

Erosion Control Blanket (ECB)

Description

Erosion control blankets are porous fabrics and are manufactured by weaving or bonding fibers made from organic or synthetic materials. Erosion control blankets are installed on steep slopes, over berms, or in channels to prevent erosion until final vegetation is established. However, blankets can also be used as separators or to aid in plant growth by holding seeds, fertilizers and topsoil in place.

Applicability

Erosion control blankets may be used in the following applications:

- To control erosion on steep slopes and to promote the establishment of vegetation.
- To stabilize channels against erosion from concentrated flows.
- To protect berms and diversions prior to the establishment of vegetation.
- To protect exposed soils immediately and temporary, such as when active piles of soil are left overnight.
- As a separator between riprap and soil to prevent soil from being eroded from beneath the riprap and to maintain the riprap's base.
- May be used on slopes as steep as 1:1.

Limitations

- Blankets used on slopes should be biodegradable, or photodegradable, non-toxic to vegetation or germination of seed, and non-toxic or injurious to humans.
- Should not be used on slopes where vegetation is already established.
- Some blankets might promote increased runoff and might blow away if not firmly anchored.
- If the fabric is not properly selected, designed, or installed, the effectiveness may be reduced drastically. Manufacturer's specifications should be followed.

Design Criteria

There are many types of erosion control blankets available. Therefore, the selected fabric should match its purpose. Effective netting and matting require firm, continuous contact between the material and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material. Table ECB-1 indicates some recommended criteria for the selection of erosion control blankets.

Construction Specifications

- Smooth soil prior to installation and apply seed prior to fabric installation for stabilization of construction sites.
- Select the appropriate fabric type using the guidelines from table ECB-1.
- Installation of the blankets shall be in accordance with the manufacturer's recommendations and according to figure ECB-1. For blankets being placed in channels, the fabric should be rolled out parallel to the channel if the width is sufficient to cover the entire width of the channel. The fabric needs to be in continuous contact with the exposed soil.
- Pins or staples shall be made of wire 0.1621" or larger in diameter. "U" shaped staples shall have legs 8" long, and a 1" crown. The bar of the "T" shall be at least 4" long. Triangular survey stakes can also be used.

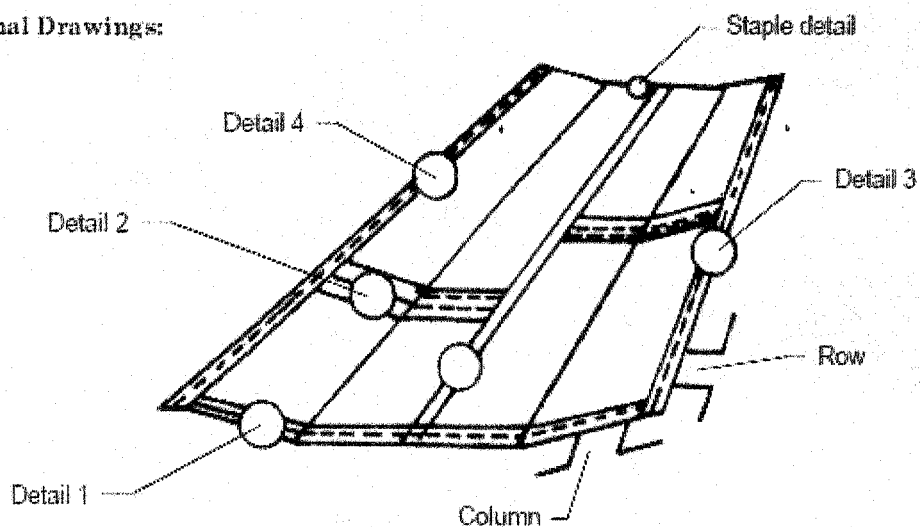
Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspections should determine if cracks, tears, or breaches have formed in the fabric. If the effectiveness of the erosion control blanket has been reduced, the fabric should be repaired or replaced immediately. Re-anchor loosened matting and replace missing matting and staple as required. It is necessary to maintain contact between the ground and the blanket at all times. Trapped sediment should be removed after each storm event.

