Port and Harbour Structures

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Mod-06
Lec-32
Calculation of fixity depth

So we will see an example problem for calculating fixity depth, so we want to calculate the fixity depth what you need is you need this L one on supported length the embedment length.

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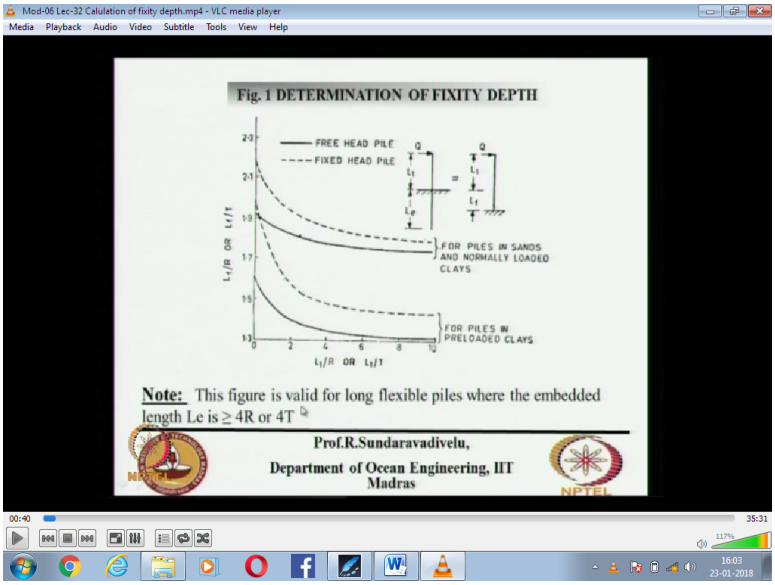

So X axis is L one by R and Y axis is LF by R. They also need this is chart is applicable only if the embedment length is greater than four R or four T.

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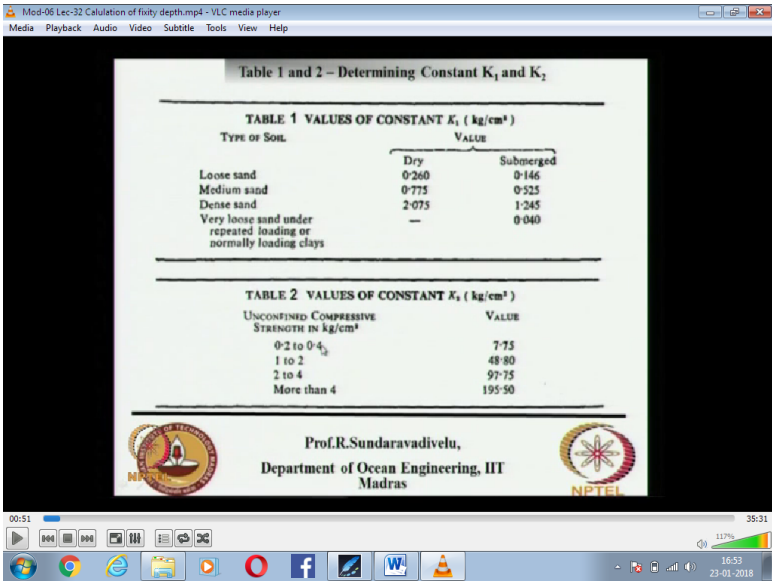

The R and T are generally applicable for constant K one K two respectively. K one is for sand and K two is for clay.

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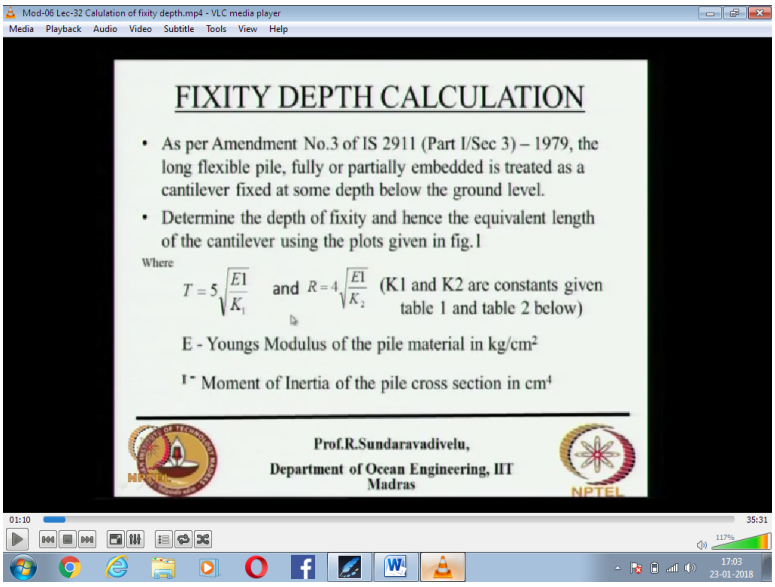

So, we have to calculate R is done I am sorry T is for sand and R is for clay. Fifth root of Ei by K one so what you need is you need K one young's modulus of the pile and movement of inertia of the pile so these are the information need for this problem.

