PRACTICE EXAM 17: CALIFORNIA SEISMIC PRINCIPLES (100 QUESTIONS)

This standalone practice exam contains 100 four-choice questions weighted to the current BPELSG Civil Engineer Seismic Principles test plan. Allow 2.5 hours for a timed simulation and select the single best answer for each item. For the remainder of 2026, BPELSG continues testing to the 2022 California Building Code and ASCE/SEI 7-16. This is independently created study material, not an official BPELSG examination.

1. During preliminary design of a municipal operations building, the mapped short-period value is Ss = 1.26 g and the site coefficient is Fa = 1.15. For this exercise use SMS = FaSs. What is SMS?

A. 1.096 g
B. 1.449 g
C. 1.260 g
D. 2.410 g

2. A study spectrum has SM1 = 0.87 g. The design one-second ordinate is defined here as SD1 = (2/3)SM1. Which value results?

A. 0.435 g
B. 0.870 g
C. 0.580 g
D. 1.305 g

3. A spectrum model places its transition at the ratio of the one-second design ordinate to the short-period design ordinate. With SD1 = 0.54 g and SDS = 0.90 g, calculate Ts.

A. 0.36 s
B. 1.44 s
C. 1.67 s

D. 0.60 s

4. A geotechnical report identifies loose saturated sand extending toward a nearby riverbank. Which earthquake-related ground failure deserves the most focused screening?

A. Liquefaction with possible lateral spreading toward the free face
B. Dry-soil shrinkage away from the river
C. Wind scour beneath the foundation
D. Thermal expansion of the ground surface

5. Two projects share the same mapped seismic hazard and site class, but one houses an emergency communications center while the other is ordinary retail. Which design input most directly distinguishes their occupancy-related seismic consequence?

A. Mapped Ss at the site
B. Risk category and associated importance treatment
C. Measured soil shear-wave velocity
D. Foundation concrete unit weight

6. A site has SDS = 0.78 g and SD1 = 0.47 g. Using Ts = SD1/SDS, what transition period should be used for this exercise?

A. 0.37 s
B. 1.25 s
C. 0.60 s
D. 1.66 s

7. Why is the subsurface site class established before final design spectral values are selected?

A. Site class determines the building occupancy group
B. Site class fixes the structural framing material

C. Site class removes seismic mass from the model
D. Near-surface stiffness can modify the mapped ground motion used by the structure

8. A project data sheet lists mapped hazard, site class, design spectral ordinates, risk category, and seismic design category. Why are these items grouped together?

A. They replace the need for structural drawings
B. They define only architectural finish selections
C. Establish the seismic design basis for later forces and detailing
D. They eliminate construction quality control

9. Two one-story frames resist the same lateral shear. Frame P has stiffness 1,050 kip/in and Frame Q has stiffness 700 kip/in. Under elastic response, what is driftQ/driftP?

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

10. A story carries 675 kips of lateral shear and has an idealized elastic stiffness of 225 kip/in. What elastic story displacement is implied?

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

11. A lateral system has two resisting lines acting in parallel with stiffnesses 420 and 580 kip/in. What combined elastic stiffness should be used for common story translation?

A. 244 kip/in

B. 1,000 kip/in
C. 580 kip/in
D. 1,420 kip/in

12. Building A may move 2.4 inches toward a seismic joint, while Building B may move 1.9 inches toward the same joint. Using a conservative sum-of-movements check, what clear separation is required?

A. 4.3 in.
B. 0.5 in.
C. 2.15 in.
D. 5.3 in.

13. A floor diaphragm is comparatively rigid in plane, and the center of mass is offset substantially from the center of rigidity. What response should the designer expect in addition to translation?

A. Uniform elimination of story shear
B. Automatic increase in soil bearing strength
C. Complete removal of diaphragm force
D. Plan rotation that changes demand among the vertical resisting lines

14. Which building condition is most consistent with a vertical stiffness irregularity?

A. A rectangular roof has uniform framing
B. Column sizes repeat at every level
C. An open first story is far more flexible than stories above
D. The mass center is near the plan center

15. If one lateral resisting line is damaged during strong shaking, which system characteristic best improves the chance that earthquake forces can still reach the foundation through other effective paths?

A. It guarantees zero inelastic deformation
B. Several effective load paths reduce reliance on one resisting line
C. It eliminates all torsional effects
D. It removes the need for connection design

16. What structural property allows a well-detailed seismic system to dissipate energy through repeated inelastic cycles without abrupt loss of resistance?

A. Ductility
B. Mass eccentricity
C. Brittleness
D. Gravity load alone

17. A pre-1960 unreinforced masonry building has heavy exterior walls and a flexible wood roof. Which retrofit action most directly reduces the risk that a wall falls away from the roof line?

A. Add ceiling finishes near the wall
B. Increase stored contents along the wall
C. Remove existing roof blocking
D. Provide positive wall-to-diaphragm anchorage with a continuous load path

18. An older precast concrete structure relies on small bearing seats and limited connection ductility. Which earthquake weakness deserves particular attention during evaluation?

A. Loss of support or brittle failure at critical precast connections
B. Uniform paint cracking on all panels
C. Excess office live load at one desk
D. Wind pressure on interior partitions

19. After strong shaking, inspectors find widening cracks and local crushing around several slab-column regions in a flat-plate building. Why is this damage especially concerning?

A. It proves every foundation has liquefied
B. Punching deterioration can threaten gravity support at the slab-column connection
C. It guarantees increased slab ductility
D. It confirms the diaphragm is perfectly rigid

20. A soft-story apartment building retrofit adds new lateral elements at the open parking level. What is the principal seismic objective of that intervention?

A. Increase first-story flexibility further
B. Move all building mass to the roof
C. Reduce concentrated drift and strengthen the weak first-story load path
D. Eliminate every gravity column above

21. An existing concentrically braced frame shows brace-end connection details prone to brittle fracture before stable cyclic yielding develops. Which retrofit goal is most appropriate?

A. Add unrelated floor dead load
B. Increase accidental eccentricity
C. Enable the intended ductile mechanism through connection detailing
D. Eliminate inspection of the brace ends

22. During a post-earthquake building screening, which observation most strongly justifies restricting entry until a detailed structural evaluation is completed?

A. Fallen books and displaced loose contents throughout rooms
B. A few shifted ceiling tiles without structural damage
C. Minor paint crazing with no structural distress
D. Major permanent deformation or connection damage in a primary lateral element

23. For a conceptual ELF exercise, use $C_s = S_{DS}/(R/I_e)$ and $V = C_sW$. A building has $S_{DS} = 0.82$, $R = 7.0$, $I_e = 1.00$, and effective seismic weight $W = 2{,}450$ kips. What base shear results?

A. 287.0 kips
B. 206.6 kips
C. 367.4 kips
D. 2,009.0 kips

24. For a conceptual ELF exercise, use Cs = SDS/(R/Ie) and V = CsW. A building has SDS = 0.68, R = 6.0, Ie = 1.00, and effective seismic weight W = 3,320 kips. What base shear results?

