Silt Fence

Plan Symbol

Description

Silt fence is used as a temporary perimeter control around sites where there will be soil disturbance due to construction activities. Silt fence consists of geotextile fabric stretched across steel posts. The lower edge of the fence is vertically trenched into the ground and covered by compacted backfill.

When and Where to Use It

Silt fence is applicable in areas:

- Where the maximum sheet or overland flow path length to the fence is 100-feet.
- Where the maximum slope steepness (normal [perpendicular] to fence line) is 2H:1V.
- That do not receive concentrated flows greater than 0.5 cfs.
- ¼ acre drainage per 100 linear feet

Do not place silt fence across channels or use it as a velocity control BMP.

Materials

Steel Posts

Use 48-inch long steel posts that meet the following minimum physical requirements:

- Composed of high strength steel with minimum yield strength of 50,000 psi.
- Have a standard "T" section with a nominal face width of 1.38-inches and nominal "T" length of 1.48-inches.
- Weigh 1.25 pounds per foot (± 8%).
- Have a soil stabilization plate with a minimum cross section area of 17-square inches attached to the steel posts.
- Painted with a water based baked enamel paint.

Use steel posts with a minimum length of 4-feet, weighing 1.25 pounds per linear foot (± 8%) with projections to aid in fastening the fabric. Except when heavy clay soils are present on site, steel posts will have a metal soil stabilization plate welded near the bottom such that when the post is driven to the proper depth, the plate will be below the ground level for added stability. The soil plates should have the following characteristics:

- Be composed of minimum 15 gauge steel.
- Have a minimum cross section area of 17-square inches.

Geotextile Filter Fabric

Filter fabric is:

- Composed of fibers consisting of long chain synthetic polymers composed of at least 85% by weight of polyolefins, polyesters, or polyamides.
- Formed into a network such that the filaments or yarns retain dimensional stability relative to each other.
- Free of any treatment or coating which might adversely alter its physical properties after installation.
- Free of defects or flaws that significantly affect its physical and/or filtering properties.
- Cut to a minimum width of 36 inches.

Use only fabric appearing on SCDOT Approval Sheet #34 meeting the requirements of the most current edition of the SCDOT Standard Specifications for Highway Construction.

Silt Fence Design Criteria

Design Aids

The Design Aids located in this section may be used to properly size silt fence. Sedimot III, SEDCAD4, and other computer models that utilize eroded particle size distributions and calculates a corresponding trapping efficiency may also be utilized. See Figure SF-1 for silt fence trapping efficiency.

General Design Requirements

a. 80 percent design removal efficiency goal for TSS
b. Maximum Slope Length - 100-feet
c. Maximum Slope Gradient – 2H:1V
d. Minimum Installed Fence Fabric Height – 18-inches
e. Maximum Installed Fence Fabric Height – 24-inches (exception for tidal areas)
f. Minimum Post Bury Depth – 18-inches
g. Maximum Post Spacing – 6-feet

Installation

Leave 10 feet between silt fence and creek or wetland.

Excavate a trench approximately 6-inches wide and 6-inches deep when placing fabric by hand. Place 12-inches of geotextile fabric into the 6-inch deep trench, extending the remaining 6-inches towards the upslope side of the trench. Backfill the trench with soil or gravel and compact.

Bury 12-inches of fabric into the ground when pneumatically installing silt fence with a slicing method.

Purchase fabric in continuous rolls and cut to the length of the barrier to avoid joints. When joints are necessary, wrap the fabric together at a support post with both ends fastened to the post, with a 6-inch minimum overlap.

Install steel posts to a minimum depth of 24-inches. Install steel posts a minimum of 1- to 2- inches above the fabric, with no more than 3-feet of the post above the ground. Space posts to maximum 6-feet centers.

Attach fabric to the steel posts using heavy-duty plastic ties that are evenly spaced and placed in a manner to prevent sagging or tearing of the fabric. In call cases, ties should be affixed in no less than 4 places.