So may I ask this question in the next class (())(1:18) case, so you have to I may give this curve relationship between L one by R and LF by R should be taken from here or L one by T to LF by T to be taken, suppose it is a sand and if it is a fix rated pile you have to use this

curve you have to first calculate L one by T for which you know what is L one then you have to calculate T for which you need the diameter of the pile and you have to check the applicability LE is greater than T so first you have to calculate T for which you ned the root of EI by K one. K one should be taken from this.

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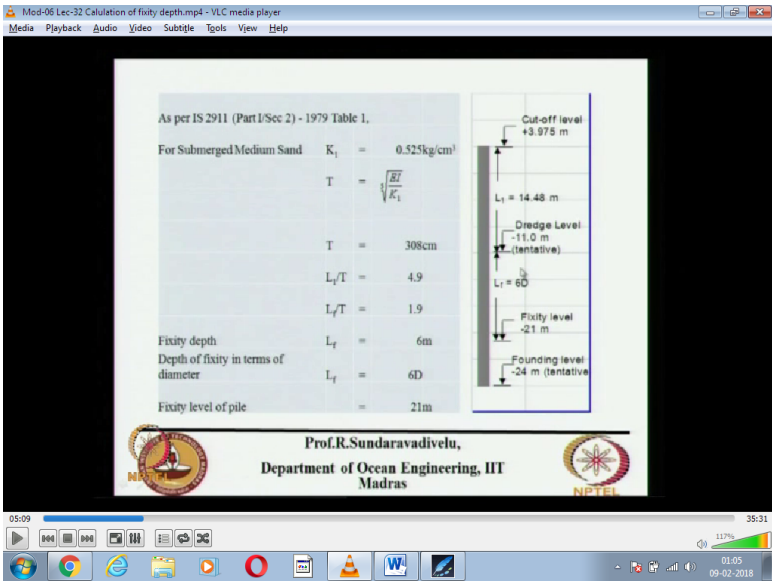

So will see one problem the top level of the pile this is rig level slightly you have to give this slightly mistake is there minus eleven, we may this should be about fourteen point Nine Seven Five.

You calculate then you calculate T, T is equal to Fifth root of EI by K one. It is given as submerged medium sand so you go to the table it is given as medium as sand submerged than the value is point five two five. Then you go and substitute here. Point five two five and you have fifth root of EI by K one.

So once you calculate the K one young's modulus of the pile that is five thousand root of FCK and movement of inertia that is Five D for Four by Sixty Four you can get T you substitute the valuesKG per centimetre square and things like that so KG per centimetre square for young's modulus. Centimetre for four for the movement of inertia and K one is the sub grad submerge K one is for submerged medium sand point five two five centimetre Q.

Then you take a fifth root then you will be getting the T value in centimetre so calculate what is L one by T, L one is known, T you have calculated we check further embedment depth is greater than see here the embedment depth is greater than four R, the step is not given here. But you have to check here, embedment depth is greater than four T, T is thirteen meters four

T is twelve meters, so embedment depth is twenty four meters minus eleven meters that is thirteen meters.

Fine is clear now, you have to calculate four T, four T is twelve meters and this distance is thirteen meters. So this is greater than twelve meters than only chart is applicable otherwise it is not applicable.What it means is you will regular the sufficient fixity, it is what it means.

Than for L one by T is equal to four point nine. You have go to the chart L one by T is given here four point nine will be somewhere here, you go here strait like this X rated pile then LF by T is equal to one point nine three or something like that, so you have taken LF by T is equal to one point nine so fixity depth will be one point nine into three about six meters so fixity depth is sixty, fixity level will be we know the diameter of the pile diameter is one meters so it will be about six meter, minus eleven plus six will be seventeen meters this is a mistake will correct it, this how we have to do, so any doubt in this.

