PRACTICE EXAM 18: 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. A hillside library site has mapped short-period acceleration Ss = 1.18 g and site coefficient Fa = 1.12. For this exercise, use SMS = FaSs. What value of SMS results?

A. 1.054 g
B. 1.180 g
C. 1.322 g
D. 1.120 g

2. A design spectrum worksheet lists SMS = 1.44 g. Using SDS = (2/3)SMS, what short-period design spectral response acceleration should be entered?

A. 1.44 g
B. 0.72 g
C. 2.16 g
D. 0.96 g

3. For a waterfront project, the mapped one-second value is S1 = 0.52 g and the site coefficient is Fv = 1.65. Using SM1 = FvS1, determine SM1.

A. 0.315 g
B. 0.858 g
C. 0.520 g

D. 1.650 g

4. A site-specific summary gives SM1 = 0.81 g. If SD1 = (2/3)SM1, what is SD1?

A. 0.54 g
B. 0.81 g
C. 0.41 g
D. 1.22 g

5. For a simplified response spectrum, the corner period is defined here as Ts = SD1/SDS. With SDS = 0.88 g and SD1 = 0.57 g, calculate Ts.

A. 1.54 s
B. 0.50 s
C. 0.65 s
D. 0.57 s

6. A boring log shows loose, saturated sand adjacent to a sloping river terrace. Which earthquake hazard should receive the most focused geotechnical evaluation?

A. Expansive-soil heave caused by seasonal drying
B. Liquefaction with possible lateral spreading toward the slope
C. Frost action beneath shallow foundations
D. Long-term concrete shrinkage in the footings

7. Two buildings occupy the same parcel and share the same mapped hazard and site class. One is an emergency response facility and the other is a routine warehouse. Which seismic design input most directly reflects that occupancy difference?

A. Mapped Ss at the shared parcel
B. Measured site shear-wave velocity

C. Concrete density used for both foundations
D. Risk category and the associated importance treatment

8. Why are mapped hazard values, site class, design spectral ordinates, risk category, and seismic design category commonly documented together on the structural design criteria sheet?

A. Together they establish the seismic design basis used by later analysis and detailing
B. They replace the need for a lateral-force-resisting system
C. They determine only architectural finish selections
D. They eliminate the need for construction inspection

9. Each of two braced frames is subjected to the same story shear. If Frame X is 900 kip/in and Frame Y is 600 kip/in, use elastic displacement V/k to determine the ratio of Y displacement to X displacement.

A. 0.67
B. 1.00
C. 1.80
D. 1.50

10. A story has two lateral lines acting in parallel with stiffnesses 460 kip/in and 640 kip/in. What translational story stiffness should be used when both lines undergo the same story displacement?

A. 180 kip/in
B. 1100 kip/in
C. 268 kip/in
D. 640 kip/in

11. Two idealized SDOF systems have the same mass. System B is stiffer than System A: kA = 500 and kB = 800 in consistent units. Using T proportional to sqrt(m/k), what is TB/TA?

A. 0.79

B. 1.26
C. 0.62
D. 1.60

12. Two adjacent buildings can move toward a joint by 2.1 inches and 1.7 inches, respectively. Using a conservative sum-of-movements check, what clear separation is required?

A. 0.40 in.
B. 1.90 in.
C. 3.80 in.
D. 2.10 in.

13. A rigid floor diaphragm has its center of mass significantly offset from its center of rigidity. What additional seismic response should the engineer expect beyond simple translation?

A. Automatic elimination of story shear
B. Plan rotation that redistributes demand among vertical resisting lines
C. Uniform increase in foundation bearing capacity
D. Complete removal of diaphragm force

14. Which configuration most clearly represents a vertical stiffness irregularity?

A. Uniform bay spacing repeated at every floor
B. A rectangular roof with symmetric framing
C. Similar column sizes continued through all stories
D. A much softer open lobby level below stiffer stories

15. A building has several independent lateral resisting lines. If one line is damaged during strong shaking, which characteristic best limits reliance on that single line for the remaining force transfer?

A. Multiple effective load paths reduce dependence on any single resisting element

B. It guarantees that all members remain elastic
C. It removes the need to design connections
D. It prevents every possible torsional response

16. Which property best describes a well-detailed seismic system that can undergo repeated inelastic deformation while retaining substantial load-carrying capacity?

A. Brittleness
B. Mass eccentricity
C. Ductility
D. Dead-load intensity

17. An older unreinforced masonry bearing-wall building has a timber roof diaphragm with little positive connection to the exterior walls. Which retrofit most directly reduces out-of-plane wall-collapse risk?

A. Add heavier ceiling finishes along the perimeter
B. Remove existing roof blocking near the walls
C. Increase storage loading against exterior walls
D. Install positive wall-to-diaphragm anchors with a continuous force-transfer path

18. An evaluation of an older precast grandstand finds short support ledges and weak positive ties at member ends. Which earthquake failure mode deserves the highest priority during retrofit planning?

A. Uniform surface discoloration of the concrete
B. Loss of bearing or brittle failure at critical precast connections
C. Wind suction on interior striping
D. Minor thermal movement at expansion joints

19. Post-earthquake inspection of a flat-plate building reveals widening cracks and crushing around several slab-column connections. Why is that observation especially serious?

A. Punching deterioration can jeopardize gravity support at the slab-column connection
B. It proves every spread footing has liquefied
C. It guarantees improved slab ductility
D. It confirms the floor diaphragm is perfectly rigid

20. A tilt-up warehouse evaluation finds wall panels with weak roof-to-wall connections. Which retrofit objective most directly addresses the historic seismic weakness?

A. Increase roof dead load without changing anchors
B. Reduce diaphragm nailing near the wall line
C. Strengthen wall anchorage and continuity between the diaphragm and wall panels
D. Remove collectors that deliver force to the walls

21. An older steel moment frame has welded beam-column connections known to be susceptible to brittle fracture. What retrofit goal is most appropriate?

A. Detail connections for controlled ductile yielding
B. Add unrelated roof dead load
C. Increase accidental eccentricity intentionally
D. Eliminate inspection of welded joints

22. After an earthquake, inspectors observe a permanently racked story and fractured connections in a primary lateral-force-resisting frame. What is the most appropriate immediate safety action?

A. Reopen immediately because nonstructural damage is expected
B. Restrict occupancy until a detailed structural evaluation determines whether the building can be safely entered
C. Ignore the frame damage if utilities still operate
D. Treat the condition as cosmetic and repaint the cracks

23. A three-story clinic uses the simplified coefficient Cs = SDS Ie/R. With SDS = 0.76, Ie = 1.00, R = 6.5, and seismic weight 2,860 kips, calculate V = CsW.

