Computer Methods of Analysis of Offshore Structures
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Module - 01
Lecture - 01
Introduction to Structural Analysis (Part - 2)

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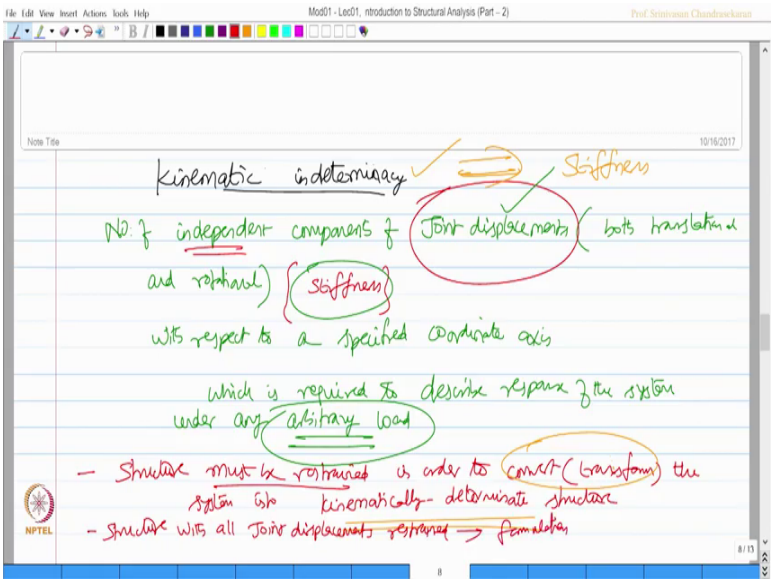

Then let us see; what is kinematic indeterminacy, because there are two indeterminacies.

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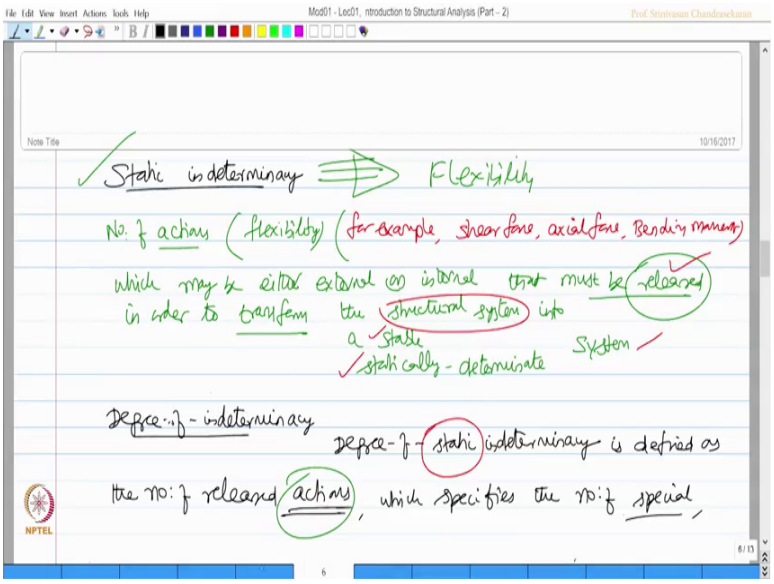

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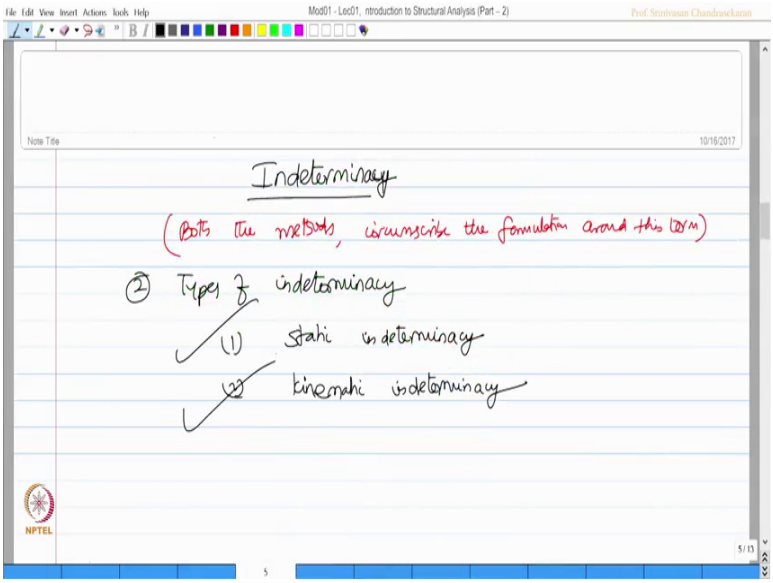

One is static other is kinematic. Let see; what is kinematic indeterminacy. This refers to the number of independent components of joint displacements. It can be both translational and rotational. Now we can get a keyword very easily I am talking about displacements; displacement is related to stiffness in the formulation I can recollect that.

