PRACTICE EXAM 13: 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. Mapped short-period acceleration is 0.92g at a site where Fa = 1.24. Under the exercise definition SMS = FaSs, which site-modified value results?

A. 0.742g
B. 0.920g
C. 2.160g
D. 1.141g

2. For a one-second spectrum calculation, use SM1 = FvS1. If Fv = 1.62 and S1 = 0.51g, what is SM1?

A. 0.826g
B. 0.315g
C. 1.130g
D. 2.130g

3. The site-modified short-period ordinate is 1.14g. This exercise takes the design ordinate as two-thirds of that value. Select SDS.

A. 0.57g
B. 1.14g
C. 0.76g

D. 1.71g

4. A design spectrum has SD1 = 0.55g and SDS = 0.76g. Using Ts = SD1/SDS, compute Ts to three decimals.

A. 0.418 s
B. 0.724 s
C. 1.310 s
D. 1.510 s

5. A spectrum construction specifies T0 = 0.2Ts. If Ts = 0.724 s, what is T0 to three decimals?

A. 0.362 s
B. 0.724 s
C. 3.620 s
D. 0.145 s

6. A geotechnical profile shows groundwater near grade beneath a thick layer of loose sand. During strong shaking, which ground-failure mechanism deserves primary attention?

A. Loose saturated sand beneath a shallow groundwater table
B. Dense dry gravel on rock
C. Dry stiff clay above groundwater
D. Massive competent bedrock

7. Why can a hospital and a similar office building at the same site have different seismic design requirements?

A. Roof color changes ground motion
B. Different risk categories reflect different consequences of failure
C. Window area sets the site class

D. Concrete slump defines seismic hazard

8. For otherwise similar structures, why can a softer soil profile produce larger design spectral response than firm rock at some periods?

A. Rock always has larger amplification
B. Soil removes all long-period motion
C. Local soil response can amplify shaking over selected period ranges
D. Site class changes only dead load

9. A vibration model keeps mass unchanged while lateral stiffness rises by 96 percent. Under T proportional to sqrt(m/k), what fraction of the original period remains?

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

10. Three lateral lines act in parallel at one story with stiffnesses 18, 27, and 35 kips/in. What is their combined translational stiffness?

A. 44 kips/in
B. 62 kips/in
C. 80 kips/in
D. 17,010 kips/in

11. A structure keeps the same stiffness while its effective seismic mass becomes 1.69 times larger. By what factor does its period change?

A. 0.59
B. 1.30

C. 1.69
D. 2.20

12. Two otherwise identical oscillators operate near resonance, but one has greater viscous damping. How does the more-damped oscillator usually respond?

A. Natural period becomes zero
B. Seismic mass doubles
C. All strength demand disappears
D. Peak dynamic response is generally reduced

13. Why is ductility valuable in a seismic-force-resisting system?

A. It prevents every crack
B. It permits stable inelastic deformation while dissipating energy
C. It eliminates inertia forces
D. It makes stiffness infinite

14. A building has one story much more flexible than the stories above and below. What response is most concerning?

A. Roof acceleration becomes zero
B. Foundation shear disappears
C. All stories drift equally
D. Drift may concentrate in the flexible story

15. If the center of mass is offset from the center of rigidity, what additional building response should be expected under lateral shaking?

A. Pure vertical shortening only
B. No change in force distribution

C. Torsional rotation coupled with translation
D. Uniform axial strain in every column

16. What seismic-system benefit comes from having several effective resisting lines rather than relying on one critical line?

A. It provides alternate seismic load paths
B. It removes the need for detailing
C. It guarantees elastic response
D. It eliminates foundation forces

17. An existing unreinforced masonry bearing-wall building has timber roof joists with little positive wall anchorage. Which earthquake vulnerability is most important?

A. Local roof membrane shrinkage at fasteners
B. Out-of-plane wall separation from the diaphragm
C. Long-term settlement beneath interior support posts
D. Temperature movement of exterior finish materials

18. An older precast concrete building relies on narrow bearing seats with limited positive ties between floor units and frames. What seismic concern is primary?

A. Excessive paint cracking at panel joints
B. Uniform thermal expansion of floor units
C. Loss of support during relative movement
D. Long-term creep of interior finish materials

19. An existing flat-plate concrete building has minimal slab-column shear reinforcement. During lateral drift, what brittle mechanism deserves particular attention?

A. Flexural yielding of roof sheathing panels

B. Long-term shrinkage of masonry veneers
C. Elastic shortening of steel brace members
D. Punching shear at slab-column connections

20. A tilt-up warehouse has heavy concrete walls and weak roof-to-wall ties. Which retrofit most directly addresses a common seismic collapse mechanism?

A. Strengthen wall-to-diaphragm anchorage and continuity
B. Increase roof finish thickness uniformly
C. Replace interior paint with flexible coatings
D. Reduce nonstructural partition dead load

21. After strong shaking, a building has residual story drift, crushed column ends, and fractured braces. What is the prudent structural-safety conclusion?

A. Cosmetic damage only; normal occupancy can resume
B. No structural concern if utilities remain operational
C. Potential instability requires controlled access and detailed evaluation
D. Automatic demolition without any engineering assessment

22. An existing soft-story building is retrofitted with new stiff shear walls. What additional effect must the engineer evaluate?

A. Only the architectural color of the walls
B. A guaranteed reduction of every member force
C. Elimination of all deformation compatibility demands
D. Force redistribution into collectors, diaphragms, and foundations

23. A building has Cs = 0.078 and effective seismic weight W = 9,200 kips. Using V = CsW, what is the base shear?

A. 640.0 kips
B. 717.6 kips
C. 780.0 kips
D. 846.4 kips

24. An idealized three-level force distribution uses weights [300, 300, 300] kips and heights [12, 24, 36] ft with exponent k = 1. For V = 360 kips, what force goes to the roof?

A. 180 kips
B. 90 kips
C. 120 kips
D. 240 kips

25. A three-level building has assigned lateral forces of 70 kips at Level 1, 90 kips at Level 2, and 110 kips at the roof. What is the base shear?

A. 160 kips
B. 270 kips
C. 180 kips
D. 200 kips

26. At the foundation, what overturning moment is caused by a single 250-kip inertia force located 48 ft above the base?

A. 12,000 kip-ft
B. 5,208 kip-ft
C. 10,000 kip-ft
D. 14,400 kip-ft

27. A story is 13 ft high and has an interstory displacement of 1.95 in. What is the drift ratio?

A. 0.80%
B. 1.50%
C. 1.95%
D. 1.25%

28. Two shear walls on one story have lateral stiffnesses 32 and 48 kips/in. If the diaphragm translation produces 400 kips total direct shear, how much goes to the 48-kip/in wall?

