 168.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

66. D — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 2 receives 240/600 of 390 kips, which is 156.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

67. C — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 1 receives 140/500 of 350 kips, which is 98.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

68. B — For a rigid diaphragm under direct translation, compatible displacement causes force to distribute in proportion to stiffness. Element 3 receives 280/800 of 520 kips, which is 182.0 kips. The alternatives use an unnormalized ratio, the complementary stiffness, or equal distribution despite unequal stiffness. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and.

69. A — The center of rigidity is the stiffness-weighted coordinate, not the simple geometric average. Computing Σ(kixi)/Σki for the listed elements gives x = 26.7 ft. The distractors either average locations without stiffness weighting or shift the result arbitrarily away from the equilibrium point defined by the analytical model. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm.

70. D — The center of rigidity is the stiffness-weighted coordinate, not the simple geometric average. Computing Σ(kixi)/Σki for the listed elements gives x = 21.0 ft. The distractors either average locations without stiffness weighting or shift the result arbitrarily away from the equilibrium point defined by the analytical model. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm.

71. C — The center of rigidity is the stiffness-weighted coordinate, not the simple geometric average. Computing Σ(kixi)/Σki for the listed elements gives x = 29.0 ft. The distractors either average locations without stiffness weighting or shift the result arbitrarily away from the equilibrium point defined by the analytical model. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm.

72. D — The center of rigidity is the stiffness-weighted coordinate, not the simple geometric average. Computing Σ(kixi)/Σki for the listed elements gives x = 19.5 ft. The distractors either average locations without stiffness weighting or shift the result arbitrarily away from the equilibrium point defined by the analytical model. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm.

73. B — Torsional moment equals the lateral force times its eccentricity. Multiplying 420 kips by 3.5 ft gives 1,470.0 kip-ft. The other options halve or increase the product without basis, or divide force by eccentricity, which has the wrong physical relationship and inconsistent units. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and a.

74. A — Torsional moment equals the lateral force times its eccentricity. Multiplying 360 kips by 4.2 ft gives 1,512.0 kip-ft. The other options halve or increase the product without basis, or divide force by eccentricity, which has the wrong physical relationship and inconsistent units. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and a.

75. C — Torsional moment equals the lateral force times its eccentricity. Multiplying 510 kips by 2.8 ft gives 1,428.0 kip-ft. The other options halve or increase the product without basis, or divide force by eccentricity, which has the wrong physical relationship and inconsistent units. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and a.

76. B — Torsional moment equals the lateral force times its eccentricity. Multiplying 300 kips by 5.0 ft gives 1,500.0 kip-ft. The other options halve or increase the product without basis, or divide force by eccentricity, which has the wrong physical relationship and inconsistent units. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior, accidental torsion, and a.

77. C — Average diaphragm unit shear is total in-plane shear divided by the resisting length. Here, 300/75 = 4.00 kip/ft. Halving or increasing that quotient is unsupported, while using half the length doubles the shear without any stated reason. Units provide a useful check: force divided by length gives kip per foot.

78. B — Average diaphragm unit shear is total in-plane shear divided by the resisting length. Here, 420/84 = 5.00 kip/ft. Halving or increasing that quotient is unsupported, while using half the length doubles the shear without any stated reason. Units provide a useful check: force divided by length gives kip per foot.

79. A — Average diaphragm unit shear is total in-plane shear divided by the resisting length. Here, 360/60 = 6.00 kip/ft. Halving or increasing that quotient is unsupported, while using half the length doubles the shear without any stated reason. Units provide a useful check: force divided by length gives kip per foot.

80. D — Average diaphragm unit shear is total in-plane shear divided by the resisting length. Here, 525/105 = 5.00 kip/ft. Halving or increasing that quotient is unsupported, while using half the length doubles the shear without any stated reason. Units provide a useful check: force divided by length gives kip per foot.

81. D — The chord couple resists diaphragm bending moment. With an effective chord separation of 40 ft, each chord force magnitude is M/d = 1800/40 = 45.0 kips. The distractors change the lever arm or scale the result without justification. Chord connections must transfer this tension or compression into the diaphragm load path.

82. C — The chord couple resists diaphragm bending moment. With an effective chord separation of 48 ft, each chord force magnitude is M/d = 2400/48 = 50.0 kips. The distractors change the lever arm or scale the result without justification. Chord connections must transfer this tension or compression into the diaphragm load path.

83. B — The chord couple resists diaphragm bending moment. With an effective chord separation of 33 ft, each chord force magnitude is M/d = 1650/33 = 50.0 kips. The distractors change the lever arm or scale the result without justification. Chord connections must transfer this tension or compression into the diaphragm load path.

84. A — The chord couple resists diaphragm bending moment. With an effective chord separation of 45 ft, each chord force magnitude is M/d = 3150/45 = 70.0 kips. The distractors change the lever arm or scale the result without justification. Chord connections must transfer this tension or compression into the diaphragm load path.

