

Eighth Edition

Print Reading for Construction

Residential and Commercial

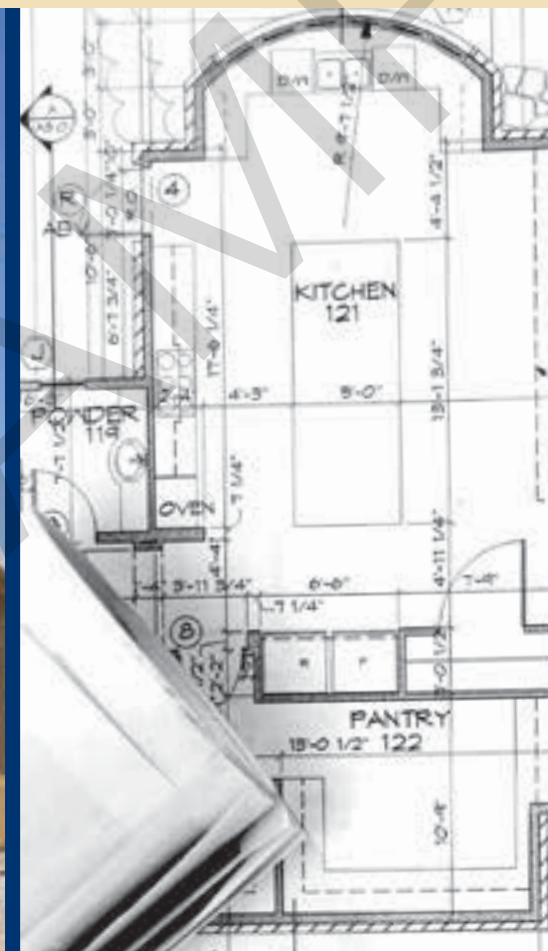
Write-in Text with 140 Large Prints

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Preface

Print Reading for Construction is a textbook for those who wish to learn basic print reading and increase their knowledge of construction drawings. The term *print reading*, as used in this textbook, refers to interpreting and visualizing construction drawings.

Print Reading for Construction is a combination text and workbook, or “write-in text.” The text tells and shows how, and the workbook provides space for meaningful print reading, sketching, and estimating activities. Actual construction prints used with the text can be found in the **Large Prints** folder. They provide realistic job experience. The text is equally applicable for students studying construction, estimating, or construction management.

Print Reading for Construction is organized into sections based on a progression of topics from simple to complex. A list of *Technical Terms* opens each unit. *Learning Objectives* are presented to provide an overview of the content and define the most important skills you will learn in the unit. Each unit is followed by *Test Your Knowledge* questions. These brief questions will help you evaluate how well you understand the topics presented in the unit.

Most units include two or more *Activities* that provide you with practical print reading experience. Many of these will make use of the residential and commercial prints contained in the **Large Prints** folder. The write-in text format with perforations allows you to remove pages from the book, complete assignments, and turn them in directly to the instructor.

Using the Large Prints

The **Large Prints** folder contains seven sets of construction prints for the building projects referenced in this text. There are 140 total prints in the folder package. Included are sets for four residential building projects and three commercial building projects.

Print reading activities corresponding to each project are presented in this text. Three of the projects are referenced in the print reading activities in Units 8–17:

- The Sullivan Residence
- The Marseille Residence
- Delhi Flower and Garden Centers Greenhouse and Sales Building

The print reading activities for these projects appear at the end of each unit and are intended to be completed after studying the corresponding unit.

There are four building projects referenced in the *Advanced Print Reading Projects* section of this text. These include two residential projects and two commercial projects:

- Advanced Project A—Residence Mercedes Pointe
- Advanced Project B—The North House Residence
- Advanced Project C—Office and Warehouse
- Advanced Project D—Cincinnati Manor Building

The print reading activities for these projects are more extensive in scope and are intended for additional print reading practice.

