

# CONSTRUCTION DOCUMENTATION SPECIALIST

NAWIC EDUCATION FOUNDATION



**Construction Working Drawings  
And Project Manual**

First Edition Copyright © 2007

NAWIC EDUCATION FOUNDATION  
Toll Free 866-277-2883

WEB Page: <http://www.nawiceducation.org>

Construction Working Drawings is a trademark and service mark of the NAWIC Education Foundation which are used to identify the goods and services provided by the NAWIC Education Foundation.

All rights reserved. This material and parts thereof may not be reproduced in any form without permission of the NAWIC Education Foundation.

## INTRODUCTION

This book deals with interpreting information conveyed from the architect/engineer to the contractor by way of a legal document and with implementing that fundamental understanding. It discusses the many components of the legal agreement that binds the parties in a construction project: working drawings, specifications, and contract requirements of the Project Manual. A comprehensive understanding of the project's construction documents is necessary to prepare an estimate for submitting a bid and to prepare a project schedule for controlling costs after the contract is awarded.

The lessons of this book review the various types of construction drawings: civil, architectural, structural, mechanical, and electrical. The review explains symbols used on drawings and methods of dimensioning. It also covers reading and understanding plans, elevations, sections and interpreting details.

Following the detailed analysis of drawings, an in-depth review of the Project Manual is presented. The Project Manual covers the bid requirements, contract requirements, general conditions, and supplementary conditions. Finally, the specifications for the materials, methods, and systems of the assembly of each of the disciplines are studied. The importance of format is emphasized and the study centers on the MasterFormat of the Construction Specifications Institute. Contrasts are made between performance and prescriptive specifications. The relationship among divisions, sections, and parts are defined.

## DISCLAIMER

**The materials provided in this course are intended to represent an amalgamation of general legal principals and standards for the topics addressed. The materials are provided for general educational and informational purposes only and are not intended as legal advice. The materials are not all-inclusive or comprehensive. It is also important to understand that the laws of each state differ and the general principals stated here may not accurately reflect the law in any particular jurisdiction. The providers and authors disclaim any responsibility or liability for the reader's reliance on these materials as the exclusive body of authority on the issues covered.**

# NOTE TO THE STUDENT

This book contains all of the information needed to prepare for the course examination. Supplemental information referenced or provided over and above this material is for reference purposes only. Likewise personal and professional experiences may differ from the program content and should be considered as supplemental information. No supplemental information will be included in the examination.

# CONSTRUCTION WORKING DRAWINGS AND PROJECT MANUAL

## Table of Contents

### Contents

LESSON 1.....	7
Working Drawings: Civil .....	7
Site Selection and Planning.....	7
Planning Documents.....	8
Topographic survey.....	9
Miscellaneous surveys and maps.....	16
Site Plan.....	16
Erosion Control Plan.....	23
Site Plan Symbols.....	30
Dimensioning Practices.....	31
Drawing Scales.....	31
Questions for Review.....	32
LESSON 2.....	33
Working Drawings: Architectural .....	33
Working Drawings.....	33
Drawing Development.....	43
Symbols.....	44
Abbreviations.....	50
Line Conventions.....	50
Dimensioning Practices.....	52
Drawing Scales.....	52
Summary .....	53
Questions for Review.....	54
LESSON 3.....	56
Working Drawings: Structural .....	56
Structural Drawings: Reinforced Concrete Construction .....	56
Structural Drawings: Precast and Prestressed Concrete Construction .....	65
Structural Drawings: Steel Construction .....	69
Welding Symbols.....	74
Dimensioning Practices.....	79
Summary .....	79
Questions for Review.....	80
LESSON 4.....	81
Working Drawings: Mechanical .....	81
Description of Systems .....	81
Air Distribution.....	84
Heating and Cooling Water .....	89
Related work .....	94
Plumbing .....	94
Fire Sprinklers .....	101
Summary .....	103
Questions for Review.....	104

LESSON 5.....	105
Working Drawings: Electrical .....	105
Lighting.....	105
Compact Fluorescent Bulbs (CFLs) Shapes and Sizes .....	106
Wiring Systems .....	107
Equipment and Accessories.....	112
Electrical Plan .....	114
Symbols & Schedules.....	116
Single Line Diagram.....	116
Electric Service Detail.....	116
Fire Alarm System .....	120
Emergency Lighting.....	120
Communication Systems.....	121
Summary .....	121
Questions for Review.....	122
LESSON 6.....	123
Project Manual .....	123
Bid Documents.....	124
Pricing scenarios – .....	125
Instructions to Bidders.....	129
Bid Form.....	131
Bonds and Certificates .....	133
The Owner-Contractor Agreement.....	134
General Conditions of the Contract.....	135
Addenda, Alternates and Modifications.....	135
Division 1- General Requirements.....	135
Bid Documents vs. Contract Documents.....	136
Summary .....	137
Questions for Review.....	138
LESSON 7.....	139
Specifications .....	139
Specifications .....	139
The six-digit MasterFormat:.....	140
Current MasterFormat Divisions (April 2014).....	141
Pre-2014 MasterFormat Divisions .....	143
MasterFormat 2004 Edition.....	143
Summary .....	150
Questions for Review.....	151
APPENDIX I .....	153
Bibliography.....	153
APPENDIX II.....	155
Common Abbreviations .....	155

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL

**LESSON 1**  
**Working Drawings: Civil**

**Objectives**

After completing this lesson, you will be able to:

- Identify factors in site selection and planning.
- Understand how to read a topographic survey plan.
- Identify symbols used to classify various soil types.
- Understand how to read a site plan.

