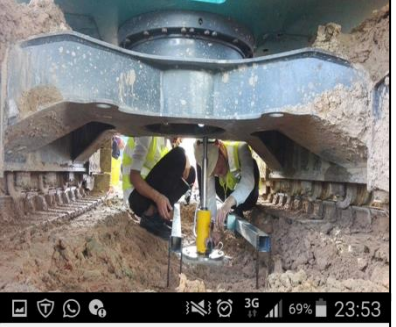

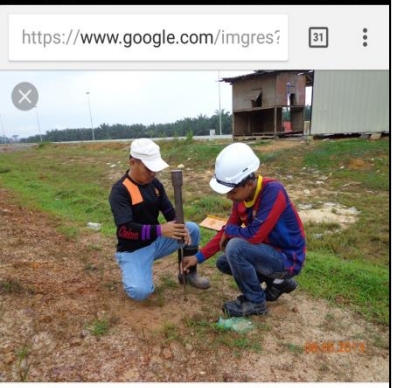

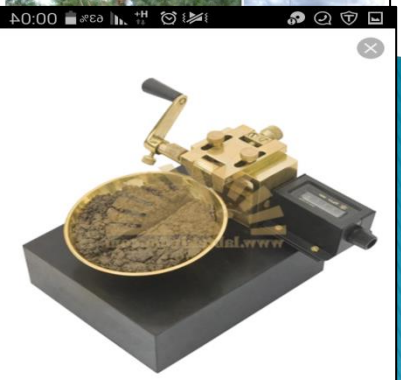

MAAC BICARA CENDIKIAWAN 2021:

SOIL & CONSTRUCTION FAILURES

Presented by:
Dato Prof. Ts. Dr. Mohd Idrus Haji Mohd Masirin
Pensyarah Sanjung FKAAB, UTHM/
Principal Researcher RECESS Malaysia, UTHM
30th October, 2021

KEMENTERIAN PENDIDIKAN TINGGI

KONGRES MAAC

UTHM
Universiti Tun Hussein Onn Malaysia

PERKASA
PERSATUAN PENSYARAH DAN PENGAJAR
UNIVERSITI TUN HUSSEIN ONN MALAYSIA (UTHM)

Prof. Dato' Ts. Dr. Mohd Idrus Hj. Mohd Masirin, DKSD, PK, PPA

PhD Engineering (UEL London), PhD International Studies (CUK, UK), MSc Civil Eng (UEL London), PgDip Civil Eng (UEL London),
BSc (Hons) Civil Eng (Hanyang Univ, Seoul), Diploma (International)(Humber College, Toronto), Diploma Civil Eng (UTMKL Malaysia)

PROF. DR. HAJI MOHD IDRUS HAJI MOHD MASIRIN

- Member of UTHM Board of Director
- Principle Researcher at RECESS UTHM
- Associate Researcher at SDRC UTHM
- Associate Researcher at iCOE-Rail UTHM
- idrus@uthm.edu.my
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EXPERTISE

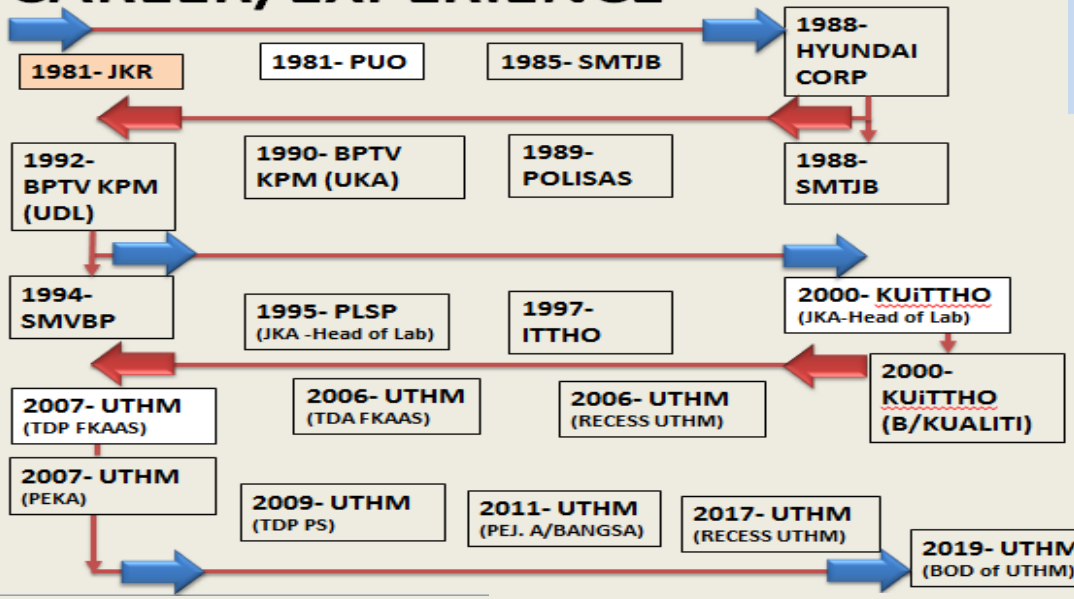
- Transportation System and Planning
- Railway Technology and Management
- Highway Materials and Maintenance
- Geo-Highways Technology

EDUCATION

Years	Awards	Institution
1981	Diploma Kejuruteraan Awam	Universiti Teknologi Malaysia
1988	BSc (Hons) Civil Eng. (Railway & U/ground Structures)	Han Yang University, Seoul, Korea
1993	PgDip in Civil Eng.	University of East London, London, United Kingdom
1994	Master in Civil Eng. (Highways & Transportation)	University of East London, London, United Kingdom
2007	PhD in Geo-Highways Engineering	University of East London, London, United Kingdom

40 years

CAREER/EXPERIENCE



PAST CONTRIBUTIONS TO UTHM

1. Founding Civil Engineering Labs
2. Establish initial KUiTTHO (UTHM) QMS Certification
3. UTHM Logo Lead Design Committee
4. RECESS UTHM Founding Management Committee
5. Enhance UTHM International Students Intake from 11 to 256 students
6. Enhance UTHM Postgraduate Students from 250 to 1200 students
7. Lead the planning of Master Railway program and a member of the Bachelor Railway curriculum design.
8. Establish and Register PERKASA UTHM as an Academic Association

COLLABORATORS/PARTNERS

- ✓ Prof. Dr. Jing; Beijing Jiaotong University, China ***(Research Collaboration)***
- ✓ Dr. Ikhsan Setiawan; Universitas Narotama, Indonesia ***(Academic Collaboration)***
- ✓ Dato Muhammad Isom; PRASARANA, Malaysia ***(Academic & Industrial Collaboration)***
- ✓ Prof. Dr. Masatoshi Kubouchi; Tokyo Institute of Technology, Japan ***(Research Collaboration)***
- ✓ Dr. Allam Musbah Al Allam; College of Technical Sciences, Libya ***(Academic Collaboration)***

INVENTIONS & INNOVATIONS

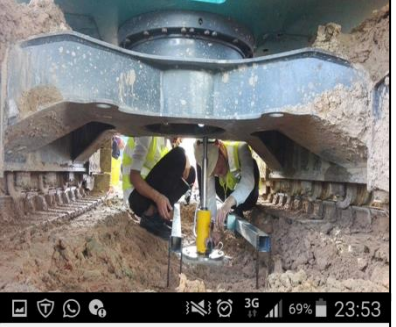
1. **ENCAPS** (PAVEMENT DESIGN SYSTEM)
2. **W-DRAIN** (INNOVATIVE SLOPE DRAIN)
3. **SAND-3-SIEVER** (INNOVATIVE SIEVER)
4. **REPOMIX** (ASPHALTIC CONCRETE COLDMIX)
5. **RCCI** (RAILWAY COMFORTABILITY INDEX)
6. **URBAN RAIL SYSTEM** (TOD RATING)
7. **IPMB** (PEAT PARTICLE BITUMEN MODIFIER)

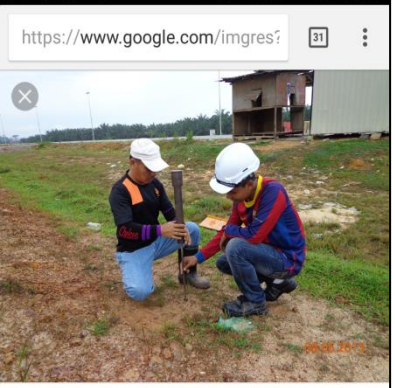
ACHIEVEMENTS/CONTRIBUTIONS

- **Invention and Innovation Awards** – 1 Platinum, 1 Double Gold, 15 Golds, 3 Silvers and 1 Bronze
- **Institutional Contributions** – Pioneer of PLSP, QMS Lead Management, MS ISO Lead Auditor, Founder RECESS, CESWEC, PERKASA UTHM and MAAC.
- **Institutional Awards** – 2 Anugerah Khidmat Cemerlang, 1 Anugerah Kepujian, 1 Anugerah Jasa Bakti, 2 Anugerah Pensyarah Cemerlang FKAAS, 1 Anugerah Inovasi Universiti, 2 Anugerah Khas Inovasi UTHM
- **Publications** – 31 Scopus documents (4 still not updated), H-index = 4 (Possible to 5), Google Scholar Index = 8 (Possible to 10).
- **Research Grants** -
- **Keynotes** – 15 Local & International Invitations, 9 Forums & mass media
- **CSR Awards and Contributions** – Through university programs and NGOs

INTRODUCTION







pbtolkerteh.blogspot.com

LPT2 TOL KERTIH: JKR Probe Test

JKR Probe Test dibuat pada tapak bangunan Surau, Balai Pengawal dan Walkway bagi menentukan kedalaman pengorekan asas bangunan.