Organization of Large Prints

Prints in the **Large Prints** folder are arranged so that each building project is printed on one side of the sheets. This organization helps in locating information across multiple sheets. The projects are grouped in the **Large Prints** folder as follows:

Group A—Left Pocket:

Front of sheet:

- The Sullivan Residence (5 prints)
- The Marseille Residence (9 prints)
- Advanced Project A—Residence Mercedes Pointe (8 prints)
- Advanced Project B—The North House Residence (13 prints)

Back of sheet:

- Delhi Flower and Garden Centers Greenhouse and Sales Building (30 prints)
- Advanced Project C—Office and Warehouse (5 prints)

The Sullivan Residence Print Index (5 Prints)		
Print Label	Sheet Number	Sheet Title
SUL-1	1	Exterior Elevations, Details, and Notes
SUL-2	2	Foundation Plan
SUL-3	3	First Floor Plan
SUL-4	4	Truss Profiles, Roof Plan, and Details
SUL-5	5	Exterior Elevations and Wall Section

Group B—Right Pocket:

Front of sheet:

- Advanced Project C—Office and Warehouse (35 prints)

Back of sheet:

- Advanced Project D—Cincinnati Manor Building (35 prints)

Indexes for Large Prints

The following tables list the prints in the **Large Prints** folder for the projects referenced in Units 8–17. Indexes for the prints associated with the advanced print reading activities appear later in the text where the projects are referenced.

The Marseille Residence Print Index (9 Prints)		
Print Label	Sheet Number	Sheet Title
MAR-1	1	Exterior Elevations, Details, and Notes
MAR-2	2	Foundation Plan
MAR-3	3	First Floor Plan
MAR-4	4	Second Floor Plan
MAR-5	5	Truss Profiles, Roof Plan, and Details
MAR-6	6	Exterior Elevations and Sections
MAR-7	MP2	Foundation Mechanical/Plumbing Plan
MAR-8	MP3	First Floor Mechanical/Plumbing Plan
MAR-9	MP4	Second Floor Mechanical/Plumbing Plan

Delhi Flower and Garden Centers Greenhouse and Sales Building Print Index (30 Prints)					
Print Label	Sheet Number	Sheet Title	Print Label	Sheet Number	Sheet Title
DEL-1	1	Title Sheet	DEL-16	S1.1	Foundation Plan
DEL-2	4	Existing Conditions/Demolition Plan	DEL-17	S1.2	Foundation Plan
DEL-3	5	Grading and Erosion Control Plan	DEL-18	S2.1	Roof Framing Plan
DEL-4	A0.1	Supplemental Specifications	DEL-19	S2.2	Framing Plans and Truss Elevations
DEL-5	A1.1	First Floor Plan	DEL-20	S3.1	Foundation Details
DEL-6	A1.2	First Floor Plan, Details	DEL-21	S4.1	Framing Details
DEL-7	A1.3	Mezzanine Plan	DEL-22	S5.1	Structural Notes
DEL-8	A2.1	Roof Plan	DEL-23	P1.1	Plumbing Plans
DEL-9	A3.1	Reflected Ceiling Plan	DEL-24	P2.1	Sanitary Isometric, Fixture Schedule, Plumbing Specs
DEL-10	A4.1	Exterior Elevations	DEL-25	M1.1	First Floor Mechanical Plan
DEL-11	A4.2	Exterior Elevations	DEL-26	M1.2	Mezzanine Mechanical Plan and Schedules
DEL-12	A5.1	Interior Elevations and Schedules	DEL-27	E1.1	First Floor Lighting Plan
DEL-13	A6.1	Enlarged Plans and Interior Elevations	DEL-28	E1.2	Lighting Plans and Schedules
DEL-14	A9.1	Interior Wall Sections	DEL-29	E2.1	First Floor Power Plan
DEL-15	A9.2	Exterior Wall Sections	DEL-30	E4.1	Riser Diagram, Panel Schedules, and Notes

New to This Edition

This edition of **Print Reading for Construction** includes new illustrations and expanded coverage of topics throughout the text. The following is a summary of changes and new features in this edition.

