Advanced Soil Mechanics
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Lecture – 01
Introduction to Course Content

Welcome back. Now, in this part of the lecture, I will try to explain what you will learn from this course.

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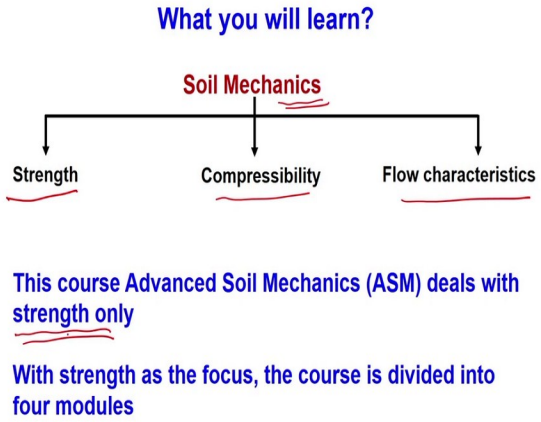

Now, if you see like soil mechanics in undergraduate, once you have learned you know that when you say soil mechanics, you need to discuss about the strength compressibility and flow characteristics. So, to better appraise soil as a material, you need to understand these 3 characteristics. But in this particular course, we will be focusing mostly on the strength that is the strength behaviour of the soil.

The reason is encompassing strength compressibility and flow characteristics, it will be a humongous task and if we want to get into the details of each, then it will not fit into one course. So, I have focused only on the strength part in this advanced soil mechanics course. So, with strength as the focus the course is essentially divided into 4 modules.

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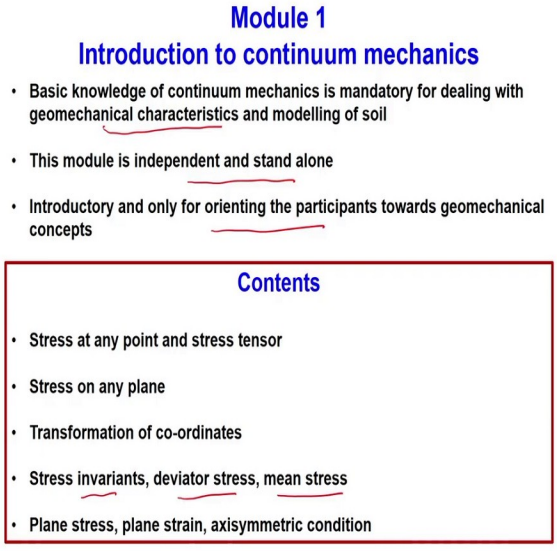

So, the module 1 is about introduction to continuum mechanics. Now, why continuum mechanics? Let me make it very clear that for any geotechnical postgraduate who is willing to work in constitutive modelling or geo mechanics of the soil, he need to have or he or she need to have the exposure to continuum mechanics. So, the basic knowledge of continuum mechanics is mandatory for dealing with geo mechanical characteristics and modelling of soil.

Let me tell you, this module is independent of the subsequent modules it is more like a stand-alone. The basic aim of this module is to give some introductory briefing on continuum mechanics. So, that the participants can develop upon it and can easily handle the higher aspects of geomechanical modelling of soil. So, it is introductory and it is for orienting the participants towards geomechanical concepts. And the basic contents of this module will be it starts with the concept of stress at a point and introduction to the terminology stress tensor.

These terminologies are very important, when you deal with the modelling of soils essentially constitutive modelling, one need to have certain exposure to these terminologies. So, that is the primary focus of this module. Followed by stress acting on any plane then, we will discuss about transformation of coordinates. Why because this is needed for understanding stress invariants which are essential for any problem related to geomechanics. So, we will discuss about stress invariants.

Essentially, we will focus on deviator stress and mean stress and its implication all of you would have already known what is meant by deviator stress, as well as mean stress. But from

the perspective of stress invariants, we will discuss this more. This will be followed by some discussion on 3d to 2d idealization in the form of plane stress, plane strain and axisymmetric condition.

So, you can see that this will be a very introductory level lecture of continuum mechanics. You would appreciate that continuum mechanics itself will be one semester full course, but that will not be dealt in this particular module, it is introductory in nature.

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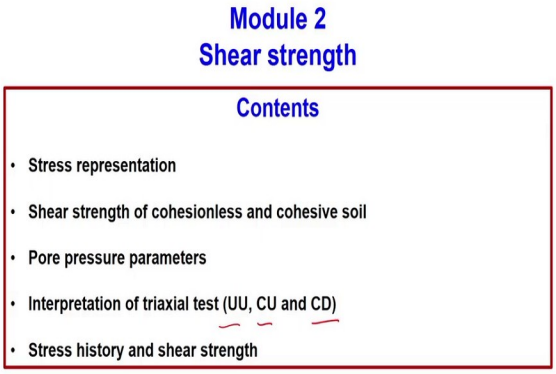

This will be followed by module 2 shear strength. Now, the terminology shear strength is nothing new to an undergraduate student but here we will focus more about stress representation, what are the different ways of stress representation, shear strength of cohesionless and cohesive soil a revisit and we will discuss a bit more in detail than what you have learned during your undergraduate, we have seen that there are different misconceptions depending upon how you conceive this topic of shear strength.