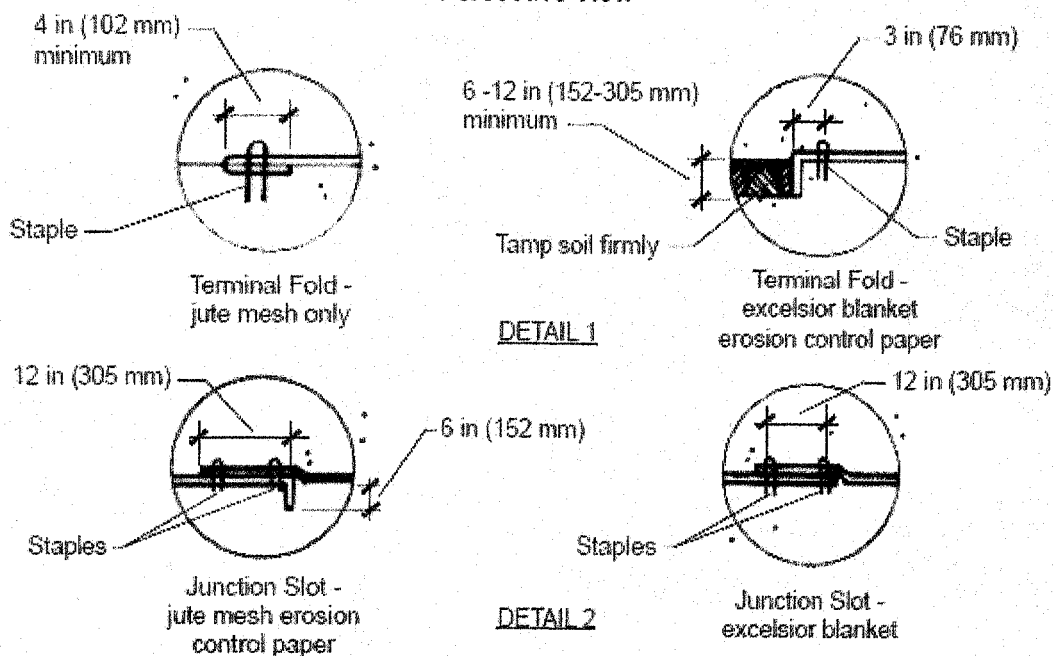
**Table ECB-1
Suggested Blanket Types**

Description	Longevity	Applications	Max. Flow Velocity (feet/sec.)
Single Net Straw Blanket	12 months	4:1 - 3:1 Slopes Low Flow Channels	5
Rapid Degrading Net	45 - 60 Days	4:1 - 3:1 Slopes Low Flow Channels	5
Double Net Straw Blanket	12 months	3:1 - 2:1 Slopes Moderate Flow Channels	6
Rapid Degrading Nets	45 - 60 Days	3:1 - 2:1 Slopes Moderate Flow Channels	6
Double Net Blanket 70% Straw/30% Coconut	24 months	2:1 - 1:1 Slopes Medium Flow Channels	8
Double Net Blanket 100% Coconut	36 months	1:1 & Greater Slopes High Flow Channels	10
Double Net Blanket Polypropylene Fiber		1:1 Slopes Extended Flow Areas High Flow Channels	9 (unveg.) 16 (veg.)
Organic Net	12 months	4:1 - 3:1 Slopes Low Flow Channels	5
Organic Nets	12 months	3:1 - 2:1 Slopes Moderate Flow Channels	6
	18 months	2:1 - 1:1 Slopes Medium Flow Channels	8
	24 months	1:1 & Greater Slopes High Flow Channels	10

Additional Drawings:

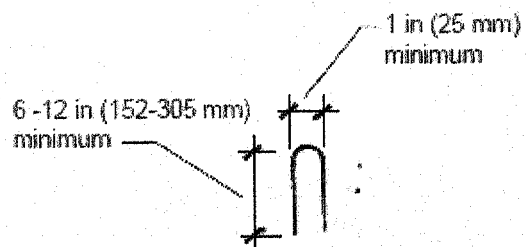
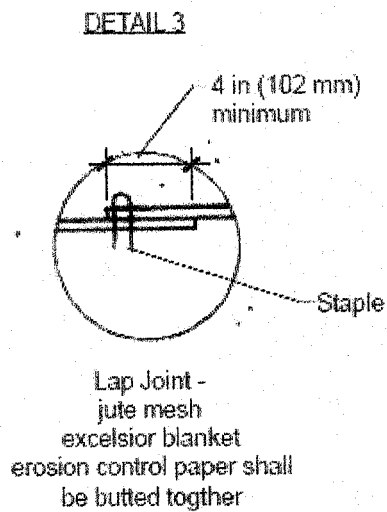
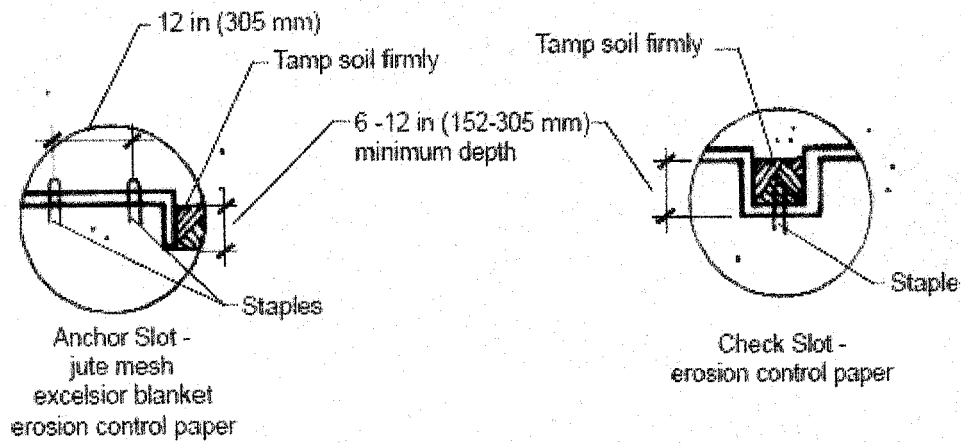


**Erosion Control Blanket
Perspective View**



**Erosion Control Blanket;
Detail 1 and Detail 2
Section View**

Additional Drawings:



**Erosion Control Blanket;
Detail 3, Detail 4, Detail 5, and Staple Detail
Section View**

References

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February 2003.

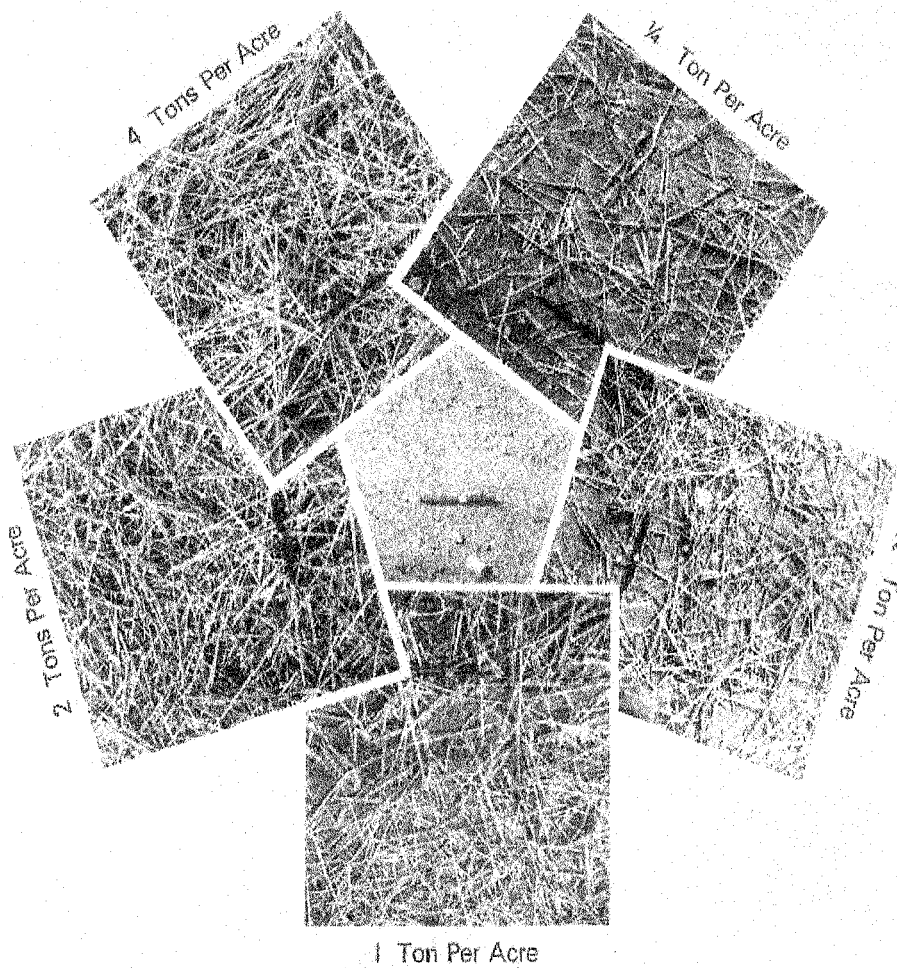
http://cfpud.epa.gov/npdes/stormwater/menufbmps/con_site.cfm

