

Module Overview

This module introduces the mathematical operations commonly used in construction, and explains how geometry is used in the trade. Trainees will learn how to add, subtract, multiply, and divide whole numbers, fractions, and decimals, as well as how to convert decimals, fractions, and percentages.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Ironworking Level One*.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Perform calculations using fractions.
2. Perform calculations using decimals and percentages.
3. Convert between fractions of a foot and decimals of a foot.
4. Calculate the areas of selected items.
5. Solve problems for right triangles.
6. Calculate the volumes of selected items.
7. Calculate the weights of selected items.
8. Solve problems for unknown quantities.

Performance Tasks

This is a knowledge-based module. There are no performance tasks.

Materials and Equipment

Multimedia projector and screen	Calculator
<i>Ironworking Level Two</i>	Standard ruler (with 1/16-inch markings)
PowerPoint® Presentation Slides (ISBN 978-0-13-266254-3)	Folding ruler
Computer	Tape measure
Whiteboard/chalkboard	Clay
Markers/chalk	Several empty vessels of various shapes
Pencils and scratch paper	Sand or water to fill vessels
Copies of your local code	Measuring cup
Sample work orders that require mathematical functions	Quick Quizzes*
	Module Examinations**

* Located at the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Applied Construction Math: A Novel Approach, 2006. National Center for Construction Education and Research. Upper Saddle River, NJ: Prentice Hall.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Trade Math*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Sessions I through III. Introduction; Math Review	
A. Introduction	_____
B. Math Review	_____
1. Working with Whole Numbers	_____
2. Adding and Subtracting Whole Numbers; Practice Exercises	_____
3. Multiplying and Dividing Whole Numbers; Practice Exercises	_____
4. Working with Common Fractions	_____
5. Reducing Common Fractions; Practice Exercises	_____
6. Finding Common Denominators; Practice Exercises	_____
7. Adding and Subtracting Common Fractions; Practice Exercises	_____
8. Multiplying and Dividing Common Fractions; Practice Exercises	_____
9. Working with Decimal Fractions; Practice Exercises	_____
10. Converting Decimal Fractions to Common Fractions; Practice Exercises	_____
11. Converting Common Fractions to Decimal Fractions; Practice Exercises	_____
12. Adding and Subtracting Decimal Fractions; Practice Exercises	_____
13. Multiplying and Dividing Decimal Fractions; Practice Exercises	_____
14. Percentages; Practice Exercises	_____
15. Tolerances; Practice Exercises	_____
16. Squares and Square Roots	_____
Sessions IV and V. Linear Measure; Equations; Formulas	
A. Linear Measure; Practice Exercises	_____
B. Equations	_____
C. Formulas	_____
1. Surface Area	_____
2. Rectangles and Squares; Practice Exercises	_____
3. Triangles; Practice Exercises	_____
4. Circles; Practice Exercises	_____
5. Volume	_____
6. Cubes and Rectangular Objects	_____
7. Cylinders; Practice Exercises	_____
Sessions VI and VII. Right Triangles; Weight; Solving for Unknowns	
A. Right Triangles	_____
1. 3-4-5 Rule Practice Exercises	_____
B. Weight	_____
1. Weight of Steel Bar	_____
2. Weight of Steel Plate	_____
3. Weight of Steel Tank	_____
C. Solving for Unknowns; Practice Exercises	_____

Sessions VIII and IX. Weight Calculations: Practical Application

A. Weight Calculations

- 1. Steel Plate; Practice Exercises
- 2. Steel Tanks; Practice Exercises
- 3. Shapes; Practice Exercises
- 4. Circular Plate; Practice Exercises
- 5. Cylinders; Practice Exercises

B. Structural Steel Member Weight Calculations; Practice Exercises

Session X. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module teaches the importance of quality workmanship and covers how to find, identify, and avoid weld imperfections while adhering to necessary codes and specifications.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29105-09.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

Performance Tasks

There are no performance tasks for this module.

Materials and Equipment List

Markers/chalk	• Arc strikes
Pencils and scratch paper	• Spatter
Whiteboard/chalkboard	• Unacceptable weld profiles
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)	Undercut gauge
Multimedia projector and screen	Butt weld reinforcement gauge
Desktop or laptop computer	Fillet weld blade gauge set
Pencils and scratch paper	Welding coupon examples
Appropriate personal protective equipment	Samples of ASME, AWS, API, and ANSI welding codes
Welding samples showing:	Photos of damage to equipment and structures caused by failed welds
• Porosity	Examples of Welding Procedure Specifications and Procedure Qualification Records
• Inclusions	Liquid penetrant test kit
• Cracks	Radiograph examples
• Weld metal cracks	Tested specimens of good and failed welds
• Base metal cracks	Module Examinations*
• Incomplete joint penetration	
• Incomplete fusion	
• Undercut	

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with welding and refer to the MSDS for liquid penetrant solvent.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

AWS B1.10: Guide for the Nondestructive Inspection of Welds, 1999. Miami, FL: The American Welding Society.

