Welcome all to lecture 13. So before starting about today's lecture, which is on subsurface wave methods. I would like to highlight here like in lecture 10 and 11 we discussed about seismic reflection. In earlier methods we discussed about seismic reflection method… seismic reflection methods, and while discussing about those methods, when we particularly were discussing about creating a shock wave and based on the response of the ground against that shockwave, which will be recorded over the range of geo phones, we will be able to interpret the subsurface properties. So when we were disc…. When we were discussing about different types of waves, we discussed about. So you create a shock, it can be artificial like in terms of traffic movement, explosion, traffic explosion, machine operation etc. And there can be natural sources or other sources, which you are actually not creating. Again here also you can have maybe like earthquake etc. As a result of which, as a result of these shock waves, primarily two kinds of waves will be generated. So one we call as body waves, because these travel within the body of the earth and can be assessed at different recording stations, particularly when… when you are talking about the earthquakes, it can be recorded at global recording station. So body wave, further you can divide it as P wave, that is primary wave or compressional wave. It is called as primary because these are the first waves, which will arrive at recording station because of any kind of shock and it is again called as compression wave or longitudinal wave, because it is causing some kind of compression or rear fraction along the direction of the wave propagation. The next one we discussed was S wave, that is called as shear wave or secondary wave. Because the passage of these waves through the earth medium cause shearing in the direction perpendicular to the wave propagation, so there will be shearing, shear waves or secondary waves. So in order to, based on the kind of shock we are generating, we will be recording the resistance offered by the material, that is the surface medium, against P-wave, if you are interpreting the results in terms of P wave, secondary S wave, if you are interpreting the results in terms of shear waves. Now in addition to this, we also discussed there are surface waves, primarily Rayleigh wave, which cause some kind of elliptical motion, just like repulse in water. So particle will undergo some kind of elliptical motion like this and then Love wave, which will cause translational motion. So when we discussed about seismic reflection method, seismic reflection method, we more… we more focused on primary waves, that is P wave interpretation and then based on Poison's ratio of the material, through which the waves are passing, once you know the P wave velocity, you can classify the material and also you can determine how much will be the shear velocity. But issue here is like particularly in case of one thing, like most of the time whenever we are interpreting the subsurface medium, we are interested to find out shear wave velocity, because that is going to give you indication of shear strength of the material, which is more important as far as particularly for seismic scenarios. Shear velocity directly you can quantify for medium identification, but issue here is medium identification, but issue with body wave is like near the surface of ground

body waves have very low signal to noise ratio, or we call it as S/N, now we call it as signal, that is the vibration you are detecting based on the source and noise we call it other resource, I mean source, which… which is known to you and then you can have noise, like vibration from other sources, which are there in the surrounding region, sources from the surroundings. So when we are interested to interpret subsurface medium particularly, near surface, near the surface of the ground, that is shallower medium may be top 50 meter at depth, we are more interested to find out the subsurface medium type, if we go with primary wave or body wave based interpretation, mostly you will end up in low signal to noise ratio, that's how, whenever you do the analysis, you will face problem.
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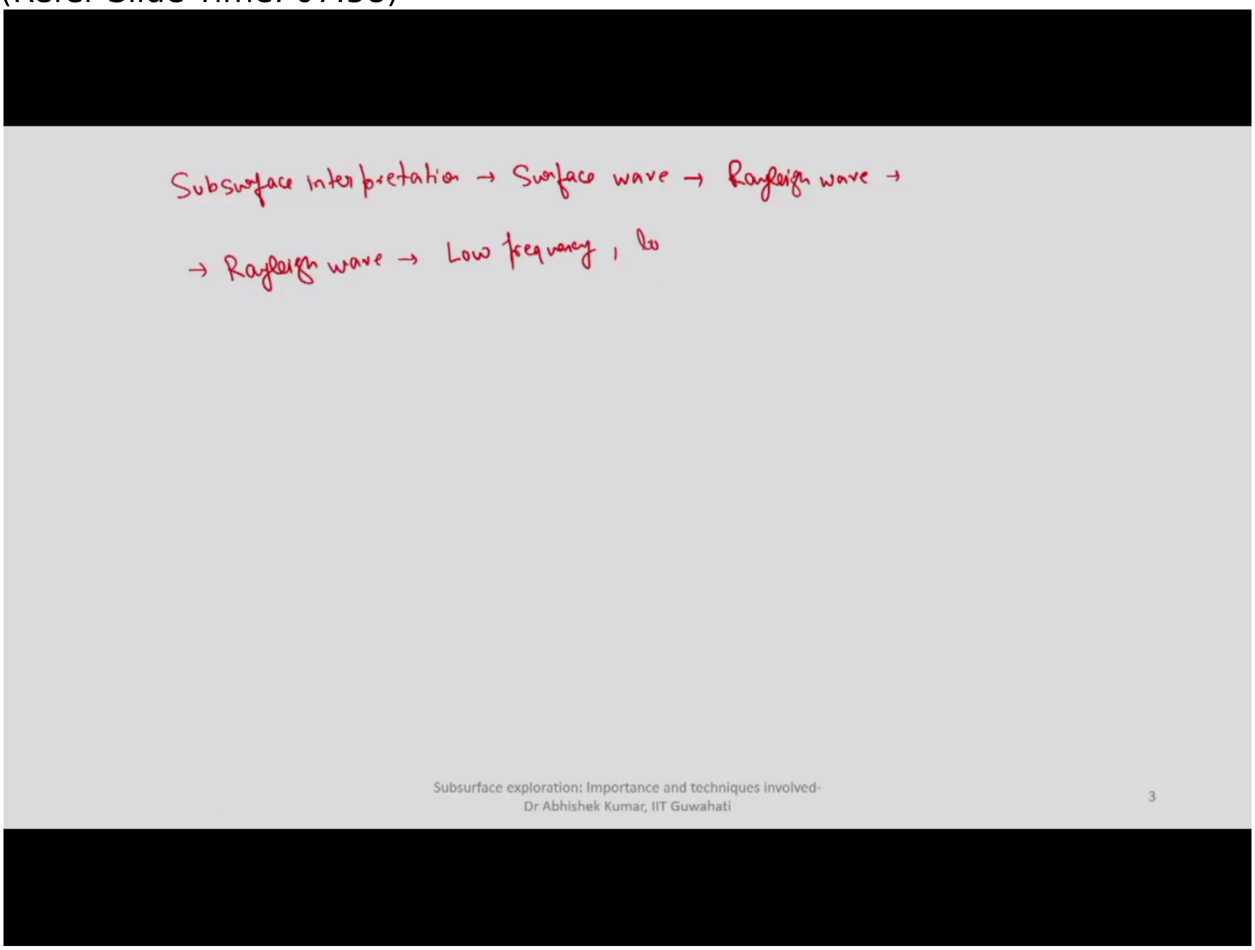

But… so the another alternate, which can be found here is, we can go with again subsurface interpretation, but based on surface waves in that further we can call it as Rayleigh wave, which contains a major portion of energy generated from the shock. So the beauty or the advantage of this Rayleigh wave is like, these are low frequency, relatively low shear… low velocity of propagation in comparison to primary wave, but with significantly high… significantly higher amplitude or in comparison to direct measurement of shear wave, the signal to noise ratio will be higher… Higher signal to noise