- New photographic and drawing-based illustrations highlighting construction methods and materials discussed in the text.
- Expanded coverage on using metric scales in Unit 3, *Reading Measuring Tools and Using Scales*. Coverage explains how to make readings with metric scales, how to work with different metric scales, and typical metric drawing scales used on construction drawings.
- Clarification of the gage system used for classifying sheet metal gages in Unit 7, *Construction Materials—Types and Uses*.
- Expanded coverage on open-web steel joists in Unit 11, *Structural Prints*.
- Coverage on open-web truss joists (floor trusses) in Unit 12, *Residential Framing Prints*.
- Enhanced coverage on developing takeoffs and estimates in Unit 17, *Estimating Construction Costs*. New takeoff and estimating sheets are provided for use with the construction estimating activity at the end of the unit. In addition, a new Microsoft Excel® spreadsheet form is available for completing the assignment electronically as assigned by the instructor. The spreadsheet form includes the entries from the Materials List in Activity 17-1. Cells in the file contain mathematical formulas for automatically calculating total costs from data entered in the file.
- Additional questions are provided for student evaluation in the *Test Your Knowledge* review sections.
- New videos supplementing the text have been added to the instructor's resources to reinforce content and assist visual learners.

About the Authors

Daniel P. Dorfmueller is an instructor and consultant for the construction industry. Mr. Dorfmueller resides in Lebanon, Ohio, and teaches print reading for construction and concrete courses. Mr. Dorfmueller has been involved in the construction industry for more than 45 years and has been teaching for more than 25 years.

Mr. Dorfmueller is a Fellow member of the American Concrete Institute (ACI) and has served on many ACI committees. Mr. Dorfmueller speaks at many construction-related trade shows such as the World of Concrete, Expo Hormigon in Chile, and the Art Deco convention, and has presented at events for various industry associations. He has written several articles and served as an adjunct instructor at Northern Kentucky University. Mr. Dorfmueller holds a bachelor's degree in architecture from the University of Cincinnati.

During his career, Dr. Walter C. Brown was a leading authority in the fields of drafting and print reading. He served as a consultant to industry on design and drafting standards and procedures and held a variety of professional offices of state and national associations.

Reviewers

The authors and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of **Print Reading for Construction**.

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Brick Institute of America
CertainTeed Corporation
CESO Engineers & Architects
Christensen, Cassidy, Billington and Candelaria, Inc.,
Architects
CITY Properties Group, LLC
Concrete Reinforcing Steel Institute
constructionphotographs.com
CR architecture + design
Cypress Specialty Steel Company
Dale/Incor
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IBI Group, Cincinnati

Delhi Flower and Garden Centers Greenhouse and Sales Building

Delhi Flower and Garden Center
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PE-Services
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Goodheart-Willcox Office and Warehouse Facility

Charles E. Smith, Areté 3 Ltd.

The Marseille Residence

Studer Residential Designs, Inc.
Schadler Plumbing
Doc Rusk Heating & Cooling

The North House Residence

Norris & Dierkers Architects/Planners, Inc.

Residence Mercedes Pointe

Eagle Custom Homes
McGill Smith Punshon, Inc.
Superior Designs, LLC

The Sullivan Residence

Studer Residential Designs, Inc.
Schadler Plumbing
Doc Rusk Heating & Cooling

Dan Dorfmueller (best known as “dorf”) thanks his wife, Deb, and his children and grandchildren for supporting the many hours spent on the revision of this book.