AWS B1.11: Guide for the Visual Inspection of Welds, 2000. Miami, FL: The American Welding Society.

OSHA Standard 1926.351, Arc Welding and Cutting.

Welding Handbook, Volume 1 (2001) and Volume 2 (2004). Miami, FL: The American Welding Society.

AWS D3.5-93R: Guide for Steel Hull Welding, 1993. Miami, FL: The American Welding Society.

AWS D3.6M: Specification for Underwater Welding, 1999. Miami, FL: The American Welding Society.

AWS D3.7: Guide for Aluminum Hull Welding, 2004. Miami, FL: The American Welding Society.

The Procedure Handbook of Arc Welding, 2000. Cleveland, OH: The Lincoln Electric Company.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Weld Quality*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction; Codes; Weld Discontinuities	
A. Introduction	_____
B. Codes Governing Welding	_____
1. American Society of Mechanical Engineers	_____
2. American Welding Society	_____
3. American Petroleum Institute	_____
4. American National Standards Institute	_____
5. Marine Codes	_____
C. Basic Elements of Welding Codes	_____
1. Welding Procedure Qualification	_____
2. Welder Performance Qualification	_____
3. Welder Operator Qualification	_____
D. Weld Discontinuities and Their Causes	_____
1. Porosity	_____
2. Inclusions	_____
3. Cracks	_____
4. Incomplete Joint Penetration	_____
5. Incomplete Fusion	_____
6. Undercut	_____
7. Arc Strikes	_____
8. Spatter	_____
9. Acceptable and Unacceptable Weld Profiles	_____

Session II. Nondestructive Examination (NDE) Practices

- A. Visual Inspection
- B. Liquid Penetrant Inspection
- C. Magnetic Particle Inspection
- D. Radiographic Inspection
- E. Ultrasonic Inspection
- F. Electromagnetic (Eddy Current) Inspection
- G. Leak Testing

Session III. Destructive Testing; Welder Performance Qualification Tests

- A. Destructive Testing
- B. Welder Performance Qualification Tests
 - 1. Welding Positions Qualification
 - 2. AWS Structural Steel Code
 - 3. ASME Code
 - 4. Welder Qualification Tests

Session IV. Quality Workmanship; Review and Testing

- A. Quality Workmanship
 - 1. Typical Site Organization
 - 2. Chain of Command
- B. Module Review
- C. Module Examination
 - 1. Trainees must score 70% or higher to receive recognition from the NCCER.
 - 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces weld joints and positions used in metal structures. It explains how to prepare welding equipment and make V-groove joints and welds.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Ironworking Level One; and Ironworking Level Two, Module 30201-11.*

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify and explain weld joints and positions.
2. Prepare arc welding equipment.
3. Identify and explain V-groove joints and welds.
4. Perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:
 - Flat (1G)
 - Horizontal (2G)
 - Vertical (3G)
 - Overhead (4G)

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Prepare arc welding equipment.
2. Perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:
 - Flat (1G)
 - Horizontal (2G)
 - Vertical (3G)
 - Overhead (4G)

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-266254-3)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Examples of fillet and groove welds
SMAW machine
Welding bench with arm for position work
Welding shop tools and safety equipment
Several angle finders

Sufficient coupons for ten trainee sessions
Two pieces of $\frac{3}{8}$ " \times 3" \times 7" and one piece of
 $\frac{1}{4}$ " \times 1" \times 8" carbon steel for each trainee per
session
Sufficient $\frac{3}{32}$ ", $\frac{1}{8}$ ", or $\frac{5}{32}$ " E7018 electrodes
Examples of acceptable and unacceptable
groove weld profiles
Example of surface welding on an inclined
vertical surface
Examples of open-root groove angles on plate
and pipe
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with and around welding equipment. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Welding Handbook, Volume 5, 2001. Miami, FL: The American Welding Society.

