

The top-left corner of the slide features a series of thin, light-brown lines that intersect to form a complex, abstract geometric pattern of overlapping polygons and triangles.

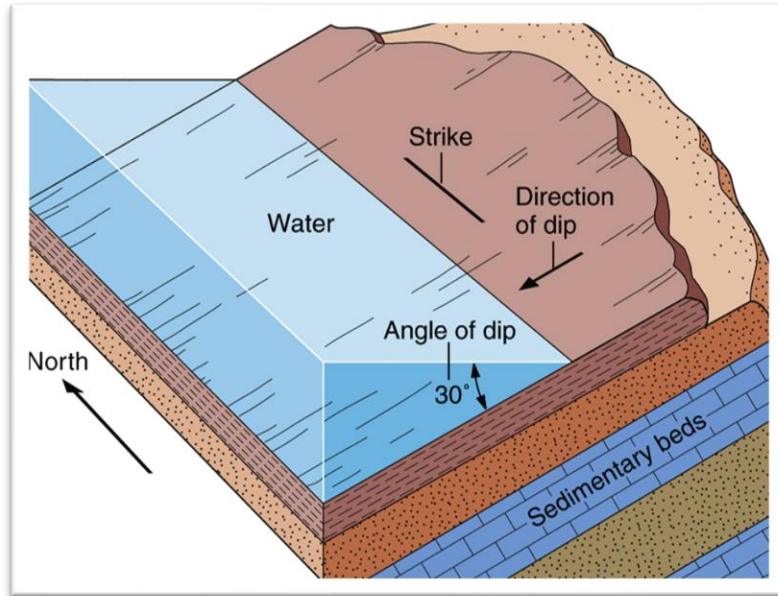
# The effects of discontinuity-induced anisotropy of permeability on rock slope

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Date: 03/07

# Outline

- Introduction
- Methodology
- Results
- Conclusions

## Slope stability



Source: <https://www3.nd.edu/~cneal/planetearth/Lab-Structural/DipStrike.html>



Source: <https://www.nasc.gov.tw>

Slope stability is affected by rock discontinuities.  
More discontinuities reduce stability and it could be broken.

