PRACTICE EXAM 15: CALIFORNIA CIVIL SEISMIC PRINCIPLES (100 QUESTIONS)

This standalone practice exam contains 100 four-choice questions weighted to the current BPELSG Civil Engineer Seismic Principles test plan. Use a 2.5-hour time limit for realistic practice. 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 and is not an official BPELSG examination.

1. A design worksheet defines SMS as Fa times Ss. For Ss = 1.10g and Fa = 1.16, what short-period site-modified value should be entered?

A. 0.948g
B. 1.100g
C. 1.276g
D. 2.260g

2. For the one-second ordinate in this exercise, use SM1 = FvS1. If Fv = 1.55 and S1 = 0.52g, determine SM1 to three decimals.

A. 0.335g
B. 1.070g
C. 2.070g
D. 0.806g

3. A simplified spectrum sets SDS equal to two-thirds of SMS. If SMS is 1.29g, what design short-period ordinate follows?

A. 0.65g
B. 0.86g
C. 1.29g

D. 1.94g

4. A study spectrum uses Ts = SD1/SDS. With SD1 = 0.57g and SDS = 0.86g, what transition period results to three decimals?

A. 0.663 s
B. 0.491 s
C. 1.509 s
D. 1.430 s

5. For a spectrum sketch, take T0 = 0.20Ts. If Ts = 0.663 s, what value should be plotted for T0?

A. 0.332 s
B. 0.663 s
C. 3.315 s
D. 0.133 s

6. A geotechnical report identifies deep soft clay over stiffer material. Relative to a rock site with the same regional mapped hazard, what is the main seismic-design implication?

A. Mapped hazard becomes zero
B. Local soil response can alter the design spectral ordinates
C. Dead load is automatically reduced
D. Risk category is fixed by soil type

7. A site contains loose saturated sand beneath a shallow water table. Which earthquake-induced ground behavior deserves the most direct investigation?

A. Liquefaction and associated ground deformation
B. Thermal expansion of soil
C. Dry-shrinkage cracking only

D. Snow-load redistribution

8. Two buildings occupy the same parcel, but one is an emergency facility expected to remain usable after a major earthquake. Why can its seismic design demands be more stringent?

A. Fa depends on wall color
B. S1 changes with room layout
C. Higher consequence of failure can increase required reliability
D. Concrete strength sets mapped hazard

9. A period-sensitivity study compares two equal-mass oscillators. One has stiffness k and the other 1.96k. What is the period of the stiffer oscillator divided by the period of the more flexible one?

A. 0.714
B. 0.510
C. 1.400
D. 1.960

10. Starting from a reference oscillator, keep lateral stiffness unchanged but increase effective seismic mass to 1.69 times its original value. What multiplier applies to the natural period?

A. 0.59
B. 1.69
C. 2.20
D. 1.30

11. At one level, three resisting lines act in parallel with lateral stiffnesses 16, 24, and 32 kips/in. What is their combined story stiffness?

A. 24 kips/in
B. 72 kips/in

C. 56 kips/in
D. 12,288 kips/in

12. An otherwise unchanged oscillator receives substantially more viscous damping. Near resonance, what response trend is generally expected?

A. Zero natural period
B. Larger seismic mass
C. Lower peak amplification with faster energy dissipation
D. No lateral force demand

13. A floor diaphragm has mass concentrated near its center but most lateral stiffness lies along one side of the plan. What behavior becomes especially important?

A. Coupled translation and torsional rotation
B. Pure vertical shortening
C. Uniform temperature strain
D. Elimination of drift

14. A building relies on several effective lateral resisting lines instead of one indispensable element. What seismic benefit does this arrangement provide if one line yields or is damaged?

A. It guarantees elastic response
B. It removes all torsion
C. It makes detailing unnecessary
D. Alternate load paths after local damage

15. A multistory building has one story that is much more flexible laterally than the stories above it. What response tendency is most concerning?

A. All floors move identically

B. Base shear becomes zero
C. Deformation concentrates in the flexible story
D. Roof mass disappears

16. Two adjacent buildings have different periods and may move out of phase during strong shaking. What is the purpose of adequate seismic separation?

A. Force equal periods
B. Reduce pounding from incompatible relative movement
C. Increase shared mass
D. Transfer diaphragm shear between buildings

17. An older unreinforced masonry building has roof framing that is poorly tied to the exterior walls. Which retrofit most directly addresses the collapse mechanism?

A. Thicken interior finishes
B. Increase roof live load
C. Remove all parapets only
D. Add positive wall-to-diaphragm anchorage and continuity ties

18. A wood apartment building has an open parking level with few lateral walls below several fully sheathed residential stories. Which improvement best targets the principal vulnerability?

A. Add roof insulation
B. Strengthen and stiffen the open first-story lateral system
C. Replace interior doors
D. Increase upper-story dead load

19. Existing reinforced-concrete columns have widely spaced transverse ties and are vulnerable to brittle shear failure. What retrofit objective is most appropriate?

A. Remove longitudinal bars
B. Reduce column dimensions
C. Increase shear capacity and confinement before flexural degradation
D. Increase unsupported height

20. An older precast building uses gravity connections with little cyclic deformation capacity. Why is this a seismic vulnerability?

A. Connection fracture can interrupt support and the lateral load path
B. Precast concrete has no mass
C. Panels cannot carry gravity load
D. All precast systems are rigid

21. After a strong earthquake, a building shows residual drift, crushed boundary regions, and damaged connections. What should the initial structural evaluation emphasize?

A. Paint color and finishes
B. Future energy use
C. Original construction schedule
D. Stability, load-path continuity, and hazards affecting safe occupancy

22. A brittle lateral system is being upgraded. Which retrofit philosophy is generally preferable to simply making one isolated member much stronger?

A. Concentrate all stiffness at one edge
B. Improve the complete load path and deformation compatibility
C. Eliminate every construction joint
D. Add mass without strengthening

23. A preliminary seismic-weight takeoff includes 1,560 kips of structural dead load and 90 kips of permanently attached equipment. If these are the only contributors, what effective seismic weight is used?

A. 1,470 kips
B. 1,560 kips
C. 1,650 kips
D. 1,740 kips

24. For this equivalent-lateral-force exercise, compute Cs = SDS/(R/Ie). With SDS = 0.88, R = 5.5, and Ie = 1.0, what coefficient results?

