Farm Machinery

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Lecture – 36
Design of Manually Operated Weeding Equipment

[Noise]

Well ah welcome students to my lecture number 36 where I want to [vocalized-noise] tell you about [noise] design of a manually operated weeding equipment [vocalized-noise], well I [noise] [vocalized-noise] it is a very [vocalized-noise] fascinating ah thing which I want to tell you today [vocalized-noise]. Because, ah [vocalized-noise] you might have seen several types of such devices, but ah there is nowhere [vocalized-noise] a [vocalized-noise] proper way of designing this equipment [noise].

We discussed about the tines [vocalized-noise] we have seen the [vocalized-noise] in the earlier ah [vocalized-noise] lecture [vocalized-noise] and ah if you want to design it a full ah device which is manually operated [vocalized-noise]. But then [vocalized-noise] it has certain [vocalized-noise] certain [vocalized-noise] components, how do we design, what are the parameters we think of [vocalized-noise] what [vocalized-noise] considerations we have to give [vocalized-noise] because the manual device [vocalized-noise].

Now, [vocalized-noise] this [vocalized-noise] device in fact you know that manually we require a lot of ah manpower only for pulling [vocalized-noise] individual [vocalized-noise] by hand [vocalized-noise]. But then the moment same power of the man can be utilized [vocalized-noise] using these small devices [vocalized-noise] and the output can be increased so [vocalized-noise] and the [vocalized-noise] these devices are very useful for ah lowland as well as upland conditions [vocalized-noise] dry land conditions what we call as a plan [vocalized-noise] and ah for a small farms [vocalized-noise] and you know that about 60 percent of the farms particularly in this country in India [vocalized-noise] are small farms [vocalized-noise]. So, for this operation [vocalized-noise] which is a arduous operation and I have told you that these are mainly [vocalized-noise] ah done by the ladies [vocalized-noise]. So, in order to [vocalized-noise] bring out the [vocalized-noise] maximum out of the same power of the [vocalized-noise] person [noise], we we should have a proper design [vocalized-noise] what should be [vocalized-noise] the [vocalized-noise] what should be the consideration in the design of such kind device.

So, that is why [vocalized-noise] I have [vocalized-noise] brought today to let you know about [vocalized-noise] how do we design such a weeding equipment [noise] [vocalized-noise] which is manually operated mind. You ah [vocalized-noise] you can think of this when you go for a [vocalized-noise] mechanic [vocalized-noise] mechanical operated or bigger equipment [vocalized-noise].

But then when you go for a small one how do we do [vocalized-noise], you might have seen what are the devices in the [vocalized-noise] which I showed you in my previous [vocalized-noise] other lectures about the small weeding devices Khurpi Arsia and then [vocalized-noise] Kudali and things like that which was [vocalized-noise] show on their spade etc [vocalized-noise].

But then [vocalized-noise] apart from [vocalized-noise] that if it proper design procedure has to be followed what should be that, so [vocalized-noise] I have come with that to show you and share with [vocalized-noise] you my [vocalized-noise] way of [vocalized-noise] understanding the design [vocalized-noise] and ah [vocalized-noise] let us see how do you [vocalized-noise] appreciate this [noise] [vocalized-noise].