ratio. Further it has been observed, so these Rayleigh wave, because these are causing elliptical motion or some kind of rolling effect, these are also called as ground rolls, because… because once Rayleigh waves are passing through a medium, it is causing some kind of roll, it's very much similar to something which is rolling on the… on the surface. So it is… it is also called as ground rolls. So in many literature you often find surface wave methods to be discussed as methods which are based on the ground rolls. Now another thing, which… which I would like to highlight, see we are interested in finding out the subsurface material characteristics, I told like particularly when we go for seismic scenarios, we are more interested to find out the institute shear strength of the material or classification of the material in some parameter, which is an indication of shear strength of the material. So we precisely go for shear wave velocity, but here in case of surface wave analysis, since we are not going for directly shear wave velocity, but we are… we can actually estimate the shear wave velocity considering at low strain, at low strain, because whenever some kind of shock will be generated, whenever the wave will be passing through the medium, it is inducing some kind of strain in the material and that low strain… or lesser, it has been observated that the value of VR, that is Rayleigh wave velocity can be approximated to 0.9194 x VS, this is called as shear wave velocity. So both, when we are talking about shear wave velocity, it will be for a particular medium. So if you are having stratification, each medium or each layer will have different shear velocity and if the strain based on which you are measuring Rayleigh wave velocity, it is in… particularly on lower side as given here, you can… you will be able to find out Rayleigh wave velocity and based on this correlation you will be able to determine the value of the shear wave velocity, which is particularly for your interest and if you recall, based on your shear wave velocity or based on your primarily wave velocity, you will get an idea about what kind of medium is existing below the ground surface, because all these methods, when we go for geophysical methods or seismic methods in particular, those are… those do not get any sample and often are classified as non destructive methods. So when it is nondestructive, you are not getting a sample, you have to classify based on some parameter, which is an indication of what kind of medium is available at the ground surface or… or beneath the ground surface.
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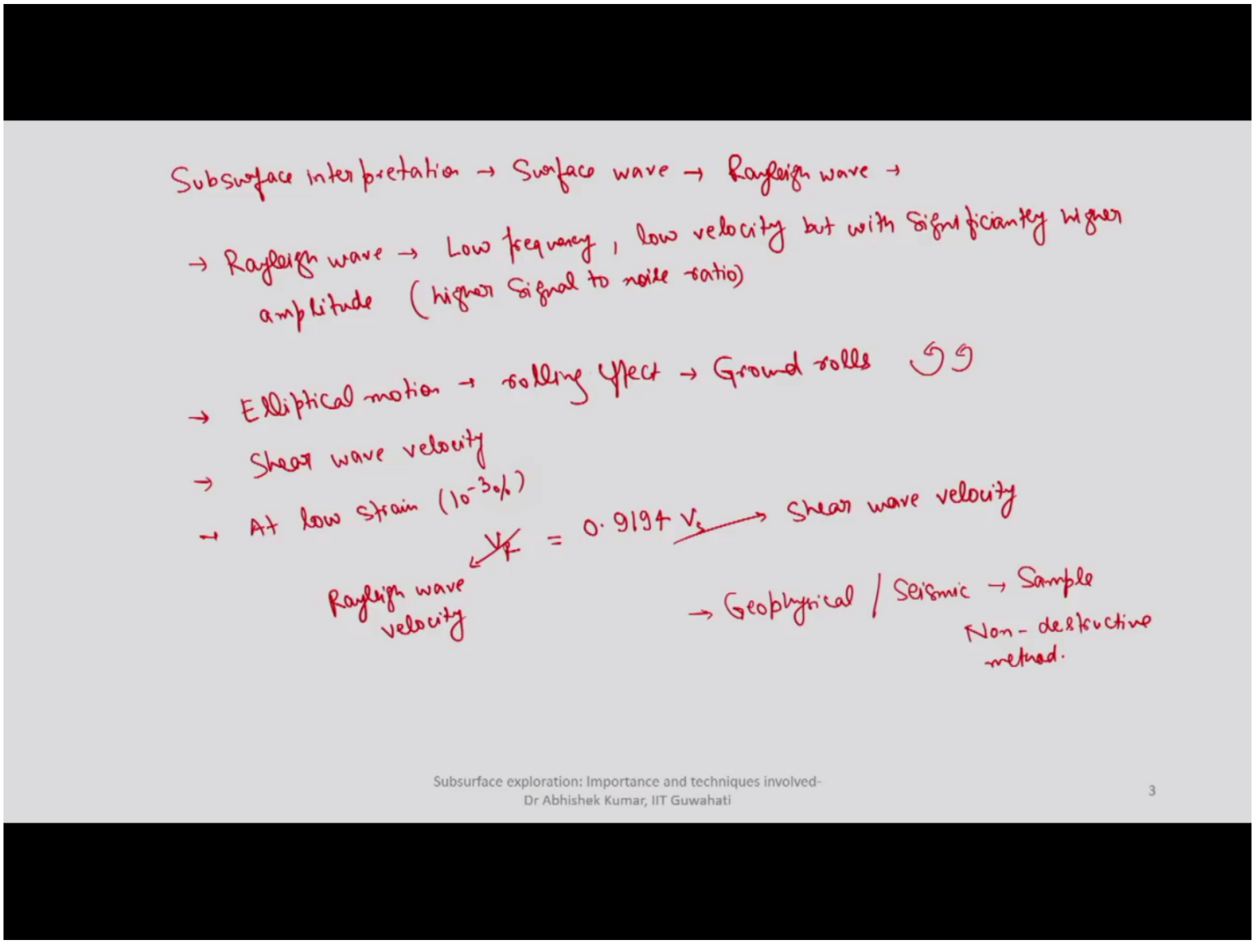

Now another thing, this value of Rayleigh wave velocity is a function of poison's ratio of the medium. So if I classify here, so VP VR/VS and this one is Poison's ratio. So over a large range of poison's ratio, it has been observed, like if we consider 1 2 3 4 5, so it has been observed, and here again I can measure different value of poison's ratio, 0.5, 0.4, 0.3, 0.2, 0.1. So it has been observed like up to a value of, if I consider here as shear wave velocity of the medium, that is, this land is indicating VS, so your Rayleigh wave velocity up to 0.2-0.25 Poison's ratio will be like this, after that it will be like this. So this is like Rayleigh wave velocity, which is approximately equal to your shear wave velocity, depending upon strain and again depending upon how much is the Poison's ratio. If you same… same way if you see the value of primary wave velocity, you will see, it will increase like this, this is called as your P wave velocity. So unless you know the subsurface medium, it will be difficult to get an idea about Poison's ratio. So that’s why it will be always better, if we are interpreting the subsurface medium in terms of Rayleigh wave velocity, because almost throughout the range of, this will come till here, nothing will be there, because beyond 0.5 it will not be possible. So… so this is going to give you, BR you can approximately consider, BR can be used. So I discussed like what is the advantage, if you go for surface wave analysis, it will be, the record will be containing higher signal to noise ratio, because… because the amplitude of surface wave particularly near the surface will be significantly higher, in comparison to, if you directly use your primary wave or shear wave velocity. So when we go for surface wave method… method we are interested to find out BR value. So based on your field record, you will be determining your Rayleigh wave velocity, it can be further used, it can be used to estimate shear wave velocity. Again based on your shear wave velocity, it can classify your subsurface medium, that is… this is the objective of your site investigation program. You have to classify what kind of medium is there, what are the different thicknesses of the medium are there. So based on your VS value, suppose VS value is 180 m/sec, I can classify the medium as soft medium, similarly if it is greater than 1500 m/sec, I can call it as weathered rock, or very stiff soil. So that’s how standard classification charts are also given, based on VS value, where you can classify your subsurface medium. In addition to this, this is going to give you your surface wave method. How I mean, the Rayleigh wave velocity profile or equivalent to that the shear wave velocity profile, like at different-different depth.

