AIR FORCE
QUALIFICATION TRAINING PACKAGE (AFQTP)

FOR

PAVEMENTS AND CONSTRUCTION EQUIPMENT OPERATOR
(3E2X1)

MODULE 24

PAVED SURFACES

TABLE OF CONTENTS

MODULE 24

PAVED SURFACES

AFQTP GUIDANCE

INTRODUCTION....24-4

AFQTP UNIT 1

CONSTRUCT PAVEMENT SURFACES
LAYOUT THE AREA USING
LINE LEVEL (24.1.2.1.1.)....24-5
COMPUTE MATERIAL REQUIREMENTS
ASPHALT (24.1.3.2.) **(OPTIONAL)**....24-11
CONCRETE (24.1.3.3.) **(OPTIONAL)**....24-11
BASE COURSE (24.1.3.4.) **(OPTIONAL)**....24-11
CLEAR THE AREA (24.1.4) **(OPTIONAL)**....24-22
PREPARE SUBGRADE
STABILIZE USING:
MECHANICAL MEANS (24.1.5.1.1.)....24-29
CHEMICAL (24.1.5.1.2.)....24-29
COMPACT (24.1.5.2.)....24-35
PREPARE BASE COURSE
PLACE MATERIALS (24.1.6.1.)....24-41
COMPACT MATERIALS (24.1.6.2.)....24-47

AFQTP UNIT 2

RIGID PAVEMENT
CONSTRUCT CONCRETE SLAB
INSTALL FORMS
WOOD (24.2.1.1.1.)....24-52
METAL (24.2.1.1.2.)....24-52
INSTALL REINFORCING MATERIALS
WIRE MESH (24.2.1.2.1.)....24-58
PLACE CONCRETE (24.2.1.5.)....24-64
FABRICATE JOINTS (24.2.1.6.)....24-64
FINISH CONCRETE
NON-SKID (24.2.1.7.2.)....24-64
CURE CONCRETE (24.2.1.8.)....24-64
REMOVE FORMS (24.2.1.9.)....24-73

TABLE OF CONTENTS (CONTINUED)

MODULE 24

PAVED SURFACES

AFQTP UNIT 3

REPAIR DEFECTIVE PAVEMENT
PERFORM FULL DEPTH PAVEMENT REPAIR
CUT PAVEMENT USING CONCRETE SAW (24.3.1.1.) 24-79
BREAK PAVEMENT USING AIR COMPRESSOR WITH JACK HAMMER ..... (24.3.1.2.) 24-85
REMOVE PAVEMENT (24.3.1.3.) **(OPTIONAL)** 24-90
PERFORM PARTIAL DEPTH REPAIR (24.3.2.) **(OPTIONAL)** 24-97

AFQTP UNIT 4

REPAIR DEFECTIVE SEALING MATERIAL
CLEAN JOINTS/CRACKS WITH
HIGH PRESSURE AIR (24.4.3.2.) (**OPTIONAL)** 24-106

AFQTP UNIT 5

FLEXIBLE PAVEMENT
APPLY PRIME COAT (24.5.2.) 24-111
PLACE ASPHALT (24.5.3.) 24-111
COMPACT ASPHALT (24.5.5) 24-111
REPAIR DEFECTIVE PAVEMENT
REMOVE PAVEMENT (24.5.6.3.) **(OPTIONAL)** 24-118
APPLY TACK COAT (24.5.6.6.) 24-118
PLACE ASPHALT (24.5.6.7.) **(OPTIONAL)** 24-118

REVIEW ANSWER KEY KEY-1

CORRECTIONS/IMPROVEMENT LETTER ..... APPENDIX A

Career Field Education and Training Plan (CFETP) references from 5 August 2002 version.

OPR: HQ AFCESA/CEOF
(SMSgt James R. Faulkner)
Supersedes AFQTP 3E2X1-24, 5 Aug 02

Certified by: HQ AFCESA/CEOF
(CMSgt Myrl F. Kibbe)
Pages: 133/Distribution F

AIR FORCE QUALIFICATION TRAINING PACKAGES
FOR
PAVEMENTS AND CONSTRUCTION EQUIPMENT OPERATOR
(3E2X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the "AFQTP Trainer/Trainee Guide."

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location*.

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOF revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

HQ AFCESA/CEOF
139 Barnes Dr Suite 1
Tyndall AFB FL 32403-5319
DSN: 523-6074, Comm: (850) 283-6074
Fax: DSN 523-6488
E-mail: ceof.helpdesk@tyndall.af.mil

CONSTRUCT PAVEMENT SURFACES

LAY OUT AREA USING

MODULE 24 **AFQTP UNIT 1**

LINE LEVEL (24.1.2.1.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

LAY OUT AREA USING LINE LEVEL

Task Training Guide

STS Reference Number/Test:	24.1.2.1.1. - Lay out area using line level.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-2, Lesson 215; *Hand Levels and the Line Level.* 2. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-1, Lesson 206; *The Layout of an Area.* 3. AF Form103, *Base Civil Engineering Work Clearance Request.* 4. Local procedures.
Prerequisites:	1. **Possess a minimum of a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-1, Lesson 206. 2.2. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-2, Lesson 215. 2.3. AF Form 103. 2.4. Local procedures.
Equipment/Tools Required:	1. Line level. 2. String line. 3. Stakes. 4. Tape measure. 5. Personal safety equipment. 6. General tool kit. 7. Additional personnel maybe required.
Learning Objective:	The trainee will be able to properly layout an area using a line level for pavement.
Samples of Behavior:	The trainee demonstrates how to layout a small area using a line level.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

LAY OUT AREA USING LINE LEVEL

1. Background. Before any construction project is started, it must be well planned. You may get involved in some planning activities in construction and repair projects. A well-planned project will make your job easier and safer. Regardless of size of the job, make sure you have the proper safety equipment before you start. The selection of the proper tools to complete a job is just as important as the proper safety equipment. Certain tools are designed for certain jobs.

2. Preparation. Site preparation is a very important part of building a road, runway, or sidewalk. Ensure a completed AF Form 103, Base Civil Engineering Work Clearance Request is on hand before starting any work. The amount of preparation depends on the terrain, location, and expected use of the completed surface. During the layout phase of our construction project, measure the dimensions of the area and then mark them to give a guide to go by. The method used to layout a project will be determined by the size of the area.

2.1. The first step is to clear the area of brush and other obstructions. Small sized projects such as patios and sidewalks can be effectively laid out with a tape measure, string, and line level. This will give you the proper dimensions but remember, when laying out an area for rigid pavement, don't forget to allow additional room for the width of the forms—as a rule 6 inches on each side. After the area has been laid out to the exact dimensions, place unmarked construction stakes in the ground and attach a string line between them. Attach the line level on the string and raise or lower one end of the string to obtain the desired slope. Ensure the string is pulled tight to ensure a correct reading of the line level.

NOTE:
Do not use a line level for a distance greater than 25 feet. The weight of the level causes the string to sag resulting in an inaccurate reading.

2.2. The layout of a large area is similar to that of a small area—only the degree of work differs. This section will concentrate on laying out a small area.

NOTE TO TRAINER/CERTIFIER:
If a construction project is not available, the minimum requirement for this task is the development of a training scenario (layout a 10’ x 10’ x 4” concrete slab) and have trainee complete the following:
Step 1: (if applicable clear area).
Step 2: (demonstrate measuring the area).
Step 3: (demonstrate layout and installation).
Step 4: (demonstrate procedures to check for square).

3. Line Level Procedures. Follow these steps to perform this task:

Step 1: Clear area (if needed).

Step 2: Measure area.

2.1. Measure the area using a tape measure.

2.2. Make sure enough room is allowed for the concrete forms.

Step 3: Place stakes.

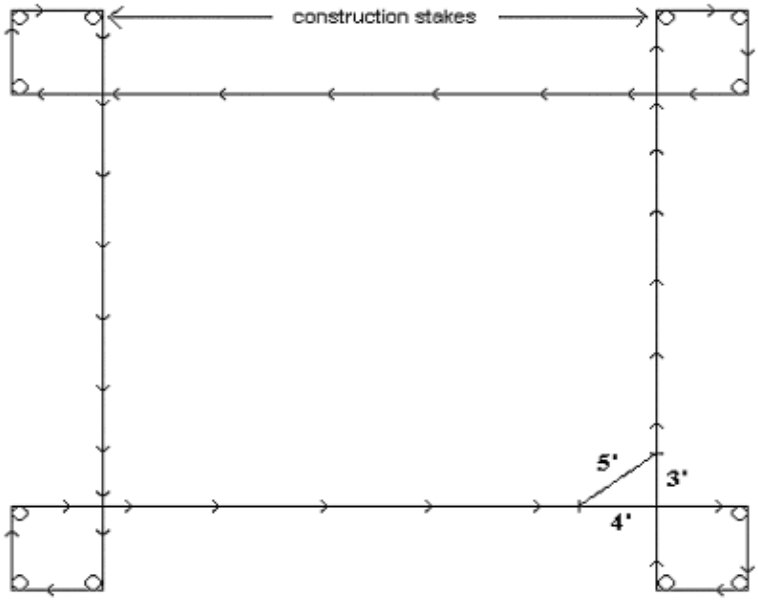
3.1. Place unmarked construction stakes outlining the project dimensions.

3.2. Attach string to the stakes placing the line level midway between the stakes.

3.3. Allow room for forms at the corners when constructing a square or rectangular concrete pad. Use a triangle stake setup on the corners. (See Figure 24-1).

3.4. Raise or lower the string to obtain the desired slope.

Figure 24-1. Project Layout Diagram.



Step 4: Check square. It is important to ensure your project is square.

4.1. There are two methods to accomplish this.

4.1.1. First, measure from one corner diagonally across to the other corner. Then measure the opposite corners and the measurement on both distances should be the same.

4.1.2. The other method involves using the Pythagorean theorem or $A^2 + B^2 = C^2$. This method is commonly known as the 3/4/5 method.

4.1.2.1. It involves measuring 3 feet out from a corner and making a mark on the string line.

4.1.2.2. Next measure 4 feet out from the corner in the opposite direction and make a mark, then measure diagonally across the two marks; the measurement should be 5 feet if the corner is square. (See Figure 24-1).

4.2. It is a good idea to use both methods to ensure the project is square.

REVIEW QUESTIONS
FOR
LAY OUT AREA USING LINE LEVEL

QUESTION	ANSWER
1. What is the first step when laying out a small area?	a. Establish project boundaries using the 3/4/5 method. b. Measure the area using a tape measure. c. Clear the area. d. Establish slope using a line level.
2. What is one method used to ensure the corners are square?	a. Measure diagonally across corners. b. Walk the distance and if it's the same number of steps, then it's square. c. Look down all four sides and you will be able to square it off of site. d. Use line level.

LAY OUT AREA

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. clear the area if required?		
2. measure area?		
3. place stakes?		
4. check to ensure project was square?		
5. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

COMPUTE MATERIAL REQUIREMENTS

MODULE 24 **AFQTP UNIT 1**

ASPHALT (24.1.3.2.)

CONCRETE (24.1.3.3.)

BASE COURSE (24.1.3.4.)

THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THIS NON-CORE TASK.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

COMPUTE MATERIAL REQUIREMENTS FOR ASPHALT / CONCRETE / BASE COURSE

Task Training Guide

STS Reference Number/Title:	24.1.3.2. - Compute material requirements for asphalt. 24.1.3.3. - Compute material requirements for concrete. 24.1.3.4. - Compute material requirements for base course.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219; *How to Construct a Base Course.* 2. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 223; *How to Compute Concrete.* 3. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3, Unit 1, Section 1-1, Lesson 401; *How to Compute Bituminous Material.* 4. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219. 2.2. 2.2.CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 223. 2.3. 2.3.CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3, Unit 1, Section 1-1, Lesson 401. 2.4. Local procedures.
Equipment/Tools Required:	1. Calculator. 2. Paper. 3. Pen/Pencil.
Learning Objective:	The trainee will be able to properly calculate base course, asphalt, and concrete materials.
Samples of Behavior:	The trainee will provide answers to calculation scenarios.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles) 2. Any safety violation is an automatic failure.	

COMPUTE MATERIAL REQUIREMENTS FOR ASPHALT / CONCRETE / BASE COURSE

1. Background. Computing for concrete, base course, and asphalt materials require different formulas. One formula for square/rectangular areas and one for circular areas. Due to worldwide deployment you may be required to order materials in metric yards, metric tons, and liters. The following can be used for converting U.S. measurements to Metric measurements.

1.1. Cubic yards to cubic meters ---multiply # of cubic yards X 0.7645549 = cubic meters.

1.2. U.S. tons to metric tons---multiply # of U.S. tons X 0.9072 = metric tons.

1.3. Gallons to liters --- multiply # of gallons X 3.7853 = liters.

2. Computing for Volume (Square/Rectangles). When computing for the amount of base course or concrete, you would need to determine the volume in cubic feet (or cubic meters). Volume is defined as the three-dimensional space an object occupies as measured in cubic feet.

2.1. To compute the volume of a square or rectangle, simply multiply the length x width x depth (V= L x W x D). Let's say we are going to build a patio 12 feet long by 10 feet wide and 4 inches deep. Since it is easier to work with one unit of measurement, first convert the inches into a decimal part of a foot by dividing 4 (inches) by 12 will gives you .3333333'. Round this number to the nearest hundredth = .33'. Round numbers at the hundredth column down if it's less then 5 and up if greater then 5.

2.2. Now, multiply 12' x 10' x .33' which gives us 39.6 cubic feet.

3. Computing for Base Course (Square/Rectangles). Base course is ordered by the ton. The weight of base course can vary depending on the type of aggregate, but generally there is 20 cubic feet of base course per ton.

3.1. First, use the formula L x W x D to compute the volume. For example an area is 12' x 10' x .33’ (4") = 39.6 cubic feet.

3.2. Next, divide the volume by 20 for the total amount of base course in tons you would need to order. The equation should be 12’ x 10’ x .33’ ÷ 20 = 1.98 or 2 tons (1.81 metric tons) of base course.

3.3. Round up to the nearest ton required.

4. Computing Concrete. Concrete is ordered by the cubic yard.

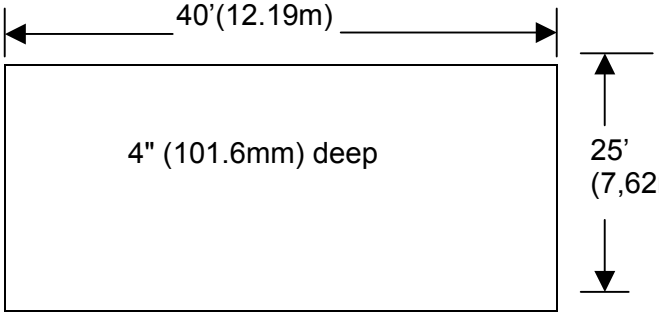
4.1. To calculate the required number of cubic yards, simply divide the volume by 27. This is because there are 27 cubic feet in one cubic yard.

4.2. The equation would be L x W x D ÷ 27 = cubic yards. Calculate for a rectangle measuring 40' x 25' x .33' ÷ 27 = 12.222222 cubic yards of concrete.

4.3. Because of low spots in the base course, you should order a little more concrete to compensate—normally 5% is sufficient.

4.4. Calculate the excess needed by multiplying the total cubic yards by 1.05 (this automatically adds 5% to the equation). Your new formula would be L x W x D ÷ 27 x 1.05 = total cubic yards of concrete plus 5%.

4.5. Example:



40 x 25 x .33 ÷ 27 x 1.05 = 12.833333 or 13 cu. yd. (9.94cu.m) of concrete
Round up to the nearest cubic yard needed.

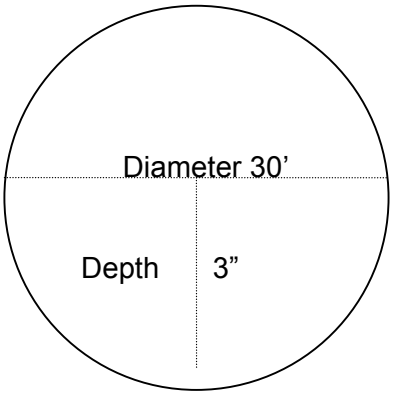
5. Compute Volume (Circular area). The formula for computing the volume of a circle is Pi, x the radius squared x the depth. (Volume = Pi x r^2 x D).

5.1. The number 3.14 represents Pi.

5.2. The radius of a circle is half of the diameter. To obtain the radius, divide the diameter in half. An example of this would be a circle with a diameter of 30 feet. The radius would be 15.

5.3. To square the radius, simply multiply the radius times its self.

5.4. Example: Diameter 30' and depth is 3 inches. First, convert the inches into feet by dividing 3 by 12, which gives us .25. Now multiply 3.14 x 15 x15 x .25, for a total of 176.625 cubic feet (5.00 cubic meter).



6. Compute Base Course (Circular area). Remember base course is ordered by the ton. Simply divide the volume by 20 cubic feet to get the number of tons required.

6.1. An example of this would be a circle 14 feet in diameter and 3 inches deep.

6.2. The equation would be (Pi x r^2 x D ÷ 20) 3.14 x 15 x 15 x .25 ÷ 20 = 8.83125 or 9 tons (8.16 metric tons).

6.3. Round up to the nearest ton needed.

7. Compute Concrete (Circular area). Concrete is ordered by the cubic yard. Simply divide the volume by 27 to get the cubic yards required.

7.1. An example of this would be a circle 18 feet in diameter and 4 inches in depth. Always remember to convert inches into feet.

7.2. The equation would be (Pi x r^2 x D ÷ 27) 3.14 x 9 x 9 x .33 ÷ 27 = 3.1086 cubic yards.

7.3. Remember to add 5% for low spots in the base course and spillage. The equation would be 3.14 x 9 x 9 x .33 ÷ 27 x 1.05 = 3.26403 or 4 cubic yards (3.058 cubic meter). Round up to the nearest cubic yard needed.

8. Compute Prime Coat and Tack Coat. Prime and tack coats are ordered by the gallon.

8.1. To calculate the amount needed, you must multiply the total square yards of the area to be sprayed by the application rate specified for the prime or tack coat.

8.2. The application rate for a prime coat varies from .10 to .25 gallons per square yard and tack coats varies from .05 to .15 gallons per square yard.

8.3. Use the formula L x W ÷ 9 x Application rate = Total gallons required.

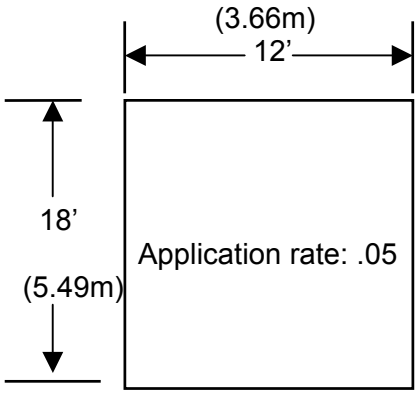
8.4. First determine the area in square feet (L X W) and divide by 9 to get the total square yards (there are 9 square feet in one square yard).

8.5. Next multiply the total square yards by the rate of application to get the total gallons of prime or tack coat required.

