Engineers as agents

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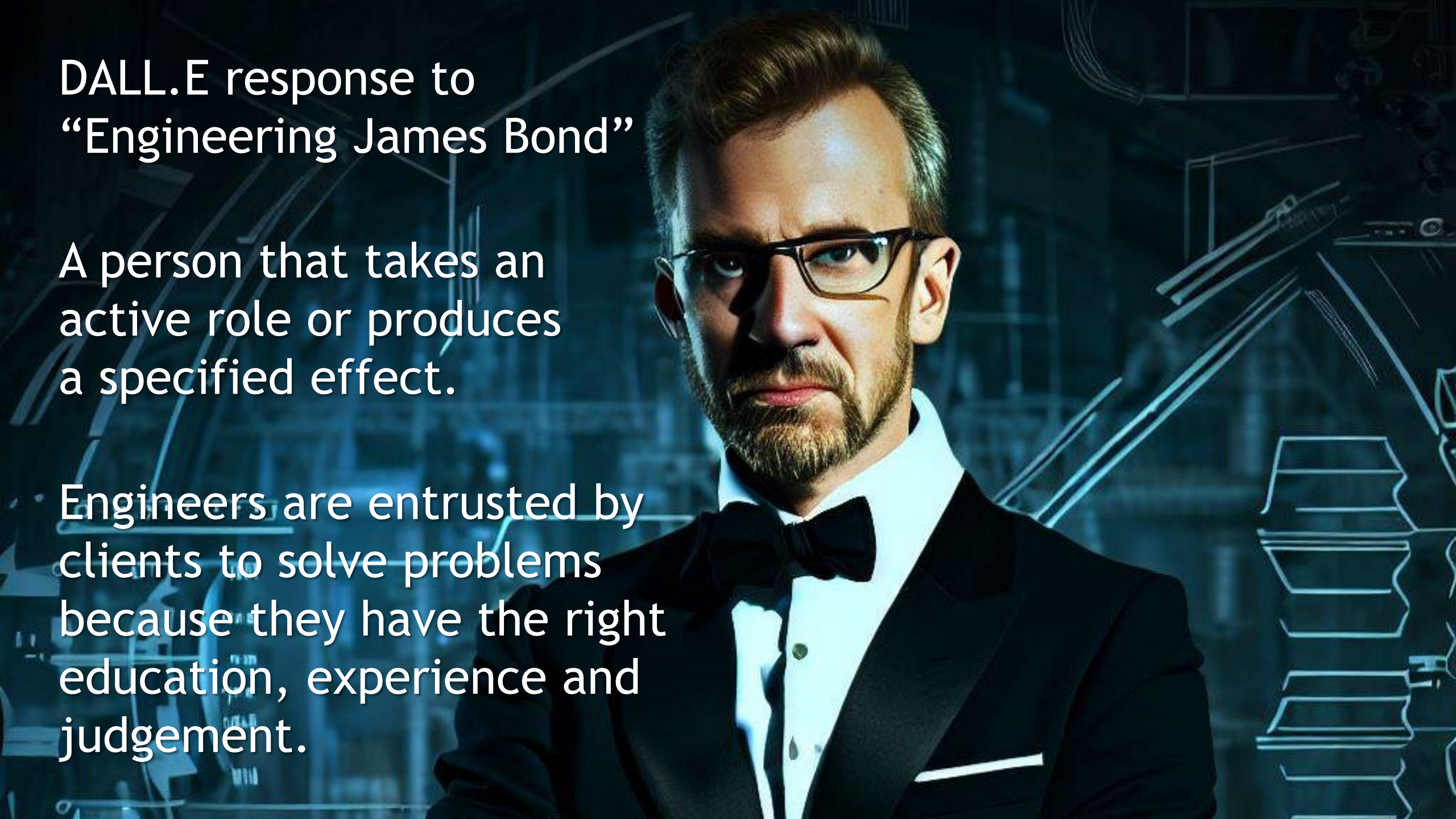
Photo by Stefan Els

DALL.E response to
“Engineering James Bond”

A person that takes an active role or produces a specified effect.

Engineers are entrusted by clients to solve problems because they have the right education, experience and judgement.



Engineer

Consulting to be confident in the art and science of engineering.

Manager

Even Ivory Towers need to be oiled.

Researcher

Developing and understanding tools that engineers use

Community

Advocate within engineers and with those outside engineering.

Teacher

Pass on knowledge and inspire young engineers.

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Facilitate adoption of best practice in a domain.

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Currently assisting a mine with disposal of dewatered residue

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Asked to evaluate the stability of a lined hazardous waste facility