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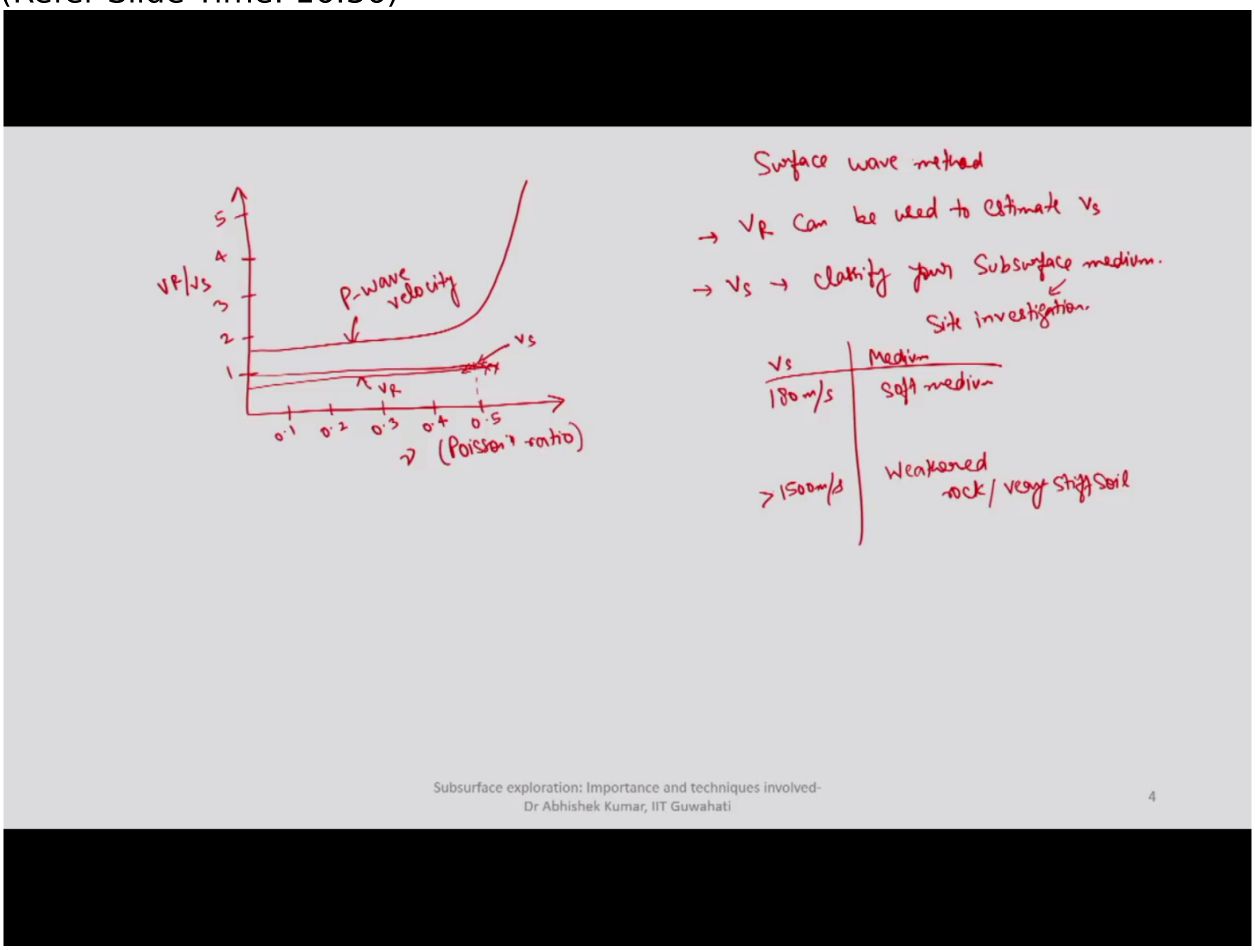

So based on this classification of this different material, based on the range of shear wave velocity, you can, you will be able to identify, what are the

thickness of may be soft medium, what are the thickness of weathered rock layers and so on and so forth.
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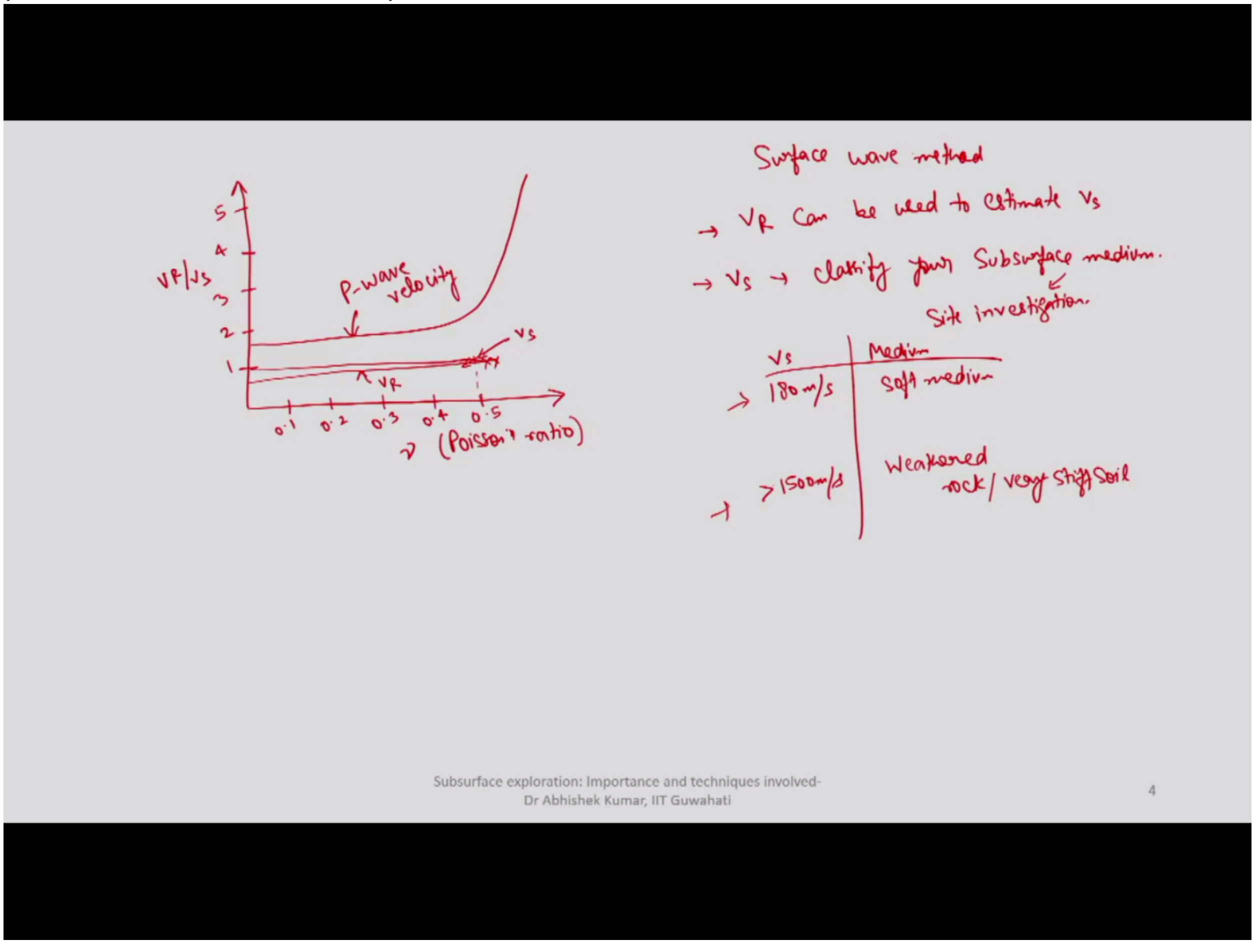

Now one important observation, one important characteristics, which we are going to discuss here is dispersion. Dispersion of wave. So what dispersion says in a homogenous first of all, it's like, based on your shock, which you are causing at your source of vibration, that will be having different frequencies like there can be lower frequency, there can be higher frequency also. If I say, maybe one shock here, equivalent to that, if I determine, how much will be the frequency content here, may be it give you some value like this. So this is like frequency and this is the amplitude, you can get based on your, possibly your transformation, how much is the frequency content. So this is going to give you what is the frequency content of that wave and what is the amplitude of each frequency content here. Now what happens, so this is like… this is at the source, I can say here. But what happens, particularly when your medium is dispersive in case of… in case of homogenous medium. Like the medium characteristics are not changing throughout the volume of the subsurface material, what will happen, the frequency content will not change, or what I mean to say. So there will be like different frequency waves, different frequency, I can call it as may be harmonic waves, different frequency, but harmonic waves will be there. So if you are going with… if… if a source, which is creating summation of different frequency harmonic wave, that is the kind of random vibration here, if you are generating it, and if it is…. If you are allowing it to pass through a homogenous medium, what will happen, the frequency content of the wave will not change, that is each wave or each frequency content will travel at same velocity. So when each frequency content is going to travel at same velocity between your source and site, which may be a certain distance away. If you put two receivers here or two geo phones, which can detect. So the kind of vibration you are seeing at the source, same thing you will be receiving at the site also, because the frequency content of each harmonic motion will remain same, like the frequency of the… the propagation velocity of each frequency content of wave will remain same, so same thing will be, same, I can call it as wave content at the site. So it's not going to change. Now this characteristic is particularly in case of homogenous medium. So the medium in which all frequencies travel at… travel at same velocity, such a medium is called as, again I am talking in terms of, velocity in terms of means Rayleigh velocity, because we highlighted the advantage of Rayleigh waves, so now onwards I will be discussing out the advantages and interpretation of Rayleigh waves. So this is like, or in general like surface wave. So same velocity, the medium is called as… is called as non dispersive medium. So it's not going to change the frequency content of wave, it's not going to change the propagation velocity of each frequency content of the wave. It is called as non dispersive medium. However, on the other hand, this is about non dispersive. On the other hand there can be a possibility that the soil is having heterogeneous medium, we will go in further detail here, like soil layer 1, soil layer 2, and so on you will be having, so these are adding some kind of heterogeneity and this is even within one soil layer, may be the soil property is not constant throughout the depth, because here I am classifying based on average resistance offered by the material, in terms… against the shock. So this is called as the heterogeneous medium. What will happen here, in this medium if you put a source here, and a receiver here, the frequency content at the source and receiver will be different, that is frequency content or I can say like for spectra, that source and receiver, because finally you will be interpreting the results received on the receiver, at receiver will be different, which is an indication of different frequencies of waves or wave content I can say, traveling at… at different velocities. So this characteristic is called as dispersion, which is giving an indication like different frequencies are travelling at different velocities, dispersion, and why it is happening, because medium is heterogeneous. So dispersion, I mean, when the same frequency content is propagating from one medium to another medium, it's, the frequency of, the velocity of, at a particular frequency wave content to travel, may increase, may decrease depending upon the physical properties of second layer, third layer, and so on and so forth. And accordingly this will affect your time of arrival of each frequency content at your receiver. So because the time of arrival of each frequency content is changing, you can call it as, like different frequencies are traveling at different velocities. This characteristic is called as dispersive characteristic and it is indication of the medium is not hetro… is not homogenous, or moreover it is like heterogeneous medium. So this characteristic is against Rayleigh wave and it is indication of heterogeneity present in the medium.

