



Erosion Control

**Georgia Department of Transportation
Copyright 2000**

The Georgia Department of Transportation wishes to thank the Louisiana Department of Transportation and Development Training and Recruitment Section, for permission to use substantial portions of their previously published Erosion Control Volume 1 programmed instructional text in the development of this text.

Reproduction of any or all portions of this Manual is prohibited without the written consent of the Georgia Department of Transportation, Office of Personnel.

FORWARD

Some six (6) billion tons of soil are eroding each year across the United States, according to conservationists who maintain that combating the problem is costing the U.S. nearly \$6 billion annually. Still, erosion continues its devastating trek.

Destroying nearly everything in its path, erosion mars slopes with ugly rills, uproots trees and kills plant and animal life. This damage, however, is only the beginning. What may appear to be a gully-riddled slope, is just the tip of the iceberg.

As dirt washes off the land, it fills water supplies, leaving less for drinking and industrial use. The dirt also carries pollution; contaminating what little water is left.

The nation's recreational areas also suffer because of erosion. Nearly \$2 billion in lost revenues is being reported by these areas because the silt from erosion is filling lakes and reservoirs and making rivers unnavigable.

This self-instructional course is designed to teach you, at your own speed, how to construct and maintain effective measures to help stop erosion.

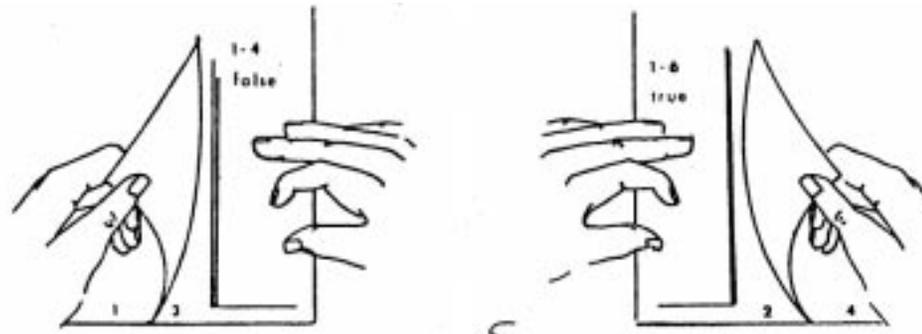
By providing you with the erosion control information, this course will periodically test your recall on that information. This method reinforces what you have just read - enabling you to retain the information longer than by traditional methods of instruction such as lecture and text book.

TO THE STUDENT

In this course, we have addressed some of the more common methods of controlling erosion while at the same time acknowledging the problems and providing solutions to the construction and maintenance of effective erosion control. We hope you will find this course helpful in your efforts to control erosion.

To get the most from this course, start at the beginning. Read each section as it comes; preparing you for the next section. To make reading easier, the information is divided into frames. At the end of some frames, you will find questions. By answering these questions, you will be able to retain what you have just read longer than by lecture or discussion.

Locate the answers to these questions as follows: If the questions are on an odd page, look on the following odd page. If the questions are on an even page, turn that page back and look at the preceding even page. To explain further, the answers to questions on page four can be found on page two.



INDEX

Chapter 1 Temporary Erosion Control Measures

Introduction to Erosion

Temporary Erosion Control

- Vegetative Buffer Areas

- Staging

- Surface Roughening

- Temporary Grassing (Cover Crop)

- Straw Mulch Stabilization (Temporary Mulch)

Chapter I Review

Chapter II Measures For Problem Areas

Erosion Control Mats

- Bituminous Treated Roving

- Permanent Soil Reinforcing Mat

- Excelsior Blanket

- Fiberglass Blanket

- Jute Mesh

Diversion Dikes and Berms

- Ditches

Check Dams

- Brush Barrier Check Dams

- Hay Bale Check Dams

- Silt Fence

Silt Control Gates

Sediment Basins

Temporary Slope Drains and Flumes

Level Spreader (Velocity Dissipater)

Chapter II Review

Chapter III Permanent Erosion Control

Grassing

Ground Preparation

Seeding

Hydraulic Seeding (Hydroseeding)

Mulching

Loose Sod

Block Sod

Vine, Shrub, & Tree Planting

Permanent Slope Drains

Concrete Paved Ditches

Sand Asphalt Paved Ditches

Revetments

Slope Paving

Riprap

Permanent Dikes

Questions and Chapter III Review

CHAPTER 1: EROSION CONTROL

Critical to nearly all construction projects is the controlling of erosion. It is important that the inspector not only have a thorough understanding of effective erosion control measures, but a keen eye that can anticipate potential problem areas that are not always specified on the plans.

It's simple enough to know that water always flows downhill in the path of least resistance. What is not so simple, though, is that many construction projects alter established drainage patterns by destroying vegetative ground cover. Coupled with the creation of steep slopes, water flows faster and soil is washed from these areas. This is called EROSION.

As this soil is washed away, it may be deposited on private property, in lakes, streams and drainage areas. This build-up of soil caused by erosion is called siltation.



Both erosion and siltation change the environment. Erosion can change the appearance of the land by creating unsightly gullies, rills, and fissures on slopes while, at the same time, siltation can alter drainage patterns, destroy plant and animal life, and in massive amounts can effect the navigability of waterways.

Since most of the changes brought about by erosion and siltation are detrimental, it is of utmost importance that erosion control measures be incorporated during construction.

FILL IN THE BLANKS

- 1-1 It is of utmost importance that erosion control measures be incorporated during _____.
- 1-2 Many construction projects alter established _____ patterns by destroying _____.
- 1-3 In addition to having a thorough understanding of effective erosion control measures, the inspector needs to have a keen eye to anticipate potential _____.
- 1-4 _____ can change the appearance of the land by creating gullies, rills and fissures on slopes.
- 1-5 The build-up of soil that has been washed away onto private property, lakes, streams, and drainage areas is called _____.

The best method to prevent erosion of bare soils is to re-establish vegetation as quickly as possible.

Erosion control methods may be either temporary (for the duration of the project) or permanent (for the life of the completed project).

However, actual job conditions may require measures in addition to those established by the original contract. The Standard Specifications allow the engineer to order changes in addition to control measures being used.

The types of temporary erosion control to be used on a project should be specified on the plans or listed in the contract specifications. The Project Engineer and the contractor at the pre-construction conference should discuss these measures.

In some cases, some forms of temporary erosion control (grass, riprap, and ditches) may be left in place for permanent erosion prevention. In fact, if it is possible to utilize permanent measures during construction, it is usually more economical to do so.

TRUE OR FALSE - CIRCLE THE CORRECT ANSWER

1-6 T F Erosion control measures that are specified on the plans or listed in contract specifications need not be discussed at the pre-construction conference.

1-7 T F The engineer cannot order additional control measures other than what is on the contract.

1-8 T F If it is possible to utilize permanent erosion control measures during construction, it is more economical to do so.

1-9 T F Erosion control methods may be temporary or permanent.

1-10 T F The best method to prevent erosion is to re-establish vegetation after more pressing tasks have been taken care of.

- 1-1 construction
- 1-2 drainage, vegetative ground cover
- 1-3 erosion problem areas
- 1-4 erosion
- 1-5 siltation

TEMPORARY EROSION CONTROL

Temporary erosion control measures are intended as a supplementary to and are not to be performed in place of permanent erosion control measures.

It is important to remember that, on work areas off the right-of-way, temporary erosion control measures should be applied to the problem areas on access roads, haul roads, borrow pits and waste areas.

Special provisions require the contractor to designate one person to be responsible for erosion control measures. This person is called the Worksite Erosion Control Supervisor or WECS. He/she shall have at least one (1) year of experience directly related to erosion control, in a responsible capacity, and be certified by the Department. The WECS is "on call" 24 hours and is to be able to reach the project site within 45 minutes after being notified of an emergency situation.

The WECS is required to perform weekly inspections of all erosion control devices installed and to check if any changed conditions on the project require any additional measures. These inspections are then reported on DOT Form EC-1 and submitted to the project manager for review. The WECS is charged with correcting any deficiencies that are found. The project manager will review the EC-1 and inspect the project for compliance and notify the WECS of any additional deficiencies that need correction. In no case should DOT project personnel fill out the EC-1 for the contractor.

FILL IN THE BLANKS

1-11 _____ is required to be designated with the responsibility for applying and maintaining erosion control measures.

1-12 The _____ is responsible for all erosion control measures.

1-13 The WECS is to respond to emergency situations in _____ minutes.

1-14 The _____ fills out DOT Form EC-1.

1-15 The _____ reviews the EC-1 and inspects for compliance.

1-6 false

1-7 false

1-8 true

1-9 true

1-10 false

Basically, there are two ways to control runoff during construction. The first is to decrease that amount of runoff; the second, to divert runoff from erodible areas onto safe drainage areas.

In order to decrease the amount of runoff, several methods may be used. These include the use of vegetation, mulches, artificial coverings, staging and surface roughening.

When runoff cannot be lessened sufficiently to prevent erosion, it is necessary to divert runoff to keep soil from eroding away from exposed areas.

To divert runoff, structures are erected to intercept and slow runoff to non-erosive speed, to hold water so that the soil it carries can settle, and to channel water into areas where siltation will not create a problem.

CIRCLE THE CORRECT WORD

- 1-16** Vegetation, mulches, artificial coverings, staging and surface roughening are several methods that can be used to (divert / decrease) runoff.
- 1-17** Controlling runoff during construction can be achieved by (eliminating / decreasing) and (diverting / directing).
- 1-18** To divert (runoff / erosion), structures are erected to slow, hold and channel water.

- 1-11** one person
- 1-12** Worksite Erosion Control Supervisor
- 1-13** 45
- 1-14** WECS
- 1-15** Project Manager

1-19 construction equipment

1-20 below

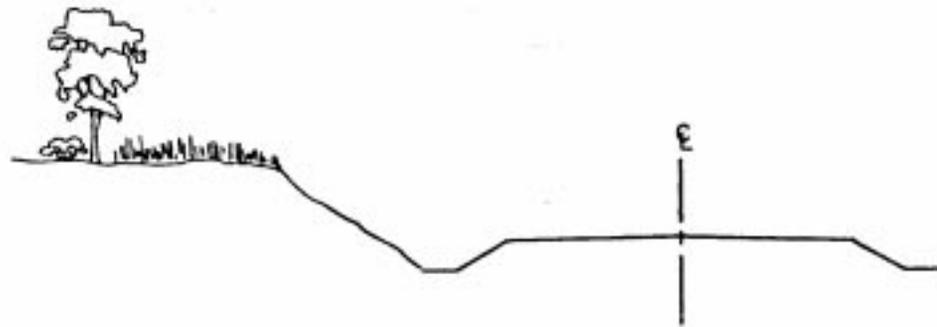
1-21 above

1-22 vegetation

VEGETATIVE BUFFER AREAS

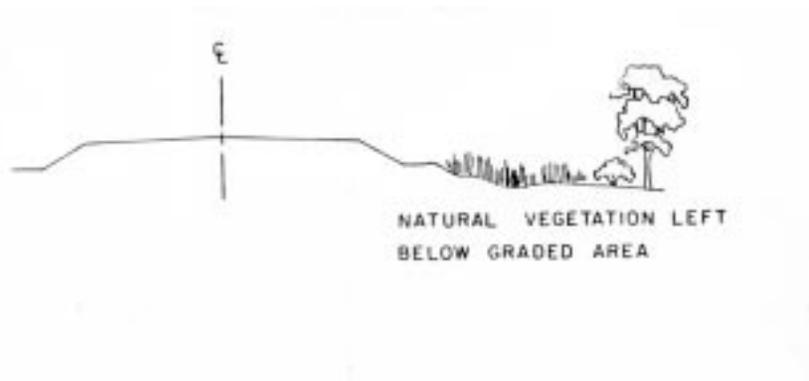
Preventing runoff can be accomplished by the use of vegetative buffer zones. By leaving as much vegetation as possible during construction, runoff can be controlled through maintenance of these buffer areas.

By leaving a vegetative buffer area above the construction site, such an area will absorb some of the rainfall and reduce the amount of runoff that reaches the construction area.



NATURAL VEGETATION LEFT
ABOVE GRADED AREA

Vegetative buffer areas can also be left below construction sites. Vegetation in this location will absorb and filter runoff from the construction area, preventing siltation of property outside the right-of-way. However, it is imperative that construction equipment not be allowed onto these vegetative buffers because such traffic will destroy the vegetative cover and the buffer will lose its effectiveness.



- 1-16 decrease
- 1-17 decreasing diverting
- 1-18 runoff

- 1-23 exposed
- 1-24 17 acres
- 1-25 staging
- 1-26 as soon as possible

FILL IN THE BLANKS

1-19 It is imperative that _____ not be allowed onto these vegetative buffer areas.

1-20 Vegetative buffer areas _____ construction sites filter runoff from the construction area - preventing siltation of private property outside right-of-way.

1-21 Vegetative buffer areas _____ construction sites will absorb some of the rainfall and reduce runoff that reaches the construction area.

1-22 Leaving as much _____ as possible during construction is one way of controlling erosion.

STAGING

Another method that allows vegetation to remain in place as long as possible is STAGING. Staging means that grading and stabilization are completed on one section of a project before earthwork begins on the next. This method limits the amount of earth exposed at one time.

Sometimes staging is not possible on large projects where clearing is necessary to make aerial photographs for cross sectioning. In this case, the inspector should be certain that erosion control measures be taken as soon as possible while the clearing operation progresses.

Under no circumstances should the surface area of erodible earth material exposed at one time by clearing and grubbing exceed 17 acres. Only the State Construction Engineer may increase this limit.

1-27 false

1-28 false

1-29 true

1-30 true

FILL IN THE BLANKS

1-23 Staging limits the amount of earth _____ at one time

1-24 The most erodible earth material that can be exposed at one time during clearing and grubbing is _____.

1-25 When grading and stabilization are completed on one section of a project before earthwork begins on the next is called _____.

1-26 When staging is not possible, the inspector should be certain that erosion control measures be taken _____ while the clearing operation progresses.

SURFACE ROUGHENING

Another procedure that can be used to decrease runoff from a graded area is surface roughening. The practice simply involves creating an uneven, bumpy surface on areas where vegetation has been stripped away.

The surface can be scarified using a bulldozer, disk, or other acceptable means. Cleated bulldozers will both roughen the ground and compact the soil, which also helps prevent runoff.

The ridges created must run horizontally across the slope in order to hold water. Vertical ridges will not only fail as a method of erosion control, but will accelerate the speed of runoff, adding to the erosion problem.

Soil roughening can also produce a surface suitable for vegetation growth. Seeds and moisture are retained in the grooves, improving the grass's chance for survival.

- 1-31 minimum
- 1-32 grass
- 1-33 temporary seeding cover crop
- 1-34 fast

TRUE OR FALSE - CIRCLE THE CORRECT ANSWER

1-27 T F The ridges created on slopes for surface roughening must run vertically in order to lessen the chances of erosion.

1-28 T F Surface roughening involves plowing vegetation to create a bumpy surface.

1-29 T F Soil roughening can also produce a suitable surface for vegetation growth.

1-30 T F A cleated bulldozer will both roughen the ground and compact the soil.

TEMPORARY GRASSING (COVER CROP) (SPECIFICATION 163)

Another use of vegetation to control runoff is the planting of grass on slopes and other graded areas as soon as portions of the earthwork are complete.

Temporary seeding, or cover crop, should be used only where final grading cannot be accomplished and the exposed earth would be left unprotected for over 60 calendar days.

Grasses used for temporary erosion control must be fast growing. For this reason, quick growing annuals such as rye, millet, or cereal grain crops are planted that are suitable to the area and the season.

Before seeds are planted, the soil must be in proper condition for the seeds to sprout. Grassing for temporary erosion control should require minimum seedbed preparation.

1-35 a

1-36 d

1-37 c

FILL IN THE BLANKS

1-31 Grassing for cover crop should require _____ seedbed preparation.

1-32 Another use of vegetation to control runoff is the planting of _____ on slopes and other freshly graded areas.

1-33 _____ or _____ should be used only where final grading cannot be accomplished, and no exposed earth would be left unprotected for a considerable period of time.

1-34 Grasses used for cover crop must be _____ growing.

The soil must be loosened so the seed can be placed at the proper depth. The weeds should be destroyed so they will not be competing with the seed for the available moisture. However, it may not be possible to kill all the weeds without making several passes over the area. If this is the case, it is better to leave a few weeds than to work the soil into a fine pulverized condition, which reduces the soil's resistance to erosion.

Normally, temporary seeding, like permanent seeding, includes applying the seed and fertilizer. However, sometimes lime may be omitted or reduced according to the engineer. Temporary seeding requires mulching.

Nitrogen shall be omitted.

If the season is so late that no cover crop can be expected, the graded areas should be mulched to provide temporary erosion control.

Seeding and mulching (or mulching alone) should be done as soon as the grading is complete - when the soil is loose and friable. If surface crust has formed, the areas must be scarified before application. After seeding, the area should be watered.

Planting dates, zones, types of seed, seed mixtures and rates of application are given in the Standard Specifications.

The State Construction Engineer should approve any changes.

MULTIPLE CHOICE - CIRCLE THE BEST ANSWER

- 1-35 Normally, temporary seeding
- a. requires mulching
 - b. requires no mulching
 - c. always includes lime and fertilizer
 - d. never includes fertilizer
- 1-36 Any changes to types of seed, planting dates, and rates of application
- a. Should never be made
 - b. Should be made when necessary
 - c. need not be approved
 - d. should have the blessing of the State Construction Engineer
- 1-37 The soil must be loosened
- a. to a fine pulverized condition
 - b. to kill all the weeds
 - c. so seed can be placed at proper depth
 - d. in hardpan areas to be grassed

- 1-38** Seeding and mulching (or mulching alone) should be done
- a. before the grading is complete
 - b. as soon as the grading is complete
 - c. after surface crust has formed
 - d. as soon as erosion is evident
- 1-39** If the season is so late that no cover crop growth can be expected
- a. the graded areas should be mulched
 - b. wait until spring to do anything
 - c. loosen and turn the soil and leave in a rough condition
 - d. protect the area with silt fence and hay bale checks

- 1-40 false
- 1-41 true
- 1-42 true
- 1-43 false
- 1-44 false
- 1-45 true
- 1-46 true

Seed may be used on the basis of the information provided on the analysis.

Be sure each bag is checked to ascertain the variety and lot number, and to assure the analysis tag is on each bag.

Seed Mixture.....			
Where Grown.....	Net Wt.....	Lot No.....	
Kind	Pure Seed Percent	Germination Percent	Date of Test
Other Crop Seed.....%; Inert.....%; Weed Seed.....%			
Name and Number of Noxious-Weed Seed per Pound.....			
Name.....			
Address.....			

Kind & Variety.....			
Where Grown.....	Net Wt.....	Lot No.....	
Pure Seed	%	Germination	%
Inert Matter	%	Hard Seed	%
Other Crop Seed	%	Total Germ & Hard Seed.....	%
Weed Seed.....	%	Date of Test.....	19
Name and Number of Noxious-Weed Seed per Pound.....			
Name.....			
Address.....			

Seed that is not pretested or is pretested but with test date more than nine months old, is to be sampled and tested before use.

1-38 b

If the test date of the seed is over nine months old, a sample of each variety, from each lot, is to be taken by the Office of Materials and Research and retested. The producer's analysis tag, attached to the bag or container from which the sample is taken, should accompany each sample of seed submitted. If the analysis tag is missing, the contractor must verify that the material is the type specified and that a guaranteed analysis is available on the project.

1-39 a

TRUE OR FALSE - CIRCLE THE CORRECT ANSWER

- 1-40 T F If seed is pretested and the test is over nine months old, it can be used.
- 1-41 T F If seed is pretested and the test is over nine months old, it needs to be tested again.
- 1-42 T F Each bag must have an analysis tag.
- 1-43 T F Seed may not be used based on analysis tag information.
- 1-44 T F An analysis tag need not accompany all seed samples to be tested.
- 1-45 T F The contractor should guarantee that seed analysis is available on the project.
- 1-46 T F The contractor must verify that the material being used is what is specified.

STRAW MULCH STABILIZATION (TEMPORARY MULCH) (SPECIFICATION 163

To stabilize the soil and reduce erosion during periods when grassing is prohibited, straw or hay mulch is used.

Before mulching, the designated areas should be finished to grade and cross section in accordance with specification requirements for finishing embankment and excavated areas.

The inspector should be sure that the mulch is uniformly spread 2 to 4 inches thick over the area.

The mulch is then walked in or crimped with a cleated dozer (preferred method), an empty sheepfoot roller, a light disc harrow, or by any other means which does not destroy the finished cross section and which is satisfactory to the engineer.

On slopes where equipment cannot operate, the straw mulch is to be bituminous treated. The bituminous treatment is usually applied at the same time as mulching by the use of a strawblower with bituminous nozzles.