So, it is a number of independent components of joint displacements; the moment I say displacement it should have a coordinate system with respect to a specified coordinate

system or coordinate axis, which is required to describe response of the system under any arbitrary loads.

So friends, we can see kinematic indeterminacy which is associated with stiffness method of formulation problem is more or less trying to converge to a generic solution. These problem formulations need to identify the number of independent displacement components which will be invoked under the external forces which are acting on the system, which can be of any nature. So, stiffness method is slightly and promisingly converging towards a generic type of problem formulation. There is one important statement which we want to make in kinematic indeterminacy. It is important to note that structure must be restrained in order to convert or let say transform the system into kinematically determinate structure.

In fact friends, they did this in the earlier method also. You see in static indeterminacy which is associated with flexibility approach you are transforming the system into statically determinate system. Similarly, in this case you are transforming the system into kinematically determinate structure. So, kinematic indeterminacy is associated with stiffness approach, whereas static indeterminacy is associated with flexibility approach.

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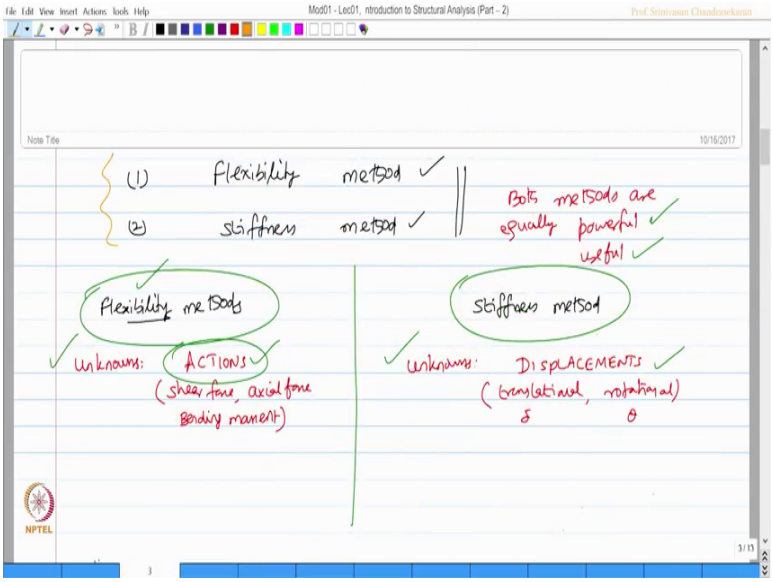

Flexibility and stiffness are two different methods of problem formulation which are used in computer methods.

Having said this, let us add one more statement saying that structure with all joint displacements restrained is the formulation.

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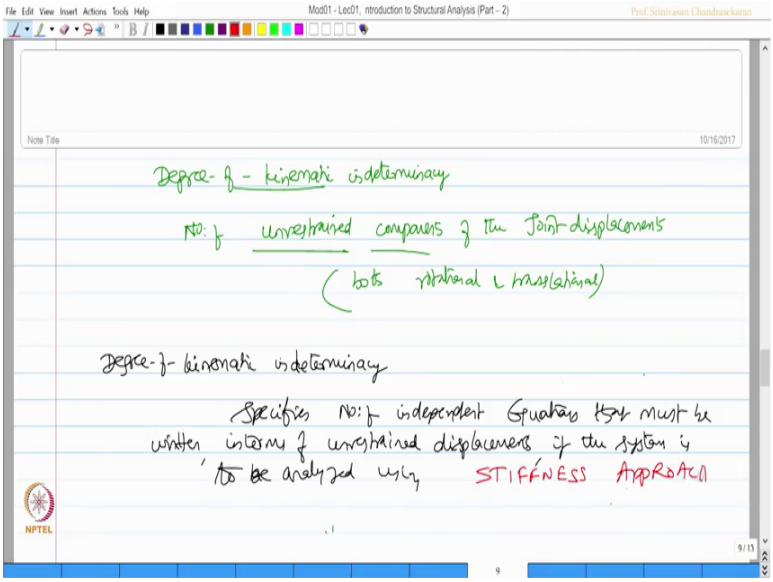

Having said this, let us now define; what is degree of kinematic indeterminacy. It is actually the number of unrestrained components of the joint displacements. It can be both rotational and translational. Therefore, friends it is important to know that degree of kinematic indeterminacy specifies the number of independent equations that must be written in terms of; what are the unknowns in this case- unrestrained displacements unrestrained displacements, if the system is to be analyzed using stiffness approach.

