yesterday

SILT FENCE THAT WORKS

For Designers, Installers, Inspectors

today

SILT FENCE THAT WORKS

by

Thomas Carpenter, CPESC
(Certified Professional in Erosion and Sediment Control)

ISBN 0-9672733-0-7

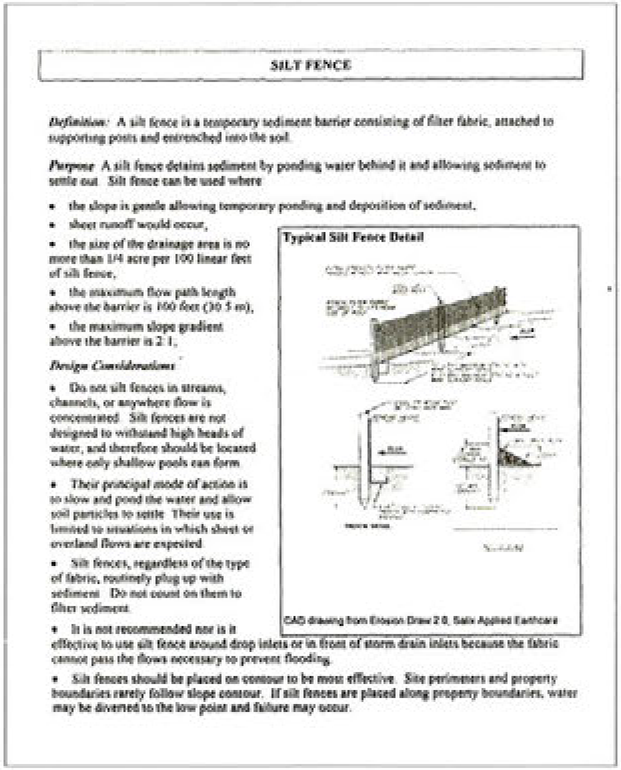
Table of Contents

Table of Contents - cont.

Introduction

The erosion and sediment control industry is still in its infancy stage. Although environmental conservation has been active for many years, there hasn't been any real bite in effective construction regulations. In the last five years, with increasing enforcement of the Clean Water Act and NPDES regulations, the industry has really exploded.

New technology for erosion and sediment control has coincided with this expansion. But *old ways and specifications* tend to lag behind technology and stay entrenched in the bureaucracy even though consistent failures exist. The established specifications may have served a purpose in the past, but don't necessarily work well relative to the new technology.



SILT FENCE

Definition: A silt fence is a temporary sediment barrier consisting of filter fabric, attached to supporting posts and entrenched into the soil.

Purpose A silt fence detains sediment by ponding water behind it and allowing sediment to settle out. Silt fence can be used where

- the slope is gentle allowing temporary ponding and deposition of sediment,
- sheet runoff would occur,
- the size of the drainage area is no more than 1/4 acre per 100 linear feet of silt fence,
- the maximum flow path length above the barrier is 100 feet (30.5 m),
- the maximum slope gradient above the barrier is 2:1,

Design Considerations

- Do not silt fences in streams, channels, or anywhere flow is concentrated. Silt fences are not designed to withstand high heads of water, and therefore should be located where only shallow pools can form.
- *Their principal mode of action* is to slow and pond the water and allow soil particles to settle. Their use is limited to situations in which sheet or overland flows are expected.
- Silt fences, regardless of the type of fabric, routinely plug up with sediment. Do not count on them to filter sediment.
- It is not recommended nor is it effective to use silt fence around drop inlets or in front of storm drain inlets because the fabric cannot pass the flows necessary to prevent flooding.
- Silt fences should be placed on contour to be most effective. Site perimeters and property boundaries rarely follow slope contour. If silt fences are placed along property boundaries, water may be diverted to the low point and failure may occur.

Typical Silt Fence Detail

CAD drawing from Erosion Draw 2.0, Salix Applied Earthcare

25 Year Old Specification

This manual was written because there really isn't any definitive comprehensive material available about sediment control using silt fence. Manuals offer the same straight 25 year-old picture of a silt fence, with a few bulleted comments, but don't tell you anything about how, what, where, when, and why.

Silt fences fail because they are improperly designed, placed, installed, or maintained.

Designers and bureaucrats consistently copy specifications from one manual to another either because it's easy and/or they don't care. Problems with efficacy are well known, and many professionals in the field have actually stopped recommending silt fence because it never works.

Proper installation is impossible without an adequate understanding of what silt fence is supposed to do, how it works, and how to construct it properly. The author/erosion control contractor has actually traveled to many parts of the country installing silt fence and talking with people in the field. He has also worked extensively on construction sites installing sediment control devices. Last but not least, he inspects those installations and analyzes what is happening, what is working, what isn't, and why.

What are the problems of silt fence efficacy?

1. **Lack of knowledge by many designers, installers and inspectors concerning how silt fence is supposed to work.**

   Failure to implement proper placement and quantity requirements is extremely harmful to the environment and costly to owners and developers. Silt fence that washes around the end because it is not placed correctly is a complete waste of money for the owners. Silt fence inundated with water because it is the only fence protecting a 5 acre site allows sediment to harm our environment.

2. **Many people who feel it is a waste, a hassle, or who just don't care.**

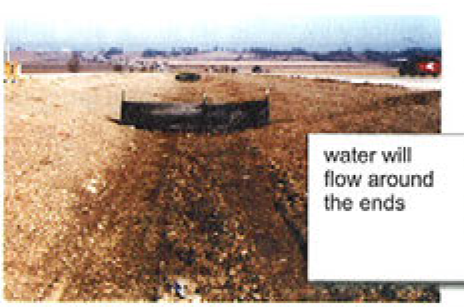
   Apathy and disregard for effective controls are also devastating to the environment and the owner's budget. When people don't care, don't think it's necessary, and don't want to spend the money, there are going to be problems. Yes, there have been positive strides in environmental protection over the past few years, but in the area of efficacy, silt fence is mostly cosmetic.

3. **Lack of effective specifications**

   - improper placement on the site
   - inadequate quantities relative to the area contained
   - shallow trenches with little or no soil compaction
   - shallow, improperly spaced, and/or inadequate support posts
   - inadequate attachment to posts
   - failure to maintain the silt fence after installation

poor support

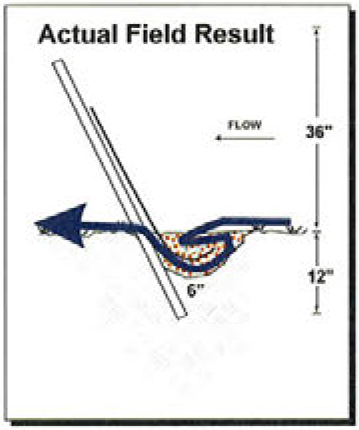
poor installation



improper placement

improper placment

Silt fence is a joke nearly everywhere in the country.



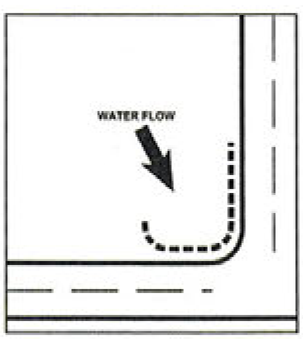
The specifications were written 25 years ago and have changed little since. Some states have recognized some of the inherent problems, such as inadequate trench depth, and implemented minor changes to improve efficacy.

Many states simply pay millions of dollars and receive little control because installers and inspectors don't know how silt fence works, where to place it, how much is needed, and no one cares.

The 25 year-old specifications, referred to as the trenching method, have never been tested for efficacy and proven worthwhile. A trencher was simply the only piece of equipment available at the time capable of securing fabric in the soil, regardless of efficacy. Today many contractors just open a furrow with a blade and backfill onto the fabric with the crumbs.

But the problem arises in just that - loose soil, either from a trencher or a blade. Loose soil absorbs water quickly and becomes saturated, easily washing out under the fabric.

The trenchers' inability to turn is also a major problem. In attempting to turn, the trencher inherently excavates the sides of the trench, creating a saucer-shaped trench that is easily washed under.

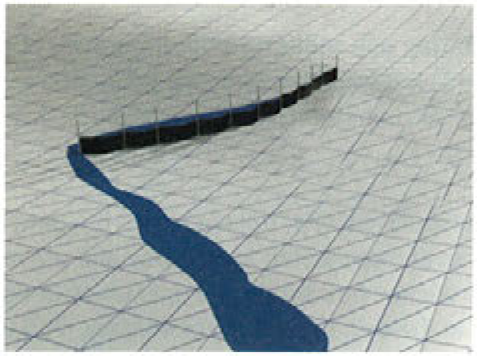


Turning is often necessary to create an area for ponding to occur. Silt fence must pond sediment-laden water to be effective.

Today's Problems

Why do we need change?

The real need for silt fence efficacy lies in saving our environment. Impacts from sediment are felt directly and immediately in adjoining streams and then through the river system and the ocean deltas. Aquatic life and habitat is lost, more soil is lost as sediment changes stream dynamics, as well as economic and recreation resources.



Improper Placement

Millions of tons of sediment are lost each year from construction sites because of improper installation. A single 100 ft run of silt fence could hold 50 tons of sediment! 50 tons. Yet many of us never see a silt fence with any sediment or water ponded behind it. When are we going to demand silt fence efficacy?

Proper Installation. One 100 ft. run of silt fence could hold 50 tons of sediment!

Sediment can change the natural flow of streams. Man can change overnight what nature has spent several hundred years developing. Sediment can cause streams to widen, which then erode streambanks. Sediment can kill plant life in a wetland, which nature has built to help cleanse our water. Sediment can kill fish in a stream directly by eliminating oxygen, etc., and/or cause the stream to change, destroying habitat and impacting all life in the food chain.

Sediment can cause floods, change the direction and velocity of rivers, and destroy ocean habitat. Yes, agricultural loss is severe at times, but the loss from construction sites per event and per area is much greater than field loss. And the cost of cleaning sediment from stormwater systems is enormous. Someone has to pay. We all do. Yet much of the destruction could be avoided with effective sediment controls.

wrong

Improperly installed silt fence is a complete waste of money and effort. A poor job can even cause more erosion than not having done anything. Silt fence is a system. It either works or it doesn't. If just one part of the system fails, the whole fence fails and becomes a waste of money.

right

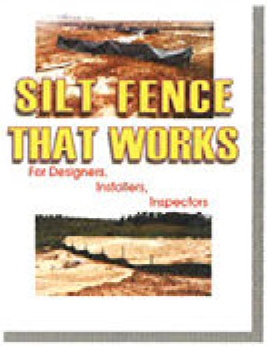
Properly installed silt fence detains water for sedimentation to occur.

right

A properly installed silt fence can retain several tons of sediment, thus saving millions of tons across the country.

Goal: Consistent, quality sediment control from silt fence

How do we achieve the goal?



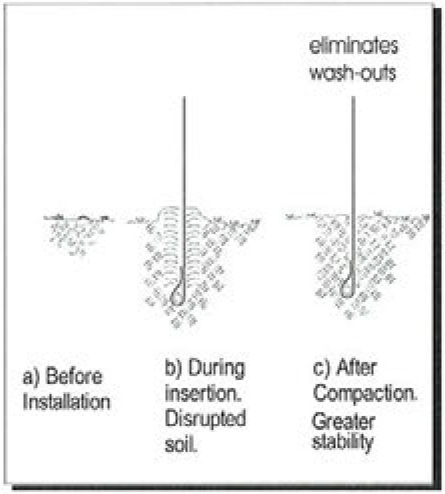
A system of proper installation, support, and attachment combined with today's materials will control sediment.

1. Educate with a comprehensive manual

- For proper placement and adequate quantities
- For proper installation, compaction, support, and attachment
- For inspection and maintenance criteria

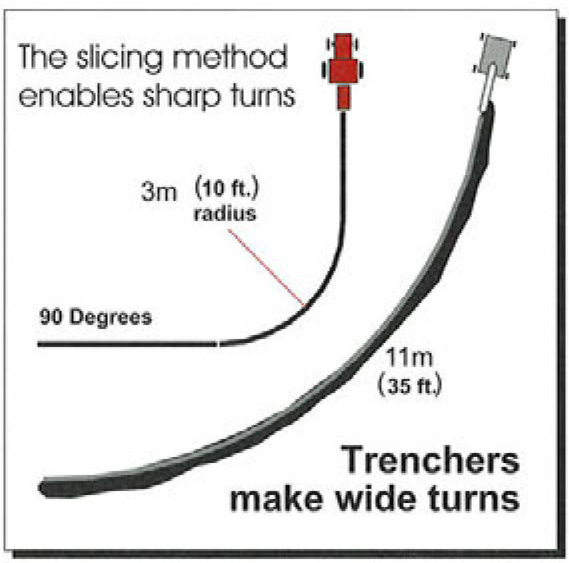
2. Implement new, proven technology into specifications

- Slicing the soil and mechanically installing fabric into the soil
- Achieving 100% relative compaction against both sides of the silt fence
- Utilizing steel support posts spaced (5')1.6m apart, and driven (24") .6m into compacted soil
- Attaching fabric to the posts with three diagonal ties



* A vibrating plow cannot be used because it creates horizontal compaction away from the fabric

The new technology, the slicing method, slices through the soil, rather than excavating it. Slicing minimally disrupts the soil upward and slightly displaces the soil, maintaining the soil's profile and creating an optimal condition for future mechanical compaction. Compacted soil resists water infiltration and moisture saturation, thus nearly eliminating washouts.



The slicing method also has the capability to turn in a short distance, thus properly installing silt fence where needed. Turning enables upturns on the ends of silt fence runs, maneuvering around obstacles on construction sites, protection along property lines, and following contours as prescribed in Best Management Practices.

The slicing method is making great strides in the industry, and has already been accepted for use in many states. It has been submitted to ASTM for inclusion in their standards, and submitted to the International Erosion Control Association as a Best Management Practice.

