

Charles-Augustin COULOMB
A geotechnical tribute
Paris, september 25 & 26,
2023

**Philosophie Globale
en Géotechnique**



par

Dr. Marc Ballouz

President de la SIMSG

President of ISSIMGE



Contents

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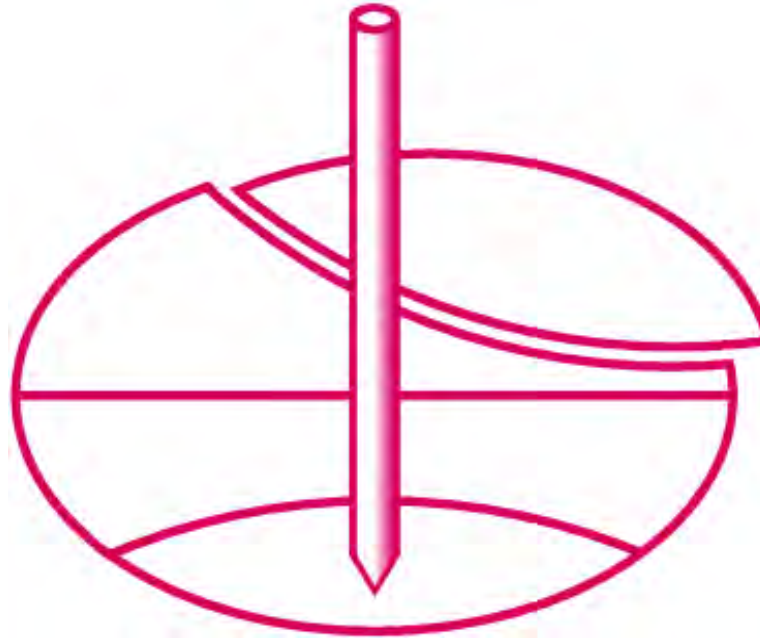
4- Business as Engineers

5- Lessons Learned

- The Crazy Units
- Intuition to Judgement
- SoLGeH

ISSMGE

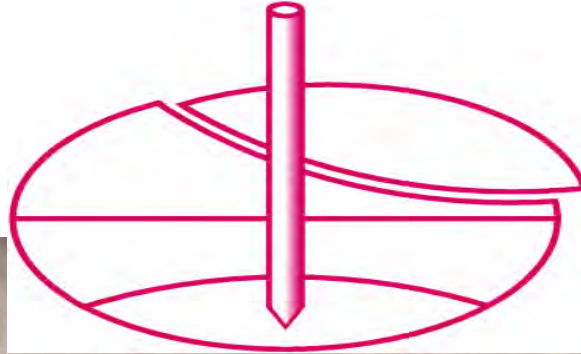
SIMSG



International Society
for Soil** Mechanics &
Geotechnical Engineering

Société Internationale
pour la Mécanique des
Sols et Géotechnique

ISSMGE



SIMSG

1936
ISSMGE
founded

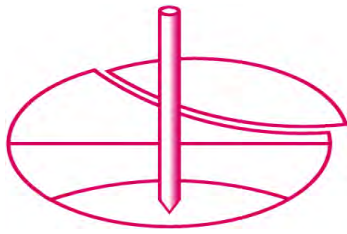
Karl Terzaghi
1883 - 1963





Category	TC Short Name	TC Official Name	TC#
Applications	Deep Foundations	Deep Foundations	TC212
Applications	Scour and Erosion	Scour and Erosion	TC213
Applications	Soft Soils	Foundation Engineering for Difficult Soft Soil Conditions	TC214
Applications	Geo-Environmental	Environmental Geotechnics	TC215
Applications	Frost	Frost Geotechnics	TC216
Applications	Land Reclamation	Land Reclamation	TC217
Applications	Reinforced Fill Structures	Reinforced Fill Structures	TC218
Applications	System Performance	System Performance of Geotechnical Structures	TC219
Applications	Field Applications	Field Monitoring and Instrumentation	TC220
Applications	Tailing and Mine Wastes	Tailing and Mine Wastes	TC221
Applications	Geotechnical BIM and DT	Geotechnical BIM and Digital Twins	TC222
Impact on Society	Historic Sites	Preservation of Historic Sites	TC301
Impact on Society	Forensic	Forensic Geotechnical Engineering	TC302
Impact on Society	Floods	Coastal and River Disaster Mitigation and Rehabilitation	TC303
Impact on Society	Risk	Engineering Practice of Risk Assessment and Management	TC304
Impact on Society	Megacities	Geotechnical Infrastructure for Megacities and New Capitals	TC305
Impact on Society	Geo-education	Geo-engineering Education	TC306
Impact on Society	Sustainability	Sustainability in Geotechnical Engineering	TC307
Impact on Society	Energy Geotechnics	Energy Geotechnics	TC308
Impact on Society	Machine Learning	Machine Learning and Big Data	TC309

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Check CAPG page on the ISSMGE.org and Video



ISSMGE Virtual University

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All

Courses

Honour/Keynote Lectures

Short Educational Videos

Webinars

Select Subject



Course
Earthquake Engineering
Instructors: Ikuo Towhata,
George Gazetas, Misco
Cubrinovski



Course
Foundations
Instructors: F Rausche, H Poulos,
L Laloui, MJ Cassidy




Course
**Risk-Mitigation, Monitoring
& Observational Methods**
Instructors: Jean-Louis Briaud,
Zenon Medina-Cetina, Marco
Uzielli, An Bing Huang,
Marc Ballouz



Course
In-Situ Testing
Instructors: Sebastiano Foti,
Fernando Schnaid, Peter
Robertson, Keneth H. Stokoe




Course
Soil Characterisation
Instructors: Cor Zwanenburg, Samuel Kofi Ampadu, Gabriel
Awineet, Serge Leroueil, Richard Jardine



Course
Unsaturated Soil Mechanics
Instructor: Delwyn G. Fredlund



Course
Geo-Engineering Education
Instructors: Andrew Bond, John Atkinson, Lawrence Wesley,
Carlo Viggiani



Course
Geosynthetics 1
Instructors: Robert M. Koerner, Kerry Rowe, F. Tazliokaj,
Jorge G. Zornberg



Course
Landslides and Mitigations
Instructors: Charles Wang Wai NG, Luciano Picarelli, Scott



Course
Soil Behaviour
Instructors: F. Tatsuoka, Eduardo Alonso, Pierre Delage



Course
Probability Analysis in Civil Engineering
Instructor: Dr. Jie Zhang



Webinar
Intelligent Compaction
Instructors: Antonio Correia, George Chang



ISSMGE International Journal of Geoengineering Case Histories

Subscribe to IJGCH newsletter

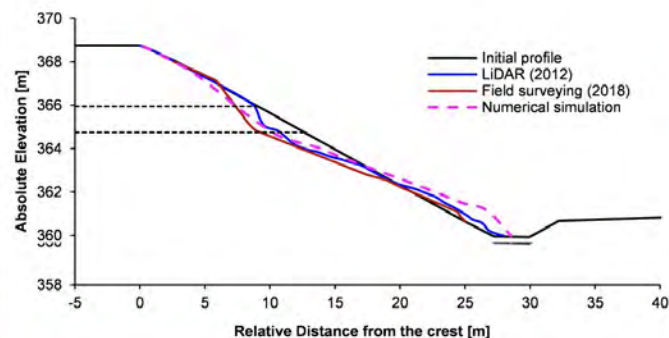
The International Journal of Geoengineering Case Histories is an official journal of the International Society for Soil Mechanics and Geotechnical Engineering, the premier scientific organization for geotechnical engineering worldwide. The Case Histories Journal covers the broad area of practice in geotechnical engineering (soils and rocks), including geotechnical earthquake engineering, environmental geotechnics and engineering geology, and energy geo-construction.

The Case Histories Journal is a peer-review, diamond-level open access journal on the geotechnical engineering practice with a focus on careful documentation of case histories with and **emphasis on observations and data collected during and after project construction**. Papers are reviewed by a distinguished international Editorial Board and a selected number of reviewers. All paper published in the journal are accompanied by electronic data for better documentation of each case history.

Latest Published Case History Papers

A Case Study on the Progressive Failure Mechanism of I-180 Slope Using Numerical and Field Observations

— Bekele, B. M., Song, C., Lindemann, M.



Progressive failure
strength degradation

hydromechanical framework
weathering; strain softening

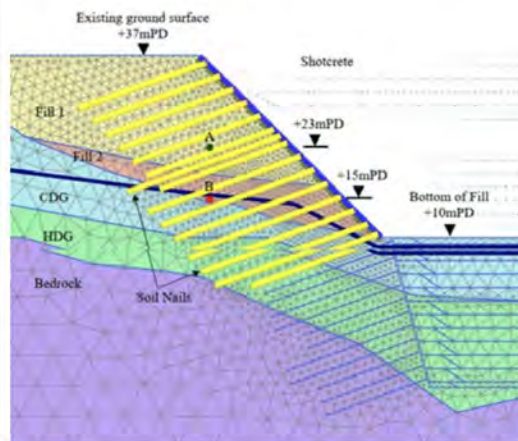
— A progressive failure of shallow slopes is commonly encountered in eastern Nebraska due to the region's unique geological and weather conditions. This study presents a case study for a slope in Nebraska that experienced a progressive failure. Emphasis was given to examine the condition and tri...

Read More

Practical Design, Numerical Analysis, and Site Monitoring for Huge Arching Effect during Massive Excavation of Undercut Slope in Open-Pit

Back Analyses of Two Deep Excavations in Hong Kong Using the Mohr-Coulomb Model with Linear Elasticity and the Hardening Soil Model

— Chan, C., Chiu, D., Lo, F., Kwan, J., Lee, S., Leung, A.



Soil model Back analysis Finite element Deep excavation

— The design of deep excavations in densely developed urban settings calls for critical assessments of the effects on sensitive receivers in the vicinity of the site. The linearly elastic, perfectly plastic Mohr-Coulomb (LEPP MC) model is one of the most commonly used soil constitutive models fo...

Read More

Ex-Post Evaluation of Countermeasures Against Residual Settlement of an Ultra-Soft Peaty Ground Due to Test Embankment Loading: A Case

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ISSMGE Awards

Introduction

ISSM

ISSMGE I

The ISSMG
the world.