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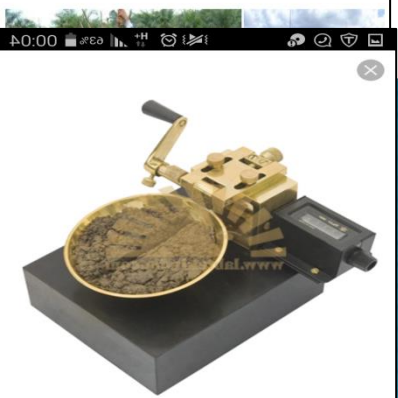
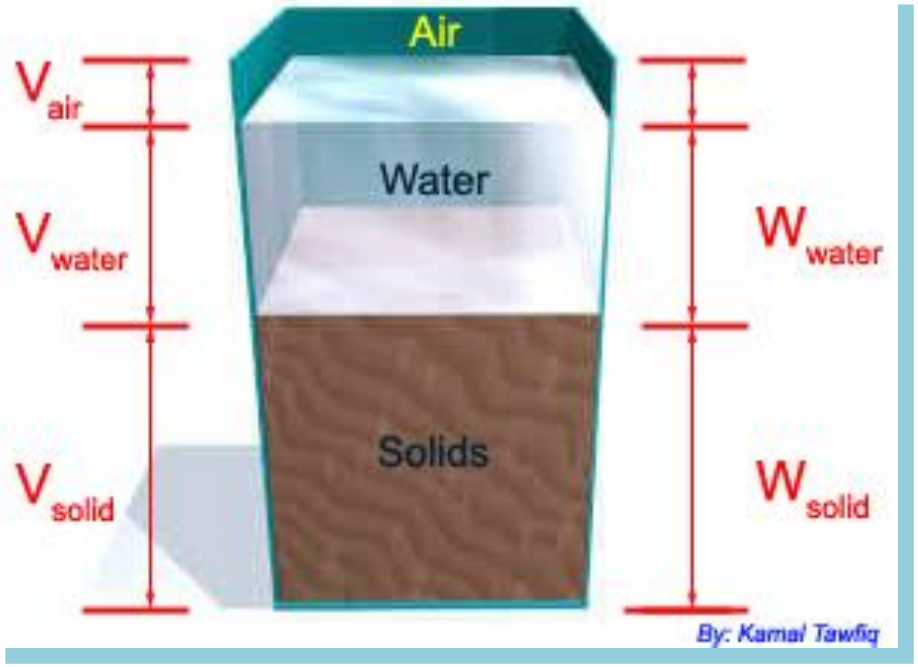
Related images VIEW ALL



WHAT IS SOIL?

COMPONENTS OF SOIL

A soil sample.



An idealised soil sample.

Fig. 2 Components of soils.

WHY WE SHOULD DISCUSS ABAOUT GEOTECHNICS?

- It is a difficult subject matter
- Not popular among students
- Abstract and lots of problems



Presentation Layout

1. Introduction To Geotechnics or Soil Engineering
2. Roles of Geotechnical Engineers
3. Importance of Soil Investigation
4. Understanding Soil Parameters and Properties
5. Soil Types and Characteristics
6. Types and Causes of Soil Failure
7. Cases to Discuss
8. Challenges of Constructions
9. Closing Remarks

GEOTECHNICAL ENGINEERING

- **Geotechnical engineering** is the branch of **engineering** concerned with the analysis, design and construction of foundations, slopes, retaining structures, embankments, tunnels, levees, wharves, landfills and other systems that are made of or are supported by soil or rock.

WHAT ARE THE ROLES OF GEOTECHNICAL ENGINEERS?

- **Geotechnical engineers** are responsible for structures' foundations.
- Work includes assessing data from the field, finding ways to ensure foundations or slopes are stable, designing foundations, and overseeing work on a construction site.
- They often work for consultancies.

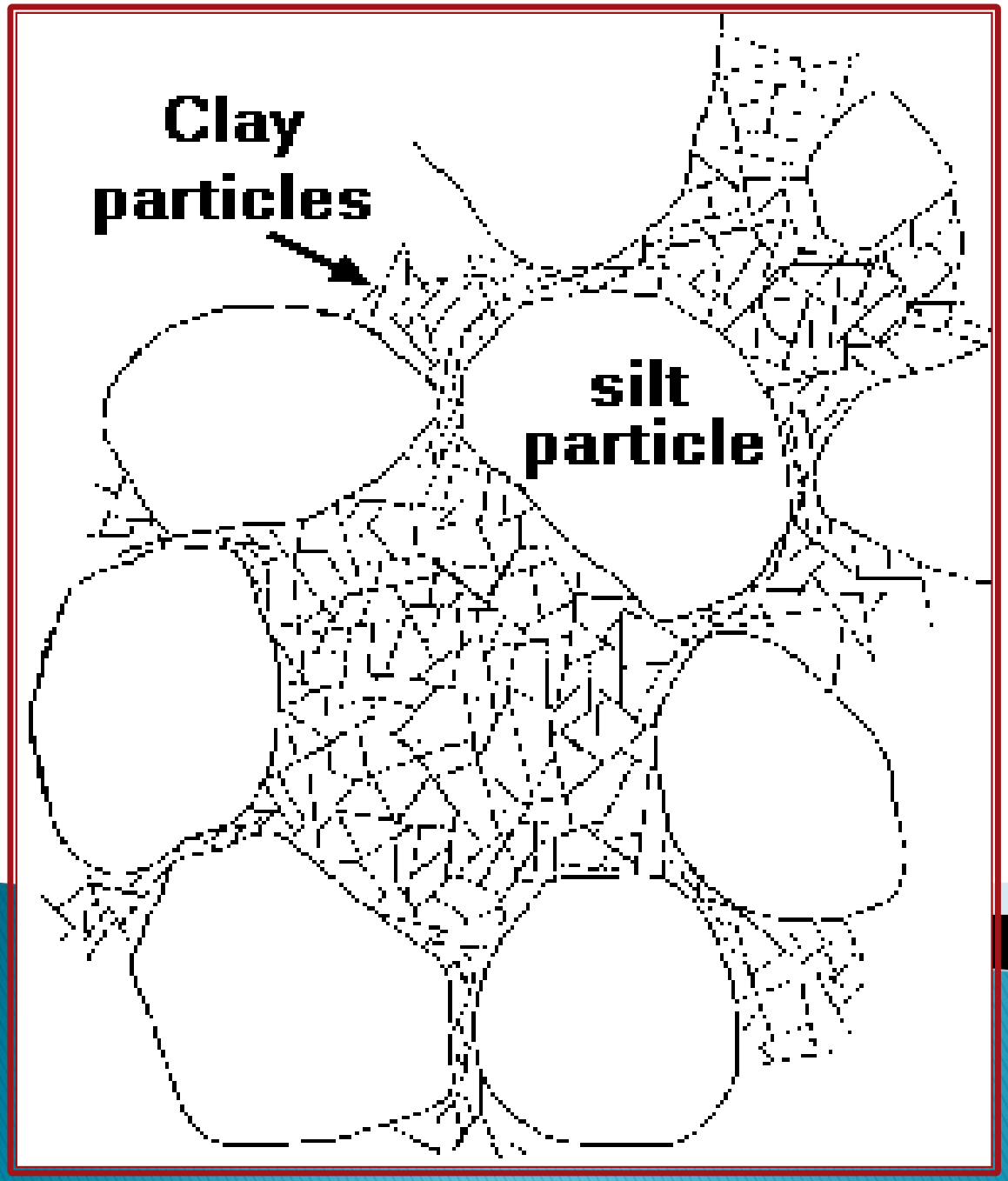
HOW DO ENGINEERS DEFINE SOIL?

- The **engineering** field described **soil** as…

  '"the solid material that can be removed without blasting."

- **Soil** is biologically defined as….
  "unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors."





1. SOLIDS
2. AIR
3. WATER

(2) + (3) = VOIDS

COMPARING GEOLOGISTS TO GEOTECHNICAL ENGINEERS

- **Geologists** are … students of the planet (its processes and make-up).