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

Keller, Gordon and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <http://www.blm.gov/bmp/field%20guide.htm>

North American Green, 2004. <<http://www.nagreen.com>

Straw Mulch (SM)



Straw/Wood Mulching

M

Description:

Straw or wood mulching is used to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Applications:

Straw or wood mulching is suitable for disturbed soil areas requiring temporary protection until permanent stabilization is established.

Limitations:

- Not suitable for slopes steeper than 3:1.
- May introduce unwanted species, weed seed, and unwanted plant material.
- When straw blowers are used, the treatment areas must be within 150 ft of a road or surface capable of supporting trucks.
- May need to be removed prior to permanent seeding or further earthwork.
- Wind may blow mulch into undesired locations.
- Not suitable for areas exposed to concentrated flows.

Design Guidelines:

Refer to figures at the end of this detail sheet for further installation guidelines and/or specifications.

Installation:

Straw Mulch

- Roughen embankments and fill rills before placing the straw mulch by rolling with a crimping or punching type roller or by track walking.
- Evenly distribute straw on the soil surface.
- Anchor straw mulch to the soil surface by "punching" it into the soil mechanically or use of a tackifier.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.

Wood Mulch

- Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a device such as a punching type roller or by track walking.
- Apply with or without seeding and evenly distribute by hand or pneumatic methods to a maximum depth of 2 to 3 inches.

Maintenance and Inspection:

- Inspect BMPs at least every 14 days and after each storm event.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible.
- If the mulch is applied without seed it should last the length of time the site will remain barren or until final re-grading and revegetation.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

Mulch Tackifier

MT

Description:

An organic soluble powder adhesive used in the form of a water slurry to adhere native hay, straw, hydromulch, or seed to a surface and together. Derivative of plant material phyllium or Guar.

Applications:

- Used in combination with a native forage material for mulching applications.
- Used in combination with seed to adhere seed to soil.
- Used to adhere wood cellulose material (hydromulch) to surface.
- Used to cover disturbances as temporary cover for wind erosion.

Limitations:

- Temporary measure to hold mulch material until native seeding is established.
- Product is water-soluble and must be reapplied 6-12 months after initial application if plants have not stabilized soils.
- Do not apply during precipitation event or over snow.
- Do not apply where in areas of concentrated flow.

Design Guidelines:

Design mixture as recommended by the manufacturer.

Installation:

- Apply within 4 hours of mulch application.
- Always apply in a liquid state.
- Can be applied in combination with organic fertilizers and humates.

Maintenance and Inspection:

- Mulch movement indicated poor application and product mixture.
- Proper application will bond mulch material together and to soil.
- Inspect by touching mulch surface to determine if adhesion has occurred.

Revegetation (RV)

Description

Revegetation involves planting seed to establish a vegetative cover in disturbed areas. Revegetation reduces erosion and sediment by stabilizing disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant material. Revegetation also:

- Absorbs the impact of raindrops.
- Reduces the velocity of runoff
- Reduces runoff volumes by increasing water percolation into the soil.
- Binds soil with roots.
- Protects soil from wind.
- Improves wildlife habitat.
- Enhances natural beauty.

Applicability

Revegetation is most effective on slopes no steeper than 2:1. Revegetation may be used as a permanent control or a temporary control in areas where exposed soil surfaces are not to be regarded for periods longer than 30 days. Such areas include denuded areas, soil stockpiles, berms, temporary road banks, etc.

Limitations

The effectiveness of revegetation can be due to the following:

- High erosion potential during establishment.
- The need for stable soil temperature and soil moisture content during germination and early growth.
- The need to reseed areas that fail to establish.
- Limited seeding times depending on the season.

- Proper seedbed preparation and the use of quality seed are important in this practice. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.
- Seeding does not immediately stabilize soils. Prior to seeding, install necessary erosion and sediment control practices such as diversions, straw bales, and basins until vegetation is established.