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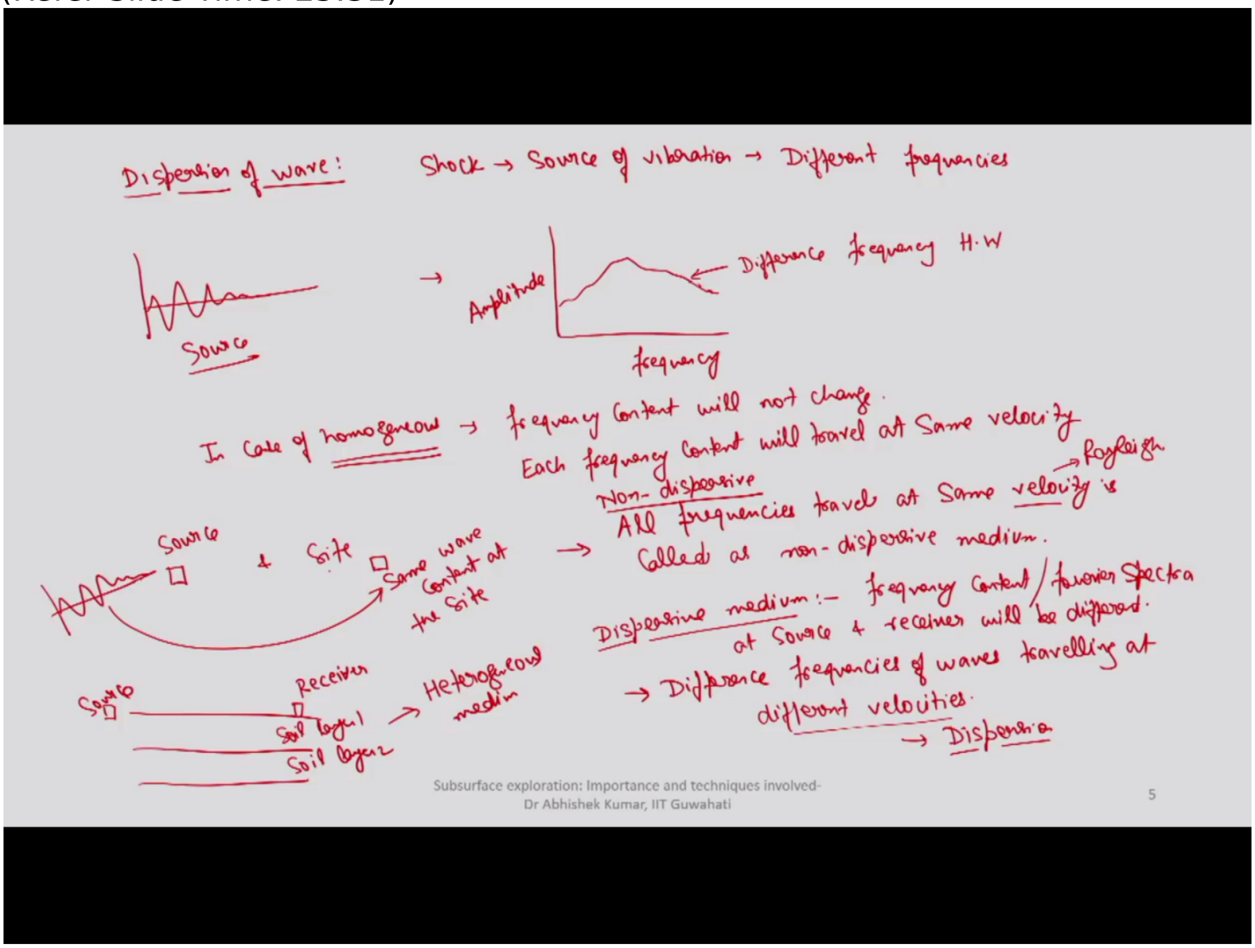

So in surface wave analysis or in precisely Rayleigh wave analysis, when we go for, we are interested to understand that dispersive characteristics of the medium, which has been identified, which has been seen based on source frequency content and based on receiver frequency content, and if you… if you are able to interpret this dispersive characteristic, we are interested to find out the corresponding medium, which is inducing this kind of dispersive characteristic to your shock content. So when we go for, again let me tell you, medium is heterogeneous, as a result of which it is causing dispersion in wave content between source, between the source and the site and the receiver. So in case, in surface wave analysis, if we can determine dispersion characteristics of the medium, we will be able to approximate or we will be able to find, this will lead to find out, finding out the possible stratifications, which is leading to above heterogeneity or above dispersion. So heterogeneity is causing dispersion. Once we know that dispersion, we are trying to find out, what heterogeneities can cause dispersion, rather than dispersion to heterogeneity, particularly when we go for surface wave analysis, that's why we go for inversion analysis, that we are going to explain later. So inversion analysis is going to give you, what equivalent characteristics of ground can give you this dispersive characteristics. So if we consider that the strength properties, shear strength properties, or I would in general like stiffness increases with depth, what will happen, this will lead to lower frequency content… content, which will be corresponding to larger wavelengths, that will be propagating deeper depths, deeper layers having higher stiffness as a result of which, what will happen to the propagation velocity, the velocity of Rayleigh wave propagation of, propagation of Rayleigh wave will increase, same will be applicable to all the frequency content. So if we plot this thing, this thing for a particular medium, you can call it as, so when we go for collective understanding of dispersion, we call it as dispersion curve, which is going to give you how the frequency content or how the velocity of each frequency content has been govern by particular stratification, which is available at the site. So you can get may be something like this, which is going to give you, so on this, we will be having the phase velocity and on this side, that is on X axis you will be having your frequency content. Now it is going to give you, corresponding to this phase velocity, what is the on an average, the propagation of, I mean on an average the propagation of this frequency content, this is going to give you an indication corresponding to this frequency what will be the wavelength and corresponding to that wavelength, what depth you are actually trying to interpret on an average. So the overall, it is going to give you, because if you go for point number 1, it will be having some component from shallower depth and some component from deeper depth. If you are going for higher frequency content, this will be more dominated by the content or the content of modification coming from shallower depth. So if I go here, we can call it as deeper depth, dominated, this will be like shallower depth dominated, which can be understand from, corresponding to this, what will be the… considering the same, I mean like for each medium, we will consider same value of shear velocity or Rayleigh wave velocity, it will be, so higher frequency content will be indicating the lower wavelength or that is shallower depth, shallower depths dominating and so on and so forth. So this is called as dispersion curve, which is the characteristics of, characteristic of medium heterogeneity… heterogeneity. So in surface wave analysis, we are interested, again repeatedly I am telling, in surface wave analysis, based on the dispersive characteristics of the medium, we are interested to find out what is the medium heterogeneity. Now let's discuss this dispersion in more detail.

