PRACTICE EXAM 9: NASCLA TRADE EXAM SIMULATION (115 QUESTIONS)

Time Allowed: 330 Minutes (5 Hours 30 Minutes)

Total Questions: 115

Passing Score: 70% (81 Correct)

DOMAIN 1: GENERAL REQUIREMENTS (Questions 1–25)

1. A contractor is constructing a fivestory mixeduse building with retail on the ground floor, offices on floors 2–4, and a restaurant on floor 5. The building uses Type IIA construction with automatic sprinklers throughout. The building official questions whether the combined occupant load of all floors exceeds the threshold for requiring a secondary water supply for the sprinkler system. Under NFPA 13, when is a secondary water supply required for a sprinkler system?

A. A secondary water supply is generally required when the system design demands exceed the capacity of a single supply, when the building is a highrise, or when the authority having jurisdiction determines that the primary supply's reliability is insufficient

B. A secondary water supply is required for every commercial building regardless of size or occupancy type

C. A secondary water supply is never required because municipal water mains always provide adequate supply

D. A secondary water supply is required only for buildings containing Group H (highhazard) occupancies

2. Under the IBC, a contractor is constructing a large Group A3 (community hall) occupancy that will accommodate 1,500 seated persons. The building has four exit doors, each 72 inches wide. Using the IBC egress capacity factor of 0.2 inches per occupant for level exit components (doors, corridors), does the combined exit door width provide adequate egress capacity?

A. Yes, because any number of exits automatically satisfies the egress capacity requirement for assembly

B. No, because each door must be at least 96 inches wide for assembly occupancies exceeding 1,000 persons

C. Yes, because 4 doors × 72 inches = 288 inches of total exit width, and 1,500 occupants × 0.2 inches = 300 inches required — the 288 inches is 12 inches short of the 300inch requirement

D. No, because assembly occupancies require a minimum of six exits regardless of occupant load or capacity

3. A building inspector discovers that a contractor has installed a fire damper in a duct penetrating a smoke barrier wall but has not installed a smoke damper at the same location. Under the IBC, when is a smoke damper required in addition to a fire damper at a duct penetration through a smoke barrier?

A. Smoke dampers are never required at smoke barrier penetrations because fire dampers provide sufficient protection

B. A smoke damper (or a combination fire/smoke damper) is required at duct penetrations through smoke barriers because the purpose of the smoke barrier is to restrict smoke migration, and a fire damper alone does not close upon smoke detection — it closes only upon heat exposure

C. Smoke dampers are required only in Group I2 occupancies and no other occupancy group

D. A smoke damper replaces the fire damper entirely at smoke barrier penetrations with no fire damper needed

4. Under the IBC, a commercial building with an occupied floor more than 55 feet above the lowest level of fire department vehicle access is classified as a highrise. The building must include a fire command center. Which of the following is NOT a required feature of the fire command center?

A. Voice/alarm communication capability for directing occupants during emergency evacuation

B. Fire alarm system annunciation and control panels showing the status of all detection zones

C. Controls for elevator recall, stairway pressurization, and smoke control systems

D. A fully equipped commercial kitchen with provisions for feeding fire department personnel during extended operations

5. A contractor is constructing a Type IIIA commercial building. The specifications call for a 1hour fireresistancerated exterior bearing wall using noncombustible materials. During construction, the contractor's superintendent asks whether a woodframed exterior wall with gypsum board protection could achieve the required 1hour rating. Under the IBC, is this substitution acceptable?

A. No, Type III construction requires exterior walls to be constructed of noncombustible materials — a woodframed exterior wall is combustible and does not comply with Type III construction requirements regardless of the fireresistance rating achieved

B. Yes, any wall achieving a 1hour rating meets the code regardless of whether it uses combustible materials

C. Yes, wood framing is considered noncombustible when covered with gypsum board in all construction types

D. No, but only because wood framing cannot achieve a 1hour fireresistance rating under any condition

6. Under the IBC, what is the minimum required width for a landing at a door in the means of egress when the door swings onto the landing?

A. The landing must be exactly equal to the door width with no additional clearance required on either side

B. 36 inches minimum landing width regardless of door width or direction of swing for all egress doors

C. The landing must be at least as wide as the door or the required exit width, whichever is greater, and must extend at least the width of the door leaf beyond the door swing

D. 60 inches minimum landing width for all doors in the means of egress without exception or calculation

7. A contractor is installing an area of rescue assistance (area of refuge) in a commercial building that is not fully sprinklered. Under the IBC, what is the purpose of an area of refuge, and where must it be located?

A. An area of refuge is a break room for construction workers with no coderequired function

B. An area of refuge is a storage room for fire department equipment located in the building basement

C. An area of refuge is an outdoor staging area for building occupants during fire drills only

D. An area of refuge is a protected space within the building (typically within or adjacent to an exit stairway) where persons unable to use stairways can wait for assistance during an emergency — it must have direct access to an exit stairway and twoway communication capability

8. Under the IBC, the fireresistance rating of a floor/ceiling assembly is measured from both above and below. When testing per ASTM E119, which direction of fire exposure governs for the purposes of determining the floor assembly's rated performance?

A. The assembly is tested with fire exposure from above the floor only, simulating fire burning on the surface

B. The assembly is tested with fire exposure from below (the ceiling side), which is the direction that the fire would attack the floor assembly from a fire originating on the floor below

C. The assembly is tested from both sides simultaneously to determine the most conservative rating

D. The direction of fire exposure is determined by the architect and is not standardized in the test method

9. A contractor is constructing a Group E (school) building and the architect specifies storm shelters within the building for tornado protection. Under IBC Appendix L and ICC 500, what structural performance level must a storm shelter achieve?

A. The storm shelter must resist wind speeds of 250 mph and resist the impact of windborne debris missiles — it is designed to a much higher standard than the typical building wind design to protect occupants during extreme tornado events

B. The storm shelter must resist wind speeds of 75 mph, matching the standard building wind design criteria

C. Storm shelters have no specific structural requirements beyond the standard building code provisions

D. The storm shelter must resist wind speeds of 150 mph, which is the maximum Category 5 hurricane speed

10. Under the IBC, a building with a Group S1 (moderatehazard storage) occupancy stores combustible materials including rubber tires stacked 15 feet high. This storage arrangement triggers highpiled combustible storage requirements under IBC Chapter 32. What additional fire protection requirement does Chapter 32 impose beyond the standard sprinkler system?

A. Chapter 32 requires only a fire alarm system with no additional sprinkler modifications needed for highpiled storage

B. Chapter 32 requires a secondary exit from the storage area but no additional fire suppression requirements

C. The sprinkler system design must be enhanced with higher density (more water per square foot) and may require inrack sprinklers between the tiers of stored material to provide effective fire suppression within the highpiled storage arrangement

D. Chapter 32 requires only portable fire extinguishers at the end of each storage aisle with no sprinkler changes

11. A contractor is reviewing the IBC requirements for elevator lobby separation in a highrise building. Under the IBC, why are enclosed elevator lobbies required at each floor in many highrise buildings?

A. Elevator lobbies are required only for aesthetic purposes and to provide a waiting area for passengers

B. Elevator lobbies prevent water from the fire sprinkler system from entering the elevator hoistway

C. Elevator lobbies are required only in buildings taller than 20 stories for traffic management purposes

D. Elevator lobbies prevent smoke from migrating from the occupied floor through the elevator hoistway doors into the shaft, which could act as a chimney and spread smoke to other floors — the lobby acts as a buffer zone between the floor and the hoistway

12. Under the IBC, what is the maximum riser height and minimum tread depth for stairways serving as accessible means of egress in commercial buildings?

A. 8inch maximum riser and 9inch minimum tread for accessible exit stairways

B. 7inch maximum riser and 11inch minimum tread, which are the same requirements as all exit stairways — accessible stairways do not have different dimensional requirements than standard exit stairways

C. 6inch maximum riser and 14inch minimum tread for accessible stairways only

D. 4inch maximum riser and 18inch minimum tread for accessible stairways in all commercial buildings

13. A building's fire sprinkler system is supplied by a fire pump that boosts the municipal water pressure to the level required by the sprinkler design. Under NFPA 20 (Standard for the Installation of Stationary Pumps for Fire Protection), what power source must a fire pump have to ensure reliability?

A. The fire pump must have a reliable power source — typically a dedicated electrical connection ahead of the building's main disconnect or a diesel engine drive — and many installations require a backup power source to ensure the pump operates when normal power fails

B. The fire pump may be powered only by the building's standard electrical panel with no backup required

C. The fire pump must be handoperated by building maintenance personnel during a fire event

D. The fire pump must be powered exclusively by solar panels to ensure continuous environmentally sustainable operation

14. Under the IBC, what is the maximum permitted slope for a walking surface that is part of an accessible route but is not classified as a ramp?

A. 1:12 slope (one inch rise per 12 inches of run) for all accessible walking surfaces including ramps

B. 1:8 slope (one inch rise per 8 inches of run) for accessible walking surfaces that are not ramps

C. 1:20 slope (one inch rise per 20 inches of run) — any slope steeper than 1:20 is classified as a ramp and must comply with ramp requirements including handrails and edge protection

D. There is no slope limitation for accessible walking surfaces that are not classified as ramps

15. A contractor is constructing a building with a Group I4 (day care) occupancy serving children under 2½ years of age on the second floor. Under the IBC, what restriction applies to Group I4 occupancies serving children of this age group?

A. Group I4 serving children under 2½ must be located on the first floor only regardless of building type

B. Group I4 serving children under 2½ may be located on any floor if the building has an elevator for access

C. No floor level restrictions apply to Group I4 occupancies serving any age group in commercial buildings

D. Group I4 serving children under 2½ must be located at the level of exit discharge (typically ground floor) in nonsprinklered buildings, though sprinkler protection and other conditions may permit upperfloor locations

16. Under the IBC, a commercial building's mechanical system includes a smoke control system designed to maintain tenable conditions in the exit stairways and corridors during a fire. What type of smoke control is most commonly used in highrise exit stairway enclosures?

A. Natural ventilation through operable windows in the stairway enclosure at every other floor level

B. Stairway pressurization — a dedicated fan system that pressurizes the stairway enclosure to a higher pressure than the adjacent floors, preventing smoke from entering the stairway through closed doors

C. Exhaustonly smoke removal that pulls smoke out of the stairway through roof vents at the top

D. A chemical fog system that neutralizes smoke particles within the stairway using an aerosol spray

17. A contractor is constructing a commercial building and the architect specifies that all penetrations through a 2hour fireresistancerated wall must be firestopped with an approved system. The firestop system must be tested per ASTM E814 (UL 1479). What two performance criteria must the firestop system demonstrate in this test?

A. The firestop system must maintain the fireresistance rating of the assembly (Frating) and must prevent the passage of flame and hot gases through the penetration for the duration of the test (Trating applies where temperature limitation is required)

B. The firestop system must only prevent water leakage through the penetration during a standard pressure test

C. The firestop system must demonstrate acoustic performance and vibration resistance during the fire test

D. The firestop system must only prevent visible flame passage with no temperature rise limitation required

18. Under the IBC, a contractor is installing a fire protection system in a commercial building that includes both a fire alarm system and a sprinkler system. The two systems must be interconnected. What specific interaction between the sprinkler system and the fire alarm system is required?

A. The fire alarm system must shut down the sprinkler system when smoke is detected to prevent water damage

B. The sprinkler system and fire alarm system operate independently with no interconnection required by code

C. The sprinkler system's waterflow switches and tamper switches must be monitored by the fire alarm system — waterflow activates the building alarm, and tamper switches alert if a sprinkler control valve is moved from its normal open position

D. The fire alarm system must open the sprinkler valves when a smoke detector activates on any floor

19. A building's fire alarm system includes a "survivability" requirement for the fire alarm circuit wiring. Under NFPA 72, what does circuit survivability mean, and when is it required?

A. Circuit survivability means the fire alarm wiring can withstand water exposure from the sprinkler system

B. Circuit survivability means the fire alarm panel must have a minimum 72hour battery backup capacity

C. Circuit survivability is required only for residential smoke alarm circuits and not for commercial systems

D. Circuit survivability means the fire alarm wiring must continue to function during a fire for a specified period — achieved through firerated cable, conduit protection, or circuit routing that ensures critical notification and control circuits remain operational even when exposed to fire conditions

20. Under the IBC, what requirement applies to the stair handrail extension at the bottom of a stair flight where the stair terminates at a landing that leads to an exit discharge corridor?

A. The handrail must turn upward at the bottom riser and terminate with a vertical return to the wall

B. The handrail must extend horizontally at least one tread depth (minimum 11 inches) beyond the bottom riser, and the extension must return to the wall or post, or must extend to the handrail of an adjacent stair flight

C. No horizontal extension is required at the bottom of any stairway regardless of the building type

D. The handrail must extend vertically upward 24 inches at the bottom landing for visibility purposes

21. A contractor is constructing a commercial building with exterior balconies on the upper floors. The balconies serve as outdoor dining areas for a restaurant on each floor. Under the IBC, what guardrail height is required at the open edge of these exterior balconies?