A. 0.105
B. 0.160
C. 0.193
D. 4.840

25. A simplified analysis gives Cs = 0.095 and effective seismic weight W = 3,200 kips. What base shear follows from V = CsW?

A. 304 kips
B. 30.4 kips
C. 337 kips
D. 3,040 kips

26. For a lower-bound coefficient check, compare 0.044SDSIe with 0.01 and use the larger number. Take SDS = 0.74 and Ie = 1.25. Which coefficient controls?

A. 0.0100
B. 0.0326
C. 0.9250
D. 0.0407

27. In this practice rule, k varies linearly from 1.0 at T = 0.5 s to 2.0 at T = 2.5 s. What k corresponds to T = 1.7 s?

A. 1.60
B. 1.20
C. 1.85
D. 2.40

28. Three floors use k = 1 with weights 80, 120, and 160 kips at heights 10, 20, and 30 ft. What fraction Cvx of base shear is assigned to the top floor?

A. 0.211
B. 0.421
C. 0.600
D. 0.789

29. Floor lateral forces are 32, 48, 63, and 77 kips from bottom to top. What story shear acts immediately below the second floor?

A. 80 kips
B. 140 kips
C. 220 kips
D. 188 kips

30. A roof force of 84 kips acts 42 ft above the base. Considering this force alone, what overturning moment is developed at the base?

A. 3,528 kip-ft
B. 2,016 kip-ft
C. 3,000 kip-ft
D. 7,056 kip-ft

31. Across a 70-ft diaphragm resisting width, 210 kips of in-plane shear is assumed to be uniformly distributed. What shear per foot corresponds to that idealization?

A. 2.1 kips/ft
B. 4.0 kips/ft
C. 3.0 kips/ft
D. 14.7 kips/ft

32. A wall tie calculation uses forty percent of SDSIpWp. With SDS = 0.90, Ip = 1.0, and tributary wall weight Wp = 82 kips, what anchorage demand is obtained?

A. 18.5 kips
B. 29.5 kips
C. 32.8 kips
D. 73.8 kips

33. A wall panel is assigned 22 psf of horizontal inertial pressure over a 12-ft story height. For one foot of wall length, what equivalent line force reaches the diaphragm?

A. 264 lb/ft
B. 132 lb/ft
C. 220 lb/ft
D. 528 lb/ft

34. The line of action of a 190-kip story resultant misses the floor rigidity center by 5.8 ft. Determine the vertical-axis moment created by that plan offset.

A. 328 kip-ft
B. 1,102 kip-ft
C. 1,900 kip-ft
D. 3,800 kip-ft

35. The center of mass is 4.5 ft from the center of rigidity in a 60-ft-wide diaphragm. What is the offset as a percentage of plan width?

A. 4.5%
B. 13.3%
C. 7.5%
D. 26.7%

36. Estimate a trial period from Ta = Ct(hn)^x with Ct = 0.018, hn = 76 ft, and x = 0.75. What is Ta to two decimals?

A. 0.28 s
B. 0.76 s
C. 1.01 s
D. 0.46 s

37. A study upper-period limit uses Cu = 1.35 and Ta = 0.74 s. What product CuTa is obtained?

A. 0.548 s
B. 0.740 s
C. 1.350 s
D. 0.999 s

38. A building has effective seismic weight 5,100 kips and a study coefficient Cs = 0.087. What base shear is obtained?

A. 391.3 kips
B. 510.0 kips
C. 443.7 kips
D. 586.2 kips

39. A loading combination retains all of a 145-kip x-direction effect and thirty percent of a 90-kip y-direction effect. What combined demand does that rule produce?

A. 172 kips
B. 117 kips
C. 145 kips
D. 235 kips

40. A diaphragm delivers 126 kips into seven identical collector lines assumed to share direct load equally. What axial force is assigned to each line?

A. 14 kips
B. 18 kips
C. 21 kips
D. 63 kips

41. A diaphragm in-plane moment of 3,360 kip-ft is resisted by a tension-compression chord pair 70 ft apart. What axial force magnitude is required in each chord?

A. 24 kips
B. 70 kips
C. 48 kips
D. 96 kips

42. Applied lateral floor forces are 28, 46, 62, and 84 kips. What total base shear is represented by those forces?

A. 158 kips
B. 220 kips
C. 192 kips
D. 248 kips

43. Two consecutive levels have elastic lateral displacements of 2.15 in and 1.30 in in the same direction. What elastic story drift is the difference between them?

A. 0.55 in
B. 1.30 in
C. 3.45 in
D. 0.85 in

44. Elastic analysis gives 0.90 in of displacement. For this exercise, amplify it by the ratio Cd/Ie, where Cd = 5.0 and Ie = 1.25. What design displacement is obtained?

A. 3.60 in
B. 1.13 in
C. 4.50 in
D. 5.63 in

45. A practice separation check adds the absolute design displacements of two adjacent structures. If they are 2.6 in and 1.8 in, what clearance does that rule require?

A. 0.8 in
B. 2.6 in
C. 4.7 in
D. 4.4 in

46. Between two floors 13 ft apart vertically, the design relative movement is 1.56 in. Express that interstory movement as a percent of the story height.

A. 1.00%
B. 0.10%
C. 1.56%
D. 12.0%

47. A 50-ft wall line receives 175 kips from the diaphragm. If the force is represented as a uniform line demand, what intensity in kips per foot should be used?

A. 2.5 kips/ft
B. 4.5 kips/ft
C. 3.5 kips/ft
D. 8.75 kips/ft

48. A collector gathers 3.2 kips/ft of diaphragm shear across a 26-ft tributary width. What accumulated axial force reaches the collector end?

A. 64.0 kips
B. 83.2 kips
C. 93.6 kips
D. 128.0 kips

49. Evaluate the rooftop-component expression [0.4apSDSWp/(Rp/Ip)](1+2z/h) for ap=1.0, SDS=0.85, Wp=4.5 kips, Rp=2.5, Ip=1.0, and z/h=0.60.

A. 2.69 kips
B. 1.35 kips
C. 2.20 kips
D. 4.21 kips

50. In the component height multiplier 1 + 2z/h, what value applies to a component located at z/h = 0.65?

A. 2.30
B. 1.30
C. 1.65
D. 3.30

51. A mechanical unit has a 1,120-lb horizontal design force resisted equally by four identical anchors, with eccentricity ignored. What direct shear is assigned to each anchor?

