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INTRODUCTION

ABOUT THIS BOOK

ARE 5 Practice Exam for the Architect Registration Exam contains over 600 problems organized into six divisions that follow the structure of version 5 of the Architect Registration Exam (ARE 5). Each division includes the same number and types of problems and covers the same subject areas in its corresponding division of the ARE.

- Division 1: Practice Management, 80 problems
- Division 2: Project Management, 95 problems
- Division 3: Programming & Analysis, 95 problems
- Division 4: Project Planning & Design, 120 problems
- Division 5: Project Development & Documentation, 120 problems
- Division 6: Construction & Evaluation, 95 problems

This book is designed to be used in conjunction with PPI's *ARE 5 Review Manual* and *ARE 5 Practice Problems*. Like this book, each companion book covers all six divisions in a single volume.

THE ARCHITECT REGISTRATION EXAM 5

Version 5 of the Architect Registration Exam (ARE 5) consists of six divisions, each of which is a separate, standalone test taking between 3.5 hours and 5 hours. You may take the divisions in any order, but you must complete all six divisions within a five-year period.

The topics covered on each division and the approximate distribution of problems are as follows.

Division 1: Practice Management

Business operations (20–26%)

- assessing resources within the practice
- applying regulations and requirements that govern work environment
- applying ethical standards to comply with accepted principles in given situations
- applying appropriate standard of care for given situations

Finances, risk, and development of practice (29–35%)

- evaluating practice's financial well-being
- identifying practice policies and methodologies for risk, legal exposures, and resolutions
- selecting and applying practice strategies for given situations

Practice-wide delivery of services (22–28%)

- analyzing and determining response for client services requests
- analyzing the applicability of contract types and delivery methods
- determining project's potential risk and/or reward and its impact on practice

Practice methodologies (17–23%)

- analyzing impact of practice methodologies in relation to structure and organization of practice
- evaluating design, coordination, and documentation methodologies

Division 2: Project Management

Resource management (7–13%)

- determining criteria required for assembling project team
- assessing criteria required for allocating and managing project resources

Project work planning (17–23%)

- developing and maintaining project work plan
- determining criteria required for developing and maintaining project schedule
- determining appropriate communication to project team—owner, contractor, consultants, and internal staff

Contracts (25–31%)

- evaluating and verifying adherence to owner/architect agreement
- interpreting key elements of and verifying adherence to architect/consultant agreement
- interpreting key elements of owner/contractor agreement

- interpreting key elements of owner/consultant agreement to integrate consultant's work into project

Project execution (17–23%)

- evaluating compliance with construction budget
- evaluating and address changes in scope of work and scope creep
- evaluating project documentation to ensure it supports specified delivery method
- identifying and conforming with the requirements set forth by authorities having jurisdiction in order to obtain approvals for the project

Project quality control (19–25%)

- applying procedures required for adherence to laws and regulations relating to project
- identifying steps in maintaining project quality control and reducing risks and liabilities
- performing quality control reviews of project documentation throughout life of project
- evaluating management of design process to maintain integrity of design objectives

Division 3: Programming & Analysis

Environmental and contextual conditions (14–21%)

- evaluating site-specific environmental and socio-cultural opportunities
- evaluating site-specific environmental constraints
- determining optimal use of onsite resources by incorporating sustainability principles

Codes and regulations (16–22%)

- identifying relevant code requirements for building and site types
- identifying relevant zoning and land use requirements
- identifying relevant local and site-specific requirements

Site analysis and programming (21–27%)

- evaluating relevant qualitative and quantitative attributes of site as they relate to program
- synthesizing site reports with other documentation and analysis
- analyzing graphical representations regarding site analysis and site programming

Building analysis and programming (37–43%)

- evaluating relevant qualitative and quantitative attributes of new or existing building as they relate to program
- evaluating documentation, reports, assessments, and analyses to inform building program
- identifying and prioritizing components of building program
- assessing spatial and functional relationships for building program
- recommending a preliminary project budget and schedule
- identifying alternatives for building and structural systems for programmatic requirements, preliminary budget, and schedule
- analyzing graphical representations regarding building analysis and building programming

