Farm Machinery
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Lecture – 54
Materials for Construction of Farm Machinery

Welcome dear students to my lecture number 54, which I have coined as Materials for Construction of Farm Machinery. Now over the last lectures I have already talked about the various machines and equipment, which are being used in agricultural engineering for operation of the various crop production systems. Now it is very logical and imperative to have some knowledge about the materials which are being used for fabrication of the different components of the machinery.

Well it must be told over here that you are not a metallurgical engineer, but then as an agricultural engineer you must have an idea about some part of what are the construction materials, what are their behaviour , what are their properties and how do they behave and hat sort of cautions we must take when we are going to use a particular machine depending upon our requirement depending upon the strength of the material and the depending upon the brittleness or hardness or whatever is the property that we look for a particular operation we must choose the right material.

So, for that I have brought this lecture for you and we have try to put it in such a way that a directory corner of the materials for each of the equipment right from tillage to harvesting and threshing, you will get some idea about this. We have taken help of the several literature available elsewhere and the literature which I had given in my course reference books, but then we have try to put in a slightly different ways which I hope it will interest you. So, let us follow the slides which I have brought it for you.

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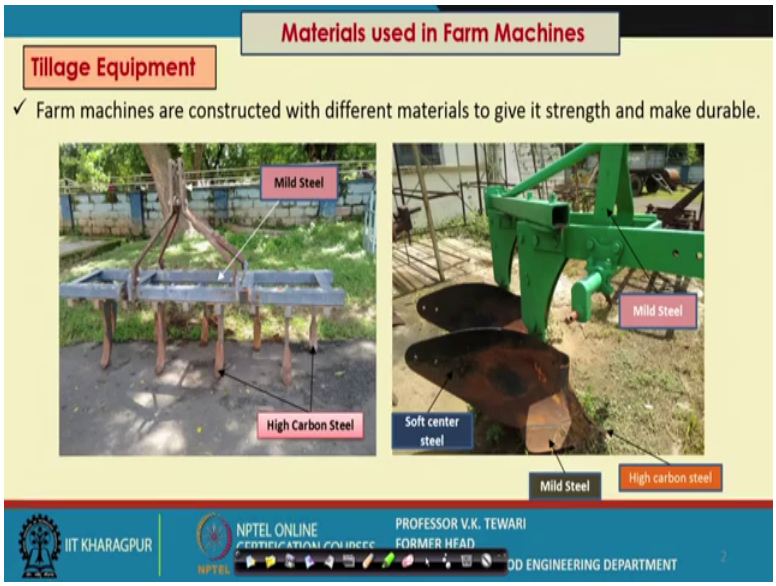

Well let us think of the materials for tillage equipment. Now we know that the equipment which are used for tillage mouldboard plough disc ploughs cultivators sometimes Herros and Rotavators these are the equipment which are used. So, if you have a look at the type of materials which are used for the say in the case of cultivator, see the tines which are made actually the shovels which are made which are doubles its shovels which are used in this tines they are may the high carbon steel and the frame to frame which is there along with the three point linkage which we have seen in the cultivators made of mild steel.

When you go to the a mouldboard plough well you know that mouldboard plough you had different components and the they the requirement and the task of different components is vary. So, it depending upon the requirement and the task which it has to do the material of construction also varies.

For example if you see in the board is made of soft centred steel lot of covering will take place similarly the mild steel used for certain portion of the board and then high carbon steel is used for the for the you can say the share which is there then the other frame mild steel of course, the frame.

Now, if there is a there is a coulter or a jointer, it will have similar property as in case of this mouldboard plough you might have seen that coulter and jointers are also used in this where a different purposes I have already discussed this in the earlier lecture which

when I was taking the tillage equipment. So, I would not like to repeat, but then I will say that if they are there they will be also made of dissimilar material which are mentioned over here.

