



# Architect Registration Examination® (ARE®) 5.0

## HANDBOOK

This handbook has been developed to help you prepare for the ARE. While the [ARE 5.0 Guidelines](#) provide information on how to take the exam and exam policies, this handbook provides information on what content will be assessed on the exam.

### In this handbook, you will find:

- Descriptions of ARE 5.0 and information on how the exam is structured to assess candidates
- A breakdown of the sections and objectives of each ARE 5.0 division
- Sample items for each section
- Suggested resources and references you may refer to while preparing for the exam

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## What is the ARE?

The Architect Registration Examination® (ARE®) is developed by the National Council of Architectural Registration Boards (NCARB). The ARE is used by U.S. jurisdictions as the registration examination for candidates seeking architectural registration. It is also accepted by select Canadian provincial and territorial architectural associations for registration.

The ARE assesses a candidate's knowledge and skills to provide various services required in the practice of architecture. No single examination can test for competency in all aspects of architectural practice; the ARE is not intended for that purpose. The ARE concentrates on the professional services that affect the public's health, safety, and welfare.

In addition to testing for competence in specific subject areas, NCARB is aware of the responsibilities an architect may have for coordinating the activities of others involved in the design/construction process. The ARE assesses a candidate's qualifications in exercising the skills and judgment of a generalist working with numerous specialists. In short, the objective is to reflect the practice of architecture as an integrated whole.

### DEFINITION OF COMPETENCE AS RELATED TO THE ARE

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To protect the health, safety, and welfare of the public, a newly licensed architect practicing independently must demonstrate the competence to be responsible for a project from its inception through completion. This includes, but is not limited to, the ability to:

- Apply architectural business practices
- Evaluate legal, ethical, and contractual standards
- Establish and coordinate project team activities
- Establish programmatic and regulatory requirements
- Provide design alternatives
- Evaluate and incorporate appropriate materials and building systems
- Provide and coordinate project documentation for a building and site
- Provide construction phase services
- Assess the project during all phases
- Address environmental sustainability, resiliency, and adaptation throughout project design

## Understanding ARE 5.0

NCARB used the results of the *NCARB 2012 Practice Analysis of Architecture* when developing ARE 5.0 to determine the critical knowledge and skills an architect must perform competently. These knowledge and skills were organized into **six practice-based divisions**:

**PcM** Practice Management

**PjM** Project Management

**PA** Programming & Analysis

**PPD** Project Planning & Design

**PDD** Project Development & Documentation

**CE** Construction & Evaluation

Each division is broken down into multiple sections, and each section has objectives on which candidates will be assessed. All of the questions, or items, on an ARE division are authored to assess candidates based on the objectives in that division.

While preparing for the ARE, it is important to understand the cognitive level at which items are targeted for each objective. The cognitive level guides the authoring of items for the exam so that each item represents the appropriate level of assessment at the point of licensure. Some objectives only require the understanding of a concept, while other objectives require analysis and evaluation.

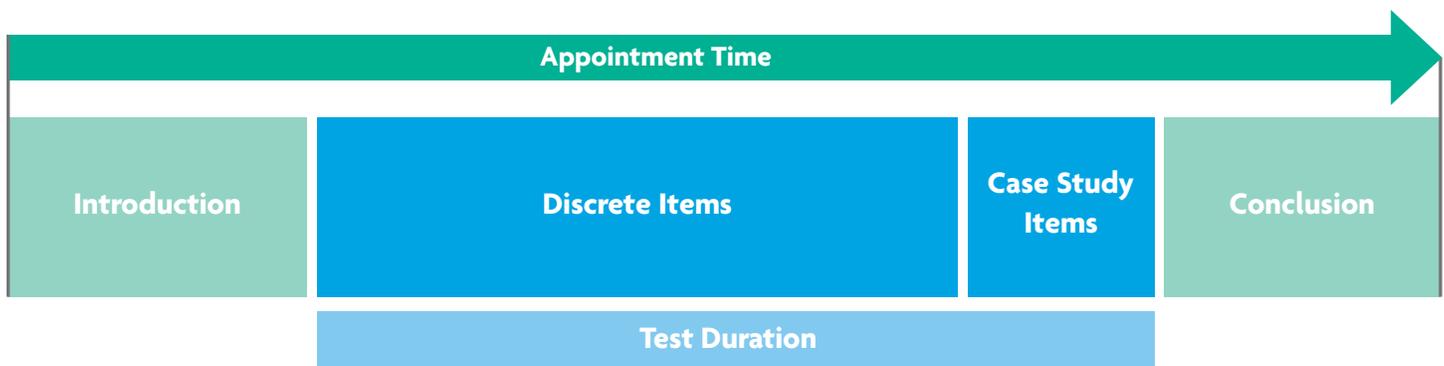
## ARE 5.0 Exam Format

All six divisions of ARE 5.0 are organized the same way, varying only in the number of items and test duration. Each exam appointment will begin with a few introductory screens, including the ARE Candidate Agreement, which you are required to accept prior to starting your exam. Your exam appointment will conclude with a reminder screen and the option to view provisional feedback on your overall exam performance.

The content portion of each division includes discrete items and case study items. Discrete items are located at the beginning of the content portion of each exam, and case studies are located at the end. You don't need to answer them in a specific order, so you may navigate directly to a case study whenever you feel most comfortable.

Optional break time is offered during each exam administration. This time can be used for a few short breaks or one long break. You can begin a break at any time. However, after returning from a break, you will not be allowed to go back to any of the items you have already viewed, regardless of whether you have answered them or not. They will be locked.

Prior to scheduling your exam, please take the ARE Demonstration Exam in order to familiarize yourself with the structure and delivery format of the ARE.



## ARE 5.0 Item Types

Each division of ARE 5.0 utilizes five different item types throughout the exam's discrete and case study items: multiple choice, check-all-that-apply, quantitative-fill-in-the-blank, hotspot, and drag-and-place. All items are worth one point and there is no partial credit.

### Multiple Choice

A multiple choice item contains a question followed by either three or four response options. To respond to this item type, you'll need to select a single response out of the possible response options.

### Check-all-that-apply

A check-all-that-apply item, sometimes called a CATA, is similar to a multiple choice item, except it allows you to select multiple responses. This item type contains a question followed by a prompt to select between two and four responses out of six possible response options. All correct response options must be selected in order to answer the item correctly. There is no partial credit for selecting only some of the correct response options.

### Quantitative-fill-in-the-blank

A quantitative-fill-in-the-blank item, sometimes called a QFIB, contains a question followed by an input box where you'll provide a **numerical** response to the question being asked. The appropriate units for the correct answer will be provided as part of the item.

### Hotspot

A hotspot item contains a question followed by a drawing, photograph, diagram, or other image. To respond to this item type, you'll need to click on an area or object within the provided image. If your response is located within the acceptable scoring area, it will be scored as correct.

### Drag-and-place

A drag-and-place item contains a question followed by a background drawing, photograph, diagram, or other image. You will also be presented with a series of design elements along the left side or top of the background image. To respond to this item type, you'll need to select one or more of the design elements and place them onto the background image. You may rotate design elements by right clicking on them, but no other manipulations are permitted. Depending on the item, multiple design elements or not all design elements will be used in the correct response(s). If all your design elements are located within the acceptable scoring areas, the item will be scored as correct.

## Understanding ARE 5.0

ARE 5.0 uses one of two designations to indicate the appropriate cognitive level of each objective: Understand/Apply (U/A) or Analyze/Evaluate (A/E).

**U/A**  
LEVEL

**Understand/Apply:** deduction of meaning from information, demonstration of comprehension of concepts or processes, application of processes or procedures in familiar or unfamiliar situations.

- Requires conceptual understanding to answer
- Focuses on standard, straight-forward application of knowledge
- May require the employment of a mathematical formula

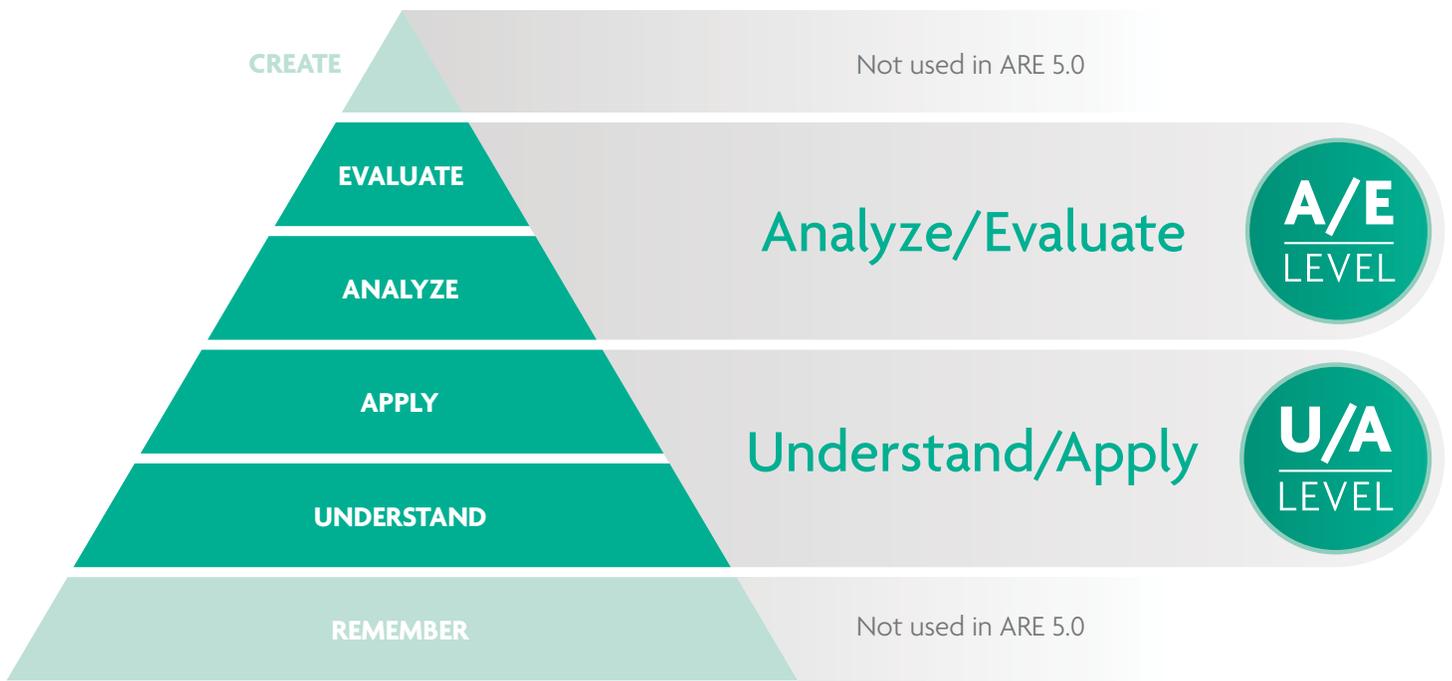
**A/E**  
LEVEL

**Analyze/Evaluate:** reduction of overall concept into component parts, determination of how parts relate to one another and to the overall structure, arrival at judgments based on given criteria.

- Requires integration of new information with existing information
- May require the prioritization of information
- Often focuses on non-standard situations

## Understanding ARE 5.0

ARE 5.0 avoids the use of “Remember,” the lowest cognitive level, or “Create,” the highest cognitive level, as they are not appropriate for the assessment of a newly licensed architect.



Throughout this handbook you will see a cognitive level designation after each objective. All of the sample items in this handbook contain an explanation of what makes the item a certain cognitive level.

Understanding the expected cognitive level for each objective should help you self-assess your knowledge and skills and better prepare for each division.

# Practice Management (PcM)

This division will assess objectives related to the management of architectural practice, including professional ethics, fiduciary responsibilities, and the regulations governing the practice of architecture. The division will focus on issues related to pre-contract tasks including negotiation, human resource management, and consultant development. Candidates must demonstrate an understanding of and abilities in business structure, business development, and asset development and protection.

<b>SECTION 1: Business Operations</b> .....	<b>11</b>
<b>SECTION 2: Finances, Risk, &amp; Development of Practice</b> .....	<b>16</b>
<b>SECTION 3: Practice-Wide Delivery of Services</b> .....	<b>20</b>
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## Practice Management

### DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
65	59	6	2	10-14	2 hr 40 min	30 min	3 hr 20 min

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count against a candidate's final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Applying competent delivery of professional architectural services
- Applying the laws and regulations of architectural practice
- Evaluating legal, ethical, and contractual standards in the performance of architectural tasks

The 65 items will assess you on four sections related to Practice Management. The number of items from each section will vary based on the targeted percentage of items within each section.

### SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*
<b>SECTION 1:</b> Business Operations	13-17	20-26%
<b>SECTION 2:</b> Finances, Risk, & Development of Practice	19-23	29-35%
<b>SECTION 3:</b> Practice-Wide Delivery of Services	14-18	22-28%
<b>SECTION 4:</b> Practice Methodologies	11-15	17-23%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you experience may vary slightly, as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

**PcM** SECTION 1

# Business Operations

*In this section you will need to understand that running a business requires attention to staffing, regulations, insurance, ethics, and the appropriate Standard of Care.*

**OBJECTIVE 1.1 (8-12%)****Assess resources within the practice (A/E)**

*You will need to analyze the staffing needs of a practice and recommend criteria and protocols for hiring, staffing assignments, staff evaluations, staff scheduling, and professional development. You will also need to evaluate capital expenditures, such as hardware, software, or training. These are items that support a firm's current business model or allow a firm to expand into a new practice area, evolve to offer more environmental design, or address other changing needs.*

**OBJECTIVE 1.2 (4-8%)****Apply the regulations and requirements governing the work environment (U/A)**

*You will need to demonstrate your understanding of laws, regulations, and insurance that apply to running a practice, including health insurance, worker's compensation, general liability, and labor laws.*

**OBJECTIVE 1.3 (2-6%)****Apply ethical standards to comply with accepted principles within a given situation (U/A)**

*You will determine the appropriate responses to given situations which demonstrate your understanding of laws, rules of conduct, and ethics in responding to client requests and business practices. This could include issues such as plagiarism, copyright or intellectual property infringement, exaggeration, and libel or slander.*

**OBJECTIVE 1.4 (1-5%)****Apply appropriate Standard of Care within a given situation (U/A)**

*You will need to understand the Standard of Care and its implications on providing professional services, the impact of errors and omissions, the responsibility to appropriately address vulnerabilities and risks associated with climate change, and how to appropriately respond to unknown conditions in order to protect the health, safety, and welfare of the public.*

## PcM SECTION 1

## Sample Items

## SAMPLE ITEM 1

Name	Title	Licensed in Jurisdiction of Office Location	Licensed in Jurisdiction of Apartment Complex	Years of Experience	Current Utilization Rate	Work Experience
<b>Employee A</b>	Principal / Co-owner	Yes	Yes	30	75%	Museums, Hotels, K-12 Education, Higher Education
<b>Employee B</b>	Principal / Co-owner	Yes	No	28	45%	Healthcare
<b>Employee C</b>	Architect	Yes	Yes	19	85%	Hotels, Condominiums
<b>Employee D</b>	Architect	Yes	No	14	50%	Museums, Healthcare
<b>Employee E</b>	Architect	Yes	Yes	13	25%	Healthcare, Hotels, Condominiums, Residential
<b>Employee F</b>	Architect	Yes	No	7	75%	Healthcare, Higher Education
<b>Employee G</b>	Architect	No	Yes	3	95%	Sports and Recreation
<b>Employee H</b>	Project Manager	Yes	Yes	15	47%	Hotels, Condominiums
<b>Employee I</b>	Project Manager	No	Yes	12	88%	Healthcare
<b>Employee J</b>	Project Manager	No	No	8	96%	K-12 Education, Higher Education, Residential

An architecture firm has been selected to design a four-story apartment complex in a neighboring jurisdiction. The office-staffing leader is in the process of assigning dedicated architecture staff to the project.

Click on the name of the employee in the staff list who is most appropriate to be the project architect and responsible for the overall design and development of the apartment complex.

## PcM SECTION 1

## Sample Items

## SAMPLE ITEM 1 - CORRECT RESPONSE

Name	Title	Licensed in Jurisdiction of Office Location	Licensed in Jurisdiction of Apartment Complex	Years of Experience	Current Utilization Rate	Work Experience
Employee A	Principal / Co-owner	Yes	Yes	30	75%	Museums, Hotels, K-12 Education, Higher Education
Employee B	Principal / Co-owner	Yes	No	28	45%	Healthcare
Employee C	Architect	Yes	Yes	19	85%	Hotels, Condominiums
Employee D	Architect	Yes	No	14	50%	Museums, Healthcare
Employee E	Architect	Yes	Yes	13	25%	Healthcare, Hotels, Condominiums, Residential
Employee F	Architect	Yes	No	7	75%	Healthcare, Higher Education
Employee G	Architect	No	Yes	3	95%	Sports and Recreation
Employee H	Project Manager	Yes	Yes	15	47%	Hotels, Condominiums
Employee I	Project Manager	No	Yes	12	88%	Healthcare
Employee J	Project Manager	No	No	8	96%	K-12 Education, Higher Education, Residential

**RATIONALE:** The process for assigning staffing resources within an architecture firm is discussed in *The Architect's Handbook of Professional Practice*. First, you must evaluate firm staff on availability, experience, and credentials. You must also verify alignment with the roles and responsibilities of the position with the project requirements. Employee E, who is licensed in the project's jurisdiction, is only charging 25 percent of their time to firm projects, and has work experience on related project types. Based on the information provided, this makes them the most appropriate choice to serve as project architect for the new apartment complex.



This is an **A/E level** item requiring you to evaluate firm resources and determine staffing based on the requirements of a building project.

## PcM SECTION 1

## Sample Items

## SAMPLE ITEM 2

Which of the following types of insurance policies help protect an architectural firm? **Check the three that apply.**

- Builder's risk insurance
- Commercial general liability insurance
- Health insurance
- Life insurance
- Professional liability insurance
- Workers' compensation insurance

**RATIONALE:** *The Architect's Handbook of Professional Practice* describes the different types of insurance and their importance to the practice of architecture. Commercial general liability insurance covers nonprofessional aspects of a practice, including property damage, bodily injury, and advertising injury. Professional liability insurance, also referred to as errors and omissions insurance, helps protect a firm against negligence in the performance of their professional duties. Workers' compensation insurance provides medical benefits and wages to an employee injured on the job in exchange for the employee's right to sue the employer for negligence, eliminating the need for litigation. All three of these help protect the firm. Builder's risk insurance is typically carried by owners or contractors to cover liability and loss during building construction. Although an architecture firm may provide employees health and life insurance as benefits to employees, they do not directly protect the firm.

## CORRECT RESPONSE

Which of the following types of insurance policies help protect an architectural firm? **Check the three that apply.**

- Builder's risk insurance
- Commercial general liability insurance**
- Health insurance
- Life insurance
- Professional liability insurance**
- Workers' compensation insurance**



**U/A**  
LEVEL

This is a **U/A level** item that requires an understanding of the different types of insurance and how they apply to an architectural practice.

## PcM SECTION 1

## Sample Items

## SAMPLE ITEM 3

Using an integrated project delivery methodology, what can the owner expect from an architect?

- The architect's and consultant's drawings will be free of errors.
- The architect will guarantee the quality and completeness of the building design.
- The architect will perform services in accordance with the highest industry standards.
- The architect will provide service in a reasonable and prudent manner.

## CORRECT RESPONSE

Using an integrated project delivery methodology, what can the owner expect from an architect?

- The architect's and consultant's drawings will be free of errors.
- The architect will guarantee the quality and completeness of the building design.
- The architect will perform services in accordance with the highest industry standards.
- The architect will provide service in a reasonable and prudent manner.**

**RATIONALE:** According to *The Architect's Handbook of Professional Practice*, providing services in a reasonable and prudent manner aligns with the professional Standard of Care for architects, while limiting the architect's liability exposure. The architect and consultants are not required to perform services perfectly and free of errors, nor is it a realistic expectation. Avoiding building design guarantees and standards higher than what are required by law will also limit the architect's liability.



**U/A**  
LEVEL

This is a **U/A level** item that requires you to understand Standard of Care within the practice of architecture and how it applies to project execution and owner expectations.

## PcM

## SECTION 2

# Finances, Risk, & Development of Practice

*This section is about how running and developing a practice requires attention to finances, mitigating risk and liability, and negotiating services and contracts. This is the largest section within the Practice Management division.*

**OBJECTIVE 2.1 (11-15%)****Evaluate the financial well-being of the practice (A/E)**

*You will need to be able to analyze financial data, business strategies, and the firm's strategic priorities to identify actions that position the practice appropriately.*

**OBJECTIVE 2.2 (10-14%)****Identify practice policies and methodologies for risk, legal exposures, and resolutions (U/A)**

*You will need to understand the implications of various types of projects, client types, and contract terms as they relate to risk, legal exposure, and insurance coverage. The application of conflict resolution and quality management techniques to various situations that arise within a practice is also a necessary component.*

**OBJECTIVE 2.3 (5-9%)****Select and apply practice strategies for a given business situation and policy (U/A)**

*You will need to make decisions, and understand the impact of those decisions, related to negotiations of services, contracts, scope creep, and scope adjustments, as well as protecting intellectual property in a given business situation.*

**PcM SECTION 2**

Sample Items

**SAMPLE ITEM 4**

Refer to the exhibit.

Office leadership at an A/E firm is performing an evaluation of the efficiency of their office and overall effectiveness of each employee.

What is the utilization rate of Architect A?

%

ARCHITECT A			
ID	PROJECT NAME	TASK/ROLE	AVERAGE WEEKLY HOURS
01886.01	Westside Community Center	Project Manager	20
02778.06	City View Rehabilitation Clinic	Project Manager	7.5
01994.02	Parkside Apartments	Drawing Review/Redlining	4.5
03020.00	Northview Gymnasium	Responding to RFP	4.5
02001.02	Office Operations	Firm Staffing	2.5
09012.01	Continuing Education	Varies	1

## PcM SECTION 2

## Sample Items

## SAMPLE ITEM 4 - CORRECT RESPONSE

80 %

**RATIONALE:** According to *The Architect's Guide to Small Firm Management: Making Chaos Work for Your Small Firm* and *The Architect's Handbook of Professional Practice*, utilization rate is a measure of the effective use of labor and is calculated by dividing an employee's direct labor by their total labor. First, you need to identify the direct labor hours for Architect A (**Step 1**). Time spent on the Westside Community Center, City View Rehabilitation Clinic, and Parkside Apartments is all direct labor because it is charged to each project. Hours spent on responding to an RFP, firm staffing, and continuing education are considered indirect labor (**Step 2**). By dividing the direct labor hours by the total hours, you determine that Architect A's utilization rate is 80% (**Step 3**). Because the % symbol is given next to the answer box, you know the correct answer should be represented as a percentage, not a decimal.

**Step 1:** 20 hrs. + 7.5 hrs. + 4.5 hrs. = 32 hrs.

**Step 2:** 32 hrs. + 4.5 hrs. + 2.5 hrs. + 1 = 40 hrs.

**Step 3:** 32 hrs. / 40 hrs. = .8 which is 80%

ARCHITECT A			
ID	PROJECT NAME	TASK/ROLE	AVERAGE WEEKLY HOURS
01886.01	Westside Community Center	Project Manager	20
02778.06	City View Rehabilitation Clinic	Project Manager	7.5
01994.02	Parkside Apartments	Drawing Review/Redlining	4.5
03020.00	Northview Gymnasium	Responding to RFP	4.5
02001.02	Office Operations	Firm Staffing	2.5
09012.01	Continuing Education	Varies	1



This is an **A/E level** item requiring you to analyze the employee's time within an architecture office to determine the effectiveness of their labor.

## PcM SECTION 2

## Sample Items

## SAMPLE ITEM 5

A client has requested to use their own design services agreement.

During contract negotiations, which of the following should the architect ensure are included in the contract to minimize risk? **Check the four that apply.**

- A stipulated monetary penalty for the architect's late performance.
- Architect's right to rely on the accuracy and completeness of owner-furnished information.
- Architect's right to suspend services and terminate the agreement for the owner's failure to make payments.
- Architect's warranty of building performance.
- Architect's relief of responsibility for construction means and methods.
- Owner's consultants must maintain professional liability insurance.

**RATIONALE:** Evaluating an owner-generated agreement and negotiating changes to a contract can protect an architect from unnecessary risk. According to *The Architect's Handbook of Professional Practice*, relying on the accuracy and completeness of owner-furnished information protects the architect from being liable for services and drawings provided by the owner. The architect's right to suspend or terminate services for the owner's failure to make payments protects the architect from financial loss. Relief of responsibility for construction means and methods protects the architect from construction-related deficiencies that are a result of contractor error. Requiring the owner's consultants to maintain professional liability insurance protects the architect from errors and omissions in the consultants' work. Including a monetary penalty for the architect's late performance and an architect's warranty in the contract would unnecessarily increase the architect's liability risk.

## CORRECT RESPONSE

A client has requested to use their own design services agreement.

During contract negotiations, which of the following should the architect ensure are included in the contract to minimize risk? **Check the four that apply.**

- A stipulated monetary penalty for the architect's late performance.
- Architect's right to rely on the accuracy and completeness of owner-furnished information.**
- Architect's right to suspend services and terminate the agreement for the owner's failure to make payments.**
- Architect's warranty of building performance.
- Architect's relief of responsibility for construction means and methods.**
- Owner's consultants must maintain professional liability insurance.**



**U/A**  
LEVEL

This is an **U/A level** item that requires you to understand and identify contract terms and conditions in order to reduce risk when dealing with an owner-generated contract.

**PcM** SECTION 3

# Practice-Wide Delivery of Services

*In this section you will need to look at projects in the context of their impact on the overall running of a practice.*

**OBJECTIVE 3.1 (3-7%)****Analyze and determine response for client services requests (A/E)**

*One of the most important things you will need to do as an architect is assess the scope of services needed, completeness of requests, public interest conflicts, and fee proposals based on client requests, prior to finalizing a contract with a client.*

**OBJECTIVE 3.2 (10-14%)****Analyze applicability of contract types and delivery methods (A/E)**

*You will also need to differentiate between the appropriate types of contracts and agreements, estimate the impact and risk of changes to contracts, and understand the impact of various delivery options for a given project.*

**OBJECTIVE 3.3 (6-10%)****Determine potential risk and/or reward of a project and its impact on the practice (A/E)**

*You must be able to evaluate projects to assess their value, liability, risk, opportunity, and anticipated benefit to the practice as a whole.*

## PcM SECTION 3

## Sample Items

## SAMPLE ITEM 6

An architecture firm is expanding into the healthcare market and has been selected to design a new hospital building on a previously undeveloped site. The client requires a design-bid-build delivery method be used.

When preparing the proposal for professional services, which factors should the architect consider? **Check the three that apply.**

- Capabilities of the contractor
- Requirements for a brownfield site assessment
- Level of risk associated with the project
- Project schedule
- Guaranteed maximum price (GMP)
- Specialty consultants required

**RATIONALE:** The preparation of a proposal for professional services, including the factors that can affect level of services, is discussed in *The Architect's Handbook of Professional Practice*. It is important for the architect to consider the schedule and its impact on project costs and project scope. The architect must also consider the level of risk associated with the project type or similar factors. Finally, the need for specialty consultants will influence the project design fee. Because this is a design-bid-build project, the capabilities of the contractor would not be a factor to consider when preparing the proposal. A GMP is typically a component of the construction manager as constructor delivery method and not applicable to this proposal. Since this is a previously undeveloped site, a brownfield site assessment is not required.

## CORRECT RESPONSE

An architecture firm is expanding into the healthcare market and has been selected to design a new hospital building on a previously undeveloped site. The client requires a design-bid-build delivery method be used.

When preparing the proposal for professional services, which factors should the architect consider? **Check the three that apply.**

- Capabilities of the contractor
- Requirements for a brownfield site assessment
- Level of risk associated with the project**
- Project schedule**
- Guaranteed maximum price (GMP)
- Specialty consultants required**

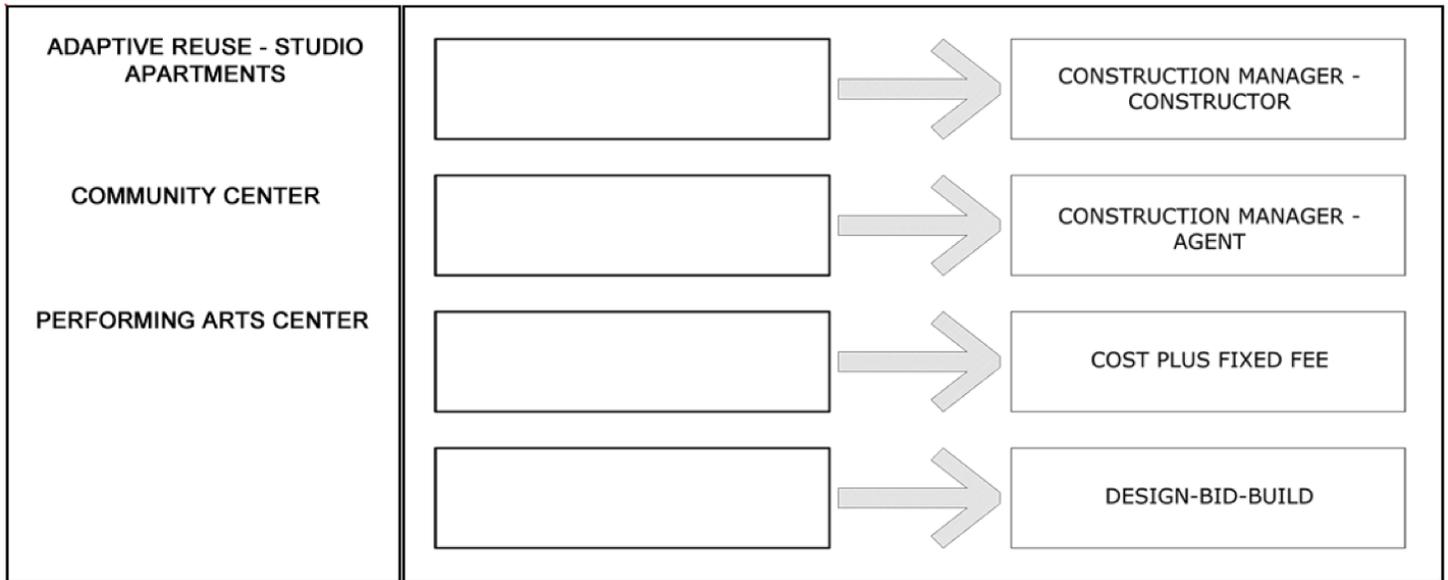


This is an **A/E level** item requiring you to determine the factors and information that are critical to the preparation of a professional services proposal.

**PcM** SECTION 3

# Sample Items

## SAMPLE ITEM 7



An architecture firm has been awarded the following projects:

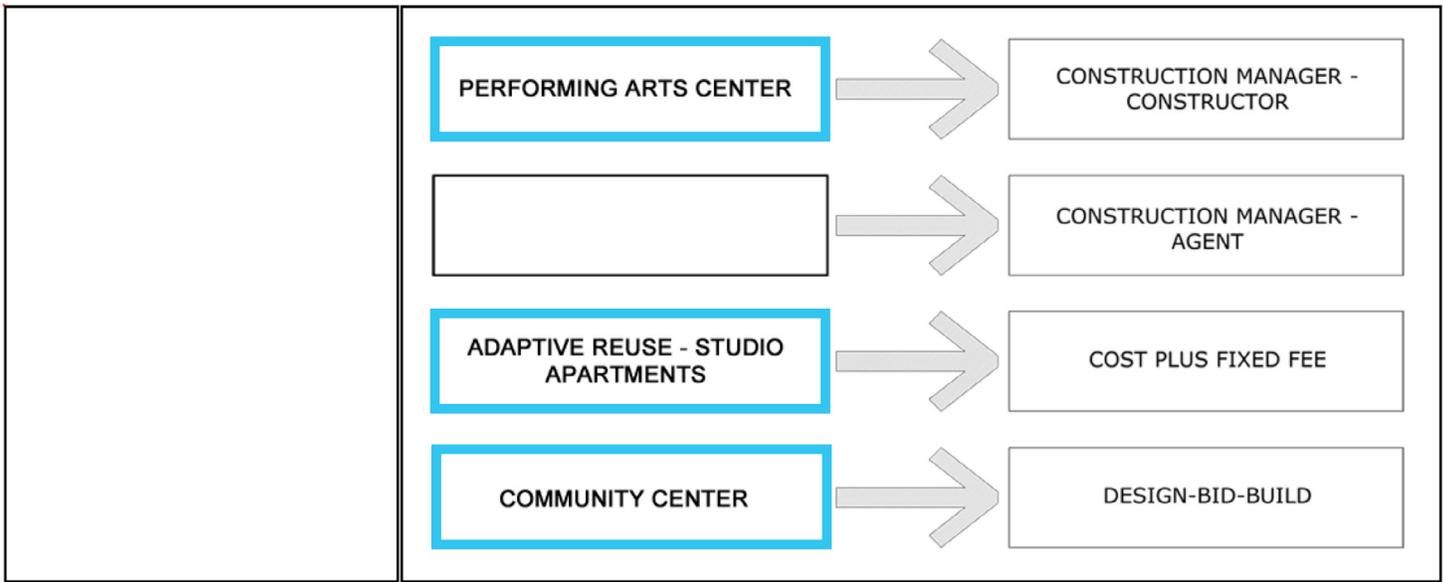
- A community center with a simple program, fixed budget, and the client’s desire for contractor competition.
- A performing arts center with an aggressive schedule and the client’s need to know a final construction cost during the design phase.
- The adaptive reuse of an existing industrial building, which contains multiple unknown conditions, into studio apartments.

Drag the project names from the left into the boxes of the diagram to identify the most appropriate delivery method for each project.

**PcM SECTION 3**

Sample Items

**SAMPLE ITEM 7 - CORRECT RESPONSE**



**RATIONALE:** Methods of project delivery and their characteristics are discussed in *Professional Practice: A Guide to Turning Designs into Buildings* and *The Architect's Handbook of Professional Practice*. In the design-bid-build methodology, project cost is a primary driver because contractors submit fixed price bids, allowing the owner to select a contractor at or under the owner's budget. This delivery method fulfills the community center's requirement of a fixed budget and contractor competition. In the construction manager as constructor delivery method, the contractor can provide technical advice early in the design process and a guaranteed maximum price (GMP) based on early design documents. They are also able to implement a fast track schedule with multiple construction documentation packages, fulfilling the requirements of the performing arts center. The construction manager as agent delivery method can provide the owner with early construction consulting, but does not provide a final construction cost during the design phase. Since the adaptive reuse project contains unknown conditions, a cost plus fixed fee delivery method would be the most appropriate because it disconnects the contractor's profit from any increase in project costs that may occur during construction.



This is an **A/E level** item because it requires the evaluation of different project goals and their alignment with various methods of project delivery.