This Wednesday exam I want give it as an open book exam you can bring anything you want to refer singly open book exam you people score very less whatever you want to bring its only problems five problems I will give all the five problems also I have told what are the five problems, activate pressure, now with activate may I ask passive act pressure also, differential auto pressure then (())(05:58) force(())(06:01) force then this problem excrete problem, you bring whatever you want you, bring some story book also I don't mind it.

You bring some concrete diesel book you want whatever you want you bring and don't ask me any date, don't ask me this chart we have given this problem you should not ask where is this chart. This chart you should not ask everything you should bring and no exchange if you don't have, don't have that all don't get it from somebody else you should have your own copy, you can have an exam by problem solve then bring that also OK.

No no, you can write separately and bring that also this presentation its already here you take it from here, already here otherwise you go to on Rammia is there in my project you go to here she only made the presentation, Balamurgun is there you will have all these materials, the purpose of giving the open book test is that is you at least go through the material in the exam.

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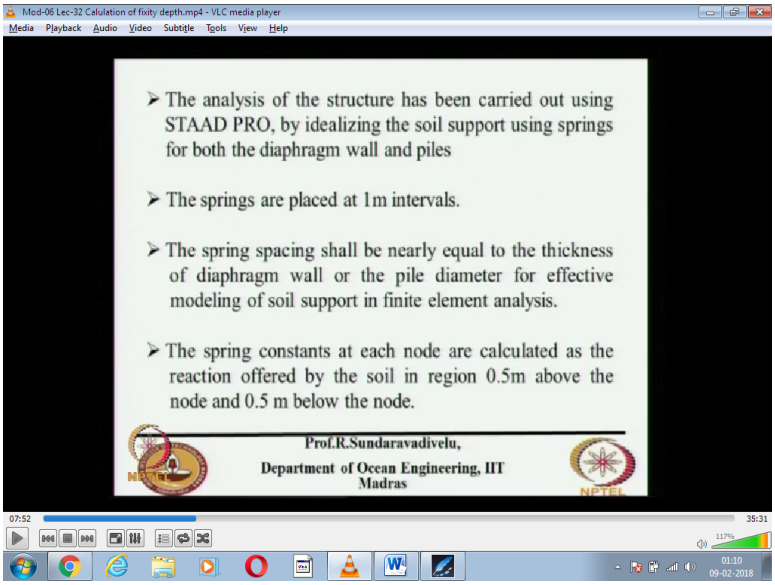

So the fixity depth method is generally adopted for preliminary design but you want to exact calculation we have to use the spring idealisation. This will discuss in this class.

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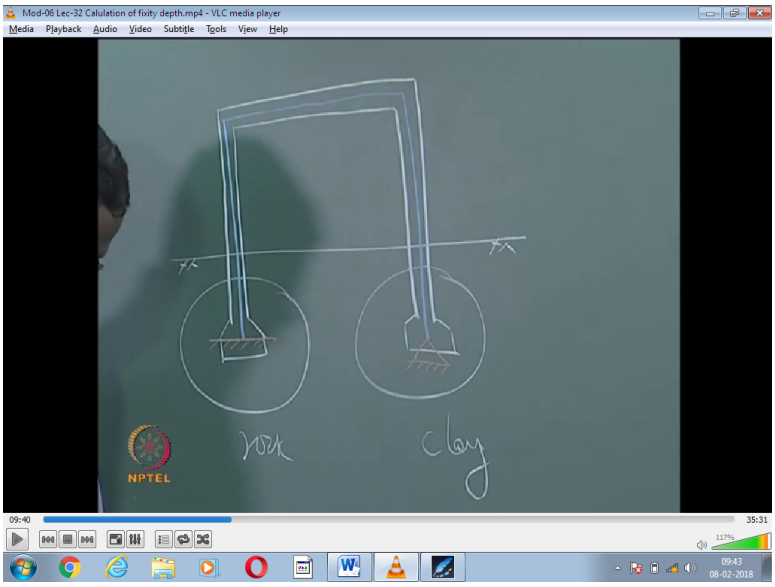

Suppose you have rock here and you have clay here generally it is not possible but sometimes it is possible but for exam for explanation I am doing so this is your structure its portal frame for a building you have two column's and a beam this will go in some spacing then you have slab on top of it you want to have the discretisation of the structure you take the central line of the structure then what you do is you have seen fixed this as it is a clean soil it will not a sufficient fixity to the structure so as seem this is as hinched and this is fixed this for a typical portal frame.

