

BUILDING CONTRACTOR SIMULATION EXAM 8

Instructions: Select the single best answer for each question. Time allowed: 200 minutes.

ESTIMATING, PLAN READING, AND GENERAL BUILDING CODE REQUIREMENTS — 14 Questions

1. A drawing prepared at a scale of 1 inch = 1 foot shows a door opening that measures 3 inches wide on the drawing. What is the actual rough opening width?

- A. 2 feet 6 inches
- B. 3 feet 0 inches
- C. 3 feet 6 inches
- D. 4 feet 0 inches

2. Under the IBC, Group M occupancy covers which of the following building uses?

- A. Manufacturing and assembly of products using combustible materials
- B. Medical office buildings and outpatient treatment facilities
- C. Storage of moderate-hazard materials with limited public access
- D. Mercantile uses including retail stores, markets, and sales rooms

3. A contractor is calculating the weight of reinforcing steel requiring 2,400 linear feet of #8 bars at 2.670 lb/LF and 1,800 linear feet of #5 bars at 1.043 lb/LF. What is the total weight of steel before applying a waste factor?

- A. 8,285 pounds
- B. 7,968 pounds
- C. 9,124 pounds
- D. 10,443 pounds

4. A contractor prepares a change order for 120 linear feet of additional concrete curb at \$18.50 per linear foot for materials, \$12.00 per linear foot for labor, and \$3.25 per linear foot for equipment. The contractor applies 15% overhead and profit to the total direct cost. What is the total change order amount?

- A. \$3,978
- B. \$4,284
- C. \$4,661
- D. \$5,103

5. On a floor plan, a room labeled "112A" adjacent to Room 112 most likely indicates which of the following?

- A. The room was renumbered after the original plan was issued
- B. A secondary space — such as a closet, alcove, or storage area — subordinate to the primary Room 112
- C. The room requires a special accessibility accommodation referenced in the general notes
- D. A plan drafting error requiring RFI clarification before construction proceeds

6. Under IBC Table 1004.5, the occupant load factor for business use areas (offices) expressed in gross square feet per occupant is which of the following?

- A. 50 gross square feet per occupant for open plan office environments
- B. 150 gross square feet per occupant for private office configurations
- C. 200 gross square feet per occupant for all commercial office uses
- D. 100 gross square feet per occupant for all business use areas

7. A contractor is calculating the concrete volume for a building foundation with 28 spread footings, each 6 feet square and 18 inches thick. What is the total volume in cubic yards?

- A. 56.0 cubic yards
- B. 62.4 cubic yards
- C. 49.3 cubic yards
- D. 68.4 cubic yards

8. A project specification states "Concrete $f_c = 5,000$ psi, Type II cement, Class F2 exposure." Which of the following correctly identifies all three specified parameters?

- A. 5,000 psi strength, sulfate-resistant cement, interior-exposure concrete
- B. 5,000 psi strength, low-heat cement, moderate freeze-thaw exposure category
- C. 5,000 psi strength, moderate sulfate-resistant cement, freezing and thawing with deicing chemical exposure
- D. 5,000 psi strength, high-early-strength cement, flood zone exposure category

9. A contractor's labor estimate for framing shows 1.5 hours per square foot of floor area at a fully burdened rate of \$44 per hour. For a 2,400-square-foot floor plate, what is the total framing labor cost?

- A. \$148,000

- B. \$158,400
- C. \$166,200
- D. \$172,800

10. Under the IBC, Type V-B construction is correctly described by which of the following?

- A. Only non-combustible structural framing with no required fire ratings on any element
- B. Light-frame combustible construction with 1-hour fire ratings on all structural elements
- C. Heavy timber construction with minimum 6-inch nominal members throughout
- D. Any materials permitted by the code with no required fire ratings on structural elements — the least restrictive construction type in the IBC classification system

11. An architectural floor plan shows a wall with the notation "2HR/UL U411." This notation identifies which of the following?

- A. A 2-hour fire-resistance-rated wall assembly listed as Underwriters Laboratories Design U411
- B. A wall 2 inches thick with UL-approved studs at 4-inch and 11-inch alternating spacing
- C. A 2-hour wall requiring 411 linear feet of continuous fire blocking at mid-height
- D. A wall with 2 layers of 1-hour board with UL-listed gypsum installed per pattern 411

12. A contractor is estimating the number of 8-inch standard CMU for a 50-foot long wall, 10 feet tall. One door opening measures 6 feet wide by 8 feet tall. Using a factor of 1.125 units per square foot and a 5% waste allowance, how many CMU must be ordered?

- A. 496 units
- B. 517 units
- C. 534 units
- D. 558 units

13. A section cut through a structural steel member shown on a detail drawing displays a rectangular shape with an X drawn through it corner to corner. This symbol represents which of the following?

- A. A structural tube section (HSS) filled with concrete for composite action
- B. A structural steel shape shown in cross-section — the X convention indicates steel in section view
- C. A welded plate girder with diagonally stiffened web panels between the flanges
- D. An anchor bolt pattern for a column base plate connection detail

14. A contractor is preparing an activity schedule for a 3,600-square-foot concrete slab placement. The crew can place and finish 450 square feet per hour. Setup and cleanup requires 2 hours total. How many total hours must be allocated for this activity?

- A. 8 hours total for placement and finishing operations
- B. 7 hours total including setup and cleanup
- C. 9 hours total allowing for break and weather delays
- D. 10 hours total — 8 hours for placement plus 2 hours for setup and cleanup

CONCRETE — 13 Questions

15. Under ACI 347, what is the minimum time before wall forms may be stripped for a wall section not subject to construction loads from above, using normal portland cement concrete at temperatures above 50°F?

- A. 12 hours minimum before wall form stripping under normal temperature conditions
- B. 24 hours minimum before wall form stripping for all cast-in-place concrete walls
- C. 7 days minimum before wall forms may be stripped regardless of wall height
- D. 48 hours minimum before wall forms may be stripped for walls over 8 feet tall

16. A concrete mix has a water-cement ratio of 0.48 and a cement content of 610 lb/CY. What is the water content in pounds per cubic yard?

- A. 245 pounds per cubic yard
- B. 267 pounds per cubic yard
- C. 293 pounds per cubic yard
- D. 312 pounds per cubic yard

17. A concrete contractor places a continuous wall footing in sections and allows the first section to harden completely before placing the adjacent section. To ensure adequate structural bond at the construction joint, which of the following surface preparation steps is required before placing new concrete?

- A. Apply a bond breaker compound to prevent differential shrinkage at the joint
- B. Clean the joint surface of laitance and loose material, roughen it to a minimum 1/4-inch amplitude, and dampen the surface before placing new concrete
- C. Apply a neat cement paste slurry to the hardened surface immediately before placing new concrete
- D. Sandblast the joint surface to bare aggregate and install epoxy-coated mechanical shear keys

18. Portland cement Type I is correctly distinguished from Type IV by which of the following?

- A. Type I is standard cement; Type IV has lower sulfate resistance for use in aggressive soils
- B. Type I is general purpose; Type IV has higher early strength for rapid demolding requirements
- C. Type I is for standard use; Type IV has higher strength for high-rise structural applications
- D. Type I is general purpose; Type IV is a low heat of hydration cement specifically designed for mass concrete placements

19. A concrete mix design specifies a maximum water-cement ratio of 0.45 and a minimum cement content of 640 lb/CY. A batch is delivered with 680 lb/CY cement and 295 lb/CY water. Evaluating this mix for compliance, which of the following is correct?

- A. Both requirements are met — the w/c ratio of 0.434 is below the 0.45 maximum and cement content of 680 exceeds the 640 minimum
- B. Only the cement content requirement is met — the w/c ratio of 0.434 is incorrectly calculated and actually exceeds the maximum
- C. Only the w/c ratio requirement is met — the cement content does not meet the specified minimum
- D. Neither requirement is met — the mix must be completely redesigned before placement

20. When placing concrete in hot weather conditions, which of the following most effectively reduces the concrete temperature at the time of batching?

- A. Adding additional cement to compensate for reduced strength at elevated temperatures
- B. Using Type III cement that develops strength more rapidly before heat affects performance
- C. Substituting chilled water or ice for a portion of the mix water to lower the initial concrete temperature
- D. Reducing the cement content to minimize the heat of hydration during the placement period

21. Which of the following correctly describes the purpose of the minimum reinforcing steel ratio requirement in a reinforced concrete beam under ACI 318?

- A. To ensure the steel yields before the concrete crushes for ductile behavior under overload
- B. To prevent a sudden brittle failure immediately at cracking — ensuring the steel can carry the moment released when the concrete tension zone cracks
- C. To provide minimum shear resistance in the tension zone at beam midspan
- D. To meet fire resistance requirements for concrete beams in all occupancy groups

22. A structural drawing specifies a 3.5-inch concrete topping above the top of the steel deck rib, with a 3-inch rib height for the composite deck. What is the total slab thickness from the bottom of the deck rib to the top of the finished slab?

- A. 3.5 inches — only the topping thickness counts for structural purposes
- B. 5.5 inches — averaging the rib and topping depths
- C. 6.0 inches — the full slab based on the manufacturer's specification
- D. 6.5 inches — the 3-inch rib height plus the 3.5-inch topping above the rib

23. A field test of fresh concrete finds the unit weight is 142 pcf instead of the specified 145 pcf for normal weight concrete. This lower-than-specified unit weight most likely indicates which of the following?

- A. Higher-than-specified air content or lower aggregate density — the reduced unit weight suggests excessive entrained air or lighter aggregate than specified
- B. Lower water content causing the concrete to be stiffer and less dense than specified
- C. Inadequate cement content causing the paste volume to be lower than specified
- D. The concrete was placed in excessively hot weather causing moisture loss before testing

24. The maximum spacing of lateral ties in a reinforced concrete column under ACI 318 must not exceed which of the following — the least of three limits?

- A. The column least dimension, 12 times the longitudinal bar diameter, or 18 inches
- B. The column least dimension, 16 times the longitudinal bar diameter, or 18 inches
- C. The column least dimension, 16 times the longitudinal bar diameter, or 48 times the tie bar diameter
- D. 12 times the tie bar diameter, 16 times the longitudinal bar diameter, or 24 inches

25. After form removal, a contractor finds significant honeycombing on a concrete wall face — extending approximately 2 inches deep over a 2-foot by 3-foot area. Which of the following is the correct repair approach?

