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Theory and Practice of
Non Destructive Testing

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Eddy current testing – 3

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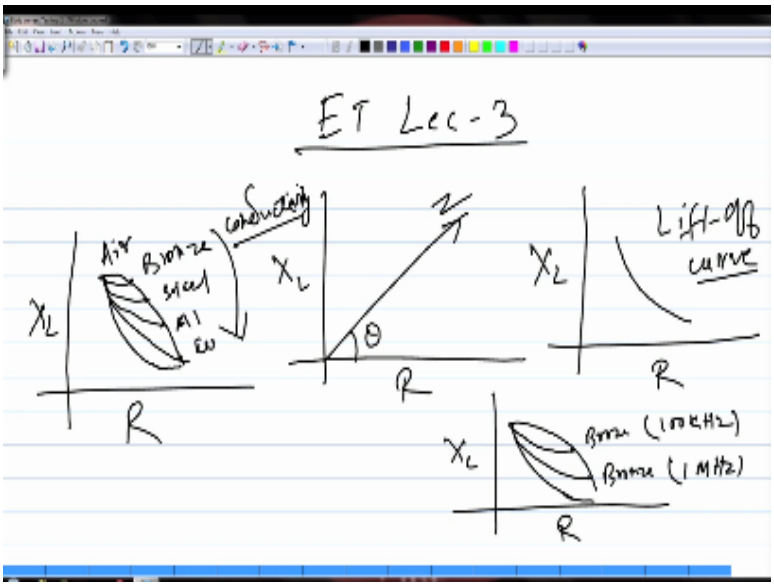

So in the last class we have seen this we derived this impedance plan and then based upon this we have derived a curve which is known as the lift of car and as I said this will be the basis for eddy current testing we also saw what will be the effect of sample conductivity on this liftoff so if you have liftoff curve like this so this is air and then if you use samples of different

conductivity like let us say to have bronze then you have steel in the order of increasing conductivity you will get this data points then aluminum and copper okay.

So if you join these points you will get a curve like this okay so it is the conductivity car this also is also as you increase the conductivity you are drawing more and more energy out of the coil and as a result the increase in the R will be more this conductivity curve is obtained because for different materials the lift of curves will be like this and if you join the endpoints of them you get this conductivity car as you could see so this is the effect of conductivity.

That is also we saw and one more thing probably I could tell you here which is the effect of the frequency of the current which is used in the coil and one more aspect about this effect of conductivity and combined with the frequency is that if you have a sample let's say I have bronze and if the frequency is 100 kHz you will see the lifter curve like this. If you increase the frequency to 1 MHz you can see the same sample behaving like a more conductive sample okay. So this is just to tell you that the frequency would also have some effect on the conductivity car or the lift of car.

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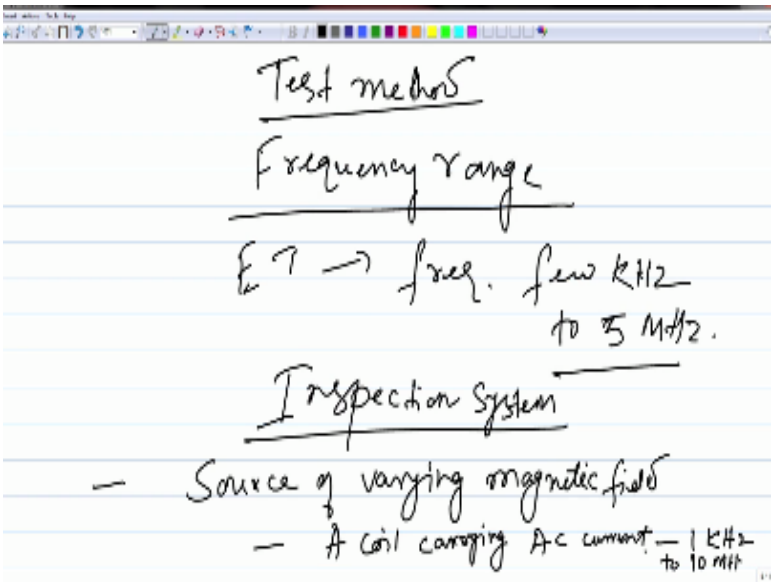

So now let us see how this can be used to do ad current testing so let us talk about the method of doing eddy current testing and see what kind of equipment and probe you need so let us first talk about the frequency which is used in the coil because all you need in this case to do eddy current testing is the source of alternating current that means the probe that you have in eddy current testing is nothing but a coil which will carry this alternating current okay.