8.6. Round this figure up to the nearest whole gallon for the amount of material needed.

8.6.1. Example: Square/Rectangle Area.

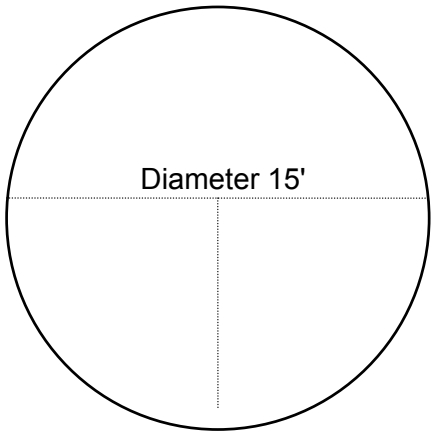
Compute the Area
Length x Width
18' x 12' = 216 sq. ft.



Length x Width ÷ 9 x application rate = gallons required
18’ x 12’ ÷ 9 x .05 = 1.2 gallons required (4.54 liter)
Round up to the nearest gallon needed = 2 gallons needed (7.57 liters)

8.6.2. Example: Circular Area.

Compute the Area
Pi x r x r
3.14 x 7.5 x 7.5 = 176.625 sq. ft.
(16.41sm)



Application rate .25

Pi x r2 ÷ 9 x application rate = gallons required
3.14 x 7.5 x 7.5 ÷ 9 x .25 = 4.90625 gallons required
(18.57 liters)
Round up to the nearest gallon = 5 gallons needed
(18.93 liters)

9. Compute Asphalt (Square/Rectangles). Now you are ready to figure the amount of asphalt needed for the job.

9.1. Use the formula L x W x D to obtain the volume in cubic feet.

9.2. Don't forget to convert inches into feet prior to making any other calculations.

9.3. Since asphalt paving materials are ordered in tons instead of cubic yards, you must know how much the material weighs.

9.4. There are several methods of calculating the weight. However, the one method most commonly used is to multiply the total number of cubic feet x 140 pounds when ordering hot-mix and 90 pounds when ordering cold-mix.

9.5. The numbers (140 and 90) represent the approximate weight of one cubic foot of compacted hot or cold mix asphalt. Cold-mix will not compact as tightly as hot-mix so its weight is less.

9.6. Asphalt is ordered by the ton. To convert to tons divide the total weight of the material by 2000 (One ton is equal to 2000 pounds). This will give you the total number of tons required.

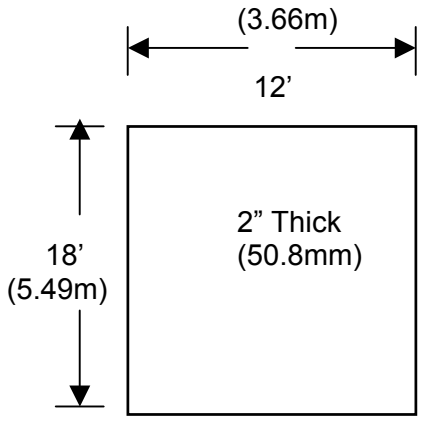
9.7. Add an additional 5% to allow for low spots in the base course and waste.

9.8. Round this figure up to the nearest whole ton for the amount of asphalt needed.

9.9. Examples:

9.9.1. Square/ Rectangle Area.

<u>Compute the Volume</u>
Length x Width x Depth
18' x 12' x .17' = 36.72 cu. ft.



9.9.1.1. Multiply the cu. ft. by 140 or 90 depending on the type of asphalt being used. Divide by 2000 (1 ton) to get the amount of asphalt needed in tons.

Hot mix: 18 ’x 12 ’x .17’= 36.72 x 140 ÷ 2000 = 2.5704 tons (2.33 metric tons)
Cold mix: 18’ x 12 ’x .17’= 36.72 x 90 ÷ 2000 = 1.6524 tons (1.49 metric tons)

9.9.1.2. Add 5% to allow for low spots in the base course and for waste.

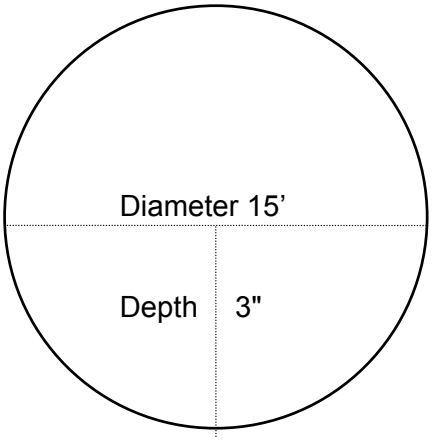
Hot mix: 2.5704 x 1.05 (+ 5%) = 2.69892 tons required (2.44 metric tons)
Cold mix: 1.6524 x 1.05 (+ 5%) = 1.73502 tons required (1.57 metric tons)

9.9.1.3. Round up to the nearest ton needed.

Hot mix: 3 tons (2.72 metric ton)
Cold mix: 2 tons (1.81 metric ton)

9.9.2. Circular Area.

Compute the Volume
Pi x r x r x Depth
3.14 x 7.5 x 7.5 x .25 = 44.15625 cu. ft.



9.9.2.1. Multiply the cu. ft. by either 140 or 90 depending on the type of asphalt being used. Divide by 2000 (1 ton) to get the amount of asphalt required in tons.

Hot mix: 44.15625 x 140 ÷ 2000 = 3.0909375 (2.80metric ton)
Cold mix: 44.15625 x 90 ÷ 2000 = 1.98703125 (1.81metric ton)

9.9.2.2. Add 5% to allow for low spots in the base course and for waste.

Hot mix: 3.0909375 x 1.05 (+5%) = 3.245484375 tons required (2.94 metric tons)
Cold mix: 1.98703125 X 1.05 (+5%) = 2.0863828125 (1.89metric tons)

9.9.2.3. Round up to the nearest ton needed.

Hot mix: 4 tons (3.63 metric ton)
Cold mix: 3 tons (2.72 metric ton)

REVIEW QUESTIONS FOR COMPUTE MATERIAL REQUIREMENTS FOR ASPHALT / CONCRETE / BASE COURSE

QUESTION	ANSWER
1. What is the application rate for prime coat?	a. .05 to .15 gallons per square yard. b. .10 to .25 gallons per square yard. c. .05 to .15 gallons per square foot. d. .10 to .25 gallons per square foot.
2. How much does one cubic foot of cold mix weigh?	a. 20 pounds. b. 90 pounds. c. 140 pounds. d. 2000 pounds.
3. Why do you divide the total weight of asphalt by 2000?	a. To break the calculations down into workable numbers. b. To account for the thickness. c. To convert pounds to tons. d. To convert tons to pounds.
4. How do you convert inches into a decimal part of a foot?	a. Divide by 3.14. b. Multiply by 3.14. c. Divide by 12. d. Multiply by 12.
5. What is the radius of a circle?	a. Half the diameter. b. The area inside a circle. c. The center point of the circle. d. The measurement around the outside of the circle.
6. How is base course ordered?	a. By the square yard. b. By the cubic yard. c. By the pound. d. By the ton.
7. How many cubic feet are in one cubic yard?	a. 9 b. 10 c. 12 d. 27

SAMPLE CALCULATIONS

Give the trainee a calculator and have them figure the following problems with no assistance.

Base Course.

1. How many tons of base course will be required for the following projects?

   a. Length 50', width 40', and a depth of 6"
   Base Course needed _____.

   b. Length 600', width 4', and a depth of 3"
   Base Course needed _____.

   c. Diameter 20' depth 8"
   Base Course needed _____.

Concrete.

2. How many cubic yards of concrete will be required to complete the following projects? Your answers should include the amount needed to complete the project including the additional 5%.

   a. Length 19' width 13' depth 7"
   Concrete needed _____.

   b. Length 325' width 4' depth 4"
   Concrete needed _____.

   c. Diameter 120' depth 9"
   Concrete needed _____.

SAMPLE CALCULATIONS (*Continued*)

Asphalt.

3. How much asphalt is needed to complete a project that is 65' long, 30' wide, and 4" deep?

   a. Amount of prime coat at .2 application rate _____

   b. Amount of hot mix required _____

   c. Amount of hot mix required plus 5% _____

   d. Amount of cold mix required _____

   e. Amount of cold mix required plus 5% _____

4. How much asphalt is needed to complete a circular project with a diameter of 100' and a depth of 5"?

   a. Amount of tack coat at .09 application rate _____

   b. Amount of hot mix required _____

   c. Amount of hot mix required plus 5% _____

   d. Amount of cold mix required _____

   e. Amount of cold mix required plus 5% _____

COMPUTE MATERIAL REQUIREMENTS FOR ASPHALT / CONCRETE / BASE COURSE

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. calculate Base Course correctly?		
2. calculate Concrete correctly?		
3. calculate Prime and Tack Coat correctly?		
4. calculate Asphalt correctly?		

FEEDBACK: Trainer/Certifier should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

MODULE 24 AFQTP UNIT 1

CLEAR THE AREA (24.1.4.)

THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THIS NON-CORE TASK.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

CLEAR THE AREA

Task Training Guide

STS Reference Number/Title:	24.1.4. Clear the area.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 2, Unit 3, Section 3-2, Lesson 219; *Removal of Brush, Trees, Rocks and Boulders.* 2. AF Form 103, *Base Civil Engineering Work Clearance Request.* 3. AF Form 813, *Request For Environmental Analysis.* 4. Local Procedures.
Prerequisites:	1. **Possess a minimum of a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 2, Unit 3, Section 3-2, Lesson 219. 2.2. AF Form 103 and 813. 2.3. Local procedures.
Equipment/Tools Required:	1. Hand Tools (Depending on size and scope of project). 2. Assorted Heavy Equipment. 3. Personal Safety Equipment. 4. General Tool Kit.
Learning Objective:	The trainee will be able to properly clear an area using hand tools or construction equipment.
Samples of Behavior:	The trainee demonstrates how to clear an area using hand tools or construction equipment.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure.	

CLEAR THE AREA

1. Background. Clearing vegetation and trees is usually necessary before moving and shaping the ground. Clearing includes removing surface boulders and other materials embedded in the ground and disposing of the cleared material. An AF Form 103, Base Civil Engineering Work Clearance Request must be completed before starting any work. An AF Form 813, Request for Environmental Analysis may also be required addressing environmental protection considerations before conducting clearing operations. Clearing operations should be planned to permit disposal of all debris in one handling. Specifications may allow shearing of the vegetation and trees at ground level, or it may be necessary to grub (removing stumps and roots from below the ground). Project specifications will dictate the proper clearing techniques. Clearing techniques vary with the type of vegetation being cleared, the soil type, and the soil's moisture condition. Method of clearing will also depend on the size of the area.

2. Clear Area Using Hand Tools. Sometimes during clearing operations you may have to utilize smaller tools to help remove vegetation, trees, brush, and rocks.

2.1. Tools that may be used include picks, mattocks, axes, round point shovels, and chainsaws.

2.1.1. The picks and mattocks are used to dig around stumps to help remove roots or boulders.

2.1.2. The round point shovel is also used to dig up roots and to dig around stumps.

2.1.3. Axes are used to chop down small saplings and very small trees.

2.1.4. Chainsaws can be used for small trees as well as very large trees.

2.2. Remember to select the right tool for the right job. This will save time, effort, and money.

3. Clear Area Using Construction Equipment.

3.1. Crawler Tractor. Typically, crawler tractors are used to clear large areas of brush, trees, and rocks.

3.1.1. When using crawler tractors to remove trees, it is best to travel in one direction when clearing. Changing direction tends to skin and scrape trees instead of uprooting them and allowing a clean cut.

3.1.2. Remove brush and small trees with the blade slightly below ground level. The blade cuts, breaks off, or uproots most of the tree and bends the rest for removal on the return trip.

3.1.3. To remove a medium-size tree (12 to 18 inches in diameter) raise the blade as high as possible to gain added leverage and push the tree over slowly. As the tree starts to fall, back the crawler tractor away quickly to avoid the rising roots. Then lower the blade and drive the crawler tractor forward, while lifting out the roots.

3.1.4. Removing large trees (18 inches and greater in diameter) is much slower and more difficult than clearing brush and smaller trees. First, gently and cautiously probe the tree for dead limbs that could fall. Determine the tree's natural direction of lean and set up to push the tree in that direction. Position the blade high and center it on the tree for maximum leverage. If possible, try to push the tree in the same way as a medium tree. However, if the tree has massive, deeply embedded roots, use the following method (Figure 24-4).

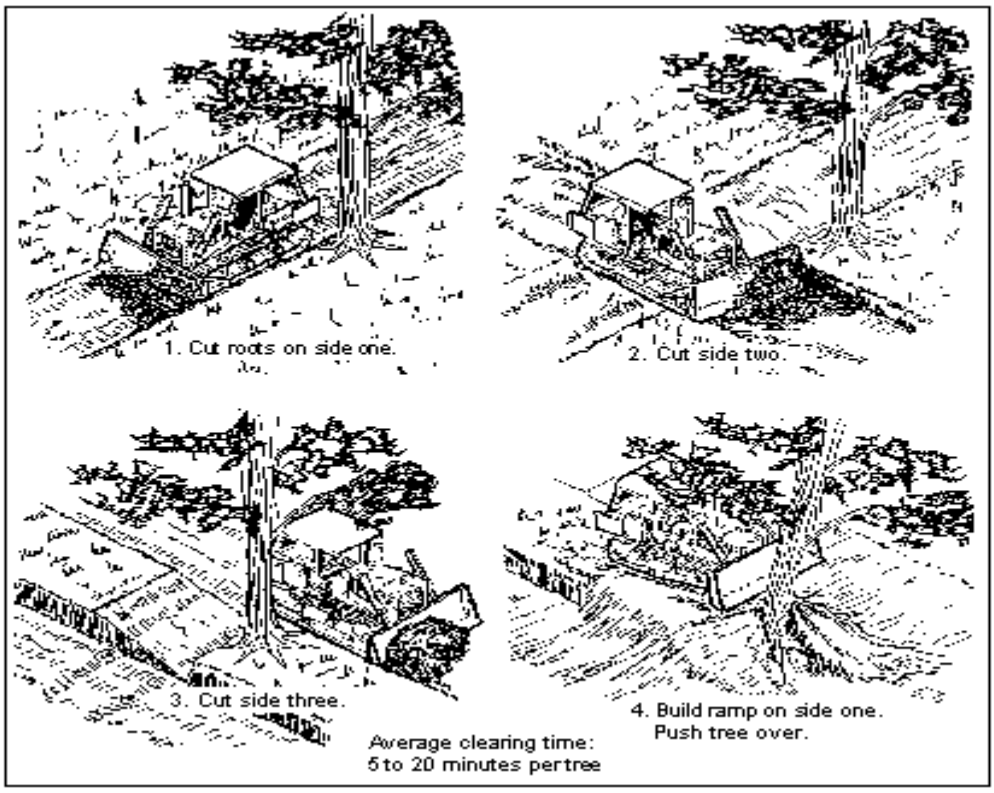
Step1: Start on the side opposite the proposed direction of fall, and make a cut deep enough to severe some of the large roots.

Step 2: Cut side two the same way.

Step 3: Cut side three the same way.

Step 4: Build an earth ramp on the same side as the original cut to obtain greater pushing leverage. Then push the tree over and as it starts to fall, reverse the crawler tractor quickly to avoid the rising roots.

Figure 24-2. Procedures for Removing Large Trees.



NOTE:
The roots on the fourth side may also need to be cut.

CAUTION
THE TREE MAY FREE FALL AFTER CUTTING THE ROOTS ON ALL FOUR SIDES.

3.2. Front-end Loaders. For smaller areas, where crawler tractors are too big and cumbersome, clearing and grubbing can be accomplished using front-end loaders with a clamshell bucket.

3.2.1. The clamshell bucket provides versatility for cutting and removing brush and vegetation. You can use the front cutting edge to cut and stockpile the material and use the clamshell to pick up debris and load it on haul vehicles.

3.2.2. The front-end loader with clamshell bucket can also be used to pick up and remove saplings and small trees.

4. Clear Area Procedures. Follow these steps to perform this task:

Step 1: Conduct a job site visit.

1.1. Use this visit to look at the area needing cleared.

1.2. Determine if the area will be cleared with hand tools or construction equipment.

1.3. Think about the tools, equipment and materials you will need to accomplish the job.

1.4. If the boundaries of the area are not clearly marked, take time to do this now.

Step 2: Develop a project checklist.

2.1. Write down details about the job while you are on site.

2.2. List hand tools or construction equipment needed for clearing operations.

2.3. Identify utilities and hazards in the work area. Review AF Form 103 and AF Form 813 (if required).

2.4. Refer to the checklist to make sure nothing is forgotten so you do not have to stop work and return to the shop for additional items.

Step 3: Clear the area.

3.1. Ensure you are wearing the appropriate personal protective equipment (PPE).

3.2. Using the appropriate hand tools or construction equipment for the size of the area and type of material you are clearing.

3.3. Remove all trees, brushes, and rocks.

SAFETY:

NEVER OPERATE CLEARING TRACTORS TOO CLOSE TOGETHER. DO NOT FOLLOW A TREE TOO CLOSELY WHEN PUSHING IT, BECAUSE WHEN IT BEGINS TO FALL, ITS STUMP AND ROOTS MAY CATCH UNDER THE FRONT OF THE BULLDOZER.

Step 4: Clean tools and service equipment.

4.1. Ensure all tools are clean prior to returning them to the tool room.

4.2. Repair or replace tools that are broken or unserviceable.

4.3. Clean and refuel each piece of equipment that was used.

4.3.1. If there are any mechanical problems that developed while using the equipment make sure you identify the problem to vehicle maintenance and your supervisor.

4.3.2. Properly park each piece of equipment in a safe and effective manner.

REVIEW QUESTIONS FOR CLEAR THE AREA

QUESTION	ANSWER
1. What hand tools are used to dig up stumps and roots?	a. Picks. b. Mattocks. c. Round point shovels. d. All of the above.
2. Which hand tool is used for chopping down saplings or very small trees?	a. Axe. b. Pick. c. Mattocks. d. Chainsaw.
3. What hand tool is used to cut down small to very large trees?	a. Axe. b. Pick. c. Mattock. d. Chainsaw.
4. What equipment is typically used to clear large areas of vegetation, brush, trees, and rocks?	a. Crawler tractor. b. Backhoe. c. Skid steer loader. d. Front-end loader.
5. How should you remove medium size trees (12 to 18 inches in diameter) with a crawler tractor?	a. Blade on ground, cut off even with soil. b. Blade raised high, push tree over. c. Blade raised high, push tree over and back up to prevent roots from lifting the crawler tractor. d. Back drag so the rear of crawler tractor knocks down trees and the blade breaks off the limbs.
6. The crawler tractor should use the ___ step process to remove large trees (12 – 30 inch diameter).	a. 1 b. 2 c. 3 d. 4

CLEAR THE AREA

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. conduct site visit identifying appropriate tools to use for clearing the area?		
2. develop a project checklist?		
3. clear area of vegetation, brush, trees, and rocks utilizing the correct tool and wearing appropriate personal protective equipment (PPE)?		
4. clean and return tools to their proper location?		
5. properly cleaned and parked equipment?		
6. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

PREPARE SUBGRADE

STABILIZE USING

MODULE 24 **AFQTP UNIT 1**

MECHANICAL MEANS (24.1.5.1.1.)