A. 160 kips
B. 200 kips
C. 240 kips
D. 320 kips

29. A wall couple resists 9,600 kip-ft of overturning with two vertical resultants separated by 24 ft. What is the magnitude of each idealized couple force?

A. 200 kips
B. 600 kips
C. 800 kips
D. 400 kips

30. A collector must transfer 165 kips into a shear wall. If two identical collector elements share the force equally, what axial force acts in each?

A. 55.0 kips
B. 82.5 kips
C. 110.0 kips
D. 165.0 kips

31. A concentrically braced bay carries 300 kips of horizontal story shear through one active diagonal inclined 36.9 degrees above horizontal. Neglecting other effects, what axial force is required if horizontal resistance is P cos(theta) and cos(36.9 degrees) = 0.80?

A. 240 kips
B. 300 kips
C. 375 kips
D. 480 kips

32. An idealized one-bay moment frame has story shear 180 kips and story height 14 ft. If the overturning is resisted by equal and opposite column axial forces 20 ft apart, what is each axial force?

A. 126 kips
B. 90 kips
C. 140 kips
D. 252 kips

33. Why is a strong-column/weak-beam hierarchy commonly sought in ductile moment frames?

A. It makes all members elastic
B. It removes joint shear
C. It favors beam hinging over column mechanisms
D. It eliminates drift

34. Why may boundary regions of a highly stressed reinforced-concrete shear wall require enhanced confinement?

A. Confinement eliminates wall shear
B. Boundary steel carries no axial force
C. It is only an architectural finish requirement
D. High compressive strains can demand stable confined concrete behavior

35. A coupling beam between adjacent wall piers is intended to yield during strong shaking. What behavior is generally desirable?

A. Immediate loss of shear capacity
B. Stable ductile energy dissipation before brittle connection failure
C. Rigid behavior with no deformation
D. Uncontrolled anchorage pullout

36. A foundation overturning couple requires 520 kips of net uplift resistance at one edge. If four identical hold-down elements share that tension equally, what demand acts on each?

A. 130 kips
B. 65 kips
C. 104 kips
D. 208 kips

37. A shear wall overturning moment is 15,600 kip-ft and its tension-compression resultants are separated by 26 ft. What vertical couple force is required?

A. 600 kips
B. 300 kips
C. 780 kips
D. 1,200 kips

38. Why is a discontinuity where an upper shear wall terminates on a transfer element a critical seismic design location?

A. The wall force vanishes at the transfer
B. Forces must redirect through the transfer
C. Only gravity load remains there
D. The transfer element cannot deform

39. A transfer girder receives 420 kips from an upper wall and delivers it equally to two lower walls. What idealized horizontal force goes to each lower wall?

A. 105 kips
B. 280 kips
C. 210 kips
D. 420 kips

40. Three wall lines with stiffness proportions 20:30:50 share 510 kips through a rigid diaphragm. What direct force is assigned to the middle-stiffness line?

A. 102 kips
B. 170 kips
C. 255 kips
D. 153 kips

41. A moment frame story has lateral stiffness 90 kips/in and resists 540 kips of shear. What elastic story translation corresponds to V = kDelta?

A. 4.5 in
B. 7.5 in
C. 6.0 in
D. 9.0 in

42. An elastic analysis gives story drift 0.72 in. If an exercise specifies an amplification factor of 4.5, what amplified drift is used?

A. 2.88 in
B. 4.50 in
C. 5.22 in
D. 3.24 in

43. A 180-in-high story develops 2.16 in of relative lateral displacement. Express the story drift as a percentage of story height.

A. 0.96%
B. 1.20%
C. 1.44%
D. 2.16%

44. Evaluate the stability index theta = PDelta/(Vh) for P = 3,600 kips, Delta = 1.8 in, V = 480 kips, and h = 144 in. Give three decimals.

A. 0.094
B. 0.047
C. 0.135
D. 0.188

45. A wall pier is 18 ft tall and 9 ft long. What is its height-to-length aspect ratio?

A. 2.0
B. 0.5
C. 1.0
D. 3.0

46. A brace has axial stiffness AE/L = 520 kips/in along its axis and is inclined so cos(theta) = 0.80. Using horizontal stiffness kx = kaxial cos^2(theta), what is kx?

A. 208.0 kips/in
B. 416.0 kips/in
C. 332.8 kips/in
D. 650.0 kips/in

47. A seismic force of 360 kips acts at a floor whose center of mass is 4.5 ft from the center of rigidity. What torsional moment results from that eccentricity?

A. 720 kip-ft
B. 1,620 kip-ft
C. 1,080 kip-ft
D. 2,160 kip-ft

48. Two edge frames are 50 ft apart and resist a pure torsional moment of 5,000 kip-ft as an equal force couple. What additional shear acts at each frame?

A. 50 kips
B. 125 kips
C. 250 kips
D. 100 kips

49. An equipment anchorage exercise specifies horizontal seismic force F = 0.42W. If the equipment weighs 18 kips, what force should the anchorage resist?

A. 7.56 kips
B. 4.20 kips
C. 9.00 kips
D. 12.60 kips

50. A rooftop unit has horizontal seismic force 9.6 kips acting 5 ft above its anchorage plane. What overturning moment acts at the base?

A. 19.2 kip-ft
B. 40 kip-ft
C. 48 kip-ft
D. 57.6 kip-ft

51. A sign support carries a 14-kip horizontal seismic load whose resultant is 12 ft above the foundation. What base moment results?

A. 84 kip-ft
B. 140 kip-ft
C. 196 kip-ft
D. 168 kip-ft

52. A vessel is anchored by four identical bolts on a tension side. If the idealized overturning model requires 96 kips total bolt-group tension and equal sharing is assumed, what tension acts in each bolt?

A. 12 kips
B. 24 kips
C. 32 kips
D. 48 kips

53. Why should a long piping run crossing a seismic separation joint include flexibility or movement accommodation?

A. The joint removes all pipe weight
B. Rigid piping prevents building drift
C. Flexibility increases seismic mass
D. Relative movement can rupture the pipe

54. A suspended component has seismic force 6.4 kips shared equally by four braces. What horizontal force is assigned to each brace in the idealized model?