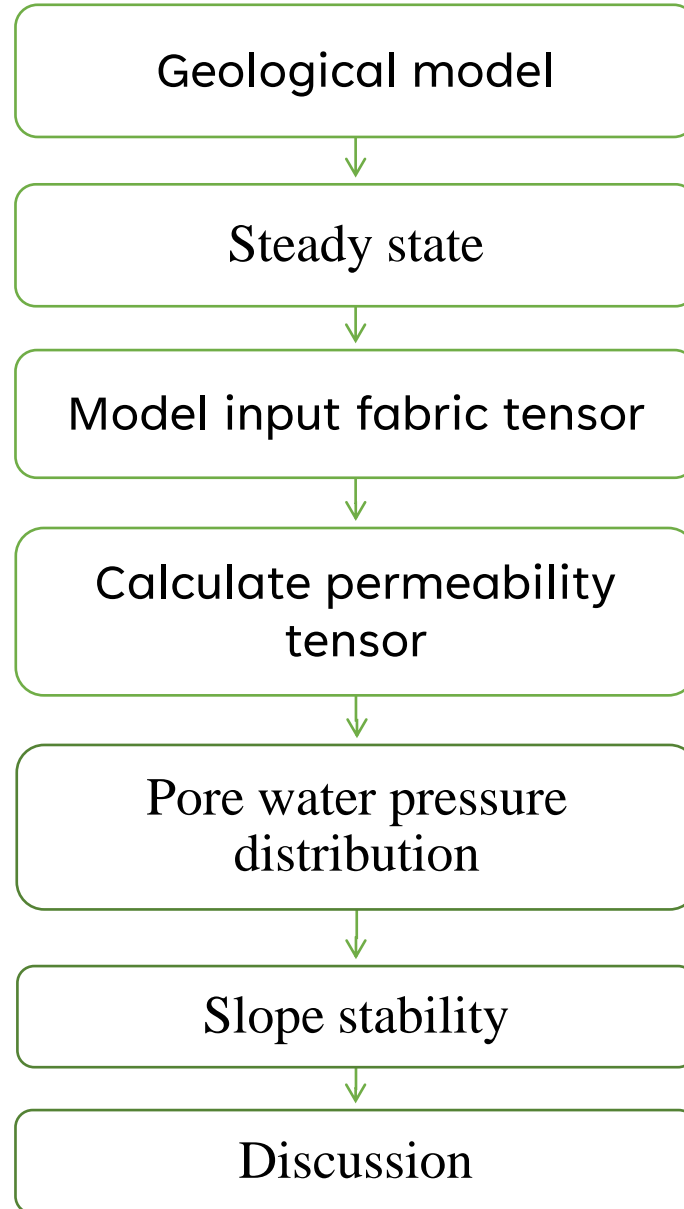
# Introduction

# Methodology

# Results

# Conclusions

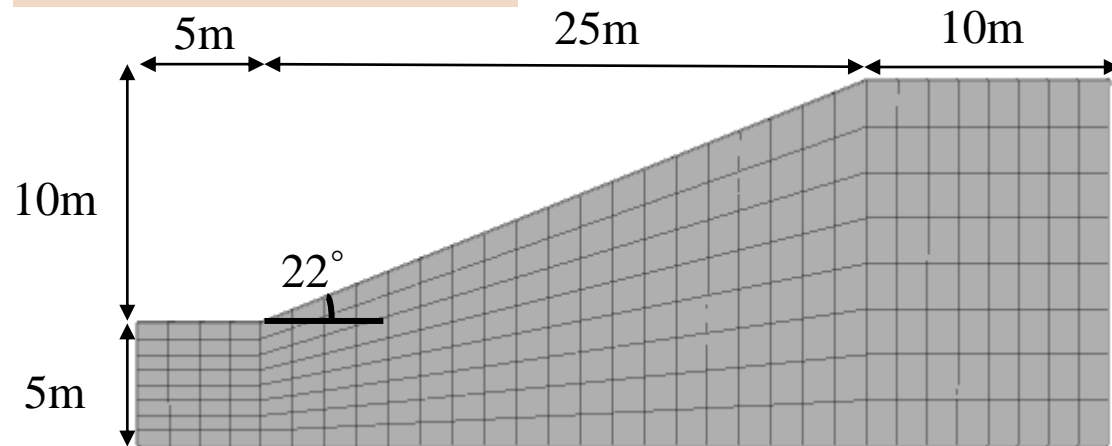
Flow chart



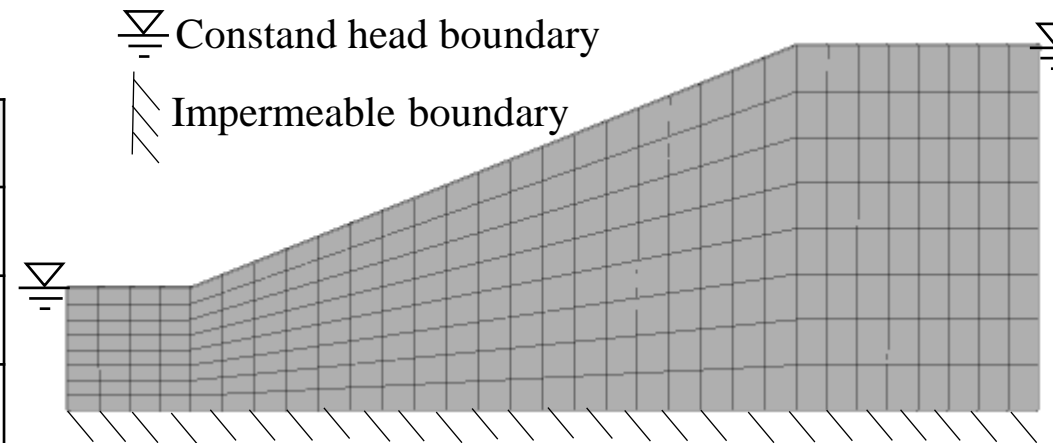
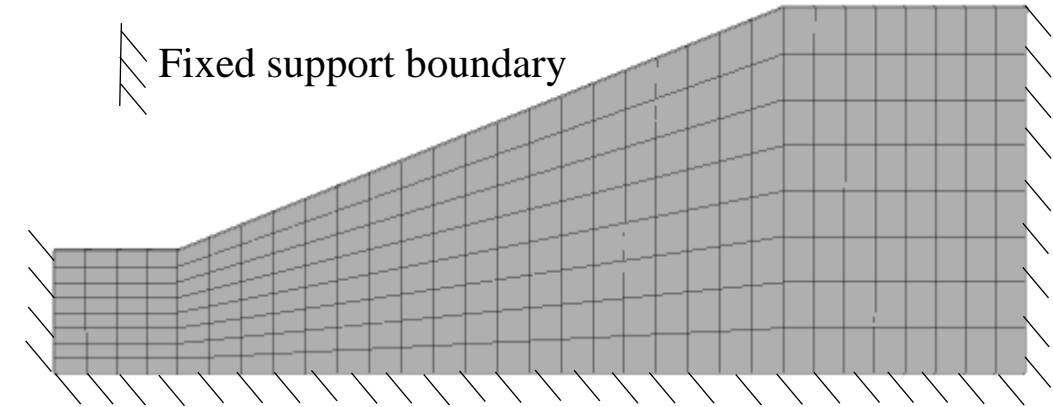
Numerical analysis software