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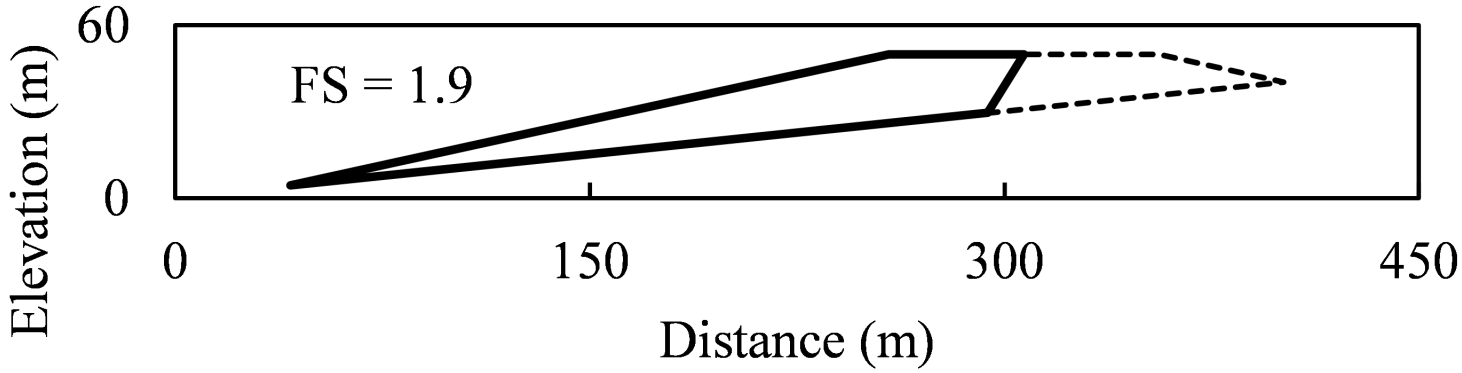
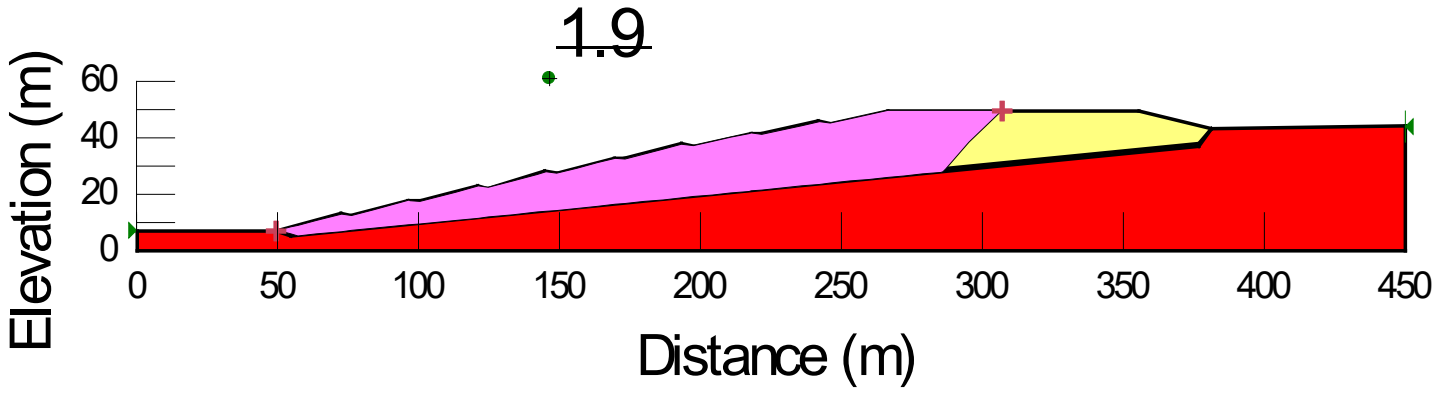
Calculation method much less important compared to strength parameters used.

"Perform as many calculation as you can and then based on a bottle of brandy and good nights sleep make your decision."

Simple hand calculation:



Limit equilibrium method:



MacRobert, C. J. 2019. A comparison of approaches to determine bottom liner stability. *In: JACOBSZ, S. W. (ed.) 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering. Cape Town: SAICE Geotechnical Division*

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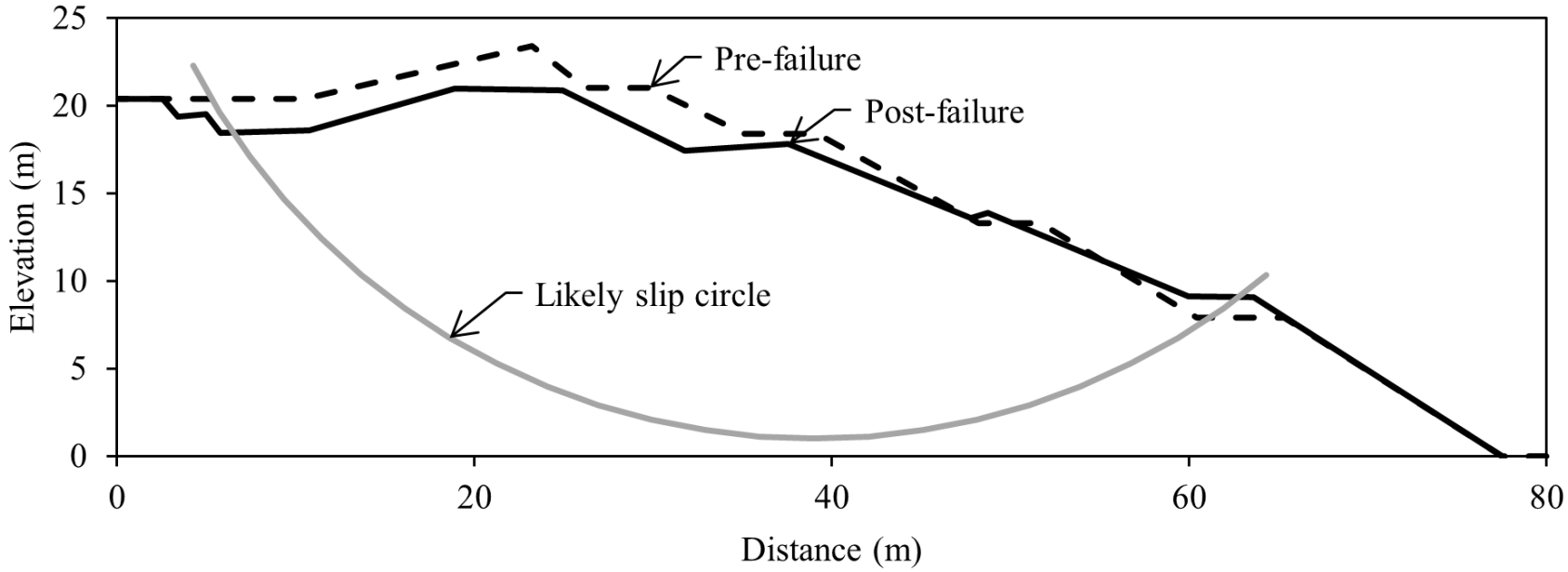

I asked some engineers to analyse a tailings dam slope (they didn't know had failed) by doing three successive tasks:

1. Going through details and writing down observations.
2. Sketching a likely failure mode.
3. Using a computer (LEM) to calculate a factor of safety.

