Environmental Geomechanics
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Lecture – 02
Introduction – II

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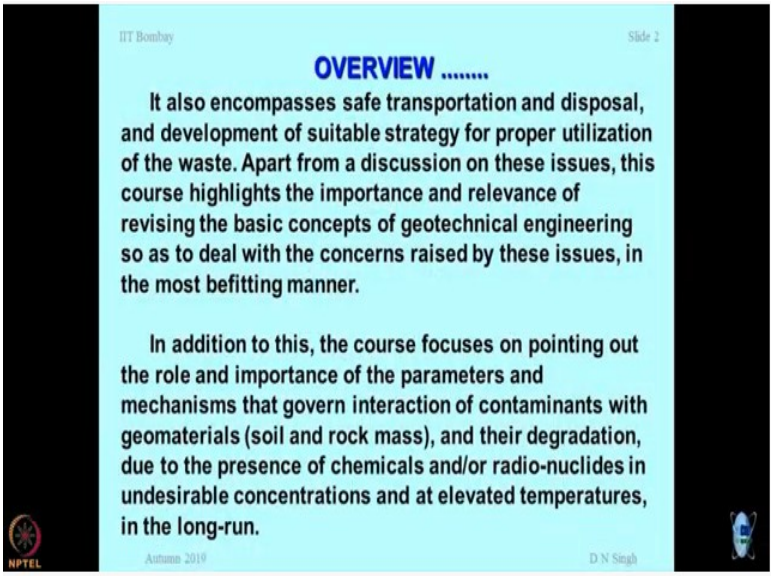

This discussion which we are going to have will also deal with safe transportation and disposal. This is becoming a very big issue. I mean industries are looking for a solution and let me tell you one thing that the whole concept of conventional geotechnical engineering is changing, or it has changed. So very soon you will realize that it will; creating a lot of situations where you will realize that this relationship between patient and the doctors is very much applicable to this. And what you are talking about material characterization?

My logic is that this is just like your pathological examination. So, this is how I treat that. So we will talk about transportation and disposal with most of the industries are facing as a big challenge in today's world and the development of a suitable strategy for proper utilization of the waste. And this is where you know our group has also point on this concept of manmade soils. So the issue is quite big I hope you are realizing this transportation and disposal, handling to utilization and converting into some value-added product which we call as valorization we will talk about that.

So apart from a discussion on these issues, this course also highlights the importance and relevance of revising the basic concepts of geotechnical engineering. This course is basically meant for PG students. A lot of students undergraduates also want to do this course. But you know what is the meaning of the word blasphemy. You must have come across yes. So what is blasphemy exactly so this is what I am going to do here now.

So this is what please remember you know apart from a discussion on these issues this course highlights the importance and relevance of revising the basic concepts. It is in a very humble and polite way of writing that this is what we are going to do? We are going to bulldoze the concepts of conventional geomechanics why? They have become obsolete you cannot use them. For solving the real-life problems as simple as that.

So when you realize that the code of conduct is not helping you in solving a problem what would be your initiative? What will be doing? Either change yourself or change the Bible which was written by whom and when and why it is not clear you understand. That is the reason why this course is meant strictly for PG students. Because you already have the background of basic soil mechanics and I expect that you can play easily with the concepts and you can change them the way you want.

So as to deal with the concerns raised by these issues very big issue you know lying. So what it indicates is that unless you change yourself unless you change the course of conducts which have been defined the books you cannot go ahead. So the situation is like this that we know that we are handicapped we cannot apply the equations which have been given in 1940s 1950s by our great researchers all right.

So and why all this is being done. So, that we can get the best answer to the questions. So in addition to this, the course focuses on pointing out the role and importance of the parameters and mechanisms that govern the interaction of contaminants with geomaterials. The interaction is going to be a keyword you know everywhere interaction when I am talking to you I said is not teaching is interaction. When you talk to me is an interaction. It is not a question so interaction is

something you know which most of the technologies talk about. How many types of interactions you have come across in geomechanics any idea?

Yes **"Professor - student conversation starts"** We only dealt with the 3 phase of internship and most of our interactions yeah give it to him yes soil-water interaction. A very good one is soil water interaction number 2 yeah give it to her soil-structure interaction. Very nice; soil-structure interaction. The third one soil-soil interaction soil-soil interaction correct; fourth any guess create new interactions "**Professor - student conversation ends"**.