A. 240.8 kips
B. 428.0 kips
C. 334.4 kips
D. 2173.6 kips

24. For a six-story office preliminary check, compute Cs from SDS Ie/R. Use SDS = 0.91, Ie = 1.00, R = 7.0, and W = 2,140 kips. What equivalent lateral base shear V follows?

A. 200.3 kips
B. 356.1 kips
C. 1947.4 kips
D. 278.2 kips

25. A hospital support building has SDS = 0.69, Ie = 1.25, R = 5.5, and W = 3,320 kips. Using V = (SDS Ie/R)W for this exercise, determine the design base shear.

A. 374.9 kips
B. 666.4 kips
C. 2290.8 kips
D. 520.6 kips

26. During conceptual sizing of a warehouse lateral system, take SDS = 0.83, Ie = 1.00, R = 8.0, and W = 4,180 kips. Using V = SDS Ie W/R, what base reaction is obtained?

A. 312.2 kips
B. 555.1 kips
C. 433.7 kips
D. 3469.4 kips

27. A courthouse annex is modeled with SDS = 0.72, Ie = 1.00, R = 6.0, and effective seismic weight 2,550 kips. Evaluate the simplified ELF base shear V = SDS Ie W/R.

A. 306.0 kips
B. 220.3 kips
C. 391.7 kips
D. 1836.0 kips

28. For a laboratory building, the preliminary seismic inputs are SDS = 0.88, Ie = 1.25, R = 7.5, and W = 3,010 kips. What base shear results from V = SDS Ie W/R?

A. 317.9 kips
B. 441.5 kips
C. 565.1 kips
D. 2648.8 kips

29. Estimate the approximate fundamental period from Ta = Ct hn^x. Use Ct = 0.028, hn = 70 ft, and x = 0.80. What value of Ta is obtained?

A. 0.59 s
B. 1.13 s
C. 1.29 s
D. 0.84 s

30. Estimate the approximate fundamental period from Ta = Ct hn^x. Use Ct = 0.031, hn = 58 ft, and x = 0.75. What value of Ta is obtained?

A. 0.46 s
B. 0.88 s
C. 0.65 s
D. 1.10 s

31. Estimate the approximate fundamental period from Ta = Ct hn^x. Use Ct = 0.024, hn = 105 ft, and x = 0.82. What value of Ta is obtained?

A. 0.76 s
B. 1.09 s
C. 1.47 s
D. 1.54 s

32. Estimate the approximate fundamental period from Ta = Ct hn^x. Use Ct = 0.036, hn = 48 ft, and x = 0.70. What value of Ta is obtained?

A. 0.54 s
B. 0.38 s
C. 0.73 s
D. 0.99 s

33. Use Cvx = wx hx^k / Σ(wi hi^k). Floor weights are [420, 510, 600] kips at heights [15, 30, 45] ft, with k = 1.0. What fraction of base shear is assigned to level 3?

A. 0.361
B. 0.750
C. 0.556
D. 0.392

34. Use Cvx = wx hx^k / Σ(wi hi^k). Floor weights are [380, 470, 560, 650] kips at heights [12, 24, 36, 48] ft, with k = 1.2. What fraction of base shear is assigned to level 4?

A. 0.319
B. 0.663
C. 0.316
D. 0.491

35. Use Cvx = wx hx^k / Σ(wi hi^k). Floor weights are [500, 500, 500] kips at heights [14, 28, 42] ft, with k = 1.5. What fraction of base shear is assigned to level 2?

A. 0.313
B. 0.204
C. 0.423
D. 0.333

36. Use Cvx = wx hx^k / Σ(wi hi^k). Floor weights are [300, 420, 540, 660] kips at heights [10, 20, 30, 40] ft, with k = 1.0. What fraction of base shear is assigned to level 1?

A. 0.050
B. 0.056
C. 0.075
D. 0.156

37. Floor lateral forces from the lowest to highest level are [90, 110, 140, 180] kips. What story shear acts in the lateral system immediately below level 2?

A. 110.0 kips
B. 200.0 kips
C. 430.0 kips
D. 410.0 kips

38. Floor lateral forces from the lowest to highest level are [75, 95, 120, 150, 190] kips. What story shear acts in the lateral system immediately below level 3?

A. 120.0 kips
B. 290.0 kips
C. 510.0 kips
D. 460.0 kips

39. Floor lateral forces from the lowest to highest level are [130, 160, 210] kips. What story shear acts in the lateral system immediately below level 1?

A. 500.0 kips
B. 130.0 kips
C. 290.0 kips
D. 370.0 kips

40. Floor lateral forces from the lowest to highest level are [60, 85, 105, 135] kips. What story shear acts in the lateral system immediately below level 3?

A. 105.0 kips
B. 250.0 kips
C. 240.0 kips
D. 280.0 kips

41. A roof diaphragm weighs 780 kips. For this exercise, the governing diaphragm force coefficient is 0.32. What in-plane diaphragm design force follows from Fpx = 0.32Wpx?

A. 124.8 kips
B. 249.6 kips
C. 312.0 kips
D. 499.2 kips

42. A diaphragm delivers 260 kips to a 130-ft-long resisting line. If the transfer is uniform, what shear demand per foot acts along that line?

A. 4.00 kip/ft
B. 1.00 kip/ft
C. 0.50 kip/ft
D. 2.00 kip/ft

43. Two diaphragm edge chords are 90 ft apart and must form a couple resisting 5,400 kip-ft. What axial force magnitude is required in each chord?

A. 120.0 kips
B. 60.0 kips
C. 30.0 kips
D. 0.0 kips

44. A wall segment has tributary seismic weight 145 kips. For a simplified out-of-plane check, use F = 0.42W. What design force is obtained?

A. 60.9 kips
B. 30.4 kips
C. 87.0 kips
D. 145.0 kips

45. A collector has a nominal seismic force demand of 185 kips. For this exercise, the amplified collector design force is Ω0E with Ω0 = 2.5. What amplified force is required?

A. 74.0 kips
B. 277.5 kips
C. 462.5 kips
D. 555.0 kips

46. Six identical anchors share a 312-kip wall-to-roof transfer equally. With eccentricity neglected, what tensile or shear demand is assigned to one anchor?

A. 52.0 kips
B. 62.4 kips
C. 39.0 kips
D. 1872.0 kips

47. A parapet has effective seismic weight 96 kips. For this simplified exercise, use an out-of-plane coefficient of 0.55. What lateral force should be applied?

A. 26.4 kips
B. 52.8 kips
C. 72.0 kips
D. 96.0 kips

48. A roof level contributes 18% of a building's effective seismic weight of 2,350 kips. What roof seismic weight is represented by that fraction?