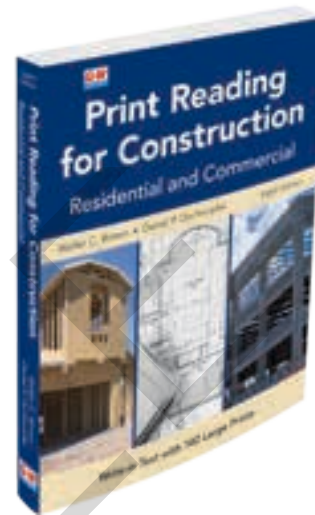
TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text

Print Reading for Construction is designed to teach students how to read prints used in residential and commercial construction. It provides a practical way to help students learn and master the skill of print reading. Included with the text is a *Large Prints* folder with 140 construction prints from residential and commercial construction. Activity questions at the ends of units in the text are based on the prints and allow students to apply concepts and gain print reading experience. Questions in the *Advanced Projects* section provide greater challenge and give students valuable hands-on experience.

Print Reading for Construction covers both residential and commercial construction with a focus on construction methods and materials. The text covers introductory topics in depth to help ensure a full understanding of basic concepts before progressing to more advanced topics. Topics covered include construction drawing organization, construction math and related applications, using measuring tools, orthographic projection principles, reading specifications, architectural drawings, structural construction, wood and metal framing systems, mechanical building systems, and estimating. The text is extensively illustrated with clear and detailed examples that enhance learning. Review questions and print reading activities enable students to reinforce learning and use problem-solving skills.



Instructor Tools

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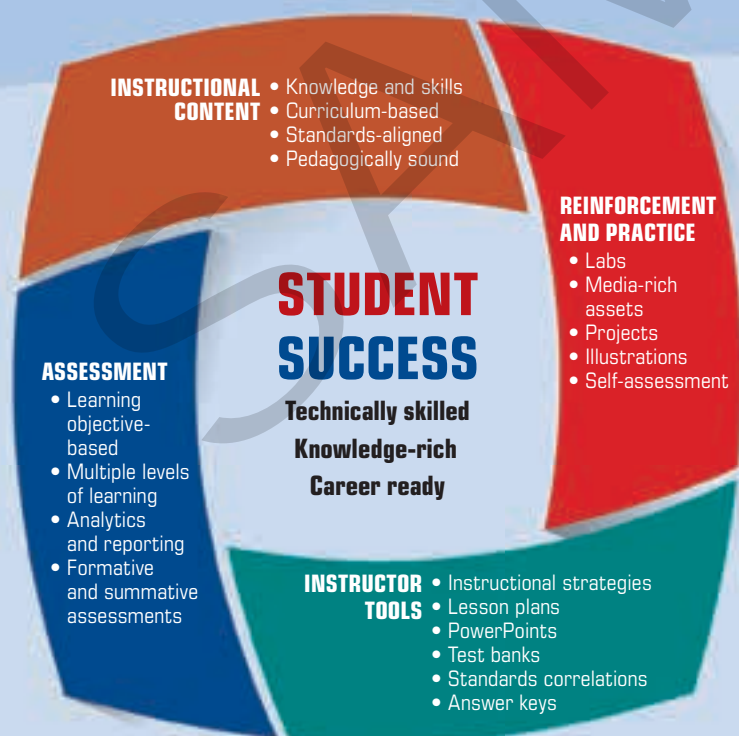
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Features of the Textbook

The instructional design of **Print Reading for Construction** includes student-focused learning tools to help you succeed. This visual guide highlights these features.

Unit Opening Materials

Each unit opener contains a list of technical terms and a list of learning objectives. The **Technical Terms** list the key words to be learned in the unit. Definitions for the **Technical Terms** are given in the Glossary. The **Learning Objectives** clearly identify the knowledge and skills to be gained when the unit is completed.