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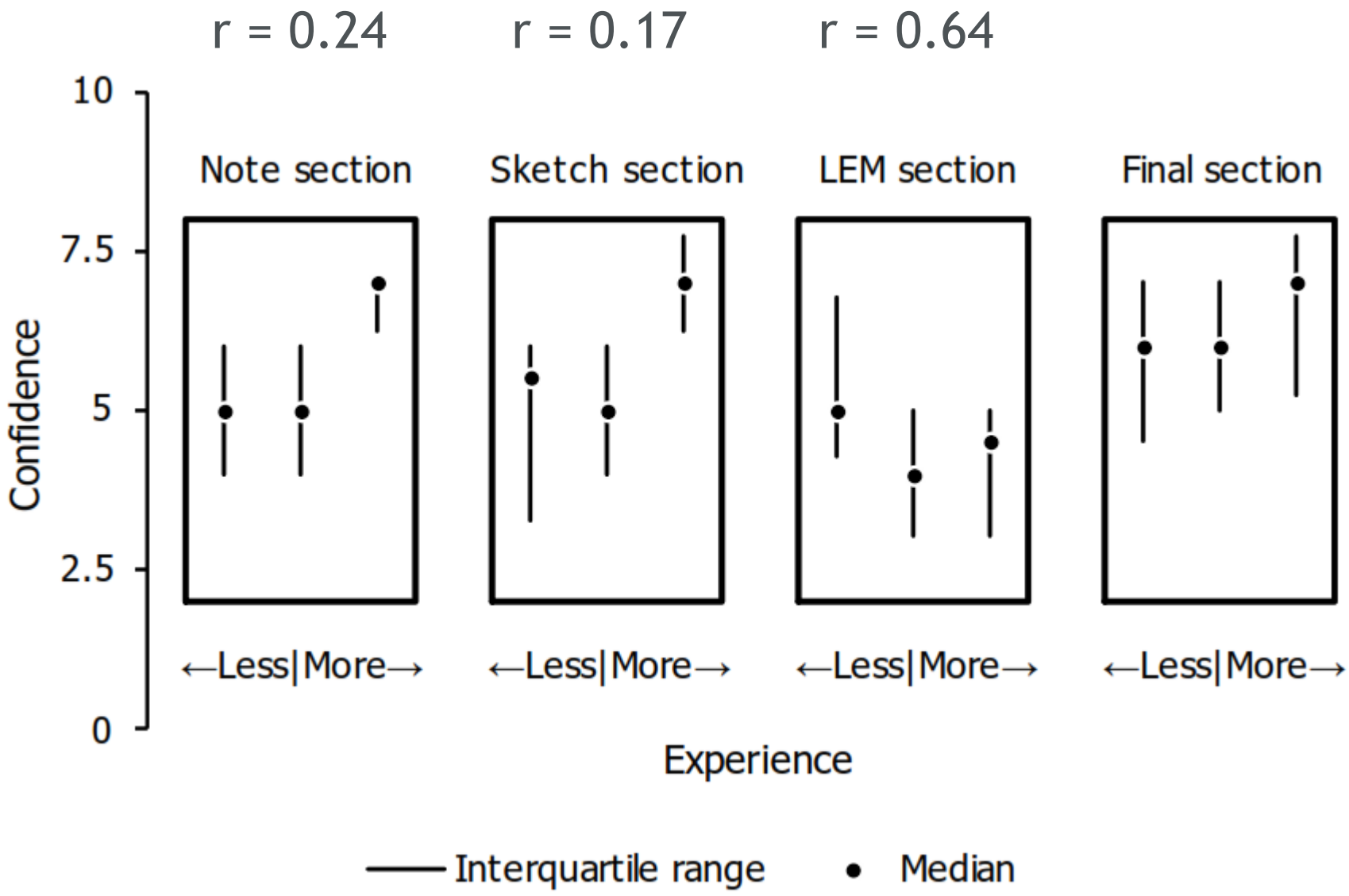
Experts place greater confidence in cognitive tasks.

Novices place greater confidence in computed tasks.

Calculated steps had a big influence on all decisions.

Correlation with decision:



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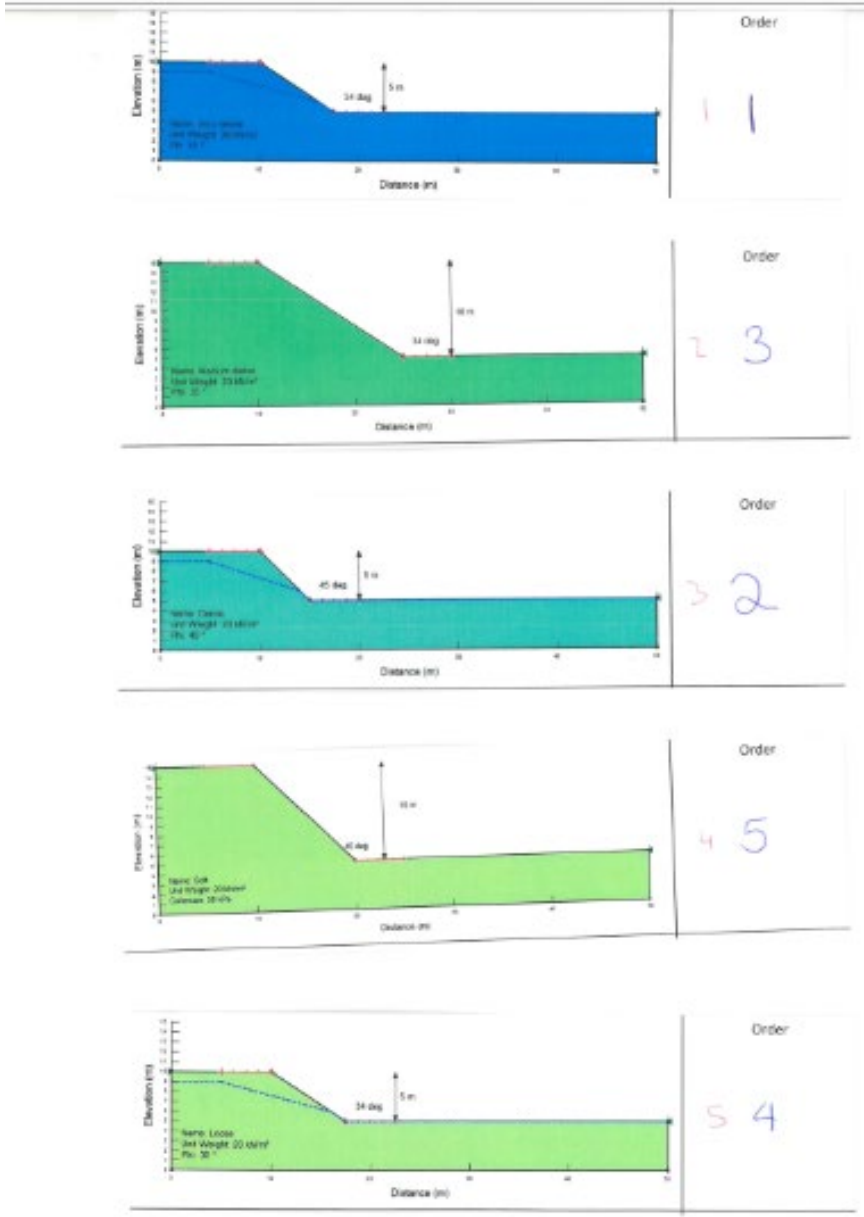

Score 4

Slope stability intuition

Instructions

- In Groups of 4:
  - Review a set of 48 slope stability analysis (learning set) and develop a set of heuristics (fallible intuitive rules) to relate slope geometry, strength, and phreatic surface (water table) to the factor of safety. Heuristics can be:
    - Language based logic (i.e., a series of statements)
    - Formal symbolic logic (i.e., a series of mathematical expressions)
  - Once you have written down your heuristics (time limit = 25 minutes) you return your learning set and receive your test set.
  - Your group will have 5 minutes to order the test set from most stable (i.e., highest factor of safety) to least stable (i.e., lowest factor of safety):
    - Label each scenario from 1 to 5, with 1 being the most stable and 5 the least stable.
    - Enclose your solution in the envelope along with your heuristics.
  - The group (or groups) that are closest to the correct order will receive a prize.

Group Members:

Heuristics:

Rules:

① Very loose Sand - most unstable, Denser or firmer material is more stable.