**PcM** SECTION 4

# Practice Methodologies

*In this section you will need to analyze how a practice is structured to achieve its goals and how to coordinate various projects and services within a practice. This section is the smallest of the four sections in the Practice Management division.*

**OBJECTIVE 4.1 (8-12%)****Analyze the impact of practice methodologies relative to structure and organization of the practice (A/E)**

*Architects must be able to examine various ways to structure a practice to achieve the firm goals. This requires you to have an understanding of the various business structures and the role evidence-based design plays in order to achieve the firm goals.*

**OBJECTIVE 4.2 (8-12%)****Evaluate design, coordination, and documentation methodologies for the practice (A/E)**

*You must also be able to evaluate the impact of various methodologies—such as evidence-based design, integrated project delivery, or phasing—and analyze how these methodologies impact quality control and security throughout all phases of a project.*

## PcM SECTION 4

## Sample Items

## SAMPLE ITEM 8

Two architects are forming a new architectural design firm and need to choose a business entity. One architect anticipates bringing several existing clients while the other architect is leaving a larger firm and is unable to bring clients. They will initially only conduct business in one state and have no plans to add additional employees. The architects would like to protect their personal assets and maximize their tax benefits.

Which legal entity should the architects establish for their practice?

- Limited liability partnership
- General partnership
- Sub C corporation

## CORRECT RESPONSE

Two architects are forming a new architectural design firm and need to choose a business entity. One architect anticipates bringing several existing clients while the other architect is leaving a larger firm and is unable to bring clients. They will initially only conduct business in one state and have no plans to add additional employees. The architects would like to protect their personal assets and maximize their tax benefits.

Which legal entity should the architects establish for their practice?

- Limited liability partnership**
- General partnership
- Sub C corporation

**RATIONALE:** According to *Law for Architects: What You Need to Know* and *The Architect's Handbook of Professional Practice*, partners of a limited liability partnership (LLP) are not personally liable for obligations of the LLP, but may be liable for their own personal negligence. LLP's are not required to pay federal taxes, as income and losses are reported on each individual's tax return. A general partnership provides no liability protection for personal assets. Although sub C corporations protect stockholders' personal assets, both the corporation and stockholders pay federal taxes.



This is an **A/E level** item that requires you to compare and align goals of an architectural practice with business and legal structures.

## PcM SECTION 4

## Sample Items

## SAMPLE ITEM 9

A small architecture firm that specializes in educational and recreational facilities is developing a new quality control policy.

Which of the following should the policy require to manage the quality of project documentation? **Check the three that apply.**

- All construction details come from the firm's library of standard details
- A project team meeting at the completion of each phase
- Completion of a LEED checklist
- In-house third-party document reviews
- Completion of a deliverable checklist for each phase
- Use of the design-bid-build delivery method

**RATIONALE:** *The Architect's Handbook of Professional Practice* discusses quality control relative to project execution, including documentation. Project team meetings at the completion of each phase would provide the team an opportunity to discuss the project moving forward, ways to improve the drawing set, areas needing further attention, and lessons learned. In-house third-party document reviews allow architectural staff who have not previously been involved in the project to check the drawings for potential errors or conflicts missed by the design team. This is particularly beneficial before deliverables are issued. Checklists at each phase are an effective method of tracking and ensuring the completeness of project-specific tasks and documentation requirements. Completion of a LEED checklist and use of the design-bid-build delivery method may be required for a particular project or client, but are not appropriate for all project types and clients. A firm's standard detail library may improve documentation efficiency and the quality of specific details, but it could also place limitations on the project, design team, and building program.

## CORRECT RESPONSE

A small architecture firm that specializes in educational and recreational facilities is developing a new quality control policy.

Which of the following should the policy require to manage the quality of project documentation? **Check the three that apply.**

- All construction details come from the firm's library of standard details
- A project team meeting at the completion of each phase**
- Completion of a LEED checklist
- In-house third-party document reviews**
- Completion of a deliverable checklist for each phase**
- Use of the design-bid-build delivery method



**A/E**  
**LEVEL**

This is an **A/E level** item requiring you to determine tasks appropriate for a quality control policy.

# PcM References

## PUBLICATIONS

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The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### ***The Architect's Handbook of Professional Practice***

The American Institute of Architects  
John Wiley & Sons, 14th edition (2008)  
and 15th edition (2014)

### ***2020 Code of Ethics and Professional Conduct***

AIA Office of General Counsel  
The American Institute of Architects, 2020

### ***Legislative Guidelines and Model Law/Model Regulations***

National Council of Architectural Registration Boards  
2018-2019

### ***Model Rules of Conduct***

National Council of Architectural Registration Boards  
2018-2019

## AIA CONTRACT DOCUMENTS

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The following list of [AIA Contract Documents](#) have content covered in the Practice Management division.

### **B101-2017**

Standard Form of Agreement Between Owner  
and Architect

### **C401-2017**

Standard Form of Agreement Between Architect  
and Consultant

# Project Management (PjM)

This division will assess objectives related to the management of architectural projects, including organizing principles, contract management, and consultant management. The division will focus on issues related to office standards, development of project teams, and overall project control of client, fee, and risk management. Candidates must demonstrate an understanding of and abilities in quality control, project team configuration, and project scheduling. In addition, candidates must demonstrate the ability to establish and deliver project services per contractual requirements in collaboration with consultants.

<b>SECTION 1: Resource Management</b> .....	<b>30</b>
<b>SECTION 2: Project Work Planning</b> .....	<b>34</b>
<b>SECTION 3: Contracts</b> .....	<b>38</b>
<b>SECTION 4: Project Execution</b> .....	<b>42</b>
<b>SECTION 5: Project Quality Control</b> .....	<b>47</b>
<b>Project Management References</b> .....	<b>50</b>

# Project Management

## DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
75	68	7	2	12-16	3 hr	30 min	3 hr 40 min

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count toward or against your final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Administering contract requirements and competent delivery of project services
- Organizing a team to design and produce contract documents
- Coordinating project team activities and project budget
- Communicating information to all constituents throughout the project delivery process
- Developing a project schedule that defines tasks and meets milestones

The 75 items will assess you on five sections related to Project Management. The number of items from each section will vary based on the targeted percentage of items within each section.

## SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*
<b>SECTION 1:</b> Resource Management	5-10	7-13%
<b>SECTION 2:</b> Project Work Planning	13-17	17-23%
<b>SECTION 3:</b> Contracts	19-23	25-31%
<b>SECTION 4:</b> Project Execution	13-17	17-23%
<b>SECTION 5:</b> Project Quality Control	14-19	19-25%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you may experience may vary slightly as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

# Resource Management

*Once you have a signed contract, it's time to determine what resources will be needed to execute the project. In this section, you will need to determine the composition of the project team and how each team member's time will be managed and allocated in order to execute the project.*

## **OBJECTIVE 1.1 (3-7%)**

---

### **Determine criteria required to assemble team (U/A)**

*You will need to determine what internal staff and outside consultants will be needed to complete the project and fulfill the contract. This will include understanding fees related to the project and consultants. You will need to anticipate the specific responsibilities of the team being assembled.*

## **OBJECTIVE 1.2 (3-7%)**

---

### **Assess criteria required to allocate and manage project resources (A/E)**

*As the project proceeds, you will also need to assess appropriate levels of staffing relative to the project needs and fees. This will require tracking the progress of the project based on personnel, hours, fees, and schedule.*

## Sample Items

## PjM SECTION 1

## SAMPLE ITEM 1

An architect is responding to an RFP for an architect-led design-build multi-building office park project.

Which of the following will be the primary responsibilities of the architect while managing the project? **Check the four that apply.**

- Direct the engineering consultants in the selection of building systems.
- Develop and maintain a project schedule.
- Assume responsibility for the accuracy of the consultant's work.
- Develop and maintain the project budget.
- Schedule and control means and methods of construction.
- Develop staffing assignments for all project team members.

**RATIONALE:** *The Architect's Handbook of Professional Practice* explains that in an architect-led design-build project, the architect has overall responsibility for keeping the project on schedule and on budget, coordinating the design and working drawing process with consultants, and scheduling and controlling means and methods of construction. Directing the engineering consultants in their selections is a team process that relies on the consultant's expertise. Developing staffing assignments for all project team members would include consultants and should be done by the head team member from each discipline.

## CORRECT RESPONSE

An architect is responding to an RFP for an architect-led design-build multi-building office park project.

Which of the following will be the primary responsibilities of the architect while managing the project? **Check the four that apply.**

- Direct the engineering consultants in the selection of building systems.
- Develop and maintain a project schedule.**
- Assume responsibility for the accuracy of the consultant's work.**
- Develop and maintain the project budget.**
- Schedule and control means and methods of construction.**
- Develop staffing assignments for all project team members.



This is a **U/A level** item requiring you to understand managing a team in an architect-led design-build project versus a contractor-led design-build project and the work of the team member and their teams.

**PjM SECTION 1**

Sample Items

**SAMPLE ITEM 2**

An architect has a total design budget of \$300,000. To estimate the weekly hours for each member of the architectural design team, the following criteria must be considered:

- The design schedule for the project is 16 weeks long at 40 hours per week.
- 30% of the total design fee is allocated to design consultants.
- Firm goal is to achieve a 3.0 multiplier for all employees.
- 25% of the Principal’s time will be devoted to the project.
- Utilization of the Project Architect and Architectural Designer should be maximized.

Drag the weekly hour allocations for each design team member from the left into the corresponding boxes of the labor schedule. Not all allocations will be used.

<b>10</b> <b>15</b> <b>20</b> <b>25</b> <b>30</b> <b>35</b> <b>40</b>	<b>Available Staff</b>	<b>Direct Rate</b>	<b>Weekly Person-Hours</b>
	Principal	\$95	
	Project Manager	\$40	
	Project Architect	\$40	
	Architectural Designer	\$25	

## Sample Items

**PjM SECTION 1**

### SAMPLE ITEM 2 - CORRECT RESPONSE

**RATIONALE:** To determine the number of hours to allocate for each design team member, begin by calculating the weekly direct rate budget and removing 30% for design consultants. This is done by dividing the maximum labor budget with design consultant fees removed by the company multiplier, then dividing by the weeks of the project **(Step 1)**. Allocate the Principal’s weekly hours to the project **(Step 2)**. The utilization rates of both the Project Architect and the Architectural Designer are to be maximized; meaning each of these project team members will allocate 40 hours per week on the project **(Step 3)**. This will provide you the remaining weekly budget to allocate to the Project Manager **(Step 4)**. Divide the \$825 remaining by the Project Manager’s rate **(Step 5)**. The remaining \$25 each week can be used to buy each team member a latte.

- Step 1:**  $(\$300,000 \times .70) / 3 = \$70,000$   
 $\$70,000 / 16 \text{ weeks} = \$4,375 \text{ per week}$
- Step 2:**  $.25 \times 40 \text{ hrs.} = 10 \text{ hours}$   
 $10 \times \$95 = \$950 \text{ per week}$
- Step 3:**  $(\$40 + \$25) \times 40 \text{ hrs.} = \$2600 \text{ per week}$
- Step 4:**  $\$4375 - \$2600 - \$950 = \$825 \text{ remaining}$
- Step 5:**  $\$825 / \$40 = 20.625 \text{ hours}$

<b>10</b> <b>15</b> <b>20</b> <b>25</b> <b>30</b> <b>35</b>	Available Staff	Direct Rate	Weekly Person-Hours
	Principal	\$95	<b>10</b>
	Project Manager	\$40	<b>20</b>
	Project Architect	\$40	<b>40</b>
	Architectural Designer	\$25	<b>40</b>



This is an **A/E level** item because it requires the evaluation of the design budget, the allocations for consultants, and the company multiplier in order to determine the appropriate number of hours for design team members.

PjM

SECTION 2

# Project Work Planning

*In this section, you will evaluate effective ways to develop and communicate a work plan with the assembled project team in order to complete the project.*

## **OBJECTIVE 2.1 (5-9%)**

---

### **Develop and maintain project work plan (U/A)**

*You will need to use resources such as Gantt charts or critical path schedules, to identify key activities and milestones in a project and how they can be achieved. You will also need to be able to modify schedules and work plans to incorporate feedback or changes to the project.*

## **OBJECTIVE 2.2 (5-9%)**

---

### **Determine criteria required to develop and maintain project schedule (A/E)**

*Prioritizing tasks and evaluating their impact on a balanced workload is a critical aspect of this section. You will need to assess how outside factors, like client reviews, regulatory submissions, and testing, impact work plans and schedules.*

## **OBJECTIVE 2.3 (4-8%)**

---

### **Determine appropriate communication to project team – owner, contractor, consultants and internal staff (U/A)**

*Architects must also determine the type and content of documents needed to communicate during the work planning phase of a project. These include documents such as agendas, meeting minutes, emails, and memos.*

## Sample Items

## PjM SECTION 2

## SAMPLE ITEM 3

A construction manager will best be used by joining a team during which phase of a fast track project?

- Schematic design
- Construction documents
- Bidding
- Construction administration

## CORRECT RESPONSE

A construction manager will best be used by joining a team during which phase of a fast track project?

- Schematic Design**
- Construction documents
- Bidding
- Construction administration

**RATIONALE:** *The Architect's Handbook of Professional Practice* identifies that an owner will gain the greatest advantage from a construction manager by including them during the schematic design phase and for the remainder of the project. This will provide continuity to the project in terms of a project design, budget and schedule. A construction manager adds technical and cost estimating advice, so their joining the team early increases their value to the project and reduces risks associated with a fast track project. The other three phases all typically occur after the design has been set.



This is a **U/A level** item because it requires you to understand the relationship between a construction manager and the owner, as well as the role of a construction manager as it applies to the phases of a fast track project.

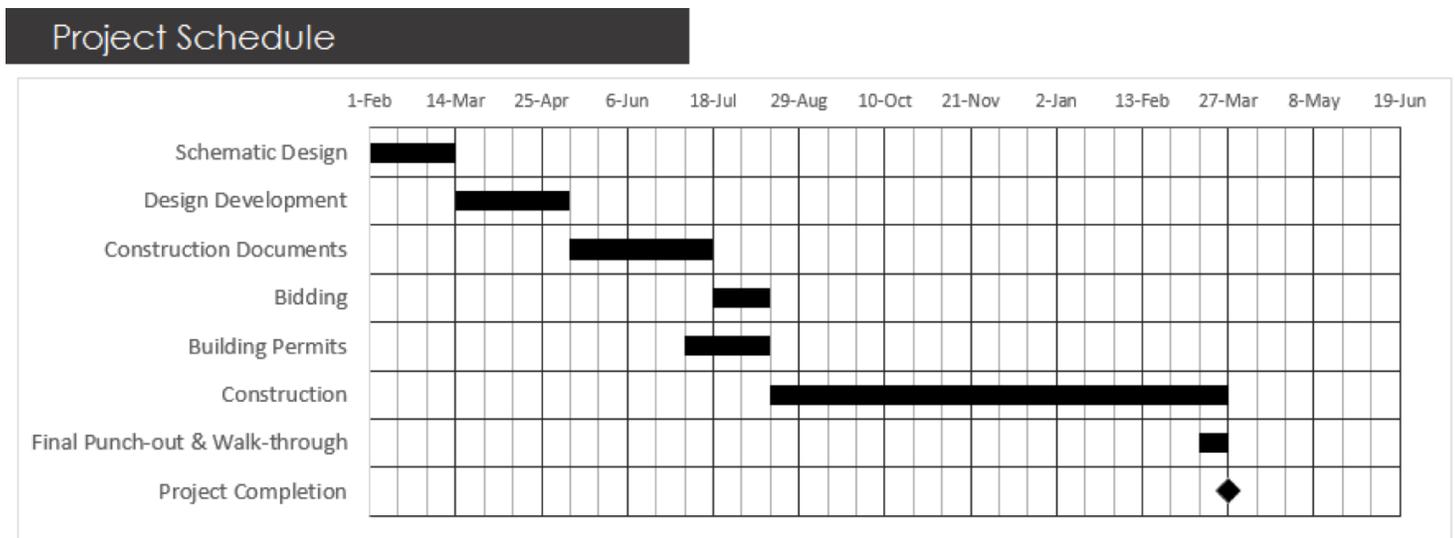
# Sample Items

**PjM SECTION 2**

**SAMPLE ITEM 4**

During the construction document phase, an owner requests changes that will delay permitting by three weeks, delay bidding by two weeks, and add an additional three weeks to the construction schedule.

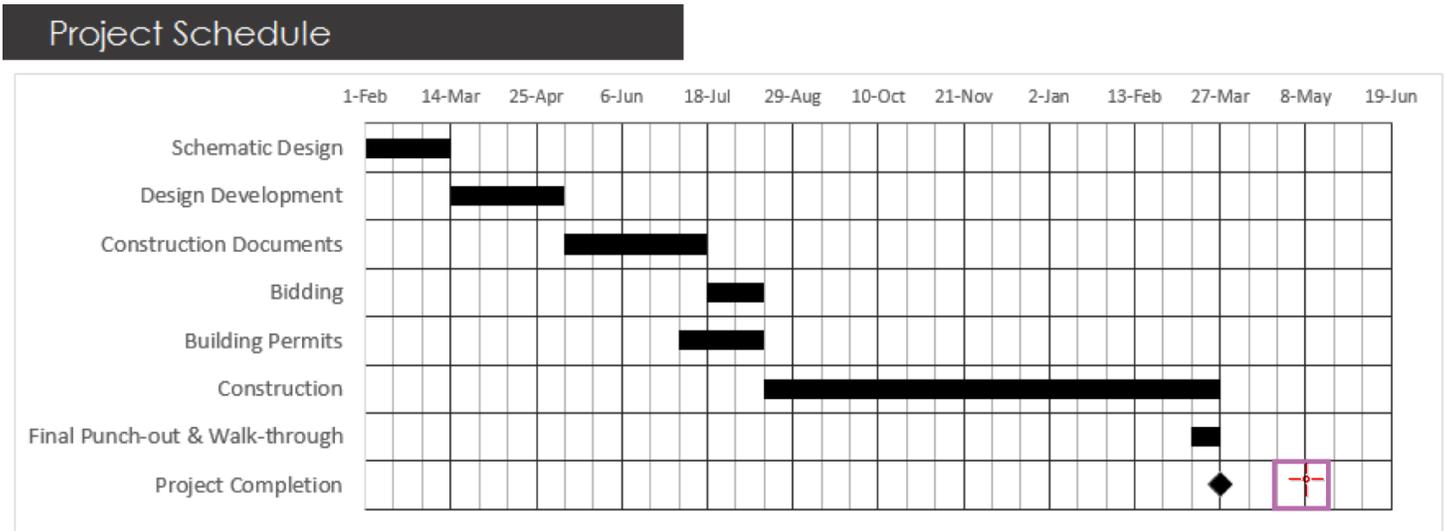
Click on the project completion point in the schedule below that reflects the impact of these changes. Each vertical line on the schedule represents two weeks.



# Sample Items

**PjM SECTION 2**

**SAMPLE ITEM 4 - CORRECT RESPONSE**



**RATIONALE:** Delays to permitting will cause other items to be delayed and the overall schedule will need to be adjusted. The delays to bidding and permitting are concurrent, so they push back the start of construction by three weeks. An additional three weeks must be added to the construction timeline. The new completion date will be six weeks later.



This is an **A/E level item** because it requires you to analyze the impact of each of the delays and determine their impact on the overall project completion.

# Contracts

*In this section, you will analyze the contracts that establish relationships between the architect, owner, contractors, and consultants.*

## **OBJECTIVE 3.1 (10-14%)**

---

### **Evaluate and verify adherence to owner/architect agreement (A/E)**

*AIA Document B101 is the primary document in this relationship. With a clear understanding of each article, you should be able to differentiate between basic, supplemental, and additional services; determine requisite billing for each phase; and recognize when a phase is completed. You will need to select the appropriate delivery method based on standard contract requirements.*

## **OBJECTIVE 3.2 (5-9%)**

---

### **Interpret key elements of, and verify adherence to architect/consultant agreement (U/A)**

*AIA Document C401 is the primary document in this relationship. You will need to identify contract requirements related to completing a project, additional services, and payment schedules.*

## **OBJECTIVE 3.3 (4-8%)**

---

### **Interpret key elements of the owner/contractor agreement (U/A)**

*AIA Documents A101 and A201 are the primary documents for this relationship. You will need to understand the architect's role relative to the owner when working with a contractor across various delivery methods.*

## **OBJECTIVE 3.4 (1-5%)**

---

### **Interpret key elements of the owner/architect agreement to integrate an owner's consultant's work into the project (U/A)**

*You will need to understand how an owner's consultant's work affects project deliverables. This requires identifying how to sequence, integrate, and coordinate an owner's consultant's work in the overall project.*

## Sample Items

## PjM SECTION 3

## SAMPLE ITEM 5

An A/V consultant is installing the wiring and equipment for an office intranet and notices conflicts with the HVAC ductwork.

According to AIA Document C401, how should the A/V consultant address this conflict?

- Notify the architect only.
- Notify the mechanical consultant only.
- Notify both the architect and mechanical consultant.

## CORRECT RESPONSE

An A/V consultant is installing the wiring and equipment for an office intranet and notices conflicts with the HVAC ductwork.

According to AIA Document C401, how should the A/V consultant address this conflict?

- Notify the architect only.**
- Notify the mechanical consultant only.
- Notify both the architect and mechanical consultant.

**RATIONALE:** According to AIA Document C401-2017, a consultant is not responsible for errors on the part of other consultants, but if they become aware of any conflicts they should promptly notify the architect.



This is a **U/A level** item because you need to understand and apply the details of the contract to this situation.

## Sample Items

## PjM SECTION 3

## SAMPLE ITEM 6

According to AIA Document A201, for which of the following activities is a contractor responsible? **Check the three that apply.**

- Compiling a comprehensive punch list
- Providing the notice of substantial completion
- Preparing the final change order
- Issuing the certificate of occupancy
- Providing the notice of final completion
- Preparing the certificate of final payment

**RATIONALE:** According to AIA Document A201-2017, the contractor is responsible for compiling a punch list, providing notice of substantial completion, and providing notice of final completion. The architect is responsible for preparing any change orders and the certificate of final payment. The building department issues the certificate of occupancy.

## CORRECT RESPONSE

According to AIA Document A201, for which of the following activities is a contractor responsible? **Check the three that apply.**

- Compiling a comprehensive punch list**
- Providing the notice of substantial completion**
- Preparing the final change order
- Issuing the certificate of occupancy
- Providing the notice of final completion**
- Preparing the certificate of final payment



This is a **U/A level** item because it requires you to know the different roles of contractors and architects regarding notices and certificates throughout the execution of this standard contract.

## Sample Items

## PjM SECTION 3

## SAMPLE ITEM 7

At the end of the design development phase for an office park, the owner reports that a major tenant had backed out of the project. The owner delays the project two months to either find a new tenant or secure additional funding.

Working under AIA Document B101, which of the following should the architect do during the two-month project suspension? **Check the three that apply.**

- Request payment for design development.
- Request two-month advance fee for construction documents.
- Prepare final bid package before ceasing work.
- Assist the owner in lining up a new tenant.
- Request payment for expenses incurred in the interruption of the architect's services.
- Submit revised schedule for when the project resumes.

**RATIONALE:** According to AIA Document B101-2017, if the owner suspends a project, the architect is entitled to payment for all expenses incurred up to that point. The architect can also request payment for expenses incurred because of the interruption. And, if the project resumes, a revised schedule can be submitted. When an owner suspends a project, the architect should suspend work on the project, so requesting an advance or completing other work is unwise for the architect. While assisting the owner in lining up a tenant may get the project back on track, it is beyond the scope of a standard owner/architect relationship and is not the role of the architect.

## CORRECT RESPONSE

At the end of the design development phase for an office park, the owner reports that a major tenant had backed out of the project. The owner delays the project two months to either find a new tenant or secure additional funding.

Working under AIA Document B101, which of the following should the architect do during the two-month project suspension? **Check the three that apply.**

- Request payment for design development.**
- Request two-month advance fee for construction documents.
- Prepare final bid package before ceasing work.
- Assist the owner in lining up a new tenant.
- Request payment for expenses incurred in the interruption of the architect's services.**
- Submit revised schedule for when the project resumes.**



This is an **A/E level** item because it requires you to analyze a situation and use your understanding of the contract to determine the delay results in both a suspension of work and consequences for both parties.

## PjM

## SECTION 4

# Project Execution

*This section assesses management of the project's execution. It is not about the design-related decisions, but rather the necessary administrative procedures throughout the project.*

**OBJECTIVE 4.1 (3-7%)****Evaluate compliance with construction budget (A/E)**

*Architects must confirm all items in construction estimates to ensure they align with the budget. You must also evaluate estimates throughout the course of the project to mitigate changes in material or scope to comply with the budget.*

**OBJECTIVE 4.2 (3-7%)****Evaluate and address changes in scope of work and scope creep (A/E)**

*You will need to be able to analyze changes in scope to determine the impact on fees, schedules, and owner financing.*

**OBJECTIVE 4.3 (5-9%)****Evaluate project documentation to ensure it supports the specified delivery method (A/E)**

*As an architect, you must be able to determine the appropriate documentation needed for projects, including consultant documents. You must also be able to coordinate close-out and construction administration documentation.*

**OBJECTIVE 4.4 (1-5%)****Identify and conform with the requirements set forth by authorities having jurisdiction in order to obtain approvals for the project (U/A)**

*Lastly, you will need to be able to identify which authorities have jurisdiction over projects and determine what submittals are required for project approvals. This includes properly responding to questions or feedback from these authorities. Authorities could include zoning commissions, neighborhood review boards, or plan reviewers.*

## PjM SECTION 4

## Sample Items

## SAMPLE ITEM 8

Which of the following items would typically be part of a site plan documentation submittal between the owner and the city planning department? **Check the four that apply.**

- Building footprint
- Legal boundary survey
- Building construction type
- Civil engineer's storm water management plan
- Landscape planting plan
- Building life safety plan

## CORRECT RESPONSE

Which of the following items would typically be part of a site plan documentation submittal between the owner and the city planning department? **Check the four that apply.**

- Building footprint**
- Legal boundary survey**
- Building construction type
- Civil engineer's storm water management plan**
- Landscape planting plan**
- Building life safety plan

**RATIONALE:** *The Architect's Handbook of Professional Practice* discusses how most municipalities require an extensive description of a project proposal, including all aspects of the architectural design, landscape design, and engineering studies for storm water and traffic management. The building construction type and a building's life safety plan are generally included in the permitting documents.



This is a **U/A level** item requiring you to understand different types of documentation used in a project and determine which ones relate to site planning submittals to a city planning department.

## Sample Items

## PjM SECTION 4

## SAMPLE ITEM 9

During the construction phase, the owner requests changes that will require 10 additional footings.

The contractor has supplied the following cost information:

- Size of each footing: 4.5 ft. x 4.5 ft. x 36 ft.
- Crew labor cost: \$175 per cubic yard.
- Material cost including reinforcing: \$225 per cubic yard.
- Miscellaneous equipment cost: \$3.00 per cubic yard.
- Contractor's overhead and profit: 10%

The construction budget is \$10,000,000 and the current construction cost is \$9,900,000.

How much over budget will this requested change place the project? Round to the nearest whole dollar.

\$

## PjM SECTION 4

## Sample Items

## SAMPLE ITEM 9 - CORRECT ANSWER

\$ 19,691

**RATIONALE:** The requested modification by the owner will increase the current construction budget. The architect must first determine the total cost of the requested change. To do so, determine the total volume of the additional footings (**Step 1**). Then determine the total cost of the footings, including labor, materials, and miscellaneous equipment costs (**Step 2**). The contractor's overhead and profit must all be included in the increased costs (**Step 3**). The total cost of the additional footings and the current construction cost must then be compared to the construction budget amount (**Step 4**). Because the \$ is in front of the answer box, only the numerals need to be entered into the box. Round to the nearest whole number as stated.

**Step 1:**  $(4.5 \text{ ft.} \times 4.5 \text{ ft.} \times 36 \text{ ft.}) \times 10 \text{ locations} = 7,290 \text{ cu. ft.} = 270 \text{ cu. yd.}$

**Step 2:**  $(\$175 + \$225 + \$3) \times 270 \text{ cu. yd.} = \$108,810$

**Step 3:**  $\$108,810 \times 110\% = \$119,691$

**Step 4:**  $(\$119,691 + \$9,900,000) - \$10,000,000 = \$19,691$



This is an **A/E level** item because it requires you to analyze the information given and calculate the increase in labor and materials compared to the current project budget.

## Sample Items

## PjM SECTION 4

## SAMPLE ITEM 10

An owner has purchased a 50,000-square-foot parcel of undeveloped land located near an older neighborhood undergoing revitalization. The owner wants to develop the land into a five-home subdivision.

Working under AIA Document B101, what steps should the architect take once the owner supplies an initial budget amount for the project? **Check the three that apply.**

- Analyze the budget against UniFormat for design cost management.
- Evaluate the budget against the program.
- Negotiate a higher budget for risk mitigation.
- Analyze the budget against the schedule.
- Begin development of design documents based on the budget.
- Evaluate the budget against market conditions.

**RATIONALE:** According to AIA Document B101-2017, the architect should always evaluate a budget amount with respect to the stated program, anticipated schedule, and market conditions. The architect should not begin the development of design documents without first understanding the budget amount and its impact. Negotiating a higher budget as a risk mitigation technique is not a wise strategy and may jeopardize the project. UniFormat is a classification system used for estimating construction costs and does not apply to project budgeting.

## CORRECT RESPONSE

An owner has purchased a 50,000-square-foot parcel of undeveloped land located near an older neighborhood undergoing revitalization. The owner wants to develop the land into a five-home subdivision.

Working under AIA Document B101, what steps should the architect take once the owner supplies an initial budget amount for the project? **Check the three that apply.**

- Analyze the budget against UniFormat for design cost management.
- Evaluate the budget against the program.**
- Negotiate a higher budget for risk mitigation.
- Analyze the budget against the schedule.**
- Begin development of design documents based on the budget.
- Evaluate the budget against market conditions.**



This is a **U/A level** item because it requires an understanding of the budget process and the relationship between the owner and the architect.

**PjM SECTION 5**

# Project Quality Control

The last section in this division analyzes quality control methods, procedures, and review processes in order to maintain the proper Standard of Care throughout the entire project. As with the previous sections, this section is not about the design-related decisions, but rather the necessary administrative procedures throughout the project.

**OBJECTIVE 5.1 (2-6%)****Apply procedures required for adherence to laws and regulations relating to the project (U/A)**

You will need to be able to identify the government agencies who have jurisdiction on the project and determine what permits and procedures will be required throughout the project duration. This also includes establishing protocols to maintain compliance on the project site. In addition, you'll need to know the requirements for performing a code analysis and understand the impact of building, zoning, and other jurisdictional codes on design and construction.

**OBJECTIVE 5.2 (4-8%)****Identify steps in maintaining project quality control, and reducing risks and liabilities (A/E)**

You will need to establish review processes to be utilized throughout the project to evaluate quality control, assess risk and liabilities, and identify level of completion at each phase of the project. Understanding the different types of insurance related to architectural practice and understanding strategies for conflict resolution are also critical ways to manage risks and liabilities.

**OBJECTIVE 5.3 (5-9%)****Perform quality control reviews of project documentation throughout life of project (A/E)**

You will need to carry out the review steps and procedures identified and established in the previous objective with regards to quality control and risk. This includes coordinating the design work and documentation of consultants. It's critical to assess the impact of design decisions and changes on constructability.

**OBJECTIVE 5.4 (3-7%)****Evaluate management of the design process to maintain integrity of design objectives (A/E)**

As an architect, you must ensure design objectives are continually monitored and met across all phases of design. In this division, it is not about the design details, but the process of communicating the design objectives through regular collaboration with project stakeholders.

## Sample Items

PjM

SECTION 5

## SAMPLE ITEM 11

During a peer-review of design documents for the local university's new business school building, the reviewer notes conflicting code references for means of egress on the life safety sheet.

The architect should design to which of the following?

- The adopted code of the local jurisdiction
- The adopted state building code
- The ICC and NFPA model building codes
- Whichever adopted code is most stringent

## CORRECT RESPONSE

During a peer-review of design documents for the local university's new business school building, the reviewer notes conflicting code references for means of egress on the life safety sheet.

The architect should design to which of the following?

- The adopted code of the local jurisdiction
- The adopted state building code
- The ICC and NFPA model building codes
- Whichever adopted code is most stringent**

**RATIONALE:** *The Architect's Handbook of Professional Practice* discusses how most jurisdictions across the United States have adopted building codes based on the ICC family of codes. At the same time, both states and local jurisdictions have the authority to make changes to portions of the building codes. As the architect, you have a legal duty to design in compliance with all the codes that govern the type and location of the project. Researching the jurisdictions and requirements for a specific project is the responsibility of the architect. When multiple codes conflict, the most stringent code always takes precedence.



This is a **U/A level** item because it requires you to understand the relationship between codes and jurisdictions and then to apply them to a specific project.

## Sample Items

## PjM SECTION 5

## SAMPLE ITEM 12

During a review of bid documents for a renovation project, the architect notices that several details are missing information due to concealed building conditions. The full scope of this work cannot be identified until demolition work is in progress.

To control project costs and limit cost increases during construction, which strategies should the architect choose as part of the bid documents? **Check the two that apply.**

- Contingencies
- Unit prices
- Change orders
- Addenda
- Bid alternates
- Supplemental instructions

**RATIONALE:** Often on renovation projects there are unknown elements or quantities until demolition occurs. Strategies to minimize this risk should be discussed with the owner and incorporated into the documents. Unit prices establish a cost for performing additional work by the contractor when encountering unknown conditions. Bid alternatives define a change in cost for scope or quality of materials during the bidding process. This provides the owner with options to reduce the overall construction costs as necessary in order to maintain the project budget. Contingencies should be a part of a project budget and cost estimate, but are not a strategy for controlling costs. Change orders are issued during construction to identify changes in the contract but are also not an effective cost control. Addenda modify the bid documents during the bid phase but do not control costs. Supplemental instructions are modifications to the general conditions of a contract and typically have a limited impact on costs.

## CORRECT RESPONSE

During a review of bid documents for a renovation project, the architect notices that several details are missing information due to concealed building conditions. The full scope of this work cannot be identified until demolition work is in progress.

To control project costs and limit cost increases during construction, which strategies should the architect choose as part of the bid documents? **Check the two that apply.**

- Contingencies
- Unit prices**
- Change orders
- Addenda
- Bid alternates**
- Supplemental instructions



This is an **A/E level** item because it requires you to understand where you are in the development phase of a project and also how one can deal with known costs without a definite scope.

# PjM References

## PUBLICATIONS

The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### ***The Architect's Handbook of Professional Practice***

The American Institute of Architects  
John Wiley & Sons, 14th edition (2008) and  
15th edition (2014)

### ***Professional Practice: A Guide to Turning Designs into Buildings***

Paul Segal, FAIA  
W. W. Norton, 2006

## AIA CONTRACT DOCUMENTS

The following list of [AIA Contract Documents](#) have content covered in the Project Management division.