Division 4: Project Planning & Design

Environmental conditions and context (10–16%)

- determining location of building and site improvements based on site analysis
- determining sustainable principles to apply to design
- determining impact of neighborhood context on project design

Codes and regulations (16–22%)

- applying zoning and environmental regulations to site and building design
- applying building codes to building design
- integrating multiple codes to a project design

Building systems, materials, and assemblies (19–25%)

- determining mechanical, electrical, and plumbing systems
- determining structural systems
- determining special systems such as acoustics, communications, lighting, security, conveying, and fire suppression
- determining materials and assemblies to meet programmatic, budgetary, and regulatory requirements

Project integration of program and systems (32–38%)

- determining building configuration
- integrating building systems into project design
- integrating program requirements into project design
- integrating environmental and contextual conditions into project design

Project costs and budgeting (8–14%)

- evaluating design alternatives based on program
- performing cost evaluation
- evaluating cost considerations during design process

Division 5: Project Development & Documentation

Integration of building materials and systems (31–37%)

- analyzing integration of architectural systems and technologies to meet project goals
- determining size of mechanical, electrical, plumbing systems and components to meet project goals
- determining size of structural systems to meet project goals
- integrating specialty systems such as acoustics, lighting, fire suppression, conveying, security, and communications to meet project goals
- detailing the integration of multiple building systems and technologies
- coordinating mechanical, electrical, plumbing, structural, and specialty systems and technologies

Construction documentation (32–38%)

- determining appropriate documentation of building design

- determining appropriate documentation of site features
- determining appropriate documentation of detailed building drawings within individual architectural systems
- applying required standards to assemble a set of clear and coordinated construction documentation
- determining impact of project changes on documentation requirements and method to communicate those changes to owner and design team

Project manual and specifications (12–18%)

- identifying and prioritizing components needed to write, maintain, and refine project manual
- identifying and prioritizing components needed to write, maintain and refine project specifications
- coordinating specifications with construction documentation

Codes and regulations (8–14%)

- determining adherence to building regulatory requirements at detail level
- determining adherence with specialty regulatory requirements at detail level

Construction cost estimates (2–8%)

- analyzing construction cost estimates to confirm alignment with project design

Division 6: Construction & Evaluation

Preconstruction activities (17–23%)

- interpreting architect's roles and responsibilities during preconstruction, based on delivery method
- analyzing criteria for selecting contractors
- analyzing aspects of contract or design to adjust project costs

Construction observation (32–38%)

- evaluating architect's role during construction activities
- evaluating construction conformance with contract documents, codes, regulations, and sustainability requirements
- determining construction progress

Administrative procedures and protocols (32–38%)

- determining appropriate additional information to supplement contract documents
- evaluating submittals including shop drawings, samples, mock-ups, product data, and test results
- evaluating contractor's application for payment
- evaluating responses to nonconformance with contract documents

Project closeout and evaluation (7–13%)

- applying procedural concepts to complete closeout activities
- evaluating building design and performance

EXAM PROBLEM TYPES

There are several types of problems on ARE 5 and in this book.

- multiple-choice problems
- check-all-that-apply problems
- fill-in-the-blank problems
- hot spot problems
- drag-and-place problems
- case study problems

Multiple-Choice Problems

Multiple-choice problems have two types. One type of multiple-choice problem is based on written, graphic, or photographic information. You will need to examine the information and select the correct answer from four given options. Some problems may require calculations. A second type of multiple-choice problem describes a situation that could be encountered in actual practice. Drawings, diagrams, photographs, forms, tables, or other data may also be given. The problem requires you to select the best answer from four options.

Multiple-choice problems often require you to do more than just select an answer based on memory. At times it will be necessary to combine several facts, analyze data, perform a calculation, or review a drawing.