## Geological model



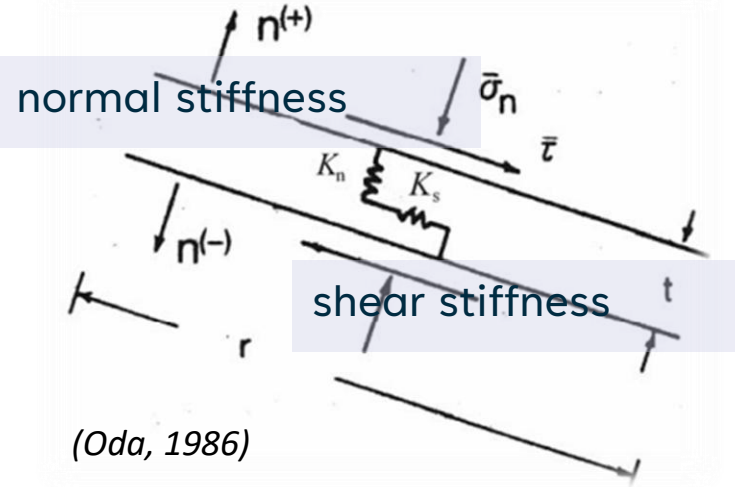
(Liu, 2023)



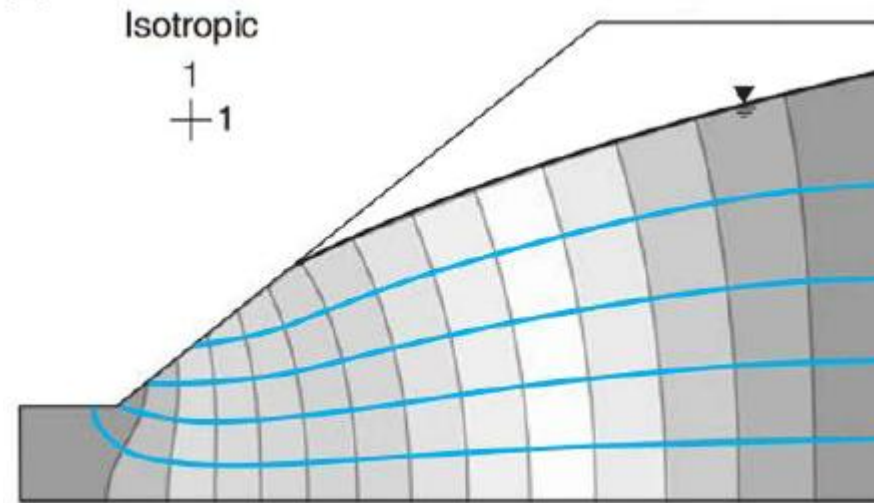
Material properties	Value	Material properties	Value
Dry density	18400 ( $\frac{kg}{m^3}$ )	Fluid modulus, $K_f$	10 (kPa)
Young's modulus, $E$	200 (MPa)	porosity, $n$	0.3
Poisson ratio, $\nu$	0.3	saturation, $S$	1
Friction angle, $\phi$	22.5°		
cohesion, $c$	17.5 (kPa)		

(CECI, 2021)

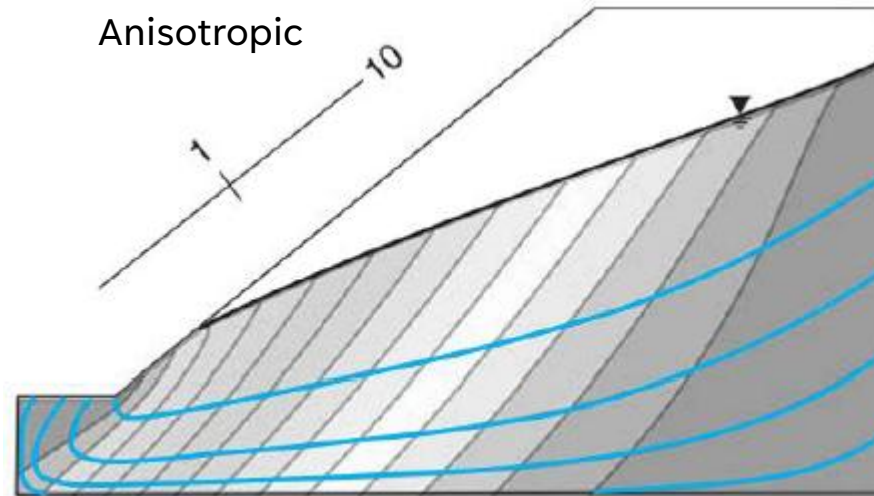
(Chen C. C. &amp; Yu C. W., 1994)



- $t$  = Aperture
- $r$  = Discontinuity length
- $\sigma_n$  = Normal stress
- $\tau$  = Shear stress

