

NAILED SOIL WALL FOR LANDSLIDE PROTECTION AT NAINITAL

By

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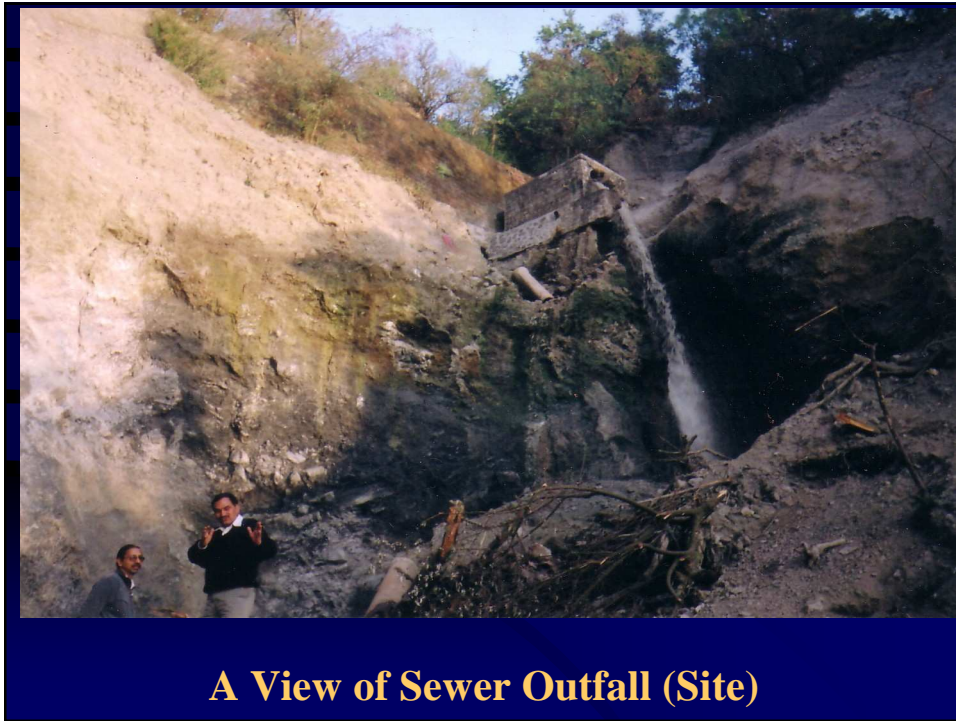
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Roorkee.



LOCATION OF SITE:

**The site is located on Nainital –
Haldwani road, about 4 kms from
Nainital.**



A View of Sewer Outfall (Site)

Statement of Problem:

- 1. Due to landslide which occurred one year back, sewage pipe line is broken which has resulted in free flow of water from pipe .**
- 2. Exposed end of pipe (with free flow of sewage water) has not only caused fouling smell there but also caused serious environment threat.**

3. Broken sewage pipe line had to be restored as early as possible as the continuous open flow was causing undermining of existing slopes and since the first day of breakage of pipe, these slopes have further deteriorated.
4. Indian Institute of Technology, Roorkee suggested the solution to stabilize the slopes on both sides of exposed sewage pipeline causing nallah.

SOIL STRATA AT SITE:

The soil present at the site is generally poorly graded sand (SP), cohesionless in nature ($c = 0$) with angle of internal friction (ϕ) as $\cong 42^\circ$. It was also observed that the soil present at site was of calcareous in nature.

SOIL NAILING

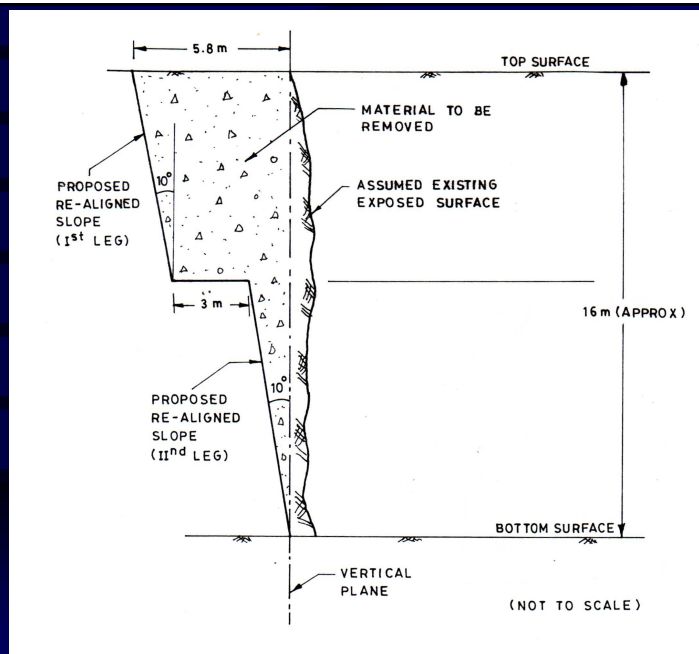
SOIL NAILING IS A METHOD OF REINFORCING THE SOIL WITH STEEL BARS OR OTHER MATERIAL