A. 270.9 kips
B. 376.3 kips
C. 481.7 kips
D. 2,257.6 kips

25. For a conceptual ELF exercise, use Cs = SDS/(R/Ie) and V = CsW. A building has SDS = 0.95, R = 8.0, Ie = 1.25, and effective seismic weight W = 1,960 kips. What base shear results?

A. 209.4 kips
B. 372.4 kips
C. 290.9 kips
D. 1,862.0 kips

26. For a conceptual ELF exercise, use Cs = SDS/(R/Ie) and V = CsW. A building has SDS = 0.74, R = 5.0, Ie = 1.00, and effective seismic weight W = 2,780 kips. What base shear results?

A. 411.4 kips
B. 296.2 kips
C. 526.6 kips
D. 2,057.2 kips

27. A preliminary building period is estimated from Ta = Ct hn^x. Using Ct = 0.027, total height hn = 64 ft, and x = 0.80, what value of Ta is obtained?

A. 0.51 s
B. 0.99 s
C. 1.17 s
D. 0.75 s

28. A preliminary building period is estimated from Ta = Ct hn^x. Using Ct = 0.031, total height hn = 52 ft, and x = 0.75, what value of Ta is obtained?

A. 0.41 s
B. 0.60 s
C. 0.79 s
D. 1.02 s

29. A preliminary building period is estimated from Ta = Ct hn^x. Using Ct = 0.022, total height hn = 96 ft, and x = 0.78, what value of Ta is obtained?

A. 0.52 s
B. 0.77 s
C. 1.02 s
D. 1.19 s

30. A preliminary building period is estimated from Ta = Ct hn^x. Using Ct = 0.036, total height hn = 44 ft, and x = 0.70, what value of Ta is obtained?

A. 0.51 s
B. 0.35 s
C. 0.67 s
D. 0.93 s

31. For floor-force allocation, define each level weight factor as Pi = wi hi^k and Cvx = Pi/ΣP. Three levels have weights 360, 420, and 510 kips at 13, 26, and 39 ft, with k = 1.2. What Cvx belongs to the roof?

A. 0.490
B. 0.700
C. 0.590
D. 0.333

32. Compute the stiffness-independent vertical force fraction from Pi = wi hi^k and Cvx = Pi/ΣP. Level weights are 520, 410, and 300 kips at 12, 24, and 36 ft, with k = 1.4. What fraction belongs to level 2?

A. 0.261
B. 0.471
C. 0.333
D. 0.361

33. In a three-level vertical distribution, use Pi = wi hi^k before normalizing by ΣP. The weights are 280, 390, and 560 kips at elevations 15, 30, and 45 ft, and k = 1.1. What is the first-level fraction?

A. 0.094
B. 0.040
C. 0.204
D. 0.333

34. A force-distribution calculation forms Pi = wi hi^k for three equal 450-kip levels at 14, 28, and 42 ft. With k = 1.5 and Cvx = Pi/ΣP, determine the roof fraction.

A. 0.476
B. 0.576
C. 0.686
D. 0.333

35. To distribute base shear, calculate Pi = wi hi^k for weights 620, 480, and 360 kips at 11, 22, and 33 ft. If k = 1.3, what normalized fraction Cvx applies to the second level?

A. 0.258
B. 0.468
C. 0.333
D. 0.358

36. Floor lateral forces from the first level through the roof are 92, 138, 176, and 214 kips. What story shear must pass through the story immediately below level 2, using the sum of forces at that level and above?

A. 138 kips
B. 230 kips
C. 528 kips
D. 620 kips

37. Floor lateral forces from the first level through the roof are 85, 120, 160, and 205 kips. What story shear must pass through the story immediately below level 3, using the sum of forces at that level and above?

A. 365 kips
B. 160 kips
C. 402 kips
D. 570 kips

38. Floor lateral forces from the first level through the roof are 110, 150, 190, and 230 kips. What story shear must pass through the story immediately below level 1, using the sum of forces at that level and above?

A. 110 kips
B. 680 kips
C. 340 kips
D. 717 kips

39. Floor lateral forces from the first level through the roof are 70, 115, 165, and 220 kips. What story shear must pass through the story immediately below level 3, using the sum of forces at that level and above?

A. 165 kips
B. 350 kips
C. 385 kips
D. 570 kips

40. A wall anchorage line must transfer 182 kips through 14 identical anchors that are assumed to share load equally. Ignoring eccentricity, what demand is assigned to one anchor?

A. 8.45 kips
B. 17.55 kips
C. 15.17 kips
D. 13.00 kips

41. A wall anchorage line must transfer 216 kips through 18 identical anchors that are assumed to share load equally. Ignoring eccentricity, what demand is assigned to one anchor?

A. 12.00 kips
B. 7.80 kips
C. 16.20 kips
D. 13.50 kips

42. A wall anchorage line must transfer 154 kips through 11 identical anchors that are assumed to share load equally. Ignoring eccentricity, what demand is assigned to one anchor?

A. 9.10 kips
B. 18.90 kips

C. 14.00 kips
D. 17.11 kips

43. A rectangular tributary zone of exterior wall is 26 ft by 15 ft. If earthquake loading is represented by a uniform out-of-plane pressure of 0.38 kip/ft^2, what total force pA acts on that zone?

A. 103.7 kips
B. 148.2 kips
C. 192.7 kips
D. 15.6 kips

44. A 22-ft-wide by 17-ft-high wall region carries a uniform seismic pressure of 0.44 kip/ft^2 normal to its surface. Determine the total out-of-plane resultant over the full rectangle.

A. 115.2 kips
B. 214.0 kips
C. 17.2 kips
D. 164.6 kips

45. A large diaphragm opening interrupts the most direct route to a shear wall. What design response is most appropriate?

A. Assume the opening removes all seismic force
B. Ignore the wall because the diaphragm is discontinuous
C. Add nonstructural weight to balance the opening
D. Trace forces around the opening and design the required chords, collectors, and connections

46. When a heavier upper floor and a lighter lower floor are at the same elevation in two otherwise identical analytical cases, what happens to that floor's share of vertically distributed seismic force?

A. The heavier floor always receives less force

B. The floor weight has no influence on distribution
C. The heavier floor generally receives a larger share because its weight term is larger
D. The force becomes independent of elevation and weight

47. A floor-level force Fx = 465 kips is assigned a diaphragm design force Fpx = 0.68Fx for this exercise. What value of Fpx follows from the stated relationship?

A. 316.2 kips
B. 148.8 kips
C. 395.2 kips
D. 465.0 kips

48. A floor-level force Fx = 390 kips is assigned a diaphragm design force Fpx = 0.74Fx for this exercise. What value of Fpx follows from the stated relationship?

A. 101.4 kips
B. 288.6 kips
C. 360.8 kips
D. 390.0 kips

49. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 2.5, SDS = 0.64, Wp = 7.5 kips, z/h = 0.25, Rp = 3.0, and Ip = 1.0, what is Fp?

A. 1.49 kips
B. 2.40 kips
C. 3.31 kips
D. 1.60 kips

50. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 1.0, SDS = 0.82, Wp = 16 kips, z/h = 0.75, Rp = 2.5, and Ip = 1.0, what is Fp?