When grassing operations begin, the mulch should be left in place and plowed into the soil during the process of seedbed preparation, thereby becoming beneficial plant food for the newly planted grass.

- 1-55 false
- 1-56 false
- 1-57 erosion control supervisor
- 1-58 erosion
- 1-59 true
- 1-60 false
- 1-61 vegetation



It is important to remember that mulch required for protection of newly planted grass shall be in addition to the mulch that has been plowed in.

Acceptance of the mulching material should be made by the field engineer, based on visual inspection as to acceptability of the material. Particular attention should be made to the quantity of weeds and foreign material in the mulch. No report is necessary, but make a note in your project diary. Once again, the contractor is responsible for verifying that the mulch meets specifications.

FILL IN THE BLANKS

- 1-47 The straw or hay mulch is _____ into the soil in a manner that does not destroy the finished cross section.
- 1-48 Mulch for newly planted grass shall be _____ to the straw mulch that has been plowed in.
- 1-49 When grassing operations begin, the straw or hay mulch is left in place, and then _____ into the soil; thereby becoming beneficial plant food.
- 1-50 A _____ inspection of the mulching material should be made by the inspector to determine the amount of _____ in the mulch.
- 1-51 For slopes where equipment cannot operate, straw or hay mulch is to be _____ treated.
- 1-52 _____ is used to stabilize soil and reduce erosion during periods when grassing is prohibited.
- 1-53 The straw or hay mulch should be uniformly spread _____ inches thick.
- 1-54 Before straw or hay mulching, the area should be _____.

- 1-70 minimum
- 1-71 false
- 1-72 true
- 1-73 nine
- 1-74 false
- 1-75 grading
- 1-76 true
- 1-77 false

CHAPTER I REVIEW

- 1-55 **T** **F** Temporary erosion control measures need not be applied to problem areas off the right-of-way, such as access roads, haul roads, borrow pits, and waste areas.

- 1-56 **T** **F** Erosion control measures that are specified on the plans or listed in the contract specifications need not be discussed at the preconstruction conference.

- 1-57 The contractor's _____ is responsible for all erosion control measures.

- 1-58 _____ can change the appearance of the land by creating gullies, rills, and fissures on slopes.

- 1-59 **T** **F** Leaving as much vegetation as possible during construction is one way of controlling erosion.

- 1-60 **T** **F** Vegetative buffer areas left below construction sites create grading problems later on.

- 1-61 The best method to prevent erosion of bare soils is to re-establish _____ as quickly as possible.

1-62 **T** **F** It is of the utmost importance that erosion control measures be taken during construction.

1-63 The build-up of soil that has been washed away onto private property, and into lakes, streams and drainage areas is called _____.

1-64 **T** **F** The ridges placed on slopes by surface roughening must run horizontally in order to prevent erosion from runoff.

1-65 _____ is when grading and stabilization are completed on one section of a project before earthwork begins on the next.

1-66 Surface roughening on slopes can be achieved with a _____ that both roughens the ground and compacts the soil.

1-67 **T** **F** For temporary grassing it is better to loosen the soil to a fine, pulverized condition than to leave a few weeds that would compete for available moisture.

1-68 **T** **F** Although surface roughening creates grooves, these grooves are not suitable for a seedbed.

1-69 **T** **F** Normally, temporary seeding requires no mulching.

1-47 walked on or crimped

1-48 in addition

1-49 plowed

1-50 visual weeds & foreign material

1-51 bituminous

1-52 straw or hay mulch

1-53 2-4 inches

1-54 finished to grade and cross section

- 1-70** Grassing for temporary erosion control should require (minimum / maximum) seed bed preparation.
- 1-71** **T** **F** The amount of exposed earth at any one time shall not exceed 7 acre.
- 1-72** **T** **F** Each bag of seed must have an analysis tag.
- 1-73** **T** **F** Seed that is not pretested or is pretested but with test date over _____
months old, is to be sampled and tested before use.
- 1-74** **T** **F** Seed may not be used on the basis of analysis tag information.
- 1-75** **T** **F** Seeding and mulching (or mulching alone) should be done as soon as the
_____ is complete.
- 1-76** **T** **F** The contractor must verify that the seed, fertilizer, and mulch used on a project is the
type specified.
- 1-77** **T** **F** The producer's analysis tag need not accompany all seed samples to be tested.

CHAPTER II: MEASURES FOR PROBLEM AREAS EROSION CONTROL MATS

Erosion control mats are an effective means of controlling runoff of freshly seeded slopes and ditches. There are five types of erosion control mats: fiberglass and excelsior blankets, jute mesh, bituminous treated glass fiber and permanent soil reinforcing mats.

Before the blankets are placed, the inspector should check to see if the grassing operation is complete and the area left in a smooth, uniform condition - free from stones, lumps, roots, or other material which would prevent snug contact with the ground.

The inspector should also make sure the blankets are placed within 24 hours after the grassing operation is complete and before any watering or rain.



- 1-62 true
- 1-63 siltation
- 1-64 true
- 1-65 staging
- 1-66 cleated bulldozer
- 1-67 false
- 1-68 false
- 1-69 false

BITUMINOUS TREATED ROVING (STANDARD SPECIFICATION 715)

2-1 0.4 to 0.5 pounds per square
yard; 0.24 to 0.30 gallons per square
yard

2-2 within 24 hours

2-3 SS-1h or RS-2h

2-4 0.2 to 0.25 pounds per square
yard; 0.12 to 0.15 gallons per square
yard

2-5 bituminous treated roving

2-6 glass fiber strands

2-7 grassing

The most widely used erosion control mat is the bituminous treated roving which is made of a multitude of continuous glass fibers and tackified with an asphalt emulsion.

An air compressor is used to apply the fiber strands and must be capable of supplying 40 cubic feet of air per minute at 80 to 100 p.s.i. of pressure.

From a 125 cubic foot compressor, three kits may be run simultaneously. A kit consists of one air gun specifically designed for spraying fibers, a 3/8-inch rubber hose for application and a bucket.

Bituminous treated fiber is to be applied within 24 hours after an area has been planted.

Asphalt for tying down the fiber material shall be Asphalt Emulsion Grade SS-1h or RS-2h.

For slopes, the fiber is spread at the approximate rate of 0.2 to 0.25 pounds per square yard, while the bituminous material is spread at the approximate rate of 0.12 to 0.15 gallons per square yard.

For waterways, ditches, flumes and channels, the fiber is to be spread at the approximate rate of 0.4 to 0.5 pounds per square yard, while the bituminous material is applied at the approximate rate of 0.24 to 0.30 gallons per square yard.

After the emulsified asphalt has broken and become tacky, a light application of sand or pulverized soil is to be applied to the treated areas, if so directed by the engineer, to keep foreign objects from sticking. Care should be taken not to apply sand or soil in an amount that would be detrimental to the newly planted areas

FILL IN THE BLANKS

- 2-1 For waterways, fiber is spread at the approximate rate of about _____ per square yard, while the bituminous material is applied at about _____ per square yard.
- 2-2 Blankets are placed within _____ after the grassing operation is complete and before any watering or rain.
- 2-3 Asphalt for tying down the fiber material shall be Asphalt Emulsion Grade _____.
- 2-4 For slopes, fiber is spread at the approximate rate of about _____ per square yard, while the bituminous material is applied at the approximate rate of about _____ per square yard.
- 2-5 _____ is the most widely used erosion control mat.
- 2-6 When bituminous treated fiber is used on an area, an air compressor is used to apply the _____.
- 2-7 Before blankets are placed, the inspector should check to see if the _____ operation is complete and the area left smooth.

PERMAMENT SOIL REINFORCING MAT (STANDARD SPECIFICATION 710)

Permanent soil reinforcing mats are erosion control blankets made of polymer nettings or vinyl monofilaments/fibers that are melt-bonded at their intersections.

Those areas that are to be protected with the permanent soil reinforcing mat must be brought to final grade, plowed, limed and fertilized, leaving the surface smooth, firm and stable, with no obstructions such as rocks, clods, roots and debris that would prevent snug contact with the ground.

When installing permanent soil reinforcing mats in ditches, 6-inch wide transverse anchor slots are to be cut at the ends of the mat and at 25-foot intervals along the ditch. These anchor slots should be cut to a depth of 9 inches.

The longitudinal edges of the mat should be buried in 4 inches deep along the full length of the ditch on each side of the mat.

If large volumes of water are anticipated, additional anchor slots may be constructed as specified by the engineer.

Starting at the lower end of the ditch, the center strip of matting is to be rolled out first, with side strips overlapping the preceding strip by about 3 inches.

2-16 wooden 12 to 18
2-17 grassed
2-18 3 feet
upslope
2-19 2
2-20 staked

The ends of each roll of mat must overlap 3 feet with the upslope mat on top.

The mat is to be stretched to the bottom of the slot, folded back and staked through the two layers of material.

Wooden stakes are used to pin the mat and must be sound 1 X 3-inch stock, sawn in a triangular shape. The stakes are to be 12 to 18 inches long depending on the compaction of the soil. Metal staples shall be 11-gauge steel in diameter or greater, "U" shaped with legs a minimum of 8 inches in length and with a 2-inch crown.

Each strip of matting is to be staked at 12-inch intervals in each transverse anchor slot with one stake securing the overlapped edges of adjoining strips. The slot is then backfilled and compacted. The mat is then folded back over the slot and continued in the upstream direction.

The mat is then staked snugly in the longitudinal slots staked a maximum of 5 feet. The longitudinal slots are then backfilled and dressed.

The entire length and width of matting is then backfilled with loose soil to a maximum depth of 2 inches.

For slopes, the installation of permanent soil reinforcing mats does not require the longitudinal joints. However, the entire slope is to be backfilled with loose soil to fill the voids.

After the mat is in place and approved, the entire mat and disturbed soil area is grassed as permanent grass.

FILL IN THE BLANKS

- 2-8 Permanent soil reinforcing mats, when laid side-by-side, should overlap _____ inches.
- 2-9 Transverse anchor slots for permanent soil reinforcing mats should be _____ wide and _____ deep.
- 2-10 The _____ of the mat should be buried in a _____ deep longitudinal anchor slot along the full length of the ditch.
- 2-11 Permanent soil reinforcing mats are made of entangled _____ or _____ monofilaments melt-bonded at their intersections.
- 2-12 Transverse anchor slots are cut at the _____ of the mat and at _____ intervals.
- 2-13 Each strip of matting is to be staked at _____ foot intervals in each anchor slot, with _____ stake securing the overlapped edges of adjoining strips.
- 2-14 Longitudinal joints must also be staked with maximum intervals of _____.
- 2-15 Installing permanent soil reinforcing mats on slopes does not require _____ joints.

2-21 false
2-22 true
2-23 false
2-24 true

- 2-16** Depending on the compaction of the soil, _____ stakes _____ inches long are used to pin the mat.
- 2-17** The entire mat and disturbed soil area is to be _____ after the mat is in place and approved.
- 2-18** The ends of each roll must overlap _____ with the _____ mat on top.
- 2-19** The entire length and width of the mats are to be backfilled with loose soil a maximum of _____ inches.
- 2-20** Stretched between anchor slots, the mat is _____ at the bottom of each slot

EXCELSIOR BLANKETS (STANDARD SPECIFICATION 713)

Excelsior blankets are machine-made mats with each blanket composed of 80 percent 6 inches or longer, curled wood fibers with photodegradable plastic mesh on the topside (used on slopes) or top and bottom (used in waterways).

The excelsior blanket is to be placed within 24 hours of the grassing operation being completed. In installing excelsior blankets, the contractor has to be very careful handling the material. When the blanket is being unrolled, be sure the net is on “top”, because it is almost impossible to turn over a strip without disturbing the fibers.

Check to see if there is a uniform distribution of fibers throughout the length of each excelsior strip. Generally, there is a ball of fibers left at the end of each roll. These can be saved and used to fill in the thin spots.

2-8	3 inches
2-9	6 inches 9 inches
2-10	edges 4-inch
2-11	polymer netting vinyl
2-12	ends 25 foot
2-13	one (1) one (1)
2-14	five (5) feet
2-15	longitudinal

- 2-25 two (2) yards
center
- 2-26 ½
- 2-27 12 inches
- 2-28 dirt, edges
- 2-29 6 inches
top (beginning at edges)
- 2-30 water flow
- 2-31 anchor slot

TRUE OR FALSE - MARK THE CORRECT ANSWER

- 2-21 When excelsior blankets are unrolled, be sure the net is only on the bottom.
True _____ False _____
- 2-22 Be sure there is a uniform distribution of fibers through the length of each excelsior blanket.
True _____ False _____
- 2-23 Excelsior blankets are man-made mats of 65 percent curled wood and 35 percent polyester.
True _____ False _____
- 2-24 The ball of fiber usually left at the end of each roll should be used to fill in the thin spots.
True _____ False _____

If two or more excelsior blankets are required, be sure they are abutting one another. The ends of all erosion control blankets should overlap at least 6 inches with the upgrade section on top.

Check to see whether blankets in ditches are set properly - in the direction of the water flow. Also, check to see if 12 inches of the upslope end of the first row of excelsior blankets are placed in a 6-inch deep anchor slot and that the slot is backfilled and solidly tamped as required.

Staples used to secure the excelsior blankets shall be in accordance with Standard Specifications and placed approximately 2 yards apart on each side of the blanket and one row in the center - alternately spaced between the side staples.

When excelsior blankets are laid side-by-side, the inspector should check to see if the staples are placed with one-half of each staple anchoring the mesh from each blanket.

At the beginning of excelsior blankets, the staples shall be placed in a row with spacing of about 12 inches.

After the erosion control blankets have been installed, the area around it must be straightened up. All ridges and piles of dirt must be removed from around the beginning and edges so the water will flow onto the protection rather than along the edges. Not only does this make a smooth transition between the surrounding area and the blanket, but it also helps hold down the edges so water cannot get underneath and tear the mat.

FILL IN THE BLANKS

2-25 Staples for excelsior blankets are placed about _____ apart on each side of the blanket and one row in the _____.

2-26 Excelsior blankets laid side-by-side require that staples be placed with _____ of each staple located in each blanket.

2-27 Staples at the beginning of both excelsior and fiberglass blankets should be placed about _____ apart.

2-28 Ridges and piles of _____ around the _____ of the installed blankets should be removed so water will flow onto the blanket rather than around and under it.

2-29 The ends of all erosion control blankets, except permanent soil reinforcing mats, should overlap at least _____ with the upgrade section on _____.

2-30 Blankets in ditches should be placed in the direction of the _____.

2-31 Twelve inches of the upslope end of the first row of excelsior blankets should be placed in a 6-inch deep _____

FIBERGLASS BLANKETS

(STANDARD SPECIFICATION 712)

Another form of erosion control mat is the fiberglass blanket; a machine-made mat consisting of a uniform layer of continuous, randomly oriented, glass fibers.

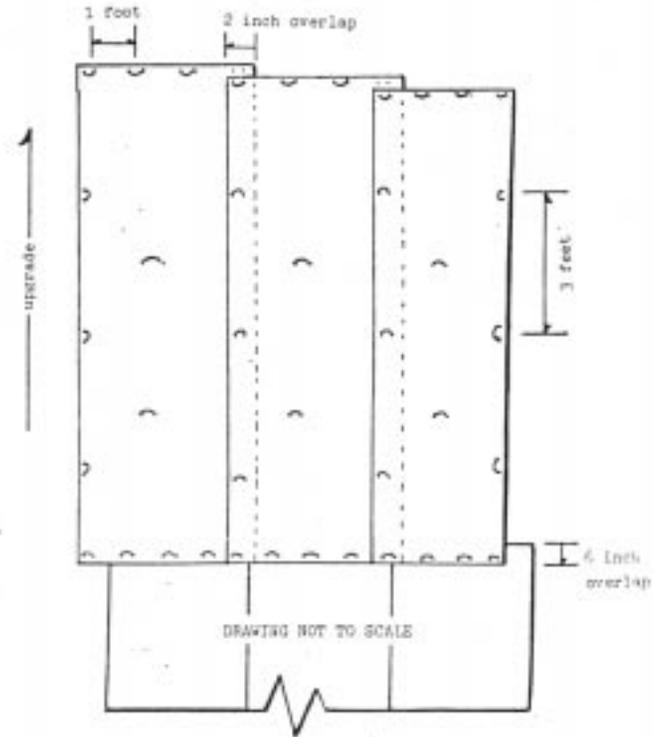
Like excelsior blankets, the grassing operation shall have been completed and the area smooth before applying blankets which should be placed 24 hours after the area has been planted and before watering or rain.

If the contractor prefers, an asphalt emulsion may be applied to anchor the blanket instead of staples (which are the same as for excelsior blankets). In this case, the inspector should check to see if the bituminous material is being uniformly applied over the blanket at the approximate rate of 0.12 to 0.15 per square yard for slopes and at the approximate rate of 0.24 to 0.30 gallons per square yard for waterways.

On slopes and in ditches, the inspector should check the 9-inch deep anchor slot that should be dug across the upgrade end of the site. The initial 12 inches of the blanket shall be placed in the slot and backfilled and solidly tamped. Adjacent strips should overlap at least 2 inches. Adjoining ends should overlap at least 6 inches with the upstream section on top.

Asphalt for tying down the blanket shall be Asphalt Emulsion Grade RS-2 or SS-1h, meeting the requirements of the Standard Specifications.

When staples are used in fiberglass blankets, they should be placed three (3) feet apart on each side of the blanket and one row in the center - alternately spaced between the side staples. The staples shall be placed in the 2-inch overlap. At the end of each blanket, staples are to be placed in a row with spacing at approximately 12 inch. After the emulsified asphalt has become tacky and broken, a light application of sand or pulverized soil shall be applied to the treated areas, if so directed by the engineer, so as to prevent the treated areas from adhering to any object that comes in contact with it.



FILL IN THE BLANKS

- 2-32 An _____ may be used instead of staples to anchor the blanket.
- 2-33 A fiberglass blanket is a machine made mat consisting of a uniform layer of continuous randomly oriented _____.
- 2-34 Fiberglass blankets should be placed within _____ after the area has been planted and before watering.
- 2-35 After the emulsified asphalt has become broken and tacky, a light application of _____ shall be applied to the treated areas.
- 2-36 The edge staples shall be placed in the _____ overlap.
- 2-37 The bituminous material should be uniformly applied over the blanket at the rate of about _____ per square yard for slopes and twice that amount for waterways.
- 2-38 When staples are used on fiberglass blankets they should be placed _____ apart on each side of the blanket and a row in the _____ alternately spaced between the staples.

2-45 false

2-46 true

JUTE MESH (STANDARD SPECIFICATION 714)

Jute mesh is usually used for protection of steep slopes. Like both fiberglass and excelsior blankets, the grassing operations must be complete and the area left smooth.

Adjacent jute mesh strips shall overlap at least 6 inches. Like both excelsior and fiberglass blankets, adjoining ends shall overlap at least 6 inches with the upstream section on top.

Jute mesh shall be rolled out in the direction of the flow except for the downstream end section that connects to a drainage structure or paved ditch.

Mesh connecting to a structure will be anchored in a 6-inch deep trench adjacent to the structure, then rolled upstream and connected by use of a junction slot with the mesh that has been rolled down stream.

In cases where one roll of jute mesh ends and a second roll begins, a junction slot as shown in the construction details shall be used to make the connection.

The up-channel end of each jute mesh installation shall be in a narrow trench 6 inches deep.

TRUE OR FALSE - MARK THE CORRECT ANSWER

2-39 Mesh connecting to a structure will be anchored in a 6 inches deep trench adjacent to drainage structures or paved ditches, then rolled upstream.

True _____ False _____

2-40 Jute mesh is usually used for the protection of steep slopes.

True _____ False _____

2-41 Mesh rolled upstream from a structure shall be connected to mesh rolled down stream by use of a junction slot.

True _____ False _____

2-42 Where one roll of jute mesh ends and another begins, a junction slot is used to make the connection.

True _____ False _____

2-43 Adjacent strips shall overlap no more than 2 inches.

True _____ False _____

2-44 The up-channel end of each installation shall be staked in place.

True _____ False _____

2-32 asphalt emulsion

2-33 glass fibers

2-34 24 hours

2-35 sand or pulverized soil

2-36 2 inch

2-37 0.12 to 0.15 gallons

2-38 3 feet; center

2-47 c

2-48 d

2-49 d

2-45 Jute mesh shall be rolled out in the direction of flow when connecting to a drainage structure or paved ditch.

True _____ False _____

2-46 Adjoining ends shall overlap at least 6 inches with the upstream section on top.

True _____ False _____

Spacing between check and anchor slots shall not exceed 50 feet on grades three percent (3%) or less. Spacing on grades over three percent (3%) shall not exceed 25 feet.

2-39 true

2-40 true

The staples shall be spaced not more than 3 feet apart in each row, with the staples in the middle row alternately spaced with those at the edges and driven flush with the ground.

2-41 true

2-42 true

At the ends of the covered area and all overlapping joints, the staples shall be spaced not more than 18 inches and driven flush with the ground.