A. 140 lb
B. 224 lb
C. 280 lb
D. 560 lb

52. A nonbuilding structure has effective seismic weight 760 kips and a simplified lateral coefficient of 0.14. What base shear results?

A. 76.0 kips
B. 114.0 kips
C. 152.0 kips
D. 106.4 kips

53. Why can a short, very stiff piece of rooftop equipment experience high seismic acceleration even if its own deformation is small?

A. Small deformation means zero inertia
B. Rigid items have no mass
C. High stiffness can transmit floor acceleration with little component flexure
D. Acceleration depends only on paint color

54. A process pipe crosses a seismic joint between two building wings. Why are flexible couplings or loops commonly provided at the crossing?

A. They accommodate relative movement without rupturing the pipe
B. They make the wings share one drift
C. They increase fluid weight
D. They eliminate all pipe supports

55. A suspended ceiling receives lateral bracing and perimeter-clearance detailing. What seismic performance goal is primarily being addressed?

A. Increase roof dead load
B. Limit instability, falling hazards, and damage during building drift
C. Change the building period only
D. Eliminate structural story drift

56. Why should a partially filled tank model distinguish liquid that moves with the shell from free-surface sloshing?

A. All liquid moves rigidly
B. Sloshing has no inertia
C. Only empty tanks need seismic checks
D. The impulsive and convective components have different dynamic behavior

57. A critical electrical component must remain operational immediately after an earthquake. What design concern becomes especially important beyond simple life safety?

A. Lower equipment mass by repainting
B. Remove all flexible connections
C. Functional anchorage and compatibility with connected services
D. Ignore support deformation

58. A cable tray weighs 42 lb/ft over a 28-ft braced segment. What total supported weight belongs to that segment?

A. 840 lb
B. 1,008 lb
C. 1,260 lb
D. 1,176 lb

59. Nine equivalent seismic braces participate in carrying a 5.4-kip horizontal component demand. Under equal direct-force sharing, what demand belongs to one brace?

A. 0.45 kip
B. 0.60 kip
C. 0.75 kip
D. 1.80 kips

60. A practice component-force ceiling is defined as 1.6SDSIpWp. For SDS = 0.70, Ip = 1.0, and Wp = 3.5 kips, calculate that ceiling.

A. 3.92 kips
B. 2.45 kips
C. 3.50 kips
D. 5.60 kips

61. A simplified parapet check assigns a horizontal coefficient of 0.55 to 16 kips of tributary seismic weight. What inertia force follows from that assumption?

A. 5.5 kips
B. 8.8 kips
C. 10.5 kips
D. 29.1 kips

62. Why must equipment anchorage design evaluate the supporting curb, slab, or framing in addition to the anchor fastener itself?

A. Anchor steel always governs
B. Support flexibility never matters
C. The supporting construction can fail first
D. Only equipment weight matters

63. A rigid diaphragm is modeled in pure translation with two resisting frames having stiffnesses 36 and 54 kips/in. If total floor shear is 270 kips, what portion is attracted by the stiffer frame?

A. 108 kips
B. 135 kips
C. 180 kips
D. 162 kips

64. Three frames with relative stiffnesses 3, 4, and 5 share 360 kips through a rigid diaphragm with torsion neglected. What direct shear goes to the 4-unit frame?

A. 120 kips
B. 90 kips
C. 150 kips
D. 180 kips

65. Two wall lines are at x = 0 and x = 36 ft with relative stiffnesses 25 and 55. What is the stiffness-weighted center of rigidity measured from x = 0?

A. 11.25 ft
B. 18.00 ft
C. 24.75 ft
D. 30.94 ft

66. The floor mass centroid is located at x = 31 ft, while the stiffness-weighted rigidity center is at x = 24.5 ft. How large is the inherent plan eccentricity?

A. 6.5 ft
B. 5.5 ft
C. 24.5 ft
D. 55.5 ft

67. A floor shear of 260 kips acts with 4.8 ft eccentricity from the rigidity center. What torsional moment must be distributed in addition to direct shear?

A. 542 kip-ft
B. 1,300 kip-ft
C. 2,496 kip-ft
D. 1,248 kip-ft

68. A 720 kip-ft diaphragm torsion is resisted by two symmetric frames. Each has relative stiffness 1 and is 18 ft from the center. Using stiffness-radius weighting, what torsional shear goes to either frame?

A. 10 kips
B. 20 kips
C. 36 kips
D. 40 kips

69. A flexible diaphragm carries 84 kips of uniformly distributed lateral load between two end wall lines with equal tributary width. What reaction reaches each wall?

A. 28 kips
B. 56 kips
C. 84 kips
D. 42 kips

70. An in-plane diaphragm moment of 2,520 kip-ft is resisted by chord forces 63 ft apart. What axial force magnitude is required in each chord?

A. 20 kips
B. 40 kips
C. 63 kips
D. 80 kips

71. A drag strut collects 2.6 kips/ft of diaphragm shear over a 34-ft tributary width. What axial force must it transmit at the wall connection?

A. 88.4 kips
B. 68.0 kips
C. 96.2 kips
D. 132.6 kips

72. The force-displacement point for a lateral element is 126 kips at 0.70 in. Using the secant slope from the origin, what lateral stiffness does that point imply?

A. 88 kips/in
B. 126 kips/in
C. 180 kips/in
D. 252 kips/in

73. Model a member as a cantilever with tip displacement PL^3/(3EI). Using P = 12, L = 9, E = 1,500, and I = 1.2 in consistent units, what displacement results to two decimals?

A. 1.62
B. 0.54
C. 1.08
D. 3.24

74. At one diaphragm level, two independent lateral elements of 38 and 47 kips/in undergo the same translation. What combined restoring stiffness do they provide?

A. 42.5 kips/in
B. 85 kips/in
C. 47 kips/in
D. 1,786 kips/in

75. At a selected load level, story shear is 204 kips and elastic interstory displacement is 1.20 in. What secant story stiffness is represented by that response point?

A. 102 kips/in
B. 204 kips/in
C. 245 kips/in
D. 170 kips/in

76. A floor has concentrated masses of 45 units at x = 10 ft and 75 units at x = 34 ft. What is the combined mass-centroid coordinate?

A. 17.0 ft
B. 22.0 ft
C. 25.0 ft
D. 29.0 ft

77. For a torsion-sensitivity exercise, accidental eccentricity is prescribed as 0.05 times a 68-ft plan dimension. What offset is used?