A. 211.5 kips
B. 658.0 kips
C. 1927.0 kips
D. 423.0 kips

49. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 1.0, SDS = 0.90, Wp = 410 kips, Rp = 2.5, and Ip = 1.0. What Fp results?

A. 29.5 kips
B. 59.0 kips
C. 88.6 kips
D. 147.6 kips

50. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 2.5, SDS = 0.82, Wp = 36 kips, Rp = 6.0, and Ip = 1.0. What Fp results?

A. 2.5 kips
B. 7.4 kips
C. 29.5 kips
D. 4.9 kips

51. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 1.0, SDS = 0.76, Wp = 125 kips, Rp = 2.5, and Ip = 1.5. What Fp results?

A. 11.4 kips
B. 34.2 kips
C. 22.8 kips
D. 38.0 kips

52. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 2.5, SDS = 0.88, Wp = 22 kips, Rp = 3.5, and Ip = 1.0. What Fp results?

A. 5.5 kips
B. 2.8 kips
C. 8.3 kips
D. 19.4 kips

53. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 1.0, SDS = 0.84, Wp = 68 kips, Rp = 2.0, and Ip = 1.0. What Fp results?

A. 11.4 kips
B. 5.7 kips
C. 17.1 kips
D. 22.8 kips

54. For a simplified nonstructural component check, use Fp = 0.4 ap SDS Wp /(Rp/Ip). Take ap = 2.5, SDS = 0.72, Wp = 14 kips, Rp = 5.0, and Ip = 1.5. What Fp results?

A. 1.5 kips
B. 4.5 kips
C. 3.0 kips
D. 10.1 kips

55. A rigid nonbuilding structure is checked with the simplified relation V = CsW. If Cs = 0.31 and seismic weight W = 520 kips, what base shear results?

A. 80.6 kips
B. 225.7 kips
C. 520.0 kips
D. 161.2 kips

56. A rigid nonbuilding structure is checked with the simplified relation V = CsW. If Cs = 0.27 and seismic weight W = 860 kips, what base shear results?

A. 116.1 kips
B. 232.2 kips
C. 325.1 kips
D. 860.0 kips

57. A rigid nonbuilding structure is checked with the simplified relation V = CsW. If Cs = 0.36 and seismic weight W = 410 kips, what base shear results?

A. 73.8 kips
B. 206.6 kips
C. 147.6 kips
D. 410.0 kips

58. A rigid nonbuilding structure is checked with the simplified relation V = CsW. If Cs = 0.24 and seismic weight W = 1250 kips, what base shear results?

A. 150.0 kips
B. 300.0 kips
C. 420.0 kips
D. 1250.0 kips

59. A rooftop unit transfers a 84-kip seismic force through four identical anchorage points that share load equally. What force is assigned to each anchor in this idealized check?

A. 21.0 kips
B. 28.0 kips
C. 14.0 kips
D. 336.0 kips

60. Why can a heavy rooftop mechanical unit require positive seismic anchorage even when it is not part of the building's primary lateral-force-resisting system?

A. Its weight eliminates earthquake acceleration
B. It can rely on friction alone under all seismic conditions
C. Its anchorage is needed only for wind, never earthquakes
D. Its inertia force must be transferred through attachments into the supporting structure

61. A suspended piping run crosses a seismic separation joint between two building wings. What detailing objective is most important at the crossing?

A. Rigidly clamp the pipe to both wings at the joint
B. Increase pipe weight to reduce movement
C. Eliminate all clearance around the pipe
D. Provide flexibility or a joint detail that accommodates expected relative movement without rupture

62. For a tall freestanding equipment rack, why is anchorage design not limited to checking only horizontal sliding at the base?

A. Tall racks cannot develop overturning moment
B. Only gravity compression acts on seismic anchors
C. Overturning and uplift can govern anchor demand
D. Rack height has no effect on seismic stability

63. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [300, 500, 700] kip/in and total shear is 360 kips. Ignoring torsion, what direct force goes to line 2?

A. 90.0 kips
B. 120.0 kips
C. 240.0 kips
D. 257.1 kips

64. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [450, 450, 600] kip/in and total shear is 270 kips. Ignoring torsion, what direct force goes to line 3?

A. 108.0 kips
B. 90.0 kips
C. 162.0 kips
D. 270.0 kips

65. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [250, 550, 400] kip/in and total shear is 300 kips. Ignoring torsion, what direct force goes to line 1?

A. 62.5 kips
B. 100.0 kips
C. 237.5 kips
D. 136.4 kips

66. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [600, 300, 300] kip/in and total shear is 240 kips. Ignoring torsion, what direct force goes to line 2?

A. 80.0 kips
B. 180.0 kips
C. 60.0 kips
D. 120.0 kips

67. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [380, 620] kip/in and total shear is 250 kips. Ignoring torsion, what direct force goes to line 1?

A. 125.0 kips
B. 95.0 kips
C. 155.0 kips
D. 153.2 kips

68. A rigid diaphragm distributes direct story shear in proportion to line stiffness. Lateral line stiffnesses are [520, 480, 800] kip/in and total shear is 450 kips. Ignoring torsion, what direct force goes to line 3?

A. 150.0 kips
B. 250.0 kips
C. 450.0 kips
D. 200.0 kips

69. A floor develops 420 kips of lateral shear, and the design force is offset 3.0 ft from the rigidity reference. What plan torsional moment follows from force times eccentricity?

A. 140 kip-ft
B. 1260 kip-ft
C. 630 kip-ft
D. 2100 kip-ft

70. At one level, 365 kips of story shear acts 4.5 ft from the selected rigidity reference. Determine the resulting plan torque T = Ve.

A. 81 kip-ft
B. 821 kip-ft
C. 2372 kip-ft
D. 1642 kip-ft

71. A 510-kip floor shear is applied with a 2.8-ft design eccentricity. What torsional moment must the diaphragm and vertical elements resist from this offset?

A. 182 kip-ft
B. 714 kip-ft
C. 1428 kip-ft
D. 2448 kip-ft

72. A story force resultant of 290 kips has a 5.2-ft eccentricity from the rigidity reference. Calculate the corresponding torsional moment.

A. 1508 kip-ft
B. 56 kip-ft
C. 754 kip-ft
D. 2088 kip-ft

73. Lateral lines have stiffnesses [200, 400, 600] kip/in at x-coordinates [0, 20, 40] ft. Using xR = Σ(kixi)/Σki, where is the center of rigidity measured from x = 0?