2-43 false

2-44 false

Before anchoring any of the mesh, adjust it laterally in the channel to bring both edges to approximately the same elevation. In those areas where the protection is being placed around a curve, the outside edge should be slightly higher than the inside edge.

After the mesh has been placed and stapled, it shall be firmly embedded in the soil surface by tamping or rolling with approved smooth rollers and/or tampers so that the mesh will be in contact with the ground surface.

As we said earlier, you need to check the areas around the beginning and edges to see that they are properly shaped. Any ridges or piles of dirt must be removed so the water can flow onto the protection rather than being diverted around it. This usually is handwork, so you may have to keep after the contractor to get it done.

Any mesh which bridges over irregularities in the soil surface shall be secured with extra staples to provide good contact with the soil at all points.

MULTIPLE CHOICE - CIRCLE THE BEST ANSWER

2-47 Staples along the edges of jute mesh shall be spaced

- a. 3 yards
- b. 6 feet
- c. 3 feet
- d. 3 inches

2-48 Spacing between check and anchor slots shall not exceed

- a. 5 feet on grades 3 percent or less
- b. 50 feet on grades 5 percent or more
- c. 50 feet on grades 3 percent or more
- d. 50 feet on grades 3 percent or less

2-49 At the ends of the jute mesh and all overlapping joints, the staples shall be spaced not more than

- a. 1.8 inches and made flush with the ground
- b. 18 yards and made flush with the ground
- c. 1.8 feet and made flush with the ground
- d. 18 inches and made flush with the ground

2-50 Spacing between check and anchor slots on grades over 3 percent shall not

- a. be less than 25 yard
- b. exceed 25 feet
- c. exceed 25 yards
- d. exist at all

2-51 Ridges of dirt that have formed around the edges of erosion control blankets

- a. help to anchor the mesh
- b. direct water on the mesh
- c. must be removed
- d. must be created

2-52 After the jute mesh has been placed and stapled

- a. it should then be sprayed with emulsified asphalt
- b. it should be tamped or rolled with approved rollers
- c. it should be thoroughly watered
- d. it should be measured for payment

2-53 In channel curves, the mesh should be adjusted to where

- a. the edges are about the same elevation
- b. the mesh covers the outside edge only
- c. the outside edge is slightly higher than the inside edge
- d. the inside edge is slightly higher than the outside edge

2-54 Mesh which bridges over irregularities in the soil surface

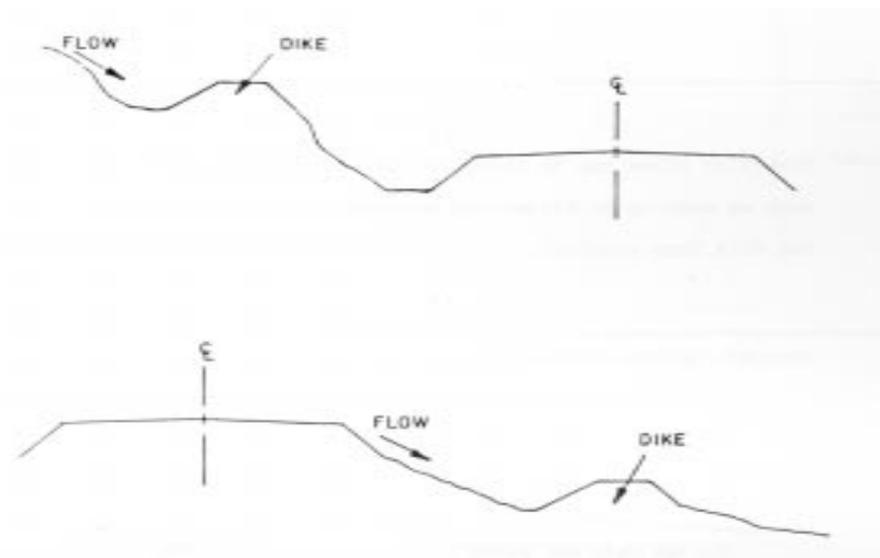
- a. is a natural phenomenon
- b. means the mesh is already doing its job
- c. means someone is trapped under it
- d. should be secured with extra staples

DIVERSION DIKES AND BERMS

When runoff cannot be lessened sufficiently to prevent erosion, it is necessary to divert runoff in order to keep eroded soil from leaving the right-of-way.

In order to divert runoff, structures are erected to intercept and slow runoff to a non-erosive speed, to hold water so that the soil it carries can settle, and to channel water into areas where siltation will not create a problem; i.e. sediment basins.

One method of catching runoff is the construction of dikes. Dikes are usually built with soil and should be compacted to approximately 85 percent density. This degree of compaction can usually be achieved using the weight of standard construction equipment.



- 2-50 b
- 2-51 c
- 2-52 b
- 2-53 c

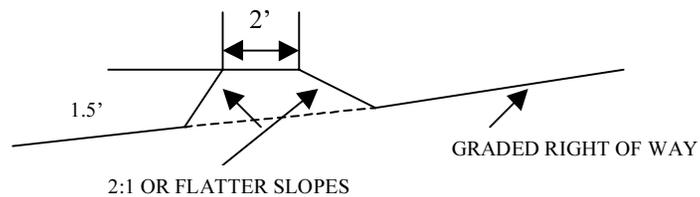
- 2-55 Dikes
85 percent
- 2-56 sediment
- 2-57 seeded or covered
- 2-58 permanent erosion control
- 2-59 cleared

Dikes can be built in any location where it is necessary to catch sediment. They can be placed above the roadway to prevent sediment from washing onto the graded roadbed. They can also be placed below the roadbed to prevent soil from leaving the right-of-way.

The dike will slow the water and allow the sediment it carries to be deposited on the uphill side of the dike. The level of this sediment deposit must be checked regularly and after every storm. The sediment must be cleared away from the dike or the water will begin to flow over the dike carrying its load of soil. At this point, the dike will no longer be an effective means of controlling erosion.

Diversion dikes can be seeded or covered with an artificial covering such as matting or bituminous treated fiber in order to prevent the dike from eroding.

Possible design criteria for an effective dike



Depending on placement with reference to the roadway, diversion dikes can be left in place as permanent erosion control structures.

It is the contractor's responsibility to maintain the top of the earthwork in all roadway sections, and through all construction stages in a manner which permits the runoff of rainwater to the outer edges.

- 2-60 ditches
- 2-61 ditches
- 2-62 berms
intercept
- 2-63 2:1
- 2-64 baled hay ditch checks
- 2-65 flared out
- 2-66 temporary slope drain facilities

FILL IN THE BLANKS

- 2-55 _____ are usually built with soil and should be compacted to approximately _____ density that usually can be achieved using the weight of standard construction equipment.
- 2-56 Dikes can be built in any location where it is necessary to catch _____, such as above and below graded roadbeds.
- 2-57 Diversion dikes can be _____ or _____ to prevent the dike from eroding.
- 2-58 Depending on where they are placed, diversion dikes can be left in place as _____ structures.
- 2-59 The sediment must be _____ from the dike or the water may overflow the ditch carrying sediment into areas that were to be protected.

Where deemed necessary, the engineer may require the construction of earth berms on the edges of roadway sections to intercept runoff.

Material excavated from ditches can be used to build a small dike or berm on the down hill side of the ditch. This will increase the capacity of the ditch and help to prevent spillover.

Where berms are used, temporary slope drain facilities with adequate inlets shall be provided to carry the runoff water to the bottom of the slopes.

Berm ditches will be used where natural ground slopes towards the roadway in fill sections and are to be protected as shown on the plans.

In berm ditches on grades 2.1 percent or greater, baled hay ditch checks will be used as shown on plans.

Unpaved berm ditches will be flared out to natural ground at inlets and cross drains.

Side slopes on berms and surface ditches are to be 2:1 unless modified on construction to meet field conditions.

FILL IN THE BLANKS

- 2-60 Berm _____ are used where natural ground slopes toward the roadway in fill sections and are to be protected as on the plans.
- 2-61 Material excavated from _____ can be used to build a small dike or berm.
- 2-62 The engineer may require the construction of earth _____ on the edges of roadway sections to _____ runoff.
- 2-63 Side slopes or berms and surface ditches are to be _____ unless modified on construction to meet field conditions.
- 2-64 In berm ditches on grades 2.1 percent or greater, _____ are to be used.
- 2-65 Unpaved berm ditches will be _____ to natural ground at inlets and cross drains.
- 2-66 Where berms are used, _____ with adequate inlets shall be provided.

DITCHES

Ditches are another simple means of diverting runoff. Ditches can be dug at any point along the project to carry water through established channels to areas of drainage collection. Other types of erosion control structures can empty into them.

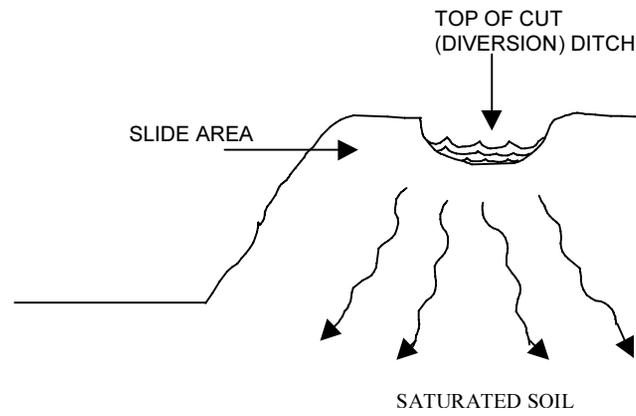
In order to prevent running water from eroding the ditch bottom, it should be protected. Seeding with fast-growing grass can usually provide protection. Ditches carrying large amounts of runoff or where water will travel at a high velocity may require permanent soil reinforcing mat or concrete paving.

When ditches are seeded, protective covering (e.g. bituminous treated fiber, vegetative mulch, or an artificial covering) should be used to prevent erosion and the washing away of seeds.

A ditch with side slopes at a ratio of 2:1 with a bottom 4 foot wide will usually have good flow capacity with little erosion of the sides or bottom. Ditches that have been programmed into the project will be shown on the plans with proper design criteria.

When ditches are dug above a steep slope (top of cut ditch), care must be taken to prevent sliding.

Slides below the top of a cut ditch are caused by water concentrated behind and within the ditch. The water seeps into the ground, saturates the slope, and causes a slide.



To prevent such slides, the top of cut ditch should be lined with a material that will not permit water to soak into the ground, instead of grassed.

TRUE OR FALSE - CIRCLE THE CORRECT ANSWER

2-67 Top of cut ditches prevents sliding on steep slopes.

True _____ False _____

2-68 When ditches are seeded, they should be covered with bituminous treated fiber, vegetative mulch, or an artificial covering.

True _____ False _____

2-69 Ditches can be dug at any point to carry water to areas of drainage collection.

True _____ False _____

2-70 Ditches carrying large amounts of runoff or where water will travel at a high velocity may require permanent soil reinforcing mat or paving.

True _____ False _____

2-71 A ditch with side slopes at a ratio of 2:1 with a bottom 4 inches wide will have good flow capacity with little erosion of sides and bottom.

True _____ False _____

2-72 Top of cut ditches should be seeded.

True _____ False _____

2-73 false

2-74 true

2-75 false

CHECK DAMS

Temporary dams can be constructed from stacked logs and brush from the clearing operation, hay bales, temporary silt fence, or riprap. These structures are sometimes referred to as check dams or sediment check dams.

Such check dams are usually placed in ditches in order to slow the running water and to catch sediment. The straw, brush, or fabric acts as sediment filters.

BRUSH BARRIER CHECK DAM

One type of check dam used is a brush barrier. A brush barrier is made up of boughs, limbs, and small logs from the clearing and grubbing operation.

The barrier is placed at the toe of a slope and runs perpendicular to the flow of water.

The barrier material is mounded up onto a row, a minimum of three (3) feet high. The base of the mound needs to be a minimum of 5 feet wide.

After being mounded up, normally a filter fabric is laid across the barrier from the upslope base to just beyond its peak.

Uphill, a 6 X 4 inch deep trench is cut along the length of the barrier to catch the sediment.

Although this is an inexpensive control measure, brush barriers shouldn't be used in urban settings where esthetics are a concern. Most of the time, these barriers are left in place, naturally decaying over time.

2-67 false

2-68 true

2-69 true

2-70 true

2-71 false

2-72 false

2-72 true

TRUE OR FALSE - MARK THE CORRECT ANSWER

2-73 A brush barrier is only to be used in urban areas.

True _____ False _____

2-74 Brush barriers should run perpendicular to the flow of water.

True _____ False _____

2-75 The brush barrier should be flattened out when it is finished being built.

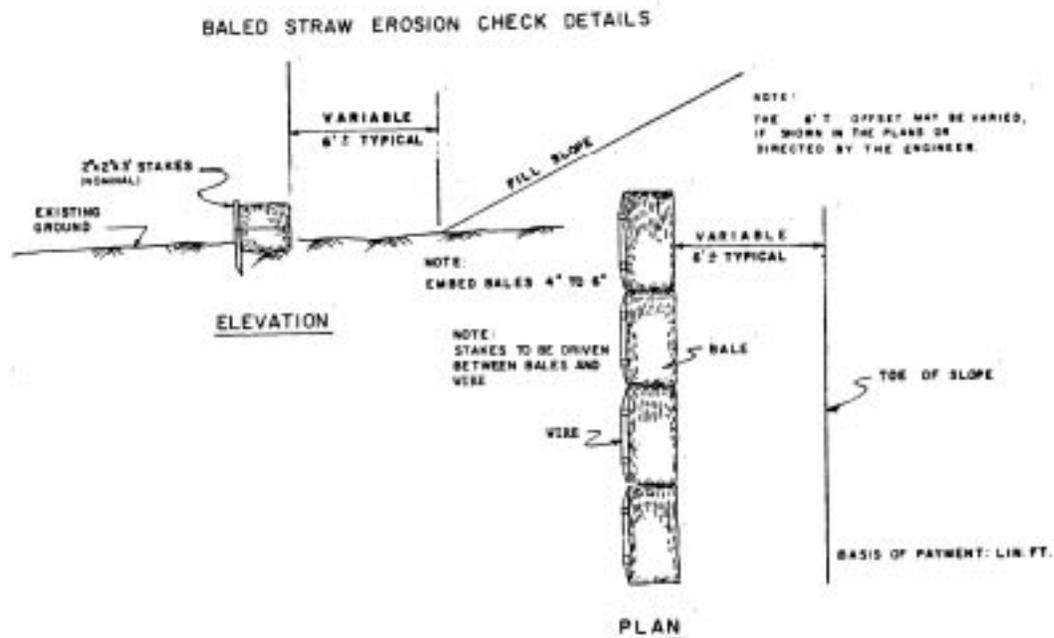
True _____ False _____

HAY BALE CHECK DAMS (SPECIFICATION 163)

Baled straw or hay has been among the most popular material for check dams for years because of its low cost. They are most likely used in ditches or along the toe of a slope or right-of-way in fills less than 10 feet.

Because hay bales are difficult to keep in place, they are only effective where grades are not steep (one percent or less). Hay bales can handle large quantities of water, as long as it is not moving at a high velocity.

Locations and standard designs for baled straw erosion checks are often included in the plans. Each bale should be entrenched or keyed into the ground 4 to 6 inches deep and secured with stakes to prevent the bales from twisting out of place. The bales should be held together with a wire or nylon tie.



2-81 hay bales

The stakes must be driven securely into the ground and located behind the bale between the wire and the hay so that the bales will not turn and wash away.

The bales placed in the ditches must be placed in such a way that water cannot flow around them. If this should occur, additional hay bales should be used, provided it does not force the water out of the ditch onto the roadway or private property.

The steeper the ditch grade, the greater the speed of the water it carries. Steeper grades require that baled straw erosion checks be placed more closely together. Refer to the uniform erosion control guidelines contained in the plans for specific guidelines for the project.

When inspecting newly installed baled straw erosion checks, inspectors should check to see whether the hay bales are keyed into the ground 4 to 6 inches; whether there are at least two stakes per bale; whether the check dam is at the appropriate distance from the toe of the slope; whether the hay bales are abutting one another; and whether the stakes are driven deep enough. In addition, at no time shall the top of the bale be above the roadway.

FILL IN THE BLANKS

2-76 Hay bale check dams should be placed _____ in the ground.

2-77 Check dams are usually placed in ditches in order to catch _____ and slow running water.

2-78 When inspecting baled straw erosion checks, inspectors should check whether:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

2-79 Stakes for baled straw erosion checks should be placed _____ the bale and _____
the wire and hay.

2-80 Steeper grades require that baled straw erosion check dams be placed _____.

2-82 boughs, limbs, small logs

2-81 _____ can handle large quantities of water, as long as it is not moving at a high velocity.

It is imperative that hay bale straw erosion checks be regularly checked to ensure that the soil deposited in front of the dam does not become so high that the water begins to flow over the bales. Accumulated soil must be removed when it reaches a level of ½ its storage capacity. Specifications require the clearing of this material from the check dam.

If wet conditions do not permit the sediment to be cleared away at the bottom of slopes, additional bales of hay can be added downstream or added on top of existing bales to collect sediment before it leaves the right of way. These extra bales should be placed as necessary and anchored accordingly.

Hay bales can also be used around catch basins during construction to filter sediment before runoff flows into established drainage systems. These bales must be securely anchored in the same manner as those used for check dams. Extra care should be used when installing hay bales around catch basins so as to not cause water to back up onto the roadway or private property.

When placing check dams in ditches, a frequent shortcoming of the hay bale erosion check is that it does not extend high enough up the ditch, thus causing washouts.

Check dams are usually placed, cleaned, and removed at periods of low or no flow so that little or no sediment enters the main stream. They should not be placed in flowing streams.

Impermeable dams may be built of rock and soil, or plastic sheets and soil. These should have formed spillways to prevent washout around the dam at high-flow conditions. A downstream dissipater apron is also required in highly erodible areas. The construction of impermeable dams should be limited to plan requirements.

2-76 entrenched 4-6 inches

2-77 catch sediment

2-78 hay bales entrenched 4 to 6
inches

two stakes per bale
appropriate distance
abutting one another
stakes deep enough
not above roadway

2-79 behind
between

2-80 closely together

- 2-83** Check dams should not be placed in _____ streams.
- 2-84** Hay bales around _____ filter sediment before runoff flows into established drainage systems.
- 2-85** _____ check dams may be built of rock and soil, or plastic sheets and soil, and should have a formed _____ to prevent washout at high flow.
- 2-86** _____ require that soil deposited in front of check dams be removed so that it does not become so high that water begins to flow over the dams.
- 2-87** At the bottom of slopes, if sediment cannot be cleared away because of wet conditions, and water is flowing over the baled straw erosion check, extra hay bales should be placed on top of the _____ and firmly anchored.
- 2-88** Baled straw erosion checks in ditches need to extend high enough up the ditch so they won't _____.
- 2-89** Impermeable check dams in highly erodible areas should have downstream _____

SILT FENCE (SPECIFICATION 171)

Silt fence is another way to prevent sediment from being carried off the project or to prevent sediment from settling at drainage structures, especially where the amount of runoff is great. Areas requiring silt fence can be ditches or major drainage areas of the construction zone. Silt fence can even be used instead of baled straw erosion checks in certain instances.

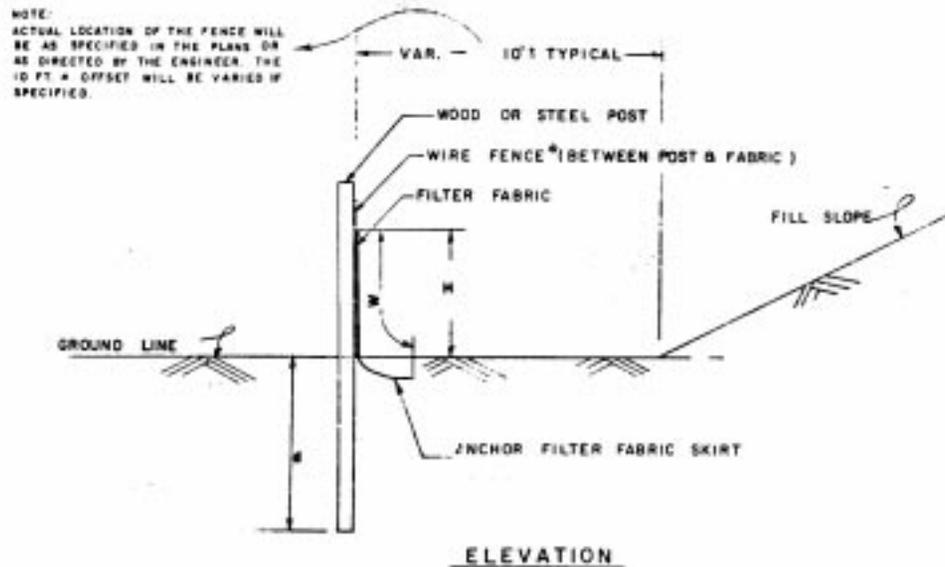
Silt fence is composed of filter fabric, posts, and in one type, it even includes wire fence. There are three (3) different types of silt fabric: Type A, Type B, Type C. Each type has specific uses.