Some designers what they do is they save, both the sides are rock or both the sides are clay as seem both the clay hinched do the analysis and they seems both us fixed and do the analysis. I will tell you why.

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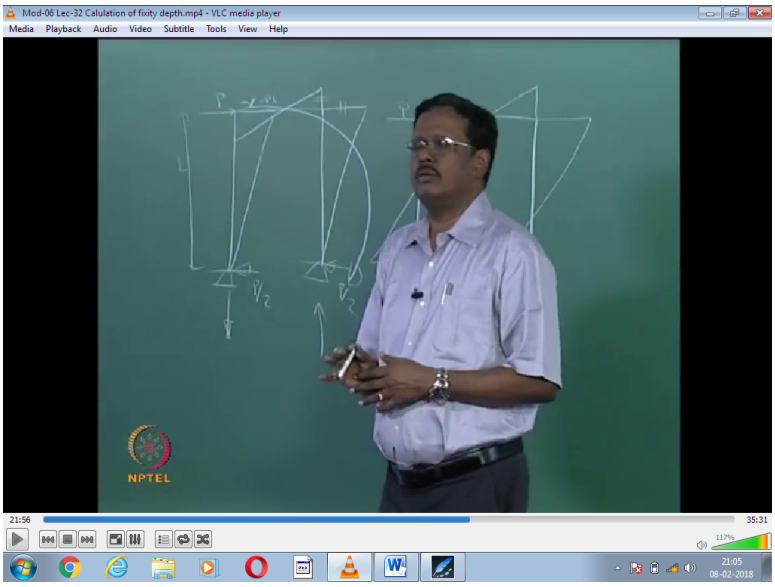

Anyone can draw binding winddiaphragm for this, who can draw binding winddiaphragm, you studied not all of these structures,come come forward civil engineering students you come here and draw, none of you come here come and draw wrongly also I will correct it, over all civil engineers I will call you, raise your hand be a civil, this fellow this fellow I want civil engineering students B tech civil OK that fellow you come that middle blue fellow come here ok next fellow also come both of you come, who have start you this analysis of the structures structural value, you don't draw yesterday also I have made a team I will tell him your students did not draw, why you are removing that force yaar, that should be there still you can draw the binding winddiaphragm use the duster, you go totally wrong go, other other B-tech's B-tech civil raise your hands yaar I don't know you are B-tech students yourself come here come here.

Who have start is analysis, Who have start is analysis structural analysis only one (()) (12:30) comecome on this binding wind diaphragm tension side or on the comparison side, comparison side, oh correct next, if you start from the T which is wrong then everything will go wrong.

See I am asking you to draw because if you really want to go to for a core job they will ask you to draw the binding wind diaphragm foe such things you should be prepare to draw we

do not want the values what we want is the shape of binding wind diaphragmyou see the other side and copy that said yes made some corrections left side is, right side is wrong why, this fellow is correct this side this is correct come here you draw separate.

This L and T ECC group all know they conduct some written exam then they conduct the interview also I also did M-tech's structures here I went for the interview on company is L and T development consent private limited. One of my colleague from mechanical he went to Audco here you have to see, you know mechanical students this company was Audco, L and T Aodco you do not know Audco Audco, L and T office where is it. Main office Manappakum we gone to pu road side you know where is MGR's house, Ramawarm Garden, don't know any of these things. Please go and see all of these things. You are civil engineering students, that is correct, what is the value at the top, no no compare to the binding movement in the column you have binding movement here, call it is X.

What will be this value it will be greater than X or less then X. who thing that is wrong it is less than X, the force is same force is the same. See actually the problem in this is this when you draw the binding wind diaphragm the load if it is something like this (())(16:01) you may draw the binding wind diaphragm like this this is a problem is binding movement no this is a movement here like this this is a movement here like this both should be equal and opposite.

That is a mistake here let is correct but we people are doing it wrong, what is reason where you are nervous or what. I want to know the real reason or you have not solved any problem like this, have you got a problem like this in the exam then that question what will be the binding movement for this, this binding like, everything is same why you are asking, what is the value here, PL by two, write PL by two .

Than what is the binding movement there, that binding movement is the binding movement here is less than that binding movement so if you are designing a structure please go and seat over, if this is hinch and this is fixed the same problem if you are analysing, the hinched condition gives maximum movement at the being column junction write whereas the fixity condition gives more movement at the foundation isolated forting. That why they do both whichever gives maximum value at any point at they take it. If there are not should of what kind of boundary condition to be adopted.