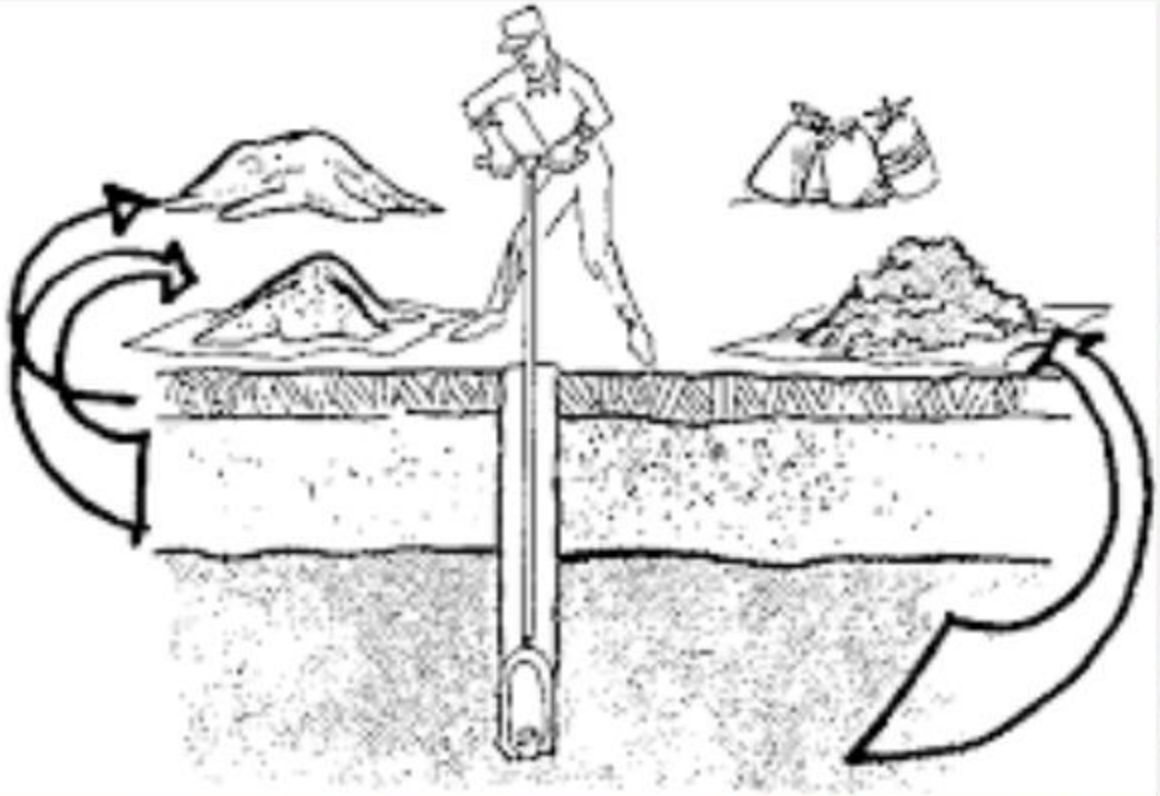
- **Geotechnical engineers** are…
  civil **engineers** who utilize their knowledge of **geology** to aid **in the** design and construction of structures, depending on the mechanics of the surrounding **geology.**



psoil

nd

ey



SOIL & CHARACTERISTICS

Introduction to Soil

What are the definitions of:

- Soil Mechanics
- Geotechnics
- Geotechnical Engineering

Why do we conduct soil investigations?

What are the purpose of each investigation?

soil me·chan·ics

noun

the branch of science concerned with the properties and behavior of soil as they affect its use in civil engineering.

Feedbac

Translations and more definitions

Soil mechanics - Wikipedia

https://en.m.wikipedia.org › wiki › Soil_...

Soil mechanics is a branch of soil physics and engineering mechanics that describes the behavior of soils.

Genesis and composition of soils

ge·o·tech·nics

/ˌjēōˈtekniks/

noun

the branch of civil engineering concerned with the study and modification of soil and rocks.

Feedback

Translations and more definitions

Geotechnics - Wikipedia

https://en.m.wikipedia.org › wiki › Geote...

Geotechnics is the application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the Earth's crust and earth materials for the solution of engineering problems and the design of engineering works.

Soil Mechanics Vs Geotechnics

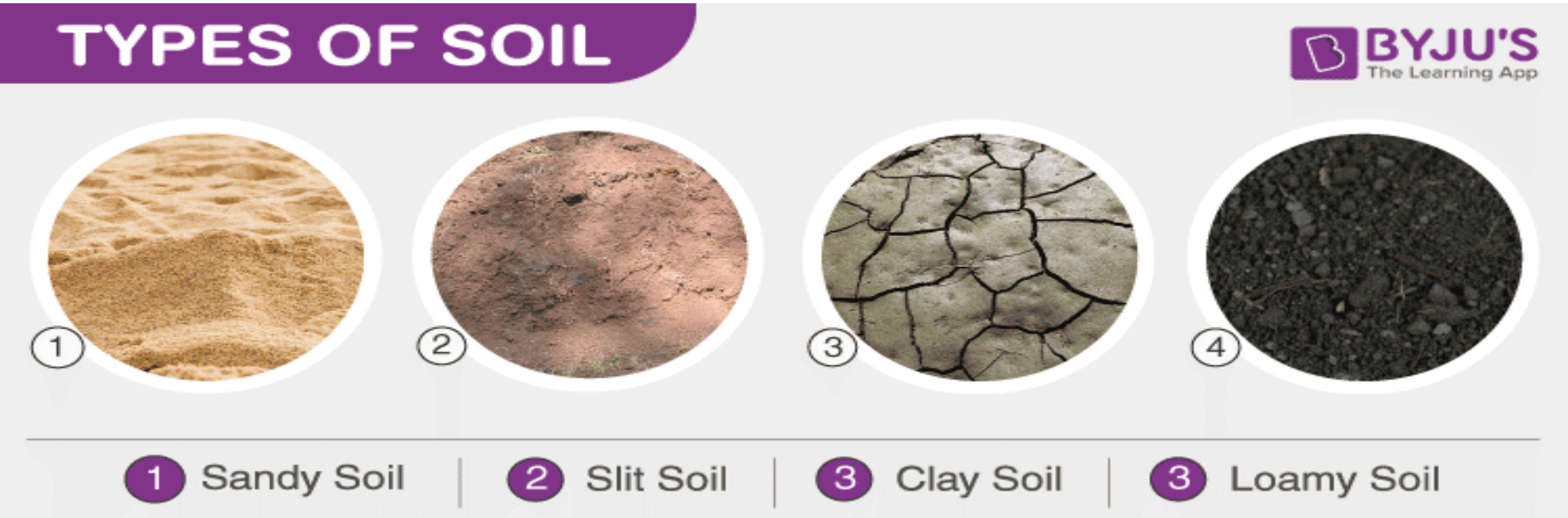
- Understanding the properties and behaviour of soils – **Soil Mechanics**

- Studying and analysing the applications of soil and its geological properties for engineering fit for purpose – **Geotechnics**

- **Geotechnical engineering** is equivalent to Geotechnics by definition but, shows direct impact to engineering applications

Soil Types

- Soil is characterized based on its properties and mechanical characteristics
- Types of soil:
- 1. Clay Soil 2. Sandy Soil 3. Silty Soil
- 4. Peaty Soil 5.Chalky Soil 6. Loamy Soil




{sandy}
{loamy}
{clay}
types of soil

GEOTECHNICIAN CONTRIBUTIONS…

CONTRIBUTIONS OF GEOTECHNICS

1. Avoid soil disasters and accidents
2. Avoid lost of lives and properties
3. Reduce continuous settlement and damages
4. Understand the soil behaviors and properties
5. Improve soil for construction purposes

SOIL INVESTIGATION

Why We Conduct Soil Investigation?

- **Laboratory Investigations** – understanding basic soil properties and characteristics at controlled condition with desired methods
- **Field Investigations** – advanced understanding and research on soil properties and characteristics at partially-controlled conditions with desired methods for specific purposes
- Conduct **relevant correlations** for advancements in soil mechanics

Importance of Soil Investigation

Among others also include:

- Fundamental of Soil Properties
- Soil Characteristics
- EFP – Engineering fit for purpose
- Design Input
- Long term Impact
- Project feasibility and monitoring
- Proposal for improvements

Understanding Soil Parameters and Properties

- There are many soil parameters, from basic properties to mechanical and dynamic properties and also its engineering characteristics

- Cohesion, bearing capacity, strength, liquidity, plasticity, permeability, homogeneity, shear, compressibility, void ratio and sensitivity

Why is soil mechanics important for civil engineers?

6 ANSWERS

Mohammadali Kia, President, Principal Geotechnical Engineer at Alpha Adroit Engineering Ltd (2013-present)

Updated Feb 19

Civil Engineering is the engineering required for civilization, to build civilization. Everything that is built to build civilization, is made of soil, or is built on soil, or is built within soil. Hence, the knowledge of mechanical behavior of soil, i.e. soil mechanics, is an integral part of civil engineering.

Soil mechanics studies how and how much soils deforms, how soils resists deformation, and estimates their strength under different boundary conditions and different loading conditions.

Loads of any civil engineering structure (such as bridges, pipelines, infrastructures, buildings, highways, oil and gas refineries, factories, dams, etc) will need to be transferred to and carried by the earth through a foundation system. Foundation engineering requires knowledge of soil mechanics (some times rock mechanics).

To protect our civilization against geo-hazards (such as slope instability issues, massive landslides, liquefaction, ground subsidence, and cracking of foundation of buildings, settlement, heave, swelling, sinkhole formation, shallow or deep isolated or connected cavity formation under infrastructures, caving soils, general subsidence, ground collapse, foundation disintegration, loss of bearing capacity, seepage and leakage, etc), we need to know the mechanical behavior of problematic soils and mechanics of how these geo-hazards form and affect our civil engineering structures.