A. 42 inches minimum guardrail height measured vertically from the balcony floor surface to the top of the guardrail, consistent with the standard guardrail height requirement for commercial buildings

B. 36 inches minimum guardrail height for balconies in commercial restaurant occupancies

C. 48 inches minimum guardrail height for all exterior balconies regardless of occupancy type

D. No guardrail is required on exterior balconies if the balcony is less than 6 feet above grade level

22. Under the IBC, what is the minimum fireresistance rating required for the structural frame of a Type IIIB building?

A. 1hour fireresistance rating for the structural frame of Type IIIB construction

B. 2hour fireresistance rating for the structural frame of Type IIIB construction

C. ½hour fireresistance rating for the structural frame of Type IIIB construction

D. 0 hours — no fireresistance rating is required for the structural frame in Type IIIB construction

23. A contractor discovers that a firerated door assembly has been installed without the door closer specified in the listing. The door is in a 1hour fire barrier separating two different occupancy groups. Under the IBC, what is the consequence of omitting the door closer?

A. The missing closer has no effect on the firerated assembly as long as the door is latched when inspected

B. The omission voids the warranty but does not affect the fireresistance rating of the door assembly

C. The door assembly is noncompliant because firerated door assemblies must include all components specified in the listing, including the selfclosing device — without the closer, the door will not return to the closed position after being opened, defeating its fire protection function

D. The closer may be omitted if the building has a functional sprinkler system on both sides of the barrier

24. Under the IBC, accessible parking spaces must include specific signage requirements. What must the sign include, and at what minimum height must it be mounted?

A. The sign must show only the parking space number and may be placed at any convenient height

B. The sign must show only the time limit for parking and be placed at ground level adjacent to the space

C. The sign must include the International Symbol of Accessibility, be mounted at a minimum height of 60 inches (measured to the bottom of the sign) so it is visible when a vehicle is parked in the space, and vanaccessible spaces must include an additional "van accessible" designation

D. No signage is required for accessible parking spaces as long as the pavement is painted blue

25. A commercial building has a twohour fireresistancerated fire barrier separating a Group A2 restaurant from a Group M retail space. The owner wants to install a serving window (passthrough opening) in the fire barrier to connect the restaurant kitchen to an adjacent retail food court. Under the IBC, is this opening permitted in the fire barrier?

A. Yes, any opening of any size is permitted in a fire barrier without any fire protection requirements

B. The opening must be protected with a firerated assembly (such as a firerated door, shutter, or window) that matches the required rating of the fire barrier, and any opening must be limited to the maximum sizes permitted by the assembly listing

C. No opening of any type is ever permitted in a fire barrier separating different occupancy groups

D. The opening is permitted only if both sides of the barrier have identical occupancy classifications

DOMAIN 2: SITE CONSTRUCTION (Questions 26–40)

26. A contractor is constructing a commercial building on a site with a high water table and the foundation design includes a waterproof basement. The structural engineer specifies that the foundation design must account for hydrostatic uplift pressure. What is hydrostatic uplift pressure, and how does it affect the foundation?

A. Hydrostatic uplift is the upward force exerted by groundwater on the underside of the basement slab and foundation, effectively trying to float the structure — the foundation must be heavy enough or anchored to resist this upward force to prevent structural failure

B. Hydrostatic uplift is the lateral pressure of water against the basement walls only and has no vertical component

C. Hydrostatic uplift refers to the weight of the roof structure pressing downward on the foundation

D. Hydrostatic uplift is a term for the evaporation of groundwater during hot weather with no structural impact

27. A contractor is performing soil compaction testing using a sand cone test (ASTM D1556) instead of a nuclear density gauge. How does the sand cone test measure the inplace density of compacted soil?

A. The sand cone test measures soil density by heating a soil sample to evaporate all moisture

B. The sand cone test uses radar waves to penetrate the soil and measure the density at various depths

C. The sand cone test measures soil density by applying a known weight to the surface and measuring deflection

D. The sand cone test excavates a small hole in the compacted fill, weighs the excavated soil, then fills the hole with calibrated sand from a jar and cone apparatus — the volume of the hole is determined by the weight of sand required to fill it, and the soil density is calculated as the weight of excavated soil divided by the measured volume

28. A contractor is constructing a retaining wall and the geotechnical engineer specifies a drainage system behind the wall consisting of a drainage blanket and weep holes. Why is drainage behind a retaining wall critical for the wall's structural performance?

A. Drainage improves the aesthetic appearance of the retaining wall face by preventing water staining

B. Without drainage, water accumulates behind the wall and creates hydrostatic pressure that significantly increases the lateral load on the wall beyond the design earth pressure — the drainage system relieves this water pressure, reducing the total lateral force to only the soil pressure

C. Drainage behind a retaining wall is purely for landscaping irrigation and has no structural significance

D. Drainage prevents ice from forming on the face of the retaining wall during winter weather conditions

29. Under OSHA, a contractor is performing trenching operations in a residential area adjacent to a commercial project. The trench crosses beneath an existing sidewalk that is temporarily removed. OSHA requires that the trench be protected when it is left unattended. What protection must be provided when the trench is left open overnight in a public area?

A. No protection is required because the trench is on private property adjacent to the public sidewalk

B. Only a single strand of yellow caution tape across the trench opening is required for public protection

C. Adequate barricading, fencing, or covering must be provided to prevent pedestrians, children, and vehicles from falling into the open trench — the protection must be substantial enough to physically prevent access

D. OSHA requires only a verbal warning to nearby residents with no physical barriers of any type

30. A contractor discovers during excavation that the native soil at the foundation bearing level has a significantly lower Standard Penetration Test (SPT) blow count (Nvalue) than what the geotechnical report indicated for that depth. The report showed N=25 (medium dense) but field conditions show N=8 (loose). What does this discrepancy indicate?

A. The actual bearing soil is significantly weaker than the design assumed — the loose condition (N=8) may not provide adequate bearing capacity for the designed foundation, requiring evaluation by the geotechnical engineer for potential redesign, ground improvement, or alternative foundation system

B. The discrepancy has no significance because SPT values are approximations with no engineering value

C. The higher Nvalue in the report was correct and the field test must be wrong in all cases

D. A lower Nvalue always indicates better soil because less resistance means the soil is easier to excavate

31. A contractor is constructing a commercial building on a coastal site in Alabama. The geotechnical engineer identifies a liquefiable sand layer at 15 feet below grade. What ground improvement technique might the engineer recommend to mitigate liquefaction risk?

A. Removing the top 6 inches of topsoil is sufficient to eliminate all liquefaction risk at any depth

B. Painting the foundation walls with waterproof coating eliminates the liquefaction hazard completely

C. Installing a silt fence around the building perimeter prevents liquefaction during seismic events

D. Vibrocompaction or vibroreplacement (stone columns) can densify the loose, liquefiable sand in place, increasing its resistance to liquefaction during seismic loading — other options include deep soil mixing, compaction grouting, or deep dynamic compaction

32. A contractor is reviewing a geotechnical report that recommends a "mat foundation with grade beams" for a commercial building on expansive clay soil. Why would the engineer specify grade beams as part of the mat foundation?

A. Grade beams provide electrical grounding for the building's lightning protection system

B. Grade beams stiffen the mat foundation by creating a ribbed structure that resists the differential movements caused by the expansive clay's uneven swelling and shrinking, reducing the risk of cracking and distortion

C. Grade beams are decorative elements visible above grade that frame the building's entrance

D. Grade beams serve only as formwork support during the mat foundation concrete placement

33. Under OSHA, a contractor performing excavation work in a busy urban area must control vehicular traffic near the excavation to protect both workers and the public. What traffic control measures does OSHA require?

A. Appropriate traffic control measures including signs, signals, barricades, flaggers, and other devices must be provided to protect workers from traffic hazards when the excavation is near vehicular traffic

B. OSHA has no requirements for traffic control near excavations regardless of the proximity to public roads

C. Only a single "Road Work Ahead" sign is required at a distance of 100 feet from the excavation

D. Traffic control is required only on federal highway projects and not on commercial building sites

34. A contractor is installing a soldier pile and lagging wall for temporary excavation support. What are the primary structural components of a soldier pile and lagging system?

A. Soldier pile and lagging uses only horizontal wood planks with no vertical support members of any type

B. Soldier pile and lagging uses a continuous sheet of interlocking steel panels driven into the ground

C. The system consists of vertical steel Hpiles (soldier piles) driven or drilled at regular spacing along the excavation perimeter, with horizontal wood or concrete planks (lagging) placed between the piles as the excavation progresses to retain the soil behind the wall

D. Soldier pile and lagging uses concrete blocks stacked without mortar to form a gravity retaining wall

35. A contractor is constructing a parking lot and the specifications call for "proof rolling the subgrade" before placing the aggregate base course. The proof roll reveals two soft areas. The geotechnical engineer recommends "overexcavation and replacement" for these areas. What does overexcavation and replacement involve?

A. Placing additional topsoil over the soft areas and seeding with grass for future landscape use

B. Pouring a thin layer of concrete over the soft areas to create a hard surface cap

C. Injecting chemical stabilizers into the soft areas through smalldiameter injection wells

D. Excavating the soft soil to a depth below the zone of weakness, replacing it with select structural fill material, and compacting the replacement fill to the specified density before placing the aggregate base

36. A contractor is installing a secant pile wall for permanent belowgrade construction of a commercial building's basement. What distinguishes a secant pile wall from a standard sheet pile wall?

A. Secant pile walls use the same interlocking steel sheets as sheet pile walls with no difference

B. A secant pile wall consists of overlapping (intersecting) reinforced concrete piles — alternating primary (unreinforced or lightly reinforced) and secondary (fully reinforced) piles that interlock to form a continuous, watertight concrete wall suitable for permanent belowgrade construction

C. Secant pile walls are temporary excavation support only and cannot serve as permanent basement walls

D. Secant pile walls use wood lagging between steel piles identical to a soldier pile and lagging system

37. A contractor is reviewing a civil engineer's design for a subsurface stormwater detention system using largediameter corrugated metal pipes buried horizontally beneath a parking lot. What is the structural design concern for pipes buried beneath a parking lot with heavy traffic?

A. The pipe must be designed to resist the combined dead load of the soil cover above and the live load from vehicles on the surface — the burial depth, pipe material, gauge thickness, and backfill type must be adequate to prevent pipe deflection or collapse under these combined loads

B. Buried pipes under parking lots have no structural design requirements because the soil carries all loads

C. Only the pipe's resistance to corrosion matters — structural capacity is not a concern for buried pipes

D. The pipe diameter is the only factor that affects structural performance of buried detention systems

38. Under OSHA's excavation safety standard, a "tabulated data" approach may be used as an alternative to the sloping, shoring, or shielding appendices for designing excavation protective systems. What are "tabulated data" in this context?

A. Tabulated data are the contractor's financial records used to estimate the cost of excavation operations

B. Tabulated data are OSHA's published fine schedules for excavation safety violations

C. Tabulated data are employee training records that document completion of excavation safety courses

D. Tabulated data are tables and charts approved by a registered professional engineer that specify the configurations of protective systems (such as the size, spacing, and depth limits of shoring members) for specific soil types and excavation conditions

39. A contractor is constructing a building on fill soil that was placed several years ago by a previous developer. The geotechnical report identifies this as "uncontrolled fill" because there are no compaction records. What risk does uncontrolled fill present for foundation construction?

A. Uncontrolled fill is always superior to engineered fill because it has had years to naturally consolidate

B. Uncontrolled fill has identical engineering properties to controlled, compacted structural fill

C. Uncontrolled fill has unknown density, composition, and compaction — it may contain debris, organic material, or voids and may settle unpredictably under structural loads, creating an unacceptable foundation bearing condition

D. Uncontrolled fill affects only the landscaping and has no impact on foundation performance

40. A contractor is installing a French drain system along the perimeter of a commercial building foundation. The specifications call for the perforated pipe to be installed with the perforations facing downward. Why are the perforations oriented downward rather than upward?

A. Downwardfacing perforations are purely aesthetic and the pipe would function identically in any orientation

B. Downwardfacing perforations allow the pipe to collect water from the gravel bed below as the water table rises, rather than collecting sediment and debris that would enter through upwardfacing holes — the water enters the pipe from below through the gravel, keeping the pipe cleaner

C. The perforations must always face upward to collect surface water flowing down through the gravel layer

D. The orientation of perforations has no effect on drainage performance and is left to installer preference

DOMAIN 3: CONCRETE (Questions 41–46)

41. A contractor is reviewing the structural drawings for a reinforced concrete parking structure and notices that the engineer has specified "headed reinforcing bars" at certain beamcolumn joints instead of standard hooked bars. What advantage do headed bars provide over standard hooks in congested reinforcement areas?

A. Headed bars develop their full design strength through a forged head (similar to a bolt head) at the end of the bar rather than requiring a 90degree or 180degree hook, reducing congestion in the joint and providing more reliable anchorage in tight spaces where hooks would interfere with each other

B. Headed bars are lighter than standard bars of the same size, reducing the total weight of reinforcement

C. Headed bars are used only in precast concrete and cannot be used in castinplace construction

D. Headed bars serve only as chair supports for upper reinforcement layers and have no anchorage function

42. A concrete contractor is placing a slab in a commercial building and the structural engineer requires "dowels" at the junction between a new slab and an existing wall. What structural function do the dowels serve?

A. Dowels serve only as temporary formwork support during the concrete pour with no permanent function

B. Dowels prevent moisture from migrating along the joint between the new slab and the existing wall

C. Dowels transfer shear and moment forces across the construction joint between the new slab and the existing wall, ensuring that the two elements act together structurally rather than separating and moving independently

D. Dowels provide acoustic isolation between the slab and the wall to reduce sound transmission

43. A contractor is placing concrete for a foundation in soil containing sulfate concentrations that the geotechnical report classifies as "severe" exposure (watersoluble sulfate content between 0.20% and 2.00% by weight). According to ACI 318, what type of cement is required for this exposure condition?