Awards for:

- Lifetime
- Outstanding
- Outstanding
- Outstanding
- Outstanding
- Outstanding
- Outstanding
- Outstanding
- Bright Spark Lecture

In addition, the following

- Terzaghi Oration
- Kevin Nash Gold

BRIGHT SPARK LECTURE AWARDS by President BALLOUZ

by BALLOUZ	NAME	CONFERENCE	Issued on
1	Kil-Wan Ko	10 th International Conference on Physical Modelling in Geotechnics in Daejeon, Korea, 19 th -23 rd of September, 2022	June 3, 2022
2	Orestis Adamidis	10 th International Conference on Physical Modelling in Geotechnics in Daejeon, Korea, 19 th -23 rd of September, 2022	June 3, 2022
3	Rakesh Malisetty	National Workshop on Transportation Geomechanics and Ground Improvement in Sydney, Australia, on 24 th of November, 2021	November 4, 2022
4	Liuxin Chen	National Workshop on Transportation Geomechanics and Ground Improvement in Sydney, Australia, on 24 th of November, 2022	November 4, 2022
5	Subhani Medawela	16th International Conference on Geotechnical Engineering (16ICGE) in Lahore, Pakistan, 7 th – 8 th of December, 2022	November 4, 2022
6	Shay Haq	16th International Conference on Geotechnical Engineering (16ICGE) in Lahore, Pakistan, 7 th – 8 th of December, 2022	November 4, 2022
7	Lutfian Rusdi Daryono	26 th National Conference on Geotechnical Engineering in Jakarta, Indonesia, 8 th – 9 th of November, 2022	November 9, 2022
8	Jeremy S Kadarman	26 th National Conference on Geotechnical Engineering in Jakarta, Indonesia, 8 th – 9 th of November, 2022	November 9, 2022
9	Anatasya Claresta	26 th National Conference on Geotechnical Engineering in Jakarta, Indonesia, 8 th – 9 th of November, 2022	November 9, 2022
10	Kuo Tian	10th International Congress on Environmental Geotechnics, June, 2023 , Chania, Greece	April 22, 2023
11	Jie Hu	10th International Congress on Environmental Geotechnics, June, 2023 , Chania, Greece	April 22, 2023
12	Nicolo Guarena	10th International Congress on Environmental Geotechnics, June, 2023 , Chania, Greece	April 22, 2023
13	Alexandra Saracho	10th International Congress on Environmental Geotechnics, June, 2023 , Chania, Greece	April 22, 2023
14	Te Xiao	HKIE Geotechnical Division 43rd Seminar , 19 th May 2023	April 29, 2023
15	Zhanbolat Shakhnov	17th ARC in Astana, Kazakhstan , 14 th -18 th of August 2023	May 7, 2023
16	Thao Doan	17th ARC in Astana, Kazakhstan , 14 th -18 th of August 2023	May 7, 2023
17	J.S. Dhanya	17th ARC in Astana, Kazakhstan , 14 th -18 th of August 2023	May 7, 2023
18	Mingliang Zhou	4th International Symposium on Machine Learning & Big Data in Geoscience, Ireland, Aug 29 th - Sept 1 st , 2023	May 22, 2023
19	Brian Shiel	5th International Symposium on Machine Learning & Big Data in Geoscience, Ireland, Aug 29 th - Sept 1 st , 2023	May 22, 2023
20	Zili Li	6th International Symposium on Machine Learning & Big Data in Geoscience, Ireland, Aug 29 th - Sept 1 st , 2023	May 22, 2023
21	Lee Long Guang	2nd GeoSS MGS Geotechnical Conference 2023 , Singapore, Nov 30 - Dec 2, 2023	June 13, 2023
22	Chia Weng Boon	2nd GeoSS MGS Geotechnical Conference 2023 , Singapore, Nov 30 - Dec 2, 2023	June 13, 2023
23	Benjamin Cerfontaine	Symposium on Energy Geotechnics SEG'23 Delft, The Netherlands, October 3-5, 2023	September 18, 2023
24	Melis Sutman	Symposium on Energy Geotechnics SEG'23 Delft, The Netherlands, October 3-5, 2024	September 18, 2023

What's New
(Achieved last year)
@
ISSMGE ?



Member Society	
1	Albania
2	Algeria
3	Argentina
4	Australia
5	Austria
6	Bangladesh
7	Belarus
8	Belgium
9	Bolivia
10	Bosnia & Herzegovina
11	Brazil
12	Bulgaria
13	Canada
14	Chile
15	China
16	Chinese Taipei
17	Colombia
18	Costa Rica
19	Croatia
20	CTGA
21	Cuba*
22	Cyprus
23	Czech & Slovakia
24	Denmark
25	Egypt
26	Estonia
27	Finland
28	France
29	Georgia
30	Germany
31	Ghana
32	Greece
33	Guatemala
34	Hong Kong
35	Hungary
36	Iceland
37	India
38	Indonesia
39	Iran
40	Iraq
41	Ireland
42	Israel
43	Italy
44	Japan
45	Kazakhstan
46	Korea
47	Kuwait
48	Latvia
49	Lithuania
50	Luxembourg
51	Malaysia
52	Maldives
53	Mexico
54	Moldova
55	Morocco
56	Netherlands
57	New Zealand
58	Nigeria
59	Poland
60	Portugal
61	Romania
62	Russia
63	Saudi Arabia
64	South Africa
65	Spain
66	Sri Lanka
67	Sudan
68	Sweden
69	Switzerland
70	Taiwan
71	Tanzania
72	Tehran
73	Togo
74	Turkey
75	UK
76	Ukraine
77	USA
78	Uzbekistan
79	Venezuela
80	Vietnam

International Society for Soil Mechanics and Geotechnical Engineering



GEO-ENGINEERS WITHOUT BORDERS

SIMSG

ISSMGE



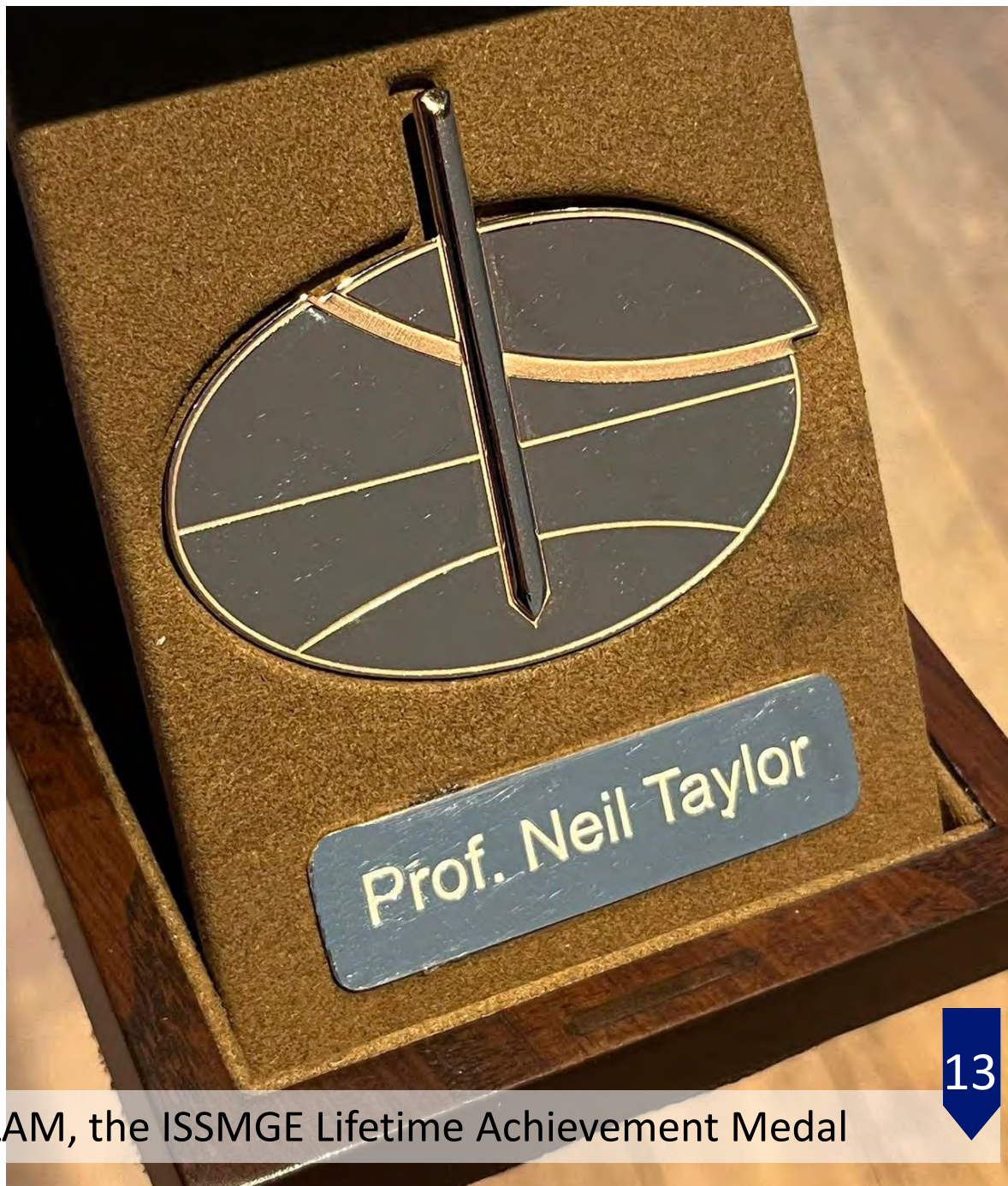
GEO-ENGINEERS
Without BORDER

Michel

80	Syria	
81	Tajikistan	x
82	Thailand	x
83	Tunisia	
84	Turkey	
85	UK	
86	Ukraine	
87	USA	x
88	Uzbekistan	
89	Venezuela	
90	Vietnam	



**Since 1999
... 24 Years
Serving ISSMGE
As Secretary
General !**



Recipient of the 2023 ILAM, the ISSMGE Lifetime Achievement Medal

President Activities Since May 2022

Summary List of President Activities

May-23	11	Meeting Xantus for second Member Society Video	(Virtual / Online)
	16	Meeting GGSME Legal advisors	(Virtual / Online)
	18	5th ISSMGE Board Meeting	(Virtual / Online)
	24	Meeting the LGES to prepare a conference for 2025	Beirut, Lebanon
Jun-23	7 - 10	Attending 17 DECGE & Keynote Lecture	Bucharest , Romania
	16	Board meeting to select the 2 ILAM recipients	(Virtual/ Online)
	21	Inaugural Presentation at the BGA Annual Conference	London, England
	23	Recording the 7th IITT on Historic Sites TC 301	(Virtual / Video)
	25 - 28	Attending 9 ICEG & Keynote Lecture	Chania, Greece
Jul-23	6	Keynote Lecture at ACTEA Conference @ NDU	Zouk, Lebanon
	8	Recording the 8th IITT on Reinforced Fill Structures TC 218	(Virtual / Video)
	11	Meeting the GeoWB team	(Virtual/ Online)
	12	Meeting the KSA Eng's to create a National Society	(Virtual/ Online)
	19	Meeting the CHAD Eng's to create a National Society	(Virtual/ Online)
	24	Meeting the HTC team preparing for ASTANA conference	(Virtual/ Online)
Aug-23	12	6th ISSMGE Board Meeting	Astana, Kazakhstan
	13	1st Council Meeting (Ballouz Mid Term)	Astana, Kazakhstan
	14	Keynote Lecture at 17 ARC Conference	Astana, Kazakhstan
	29	Meeting the HTC team designing the new website	(Virtual/ Online)
	30	Recording the 9th IITT on Machine Learning TC 309	(Virtual / Video)
	31	Meeting the LGES team preparing Pan-Mediterranean Conference	Beirut, Lebanon
Sep-23	5	Director's Cut Interview of the Geo-Institute	(Virtual/ Online)
	12	Meeting to release the Final Version of the ISSMGE Members Video	(Virtual/ Online)
	17	Attending/Opening the 12ICG Conference in Roma	Rome, Italy
	18	Recording the 10th IITT on Field Monitoring TC 220	(Virtual / Video)
	19	Presenting the ILAM medal to Jamiolkowski's family at 12ICG	Rome, Italy
	25	Attending/Opening the Symposium honoring A. Coulomb	Paris, France