A. 20.00 ft
B. 13.33 ft
C. 26.67 ft
D. 17.33 ft

74. Lateral lines have stiffnesses [350, 250, 500] kip/in at x-coordinates [0, 30, 60] ft. Using xR = Σ(kixi)/Σki, where is the center of rigidity measured from x = 0?

A. 30.00 ft
B. 25.91 ft
C. 22.16 ft
D. 34.09 ft

75. Lateral lines have stiffnesses [300, 700] kip/in at x-coordinates [10, 50] ft. Using xR = Σ(kixi)/Σki, where is the center of rigidity measured from x = 0?

A. 38.00 ft
B. 30.00 ft
C. 12.00 ft
D. 24.70 ft

76. Lateral lines have stiffnesses [450, 300, 250] kip/in at x-coordinates [0, 25, 55] ft. Using xR = Σ(kixi)/Σki, where is the center of rigidity measured from x = 0?

A. 26.67 ft
B. 21.25 ft
C. 33.75 ft
D. 13.81 ft

77. A diaphragm transfers 330 kips uniformly into a resisting line 110 ft long. What average diaphragm unit shear is implied?

A. 3.00 kip/ft
B. 6.00 kip/ft
C. 1.50 kip/ft
D. 0.33 kip/ft

78. A diaphragm transfers 420 kips uniformly into a resisting line 140 ft long. What average diaphragm unit shear is implied?

A. 6.00 kip/ft
B. 1.50 kip/ft
C. 3.00 kip/ft
D. 0.33 kip/ft

79. A diaphragm must resist an in-plane moment of 7,200 kip-ft using chord lines separated by 120 ft. Using F = M/d, what axial chord force is required?

A. 120.0 kips
B. 60.0 kips
C. 30.0 kips
D. 0.0 kips

80. A diaphragm must resist an in-plane moment of 4,950 kip-ft using chord lines separated by 75 ft. Using F = M/d, what axial chord force is required?

A. 132.0 kips
B. 33.0 kips
C. 0.0 kips
D. 66.0 kips

81. The lateral displacement at the top of a story is 2.6 in. and at the bottom is 0.9 in. The story height is 13 ft. What story drift ratio is implied, in percent?

A. 1.67%
B. 1.09%
C. 2.24%
D. 13.08%

82. The lateral displacement at the top of a story is 3.1 in. and at the bottom is 1.2 in. The story height is 14 ft. What story drift ratio is implied, in percent?

A. 1.85%
B. 2.56%
C. 1.13%
D. 13.57%

83. The lateral displacement at the top of a story is 2.2 in. and at the bottom is 0.6 in. The story height is 12 ft. What story drift ratio is implied, in percent?

A. 1.53%
B. 1.94%
C. 13.33%
D. 1.11%

84. The lateral displacement at the top of a story is 3.8 in. and at the bottom is 1.5 in. The story height is 15 ft. What story drift ratio is implied, in percent?

A. 1.28%
B. 2.11%
C. 2.94%
D. 15.33%

85. Why are seismic load effects sometimes combined with gravity load using both positive and negative earthquake directions in analysis?

A. Earthquake effects reverse, so both seismic signs must be checked
B. Seismic force acts only upward
C. Gravity load disappears during strong shaking
D. Only the larger building dimension matters

86. When a response-spectrum analysis produces a base shear below a required minimum scaling level, what is the purpose of scaling the modal results upward?

A. To force every modal period to equal the approximate period
B. To eliminate torsional response from the model
C. To prevent an unrealistically low dynamic solution from undercutting the prescribed minimum design force level
D. To make all floor accelerations identical

87. A diaphragm is flexible rather than rigid in its own plane. How is lateral load generally distributed to vertical resisting elements in a simplified analysis?

A. Entirely by the vertical lines' relative stiffness
B. Equally to every resisting line regardless of geometry
C. Only to the stiffest vertical line
D. Mainly by tributary area or span

88. What is the main purpose of a collector, or drag strut, in a diaphragm system?

A. Increase soil bearing capacity beneath the foundation
B. Transfer diaphragm force into designated vertical resisting elements
C. Reduce building seismic weight by removing mass
D. Eliminate the need for chord forces at diaphragm edges

89. In a special steel moment frame, why is connection detailing intended to support a ductile beam-yielding mechanism rather than brittle joint failure?

A. Brittle fracture provides greater cyclic ductility
B. Stable inelastic deformation preserves the seismic load path
C. Connection detailing is unrelated to seismic performance
D. Beam yielding eliminates all story drift

90. Why are closely spaced transverse reinforcement and confinement important in ductile concrete seismic regions?

A. Confine concrete and restrain longitudinal-bar buckling
B. They eliminate all concrete cracking
C. They are used only to increase member dead load
D. They make development length unnecessary

91. In a reinforced masonry shear wall, what is the seismic reason for fully grouting cells that contain required reinforcing bars?

A. It intentionally creates voids for flexibility
B. It makes reinforcement unnecessary
C. Develop composite action among masonry, grout, and reinforcement
D. It eliminates the need for inspection of reinforcement placement

92. Why is diaphragm edge nailing and blocking continuity important in wood seismic construction?

A. It reduces wood density to lower seismic mass
B. It permits panel edges to slide freely during shaking
C. It replaces all hold-down and anchorage requirements
D. It maintains shear transfer and provides a continuous path into chords, collectors, and supporting walls

93. A concrete or masonry wall is anchored to a flexible roof diaphragm. What detailing principle is most critical at the connection?

A. Rely on gravity friction alone
B. Allow the wall to separate freely from the roof
C. Remove continuity elements near the wall line
D. Provide positive wall anchorage into the diaphragm

94. During erection of a seismic steel frame, what role does special inspection serve for designated critical welds?

A. Verify specified seismic welding procedures, materials, and workmanship
B. Replace the engineer's structural design
C. Guarantee that no future earthquake damage can occur
D. Permit undocumented field changes without review

95. Why may structural observation be required on a significant seismic project even when special inspection is also provided?

A. Observation replaces all material testing
B. Observation is only an architectural finish review
C. Assess overall conformance with the intended seismic structural system
D. Observation permits inspectors to redesign members in the field

96. A nonstructural partition crosses a seismic joint. What detailing objective best addresses deformation compatibility?

A. Rigidly bridge the joint with no slip capacity
B. Allow the partition and its attachments to accommodate expected differential movement without creating a brittle restraint
C. Eliminate all clearance at the joint
D. Anchor the partition to both sides so they cannot move independently

97. Why are collector and drag-strut connections often detailed for forces larger than an ordinary elastic analysis value?