UNIT 7 Construction Materials—Types and Uses

TECHNICAL TERMS		
aluminum alloy brick aggregate angle asphalt bar glass band band beams brick masonry building brick concrete concrete brick concrete masonry unit (CMU) cut stone face brick ferrous metals fin-decay tile float glass float glass gyp system	glass glass block glazed brick gravel green building grout header course hydration insulating glass kiln-burned brick laminating laths low-R insulation lumber mortar masonry tiles medium-density fiberboard open-web steel joist paving brick precast concrete plywood	quarry reflective insulation refractory rigid insulation rough-sawn lumber rubble scab safety glass sand core brick single-xylo walls stained glass stone masonry structure structural clay tile strutted steel surfaced lumber sustainable design sustainable design thermal insulation welded wire fabric (WVF) wythe

- #### LEARNING OBJECTIVES
- After completing this unit, you will be able to:
- Identify a variety of basic materials used in construction.
 - Identify the basic components of concrete.
 - Distinguish different types of masonry brick, block, and mortar.
 - Classify wood as hardwood or softwood.
 - Recognize different structural steel shapes.
 - Describe various types of glass, plastic, and insulation.
 - Identify symbols representing materials on a drawing.
 - Explain the fundamentals of green building construction.

Additional Features

Additional features are used throughout the body of each unit to further learning and knowledge. **Careers in Construction** features provide information about career opportunities in the construction trades. **Green Building** features highlight key items related to green building technology, sustainability, energy efficiency, and environmental issues. **Notes** clarify explanations in the text and provide more detailed information about related topics.

Illustrations

Illustrations have been designed to clearly and simply communicate the specific topic. Photographic images have been updated in this edition to show new technology and products in the construction industry.

Figure 10-4 Footings are designed to carry the weight of the entire building and transfer that weight to the earth below.

CAREERS IN CONSTRUCTION

Concrete Construction

Concrete construction offers many employment opportunities. Concrete is a widely used material in building construction. In residential construction, concrete is typically used to construct foundations and basements. In commercial construction, concrete is often used for both structural and architectural purposes. The number of individuals involved in concrete work on a construction project depends on the size and complexity of the project.

On large projects, workers involved in concrete construction include laborers, carpenters, cement masons, and reinforcing steel installers. A laborer is a worker who works the trade without experience and learns and advances with training. The laborer assists the other workers on the job by helping the carpenter move materials, the cement mason place concrete, and the reinforcing steel installer move rebar. Carpenters build formwork for footings and foundation walls. Cement masons work with fresh concrete or lay concrete block. Cement masons are also responsible for concrete finishing. A concrete finisher screeds and trowels the placed concrete and must have a working knowledge of the mechanical properties of concrete. Reinforcing steel installers, commonly called rebar installers, build the rebar into the formwork before the concrete is placed. On large projects, reinforcing steel assemblies and rebar cages can be very substantial.

Concrete construction is performed by skilled workers. These workers are using a metal screed to level the concrete as it is placed.

Workers entering concrete construction typically learn skills on the job by working with experienced tradesworkers. They may also receive training from a trade school or through an apprenticeship program. Work in the concrete industry is fast paced and requires physical strength. Concrete construction workers must be skilled in knowing how to work with concrete and must be able to work in different weather conditions because most work occurs outdoors.

UNIT 8 Structural Framing

GREEN BUILDING

Engineered Wood Products

The development of modern engineered wood products has done much to help support green construction. The International Wood Products Association (IWPA) has issued a new standard, EN 14906, for structural wood products. This standard is designed to provide the strength characteristics while using less material. Engineered wood products can be purchased in dry kiln wood, or ceramic tile, will cover the substrate.

Additional floor framing members

Double header. When an opening in the framing pattern is needed, a double header is normally used. The double header is a joist member that is used for the opening.

Double trimmer. A double trimmer is a joist member that is used for the opening. It is used to support the double header and the joists on either side of the opening.

Tail joint. This is a joint between two joists. It is used to support the double header and the joists on either side of the opening.

Ledge. A ledge is a small piece of wood that is used to support the double header and the joists on either side of the opening.

Bridging. Bridging consists of a member connected between the sides of adjacent joists. Bridging provides stability for the joists and helps to level the joists. Many types are used, including post-and-rivet, double, and cross-braced metal beams.

The floor framing system is often shown on a framing plan. The size of the members, marks, or arrows are used to indicate the size. A note is typically used to specify the size.

2x12 JOISTS 16" O.C.