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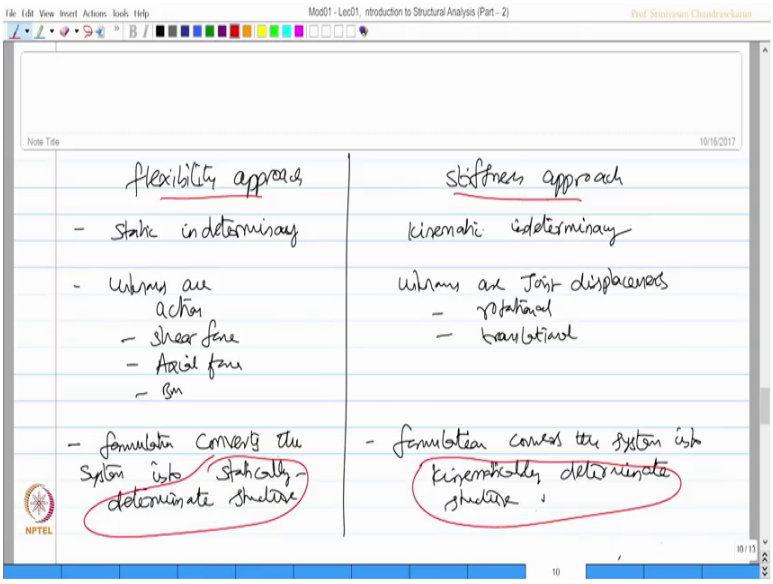

So, friends let us try to quickly summarize flexibility approach, stiffness approach. Both are two methods of problem formulation and solution. This deals with static indeterminacy, these deals with kinematic indeterminacy. To be very specific here unknowns are actions; example shear force, axial force, bending moment etcetera. Here unknowns are joint displacements; example rotational, translational, displacements. Here the formulation converts the structural system into statically determinate structure. Here the problem formulation converts the system into kinematically determinate structure.

So, one is focused on static determinacy, other is focused on kinematic indeterminacy. Stiffness and flexibility approaches are two different methods of formulating the problem which of course helps you to solve the problem as well.

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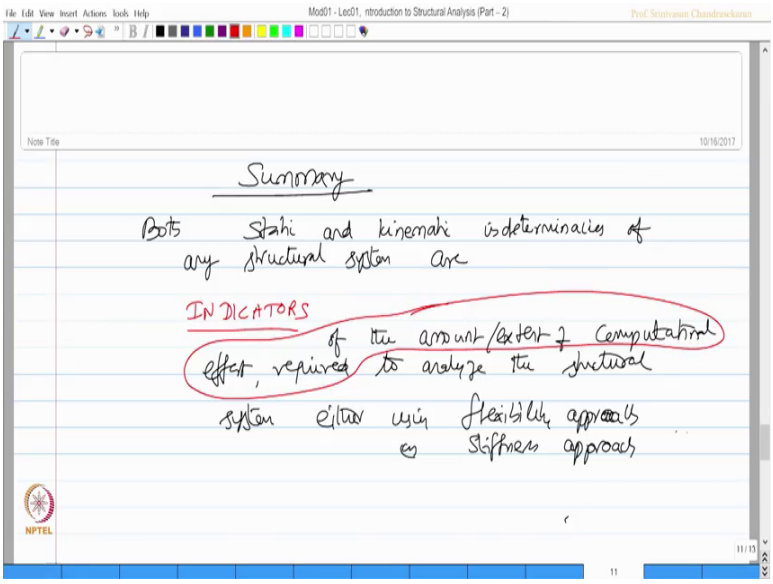

Now, let us make quickly a summary. Both static and kinematic indeterminacies of any structural system are indicators. They indicate what? Indicators of the amount or extent of computational effort required to analyze the structural system either using flexibility approach or stiffness approach.