And there is a particular frequency range in which this is used so we are talking about testing the thought so in case of etiquette and testing the frequency varies between few kHz to around 5MHz okay, so this is the frequency of the alternating current that is being used for eddy current testing so if you talk about the inspection system now which is used for doing the test so as I said the first requirement is what you need is a source of varying magnetic field because that is what generates the induced current and this is provided by a coil carrying alternating current.

And the frequency of this current can be anything between 1 kHz to 10MHz are depending on the situation you could select from this frequency range so the probe that you have as I would have told before also primarily contains a coil which carries this AC current and then of course you need the sensor.

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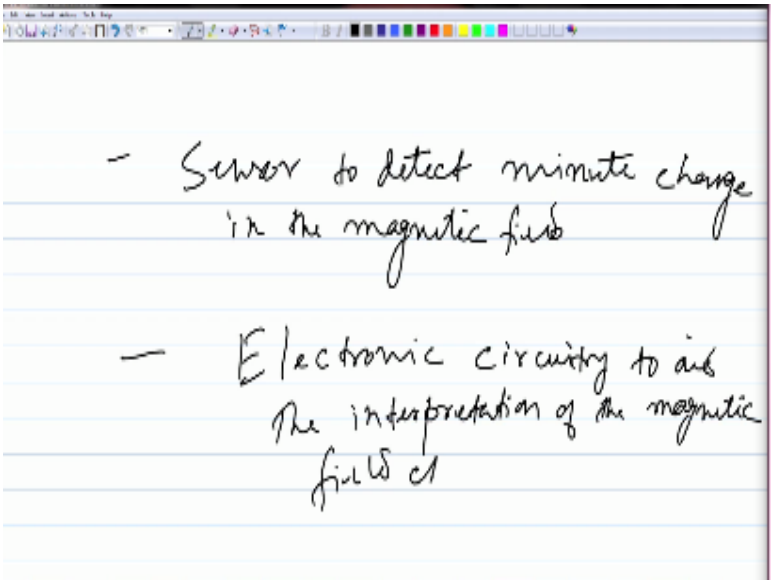

To detect any change in the impedance of the coil as we have already discussed this change will be generally very small, so the detectors would be able to detect this kind of minor changes so if there is a change in the coil in the impedance so there will be a change in the current also and as a result there will be a change in the magnetic field which can be detected by the sensor which is used.

And of course you need this electronic circuit to do that detect that change and then give you a signal which can be seen on the screen and based upon that signal you take a call whether there is a defect or not so you need this electronic circuitry to aid the interpretation the magnetic field change I would have said this before also this technique and some of the other entity technique the indications are indirect like what you have seen in case of dye penetrant testing and magnetic particle testing the indications are direct you see that defects visibly on the surface but in this case the indications are indirect.

So they are subjected to interpretation in terms of a change in the magnetic field and based upon that change this electronic circuit should give you a signal that you can see on the screen and then that has to be interpreted in terms of a effect so this is all you have in the inspection system you have a small probe which contains this coil which carry the AC current and then you have a small box which will have all this electronic circuitry and it will also have a small display an Aussie low scope kind of display on page you can see the impedance plane.

You can see the lift up car and if there is a crack or any other kind of defect you can see that defect signal as well so this is a very handy system a very small portable system all you have is a small box which contains all this electronics display and so on other things and in that boxes o you can to that box you can hook your probe you can connect the probe to that box and you can connect it to a power supply and there are systems also which can run on battery okay so this is a very handy portable system which can be carried anywhere and you can do eddy current testing you know anywhere in the lab outside the lab or on-site okay.