A. Collectors carry only gravity load
B. Their failure could interrupt the diaphragm-to-frame load path
C. Their connections are intentionally designed as brittle fuses
D. Amplification is used to eliminate diaphragm shear

98. Before concrete placement in a seismic wall boundary region, what field verification is especially important?

A. Confirm required reinforcement, confinement, splices, and embedments are correctly placed before they become concealed
B. Check only the exterior paint color
C. Delay all inspection until after the wall is loaded

D. Remove ties that interfere with concrete flow

99. Why is weld access and surface preparation important for a seismic steel connection?

A. They are needed only for appearance
B. They eliminate the need for welding procedures
C. They allow cracked welds to be accepted without evaluation
D. Support sound weld quality and reduce connection defects

100. What is the best reason to maintain continuous ties between major structural elements in a seismic system?

A. They prevent all inelastic response
B. They remove the need for foundations
C. Preserve a continuous structural load path through connected elements
D. They make every diaphragm rigid

Practice Exam 18: Answer Key and Explanations

1. C — Multiply the mapped short-period value by the site coefficient because the stem explicitly defines SMS = FaSs. The product is 1.3216 g, which rounds to 1.322 g. Choosing Ss alone ignores site amplification, while dividing by Fa reverses the stated operation. The site coefficient itself is not a spectral ordinate.

2. D — The design short-period ordinate is two-thirds of the maximum considered value given in the problem. Two-thirds of 1.44 g is 0.96 g. The other values come from keeping SMS unchanged, taking one-half, or multiplying by three-halves. Only the stated two-thirds conversion produces the design ordinate. A disciplined setup also makes unit checks and sign conventions easier to manage during a.

3. B — The one-second maximum considered spectral value is obtained by multiplying the mapped one-second hazard by Fv. Multiplying 0.52 by 1.65 gives 0.858 g. Dividing instead, carrying forward S1 unchanged, or selecting the coefficient by itself would not follow the relationship stated in the stem. A disciplined setup also makes unit checks and sign conventions easier to manage during a timed.

4. A — Apply the two-thirds design conversion directly to the given one-second maximum considered ordinate. Two-thirds of 0.81 g equals 0.54 g. Leaving the value at 0.81 g skips the design reduction, 0.405 g uses one-half, and 1.215 g incorrectly increases rather than reduces the ordinate. A disciplined setup also makes unit checks and sign conventions easier to manage during a timed.

5. C — The corner period in this exercise is the ratio SD1/SDS. Dividing 0.57 by 0.88 gives about 0.648 second, which rounds to 0.65 second. Reversing the ratio produces a much larger value, multiplying the ordinates is dimensionally inappropriate, and using SD1 alone confuses acceleration with period. A disciplined setup also makes unit checks and sign conventions easier to manage during a.

6. B — Loose saturated granular soils can lose effective stress during shaking and develop liquefaction. When the ground surface slopes or lies beside a free face, lateral spreading may accompany that loss of strength. The other choices are unrelated environmental or material phenomena and do not describe the shaking-induced mechanism highlighted by the subsurface conditions.

7. D — Mapped ground motion and site class are properties of the location, so they do not change merely because occupancy changes. Risk category captures the consequence of failure associated with the facility's use and can affect importance-related design requirements. The warehouse and emergency facility therefore differ primarily through occupancy-based risk treatment, not the common site parameters.

8. A — These items collectively define the seismic design basis that feeds subsequent system selection, force calculations, analysis requirements, and detailing. None of them replaces structural drawings or quality control. Grouping them on the design criteria sheet lets reviewers and constructors see the assumptions governing the seismic design and check that later calculations remain consistent with those assumptions.

9. D — For the same lateral force, elastic displacement is inversely proportional to stiffness. Therefore driftY/driftX equals kX/kY, or 900/600 = 1.50. The softer frame drifts more. Reversing the ratio predicts the opposite behavior, while the remaining values do not follow the force-displacement relationship F = k delta. A disciplined setup also makes unit checks and sign conventions easier to manage during.

10. B — Parallel resisting lines experience the same story translation, so their resisting forces add. The equivalent stiffness is therefore the sum, 460 + 640 = 1,100 kip/in. The difference ignores one line's resistance, the series-spring expression is inappropriate for parallel action, and using only the stiffer line discards the other load path.

11. A — With equal mass, period varies with the inverse square root of stiffness. Thus TB/TA = sqrt(kA/kB) = sqrt(500/800), about 0.79. The stiffer system has the shorter period. Using the direct stiffness ratio or reversing the square-root ratio would predict the wrong dependence of period on lateral stiffness. A disciplined setup also makes unit checks and sign conventions easier to manage.

12. C — The stated check requires adding the two possible movements toward the joint. The required separation is 2.1 + 1.7 = 3.8 inches. Taking the difference, the average, or only the larger movement would allow the buildings to overlap when both displacements occur toward the gap at the same time. A disciplined setup also makes unit checks and sign conventions easier.

13. B — An offset between the center of mass and center of rigidity creates torsional moment when inertia forces act through the mass center. A rigid diaphragm then rotates as well as translates, changing the force attracted by individual vertical resisting lines. The other choices do not follow from plan eccentricity and do not represent a seismic equilibrium response.

14. D — A vertical stiffness irregularity occurs when lateral stiffness changes abruptly from one story to another. A very flexible open lobby beneath stiffer upper stories concentrates drift and demand at that level, a classic soft-story condition. Repeated framing, symmetric roof geometry, and similar columns tend to promote regularity rather than an abrupt vertical stiffness discontinuity.

15. A — Redundancy provides alternate paths for transferring earthquake forces if one member or connection loses capacity. It does not guarantee elastic behavior, eliminate connection design, or erase torsion. In seismic performance, distributing resistance among multiple effective elements can limit disproportionate loss of capacity and improve the system's ability to sustain localized damage without collapse.

16. C — Ductility is the ability to deform inelastically without sudden loss of strength or stability. Seismic systems rely on controlled yielding and cyclic deformation to dissipate energy. Brittleness is the opposite behavior, while mass eccentricity and dead-load intensity are design conditions rather than material or system properties describing stable inelastic deformation capacity.

17. D — URM exterior walls are vulnerable to separating from flexible diaphragms and falling outward during shaking. Positive wall-to-diaphragm anchorage ties the wall to the roof or floor system so inertial forces can be transferred through a defined load path. The distractors add weight or remove support and do not correct the critical connection deficiency.

18. B — Precast structures can be especially vulnerable where components have short bearing lengths or inadequate positive ties. Earthquake drift and support movement may cause loss of seat or brittle connection failure, interrupting gravity support and the lateral load path. Cosmetic discoloration, striping, and ordinary thermal movement do not address the principal life-safety weakness described.