Design Criteria

Successful plant establishment can be maximized with proper planning; consideration of soil characteristics; selection of plant materials that are suitable for the site; adequate seedbed preparation, liming, and fertilization; timely planting; and regular maintenance.

When to seed

Areas to be stabilized with vegetation must be seeded or planted one to four months after grading is completed unless temporary stabilization measures are in place. Possible dates for seeding are as follows:

Seed Mix

Climate, soils, and topography are major factors that dictate the suitability of plants for a particular site. Vegetation that is adapted to the site, has strong roots, and provides good ground cover should be used. Although a native seed mix is best some grasses, such as Vetiver, have been used extensively worldwide because of their strong, deep roots, adaptability, and non-invasive properties.

Construction Specifications

1. Seeding does not immediately stabilize soils. Temporary erosion and sediment control measures should be in place to prevent off-site transport of sediments from disturbed areas until vegetation is established.
2. Vegetation should not be established on slopes that are unsuitable due to inappropriate soil texture, poor internal structure or internal drainage, volume of overland flow, or excessive steepness, until measures have been taken to correct these problems.
3. If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted, or hardened, the soil surface shall be loosened by disking, raking, harrowing, or other acceptable means to ensure good water infiltration and root penetration (see SURFACE ROUGHENING [SR]).

4. The soil on a disturbed site may need to be modified to provide an optimum environment for seed germination and seedling growth. To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. If any of the below criteria cannot be met then topsoil shall be applied. The existing soil must have these characteristics:

- Enough fine-grained material to maintain adequate moisture and nutrient supply.

Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans shall be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.

- A favorable pH range for plant growth. If the soil is so acidic that a pH range of 6.0-7.0 cannot be attained by addition of pH-modifying materials, then the soil is considered an unsuitable environment for plant roots and further soil modification would be required.
- Freedom from toxic amounts of materials harmful to plant growth.
- Freedom from excessive quantities of roots, branches, large stones, large clods, earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they do not significantly impede good seed soil contact.

5. Add fertilizer and/or lime, if necessary. Lime and fertilizer may be incorporated into the top two to four inches of the soil if possible. The addition of lime is equally as important as applying fertilizer. Lime will modify the pH and supply calcium and magnesium. Its effect on pH makes other nutrients more available to the plant.

6. The appropriate seed shall be evenly applied with a broadcast seeder, drill, cultipacker seeder or hydroseeder. Seeding depth should be $\frac{1}{4}$ to $\frac{1}{2}$ inch.

7. If necessary, apply mulch according to MULCHING (M). The mulch will hold moisture and modify temperature extremes, and prevent erosion while seedlings are growing.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Vegetation is considered established when a density of at least 80 percent of pre-disturbance levels has been reached. Seeded areas should be inspected for failure and any necessary repairs and re-seedings should be made within the same season if possible.

References

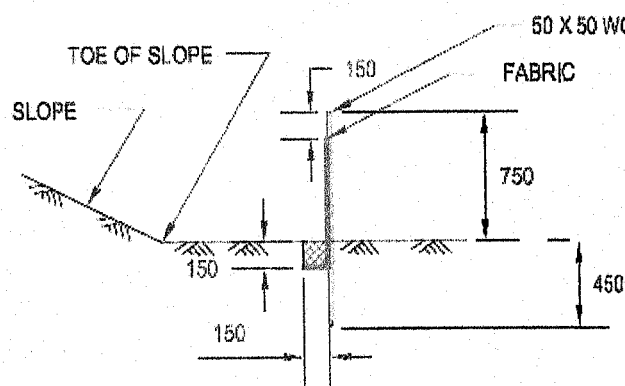
Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February 2003.