A. 3.25 kips
B. 7.24 kips
C. 2.10 kips
D. 5.25 kips

51. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 2.5, SDS = 0.58, Wp = 9 kips, z/h = 0.55, Rp = 3.5, and Ip = 1.0, what is Fp?

A. 3.13 kips
B. 1.94 kips
C. 4.32 kips
D. 1.49 kips

52. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 1.0, SDS = 0.9, Wp = 20 kips, z/h = 0.4, Rp = 2.0, and Ip = 1.0, what is Fp?

A. 4.02 kips
B. 8.94 kips
C. 6.48 kips
D. 3.60 kips

53. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 2.5, SDS = 0.7, Wp = 5.5 kips, z/h = 0.9, Rp = 2.5, and Ip = 1.0, what is Fp?

A. 4.31 kips
B. 2.67 kips
C. 5.95 kips
D. 1.54 kips

54. For a component-force drill use Fp = 0.4 ap SDS Wp(1 + 2z/h)/(Rp/Ip), and ignore any separate minimum or maximum. With ap = 1.0, SDS = 0.66, Wp = 28 kips, z/h = 0.15, Rp = 3.0, and Ip = 1.0, what is Fp?

A. 1.98 kips
B. 4.42 kips
C. 2.46 kips
D. 3.20 kips

55. A rigid equipment platform weighs 460 kips for seismic purposes. A simplified coefficient Cs = 0.19 is specified, with V = CsW. What lateral base shear is assigned to the platform?

A. 52.4 kips
B. 87.4 kips
C. 122.4 kips
D. 2421.1 kips

56. A freestanding process vessel has effective seismic weight 285 kips. For this exercise its lateral coefficient is Cs = 0.24 and V = CsW. Calculate the design base shear.

A. 41.0 kips
B. 95.8 kips
C. 68.4 kips
D. 1187.5 kips

57. A supported industrial tank is idealized with effective seismic weight 620 kips and coefficient Cs = 0.17. Under the stated rule V = CsW, what horizontal base shear results?

A. 63.2 kips
B. 147.6 kips

C. 3647.1 kips
D. 105.4 kips

58. A nonbuilding equipment frame has effective seismic weight 345 kips. Using the exercise coefficient Cs = 0.21 in V = CsW, determine its base shear.

A. 72.5 kips
B. 43.5 kips
C. 101.5 kips
D. 1642.9 kips

59. A piece of rooftop equipment transfers a horizontal seismic force of 96 kips through 8 identical support points with equal stiffness. Under the stated equal-share idealization, what horizontal force acts at each support?

A. 6.0 kips
B. 18.0 kips
C. 12.0 kips
D. 13.7 kips

60. A piece of rooftop equipment transfers a horizontal seismic force of 132 kips through 12 identical support points with equal stiffness. Under the stated equal-share idealization, what horizontal force acts at each support?

A. 5.5 kips
B. 11.0 kips
C. 16.5 kips
D. 12.0 kips

61. A rooftop air-handling unit has strong anchor bolts but a lightly framed curb below it. What is the main seismic design concern?

A. Anchor bolts cancel equipment acceleration
B. The curb carries only architectural finishes
C. Roof framing is irrelevant to seismic attachment
D. Carry equipment inertia through curb and roof framing

62. If a component's response acceleration is unchanged but its seismic weight is increased by 30 percent, what happens to its inertial force before other limits are considered?

A. It decreases by 30 percent
B. It remains unchanged
C. It increases 30% because inertia is proportional to weight
D. It drops to zero if anchorage is strong

63. A rigid diaphragm delivers 490 kips of direct story shear to three parallel resisting lines with stiffnesses 140, 210, and 350 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 3?

A. 245.0 kips
B. 163.3 kips
C. 264.0 kips
D. 0.7 kips

64. A rigid diaphragm delivers 420 kips of direct story shear to three parallel resisting lines with stiffnesses 280, 170, and 150 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 1?

A. 140.0 kips
B. 196.0 kips
C. 224.0 kips
D. 0.7 kips

65. A rigid diaphragm delivers 510 kips of direct story shear to three parallel resisting lines with stiffnesses 110, 240, and 330 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 2?

A. 170.0 kips
B. 330.0 kips
C. 0.8 kips
D. 180.0 kips

66. A rigid diaphragm delivers 455 kips of direct story shear to three parallel resisting lines with stiffnesses 190, 260, and 250 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 2?

A. 151.7 kips
B. 169.0 kips
C. 286.0 kips
D. 0.7 kips

67. A rigid diaphragm delivers 390 kips of direct story shear to three parallel resisting lines with stiffnesses 160, 290, and 130 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 1?

A. 107.6 kips
B. 130.0 kips
C. 282.4 kips
D. 0.7 kips

68. A rigid diaphragm delivers 600 kips of direct story shear to three parallel resisting lines with stiffnesses 230, 310, and 360 kip/in. If direct shear is allocated in proportion to stiffness, how much goes to line 3?

A. 200.0 kips

B. 360.0 kips
C. 240.0 kips
D. 0.7 kips

69. Find the stiffness-weighted x-coordinate of resistance for three lines at 0, 24, and 52 ft with lateral stiffnesses 120, 240, and 300 kip/in. Evaluate xCR = (Σkixi)/(Σki).

A. x = 32.4 ft
B. x = 25.3 ft
C. x = 39.9 ft
D. x = 25.9 ft

70. Resistance lines occur at x = 0, 32, and 68 ft and have stiffnesses 280, 170, and 150 kip/in. What stiffness-weighted center coordinate xCR = (Σkixi)/(Σki) follows?

A. x = 33.3 ft
B. x = 33.6 ft
C. x = 19.6 ft
D. x = 26.1 ft

71. A diaphragm is supported by three lateral lines at x = 6, 30, and 60 ft. Their stiffnesses are 200, 260, and 220 kip/in. Determine the stiffness centroid xCR from Σkixi/Σki.

A. x = 32.0 ft
B. x = 40.1 ft
C. x = 32.6 ft
D. x = 26.1 ft

72. For resisting lines at x = 0, 20, and 50 ft with stiffnesses 180, 330, and 190 kip/in, calculate the x-coordinate of the center of rigidity using the stiffness-weighted average.

A. x = 23.3 ft
B. x = 23.0 ft
C. x = 30.5 ft
D. x = 16.5 ft

73. A story shear resultant of 450 kips acts 3.2 ft from the center of rigidity. What torsional moment Ve must be included before distributing torsional effects to the resisting lines?

A. 1,440.0 kip-ft
B. 864.0 kip-ft
C. 2,016.0 kip-ft
D. 140.6 kip-ft

74. A story shear resultant of 385 kips acts 4.6 ft from the center of rigidity. What torsional moment Ve must be included before distributing torsional effects to the resisting lines?

A. 1,062.6 kip-ft
B. 1,771.0 kip-ft
C. 2,479.4 kip-ft
D. 83.7 kip-ft

75. A story shear resultant of 540 kips acts 2.5 ft from the center of rigidity. What torsional moment Ve must be included before distributing torsional effects to the resisting lines?