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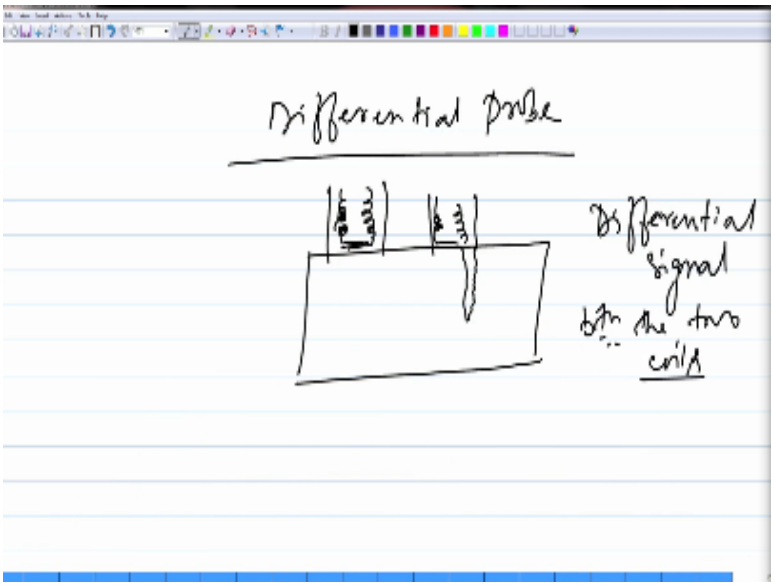

So now if you talk about the probes there are different kinds of probes depending on what kind of sample you have and what exactly you want to inspect depending on that you could choose one of these categories so let us talk about the eddy current probes the first one that we have is known as absolute probe this consists of only one coil which will carry that current okay, so it has two coils in the same housing and when you move it on the sample surface let us say there is a crack over here when it is when the probe is on a defect-free region.

Then there will be no signal between these two coils or if both of the coils are on the defect then also there will be no differential signal between them because both are at the same location and receiving similar kind of signal but whenever there is like this one coil over the defect and another coil is not directly over the defect like this then a differential signal will be generated between these two coils.

And this will be sensed by the sensor that you that you have in the system and the crack signal will be shown on the display okay so this is based upon a differential signal between the coils when one of the coils will be over the defect.

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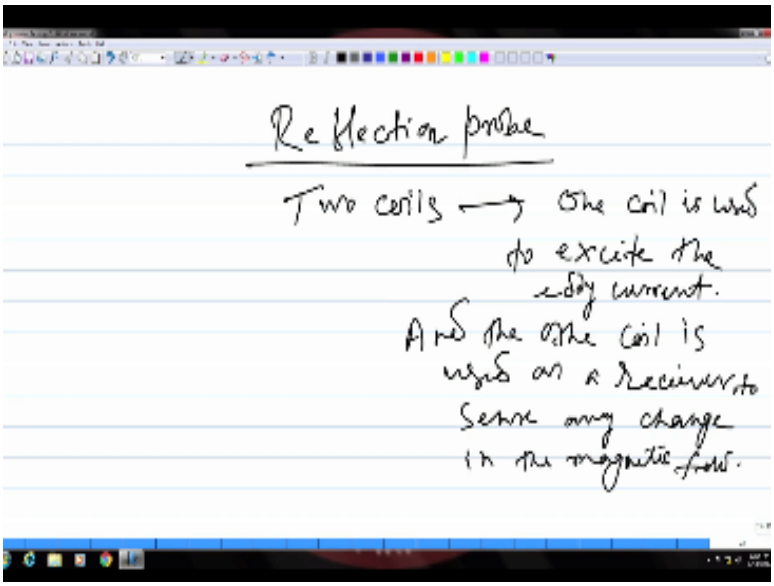

And the next one that we have is known as a reflection probe so like the differential probe this also has two coils in the same housing but in this case one coil is used to excite the current and the other coil is used as a receiver if there is a change in order to sense that chain the other coil is used so that is used as a receiver, receiver to sense any change in the magnetic field okay. so this in terms of the construction of the coils these are the three categories and in terms of the geometry of the coil if you see then also you have three or four categories of three or four different types of probes one of them is surface.