http://cfpud.epa.gov/npdes/stormwater/menufbmps/con_site.cfm

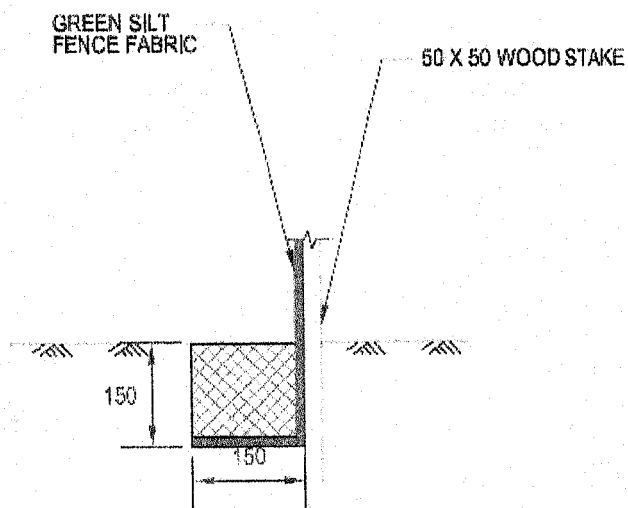
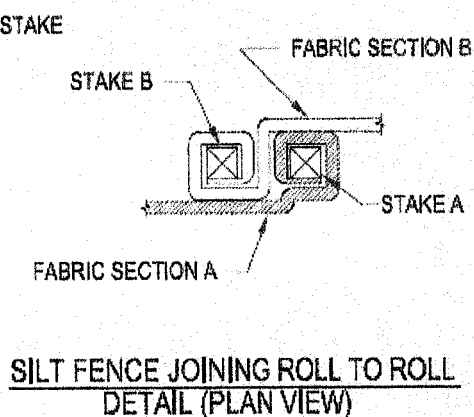
Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

Keller, Gordon and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <http://www.blm.gov/bmp/field%20guide.htm>

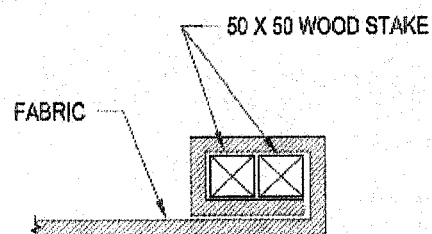
Silt Fence (SF)



SILT FENCE INSTALLATION AT SLOPE BASE



INSTALLATION TRENCH DETAIL (PLAN VIEW)



END STAKE DETAIL (PLAN VIEW)

Description

Silt fences are used as temporary perimeter control around sites where there will be soil disturbance due to construction activities. They consist of a length of filter fabric stretched between anchoring post at regular intervals along the site perimeter.

Applicability

Silt fences are generally applicable to construction sites with relatively small drainage areas. They are appropriate in areas where runoff will be occurring as low-level shallow flow, not

exceeding 0.5cfs. The drainage area for silt fences generally should not exceed 0.25 acre per 100-foot fence length. Slope length above the fence should not exceed 100 feet.

Limitations

- Silt fence should not be installed along areas where rocks or other hard surfaces will prevent uniform anchoring of fence posts and entrenching of the filter fabric. This will greatly reduce the effectiveness of silt fencing and can create runoff channels leading offsite.
- Silt fences are not suitable for areas where large amounts of concentrated runoff are likely.
- Open areas where wind velocity is high may present a maintenance challenge, as high winds may accelerate deterioration of the filter fabric.
- Silt fences should not be installed across streams, ditches, or waterways.
- When the pores of the fence fabric become clogged with sediment, pools of water are likely to form on the uphill side of the fence. Location and design of the silt fence should account for this and care should be taken to avoid un-necessary diversion of storm water from these pools that might cause further erosion damage.

Design Criteria

The fence should be designed to withstand the runoff from a 10-year storm event.

Construction Specifications

1. Erect silt fence according to figure SF-1.
2. If standard strength fabric is used in combination with wire mesh, the support posts should be spaced no more than 10 feet apart. If extra-strength fabric is used without wire mesh reinforcement, the support posts should be spaced no more than 6 feet apart.
3. Stakes used to anchor the filter fabric should either be wooden or metal. Wooden stakes should be at least three feet tall and have a minimum diameter of two inches if a hardwood such as oak is used. Softer woods such as pine should be at least four inches in diameter. When using metal post in place of wooden stakes, they should have a minimum weight of 1 to 1.33lb/linear foot. If metals post are used, attachment points are needed for fastening the filter fabric using wire ties. The height of the fence post should be between 16 and 34 inches above the original ground surface.