A. Type I portland cement, which is the standard generalpurpose cement for all applications

B. Type III portland cement, which provides high early strength for fasttrack construction

C. Type IV portland cement, which generates the lowest heat of hydration for mass concrete pours

D. Type V portland cement, which provides the highest sulfate resistance for severe sulfate exposure conditions

44. A concrete contractor is constructing an elevated posttensioned parking slab and the engineer specifies that the slab must have a minimum compressive strength of 3,500 psi before the tendons may be stressed. The concrete was placed three days ago and the cylinder breaks show 3,200 psi. What should the contractor do?

A. Stress the tendons immediately because 3,200 psi is close enough to the 3,500 psi requirement

B. Wait for the concrete to gain additional strength before stressing — premature stressing below the specified minimum strength can crush the concrete at the anchorage zones and cause splitting cracks that compromise the structural integrity of the slab

C. Add more cement to the surface of the slab to increase the concrete strength before stressing

D. The stressing strength requirement is only a suggestion and may be disregarded at the contractor's discretion

45. A contractor is reviewing concrete specifications and sees a requirement for "maturity method" strength verification per ASTM C1074. How does the maturity method differ from standard cylinder testing for verifying concrete strength?

A. The maturity method estimates inplace concrete strength by monitoring the temperature history of the actual concrete element and correlating it to a preestablished strengthmaturity relationship, providing realtime strength data without waiting for standard 28day cylinder breaks

B. The maturity method requires breaking twice as many cylinders as the standard test method

C. The maturity method is identical to standard cylinder testing with no procedural differences

D. The maturity method uses chemical analysis of concrete samples rather than compression testing

46. A concrete contractor is placing a large elevated structural slab and the specifications require "bonding agent" (epoxy bonding compound) to be applied to the surface of hardened concrete before placing new concrete against it at a construction joint. When must the bonding agent be applied relative to the new concrete placement?

A. The bonding agent must be applied 24 hours before the new concrete to allow full epoxy curing

B. The bonding agent should be applied months in advance to ensure maximum penetration into the substrate

C. The bonding agent must be applied to the prepared joint surface and must still be tacky (not fully cured) when the new concrete is placed against it — if the epoxy cures before the concrete is placed, the bonding agent becomes a bond breaker instead of a bonding agent

D. The bonding agent is applied after the new concrete is placed by injecting it into the joint from the exterior

DOMAIN 4: MASONRY (Questions 47–50)

47. A masonry contractor is constructing a reinforced CMU retaining wall and the structural drawings show "counterforts" on the back side of the wall. What is the structural function of counterforts on a retaining wall?

A. Counterforts are decorative pilasters on the exposed face of the retaining wall for aesthetic appearance

B. Counterforts are vertical reinforced concrete or masonry elements on the soil side of the wall that tie the wall face to the footing, acting as vertical stiffeners that increase the wall's ability to resist lateral earth pressure and allow a thinner wall section than a plain cantilever wall

C. Counterforts are horizontal drainage channels built into the base of the retaining wall for water management

D. Counterforts are sacrificial blocks on the wall face designed to crumble during earthquakes for energy dissipation

48. A masonry specification requires that all exterior CMU walls receive an application of "integral water repellent" (IWR) admixture in both the CMU blocks and the mortar. How does an IWR differ from a surfaceapplied water repellent sealer?

A. IWR and surfaceapplied sealers are identical products applied using the same technique at the same time

B. A surfaceapplied sealer provides permanent protection that never needs reapplication over the building's life

C. IWR only affects the mortar joints and has no effect on the CMU block faces themselves

D. IWR is mixed into the block material during manufacturing and into the mortar during mixing, providing water repellency throughout the full thickness of the wall — unlike a surface sealer that forms a film on the exterior face only and must be reapplied periodically

49. A masonry contractor is building a loadbearing reinforced masonry wall and the structural engineer specifies "inspection level B" per TMS 402/602 (the masonry code). What does inspection level B require?

A. Inspection level B requires continuous fulltime inspection by a qualified special inspector during all grouting and placement of reinforcement in masonry construction — this is the more stringent inspection level that allows the engineer to use higher design values

B. Inspection level B requires only a visual inspection of the completed wall with no inprogress monitoring

C. Inspection level B requires inspection only of the mortar materials delivered to the site

D. Inspection level B has no inspection requirements and relies solely on the mason's selfcertification

50. A masonry contractor is constructing a multistory reinforced CMU wall and the engineer specifies "lap splices" for the vertical reinforcement at each floor level. What is the minimum required lap splice length for vertical reinforcement in a grouted masonry wall?

A. 6 inches minimum lap regardless of bar size or wall configuration for all masonry applications

B. The lap splice length varies from 12 inches to 72 inches depending on the bar size and the conditions

C. The minimum lap splice length is calculated based on the bar diameter, the specified masonry compressive strength (f'm), and the reinforcing steel grade, and is typically expressed as a multiple of the bar diameter (e.g., 48db or 60db) — it must be sufficient to transfer the full tensile force from one bar to the next through the surrounding grout

D. No lap splices are required because vertical reinforcement must always be continuous from footing to top

DOMAIN 5: METALS (Questions 51–56)

51. A contractor is reviewing structural drawings for a commercial building and sees that the engineer has specified "moment connections" at the tops of certain columns where they connect to the roof beams, but "pinned connections" at the column bases. What is the structural effect of using a pinned base versus a fixed base for a steel column?

A. Pinned and fixed column bases are identical and produce the same structural behavior in all frames

B. A pinned base cannot transfer any forces to the foundation and the column will collapse immediately

C. A fixed base increases the column's axial load capacity but has no effect on lateral force resistance

D. A pinned base allows the column to rotate freely at its base, transferring only vertical and horizontal forces to the foundation — it does not transfer bending moment to the foundation, which simplifies the foundation design but requires the frame above to provide all lateral resistance through the moment connections

52. A structural steel fabricator discovers that several wide flange beams show excessive mill camber (natural curvature from the rolling process) that exceeds the AISC tolerance. The beams are curved upward beyond the acceptable limits. What action must be taken?

A. The beams must be straightened by controlled heat application (heat straightening) or mechanical means to bring them within AISC tolerance before erection — beams with excessive camber that cannot be corrected must be rejected

B. Beams with excessive camber are always acceptable because upward curvature improves load performance

C. The beams should be installed upside down so the excessive camber becomes a downward deflection

D. Excessive mill camber has no engineering significance and all beams may be installed without correction

53. A contractor is installing structural steel in a seismic zone and the engineer specifies that certain welded connections must be made by welders certified under AWS D1.8 (Structural

Welding Code — Seismic Supplement) rather than the standard AWS D1.1. What additional requirements does D1.8 impose?

A. D1.8 applies only to nonstructural architectural steel and has no seismic requirements

B. D1.8 has identical requirements to D1.1 with no additional provisions for seismic connections

C. D1.8 imposes stricter requirements for welder qualification, filler metal selection, welding procedures, and quality assurance for demandcritical welds in seismic forceresisting systems — these welds must maintain their integrity during the severe cyclic loading of earthquake events

D. D1.8 requires only visual inspection of seismic welds with no additional testing or qualification

54. A contractor is erecting a steelframed commercial building and the erection plan shows that certain connections will be made using "fingertight" bolts initially, with final tightening to occur after the frame is plumbed and aligned. Under AISC's Code of Standard Practice, what is the purpose of the initial fingertight installation?

A. Fingertight installation is the final tightened condition for all bearingtype connections in nonseismic frames

B. Fingertight installation allows the ironworkers to adjust the frame alignment (plumb and level) before the bolts are fully tightened — once the frame is properly aligned, all bolts are tightened to their final specified tension

C. Fingertight installation eliminates the need for any further bolt tightening on the entire project

D. Fingertight bolts are permanent connections that never require additional tightening after erection

55. A contractor is reviewing specifications for a commercial building that includes exposed steel tube columns (HSS) with welded connections. The engineer specifies that all HSS columntobase plate welds must be complete joint penetration (CJP) groove welds. Why are CJP welds specified for this connection instead of fillet welds?

A. CJP welds are less expensive and faster to install than fillet welds on HSS members in all conditions

B. Fillet welds provide higher capacity than CJP welds on all HSS tube connections without exception

C. CJP and fillet welds are identical in capacity and the specification is purely a matter of aesthetic preference

D. CJP groove welds develop the full strength of the HSS tube wall at the base connection, providing maximum load transfer capacity and ductility — this is critical for columns where the base connection must resist combined axial, bending, and shear forces

56. A contractor is installing coldformed steel (CFS) framing for a commercial building's exterior curtain walls. The CFS studs are spaced at 16 inches on center and are not loadbearing. The building inspector asks about the stud depth selection. In CFS curtain wall framing, what factor primarily governs the selection of stud depth?

A. The stud depth is selected based on the wind load deflection criteria — the studs must resist the design wind pressure without exceeding the allowable deflection limit (typically L/240 or L/360 of the span) while spanning between floortofloor supports

B. The stud depth is always 3⅝ inches regardless of the span, wind load, or building height

C. The stud depth is selected solely for aesthetic reasons to match the wall cavity insulation thickness

D. The stud depth is determined by the weight of the exterior cladding only with no wind load consideration

DOMAIN 6: WOOD (Questions 57–61)

57. A contractor is reviewing a specification that requires "preservativetreated" glulam beams for an outdoor covered pavilion at a commercial recreation center. The specification references AWPA (American Wood Protection Association) Use Category UC4A. What does UC4A indicate about the intended end use?

A. UC4A indicates interior use only with no exposure to moisture or weather of any kind

B. UC4A indicates exterior abovegrade use where the wood is exposed to weather but not in ground contact

C. UC4A indicates groundcontact use or freshwater immersion where the preservative retention must be sufficient to resist decay and insect attack in direct contact with soil or water

D. UC4A indicates fireretardant treatment rather than preservative treatment for interior firerated applications

58. A contractor is framing a commercial building and the structural engineer specifies that all floor sheathing must be glued and nailed to the floor joists using construction adhesive conforming to AFG01. What benefit does the gluedandnailed floor system provide over nailing alone?

A. Gluedandnailed floors produce only an aesthetic improvement with no structural or performance benefit

B. The adhesive bond between the sheathing and the joists creates a composite Tbeam action that increases the floor system's stiffness and strength, reduces squeaks by eliminating movement between the sheathing and the joist, and improves the floor's ability to act as a structural diaphragm

C. The adhesive replaces the nails entirely, and nailing is unnecessary when adhesive is used

D. Gluedandnailed floors are weaker than nailedonly floors because the adhesive reduces the nail capacity

59. A contractor is installing crosslaminated timber (CLT) floor panels in a mass timber commercial building. The CLT panels are delivered to the site in large sections. What critical consideration applies to the protection of CLT panels during storage on the construction site?

A. CLT panels require no protection during storage and may be left exposed to rain indefinitely

B. CLT panels must be stored in a refrigerated container to prevent thermal expansion damage

C. CLT panels must be stored on a concrete slab and cannot be placed on any other surface

D. CLT panels must be protected from prolonged moisture exposure during storage — they should be stored off the ground on blocking, covered with protective wrapping, and ventilated to prevent moisture buildup that could cause swelling, delamination, mold growth, and dimensional changes

60. A contractor is constructing a woodframed building and the structural drawings show "letin bracing" on certain exterior walls. What is letin bracing, and what has largely replaced it in modern wood construction?

A. Letin bracing is a diagonal board notched (letin) into the face of the wall studs to provide racking resistance — it has been largely replaced by structural wood panel sheathing (plywood or OSB), which provides superior racking resistance in a single application

B. Letin bracing is a metal strap applied to the surface of the wall studs after the sheathing is installed

C. Letin bracing is a horizontal blocking member installed between studs at midheight for fire blocking

D. Letin bracing is a type of foundation anchor bolt that is recessed into the concrete sill plate

61. A contractor is reviewing a specification for a commercial timberframe building that uses traditional timberframe joinery (mortise and tenon connections) for the exposed heavy timber frame. Under the IBC, what construction type accommodates this type of heavy timber construction?

A. Type VB construction, which allows any material including lightframe wood with no rating requirements

B. Type IIB construction, which requires noncombustible materials for all structural elements

C. Type IV (Heavy Timber) construction, which requires structural wood members to meet minimum crosssectional dimensions and specifies limits on concealed spaces — the heavy timber members provide inherent fire resistance through their mass

D. Type IA construction, which requires the highest fireresistance ratings and only noncombustible materials

DOMAIN 7: THERMAL AND MOISTURE PROTECTION (Questions 62–66)

62. A contractor is installing a commercial roof system and the specifications call for a "coverboard" between the rigid insulation and the roof membrane. The specifications allow the contractor to choose between highdensity polyisocyanurate coverboard and gypsum fiber coverboard. What factor should the contractor consider when selecting between these two materials?

A. Both materials are identical in every performance characteristic and the selection makes no difference

B. The selection should be based only on the color of the coverboard for aesthetic coordination with the membrane

C. Highdensity polyiso coverboard is always less expensive and should be selected for cost savings alone

D. The selection should consider fire performance (gypsum fiber provides higher fire resistance), moisture resistance (gypsum fiber performs better when exposed to moisture before the membrane is installed), compressive strength, and compatibility with the membrane adhesive system

63. A building envelope consultant identifies "thermal bypass" as a major contributor to energy loss in a commercial building wall assembly. What is a thermal bypass?

