Environmental Geotechnics
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Lecture – 02
Overview 2

The biggest challenge right now is that whatever waste is coming out of the industry can it be altered for certain uses. Now, when you talk about the application were the industrial uses unless you transform the waste in a activated form it cannot be used. A good example of this is if I want to develop zeolites, now zeolites are nothing but catalysts. So, there is a process by which you can alter the mineralogical form of a material. Please notice when I say material these are nothing but the geomaterials which are essentially soils and rocks, in a elevated or altered state of activity which is nothing but a catalyst or a zeolite.

So, this is what is meant by mineralogical transformation or mineralogical modelling, that means, just for your information lot of efforts are being made by people and particularly civil engineers in doing some research related to SRT that is Silica Reduction Technology. Civil engineering has become a very interesting profession these days by the way. And my focus of lecturing and discussing with you is to tell you a civil engineering no more deals with what it used to be and that is where you will find that this philosophy which we are going to talk about gives you enormous opportunities and dimensions it adds to your thinking process and so on. Ok, Any other question? Yes, please.

Sir, the basic objective of this modelling techniques is to find the contaminant geo material interaction is it, but like we have you have already mentioned that this interaction is very very slow. And when we need and its very complex process then how accurate is this modelling technique going to be like if it is a time bound process, then there will be instances where we need we need to get the results very soon and so that we can take any alternative measures and all. But since it is a very complex and a slow process like you are mentioning how accurate we to the results.

You should understand it is a good question you are asking Sneha is suppose, is it not?

Yes.

What is the need of modelling first of all? You should understand. What is modeling? Is a sort of a prediction, simulation of something which is happening somewhere and you want to speculate when monsoons will come?

Yeah.

What is going to happen to stock market tomorrow, what is going to happen to the price of the dollar say after 5 days. Why do you speculate all these things? So, this is where actually mathematical modelling is involved, there must be some algorithm which projects the data of 25 years for another few months or few days or few years. So, coming back to your question, do you not want to live a good and clean environment and the world for your future generations? Yes, now this is what is bugging most of the researchers and planners whatever activities we are doing today what is the impact of this activity down the line after 5 years, 10 years, 50 years.

A good example of this would be most of the atomic power plants which are being in constructed in the country did you have a wonder that what is the biggest challenge in front of these atomic power plants?

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Exactly. So, when you talk about waste disposal where you are going to dispose the waste, now this is where atomic physicists' role is over and a geotechnical engineers work starts you know because you are going to handle the waste. Now, if you burry in the ground, what is going to happen? Sub surface is not a passive environment I hope you understand this. So, slowly and slowly because of the interaction of the water table or the moving water, what is going to happen to the waste, this waste is going to get carried from one point to another point.

Now, this is where the role of modelling comes into the picture, what would be the intensity of a contaminant at a certain point of time at a certain place, so that I can draw a limit of the zone of influence of an atomic power plant and I can put a warning that nobody should live in this area for another 100 years. This is one of the examples which

I have given to you indirectly that why this type of modellings are required even if the process are slow.

In fact, it is other way when the process are going and the mechanisms are going to be so slow the modelling exercise becomes much more important and useful. And this is where actually we take help of accelerated modelling that means, you like to accelerate a phenomena and we will try to see what is the impact of this mechanism on the system. We will talk about these issues slowly and slowly.