180 degree turning enables proper placement and effective installation.

What is silt fence?

Silt fence is usually a synthetic material, somewhat porous, installed on construction sites to minimize sediment leaving the site. The fabric is installed partially in the ground with the balance, approximately 20 inches (500mm), supported above ground on stakes.

You've Got To Stop The Water

There are a few variations in silt fence material, woven, non-woven, mono-filament, etc., but because all types generally clog rapidly, the type of fabric may not matter in many instances.

However, fabric that tears easily may also be difficult to attach properly. The installation, physical support, and attachment thereto are much more important than fabric type in creating a structure to contain runoff, slow sheet flow velocity, and ultimately detain (20 inches) 500mm of sediment-laden water.

Silt fence fabric is relatively ineffective for filtration because it clogs rapidly. **Silt fence captures sediment by ponding sediment-laden water, permitting sedimentation to occur.** This sedimentation pool is very effective. It not only allows the larger particles to drop out fairly fast as the water stills, it also enables some finer particles to settle out.

Silt fence is often referred to as temporary because it is only intended to control sedimentation until the site is stabilized by vegetation or development, at which time it is to be removed. It is also temporary because it can be readily built at different locations on construction sites.

The purpose of silt fence

The purpose of most silt fence is to pond water. When full, they must drain over the top.

The greatest waste of money is a silt fence improperly placed – it has no chance of working! A partial dam or improperly built structure is worthless. There is no middle ground.

Where is silt fence used?

- Silt fence is used on construction sites to divert additional runoff from entering the site, to control the sediment from moving off-site, and to segment the site into manageable ponding areas.

Protect stormwater inlets before sediment gets onto streets.

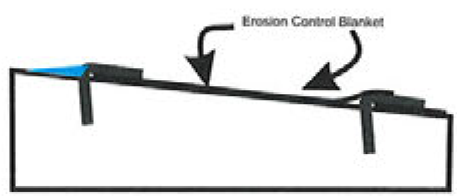
Create a storage area for sedimentation.

- Silt fence can be used in certain situations to divert low volume and low velocity water, for instance, diverting clean runoff from another adjacent site to an existing outlet.

- Silt fence can also be used to slow the velocity of sheet flows on a slope. Erosion loss increases dramatically with velocity of flow.

- Silt fence fabric installed without stakes can act as fabric check dams in flatter waterways or low shouldered channels. Fabric check dams installed every 50 to 100 ft (15-30m) inhibit rills and gullies from forming before vegetative cover is established. Runoff collides with the fabric buried in the soil and the erosion process is temporarily interrupted.

Fabric dams (fabric installed without support posts) can be installed in agricultural waterways and shallow ditches to minimize gully erosion.



Fabric dams, using the slicing method, can be installed at the head of erosion control blankets to prevent under-cutting.

Who needs to learn about silt fence?

The entire construction team must each know about proper silt fence installation to maximize effective benefits from their efforts:

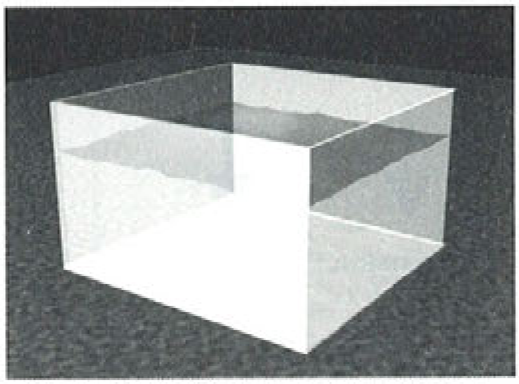
Do your installations work like this?

- The owner needs to understand the big picture on erosion and sediment control because using the proper measures and effective controls affect their bottom line;
- The designer needs to understand how and where it works to determine proper placement and appropriate quantities;
- The dirt contractor needs to know because they are on site during the critical period, and physically responsible for erosion and sediment control;
- The erosion and sediment control (ESC) professional needs to know how, where, what, and why, to advise on proper placement and proper quantities for field adjustment;
- ESC contractors need to know for proper placement and effective installations; and
- The site inspectors and regulatory personnel need to know whether it will work for determination of payment and for determining maintenance requirements.

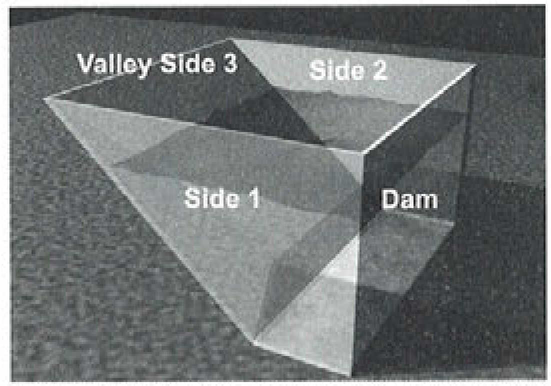
Whether or not you agree with all of the observations and conclusions, this manual will at least begin the process for education and research on effective silt fence. With a benchmark, professionals can utilize the many resources available to incorporate new technology and update research into specifications resulting in measurable benefits to the environment.

UNDERSTANDING HOW SILT FENCE WORKS

Silt fence is, in effect, a dam for temporarily detaining water. *It must always be looked at from that perspective.* Many people, from engineers to installers to inspectors, just draw a line on the plan or mark the prospective location without considering the fence has to dam water to be effective. ***The result is often a worthless silt fence because water runs around one end or the other without any chance of ponding.***

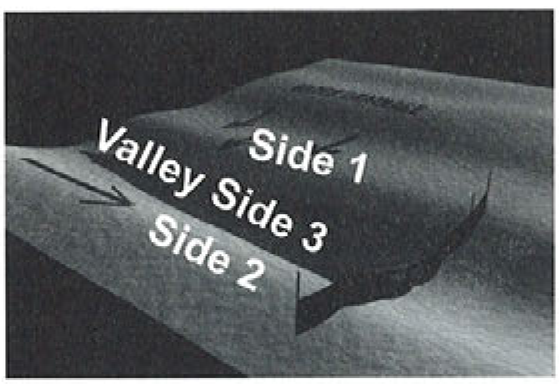


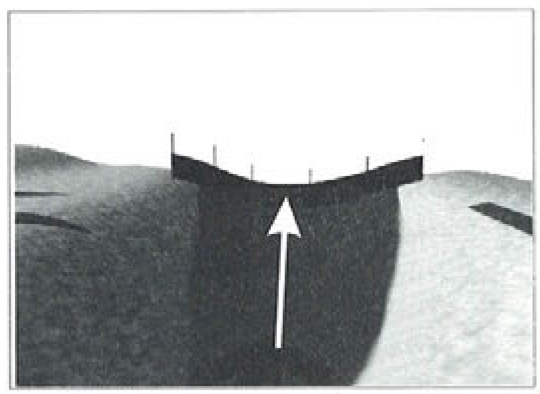
A swimming pool dams water on four sides, like this semi-transparent box



If one side of the box is made to slope, it still serves to dam the water on that side.

A pond actually has four sides, just like a rectangular swimming pool. And like the bottom of a swimming pool that has a gentle slope making one end deeper than the other, the bottom of a pond, called the valley, is the third side of the pond – the flattest slope of the three sides. The other two sides have steeper slopes, even if they're miles apart.





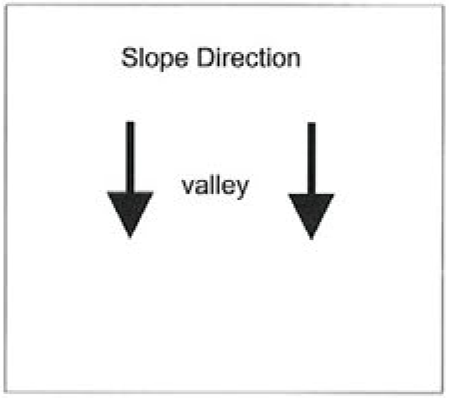
water is dammed and must overflow over the middle, not around the ends.

In the simplest example, silt fence is used to dam a channel. A channel consists of two parallel slopes and a third slope where the two converge, again called a valley. For instance, a roadside ditch is a channel. *All silt fence installations are a variance of this concept.* That is, you need the dam and three sides to pond water. Variations arise because the terrain where you need silt fence is rarely in the simple shape of a channel.

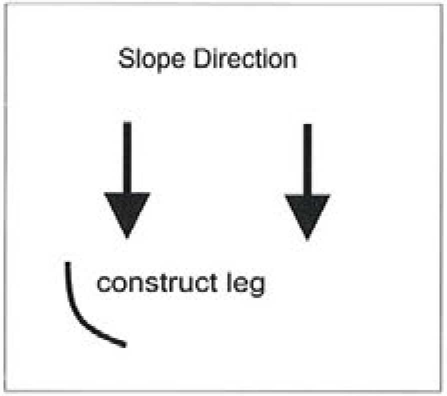
One Slope

When you have one slope, for instance a hillside draining straight away, it is in essence the valley slope and you must construct the other three slopes with silt fence to create a detention area.

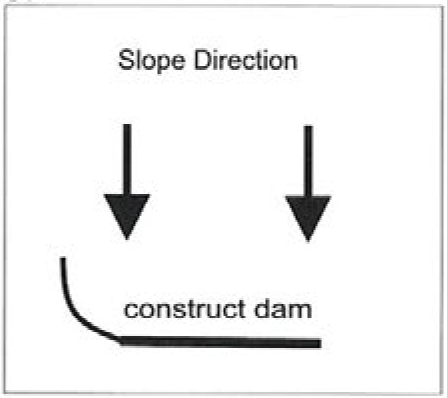
1.



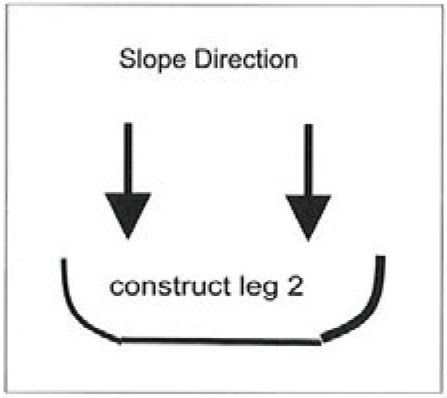
2.



3.



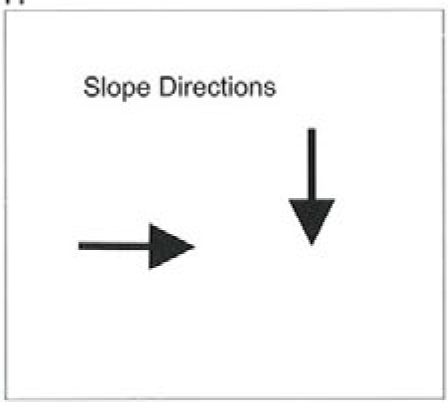
4.



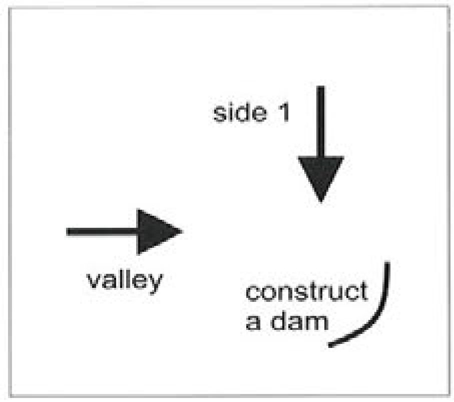
Two Slopes

When you have two slopes, the flattest slope is the valley and the steeper slope becomes one side of your dam. To create a pond, you must create the dam and one other side. The fastest and most efficient means is to build a silt fence creating the dam and required third side.

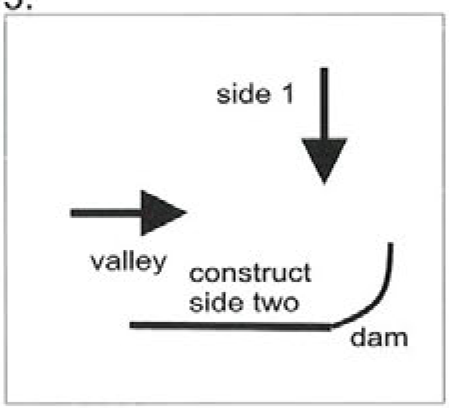
1.



2.



3.



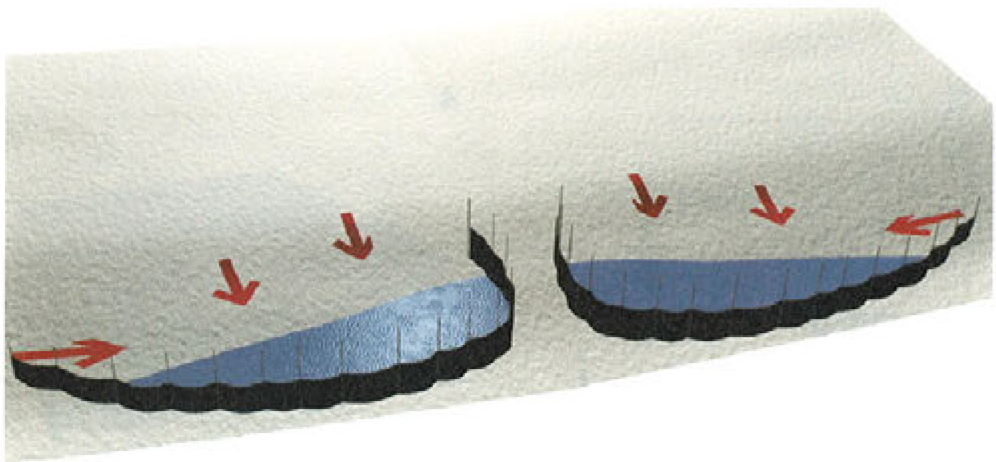
4.