19. A — Flat-plate systems transfer gravity load through slab-column regions that can be vulnerable to punching shear, especially when lateral drift imposes additional deformation demands. Significant cracking and crushing there may threaten gravity support and progressive damage. The observation does not by itself prove liquefaction, improve ductility, or establish rigid-diaphragm behavior. A disciplined setup also makes unit checks and sign conventions easier.

20. C — Tilt-up and masonry wall buildings have experienced wall separation when roof diaphragms were not adequately anchored to the wall panels. Strengthening the roof-to-wall connection and ensuring continuity of the force path directly addresses that vulnerability. Adding weight, reducing diaphragm connection capacity, or removing collectors would increase demand or weaken load transfer rather than improve performance.

21. A — The retrofit should shift behavior away from brittle connection fracture toward a predictable ductile mechanism capable of cyclic deformation. Improving weld quality, continuity, and connection detailing supports that goal. Added mass raises seismic demand, intentional eccentricity increases torsion, and eliminating inspection would reduce confidence in the very connections whose performance is critical.

22. B — Permanent story deformation and fractured primary lateral connections indicate potentially serious loss of structural capacity. Immediate occupancy should therefore be restricted pending a detailed evaluation by qualified personnel. Utility service and cosmetic appearance do not demonstrate structural safety. Post-earthquake screening prioritizes evidence of instability, compromised gravity support, and damage to the main lateral system.

23. C — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

24. D — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

25. D — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

26. C — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

27. A — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

28. B — The stated ELF relationship gives Cs by dividing SDS by R/Ie, then multiplies that coefficient by effective seismic weight. Carrying the given values through produces the keyed base shear. The distractors represent common errors such as using an incorrect scale factor or omitting the response modification divisor. Base shear must remain proportional to W.

29. D — The approximate period follows directly from the power-law expression supplied in the stem. Raise the building height to the exponent, then multiply by Ct. The keyed value is the resulting period.

The distractors reflect common errors in exponent use or scaling. Because height enters nonlinearly, simply multiplying Ct by height would be incorrect.

30. C — The approximate period follows directly from the power-law expression supplied in the stem. Raise the building height to the exponent, then multiply by Ct. The keyed value is the resulting period. The distractors reflect common errors in exponent use or scaling. Because height enters nonlinearly, simply multiplying Ct by height would be incorrect.

31. B — The approximate period follows directly from the power-law expression supplied in the stem. Raise the building height to the exponent, then multiply by Ct. The keyed value is the resulting period. The distractors reflect common errors in exponent use or scaling. Because height enters nonlinearly, simply multiplying Ct by height would be incorrect.

32. A — The approximate period follows directly from the power-law expression supplied in the stem. Raise the building height to the exponent, then multiply by Ct. The keyed value is the resulting period. The distractors reflect common errors in exponent use or scaling. Because height enters nonlinearly, simply multiplying Ct by height would be incorrect.

33. C — Vertical distribution is based on each level's weight times height raised to k, divided by the sum of those terms for all levels. Computing those terms and normalizing gives the keyed fraction. Using weight alone ignores height, while the scaled alternatives misrepresent the numerator or denominator. All level fractions should sum to one.

34. D — Vertical distribution is based on each level's weight times height raised to k, divided by the sum of those terms for all levels. Computing those terms and normalizing gives the keyed fraction. Using weight alone ignores height, while the scaled alternatives misrepresent the numerator or denominator. All level fractions should sum to one.

35. A — Vertical distribution is based on each level's weight times height raised to k, divided by the sum of those terms for all levels. Computing those terms and normalizing gives the keyed fraction. Using weight alone ignores height, while the scaled alternatives misrepresent the numerator or denominator. All level fractions should sum to one.

36. B — Vertical distribution is based on each level's weight times height raised to k, divided by the sum of those terms for all levels. Computing those terms and normalizing gives the keyed fraction. Using weight alone ignores height, while the scaled alternatives misrepresent the numerator or denominator. All level fractions should sum to one.

37. C — Story shear at a given level equals the sum of the lateral forces acting at that level and all levels above it. Summing the listed floor forces from the specified level upward produces the keyed result. Using only one floor force or summing the wrong side of the cut fails equilibrium of the free body.

38. D — Story shear at a given level equals the sum of the lateral forces acting at that level and all levels above it. Summing the listed floor forces from the specified level upward produces the keyed result. Using only one floor force or summing the wrong side of the cut fails equilibrium of the free body.

39. A — Story shear at a given level equals the sum of the lateral forces acting at that level and all levels above it. Summing the listed floor forces from the specified level upward produces the keyed result. Using only one floor force or summing the wrong side of the cut fails equilibrium of the free body.

40. C — Story shear at a given level equals the sum of the lateral forces acting at that level and all levels above it. Summing the listed floor forces from the specified level upward produces the keyed result. Using only one floor force or summing the wrong side of the cut fails equilibrium of the free body.

41. B — The diaphragm design force in this exercise is the stated coefficient multiplied by the diaphragm weight. Multiplying 0.32 by 780 kips gives the keyed force. The distractors use half, a larger arbitrary coefficient, or double the stated coefficient. The relationship is linear, so doubling the coefficient would double the diaphragm force.

42. D — Average diaphragm unit shear is total in-plane shear divided by the length over which that shear is transferred. Dividing 260 kips by 130 ft gives 2.00 kip/ft. Halving or doubling the effective length changes the result incorrectly, while reversing the ratio produces units that do not represent unit shear. A disciplined setup also makes unit checks and sign conventions easier.

43. B — A chord couple resists diaphragm moment through equal and opposite axial forces separated by the effective chord spacing. Using $F = M/d$, 5,400 kip-ft divided by 90 ft gives the keyed axial force. Using half or double the spacing changes the lever arm incorrectly, and reversing the ratio is dimensionally inconsistent.

44. A — The simplified out-of-plane check applies the stated coefficient directly to the tributary wall weight. Multiplying 0.42 by 145 kips yields the keyed force. The other values come from using a different coefficient or taking the full weight as lateral force. The calculation should scale linearly with the tributary seismic weight.

45. C — When the exercise specifies an overstrength-amplified seismic effect, multiply the nominal seismic force by Ω0. The collector demand is therefore 185 x 2.5, giving the keyed value. Dividing by Ω0 reduces demand incorrectly, while subtracting one from the factor or adding an unrelated multiplier does not follow the stated requirement.

46. A — With equal load sharing and no eccentricity, each anchor carries the total anchorage force divided by the number of anchors. Dividing 312 kips by six gives the keyed force per anchor. Using a different anchor count or multiplying instead of dividing violates the equal-sharing assumption stated explicitly in the problem.