So, these types of misconceptions we will try to elevate in this particular course and you are also welcome to give me feedbacks, if there are certain topic which is not in line with your understanding, you can always discuss with me, this will be followed by pore pressure parameters. As you will appreciate why soil mechanics is different from its allied solid mechanics, most important aspect is the presence of void and the influence of pore water in it.

So, we will discuss about pore pressure parameters, which are equally important when you consider soil modelling. Then it will be followed by interpretation of triaxial tests. All of you

would agree with me that triaxial testing is one of the most versatile testing for understanding the shear strength of saturated soils there are different versions of triaxial testing, but in this particular course, we will focus only on conventional triaxial testing and its interpretation essentially.

3 types of tests were unconsolidated undrained, consolidated undrained and consolidated drained. And the last part of it will be what is the influence of stress history on shear strength?

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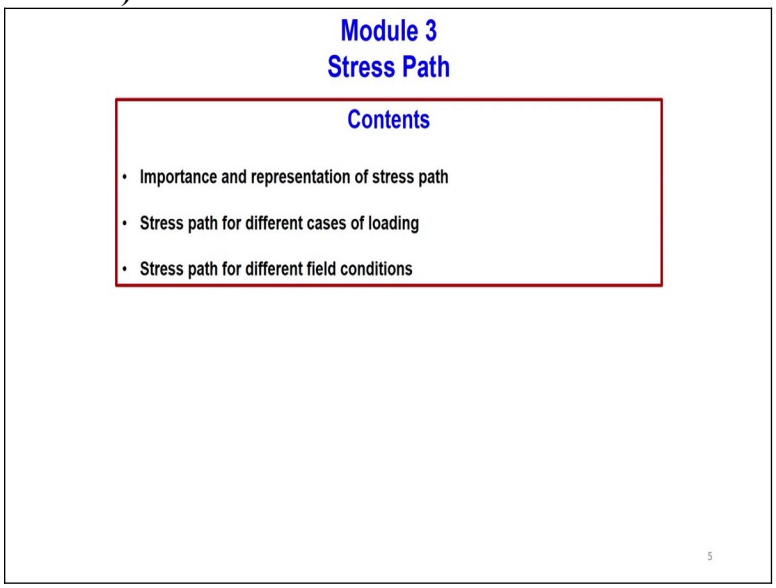

The module 3 will be founded on module 2 different types of stress representations is not enough to have better insight into the soil behaviour during loading, one need to study about stress spots. So, this will be module 3 importance and representation of stress path. Stress path for different cases of loading and in that we will be specifically focusing on traction loading in the laboratory. And the final part will be stress path for different field conditions only to show you how stress path is beneficial in dealing with certain problems in soil mechanics.

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Module 4
Critical State Soil Mechanics

Contents

- Critical state (CS) concept and its importance
- Parameters relevant to critical state
- 2 D analysis of critical state
- Soil yielding
- Prediction of soil behaviour with respect to stress history
- Elements of CS model
- Introduction of Cam Clay and modified Cam Clay
- 3D representation and state boundary surface

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And the last module, module 4 is the most important module of this course, which talks about critical state soil mechanics and the contents would be critical state concept and its importance parameters relevant to critical state, 2d analysis of critical state soil yielding which is very important and prediction of soil behaviour with respect to stress history, you will appreciate that this particular point is already discussed in the module 2, but here you will understand how it connects in critical state framework.

Then what are the different elements of critical state model. Introduction of Cam Clay and modified Cam Clay these are critical state-based models, but it will be dealt only at an introductory level again. And finally, the closure would be 3-dimensional representation and state boundary surface based on critical state model. So, these are the 4 modules which we will be dealing in this course.

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References

Module 1

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Module 2, 3 and 4

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4. Budhu, M., Soil Mechanics., Soil Mechanics and Foundations, 3rd Edition, Wiley 2010
5. Holtz, R. D., and Kovacs, W. D., An Introduction of Geotechnical Engineering, Prentice Hall, 1981.
6. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
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8. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to critical soil mechanics, University Series in Civil Engineering, I A Books, 2013.
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10. Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering: Theory, Thomas Telford, USA, 1999.
11. Yu, M-H and Li J-C., Computational Plasticity, Zhejiang University Press, Springer, 2012.

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And these are lists of references you can see that the first 2 reference essentially will help you to brush up the basics of module 1. Module 2, 3 and 4 follows this list of references. Some of them are very, very important books. In fact, I have drawn a lot of inspiration from Munira, Budhu book on soil mechanics and foundation Wiley's third edition is available now. It is a beautiful book.

Similarly, Holtz and Kovacs, all books are equally important, but I have laboriously followed professor Budhu book and I have also taken some help from him in clearing my concepts related to critical state. So, every book is important. I am just telling you certainly similarly stress path you can follow Parry's book it is also a very good book, if you want to learn more about Mohr circles and stress path. So, these are the lists of reference which you can follow and any other web materials relevant to each topic.

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So, with that I would like to before winding up the course this lecture, I would like to introduce my course teaching assistance, Mr. Bharat Ratan, who is a research scholar in geotechnical engineering, Charakho N. Chah, Vineet Gajamer, Tharunkumar, Biswajyoti Deka and Jishnu Choudhury. It is a vibrant team of students who is helping me in developing this course. So, before winding up this session, I would also like to extend my thanks to Centre for Education Technology IIT, Guwahati for facilitating me in doing this course. Thank you.