There are much more to be told in this short answer. Feel free to ask particular questions you may have. Alpha Adroit Engineering Ltd also shares geotechnical engineering knowledge at:
http://www.alphaadroit.ca/
http://www.alphaadroit.ca/alpha-...
Alpha Adroit is a Canadian consulting company

TABLE 1. PROPROPERTIES OF SUBGRADE SOIL

S. No.	property	Result
1	Soil type	A- 3
2	OMC (%)	14
3	Max dry density (kg/m^3)	1850
4	Field density (kg/m^3)	1757
5	L.L (%)	16
6	P.I (%)	NP
7	G.I	0

E 5. RESULTS OF OMC, DRY DENSITY AND CBR VALUE

Type of material	CBR value (%)
Gravel	60.10
80% gravel + 20% crushed aggregates	64.75
70% gravel + 30% crushed aggregates	75.23
Crushed aggregates	85.30

TABLE 7. MODULUS OF ELASTICITY AND MODULUS OF SUBGRADE REA OF DIFFERENT PAVEMENT MODELS

Pavement model No.	E-value (kg/m^2) x 10^4	K-value (kg/m^3) x 10^4
1	788.37	5.50
2	1020.25	5.95
3	1576.75	6.70
4	1855.00	7.15

TABLE 3

Main Contents of Reinforcing Materials

Materials	Main contents(%)			
	Al_2O_3	Fe_2O_3	TiO_2	$Ca(OH)_2$
Al-Fe-Ti-Ca No.1	5.00	36.13	0.62	48.85
Al-Fe-Ti-Ca No.2	10.51	22.24	1.42	48.85
Al-Fe-Ti-Ca No.3	15.02	31.80	1.92	27.85
Fe lime (conventional)	0.51	47.46	–	48.85
Slaked lime	Trace	Trace	–	97.72

Table 5

Ranges of Thickness of the Permeable Composition

	Minimum Value	Maximu Value
General Weight of Permeable Composition Applied to Substrate Material (%, by weight of coated product or substrate material)	15%	30%
General, Approximate Thickness Applied to Substrate Material (microns)	45 microns	90 micro
Preferable Weight of Permeable Composition Applied to Substrate Material (%, by weight of coated product or substrate material)	15%	25%
Preferable Approximate Thickness Applied to Substrate Material (microns)	45 microns	75 micro

Type of Aggregate | *Coefficient of Thermal Expansion/C°*

Table 10.10. Field test of soils

No.	Purpose of test	Type of test
1.	Relative density (coarse grained soil)	(*i*) SPT (*ii*) DCPT
2.	Shear strength (cohesive soil)	(*i*) Vane shear test (*ii*) CPT (*iii*) In-situ direct shear test
3.	Permeability	(*i*) Pumping test (*ii*) Piezometer test
4.	Bearing capacity and settlement	Plate load test
5.	Testing of piles	Pile load test
6.	Compaction control	Proctor's needle test

Indian Standard Soil Classification

- Similar to USCS
- Difference is w.r.t fine grained soils
  - Sub divided into 3 categories – low, medium and high compressibility
- Total 18 types of soils
- Symbols used are same as USCS

CLAY	SILT	SAND			GRAVEL
		Fine Sand	Medium Sand	Coarse Sand	
0.002mm (2 micron)	0.075mm (75 micron)	0.425mm (425 micron)	2.0 mm	4.75 mm	

Table 10 Field CBR Values for Different Conditions

No	Description	CBR values, %
	CBR without Plastic Sheet	6.74
	CBR with Plastic Sheet at 2.5 cm from Surface	8.95
	CBR with Plastic Sheet at 5.0 cm from Surface	11.28

Laboratory Versus Field Investigation

Both has their advantages and disadvantages:

1. Laboratory works are at ideal conditions but field works are actual soil experiential situation
2. Laboratory tests are easy to control and predict but field tests are full with uncertainty and surprises
3. Laboratory tests can be repeated and results are similar but field tests depended on weather and workmanship
4. Field tests are real time but engineers must always use their wisdom to overcome challenges.

Iron, Fe	DTPA	46	ppm	High
Manganese, Mn	DTPA	18	ppm	High
Copper, Cu	DTPA	2.4	ppm	High
Nickel, Ni	DTPA	0.24	ppm	
Nitrate-N, NO_3-N	Calibrator ion	3	ppm	Low
Phosphate-P, PO_4-P	Olsen	56	ppm	High
Sulfate-S, SO_4-S	Hot Water	1,300	ppm	Very High
Boron, B	Hot Water	3.9	ppm	High
Free Lime, FL		High		
ESP	Calculated	20.5	%	
CEC	Calculated	38.1	meq/100g	

% Base Saturation	Calculated	Ca	Mg	K	Na
		64.3%	11.4%	3.8%	20.5%

Levels are generalized and apply to most cropping environments.
Low means a high probability that applying nutrient will elicit a growth response.
Medium means a moderate probability of plant growth from application.
High means little or no response reported from application of this nutrient.
Very High means adding the nutrient may reduce growth or cause imbalance.

Soil Compaction Testing

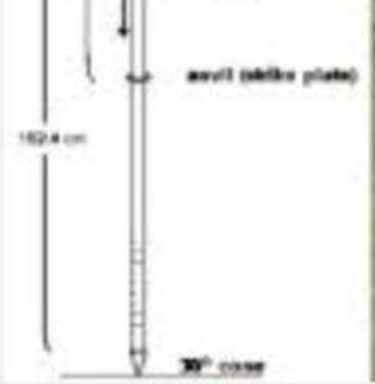
Proctor Test - Optimizes Relationship of a Specific Soil Regarding Density + Moisture

SOIL ANALYSIS

- *Soil testing or soil analysis is essential for building permits. Soil test for construction taken by the engineers may need to make further soil tests to make sure of the subsurface of soil conditions.*
- *Initial investigation measure is necessarily required for soil testing.*

Laboratory Investigation

- Equipment used are typically for basic soil properties and characteristics
- Samples tested are disturbed and undisturbed
- Usually involved the moisture content determination and soil classification process
- Simple to advanced apparatus in the laboratory
- Commonly using BS, ASTM or AASHTO as standard references during tests



le 1: Homesite use limitations by soil depth class.

ASSES / Depth to Bedrock	Foundations with Basement	Lawns & Gardens	Septic System	Ponds & Lagoons
y Deep: ≥72"	No-slight	No-slight	No-slight	No-slight
p: 36 to <72"	Moderate	No-slight	Moderate	Moderate
l, Deep: 20 to <36"	Severe*	No-slight	Severe	Severe

www.geo-gulf.com

CPT Cone Penetration Testing Specialist in UAE and Gulf | Soil Me...

keywordsuggest.org

lab test equipment Gallery

soil laboratory testing equipment

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www.hoskin.ca

Advanced Soil Mechanics [Various] : Hoskin Scientific, Supplier of testing...

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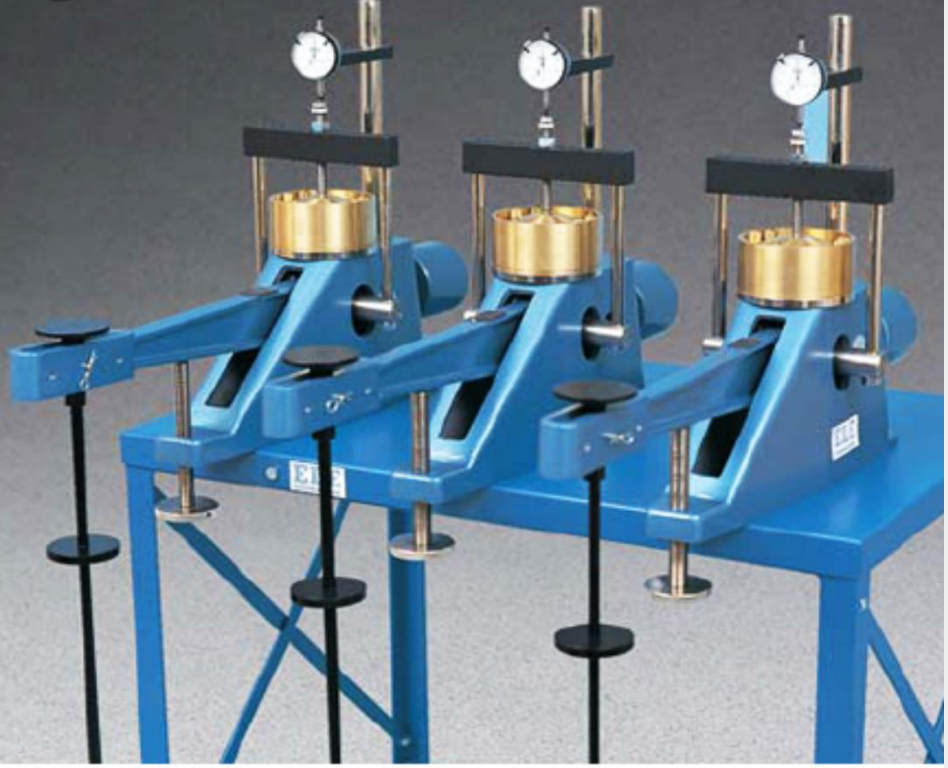
A
B

Laboratory Consolidation Test

Civil Engineering - Texas Tech University

www.slideshare.net

Class 7 Consolidation Test (Geotechnical Engineering)



www.hoskin.ca

Soil Mechanics : Hoskin Scientific, Supplier of testing and monitoring i...