**Site Selection and Planning**

---

Buildings are designed and located on the site to fit the existing conditions. If possible, existing natural features (such as trees and vegetation) will be incorporated into the design. Some buildings are oriented to face the south allowing their major window areas to catch winter sunlight for solar heat. Building orientation for a pleasing view may be incorporated into the design to create a pleasant living or working area. Of course, location of streets and utilities and the shape and slope of the site all play a part in designing and placing a building to its best advantage.

In addition to these factors, the impact of the proposed structure on the environment is a major consideration. Larger projects, especially if they are in part federally funded or if they are in an urban area, may be required to make a study and develop an Environmental Impact Statement (EIS) before the construction proposal can be evaluated or approved for a building permit. The Environmental Impact Statement describes the environment of the area, discusses the environmental consequences (both short and long term) that the proposed change will have on the area, and offers alternatives. The effect commercial or industrial development will have on the total environment of an area, including flora and fauna, air quality, water resources, noise levels, and traffic flow, must be considered. Protection of existing natural area and wildlife habitats also plays an important part in the choice and development of a building site.

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL  
**LESSON 2**  
**Working Drawings: Architectural**

### Objectives

After completing this lesson, you will be able to identify:

1. The various types of drawings that comprise the working drawings of a project.
2. The sheet sequence for a set of working drawings.
3. Plan, section and elevation symbols.
4. Common abbreviations and dimensioning practices.

### Working Drawings

---

Working drawings, also known as construction plans, show in graphic form the design, location and dimensions of a project. They are prepared by the architect/engineer (A/E) for the owner. The set of working drawings works with the written specifications to provide the information necessary to construct the project.

Several types of drawings are common to the construction industry. The floor plan shows what you would see looking straight down on the exposed floor as if the structure over the floor were cut away and removed. Locations of exterior and interior walls, door openings and windows are typically shown on a floor plan. Other fixed elements such as fireplaces, staircases, cabinets, sinks, toilets and showers are also shown on a floor plan. The floor plan also depicts exterior dimensions, interior dimensions of rooms and window openings, and section symbols. Figure 2.1 shows a simplified view of a residential floor plan. A reflected ceiling plan shows a view of the room as if looking from above through the ceiling at a mirror installed just below the ceiling level, which shows the “reflected” image of the ceiling above. This convention maintains the same orientation as the floor plans. Reflected ceiling plans illustrate the location of light fixtures, sprinkler heads, exit signs, smoke detectors, HVAC registers and diffusers, and ceiling finish materials and forms.

Figure 2.2 shows the plan view of the roof and elevations. Note that plan views are seen directly from above while elevations are seen directly from the side. Elevations show the vertical layout of doors and windows, roof pitch, location of chimneys and other exterior elements. Elevations may also depict vertical dimensions or elevations of the floors in a structure. Elevation drawings provide important information about the type of materials used on the exterior of the structure as well as how those materials are to be constructed. For example, elevation drawings may show brick in a typical running bond pattern, a brick soldier course as headers over windows, brick quoins at the corners, and concrete sill plates below windows. The elevation drawings will indicate the roofing material (i.e., shingles, metal or tile).

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL

**LESSON 3**  
**Working Drawings: Structural**

**Objectives**

After completing this lesson, you will be able to:

1. Identify the types of structural drawings used for cast-in-place concrete, precast/prestressed concrete and structural steel.
2. Understand how precast panels are erected.
3. Become familiar with the various types of welding symbols.
4. Understand how structural steel members are dimensioned.

**Structural Drawings: Reinforced Concrete Construction**

---

Reinforced concrete buildings use concrete members to form the framework. The concrete floor system is supported by columns or walls; columns and walls are supported by footings. Figure 3.1 shows a typical poured-in-place reinforced concrete framework: walls, or circular or rectangular columns, support the floor slab. The floor slab may be flat (Figure 3.1, bottom) or have ribs or joints (Figure 3.1, top). Steel reinforcement runs through the support framework and the floor slabs.

Two types of drawings are used to show cast-in-place reinforced concrete: engineering drawings and structural steel shop drawings. Engineering drawings show the general layout of the structure, size and spacing of concrete members. Structural steel shop drawings are more detailed than engineering drawings and show—in addition to size and spacing of members—the location, size and shape of the steel reinforcement. A schedule may be included to give detailed information on the reinforcement bars.

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL

**LESSON 4**  
**Working Drawings: Mechanical**

**Objectives**

After completing this lesson, you will be able to:

1. Describe the types of mechanical systems found in buildings: HVAC, plumbing and fire protection.
2. Identify drawing symbols common to mechanical drawings.
3. Understand the purpose of riser diagrams.

