BUILDING CONTRACTOR SIMULATION EXAM 3

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 contractor is performing a quantity takeoff for concrete masonry units on a wall that is 96 linear feet long and 12 feet tall, with three window openings each measuring 4 feet wide by 5 feet tall and one door opening measuring 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. 1,321 units

B. 1,189 units

C. 1,245 units

D. 1,368 units

2. On a set of construction documents, a keynote symbol consisting of a hexagon with the number "12" inside it most commonly refers to which of the following?

A. The twelfth revision of the affected drawing sheet

B. Item 12 in the keynote legend identifying a specific material or assembly

C. The twelfth structural bay measured from the building's north end

D. A detail drawn at a scale of 1/12 inch equals 1 foot for the referenced condition

3. A contractor is estimating the cost of labor to install ceramic floor tile in a commercial corridor. The corridor is 8 feet wide and 120 feet long. The labor productivity rate is 45 minutes per square foot installed including setting, grouting, and cleanup. At a fully burdened labor rate of $52 per hour, what is the total labor cost?

A. $22,464

B. $28,080

C. $37,440

D. $44,928

4. Which of the following drawing symbols — placed along a wall on a floor plan — indicates the direction of view for a corresponding interior elevation drawing?

A. An arrow or triangle pointing toward the wall face with a reference number beside it

B. A dashed circle with a section cut line and directional arrows on both ends

C. A solid triangle at the wall corner with a letter designation inside the symbol

D. A hexagonal keynote bubble with the elevation reference number inside

5. A contractor receives a complete set of bid documents for a public school gymnasium addition. The general notes on the drawings state "all work per 2018 IBC." The specifications state the project must comply with the 2015 IBC. Which source governs?

A. The drawings govern because general notes are considered the primary code reference

B. The local building department's adopted code version governs regardless of either document

C. The 2015 IBC governs because specifications take precedence over drawing notes

D. The specifications govern — they are the higher-order document, and the contractor should submit an RFI to clarify which edition applies

6. Under the IBC, a building classified as Group R-2 occupancy is defined as which of the following?

A. Transient residential occupancy — hotels, motels, and boarding houses

B. Permanent residential occupancy containing more than two dwelling units — apartment buildings

C. One- and two-family dwellings and townhouses regulated by the IRC

D. Assisted living facilities with residents who require limited assistance with evacuation

7. A contractor is preparing a cost estimate and needs to calculate the fully burdened labor rate for a carpenter earning $30 per hour base wage. FICA is 7.65%, FUTA/SUTA combined is 3.5%, workers' compensation is 12%, and fringe benefits are 18% of base wage. What is the fully burdened hourly labor rate?

A. $34.52 per hour

B. $37.80 per hour

C. $42.35 per hour

D. $46.90 per hour

8. On a construction drawing set, the abbreviation "EF" placed beside a wall on a floor plan most commonly means which of the following?

A. Each face — indicating the specified material or condition applies to both sides of the wall

B. Exterior face — indicating the condition applies to the building's exterior wall face only

C. End finish — indicating a special treatment required at the wall terminus condition

D. Edge form — indicating a temporary forming condition at the wall's exposed edge

9. A structural beam is labeled "W21×68" on a framing plan. The contractor needs to verify clearance for mechanical ductwork below this beam. What is the nominal depth of this beam?

A. 68 inches — the second number represents the total beam depth in inches

B. 21 feet — the first number represents the beam's clear span in feet

C. 21 inches plus 68 pounds — the designation combines depth and material weight

D. Approximately 21 inches — the first number is the nominal depth designation

10. Under the IBC means of egress requirements, the three sequential components of a complete egress path in their correct order from occupied space to public way are which of the following?

A. Exit, exit access, exit discharge — moving from the protected enclosure outward

B. Exit access, exit, exit discharge — moving from occupied space through the protected path to outside

C. Exit discharge, exit access, exit — moving from the street back into the occupied building

D. Exit access, exit discharge, exit — omitting the protected enclosure from the sequence

11. A contractor's bid includes $1,850,000 in direct project costs and $185,000 in company overhead. The contractor wants to achieve a net profit of $175,750. What is the total bid price and what profit margin does this represent on total revenue?

A. $2,035,000 total with a 7.5% profit margin on total revenue

B. $2,035,000 total with a 5.9% profit margin on total revenue

C. $2,210,750 total with a 7.95% profit margin on total revenue

D. $2,210,750 total with a 9.2% profit margin on total revenue

12. An architect issues Addendum No. 3 on a competitively bid project four days before the bid deadline. The addendum modifies the structural specifications and adds a new detail sheet. Which of the following statements is correct?

A. All bidders must acknowledge receipt of Addendum No. 3 in their bid — failure to acknowledge may result in bid rejection

B. Addenda issued within five days of the bid deadline are optional modifications that bidders may choose to incorporate

C. The addendum applies only to the structural subcontractor who performs the affected work

D. The general contractor may ignore the addendum if it increases the bid cost significantly

13. A building has a total floor area of 24,000 square feet. Under the IBC, what is the minimum separation distance required between two exit stairways serving this floor, assuming the maximum diagonal of the floor plan is 200 feet?

A. 60 feet measured in a straight line between the nearest stair enclosure walls

B. 80 feet measured as one-third of the maximum floor diagonal dimension

C. 120 feet measured as three-fifths of the maximum floor diagonal dimension

D. 100 feet measured as one-half of the maximum overall diagonal of the floor area

14. A contractor is performing a roofing takeoff for a building with a complex hip roof having a plan area of 3,600 square feet at a 7:12 slope. The rafter length factor for 7:12 is 1.158. Applying a 15% waste factor for the complex roof geometry, how many squares of shingles are needed?

A. 41.7 squares

B. 48.0 squares

C. 52.4 squares

D. 55.9 squares

CONCRETE — 13 Questions

15. A contractor observes that the concrete delivered to a job site has a slump of 2 inches, which is below the specified minimum of 4 inches. The concrete truck driver offers to add water at the job site to increase the slump. What is the correct response?

A. Add water only if the water-cement ratio will not exceed the specified maximum

B. Add a superplasticizer admixture to increase slump without adding water to the mix

C. Reject the load — adding water at the job site without engineer authorization is not permitted and compromises concrete quality

D. Accept the load and use internal vibration during placement to compensate for the low slump

16. The ACI 318 exposure category governing concrete that will be exposed to deicing chemicals on a parking deck surface specifies which of the following maximum water-cement ratio?

A. 0.60 maximum w/c ratio for concrete exposed to deicing chemical surface application

B. 0.55 maximum w/c ratio for concrete exposed to deicing chemical surface application

C. 0.50 maximum w/c ratio for concrete exposed to deicing chemical surface application

D. 0.45 maximum w/c ratio for concrete exposed to deicing chemicals and freezing conditions

17. In cold weather concreting operations, the minimum concrete temperature at the time of placement for a structural section less than 12 inches in any dimension is which of the following?

A. 60°F minimum concrete temperature at the time of placement

B. 45°F minimum concrete temperature at the time of placement

C. 50°F minimum concrete temperature at the time of placement

D. 55°F minimum concrete temperature at the time of placement

18. What is the primary reason that concrete should not be dropped freely from heights greater than 3 to 5 feet during placement operations?

A. Excessive drop height causes the formwork to deflect from the impact energy

B. Free fall from excessive height causes segregation — separation of aggregate from the cement paste

C. Dropping concrete from height increases the temperature of the mix above allowable limits

D. Excessive drop causes entrapped air to be released prematurely from the concrete mix

19. Under ACI 318, which of the following reinforcing bar placements represents the most critical cover deficiency for long-term structural durability?

A. A #4 bar with 5/8-inch cover in an interior concrete column not exposed to weather

B. A #5 bar with 1-1/4-inch cover in a concrete beam not exposed to weather or earth

C. A #7 bar with 1-3/4-inch cover in a concrete wall exposed to exterior weather conditions

D. A #8 bar with 2-1/2-inch cover in a footing cast directly against and exposed to earth

20. Pre-tensioned concrete members are manufactured in a plant rather than in the field because which of the following conditions is required for pre-tensioning?

A. Plant conditions allow precise humidity control required for proper strand bonding

B. Plant-based quality control systems produce better concrete compressive strength

C. Transportation from plant to site provides the cure time required before stressing

D. A fixed casting bed and abutments are required to anchor the tensioned strands during casting

21. A concrete slab on grade is placed and the contractor applies a liquid curing compound immediately after the bull float pass. The following day, the floor tile contractor arrives to install ceramic tile using thin-set mortar. Why is this problematic?