CHEMICAL (24.1.5.1.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

STABILIZE USING MECHANICAL MEANS / CHEMICALS

Task Training Guide

STS Reference Number/Title:	24.1.5.1.1. - Stabilize subgrade using mechanical means. 24.1.5.1.2. - Stabilize subgrade using chemicals.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 217; *How To Stabilize a Subgrade.* 2. Air Force Joint Manual (AFJMAN) 32-1034; *Materials Testing.* 3. AFJMAN 32-1019; *Soil Stabilization for Pavements.* 4. Local Procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 217. 2.2. AFJMAN 32-1034, Chapter 5; *Soil* Stabilization, Sections 1-2. 2.3. AFJMAN 32-1019, Chapters 2-4. 2.4. Review Material Safety Data Sheet (MSDS) for chemicals (if applicable).
Equipment/Tools Required:	1. Soil, lime, Portland cement or bituminous material. 2. MSDS if applicable. 3. Mixing equipment. 4. Personal safety equipment. 5. General tool kit.
Learning Objective:	The trainee will be able to properly stabilize an area using mechanical means and/or chemicals.
Samples of Behavior:	The trainee will mechanically and/or chemically stabilize an area.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

STABILIZE USING MECHANICAL MEANS / CHEMICALS

1. Background. Soil stabilization is the process that alters any property of soil to improve its engineering characteristics. The purpose of soil stabilization is to increase the strength of the soil or increase the drainage qualities of the soil. Soil stabilization is most frequently used to improve existing subgrade soil, so that the soils load bearing capacity is sufficiently increased. Thus, the thickness of the base course may be reduced, or the need for a separate base course of imported materials may be eliminated.

2. Types of Stabilization. There are two general types of stabilization -- mechanical and chemical.

2.1. Mechanical Stabilization. There are two methods of mechanical stabilization -- blending and compaction.

2.1.1. Blending is the addition of other grain sizes to an existing soil to achieve the desired gradation or to reduce plasticity before compaction. This means adding soil to soil. This involves the adding and mixing of gravel, sand, silt, and clay as required by the existing soil.

2.1.2. Compaction is the act of artificially densifying the soil.

2.1.3. Mechanical stabilization is done to improve the drainage or the compaction characteristics of the soil.

2.1.4. The essentials for good mechanical stabilization are proper gradation of coarse-grained materials, a good binder soil, and proper control of the moisture content.

2.1.5. Mechanical stabilization can help when a large amount of clay is present in the subgrade. Since clay soils drain very poorly, it must be blended with coarse sand. This mixture will increase the drainage qualities of the soil.

2.1.6. The soil must be thoroughly mixed prior to compaction.

2.2. Chemical Stabilization. A chemical stabilized soil is one that has been mixed with cement, lime, or a bituminous material to increase the strength of the existing soil.

2.2.1. Chemical stabilization will accomplish two things—it cements the soil into a hard mass and it changes the soil making it more suitable for construction.

2.2.2. Soil-cement stabilization consists of mixing silt, Portland cement, and water in definite proportions, then compacting the mixture to a prescribed density. Thorough pulverization of the soil and thorough mixing with cement and water is essential to success.

2.2.3. Soil-lime stabilization consists of mixing clay and lime. This will reduce the plasticity of the clay making the soil easier to pulverize, mix, and compact. Lime is also valuable as a drying agent in subgrades, where a high water table is likely to cause saturation of the subgrade.

2.2.4. Bituminous soil-stabilization is the process by which a controlled amount of bituminous material is thoroughly mixed with an existing subgrade that is granular or crumbly. The type and grade of bituminous material used depends on the type of soil, method of construction and weather conditions. The required bitumen content varies from 4 to 9 percent by weight, depending on the soil.

2.2.5. Adhere to environmental precautions when applying chemicals.

2.2.6. Environmental precautions and safety information can be found in the MSDS for the chemical being used.

2.3. Mixing Soils and Stabilization. The two common methods of mixing soils and stabilization agents together are:

2.3.1. Grader – this method is satisfactory when mixing soils together.

2.3.2. Rotary-tiller type equipment is commonly used in chemical stabilization, as it mixes the materials in place.

NOTE:
Chemicals used to stabilize soils must be thoroughly mixed with the soil prior to compaction.

CAUTION
USE A RESPIRATOR WHEN APPLYING CHEMICALS FOR STABILIZATION.

NOTE TO TRAINER/CERTIFIER:
If a stabilizing project is not available, the minimum requirement for this task is the development of a training scenario and select an area (10' x 10'). Then have the trainee complete step 1, then explain the procedures in steps 2, 3, and 4. Recommend this task be accomplished along with the next core task (24.1.5.2., Compact).

3. Stabilizing Procedures. Follow these steps to perform this task:

Step 1: Determine stabilization method.

1.1. Identify type of soil.

1.2. Determine if the drainage qualities or strength of the existing soil must be increased.

1.3. Decide whether you are going to use mechanical or chemical stabilization.

1.4. Determine type of mixing equipment.

Step 2: Acquire the appropriate materials.

2.1. If using mechanical stabilization, load and haul soil to the site.

2.2. If using chemicals, determine amount needed and review the MSDS.

Step 3: Mix the materials.

3.1. Place materials

3.2. Thoroughly mix and spread the materials throughout the entire area.

3.3. Adhere to all safety requirements.

Step 4: Clean mixing equipment.

4.1. Thoroughly wash the equipment used to mix the materials, especially if you used chemicals.

4.2. Store any unused materials in the proper location.

REVIEW QUESTIONS
FOR
STABILIZE USING MECHANICAL MEANS / CHEMICALS

QUESTION	ANSWER
1. What type of chemical would you add to granular, crumbly soil?	a. Lime. b. Portland cement. c. Sodium calciumate. d. Bituminous materials.
2. Lime is used to stabilize:	a. silt. b. clay. c. sand. d. gravel.
3. What are the two types of stabilization?	a. Intrensive and intensive. b. Mechanical and chemical. c. Mechanical and intrensive. d. Consolidation and compaction.
4. The blending method of mechanical stabilization means mixing _____ with _____.	a. soil with soil. b. lime with silt. c. cement with clay. d. bitumen with sand.

STABILIZE USING MECHANICAL MEANS / CHEMICALS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. determine the appropriate stabilization method?		
2. acquire the correct materials?		
3. review MSDS if required?		
4. spread and mixed materials?		
5. comply with all safety requirements?		
6. clean mixing equipment?		
7. store unused material properly?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

PREPARE SUBGRADE

MODULE 24 **AFQTP UNIT 1**

COMPACT (24.1.5.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

COMPACT SUBGRADE

Task Training Guide

STS Reference Number/Title:	24.1.5.2. - Compact subgrade.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 218; *How to Compact a Subgrade*. 2. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 2, Unit 1, Section 1-3, Lesson 208; *Design Feature and Operation of the Sheepsfoot, Steel-wheel,and Pneumatic-tire Rollers.* 3. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 1, Unit 1, Section 1-1, Lesson 001; *Operator Inspection and Maintenance Procedures.* 4. Local Procedures
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 218. 2.2. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 1, Unit 1, Sections 1-1 and 1-3, Lessons 001 and 208. 3. **Complete the following:** 3.1. AFQTP 3E2x1-17; *Compaction Equipment,* dated 4 Apr 03. 3.2. AFQTP 3E2x1-24, Unit 1; *Stabilize Using Mechanical Means / Chemicals,* dated 4 Apr 03.
Equipment/Tools Required:	1. Compaction equipment. 2. Personal safety equipment. 3. General tool kit.
Learning Objective:	The trainee will be able to properly compact an area that has been mechanically or chemically stabilized.
Samples of Behavior:	The trainee will compact an area that has been mechanically or chemically stabilized.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

COMPACT SUBGRADE

1. Background: One of the basic construction procedures involved in building subgrade and a base course for roads, airfield pavements, embankments, earth-fill dams, and similar structures is compaction. Soils become loosely packed whenever it is disturbed. During subgrade preparation it must be compacted into a solid mass. Compaction is the process of increasing the density of the soil by mechanical means. If the soils are not compacted properly during construction, it will eventually settle and the pavement place upon it fails. Field compaction is accomplished by rolling or by the passage of construction equipment over the material.

2. Purpose. The purpose of compaction is to increase the density of a soil. The amount of compaction a soil must undergo depends upon the amount of strength that must be built into a pavement. The weight and traffic to which it will be subjected to determine pavement strength required. Compaction helps prevent shearing and settlement when loads are applied. Consider the type and size of equipment to be used. It would be very time consuming to compact a large area with small powered equipment. On the other hand, a large bulky roller would not fit into a small area.

3. Compaction Equipment. The size of the construction area will determine the size of the compaction equipment.

3.1. Small Areas. Small areas require smaller equipment such as the vibratory plate compactor. Should only be used on stable material. Ensure each pass is overlapped compactor width.

3.2. Large Areas. In large areas, rollers are normally used. The type of soil in the subgrade determines the type of roller needed. For example:

3.2.1. Pneumatic-tired rollers are used for all types of soil and are especially useful for the final compaction of the upper 6" of sub-grades and base courses.

3.2.2. Steel-wheel rollers are used for the final rolling of subgrades and rolling of base courses to a smooth surface and especially used for compacting granular soils with little or no fines such as sand and gravel mixtures.

3.2.3. Sheepsfoot rollers compact from the bottom up, so they are best to use on clay type soils. When using the sheep's-foot roller the lift thickness for each layer of soil being compacted should not exceed 6 inches in depth. For example, if an area requires 10 inches of material to be stabilized and compacted, then you would need to compact in layers. One layer approximately 6 inch in depth and the other 4 inches in depth. Compacting in layers helps achieve maximum compaction.

4. Soil Moisture. In order to achieve maximum compaction it is important to add water to the soil. When compacting the subgrade with either large or small equipment, you should ensure you have optimum moisture content. If the soil is too dry, it will tend to shear (or tear) under the weight of the roller or the vibration of the tampers. If the soil is too wet, it will stick to the roller drums, tires, or plates of the compaction equipment. This causes the forward motion of the tamper to stop and rollers to lose their compaction ability because of the mucky conditions. Correct these conditions by re-wetting dry soils and aerating wet soils. Ensure compaction is continued until the desired density is obtained.

NOTE TO TRAINER/CERTIFIER:

If a compaction project is not available, the minimum requirements for this task is the development of a training scenario (may continue scenario from the previous task) and have the trainee explain the steps to compact the type of subgrade encountered on the installation by:

1. Identify soil.
2. Determine equipment.
3. Explain operation of equipment.

5. Compact Procedures. Follow these steps to perform this task:

Step 1: Identify the type of soil to be compacted.

Step 2: Determine compaction equipment to use.

2.1. Perform operational checks on equipment. Refer to AFQTP 3E2X1-17, Unit 1, *Perform Operational Checks on Compaction Equipment.*

2.2. Ensure area has been properly stabilized if required. Refer to AFQTP 3E2X1-24, Unit 1; *Stabilize Using Mechanical Means / Chemicals*.

Step 3: Compact the materials.

3.1. Ensure soil has optimum moisture content.

3.2. Operate the equipment so that the subgrade is uniformly compacted.

3.3. Compact subgrade in lifts.

3.4. Continue compaction until the desired density is obtained.

Step 4: Perform operator maintenance. Refer to AFQTP 3E2X1-17, Unit 2, *Perform Operators Maintenance on Compaction Equipment.*

REVIEW QUESTIONS
FOR
COMPACT SUBGRADE

QUESTION	ANSWER
1. The purpose of compaction is to increase the subgrades:	a. thickness. b. moisture. c. density. d. shape.
2. Compaction prevents shearing and _____ when loads are applied.	a. settlement b. upheaval c. tearing d. undercutting
3. Which roller is best used on granular soils with little or no fine such as sand and gravel mixtures?	a. Sheepsfoot. b. Pneumatic. c. Steel Wheel. d. Vibratory Plate.
4. Which roller is best used for clay soils?	a. Sheepsfoot. b. Pneumatic. c. Steel Wheel. d. Vibratory Plate.

COMPACT SUBGRADE

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. identify the type of soil to be compacted?		
2. determined appropriate compaction equipment?		
3. compact the subgrade ensuring equipment was operated correctly and safely?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

PREPARE BASE COURSE

MODULE 24 **AFQTP UNIT 1**

PLACE MATERIALS (24.1.6.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

PLACE (BASE COURSE) MATERIALS

Task Training Guide

STS Reference Number/Title:	24.1.6.1. - Place base course materials.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219; *How to Construct a Base Course*. 2. Air Force Joint Manual (AFJMAN) 32-1040, *Maintenance and Repair of Surface Areas.* (Army TM 5-624) 3. Local Procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219. 2.2. AFJMAN 32-1040, Chapter 2, Paragraphs 2-4 and 2-5. 3. **Complete the following:** 3.1. AFQTP 3E2x1-15, Unit 1, *Dump Truck,* dated 4 Apr 03. 3.2. AFQTP 3E2x1-24, Unit 1, *Stabilize Using Mechanical Means / Chemicals and Compact Subgrade,* dated 4 Apr 03.
Equipment/Tools Required:	1. Hand tools. 2. Construction equipment (dump truck / front-end loader). 3. Personal safety equipment. 4. General tool kit. 5. Additional personnel as required.
Learning Objective:	The trainee will be able to properly place base course.
Samples of Behavior:	The trainee will place base course.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

PLACE (BASE COURSE) MATERIALS

1. Background: Experience has shown that high-quality materials must be used in the base course (the layer directly beneath the pavement surface). For flexible pavements, low subgrade strength requires a substantial thickness of select material, subbase, and base material to reduce the imposed stress on the subgrade. Where the subgrade strength is high, only a base course may be required to provide for adequate load distribution. Since the stresses in the base courses are always higher than those in the subgrade, the base course must have a higher strength than the subgrade and be sufficiently compacted to prevent consolidation under traffic. The purpose of a base course is to provide a uniform distribution of the wheel load so it will not exceed the strength of the subgrade and to provide adequate drainage.

2. Base Course Requirements. Careful selection of materials for base courses must be considered.

2.1. For both flexible and rigid pavements base courses provide the following functions:

2.1.1. Additional structural strength.

2.1.2. More uniform bearing surface for the pavement.

2.1.3. Replacement for soft highly compressible or expansive soils.

2.1.4. Protection for the subgrade against detrimental frost action.

2.1.5. Drainage and prevention of pumping.

2.1.6. Suitable surface for the operation of construction equipment during adverse weather conditions.

2.2. The materials should be well-graded, angular in shape, and uniformly compacted to its maximum density.

2.3. Pit-run gravel, shells, limestone, and caliche make good base courses.

2.4. Crush and grade material if it is not dense enough or cannot be well compacted.

2.5. Base course material must meet certain gradation requirements so that it can be well compacted.

2.6. Positive drainage will be provided for all base courses to ensure against water being trapped and saturating the layers.

2.7. Saturated layers reduce pavement strength and promote the pumping condition that the base course is designed to prevent.

3. Gradation Requirements. Gradation of particle sizes is determined by sieve analysis.

3.1. Crushed rock or gravely material make a satisfactory base if:

3.1.1. Fifty percent is well-graded gravel.

3.1.2. Forty percent is well-graded sand.

3.1.3. Ten percent is made up of fin-grained soil (slightly plastic silt).

3.2. This is the best blend to use and is relatively easy to place and spread.

4. Placing and Spreading. Base course materials are placed on a prepared subgrade, which has been stabilized and compacted.

4.1. Placement and spreading may begin at the point nearest the source or at the point farthest from the source. The material is then placed progressively away from or toward the source, respectively.

4.2. The advantage of working from the point nearest the source is that hauling vehicles can be routed over the spread material, which assists in compacting the base and avoids cutting up the subgrade.

4.3. Advantages of working from the point farthest from the source is that the hauling equipment will further compact the subgrade, reveal any weak spots in the subgrade so they can be corrected promptly, and interfere less with the movement of spreading and compacting equipment.

4.4. Probably the biggest problem encountered when placing and spreading base course materials is segregation. This occurs when the material is dropped from too great a height or moved with shovels or rakes. When placing or spreading base course material, be careful to prevent segregation of the mix.

NOTE TO TRAINER/CERTIFIER:

If a construction project is not available, the minimum required for upgrade training is the development of a training scenario where the trainee will proceed to stockpile area or training area and place 3" of base course material within a 12' x 12' area using construction equipment and the steps listed below.

Recommend this task be combine with the next unit core task 24.1.6.2., Compact Base Course Material.

Depending on the size of the project additional personnel may be needed during loading and placing/spreading of the material.

5. Place Material Procedures. Follow these steps to place base course material:

Step 1: Determine amount of base course needed (L x W x D ÷ 20).

Step 2: Load material into dump truck and haul material to dump location.

Step 3: Place base course materials on a prepared subgrade.

3.1. Determine the best method to place the material.

3.2. Adjust tailgate chains for spreading.

3.3. Check for overhead obstructions.

3.4. Spread dump or dump material and spread with other equipment.

3.5. Prevent segregation of the mix.

REVIEW QUESTIONS
FOR
PLACE (BASE COURSE) MATERIALS

QUESTION	ANSWER
1. A satisfactory base course is made up of:	a. 50% well-graded gravel, 40% well-graded sand, and 10% slightly plastic silt. b. 50% open graded gravel, 40% slightly plastic silt, and 10% well-graded sand. c. 50% gap graded gravel, 40% well-graded silt, and 10% slightly plastic sand. d. 50% well-graded gravel, 40% open graded sand, and 10% well-graded silt.
2. To prevent consolidation under traffic, the base course must be:	a. weaker than the sub-grade. b. stronger than the sub-grade. c. the same strength as the sub-grade. d. None of the above.
3. When placing the base course, try to prevent:	a. settlement. b. segregation. c. shearing. d. sinking.

PLACE (BASE COURSE) MATERIALS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. determine the correct amount of base course material?		
2. place base course material and spread as required?		
3. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

CONSTRUCT PAVEMENT SURFACES

PREPARE BASE COURSE

MODULE 24 **AFQTP UNIT 1**

COMPACT MATERIALS (24.1.6.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

COMPACT BASE COURSE MATERIALS

Task Training Guide

STS Reference Number/Title:	24.1.6.2. - Compact base course materials.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219; *How to Construct a Base Course*. 2. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 2, Unit 1, Section 1-3, Lesson 208; *Design Feature and Operation of the Sheepsfoot, Steel-wheel, and Pneumatic-tire Rollers.* 3. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 1, Unit 1, Section 1-1, Lesson 001; *Operator Inspection and Maintenance Procedures.* 4. Local Procedures
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 2, Section 2-3, Lesson 219. 2.2. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 2, Unit 1, Section 1-3, Lesson 208. 2.3. CDC Pavements and Construction Equipment Operator Journeyman 3E251B, Volume 1, Unit 1, Section 1-1, Lesson 001. 3. **Complete AFQTP 3E2X1-24, Unit 1, *Place (Base Course) Materials*, dated 4 Apr 03.**
Equipment/Tools Required:	1. Compaction equipment. 2. Personal safety equipment. 3. General tool kit. 4. Additional personnel as required.
Learning Objective:	The trainee will be able to properly compact base course.
Samples of Behavior:	The trainee will compact base course.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

COMPACT BASE COURSE MATERIALS

1. Background. Base course compaction must produce a uniformly dense layer conforming in every way to specification requirements. The thickness of the layers of material being placed should not exceed the capabilities of the compaction equipment. This typically depends on the size of the equipment you are using. For smaller compaction equipment, base course materials should be compacted in layers of 2 to 3 inches. For larger compaction equipment the thickness of layers can go up to six inches. In areas that are inaccessible to the rollers, small tampers and compactors will be utilized. In this case, layer thickness must be three inches or less. The base course must be sufficiently compacted to prevent consolidation (settlement) under traffic. The support foundation must be capable of withstanding the wheel loads for which it was designed.