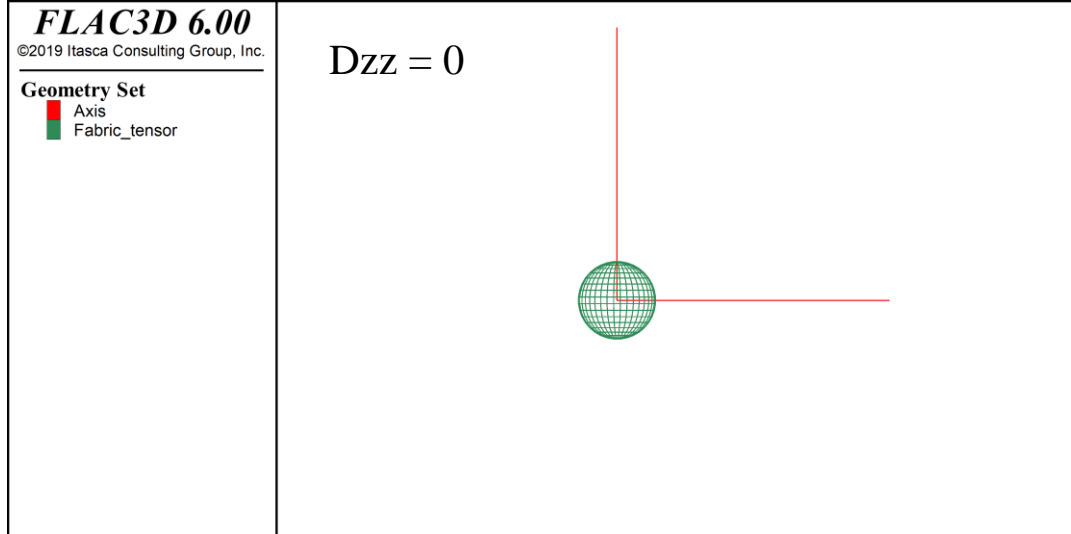


- Flow line
- Equipotential line



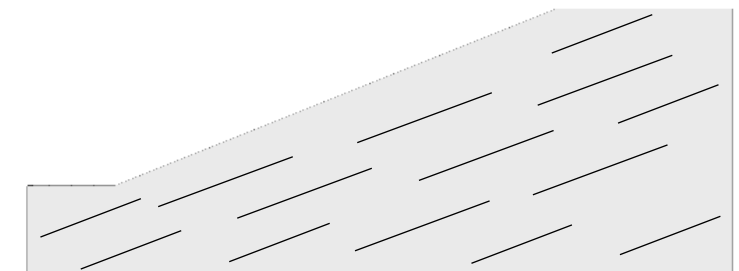
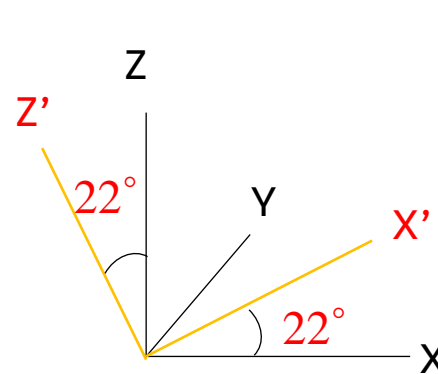
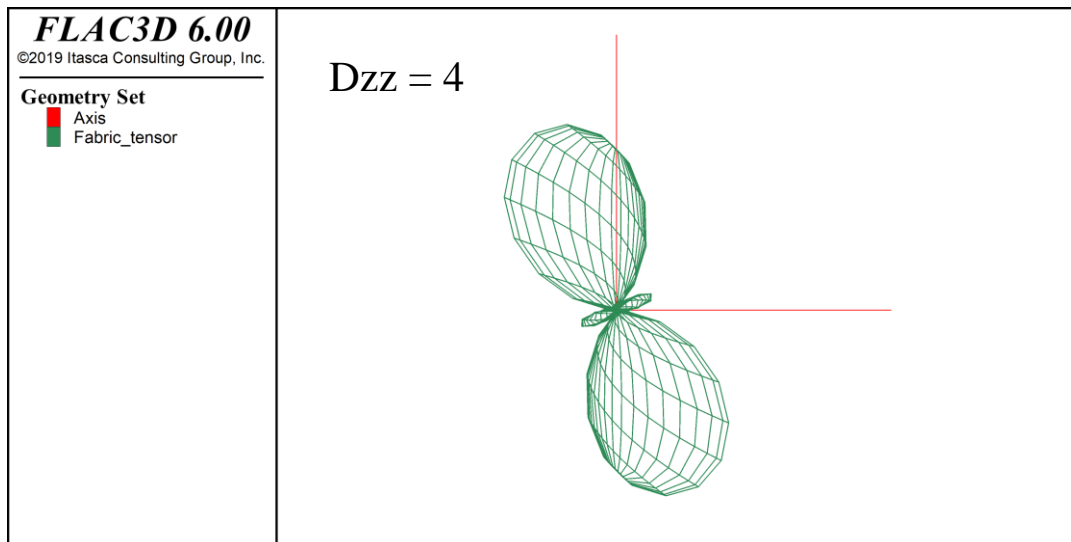
(Wyllie and Chris, 2004)