A. 1.7 ft
B. 3.4 ft
C. 5.0 ft
D. 13.6 ft

78. For one torsion load case, a 210-kip floor shear is applied with 4.2 ft of inherent eccentricity and an additional 3.4 ft accidental offset in the same direction. What moment results?

A. 882 kip-ft
B. 1,260 kip-ft
C. 2,478 kip-ft
D. 1,596 kip-ft

79. Compute the stability index from theta = PDelta/(Vh) using P = 1,200 kips, Delta = 1.10 in, V = 240 kips, and h = 168 in. Report three decimals.

A. 0.033
B. 0.013
C. 0.055
D. 0.330

80. A design displacement difference of 2.16 in occurs between floors separated by 16 ft. What percentage of the story height does that displacement represent?

A. 0.750%
B. 1.350%
C. 1.125%
D. 13.50%

81. A response-spectrum model produces modal base shears of 100 and 140 kips. If their peaks are combined by the square root of the sum of squares, what total response results?

A. 120 kips
B. 240 kips
C. 300 kips
D. 172 kips

82. Two important vibration modes have very close natural frequencies. Why can a correlation-sensitive modal combination be preferable to simple SRSS?

A. SRSS always gives zero
B. Closely spaced modes can have correlated peaks
C. Close modes have no mass
D. Correlation removes all damping

83. Why are response-spectrum design results sometimes scaled to a specified minimum reference base shear?

A. Prevent unrealistically low dynamic design forces
B. To force every mode to equal amplitude
C. To remove torsional response
D. To replace the structural model

84. Which analytical condition most strongly supports treating a floor diaphragm as rigid in its own plane?

A. The floor has any concrete topping
B. The building is one story
C. In-plane diaphragm deformation is comparatively small
D. All walls have equal length

85. A 20-ft diaphragm strip carries triangular lateral line load increasing from zero to 9 kips/ft. What resultant force is represented by the load diagram?

A. 90 kips
B. 45 kips
C. 180 kips
D. 270 kips

86. A triangular diaphragm line load rises uniformly from zero at the left support to its maximum at the right over a 20-ft base. Measured from the zero-intensity end, where is the load resultant located?

A. 6.67 ft
B. 13.33 ft
C. 10.00 ft
D. 16.67 ft

87. A simply supported diaphragm span is 40 ft long and carries a 160-kip lateral resultant 14 ft from the left support. What reaction occurs at the right support?

A. 40 kips
B. 104 kips
C. 160 kips
D. 56 kips

88. A large diaphragm opening interrupts the direct path between floor regions and a shear wall. Why are collectors and opening-edge reinforcement important?

A. They eliminate floor mass
B. They prevent all vertical deflection
C. Redirect diaphragm forces around the opening
D. They make torsion impossible

89. In a reinforced-concrete plastic-hinge region, what is the main reason for closely spaced transverse reinforcement?

A. Increase mapped hazard
B. Replace flexural steel
C. Confine concrete and restrain bar buckling
D. Eliminate axial load

90. Why are lap splices generally kept away from the region of highest cyclic strain in a member expected to form a plastic hinge?

A. Avoid bond failure in the hinge region
B. Splices stop all yielding
C. Cover concrete carries all tension
D. Splices always increase curvature

91. A seismic steel moment connection appears visually smooth after welding. Why is compliance with the qualified welding procedure still essential?

A. Smooth appearance proves toughness
B. Assure qualified materials, heat control, and toughness
C. Any electrode performs equally
D. Visual inspection finds every defect

92. At the end of a ductile steel brace, why does gusset-plate geometry matter in addition to plate strength?

A. Only plate color matters
B. Thickness solves every issue
C. Brace force stops before the gusset
D. Accommodate force transfer, rotation, and buckling

93. During reinforced-masonry inspection, why are bar position and grout consolidation critical seismic items?

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

94. Why are nail spacing and edge distance carefully inspected in a wood structural-panel shear wall?

A. They determine site class
B. They remove hold-down tension
C. Control fastener strength, slip, and splitting
D. They control concrete curing

95. A diaphragm collector crosses a construction joint before entering a shear wall. What detailing objective is essential at the joint?

A. Provide developed continuity for reversing axial force across the interruption
B. Stop the collector at the joint
C. Use finishes as the splice
D. Design for one force direction only

96. Why is positive anchorage between a heavy wall and a floor or roof diaphragm a critical earthquake detail?

A. It increases roof weight intentionally
B. It transfers out-of-plane wall inertia and helps prevent wall separation
C. It removes all in-plane wall shear
D. It prevents every foundation movement

97. A post-installed anchor is close to a free concrete edge. Why must the engineer check concrete failure modes as well as steel strength?

A. Steel always fails first
B. Edge distance has no effect
C. Closer edges always increase strength
D. Concrete breakout or splitting can govern

98. A sprinkler main crosses a seismic separation between building wings. What characteristic should the crossing detail provide?

A. A rigid tie between wings
B. Flexibility and clearance for the expected relative displacement
C. No supports near the joint
D. Added water weight for stability

99. Field inspection reveals that a brace connection was built with a geometry different from the approved seismic detail. What quality-control action is required before accepting that connection?

A. Document the deviation and obtain an approved engineering disposition
B. Accept it because it is complete
C. Delete the observation
D. Assume equal capacity without review

100. During construction of a significant seismic structure, what does structural observation by the design professional primarily add to the quality-assurance process?

A. Replace every special inspection
B. Guarantee zero earthquake damage
C. Review critical work and design deviations
D. Eliminate approved drawings

Practice Exam 15: Answer Key and Explanations

1. C — The worksheet relationship is a direct product: SMS = 1.16(1.10g) = 1.276g. Dividing by the site factor, carrying forward the mapped value unchanged, or adding the two numbers does not apply the stated site-modification equation. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

2. D — Multiplying the stated one-second mapped value by the site coefficient gives SM1 = 1.55(0.52g) = 0.806g. The other choices arise from division, addition, or an unrelated scale factor rather than the product defined in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

3. B — Applying the stated two-thirds conversion gives SDS = (2/3)(1.29g) = 0.86g. One-half of the MCE value, leaving the value unreduced, or multiplying by 1.5 does not follow the design-spectrum relationship supplied in the question. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

4. A — The transition period is the ratio 0.57/0.86 = 0.6628 second, rounded to 0.663 second. Reversing the ratio or combining the spectral ordinates by addition or subtraction does not represent the definition of Ts used in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

5. D — Twenty percent of 0.663 second is 0.1326 second, which rounds to 0.133 second. Halving the value, leaving Ts unchanged, or dividing by 0.20 would not implement the stated T0 relationship. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

6. B — Soft deposits can amplify or reshape shaking at selected periods, so local site response can modify the spectral values used for design even when regional mapped hazard is the same. Soil profile does not eliminate hazard, change gravity dead load by itself, or determine occupancy risk category. This confirms the selected response for the stated idealization.

