CHANNEL LININGS

- **Options for Channel Lining**
- **Channel Design Considerations**
  - Maximum Permissible Velocities, V_{max}
  - Allowable Tractive Force (Shear Stress)




Channel Linings

- Bare soil
- Vegetation (grasses)
- Rolled Erosion Control Products (RECP)
- Turf reinforced mats (TRM)
- Hard linings



Bare Soil	Manning n	Allowable Velocity v_{max} (ft/s)	Allowable Shear Stress τ_{all} (lbs/ft^2)
Fine sand	0.02	1.50	0.03
Sandy loam	0.02	1.75	0.02
Silt loam	0.02	2.00	0.12
Firm loam	0.02	2.50	0.03
Graded loam	0.03	3.75	0.12
Alluvial silt	0.02	3.75	0.12
Stiff clay	0.025	3.75	0.25
Graded silt	0.03	4.00	0.12
Coarse gravel	0.03	4.00	0.25
Cobbles & shingles	0.035	5.00	0.50
Shale & Hardpan	0.03	6.00	1.00

Vegetation Lining

Grass	n	v_{max} (ft/s)	τ_{all} (lbs/ft^2)
Bermuda grass	Variable	4 - 8	1.00
Rye Grain	Variable	2.5 – 3.5	0.60
Hard Fescue	Variable	2.5 – 3.5	1.00
Bluegrass	Variable	3 – 7	1.00

Rolled Erosion Control Products

Blanket (RECP)	v_{max} (ft/s)	τ_{all} (lbs/ft^2)
Straw, no nets	3.0	1.00
Straw, 1 net	3.5	1.25
Straw, 2 nets	4.5	1.50
70% Straw, 30% Coir	8.0	2.00
Excelsior, 2 nets	8.5	2.30
Polypropylene, 2 nets	9.0	3.20
Coir Netting, 900 g	15.0	4.60

Jute Coir Excelsior

Turf Reinforced Mats

TRM	V_{max} (ft/s)	τ_{all} (lbs/ft^2)
NAG, SC250; bare soil	9.5	2.50
NAG, C350; bare soil	10.5	3.00
NAG, P550; bare soil	12.5	3.25
Pro/Enka II; bare soil	13.0	10.0
Pro/Enka, 7220, BFM, vegetated	14.0	8.0
NAG, C350; vegetated	20.0	10.0
NAG, P550; vegetated	25.0	12.5

Turf Reinforced Mat (TRM)

Plastic Mesh w/BFM
(bonded fiber matrix)

Stone Sizes

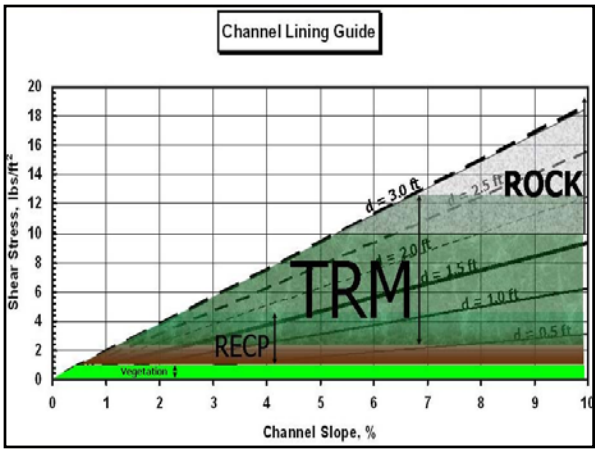
	Min. (inches)	Median (inches)	Max. (inches)
Sediment Control Stone (washed, no fines) No.5/No. 57	~3/8	½-3/4	1.5
Structure Stone--Class A	2	4	6
" " --Class B	5	8	12
" " --Class I	5	10	17
" " --Class II	9	14	23

Rock & Hard Linings

Lining	n	v_{max} (ft/s)	t_{all} (lbs/ft^2)
Rock, Class A	variable	7.5	1.0
Rock, Class B	variable	10.0	2.0
Rock, Class I	variable	12.5	3.0
Rock, Class II	variable	14.0	4.0
Reno Mattress	0.025	13 – 18	8.35
Gabions	0.027	22	8.35
Concrete	0.017		100.0

Summary

Groundcovers	V_{max} (ft/s)	τ_{all} (lbs/ft^2)
None	1.5 – 4.0	0.03 – 0.25
Vegetated	2.5 – 8.0	0.6 – 1.0
RECP	3.0 – 15.0	1.0 – 4.6
TRM	9.5 – 25.0	2.5 – 12.5
Rock	**7.5 - >22**	**1.0 – 100**



Guidelines

Min. Slope (%)	Max. Slope (%)	Recommended Practice
0	1.5	Seed and mulch
1.5	5	Temporary liner
>5		TRM or Rock

Selecting a Channel Lining

Example: Select a suitable lining for a triangular channel with 3:1 side slopes, a channel slope of 2%, and a flow depth of 0.8 ft.

$$\tau_{max} = \gamma d_{max} S$$

$$\tau_{max} = (62.4 lbs/\ ft^3)(0.8\, ft)(0.02 ft/\ ft) = x lbs/\ ft^2$$

Sample Problem

Compute the sheer stress in a trapezoidal channel (b = 8 ft, d = 1.0 ft, z = 3, S = 5%).

$\tau = \gamma dS = (62.4 lbs/ft^3)(1.0ft)(0.05ft/ft)$
$= x\ lbs/ft^2$

Select an appropriate channel lining for this channel.

Sample Problem

Compute the shear stress in a triangular channel (d = 1.5 ft, S = 0.5%).

$\tau = \gamma dS = (62.4 lbs/ft^3)(1.5ft)(0.005ft/ft) =$ x lbs/ft^2

Select an appropriate channel lining for this channel.

Cut/Fill Slope Protection

Category	Blanket	τ (lbs/ft^2)	Slope
RECP	Straw, 1 net	1.25	3:1
RECP	Curlex, 1 net	1.55	2:1
RECP	Blanket, 2 nets	1.75	2:1
RECP	Curlex, 2 nets	2.00	1.5:1
RECP	Coir/Polypropylene	2.25	1:1
RECP	Curlex, Enforcer, 2 nets	2.30	0.75:1
TRM	Recyclex	10.0	0.5:1

Channel Lining Design Software

- Erosion Control Materials Design Software (ECMDS)
  http://www.nagreen.com/software/
- Profile Soil Solutions Software (PS^3)
  http://www.profileps3.com/Intro.aspx

Questions