in 1.4 years, toured the world twice, attended 103 events in 25 countries

2 – Basic Principles

- The Crazy Units
- Intuition to Judgement
- SoLGeH

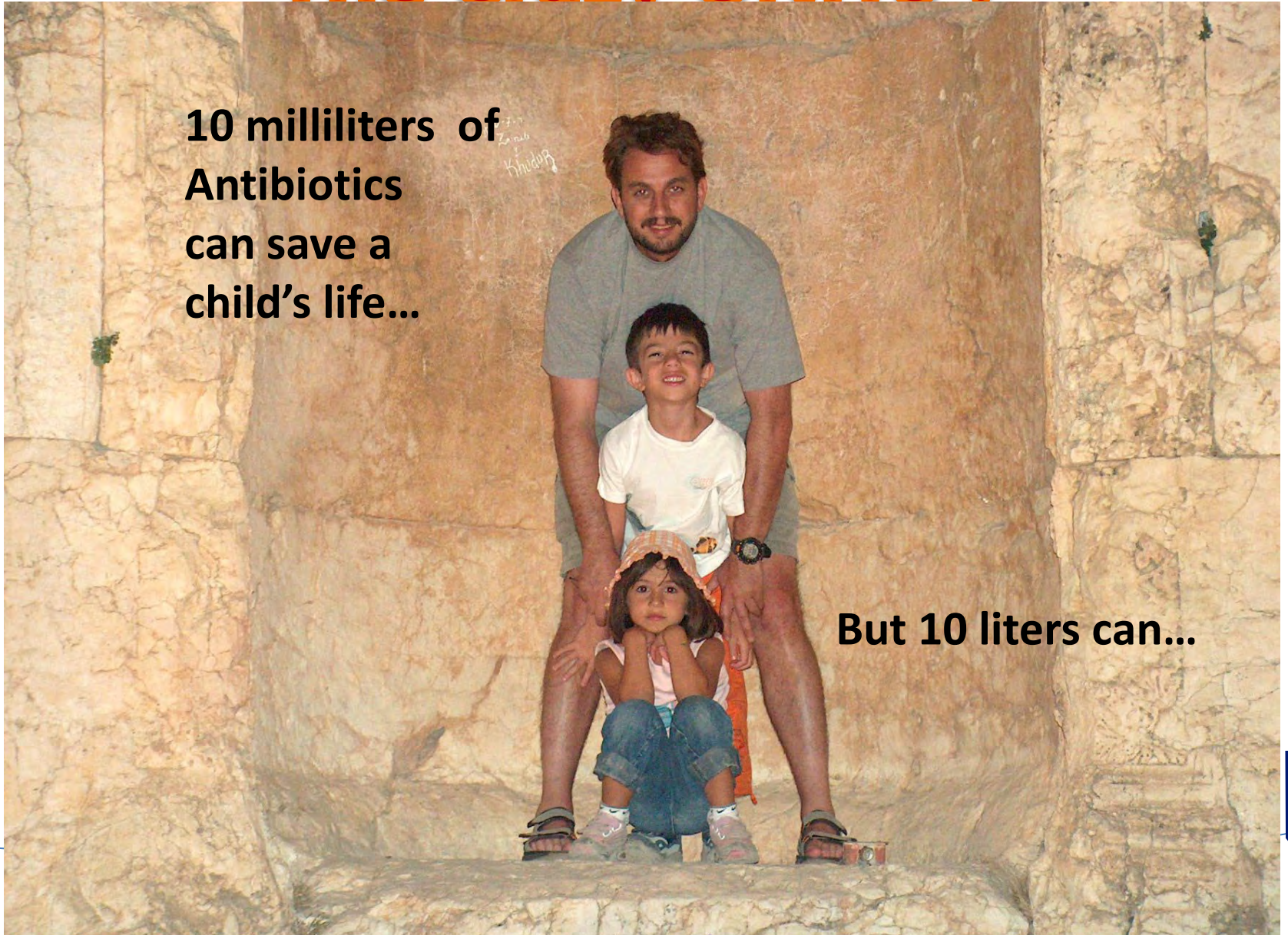
SYMPOSIUM COULOMB
PARIS, SEPTEMBER 25 & 26, 2023

The Crazy UNITS !
Check the Logic of your Results
When Analyzing the Data
& NEVER EVER SUBMIT
AN ANSWER WITHOUT
UNITS !

The Crazy UNITS !

10 milliliters of
Antibiotics
can save a
child's life...

But 10 liters can...



The Crazy UNITS !



The Crazy UNITS !

Nov. 10, 1999

NASA's Mars Climate
Orbiter approaching
the Red Planet...



The Crazy UNITS !

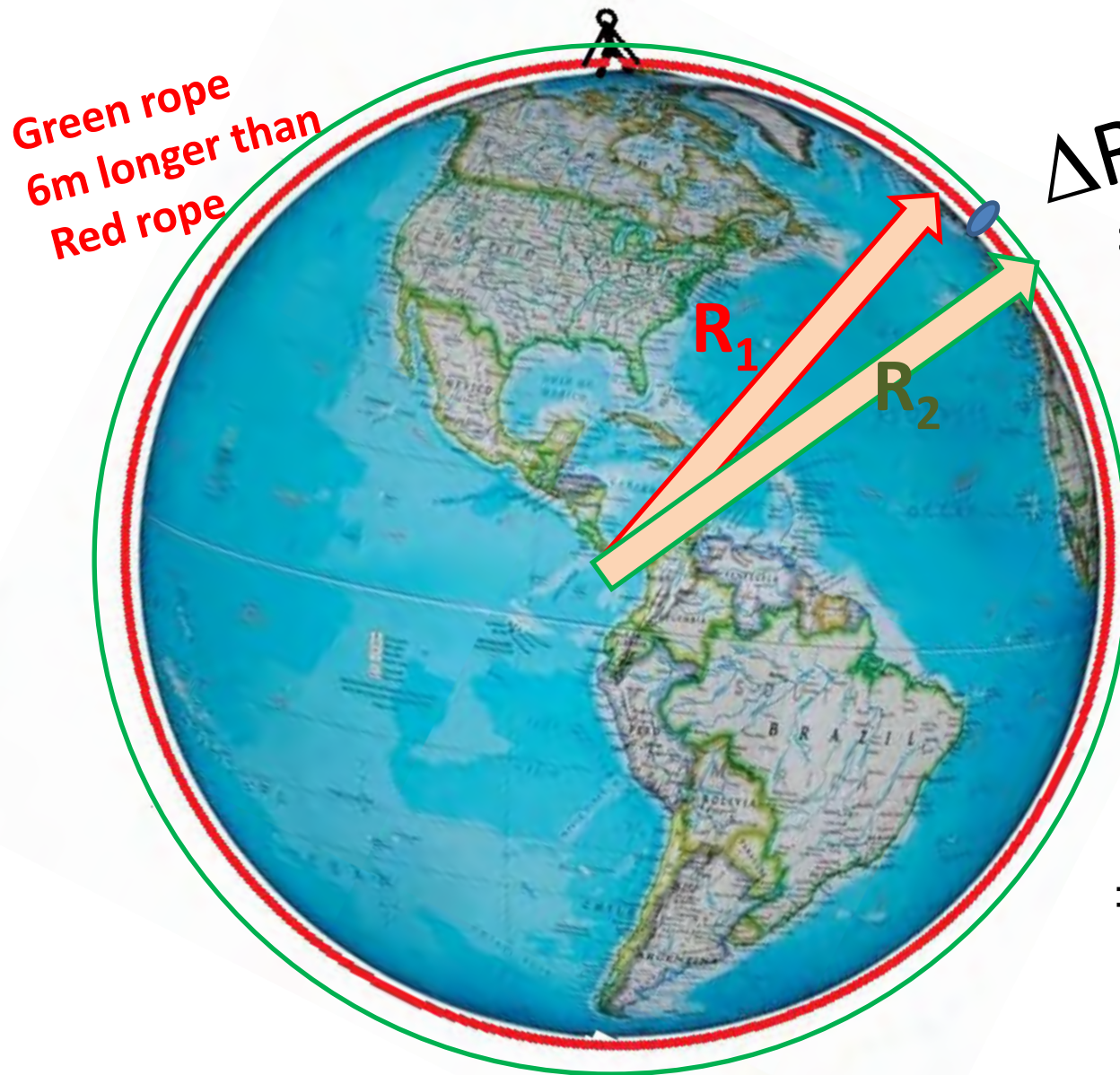
The \$125 million satellite was supposed to be the first weather observer on Mars. But as it approached the red planet the orbiter vanished !

A NASA review board found that the problem was in the software controlling the orbiter's thrusters. The software calculated the force the thrusters needed to exert in *Pounds* of force. A separate piece of software took in the data assuming it was in metric *Newtons*...

Engineers at NASA's Jet Propulsion Lab assumed the conversion had been made, and didn't check!

"Everyone was amazed we didn't catch it", NASA engineer Richard Cook said...