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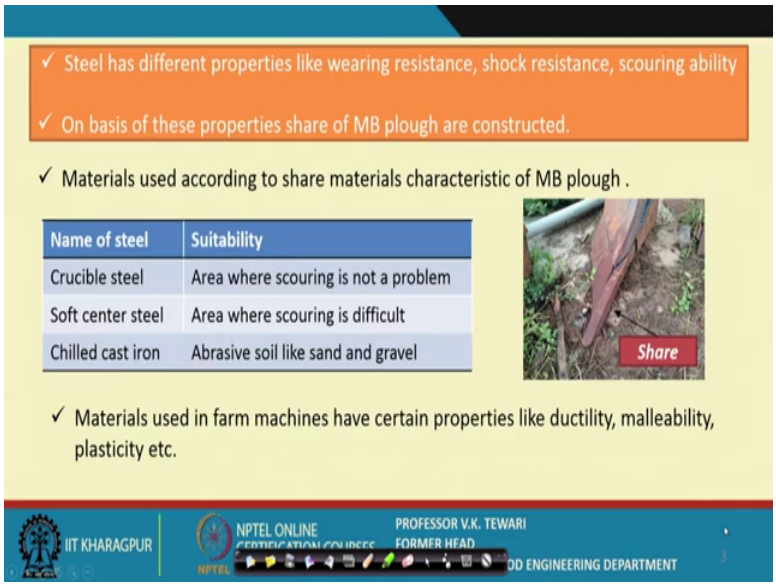

Let us see what are these steels we are talking of the various steel and all that we will take up this and then we will go to some other equipment, well you see here that this share which I had shown you this share is made of certain material which I was told to you. Now what the steel has for different properties well you know mild steel and the iron from where and from the figure and the whole process you might have learnt elsewhere in some course.

But then from there when the still is available this steel has different properties like wear resistance shock resistance in scouring ability this has. So, on the basis of these properties share of mould board plough are constructed as I told you earlier that scouring ability will be required for this it should be able to with stand the pressure of the scouring property of the soil which will be there this soil maybe a sandy soil a soil maybe a loamy soil maybe hard soil and all that. So, accordingly the mould board plough is then designed name ok.

Let us see some of the steels different types steels and their suitability for example, crucible steel a area where scouring is not a problem. So, you can use a crucible steel soft

center steel where area where scouring is difficult, then chilled cast iron abrasive soil like sand and gravel.

So, as I said that there will be a difference. So, material used in formations of certain properties like ductility, malleability and plasticity. Yes these are also important they need they are needed at some point or the other and that is why when we talk of this as an engineer you must keep in mind that the proper material choice is one of the important things to be considered.

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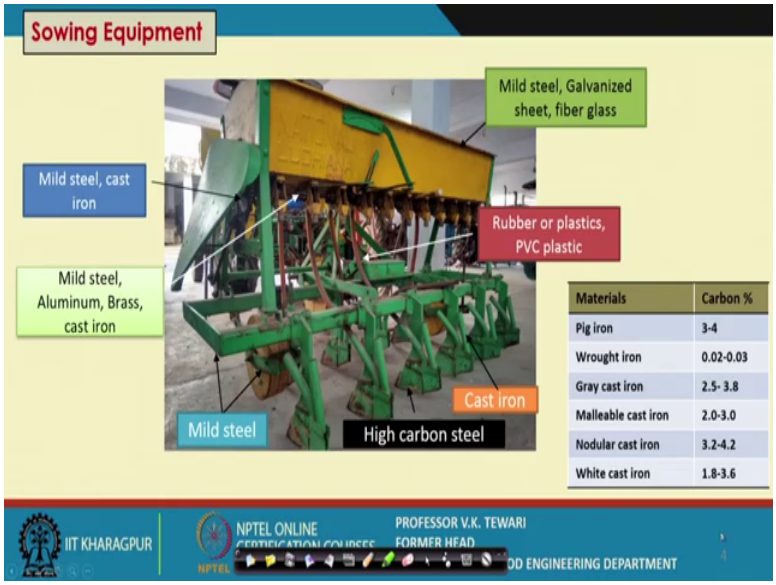

Let us go to Sowing Equipment you we have talked of this sowing equipment earlier and more details are known to you know about all the components which are there in the equipment which starts from the hopper and then goes to the tines and then it goes to the tube. Then it has the mitring shaft mitre mechanism that the power transmission etcetera.

So, if you look at these the different components and their material you can see that mild steel and galvanized sheet fiber glass sometimes, where used for the hopper. Then the rubber or plastic materials are used for the tubings, which are there through which the seed or the fertilizer is transferred from the hopper to the soil furrow.