A. 0.8 kips
B. 2.4 kips
C. 1.6 kips
D. 3.2 kips

55. A cantilevered nonstructural component has lateral force 3.5 kips at a height of 7 ft above its base. What base moment does the force create?

A. 24.5 kip-ft
B. 10.5 kip-ft
C. 21.0 kip-ft
D. 28.0 kip-ft

56. Why are sloshing effects important for some liquid-storage tanks during earthquakes?

A. Liquid behaves as a rigid solid
B. Sloshing adds dynamic pressure and displacement
C. Sloshing removes base shear
D. Tank mass becomes zero

57. A rack row carries 84 kips of seismic shear resisted equally by six braced frames. What shear is assigned to each frame?

A. 7 kips
B. 21 kips
C. 28 kips
D. 14 kips

58. A parapet segment weighs 22 kips and an exercise specifies seismic force F = 0.55W. What horizontal force results?

A. 12.1 kips
B. 8.8 kips
C. 11.0 kips
D. 17.6 kips

59. Why can a tall, slender equipment cabinet require attention to both sliding and overturning during seismic design?

A. Only vertical force acts on cabinets
B. Overturning removes sliding demand
C. Inertia creates shear and overturning moment
D. Cabinet height has no effect

60. A platform-and-tank assembly weighs 260 kips and is assigned a seismic coefficient of 0.30. Under V = cW, calculate its lateral base shear.

A. 52 kips
B. 78 kips
C. 65 kips
D. 104 kips

61. A rooftop mechanical unit weighs 30 kips. If an idealized force is 0.36W and two identical anchors share the direct shear equally, what shear acts on each anchor?

A. 3.6 kips
B. 5.4 kips
C. 7.2 kips
D. 10.8 kips

62. Why should architectural cladding attachments accommodate expected story drift?

A. Relative movement can otherwise damage panels, anchors, or joints
B. Drift affects only foundations
C. Cladding carries all building shear
D. Rigid attachment eliminates deformation

63. A diaphragm transfers 420 kips to two resisting lines with direct stiffnesses 35 and 65 units. Ignoring torsion, what shear goes to the 65-unit line?

A. 147 kips
B. 210 kips
C. 315 kips
D. 273 kips

64. A diaphragm chord pair is separated by 72 ft and must resist 8,640 kip-ft of in-plane bending moment. What axial force is required in each chord?

A. 60 kips
B. 144 kips
C. 120 kips
D. 240 kips

65. A collector line gathers 240 kips from a diaphragm and splits the force equally into three wall segments. What axial transfer goes to each segment?

A. 80 kips
B. 60 kips
C. 120 kips
D. 240 kips

66. A diaphragm has uniform in-plane shear of 96 kips distributed across a 48-ft width. What average shear transfer per foot is required?

A. 1.0 kips/ft
B. 3.0 kips/ft
C. 2.0 kips/ft
D. 4.0 kips/ft

67. A rectangular diaphragm spans 60 ft between shear walls and carries a uniform lateral line load of 3 kips/ft. Treating it as a simply supported beam, what reaction occurs at each wall?

A. 60 kips
B. 120 kips
C. 180 kips
D. 90 kips

68. Using the same simply supported diaphragm analogy, a 60-ft span carries uniform lateral line load 3 kips/ft. What maximum in-plane bending moment is wL^2/8?

A. 675 kip-ft
B. 1,350 kip-ft
C. 1,080 kip-ft
D. 2,700 kip-ft

69. If the diaphragm in-plane moment is 1,350 kip-ft and its effective chord spacing is 45 ft, what chord force is required?

A. 30 kips
B. 15 kips
C. 45 kips
D. 60 kips

70. A diaphragm opening interrupts a collector carrying 150 kips. Two equal drag paths are detailed around opposite sides of the opening. What force is assigned to each path?

A. 50 kips
B. 100 kips
C. 75 kips
D. 150 kips

71. Why can a large diaphragm opening create a critical seismic region even if the surrounding floor area is strong?

A. The opening eliminates all diaphragm force
B. Openings increase seismic mass only
C. Walls no longer need anchorage
D. Force flow detours around the opening

72. A rigid diaphragm has direct shear 300 kips and an eccentricity of 6 ft between mass and rigidity centers. What torsional moment accompanies the direct shear?

A. 1,800 kip-ft
B. 900 kip-ft
C. 1,200 kip-ft
D. 2,400 kip-ft

73. Two edge shear lines 40 ft apart resist a pure diaphragm torsional moment of 1,800 kip-ft as a force couple. What torsional shear increment acts at each edge?

A. 22.5 kips
B. 45 kips
C. 60 kips
D. 90 kips

74. One edge line has 150 kips of direct shear and receives a 45-kip torsional increment in the same direction. What total shear acts at that edge?

A. 105 kips
B. 150 kips
C. 240 kips
D. 195 kips

75. A flexible diaphragm distributes 240 kips to two parallel walls based on tributary widths of 30 ft and 50 ft. What force goes to the 50-ft wall?

A. 90 kips
B. 150 kips
C. 120 kips
D. 160 kips

76. Why can treating a genuinely flexible diaphragm as rigid produce misleading wall forces?

A. It changes only roof dead load
B. It removes all torsion
C. Rigid modeling can distort load sharing
D. It makes wall stiffness irrelevant

77. A wall anchorage line must transfer 132 kips of out-of-plane wall force through six identical anchors. Assuming equal sharing, what force acts at each anchor?

A. 11 kips
B. 33 kips
C. 44 kips
D. 22 kips

78. A wood diaphragm panel line carries 84 kips of shear through 28 ft of length. What average shear transfer is required per foot?

A. 3.0 kips/ft
B. 1.5 kips/ft
C. 2.0 kips/ft
D. 4.0 kips/ft

79. Why is blocked panel-edge construction often used where high wood-diaphragm shear transfer is required?

A. It sets the mapped spectral acceleration
B. Blocking supports edge fasteners for shear transfer
C. It eliminates chord forces
D. It replaces all collectors

80. A collector line has axial force 190 kips and is spliced with two identical connectors designed to share equally. What force is assigned to each connector?

A. 47.5 kips
B. 126.7 kips
C. 95 kips
D. 190 kips

81. A diaphragm force of 280 kips is collected into a wall line over a 70-ft collector length. What average axial transfer per foot is implied if the transfer is uniform?