table top consolidation apparatus

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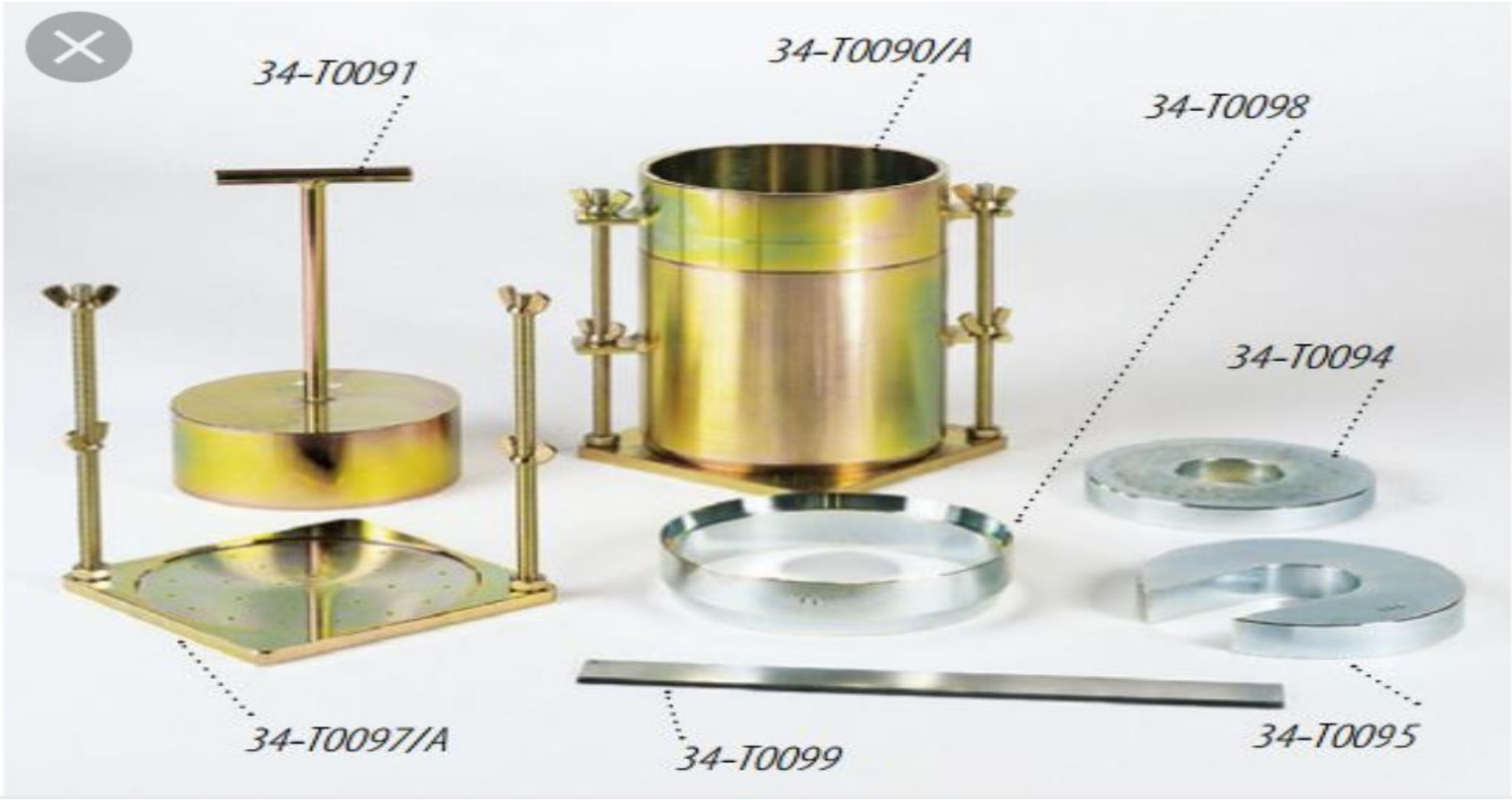
Dynamic Hollow Cylinder Testing System | Avantech Engineering Con...

The GCTS Dynamic Hollow Cylinder Testing System allows Direct Digital Servo Control of axial load, torque, confining pressure, internal pressure for performing 'true triaxial' tests. This system is capable of simulating most

THE SIEVER



Controls Group

CBR equipment, ASTM/AASHTO version, Soil testing equipment, Con...

ASTM/AASHTOCBR mould set (partial) ...

NGI

Norsk | English

NGI | Oslo

P.O. Box. 3930 Ullevål Stadion, N-0806 Oslo,
Norway

Sognsvn. 72,
N-0855 Oslo,
Norway

22 02 30 00
ngi@ngi.no

The tests on soil are as follows.

- Moisture content test.
- Atterberg limits tests.
- Specific gravity of soil.
- Dry density of soil.
- Compaction test (Proctor's test)

TYPES OF SOIL TESTS FOR BUILDING CONSTRUCTION - The ...

https://theconstructor.org › geotechnical

FIELD INVESTIGATIONS

Conducting Field Investigation

- Field investigation needs planning and management skills
- Planning the types of tests and equipments to be used, managing the time of mobilization and the people including the cost and welfare
- Accuracy is not the priority but attempting to determine and study the properties and behaviour of soils at site is crucial for the main aim of the field works.
- Appropriate measures and contigencies must be prepared prior execution of plan.

required for testing
- Budget for soil test on a 6mx12m site is Rs.8000

- Lack of laboratory in vicinity

- Achieving required depth for foundation
  - IS 1080-1985- Code of Practice foe Design and Construction of Shallow Foundation in Soils
  - Min. required foundation depth is 3m

- Validity of the soil test report when compared to the actual conditions

What is a test soil boring and why is it performed?

"A **soil boring test** are conducted for different reasons, including to determine good drilling locations and depths for wells and basements. The **soil boring tests** are **performed** by excavating **soil** from an area."

Why are soil boring tests conducted? | Reference.com

https://www.reference.com › science › so

INSTRUMENTATIONS

- Laboratory tests used workstation approach
- Field tests equipment are mobile units
- Both require appropriate calibrations and care during operation
- Electronics operated equipment are more accurate but very sensitive and delicate
- Accuracy will be the priority of laboratory tests but appropriate setting and near to accurate will be for field tests
- Field work involves wise and analytical decision and lab works requires diligence and sensitivity


Dynamic Cone
Penetration

DIFFERENT TRAINING REQUIREMENTS

- Field works need strength and determinations
- Skill to handle fieldwork apparatus with safety precautions are necessary
- Lab works are typically easily organized and less mobility
- Skill are acquired by understanding and practicing the SOPs for each apparatus
- Operation of field work equipment must be conducted after appropriate training
- Trained supervisor must accompany researchers or operators.


Chelsea
STARWILL
08 05 2013


TIME
ENERGY

TYPES & CAUSES OF FAILURES

SOIL FAILURES (ON-SITE)

Some are made made & some are natural disaster

1. Landslides
2. Settlements due to time or workmanship
3. Earthquakes
4. Floods




963

CASES OF CONSTRUCTION FAILURES DUE TO SOIL



LIST OF SOME SOIL FAILURES IN MALAYSIA

a) The famous Highland Tower Building Collaspe (1993)
b) The Gua Tempurung Mudslide (2004)
c) The Taman Muda Flood (Every Year)
d) The Cameron Highlands & KKB Landslide (2004 till now, 2021)
e) The Sibu Peat construction failures (Not so famous) (Until now)
f) The S-R (Senggarang-Rengit) Coastal Road Failure (2019)

IPOH (Bernama): The cracks on Federal Route 185 involving Jalan Simpang Pulai-Blue Valley here heading towards Cameron Highlands, Pahang could get worse if rains continue at the location, said Perak Menteri Besar Datuk Saarani Mohamad.

Tuesday, 26 Oct 2021

The extent of damage that can be seen from afar along Section 44 hillslope. - RONNIE CHIN/The Star

Related News

NATION 24 Sep 2021

Jalan Simpang Pulai-Blue Valley now open to light vehicles

NATION 20 Sep 2021

Pahang MB: Landslide occurred in Perak's Kinta

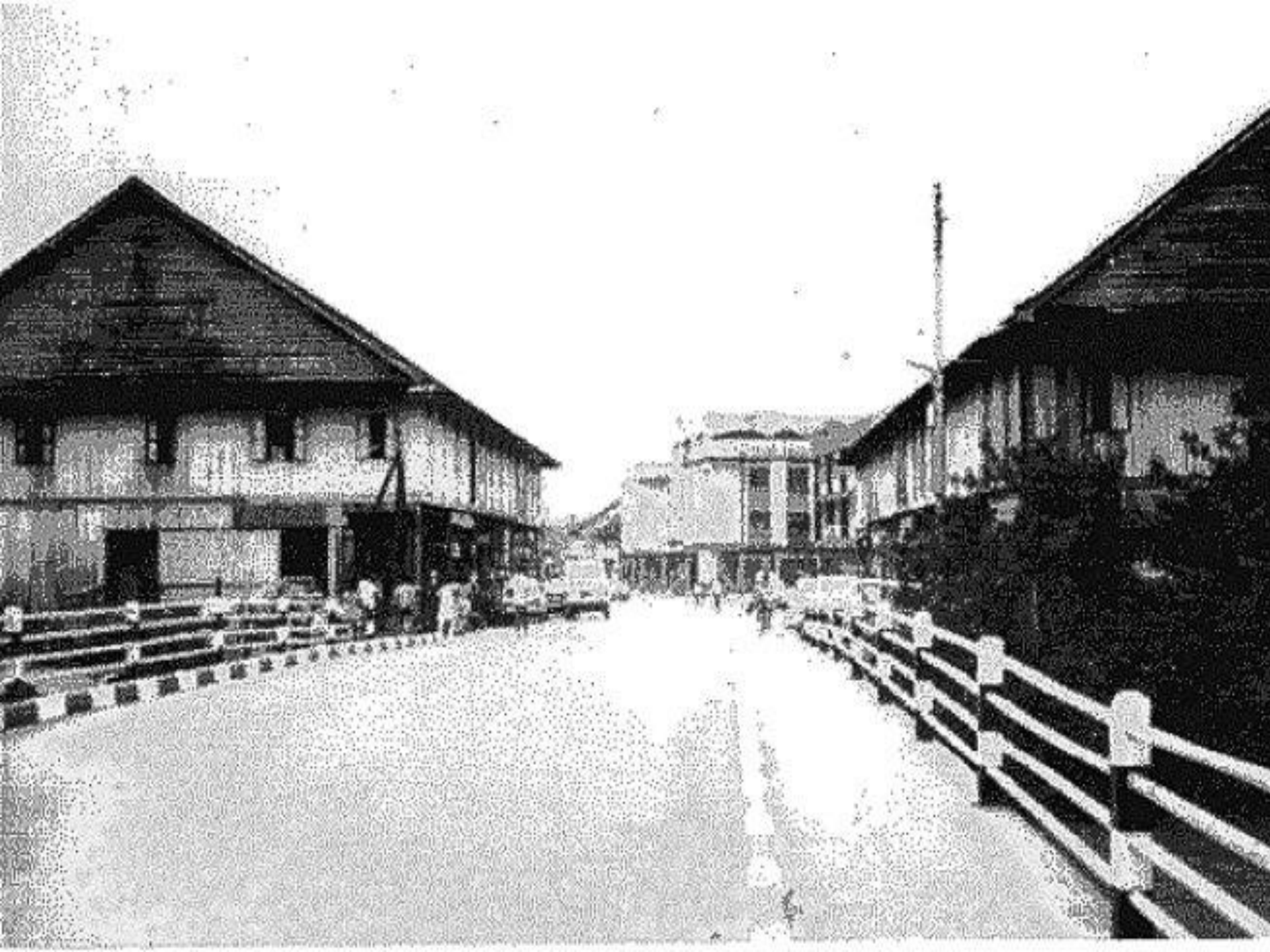
THE SIBU PEAT CONSTRUCTION FAILURE (Research conducted in 2015)