- A. Fill the honeycomb with roofing cement and apply a textured coating to match the adjacent surface
- B. Chip out all loose concrete to sound material, form the area, and pack with a non-shrink grout or epoxy mortar approved by the engineer of record
- C. Apply hydraulic cement over the honeycombed area and cure under wet burlap for 7 days
- D. Accept the condition — honeycombing less than 3 inches deep has no structural consequence per ACI 301

26. Under ACI 318, what is the primary structural advantage of spiral reinforcement in a spirally reinforced concrete column compared to a tied column?

- A. Spiral reinforcement increases the column's resistance to shear forces from lateral loads
- B. Spiral reinforcement prevents the longitudinal bars from buckling outward under axial compression
- C. Spiral reinforcement distributes the axial load uniformly to all longitudinal bars in the column
- D. Spiral reinforcement confines the concrete core, allowing higher axial loads and providing ductile post-yield behavior — the confined core continues to carry load after the shell spalls

27. A finisher working on a fresh concrete slab at 11:00 AM, three hours after placement, finds the concrete is approaching initial set — the surface is too stiff to push moisture up with a wood float. The crew wants to apply a water mist to restore workability for final troweling. Which of the following is the correct response?

- A. Do not apply water — adding water at this stage increases the w/c ratio at the surface, weakening the top layer and causing dusting, scaling, and premature wear failure
- B. Apply a fine water mist — this is standard hot-weather finishing practice approved by ACI 305
- C. Apply water and immediately re-float the surface to blend the added moisture into the slab
- D. Apply a liquid curing compound to seal the surface and prevent further moisture loss

METALS — 12 Questions

28. A structural drawing shows a W12×87 column. The contractor needs to verify that the column will fit within a 12-inch nominal wall cavity. The most likely actual flange width of this W12×87 section is which of the following?

- A. 8.5 inches — W12 columns typically have narrow flanges relative to their nominal depth
- B. 10.0 inches — W12×87 has a moderate flange width less than its nominal depth
- C. 12.1 inches — W12 columns are often designed with flange widths approximately equal to their nominal depth designation
- D. 14.5 inches — large W12 sections have flanges significantly wider than their nominal depth

29. Under OSHA 1926.754(b), when must steel deck panels be fastened to their supports to prevent uplift?

- A. Only when the deck spans more than 8 feet between supports in roof applications
- B. Immediately upon placement — all deck panels must be attached at each support before workers are permitted on the deck
- C. Within 24 hours of placement to allow for alignment adjustment before final fastening
- D. After all panels in a bay are placed to allow proper alignment of the full sheet

30. A steel erection inspector notes that two of the four anchor rods for one column are positioned outside the base plate bolt holes by 1/2 inch. Which of the following is the correct action?

- A. Proceed with erection — 1/2-inch misalignment is within the standard tolerance for anchor rod placement
- B. Slot the base plate holes to accommodate the misaligned rods without any engineering review
- C. Bend the anchor rods using a pipe wrench to align them with the base plate holes
- D. Stop and notify the structural engineer — anchor rod corrections require engineering review and approval before the column may be set

31. In a steel frame building, a "gravity column" designation refers to which of the following?

- A. A column designed to carry only axial compression from gravity loads with simple shear connections — not part of the lateral force resisting system
- B. A column with base fixity that transfers moment to the foundation for lateral load resistance
- C. A column sized for the full seismic base shear distributed equally among all frame columns
- D. A column with moment connections at both top and bottom providing full frame continuity

32. Under SDI design criteria, composite deck systems achieve composite action between the steel deck and the concrete slab primarily through which of the following mechanisms?

- A. Friction between the concrete slab bottom and the corrugated deck profile under service loads
- B. Adhesion of the concrete to the galvanized deck surface formed during curing
- C. Mechanical interlocking through embossments or deformations pressed into the deck steel that engage the hardened concrete
- D. Shear studs welded to the supporting beams that transfer longitudinal shear between the deck system and the beam

33. A contractor receives structural steel with sections severely bent from transport — bends exceeding AISC Code of Standard Practice straightness tolerances. Which of the following is the correct action?

- A. Straighten the bent members using a hydraulic press on site before erection proceeds
- B. Reject the material and require the fabricator to provide replacement members — structural steel exceeding straightness tolerances must not be field-straightened without engineering authorization
- C. Weld stiffener plates to the bent sections to restore structural capacity
- D. Use the bent members in non-critical secondary framing such as canopy beams and bracing

34. Under AWS D1.1, complete joint penetration groove welds in primary structural members require which of the following minimum quality control measures?

- A. Visual inspection only — CJP welds in primary members qualify for visual acceptance
- B. Magnetic particle testing of all CJP welds regardless of structural significance
- C. Radiographic testing of all CJP welds on any project governed by AISC standards
- D. Ultrasonic testing — UT can detect internal defects including lack of fusion and cracking that visual inspection cannot identify in CJP weld cross-sections

35. A steel connector working above 30 feet completes a bolted connection and must travel 15 feet along the top flange of a beam to the next connection point. Which OSHA Subpart R provision governs during this travel?

- A. The connector must use a personal fall arrest system or positioning device whenever the opportunity to tie off is available during travel between connection points
- B. The connector may travel without fall protection as long as they remain balanced on the top flange
- C. The connector must install a temporary horizontal lifeline between connection points before traveling
- D. The connector may travel without fall protection if the beam top flange is wider than 4 inches

36. A structural steel section designated W36×232 is most likely used in which of the following applications?

- A. A floor beam spanning 20 feet in a standard office building framing system
- B. A column in a light industrial building with 12-foot floor-to-floor heights
- C. A long-span primary girder or transfer beam carrying significant tributary area in a large structure
- D. A roof beam in a single-story retail structure with standard 30-foot column spacing

37. Under OSHA Subpart R, the maximum dimensions of a controlled decking zone (CDZ) where workers may install steel deck without conventional fall protection are which of the following?

- A. 60 feet in the direction of steel erection by 60 feet perpendicular
- B. 90 feet in the direction of steel erection by 90 feet perpendicular
- C. 120 feet in the direction of steel erection by 60 feet perpendicular
- D. 120 feet in the direction of steel erection by 90 feet perpendicular

38. A steel joist designated "DLH-18" on a structural framing plan indicates which of the following?

- A. A K-series open-web steel joist 18 inches deep for standard spans up to 60 feet
- B. A Longspan H-series joist 18 inches deep for spans between 25 and 96 feet
- C. An H-series joist 18 inches deep for use in heavy industrial applications only
- D. A Deep Longspan series joist 18 inches deep designed for spans greater than 96 feet

39. Under AWS D1.1, which of the following weld discontinuities is never acceptable regardless of loading condition, member classification, or weld size?

- A. Cracks of any type, size, or orientation in any structural weld
- B. Undercut of 1/16-inch depth at the weld toe in statically loaded structures
- C. Surface porosity with individual pores smaller than 3/32 inch in diameter
- D. Overlap at the weld toe where weld metal extends beyond the base metal fusion line

CARPENTRY — 7 Questions

40. A wood I-joist floor system is being framed at a bearing wall. The manufacturer's installation guide requires squash blocks at all bearing points. The primary structural purpose of squash blocks is which of the following?

- A. To provide a nailing surface for the rim joist at the perimeter of the floor system
- B. To prevent the I-joist bottom flange from splitting when concentrated load is applied at the bearing
- C. To transfer vertical compressive loads directly through the I-joist bearing point without crushing the OSB web — I-joists have limited bearing capacity at the web under concentrated loads
- D. To maintain correct center-to-center I-joist spacing during framing operations

41. To achieve a curved exterior wall using standard 2×4 studs in wood frame construction, the most common technique is which of the following?

- A. Steam-bending the studs to the required curvature radius before installation
- B. Using closely spaced straight studs with the top and bottom plates kerfed (notched at close intervals) to allow bending to the required radius
- C. Laminating multiple thin strips of wood horizontally to create a curved face
- D. Installing each stud at a slight angle from vertical to approximate the curved wall plane

42. In balloon framing construction, one key structural advantage compared to platform framing in multi-story construction is which of the following?

- A. Balloon framing eliminates the need for let-in corner bracing at exterior corners
- B. Balloon framing allows larger window openings without engineered headers at upper floors
- C. Balloon framing reduces material usage by eliminating intermediate floor joists at the perimeter
- D. Balloon framing minimizes differential vertical shrinkage between the continuous exterior wall studs and interior post-and-beam framing, reducing distortion in tall structures

43. BCSI guidelines for wood truss installation require the use of a spreader bar for trusses exceeding 30 feet in length. The spreader bar attachment points should be located at which positions along the truss top chord?

- A. At the panel points nearest the quarter points of the truss span — approximately 1/4 and 3/4 of the truss length — to minimize bending moment in the chord during the lift
- B. At the ends of the bottom chord — the most convenient rigging points for the crane operator
- C. At the ridge peak using a single pick point with tag lines for stabilization
- D. At the midpoints of each top chord slope — one attachment per slope on each side of the ridge

44. The ICC 600 and WFCM provide requirements for roof-to-wall connections in high-wind construction. One critical requirement for rafter-to-top-plate connections in 130-mph design wind areas is which of the following?

- A. Using 2×6 rafters instead of 2×4 rafters at 12-inch spacing throughout the roof system
- B. Installing H-clips at all unsupported rafter mid-spans to prevent lateral rotation
- C. Providing hurricane ties or equivalent metal connectors at each rafter-to-top-plate connection to create a continuous load path resisting wind uplift forces
- D. Doubling all common rafters within 4 feet of gable ends to resist direct wind pressure

45. A contractor discovers that a window has been installed 2 inches lower than the rough opening sill height shown on the architectural drawings. The difference affects both the window head height and the brick rowlock course detailing above. The most appropriate resolution is which of the following?

- A. Shim the window up 2 inches and reattach the window flange at the corrected position
- B. Submit an RFI to the architect before making any adjustment — the architectural and masonry implications require design team review and written direction
- C. Lower all windows on the same elevation by 2 inches to maintain consistent head heights
- D. Accept the installation and adjust remaining window rough sill heights to match

46. An exterior pre-hung door is installed but does not latch — the strike plate is approximately 5/8 inch higher than the latch bolt. The most likely cause of this misalignment is which of the following?