② Soft Sand has big failure envelope

③ Higher angle, θ, is more unstable

④ Higher elevation is more unstable

⑤ Lower cohesion is more unstable

⑥ Higher ϕ, more stable

⑦ A water table closer to surface is less stable

⑧ lower angle big bigger failure envelope

⑨ Higher Safety Factor - more stable

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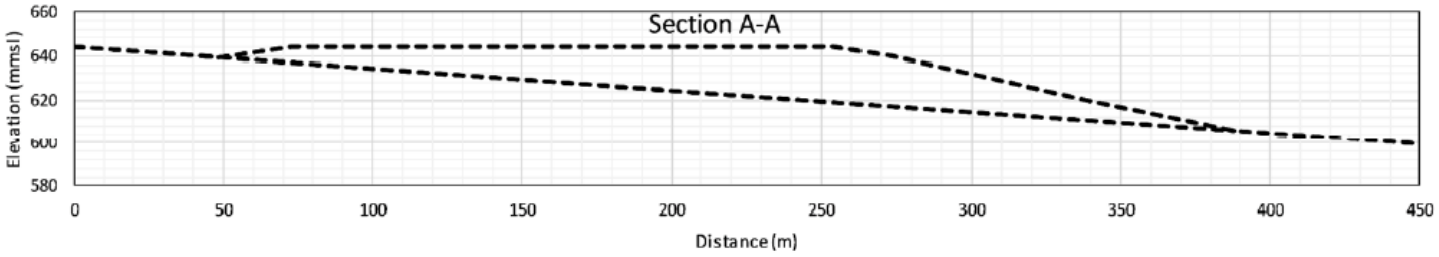
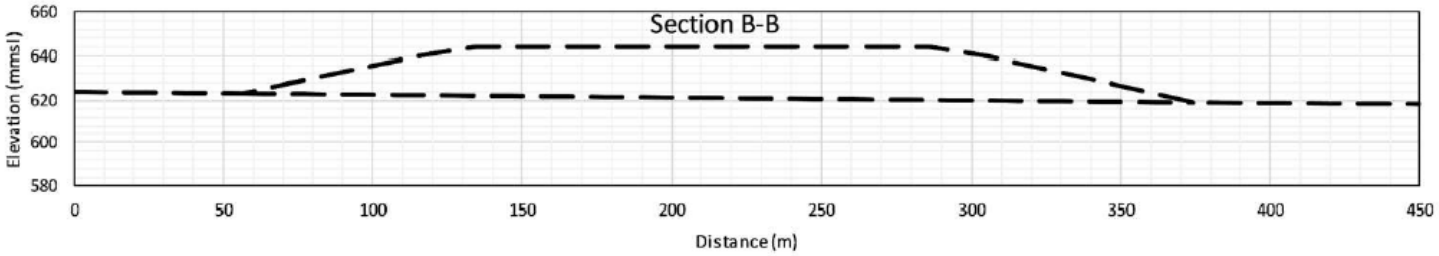
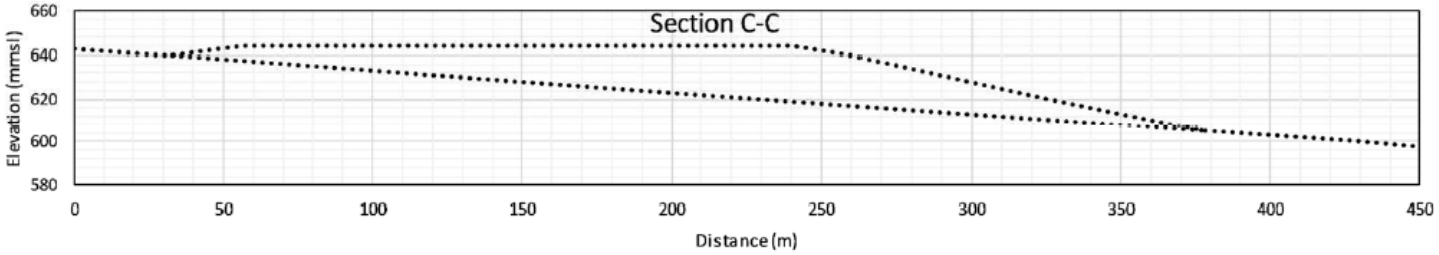






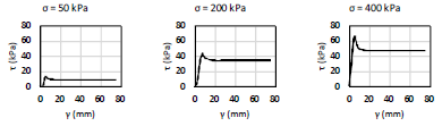
Soil Lab Inc.

Large direct shear box test (305 x 305 x 102 mm)

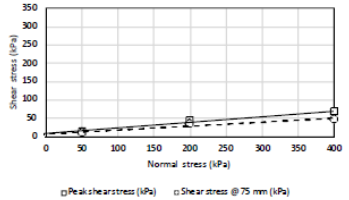
Client:	Coracias Mining
Project:	Barragem
Sample:	Representative Bentonite GCL vs. 2.0 mm HDPE smooth geomembrane
Test ID:	CB-LDSB02

Test conditions:

Upper box: Bentonite GCL (black side down)
Lower box: 2.0 mm HDPE smooth geomembrane
Interface condition: Interface loading applied for a minimum of 1 hour prior to shear
Test condition: Dry
Shearing rate: 1.0 mm/minute
Shearing occurred at the interface



Normal stress (kPa)	Peak shear stress (kPa)	Shear stress @ 75 mm (kPa)
50	13	9
200	44	35
400	67	48



	ϕ (deg)	c (kPa)
Peak shear envelope:	8.7	8
Large displacement envelope (@75 mm):	6.2	7

Asked students to design a lined waste facility

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Database of high fidelity back-analysed slope stability incidents.