Lincoln Electric website: www.lincolnelectric.com offers sources for products and training.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Position Arc Welding*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction; Welding Positions; Preparing Equipment	
A. Introduction	_____
B. Weld Positions and Joints	_____
1. Weld Positions	_____
2. Types of Joints	_____
3. Types of Welds	_____
4. Welding Position	_____
5. Codes and Welding Procedure Specifications	_____
6. Welding Joint Preparation	_____
C. Welding Equipment Setup	_____
1. Preparing the Welding Area	_____
2. Preparing the Weld Coupons for V-Groove Welds with Backing	_____
a. Laboratory	_____
Have trainees practice preparing a weld coupon and tack-welding it.	
3. Electrodes	_____
4. Preparing the Welding Machine	_____
D. PT/Laboratory	_____
Have trainees prepare arc welding equipment. This laboratory corresponds to Performance Task 1.	

**Sessions III through VII. V-Groove Welds; SMAW of V-Groove Welds with Backing;
Open-Root V-Groove Welds; SMAW of Open-Root
V-Groove Welds**

- A. V-Groove Welds with Backing
- B. SMAW of V-Groove Welds with Backing
 - 1. Practicing Flat V-Groove Welds with Backing (1G Position)
 - a. Laboratory
Have trainees practice making flat V-groove welds with backing (1G Position)
 - 2. Horizontal Welds (2G Position)
 - a. Laboratory
Have trainees practice running beads and making horizontal V-groove welds with backing (2G Position)
 - 3. Vertical Welds (3G Position)
 - a. Laboratory
Have trainees practice running beads and making vertical welds with backing (3G Position)
 - 4. Overhead Welds (4G Position)
 - a. Laboratory
Have trainees practice running overhead beads and making overhead V-Groove welds with backing (4G Position)
- C. Open-Root V-Groove Welds
 - 1. Prepare the Welding Coupons for Open-Root V-Groove Welds
 - 2. Electrodes
 - 3. Root Pass
 - 4. Acceptable and Unacceptable Groove Weld Profiles
- D. SMAW of Open-Root V-Groove Welds
 - 1. Practicing Flat Open-Root V-Groove Welds (1G Position)
 - a. Laboratory
Have trainees practice making Flat open-root V-groove welds (1G Position)
 - 2. Horizontal Welds (2G Position)
 - a. Laboratory
Have trainees practice making horizontal open-root V-groove welds (2G Position)
 - 3. Vertical Welds (3G Position)
 - a. Laboratory
Have trainees practice running vertical beads and making vertical open-root V-groove welds (3G Position)
 - 4. Overhead Welds (4G Position)
 - a. Laboratory
Have trainees practice running overhead beads and making overhead open-root V-groove welds (4G Position)

E. PT/Laboratory

Have trainees perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:

- Flat (1G)
- Horizontal (2G)
- Vertical (3G)
- Overhead (4G)

This laboratory corresponds to Performance Task 2.

Session VIII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the types and configurations of forklifts, their operation, and how to inspect and maintain them.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Ironworking Level One*; and *Ironworking Level Two*, Modules 30201-11, 29106-09, and 30202-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the uses of a forklift.
2. Identify the components and controls on a typical forklift.
3. Describe the attachments used on forklifts.
4. Explain safety rules and qualifications for operating a forklift.
5. Explain how to perform prestart inspection and maintenance procedures.
6. Explain how to operate and use a forklift:
 - Start, warm up, and shut down a forklift
 - Perform basic maneuvers with a forklift
 - Interpret forklift load charts
 - Perform basic lifting operations with a forklift
7. Interpret and demonstrate the proper hand and verbal signals for forklift operations.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Perform prestart inspection and maintenance procedures.
2. Start, warm up, and shut down a forklift.
3. Perform basic maneuvers with a forklift.
4. Interpret forklift load charts.
5. Perform basic lifting operations with a forklift.
6. Perform the proper hand and verbal signals for forklift operations.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-266254-3)

Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment

Access to multiple forklifts and telehandlers
Access to multiple attachments for forklift forks
Operator manuals and load charts for any available forklifts and telehandlers
Operator's manual with a service hours schedule
Suitable area for forklift practice and work
Miscellaneous loads for forklift practice
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on or operating forklifts. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Forklift Safety: A Practical Guide to Preventing Powered Industrial Truck Incidents and Injuries, 2nd Edition, 1999. George Swartz. Lanham, MD: Government Institutes.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ hours are suggested to cover *Forklifts*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction; Identification of Equipment Components and Controls; Safety Guidelines; Basic Preventive Maintenance; Basic Operation	
A. Introduction	_____
1. Types of Forklifts	_____
2. Forklift Uses	_____
B. Identification of Equipment Components and Controls	_____
1. Operator's Cab	_____
2. Instruments	_____
3. Controls	_____
4. Operator Comfort and Other Controls	_____
5. Forklift Attachments	_____
C. Safety Guidelines	_____
1. Operator Training and Certification	_____
2. Operator Safety	_____
3. Safety of Co-Workers and the Public	_____
4. Equipment Safety	_____
5. Spill Containment and Cleanup	_____
6. Hand Signals Used with Forklifts	_____
D. Basic Preventive Maintenance	_____
1. Daily Inspection Checks	_____
2. Servicing a Forklift	_____
3. Preventive Maintenance Records	_____
E. Basic Operation	_____
1. Load Charts	_____
2. Suggestions for Effective Forklift Operation	_____
3. Preparing to Work	_____
4. Basic Maneuvering	_____

Sessions III through VI. Work Activities

A. Work Activities

- 1. Basic Operation Movement
- 2. Using Special Attachments
- 3. Transporting the Forklift

B. PT/Laboratories

- 1. Have trainees perform prestart inspection and maintenance procedures. This laboratory corresponds to Performance Task 1.
- 2. Have trainees start, warm up, and shut down a forklift. This laboratory corresponds to Performance Task 2.
- 3. Have trainees perform basic maneuvers with a forklift. This laboratory corresponds to Performance Task 3.
- 4. Have trainees interpret forklift load charts. This laboratory corresponds to Performance Task 4.
- 5. Have trainees perform basic lifting operations with a forklift. This laboratory corresponds to Performance Task 5.
- 6. Have trainees perform the proper hand and verbal signals for forklift operations. This laboratory corresponds to Performance Task 6.

Session VII. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the typical information found on computer-aided design (CAD) drawings.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Ironworking Level One*; and *Ironworking Level Two*, Modules 30201-11, 29106-09, 30202-11, and 30203-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Name the types of structural plans, and identify the information included on each.
2. Describe the purpose and relationship of the different types of drawings.
3. Read and interpret the symbols and abbreviations on erection plans and drawings.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Name the types of structural plans, and identify the information included on each.
2. Given a set of drawings, locate information as specified by the instructor.
3. Read and interpret the symbols and abbreviations on erection plans and drawings.

Materials and Equipment

Multimedia projector and screen

Ironworking Level Two

PowerPoint® Presentation Slides

(ISBN 978-0-13-266254-3)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Miscellaneous pictures of numbered pieces and a related erection drawing

Miscellaneous examples of drawings and plans, including:

Architectural drawings

Structural drawings/plans

Elevation drawings

Framing plans

Foundation plans (shallow, intermediate, and deep)

Erection drawings

Shop drawings

Fabrication drawings

Ornamental erection drawings

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working around construction sites and structural iron. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Architectural Graphic Standards, The American Institute of Architects. New York, NY: John Wiley & Sons, Inc.

Reading Architectural Plans for Residential and Commercial Construction, 1998. Ernest R. Weidhaas. Upper Saddle River, NJ: Prentice Hall.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Trade Drawings Two*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Plans and Drawings, Part One	
A. Introduction	_____
B. Plans and Drawings	_____
1. Foundation Plans	_____
2. Framing Plans	_____
3. Plan and Drawing Creation	_____
4. Erection Drawings	_____
5. Detail Drawings	_____
6. Shop Drawings	_____
Sessions II and III. Plans and Drawings , Part Two; Reinforcing Drawings; General Notes	
A. Plans and Drawings	_____
1. Other Uses for Erection Drawings	_____
2. Elevation Drawings	_____
3. Sections and Details	_____
4. Ornamental Erection Drawings	_____
5. Shop Fabrication Drawings	_____
B. Reinforcing Drawings	
1. Typical Placing Drawings	_____
2. Reinforcing Details	_____
C. General Notes	_____
D. PT/Laboratory	_____
1. Have trainees name the types of structural plans, and identify the information included on each. This laboratory corresponds to Performance Task 1.	
2. Given a set of drawings, have trainees locate information as specified by the instructor. This laboratory corresponds to Performance Task 2.	
3. Have trainees read and interpret the symbols and abbreviations on erection plans and drawings. This laboratory corresponds to Performance Task 3.	