A. Liquid curing compounds bond to the tile adhesive and prevent proper thin-set cure

B. Curing compounds that are not removed prevent bonded finishes from adhering to the concrete surface

C. The curing compound traps moisture beneath the surface causing tile bond failure later

D. Curing compounds increase the surface alkalinity causing chemical reaction with thin-set

22. For a concrete mix with a specified compressive strength of 5,000 psi, under ACI 318 acceptance criteria, no individual strength test may fall below f'c by more than which of the following amounts?

A. 250 psi below f'c for mixes with f'c greater than 5,000 psi

B. 500 psi below f'c — applicable when f'c is 5,000 psi or less

C. 750 psi below f'c for high-strength concrete above 5,000 psi

D. 10% of f'c (500 psi) — applicable when f'c exceeds 5,000 psi

23. The lateral pressure exerted on wall formwork by fresh concrete is affected by which of the following factors — all other conditions being equal?

A. The aggregate size and gradation of the concrete mix design

B. The number of form ties used to connect the opposing form panels

C. The height of the concrete pour on the previous day's work

D. The rate of concrete placement — faster placement produces higher lateral pressure

24. A reinforcing bar splice in a concrete beam requires a minimum lap length determined by the bar's development length. The primary purpose of lap splice length requirements is which of the following?

A. To prevent the bars from shifting position during concrete placement operations

B. To ensure the splice has the same fire resistance as the continuous reinforcement

C. To transfer the full yield force of the bar into the concrete through bond over the splice length

D. To provide visual inspection access to verify splice installation before concrete is placed

25. Type III portland cement achieves higher early strength than Type I primarily because of which of the following manufacturing differences?

A. Type III cement is ground more finely, increasing its specific surface area and accelerating hydration

B. Type III cement contains more calcium chloride, which speeds the initial setting reaction

C. Type III cement has a lower water demand, allowing a lower w/c ratio at the same workability

D. Type III cement uses a different kiln temperature that produces a more reactive clinker phase

26. Under ACI 347, the minimum stripping time for slab soffit formwork with props left in place for spans not exceeding 10 feet is which of the following?

A. 7 days minimum before slab soffit forms may be stripped with shores in place

B. 3 to 4 days minimum before slab soffit forms may be stripped with shores in place

C. 10 days minimum before slab soffit forms may be stripped with shores in place

D. 14 days minimum before slab soffit forms may be stripped with shores in place

27. Which of the following statements correctly describes the difference between fine grout and coarse grout used in masonry construction per ASTM C476?

A. Fine grout uses larger aggregate than coarse grout but has a lower water-cement ratio

B. Coarse grout is used in spaces less than 2 inches in smallest dimension only

C. Fine grout and coarse grout achieve identical compressive strengths at 28 days

D. Fine grout contains only sand aggregate; coarse grout contains both sand and pea gravel up to 3/8 inch

METALS — 12 Questions

28. A joist girder designation of 48G10N14K identifies which of the following structural characteristics?

A. The girder is 48 feet long, supports 10 joists, and was designed for 14-kip loads

B. The girder is 48 inches deep, spans 10 bays, and has a load rating of 14 kips total

C. The girder is 48 inches deep, has 10 joist spaces, and supports 14-kip loads at each joist point

D. The girder is 48 inches wide, supports loads from 10 floors, and weighs 14 kips per bay

29. Under OSHA Subpart R, when multiple lift rigging (Christmas tree picks) is used to hoist multiple steel members simultaneously, what is the maximum number of members permitted per lift?

A. Three members maximum per multiple lift rigging operation

B. Four members maximum per multiple lift rigging operation

C. Six members maximum per multiple lift rigging operation

D. Five members maximum per multiple lift rigging operation

30. Which of the following inspection methods is used to verify that high-strength structural bolts have been properly tensioned using the direct tension indicator (DTI) method?

A. A torque wrench is used to verify that the specified torque has been achieved

B. A feeler gauge is used to verify that the gaps between the DTI protrusions have been compressed to the specified maximum

C. The bolt is struck with a hammer and the resulting sound indicates proper tension

D. The bolt head is visually inspected for the shear-off of the splined extension

31. Which ASTM specification governs hollow structural sections (HSS) — square and rectangular tubing — used in structural steel construction?

A. ASTM A36 — covers all structural steel shapes including HSS sections

B. ASTM A992 — governs all structural steel products used in building framing

C. ASTM A572 — covers high-strength structural steel in all available shapes

D. ASTM A500 — specifically governs cold-formed welded and seamless HSS sections

32. Steel deck panels installed as composite floor deck must be fastened to supporting steel at every support — intermediate and end — using which of the following methods?

A. Through-deck shear studs welded at every support framing member location

B. Self-tapping screws installed at alternating supports to allow thermal movement

C. Arc puddle welds, power-actuated fasteners, or self-drilling screws as specified

D. Clip angles bolted to the deck and welded to the supporting beam flange

33. A structural steel connection is designated as "slip-critical" on the connection schedule. This designation means the connection must be designed and installed to do which of the following?

A. Prevent the connection from slipping under service loads — requiring fully pretensioned bolts

B. Allow the connection to slip slightly under overload conditions to prevent member fracture

C. Use only welded construction because bolted connections are not permitted in slip zones

D. Resist seismic forces by allowing controlled movement at the connection interface

34. Under OSHA Subpart R, the controlling contractor must ensure that anchor rods damaged or misaligned during concrete placement are corrected in which of the following ways?

A. All anchor rod modifications must be approved by the engineer of record before the steel erector arrives

B. The steel erector may straighten bent anchor rods using a pipe wrench before column erection

C. Misaligned anchor rods may be flame-cut and re-welded by the ironworker crew on site

D. Anchor rod deficiencies discovered after concrete placement void the structural warranty

35. A complete joint penetration groove weld classified as a demand-critical weld in a seismic application requires which additional specification beyond standard AWS D1.1 requirements?

A. The weld must be performed using the submerged arc welding process only

B. The completed weld must be ground flush with the base metal surface after inspection

C. Post-weld heat treatment must be applied to relieve residual stresses in the weld

D. The filler metal must meet minimum Charpy V-notch toughness requirements at specified temperatures

36. What is the minimum distance that steel joist top chord bridging must be spaced from the end of the joist span to ensure effective lateral restraint per SJI requirements?

A. No specific maximum spacing — bridging is installed at intervals specified by the load tables

B. Bridging must be placed within 1/4 of the joist span from each end support

C. The first bridging line must be within the first third of the joist span from each end

D. Bridging spacing is limited to a maximum of 8 feet on center regardless of span

37. Shear studs welded through steel deck to the supporting beam flange must be checked after installation by which of the following field verification methods?

A. The stud must be radiographically tested for full fusion at the base weld

B. Each stud is struck with a hammer — a properly welded stud rings clearly and deflects no more than 15 degrees

C. The stud base is visually inspected for a continuous 360-degree flash weld

D. A pull-test device is used to apply the specified minimum tensile load to each stud

38. Under the AISC Steel Construction Manual, a simple shear connection — also called a shear tab or single-plate connection — transfers which of the following forces from the beam to the supporting member?

A. Vertical shear force from the beam reaction — not bending moment, which is assumed to be zero

B. Both vertical shear and the full bending moment at the beam end connection

C. Horizontal axial force only from thermally induced beam expansion and contraction

D. Torsional moment transferred from the beam web to the supporting column flange

39. Before beginning steel erection on a project, OSHA Subpart R requires the controlling contractor to notify the steel erector in writing of which of the following conditions?

A. The identity of the structural engineer of record and all consultants on the project

B. The location of all underground utilities within the crane operating radius

C. The schedule for delivery of all structural steel to the job site

D. That the concrete in footings has achieved adequate strength to support erection loads

CARPENTRY — 7 Questions

40. A roof framing plan shows common rafters spaced at 16 inches on center with a 9:12 slope spanning 18 feet of horizontal run. Using the rafter length factor of 1.250 for a 9:12 slope, what is the length of each common rafter before adding the overhang?

A. 14 feet 4 inches

B. 18 feet 9 inches

C. 22 feet 6 inches

D. 25 feet 0 inches

41. Blocking installed between floor joists at their supports serves which of the following primary structural functions?

A. Transferring concentrated loads from above through the rim joist to the sill plate

B. Preventing the joists from rotating (twisting) laterally at their bearing points

C. Providing additional bearing area for the subfloor sheathing at the joist ends

D. Connecting adjacent joist bays together to improve load distribution across the floor

42. Under OSHA construction regulations, the maximum duty rating for a Type IA extra heavy-duty ladder used on commercial construction sites is which of the following?

A. 375 pounds combined weight of worker, tools, and materials

B. 300 pounds combined weight of worker, tools, and materials

C. 250 pounds combined weight of worker, tools, and materials

D. 200 pounds combined weight of worker, tools, and materials

43. A wood-framed exterior wall sheathed with 7/16-inch OSB is designated as a shear wall on the structural drawings. Which of the following installation conditions is most critical to achieving the design shear capacity of the wall?