A. 4.0 kips/ft
B. 2.0 kips/ft
C. 5.0 kips/ft
D. 7.0 kips/ft

82. Why can a re-entrant corner in a diaphragm require added attention to collectors and local reinforcement?

A. The corner eliminates diaphragm shear
B. It prevents torsional response
C. Geometry can concentrate in-plane deformation and redirect force flow
D. It makes chords unnecessary

83. A diaphragm has 360 kips of shear and three identical shear-wall lines. Ignoring torsion and assuming equal stiffness, what direct shear goes to each line?

A. 90 kips
B. 180 kips
C. 360 kips
D. 120 kips

84. A diaphragm edge chord carries 140 kips of tension and is spliced by four identical bolts sharing load equally. What idealized tension acts on each bolt?

A. 17.5 kips
B. 35 kips
C. 46.7 kips
D. 70 kips

85. A rectangular diaphragm is 54 ft deep between its chords. If the in-plane bending moment is 4,860 kip-ft, what chord axial force is required?

A. 45 kips
B. 120 kips
C. 90 kips
D. 180 kips

86. Why must a collector-to-wall connection be designed for the force path rather than only the collector member strength?

A. Member strength automatically guarantees connection strength
B. The force must develop into the wall
C. The joint carries gravity only
D. Collectors do not reverse force

87. A diaphragm shear of 250 kips is delivered to two wall lines. The first line is assigned 40 percent. What force goes to the second line?

A. 100 kips
B. 125 kips
C. 175 kips
D. 150 kips

88. Two diaphragm resisting lines have direct stiffnesses 45 and 75 units. If total direct shear is 360 kips, what force goes to the 45-unit line?

A. 135 kips
B. 90 kips
C. 180 kips
D. 225 kips

89. In a reinforced-concrete column expected to undergo large curvature reversals, what is the primary role of tight transverse hoops in the hinge zone?

A. It confines concrete and restrains bar buckling
B. It removes all axial load
C. It replaces longitudinal reinforcement
D. It eliminates anchorage requirements

90. Why are reinforcing-bar splices generally kept away from the most highly strained portion of an intended plastic hinge when practical?

A. Splices make yielding impossible everywhere
B. Concrete cover alone carries tension
C. Splices always increase curvature capacity
D. Bond or splice deterioration could disrupt the intended ductile mechanism

91. During inspection of a seismic steel moment connection, why is weld procedure compliance important even when the weld surface looks smooth?

A. Paint appearance proves weld toughness
B. Cyclic performance requires qualified welding procedures and inspection
C. Any electrode is acceptable
D. Visual smoothness guarantees internal quality

92. Why does gusset-plate geometry matter in a ductile braced-frame connection?

A. It controls only architectural appearance
B. Thicker plate always solves every problem
C. Geometry controls force transfer, rotation, buckling, and local stress
D. Brace force stops before the gusset

93. In reinforced masonry, why should grout consolidation and reinforcement location be checked during construction?

A. They affect only wall color
B. Grout makes bar placement irrelevant
C. Masonry never carries cyclic tension
D. They enable the intended composite seismic load path

94. Why are wood shear-wall nail spacing and edge distance important seismic inspection items?

A. They determine mapped spectral values
B. They remove overturning tension
C. They affect strength, ductility, slip, and splitting
D. They control concrete curing time

95. A collector passes across a construction joint before reaching a shear wall. What detailing objective is essential?

A. Terminate the collector at the joint
B. Provide developed continuity so cyclic axial force can cross the joint
C. Use finish materials for force transfer
D. Design the connection for one force direction only

96. Why is positive anchorage between a heavy wall and the floor or roof diaphragm important?

A. It transfers wall inertia into the diaphragm
B. It intentionally increases roof weight
C. It removes all in-plane wall shear
D. It prevents every foundation settlement

97. For a post-installed anchor near a concrete edge, why must concrete breakout and splitting be checked in addition to steel strength?

A. Concrete may fail before the anchor steel
B. Steel failure always governs
C. Edge distance has no effect
D. Closer edges always increase strength

98. A fire-sprinkler main crosses a seismic separation between building wings. What construction detail is most important?

A. Use the pipe as a rigid structural tie
B. Provide flexibility and clearance for relative movement of the wings
C. Remove all supports near the joint
D. Add water weight to resist drift

99. Field installation of a brace joint no longer matches the approved seismic detail. What should the special inspector do before the work is accepted?

A. Accept it because installation is complete
B. Delete the observation from the report
C. Document the deviation and obtain engineering review before acceptance
D. Assume equal capacity without review

100. During construction, what does structural observation by the design professional principally add to the seismic quality-assurance process?

A. Replace every special inspection
B. Guarantee zero earthquake damage
C. Eliminate the need for approved plans
D. Review significant structural work and design deviations

Practice Exam 13: Answer Key and Explanations

1. D — The site-modified short-period value is found by direct multiplication: SMS = 1.24(0.92g) = 1.1408g, which rounds to 1.141g. The other values come from division, leaving the mapped value unchanged, or addition instead of the stated product. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

2. A — Multiplying the supplied values gives SM1 = 1.62(0.51g) = 0.8262g, which rounds to 0.826g. Dividing, adding, or using an unrelated multiplier does not follow the site-adjustment equation provided in the question. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

3. C — Applying the stated two-thirds factor gives SDS = (2/3)(1.14g) = 0.76g. The alternatives represent one-half of SMS, no reduction, or multiplication by 1.5, none of which satisfies the relationship supplied in the stem. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

4. B — The transition period follows directly from Ts = 0.55/0.76 = 0.7237 second, which rounds to 0.724 second. Reversing the ratio or combining the ordinates by addition produces values that do not represent the defined transition period. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

5. D — Multiplying 0.724 second by 0.2 gives 0.1448 second, which rounds to 0.145 second. The other choices result from halving, leaving the period unchanged, or dividing by 0.2 rather than applying the stated factor. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

6. A — Liquefaction is most associated with loose, saturated granular soils that can develop excess pore-water pressure and lose effective stress during shaking. Dense dry gravel, unsaturated stiff clay, and competent rock do not present the same combination of loose structure and saturation that drives classic liquefaction susceptibility. That relationship governs the stated idealization.

7. B — Buildings with similar geometry and structural systems can have different required reliability because occupancy and post-earthquake function influence risk category. A facility whose failure has greater consequences may require more stringent seismic performance. Architectural color, glazing area, and concrete slump do not define regional hazard or geotechnical site classification. That relationship governs the stated idealization.