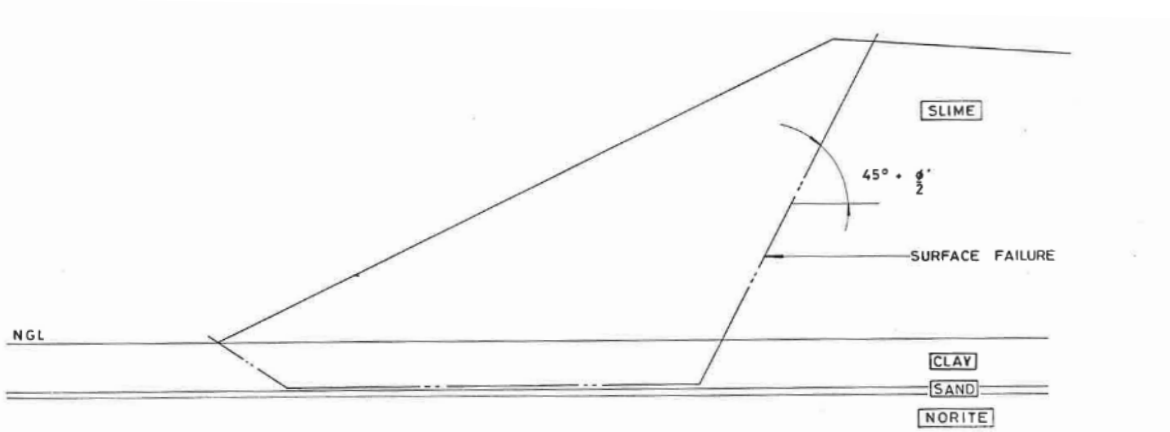


FIGURE 4

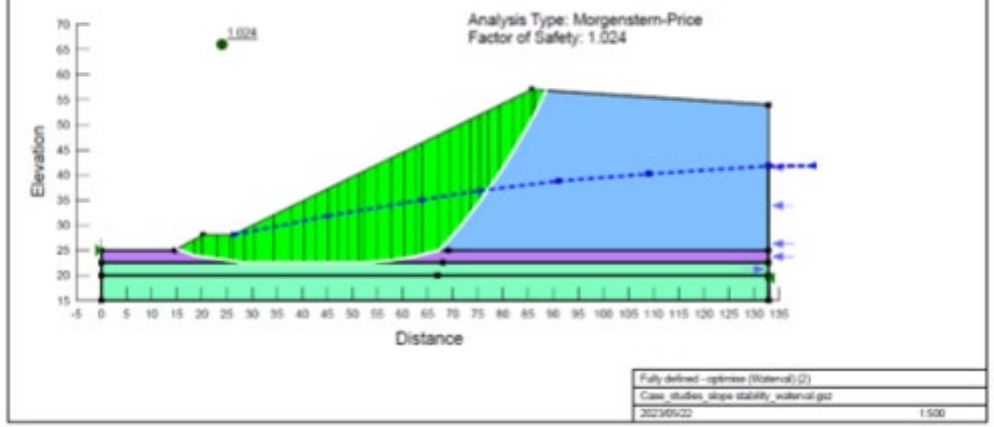
SUSPECTED FAILURE SURFACE FOR COHESIONLESS FILL ON A WEAK CLAY FOUNDATION

DAM	HOLE/ SAMPLE No.	SOAKED DRAINED CONSOLIDATED SHEAR BOX ON UNDISTURBED SAMPLES				SOAKED DRAINED CONSOLIDATED SHEAR BOX ON REMOULDED SAMPLES			
		PEAK		RESIDUAL		PEAK		RESIDUAL	
		C'	ϕ'	C'	ϕ'	C'	ϕ'	C'	ϕ'
KLIP-FONTEIN	2/6,7*	43	16,5	37,5	6,0	25	13	16	8,3
WATER-VAL	22/22**	35	12,5	33	7	30	14	17	9

NOTES
C' IN kPa
ϕ' IN DEGREES
* TWO BLOCK SAMPLES
** RING SAMPLE

TABLE 7.1.2. TABLE OF CONSOLIDATED SOAKED DRAINED SHEAR BOX TEST RESULTS ON FOUNDATION SOILS

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Buttress (Waterval)	Mohr-Coulomb	18.6	0	40	0	1
	Clay (Waterval)	Mohr-Coulomb	18.6	25	10	0	1
	gabbro	Bedrock (Impenetrable)					1
	Tailings (Waterval)	Mohr-Coulomb	17.7	0	35	0	1



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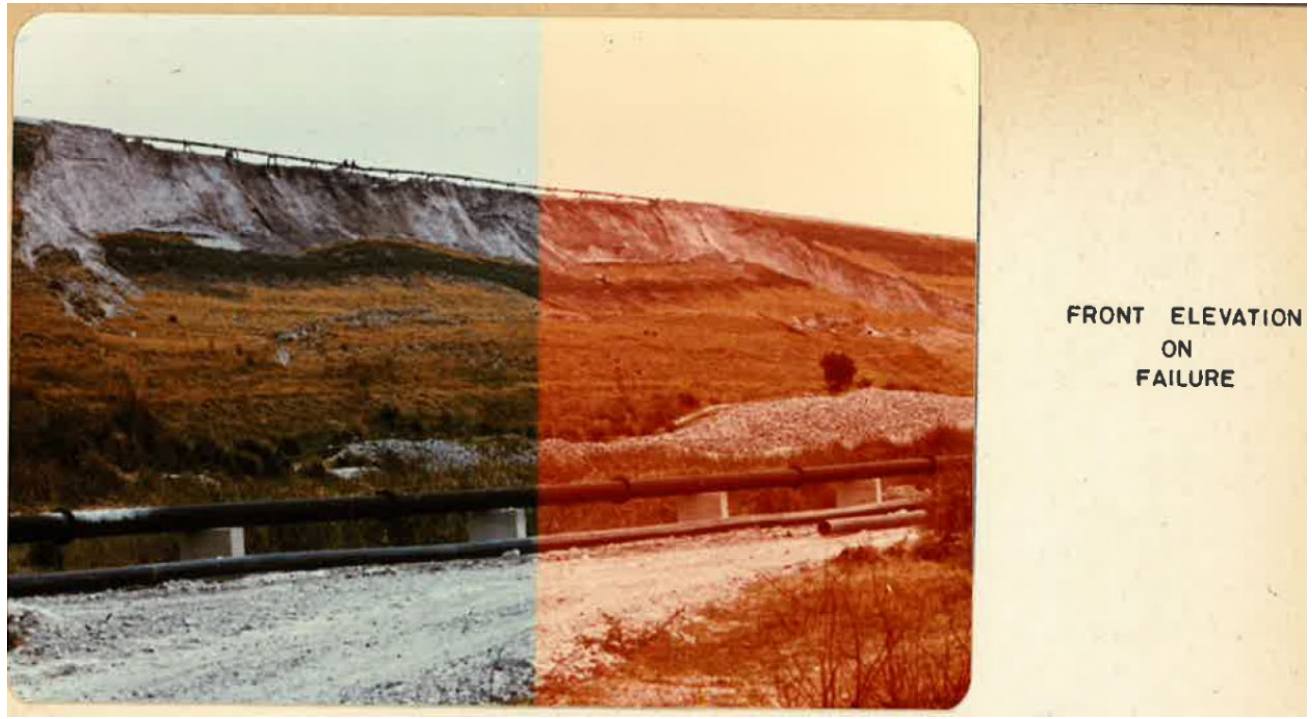