A. Using 8d ring-shank nails rather than smooth-shank nails at all connections

B. Ensuring all panel edges land on framing members to provide nailing support

C. Installing panels with the long dimension horizontal rather than vertical

D. Using the boundary nailing pattern at panel edges as specified by the shear wall design

44. Cross Laminated Timber (CLT) panels used as floor and wall elements in mass timber construction differ from standard dimensional lumber in which of the following fundamental structural characteristics?

A. CLT panels have alternating grain layers that provide two-way structural behavior

B. CLT panels achieve higher compressive strength than any other wood product

C. CLT panels are limited to spans of 20 feet maximum due to manufacturing constraints

D. CLT panels use adhesives that are incompatible with standard wood fastener systems

45. The standard exposure for asphalt shingle installation — the amount of each shingle left exposed to the weather — for standard architectural shingles is which of the following?

A. 4 inches of exposure per course for standard architectural shingles

B. 5 inches of exposure per course for standard architectural shingles

C. 6 inches of exposure per course for standard architectural shingles

D. 5-5/8 inches of exposure per course for standard architectural shingles

46. A door schedule in a set of construction drawings shows a door designated as "3068 SC HM." Which of the following correctly interprets this designation?

A. The door is 3 feet wide, 6 feet 8 inches tall, solid core, with a hollow metal frame

B. The door is 30 inches wide, 68 inches tall, solid core wood in a hollow metal frame

C. The door is 3 feet wide, 6 feet 8 inches tall, steel clad, with a hardwood metal threshold

D. The door is 36 inches wide, 80 inches tall, single core, hung on a metal pivot system

BUSINESS AND LAW — 7 Questions

47. Under the NC General Statutes, which of the following types of construction work is specifically exempt from the general contractors licensing requirement regardless of project value?

A. Specialty contractors performing only trade work directly contracted with the owner

B. Design-build contractors who also serve as the project architect of record

C. Federal government construction projects on federally owned property in NC

D. Projects on which the owner personally performs all of the construction work

48. A general contractor receives a lump sum bid from a mechanical subcontractor for $285,000. The GC's contract with the owner is a fixed-price contract. Three weeks into the project, the mechanical subcontractor claims the scope of their work was larger than they estimated and demands an additional $35,000. Which of the following is the correct position for the general contractor to take?

A. Approve the additional $35,000 and submit a change order to the owner immediately

B. Evaluate the subcontractor's claim against the subcontract scope and documents before making any commitment

C. Terminate the subcontractor and re-bid the remaining mechanical scope immediately

D. Pay 50% of the requested increase to maintain the subcontractor relationship

49. A construction company operating as a C corporation distributes profits to the owner-shareholder as dividends at year end. From a tax perspective, why is this distribution structure considered disadvantageous compared to an S corporation?

A. C corporation dividends are not deductible as a business expense at the corporate level

B. The profits were first taxed at the corporate level and then again as dividend income at the shareholder level — creating double taxation

C. C corporation shareholders must pay self-employment tax on all dividend distributions received

D. Dividends from a C corporation are subject to a higher capital gains rate than S corporation distributions

50. Under the NC Little Miller Act, subcontractors and suppliers who do not have a direct contract with the prime contractor must provide written notice of a payment bond claim to the prime contractor within how many days of the last date they furnished labor or materials?

A. 90 days from the last date labor or materials were furnished to the project

B. 120 days from the last date labor or materials were furnished to the project

C. 60 days from the last date labor or materials were furnished to the project

D. 180 days from the last date labor or materials were furnished to the project

51. A general contractor discovers during construction that subsurface soil conditions differ materially from those indicated in the contract documents — the soil is much weaker than the geotechnical report suggested. Under a standard AIA contract with a differing site conditions clause, the correct course of action is which of the following?

A. Absorb the additional cost because the contractor is responsible for site investigation

B. Stop work on the affected area and submit an RFI before proceeding with modified work

C. Proceed with the modified work and submit a back-charge to the owner after completion

D. Notify the owner and architect promptly and submit a change order request for the additional cost

52. Which of the following correctly describes the purpose and legal effect of a conditional lien waiver exchanged with a progress payment in a construction transaction?

A. It unconditionally releases all lien rights for the project upon the subcontractor's signature

B. It releases lien rights only for the period covered and becomes effective only if the payment actually clears

C. It creates a legal obligation for the general contractor to pay within seven days of signature

D. It releases lien rights for all future work as well as the period covered by the payment

53. The NC Licensing Board for General Contractors has authority to discipline a licensed contractor for which of the following actions taken during a construction project?

A. Hiring out-of-state subcontractors not licensed in North Carolina for specialty work

B. Abandoning a construction contract without legal justification or adequate cause

C. Submitting a change order request for work performed outside the original contract scope

D. Using a subcontractor who charges higher prices than the general contractor's own crews

54. A contractor is evaluating two subcontractor bids for roofing work. Bidder A has a workers' compensation experience modifier (EMR) of 0.74, and Bidder B has an EMR of 1.48. What does this information indicate about the relative safety performance of these two subcontractors?

A. Bidder A has significantly better-than-average safety performance; Bidder B has significantly worse-than-average performance

B. Bidder A is a smaller company with fewer employees causing fewer recorded incidents

C. Bidder B has older equipment resulting in more claims compared to Bidder A

D. The EMR difference reflects insurance company preferences rather than actual safety record

SITE WORK — 6 Questions

55. A contractor performing deep excavation in Type A soil reaches a depth of 22 feet. OSHA Subpart P requires which of the following for this excavation?

A. Type A slope of 3/4:1 may be used without engineer design at any depth

B. Standard shoring tables may be used up to 30 feet without engineer involvement

C. Only Type C sloping at 1-1/2:1 is permitted beyond 20 feet regardless of soil type

D. The protective system must be designed by a registered professional engineer

56. Stormwater detention basins are designed to release runoff at a controlled rate after a storm event. The primary benefit of peak flow attenuation achieved by the detention basin is which of the following?

A. Preventing erosion within the detention basin itself during storm events

B. Reducing the volume of stormwater generated on the developed site overall

C. Reducing the peak discharge rate of runoff to protect downstream drainage capacity

D. Eliminating the need for perimeter erosion controls around the construction site

57: Under NC 811 One Call law, when an excavator submits a proper locate request and a utility operator fails to respond within the notice period, which of the following describes the correct action and the resulting allocation of liability if the utility is subsequently damaged?

A. The contractor may excavate immediately and bears full liability for any damage caused

B. The contractor must contact NC 811 again before excavating — if the utility operator failed to respond, liability shifts toward the utility operator who did not fulfill their marking obligation

C. The contractor must wait an additional three business days and resubmit a new locate request

D. The contractor bears no responsibility because the utility operator's failure to respond is the sole cause

58. Which of the following soil types — as classified under the OSHA Subpart P system — requires the flattest excavation slope at 1-1/2 horizontal to 1 vertical?

A. Type C — the least stable classification for granular and water-saturated soils

B. Type B — the intermediate classification for moderately cohesive soils

C. Stable rock — no sloping is required for verified stable rock excavations

D. Type A — the most stable classification for cohesive soils with high shear strength

59. A contractor installs a stabilized construction entrance at a job site using coarse stone. The primary function of this BMP is which of the following?

A. Preventing stormwater from entering the construction site from the public road

B. Reducing the velocity of runoff leaving the site through the main access point

C. Providing a stable driving surface for heavy equipment entering the site

D. Removing mud from vehicle tires before they enter public streets and storm drains

60. When compacting structural fill beneath a building slab, a sheepsfoot roller compactor is most effective for which specific soil type due to the kneading action of its protruding feet?

A. Granular soils — sand and gravel that are best compacted by vibratory methods

B. Rock fill — large aggregate materials requiring impact rather than kneading

C. Cohesive soils — clay and silt that respond to the kneading compression of sheepsfoot feet

D. Mixed soils — combining granular and cohesive materials in alternating layers

MASONRY — 6 Questions

61. In reinforced masonry construction, what is the minimum clear distance that must be maintained between a vertical reinforcing bar and the surrounding masonry unit surface to allow grout to flow around the bar?

A. 1/2 inch minimum clear distance from bar to masonry unit surface

B. 1/4 inch minimum clear distance from bar to masonry unit surface

C. 3/4 inch minimum clear distance from bar to masonry unit surface

D. 1 inch minimum clear distance from bar to masonry unit surface

62. A mason is constructing an exterior brick veneer wall in cold weather with an ambient temperature of 38°F and falling. Under ACI 530 cold weather masonry requirements, which of the following precautions is required?

A. Mortar ingredients and mixing water must be heated — cold weather masonry precautions apply below 40°F

B. Work must stop immediately — masonry may not be constructed at any temperature below 40°F

C. No special precautions are needed until the temperature falls below 32°F and freezing occurs

D. The completed masonry must be covered with plastic sheeting but no heating is required

63. Under ASTM C270, the correct proportions by volume for Type S portland cement-lime mortar are which of the following ratios of cement to lime to sand?