### **A101-2017**

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

### **A133-2019**

Standard Form of Agreement Between Owner and Construction Manager as Constructor where the basis of payment is the Cost of the Work Plus a Fee with a Guaranteed Maximum Price

### **A195-2008**

Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery

### **A201-2017**

General Conditions of the Contract for Construction

### **A295-2008**

General Conditions of the Contract for Integrated Project Delivery

### **B101-2017**

Standard Form of Agreement Between Owner and Architect

### **B195-2008**

Standard Form of Agreement Between Owner and Architect for Integrated Project Delivery

### **C401-2017**

Standard Form of Agreement Between Architect and Consultant

# Programming & Analysis (PA)

This division will assess objectives related to the evaluation of project requirements, constraints, and opportunities. The division will focus on issues related to programming, site analysis, and zoning and code requirements. Candidates must demonstrate an understanding of and abilities in project type analysis, the establishment of qualitative and quantitative project requirements, evaluation of project site and context, and assessment of economic issues.

<b>SECTION 1: Environmental &amp; Contextual Conditions</b> .....	<b>53</b>
<b>SECTION 2: Codes &amp; Regulations</b> .....	<b>57</b>
<b>SECTION 3: Site Analysis &amp; Programming</b> .....	<b>60</b>
<b>SECTION 4: Building Analysis &amp; Programming</b> .....	<b>65</b>
<b>Programming &amp; Analysis References</b> .....	<b>72</b>

# Programming & Analysis

## DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
75	68	7	2	12-16	3 hr	30 min	3 hr 40 min

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count toward or against your final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Evaluating qualitative and quantitative project requirements
- Analyzing environmental, social, and economic requirements of a project
- Synthesizing project requirements based on gathered information

The 75 items will assess you on four sections related to Programming & Analysis. The number of items from each section will vary based on the targeted percentage of items within each section.

## SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*	
<b>SECTION 1:</b> Environmental & Contextual Conditions	11-16	14-21%	
<b>SECTION 2:</b> Codes & Regulations	12-17		16-22%
<b>SECTION 3:</b> Site Analysis & Programming	16-20		21-27%
<b>SECTION 4:</b> Building Analysis & Programming	28-32		37-43%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you may experience may vary slightly as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

## PA

## SECTION 1

# Environmental & Contextual Conditions

*In this section, you'll evaluate a project site and identify both the opportunities and constraints that may impact future development.*

**OBJECTIVE 1.1 (2-6%)** \_\_\_\_\_**Evaluate site-specific environmental and socio-cultural opportunities (A/E)**

*You will need to analyze a project site and assess opportunities that could be incorporated into future site and building development. These opportunities may include alternative energy resources, natural landscape features, microclimates, and neighborhood context, along with other environmental, social, and cultural conditions.*

**OBJECTIVE 1.2 (7-11%)** \_\_\_\_\_**Evaluate site-specific environmental constraints (A/E)**

*You will need to analyze a project site and assess constraints and hazardous conditions that could limit a building's location and future site development. These constraints may include issues like a floodplain, unstable soil, radon, lead, a brownfield, abandoned structures, environmental policies and regulations, or vulnerabilities and risks associated with climate change. You will also need to identify strategies that could mitigate adverse site conditions.*

**OBJECTIVE 1.3 (2-6%)** \_\_\_\_\_**Determine optimal use of onsite resources by incorporating sustainability principles (U/A)**

*After evaluating a site for both opportunities and constraints, you must be able to identify appropriate design responses for a building's location, orientation, massing, footprint, and passive energy use in order to minimize the project's negative environmental impacts and make use of existing natural features.*

## PA

## SECTION 1

## Sample Items

## SAMPLE ITEM 1

An owner has selected a hilly site for a new two-story residence. The site is located in a temperate climate with winter winds predominantly from the northwest and summer winds from the southwest.

Which location on the site is a favorable microclimate for passive heating, cooling, and daylighting?

- Bottom of the north-facing slope
- Bottom of the south-facing slope
- Midway up the south-facing slope

**RATIONALE:** According to *Sun, Wind & Light: Architectural Design Strategies*, locating the residence midway up the south-facing slope would be favorable for access to sun and summer winds, which are critical components of passive heating, cooling, and daylighting. The bottom of the slope would not be favorable due to cold air collection in the winter.

## CORRECT RESPONSE

An owner has selected a hilly site for a new two-story residence. The site is located in a temperate climate with winter winds predominantly from the northwest and summer winds from the southwest.

Which location on the site is a favorable microclimate for passive heating, cooling, and daylighting?

- Bottom of the north-facing slope
- Bottom of the south-facing slope
- Midway up the south-facing slope**



This is an **A/E level** item requiring you to analyze the environmental conditions to determine the site location that has the greatest potential to accommodate passive design.

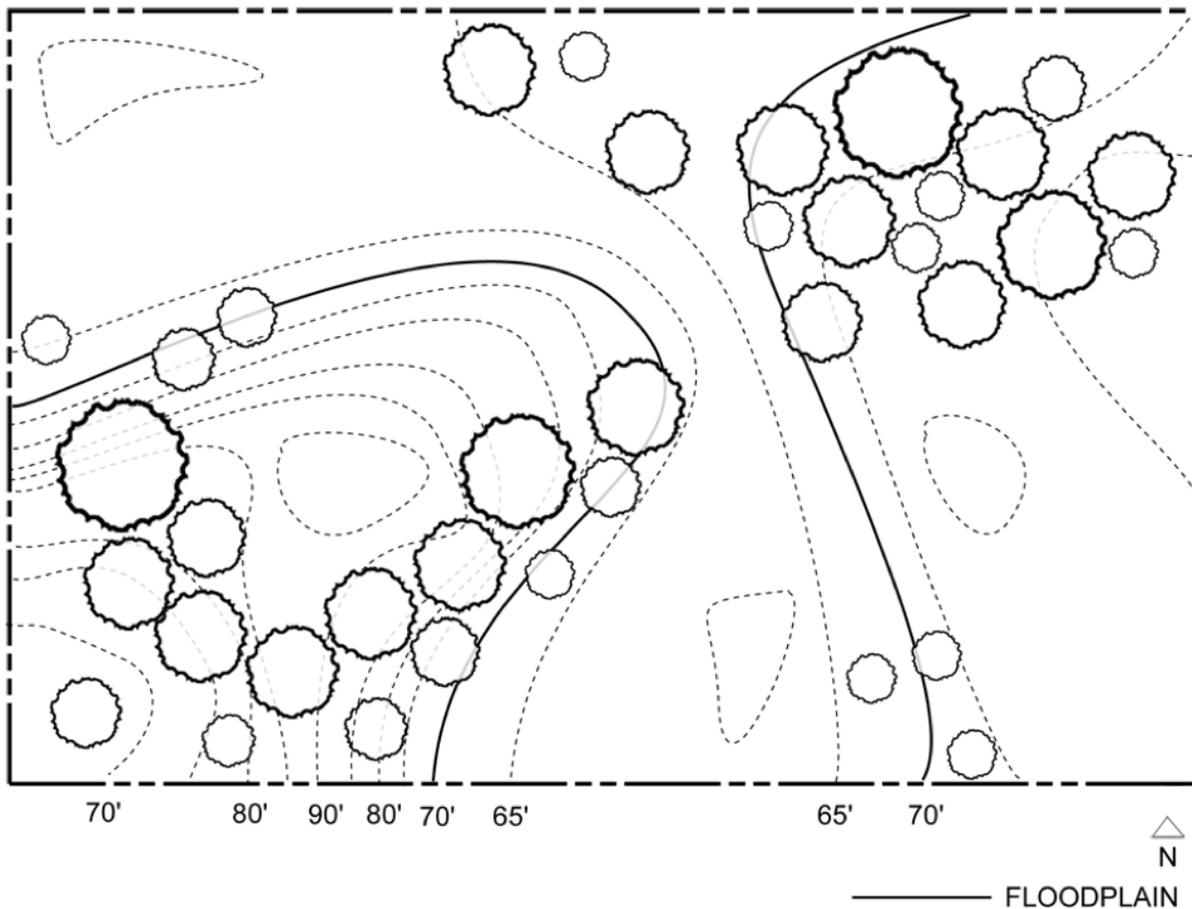
PA SECTION 1

Sample Items

SAMPLE ITEM 2

A parks and recreation society has approached an architect to construct a picnic pavilion, restroom facility, and recreational volleyball courts on a riverfront property. The client has requested the development of the site be environmentally responsive and cost effective.

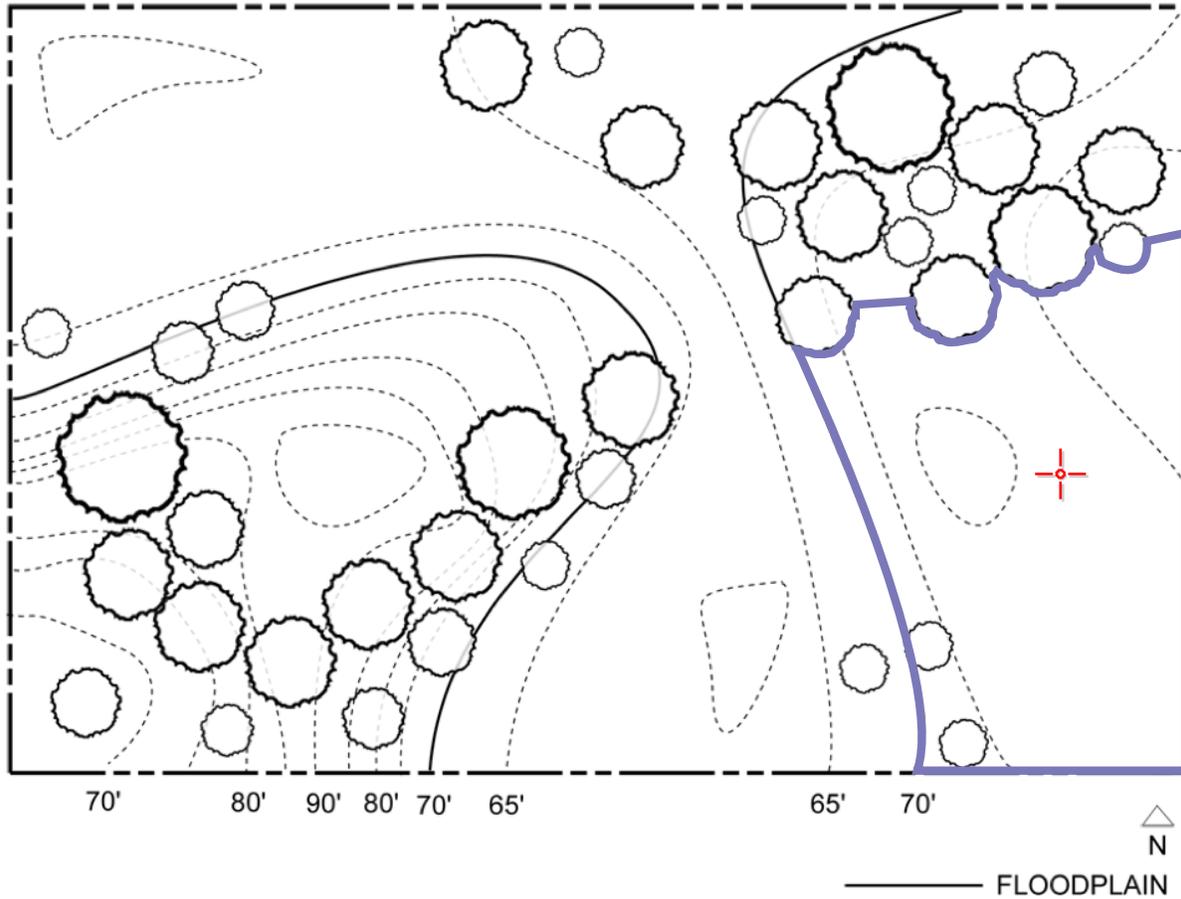
Click on the area of the site plan below where the architect should recommend the development be located.



PA SECTION 1

Sample Items

SAMPLE ITEM 2 - CORRECT RESPONSE



**RATIONALE:** The architect should recommend the southeastern region of the site. *The Site Planning and Design Handbook* discusses site analysis, sustainability, and development principles that can be directly applied to the evaluation of this riverfront property. The southeastern area of the site is relatively flat, limiting the amount of construction dollars dedicated to excavation and related site work. It is also located outside of the defined floodplain, reducing the potential risk of water damage to the buildings and recreational courts over time.



This is an **A/E level** item requiring you to evaluate the existing site constraints to determine which areas of the site may inhibit development. You must also determine which areas of the site present design opportunities that fulfill the client's requirements.

## PA

## SECTION 2

# Codes & Regulations

*In this section, you'll look at the codes and regulations appropriate to the initial analysis and programming phase of a project.*

**OBJECTIVE 2.1 (5-9%)****Identify relevant code requirements for building and site types (U/A)**

*As an architect, you need to be able to determine and understand the codes and regulations that govern a specific project type and geographic region. This includes distinguishing relevant accessibility and ADA requirements, applicable building and energy codes, and sustainability-related standards and guidelines. It's important to conduct an initial code analysis to understand how the codes will affect a project's design.*

**OBJECTIVE 2.2 (5-9%)****Identify relevant zoning and land use requirements (U/A)**

*You need to be able to determine and understand requirements that limit the extent of site and building development. This includes issues like setbacks, footprint limitations, maximum building heights, FAR, parking requirements, easements, and other zoning and land use regulations. Recognizing situations where a special exception or variance is suitable and understanding the process for approval are also included in this objective.*

**OBJECTIVE 2.3 (3-7%)****Identify relevant local and site-specific requirements (U/A)**

*You will need to determine and understand specialty regulations that apply to a particular site. These may include requirements about wetlands, flood plains, design overlay districts, or historic preservation.*

## PA

## SECTION 2

## Sample Items

## SAMPLE ITEM 3

An architect has been selected to complete a major interior and exterior renovation of all areas within a three-story library building. The building was constructed in the early-1980s.

During the programming phase of the project, which of the following should the architect recommend to the client regarding accessibility?

- Only the public spaces need to be made accessible.
- Only the primary function spaces need to be made accessible.
- All areas of the library should be made accessible.
- Since this is a renovation of an existing building, accessibility upgrades are not required.

**RATIONALE:** The *ADA Standards for Accessible Design* require all altered elements and spaces within a renovation project to comply with the accessibility standards. Since this is a major renovation of all areas within the building, the architect should recommend that all areas of the library be made accessible.

## CORRECT RESPONSE

An architect has been selected to complete a major interior and exterior renovation of all areas within a three-story library building. The building was constructed in the early-1980s.

During the programming phase of the project, which of the following should the architect recommend to the client regarding accessibility?

- Only the public spaces need to be made accessible.
- Only the primary function spaces need to be made accessible.
- All areas of the library should be made accessible.**
- Since this is a renovation of an existing building, accessibility upgrades are not required.



This is a **U/A level** item requiring you to identify accessibility requirements that are applicable to a renovation project.

## PA

## SECTION 2

## Sample Items

## SAMPLE ITEM 4

Setback rules, as prescribed by a zoning ordinance, can accomplish which of the following? **Check the three that apply.**

- Prescribe adjacent building uses.
- Ensure availability of light and air circulation.
- Establish a minimal degree of privacy.
- Establish building exterior wall construction.
- Minimize floor area ratio.
- Provide space for maintenance of building exteriors.

## CORRECT RESPONSE

Setback rules, as prescribed by a zoning ordinance, can accomplish which of the following? **Check the three that apply.**

- Prescribe adjacent building uses.
- Ensure availability of light and air circulation.**
- Establish a minimal degree of privacy.**
- Establish building exterior wall construction.
- Minimize floor area ratio.
- Provide space for maintenance of building exteriors.**

**RATIONALE:** As described in *Building Construction Illustrated*, a setback in zoning is a prescribed distance in which a structure is set back from a property line or other identified element. Setbacks ensure access to air and light, provide building privacy, and provide space to perform building maintenance. Zoning ordinances typically address floor area ratio, adjacent building uses, and exterior wall construction; however, these are not accomplished through the implementation of setback rules.



This is a **U/A level** item requiring you to understand setbacks within zoning requirements, as well as what they can accomplish when applied to a building project.

## PA

## SECTION 3

# Site Analysis & Programming

*In this section, you'll need to analyze a project site relative to the program and project requirements.*

**OBJECTIVE 3.1 (6-10%)****Evaluate relevant qualitative and quantitative attributes of a site as they relate to a program (A/E)**

*This objective assesses your ability to analyze a project site relative to the requirements in the program to determine if it is appropriate and feasible for development. You will need to consider the climate, topography, drainage, soil, built and natural features, utilities, access points, traffic patterns, easements, and other attributes relevant to the project and program.*

**OBJECTIVE 3.2 (8-12%)****Synthesize site reports with other documentation and analysis (A/E)**

*In addition to analyzing the attributes of the site, you will also need to review and interpret site documentation such as geotechnical reports, landscape reports, archaeological studies, utility surveys, topographic maps, demographics, traffic studies, environmental data, historic reports, and other site related reports. This is used to determine the feasibility of a project and verify the selection of site related consultants needed to execute the project.*

**OBJECTIVE 3.3 (4-8%)****Analyze graphical representations regarding site analysis and site programming (A/E)**

*You must be able to evaluate and understand diagrammatic graphics and how they are used to represent and communicate site conditions, relationships, and program requirements. These graphics include topographic, programming, circulation, adjacency, environmental, view, and vegetation diagrams, which communicate site information and relationships.*

PA SECTION 3

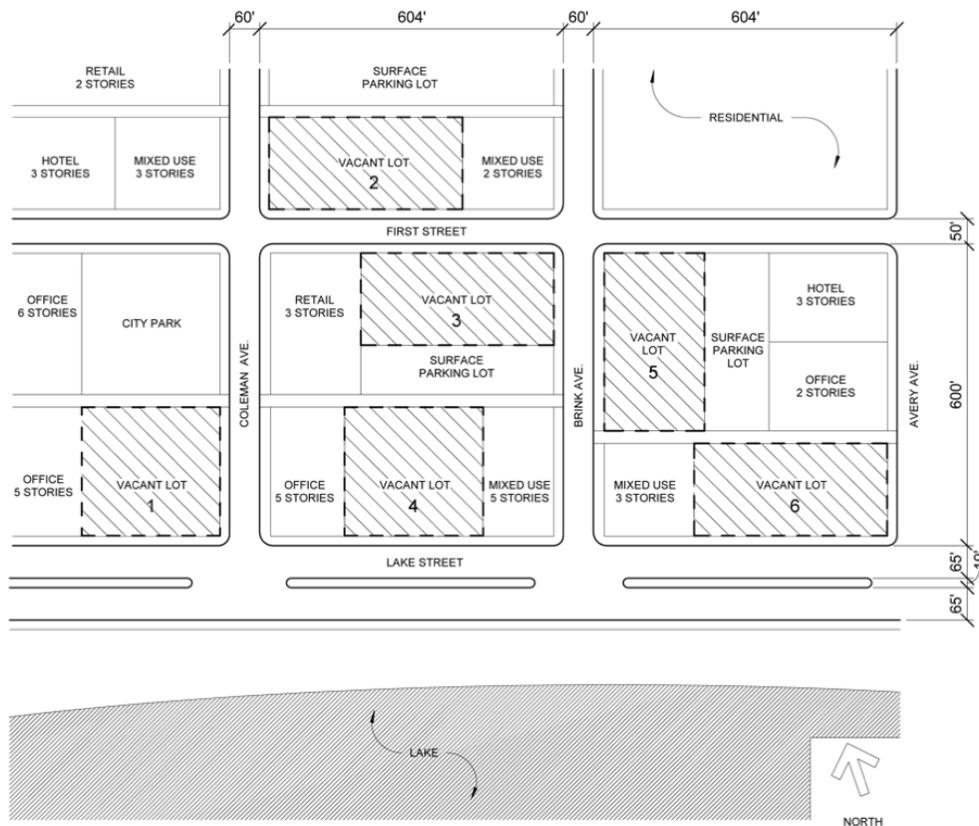
Sample Items

SAMPLE ITEM 5

An architect has been selected to design a new mixed-use development that includes retail spaces, parking, and apartments in an urban community. The client has provided the following programmatic requirements:

- The building should be five stories above grade and two stories below grade.
- Access to daylight should be maximized for all spaces.
- The number of apartments with balconies and a view should be maximized.
- The building should be contextual within the community in regards to massing, scale, and detail.

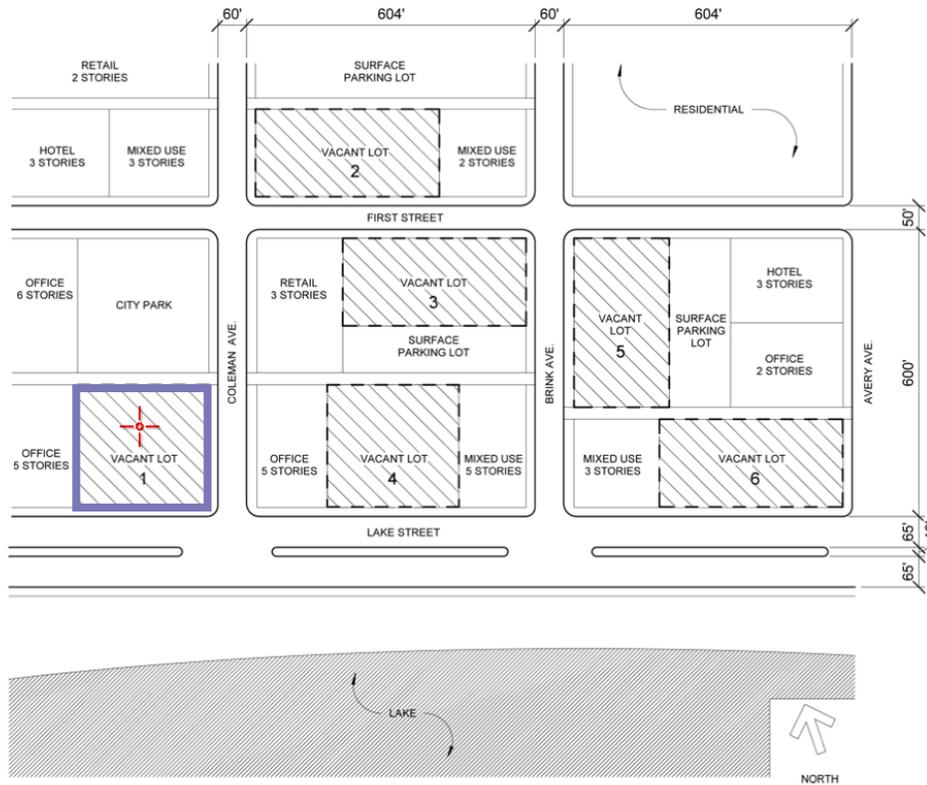
Click on the vacant lot in the site plan below that the architect should recommend to the client.



PA SECTION 3

Sample Items

SAMPLE ITEM 5 - CORRECT RESPONSE



**RATIONALE:** The architect should recommend Vacant Lot 1. To make this determination, you'll need to analyze the contextual conditions of each vacant lot, including both environmental conditions and site attributes. The client has requested that the five-story building fit contextually within the community from a massing, scale, and detail standpoint, making Lots 1 and 4 most contextually appropriate because they are adjacent to five-story structures. Vacant Lot 1 has access to daylight on three sides with views to the city park to the north and the lake to the south, making it the most appropriate site for the development. Vacant Lots 2, 3, and 5 have limited views and are located adjacent to buildings of a smaller scale than the proposed development. Although Vacant Lot 6 has views to the south and access to daylight on three sides, the surrounding context is of a smaller scale.



This is an **A/E level** item requiring you to evaluate multiple sites relative to views, contextual scale, daylight, and client requirements.

## PA

## SECTION 3

## Sample Items

**SAMPLE ITEM 6**

An architect is completing a feasibility study for a small marine research facility. The following site information has been provided by the client:

- Located in a remote area near the seashore
- Undeveloped, except for a small storage building that will be demolished
- Contains a small area of wetlands
- Adjacent to an environmentally protected area

As part of the feasibility study, what documentation should the architect evaluate? **Check the four that apply.**

- FEMA maps
- Geotechnical report
- Traffic report
- Structural report
- Topographic survey
- Hydrologic conditions report

## PA

## SECTION 3

## Sample Items

## SAMPLE ITEM 6 - CORRECT RESPONSE

An architect is completing a feasibility study for a small marine research facility. The following site information has been provided by the client:

- Located in a remote area near the seashore
- Undeveloped, except for a small storage building that will be demolished
- Contains a small area of wetlands
- Adjacent to an environmentally protected area

As part of the feasibility study, what documentation should the architect evaluate? **Check the four that apply.**

- FEMA maps**
- Geotechnical report**
- Traffic report
- Structural report
- Topographic survey**
- Hydrologic conditions report**

**RATIONALE:** According to the *Site Planning and Design Handbook*, evaluating FEMA maps, geotechnical reports, topographic surveys, and a hydrologic conditions report are critical in understanding the site's potential for coastal flooding, the makeup and stability of the soils, potential earthwork requirements, and how the presence of water and wetlands may impact development. Since this is an undeveloped and remote site, a traffic report and structural report would not be necessary for this feasibility study.



This is an **A/E level** item requiring you to analyze the site information provided and determine what documentation should be evaluated to assess the feasibility of the project.

## PA

## SECTION 4

# Building Analysis & Programming

*In this section, you'll analyze new or existing buildings relative to the program requirements, cost, and schedule. This is the largest section in the Programming & Analysis division.*

**OBJECTIVE 4.1 (3-7%)****Evaluate relevant qualitative and quantitative attributes of a new or existing building as they relate to the program (A/E)**

*As an architect, you will need to review an existing or new building to determine if the design addresses views, daylight, spatial organization, and other program requirements. You will also need to analyze an existing building to determine if renovation, adaptive reuse, preservation, or demolition are appropriate and feasible to meet project needs. Relevant factors may include a building's MEP systems, structural stability, hazardous materials, historic features, or eligibility for tax credits.*

**OBJECTIVE 4.2 (3-7%)****Evaluate documentation, reports, assessments, and analyses to inform the building program (A/E)**

*In addition to analyzing the attributes of a building, you will need to review and interpret technical documentation such as structural assessments, geotechnical reports, neighborhood and regional context, and condition assessment reports. These are used to consider the feasibility of a project and how the building program may be positively or negatively affected.*

**OBJECTIVE 4.3 (8-12%)****Identify and prioritize components of the building program (A/E)**

*As an architect, you must be able to review and understand the building program relative to the client's requirements. This includes the consideration of primary vs. subsidiary, back of house vs. front of house, occupied vs. unoccupied, as well as phasing and major circulation components. Understanding the area requirements of a building type relative to the program, including net square footage and gross square footage, is very important, as are how they relate to each other and the overall program requirements.*

**CONTINUED****OBJECTIVE 4.4 (8-12%)** \_\_\_\_\_**Assess spatial and functional relationships for the building program (A/E)**

*Spatial organization is an important aspect of architecture, so reviewing and analyzing the building program relative to both horizontal and vertical spatial and functional relationships is an important assessment. You must consider the vertical relationships of shafts, stairs, conveying systems, atriums, and other multi-level spaces, as well as the horizontal relationships including circulation, entry, loading, assembly, MEP spaces, and other programmed spaces.*

**OBJECTIVE 4.5 (2-6%)** \_\_\_\_\_**Recommend a preliminary project budget and schedule (U/A)**

*As an architect, you must be able to compare available project information (master plans, existing documentation, program requirements, site information, etc.) to determine a preliminary project schedule and cost. If the project budget and schedule have been defined by the client, you should be able to evaluate this information to determine the feasibility of the project and provide appropriate recommendations.*

**OBJECTIVE 4.6 (1-5%)** \_\_\_\_\_**Identify alternatives for building and structural systems for given programmatic requirements, preliminary budget, and schedule (U/A)**

*You will need to understand various building materials as well as civil, structural, and MEP systems to determine the appropriateness of each to meet project needs, based on factors such as building type, function, program, availability, cost, and sustainability goals. Even before the selection of each system, you will need to be able to identify alternative systems that could fulfill the project requirements.*

**OBJECTIVE 4.7 (2-6%)** \_\_\_\_\_**Analyze graphical representations regarding building analysis and building programming (A/E)**

*You will need to understand diagrammatic graphics and evaluate how they are used to communicate building relationships and other requirements. These may include diagrams that depict horizontal and vertical circulation, space adjacencies, solar path, or views.*

PA

SECTION 4

# Sample Items

## SAMPLE ITEM 7

Refer to the exhibit.

A preliminary budget for the adjacent program was estimated at \$3,000,000 with 60% building efficiency. The client has requested the preliminary cost be reduced by \$500,000 while maintaining the same program spaces and overall construction quality.

What overall building efficiency must the architect achieve to fulfill the client’s preliminary cost goals?

%

SPACE	SIZE (NET SF)	QUANTITY
Break Room	600	1
Conference Room	400	4
Open Work Area	4000	1
Private Office	100	20
Reception/Waiting	300	1
Restroom	175	2
Storage	50	3

## PA SECTION 4

## Sample Items

## SAMPLE ITEM 7 - CORRECT RESPONSE

72 %

**RATIONALE:** Prior to performing any calculations, you'll need to understand building efficiency as it relates to gross and net area. *Problem Seeking: An Architectural Programming Primer* describes building efficiency as a ratio of the net assignable area to the building gross area. In the provided program, the net assignable area is 9,000 square feet with 60% overall building efficiency. Dividing the net assignable area by the building efficiency factor will give you the gross building area required (**Step 1**). Since the client has requested to maintain the program and construction quality, the current cost per square foot for construction must be determined (**Step 2**). If the preliminary budget is reduced to \$2,500,000 and the cost of construction remains constant, the client can only afford 12,500 gsf of area (**Step 3**). Dividing the net assignable area by the gross area that the client can afford will give you the building efficiency that the architect must achieve to stay on budget (**Step 4**). Because the % symbol is given next to the answer box, you know the correct answer should be represented as a percentage, not a decimal.

**Step 1:**  $9,000 \text{ nsf} / .6 = 15,000 \text{ gsf}$

**Step 2:**  $\$3,000,000 / 15,000 \text{ gsf} = \$200 \text{ per sq. ft.}$

**Step 3:**  $\$2,500,000 / \$200 \text{ per sq. ft.} = 12,500 \text{ gsf}$

**Step 3:**  $4: 9,000 \text{ nsf} / 12,500 \text{ gsf} = .72 \text{ which is } 72\%$

SPACE	SIZE (NET SF)	QUANTITY
Break Room	600	1
Conference Room	400	4
Open Work Area	4000	1
Private Office	100	20
Reception/Waiting	300	1
Restroom	175	2
Storage	50	3



This is an **A/E level** item that requires you to evaluate and compare a preliminary budget and program to determine the required gross building area and overall building efficiency.

**PA SECTION 4**

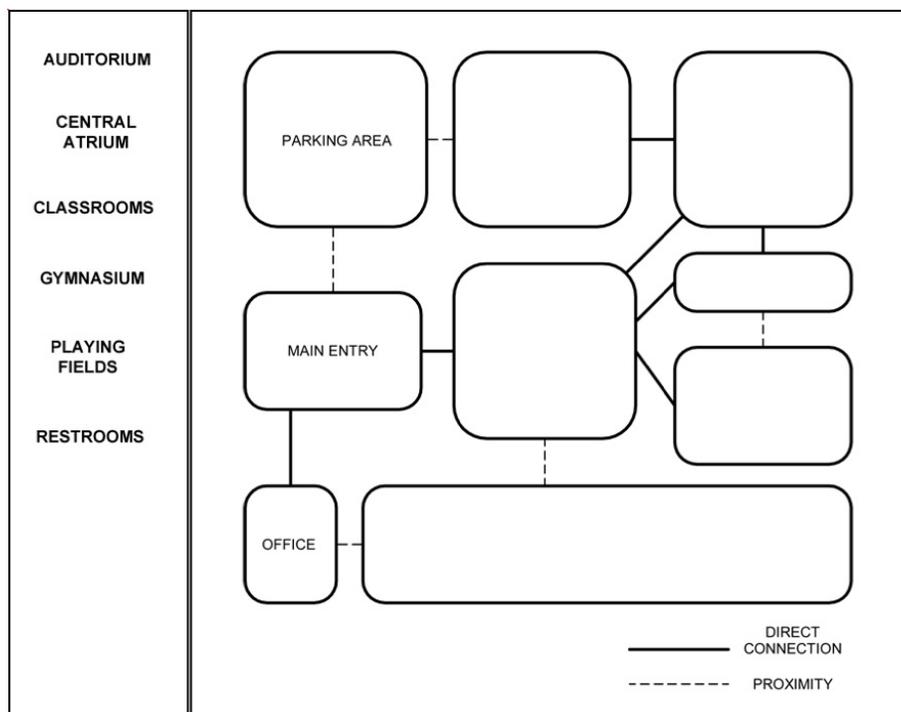
Sample Items

**SAMPLE ITEM 8**

An architect is completing an adjacency diagram for a new high school in a rural community. The client has provided the following requirements:

- The Playing Fields will be used by the school and community for daytime and evening sporting events. Convenient access to the fields should be provided to all visitors.
- The Central Atrium needs to be a key gathering space during school hours, as well as host school and community related events in the evening. Additionally, it will serve as a pre-function space for events held in the Auditorium.
- The Restrooms need to be connected to both the Gymnasium and Central Atrium.
- The Office will provide faculty and student support throughout the school day.
- The Main Entry will be the secured point of entry for students and visitors.

Drag the labels on the left into the appropriate bubbles of the diagram to show the required programmatic relationships.

