MODULE OVERVIEW

This module provides additional information relating to plane geometry concepts and calculations. It introduces solid geometry, trigonometry, azimuth conversions, and the use of coordinate and grid systems.

PREREQUISITES

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

OBJECTIVES

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

1. Solve problems relating to areas of geometric planes and solid figures.
2. Solve problems relating to volumes of geometric solid figures.
3. Use the Pythagorean theorem to solve unknown lengths and distances in a right triangle.
4. Use right angle trigonometry to determine unknown values.
5. Convert angular measurements stated in decimal degrees to degrees, minutes, seconds and vice versa.
6. Convert azimuth to bearing and vice versa.
7. Convert polar coordinates to rectangular coordinates and vice versa.
8. Calculate parameters for basic horizontal and vertical curves.
9. Describe the common coordinate and grid systems used by surveyors and topographical mapmakers.

PERFORMANCE TASKS

There are no Performance Tasks for this module.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Scientific calculator

Global positioning system (GPS) receiver (optional)

Universal transverse mercator (UTM) system topographic map (optional)

Copies of the Quick Quizzes*

Module Examinations**

* Located at the back of the module.
**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. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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. Westley 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.

Machinery's Handbook, 2004. Erik Oberg, Franklin D. Jones, Holbrook L. Horton, and Henry H. Ryffel. New York, NY: Industrial Press Inc.

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

Surveying Principles and Applications, 2000. Barry F. Kavanagh and Glenn 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 *Advanced 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**
Sessions I and II. Introduction and Geometric Shapes	
A. Introduction	_____
B. Circles and Arcs	_____
C. Area Measurements	_____
D. Volume Measurements	_____
Sessions III and IV. Advanced Trigonometry	
A. Pythagorean Theorem	_____
B. Trigonometry	_____
C. Slope Distances	_____
D. Using Tables of Trigonometric Functions	_____
Sessions V and VI. Rectangular and Polar Coordinate Systems and Azimuth Conversions	
A. Converting Polar Coordinates to Rectangular Coordinates	_____
B. Converting Rectangular Coordinates to Polar Coordinates	_____
C. Converting Between Decimal Degrees and Degrees, Minutes, Seconds	_____
D. Relationship Between Azimuths and Bearings	_____
E. Forward and Reverse Direction of Lines	_____
Sessions VII–X. Mathematics of Horizontal and Vertical Curves	
A. Horizontal Curves	_____
B. Vertical Curves	_____
Session XI. Surveying Coordinate Grid System	
A. Geographic Coordinate System	_____
B. Universal Transverse Mercator (UTM) Geographic System	_____
C. State Plane Coordinate System	_____
D. Public Land Survey System	_____

Session XII. Review and Module Examination

A. Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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.

Survey Equipment Use and Care Two, EDMIs and Total Stations

Module 78202-04

Annotated Instructor's Guide

MODULE OVERVIEW

This module builds on the information studied earlier in the *Site Layout Level One* module *Survey Equipment Use and Care One*. It provides a brief history of the evolution of distance measurement and total station instruments. The remainder of the module covers basic operation and application of total stations, the procedures for field checking commonly used types of distance and angular measurement instruments, and the leveling procedures used to transfer and determine elevations.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Module 78201-04.

OBJECTIVES

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

1. Explain the evolution of electronic distance measurement instruments and total stations.
2. Describe the principles of operation for electronic distance measurement instruments used for construction layout work.
3. Identify, set up, safely use, and properly maintain a total station.
4. Field check the calibration of commonly used surveying and leveling instruments.
5. Use a transit, theodolite, or total station to determine site and building elevations.