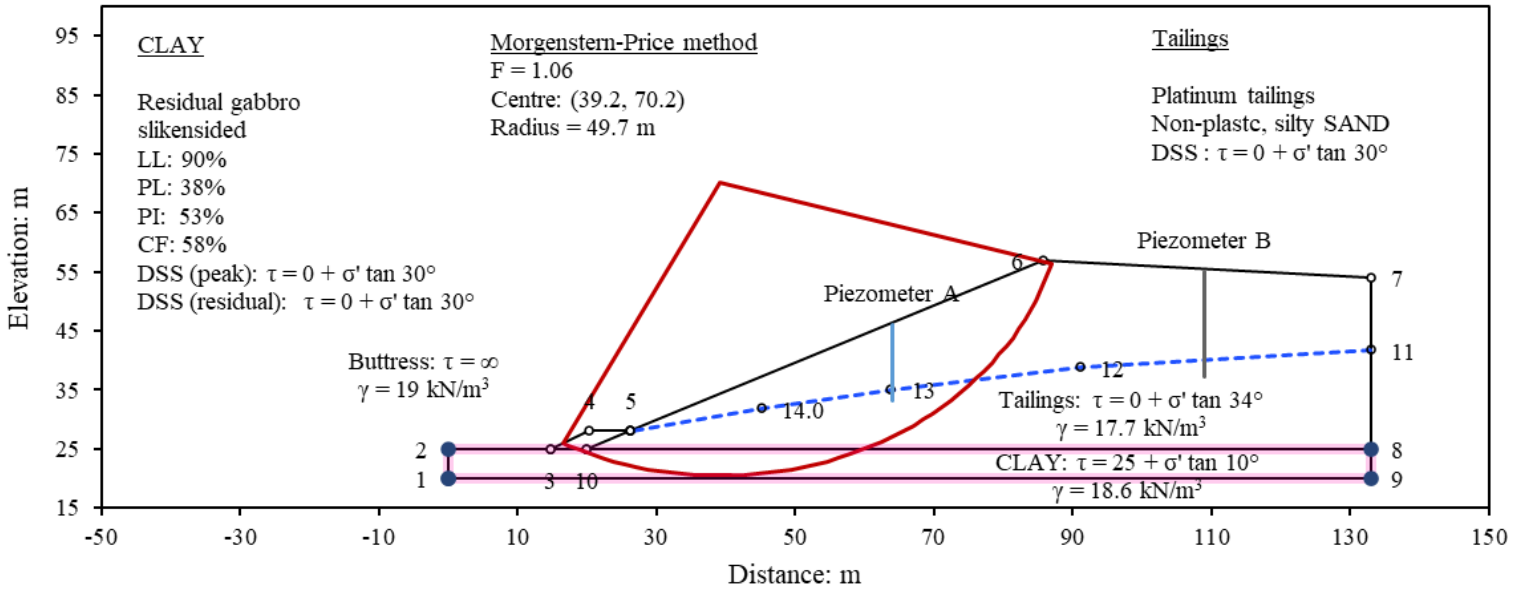

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https://www.youtube.com/watch?v=yrXaULeL6nI

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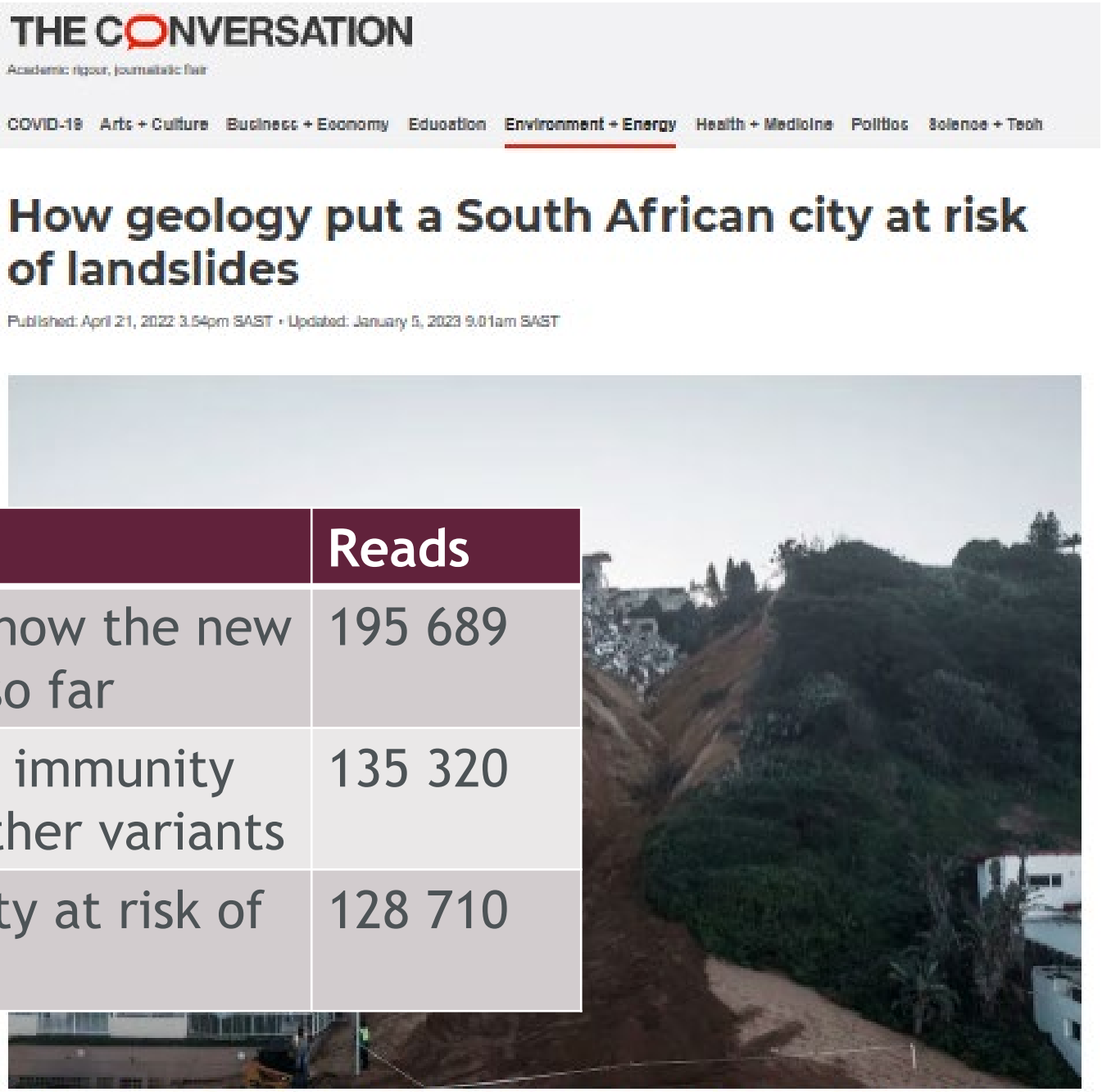
https://theconversation.com/how-geology-put-a-south-african-city-at-risk-of-landslides-181627