A. A thermal bypass is a gap in the building's fire alarm coverage where smoke detectors are missing

B. A thermal bypass is an air leakage pathway that allows conditioned air to flow around (bypass) the insulation layer without passing through it, effectively rendering the insulation useless in the area of the bypass — common examples include air flowing through unsealed wall cavities, around electrical boxes, and through gaps between insulation and framing

C. A thermal bypass is an oversized HVAC duct that delivers excessive conditioned air to a specific zone

D. A thermal bypass is a design feature that intentionally vents conditioned air to the exterior for ventilation

64. A contractor is installing sprayapplied fireresistive material (SFRM) on the structural steel frame of a commercial building. The SFRM specification states a minimum dry film thickness (DFT) of 1½ inches. The contractor's quality control inspector measures the DFT and finds several areas at 1 inch. What must be done?

A. The areas measuring only 1 inch must be corrected by applying additional SFRM to achieve the specified minimum thickness of 1½ inches — insufficient thickness reduces the fireresistance rating and creates a code violation

B. The 1inch thickness is within acceptable tolerance and no additional application is required

C. The SFRM must be completely removed from the entire building and the steel reprimed before reapplication

D. The 1inch measurement is acceptable if the building has a fully operational sprinkler system installed

65. A contractor is installing a belowgrade waterproofing system and the specification calls for a "protection board" over the waterproofing membrane before backfilling. What is the purpose of the protection board?

A. The protection board provides thermal insulation to the waterproofing membrane for energy efficiency

B. The protection board is a decorative finish applied for aesthetic purposes above grade only

C. The protection board protects the waterproofing membrane from physical damage during the backfilling operation — without it, rocks, construction debris, and compaction equipment in the backfill can puncture or tear the membrane

D. The protection board prevents roots from growing through the waterproofing membrane into the building

66. A building envelope consultant recommends a "pressureequalized rainscreen" (PER) cladding system for a commercial building in a winddriven rain exposure zone. How does pressure equalization work in a PER system?

A. Pressure equalization uses mechanical pumps to create positive pressure in the drainage cavity

B. Pressure equalization has no relationship to water management and only improves wind resistance

C. Pressure equalization is achieved by sealing the cladding completely with no openings or ventilation

D. The drainage cavity behind the cladding is compartmentalized and vented to the exterior so that the air pressure in the cavity equals the exterior wind pressure — when the pressure differential across the cladding is eliminated, winddriven rain has no force to push water through the cladding joints

DOMAIN 8: DOORS, WINDOWS, AND GLAZING (Questions 67–70)

67. A contractor is installing commercial aluminumframed windows and the specifications require compliance with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS). What performance characteristics does this standard evaluate for commercial windows?

A. NAFS evaluates only the window's visual appearance and color consistency for architectural coordination

B. NAFS evaluates structural performance (wind load resistance), water penetration resistance, air leakage rate, forced entry resistance, and operating force — classifying windows by performance grade based on their design pressure rating

C. NAFS evaluates only the window's thermal performance (Ufactor and SHGC) for energy code compliance

D. NAFS evaluates only the window frame's recycled content for environmental sustainability certification

68. A contractor is installing firerated window assemblies in a 1hour fireresistancerated corridor wall of a hospital (Group I2 occupancy). The windows must be fireprotectionrated. Under the IBC, what is the maximum area permitted for fireprotectionrated glazing in a fire barrier that is not an exit enclosure?

A. The maximum area of fireprotectionrated glazing in a 1hour fire barrier is limited to 25% of the wall area and no individual panel may exceed 1,296 square inches (equivalent to a 36inch × 36inch panel) unless the glazing is fireresistive rated for the full wall rating

B. There is no limit on the area of fireprotectionrated glazing in fire barrier walls under any condition

C. Fireprotectionrated glazing is limited to 100 square inches per panel in all firerated walls without exception

D. Fireprotectionrated glazing is prohibited in all hospital corridor walls regardless of size or rating

69. A contractor is installing a blastresistant window system on a government building. What performance characteristic distinguishes blastresistant glazing from standard commercial glazing?

A. Blastresistant glazing is thinner than standard glass to allow it to flex and absorb blast pressure

B. Blastresistant glazing has a higher Rvalue than standard glazing for improved thermal performance

C. Blastresistant glazing (typically laminated glass with specific interlayer materials and bite depth) is designed to resist the positive and negative pressure phases of a blast wave, remain in the frame, and minimize hazardous glass fragments that would injure building occupants

D. Blastresistant glazing is identical to standard tempered glass with no additional performance requirements

70. Under the IBC, what is the maximum door opening force permitted for exterior swinging doors along an accessible route?

A. 5 pounds maximum opening force for exterior swinging doors along accessible routes

B. 15 pounds maximum opening force for exterior swinging doors along accessible routes

C. 8.5 pounds maximum opening force for exterior swinging doors along accessible routes

D. There is no maximum opening force specified for exterior swinging doors — the 5pound limit applies only to interior doors, and exterior doors are exempt because wind, weather seals, and door closers create variable resistance

DOMAIN 9: FINISHES (Questions 71–75)

71. A contractor is installing a seamless resinous floor coating (epoxy) in a commercial kitchen. The specification requires a minimum dry film thickness (DFT) of 60 mils for the complete floor system. What measurement tool does the contractor use to verify the wet film thickness during application to ensure the correct DFT will be achieved after curing?

A. A laser level positioned at the floor surface to measure the coating thickness by reflection angle

B. A standard tape measure held vertically at the edge of the floor coating to measure the film thickness

C. A wet film thickness gauge (comb gauge or notch gauge) pulled through the wet coating to measure the thickness immediately after application, allowing the applicator to adjust the application rate before the coating cures

D. A nuclear density gauge calibrated for liquid film measurement positioned on the floor surface

72. A contractor is installing gypsum board on a commercial building's steel stud walls and the specification requires "resilient channels" between the steel studs and the gypsum board on one side of the wall. What is the purpose of resilient channels in this wall assembly?

A. Resilient channels decouple the gypsum board from the steel studs, creating a gap that reduces sound transmission through the wall by breaking the direct path for vibration transfer — this significantly improves the wall's Sound Transmission Class (STC) rating

B. Resilient channels increase the fireresistance rating of the wall by adding an additional layer of metal

C. Resilient channels are decorative trim elements that provide a shadow line at the base of the wall

D. Resilient channels prevent moisture from reaching the gypsum board by creating a ventilated air gap

73. A contractor is specifying ceiling tile for a commercial swimming pool facility. The ceiling tiles must resist high humidity and condensation without sagging, warping, or growing mold. What type of ceiling tile is most appropriate for this application?

A. Standard mineral fiber ceiling tile with a painted surface for aesthetic appearance in the pool area

B. Paperfaced gypsum ceiling tile with no special moisture treatment for the swimming pool environment

C. Standard fiberglass ceiling tile with a foil backing designed for dry interior commercial office applications

D. Fiberglass ceiling tiles with a washable vinyl or mylar facing and nonhygroscopic (nonmoistureabsorbing) core material specifically designed for highhumidity environments

74. A contractor is installing a commercial terrazzo floor and the specification calls for dividing strips (zinc or brass) at all construction joints, column lines, and changes in terrazzo color. What function do the dividing strips serve beyond separating different colors?

A. Dividing strips serve only as decorative elements with no structural or crackcontrol function

B. Dividing strips control cracking by providing stress relief at locations where the terrazzo matrix is most likely to crack — construction joints, column lines, and changes in substrate condition create stress concentrations, and the dividing strips accommodate movement at these locations

C. Dividing strips provide electrical grounding for the terrazzo floor's antistatic dissipation properties

D. Dividing strips serve as expansion joints that allow the terrazzo to expand upward during hot weather

75. A contractor is installing luxury vinyl tile (LVT) flooring in a commercial office building and the specification requires that the flooring be installed using the "floating floor" method rather than gluedown adhesive. What distinguishes the floating floor installation from the gluedown method?

A. Floating floor installation glues each tile directly to the concrete substrate with fullspread adhesive

B. Floating floor and gluedown are identical installation methods with no difference in technique or performance

C. Floating floor tiles are attached to each other (through clicklock edges or adhesive between tiles) and rest freely on the substrate without being bonded to it — the assembly "floats" over the substrate, allowing for thermal expansion and simplifying installation and future removal

D. Floating floor installation requires the tiles to be nailed to a plywood subfloor with finish nails at each corner

DOMAIN 10: MECHANICAL AND PLUMBING SYSTEMS (Questions 76–81)

76. A contractor is constructing a commercial building and the mechanical engineer specifies a "makeup air unit" (MAU) for the kitchen. What is the purpose of the makeup air unit?

A. The MAU supplies conditioned outdoor air to the kitchen to replace the air exhausted by the kitchen exhaust hood system — without makeup air, the negative pressure created by the exhaust fan would draw unconditioned air through doors, windows, and other openings, causing drafts, comfort problems, and difficulty opening doors

B. The MAU is a backup exhaust fan that operates when the primary kitchen exhaust hood fan fails

C. The MAU is a grease filtration system installed within the kitchen exhaust ductwork for fire prevention

D. The MAU is a water heater that provides hot water to the kitchen's threecompartment sink for dishwashing

77. Under the International Plumbing Code, a commercial building's sanitary drainage system must be designed to maintain adequate flow velocity through all horizontal drain pipes. If a drain pipe is oversized (larger diameter than necessary for the fixture load), what problem can this create?

A. An oversized drain pipe increases the flow velocity, which erodes the pipe material over time

B. An oversized drain pipe increases the water consumption of the connected fixtures proportionally

C. Oversized drain pipes have no adverse effects and always improve drainage system performance

D. An oversized drain pipe reduces the flow velocity below the selfcleaning speed, allowing solids to settle and accumulate in the pipe, eventually causing blockages — proper pipe sizing maintains the minimum 2 fps velocity needed for selfcleaning

78. A contractor is installing a commercial fire sprinkler system and the design includes "upright," "pendent," and "sidewall" sprinkler head orientations. The contractor accidentally installs a pendent head in an upright position. Under NFPA 13, is this installation acceptable?

A. Sprinkler heads may be installed in any orientation regardless of their labeled position type

B. No, sprinkler heads must be installed in the specific orientation for which they are designed and listed — a pendent head installed upright will not distribute water properly, potentially creating coverage gaps that could allow fire to spread beyond the sprinkler's effective range

C. Pendent and upright heads are identical and may be freely interchanged in all applications

D. Head orientation matters only for aesthetic purposes and has no effect on fire suppression performance

79. Under the International Plumbing Code, a cleanout must be provided at specific intervals in a commercial building's sanitary drainage system. What is the purpose of cleanouts, and at what maximum interval must they be installed in horizontal drain piping?

A. Cleanouts serve only as test points for pressure testing the drain system during installation

B. Cleanouts provide no functional purpose and are installed only for future plumbing expansion

C. Cleanouts provide access points for drain cleaning equipment to clear blockages — they must be installed at the upper end of each horizontal drain run, at each change in direction exceeding 45 degrees, and at intervals not exceeding 100 feet for pipes 4 inches and smaller (or 150 feet for larger pipes)

D. Cleanouts are required only at the building's main sewer connection with no interior requirements

80. A contractor is installing a commercial HVAC system with a variable frequency drive (VFD) controlling the supply fan motor. What energy benefit does a VFD provide compared to a constantspeed fan motor?

A. A VFD varies the motor speed to match the actual airflow demand, consuming significantly less energy at reduced speeds than a constantspeed motor — fan energy consumption varies with the cube of the speed, so reducing speed by 20% reduces energy consumption by approximately 50%

B. A VFD increases the motor speed beyond its rated capacity for higher airflow during peak demand

C. A VFD has no energy benefit and is used only to reduce motor noise at lowspeed operation

D. A VFD converts the motor from electric power to natural gas for lower energy costs during heating

81. A fire protection engineer specifies that the commercial building's sprinkler system must include "quickresponse early suppression" (ESFR) heads in the highbay warehouse portion of the building. How do ESFR heads differ from standard quickresponse heads?

A. ESFR heads are smaller than standard heads and provide less water coverage per head

B. ESFR heads are identical to standard quickresponse heads with no difference in performance

C. ESFR heads produce only a fine mist and are designed for lighthazard occupancies such as offices

D. ESFR heads are designed to suppress a fire in highpiled storage rather than merely controlling it — they discharge a very high volume of large water droplets at high pressure that can penetrate the rising fire plume and directly suppress the fire at its base, potentially eliminating the need for inrack sprinklers

DOMAIN 11: ELECTRICAL SYSTEMS (Questions 82–84)

82. A contractor is installing a commercial electrical system and the engineer specifies a "metering switchboard" at the service entrance. The switchboard includes both the main disconnect and revenuegrade utility metering. Under the NEC, what is the primary function of the metering equipment at the service entrance?

A. The metering equipment monitors the building's fire alarm system for communication with the fire department

B. The metering equipment measures the electrical energy consumed by the building for utility billing purposes and may also monitor power quality parameters such as demand, power factor, and harmonic distortion

C. The metering equipment controls the building's HVAC system by monitoring electrical consumption patterns

D. The metering equipment serves only as a backup disconnect and has no measurement function

83. Under the NEC, a commercial building's electrical system must include an equipment grounding conductor in every branch circuit. What is the primary function of the equipment grounding conductor in a branch circuit?