2. Compaction.

2.1. When compacting base course, optimum moisture content should be maintained during compaction procedures.

2.2. Equipment and methods must be adjusted on each job to suit the characteristics of the base material since thorough compaction is important in developing maximum stability.

2.3. If the correct equipment is unavailable, renting the correct equipment may be required to do the job properly.

2.4. The compaction operation will continue until the desired density is obtained.

2.5. After the base course is compacted, a final rolling should be accomplished it to furnish a tight, water-shedding surface free of roller marks that may prevent water runoff.

2.6. The final rolling is best accomplished using steel-wheel rollers.

2.7. After the final compaction, the height of the compacted base course must be at the proper elevation.

NOTE TO TRAINER/CERTIFIER:

If a compaction project is not available, the minimum required for upgrade training is the development of a training scenario (may continue scenario from the previous task) and have the trainee compact the material using the steps listed below. Depending on the size of the project additional personnel may be needed during loading and placing/spreading.

3. Compaction Procedures. Follow these steps to compact base course materials:

Step 1: Determine compaction equipment.

1.1. Size of the area will determine the size of compaction equipment.

1.2. Small areas require smaller equipment.

1.3. Larger areas will accommodate large rollers

Step 2: Compact the materials.

2.1. Ensure entire area is uniformly compacted.

2.2. If compacting in lifts, do not exceed capabilities of the compaction equipment

2.3. Continue compaction until the desired density is obtained.

2.4. Final roll to a smooth, tight water-shedding surface.

2.5. Ensure the area is free from roller marks so water will not get trapped on the surface.

REVIEW QUESTIONS
FOR
COMPACT BASE COURSE MATERIALS

QUESTION	ANSWER
1. When using small compaction equipment the thickness of each layer should be:	a. 6 inches or less. b. 5 inches or less. c. 4 inches or less. d. 3 inches or less.
2. When using large compaction equipment the thickness of each layer can be as much as _____ inches.	a. 3 b. 4 c. 5 d. 6
3. A final rolling of the base course should be accomplished to furnish a:	a. loose water shedding surface. b. tight water shedding surface. c. tight well draining surface. d. dense gap graded surface.

COMPACT BASE COURSE MATERIALS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. determine the appropriate compaction equipment to use?		
2. compact the material correctly?		
3. conduct final roll of the base course?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

RIGID PAVEMENT

CONSTRUCT CONCRETE SLAB

INSTALL FORMS

MODULE 24 **AFQTP UNIT 2**

WOOD (24.2.1.1.1.)

METAL (24.2.1.1.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

INSTALL WOOD/METAL FORMS

Task Training Guide

STS Reference Number/Title:	24.2.1.1.1. - Install wood forms. 24.2.1.1.2. - Install metal forms.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 224: *How To Set Concrete Forms.* 2. Field Manual (FM) 5-436, *Paving and Surfacing Operations.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 224. 2.2. FM 5-436, Chapter 12, *Forms and Joints*. 2.3. Local procedures. 3. **Complete AFQTP 3E2X1-24, Unit 1, *Lay Out Area Using Line Level*, dated 4 Apr 03.**
Equipment/Tools Required:	1. Forms (wood / metal). 2. Stakes (wood / metal). 3. Tool bag. 4. Personal protective equipment.
Learning Objective:	The trainee will be able to properly install concrete forms.
Samples of Behavior:	The trainee will be able to install concrete forms.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

INSTALL WOOD/METAL FORMS

1. Background: Construction forms used in rigid pavements serve three purposes. They contain the concrete, provide a track for form riding equipment, and aid in curing. Forms may be constructed of either wood or metal. Use of wooden forms is generally restricted to small slabs. Metal forms are used for large slabs, long sidewalks, and driveways. Height of forms should be equal to the thickness of the concrete to be placed.

2. Types of Forms.

2.1. Wood.

2.1.1. Generally restricted to small slabs.

2.1.2. Normally made from common lumber.

2.1.3. Erected or constructed on the job site.

2.1.4. 2 x 4s or 2 x 6s turned up on edge can be cut to the desired lengths.

2.1.5. Require more stakes then metal forms.

2.2. Metal:

2.2.1. Metal forms are used for large slabs, long sidewalks, and driveways.

2.2.2. Used for pavement 4-inches or more in thickness.

2.2.3. Metal forms are 10' long and vary from 4-to 12-inches in height.

2.2.4. All standard forms have three stake pockets with wedges to hold the forms firmly in position.

2.2.5. Weight varies 204 pounds for 8-inch forms to 292 pounds for 12-inch forms.

2.2.6. Width of the steel form base should be at least 80 percent of the form height.

2.2.7. Increased the height by bolting a plate to the bottom of the form. The plate should not exceed 25 percent of the original form height.

2.2.8. Stake lengths for metal forms vary in height.

2.2.8.1. 18 inches long for 8-inch forms.

2.2.8.2. Increase to 30 inches for 12-inch forms.

2.2.9. Steel form should deflect no more than ¼ inch when set.

2.2.10. Metal forms are convenient and reusable.

NOTE TO TRAINER/CERTIFIER:

If a construction project is not available, the minimum required for this task is the development of a training scenario for the trainee to demonstrate the installation and forming of 20' of sidewalk using metal or wood forms and the steps listed below.

Recommend the training scenario cover this core task and the following core tasks in this unit:

1. 24.2.1.2.1., Install Wire Mesh.
2. 24.2.1.5., Place Concrete.
3. 24.2.1.6., Fabricate Joints.
4. 24.2.1.7.2., Non-Skid Finish Concrete.
5. 24.2.1.8., Cure Concrete
6. 24.2.1.9., Remove Forms.

3. Install Forms Procedures. Follow these steps to install wood or metal forms:

Step 1: Lay out and measure area.

1.1. Excavate and stabilize area as required.

1.2. Set string line for elevation and alignment.

Step 2: Line up forms.

2.1. Line up the top inside edge of the form to the string line.

2.2. Place as close to final alignment as possible.

Step 3: Install stakes.

3.1. For wooden forms, drive a stake at each end of the form, then go back and install stakes every two feet along the form.

3.2. For metal forms, drive stakes through the end stake pockets and lock in place with the wedges. Then install a stake in the center pocket.

3.3. Ensure stakes do not extend above the forms.

Step 4: Final adjustments.

4.1. Ensure the top inside edge of the form is barely touching the string.

4.2. Recheck height and alignment.

4.2.1. If the form is too high, lower it by tapping on the stakes not the form.

4.2.2. If the form is too low, loosen the wedges on the metal forms and re-adjust.

4.2.3. For wooden forms, you may have to pull the nails and re-adjust.

4.2.4. Adjust the form to the string by packing the dirt at the side of the stake. If you want the form to move inward toward the string, hit the dirt on the outside of the stake with a hammer. If you want the form to move outward, hit the dirt on the inside of the stake.

4.3. Remove string line.

HINT:

Place soil behind the forms to prevent concrete from entering the stake pockets on metal forms and pushing out from under the forms.

REVIEW QUESTIONS
FOR
INSTALL WOOD / METAL FORMS

QUESTION	ANSWER
1. Why place soil behind the forms?	a. To prevent concrete from getting in the stake pockets. b. To keep the sides of the pad from loosing heat. c. To ensure proper elevation of the form. d. To allow for drainage.
2. How do you ensure proper elevation of a form?	a. By aligning the top outside edge of the form with the string line. b. By aligning the top inside edge of the form with the string line. c. By aligning the top of the form with the top of the stakes. d. By placing soil behind the forms.
3. What is the stake length for 8-inch metal forms?	a. 10” b. 12” c. 16” d. 18”
4. Metal forms should deflect no more than ____ inch when set.	a. $^{1}/_{8}$ b. ¼ c. ½ d. $^{3}/_{4}$

INSTALL WOOD / METAL FORMS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. lined up forms?		
2. installed stakes correctly?		
3. make final adjustments to forms?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

RIGID PAVEMENT

CONSTRUCT CONCRETE SLAB

INSTALL REINFORCING MATERIALS

MODULE 24 **AFQTP UNIT 2**

WIRE MESH (24.2.1.2.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

INSTALL WIRE MESH

Task Training Guide

STS Reference Number/Title:	24.2.1.2.1. - Install wire mesh.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 226: *How To Install Reinforcing Materials.* 2. Field Manual (FM) 5-436, *Paving and Surfacing Operations*. 3. Local procedures
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 226. 2.2. FM 5-436, Chapter 13, Section IV, *Reinforced Concrete*. 2.3. Local procedures. 3. **Complete AFQTP 3E2X1-24, Unit 1, *Lay Out Area Using Line Level* and Unit 2, *Install Wood / Metal Forms*, dated 4 Apr 03.**
Equipment/Tools Required:	1. Reinforcing materials. 2. Tool bag. 3. Personal protective equipment. 4. Additional personnel for safety.
Learning Objective:	The trainee will be able to properly install reinforcing materials.
Samples of Behavior:	The trainee will install reinforcing materials.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

INSTALL WIRE MESH

1. Background. Reinforcement is the term used to describe the steel bars and small or large welded wire fabric positioned in concrete. Its purpose is to increase the tensile strength of the hardened concrete. Concrete has great strength in compression, that is, it can support great loads placed directly upon it. Steel bars or other metal reinforcement is required in concrete if it is to resist stresses or forces that tend to bend it or pull it apart. The compressive strength of concrete is about 10 times greater than its tensile strength. When metal reinforcement is used in concrete, the reinforcement withstands the tensile pull. The tensile strength can be made equal to or greater than the compressive strength depending on the amount of reinforcement used. This material is used in concrete only where additional tensile strength is required. Concrete slabs that are not expected to withstand heavy loads do not normally require steel reinforcement. An example of a "non" load-bearing surface would be a sidewalk (except where they cross a driveway), a patio, or porch. Natural bonding of the concrete to steel is brought about by adhesion and shrinkage of concrete during hydration. This action causes the concrete to grip the metal tightly.

2. Reinforcement Materials. Many materials have been tried as reinforcement in concrete. Steel is the universally accepted and used. One important advantage of steel is that its contraction and expansion characteristics due to temperature changes are nearly the same as those of concrete. Reinforcing steel can be purchased two ways:

2.1. Keep bars (called rebar):

2.1.1. May be plain, twisted, or deformed by rolling or stamping.

2.1.2. Woven, welded or tied together to form reinforcement units.

2.1.3. When used for concrete floors, columns and slabs, it is assembled at the beginning of the job so that it is ready for installation when the formwork is complete.

2.2. Welded wire fabric (wire mesh):

2.2.1. May have any number of mesh patterns.

2.2.2. Can be several sizes with different size wire.

2.2.3. Normally purchased in rolls of various widths and rolls.

2.2.4. Commonly used as reinforcement in footings, walls, and slabs.

2.2.5. Can be cut easily by hand, normally, all that is needed is a pair of bolt cutters.

2.2.6. Overlap the fabric at least 6-inches or one complete square and use 7-gauge tie wire to secure the pieces together.

CAUTION

NEVER TRY TO CUT WIRE FABRIC FROM A ROLL BY YOURSELF. ALWAYS HAVE ANOTHER PERSON HOLD DOWN ONE END WHILE YOU UNROLL THE OTHER.

3. Reinforcement Material Placement.

3.1. Chairs normally support the reinforcement material off the ground.

3.2. Allow at least 2-inches from any edge or the top and that it is more than ½ the slab thickness above the bottom.

3.3. If commercially produced chairs are not available, broken brick or any other suitably sized material can be used to support the material.

3.4. If chairs are not used when placing wire mesh the wire may be placed directly on the base course and pulled to the center of the concrete with a hook device rake while the concrete is still in a plastic state.

NOTE TO TRAINER/CERTIFIER:

If a construction project is not available, the minimum requirements for this task is the development of a training scenario (recommend the continuation of the "Install Wood / Metal Forms" scenario from the previous task) and have the trainee demonstrate the installation of a 5' area by:

1. Unroll wire mesh safely.
2. Simulate cutting wire mesh.
3. Explain how to overlap wire mesh (when required).
4. Explain how to properly place the wire mesh within the formwork.

4. Reinforcing Material Procedures. Follow these steps to install wire mesh:

Step 1: Cut amount needed by:

1.1. Unroll and cut the wire mesh to the desired dimensions.

1.2. Cut the wire mesh so that it fits inside the forms without touching the forms.

Step 2: Install wire mesh

2.1. Place chairs.

2.2. Ensure at least 2-inches from any edge or the top and that it is more than ½ the slab thickness above the bottom.

2.3. Overlap the fabric at least 6-inches or one complete square and use 7-gauge tie wire to secure the pieces together (if required).

REVIEW QUESTIONS
FOR
INSTALL WIRE MESH

QUESTION	ANSWER
1. What is the purpose of reinforcing steel?	a. To aid in concrete curing. b. To reinforce the base course. c. To increase the tensile strength of the hardened concrete. d. To decrease the amount of concrete needed for the project.
2. What are the types of reinforcing steel?	a. Rebar and welded wire fabric. b. Angle iron and round stock. c. Angle iron and rebar. d. Hard and semi hard.
3. When using wire mesh for reinforcement, how is it positioned in the pour area?	a. Using chairs or pulled to the center with a hook device. b. After the concrete is in place and pushed down. c. Flat on the bottom of the pad. d. After floating.

INSTALL WIRE MESH

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. cut wire mesh correctly?		
2. place wire mesh correctly?		
3. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

RIGID PAVEMENT

CONSTRUCT CONCRETE SLAB

MODULE 24 **AFQTP UNIT 2**

PLACE CONCRETE (24.2.1.5.)

FABRICATE JOINTS (24.2.1.6)

(FINISH CONCRETE) NON-SKID (24.2.1.7.2.)

CURE CONCRETE (24.2.1.8.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

PLACE CONCRETE / FABRICATE JOINTS / NON-SKID FINISH CONCRETE / CURE CONCRETE

Task Training Guide

STS Reference Number/Title:	24.2.1.5. - Place concrete. 24.2.1.6. - Fabricate joints. 24.2.1.7.2. - Finish concrete non-skid finish. 24.2.1.8. - Cure concrete.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-4, Lessons 229 - 232: *Mix, Place, Finish, and Cure Concrete.* 2. Field Manual (FM) 5-436, *Paving and Surfacing Operations.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-4, Lessons 229 – 232. 2.2. FM 5-436, Chapters 12, *Forms and Joints* & 13, *Concrete Paving*. 2.3. Local procedures. 3. **Complete AFQTP 3E2X1-24, Unit 1, *Lay Out Area Using Line Level,* Unit 2, *Install Wood / Metal Forms*, and *Install Wire Mesh* dated 4 Apr 03.**
Equipment/Tools Required:	1. Bull float. 2. Magnesium float. 3. Hammer. 4. Soft bristled broom. 5. Edger. 6. Jointer. 7. Tool bag. 8. Personal protective equipment.
Learning Objective:	The trainee will be able to properly place, finish, cure, and fabricate joints in concrete
Samples of Behavior:	The trainee will place, finish, cure, and fabricate joints in concrete
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

PLACE CONCRETE / FABRICATE JOINTS / NON-SKID FINISH CONCRETE / CURE CONCRETE

1. Background. Construction of a concrete project involves following a sequence of operations in which many different tasks will be completed. Some of these tasks overlap, meaning they are accomplished at the same time as other tasks. There are also some tasks that have to be accomplished after others. For example, you cannot finish the concrete until it all of the placing operations are completed. In order to construct a quality project, you need to understand and be able to accomplish all the tasks associated with placing, finishing, fabricating joint, and curing the concrete.

2. Place Concrete.

2.1. Recheck the forms for proper alignment. This is especially important if the forms have been in place for several days. Next, moisten the area with water just prior to placing the concrete. The base course, forms, and reinforcement steel (if any) must be moistened. This is to stop the base course and the forms from drawing excess amounts of moisture out of the concrete mixture. This will also reduce the surface temperature of materials that may have been exposed to the sun for several hours. It is important to mention that these surfaces should not be saturated, only moistened. At this time oil the forms using a form release agent. This prevents concrete from sticking to the forms.

2.2. If the new concrete is going to butt against old concrete you need to install expansion material creating an expansion joint. If the dowel rods are located place expansion material over the dowels.

2.3. When placing the concrete, do not allow concrete to free fall any further than absolutely necessary. Concrete should be placed evenly and uniformly. Place the mix as dry as possible (add only enough water to make it workable). The concrete should be stiff enough to stand without flowing but is easily workable without segregation. Avoid long distance wheelbarrow trips as this causes coarse aggregates to settle to the bottom. Try to place the concrete as near as possible to its final resting-place.

2.4. Consolidate (vibrate) the mix. Consolidation eliminates stone pockets and large pockets of air. This will creates a uniform plastic mass. Some of the most common tools for consolidating concrete are jitterbugs, vibrating screeds and spud vibrators. Consolidating tools should be used sparingly otherwise the concrete will segregate.

2.5. Screed (strike-off) the concrete. Screeding is done by laying a straight length of either wood (2" x 4", 2" x 6", etc.) or commercially purchased aluminum (2" x 4", 2" x 6", etc.) across parallel forms and moving in a sawing motion from one end of the job to the other. This removes excess concrete and leaves a level, but rough surface. Screeding may often need to be done two or more times after the concrete is placed. At this same time one person should be assigned the duty of "tapping" the outside of the forms with a hammer. This will consolidate the edges of the slab and eliminate air pockets (honeycomb) between the form and slab sides.

3. Finishing Operations (Initial/Final).

3.1. <u>Initial Finishing</u>.

3.1.1. Float the concrete as necessary with a wood, aluminum, or magnesium alloy float. Initial floating should be accomplished before bleed water reaches the surface to prevent sealing of the surface. A bull float is used for large areas and a hand float is used for small areas.

3.1.1.1. The hand float should be held flat on the concrete surface and moved with a slight sawing motion in a sweeping arc.

3.1.1.2. This action will fill in holes, cut off high areas, embed the aggregate particles just beneath the surface and compacts the mortar at the surface in preparation for additional finishing operations.

3.1.2. Floating too much will work excessive amounts of cement/water paste to the surface and must be avoided. Excessive surface paste weakens the surface and can cause it to chip and break under little or no stress.

3.1.3. Place an initial edge on the concrete using the edging tool. Edging is required along all the edge forms and expansion and construction joints.

3.1.3.1. Edging compacts the concrete next to the form where floating is less effective. This makes the edge more durable and less vulnerable to spalling and chipping.