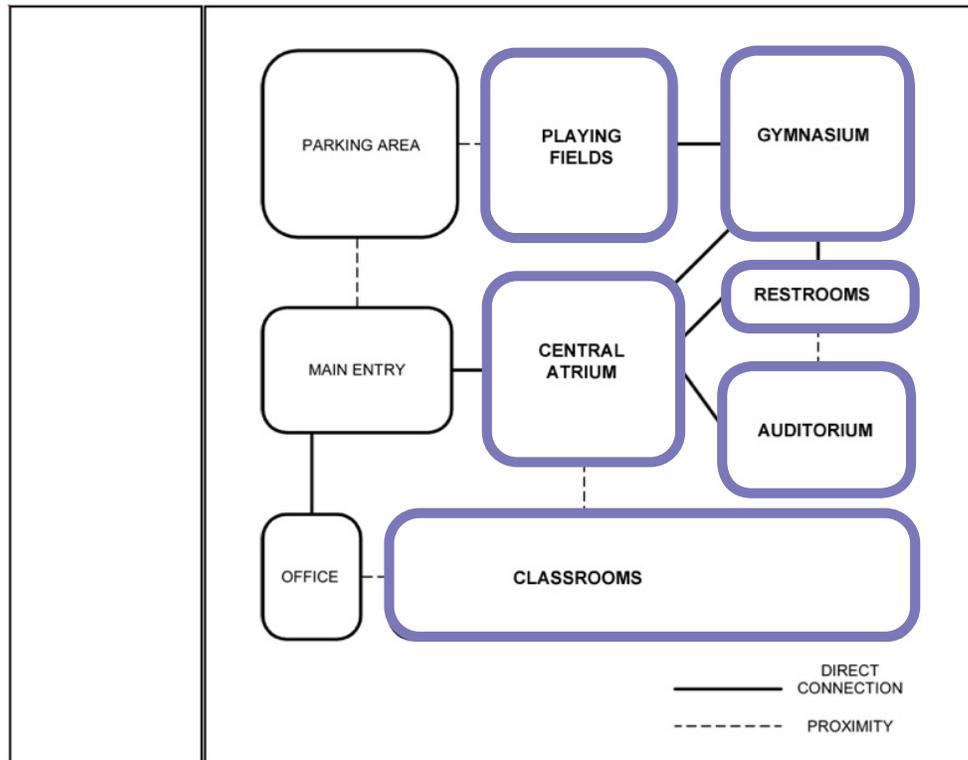


PA

SECTION 4

Sample Items

SAMPLE ITEM 8 - CORRECT RESPONSE



**RATIONALE:** To complete this bubble diagram, you'll need to understand the spatial relationships of the high school as they relate to the program and the client's requirements. The Playing Fields require convenient access for both daytime and evening activities, making the best location within close proximity to the school as well as the Parking Area. The Central Atrium should be located central to the major program spaces with a connection to the Main Entry for secured access to evening events. Since the Central Atrium is also a pre-function space for the Auditorium, the spaces should be directly connected. The Restrooms have a direct connection between the Gymnasium and Central Atrium, while also being in close proximity to the Auditorium for use during performances and events. The Classrooms' proximity to the Office provides convenient access for faculty and student support throughout the school day.



This is an **A/E level** item requiring the analysis of horizontal functional relationships as they relate to the building program and client requirements.

## PA

## SECTION 4

## Sample Items

## SAMPLE ITEM 9

As part of the programming phase, an architect is required to create a preliminary project schedule for the renovation of a 50,000-square-foot laboratory facility.

Which items should the architect consider when creating this schedule? **Check the three that apply.**

- Coordination meeting schedule
- Lead time for construction materials
- Project delivery method
- Project budget
- Regulatory requirements
- Shop drawings

## CORRECT RESPONSE

As part of the programming phase, an architect is required to create a preliminary project schedule for the renovation of a 50,000-square-foot laboratory facility.

Which items should the architect consider when creating this schedule? **Check the three that apply.**

- Coordination meeting schedule
- Lead time for construction materials
- Project delivery method**
- Project budget**
- Regulatory requirements**
- Shop drawings

**RATIONALE:** According to *The Architect's Handbook of Professional Practice*, project delivery method, project budget, and regulatory requirements can have an impact on a project's schedule. Multiple project delivery methods exist today, each implementing a different process with specific requirements and deliverables. The project budget impacts the schedule directly, specifically regarding economic inflation over the duration of a project and staff hours required to complete a project. Regulatory requirements vary by jurisdiction and may contain a complex and time-consuming approvals process. A coordination meeting schedule, lead time for construction materials, and shop drawings would be unknown in the programming phase of a project.



This is a **U/A level** item requiring you to understand the factors that can influence a preliminary project schedule.

# PA References

## PUBLICATIONS

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The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### **Architectural Graphic Standards**

The American Institute of Architects  
John Wiley & Sons, 11th edition (2007) and  
12th edition (2016)

### **Problem Seeking: An Architectural Programming Primer**

William M. Peña and Steven A. Parshall  
John Wiley & Sons, 5th edition, 2012

### **Site Planning and Design Handbook**

Thomas H. Russ  
McGraw-Hill, 2nd edition, 2009

## CODES

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The following code and accessibility requirements have content covered in the Programming & Analysis division.

### **2010 ADA Standards for Accessible Design**

U.S. Department of Justice, 2010

### **ICC A117.1-2009 Accessible and Usable Buildings and Facilities**

International Code Council, 2010

### **International Building Code (2018)**

International Code Council, 2017

## AIA CONTRACT DOCUMENTS

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None of the standard list of [AIA Contract Documents](#) related to the ARE have specific content covered in the Programming & Analysis division.

# Project Planning & Design (PPD)

This division will assess objectives related to the preliminary design of sites and buildings. The division will focus on issues related to the generation or evaluation of design alternatives that synthesize environmental, cultural, behavioral, technical and economic issues. Candidates must demonstrate an understanding of and abilities in design concepts, sustainability/environmental design, universal design, and other forms of governing codes and regulations.

<b>SECTION 1: Environmental Conditions &amp; Context</b> .....	<b>75</b>
<b>SECTION 2: Codes &amp; Regulations</b> .....	<b>78</b>
<b>SECTION 3: Building Systems, Materials, &amp; Assemblies</b> .....	<b>81</b>
<b>SECTION 4: Project Integration of Program &amp; Systems</b> .....	<b>87</b>
<b>SECTION 5: Project Costs &amp; Budgeting</b> .....	<b>95</b>
<b>Project Planning &amp; Design References</b> .....	<b>97</b>

## Project Planning & Design

### DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
100	91	9	2	16-20	4 hr 5 min	45 min	5 hr

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count toward or against your final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Evaluating project design alternatives
- Determining if a design meets project parameters, including those defined by the client, the environment, and society
- Selecting the appropriate building systems and material to meet project goals and regulatory requirements
- Integrating technical knowledge and information to develop a design

The 100 items will assess you on five sections related to Project Planning & Design. The number of items from each section will vary based on the targeted percentage of items within each section.

### SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*
<b>SECTION 1: Environmental Conditions &amp; Context</b>	10-16	10-16%
<b>SECTION 2: Codes &amp; Regulations</b>	16-22	16-22%
<b>SECTION 3: Building Systems, Materials, &amp; Assemblies</b>	19-25	19-25%
<b>SECTION 4: Project Integration of Program &amp; Systems</b>	32-38	32-38%
<b>SECTION 5: Project Costs &amp; Budgeting</b>	8-14	8-14%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you may experience may vary slightly as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

## PPD SECTION 1

# Environmental Conditions & Context

*In this section, you'll use the site information gathered in the programming and analysis phase of a project to plan the site and environmental aspects of a project.*

**OBJECTIVE 1.1 (4-8%)****Determine location of building and site improvements based on site analysis (A/E)**

*Based on views, wind, solar path, topography, adjacencies, planning concepts, and vulnerabilities and risks associated with climate change, you will need to locate a new built project on its site. This can include the orientation of one building, the arrangement of multiple buildings, the configuration of an addition to an existing building, or the layout of site improvements.*

**OBJECTIVE 1.2 (2-6%)****Determine sustainable principles to apply to design (A/E)**

*An architect must use sun, wind, temperature, precipitation, and other climatic data to determine building orientation and shape, building envelope design, site features, and active and/or passive building systems. Sustainable principles also include considering recycled content, identifying opportunities to minimize waste when selecting building materials, and other strategies to increase the project's resilience and reduce its negative impact on the environment.*

**OBJECTIVE 1.3 (1-5%)****Determine impact of neighborhood context on the project design (U/A)**

*You will need to consider the character of a site's neighborhood, including proximity to various modes of transit, nearby amenities and public services, utilities, noise pollution, the scale of adjacent buildings, surrounding façade materials, historic precedent, and historic preservation requirements. Understanding how these impact a project is necessary as you determine an appropriate design response for a given architectural context.*

## Sample Items

## PPD SECTION 1

## SAMPLE ITEM 1

A preliminary drainage analysis for a small land parcel in a cold, wet location indicates slopes of 1% or less. The land parcel is intended to be developed into a suburban shopping center.

Which types of stormwater management systems should the architect recommend? **Check the three that apply.**

- An underground cistern, fed from rainwater collection on the shopping center roof
- Porous asphalt in the parking lot
- Foundation drainage around building perimeter
- A constructed stormwater wetland planted with native vegetation
- Onsite graywater treatment
- Diversion ditches between adjacent rows of parking spaces

**RATIONALE:** All of these strategies are discussed in *Architectural Graphic Standards*. Runoff from impervious surfaces, such as roofs or paving, can cause erosion and flooding. The underground cistern will instead capture the rainwater, and porous paving will allow the water to seep back into the soil. Diversion ditches will collect any additional runoff from the parking area and divert it away from the built areas. Foundation drainage and graywater treatment options are not related to stormwater management and a constructed wetland is not appropriate for a small commercial site in a cold climate.

## CORRECT RESPONSE

A preliminary drainage analysis for a small land parcel in a cold, wet location indicates slopes of 1% or less. The land parcel is intended to be developed into a suburban shopping center.

Which types of stormwater management systems should the architect recommend? **Check the three that apply.**

- An underground cistern, fed from rainwater collection on the shopping center roof**
- Porous asphalt in the parking lot**
- Foundation drainage around building perimeter
- A constructed stormwater wetland planted with native vegetation
- Onsite graywater treatment
- Diversion ditches between adjacent rows of parking spaces**



This is an **A/E level** item requiring the analysis of existing site conditions and stormwater management systems to determine the most appropriate strategies.

## Sample Items

## PPD SECTION 1

## SAMPLE ITEM 2

A new, one-story daycare center is being planned in a hilly, suburban location in a hot, humid climate. The prevailing winds are from the south. The client wants to use passive cooling.

Which of the following strategies should the architect recommend? **Check the three that apply.**

- The building should be located at the top of the slope.
- The building should be elongated along the north-south axis.
- The playground should be located north of the building.
- The building's main corridor should include operable transoms above the doors.
- The building should include large openings on the north and south sides.
- A line of shrubs should be planted west of the playground.

**RATIONALE:** All of these strategies are discussed in *Sun, Wind, and Light: Architectural Design Strategies*. Buildings in a hot/humid climate should be located at the top of a slope to catch cooling breezes. Large openings on the north and south sides and operable transoms in the corridor will allow for cross-ventilation. A north-south axis would actually limit the opportunities for cross-ventilation and expose the building to the hot afternoon sun. Placing the playground north of the building would provide limited shading but would block cooling breezes from reaching the playground. Planting shrubs west of the playground may provide visual interest but would not be effective in blocking the hot afternoon sun.

## CORRECT RESPONSE

A new, one-story daycare center is being planned in a hilly, suburban location in a hot, humid climate. The prevailing winds are from the south. The client wants to use passive cooling.

Which of the following strategies should the architect recommend? **Check the three that apply.**

- The building should be located at the top of the slope.**
- The building should be elongated along the north-south axis.
- The playground should be located north of the building.
- The building's main corridor should include operable transoms above the doors.**
- The building should include large openings on the north and south sides.**
- A line of shrubs should be planted west of the playground.



This is an **A/E level** item requiring analysis of existing site conditions and passive cooling strategies to determine the most appropriate strategies.

## PPD SECTION 2

# Codes & Regulations

*In this section, you'll look at the codes and regulations relevant to the planning phase of a project.*

**OBJECTIVE 2.1 (3-7%)****Apply zoning and environmental regulations to site and building design (U/A)**

*It is important to understand the regulations that govern the outside of a building, including standard and accessible parking requirements, allowable building size based on FAR, site coverage, property line setbacks, and requirements for managing stormwater runoff.*

**OBJECTIVE 2.2 (8-12%)****Apply building codes to building design (U/A)**

*It is also important to assess the building code requirements that impact a project. This includes building height and area limits, maximum occupant load, fire separation, required egress, accessibility, plumbing fixture counts, and energy usage. Architects must be able to compile this information into a code analysis and incorporate it into the design.*

**OBJECTIVE 2.3 (2-6%)****Integrate multiple codes to a project design (A/E)**

*Multiple codes may govern a project, depending on the jurisdiction, funding stream, or other factors. You will need to understand the use of related codes, like energy, mechanical, and universal design; determine how multiple codes are used together; and discern which code governs when a conflict arises.*

## Sample Items

## PPD SECTION 2

## SAMPLE ITEM 3

An office building is proposed for a rectangular suburban office park site measuring 300 feet by 600 feet. The program requires an uncovered grade level entrance plaza of 30,000 square feet, a 120,000-square-foot below grade parking garage, plus 450,000 gross square feet of office space. Setbacks must be free of built site improvements.

What is the minimum total number of parking and office levels needed if the city requires a 20-foot setback on all sides?

levels



This is a **U/A level** item requiring an understanding of zoning setbacks and building massing.

## CORRECT RESPONSE

levels

**RATIONALE:** You'll first need to calculate the buildable areas. The below-grade buildable area equals the surface area of the site reduced by the required setbacks (**Step 1**). The above-grade buildable area equals the below-grade area, reduced by the required plaza (**Step 2**). Next, you'll calculate the number of levels required to accommodate the office space. This can be found by dividing the total office area by the above-grade buildable area (**Step 3**). Finally, you'll calculate the number of levels required to accommodate the parking garage, which is found by dividing the total parking area by the below-grade buildable area (**Step 4**). Remember that all partial levels should be rounded up to the nearest whole number. Add the above-grade and below-grade levels together to find the total answer (**Step 5**). The answer must be entered in the box as a numeral (5), not as text (five). Also note the units are already provided.

**Step 1:** 560 ft. x 260 ft. = 145,600 sq. ft.

**Step 2:** 145,600 sq. ft. – 30,000 sq. ft. = 115,600 sq. ft.

**Step 3:** 450,000 sq. ft. / 115,600 sq. ft. = 3.9 levels

**Step 4:** 120,000 sq. ft. / 145,600 sq. ft. = .8 levels

**Step 5:** 4 levels + 1 level = 5 levels

## Sample Items

## PPD SECTION 2

## SAMPLE ITEM 4

IBC contains requirements for the ventilation of attics and concealed roof spaces for which of the following reasons?

- To prevent heat transfer from the building into the spaces
- To prevent moisture accumulation and condensation in the spaces
- To eliminate the need for installation of an air barrier in the spaces
- To exhaust fire or smoke from the spaces

## CORRECT RESPONSE

IBC contains requirements for the ventilation of attics and concealed roof spaces for which of the following reasons?

- To prevent heat transfer from the building into the spaces
- To prevent moisture accumulation and condensation in the spaces**
- To eliminate the need for installation of an air barrier in the spaces
- To exhaust fire or smoke from the spaces

**RATIONALE:** As shown in *Building Codes Illustrated: A Guide to Understanding the 2018 International Building Code*, when building materials are enclosed on both the exterior and interior side of a space, the concealed space—whether an attic or rafter space—becomes susceptible to moisture intrusion. Ventilation paths allow moist air to be exhausted from a concealed space. The other options, while important to consider when designing a building, are not relevant to this code requirement.



This is a **U/A level** item requiring an understanding of the code and strategies for meeting code requirements.

## PPD SECTION 3

# Building Systems, Materials, & Assemblies

*In this section, you'll focus on other disciplines with which an architect must be familiar, along with the various components that make up the building.*

**OBJECTIVE 3.1 (5-9%)****Determine mechanical, electrical, and plumbing systems (A/E)**

*You will need to evaluate mechanical, electrical, and plumbing systems, including their impact on building and site design. Based on function, cost, size, availability, programmatic needs, and energy/water usage, you will need to select the appropriate systems for a building.*

**OBJECTIVE 3.2 (4-8%)****Determine structural systems (A/E)**

*You will need to evaluate different structural systems, including their cost, availability, load capacity, and impact on building design and configuration. Based on these factors, as well as building size and function, you will need to select the appropriate structural system and layout for a building.*

**OBJECTIVE 3.3 (1-5%)****Determine special systems such as acoustics, communications, lighting, security, conveying, and fire suppression (A/E)**

*You will need to evaluate specialty systems and select the appropriate systems for a building based on the building type, function, and programmatic requirements. You will also need to assess the impact of these specialty systems on the overall design of a building.*

**OBJECTIVE 3.4 (4-8%)****Determine materials and assemblies to meet programmatic, budgetary, and regulatory requirements (A/E)**

*You will need to select a building's envelope system, interior materials, and other assemblies based on cost, availability, program requirements, environmental conditions, sustainability requirements, or other factors. You will also need to evaluate the impact of those decisions on building design.*

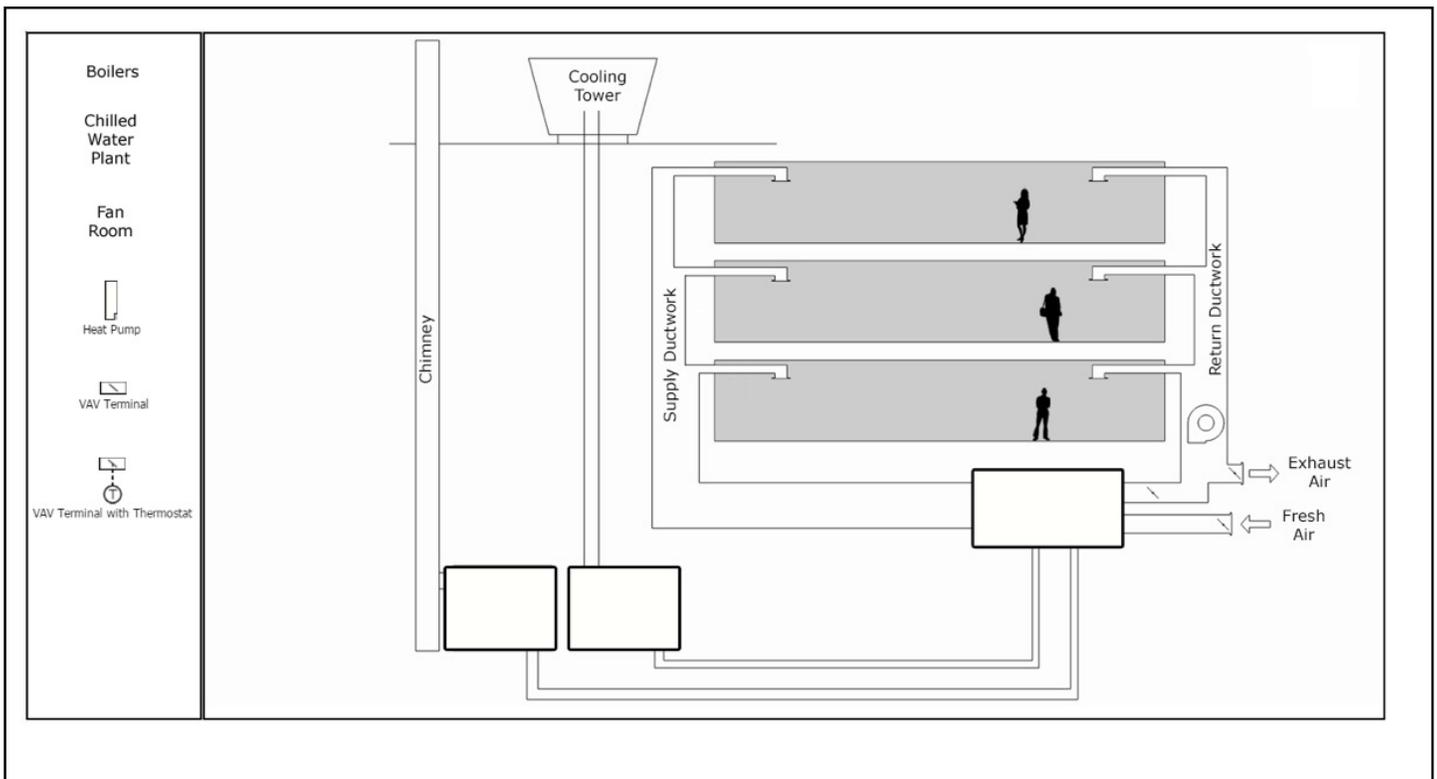
**PPD SECTION 3**

# Sample Items

## SAMPLE ITEM 5

The client for a new mid-rise office building desires a mechanical system that will have minimal operating cost and maintenance, allow maximum flexibility for office space layout, and provide individual control over the interior temperature.

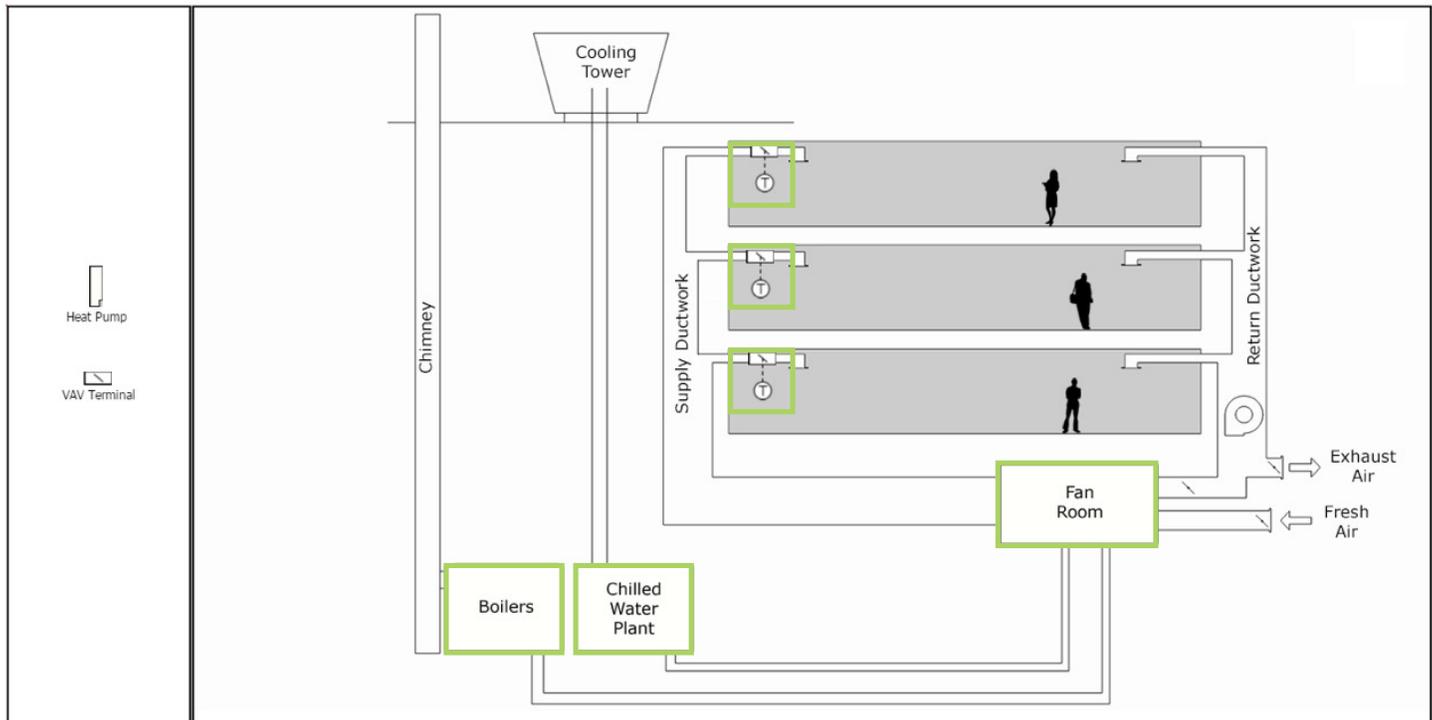
Drag the labels and symbols from the left onto the schematic layout of the recommended system below. Not all labels and symbols will be used.



## PPD SECTION 3

## Sample Items

## SAMPLE ITEM 5 - CORRECT RESPONSE



**RATIONALE:** The single-duct, variable air volume (VAV) system, as described in *The Architect's Studio Companion: Rules of Thumb for Preliminary Design*, meets all of the client's requirements. The Fan Room is the central hub for the system, conditioning the fresh air before distributing it through the building. Cooling is provided by the chilled water plant, which requires a cooling tower. Heating is provided by boilers, which exhaust through the chimney. Finally, each conditioned space requires a VAV terminal with a thermostat, providing both flexibility and temperature control within individual spaces.

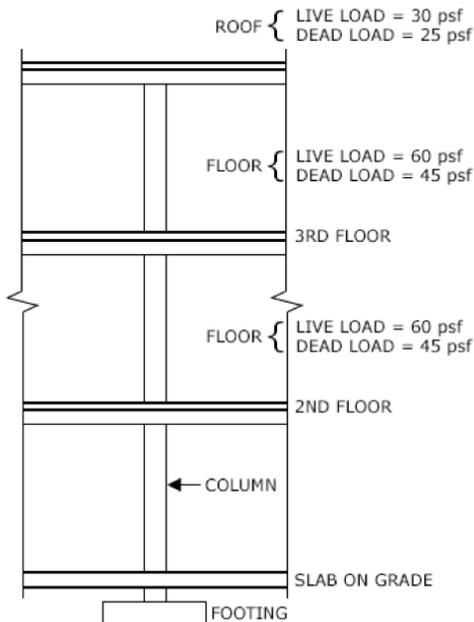


This is an **A/E level** item requiring analysis of the client requirements and an evaluation of system options.

## PPD SECTION 3

## Sample Items

## SAMPLE ITEM 6



Refer to the exhibit.

The cross section shown indicates an interior column. The tributary area for loading on the column equals 20 feet by 24 feet.

Assuming no live load reductions, which one of the following is the design live load for the footing?

- 43,200 lb
- 57,600 lb
- 72,000 lb
- 96,000 lb

## CORRECT RESPONSE

- 43,200 lb
- 57,600 lb
- 72,000 lb
- 96,000 lb

**RATIONALE:** You'll first need to calculate the tributary area for the column (**Step 1**). Next, you must add up the live loads acting on the column (**Step 2**). The total live load multiplied by the tributary area (**Step 3**) will give you the design live load for the footing.

**Step 1:** 20 ft. x 24 ft. = 480 sq. ft.

**Step 2:** 30 psf + 60 psf + 60 psf = 150 psf

**Step 3:** 480 sq. ft. x 150 psf = 72,000 lb



This is an **A/E level** item requiring you to analyze the information presented in the drawing and discern how to use the information to calculate the design load.

PPD SECTION 3

Sample Items

SAMPLE ITEM 7

The partial schematic design plan for a new reception and conference area is shown below, along with the wall types to be used in the project. Specific requirements include:

- Conference rooms must include acoustic separation from each other and surrounding spaces.
- The Storage/Copy room must include the copy machine and space for office supplies.

Drag the tag numbers from the left onto the gray wall tags in the partial floor plan to indicate which wall type is required at each location. Not all tag numbers will be used.

1	1		Structure Ceiling Floor
2	2		Structure Ceiling Floor
3	3		Structure Ceiling Floor
4	4		Structure Ceiling Floor

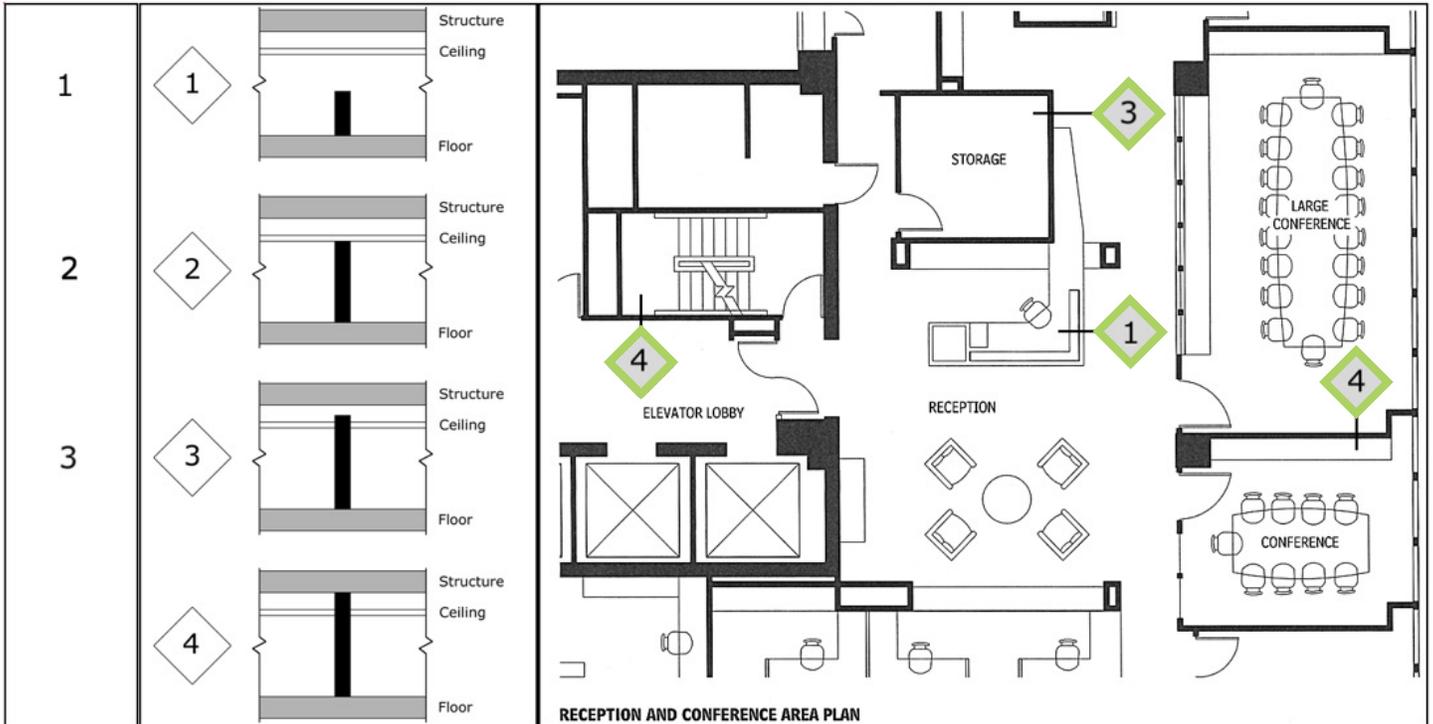
  

**RECEPTION AND CONFERENCE AREA PLAN**

PPD SECTION 3

Sample Items

SAMPLE ITEM 7 - CORRECT RESPONSE



**RATIONALE:** This image, adapted from *Architectural Graphic Standards*, includes a variety of conditions for which different wall types are required. As described in *Time Saver Standards for Architectural Design: Technical Data for Professional Practice*, fixed, rail-high walls are appropriate for an open reception desk that requires both vision and sound communication; framed walls that extend above the ceiling are appropriate where some sound attenuation from equipment such as a copy machine is desired; and partitions that extend from structure to structure are needed where a fire rating or complete sound attenuation are required, such as at egress locations and conference rooms. Wall type 2 is not used because none of the walls shown are appropriate to stop at the ceiling.



This is an **A/E level** item requiring an assessment of different wall types and the classification of various spaces in order to recommend wall types that will provide expected performance characteristics.

## PPD SECTION 4

# Project Integration of Program & Systems

*In this section, you'll pull together all the decisions from the previous three sections regarding environmental conditions, code, systems, and assemblies. This is the largest section in the Project Planning & Design division.*

**OBJECTIVE 4.1 (8-12%)****Determine building configuration (A/E)**

*As an architect, you will need to resolve the building's configuration based on program and code requirements, selected MEP and structural systems, site and environmental conditions, historic precedent, sustainability requirements, and principles of design logic.*

**OBJECTIVE 4.2 (10-14%)****Integrate building systems in the project design (A/E)**

*Within this division is the beginning of systems coordination. You must consider how the selected systems fit together, both spatially and functionally, and how they are coordinated into the architectural design. You will also need to evaluate how changes in one building system impact another system as well as the overall project design.*

**OBJECTIVE 4.3 (6-10%)****Integrate program requirements into a project design (A/E)**

*Architects must be able to reconcile the relationships between various program requirements, evaluate the program's impact on cost and building systems, and assess how the program is affected by environmental factors. It's important that you are able to create a building layout that incorporates program requirements for a project.*

**OBJECTIVE 4.4 (3-7%)****Integrate environmental and contextual conditions in the project design (A/E)**

*You will need to incorporate various design strategies, including those assessed in Section 1, into the project. This may include elements like view corridors, shading elements, building materials, and landscape design.*

## PPD SECTION 4

## Sample Items

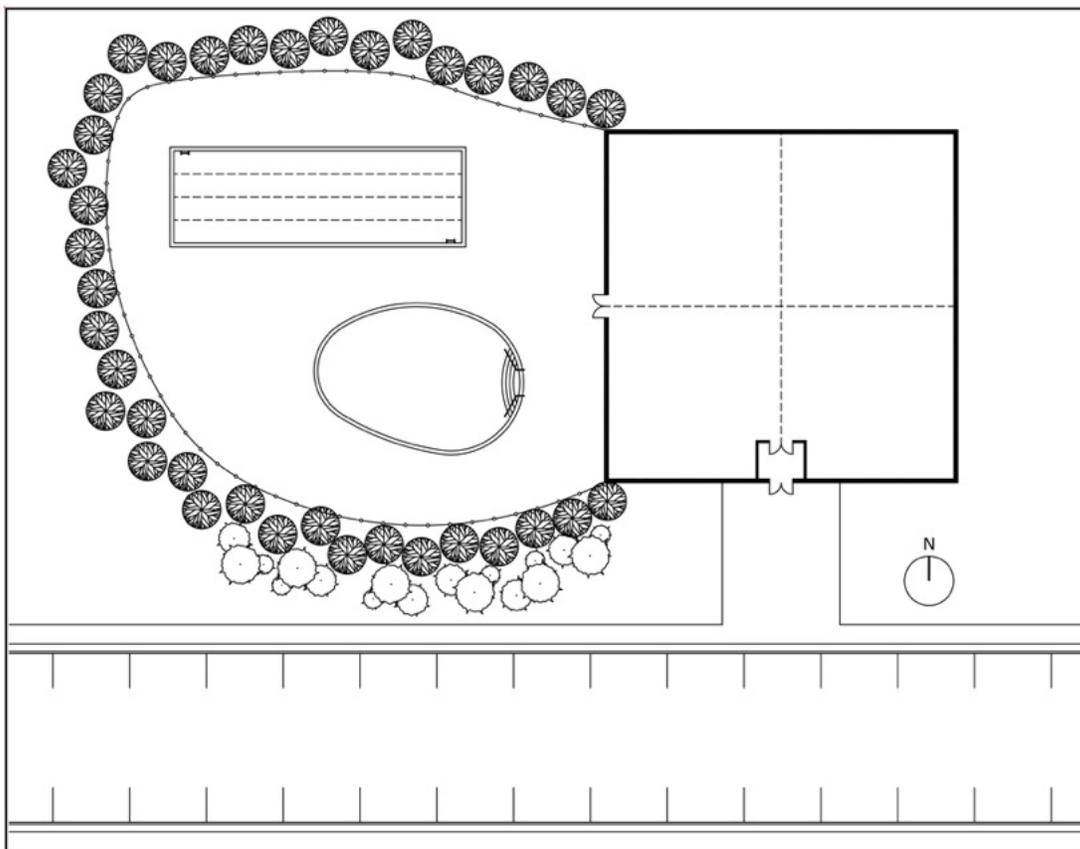
## SAMPLE ITEM 8

The plan below shows a new community center planned for an existing apartment complex. The community center will include four main program areas with the following requirements:

- Leasing Office - near Main Entrance
- Multipurpose Room - near Pool Deck
- Exercise Room - near Restroom/Locker Rooms
- Restrooms/Locker Rooms - near Pool Deck

Each program area will occupy one quadrant of the building.