A. The grounding conductor carries normal operating current during regular building operations

B. The grounding conductor provides a return path for Internet and telecommunications signals

C. The equipment grounding conductor provides a lowimpedance fault current path from the equipment enclosure back to the source, ensuring that overcurrent protective devices (breakers/fuses) can detect and clear ground faults quickly — preventing equipment enclosures from remaining energized

D. The grounding conductor regulates the voltage level at each receptacle to maintain a constant 120V

84. A contractor is installing a standby generator for a commercial building. The NEC requires a transfer switch between the generator and the normal utility power. What is the primary function of the transfer switch?

A. The transfer switch automatically switches the building's electrical load from the normal utility source to the standby generator when the utility power fails, and switches back when utility power is restored — it also prevents the generator from feeding power back into the utility grid, which could endanger utility workers

B. The transfer switch serves only as a manual disconnect for the generator during maintenance operations

C. The transfer switch converts the generator's DC output to AC power compatible with the building's system

D. The transfer switch regulates the generator's fuel consumption to maximize fuel efficiency during outages

DOMAIN 12: PROCUREMENT AND CONTRACTING REQUIREMENTS (Questions 85–115)

85. A contractor is preparing a detailed cost estimate for a commercial building project. The estimate includes direct costs, general conditions, overhead, and profit. What is the difference between "project overhead" (general conditions) and "home office overhead" in a construction cost estimate?

A. Project overhead and home office overhead are identical cost categories with no distinction between them

B. Home office overhead is always greater than project overhead on every commercial construction project

C. Project overhead applies only to subcontractors while home office overhead applies only to the general contractor

D. Project overhead (general conditions) includes timedependent costs specific to the project site (superintendent, temporary facilities, safety), while home office overhead includes the

contractor's corporate expenses that are shared across all projects (rent, accounting, executive salaries, insurance)

86. Under AIA A201, the contractor must correct defective work discovered during the oneyear warranty period. If the contractor fails to correct defective work after receiving written notice, what remedy does the owner have?

A. The owner has no remedy and must accept the defective work asis for the remaining building life

B. The owner may correct the defective work using the owner's own forces or a separate contractor and deduct the cost from any amounts due to the contractor, or may pursue the contractor legally for the cost of correction

C. The owner must negotiate a reduced purchase price for the defective building and accept the condition

D. The owner's only option is to demolish the entire building and start over from the foundation level

87. A contractor is evaluating a project where the specifications require "substitution requests" to be submitted within a specified window after contract award. Why do specifications limit the substitution request period?

A. Limiting the substitution window ensures that all product decisions are made early enough to avoid procurement delays, allows the architect adequate time to evaluate alternatives, prevents lastminute substitutions that could affect coordination with other trades, and maintains project schedule integrity

B. The substitution window limitation has no practical purpose and is an arbitrary administrative requirement

C. The limitation exists only to prevent the contractor from obtaining lowerpriced materials for cost savings

D. Substitution deadlines apply only to government projects and not to private commercial construction

88. Under standard construction contract provisions, what is the contractor's obligation regarding "means and methods" when a construction accident occurs on the project site?

A. The contractor has no responsibility for construction accidents because all risk is assumed by the owner

B. The architect is solely responsible for all construction accidents due to the architect's design obligations

C. The contractor bears primary responsibility for jobsite safety including means and methods — if an accident results from the contractor's construction procedures, the contractor is liable for the consequences and the contractor's CGL and workers' compensation insurance policies respond to the resulting claims

D. OSHA bears sole liability for all construction accidents on every commercial construction project

89. A contractor is reviewing a project where the owner has engaged a "program manager" to oversee a portfolio of construction projects. How does a program manager's role differ from a construction manager's role?

A. A program manager and a construction manager perform identical functions on every project without exception

B. A program manager oversees only the project's financial aspects while a construction manager handles all other duties

C. A program manager is always a licensed architect while a construction manager is always a licensed contractor

D. A program manager oversees multiple related projects within a larger building program (coordinating budgets, schedules, and standards across the portfolio), while a construction manager focuses on the execution of a single construction project

90. Under AIA A201, the contractor must obtain and pay for all permits required for the construction. However, the owner is typically responsible for certain permits. Which permits are typically the owner's responsibility?

A. The contractor is responsible for all permits without exception including zoning, environmental, and utility permits

B. The owner is typically responsible for permanent landuse and zoning approvals, environmental permits tied to the property (wetlands, NPDES), and utility connection agreements that are propertyspecific and extend beyond the construction contract

C. The owner has no responsibility for any permits and the contractor obtains all permits for every project

D. The architect is responsible for obtaining all permits for both the owner and the contractor on every project

91. A contractor is working on a project where the owner requests a "value analysis" of the structural system before final design. What is the difference between value engineering (VE) and value analysis (VA)?

A. Value analysis is typically performed during the design phase to evaluate alternative design approaches and materials before the design is finalized, while value engineering is performed during construction to find cost savings within the existing design — both seek to optimize value by reducing cost without sacrificing function

B. Value analysis and value engineering are identical processes with no distinction in timing or application

C. Value analysis applies only to mechanical systems while value engineering applies only to structural systems

D. Value analysis increases project cost while value engineering decreases it — they have opposite objectives

92. Under standard construction contract provisions, what is the significance of the "date of substantial completion" for purposes of calculating liquidated damages?

A. Liquidated damages begin accruing on the first day of construction and continue until the contract is signed

B. Liquidated damages are calculated based on the number of change orders issued, not the completion date

C. The date of substantial completion has no relationship to liquidated damages under any contract provision

D. Liquidated damages for delay accrue from the contractual completion date until the date of substantial completion — if the contractor achieves substantial completion after the contractual date, the contractor owes liquidated damages for each day between the two dates

93. A contractor is reviewing a subcontract agreement and notices a clause requiring the subcontractor to "indemnify, defend, and hold harmless" the general contractor. What are the three distinct obligations in this clause?

A. Indemnify means the subcontractor compensates the GC for losses, defend means the subcontractor provides legal representation and pays defense costs, and hold harmless means the subcontractor assumes the GC's liability so the GC is not held responsible — these three obligations together provide comprehensive protection to the GC against claims arising from the subcontractor's work

B. All three terms are synonymous and mean the subcontractor must pay the GC's insurance premiums

C. Indemnify applies to past events, defend applies to future events, and hold harmless applies to current events

D. These three terms are ceremonial legal language with no practical meaning or enforceable obligation

94. A contractor is preparing a claim for "extended home office overhead" on a delayed commercial project. The contractor uses the Eichleay formula. What three pieces of financial data are required to calculate the Eichleay formula?

A. The contractor's total home office rent, the number of employees, and the CEO's annual salary

B. The project's total material cost, the subcontractor payments, and the equipment rental charges

C. The contractor's total billings for the contract period, the total company billings for the same period, and the total home office overhead for the same period — these three data points establish the project's proportional share of the company's overhead

D. The project's total change order value, the original contract price, and the cost of the surety bond

95. A contractor is working on a project where the specifications include a "commissioning prerequisite" for LEED certification. The prerequisite requires fundamental commissioning per ASHRAE Guideline 0. What is the minimum scope of fundamental commissioning under LEED?

A. Fundamental commissioning requires only a visual walkthrough of the mechanical room with no testing

B. Fundamental commissioning requires testing of only the fire alarm system with no HVAC involvement

C. Fundamental commissioning requires only the submission of equipment shop drawings with no field testing

D. Fundamental commissioning requires development of a commissioning plan, verification of equipment installation, functional performance testing of HVAC and lighting control systems, and completion of a commissioning report documenting all findings and resolutions

96. Under standard construction contract provisions, the contractor is required to prepare a construction schedule using the critical path method (CPM). The schedule shows that a particular activity has 15 days of "total float." What does total float represent?

A. Total float is the number of additional workers needed to complete the activity within the original duration

B. Total float is the amount of time an activity can be delayed from its earliest start date without delaying the project's overall completion date — 15 days of float means the activity can slip by up to 15 days without affecting the critical path

C. Total float is the amount of overtime required to accelerate the activity to zero duration

D. Total float applies only to procurement activities and has no meaning for construction work activities

97. A contractor discovers that a major equipment manufacturer has gone out of business during construction, and the specified rooftop HVAC unit is no longer available. The contractor identifies an equivalent unit from a different manufacturer. Under standard contract provisions, what process must the contractor follow?

A. The contractor must submit a formal substitution request to the architect with complete technical documentation demonstrating that the proposed alternative meets or exceeds the performance requirements of the originally specified equipment, and the architect must approve the substitution before procurement

B. The contractor may install any available equipment without notification because the original is unavailable

C. The owner must redesign the entire HVAC system to accommodate a completely different system type

D. The project must be terminated because the specified equipment is no longer available from any source

98. Under AIA A201, what is the contractor's obligation regarding the coordination of the construction documents before construction begins?

A. The contractor has no obligation to review the construction documents for coordination before construction

B. The architect bears sole responsibility for document coordination and the contractor may not identify errors

C. The contractor must only review the drawings and has no obligation to review the specifications at all

D. The contractor must carefully study and compare the construction documents (both drawings and specifications), report any errors, inconsistencies, or omissions to the architect and owner promptly, and request interpretation before proceeding with affected work

99. A contractor is evaluating whether to selfperform or subcontract the concrete work on a commercial building project. What factors should the contractor consider in making this decision?

A. The contractor should always selfperform all concrete work regardless of the project's complexity or size

B. The contractor should consider the scope and complexity of the concrete work, the contractor's own workforce capability and experience, equipment availability, cost comparison between selfperformance and subcontracting, schedule implications, risk allocation, and the impact on the contractor's bonding capacity

C. The contractor must always subcontract all concrete work and may never selfperform under any condition

D. The decision should be based solely on which option produces the lowest direct cost with no other factors

100. Under standard construction contract provisions, what is the "substantial completion" percentage of work that must be achieved before the contractor can request final payment?

A. The contractor may request final payment at any time during the project regardless of completion status

B. The contractor must achieve 90% completion before requesting final payment on commercial projects

C. The contractor must achieve 100% completion of all work, including correction of all punch list items, submission of all closeout documentation, and fulfillment of all contractual obligations before requesting final payment — final payment is distinct from and occurs after substantial completion

D. The contractor must achieve only 50% completion before requesting both final payment and retainage release

101. A contractor is preparing a bid for a project that includes both fixedprice and costreimbursable components. The owner wants the building shell constructed under a lump sum contract but the tenant improvement work performed under a costplusfee arrangement because the tenant's design is not yet complete. Under standard practice, how are these two components typically structured?

A. The two components are combined into a single lump sum contract with the tenant improvement estimated

B. The contractor has no obligation to accept a hybrid contract structure and may refuse to bid the project

C. The two components must always be bid by different contractors with no single contractor performing both

D. Hybrid contract structures are not recognized in construction law and cannot be legally executed

102. Under AIA A201, the contractor is required to maintain accurate cost records on costreimbursable projects. The owner has the right to audit these records. What is the typical audit period allowed after final payment?

A. The owner has no right to audit the contractor's cost records under any contract provision

B. The audit period is typically one business day after the final payment is processed

C. The owner may audit the contractor's records only during the first week of construction

D. The owner typically has the right to audit the contractor's project cost records for a specified period after final payment (commonly 3 to 7 years, as stated in the contract) to verify that all charged costs are legitimate and properly documented

103. A contractor is working on a large commercial project and the owner's representative asks the contractor to provide a "threeweek lookahead schedule" in addition to the master CPM schedule. What purpose does the lookahead schedule serve?

A. The lookahead schedule replaces the master CPM schedule entirely for the remainder of the project

B. The threeweek lookahead schedule provides a detailed, shortterm plan of upcoming activities showing specific crew assignments, material deliveries, equipment needs, and coordination requirements for the next three weeks — it translates the master schedule's highlevel activities into actionable daily and weekly work plans

C. The lookahead schedule is used only for financial forecasting and has no construction planning value

D. The lookahead schedule is required only on government projects and is never used in private construction

104. Under standard construction contract provisions, the contractor must comply with all applicable building codes and standards. If the contractor discovers that strict compliance with the building code would conflict with the architect's design, what should the contractor do?

A. The contractor should silently build per the architect's design and ignore the code conflict entirely

B. The contractor should shut down the project immediately and refuse to perform any additional work

C. The contractor must notify the architect and owner in writing of the conflict between the code and the design, and must not proceed with the conflicting work until the architect issues a resolution that achieves code compliance

D. The contractor should report the conflict directly to the media before notifying the architect or owner

105. A contractor is reviewing a specification that requires "concrete scanning" before core drilling through an existing elevated concrete slab. What is the purpose of concrete scanning before core drilling?

A. Concrete scanning locates embedded reinforcing steel, posttensioning tendons, conduits, and other items within the slab using groundpenetrating radar (GPR) or similar technology, preventing the core drill from cutting through critical structural reinforcement or active posttensioning tendons, which could cause structural failure

B. Concrete scanning measures the compressive strength of the concrete at the proposed core location

C. Concrete scanning determines the aesthetic quality of the concrete surface for architectural evaluation

D. Concrete scanning measures the slab thickness only and provides no information about embedded items

106. A contractor is closing out a project and the owner asks for "attic stock" of certain finish materials. What is attic stock, and why is it important?