3.1.3.2. Additional edging may be required after subsequent finishing operations. This moves the large aggregate away from the edge making it easier for other subsequent finishing operations.

3.1.4. Once water sheen (bleed water) has accumulated on the surface, operations must cease until the water sheen has disappeared.

NOTE:

Keep in mind that air-entrained concrete will bleed very little. Do Not use a wood float on concrete, which is air-entrained.

3.2. Final Finishing.

3.2.1. The concrete should be firm but not yet completely set. Final finishing while the concrete is still too plastic (wet) will yield the same net results as over-floating. Continue finishing when the water sheen has disappeared and the surface appears dull and olive green. This will eliminate minor irregularities and smooth and fill in open-textured areas in the pavement's surface.

3.2.2. Immediately fill depressions with freshly mixed concrete that is struck off, consolidated, and refinished.

3.2.3. Use a power trowel (motorized) in large areas and hand trowels in smaller areas.

3.2.4. Actual troweling is very similar in practice to floating.

4. Fabricate Joints. Joints are necessary in concrete pavement. All plastic concrete contains more water than is required for the hydration of the cement. When this extra water starts to evaporate, the process of drying-shrinkage of the slab creates tensile stresses in the concrete. Providing joints can relieve these tensile stresses. If the stresses are not relieved, cracks will develop. Three basic types of joints, which are called expansion, construction, and contraction joints, are easy to make and should be used in flat work such as floors, slabs, and walks. Inspect the area before, during, and after placing the concrete to ensure good joints.

4.1. Expansion Joint. Constructed by placing a compressible material placed between the new and old concrete. Expansion-joint filler may be a wooden board or a preformed bituminous-treated fiber that conforms to specification requirements and dimensions. Expansion joints allow the concrete to move without disturbing the adjacent structure or intersecting pavement.

4.1.1. They also decrease compressive stress, which may cause sections of the concrete pavement to blow up.

4.1.2. Use expansion joints in pavement that is <10 inches thick, at pavement intersections, and around structures that are in contact with the pavement.

4.1.3. Installed before placing the concrete.

4.2. Construction Joint. Any place where fresh concrete comes in direct contact against old concrete is considered to be a construction joint.

4.2.1. Install transverse construction joints after the paving operation is complete. Place transverse construction joints at the end of a day's placement or at other points where placement has stopped long enough for the concrete to start setting. Transverse construction joints are generally formed by installing a temporary bulkhead between the forms or at the end of them.

4.2.2. Longitudinal construction joints are placed prior to placing the concrete. There is no material of any kind placed between old and new concrete. When practical, these joints take the place of a planned transverse or expansion joints. When impractical, install a transverse construction joint not less than 10 feet from the closest, regularly spaced transverse joint.

4.3. Contraction Joint. Contraction joints (sometimes called dummy joints) relieve tensile stresses caused by pavement contraction and helps control cracking of the concrete. They consist of grooves formed in the surface of the concrete with a jointer or sawed with a concrete saw. These grooves reduce the pavement cross section at prescribed locations so the cracks will occur below the joint. These grooves are sawed to a depth of one-eight to one-fourth of the slab thickness and are ½ minimum to 5/8 maximum inch wide. Dummy joints may be formed into plastic concrete with a concrete saw 4 to 12 hours after finishing the pad or by using a tool called a jointer which forms a groove (not to exceed $^1/_4$ slab thickness). Carefully inspect joint forming to avoid faulty joints.

5. Finish Concrete Surface (Non-Skid). Most of the projects done within our career field require a non-skid surface. Use either a soft-bristle broom or burlap material for this type of surface.

5.1. Pull the broom across the surface to place slight indentations in the concrete. The indentations should be perpendicular to the flow of traffic. No pressure should be applied to the broom while pulling it.

5.2. When using burlap, it is usually pulled along the length of the pavement with approximately one foot of burlap in contact with the surface.

5.3. Applying a nonskid surface will increase traction during wet weather.

6. Curing Concrete. Curing prevents the rapid loss of moisture from the concrete. As moisture is maintained in the concrete, a chemical reaction between the water and cement causes the concrete to harden. This chemical reaction is referred to as "hydration." The length of hydration and the strength of the concrete are directly related. When hydration stops, strength gain also stops. Concrete will continue to hydrate as long as the exterior surfaces of the concrete remain moist. Type I cement (the most common type used) should be cured at least 72 hours and preferably 28 days for its designed strength. A three-day (72 hours) curing time will yield concrete of sufficient strength for most jobs.

6.1. Ensure that equipment needed for adequate curing and protection is on hand and ready to install before placement begins. Start curing the concrete immediately after finishing or when the concrete surface is hard enough to resist marking. It's important that once started, curing must be continuous or hydration will stop. Concrete can be kept moist by a number of curing methods. These methods can be divided into two classifications:

6.1.1. Those that supply additional moisture to the concrete.

6.1.2. Those that prevent loss of moisture from the concrete by sealing the surface.

6.2. Methods of Curing.

6.2.1. Curing Compounds. These are several chemical compounds that when applied to concrete will form a thin membrane covering over the surface. This membrane, if correctly applied, will completely seal in moisture. The advantages of this method are many, but the two biggest advantages are ease of application and the fact that once correctly applied, it requires no further maintenance.

6.2.2. Plastic Sheeting. This is an extremely efficient method of curing concrete. Anchor the plastic in such a manner that wind cannot get under it or let moisture escape. Covering edges and joints with sand works well. As moisture evaporates from the surface, it forms droplets on the underside of the plastic and eventually re-deposits onto the concrete surface. This method of curing requires only a spot check every now and then to ensure the edges and joints are still covered.

6.2.3. Continuous Water. This method involves simply applying water continually or at regular intervals to the concrete. It is the most troublesome method of curing, but is very efficient. Curing should begin as soon as the concrete is hard enough to resist damage from the water.

6.2.4. Burlap and Straw. This method involves covering the surface area with burlap or straw and saturate with water. The material will hold moisture for several hours (depending on the air temperature) and requires fewer trips back to the job site to apply water than "continuous water" method. The burlap or straw need not be weighted, as the weight of the water will hold it in place.

NOTE TO TRAINER/CERTIFIER:

If a concrete project is not available, the minimum required for this task is the development of a training scenario (recommend that you continue the scenario "Install Forms") for the trainee to demonstrate the placement, joint fabrication, finish, and cure concrete of 5' of sidewalk using the steps listed below.

Recommend this task be combined with this unit core tasks 24.2.1.1.1. & 24.2.1.1.2., Install Wood / Metal Forms and 24.2.1.2.1., Install Wire Mesh.

7. Construct Concrete Slab Procedures. Follow these steps to perform the following tasks:

7.1. Place Concrete.

Step 1: Recheck form alignment.

Step 2: Moisten the area.

Step3: Oil the forms.

Step 4: Install expansion material (if required).

Step 5: Place the concrete.

Step 6: Consolidate the mix.

Step 7: Tap the forms.

Step 8: Screed the concrete.

Step 9: Float the concrete.

Step 10: Edge concrete.

7.2. Fabricate Joint.

Step 11: Determine the appropriate type of joint(s) to fabricate.

11.1. Identify location for each joint.

11.2. Obtain proper tool or material for the joint(s).

11.3. Measure the distances between each location.

11.4. Fabricate the joint(s) as required.

7.3. Finish Concrete.

Step 12: Determine the appropriate type of finish.

12.1. Non-skid finish.

12.2. Smooth finish.

12.3. Use the broom or burlap material for a non-skid surface.

12.4. Use a power trowel or hand trowel for a smooth surface.

Step 13. Apply non-skid finish.

7.4. Cure Concrete.

Step 14: Cure concrete using one of the methods below.

14.1. Curing compound.

14.2. Plastic sheeting.

14.3. Continuous water.

14.4. Burlap/straw.

REVIEW QUESTIONS
FOR
PLACE CONCRETE / FABRICATE JOINTS / NON-SKID FINISH CONCRETE / CURE CONCRETE

QUESTION	ANSWER
1. Prior to actually placing the concrete, you want to _____ the forms so concrete will not stick to them.	a. check for alignment b. consolidate c. screed d. oil
2. Why do we tap the outside of the forms with a hammer?	a. To keep the forms from sticking to the concrete. b. To move the aggregate from top to bottom. c. To consolidate the edge of the slab and eliminate honeycomb. d. To keep the forms in line.
3. After placing the concrete in the forms you need to _____ the concrete so that it is level with the forms.	a. screed b. jitterbug c. consolidate d. fabricate joint
4. What are the three types of joints?	a. Contraction, construction, and expansion. b. Contraction, compressive, and expansion. c. Compressive, construction, and expansion. d. Contraction, construction, and compressive.
5. When does final finishing begin?	a. Concrete is set. b. After brooming. c. As soon as you moisten the base.. d. Concrete is firm but not yet completely set.
6. A bull float is used for large areas and a hand float is used for small areas.	a. True. b. False.
7. Which of the following items would be used to obtain a non-skid surface on a recently poured concrete pad?	a. Sandpaper. b. Wire brush. c. Jitterbug. d. Broom.

PLACE CONCRETE / FABRICATE JOINTS / NON-SKID FINISH CONCRETE / CURE CONCRETE

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
Place Concrete		
1. recheck form alignment?		
2. moisten the area?		
3. oil forms?		
4. install expansion material as required?		
5. place concrete?		
6. consolidate concrete?		
7. tap the forms?		
8. screed concrete?		
9. float concrete?		
10. edge concrete?		
Fabricate Joints		
11. determine appropriate type of joints?		
12. identify location of each joint?		
13. obtain proper tool/material for joints?		
14. fabricate joints correctly?		
Non-Skid Finish		
15. determine appropriate type of finish?		
16. select proper tools?		
17. determine correct time to finish?		
18. apply required finish?		
Cure Concrete		
19. decide on method of curing?		
20. gather appropriate materials?		
21. cure concrete?		
22. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

RIGID PAVEMENT

CONSTRUCT CONCRETE SLAB

MODULE 24 **AFQTP UNIT 2**

REMOVE FORMS (24.2.1.9.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

REMOVE FORMS

Task Training Guide

STS Reference Number/Title:	24.2.1.9. - Remove forms.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 233: *The Removal of Forms Used in Concrete Construction.* 2. Field Manual (FM) 5-436, *Paving and Surfacing Operations.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 3, Section 3-2, Lesson 233. 2.2. FM 5-436, Chapter 13, Section II, *Remove Forms*. 2.3. Local procedures. 3. **Complete the AFQTP 3E2x1-24, Unit 2, *Install Wood / Metal Forms,* dated 4 Apr 03.**
Equipment/Tools Required:	1. Hand tools. 2. Tool bag. 3. Personal protective equipment.
Learning Objective:	The trainee will be able to properly remove forms.
Samples of Behavior:	The trainee will remove forms from a concrete project.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

REMOVE FORMS

1. Background: Form removal is considered the last formal step in the process of constructing a concrete slab. Remove forms as soon as the concrete has set enough so that the concrete will not be damaged when you remove them. The normal time for removal is 1 to 3 days after the concrete is placed. In cold weather, leave forms in place for 7 days. When removing forms from concrete, always try to pry "up", never "out" from the slab. Prying "out" against the slab will often result in breakage of the slab edges. The main thing when removing forms is to take your time and be careful. Protect the sides of concrete slabs for 1 hour after removing the forms. This provides continuous curing treatment to exposed surfaces and also prevents damage to pavement edges and the underlying subgrade.

2. Removal of Wood Forms. To remove wood forms, hook one point of an ordinary dirt pick under the edge of the form, press your foot down on the other pick point, and pull the pick handle toward you. This will lift the form straight up, without damaging the concrete.

2.1. As each form is removed, move it away from the new concrete. If you lay the forms on or against the new concrete, you may damage it.

2.2. Remove the stakes.

2.3. If you plan to reuse the wood, remove any nails and dispose of them properly. Clean and stack the forms. The sooner you clean the forms, the easier they will be to clean.

2.4. Properly dispose of any wood that can no longer be used.

3. Removal of Metal Forms. To remove metal forms, first remove the soil from around the stake pockets. Loosen the stake wedges; unlock the locking plates (you may have to loosen the stake wedges and locking plates by driving them back with a sledgehammer).

3.1. Pull the stakes. It is easier and faster to remove stakes with a mechanical stake puller. It also requires less manpower to accomplish the work.

3.1.1. Removal of stakes may also be accomplished by using a front-end loader or other equipment that has a boom attached.

3.1.1.1. If you use a boom mounted attachment. The boom should rotate or be side mounted, allowing you to drive alongside the forms and pull the stakes.

3.1.1.2. If you use a rear or front-mounted boom, pull up to each stake, pull it, and reposition for the next stake.

3.1.2. Pulling stakes can be accomplished with almost any device that will hold onto them.

3.1.2.1. One type of device is a chain with a pair of heavy pieces of metal (in the shape of washers) welded to the chain.

3.1.2.2. The hole in the washers should be just large enough to go over the stake easily. When you raise the chain, with the boom, the washers will catch the stake at an angle and pull it.

3.1.2.3. To release the stake, straighten the washers so that they will come off.

3.2. Lift each form section up and away from the concrete.

3.3. If the form has a keyway bolted to it, or if it has dowels through it, you must move it directly away from the concrete before lifting.

3.4. Clean and oil the metal forms before storing.

3.5. After forms are removed, backfill with topsoil.

3.5.1. Compact as necessary to bring soil even with the top edge of the concrete slab.

3.5.2. The backfill material should slope away from the concrete slab to ensure proper drainage, appearance, and traffic safety.

3.6. Finally, be sure to clean up the job site before considering the job complete.

NOTE TO TRAINER/CERTIFIER:

If a form project is not available, the minimum required for this task is the development of a training scenario (recommend that you continue the scenario "Install Forms") for the trainee to demonstrate the remove of 20' of sidewalk forms using the steps listed below.

4. Form Removal Procedures. Follow these steps to remove forms:

Step 1: Remove forms by:

1.1. Removing nails if required.

1.2. Unlocking wedges if required.

1.3. Pulling stakes.

1.4. Removing form sections.

1.5. Cleaning and oiling forms as required.

Step 2: Backfill the area by:

2.1. Using topsoil or appropriate material.

2.2. Compacting as necessary.

2.3. Ensuring proper drainage, appearance, and traffic safety.

2.4. Cleaning up the job site.

REVIEW QUESTIONS
FOR
REMOVE FORMS

QUESTION	ANSWER
1. How long should forms be in place before removal?	a. 3 to 28 days. b. 2 to 38 days. c. 1 to 3 days. d. 7 hours to 12 hours.
2. When removing forms always pry _____ and away from the concrete.	a. down b. out c. up d. in
3. You want to clean and oil forms as soon as possible after removing them.	a. True. b. False.
4. After all forms are removed, you want to _____ the area.	a. screed b. backfill c. excavate d. consolidate

REMOVE FORMS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. remove the wood and/or steel forms correctly?		
2. backfill area the area correctly?		
3. use the proper tools?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

REPAIR DEFECTIVE PAVEMENT

PERFORM FULL DEPTH PAVEMENT REPAIR

MODULE 24 **AFQTP UNIT 3**

CUT PAVEMENT USING CONCRETE SAW (24.3.1.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

CUT PAVEMENT USING CONCRETE SAW

Task Training Guide

STS Reference Number/Title:	24.3.1.1. - Cut pavement using concrete saw.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2, *Repairing and Replacing Defective Rigid Pavements.* 2. Unified Facilities Criteria (UFC) 3-270-04, *Concrete Repair.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2. 2.2. UFC 3-270-04, Chapter 4, *Full-Depth Repair of Pavement.* 2.3. Local procedures.
Equipment/Tools Required:	1. Various construction equipment. 2. Hand tools. 3. Tool bag. 4. Personal protective equipment.
Learning Objective:	The trainee will be able to properly cut pavement using the concrete saw.
Samples of Behavior:	The trainee will cut pavement using a concrete saw.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

CUT PAVEMENT USING CONCRETE SAW

1. Background. Concrete saw cuts rigid or flexible pavement to ensure clean, straight, vertical edges which provide for a better repairs. Sawing rigid pavement involves the use of a concrete saw equipped with a diamond-tipped blade designed for cutting concrete or asphalt. Ensure you are using the correct type of blade for the pavement being cut. The blades are very expensive and if properly cared for, will last a long time. Diamond-tipped blades for concrete normally must have water on it or heat buildup will cause the blade to warp or break. There are concrete blades available for dry cutting. It is important know how to utilize both types of blades so that you will be prepared for any situation.

2. Purpose. When normal maintenance procedures can no longer correct the effects of ordinary pavement wear or use, full-depth repair may become necessary to restore damaged areas to their original condition. Full-depth repairs are generally necessary when slabs have been shattered or have deteriorated to such an extent that the safe support of the required load is no longer possible.

3. Repair Boundaries.

3.1. First, a detailed survey should be done to accurately identify the required repair areas so that all significant underlying distresses are found.

3.2. Partial-slab replacement is acceptable where the distresses are within one-half of the slab length.

3.3. Full-width slab patching is required if the original slab length is less than 20 feet (6 meters), or full-depth cracks are located within the interior area of the slab.

3.4. A minimum slab length is required to avoid rocking and pumping of the repair.

3.5. General experience indicates that 10 feet (3 meters) or one-half of the slab length, which ever is less, is a minimum length when load transfer is provided.

3.6. The recommended **minimum** patch dimensions are:

3.6.1. Saw cuts will be a minimum of 2 feet (600 millimeters) from the joint.

3.6.2. If patch is a utility cut, make cuts 6 to 12 inches (150 to 300 millimeters) beyond limits of the trench.

3.6.3. For continuously reinforced concrete, the distressed portion must be in the middle of the patch area. Patch should be 6 feet (1.8 meters) long if steel is to be tied, and 4 feet (1.2 meters) long, if welded.

3.7. Vertical cuts with the concrete saw should be a minimum of 2” deep.

3.8. Saw cuts shall be straight lines forming rectangles in line with the jointing pattern.

3.9. Full-depth saw cuts will completely separate the concrete that is to be removed.

NOTE:
Ensure adequate supply of water is provided if using wet cut blades.

NOTE TO TRAINER/CERTIFIER:

If a pavement project is not available, the minimum required for upgrade training is to have trainee complete the following:

Step 1: Explain how to mark the area to be cut.

Step 2: Demonstrate starting procedures on the saw.

Step 3: Simulate cutting pavement.

4. Cutting Procedures. Follow these steps to perform full-depth repairs by cutting pavement:

Step 1: Mark area to be cut.

1.1. Repair area should be laid out as a rectangle and corners should be square and perpendicular to the flow of traffic.

1.2. Marking material must be waterproof.

1.3. Mark the area at least two inches back from the defective area. This will ensure you remove all of the defective material.

Step 2: Perform pre-operational inspection on concrete saw. Refer to local procedures and manuals for proper pre-operational inspection instructions.

Step 3: Start the saw.

3.1. Ensure the correct type blade is on the saw.

3.2. Ensure that the drive clutch is disengaged and start the engine.

3.3. If using the diamond-tip concrete blade, turn on the water system.

3.4. Hearing protection and goggles are required when using the saw.

3.5. Align saw blade on marked lines for cut.

SAFETY:

NEVER STAND IN FRONT OF THE SAW WHEN THE ENGINE IS RUNNING.