From Intuition to Judgement



$$\Delta R = ?$$
$$= R_2 - R_1$$

But

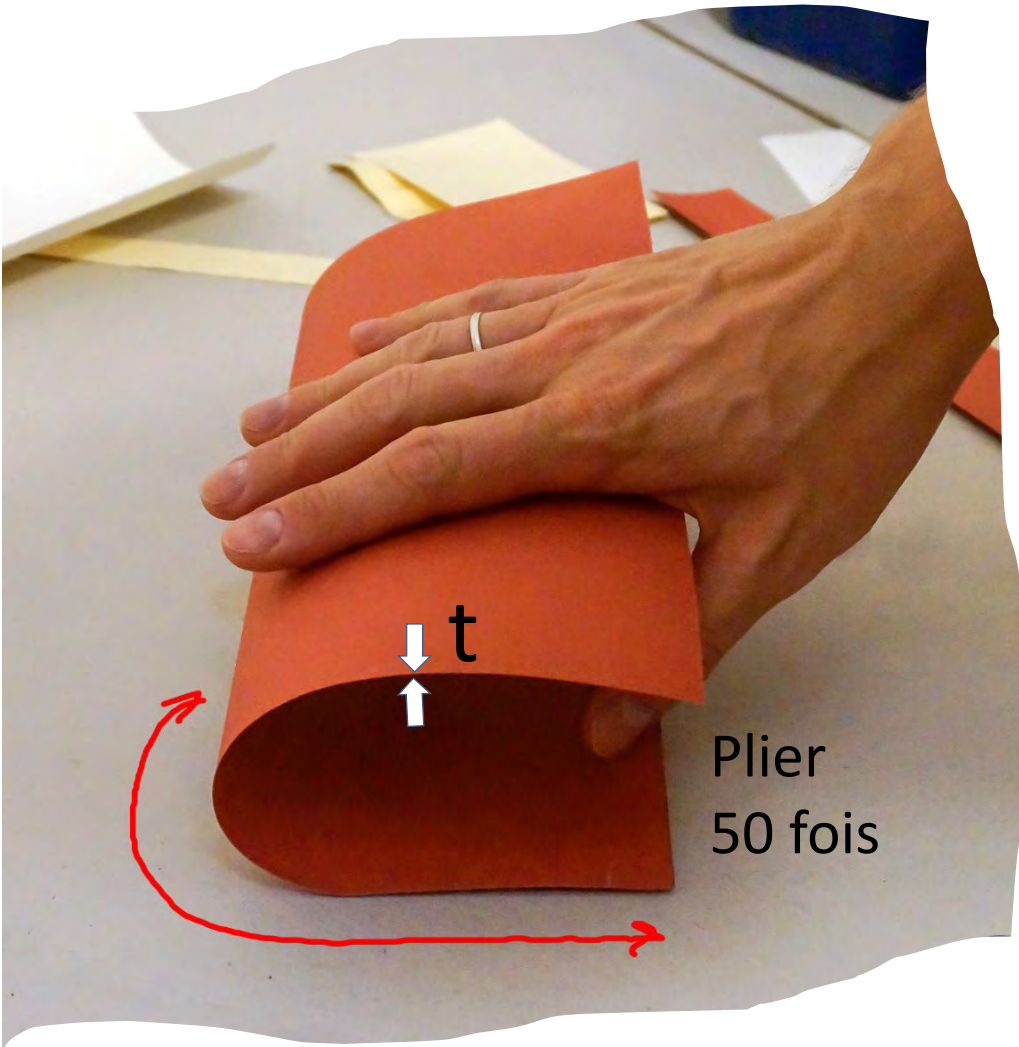
$$2\pi R_2 = 2\pi R_1 + 6$$

$$R_2 = (2\pi R_1 + 6) / 2\pi$$

$$\Rightarrow \Delta R = 6 / 2\pi$$

$$\sim 1 \text{ m} !$$

From Intuition to Judgement



$$T_{\text{total}} = (t \times 2) \times 2 \times 2 \dots$$

50 times

so

$$T_{\text{total}} = t \times 2^{50}$$

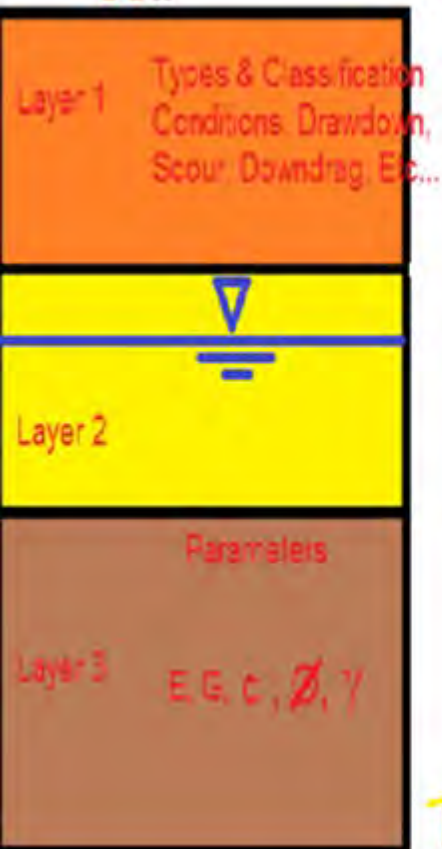
So if $t = 0.2 \text{ mm}$,

$$\begin{aligned} T &= 0.2 \times 2^{50} \\ &= \sim 225 \times 10^{12} \text{ mm} \\ &\sim 225,200,000 \text{ km} \end{aligned}$$

SoLGeH

ALWAYS VISIT
THE SITE

Soil



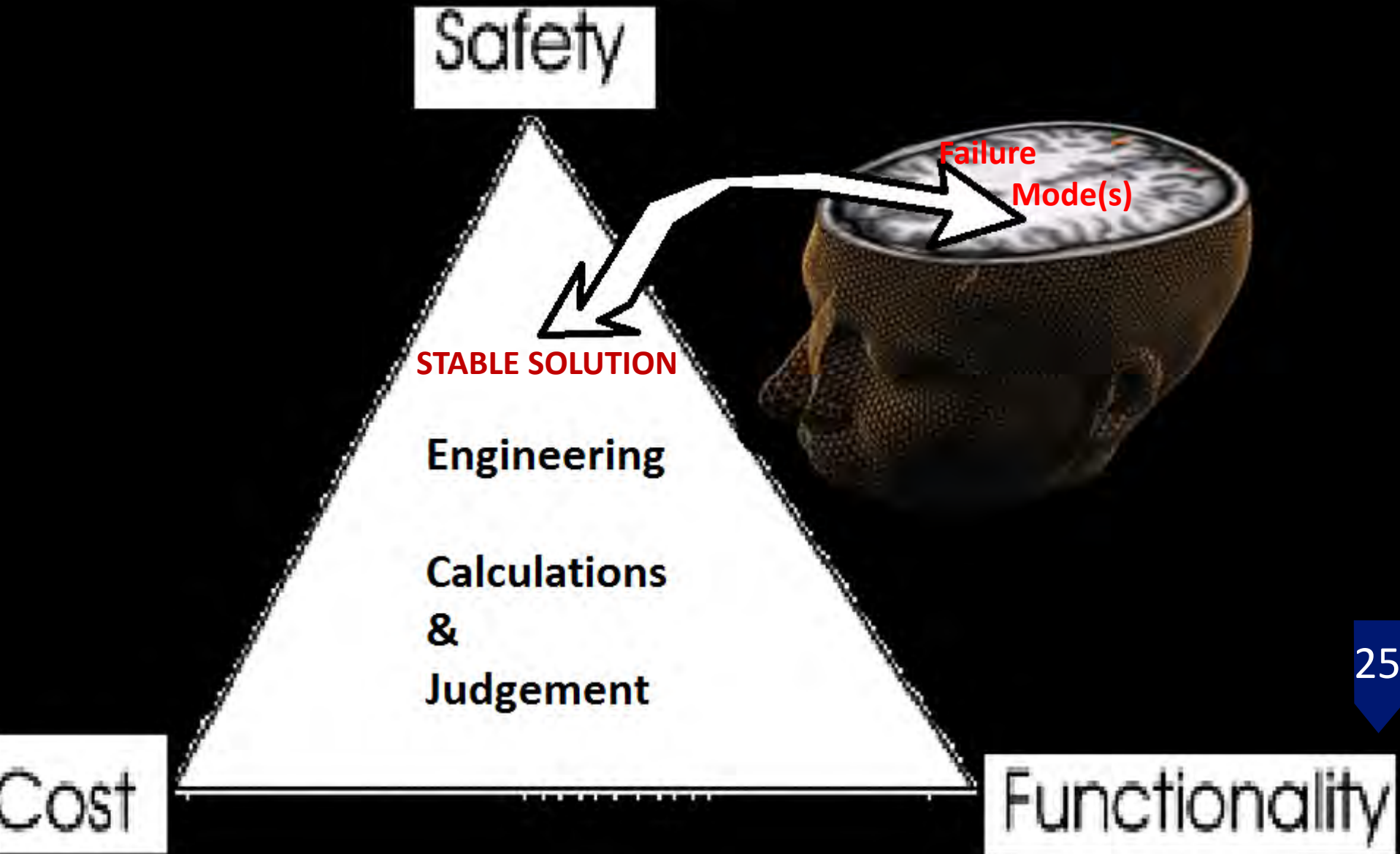
History

GoogleEarth Time Bar
Local Stories & Observations
Previous Failures



And...

SoLGeH



3- Eng'g in Life

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PARIS, SEPTEMBER 25 & 26, 2023

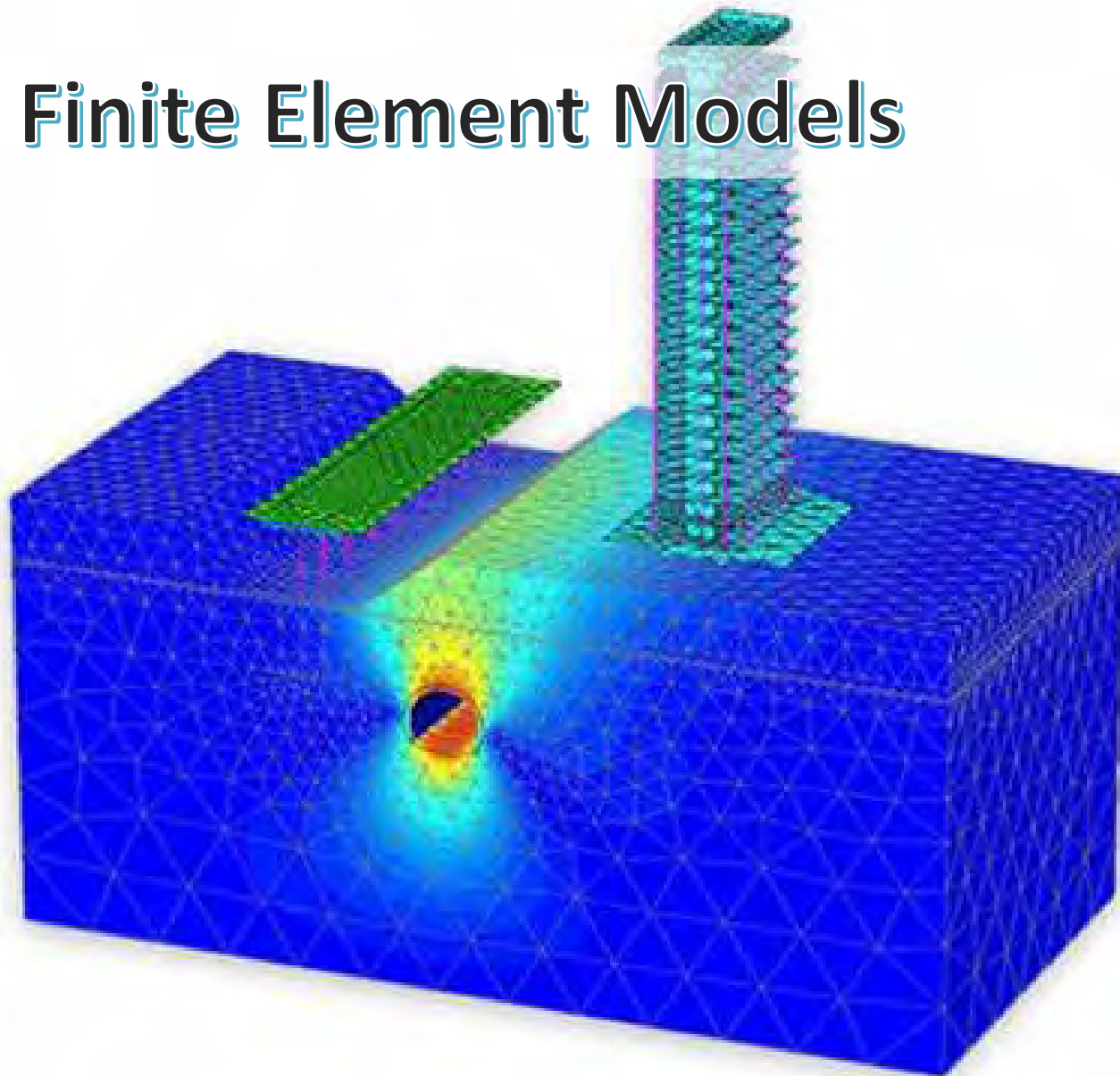
Applying those engineering theories
will lead to more Fun in every day life