A. Attic stock refers to surplus construction materials stored in the building's attic for structural reinforcement

B. Attic stock is the contractor's surplus materials that are returned to the supplier for credit after project completion

C. Attic stock refers to materials that are discarded during construction cleanup with no future use intended

D. Attic stock is a specified quantity of extra finish materials (such as ceiling tiles, floor tiles, carpet, and paint) delivered to the owner for future maintenance and repairs — it ensures the owner has matching materials from the same production lot to address future damage or wear

107. Under standard construction contract provisions, the contractor must provide training to the owner's maintenance staff on the operation and maintenance of installed building systems. When must this training occur?

A. Training must occur during the design phase before any equipment is selected for the project

B. Training must occur before substantial completion while the contractor's knowledgeable personnel and system installers are still mobilized on the project, ensuring the owner's staff can operate all systems when they assume responsibility for the building

C. Training is performed only after the warranty period expires as a paid service contract

D. Training is optional and the contractor has no obligation to train the owner's staff under any contract

108. A contractor is reviewing a contract that includes "consequential damages" provisions. Under AIA A201, the standard form includes a mutual waiver of consequential damages between the owner and the contractor. What types of damages does this waiver typically cover?

A. The waiver covers only direct costs of correcting defective work and has no broader application

B. The waiver has no effect on either party's liability and is merely advisory language

C. The mutual waiver typically covers consequential damages such as the owner's lost rental income, lost business profits, and loss of use of the building, and the contractor's lost profits on other projects, loss of bonding capacity, and loss of business reputation — the waiver limits both parties to direct damages

D. The waiver applies only to the contractor and does not limit the owner's damages in any way

109. A contractor is preparing a claim that includes both "direct costs" and "indirect costs" (consequential damages). Under standard contract provisions, what is the difference between direct and indirect costs in a construction claim?

A. Direct costs are the immediate, foreseeable costs directly caused by the event (additional labor, materials, equipment, and subcontractor costs to perform the changed or delayed work), while indirect costs are the secondary, consequential impacts (extended general conditions, lost productivity on unaffected work, home office overhead, and other ripple effects)

B. Direct costs and indirect costs are identical categories with no distinction in construction claims

C. Direct costs apply only to the contractor while indirect costs apply only to the owner in all situations

D. Direct costs are always larger than indirect costs and indirect costs are always immaterial

110. A contractor is working on a project where the specifications require "special inspections" by a qualified special inspector for certain structural elements. Under the IBC, who engages the special inspector and who pays for the special inspection services?

A. The contractor always engages and pays for the special inspector on all commercial construction projects

B. The architect serves as the special inspector and performs inspections as part of the design services fee

C. Special inspections are performed only by OSHA compliance officers as part of routine safety inspections

D. The owner or the owner's designated agent typically engages the special inspector, and the special inspection program is administered through the design professional — the owner pays for the service, though the contractor must facilitate access and cooperate with the inspector

111. A contractor is reviewing a specification that requires "integrated project delivery" (IPD) as the contract structure. What distinguishes IPD from traditional designbidbuild delivery?

A. IPD is identical to designbidbuild with the same separate contracts and adversarial relationships

B. IPD uses a multiparty agreement that joins the owner, architect, and contractor (and sometimes key subcontractors) into a single collaborative contract with shared risk and reward, early involvement of all parties, and joint decisionmaking — it fundamentally changes the contractual relationships from adversarial to collaborative

C. IPD eliminates the architect from the project team and relies solely on the contractor for all design services

D. IPD requires each party to work in complete isolation with no communication between team members

112. Under standard construction contract provisions, what is the contractor's obligation when the owner furnishes equipment for contractor installation (OFCI items) and the equipment arrives damaged?

A. The contractor must inspect OFCI items upon delivery, document any damage with photographs and written notice to the owner immediately, and must not install damaged

equipment without the owner's written authorization — the contractor is typically not responsible for damage that occurred before delivery

B. The contractor must repair all damaged OFCI equipment at the contractor's expense regardless of fault

C. The contractor has no obligation to inspect OFCI items and may install them in any condition received

D. Damaged OFCI equipment becomes the contractor's property and the contractor disposes of it freely

113. A contractor is preparing a schedule of values for a $8,000,000 commercial project. The architect rejects the submission because the "general conditions" line item is a single lump sum of $650,000 with no further breakdown. What level of detail does the architect typically require for the general conditions portion of the schedule of values?

A. A single lump sum line item is always acceptable for general conditions in every schedule of values

B. The general conditions line item must always equal exactly 10% of the total contract price

C. The architect typically requires the general conditions to be broken down into individual timebased and nontimebased line items (such as superintendent salary, temporary facilities, temporary utilities, insurance, cleanup, and similar items) so that progress can be accurately assessed for each component in monthly pay applications

D. The general conditions should not appear in the schedule of values at all and must be excluded

114. A contractor is reviewing a contract that includes a provision for "shared savings" on a GMP project. The GMP is $5,000,000, the contractor's fee is $350,000, and the actual cost of the work is $4,600,000. The contract specifies a 60/40 sharing split (60% to the owner, 40% to the contractor) for savings below the GMP. How much does the contractor receive from the shared savings?

A. The contractor receives the entire $400,000 savings because the contractor's fee already covers the owner's share

B. The savings amount is $5,000,000 minus $4,600,000 = $400,000 in savings, but the contractor's fee of $350,000 is not included in the savings calculation — the savings below the

GMP (excluding the fee) depend on the specific contract language defining what constitutes the savings pool

C. There are no savings because the actual cost plus the fee ($4,600,000 + $350,000 = $4,950,000) is less than GMP

D. The savings below the GMP is $400,000 ($5,000,000 GMP minus $4,600,000 actual cost). The contractor's 40% share of the $400,000 savings is $160,000, which the contractor receives in addition to the agreed $350,000 fee — the total contractor compensation is $510,000

115. A contractor is closing out a commercial project and the owner's facility manager asks when the contractor's obligation to maintain the building ends. Under standard contract provisions, what event marks the definitive end of the contractor's maintenance obligations?

A. The contractor's maintenance obligation ends at the notice to proceed with no ongoing obligation thereafter

B. The contractor's warranty obligation ends at the expiration of the warranty period (typically one year from substantial completion), but the contractor's legal liability may extend beyond the warranty period under the applicable statute of limitations or statute of repose — the warranty period defines the contractor's strict obligation to correct defects at no cost, while the statute of limitations governs the broader legal timeframe for claims

C. The contractor's obligations end permanently the moment the last worker leaves the construction site

D. The contractor's obligations never end and continue for the entire life of the building without any time limit

Practice Exam 9: Answer Key and Explanations

DOMAIN 1: GENERAL REQUIREMENTS (Questions 1–25)

1. A — A secondary water supply for a sprinkler system is generally required when the primary supply cannot meet the system's design demands alone, when the building is classified as a highrise, or when the authority having jurisdiction determines that the primary supply's reliability is insufficient. The secondary supply ensures uninterrupted fire suppression capability even if the primary source fails.

2. C — The total required exit width is 1,500 occupants × 0.2 inches = 300 inches. The four doors provide 4 × 72 = 288 inches, which is 12 inches short of the 300inch requirement. The

contractor must either widen the existing doors or add additional exit capacity to meet the egress width calculation.

3. B — A smoke damper (or combination fire/smoke damper) is required at duct penetrations through smoke barriers because a fire damper alone closes only when exposed to heat — it does not respond to smoke detection. The smoke barrier's purpose is to restrict smoke migration, and a smoke damper connected to the smoke detection system closes upon detecting smoke before heat levels trigger a fire damper.

4. D — A fully equipped commercial kitchen is not a required feature of a fire command center. Required features include fire alarm annunciation panels, voice/alarm communication capability, elevator recall controls, stairway pressurization controls, smoke control system controls, fire department communication systems, and building information displays.

5. A — Type III construction requires exterior walls to be constructed of noncombustible materials regardless of the fireresistance rating achieved. A woodframed exterior wall is combustible by nature and cannot satisfy the noncombustibility requirement even if it achieves a 1hour rating through gypsum board protection. Interior elements in Type III may be combustible.

6. C — IBC Section 1010.1.6 requires that landings at doors in the means of egress be at least as wide as the door or the required exit width (whichever is greater), and must extend at least the width of the door leaf beyond the strike side of the door when the door swings onto the landing. This provides adequate clearance for the door swing and pedestrian traffic.

7. D — An area of refuge is a protected space within the building where persons unable to use stairways (wheelchair users, persons with mobility impairments) can wait safely for assistance during an emergency. It must be located within or adjacent to an exit stairway, must be separated by firerated construction, and must have twoway communication with the fire command center or building management.

8. B — ASTM E119 tests floor/ceiling assemblies with fire exposure from below — the ceiling side — because a fire originating on a lower floor attacks the floor assembly from underneath. The test evaluates how long the assembly maintains structural integrity, prevents flame passage, and limits temperature rise on the unexposed (upper) surface.

9. A — Storm shelters per ICC 500 must resist wind speeds of 250 mph and resist impact from windborne debris missiles (a 15pound 2×4 lumber section traveling at 100 mph). This design standard far exceeds normal building wind design and provides nearabsolute protection for occupants during the most severe tornado events.

10. C — Highpiled combustible storage triggers enhanced sprinkler system design with higher density (more gallons per minute per square foot) and may require inrack sprinklers installed between tiers of stored material. Standard ceilinglevel sprinklers alone cannot effectively suppress a fire deep within a highpiled storage arrangement because the stored materials obstruct the water spray pattern.

11. D — Enclosed elevator lobbies prevent smoke from migrating from a fire floor through the elevator hoistway doors into the shaft. The hoistway can act as a chimney, pulling smoke

upward and distributing it to every floor the elevator serves. The lobby creates a buffer zone with selfclosing doors that limits smoke entry into the hoistway.

12. B — The IBC does not establish separate dimensional requirements for accessible stairways versus standard exit stairways — both require a maximum 7inch riser height and minimum 11inch tread depth. Accessible stairways must additionally comply with ICC A117.1 for handrail design, nosing profile, and visual contrast at tread nosings.

13. A — Fire pumps must have a reliable power source to ensure operation during emergencies. Typical configurations include a dedicated electrical connection ahead of the building's main disconnect (so the fire pump remains powered even if the main is turned off) or a diesel engine drive. Many installations require both an electric and a diesel backup to ensure redundancy.

14. C — Under ICC A117.1, any walking surface along an accessible route with a slope steeper than 1:20 (5%) is classified as a ramp and must comply with ramp requirements including maximum 1:12 slope, handrails on both sides, edge protection, and 60inch landings at the top and bottom. Surfaces at 1:20 or flatter are classified as accessible walking surfaces.

15. D — Group I4 occupancies serving children under 2½ years of age must generally be located at the level of exit discharge because these children cannot selfevacuate via stairways. Sprinkler protection and other conditions specified in the IBC may permit upperfloor locations, but the default requirement places the youngest children at the safest egress level.

16. B — Stairway pressurization is the most common smoke control method for highrise exit stairways. A dedicated fan system pressurizes the stairway to a higher pressure than the adjacent floors, creating a positive pressure differential that prevents smoke from entering through the closed stairway doors. This keeps the stairway tenable for occupant evacuation.

17. A — ASTM E814 (UL 1479) evaluates firestop systems on two criteria: the Frating (the time the system prevents flame passage through the penetration) and the Trating (the time until the temperature on the unexposed side exceeds specified limits). Both ratings must equal or exceed the required fireresistance rating of the penetrated assembly.

18. C — The sprinkler system's waterflow switches must be connected to the fire alarm system so that sprinkler activation triggers the building alarm and occupant notification. Tamper switches on sprinkler control valves must also be monitored by the fire alarm system, generating a supervisory signal if a valve is moved from its normal open position.

19. D — Circuit survivability ensures that critical fire alarm wiring continues to function during a fire for a specified period. This is achieved through firerated cable (2hour rated mineral insulated cable), conduit protection (circuits enclosed in firerated conduit), or routing circuits through areas protected by sprinklers. Survivability is required for voice communication and certain notification circuits.

20. B — IBC Section 1014.6 requires handrails to extend horizontally at least one tread depth (minimum 11 inches) beyond the bottom riser. The extension must return to the wall or post, or continue to the handrail of an adjacent stair flight. This provides a stable handhold for occupants transitioning from the stair to the landing surface.

21. A — The standard IBC guardrail height of 42 inches applies to all commercial building applications including exterior balconies serving as dining areas. The guardrail must also resist a 200pound concentrated load and prevent a 4inch sphere from passing through any opening in the guardrail assembly.

22. D — IBC Table 601 requires 0 hours (no fireresistance rating) for the structural frame in Type IIIB construction. Type IIIB requires noncombustible exterior walls but imposes no fireresistance rating on any building element. The interior structural elements may be combustible with no rating requirement.

23. C — Firerated door assemblies are listed with specific components — frame, door leaf, hardware, glazing, and selfclosing device. Omitting the door closer means the door will not return to the closed position after being opened, leaving the opening unprotected during a fire. The missing closer voids the assembly's fire rating and creates a life safety code violation.

24. C — Accessible parking space signs must display the International Symbol of Accessibility, be mounted at a minimum height of 60 inches (measured to the bottom of the sign) to remain visible when a vehicle is parked in the space, and vanaccessible spaces must include an additional "van accessible" designation. Pavement markings alone are not sufficient.