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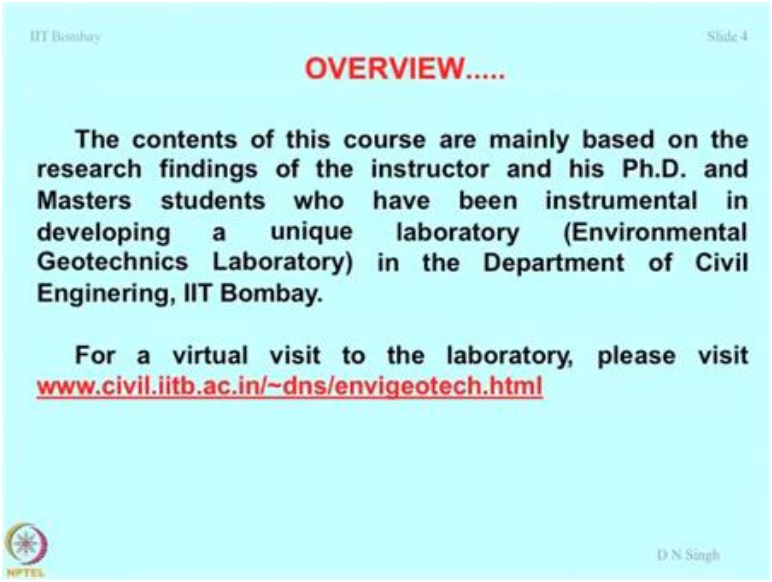

So, it is a sort of acknowledgement which I include in the overview that the contents of this course are mainly based on the research findings of the instructor that is myself and my PhD and Masters students who have been instrumental in developing a unique laboratory Environmental Geotechnics Laboratory in the Department of Civil Engineering, IIT Bombay. And you can visit this laboratory by clicking on this website. www.civil.iitb.ac.in/~dns/envigeotech.html

This is how the laboratory looks like.

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You will find most of the facilities and the instruments which we are using and the studies which were done by the previous students and the present students. Where findings are being used for development of this course. You will notice that we have good facilities for determination of thermal properties of the geo materials, soils, rocks admixtures. Admixtures are I am sure you must be aware of what are the admixtures, these are nothing but pozzolana or the cement, silica fume, fly ash, gypsum powder and so many things.

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We try to characterize these materials for finding out what is the heat of hydration, what is the heat how heat migrates in this materials. Another new concept which we are working on is the determination of electrical properties of the geo materials and the pore solution. Pore solution is the chemistry part of the geo material that is what type of chemicals which are present in the pores of a geomass or a geomaterial that is soils or rocks.

We talk about the electrical resistivity dielectric properties and all and based on this we try to characterize the material. We deal with fly ash and cenosphere characterization which is a form of a waste which is coming out of the industry. Another new subject which is being pursued by my research group is characterization of unsaturated soils. I will just give you a bit of idea about the unsaturated soils Seema is working in this area, your senior. So, whenever you get time, you can talk to her and get apprised. I will try to give you bit of information on unsaturated properties of the soils. This is what you have been asking Sneha detection and migration of contaminants in soils and rocks.

So, this type of modelling we have now I would say Mastered where we simulate contaminant transport in porous system, though it is very very slow, but we can augment it we can accelerate this process and we can study how contaminants are migrating from one point to another point.

Then we study the simulation of environmental influences on soil properties that is you were asking about this question Shivaprakash about the humidity and temperature. So, we can expose the material to certain humidity and temperature and we can see how the properties get altered. Determination of volumetric moisture content of soil this is a new concept in geomechanics where we do not rely much more on gravimetric moisture, the conventional way of finding out the moisture by oven drying method rather we try to find out what is the amount of moisture which is present in the pores of the soil that is at the pore volume level without disturbing the matrix of the soil. And there is lot of studies going on the hydraulic conductivity of soils.

You are most welcome to those of you who are from IIT Bombay, you can visit the website sorry we you can come to the laboratory directly and those of you who are from the remote center can visit the website.