Click in the quadrant of the floor plan that is the most suitable location for the Exercise Room.

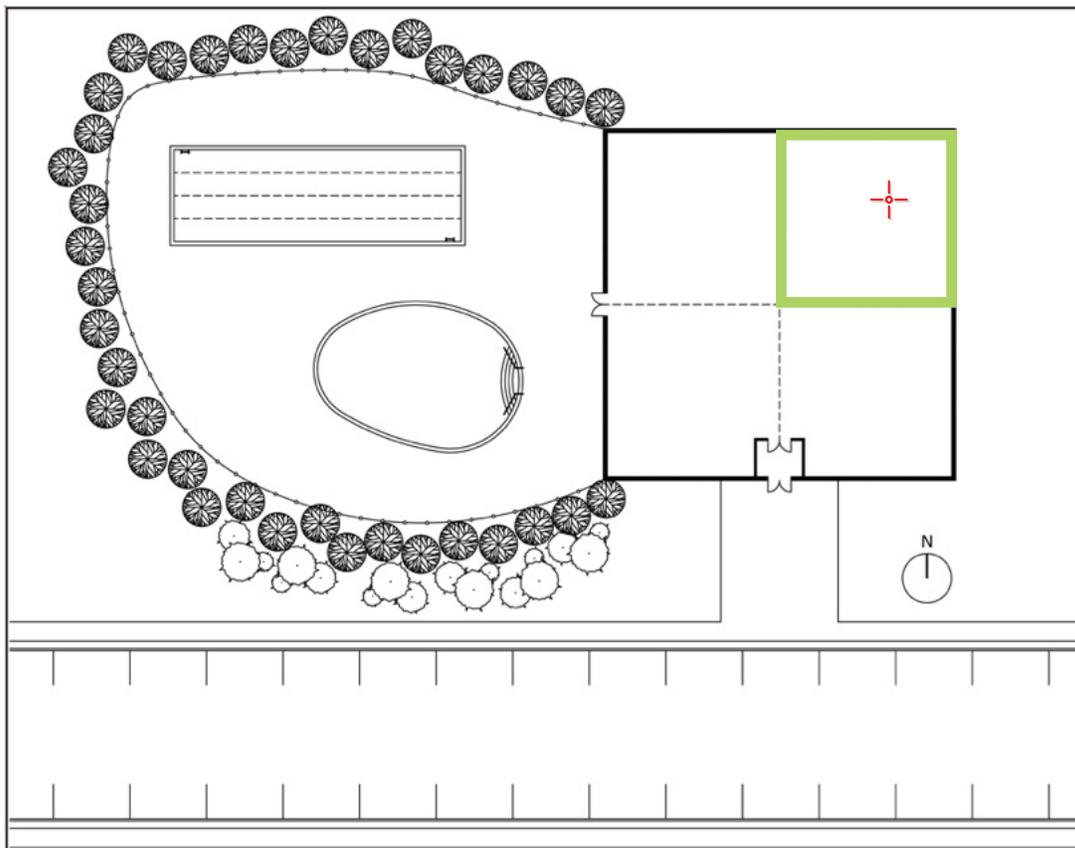


## PPD SECTION 4

## Sample Items

## SAMPLE ITEM 8 - CORRECT RESPONSE

**RATIONALE:** By reviewing the site plan, you can see the locations of the Main Entrance and the Pool Deck. Based on their locations, you can then determine the locations of the various program spaces given the listed requirements. The Multipurpose Room and the Restrooms/Locker Rooms must both be on the west side of the building. The Leasing Office goes in the southeast corner of the building in order to be near the Main Entrance. This leaves the northeast quadrant for the Exercise Room location.



**A/E**  
LEVEL

This **A/E level** item requires you to evaluate multiple pieces of plan and program information to provide an acceptable solution.

## PPD SECTION 4

## Sample Items

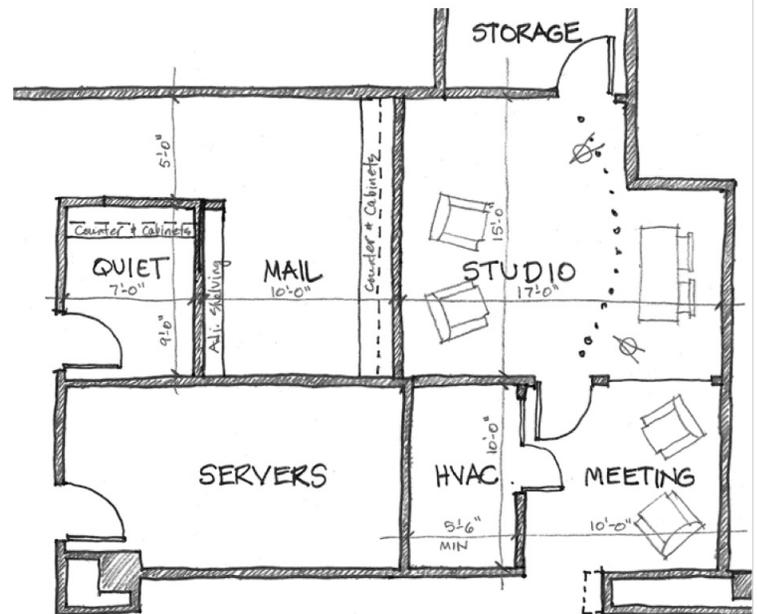
## SAMPLE ITEM 9

Refer to the exhibit.

The client for this partial office renovation has requested a new Studio to be used for video broadcasts. Due to existing conditions, the Studio must be located adjacent to the existing HVAC closet, Server Room, and Mailroom.

Which of the following should the architect recommend to best minimize outside noise within the Studio?

- Fabric wall panels in the Studio and on the shared walls between the HVAC closet, Server Room, and Mailroom.
- Internally line all HVAC ducts with sound absorptive material.
- Insulated double-stud partition walls between the Studio and the other rooms, extending to the structural deck above.
- Insulated shaft walls between the Studio and the other rooms, extending to the structural deck above.



## Sample Items

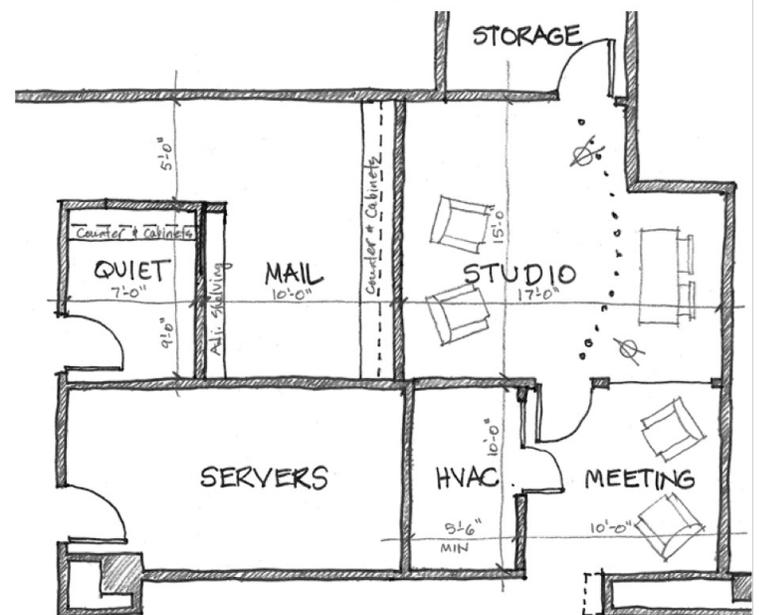
## PPD SECTION 4

## SAMPLE ITEM 9 - CORRECT RESPONSE

The client for this partial office renovation has requested a new Studio to be used for video broadcasts. Due to existing conditions, the Studio must be located adjacent to the existing HVAC closet, Server Room, and Mailroom.

Which of the following should the architect recommend to best minimize outside noise within the Studio?

- Fabric wall panels in the Studio and on the shared walls between the HVAC closet, Server Room, and Mailroom.
- Internally line all HVAC ducts with sound absorptive material.
- Insulated double-stud partition walls between the Studio and the other rooms, extending to the structural deck above.**
- Insulated shaft walls between the Studio and the other rooms, extending to the structural deck above.



**RATIONALE:** Based on *Plumbing, Electricity, Acoustics: Sustainable Design Methods for Architecture*, sound absorbing materials help reduce noise within a room. However, when noise comes from outside a particular room, the sound transmission into that room must be reduced. An insulated double-stud wall minimizes sound transmission in two ways: first, the separation between the studs provides an acoustic break from one side of the wall to the other; second, the insulation absorbs sound within the wall cavity. Extending the wall to the structural deck above will prevent the sound from transmitting over the top of the wall. While the fabric wall panels and duct lining will help with acoustic issues, they would not be the best choice in this situation. Shaft walls are not appropriate for a floor to ceiling wall type.



This is an **A/E level** item requiring you to analyze existing conditions and program requirements and evaluate various treatment options.

## PPD SECTION 4

## Sample Items

## SAMPLE ITEM 10

Which of the following tree arrangements is best suited for optimal solar energy utilization and control for a house in the northeast region of the United States?

- Evergreens on the east and south; deciduous on the west.
- Evergreens on the west and north; deciduous on the south.
- Evergreens on the west and north; no trees on the south.
- Evergreens on the north and south; deciduous on the east and west.

**RATIONALE:** *Site Planning and Design Handbook* describes strategies for using trees to improve a building's energy efficiency. Since the site is in the northeast region of the United States, evergreen trees to the north and west will help to block winter winds, as well as the heat gain from western sunlight in the summer. Deciduous trees to the south allow winter sun, when it is desired for passive heat gain, but block summer sun, providing valuable shade.

## CORRECT RESPONSE

Which of the following tree arrangements is best suited for optimal solar energy utilization and control for a house in the northeast region of the United States?

- Evergreens on the east and south; deciduous on the west.
- Evergreens on the west and north; deciduous on the south.**
- Evergreens on the west and north; no trees on the south.
- Evergreens on the north and south; deciduous on the east and west.



**A/E**  
LEVEL

This is an **A/E level** item requiring you to evaluate the climate conditions of the region of the country and determine the appropriate trees and planting locations to meet both of the stated requirements.

## PPD SECTION 4

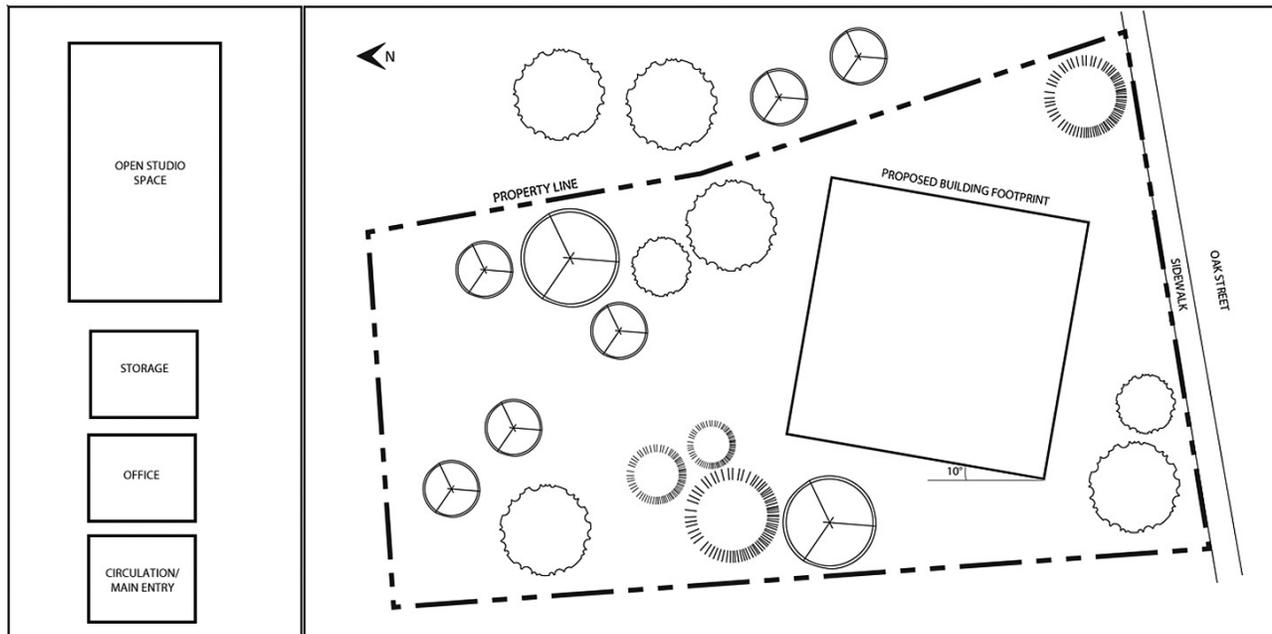
## Sample Items

## SAMPLE ITEM 11

An architect has been commissioned to design a painting studio in the southwest region of the United States. The client has provided the following information:

- Daylight must be provided in all spaces.
- The office must receive direct morning sun.
- The open studio space must have a panoramic view of the landscape with limited direct sunlight.
- The storage space must be directly accessible from both the office and open studio space.
- The circulation/main entry space must have a view of Oak Street.

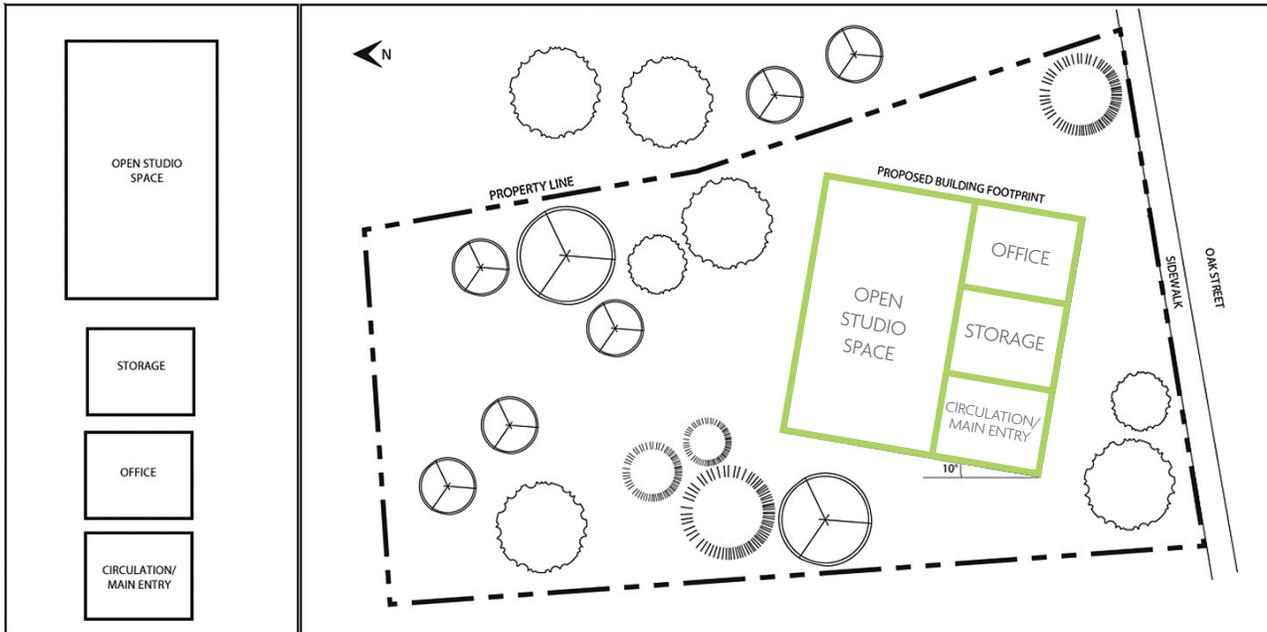
Drag the spaces from the left onto the proposed building footprint to fulfill all client requirements.



PPD SECTION 4

Sample Items

SAMPLE ITEM 11 - CORRECT RESPONSE



**RATIONALE:** First, you'll need to review the site plan to understand the orientation, proposed building footprint, street views, and landscape. According to *Sun, Wind, and Light: Architectural Design Strategies*, placing the open studio space along the northern edge of building footprint would allow for diffused northern light to enter the space throughout the day. This location also provides a view to the northern landscape. Locating the office along the eastern edge of the building would allow the space to receive morning sun through an east facing window. Because the storage space requires a direct connection to both the office and open studio, it should be located adjacent to both spaces. Locating the circulation/main entry space in the southwest corner fulfills the requirement of having a view of Oak Street. You'll need to rotate the spaces by 10 degrees to properly locate them within the proposed building footprint. To do this, right click on each space, select rotate, enter the rotation angle in degrees, and click apply.



This is an **A/E level** item requiring the analysis of existing site conditions and program requirements to determine a building's spatial configuration.

## PPD

## SECTION 5

# Project Costs & Budgeting

*In this last section, you'll consider the bottom line: how much does this project cost.*

**OBJECTIVE 5.1 (2-6%)****Evaluate design alternatives based on the program (A/E)**

*The first design is not necessarily the best, so analyzing design alternatives against the program requirements, project goals, and project budget, as well as considering the various factors that affect costs, is critical as you determine the most appropriate design option that fits within the project budget.*

**OBJECTIVE 5.2 (1-5%)****Perform cost evaluation (A/E)**

*It is important for you to evaluate various methods of estimating project costs, including those based on program type, square footage, or systems/assemblies. You must be able to create a preliminary cost estimate, adjust the estimate as the design develops, calculate the cost of design alternatives, and reconcile the estimate with the project budget.*

**OBJECTIVE 5.3 (2-6%)****Evaluate cost considerations during the design process (A/E)**

*Architects need to consider client priorities and life cycle costs when selecting materials and systems, and they must evaluate the cost effectiveness of various design decisions. As an architect, you will need to determine if a project design must be modified based on cost evaluations and budgetary needs.*

## Sample Items

## PPD SECTION 5

## SAMPLE ITEM 12

A mechanical engineer has proposed two different HVAC systems for a new project. Either system is suitable for the project type and location, but for tax purposes, the owner prefers a higher HVAC equipment depreciation cost over the lifecycle of the system. System A is a forced air heating and cooling system with an upfront cost of \$10,000, an anticipated useful life of 20 years, and a salvage value of \$1,000. System B is an electric packaged terminal unit with an upfront cost of \$7,500, an anticipated useful life of 15 years, and a salvage value of \$1,500.

What is the annual depreciation of the system with the higher per year depreciation?

- \$400
- \$450
- \$500



This is an **A/E level** item requiring an appraisal of life cycle costs as applied to mechanical systems and a comparison between the costs in order to recommend a system.

## CORRECT RESPONSE

A mechanical engineer has proposed two different HVAC systems for a new project. Either system is suitable for the project type and location, but for tax purposes, the owner prefers a higher HVAC equipment depreciation cost over the lifecycle of the system. System A is a forced air heating and cooling system with an upfront cost of \$10,000, an anticipated useful life of 20 years, and a salvage value of \$1,000. System B is an electric packaged terminal unit with an upfront cost of \$7,500, an anticipated useful life of 15 years, and a salvage value of \$1,500.

What is the annual depreciation of the system with the higher per year depreciation?

- \$400
- \$450
- \$500

**RATIONALE:** Annual depreciation value is an important aspect of life cycle considerations. It can be determined by subtracting the salvage value from the initial investment (**Step 1**), then dividing by the estimated life span of the system (**Step 2**). Based on the results of each annual depreciation value, you determine that System A has a higher per year depreciation of \$450.

**Step 1.** System A:  $\$10,000 - \$1,000 = \$9,000$

**Step 2.** System A:  $\$9,000 / 20 = \$450$

**Step 1.** System B:  $\$7,500 - \$1,500 = \$6,000$

**Step 2.** System B:  $\$6,000 / 15 = \$400$

# PPD References

## PUBLICATIONS

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The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### **Architectural Graphic Standards**

The American Institute of Architects  
John Wiley & Sons, 11th edition (2007)  
and 12th edition (2016)

### **Building Construction Illustrated**

Francis D. K. Ching  
John Wiley & Sons, 6th edition, 2020

### **Heating, Cooling, Lighting: Sustainable Design Methods for Architects**

Norbert Lechner  
John Wiley & Sons, 4th edition, 2014

### **Mechanical & Electrical Equipment for Buildings**

Walter T. Grondzik and Alison G. Kwok  
John Wiley & Sons, 12th edition (2014)  
and 13th edition (2019)

## CODES

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The following code and accessibility requirements have content covered in the Project Planning & Design division.

### **2010 ADA Standards for Accessible Design**

U.S. Department of Justice, 2010

### **International Building Code (2018)**

International Code Council, 2017

## AIA CONTRACT DOCUMENTS

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None of the standard list of [AIA Contract Documents](#) related to the ARE have specific content covered in the Project Planning & Design division.

# Project Development & Documentation (PDD)

This division will assess objectives related to the integration and documentation of building systems, material selection, and material assemblies into a project. The division will focus on issues related to the development of design concepts, evaluation of materials and technologies, selection of appropriate construction techniques, and appropriate construction documentation. Candidates must demonstrate an understanding of and abilities in integration of civil, structural, mechanical, electrical, plumbing, and specialty systems into overall project design and documentation.

<b>SECTION 1: Integration of Building Materials &amp; Systems</b> .....	<b>100</b>
<b>SECTION 2: Construction Documentation</b> .....	<b>107</b>
<b>SECTION 3: Project Manual &amp; Specifications</b> .....	<b>113</b>
<b>SECTION 4: Codes &amp; Regulations</b> .....	<b>117</b>
<b>SECTION 5: Construction Cost Estimates</b> .....	<b>122</b>
<b>Project Development &amp; Documentation References</b> .....	<b>127</b>

# Project Development & Documentation

## DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
100	91	9	2	16-20	4 hr 5 min	45 min	5 hr

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count toward or against your final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Evaluating project documentation for the constructability of a building and site
- Integrating technical knowledge and information to refine a design
- Integrating materials and building systems to meet the project design requirements
- Translating design decisions into appropriate construction documentation

The 100 items will assess you on five sections related to Project Development & Documentation. The number of items from each section will vary based on the targeted percentage of items within each section.

## SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*
<b>SECTION 1:</b> Integration of Building Materials & Systems	31-37	31-37%
<b>SECTION 2:</b> Construction Documentation	32-38	32-38%
<b>SECTION 3:</b> Project Manual & Specifications	12-18	12-18%
<b>SECTION 4:</b> Codes & Regulations	8-14	8-14%
<b>SECTION 5:</b> Construction Cost Estimates	2-8	2-8%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you may experience may vary slightly as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

**PDD** SECTION 1

# Integration of Building Materials & Systems

*In this section, you'll focus on resolving and detailing architectural systems and assemblies, building materials, and engineering systems.*

**OBJECTIVE 1.1 (5-9%)****Analyze the integration of architectural systems and technologies to meet project goals (A/E)**

*As an architect you will first need to resolve and detail roof, curtain wall, cladding, window, floor, and other architectural systems, while also considering the detail requirements and capabilities of individual building materials.*

**OBJECTIVE 1.2 (5-9%)****Determine the size of mechanical, electrical, and plumbing systems and components to meet project goals (U/A)**

*You will need to identify and develop mechanical, electrical, and plumbing systems based on system type, system requirements, programmatic requirements, and other factors. This may include tasks such as calculating the size of system components, determining a lighting layout, or incorporating renewable energy systems into a design.*

**OBJECTIVE 1.3 (5-9%)****Determine the size of structural systems to meet project goals (U/A)**

*You will need to identify and develop structural systems, including detailing connections between standard horizontal and vertical structural components and calculating the size of some structural components based on the system type, system requirements, programmatic requirements, and other factors.*

**CONTINUED****OBJECTIVE 1.4 (1-5%)****Integrate specialty systems such as acoustics, lighting, fire suppression, conveying, security, and communications to meet project goals (U/A)**

*You will need to be able to identify, develop, and integrate individual specialty system components based on system type, system requirements, programmatic requirements, and other factors.*

**OBJECTIVE 1.5 (3-7%)****Determine how to detail the integration of multiple building systems and technologies (U/A)**

*You must also be able to detail and resolve the intersection of roof, curtain wall, cladding, window, floor, structural, interior, and other architectural systems as they come together within a building project.*

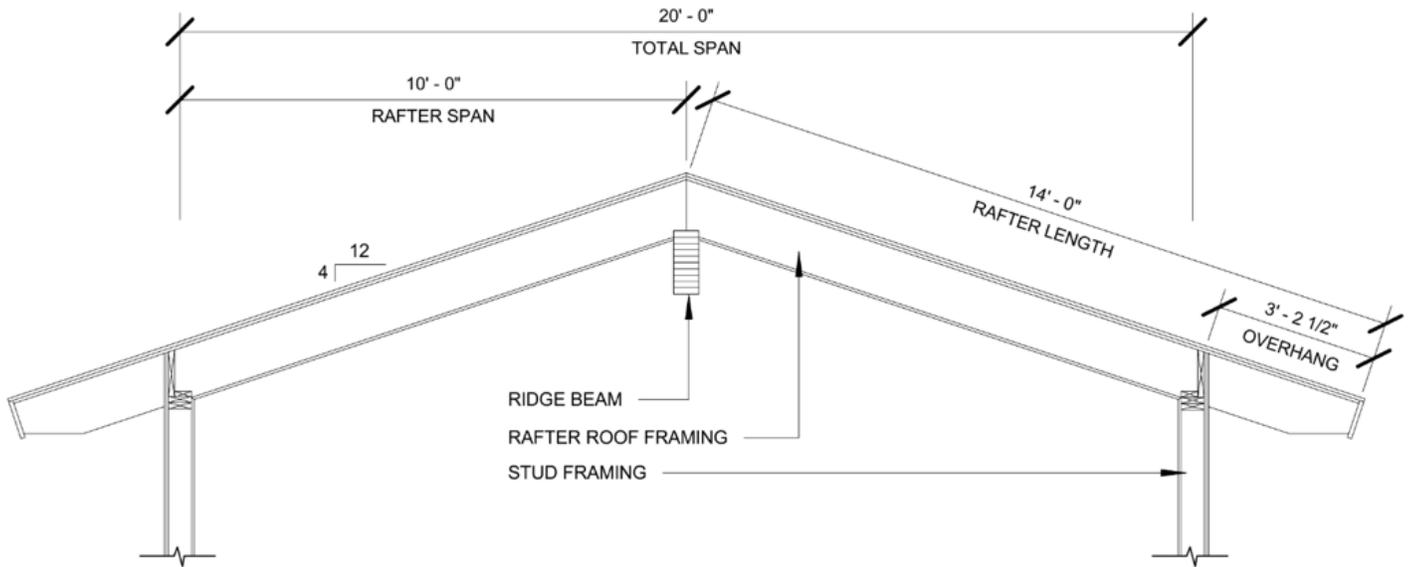
**OBJECTIVE 1.6 (3-7%)****Coordinate mechanical, electrical, plumbing, structural, and specialty systems and technologies (U/A)**

*You must identify and resolve conflicts between engineering systems (mechanical, electrical, plumbing, and structural) and other specialty systems as they integrate into the project. This also includes coordinating engineering systems with the architectural design to fulfill programmatic, system, and other project requirements.*

**PDD SECTION 1**

Sample Items

**SAMPLE ITEM 1**



Refer to the exhibit.

An architect is sizing a glue-laminated ridge beam for a wood-framed residential project.

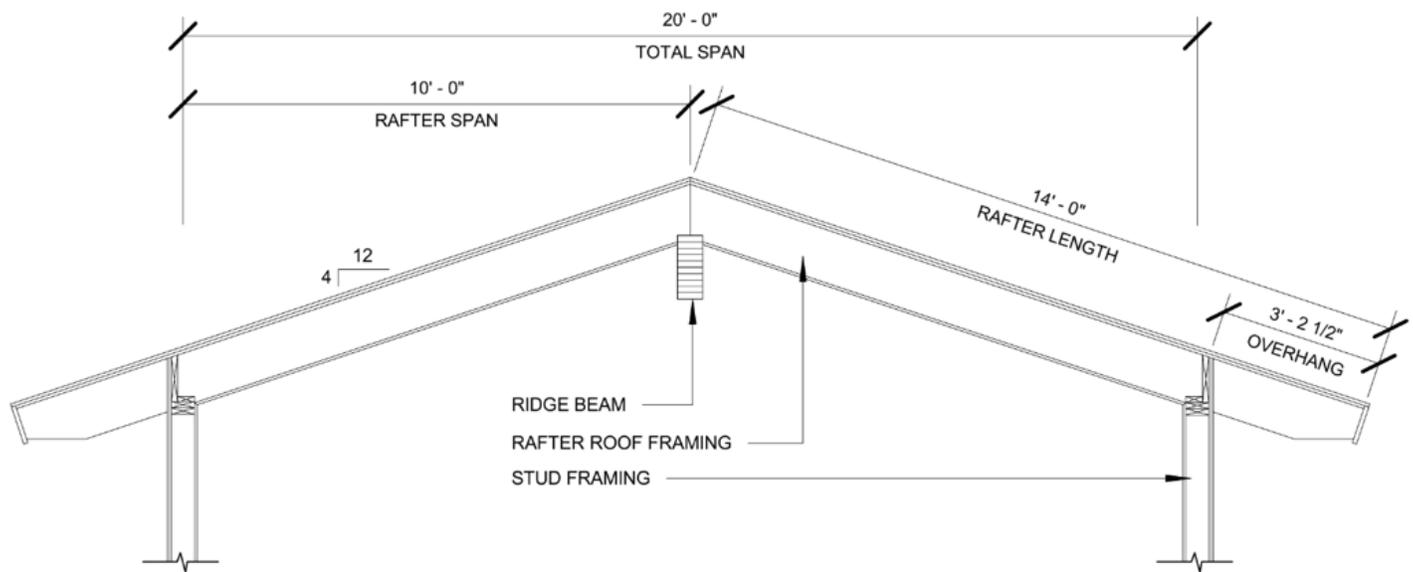
If the design snow load is 60 psf, what is the total snow load per linear foot on the ridge beam?

lb/ft

## PDD SECTION 1

## Sample Items

## SAMPLE ITEM 1 - CORRECT RESPONSE



600

 lb/ft

**RATIONALE:** According to the *International Building Code*, design snow loads are assumed to act vertically on the horizontal projection of sloped surfaces. Considering this, you will need to multiply half the total span by the design snow load to determine the snow load on the ridge beam. Because the units are provided after the answer box, only the numerals should be entered in the box.

$$10'-0" \times 60 \text{ psf} = 600 \text{ lb/ft}$$

**U/A**

---

**LEVEL**

This is a **U/A level** item requiring you to understand the application of live loads on wood-framed structures.

## PDD SECTION 1

## Sample Items

## SAMPLE ITEM 2

A holed hydraulic elevator has been selected for a new low-rise development.

During project documentation, which of the following should the architect consider? **Check the three that apply.**

- Car support rails
- Counterweights
- Elevator pit
- Hoisting cables
- Penthouse machine room
- Piston and underground cylinder

## CORRECT RESPONSE

A holed hydraulic elevator has been selected for a new low-rise development.

During project documentation, which of the following should the architect consider? **Check the three that apply.**

- Car support rails**
- Counterweights
- Elevator pit**
- Hoisting cables
- Penthouse machine room
- Piston and underground cylinder**

**RATIONALE:** *Mechanical and Electrical Equipment for Buildings* and *Architectural Graphic Standards* discuss the critical components of each of the primary elevator systems. The car support rails extend from the pit floor to the top of the hoistway and guide the car within the hoistway. The elevator pit is an element of both traction and hydraulic elevators located at the base of the hoistway, extending below the lowest level served. It provides both overrun clearance and space for elevator equipment. Finally, the piston is located within the underground cylinder with one end connected to the elevator car. When hydraulic fluid is pumped into the cylinder, the piston and elevator car move up. Hoisting cables, counterweights, and a penthouse machine room are all components of traction elevators.



**U/A**  
LEVEL

This is a **U/A level** item requiring you to have a detailed understanding of the main components of a conveying system.

**PDD SECTION 1**

# Sample Items

## SAMPLE ITEM 3

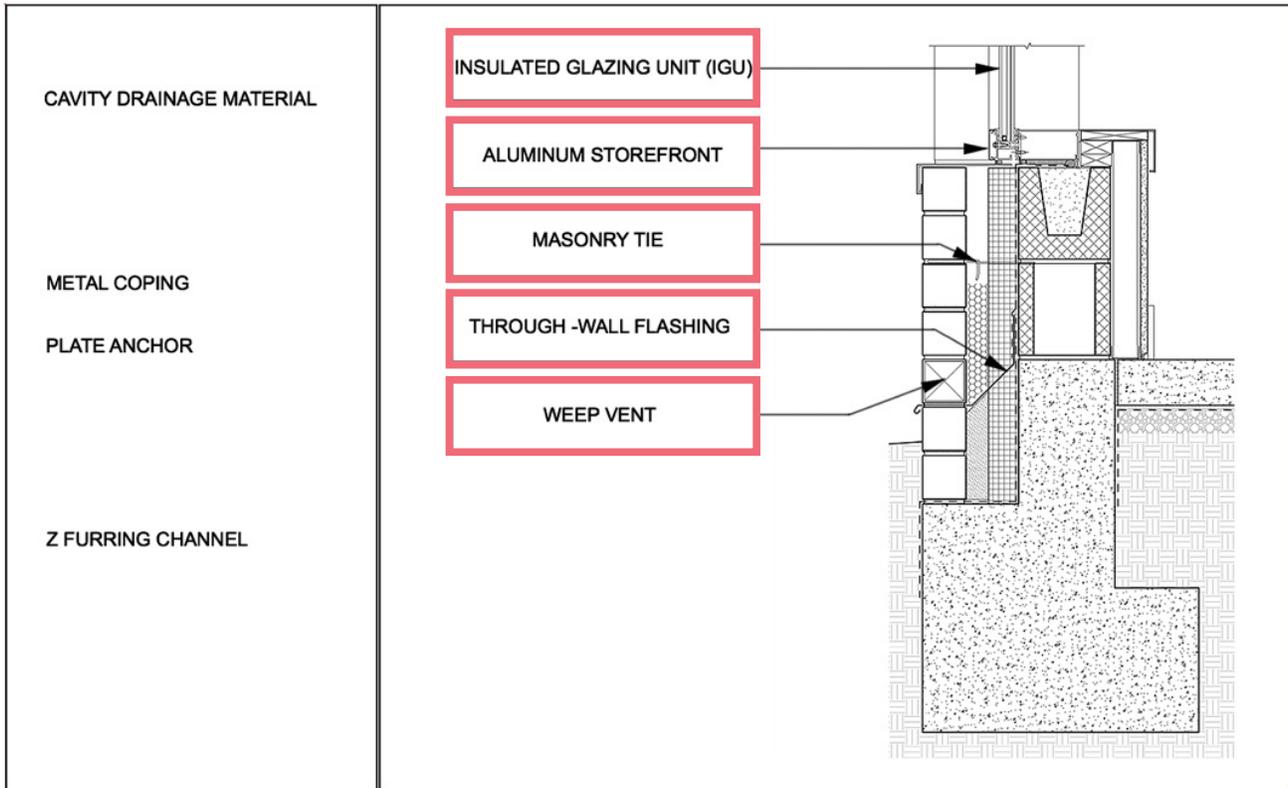
Drag the material labels from the left into the boxes on the **brick cavity** wall section detail. Not all material labels will be used.