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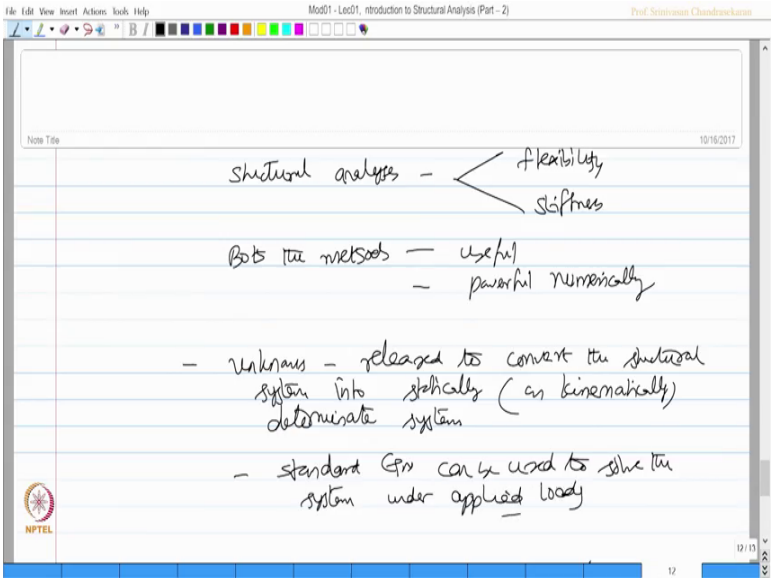

So friends, it is clear that structural analysis can be carried by two methods: flexibility approach or stiffness method or stiffness approach. Both the methods are equally useful and powerful numerically. One of the methods have superiority over the other only in

terms of problem formulation which we will discuss subsequently in other lectures. So, the unknowns are released to convert the structural system into statically or kinematically determinate system; so that the standard equations can be used to solve the system under applied loads.

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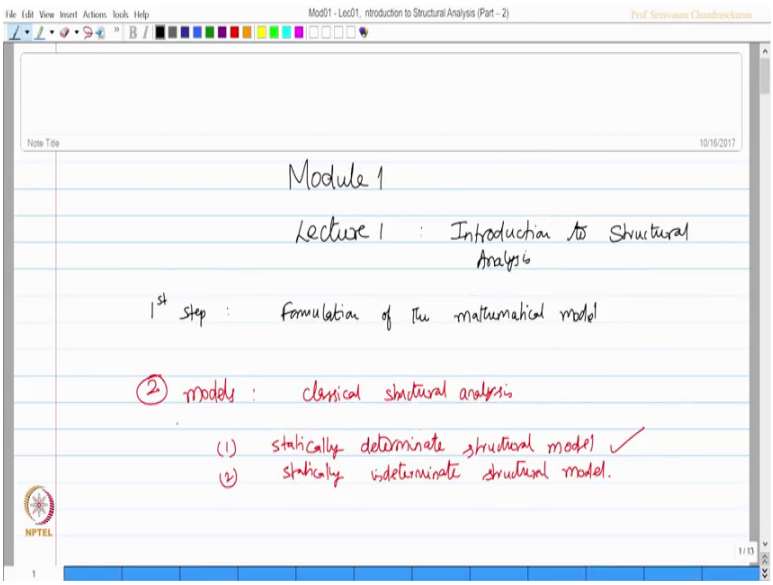

So friends in this lecture we started to just introduce the computer analysis, applied to structural analysis of offshore structures, we discussed about the formulation of the mathematical model.

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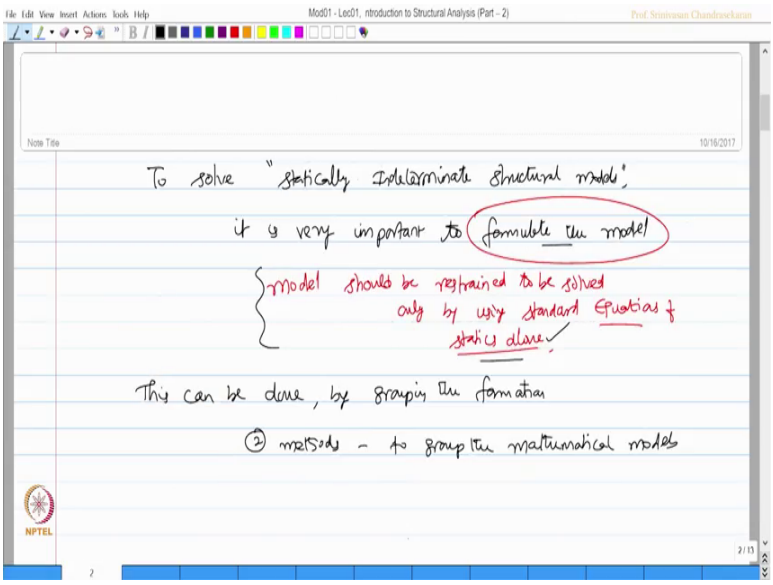

We explained what should actually been done to the model to solve the problem, what are different methods namely flexibility and stiffness method, what are the unknowns in both the methods, what are the basic assumptions which are actually idealized in solving the problem by both the methods.