7. A — Loose saturated granular soils can develop excess pore-water pressure during cyclic shaking, reducing effective stress and triggering liquefaction, settlement, lateral spreading, or loss of bearing support. The other choices are unrelated to the groundwater and loose-sand condition described in the stem. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

8. C — Seismic reliability requirements reflect the consequences of failure and the importance of post-earthquake function. An emergency facility can therefore be assigned more demanding design provisions than an ordinary occupancy at the same site. Architectural color, room arrangement, and concrete strength do not change regional mapped hazard. This confirms the selected response for the stated idealization.

9. A — With equal mass, period varies inversely with the square root of stiffness. Thus TX/TY = 1/sqrt(1.96) = 1/1.4 = 0.714. Using the stiffness ratio directly, its reciprocal, or a linear stiffness-period relationship would be inconsistent with the stated dynamic model. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

10. D — For unchanged stiffness, natural period varies with the square root of mass. The period factor is sqrt(1.69) = 1.30. The other options use the mass factor directly, its reciprocal, or an unrelated product instead of the square-root dependence. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

11. B — Parallel lateral elements undergo the same story translation, and their restoring forces add. Equivalent stiffness is therefore 16 + 24 + 32 = 72 kips/in. Averaging, omitting one line, or multiplying the stiffnesses does not represent parallel structural action. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

12. C — Additional damping removes vibrational energy more rapidly and generally reduces resonant amplification and peak response. It does not eliminate the natural period, increase structural mass, or make all earthquake forces vanish. The system still responds dynamically, but the amplification is moderated. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

13. A — Offset between the centers of mass and rigidity causes lateral inertia to create both translation and torsional rotation. That coupling can increase demand at edge elements even when total floor shear is unchanged. The other choices do not follow from the plan stiffness imbalance. This confirms the selected response for the stated idealization.

14. D — Redundancy allows seismic forces to redistribute if one element yields, degrades, or loses stiffness, reducing dependence on a single critical load path. It does not guarantee elastic behavior, eliminate torsion, or remove the need for ductile detailing and reliable connections. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

15. C — A sharp stiffness discontinuity attracts large relative deformation to the flexible story, which can produce a weak- or soft-story mechanism and severe local damage. The condition does not force rigid-body motion, remove base shear, or change the actual roof mass. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

16. B — Seismic separation provides clearance so neighboring structures can undergo their own lateral displacements without colliding. It does not make their periods equal, increase combined mass, or intentionally transfer diaphragm shear from one independent building into the other. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

17. D — Poor wall-to-diaphragm anchorage permits heavy masonry walls to separate and fall out of plane during shaking. Positive ties and a continuous load path directly address that mechanism. Cosmetic finishes, added roof load, or parapet removal alone do not provide the missing anchorage. This confirms the selected response for the stated idealization.

18. B — The open parking level creates a severe stiffness and strength discontinuity that can concentrate drift and damage in the first story. Adding appropriately designed frames, walls, collectors, and foundations at that level directly addresses the weakness. Nonstructural upgrades or added upper-story weight do not. This confirms the selected response for the stated idealization.

19. C — Widely spaced transverse reinforcement can permit shear failure, poor confinement, and bar buckling before ductile flexural behavior develops. Retrofit measures such as jacketing or added confinement should raise shear capacity and deformation tolerance. Removing steel, reducing section size, or increasing unbraced length would worsen vulnerability. This confirms the selected response for the stated idealization.

20. A — Precast members may remain strong while brittle or poorly detailed connections fail under repeated drift, causing loss of support or load-path discontinuity. The vulnerability is therefore concentrated at the connections and compatibility details, not in an assumption that precast construction lacks mass or gravity capacity. This confirms the selected response for the stated idealization.

21. D — Post-earthquake evaluation first addresses conditions that threaten stability, falling hazards, support, and safe use. Residual drift, crushed regions, and connection damage may indicate compromised lateral capacity or gravity support. Cosmetic finishes, energy efficiency, and the historic construction schedule are secondary to immediate structural safety. This confirms the selected response for the stated idealization.

22. B — Effective seismic rehabilitation considers how forces travel from diaphragms through collectors, vertical elements, connections, and foundations while preserving compatible deformation. Strengthening one member alone can shift failure to another brittle link. A coordinated load-path retrofit is therefore preferable to isolated strength increases. This confirms the selected response for the stated idealization.

23. C — The stated effective seismic weight is the sum of the included permanent weights: 1,560 + 90 = 1,650 kips. Subtracting the equipment, omitting it, or doubling part of the load would not follow the takeoff assumptions given in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

24. B — The denominator R/I_e equals 5.5, so $C_s = 0.88/5.5 = 0.160$. Multiplying instead of dividing, altering the importance factor, or using the response factor as a numerator would not match the equation stated in the problem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

25. A — Multiplying the coefficient by effective seismic weight gives $V = 0.095(3{,}200) = 304$ kips. Moving the decimal one place, dividing by the coefficient, or multiplying by ten would not satisfy the stated base-shear equation. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

26. D — The calculated lower-bound term is $0.044(0.74)(1.25) = 0.0407$, which exceeds 0.01 and therefore governs. Choosing 0.01 ignores the larger specified minimum, while the other values come from omitting or misusing a factor. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

27. A — The interval from 0.5 to 2.5 seconds spans 2.0 seconds. A period of 1.7 seconds lies $1.2/2.0 = 0.60$ of the way through the interval, so $k = 1.0 + 0.60(1.0) = 1.60$. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

28. C — For $k = 1$, the distribution weights are wh. They are 800, 2,400, and 4,800, totaling 8,000. The top-floor fraction is therefore $4{,}800/8{,}000 = 0.600$. The other choices result from using only one lower level, an incorrect total, or the wrong numerator. A quick check of units and order of magnitude provides an independent confirmation of the selected value.