<ul style="list-style-type: none"> <li>ALUMINUM STOREFRONT</li> <li>CAVITY DRAINAGE MATERIAL</li> <li>INSULATED GLAZING UNIT (IGU)</li> <li>MASONRY TIE</li> <li>METAL COPING</li> <li>PLATE ANCHOR</li> <li>THROUGH -WALL FLASHING</li> <li>WEEP VENT</li> <li>Z FURRING CHANNEL</li> </ul>	
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**PDD SECTION 1**

Sample Items

**SAMPLE ITEM 3 - CORRECT RESPONSE**



**RATIONALE:** The wall section detail provided represents a brick cavity wall with CMU backup construction. This type of wall system is illustrated and described in *Architectural Graphic Standards*. As part of this wall system, masonry ties are required to anchor the brick veneer to the backup wall. Through-wall flashing is required to divert moisture that has entered the wall cavity to the outside through weep vents or holes. The CMU backup wall supports a storefront system infilled with insulated glazing units (IGUs). The cavity drainage material is located in the air space above the through-wall flashing to ensure cavity wall moisture performance, but is not labeled in this section. Metal coping, plate anchors, and Z furring channels are essential elements of some wall systems, but are not part of this detail.



This is a **U/A level** item that requires you to understand the different components of an exterior wall assembly and how they integrate with other materials and systems.

**PDD SECTION 2**

# Construction Documentation

*In this section, you'll focus on project documentation necessary to assemble a set of drawings and update these drawings over the course of a project.*

**OBJECTIVE 2.1 (7-11%)****Determine appropriate documentation of building design (A/E)**

*Architects must identify a drawing and documentation approach based on project complexity, materials and assemblies, delivery method, and other project or construction related requirements. Throughout project documentation, you must know how to refine, update, and make adjustments to the drawings to align with new or changing project requirements. Documentation must also indicate final selections of building materials, assemblies, and finishes.*

**OBJECTIVE 2.2 (2-6%)****Determine appropriate documentation of site features (A/E)**

*Architects must also coordinate with civil engineers, landscape architects, and other consultants to verify the documentation of site drainage, utilities, pedestrian and vehicular circulation paths, parking, grading, and other site features and structures, including those related to environmental sustainability and resilience. It is critical to ensure site documentation is coordinated with all project disciplines.*

**OBJECTIVE 2.3 (8-12%)****Determine appropriate documentation of detailed building drawings within individual architectural systems (A/E)**

*You will need to resolve, detail, and document individual architectural systems such as partition types, expansion joints, windows, doors, louvers, stairs, and other systems based on constructability, environmental, programmatic, and other building requirements.*

**CONTINUED****OBJECTIVE 2.4 (5-9%)** \_\_\_\_\_**Apply standards required to assemble a set of clear and coordinated construction documentation (U/A)**

*As an architect, you will also need to determine the necessary drawings required to communicate an architectural design based on the project delivery method. This requires assembling these drawings into a clear set of construction documents and ensuring the quality of the documentation meets the appropriate standard of care.*

**OBJECTIVE 2.5 (3-7%)** \_\_\_\_\_**Determine impact of project changes on documentation requirements and methods to communicate those changes to owner and design team (U/A)**

*Architects must incorporate value engineering, changes in scope, and owner or project team comments into the drawing set, and determine the impact of these changes on the project delivery method and schedule. You will also need to recognize when changes in scope or owner/project team comments require the architect to perform additional services.*

## PDD SECTION 2

## Sample Items

## SAMPLE ITEM 4

Glass is being used for the exterior storefront system of a clothing store located in a cold climate. The client has requested that the glass be neutral in color and as transparent as possible to allow maximum visibility into the store.

What type of glass should the architect specify for the storefront system?

- Double pane, insulating glass unit (IGU) with clear glass and a ceramic frit pattern
- Double pane, insulating glass unit (IGU) with clear glass
- Double pane, insulating glass unit (IGU) with low-iron clear glass and a low-e coating

**RATIONALE:** *Olin's Construction: Principles, Materials, and Methods* describes architectural glazing in detail, including specific types, performance properties, and their integration into entrances, storefronts, or glazed curtain walls. Since the clothing store is located in a cold climate, double pane insulating glass with a low-e coating is important to minimize interior heat loss during the winter months. The client has requested the glass be neutral in color and as transparent as possible, making low-iron clear glass the best option because it has less of a green tint than standard clear glass.

## CORRECT RESPONSE

Glass is being used for the exterior storefront system of a clothing store located in a cold climate. The client has requested that the glass be neutral in color and as transparent as possible to allow maximum visibility into the store.

What type of glass should the architect specify for the storefront system?

- Double pane, insulating glass unit (IGU) with clear glass and a ceramic frit pattern
- Double pane, insulating glass unit (IGU) with clear glass
- Double pane, insulating glass unit (IGU) with low-iron clear glass and a low-e coating**



This is an **A/E level** item requiring you to evaluate the climate conditions and client requirements to complete the selection of final building materials.

## PDD SECTION 2

## Sample Items

## SAMPLE ITEM 5

During the review of the 95% construction documents cost estimate for a hospital project, construction costs are estimated to exceed the funds available for construction by 12%.

Prior to the bidding phase, what should the architect recommend to the owner?

- Incorporate design alternates into the documents.
- Eliminate project contingencies budget.
- Reduce the scope of the project.

**RATIONALE:** *The Architect's Handbook of Professional Practice* discusses these concepts as they relate to project execution. Incorporating design alternates into the documents would be advantageous to the owner because doing so would provide them an opportunity to modify the project design and ensure the project stays within budget. This recommendation also allows the owner to select specific materials or design features after the actual construction costs are known. Project contingencies cover unforeseeable project conditions while addressing risk-related issues; therefore, it is not advisable to eliminate these values. Reducing the scope of the project is possible, but could contain schedule delays and be costly for the architect as this would require revising the construction documents.

## CORRECT RESPONSE

During the review of the 95% construction documents cost estimate for a hospital project, construction costs are estimated to exceed the funds available for construction by 12%.

Prior to the bidding phase, what should the architect recommend to the owner?

- Incorporate design alternates into the documents.**
- Eliminate project contingencies budget.
- Reduce the scope of the project.



This is a **U/A level** item requiring an understanding of how construction estimates can influence project documentation and how to address cost concerns prior to the bidding phase.

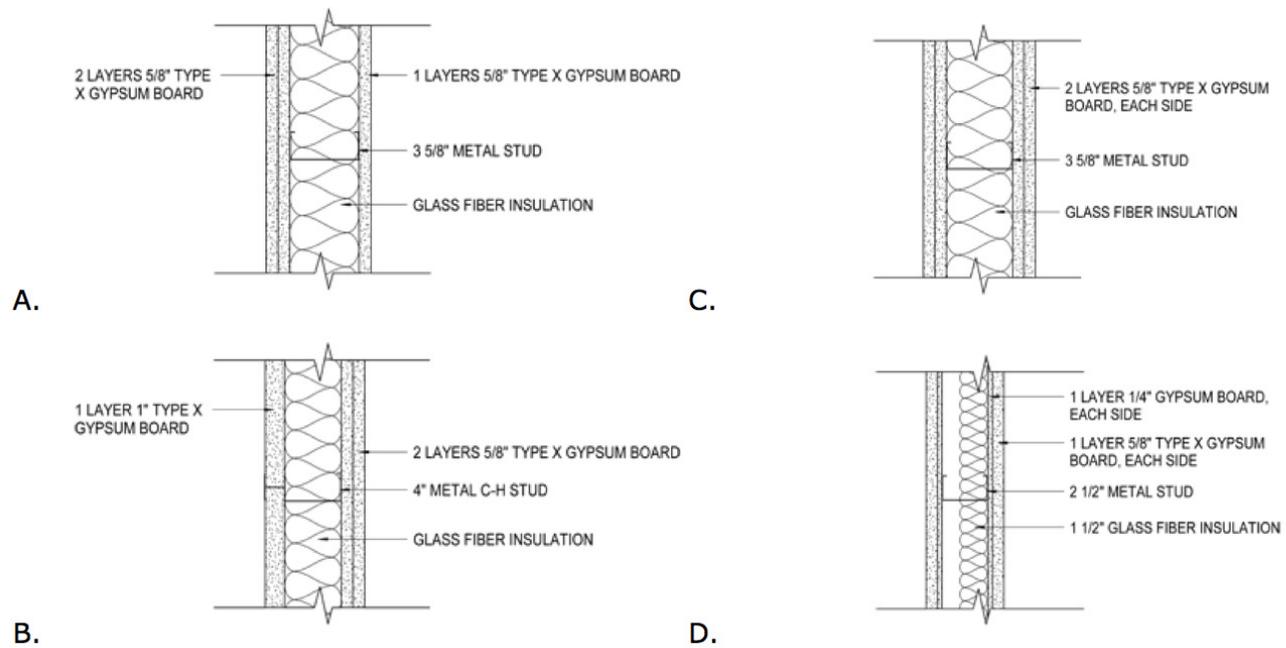
**PDD SECTION 2**

**Sample Items**

**SAMPLE ITEM 6**

An architect is detailing a 2-hour rated wall assembly between a lecture hall and lobby corridor for a new business school. Wall thickness needs to be minimized, and acoustical separation between the spaces needs to be maximized.

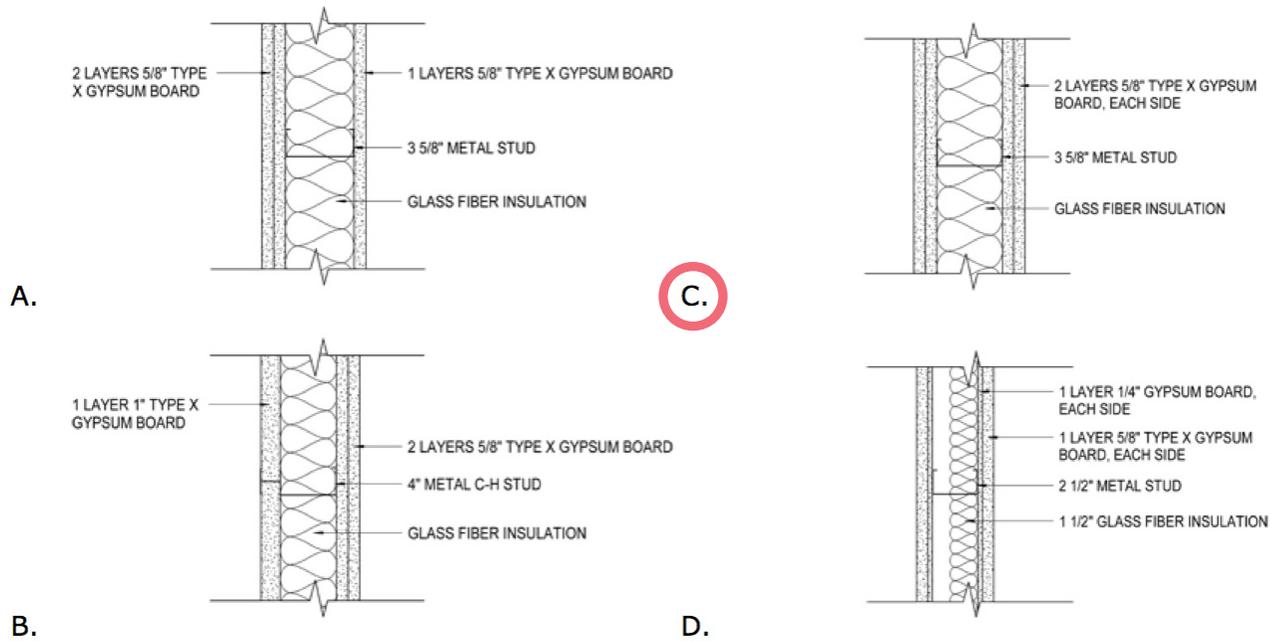
Which interior wall assembly is appropriate for this location?



**PDD SECTION 2**

Sample Items

**SAMPLE ITEM 6 - CORRECT RESPONSE**



**RATIONALE:** According to the *International Building Code* and *Architectural Graphic Standards*, each of the interior wall assembly options provides at least a one-hour fire rating with good acoustical properties. Although options A and D provide sound transmission class (STC) ratings of up to 49 and 59, they are only constructed as 1-hour rated assemblies. Option B is a shaft wall assembly, which is not appropriate for this specific location in the business school. Option C provides a high STC rating and a 2-hour fire rating, making it the most appropriate wall assembly for the corridor partition.



This is an **A/E level** item requiring you to analyze the detailed interior wall assemblies as they relate to acoustics, fire rating, and location within the identified building.

**PDD** SECTION 3

# Project Manual & Specifications

*In this section, you'll focus on the development of documentation beyond construction drawings—the project manual and specifications.*

**OBJECTIVE 3.1 (1-5%)****Identify and prioritize components required to write, maintain, and refine project manual (U/A)**

*You will need to be able to determine and assemble the content of a project manual, including the general conditions; instructions for procurement, bidding, and contracting; and project specific requirements. This also requires the identification and preparation of any additional exhibits or special conditions required for project execution.*

**OBJECTIVE 3.2 (6-10%)****Identify and prioritize components required to write, maintain, and refine project specifications (U/A)**

*You will need to determine the appropriate type of specifications to be used for a project, and you will need to identify which divisions are necessary based on project requirements. You will also need to analyze, select, and specify materials within a project in order to meet project requirements, testing protocols during construction, and common industry standards for materials and methods.*

**OBJECTIVE 3.3 (2-6%)****Coordinate specifications with construction documentation (U/A)**

*You must also coordinate the specifications with information found on the architectural construction drawings and consultant documents. This includes all materials, assemblies, hardware, methods, and other identified information.*

## PDD SECTION 3

## Sample Items

## SAMPLE ITEM 7

A client representative for a publicly funded project has requested the specifications be written in a way to promote competition and maximize client value.

Which methods of specifying should the architect consider? **Check the three that apply.**

- Descriptive
- MasterSpec
- Performance
- Proprietary
- Reference
- Restrictive

**RATIONALE:** Specifications can be prepared in several different ways, each containing advantages and disadvantages. According to *The Architect's Handbook of Professional Practice*, descriptive specifications require descriptions of a material or product's characteristics; performance specifications describe the performance qualities of a material or product; lastly, reference specifications provide standards, which are published by industry associations. Since each of these specification methods do not list specific products and materials by name, they would promote competition among manufacturers and allow the owner to receive maximum value. Proprietary and restrictive specifications include product and material names, which will limit competition among manufacturers. MasterSpec is not a method of specifying; rather, it is a product used for producing specifications.

## CORRECT RESPONSE

A client representative for a publicly funded project has requested the specifications be written in a way to promote competition and maximize client value.

Which methods of specifying should the architect consider? **Check the three that apply.**

- Descriptive**
- MasterSpec
- Performance**
- Proprietary
- Reference**
- Restrictive



This is a **U/A level** item that requires you to understand the different types of specifications available, as well as determine which type is appropriate for a particular client and project type.

**PDD SECTION 3**

**Sample Items**

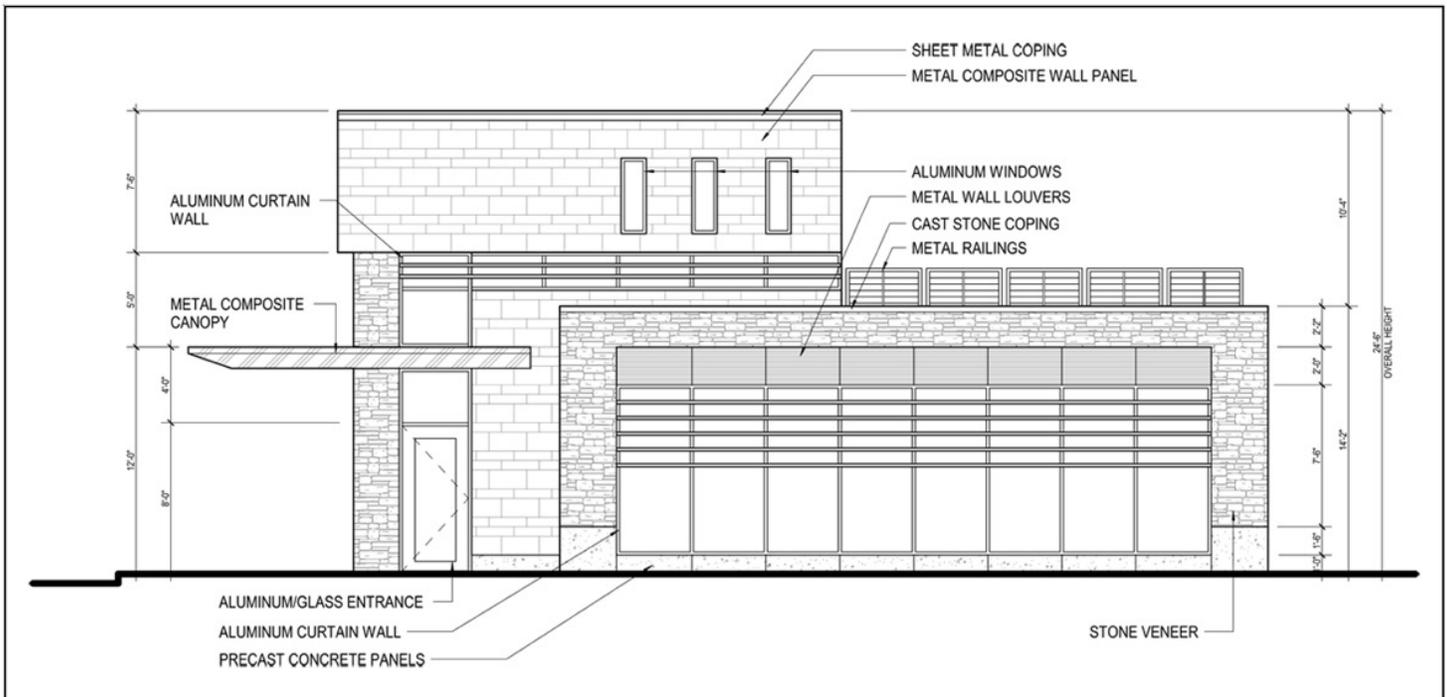
**SAMPLE ITEM 8**

Refer to the exhibit.

An architect is completing a coordination review of the exterior materials with the specifications received from their consultant spec writer.

Click on the element in the elevation below that is missing from the specifications.

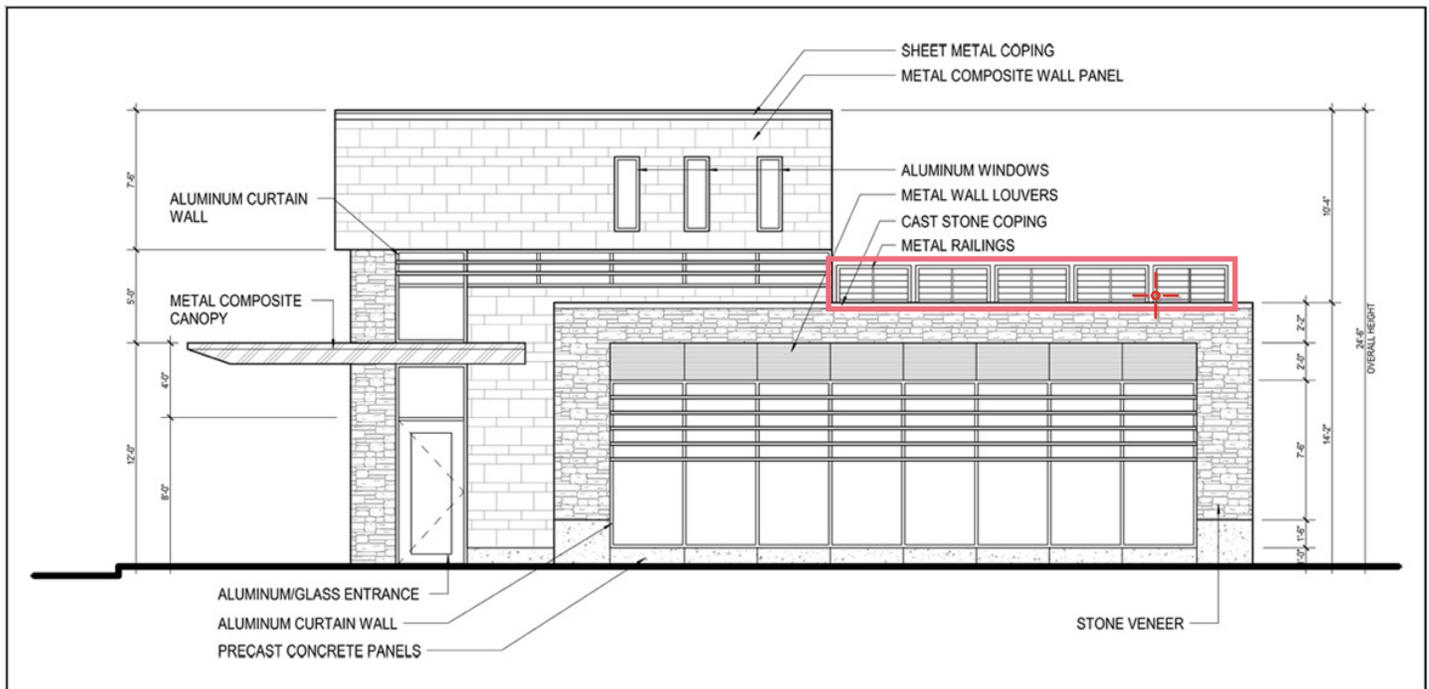
TABLE OF CONTENTS - SPECIFICATIONS	
Division 02 - Existing Conditions	Division 09 - Finishes
Division 03 - Concrete	Division 10 - Specialties
Division 04 - Masonry	Division 12 - Furnishings
Division 06 - Wood, Plastics, and Composites	Division 21 - Fire Suppression
Division 07 - Thermal and Moisture Protection	Division 22 - Plumbing
Division 08 - Openings	Division 28 - Electronic Safety and Security



PDD SECTION 3

Sample Items

SAMPLE ITEM 8 - CORRECT RESPONSE



**RATIONALE:** Based on The Construction Specifications Institute’s (CSI) MasterFormat divisions, Division 05 – Metals is missing from the Table of Contents provided by the consultant spec writer. This division includes metal handrails and railings, which are noted on the above elevation. The remainder of the exterior materials labeled are found in the specification list provided.

This is a **U/A level** item requiring you to understand the MasterFormat specification divisions and verify that materials shown on architectural drawings are properly specified.

**PDD** SECTION 4

# Codes & Regulations

*Codes and regulations appear in several divisions, but in this division, you'll look at codes and regulations at a detail level and determine how they pertain to project documentation.*

**OBJECTIVE 4.1 (4-8%)****Determine adherence to building regulatory requirements (IBC) at detail level (U/A)**

*It is critical to be able to apply the International Building Code to the design and documentation of a project, including means of egress, fire and smoke protection, material and assembly requirements, and the ways in which changes to occupancy, floor size, or other details can impact code requirements.*

**OBJECTIVE 4.2 (3-7%)****Determine adherence with specialty regulatory requirements at the detail level (U/A)**

*It is also important to be able to apply specialty regulations to the design and documentation of a project. This includes accessibility requirements, energy codes, standards for historic preservation, Fair Housing, environmental regulations, and other local or site specific regulations.*

**PDD SECTION 4**

Sample Items

**SAMPLE ITEM 9**

Refer to the exhibit.

The occupancy of the top floor of a museum project has increased from 800 to 1,200 occupants. The building contains an automatic fire sprinkler system, emergency communication system, and four stairwells to provide equally distributed egress from all floors.

Drag the dimensions from the left into the three boxes on the enlarged stair plan drawing to identify the minimum dimensions required for egress. Not all dimensions will be used.

**SECTION 1005  
MEANS OF EGRESS SIZING**

**1005.1 General.** All portions of the *means of egress* system shall be sized in accordance with this section.

**Exception:** *Aisles and aisle accessways* in rooms or spaces used for assembly purposes complying with Section 1029.

**1005.2 Minimum width based on component.** The minimum width, in inches (mm), of any *means of egress* components shall be not less than that specified for such component, elsewhere in this code.

**1005.3 Required capacity based on occupant load.** The required capacity, in inches (mm), of the *means of egress* for any room, area, space or story shall be not less than that determined in accordance with Sections 1005.3.1 and 1005.3.2:

**1005.3.1 Stairways.** The capacity, in inches, of *means of egress stairways* shall be calculated by multiplying the *occupant load* served by such *stairways* by a means of egress capacity factor of 0.3 inch (7.6 mm) per occupant. Where *stairways* serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required capacity of the *stairways* serving that story.

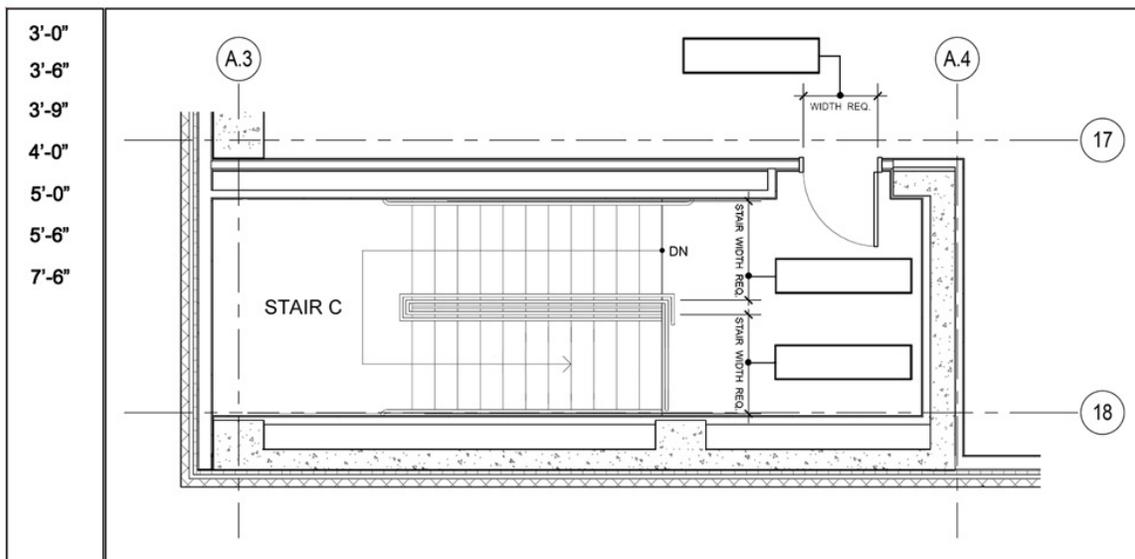
**Exceptions:**

- For other than Group H and I-2 occupancies, the capacity, in inches, of *means of egress stairways* shall be calculated by multiplying the *occupant load* served by such *stairways* by a means of egress capacity factor of 0.2 inch (5.1 mm) per occupant in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and an *emergency voice/ alarm communication* system in accordance with Section 907.5.2.2.

**1005.3.2 Other egress components.** The capacity, in inches, of *means of egress* components other than *stairways* shall be calculated by multiplying the *occupant load* served by such component by a means of egress capacity factor of 0.2 inch (5.1 mm) per occupant.

**Exceptions:**

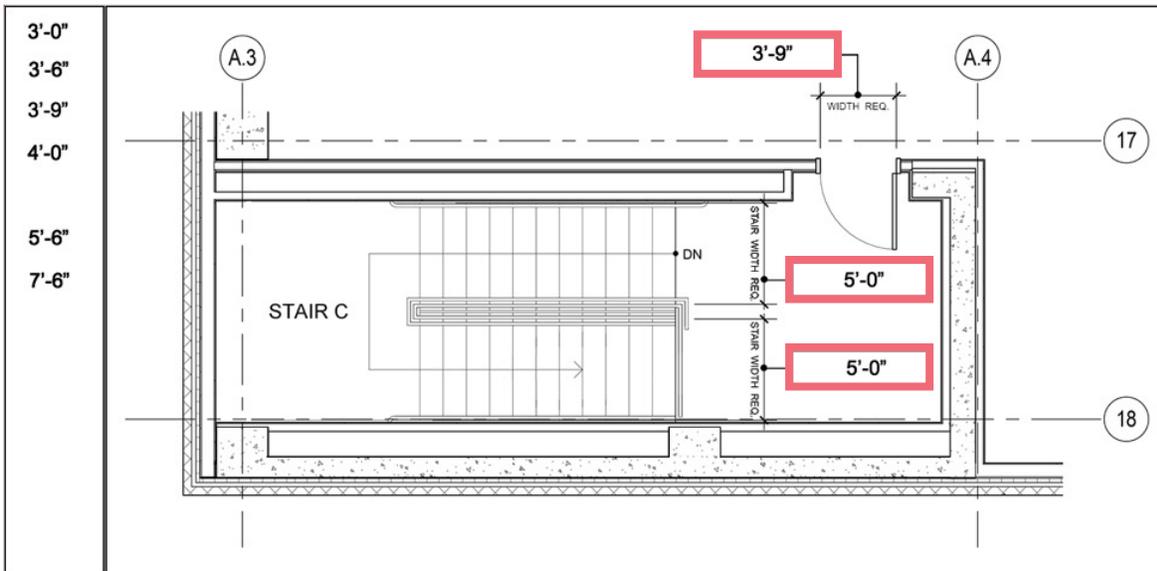
- For other than Group H and I-2 occupancies, the capacity, in inches, of *means of egress* components other than *stairways* shall be calculated by multiplying the *occupant load* served by such component by a means of egress capacity factor of 0.15 inch (3.8 mm) per occupant in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and an *emergency voice/ alarm communication* system in accordance with Section 907.5.2.2.



## PDD SECTION 4

## Sample Items

## SAMPLE ITEM 9 - CORRECT RESPONSE



**RATIONALE:** Prior to calculating the required widths, you will need to determine the egress capacity factors for stairs and doors from the *International Building Code* exhibit provided. Since this building contains an automatic fire sprinkler system and emergency communication system, stairs require .2 inches per occupant and doors require .15 inches per occupant. If the top floor of the building has increased to 1,200 occupants and has four stairwells providing equally distributed egress, each stair must egress 300 occupants (**Step 1**). By multiplying this occupant value by the egress capacity factor for doors (**Step 2**) and stairs (**Step 3**), you will calculate the minimum required width for each egress component.

**Step 1:**  $1,200 / 4 = 300$  occupants

**Step 2:**  $300 \text{ occupants} \times .15 \text{ inches per occupant} = 45" = 3'-9"$

**Step 3:**  $300 \text{ occupants} \times .2 \text{ inches per occupant} = 60" = 5'-0"$

**U/A**  
LEVEL

This is a **U/A level** item requiring you to understand means of egress requirements, as well as how to apply them at a detailed level to different egress components of a building.

**PDD SECTION 4**

**Sample Items**

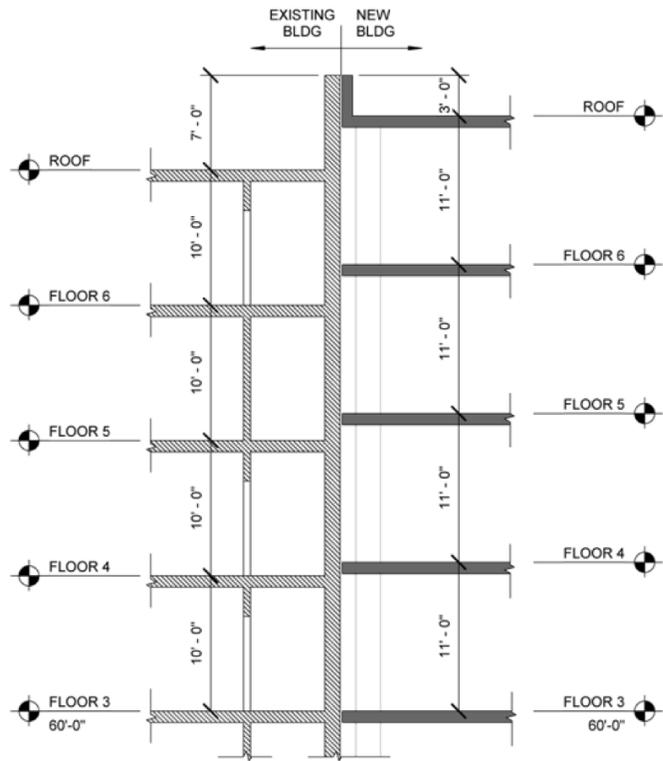
**SAMPLE ITEM 10**

Refer to the exhibit.

An architect is designing an addition to an existing medical research building. An accessible route between the buildings is required on all floors.