You know why I am giving this problem what is the reason ask you to do this problem nothing to do with port and harbour structure, why I am doing this problem, I do not have

time or I want to kill time hour, what is the motivation for comparing this two results what is the reason you do not know.

I want you to impression the effect of correct assumption boundary condition so that the results will be appropriate for the design. So if you see hinch what happens suppose the actual condition is fix at and design it is for hinchre condition what will happen, you may not design the isolated forting properly so your design will fail there. Suppose actual condition is fixed actual condition is hinched but you are assuming a fixed boundary condition what will happen, this joint you will design it for PL by two and that means actual movement is P and TL that means this joint will be fail.

That why it is required that you have to calculate the binding movement properly which will have more deflection, hinchre boundary condition orhinch will have more deflection. so whenever you do the analysis before going for the design what you have to do is, you have to not only check the binding movement share force excel force but also you have to check the deflection will there be any excel force in these members this member and this member, you have three equations of equilibrium sigma fall the horizontal force is to be zero vertical force is to be zero sigma fall the movement to be zero.

There will be excel force or not, if excel force will be there know you have a movement like this then you have a tension here and compression here. Please do the analysis in side pro. What will be the reaction here this will be P by two this will be P by two. This a horizontal force so this P will give P and T will give the movement about the base that will be counter acted by tension and compression so you will have the tensile force and comprehensive force both are equal and opposite.

How many of you know the start pro, any software package you please lend start pro and done if you want to go for core engineering you have a guarantee of a job you have to let start pro, start pro is there in structure department, there or not, yes or no, you do not know please check they may have some other software also what about our department we have start pro. In department it is not there, how did you know. Sir I worked in start pro only. Where. I worked in L and T Ramroad. And resign and came here. Yes sir. How would you know. What about you. Sir I know. Where. But the crack versions are there in start pro and it is recommended not use that.

So now we will come back to our problem, but it is better not assume one condition is conservative and another is one is unsafe correct condition is required. People may thing that I will do design like this because this gives the conservative binding movement but you go by this beside the boundation foundation will fail. But actual condition may be in between in these two.

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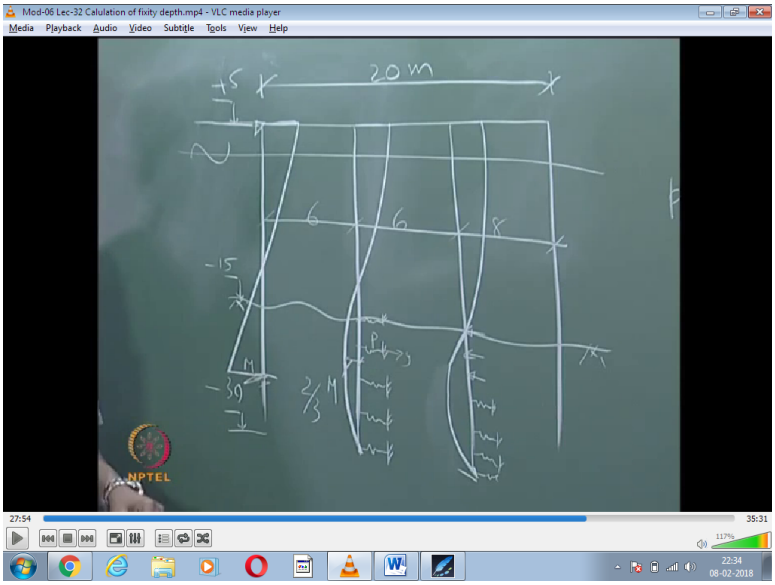

Typically this birthing structure are having about twenty, twenty five meter spacing so you may have six meter six meter and eight meter spacing for this, this will be your level angle, Bekele the top level will be a blot plus five and bit level is minus fifteen, and the founding level will be minus thirty this is a typical values what we have do. So just like as we have drawn then if you have diaphragm like this, this similar binding movement will come if you have seem, fixity depth.

If you have seem virtual fixity depth you will get the binding movement diaphragm like this, suppose instead of doing that, suppose I do the analysis by spring another class is said that this spring spacing should be equal to the diameter of the pile do the analysis which, what will be the binding movement. This point and this point if you do spring, how do expect maximum change major change. And even diaphragm will change write. We have the binding diaphragm will change, where the value are change. You have two points top point and fixity point which point the binding movement diaphragm will change. Binding movement value will change. Both the point if may change where it will change more.