25. B — Openings in fire barriers are permitted but must be protected with firerated assemblies (doors, shutters, windows) that match the required rating of the barrier. The opening must comply with the maximum size limitations of the listed assembly and must include selfclosing or automaticclosing devices to maintain the barrier's integrity during a fire.

DOMAIN 2: SITE CONSTRUCTION (Questions 26–40)

26. A — Hydrostatic uplift is the upward force exerted by groundwater pressure on the underside of a basement slab and foundation. When the water table is above the basement floor level, the upward water pressure can exceed the weight of the structure, potentially causing the basement to float upward. The foundation must be designed with sufficient weight or anchoring to resist this uplift force.

27. D — The sand cone test excavates a small hole in the compacted fill, weighs the excavated soil, then fills the hole with calibrated sand from a standardized jar and cone apparatus. The volume of the hole equals the weight of sand used divided by the sand's known density. The inplace soil density is then calculated as the weight of excavated soil divided by the hole volume.

28. B — Without drainage behind a retaining wall, groundwater accumulates and creates hydrostatic pressure that significantly increases the total lateral load on the wall — often doubling the design force. The drainage system (drainage blanket, perforated pipe, weep holes) relieves this water pressure, reducing the lateral load to only the soil pressure.

29. C — OSHA requires that open trenches in public areas be adequately barricaded, fenced, or covered to physically prevent pedestrians, children, and vehicles from falling in. A single strand of caution tape does not provide adequate physical protection. Substantial barriers such as fencing, plywood covers rated for pedestrian traffic, or steel plates must be used.

30. A — An SPT blow count of N=8 indicates loose soil with significantly lower bearing capacity than the N=25 (medium dense) condition assumed in the geotechnical report's foundation design. The geotechnical engineer must evaluate whether the actual soil can support the designed foundation or whether the foundation must be redesigned, deepened, or the soil improved.

31. D — Vibrocompaction or vibroreplacement (stone columns) densifies loose, liquefiable sand by inserting a vibratory probe that compacts the sand and/or replaces it with compacted stone. The increased density raises the sand's resistance to liquefaction during seismic shaking. Alternative techniques include compaction grouting, deep soil mixing, and deep dynamic compaction.

32. B — Grade beams stiffen the mat foundation by creating a ribbed or wafflelike structure that resists the differential movements caused by expansive clay. When clay swells unevenly beneath the mat, the grade beams resist the resulting bending forces, preventing the slab from cracking and distorting.

33. A — OSHA requires appropriate traffic control measures including warning signs, signals, barricades, flaggers, and other devices when excavation work is near vehicular traffic. These measures protect both the workers in the excavation and the motoring public from the hazards created by the open trench and construction activity.

34. C — A soldier pile and lagging system consists of vertical steel Hpiles driven or drilled at regular spacing (typically 6 to 10 feet) along the excavation perimeter. As the excavation progresses, horizontal wood or concrete planks (lagging) are placed between the pile flanges to retain the soil. This system is efficient for temporary excavation support in a variety of soil conditions.

35. D — Overexcavation and replacement involves excavating the soft, unsuitable soil to a depth below the zone of weakness, replacing it with select structural fill material (typically granular material meeting specific gradation requirements), and compacting the replacement fill to the specified density. The repaired area is then reproof rolled to verify adequate bearing capacity.

36. B — A secant pile wall consists of overlapping reinforced concrete piles installed in a sequence. Primary piles are installed first, then secondary piles are drilled to overlap the primary piles, creating a continuous, interlocking concrete wall. The overlapping configuration provides a watertight barrier suitable for permanent belowgrade construction.

37. A — Buried detention pipes must resist the combined dead load of the soil cover above and the live load from vehicles on the surface. The structural design must ensure the pipe's material, gauge, diameter, and burial depth are adequate to prevent deflection or collapse under these combined loads. Insufficient cover or undersized pipe can lead to catastrophic pavement failure.

38. D — Tabulated data per OSHA are preengineered tables and charts approved by a registered professional engineer that specify protective system configurations for specific soil types and excavation conditions. They provide an alternative to the standard OSHA appendices for sloping, shoring, and shielding, allowing contractors to use manufacturerspecific or sitespecific designs.

39. C — Uncontrolled fill has unknown density, composition, and compaction because no compaction testing or documentation was performed during placement. It may contain debris, organic material, or voids and may settle unpredictably under structural loads. Foundations on uncontrolled fill require either removal and replacement with controlled fill, deep foundations, or ground improvement.

40. B — Downwardfacing perforations allow the pipe to collect water from the gravel bed below as the water table rises into the gravel envelope. Water enters through the bottom perforations by gravity. Upwardfacing perforations would collect sediment and debris falling from the soil above, eventually clogging the pipe and reducing drainage capacity.

DOMAIN 3: CONCRETE (Questions 41–46)

41. A — Headed reinforcing bars develop their full design strength through a forged head welded or attached to the end of the bar, eliminating the need for 90degree or 180degree hooks. In congested beamcolumn joints where multiple bars converge, hooks interfere with each other and make concrete placement difficult. Headed bars provide reliable anchorage in significantly less space.

42. C — Dowels are short reinforcing bars that extend from the existing wall into the new slab, transferring shear and moment forces across the construction joint. Without dowels, the slab and wall would act as independent elements that could separate and move independently, creating structural problems and potential cracking at the junction.

43. D — ACI 318 requires Type V portland cement for severe sulfate exposure conditions (watersoluble sulfate between 0.20% and 2.00%). Type V has the highest sulfate resistance of all standard cement types because it contains the lowest percentage of tricalcium aluminate (C3A), which is the compound most vulnerable to sulfate attack.

44. B — The contractor must wait for the concrete to reach the specified minimum stressing strength of 3,500 psi before stressing the tendons. Stressing at 3,200 psi — below the minimum — risks crushing the concrete at the anchorage zones where the concentrated posttensioning force is transferred to the slab, potentially causing irreversible structural damage.

45. A — The maturity method estimates inplace concrete strength by monitoring the actual concrete element's temperature history using embedded sensors and correlating it to a preestablished strengthmaturity relationship. This provides realtime strength data without breaking cylinders, enabling earlier form stripping and faster construction when strength gain exceeds the standard 28day schedule.

46. C — The epoxy bonding agent must be applied to the prepared joint surface and must still be tacky (not fully cured) when the new concrete is placed against it. If the epoxy cures completely before the concrete is placed, the hardened epoxy film becomes a smooth, nonporous surface that acts as a bond breaker rather than a bonding agent, producing the opposite of the intended effect.

DOMAIN 4: MASONRY (Questions 47–50)

47. B — Counterforts are vertical reinforced concrete or masonry elements constructed on the soil side (back) of the retaining wall, tying the wall face to the footing. They act as vertical

stiffeners that increase the wall's bending resistance against lateral earth pressure, allowing the wall between counterforts to be thinner than a plain cantilever wall of the same height.

48. D — Integral water repellent (IWR) is mixed into the CMU block material during manufacturing and into the mortar during mixing, providing water repellency throughout the full thickness of the wall. Unlike a surfaceapplied sealer that forms a film on the exterior face only and must be reapplied periodically, IWR provides permanent, throughwall moisture resistance.

49. A — Inspection level B per TMS 402/602 requires continuous fulltime inspection by a qualified special inspector during all grouting operations and placement of reinforcement. This is the more stringent inspection level that allows the structural engineer to use higher allowable stress values in the design. Level A (periodic inspection) uses lower design values.

50. C — The minimum lap splice length for vertical reinforcement in grouted masonry is calculated based on the bar diameter, the specified masonry compressive strength, and the reinforcing steel grade. It is typically expressed as a multiple of the bar diameter and must be sufficient to develop the full tensile capacity of the bar through bond with the surrounding grout.

DOMAIN 5: METALS (Questions 51–56)

51. D — A pinned column base allows free rotation, transferring only vertical (axial) and horizontal (shear) forces to the foundation without transferring bending moment. This simplifies the foundation design because the footing does not need to resist moment. However, the frame above must provide all lateral resistance through moment connections or bracing at the upper levels.

52. A — Beams with excessive mill camber that exceed AISC tolerances must be straightened by controlled heat application (heat straightening) or mechanical means before erection. If the camber cannot be corrected to within tolerance, the beam must be rejected and replaced. Excessive camber causes fitup problems during erection and may create unacceptable floor levelness.

53. C — AWS D1.8 (Seismic Supplement) imposes stricter requirements than D1.1 for demandcritical welds in seismic forceresisting systems. These include enhanced welder qualification testing, specific filler metal toughness requirements (CVN impact testing), more restrictive welding procedure specifications, and additional nondestructive testing — all aimed at ensuring weld integrity under severe cyclic seismic loading.

54. B — Fingertight (snugtight) installation is the initial phase that allows the erection crew to adjust the frame's plumb, level, and alignment before bolts are fully tightened. Once the surveyor confirms that the frame is properly positioned within AISC erection tolerances, all bolts are tightened to their final specified tension using the appropriate installation method.

55. D — CJP groove welds develop the full strength of the HSS tube wall at the base connection, providing maximum load transfer capacity and ductility. At column bases, the connection must resist combined axial compression, bending from lateral loads, and shear — CJP welds ensure the connection is at least as strong as the tube wall, preventing premature connection failure.

56. A — CFS curtain wall stud depth is primarily governed by the wind load deflection criteria. The studs must span between floortofloor supports and resist the design wind pressure without exceeding the allowable deflection limit (typically L/240 or L/360). Greater wind loads and longer spans require deeper studs to maintain acceptable deflection performance.

DOMAIN 6: WOOD (Questions 57–61)

57. C — AWPA Use Category UC4A indicates groundcontact or freshwater immersion applications where the preservative retention must be sufficient to resist decay and insect attack in these severe exposure conditions. For outdoor pavilion glulam beams, UC4A ensures the treatment level protects against the moisture and biological exposure inherent in groundcontact or nearground outdoor applications.

58. B — The adhesive bond between the sheathing and joists creates composite Tbeam action where the sheathing acts as the flange and the joist acts as the web. This composite behavior increases the floor system's stiffness (reducing deflection and bounce), eliminates squeaks from sheathing movement, and improves diaphragm performance for lateral load transfer.

59. D — CLT panels must be protected from prolonged moisture exposure during jobsite storage. They should be stored on blocking (off the ground), covered with protective wrapping or tarps, and ventilated to prevent moisture buildup. Excessive moisture causes swelling, delamination of the adhesive between laminations, mold growth, and dimensional changes that affect installation.

60. A — Letin bracing is a diagonal 1×4 board notched into the face of the wall studs at a 45degree angle, providing racking (shear) resistance to the wall frame. It has been largely replaced by structural wood panel sheathing (plywood or OSB), which provides superior racking resistance across the entire wall surface in a single application without notching studs.

61. C — Type IV (Heavy Timber) construction requires structural wood members to meet minimum crosssectional dimensions (typically 6×8 minimum for beams, 8×8 for columns) and limits concealed spaces within the construction. The mass of the heavy timber members provides inherent fire resistance through charring — the charred outer layer insulates the unburned interior.

DOMAIN 7: THERMAL AND MOISTURE PROTECTION (Questions 62–66)

62. D — The selection between highdensity polyiso and gypsum fiber coverboard should consider fire performance (gypsum fiber has superior noncombustibility), moisture resistance during construction exposure, compressive strength under foot traffic, compatibility with the membrane adhesive system, and cost. Each material has specific advantages depending on the project's priorities.

63. B — A thermal bypass is an air leakage pathway that allows conditioned air to flow around the insulation layer without passing through it. Common examples include air flowing through unsealed wall cavities at floor lines, around electrical boxes, and through gaps between insulation and framing. These bypasses render the insulation ineffective in the affected areas.

64. A — Areas of SFRM measuring only 1 inch do not meet the specified minimum DFT of 1½ inches. Insufficient thickness reduces the assembly's fireresistance rating because the

thinner coating cannot provide adequate insulation to the steel during fire exposure. Additional SFRM must be applied to bring all areas to the specified minimum thickness.

65. C — The protection board shields the waterproofing membrane from physical damage during backfilling operations. Without it, rocks, sharp objects, and construction debris in the backfill, combined with the force of compaction equipment, can puncture, tear, or abrade the waterproofing membrane, creating leak paths that are extremely expensive to locate and repair after backfilling.

66. D — In a pressureequalized rainscreen, the drainage cavity is compartmentalized and vented so that air pressure in the cavity equalizes with the exterior wind pressure. When the pressure differential across the cladding is eliminated, winddriven rain has no driving force to push through the cladding joints. Water entry is limited to gravity and surface tension, which the drainage plane manages.

DOMAIN 8: DOORS, WINDOWS, AND GLAZING (Questions 67–70)

67. B — NAFS (North American Fenestration Standard) evaluates commercial windows for structural performance under design wind pressure, water penetration resistance under simulated winddriven rain, air leakage rate at specified pressure differentials, forced entry resistance, and operating force. Windows are classified by performance grade based on their tested design pressure rating.

68. A — Fireprotectionrated glazing in a fire barrier (not an exit enclosure) is limited to 25% of the common wall area between separated occupancies, with individual panels limited to 1,296 square inches maximum. Fireresistive glazing (which meets full ASTM E119 criteria including temperature rise) may be used in larger sizes if the assembly is listed for the required rating.

69. C — Blastresistant glazing (typically laminated glass with polyvinyl butyral or ionoplast interlayers) is designed to resist both the positive pressure phase and the negative suction phase of a blast wave. The laminated construction ensures the glass remains in the frame after breaking, and the interlayer captures glass fragments that would otherwise become lethal projectiles.