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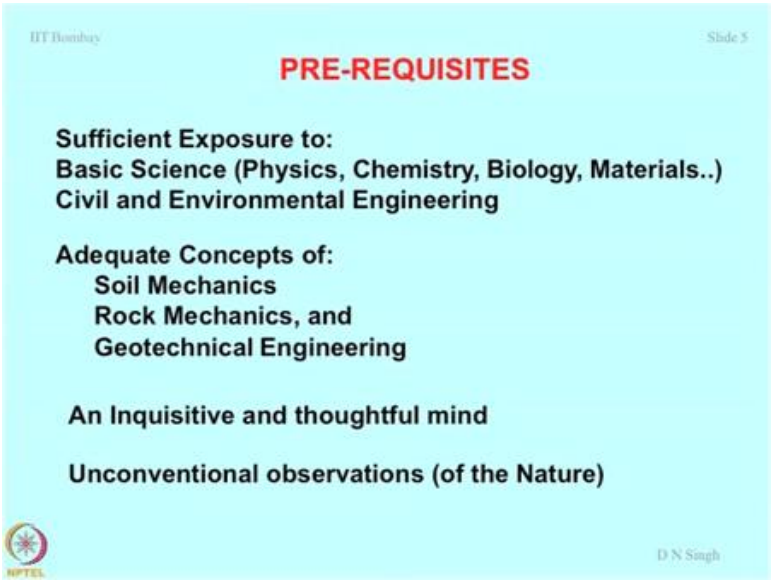

Well, let us talk a bit about the prerequisite for the course. The first prerequisite is sufficient exposure to basic science in fact sciences that is physics, chemistry, biology, materials and dot dot dot dot dot. You can keep on adding civil and environmental engineering, anything which comes to your mind after hearing me after 40 minutes what all should be added as a prerequisite for this course. This is the requirement of CDEEP that I should include a slide on prerequisites for this course. So, I could write only this much and I need your ideas to complete the slide. Bindhya?

Geology.

Geology, well that is also a I am sorry I have ignored geology it should be include and basic science like physics, chemistry, biology, materials, geology and so on. Yes, anything apart from this which you like to get added?

Mathematics.

Mathematics. Ok, yes.

Sir to be more precise geotechnical engineering itself should be added in this.

Good. So, I thought of adding this adequate concepts of soil mechanics. So, see these are two different words; one is the sufficient exposure and another one is adequate concepts of soil mechanics, rock mechanics, and geotechnical engineering, missed some spaces

left. So, can you suggest some more prerequisites here? Seema, anything which is left out?

Prerequisites just make thinking should be drawn.

You have read my mind. So, an inquisitive and thoughtful mind is the first prerequisite in fact. What else believe me she has not seen the slides when I was preparing.

What do you say, Suchith?

Unconventional observations of the nature what do I mean by unconventional is and what I keep on telling to myself and to my research associates is your observation should not be conventional. To a researcher you know something should be apparent with others cannot visualize so that is a must for this type of a course. In fact, I would say again and again this is not a real course, but this is a basically a philosophy which we are trying to give it a form of a course and to share with all of you. Anything apart from this which I have missed out Sneha, what comes to your mind?

Foresight or vision.

Okay.

Foresight and vision, Okay. All right, anything else? So, let me complete the list which sorry this is what I could think of. So, you are talking about foresight and vision, any other input. I think it should cover almost everything. If you have exposure of civil engineering, environmental engineering, basic sciences, adequate concepts of soil mechanics, rock mechanics, geotechnical engineering, inquisitive and thoughtful mind unconventional observations of the nature, I think it should be good enough to start with. Please complete the list and keep on sending your feedback.

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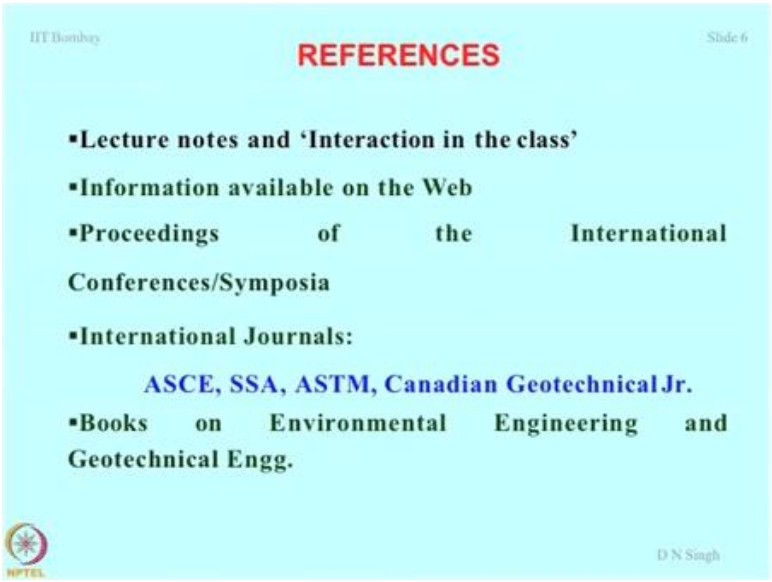