Install the fabric a minimum of 24-inches above the ground. When necessary, the height of the fence above ground may be greater than 24-inches. In tidal areas, extra silt fence height may be required.

The post height will be twice the exposed post height. Post spacing will remain the same and extra height fabric will be 4-, 5-, or 6-feet tall.

Locate silt fence checks every 100 feet maximum and at low points.

Install the fence perpendicular to the direction of flow and place the fence the proper distance from the toe of steep slopes to provide sediment storage and access for maintenance and cleanout.

Height of Fill (ft)	Fill Slope	Minimum Silt Fence Offset from Toe of Slope (ft)	Minimum right of Way Offset From Toe of Slope (ft)
< 6	2:1 4:1 6:1	2	3
6-10	2:1	12*	13*
	4:1 6:1	3	4
>10	2:1	12*	13*
	4:1 6:1	4	5

*These minimum offsets may be reduced when curb and gutter or some other feature reduces the flow of water down the slope. The smaller offsets of each group of height of fill can not be reduced.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation. Check for sediment buildup and fence integrity. Check where runoff has eroded a channel beneath the fence, or where the fence has sagged or collapsed by fence overtopping.
- If the fence fabric tears, begins to decompose, or in any way becomes ineffective, replace the section of fence immediately.
- Remove sediment accumulated along the fence when it reaches 1/3 the height of the fence, especially if heavy rains are expected.
- Remove trapped sediment from the site or stabilize it on site.
- Remove silt fence within 30 days after final stabilization is achieved or after temporary best management practices (BMPs) are no longer needed.
- Permanently stabilize disturbed areas resulting from fence removal.

Silt Fence Design Aids

This design aid for applies to silt fences placed in areas down slope from disturbed areas where it serves to retard flow and cause settling. Two conditions must be met for satisfactory design:

- Trapping efficiency must meet the desired level of control, and
- Overtopping of the fence must not occur.

The silt fence design aid is a single line grouping all soil textures together. A similar procedure was used for development of the ratio as used for the ponds and rock checks. For the silt fence, the ratio is:

$$\text{Silt Fence Ratio} = \frac{q_{po}}{V_{15} P_{area}}$$

Where:

q_{po} = Peak outflow through the fence for the 10-year 24-hour storm event (cfs),
V_{15} = Characteristic settling velocity (fps), of the characteristic D_{15} eroded particle (mm),
P_{area} = Potential ponding area up slope of the fence (ft^2).

Estimate the ponding area by using the height of the fence available for flow through and extending a horizontal line from the fence to an intersection with the ground surface upslope of the fence. Calculate the unit available area by multiplying the fence height by the ground slope. Obtain the potential ponding area by multiplying this unit area by the available fence length.

Using the calculated ponding area, calculate the ratio and enter the value in Figure SF-1 to determine the trapping efficiency. Perform an overtopping calculation using the slurry flow rate through the fence. Check this rate against the incoming flow to determine if enough storage exists behind the fence preventing overtopping.

Constraints for the use of Silt Fence Design Aids:

- Watershed area is less than or equal to 5 acres
- Overland flow length is less than or equal to 500-feet
- Overland slope is less than or equal to 6 percent
- Slurry flow rate through the fence is less than or equal to 10 gpm/ft
- Maximum height of the silt fence is less than or equal to 3-feet

Silt Fence Ratios above the design curves are not recommended for any application of the design aids. If the silt fence ratio intersects the curve at a point having a trapping efficiency less than the desired value, the design is inadequate and must be revised.

A silt fence ratio equal to 0.23 has an 80 percent trapping efficiency as shown in Figure SF-1.

Silt Fence Design Examples

Given: Design a silt fence 1.5 ft-tall at the toe of a 2.0 percent slope draining a linear construction site.

Topography will cause runoff to drain through 400-feet of total fabric length.
Peak flow from the 1.0-acre upslope area is estimated at 2.5 cfs using the rational equation with "C" equal to 0.25 and intensity equal to 10.0 iph.