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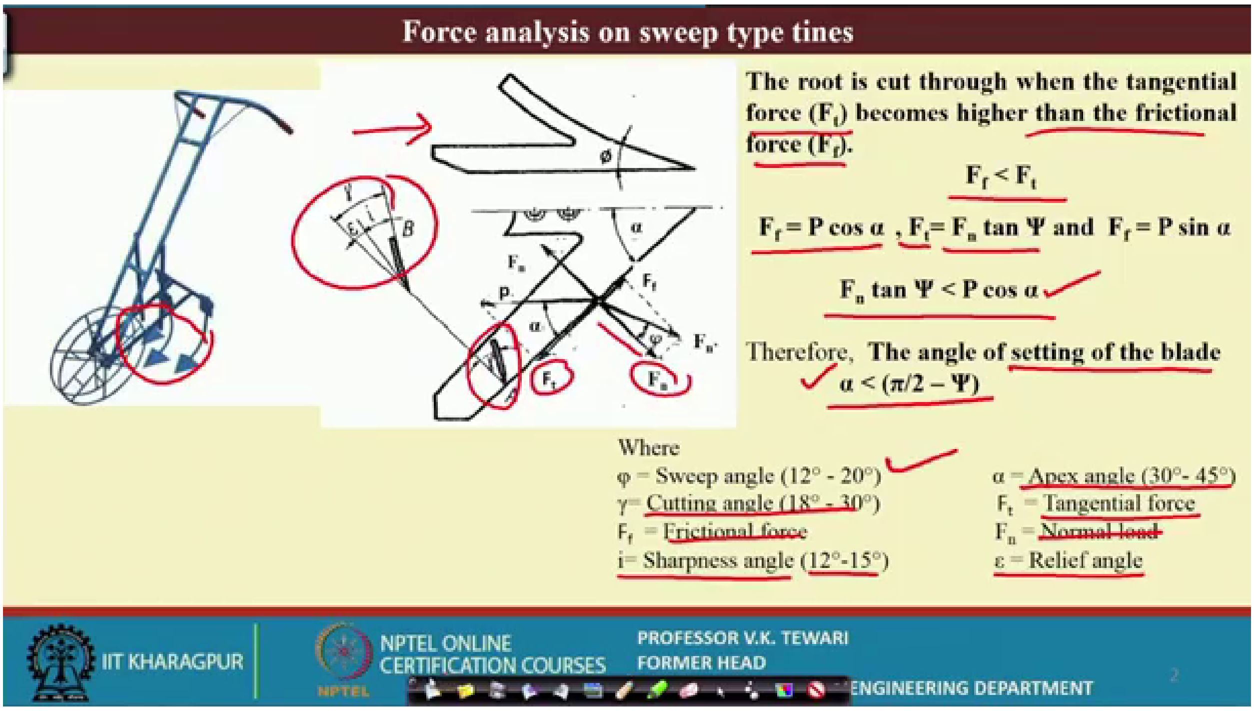

Force analysis ok [noise] now go first of all we should go back to the [vocalized-noise] weeding tine, see what should be the tine what should be the design of this particular tine [noise]. Now, we have taken [vocalized-noise] a sweep type of tine in this ah case for [vocalized-noise] ah showing you the analysis [vocalized-noise] and how as an engineer you would appreciate such analysis. Now you see here [noise] that ah [vocalized-noise] this is a sweep in a type of a [vocalized-noise] tine which we have [vocalized-noise] attached here [vocalized-noise] and this tine [noise] what are the [vocalized-noise] forces [vocalized-noise] acting on this how do we measure these forces [vocalized-noise].

See [vocalized-noise] ah the if you consider this part this particular diagram you can see here [vocalized-noise] then ah what you get here is phi, now this phi is a sweep angle [noise] this phi is the sweep angle which is there [vocalized-noise], now this angle is generally between 12 to 20 degrees [vocalized-noise]. Now ah [vocalized-noise] there are certain things [noise] which we need to [vocalized-noise] take it for [noise] granted for that matter if you tell because [vocalized-noise], it is not possible to go into each and every aspect of the design for this. But there are certain aspect when we consider a particular component [vocalized-noise] from no literature, we we should ah [vocalized-noise] instead of ah redefining and redesigning the wheel [vocalized-noise] we must gather information which is available at elsewhere [vocalized-noise] and can be used for our ah requirement [vocalized-noise].