PERFORMANCE TASKS

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

1. Set up a total station:
   - Check for horizontal closure
   - Establish foresight off backsight
   - Establish given angles
2. Set up an EDMI, and record horizontal and vertical distance off a given point.
3. Set up and adjust a laser level.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Electronic distance measurement instrument (EDMI) and accessories
Prism and instruction manual
Reflective targets
Total station, instruction manual, and accessories
Laser level and instruction manual
Module Examinations*
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. Trainees will be working with lasers and should be briefed on hazards and how to work safely with lasers. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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 McCormac. 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. 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 10 hours are suggested to cover *Survey Equipment Use and Care Two, EDMIs and Total Stations*. 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 and Electronic Distance Measurement	
A. Introduction	_____
B. The History of Electronic Distance Measurement	_____
C. Electronic Distance Measurement Instruments	_____
D. Laboratory – Trainees practice setting up an EDMI and recording horizontal and vertical distance off a given point. This laboratory corresponds to Performance Task 2.	_____
Session II. Total Stations	
A. The History of Total Stations	_____
B. Prisms and Reflective Targets	_____
C. Understanding Parts Per Million Distance Measurements	_____
D. Setup and Checkout of a Total Station	
1. Total Station Controls	_____
2. Total Station Initial Setup and Coarse Centering	_____
3. Initializing the Total Station for Measurements	_____
E. Laboratory – Trainees practice setting up a total station, checking for horizontal closure, and establishing foresight off backsight and given angles. This laboratory corresponds to Performance Task 1.	_____

Session III. Instrument Field Checks and Trigonometric Leveling

A. Surveying and Site Layout Instrument Field Checks _____

1. Geometry of Angle Measuring Instruments _____
2. Surveying Instrument Field Checks _____
3. Laser Beam Level Check _____

B. Laboratory – Trainees practice setting up and adjusting a laser level. This laboratory corresponds to Performance Task 3. _____

C. Trigonometric Leveling _____

Session IV. Review, Module Examination, and Performance 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 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.

Control Setup
Annotated Instructor's Guide

Module 78203-04

MODULE OVERVIEW

This module provides information and general procedures for making, checking, and adjusting horizontal angle and distance measurements for a traverse. Similar information is provided for making, checking, and adjusting elevation measurements in a level loop.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Modules 78201-04 and 78202-04.

OBJECTIVES

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

1. Set up, run, record, and close a horizontal traverse.
2. Set up, run, record, and close a level loop.
3. Review plans and establish primary and secondary control points.
4. Establish vertical control for multi-level structures.

PERFORMANCE TASKS

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

1. Set up, record, run, and close a five-station traverse.
2. Run and close a level loop.
3. Review plans, locate control points, and establish secondary control points.
4. Establish ground control for multi-level structures.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Electronic distance measurement instrument (EDMI) and accessories or steel tape

Transit, theodolite, or total station with instruction manual and accessories

Field notebooks

Scientific calculator

Control point markers

Site map

Module Examinations*

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. Trainees will be working with lasers and should be briefed on hazards and how to work safely with lasers. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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 McCormac. 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. 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 *Control Setup*. 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 through IV. Introduction and Traverse Measurements	
A. Introduction	_____
B. Traverse Measurements	_____
1. Open and Closed Traverses	_____
2. Planning a Traverse	_____
3. Measuring Traverse Angles	_____
4. Traverse Calculations	_____
C. Laboratory – Trainees practice setting up, recording, running, and closing a five-station traverse. This laboratory corresponds to Performance Task 1.	_____
Sessions V through VII. Level Loop Measurements	
A. Level Loop Measurements	_____
B. Laboratory – Trainees practice running and closing a level loop. This laboratory corresponds to Performance Task 2.	_____
Sessions VIII through XI. Control Surveys and Planning Control Networks	
A. Control Surveys	_____
1. Primary Horizontal Control Points	_____
2. Secondary Horizontal Control Points	_____
3. Building Layout or Working Horizontal Control Points	_____
4. Primary and Secondary Vertical Control Points	_____
5. Control Point Layout Using the Radial Method	_____
B. Planning Primary and Secondary Control Networks	_____
C. Laboratory – Trainees practice reviewing plans, locating control points, establishing secondary control points, and establishing ground control for multi-level structures. This laboratory corresponds to Performance Tasks 3 and 4.	_____

Session XII. Review, Module Examination, and Performance 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 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.

MODULE OVERVIEW

This module provides background information and describes the procedures used to perform profile leveling and cross-section leveling tasks. This includes how the profiling information recorded in the field is used to develop plan and profile sheets. The content and format of site/plot plans is also reviewed, with an emphasis on how to locate existing underground utilities in order to accurately show them on a site/plot plan.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Modules 78201-04 through 78203-04.