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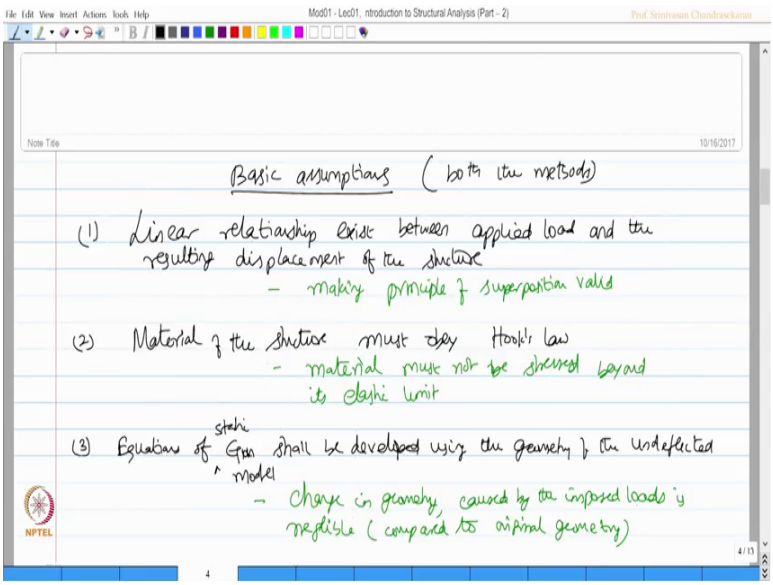

Each assumption has some statement which is very important to apply for the analysis.

Then we discussed about indeterminacy. We spoke about two types of indeterminacy static and kinematic. Static aligns itself to flexibility approach, kinematic aligns itself to stiffness approach in which the unknowns are independent displacement components, whereas in earlier case they were the force or the action components. Both methods can be compared by the table showed in the screen. And we can now aim or objective to convert the given system either to statically determinate structure or kinematically determinate structure.

Both methods actually have unknowns which are indicators to know or to realize the extent of computational effort what you want to make to solve the problem. So, we must converge to a specific method which is easy to program in the digital computer and also we can minimize the computational effort and maximize the solution efficiency in the problem formulation stage itself which will discuss in the subsequent lectures.

I hope in introduction lecture, it is interesting for you in the first module and you will find it more cumbersome and convenient, in the same time to follow my algorithm in this. I wish to state very interesting reference which you need to follow, which is very helpful for this specific course to be further interesting.

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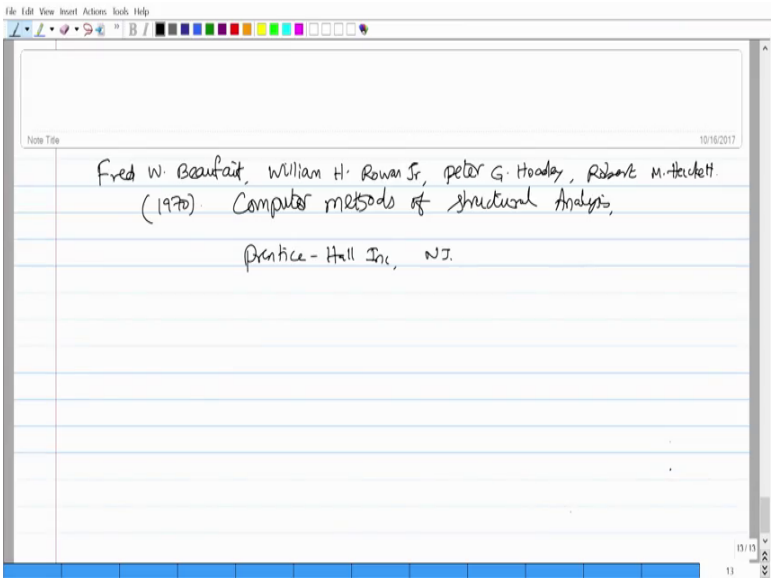

So friends, if you have an access to this book please use this reference material as well along with the list of reference given in the NPTEL website. Fred W. Beaufait, William H. Rowan Junior, Peter G. Hoodlay, and Robert M. Hackett: 1970 Computer Methods of Structural Analysis which is Prentice Hall Publication New Jersey.

This is one of the interesting references which I could suggest you to go through, along with a list of references and text books given in the NPTEL website of this specific course.

Thank you very much.