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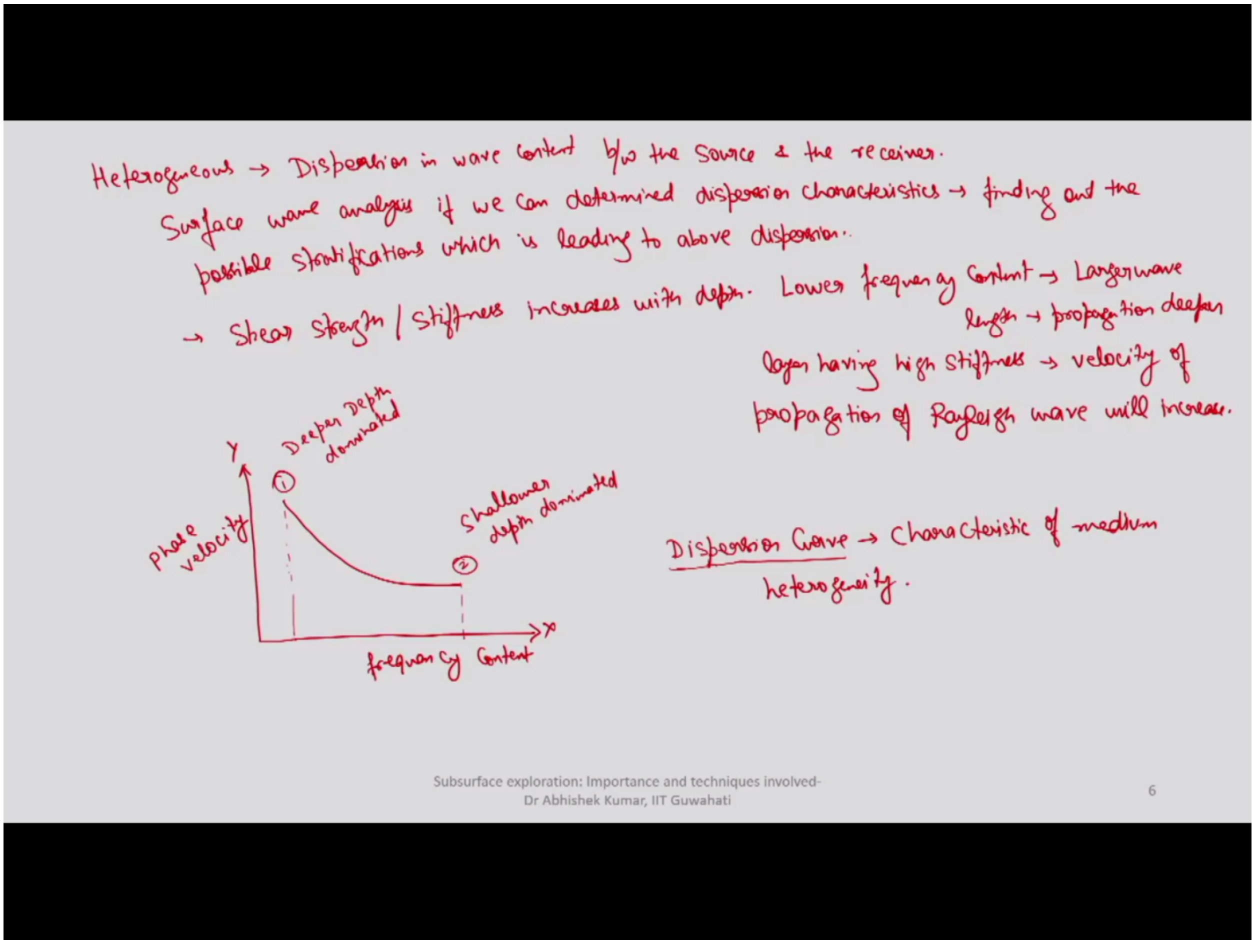

So in order to start with this analysis… with this interpretation, because heterogeneity, so that means, your medium is like multiple degree of freedom system, MDOF system, MDOF system. So I am going to write here about MDOF system like this, any MDOF system, I have taken as like 5 degree of freedom system. Now any MDOF, any surface wave propagation should satisfy three cons, which are… So what are these three conditions, first of all satisfy equation of motion, equation of motion, second should produce… produce 0 stress at free surface and 0 displacement at infinite depth, because of confinement. So where there will be some stresses, but there will not be any displacement at infinite depth. So it is causing some displacement at greater depth, but as you come near to the surface, because it is a free field condition, so stresses will be 0, infinite depth, it will be significantly, I can call it, there will be increase in the stresses and then of course it should satisfy your, this condition. So if I consider here like five masses, M1 M2 M3 M4 M5. If you go with this system, it is definitely indicating system with… system having 5 degrees of freedom. I am just saying here like, you can consider that equivalent to, may be different layers of soil and at the center of that particular layer, the masses content. So I am just showing you, because of any kind of excitation, which may be because of wave propagation, how much displacement will be there. So other physical

properties of the system will remain same, but what we… we can understand here. So the, possibly the system, because it is this, so possibly such system… such system will have 5 degrees, 5 natural frequencies corresponding to each mass and it will dominated and that’s how you will be having collectively five natural frequencies here, one will be corresponding to, while one frequency, one frequency at fundamental mode, others will be at, will be corresponding to higher modes. So based on the stiffness and M1 M2 values, you will… can determine corresponding what will be the fundamental mode and what will be the higher mode values, okay. So if you consider each of these frequencies, each of such frequencies can be determined as… as omega N= twice omega knot sin N Pi over two times N+1, where omega knot = root KYM, indication of fundamental mode frequencies. So this you can call it as equation number 1 and same way maximum possible frequency based on this, maximum possible frequency, omega N can be equals to twice omega know. Now if you consider corresponding to this what is the wave number, if I call it as K as wave number. So in general KN can be classified as twice Pi N over L, this is called as equation number 2. So from equation 1, equation 1, it can be understood like omega N is not varying linearly with N. So as more and more degree of freedom keeps on increasing, it's not varying linearly the frequency corresponding to each, the natural frequency corresponding to each mode of vibration, it's not varying linearly, however… however, based on equation 2, based on 2, the value of KN varies linearly with N, okay it is varying linearly with N, as we can see from equation number 2.
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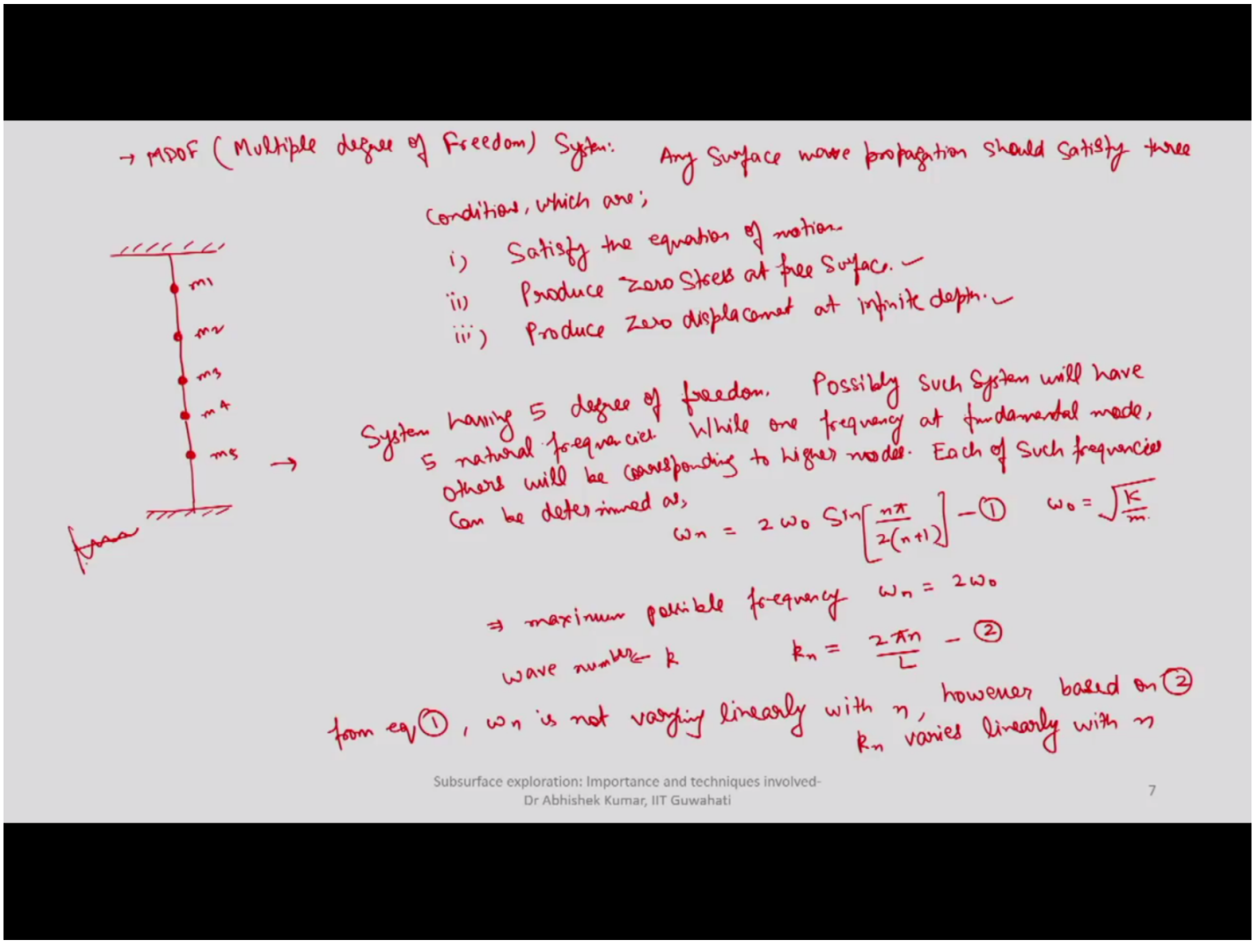