What is the minimum length of an unobstructed straight ramp system required to create an accessible route between the existing and new buildings on Floor 6 (including top and bottom landings)?

ft



## PDD SECTION 4

## Sample Items

## SAMPLE ITEM 10 - CORRECT RESPONSE

51 ft

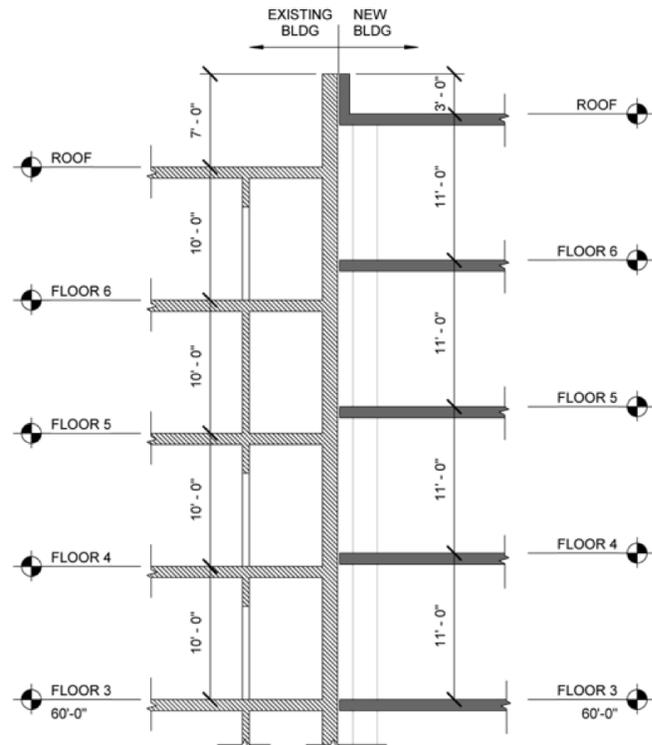
**RATIONALE:** In order to calculate the minimum length of ramp required, you will first need to determine that Floor 6 of the new building is 3'-0" higher than the same floor in the existing building (**Step 1**). Prior to performing a calculation, it is also important to understand that the *ADA Standards for Accessible Design* permit a maximum ramp slope of 1:12, a maximum ramp rise of 30", and a minimum landing length of 60" in a straight direction of travel. With this information in mind, you can determine that 3'-0" of vertical rise requires a minimum of 36'-0" of ramp length (**Step 2**). Since the rise is over 30", 30'-0" ramp and 6'-0" ramp sections are required (**Step 3**), as well as three 5'-0" landings (bottom, intermediate, and top). Adding the three landing lengths and the two ramp lengths together will give you 51'-0" (**Step 4**), the minimum length required for the ramp system. Because the unit ft is provided after the answer box, only the numerals 51 need to be entered in the box.

$$\text{Step 1: } (11'-0" + 11'-0" + 11'-0") - (10'-0" + 10'-0" + 10'-0") = 3'-0"$$

$$\text{Step 2: } 3'-0" \times 12 = 36'-0" \text{ of ramp length}$$

$$\text{Step 3: } 36'-0" - 30'-0" = 6'-0"$$

$$\text{Step 4: } 5'-0" + 30'-0" + 5'-0" + 6'-0" + 5'-0" = 51'-0"$$



**U/A**  
LEVEL

This is a **U/A level** item requiring you to understand the ADA requirements and apply them to accessible routes in buildings.

**PDD** SECTION 5

# Construction Cost Estimates

*In this last section, you'll consider the construction cost of a project by analyzing an estimate. This section contains only one objective and is the smallest section in the division.*

**OBJECTIVE 5.1 (2-8%)****Analyze construction cost estimates to confirm alignment with project design (A/E)**

*As an architect, you will need to compare and modify a construction cost estimate based on the development of a project, including value engineering, substitution of materials, and alignment with the project documentation and requirements. You will need to utilize appropriate estimating techniques based on the project type, phase, delivery method, or other requirements.*

## PDD SECTION 5

## Sample Items

## SAMPLE ITEM 11

EXTERIOR WALL CONSTRUCTION TYPE	QUANTITY (SQ. FT.)	UNIT COST (\$/SQ. FT.)
Brick veneer cavity wall, metal stud backup	30,000	60.00
Thin brick on thin set mortar, metal stud backup		49.00
Precast concrete insulated panels, form liner exterior finish		46.00
Precast concrete insulated panels, thin brick exterior finish		42.00
Exterior insulation and finish system (EIFS), metal stud backup		20.00

Refer to the exhibit.

An architect has received a construction cost estimate for an 85,000 gsf elementary school that is \$420,000 over the construction budget. The owner requests that the current brick veneer cavity wall system with a metal stud backup be replaced with a more cost effective system, while maintaining a similar exterior aesthetic. The contractor has provided pricing for alternative exterior systems.

Based on this pricing information, what system should the architect recommend to the client?

- Exterior insulation and finish system (EIFS), metal stud backup
- Precast concrete insulated panels, form liner exterior finish
- Precast concrete insulated panels, thin brick exterior finish
- Thin brick on thin set mortar, metal stud backup

## PDD SECTION 5

## Sample Items

## SAMPLE ITEM 11 - CORRECT RESPONSE

Refer to the exhibit.

An architect has received a construction cost estimate for an 85,000 gsf elementary school that is \$420,000 over the construction budget. The owner requests that the current brick veneer cavity wall system with a metal stud backup be replaced with a more cost effective system, while maintaining a similar exterior aesthetic. The contractor has provided pricing for alternative exterior systems.

Based on this pricing information, what system should the architect recommend to the client?

- Exterior insulation and finish system (EIFS), metal stud backup
- Precast concrete insulated panels, form liner exterior finish
- Precast concrete insulated panels, thin brick exterior finish**
- Thin brick on thin set mortar, metal stud backup

**RATIONALE:** Prior to calculating the cost savings of each exterior wall system, you will need to identify which systems can provide a similar exterior aesthetic. *Fundamentals of Building Construction: Materials and Methods* and *Architectural Graphic Standards* provide information on each of the identified systems. Both the exterior insulation and finish system (EIFS), which typically has a stucco-like exterior finish, and the precast concrete insulated panels, with a form liner exterior finish, differ from client's requirement for a brick aesthetic. Thin brick on thin set mortar with a metal stud backup visually would be appropriate, but does not reduce the project cost enough to meet the required budget ( $30,000 \text{ ft}^2 \times \$11.00 \text{ savings/ft}^2 = \$330,000 \text{ savings}$ ). The precast concrete insulated panels with a thin brick exterior finish provide the desired aesthetic and reduce the project cost to a value below the construction budget ( $30,000 \text{ ft}^2 \times \$18.00 \text{ savings/ft}^2 = \$540,000 \text{ savings}$ ).



This is an **A/E level** item that requires you to evaluate, compare, and recommend a replacement exterior wall system based on system cost and the client's aesthetic requirements.

**PDD SECTION 5****Sample Items****SAMPLE ITEM 12**

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An architect reviews the construction cost estimate for a financial institution located in a cold climate. The contractor needs to reduce the cost by at least \$26,000 and has included options that were presented by the curtain wall supplier. The building's energy performance is a top priority of the client.

Which cost savings options should the architect consider? **Check the three that apply.**

- Change the tint of windows from brown to gray (net savings of \$2,000).
- Reduce the air space from 3/4" to 1/4" on all IGUs (net savings of \$13,000).
- Remove the interior entry vestibule (net savings of \$13,000).
- Remove the low-e coating from the window glazing (net savings of \$12,000).
- Revise custom hardware to the manufacturer's standard hardware (net savings of \$5,000).
- Revise finish from a fluoropolymer coating to anodized aluminum finish (net savings of \$20,000).

## PDD SECTION 5

## Sample Items

## SAMPLE ITEM 12 - CORRECT RESPONSE

An architect reviews the construction cost estimate for a financial institution located in a cold climate. The contractor needs to reduce the cost by at least \$26,000 and has included options that were presented by the curtain wall supplier. The building's energy performance is a top priority of the client.

Which cost savings options should the architect consider? **Check the three that apply.**

- Change the tint of windows from brown to gray (net savings of \$2,000).**
- Reduce the air space from 3/4" to 1/4" on all IGUs (net savings of \$13,000).
- Remove the interior entry vestibule (net savings of \$13,000).
- Remove the low-e coating from the window glazing (net savings of \$12,000).
- Revise custom hardware to the manufacturer's standard hardware (net savings of \$5,000).**
- Revise finish from a fluoropolymer coating to anodized aluminum finish (net savings of \$20,000).**

**RATIONALE:** Since this is a cold climate, you need to recognize the options that may have a negative impact on the energy performance of the building, as well as those that will have little to no effect. According to *Fundamentals of Building Construction: Materials and Methods*, reducing the air space and removing the low-e coating will have a negative impact on the thermal performance of glazing system, thus reducing the overall performance of the building envelope and occupant thermal comfort. Removing the entry vestibule would increase infiltration of air into the building, also causing thermal comfort and building performance issues. Changing the tint of the windows, revising custom hardware to manufacturer's standard hardware, and revising the finish to anodized aluminum are the most appropriate options to consider since they will primarily affect only the aesthetics of the building.



This is an **A/E level** item requiring you to evaluate and compare architectural systems in relation to cost and impact on overall building performance.

# PDD References

## PUBLICATIONS

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The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### **Architectural Graphic Standards**

The American Institute of Architects  
John Wiley & Sons, 11th edition (2007)  
and 12th edition (2016)

### **Building Structures**

James Ambrose and Patrick Tripeny  
John Wiley & Sons, 3rd edition, 2011

### **Fundamentals of Building Construction: Materials and Methods**

Edward Allen and Joseph Iano  
John Wiley & Sons, 6th edition (2013)  
and 7th edition (2019)

### **Mechanical & Electrical Equipment for Buildings**

Walter T. Grondzik and Alison G. Kwok  
John Wiley & Sons, 12th edition (2014)  
and 13th edition (2019)

### **Olin's Construction Principles, Materials, and Methods**

H. Leslie Simmons  
John Wiley & Sons, 9th edition, 2011

## CODES

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The following code requirements have content covered in the Project Development & Documentation division.

### **2010 ADA Standards for Accessible Design**

U.S. Department of Justice, 2010

### **International Building Code (2018)**

International Code Council, 2017

## AIA CONTRACT DOCUMENTS

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None of the standard list of [AIA Contract Documents](#) related to the ARE have specific content covered in the Project Development & Documentation division.

# Construction & Evaluation (CE)

This division will assess objectives related to construction contract administration and post-occupancy evaluation of projects. The division will focus on issues related to bidding and negotiation processes, support of the construction process, and evaluation of completed projects. Candidates must demonstrate an understanding of and abilities in construction contract execution, construction support services (including construction observation and shop drawing or submittal review), payment request processing, and project closeout. In addition, candidates must also demonstrate an understanding and abilities in project evaluation of integrated building systems and their performance.

<b>SECTION 1: Preconstruction Activities</b> .....	<b>130</b>
<b>SECTION 2: Construction Observation</b> .....	<b>134</b>
<b>SECTION 3: Administrative Procedures &amp; Protocols</b> .....	<b>138</b>
<b>SECTION 4: Project Closeout &amp; Evaluation</b> .....	<b>142</b>
<b>Construction &amp; Evaluation References</b> .....	<b>146</b>

## Construction & Evaluation

### DIVISION DETAILS

TOTAL ITEMS	SCORED ITEMS	PRETEST ITEMS	NUMBER OF CASE STUDIES	NUMBER OF CASE STUDY ITEMS	TEST DURATION	OPTIONAL BREAK DURATION	TOTAL APPOINTMENT DURATION*
75	68	7	2	12-16	3 hr	30 min	3 hr 40 min

\*Appointments allow for introductory screens, optional break time, and closing screens. Pretest items don't count toward or against your final score.

This division will test a candidate's ability to protect the public's health, safety, and welfare by:

- Delivering professional services during project construction
- Translating construction documents and specifications to communicate and bring clarity to design intent
- Coordinating construction activities to meet design intent
- Evaluating completed projects

The 75 items will assess you on four sections related to Construction & Evaluation. The number of items from each section will vary based on the targeted percentage of items within each section.

### SECTION DETAILS

SECTIONS	EXPECTED NUMBER OF ITEMS	TARGET PERCENTAGE*
<b>SECTION 1:</b> Preconstruction Activities	13-17	17-23%
<b>SECTION 2:</b> Construction Observation	24-29	32-38%
<b>SECTION 3:</b> Administrative Procedures & Protocols	24-29	32-38%
<b>SECTION 4:</b> Project Closeout & Evaluation	5-10	7-13%

\*The percentages shown for each section and objective represent a typical form of this division. The specific form you may experience may vary slightly as adjustments are made from form to form to balance factors such as overall form level of difficulty and average time to answer the assembled items.

CE

SECTION 1

# Preconstruction Activities

*In this section, you'll focus on the construction planning and activities that occur prior to the start of construction.*

## **OBJECTIVE 1.1 (8-12%)**

---

### **Interpret the architect's roles and responsibilities during preconstruction based on delivery method (U/A)**

*Understanding the key elements of bidding is an important aspect of preconstruction activities. This includes the required bidding documents, typical procedures for distributing documents and the pre-bid meeting, prequalification of bidders, selection of the contractor, and applicable standard AIA documents. The architect's responsibilities for each of these may vary depending on the project delivery type.*

## **OBJECTIVE 1.2 (3-7%)**

---

### **Analyze criteria for selecting contractors (A/E)**

*You will need to be able to establish the criteria for reviewing contractors' bids, including accuracy and completeness. Based on these criteria, you will then need to evaluate contractors' bids and compare contractors' qualifications to each other.*

## **OBJECTIVE 1.3 (3-7%)**

---

### **Analyze aspects of the contract or design to adjust project costs (A/E)**

*You must evaluate and prioritize opportunities to reduce the project cost, scope, quality, or schedule. This will include consideration of the contractual implications of the changes, sustainability and life cycle cost goals, and the impact on project design and overall budget.*

## CE SECTION 1

## Sample Items

## SAMPLE ITEM 1

Which of the following should the contractor submit to the owner, through the architect, during the preconstruction phase of a traditional design-bid-build project? **Check the three that apply.**

- Certificates of required insurance
- Schedule of values
- Product submittals for long lead time items
- Application for first payment
- List of proposed subcontractors
- Lien releases from subcontractors

**RATIONALE:** These items are discussed in *The Project Resource Manual: CSI Manual of Practice*. Certificates of required insurance, the schedule of values, and a list of proposed subcontractors are three of many items that the contractor is required to submit prior to starting construction. Product submittals cannot be submitted until the list of subs is approved and subcontracts are awarded. No payment is due to the contractor until work has actually started, and lien releases are required before final payment.

## CORRECT RESPONSE

Which of the following should the contractor submit to the owner, through the architect, during the preconstruction phase of a traditional design-bid-build project? **Check the three that apply.**

- Certificates of required insurance**
- Schedule of values**
- Product submittals for long lead time items
- Application for first payment
- List of proposed subcontractors**
- Lien releases from subcontractors



This is a **U/A level** item requiring an understanding of various construction-related documents and the phase at which they must be reviewed.

**CE**

**SECTION 1**

# Sample Items

## SAMPLE ITEM 2

An architect is completing the bid documents for a new mixed-use building. The owner requests the architect to include in the specifications several items that are not yet fully defined.

Drag the labels from the left into the boxes adjacent to the item descriptions below to identify how each of the unknown items should be included in the bid specification. Not all labels will be used.

<p><b>Allowance</b></p> <p><b>Alternate</b></p> <p><b>Unit Price</b></p>	<div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-right: 10px;"></div> <div>Automated irrigation system at vegetated roof areas in addition to tamper-proof hose bibs.</div> </div> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-right: 10px;"></div> <div>Cost to manage, excavate, and dispose of hazardous materials, at the direction of the Owner's environmental consultant.</div> </div> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-right: 10px;"></div> <div>Earthwork materials, including base course, fill, and drainage course, as associated with utility installation.</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-right: 10px;"></div> <div>Occupancy sensors in all conference rooms in lieu of standard wall switches.</div> </div>
--	--

**CE SECTION 1**

# Sample Items

## SAMPLE ITEM 2 - CORRECT RESPONSE

Allowance	<b>Alternate</b>	Automated irrigation system at vegetated roof areas in addition to tamper-proof hose bibs.
Unit Price	<b>Allowance</b>	Cost to manage, excavate, and dispose of hazardous materials, at the direction of the Owner’s environmental consultant.
	<b>Unit Price</b>	Earthwork materials, including base course, fill, and drainage course, as associated with utility installation.
	<b>Alternate</b>	Occupancy sensors in all conference rooms in lieu of standard wall switches.

**RATIONALE:** According to *The Project Resource Manual: CSI Manual of Practice*, allowances and unit prices allow the architect to incorporate into the contract documents information that can’t be fully specified or drawn. Alternates, on the other hand, are a way to price options for the work so the owner can finalize the scope of work after evaluating the bids. In this case, the hazardous materials cost is an allowance because the full cost is unknown at the time of bidding, but the work needs to be included in the project. The earthwork cost is a unit price because the basic scope is understood, but the extent of the work is unknown. The irrigation system and occupancy sensors are both alternates because they are “in addition to” or “in lieu of” other parts of the work.



This is an **A/E level** item requiring the classification of different scope items in order to recommend the appropriate use of contract variables.

## CE

## SECTION 2

# Construction Observation

*This section addresses visiting the job site throughout the course of construction and the architect's roles and responsibilities.*

**OBJECTIVE 2.1 (13-17%)****Evaluate the architect's role during construction activities (A/E)**

*This objective assesses the architect's responsibilities to the owner during construction site visits and subsequent documentation, including site observations and action items for project team members. You must recognize the contractor's responsibilities to the architect, including change orders, applications for payments, shop drawings and other submittals, and the appropriate level of detail required for the schedule of values, based on project size, scope, phasing requirements, and schedule. You must also know the difference between the architect's design intent and the contractor's means and methods. Finally, you must identify the appropriate limits and extent of the architect's authority and actions during construction.*

**OBJECTIVE 2.2 (13-17%)****Evaluate construction conformance with contract documents, codes, regulations, and sustainability requirements (A/E)**

*You will need to be able to analyze the contractor's completed work against the project requirements and identify non-conforming construction on site. This may also require evaluating the impacts of unforeseen conditions and material substitutions against code, quality, and program requirements. You will need to coordinate your evaluations of construction conformance with that of your consultants and the owner's consultants.*

**OBJECTIVE 2.3 (3-7%)****Determine construction progress (U/A)**

*Construction observation also requires the review of work in place against the contractor's construction schedule and schedule of values, and understanding the impact of delays along the critical path.*

## CE SECTION 2

## Sample Items

## SAMPLE ITEM 3

During a routine site visit, the owner tells the architect to change the layout of two interior framed walls the contractor has already framed based on the construction documents. The framing changes will not have an impact on any code-related issues.

The owner is adamant the walls be reframed per their new request.

How should the architect address the owner's request?

- Ask the contractor to schedule a meeting onsite with the owner, architect, and framing subcontractor to review the changes.
- Review the expected effect on construction cost and schedule with the contractor, then prepare a change order for owner review.
- Issue a construction change directive, with a requirement for time and material invoices to be submitted for the work.
- Include documentation of the discussion and a drawing of the revised framing in the field report of the site visit.

**RATIONALE:** Per AIA Document A201-2017, General Conditions of the Contract for Construction, a construction change directive is appropriate when a change must take place regardless of time or cost impacts. Reviewing the expected costs ahead of completing the work is unnecessary in this situation. On the other hand, a field report alone is inadequate, because this change certainly has both time and cost impacts. Finally, an onsite meeting with the sub is unnecessary, as the requested changes can be fully documented by the architect.

## CORRECT RESPONSE

During a routine site visit, the owner tells the architect to change the layout of two interior framed walls the contractor has already framed based on the construction documents. The framing changes will not have an impact on any code-related issues.

The owner is adamant the walls be reframed per their new request.

How should the architect address the owner's request?

- Ask the contractor to schedule a meeting onsite with the owner, architect, and framing subcontractor to review the changes.
- Review the expected effect on construction cost and schedule with the contractor, then prepare a change order for owner review.
- Issue a construction change directive, with a requirement for time and material invoices to be submitted for the work.**
- Include documentation of the discussion and a drawing of the revised framing in the field report of the site visit.



This is an **A/E level** item requiring an assessment of a built condition in order to determine the appropriate contract change.

**CE SECTION 2****Sample Items****SAMPLE ITEM 4**

During a construction observation site visit to a new townhouse development, the architect reviews the contractor's installation of the roof sheathing.

Click on the material in the photo that contributes to the required fire separation between adjacent townhouses.



## CE SECTION 2

## Sample Items

## SAMPLE ITEM 4 - CORRECT RESPONSE



**RATIONALE:** In a group of townhouses, each townhouse must be considered a separate building from its neighbors. According to the *International Residential Code*, in order to provide the appropriate separation, using fire-retardant treated wood, along with a class C roof covering, is an acceptable alternative to using a parapet.

**A/E**  
LEVEL

This is an **A/E level** item that requires you to consider the code implications of a particular building type in order to interpret the photograph for evidence of code compliance.

## CE SECTION 3

# Administrative Procedures & Protocols

*The previous section is about the onsite responsibilities of an architect. This section is about the documentation necessary to the construction process. Clear written communication is an essential aspect of the construction process.*

**OBJECTIVE 3.1 (8-12%)****Determine appropriate additional information to supplement contract documents (U/A)**

*As an architect, you will need to evaluate contractor requests for additional information and determine if a request, unexpected disruption, or other situation requires a change in the construction contract. You will need to determine the appropriate documents for communicating requested information and design revisions due to a scope change, schedule delay, or unforeseen condition.*

**OBJECTIVE 3.2 (8-12%)****Evaluate submittals including shop drawings, samples, mock-ups, product data, and test results (A/E)**

*Architects must assess the contractor's understanding of the project scope by reviewing the contractor's submittals against the contract documents. They also must determine appropriate responses to the contractor and evaluate requests for substitutions.*

**OBJECTIVE 3.3 (3-7%)****Evaluate the contractor's application for payment (A/E)**

*Reviewing the contractor's application for payment against the completed work is a critical component of the construction process. This is done based on observations during construction site visits and a concurrent review of the contractor's schedule of values and approved change orders. You will also need to evaluate methods of retainage and their application throughout the project.*

**OBJECTIVE 3.4 (8-12%)****Evaluate responses to non-conformance with contract documents (A/E)**

*After non-conforming work is identified during site observations, you must be able to determine the source of the non-conformance; analyze the cost, schedule, and design implications; evaluate possible resolutions of the non-conformance; and communicate the selected solution to the team. These steps will need to be taken in coordination with your consultants and the owner's consultants.*

## CE SECTION 3

## Sample Items

## SAMPLE ITEM 5

A contract indicates the completion time for a project is 465 calendar days, including 45 days for weather days. Extremely bad weather delayed construction by 65 days. The contractor has requested an extension in the number of contract days due to the extremely bad weather.

What should the architect advise the owner?

- Issue a supplemental instruction to extend the schedule by 20 days.
- Extend the contract by 20 days via change order.
- Ask the contractor to accelerate the construction schedule.

**RATIONALE:** Per AIA Document A201-2017, General Conditions of the Contract for Construction, if the contractor is delayed by causes beyond the contractor's control, then the contract time shall be extended via change order. Weather delays are certainly outside the contractor's control. A supplemental instruction is not appropriate because this extension affects contract time and cost. Accelerating the construction schedule is not reasonable based on standard contract terms.

## CORRECT RESPONSE

A contract indicates the completion time for a project is 465 calendar days, including 45 days for weather days. Extremely bad weather delayed construction by 65 days. The contractor has requested an extension in the number of contract days due to the extremely bad weather.

What should the architect advise the owner?

- Issue a supplemental instruction to extend the schedule by 20 days.
- Extend the contract by 20 days via change order.**
- Ask the contractor to accelerate the construction schedule.



This is a **U/A level** item requiring an understanding of standard contract terms and their application to a viable scenario.

CE

SECTION 3

## Sample Items

## SAMPLE ITEM 6

After construction has started, the contractor finds that the specified carpet has been discontinued. The budgeted cost was \$17/sq. yd., with a total of 3,500 square yards of carpet needed.

The carpet subcontractor suggests an alternate carpet, which is acceptable to the owner. It's \$18/sq. yd., but the price would drop to \$15/sq. yd. with a 4,500 sq. yd. minimum. Due to the delay in finding the replacement carpet, the order must be expedited, which adds a \$1/sq. yd. premium.

Using the most cost-effective option, what will the cost difference be for the new carpet?

\$

## CE SECTION 3

## Sample Items

## SAMPLE ITEM 6 - CORRECT RESPONSE

\$ 7,000

**RATIONALE:** You'll first need to calculate the original cost of the carpet (**Step 1**). Next, you'll calculate the cost of the two alternates: the higher price at the specified yardage (**Step 2**), and the discounted price at the increased yardage (**Step 3**). In both cases, the premium for expedited the order must be included. After deciding on the more cost effective option, you'll subtract the original cost from the cost of the alternate to determine the cost difference (**Step 4**). Because the \$ is included next to the answer box, you know the answer must be provided in dollars.

**Step 1:**  $3,500 \text{ sq. yd.} \times \$17/\text{sq. yd.} = \$59,500$

**Step 2:**  $(\$18/\text{sq. yd.} + \$1/\text{sq. yd.}) \times 3,500 \text{ sq. yd.} = \$66,500$

**Step 3:**  $(\$15/\text{sq. yd.} + \$1/\text{sq. yd.}) \times 4,500 \text{ sq. yd.} = \$72,000$

**Step 4:**  $\$66,500 - \$59,500 = \$7,000$



This is an **A/E level** item requiring you to analyze cost and specification information to evaluate product alternates.

CE

SECTION 4

# Project Closeout & Evaluation

*In this section, you'll focus on post-construction activities. This is the smallest section of the division but covers several important aspects of completing a project.*

## **OBJECTIVE 4.1 (3-7%)**

---

### **Apply procedural concepts to complete close-out activities (U/A)**

*As an architect, you will need to be familiar with project close-out documents, which may include warranties, record drawings, a punch list, and a final application for payment, submitted by the contractor. You will also need to review the contractor's completed work and make determinations regarding substantial completion and final completion of a project, understanding the implications of each process.*

## **OBJECTIVE 4.2 (3-7%)**

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### **Evaluate building design and performance (A/E)**

*You will need to assess a building's performance during its first year of use, with tools such as user surveys and building commissioning, which may include sustainability rating systems. It's critical that you then determine a response to identified building performance issues.*

## CE SECTION 4

## Sample Items

## SAMPLE ITEM 7

The contractor notified the architect that the project was ready for substantial completion. The architect inspected the work and prepared the following list of incomplete work.

Click in the box next to the item in the punch list below that must be completed before the architect can issue the certificate of substantial completion.

<b>Punch List</b>	
<b>PROJECT:</b> Parkview Garden Apartments	
<b>DATE:</b> March 15	
<b>PERSONNEL PRESENT AT SITE:</b>	Sue Greene, SG Architects & Assoc. Mike Smith, MS Construction, Inc.
<b>Lobby</b>	
<input type="checkbox"/>	Paint touch up needed on west wall
<input type="checkbox"/>	Replace damaged baseboard on east wall (approx. 4' section)
<input type="checkbox"/>	Wrong threshold material at entry door
<b>Apartment 103</b>	
<input type="checkbox"/>	Paint touch up needed next to window in living room
<input type="checkbox"/>	Bathtub doesn't drain properly
<input type="checkbox"/>	Paint touch up needed on bedroom door
<b>Apartment 201</b>	
<input type="checkbox"/>	Paint touch up needed in bathroom
<input type="checkbox"/>	Replace light bulb in kitchen fixture
<b>Apartment 202</b>	
<input type="checkbox"/>	Paint touch up needed in bedroom closet
<input type="checkbox"/>	Replace HVAC filter and damaged grill
<b>Apartment 304</b>	
<input type="checkbox"/>	Paint touch up needed in kitchen
<input type="checkbox"/>	Missing window screen in bedroom
<input type="checkbox"/>	Missing shelf bracket in bedroom closet

## CE SECTION 4

## Sample Items

## SAMPLE ITEM 7 - CORRECT RESPONSE

**Punch List**

---

**PROJECT:** Parkview Garden Apartments  
**DATE:** March 15

**PERSONNEL PRESENT AT SITE:** Sue Greene, SG Architects & Assoc.  
Mike Smith, MS Construction, Inc.

**Lobby**

- Paint touch up needed on west wall
- Replace damaged baseboard on east wall (approx. 4' section)
- Wrong threshold material at entry door

**Apartment 103**

- Paint touch up needed next to window in living room
- Bathtub doesn't drain properly
- Paint touch up needed on bedroom door

**Apartment 201**

- Paint touch up needed in bathroom
- Replace light bulb in kitchen fixture

**Apartment 202**

- Paint touch up needed in bedroom closet
- Replace HVAC filter and damaged grill

**Apartment 304**

- Paint touch up needed in kitchen
- Missing window screen in bedroom
- Missing shelf bracket in bedroom closet

**RATIONALE:** According to *The Project Resource Manual: CSI Manual of Practice*, reaching substantial completion does not mean all the work is completed. However, any remaining work must not prevent the owner's use of the building. The only item on this punch list that prevents full use of the building is the bathtub that doesn't drain properly.



This **A/E level** item requires you to evaluate a typical construction procedure and determine the required outcome.

## CE SECTION 4

## Sample Items

## SAMPLE ITEM 8

Seven months after substantial completion for a new office building, the building owner contacts the architect to report that mold has been found in a basement utility room. It appears a mechanical exhaust fan has malfunctioned.

In which of the following ways should the architect address this issue? **Check the two that apply.**

- Submit an additional service request to the owner.
- Meet with the owner to review the building operations.
- Advise the owner to file a claim for damages.
- Advise the owner to notify the original contractor about the issue.
- Advise the owner to hire a new contractor to fix the fan.
- Specify a new fan for the owner to purchase as a replacement.

**RATIONALE:** This item is based on two AIA Documents: A201-2017 and B101-2017. Per B101, the Standard Form of Agreement between Owner and Architect, the owner can request a meeting with the architect to review facility operations and performance at no additional cost for up to one year from the date of substantial completion. That is appropriate in this scenario, so the owner can fully review the mold issue with the architect. Per A201, General Conditions of the Contract for Construction, the contractor shall correct any work not found to be in accordance with the contract documents within one year of the date of substantial completion and after receipt of written notice from the owner. A201 also specifies that the owner must give the contractor an opportunity to correct the problem or the owner waives the right to file a claim for damages.

## CORRECT RESPONSE

Seven months after substantial completion for a new office building, the building owner contacts the architect to report that mold has been found in a basement utility room. It appears a mechanical exhaust fan has malfunctioned.

In which of the following ways should the architect address this issue? **Check the two that apply.**

- Submit an additional service request to the owner.
- Meet with the owner to review the building operations.**
- Advise the owner to file a claim for damages.
- Advise the owner to notify the original contractor about the issue.**
- Advise the owner to hire a new contractor to fix the fan.
- Specify a new fan for the owner to purchase as a replacement.



This is an **A/E level** item requiring you to analyze a post-construction situation and determine the correct response based on your understanding of contractual agreements.

# CE References

## PUBLICATIONS

The following sources are provided as the top references to assist candidates in preparation for this division. For a longer list of relevant reference materials, please see the [Reference Matrix](#) at the end of this handbook.

### ***The Architect's Handbook of Professional Practice***

The American Institute of Architects  
John Wiley & Sons, 14th edition (2008)  
and 15th edition (2014)

### ***CSI MasterFormat***

The Construction Specifications Institute  
2018 edition

## AIA CONTRACT DOCUMENTS

The following list of [AIA Contract Documents](#) have content covered in the Construction & Evaluation division.

### **A101-2017**

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

### **A201-2017**

General Conditions of the Contract for Construction

### **A305-1986**

Contractor's Qualification Statement

### **A701-2018**

Instructions to Bidders

### **B101-2017**

Standard Form of Agreement Between Owner and Architect

### **C401-2017**

Standard Form of Agreement Between Architect and Consultant

### **G701-2017**

Change Order

### **G702-1992**

Application and Certificate for Payment

### **G703-1992**

Continuation Sheet

### **G704-2017**

Certificate of Substantial Completion

# Case Studies

## What is a case study?

ARE 5.0 uses case studies to assess your ability to synthesize multiple pieces of information and make evaluative judgments based on the information. A case study includes a scenario, which provides a description of the case study and key information, as well as several additional resources associated with the scenario. The resources vary by division and by case, but could include drawings, project schedules and budgets, specifications, field reports, code and zoning excerpts, program requirements, photographs, submittals, RFPs, and/or contracts.

Each ARE division will include two case studies. The scenario and resources within a case study will not change from question to question; questions do not build on each other based on previous responses. You will be able to access all the resources associated with a case study while reviewing any of that case study's items. Case study items cannot be answered without the supporting resources, so you'll need to evaluate the resources prior to answering each item.

## Navigating a Case Study

All ARE 5.0 case studies are formatted the same way, varying only in the content and the number of resources. The resources for each case study are displayed as PDFs and include various tools to assist you in navigating the documents. Tabs are displayed across the top of each case study window and include the scenario along with an individual tab for each case study resource.

Check out two sample case studies on the ARE 5.0 Demonstration Exam, which can be accessed through your NCARB Record. You can practice navigating through the various resources, using the search function and bookmarks, and answering the sample case study items.

## CS

## Sample Items

## SAMPLE ITEM 1

The architect is considering classifying the Event Center as construction Type I-B with an approved automatic sprinkler system.

Based on this classification and the project information provided, what is the maximum allowed building height?

- 50 feet
- 60 feet
- 160 feet
- 180 feet

**RATIONALE:** You'll first need to review the *International Building Code*, located within the **Codes and Regulations** resource, to determine the maximum building height allowed for the proposed structure. According to Table 504.3, Type I-B structures containing an automatic sprinkler system can have a maximum building height of 180 feet above the grade plane. Next, you will need to review the **Zoning Ordinance** resource to determine if any additional height restrictions apply to the proposed building site. According to Section 5, Building Height Requirements, buildings constructed on sites zoned as DR-3.5 are limited to 50 feet in height.

## CORRECT RESPONSE

The architect is considering classifying the Event Center as construction Type I-B with an approved automatic sprinkler system.

Based on this classification and the project information provided, what is the maximum allowed building height?

- 50 feet**
- 60 feet
- 160 feet
- 180 feet



This is a **U/A level** item requiring an understanding of building height restrictions and massing as prescribed by building codes and zoning.

CS

## Sample Items

## SAMPLE ITEM 2 \_\_\_\_\_

What is the minimum number of off-street parking spaces required for the new Event Center?

parking spaces

## CORRECT RESPONSE \_\_\_\_\_

What is the minimum number of off-street parking spaces required for the new Event Center?

parking spaces

**RATIONALE:** The **Zoning Ordinance** resource provides information regarding land use, setbacks, building massing, and parking requirements. Per Section 4, Off-Street Parking Requirements, a theater, auditorium, arena, or stadium requires one off-street parking space per four seats. To determine the number of seats proposed for the new Event Center, you'll need to review the **Program Elements** resource, which states the building will include 5,000 fixed spectator seats. By dividing the number of seats by four (**Step 1**), you will determine that 1,250 off-street parking spaces are required for the Event Center.

