

## **MODULE OVERVIEW**

This module provides an overview of the site layout trade and related tasks. The use of the builder's level and leveling rods are covered, as well as the equipment and procedures for making distance measurements by taping (chaining). Also covered are the elements of professional conduct, safety, and communications. The aspects of an apprenticeship program and the career path and professional opportunities related to the site layout trade are also briefly described.

## **PREREQUISITES**

Please refer to the Course Map in the Trainee Guide. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum

## **OBJECTIVES**

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

1. State the purpose of site layout and describe the role of a site layout technician in the construction industry.
2. Describe the different kinds of surveys related to the construction project.
3. Explain the relationship between Earth's latitude and longitude and how these lines are used.
4. Define the various survey control points used in the process of site layout.
5. Explain the meaning of terminology used in site layout.
6. Identify the career opportunities available to people in the site layout field.
7. State the rules for the professional and ethical conduct of a site layout person.
8. Set up a builder's level, shoot an elevation, and properly record the data.
9. Take an inverted rod reading.
10. Chain a distance on even terrain and correctly record the data.
11. Use a plumb bob correctly.
12. Set up a tripod correctly.

## **PERFORMANCE TASKS**

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

1. Set up a builder's level, shoot an elevation, and properly record the data.
2. Chain a distance on uneven terrain and correctly record the data.
3. Demonstrate the proper use of a plumb bob.
4. Set up a tripod correctly.
5. Take an inverted rod reading.

## **MATERIALS AND EQUIPMENT LIST**

Overhead projector and screen  
Transparencies  
Whiteboard/chalkboard  
Markers/chalk  
Blank acetate sheets  
Transparency pens  
Pencils and scratch paper

Copies of various types of surveys  
ANSI and OSHA standards  
GPS  
Steel tape (100')  
Hand Sight Level  
Gammon reel  
Plumb bob and line

## MATERIALS AND EQUIPMENT LIST (Continued)

Builder's level and tripod	Project plans
Leveling rods	Module Examinations*
Direct elevation rod	Performance Profile Sheets*

\*Located in the Test Booklet.

## SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize basic field and site safety.

## 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.

*Construction Surveying and Layout*, Westley G. Crawford. West Lafayette, IN: Creative Construction Publishing, Inc.

*Principles and Practices of Commercial Construction*, Cameron K. Andres and Ronald C. Smith. 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 *Introduction to Site Layout*. 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
<b>Session I. Introduction to Site Layout</b>	
A. Introduction	_____
B. Site Layout Terminology	_____
C. Surveying Overview	_____
D. Latitude and Longitude as Geographic References	_____
E. Site Layout Control Points	_____
<b>Session II. Measurements</b>	
A. Measurements	_____
B. Distance Measurement Tools and Equipment	_____
C. Measuring Distances By Taping	_____
D. Laboratory – Trainees practice chaining a distance on uneven terrain and correctly recording the data and using a plumb bob correctly. This laboratory corresponds to Performance Tasks 2 and 3.	_____
<b>Session III. Site Layout Instruments and Equipment, Plans, and Safety</b>	
A. Site Layout Instruments and Equipment	_____
1. Builder's Level	_____
2. Tripods	_____
3. Leveling Rods	_____
B. Plans	_____

C. Safety

D. Laboratory – Trainees practice setting up a tripod, taking an inverted rod reading, and correctly setting up a builder’s level, shooting an elevation, and properly recording the data. This laboratory corresponds to Performance Tasks 1, 4, and 5.

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**Session IV. Professionalism, Review, Module Examination, and Performance Testing**

A. Careers in Site Layout

B. Training

C. Site Layout Personnel Creed and Responsibilities

D. Communicating as a Professional

E. Module Examination

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

F. 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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

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**Annotated Instructor's Guide****MODULE OVERVIEW**

This module expands the trainee's knowledge of mathematics needed for site layout. Basic concepts of working with formulas, equations, geometry, and right angle trigonometry are covered. Conversion between the English and metric systems is also discussed.

**PREREQUISITES**

Please refer to the Course Map in the Trainee Guide. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Site Layout Level One, Module 78101-04

**OBJECTIVES**

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

1. Solve basic equations, including those involving squares and square roots.
2. Identify basic geometric shapes and angles.
3. Apply the Pythagorean theorem to solve math problems involving right triangles.
4. Perform decimal and metric conversions for linear measures, areas, and volumes.

**PERFORMANCE TASKS**

There are no performance tasks for this module.

**MATERIALS AND EQUIPMENT LIST**

Overhead projector and screen

Transparencies

Whiteboard/chalkboard

Markers/chalk

Blank acetate sheets

Transparency pens

Pencils and scratch paper

Concrete calculator

Copies of worksheets\*

Module Examinations\*

\*Located in the Test Booklet.