A. 810.0 kip-ft
B. 1,890.0 kip-ft
C. 1,350.0 kip-ft
D. 216.0 kip-ft

76. A story shear resultant of 325 kips acts 5.4 ft from the center of rigidity. What torsional moment Ve must be included before distributing torsional effects to the resisting lines?

A. 1,053.0 kip-ft
B. 2,457.0 kip-ft
C. 60.2 kip-ft
D. 1,755.0 kip-ft

77. For a simplified flexible-diaphragm tributary-width model, 420 kips is distributed to three resisting lines with tributary widths 18, 27, and 35 ft. What force goes to line 3?

A. 140.0 kips
B. 236.2 kips
C. 420.0 kips
D. 183.8 kips

78. For a simplified flexible-diaphragm tributary-width model, 360 kips is distributed to three resisting lines with tributary widths 22, 18, and 30 ft. What force goes to line 1?

A. 120.0 kips
B. 113.1 kips
C. 246.9 kips
D. 264.0 kips

79. For a simplified flexible-diaphragm tributary-width model, 500 kips is distributed to three resisting lines with tributary widths 20, 25, and 25 ft. What force goes to line 2?

A. 178.6 kips
B. 166.7 kips
C. 321.4 kips
D. 500.0 kips

80. For a simplified flexible-diaphragm tributary-width model, 450 kips is distributed to three resisting lines with tributary widths 16, 24, and 40 ft. What force goes to line 3?

A. 150.0 kips
B. 241.0 kips
C. 225.0 kips
D. 450.0 kips

81. A chord pair separated by 42 ft is idealized as a force couple resisting a diaphragm moment of 2,100 kip-ft. If Fd = M, what magnitude F acts in each chord?

A. 30.0 kips
B. 70.0 kips
C. 50.0 kips
D. 100.0 kips

82. A diaphragm moment of 2,750 kip-ft is resisted by chord resultants 50 ft apart. Using the idealized couple relation F = M/d, determine the chord force magnitude.

A. 55.0 kips
B. 33.0 kips
C. 77.0 kips
D. 110.0 kips

83. Two diaphragm chord resultants are separated by 37.5 ft and resist an in-plane moment of 1,875 kip-ft. What tension/compression magnitude follows from F = M/d?

A. 30.0 kips
B. 50.0 kips
C. 70.0 kips
D. 100.0 kips

84. A 3,360 kip-ft in-plane diaphragm moment is carried by a chord couple with a 48-ft lever arm. Determine the required chord-force magnitude from Fd = M.

A. 42.0 kips
B. 98.0 kips
C. 140.0 kips
D. 70.0 kips

85. Adjacent floors move 3.4 inches and 1.9 inches in the same horizontal direction. What is the interstory drift between those two levels?

A. 0.75 in.
B. 2.65 in.
C. 1.5 in.
D. 5.3 in.

86. For a collector demand check, evaluate the stated combination U = 1.2D + E + 0.5L using D = 610 kips, E = 205 kips, and L = 140 kips.

A. 837 kips
B. 937 kips
C. 1,077 kips
D. 1,007 kips

87. A rigid-diaphragm model predicts large torsional amplification at one perimeter wall. What modeling feature should be checked first for consistency with that result?

A. The interior paint specification
B. The locations and relative stiffnesses that define mass-rigidity eccentricity
C. The roof drainage slope only
D. The concrete curing schedule only

88. What is the principal analytical function of a collector where diaphragm shear cannot enter a wall directly?

A. Collect diaphragm force and deliver it to the vertical resisting element
B. Replace every diaphragm chord along the force path
C. Remove all torsional effects from the diaphragm system
D. Carry only ceiling gravity load across the diaphragm

89. At a reinforced-concrete plastic-hinge region, why are closely spaced transverse hoops valuable during cyclic deformation?

A. They eliminate all flexural cracking
B. They confine core concrete and restrain longitudinal-bar buckling
C. They replace longitudinal reinforcement
D. They remove axial load from the member

90. Why should a ductile moment-frame splice be kept away from the region expected to experience the largest cyclic plastic strains?

A. Splices make all yielding impossible
B. Concrete cover alone carries tension
C. Splices always increase curvature capacity
D. Bond deterioration and slip could interrupt the intended ductile mechanism

91. A steel seismic weld looks smooth after grinding. Why is compliance with the specified qualified welding procedure still essential?

A. Qualified procedures govern variables that surface appearance cannot verify
B. Any electrode gives identical cyclic behavior
C. Grinding proves fracture toughness
D. Visual smoothness guarantees internal quality

92. At the end of a yielding steel brace, why can gusset-plate geometry matter even when the plate has adequate nominal strength?

A. Only plate color affects cyclic response
B. Brace force stops before reaching the gusset
C. Geometry controls force transfer and brace deformation capacity
D. Thickness alone determines every deformation mode

93. During reinforced-masonry construction, why should bar location and grout consolidation be verified before the wall is concealed?

A. They affect only wall color
B. Grout makes bar location irrelevant
C. They ensure bond, composite action, and load-path continuity
D. Masonry never develops cyclic tension

94. Why are edge distance and embedment important when a seismic anchor transfers tension or shear into concrete?

A. Steel failure always governs regardless of geometry
B. Concrete breakout can govern before anchor steel failure
C. Closer edges always increase capacity
D. Embedment affects only architectural appearance

95. A wood shear-wall schedule specifies closely controlled panel-edge nailing. What seismic behavior is that detail intended to develop?

A. Distributed shear transfer with predictable strength, slip, and cyclic deformation
B. Concrete compression at the wall base only
C. Elimination of all overturning tension
D. A change in the site's seismic category

96. A drag element reaches a shear wall only after crossing a construction joint. Which connection requirement at that interface preserves the intended seismic force path?

A. Terminate the collector at the joint
B. Transfer the force through finish materials
C. Ignore force direction across the joint
D. Maintain collector-force continuity across the construction joint

97. During shaking, a heavy masonry wall tends to move out of plane relative to the roof. Why is a positive wall-to-roof anchorage detail important for life safety?

A. Transfer wall inertia into the diaphragm for lateral support
B. Increase roof dead load intentionally
C. Eliminate every in-plane wall force
D. Prevent all foundation movement

98. Two wings can drift independently across a seismic separation, yet a sprinkler pipe must pass between them. What performance should the pipe crossing provide during the design movement?

A. Act as a rigid structural brace between wings
B. Assume the joint never changes width
C. Remove all supports near the crossing
D. Accommodate relative movement without rupture or unintended restraint

99. Inspection reveals that a brace-to-frame seismic connection was built with a field modification not shown in the approved detail. Before the work is accepted, what should occur?

A. Accept it because construction is complete
B. Document it and obtain engineering evaluation or approved correction
C. Delete the observation from the report
D. Assume the capacity is unchanged without review

100. On a major seismic project, the design professional periodically visits the site to review significant structural work and noteworthy deviations. What is the purpose of that structural-observation activity?