Type A is used along the toe of slopes greater than 10 feet high, along the right-of-way line or parallel to streams. When used as ditch checks they should be spaced every 100 feet for slopes of 1% to 2%; 50 feet for slopes of 2% to 3%.

Type B can be used in lieu of baled straw erosion checks at the contractor's option. If it is to be used for the purpose of a check, the slopes must be less than 1%. It can be used at the toe of fills less than 10 feet high.

Type C silt fence, unlike Type's A & B, consists of the filter fabric being placed in front of a wire fence, which gives it additional strength. It is used as ditch checks where slopes are 3% to 5% using a 25 feet spacing, along the toe of the fill, along the right-of-way, or parallel to streams and under bridges.

Silt fence is available in two fabric heights. Type A & C is 36 inches high. Type B is 22 inches high.



- 2-83 flowing
- 2-84 catch basins
- 2-85 impermeable
- 2-86 specifications
- 2-87 hay bales in place
- 2-88 washout
- 2-89 downstream dissipator apron

The fabric is attached to specified wood or metal fence posts with cord, wire, pockets, staples, or nails and stretched across the drainage area.

The posts must be driven firmly into the ground a minimum of 18 inches to prevent them from being knocked over by water or sediment. Sometimes it is a good practice to incline the posts slightly (about one o'clock) toward the direction of the flow. Then, the force of the water and the weight of the sediment build-up will push the posts upright, instead of backwards and may prevent the fence from toppling. If there is a low point, it is a good place for the posts to be installed first.

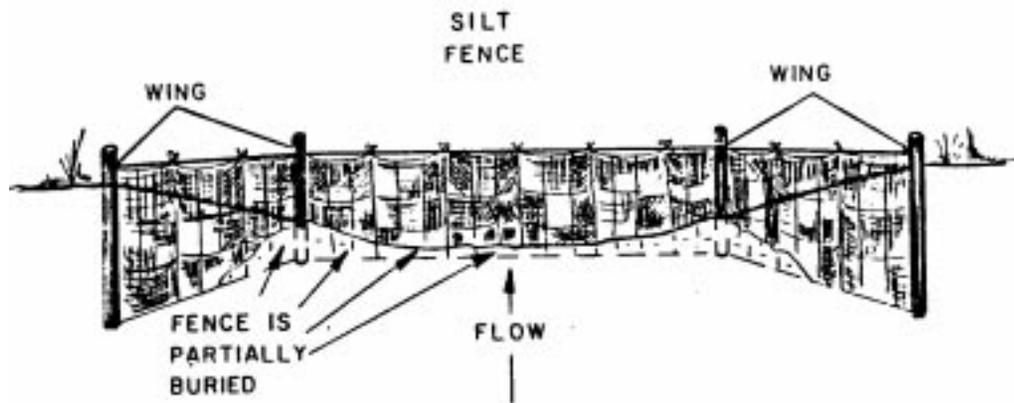
Even properly secured posts may require additional bracing, which should be placed from the backside.

The bottom of the filter fabric fencing should be buried in a trench about 4 to 6 inches deep to prevent the fence from being undermined.



Silt fence can also be used around drop inlets or catch basins to prevent sediment from entering storm drainage systems until vegetation has been established. Extra care should be used during these installations to not cause water to backup onto the roadway or private property.

The contour of the land must be taken into account when aligning a silt fence. The fence should be strung across the path of drainage in such a way that runoff is entirely blocked. Wings at each end can be used to funnel water and to prevent silt from flowing around the ends of the fence. If sediment begins to flow around the ends of the fence, the fence must be extended. The “point” of the silt fence should be toward the uphill side of the ditch as to divert the water to each side of the piece of silt fence which will assist in slowing down the flow of water.



2-96 silt fence
2-97 filter fabric
2-98 one
2-99 4 to 6 inches
2-100 bracing
2-101 36 inches
22 inches

It is imperative that a silt fence be carefully and continuously maintained if it is to perform adequately.

Maintenance of erosion control structures is the responsibility of the contractor; however, the inspector must be certain this work is properly performed.

Any holes that are made in the fence (e.g. by brush or other objects carried by water) must be repaired immediately. Hay bales can be used in front of some holes; however, if the fence is severely damaged, it should be replaced.

Hay bales used to block holes must be securely staked per specifications as for the check dam.

Any fence that fails or is washed away must be immediately replaced. Accumulated sediment should be removed and properly disposed of before the next rainfall.

Should it become apparent that a single silt fence is unable to contain sediment or runoff, a second fence should be constructed behind it, or an alternate method of erosion control such as a settling basin in front of the fence could be added.

Inspectors should always check to see if the silt fences are installed properly. Some of the things to look for are: whether the toe of the fabric is anchored properly; whether the post spacing is according to specifications; whether the posts are driven to the proper depth; whether the filter fabric is at the proper height; whether the filter fabric is securely fastened to the post and whether the fence location is according to plans or as determined by the engineer.

FILL IN THE BLANKS

2-90 If the silt fence is severely damaged, they should immediately be _____.

2-91 Inspectors should always check silt fence to see (name five)

1. _____

2. _____

3. _____

4. _____

5. _____

2-92 Holes in silt fence made by brush or debris must be repaired _____.

2-93 If sediment begins to flow around the ends of a silt fence, the fence must be _____.

2-94 _____ at the ends of a fence can be used to funnel runoff and prevent silt from flowing around the ends.

2-95 A second silt fence should be constructed _____ the original, or a settling basin in front of the fence if the original silt fence is failing.

- 2-96** _____ is used where the amount of runoff is too great to be handled by baled hay or log and brush check dams.
- 2-97** Generally, silt fence is composed of _____ and attached to specified posts with cord or wire.
- 2-98** It's good idea to incline silt fence posts about _____ o'clock.
- 2-99** The bottom of silt fence fabric should be buried about _____ to prevent sediment from washing beneath the fence.
- 2-100** Sometimes properly secured posts may require additional _____ placed from the backside.
- 2-101** Type A and C silt fence is _____ high, while Type B silt fence is _____ high.

SILT CONTROL GATE (SPECIFICATION 163)

An effective method to keep silt from clogging cross drain structures is the silt control gate. The type of silt control gate to be used should be indicated on the plans and construction details.



After the silt control gate is installed, the inspector should check to see if the grading of the roadbed is complete in the affected drainage area. Also he should check to see if all slopes and ditches that are not to be paved are grassed and mulched.

- 2-90 replaced
- 2-91 anchored properly
proper post spacing
posts are deep enough
fabric is proper height
proper location
fabric secure to post
- 2-92 immediately
- 2-93 extended
- 2-94 wings
- 2-95 behind

When silt has been deposited at the gate to a depth equal to half the height of the gate, the silt will be removed and placed outside the affected drainage area. Silt that is removed should never be placed upstream of the silt gate and certainly not downstream. It is recommended that it be placed in a flat area, if possible, or hauled off.

When grass on the project has attained sufficient growth to control erosion of the roadway, all silt deposited in the gate area shall be removed and placed outside the affected drainage area. The area where silt was removed will then be grassed.

The gate shall remain in place until all work in the affected drainage area is complete and accepted by the engineer.

The gate assembly will then be removed by sawing off the wood posts flush with the concrete apron. The concrete apron between the gate and the structure inlet shall be left in place.

TRUE OR FALSE - MARK THE CORRECT ANSWER

2-102 The silt control gate shall remain in place until all work in the area is complete and accepted by the engineer.

True _____ False _____

2-103 Silt control gates are an effective method to keep silt from clogging cross drain structures.

True _____ False _____

2-104 When deposited silt has covered $\frac{3}{4}$ of the silt control gate, it should be removed and placed to the side.

True _____ False _____

2-105 After silt control gates are installed, the inspector should check to see if roadbed grading is complete and slopes and ditches are grassed and mulched.

True _____ False _____

2-106 The area where silt was removed at the silt control gate should be grassed before grass on the project has attained sufficient height to control roadway erosion.

True _____ False _____

2-107 The silt control gate will then be removed by sawing off the wooden posts and removing the concrete apron.

True _____ False _____

SEDIMENT BASIN (SPECIFICATION 163)

A sediment basin is an artificially created pool that stops running waters and holds it, and allows sediment to settle to the bottom of the pool.

Sediment basins are used alone or in conjunction with silt fence and other devices used to prevent silt from getting into natural streams, filling up ditches or settling on private property.

The use of sediment basins should be reserved for critical situations (such as drainage into surface water supplies) and should be considered a back-up safety device if other controls fail on the project.

Sediment basins usually contain a perforated standpipe that allows water to flow out slowly, allowing time for sediment to settle out. The top of the standpipe is open and allows full flow at an elevation below the top of the dam and spillway and the roadway if it is adjacent to it.

Some sediment basins are also designed with a riprap or otherwise lined spillway for overflow during major floods. The spillway must be maintained to prevent washout of the dam.

Sediment basins permit sedimentation of coarse soils only as silt and clay-sized particles remain in suspension. Allowable sediment depth is to be $\frac{1}{2}$ total basin depth.

The sediment basin must be large enough to accommodate the anticipated runoff from the drainage area. Multiple basins may be used, or used in conjunction with other erosion control measures to prevent runoff.



2-102 true

2-103 true

2-104 false

2-105 true

2-106 false

2-107 false

Regular maintenance is also the key to the effective functioning of a sediment basin. Sediment must be removed from the basin before it reaches a height of one-half the wet storage volume. Furthermore, at the end of a project, temporary control measures can be left in place if a problem is anticipated. Maintenance forces can later remove these erosion control measures and the site properly restored. Refer to the specifications for the payment of a sediment basin that is retained after project completion.

FILL IN THE BLANKS

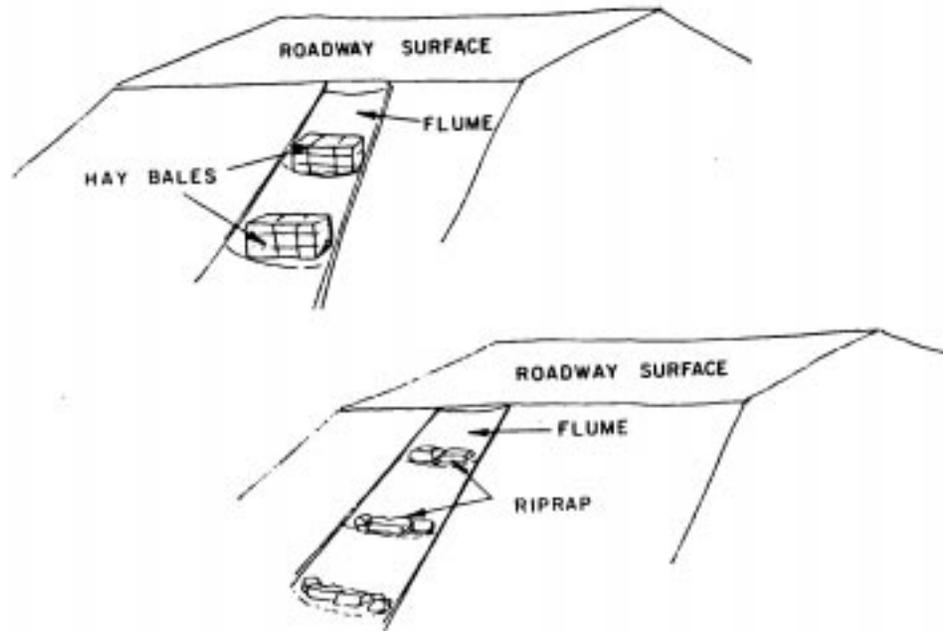
- 2-108** Basins are often dug at natural _____ spots in ditches.
- 2-109** A _____ is an artificially created pool that stops running water and allows its sediment to settle to the bottom.
- 2-110** Sediment basins are used alone or in conjunction with other devices to prevent _____ from getting into natural streams, filling up ditches, or settling on private property.
- 2-111** Sediment basins usually contain a perforated _____, which allows water to flow out slowly, allowing time for the sediment to settle.
- 2-112** Some sediment basins are also designed with a riprap or otherwise lined _____ for overflow during major floods.
- 2-113** Sediment basins should be considered _____ devices if other silt control devices fail.
- 2-114** The allowable amount of sediment that can accumulate in sediment basins is _____ the total basin depth.

TEMPORARY SLOPE DRAINS AND FLUMES (SPECIFICATION 163)

Slope drains prevent erosion from running water by directing it down through a protected sluice to the bottom of the slope.

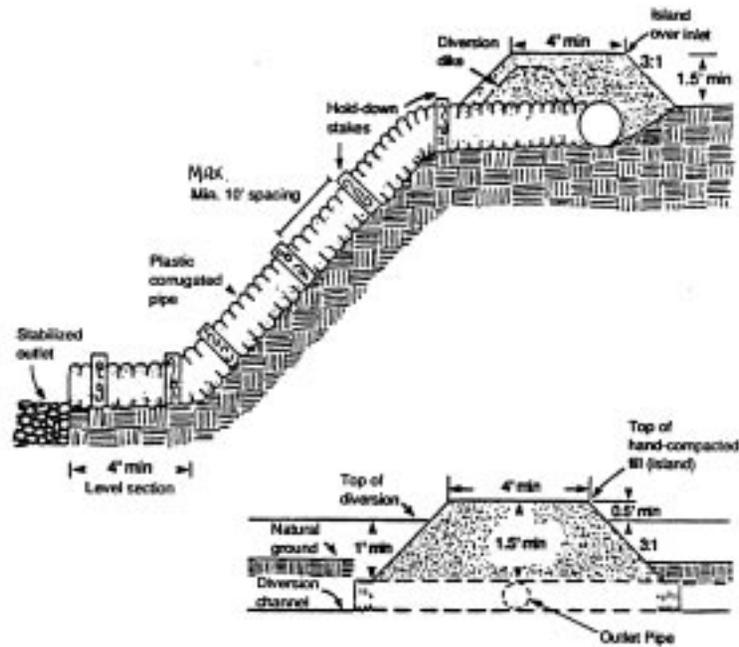
Open temporary slope drains may be constructed of burlap, jute mesh, plastic sheets, bituminous treated fiber or any other material approved by the engineer.

The edges of the plastic sheeting or bituminous treated glass fiber must be buried or held in place by baled hay or sandbags. If the edges are not properly anchored, water will flow around the edge and cause erosion there.



Erosion around the edges of flumes or other down drain is called piping.

If an open slope drain (i.e., flumes) is long or on a steep slope, baffles may be needed to slow the flow of water. Baffles for temporary slope drains can be bales of hay or pieces of riprap that are placed at points along the length of the flume to break the downward force of the water.



Down Draine Pipe and Inlet Detail

Temporary pipe slope drains are used during construction on both front and back slopes to control runoff and protect slopes from erosion. Proper installation extends from the top of the slope down to the toe of the slope and then four (4) feet down stream or out from the slope. Slope drains that terminate anywhere in between, tend to cause washouts and possible sluffing.

- 2-108 low
- 2-109 sediment basin
- 2-110 silt
- 2-111 stand pipe
- 2-112 spillway
- 2-113 back up
- 2-114 one-half

2-122 false

2-123 true

2-124 false

While plastic pipe is increasingly becoming more popular for temporary slope drains, corrugated metal pipe may also be used.

In fill areas, earth berms and drain inlets are used on fills higher than 10 feet and should be spaced at 500 feet, on a 4% grade and at 200 feet on grades over 4%.

After the fill is completed to grade template line, the earth shoulder berm is to be sprayed with RS-2 or SS-1 asphalt, or lined with polyethylene plastic sheeting.

Inlets for temporary pipe slope drains can be a sump hole with dimensions at least equivalent to the metal drain and lined with polyethylene or emulsified asphalt, or other material approved by the engineer.

TRUE OR FALSE - MARK THE CORRECT ANSWER

2-115 Baffles used on long or steep temporary slope drains can be tamped piles of dirt or small branches.

True _____ False _____

2-116 Piping is erosion around the edges of flumes and other down drains.

True _____ False _____

2-117 Temporary pipe slope drains are used on both front and back slopes under construction.

True _____ False _____

2-118 For temporary slope drains the edges of plastic sheeting or bituminous treated fiber need not be anchored.

True _____ False _____

2-119 Corrugated metal pipe is increasingly becoming more popular for temporary slope drains.

True _____ False _____

2-120 Earth berms and drain inlets may be used during the construction of a fill.

True _____ False _____

2-121 Temporary pipe slope drain inlets are constructed of concrete.

True _____ False _____

2-125 ½ inch

2-126 front lip

2-127 metal

2-128 12 inch

2-129 compacted

2-130 outfall end

2-131 heavy rains

2-132 staked

2-122 After the fill is completed, the earth shoulder berm is removed.

True _____ False _____

2-123 Temporary slope drains may be constructed of burlap, jute mesh, plastic sheets, or bituminous treated fiber.

True _____ False _____

2-124 Slope drains prevent erosion from occurring by channeling running water away from slopes.

True _____ False _____

For plastic pipe slope drains, a plastic drain inlet or plastic flared end section having similar design to metal inlets or end sections may be used for the drain inlet.

2-115 false

If the pipe slope drain is 10 inch plastic or 10 inch corrugated metal, a standard metal flared end section for 12 inch pipe may be used for the drain inlet, provided it is modified for use with a 10 inch pipe. The connection, however, must be leak proof.

2-116 true

2-117 true

The inlet is secured to the extension collar with a metal strap, then the corrugated plastic pipe is attached firmly to the collar using fabric straps, wire, metal collars, or other suitable materials.

2-118 false

2-119 false

The inlet of the slope drain must be tilted downward in order to adequately capture runoff. About ½ inch of tilt per foot of drain length is sufficient.

2-120 true

2-121 false

The pipe is then staked in place with wooden stakes.

For metal inlet sections, the front lip anchors the device and prevents the seepage of water beneath the drain.

Nevertheless, the soil around the inlet should be compacted. The downward tilt of the inlet and the compaction of the soil help to prevent piping.

The outfall end should be protected against erosion with riprap, sandbags, etc.

It is important to check the outfall end of the drain after heavy rains. Any silt that remains should be removed to prevent the drain from clogging. The surrounding ground should also be checked for erosion.

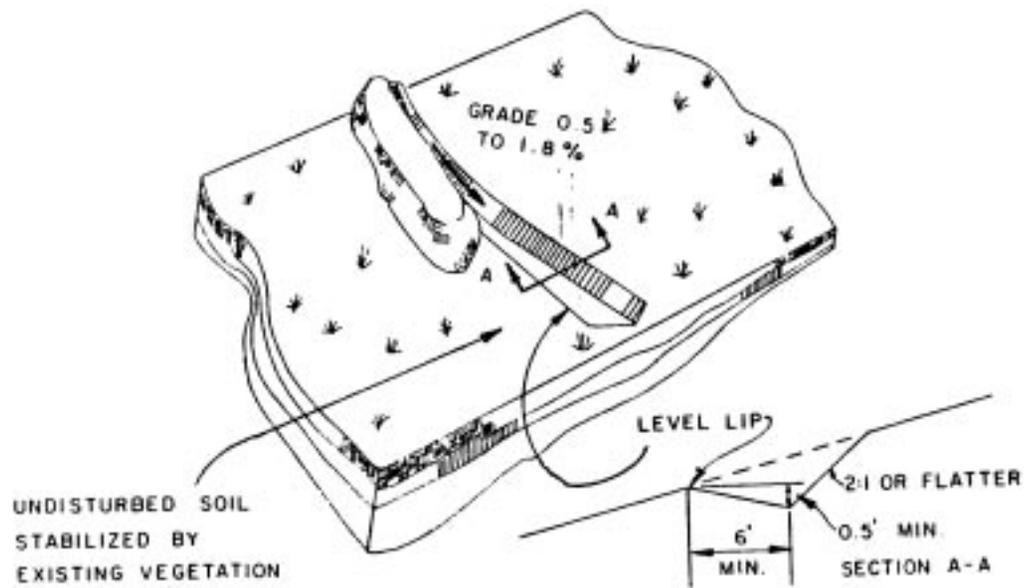
The pipe is then staked in place with wooden stakes.

FILL IN THE BLANKS

- 2-125 To adequately capture runoff, the slope drain inlet must be tilted downward about _____ of tilt per foot of drain length.
- 2-126 The _____ of metal inlet sections anchors the device and prevents seepage of water beneath the drain.
- 2-127 Drain inlets for plastic pipe slope drains can be plastic with a design similar to _____ drain inlets or end section.
- 2-128 If a 10-inch plastic or metal pipe slope drain is used, a standard metal flared end section for _____ pipe may be used for the drain inlet.
- 2-129 The soil around the inlet should be _____.
- 2-130 Riprap, sandbags, etc., should be used at the _____ of the slope drains to protect against erosion.
- 2-131 It is important to check the outfall end of slope drains after _____ for any silt so that it can be removed.
- 2-132 Temporary pipe slope drains are _____ in place.