So, coming to the references for this course, I hope you will realize that is mostly like you know sharing the knowledge and experience with you, sometimes knowledge and experience may be wrong also. So, you should not blindly follow what I say in the lectures. So, you should have a mechanism by which you can filter out what is correct and what is not correct.

But still you can rely on lecture notes and interaction in the class, interaction is very important not only for geomaterial contaminant interaction, but interaction between the person who is preaching and the taught you know. You will find that information available on the web is most important here. Anything which you come across newspapers particularly they are talking a lot about environmental issues these days' proceedings of the international conferences and symposia. There are specialized conferences which are being conducted these days on environmental geotechnics, geomechanics.

These are all misnomers basically environmental geo environmental geo technology. I offer this course as a undergraduate course with little bit of change of the contents. This course is basically for mature minds and the minds which are free from all other headaches, those who are not doing you know undergraduate those who are not going through the trauma of undergraduate teaching over here. Some of the international journals which are useful for this course would be ASCE geoenvironmental engineering,

Soil Science Society of America, ASTM - American Society of Testing Materials, Canadian Geotechnical journal and so many other journals which have come up in the recent past.

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Books on Environmental Engineering and Geotechnical Engineering may be helpful. To be a specific, these are the books which I think are very useful, but you are not really I would not force you to buy these books or occupy procure a copy of these books, but these are good references whenever you get hold of these books for references please go through or in your career also you may use them later on.

Dixon and Weed "Mineralogy Minerals in Soil Environments'' specialty volume on Soil Science Society of America, 1989. Those of you who are too much interested in the mineralogy or those of you who may work further in mineralogical alteration and mineralogical properties of the soils and geo materials, it is a bible for them. There is a book by John F. Rees, "Contaminated Land Treatment Technologies''. Acar and Daniel, ''Geoenvironmental 2000'', it is a conference volume Containment, Remediation and Performance in Environmental Geotechnics.

As I said people are using these words very loosely Geotechnics, geomechanics, geo technology and so on. The essence is same; the cover is different. Another good book which has come in the market recently is by Hari and Krishna, "Geoenvironmental Engineering": Site Remediation, Waste Containment and Emerging Waste Management

Technologies, but you will find that these books are mostly you know specific on a certain topic like this book is mostly on geoenvironmental engineering, site remediation, waste containment and whatever the management technology should be evolved and so on.

There is another book by Oweis and Khera, Geotechnology of Waste Management second edition. This book normally talks about more into the waste management techniques. What my efforts would be to give you something which is totally different than what is existing here and that is why actually I say that become it is more important if you interact during the class and let me not proceed further ok rather than sitting silently here.

Sometime back one student had asked me a question that why do not you write a book on this. So, my answer was that still I am learning the subject and the day I learn it, then I will try to write some book on this, it is not so easy. So, it's really you should appreciate the efforts made by these researchers in coming up with some you know books or a sort of a compiled version of their research it is difficult.