Article	Reads
The hunt for coronavirus variants: how the new one was found and what we know so far	195 689
Omicron: evidence shows it evades immunity from earlier infection more than other variants	135 320
How geology put a South African city at risk of landslides	128 710



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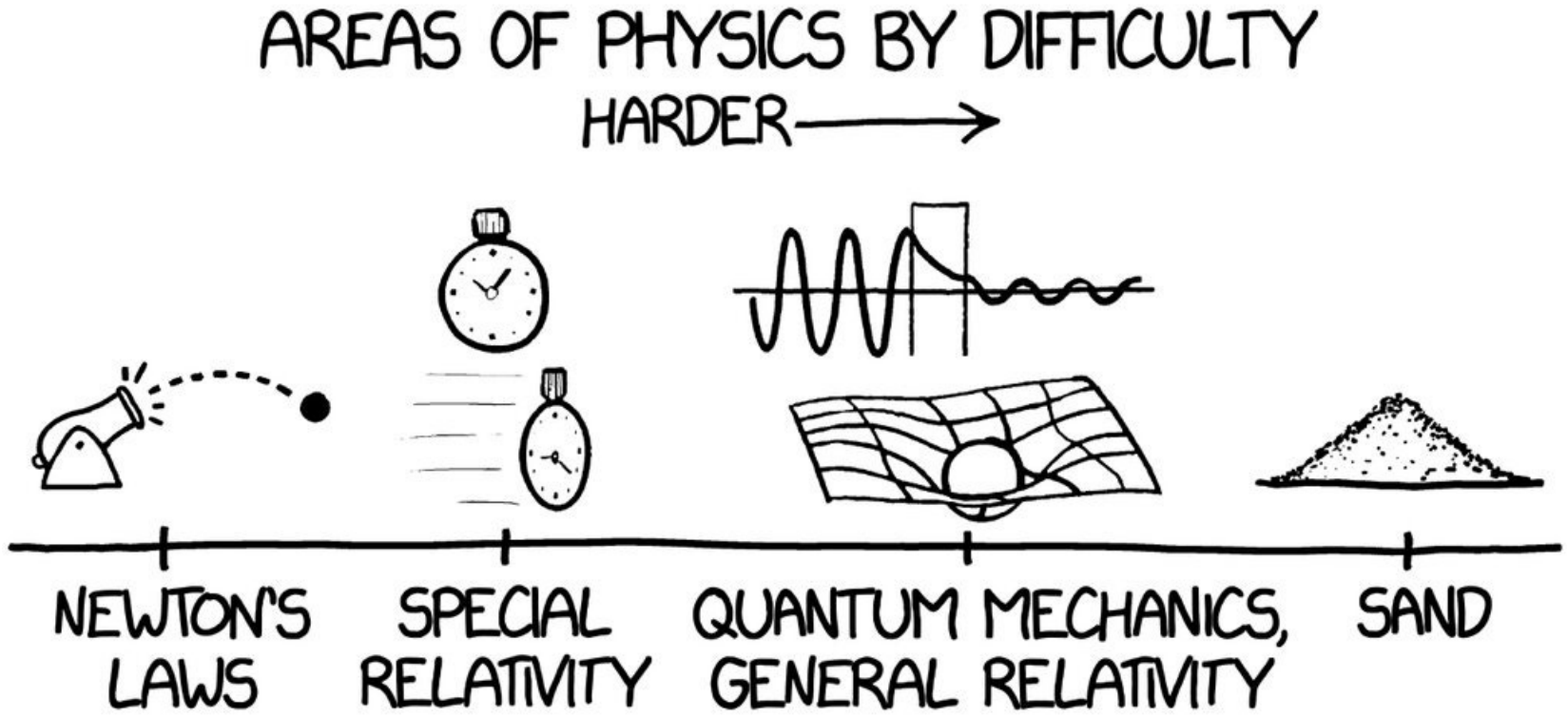
Work in progress…


Engineers are agents to avoid environmental disasters.

Questions?


AREAS OF PHYSICS BY DIFFICULTY
HARDER
NEWTON'S LAWS
SPECIAL RELATIVITY
QUANTUM MECHANICS, GENERAL RELATIVITY
SAND

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Thank you
Enkosi
Dankie

Photo by Stefan Els