

# *Road Slope Stability in Nepal:*

*Standing Strong in the Himalayas*

*From Roorkee to Nepal: Shaping Slopes, Shaping Futures.*

*Tuk Lal Adhikari*

IIT Roorkee Alumnus | ITECO Nepal

Mff" w

i z e-ff we st " Ys w

S" s-s s" P sy"

S • s" Psu ff

Zw s-d ffsv Zw ff fl

S" ff "us-b su "uw

b fffi w s" v dw "w" uw

W" v• s fl b fffi w

Mzs "s s "dwzst "s "ff" b fffi w

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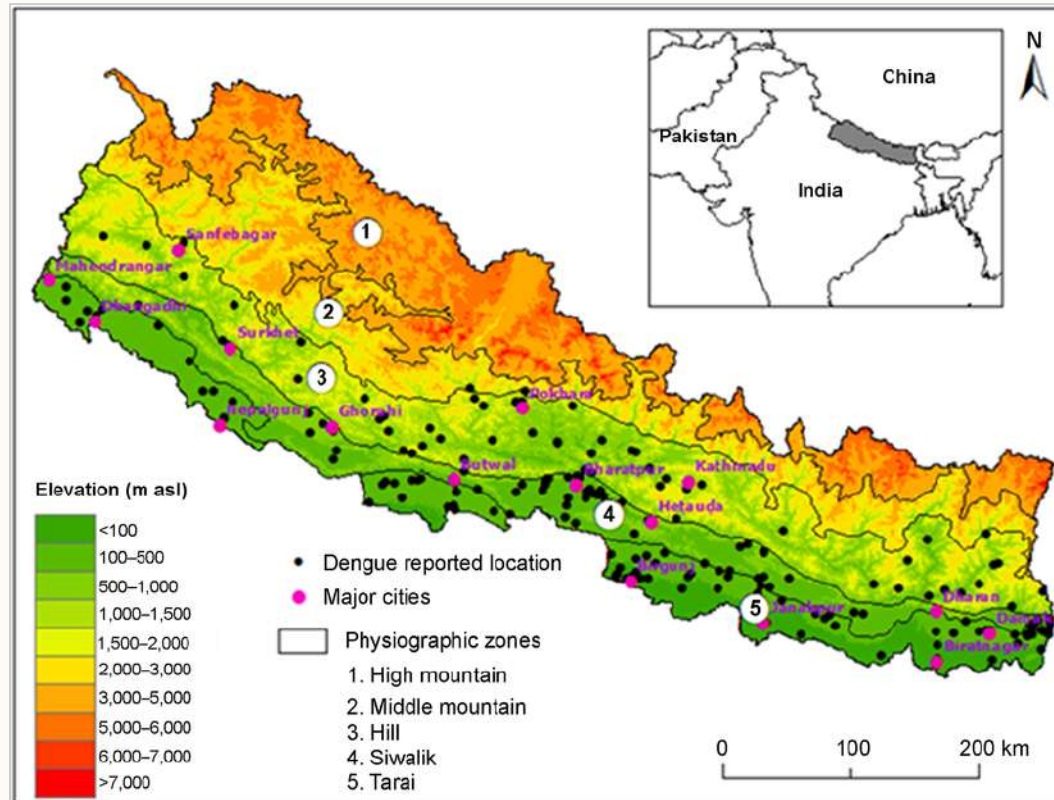
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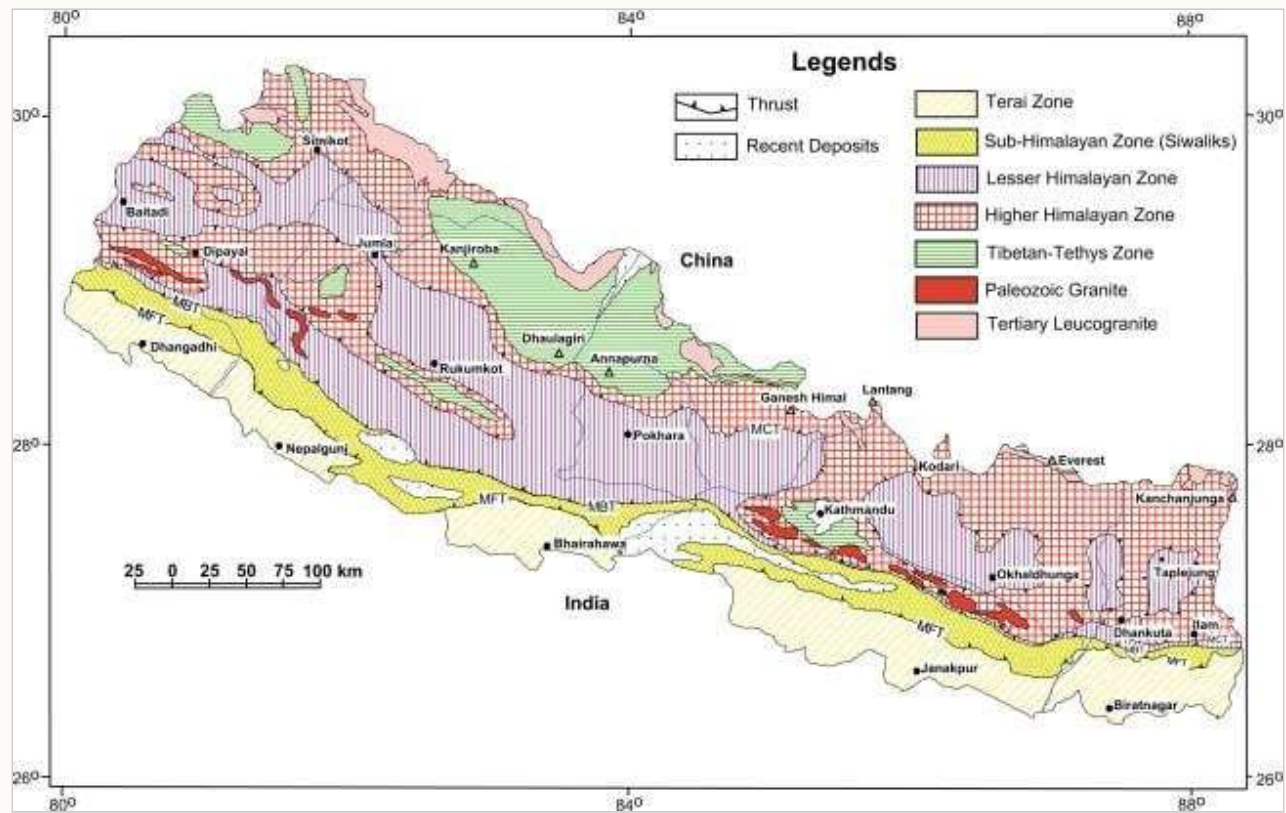
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Mff" u- "ff" s" v K-• " "Mff" "t "ff"