OBJECTIVES

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

1. Gather, record, and plot profile leveling data.
2. Gather, record, and plot cross-section leveling data.
3. Interpret site/plot plans, including identifying rights-of-way, setbacks, boundaries, and building tie-in locations.
4. Locate and sketch existing utilities and conditions on site/plot plans.

PERFORMANCE TASKS

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

1. Gather field data and draw a cross-section.
2. Identify rights-of-way, setbacks, boundaries, and building tie-in locations from plans.
3. Locate and sketch existing utilities.
4. Locate and sketch existing conditions.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Leveling rod, hand level, transit, theodolite, or total station with instruction manual and accessories

Jacob's staff

Electronic distance measurement instrument (EDMI) and accessories or steel tape

Field notebooks

Scientific calculator

Utility markers

Plan and profile sheets

Site map

Site/plot plans

Dig Safely cards

Module Examinations*

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. Trainees will be working with lasers and should be briefed on hazards and how to work safely with lasers. This module will require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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 McCormac. 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. 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 10 hours are suggested to cover *Boundary and Topography Surveys*. 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, Profile Leveling, and Cross-Sectional Leveling	
A. Introduction	_____
B. Profile Leveling	_____
C. Cross-Sectional Leveling	_____
D. Laboratory – Trainees practice gathering field data and drawing a cross-section. This laboratory corresponds to Performance Task 1.	_____
Session II. Grade Information from Plans and Interpreting and Preparing Site/Plot Plans	
A. Grade Information from Plans	_____
1. Plan and Profile Sheets	_____
2. Cross-Sections	_____
B. Interpreting and Preparing Site/Plot Plans	_____
1. Site/Plot Plan Content and Format	_____
2. Site/Plot Plan Symbols	_____
C. Laboratory – Trainees practice identifying ROWs, setbacks, boundaries, and building tie-in locations from plans.This laboratory corresponds to Performance Task 2.	_____

Session III. Locating Utilities and Pipelines

A. Locating Utilities and Pipelines _____

1. Locating Existing Utilities and Pipelines _____
2. Marking As-Built Drawings to Show Underground Utilities and Pipelines _____

B. Laboratory – Trainees practice locating and sketching existing utilities and conditions. This laboratory corresponds to Performance Tasks 3 and 4. _____

Session IV. Review, Module Examination, and Performance 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 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.

Data Collection and Basic Computer Skills
Annotated Instructor's Guide

Module 78205-04

MODULE OVERVIEW

This module provides information on the newer integrated total station data systems and global positioning system (GPS) surveying systems that are rapidly entering the field. It provides an overview of the integrated field and office software used with these systems to collect data and execute design and quality control. It also includes an overview of GPS surveying systems and future improvements to the system. An operation overview of the new types of GPS survey receivers is also included.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Modules 78201-04 through 78204-04.

OBJECTIVES

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

1. Explain typical methods of data collection.
2. Explain the advantages, disadvantages, and capabilities of field software.
3. Describe some of the capabilities of integrated office software.
4. Briefly explain the origin of GPS surveying systems.
5. Describe the operation of GPS surveying systems and receivers.

PERFORMANCE TASKS

There are no Performance Tasks for this module.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
PCMCIA card
Computer with integrated total station software
GPS receiver
Integrated GPS surveying equipment
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. This module will require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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.

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

Surveying Principles and Applications, 2000. Barry F. Kavanagh. 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 10 hours are suggested to cover *Data Collection and Basic Computer Skills*. 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 and II. Introduction and Integrated Total Station Data Systems	
A. Introduction	_____
B. Integrated Total Station Data Systems	_____
1. Data Collection	_____
2. Field Software	_____
3. Integrated Office Software	_____
Session III. GPS Surveying Systems	
A. Overview of GPS Receiver Operation	_____
B. Integrated GPS Surveying Equipment	_____
Session IV. Review and Module Examination	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70 percent 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.	

Concrete Properties and Quality Control
Annotated Instructor's Guide

Module 78206-04

MODULE OVERVIEW

This module introduces the trainee to the types of cement, aggregates, and additives used in concrete. It describes general types of concrete, provides concrete mixing information, and describes various methods used to test concrete. It also provides concrete quantity estimating procedures for various job applications, as well as instructions for testing freshly mixed concrete.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Modules 78201-04 through 78205-04.