Step 4: Cut pavement.

4.1. Lower the blade to the desired depth and engage the drive clutch.

4.2. Guide the saw along the marked lines. Don't force the saw while cutting or you could damage the blade.

4.3. When you reach the end of the cut, disengage the drive clutch, raise the blade, and if applicable, turn the water off.

NOTE:

Overlap the cut by ½ the blade width when making corner cuts. This ensures the repair will have square corners.

REVIEW QUESTIONS
FOR
CUT PAVEMENT USING CONCRETE SAW

QUESTION	ANSWER
1. Before starting the concrete saw, what should you ensure?	a. No one is standing in front of the blade. b. The saw was properly checked out. c. The drive clutch is disengaged. d. All of the above.
2. What is the minimum depth you should cut when using the concrete saw?	a. 1 inch. b. 2 inches. c. 3 inches. d. 4 inches.
3. Why should saw cuts overlap at least one-half the blade diameter?	a. To allow for concrete expansion and contraction. b. Permits the blade to cool down before finishing. c. Ensures the patch will have square corners. d. Allows the water from the saw to drain.

CUT PAVEMENT USING CONCRETE SAW

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. mark area to be cut?		
2. perform a pre-operational check on concrete saw?		
3. start saw correctly?		
4. align saw correctly?		
5. cut pavement correctly?		
6. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

REPAIR DEFECTIVE PAVEMENT

PERFORM FULL DEPTH PAVEMENT REPAIR

MODULE 24 **AFQTP UNIT 3**

BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER (24.3.1.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER

Task Training Guide

STS Reference Number/Title:	24.3.1.2. - Break pavement using air compressor with jackhammer.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2, *Repairing and Replacing Defective Rigid Pavements*. 2. Unified Facilities Criteria (UFC) 3-270-04, *Concrete Repair.* 3. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 1, Unit 5, Section 5-2, Lesson 043; *Operator Inspection and Maintenance.* 4. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. UFC 3-270-04, Chapter 4, Paragraph 4-5, *Removal of Existing Concrete*. 2.2. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2. 2.3. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 1, Unit 5, Section 5-2, Lesson 043. 2.4. Local procedures.
Equipment/Tools Required:	1. Jackhammer. 2. Air compressor. 3. Hand tools. 4. Tool bag. 5. Personal protective equipment.
Learning Objective:	The trainee will be able to properly break pavement using the air compressor with jackhammer.
Samples of Behavior:	The trainee will break pavement using the air compressor with jackhammer.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER

1. Background. The most common way to remove defective concrete is by use of a pneumatic hammer, commonly called a “jackhammer. Pneumatic hammers are available in many sizes. For breaking concrete slabs, the pneumatic hammer most commonly used is the 50 to 90-pound class and requires 90 pound square inch (psi) of air pressure to operate. A basic rule of thumb is the thicker the concrete, the heavier the hammer. When you use a pneumatic hammer it is absolutely necessary to wear steel toe boots or toe guards, hearing protection, eye protection and hand protection. You must always work inside the sawed area. Never stand outside the defective area to try to break out the pavement. The bit will tend to vibrate against the vertical face and damage the adjacent area.

NOTE TO TRAINER/CERTIFIER:

If a pavement project is not available, the minimum required for upgrade training is to have trainee complete the following:

Step 2: All steps.

Step 3: Attach hammer to air hose and secure with safety wire.

Step 5: Explain procedures.

2. Jackhammer Procedures. Follow these steps to perform full-depth repairs by jackhammer:

Step 1: Perform pre-operational inspections. Refer to local procedures and manuals.

Step 2: Insert bit into hammer.

2.1. Ensure you have the correct bit.

2.2. Ensure that the hammerlock is operational.

Step 3: Attach hammer to air hose and secure with safety wire.

Step 4: Start air compressor.

4.1. Ensure air valves are closed prior to starting.

4.2. Monitor gauges once started.

4.3. Open air valves slowly.

Step 5: Hammer the pavement.

5.1. Position hammer as close to the defect as possible.

5.2. Depress the trigger located on the handle of the hammer. The concrete will begin to crack.

5.3. Break the concrete into small pieces to make it easier to be picked up.

5.4. Stop occasionally to remove pieces.

5.5. Continue in this manner until the entire defective area is removed.

Step 6: Stop air compressor.

6.1. Purge airline before disconnecting the hose from the jackhammer.

6.2. Close air valves.

Step 7: Perform operator maintenance. Refer to local procedures and manuals.

REVIEW QUESTIONS
FOR
BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER

QUESTION	ANSWER
1. What amount of air pressure does a pneumatic hammer require to operate?	a. 110 psi. b. 100 psi. c. 95 psi. d. 90 psi.
2. What safety equipment is required when operating a pneumatic hammer?	a. Hearing protection. b. Steel toed boots. c. Eye protection. d. All of the above.

BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. perform pre-operational check on jackhammer and air compressor?		
2. insert bit properly?		
3. attach hammer to air hose and secure correctly?		
4. jackhammer the pavement correctly?		
5. use appropriate PPE?		
6. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

REPAIR DEFECTIVE PAVEMENT

PERFORM FULL DEPTH PAVEMENT REPAIR

MODULE 24 **AFQTP UNIT 3**

REMOVE PAVEMENT (24.3.1.3.)

THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THIS NON-CORE TASK.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

REMOVE PAVEMENT

Task Training Guide

STS Reference Number/Title:	24.3.1.3. - Remove pavement.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2: *Repairing and Replacing Defective Pavement.* 2. Unified Facilities Criteria (UFC) 3-270-04, *Concrete Repair.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4. 2.2. Local procedures. 3. **Complete AFQTP 3E2X1-24, Unit 3, *Cut Pavement Using Concrete Saw,* dated 4 Apr 03.**
Equipment/Tools Required:	1. Various construction equipment. 2. Concrete saw. 3. Water truck. 4. Hand tools. 5. Tool bag. 6. Personal protective equipment.
Learning Objective:	The trainee will be able to properly remove defective pavement.
Samples of Behavior:	The trainee will remove defective pavement.

Notes:

1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles).
2. Any safety violation is an automatic failure.
3. Additional personnel required due to safety.
4. Trainer will need to develop a training scenario.

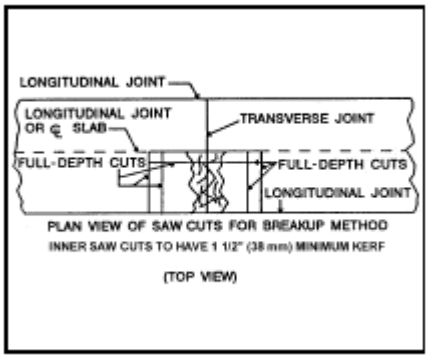
REMOVE PAVEMENT

1. Background. Procedures used for removal must not spall or crack adjacent concrete or significantly disturb the base or subgrade. There are two basic methods to remove concrete pavement.

1.1. Breakup and Cleanout Method. This is normally accomplished using a pavement breaker with removal by a backhoe. This method usually disturbs the base and requires replacement or filling with concrete. It also has the potential to damage the adjacent slab if proper sawing procedures are not followed.

1.1.1. The repair is isolated by full-depth saw cuts, additional saw cuts using a wheel saw with at least 1 $^{1}/_{2}$ inch kerf, are made within the repair area, parallel and approximately 1 $^{1}/_{2}$ feet from each perimeter saw cut or joint (Figure 24.4.).

Figure 24-4. Additional Saw Cuts (Breakup Method).



1.1.2. Breakup should begin in the center of the removal area within the inner saw cuts.

1.1.3. After breakup of the inner area, a backhoe can then be used to gently pull the outer region free of the adjacent slab, or this strip can be broken up with light hand-held jackhammers.

1.2. Lift-out Method. This is normally accomplished using a crane or front-end loader to lift the deteriorated concrete from its position. This method generally does not disturb the base or damage the adjacent slab.

1.2.1. Lift-out operations should be closely controlled to prevent accidents.

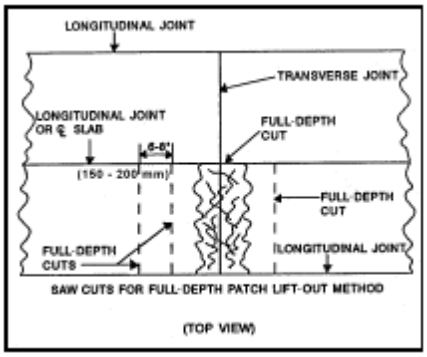
1.2.1.1. After the repair area is isolated by full-depth saw cuts, holes are drilled through the slab and fitted with lift pins, and the slab is then lifted in one or more pieces.

1.2.1.2. If it is necessary to decrease the load, the slab may be cut into smaller pieces.

1.2.2. During hot weather, the sawing equipment may bind during initial transverse sawing procedures. It may be necessary to perform sawing at night when the temperatures are lower and the slabs are contracting.

1.2.3. Another solution is to use a carbide-tipped wheel saw to provide a pressure relief cut within the patch area prior to boundary sawing (Figure 24.5.).

Figure 24-5. Pressure Relief Cut (Lift-out Method).



1.2.3.1. It is strongly recommended that the wheel saw cut be made no closer than 6 to 8 inches from the proposed patch boundary due to possible damage and micro-cracking in adjacent concrete.

1.2.3.2. The same procedures may be used for the removal of continuously reinforced concrete.

1.2.4. Concrete in the two reinforcing lap areas must be carefully removed so as not to damage the reinforcing and to avoid spalling of the concrete at the bottom of the joint.

NOTE TO TRAINER/CERTIFIER:

1. If a pavement project is not available, the minimum required for upgrade training is to have the trainee explain the two methods for removing pavement during full depth repairs.

2. If a pavement project is available, additional personnel will be needed to assists the trainee in perform this task.

2. Removal Procedures. Follow these steps to remove pavement:

Step 1: Mark area to be cut.

1.1. Repair area should be laid out as a rectangle and corners should be square and perpendicular to the flow of traffic.

1.2. Marking material must be waterproof.

Step 2: Perform pre-operational inspection on concrete saw. Refer to local procedures and manuals for proper pre-operational inspection instructions.

SAFETY:

NEVER STAND IN FRONT OF THE SAW WHEN THE ENGINE IS RUNNING.

Step 3: Cut pavement.

3.1. Ensure the correct type blade is on the saw.

3.2. Ensure that the drive clutch is disengaged and start the engine.

3.3. If using the diamond-tip concrete blade, turn on the water system.

3.4. Hearing protection and goggles are required when using the saw.

3.5. Align saw blade on marked lines for cut.

3.6. Make cuts as required.

Step 4: Perform pre-operational check on construction equipment. Refer to local procedures and manuals for pre-operational checks.

Step 5: Remove pavement.

5.1. Use breakup and cleanout method or lift-out method.

5.2. Continue until the entire defective area is removed.

5.3. Dispose of defective pavement.

REVIEW QUESTIONS
FOR
REMOVE PAVEMENT

QUESTION	ANSWER
1. During breakup and cleanout method, full-depth saw cuts are made parallel and approximately how far apart from each perimeter saw cut or joint?	a. 1 foot. b. 1 ½ feet. c. 2 feet. d. 2 ½ feet.
2. When making saw cuts for the lift-out method how close should pressure relief cuts be made from the proposed patch boundary?	a. 2 - 4 inches. b. 4 - 6 inches. c. 6 - 8 inches. d. 12 inches.

REMOVE PAVEMENT

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. mark area to be cut?		
2. perform pre-operational check on concrete saw?		
3. cut pavement?		
4. perform pre-operational check construction equipment?		
5. remove pavement?		
6. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

REPAIR DEFECTIVE PAVEMENT

MODULE 24 **AFQTP UNIT 3**

PERFORM PARTIAL DEPTH REPAIR (24.3.2.)

THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THIS NON-CORE TASK.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

PERFORM PARTIAL DEPTH REPAIR

Task Training Guide

STS Reference Number/Title:	24.3.2. - Perform partial depth repair.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2, Lesson 240; *Partial Depth Patch Procedures.* 2. Unified Facilities Criteria (UFC) 3-270-04, *Concrete Repair.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 1-1, Lesson 240. 2.2. UFC 3-270-04, Chapter 5, *Partial-Depth Repair of Pavements*. 2.3. Local procedures. 3. **Complete AFQTP 3E2x1-24, Unit 3, *Cut Pavement Using Concrete Saw*, dated 4 Apr 03.**
Equipment/Tools Required:	1. Various construction equipment. 2. Air compressor / jackhammer. 3. Concrete saw. 4. Water truck. 5. Hand tools. 6. Tool bag. 7. Personal protective equipment.
Learning Objective:	The trainee will be able to properly perform partial depth repairs.
Samples of Behavior:	The trainee will perform partial depth repairs.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Additional personnel required due to safety. 4. Trainer will need to develop a training scenario.	

PERFORM PARTIAL DEPTH REPAIR

1. Background. When the distress effects only the top few inches of the slab, the weakened concrete is removed down to sound concrete and the area patched. Partial depth repair is typically used to repair spalling either at pavement joints or at mid-slab locations. Generally, joint spalling occurs when unsealed joints are filled with incompressible material preventing movement of the slab in hot weather and results in breakage of the concrete. Other causes of spalling at joints include keyway failures (of oversized, poorly designed keyways), poor construction, poor repairs, dowel bar lockup, improperly located dowels, and dowels in reamed out sockets. "D" cracking can also be a major cause of spalling at joints. Spalling at mid-slab is generally caused by reinforcement that is too close to the surface or by foreign matter in the original pavement. Spans (areas of repair) create a rough ride and can accelerate deterioration. Spalling is typically a localized distress and therefore warrants a localized repair. If several severe spans are present on one joint, it may be more economical to place a full depth repair along the entire joint than to repair individual spans.

2. Purpose of Partial Depth Repair. The purpose of partial depth repairs is to correct localized areas of concrete pavement distress. A repair of this type restores ride ability, deters further deterioration, reduces foreign object damage (FOD) potential, and provides proper edges so joints can be effectively resealed.

3. Repair Boundaries.

3.1. Complete a survey to determine areas of unsound or defective concrete to establish the repair boundaries.

3.2. All areas of unsound concrete should be determined using a sounding technique.

3.2.1. Sounding the pavement is accomplished by striking the existing concrete surface with a steel rod or carpenters hammer.

3.2.2. Defective or unsound concrete will produce a dull or hollow sounding thud, while a sharp metallic ring will indicate sound concrete.

3.3. Repair boundaries should be extended beyond the detected delaminated or spalled area by 3 times the aggregate size if known, or 2 inches minimum if not known to assure removal of all unsound concrete.

3.4. The repair boundaries should be kept square or rectangular to avoid irregular shapes.

3.5. Irregular shapes may cause cracks to develop in the repair material.

3.6. Repair areas closer than 24 inches apart, should be combined. This will help reduce costs and eliminate numerous small patches.

4. Removal of Existing Concrete. Removal of existing concrete can be accomplished by sawing and chipping, or by a milling process.

4.1. To remove concrete by sawing and chipping, a saw cut should be made around the perimeter of the repair area a minimum depth of 2 inches. This will provide a vertical face of sufficient depth to give integrity to the patch.

4.1.1. Concrete within the repair area should be removed to the bottom of the saw cuts or to sound and clean concrete with light pneumatic tools.

4.1.2. It is important that the proper size tools are used.

4.1.3. The recommended **maximum size** of the chipping hammer for partial depth repairs is **30 pounds**.

4.2. Concrete within the repair area can also be removed by carbide-tipped cold milling equipment. Cold milling is especially effective where the repair area extends over the majority of the slab width.

4.2.1. Milling machines must be equipped with a device for stopping at a preset depth in order to prevent excessive removal or damage to existing dowel bars or reinforcement.

4.2.2. After removal of concrete the bottom of the repair area should be sounded again to ensure all unsound or delaminated concrete has been removed.

4.2.2.1. Occasionally, what appears to be spalling at the surface will actually extend through the full slab depth, or for more than one-half the slab thickness.

4.2.2.2. Partial depth repair should not be tried at such locations.

4.2.2.3. Area should be marked, and a full depth repair accomplished.

4.2.3. Full depth repairs should also be made if the concrete below one-half the slab depth is damaged during chipping or if dowel bars or reinforcing are encountered during removal.

4.2.4. Under no circumstances should partial depth repair material rest upon dowel bars or reinforcement.

5. Cleaning. The exposed faces of the concrete and any exposed steel should be sandblasted to remove all loose particles, oil, dirt, dust, asphaltic concrete, rust, and other contaminants prior to patching. Any contamination of the surface will reduce the bond between the new material and the existing concrete.

6. Joint Preparation. When placing a partial depth patch adjacent to any joint, there must be no bond of the repair patch to the joint face of the adjacent concrete. Elimination of bond can be accomplished by using either a compressible insert (styrofoam or asphalt-impregnated fiber-board are commonly used) along the joint prior to placing the patch material.

7. Patch Materials.

7.1. High early strength (Type III) Portland cement concrete should be used where early opening to traffic is required. An epoxy bonding agent should be used to bond the new concrete to the old concrete. The concrete should not be placed until the epoxy becomes tacky.

7.2. Normal set Type I Portland cement concrete can be used when the patch material can be protected from traffic for 24 hours.

7.2.1. A bonding mortar composed of 1 part Portland cement to 1 part sand by volume with sufficient water to produce a mortar with a creamy consistency is applied to the patch area.

7.2.2. The concrete must be placed before the grout dries. If the grout dries or hardens prior to placement of the concrete, it should be removed by sandblasting.

7.2.3. Patches using normal set concrete should not be placed when the air temperature is below 50 degrees Fahrenheit. At temperatures below 55 degrees Fahrenheit, a longer curing period and/or insulation mats may be required.

7.3. Rapid set proprietary patching materials should be used in compliance with the manufactures recommendations--this includes bonding, placing, time required before opening to traffic, and temperature ranges.

7.4. Epoxy mortar and epoxy concrete mix designs should be evaluated in the laboratory before use.

7.4.1. The epoxy resin catalyst should be preconditioned before blending to produce a liquid blended between 75 and 90 degrees Fahrenheit Centigrade).

7.4.2. The epoxy components should be mixed in compliance with the manufactures recommendations prior to addition of aggregate.

7.4.3. The material should be blended in a suitable mixer.

7.4.4. Only material that can be used within 1 hour (dependent on materials and air temperature, may be less than 1 hour) should be mixed in each batch.

8. Placement of Patch Material.

8.1. The bonding agent should be applied with a stiff bristle brush and scrubbed into the patch area; and not be allowed to puddle.

8.2. The volume of material required for a partial depth repair is usually less than 2.0 cubic feet. Therefore, patching-material should be mixed on site in small mobile drum or paddle mixers.

8.3. Transit mix trucks and other large equipment cannot efficiently produce such small quantities since maximum mixing times for a given temperature may be exceeded, resulting in waste of material.

8.4. On large partial depth patches or many small partial depth patches in the same locality that are ready to fill at the same time, a transit mixer may be more economical.

8.5. Slightly over filled to compensate for consolidation.

8.6. Consolidated to eliminate any voids at the interface of the patch and the existing concrete, using small spud vibrators.