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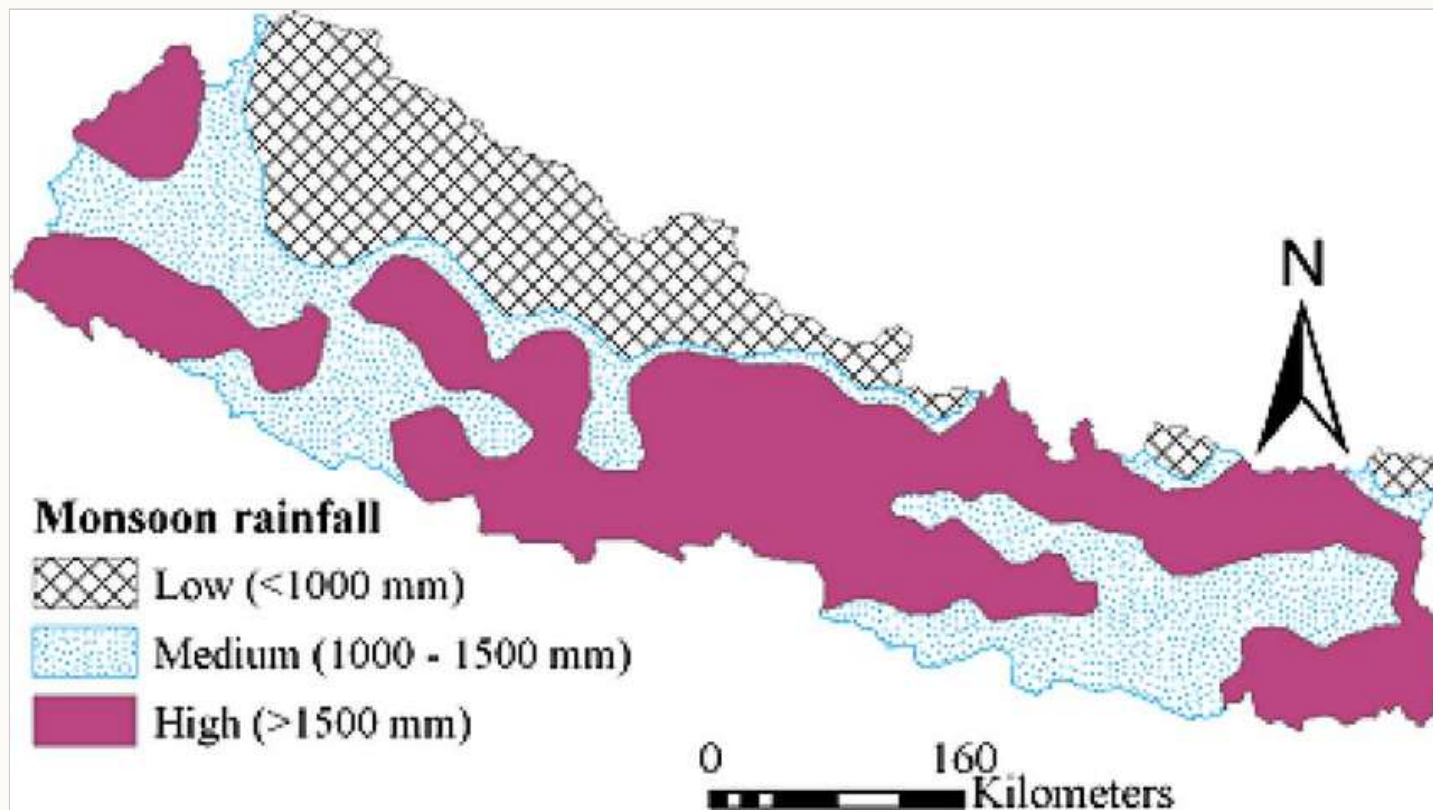
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 Yff" ffff" s<sup>"</sup> x-0 xsy<sup>-</sup>wywf-fy Gz<sup>"</sup>yz " fl  
 e-ff w st<sup>-</sup> " uw' s-ff w<sup>-</sup>w uw





Zw s- z "fy s z'u • s

Zw s-ywff-fy"us→ s

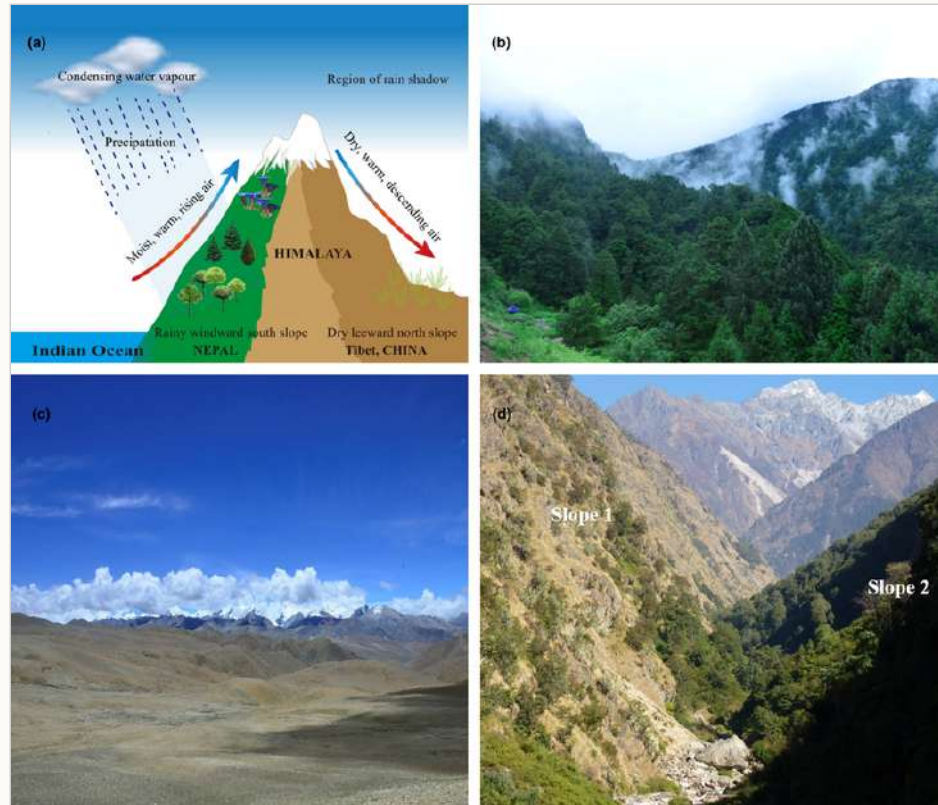


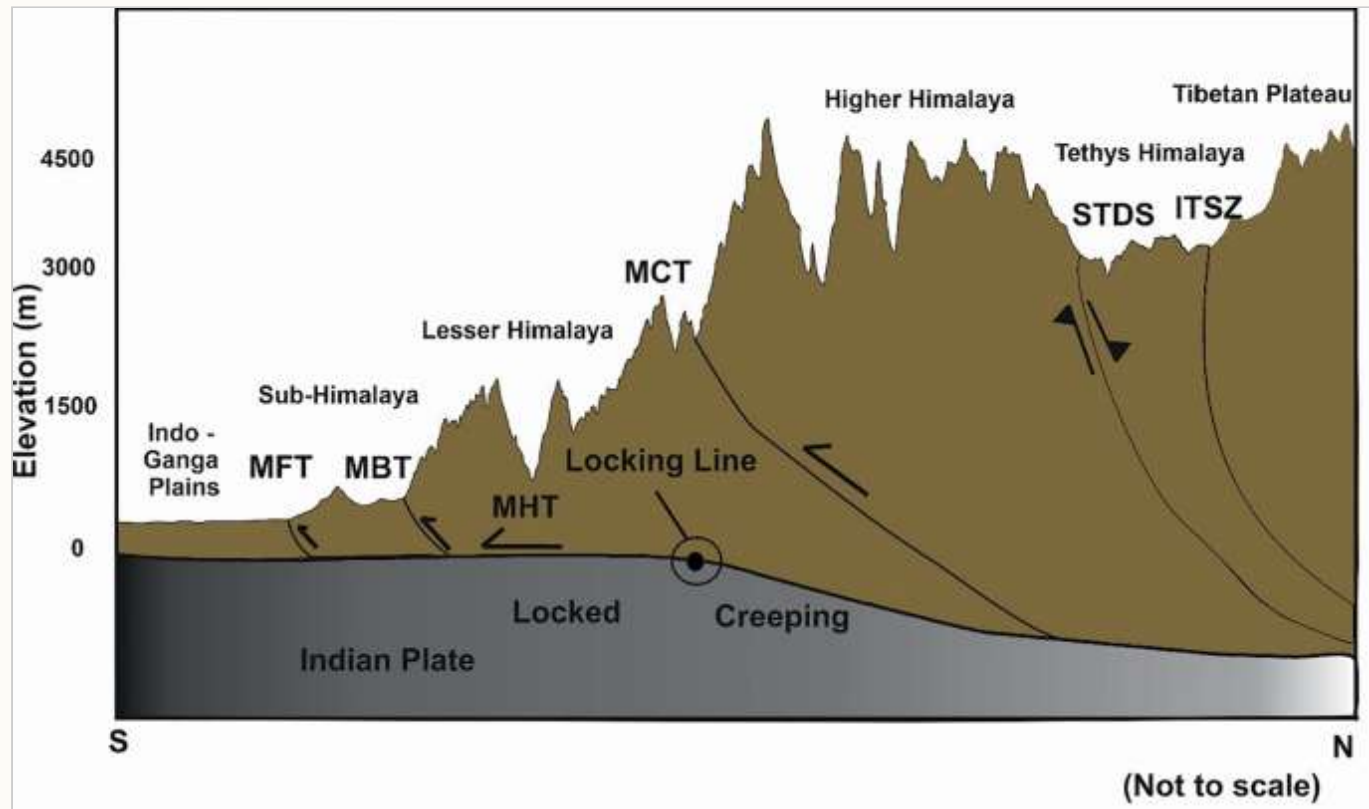
Zw s→ ff'' fff''  
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r

o

kff "y S• s-s s 1 wu ff" "u -x1 w' • "u"  
e ww ff w 1 ffx ff"1" w' w s" x—  
Zs s- uw "t " ff-s" v -vw