A. Replace every special inspection and test

B. Guarantee the building will suffer no earthquake damage

C. Provide focused review of important structural work and observed departures from design intent

D. Eliminate the need for approved construction documents

Practice Exam 17: Answer Key and Explanations

1. B — Apply the stated site modification directly: SMS = 1.15(1.26 g) = 1.449 g. Dividing by Fa, copying Ss unchanged, or adding the numerical inputs does not follow the supplied relationship, so those operations lead to the distractors rather than the site-adjusted short-period ordinate. Check the units and the physical direction of the effect before selecting an answer.

2. C — Multiplying 0.87 g by two-thirds gives SD1 = 0.580 g. The 0.435 g choice uses one-half, 0.870 g omits the reduction, and 1.305 g increases the value by one-half instead. The equation in the stem therefore determines the design one-second ordinate unambiguously. Check the units and the physical direction of the effect before selecting an answer.

3. D — The transition period follows the ratio stated in the problem: Ts = 0.54/0.90 = 0.60 second. Multiplication, addition, or reversing the ratio produces the other values and does not preserve the required units. A period must have time units rather than acceleration units. Check the units and the physical direction of the effect before selecting an answer.

4. A — Loose saturated granular soil can lose effective stress during cyclic shaking, and proximity to a free face creates a setting where lateral spreading may accompany liquefaction. Dry shrinkage, wind scour, and thermal expansion are different mechanisms and do not match the combination of saturation, loose sand, and earthquake loading described.

5. B — The occupancy and consequence of failure are reflected through risk category and related importance provisions. Mapped hazard and soil properties belong to the site, while concrete unit weight is a material property. Changing the building function therefore changes the occupancy-related design treatment rather than the regional ground-motion map or geotechnical classification.

6. C — The stated spectrum relationship gives Ts = 0.47/0.78 = 0.6026 second, which rounds to 0.60 second. Multiplying the ordinates, dividing in the opposite direction, or adding them creates different quantities. The ratio is dimensionally consistent because the acceleration units cancel, leaving seconds in the defined spectrum relation. This also provides a quick reasonableness check on the selected option.

7. D — Site class characterizes near-surface soil and rock behavior that can amplify or deamplify mapped ground motion over different period ranges. It does not determine occupancy, dictate structural material, or eliminate seismic mass. The design spectrum therefore combines regional hazard information with local site-response characteristics before structural forces are finalized. This also provides a quick reasonableness check on the selected option.

8. C — These values document the hazard, site response, occupancy consequence, and resulting design classification that underlie later seismic calculations and detailing decisions. They do not replace structural drawings, control only finishes, or eliminate inspection. Recording the design basis allows reviewers and constructors to understand the assumptions from which the seismic system was developed.

9. A — For equal lateral force, elastic drift is inversely proportional to stiffness. Therefore driftQ/driftP = kP/kQ = 1050/700 = 1.50. The 0.67 option reverses the ratio, while 1.20 and 1.80 do not follow from force divided by stiffness. The less stiff frame experiences the larger translation. Check the units and the physical direction of the effect before selecting an answer.

10. D — Using the stated linear model, displacement equals shear divided by stiffness: 675/225 = 3.00 inches. The 0.33-inch value reverses the ratio, 1.50 inches arbitrarily halves the response, and 6.00 inches doubles it. The calculation is a direct force-deflection relationship for the idealized story. Check the units and the physical direction of the effect before selecting an answer.

11. B — Parallel resisting lines undergo compatible story translation, so their individual resisting forces add. The equivalent stiffness is therefore 420 + 580 = 1,000 kip/in. A reciprocal-style combination is inappropriate, keeping only 580 ignores one line, and 1,420 does not follow from the stated parallel arrangement. Check the units and the physical direction of the effect before selecting an answer.

12. A — Under the stated conservative approach, the possible closing movements are added because both structures can move toward the joint at the same time. Thus 2.4 + 1.9 = 4.3 inches. Subtraction, averaging, or adding an arbitrary extra inch does not match the defined separation check. Check the units and the physical direction of the effect before selecting an answer.

13. D — Lateral inertia acts through the center of mass, while resistance is centered near the center of rigidity. Their offset creates a torsional moment that rotates the diaphragm and changes force demand among resisting lines. It does not remove story shear, improve soil bearing capacity, or eliminate diaphragm action. This also provides a quick reasonableness check on the selected option.

14. C — A pronounced drop in lateral stiffness over one story concentrates interstory deformation and is characteristic of a soft-story type vertical irregularity. Uniform framing, repeated column sizes, and a centered mass distribution do not themselves create that stiffness discontinuity. Concentrated drift can increase second-order effects and damage at the flexible level.

15. B — Redundancy provides more than one effective path for resisting and transferring earthquake forces, reducing reliance on a single element or line whose failure could be disproportionate. It does not guarantee elastic response, eliminate torsion, or make connections unnecessary. The benefit is improved robustness when demands redistribute during strong shaking. This also provides a quick reasonableness check on the selected option.

16. A — Ductility is the capacity to sustain substantial inelastic deformation while retaining useful strength and energy-dissipation ability. Mass eccentricity can increase torsion, brittleness promotes sudden failure, and gravity load is a demand rather than a deformation capacity. Earthquake-resistant systems therefore rely on deliberate ductile mechanisms supported by appropriate detailing. This also provides a quick reasonableness check on the selected option.

17. D — Heavy URM walls are vulnerable to out-of-plane separation when roof or floor diaphragms do not provide reliable positive anchorage. Strengthening wall-to-diaphragm connections and the receiving load path directly addresses that mechanism. Adding contents or finishes increases mass, while removing blocking can weaken rather than improve transfer. Check the units and the physical direction of the effect before selecting an answer.

18. A — Precast systems can be vulnerable where members depend on limited bearing length or brittle connections that must accommodate earthquake deformation. Loss of support or connection failure can interrupt both lateral and gravity load paths. Cosmetic cracking, localized office loading, and interior wind pressure do not represent the same critical seismic connection mechanism.

19. B — Flat-plate slab-column regions carry gravity load while also undergoing drift-related deformation. Severe punching damage can reduce the connection's ability to support the slab and may create local or progressive collapse risk. The observation does not prove liquefaction, increase ductility, or establish diaphragm rigidity, so detailed structural evaluation is warranted. This also provides a quick reasonableness check on the selected option.

20. C — A soft first story concentrates lateral deformation because its stiffness and often its strength are substantially lower than the levels above. Adding appropriately designed lateral elements can reduce that concentration and improve the force path. Increasing flexibility, moving mass upward, or removing gravity support would worsen rather than correct the vulnerability.

21. C — A retrofit should prevent the brittle connection from governing before the intended brace or system mechanism can dissipate energy. Strengthening and detailing the connection for compatible cyclic behavior addresses the controlling weakness. Added mass, increased eccentricity, or reduced inspection would increase demand or uncertainty rather than improve seismic performance. This also provides a quick reasonableness check on the selected option.

22. D — Major new permanent deformation or connection damage in a primary lateral element can indicate reduced strength, stiffness, or stability and therefore supports conservative occupancy restriction. Fallen contents, shifted ceiling tiles, and paint crazing document shaking but do not by themselves demonstrate comparable structural danger. The screening decision should focus on life-safety significance.