LEVEL SPREADER (VELOCITY DISSIPATOR)

When the volume of runoff flowing into vegetative area becomes too concentrated for the area to handle, a special type of ditch called a level spreader can be used to diffuse the flow. The level spreader will change a concentrated flow into a sheet of water that flows at a non-erosive speed.



- 2-137 true
- 2-138 two (2) yards
- 2-139 anchor slot
- 2-140 one half
- 2-141 12 inches
- 2-142 asphalt emulsion
- 2-143 24 hours
- 2-144 grassing

When constructing a level spreader, the length and width will be determined by the amount of water to be handled.

The most important feature of a level spreader is the downhill lip. The outlet lip must be perfectly level along the entire length of the spreader. If it is not, the water will concentrate in the low places and erode the lip, causing further concentrated flow.

Like other ditches, the level spreader must be stabilized with a protective cover such as bituminous treated fiber.

TRUE OR FALSE - MARK THE CORRECT ANSWER

2-133 The length and width of a level spreader is determined by the amount of water to be handled.

True _____ False _____

2-134 The outlet lip of a level spreader must be perfectly level along the level spreader's length.

True _____ False _____

2-135 The level spreader must be stabilized with a protective cover such as bituminous treated glass fiber.

True _____ False _____

2-136 A level spreader is a special type of berm used to spread runoff into level areas.

True _____ False _____

- 2-154 Three (3) foot
- 2-155 12 inches
- 2-156 true
- 2-157 2 inch
- 2-158 true
- 2-159 2 inches
- 2-160 false
- 2-161 true

CHAPTER II REVIEW

- 2-137 The ends of all erosion control blankets, except permanent soil reinforcing mats, should overlap at least 6 inches with the upgrade section on top.
True_____ False_____
- 2-138 Staples for excelsior blankets are placed about _____ apart on each side of the blanket and one row in the center, alternately spaced between the side staples.
- 2-139 Twelve (12) inches of the upslope end of the first row of excelsior blankets should be placed in a six-(6) inch deep _____.
- 2-140 _____ of each staple should be located in each excelsior blanket when they are side by side.
- 2-141 For excelsior and fiberglass blankets, the staples at end shall be placed in a row with spacing of about _____.
- 2-142 When installing fiberglass blankets, an _____ may be applied to anchor the blanket instead of staples.
- 2-143 Erosion control blankets are to be placed within _____ after the grassing operation is complete and before any watering or rain.
- 2-144 _____ operations must be complete and the area left smooth before erosion control blankets are placed.

- 2-145** When excelsior blankets are unrolled, be sure the net is on the bottom.
True _____ False _____
- 2-146** In installing bituminous treated fiber on slopes, the fiber is spread at the approximate rate of about _____ square yard, while the bituminous material is applied at approximately _____ gallons per square yard.
- 2-147** For waterways, glass fiber is spread at the approximate rate of about _____ per square yard, while the bituminous material is applied at approximately _____ gallons per square yard.
- 2-148** When bituminous treated fiber is used on an area, an air compressor is used to apply the _____.
- 2-149** Permanent soil reinforcing mats, when laid side-by-side, should overlap _____ inches.
- 2-150** Installing permanent soil reinforcing mats on slopes does not require _____ joints.
- 2-151** The entire permanent soil reinforcing mat and the disturbed soil area is to be grassed and mulched after the mat is in place and is approved.
True _____ False _____
- 2-152** Longitudinal joints for permanent soil reinforcing mats must be staked with maximum intervals of _____.
- 2-153** The ends of each roll of permanent soil reinforcing mat must overlap _____ with the _____ mat on top.

2-133 true

2-134 true

2-135 true

2-136 false

- 2-169 true
- 2-170 2:1
- 2-171 sediment
- 2-172 85
- 2-173 temporary slope drain
- 2-174 false
- 2-175 false
- 2-176 baled hay ditch checks

- 2-154** When staples are used in fiberglass blankets, the staples in the side are placed _____ apart with an alternately spaced row in the center.
- 2-155** The initial _____ of fiberglass blankets shall be placed in the anchor slot at the upgrade end.
- 2-156** The asphalt emulsion applied to fiberglass blankets is applied at the rate of 0.12 to 0.15 gallons per square yard for slopes and twice that amount for waterways.
True_____ False_____
- 2-157** Side staples for fiberglass blankets are placed in the _____ overlap of adjacent blankets.
- 2-158** Adjoining ends of both excelsior and fiberglass blanket shall overlap at least 6 inches with the upstream section on top.
True_____ False_____
- 2-159** Adjacent fiberglass blanket strips should overlap at least _____.
- 2-160** Adjacent jute mesh strips shall overlap at least two (2) inches.
True_____ False_____
- 2-161** In installing fiberglass blankets on slopes and ditches, a 9-inch deep anchor slot should be dug across the upgrade end of the site.
True_____ False_____

- 2-162** Jute mesh that connects to a structure is anchored in a 6 inch deep trench then rolled upstream and connected by a junction slot.
True ___ False ___
- 2-163** Staples along the edges of the jute mesh shall be spaced not more than 3 feet apart.
True ___ False ___
- 2-164** Spacing between check and anchor slots for jute mesh shall not exceed 50 feet on grades three percent or less.
True ___ False ___
- 2-165** The up-channel end of each jute mesh strip is to be buried in a narrow _____ deep trench.
- 2-166** Ridges and piles of dirt that have formed around the edges of erosion control blankets help to anchor the blanket.
True ___ False ___
- 2-167** In channel curves, the jute mesh should be adjusted to where the _____ edge is slightly higher than the _____ edge.
- 2-168** All overlapping joints and at the ends of jute mesh staples shall be placed not more than _____ and made flush with the ground.

- 2-145 false
- 2-146 0.2 to 0.25 pounds per
0.12 to 0.15 gallons
- 2-147 0.4 to 0.5 pounds
0.24 to 0.30 gallons
- 2-148 glass fiber strands
- 2-149 three (3)
- 2-150 longitudinal
- 2-151 true
- 2-152 5 feet
- 2-153 3 feet
upslope

- 2-186 behind
between
- 2-187 Impermeable
spillway
- 2-188 dissipator or apron
- 2-189 false
- 2-190 1. 4; 6
2. 2
3. location
4. abutting
5. deep enough
- 2-191 downstream
- 2-192 catch basins

- 2-169** For all grades over three percent, spacing between check and anchor slots for jute mesh shall not exceed 25 feet.
True _____ False _____
- 2-170** Side slopes on berms and surface ditches are to be _____ unless modified on construction to meet field conditions.
- 2-171** Dikes can be built in any location where it is necessary to catch _____ such as above and below graded roadbeds.
- 2-172** Soil dikes should be compacted to about _____ percent density that usually can be achieved using the weight of standard construction equipment.
- 2-173** Where berms are used, _____ with adequate inlets shall be provided.
- 2-174** Diversion dikes never should be seeded or covered.
True _____ False _____
- 2-175** Dikes are for temporary erosion control only, and are never to be used as a permanent measure.
True _____ False _____
- 2-176** In berm ditches on grades 2.1 percent or greater, _____ are to be used.

2-177 Material excavated from ditches should be hauled away from the site and disposed of properly.

True _____ False _____

2-178 _____ are usually placed in ditches in order to catch sediment and slow running water.

2-179 Temporary check dams can be constructed from stacked hay bales or logs and brush from clearing operations.

True _____ False _____

2-180 Top of cut ditches should be _____ with a material that will not permit water to soak into the ground.

2-181 Slides below a top of cut ditch are caused by water concentrated behind and within the ditch.

True _____ False _____

2-182 A ditch with side slopes 3:1 and a 4-foot wide bottom will have little erosion of the sides and bottom.

True _____ False _____

2-183 _____ can be dug at any point to carry water to areas of drainage collection.

2-184 Baled straw erosion checks should be entrenched into the ground between _____ and _____ inches deep.

2-185 When ditches are _____, they should be covered with bituminous treated glass fiber, vegetative mulch, or and artificial covering.

2-162 true

2-163 true

2-164 true

2-165 6 inch

2-166 false

2-167 outside
inside

2-168 18 inches

2-200 shouldn't
2-201 silt fence
2-202 silt control gates
2-203 true
2-204 false
2-205 slope drains
2-206 one half
2-207 sediment basin
2-208 true

- 2-186** Stakes for hay bale check dams should be placed (inside / behind) the bale (between / behind) the wire and hay.
- 2-187** _____ check dams may be built of rock and soil, or plastic sheets and soil, and should have a formed _____ to prevent washout at high flow.
- 2-188** In highly erodible areas, impermeable check dams should have a downstream _____.
- 2-189** Soil deposited in front of check dams acts as reinforcement to the dam and should only be removed when the check dam is removed.
True _____ False _____
- 2-190** When inspecting baled straw erosion check dams, the inspector should check whether
1. they are entrenched _____ inches to _____ inches
 2. there are at least _____ stakes per bale
 3. they are at an appropriate _____
 4. they are _____ one another
 5. the stakes are driven _____
- 2-191** When wet conditions prevent the removal of sediment in front of a hay bale check dam, extra hay bales should be placed _____ and firmly anchored.
- 2-192** Hay bales are placed around _____ to filter sediment before runoff flows into established drainage systems.

2-193 Temporary check dams should not be placed in flowing streams.

True _____ False _____

2-194 Type A silt fence is 36 inches high, while Type B silt fence is 22 inches high.

True _____ False _____

2-195 Inspectors should always check silt fence to see whether:

1. it is _____ properly
2. there is proper _____
3. _____ are driven deep enough
4. _____ is at proper height
5. filler fabric is securely fastened to the _____
6. fence is in proper _____

2-196 The bottom of silt fence fabric should be buried from _____ to _____ inches to prevent sediment from washing beneath the fence.

2-197 _____ at the ends of a silt fence can be used to funnel runoff and prevent silt from flowing around the ends.

2-198 Generally, silt fence is composed of plastic sheets and attached to specified posts.

True _____ False _____

2-199 Log and brush check dams are most effective if a _____ is dug along the barrier to catch the sediment.

2-177 false

2-178 check dams

2-179 true

2-180 lined

2-181 true

2-182 false

2-183 ditches

2-184 4
6

2-185 seeded

- 2-200** Brush barriers _____ be used in urban areas.
- 2-201** _____ is used where the amount of runoff is too great to be handled by baled hay or log and brush check dams.
- 2-202** _____ are an effective method to keep silt from clogging cross drain structures.
- 2-203** To remove the silt control gate, the wood posts should be sawed off flush with the concrete apron and the apron is to be left in place.
True____ False____
- 2-204** The use of sediment basins should be used whenever possible, especially where drainage emptied into surface water supplies.
True____ False____
- 2-205** _____ prevent erosion from running water by directing it down a protected sluice.
- 2-206** Allowable sediment depth in sediment basins is _____ the total basin depth.
- 2-207** A _____ is an artificially created pool that stops running water and allows its sediment to settle to the bottom.
- 2-208** The silt control gate shall remain in place until all work in the area is completed and accepted by the engineer.
True____ False____

2-209 When deposited silt has covered $\frac{3}{4}$ of the silt control gate, it should be removed and placed to the side.
True ___ False ___

2-210 _____ is erosion around the edges of flumes and other down drains.

2-211 A _____ is a special type of ditch used to diffuse water flow to a non-erosive speed.

2-212 After the fill is complete to grade template line, the earth shoulder berm is sprayed with grade _____ asphalt

2-213 Temporary pipe slope drains are used during construction on both front and back slopes.
True ___ False ___

2-214 Earth berms and drain inlets may be used during the construction of a fill.
True ___ False ___

2-215 To adequately capture runoff, the slope drain inlet must be tilted downward about _____ of tilt per _____ of drain length.

2-216 The soil around the inlet should be _____.

2-217 The level spreader must be stabilized with a protective cover such as bituminous treated glass fiber.
True ___ False

2-218 The length of a level spreader should never exceed 3 feet
True ___ False

2-219 Sediment basins usually contain a perforated _____, which allows water to flow out slowly - allowing time for the sediment to settle out.

2-193 true

2-194 true

2-195 1. anchored
2. post spacing
3. posts
4. filter fabric
5. post
6. location

2-196 4; 6

2-197 wings

2-198 false

2-199 trench

This is the end of Chapter 2. If you missed any questions, review the appropriate frames before going on to Chapter 3.

CHAPTER III: PERMANENT EROSION CONTROL

Permanent erosion control devices are designed to prevent erosion after work on the project has been completed. Measures commonly used for permanent erosion control include grass, slope drains, slope paving and revetments and landscaping with shrubs and trees.

GRASSING: GROUND PREPARATION (SPECIFICATION 700)

Unlike temporary grassing for erosion control, permanent grassing requires maximum seedbed preparation.

In preparing the soil for permanent grassing, the soil must be loosened so that the seed can be placed at the proper depth. Slopes to be seeded must be prepared by approved methods such as breaking, harrowing, or disking. Hardpan areas may require plowing with a bulldozer.

After the seedbed has been worked up and prior to seeding, it is important that all large rocks, roots, and limbs must be cleared from the area so they won't hamper mower operations later.

Shoulders and embankment slopes should be prepared by plowing to a depth between four (4) and six (6) inches. For front and back slopes of cuts, 3:1 or flatter, plowing should be six (6) inches or greater. The area should then be thoroughly disked, until pulverized, to the plowed depth.

Cut slopes steeper than 3:1 shall be serrated where plan detail is shown. Serrated slopes are left with small one (1) to three (3) foot benches rising along the slope. The benches should be approximately level, but it is not necessary that the slope be perfectly uniform.

If serration detail is not shown on the plans, the slopes shall be prepared sufficiently to provide an adequate seed bed by plowing, using a spiked chain, walking it in with a cleated bulldozer, or scarification.

- 2-209 false
- 2-210 piping
- 2-211 level spreader
- 2-212 RS-2h or SS-1h
- 2-213 true
- 2-214 true
- 2-215 ½ inch
foot
- 2-216 compacted
- 2-217 true
- 2-218 false
- 2-219 stand pipe

Following bed preparation, the slopes must be smoothed to eliminate any rills or gullies that may have formed. If necessary, extra soil may be added.

Topsoil stockpiled during grading shall be spread evenly over desired areas after the ground preparation is complete. Topsoil may be pushed from the top over the serrated slopes. No equipment should be allowed on the face of the completed serrated cuts.

FILL IN THE BLANKS

- 3-1 Topsoil can be pushed over _____ slopes.
- 3-2 _____ stockpiled during grading shall be spread evenly over desired areas after the ground preparation is complete.
- 3-3 Cut slopes steeper than 3:1 shall be _____ where plan detail is shown.
- 3-4 Serrated slopes are left with small _____.
- 3-5 If the serration detail is not shown, the slopes should be plowed to provide an _____.
- 3-6 _____ devices are designed to prevent erosion after work on the project has been completed.
- 3-7 It is important that all large rocks, roots, and limbs must be cleared from the area when it is prepared for permanent grassing so they won't hamper _____ operations later.
- 3-8 Front and back slopes of cuts should be plowed _____ or greater.
- 3-9 Permanent grassing requires _____ seedbed preparation.
- 3-10 In preparing the soil for permanent grassing, the soil should be worked until the seed can be placed at the proper _____.
- 3-11 Except for front and back cut slopes, the ground should be plowed to a depth between _____ and _____ inches.

After the area is fully prepared, fertilizer and agricultural lime should be added to the soil.

Ground dolomitic agricultural lime is applied uniformly to the surface of the ground at the rate in the specifications. Soil tests can be performed where growth is sparse.

The fertilizer should be uniformly spread over the ground surface at a rate of about 1200 pounds per acre.

Lime and fertilizer should then be uniformly mixed into the top 4 inches of soil by suitable harrows, rotary tillers, or other equipment deemed appropriate by the engineer.

On grassing projects with approximately 15.0 acres on the whole project, agricultural lime shall be uniformly spread at the approximate rate of 2 tons per acre, while fertilizer mixed-grade shall be spread at about 1000 pounds per acre.

On cut slopes steeper than 3:1, the mixing may be reduced to the maximum practical depth as determined by the engineer. On serrated slopes, mixing may be omitted.

TRUE OR FALSE - MARK THE CORRECT ANSWER

3-12 Mixing of lime and fertilizer on cut slopes steeper than 3:1 may be reduced to the maximum practical depth as determined by the engineer.

True _____ False _____

3-13 Lime and fertilizer are uniformly mixed into the top 4 inches of soil.

True _____ False _____

3-14 Fertilizer should be uniformly spread at a rate of 1200 pounds per acre or as specified in the special provision, plans, etc.

True _____ False _____

3-15 Agricultural lime for grassing projects of approximately 15.0 acres is uniformly spread at about 2 tons per acre, while fertilizer mixed grade is spread at about 100 pounds per acre.

True _____ False _____

- 3-1 serrated
- 3-2 Topsoil
- 3-3 serrated
- 3-4 benches
- 3-5 adequate seed bed
- 3-6 permanent erosion control
- 3-7 the mowing
- 3-8 six (6) inches
- 3-9 maximum
- 3-10 depth
- 3-11 four (4), six (6)

In urban areas, and in particular, those areas that will be closely mown and maintained, a higher quality finish is required. Where the grading is adjacent to lawns, hand raking to obtain results similar to the adjoining area should be required.

While machine dressing obtained by such equipment as bulldozers, graders, drags and chains can be operated on highway cuts and fill, gentle slopes and level areas should require power rakes to obtain a smooth finish.

Nevertheless, a certain degree of roughness of the surface makes for a better seedbed as it assists in seed lodging and germination.

FILL IN THE BLANKS

- 3-16** While machine dressing with bulldozers, graders, drags, and chains can be operated on highway cuts and fills gentle slopes and level areas should require _____ to obtain a smooth finish.
- 3-17** A certain degree of _____ of the surface makes for a better seedbed as it assists in seed lodging and germination.
- 3-18** Where grading is adjacent to closely mown and maintained lawns, _____ to obtain a higher quality finish is to be required.

3-12 true

3-13 true

3-14 true

3-15 false

- 3-19 true
- 3-20 false
- 3-21 false
- 3-22 false

SEEDING

Weather permitting, seed shall be sown within 24 hours following the application of fertilizer and lime and preparation of the seedbed.

No sowing shall be done during windy weather which prevents an even distribution of the seed, when the prepared surface is crusted, or when the ground is frozen.

The type of seed for planting depends on the planting zone and the time of year as shown by the charts from the Standard Specifications, Section 700.04.

PLANTING ZONES

The seeding table shows required permanent plant on the right hand portion. An established stand of this plant is required prior to final acceptance as defined in the specifications.

Seed shall be uniformly sown by the use of approved mechanical seed drills, rotary hand seeders, hydraulic equipment or any other type of equipment that will produce a uniform application of seed. No distribution by hand is permitted.

Hydroseeding may be used on any area to be grassed. Under this method of seeding, the seed and fertilizer, at specified rates, with wood fiber mulch, shall be distributed over the area to be seeded in the form of slurry. Seeds of all sizes may be mixed together in the slurry.

PLANTING ZONES	PLANTING DATES	Pounds of Seed Per Acre										REQUIRED PERMANENT PLANT
		Annual Ryegrass	Common Bermudagrass (Sub)(1)(2)	Common Bermudagrass (Sub)(1)(2)	Tall Fescue	Wearing Lovegrass (3)	Reverend Crimson Clover	White Dutch Clover	Centipede Grass (1)	Interstate Lespedeza (Sub)(1)(2)	Interstate Lespedeza (Unsub)(1)(2)	
THESE COMBINATIONS SHALL BE PLANTED ON SHOULDERS, MEDIANS AND RELATIVELY FLAT AREAS												
1	March 1 to May 15		10	50			8					Tall Fescue
1	May 16 to July 31		10	50								Tall Fescue or Bermuda
1	Aug. 1 to Nov. 15			50	20	6						Tall Fescue
1A	Feb. 15 to April 30		10	50			60					Tall Fescue
1A	May 1 to Aug. 15		10	50								Common Bermudagrass
1A	Aug. 16 to Nov. 15			50	20	6						Tall Fescue
2	Feb. 15 to April 15		10	10			6					Common Bermudagrass
2	April 16 to Aug. 31		10	10								Common Bermudagrass
2	Sept. 1 to Nov. 15			50	20	6						Tall Fescue
3	March 1 to Aug. 31		10	10								Common Bermudagrass
3	Sept. 1 to Feb. 29	15	10				15*					Centipede Grass (1) None - First Stage (2)
4	Feb. 15 to Aug. 31		10	10								Common Bermudagrass
4	Sept. 1 to Feb. 14	15	10				15*					Centipede Grass (1) None - First Stage (2)
THESE COMBINATIONS SHALL BE PLANTED ON BACK SLOPES, FILL SLOPES AND AREAS WHICH WILL NOT BE SUBJECT TO FREQUENT MOWING												
1, 1A	March 1 to July 31				4		50					Interstate Lespedeza
1, 1A	Aug. 1 to Nov. 15			30				75				Interstate Lespedeza
2	Feb. 15 to June 30				4		50					Interstate Lespedeza
2	July 1 to Aug. 31		10		4			75				Interstate Lespedeza
2	Sept. 1 to Nov. 15		10	30				75				Interstate Lespedeza
3	Feb. 15 to Aug. 31				4		50					Interstate Lespedeza
3	Sept. 1 to Feb. 14	15										None - First Stage (2)
4	Feb. 1 to Aug. 31		10	10			50					Interstate Lespedeza
4	Sept. 1 to Jan. 31	15										None - First Stage (2)

* White Dutch or Crimson Clovers may be deleted in residential areas by the Engineer.