## Fabric tensor



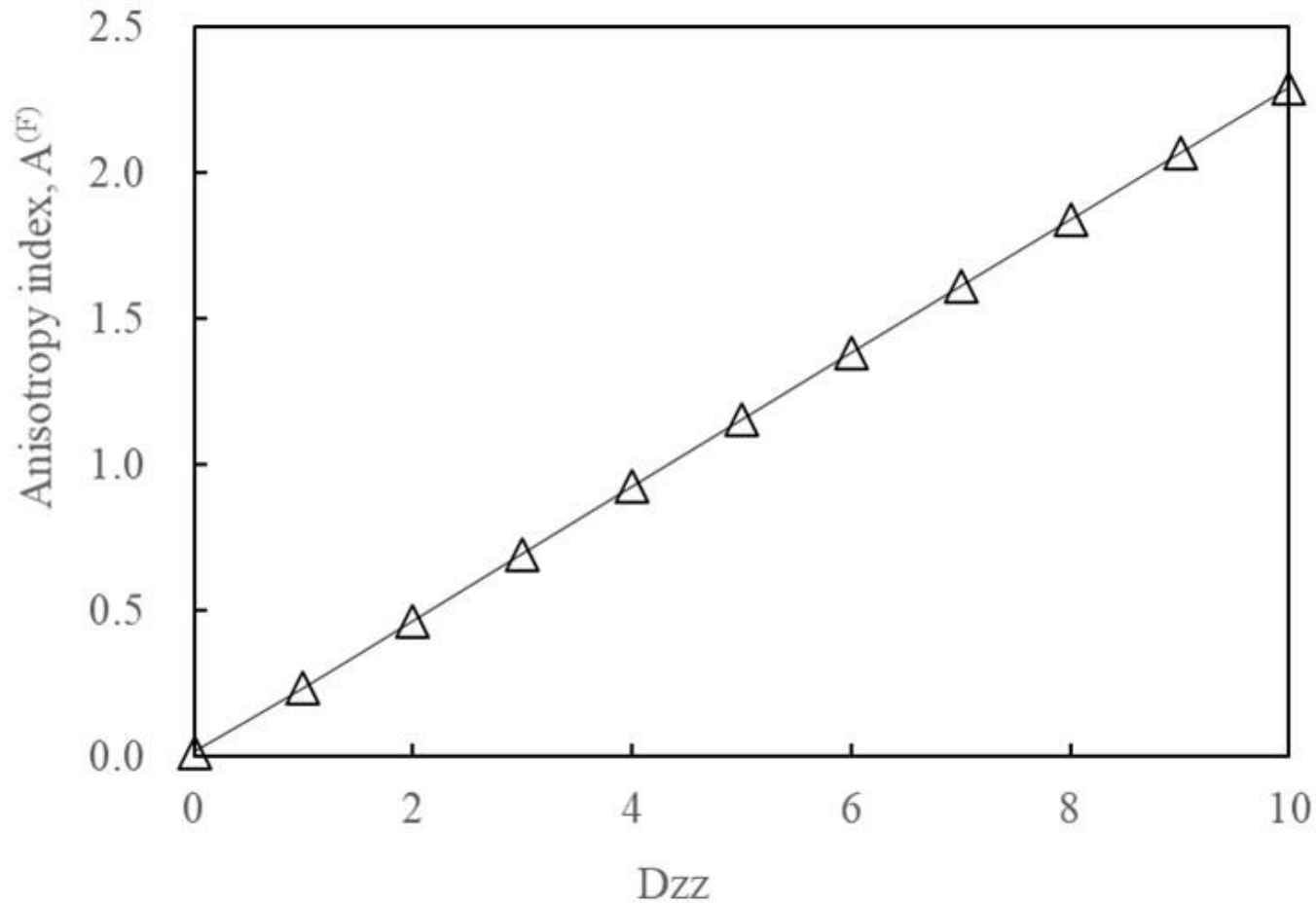
Fabric tensor is normal vector function of discontinuity density.

$$D_{xx} = D_{yy} \quad , \quad D_{xx} + D_{yy} + D_{zz} = 0 \quad (\text{Kanatani, 1984})$$



