

# NCARB

## Project-Planning-Design

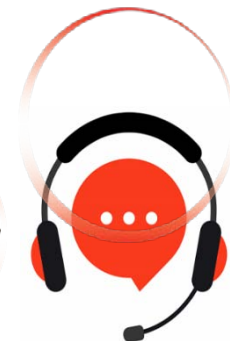
### ARE 5.0 Project Planning & Design (PPD)

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## Question: 1

An architect is commissioned to design a lodge in a location where the water service is insufficient for a sprinkler system. The architect plans to maximize sight lines by using exposed columns and roof structure in the primary assembly space.

Which of the following systems meet these requirements? Check the three that apply.

- A. 6" diameter steel columns with open web girders and joists
- B. 12" diameter peeled log columns with glulam beams and 4" wood decking
- C. 8" cast-in-place concrete columns and beams and 8" precast planks
- D. 6" precast concrete columns, beams, and 8" precast concrete planks
- E. 3" light gauge steel columns with 6" "z" purlins and 28 gauge corrugated metal decking
- F. 6 x 6 cedar columns with 6" light gauge "z" purlins and fire retardant treated plywood decking

**Answer: A, B, F**

Explanation:

Comprehensive and Detailed Explanation From Exact Extract:

When designing in locations with insufficient water service to support sprinkler systems, architects must rely on inherently fire-resistant materials or assemblies that can provide passive fire protection while also meeting the aesthetic and structural needs of the space. This is especially critical in assembly spaces where sight lines are important and exposed structure is desired.

Option A: Steel columns with open web girders and joists are acceptable because steel does not combust and can be designed for fire resistance either by inherent fireproofing or applied fireproofing. The openweb design also supports maximizing sight lines by minimizing visual obstruction.

Option B: Large peeled log columns with glulam beams and wood decking are commonly used in lodge designs. Although wood is combustible, large timber members like glulam beams char on the surface and maintain structural capacity for a predictable duration under fire conditions, which often meets code for exposed timber in assembly spaces without sprinkler systems.

Option F: Cedar columns with light gauge steel purlins and fire retardant treated plywood decking can be suitable where fire retardant treatment extends the fire resistance of wood members. This is an accepted strategy in areas lacking sprinkler protection, particularly for visual warmth and compatibility with lodge aesthetics.

Options C and D: Concrete columns and beams are noncombustible but tend to be bulky and can obstruct sight lines. Additionally, precast planks with concrete may not fit the desired exposed wood or open aesthetic.

Option E: Light gauge steel columns with corrugated metal decking are lightweight and minimal, but 3" steel columns are structurally insufficient for large assembly spaces and metal decking without proper fireproofing is less common in exposed wood aesthetic projects.

These design choices align with NCARB's Project Planning & Design content regarding material selection for fire resistance, visual requirements, and assembly occupancy considerations. Specifically, the guidelines recommend using heavy timber, fire-retardant-treated wood, or protected steel systems

where sprinkler systems are not feasible to comply with fire and life safety codes while addressing architectural intent.

Reference:

ARE 5.0 PPD Content Outline: Building Systems, Materials, and Assemblies (NCARB)

The Architect's Handbook of Professional Practice, 15th Edition, Chapter 13: Building Codes, Standards, and Regulations

NCARB ARE 5.0 Guidelines: Fire Protection and Material Performance in Assembly Spaces

## Question: 2

For a three-story building, which of the following is considered a vertical irregularity with respect to seismic design?

- A. The effective mass of the roof is one-half the mass of the floor immediately below.
- B. The building has a significant reentrant corner on the front side.
- C. The effective mass of story 2 is two times the mass of story 1.
- D. Interior symmetrically placed shear walls are four times as stiff as perimeter columns.

**Answer: C**

Explanation:

Comprehensive and Detailed Explanation From Exact Extract:

In seismic design, vertical irregularities are discontinuities or abrupt changes in the building's mass, stiffness, or geometry that can affect seismic response and increase vulnerability during an earthquake. The NCARB ARE 5.0 Project Planning & Design guidelines describe vertical irregularities as changes occurring along the height of the building.

Option C describes a mass irregularity where story 2 has twice the effective mass of story 1. According to seismic code provisions (such as those referenced in ASCE 7 and adopted by IBC), a vertical mass irregularity is present if the effective seismic mass in any story is more than 150% (1.5 times) or less than 70% (0.7 times) of the mass of an adjacent story. Here, doubling the mass is a significant vertical irregularity that affects the dynamic behavior and design.

Option A, the roof mass being half that of the floor below, is a decrease in mass but less than the typical threshold of 30% difference (the ratio is 0.5, which is a 50% difference). This might also be considered, but the mass irregularity is more typically flagged at the 1.5x or 0.7x threshold and tends to be more critical in lower floors, making C the clearer choice.

Option B describes a reentrant corner, which is a horizontal plan irregularity, not vertical. Reentrant corners affect torsional behavior but are not classified as vertical irregularities.

Option D refers to stiffness differences between interior shear walls and perimeter columns but, when symmetrically placed, this is not necessarily considered an irregularity. Vertical stiffness irregularities are defined by abrupt stiffness changes in vertical elements, but symmetry mitigates torsional effects. The presence of vertical mass irregularities significantly influences seismic forces distribution, dynamic response, and the potential for torsional motions. Designers must recognize these irregularities per NCARB guidelines and apply appropriate structural detailing and design modifications to meet life-safety requirements.