Session IV. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module provides an overview of personnel lifting and lift planning, and introduces crane load charts and load balancing. It explains how the center of gravity is calculated and affects the lift. It also covers sling selection, and explains the uses of jacks, tuggers, hoists, skids, and rollers.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Basic Rigger*.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the basic requirements to lift personnel.
2. Explain how a sling stress is determined.
3. Describe the basic elements of a lift plan.
4. Explain the purpose of a load chart.
5. Calculate and explain how the center of gravity is determined.
6. Given a particular load, select the appropriate sling(s) for a lift.
7. Describe how jacks, hoists, skids, and rollers are used to move load laterally.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Calculate the center of gravity of a load.
2. Given a particular load, select the appropriate sling(s) for a lift.

Materials and Equipment

Multimedia projector and screen
Basic Rigger / Intermediate Rigger / Advanced Rigger
PowerPoint® Presentation Slides
(ISBN 978-0-13-257363-4)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

OSHA regulations on lifting personnel

OSHA guidance on personnel platforms:

Crane or Derrick Suspended Personnel Platforms

Various types of slings and hitches

Sample lift plan

Manufacturer's literature for different types of cranes

Sample load charts

ASME B30.5

ANSI/SAE J987

Teeter-totter and weights

Several jacks

Grip hoist

Tuggers

Rollers

Skids

Copies of the Quick Quiz*

Module Examinations**

Performance Profile Sheets**

* Located in the back of this module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with hand tools and slings. Ensure that trainees are briefed on shop safety policies and hand tool safety.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Bob's Rigging and Crane Handbook, Latest Edition. Leawood KS: Pellow Engineering Services.

Crane Safety on Construction Sites, 1998. Task Committee on Crane Safety on Construction Sites. Reston, VA: ASCE.

Occupational Safety and Health Standards for the Construction Industry, 29 CFR Part 1926. Washington, DC: OSHA Department of Labor, U.S. Government Printing Office.

Rigging Handbook, 2003. Jerry A. Klinke. Stevensville, MI: ACRA Enterprises, Inc.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Intermediate Rigging*. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Personnel Lifting; Slings	
A. Introduction	_____
B. Personnel Lifting	_____
1. Platform Requirements	_____
C. Slings	_____
1. Sling Tensions	_____
2. Bridle Hitches	_____
3. Basket Hitches	_____
4. Choker Hitches	_____
D. Laboratory	_____
Have trainees practice selecting the appropriate sling(s) for a lift. This laboratory corresponds to Performance Task 2.	
Session II. Lift Planning; Types of Cranes; Crane Load Charts	
A. Lift Planning	_____
1. Lift Plan Data	_____
B. Types of Cranes	_____
1. Industrial Hydraulic Cranes	_____
2. Rough-Terrain Cranes	_____
3. All-Terrain Cranes	_____
4. Truck-Mounted Telescopic Crane	_____
5. Lattice Boom Cranes	_____
6. Crane Component Terminology	_____
C. Crane Load Charts	_____
1. Importance of Load/Capacity Charts for Lift Planning	_____
2. Operating Conditions	_____

Session III. Load Balancing; Special Equipment Used for Lateral Movement of Loads

A. Load Balancing

- 1. Center of Gravity
- 2. Center of Gravity and Leverage

B. Laboratory

Have trainees practice calculating the center of gravity of a load. This laboratory corresponds to Performance Task 1.

C. Special Equipment Used for Lateral Movement of Loads

- 1. Jacking
- 2. Grip Hoists
- 3. Skids
- 4. Rollers

Session IV. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70 percent or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the codes and procedures involved in erecting structural steel.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Ironworking Level One*; and *Ironworking Level Two*, Module 30201-11, Module 29106-09, Modules 30202-11 through 30204-11, and Module 38201-10.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Explain and demonstrate pre-erection activities for structural steel.
2. Explain and demonstrate erecting bearing devices.
3. Explain and demonstrate erecting columns.
4. Explain and demonstrate erecting horizontal members.
5. Explain and demonstrate erecting bracing and bridging.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Demonstrate pre-erection activities for structural steel.
2. Demonstrate erecting bearing devices.
3. Demonstrate erecting columns.
4. Demonstrate erecting horizontal members.
5. Demonstrate erecting bracing and bridging.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two PowerPoint® Presentation
Slides (ISBN 978-0-13-266254-3)

Computer

Whiteboard / chalkboard

Markers / chalk

Pencils and scratch paper

Appropriate personal protective equipment

Sample project drawings, including general information drawing

Current copies of the following manuals:

AISC Manual of Steel Construction

AISC Code of Standard Practice for Steel Buildings and Bridges

AISC Manual of Steel Construction – Allowable Stress Design

Standard Specifications for Highway Bridges of American Association of State Highway and Transportation Officials (AASHTO)

Specifications for Steel Railway Bridges of the American Railway Engineering and Maintenance of Way Association (AREMA)
Structural Welding Code of American Welding Society (AWS)

Job site or training area where structural members and erection equipment is set up with appropriate drawings for the site

Job site or training area prepared for erecting structural steel members

Examples of pick lists

A supply of structural steel components (bearing devices, columns, beams, girders, joists, shear connections, bracing and bridging material, and fasteners)

Tools needed to erect and secure structural steel components

Examples of good and bad anchor bolts

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with structural iron. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

AISC Code of Standard Practices for Steel Buildings and Bridges, Latest edition. Chicago, IL: American Institute of Steel Construction, Inc.