** (1) Centipede grass is to be planted only where shown on the plans.

(2) See 700.04.F.

(3) Any lovegrass other than on nonmowable (steep) slopes shall be removed at no additional cost to the Department.

3-16 power rakes

3-17 roughness

3-18 hand raking

TRUE OR FALSE - MARK THE CORRECT ANSWER

3-19 Seed shall be sown within 24 hours following the application of fertilizer, lime, and preparation of the seedbed.

True_____ False_____

3-20 Hydroseeding is used only where mechanical seed drills, rotary hand seeders, or other approved seeding methods cannot operate satisfactorily.

True_____ False_____

3-21 Seed may be distributed by hand only when other methods are not available.

True_____ False_____

3-22 Sowing shall be done on windy days, before the ground surface has crusted or has frozen.

True_____ False_____



From the seeding table, we see that in all parts of the state, steep back slopes and fill slopes which will not be subject to frequent mowing are required to be planted with Interstate Lespedeza. Interstate Lespedeza is slow to become established and it must be planted with a companion grass, which grows quickly. In the spring and summer, this would be Weeping Lovegrass or Common Bermudagrass. In the late summer and fall, Tall Fescue would be used. It is important that the seeding rate for the companion grasses not be exceeded, as the Lespedeza will choke it out. Refer to the seed table for required amounts.

3-23 b
3-24 a
3-25 c
3-26 b

All Legumes (Lespedezas and clovers) must be inoculated the same day the seed is planted. The seed needs to be protected from the sun prior to planting. Inoculation is the preparation of the seeds to germinate. The contractor may use whatever means he feels will accomplish this: soaking, inoculant, etc.

When Legumes are planted by hydroseeder, the inoculant is to be included in the hydroseeder at two times the normal rate.

In Zones 2, 3, and 4, Centipede grass may be specified for use around rest areas, weigh stations, and welcome centers. Centipede or Centipede block sod or both shall be used and planted between March 15 and August 15, and must only be planted where shown on the plans.

After being smoothed, the area is rolled, usually with a culti-pactor, which works in the seed and fertilizer and recompacts the slope.



Except on steep slopes where rollers cannot operate satisfactorily, all seeded areas should be rolled before applying mulch.

On slopes inaccessible to compaction equipment, the seeds may be covered by dragging a spiked chain or by other satisfactory methods.

An application of mixed-grade fertilizer at the approximate rate of 600 pounds per acre shall be applied each spring after initial establishment. Annual applications shall continue until final acceptance.

MULTIPLE CHOICE - CIRCLE THE BEST ANSWER

- 3-23** All legumes
- must be inoculated as it is being planted
 - must be inoculated just prior to planting
 - need not be inoculated
- 3-24** When Legumes are planted by hydroseeder, the inoculant is included in the hydroseeder at
- twice the normal rate.
 - ten times the normal rate.
 - normal recommended rate
- 3-25** For steep back slopes and fill slopes that are not subject to frequent mowing, which combinations, per acre, are used in Zone 2 between Feb. 15 and June 30?
- 10 pounds Common Bermuda (hulled), 10 pounds (unhulled), 6 pounds White Dutch Clover
 - 10 pounds Common Bermuda (hulled), 30 pounds (unhulled), 75 pounds Interstate Lespedeza
 - 4 pounds Weeping Lovegrass, 50 pounds Scarified Lespedeza
- 3-26** Which combinations per acre are used for steep back slopes and fill slopes not subject to frequent mowing in Zone 4 for the period of Sept. 1 through Jan. 31?
- 10 pounds Common Bermuda (hulled), 10 pounds (unhulled)
 - 15 pounds Annual Rye Grass, temporary only until the following spring
 - 10 pounds Common Bermuda (hulled), 15 pounds Centipede grass

3-27 Whenever possible, all seeded areas should be _____ before applying mulch.

- a. watered
- b. rolled
- c. turned

3-28 After initial establishment, mixed-grade fertilizer is applied each spring at the rate of _____ pounds per acre.

- a. 600
- b. 1200
- c. 50

- 3-29 true
- 3-30 true
- 3-31 false
- 3-32 true
- 3-33 true
- 3-34 false
- 3-35 true

HYDRAULIC SEEDING (Hydroseeding)

Most hydraulic seeding techniques utilize a mixing tank and pump powered sprayer. The seeds, fertilizer, wood-fiber mulch, and water are mixed together in the tank, then sprayed through the gun over the area to be covered. Other substances such as lime, soil binders, etc., also can be mixed into the slurry.

The inspector should be certain that the correct amount of slurry is being applied per acre and that the slurry contains the correct quantity of seed and fertilizer, as required by the Standard Specifications.

Wood-fiber mulch is used as a metering agent and seedbed when hydroseeding is used,



When seeding a slope it is best to apply more seed at the top than at the bottom. Because the seed is laying on the top of the ground, wind and rain will cause it to move downward. In the end, this will result in the slope being uniformly covered.

3-27 b

3-28 a

The wood fiber mulch often contains a short-lived green dye. The dye can be used by the inspector as an aid in observing the uniformity of distribution.

The rate of wood-fiber mulch required in hydroseeding is 500 pounds per acre.

After the area has been seeded, it is occasionally necessary to water the seedlings in order to promote grass growth. However, it should be noted that natural rainfall is far more effective than watering. Unless an adequate supply of water can provide enough moisture, more harm than good can result. An inadequate supply of water can provide enough moisture to germinate the seeds to only cause them to swell and die; necessitating reseeding of the area.

If water is to be applied, it will be most effective if done at night. Watering should be done in stages, to limited sections of a project. This procedure will allow an area to receive adequate moisture, rather than an inadequate supply for an entire project.

TRUE OR FALSE - MARK THE CORRECT ANSWER

- 3-29** Wood-fiber mulch used in the hydroseeder should be used at a rate of 500 pounds per acre.
True _____ False _____
- 3-30** When watering seeded areas, the watering should be done in stages at night, to guarantee adequate moisturization.
True _____ False _____
- 3-31** When hydroseeding a slope, be sure there is an even distribution on the top and bottom of the slope.
True _____ False _____
- 3-32** Seeds, fertilizer, wood-mulch, water, lime, and soil binders can all be mixed together in the mixing tank to form slurry.
True _____ False _____
- 3-33** Wood-fiber mulch is used as a metering agent and seedbed when hydroseeding is used.
True _____ False _____
- 3-34** Wood-fiber often contains a green dye to give the appearance of newly sprouting grass.
True _____ False _____
- 3-35** After an area has been seeded, natural rainfall is usually more effective than watering to promote grass growth.
True _____ False _____

MULCHING

Mulch helps to prevent the seeds and soil from washing off the slopes during rainstorms, and also in retaining moisture in the ground.

Mulch is to be placed on the seeded and fertilized area after these operations have been completed. This means you will have to watch the seeding operation to see that it does not get too far ahead of the mulch. You will also have to keep an eye on the weather conditions to see that you do not get caught with areas that are seeded and cannot be mulched right away.

Mulching operations include three types: mulch with binder, mixed-in-place mulch, and walked in mulch. Each of the three types begins with an application of straw or hay, which is then anchored by chemical or mechanical means.

Mulch for grassing and erosion control are typically threshed rye, oat or wheat straw, or Bermuda Grass or Fescue hay.

Types of binders used in mulching are: Emulsified Asphalt, a tackifier listed in the Laboratory Qualified Products Manual, jute mesh, or plastic netting.

Mulch with binder may be applied to any seeded area immediately after seeding regardless of whether ground or hydroseeding equipment is used.

Where straw or hay mulch is used, the quantity of mulch to be applied shall be that required to evenly cover the ground to at least $\frac{3}{4}$ inch to no more than $1\frac{1}{2}$ inch.

You should be able to see approximately 10 percent of the soil surface through the mulch blanket. The thickness of the mulch is intended to allow sunlight to penetrate and the air to circulate; and at the same time the mulch will shade the ground which will help reduce erosion and conserve the moisture in the soil.

Try to avoid having the mulch placed in piles as this will smother and kill the new seedlings. If the mulch is being placed in bunches, there are several things that could be causing the problem:

3-36 500 pounds per acre
3-37 finished grade
3-38 mulch
3-39 bituminous
3-40 straw or hay
3-41 seeding
3-42 $\frac{3}{4}$ inches
1 $\frac{1}{2}$ inches
3-43 anchored

1. The mulch is too wet, making it impossible for the machine to separate and blow it out uniformly. If this is the case, the mulch should be left to dry or be rejected.
2. The operator is not moving the blower back and forth enough to give an even covering.
3. The mulch is being blown against the wind. If this is the case, the mulch should be blown with the wind or stopped until the wind dies down. In many cases, the wind will help carry the mulch to areas that otherwise would be hard to get to.

Should you have difficulty obtaining cooperation from the contractor in placing enough mulch, you can measure the area to be mulched, and require 2 tons of mulch per acre. There is a great variation in the size and weight of bales, so it is best to weigh the truck hauling the mulch

Where hydroseeding is used, wood-fiber mulch must be used as a metering agent and seedbed at a rate of 500 pounds per acre. These areas are then mulched with hay or straw.

Besides hay and asphalt mulches, artificial coverings can also be used to protect seeded slopes.

Artificial coverings, such as bituminous treated fiber, erosion control blankets, jute matting and plastic netting can also be used on slopes to protect seeds. When these coverings are used, they must be securely anchored into the ground to prevent them from being washed or blown away.

Mixed-in-place mulch may be used on flat areas with a slope of 3:1 or flatter and should be mixed into the soil from three (3) to four (4) inches deep. The area should then be returned to grade.

If a cut slope is dressed out of season for seeding, the area should be mulched, using straw mulch stabilization. Seed and fertilizer should be applied in the next seeding season.

If a cut cannot be brought to final grade and must remain uncompleted for a period of time, the area should be mulched using straw mulch stabilization or temporarily grassed.

Although mulches provide good protection against erosion, heavy runoff can cause washout. Should this occur, the area must be repaired, re-seeded and re-mulched to prevent further erosion.

3-48 c

3-49 c

3-50 a

FILL IN THE BLANKS

- 3-36** Wood fiber mulch is used as a metering agent and seed bed and shall be applied at the rate of _____ when used in a hydroseeder.
- 3-37** Areas to be mulched for temporary erosion control need not be brought to _____.
- 3-38** _____ helps to prevent seeds and soil from washing off slopes and helps retain moisture in the ground.
- 3-39** It is a good idea that mulches used to protect seeded slopes be treated with _____ .
- 3-40** Hydroseeded areas may be mulched with _____ or _____ even though wood fiber mulch is used.
- 3-41** Mulch with binder may be applied to any seeded area immediately after _____.
- 3-42** Where straw or hay mulch is used, it should cover the ground to at least _____, no more than _____.
- 3-43** Artificial coverings like jute matting and plastic netting can also be used to protect seeded slopes, but they must be securely _____ to the ground so they won't wash away.

MULTIPLE CHOICE - CIRCLE THE BEST ANSWER

- 3-44 If mulched areas wash out or erosion occurs, the area must
- be overseeded
 - have other temporary erosion control methods used
 - be repaired, reseeded, and remulched
- 3-45 If a cut slope is dressed out of season for seeding, the area should be
- mulched using straw mulch stabilization
 - mulched with wood-fiber mulch
 - covered with artificial covering like jute mesh
 - left in a rough condition until the planting season
- 3-46 Mixed-in-place mulch may be used on
- 4:1 or flatter slopes and mixed 3 to 4 inches deep
 - all slopes and mixed 6 inches
 - 3:1 or flatter slopes and mixed 3 to 4 inches deep
 - 3:1 or flatter slopes and mixed 4 to 5 inches deep
- 3-47 Cuts that cannot be brought to final grade and must remain uncompleted for a considerable period of time should be
- mulched with mixed-in-place mulch
 - covered with jute mesh or other artificial covering
 - temporarily grassed
 - mulched with straw mulch or temporarily grassed

- 3-51 watered
- 3-52 overseeded
- 3-53 4 inches
- 3-54 600 pounds
- 3-55 accepted
- 3-56 600

3-48 After an area has been mulched, you should see _____ of the surface.

- a. none
- b. 30 percent
- c. about 10 percent
- d. 50 percent

3-49 When a hydroseeder is used, wood fiber mulch is used as a metering agent and seedbed as is required to be applied at

- a. a rate of 50 pounds per acre
- b. a rate of 50 tons per acre
- c. a rate of 500 pounds per acre

3-50 If the mulch bunches up, it may be because the operator is

- a. not moving the blower back and forth enough
- b. too slow
- c. applying too much mulch

LOOSE SOD

Before placing loose sod, the ground should be prepared as if for grassing.

Application of agricultural lime and fertilizer mixed grade should be done like that for permanent grassing except that the fertilizer shall be spread the approximate rate of 600 pounds per acre.

After ground preparation has been completed, the inspector should check to see that the loose sod is being placed to a depth of at least 4 inches, that is, unless additional depths are specified.

The engineer shall be notified of sources of sod for inspection before it is harvested. Approval of such sources shall not be construed as acceptance of the material.

Loose sod shall be thoroughly moist, natural friable loam, heavily matted with the designated species. It shall be reasonably free from subsoil, clay lumps, stones, stump roots, brush, weeds and other litter. The inspector should check the sod while it is being planted.

After placement, the sodded area shall immediately receive an additional application of fertilizer mixed grade applied uniformly at the approximate rate of 600 pounds per acre.

Immediately after fertilization, the area shall be thoroughly watered.

Due to chunky conditions of the sod, a completely smooth and finished appearance will not be required.

As soon as a loose sodded area is complete, the area shall be overseeded.

3-44 c

3-45 a

3-46 c

3-47 d

3-57 false

3-58 true

3-59 true

3-60 false

3-61 false

3-62 true

FILL IN THE BLANKS

3-51 Immediately after fertilization, the area shall be _____.

3-52 As soon as a loose sod area is complete, the area shall be _____.

3-53 After ground preparation is complete, the inspector should check to see if the loose sod is being placed at least _____ deep, unless other depths are specified.

3-54 When preparing the ground for the placement of loose sod, fertilizer mixed grade is spread at the rate of about _____ pounds per acre.

3-55 Just because the engineer has approved a sod source does not mean it has been _____.

3-56 After placement, the sodded area shall immediately receive an additional application of fertilizer mixed grade uniformly applied at the rate of about _____ pounds per acre.

BLOCK SOD

In preparing the area for the placement of block sod, the ground shall be excavated to a sufficient depth to allow the placing of plant topsoil. Plant topsoil shall be spread on the prepared area to a depth of 4 inches.

Before the block sod is placed, fertilizer mixed grade shall be applied at a rate of 1200 pounds per acre and mixed with the top surface of the plant topsoil by a spiked-tooth harrow, or hand rake.

The finished surface shall be left smooth and uniform.

Check to see if the sod is moist. If the sod is so dry that it crumbles and breaks during placement, there is a good chance the root system is damaged and good growth cannot be expected.

A good way to check to see how much of the root system there is, is by picking away a small portion of dirt. If you can find lot of fine roots, you are getting good sod.

Another way to tell if you have most of the dense root system is to pick up one of the ends. If it doesn't tear apart, you probably have most of the root system.

While placing the block sod, the inspector should check to see if the blocks are laid smoothly, edge to edge, with staggered joints.

Then the sod should immediately be firmly pressed into contact with the sod bed by tamping or rolling without undue deformation to the surface.

TRUE OR FALSE. MARK THE CORRECT ANSWER

- 3-57** The fertilizer mixed grade is mixed with the top surface of the prepared soil by thorough disking.
True _____ False _____
- 3-58** Ground preparation for block sod allows enough excavation so that topsoil can be spread over the area to a depth of 4 inches.
True _____ False _____
- 3-59** For block sod areas, fertilizer mixed grade is to be applied before the block sod is placed at the rate of about 1200 pounds per acre.
True _____ False _____
- 3-60** While in place, the block sod is firmly pressed into contact with the sod bed with the use of standard construction equipment.
True _____ False _____
- 3-61** A good way to check to see if the root system is good is by tearing a piece apart. If it's easy to tear apart, the roots are bad.
True _____ False _____
- 3-62** Block sod should be laid smoothly, edge to edge, with staggered joints.
True _____ False _____

Check to see if soil is used to fill in the cracks between the blocks and be sure it is not smothering the grass.

Where block sod is being used in a waterway, it is good idea to undercut so that the surface of the sod will match the surrounding surface.

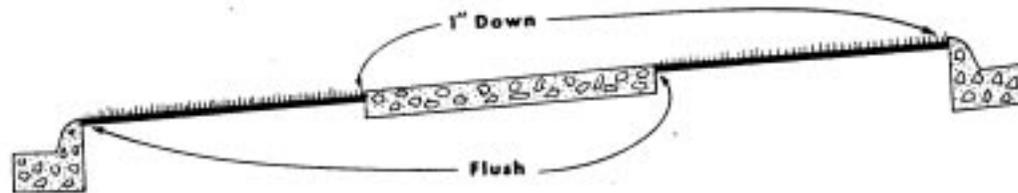
Block sod placed in flumes should be held down with stakes at least 8 inches long, spaced about 1 foot apart.

Stakes should be used on all other areas where they are necessary to prevent movement of the sod.

Where sod is placed on steep slopes, or otherwise subject to displacement, it should be held down with stakes not less than 12 inches long, spaced about 1 foot apart.

Where sod is being placed adjacent to curbs, sidewalks, etc. the amount of undercutting will depend on what direction the water flows. undercutting will depend on what direction the water flows.

If water flows toward the curb, sidewalk, etc., the undercut should be enough to put the sod surface flush with the top of the concrete.



If it flows away from the curb, sidewalk, etc., undercut enough to put the sod surface below the top of the concrete.

FILL IN THE BLANKS

- 3-63** Block sod placed in flumes should be held down with stakes at least _____ inches long and spaced about _____ part.
- 3-64** Where sod is placed on steep slopes, it should be held down with stakes not less than _____ long and spaced _____ apart.
- 3-65** It's a good idea to _____ when placing block sod in a waterway so that the surface of the sod will match the surrounding surface.
- 3-66** _____ should be used to fill in the cracks between the blocks and be sure it's not smothering the grass.
- 3-67** If water flows toward the curb, sidewalk, etc., the undercut should be enough to make the sod surface and the top of the concrete _____.
- 3-68** If water flows away from the curb, sidewalk, etc., undercut enough to put the sod surface _____ the top of the concrete.

VINE, SHRUB, AND TREE PLANTING (SPECIFICATION 702)

All plants should meet the grade requirements of the “American Standard for Nursery Stock” of the American Association of Nurserymen in effect at the time of invitation for bids.

The plans contain a sheet titled “Plant Specifications” which will designate the plant name and plant specifications for each plant to be furnished under the contract.

Trees must have reasonably straight stems and should be well branched and symmetrical in accordance with the natural habits of growth. Trees with broken or damaged terminal or main stems will be rejected.

Unless otherwise specified, all plants shall be nursery grown stock that has been grown in licensed nursery under intensive care and cultivation for at least one year. The branch system shall be normal development and free from disease, injurious insects, disfiguring knots, sun scald, injuries, abrasions of the bark, dead or dry wood and broken terminal growth.

All nursery grown plants shall be accompanied with proper certification of inspection.

The root system of nursery grown plants should be randomly inspected. Remove the plant from the pot or unwrap balled or burlap plants to inspect the roots. There should be a dense fibrous root system present. The roots should be moist and pliable. Attempt to break a small root. It should bend readily without breaking.

Collected plants are those which have been grown in the wild, uncultivated and untransplanted. Collected plants shall not be collected more than 24 hours in advance of actual planting.

At least 24 hours before beginning to dig collected plants, the contractor must notify the engineer of the time and place of digging so that inspection of the work and the plants can be made.

Collected plants are to be loaded into a covered truck, protected from the sun and wind, their roots protected with a moist packing material, and transferred to the final planting site at the time of actual planting.

Collected plants are to be dug with a wide root system equal to at least the spread of the top of the plant.