Figure 13-14 A portion of a structural framing drawing for a commercial building. Note that beams are represented with centerlines. In addition, note the use of grid lines to identify beam and column locations.

Information of a general nature, such as insurance, supervision, and inspection, is found in Division 03—Government and Contracting Requirements for Division 03—General Requirements.

When working for a particular type, determine what the division is used for. For example, if you need to know the required concrete strength, you would look under Division 03—Concrete.

Note

Whether you are bidding a specified material item, specification section, or entire project, it is recommended that you read and become familiar with information included under General Requirements and Project Conditions in the specifications. It is common to have material suppliers, subcontractors, and contractors say they were required to perform something they did not intend to do. It is important to have a clear understanding of the requirements of the specifications. This is also helpful when preparing a proposal and statement of qualifications.

Building Codes

Building codes are laws and standards specifying requirements for building construction. Building codes establish standard construction practices and materials and are enforced by local building officials to ensure that required standards are met. Building codes impact all aspects of the building design and construction process. Becoming familiar with the requirements of building codes and careful inspection of them is important to all building projects.

There are different types of building codes in existence. Model codes are national building codes.

X

Test Your Knowledge

Name _____

Write your answers in the spaces provided.

1. True or False? Concrete is stronger when it is in tension (pulled) than when it is in compression (pushed).
2. When preparing a batch of concrete, which of the following would not be included?
 - A. Water
 - B. Cement
 - C. Aggregate (sand, gravel)
 - D. Chemical admixtures
 - E. All of these items could be included in the mix.
3. Which of the following types of brick is made from a mixture of Portland cement and aggregate?
 - A. Sand-lime brick
 - B. Adobe brick
 - C. Klinkers brick
 - D. Concrete brick
 - E. All of the above.
4. True or False? Firebrick is referred to as "common brick" because it is the most commonly used type of brick.
5. Squared stones that have been laid in a pattern but not cut to dimensions are called _____.
 - A. rubble stones
 - B. pea gravel
 - C. rubble
 - D. concrete masonry
 - E. cut stones
6. Which mortar type situations requiring _____.
 - A. Type M
 - B. Type S
 - C. Type N
 - D. Type O
 - E. None of the above
7. True or False? Lumber classified as rough-sawn lumber has been dressed or finished to size by routing it through a planer.
8. What is the difference between interior and exterior plywood?
 - A. The type of wood used
 - B. The size of the sheets
 - C. The type of adhesive used
 - D. The thickness of the sheets
 - E. Interior and exterior plywood are identical.
9. The steel beam identification W6x15 represents a wide-flange beam _____.
 - A. 6" deep and weighing 15 pounds per linear foot
 - B. 6" deep and 15" wide
 - C. 6" wide and 15" deep
 - D. 6" deep and 15" long
 - E. None of the above is correct.
10. True or False? Nonferrous metals contain little or no aluminum.
11. True or False? Concrete completely hardens within 48 hours after it is poured.
12. Which of the following is not considered to be a type of safety glass?
 - A. Tempered glass

Review Content

Review content at the end of each unit provides an opportunity to reinforce learning and apply concepts. **Test Your Knowledge** questions enable you to demonstrate comprehension of the textbook content. **Activities** allow you to apply knowledge and solve problems. **Print Reading Activities** provide opportunities to apply print reading skills using prints in the **Large Prints** folder that accompanies the text. Use the corresponding prints to locate information and answer the questions. **Advanced Projects** are provided at the end of the text for additional practice in reading prints and completing exercises.

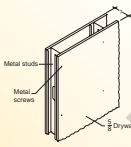
Activity 2-1

Problems in Construction Mathematics

Name _____

Solve the following problems. Show your work and calculations. Write your answers in the spaces provided.