SIBU PEAT CONSTRUCTION FAILURE

- Buildings were constructed on peat soil
- High water table
- Situated near to Sungai Rajang
- On-going problems – Settlement
- Buildings after 20 years – 2 storey remain 1 storey
- Roads after 20 years – each year were resurfaced & some were reconstructed (1 km of road costs more than RM1.2millions – Now is more costlier!)

SIBU TOWN @ RAJANG RIVER

- Population: 180k
- Area: 130 square km
- More than 60% is peaty soil
- Established by James Brooke (1862)
- Density: 1,300 people per km^2



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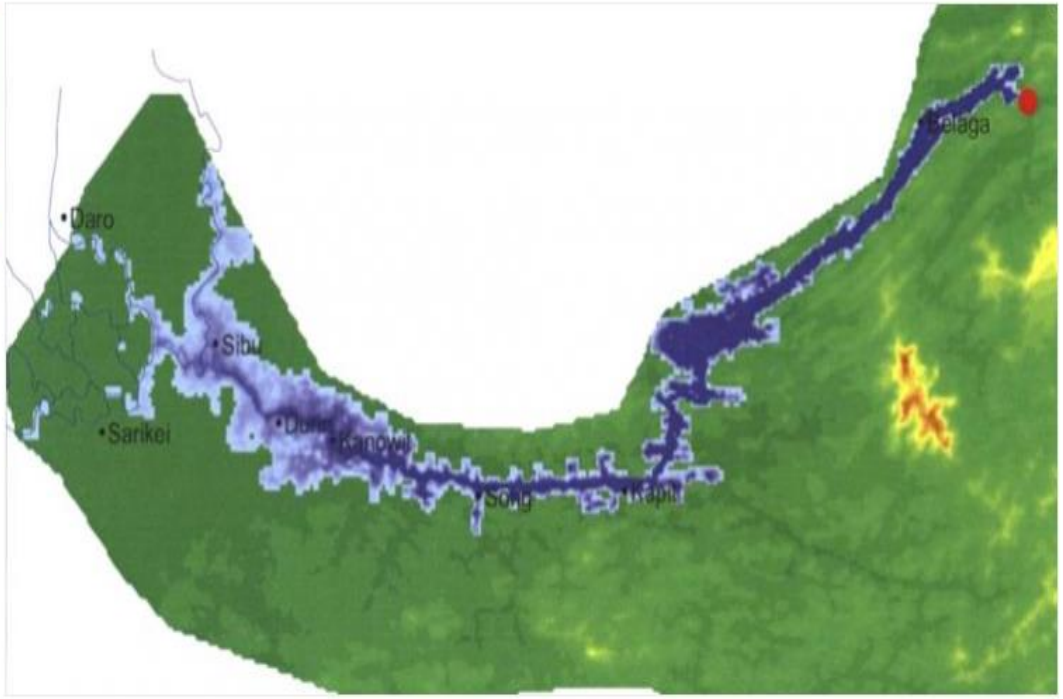

Sections

"Cascading Failure" - Catastrophic Warning On Murum Dam Was Kept

Case study on bridge failure

- Ong [3] described the construction of a 13.5 km single-carriageway linking the existing Igan Bridge to a proposed university site in Sibu, Sarawak, East Malaysia.
- The soft soils of maximum 30 m thick, which were found below the 5-m thick Peat layer.
- They were treated with pre-fabricated vertical drains to reduce post-construction settlements so that design requirements were met.
- After site investigation and soil characterization tests, it was successfully constructed using hydraulically placed sand-fill to replace the underlying fibrous peat.
- Settlement plates were installed to monitor the settlement of the sand layer-PVD system.
- It was shown that the rate of settlement increased markedly when PVD was installed.
- Field instrumentation results cross-checked with Asoaka observational method to measure settlements was successfully implemented to provide a good understanding of ground treatment of fibrous peat and soft soil. Figure 3 shows the installed PVD and the settlement plates [3].

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Construction of Buildings on Peat: Case Studies and Lessons Learned 3 / 5 175%

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ground treatment of fibrous peat and soft soil. Figure 3 shows the installed PVD and the settlement plates [3].

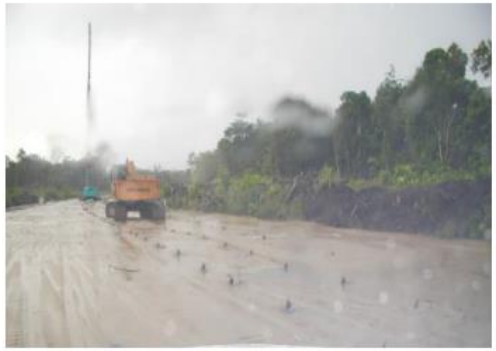

Figure 3. a) (left) PVD installed after sand-fill reached existing ground level and b) (right) condition of settlement plates when site was flooded [3].

2.4 Physio-chemical behaviour of peat

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Full paper on this discussion can be found at:

https://www.matec-conferences.org/articles/matecconf/abs/2016/10/matecconf_iconcees2016_03013/matecconf_iconcees2016_03013.html

THE S-R COASTAL ROAD FAILURE

The S-R COASTAL ROAD FAILURE

- The Senggarang-Rengit Coastal Road is an alternative route to JB from North via BP
- The road was resurfaced everytime it is damaged
- The design is for single carriageway, federal road
- Cracks were seen at the nearside of the road
- Accidents due to road damages and uneven surface occurred
- The route is congested with villages nearby
- Failure: Due to traffic loadings resulting in SETTLEMENT!


TANGKI AIR
SENGGARANG
SAJ
Kemang
SHARP

EXAMPLE OF ROAD DEFECTS AT SENGGARANG-RENGIT ROADS

CHALLENGES OF CONSTRUCTION

CONSTRUCTION CHALLENGES

i. Construction is needed due to development and societal needs
ii. Soil cannot be changed but, can be improved/ rehabilitate/ remediated
iii. New methods/ technology can improve or can be proposed but, it does not necessarily be successful
iv. Engineers need the technology to solve problems but, most importantly is Engineers need wisdom and co-operation from leaders and the community

Closing Remarks

- Soil investigation is important
- Laboratory tests are for ideal conditions but can simulate and identify properties plus characteristics of investigated soils
- Disaster happens because of human can be avoided
- Disaster due to nature is unavoidable
- New technology can assist in improvement, prevention and MONITORING

RECAPPING….

What is meant by geotechnical engineering?

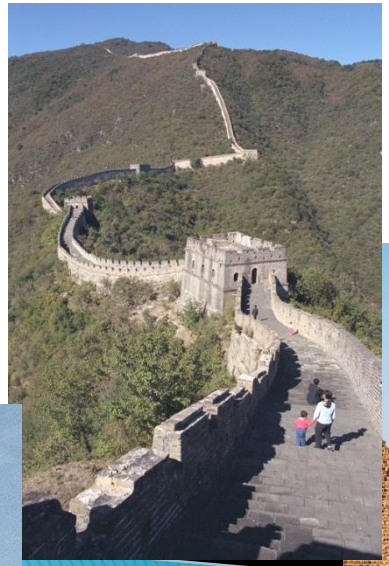
"**Geotechnical engineering** is a civil **engineering** discipline that is concerned with building on, in, or with soil and rock. **Geotechnical engineers** design dams, embankments, cuts, foundations, retaining walls, anchors, tunnels, and all other structures directly interacting with the subsoil, both onshore and offshore."

WITH GEOTECHNICAL ENGINEERING, WE CAN KEEP THE SOCIETY AND THE WORLD SAFE!!!