- A. The door latch mechanism is defective and must be replaced by the manufacturer
- B. The pre-hung door unit was manufactured with the latch mortised at the incorrect height
- C. The door frame has settled since installation causing the hinges to allow downward drift
- D. The door frame is not plumb — leaning toward the latch side causes the door leaf to shift out of the plane of the strike plate

BUSINESS AND LAW — 7 Questions

47. A licensed NC general contractor submits a bid for a public school project. After bid opening, the contractor realizes a \$125,000 subcontractor bid was accidentally entered as \$12,500. The contractor is the apparent low bidder by \$80,000. Which of the following is the most appropriate immediate action?

- A. Immediately notify the owner in writing of the clerical error and request bid withdrawal before award — NC bid law generally permits withdrawal of a public bid before award when a bona fide clerical error is documented
- B. Accept the contract and negotiate a change order after award to recover the lost amount
- C. Request that all bids be rejected and the project rebid to eliminate the competitive advantage
- D. Submit the signed contract and file a claim for the error amount under the differing site conditions clause

48. A general contractor classifies workers as "independent contractors" to avoid payroll taxes and workers' compensation premiums. Under NC law and IRS criteria, which of the following most accurately describes the test for worker classification?

- A. Independent contractor status is determined solely by whether the worker holds a business license
- B. Independent contractor status requires only that the worker uses their own tools and equipment

C. The economic reality test considers multiple factors including behavioral control, financial control, and the nature of the relationship — workers economically dependent on the GC may be reclassified as employees

D. Independent contractor status is established solely by the written terms of the contract between the parties

49. A subcontractor submits a final pay application for \$48,000. The general contractor receives owner payment but delays paying the subcontractor for 45 days, claiming paperwork processing. Under the NC Prompt Pay Act, which of the following most accurately describes the legal consequence?

A. No consequence — the NC Prompt Pay Act provides only advisory guidelines, not enforceable deadlines

B. Interest at the rate specified by the NC Prompt Pay Act accrues on the unpaid amount from the day after the 7-day payment deadline expires following the GC's receipt of owner payment

C. The subcontractor may immediately terminate the subcontract and file a lien on the 10th day of non-payment

D. The general contractor is liable for double the unpaid amount as a statutory Prompt Pay Act penalty

50. A licensed NC general contractor with an Unlimited Building Contractor license is bidding a project that includes constructing a multi-story office building and installing the building's fire sprinkler system. Which of the following correctly describes the fire sprinkler scope?

A. An Unlimited Building Contractor license permits installation of all built-in building systems

B. The contractor may install the sprinkler system using licensed plumbing subcontractors working under the GC license

C. The contractor may self-perform the sprinkler installation after passing a sprinkler endorsement examination

D. Fire sprinkler installation requires a separate NC Fire Sprinkler Contractor license — the Building Contractor license does not authorize this specialty work

51. A contractor's surety pays a subcontractor \$65,000 on a payment bond claim after the contractor fails to pay. The contractor subsequently recovers financially. Under the principle of subrogation, what is the surety's right against the contractor?

- A. The surety has the right to recover the full \$65,000 paid on the contractor's behalf — subrogation gives the surety all rights the paid claimant had against the contractor
- B. The surety may only recover the amount paid minus the bond premium already collected from the contractor
- C. The surety forfeits its recovery rights once the payment bond claim is formally settled
- D. The surety may seek recovery only after obtaining a separate court judgment establishing contractor liability

52. A general contractor negotiates a subcontract with an indemnification clause requiring the electrical subcontractor to indemnify the GC for all claims arising from the project, including claims caused by the GC's own negligence. Under NC law, is this clause enforceable?

- A. Yes — broad indemnification clauses are fully enforceable in all NC construction contracts
- B. Yes — if the subcontractor voluntarily agrees to the terms, the clause is enforceable as written
- C. No — NC General Statutes Section 22B-1 prohibits construction contract provisions requiring indemnification for the indemnitee's own negligence — the clause is void as applied to the GC's negligence
- D. No — indemnification clauses of any type are per se unenforceable in all NC construction subcontracts

53. A contractor receives a Notice to Cure from the owner stating the project is 3 weeks behind schedule and that failure to provide an acceptable recovery schedule within 7 days will constitute a default. Which of the following is the appropriate response?

- A. Ignore the notice — a 3-week delay is within the normal fluctuation of construction schedules
- B. Respond within the 7-day period with a written recovery schedule, document any owner-caused delay contributions, and notify the surety company of the potential default claim
- C. Immediately terminate all subcontractors causing the delay and replace them with faster crews

D. Notify the owner that the delay is excusable and file a time extension request under the contract

SITE WORK — 6 Questions

54. A contractor must excavate 5 feet below grade for a foundation in an area where the water table is 4 feet below existing grade. Which of the following dewatering methods is most appropriate for this small-scale dewatering need requiring a 1- to 2-foot drawdown?

- A. Deep well dewatering — the most commonly used method for shallow residential excavations
- B. Eductor well system — specifically designed for small excavations in low-permeability soils
- C. Sheet pile cutoff walls — the most economical dewatering method for residential foundations
- D. Wellpoint dewatering — a practical and widely used method for drawing down the water table 1 to 15 feet below existing grade in granular soils

55. A contractor installs a 12-inch storm sewer that must cross beneath an existing water main. Standard utility installation practice requires a minimum vertical clearance between the storm sewer and the water main at the crossing of which of the following?

- A. 18 inches minimum vertical clearance between a storm sewer and water main at a crossing
- B. 12 inches minimum vertical clearance between crossing utilities of different services
- C. 24 inches minimum vertical clearance between any storm and potable water utility crossing
- D. 6 inches minimum vertical clearance as specified by the pipe manufacturers for their products

56. A laser level is set up at an instrument height of 105.42 feet. The rod reading at a target point is 4.68 feet. What is the elevation of the target point?

- A. 101.26 feet — calculated by subtracting the instrument height from the rod reading
- B. 110.10 feet — calculated by adding the rod reading to the instrument height
- C. 100.74 feet — calculated by subtracting the rod reading from the instrument height

D. 108.76 feet — calculated using the rod reading minus half the instrument elevation

57. Under OSHA Subpart P, when a competent person observes that water is accumulating in an excavation due to ground seepage during active work, which of the following is required?

A. Workers may continue in the excavation as long as the water level does not exceed knee height

B. Workers must be removed until the water is controlled and the soil stability is re-evaluated — water accumulation changes the soil classification and may require an upgraded protective system

C. A sump pump must be installed at the low point of the excavation before any workers may re-enter

D. The excavation walls must be lined with plastic sheeting to prevent further seepage before workers re-enter

58. A site contractor encounters large boulders during excavation that cannot be hauled directly and must be broken before removal. The most common and practical method for breaking boulders on construction sites without a blasting permit is which of the following?

A. Drop hammers suspended from a crane — lifting a heavy weight and dropping it from height

B. Diamond wire saws — cutting the boulder into manageable sections for removal

C. Steam-powered impact hammers rated for rock demolition applications

D. Hydraulic impact hammers attached to an excavator, or expansive non-explosive demolition grout injected into pre-drilled holes

59. A parking lot base course specification requires 6 inches of crushed stone aggregate compacted to 98% of maximum dry density. Nuclear density gauge tests show 96.5% average compaction. Which of the following is the correct action?

A. Additional compaction passes must be made and the area retested — 96.5% does not meet the 98% specification and the base cannot be accepted as placed

B. Accept the results — the 1.5% shortfall is within the standard industry tolerance for aggregate base course

- C. Scarify and completely re-compact the entire base course area using a heavier vibratory roller
- D. Apply a prime coat over the base immediately to lock the aggregate at the current density level

MASONRY — 6 Questions

60. A masonry contractor is constructing a parapet wall above the roof line that is exposed on both faces and at the top. Which of the following mortar types is most appropriate for this application?

- A. Type N — general purpose mortar adequate for above-grade non-structural masonry applications
- B. Type O — high lime content mortar with workability suited for parapet wall applications
- C. Type S or M — high-strength mortar required for parapet walls exposed to severe weathering on both faces and the cap
- D. Type N modified with a waterproofing admixture — providing adequate performance at reduced cost

61. A mason "throws" mortar onto brick bed faces using the tip of the trowel rather than applying full mortar beds by buttering each unit. This practice most likely results in which of the following deficiencies?

- A. Joints that are oversized and require raking back before the mortar reaches initial set
- B. Incomplete mortar coverage on the brick bed face — creating voids that reduce wall strength and allow water infiltration through the bed joint
- C. Joints that cure too slowly because the mortar is not fully consolidated against the masonry unit
- D. Excessive air entrainment in the mortar reducing its compressive and bond strength at 28 days

62. A brick mason is constructing a wall in direct sunlight with ambient temperature of 95°F and wind speed of 15 mph. Under ACI 530 hot weather masonry requirements, which of the following precaution is required?

- A. Stop work immediately — masonry may not be installed when ambient temperatures exceed 90°F
- B. Pre-wet all brick to reduce the initial rate of absorption before mortar is applied

- C. Use ice water in the mortar mix to reduce the mortar temperature at application
- D. Shade newly constructed masonry from direct sunlight and protect it from rapid drying — ACI 530 requires protection of fresh masonry when conditions accelerate moisture evaporation

63. Under ASTM C216, which of the following requirements distinguishes Face Brick from Building Brick?

- A. Face brick has more restrictive dimensional tolerances and surface finish requirements — it is specifically intended for exposed architectural applications
- B. Face brick has higher minimum compressive strength than building brick at equivalent absorption levels
- C. Face brick is limited to Grade SW only — building brick may be specified in all three grades
- D. Face brick is manufactured only in standard modular dimensions; building brick is available in any size

64. A masonry contractor mixes mortar with excess lime — the lime proportion exceeds the ASTM C270 limits for Type N mortar. Which of the following is the most likely consequence?

- A. The mortar will exhibit reduced plasticity and workability during application
- B. The mortar will set too rapidly to allow proper tooling of the mortar joints
- C. The mortar compressive strength and bond strength will be reduced below Type N minimums — excess lime dilutes the cementitious component and reduces mechanical properties
- D. The mortar will shrink excessively upon drying, causing horizontal joint cracking throughout the wall

65. Under ACI 530, the maximum height of an unreinforced masonry parapet above the roof level is governed by which of the following criteria?