1. A triangular frame has sides that measure 15'-0", 20'-4", and 26'-2". What is the total length of the three sides? _____
2. A carpenter had a board 2'-10 3/4" long. To fit the space for a shelf, the carpenter cut 7'-10" off one end. How long was the board after the piece was removed? _____
3. Fifteen strips, 1 1/4" wide, are to be ripped from a sheet of plywood 8 1/2" in. In how many cuts how much of the plywood sheet is used in making the 15 strips? (Assume 15 cuts are necessary) _____
4. An interior wall of a building is made up of metal studs with 5/8" gypsum board on each side. See the drawing below. If the actual width of a stud is 3 1/2", what is the total thickness of the wall? _____



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Advanced Project A

Residence Mercedes Pointe

This project is based on drawings for the two-story brick and stone veneer residence shown in Figure A-1. This large, four-bedroom, 3 1/2 bath home includes a large garage, a study, and a covered porch and deck. Refer to Prints RAMP-1 through RAMP-10 in the Large Prints supplement when working on the following activities. An index is provided below. Note: The prints provided do not represent a complete set of drawings for the building.



Figure A-1. Front elevation of the Residence Mercedes Pointe residence.

PRINT INDEX - RESIDENCE MERCEDES POINTE

PRINT	SHEET	SHEET LABEL	NUMBER	TITLE
RAMP-1	1	FRONT & RIGHT ELEVATIONS		
RAMP-2	2	LEFT & REAR ELEVATIONS		
RAMP-3	3	FOUNDATION PLAN, SITE PLAN		
RAMP-4	4	FIRST FLOOR PLAN		
RAMP-5	5	SECOND FLOOR PLAN		
RAMP-6	7	FIRST FLOOR ELECTRICAL PLAN		
RAMP-7	8	WALL SECTIONS, STAIR SECTIONS		
RAMP-8	10	GENERAL NOTES, WALL SECTIONS		

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Activity 9-1

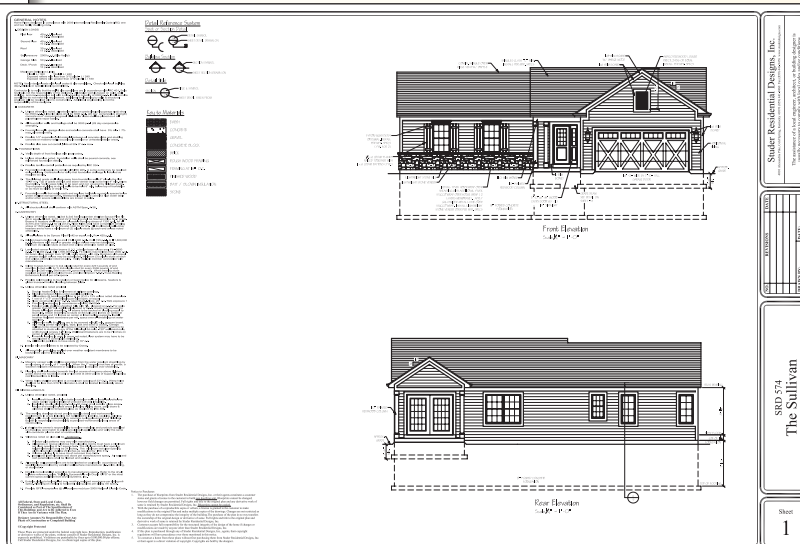
Architectural Drawings for a Residential Building Project

Name _____

Refer to Sheets 1, 3, and 5 from the Sullivan residential building plans in the Large Prints supplement to answer the following questions.

1. On which sheet is the first floor plan?
2. What is the scale of the first floor plan?
3. On which sheets are the elevations found?
4. What is the overall size of the following rooms?
 - A. Garage
 - B. Kitchen
 - C. Master Bedroom
5. How many bedrooms are in this house?
6. Which two bathrooms back up to each other?
7. What kind of ceiling is in the great room?
8. What kind of materials are specified for the exterior of the house?
9. What is the insulation required in the roof?
10. Describe the housewrap material to be installed under the lightweight stone veneer.

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880-574 The Sullivan

Sheet 1

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