AISC Manual of Steel Construction Allowable Stress Design, Latest edition. Chicago, IL: American Institute of Steel Construction, Inc.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Structural Ironworking Two*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I– III. Introduction; Pre-Erection Activities	
A. Introduction	_____
B. Pre-Erection Activities for Structural Steel	_____
1. Reviewing Drawings, Codes, and Safety Issues	_____
2. Verifying Site Readiness	_____
3. Planning Jobs	_____
4. Unloading, Inspecting, and Preparing Structural Materials	_____
5. Inspecting and Preparing Foundations	_____
6. Inspecting and Preparing Bearing Devices	_____
7. Inspecting Grouting	_____
8. Reviewing Field Connection Materials	_____
9. Reviewing Temporary Supports for Structural Steel Frames	_____
10. Building Trusses and Bents	_____
11. Reviewing Bracing and Bridging Requirements	_____
12. Reviewing Tolerances	_____
C. Laboratory	_____
Have trainees demonstrate pre-erection activities for structural steel. This laboratory corresponds to Performance Task 1.	

**Sessions IV–XI. Erecting (Setting) Bearing Devices; Erecting Columns;
Erecting Horizontal Members; Erecting Bracing and Bridging**

- A. Erecting (Setting) Bearing Devices
 - 1. Preparing Bearing Devices for Erection _____
 - 2. Positioning and Securing Bearing Devices _____
- B. Erecting Columns
 - 1. Preparing Erection of Columns _____
 - 2. Rigging Columns for Erection _____
 - 3. Positioning and Securing Columns _____
- C. Erecting Horizontal Members
 - 1. Relationships of Beams, Girders, and Joists _____
 - 2. Bearing and Shear Connections _____
 - 3. Preparing Erection of Horizontal Members _____
 - 4. Rigging Horizontal Members for Erection _____
 - 5. Positioning and Securing Horizontal Members _____
- D. Erecting Bracing and Bridging
 - 1. Preparing Erection of Bracing and Bridging _____
 - 2. Rigging Bracing and Bridging Components for Erection _____
 - 3. Positioning and Securing Bracing and Bridging Components _____
- E. Performance Tasks/Laboratory
 - 1. Have trainees demonstrate erecting bearing devices. This laboratory corresponds to Performance Task 2. _____
 - 2. Have trainees demonstrate erecting columns. This laboratory corresponds to Performance Task 3. _____
 - 3. Have trainees demonstrate erecting horizontal members. This laboratory corresponds to Performance Task 4. _____
 - 4. Have trainees demonstrate erecting bracing and bridging. This laboratory corresponds to Performance Task 5. _____

Session XII. Review and Testing

- A. Review _____
- B. Module Examination
 - 1. Trainees must score 70% or higher to receive recognition from NCCER. _____
 - 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor. _____
- C. Performance Testing
 - 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements. _____
 - 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor. _____

Module Overview

This module introduces some of the information and techniques involved in erecting steel joists and joist girders.

Prerequisites

Before you begin this module, it is recommended that you successfully complete *Core Curriculum; Ironworking Level One*; and *Ironworking Level Two*, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38201-11, and 30205-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Locate and describe the information on a framing plan used by ironworkers.
2. Describe steel joist installation procedures.
3. Describe the necessary conditions and benefits of panelizing bar joists.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Interpret framing plans to determine the placement of joists and bridging.
2. Assemble, rig, and place available joists and joist girders in accordance with drawings and SJI specifications.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two PowerPoint® Presentation
Slides (ISBN 978-0-13-266254-3)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Current editions of the following manuals:

AISC Manual of Steel Construction

AISC Code of Standard Practice for Steel Buildings and Bridges

AISC Manual of Steel Construction – Allowable Stress Design

SJI Technical Digest No. 9 of the Steel Joist Institute (SJI)

Job site or training area where structural members and erection equipment are set up with appropriate drawings for the site