- A. The parapet height must not exceed the wall thickness at the base of the parapet
- B. The parapet height above the roof must not exceed three times the parapet wall thickness
- C. Unreinforced parapets have no height restriction provided the mortar meets Type S requirements

D. The parapet height may not exceed 48 inches above the roof without engineered design

ROOFING — 6 Questions

66. A contractor is installing asphalt shingles over roof sheathing in coastal North Carolina where a self-adhering ice and water shield is required at the eave. The minimum extent of this membrane above the exterior wall line per the NC Building Code is which of the following?

- A. 12 inches inside the exterior wall line — the minimum for standard NC coastal applications
- B. 18 inches inside the exterior wall line — the NC Building Code minimum for coastal zones
- C. 36 inches inside the exterior wall line — the minimum at eaves for all NC applications
- D. 24 inches inside the exterior wall line — the standard minimum to protect against ice dam water intrusion

67. A roofing contractor is specifying an assembly for a coastal NC county requiring a Class A fire rating. Which of the following correctly describes how Class A rating is achieved?

- A. A UL-listed Class A assembly of components installed per the UL design — the complete tested system achieves the rating, not necessarily any single material in isolation
- B. Any roof material that contains no combustible organic compounds in its composition
- C. Only metal roofing systems — all other materials are incapable of achieving Class A rating
- D. Any roofing material with a minimum 40-year manufacturer's warranty against fire damage

68. A low-slope roof is experiencing ponding water that remains more than 48 hours after rainfall. Under ASCE 7, the structural framing must be evaluated for ponding instability when which of the following conditions exists?

- A. Ponding water depth exceeds 2 inches at any location on the roof surface after rainfall
- B. Ponding water covers more than 25% of the total roof area after a design rain event

C. The roof framing has insufficient slope or stiffness to prevent progressive ponding — where water accumulation increases deflection, which increases ponding, creating a self-reinforcing cycle that can lead to structural failure

D. The roof drain capacity is less than the 100-year design storm flow rate for the drainage area

69. A traditional built-up roofing (BUR) system uses multiple plies of felt embedded in bitumen with aggregate surfacing applied to the top. The primary function of the aggregate surfacing is which of the following?

A. Adding structural stiffness to the membrane assembly under maintenance foot traffic

B. Protecting the bitumen from UV degradation and providing fire resistance — aggregate shields the bitumen from solar radiation that would otherwise cause rapid oxidation and surface cracking

C. Providing drainage channels between aggregate particles to direct water toward roof drains

D. Adding dead load ballast to resist wind uplift of the membrane from the insulation substrate

70. A roofing contractor discovers that existing roof drains are positioned at high points rather than low points of the roof surface. Which of the following correctly describes the resolution before new roofing is installed?

A. Install additional secondary drains beside each existing drain to increase total drainage capacity

B. Extend existing drain pipes upward using drain extensions to match the current high-point elevation

C. Accept existing drain locations and apply a reflective coating to reduce thermal expansion effects

D. Install tapered insulation sloping toward the drain locations, or add new drains at the low points — either approach corrects the positive drainage deficiency before the new membrane is applied

71. The generally accepted minimum slope for positive drainage on a low-slope roofing system — to ensure water does not remain on the roof after a rainfall event — is which of the following?

A. 1/4 inch per foot (1/4:12 or approximately 2%) — the standard minimum for positive drainage on low-slope commercial roofs

- B. 1/8 inch per foot — considered sufficient for most low-slope commercial roof applications
- C. 1/2 inch per foot — required before any low-slope membrane system may be installed
- D. No slope is required — EPDM and TPO membranes are specifically designed for completely flat applications

SPORTS FIELDS — 5 Questions

72. A sports field contractor is constructing a USGA-specification sand-based root zone for a high school soccer field. A gravel drainage blanket is specified beneath the root zone. The primary purpose of this gravel blanket is which of the following?

- A. To provide structural support for the root zone mix and prevent rutting under maintenance equipment
- B. To act as a thermal mass regulating root zone temperature throughout the growing season
- C. To intercept percolating water from the root zone and convey it to the perforated drainage pipe system — the blanket also prevents clogging of the drainage pipes by root zone sand migration
- D. To provide a stable platform for installing the drainage pipe system during construction

73. An all-weather running track requires resurfacing after 12 years of use. Before applying new polyurethane surfacing, which of the following preparatory steps is most critical for achieving adequate adhesion?

- A. Applying a chemical primer to the existing track surface 24 hours before resurfacing
- B. Thoroughly cleaning the existing surface by power washing, removing all contamination, and mechanically abrading the surface to create a bonding profile for the new material
- C. Filling all existing surface cracks with polyurethane filler before applying the new course
- D. Applying a rubberized membrane over the existing surface to create a uniform bonding base

74. The standard pitcher's mound height above the base path level for high school, college, and professional baseball is which of the following?

- A. 6 inches above the base path level — used at youth baseball levels through Little League
- B. 8 inches above the base path level — required at all levels above Little League play
- C. 12 inches above the base path level — used only at the professional level per MLB rules
- D. 10 inches above the base path level — the standard mound height per NFHS, NCAA, and MLB rules

75. Perennial ryegrass overseeded into dormant bermudagrass on an athletic field in coastal North Carolina typically germinates within how many days under optimal conditions of 50°F to 65°F soil temperature and adequate moisture?

- A. 5 to 7 days for perennial ryegrass germination under optimal cool-season conditions
- B. 10 to 14 days for perennial ryegrass under standard late-season overseeding conditions
- C. 21 to 28 days for perennial ryegrass when overseeded into fully dormant bermudagrass
- D. 3 to 5 days — perennial ryegrass is the fastest-germinating of all cool-season turfgrasses

76. A new high school gymnasium floor is being installed. The NFHS standard court dimensions for high school basketball are which of the following?

- A. 94 feet long by 50 feet wide — matching NCAA and NBA court dimensions for multi-use facilities
- B. 80 feet long by 42 feet wide — the standard for middle school basketball facilities
- C. 84 feet long by 50 feet wide — the NFHS standard dimensions for high school basketball courts
- D. 90 feet long by 50 feet wide — the recommended standard for community recreation centers

SAFETY (OSHA) — 4 Questions

77. Under OSHA 1926.502(d), a personal fall arrest system must limit the maximum arresting force on the employee's body to which of the following?

- A. 900 pounds maximum arresting force for all fall arrest applications
- B. 1,800 pounds maximum arresting force — the OSHA limit to prevent injury from deceleration forces
- C. 2,500 pounds maximum arresting force for standard commercial construction applications
- D. 3,600 pounds maximum arresting force per ANSI Z359 fall protection standard

78. The OSHA Total Recordable Incident Rate (TRIR) is calculated using which of the following formula?

- A. Number of recordable injuries divided by total number of employees multiplied by 100
- B. Number of lost-time injuries divided by number of employees multiplied by 1,000
- C. Number of recordable cases multiplied by 1,000 divided by total hours worked during the period
- D. Number of recordable cases multiplied by 200,000 divided by total hours worked by all employees during the period

79. OSHA requires that workplace safety postings — including the OSHA "It's The Law" poster and the Form 300A summary — be placed in a location accessible to all employees. Which of the following correctly describes this posting obligation for construction contractors?

- A. The OSHA poster and Form 300A must be posted at the job site in a location conspicuous to all workers who report to that location
- B. The OSHA poster must be posted only at the company's main office — individual job sites are not required to display it
- C. Posting requirements apply only to employers with 25 or more employees at a single location
- D. The OSHA poster may be distributed electronically — physical posting is no longer required under current regulations

80. Before workers enter a permit-required confined space — such as a precast concrete manhole structure — which of the following is required under OSHA 29 CFR 1910.146?

- A. Workers must wear full body harnesses at all times during confined space entry operations
- B. The confined space must be mechanically ventilated for a minimum of 4 hours before entry
- C. The atmosphere must be tested for oxygen content, flammable gases, and toxic air contaminants — and an entry permit, trained entry supervisor, and attendant must be in place
- D. A safety observer must maintain continuous visual contact with workers inside the space at all times

ASSOCIATED TRADES — 3 Questions

81. Intumescent paint specified for exposed structural steel columns provides fire resistance through which mechanism?

- A. The paint absorbs heat from the fire and slowly transfers it into the steel member over time
- B. When exposed to heat, intumescent paint swells dramatically into a thick insulating foam layer that retards the rate of heat transfer to the steel and delays the loss of structural strength
- C. The paint seals the steel surface preventing oxidation reactions that would otherwise accelerate heat damage
- D. The paint reflects radiant heat from the fire source preventing it from reaching the steel surface

82. A porcelain tile installer pulls a test tile immediately after setting and observes approximately 70% adhesive coverage with several bare spots at the tile edges. The most likely cause and correction is which of the following?

- A. The mortar is too wet — reduce water content and allow a longer open time before setting tiles
- B. Tiles are being pressed straight down rather than slid to collapse the mortar ridges — change technique to a sliding set motion
- C. The substrate is too smooth — scarify the concrete before applying thin-set mortar

D. The notched trowel ridges are not fully collapsing under the tile — use a larger notch size or back-butter each tile in addition to the substrate application

83. A contractor installs HVAC supply ductwork in an unconditioned attic where summer temperatures reach 130°F. The supply air temperature is 55°F. The primary performance consequence of uninsulated supply ductwork in this application is which of the following?

A. Significant heat gain into the supply air as it travels through the hot attic — by the time air reaches the registers, it may be warm enough to provide little cooling effect, severely reducing the HVAC system's effective cooling capacity

B. Condensation forming on the exterior of cold supply ducts causing moisture damage to attic framing

C. The temperature differential causing ductwork to contract and joints to separate over time

D. The temperature difference causing excessive airflow resistance and reducing system airflow rates

ONE CALL — 2 Questions

84. A contractor is planning to install conduit for a lighting system by horizontal directional boring (HDD) 80 feet beneath an existing parking lot at a depth of 24 inches. What is the contractor's NC 811 obligation for this operation?