Now if you go here further, the propagation velocity, propagation velocity of Rayleigh wave can be defined as BR, which will be equal to omega N over KN, where omega N is angular frequency and this is your wave number. So depending upon the ratio of omega N and KN, one can get to know what will be the Rayleigh wave velocity in the medium, particularly where KN is the wave number or the case of string, as we discussed in last slight, the string which is actually fixed at both ends. Now same way in case of multilayer system, if you consider, considering the motion is also having different frequency content as well as the medium, the sub surface medium is also multiple layer, so this will be equal to K1 K2 K3 K4, different, so each is resembling different portion of wavelength and this is omega 1, omega 2, omega 3, omega 4, omega 5, omega 6 and so on. So if you take in… particularly in case of dispersive medium, dispersive medium, subjected to wide range of frequencies. So how these wide range of frequencies by means of shock waves, or shock, which are… you are actually generating by means of hammer impact. So what will be the response of MDOF system, it can be like this. So if you join these, based on equations, we call it as equation #3, one can understand how much will be the propagation velocity here of Rayleigh wave. So consider, for example, in case of six layer system or in case of five layer system, N=5, so we have V5 at the Rayleigh wave velocity

at layer 5 will be called as omega 5 over V5, which will be lesser than, as per figure, which will be V3 over... V3, which is omega 3 over K3. Collectively it's like, it's like depending upon the dispersive characteristics of the medium, dispersive characteristics of the medium, it may be possible, like a higher frequency content, a higher frequency content may travel at higher or may be lower velocity, both are possible depending upon the dispersive characteristic of the medium, or may be lower velocities in comparison to, in comparison to lower frequency content. So this content of lower and higher, I am telling in terms of the frequency content of the shock wave. So remember, like the dispersive characteristic, dispersiveness is the characteristics of multiple degree of freedom system, that is more precisely we can call it as multiple layer system or sub stratification. So as per stokes, the Rayleigh wave disperses, disperses only when wave length, when wavelength is 1 to 30 times the layer thickness. So in this case it's only the Rayleigh wave, which we are actually targeting to recall or to... we are trying to understand the dispersive characteristic of the Rayleigh wave, so that we can, one can get to know, what is the subsurface medium characteristics. So this dispersive characteristic will be only shown when the... the wave length is 1 to 3 times, 1 to 30 times the layer thickness of the soil.
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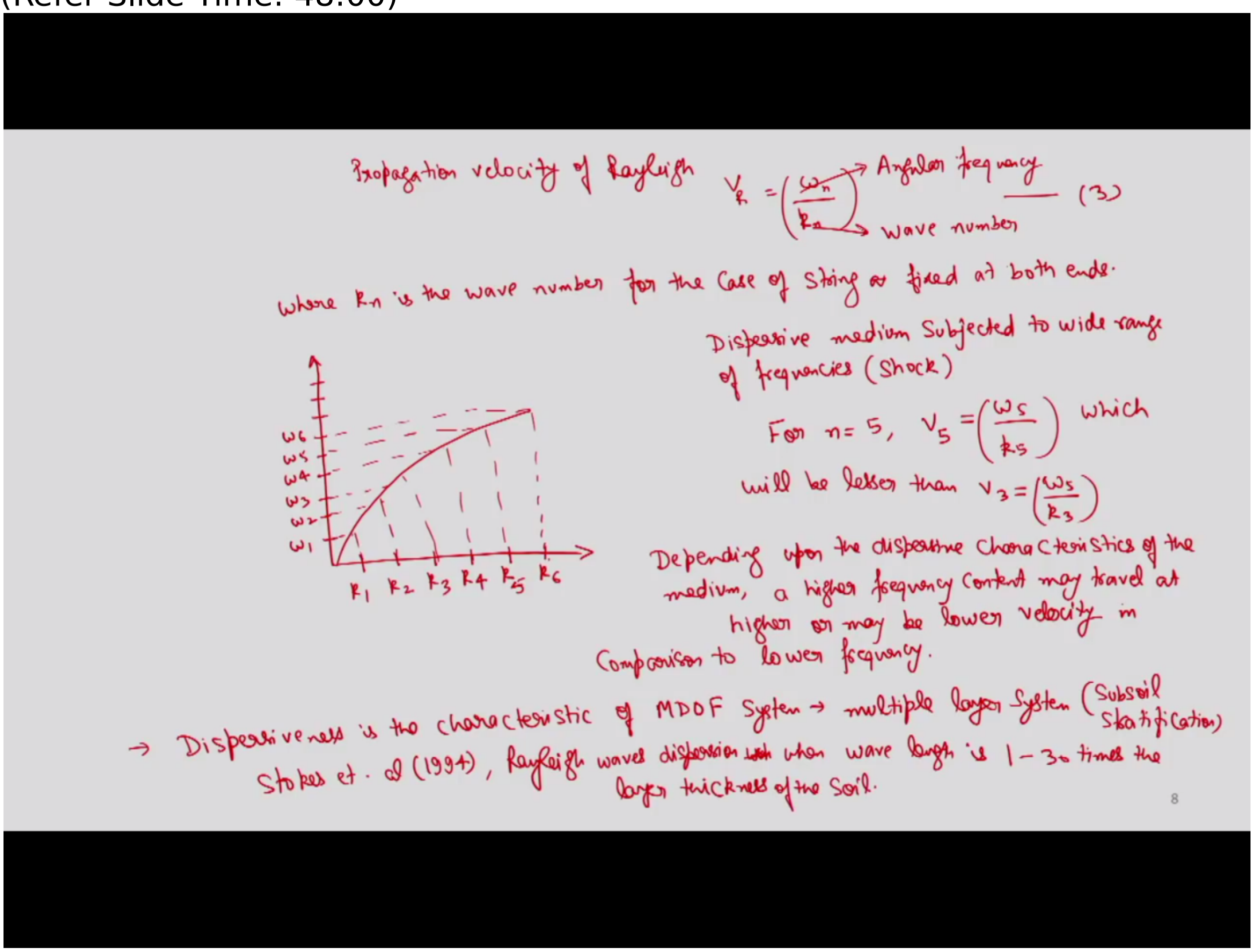