23. A — First evaluate $Cs = 0.82/(7.0/1.00) = 0.1171$. Multiplying that coefficient by 2,450 kips gives $V = 287.0$ kips. The distractors apply arbitrary scaling or omit the response-modification denominator, so they do not follow the relationship stated in the exercise. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

24. B — First evaluate $Cs = 0.68/(6.0/1.00) = 0.1133$. Multiplying that coefficient by 3,320 kips gives $V = 376.3$ kips. The distractors apply arbitrary scaling or omit the response-modification denominator, so they do not follow the relationship stated in the exercise. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

25. C — First evaluate $C_s = 0.95/(8.0/1.25) = 0.1484$. Multiplying that coefficient by 1,960 kips gives $V = 290.9$ kips. The distractors apply arbitrary scaling or omit the response-modification denominator, so they do not follow the relationship stated in the exercise. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

26. A — First evaluate $C_s = 0.74/(5.0/1.00) = 0.1480$. Multiplying that coefficient by 2,780 kips gives $V = 411.4$ kips. The distractors apply arbitrary scaling or omit the response-modification denominator, so they do not follow the relationship stated in the exercise. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

27. D — Substituting the given values into $T_a = C_t h_n^x$ gives approximately 0.75 second. The other choices scale or offset the result rather than following the supplied power-law expression. Calculating the period consistently is important because later force coefficients may depend on which portion of the response spectrum is used. This also provides a quick reasonableness check on the selected option.

28. B — Substituting the given values into $T_a = C_t h_n^x$ gives approximately 0.60 second. The other choices scale or offset the result rather than following the supplied power-law expression. Calculating the period consistently is important because later force coefficients may depend on which portion of the response spectrum is used. This also provides a quick reasonableness check on the selected option.

29. B — Substituting the given values into $T_a = C_t h_n^x$ gives approximately 0.77 second. The other choices scale or offset the result rather than following the supplied power-law expression. Calculating the period consistently is important because later force coefficients may depend on which portion of the response spectrum is used. This also provides a quick reasonableness check on the selected option.

30. A — Substituting the given values into $T_a = C_t h_n^x$ gives approximately 0.51 second. The other choices scale or offset the result rather than following the supplied power-law expression. Calculating the period consistently is important because later force coefficients may depend on which portion of the response spectrum is used. This also provides a quick reasonableness check on the selected option.

31. C — Each level contribution is $w_i h_i^k$, then the selected level's contribution is divided by the sum of all three. Using the stated weights, heights, and k gives $C_{vx} = 0.590$ for the roof level. The other fractions come from different weighting assumptions or from ignoring the normalization step. This also provides a quick reasonableness check on the selected option.

32. D — Each level contribution is $w_i h_i^k$, then the selected level's contribution is divided by the sum of all three. Using the stated weights, heights, and k gives $C_{vx} = 0.361$ for the second level. The other fractions come from different weighting assumptions or from ignoring the normalization step. This also provides a quick reasonableness check on the selected option.

33. A — Each level contribution is $w_i h_i^k$, then the selected level's contribution is divided by the sum of all three. Using the stated weights, heights, and k gives $C_{vx} = 0.094$ for the first level. The other fractions come from different weighting assumptions or from ignoring the normalization step. This also provides a quick reasonableness check on the selected option.

34. B — Each level contribution is wi hi^k, then the selected level's contribution is divided by the sum of all three. Using the stated weights, heights, and k gives Cvx = 0.576 for the roof level. The other fractions come from different weighting assumptions or from ignoring the normalization step. This also provides a quick reasonableness check on the selected option.

35. D — Each level contribution is wi hi^k, then the selected level's contribution is divided by the sum of all three. Using the stated weights, heights, and k gives Cvx = 0.358 for the second level. The other fractions come from different weighting assumptions or from ignoring the normalization step. This also provides a quick reasonableness check on the selected option.

36. C — Story shear is cumulative: the story immediately below level 2 must transmit every lateral force applied at that level and above. Summing the relevant floor forces gives 528 kips. The distractors use only one floor, sum the wrong side of the building, or use the total base shear when it is not required.

37. A — Story shear is cumulative: the story immediately below level 3 must transmit every lateral force applied at that level and above. Summing the relevant floor forces gives 365 kips. The distractors use only one floor, sum the wrong side of the building, or use the total base shear when it is not required.

38. B — Story shear is cumulative: the story immediately below level 1 must transmit every lateral force applied at that level and above. Summing the relevant floor forces gives 680 kips. The distractors use only one floor, sum the wrong side of the building, or use the total base shear when it is not required.

39. C — Story shear is cumulative: the story immediately below level 3 must transmit every lateral force applied at that level and above. Summing the relevant floor forces gives 385 kips. The distractors use only one floor, sum the wrong side of the building, or use the total base shear when it is not required.

40. D — Equal sharing under the stated assumption means dividing total anchorage force by the number of participating anchors: 182/14 = 13.00 kips per anchor. The alternatives arbitrarily scale the result or assume fewer anchors. Real anchorage design may require additional checks, but this exercise isolates the equal-distribution calculation. This also provides a quick reasonableness check on the selected option.

41. A — Equal sharing under the stated assumption means dividing total anchorage force by the number of participating anchors: 216/18 = 12.00 kips per anchor. The alternatives arbitrarily scale the result or assume fewer anchors. Real anchorage design may require additional checks, but this exercise isolates the equal-distribution calculation. This also provides a quick reasonableness check on the selected option.

42. C — Equal sharing under the stated assumption means dividing total anchorage force by the number of participating anchors: 154/11 = 14.00 kips per anchor. The alternatives arbitrarily scale the result or assume fewer anchors. Real anchorage design may require additional checks, but this exercise isolates the equal-distribution calculation. This also provides a quick reasonableness check on the selected option.

43. B — The resultant of uniform pressure equals pressure times tributary area. The area is 26(15) = 390 ft^2, so the force is 0.38(390) = 148.2 kips. The distractors apply arbitrary factors or use a perimeter-like expression rather than the pressure-area relationship. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

44. D — The resultant of uniform pressure equals pressure times tributary area. The area is 22(17) = 374 ft^2, so the force is 0.44(374) = 164.6 kips. The distractors apply arbitrary factors or use a perimeter-like expression rather than the pressure-area relationship. After the arithmetic, the calculated force still has to be traced through diaphragms, collectors, vertical elements, connections, and foundations.

45. D — A large opening changes the in-plane stress field and can concentrate shear, chord, and collector demands around its edges. The design should explicitly trace an alternate load path into the vertical resisting system. The opening does not eliminate inertia force, justify ignoring the wall, or become safer simply by adding nonstructural mass.

46. C — Vertical distribution expressions weight each level by seismic weight together with an elevation term. Holding height and the exponent constant, increasing a floor's participating weight increases its numerator and therefore its share of the total. The alternatives contradict the stated weight-height form or incorrectly remove weight from the distribution. This also provides a quick reasonableness check on the selected option.

47. A — The stem defines diaphragm force as a direct fraction of the floor-level force. Multiplying 0.68 by 465 kips gives Fpx = 316.2 kips. The other choices use the complementary fraction, arbitrarily increase the product, or retain the full floor force instead of applying the specified multiplier. Check the units and the physical direction of the effect before selecting an answer.