OBJECTIVES

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

1. Identify various types of cement and describe their uses.
2. Identify types and sizes of concrete aggregates.
3. Identify types of concrete admixtures and describe their uses.
4. Identify special types of concrete and describe their uses.
5. Identify concrete curing methods and materials.
6. Identify and describe concrete testing methods.
7. Demonstrate sampling methods used for the testing of concrete.
8. Perform volume estimates for concrete quantity requirements.
9. Identify types of concrete reinforcement bars and describe their uses.
10. Identify types of reinforcement bar supports and describe their uses.
11. Identify types of welded-wire fabric reinforcement material and describe their uses.

PERFORMANCE TASKS

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

1. Perform volume estimates for concrete quantity requirements.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
ASTM Standard C150
ASTM Standard C33
Several small samples of cured concrete
ACI concrete mix table
Concrete calculator
Concrete table
ASTM standards for rebar
Sample pieces of rebar
Specification that identifies the type of rebar and supports needed
Samples of tie wire
Various types of mechanical splicing devices (optional)
Samples of welded-wire fabric
ASTM Standard A82
ASTM standards for concrete testing
ASTM Standard C172
ASTM Standard C143
Concrete mix and water (optional)
Slump cone mold and accessories (optional)

ASTM Standard C31
ASTM Standard C39
ASTM Standard C138
ASTM Standard C231
ASTM Standard C173
ASTM Standard C94
Cylindrical molds and tools to fill and level the molds
Performance Profile Sheets*
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. Concrete dust and its components are caustic; brief trainees on the hazards posed by wet concrete and respiratory and skin protection needed. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

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.

Carpentry, 1997. Leonard Koel. Homewood, IL: American Technical Publishers.

Concrete Construction Handbook, 1998. Joseph A. Dobrowolski. New York, NY: McGraw-Hill, Inc.

Formwork for Concrete Structures, 1996. Clois E. Kicklighter. Tinley Park, IL: The Goodheart-Willcox Company, Inc.

Modern Masonry: Brick, Block, Stone, 1996. Clois E. Kicklighter. Tinley Park, IL: The Goodheart-Willcox Company, 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 15 hours are suggested to cover *Concrete Properties and Quality Control*. 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, Concrete, Concrete Materials, and Proportions	
A. Introduction	_____
B. Concrete and Concrete Materials	_____
C. Normal Concrete Mix Proportions and Measurements	_____
D. Special Types of Concrete	_____
Session II. Curing Methods and Estimating Volume	
A. Curing Methods and Materials	_____
B. Estimating Concrete Volume	_____
1. Rectangular Volume Calculations	_____
2. Circular Volume Calculations	_____
C. Laboratory – Trainees practice performing volume estimates for concrete quantity requirements. This laboratory corresponds to Performance Task 1.	_____

Session III. Concrete Reinforcement Materials

A. Reinforcing Bars _____
B. Bar Supports _____
C. Splicing Reinforcing Bar _____
D. Welded-Wire Fabric _____

Session IV. Joints and Handling Concrete

A. Joints in Concrete Structures _____
   1. Construction Joints _____
   2. Isolation Joints _____
   3. Control Joints _____
   4. Decorative Joints _____
B. Moving and Handling Concrete _____
   1. Off-Site Equipment for Mixing and Conveying Concrete _____
   2. On-Site Equipment for Conveying and Placing Concrete _____

Session V. Testing Concrete

A. Sampling of Concrete _____
B. Concrete Slump Testing _____
C. Concrete Strength Testing _____
D. Air Content Testing _____
E. Temperature Testing _____

Session VI. Review, Module Examination, and Performance 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 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.

MODULE OVERVIEW

This module provides the trainee with a basic understanding of soil composition and covers excavation methods and safety considerations. Basic layout techniques for foundations, flatwork, walls, penetrations, and stairs are also addressed.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Site Layout Level One*; and *Site Layout Level Two*, Modules 78201-04 through 78206-04.