**Introduction**

Mechanical work is a major part of the complete structure. The mechanical drawings show the plumbing, heating, air conditioning, ventilation, process piping, and fire sprinkler work required for the project.

Heating, ventilating, and air conditioning work is often referred to as HVAC. The HVAC sheet metal, piping, and equipment are usually shown on the drawings designated M, plumbing work as P, and fire protection systems as FP.

Upon receiving a set of drawings, it is best to first scan the drawing index, architectural elevations and floor plans to determine the size and type of building. This will aid in understanding the mechanical drawings.

**Description of Systems**

---

- Air distribution: Fans, ductwork, grilles and registers generally installed by sheet metal workers.
- Heating, cooling water: Chillers, furnaces or boilers, cooling towers, pumps and the piping to supply conditioned water, generally installed by steam or pipe fitters.
- Plumbing: Water and waste systems for domestic use, generally installed by plumbers.
- Fire sprinklers: Pumps, piping, controls and sprinkler heads, generally installed by pipe fitters.

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL  
**LESSON 5**  
**Working Drawings: Electrical**

### **Objectives**

After completing this lesson, you will be able to:

1. Identify common types of electrical equipment, lighting fixtures and wiring systems.
2. Identify types of overcurrent protection.
3. Identify drawing symbols common to electrical drawings.
4. Understand the purpose of single line diagrams.

### **Introduction**

The electrical drawings complete the set of working drawings. They indicate the type of electrical system to be installed in the building and how it is to be installed. The components include lighting, wiring, equipment, , electric service, emergency lighting, fire alarm and communication systems.

### **Lighting**

---

Lighting is a sophisticated and complicated matter, and lighting design has become an exacting science. General contractors do not need to understand lighting design, but in order to accomplish their task, it is important for them to have at least a rudimentary knowledge of the types of fixtures that are available. The main types are as follows:

#### **Incandescent Lighting.**

Incandescent lamps consist of a vacuum-type glass envelope with a wire filament that glows when electricity is applied. Incandescent lamps were used in a multitude of enclosures called lighting fixtures. Incandescent lighting fixtures are no longer manufactured and should no longer be specified.

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL

**LESSON 6**  
**Project Manual**

**Objectives**

After completing this lesson, you will be able to:

- Understand what comprises the project manual.
- Understand which documents become part of the contract and which do not.
- Identify information contained in the Invitation to Bid versus the Instructions to Bidders.
- Identify components of a bid form.
- Define the various types of bonds.
- Distinguish between general and supplementary conditions.

**Project Manual**

The Project Manual is the title given to the bound, written documents prepared by the architect/engineer for the owner for bidding and constructing the project. The term Project Manual originated with the American Institute of Architects (AIA) in 1964 when it adopted the concept and title Project Manual in lieu of the commonly used title Specifications. Since the book of specifications usually contained bid documents, various forms, conditions of the contract, and other information in addition to the requirements for materials and methods to be used in the construction, it was in reality a manual of project requirements and contract documents.

The basis of the Project Manual concept was the organization of the written documents into two general categories: those describing the bid requirements (non-contract documents) and those that become part of the contract (contract documents) upon the signing of the agreement (contract).

In 1972, the Construction Specifications Institute (CSI) officially accepted the title Project Manual and began a study of an expanded standard arrangement of the documents to be contained in the Project Manual. They established a location for each item in a logical sequence and categorized bid requirements and those items that comprise the contract documents upon the signing of the agreement. The following categories resulted and will be discussed in detail later in the chapter:

CONSTRUCTION DOCUMENTATION SPECIALIST  
CONSTRUCTION WORKING DRAWINGS  
AND PROJECT MANUAL

**LESSON 7**  
**Specifications**

**Objectives**

After completing this lesson, you will be able to:

- Understand the organization and numbering system of the 2004 and 2014 CSI MasterFormat.
- Distinguish between the various types of specifications.
- Understand the three parts that comprise a specification section.

**Specifications**

---

Specifications describe the materials and workmanship required for a development. They do not include cost, quantity or drawn information, and so need to be read alongside other information such as quantities, schedules and drawings.

Specifications vary considerably depending on the stage to which the design has been developed, ranging from performance specifications (open specifications) that require further design work to be carried out, to prescriptive specifications (closed specifications) where the design is already complete.

MasterFormat is a master list of numbers and titles classified by work results for construction practices. It is used to organize project manuals, detail cost information, and relate drawing notations to specifications. By fostering fuller and more detailed construction specifications, MasterFormat is designed to reduce costly changes and delays in projects due to incomplete, misplaced or missing information.

Every construction project needs specifications to describe the specific requirements and the quality of materials and methods of construction to be used on a project. Specifications are categorized as Division 00 through Division 49 in accordance with the MasterFormat (see Figure 7.1). This is a technique for organizing written construction documents. It is a document which is prepared by the Construction Specifications Institute (CSI) and clearly establishes a distinction between requirements and specifications. The 2004 version changed the numbering system from five digits to a six digit format. Additional updates were made in 2014, you should become familiar with the entire MasterFormat list found at [www.csinet.org](http://www.csinet.org). or [www.masterformat.com](http://www.masterformat.com).