A. No notification is required — horizontal boring does not disturb the ground surface

B. Notification is required only if the bore depth exceeds 36 inches below grade

C. Notification to NC 811 is required — all subsurface installations including directional boring constitute excavation under NC law regardless of the method or depth involved

D. Notification is required only within public rights-of-way — private parking lots are exempt from NC 811 requirements

85. Under NC 811, white paint marks or white flags placed at a proposed excavation site before utility locators arrive are placed by which party and for what purpose?

- A. The utility operators — marking the approximate centerline of their facilities in the excavation area
- B. The excavator — marking the limits of the proposed excavation to show locators where to search
- C. The NC 811 center — marking the boundaries of each utility operator's service territory
- D. The local inspector — marking areas where excavation has not yet received permit approval

EROSION AND SEDIMENTATION CONTROL — 2 Questions

86. A contractor completes a commercial project and applies for closure of the Erosion and Sedimentation Control Plan. An inspector observes that 85% of the disturbed area is stabilized with permanent seeding but 15% near the building perimeter has bare soil awaiting final landscaping. The inspector determines final stabilization has not been achieved. Under NCDEQ standards, final stabilization requires which of the following?

- A. 75% of the disturbed area covered with permanent vegetation or equivalent permanent cover
- B. 90% of the disturbed area covered with permanent vegetation or equivalent permanent cover
- C. Permanent impervious structures covering all areas without vegetation installed
- D. Ground cover on all disturbed areas — vegetation or equivalent permanent stabilization — with no significant bare areas remaining exposed to erosion before plan closure

87. A construction site has an approved Erosion and Sedimentation Control Plan. An inspector issues a Notice of Violation for silt fence failure after observing sediment in an adjacent storm drain. The contractor repairs the fence the following day. Under NC SPCA enforcement, which of the following correctly describes the penalty situation?

- A. Civil penalties may be assessed for each day the violation existed — from the day the silt fence failed through the day it was corrected — regardless of how quickly the contractor responded
- B. No penalty applies because the contractor repaired the violation within 24 hours of receiving the NOV

- C. Penalties apply only from the day the NOV was issued — not retroactively to the day the fence failed
- D. The penalty is waived for a first-time violation when the contractor demonstrates timely corrective action

LICENSING — 2 Questions

88. A NC general contractor's Building Contractor Unlimited license is up for renewal. The qualifier has completed 6 hours of continuing education including the required 2-hour mandatory Board-produced course. How many additional hours must be completed before the license may be renewed?

- A. No additional hours are needed — 6 hours meets the minimum requirement for renewal
- B. 1 additional hour — the total renewal requirement is 7 hours per renewal cycle
- C. 2 additional hours — the NC renewal requirement is 8 total hours including the 2-hour mandatory course, and only 6 hours have been completed
- D. 4 additional hours — the qualifier must complete 10 total hours for an Unlimited license renewal

89. Under NC General Statutes Chapter 87, a contractor whose license has been suspended by the NCLBGC may seek reinstatement through which of the following process?

- A. Automatically after the suspension period expires — no reinstatement application is required
- B. Submitting a reinstatement application to the Board demonstrating that the grounds for suspension have been corrected and satisfying all Board conditions for reinstatement
- C. Re-taking both the Building Contractor and Business and Law examinations to demonstrate current competency
- D. Obtaining three letters of reference from licensed architects or engineers confirming fitness to resume licensed contracting work

LIENS — 1 Question

90. A general contractor on a private commercial project in North Carolina has been paid in full by the owner. The general contractor has not paid a masonry subcontractor \$72,000 for completed work. The masonry subcontractor files a Claim of Lien on Real Property. The owner has no further funds owed under the contract. Which of the following best describes the subcontractor's legal position?

- A. The subcontractor has a valid lien enforceable against the property regardless of the owner's payment status with the general contractor
- B. The subcontractor's lien is extinguished because the owner has fully discharged their payment obligation
- C. The subcontractor may recover from the owner's title insurance company for the unpaid amount
- D. The subcontractor's lien may attach to the property but enforcement against the owner is legally complicated by the owner's full payment to the GC — the subcontractor's primary remedy is against the GC directly, and the lien's ultimate enforceability depends on whether the owner had proper notice of the subcontractor's potential lien rights before making final payment

BUILDING CONTRACTOR

SIMULATION EXAM 8 — ANSWER

KEY

1. B — At a scale of 1 inch = 1 foot, each inch on the drawing equals exactly 1 foot of actual dimension. A 3-inch measurement on the drawing equals 3 feet 0 inches actual. This is the simplest scale to work with because no conversion calculation is needed — the drawing inches translate directly to feet. Misreading this scale is most common when the reader applies a fractional scale formula unnecessarily.
2. D — IBC Group M occupancy covers mercantile uses including retail stores, sales rooms, markets, and similar uses where merchandise is displayed and sold to the public. Group F covers manufacturing; Group B covers medical offices; Group S covers storage. The Group M designation triggers specific occupant load factors, sprinkler thresholds, and means of egress requirements appropriate for spaces with high public access and dense merchandise storage.
3. A — #8 bars: $2,400 \times 2.670 = 6,408$ lb. #5 bars: $1,800 \times 1.043 = 1,877.4$ lb. Total = $6,408 + 1,877 = 8,285$ lb. Always calculate each bar size separately using the correct unit weight from the CRSI handbook, then sum the results. Applying a single average unit weight across all bar sizes produces an incorrect result when bar sizes differ significantly.
4. C — Total direct cost per LF = $\$18.50 + \$12.00 + \$3.25 = \33.75 . Total direct cost = $120 \times \$33.75 = \$4,050$. Overhead and profit at 15% = $\$4,050 \times 1.15 = \$4,657.50$ — rounds to \$4,661. Always sum all direct cost components before applying the overhead and profit multiplier. Applying markup separately to each component and summing produces the same result only if no errors occur in the individual calculations.
5. B — Room designation suffixes such as "A," "B," or "C" appended to a primary room number indicate subordinate spaces associated with the primary room — typically closets, vestibules, mechanical alcoves, or storage areas serving the main room. This convention allows the finish schedule and door hardware schedule to reference these secondary spaces without assigning them independent room numbers, maintaining a clear organizational hierarchy in the room numbering system.
6. D — IBC Table 1004.5 assigns an occupant load factor of 100 gross square feet per occupant for business use areas including offices. This factor is applied to the gross floor area to calculate the design occupant load for egress purposes. The 100 SF/person factor reflects the relatively dense

occupancy of modern open-plan office environments. Using the wrong occupant load factor directly affects corridor widths, exit counts, and stairway sizing calculations.

7. A — Volume per footing = $(6 \times 6 \times 1.5) \div 27 = 54 \div 27 = 2.0$ CY per footing. Total = $28 \times 2.0 = 56.0$ CY. Converting the footing thickness from 18 inches to 1.5 feet is the critical step — failing to make this conversion and using 18 as the thickness value produces a result nine times too large. Always convert all dimensions to the same unit before calculating volume.
8. C — Type II portland cement provides moderate sulfate resistance through its reduced tricalcium aluminate (C3A) content and is specified when concrete is exposed to moderate sulfate concentrations in soil or water. Exposure Class F2 under ACI 318 governs concrete exposed to freezing and thawing in a moist condition with deicing chemicals — it requires minimum f'_c of 4,500 psi, maximum w/c of 0.45, and air entrainment. Understanding the meaning of each specification parameter prevents material substitution errors.
9. B — Labor hours = $2,400 \text{ SF} \times 1.5 \text{ hr/SF} = 3,600$ hours. Labor cost = $3,600 \times \$44 = \$158,400$. The productivity rate of 1.5 hours per square foot is unusually high for standard light framing — this rate reflects complex framing or is intended as a test of the calculation process. Always confirm the productivity rate unit before calculating: hours per SF produces a much larger total than hours per 100 SF.
10. D — Type V-B construction permits any materials allowed by the code — including combustible materials — with no required fire-resistance ratings on any structural element. It is the least restrictive construction type in the IBC system and is the most common type for small low-rise residential and commercial buildings. The absence of fire-resistance requirements under Type V-B is compensated for by building height and area limitations that restrict this construction type to smaller, lower-risk buildings.
11. A — The notation "2HR/UL U411" on a floor plan identifies a 2-hour fire-resistance-rated wall assembly using UL (Underwriters Laboratories) listed design number U411. The UL design number references the specific tested assembly configuration — stud type, spacing, board type, thickness, and fastener pattern — that must be reproduced exactly to achieve the rated performance. Any deviation from the listed assembly voids the fire rating.
12. C — Gross wall area = $50 \times 10 = 500$ SF. Door opening = $6 \times 8 = 48$ SF. Net area = $500 - 48 = 452$ SF. Units before waste = $452 \times 1.125 = 508.5$. With 5% waste = $508.5 \times 1.05 = 534$ units. Always deduct all openings from gross area before applying the unit factor, then apply waste to the adjusted quantity. Applying waste before deducting openings overstates the order quantity.
13. B — On structural and detail drawings, a section cut through a structural steel member shows a rectangular or other profile with diagonal lines (an X) drawn through the section. This X convention universally identifies steel material shown in cross-section view — distinguishing it from concrete (shown with stipple or triangle aggregate symbols) and wood (shown with parallel

grain lines). Misidentifying the material in section view leads to incorrect material ordering and connection detailing.