Similarly, the materials which are aluminium brass or cast iron and some of these steels are used for the you are talking of the is fruited roles which are many times now fruited roles are being made of lighter materials like plastics and all that depending upon the

total weight of the machine and the size of the machine. They have also been used and of course, this the gears which are made here mild steel or cost irons some of these gear materials which have been used or the chains which are used.

So, some of the materials which are say for example, this boot or the where it will open the soil high carbon steel which is used cast iron is used for the tubings in which the pipe goes you can see you know you have be given the details in this figure. And then we will just talk of this material slightly with respect to what metallurgy talks off and; that means, we are talking with respect to the carbon content which is the important parameter or you constituent in giving you the strength of the material.

So, if the pig iron is there it had about 3 to 4 percent of carbon, rod iron has 0.02 to 0.23 percent, carbon gray cast iron has 0.2 2.5 to 3.8 malleable cast iron has 2.0 to 3.0; then nodular cast iron has 3.2 to 4.2 and white cast iron is 1.8 to 3.6.

The this is the percentage of carbon which is there in all these materials, mind you that one the this knowledge is very essential as an agricultural engineer or for that matter this knowledge will help you elsewhere as well when you are if you are not only talking a farm machinery for talking of some equipment for a food processing or for something else you this knowledge will definitely be helpful to you.

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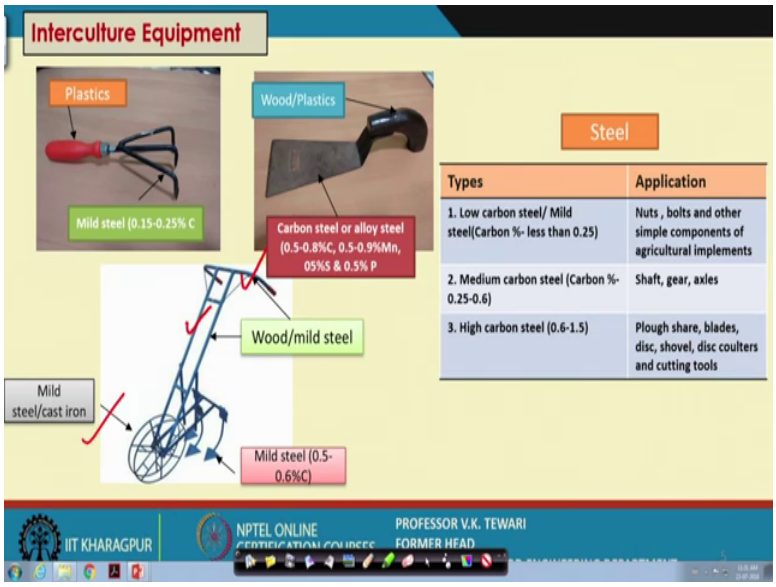

Say Inter Culture next operation, which comes in line with the crop production is the intercultural equipment. So, the various equipment we have discussed already or the you can see the here the coorpa or the one which is for weeding this is also another one for weeding be utilized. Now it is handles many a times are wood or plastic you can see here plastic is used here, but the blades which are there or the tines or the ones which will actually work with grasses or the weeds a mild steel with 0.15 to 0.25 percent carbon.

Similarly, the coorpa are or this device which is there for manual operation you can see here that the carbon steel or alloy steels are there because it has to have some sort of sharpness at the edges, these edges should be having certain sharpness and therefore, 0.5 to 0.8 percent or where if the 0.5 to 0.9 percent manganese and 0.5 percent of sulphur and 0.5 percent of phosphorus. Now this is the carbon steel or alloy steels are comprise of these.

When you talk of a the field hoe are the one which is push and full type of feeders for them you see the either wood or mild steel is the pipes which are used for handles the handles, which are there or the frame which you are talking of here. So, you can talking of this or you are talking of this then you give me then mild steel they the wheel generally this wheel must be cast iron it does not have well it need some sort of weight will required for giving the momentum forward momentum (Refer Time: 10:25) and we are doing push and pull. So, the cast iron or mild steel will helpless in having this material.

Now, here when we are talking of there is let us have some application as well because we have not talk the more details about the nuts and bolts and all that. So, some of the better details of the steel are given here as per the requirement for example, say types low carbon steel and mild steel with carbon percentage less than 0.25 the it has a application in nuts, bolts another simple components of agricultural implements.