8. C — Site conditions modify the motion transmitted from underlying rock to the structure. Softer deposits can amplify response over certain frequency or period ranges, so design spectra may differ even at the same mapped hazard location. Site classification does not merely change gravity load, and amplification is not always largest on rock.

9. A — With equal mass, natural period varies inversely with the square root of stiffness. Therefore TX/TY = 1/sqrt(1.96) = 1/1.4 = 0.714. The distractors use the stiffness ratio directly, its reciprocal, or a linear relation instead of the square-root dependence. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

10. C — Parallel resisting lines experience the same story translation, so their restoring forces add. The equivalent stiffness is 18 + 27 + 35 = 80 kips/in. Averaging, subtracting, or multiplying the individual stiffnesses does not describe elements acting in parallel under a common displacement. Checking units and order of magnitude provides a useful independent check before selecting the final option.

11. B — For unchanged stiffness, natural period scales with the square root of mass. Thus the period factor is sqrt(1.69) = 1.30. The other values use the mass factor itself, its reciprocal, or an unrelated combined factor instead of the governing square-root relationship. The distractors reflect a common reversal, omitted factor, or arithmetic slip rather than the relationship stated in the stem.

12. D — Damping dissipates vibration energy and generally reduces resonant amplification and peak dynamic response. Increasing damping does not make the natural period vanish, double the mass, or eliminate all required strength. The structure still develops inertia forces, but the amplitude of vibration is usually lower than for a lightly damped system.

13. B — Ductility allows selected regions to yield and undergo repeated inelastic deformation without sudden loss of load-carrying capacity. That behavior dissipates earthquake energy and provides deformation capacity beyond first yield. Ductility does not prevent all damage, cancel inertia, or create infinite stiffness; it supports controlled rather than brittle response. That relationship governs the stated idealization.

14. D — A pronounced stiffness discontinuity can concentrate lateral deformation in the flexible story, increasing local drift, P-delta effects, and damage demand. The behavior is not one of equal drift or vanished shear. Seismic design seeks to avoid a weak deformation mechanism concentrated in a single story when the rest of the structure remains comparatively stiff.

15. C — An offset between mass and stiffness centers creates an eccentricity between inertia force and resistance. That eccentricity produces a torsional moment, so the floor can rotate while translating. Edge elements may then see unequal demand. Pure vertical shortening, unchanged distribution, or uniform axial strain do not capture this coupled response.

16. A — Redundancy gives earthquake forces alternative paths if one component yields, degrades, or is locally damaged. A system that depends on a single critical element can experience disproportionate consequences from one failure. Redundancy does not replace ductile detailing, guarantee purely elastic behavior, or remove the forces that must be transferred into the foundation.

17. B — Unreinforced masonry walls are heavy and brittle, and weak roof-to-wall anchorage can allow out-of-plane inertia to pull the wall away from the diaphragm. Loss of that support path can lead to partial or complete wall collapse. The listed shrinkage, settlement, and finish-movement issues do not address the principal earthquake connection vulnerability.

18. C — Precast components can experience relative displacement during earthquake response. If bearing seats are narrow and positive ties are inadequate, a floor or panel can lose support before the primary members reach a ductile mechanism. Seismic evaluation therefore emphasizes connection continuity, seating, and displacement capacity rather than finish cracking, thermal expansion, or long-term creep.

19. D — Lateral drift can increase unbalanced moment and shear transfer at slab-column joints in flat-plate construction. Where punching-shear capacity or reinforcement is limited, the connection can fail in a brittle manner and threaten gravity-load support. Roof sheathing yielding, veneer shrinkage, and brace shortening do not describe this critical cast-in-place concrete vulnerability.

20. A — Tilt-up and masonry buildings have historically been vulnerable when heavy walls are not positively anchored to roof diaphragms. Strengthening wall-to-diaphragm ties and the associated continuity path helps transfer out-of-plane wall inertia and prevent separation. Finish thickness, paint flexibility, and modest partition-weight changes do not directly repair the critical wall anchorage deficiency.

21. C — Residual drift, crushed column regions, and fractured braces are signs of significant structural damage and possible loss of lateral or gravity-load capacity. Immediate unrestricted occupancy would be inappropriate without further evaluation. At the same time, damage observations alone do not justify automatic demolition; the condition should be controlled, documented, and evaluated by qualified personnel.

22. D — Adding stiff shear walls can improve a soft story, but it also changes the building stiffness pattern and attracts lateral force into new load paths. Collectors, diaphragms, connections, and foundations may therefore receive larger or newly concentrated demands. Retrofit design must evaluate those redistribution effects rather than assuming every existing member force or compatibility demand decreases.

23. B — Multiplying the supplied coefficient by seismic weight gives V = 0.078(9,200) = 717.6 kips. The distractors use nearby coefficients or arithmetic variants. Since the stem directly provides Cs, no additional reduction or amplification factor belongs in this idealized calculation. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

24. A — With equal weights and k = 1, the distribution factors are proportional to height. The roof factor is 36/(12+24+36) = 0.50, so the roof force is 0.50(360) = 180 kips. Equal sharing or other ratios do not follow the supplied vertical-distribution rule. The distractors omit or misapply a required force, moment, stiffness, eccentricity, or deformation relationship for the stated model.

25. B — Base shear equals the sum of all assigned floor inertia forces. Adding the three level forces gives 70 + 90 + 110 = 270 kips. The distractors omit one level or use a partial combination. This equilibrium check is independent of the vertical-distribution procedure that originally produced the floor forces.

26. A — Base overturning moment from a single lateral force equals force times height, so M = 250(48) = 12,000 kip-ft. The other choices reflect division or use of an incorrect lever arm. Moment equilibrium directly determines the result in this idealized case. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

27. D — Convert the story height to 156 inches, then divide: drift ratio = 1.95/156 = 0.0125, or 1.25%. Using feet and inches without conversion, treating the displacement itself as a percent, or using another denominator gives an inconsistent dimensionless ratio. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

28. C — The stiffer wall provides 48/(32+48) = 0.60 of the combined stiffness. Under the same diaphragm translation, its direct share is 0.60(400) = 240 kips. Equal sharing or other percentages do not follow the stiffness-proportional distribution. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

29. D — For an idealized force couple, moment equals one force times the separation between the equal and opposite resultants. Thus F = 9,600/24 = 400 kips. Halving the force again or using unrelated multiples does not satisfy moment equilibrium. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

30. B — Equal load sharing between two identical collectors gives 165/2 = 82.5 kips per element. The other options correspond to thirds, a different split, or assigning the entire collector force to each element. The stated symmetry governs the result. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

31. C — The diagonal must supply a horizontal component of 300 kips. Since P(0.80) = 300, the axial force is P = 300/0.80 = 375 kips. Multiplying by the cosine, leaving the shear unchanged, or applying a larger unsupported factor does not satisfy horizontal equilibrium. An independent equilibrium and compatibility check helps confirm that the selected result is consistent with the assumptions.