85. A — Story drift is the relative lateral displacement between adjacent levels, not either floor's absolute displacement. Subtracting 1.6 inches from 2.8 inches gives 1.2 inches. The other values reflect halving, adding, or otherwise combining the floor movements incorrectly. Relative displacement is the quantity compared with story drift limits and deformation-sensitive detailing requirements.

86. B — Apply the coefficients exactly as stated: 1.2(520) + 1.0(180) + 0.5(160) = 624 + 180 + 80 = 884 kips. The other totals result from omitting or misapplying a coefficient. Load-combination arithmetic should be kept separate from the later structural distribution of the resulting seismic effect. Analysis should preserve equilibrium and compatibility while reflecting relative stiffness, diaphragm behavior.

87. D — A rigid-diaphragm idealization is appropriate when in-plane diaphragm deformation is small compared with lateral deformation of the vertical resisting elements. Openings, equal strength, or a single story do not automatically establish rigidity. The analytical assumption should reflect relative stiffness because it controls how translation and torsion distribute forces to walls, frames, and braces.

88. C — A collector, also called a drag element, transfers in-plane diaphragm force to a wall, frame, brace line, or other vertical element when direct transfer is not available. It is not limited to ceiling loads, does not make torsion disappear, and does not replace the distinct chord function of resisting diaphragm bending tension and compression.

89. B — Confinement reinforcement helps maintain core concrete integrity, restrain longitudinal-bar buckling, and preserve deformation capacity during repeated inelastic cycles. It does not eliminate flexural cracking, substitute for longitudinal reinforcement, or change seismic mass. The detailing objective is controlled ductile behavior so strength does not degrade abruptly after yielding begins. Seismic detailing converts the analytical force path into constructible behavior.

90. A — Steel moment-frame detailing is arranged so inelastic action occurs in deliberate ductile regions while brittle connection failures are avoided. Protected zones and qualified connection details support that mechanism. They do not prevent all yielding, eliminate weld quality controls, or remove column demand. Seismic performance depends on both member proportions and connection execution.

91. D — Continuous ties help keep portions of a structure connected and provide alternate or direct paths for seismic forces where separation could otherwise occur. Adding dead load is not their objective, free wall separation is undesirable, and collectors may still be needed. Integrity detailing complements the calculated lateral-force system by supporting continuity during deformation.

92. C — Masonry seismic performance depends on reinforcement location, grout consolidation, anchorage, and related details that become difficult to verify after construction is concealed. Field inspection therefore focuses on those structural features. Paint, furniture, and irrigation may require separate project reviews, but they do not establish conformance of the masonry seismic-force-resisting system.

93. C — Critical seismic welds depend on material, procedure, workmanship, and acceptance criteria. Special inspection provides independent verification that the specified requirements are being followed and that identified deficiencies are addressed. It cannot guarantee zero earthquake damage, transfer design responsibility away from the engineer, or change the intended structural behavior of a welded connection.

94. B — Structural observation is a periodic professional review of significant structural construction for general conformance with the design intent. It complements, rather than replaces, contractor quality control, testing, and special inspection. The observer does not personally perform every material test, and required inspections are not waived merely because structural observation is also provided.

95. A — A seismic load path is governed by its weakest discontinuity. Chords and collectors may carry substantial tension, compression, or shear, so splices and connections must transfer the required force rather than merely connect pieces geometrically. Splices do not eliminate diaphragm bending, and seismic force can cross them in addition to ordinary gravity-related effects.

96. D — Anchor strength and deformation capacity depend on how load is transferred into the supporting material. Edge distance, embedment, spacing, installation, and substrate condition can control concrete or masonry failure modes. Those variables do not determine occupancy, mapped hazard, or finishes. Proper anchorage detailing is essential for transmitting wall inertia and diaphragm forces reliably.

97. B — Wood shear-wall resistance depends on many fasteners sharing load through the sheathing-to-framing connection. Edge spacing therefore affects unit shear capacity, stiffness, and cyclic behavior. It does not determine concrete strength, automatically eliminate overturning hold-down forces, or establish seismic design category. Field verification of nailing is a direct quality-control check on the lateral system.

98. C — Nonstructural components can be damaged when adjacent floors or building segments move relative to one another. Flexible connections, clearances, and compatible detailing allow that movement without brittle failure or unintended load transfer. Adding weight, rigidly tying floors through a nonstructural element, or defeating a separation joint would generally worsen seismic performance rather than improve it.

99. D — Seismic steel connections depend on the specified bolt type, installation method, pretension where applicable, hole and faying-surface condition, and connection geometry. Quality control therefore verifies those structural requirements. Paint gloss and floor appearance do not establish bolt performance, and critical connection checks cannot be replaced by unrelated visual observations elsewhere in the building.

100. A — Critical seismic connections are proportioned as part of an intended load path and deformation mechanism. A field change can alter geometry, weld demand, anchor behavior, stiffness, or ductility even when it seems minor. Review is therefore needed before acceptance. Changes do not automatically reduce dead load, eliminate tolerances, or provide beneficial damping.