Then shafts gears and axles well the these are made of carbon with 0.52 0.6 where medium carbon steel is used and high carbon steel where 0.6 to 1.5 where the plough share the blades disc discs the disc of the plough then shovels disc coulters and cutting tools. So, the this information which has been put here for you to have a look at it will be ready reckoner for you to understand the details about the materials.

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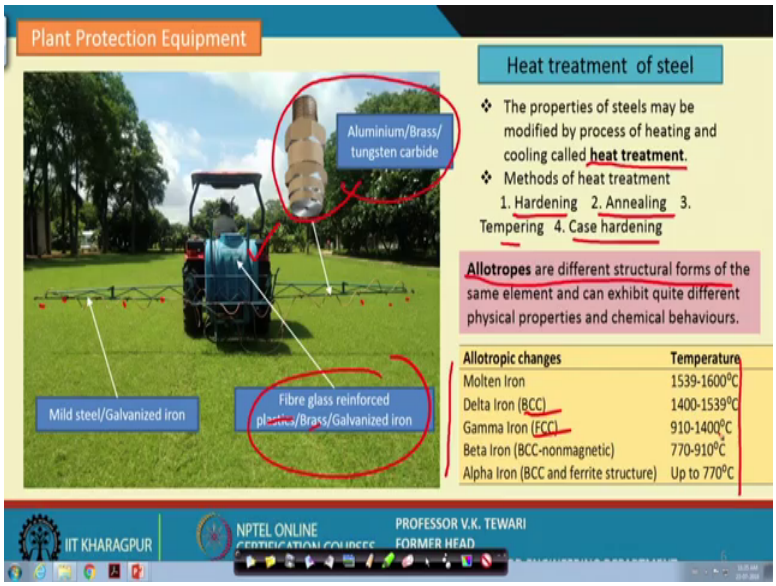

Well Plant Protection Equipment you we have already discussed about this plant protection equipment as well and the first recombinant is the is the container or the drum when which we have to have the material, which is there in liquid form or the solution which has been prepared has to be kept this is generally made of fiber glass, reinforced plastic brass, galvanized iron. So, depending upon what is the type you can see that this is made of the material which you want particularly depending upon what type of the chemical is because if it is one which will corrode faster and all that then you will have to take care of the proper either plastics or maybe brass which will not react with that.

Similarly, the booms you can see here the booms which are made a mild steel and galvanized iron the booms are made of and the nozzles you can see the nozzles which are tugged of here nozzles, which are there at several locations they different locations over here. So, these nozzles are made of a browser tungsten carbide.

So, because they have certain properties required. Now these when we are talking of these materials in the components certain other things are also required for example, you we must have some idea about what is the level of strengthening which is given to the materials which we call as heat treatment of the particular constituent or the steel which is there.

So, the properties of heat treatment of steel maybe modified, processing of by processing of heating and cooling called heat treatment. So, heat treatment is a process by which we

are in a position to modify a certain properties of this, out of these very the ones which are very much common which are used in our equipment particularly with respect to farm machines we can say that the hardening any link tempering and case hardening are most commonly used and we will just talk of the different structure forms of this.

So, allotropes are different forms of the same element and how and how they exhibit different properties. So, we have just jotted down here for your radian standing you can see that the changes which are taking place in the iron the temperature or changing. So, as the as it cools down you can say that the different changes in the structure of this material if these are the different structures with which are talked off.

So, you can see that the molten iron at a temperature of up to 1539 to 1600 Celsius, delta iron which is 1400 to this then gamma iron which is fcc is 910 to 1400 degree Celsius and as you come down you can see that the material has different property. Well this has been brought down in concise form or you to have this knowledge as best if you know you are interested to know more about this I think it will be better for you to consult the books relevant books of metallurgy and going to some more tools provided you are encounter with a problem which is required for more consideration with respect to the materials, which you want to use suppose you want to may use a material which is high in strength and lighter then you will have to accordingly choose the materials.