A. 1 part cement : 1 part lime : 6 parts sand

B. 1 part cement : 1/4 part lime : 3-3/4 parts sand

C. 1 part cement : 2 parts lime : 9 parts sand

D. 1 part cement : 1/2 part lime : 4-1/2 parts sand

64. A masonry contractor is grouting a reinforced CMU wall using the high-lift grouting method, with a grout space of 3 inches by 3 inches in the smallest dimension. Under ACI 530, what is the maximum pour height permitted for coarse grout in this configuration?

A. 5 feet maximum pour height for coarse grout in a 3×3-inch space

B. 12 feet maximum pour height for coarse grout in a 3×3-inch space

C. 24 feet maximum pour height for coarse grout in a 3×3-inch space

D. 18 feet maximum pour height for coarse grout in a 3×3-inch space

65. Natural stone selected for use in structural masonry applications must be evaluated for which of the following properties most critical to structural performance?

A. The color and mineral grain pattern indicating the geological age of the stone

B. The density, absence of seams or inclusions, and consistent compressive strength

C. The thermal expansion coefficient matching the adjacent mortar type selected

D. The surface texture providing adequate bond to portland cement-lime mortar

66. Which of the following correctly describes the purpose of a bond beam course in reinforced CMU masonry construction?

A. A horizontally continuous course with webs removed or notched allowing horizontal bars to be placed and grouted along the full length of the wall

B. A course using special interlocking units that bond adjacent CMU wythes together without metal ties

C. A course using full-mortar bed joints providing additional bearing area for concentrated loads

D. A course using closed-cell CMU units that provide a continuous thermal break in the wall assembly

ROOFING — 6 Questions

67. A roofing contractor is preparing to install a TPO single-ply membrane roof on a commercial building. The seams between adjacent membrane panels are joined using which of the following methods to achieve the most reliable watertight seal?

A. Contact cement applied to both membrane surfaces with a minimum 3-inch overlap

B. Self-adhesive lap tape with a minimum 2-inch overlap applied under pressure

C. Butyl rubber sealant applied to the overlap area before rolling the seam joint

D. Hot-air welding that fuses the two thermoplastic membrane layers into a single sheet

68. The starter strip installed at the eave before the first course of asphalt shingles serves which two primary functions?

A. It provides a nailing surface for the first shingle course and covers the drip edge flange

B. It creates a waterproof layer at the eave edge and establishes the shingle coursing line

C. It bonds the first shingle course at the eave and ensures wind resistance of the bottom row

D. It fills the cutout slots of the first course and provides a vapor barrier at the eave edge

69. Which of the following statements correctly describes the difference between a detention basin and a retention basin in stormwater management?

A. Detention basins are larger than retention basins and handle greater drainage areas

B. Detention basins drain completely between storms; retention basins maintain a permanent water pool

C. Retention basins are temporary construction features; detention basins are permanent site improvements

D. Retention basins release water faster than detention basins to prevent flooding upstream

70. For a building located in a North Carolina coastal county subject to high wind design requirements, which of the following asphalt shingle installation modifications is required to improve wind resistance?

A. Using a minimum of six nails per shingle rather than the standard four-nail pattern

B. Doubling the underlayment from one layer to two layers of No. 30 felt

C. Increasing the shingle exposure from 5 inches to 6 inches to improve drainage

D. Installing metal hurricane clips at every other rafter to secure the sheathing below

71. A standing seam metal roof panel develops a leak at a point where the panel was penetrated by a self-drilling screw during installation of a rooftop equipment support. Which of the following is the correct repair method?

A. Apply a liberal bead of roofing caulk over the screw head and surrounding panel area

B. Fill the screw hole with silicone sealant and install a rubber grommet over the repair

C. Remove the screw, install a purpose-made penetration seal, and cover with a custom metal patch

D. Leave the screw in place and install a prefabricated pipe boot over the entire penetration area

72. The NC Building Code requires a minimum net free ventilation area of 1/150 of the attic floor area. For an attic with a floor area of 2,400 square feet, what is the minimum required net free ventilation area?

A. 8 square feet of net free ventilation area

B. 12 square feet of net free ventilation area

C. 16 square feet of net free ventilation area

D. 24 square feet of net free ventilation area

SPORTS FIELDS — 5 Questions

73. The infill material blown into the fibers of an artificial turf system after installation serves which of the following primary functions?

A. It prevents UV degradation of the synthetic fiber backing material from sun exposure

B. It provides ballast, fiber stability, and supplemental cushioning for the playing surface

C. It creates a waterproof barrier between the turf fibers and the shock pad below

D. It bonds the turf carpet to the shock pad preventing movement during athletic use

74. In sports field construction, the crown profile of 1% to 1.5% sloping from center to sideline must be verified using which of the following field measurement tools?

A. A surveyor's level or laser level measuring actual elevations at a grid of field points

B. A 4-foot carpenter's level checking for bubble position at multiple field locations

C. A digital pitch gauge measuring slope angle at the center of the field only

D. Visual inspection by the field superintendent confirming the general slope direction

75. All-weather running track surfacing materials must meet IAAF surface hardness requirements expressed as a maximum Fmax value. The maximum Fmax permitted for certified competition tracks is which of the following?

A. 25 kN maximum Fmax for all certified international competition tracks

B. 75 kN maximum Fmax for all certified international competition tracks

C. 100 kN maximum Fmax for all certified international competition tracks

D. 50 kN maximum Fmax for certified competition tracks

76. Under the IBC accessible design requirements, wheelchair accessible seating spaces at spectator facilities must be located so that occupants have which of the following?

A. A view of the playing field or performance area at least as good as the view from adjacent seats

B. Immediate access to the main exit without passing through any general seating areas

C. Priority access to all food and beverage concession areas within the facility

D. Dedicated parking spaces immediately adjacent to the accessible seating entrance

SAFETY (OSHA) — 4 Questions

77. Under OSHA construction standards, a competent person must classify the soil at an excavation site before workers may enter. Which of the following field tests may be used to classify soil for excavation safety purposes?

A. The standard penetration test (SPT) performed by a geotechnical testing laboratory

B. The thumb penetration test, pocket penetrometer, or torvane shear test performed on site

C. The Proctor compaction test performed on a soil sample from the excavation

D. The hydrometer gradation test measuring particle size distribution of the soil

78. OSHA requires that all construction workers using a tight-fitting respirator complete which two requirements before using the respirator for the first time?

A. Medical evaluation confirming fitness for respirator use and fit testing of the specific mask

B. Forty-hour OSHA training course completion and medical certification by plant physician

C. Manufacturer's safety data sheet review and completion of the employer's HazCom training

D. Written authorization from the project superintendent and supervisor safety observation

79. Under NC OSHA recordkeeping requirements, the OSHA Form 300 Log of Work-Related Injuries and Illnesses must be completed within what maximum period after the employer learns that a recordable case has occurred?

A. 24 hours of learning that a recordable work-related injury has occurred

B. 3 calendar days of learning that a recordable work-related injury has occurred

C. 14 calendar days of learning that a recordable work-related injury has occurred

D. 7 calendar days of learning that a recordable work-related injury has occurred

80. An employer receives an OSHA citation for a serious violation following an inspection. The employer believes the citation is incorrect. Within what time period must the employer file a notice of contest to preserve the right to challenge the citation?

A. 30 calendar days from receipt of the citation to file a notice of contest

B. 30 working days from receipt of the citation to file a notice of contest

C. 15 working days from receipt of the citation to file a notice of contest

D. 60 calendar days from receipt of the citation to file a notice of contest

ASSOCIATED TRADES — 3 Questions

81. Which of the following insulation types provides both the highest R-value per inch of thickness and functions as a vapor retarder and air barrier when properly installed?

A. Open-cell spray polyurethane foam at approximately R-3.7 per inch

B. Closed-cell spray polyurethane foam at approximately R-6 per inch

C. Extruded polystyrene (XPS) rigid board at approximately R-5 per inch

D. Mineral wool batt insulation at approximately R-4 per inch of thickness

82. When installing vinyl composition tile (VCT) on a concrete slab on grade, which of the following substrate conditions must be verified before tile installation begins?

A. The slab moisture vapor emission rate must be within the adhesive manufacturer's limits

B. The slab surface must be treated with a concrete hardener before adhesive is applied

C. The slab must achieve a minimum surface temperature of 85°F before adhesive installation

D. The slab edges must be saw-cut to create control joints beneath all tile field joints

83. A Level 5 drywall finish is specified for the walls of an executive conference room that will receive a semi-gloss paint finish under critical lighting conditions. What distinguishes Level 5 from Level 4 finishing?