— rock discontinuities

## Anisotropy index



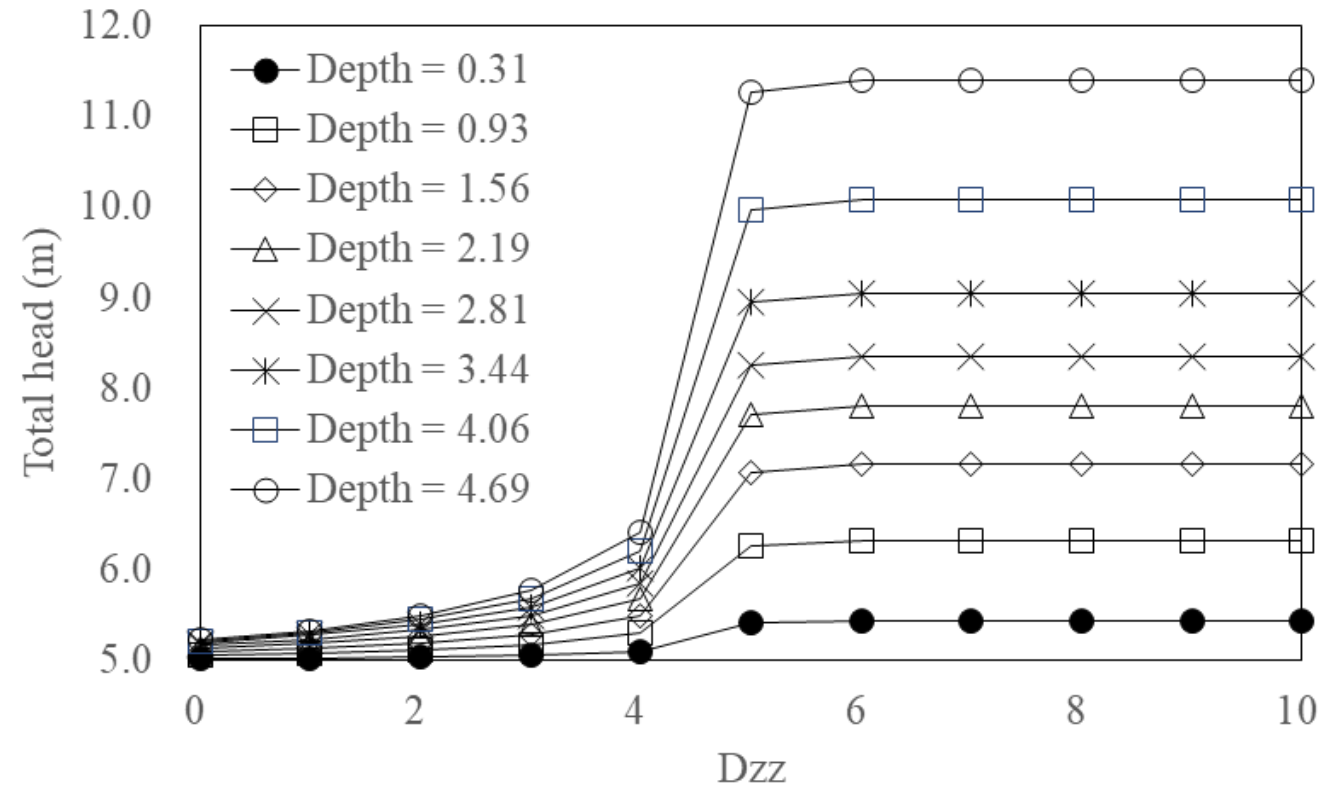
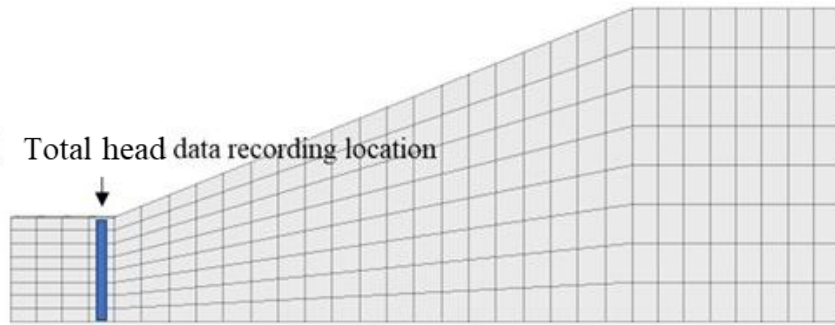
The anisotropy index shows how the fabric tensor affects permeability anisotropy.

The anisotropy index has a linear relationship with the fabric tensor.

A larger fabric tensor increases permeability anisotropy.