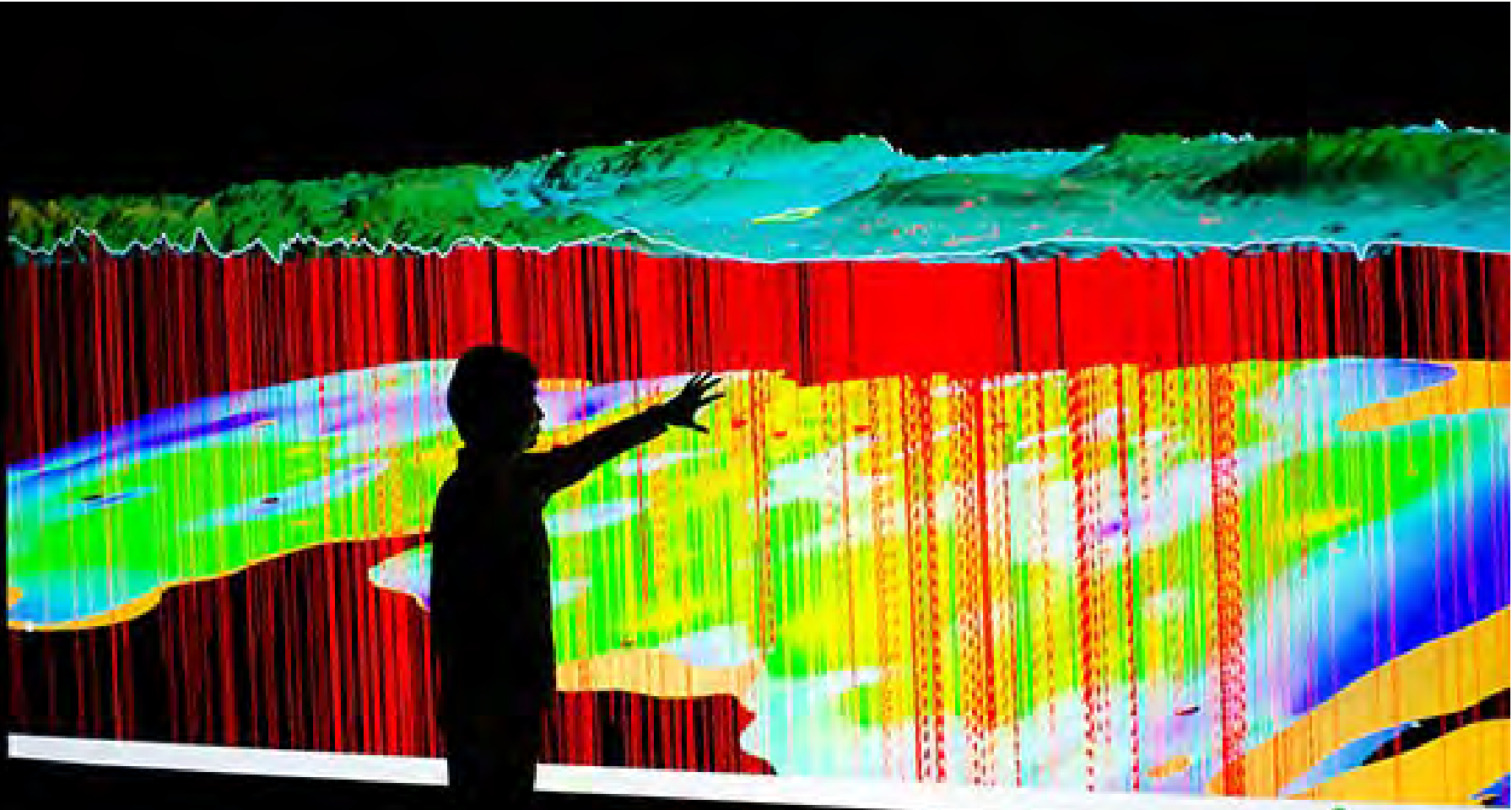
Equations That Changed The World

1.	Pythagoras's Theorem	$a^2 + b^2 = c^2$	Pythagoras, 530 BC
2.	Logarithms	$\log xy = \log x + \log y$	John Napier, 1610
3.	Calculus	$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$	Newton, 1668
4.	Law of Gravity	$F = G \frac{m_1 m_2}{r^2}$	Newton, 1687
5.	The Square Root of Minus One	$i^2 = -1$	Euler, 1750
6.	Euler's Formula for Polyhedra	$V - E + F = 2$	Euler, 1751
7.	Normal Distribution	$\Phi(x) = \frac{1}{\sqrt{2\pi\rho}} e^{-\frac{(x-\mu)^2}{2\rho^2}}$	C.F. Gauss, 1810
8.	Wave Equation	$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$	J. d'Alembert, 1746
9.	Fourier Transform	$f(\omega) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \omega} dx$	J. Fourier, 1822
10.	Navier-Stokes Equation	$\rho \left(\frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v} \right) = -\nabla p + \nabla \cdot \mathbf{T} + \mathbf{f}$	C. Navier, G. Stokes, 1845
11.	Maxwell's Equations	$\nabla \cdot \mathbf{E} = 0$ $\nabla \times \mathbf{E} = -\frac{1}{c} \frac{\partial \mathbf{H}}{\partial t}$	$\nabla \cdot \mathbf{H} = 0$ $\nabla \times \mathbf{H} = \frac{1}{c} \frac{\partial \mathbf{E}}{\partial t}$ J.C. Maxwell, 1865
12.	Second Law of Thermodynamics	$dS \geq 0$	L. Boltzmann, 1874
13.	Relativity	$E = mc^2$	Einstein, 1905
14.	Schrodinger's Equation	$i\hbar \frac{\partial}{\partial t} \Psi = H\Psi$	E. Schrodinger, 1927
15.	Information Theory	$H = -\sum p(x) \log p(x)$	C. Shannon, 1949
16.	Chaos Theory	$x_{t+1} = kx_t(1 - x_t)$	Robert May, 1975
17.	Black-Scholes Equation	$\frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} + \frac{\partial V}{\partial t} - rV = 0$	F. Black, M. Scholes, 1990