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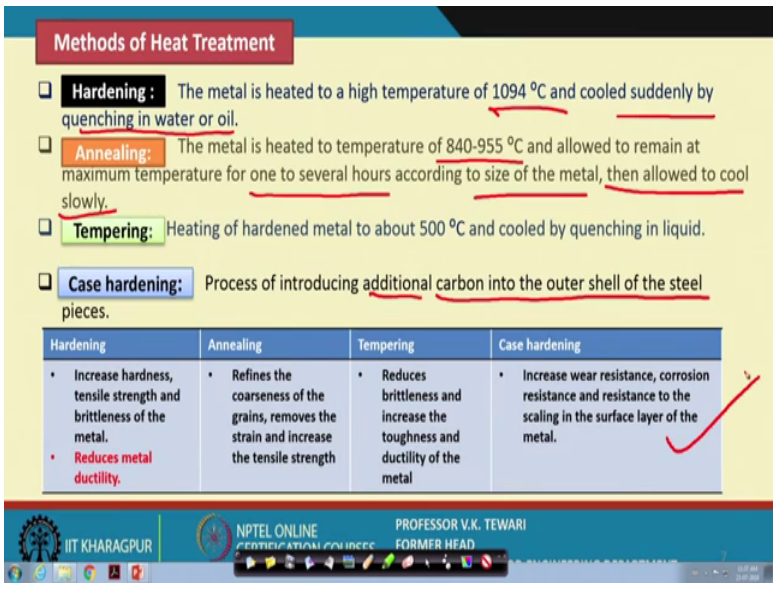

Methods of Heat Treatment well we talked of the different methods of heat treatment which we add here. Now, what hardening? It is the hardening is a process and cooled suddenly this is the process where the material metal is heated to a temperature of the 1094 is a value is given over here 1094 and is cooled suddenly by quenching in the oil or water. So, these are the process which is there and once you your experienced you will understand what is the level of hardness which is required for a particular component in a in a equipment.

Similarly, Annealing the metal is heated to a temperature of 840 to about 955 degree centigrade and allowed to remain at the maximum temperature for one two several hours according to the size of the metal then allowed to cool slowly. Now this is another process because accordingly the structure we talked the bcc fcc those structures of the material made changes and the moment you follow the this process of heat treatment it will have one property which will help you.

Similarly tempering this tempering is the temperature is 500 degree and about 500 degree and cooled by quenching in liquid any liquid you can do. So, tempering is one property which is where case hardening now this process of case hardening is addition of carbon into outer shell of the steel, now what do we mean by outer shell of the steel if you go to the structure of the steel you will understand which of course, requires knowledge of more metallurgy into that, but then you will understand there that the carbon additional carbon is added for case hardening which is required for some of the components which I have talked of them earlier.

Well, the details are given here about all of these and the changes in the property etcetera and its strength etcetera or even over here for you to have a note of this.

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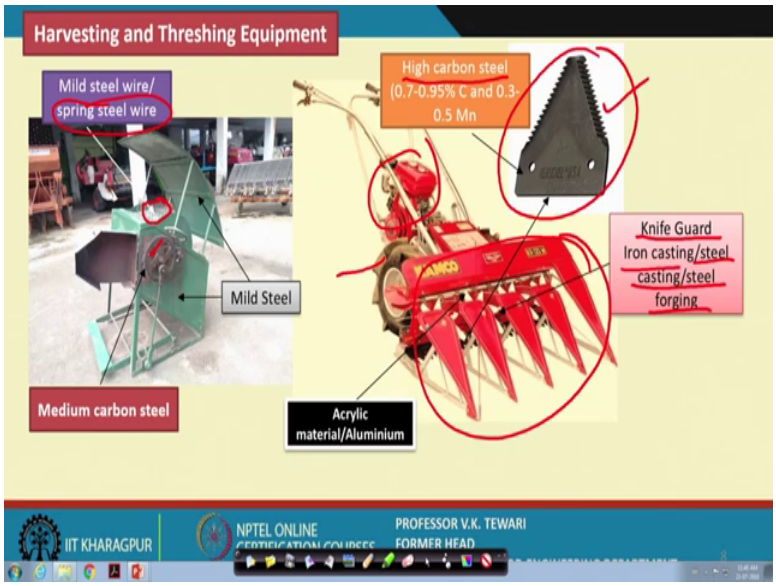

Well Harvesting and Threshing Equipment, we are talked of this equipment already and we know the various components of these equipment, see the mild steel. Now I have given you here some of the equipment which we have and we would like to you to have a note of this. That is why it is worth understanding that instead of telling you that this is made of this and that we have the equipment here and we wish that you take a note of these.