32. A — The story overturning moment is 180(14) = 2,520 kip-ft. Resisting that with a column couple 20 ft apart requires F = 2,520/20 = 126 kips. The other values result from omitting the height, using the story shear directly, or double counting the couple. An independent equilibrium and compatibility check helps confirm that the selected result is consistent with the assumptions.

33. C — A strong-column/weak-beam hierarchy encourages inelastic rotations to form in beams while columns retain greater flexural capacity, reducing the likelihood of a weak-story mechanism. The concept does not guarantee zero yielding, remove joint shear, or eliminate lateral drift. It is a capacity-design strategy for a more stable ductile mechanism. That relationship governs the stated idealization.

34. D — Large overturning can concentrate compression at wall edges, producing high strains and potential concrete crushing or bar instability. Enhanced transverse reinforcement can improve confinement and cyclic stability in those boundary regions. It does not eliminate wall shear, remove axial demand, or serve merely as an architectural finish detail. That relationship governs the stated idealization.

35. B — A coupling beam can be part of the intended inelastic mechanism, so detailing should support stable cyclic deformation and energy dissipation while maintaining force transfer into the wall piers. Brittle shear failure, anchorage pullout, or an assumption of zero deformation would undermine the intended coupled-wall response. That relationship governs the stated idealization.

36. A — With four identical hold-downs sharing the net uplift equally, each carries 520/4 = 130 kips. The alternatives reflect dividing by eight, five, or two and do not match the stated number of equal tension-resisting elements. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

37. A — The vertical force couple must satisfy M = Fd. Dividing 15,600 kip-ft by 26 ft gives F = 600 kips. The other values correspond to halving, multiplying, or using a different lever arm rather than the stated wall couple geometry. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

38. B — When a wall terminates, its shear, overturning, and axial effects must be transferred into other elements rather than continuing directly to the foundation. The transfer region can develop concentrated demand and compatibility issues. Seismic forces do not vanish, and the supporting element must be designed for both force transfer and deformation compatibility.

39. C — Equal distribution to two lower walls gives 420/2 = 210 kips to each wall. The other options correspond to dividing by four, using a two-thirds split, or assigning the entire force to both supports. The simplified symmetry in the stem controls the force division. That relationship governs the stated idealization.

40. D — The 30-unit wall provides 30/(20+30+50) = 0.30 of total translational stiffness. Its direct shear is therefore 0.30(510) = 153 kips. The other choices use the 20-unit share, equal thirds, or one-half rather than stiffness-proportional distribution. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

41. C — From V = kDelta, the story translation is Delta = 540/90 = 6.0 inches. The remaining choices use different divisions or multipliers and do not satisfy the stated linear force-displacement relationship. This is an idealized elastic stiffness calculation, not a code drift amplification exercise. That relationship governs the stated idealization.

42. D — The exercise directly specifies that the elastic drift be multiplied by 4.5, so the amplified drift is 0.72(4.5) = 3.24 inches. The other values use different factors or operations. No additional coefficient should be introduced because the amplification rule is fully stated. The distractors omit or misapply a required force, moment, stiffness, eccentricity, or deformation relationship for the stated model.

43. B — Convert 15 ft to 180 inches. The drift ratio is 2.16/180 = 0.012, or 1.20%. The distractors reflect different denominators or treating the displacement directly as a percentage. A drift ratio must be dimensionless, so consistent units are essential. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

44. A — Substituting the given values gives theta = 3,600(1.8)/(480(144)) = 0.09375, which rounds to 0.094. The other choices result from omitted or doubled terms. Keeping both displacement and story height in inches preserves a dimensionless stability ratio. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

45. A — The aspect ratio is height divided by length, 18/9 = 2.0. Reversing the ratio gives 0.5, while the other values do not follow the dimensions provided. Aspect ratio helps describe whether wall response is relatively squat or slender, although actual behavior also depends on reinforcement and boundary conditions. That relationship governs the stated idealization.

46. C — The horizontal stiffness contribution is 520(0.80)^2 = 520(0.64) = 332.8 kips/in. Multiplying by one cosine, dividing by the cosine, or using another unsupported factor does not satisfy the supplied projection relationship. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

47. B — The eccentric force produces M = Ve = 360(4.5) = 1,620 kip-ft. The other options use different lever arms or arithmetic combinations. This torsional moment acts in addition to the direct translational force distribution in the idealized floor model. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

48. D — An equal and opposite frame-force couple separated by 50 ft must satisfy $M = Fd$. Therefore $F = 5{,}000/50 = 100$ kips at each edge, acting in opposite directions. The other values do not produce the stated torsional moment. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

49. A — The problem directly defines the equipment force as 42 percent of weight. Thus $F = 0.42(18) = 7.56$ kips. The alternatives represent a different percentage, one-half the weight, or an unsupported larger factor. No separate component coefficient belongs because the force rule is supplied. That relationship governs the stated idealization.

50. C — The base moment from the horizontal equipment force is $M = Fh = 9.6(5) = 48$ kip-ft. The other values use incorrect lever arms or multipliers. The anchorage must resist this overturning effect together with the other applicable component forces in the stated idealization. That relationship governs the stated idealization.

51. D — The seismic overturning moment is the force times its lever arm: $14(12) = 168$ kip-ft. Halving the moment, using a 10-ft lever arm, or multiplying by 14 again does not satisfy moment equilibrium for the supplied geometry. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

52. B — With four identical tension anchors sharing equally, each bolt carries $96/4 = 24$ kips. The other values correspond to eight, three, or two effective bolts. Actual anchor design also considers group behavior and concrete failure modes, but the simplified sharing assumption is explicit here. That relationship governs the stated idealization.

53. D — Different building portions can move relative to one another during earthquake response. A rigid pipe crossing the separation can become an unintended tie, develop large forces, or rupture. Flexible couplings, loops, or other accommodation allow differential movement. The joint does not remove weight, and the pipe should not be used to restrain structural drift.