Overall mechanical engineers raise your hands, Are you following any of these things. Have you said binding movement diaphragm bundle share force diaphragm which semester. Third semester. Third semester. Which department. Thread mechanical department. Or mechanical they have. What course, I do not know what is the subject material. Which book you have follow, no book. Which book you have followed. What about civil engineering, you do not know. Book is there in analysis. Did you see any book on port and harbour structure. NO. You go to library. Two books I said Goethite and Agarshow. It is not in the library main library, I have given the lectures on these two books.

This movement or this movement, which movement there will be change. You tell top point or fixity point. Top point how many people raise your hand. How many people top point up level, no body, and water point. Where you change the condition, here only it will change. If you see the point maximum binding movement this may be only two third of binding movement suppose this is M binding movement will be two third of M you will have so much reduction.

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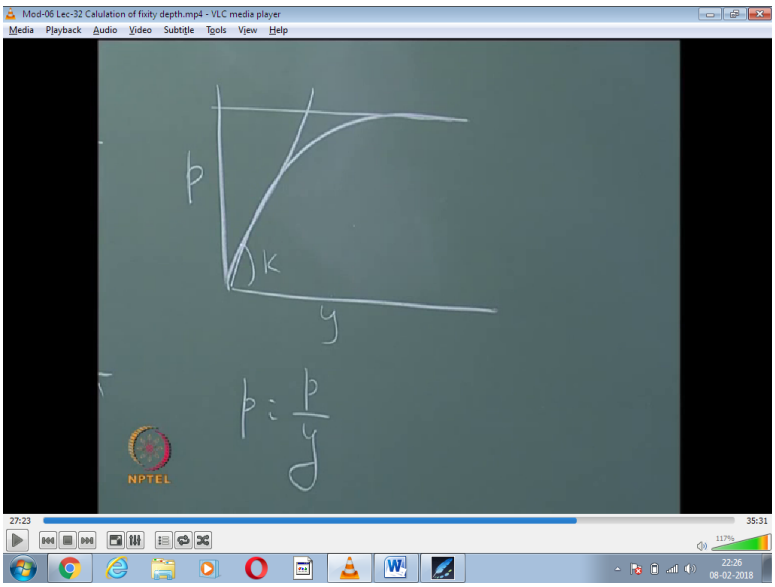

But there is the spring if you want to do analysis this spring like this that is the spring deflection in this direction Y and the force is taken by this is PY there is stiffness called as K this K will be P divided by Y. the stiffness of the spring. This is only near curve but there is a maximum value it will reach. Beyond it will not go. So what we have to do is, when we do the analysis some plastic hinched will be formed plastic reaction will be formed, you have to remove the spring and put the binding movement in opposite direction. Then you have to put

the binding movement typically this may be more then this value, but less than the fixity point. This value will be more than this.

But this you understood no, the soil is a capacity beyond certain level any amount of deflection it goes the load will remain the same that is teaches the plastic stage so you have to detractive method do analysis and you have to come to that point.

So because of all these reasons people say you go ahead and do the design as per this. Where these gives small movement is here, this movement will be slightly only change top movement not very much change actually there will be slight increase in binding movement at the top that is why you have to go for spring analysis.

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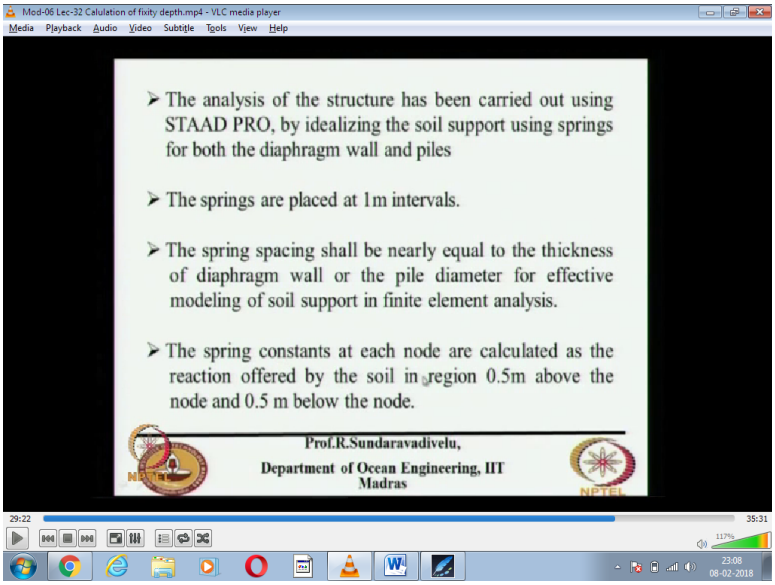

So now we have to see what this spring analysis means. So this particular problem we have diaphragm wall and piles we have use spring at one meter and because diameter of the pile is one meter the spring spacing shall be nearly equal to the thickness of diaphragm wall of the pile diameter for effective modelling of soil support in finite element analysis.