A construction site example would be water running down a slope, encountering the valley slope, and then changing direction of flow to follow the change in slope. To create a dam, the silt fence must dam the valley slope and also turn up, parallel to the first slope, to create an artificial side, and thus complete the dam structure. Without the artificial side, water would flow around the end of the dam.

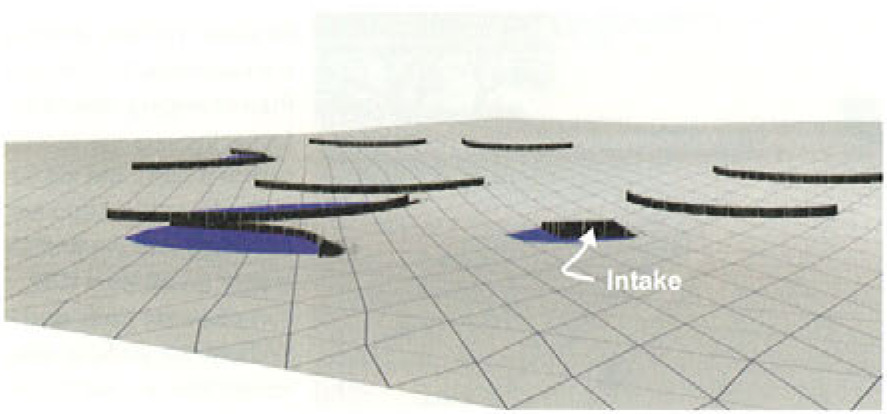
Large Area

Divide large areas into multiple collection areas. Do not use one long run.

In this example, the long run concentrates water in one area and overflows quickly.



In this example, 2 ponds are created which normally doubles the storage capacity.



Several fences difuse volume of rainfall over large areas. A watershed area above any fence should not exceed .5 acre (.20 HA)

Silt Fence on a two-direction slope

Occasionally you must install silt fence on a slope to either slow the water's velocity or to restrict the volume of water reaching the lower sediment controls in a fast, heavy rain event. Water concentrating in one area of the silt fence and overflowing quickly is the major problem with this placement issue. Such concentration greatly diminishes the value and investment of the silt fence, often times making it worthless.

In the field, even experienced contractors often have a difficult time determining where to place the fence properly to avoid concentration, and wasting time and money on a poorly placed silt fence. It seems the best advice is to place the fence in multiple runs when possible, and to follow the contour as close as possible.

Following the contour means the silt fence is placed as level as possible on the slope, thereby detaining water where it encounters the silt fence, rather than allowing the water to flow one direction or the other and ultimately concentrate in one or more small areas.

On a two-direction contour, for instance, one sloping both north and westerly, the silt fence should cut across the slope diagonally, perpendicular to the water flow, as level as possible.

The Erosion and Sediment Control Plan-

Responsibilities and Liabilities

The role of the designer, landscape architect, and ESC professional

The designer, or whoever does the erosion control plan, has overall responsibility for proper placement and quantity on site. The designer develops the site and grading plan, and hopefully goes through a precise process in this planning effort.

Terrible design and placement

Long runs should be avoided

Some items considered in an erosion and sediment control plan:

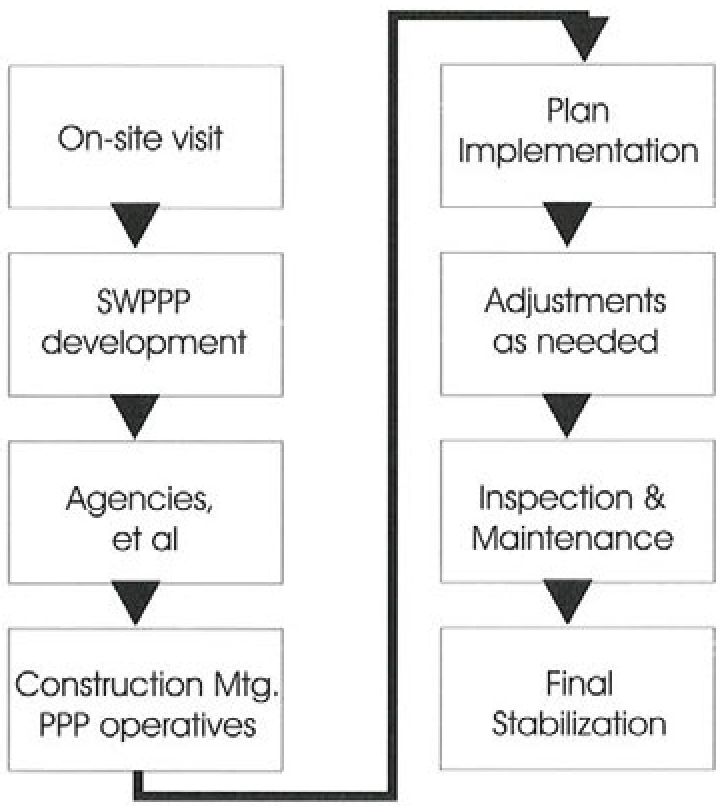
- What kind of runoff, and how much, is coming onto the site? Clean rainwater from a stabilized site, bare ground runoff, sheet flows, channel flows, etc.?
- Where is the total volume going to exit and how? Where is it going to go? A stream, pond, stormwater system, residential yard, downtown business district?
- In a major rain event, what are some worst case scenarios upstream and downstream?
- What types of soil are above, on, and below the site? Are they vegetated, sandy, clays, rock, etc.?
- What is the overall construction environment? Open fields, downtown, residential, pristine, industrial, etc.
- What rainfall region is involved? What season will construction be done? What is the construction schedule? Will construction phasing be attempted?
- What concerns have the excavation contractor and others raised about this project?
- What are the marketing goals of the developer? How long will the land be idle?
- What Best Management Practices will work best on this project?

The Design process

The designer puts the plan together in the office, determines what measures are appropriate, and finishes the requirements with 'install other measures as needed'. The plan then goes through all the red tape, permits, and is finally used during construction, at which time reality mandates field adjustment. This adjustment theoretically should not be significant.

However, today's environmental rules present some challenges and questions for everyone involved. Everyone on-site is basically a co-permitee to the NPDES permit, and as such, directly or indirectly has input into the plan. Owners, contractors, and erosion and sediment control contractors have a defined responsibility to prevent pollution from leaving the site. They must follow the plan and additionally insure the site is stable. So between a plan drawn in an office, the reality of construction, co-permitee responsibilities, and Mother Nature, ***site adjustment is inevitable, and mandatory.***

However, when the erosion and sediment control plan is inadequate, the responsibility falls on the ESC professional for control and compliance. It then may appear like the fox is watching the hen house, because the ESC professional may also be selling the erosion and sediment control measures. The best scenario is for a good plan from the outset, open lines of communication, and defined responsibility.



Potential liability issues

But what about liability issues when you do site adjustment? What about quantity and payment issues? Who is going to pay for site adjustment? Changing or adjusting the plan of an engineer may create some unknown consequences. As we discussed earlier, the industry is evolving and these answers are not clear cut.

- Is the owner, or possibly the designer, responsible for erosion and sediment control work necessary, but not provided for, on the plan? Is the excavating contractor?
- Does the simple disclaimer 'install additional measures as needed' absolve the designer of their responsibilities to the owner for adequate estimates, and to the law for an appropriate storm water pollution prevention plan (SWPPP)?
- Shouldn't the site development cost estimates include amounts for maintenance?
- Is an erosion and sediment control professional liable if they follow an inadequate plan, knowing it is not adequate for effective sediment control? Is notification to the owner of such inadequacies enough to limit their liability?
- Should an erosion and sediment control firm withdraw from employment if a SWPPP is inadequate? What is the process for negotiating a workable plan?
- What responsibility does the excavating contractor carry? What if they know from real world experience that a plan is inadequate, when and where should they step up and question the process?
- What about weather related scheduling problems? What if estimates are utilized for completion during one construction season, weather prohibits stabilization, and an interim mulch cover is mandated. Who pays? Does the site go unprotected?
- Who should the excavator address, the owner or the designer? What if they present concerns to the engineer, who doesn't consult the owner, and then a major rain event causes havoc and damage?
- What if governing authorities demand interim cover on specific areas? Who pays when this doubles the estimate? Shouldn't those types of potential liabilities be addressed in the estimates and on the SWPPP?
- What about the neighboring projects? One owner follows the plan and controls their site. An adjacent developer does not, maybe because his plan is inadequate, maybe because they are willing to take a risk of non-compliance. Economically it is unfair. Should someone report that project to governing bodies? Should those governing bodies impose fines if they can not adequately inspect on an equal basis?

It seems a common sense solution would be working as at team, owners, designers, excavators, and the erosion control professional, to stabilize the site. How that team is structured will probably vary across the country with the different construction cultures, but the common goal of compliance should be universal.

Compaction - Why does it matter?

Compact Soil Prevents Piping and Washouts

The size, shape, and arrangement of soil particles determine the volume of air space between the soil particles and the potential pathways for water infiltration. The more air space a soil has, the more room it has for water infiltration. Compaction compresses the soil particles, minimizing the volume of air space between particles, and thus minimizing the volume of water the soil will hold.

Moisture content of the soil also plays an important role in compaction by helping to 'lubricate' the soil during the act of compaction. Dry soil particles will tend to bridge between one another, thus retaining air space. Some moisture allows the particles to give and slide, and thus 'settle' closer together in a more dense position. Too much moisture means the air spaces have been filled with water, physically occupying space and preventing the soil particles to densify.

Compaction is mandatory! It is required in virtually all specifications because the more air space a soil has, the more room it has for water infiltration, which is called piping. Infiltration enables water to saturate the soil, causing it to become fluid and potentially mobile. **Fluid and mobile soil converts directly to erosion and sediment transport.**

Compaction, by definition, is the act of compressing a given volume of material into a smaller volume.

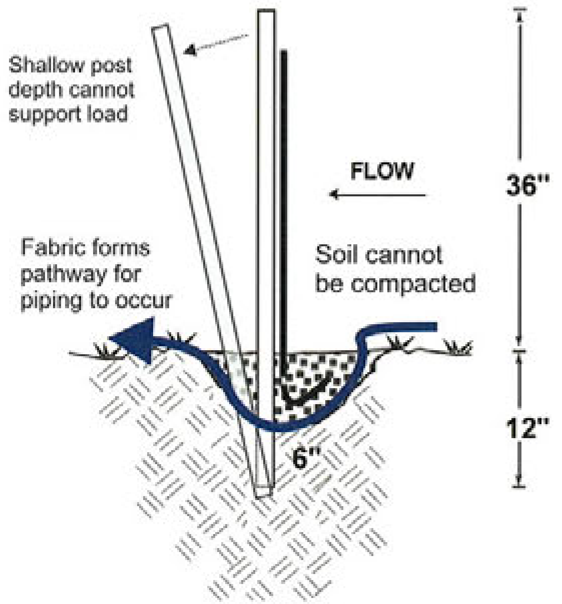
The trenching method-

**** Is physically an inadequate specification***

**** Is [redacted] to compact***

difficult

Actual Field Installation



The trenching method generally calls for a 6-inch trench, 4-6 inches wide(100-150mm). Although often not defined in words, but shown in illustrations, the walls of the trench are meant to be somewhat vertical, with wood support posts for the fabric realizing some structural support from the trench wall.

The bottom flap of the silt fence fabric, approximately 6 inches, is laid on the bottom of the trench which is back-filled with the excavated soil. **Compaction is specified in nearly all instances,** but not defined as to what exactly compaction actually means or how it is to be accomplished.

However in reality, compaction is rarely attempted. Inspectors don't enforce the specification, or don't know it even exists. Even if asked, contractors say no one else is doing it – that it's not a traditional practice. It costs more money and time to attempt compaction.

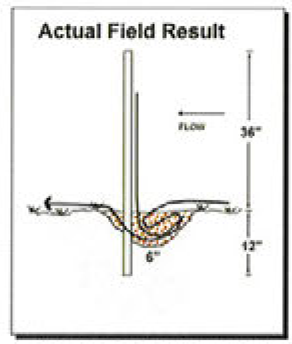
Additionally, it is difficult to compact the soil when wheel-rolling the trench because most contractors insert the posts in the trench prior to back-filling.

Inherent Problems With Current Specifications

1. Compaction problems with trenching and V-Cuts

No Compaction = Under-Cutting

a. It is physically difficult [redacted] to compact soil in a 6-inch (150mm) trench dense enough to prevent infiltration and saturation.. The fabric separates the soil particles, prohibiting them from being compressed and from forming a consistent structure to resist piping.



6" inch trenches is usually saucer-shaped.

b. This inherent problem is compounded by the trencher action, which rarely makes a nice square side-wall as seen in specifications primarily because the trencher is a large cumbersome machine, and the soil as often as not is dry and crumbly on the top 6 inches. The 6-inch trench is usually saucer-shaped versus the neat, square-sided trench drawn in the specifications.

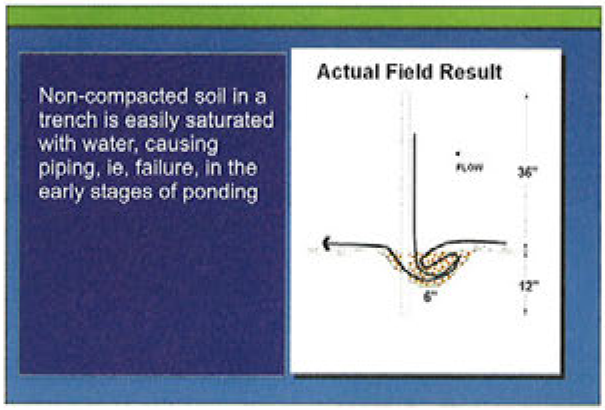
Fabric easily displaced

c. After the relatively small volume of excavated soil has been exposed to the air for a few minutes during construction of the silt fence, the moisture content is significantly reduced, and the capacity for compaction is considerably diminished.

d. Any trash, sod or weeds, excavated from the trench and back-filled, can not be compacted because this trash forms many air spaces which can not be compressed out, and are easily infiltrated with water. This is well documented, yet back-filling with this sort of trash is allowed virtually all of the time.

e. Trench depth is directly related to compaction. A 12 inch (300mm) trench adds significant substance to an installation and more potential for compaction. However, there are still significant problems for a 12 inch trench.