54. C — Equal sharing among four braces gives $6.4/4 = 1.6$ kips per brace. The other choices correspond to eight, roughly three, or two braces. The actual support geometry can introduce vertical components, but the stem specifically asks for idealized equal horizontal sharing. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

55. A — The cantilever base moment is $M = Fh = 3.5(7) = 24.5$ kip-ft. The distractors use an incorrect height or multiplier. This simple moment is one part of the anchorage demand and follows directly from equilibrium. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

56. B — Stored liquid can have convective modes in which the free surface moves relative to the tank. That motion can create additional pressures, roof or freeboard demands, and distinct dynamic response from the impulsive mass. Treating the liquid as a perfectly rigid solid can miss important behavior; sloshing does not eliminate inertia or base shear.

57. D — Equal distribution to six frames gives 84/6 = 14 kips per frame. The other choices correspond to twelve, four, or three frames. This is a simplified force-sharing exercise; actual rack behavior also depends on stiffness, connections, anchorage, and load distribution. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

58. A — Using the supplied component-force rule gives F = 0.55(22) = 12.1 kips. The distractors use 40 percent, 50 percent, or 80 percent of the weight rather than the stated coefficient. The calculation is complete with the formula given in the stem. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

59. C — A horizontal inertia force acting above the base creates shear and a moment proportional to its height. Depending on anchorage, friction, footprint, and center of mass, either sliding or overturning behavior can become important. Tall equipment cannot be evaluated solely as a vertical-load problem, and overturning demand does not automatically erase shear demand.

60. B — The specified force coefficient is 0.30, so V = 0.30(260) = 78 kips. The alternatives use 20, 25, or 40 percent instead. Because the stem directly defines the design relation, no other coefficient is needed for this simplified platform calculation. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

61. B — First calculate total force: 0.36(30) = 10.8 kips. Equal sharing between two anchors gives 10.8/2 = 5.4 kips each. The other values reflect using the coefficient alone, an incorrect split, or assigning the entire component shear to each anchor. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

62. A — Cladding spans or attaches to structural levels that can move relative to one another during earthquake response. If attachments cannot accommodate that movement, panels, anchors, glazing, or joints may be damaged even when the primary structure remains stable. Rigid attachment does not eliminate building deformation, and cladding is not intended to carry the entire lateral system demand.

63. D — The 65-unit line provides 65/(35+65) = 0.65 of total stiffness, so it receives 0.65(420) = 273 kips. The other values correspond to the flexible line, equal sharing, or a 75-percent assumption not supported by the given stiffnesses. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

64. C — The chord couple follows M = Fd, so F = 8,640/72 = 120 kips. One chord is in tension and the opposite chord in compression for the idealized loading direction. The other choices do not generate the stated diaphragm moment with the given separation. That relationship governs the stated idealization.

65. A — Equal division among three wall segments gives 240/3 = 80 kips. The other choices correspond to four, two, or one receiving segment. The result follows the simplified equal-sharing condition; real collector force distribution also depends on stiffness and connection geometry. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

66. C — Average shear transfer per unit width is total shear divided by width: 96/48 = 2.0 kips/ft. The alternatives correspond to different effective widths or multipliers. This average is an idealized distribution useful for checking the scale of diaphragm shear transfer. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

67. D — The total lateral load is 3(60) = 180 kips. Symmetry gives equal reactions, so each wall receives 180/2 = 90 kips. Assigning one-third, two-thirds, or the entire load to each support does not satisfy the simply supported beam analogy stated in the problem. An independent equilibrium and compatibility check helps confirm that the selected result is consistent with the assumptions.

68. B — For a simply supported beam under uniform load, maximum moment is wL^2/8. Substitution gives 3(60^2)/8 = 1,350 kip-ft. The distractors reflect half, another coefficient, or twice the correct moment rather than the beam analogy specified. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

69. A — Using the diaphragm chord couple relationship F = M/d gives 1,350/45 = 30 kips. The other options correspond to half, one-and-a-half, or twice the needed force and do not satisfy moment equilibrium for the stated chord separation. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

70. C — If the two drag paths are intentionally identical and share equally, each must transfer 150/2 = 75 kips around the opening. The remaining choices correspond to three paths, an unequal split, or assigning the entire collector demand to both sides. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

71. D — An opening interrupts the direct in-plane force path. Shear flow, chord forces, and collector forces must turn around the discontinuity, which can create local concentrations and deformation incompatibility. The diaphragm force does not vanish, the principal issue is not added mass, and wall anchorage remains necessary where forces enter or leave the diaphragm.

72. A — The eccentricity produces M = Ve = 300(6) = 1,800 kip-ft. The alternatives use smaller or larger lever arms than the six feet given. This torsional moment must be superimposed on direct translational distribution when evaluating edge-element demand in the idealized rigid-diaphragm model. An independent equilibrium and compatibility check helps confirm that the selected result is consistent with the assumptions.

73. B — The equal and opposite edge-force couple must satisfy M = Fd. Thus F = 1,800/40 = 45 kips. The other choices result from an incorrect spacing or extra factor. One edge receives the increment in one direction and the opposite edge receives an equal opposite increment. That relationship governs the stated idealization.

74. D — At the edge where torsional and direct components act in the same direction, they add: 150 + 45 = 195 kips. The opposite edge may experience subtraction depending on sign. The other options omit the increment, subtract it, or add an unsupported larger amount. That relationship governs the stated idealization.

75. B — For the stated flexible-diaphragm tributary model, the 50-ft wall receives 50/(30+50) = 0.625 of the total, or 0.625(240) = 150 kips. The other values correspond to the 30-ft wall, equal sharing, or a different unsupported fraction. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

76. C — A rigid-diaphragm model forces all connected vertical elements to share a common in-plane translation and rotation. If the actual diaphragm deforms significantly, that assumption can misrepresent compatibility and force distribution. The issue is not dead load, complete removal of torsion, or elimination of wall-stiffness effects. That relationship governs the stated idealization.

77. D — Equal distribution among six anchors gives 132/6 = 22 kips per anchor. The distractors correspond to twelve, four, or three anchors. Actual design also considers spacing, edge distance, connection flexibility, and material failure modes, but the simplified load-sharing assumption is explicit. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

78. A — Average shear transfer is total shear divided by length: 84/28 = 3.0 kips/ft. The alternatives use twice the effective length, a different length, or a larger assumed demand. The calculation gives a useful average for evaluating the scale of sheathing and connection demand. An independent equilibrium and compatibility check helps confirm that the selected result is consistent with the assumptions.