**SAFETY CONSIDERATIONS**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

## 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 *Surveying 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
<b>Sessions I and II. Introduction and Working with Formulas</b>	
A. Introduction	_____
B. Sequence of Operations	_____
C. Squares and Square Roots	_____
D. Using Formulas to Solve Problems	_____
<b>Sessions III and IV. Plane Geometry and Geometric Shapes</b>	
A. Points and Lines	_____
B. Circles	_____
C. Angles	_____
D. Polygons	_____
E. Triangles	_____
<b>Sessions V and VI. Working with Right Triangles</b>	
A. Introduction to Right Triangles	_____
B. Right Triangle Calculations Using the Pythagorean Theorem	_____
C. The 3-4-5 Rule	_____
<b>Sessions VII and VIII. Conversion Processes I</b>	
A. Linear Measurements	_____
B. Converting Between Measurement Systems	_____
1. Converting Decimal Feet to Feet and Inches	_____
2. Converting Feet and Inches to Decimal Feet	_____
C. Converting Area Measurements	_____
<b>Sessions IX and X. Conversion Processes II</b>	
A. Volume	_____
B. Applying Volume Measurements	_____
1. Estimating Concrete Volume	_____
2. Wet Measurements	_____
<b>Session XI. Review</b>	
A. Trainees complete the Review Questions.	_____
B. Go over each Review Question and explain the answers. Show all calculations for each question.	_____
<b>Session XII. Module Examination</b>	
A. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

## **MODULE OVERVIEW**

This module covers the use and care of tools and instruments commonly used to perform site survey work. It introduces the trainee to the instruments and procedures used for making distance measurements electronically and for performing differential leveling and basic horizontal and vertical angular measurements. Guidelines for recording surveying measurement data in field notes are also included.

## **PREREQUISITES**

Please refer to the Course Map in the Trainee Guide. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Site Layout Level One, Modules 78101-04 and 78102-04

## **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 instruments commonly used for site layout tasks.
2. Use a builder's level, transit, or theodolite and differential leveling procedures to determine site and building elevations.
3. Use accepted practices to record site layout data and information in field notes.
4. Check and/or establish 90° angles using the 3-4-5 rule.
5. Turn a 90° angle and double an angle.

## **PERFORMANCE TASKS**

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

1. Set up and establish height of instrument using the following:
  - A laser
  - A theodolite
  - A transit level
2. Show the proper method for turning 90 degrees and doubling an angle.
3. Prepare field notes.
4. Check/establish 90° angles using the 3-4-5 rule.

## **MATERIALS AND EQUIPMENT LIST**

Overhead projector and screen	Electronic transit
Transparencies	Total station
Whiteboard/chalkboard	Electronic field book
Markers/chalk	Laser instruments used in site layout
Blank acetate sheets	Manufacturer's operating instructions for a transit or theodolite
Transparency pens	Instrument level
Pencils and scratch paper	Module Examinations*
Transit	Performance Profile Sheets*
Optical theodolite	

\*Located in the Test Booklet.

## **SAFETY CONSIDERATIONS**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize basic field and site safety.

## **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.

*Construction Surveying and Layout: A Step-by-Step Engineering Methods Manual*, 1995. Wesley G. Crawford. West Lafayette, IN: Creative Construction Publishing.

*Principles and Practices of Commercial Construction*, 2001. Cameron K. Andres and Ronald C. Smith. Upper Saddle River, NJ: Prentice Hall.

*Surveying*, 1999. Jack McCormack. New York, NY: John Wiley & Sons.

*Surveying Practice*, 1998. Jerry A. Nathanson, et al. New York, NY: McGraw-Hill, Inc.

*Surveying Principles and Applications*, 2000. Barry F. Kavanagh and Glen Bird. Upper Saddle River, NJ: Prentice Hall.

*Surveying with Construction Applications*, 1997. 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 30 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.

<b>Topic</b>	<b>Planned Time</b>
<b>Session I. Introduction, Site Layout Instruments and Equipment</b>	
A. Introduction	_____
B. Site Layout Instruments and Equipment	_____
1. Automatic Leveling Instruments	_____
2. Transits	_____
3. Optical Theodolites	_____
4. Electronic Transits and Theodolites	_____
5. Total Station	_____
6. Electronic Field Books	_____
7. 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	_____
<b>Sessions II–IV. Reading Scales and Instrument Setup</b>	
A. Reading Transit/Theodolite Scales and Verniers	_____
1. Understanding Degrees, Minutes, and Seconds	_____
2. Reading Vernier Scales	_____

- 3. Reading Optical Scales and Digital Displays \_\_\_\_\_
- B. Initial Setup, Adjustment, and Checkout of a Transit/Theodolite \_\_\_\_\_
  - 1. Setup \_\_\_\_\_
  - 2. Checking the Calibration \_\_\_\_\_
- C. Laboratory – Trainees practice setting up and establishing the height of instrument with a laser, a theodolite and and a transit level. This laboratory corresponds to Performance Task 1. \_\_\_\_\_