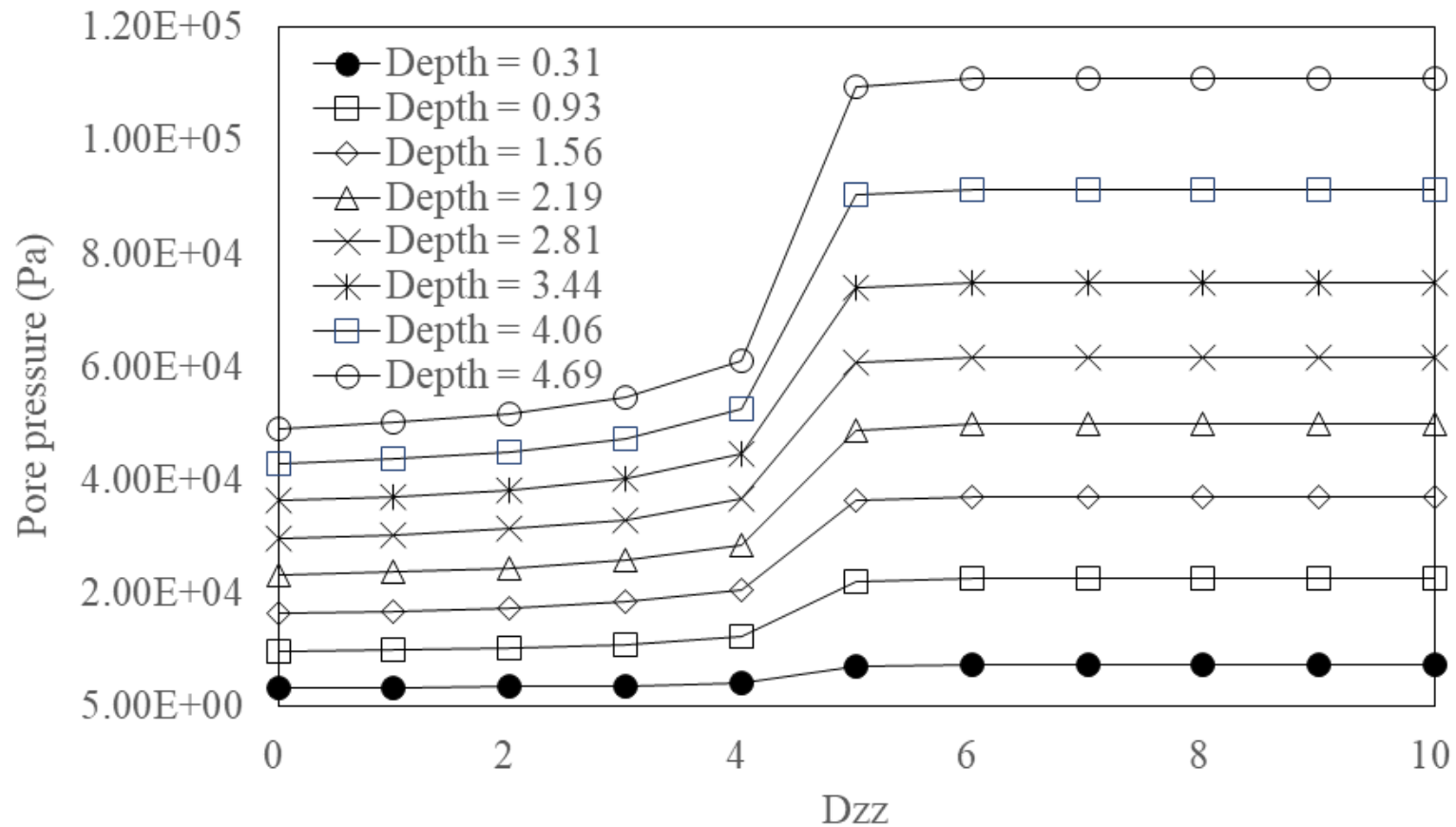


## Total head (m)



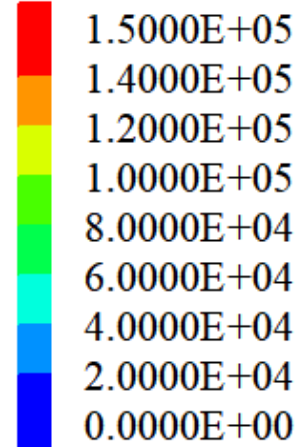


## Pore pressure (Pa)

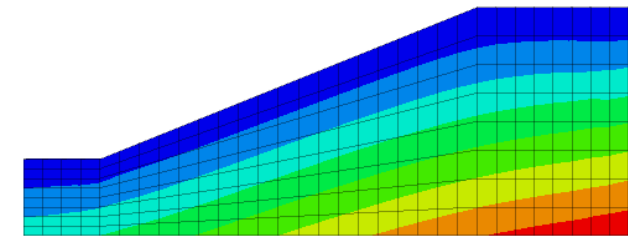


# Pore pressure (Pa)

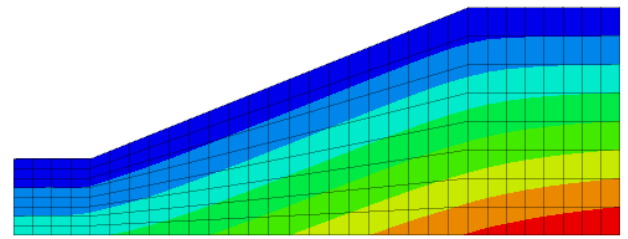
## Pore Pressure (Pa)



