Day 9: Filter Fences for Perimeter and Downslope Control at Construction Sites

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Erosion Controls
Control Site Discharges

- Filter fencing for small sites (but only for slope lengths less than about 100 ft). Expect about 10 to 50% control of suspended solids.
- Sediment ponds for areas larger than 10 acres. Expect up to 80% control of suspended solids.

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There are three aspects of filter fences that can be evaluated:

1) sediment capture behind the fence,

2) water flow rate reduction down slope, and

3) pressure forces on the fence from the water and resisting forces from the soil on the fence stakes.

The first two aspects determine the erosion and sediment control benefits of filter fences, while the third aspect determines how filter fences may fail structurally.

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Filter Fences

- Woven and non-woven fabric varieties
- Act as small detention ponds by ponding water behind the barrier
- Frequently badly installed and maintained
- Measured moderate SS performance (30 to 50% removals in the laboratory, much less under actual field conditions).

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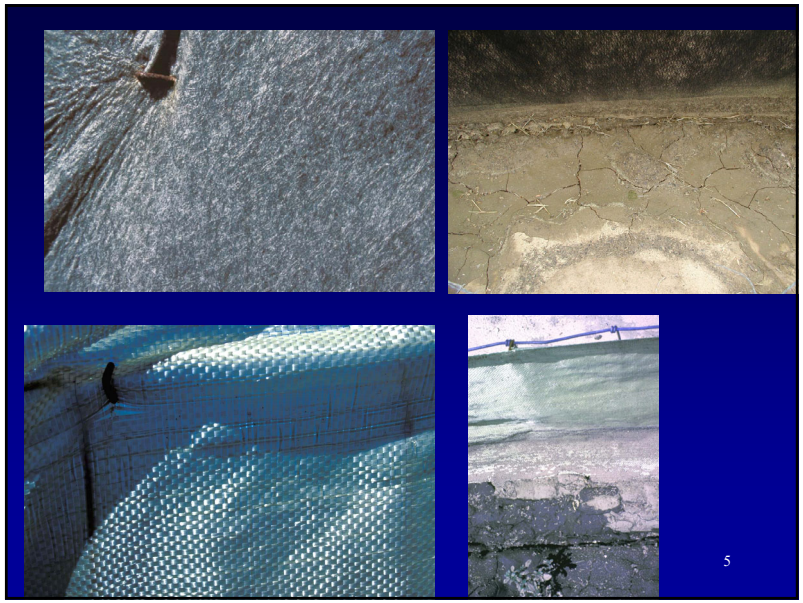
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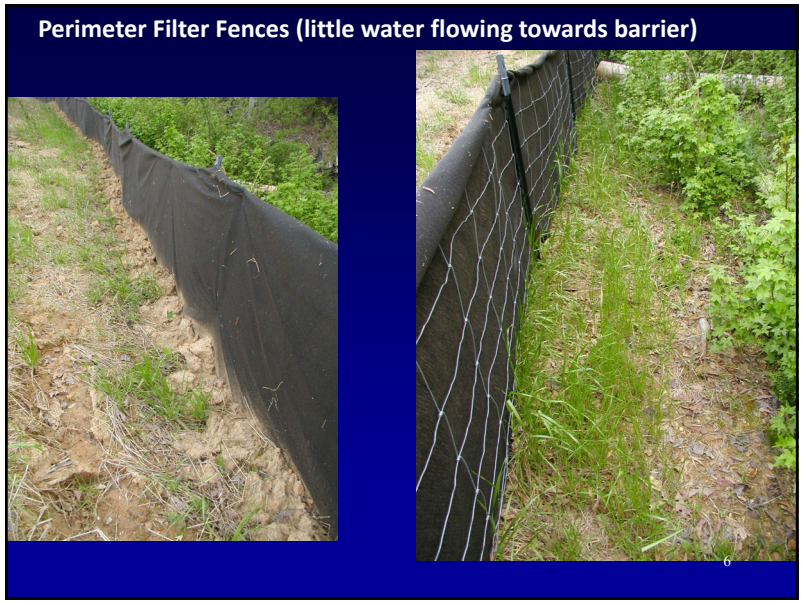
Perimeter Filter Fences (little water flowing towards barrier)
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Filter Fabric Fences at Toe of Slope

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Multiple fence lines and a tree barrier:
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Filter Fence Performance at Construction Sites

- Filter fences also act as sedimentation devices for trapping eroded material.
- Their performance has been disappointing during monitoring projects:
  - Inadequate filter fabric material splicing (splits and tears)
  - Fence failure due to sustained over-topping
  - Unrepaired holes in fabric
  - Flow beneath fabric due to inadequate trenching