So that’s how we can get an idea like, what will be the layer thickness and corresponding to that what frequency content or what wavelength is going to undergo any kind of dispersion, particularly analyzing the Rayleigh wave velocity. So we… we, because I discussed about dispersive characteristic, which is shown here, dispersive characteristic shown above is in case of heterogeneous, yeah, like MDOF system, system, and in this case, we are interested, I mean, particularly when we go for subsurface exploration, we… this MDOF system is, you can consider as multiple layer… layers of soil. So that’s you are interested to find out based on the dispersive characteristics.
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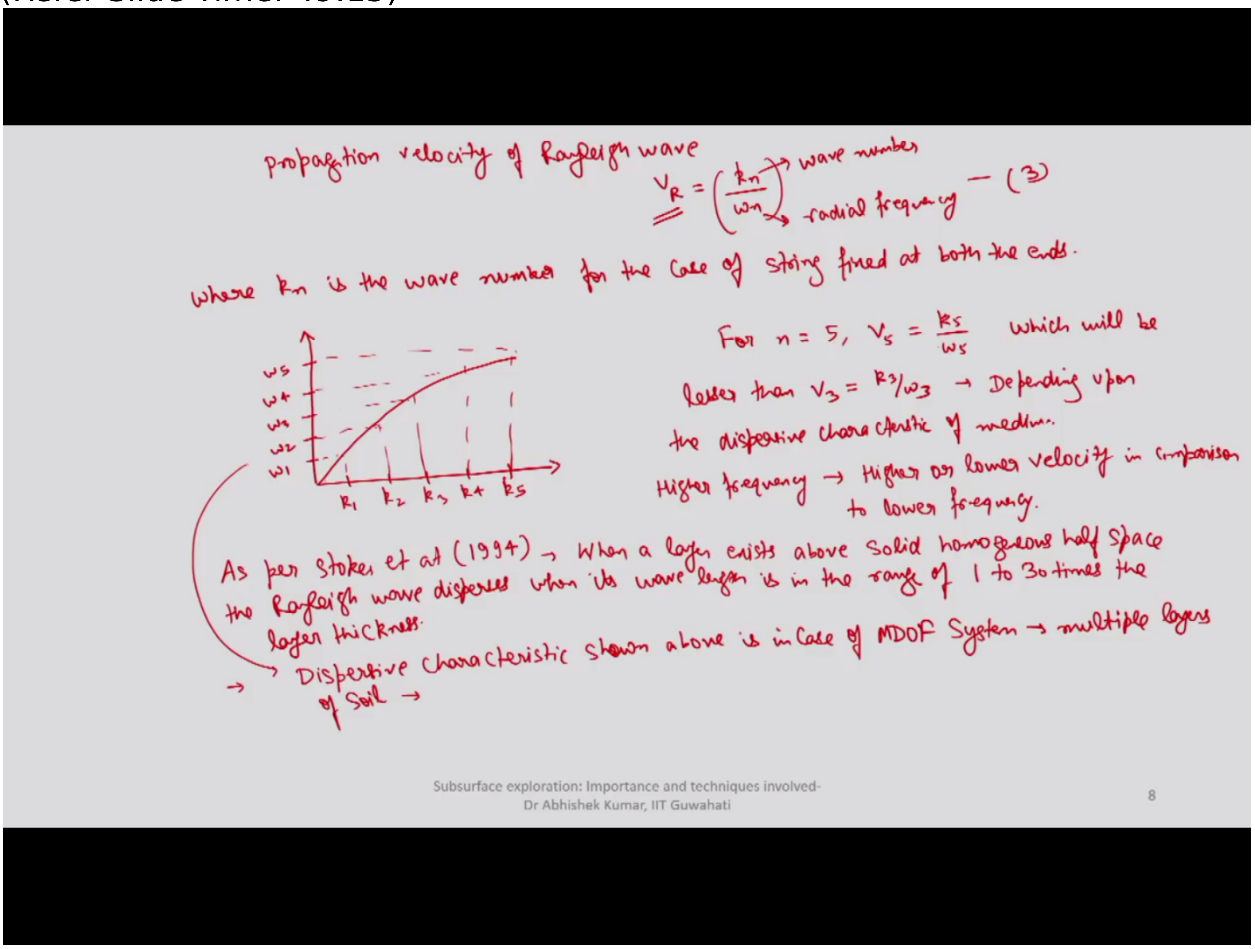

Now we… we will see how this dispersive characteristics changes with respect to the depth. So if I put it here, amplitude at depth Z to amplitude at surface, again this is causing two kinds of motions, one may be vertical component and one will be horizontal component. So I am going to give you here, this is like 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, and same way here also we can have 0.2, 0.4, 0.6, 0.8, 0.2, 0.4, 0.6, this is like minus 0.8, so this is like, again so with 1 if I start, again on this side you will be having 0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, it's not on scale, so be careful with that part. Again so start, it is showing… it is going to give you with respect to depth what different poison's ratio material, how, it should be different here, it should be like this.

So this is about vertical component of wave and this is Z over Lambda R, that is wavelength, if you are making in comparison with respect to the depth, this will be like minus 0.4. So this for horizontal component should be like this, this is like horizontal component of… Now this is varying because of change in your Poison's ratio, this is for Poison's ratio of 0.5, this is for Poison's ratio of 0.4, this is for Nu = 0.25. Similarly here also this will be corresponding to 0.25, 0.33, 0.4, and 0.5. One important observation to be drawn here, it is like, if you consider a particular wavelength or particular wave, as you are going deeper, that is she you are going, as the Z value increases, Z is like dept from ground surface… surface. So if you are interested to, if you are… if you target for one particular depth and try for different wavelength, so as the wavelength keeps on increasing, the value keeps on decreasing. So that means you can say like, with increase in wavelength, in wavelength, that is you are going towards this, like there will be increase in Z by Lambda R value, the amplitude of wave… amplitude of wave will increase at same depth. On the contrary if you target keeping Z constant, second thing keeping Lambda R as constant, like for a particular kind of wave… particular wavelength, if you are observing that with respect to the depth, you will see the amplitude is… amplitude of wave decreases with depth, with increase in depth. So that's how, Rayleigh wave velocity, though the amplitude is significant at the ground surface, but as you go deeper and deeper, the… the signature of Rayleigh wave to be detected by any sensor, it will be relatively less. So amplitude of wave decreases with increase in the depth. This is same way it is applicable for, so this is indication, so this is… So one I discussed about the dispersive characteristics, second, here I am trying to show how the amplitude of the wave, because finally your detection of the wave, secondly your signal to noise ratio will be govern by the amplitude of the wave. As you can see from this figure, the amplitude of the wave. So this is like at any depth, if you put, how much of the amplitude is going to increase or decrease with respect to the amplitude of the surface. So these are ratio like this. So whenever it is reaching 1, it means at that particular depth, the amplitude is almost equivalent to the amplitude which was recorded at the surface.

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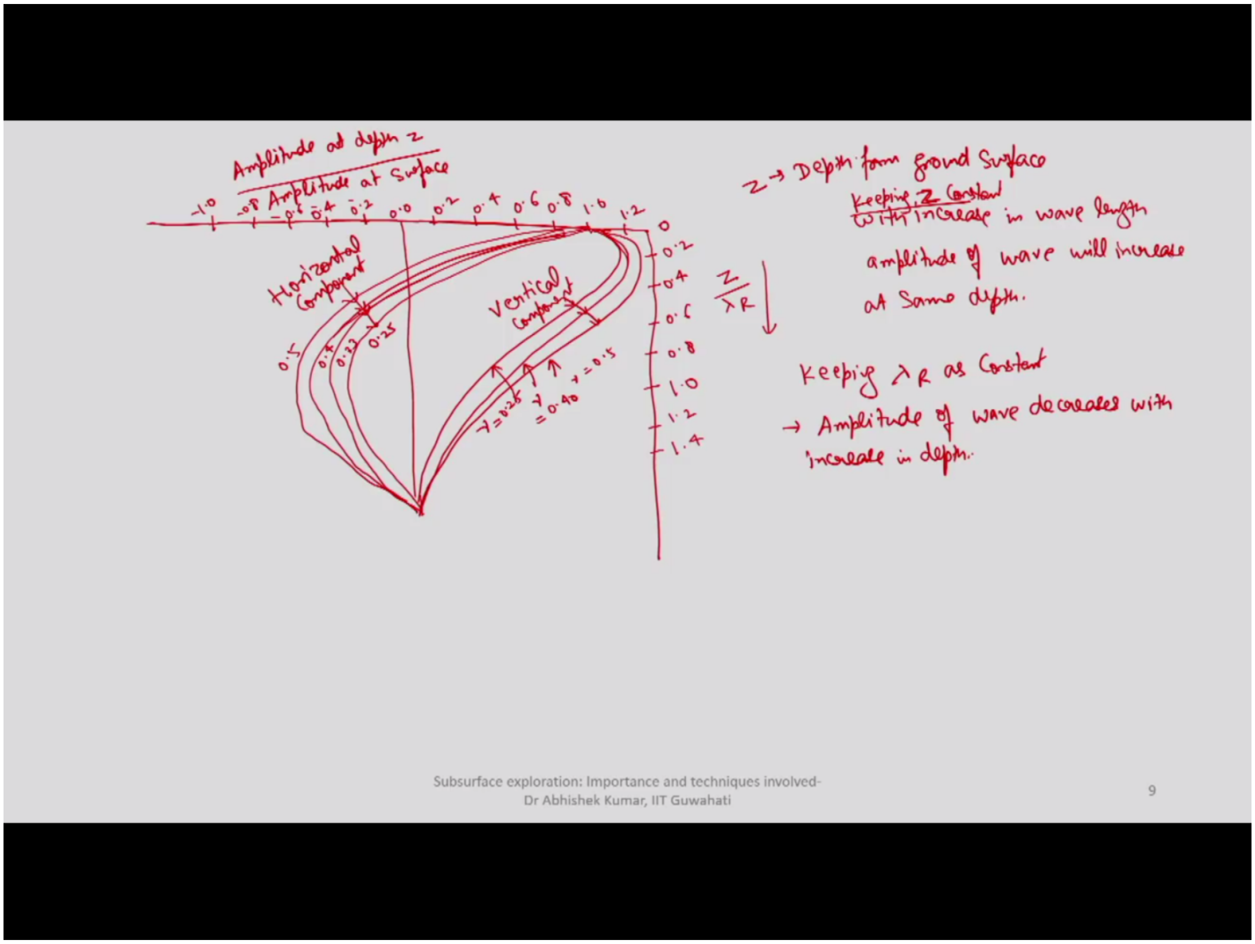