- soil moisture loss in the back-fill
- sod and/or trash in the back-fill
- costly labor and time for compaction
- Lack of trencher maneuverability



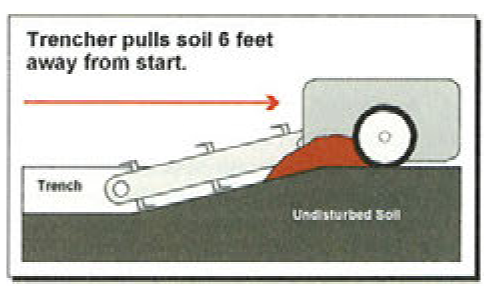
2. The flap of fabric under the back-fill in the trench inherently forms a pathway for water directly causing undercutting of the silt fence, and therefore failure, completely contrary to its objective. Since the soil at the edge of the trench can not be compacted, it is only a matter of time before water follows the undisturbed soil and undercuts the silt fence.

3. Bar trenchers cannot turn without excavating and rounding out the side-walls of the trench. Turning is required to construct an upturn or hook at the end of a silt fence, required to maneuver around obstacles on construction sites, required to closely follow contours of the terrain, and required to follow property lines.

Rounding out the side-walls presents two problems. One, instead of a nice square trench as seen in the specification, you have a saucer-shaped hole, which offers no support for the posts as shown in the specification, and no back support for the fabric, which sags down when soil is added, or bulges out the back-side. And two, instead of a squared-off structure to support the back-fill for potential compaction, you have no external support.

Occasionally you can trench from two directions, but often see results as discussed next, where the soil is quite a distance from where you need it, and the corner is usually the critical area in the fence structure for detaining water.

4. Bar trenchers pull the excavated soil of the trench several feet away from the beginning of the trench. Theoretically, the soil is pushed back when it is back-filled, but realistically many installers just get what they can, which leaves a void at the beginning of the run and potentially an easy washout in a critical area of the silt fence.



5. Inherent with excavating the soil is somehow getting it back into the trench, and thus the addition of the labor factor. Although much of the soil is pushed back in with the trencher, many times it is just not practical. Whenever an operation adds more labor inputs, more problems are encountered, it's just human nature.

6. Trenchers are traditionally quite heavy and cannot operate in wet, soft conditions or steep slopes, greatly restricting their timeliness and effectiveness. Maneuverability is not one of their highlights.

7. Windy conditions greatly diminishes the quality of the silt fence installed in a trench:

- Man-handling a loose roll of silt fence and attempting to pull it tight,
- trying to tie fabric blowing in the wind to a post and make it tight,
- attempting to install pre-fabricated silt fence tightly,
- and trying to properly back-fill when the fabric won't stay in the trench

8. Items 3-7 illustrate inherent trenching problems are not insurmountable, but the cost to correct them in the field properly is very costly in terms of labor and time.

These inherent problems with a trench or v-cut all contribute to a poor installation that usually won't hold water!

Summary of the trenching method

- *The trenching method (and the graded v-trench) must be discontinued and prohibited because of numerous inherent problems throughout.*
- ***These inherent problems allow millions of tons of sediment to flow off-site each rainfall.***
- *No amount of regulation and inspection will solve these efficacy issues.*

Support Posts and Attachment

Last but not least in the silt fence installation system are support posts and attachment. As part of a system, each segment is dependent on the others. Posts must hold the fabric up, and also support the considerable weight of detained water and sediment. Correspondingly, the attachment system must hold the fabric to the post, and carry part of the water and sediment load.

Problems: 1) Wood posts cannot be driven deep enough into the ground.
2) Wire-supported fence is costly and ineffective.
3) Improper spacing causes failures

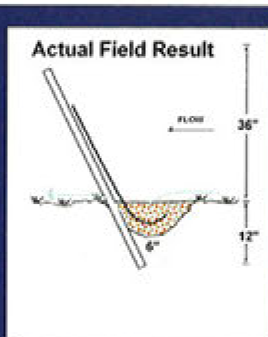
1) Wood Posts

Wood posts are used extensively to support silt fence though not effectively. One reason for their use is cost, being quite a bit cheaper than steel posts. They are also allowed in the specifications of nearly all the states, with *those choosing not to allow wood posts* being the ones who desire their silt fence to stand up.

Wood posts (2x2 hardwood) are potentially strong enough to support horizontal loads, but are very difficult to drive into the ground more than 6-8 inches (150 - 200mm). They displace 3 square inches of soil for the full depth of impoundment, compacting the soil below as they go down. Plain and simple, posts 6 to 8 inches (150-200 mm) deep are not near deep enough to hold 18 inches (450 mm) of sediment and water.

Wood Support Posts...

Are often too shallow to hold the weight of the ponding water



Although shown in drawings as providing back-side support for a post a total of 12 inches in the ground, in reality a saucer trench is the norm, and posts tapped a few inches into the soil at the bottom of the trench receive no support from the backside.

1 x 1 wood posts are grossly inadequate to hold even 50% of a typical silt fence sediment and water requirement. They can withstand only minimal strikes from a hammer, and offer little resistance to horizontal stress. This application is a total waste of money and effort.

The conclusion is clear and simple. Wood posts are inadequate. Steel t-posts weighing at least 1.25 pounds per ft. are required. They can be driven 24 inches (600mm) into compacted soil, which is necessary to hold a horizontal load 18 inches high. They can also be recycled and used repetitively.

2) Wire-supported silt fence is costly and ineffective

In the early years of silt fence fabric development, woven fabrics were the only option. They tended to stretch more than desired, so wire-backing was considered. The concept caught on and is still stuck in many bureaucratic specifications.

- The first oversight was failing to mechanically pull the wire tight. Wire rolled out by hand stretches nearly as much as the woven fabric they were trying to assist. The second was failing to support the ends, which often pulled down if the fence held water. The third was maintaining the post spacing at 8 to 10 ft. (2-3m) Again, if the fence held water, the wire stretched and the posts couldn't support the load.

- ***Which comes right around to the beginning, all they really had to do all along was space the posts closer together.*** The fabric would have been supported, the posts would have been strong enough to hold, and the cost would have been millions of dollars cheaper.

- the system is so expensive, its cost isn't worth the high risk of failure – the trench can not be compacted;

- the specification creates an environmental disposal problem for the wire and additional landfill expenses;

- today's fabrics are much stronger and do not require additional support.

3) Improper post spacing causes failures

Improper spacing is another major concern. Although 8 to 10 ft. (2-3m) spacing between posts are allowed in many specifications, those post spacings are too far apart. 4-6ft. (1-1.6m), is more appropriate. The fabric will sag significantly over that distance, and fall over when water ponds up behind it.

Does fabric make a difference?

The answer to this is technical and beyond the scope of this manual. However, as a general answer, if all the elements of the silt fence installation system are properly adhered to, the fabric does not make much difference. Even lightweight non-woven fabric will hold 18 inches (450mm) of sediment if properly supported. But lightweight fabric tends to tear easily at the attachment point.

Today, fabrics are available to handle the load, and the challenge is to properly place, support, and attach the silt fence to perform as desired.

What about straw bales?

Straw bales have no redeeming value in sediment control except as mulch. In any significant water volume situation where ponding and sedimentation is desired, straw bales will fail. **Have you ever seen sediment behind a straw bale installation?**

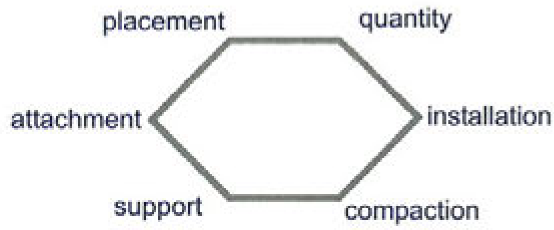
The problems are simple.

- Bales are square. Most ditches are concave
- Bales are bunched at the cords, forming a void when butted. How long do they hold water?
- Soil can not be compacted next to them, so saturation and piping begins almost immediately.
- As soon as the momentary water volume builds up, destruction begins.
- When failure occurs, all the sediment continues to wash down the hill. Nothing gained.

It costs just as much to do as silt fence, why not use a specialized product? At least when its full, you still have the sediment you paid for.

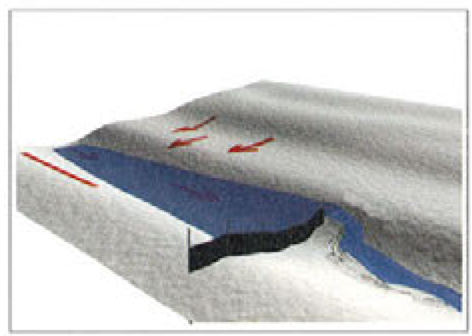
Other silt fence systems – panels, self-standing structures, continuous berms, etc. – each have a niche solution to a particular problem. The same efficacy criteria apply to all systems. Is it cosmetic, *does it actually hold water*, and does it economically perform for the user?

Silt Fence Is A System

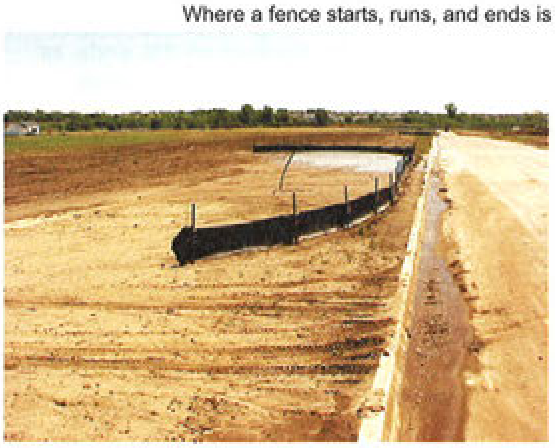


Placement is a part of the silt fence system


good


bad

Where a fence starts, runs, and ends is paramount to gathering and detaining water


good
Water must not wash around the end.

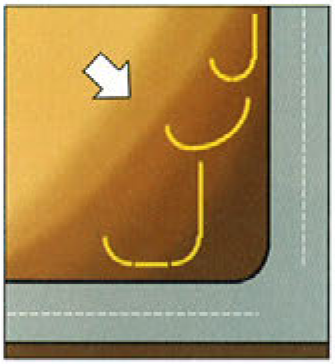

bad

Placement refers to specific locations on each construction site, and to specific designs of silt fence at each of those locations. Placement is important because where a fence starts, runs, and ends is paramount to gathering and detaining water. As little as 6 inches can miss a major vein of water, or allow water to run around an end and wash out the slope, making the fence a complete waste of money and causing more damage than no sit fence at all.

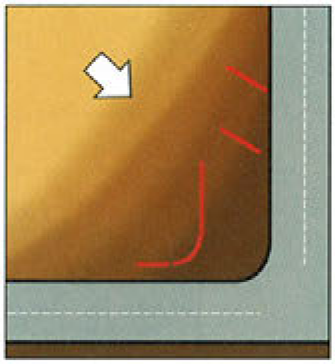
Proper placement means actually stopping sheet flows. Ill-placed silt fence funnels water to one end, concentrating the water for more erosion.

Proper placement also means considering a storage area for the water. Is there area available for storage? Can the area be divided for doubling the storage area or minimizing the pressure on the fence?

This is often accomplished with fence designs referred to as smiles, or J-hooks, where the end of a run actually hooks up and around to detain water. A hook or upturn is necessary on 75% of silt fence runs because terrain is rarely contoured exactly fitting sediment control practices.



correct



incorrect

Silt fence turned up to create a dam

Silt fence should be at least 6 ft from the to of the slope for adequate storage capacity. Here, again the fence must be hooked on the ends, or run into the slope, to create a detention area.

Ask for ground preparation

Proper placement may also entail some special grading or area clean-up. The contractor should always provide you with a workable soil environment and terrain. Again it is a waste of money if conditions inhibit a quality installation. Always approach the dirt contractor and ask to have the area shaped into a workable condition. *It is also their responsibility for environmental compliance.*

Placement in a Ditch Situation

In a channel or ditch situation, a sight-level or line-level should be used to determine where the silt fence should start and finish. After the posts are driven into the soil at the marked end points, a level should again be used to set the height of the silt fence in the center of the channel below the base of the two ends. This insures that when full, water will flow over the top and not around either end causing the side to washout.

a sight-level or line-level should be used to determine where the silt fence should start and finish

Accessibility for equipment is also a consideration for placement and quantity. Certain conditions, such as wetlands, steep slopes, and trashy soils may inhibit certain installation methods.

Trencher has poor maneuverability

Overflowing Silt Fence

In answer to the concern of allowing water to run over the top of the silt fence, potentially causing washout or undercutting on the backside, there are two considerations. One, if the quantity of silt fence is appropriate for the drainage area, the fence should not be overflowing under rain events. Two, the slicing method compacts the soil on both sides of the fence, making it more stable for a longer time period of overflow.

Work As A Team

Always work as a team member and consult with others when you encounter a tough/impossible installation situation. If you can't install it properly, look for and discuss other options that might provide the same results. It really is a waste of money if you can't install a functioning measure, and it won't work anyway.

Quantity is Part of a Silt Fence System

Quantity is so important that it must be considered one of the six parts of the system. Proper quantity means the ratio of silt fence to area protected is in sync. A hard and fast rule does not exist, but '100 linear feet (30m) of silt fence per 10,000 sq.ft. (900 sq. meters)', works out to be reasonable.