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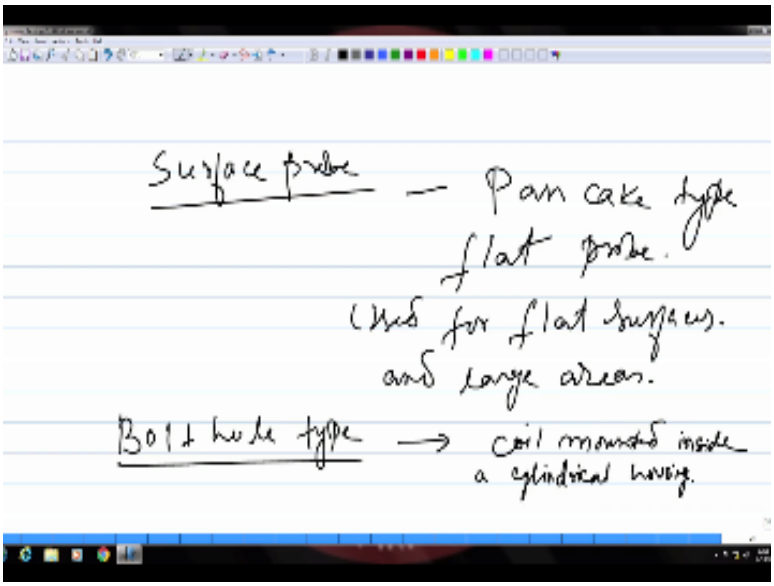

Surface pro this is basically a pancake type flat flow and as the name suggests it is primarily used for flat surfaces and large areas but you might have other kind of areas also to be inspected for example you might have a bolt hole and you want to inspect these threads which are inside this bolt hole so in those cases you need to insert the probe inside the hole so you have this bolt hole type or pencil type probes which can be inserted inside a hole to inspect the inner diameter.

So this will be construction wise this is a coil mounted inside a cylindrical housing okay and the diameter of this cylinder can be varied or can be chosen based upon the diameter of the part so it should be a little less than the diameter of the part so that it can go inside and at the same time it should not be very different also it should not be too low compared to the diameter of the part so it should be closely fitting inside the bolt hole so that you would be able to inspect the circumference of the part okay.

So it may be the, the probe might just look like this pen okay if you have a look at this pin any time eddy current probes have this kind of geometry and this kind of appearance okay so you can take this and if you have a hole like this you can put it inside the hole diameter line inner diameter and you can inspect the circumference so these are the bolt-hole type probes.

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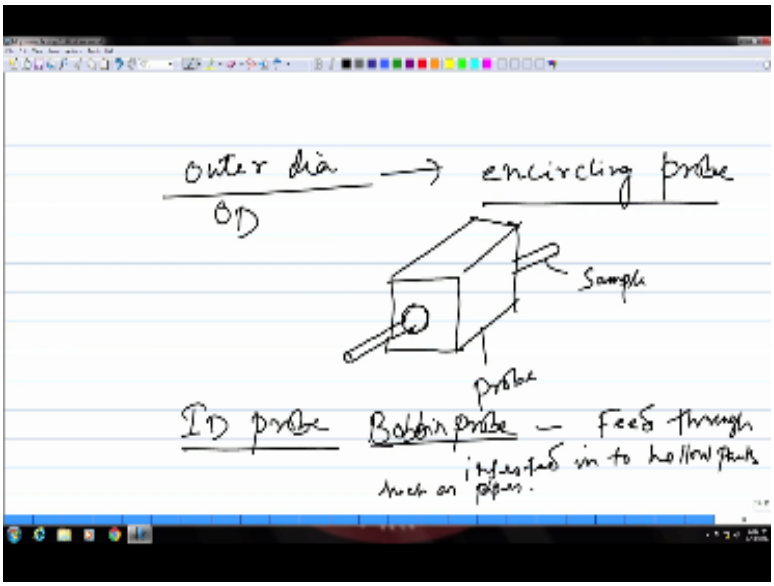

Then if you want to inspect the outer diameter of any part so then you need to have an encircling kind of probe which can encircle the part and induce the current along the outer periphery or the outer diameter of the part so that you'd be able to inspect the circumference along the outer dia so this probe will encircle the part by like this so this will learn so this is the pro and in this case this will have a hole like this and through this whole layer to insert the part to be inspected in this manner okay.