8.7. Vibrators greater than 1 inch in diameter are not recommended for this work.

8.8. On very small repairs, hand tools should be sufficient to work the repair and attain adequate consolidation.

9. Finishing.

9.1. The repair area should be finished without leaving excess material on the adjacent pavement surface.

9.2. The recommended finishing procedure is to screed from the center of the patch area to the patch boundaries. This pushes the material toward the interface increasing the potential for high bond strength.

9.3. Finish surface to approximately match the surface finish of the existing adjacent concrete pavement.

9.4. Excess mortar from finishing can be used to fill any saw cuts that extend beyond the patch perimeter at patch corners.

10. Sealing Patch/Slab Interface. An important procedure in placement of partial depth repairs is sealing the patch/slab interface.

10.1. Seal using a one to-one cement grout.

10.2. This grout will form a moisture barrier over the interface and impede deterioration of the patch.

11. Curing. Proper curing of partial depth repairs is very important, due to the large surface area of small patches compared with the volume of patch material.

11.1. This relationship is conducive to quick moisture loss and is different from most other concrete applications,

11.2. Proper curing generally employs the application of curing compound at the time bleed water has evaporated from the surface.

11.3. Because curing is critical for partial depth patches, the first 24 hours should be wet curing with wet burlap or similar material. The balance of the 7-day curing period may be with liquid membrane compounds. In general, the procedures used for curing full depth repairs can be considered for partial depth repairs.

12. Joint Resealing. Resealing the repair joint is extremely important because it will help prevent moisture and incompressible from causing further damage.

12.1. New transverse and longitudinal joints constructed within the patch area need to be formed or sawn to provide the proper joint seal reservoir.

12.2. The joint faces must be clean and dry for good sealant performance.

NOTE TO TRAINER/CERTIFIER:

1. If a pavement project is not available, the minimum required for upgrade training is to have the trainee explain the steps in performing partial depth repairs.

2. If a pavement project is available, additional personnel are required to assists the trainee in accomplishing this task.

13. Pavement Repair Procedures. Follow these steps to perform partial depth repair:

Step 1: Mark area to be cut.

1.1. Repair area should be laid out as a rectangle and corners should be square and perpendicular to the flow of traffic.

1.2. Marking material must be waterproof.

Step 2: Perform pre-operational inspection on concrete saw. Refer to local procedures and manuals for proper pre-operational inspection instructions.

Step 3: Cut pavement.

3.1. Ensure the correct type blade is on the saw.

3.2. Make cuts as required

3.3. Minimum depth 2 inches

SAFETY:

NEVER STAND IN FRONT OF THE SAW WHEN THE ENGINE IS RUNNING.

Step 4: Remove of existing concrete.

4.1. Minimum of 2 inches in depth.

4.2. Maximum size chipping hammer is 30 pounds.

4.3. Recheck bottom of repair for unsound concrete.

4.4. Clean concrete surfaces.

Step 5: Joint preparation.

5.1. Ensure no bond of the repair patch to the face of the adjacent concrete.

5.2. Using a compressible insert.

Step 6. Place patch material.

6.1. Place bonding agent.

6.2. Place patch material, slightly over filled to compensate for consolidation.

6.3. Consolidate.

6.4. Finish.

6.5. Sealing patch/slab interface.

6.6. Cure patch.

Step 7. Reseal joints as required.

REVIEW QUESTIONS
FOR
PERFORM PARTIAL DEPTH REPAIR

QUESTION	ANSWER
1. Repair boundaries should extend a minimum of ____inches to assure removal of all unsound concrete.	a. 1 ½ b. 2 c. 2 ½ d. 3
2. Maximum size hammer for partial depth repairs is ____ pounds?	a. 10 b. 20 c. 30 d. 60
3. What type of cement should be used where early opening to traffic is required?	a. Type III. b. Type I. c. Type IV. d. Type II.
4. Normal set concrete should not be placed when the air temperature is below _____ degree Fahrenheit.	a. 60 b. 55 c. 50 d. 40
5. For partial depth repairs, vibrators greater than _____in diameter are not recommended.	a. 4 b. 3 c. 2 d. 1
6. What ratio should the cement grout be to seal the patch/slab interface?	a. One to one. b. Two to one. c. Two to three. d. One to three.

PERFORM PARTIAL DEPTH REPAIR

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. mark area to be cut?		
2. perform pre-operational check on concrete saw?		
3. cut pavement correctly?		
4. remove existing concrete correctly?		
5. prepare joints if required?		
6. place patch materials?		
7. reseal joints?		
8. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

REPAIR DEFECTIVE SEALING MATERIAL

CLEAN JOINTS/CRACKS WITH

MODULE 24 **AFQTP UNIT 4**

HIGH PRESSURE AIR (24.4.3.2.)

THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THIS NON-CORE TASK

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

CLEAN JOINTS/CRACKS WITH HIGH PRESSURE AIR

Task Training Guide

STS Reference Number/Title:	24.4.3.2. - Clean joint/cracks with high-pressure air.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2, Lesson 240; *Partial-Depth Patch Procedures.* 2. Unified Facilities Criteria (UFC) 3-270-04, *Concrete Repair.* 3. Air Force Joint Manual (AFJMAN) 32-1040, *Maintenance and Repair of Surface Areas.* 4. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E231 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 2, Unit 4, Section 4-2, Lesson 240. 2.2. UFC 3-270-04, Chapter 5, Paragraph 5-5, *Cleaning*. 2.3. AFJMAN 32-1040, Chapter 4, Paragraph 4-7c(2); *Preparation of the Joints and Cracks*. 2.4. Local procedures.
Equipment/Tools Required:	1. Air compressor. 2. Tool bag. 3. Personal protective equipment.
Learning Objective:	The trainee will be able to clean joints/cracks using high-pressure air.
Samples of Behavior:	The trainee will clean joints/cracks using high-pressure air.
Notes:	
1. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 2. Any safety violation is an automatic failure. 3. Trainer will need to develop a training scenario.	

CLEAN JOINTS/CRACKS WITH HIGH PRESSURE AIR

1. Background. Before resealing joints and cracks they must be clean and dry for good sealant performance. The cleaner the area, the better the sealant bonds. One way of cleaning concrete surfaces is with high-pressure air. Any air compressor capable of maintaining a line pressure of 90 pounds per square inch at the nozzle is the minimum size suggested for cleaning cracks and joints. The compressor will be in good operating condition and equipped with traps that will maintain the compressed air system free of oil and water. No special attachments are required.

2. Safety. When cleaning concrete surfaces with high-pressure air, you must observe all safety precautions. Never direct the nozzle toward anyone or straight down at the pavement. Always wear the appropriate personal protective equipment. Always use safety wire on the hose connections.

3. Joints/Cracks. Once the old sealant has been removed and any required re-facing or rebuilding of the joints has been accomplished the joints are ready for cleaning. Failure to properly clean the joints is the leading cause of joint sealant failure. Cracks are normally irregular in dimension and direction, making them more difficult to prepare and seal. Because of the irregular nature, the equipment used to prepare joints may not be suitable for preparing cracks. The techniques change, however, the procedures remain basically the same.

4. Joint/Crack Cleaning Procedures. Follow these steps to clean joints/cracks with high pressure air:

Step 1: Perform pre-operational inspection on air compressor. Refer to local procedures and manuals.

Step 2: Ensure all air valves are closed and air hose is secured with safety wire.

Step 3: Start the air compressor.

3.1. Ensure air compressor is equipped with traps that will maintain the compressed air system free of oil and water.

3.2. Unroll hose and open the air valve slowly.

Step 4: Clean the concrete surface.

4.1. Direct the air blast onto the surface.

4.2. Continue until the surface has no loose particles.

SAFETY:
NEVER DIRECT THE AIR NOZZLE TOWARD ANYONE OR STRAIGHT DOWN AT THE PAVEMENT.

Step 5: Close the air valve and store hose.

Step 6: Shut off air compressor.

REVIEW QUESTIONS
FOR
CLEAN JOINTS/CRACKS WITH HIGH PRESSURE AIR

QUESTION	ANSWER
1. Special adapters for the air hoses are needed when using the air compressor to clean concrete.	a. True. b. False.
2. What should you never do when using high-pressure air to clean concrete surfaces?	a. Direct the air at anyone. b. Use on wet surfaces. c. Direct the air straight down. d. Both a and c are correct.

CLEAN JOINTS/CRACKS WITH HIGH PRESSURE AIR

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. perform pre-operational inspection on air compressor?		
2. ensure all air valves were closed and air hose was secured?		
3. start air compressor correctly?		
4. open air valves and cleaned concrete surface?		
5. close air valve and stored hose?		
6. shut off air compressor correctly?		
7. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

FLEXIBLE PAVEMENT

MODULE 24 **AFQTP UNIT 5**

APPLY PRIME COAT (24.5.2.)

PLACE ASPHALT (24.5.3.)

COMPACT ASPHALT (24.5.5.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

APPLY PRIME COAT / PLACE ASPHALT / COMPACT ASPHALT

Task Training Guide

STS Reference Number/Title:	24.5.2. - Apply prime coat. 24.5.3. - Place asphalt. 24.5.5. - Compact asphalt.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3, Unit 1, Section 1-2, Lesson 403, *How to Apply Prime Coat*, and Section 1-3, Lessons 406, *How to Place Bituminous Materials* and 407, *How to Compact Bituminous Materials.* 2. Unified Facilities Criteria (UFC) 3-250-03, *Standard Practice Manual for Flexible Pavements.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E251 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3, Unit 1, Sections 1-2 &1-3, Lessons 403, 406, & 407. 2.2. UFC 3-250-03, Chapter 3, *Spray Applications*. 2.3. Local procedures.
Equipment/Tools Required:	1. Prime or tack coat and applicator. 2. Hand tools. 3. Compaction equipment. 4. Personal safety equipment. 5. General tool kit.
Learning Objective:	The trainee will be able to properly apply a prime coat, place asphalt, and compact asphalt.
Samples of Behavior:	The trainee will apply prime coat, place asphalt, and compact asphalt.
Notes:	
1. These are 7-level core tasks. 2. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 3. Any safety violation is an automatic failure. 4. Trainer will need to develop a training scenario.	

APPLY PRIME COAT / PLACE ASPHALT / COMPACT ASPHALT

1. Background. Bituminous materials provide a resilient, relatively waterproof, load-distributing pavement that protects the base course from the harmful effects of water and the abrasion of traffic. Wear, weathering, and deterioration from aging all act on bituminous pavements, and therefore maintenance of these pavements is necessary for long life. The flexibility of bituminous concrete allows a pavement structure to adjust slightly to consolidation of underlying layers or deformation due to loads without affecting pavement performance. Bituminous pavements may use a wide range of construction materials, often leading to substantial savings from the use of locally available materials. Surfaces must be properly prepared before the pavement mixture is placed. Additional pavement courses can be placed on existing pavements to provide additional structural strength as total loads or traffic intensity increase. The paving engineer must design and construct the most economical pavement that will satisfy the objective of long pavement life.

2. Prime Coat. A light application of a liquid bituminous material to an absorbent surface.

2.1. Purposes of the prime coat are to prevent raveling of the base course during pavement construction; to waterproof during pavement construction; and to form a tight, tough base to which a bituminous pavement will adhere. Prime coats provide a bond between the pavement and the base course. This bond is especially important when constructing relatively thin pavements that might otherwise have a tendency to shift under traffic loads.

2.1.1. To accomplish these purposes, the prime material must penetrate into the base course and fill the void spaces.

2.1.2. A completed base course is susceptible to serious damage from rain, wind, and traffic.

2.1.3. An adequate prime coat is insurance against this water and traffic damage.

2.1.4. Prime coat material should be applied to a dust-free base as soon as the base has been thoroughly compacted and before construction or other traffic loosens surface material in the compacted base.

2.1.5. Sufficient time should be allowed to permit prime coat material to penetrate thoroughly into the compacted base.

2.1.6. Generally most of the primer should be absorbed into the surface in 2-3 hours, and normal drying or curing period should be approximately 48 hours.

2.1.7. Prime coats are usually applied in quantities of 0.10 to 0.25 gallon per square yard.

2.1.8. When excessive prime is used, unabsorbed material is absorbed by the new pavement and may contribute to pavement slippage, cracking, or surface bleeding.

2.1.9. Where excessive prime is applied, the excess may be blotted with an application of clean fine sand or mineral dust.

2.2. Asphalt emulsions are the best materials to use for prime coats because environmental restrictions have begun to limit the types of prime material available in some areas of the United States.

2.2.1. Types of emulsions used as primers on dense, well-compacted bases are: SS-1, SS-1h, CSS-1 and CSS-1h.

2.2.2. SS types are used because they are more fluid and penetrate the base better.

2.2.3. Asphalt emulsions must be diluted with water before being applied as a prime, and special handling and storage considerations to prevent freezing, settling, and breaking must be exercised.

2.3. Prime coats should be uniformly applied with a pressure distributor at the required application rate and at the proper temperature for the bitumen used.

2.4. Surfaces to be primed which contain appreciable amounts of loose material or are dusty should be cleaned thoroughly.

2.5. A dusty surface will sometimes cause prime to "freckle," that is, have small areas with no prime and adjacent areas with drops of excess prime.

2.6. A light application of water just before applying the prime will aid in reducing "freckles" and getting good distribution of the prime.

3. Asphalt Placement.

3.1. Hand spreading is the oldest method used to place, spread and shape the mixed material.

3.1.1. Mix is dumped from the dump trucks onto dump boards from which the material is shoveled onto the road or runway.

3.1.2. It is raked smooth to grade and contour, and compacted with a roller.

3.1.3. Mainly used to supplement other placement and spreading methods.

3.1.4. When using hot-mix overfill the area by 25 to 50 % to allow for compaction.

3.1.5. If cold mix is used, spread and roll it in 2 to 3 inch layers and allow mix to aerate before compaction.

3.1.6. When placing material by hand, be careful to prevent segregation of the mix.

3.1.7. Dump the material in small piles ahead of the workers.

3.1.8. Level with shovels, rakes, and lutes.

3.1.9. Material should be as level as possible before compacting.

3.2. Blade spreading is done with a grader.

3.2.1. Successive passes of the blade reduce the irregularities in the surface.

3.2.2. Poor edges usually accompany blade-spreading operations.

3.2.3. Joints present a problem and are seldom attempted.

3.3. Mechanical spreading is accomplished through the use of bituminous paving machines.

3.3.1. They may be towed-type for small paving jobs or self-propelled for large projects.

3.3.2. Savings in spreading time, greater smoothness of the placed mixes and the ability of the machine to handle the stiffer hot mixes are advantages over motor graders.

4. Compact Asphalt.

4.1. Rollers used to compact bituminous mixtures are static steel-wheel, vibratory steel-wheel, and rubber-tire rollers.

4.1.1. Static steel-wheel rollers are generally used for breakdown and finish rolling

4.1.2. Vibratory steel-wheel rollers can be used for breakdown, intermediate, and finish rolling. Breakdown and intermediate rolling are performed in the vibratory mode, while finish rolling is performed in the static mode.

4.1.3. Rubber-tire rollers are used for intermediate rolling and should be used compaction of all heavy-duty bituminous pavements.

4.2. Rolling of freshly placed asphalt mix is accomplished in the following order:

4.2.1. Transverse joints - 6-inch pass on new material with successive passes covering 6 – 8 inches of fresh material until entire width of the roller is on the new material.

4.2.2. Longitudinal joints - directly behind the paving operation not more than 6 inches to pinch and press the fines together at the joint.

4.2.3. Initial or breakdown rolling - 80-90% of compaction occurs during this phase. Start on the low side of the spread and use a rolling pattern that provides the most uniform coverage of the lane being placed.

4.2.4. Second or intermediate rolling - closely follow breakdown rolling while the mix is still plastic and at a temperature that will result in maximum density.

4.2.5. Finish rolling - done to improve the surface.

NOTE TO TRAINER/CERTIFIER:

If a flexible pavement project is not available, the minimum required for upgrade training is the development of a scenario simulating a construction of a roadway measuring 1 mile (5,280') long, 24' wide, and 4 inches thick. The application rate for prime coat is 0.25. Have the trainee explain /demonstrate the following steps:

Step 1: Determine amount of prime coat and asphalt needed for a 1 mile by 24' wide by 4 inches thick roadway.

Step 2: Explain.

Step 3: Explain.

Step 4: Explain/demonstrate rolling steps.

5. Procedures. Follow these steps to apply prime coat, place asphalt, and compact asphalt:

Step 1: Determine amount of prime coat and asphalt needed.

Step 2: Apply a light application of water to base.

2.1. Apply prime coat to base.

2.2. Allow prime coat to absorb into base and time to cure.

Step 3: Place asphalt by hand, blade, or mechanical spreading.

3.1. Place required thickness of asphalt.

3.2. Overfill 25 to 50% if using hot-mix for repairs.

3.3. If using cold-mix, spread and roll 2-3 inch layers and allow mix to aerate before compacting.

Step 4: Compact asphalt.

4.1. Transverse joints.

4.2. Longitudinal joints.

4.3. Initial or breakdown rolling.

4.4. Second or intermediate rolling.

4.5. Finish rolling.

REVIEW QUESTIONS
FOR
APPLY PRIME COAT / PLACE ASPHALT / COMPACT ASPHALT

QUESTION	ANSWER
1. What is the definition of a prime coat?	a. A light application of liquid bituminous material applied to an absorbent surface b. A heavy application of liquid bituminous material applied to an absorbent surface c. A light application of liquid bituminous material applied to a non-absorbent surface d. A heavy application of liquid bituminous material applied to a non-absorbent surface
2. What is the application rate for a prime coat?	a. .01 to 0.05 gallon per square yard. b. 0.10 to 0.25 gallon per square yard. c. .01 to 0.05 gallon per square foot. d. 0.10 to 0.25 gallon per square foot.
3. The primer should be generally absorbed into the base in _____ hours.	a. 2-3 b. 3-6 c. 4-8 d. 5
4. If cold mix is used it should be allowed to _____before compaction.	a. soften b. aerate c. segregate d. None of the above.
5. How much should you overfill when using hot-mix asphalt?	a. 25% - 50% b. 30% - 40 % c. 40% - 45% d. 50% - 55%
6. How much compaction occurs during initial or breakdown rolling?	a. 50-60% b. 60-70% c. 80-90% d. 95%

APPLY PRIME COAT / PLACE ASPHALT / COMPACT ASPHALT

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE….	YES	NO
1. accurately determined amount of prime coat and asphalt?		
2. apply prime coat correctly?		
3. place asphalt correctly?		
4. compact asphalt correctly?		
5. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

FLEXIBLE PAVEMENT

REPAIR DEFECTIVE PAVEMENT:

MODULE 24 **AFQTP UNIT 5**

REMOVE PAVEMENT (24.5.6.3.) OPTIONAL

APPLY TACK COAT (24.5.6.6.) MANDATORY

PLACE ASPHALT (24.5.6.7.) OPTIONAL

TWO TASKS IN THIS UNIT IS **OPTIONAL** AND AVAILABLE TO USE AS A LESSON PLAN WHEN TRAINING ON THESE NON-CORE TASKS.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

REMOVE PAVEMENT/APPLY TACKCOAT/PLACE ASPHALT

Task Training Guide

STS Reference Number/Title:	24.5.6.3. - Remove pavement. 24.5.6.6. - Apply tack coat. 24.5.6.7. - Place asphalt.
Training References:	1. Career Development Course (CDC) Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3: 1.1. Unit 1, Sections 1-2 & 1-3, Lessons 404, *How to Apply a Tack Coat*; 406, *How to Place Bituminous Materials*; 407*, How to Compact Bituminous Material.* 1.2. Unit 2, Section 2-2, Lessons 411, *How to Remove Defective Flexible Pavement;* 412*, Replacing Defective Flexible Pavement.* 2. Unified Facilities Criteria (UFC) 3-250-03, *Standard Practice Manual for Flexible Pavements.* 3. Local procedures.
Prerequisites:	1. **Possess as a minimum a 3E251 AFSC.** 2. **Review the following references:** 2.1. CDC Pavements and Construction Equipment Operator Journeyman 3E251A, Volume 3: 2.1.1. Unit 1, Sections 1-2 &1-3, Lessons 404, 406, & 407. 2.1.2. Unit 2, Section 2-2, Lessons 411 & 412. 2.2. UFC 3-250-03, Chapter 2, *Hot-Mix Asphalt*. 2.3. Local procedures.
Equipment/Tools Required:	1. Concrete saw. 2. Pneumatic hammer. 3. Air compressor. 4. Hand tools. 5. Tool bag. 6. Safety equipment.
Learning Objective:	The trainee will be able to properly remove pavement, apply tack coat, and place asphalt.
Samples of Behavior:	The trainee will remove pavement, apply tack coat, and place asphalt.
Notes:	
1. These are 7-level optional and mandatory core tasks. 2. Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles). 3. Any safety violation is an automatic failure. 4. Trainer will need to develop a training scenario.	