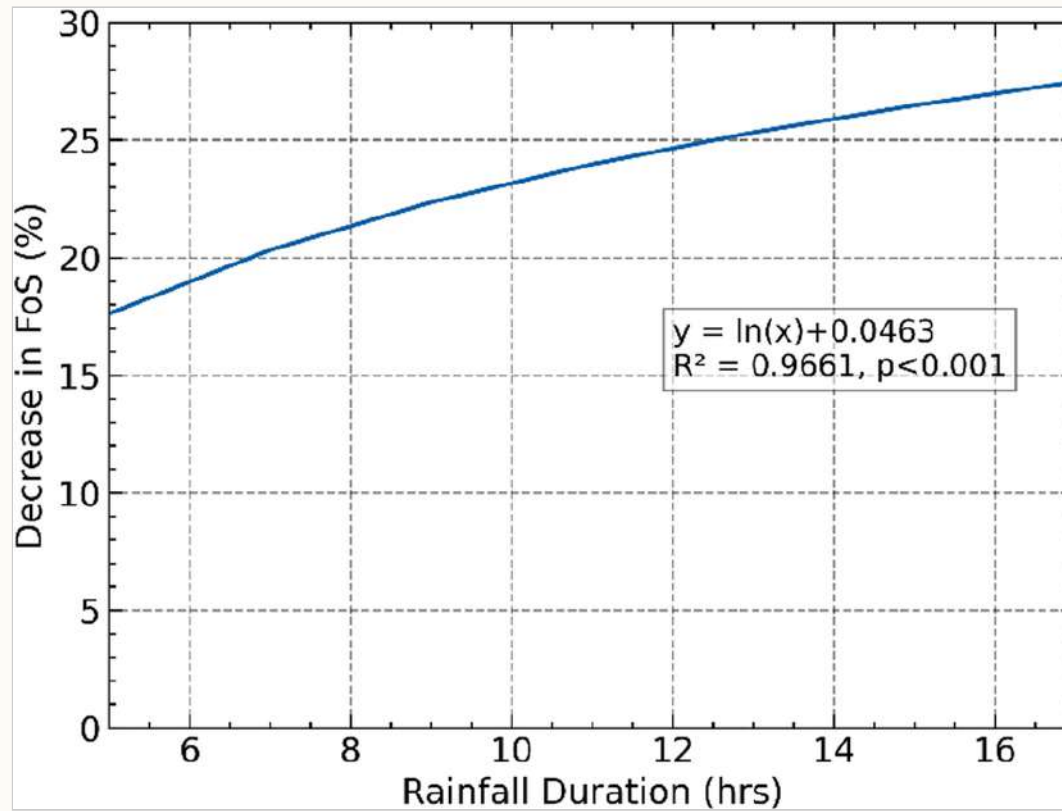
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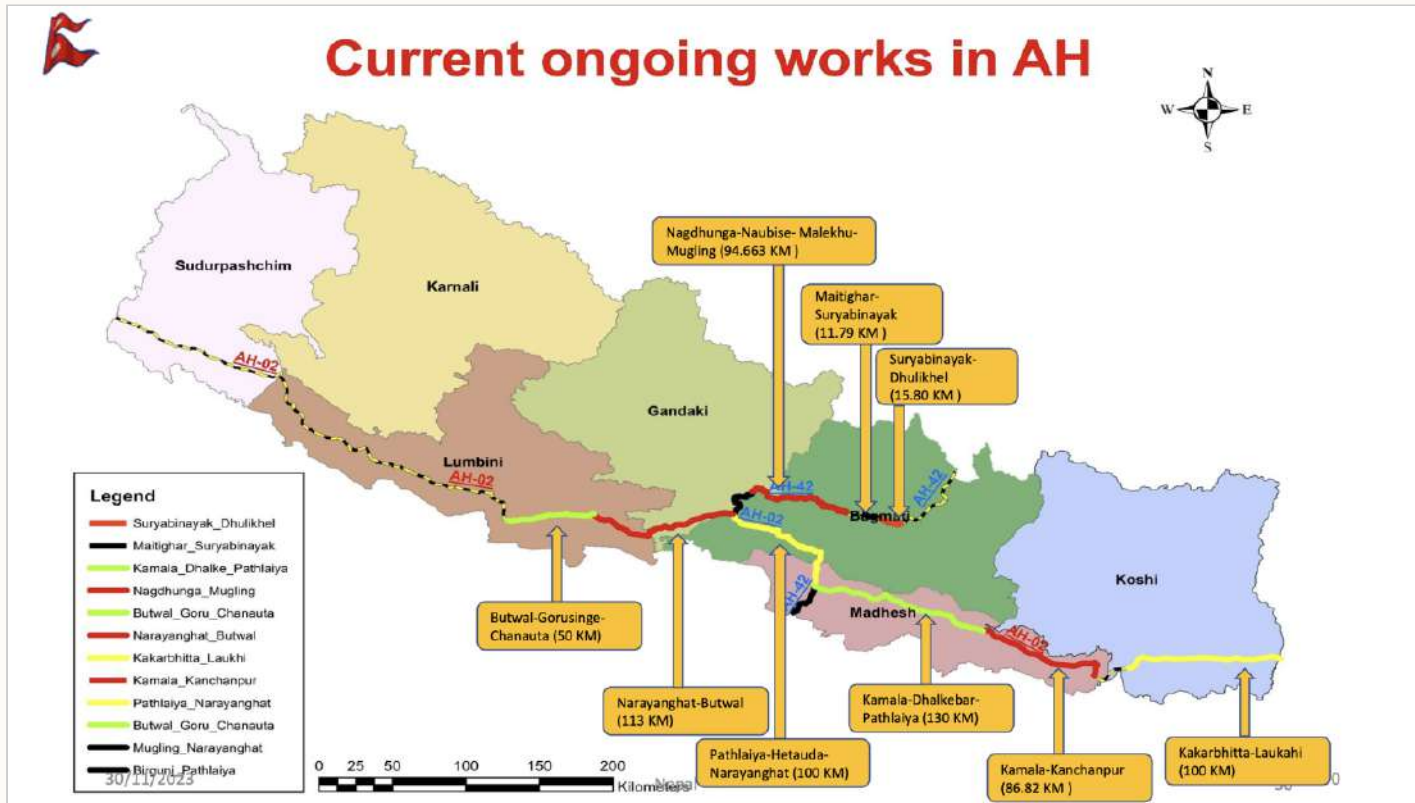
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Ss zs s v ffsv u "y s"v ff ww us s "ff"  
g" -s" w w w w s" v vwff w s "ff"  
i wsl v s"syws"v ffff uff" u "ff" su "uw

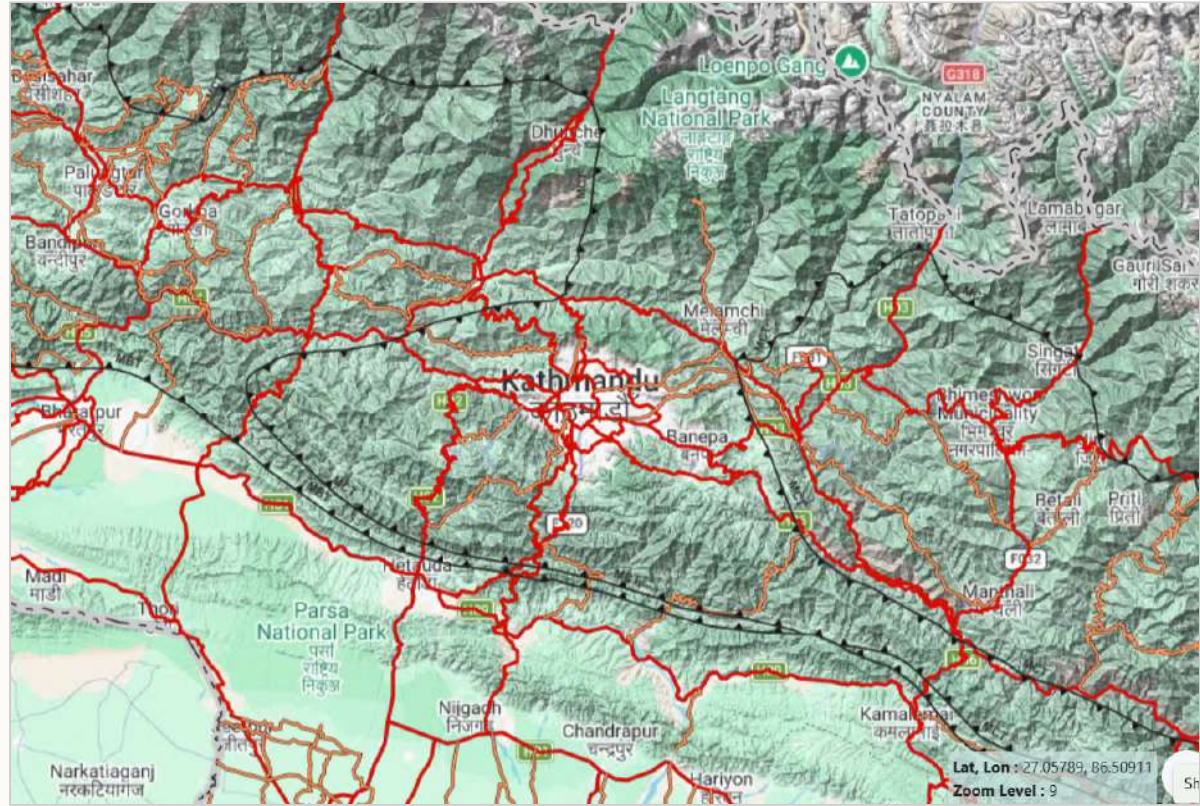












r

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Rst "ff" s— s" v t "ffw' y" ww" y wyws "ff"