- In-situ stabilization of soil
- Possible in granular soils with a little cohesion
- Very effective in granular soils

DESIGN OF NAILED CUT

Input Parameters for Soil Nailed Wall Design

Sl.	Parameter	Left Bank	Right bank
No.	Vertical Height of slope	16m	16m
(1)	Angle of slope with vertical (**)	10°	10°
(2)	Angle of internal friction (ϕ°) of soil material	42.0	42.5
(3)	Seismic coefficients	$\alpha_h=0.15,$ $\alpha_v=\alpha_h/2$	$\alpha_h=0.15,$ $\alpha_v=\alpha_h/2$
(4)	Surcharge (q) t/m ²	4.0	4.0
(5)	Cohesion (C) Kg/cm ²	0.0	0.0
(6)	f^*	0.6	0.6



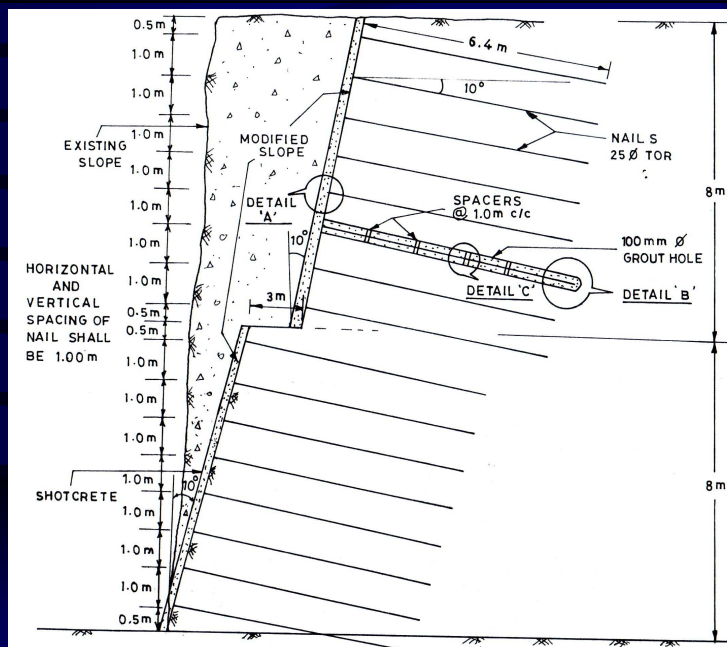
Re-alignment of Existing Slopes

Design for Proposed Nailed Wall

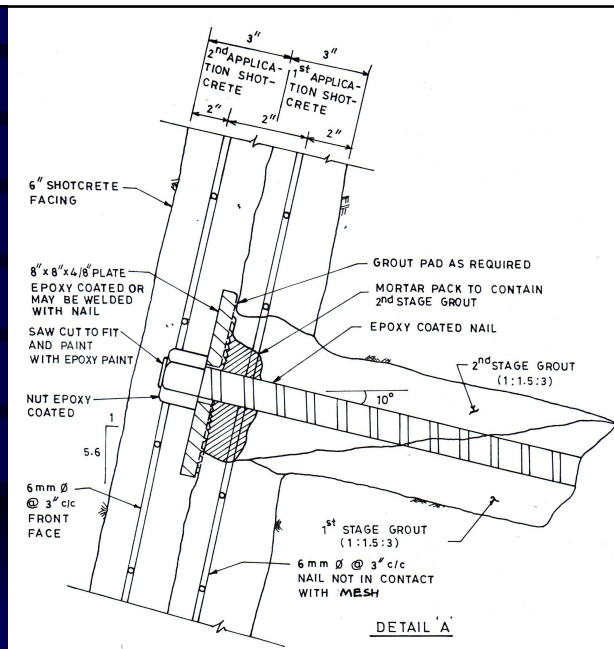
Sl. No.	Parameter	Left & Right Bank
(i)	Horizontal & vertical spacing of nail	1.0m
(ii)	Length of nail	0.8 H'=6.4m
(iii)	Dia & Material of nail	tor steel bar- (dia = 25mm)
(iv)	Bore hole - Diameter	100mm (with 1:1.5:3)
(v)	Method of nailing	Grouted

