Advanced Soil Mechanics
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Lecture – 16
Summary of Module 1

Welcome all of you, till the last lectures we were essentially discussing about module 1 and with the mathematical formulation of axisymmetric condition, we came to the end of module 1. So, before going to module 2, let us understand and summarize what actually we have learned in module 1.

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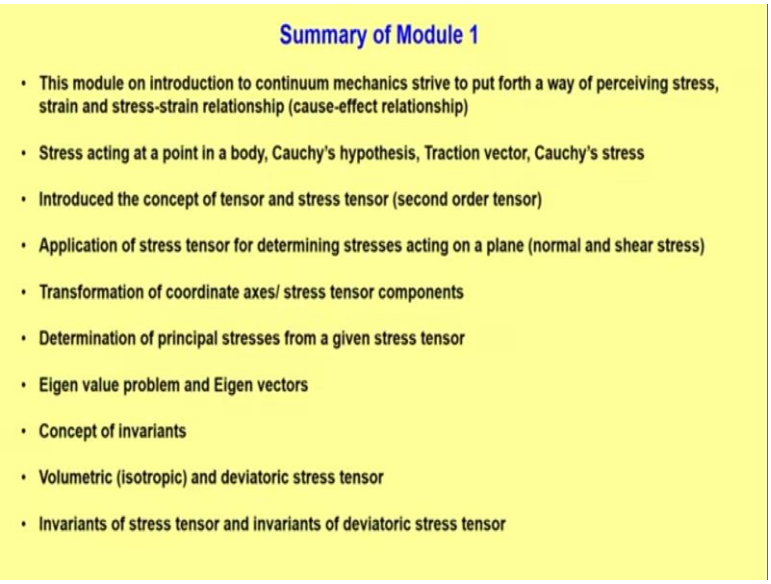

The module 1 was on introduction to continuum mechanics and strive to put forth a way of perceiving stress, strain and stress strain relationship which we call as cause-effect relationship. Now, you would have noticed the initial few lectures, I was fairly slow in delivering the lecture and I have used repetitions in between the sentences. This was done intentionally, because some of the participants may be new to this topics and it will be easy for them to grasp better.

So, I have made it intentionally a bit slow. And for those who already know the concept or already know the subject, well, it will be a bit dragging for them that is fine but the whole purpose was to deliver the concept to the maximum possible. We started of with the concept of

stress acting on a body or stress acting at a point in the body. And for that, we have discussed Cauchys hypothesis, the concept of traction based on the traction and using Cauchys formula.

We have evolved Cauchys stress which is the stress acting at that point. And it was a 3 by 3 matrix formulation and 9 stress components. Later, we have seen that there are 6 independent stress components. Then, another important aspect was introducing the concept of tensor, what is a tensor and which is very essential when you deal with higher realms of geomechanical problems, mostly stresses are dealt with in the form of tensors.

A tensor is a quantity with magnitude and direction we have discussed that and the stress tensor we have understood that it is a second order tensor. Application of stress tensor for determining stresses acting on a plane the normal and shear component of traction which we have understood as normal stress and shear stress which are the stresses acting on a plane, we have discussed that based on the knowledge of stress tensor.

Then a very important aspect of transformation of coordinate axis which is very important for evolving principle stresses. So, we have understood how the given stress components can be transformed to an altogether different axes a set of different orthogonal axes. Then comes determination of principle stresses based on the transformation, we have discussed how to evolve principle stresses by diagonalizing the given stress tensor.

We have discussed about characteristic equations and also understood that the Eigenvalue problem. So, characteristic equation when you solve the parameters of the equations are called invariants. We discussed about principle stresses and also the direction cosine matrix which we get based on Eigen vectors. So, Eigen vectors is again by solving the matrix equation the characteristic equation you get the normal vector.

And that normal vector when arranged in a matrix form gives direction cosine matrix for transforming the given set of stress component to a given axis. And the concept of invariants was discussed which is very essential in most of the geomechanical problems, the stress strain

relationship or the constitutive relationship when you try to solve various problems, you will know that it is mostly in terms of these invariants essentially for soils and rocks.

Volumetric and deviatoric stress concept, we have seen that the whole of the stress is divided into or it was decomposed into volumetric component and deviator component. So, volumetric stress and deviatoric stress we have seen. Then, we discussed about invariants of stress tensor i_1, i_2, i_3 and in variants of deviatoric stress tensor j_1, j_2, j_3 we have discussed majority of the aspects and the relationship.

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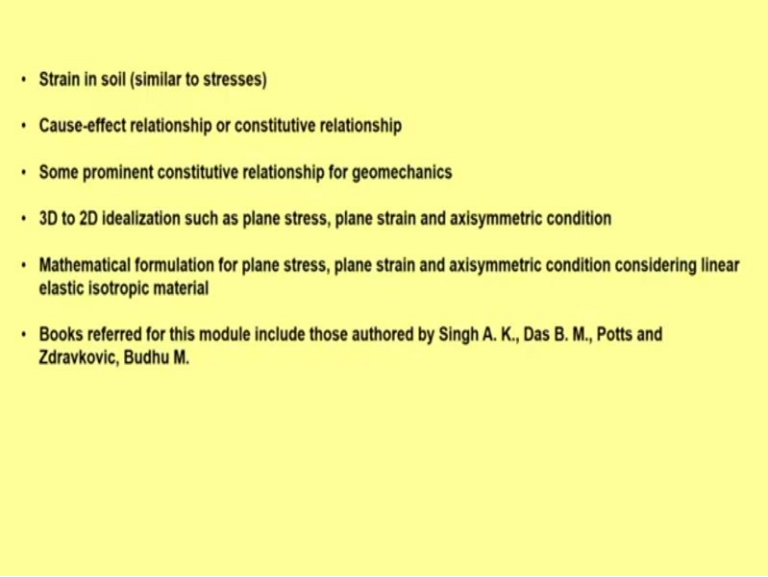

Having said about stresses then we discussed a bit about strain and we also told that whatever was relevant for stresses, all of these concepts were relevant for strain and hence, we did not spend much time discussing strain. So, we discussed about linear strain as well as shear strain, the strain tensor all those things we have discussed. Once that was done both cause and the effect both were discussed further, we went on to cause-effect relationship.

We discussed about very simplistic linear elastic model and the constitutive relationship. Then, we have seen some prominent constitutive relationships which are essentially there for geo mechanical problems. But we did not go into the details of it, some of the very relevant models we have seen. And for any further understanding, the participants are suggested to read the advanced books in geomechanics for constitutive relationship and understanding its formulation.

We have not discussed about any formulation in this course and it is out of scope of this particular course, you can refer to any specific courses on geomechanics. Then we discussed 3D to 2D idealization which is very important for solving problems and making it more simple in its approach. So, then we have discussed in terms of 3D to 2D we discussed about 3 conditions, the first one was plane stress, plane strain and axisymmetric condition.

And we insisted on the point that in geomechanics plane strain and axisymmetric condition is very important. Then, we discussed about the mathematical formulation for plane stress, plane strain and axisymmetric condition, considering linear elastic isotropic material because that is the most simplistic model that we could discuss in this particular course. Most of the books referred for this particular module specifically include the 1 authored by Singh A.K, Das B.M, Potts and Zdravkovic and the book by Budhu M.

All these books are listed in the reference. In addition to this I have also gone through some web materials for making the concept in a more understandable manner. So, I would suggest the participants also to do this that apart from whatever you have gone through in this slide, you are suggested to read through more related to this topic. So, then this is all from for module 1. Now, we will move on to module 2 which is basically on shear strength. Thank you.