Improper Quantities

The appropriate quantity of silt fence is often well under-estimated on construction projects, probably for a few soft reasons;

- environmental rules not enforced – so designers didn't really have to compute it,
- designers desired the lowest cost design on a bid situation – so it is easy to slide on silt fence and other BMP's
- and many just draw silt fence on the plan at the last minute near the low areas – again not really computing the area of land draining into that one silt fence.

When underestimating occurs, it causes major problems down the line.

1. If erosion and sediment control is done properly, regardless of the original plan, it may cost the owner or contractor much more than they were told, and throw off their investment returns.
2. The erosion and sediment control contractor is questioned because he is both recommending and selling the product. It is difficult to challenge an designer anytime, leading to suspicions and questions - not a good relationship.
3. Overall, the cost of erosion and sediment control has to be equal among developers/owners. If one developer follows the rules and has control on his property, and another developer follows an inadequate plan at a lower cost, they are not on equal ground, and the correct developer is penalized for doing the right thing.

Improper quantities have a direct relationship to silt fence failures. *Too much volume of water per silt fence area means failure will happen - either the fence will fail somewhere or sediment-laden water will overtop the fence and pollute downstream, even though you may not see it when it is actually happening in a storm event.*

100ft per 10,000sq ft

Cosmetic silt fence

Placed too far from curb

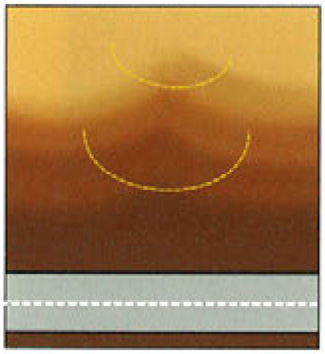
One control at outlet is not adequate

Extreme quantity deficiency

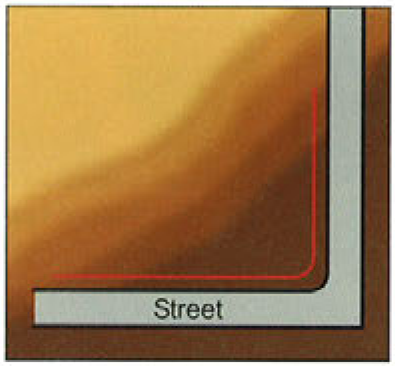
Improper quantites lead to faliures

Trenches often wash out easily

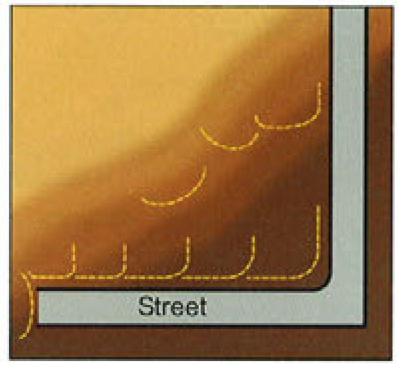
Quantity relates to area. You cannot control the volume of water from 5 acres in one run of silt fence – it will be inundated somewhere along the run. Yet you see this design over and over again. Long runs should be avoided because they tend to accumulate water and sediment in one area, causing premature failure. **Silt fence should be installed in multiple runs up the slope commensurate with the drainage area.**



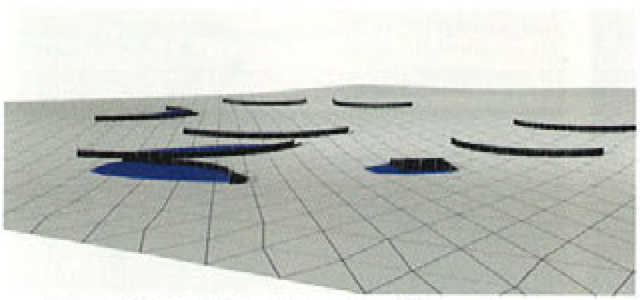
Install interior fences to slow velocity and difuse volume.



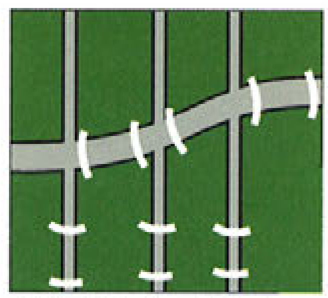
Long runs fail prematurely.



Divide into multiple areas.



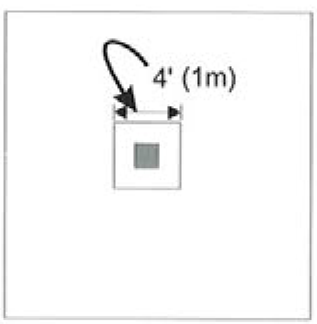
Several fences difuse volume of rainfall over a large area.



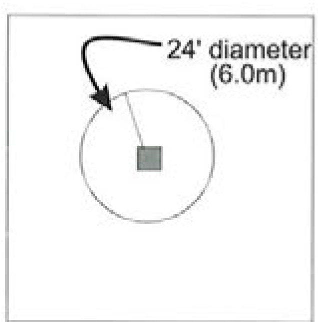
Protect streets cut, but not yet poured.

Multiple runs apply to streets cut in the grade, but not yet poured. Cut streets are prime conduits for erosion because all the water drains into them, and then into the unprotected storm water system. Even though contractors don't like silt fence installed in cut streets, if they are not going to pour right away, you need to install silt fence.

Proper quantities also reduce total maintenance costs because your control is spread out over the site versus all in one area. You are reducing the volume of water and sediment at each fence that in turn reduces failures and the need for constant maintenance.

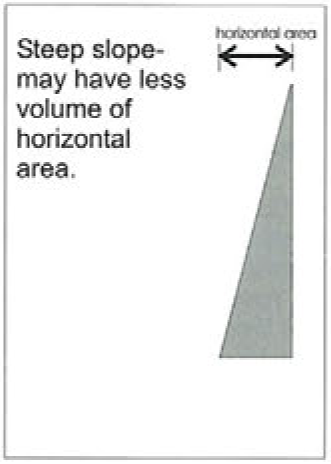


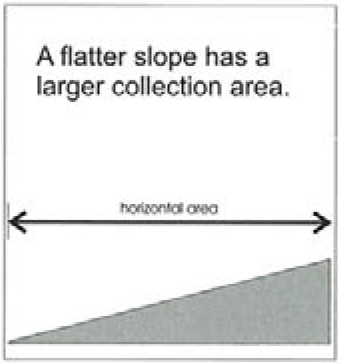
24 sq. ft. of fabric protection



100 sq. ft. of fabric protection

For an area drain, a larger circle of silt fence, maybe 24 feet (6.0m) in diameter, is a better installation than a small 4 ft. (1m) square structure because you are getting more square feet of fence per area, which in turn reduces your chance for overtopping.





A common perception that you **only** have to worry about water off a steep slope is incorrect. Yes, slope contributes to velocity, which is harmful, but a steep slope may not have a large collection area, and therefore really not have much water to contend with.

If you get a one-inch rain over one acre in 2 hours you will have erosion, regardless of slope. If there is only a half per cent slope over one acre, non-absorbed water will concentrate and start eroding the soil somewhere as it seeks the lowest area.

Slope will contribute to velocity, which increases the rate of erosion, but the total drainage area is more important in determining sediment loss. As the volume of water concentrates, its weight and velocity will increase, as will the erosion of soil.

Multiple runs diffuse the volume of sediment laden water.

If you still have 3-4 inches of sediment in the street after a rain, you know a lot of sediment-laden water went down the drain.

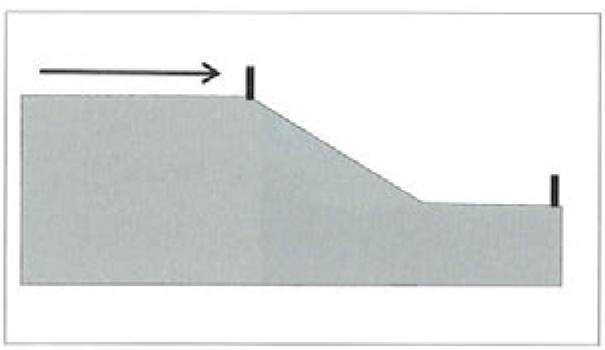
In reality, even if you have a fairly flat, bare four-acre development, you're going to have water concentrations and sediment problems in a strong rain event.

And the telltale reality will be in the streets. If you still have 3-4 inches (75-100mm) of sediment in the street after a rain, you know a lot of sediment-laden water went down the drain.

Sandy soils might require more silt fence per area to contain the volume of potential sediment.

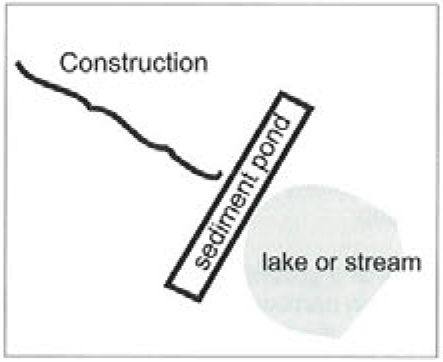
Soil type can play a role in placement and quantity requirements. Sandy soils might require more silt fence per area to contain the volume of potential sediment.

Clay soils might need fewer fences because the volume of potential sediment loss is less, although the volume of water might be greater because clay soils allow less rainfall infiltration.



When draining a large area over a slope, install sift fence at the head of the slope to slow the velocity and the volume of water flowing over the slope in a given time period. Also, place a silt fence away from the toe 6'-10' feet (2-3 m) to create a storage area for sediment.

Total drainage area is the prime consideration of silt fence quantity, not necessarily slope. (.5 acre) .20 HA should be the maximum area above any silt fence.



A sloping 15-acre (6 HA) site adjacent to a lake would probably require a large man-made sediment basin. Reality dictates that maintaining sediment devices on the interior would be difficult during actual construction.

Many designers use detention ponds as sediment ponds during the construction phase – but fail to install stand-pipes or other proper draining devices. What good is a sediment pond that is full of water or sediment?

With each new rain event, runoff flows straight out the overflow. The same question begs for sediment basins – once they are full of water, are they really performing any function?

Should silt fence be placed across drainage channels because the flowing water may collapse or undermine the fence? It should not be placed in continuous flow channels, but for drainage channels silt fence is appropriate, depending on the factors discussed earlier.

Summary

Common sense, teamwork, consultation with others, knowledge of your products, and experience all contribute to a quality, consistent, and functioning installations. Proper placement and quantities are vital to protect our environment from sediment pollution. Take pride in your work and earn the respect of your clients by knowing what you are talking about.

Silt fence properly placed and in appropriate quantities will save millions of tons of sediment today!

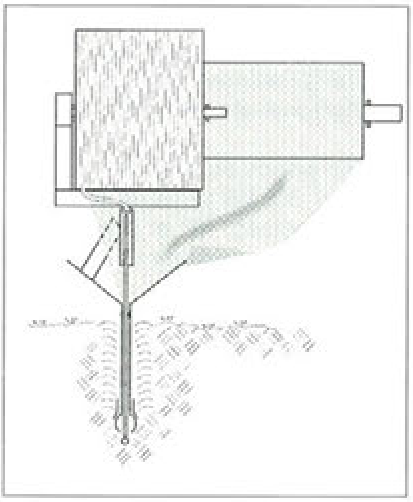
Placement

- Insure the ends of each silt fence run are higher than the middle area
- Utilize up turns, or j-hooks, to dam water
- Do not install long, consistent runs
- You've got to stop the water flow

Quantity

- Employ interior fences where possible
- Break up large areas with multiple runs
- Protect street cuts
- Consider soil types and regional rainfall

The slicing method



The slicing method describes a process whereby a soil disrupter slices thinly through the soil 8-12 inches (200-300m) deep, and an apparatus inserts silt fence into the slit. The soil disrupter utilizes a chisel type horizontal point to slightly disrupt soil upward, minimizing horizontal compaction, thus creating an optimum soil condition for future mechanical compaction.

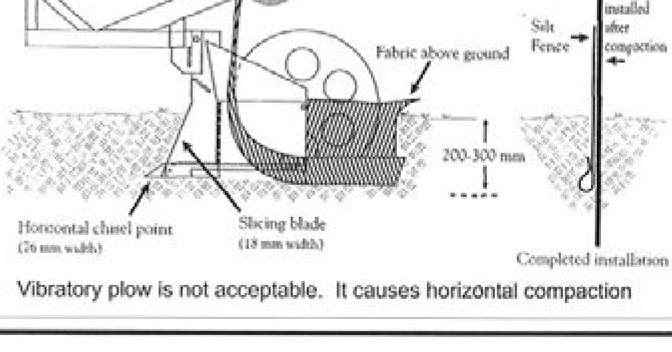
The apparatus is comprised of a ground-driven vertical wheel, positioned between two narrow parallel panels, acting as a moving pivot where the horizontal silt fence fabric is converted to a vertical position between the panels.

In this dynamic operation silt fence is simultaneously pulled off the roll by the ground-driven vertical wheel, funneled into the apparatus, converted to a vertical position between the panels, and inserted into the soil being held open by the panels. As the machine progresses, soil collapses onto the silt fence, thus securing silt fence in the desired position.

The silt fence material is converted to the vertical position by the wheel engaging the horizontal fence fabric perpendicularly and causing it to fold as it flows between the panels and pivots against the wheel. The fabric maintains the same position in the soil, one flap of the fold being approximately 6 inches (150mm) long, with the balance of the silt fence as the other flap.