Os — st "s "ff" • wzffv 1-ff uff t → "w

Pff " vs "ff" xf -s w ywff wuz" "us—sv s" uw





# V

Nzs s" Nzs" fl s dffsvDw' "ff" • w' x"W" v- uff" u "ff"

W• ff s" y U " dffsvD "ff" ww "y W•" v -vwT xw s "ff" 1Nw "y" s" v T -w w' s "ff" ffx ff w st "s "ff" 1 " w  
s" "y1v s" syws" v t "ffw" y" ww "y  
ew wwww' xf ff w• s" syw w'



a) Gabion retaining walls to support unstable slopes



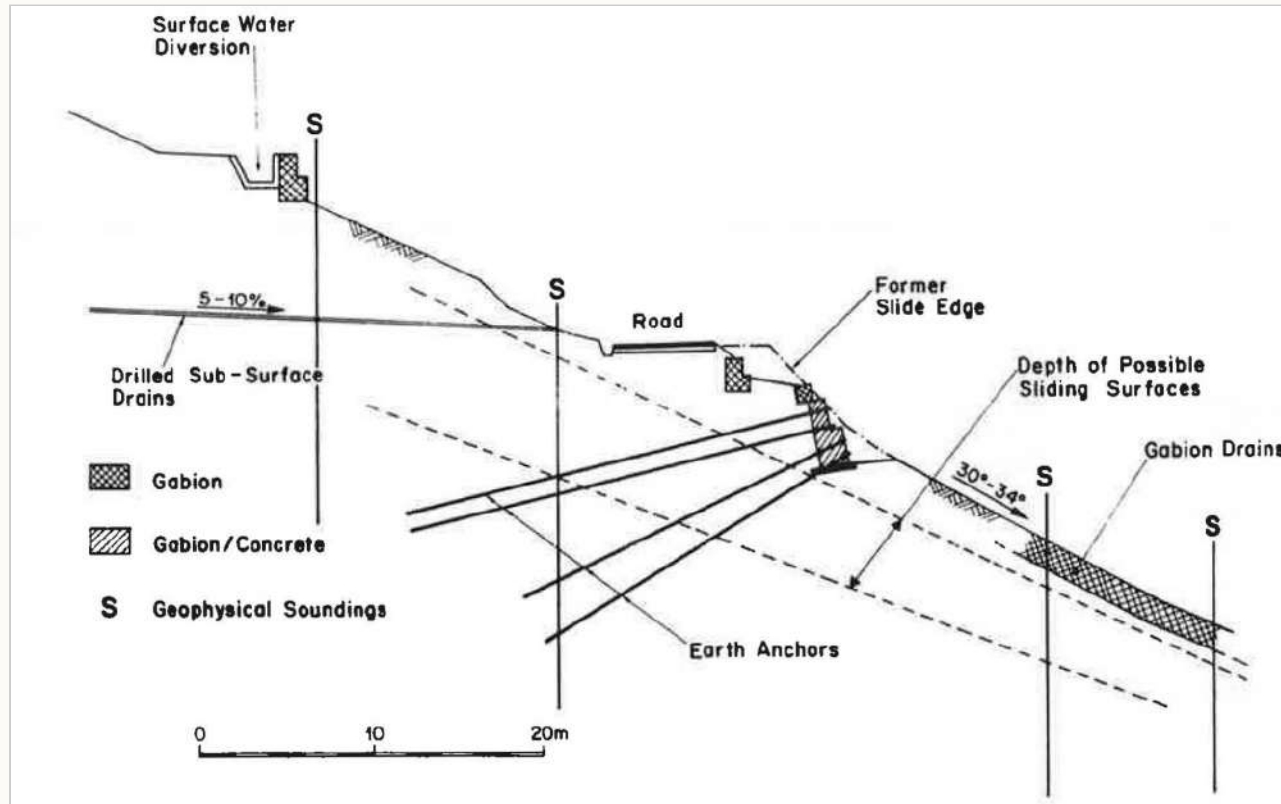
b) Extensive use of gabion retaining walls to support road fill and revetments to protect cut slopes