Design for Proposed Nailed Wall

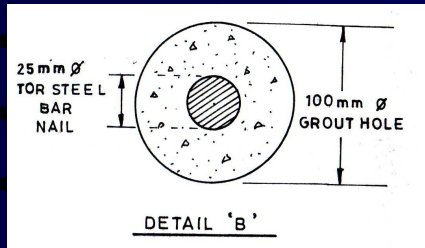
(vi)	Screen/facia of cut	Shotcreting with two layers of 6mm dia. Wire mesh, tk = 150mm
(vii)	Surcharge load for Design	40 kN/m ²
(viii)	F.O.S.	2.5
(ix)	Inclination of nail with horizontal	10°



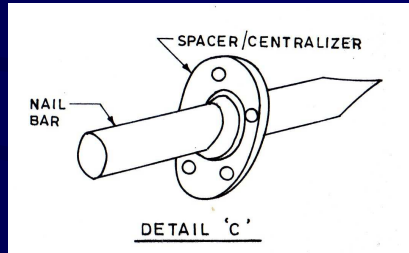
Proposed Section of Nailed Slope



Nail Head Details at Section A



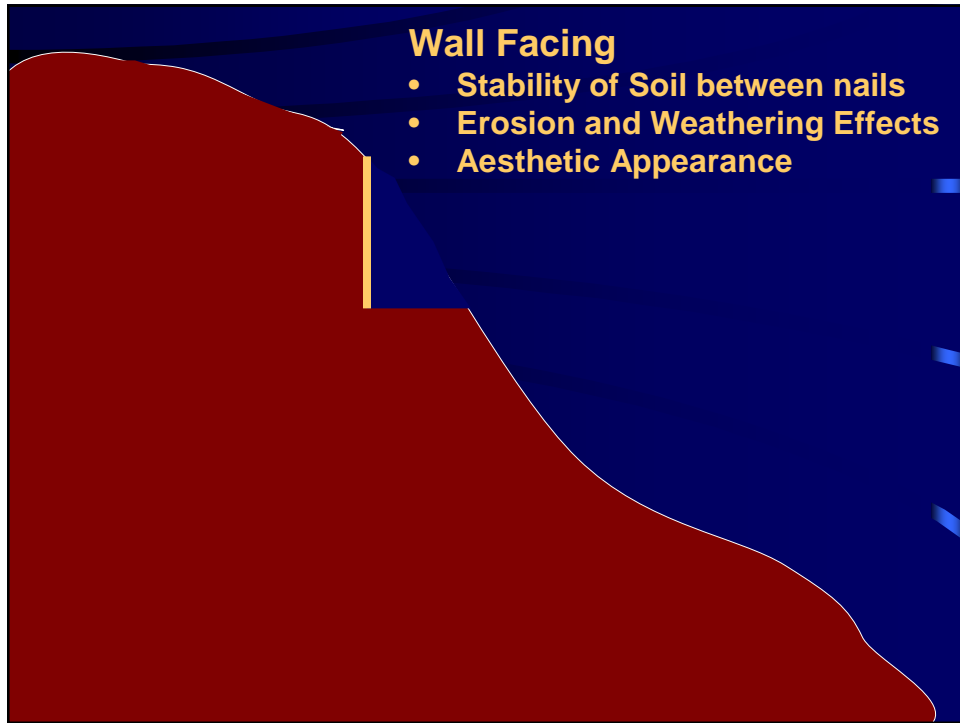
Grouted Nail Detail 'B'



Detail of Spacer Used 'C'