**Sessions V–VIII. Basic Measurements, Differential Leveling, and Field Notes**

- A. Basic Horizontal and Vertical Angle Measurements \_\_\_\_\_
  - 1. Turning 90-Degree Angles \_\_\_\_\_
  - 2. Measuring Horizontal Angles \_\_\_\_\_
  - 3. Measuring Vertical Angles \_\_\_\_\_
  - 4. Common Mistakes Made When Making Angular Measurements \_\_\_\_\_
- B. Basics of Differential Leveling \_\_\_\_\_
  - 1. Terminology \_\_\_\_\_
  - 2. Procedure \_\_\_\_\_
- C. Field Notes \_\_\_\_\_
- D. Laboratory – Trainees show proper method for turning 90 degrees and doubling an angle. This laboratory corresponds to Performance Task 2. \_\_\_\_\_

**Sessions IX–XI. Batter Boards, Layout, and Hand Signals**

- A. Batter Boards \_\_\_\_\_
- B. Laying Out and Checking 90-Degree Angles Using the 3-4-5 Rule \_\_\_\_\_
- C. Communicating with Hand Signals \_\_\_\_\_
- D. Laboratories \_\_\_\_\_
  - 1. Trainees practice making field notes. This laboratory corresponds to Performance Task 3. \_\_\_\_\_
  - 2. Trainees practice checking and establishing 90-degree angles using the 3-4-5 rule. This laboratory corresponds to Performance Task 4. \_\_\_\_\_

**Session XII. Review, Module Examination and Performance Testing**

- A. Review \_\_\_\_\_
- B. Module Examination \_\_\_\_\_
  - 1. Trainees must score 70% or higher to receive recognition from NCCER. \_\_\_\_\_
  - 2. Record the testing results on Craft 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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor. \_\_\_\_\_



**Annotated Instructor's Guide****MODULE OVERVIEW**

This module expands upon the Core curriculum *Introduction to Blueprints* module. Trainees will learn the techniques for reading and using blueprints and specifications, with an emphasis placed on those drawings and types of information that are relevant to the site layout trade.

**PREREQUISITES**

Please refer to the Course Map in the Trainee Guide. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Site Layout Level One, Modules 78101-04 through 78103-04

**OBJECTIVES**

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

1. Describe the types of drawings usually included in a set of plans and list the information found on each type.
2. Identify the different types of lines used on construction drawings.
3. Identify selected architectural symbols commonly used to represent materials on plans.
4. Identify selected electrical, mechanical, and plumbing symbols commonly used on plans.
5. Identify selected abbreviations commonly used on plans.
6. Read and interpret plans, elevations, schedules, sections, and details contained in basic construction drawings.
7. State the purpose of written specifications.
8. Identify and describe the parts of a specification.
9. Demonstrate or describe how to perform a quantity takeoff for materials.
10. Read and interpret orthographic projection and isometric drawings.
11. Perform a quantity takeoff to determine a concrete quantity.
12. Calculate rebar required for an identified segment of a drawing.

**PERFORMANCE TASKS**

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

1. Sort a set of blueprints.
2. Determine the dimensions of a site.
3. Perform a quantity takeoff for concrete, as specified by your instructor.
4. Perform a materials takeoff for rebar.

**MATERIALS AND EQUIPMENT LIST**

Overhead projector and screen

Transparencies

Whiteboard/chalkboard

Markers/chalk

Blank acetate sheets

Transparency pens

Pencils and scratch paper

Sample drawing set

Module Examinations\*

Performance Profile Sheets\*

\*Located in the Test Booklet.



- 5. Abbreviations \_\_\_\_\_
- 6. Architectural Terms Used in Drawings and Specifications \_\_\_\_\_
- 7. Orthographic Projection Drawings \_\_\_\_\_
- 8. Isometric Drawings \_\_\_\_\_
- B. Laboratory – Trainees determine the dimensions of a site. This laboratory corresponds to Performance Task 2. \_\_\_\_\_

**Session V. Other Drawings and Reading a Drawing Set**

- A. Structural Steel and Concrete Construction-Related Drawings \_\_\_\_\_
  - 1. Various Structural Drawings \_\_\_\_\_
  - 2. Interpreting the Shapes and Types of Structural and Reinforcing Steel Shown on Drawings \_\_\_\_\_
- B. Reading a Drawing Set \_\_\_\_\_

**Session VI and VII. Specifications, Building Codes, and Takeoffs**

- A. Specifications \_\_\_\_\_
- B. Building Codes \_\_\_\_\_
- C. Takeoffs \_\_\_\_\_
- D. Laboratory – Trainees practice preparing a quantity takeoff for concrete and a materials takeoff for rebar. This laboratory corresponds to Performance Tasks 3 and 4. \_\_\_\_\_

**Session VIII. Review, Module Examination, and Performance Testing**

- A. Review \_\_\_\_\_
- B. Module Examination \_\_\_\_\_
  - 1. Trainees must score 70% or higher to receive recognition from NCCER. \_\_\_\_\_
  - 2. Record the testing results on Craft 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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor. \_\_\_\_\_