Check-All-That-Apply Problems

Check-all-that-apply problems are a variation of a multiple-choice problem, where six options are given, and you must choose all the correct options. The problem tells how many of the options are correct, from two to four. You must choose all the correct options to receive credit; partial credit is not given.

Fill-in-the-Blank Problems

Fill-in-the-blank problems require you to fill in a blank with a value that you have derived from a table or a calculation.

Hot Spot Problems

Hot spot problems are used to assess visual judgment, evaluation, or prediction. Hot spot problems include the information needed to make a determination, along with an image (e.g., diagram, floor plan) and instructions on how to interact with the image. The problems will indicate that you should place a single target, also known as a hot spot icon, on the base image in the correct location or general area. On the exam, you will place the target on the image by moving the computer cursor to the correct location on the image and clicking on it. You will see crosshairs to help you position the point of click. You will be able to click on an alternate spot if you think your first choice is not correct. Your choice is not registered until you exit the problem. You can click anywhere within an acceptable area range and still be scored as correct.

Drag-and-Place Problems

Drag-and-place problems are similar to hot spot problems, but whereas hot spot problems involve placing just one target on the base image, drag-and-place problems involve placing two to six design elements on the base image. Drag-and-place problems are used to assess visual judgment or evaluation with multiple pieces of information. The problem statement describes what information is to be used to make the determination, and provides instructions on how to interact with the image or graphic item.

A drag-and-place problem, for example, may require you to drag and place design elements such as walls or beams onto the base image. On the exam, you will use the computer cursor to place the

elements on the image by clicking and holding elements and dragging and releasing the elements on the correct location on the image. Depending on the question, you may use an element more than once or not at all. This type of question also provides an acceptable area range for placing the elements. The range may be small for questions about a detail or large for something like a site plan.

Case Study Problems

Each division's exam includes one to two case studies. Case studies are performance problem types comprising a scenario, a set of related resource documents (for example, code resources, drawings, and specifications), and a set of case study-specific problems. During the exam, you will be able to click on browser-like tabs at the top of the computer screen and flip back and forth between the case study scenario and resource documents. The case studies will test your ability to examine and use multiple pieces of information to make decisions about scenarios that could be encountered in the practice of architecture.

Case study problems may be multiple-choice, check-all-that-apply, fill-in-the-blank, hot spot, or drag-and-place.

For more information and tips on how to prepare for ARE 5, consult the *ARE 5 Review Manual* or visit PPI's website, **ppi2pass.com/arefaq**.

CODES AND STANDARDS USED IN THIS BOOK

ACI 318: *Building Code Requirements for Structural Concrete*, 2014. American Concrete Institute, Farmington Hills, MI.

ADA Standards: *2010 Americans with Disabilities Act (ADA) Standards for Accessible Design*, U.S. Department of Justice, Washington, DC.

AIA: Contract Documents, 2007. American Institute of Architects, Washington, DC.

AISC: *Steel Construction Manual*, 14th ed, 2011. American Institute of Steel Construction, Chicago, IL.

ANSI/ASHRAE 62.1: *Ventilation for Acceptable Indoor Air Quality*, 2016. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.

ANSI/ASHRAE 62.2: *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*, 2016. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.

ANSI/ASHRAE/IESNA 90.1: *Energy Standard for Buildings Except Low-Rise Residential Buildings*, 2013. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA.

ANSI/BOMA Z65.1: *Office Buildings: Standard Methods of Measurement*, 2010. Building Owners and Managers Association, Washington, DC.

ASCE/SEI7: *Minimum Design Loads for Buildings and Other Structures*, 2010. American Society of Civil Engineers, Reston, VA.

CSI: MasterFormat, 2016. Construction Specifications Institute, Alexandria, VA.

CSI: SectionFormat, 2009. Construction Specifications Institute, Alexandria, VA.

IBC: *International Building Code*, 2015. International Code Council, Washington, DC.