48. B — The stem defines diaphragm force as a direct fraction of the floor-level force. Multiplying 0.74 by 390 kips gives Fpx = 288.6 kips. The other choices use the complementary fraction, arbitrarily increase the product, or retain the full floor force instead of applying the specified multiplier. Check the units and the physical direction of the effect before selecting an answer.

49. B — Substitution into the equation supplied in the stem gives Fp = 2.40 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

50. D — Substitution into the equation supplied in the stem gives Fp = 5.25 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

51. A — Substitution into the equation supplied in the stem gives Fp = 3.13 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

52. C — Substitution into the equation supplied in the stem gives Fp = 6.48 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

53. A — Substitution into the equation supplied in the stem gives Fp = 4.31 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

54. D — Substitution into the equation supplied in the stem gives Fp = 3.20 kips. The distractors either omit the height amplification term or scale the result without support. Because the exercise explicitly excludes separate minimum and maximum checks, the task is only to evaluate the stated component-force expression consistently. This also provides a quick reasonableness check on the selected option.

55. B — The relationship given in the problem is a direct product: V = 0.19(460) = 87.4 kips. The distractors arbitrarily scale that product or divide by the coefficient, which produces a quantity inconsistent with the defined force equation. The coefficient is dimensionless, so the result retains force units. This also provides a quick reasonableness check on the selected option.

56. C — The relationship given in the problem is a direct product: V = 0.24(285) = 68.4 kips. The distractors arbitrarily scale that product or divide by the coefficient, which produces a quantity inconsistent with the defined force equation. The coefficient is dimensionless, so the result retains force units. This also provides a quick reasonableness check on the selected option.

57. D — The relationship given in the problem is a direct product: V = 0.17(620) = 105.4 kips. The distractors arbitrarily scale that product or divide by the coefficient, which produces a quantity inconsistent with the defined force equation. The coefficient is dimensionless, so the result retains force units. This also provides a quick reasonableness check on the selected option.

58. A — The relationship given in the problem is a direct product: V = 0.21(345) = 72.5 kips. The distractors arbitrarily scale that product or divide by the coefficient, which produces a quantity inconsistent with the defined force equation. The coefficient is dimensionless, so the result retains force units. This also provides a quick reasonableness check on the selected option.

59. C — Equal support stiffness and the stated symmetric idealization mean the total component force is divided by 8: 96/8 = 12.0 kips per support. The other options apply arbitrary scaling or use a different number of supports. Actual equipment anchorage may also require eccentricity and connection checks beyond this simplified distribution.

60. B — Equal support stiffness and the stated symmetric idealization mean the total component force is divided by 12: 132/12 = 11.0 kips per support. The other options apply arbitrary scaling or use a different number of supports. Actual equipment anchorage may also require eccentricity and connection checks beyond this simplified distribution.

61. D — Seismic component force must travel from the equipment through the anchors, curb or support frame, local roof structure, and into the building load path. Strong anchor bolts do not protect a weak curb or receiving frame. The curb may be structural, and roof framing is an essential part of the attachment rather than an unrelated element.

62. C — For unchanged response acceleration, inertial force is directly proportional to mass and therefore to seismic weight. Increasing the weight by 30 percent increases the uncapped inertial force by the same percentage. Strong anchorage does not make inertia disappear, and neither an unchanged nor reduced force is consistent with the basic mass-acceleration relationship.

63. A — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 3 therefore receives 350/700 of 490 kips, or 245.0 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

64. B — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 1 therefore receives 280/600 of 420 kips, or 196.0 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

65. D — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 2 therefore receives 240/680 of 510 kips, or 180.0 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

66. B — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 2 therefore receives 260/700 of 455 kips, or 169.0 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

67. A — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 1 therefore receives 160/580 of 390 kips, or 107.6 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

68. C — Compatible translation under a rigid-diaphragm idealization causes direct shear to distribute in proportion to lateral stiffness. Line 3 therefore receives 360/900 of 600 kips, or 240.0 kips. The alternatives use equal sharing, complementary stiffness, or an unnormalized ratio instead of the required proportional allocation. Check the units and the physical direction of the effect before selecting an answer.

69. A — The center of rigidity is a stiffness-weighted coordinate. Multiplying each location by its stiffness, summing those products, and dividing by total stiffness gives xCR = 32.4 ft. A simple geometric average ignores the unequal stiffnesses, while the shifted alternatives have no equilibrium basis in the supplied analytical model. This also provides a quick reasonableness check on the selected option.

70. D — The center of rigidity is a stiffness-weighted coordinate. Multiplying each location by its stiffness, summing those products, and dividing by total stiffness gives xCR = 26.1 ft. A simple geometric average ignores the unequal stiffnesses, while the shifted alternatives have no equilibrium basis in the supplied analytical model. This also provides a quick reasonableness check on the selected option.

71. C — The center of rigidity is a stiffness-weighted coordinate. Multiplying each location by its stiffness, summing those products, and dividing by total stiffness gives xCR = 32.6 ft. A simple geometric average ignores the unequal stiffnesses, while the shifted alternatives have no equilibrium basis in the supplied analytical model. This also provides a quick reasonableness check on the selected option.

72. B — The center of rigidity is a stiffness-weighted coordinate. Multiplying each location by its stiffness, summing those products, and dividing by total stiffness gives xCR = 23.0 ft. A simple geometric average ignores the unequal stiffnesses, while the shifted alternatives have no equilibrium basis in the supplied analytical model. This also provides a quick reasonableness check on the selected option.

73. A — Torsional moment is the lateral force multiplied by the perpendicular eccentricity: 450(3.2) = 1,440.0 kip-ft. The alternatives scale the product arbitrarily or divide force by distance, which has incompatible units. That torsional action is then combined with direct shear when evaluating individual resisting-line demands. Check the units and the physical direction of the effect before selecting an answer.

74. B — Torsional moment is the lateral force multiplied by the perpendicular eccentricity: 385(4.6) = 1,771.0 kip-ft. The alternatives scale the product arbitrarily or divide force by distance, which has incompatible units. That torsional action is then combined with direct shear when evaluating individual resisting-line demands. Check the units and the physical direction of the effect before selecting an answer.

75. C — Torsional moment is the lateral force multiplied by the perpendicular eccentricity: 540(2.5) = 1,350.0 kip-ft. The alternatives scale the product arbitrarily or divide force by distance, which has incompatible units. That torsional action is then combined with direct shear when evaluating individual resisting-line demands. Check the units and the physical direction of the effect before selecting an answer.

76. D — Torsional moment is the lateral force multiplied by the perpendicular eccentricity: 325(5.4) = 1,755.0 kip-ft. The alternatives scale the product arbitrarily or divide force by distance, which has incompatible units. That torsional action is then combined with direct shear when evaluating individual resisting-line demands. Check the units and the physical direction of the effect before selecting an answer.

77. D — Under the stated flexible-diaphragm idealization, force follows tributary width rather than stiffness. Line 3 receives 35/80 of the 420-kip total, giving 183.8 kips. Equal sharing, complementary width, or normalization by only the largest width does not match the distribution assumption given in the stem. Check the units and the physical direction of the effect before selecting an answer.