For example; see medium carbon steel is used for the gear which is shown over here when power transmission takes place in case of the thresher and mild steel is for this cover and then the covers etcetera or the frame etcetera which are used, you can see that mild steel is spring steels sometimes of the actually when we are talking of these actually on the bar actually if it is paddy thresher so, and then the hoops which are required.

So, they reduce your threshing elements. So, the threshing elements which are here they require that they should be stronger here. So, a spring steel wires are used on that. So, because they have to have different strength and enough strength for as a threshing element; so, we need that they should be made of these materials.

Now when you go to the harvesting see most important is the knife guard which is over here and then the casting is iron casting, steel casting, steel forging now these are the different types of materials, which are used for these sometimes the these ones which are the which will try to put the material or the cut crop, but this is a vertical conveyor

reaper. So, the cut crop will be transported for that these are the, you can say that these are some of the, this plastic materials which are used for sprockets which will allow them to go like this.

Then the material for the or you can have even aluminium materials are also used depending upon this depending upon the performance and the type of this particular equipment some manufacturers have used even aluminium acrylic materials or aluminium or plastic that we are calling of here.

Then the, a crusher plate and the ledger plate and the share cutting share a blade. So, you can see that these are these require a different material here you require a high carbon steel here because this has to cut and he has to have a longer life. So, this is made of a this material where 0.7 to 0.95 percent carbon and 0.3 to 0.5 percent manganese is required in this.

Well we are not talking of the other components, which are there of the engine or we are not talking of the rubber of the tire etcetera, but we are talking of only of this part of it where the if the power transmission is also there gear etcetera because we have talked of the gear etcetera here. So, we are just talking of those elements which are essential with regard to the we are not yes we are not talking of the engines other transporting materials like tail, wheel or the transport wheel etcetera, but we are talking of this.

So, as such for the harvesting and threshing equipment we find that these are the components and these are materials, there could be different requirements also for the thresher depending upon what type of thresher you have whether you are talking of a full flow thresher where the full paddy paddy plant itself is given there could be different if you are talking of the with thresher you will require different type of heating element I mean the threshing element etcetera.

So, keeping these in mind I think an idea is given to you about this equipment materials.

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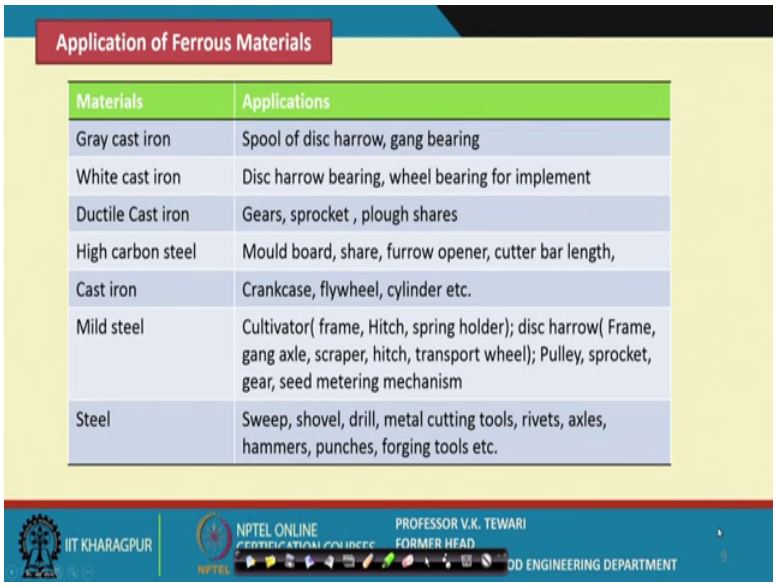

Application of Ferrous Materials well we know that iron is the major content in this now here we will see that what is the ferrous materials which are used. Now a list is given over here and their corresponding applications are given you can see that we have talked of this, but then some more details which will help you in understanding these materials say like gray cast iron, white caster iron and ductile cast iron, cast iron mild steel and steel and they are respective applications, which are given over here in a nutshell which will help you in understanding these and then help you in picking up the materials choosing the materials while construction or designing when you are thinking of depending upon the requirement of the equipment.