Slurry flow rate for the filter fabric is 10 gpm/ft^2 of fabric according to manufacturer specifications or other source.

Find: **(A)** The trapping efficiency if the soil is Lakeland Sand with an eroded size distribution having a D_{15} equal to 0.0463 mm.

(B) The trapping efficiency if the soil is Cecil with an eroded size distribution having a D_{15} equal to 0.0066 mm.

Solution:

A:

1. The settling velocity V_{15} of the D_{15} particle (0.0463 mm) is read from Figure SV-1 as 5.1 E-3 ft/sec.

2. Estimate the ponded area using the geometry of the installation. With a fence length of 400 ft, maximum depth equal to 1.5 ft, and upstream slope of 2.0 percent, there will be ponded area of 75 ft^2/linear ft of fabric for a total ponded area of:

$$P_{area} = (75\ ft^2/ft)\ (400\ ft) = 30{,}000\ ft^2$$

   The geometry calculates a required tie back of 75-feet to provide an adequate ponding area.

3. The silt fence ratio is calculated as:

$$\text{Silt Fence Ratio} = q_{po} / (V_{15}\ P_{area}) = 2.5/[(5.1E\text{-}3)(30{,}000)] = 0.017$$

4. Reading the trapping efficiency from the Silt Fence Design Aid (Figure SF-1) with the ratio equal to 0.017, the trapping efficiency is approximately **<u>94 percent</u>.**

- Check the fence for its ability to pass the design flow without overtopping.

5. Convert the peak flow from cfs to gpm:

$$q_{po} = (2.5\ ft^3/sec)(7.48\ gal/ft^3)(60\ sec/min) = 1122\ gpm$$

6. Divide the peak flow rate by the effective height (1.5-ft) and the slurry flow rate of 10 gpm/ft^2 of fabric to calculate the required fence length.

$$L = (1122)/\ (1.5)\ (10) = 75\ ft$$

7. 75 ft is less than the 400 ft available, so the fence will not overtop if it is properly maintained. Note: This analysis does not account for concentration of flows or strength of the posts, or fabric.

B.

1. A Cecil D_{15} topsoil is 0.0066 mm, and the settling velocity is found to be V_{15} = 1.2 E-4 fps.

2. The filter fence ratio is calculated as:

   Silt Fence Ratio = $q_{po} / (V_{15}\ P_{area})$ = 2.5/[(1.2E-4)(30,000)] = 0.70

3. Reading the trapping efficiency from the Silt Fence Design Aid (Figure SF1) with the ratio equal to 0.70, the trapping efficiency is approximately **<u>70 percent.</u>**

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Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment accumulation.	Remove sediment. Apply hydraulic mulch or straw mulch or other BMPs upstream to reduce eroded sediment.
Bottom of fence is not properly keyed in.	Dig trench, place fabric, and backfill.
Length of slope draining to silt fence is too long.	Shorten slope length using diversion ditches, additional silt fence runs, or other BMPs.
Storage capacity is inadequate due to sediment buildup.	Remove accumulated sediment when it reaches 1/3 the height of the barrier.
Lack of sufficient ponding area.	Install fence with at least a 5-feet setback from the toe of the slope where possible. Divert flow at top of slope with diversion ditches.
Erosion occurs around ends.	Turn ends into the up-slope area every 100 feet.
Silt fence is not installed along level contour.	Reinstall silt fence so that change in elevation does not exceed 1/3 the fabric height along the reach.
Slope draining to fence is too steep.	Shorten slope length using fiber rolls or equivalent. Increase setback of silt fence from the toe of slope.
Fence is installed in concentrated flow area.	Replace fence with proper BMP such as check dams, if appropriate.
Tie backs or j-hooks not installed or installed incorrectly.	Place Tie backs or j-hooks at a maximum separation of 100-feet.
Posts are too far apart.	Add stakes a maximum of 6-feet apart.
Concentrated flows causing erosion.	Place cross barrier check dams behind the silt fence.