Construction Methodology

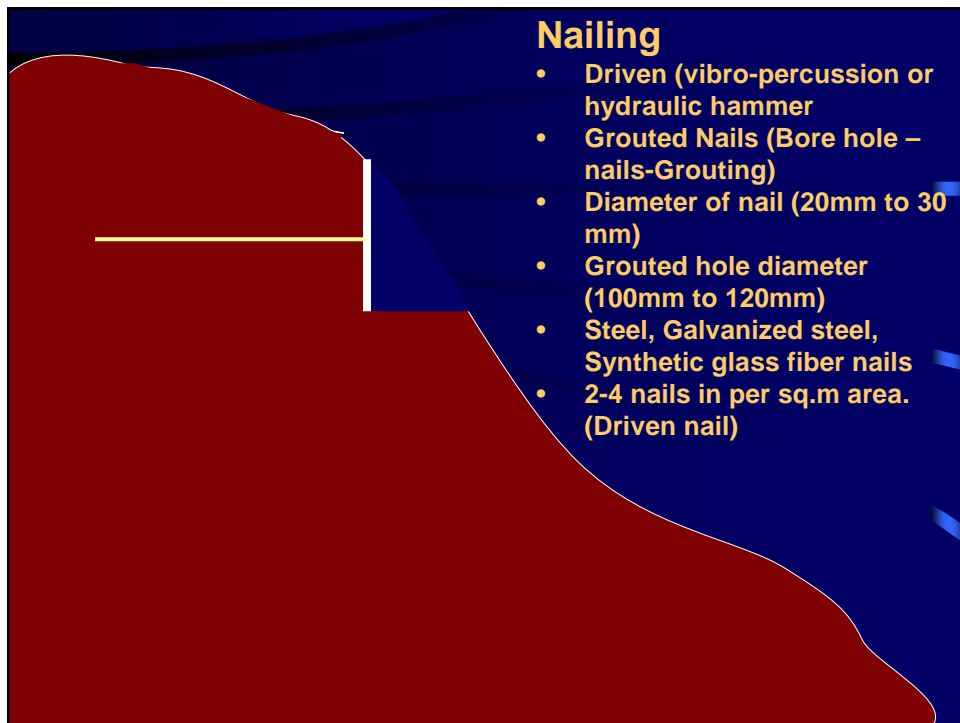
- Excavation
- Staged Construction— “Top – Down”
 - Maximum excavation - Ability to stand unsupported
 - Cohesion less soil- Capillary moisture
 - Usually 1.0 to 1.5m



The diagram shows a cross-section of a soil slope on the left, colored in a dark red. To the right of the slope, a vertical wall facing is shown as a thin white line. The background is a dark blue gradient. The text is in yellow.