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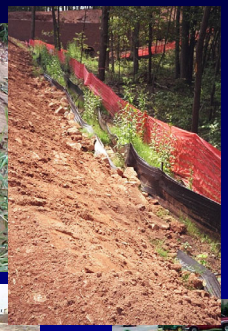
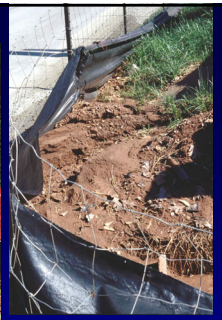
Over-loaded Silt Fences





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Water Flowing Under or Around Silt Fences

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Straw bale barriers seldom effective and not commonly allowed

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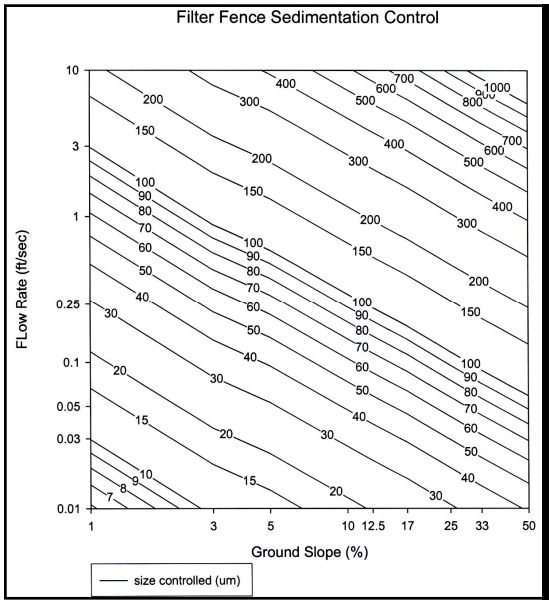

Filter fences act as sedimentation devices by trapping material. Their performance can be calculated using the upflow procedure. The discharge rate is based on the water depth and the unit area flow rate of the fabric and the surface area is based on the water depth and slope.

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Water ponds behind fabric, small amount is filtered on fabric

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Silt fence and ponding water

Material trapped in ponded water area of silt fence

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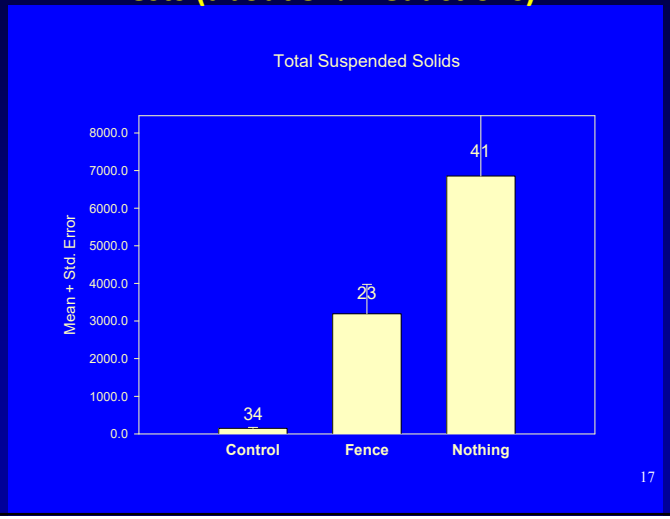
Measured Silt Fence Performance during Alabama Tests (about 54% reductions)



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Summary of Local Silt Fence Tests

- Silt fences in good condition remove 1/3 to 1/2 of the particles in the runoff.
- Runoff below silt fences contains more than 100 times more particles than runoff from undisturbed vegetation.
- Even with silt fences, the suspended solids content in the construction site runoff was found to be very high with an average of about 3,000 mg/L, while the undisturbed locations had runoff concentrations less than 100 mg/L.
- Silt fences, at best, are only partially effective in removing particulate matter from runoff during

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Silt Fences to Slow Water Flowing Down Critical Slopes

- The upslope length of the ponded area will be obviously protected from rain impaction and by flowing water. This length can be estimated for different water depths impounded behind a silt fence. As an example, for a 5% slope and a 1-ft water depth, the ponding would extend uphill 20 ft.
- Generally, non-woven filter fabrics have much lower flow rates compared to woven filter fabrics.
- A slope of 10% that is 100 ft long would have a travel time of about 5 minutes, or a velocity of about 0.33 ft/sec.