**Step 1:** 5,000 seats / 4 = 1,250 parking spaces



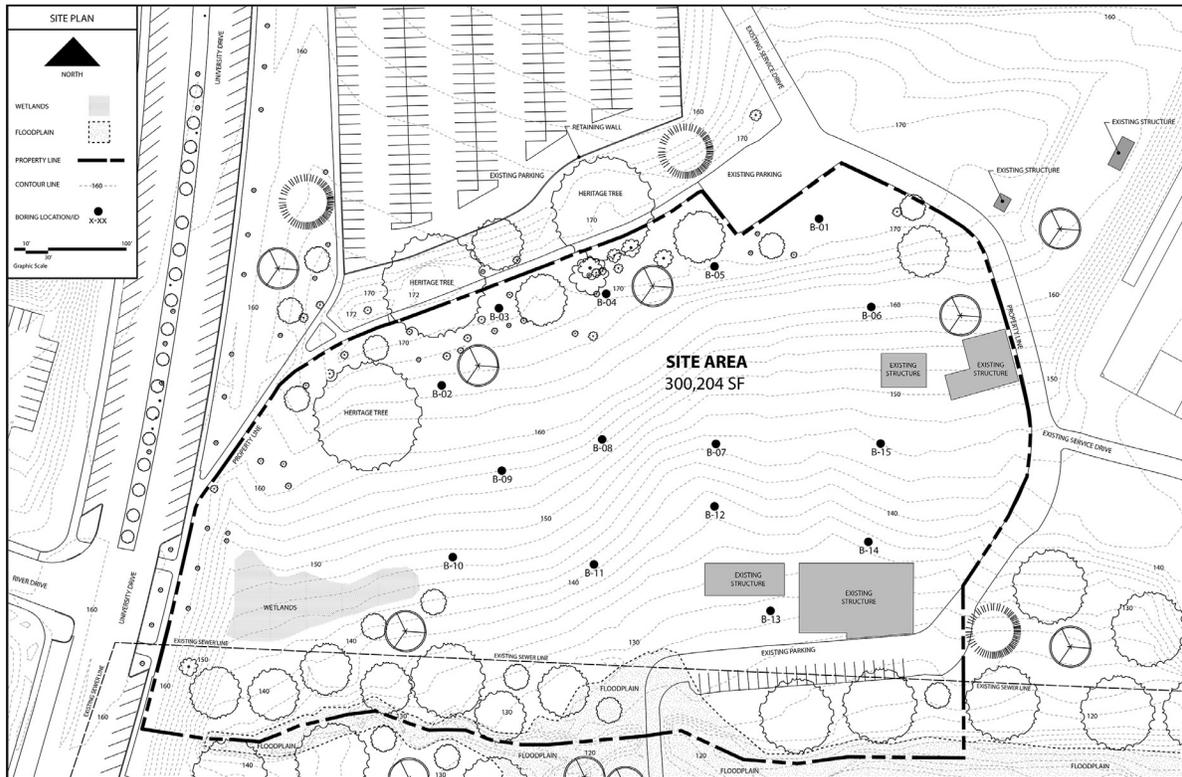
This is a **U/A level** item requiring you to understand how a building program and zoning ordinance impact parking requirements.

CS

Sample Items

SAMPLE ITEM 3

Click on the area of the site plan that is the most appropriate location for the Exterior Plaza.



CS

Sample Items

SAMPLE ITEM 3 - CORRECT RESPONSE



**RATIONALE:** The northwest region of the site, adjacent to University Drive and between the wetlands and heritage tree, is the most appropriate location for the Exterior Plaza. According to the **Program Elements** resource, the Exterior Plaza must be located at the front of the building, connecting University Drive to the Main Entry, and allow for the movement of both pedestrians and emergency vehicles. The scenario also requires that the wetland area and heritage trees remain undisturbed. By reviewing the **Site Plan** resource, you can identify the northwest region of the site as the only area fulfilling these requirements.



This is an **A/E level** item requiring you to evaluate programmatic and client requirements as they relate to existing site conditions.

## CS

## Sample Items

## SAMPLE ITEM 4

Which program spaces must be located on the ground floor? **Check the three that apply.**

- Guest Services/Information
- Main Entry
- General Building Storage
- Athletic Locker Rooms
- Hospitality Room
- Loading/Staging Area

**RATIONALE:** The **Program Elements** resource includes a list of required spaces, spatial characteristics, and adjacency requirements. According to the resource, Loading/Staging requires direct access to the Main Event Space and General Building Storage, making the ground floor the most appropriate location for these spaces. Placing the Athletic Locker Rooms on the ground floor fulfills the programs requirement of allowing athletes easy access to the athletic court. The Main Entry and Hospitality Room require a connection to the Main Concourse, making the first floor the appropriate location for both spaces. Guest Services/Information should be located adjacent to the Main Entry per the program requirements.

## CORRECT RESPONSE

Which program spaces must be located on the ground floor? **Check the three that apply.**

- Guest Services/Information
- Main Entry
- General Building Storage**
- Athletic Locker Rooms**
- Hospitality Room
- Loading/Staging Area**



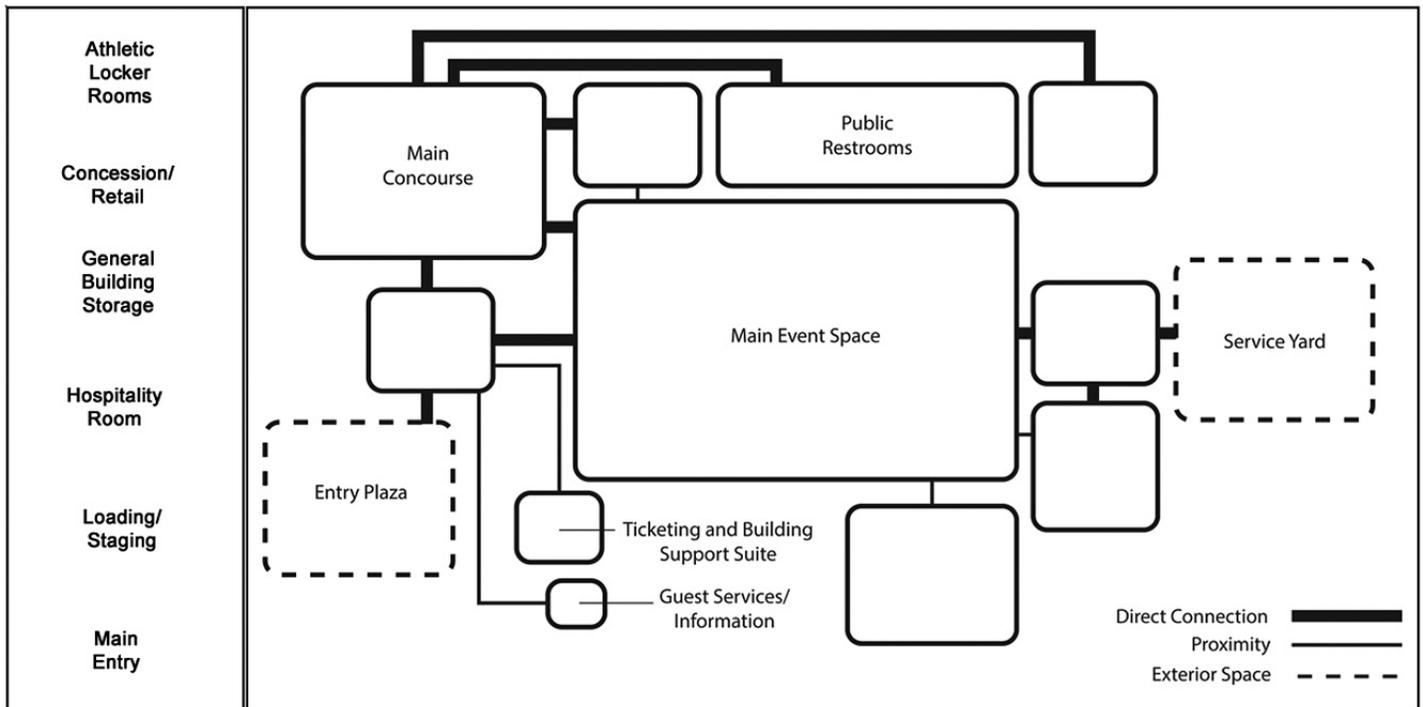
This is an **A/E level** item requiring the analysis of both horizontal and vertical spatial relationships based on a building program.

**CS**

Sample Items

**SAMPLE ITEM 5**

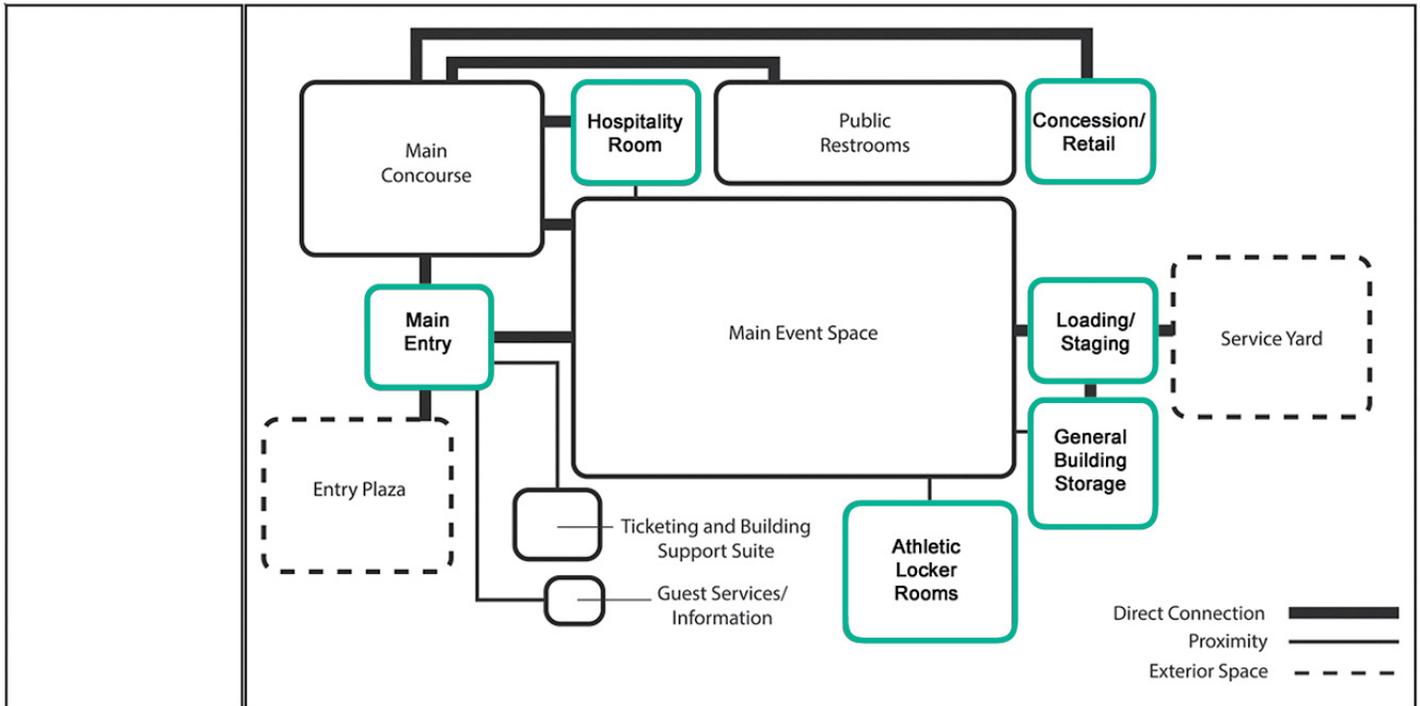
In the bubble diagram below, drag the space labels from the left into the appropriate bubbles to meet all programmatic and client requirements.



CS

Sample Items

SAMPLE ITEM 5 - CORRECT RESPONSE



**RATIONALE:** To complete this bubble diagram, you'll need to understand the spatial relationships of the new Event Center as they relate to the program and the client's requirements. Per the **Program Elements** resource, the Main Entry is a transitional space from the Entry Plaza to the Main Event Space. The Hospitality Room requires views of the Main Event Space as well as a connection to the Main Concourse. Concessions/ Retail only requires a connection to the Main Concourse. Loading/Staging must have direct access to the Service Yard, General Building Storage, and the Main Event Space. Finally, the Athletic Locker Rooms need to be located near the Main Event Space, allowing athletes easy access to the athletic court.



This is an **A/E level** item requiring you to analyze the functional relationships of each space as they relate to the client requirements and building program.

# ARE 5.0 References

This section of the handbook provides you with resources, formulas, and common abbreviations or terms that should help you in preparation for the ARE. You will also find a comprehensive list of publications and resources for each division, from which many of the items on ARE 5.0 are drawn.

<b>Preparing for ARE 5.0</b> .....	<b>156</b>
<b>Structural Resources</b> .....	<b>157</b>
<b>Typical Beam Nomenclature</b> .....	<b>159</b>
<b>Formulas</b> .....	<b>160</b>
<b>Common Abbreviations</b> .....	<b>166</b>
<b>ARE 5.0 Reference Matrix</b> .....	<b>168</b>

## Preparing for ARE 5.0

In addition to this Handbook, NCARB has many other resources that can help you prepare for the ARE. Be sure to check [ncarb.org](https://www.ncarb.org) and the [NCARB Blog](#) for the latest information and click on each resource to access it directly.



### ARE 5.0 GUIDELINES

The *ARE 5.0 Guidelines* includes an introduction to the exam and an overview of exam policies and procedures you should know before you take the ARE.



### ARE 5.0 COMMUNITY

Get expert help, form study groups, and take advantage of other resources as part of the ARE 5.0 Community.



### ARE 5.0 DEMONSTRATION EXAM

Use the ARE 5.0 Demonstration Exam, which can be accessed through your NCARB Record, to explore the interface and item types. You can practice navigating a division and using the various tools available to you in the test center.



### ARE 5.0 DIVISION VIDEO SERIES

This video prep series offers exclusive insight into each ARE 5.0 division with information on content, sample questions, and suggested references. Watch each one to learn more about a division.



### ARE 5.0 EXAM STRATEGIES VIDEO

Explore several tips and techniques to help you navigate and take a division of ARE 5.0, including pointers on item types and scoring, navigating to a case study during your exam, and approaching case study resources efficiently.



### ARE 5.0 EXAM NAVIGATION VIDEO

Walk through the new exam's navigation tools and format with an NCARB expert. Watch to learn more about accepting the Candidate Agreement, using the tools available to you in the new exam, marking and reviewing items, and exiting the exam when you're finished.

## Structural Resources

The following is a list of structural resources you may encounter while taking the ARE. You should familiarize yourself with the use of each resource in preparation for testing. If a resource is required to determine a correct response, it will be provided within the item.

BEAM DIAGRAMS AND FORMULAS	SOURCE	PAGES
Simple Beam: Diagrams and Formulas - Conditions 1-3	A	3-213
Simple Beam: Diagrams and Formulas - Conditions 4-6	A	3-214
Simple Beam: Diagrams and Formulas - Conditions 7-9	A	3-215
Beam Fixed at Both Ends: Diagrams and Formulas - Conditions 15-17	A	3-218
Beam Overhanging One Support: Diagrams and Formulas - Conditions 24-28	A	3-221 & 222

### SOURCES

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**A**

United States. American Institute of Steel Construction, Inc. Steel Construction Manual; 14th edition. Chicago, Illinois, 2011.

## Structural Resources

DIMENSIONS AND PROPERTIES	SOURCE	PAGES
W Shapes 44 thru 27: Dimensions and Properties	A	1-12 thru 17
W Shapes 24 thru W14x145: Dimensions and Properties	A	1-18 thru 23
W Shapes 14x132 thru W4: Dimensions and Properties	A	1-24 thru 29
C Shapes: Dimensions and Properties	A	1-36 & 37
Angles: Properties	A	1-42 thru 49
Rectangular HSS: Dimensions and Properties	A	1-74 thru 91
Square HSS: Dimensions and Properties	A	1-92 thru 95
Round HSS: Dimensions and Properties	A	1-96 thru 100
LIVE LOADS	SOURCE	PAGES
Table 1607.1 - Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads	B	368-369

### SOURCES

**A**

United States. American Institute of Steel Construction, Inc. Steel Construction Manual; 14th edition. Chicago, Illinois, 2011.

**B**

United States. International Code Council, Inc. 2018 International Building Code. Country Club Hills, Illinois, 2017.

## Typical Beam Nomenclature

<b>E</b>	Modulus of Elasticity of steel at 29,000 ksi
<b>I</b>	Moment of Inertia of beam, in <sup>4</sup>
<b>L</b>	Total length of beam between reaction point, ft
<b>M<sub>max</sub></b>	Maximum moment, kip-in
<b>M<sub>1</sub></b>	Maximum moment in left section of beam, kip-in
<b>M<sub>2</sub></b>	Maximum moment in right section of beam, kip-in
<b>M<sub>3</sub></b>	Maximum positive moment in beam with combined end moment conditions, kip-in
<b>M<sub>x</sub></b>	Maximum at distance x from end of beam, kip-in
<b>P</b>	Concentrated load, kips
<b>P<sub>1</sub></b>	Concentrated load nearest left reaction, kips
<b>P<sub>2</sub></b>	Concentrated load nearest right reaction and of different magnitude than P <sub>1</sub> , kips
<b>R</b>	End beam reaction for any condition of symmetrical loading, kips
<b>R<sub>1</sub></b>	Left end beam reaction, kips
<b>R<sub>2</sub></b>	Right end or intermediate beam reaction, kips
<b>R<sub>3</sub></b>	Right end beam reaction, kips
<b>V</b>	Maximum vertical shear for any condition of symmetrical loading, kips
<b>V<sub>1</sub></b>	Maximum vertical shear in left section of beam, kips
<b>V<sub>2</sub></b>	Vertical shear at right reaction point, or to left of intermediate reaction of beam, kips
<b>V<sub>3</sub></b>	Vertical shear at right reaction point, or to right of intermediate reaction of beam, kips
<b>V<sub>x</sub></b>	Vertical shear at distance x from end of beam, kips

<b>W</b>	Total load on beam, kips
<b>a</b>	Measured distance along beam, in
<b>b</b>	Measured distance along beam which may be greater or less than a, in
<b>l</b>	Total length of beam between reaction points, in
<b>w</b>	Uniformly distributed load per unit of length, kips/in
<b>w<sub>1</sub></b>	Uniformly distributed load per unit of length nearest left reaction, kips/in
<b>w<sub>2</sub></b>	Uniformly distributed load per unit of length nearest right reaction and of different magnitude than w <sub>1</sub> , kips/in
<b>x</b>	Any distance measured along beam from left reaction, in
<b>x<sub>1</sub></b>	Any distance measured along overhang section of beam from nearest reaction point, in
<b>Δ<sub>max</sub></b>	Maximum deflection, in
<b>Δ<sub>a</sub></b>	Deflection at point of load, in
<b>Δ<sub>x</sub></b>	Deflection at point x distance from left reaction, in
<b>Δ<sub>x1</sub></b>	Deflection of overhang section of beam at any distance from nearest reaction point, in

### EXCERPTED FROM \_\_\_\_\_

- A** United States. American Institute of Steel Construction, Inc. Steel Construction Manual; 14th edition. Chicago, Illinois, 2011.

## Formulas

The following is a list of formulas you may encounter while taking the ARE. You should familiarize yourself with the use of each formula in preparation for testing. If a formula is required to determine a correct response, it will be provided within the item.

### STRUCTURAL

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#### Flexural stress at extreme fiber

$$f = \frac{Mc}{I} = \frac{M}{S}$$

#### Flexural stress at any fiber

$$f = \frac{My}{I}$$

where  $y$  = distance from neutral axis to fiber

#### Average vertical shear

$$v = \frac{V}{A} = \frac{V}{dt}$$

for beams and girders

#### Horizontal shearing stress at any section A-A

$$v = \frac{VQ}{Ib}$$

where  $Q$  = static moment about the neutral axis of the entire section of that portion of the cross-section lying outside of section A-A  
 $b$  = width at section A-A

## Formulas

### ELECTRICAL

$$\text{Foot-candles} = \frac{\text{lumens}}{\text{area in ft}^2}$$

$$\text{Foot-candles} = \frac{(\text{lamp lumens}) \times (\text{lamps per fixture}) \times (\text{number of fixtures}) \times (\text{CU}) \times (\text{LLF})}{\text{area in ft}^2}$$

$$\text{Number of luminaires} = \frac{(\text{foot-candles}) \times (\text{floor area})}{(\text{lumens}) \times (\text{CU}) \times (\text{LLF})}$$

where CU = coefficient of utilization  
LLF = Light Loss Factor

$$\text{DF}_{\text{av}} = 0.2 \times \frac{\text{window area}}{\text{floor area}}$$

for spaces with sidelighting or toplighting with vertical monitors

$$\text{watts} = \text{volts} \times \text{amperes} \times \text{power factor}$$

for AC circuits only

$$\text{Demand charge} = \text{maximum power demand} \times \text{demand tariff}$$

## Formulas

### PLUMBING

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$$1 \text{ psi} = 2.31 \text{ feet of water}$$

$$1 \text{ cubic foot} = 7.5 \text{ U.S. gallons}$$

### HVAC

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$$\text{BTU/year} = \text{peak heat loss} \times \frac{\text{full-load hours}}{\text{year}}$$

$$\text{BTU/h} = (\text{cfm}) \times (1.08) \times (\Delta T)$$

$$1 \text{ kWh} = 3,400 \text{ BTU/h}$$

$$1 \text{ ton of air conditioning} = 12,000 \text{ BTU/h}$$

## Formulas

### HVAC - CONTINUED

$$\text{BTU/h} = (U) \times (A) \times (T_d)$$

where  $T_d$  is the difference between indoor and outdoor temperatures

$$U = 1/R_t$$

$$U_o = \frac{(U_w \times A_w) + (U_{op} \times A_{op})}{A_o}$$

where  $o$  = total wall,  $w$  = window, and  $op$  = opaque wall

$$U_o = \frac{(U_R \times A_R) + (U_S \times A_S)}{A_o}$$

where  $o$  = total roof,  $R$  = roof, and  $S$  = skylight

$$R = x/k$$

where  $x$  = thickness of material in inches

$$\text{Heat required} = \frac{\text{BTU/h}}{\text{temperature differential}} \times (24 \text{ hours}) \times (\text{DD } ^\circ\text{F})$$

where  $DD$  = degree days

## Formulas

### ACOUSTICS

$$\lambda = \frac{c}{f}$$

where  $\lambda$  = wavelength of sound (ft)  
 $c$  = velocity of sound (fps)  
 $f$  = frequency of sound (Hz)

$$a = \text{SAC} \times S$$

where  $a$  = Absorption of a material used in space (sabins)  
 SAC = Sound Absorption Coefficient of the material  
 $S$  = Exposed surface area of the material (ft<sup>2</sup>)

$$A = \sum a$$

where  $A$  = Total sound absorption of a room (sabins)  
 $\sum a = (S_1 \times \text{SAC}_1) + (S_2 \times \text{SAC}_2) + \dots$

$$T = 0.05 \times \frac{V}{A}$$

where  $T$  = Reverberation time (seconds)  
 $V$  = Volume of space (ft<sup>3</sup>)

NRC = average SAC for frequency bands 250, 500, 1000, and 2000 Hz

## Common Abbreviations

The following is a list of common abbreviations you may encounter while taking the ARE. You should familiarize yourself with each abbreviation in preparation for testing.

PROFESSIONAL ORGANIZATIONS, SOCIETIES, AND AGENCIES	
American Concrete Institute	ACI
American Institute of Architects	AIA
American Institute of Steel Construction	AISC
American National Standards Institute	ANSI
American Society for Testing and Materials	ASTM
American Society of Civil Engineers	ASCE
American Society of Heating, Refrigerating, and Air-Conditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
American Society of Plumbing Engineers	ASPE
Architectural Woodwork Institute	AWI
Construction Specifications Institute	CSI
Department of Housing and Urban Development	HUD
Environmental Protection Agency	EPA
Federal Emergency Management Agency	FEMA
National Fire Protection Association	NFPA
Occupational Safety and Health Administration	OSHA
U.S. Green Building Council	USGBC

## Common Abbreviations

AIA CONTRACT DOCUMENTS	
A101-2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum	<b>A101</b>
A133-2019, Standard Form of Agreement Between Owner and Construction Manager as Constructor where the basis of payment is the Cost of the Work Plus a Fee with a Guaranteed Maximum Price	<b>A133</b>
A195-2008, Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery	<b>A195</b>
A201-2017, General Conditions of the Contract for Construction	<b>A201</b>
A295-2008 General Conditions of the Contract for Integrated Project Delivery	<b>A295</b>
A305-1986, Contractor's Qualification Statement	<b>A305</b>
A701-2018, Instructions to Bidders	<b>A701</b>
B101-2017, Standard Form of Agreement Between Owner and Architect	<b>B101</b>
B195-2008 Standard Form of Agreement Between Owner and Architect for Integrated Project Delivery	<b>B195</b>
C401-2017, Standard Form of Agreement Between Architect and Consultant	<b>C401</b>
G701-2017, Change Order	<b>G701</b>
G702-1992, Application and Certificate for Payment	<b>G702</b>
G703-1992, Continuation Sheet	<b>G703</b>
G704-2017, Certificate of Substantial Completion	<b>G704</b>

CODES AND REGULATIONS	
ADA Standards for Accessible Design	<b>ADA</b>
International Code Council	<b>ICC</b>
International Building Code	<b>IBC</b>
International Energy Conservation Code	<b>IECC</b>
International Existing Building Code	<b>IEBC</b>
International Mechanical Code	<b>IMC</b>
International Plumbing Code	<b>IPC</b>
International Residential Code	<b>IRC</b>
Leadership in Energy and Environmental Design	<b>LEED</b>
National Electrical Code	<b>NEC</b>

## Common Abbreviations

COMMONLY USED TERMS	
Air Handling Unit	<b>AHU</b>
Authority Having Jurisdiction	<b>AHJ</b>
Building Information Modeling	<b>BIM</b>
Concrete Masonry Unit	<b>CMU</b>
Contract Administration	<b>CA</b>
Construction Document	<b>CD</b>
Dead Load	<b>DL</b>
Design Development	<b>DD</b>
Exterior Insulation and Finish System	<b>EIFS</b>
Furniture, Furnishings & Equipment	<b>FF&amp;E</b>
Floor Area Ratio	<b>FAR</b>
Guaranteed Maximum Price	<b>GMP</b>
Heating, Ventilating, and Air Conditioning	<b>HVAC</b>
Insulating Glass Unit	<b>IGU</b>
Indoor Air Quality	<b>IAQ</b>
Indoor Environmental Quality	<b>IEQ</b>
Live Load	<b>LL</b>
Material Safety Data Sheets	<b>MSDS</b>
Mechanical, Electrical, and Plumbing	<b>MEP</b>
Photovoltaic	<b>PV</b>
Quality Assurance	<b>QA</b>
Quality Control	<b>QC</b>
Reflected Ceiling Plan	<b>RCP</b>
Request for Information	<b>RFI</b>
Request for Proposal	<b>RFP</b>
Roof Top Unit	<b>RTU</b>
Schematic Design	<b>SD</b>
Variable Air Volume	<b>VAV</b>
Volatile Organic Compound	<b>VOC</b>

UNITS OF MEASURE	
British Thermal Unit	<b>btu</b>
Cubic Feet per Minute	<b>cfm</b>
Cubic Feet per Second	<b>cfs</b>
Cubic Foot	<b>cu. ft. ft<sup>3</sup></b>
Cubic Inch	<b>cu. in. in<sup>3</sup></b>
Cubic Yard	<b>cu. yd. yd<sup>3</sup></b>
Decibel	<b>dB</b>
Foot	<b>ft</b>
Foot-candle	<b>fc</b>
Gross Square Feet	<b>gsf</b>
Impact Insulation Class	<b>IIC</b>
Inch	<b>in</b>
Net Square Feet	<b>nsf</b>
Noise Reduction Coefficient	<b>NRC</b>
Pound	<b>lb</b>
Pounds per Linear Foot	<b>plf</b>
Pounds per Square Foot	<b>psf</b>
Pounds per Square Inch	<b>psi</b>
Sound Transmission Class	<b>STC</b>
Square Foot	<b>sq. ft. sf ft<sup>2</sup></b>
Square Inch	<b>sq. in. in<sup>2</sup></b>
Square Yard	<b>sq. yd. sy yd<sup>2</sup></b>

## ARE 5.0 Reference Matrix

The ARE 5.0 Reference Matrix provides a list of materials and publications frequently used in the development of items for each division of ARE 5.0.

REFERENCE	PCM	PJM	PA	PPD	PDD	CE
<b>2010 ADA Standards for Accessible Design</b> U.S. Department of Justice, 2010						
<b>2020 Code of Ethics and Professional Conduct</b> AIA Office of General Counsel The American Institute of Architects, 2020						
<b>The Architect's Handbook of Professional Practice</b> The American Institute of Architects John Wiley & Sons, 14th edition (2008) and 15th edition (2014)						
<b>The Architect's Studio Companion: Rules of Thumb for Preliminary Design</b> Edward Allen and Joseph Iano John Wiley & Sons, 6th edition, 2017						
<b>Architectural Acoustics</b> M. David Egan J. Ross Publishing, 2007 Reprint. Original publication McGraw Hill, 1988						
<b>Architectural Graphic Standards</b> The American Institute of Architects John Wiley & Sons, 11th edition (2007) and 12th edition (2016)						
<b>Building Codes Illustrated: A Guide to Understanding the 2018 International Building Code</b> Francis D.K. Ching and Steven R. Winkel, FAIA, PE, CASp John Wiley & Sons, 2018						
<b>Building Construction Illustrated</b> Francis D.K. Ching John Wiley & Sons, 6th edition, 2020						

## ARE 5.0 Reference Matrix

REFERENCE	PCM	PJM	PA	PPD	PDD	CE
<b>Building Structures</b> James Ambrose and Patrick Tripeny John Wiley & Sons, 3rd edition, 2011						
<b>CSI MasterFormat</b> The Construction Specifications Institute 2018 edition						
<b>Daylighting Handbook I</b> Christoph Reinhart Building Technology Press, 2014						
<b>Dictionary of Architecture and Construction</b> Cyril M. Harris McGraw-Hill, 4th edition, 2006						
<b>Framework for Design Excellence</b> American Institute of Architects <a href="#">Available Online</a>						
<b>Fundamentals of Building Construction: Materials and Methods</b> Edward Allen and Joseph Iano John Wiley & Sons, 6th edition (2013) and 7th edition (2019)						
<b>Green Building Illustrated</b> Francis D.K. Ching and Ian M. Shapiro Wiley, 2014						
<b>The Green Studio Handbook: Environmental Strategies for Schematic Design</b> Alison G. Kwok and Walter Grondzik Routledge, 3rd edition, 2018						

## ARE 5.0 Reference Matrix

REFERENCE	PCM	PJM	PA	PPD	PDD	CE
<b>Heating, Cooling, Lighting: Sustainable Design Methods for Architects</b> Norbert Lechner John Wiley & Sons, 4th edition, 2014						
<b>The HOK Guidebook to Sustainable Design</b> Sandra F. Mendler, William Odell, and Mary Ann Lazarus John Wiley & Sons, 2nd edition, 2006						
<b>ICC A117.1-2009 Accessible and Usable Buildings and Facilities</b> International Code Council, 2010						
<b>International Building Code (2018)</b> International Code Council, 2017						
<b>Law for Architects: What You Need to Know</b> Robert F. Herrmann and the Attorneys at Menaker & Herrmann LLP W. W. Norton, 2012						
<b>Legislative Guidelines and Model Law/Model Regulations</b> National Council of Architectural Registration Boards 2018-2019						
<b>Mechanical &amp; Electrical Equipment for Buildings</b> Walter T. Grondzik and Alison G. Kwok John Wiley & Sons, 12th edition (2014) and 13th edition (2019)						
<b>Mechanical and Electrical Systems in Buildings</b> Richard R. Janis and William K. Y. Tao Pearson, 6th edition, 2018						

## ARE 5.0 Reference Matrix

REFERENCE	PCM	PJM	PA	PPD	PDD	CE
<b>Model Rules of Conduct</b> National Council of Architectural Registration Boards 2018-2019						
<b>Olin’s Construction Principles, Materials, and Methods</b> H. Leslie Simmons John Wiley & Sons, 9th edition, 2011						
<b>Planning and Urban Design Standards</b> American Planning Association John Wiley & Sons, 2006						
<b>Plumbing, Electricity, Acoustics: Sustainable Design Methods for Architecture</b> Norbert M. Lechner Wiley, 2011						
<b>Problem Seeking: An Architectural Programming Primer</b> William M. Peña and Steven A. Parshall John Wiley & Sons, 5th edition, 2012						
<b>Professional Practice: A Guide to Turning Designs into Buildings</b> Paul Segal, FAIA W. W. Norton, 2006						
<b>The Professional Practice of Architectural Working Drawings</b> Osamu A. Wakita, Nagy R. Bakhoum, and Richard M. Linde John Wiley & Sons, 5th edition, 2017						
<b>The Project Resource Manual: CSI Manual of Practice</b> The Construction Specifications Institute McGraw-Hill, 5th edition, 2005						

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REFERENCE	PCM	PJM	PA	PPD	PDD	CE
<b>Simplified Engineering for Architects and Builders</b> James Ambrose and Patrick Tripeny John Wiley & Sons, 12th edition, 2016						
<b>Site Planning and Design Handbook</b> Thomas H. Russ McGraw-Hill, 2nd edition, 2009						
<b>Space Planning Basics</b> Mark Karlen and Rob Fleming John Wiley & Sons, 4th edition, 2016						
<b>Steel Construction Manual</b> American Institute of Steel Construction 14th edition, 2011						
<b>Structural Design: A Practical Guide for Architects</b> James R. Underwood and Michele Chiurini John Wiley & Sons, 2nd edition, 2007						
<b>Structures</b> Daniel Schodek and Martin Bechthold Pearson, 7th edition, 2013						
<b>Sun, Wind, and Light: Architectural Design Strategies</b> G.Z. Brown and Mark DeKay John Wiley & Sons, 3rd edition, 2013						
<b>Sustainable Construction: Green Building Design and Delivery</b> Charles J. Kibert John Wiley & Sons, 4th edition, 2016						
<b>A Visual Dictionary of Architecture</b> Francis D.K. Ching John Wiley & Sons, 2nd edition, 2011						

## ARE 5.0 Reference Matrix

The following list of [AIA Contract Documents](#) have content covered in the various divisions of ARE 5.0. Candidates can access sample AIA Contract Documents for free through their NCARB Record.

DOCUMENT	PCM	PJM	PA	PPD	PDD	CE
<b>A101-2017</b> , Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum						
<b>A133-2019</b> , Standard Form of Agreement Between Owner and Construction Manager as Constructor where the basis of payment is the Cost of the Work Plus a Fee with a Guaranteed Maximum Price						
<b>A195-2008</b> , Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery						
<b>A201-2017</b> , General Conditions of the Contract for Construction						
<b>A295-2008</b> , General Conditions of the Contract for Integrated Project Delivery						
<b>A305-1986</b> , Contractor's Qualification Statement						
<b>A701-2018</b> , Instructions to Bidders						
<b>B101-2017</b> , Standard Form of Agreement Between Owner and Architect						
<b>B195-2008</b> , Standard Form of Agreement Between Owner and Architect for Integrated Project Delivery						
<b>C401-2017</b> , Standard Form of Agreement Between Architect and Consultant						
<b>G701-2017</b> , Change Order						
<b>G702-1992</b> , Application and Certificate for Payment						
<b>G703-1992</b> , Continuation Sheet						
<b>G704-2017</b> , Certificate of Substantial Completion						