Wall Facing

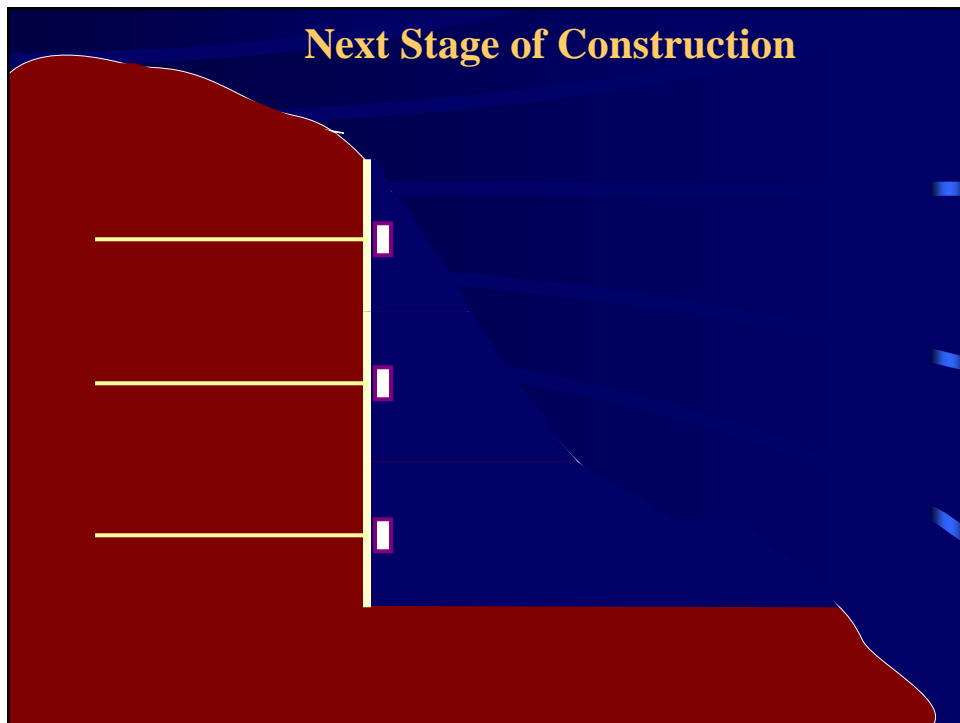
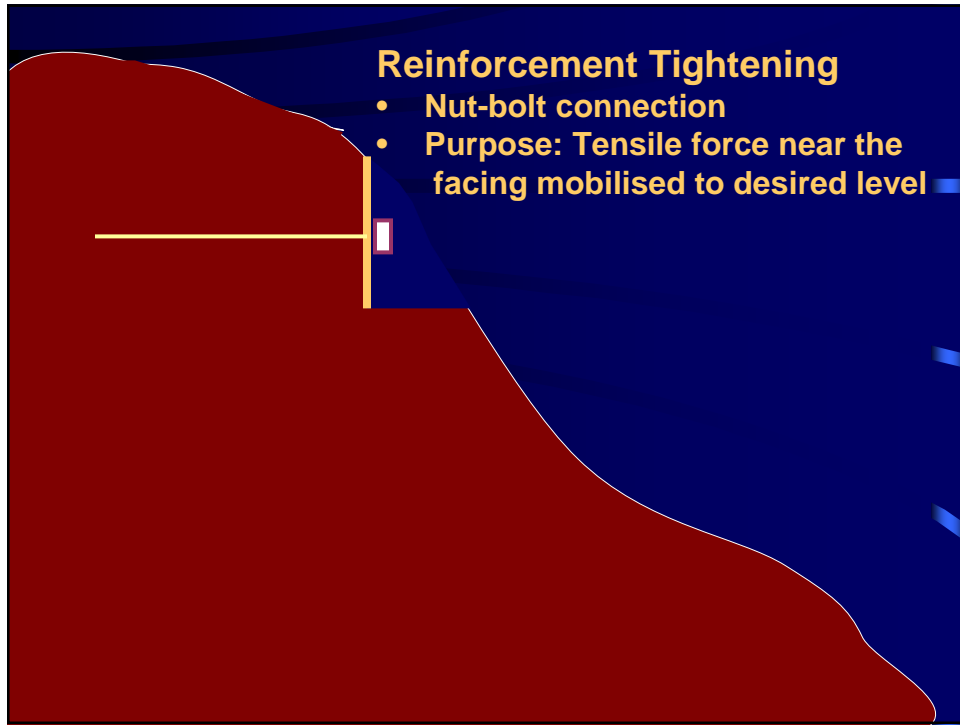
- Stability of Soil between nails
- Erosion and Weathering Effects
- Aesthetic Appearance



The diagram shows a cross-section of a soil slope on the left, colored in a dark red. A horizontal nail is shown as a thin white line extending from the wall facing into the soil. The background is a dark blue gradient. The text is in yellow.

Nailing

- Driven (vibro-percussion or hydraulic hammer)
- Grouted Nails (Bore hole – nails-Grouting)
- Diameter of nail (20mm to 30 mm)
- Grouted hole diameter (100mm to 120mm)
- Steel, Galvanized steel, Synthetic glass fiber nails
- 2-4 nails in per sq.m area. (Driven nail)



CONCLUSIONS & RECOMMENDATIONS

- The soil nailing technique is a right solution for the present site. The solutions suggested in this report can stabilize the slopes.
- Concrete mix of 1:1.5:3 was suggested to be used in grouting and standard Tor steel bar of 25mm diameter as grouted nails.
- Chicken mesh be properly intact in position by U-hooks.

CONCLUSIONS & RECOMMENDATIONS

- Spacer/centralizers be used in grouted nails.
- Weep holes at suitable locations be provided through the facia of finished wall. Alternatively, G.I. perforated pipe 6m long, 4" ϕ duly wrapped with geosynthetic from outside should be used for drainage purpose. This pipe may be suitably filled up with filter material.

THANK YOU

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