4. Material for silt fences should be a pervious sheet of synthetic fiber such as polypropylene, nylon, polyester, or polyethylene yarn, chosen based on minimum synthetic fabric requirements, as shown in the following table:

Physical Property	Requirements
Filling Efficiency	75 - 85% (minimum); highly dependent on local conditions
Tensile Strength at 20% (maximum) Elongation	Standard Strength: 30 lbs/linear inch (minimum) Extra Strength: 50 lbs/linear inch (minimum)
Ultraviolet Radiation	90% (minimum)
Slurry Flow Rate	0.3 gal/ft ² /min (minimum)

5. Use a continuous roll of fabric to eliminate unwanted gaps in the fence. If a continuous roll of fabric is not available, the fabric should overlap from both directions only at the stakes or posts with a minimum overlap of six inches.

6. Extend silt fence across grade and upslope for a short distance.

7. Compact backfill at base of fabric.

8. Plow in or entrench the bottom of the fabric fence at least 6 inches below the ground surface. This will help prevent gaps from forming near the ground surface that would render the fencing useless as a sediment barrier.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspect silt fences to ensure that they are intact and that there are no gaps at the fence-ground interface or tears along the length of the fence. If gaps or tears which impact the effectiveness of the silt fence are discovered, they should be repaired or the fabric should be replaced immediately. Accumulated sediments should be removed from the fence base when the sediment reaches 1/3 to 1/2 the height of the fence. Sediment removal should occur more frequently if accumulated sediment is creating noticeable strain on the fabric and there is the possibility of the fence failing from a sudden storm event.

Removal

Remove silt fences and all accumulated sediment after uphill drainage areas are stabilized by vegetation or other means.

References

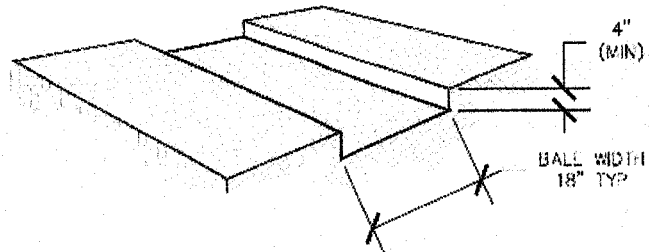
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Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February 2003.

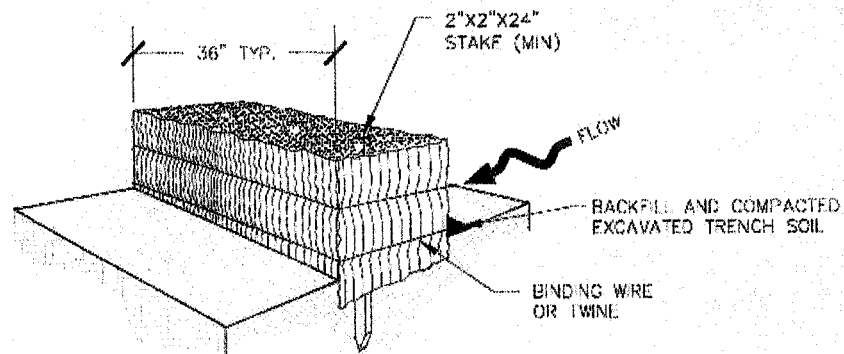
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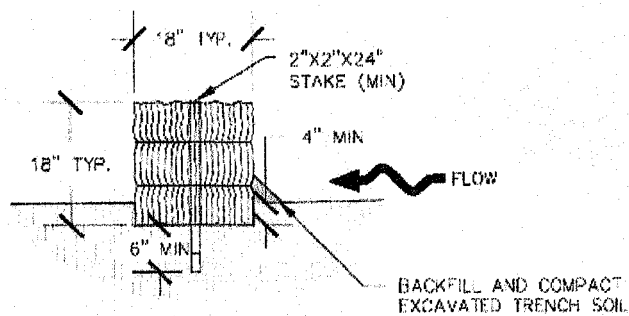
Straw Bale (SB) – Straw Bale Placement in Swale (SBS)



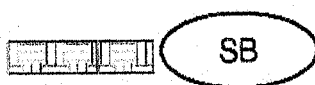
TRENCH EXCAVATION



STRAW BALE INSTALLATION

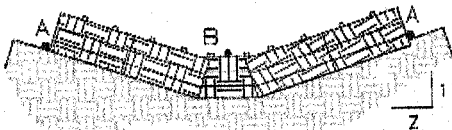


SECTION



STRAW BALE

END POINTS "A" MUST BE
HIGHER THAN POINT "B"