TRUE OR FALSE. CIRCLE THE CORRECT ANSWER

- 3-69** Trees with broken or damaged terminal or main stems shall be mended and repaired after they are planted.
True _____ False _____
- 3-70** All plants should meet the grade requirements of the “American Standard for Nursery Stock” of the American Association of Nurserymen in effect at the time of actual planting.
True _____ False _____
- 3-71** Collected plants are to be loaded into a covered truck with their roots protected in a moist packing material and transferred to the final planting site at the time of actual planting.
True _____ False _____
- 3-72** Collected plants, which are grown in the wild, shall be collected at least 24 hours in advance of actual planting.
True _____ False _____
- 3-73** Unless otherwise specified, plants shall be grown in a licensed nursery under intensive care and cultivation for at least nine months.
True _____ False _____
- 3-74** Proper certificates of inspection shall accompany all nursery grown plants.
True _____ False _____
- 3-75** The contractor must notify the engineer at least 24 hours in advance before beginning to dig collected plants.
True _____ False _____
- 3-76** Collected plants are dug with the root system at least 12 inches wide.
True _____ False _____

- 3-63 8
1 foot
- 3-64 12 inches
1 foot
- 3-65 undercut
- 3-66 soil
- 3-67 flush
- 3-68 below

Bare rooted plants must be tied in bundles with moist sphagnum moss, shingletoe, or other moisture retaining material placed around the roots sufficiently to keep plants moist up to 10 days.

The bundle shall be overwrapped with a heavy weight, waterproof, flexible material, covering the roots and one-half the tops.

In cases where plants cannot be planted within 10 days from the time of shipment, the plants shall be unwrapped, roots spread out and heeled in using moist soil, and then watered well.

For balled and burlapped plants (B&B), the soil in the ball shall be the original and undisturbed soil in which the plant has been grown. Plants with broken or loose balls are to be rejected.

Container grown plants are to be kept moist until planted. They shall be handled by the container or soil ball and not by the growth.

Before plant bed preparation, the planting limits shall be staked by the contractor in accordance with plan details and approved by the engineer.

Before the actual planting is begun, the inspector should check to see that all necessary materials including prepared plant topsoil, water, stakes, and mulch are on hand.

FILL IN THE BLANKS

- 3-77** Balled and burlapped plants shall have the _____ soil.
- 3-78** Overwrapping the moist bundled, bare rooted plants shall be with a heavy weight, _____ material, covering the roots and _____ the tops.
- 3-79** Before plant bed preparation, planting limits shall be _____ by the contractor in accordance with plan details and approved by the engineer.
- 3-80** Container grown plants are to be handled by the _____ or _____ and not by the top growth.
- 3-81** Moisture retaining material must be placed around the roots of bare rooted plants sufficiently to keep the plants moist up to _____ days.
- 3-82** Where plants cannot be planted within 10 days from time of shipment, they are then unwrapped, roots spread out and _____ using moist soil, and then watered well.

3-69 false

3-70 false

3-71 true

3-72 false

3-73 false

3-74 true

3-75 true

3-76 false

All planting shall be done by either the pit method or by the dibble method as called for in the Plant Specifications Sheet.

Fertilizer may be 6-12-12 if 4-12-12 is not available and should be applied at the rate of about 3 pounds per 100 square feet of bed surface, and fertilizer shall be applied before the organic soil additive is spread over the plant bed.

Also, agricultural lime shall be applied at the rate of 5 pounds per 100 square feet before the organic soil additive is spread over the plant bed.

An organic soil additive, either peat moss or pine bark, shall be spread evenly throughout the designated soil to a minimum depth of 2 inches. Then it is to be thoroughly dug into the soil to a minimum depth of 6 inches by use of a rotary hoe type tiller or other suitable equipment which will give an even mix of soil, lime, fertilizer, and organic soil additive.

As soon as the planting of each plant is complete, provisions for retaining water adjacent to the plant must be done in accordance with plan details or as directed by the engineer.

For Pit Planting, mulch shall be applied within five days after planting at a minimum depth of 4 inches loose for pine straw, or 3 inches loose for pine bark to obtain minimum compacted depth of 2 inches. Compaction shall be by natural causes and shall be determinable at not less than three months exposure to the elements after spreading.

Mulch shall be applied before planting when the Dibble method is used and the minimum compacted height after three months exposure shall be 1 inch instead of 2 inch.

Any required wrapping shall immediately follow planting.

All isolated vines, shrubs, and miscellaneous plants that are planted outside of solid mulch beds shall be marked with identification stakes in accordance with plan details.

FILL IN THE BLANKS

- 3-83** Isolated vines, shrubs, and miscellaneous plants that are planted outside solid mulch beds shall be marked with identification _____ in accordance with plan details.
- 3-84** Organic soil additive, either peat moss or pine bark is spread at least _____ inches - giving an even distribution of soil, lime, fertilizer and organic additive.
- 3-85** For Pit planting, if pine straw is used for mulch, it should be spread to at least _____ inches, and at least _____ inches loose if pine bark is used.
- 3-86** Compaction of the plant mulch by natural causes shall be determined not less than _____ months after spreading.
- 3-87** Mulch shall be applied within _____ days after planting for Pit Planting.
- 3-88** For Pit Planting, after three months exposure to natural elements, the plant mulch should be compacted to at least _____ inches.
- 3-89** Fertilizer and agricultural lime are spread _____ the organic soil additive is spread over the plant bed.
- 3-90** All planting shall be done by either the _____ or _____ method.
- 3-91** When required, _____ shall immediately follow planting.

- 3-77 original
- 3-78 waterproof
one half
- 3-79 staked
- 3-80 container
soil ball
- 3-81 ten
- 3-82 heeled in

All plants shall be given an initial watering at the time of planting. Additional watering shall be made following each fertilizer application and as necessary to maintain moisture adequate to promote plant growth.

Enough water shall be applied to wet the soil to slightly below the roots.

All trees shall be staked with an identification stake or guyed in accordance with plan details.

Unless otherwise specified, the trunks of all deciduous trees 1 ¼ inches and over in caliper, shall be tightly wrapped in strip burlap and waterproof crepe tree wrapping paper or other approved materials.

Wrapping shall begin at the ground and extend spirally up and beyond the first rosette of branches with an overlap of ½ the width of the wrapping material.

The wrapping material shall be securely tied with binder twine spaced every 12 inches for the full length of the wrapping.

FILL IN THE BLANKS

- 3-92** Wrapping shall begin at the _____ and extend spirally up and beyond the first rosette of branches with an overlap of _____ the width of the wrapping material.
- 3-93** All _____ shall be staked or guyed in accordance with plan details.
- 3-94** Enough water shall be applied to wet the soil to slightly below the _____.
- 3-95** The wrapping material shall be securely tied with _____ and spaced every _____ inches for the full length of the wrapping.
- 3-96** The trunks of all _____ trees at least _____ inches in caliper shall be tightly wrapped in strip burlap and waterproof crepe tree wrapping paper or other approved materials

- 3-83 stakes
- 3-84 2
- 3-85 4, 3
- 3-86 3
- 3-87 5
- 3-88 2
- 3-89 before
- 3-90 pit
dibble
- 3-91 wrapping

Guy wires consist of two 18-gauge malleable galvanized iron wires twisted into a single strand and enclosed loosely in a rubber hose or other approved covering extending around the trunk.

After fastening the guy wire to the stake by tying or twisting in the shape of a figure "8", the wire shall be nailed or stapled to the stake to prevent slippage using a 4d nail or ½ inch staple.

The wire shall be tightened so that a slight strain is set up between the tree and the stake by twisting the wire.

Guy wires shall be placed above the first rosette of lower branches and fastened to the stake approximately 6 inches above the ground.

Wire reinforced plastic tape of accepted size and quality may be used in the place of the hose and wire specified above.

FILL IN THE BLANKS

3-97 Guy wires are fastened to stakes by twisting them in the shape of a _____.

3-98 Guy wires are enclosed loosely in a _____ or other approved covering extending around the trunk.

3-99 Guy wires shall consist of _____ specified iron wires twisted into a single strand.

3-100 Guy wires are nailed or stapled to the stake about _____ inches above the ground.

3-101 Guy wires are placed _____ the first rosette of lower branches.

3-92 ground
one half

3-93 trees

3-94 roots

3-95 binder twine
12

3-96 deciduous
1 ¼

PERMANENT SLOPE DRAIN

Permanent slope drains for erosion control work on the same principles as temporary flumes except they are paved with concrete or constructed with metal or plastic pipe.

Excavation for concrete slope drains shall not be carried below the foundation elevation or wider than necessary to provide working space.

For concrete slope drains, the subgrade must be finished to line and grade as indicated on the plans.

The subgrade must then be compacted to the same degree as that portion of the roadway on which it is placed.

As indicated on the plans, weep holes will then be constructed at the appropriate locations.

Where spillways are to be fitted to concrete pavement, the specified dowel bars must be set into the pavement when it is laid.

Metal parting strips may be used to hold the ends of dowels bent into the grooves.

Poured in place concrete shall be Class B minimum. Class A concrete shall be used for baffles, if they are precast.

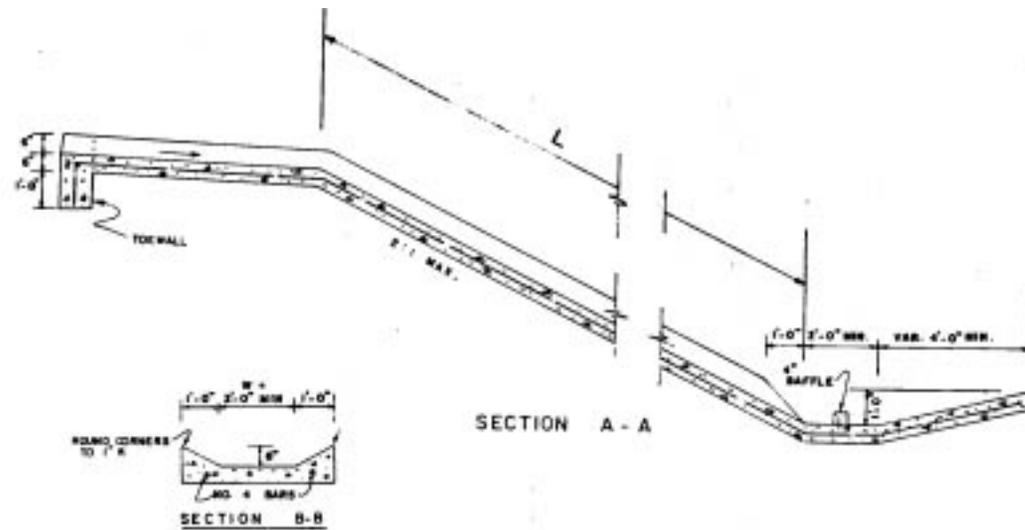
TRUE OR FALSE. MARK THE CORRECT ANSWER

- 3-102** Compaction for the subgrade is the same degree as that portion of the roadway on which it is placed
True _____ False _____
- 3-103** Where spillways are to be fitted to concrete pavement, the specification dowel bars must be set into the pavement after they are laid.
True _____ False _____
- 3-104** Excavating for concrete slope drain shall not be carried below the foundation elevation.
True _____ False _____
- 3-105** The subgrade for concrete slope drains need not be finished to line and grade.
True _____ False _____
- 3-106** Poured in place concrete shall be Class A for concrete slope drains.
True _____ False _____
- 3-107** Baffles for concrete slope drains shall be Class A concrete if they are precast.
True _____ False _____

- 3-97 figure "8"
- 3-98 rubber hose
- 3-99 two
- 3-100 6
- 3-101 above

Concrete flumes are of two types “A” and “B” and may be adjusted for an individual site where shown on the plans or as directed by the engineer.

A 12-inch deep toewall is constructed at the upper end of the flume to keep the flume from buckling and sliding.



The sides of concrete flumes should be flared and the edges rounded. It is a good idea to bury the drain edges two to four inches deeper than the surrounding soil, this prevents erosion at the sides and piping.

At locations where flume outlets empty into an inlet structure, omit the baffle and downturn the end and connect the flume to the inlet structure.

Where baffles are placed in flumes, it's a good idea to place sand-cement bag riprap along the sides of the flume just outside the baffled area.

Sand-cement bag riprap shall be omitted in paved ditches or where other approved erosion control material is used.

TRUE OR FALSE. MARK THE CORRECT ANSWER

3-108 The sides of the concrete flume should be vertical and the edges squared.

True _____ False _____

3-109 Where flumes outlet into an inlet structure, secure the baffle and connect the flume to the inlet structure.

True _____ False _____

3-110 Sand-cement bag riprap is to be omitted in paved ditches or where other approved erosion control is used.

True _____ False _____

3-111 12-inch deep toewall constructed at the upper end of the flume keeps the flume from buckling and sliding.

True _____ False _____

3-112 Where baffles are placed in flumes, it's a good idea to place sand cement bag riprap along the sides of the flume just outside the baffled area.

True _____ False _____

3-102 true

3-103 false

3-104 true

3-105 false

3-106 false

3-107 true

3-113	12 inches	Where permanent slope drains are constructed of metal or plastic pipe, the pipes are buried beneath the surface of the slope to a minimum depth of 12 inches.
3-114	trench	Where slope drainpipes are connected to cross drain pipes, the inside circumference of the slope drainpipe must be equal to the inside circumference of the cross drainpipe.
3-115	omitted	
3-116	equal	The connection is then made with the use of a concrete collar made of Class A concrete and should overlap both the slope drain pipe and the cross drain pipe by at least 6 inches.
3-117	6	
3-118	9	The collar, however, may be trench formed.

If plastic pipe is used, metal inlets are secured to the extension collar with a metal strap. The pipe is attached to the extension collar with fabric straps, wire, metal collars or other suitable material.

3-108 false

Where metal slope drainpipes are connected to flared metal drain inlets and end sections, they are connected by either a shop riveted or continuous weld connects them. The connection shall be leak proof.

3-109 false

3-110 true

At the outfall end of the slope drain pipe, riprap may be omitted where the pipe ends in a paved ditch.

3-111 true

3-112 true

After installing the pipe, the trench shall be immediately backfilled in layers no more than 9 inches thick, and each layer compacted until it is firm and stable.

FILL IN THE BLANKS

- 3-113** Permanent slope drainpipes are buried beneath the surface of the slope to a minimum depth of _____.
- 3-114** The collar used in connecting slope drain and cross drainpipes may be _____ formed.
- 3-115** At the outfall end of the slope drainpipe, riprap may be _____ where the pipe ends in a paved ditch.
- 3-116** Where slope drainpipes are connected to cross drainpipes, the inside circumference of both pipes must be _____.
- 3-117** Class A concrete is used to make the connection of the slope drain and cross drainpipes, and the concrete should overlap both pipes by at least _____ inches.
- 3-118** After the pipe is installed, the trench is backfilled in layers no more than _____ inches deep, and each layer compacted until it is firm and stable.

CONCRETE PAVED DITCHES (SPECIFICATION 441)

Where paving is to be placed on front slopes of ditches and shoulders, any special materials required shall be placed during the appropriate roadway construction.

A 10 foot straightedge is good for determining deviation of straight grade tangents. For ditch paving, there shall be no deviation of more than (one) 1 inch in 10 feet.

A 1-inch in 10-foot tolerance will not be permissible if the thickness of the ditch paving is reduced, if water ponds or the direction of flow altered.

Expansion joints shall be placed only where the paved ditch joins roadway pavement or some other structure. Contraction joints shall be spaced at 30-Foot intervals. The joints can be hand formed or troweled to a depth of one fourth of the ditch paving thickness. (See Standard Specification, Section 441.03E3b)



Expansion joints are required where paved ditches connect to other concrete structures.

Drop end sections must be constructed before the adjacent upstream section is poured.

A drop end section will be constructed as 4-inch concrete ditch paving on the downstream end of all paved ditches.

The drop-end section portion may be omitted and the end section of the paved ditch buried three (3) feet below the natural channel when approved by the engineer.

The inspector should check to see if the surface of the bottom and sides of paved ditches are uniform in appearance and true to grade and cross section.

TRUE OR FALSE. MARK THE CORRECT ANSWER

- 3-119** Drop end sections must be constructed before the adjacent upstream section is poured.
True _____ False _____
- 3-120** Expansion joints are spaced at least at 30-foot intervals.
True _____ False _____
- 3-121** A one (1) inch in 10-foot tolerance will be permissible even if the ditch paving is reduced, but not if water ponds or the direction of flow altered.
True _____ False _____
- 3-122** For ditch paving, the deviation of straight grade tangents shall be no more than 1 inch in 10 foot.
True _____ False _____
- 3-123** Paved ditches need not be true to grade and cross section, if the surface of the bottom and sides are uniform in appearance.
True _____ False _____
- 3-124** When approved by the engineer, the drop end section may be omitted and the end section left above the natural channel.
True _____ False _____
- 3-125** Expansion joints can be hand formed or troweled to a depth of one fourth of the ditch paving thickness.
True _____ False _____
- 3-126** On the downstream end of all paved ditches, a drop end section is constructed as 4-inch concrete ditch paving.
True _____ False _____

SAND ASPHALT PAVED DITCH (SPECIFICATION 434)

During the preparation of the subgrade for sand asphalt paved ditches, the inspector should be sure that proper precautions are taken to protect all portions under construction from flowing water, the elements, and all other disturbances until the materials are fully set.

The subgrade for sand asphalt paved ditches shall be free of all soft, yielding material and substituted with suitable material.

The subgrade shall be compacted to 90 percent of the maximum dry density and finished to a smooth, firm finish.

When placing the sand asphalt mixture, the inspector should check to see if it is a smooth, firm finish.

The sand asphalt mixture shall be smoothed by raking or screeding and then thoroughly rolled to compaction with a hand operated roller weighing not less than 300 pounds, or with a small power roller or vibratory device that is satisfactory to the engineer. Areas that cannot be reached with rollers or vibrators may be compacted with hand tampers.

FILL IN THE BLANKS

- 3-127** During sand asphalt paved ditch subgrade preparation, care should be taken to _____ the construction from flowing water, and other elements until the materials are fully set.
- 3-128** The _____ for sand asphalt paved ditches shall be free of all soft, yielding material and substituted with a suitable material.
- 3-129** The subgrade of sand asphalt paved ditches shall be compacted to _____ percent of the maximum dry density, and finished to a smooth, firm finish.
- 3-130** The _____ mixture shall be smoothed by raking or screeding and then thoroughly rolled to compaction with a hand-operated roller weighing not less than 300 pounds.

- 3-119 true
- 3-120 false
- 3-121 false
- 3-122 true
- 3-123 false
- 3-124 false
- 3-125 true
- 3-126 true

REVETMENTS

Revetments are used under bridges and overpasses to protect steep slopes from erosion and slides.

Revetments under bridges protect the slopes and bridge footing from erosion caused by river currents and rising water.

Either concrete or cast-in-place slope paving, riprap, or some form of flexible revetment can be used.

Revetments of poured concrete, commonly referred to as slope paving, require constructed joints between slabs (Actual distance will be indicated on the plans.) These joints allow for a planned pattern of breakage, rather than random cracking from expansion and contraction. (See Specification 441)

All revetments must be constructed in dry or dewatered areas, unless otherwise directed. All logs, stumps, and other undesirable material should be removed from the limits to the engineer's satisfaction. Grades and cross section must be in conformity with the plans before construction.

Before concrete is poured for the revetment, preformed ½ inch joint filler must be placed around piles, columns, etc.

Concrete placement must begin at the toe of the toewall of the revetment and proceed upslope.

After the concrete is in place, the surface must be kept moist or be cured by other approved means for at least three days. Methods of curing can be found in the Standard Specifications.

Concrete slope paving shall be given a final finish with a stiff broom. With the engineer's approval, concrete may be mechanically conveyed to the forms.

TRUE OR FALSE. MARK THE CORRECT ANSWER

3-131 Revetments of poured concrete require constructed joints between slabs. These allow for a planned pattern of breakage.

True _____ False _____

3-132 Revetments are used under bridges and overpasses to protect steep slopes from erosion and slides.

True _____ False _____

3-133 Before revetment concrete is poured, ½ inch preformed joint filler must be placed around piles, columns, etc.

True _____ False _____

3-134 Concrete slope paving shall be given a final finish with a stiff broom.

True _____ False _____

3-135 All revetments need not be constructed in dry, dewatered areas.

True _____ False _____

3-136 Concrete placement must begin at the tip of the toe wall of the revetment and proceed downslope.

True _____ False _____

3-127 protect

3-128 subgrade

3-129 90

3-130 sand asphalt

RIPRAP (SPECIFICATION 603)

There are several forms of flexible revetment that can be used. These include: sand-cement bag riprap, stone riprap, and where called for, crushed stone filter material or plastic filter fabric beneath stone riprap.

Riprap is used when the velocity of water is greater than what bituminous treated glass fiber, jute mesh, excelsior blanket or sod can withstand. It is also used in locations where there will be a continual wave action against the slope. It is sometimes used to protect bridge berms around inlets and outlets of pipe and smaller drainage channels.