29. D — Story shear immediately below the second floor must carry the forces from levels two through four: $48 + 63 + 77 = 188$ kips. Including only the two upper forces, only lower floors, or all four levels would correspond to different cut locations. A quick check of units and order of magnitude provides an independent confirmation of the selected value.

30. A — The overturning moment from a single horizontal force is force times its vertical lever arm: $84(42) = 3{,}528$ kip-ft. Using the wrong height, rounding to an unrelated value, or doubling the couple does not satisfy moment equilibrium. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

31. C — Average unit shear is total shear divided by resisting width: 210/70 = 3.0 kips/ft. Multiplying rather than dividing, using an incorrect width, or shifting the decimal does not represent uniform distribution across the stated diaphragm width. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

32. B — The stated anchorage expression gives F = 0.4(0.90)(1.0)(82) = 29.52 kips, rounded to 29.5 kips. Omitting the 0.4 factor, using a different coefficient, or nearly taking the full wall weight does not follow the exercise. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

33. A — For one foot of wall length, the tributary area is 12 square feet. Multiplying 22 psf by 12 ft gives 264 lb/ft of diaphragm-level line force. Halving, using the pressure alone, or doubling the result does not match the stated tributary area. A quick check of units and order of magnitude provides an independent confirmation of the selected value.

34. B — Plan torsion from an eccentric lateral force is M = Ve. Multiplying 190 kips by 5.8 ft gives 1,102 kip-ft. The alternatives reflect adding the values, using force alone, or doubling without justification rather than forming the correct moment. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

35. C — The eccentricity ratio is 4.5/60 = 0.075, or 7.5 percent. Using the eccentricity as though it were already a percentage, reversing the ratio, or applying an unrelated fraction does not describe the offset relative to the diaphragm width. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

36. D — Substitution gives Ta = 0.018(76^0.75), which is approximately 0.463 second and rounds to 0.46 second. Using a linear height relation, omitting the exponent, or multiplying the constants differently does not follow the empirical expression stated in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

37. D — The upper-period product is 1.35(0.74 s) = 0.999 second. Dividing by Cu, leaving Ta unchanged, or reporting the coefficient itself does not implement the specified multiplication used in the study limit. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

38. C — The base shear is V = CsW = 0.087(5,100) = 443.7 kips. The alternative values result from different coefficients or a misplaced decimal rather than the coefficient and effective weight stated in the problem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

39. A — Thirty percent of the orthogonal component is 0.30(90) = 27 kips. Adding that to 145 gives 172 kips. Subtracting the orthogonal portion, ignoring it, or adding the full Ey does not follow the combination rule provided in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

40. B — Equal sharing among seven identical collector lines gives 126/7 = 18 kips per line. Dividing by a different number of lines, multiplying by a fraction incorrectly, or assigning half the total to one collector does not satisfy the stated idealization. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

41. C — A chord couple resists the diaphragm moment, so F = M/d = 3,360/70 = 48 kips. Halving the force, using the chord spacing as the answer, or doubling the required couple force does not satisfy moment equilibrium. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

42. B — The base must equilibrate the sum of all applied floor forces: 28 + 46 + 62 + 84 = 220 kips. Omitting a level or combining only the upper forces would correspond to story shear at a different elevation, not the total base reaction. This confirms the selected response for the stated idealization.

43. D — Elastic interstory drift is the relative displacement between adjacent levels, so 2.15 - 1.30 = 0.85 inch. Using the lower displacement alone, subtracting the wrong values, or adding the displacements does not represent relative story deformation. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

44. A — The amplification factor is Cd/Ie = 5.0/1.25 = 4.0. Multiplying by the elastic displacement gives delta = 4.0(0.90) = 3.60 inches. The other values come from multiplying the factors incorrectly or omitting the division by Ie. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

45. D — The stated practice rule uses the sum of the absolute displacements, so required separation is 2.6 + 1.8 = 4.4 inches. Taking their difference, using only the larger displacement, or adding an unrelated allowance would not follow the rule provided in the stem. A quick check of units and order of magnitude provides an independent confirmation of the selected value.

46. A — Convert the story height to inches: 13 ft = 156 in. The drift ratio is 1.56/156 = 0.0100, or 1.00 percent. Dividing by feet without unit conversion or treating the drift itself as a percentage gives incorrect results. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

47. C — Average line demand is total force divided by wall-line length: 175/50 = 3.5 kips/ft. The distractors result from using the wrong divisor or multiplying rather than distributing the force over the stated resisting length. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

48. B — Collector axial force equals the distributed diaphragm demand times the tributary width: 3.2(26) = 83.2 kips. Using a different width, adding the quantities, or multiplying by an unrelated factor does not represent the accumulated drag force. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

49. B — The basic term is 0.4(1.0)(0.85)(4.5)/2.5 = 0.612 kips. The height multiplier is 1 + 2(0.60) = 2.20. Their product is 1.3464 kips, which rounds to 1.35 kips. The distractors result from omitting or misapplying one of those factors. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

50. A — Substituting z/h = 0.65 gives 1 + 2(0.65) = 1 + 1.30 = 2.30. The distractors omit the leading 1, use z/h directly, or add an extra unit rather than following the stated multiplier. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

51. C — Equal direct sharing among four identical anchors gives 1,120/4 = 280 lb per anchor. Dividing by eight, by five, or assigning half the total to each anchor would not match the equal-share idealization stated in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

52. D — The simplified base shear is the coefficient times effective weight: 0.14(760) = 106.4 kips. The alternative values result from a misplaced decimal, using a different coefficient, or applying an unrelated factor rather than the one given. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

53. C — A stiff component may move nearly with its supporting floor, so small internal deformation does not imply small inertia force. Its mass can still experience substantial acceleration transmitted through the support. The other choices incorrectly equate flexibility with inertia or invoke unrelated properties. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

54. A — The two building wings can move differently during an earthquake. Flexible couplings, loops, or clearance allow the utility line to tolerate relative displacement without rupture or unintended structural tying. They do not force equal drift, increase the fluid weight beneficially, or remove the need for support. This confirms the selected response for the stated idealization.

55. B — Seismic ceiling detailing helps the suspended system remain stable, control relative movement, and reduce falling hazards while the building drifts. It is not intended to increase dead load, determine the building period by itself, or eliminate the structural drift imposed by the primary lateral system. This confirms the selected response for the stated idealization.