GEOTECHNICAL SUCCESSES

Early Geotechnical Engineering Successes

- The Pyramids in Egypt
- Ancient Roman Roads and Aqueducts
- The Great Wall of China
- The Erie Canal
- The Panama Canal
- Druid Lake Dam
- Brooklyn



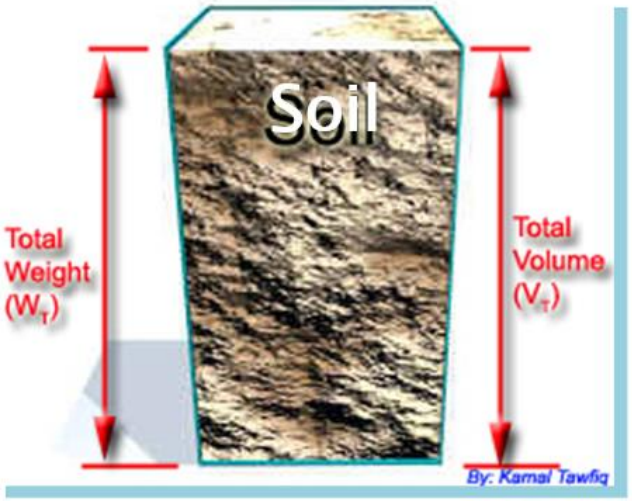
KONSEP BERFIKIR……

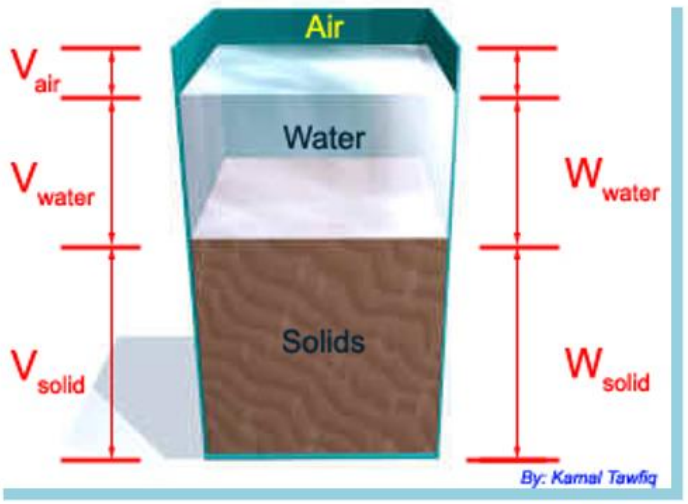
1. BERFIKIR DI LUAR KOTAK
2. BERFIKIR DI DALAM KOTAK
3. BERFIKIR TANPA KOTAK

THANK YOU

For Your Attention

COMPONENTS OF SOIL





A soil sample. An idealised soil sample.

Fig. 2 Components of soils.

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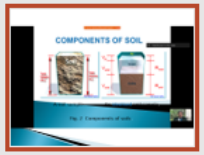