So this is the sample and the coils are around this whole so as you insert this through this hole the current will be induced on the outer diameter of the sample and you'd be able to inspect the outer died and the circumference similarly you have ID or inner diameter probe so this is OD probe and similarly you could have ID flow for inspecting the inner diameter and sometime these I would probes are also known as Bobbin Pro.

So this is a feed-through probe like what we discussed for the bolt hole kind of probes so this has to be feed through the sample hole so you have to insert it inside the inner diameter to inspect the inside diameter so this is inserted into hollow parts such as pipes and similar hollow products to

inspect the inner surface and the inner diameter so depending on the geometry these are the different types of approach that, that you have and finally we will see one more aspect.

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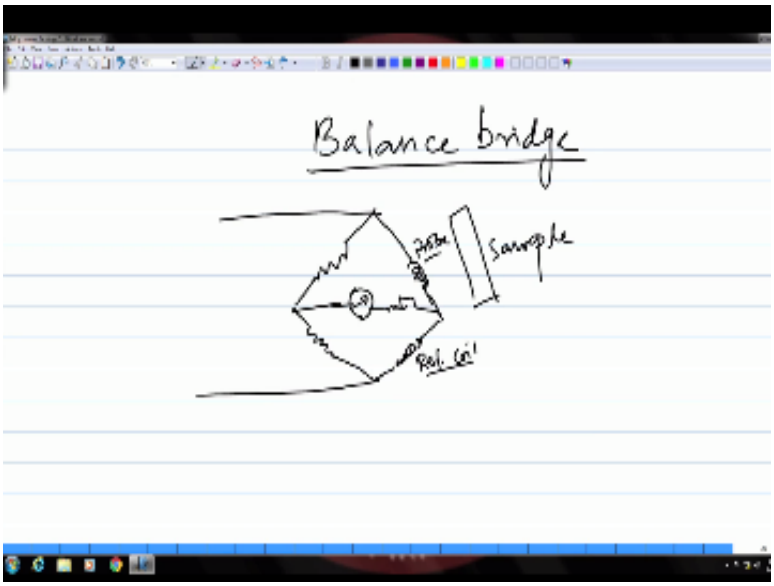

About this inspection system as to what kind of circuit is used you know to get a sense of this change due to the presence of a defect so as I said if there is a defect there will be change in the eddy current and as a result of that there will be a change in the magnetic field of the coil which has to be sensed by the detector and generate a signal which can be shown on the display ok so this is one example of a circuit which is used to detect this change and this is known as a balance bridge circuit .

So what you have in this case it is like this you have the primary coil or the probe here and then on the other side there is a reference file like this, this is the probe so your sample will be close to this and then the data detector to detect any change will be connected to this okay so if there is no defect on the sample when you bring it close to this probe to this primary coil then there will be no difference between this reference coil and this probe so there will be no signal.

In this detector okay on the other hand if there is any defect on the sample then there will be a change in this coil in this probe as we have seen before and due to that change now since the reference coil is kept constant so there will be a differential signal between the reference coil and this probe due to that change and as a result of that this detector will sense a change so it will pick up a signal and that is what is going to be used finally for the eddy current system to make indications about the flaws so this is one of the example one of the circuits which is known as balance bridge is used.

But there could be other type of circuits also which can also be used to detect this change okay so this is about the inspection system so we have learned about the basic principles we have learned about the inspection system also and now in the next class we will see the other things as to how exactly it is used what are the different applications and few more aspects about eddy current testing so for today this is all I have thank you.

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