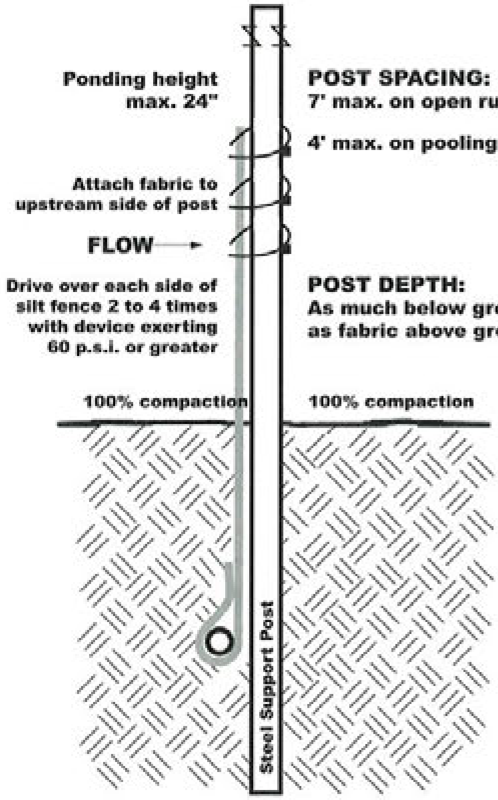
As submitted to ASTM for recognition as a standard:

The geotextile shall be inserted in a slit in the soil 8-12 inches (.2 - .3 m) deep so that no flow can pass under the silt fence. The slit shall be created such that a horizontal chisel point 3 inches (76 mm wide) at the base of a soil slicing blade .75 inches (18 mm wide) slightly disrupts soil upward as the blade slices through the soil. This upward disruption minimizes horizontal compaction and creates an optimal soil condition for mechanical compaction against the geotextile. The geotextile shall be mechanically inserted directly behind the soil slicing blade in a simultaneous operation, achieving consistent placement and depth. Compact the soil immediately next to the silt fence fabric with the front wheel of a tractor, skid steer, roller, or other device exerting at least 420 kPa (60 psi). Compact the upstream side first, and then the downstream side. Wheel-roll each side at least twice, until consistent compaction is achieved.

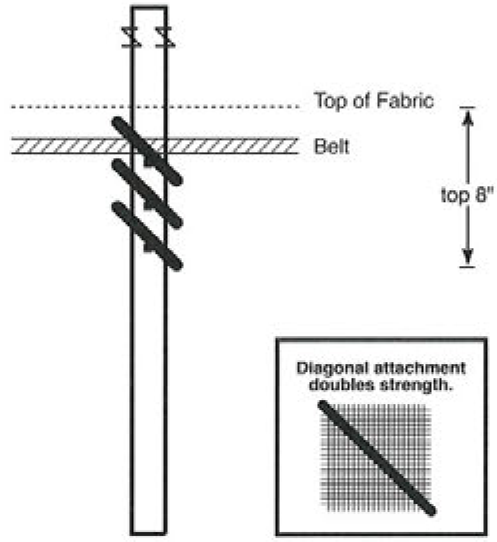


Vibratory plow is not acceptable. It causes horizontal compaction

The Slicing Method

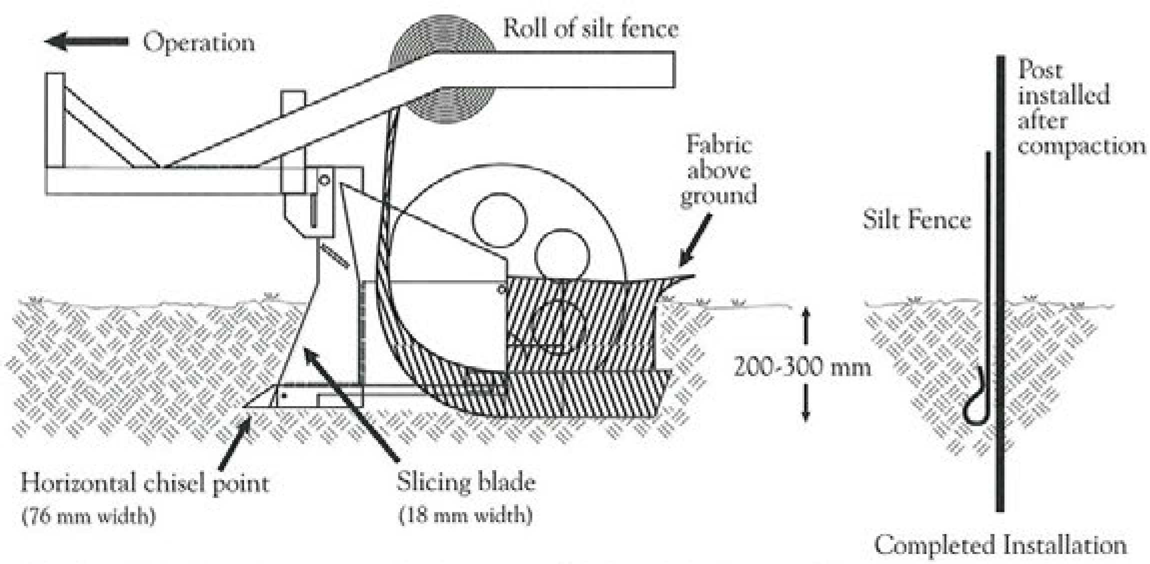


No more than 24" of a 36" fabric is allowed above ground.



ATTACHMENT DETAILS:

- Gather fabric at posts, if needed.
- Utilize three ties per post, all within top 8" of fabric.
- Position each tie diagonally, puncturing holes vertically a minimum of 1 inch apart.
- Hang each tie on a post nipple and tighten securely.
- Use cable ties (50 lbs.) or soft wire.



Vibratory plow is not acceptable because of horizontal compaction

Specification Details

1. The base of both end posts must be at least 2-4" above the top of the silt fence fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.

2. Install posts 3-4ft apart in critical water retention areas and 6-7ft apart on standard applications.

3. Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.

4. Install posts with the nipples facing away rom the silt fence fabric.

5. Attach the fabric to each post with three ties, all spaced within the top 8" of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1" vertically apart. Also, each tie should be positioned to hang on a post nipple when tightened to prevent sagging.

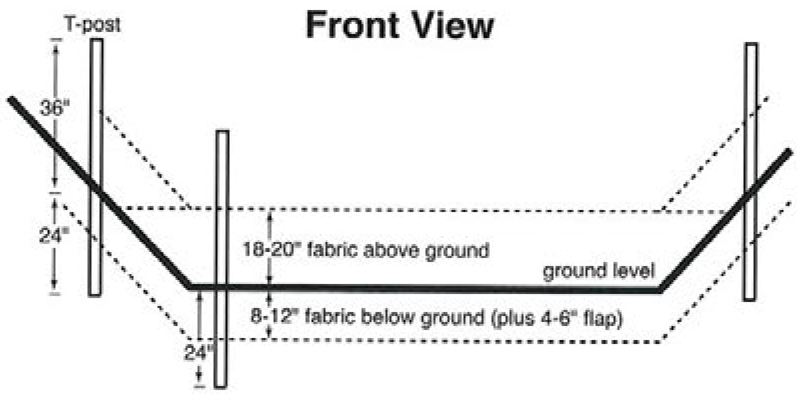
6. Wrap approximately 6 inches of fabric around the end posts and secure with 3 ties.

7. No more than 24" of a 36" fabric is allowed above ground level.

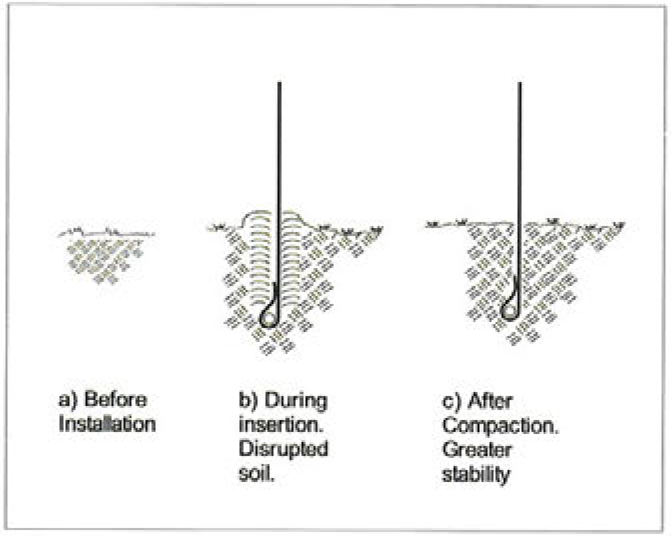
8. The rope lock system must be used in all ditch check applications.

9. The installation should be checked and corrected for any deviations before compaction. Use a flat-bladed shovel to tuck fabric deeper into the slit if necessary.

10. Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per sq. inch. Compact the upstream side first, and then each side twice for a total of four trips.



The base of both end posts must be 2-4" above the fabric on the middle posts for the silt fence to properly drain. Use string level when necessary.



Minimal soil disruption and displacement somewhat maintains the soil's original profile enabling compaction back to its original state, insuring greater soil stability, and thus greater resistance to washout.

Minor disruption also minimizes soil moisture loss during fence construction, which also contributes to high relative compaction.

Testing has shown the relative compaction of the soil next to the fabric to be 85%-115% of the undisturbed soil 90% of the time.

Relative compaction refers to a comparison between soil compacted 1 to 2 inches (25-50mm) perpendicular from the fabric with soil 8 to 10 inches (200-300mm) from the fabric.

As discussed earlier, properly compacted soil does not allow water infiltration, and the slicing method employs known physical requirements to prepare for proper compaction.

The slicing method nearly eliminates washouts. The word nearly is used because other factors such as the machine operator, the weight and repetitions of compaction, trash in the soil, soil structure, and moisture can all effect the outcome.

Potential Problems: Inadequate Compaction

Probably the most common cause of washout with the slicing method, if the operator has installed it properly, is inadequate compaction. Washout occurs by piping, water finding a channel for infiltration down through the installation. However this usually only occurs after the fence detains several inches of water for several hours. Gross failure always has an external cause.

Optional rope-lock system

Where silt fence is to be installed in a ditch situation, through valleys in the terrain, or in very rough terrain, inserting a .75 inch (19 mm) rope in the bottom of the fold of silt fence is highly recommended. This helps insure a proper installation by restricting the fabric from floating up in extremely variable terrain, especially when the operator of the tractor is fairly inexperienced.

The rope-lock is not necessary in most open space applications. The slicing method prepares the soil for optimum compaction, and after compaction, the fabric is held tightly in the soil.

Joints

If possible, a silt fence should be a continuous to avoid the use of joints. Do not install a joint in a area where water will be concentrating and the stress on the fence will be critical. This is usually in the upturn area, or at the center of a smile configuration.

Summary

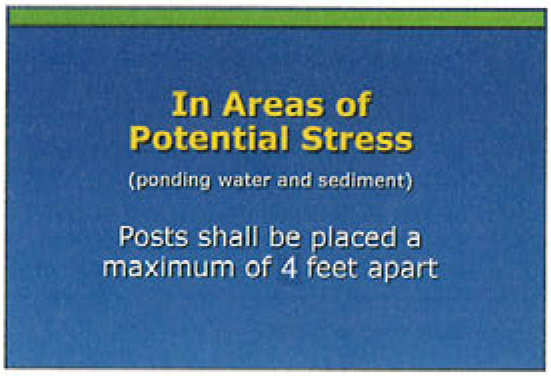
The slicing method was developed to install silt fence. The slicing method mechanically installs quality, consistent silt fence, placing it properly in nearly all conditions and soil types, and nearly eliminating washouts.

Compacted soil prevents piping

Placement- easily turns 90 degrees to maneuver around site contours and obstacles properly placing silt fence for detaining sediment-laden water.

Operation- slices through the soil and mechanically installs silt fence for consistent, quality results, eliminating washouts and fabric blowing in the wind.

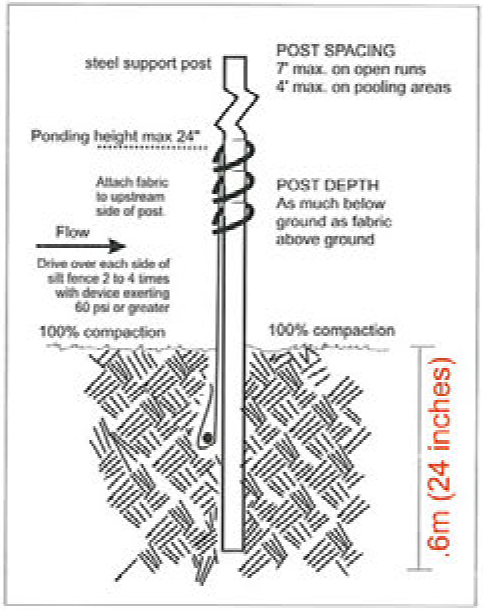
Productivity- dramatically improves production, increasing response time, while decreasing labor costs.



PROPER POST SPACING

Steel posts weighing 1.25 pounds per linear ft. should be spaced a maximum of 6.5 ft.(2m) apart on areas of silt fence parallel to the flow of water. The 1.25 pound steel post should be spaced 4 ft. (1.2m) apart on areas of silt fence perpendicular to the flow of water, and any areas where water will concentrate for detention.

Steel posts should be driven 24 inches (.6m) deep into compacted soil on the downstream side of the silt fence



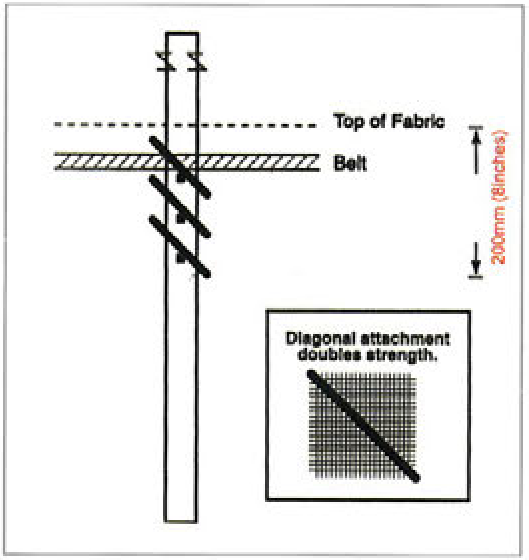
Steel posts will hold the weight.

The on-site erosion professional should insure proper silt fence installation by directing the spacing of support posts according to the probable areas of stress. Again we have a need for adjustment in the field, and a responsibility for good decision-making based on desired results, and not on the expense of a few extra posts.