Finite element means the size of element is known so should have discretization very close to correct answer. The spring constant at each node are calculated as the reaction offered by the soil in the region spring force point five meters and above the node and point five meter below the node.

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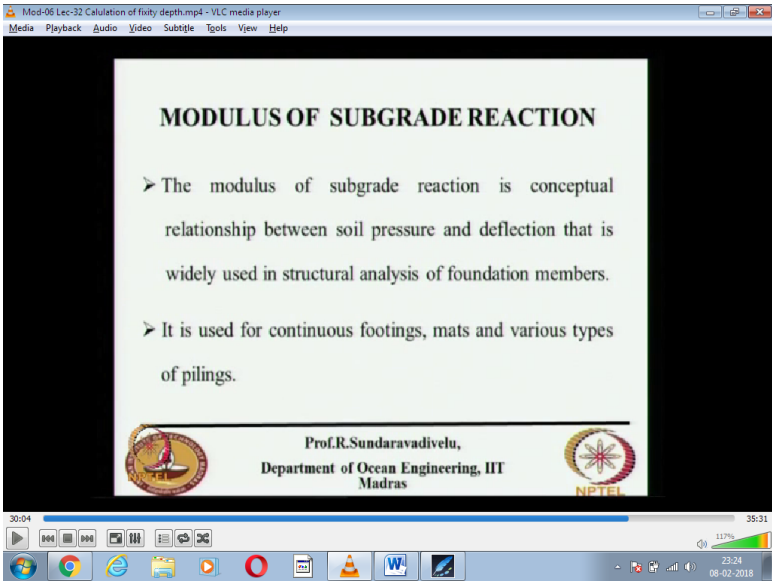

So to calculate the spring constant there are various methods available I will be giving one method you will seeing basic formula for which use a modulus of subgrade reaction this is conceptual reaction between soil pressure and deflection that is widely used in structural analysis, it can be used for continuous footings, mats and various types of piling. So this subgrade reaction approach you seeing soil springs can be used for this foundation also what we have discus both literal and unbury so this particular problem you can analysis with so you can put the springs both vertical as well as horizontal than you will get exactly what binding wind diaphragm you can get.

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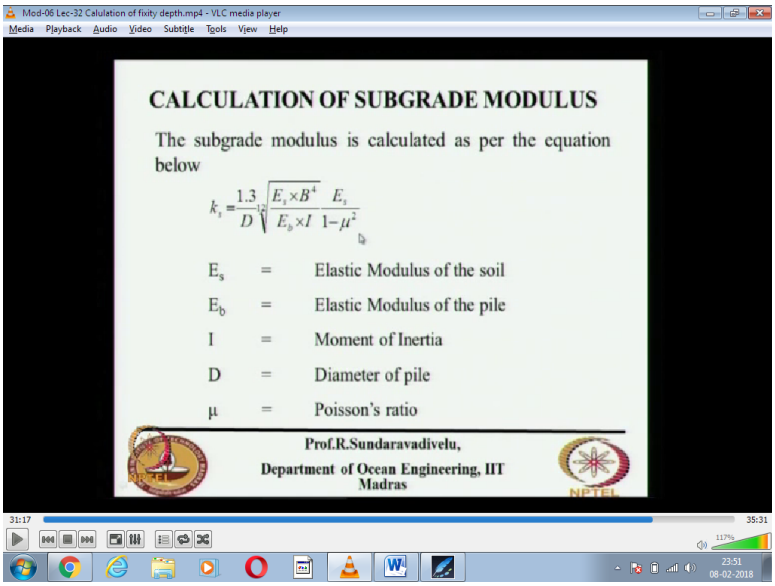

So the formula is one point three divided by D, D is the diameter of the pile this is twelfth root of ES is young's modulus of the soil B to the power of four this young's modulus of the pile movement of inertia of the pile multiple by the young's modulus of the pile divided by the one minus mue square. That is a Poisson's ratio.

Generally young's modulus of pile is about clay and all about about one tenth of the young's modulus of pile. Young's modulus of pile is nothing but the young's modulus of concert which five thousand root of FCK this mue is the Poisson's ratio of the soil not concert.

