Environmental Geomechanics
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Lecture – 01
Introduction - I

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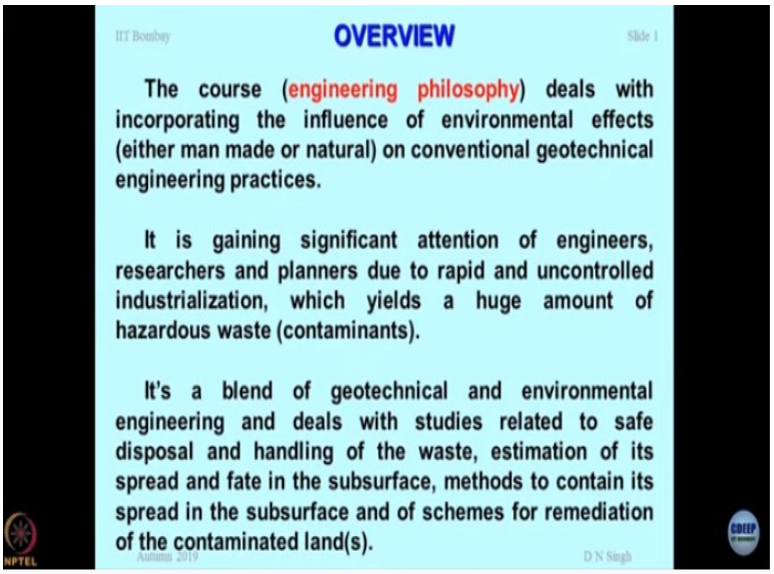

So today I intend to give you a brief background of what environmental geomechanics is all about and to give you the overview of this course I define this course as an engineering philosophy and the genesis of this course was you know I have been teaching soil mechanics, energy mechanics, foundation engineering, advanced soil mechanics to different levels of students and then this idea came to my mind that why not play with the conventional subjects and create something new.

The prompting was done by my undergraduate student who was sitting in the class and he prompted me to develop something new. So, this was the back of the mind to create something interesting and something which is unconventional and that was a genesis of this course. So why I call this as an engineering philosophy very soon, you will realise that most of the discussion which I am going to do in this interaction are based on some premise and basically when you create a premise this is nothing, but a philosophy and it so happens that most of these philosophies we find them happening in real life.

Okay so my emphasis of our discussion would be to showcase how the philosophies can be realities in life and that too when we talk about the engineering philosophies so to answer your question quickly Vikram I suppose you asked this question in the last lecture that why environmental geomechanics? So truly speaking, we are trying to either incorporate the influence of environmental activities or effects on the systems either this could be man-made, or this could be natural on conventional geotechnical engineering concepts and practices.

So, if you check the internet you will find that most of the western universities you know they do not offer civil engineering as the course is right now, they talk about you know man-made structures or built environment. So the present-day context is built environment the connotation is that the built environment is the one which is created by human beings and we along with our systems if we create coexist in the environment and subsequently, we will see that the environment itself could be either man-made or natural. All right.

So if you look into this like you know our great grandfathers they used to live in caves and most of them these caves were naturally built, of course, they might have created cave also and then caves are the best examples of you know where the soil, rock, water, environment interaction takes place because most of the caves either are leaking or they get frozen or they get you to know debris flow or they may have seen the collapse of the walls because of the movement of tectonics all right.

So, all these possibilities are there so basically what we want to do is we want to study how the environment is influencing the structures which are either natural or which are mam made. So, when I say this, the scope of the studies become quite diversified. So, anything which is happening you know under the Sun is our focus of interest because Sun also is a part or attribute of the environment why?

Right now the humidity is very high in cities like Bombay because there is no Sun so disappearance of the Sun is an attribute associated with very high humidity when very high humidity occurs how the systems which are created in the soils are going to behave this is what I

would like to study or in the words how the soils will respond to this type of a system where the humidity level is extremely high.

The reverse could be the situation two months back when there was no humidity it was extremely hot all right Sun was on its full glow how the soils were responding how the structures are responding so these type of extreme climatic conditions or the environmental conditions you know one has to study if you really want to do good engineering and if you want to avoid failures.

So basic theme of our discussion is how the environment influences the structures and this is what we will put up in the form of a philosophy and then we will try to visualize how this philosophy is really work in real-life situations. So it so happens that this is becoming a very trivial situation for all of us who are dealing with you know issues like municipal solid waste I would say alright or suppose if you have to do engineering in the regions which are quite difficult to you know to work on problematic soils, marshy lands, coastal environments.

So these are the situations which are very tricky so when you come out of the realm of the areas where already enough construction, rehabilitation has been done and when you focus on the areas which have not been touched yet we call them as virgin lands and why they are virgin because human activity could not influence them in conventional geomechanics we gave them a term as problematic soils.

Now subsequently we will study there is nothing known as a problematic soil if you are a technologist you understand? Why because I can negotiate with the situation. So, the problematic soils can also be trained very well provided I know how to deal with them. So this is the context in which we try to study Environmental Geomechanics clear the places, the situation which was never studied earlier which was supposed to be quite hypothetical few years back are now becoming very practical and then there is a pressure from the society that somebody has to give the solution for these problems.

How and when and in what form these solutions can be given would be a challenge. So, this subject is gaining significant intention of engineers, researchers and planners due to rapid and uncontrolled industrialization. Industrialization is the main problem the more and more industrialization the more and more so-called pollution. The more and more population load when all these happens what happens there is a scarcity of the land.