OBJECTIVES

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

1. Explain the various types of soils and how they are classified.
2. Interpret a soil survey.
3. Examine and classify soil samples.
4. Describe how various types of soils will behave in excavations.
5. State the safety precautions associated with working in or near trenches.
6. Describe how trenches are reinforced to prevent cave-ins.
7. Explain how footings and piers are laid out and formed.
8. Perform selected layout procedures:
   - Building corners
   - Columns
   - Walls
   - Embedments
   - Stairs

PERFORMANCE TASKS

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

1. Examine and classify soil samples.
2. Interpret a soils report.
3. Lay out a four-corner building with reference elevations.
4. Lay out column line offsets per a plan.
5. Lay out wall lines and offsets per a plan.
6. Perform an embed layout.
7. Given the total rise and run of a set of stairs, calculate the tread and riser dimensions.
8. Lay out a three-step set of stairs on grade with a top landing.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
ASTM D2487
ASTM C1064
Samples of various types of soil
Soils report
Soil survey
OSHA trench safety guidelines
MSDS for form oil

Videocassette recorder (VCR)/TV set (optional)

NCCER training video: *Foundation and Curb Forms* (optional)

NCCER training video: *Job-Built Wall Forms* (optional)

NCCER training video: *Job-Built Stair Forms* (optional)

Trenching safety video: *Shoring Safety, Trenching Safety I and II, Trenching and Shoring*, or *Trenching and Shoring Operations* (optional)

Edge forms (sheathing, scabs, nails, stakes, and braces)

Stakes, batter boards, pins, nails, and line

Transit, theodolite, or total station

Steel tape

2' or 4' level

Builder's level

Plumb bob or optical sight

Anchor bolts and base plates

Markers for layout

Plan and elevation views of columns

Plan and elevation views for a wall

Embed placing or lift drawings

Stair detail plan

Module Examinations*

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. Brief trainees on the hazards posed by any chemicals or oils used and any skin protection needed. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits. If trainees will be working with laser levels, review laser 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.

Carpentry, 1997. Leonard Koel. Homewood, IL: American Technical Publishers.

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

Excavation and Grading Handbook, 1994. Nick Capachi. Carlsbad, CA: Craftsman Book Company.

Heavy Equipment Operations Modules 22107, 22207, and *22307*, Latest Editions. Upper Saddle River, NJ: Prentice Hall.

Surveying with Construction Applications, 1997. Barry F. Kavanagh. Upper Saddle River, NJ: Prentice Hall.

Foundation and Curb Forms, Videotape. Gainesville, FL: The National Center for Construction Education and Research.

Job-Built Wall Forms, Videotape. Gainesville, FL: The National Center for Construction Education and Research.

Job-Built Stair Forms, Videotape. Gainesville, FL: The National Center for Construction Education and Research.

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 40 hours are suggested to cover *Means and Methods*. 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 and Soil Composition	
A. Introduction	_____
B. Soil Composition	_____
1. Soil Terminology and Properties	_____
2. Soil Condition and Related Tests	_____
3. Soil Classification Systems	_____
4. Engineering Properties of Soil	_____
5. Soil Surveys and Sampling	_____
6. Soil Hazards	_____
C. Laboratory – Trainees practice examining and classifying soil samples and interpreting a soils report. This laboratory corresponds to Performance Tasks 1 and 2.	_____
Sessions IV and V. Excavations	
A. Trenching Hazards	_____
B. Trench Safety	_____
C. Shoring, Shielding, Sloping, and Combined Systems	_____
D. Sloping Requirements for Different Types of Soil	_____
Sessions VI–VIII. Foundations and Flatwork	
A. Footings	_____
B. Edge Forms	_____
C. Removing Forms	_____
D. Laboratory – Trainees practice laying out a four-corner building with reference elevations. This laboratory corresponds to Performance Task 3.	_____
Sessions IX–XV. Basic Building Layout	
A. Objectives of Basic Building Layout	_____
B. Concrete and Steel Columns	_____
C. Laboratory – Trainees practice laying out column line offsets per a plan. This laboratory corresponds to Performance Task 4.	_____
D. Walls	
E. Laboratory – Trainees practice laying out wall lines and offsets per a plan. This laboratory corresponds to Performance Task 5.	_____
F. Embedded Items	_____
G. Laboratory – Trainees practice performing an embed layout. This laboratory corresponds to Performance Task 6.	_____
H. Stairs	_____
I. Laboratory – Trainees practice calculating the tread and riser and laying out a three-step set of stairs on grade with a top landing This laboratory corresponds to Performance Tasks 7 and 8.	_____

Session XVI. Review, Module Examination, and Performance 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 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.