70. D — The IBC's 5pound maximum opening force applies only to interior doors along accessible routes. Exterior doors are exempt from this specific force limitation because wind pressure, weather seals, and door closer tension create variable resistance that cannot be consistently controlled to 5 pounds. However, exterior doors must still be operable and should minimize the force required.

DOMAIN 9: FINISHES (Questions71–75)

71. C — A wet film thickness gauge (comb gauge or notch gauge) is drawn through the wet coating immediately after application. The gauge has calibrated teeth of known depths — the highest tooth that is wet indicates the wet film thickness. This allows the applicator to verify that the correct amount of material is being applied before the coating cures, ensuring the specified DFT is achieved.

72. A — Resilient channels decouple the gypsum board from the steel studs by creating a flexible connection that absorbs and dissipates sound vibrations rather than transmitting them directly through the wall. This decoupling significantly improves the wall's STC rating — a wall with resilient channels can achieve an STC rating 5 to 10 points higher than the same wall without them.

73. D — Swimming pool environments require ceiling tiles with nonhygroscopic (nonmoistureabsorbing) core materials and washable vinyl or mylar facings that resist constant high humidity and condensation. Standard mineral fiber tiles absorb moisture, sag, and develop mold in these conditions. Fiberglassbased tiles with moistureresistant facings are specifically designed for natatorium environments.

74. B — Dividing strips control cracking by providing stress relief at locations where the terrazzo is most susceptible to cracking. Construction joints, column lines, and changes in substrate condition create stress concentrations, and the dividing strips accommodate the differential movement at these locations, preventing random cracks from forming in the terrazzo surface.

75. C — Floating floor LVT tiles connect to each other through clicklock edges or adhesive between adjacent tiles and rest freely on the substrate without being bonded to it. The entire assembly "floats" over the substrate, accommodating thermal expansion and contraction. This method simplifies both installation and future removal compared to gluedown installation.

DOMAIN 10: MECHANICAL AND PLUMBING SYSTEMS (Questions 76–81)

76. A — The makeup air unit supplies conditioned outdoor air to the kitchen to replace the volume of air exhausted by the kitchen exhaust hood system. Without adequate makeup air, the exhaust fan creates negative pressure that draws unconditioned air through doors and openings, causing drafts, temperature complaints, difficulty opening exterior doors, and poor hood capture performance.

77. D — An oversized drain pipe reduces the flow velocity below the selfcleaning speed of approximately 2 feet per second. At lower velocities, solid waste particles settle and accumulate in the pipe rather than being carried along by the flow. Over time, this accumulation causes blockages and backup. Proper pipe sizing maintains adequate velocity for selfcleaning.

78. B — Sprinkler heads are designed and listed for specific installation orientations — pendent heads distribute water downward through a deflector, upright heads distribute water upward against a deflector and then outward, and sidewall heads distribute water sideways. Installing a head in the wrong orientation produces an improper spray pattern with inadequate coverage.

79. C — Cleanouts provide access for drain cleaning equipment (mechanical snakes, hydrojetting) to clear blockages in the drainage system. They are required at the upper end of each horizontal run, at direction changes exceeding 45 degrees, and at maximum intervals of 100 feet for pipes 4 inches and smaller (150 feet for larger pipes).

80. A — A VFD varies the motor speed to match the actual airflow demand. Fan energy follows the affinity laws — power consumption varies with the cube of the speed. Reducing fan speed by 20% (from 100% to 80%) reduces energy consumption by approximately 49% (0.8^3 =

0.512). This cubic relationship makes VFDs one of the most effective energysaving technologies available.

81. D — ESFR (Early Suppression Fast Response) heads are specifically designed to suppress fires in highpiled storage rather than merely controlling them. They discharge large water droplets at high pressure (high Kfactor heads at elevated system pressure) capable of penetrating the rising fire plume and reaching the fire's base. This aggressive suppression capability can potentially eliminate the need for inrack sprinklers.

DOMAIN 11: ELECTRICAL SYSTEMS (Questions 82–84)

82. B — Revenuegrade metering equipment at the service entrance measures the total electrical energy consumed by the building for utility billing purposes. Advanced metering may also monitor demand (peak power consumption), power factor, harmonic distortion, and other power quality parameters that affect both billing and equipment performance.

83. C — The equipment grounding conductor provides a lowimpedance fault current path from equipment enclosures back to the source (transformer or panel). When a ground fault occurs, the fault current flows through this conductor, causing the overcurrent protective device to detect the fault and clear the circuit quickly — preventing equipment enclosures from remaining energized and creating an electrocution hazard.

84. A — The automatic transfer switch (ATS) monitors the normal utility power and, upon detecting a power failure, signals the generator to start. After the generator reaches rated speed and voltage, the ATS transfers the building's emergency and standby loads from the failed utility to the generator. When utility power is restored, the ATS transfers the loads back and signals the generator to shut down. The ATS also prevents dangerous backfeeding into the utility grid.

DOMAIN 12: PROCUREMENT AND CONTRACTING REQUIREMENTS (Questions 85–115)

85. D — Project overhead (general conditions) includes costs specific to the project site — superintendent salary, temporary facilities, safety, temporary utilities, and site cleanup. Home office overhead includes the contractor's corporate expenses shared across all projects — rent, accounting, executive salaries, corporate insurance, marketing, and IT. Both are real costs of doing business but are categorized separately.

86. B — Under AIA A201, if the contractor fails to correct defective work after receiving written notice, the owner may correct the work using the owner's own forces or a separate contractor and deduct the cost from amounts due to the contractor. The owner may also pursue the contractor's performance bond surety or seek legal remedies for the cost of correction.

87. A — Limiting the substitution window ensures that product decisions are made early enough to avoid procurement delays, gives the architect time to evaluate alternatives against the design intent, prevents lastminute changes that could affect coordination with other trades, and maintains schedule integrity. Late substitutions can create cascading impacts on multiple building systems.

88. C — The contractor bears primary responsibility for construction safety including all means, methods, techniques, and sequences. If a construction accident results from the contractor's procedures, equipment, or failure to maintain safe conditions, the contractor is liable. The contractor's CGL insurance covers thirdparty injury claims, and workers' compensation covers employee injuries.

89. D — A program manager oversees multiple related projects within a larger building program — coordinating budgets, schedules, design standards, and procurement across the portfolio. A construction manager focuses on the execution of a single construction project. The program manager provides the strategic oversight that ensures individual projects align with the owner's overall program objectives.

90. B — The owner is typically responsible for permanent landuse and zoning approvals, environmental permits tied to the property (wetlands, stormwater, NPDES), and utility connection agreements. These permits are propertyspecific, often require long lead times, and extend beyond the construction contract's scope. The contractor obtains the building permit and trade permits.

91. A — Value analysis is typically performed during the design phase to evaluate alternative design approaches and optimize value before the design is finalized. Value engineering is performed during construction to find cost savings within the existing design. Both aim to achieve the required function at the lowest total cost, but their timing in the project lifecycle differs.

92. D — Liquidated damages for delay accrue from the contractual completion date until the date of substantial completion. If the contractor achieves substantial completion 30 days after the contractual date, the contractor owes 30 days of liquidated damages at the daily rate specified in the contract. The substantial completion date is the critical milestone.

93. A — Indemnify means the subcontractor compensates the general contractor for financial losses. Defend means the subcontractor provides and pays for legal representation in lawsuits arising from the subcontractor's work. Hold harmless means the subcontractor assumes the liability so the general contractor is not held responsible. Together, these three obligations provide comprehensive contractual protection.

94. C — The Eichleay formula requires three financial data points: the contractor's total billings on the delayed project during the contract period, the total company billings across all projects during the same period, and the total home office overhead for that period. These establish the project's proportional share of overhead that was unabsorbed during the delay.

95. D — Fundamental commissioning under LEED requires developing a commissioning plan, verifying equipment installation matches the design intent, conducting functional performance testing of HVAC and lighting control systems, and completing a commissioning report documenting all findings, deficiencies, and resolutions. This ensures systems operate as designed.

96. B — Total float is the amount of time an activity can be delayed from its earliest possible start date without delaying the project's overall completion date. An activity with 15 days of float can slip by up to 15 days before it becomes critical. Activities with zero float are on the critical path.

97. A — When a specified product becomes unavailable, the contractor must submit a formal substitution request with complete technical documentation demonstrating that the proposed alternative meets or exceeds all performance requirements. The architect evaluates the submission against the design intent and specification requirements before approving or rejecting the substitution.

98. D — Under AIA A201 Section 3.2, the contractor must carefully study and compare both the drawings and specifications, report any errors, inconsistencies, or omissions to the architect and owner promptly, and request clarification before proceeding with affected work. This duty extends to reasonable discovery — not a professional design review.

99. B — The selfperform versus subcontract decision should consider scope complexity, workforce capability, equipment availability, cost comparison, schedule impact, risk allocation, bonding capacity impact, and quality control capability. Each factor may favor a different approach depending on the project's specific circumstances.

100. C — Final payment requires 100% completion of all work, including correction of all punch list items, submission of all closeout documentation (asbuilts, O&M manuals, warranties, lien waivers, training), and fulfillment of all contractual obligations. Final payment occurs after substantial completion and is a separate, later milestone.

101. A — Hybrid contract structures combining fixedprice and costreimbursable components are recognized and commonly used in practice. The building shell scope is clearly defined and suitable for lump sum pricing, while the tenant improvement scope is undefined and better suited to costplus pricing. The two components are typically structured as separate sections within a single contract.

102. D — The owner typically has the right to audit the contractor's project cost records for a specified period after final payment, commonly 3 to 7 years as defined in the contract. The audit right ensures the owner can verify that all costs charged under a costreimbursable contract are legitimate, properly documented, and attributable to the project.

103. B — The threeweek lookahead schedule translates the master CPM schedule's summarylevel activities into detailed, actionable daily and weekly work plans. It shows specific crew assignments, material delivery dates, equipment requirements, and coordination needs for the immediate future, enabling field supervisors to manage daytoday operations effectively.

104. C — The contractor must notify the architect and owner in writing of any conflict between the building code and the design, and must not proceed with the conflicting work until the architect issues a resolution. The resolution must achieve code compliance — the contractor cannot knowingly construct noncompliant work even if the architect's drawings show it.

105. A — Concrete scanning using GPR or similar technology locates embedded reinforcing steel, posttensioning tendons, electrical conduits, and other items before core drilling. Cutting through a posttensioning tendon can cause catastrophic structural failure, and cutting through rebar or conduit causes structural damage and utility disruption.

106. D — Attic stock is a specified quantity of extra finish materials from the same production lot delivered to the owner for future maintenance and repairs. Matching materials from the

original lot ensures color consistency and product compatibility when replacing damaged tiles, carpet, or other finishes during the building's service life.

107. B — Training must occur before substantial completion while the contractor's knowledgeable personnel and system installers are still mobilized. Training sessions cover all major building systems (HVAC, fire alarm, fire suppression, lighting controls, plumbing, elevators) so the owner's maintenance staff can operate the building independently when they assume responsibility.

108. C — The mutual waiver of consequential damages limits both parties to direct damages only. The owner waives claims for lost rental income, lost business profits, and loss of use. The contractor waives claims for lost profits on other projects, loss of bonding capacity, and loss of reputation. This mutual limitation reduces the financial exposure for both parties.

109. A — Direct costs are the immediate, foreseeable costs directly caused by the event — additional labor, materials, equipment, and subcontractor costs. Indirect costs are the secondary, consequential impacts — extended general conditions, lost productivity on unaffected work, home office overhead, and other ripple effects that flow from the original event.

110. D — The owner or the owner's designated agent typically engages the special inspector, and the special inspection program is administered through the design professional (architect or structural engineer). The owner pays for the service. The contractor must facilitate access, provide advance notice of work requiring inspection, and cooperate with the inspector.

111. B — IPD uses a multiparty agreement that joins the owner, architect, and contractor into a single collaborative contract with shared risk and reward. All parties are involved from the earliest design stages, decisions are made jointly, and financial incentives are aligned so that all parties benefit from project success. This fundamentally changes the traditional adversarial dynamics.

112. A — The contractor must inspect all OFCI items upon delivery, thoroughly document any damage with photographs and written notice to the owner immediately upon discovery, and must not install damaged items without the owner's written direction. Damage occurring before delivery is typically the owner's responsibility since the owner procured the equipment.

113. C — The architect typically requires general conditions to be broken down into individual line items — superintendent salary, project engineer salary, temporary facilities, temporary utilities, temporary fencing, safety equipment, dumpsters, insurance, cleanup, and similar items. This breakdown allows accurate assessment of progress for timebased costs in monthly pay applications.

114. D — The savings below the GMP is $5,000,000 − $4,600,000 = $400,000. Under the 60/40 sharing split, the contractor receives 40% of $400,000 = $160,000 in shared savings, in addition to the agreed $350,000 fee. The contractor's total compensation is $350,000 fee + $160,000 savings share = $510,000. The owner saves $240,000 (60% of $400,000).

115. B — The contractor's strict warranty obligation to correct defects at no cost typically expires one year after substantial completion. However, the contractor's broader legal liability may extend well beyond the warranty period under the applicable statute of limitations

(typically 46 years for breach of contract) or statute of repose (typically 612 years from substantial completion), which varies by jurisdiction.