Now another important thing, so we discussed about what is dispersion and then we discussed about change in amplitude with depth… amplitude with depth. Remember dispersion is a characteristic of heterogeneous medium considering Rayleigh wave. So whenever I am telling dispersive characteristic in case of heterogeneous medium, I mean for Rayleigh wave. So this is about the background. So when we go for surface wave analysis, what are the advantages, yes advantages also we had discussed, advantages of using surface waves… surface waves in interpreting near surface medium. So we started with this, then we went to what is the characteristic of wave in heterogeneous and then what will happen, if you observe the, if you try to record the wave at different-different depths, what will happen there. Now two methods precisely, the objective of introducing this to this course, this topic to this course like more commonly, in like forensic investigation in micro examination studies, even in quality control also, when… when I discussed about the advantages, the surface based geophysical methods are becoming more and more common. So one is like MSW survey, that is multiple channel analysis, multi-channel analysis of surface waves and the other one is SASW that is like spectral analysis of surface waves. So in this, the first one we try to find out the dispersive characteristics over multiple frequencies or multiple channels… channels using multiple number of geo phones… geo phones or sensors. That's how you will be able to identify at the same time, based on your signal to noise ratio, which is the fundamental mode, based dispersion curve from your field record… record and what are dispersion curve at…. And dispersion curves at higher modes. In spectral analysis of surface waves, we… we try to understand the dispersive characteristics… characteristics are at rest using a pair of geo phones, that's how you will go for multiple recordings… recordings with varying geo phone interval, varying geo phone distance… distance, this will help. So the identification of fundamental and higher mode… fundamental and higher mode will not be possible, or will be difficult, based on one record and hence multiple records, recordings are… mandatory.

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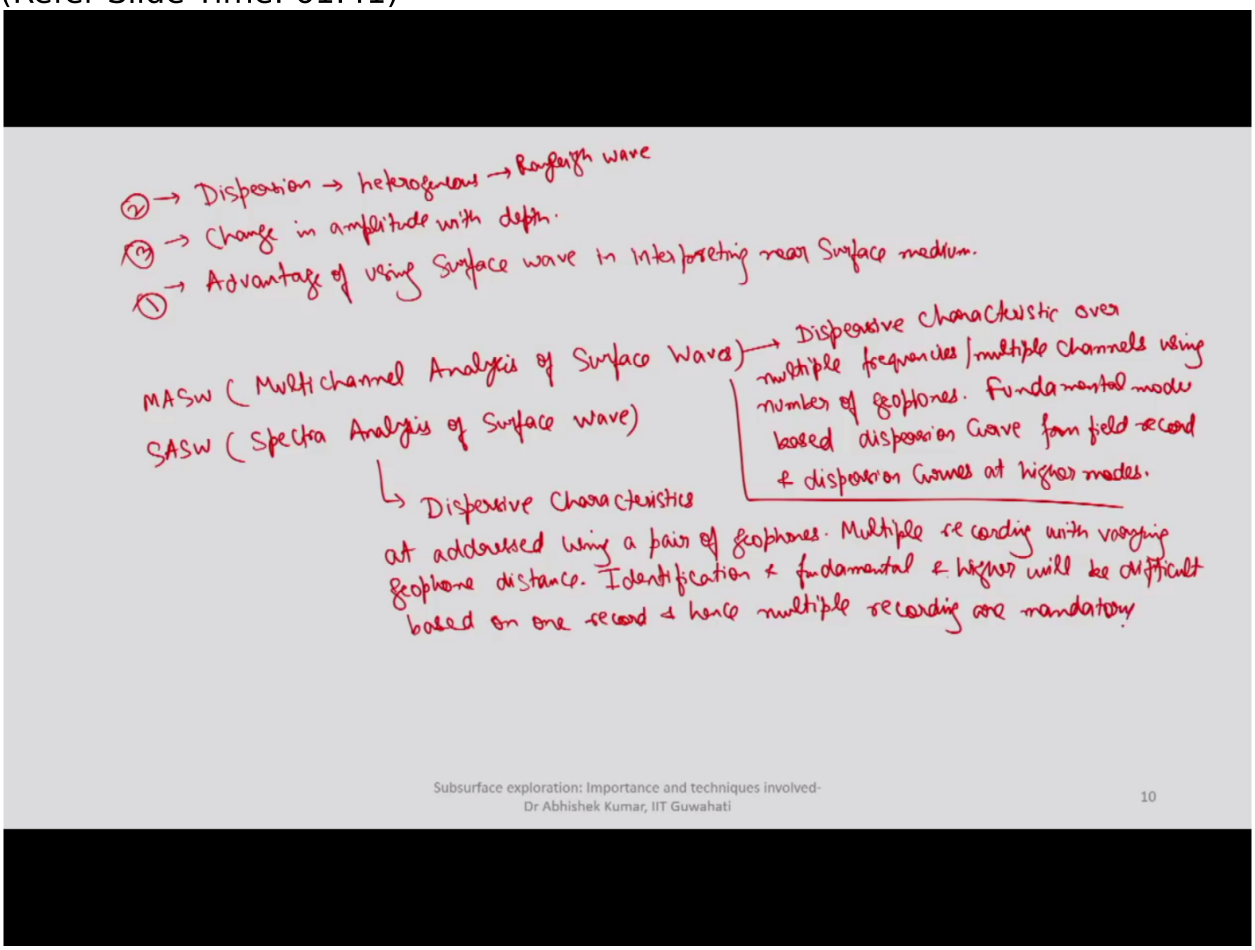

So this is like, there can be more number of discussions, based on MSW survey, based on your SASW survey, but this is like more precisely in multi-channel analysis, we put number of geo phones and we try to find out the dispersive characteristics over wide range of frequencies, that will help you once you see this dispersive characteristics in terms of signal to noise ratio also and in terms of, okay… in terms of signal to noise ratio that is help you in identifying, which is the fundamental mode and which is the higher modes. And second one spectral analysis of surface waves, we go for this interpretation in terms of two frequencies, Okay one important and last parameter here is enter test consists of field recording, that is based on geo phones, you will put and try to record. So shock waves recording, then dispersion curve, dispersion curve from filed record. And the last part is determination of shear wave velocity profile or Rayleigh wave velocity profile based on inversion. It is called as inversion, because you try to approximate or you try to find out based on… you take an initial earth model and based on this model find out theoretical dispersion curve, try to match with experimental dispersion curve, dispersion curve obtained in part 2 and then if it is not matching, then update… update your theoretical dispersion curve and then compare with, your experimental dispersion curve. So unless based on your R square value also you can get. So it's like every time you keep on updating your theoretical dispersion curve, till it matches with your experimental dispersion curve and once both are matching, once matching corresponding to theoretical dispersion curve, obtained at the last of the iteration, you will get your shear wave velocity… velocity profile… profile that is with respect to depth, shear wave variation… shear wave velocity variation with depth, that will identify stratification details. So this is more… I tried to give here, an overall idea about what is the surface wave method, what are the advantages, when we go for surface wave method in comparison to body waves, then overall what is the characteristic, based on which surface wave, see heterogeneity in the medium. If that characteristics, that is called as dispersion characteristics or dispersive characteristics, if based on method we are able to identify that dispersive characteristics. Based on field record, we will be able to find out, equivalent to that field based dispersive characteristic, what are the stratification details, okay. So that is all for today.

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