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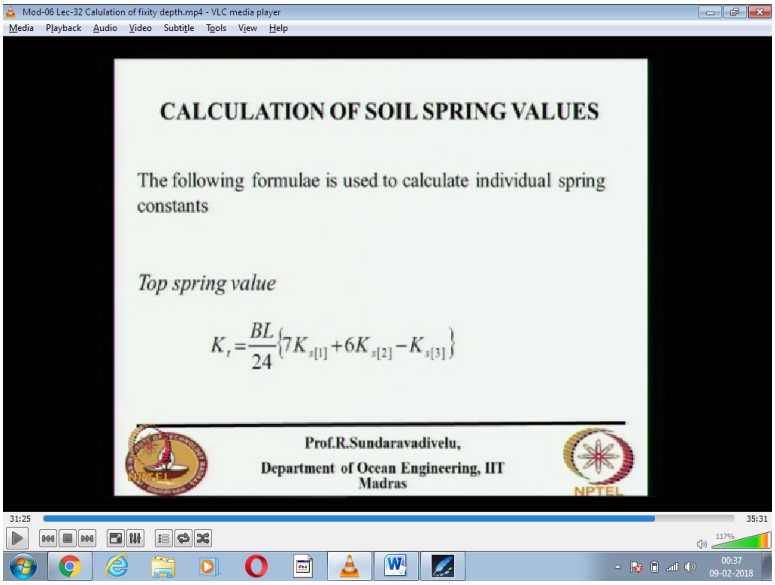

Once you calculate this K, from KS you have to calculate the spring constants.

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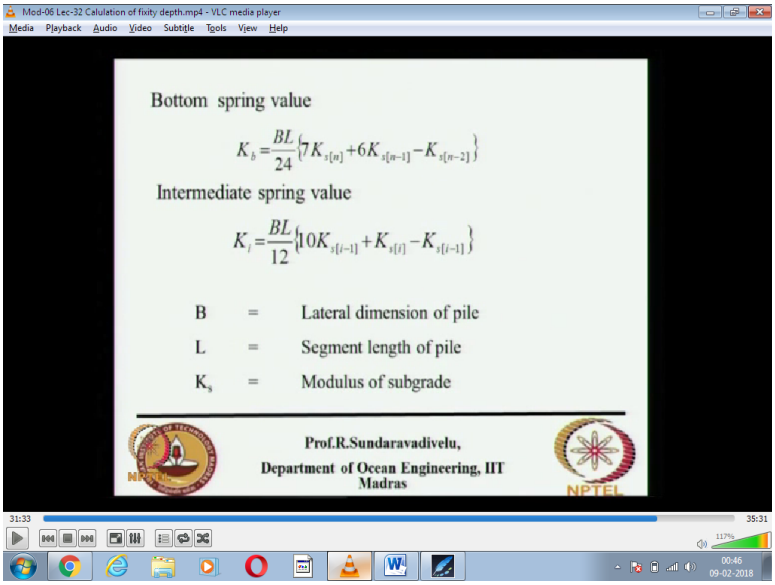

Suppose you take this spring the intermediate node for some where you take the spring this is KI so this is KI minus one this is KI plus one, so what this figure show is KI will BL by twelve where L is the spacing materials in the springs so if you want KI this is what you have seen KI is nothing but this KI. KI is BL by ten, so the soil will be laid soil suppose soil is uniform the KSI will be the same. KSI KSI minus one and KSI plus one or the same.

Than this will become twelve KSI, that twelve and twelve cancel and it will be equal to BL by, BL into KSI is it clear. It is same soil this is call Newmark's method you seen finest different method you find out the relationship at a particular spring because about point five meters above the spring and point five meters below the spring the spring spacing is one meter you have to consider. So to get the interaction of the soil above the spring below the spring use this.

If it is the last node KN, KN minus one KN minus two, you get this expression KN will be, write it as KSI minus one, KS, KS, KS, so KN will be BL by twenty four multiplied by seven KSN minus plus six KSN minus one minus KS minus two, so what we says we want from last spring this effected by the one spring above and another spring above this has more wattage seven KSN. This has less wattage six KSN minus one, and this is minus KN minus two.

So here it is ten KSI, plus one KSI minus one, plus one KSI minus two. So this will be BL into KSI if it is any from soil, if it is any from soil here it is BL by two into KSI. Assumption here is KSN is equal to KSN minus one equal to KSN minus two. OK, we will see in the next class.