3D Finite Element Models



3D Vizualization & Holograms



Drone Mapping & AI Technologies

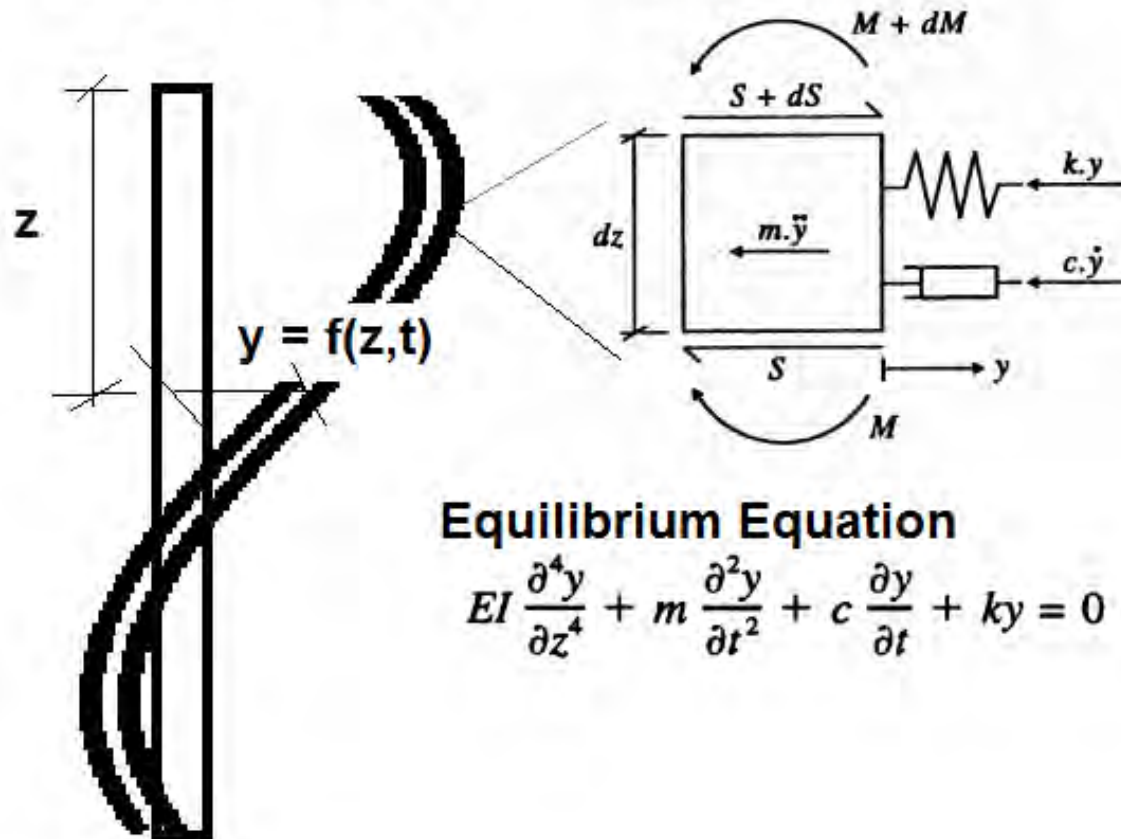


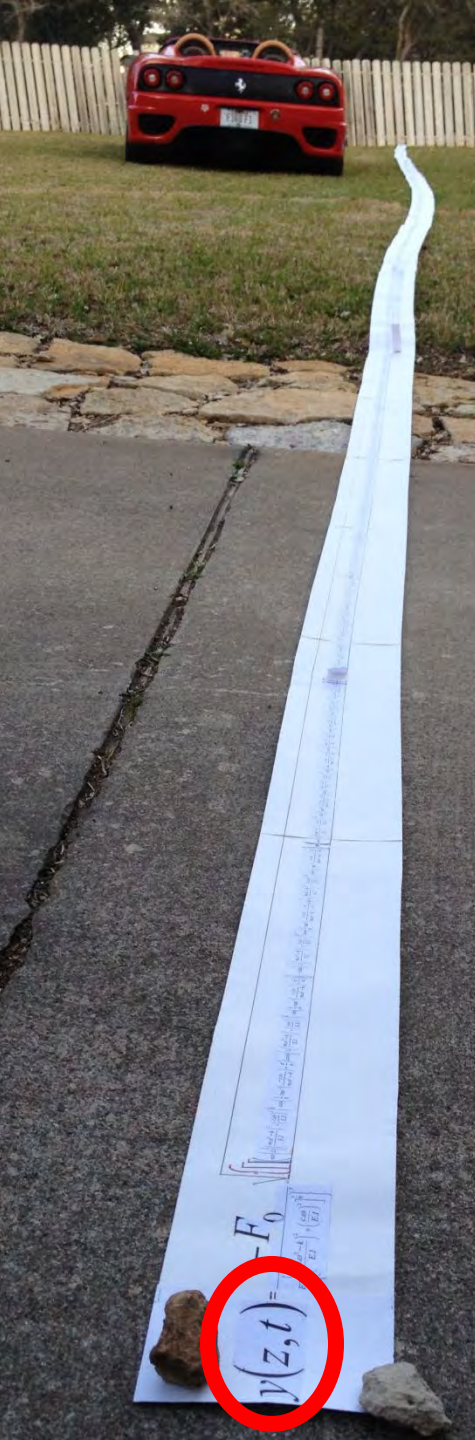
Flexural Wave Propagation in Piles

SINGLE PILE DYNAMIC ANALYSIS

PILE UNDER
LATERAL LOADS

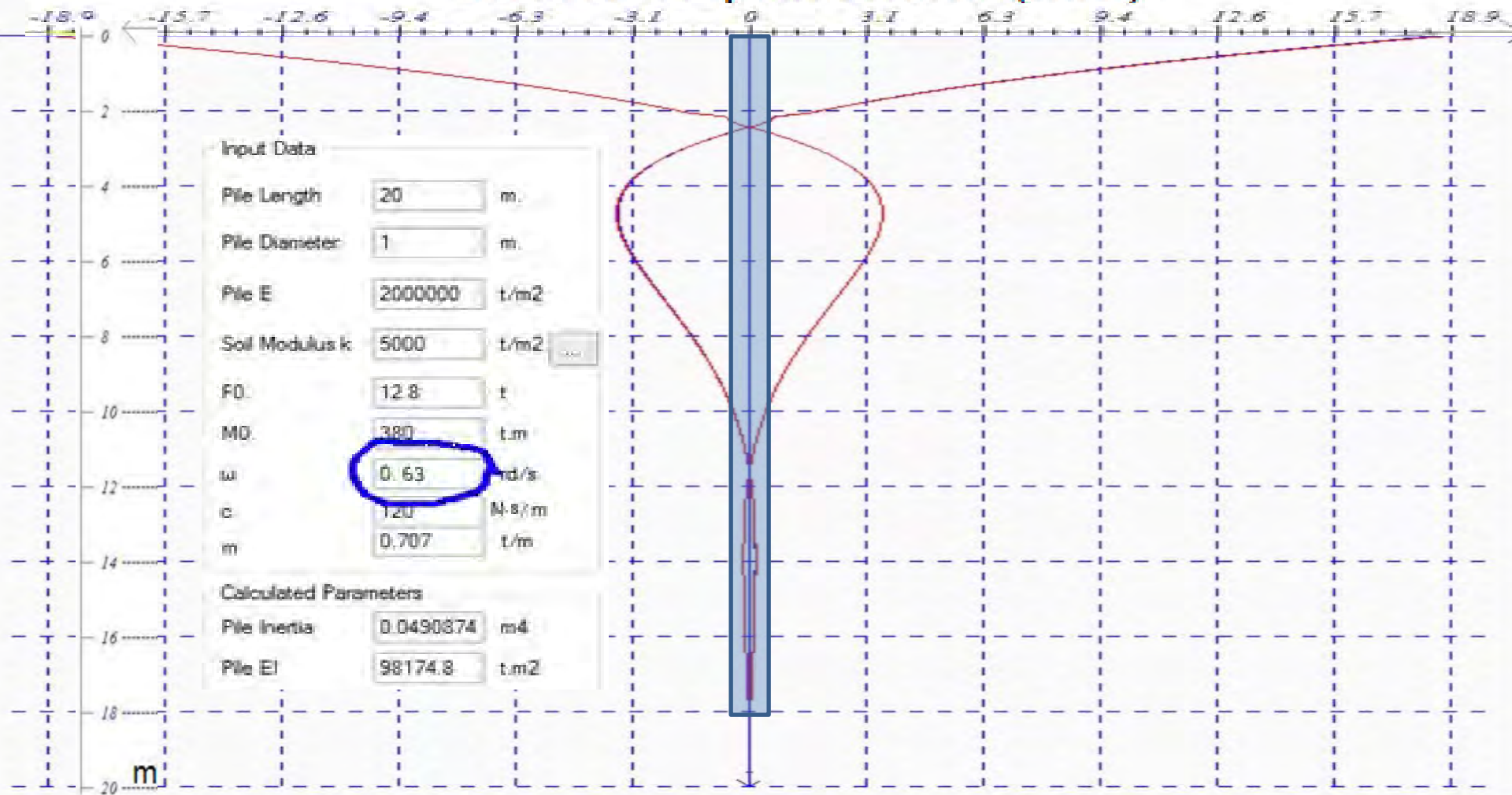
PILE DISCRETE
ELEMENT



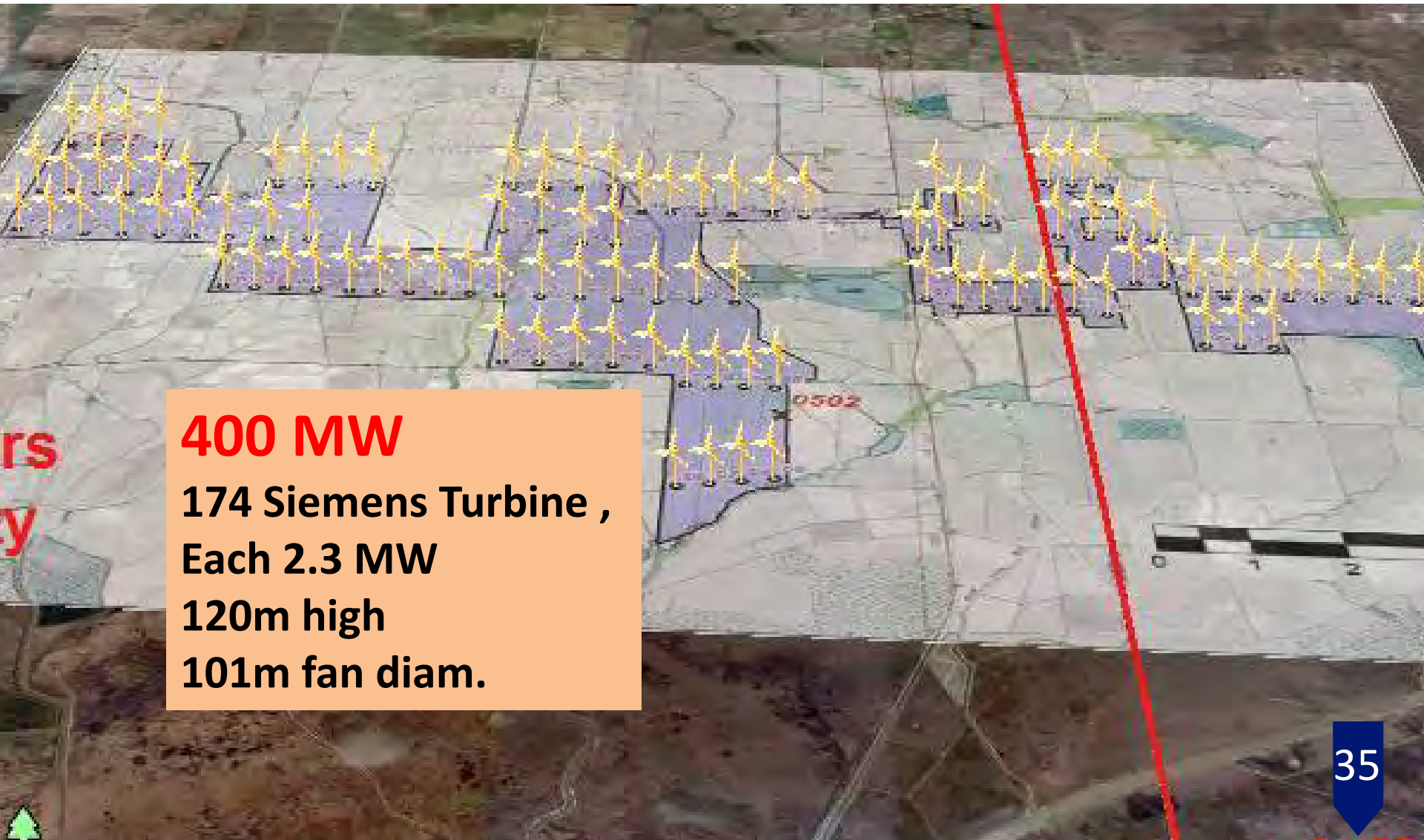


Sea Breeze WindFarm , Texas

Lateral Displacement (mm)



Sea Breeze WindFarm , Texas



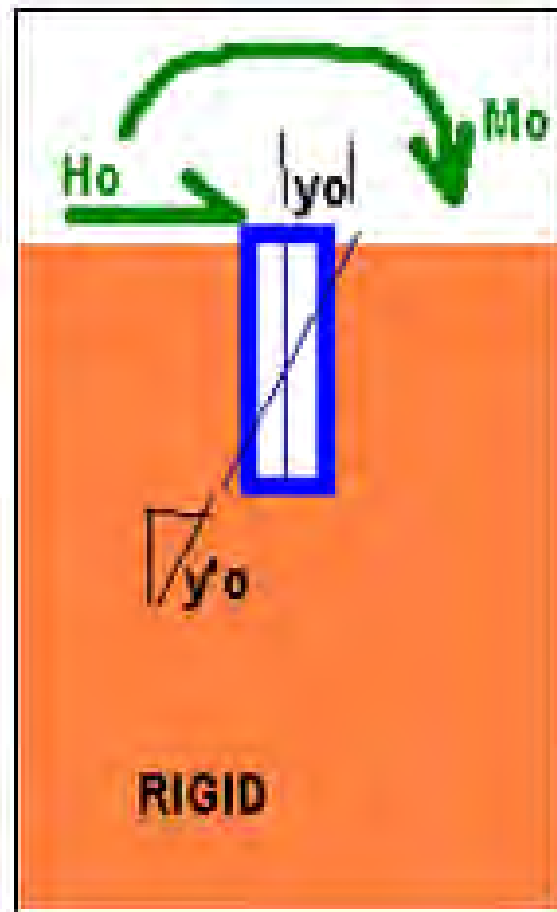
400 MW

**174 Siemens Turbine ,
Each 2.3 MW**

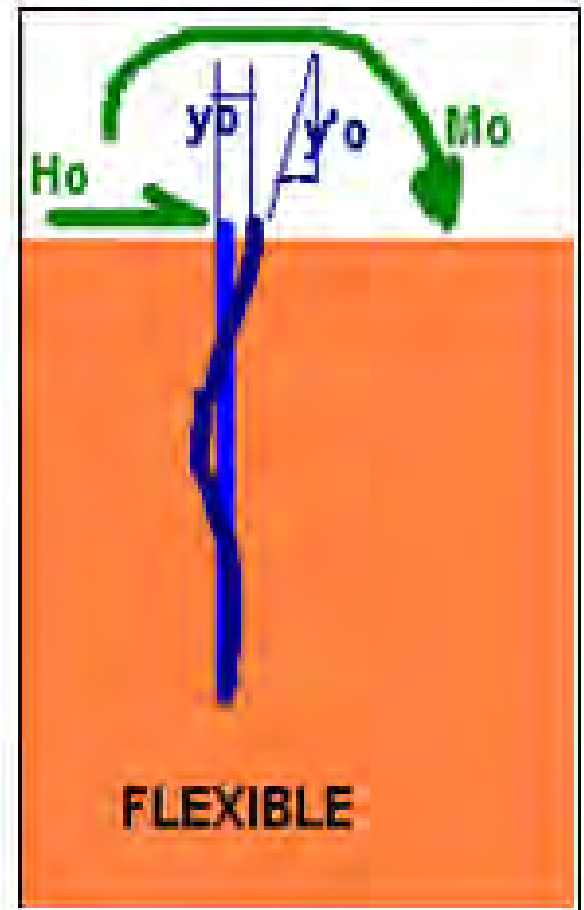
120m high

101m fan diam.