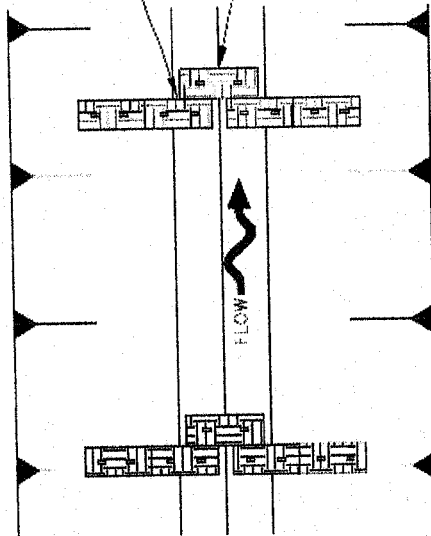


**STRAW BALE IN SWALES
SECTION**

STRAW BALES SHALL NOT BE USED IN
CHANNELS/SWALES LESS THAN 3.0' IN
DEPTH. CONTRACTOR SHALL INSTALL ROCK
SOCK **RSS** IN ALL CHANNELS/SWALES LESS
THAN 3.0' IN DEPTH.

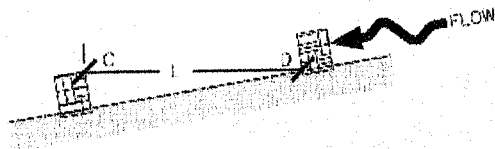
STRAW BALS MUST
BE TIGHTLY ABUTTING
WITH NO GAPS

ONE OR MORE BALES IN
CHANNEL BUT TIGHTLY
ABUTTING EACH OTHER



**STRAW BALE IN SWALES
SECTION**

L = THE DISTANCE SUCH THAT POINT D AND
C ARE OF EQUAL ELEVATION.



**STRAW BALE
DOWNSTREAM SPACING**



SBS

STRAW BALE PLACEMENT IN SWALE

Straw Bale Installation Notes

Straw Bales shall consist of certified weed free straw or hay certified under the Colorado Department of Agriculture weed free forage certification program and inspected as regulated by the weed free forage act, Title 35, Article 27.5, CRS. Each certified weed free mulch bale shall be identified by one of the following:

- One of the ties binding the bale shall consist of blue and orange twine, or
- Once of the ties binding the bale shall consist of specially produced galvanized shiny wire, or
- The bale shall have a regional forage certification program tag indicating the regional forage certification program number.

Straw bales shall be inspected for and regionally certified as weed free based on the regionally designated noxious weed and undesirable plant list from Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas, South Dakota or any other State not listed that served as the place of origin for the straw mulch.

No one shall unload certified weed free mulch bales or remove the identifying twine, wire or tags until the Inspector has inspected and accepted them.

The contractor shall provide a transit certificate that has been filled out and signed by the grower and by the Department of Agriculture Inspector.

The contractor may obtain a current list of Colorado weed free forage crop producers who have completed certification by contacting the Colorado Department of Agriculture, Division of Plant Industry.

Straw bales shall be approximately 36"X18"X18".

A uniform anchor trench shall be excavated to a depth of 6". Straw bales shall be placed so that binding twine is encompassing the vertical sides of the bale(s). All excavated soil shall be placed on the uphill side of the straw bales(s) and compacted.

Two (2) wooden stakes shall be used to hold each bale in place. Wooden stakes shall be 2"X2"X24".

Wooden stakes shall be placed 6" into the ground.

Straw bales shall be spaced and positioned according to details.

Straw Bale Installation & Maintenance Notes

The Erosion Control Supervisor shall inspect the straw bales at the following intervals:

- Immediately following initial installation.
- Every 14 days while the site is under active construction.
- After any storm event that causes soil erosion.
- Once a month following the end of construction, until vegetative cover has reached a consistent density of at least 80% of full vegetative cover.

Accumulated sediment shall be removed once the sediment has reached a depth equal to $\frac{1}{4}$ the height of the straw bale.

Straw bales shall be replaced if they become heavily soiled, rotten, or other damages.

Straw bales shall remain in place and properly maintained until vegetative cover has reached a consistent density of at least 80% of full vegetative cover and erosion and sedimentation is no longer a possibility as determined by the Inspector.

When the straw bales are removed, any disturbed areas associated with the installation, maintenance, and/or removal of the straw bales shall be roughened, seeded, mulched, and crimped.