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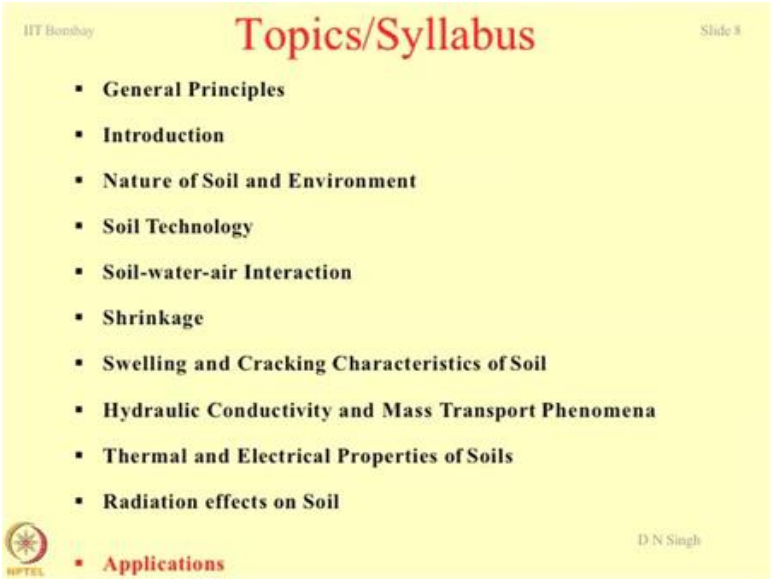

The topics and syllabus would be something like this. General principles of the subject, which takes almost 3 to 4 lectures to clear what are the basic principles behind this topic or this subject. Introduction, what we have discussed is half of the introduction covered for the topic. Nature of Soil and Environment, this is something interesting it gives you a

new vision to understand how soils can be treated and they can be given their due weightage particularly when they are taken out of the environment or when they are lying in the environment itself or when they are forced to interact with the environment, which happens to be very aggressive. This is another word which normally we use aggressive environment.

So, aggressive environment is nothing but an environment which is having everything of extreme, extreme humidity, extreme temperature, extreme chemical flux, extreme radiological activity and so on clear. So, this is why we say that this environment is very aggressive not conducive to mankind. It is a topic which I like to discuss about is soil technology. There is no course offered on soil technology itself truly speaking soil technology itself is a big course you can spend enough time learning what is meant by technology of soil.

Any guess? You do a course on soil mechanics, soil engineering. So, what should be the difference between soil engineering and soil technology? What is the difference between two words engineering and technique? I am sure that 4-5 years back you must have gone through this trauma of selecting a B.E or B.Tech., degree from certain institutes. Some institutes offer a course in degree as B.E and some institutes offer a course at B.Tech. Did you wonder about the difference between B E and B Tech and everything is same, you never bothered about this?

So, anyway I will not go in the debate of all this I will simply ask a question what is the difference between engineering and technology? And then the question is why this topic should be studied, why you should not be satisfied only with soil engineering? And I think in our department we offer two courses soil engineering 1 and soil engineering 2. Seema is this correct, 1 and 2? So, one you must be doing has suppose this semester itself, second course you will be doing next semester. So, any guess what is that you do not cover or do you do not study in soil engineering which requires some technology to be developed?

In day-to-day life how would you classify engineering and technology?

Suchith

Sir, I would like you give you an example.

Yeah.

Suppose a car is there. So, a car what are that basic parts of the cars that is nothing but engineering, but some advances which are there in the car or some advance cars so that is nothing, but technology. So, we are studying some advanced techniques not only the basic principles, so that is technology.

Engineering is the learning time, technology is the applications right and given that.

Good, I think both of you have given an interesting suggestion, yes please.

Sir, like soil engineering deals with the basic principles of the soil with how soil behaves and all in the last so many years how people what people have researched. Soil technology is me something which tells us that how we modify soils to so that it can work according what we want from it, like how what ground improvement techniques should be applied and how we modify soil to achieve those desired properties which we want from it that.

Good, I think your answer is quite near perfection, it is true. Yes, Sneha, try, say something.