Job site or training area prepared for erecting structural steel members

Examples of pick lists

A supply of joists, joist girders, bridging material, and fasteners

Tools needed to erect and secure joists and joist girders

Sample project drawings, including general information drawing

Safety Quiz*

Module Examinations**

Performance Profile Sheets**

* Located at the back of the module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with joists and girders. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

The Steel Joist Institute website: www.steeljoist.org.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Steel Joists and Joist Girders*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Framing Plan; Receiving, Unloading, and Storage	
A. Introduction	_____
B. Framing Plan	_____
C. Receiving, Unloading, and Storage	_____
Session II. Laboratory	
A. Laboratory	_____
Have trainees demonstrate their understanding of the layouts from the framing plan provided by the instructor for steel joists and joist girders. This laboratory corresponds to Performance Task 1.	
Session III. Erecting Joist Girders; Erecting and Installing Joists	
A. Erecting Joist Girders	_____
1. Lifting and Sorting Joist Girders	_____
2. Installing Joist Girders	_____
3. Bridging Guidelines	_____
B. Erecting and Installing Joists	_____
1. Installing Simple Joists	_____
2. Installing Panelized Joists	_____
Session IV. Laboratory	
A. Laboratory	_____
Have trainees demonstrate assembling, rigging, and installing joists and/or girders. This laboratory corresponds to Performance Task 2.	
Session V. Panels with Decking; Trusses; Safety	
A. Panels with Decking	_____
B. Trusses	_____
C. Safety	_____

Session VI. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module provides information on types of tower cranes and their components. It describes safe rigging and lifting procedures and explains the use of load charts. The use of standard hand signals is also discussed.

Prerequisites

Before you begin this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Ironworking Level One; and Ironworking Level Two*, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38206-10, 30205-11, and 30206-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the different types of tower cranes and their accessories and how each is used.
2. Define the effects of leverage as it applies to tower cranes.
3. Define the factors affecting tower crane lifting capacities.
4. Describe the four base support systems for tower cranes.
5. Describe basic tower crane safety and rigging precautions.
6. Explain site and environmental hazards associated with tower cranes.
7. Describe the various methods of communication used with tower cranes.
8. Demonstrate communication procedures using a handheld radio.
9. Demonstrate the standard tower crane hand signals as specified in *ASME B30.3*.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Demonstrate communication procedures using a handheld radio.
2. Demonstrate the standard tower crane hand signals as specified in *ASME B30.3*.

Materials and Equipment

Multimedia projector and screen	A supply of balancing devices, including:
<i>Ironworking Level Two</i> PowerPoint® Presentation	1" × 8" × 10' board
Slides (ISBN 978-0-13-266254-3)	A concrete block
Computer	Two bricks
Whiteboard/chalkboard	A sawhorse
Markers/chalk	A supply of spools and thread for reeving practice
Pencils and scratch paper	Sufficient supply of handheld radios
Appropriate personal protective equipment	Module Examinations*
Load rating chart	Performance Profile Sheets*
Examples of tower crane load charts	

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with tower crane operation. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

ASME Standard B30.3-2009, Construction Tower Cranes, 2009. New York, NY: American Society of Mechanical Engineers.

Crane Safety: A Guide to OSHA Compliance and Injury Prevention, 1999. Carl O. Morgan. Rockville, MD: ABS Group, Inc.

Occupational Safety and Health Standards for the Construction Industry, 29 CFR, Part 1926, Latest Edition. Washington, DC: OSHA Department of Labor, U.S. Government Printing Office.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22½ hours are suggested to cover *Tower Cranes*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction; Crane Types and Uses; Tower Crane Terminology; Tower Crane Components	
A. Introduction	_____
B. Crane Types and Uses	_____
1. Hammerhead Tower Cranes	_____
2. Luffing Boom Tower Cranes	_____
3. Attachments	_____
C. Tower Crane Terminology	_____
1. Component Terminology	_____
2. Operations Terminology	_____
3. Leverage and Balance	_____
D. Tower Crane Components	_____
1. Counterweights	_____
2. Pendants and Guys	_____
3. Travel Equipment	_____
4. Load Hoisting and Boom Luffing Equipment	_____
5. Load Trolleys	_____
6. Base Support Systems	_____
E. Laboratory	
1. Have trainees practice using various leverage and balance devices.	_____
2. Have trainees practice calculating rotational forces.	_____
3. Have trainees practice reeving different hoisting rope configurations.	_____
4. Have trainees observe different tower crane base support systems firsthand.	_____