Soil/Structure Interaction



$$L < l_o$$

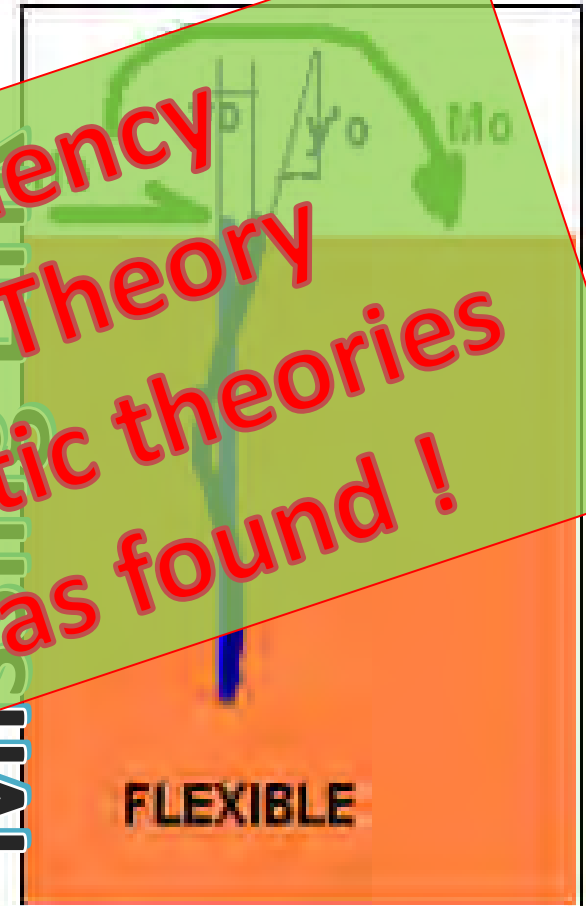


$$L > 3 \times l_o$$

Soil/Structure Interaction



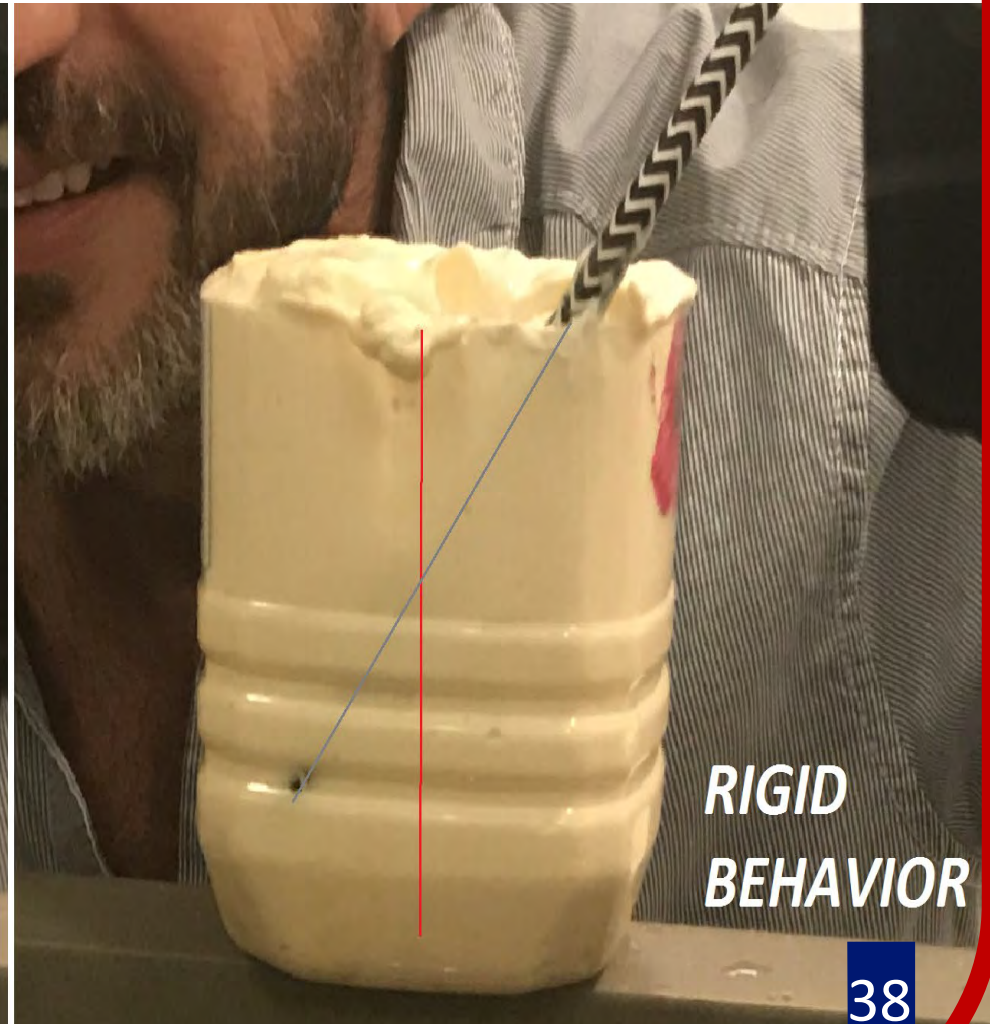
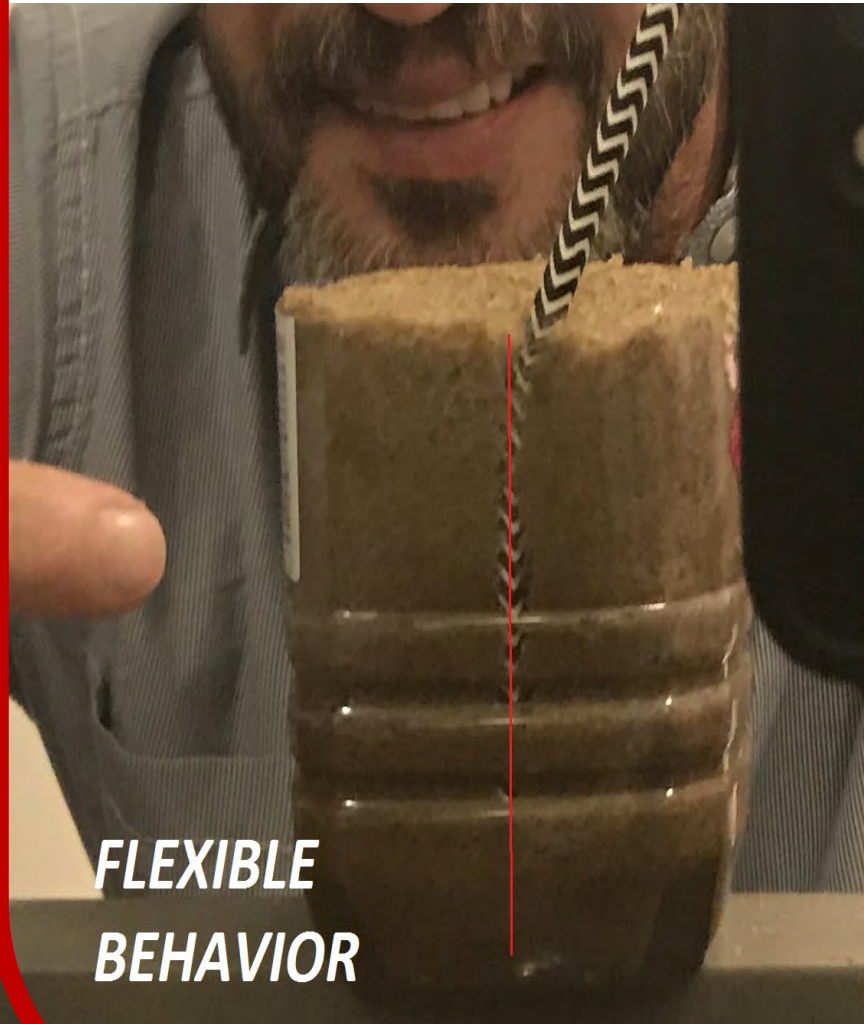
$L < l_0$