May be soil engineering means the be we only know how the soil behaves to I mean how does it like we like this construction activity that is going on. So, what are the basic requirements as a soil should satisfy and all, but soil technology is maybe the improvements in soil which we desire in so that apart from understanding how the soil behaves, you also need to know that if such a situation does not arise that we need in soil maybe to improve its properties maybe techniques must be developed soil technology.

Your name please?

Sangeetha.

Your name please, please try, you want to say something Sangeetha?

No sir, no sir.

Yes please.

Me sir.

Yeah.

Sir, may be engineering is the branch already which has been already studied already it is there, it's no let us some difference has made it us its upgradation is not may made, but technology is a science where its upgradation is required in further future references I think it is.

Good so that means, you are saying that more work for the researchers.

That will come that is correct. So, soil technology is as I perceive is a big question mark.

Yes, I think I like your answer to this soil technology yes please.

(Refer Time: 25:23) I agree with their views, sir. Like it's right like technology is something like which we need to develop further we requires a further enhancement to what like we already have.

What is the difference between Intel and something else you always use the word Intel technology? Am I right? Why so, why others could not use the word dot dot technology? Ravi coming back to you, yes please.

So, what I personally believe is like soil technology is like something improvement like so that it will be useful for the future generations something which will be helpful for them like an extension to the engineering soil engineering.

Building a bridge is then engineering or it is a technology, why?

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So, the moment you ask a question why that means, most of the ingredients are not there, and you are looking for something which is missing. So, your soil engineering-1, soil mechanics-1, soil mechanics-2, whatever courses you have done in your undergraduate or what you are going to do here, they are incomplete in my opinion. Do you agree with this, what is your name?

Beneal.

Sorry.

Beneal.

Beneal.

So, what is incomplete?

Already the idea is there, we have to face the upcoming problem also.

Like?

Like in this take the (Refer Time: 27:22) in this take the what are the problems if they a new contaminant in seen.

Like you deal with five contaminants ten times, it becomes a known thing there is nothing new. So, why should we study?

Sir, like suppose take for like we are having problems like ground improvement techniques for suppose like initially draining of the water if it was a soft clay like what I feel is like this sand drains and all for consolidation techniques, they will be taking a more time to make the consolidate that clay consolidated. So, like we need to find these techniques like to make them more faster and all, like if it is taking like some 2 years or 3 years to consolidate like we should be developing a technique. So, that it should be the like the is consolation should be achieved in 2 to 3 months or so.

So, basically augmentation of engineering is technology this is what you are saying.

Yes.

Or augmentation of the experiences which you have in the past would be technology, yes.

Like while constructing any structure will not only design for load will also check in to the serviceability condition. So, while soil we know what is the condition of the soil, what are we going to construct on it, how are we going to construct on it, but with the time we are we also have to check with the serviceability like foundation like over a period of time how does the soil is going to behave it.

We have to check whether the serviceability of soil is also needed or not for that soil technology may be.

So, need based.

Serviceability.

That is a very important word need based.

Yes, need based.

Work or thoughts would lead to some technology that is correct. Yes.

Jain.

Yes.

Jain.

Anirudh Jain.

Anirudh Jain yes please.

Sir actually engineering is like whatever the things we made earlier the that is the people studied earlier we are applying the same thing like if we encounter something new and we work upon it and we develop something that is technology.

Shiv Shivaprakash.

Sir I would you like to talk about soil engineering and technology. In soil engineering, as per my knowledge you study the dynamic properties of soil how it behaves for a building load or a load of a structure how it behaves. In soil technology we will be studying the technical aspects not only for engineering purpose also for I like environmental contamination, soil contamination and interaction of water and soil, and geo micro by microorganisms in the soil how they accelerate then interaction and such kind of aspects, we will study in soil technology.

All right, thank you. Let’s see over the few days that how definition of soil technology can be put in a better way. One of the answers of what soil technology should be most of the engineering works on convenience, human mind basically works on convenience, whatever I know I will prefer teaching. Whatever I do not know I will never teach. You agree? You do not agree, no? You agree correct.