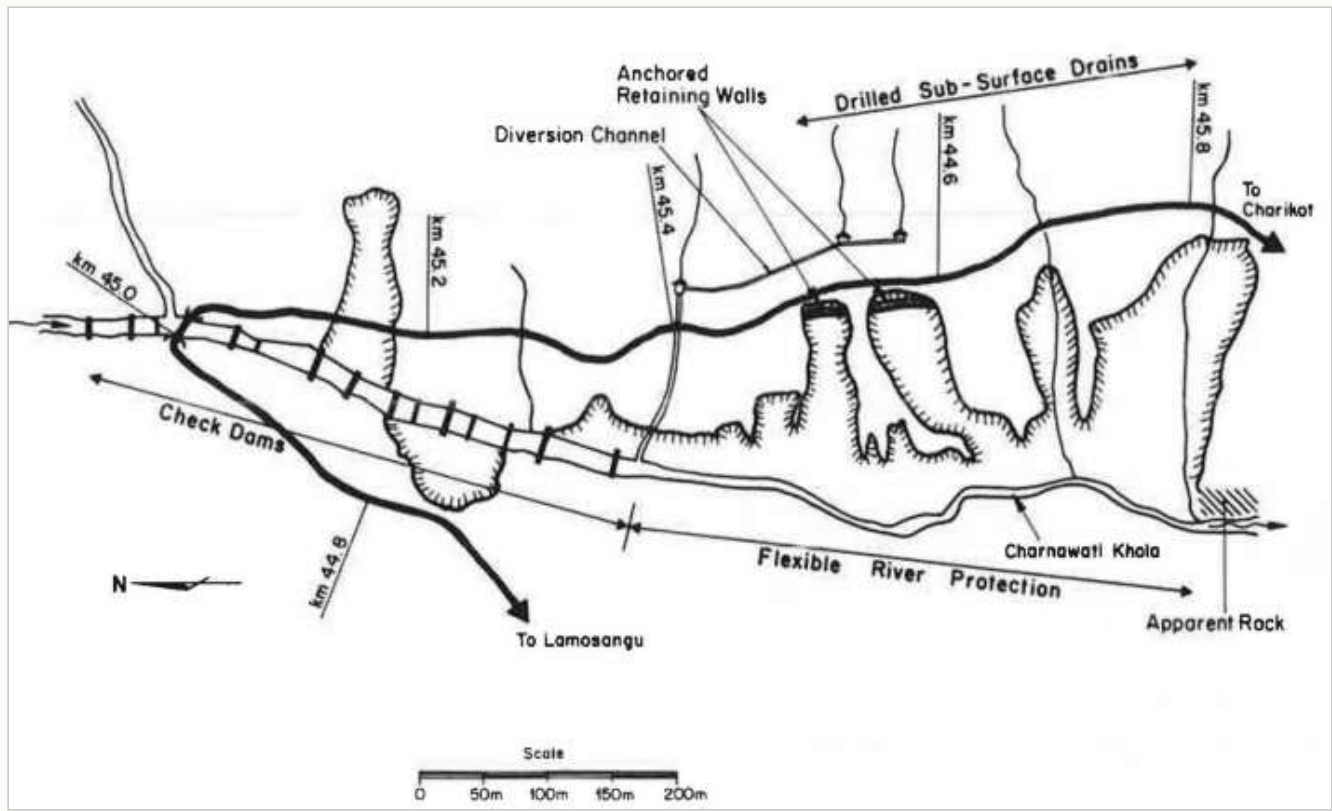


c) Continuous gabion cascade protecting central drainage line from scour

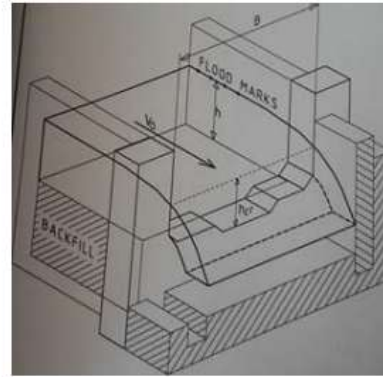
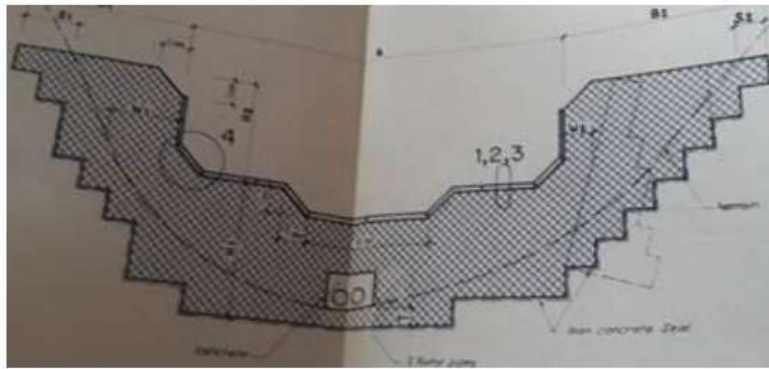


T ffv uw P w' uz v s'' 1 ff'' s''-1s'' uzff w s—  
T wy s w " w ff wu "ff" s" v -ff w st "" s "ff"  
Y "w ff" w "'' ''" ff s " wywff wuz "us- ff fl

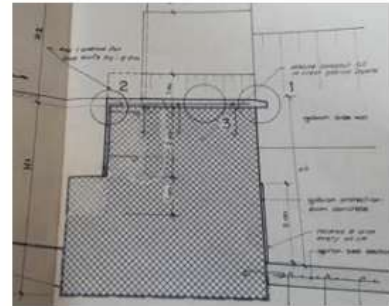
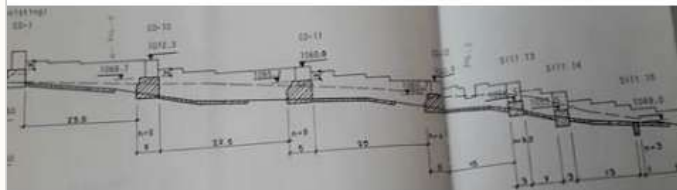


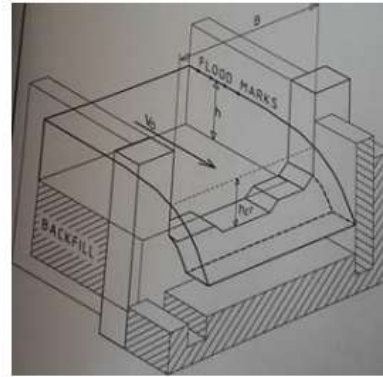
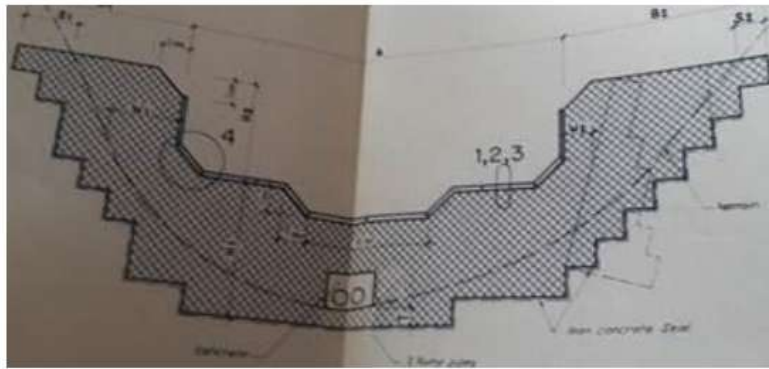




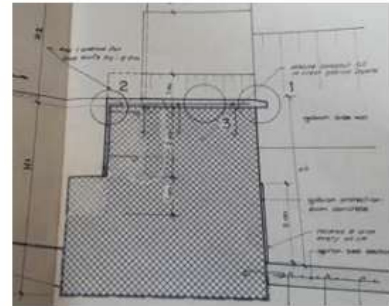
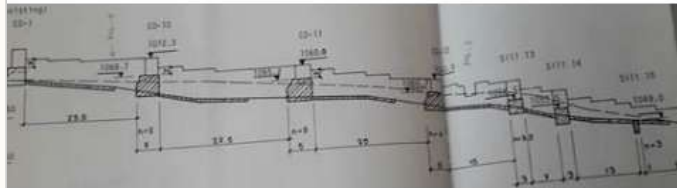


Design Discharge 120 m<sup>3</sup>/s





Design Discharge 120 m<sup>3</sup>/s

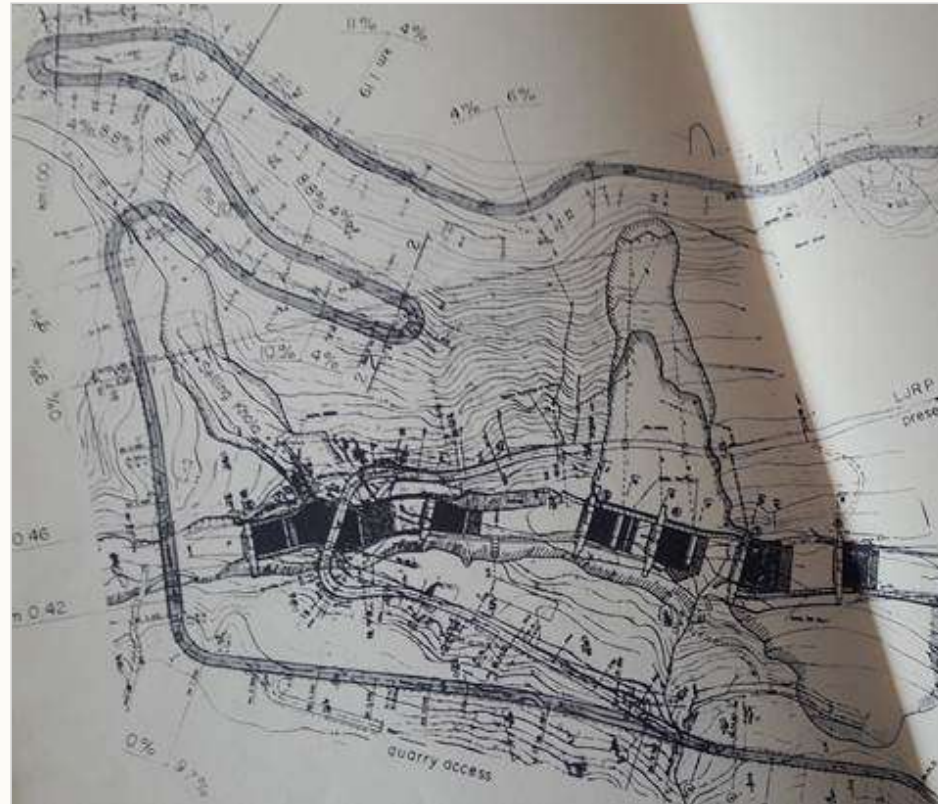


ML

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N“ s w s Mzs ”s s “hs-w  
86 U – 56 K y 6CBA



W6 ff ffxa "ff" e v'w

**ETH zürich**

### Charnawati River Stabilisation Project



CAB's (Concrete Armor Blocks) placed on the bed and on the banks of the Charnawati River, Prototype.

CAB's (Concrete Armor Blocks) placed on the bed and on the banks of the Charnawati River, Hydraulic Model.