56. D — A partially filled tank can have an impulsive portion that moves largely with the shell and a convective portion associated with sloshing. These components have different periods, force distributions, and potential failure effects. Treating all liquid as one rigid mass can misrepresent the response. This confirms the selected response for the stated idealization.

57. C — Operational performance requires the component, its anchorage, supporting structure, and connected utilities to remain functional under earthquake movement. A unit that does not fall can still be unusable if connections rupture or supports distort. Cosmetic changes and ignoring compatibility do not satisfy that objective. This confirms the selected response for the stated idealization.

58. D — The supported segment weight is the uniform weight times length: 42 lb/ft × 28 ft = 1,176 lb. Using a shorter assumed length, omitting part of the tray, or multiplying by an unrelated factor does not match the stated braced segment. A quick check of units and order of magnitude provides an independent confirmation of the selected value.

59. B — Equal sharing among nine identical braces gives 5.4/9 = 0.60 kip per brace. The distractors result from dividing by a different number of braces or assigning a larger fraction than the equal-share assumption permits. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

60. A — Substitution gives Fmax = 1.6(0.70)(1.0)(3.5) = 3.92 kips. Omitting the 1.6 multiplier, using the component weight alone, or applying an unrelated factor does not follow the upper-force equation stated in the stem. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

61. B — The simplified lateral force is 0.55(16) = 8.8 kips. The other choices come from using the coefficient as a force, applying a different multiplier, or reversing the relationship rather than multiplying the prescribed coefficient by the tributary weight. The distractors correspond to a reversed ratio, omitted factor, or arithmetic slip rather than the relationship stated in the problem.

62. C — Anchors transfer force into the supporting construction, so concrete breakout, local bending, curb failure, weld failure, or support deformation may control before the fastener itself reaches its nominal capacity. Evaluating only the anchor steel can therefore miss the actual weakest link in the load path. This confirms the selected response for the stated idealization.

63. D — Under pure translation, direct shear is distributed in proportion to stiffness. The stiffer frame receives 54/(36+54) of 270 = 162 kips. Equal sharing or using an incorrect stiffness fraction does not satisfy the rigid-diaphragm compatibility assumption. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

64. A — The total relative stiffness is 3 + 4 + 5 = 12. The 4-unit frame therefore receives 4/12 of 360 = 120 kips. The other choices correspond to different stiffness fractions or equal-share assumptions that do not match the stated frame stiffnesses. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

65. C — The rigidity coordinate is sum(kx)/sum(k) = [25(0) + 55(36)]/(25+55) = 1,980/80 = 24.75 ft. The alternatives reflect an unweighted midpoint, the wrong stiffness assigned to the far line, or an incorrect denominator. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model. This confirms the selected response for the stated idealization.

66. A — Inherent eccentricity is the absolute distance between the centers of mass and rigidity: |31 - 24.5| = 6.5 ft. Using either coordinate directly or adding the coordinates does not represent the physical offset that produces plan torsion. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

67. D — The torsional moment is the product of floor shear and eccentricity: 260(4.8) = 1,248 kip-ft. The distractors come from addition, rough substitution, or doubling rather than using the stated force and lever arm in moment equilibrium. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

68. B — The denominator is 1(18^2) + 1(18^2) = 648. The numerator for either frame is 720(1)(18) = 12,960, so Vi = 12,960/648 = 20 kips. The other values come from omitting one frame or mishandling the radius terms. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

69. D — With equal tributary widths and symmetric support conditions, the total 84-kip diaphragm load divides equally, giving 42 kips to each wall line. The other choices assign one-third, two-thirds, or all of the load to a single support without justification. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

70. B — The chord pair forms a couple, so each axial force has magnitude F = M/d = 2,520/63 = 40 kips. Halving the value, using the spacing itself, or doubling the force does not satisfy the required in-plane moment equilibrium. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

71. A — The accumulated collector force is distributed demand times tributary width: 2.6(34) = 88.4 kips. The alternatives use different widths or an incorrect multiplier rather than summing the uniform in-plane load over the stated tributary distance. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

72. C — Secant stiffness is force divided by displacement: 126/0.70 = 180 kips/in. Treating the force itself as stiffness, multiplying by displacement, or using an unrelated divisor does not match the stated force-displacement relationship. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model. This confirms the selected response for the stated idealization.

73. A — Substitution gives delta = 12(9^3)/[3(1,500)(1.2)] = 8,748/5,400 = 1.62 in consistent units. The alternatives arise from omitting a factor of three, halving, or doubling the correct elastic cantilever expression. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model. This confirms the selected response for the stated idealization.

74. B — Elements acting in parallel experience the same floor translation and their restoring forces add, so equivalent stiffness is 38 + 47 = 85 kips/in. Averaging, selecting only the stiffer element, or multiplying stiffnesses does not represent parallel action. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

75. D — Effective story stiffness is the lateral shear divided by story drift: 204/1.20 = 170 kips/in. Using the shear itself, multiplying by drift, or dividing by a different value does not match the linearized force-displacement relationship stated in the stem. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

76. C — The mass centroid is [45(10) + 75(34)]/(45+75) = (450 + 2,550)/120 = 25.0 ft. An unweighted midpoint or an incorrect mass weighting would not satisfy the centroid definition. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model. This confirms the selected response for the stated idealization.

77. B — The prescribed accidental offset is 0.05(68 ft) = 3.4 ft. The distractors use half the percentage, treat five percent as five feet, or double the intended offset rather than applying the stated plan fraction. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

78. D — When the eccentricities act on the same side, the total offset is 4.2 + 3.4 = 7.6 ft. Multiplying by 210 kips gives 1,596 kip-ft. Using only one eccentricity or subtracting them would represent a different loading case. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

79. A — The numerator is 1,200(1.10) = 1,320 kip-in. The denominator is 240(168) = 40,320 kip-in, so theta = 1,320/40,320 = 0.0327, rounded to 0.033. The other values result from unit or ratio errors. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model. This confirms the selected response for the stated idealization.