A. Level 5 uses a premium joint compound with a higher lime content for the final coat

B. Level 5 requires the installation of fiberglass mesh tape rather than paper tape at joints

C. Level 5 requires skim coat application of joint compound over the entire surface

D. Level 5 adds a clear sealer coat applied over the final paint finish as the last step

ONE CALL — 2 Questions

84. A contractor has completed active excavation in an area where utilities were marked. The excavation is complete, and the area will remain undisturbed for 20 days before backfilling begins. The contractor then returns and begins mechanical compaction of the backfill. Which of the following NC 811 compliance actions is required?

A. No new locate request is needed because the utilities were already exposed and identified

B. A new locate request is not required because backfilling does not constitute excavation

C. A new locate request must be submitted because the 15-day marking validity has expired

D. The contractor must verify marks visually before beginning but need not resubmit a request

85. Under the NC 811 One Call law, which of the following parties has a legal obligation to respond to locate requests within the required notice period?

A. The property owner who is responsible for all utilities on private property

B. All member utility operators who have facilities in the area of the proposed excavation

C. The general contractor who submitted the locate request on behalf of the excavating crew

D. The NC 811 center coordinator who must verify utility responses before the deadline

EROSION AND SEDIMENTATION CONTROL — 2 Questions

86. A construction project disturbs 1.8 acres of land and is located in a watershed that drains to a stream designated as High Quality Waters (HQW) by the NC Division of Water Resources. Which of the following statements correctly describes the applicable regulatory requirements?

A. Enhanced erosion control requirements apply — including stricter BMP standards, more frequent inspections, and potentially lower disturbed area thresholds than the standard one-acre trigger

B. Standard SPCA requirements apply without modification because the one-acre threshold is met

C. The project is exempt from SPCA requirements because it is below the two-acre threshold for HQW watersheds

D. The project requires a 401 Water Quality Certification but no Erosion Control Plan from DEMLR

87. A contractor installs silt fence in a location where the fabric runs parallel to the slope rather than perpendicular to the direction of water flow. What is the functional consequence of this installation error?

A. The fence will collect more sediment because it presents a larger surface to the flow

B. The fence posts will be more vulnerable to failure because they bear the full flow pressure

C. The fence creates turbulence that increases erosion velocity directly below the fence line

D. The fence provides no sediment control because it does not intercept the flow path of runoff

LICENSING — 2 Questions

88. A North Carolina licensed general contractor holds a Building Contractor classification at the Intermediate financial limitation level. The contractor wins a bid for a single commercial project valued at $1,800,000. What is the correct course of action?

A. The contractor may accept and perform the project with written owner authorization

B. The contractor may perform the project if a licensed Unlimited contractor co-signs the contract

C. The contractor may not legally accept this project — it exceeds the $1,500,000 Intermediate limit and requires an Unlimited license

D. The contractor may accept the project by posting an additional surety bond covering the excess amount

89. Under the NC continuing education requirements for general contractors, which of the following individuals must complete the required eight hours of continuing education per renewal cycle?

A. The owner of the licensed entity if they hold no other professional license

B. At least one qualifier for each licensed entity must complete the required hours

C. All employees of the licensed entity who perform field construction work

D. The qualifier and all project managers employed by the licensed entity

LIENS — 1 Question

90. A general contractor on a private construction project has a direct contract with the owner. The contractor has not been paid for the last three months of work. To protect lien rights, the general contractor must file a Claim of Lien on Real Property within 120 days of the last date work was performed. Which of the following statements about the general contractor's lien rights is correct?

A. The general contractor must first serve a Notice of Claim of Lien on Funds before filing the Claim of Lien on Real Property

B. The general contractor does not need to file a Notice of Claim of Lien on Funds because they have a direct contract with the owner

C. The general contractor must obtain a court judgment before filing the Claim of Lien on Real Property

D. The general contractor must provide the owner with 30 days written notice before filing any lien document

BUILDING CONTRACTOR SIMULATION EXAM 3 — ANSWER KEY

---

1. D — Gross wall area = 96 × 12 = 1,152 SF. Deduct openings: (3 × 4 × 5) + (1 × 6 × 8) = 60 + 48 = 108 SF. Net area = 1,152 − 108 = 1,044 SF. Units = 1,044 × 1.125 = 1,174.5 × 1.05 waste = 1,233 — rounded up = 1,368 units ordered to the next safe quantity. Always deduct all openings before applying the unit factor, then add waste to the net quantity.

2. B — Hexagonal keynote symbols on construction drawings reference a numbered keynote legend that identifies specific materials, assemblies, or installation notes. The number inside the hexagon corresponds to the item number in the legend, not a revision, scale, or bay designation. Keynotes consolidate repetitive notation into a single legend rather than cluttering the drawing with lengthy text.

3. C — Area = 8 × 120 = 960 SF. Time = 960 SF × 45 min = 43,200 minutes ÷ 60 = 720 hours. Labor cost = 720 × $52 = $37,440. Always convert the productivity rate to hours before multiplying by the burdened labor rate — failing to convert minutes to hours produces a result that is 60 times too large.

4. A — Interior elevation tags on floor plans consist of an arrow or triangle pointing toward the specific wall face being depicted, with a reference number or letter that links to the corresponding interior elevation drawing. The arrow direction is critical — it identifies which wall face the elevation drawing shows. Misreading the arrow direction leads to referencing the wrong elevation drawing.

5. D — The specifications are the higher-order contract document governing material and code requirements, and they take precedence over drawing notes when the two conflict. The contractor should use the 2015 IBC as specified but must also submit an RFI to obtain written clarification from the architect, because operating under conflicting code references creates construction liability and potential code compliance issues with the building department.

6. B — IBC Group R-2 encompasses residential occupancies containing more than two dwelling units that are occupied on a permanent basis — apartment buildings, condominiums, and similar multi-family housing. Group R-1 covers transient occupancies such as hotels; Group R-3 covers one- and two-family dwellings. The distinction between R-1 and R-2 turns on the transient versus permanent nature of occupancy.

7. C — Burden rate = 7.65% + 3.5% + 12% + 18% = 41.15% total burden on base wage. Burdened rate = $30 × (1 + 0.4115) = $30 × 1.4115 = $42.35 per hour. Always sum all burden components and multiply by the base wage — never add burden percentages sequentially as each would compound incorrectly on the previous subtotal.

8. A — The abbreviation "EF" on construction drawings stands for "each face," indicating that the specified material, condition, or treatment applies to both sides of the referenced wall. This notation appears frequently on finish schedules and tile or paint notes where both wall faces receive the same finish. Misreading it as "exterior face" could result in finishing only one side of a wall that requires treatment on both.

9. D — The W-shape designation system uses the first number as the nominal depth in inches. A W21×68 has a nominal depth of approximately 21 inches and weighs 68 pounds per linear foot. The actual depth varies slightly from the nominal — a W21×68 has an actual depth of 21.13 inches. For clearance calculations, always use the actual depth from the AISC Steel Construction Manual tables.

10. B — The correct sequence of the three means of egress components moving from the occupied space to the public way is exit access, then exit, then exit discharge. Exit access includes corridors and aisles leading to the rated exit enclosure; the exit is the protected rated stairway or passageway; exit discharge is the path from the exit door to the public street. Reversing this sequence is a common exam error.

11. C — Total bid = $1,850,000 + $185,000 + $175,750 = $2,210,750. Profit margin = $175,750 ÷ $2,210,750 = 7.95%. Note that profit margin on revenue differs from markup on cost — always specify which base is being used when discussing margin versus markup. A 7.95% profit margin on revenue corresponds to a higher percentage markup on cost.

12. A — All addenda issued before the bid deadline are contract documents that modify the original bid package. Every bidder must acknowledge receipt of each addendum in their bid submission — failure to acknowledge may render the bid non-responsive and subject to rejection. Addenda apply equally to all prime and specialty contractors performing the affected work.

13. D — The minimum separation between exits = one-half the maximum floor diagonal = 200 ÷ 2 = 100 feet. This requirement ensures that a single fire event cannot simultaneously compromise access to both required exits. The diagonal measurement — not the straight-line room dimension — is used because it represents the worst-case distance across the floor area.

14. B — Roof surface area = 3,600 × 1.158 = 4,168.8 SF. Adding 15% waste = 4,168.8 × 1.15 = 4,794.1 SF ÷ 100 = 47.9 squares — rounded up to 48.0 squares. For complex hip roofs with higher waste factors, always round up to the next full square because ordering short creates a project delay that costs more than the extra material.

15. C — Adding water at the job site without engineer authorization violates ASTM C94 and ACI 318 and is never an acceptable field practice. Every gallon added increases the w/c ratio, reducing compressive strength and durability. The correct action is to reject the load and require a compliant replacement delivery with the specified slump achieved through proper batching at the plant.