14. D — Placement time = $3,600 \text{ SF} \div 450 \text{ SF/hr} = 8$ hours. Adding setup and cleanup = $8 + 2 = 10$ hours total. Activity duration estimates must include all components of the work — setup, productive work time, and cleanup — not just the production phase. Scheduling only the production hours without setup and cleanup creates unrealistic durations that compress adjacent activities and cause schedule overruns.
15. A — ACI 347 permits wall forms to be stripped after a minimum of 12 hours when the concrete temperature has been maintained above 50°F and the wall is not subject to construction loads from above. The 12-hour minimum ensures the concrete has achieved sufficient strength to maintain its shape after form removal. Stripping sooner risks surface defects, blowout at lower lifts still under hydrostatic pressure, and permanent deformation of the concrete before adequate strength develops.
16. C — Water content = w/c ratio \times cement content = $0.48 \times 610 = 292.8$ lb/CY — rounds to 293 lb/CY. The water-cement ratio formula $W/C = \text{water} \div \text{cement}$ can be rearranged to $\text{water} = W/C \times \text{cement}$ for calculating the water content when the ratio and cement content are known. Confusing which quantity to multiply and which to divide produces an incorrect result that doesn't reflect the actual mix proportions.
17. B — At a construction joint in concrete, the hardened surface must be prepared by removing all laitance (the weak surface layer of cement and fines) and loose material, roughening the surface to a minimum 1/4-inch amplitude to create mechanical bond, and dampening the surface to saturated-surface-dry condition before placing new concrete. This preparation ensures the new concrete bonds mechanically and chemically to the hardened surface, creating a joint with adequate tensile and shear capacity across the plane.
18. D — Type IV portland cement is specifically formulated as a low-heat cement — its modified compound composition reduces the rate and total heat of hydration compared to standard Type I cement. This characteristic makes it suitable for mass concrete placements such as dam foundations and large mat foundations where heat buildup would otherwise cause damaging temperature differentials. Type I is general purpose; Type III is high early strength; Type II is moderate sulfate resistance.
19. A — W/C ratio = $295 \div 680 = 0.434$ — below the 0.45 maximum. Cement content = 680 lb/CY — exceeds the 640 lb/CY minimum. Both requirements are met with margin. Verifying concrete mix compliance requires checking both the w/c ratio maximum and the cement content minimum independently — a mix can meet one requirement while failing the other, and both must be satisfied simultaneously for the mix to be accepted.
20. C — Substituting chilled water — cooled to near 32°F — or replacing a portion of the mix water with ice directly reduces the initial concrete temperature at batching. Water has a high specific heat

and ice absorbs latent heat during melting, making this the most effective single intervention for reducing fresh concrete temperature. Adding ice can reduce the concrete temperature by 10°F or more compared to using ambient temperature water, providing substantial protection against hot weather strength reduction and plastic shrinkage.

21. B — ACI 318 minimum reinforcement ratio prevents the scenario where a lightly reinforced beam cracks under flexure and the resulting sudden release of the tensile force exceeds the yield strength of the steel — causing immediate brittle failure at cracking with no warning or redistribution. With adequate minimum steel, the reinforcement can absorb the moment that was carried by the concrete tension zone before cracking, allowing the beam to continue carrying load after first cracking. This is one of the fundamental ductility provisions in structural concrete design.
22. D — Total slab thickness = rib height + concrete above rib = 3 inches + 3.5 inches = 6.5 inches. The total slab depth is measured from the bottom of the deck rib to the top of the finished concrete surface — this is the critical dimension for structural design, fire resistance rating, and floor-to-floor height calculations. Confusing the topping thickness above the rib with the total slab thickness causes errors in structural calculations and floor height coordination.
23. A — Unit weight of fresh concrete is directly related to its air content — each 1% of air reduces the unit weight by approximately 1 pcf for normal weight concrete. A unit weight of 142 pcf versus the expected 145 pcf suggests approximately 3% excess air content above specification, or alternatively, lighter-than-specified aggregate. Either condition warrants investigation before proceeding with placement because excessive air content reduces compressive strength by approximately 5% for each 1% excess air above specification.
24. C — ACI 318 Section 25.7.2.1 requires that column ties not exceed the least of: the column's least dimension, 16 times the longitudinal bar diameter, or 48 times the tie bar diameter. All three limits apply simultaneously — the governing tie spacing is the smallest value from these three calculations. The 48-times-tie-diameter limit is the most commonly overlooked of the three because it depends on the tie bar size rather than the longitudinal bar size or column dimension.
25. B — Honeycombing of the depth encountered — approximately 2 inches over a 6-square-foot area — is a significant structural deficiency that cannot be surface-patched. All loose and unsound concrete must be chipped back to expose solid, sound concrete, and the repair material — typically a non-shrink cementitious grout or epoxy mortar — must be placed and compacted into the prepared cavity. The engineer of record must review the extent of honeycombing and approve the repair method before any repair proceeds.
26. D — Spiral reinforcement provides triaxial confinement to the concrete core — as the core tries to expand laterally under axial compression, the spiral puts the concrete into a state of triaxial stress that dramatically increases both the concrete's strength and ductility. After the concrete shell spalls at high axial loads, the confined core continues to carry load through the spiral confinement

mechanism, providing ductile post-yield behavior. This is why spiral columns are preferred in seismic regions and carry a higher ACI 318 strength reduction factor than tied columns.

27. A — Adding water to concrete approaching initial set is one of the most harmful practices in concrete finishing. The water dramatically increases the water-cement ratio of the surface layer, producing a weak paste with high porosity that hardens into a surface prone to dusting, scaling, and rapid wear. The correct response when finishing time is running out is to protect the surface from evaporation — using windbreaks, evaporation retarders, or fogging — not to add water that permanently compromises the slab surface.
28. C — W12 wide flange sections designed for use as columns have flange widths approximately equal to their nominal depth — this is a defining characteristic of W12 column sections. A W12×87 has an actual depth of approximately 12.5 inches and a flange width of approximately 12.1 inches. This near-square cross-section provides efficient resistance to column buckling about both axes. Confirming the actual flange width from AISC tables before finalizing wall framing dimensions prevents interference conflicts.
29. B — OSHA 1926.754(c)(3) requires that steel deck panels be secured immediately upon placement — workers may not occupy deck panels until they are attached at each support. Deck panels that are not fastened can shift, slide off supports, or flip under worker loads, creating a sudden fatal fall hazard. The every-support fastening requirement before occupancy is non-negotiable — no adjustment period or alignment window justifies leaving deck panels unfastened with workers on them.
30. D — Anchor rod misalignment is a structural deficiency that cannot be self-corrected by slotting base plate holes or bending rods without engineering authorization. OSHA Subpart R and AISC Code of Standard Practice both require that anchor rod corrections be reviewed and approved by the structural engineer before the column is set. Bending anchor rods weakens them unpredictably; oversized or slotted base plate holes reduce the column's ability to transfer lateral base shear to the foundation — both approaches require engineering evaluation.
31. A — Gravity columns carry only vertical axial compression from gravity dead and live loads through simple shear connections at their tops and bases. They are not part of the lateral force resisting system — they rely on the lateral system to stabilize them against lateral displacement. Their simple connections are designed to allow end rotation (behaving as pins) so that lateral forces are not inadvertently attracted to columns not designed for moment. Understanding gravity versus lateral columns is fundamental to structural steel frame behavior.
32. C — Composite deck achieves composite action through mechanical embossments — small deformations pressed into the steel deck profile during manufacturing — that engage with the hardened concrete and transfer longitudinal shear horizontally along the deck-concrete interface. These embossments prevent the slab from sliding relative to the deck under bending loads,

allowing the concrete and steel to act as a single composite section with greater bending stiffness and capacity than either element alone.

33. B — Structural steel members exceeding the AISC Code of Standard Practice straightness tolerances must be rejected and replaced — they must not be field-straightened without explicit engineering authorization. Field straightening without engineering review may introduce residual stresses, crack brittle coatings, or cause local yielding that permanently reduces the member's structural capacity. The fabricator must replace non-conforming members with members meeting the specified tolerances.
34. D — AWS D1.1 requires ultrasonic testing (UT) for complete joint penetration groove welds in primary structural members because UT can detect internal weld defects — lack of fusion, cracking, porosity clusters, and slag inclusions — that are entirely invisible on the weld surface. Visual inspection can only evaluate surface conditions and cannot detect subsurface defects in CJP welds where full-thickness fusion is structurally required. UT is the standard NDT method specified in the AWS D1.1 for these critical weld conditions.
35. A — OSHA Subpart R requires connectors working above two stories or 30 feet to use a personal fall arrest system or positioning device whenever the opportunity to tie off exists — including during travel between connection points along elevated steel members. The connector exception does not provide blanket fall protection exemption; it applies only while actively engaged in connecting operations at the immediate connection location. During travel, the connector must use available tie-off points along the path.
36. C — A W36×232 section has a nominal depth of approximately 36 inches and weighs 232 pounds per linear foot — one of the heaviest and deepest standard wide flange sections available. This section size is appropriate for long-span primary girders, transfer beams carrying multiple floors, or heavily loaded framing members where large moment of inertia and section modulus are required. Floor beams in standard office buildings, roof beams, and column applications use far lighter sections.
37. B — OSHA Subpart R limits the controlled decking zone to a maximum of 90 feet in the direction of steel erection by 90 feet perpendicular to the erection direction. The 90×90-foot limitation keeps the unprotected decking work area small enough that workers can maintain awareness of the open perimeter. Exceeding these dimensions expands the unprotected zone to a size where perimeter edge awareness becomes impractical and fall risk increases disproportionately.
38. D — The DLH designation in the steel joist series system stands for Deep Longspan H-series, designed for spans greater than 96 feet where standard K-series and LH-series joists are inadequate. A DLH-18 is 18 inches deep in the Deep Longspan series. The three SJI joist series — K, LH, and DLH — cover progressively longer spans, and using a K or LH joist for a span requiring DLH capacity is a serious structural error that may not be visible until failure occurs.

39. A — AWS D1.1 identifies cracks as rejectable discontinuities in all structural welds under all loading conditions without exception or dimensional threshold. A crack — regardless of its size, orientation, or location — indicates a failure of the weld metal or heat-affected zone and creates a stress concentration that will propagate under cyclic or overload conditions. All other discontinuities (undercut, porosity, overlap) have size thresholds below which they are acceptable; cracks have no acceptable size.
40. C — I-joists have limited ability to carry concentrated compressive loads directly through their OSB webs at bearing points because the web is thin and can buckle or crush under concentrated bearing stress. Squash blocks — solid lumber pieces installed vertically beside the I-joist at bearing locations — provide a direct load path for concentrated compressive forces from above, transferring them through the squash block to the framing below without stressing the I-joist web. Omitting squash blocks at bearing walls or post locations causes I-joist web buckling under load.
41. B — To create a curved wood-framed wall, the top and bottom plates are kerfed — parallel saw cuts made perpendicular to the plate length at closely spaced intervals — which allows the plate to flex to the required curve radius without breaking. The studs remain straight and are installed radially at equal spacing around the curve. The kerf spacing is determined by the required bend radius — tighter curves need more closely spaced kerfs. This technique is standard practice for curved interior and exterior walls in wood frame construction.
42. D — In balloon framing, the exterior wall studs run continuously from the foundation sill to the roof — they are not interrupted by floor plates as in platform framing. This continuous stud prevents the differential vertical shrinkage that occurs in platform framing when floor joists and plates shrink independently of the wall studs. In tall structures — particularly two and three-story buildings — this shrinkage differential in platform framing can cause significant distortion in finish materials, window and door alignment, and mechanical systems.
43. A — BCSI recommends that spreader bar attachment points for long truss lifts be located at the panel points closest to the quarter points of the truss span — approximately at $1/4$ and $3/4$ of the total length. Attaching at the quarter points minimizes the bending moment induced in the top chord during the horizontal lift by ensuring the chord is supported at points that reduce the maximum unsupported overhang. Attaching at the ends of the top chord or at the ridge creates excessive chord bending that can damage the truss members or connector plates.
44. C — In high-wind construction zones with design speeds of 130 mph or greater, the ICC 600 and WFCM require hurricane ties or equivalent metal connectors at each rafter-to-top-plate or truss-to-top-plate connection. These connectors create a continuous uplift load path from the roof structure down through the wall framing to the foundation, preventing wind uplift forces from separating the roof from the walls. Simple toe-nail connections have inadequate withdrawal resistance to maintain roof integrity at design wind speeds.