Session III. Factors Affecting Lifting Capacity

A. Factors Affecting Lifting Capacity

- 1. Load Ratings
- 2. Tower Height
- 3. Operating Radius
- 4. Wind Velocity
- 5. Dynamic and Shock Loading
- 6. Side Loading
- 7. Critical Lifts

Session IV. General Tower Safety

A. General Tower Safety

- 1. Lifting Operations
- 2. Equipment and Supervision
- 3. Basic Rigging Precautions
- 4. ASME Hand Signals
- 5. Swing Path, Load Control, and Tag Lines
- 6. Load-Handling Safety
- 7. Hazardous Weather
- 8. Using Cranes to Lift Personnel

Sessions V through VIII. Methods and Modes of Communication

A. Methods and Modes of Communication

- 1. Verbal Modes of Communication
- 2. Laboratory

Have trainees demonstrate verbal communication procedures using a handheld radio. This laboratory corresponds to Performance Task 1.

- 3. Nonverbal Modes of Communication
- 4. Laboratory

Have trainees demonstrate the standard tower crane hand signals as specified in *ASME B30.3*. This laboratory corresponds to Performance Task 2.

Session IX. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the use and care of the tools used to perform surveys and site layout activities.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Ironworker Level One; and Ironworker Level Two*, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38201-11, and 30205-11 through 30207-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify, safely use, and properly maintain the tools and equipment commonly used for site layout tasks.
2. Describe the purpose and use of survey equipment, including:
 - Builder's level
 - Transit
 - Theodolite
 - Total station

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Set up a builder's level.
2. Set up a theodolite.
3. Shoot elevations with a builder's level.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two PowerPoint® Presentation
Slides (ISBN 978-0-13-266254-3)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Several types of builder's levels

Tripod

Standard rods

Telescoping rods

Transit

Transit assemblies and parts:

Alidade

Horizontal circle

Leveling head

Automatic level

Optical transit level

Transit or theodolite with optical plummet

Optical theodolite and tripod

Electronic transit

Electronic theodolite

Electronic distance measurement instrument

Total station

Global positioning satellite survey device

Fixed beam laser plumb bob

Rotating beam laser instrument

Auto-leveling laser instrument

Electronic laser beam detector

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with or near survey equipment and laser beams. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Construction Surveying and Layout: A Step-by-Step Engineering Methods Manual, 2002. Wesley G. Crawford. West Lafayette, IN: Creative Construction Publishing.

Principles and Practices of Commercial Construction, 2008. Cameron K. Andres and Ronald C. Smith. Upper Saddle River, NJ: Prentice Hall.

Surveying Principles and Applications, 2008. Barry F. Kavanagh. Upper Saddle River, NJ: Prentice Hall.

Surveying With Construction Applications, 2009. Barry F. Kavanagh. Upper Saddle River, NJ: Prentice Hall.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Survey Equipment Use and Care One*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Site Layout Instruments and Equipment; Laser Instruments	
A. Introduction	_____
B. Site Layout Instruments and Equipment	_____
1. Builder's Level	_____
2. Automatic Leveling Instruments	_____
3. Transits	_____
4. Optical Theodolites	_____
5. Electronic Transits and Theodolites	_____
6. Electronic Distance Measurement Instruments	_____
7. Total Station	_____
8. Global Positioning Satellite Survey Devices	_____
9. Electronic Data Collection	_____
10. Care and Handling of Instruments	_____
C. Laser Instruments	_____
1. Construction Laser Instruments	_____
2. Electronic Beam Detectors	_____
3. Use and Selection of Construction Lasers	_____
4. Laser Instrument Safety	_____
5. Calibration and Care of Laser Instruments	_____

Sessions II and III. Reading Transit/Theodolite Scales; Initial Setup, Adjustment, and Checkout of a Transit/Theodolite

A. Reading Transit/Theodolite Scales _____

1. Reading Optical Scales and Digital Displays _____

B. Initial Setup, Adjustment, and Checkout of a Transit/Theodolite _____

1. Setting Up Over a Point Using an Instrument with an Optical Plummet _____

2. Survey Instrument Field Checks _____

C. Laboratory _____

1. Have trainees set up a builder's level. This laboratory corresponds to Performance Task 1. _____

2. Have trainees set up a theodolite. This laboratory corresponds to Performance Task 2. _____

3. Have trainees shoot elevations with a builder's level. This laboratory corresponds to Performance Task 3. _____

Session IV. Review and Testing

A. Review _____

B. Module Examination _____

1. Trainees must score 70% or higher to receive recognition from NCCER.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing _____

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.