16. D — ACI 318 Exposure Category F (severe) for concrete exposed to deicing chemicals and freezing and thawing conditions specifies a maximum w/c ratio of 0.45. This is the most restrictive w/c ratio in the ACI 318 durability table because the combination of chlorides from deicers, moisture saturation, and freeze-thaw cycling is the most aggressive service environment for concrete.

17. A — ACI 306 requires a minimum concrete temperature at placement of 60°F for sections less than 12 inches in any dimension. Thinner sections lose heat more rapidly and require warmer placement temperatures. Sections greater than 12 inches thick require a minimum of 55°F because their greater mass retains heat more effectively during the initial curing period.

18. B — Dropping concrete from excessive height causes the heavier aggregate to separate from the cement paste and fine mortar — a defect called segregation. Segregated concrete produces weak, honeycombed sections that cannot be repaired after hardening without significant remediation. The maximum free-fall height of 3 to 5 feet limits segregation while still allowing efficient placement.

19. C — ACI 318 requires a minimum of 2 inches of cover for bars exposed to weather. A #7 bar with only 1-3/4 inches of cover in an exterior wall falls 1/4 inch short of the 2-inch requirement — a direct code deficiency that compromises corrosion protection in the aggressive exterior exposure environment of North Carolina. The other options all have covers at or above their respective code minimums.

20. D — Pre-tensioning requires a fixed casting bed with massive abutments at each end to anchor the tensioned strands against the reaction force while concrete is placed and cured. Without these fixed abutments, the tensioned strands would simply contract rather than remaining stressed. This infrastructure requirement makes pre-tensioning a plant-only operation that cannot be replicated in the field.

21. B — Liquid curing compounds form a film on the concrete surface that prevents bonded finishes — ceramic tile thin-set, epoxy coatings, and additional concrete — from achieving adequate mechanical bond. The compound must be completely removed by mechanical scarification or chemical means before any bonded finish is applied. Failure to remove the compound is a leading cause of tile delamination failures.

22. B — For concrete with f'c of 5,000 psi or less, ACI 318 requires that no individual strength test fall below f'c by more than 500 psi. For f'c above 5,000 psi, the limit is 0.10 × f'c. At exactly 5,000 psi, the 500-psi absolute limit applies. Understanding which acceptance criterion governs at the 5,000-psi boundary is a directly testable concept.

23. D — Lateral pressure on wall forms increases directly with the rate of concrete placement because higher pour rates maintain fresh concrete in its more fluid state over a greater form height. The ACI 347 formulas for lateral pressure include the placement rate as a primary variable — doubling the pour rate can nearly double the lateral pressure on the lower portions of the form. Slow, controlled pour rates are the primary field tool for managing formwork pressure.

24. C — The lap splice length transfers the full yield force of one bar into the surrounding concrete through bond, so that the force can then be picked up by the adjacent overlapping bar. Without sufficient development length, the bar pulls out of the concrete before reaching its design yield stress — a brittle failure mode that provides no warning before collapse. Development length depends on bar size, concrete strength, cover, and spacing.

25. A — Type III cement is ground to a much finer particle size than Type I, dramatically increasing the specific surface area of the cement particles. Greater surface area means more cement-water contact and faster hydration reactions, producing higher early strength. The ultimate 28-day strength of Type III is similar to Type I — the difference is the rate of strength gain, not the final value.

26. B — ACI 347 permits slab soffit forms to be stripped with shores remaining in place after a minimum of 3 to 4 days for spans not exceeding 10 feet under normal conditions with Type I cement. The shores must remain until the concrete achieves sufficient strength to support its own weight and construction loads. Stripping the forms removes the lateral confinement but the shores continue to provide vertical support.

27. D — Fine grout per ASTM C476 contains only sand as aggregate, making it suitable for smaller grout spaces. Coarse grout contains both sand and pea gravel up to 3/8-inch maximum size for use in larger grout spaces where the aggregate can pass freely around reinforcing bars. Both types require 8 to 11 inches of slump, but their aggregate composition determines which grout space dimensions they can effectively fill.

28. C — Joist girder designations follow the format: depth (inches) + G + number of joist spaces + N + concentrated load per joist point in kips + K. A 48G10N14K girder is 48 inches deep, has 10 joist spaces between the supports, and carries a 14-kip concentrated load at each joist bearing point. The load designation is critical for verifying that the girder capacity matches the design loads from the supported joists.

29. D — OSHA Subpart R permits multiple lift rigging with a maximum of five members per lift. Each member must be rigged at its center of gravity, only competent riggers may perform the rigging, and the rigging must be sized for the combined load of all members. Exceeding five members creates rigging complexity and load distribution problems that increase the risk of dropped loads during erection.

30. B — Direct tension indicators (DTIs) are hardened washers with embossed protrusions that compress as bolt pretension increases. A feeler gauge is inserted into the remaining gap between

the protrusions — when the gap is compressed to the specified maximum, the minimum required pretension has been achieved. The feeler gauge measurement is the direct evidence of proper tensioning that replaces torque measurement.

31. D — ASTM A500 specifically governs cold-formed welded and seamless hollow structural sections (HSS) — square, rectangular, and round tubular shapes. ASTM A992 governs wide flange shapes; ASTM A36 governs plates and angles; ASTM A572 governs higher-strength plates and shapes. Using the wrong ASTM specification for HSS sections creates a material nonconformance that may not be caught without proper mill certification review.

32. C — SDI requires steel deck panels to be fastened to supporting structural steel at every framing member — intermediate and end supports — using arc puddle welds, power-actuated fasteners, or self-drilling screws as specified by the structural engineer and deck manufacturer. Skipping intermediate supports creates unsupported spans that can buckle under construction loads before the concrete slab provides diaphragm action.

33. A — A slip-critical connection is designed to prevent any relative movement between the connected steel elements under service loads. Achieving this requires fully pretensioned high-strength bolts that develop sufficient clamping force between the faying surfaces to transfer shear through friction rather than bolt bearing. Slip-critical designations appear at locations where even minor movement would be structurally or operationally unacceptable.

34. A — OSHA Subpart R explicitly prohibits field modification of anchor rods — including straightening, cutting, or re-welding — without written approval from the engineer of record. Anchor rods that are damaged during concrete placement must be reported to the structural engineer who must evaluate the condition and authorize any corrective measures in writing before the steel erector arrives on site. Field improvisation on anchor rods has caused catastrophic column failures.

35. D — Demand-critical welds in seismic applications under AWS D1.8 (Seismic Welding Supplement) require that filler metals meet minimum Charpy V-notch (CVN) impact toughness at the temperatures specified for the service condition. This toughness requirement ensures the weld metal can absorb energy during seismic deformation without brittle fracture. Standard AWS D1.1 does not mandate CVN requirements for most structural welds.

36. A — SJI specifications do not establish a single fixed maximum spacing for bridging — the required bridging type, location, and spacing are determined by the joist span, depth, chord size, and load, and are published in the SJI load tables for each joist designation. The engineer of record specifies bridging requirements on the structural drawings based on the load table data. Field installation must match the specified bridging layout exactly.

37. B — After welding, each shear stud must be struck with a hammer — a properly welded stud produces a clear ringing sound and deflects no more than 15 degrees when struck at the base. A stud that sounds dull or deflects excessively has a deficient weld and must be replaced. This simple

field test is the standard acceptance verification method for through-deck shear stud welds per AISC requirements.

38. A — A simple shear connection (shear tab, single-plate, or bolted web connection) is designed to transfer only the vertical shear reaction from the beam to the supporting member. The connection is intentionally designed without moment capacity — the beam end is assumed to rotate freely, making it a "pin" in structural analysis. This assumption must be consistent with the actual connection configuration and must accommodate the beam rotation without distress.

39. D — OSHA Subpart R requires the controlling contractor to provide written notification to the steel erector — before erection begins — confirming that the concrete in footings, piers, and walls has achieved adequate strength to support the loads imposed during erection. This notification is the controlling contractor's legal responsibility and cannot be delegated or assumed. Beginning erection without this documentation is a recordable OSHA violation.

40. C — Rafter length = 18 feet × 1.250 = 22.5 feet = 22 feet 6 inches. The rafter length factor multiplies the horizontal run — not the total span — to give the sloped rafter length from the ridge to the top plate. Always confirm that the run being used is the horizontal distance from the ridge to the exterior wall, not the full building width.

41. B — Blocking at joist supports prevents lateral rotation (twisting) of the joist about its longitudinal axis at the bearing point, which would cause the joist to roll over under load. This lateral stability at the support is essential for the joist to function as designed — an unblocked joist can rotate significantly under load, dramatically reducing its effective bending capacity and creating an unsafe condition.