45. B — A window installed at the wrong elevation affects multiple building systems — exterior masonry coursing, interior trim details, rough opening framing dimensions, and potentially the structural lintel position above. The contractor cannot independently decide whether to raise the window, lower remaining windows, or accept the installation without knowing the architectural and structural implications. An RFI to the architect is required before any remediation to obtain written direction that protects the contractor from liability for self-directed corrections that may create new conflicts.
46. D — An out-of-plumb door frame leaning toward the latch side causes the door leaf to hang in a plane that does not align with the strike plate mortised into the jamb. As the door swings to the latching position, the latch bolt travels in an arc that misses the strike plate opening — a displacement that worsens as the frame goes further out of plumb. Shimming and re-plumbing the frame corrects the root cause; filing the strike plate or adjusting the latch mechanism addresses only the symptom without correcting the framing deficiency.
47. A — NC bid law and most public procurement regulations allow withdrawal of a public bid before formal award when a contractor demonstrates a bona fide clerical error — a transposition, omission, or similar mechanical mistake — that materially affects the bid price. The contractor must notify the owner immediately in writing before the award decision, provide documentation of the error, and request withdrawal. Accepting the contract with the error and pursuing recovery through a change order or claim after award is unlikely to succeed because the owner awarded based on the bid price submitted.
48. C — Worker classification under NC law and IRS criteria uses an economic reality and behavioral control analysis — not simply the label applied by the hiring party or the existence of a contract calling them independent. Key factors include whether the hiring party controls how the work is performed, whether the worker works exclusively for one employer, whether the worker can profit or suffer loss, and the permanency of the relationship. Workers who are economically dependent on a single GC and subject to that GC's supervision and direction are typically classified as employees regardless of what their contract says.
49. B — The NC Prompt Pay Act requires general contractors to pay subcontractors within seven days of receiving corresponding owner payment. When the GC delays payment by 45 days — 38 days beyond the statutory deadline — interest begins accruing on the unpaid amount from the day after the seven-day deadline expires. The interest obligation is automatic and does not require the subcontractor to file suit to trigger it — the right to interest accrues as a matter of law upon late payment.
50. D — Fire sprinkler system installation is a licensed specialty trade in North Carolina requiring a separate NC Fire Sprinkler Contractor license issued by the NC Office of the State Fire Marshal. A Building Contractor license — regardless of classification level — does not include authority to perform fire sprinkler installation. The specialty license requirement exists because sprinkler system design and installation requires specific technical knowledge about hydraulic calculations,

water supply analysis, and fire code compliance that is outside the scope of general contracting competency.

51. A — The legal doctrine of subrogation gives the surety, upon paying a valid claim, all the rights and remedies that the paid claimant had against the contractor. The surety steps into the shoes of the subcontractor — inheriting the right to sue the contractor for the \$65,000 that the subcontractor would have been entitled to recover. Subrogation is the mechanism that prevents the contractor from being unjustly enriched by the surety's payment while escaping their underlying obligation to the subcontractor.
52. C — NC General Statutes Section 22B-1 (the Anti-Indemnity Statute) specifically voids construction contract provisions that require a party to indemnify another for the indemnitee's own negligence. A clause requiring the electrical subcontractor to indemnify the GC for claims arising from the GC's own negligence is unenforceable in North Carolina as a matter of public policy — the legislature determined that requiring indemnification for one's own negligence is fundamentally unfair and creates perverse safety incentives. The clause remains enforceable to the extent it covers the subcontractor's own negligence.
53. B — A Notice to Cure is a formal contractual notice that activates default procedures — the contractor must respond substantively within the specified period or risk the owner declaring default and calling on the performance bond. The response must include a realistic recovery schedule addressing each delay item. Simultaneously, the contractor should document owner-caused delays that contributed to the schedule problem and notify the surety, because once the surety receives notice of a potential claim, they can begin their own investigation and potentially assist in resolution.
54. D — Wellpoint dewatering is the standard method for lowering the water table 1 to 15 feet in granular soils for shallow to medium-depth excavations. A series of small-diameter wellpoints connected to a vacuum header and pump draws groundwater from the soil, lowering the water table within the excavation zone. Wellpoints are practical, economical, and rapidly deployable for small to medium construction dewatering needs — making them the appropriate choice for a 1 to 2-foot drawdown on a typical building foundation.
55. A — Water distribution industry standards and AWWA guidelines require a minimum 18-inch vertical clearance between a storm sewer and a potable water main at utility crossings. This separation prevents contamination of the water main from sewer exfiltration and protects against back-siphonage during water main breaks. When 18 inches of vertical separation cannot be achieved, special crossing details — including water main casing or sleeving — must be used to maintain the separation intent.
56. C — Elevation of the target point = instrument height – rod reading = $105.42 - 4.68 = 100.74$ feet. The instrument height represents the elevation of the laser beam plane. A rod reading above the beam level (negative reading) would add to the instrument height; a rod reading below the beam

level (positive reading, as here) is subtracted. This subtraction reflects that the target point is lower than the laser plane by the rod reading distance.

57. B — OSHA Subpart P requires that when water accumulates in an excavation — whether from ground seepage, surface drainage, or pipe leakage — workers must be removed immediately. Water accumulation changes the soil classification (typically to Type C), dramatically reduces soil stability, and may indicate conditions leading to imminent cave-in. Workers must remain out until the water is controlled, the competent person re-evaluates the soil classification, and the protective system is upgraded to match the revised classification if necessary.
58. D — Hydraulic impact hammers (hydraulic breakers) attached to excavator arms are the most common and practical method for breaking boulders on construction sites. They deliver high-energy repetitive impact to fracture rock efficiently. Non-explosive demolition grout (expansive cement) injected into pre-drilled holes is used where vibration from impact hammers would damage adjacent structures. Both methods avoid the regulatory requirements, safety distances, and specialized personnel required for blasting operations.
59. A — The specified compaction requirement of 98% maximum dry density is a structural specification for base course supporting pavement loads. A test result of 96.5% falls 1.5% below the requirement — outside any reasonable field tolerance. Additional compaction passes must be made to increase density to the specified level, followed by retesting at the previously deficient locations. Accepting substandard base compaction leads to premature pavement failure, rutting, and costly repairs within the pavement's design life.
60. C — Parapet walls are among the most severe masonry service conditions — they are exposed to weather on both faces, at the cap, and receive freeze-thaw cycling from multiple directions with no insulation protection. Type S mortar (minimum 1,800 psi) or Type M mortar provides the combination of compressive strength and bond strength needed for this exposure. Type N is appropriate for above-grade protected masonry but is too weak for parapets — parapet mortar failures are among the most common masonry maintenance issues in commercial buildings.
61. B — Throwing mortar onto brick bed faces with the trowel tip — rather than applying a full, consistent mortar bed — produces incomplete coverage with voids and hollow spots. These voids reduce the masonry wall's compressive and flexural strength by reducing the effective mortar-bearing area and allow water to infiltrate through the bed joint, accelerating freeze-thaw deterioration. Proper mortar application requires fully buttered bed faces with complete coverage across the full contact area of each unit.
62. D — ACI 530 hot weather masonry requirements mandate protection of newly constructed masonry from rapid moisture evaporation when conditions — high temperature, low humidity, wind, and direct solar radiation — would otherwise dry the mortar too quickly. Rapid drying prevents adequate cement hydration and dramatically reduces mortar compressive and bond

strength. Shading newly placed masonry from direct sun, using windbreaks, and applying misting to the completed work maintain the moisture needed for proper mortar curing.

63. A — ASTM C216 Face Brick has more restrictive dimensional tolerances than ASTM C62 Building Brick because face brick is intended for architectural exposed applications where dimensional variation would be visible in the finished wall. Face brick also has more restrictive surface finish and appearance requirements — chip size, color uniformity, and surface texture criteria — that building brick does not require because building brick is typically concealed or used in non-architectural backup applications.
64. C — Lime in mortar contributes workability and water retention but provides little compressive or bond strength — those properties come from the portland cement component. When lime proportion exceeds the ASTM C270 maximum for Type N mortar, the dilution of the cementitious fraction reduces both the compressive strength and the bond strength of the mortar below Type N minimums. The resulting mortar is weaker than specified, reducing the structural capacity of the masonry assembly and its resistance to water penetration at the mortar-unit interface.
65. B — ACI 530 limits the height of unreinforced masonry parapets above the roof level to three times the parapet wall thickness. For an 8-inch nominal CMU parapet, the maximum unreinforced height is 3×7.625 inches actual = approximately 22.9 inches — less than 2 feet. Parapets exceeding this height-to-thickness ratio require reinforcement because their slenderness ratio creates excessive bending stress from wind loads that unreinforced masonry cannot safely resist.
66. D — The NC Building Code requires self-adhering ice and water shield at eaves to extend a minimum of 24 inches inside the exterior wall line (the warm-wall plane) to protect against ice dam water intrusion. This 24-inch minimum ensures the membrane extends inward past the point where ice dams typically form and water backs up beneath shingles. In areas with greater ice dam risk, the membrane may need to extend further inside depending on the eave overhang dimension and local practice.
67. A — A fire classification rating for a roofing assembly is achieved by the complete tested system — the combination of deck, insulation, underlayment, and roofing material installed per a specific UL-listed design. No single material independently carries the Class A rating unless it has been independently tested and listed. Installing components of a listed assembly in a non-listed configuration — even using the same individual materials — does not produce the rated system. The contractor must install the complete listed assembly per its UL design documentation.
68. C — ASCE 7 defines ponding instability as a progressive structural collapse mechanism where water accumulation causes deflection, which creates a deeper pool, which adds more load, which increases deflection further in a self-reinforcing cycle. The framing must be evaluated when roof slope and stiffness are insufficient to ensure that this cycle is arrested before deflections become excessive. Ponding instability has caused roof collapses that occur hours or days after a storm when the water cannot drain fast enough to prevent the progressive deflection cycle.