79. B — Blocking provides a solid nailing surface along panel edges, allowing sheathing fasteners to transfer shear effectively between adjacent panels and framing. It can improve diaphragm capacity and continuity. Blocking does not determine regional seismic hazard, remove chord force, or replace collector elements where concentrated force transfer is required. That relationship governs the stated idealization.

80. C — Under the explicit equal-sharing assumption, each of two connectors carries 190/2 = 95 kips. The other values correspond to four, one-and-a-half, or one connector. The splice still requires adequate development and cyclic detailing, but the arithmetic force split is straightforward. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

81. A — Uniform transfer over the collector length gives 280/70 = 4.0 kips/ft. The other values correspond to a different length or unsupported fraction. Real collectors may have nonuniform force introduction, but the stem explicitly assumes a uniform average along the seventy-foot length. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

82. C — A re-entrant corner interrupts a simple rectangular force path and can create local deformation concentrations and redirected shear flow. Collectors, chords, or local reinforcement may be needed to transfer forces around the geometric discontinuity. The corner does not make diaphragm shear, torsion, or chord action disappear. That relationship governs the stated idealization.

83. D — Equal stiffness and symmetric conditions imply equal direct load sharing. Dividing 360 kips by three lines gives 120 kips per wall line. The other choices correspond to four, two, or one effective line and do not match the stated model. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

84. B — Equal sharing among four bolts gives 140/4 = 35 kips per bolt. The other choices correspond to eight, three, or two bolts. Actual splice design must evaluate connection and member limit states, but the simplified force division in the problem is exact. The distractors omit or misapply a required force, moment, stiffness, eccentricity, or deformation relationship for the stated model.

85. C — The chord couple satisfies M = Fd, giving F = 4,860/54 = 90 kips. The remaining choices correspond to half, a different spacing, or twice the required force. Chord anchorage and splices must then be capable of transferring this axial demand. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

86. B — A strong collector member is ineffective if its connection cannot transfer the gathered diaphragm force into the wall. Bolts, welds, anchors, reinforcement, and development details must complete the load path, often under cyclic force reversals. Member capacity alone does not establish joint capacity, and the connection is not a gravity-only detail.

87. D — If the first line receives 40 percent, the second receives the remaining 60 percent. Thus its force is 0.60(250) = 150 kips. The other options correspond to the first-line force, equal sharing, or a 70-percent assumption not stated in the problem. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

88. A — The 45-unit line provides 45/(45+75) = 0.375 of the combined stiffness. Its direct share is 0.375(360) = 135 kips. The other values represent one-quarter, one-half, or five-eighths of the total and do not follow stiffness-proportional distribution. A defensible seismic idealization must satisfy equilibrium while representing the stiffness, geometry, and compatibility that control the actual response.

89. A — Plastic-hinge regions can experience large cyclic compression strains and repeated bar yielding. Closely spaced transverse reinforcement confines the concrete core and braces longitudinal bars against buckling, helping preserve strength and ductility. It does not remove axial force, replace longitudinal reinforcement, or eliminate the need for proper development and anchorage. That relationship governs the stated idealization.

90. D — Plastic hinges undergo large repeated strains and demanding bond reversals. A splice in that region can slip, split surrounding concrete, or degrade before the intended flexural mechanism develops fully. Moving the splice to a lower-strain region improves reliability. The alternative statements incorrectly assume splices either eliminate yielding or automatically improve ductility.

91. B — Seismic weld performance depends on more than surface appearance. Qualified procedures, correct filler metals, base materials, fit-up, preheat, workmanship, and required inspection help achieve the intended toughness and cyclic capacity. A visually smooth weld can still contain unacceptable defects or use incompatible procedures, so appearance alone is not sufficient acceptance evidence.

92. C — Gusset geometry influences how brace force enters the frame, how the brace end rotates, whether expected buckling has adequate clearance, and where local stresses concentrate. Poor geometry can cause premature connection fracture. Increasing thickness alone cannot correct every geometric problem, and brace force must be transmitted through the gusset rather than disappearing at it.

93. D — Reinforced masonry relies on steel, grout, and masonry acting together to transfer flexure, shear, and tension. Misplaced bars, voided grout, or poor consolidation can reduce bond, strength, and continuity. Grout does not make reinforcement location irrelevant, and reinforced masonry can develop significant cyclic tension and compression during seismic response. That relationship governs the stated idealization.

94. C — Wood shear-wall response depends strongly on the sheathing-to-framing connections. Nail spacing and edge distance affect shear capacity, cyclic slip, ductility, and the likelihood of splitting or tear-out. These construction details do not establish regional seismic hazard, eliminate overturning forces, or control the curing of unrelated concrete work. That relationship governs the stated idealization.

95. B — A collector is part of the seismic load path, so its axial force must cross construction joints and enter the wall through developed reinforcement, anchors, welds, or other designed connections. Because seismic force can reverse, one-direction detailing is inadequate. Finishes are not dependable structural transfer elements, and stopping the collector would break the load path.

96. A — Heavy walls develop out-of-plane inertia during shaking and need a direct tie to the diaphragm so that force can enter the horizontal system. Inadequate anchorage can allow separation, loss of support, or collapse. The connection is not intended to add weight, eliminate in-plane shear, or solve every possible foundation movement.

97. A — Anchor demand is transferred into the surrounding concrete, so embedment, edge distance, spacing, cracking, and concrete strength influence breakout and splitting resistance. The steel fastener may be stronger than the concrete failure mechanism. Assuming steel always governs or that reduced edge distance improves capacity can lead to an unsafe anchorage assessment.

98. B — The two building wings can move differently during earthquake response. A rigid sprinkler crossing can become an unintended brace or rupture if it cannot accommodate that relative displacement. Flexible joints, loops, or clearance maintain serviceability and safety. Removing support or increasing fluid weight does not provide reliable deformation compatibility. That relationship governs the stated idealization.

99. C — A field change in a seismic connection can alter force transfer, stiffness, anchorage, and cyclic behavior. The inspector should document the condition and obtain evaluation or approved corrective direction before acceptance. Completion or visual similarity does not prove equivalent performance, and omitting the deviation would defeat the purpose of quality assurance.

100. D — Structural observation allows the responsible design professional to review selected significant construction and identify deviations that could affect intended seismic behavior. It complements rather than replaces special inspection and testing. Observation cannot guarantee that no damage will occur in an earthquake and does not eliminate the need for approved construction documents.