Riprap is used to prevent banks from eroding into bodies of water. When riprap is located in currents, it must be placed in a manner that will compensate for drift.

The area where riprap is to be placed must first be shaped to the required cross section. All brush stumps, trees, and junk must be removed. Any soft spots are to be removed, backfilled, and thoroughly compacted. Unless otherwise shown or directed, riprap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope.

The toe ditch shall be 2 foot deep in original ground and the side next to the fill or cut shall have the same slope.

Watch the placement closely to see that a uniform, well-graded mass is obtained. Watch for segregation of sizes and voids. If this does occur, the method of placement will have to be changed so they are eliminated.

Riprap must be placed in such a manner that the smaller stones will be evenly distributed. Handwork may be necessary to assure an even distribution.

After the riprap is placed, the toe ditch shall be backfilled and the excess dirt spread neatly within the right-of-way.

Where riprap is to commence in water, or below normal water level, the toe ditch will be omitted and an apron of riprap shall be substituted.

FILL IN THE BLANKS

3-137 _____ is used in locations where there will be a continual wave action against the slope and prevents banks from eroding into bodies of water.

3-138 Unless otherwise directed, riprap shall begin in a _____ constructed in original ground.

3-139 Toe ditches for riprap are to be _____ deep and the side next to the fill or cut must have the _____ slope.

3-140 Riprap must be placed in such a manner that the _____ stones will be evenly distributed.

3-141 After the riprap is placed, the toe ditch is to be backfilled and excess dirt spread neatly within the _____.

3-142 Where riprap is to begin in water or below normal water level, the _____ will be omitted and an _____ made of _____ shall be substituted.

3-143 When riprap is placed in currents, it must be placed in a manner that will _____ for drift.

3-131 true

3-132 true

3-133 true

3-134 true

3-135 false

3-136 false

3-144 true

3-145 true

3-146 false

3-147 true

3-148 true

3-149 false

3-150 false

3-151 true

3-152 false

3-153 true (answer sheet did not match question)

Stone plain riprap (Specification 805) normally consists of a uniform stone size with no more than 10 percent of the total weight passing a 5-inch sieve nor the volume of the largest pieces exceeding 2 cubic feet. Stone plain riprap is dumped and handled into place to form a compact layer to the design thickness.

The thickness tolerance for the course shall be plus 12 inches with no under tolerance. If the plans do not show a thickness, stone plain riprap shall be placed to a thickness of not less than 12 inches and not more than 24 inches.

Unlike stone plain riprap, stone dumped riprap consists of well graded stone sized down to the finest sizes. Stone dumped riprap comes in two types with Type 1 containing the largest stone at two (2) cubic foot and Type 3 containing sizes up to one (1) cubic foot.



Stone dumped riprap is dumped into place to form a uniform surface and to the thickness specified in the plans. The thickness tolerance of the course shall be minus six (6) inches and plus twelve (12) inches. If the plans or proposal do not specify thickness, the course shall be placed to a thickness of not less than 24 inches. With stone dumped riprap, particular care must be exercised to prevent segregation of the stone sizes.

Stone grouted riprap is placed like stone plain riprap except care shall be taken to prevent earth from filling the spaces between stones.

After the stone has been acceptably placed, the spaces between them shall be filled with 1:3 grout composed of Portland Cement and sand mixed thoroughly with sufficient water to give a thick, creamy consistency.

The grout shall be placed beginning at the toe and finished by sweeping with a stiff broom.

After the grouting is complete, the riprap shall be covered and kept wet for five days or covered and kept wet for 24 hours and then coated with white pigmented membrane curing compound.

- 3-137 riprap
- 3-138 toe ditch
- 3-139 2 feet
same
- 3-140 smaller
- 3-141 right-of-way
- 3-142 toe ditch
apron
riprap
- 3-143 compensate

TRUE OR FALSE. MARK THE CORRECT ANSWER

- 3-144** Three types of stone riprap are: stone plain, stone dumped and stone grouted.
True_____ False_____
- 3-145** Stone plain riprap is dumped and handled into place.
True_____ False_____
- 3-146** If the plans do not show a thickness, stone plain riprap shall be placed to a thickness of not less than 24 inches and no more than three (3) foot.
True_____ False_____
- 3-147** Stone dumped riprap is dumped and handled into place.
True_____ False_____
- 3-148** The thickness tolerance for a stone dumped course shall be minus six (6) inches and plus 12 inches
True_____ False_____
- 3-149** If the plans don't show the thickness of stone dumped riprap, the course shall be placed to a thickness of not less than 24 inches.
True_____ False_____
- 3-150** Stone grouted riprap is placed like stone plain riprap except the spaced between the stones shall be filled with dirt.
True_____ False_____
- 3-151** The spaces between stones in stone grouted riprap shall be filled with 1:3 grout composed of Portland Cement and sand.
True_____ False_____
- 3-152** The grout shall be placed beginning at the top of the course and finished with a stiff broom.
True_____ False_____
- 3-153** After the grouting is complete, the riprap is to be covered and kept dry for five days or kept wet for 24 hours and then coated with a white pigmented membrane-curing compound.
True_____ False_____

Stone filter material shall be uniformly placed to the thickness and limits shown and to a thickness tolerance of plus or minus ½ inch. It shall be compacted to the extent necessary to hold it in place while stone riprap is placed upon it.

The filter blanket shall be placed after the riprap is placed in the toe ditch and before the riprap is placed upon the slopes.

When placing the plastic filter fabric, be sure that the ground surface is relatively smooth and free from obstructions, depressions, and debris.

The fabric shall be placed with the long dimension running up the slope and shall be placed to provide a minimum width of 1 foot of overlap for each joint.

The fabric shall be placed so that the upstream strip will overlap the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones.



The stones shall be dropped no more than three (3) feet during construction.

Sand-cement bag riprap is composed of sand and Portland Cement. It shall be mixed at the maximum ratio of 5:1 by weight.

When sand-cement riprap is to be pre-bagged, the sand-cement shall be mixed dry, and after placing the course, the bags shall be wetted.

The bags shall be uniformly filled to the maximum capacity which will permit satisfactory tying.

The bags are placed beginning at the toe or toewall and progresses upslope. The bags must be placed in contact with one another, either side-by-side or stacked.

The bagged riprap shall be placed by hand with the tied ends facing the same direction with close, staggered joints.

Header courses shall then be placed. After placing, the bags shall be rammed or packed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than three (3) inches above or below the required plane.



FILL IN THE BLANKS

- 3-154 Either _____ or _____ may be used for filter blankets.
- 3-155 Stone filter material shall be uniformly placed to a thickness tolerance of plus or minus _____.
- 3-156 The _____ shall be placed after the riprap is placed in the toe ditch and before the riprap is placed on the slopes.
- 3-157 Filter fabric placed side-by-side should overlap _____ for each joint.
- 3-158 The upstream end of filter fabric must _____ the downstream strip.
- 3-159 The fabric shall be placed _____ so as to give during placement of riprap.
- 3-160 The stones shall be dropped no more than _____ during construction.
- 3-161 _____ riprap is composed of sand and Portland Cement.
- 3-162 When sand-cement riprap is to be pre-bagged, it shall be mixed at the maximum ratio of _____ by weight.
- 3-163 The bags are placed beginning at the _____ and progress upslope.
- 3-164 While being placed by hand, the _____ should face the same direction with close, _____ joints.
- 3-165 The top of each bag shall not vary more than _____ above or below the required plane

- 3-169 false
- 3-170 mower
- 3-171 permanent
- 3-172 4
6
- 3-173 false
- 3-174 6 inches
- 3-175 benches
- 3-176 provide an adequate seedbed
- 3-177 1200 pounds
- 3-178 2 ton
1000 pounds
- 3-179 serrated
- 3-180 4 inches

PERMANENT DIKES

Permanent dikes are sometimes constructed near bridges to slow and divert stream currents, thus preventing bridge supports and revetments from being damaged by swiftly running water. These structures are called spur dikes.

The dikes themselves are often protected from erosion by riprap.

Permanent dikes are also stabilized with grass, either alone or in conjunction with other erosion control measures.

FILL IN THE BLANKS

- 3-166** Permanent dikes are also stabilized with _____, sometimes in conjunction with other erosion control measures.
- 3-167** The dikes are often protected from erosion by _____.
- 3-168** _____ dikes are sometimes constructed near bridges to slow and divert stream currents.

3-154 stone-woven fabric (filter fabric)

3-155 ½ inch

3-156 filter blanket

3-157 one (1) foot

3-158 overlap

3-159 loosely overlap

3-160 three (3) feet

3-161 sand cement bag

3-162 5:1

3-163 toe

3-164 tied ends, staggered

3-165 3 inches

- 3-193 10
- 3-194 500
- 3-195 mulch
- 3-196 chemical, mechanical
- 3-197 true
- 3-198 500 pounds per acre
- 3-199 $\frac{3}{4}$; $\frac{1}{2}$ inch
- 3-200 straw mulch stabilization
- 3-201 wood fiber mulch
- 3-202 temporarily grassed
- 3-203 3:1
- 3-204 true

CHAPTER III REVIEW

- 3-169 On some occasions, permanent grassing requires maximum seedbed preparation.
True _____ False _____
- 3-170 When an area is being prepared for permanent grassing, all large rocks, roots and limbs must be cleared from the area so they will not hamper _____ operations later.
- 3-171 Devices designed to prevent erosion after work on the project has been completed are _____ erosion control measures.
- 3-172 When preparing the ground for permanent grassing, the ground should be plowed to a depth between _____ inches and _____ inches .
- 3-173 Cut slopes should be plowed between four (4) to six (6) inches for permanent grassing.
True _____ False _____
- 3-174 For front and back slopes of cuts, 3:1 or flatter, the ground should be plowed _____ or greater for permanent grassing.
- 3-175 Serrated slopes are left with one (1) to three (3) foot _____.
- 3-176 If serration detail is not shown in the plans, the slopes shall be thoroughly plowed to _____.
- 3-177 Except as specified in the special provisions, plans, etc., fertilizer mixed grade should be uniformly spread at a rate of about _____ per acre.
- 3-178 Agricultural lime, for grassing projects of approximately 15 acres, is uniformly spread at about _____ per acre, while fertilizer mixed grade is spread at about _____ per acre.
- 3-179 On _____ slopes, mixing may be omitted.
- 3-180 Lime and fertilizer are uniformly mixed into the top _____ of soil

- 3-181** _____ is done to obtain a higher quality finish is to be required where grading is adjacent to closely mown and maintained lawns.
- 3-182** _____ can be spread over serrated slopes.
- 3-183** Gentle slopes and level areas should require _____ to obtain a smooth finish.
- 3-184** Seed shall be sown within _____ following the application of fertilizer, lime and preparation of the seedbed.
- 3-185** Hydroseeding may be used on any area to be grassed.
True____ False____
- 3-186** Seed shall not be distributed by hand.
True____ False____
- 3-187** In all parts of the state, steep back slopes and fill slopes, not subject to frequent mowing, are required to be planted with Interstate Lespedeza and a _____ grass.
- 3-188** All Legumes (Lespedeza, clovers) must be _____ before planting.
- 3-189** When Legumes are planted by hydroseeder, the inoculant is to be included in the hydroseeder at _____ times the normal rate.
- 3-190** All seeded areas should be rolled whenever possible before applying mulch.
True____ False____
- 3-191** After seeds are planted, the area is then mulched.
True____ False____
- 3-192** After initial establishment, mixed grade fertilizer is applied each spring at the rate of 600 pounds per acre.
True____ False____

3-166 grass

3-167 riprap

3-168 permanent

3-215 false
3-216 true
3-217 c
3-218 c
3-219 false
3-220 a
3-221 c
3-222 false
3-223 b

- 3-193** Mulch is to be placed on the seeded and fertilized area when the seeding operation has been completed.
True _____ False _____
- 3-194** You should be able to see about _____ percent of the soil surface through a mulch blanket.
- 3-195** When a hydroseeder is used, mulching with wood fiber mulch is used at a rate of _____ pounds per acre.
- 3-196** _____ helps to prevent seeds from washing off slopes and helps to retain moisture in the ground.
- 3-197** Mulching operations begin with an application of straw or hay that is then anchored by _____ or _____ means.
- 3-198** Each bag of seed must have a analysis tag.
True _____ False _____
- 3-199** Wood fiber mulch when used as a binder shall be applied at a rate of _____ when used in a hydroseeder.
- 3-200** Where straw or hay mulch is used, it should cover the ground to at least _____ and no more than _____.
- 3-201** If a cut slope is dressed out of season for seeding, the area should be mulched using _____.
- 3-202** _____ is used as a metering agent and seedbed when hydroseeding is used.
- 3-203** Cuts that cannot be brought to final grade and must remain uncompleted for a considerable period should be mulched using straw mulch stabilization or _____.
- 3-204** Mixed in place mulch may be used on slopes _____ or flatter and mixed 3 to 4 inches deep.

- 3-205** When seeding a slope with a hydroseeder, it is a good idea to apply more seed at the top than at the bottom.
True _____ False _____
- 3-206** When preparing the ground for loose sod, fertilizer mixed grade is spread at the rate of about 200 pounds per acre.
True _____ False _____
- 3-207** Loose sod is to be placed at least 4 inches deep, unless otherwise specified.
True _____ False _____
- 3-208** After placement of the loose sod, an additional application of fertilizer is applied at the rate of 600 pounds
True _____ False _____
- 3-209** As soon as the loose sod area is complete, the area is to be _____.
- 3-210** Excavation for block sod should allow topsoil to be spread over the area to a depth of _____ inches.
- 3-211** While in place, block sod is immediately pressed firmly into contact with the bed by _____.
- 3-212** Block sod placed in flumes should be held down with stakes at least:
a. 12 inches long and spaced one (1) foot apart
b. 8 inches long and spaced one (1) foot apart
c. 8 inches long and spaced 8 inches apart
d. 16 inches long and spaced two (2) feet apart
- 3-213** Fertilizer mixed grade is to be applied before the block sod is placed at the rate of 1200 pounds per acre.
True _____ False _____
- 3-214** Block sod should be laid smoothly, edge to edge with even joints.
True _____ False _____

- 3-181 handraking
- 3-182 Topsoil
- 3-183 power rakes
- 3-184 24 hours
- 3-185 true
- 3-186 true
- 3-187 companion
- 3-188 inoculated
- 3-189 2
- 3-190 true
- 3-191 false
- 3-192 true

- 3-235 equal
- 3-236 false
- 3-237 paved ditch
- 3-238 trench
- 3-239 9
- 3-240 one (1) inch in 10 foot
- 3-241 ¼
- 3-242 expansion
- 3-243 false
- 3-244 before
- 3-245 drop end

- 3-215** When block sod is placed in waterways, the surrounding area should be built up so the sod will be flush.
True_____ False_____
- 3-216** If water flows toward the curb, sidewalk, etc., the sod surface and the top of the concrete should be flush.
True_____ False_____
- 3-217** Collected plants shall be dug with a root system equal to at least:
 - a. 12 inches
 - b. the spread of the top of the plant
 - c. the width of the root system
 - d. a football
- 3-218** Where plants cannot be planted within 10 days from time of shipment, they are to be:
 - a. sent back
 - b. rejected
 - c. heeled in
 - d. cut up
- 3-219** If water flows away from the curb, sidewalk, etc., the sod surface should be above the top to the concrete.
True_____ False_____
- 3-220** Sod placed on steep slopes should be held down with stakes at least:
 - a. 12 inches long and spaced 12 inches apart
 - b. 8 inches long and spaced 12 inches apart
 - c. 8 inches long and spaced 8 inches apart
 - d. 18 inches long an dspaced 18 inches apart
- 3-221** Unless specified, plants shall be grown in a licensed nursery under intensive care and cultivation for at least:
 - a. six months
 - b. nine months
 - c. one year
 - d. two years
- 3-222** Planting limits are to be staked by the engineer before plant bed preparation.
True_____ False_____
- 3-223** Mixed grade fertilizer for plants shall be applied at the rate of:
 - a. 3 ton per 100 square feet
 - b. 3 pounds per 100 square feet
 - c. 3 pounds per 10 square feet
 - d. 3 tons per 1,000 square feet

<p>3-224 Collected plants are to be handled by their trunks. True _____ False _____</p>	<p>3-205 true</p>
<p>3-225 Wrapping shall immediately follow _____.</p>	<p>3-206 false</p>
<p>3-226 Fertilizer and agricultural lime are spread before the organic soil additive is spread on the plant bed. True _____ False _____</p>	<p>3-207 true</p>
<p>3-227 For Pit Planting, after three months exposure to natural elements, the plant mulch should be compacted to at least _____ inches.</p>	<p>3-208 true</p>
<p>3-228 The trunks of all newly planted deciduous trees at least 1 ¼ inch in caliper shall be tightly wrapped. True _____ False _____</p>	<p>3-209 overseeded</p>
<p>3-229 Securing the wrapping material shall be with _____ and spaced every _____ inches for the full length of the wrapping.</p>	<p>3-210 2</p>
<p>3-230 Wrapping shall begin at the ground and extend spirally up and beyond the first rosette of branches with an overlap _____ the width of the wrapping material.</p>	<p>3-211 tamping or rolling</p>
<p>3-231 Guy wires shall consist of two specified iron wires twisted into a single strand. True _____ False _____</p>	<p>3-212 b</p>
<p>3-232 Guy wires are enclosed loosely in a rubber hose or other approved covering extending around the _____.</p>	<p>3-213 true</p>
<p>3-233 Guy wires are placed _____ the first rosette of lower branches.</p>	<p>3-214 false</p>
<p>3-234 Permanent slope drain pipes are buried beneath the surface of the slope to a minimum depth of _____.</p>	

- 3-235** Where slope drainpipes are connected to cross drainpipes, the inside circumference of both pipes must be _____.
- 3-236** Class B minimum concrete is used to make the connection of the slope and cross drain pipes, and the concrete should overlap both pipes by at least 12 inches.
True _____ False _____
- 3-237** At the outfall used in connecting slope drainpipe, riprap may be omitted where the pipe ends in a _____.
- 3-238** The collar used in connecting slope drain and cross drainpipes may be _____ formed.
- 3-239** After the pipe slope drain is installed, the trench is backfilled in layers no more than _____ inches deep, with each layer compacted until it is firm and stable.
- 3-240** For concrete ditch paving, the deviation or straight grade tangents shall be no more than _____.
- 3-241** Expansion joints can be hand formed or troweled to a depth of _____ of the ditch paving thickness.
- 3-242** _____ joints are placed only where a paved ditch joins roadway pavement or some other structure.
- 3-243** Expansion joints for paved ditches are spaced at least at 30-foot intervals.
True _____ False _____
- 3-244** Drop end sections must be constructed _____ the adjacent upstream section is poured.
- 3-245** On the downstream end of all paved ditches, a _____ section is constructed as 4-inch concrete ditch paving.

<p>3-246 Before revetment concrete is poured, _____ preformed joint filler must be placed around the piles, columns, etc.</p>	<p>3-224 false</p>
<p>3-247 The subgrade of sand asphalt paved ditches shall be compacted to _____ percent of the maximum dry density, and finished to a smooth, firm finish.</p>	<p>3-225 planting</p>
<p>3-248 The drop end section may be omitted and the end section of the paved ditch buried _____ below the natural channel when approved by the engineer.</p>	<p>3-226 true</p>
<p>3-249 _____ are used under bridges and overpasses to protect steep slopes from erosion and slides.</p>	<p>3-227 2</p>
<p>3-250 Revetments of poured concrete require constructed joints between slabs. True _____ False _____</p>	<p>3-228 true</p>
<p>3-251 _____ revetments that can be used include concrete, cast in place concrete and riprap.</p>	<p>3-229 binder twine 12</p>
<p>3-252 Cellular concrete blocks and stone is placed on a plastic filter cloth when constructing flexible revetments. True _____ False _____</p>	<p>3-230 one half</p>
<p>3-253 Concrete placement for revetments must begin at the toe of the toewall of the revetment and proceed _____.</p>	<p>3-231 true</p>
<p>3-254 The ends of the plastic filter fabric used under flexible revetments should be staked. True _____ False _____</p>	<p>3-232 trunk</p>
<p>3-255 When laid side by side, plastic filter cloth used under flexible revetments should: a. overlap no more than 2 inches and pinned at 5 foot intervals b. be adjacent and pinned at 5 foot intervals c. overlap at least 12 inches d. overlap 12 inches and staked</p>	<p>3-233 above</p>
<p>3-256 If concrete is dry batched for sacked concrete revetments, the revetment need not be wetted after completion. True _____ False _____</p>	<p>3-234 12 inches</p>

This page is left blank intentionally.

3-246 1/2 inch
3-247 90
3-248 three (3) feet
3-249 Revetments
3-250 true
3-251 flexible
3-252 true
3-253 upslope (upwards)
3-254 false
3-255 c
3-256 false