So most of the times you have talked about you know solids interacting with the liquids. In the petroleum industry, is solids, liquids and gases interacting with each other? So there nobody is interested in doing hydraulic conductivity of a porous media why? They are more interested in letting us say gas permeability of the porous media. But they are producing gas so they want to know how much volume of the gas passes through the porous media in a certain amount of time.

So this becomes your gas-solid interaction. The more complex situation would be you have fluid; you have gaseous form crude oil coming out of a well. And the whole mechanism is taking place in the porous system clear. So this becomes the liquid, solid, gas interface. The interaction between all the 3, phases of the matter. Is this fine so we are going to talk about you know how this interaction takes place interaction between one entity and another entity.

Gases, interacting with solids, solids interacting with water, gases interacting with water. So until now, you are talked about only pore water pressures is it not. Very conveniently you remove the term pore gas pressure why? You saturated everything before testing. This is not the justice done with the material. Nowhere in nature, we have; saturated soils. If that was a situation country would not have been crying for water agreed.

So you have been studying a state of the material which is artificially created by you oversimplified. This is quite clear I can see lot of heads nodding is this okay. So the first premise that you are talking about the states of the materials which are hypothetical, utopian they are not

real. We will discuss this more and more clear. So, the interaction of contaminant with the geomaterials and their degradation.

In our conventional subject, we were always talking about the control volumes. We never bothered about the degradation hope this is correct when you are doing seepage analysis you took a control volume and the control volume never deforms, never distorts, never degrades everything remains intact as if it is made up of steel. Even steel also degrades but a porous media never degrades all right clear.

The second thing is consolidation theory again you talked about the control volumes and you said influx, outflux and balancing the two the material remains as it is. Of course, it shrinks or swells depending upon the load conditions. But in real life, this is not going to happen. In real life, the material degrades why? I just cited an example of organic systems. So most of the soils might be having some organic content in them and this organic matter is going to degrade is this fine.

Another good example of this would be MSW municipal solid waste where the whole idea is to let the material degrade. If it remains as it is, it is of no use clear. So all this degradation either this could be natural or this could be in the presence of chemicals or radionuclides. So radionuclides are coming out of a very specific situation which is when you are handling radioactive materials pores when you are processing them all right nuclear power stations.

Weapons where you are making weapons and I know in today's, the context I hope all of you will agree that every nation would like to do this. Because every nation wants to become a powerful nation G5 G9 G12 all those clubs are there you know. You want to join a club or not G5. So India is trying to become a club member of G5. I hope you understand the connotation of this. what is G5? What is G9? What is G12 and so on?

Now, this type of situation may also occur when we are dealing with the temperatures because industrial waste comes out at elevated temperatures. So how these temperatures are going to influence the whole system, the porous media, the geomaterials and so on. So the scope is

becoming quite big. I am sure you must be realizing but more realistic is this okay. Are you convinced? Any questions.

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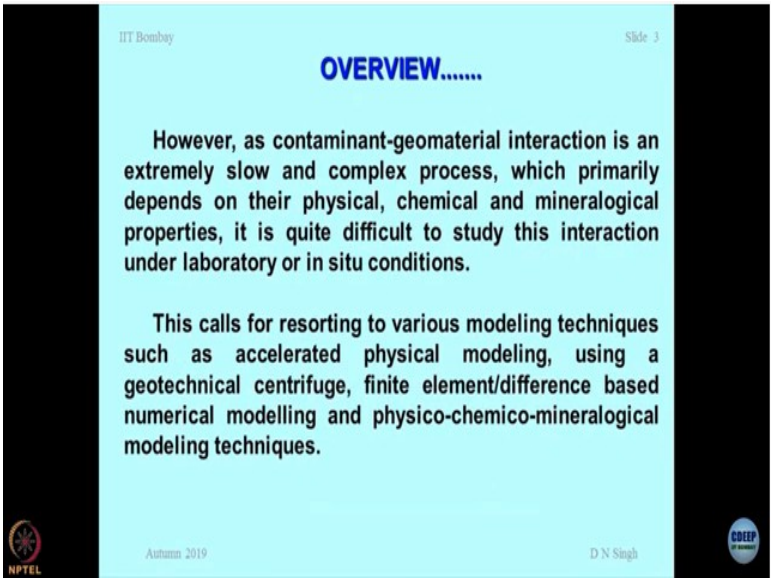

So however as contaminant-geomaterial interaction is an extremely slow and complex process why? Because the permeabilities are extremely low of the porous system which primarily depends upon their physical, chemical and mineralogical properties it is quite difficult to study this interaction under laboratory or in situ conditions. Because the process is extremely slow. The fluid phase migration is an extremely slow process.