ATTACHMENT

The best preparation is all for naught if you let the last segment fail. ***One attachment is not enough.*** With a full 20 inches (.5m) of sediment-laden water, either the fabric will tear or the tie will slide down the post. Two ties will normally hold the fabric and the weight of the sediment if the posts are spaced appropriately for the expected load on the fence.

However, three ties offer the best solution.



1) Spaced over the top (8 inches) 200mm of fabric, 3 ties will hold the load and offer a little insurance against one breaking. Ties must be positioned diagonally at each location on the post – this doubles the effectiveness by doubling the number of threads attached to the post, for instance; 20 vertical threads and 20 horizontal threads, versus only 20 vertical threads on a horizontal attachment.

2) Each tie must hang on a post nipple and pulled tightly around the post. The post must be placed with the nipples facing away from the fabric.

3) It must be pulled tight to minimize problems. Loose ties allow uneven pressure on individual ties, causing failure under stress. Use cable ties (50 lb.) or soft wire. UV protected ties are available if required.

Does your fence work like this?

Summary

Silt fence supported by steel posts properly spaced and driven 24 inches into the ground, properly attached with three ties, will support up to 24 inches of sediment and water.

INSPECTION

Silt fences fail because they are improperly designed, installed, or maintained.

Inspector Responsibilities

- Erosion and sediment control measures, practices and devices should work as a system – all the components should work to prevent erosion and off-site sediment damage. Regular inspections and maintenance of all devices are necessary for the system to work effectively.
- Contractors and the responsible parties cannot know that a device needs maintenance unless they inspect it regularly. NPDES rules and local ordinances require weekly inspections for mechanical problems, such as fence destroyed by equipment, and within 24 hours of a significant rain event. The site manager should inspect daily.
- The inspector must insist that contractors and the responsible parties regularly inspect and sediment control measures.
- The owners are responsible for ensuring that all erosion and sediment control measures are frequently inspected and repaired.

Properly maintained silt fence

Improperly maintained silt fence

Inspection

Maintenance

- Most specifications call for cleaning out silt fence when it accumulates half its potential volume. In the real world, this may not be practical. The area behind the fence is usually very wet, and difficult to operate equipment in. The sediment, wet and fluid, is a difficult disposal problem.
- Once a fence is full, the value of cleaning it out is questionable. At this stage, the fence is plugged with silt, so the water will not seep out of it as it is supposed to. Scooping a few buckets of sediment away from the backside of the fence effectively makes the area a limited capacity sediment basin, which generally stays full of water, etc., and therefore useless, and the disposal problem for sediment still exists.
- A new fence in front of or below the existing silt fence seems to make sense – you gain an empty storage area, the previous sediment is still contained, and the new fence should slowly release water as designed. But there may not be room for a new fence. **Decisions and adjustments must be determined on a site by site basis.** Blind rules are not applicable to many erosion and sediment problems on construction sites.
- Adequate access to the sediment control devices may not be provided for in the plans or may be blocked by construction. If the contractor cannot get in to clean out the trapped sediment and make repairs, violations may occur. All sediment control devices must be accessible so that cleaning, or replacement, inspections and maintenance can be performed.
- Responsible parties must acknowledge the goals and work together. Compliance has many short and long term benefits for everyone; from the owner, to our neighbors, to our environment, to our kids, and to future generations.
- Prior to final stabilization measures, the fences and basins are removed, the sediment spread out, and the site covered with seed and mulch.

A new fence is often a better solution than cleaning an old fence.

Informational only – not legal advice

This section does not have any legal basis, only opinion. Seek legal advice from competent resources.

Inspection reports

Inspection reports range from a daily report log to specific forms by an erosion control contractor/manager. A sample report is enclosed, but here are some general concepts:

1. date of inspection
2. type of inspection - rain event or prescribed inspection
3. who did the inspection
4. what practices were inspected – silt fence only, all BMP's, basins, cover?
5. where was the inspection
6. what was observed – see example
7. recommendations and to whom
8. responsible party for correction

Inspection reports are required within 24 hours after a significant rain event, weekly, and should be done daily for inspection of mechanical devices. Some jurisdictions may require the inspection reports on-site, others may allow a grace period for presentation. Most ordinances require the PPP plan to be kept on-site.

Disclaimers of recommendations and notification to owners

Where a dispute arises about implementation of the recommendations provided by a qualified ESC professional, to a project manager, dirt contractor, or the owner, a disclaimer of some sort is recommended stating the precise recommendations, who rejected them, and the date of the recommendations.

Since everyone on site is generally considered a co-permitee, documentation of recommendations and rejections would certainly be helpful. Actually, they should work just like work orders, except in reverse.

In conjunction with documenting the recommendations, it might be helpful to notify the owner, or rejecting party, with a copy, fax, or letter confirming the conversation, et al.

A sample copy is provided for general knowledge and is not a legal document, nor has it been tested, reviewed, or handled in any way by an attorney.

XYZ CORPORATION
ANYWHERE
USA

Inspection and Maintenance Agreement for Sediment Control Devices

DATE: ______________________ **WORK ORDER #:**________________

PROJECT NAME & ADDRESS: ____

OWNER: ____________________________ **PHONE #:**_______________ **FAX:**__________

DIRT CONTRACTOR: ____________________________

CONTACT NAME & PHONE #:____

Silt Fence Installation & Inspection Policy

Service and Quality Guarantee:

1. **Proper placement and installation guaranteed.**
2. **Regular inspections (every 7-10 days or after a ½" rain occurrence) at no extra charge (provided we do original installation work).**
3. **Any repairs, maintenance, or additional silt fence will be provided promptly (as required by the stormwater discharge permit) and the owner or contractor invoiced for actual services received.**
4. **Normal response time is less than 48 hours, 12 hours if requested.**
5. **Inspection reports will be provided upon request.**
6. **Consultation with architect on proper quantities and other aspects of the Erosion and Sediment Control Plan.**

START DATE: ____________________

END DATE: ______________________

- **Does not include winter months. (determined by frost in ground)**
- **Contractor reserves the right to impose minimum standards for inspections.**

Inspection Report for WESTVIEW CHURCH

Initials of Inspector	Type of Inspection		Date of Inspection	Areas to be Inspected				Carpenter Erosion Control 3718 SW Court Ave. Ankeny, IA 50021 Ph. 515/964-1267
	Routine weekly	24 hours after rain		All erosion & sediment control BMPs	Temporary Sedimentation basins	Drainage ditches	Construction site exits	Comments:
TC	X		10/30/98		X			recommended stand pipe,and s&m
tc		x	11/11/98		x			installed sf lst wk
tc	x		11/18/98		x			no stand pipe, no mulch, incorrect sf by brieholtz, I left msg
tc	x		11/30/98		x			installed sf, waiting on mulch decision
TC	X		12/04/98		X			they washed out hydrants, sf filled up,need r&r
TC	X		12/17/98		X			repaired sf in ditch,mulch recommended, failed to decide before ground frozen
tc	x		03/30/99		x			repaired sf last week, s&m partial this week
tc		x	04/06/99	x	x			sf full along univ, other into sed pond ok,too wet to work
tc		x	04/09/99	x	x			minor repairs needed
tc		x	04/17/99	x				same, most fences working near sed pond
tc		x	04/26/99	x				same, most fences working near sed pond
tc		x	05/06/99		x			grass coming good, most fences working w pond
tc		x	05/11/99	x				minor repairs needed
tc	x		05/27/99	x				grass coming good, most fences working w pond
tc	x		06/01/99	x				fences full, sed pond filling up, sent notification
tc	x		06/09/99	x				steve said ok to fix today, in schedule

As of 6/16/99

Sample Report Form

Inspection Report for Template

Initials of Inspector	Type of Inspection		Date of Inspection	Areas to be Inspected				Carpenter Erosion Control 3718 SW Court Ave. Ankeny, IA 50021 Ph. 515/964-1267
	Routine weekly	24 hours after rain		All erosion & sediment control BMPs	Temporary Sedimentation basins	Drainage ditches	Construction site exits	Comments:

XYZ EROSION CONTROL

ANYWHERE

USA

OFFICE FAX

TO:	FROM:
COMPANY:	DATE:
FAX NUMBER:	TOTAL NO. OF PAGES INCLUDING COVER: 1

NOTIFICATION

As a contractor working under the Erosion Control Plan, I have recommended:

- ☐ Seeding
- ☐ Mulch
- ☐ Silt Fence
- ☐ Silt Basin
- ☐ Other

These items are probably required under the local jurisdiction building codes and the Pollution Prevention Plan.

______________________________, as owner or general contractor has decided the following items are not necessary for reasons unknown to me and beyond my scope to know on this project.

Items:

Respectfully submitted, ______________________ 1999.

INSTALLERS RESPONSIBILITIES

Responsibilities of an ESC Professional, or the installation manager

1. **Analyze** the contours of a construction site for proper placement and quantity requirements.

2. **Consult** with the project manager or inspector about the construction project, construction schedules, disturbed areas, future water flows, etc. to understand the needs of the project, make suggestions for field adjustments if necessary, and thus help create a working sediment control schedule for the PPP plan.

3. A working ESC plan means actual, in-the-field applications, versus an ESC plan drawn in the office. Quantity discrepancies often show up here, maybe more than any other issue. Although the rule of thumb 100 linear ft per 10,000 square ft is not black and white, it does seem to be fairly reasonable. **Field adjustment** is necessary.

4. **Determine** quantity based on area, terrain, job schedule, and site goals.

5. **Locate** each position on site, and mark the shape and beginning/end points of each silt fence with flags or paint.

6. **Make notes** of particulars for each site and discuss those special site needs with the installers, especially issues like where the water is going, what measures are to be utilized, and why particular designs and placements were chosen. This helps insure proper installation the first time, increases their knowledge of the profession, and makes them part of the team effort.

Create smaller coverage areas with multiple runs

Discuss inspection and maintenance issues with the dirt contractor, and possibly sign an order, to insure no mix-ups about who is responsible.

Installers responsibilities

The buck stops here. The installers can and should make it happen. The bureaucracy can have its specifications, owners their risk tolerance, and inspectors may or may not be on the job, but installers can and should make it happen.

Installers should be the experts in this arena. They work in the soil every day, they know their equipment restrictions, they have invaluable first-hand experience on all the different soil types and nuances, and they should be analyzing the efficacy of their work whenever they return to projects for maintenance.

Realistically, there may be only one manager on the crew who is actually involved in the big picture, but each member should know how silt fence works, why it is needed, what the goals are, where to install it, and how to properly install silt fence. That knowledge enables a team effort in insuring proper silt fence placement and installation. People do a better job when they know why and how and what about their work.

Installers often have the opportunity to advise on placement and quantity as field adjustments. The plans may be vague or inadequate, the site manager may not have experience in placement, and there may not be an inspector who knows correct placement issues. Installers need to work with these people offering suggestions and alternatives in arriving at an effective control plan.

Proper Placement and Quantity

1. Installers must understand how silt fence is supposed to work – to create a dam for ponding and sedimentation.

2. Must prepare the terrain before placement. The construction site is rarely graded-out clean and level. The dirt contractor is responsible to prepare the area for silt fence. Request a clean up if large clods, rough terrain, or gullies prevent your equipment from operating effectively.

3. Repair any gullies 6 inches or deeper with the bucket on your equipment by rounding out the edges and creating a gentle dip. Do not just push some loose soil into the gully and then install through it.

4. Silt fence should be installed in stable, compacted soil. Occasionally silt fence is required adjacent or through a wetland area. The slicing method works nicely in this situation, but compaction is not viable. Recognize potential site needs and discuss those with the ESC professional or project manager.

Legs long enough to pond water

5. Place silt fence strategically for water detention. Site adjustment of the erosion and sediment control plan is necessary. Don't be afraid to move the exact location shown on the plans a few feet up or down the slope. In some cases, a few square feet of unprotected soil must be sacrificed for an installation that will hold water. Each and every location is critical. It either works, or it doesn't – there is no middle ground.

A hook is required on most silt fence runs to pond water

6. Must absolutely make sure the ends are higher than the top of the fence at the detention area of the silt fence, insuring water will flow over the top when the silt fence is full, and not around the ends.

PROPER INSTALLATION AND COMPACTION

Installation shall be done with the slicing method for all the reasons discussed earlier. Slicing with a vibratory plow is not acceptable. Equipment must have a soil disrupter as described to properly install silt fence.

1. Slicing must actually begin before the critical point to insure adequate depth of fabric at that point.

2. Slicing must also continue beyond the critical end point to insure the fabric depth is maintained following removal of the apparatus form the soil.

3. Follow manufacturer's instructions for installation procedures.

4. A 36-inch wide fabric shall not be out of the ground more than 24 inches. Either a splice or new run must correct the deficient installation.

5. Do not splice in critical water detention/stress areas. Silt fence should be continuous in these locations.

6. Determine length and balance remaining on fabric roll before installing. If estimated as enough for the run, start closest to the critical area, and proceed away, insuring a potential splice will be in diversion area. If most of the distance is critical, change the fabric roll and use in another location later.

7. Splicing is achieved by centering the soil disrupter 4 ft behind the end of the previously installed fabric, dropping it down on the downstream side of that fabric and in the slit, and installing as if a new run. At least 12 inches of properly installed fabric should overlap the previous run. A post should be installed at the splice. Fabric should be sewn together in several locations with the plastic ties, and 6 ties attached to the post over the entire width of fabric.
8. Any obstruction encountered beneath the soil and removed must have the void replaced with soil.

9. Any problem arising from the machine coming out of the soil shall be fixed and the installation restored for proper compaction. If the location allows splicing, this may be the best, most effective solution.