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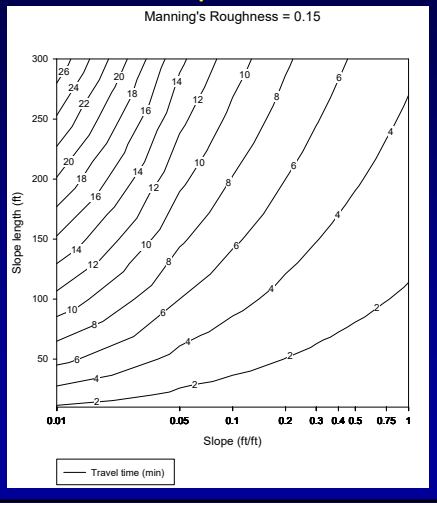
Sheetflow travel times for different slopes



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Slope Limitations for Silt Fences (ASWCC 2014)

Land Slope (percent)	Maximum Slope Length above Silt Fence (feet)
<2	100
2 to 5	75
5 to 10	50
10 to 20*	25
>20*	15

* In areas where the slope is >10%, a flat area length of 10 feet between the foe of the slope to the fence should be provided

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Silt fence check dams on a construction site (practice not commonly approved; silt fences best use for sheet flows)

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Pressure Force on Filter Fences

The pressure equation can be used to calculate the forces acting on filter fences. The following calculation shows the resisting force needed for a 10 ft span of filter fence with 2 ft of standing water:

$$F_1 = \frac{(62.4lb/ft^3)(20ft^2)(2ft)}{2} = 1248lb$$

Basically, the forces acting on a filter fence can be very large and the filter fence stake systems must be selected to withstand this force. In addition, the resisting forces of the soil also act on the fence stake to hold it upright, and also needs to be considered. Wet and soft soils may need long stakes driven deeply in the ground to resist this pressure.

23

AL Silt Fence Specifications	Type A	Type B	Type C
Tensile Strength (Lbs. Min. ASTM D-4632)	Warp – 260 Fill – 100	Warp – 120 Fill – 100	Warp – 120 Fill – 100
Elongation (% Max.) (ASTM D-4632)	40	40	40
AOS (Apparent Opening Size) (Max. Sieve Size) (ASTM D-4751)	no. 30	no. 30	no. 30
Flow Rate (Gal/Min/Sq. Ft.) (GDT-87)	70	25	25
Ultraviolet Stability (ASTM D-4632 after 300 hours weathering in accordance with ASTM D-4355)	80	80	80
Bursting Strength (PSI Min.) (ASTM D-3786 Diaphragm Bursting Strength Tester)	175	175	175
Minimum Fabric Width (Inches)	36	36	22

24

24

Minimum Length		Type of Post	Size of Post
Type A	4’	Steel	1.3lb/ft minimum
Type B	4’	Soft Wood Oak Steel	3” diameter or 2X4 1.5” X 1.5” 1.3lb/ft minimum
Type C	3’	Soft Wood Oak Steel	2” diameter or 2X2 1” X 1” 0.75lb/ft minimum

Gauge		Crown	Legs	Staples/Post
Wire Staples	17 minimum	¾” wide	½” long	5 minimum
		Length	Button Heads	Nail/Post
Nails	14 minimum	1”	¾” long	4 minimum

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Types of Silt Fences (ASWCC 2014) Type A Silt Fence

- Type A fence is at least 32” above ground with wire reinforcements and is used on sites needing the highest degree of protection by a silt fence.
- The wire reinforcement is necessary because this type of silt fence is used for the highest flow situations and has almost 3 times the flow rate as Type B silt fence.
- Type A silt fence should be used where runoff flows or velocities are particularly high or where slopes exceed a vertical height of 10 feet.
- Staked tie backs on each end of a Type A silt fence may be necessary to prevent overturning.

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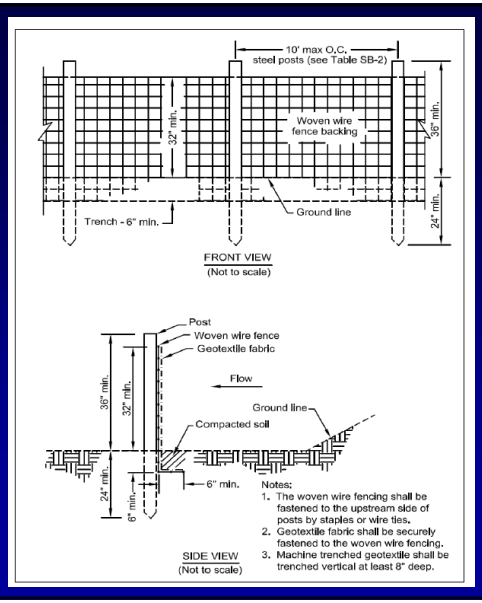
Type A Silt Fence (ASWCC 2014)



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Types of Silt Fences (ASWCC 2014) Type B Silt Fence

- This 36” wide filter fabric should be used on developments where the life of the project is greater than or equal to 6 months.