80. C — Convert 16 ft to 192 inches. The drift ratio is 2.16/192 = 0.01125, or 1.125 percent. The distractors arise from using the wrong height, treating inches and feet inconsistently, or moving the decimal one place. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

81. D — SRSS gives sqrt(100^2 + 140^2) = sqrt(29,600) = 172.05 kips, rounded to 172 kips. Simple averaging, direct addition, or adding an extra contribution would not follow the square-root-of-sum-of-squares procedure stated in the stem. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

82. B — SRSS assumes modal peak responses are sufficiently independent. When frequencies are close, their responses can be correlated, so a method that accounts for modal correlation can provide a more appropriate combined estimate. Close frequency spacing does not remove modal mass, damping, or structural response. This confirms the selected response for the stated idealization.

83. A — Dynamic analysis can produce a total base shear below a required reference level because of modeling assumptions, period effects, or modal response characteristics. Scaling preserves the distribution from the dynamic model while meeting the prescribed minimum force benchmark. It does not equalize modes or eliminate torsion. This confirms the selected response for the stated idealization.

84. C — A rigid-diaphragm idealization is appropriate when in-plane floor deformation is small compared with deformation of the vertical resisting elements, so floor points move approximately as a rigid body. Material type or building height alone does not establish that relative stiffness condition. The other choices describe a different seismic mechanism or omit the force-transfer behavior that controls this scenario.

85. A — The resultant of a triangular load is its area: one-half times base times peak intensity. Thus F = 0.5(20)(9) = 90 kips. Using the average incorrectly, omitting the one-half factor, or multiplying by an extra factor produces the distractors. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

86. B — The centroid of a triangular load lies two-thirds of the base length from the zero-intensity end. Therefore the resultant acts at (2/3)(20) = 13.33 ft from the left. One-third or one-half positions correspond to different load shapes or reference ends. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

87. D — Taking moments about the left support gives Rright(40) = 160(14), so Rright = 56 kips. The remaining 104 kips acts at the left support. Assigning the full load or an equal split would not satisfy moment equilibrium for the eccentric resultant. The result follows directly from equilibrium, stiffness compatibility, and the geometry stated in the simplified analytical model.

88. C — Large openings can interrupt normal diaphragm shear flow and create concentrated forces around corners and reentrant edges. Collectors, chords, and local reinforcement provide a deliberate path around the opening and into the vertical system. They do not eliminate mass, vertical deflection, or all torsional response. This confirms the selected response for the stated idealization.

89. C — Closely spaced hoops or ties confine compressed concrete, restrain longitudinal bars from buckling, and help preserve strength and deformation capacity through repeated inelastic cycles. They do not alter regional hazard, replace longitudinal reinforcement, or eliminate the axial load that the member must continue to carry. Inspection should emphasize details that govern repeated force transfer and deformation rather than appearance alone.

90. A — Plastic-hinge regions undergo repeated large tensile and compressive strains that can severely challenge bond and splice performance. Moving lap splices away from the highest strain reduces the likelihood that bond deterioration, splitting, or slip will govern before the intended flexural yielding mechanism develops. A field deviation can change strength, stiffness, anchorage, or deformation capacity and therefore requires evaluation before acceptance.

91. B — A smooth surface does not establish weld-metal toughness, proper filler selection, heat input, preheat, penetration, or freedom from hidden discontinuities. Qualified procedures, appropriate materials, fit-up, workmanship, and required inspection collectively support reliable cyclic performance that visual appearance alone cannot demonstrate. A field deviation can change strength, stiffness, anchorage, or deformation capacity and therefore requires evaluation before acceptance.

92. D — The gusset must transmit brace force while accommodating rotations and deformations expected during cyclic yielding and buckling. Shape, clearances, weld or bolt layout, and connection geometry influence local stress and fracture risk. Adequate plate thickness alone cannot correct every geometric incompatibility. A field deviation can change strength, stiffness, anchorage, or deformation capacity and therefore requires evaluation before acceptance.

93. D — Reinforced masonry depends on units, grout, and steel acting together. Misplaced reinforcement or poorly consolidated grout can reduce bond, effective section properties, anchorage, and continuity under cyclic tension, compression, and shear. These are structural load-path issues rather than cosmetic construction details. A field deviation can change strength, stiffness, anchorage, or deformation capacity and therefore requires evaluation before acceptance.

94. C — Sheathing fasteners are central to wood shear-wall behavior. Nail spacing and edge distance affect strength, cyclic deformation, energy dissipation, tear-out, and splitting. Incorrect patterns can change both capacity and stiffness. Those details do not establish soil site class, eliminate overturning tension, or govern concrete curing. Inspection should emphasize details that govern repeated force transfer and deformation rather than appearance alone.

95. A — The collector is part of the seismic load path, so its axial force must cross the construction joint through developed reinforcement, welds, anchors, or another designed transfer mechanism. Because earthquake forces reverse, one-way or cosmetic continuity is insufficient. The connection must preserve the intended force path. This confirms the selected response for the stated idealization.

96. B — Heavy walls generate substantial out-of-plane inertia during shaking. Positive ties transfer that force into the diaphragm and help keep the wall attached to the supporting structure. The anchorage is not intended to add dead load, eliminate in-plane shear, or prevent every possible foundation displacement. Inspection should emphasize details that govern repeated force transfer and deformation rather than appearance alone.

97. D — Anchor force is transferred into a finite concrete region. Small edge distance, limited embedment, cracking, and spacing can reduce breakout or splitting resistance so the concrete fails before the steel fastener. Evaluating only steel strength can therefore overstate the usable anchorage capacity. A field deviation can change strength, stiffness, anchorage, or deformation capacity and therefore requires evaluation before acceptance.

98. B — The building wings can move independently during an earthquake. A rigid crossing may rupture or unintentionally couple the structures, so flexible joints, loops, and clearance are used to accommodate relative displacement while maintaining service. Removing supports or adding fluid weight does not solve the compatibility problem. This confirms the selected response for the stated idealization.

99. A — A field change in a seismic connection can alter strength, stiffness, anchorage, fracture behavior, and cyclic deformation capacity. The deviation should be documented and evaluated by the responsible design authority or corrected through an approved process. Completion or visual similarity alone does not demonstrate equivalent seismic performance. This confirms the selected response for the stated idealization.

100. C — Structural observation provides periodic professional review of significant construction to identify deviations that could affect the intended seismic behavior. It complements required special inspection and testing rather than replacing them. Observation cannot guarantee damage-free performance and does not eliminate the need for approved construction documents. Inspection should emphasize details that govern repeated force transfer and deformation rather than appearance alone.