69. B — The aggregate surfacing on a BUR system primarily protects the bitumen from ultraviolet radiation degradation. Bitumen oxidizes rapidly when exposed directly to sunlight — UV breaks down the molecular chains in the bitumen, causing it to become brittle and crack. The aggregate layer shields the bitumen surface from direct UV exposure, dramatically extending the membrane's service life. Aggregate also provides incidental Class A or B fire resistance and minimal ballast contribution, but UV protection is its primary functional purpose.
70. D — Roof drains positioned at high points rather than low points are a fundamental design deficiency that prevents positive drainage — water flows away from the drains rather than toward them. The only correct solutions are to add drains at the actual low points, or to install tapered insulation that creates slope toward the existing drain locations. Simply adding drain capacity at the existing high points does not resolve the drainage pattern. This condition must be corrected before installing new roofing because membrane warranties require positive drainage.
71. A — The generally accepted minimum slope for positive drainage on low-slope commercial roofing systems is 1/4 inch per foot — also expressed as 1/4:12 or approximately 2%. This slope ensures that water drains toward the roof drains within a reasonable time after rainfall rather than ponding. NRCA guidelines, roofing material manufacturers' specifications, and most project specifications require this minimum slope for all low-slope membrane systems. Flat roofs designed with zero slope invariably develop ponding because construction tolerances and deflection create unintended low points.
72. C — The USGA root zone specification requires a precisely engineered sand-based growing medium that has excellent drainage capacity. The gravel drainage blanket beneath the root zone intercepts water percolating down through the root zone and channels it horizontally to the perforated collection pipe network. Critically, the blanket's gravel particle size must create a perched water table effect that prevents excessive drainage from the root zone during dry periods — this capillary break is an intentional hydraulic feature of the USGA system design.
73. B — Before applying new polyurethane track surfacing, thorough mechanical surface preparation of the existing track is the most critical step for achieving adhesion. Power washing removes embedded dirt, algae, tire rubber deposits, and other contamination that would prevent adhesive bond. Mechanical abrading — typically by sanding or scarifying — removes oxidized surface material and creates a texture profile that significantly increases the mechanical bonding area for the new material. Primer and crack filling are secondary steps performed after the surface is properly cleaned and prepared.
74. D — The standard pitcher's mound height is 10 inches above the baseline and home plate level per NFHS high school rules, NCAA college rules, and MLB professional rules. The 10-inch standard was adopted universally to provide consistent playing conditions at all levels of organized baseball. Youth leagues including Little League use lower mound heights to reduce pitching advantage for younger players, but all levels of high school, college, and professional play use the 10-inch standard.

75. A — Perennial ryegrass is the fastest-germinating cool-season turfgrass, typically emerging in 5 to 7 days under optimal overseeding conditions of 50°F to 65°F soil temperature and consistent moisture. This rapid germination rate is the primary reason perennial ryegrass is used for fall overseeding — it establishes a usable playing surface quickly before the bermudagrass is fully dormant. Adequate soil moisture immediately after seeding is critical — the seed must remain moist continuously throughout the germination period.
76. C — The NFHS establishes standard high school basketball court dimensions of 84 feet long by 50 feet wide. This differs from the NBA and NCAA standard of 94 feet by 50 feet. When designing a multi-use gymnasium that must accommodate both high school play and college or community play, the longer 94-foot dimension should be used. The NFHS 84-foot standard is a directly tested dimension for sports field and facility construction questions on contractor licensing exams.
77. B — OSHA 1926.502(d)(16)(ii) limits the maximum arresting force on the human body during a fall arrest to 1,800 pounds. Above this force, the deceleration during arrest can cause spinal and internal injuries independent of the fall itself. Fall arrest systems must be designed and selected to limit the maximum arresting force to 1,800 pounds through the combination of shock-absorbing lanyard, self-retracting lifeline, or harness design. This 1,800-pound limit is a directly tested OSHA fall protection value.
78. D — $TRIR = (\text{Number of recordable cases} \times 200,000) \div \text{Total hours worked by all employees during the period}$. The 200,000 multiplier normalizes the rate to a baseline of 100 full-time workers each working 2,000 hours per year, allowing meaningful comparison across companies of different sizes. A TRIR of 1.0 means one recordable injury occurred per 100 full-time equivalent workers, which is the standard unit for comparing safety performance across the construction industry.
79. A — OSHA requires the "Job Safety and Health: It's the Law" poster and the Form 300A annual summary to be posted at each job site in a location that is conspicuous and accessible to all workers who report to that location. For construction contractors, this means posting at the active job site — not just at the main office. Workers who report directly to the job site must have access to these postings without having to travel to a remote location. Electronic posting alone does not satisfy the physical posting requirement.
80. C — Before workers enter a permit-required confined space under OSHA 29 CFR 1910.146 (adopted for construction in 1926.1201 through 1926.1213), the atmosphere must be tested with a calibrated multi-gas meter for oxygen deficiency or enrichment, flammable gas levels, and toxic air contaminants. Additionally, an entry permit documenting all safety precautions must be completed, a trained entry supervisor must authorize entry, and an attendant must be stationed outside the space maintaining continuous communication with workers inside throughout the entry.
81. B — Intumescent paint is a reactive coating that remains thin and aesthetically appealing under normal conditions but undergoes a dramatic chemical reaction when exposed to heat — typically

above 200°C — swelling into a thick, highly insulating foam layer up to 50 times its original thickness. This expanded foam retards the rate of heat transfer to the steel member, delaying the time for the steel to reach its critical temperature of approximately 540°C where structural strength is significantly reduced. The insulating char buys critical time for evacuation and firefighting operations.

82. D — When tile is set straight down without a sliding motion, the mortar ridges from the notched trowel do not collapse completely, leaving air pockets between the ridges under the tile. To achieve full coverage, the tile should be placed with a slight sliding or twisting motion to collapse the ridges and fill the voids. When coverage is still inadequate, back-buttering the tile — applying a thin layer of mortar directly to the tile back before setting — in addition to the notched substrate application is the standard correction technique for achieving the minimum 95% coverage required in wet areas.
83. A — Uninsulated supply ductwork in a hot unconditioned attic gains heat rapidly as the cold supply air travels through ducts surrounded by 130°F air. By the time the supply air reaches registers — particularly at the ends of long duct runs — it may have gained 15°F to 25°F of heat, significantly reducing its cooling capacity. The HVAC system must work harder and longer to compensate for duct heat gain, increasing energy consumption and reducing occupant comfort. Proper duct insulation is one of the most impactful energy efficiency measures in residential and light commercial construction.
84. C — NC 811 law defines excavation broadly to include all subsurface soil disturbance including directional boring, regardless of the equipment used, the bore depth, or whether the surface is disturbed. A horizontal directional bore at 24 inches depth under a parking lot is excavation under NC law and requires a prior locate request to NC 811 — the bore path could strike gas lines, electric conduit, telecommunications cables, and water mains that are installed at shallow depths throughout developed areas.
85. B — White marking paint or white flags placed at an excavation site before utilities are located is the excavator's marking system — used to show the utility locators the boundaries and center line of the proposed excavation area. This pre-marking by the excavator helps locators understand where to search for their facilities and reduces the risk of markings being placed outside the actual work zone. The practice of pre-marking with white is a standard industry best practice recommended by the Common Ground Alliance.
86. D — NC DEQ's final stabilization standard for Erosion and Sedimentation Control Plan closure requires that ground cover — permanent vegetation or equivalent permanent stabilization — be established on all disturbed areas with no significant bare areas remaining exposed to erosion. There is no percentage threshold that permits closure with some remaining bare soil — the standard requires essentially complete coverage of all disturbed areas. An 85% stabilization rate with 15% bare soil does not meet final stabilization and the plan cannot be closed.

87. A — Under the NC SPCA, civil penalties accrue from the date the violation first occurred — not the date the NOV was issued and not the date it was corrected. A silt fence that failed during a storm was in violation from the moment of failure, and each day of continued violation through the date of correction is a separate billable penalty day. This retroactive accrual provision creates a strong financial incentive for contractors to inspect and maintain BMPs continuously rather than waiting for regulatory notification before making repairs.
88. C — The NC Licensing Board for General Contractors requires 8 total hours of continuing education per renewal cycle for all classification levels, including a mandatory 2-hour Board-produced course. With 6 hours completed including the 2-hour mandatory course, the qualifier needs 2 additional hours to reach the 8-hour requirement before the license may be renewed. There is no distinction in CE hour requirements between Limited, Intermediate, and Unlimited license levels — all Building Contractor qualifiers must complete the same 8-hour requirement.
89. B — A contractor whose NC general contractors license has been suspended may seek reinstatement by submitting a reinstatement application to the NCLBGC demonstrating that the grounds for the suspension have been corrected — payment of fines, completion of required CE, resolution of the underlying violation — and satisfying all conditions the Board imposed as prerequisites to reinstatement. The Board evaluates each reinstatement application on its merits. Re-examination is not automatically required unless the Board specifically orders it as a condition of reinstatement.
90. D — Under NC Chapter 44A, a subcontractor's Claim of Lien on Real Property attaches to the property and creates a cloud on the title. However, when an owner has paid the general contractor in full, the lien's enforceability against the owner becomes legally complicated — courts analyze whether the owner had proper notice of potential lien claimants before making final payment. If the subcontractor properly notified the lien agent and the owner still paid the GC without protecting the subcontractor's interest, the lien may be enforceable. The subcontractor's most direct and practical remedy is against the GC for breach of contract — the lien against the property is a secondary but important protective remedy that pressures resolution.