Look at the city like Bombay everybody wants to come in setting down the city like Bombay all right there is a scarcity of the land so when there is a scarcity of the land what would be the best possible solution you go to the places which remain untouched which I was talking about marshy areas all right the salt pans these people did not consider earlier for construction either the techniques are not there or the courage was an ignorance of the people clear whatever the situation could be.

So, this is because of the rapid and uncontrolled industrialization I will say several examples where you know how industrialization is causing major stress on the society and on the professionals like us this will become clear. So, when we talk about the uncontrolled industrialization there is a huge amount of hazardous waste which is being generated and the question is how you are going to deal with this.

So, when we talk about the hazardous wastes one of the attributes of hazardous waste could be the presence of contaminants, I am sure all of you must be aware of this. Now if you look at the dictionary meaning of the word contaminants is something which is not you know acceptable, not welcome. So, in a system when you are sitting very comfortably over here suppose power switch power goes off or suppose a fly comes or an insect comes.

It's s not a very rosy situation very comfortable situation all right so that particular object becomes a contaminant so similarly when we talk about a very big larger sphere say biosphere, and I will be talking about what is biosphere the presence of elements which are not welcome would be a contaminant all right. So how you are going to deal with the contaminants is going to be a big question what is the attribute of these contaminants is also going to be a big question.

Now this subject is a blend of the geotechnical and environmental engineering and just coming out of my mind I just tried to amalgamate the two subjects and it's up to you to decide how it was created. So, I am just trying to serve to you what has been done until now and this would deal with the studies related to safe disposal and handling of the waste. But before I go into all these things, I have to create a lot of ground to make you understand that what are the situations which you can take into account which become very you know handy.

So that we can talk about disposal of the waste and come out of the understanding of the waste which is only MSW, so the more and more industrialization takes place countries like India are becoming superpower so more and more atomic activities are happening alright and the question is who is going to handle the waste which is coming out of not only the municipalities which everybody is aware of the waste which is coming out of industries, the waste which is coming out of your research units, the waste which is coming out of the atomic establishments.

I hope this point is clear to you, so we are not talking about only the municipal solid waste which has become a very bottom-line situation which everybody is aware of. So let us keep this word waste in the inverted quotes so we would like to study how safe disposal and handling of the waste can be done estimation of its spread and fate in the subsurface. Subsurface is nothing the one which is or the domain which is below you know ground level which you may say.

So when I say subsurface the connotation is rocks, soils and the groundwater, yeah and I am sure with the basic knowledge of geomechanics which you have until now it might so happen that the rocks might be intact, or they could be weathered, or they could be fragmented they could be highly fractured. So I have created different scenarios so within few seconds what I have done you know from subsurface I have created another category of the subsurface which could be intact rock mass, which could be weathered rock mass, which could be disintegrated rock mass, which could be fractured rock mass and so on.

Number 2 with the soils I am sure you are aware that this soils could be of different types all right they could be clay they could be a shell, there could be gravelly material, they could be gold Vray material they could be a mixture of all these signals so on. So, I am sure you must be

realizing I am creating more and more situations in the subsurface because each of this term corresponds to it has a connotation.

So the moment you SM type of a soil you have a connotation engineering properties are intact clear the moment you say CL CI you know what type of soils you are talking about another situation could be rocks and soils they could be partially submerged, they could be dry, they could be saturated and so on. So, imagine how many types of situations have been created within the subsurface and of course, the third parameter or the attribute would be the groundwater.

So essentially, when we talk about the subsurface, we talk about rocks, soils, groundwater and in this domain, there could be a presence of the contaminant. So, contaminant becomes a foreign body which is not acceptable which is not welcome, and we want to understand how the presence of contaminants is going to alter the overall characteristics of itself first of all or the subsurface is this part clear.

So this has become a big matrix I have talked about the material properties I have talked about the situations I have talked about how this interaction is going to occur between a foreign element which is not welcome into the subsurface which normally in technical language we define as porous media. So, the attributes of the porous media are soils, rocks, groundwater in different forms.

So, we will try to study how to estimate the spread and fate of contaminants. Now fate is the word which is normally used you know for human beings people have this habit of going to astrologers, palmists, face readers what for they want to know their fate this is correct, but here we are using the word fate for contaminants why any clues? Yes, exactly right so we want to understand how this is going to behave in the future how what is the fate means what is going to happen to this system.

The system might be having both together, so it may so happen that the contaminants are detrimental to the porous media or otherwise also the porous media might be detrimental to the contaminants. The contaminants could be so aggressive that they may eat up the porous media. A

good example is if I take acids, and if I flush them from my laboratory all right and suppose the subsurface oil happens to be organic, what is going to happen.

So, this acid is going to interact with the organic material, and then this interaction is going to result in something so what's the fate of the system, something is detrimental to another clear. So, this type of situation is becoming very prominent in most of the industrial activities which are happening in today's world. The second thing which we will talk about is the methods to contain its spread as a Geotechnologist, environmental geotechnologist.

I want to avoid the situation to occur where the contaminants are going to spread in the entire subsurface how would you do that curtail the spread containment. So, we will talk about a lot about the containment of the contaminants all right and suppose if I fail in containing the spread of contaminants and the geomaterials or the porous media or the subsurface gets contaminated how would I remediate it.

So, I am sure within one slide which I had shown you I had taken you from different levels to different levels by the time we started from philosophy and I have created several situations by the end of this statement.