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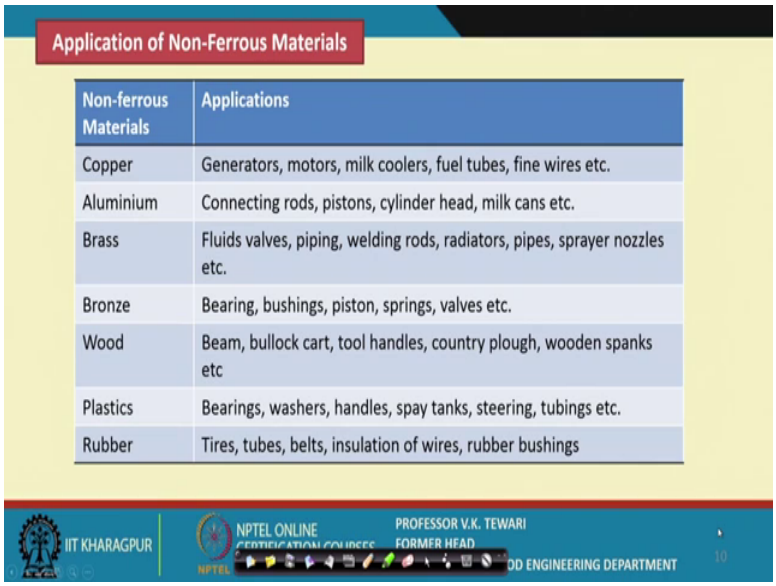

Application of Non Ferrous Materials yes, these are also required as you talk of the ferrous base materials and nonferrous base materials here the copper, aluminium, brass, bronze, wood, plastic and rubber these are also used in equipment, which we know and it is since we did not give every detail of every component in as I said in case of thresher and all that. So, you can here say for example, rubber, tyres, tubes, belts then insulation wires, rubbing, rubber, bushings etcetera.

These are the ones which are used from rubber see wood yes bullock cart the bullock cart or the simple you can see that more simple plough which is driven by animals has the beam you choose used for they the using wood wooden spank wooden spanks or wooden planks for you sometimes which were used it for is measuring the or planning you can see that, for planking which is the aberration for after the equipment has been operated we would like to level the land. So, for that you can use wood.

Then the copper, aluminium, brass etcetera you we more details are given about where they are used and all that. So, it is worth having some information about the ferrous materials, nonferrous materials, the heat treatments, which are utilised and what is the level of carbon which is there and which carbon helps you in what sort of property etcetera its worth knowing and then worth having this information.

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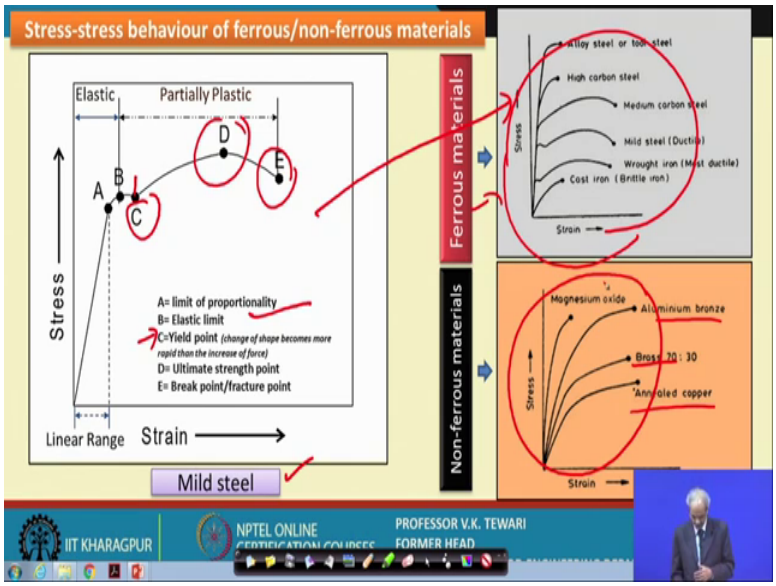

Now, so, we wanted to wanted to give you since we have talked of the materials it is worth and very logical and very imperative, that we also talking about these stress behaviour of the ferrous and nonferrous materials. Now in case of mild steel which is the one, which is very widely used in all the equipment that we have talked up so far.