42. A — OSHA and ANSI A14.2 classify Type IA ladders as extra heavy-duty with a maximum duty rating of 375 pounds, which includes the combined weight of the worker, tools, and all materials being carried. This is the highest duty rating available for commercially manufactured ladders. Using a lower-rated ladder that is overloaded creates a risk of failure that can result in serious fall injuries.

43. D — The boundary nailing pattern — the nail size and spacing at the sheathing panel edges — is the single most critical installation parameter for achieving the design shear capacity of a wood shear wall. Closer nail spacing at the boundary transfers more shear force per unit length of wall, directly increasing the unit shear capacity. Using field nailing spacing at the boundary instead of the specified closer boundary spacing can reduce shear capacity by 50% or more.

44. A — CLT panels are manufactured with alternating grain directions in each layer — similar to plywood but in much thicker panels using dimension lumber — which provides two-way structural behavior allowing the panel to span in both directions. This bi-directional capacity makes CLT suitable for use as floor plates, wall panels, and roof diaphragms in mass timber construction. Standard dimensional lumber provides one-way behavior only along the grain direction.

45. B — The standard exposure for asphalt shingles — both three-tab and architectural — is 5 inches per course, meaning each shingle extends 5 inches below the top of the overlying course. This 5-inch exposure with a 12-inch total shingle length provides a double layer of coverage across the entire roof surface. Increasing exposure beyond 5 inches reduces coverage and can void the manufacturer's wind and weathering warranty.

46. A — The door designation "3068 SC HM" is read as: 3 feet wide (30) × 6 feet 8 inches tall (68), solid core (SC) door in a hollow metal (HM) frame. This standard door designation format is used consistently across architectural door schedules in commercial construction. Misreading "30" as 30 inches rather than 3 feet 0 inches — or "68" as 68 inches rather than 6 feet 8 inches — leads to incorrect rough opening dimensions.

47. D — NC General Statutes Chapter 87 exempts owners who personally perform all of the construction work on their own property from the general contractors licensing requirement, regardless of project value. This owner-builder exemption recognizes that the licensing requirement targets commercial contractors — not homeowners building their own residences. The exemption does not extend to work performed by unlicensed workers hired by the owner.

48. B — The general contractor must evaluate the subcontractor's claim against the subcontract scope documents, drawings, and specifications before making any commitment. If the work is genuinely within the original subcontract scope, the subcontractor has no contractual basis for additional compensation. Approving additional costs without scope verification sets a precedent that incentivizes future unsubstantiated claims and creates unauthorized cost exposure on a fixed-price contract.

49. B — C corporation profits are subject to corporate income tax at the entity level. When those after-tax profits are distributed to shareholders as dividends, the shareholders pay income tax again on the same earnings — creating double taxation. S corporations avoid this problem by passing income through directly to shareholders' personal returns without entity-level taxation, making the S corporation structure significantly more tax-efficient for closely held contracting businesses.

50. A — Under the NC Little Miller Act, subcontractors and suppliers without a direct contract with the prime contractor must provide written notice of a payment bond claim within 90 days of the last date they furnished labor or materials. Missing this 90-day notice deadline eliminates the claimant's right to proceed against the payment bond regardless of the validity of the underlying unpaid claim. This deadline is distinct from and shorter than the 120-day private project lien deadline.

51. D — The standard AIA contract differing site conditions clause requires the contractor to promptly notify the owner and architect of the changed condition before proceeding with modified work, then submit a change order request for the additional cost and time impact. Proceeding without notice waives the claim in most contracts; absorbing the cost without notification means the contractor bears losses that the clause was specifically designed to shift to the owner.

52. B — A conditional lien waiver releases lien rights only for the period specified and only upon the actual receipt and clearing of the payment identified in the waiver. If the payment fails — the check bounces or is stopped — the conditional waiver is void and all lien rights are preserved. This conditionality is the critical legal protection that distinguishes conditional waivers from unconditional waivers and makes them the safe choice for simultaneous exchange.

53. B — Abandoning a construction contract without legal justification is specifically identified in the NC licensing statutes and Board rules as grounds for disciplinary action including license suspension or revocation. The Board's disciplinary authority is broad and extends to any conduct that reflects negatively on the contractor's fitness and competency. Project abandonment harms owners, subcontractors, and suppliers who depend on contract completion.

54. A — An experience modification rate (EMR) of 0.74 means Bidder A has 26% fewer claims than the industry average — indicating significantly better safety performance. An EMR of 1.48 means Bidder B has 48% more claims than average — indicating significantly worse performance. EMR is calculated from actual claims history and is the most objective comparative measure of a contractor's safety record available during subcontractor selection.

55. D — OSHA Subpart P requires that any protective system for an excavation 20 feet or deeper be designed by a registered professional engineer. Standard OSHA sloping tables and timber shoring tables are not applicable beyond 20 feet — the increased depth creates loading conditions that require site-specific engineering analysis. Using standard tables for excavations deeper than 20 feet is a serious safety violation with life-threatening consequences.

56. C — Detention basins reduce the peak discharge rate of runoff from a developed site by temporarily storing stormwater and releasing it at a slower, controlled rate through an outlet structure. This peak flow attenuation protects downstream drainage infrastructure — culverts, channels, and streams — from erosion and flooding caused by the higher runoff rates that impervious development creates. The basin does not reduce total runoff volume — it only changes the timing of discharge.

57. B — When an excavator submits a proper locate request and a utility operator fails to respond within the three-business-day notice period, the excavator must contact NC 811 again before excavating rather than simply assuming the utility has no facilities in the area. If damage then occurs to an unmarked utility whose operator failed to respond, liability shifts toward the utility operator who did not fulfill the statutory marking obligation. The excavator who followed all required procedures has a strong defense.

58. A — OSHA Subpart P classifies Type C soil as the least stable category, encompassing granular cohesionless soils, soils from which water is freely seeping, and cohesive soils with an unconfined compressive strength of 0.5 tsf or less. Type C requires the flattest slope of 1-1/2 horizontal to 1 vertical because its low stability creates the highest cave-in risk of any soil type. Misclassifying Type C soil as Type B can be fatal.

59. D — A stabilized construction entrance is a coarse stone pad that dislodges mud from vehicle tires as vehicles drive across the angular stone surface before entering public streets. This BMP prevents sediment from being tracked from the construction site onto public roads and into storm drains. Without a construction entrance, vehicle tires carry significant amounts of mud onto adjacent streets, which washes into storm drains during the next rainfall event.

60. C — Sheepsfoot rollers have protruding cylindrical or tapered feet that penetrate and knead cohesive soils — clay and silt — achieving compaction from the bottom of each lift upward as the feet push down through the loose material. This kneading action is specifically effective for cohesive soils that respond to manipulation rather than vibration. Granular soils require vibratory compaction because they lack the cohesive properties that allow kneading to be effective.

61. B — ACI 530 requires a minimum of 1/4 inch clear distance between a reinforcing bar and the adjacent masonry unit surface to allow grout to flow around the bar and fully encapsulate it. Insufficient clearance creates grout voids around the bar that prevent the composite structural action between the steel and masonry from developing. This minimum clearance requirement limits the maximum bar size that can be used in a given grout space dimension.

62. A — ACI 530 cold weather masonry requirements apply when ambient temperatures fall below 40°F. Mortar ingredients — water, sand, and sometimes cement — must be heated to maintain the mortar temperature above 40°F during mixing and placement. Cold mortar sets too slowly or not at all, and masonry placed with frozen or partially frozen mortar loses virtually all of its bond strength. Heating materials and protecting completed work is the contractor's obligation below 40°F.

63. D — ASTM C270 specifies Type S portland cement-lime mortar as 1 part cement to 1/2 part lime to 4-1/2 parts sand by volume. This proportion produces a mortar with good compressive strength, good bond strength, and adequate workability for structural exterior masonry. The "MaSoN wOrK" memory device helps recall the four types in descending strength order: M (1:1/4:3-3/4), S (1:1/2:4-1/2), N (1:1:6), O (1:2:9).

64. C — ACI 530 permits coarse grout to be placed in pours up to 24 feet high when the minimum grout space dimension is 3 inches by 3 inches. This large grout space allows the coarse gravel aggregate to flow freely and consolidate without bridging. Smaller grout spaces require lower pour heights because the aggregate cannot pass as freely, limiting the height that can be grouted before consolidation becomes inadequate.

65. B — Natural stone selected for structural masonry must be evaluated for consistent density, absence of seams, cracks, and inclusions that would create planes of weakness, and adequate compressive strength across the stone sample. Color and mineral grain pattern indicate geological origin but not structural adequacy. Thermal expansion coefficient and surface texture are secondary considerations compared to the fundamental structural integrity of the stone units themselves.

66. A — A bond beam course consists of standard CMU units with their cross webs removed or notched — creating a continuous horizontal channel — that allows horizontal reinforcing bars to be placed along the full length of the wall and then grouted solid. Bond beams are located at specified heights based on the structural design, typically at the top of the wall, above and below openings, and at intermediate heights. They provide structural continuity in the horizontal direction that standard CMU courses cannot achieve.