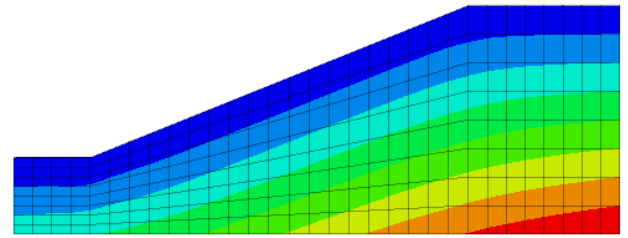
Isotropic



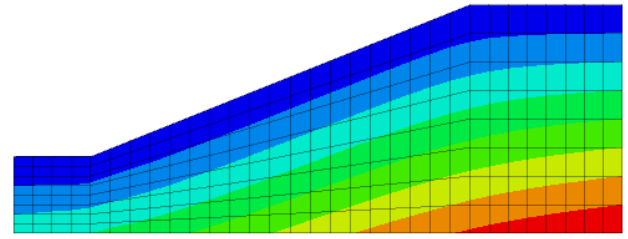
$D_{zz} = 0$



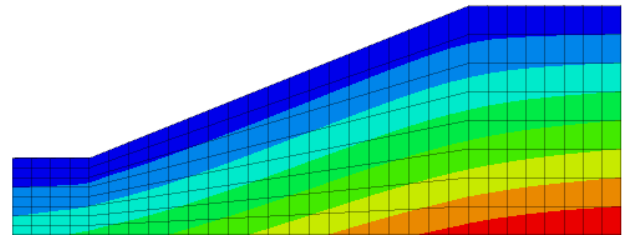
$D_{zz} = 1$



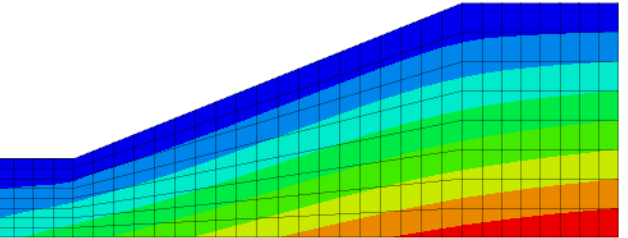
$D_{zz} = 2$



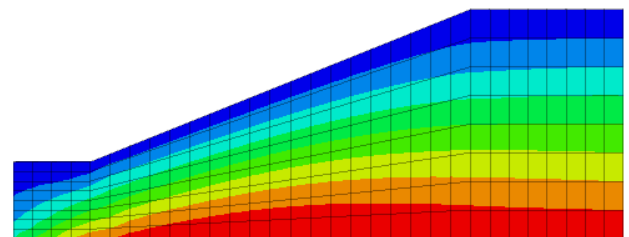
$D_{zz} = 3$



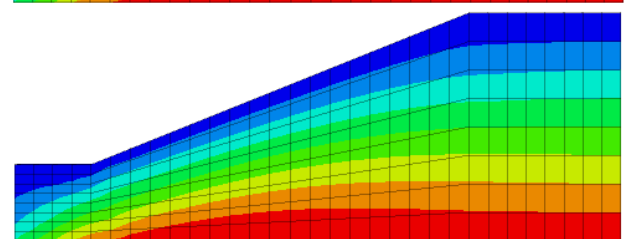
$D_{zz} = 4$



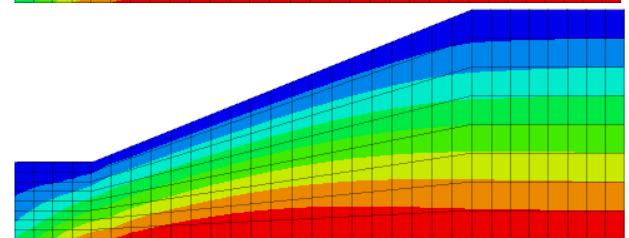
$D_{zz} = 5$



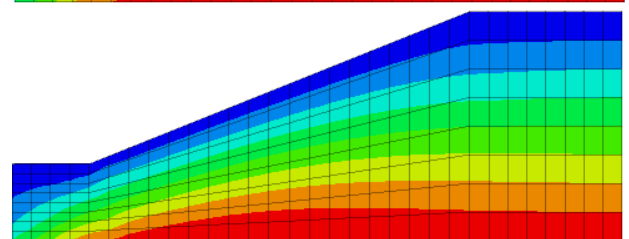
$D_{zz} = 6$



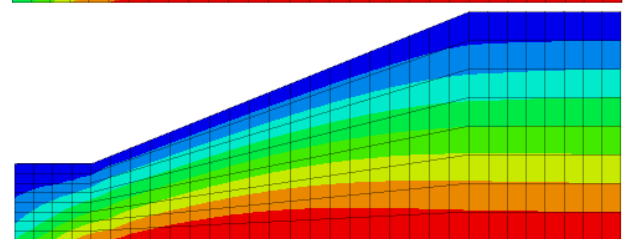
$D_{zz} = 7$



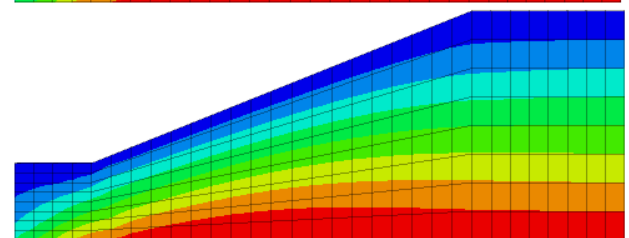
$D_{zz} = 8$



$D_{zz} = 9$



$D_{zz} = 10$



- Even if the fabric tensor is 0, the results are still different from the isotropic model because  $D_{zz} = 0$  model includes discontinuity.
- When the fabric tensor is 0 ~ 4, pore water pressure and total head increase with depth.
- When the fabric tensor is above 5, pore water pressure and total head increase fast and stay stable.
- This means the fabric tensor above 5 has no further impact on pore water pressure and total head.
- The slope stability analysis code is still modify, and the results will be added in the future.

A decorative graphic in the top-left corner consisting of several thin, light-brown lines that intersect to form a series of overlapping, irregular polygons. The lines extend from the top and left edges of the page towards the center.

**Thanks for your attention**