78. B — Under the stated flexible-diaphragm idealization, force follows tributary width rather than stiffness. Line 1 receives 22/70 of the 360-kip total, giving 113.1 kips. Equal sharing, complementary width, or normalization by only the largest width does not match the distribution assumption given in the stem. Check the units and the physical direction of the effect before selecting an answer.

79. A — Under the stated flexible-diaphragm idealization, force follows tributary width rather than stiffness. Line 2 receives 25/70 of the 500-kip total, giving 178.6 kips. Equal sharing, complementary width, or normalization by only the largest width does not match the distribution assumption given in the stem. Check the units and the physical direction of the effect before selecting an answer.

80. C — Under the stated flexible-diaphragm idealization, force follows tributary width rather than stiffness. Line 3 receives 40/80 of the 450-kip total, giving 225.0 kips. Equal sharing, complementary width, or normalization by only the largest width does not match the distribution assumption given in the stem. Check the units and the physical direction of the effect before selecting an answer.

81. C — The diaphragm chord couple resists in-plane bending. Dividing the moment by the effective separation gives F = 2100/42 = 50.0 kips. The distractors change the lever arm or scale the result without justification. Chord splices and connections must be capable of transferring the resulting tension or compression. This also provides a quick reasonableness check on the selected option.

82. A — The diaphragm chord couple resists in-plane bending. Dividing the moment by the effective separation gives F = 2750/50 = 55.0 kips. The distractors change the lever arm or scale the result without justification. Chord splices and connections must be capable of transferring the resulting tension or compression. This also provides a quick reasonableness check on the selected option.

83. B — The diaphragm chord couple resists in-plane bending. Dividing the moment by the effective separation gives F = 1875/37.5 = 50.0 kips. The distractors change the lever arm or scale the result without justification. Chord splices and connections must be capable of transferring the resulting tension or compression. This also provides a quick reasonableness check on the selected option.

84. D — The diaphragm chord couple resists in-plane bending. Dividing the moment by the effective separation gives F = 3360/48 = 70.0 kips. The distractors change the lever arm or scale the result without justification. Chord splices and connections must be capable of transferring the resulting tension or compression. This also provides a quick reasonableness check on the selected option.

85. C — Interstory drift is the relative displacement between adjacent floors, so the smaller displacement is subtracted from the larger: 3.4 - 1.9 = 1.5 inches. The other values come from halving, averaging, or adding the floor displacements. Drift checks use relative movement rather than either floor's absolute translation. This also provides a quick reasonableness check on the selected option.

86. D — Apply each coefficient exactly as stated: 1.2(610) + 205 + 0.5(140) = 732 + 205 + 70 = 1,007 kips. The distractors omit or misapply one of the factors. Load-combination arithmetic establishes the combined effect before that demand is distributed through the structural system. Check the units and the physical direction of the effect before selecting an answer.

87. B — Rigid-diaphragm torsion depends on the offset between applied inertia force and the center of rigidity, along with the location and stiffness of resisting elements. Those analytical inputs should therefore be checked first. Paint, drainage slope, and curing schedules may matter elsewhere in a project but do not define the plan torsion mechanism.

88. A — A collector or drag element gathers in-plane diaphragm force and transfers it across an offset, opening, or discontinuity into a wall, frame, or brace line. It does not replace chords, eliminate building torsion, or serve only ceiling gravity loads. The analysis must include both the collector force and the connections that complete the load path.

89. B — Closely spaced transverse reinforcement helps maintain core-concrete integrity and restrains longitudinal bars against buckling as the member undergoes repeated inelastic curvature. That confinement supports ductile cyclic behavior. Hoops do not prevent all cracking, substitute for longitudinal steel, or remove axial force. Their purpose is controlled deformation without abrupt strength degradation.

90. D — Plastic-hinge regions experience large cyclic strains, cracking, and bond demand. Locating a lap splice there can promote slip or premature bond deterioration before the intended ductile mechanism develops. Moving the splice away from the most highly strained zone reduces that risk. Splices do not prevent yielding or automatically increase curvature capacity.

91. A — Seismic weld performance depends on base metal, filler metal, procedure variables, joint preparation, workmanship, and acceptance criteria. A smooth surface alone cannot demonstrate that those requirements were satisfied. Qualified procedures and inspection provide control beyond appearance. Using arbitrary electrodes or assuming grinding proves fracture toughness can conceal rather than prevent connection weakness.

92. C — Gusset geometry influences load transfer, connection eccentricity, and the space available for brace rotation or out-of-plane deformation during cyclic response. Adequate nominal plate strength alone does not guarantee compatible deformation. The force must pass through the gusset, and thickness is only one of several variables controlling connection behavior. This also provides a quick reasonableness check on the selected option.

93. C — Reinforced masonry relies on correctly located reinforcement, adequately consolidated grout, and proper anchorage so forces can transfer through the composite wall. Voids or misplaced bars can reduce strength and ductility. These conditions become difficult to verify after concealment, so inspection before closure is a direct quality-control step for the seismic system.

94. B — Anchor resistance depends on both the steel fastener and the surrounding concrete. Limited edge distance, shallow embedment, spacing, and reinforcement can control breakout, pullout, pryout, or related failure mechanisms before the steel reaches its strength. Therefore geometric and installation details are structural design variables rather than cosmetic considerations. This also provides a quick reasonableness check on the selected option.

95. A — Wood shear walls transfer in-plane force through many sheathing fasteners into framing. Nail size, spacing, edge distance, and installation influence unit shear strength, slip, ductility, and splitting risk. Those details do not eliminate overturning forces or alter site hazard. Field verification is therefore essential to achieving the intended diaphragm or wall behavior.

96. D — Collectors exist to deliver diaphragm force to designated vertical elements, so a construction joint cannot be allowed to interrupt that path. Reinforcement, welds, bolts, or other connection details must transfer the required collector demand across the interface. Finishes are not structural transfer mechanisms, and terminating the collector defeats its purpose.

97. A — Positive wall anchorage provides lateral support by transferring out-of-plane wall inertia into the diaphragm and its load path. Without adequate anchorage, heavy walls can separate from floors or roofs and fall. The connection does not intentionally add roof weight, eliminate in-plane shear, or control every possible foundation movement. This also provides a quick reasonableness check on the selected option.

98. D — A seismic separation exists because adjacent building portions may move differently during shaking. A utility crossing should therefore include flexibility, clearance, sliding support, or another configuration that tolerates the expected relative displacement. Rigidly bridging the gap can rupture the utility or create unintended restraint, while removing all support can create instability.

99. B — A deviation in a critical seismic connection can alter strength, stiffness, ductility, or the intended force path. It should be documented and evaluated by the responsible design process, with an approved correction when needed. Completion of the work does not establish equivalence, and undocumented assumptions cannot substitute for technical review.

100. C — Structural observation is a periodic professional review of significant structural construction for general conformance with the design intent and attention to important deviations. It complements rather than replaces special inspection, testing, and contractor quality control. The observer cannot guarantee zero damage or eliminate the need for approved drawings and specifications.