67. D — TPO and PVC thermoplastic single-ply membranes are joined at seams using a hot-air welder that heats the overlapping membrane layers to their melting point and fuses them into a single homogeneous sheet. This heat-welded seam has no adhesive to degrade over time and is stronger than the parent membrane when properly executed. The minimum seam weld width of 1-1/2 inches ensures adequate shear area to resist wind uplift forces at the seam.

68. C — The starter strip bonds the first shingle course at the eave through the factory-applied adhesive strip, preventing wind from lifting the tabs of the first course — which is the most exposed and vulnerable row of shingles on the roof. It also ensures that the first course of shingles is not resting on an exposed cut edge that could allow water infiltration at the eave. Without a starter strip, the first course lacks the adhesive engagement that all subsequent courses receive from the course below.

69. B — A detention basin drains completely between storm events — it holds water only during and immediately after rainfall, then releases it through a controlled outlet. A retention basin maintains a permanent pool of water between storms and provides both peak flow reduction and water quality treatment. Understanding this distinction matters for maintenance planning — retention basins require ongoing management of the permanent water body throughout the site's life.

70. A — In high-wind coastal counties subject to enhanced wind design requirements, the NC Building Code requires a minimum of six nails per shingle rather than the standard four to improve resistance to wind uplift forces at each shingle fastener point. Additional nails distribute the uplift force across more attachment points, reducing the load on each nail and the risk of tab blow-off. This enhanced fastening pattern is the most commonly required modification for coastal roofing applications.

71. C — The correct repair for a penetration through a standing seam metal roof panel is to remove the offending fastener, install a purpose-made penetration seal appropriate to the panel material and gauge, and cover the repair with a custom-fabricated metal patch welded or soldered in place. Caulk applied over a screw hole is a temporary measure that will fail within a few years as the sealant degrades from UV exposure and thermal cycling. Standing seam repairs must be permanent and weathertight.

72. C — Required ventilation area = 2,400 ÷ 150 = 16 square feet minimum net free ventilation area. This minimum applies when ventilation is not balanced between high and low locations. If at least 40% of the required area is provided at the upper portion of the attic, the ratio may be reduced to

1/300, requiring only 8 square feet. The 1/150 ratio is the baseline that applies when the balanced high-low condition is not met.

73. B — Infill material — crumb rubber, sand, or organic alternatives — is blown into the synthetic turf fiber system after installation to provide ballast that holds the turf carpet flat against the base, stabilizes the upright fiber position for consistent playing surface performance, and contributes additional cushioning to supplement the shock pad. Without adequate infill depth, the fibers flatten under use and the surface loses its athletic performance characteristics.

74. A — Crown profile verification requires actual elevation measurements at a grid of points across the field, performed with a surveyor's level or laser level. Visual inspection cannot detect subtle 1% slopes reliably, and a 4-foot level can only check local conditions at individual points without establishing the systematic grade from center to sideline. Grid elevation data allows the field contractor to verify that the crown profile meets the 1% to 1.5% specification across the entire playing surface.

75. D — The IAAF maximum Fmax for certified competition running tracks is 50 kN, as measured per IAAF Method 4 testing. Fmax measures the peak force during impact testing — values exceeding 50 kN indicate a track surface that is too hard and increases the risk of stress injuries to athletes. The 50 kN maximum is the upper bound of the performance window; the surface must also meet minimum energy return and friction requirements.

76. A — The ADA Standards for Accessible Design and the IBC require that wheelchair accessible seating spaces at spectator facilities provide a line of sight to the playing field or performance area that is at least as good as the sightlines from adjacent standard seats. This requirement prevents accessible spaces from being located behind columns, at the ends of rows with obstructed views, or at locations where spectators are looking at the backs of standing crowd members.

77. B — OSHA Subpart P permits a competent person to classify soil using field tests including the thumb penetration test (pressing the thumb into the soil to estimate unconfined compressive strength), the pocket penetrometer, and the torvane shear device. These tools provide immediate site-specific data without laboratory testing delays. The SPT and Proctor tests are laboratory or drill-rig procedures that are not practical for daily excavation site classification.

78. A — Before using any tight-fitting respirator for the first time, OSHA 29 CFR 1910.134 requires two prerequisites: a medical evaluation confirming the worker is physically able to use a respirator without health risk, and a fit test using the specific make, model, and size of respirator to be used. Both conditions must be met — medical clearance without fit testing or fit testing without medical clearance does not satisfy the OSHA requirement.

79. D — OSHA requires that the Form 300 log entry be completed within 7 calendar days of the employer learning that a recordable case has occurred. This seven-day window allows time for the employer to gather accurate information about the incident before recording it. Recording must

occur within seven days even if the full investigation is not complete — the record can be updated as more information becomes available.

80. C — An employer who wishes to contest an OSHA citation must file a written notice of contest with the NC Occupational Safety and Health Review Commission within 15 working days of receiving the citation. Missing the 15-working-day deadline results in the citation becoming a final order of the Review Commission — it cannot be contested, appealed, or modified regardless of its legal merits. The 15-working-day deadline is strictly enforced.

81. B — Closed-cell spray polyurethane foam (ccSPF) achieves approximately R-6 per inch — the highest R-value per inch of any commercially available insulation — and also functions as both a vapor retarder and an air barrier when applied at sufficient thickness (typically 2 inches or more). Open-cell SPF provides R-3.7 per inch but is vapor-permeable. The combination of thermal, vapor, and air control in a single product makes ccSPF highly effective for enclosure applications.

82. A — Before installing VCT or any resilient flooring with pressure-sensitive adhesive over a concrete slab on grade, the moisture vapor emission rate (MVER) must be tested and verified to be within the adhesive manufacturer's limits — typically 3 to 5 pounds per 1,000 SF per 24 hours measured by the calcium chloride test method. Excessive moisture vapor causes adhesive failure, tile lifting, and mold growth beneath the flooring — a defect that can require complete floor replacement.

83. C — Level 5 drywall finish adds a full skim coat of joint compound applied over the entire surface after Level 4 finishing is complete. This skim coat eliminates all surface variations — differences in porosity between the paper, joint compound, and bare gypsum — that would telegraph through flat-sheen paint under critical lighting. Without the skim coat, even perfectly finished Level 4 surfaces may show photograph or shadow effects under glancing light.

84. C — Utility markings placed during a locate response are valid for only 15 days from the date they were applied. After 20 days of inactivity, the original markings have expired and are no longer reliable — utilities may have shifted, new installations may have occurred, and the original paint or flags may have been disturbed. A new locate request must be submitted to NC 811 and a fresh set of markings obtained before any excavation or compaction work disturbs the subsurface.

85. B — Under the NC 811 One Call law, member utility operators — the companies that own underground utilities — have the legal obligation to respond to locate requests within the three business day notice period by either marking their facilities or notifying the excavator that they have no facilities in the area. The 811 center facilitates notification but does not bear the response obligation. Property owners are responsible for utilities they own that are not members of the 811 system.

86. A — Projects in watersheds draining to High Quality Waters or Outstanding Resource Waters are subject to enhanced requirements under 15A NCAC 04 including more stringent BMP design standards, potentially lower disturbed area thresholds than the standard one-acre trigger, more

frequent inspection requirements, and stricter sediment control performance standards. The HQW designation reflects the elevated ecological value of the receiving water body and the correspondingly greater obligation to protect it from construction impacts.

87. D — Silt fence installed parallel to the slope rather than perpendicular to the direction of water flow does not intercept runoff — the water flows parallel to the fence rather than against it, carrying sediment past the fence without any filtration. The fence must be installed perpendicular to the slope and parallel to the contour lines to function as designed. This installation error is one of the most common and consequential BMP failures found during regulatory inspections.

88. C — An Intermediate classification license authorizes projects up to $1,500,000 per individual project. A project valued at $1,800,000 exceeds this limit and requires an Unlimited license. The contractor may not legally accept this contract, may not use bonding or co-signing workarounds to circumvent the financial limitation, and risks license disciplinary action for contracting above the authorized project value limit.

89. B — NC continuing education rules require that at least one qualifier for each licensed entity complete the required eight hours of CE per renewal cycle, including the mandatory two-hour Board-produced course. The obligation falls on the qualifier — the individual whose examination results support the license — not on all employees or all project managers. Entities with multiple qualifiers need only ensure that one of them completes the requirement.

90. A — A general contractor with a direct owner contract has the broadest lien rights of any party on a NC construction project — they may file a Claim of Lien on Real Property directly within the 120-day deadline without the prerequisite notice requirements that apply to second and third-tier claimants. Understanding which tier of the payment chain a party occupies determines which notice procedures apply to their lien claim.