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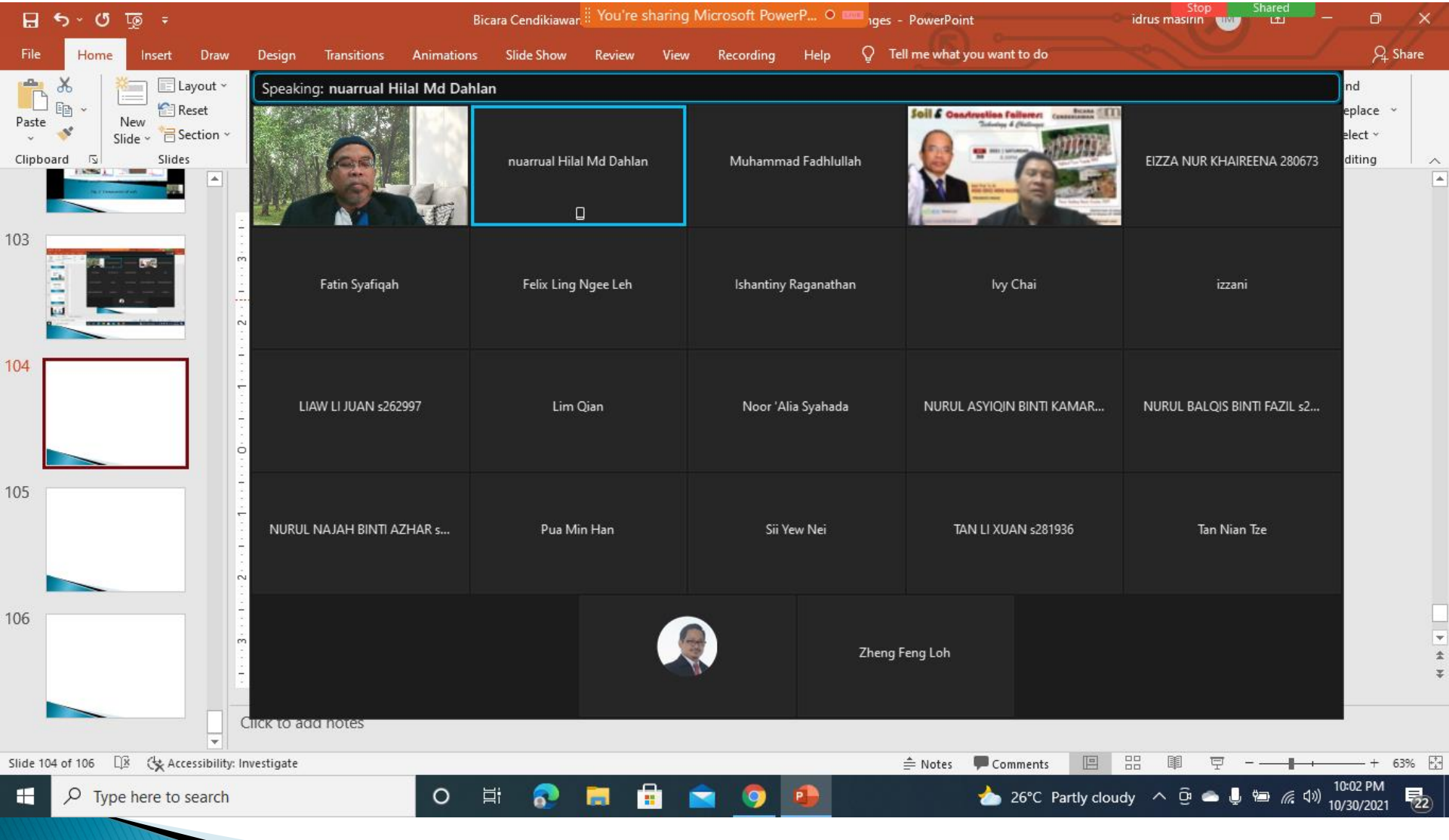
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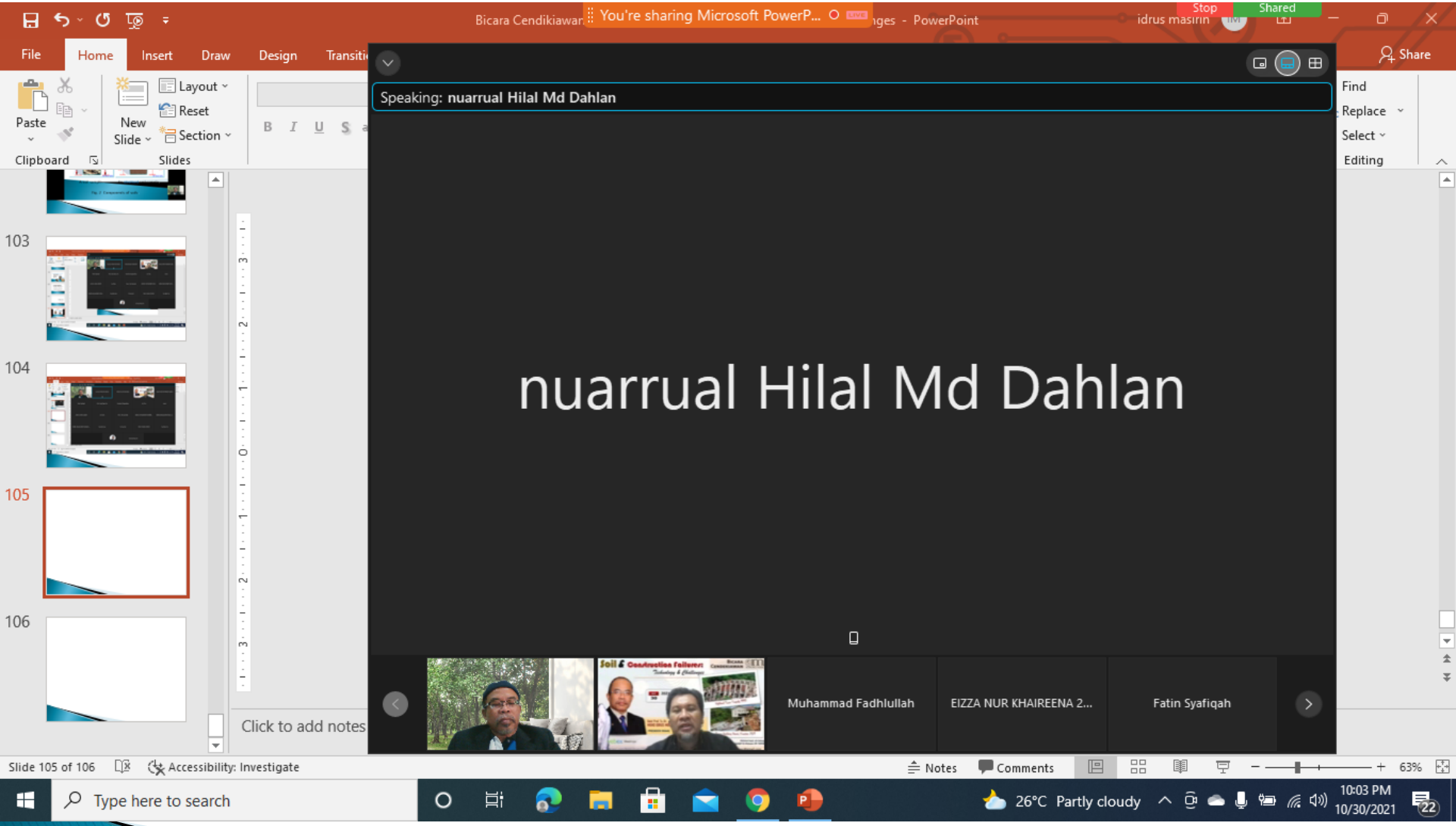
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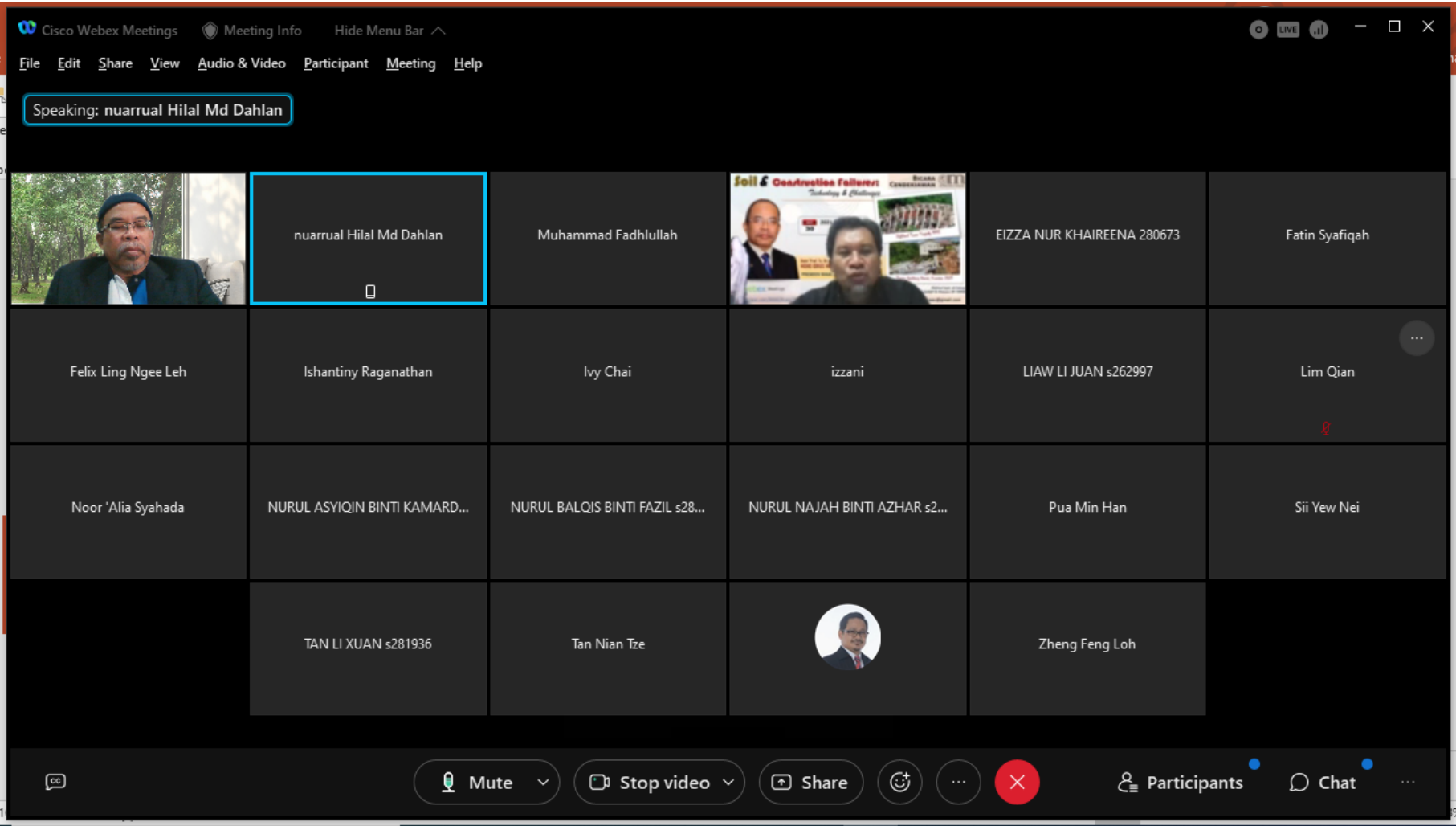
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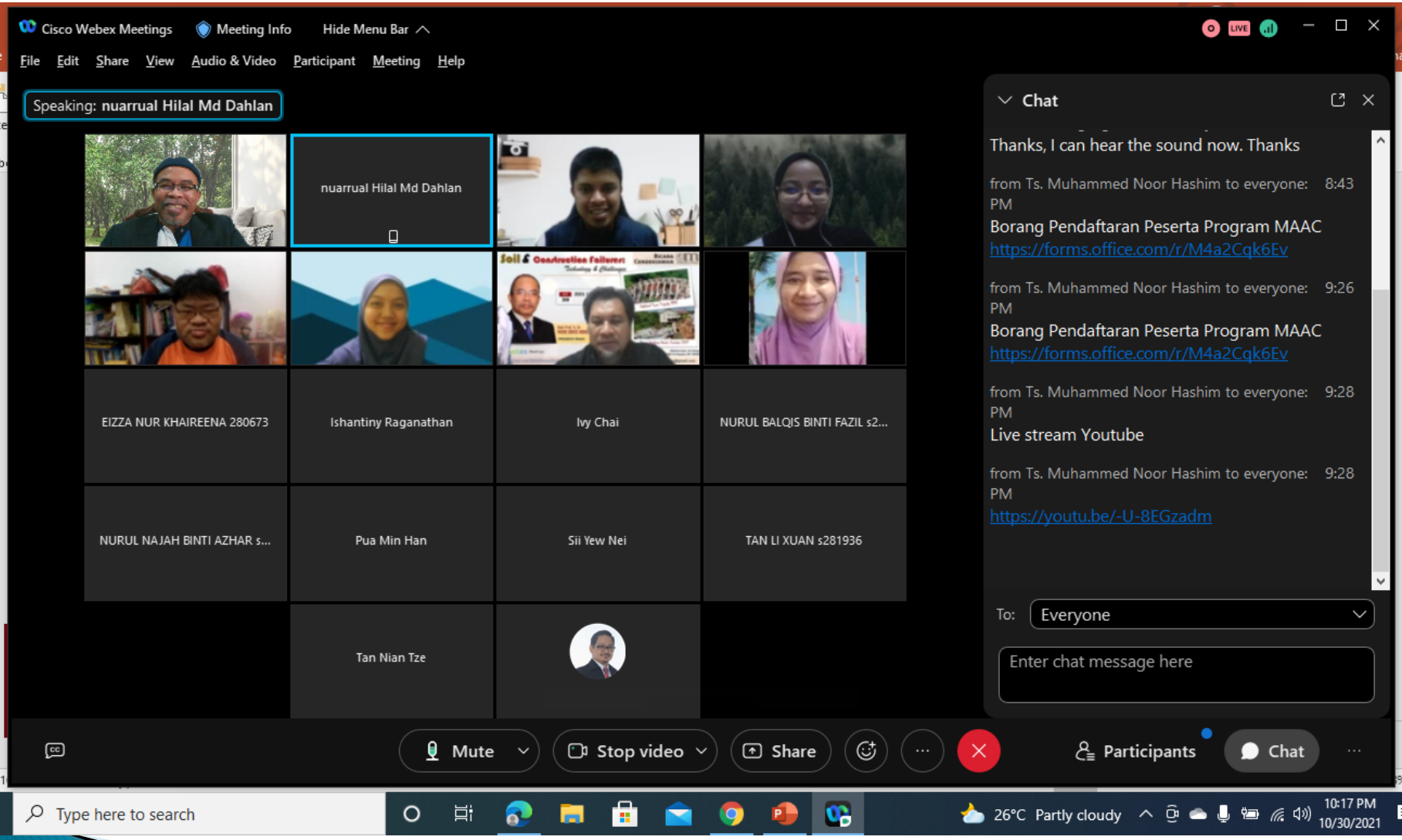
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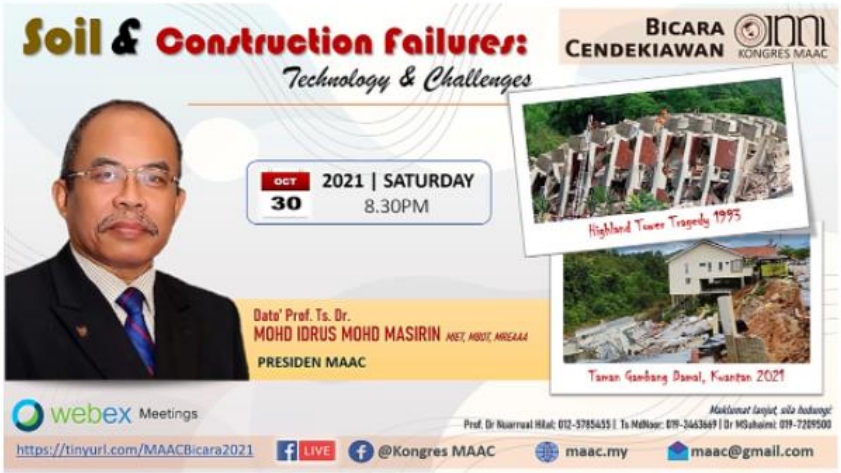

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