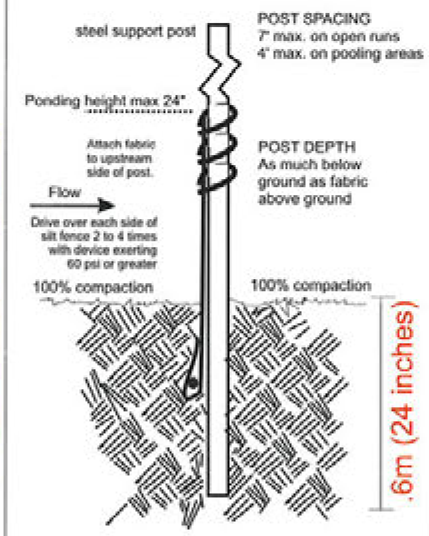
10. Variable construction conditions and terrain require fabric height adjustment prior to compaction. The fabric is usually installed about the right height, but someone should walk along the run and insure it is consistently the desired height everywhere before it is compacted.

11. Compaction shall be achieved by wheel-rolling the power equipment over each side of the silt fence - the upstream side first, then the downstream side. Compact the soil with the loader bucket full of material for added weight. In dry conditions, or where large clods of soil are disrupted, 2 or 3 compaction trips over each side are required.

12. Improper compaction can allow piping to occur in a critical area. Piping occurs in areas where the soil has been disrupted into larger, hard clods, or very rocky soil with few fine aggregates. Installers must recognize this condition. Extra weight and multiple compaction trips are mandatory. Fine aggregates may have to be added if compaction won't work.

13. Compaction is especially critical in areas where water is detained. The slicing installation will pond 18 inches of water, which actually create significant water pressure causing piping to occur. Installers must treat these areas with great care.

SUPPORT POSTS



Last but not least, installers have to finish the job as well as they started it.

1. Support posts should be spaced 6-7 ft (1.6m) apart on the diversion leg of a silt fence where there isn't any appreciable water detention. 8 ft (1.8m) is the maximum width, but you may get a little more slump in the fence than you prefer. Installers often just pace the distance off, so at 6-7 ft (1.6m) specification you stay inside your maximum.

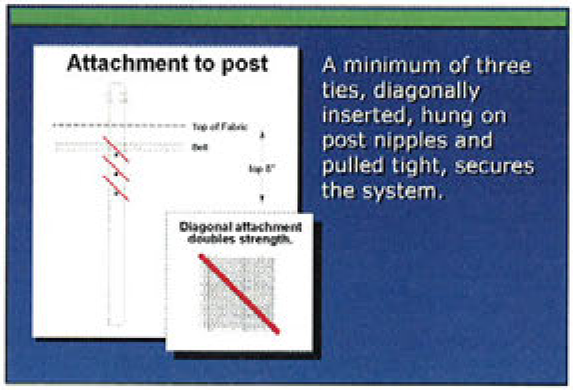
2. Support posts should be spaced 3-4 ft (.8-1.0m) apart in critical water detention areas, with a maximum of 5 ft (1.2m) in general detention areas. The detention areas are usually where the fence has been turned uphill and/or the dam created from two slopes converging.

3. Water usually converges in a 10-15 ft (3-4m) area where it will run over the top – which is the critical water detention area. The adjacent areas on both sides usually carry a significant load, thus requiring a 5 ft (1.2m) maximum post spacing.

4. Posts should be installed with the nipples facing away from the fabric. This minimizes wear on certain points on the fabric, and provides a place to hang the ties on – preventing them from sliding down the post.

5. Post spacings should be determined in the field according to potential water load, and not according to costs involved. An average post spacing, for instance 5 ft., should be used in estimating projects to cover installation costs appropriately.

ATTACHMENT



1. Ties must be positioned diagonally at each location on the post – this doubles the effectiveness by doubling the number of threads attached to the post, for instance; 20 vertical threads and 20 horizontal threads, versus only 20 vertical threads on a horizontal attachment.

2. Each tie must hang on a post nipple and pulled tightly around the post. The post must be placed with the nipples facing away from the fabric to have something to hang the ties from. It's best to kneel facing the post nipples for the tying operation. Be sure to gather any slack in the fabric if needed.

3. Loose ties allow uneven pressure on individual ties, causing failure under stress. Use cable ties (50 lb.) or soft wire. UV protected ties are available if required.

INSPECTORS RESPONSIBILITIES

People paying the bills rely on inspectors to insure they receive what products and installation quality were specified in the contracts. Those people have a reasonable expectation that their inspectors are qualified to monitor the project for them. Sometimes inspectors must make the field adjustments we've discussed and instruct installers of silt fence where and how much silt fence to install.

In the past, and in a few places today, silt fence was for all intent and purpose only cosmetic. Few people knew working from poor silt fence, few people cared, and most thought it was a waste of money – which is was because it rarely worked. Enforcement meant having it around the site, not having it working.

Today, it is a whole new ballgame. Pollution fines can range up to $27,500 per day per infraction. Erosion and sediment control are expensive items and owners want to get value for their investment. Neighbors and downstream people often know they can complain, who to complain to, and that they can be compensated for damages. Environmental departments and local jurisdictions are enforcing the NPDES rules.

Inspectors must know how erosion and sediment control measures work, correct installation procedures, whether they are working, and what the inspection and maintenance requirements are. NPDES rules call for daily inspection by on-site managers, weekly inspections, and inspections within 24 hours following a significant rain event.

This environmental aspect of construction is changing so fast that protocol hasn't been established yet in any areas. Responsibilities for what and when, and who decides what is still being worked out. In the interim, inspectors must learn about erosion and sediment control measures, and be able to apply what they know in the field.

Poor installation can cause severe erosion around the end

Inspectors have a large responsibility. They are paid to oversee construction activities. They must know proper installation and placement concepts.

Poorly installed silt fence impacts the environment, your neighbors, and the people who are paying you.

The landowner or developer has made an investment in erosion and sediment control. They expect working sediment control measures, not cosmetic makeovers. Poor installations put them at risk for fines and lawsuits, accidents from mud in the streets, and for public relations problems.

Approval of poor placed or poorly constructed silt fence for payment is a major problem all around the country. If contractors continue to be paid for installations that have no chance of working, the problem will never be fixed. Silt fence that merely funnels water is a complete waste of money and effort. Yet we see it everywhere and apparently contractors are getting paid for improper installations. And DOT projects are certainly culprits in this tragedy. Those inspectors have the specifications in their hands, and only do highway work, yet routinely allow non-conforming silt fence installation, and consistently approve payment on improper installations. The defensive argument 'everyone does it this way' does not hold water. Everyone does it this way because inspectors allow it to happen.

The two most common allowances are placement issues - failing to demand the ends are higher than the middle – and thus detain water, and ignoring compaction specifications. Placement may not always be well defined, but in many cases an inspector can see a silt fence physically will not hold water. And, inspectors know full well what compaction means as they routinely monitor fill projects for engineers, et al.

This manual covers one small aspect – silt fence – how it works, how to decide where to install it, how to install it properly, how much to install, and how to tell if it is working.

What to look for during construction of and following installation of silt fence.

1. **Proper placement** – are the ends of every fence run higher than the top of the center – in other words, if it fills up, will it flow over the top?

Improper placement - waste of money

- Are long perimeter runs restricted to about 200 ft? Are long runs broken up with upturns to minimize water concentrations according to area covered?
- Are areas broken up with interior fences to minimize water concentrations and slow runoff velocities?
- Are stormwater intakes protected before the sediment-laden water reaches the street? The best solution is control before it reaches hard surface.
- Are streets protected from runoff areas? Streets are major conduits of water and sediment and drain into a stormwater inlet somewhere.

poor placement - funnels water to end

good placement - ponds water

Several fences difuse volume and thus minimize failures and maintenance

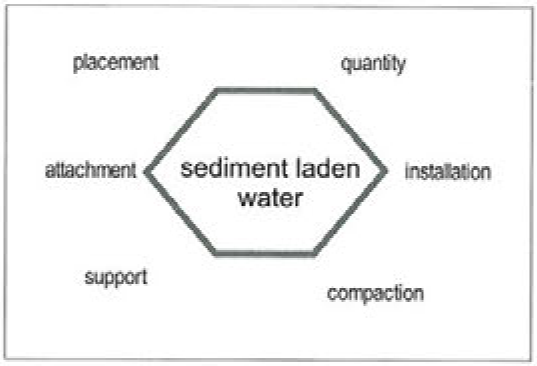
- Are channels or ditches protected before they connect to a stream or storm water inlet? Are there multiple fences to prevent volume concentration?
- Are sensitive areas accessible for machine installation?
- Would moving the fence shown on the plan to a better location be feasible? Sometimes giving up a few square feet of no control yields a much better location for a quality installation or total area control. For example, a fence at the head of a short slope which stores a large volume of water might be much better than a fence at the toe of the slope that offers no storage area, or is so rough that a quality installation is improbable. Where is the water now? Where is it flowing? Look for existing rills and sedimentation areas.

Fence at head of slope decreases vloume of water and erosion potential.

2. **Proper quantities** – each fence should only contain an area of about 10,000 square ft.

- What is the size of the drainage area?
- Can it be divided into manageable sections?
- How is division best accomplished?
- If unable to install in the interior, can a detention area be created with silt fence? Is there an open flat area available at the base of the drainage area?
- Would a detention pond be more economical for the owner than multiple silt fence runs?

Multiple runs store more sediment



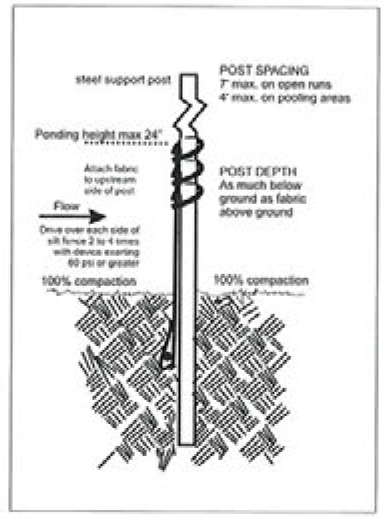
silt fence is a system

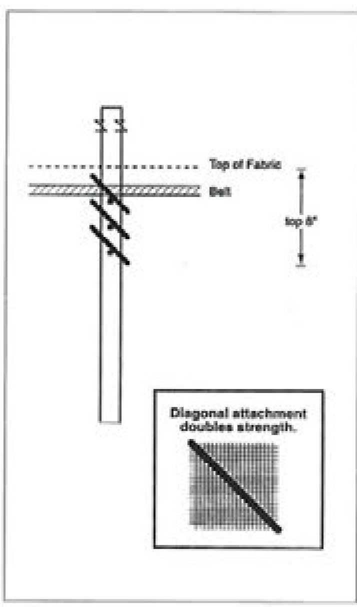
3. Proper installation

- Is the fabric installed deep enough in the soil?
- Do any weak areas need special attention?
- If trenched, was the trench 12 inches deep?

4. Proper compaction

- Has the soil been properly compacted?
- Was the vehicle heavy enough to compact large clods? If necessary, did the operator compact with multiple trips?
- Was the compacting vehicle operated on or next to the fabric and on both sides?
- Were critical high stress areas double-checked for proper compaction?





5. Adequate post spacing and support

- Are support posts driven 24 inches into compacted ground?
- Are support posts spaced closed together in potentially high stress areas?
- Are posts on the downstream side of the water flow?

6. Proper attachment

- Was the fabric gathered where possible to insure a tight fabric fence?
- Are 3 ties per post utilized?
- Are the ties installed diagonally, with the pierced vertical holes 1.5 inches apart, gathering a substantial number of horizontal and vertical threads?
- Are the ties pulled tight? Have they been tested for tightness with pliers?
- If wood is used, is a small lathe utilized against the fabric prohibiting the staples from pulling through the fabric?

Is the silt fence ponding water, or could it ?

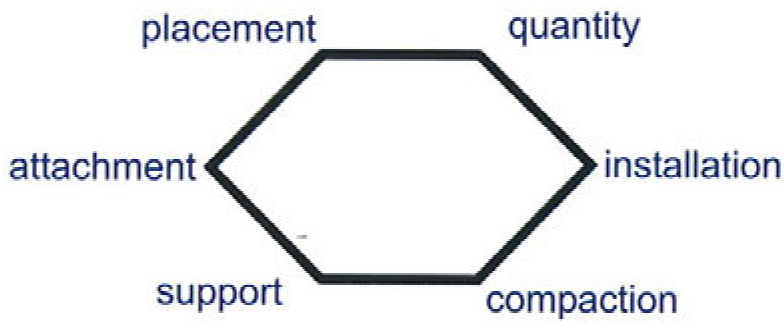
Working silt fence usually has some sediment and/or moisture behind it.

- The lack of water, sediment, or debris is usually a good indication that the silt fence has a problem.
- Fence where the back-fill has been washed out along the trench is also faulty, even though it appears ok because you may not be able to see daylight underneath, the fact there isn't any sediment shows you its not working.
- Fence funneling water out one end is not working.
- Fence in a long continuous run probably has several failures.
- Pre-fab fence standing more than 24 inches above the ground is probably not working.
- If you can walk up and pull the silt fence out of the trench, it's probably not working, or won't work under water detention stress.
- An area looking like a empty reservoir, about 6 ft in diameter and on the inside of a silt fence relatively full of sediment, is a clear indication that failure has occurred. You may not be able to see the breach under the fence, but the water has piped its way through and drained, as evidenced by the crater inside the silt fence.

SUMMARY

Inspectors must know how silt fence works, how to decide where to install it, how to install it properly, how much to install, and how to tell if its working. Cosmetic silt fence is no longer an option. Allowing and approving cosmetic silt fence for payment is no longer an option. The law, the environment, the landowner/developer, and the neighbors demand erosion and sediment control measures that work!

Silt Fence Is A System



Properly installed silt fence will effectively protect our environment - retaining millions of tons of sediment on construction sites

One corner lot silt fence saved 7 tons of sediment.

One silt fence saved fifty tons of sediment.

9 780972 733076
90000