Reference:

ARE 5.0 Project Planning & Design Outline: Environmental Conditions and Context - Seismic Design

## Considerations

NCARB ARE 5.0 Guidelines, Seismic Design and Irregularities

ASCE 7-16, Chapter 12 - Seismic Design Criteria

The Architect's Handbook of Professional Practice, 15th Edition, Chapter 13: Building Codes, Standards, and Regulations

### Question: 3

An architect is designing a multistory student housing project to be built of light wood framing. The following criteria must be met:

Minimize the floor assembly thickness

Maximize ceiling height

No individual HVAC room controls

No exposed ductwork

Which HVAC system should be selected for this project?

A. Packaged terminal units (PTAC)

B. Four-pipe fan-coil system

C. Variable air volume (VAV)

**Answer: B**

#### Explanation:

For multistory residential buildings such as student housing with light wood framing, HVAC system selection must balance space constraints and occupant comfort. The requirement to minimize floor thickness and maximize ceiling height typically rules out bulky ductwork or ceiling-mounted systems. Packaged Terminal Air Conditioners (PTACs) provide individual room control and require wall penetrations, conflicting with the "no individual HVAC room controls" and likely leading to more complex maintenance.

Variable Air Volume (VAV) systems typically require extensive ductwork and ceiling space, contradicting the goal to minimize floor thickness and eliminate exposed ductwork.

The Four-pipe fan-coil system is an efficient choice for this application: it uses small fan coil units within the ceiling or wall cavities with chilled and hot water supply pipes running vertically. This system minimizes the thickness of mechanical floors and allows centralized control rather than individual room controls. The fan coil units can be concealed, addressing the "no exposed ductwork" criterion.

This approach aligns with NCARB's guidance on HVAC system selection for multifamily and residential occupancies where ceiling height and floor thickness are critical constraints, and centralized control systems are preferred for ease of maintenance and energy management.

#### Reference:

ARE 5.0 PPD Study Guide – Building Systems and Assemblies

The Architect's Handbook of Professional Practice, 15th Edition – Mechanical Systems

NCARB Guidelines on HVAC Systems for Residential Buildings

### Question: 4

Which of the following is considered when using natural light as the primary source of ambient light to improve building quality and reduce energy costs?

- A. Operable windows located on opposite walls
- B. Exterior shading devices
- C. Clear glazing window wall system
- D. Single switched lighting controls

**Answer: B**

Explanation:

Comprehensive and Detailed Explanation From Exact Extract:

Using natural light as a primary source of ambient lighting is a sustainable strategy to improve indoor environmental quality and reduce energy consumption. However, careful control of daylighting is essential to avoid glare and overheating.

Exterior shading devices (such as louvers, overhangs, and fins) are critical in managing solar heat gain and glare by controlling direct sunlight before it enters the building envelope. They help maintain visual comfort and reduce cooling loads, directly impacting energy costs and occupant comfort.

Operable windows on opposite walls facilitate cross ventilation, which is beneficial for natural ventilation but does not directly control daylighting quality or energy use related to lighting.

Clear glazing window wall systems maximize daylight penetration but can increase solar heat gain if not properly shaded, thus increasing cooling loads.

Single switched lighting controls are a basic electrical feature and do not influence daylighting quality or energy efficiency related to natural light.

NCARB's PPD guidelines emphasize integrating exterior shading as a passive design strategy to optimize daylight use and reduce reliance on mechanical cooling and artificial lighting, improving building performance sustainably.

Reference:

ARE 5.0 Project Planning & Design – Environmental Conditions and Context

The Architect's Handbook of Professional Practice, 15th Edition – Sustainable Design and Daylighting  
NCARB Guidelines on Daylighting and Energy Efficiency

## Question: 5

An existing building containing the maximum allowable area may be extended horizontally provided the extension is separated from the existing building by which one of the following?

- A. A fire-rated shutter
- B. An outside space separation of at least 10 ft
- C. A fire wall
- D. A water curtain

**Answer: C**

Explanation:

Comprehensive and Detailed Explanation From Exact Extract:

According to the International Building Code (IBC) and reflected in the NCARB Project Planning & Design guidelines, when an existing building has reached the maximum allowable floor area, horizontal extensions (additions) can be made only if there is a proper separation between the existing structure and the new addition. This separation must prevent fire spread and protect structural integrity.

A fire wall is a continuous, fire-resistive barrier designed to prevent the spread of fire between adjacent buildings or different parts of a building. It must have structural stability under fire conditions and can allow the two portions of the building to be treated as separate structures for area calculations, effectively permitting expansion beyond the allowable area of a single building.

Fire-rated shutters (Option A) are movable devices used for compartmentation but are not intended for permanent separation of building areas.

Outside space separation of at least 10 ft (Option B) is generally insufficient for full area separation unless it meets specific fire-resistance rating and distance requirements that typically exceed 10 feet.

Water curtains (Option D) are active fire protection devices but are not substitutes for passive separations required by code to extend allowable building area.

Thus, the correct method to extend a building beyond its maximum allowable area is to separate it with a fire wall, as per NCARB and IBC provisions.

Reference:

ARE 5.0 PPD – Codes and Regulations, Building Area and Occupancy Separation

IBC 2018, Chapter 7: Fire and Smoke Protection Features

The Architect's Handbook of Professional Practice, 15th Edition – Fire Protection

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