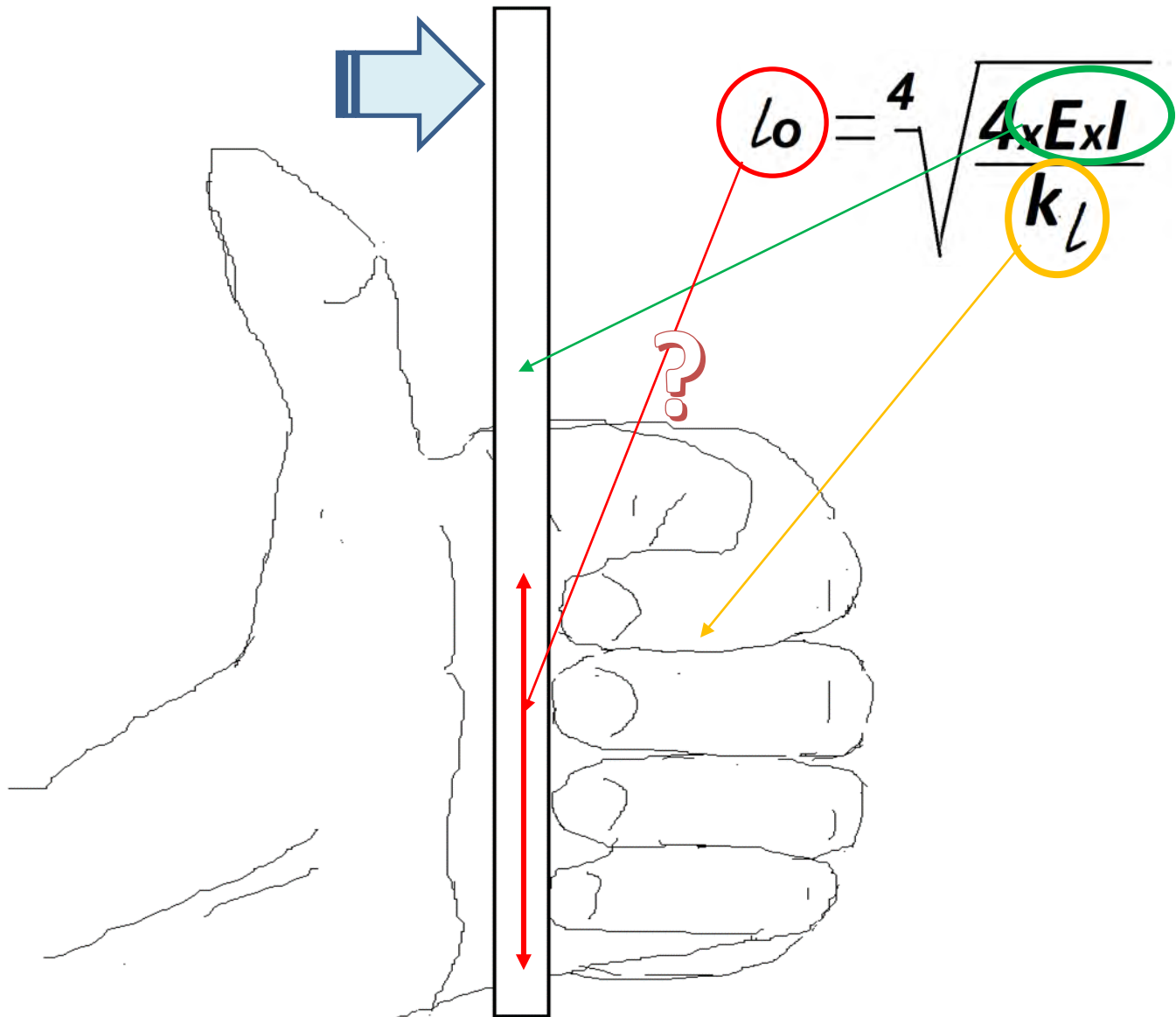
$L > 3 \times l_0$

At very slow frequency
The new Dynamic Theory
matches existing static theories
 \Rightarrow Missing Link was found !

Soil/Structure Interaction



Soil/Structure Interaction



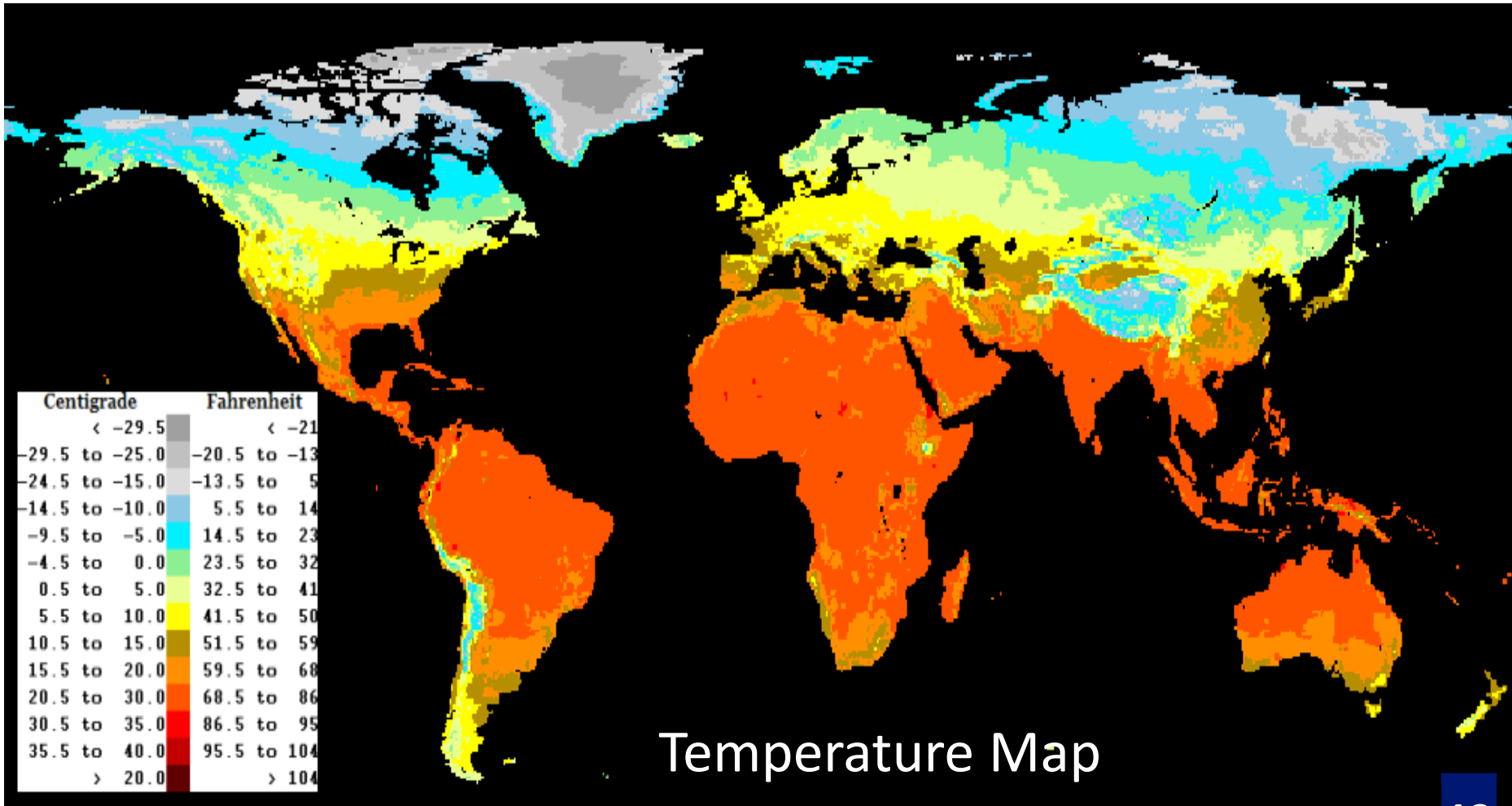
4- Business as Engineers

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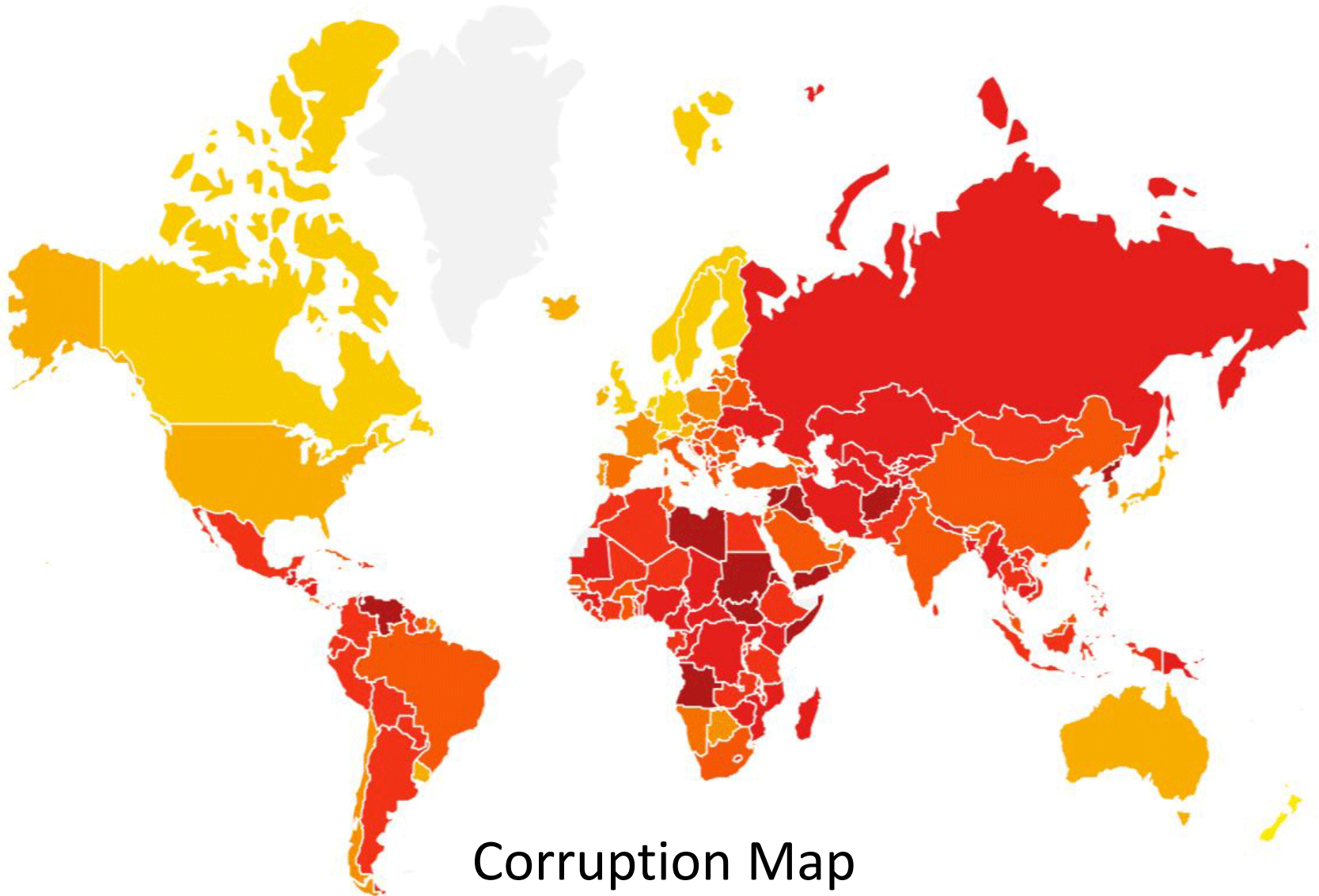
**There are the few who make things happen,
the many more who watch things happen,
and the overwhelming majority who
have no notion of what happens.**

Butler 1931

Be Ready to be International



Be Ready to be International





cfms

COMITÉ FRANÇAIS DE MÉCANIQUE
DES SOLS ET DE GÉOTECHNIQUE

5- Lessons Learned

SYMPOSIUM COULOMB
PARIS, SEPTEMBER 25 & 26, 2023

1. Collect Data “SoLGeH” before giving any answers, always check compatibility of Units, and Never Ever give an answer without UNITS !
2. Don't rely on intuition, Always Marry Theory to Practice by all methods possible using all data made available to make the best Judgement. Simplify to get the first Estimate.
3. Respect but Don't LIMIT yourself to the code because every problem is different and the code may not cover this particular one, Innovate without compromising safety...
4. Conduct Monitoring & Long Term Observation =
=> Best Value Eng'g & Continuing Education
5. Be ready to expand internationally with your Business
6. Stay connected to ISSMGE.org, it's your geotechnical Family !
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1. Collect Data "SoLGeH" before giving any answers, always check compatibility of Units, and Never Ever give an answer without UNITS !
2. Don't rely on intuition, Always Marry Theory to Practice by using all data made available to make the best judgment. Simplify to get the first Estimate.
3. Respect but Don't Limit yourself to the code book. Every problem is different and the code may not cover this particular case, Innovate without compromising safety...
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**The only way to do great work
is to Love what you do**
Steve Jobs

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Merci

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