After the intense flood in June 1987 stabilisation of the Charnawati River in Nepal became necessary at the crossing with the Lamosangu-Jiri Road. A new concept of stabilising the riverbed with concrete elements arranged to flexible structures was developed and tested in a hydraulic model. Element shapes known from shore protection

Mff" u wwK • ff Ls" v



Nw "y" ts w ff" z v s -u • ffvw-w uff" v u w s PKi -P- ts "vi s wts .s Of SI "uz1e " w-s"v  
ff ffy s z s"v tff -vw ww • ffvw-w " us-w695 xf s "y v" uzs yw ff 675 u • wu 3





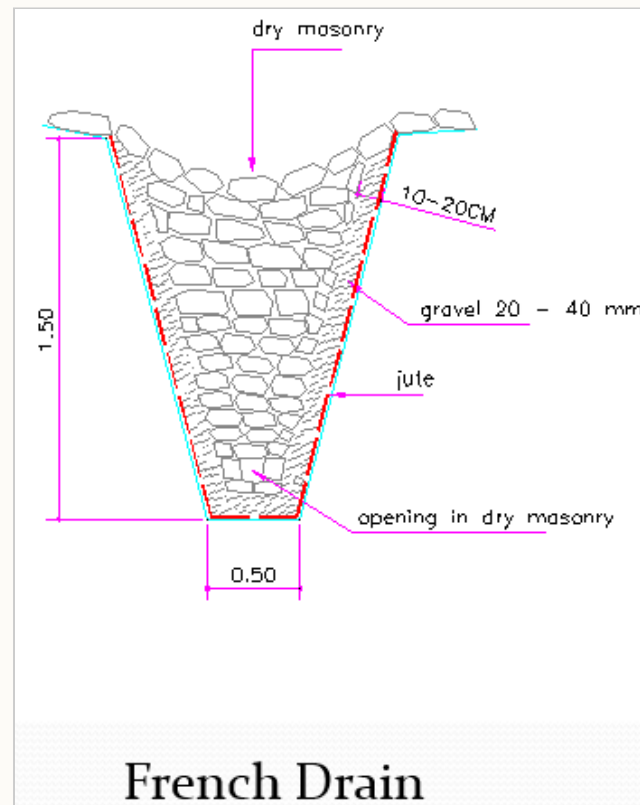


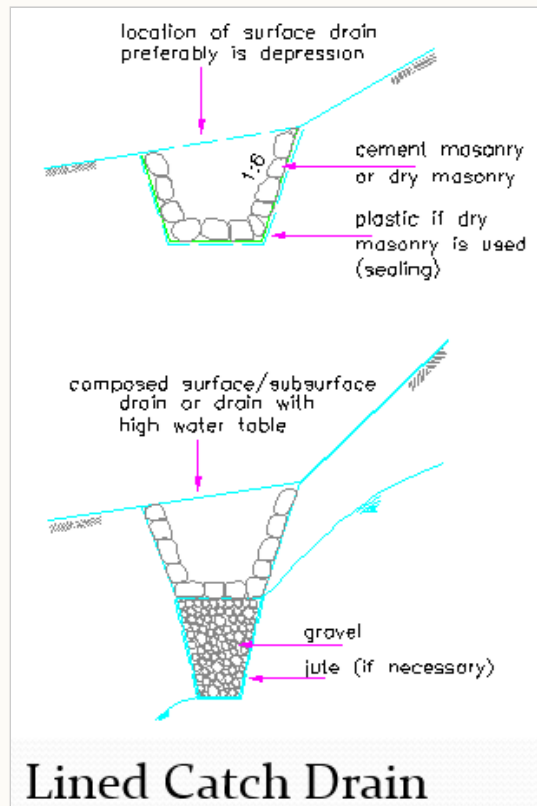


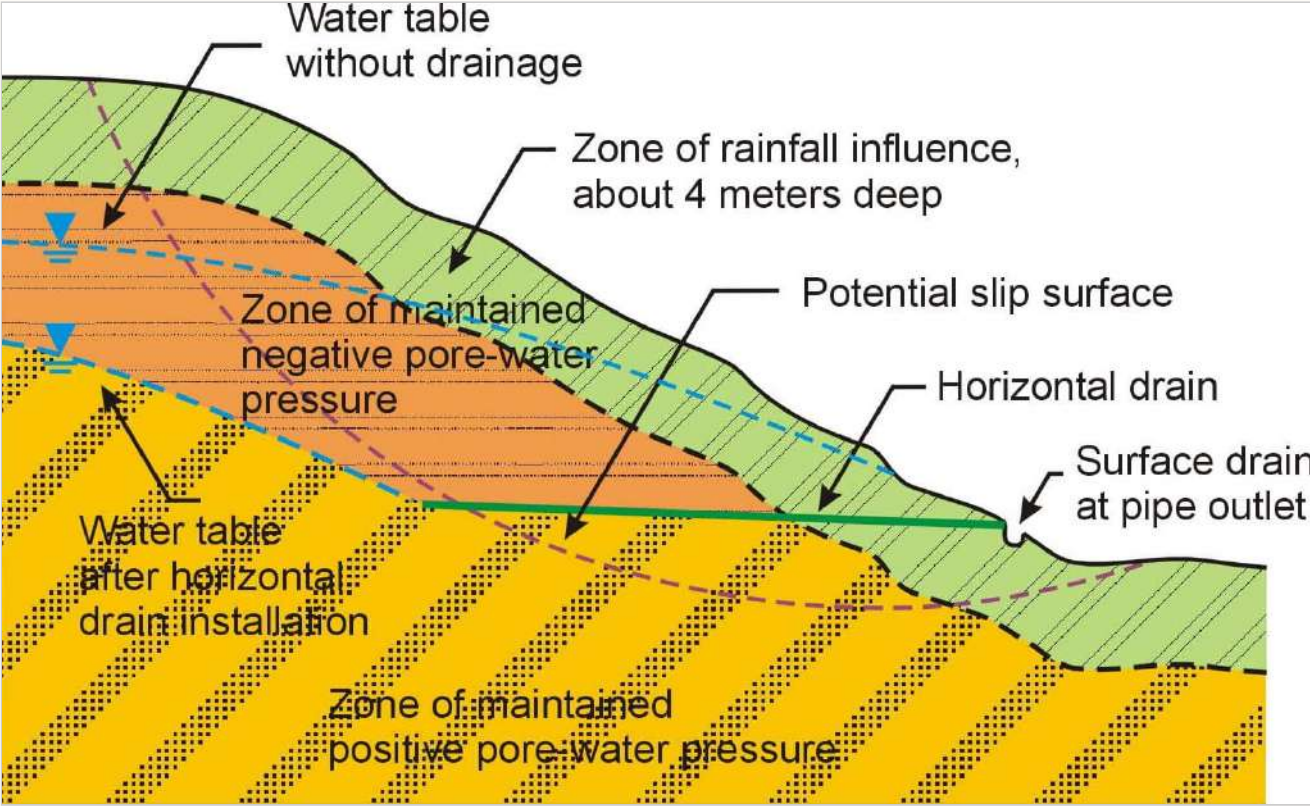
e s Mzs "s s"  
ffxi ff fl

m

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# Ittlibach Gully Erosion Protection Works

Engelberg, Switzerland



Snowmelt & Heavy Rainfall



Risk to Infrastructure & Tourism



Downstream Sedimentation

**Harnessing Alpine Resilience: Engineering Meets Ecology.**



L ff z vwt " ff w w' zs w' w w "" 6CBA

Y ffvw-w w w s PKi 1Of S1l "uz

Y "ys "ff" • ws w " "s Duzwufi vs• 1y "vw s-1vwt " ff t s "w 1t "ffw" y"" w w "" y

Mzs "s s "1Zw s- T-t suz1e " w-s" v

# j r

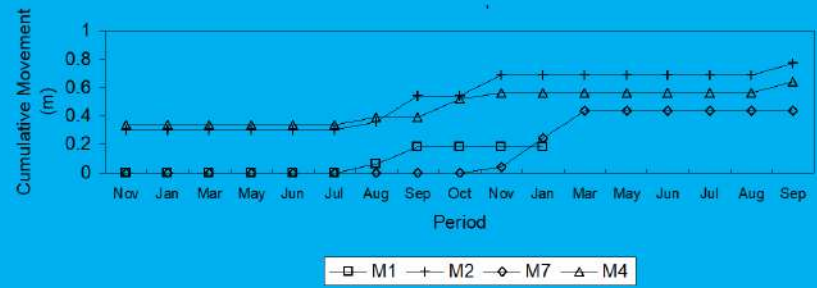
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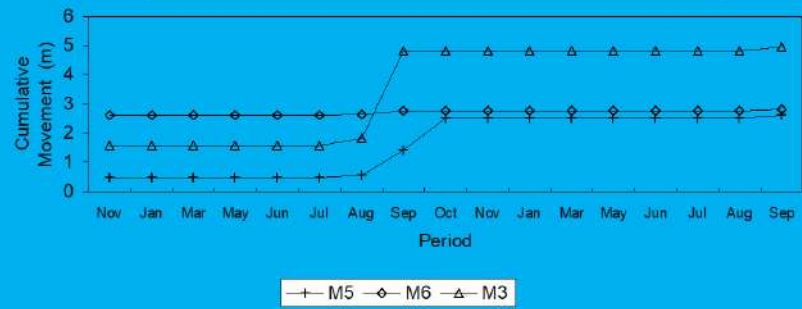
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eff- "ff" zff w w "w uw" Rff flzs Os z sflw756:



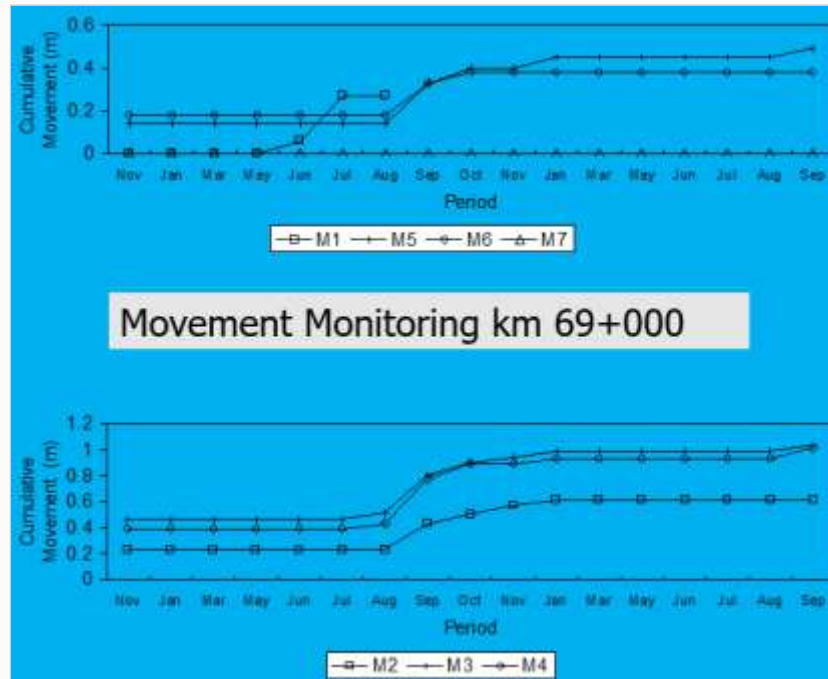


### Movement Monitoring km 72+500







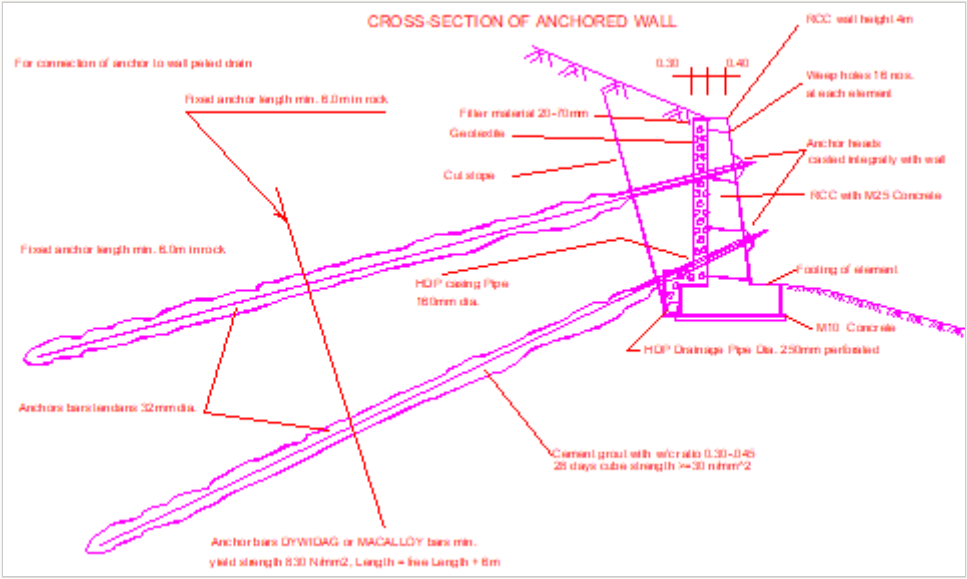


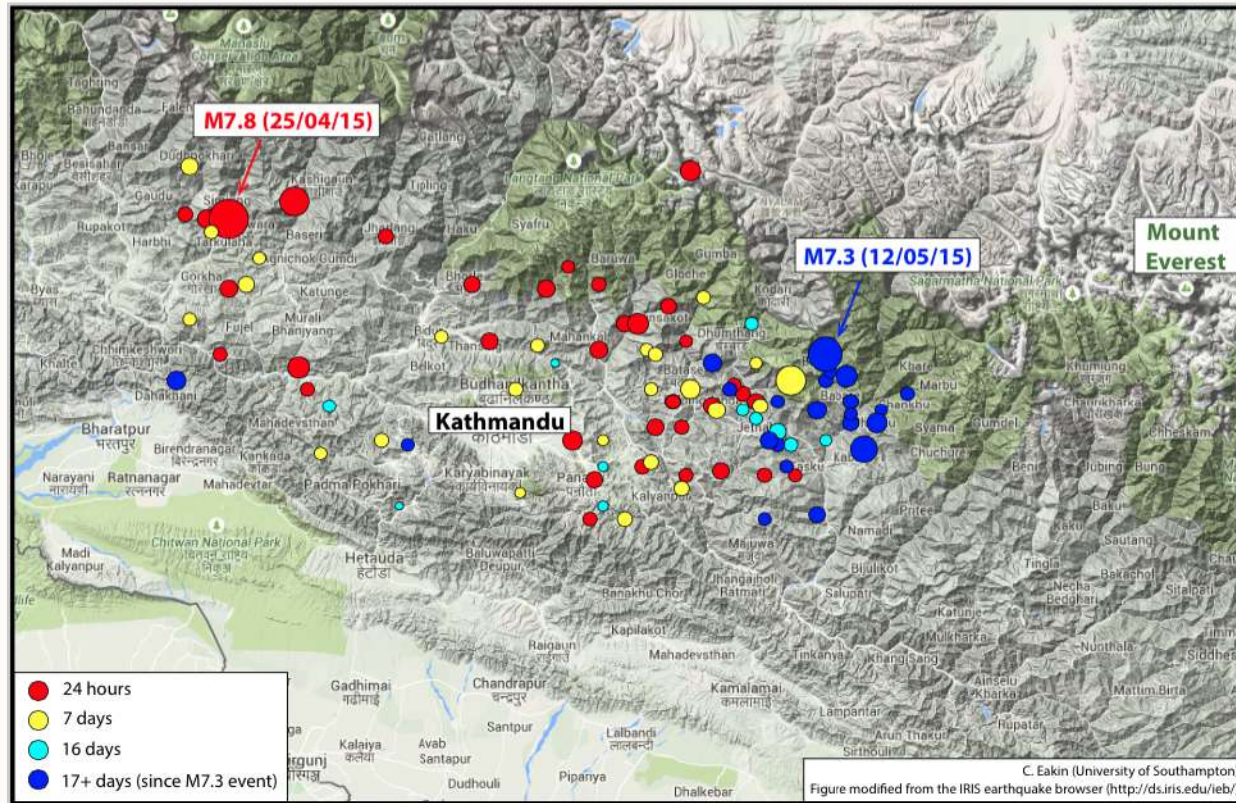
K s" flff S"yz s =Cfl•











e st “ w e “vw Wfus w i “ z” l ff” wffxRff flzs Os z sflw756:  
 W• ff s”y 2U“ dffsv  
 Mzs ”s s “dwzst “s “ff” b fffiw  
 K ”“flff S“yz s -fl• =72BA  
 f zs” flff 2Zs t “ wdffsv  
 f “t z s” dsfi s z  
 b “z “S“yz s -Zs t “ w2Y y“0” y.