47. B — Apply the stated out-of-plane coefficient to the parapet seismic weight. Multiplying 0.55 by 96 kips gives the keyed lateral force. The other choices use a halved coefficient, an unrelated larger factor, or the entire weight as lateral force. The result should vary directly with both coefficient and parapet weight. A disciplined setup also makes unit checks and sign conventions easier.

48. D — The roof contribution is the stated fraction of the total effective seismic weight. Multiplying 2,350 kips by 0.18 produces the keyed roof weight. The distractors use half the percentage, a different percentage, or the complement. Because the problem asks for the roof portion, the direct fractional product is appropriate. A disciplined setup also makes unit checks and sign conventions easier.

49. B — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

50. D — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

51. C — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

52. A — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

53. A — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

54. C — Substitute the component amplification, design spectral acceleration, component weight, response factor, and importance factor into the expression given in the stem. The keyed force follows directly. The distractors reflect omitting the Rp/Ip divisor or applying an incorrect scale. Component force should increase with ap, SDS, Wp, and Ip, but decrease as Rp increases.

55. D — The simplified rigid nonbuilding check multiplies the seismic coefficient by the structure's effective seismic weight. Applying the given values produces the keyed base shear. The distractors represent an arbitrary half or increase, or the full weight treated as lateral force. The result should remain a fraction of W when Cs is less than one.

56. B — The simplified rigid nonbuilding check multiplies the seismic coefficient by the structure's effective seismic weight. Applying the given values produces the keyed base shear. The distractors represent an arbitrary half or increase, or the full weight treated as lateral force. The result should remain a fraction of W when Cs is less than one.

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59. A — Equal load sharing means the total component force is divided by the number of identical anchors. Dividing 84 kips by four gives the keyed force per anchorage point. Using three or six anchors contradicts the stem, and multiplying by four would increase rather than distribute the total force. Real anchorage design may also require eccentricity checks.

60. D — Nonstructural equipment develops inertia force during earthquake motion, and that force needs a continuous transfer path through equipment attachments, supports, and the building structure. Being outside the primary lateral system does not remove seismic demand. Weight does not eliminate acceleration, and friction alone is not a universally reliable substitute for positive seismic anchorage.

61. D — Separate building wings may move relative to one another during an earthquake. A piping run that crosses the joint must accommodate that differential movement without rupturing, pulling apart, or imposing damaging forces on its supports. Rigidly tying the pipe to both sides or removing clearance restrains the movement and can convert building displacement into component damage.

62. C — A freestanding rack develops overturning moment when lateral inertia forces act above its base. That moment can create compression on one side and uplift tension on anchors at the other side, so sliding alone is not enough. Rack height and mass distribution directly affect overturning demand and therefore the required anchorage and base-plate behavior.

63. B — For rigid-diaphragm direct translation, each vertical line attracts a share of story shear proportional to its stiffness. Multiply total shear by the selected line stiffness divided by the sum of all line stiffnesses. The keyed force satisfies that relation. Equal sharing is appropriate only for equal stiffnesses, and the other ratios misstate the denominator.

64. A — For rigid-diaphragm direct translation, each vertical line attracts a share of story shear proportional to its stiffness. Multiply total shear by the selected line stiffness divided by the sum of all line stiffnesses. The keyed force satisfies that relation. Equal sharing is appropriate only for equal stiffnesses, and the other ratios misstate the denominator.

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67. B — For rigid-diaphragm direct translation, each vertical line attracts a share of story shear proportional to its stiffness. Multiply total shear by the selected line stiffness divided by the sum of all line stiffnesses. The keyed force satisfies that relation. Equal sharing is appropriate only for equal stiffnesses, and the other ratios misstate the denominator.

68. D — For rigid-diaphragm direct translation, each vertical line attracts a share of story shear proportional to its stiffness. Multiply total shear by the selected line stiffness divided by the sum of all line stiffnesses. The keyed force satisfies that relation. Equal sharing is appropriate only for equal stiffnesses, and the other ratios misstate the denominator.

69. B — Torsional moment equals the lateral story shear multiplied by the perpendicular eccentricity between the force line and the reference point. Multiplying the two given values yields the keyed moment. Dividing by eccentricity or changing the lever arm does not satisfy moment equilibrium. The units should be force times distance, or kip-ft.

70. D — Torsional moment equals the lateral story shear multiplied by the perpendicular eccentricity between the force line and the reference point. Multiplying the two given values yields the keyed moment. Dividing by eccentricity or changing the lever arm does not satisfy moment equilibrium. The units should be force times distance, or kip-ft.

71. C — Torsional moment equals the lateral story shear multiplied by the perpendicular eccentricity between the force line and the reference point. Multiplying the two given values yields the keyed moment. Dividing by eccentricity or changing the lever arm does not satisfy moment equilibrium. The units should be force times distance, or kip-ft.

72. A — Torsional moment equals the lateral story shear multiplied by the perpendicular eccentricity between the force line and the reference point. Multiplying the two given values yields the keyed moment. Dividing by eccentricity or changing the lever arm does not satisfy moment equilibrium. The units should be force times distance, or kip-ft.

73. C — The center of rigidity is the stiffness-weighted average of the line coordinates, not the simple geometric average unless all stiffnesses are equal. Multiply each stiffness by its coordinate, sum those products, and divide by total stiffness. The keyed coordinate is the point through which direct translational resistance acts for this idealized one-dimensional calculation.

74. D — The center of rigidity is the stiffness-weighted average of the line coordinates, not the simple geometric average unless all stiffnesses are equal. Multiply each stiffness by its coordinate, sum those products, and divide by total stiffness. The keyed coordinate is the point through which direct translational resistance acts for this idealized one-dimensional calculation.

75. A — The center of rigidity is the stiffness-weighted average of the line coordinates, not the simple geometric average unless all stiffnesses are equal. Multiply each stiffness by its coordinate, sum those products, and divide by total stiffness. The keyed coordinate is the point through which direct translational resistance acts for this idealized one-dimensional calculation.

76. B — The center of rigidity is the stiffness-weighted average of the line coordinates, not the simple geometric average unless all stiffnesses are equal. Multiply each stiffness by its coordinate, sum those products, and divide by total stiffness. The keyed coordinate is the point through which direct translational resistance acts for this idealized one-dimensional calculation.

77. A — Average unit shear is the total in-plane force divided by the transfer length. Applying that relationship to the values in the stem gives the keyed kip-per-foot result. Using half or double the transfer length changes the force intensity incorrectly, while reversing force and length produces units that cannot represent diaphragm shear demand.

78. C — Average unit shear is the total in-plane force divided by the transfer length. Applying that relationship to the values in the stem gives the keyed kip-per-foot result. Using half or double the transfer length changes the force intensity incorrectly, while reversing force and length produces units that cannot represent diaphragm shear demand.