ICC/ANSI A117.1: *Accessible and Usable Buildings and Facilities*, 2009. International Code Council. Washington, DC.

IECC: *International Energy Conservation Code*, 2015. International Code Council, Washington, DC.

IgCC: *International Green Construction Code*, 2015. International Code Council, Washington, DC.

IMC: *International Mechanical Code*, 2015. International Code Council, Washington, DC.

IPC: *International Plumbing Code*, 2015. International Code Council, Washington, DC.

IRC: *International Residential Code*, 2015. International Code Council, Washington, DC.

LEED: Leadership in Energy and Environmental Design (LEED) 2013 Green Building Rating System for New Construction. U.S. Green Building Council, Washington, DC.

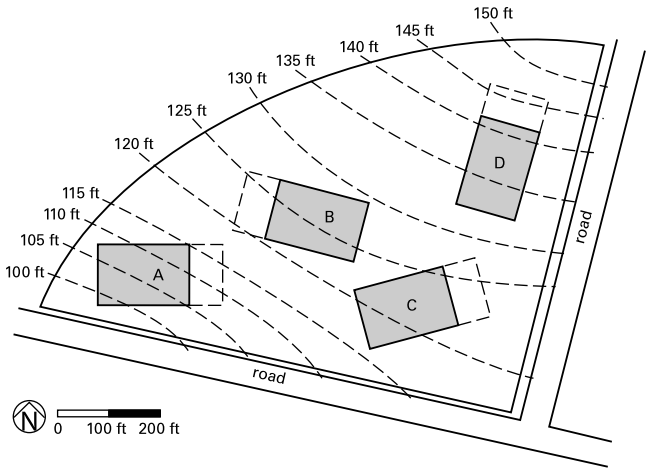
NDS: *National Design Specification (NDS) for Wood Construction*, 15th ed., 2015. American Wood Council, Leesburg, VA.

NEC (NFPA 70): *National Electrical Code*, 2014. National Fire Protection Association, Quincy, MA.

NFPA 101: *Life Safety Code*, 2015. National Fire Protection Association, Quincy, MA.

The Secretary of the Interior's Standards for Rehabilitation, 2010. *Code of Federal Regulations*, Title 36, Part 67.

378. A two-story office building is being planned in a temperate climate zone for the site shown. The site is bounded on two sides by streets.



The program requires a sustainable design, the ability to integrate both passive and active solar design into the building, an expansion of the building in the lengthwise direction, and the addition of more buildings as the site is fully developed. The architect is considering four locations for the building. The remainder of the site will be used for the additional buildings, landscaping, and parking. Which building location meets the program requirements?

(A) A

(B) B

(C) C

(D) D

379. An architect is working on a preliminary planning study for an elementary school. The school is being designed for 750 students: 400 girls and 350 boys. From the following sample code, a total of ____ water closets are required. (Fill in the blank.)

Plumbing fixture requirements for pupils' use:

water closets:
- 1 per 100 males
- 1 per 35 females

lavatories:
- 1 per 50 students

urinals:
- 1 per 30 male students

drinking fountains:
- 1 per 150 students

380. An architect is planning a small day care center for three- to six-year-old children. The space needs are given in the table.

space	area (ft^2)	location requirements
administrator office	150	near entry
assistant's office	150	directly adjacent to administrator's office
staff lounge	200	–
children's toilets	200	adjacent to classrooms and outdoor play area
kitchen	250	adjacent to multipurpose room
storage	250	–
adult toilets	300	–
entry and reception	400	at drop-off area
classroom I	500	directly adjacent to outdoor play area
classroom II	500	directly adjacent to outdoor play area
multipurpose room	600	adjacent to storage
outdoor play area	3000	–

When designing the center, what are the most important issues that the architect must consider? (Choose the three that apply.)