Hydraulic conductivity of clays at 10 power -11 meter per second, even sands would be 10 power -6, 10 power -7 meter per second. When you talk about the rocks 10 power -21 meter per second but the interaction is occurring. So a big challenge is whatever is happening in nature how would you simulate it? How would you study this? How would you see what would be the detrimental effect of this interaction?

So this is becoming a challenging situation. In other words, whatever happens in nature would it be possible for me to simulate in a realistic manner either numerically or experimentally in the laboratory is this part okay. So, all these are going to be challenging. So this calls for different types of modelling techniques. I do not know how many types of modelling techniques you have been exposed to.

There is something known as you know accelerated physical modelling I am sure you must be doing a course on this centrifuge modelling this semester. Now next semester will be good. So, this what is accelerated physical modelling centrifuge modelling. You know we can use FEM finite difference numerical modelling, analytical analysis and so on all right. So these are mathematical models which you develop for the situations.

Sometimes the concept which has been ignored is that how physical, chemical and mineralogical properties might get changed when all these situations which we have discussed sometime back become pertinent. So I was talking about you know temperatures and then I said the system might change its characteristics. I was talking about the type of contaminants which might be so aggressive that they may have a tendency to eat up the porous media clearly.

That means the overall properties of the porous system are bound to change because of this interaction. Unfortunately, this type of discussion we have not done in conventional geomechanics is this okay. So this is what actually we will be doing more and more into here. So the contents of this course were mostly developed by my student's activities you know in the form of my PhD students and the masters' students.

So what I try to do is? I try to share what has been done by them in this context for several years. And in the process, we have developed the laboratory which you visited and you have already physically seen this but those of you who were not you can visit the website and you can go to this link.

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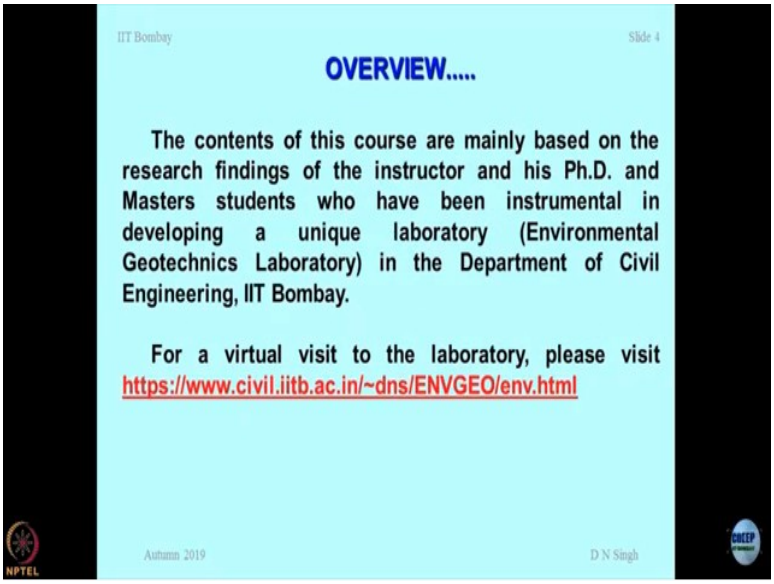

So most of the time you will see when I discuss in this course and this is what I have written that most of the findings of my ex-students I present over here. Because this is how the course has got developed you know so mostly this is the PhD thesis and master's thesis which were thematic and those themes are becoming the modules to environmental geomechanics. This is what actually I wanted to emphasize is it okay.

There was no way we could have ordered the instrument directly 2, 3 things. The instrument might not be available, the instrument might be very expensive which we cannot afford and another thing is when the students work on a thesis you know you should have easy access to the setup. You cannot wait for 2 years for the instrument to come. By that time the thesis would be over.