79. B — The chord couple resists diaphragm moment through axial tension and compression separated by the effective chord spacing. Dividing the moment by that spacing gives the keyed force. Halving the spacing doubles the force, doubling the spacing halves it, and reversing the ratio is dimensionally wrong. Chord force must be compatible with connection and collector detailing.

80. D — The chord couple resists diaphragm moment through axial tension and compression separated by the effective chord spacing. Dividing the moment by that spacing gives the keyed force. Halving the spacing doubles the force, doubling the spacing halves it, and reversing the ratio is dimensionally wrong. Chord force must be compatible with connection and collector detailing.

81. B — Story drift is the relative displacement across the story divided by story height. Subtract the lower-floor displacement from the upper-floor displacement, convert the story height from feet to inches, then form the ratio and express it as a percentage. The distractors use absolute displacement, add displacements, or omit the feet-to-inches conversion.

82. C — Story drift is the relative displacement across the story divided by story height. Subtract the lower-floor displacement from the upper-floor displacement, convert the story height from feet to inches, then form the ratio and express it as a percentage. The distractors use absolute displacement, add displacements, or omit the feet-to-inches conversion.

83. D — Story drift is the relative displacement across the story divided by story height. Subtract the lower-floor displacement from the upper-floor displacement, convert the story height from feet to inches, then form the ratio and express it as a percentage. The distractors use absolute displacement, add displacements, or omit the feet-to-inches conversion.

84. A — Story drift is the relative displacement across the story divided by story height. Subtract the lower-floor displacement from the upper-floor displacement, convert the story height from feet to inches, then form the ratio and express it as a percentage. The distractors use absolute displacement, add displacements, or omit the feet-to-inches conversion.

85. A — Earthquake response is cyclic and can reverse direction, so axial force, shear, and moment effects may change sign in members and connections. Load combinations therefore consider the appropriate positive and negative seismic effects with gravity. Gravity does not vanish, and the building's larger dimension alone cannot represent the directional reversal of seismic response.

86. C — Response-spectrum analysis distributes dynamic response among modes, but a model can produce a total base shear below the code's required minimum design level. Scaling raises the modal results so the design is not based on an artificially small overall force. It does not change every period, erase torsion, or make floor accelerations uniform.

87. D — A flexible diaphragm deforms enough that it does not enforce common in-plane translation among all vertical resisting lines. In simplified treatment, load distribution therefore follows tributary area or span to supporting lines rather than a global stiffness-proportional distribution. Rigid-diaphragm stiffness sharing would impose behavior the flexible diaphragm is not capable of developing.

88. B — Collectors gather and transfer diaphragm forces into walls, frames, or other vertical resisting elements when the load path does not align directly. They are axial force-transfer elements within the seismic load path. They do not change foundation soil capacity, reduce seismic mass, or replace edge chords, which serve a different function in resisting diaphragm moment.

89. B — Seismic moment-frame detailing seeks a predictable ductile mechanism in which designated regions yield while critical connections remain capable of transferring force. Stable cyclic deformation dissipates energy and helps preserve the load path. Brittle fracture can cause abrupt strength loss, and controlled yielding does not eliminate story drift; it manages how inelastic demand is accommodated.

90. A — Confinement reinforcement helps maintain concrete integrity and restrain longitudinal bars during large cyclic strains. Closely spaced hoops or ties in critical regions improve ductility and delay strength degradation. They do not eliminate cracking, exist to add dead load, or remove anchorage and development requirements. Their purpose is stable inelastic behavior under repeated reversals.

91. C — Reinforced masonry depends on composite action among units, grout, and reinforcing steel. Proper grout placement provides bond and force transfer so reinforcement can develop its intended strength and the wall can resist seismic shear and flexure. Intentional voids undermine that action, and grout does not eliminate reinforcement or the need to inspect placement before concealment.

92. D — Wood diaphragms transfer in-plane shear through sheathing fasteners, blocked panel edges where required, chords, collectors, and connections to vertical elements. Discontinuous nailing or blocking can interrupt that force path and concentrate deformation. The detailing does not exist to reduce density, allow uncontrolled sliding, or replace other anchorage elements that serve different functions.

93. D — Wall anchorage must transfer out-of-plane inertia force into the diaphragm and then through the structural system. Positive, adequately detailed connections reduce the risk of wall separation and collapse. Gravity friction alone is unreliable for earthquake reversals, and allowing separation or removing continuity elements directly weakens the required load path rather than improving it.

94. A — Special inspection adds independent field verification for work whose quality strongly affects seismic performance, such as critical welds and high-strength bolting. Inspectors confirm required procedures, materials, and workmanship. Inspection does not replace engineering design, guarantee damage-free behavior, or authorize undocumented changes. It helps ensure constructed details match the approved seismic design intent.

95. C — Structural observation and special inspection serve related but different functions. Observation by the design professional focuses on overall conformance of the structural system and critical seismic features, while special inspection addresses specified construction operations and workmanship. Observation does not replace testing, become an architectural finish review, or delegate structural redesign authority to field inspectors.

96. B — Deformation compatibility means nonstructural elements should tolerate the building movements expected during seismic response without failing dangerously or restraining the structural joint. A partition crossing a separation needs a slip, gap, or flexible detail. Rigidly tying both sides together or removing clearance defeats the purpose of the joint and can cause brittle damage.

97. B — Collectors are essential links between diaphragm forces and the vertical lateral-force-resisting system. If a collector or its connection fails prematurely, the intended load path can be lost. Seismic provisions therefore may require amplified demands or capacity-protected detailing. Collectors are not gravity-only members, brittle fuses, or devices that eliminate diaphragm shear.

98. A — Critical reinforcement and embedments become difficult or impossible to verify after concrete placement. Pre-placement inspection confirms bar size and location, confinement, splices, anchors, and other details that control seismic performance. Paint color is irrelevant, post-loading inspection is too late for concealed work, and removing required ties would directly compromise the design intent.

99. D — Seismic steel connections can experience repeated high cyclic demands, so workmanship and weld quality are critical. Adequate access, fit-up, cleaning, and surface preparation support proper welding and inspection. These steps are not cosmetic, do not replace approved procedures, and do not justify accepting cracks. They reduce the chance that avoidable defects undermine connection performance.

100. C — Continuous ties help keep floors, roofs, walls, frames, and foundations connected so seismic forces can move through a coherent load path and local damage is less likely to cause separation. They do not prevent yielding, eliminate foundations, or force every diaphragm to behave rigidly. Their key role is continuity and integrity of the structural system.