So, we see here it is a graph, which is you might have seen in various strength of material books and all that and we wanted that it should be presented to you in this lecture. So, that you have this information readymade at your location and you follow this up, remember always that when we are talking of these we are talking of with respect to only the equipment which are used and which we have discussed so far in my lectures right from the beginning to up to this.

ah But then if you want to have more information and you should have more information depending upon your requirement, you can go to metallurgy books any book on metallurgy and with that will give you certain more informations about for example, about the structure V BCC FCC, what are these? And how the structures change? If you go into the chemistry of and bonding of these elements you will have more information.

Now, you can see here that we are just talked the by stress strain curve and you know that to which up to this point A which is the limit of proportionality. So, you know that stress various strain in the up to this, then between A and B the is the elastic limit up to of the material, then from C from B to C we are talking of yield point you must have

heard that the yield point of a material is this much. So, what is this in point? So, this is the yield point which is given over here you can see this is the point which are which is the yield point.

Then partially plastic you can go to the D ultimate strength this stocks of the ultimate strength here and E breaking point or fracture point at this point. So, this is for mild steel this is the this is the behaviour of the material when you talk of stain and various strain. Now when you go to non ferrous and ferrous materials over here there is some change which is required for the this curve which is varying here you can have a look at this say alloy steel or tool steels you can see that this is the this is the curve here.

When you go to high carbon you can see what behaviour it is having then medium carbon steel where is the change then when you go to mild steel ductile ductility is the requirement you could see this similarly wrought iron, cast iron see the behaviour which has been shown over here for the ferrous materials.

When you go to non ferrous materials when you are talking of aluminium, brass or annealed copper and things like that, you see the behaviour of these materials and for these the total properties are already given to you and you can use from the tables which are available and then worth having for this information.

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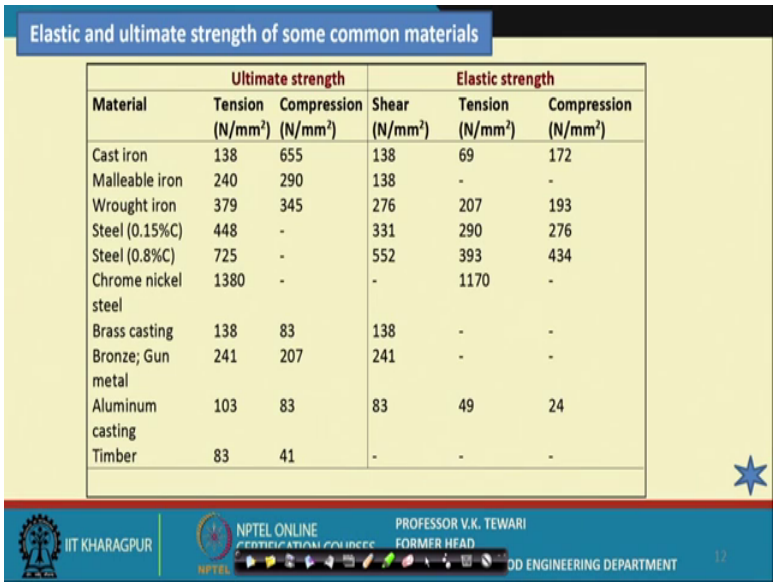

Well elastic and ultimate strength of some common materials we thought it is worth to give you we talked of the proportionality we talked of the stress strain curve in ferrous and nonferrous materials we talked about behaviour and we just want to give you what are the different ultimate strength and elastic strength of the materials which we had here.

For example; cast iron, malleable iron, wrought iron, chrome, steel, bronze, aluminium, casting and timbers and all the tension in tension compression what is the ultimate strength in elastic strength what is the tension and compression. So, these are all given over here it will help you definitely when you want to design a particular component while thinking of any operation of the equipments so far.

I can tell you that in this particular lecture we wanted to we wanted to give you some idea about the materials and their construction and their behaviour and the properties of these materials, which help you in choosing the material from the galaxy of the materials available for different components when you are designing an equipment. I hope I have answered quite a good questions, but then there could be quiet good questions which may also follow and we will be happy to answer them in future as they come I hope we will be in a position to answer them so, I think.

Thank you very much for this.