(A) educational needs

(B) relationship to outdoor spaces

(C) toilet rooms

(D) exits

(E) children's storage areas

(F) multipurpose room location

376. The net assignable space includes the spaces used for specific functions (i.e., book stacks, reading rooms, offices, meeting rooms, and similar spaces). It does not account for circulation, toilet rooms, mechanical rooms, walls, and the like. The estimated 10% circulation space is part of the 80% efficiency ratio and is not included in the calculation.

The total gross area required is determined by dividing the net assignable area by the efficiency ratio.

$$\begin{aligned}\text{gross area} &= \frac{\text{net assignable area}}{\text{efficiency ratio}} \\ &= \frac{25{,}000\ \text{ft}^2}{0.80} \\ &= 31{,}250\ \text{ft}^2\end{aligned}$$

The answer is (C).

377. A long space can function for the initial design but a long space with separate assembly areas is not as flexible as a rectangular or square plan. Expansion is not mentioned. Although a flexible system of electrical and mechanical services is a good idea for any building shape, a grid system of support does not fully accommodate the needs.

The portion of the program given relates to providing timely flexibility as needs change. Future requirements are not known, except for electronics manufacturing. The architect plans for this facility by providing a large open space that can be reconfigured as required. A rectangular space most likely serves a linear assembly line and wide structural bays keep the space as unencumbered as possible.

The answer is (D).

378. Building location A is oriented in a suitable direction for passive solar design. Because it is located on a steeper slope, however, construction on location A is difficult and costly. Building location B allows for easy expansion and allows an adequate though not ideal orientation for passive and active solar design. Location B is in the middle of the site, however, making future development difficult. Building location D is oriented in the wrong direction for solar design (the length-oriented north to south) and runs across the contour lines, making construction difficult and costly.

Building location C integrates the given program requirements. It is oriented with the long direction slightly to the east of south, which is ideal for passive solar design in a temperate climate and active solar design. Placing the building at location C also allows for easy expansion. The building lies on a gentle slope, and the remainder of the site remains clear for future expansion. The possibility of placing the first building of the development in a prominent corner location is an added advantage.

The answer is (C).

379. This problem asks only for a calculation of water closets, so the information on lavatories, urinals, and drinking fountains can be disregarded.

$$\frac{400\ \text{girls}}{35\ \dfrac{\text{girls}}{\text{water closet}}} = 11.42\ \text{water closets for girls}$$

$$\frac{350\ \text{boys}}{100\ \dfrac{\text{boys}}{\text{water closet}}} = 3.50\ \text{water closets for boys}$$

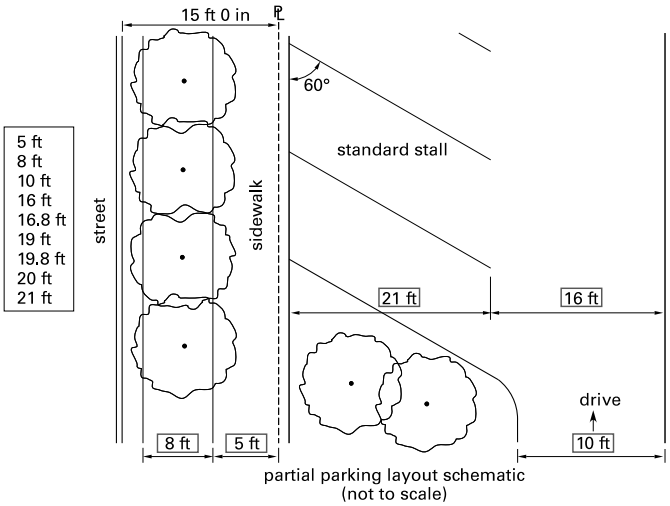
Toilet fixture calculations are always rounded up, so 12 girls' and 4 boys' water closets are needed.

The answer is 16 water closets.

380. Toilet rooms, storage areas, and the specific location of the multipurpose room are not the most important spaces for a day care center. For any day care facility or school, educational needs and outdoor spaces are the primary concerns. Children must be able to evacuate the building safely, so exits are critical components of the design.