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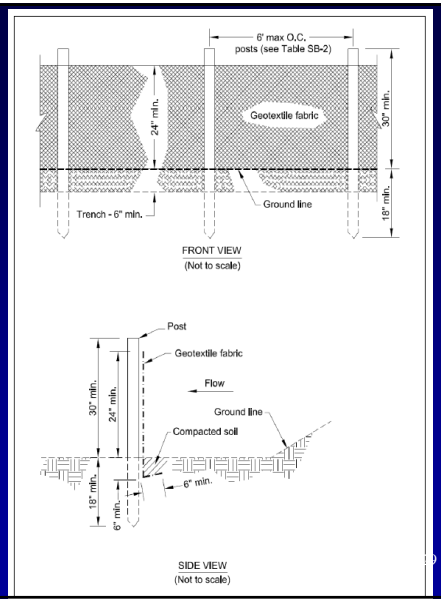
Type B Silt Fence (ASWCC 2014)



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Types of Silt Fences (ASWCC 2014) Type C Silt Fence

Though only 22” wide, this filter fabric allows the same flow rate as Type B silt fence. Type C silt fence should be limited to use on relatively minor projects, such as residential home sites or small commercial developments where permanent stabilization will be achieved in less than 6 months.

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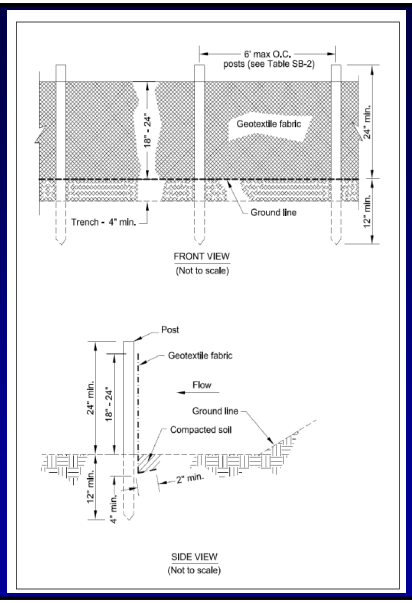
Type C Silt Fence (ASWCC 2014)



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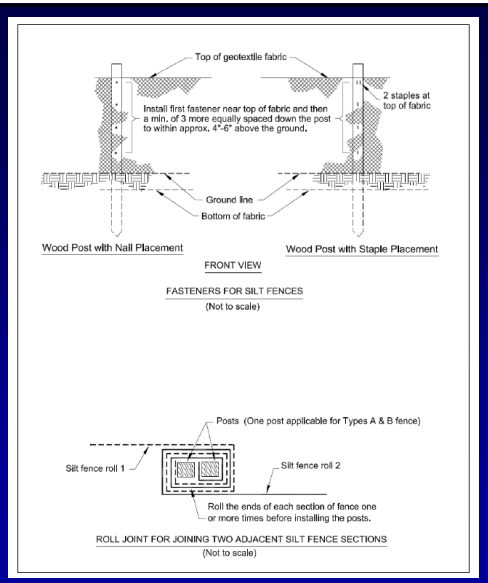
Silt Fence Installation Details (ASWCC 2014)



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- A rather recent innovation that somewhat resembles a double silt fence and referred to as a “sediment retention barrier with flocculant” is used to reduce turbidity in the runoff that will reach sensitive sites.
- The measure consists of a double row of netting or high flow silt fences installed parallel with loose straw, woodchips or other organic fill spread between the rows and straw or other organic material laid on the ground adjacent to the downslope row.
- An approved flocculant powder is added to the material between the rows and to the organic material below the downslope row prior to runoff events. (Alabama Handbook, ASWCC 2014)

33

33

Conclusions

- Silt fences are suitable for much smaller areas than sediment ponds, and their maximum expected performance is less.
- They also act as small detention ponds by ponding water behind the fabric on the upslope side, allowing sedimentation.
- Common problems with silt fence installations include improper installation, placement, and maintenance.
- They frequently are not adequately secured along their bottom edges, allowing passage of water under the fabric.
- In many cases, the drainage areas also are too large.
- Sediment control with silt fences is relatively low and need to used with suitable site erosion controls.
- They are mostly used as perimeter controls around construction sites.

34

34