REMOVE PAVEMENT/APPLY TACK COAT/PLACE

1. Background. Flexible pavements should be repaired with the same materials that were used to build them. Bituminous materials provide a resilient, relatively waterproof, load-distributing medium that protects the base course from the harmful effects of water and the abrasion of traffic. Wear weathering, and deterioration from aging all act on bituminous pavements, and therefore maintenance of these pavements is necessary for long life. Partial depth and full depth repairs will require removal of the defective pavement, preparing the area and placing new material.

2. Pavement Removal and Replacement. The first step is to mark the area for repair. Use waterproof material if using the pavement saw to cut the pavement. Flexible pavements lack the beam strength of rigid pavements so mark the area at least 1 foot (12 inches) into the good pavement. Shape of the repair is important so the repair will be strong enough to support traffic. The repair area should be square or rectangular in shape with two faces at right angles to the flow of traffic. This will ensure that the patch does not shove or corrugate when traffic is placed on it. Cut the pavement using the pavement saw with the appropriate blade or use the pneumatic hammer (Jackhammer) 5- inch asphalt cutting bit.

2.1. Partial Depth Repairs. Partial-depth repairs will extend only as deep as necessary into the pavement to reach undamaged pavement.

2.1.1. A light tack coat (0.05 to 0.15 gallon per square yard) of SS-1 or SS-1h asphalt emulsion diluted with equal parts of water should be applied to the cleared area.

2.1.2. Tack coat should be allowed to cure until it becomes tacky to touch.

2.1.3. Place enough hot-mix material into the repair area so that when compacted, it will bring the area back to the original grade.

2.1.4. If the material has been carefully spread, allowance of approximately 25 to 50 percent overfill should correct for compaction.

2.1.5. If edges of patch are feathered, coarse aggregate must be removed from the edges prior to compaction.

2.1.6. If plant-mix cold-laid material must be used, it should be aerated as required before it is placed in the depression.

2.1.7. After material has been placed, thoroughly compact using a vibrating plate compactor, roller, or hand tamper.

2.1.8. In the repair of deep depressions normally two or more layers of mix are required. The layers should be between 2 to 3 inches each.

2.1.9. Check elevation with a straight edge. If needed, additional material may be raked into the surface and re-compacted.

2.2. Full Depth Repairs. A full-depth patch normally extends to the subgrade. If the subgrade is damaged, it should be repaired.

2.2.1. Apply a light tack coat to the vertical face and allow it to become tacky (cure).

2.2.2. If the patch is placed on subgrade, no prime is needed; however, if it is placed on a granular base, it should be primed.

2.2.3. For best results, the entire area should be filled with dense-graded hot-asphalt plant mix.

2.2.4. The patch should be backfilled and compacted in 2 to 3 inch lifts.

2.2.5. A rubber-tire or vibratory roller should be used whenever possible along with the hand-held compactors.

2.2.6. Partial backfilling of the hole with compacted granular fill and topping with hot mix can be done when there is a shortage of hot mix.

2.2.7. Cold mix can be used when necessary, but it is not encouraged.

2.2.8. Check elevation with a straight edge. If needed, additional material may be raked into the surface and re-compacted.

NOTE TO TRAINER/CERTIFIER:

If a pavement project is not available, the minimum required for upgrade training is to have the trainee simulate actual repairs by explaining the steps to complete the repairs.

3. Removal and Replacement Procedures. Follow these steps to remove pavement, apply tack coat, and place asphalt:

Step 1: Remove pavement for repair.

1.1. Mark the area at least 1 foot into the good pavement.

1.2. Square or rectangular in shape.

1.3. Cut pavement using pavement saw or pneumatic hammer.

1.4. Remove defective pavement

Step 2: Prepare area for type of repair to be made.

2.1. Partial depth:

2.1.1. Apply tack coat to cleared area.

2.1.2. Allow tack coat to cure.

2.2. Full depth:

2.2.1. Repair subgrade if needed.

2.2.2. Apply tack coat to vertical faces of repair.

2.2.3. Allow tack coat to cure.

Step 3: Place asphalt for type of repair to be made.

3.1. Place required thickness of asphalt.

3.2. Allow approximately 25 to 50 percent overfill for compaction.

3.3. Thoroughly compact using a vibrating plate compactor, roller, or hand tamper.

Step 4: Check elevation.

REVIEW QUESTIONS
FOR
REMOVE PAVEMENT / APPLY TACK COAT / PLACE ASPHALT

QUESTION	ANSWER
1. Mark areas for repair at least _____ into the good pavement.	a. 2 inches b. 1 foot c. 1 ½ feet d. 2 feet
2. Place material in _____ inch lifts.	a. 1 - 2 b. 2 c. 2 - 3 d. 4
3. How much overfill should be allowed for compaction?	a. 10-20%. b. 20-30%. c. 25-50%. d. 25-30%.
4. On full depth repairs on what areas is the tack coat placed?	a. Vertical. b. Horizontal. c. Not required.
5. Repair areas should have ____ faces at right angles to the flow of traffic.	a. 1 b. 2 c. 3 d. 4

REMOVE PAVEMENT / APPLY TACK COAT / PLACE ASPHALT

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

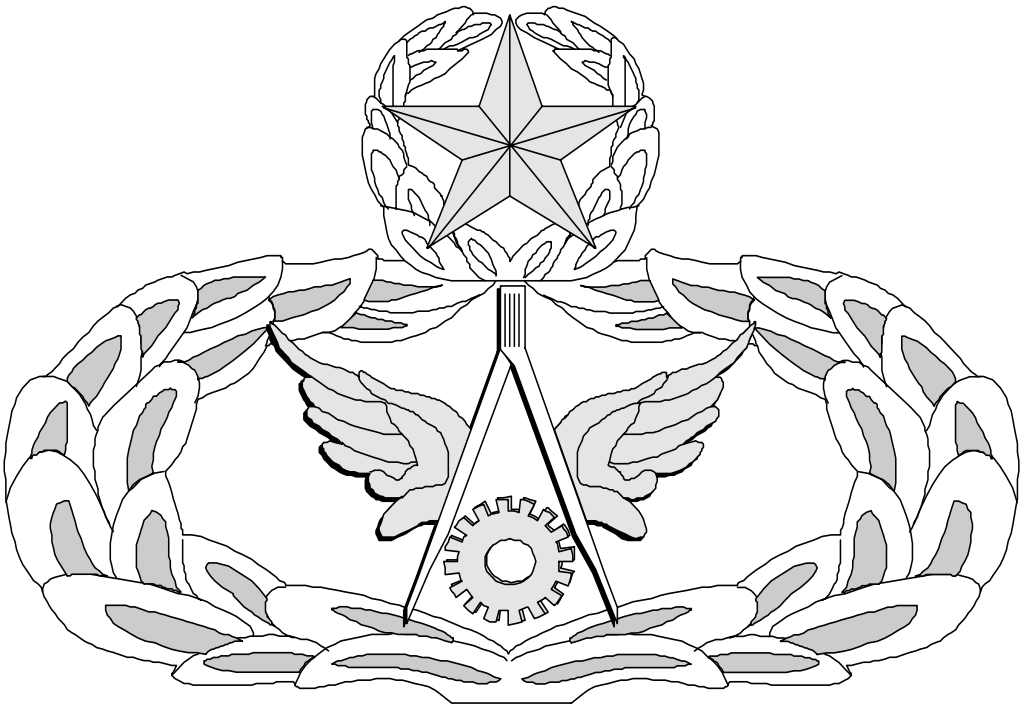
DID THE TRAINEE….	YES	NO
1. mark area correctly for repair?		
2. removed defective pavement?		
3. prepare area for type of repair to be made?		
4. place asphalt?		
5. compact material?		
6. check elevation?		
7. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

AIR FORCE CIVIL ENGINEER

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



FOR

PAVEMENTS & CONSTRUCTION EQUIPMENT OPERATOR

(3E2X1)

MODULE 24

PAVED SURFACES

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

LAY OUT AREA USING LINE LEVEL
(3E2X1-24.1.2.1.1.)

QUESTION	ANSWER
1. What is the first step when laying out a small area?	c. Clear the area.
2. What is one method used to ensure the corners are square?	a. Measure diagonally across corners.

COMPUTE MATERIAL REQUIREMENTS FOR ASPHALT / CONCRETE / BASE COURSE
(3E2X1-24.1.3.2. / 24.1.3.3. / 24.1.3.4.)
(OPTIONAL)

QUESTION	ANSWER
1. What is the application rate for prime coat?	b. .10 to .25 gallons per square yard.
2. How much does one cubic foot of cold mix weigh?	b. 90 pounds.
3. Why do you divide the total weight of asphalt by 2000?	d. To convert pounds to tons.
4. How do you convert inches into a decimal part of a foot?	c. Divide by 12.
5. What is the radius of a circle?	a. Half the diameter.
6. How is base course ordered?	d. By the ton.
7. How many cubic feet are in one cubic yard?	d. 27

CLEAR THE AREA
(3E2X1-24.1.4.)
(OPTIONAL)

QUESTION	ANSWER
1. What hand tools are used to dig up stumps and roots?	d. All of the above.
2. Which hand tool is used for chopping down saplings or very small trees?	a. Axe.
3. What hand tool is used to cut down small to very large trees?	d. Chainsaw.
4. What equipment is typically used to clear large areas of vegetation, brush, trees, and rocks?	a. Crawler tractors.
5. How should you remove medium size trees (12 to 18 inches in diameter) with a crawler tractor?	c. Blade raised high, push tree over and back up to prevent roots from lifting dozer.
6. The crawler tractor should use the ___ step process to remove large trees (12 – 30 inch) diameter.	d. 4

STABILIZE USING MECHANICAL MEANS / CHEMICALS
(3E2X1-24.1.5.1.1. / 24.1.5.2.)

QUESTION	ANSWER
1. What type of chemical would you add to granular, crumbly soil?	d. Bituminous materials.
2. Lime is used to stabilize:	b. clay.
3. What are the two types of stabilization?	b. Mechanical and chemical.
4. The blending method of mechanical stabilization means mixing _____ with _____.	a. soil with soil.

COMPACT SUBGRADE
(3E2X1-24.1.5.2)

QUESTION	ANSWER
1. The purpose of compaction is to increase the subgrades:	c. density.
2. Compaction prevents shearing and _____ when loads are applied.	a. settlement
3. Which roller is best used on granular soils with little or no fine such as sand and gravel mixtures?	c. Steel Wheel.
4. Which roller is best used for clay soils?	a. Sheepsfoot.

PLACE (BASE COURSE) MATERIALS
(3E2X1-24.1.6.1.)

QUESTION	ANSWER
1. A satisfactory base course is made up of:	a. 50% well graded gravel, 40% well graded sand, and 10% slightly plastic silt.
2. To prevent consolidation under traffic, the base course must be:	b. stronger than the sub-grade.
3. When placing the base course, try to prevent:	b. segregation.

COMPACT BASE COURSE MATERIALS
(3E2X1-24.1.6.2)

QUESTION	ANSWER
1. When using small compaction equipment the thickness of each layer should be:	d. 3 inches or less.
2. When using large compaction equipment the thickness of each layer can be as much as _____ inches.	b. 6
3. A final rolling of the base course should be accomplished to furnish a:	c. tight water shedding surface.

INSTALL WOOD / METAL FORMS
(3E2X1-24.2.1.1.1. / 24.2.1.1.2.)

QUESTION	ANSWER
1. Why place soil behind the forms?	a. To prevent concrete from getting in the stake holes.
2. How do you ensure proper elevation of a form?	b. By aligning the top inside edge of the form with the string line.
3. What is the stake length for 8-inch metal forms?	d. 18”’
4. Metal forms should deflect no more than ____ inch when set.	a. ¼

INSTALL WIRE MESH
(3E2X1-24.2.1.2.1.)

QUESTION	ANSWER
1. What is the purpose of reinforcing steel?	c. To increase the tensile strength of the hardened concrete.
2. What are the types of reinforcing steel?	a. Rebar and welded wire fabric.
3. When using wire mesh for reinforcement, how is it positioned in the pour area?	a. Using chairs or pulled to the center with a hook device.

PLACE CONCRETE / FABRICATE JOINTS / NON-SKID FINISH CONCRETE / CURE CONCRETE
(3E2X1-24.2.1.5. / 24.2.1.6. / 24.2.1.7.2. / 24.2.1.8.)

QUESTION	ANSWER
1. Prior to actually placing the concrete, you want to _____ the forms so concrete will not stick to them.	d. oil
2. Why do we tap the outside of the forms with a hammer?	c. To consolidate the edge of the pad and eliminate honeycomb.
3. After placing the concrete in the forms you need to _____ the concrete so that it is level with the forms.	a. screed
4. What are the three types of joints?	b. Contraction, construction, and expansion.
5. When does final finishing begin?	d. Concrete is firm but not yet completely set.
6. A bull float is used for large areas and a hand float is used for small areas.	a. True
7. Which of the following items would be used to obtain a non-skid surface on a recently poured concrete pad?	d. Broom.

REMOVE FORMS
(3E2X1-24.2.1.9.)

QUESTION	ANSWER
1. How long should forms be in place before removal?	c. 1 day to 3 days.
2. When removing forms always pry _____ and away from the concrete.	c. up
3. You want to clean and oil forms as soon as possible after removing them.	a. True.
4. After all forms are removed, you want to _____the area.	b. backfill

CUT PAVEMENT USING CONCRETE SAW
(3E2X1-24.3.1.1.)

QUESTION	ANSWER
1. Before starting the concrete saw what should you ensure?	d. All of the above.
2. What is the minimum depth you should cut when using the concrete saw?	b. 2 inches.
3. Why should saw cuts overlap at least one-half the blade diameter?	c. Ensures the patch will have square corners.

BREAK PAVEMENT USING AIR COMPRESSOR WITH JACKHAMMER
(3E2X1-24.3.1.2.)

Question	Answer
1. What amount of air pressure does a pneumatic hammer require to operate?	d. 90 psi.
2. What safety equipment is required when operating a pneumatic hammer?	d. All of the above.

REMOVE PAVEMENT
(3E2X1-24.3.1.3.)
(OPTIONAL)

QUESTION	ANSWER
1. During breakup and cleanout method, full-depth saw cuts are made parallel and approximately how far apart from each perimeter saw cut or joint?	b. 1 ½ feet.
2. When making saw cuts for the lift-out method, how close should pressure relief cuts be made from the proposed patch boundary?	c. 6 - 8 inches.

PERFORM PARTIAL DEPTH REPAIR
(3E2X1-24.3.2.)
(OPTIONAL)

QUESTION	ANSWER
1. Repair boundaries should extend a minimum of ___ inches to assure removal of all unsound concrete.	b. 2
2. Maximum size hammer for partial depth repair is ____ pounds.	c. 30
3. What type of cement should be used where early opening to traffic is required?	a. Type III.
4. Normal set concrete should not be placed when the air temperature is below ___ degree Fahrenheit.	c. 50
5. For partial depth repairs, vibrators greater than ___ inch diameter are not recommended.	d. 1
6. What ratio should the cement grout be to seal the patch/slab interface?	a. One to one.

CLEAN JOINTS/CRACKS WITH HIGH PRESSURE AIR
(3E2X1-24.2.3.2.2.)
(OPTIONAL)

QUESTION	ANSWER
1. Special adapters for the air hoses when using the air compressor to clean concrete.	b. False.
2. What should you never do when using high-pressure air to clean concrete surfaces?	d. Both a and c are correct.

APPLY PRIME COAT / PLACE ASPHALT / COMPACT ASPHALT
(3E2X1-24.5.2. / 24.5.3. / 24.5.5.)

QUESTION	ANSWER
1. What is the definition of a prime coat?	a. A light application of liquid bituminous material applied to an absorbent surface
2. What is the application rate for a prime coat?	b. 0.10 to 0.25 gallon square yard.
3. The primer should generally absorb into the base in ____ hours.	a. 2-3
4. If cold mix is used it should be allowed to _____ before compaction.	b. Aerate.
5. How much should you overfill when using hot-mix asphalt?	a. 25% - 50%
6. How much compaction occurs during initial or breakdown rolling?	c. 80-90%

REMOVE PAVEMENT / APPLY TACK COAT / PLACE ASPHALT
(3E2X1-24.5.6.3. / 24.5.6.7.) *(OPTIONAL)*
(3E2X1-24.5.6.6.) (*MANDATORY*)

QUESTION	ANSWER
1. Mark areas for repair at least _____ into the good pavement.	b. 1 foot
2. Place material in ____ inch lifts.	c. 2 - 3
3. How much overfill should be allowed for compaction?	c. 25-50%
4. On full depth repairs on what areas is the tack coat placed?	a. Vertical.
5. Repair areas should have ___ faces at right angles to the flow of traffic.	b. 2

MEMORANDUM FOR HQ AFCESA/CEOF
139 Barnes Drive Suite 1
Tyndall AFB, FL 32403-5319

FROM:

SUBJECT: Qualification Training Package Improvement

1. Identify module.

   Module # and title_____

2. Identify improvement/correction section(s):

   _____ STS Task Reference
   _____ Training Reference
   _____ Evaluation Instructions
   _____ Performance Resources
   _____ Steps in Task Performance
   _____ Performance Checklist
   _____ Feedback
   _____ Format
   _____ Other

3. Recommended changes--use a continuation sheet if necessary.

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

4. You may choose to call in your recommendations to DSN 523-6074 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email ceof.helpdesk@tyndall.af.mil.

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF
Title/Position