The answer is (A), (B), and (D).

381.



For right-of-ways that are at least 15 ft, the surface parking lot and landscaping figure shows that walks must be a minimum of 5 ft and landscaped areas must be a minimum of 8 ft. For standard parking spaces, the required dimensions are given in the table row labeled 60°. Although the required width of the parking row access is 16 ft, the minimum required width of a one-way internal drive is 10 ft, as stated in the parking dimensions table footnote.

492. What distance from the foundation wall to the centerline of the dry well, as shown in Resource 5.2, should be used?

(A) 2 ft
(B) 5 ft
(C) 8 ft
(D) 9 ft

493. The simple dry well selected for this project must be

(A) empty
(B) filled with sand
(C) filled with clay
(D) filled with stone and gravel

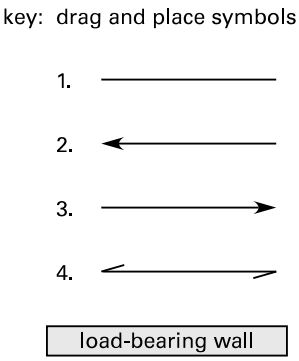
494. A rain garden can help manage stormwater and reduce runoff pollution. Designed to absorb some or all roof runoff, a rain garden consists of a depression in the soil that is populated with plants and is located 9 ft from the foundation wall. If the architect uses a rain garden in the design of the new addition and the capacity matches the volume of the dry well, how long is the rain garden?

(A) 8 ft
(B) 10 ft
(C) 12 ft
(D) 15 ft

495. The architect wants to draw a building section through the existing structure. So that the existing structure and the new structure are stable, the new foundation wall footing must be

(A) drawn 3 ft deeper than the existing footing
(B) drawn immediately beneath the frost depth
(C) shown at the new depth, and the existing foundation footing must be shown as underpinned
(D) no deeper than the existing footing so the architect must revise the design before drawing both footings at the same depth

496. The second floor plan is shown in Resource 1. Designate the load-bearing walls by drawing the load-bearing wall symbol in the appropriate locations.



497. On the second floor plan shown in Resource 5.1, draw the correct joist span symbol in the appropriate framing span direction (horizontal, vertical, or diagonal).

498. In ascending order, place the uniform live load requirements of various elements of the residence.

- pitched roof
- second floor
- uninhabitable attics without storage

499. To support the second floor plan shown in Resource 5.1, the joists will be constructed of which types of products? (Choose the two that apply.)

(A) lumber joists
(B) wood I-joists
(C) laminated veneer lumber (LVL)
(D) parallel strand lumber (PSL)
(E) glued laminated members (glulam)
(F) steel

Solve for length.

$$V_R = wd_R L$$

$$L = \frac{V_R}{wd_R}$$

$$= \frac{29.44 \text{ ft}^3}{(2.5 \text{ ft})(1 \text{ ft})}$$

$$= 11.78 \text{ ft} \quad (12 \text{ ft})$$

The answer is (C).

495. Because the new basement is designed to be deeper than the existing one, the existing adjacent foundation footing must be underpinned so as to not destabilize the structure. The contractor will need to underpin in alternate sections of approximately 3 ft. Concrete with rebar will be cast under the existing footing to a depth that matches the new footing depth. The new footing will also need to connect to the underpinning concrete using rebar.

The existing footing is below the frost depth. To remain economical, the new foundation should not be deeper than needed to underpin the existing foundation. Option (D) will not allow the existing footing to be underpinned properly.

The answer is (C).

496. The load-bearing walls are the long walls running in the horizontal direction of the addition. It is better not to overload the existing wall on the right side of the plan.

497. The new floor joists run perpendicular to the load-bearing walls. It is better to support the joists of the new framing on the new foundation and load-bearing walls running in the horizontal direction of the plan. The correct framing span symbol is shown. The symbol must be placed vertically and perpendicular to these new bearing walls.

Illustration for Sol. 496