Zs s s" yzs 2Y y" y d ffsv

y

Fw

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fl• 6A

K” uzff w dws“” y i s—









W6 • “vs” vs W6” v –vwb ff wu “ff” i ff fl









Vzs " s s W" v -vw  
f Z65K  
f zs" flff 2Zs t " wdffsv









V “ z” st z“ W” v -vw

b “z “S“yz s

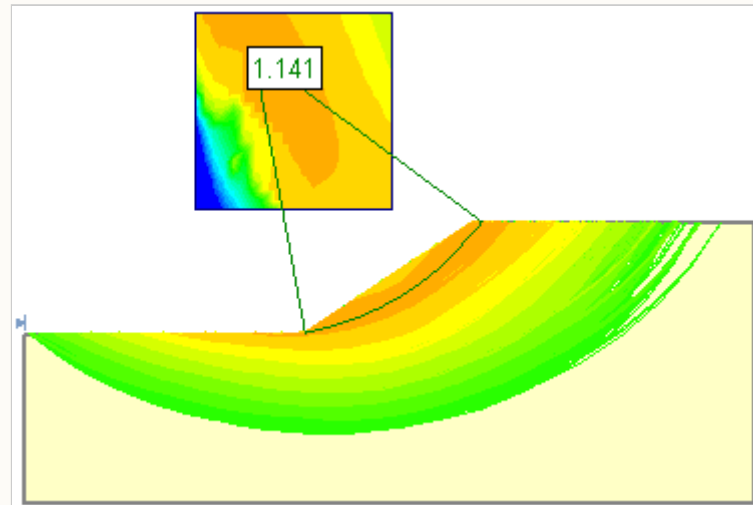
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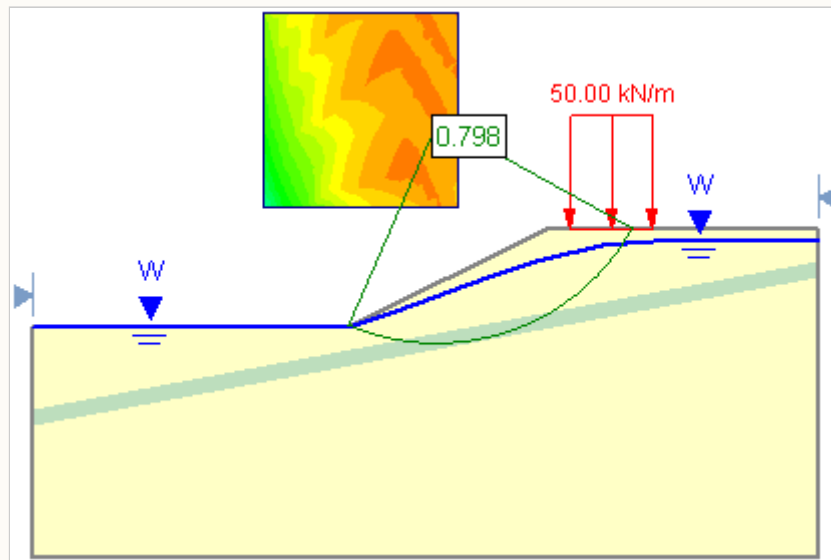
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Lz s" Ws ws-S"yz s DZw s-w ww w w ff w s" uzff w s-1zff " ff" s-v s" 1ywff z "us-" w "ys "ff"  
wuz" " w s" v t "ffw" y" ww" y • ws w  
f wuz" " w w "us ww " U+V s" v Y" ff s• ffxT v"s s" v Lz s"  
Zw s- s" v z"yz s s wy"ff" s- wvw" uwD  
L "ffw" y" ww" y Ss" vt fffffl s" v dwww" uwYs" s- - ff ff-• w . s wt w" uz• s fl vffu • w' " zw dwy"ff"  
Yff " s" d" fl O" y" ww" y Ss" vt fffffl - ff ff-• w . s ws• ff" y zw• ff uff• wzw" " w wvw" uw " SVS wy"ff"  
R "vw ff e-ff wb ff wu "ff" i ff fl s" v dffsv "vwRwff wuz" "us-b fft-w DK b su "us-R "vw ff f zw' e-ff- "ff" s w  
" " wzs" v t fffffl t- zw t Nad1Zw s-  
Mzs "s s "dwzst "s "ff" b fffiwu s" v K s" flff S"yz s zs w w w s zw wv-st ff s ff ff zff us wZw s-  
uuw x - ff w st "s "ff" ff- "ff" xf " • wff " w" s "ff" s- s" "y uff" v u w t TMY a N1i L s" v Ra Z  
K "w v s" sywl ff-" s- s" v t "ffw" y" ww" y ff- "ff" zs w wxf • ww w uw-w" s" v zff " w-"w" uw" w • "u  
w w' "flwRff flzs Os z sflw756: ffxY A3  
Rwff O" "ff" • w' s" v effu"s-g" " " "s " w " Nad1Zw s-  
L-w" v ffxt "ffw" y" ww" y s" v ywff wuz" "us- ff- "ff" 1" ff ff" w ff- "ff"

# j

Zw s-zs vw ff" s w s w ffx2zw2s fff- s"v wuz"" w "" ff w st "" • s"syw w" D  
W" O "t " • Ywzffv "z e-vwff ffzw ffx s w  
P""wOw w' Ywzffv "z zws w'y z w u"ff" "z de7 ff b-s " ffx s w  
RtE t s w -s"v -vw uw "t "" • s "y  
Zw s; OvywD  
P "ff" ffx t "ffw" y"" ww"" y 0 ywff wuz" "us-• ws w  
K ff vst -w1 s""st -w1 wy"ff" s- sv• "w  
g"" w• ffvw-xf • ff " s"" ffsv





**S**

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## Innovations & Knowledge Transfer in Slope Stability



**Replication & Resilience**

- Technologies replicated across SRN.
- Resilient during the 2015 Gorkha Earthquake.

**Knowledge Transfer**

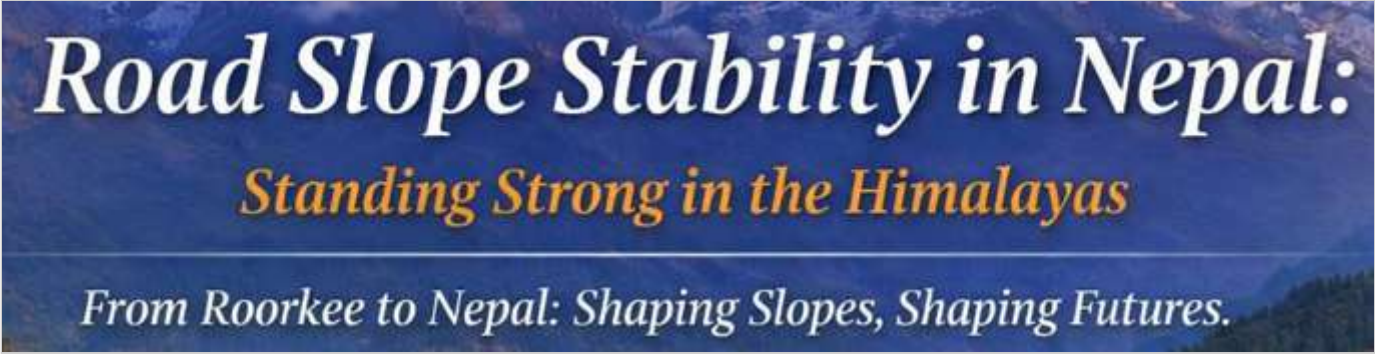
- Manuals & handbooks as regional benchmarks.
- Dissemination from projects to academia & industry.

**Future Commitment**

- Import, adapt & scale proven technologies.
- Embed knowledge transfer in every project design.

**Nepal's Edge = Innovation + Knowledge Transfer → Regional Leadership**

Mff" u- "ff"  
e st "s "ff" 4 "ys "ff" • ws w " w zwRff flzs ws z sflw  
Y" ff vs• syw • s"sywst-w "z wu w' 4w wyw' u • s" w's" uw  
Yws w wxf • w w-ff w 75 85 ws -xw s"  
V" ff -wyw s" xw w'st-w Zw s-w ww w 4ff" su ff ff vw "y" + "• -w w'  
dw -us "ff" su ff edZ ffsv s" v t w ff" v Zw s-  
K-• " "Mff" "t "ff"  
V" ff -wyw s" xw + • w' ff z" xf ff "y w' y" ww  
b "vw" Zw s- wsvw z" " ff w st "s "ff"  
T "s "ff" xf sv s" uw v"w " ywff wuz" "us-w" y" ww "y  
Kuf" ff -wyw K-• "DLw" "Ysvzs Wflzsf11es" v" ezs1Ls Nw bfflz w1a• ds 1Z"s Kz• sv1g s•  
K• s s1Yffzs" ds "s ezsfl s1ez" ezs" fls Vs fl"1f fl W-Kvz"fls "wu3  
Kuf" ff -wyw T " "ff" DeNM1i L1KNL1geKT1MYa N1Na d1NffW1Y ffOi dT1T OMa Zw s-



f zs" fl ff xf ff s w' "ff" !