So, here [vocalized-noise] this phi [vocalized-noise] is a sweep angle, so this sweep angle now they [vocalized-noise] they root is cut through [vocalized-noise] what what is the root root we are talking root of the weeds. Now this [vocalized-noise] when we try to cut the weeds we cut about ah [vocalized-noise] 2 to 3 centimeters only [vocalized-noise] of that we are not interested in going for about 6 inches or so [vocalized-noise]. Because these are tender roots they are generally [vocalized-noise] coming up [vocalized-noise] these weeds coming after ah 21 days after sowing we called 21 days after sowing [vocalized-noise] ah days after sowing [vocalized-noise].

So, in 21 days of sowing these weeds are very tender [vocalized-noise] and then it will be [vocalized-noise] they are hardly [vocalized-noise] 2 to 2.5 [vocalized-noise] ah 2 3 centimeters just below the soil and the soil is also not that very hard [vocalized-noise] it is just [vocalized-noise]. So, it is easier to remove them [vocalized-noise] from there either we cut them or remove them, so when we damage them [vocalized-noise] they [vocalized-noise] they are by there with the sun they dry and then they are controlled they do not grow further [vocalized-noise].

So, we can see the various ah [vocalized-noise] let us see what are the various [vocalized-noise] angle etc when we consider such a stand [vocalized-noise]. You can see the root is cut through and the tangential force Ft [noise], now this this is the tangential force Ft [vocalized-noise] over here [vocalized-noise] you can see this is the force [noise] tensile force Ft which is in this direction here [vocalized-noise]. Now this force [noise] becomes higher than the frictional force Ff, so this is the frictional force which is in this direction [vocalized-noise]. So, then the moment this removed than this it will cut.

So, this is [noise] one consideration fine [vocalized-noise] then F how is F [vocalized-noise] this frictional force give P cos alpha [vocalized-noise], now what is this P cos alpha these this is here [vocalized-noise]. In fact, this is [vocalized-noise] capital one so this is the angle alpha which is maintained and this angle alpha [vocalized-noise] [noise] is the apex angle [vocalized-noise], this is also apex angle at this point of this [vocalized-noise]. So, [noise] you are talking of the apex angle it is 30 to 45 degrees, so P cos alpha [vocalized-noise] is this, that means P cos alpha will be working in this direction [vocalized-noise]. So, P cos alpha is the frictional force which is acting here [vocalized-noise] then the [vocalized-noise] Ft [noise] which is the ah frictional force [vocalized-noise] no sorry which is the tangential force [vocalized-noise], this tensile force is F n tan psi [vocalized-noise]. Now you can see this is F n here this is the F n here through this this is F n here [vocalized-noise] and this at an angle psi [vocalized-noise] or [vocalized-noise] in fact this is also an angle phi a similar angle [vocalized-noise] which will get here [vocalized-noise].

So, at this angle then [vocalized-noise] we we this tangential force Ft [vocalized-noise], normal load F n [noise] and ah relief angle ah xi you can say [vocalized-noise]. So, the frictional force [vocalized-noise] then the sharpness angle 12 to 15 degree you can see that here. Details of these are ah given here sharpness angle xi [vocalized-noise], the relief angle [vocalized-noise] as well as [vocalized-noise] this ah cutting angle 18 to 30 [vocalized-noise]. So, these details are given through this you can see a portion of this has been given and explained [vocalized-noise].

Now, we are talking about actually Fn tan [vocalized-noise] psi [vocalized-noise] [noise] a less than P cos alpha. So therefore, the angle of setting of the blade should be in this, this is what we say that [vocalized-noise] the apex angle [vocalized-noise] or the angle at which the setting should be done phi by 2 minus psi [vocalized-noise]. So, [vocalized-noise] ah this talks of what should be the angle which is [vocalized-noise] given over here [vocalized-noise]. Now this [vocalized-noise] from the literature we have [vocalized-noise] collected just to a [vocalized-noise] to show it to you that how do we appreciate [vocalized-noise] the [vocalized-noise] different angles which are there while is cutting the roots [vocalized-noise] of the [vocalized-noise] of the weeds [noise] [vocalized-noise].

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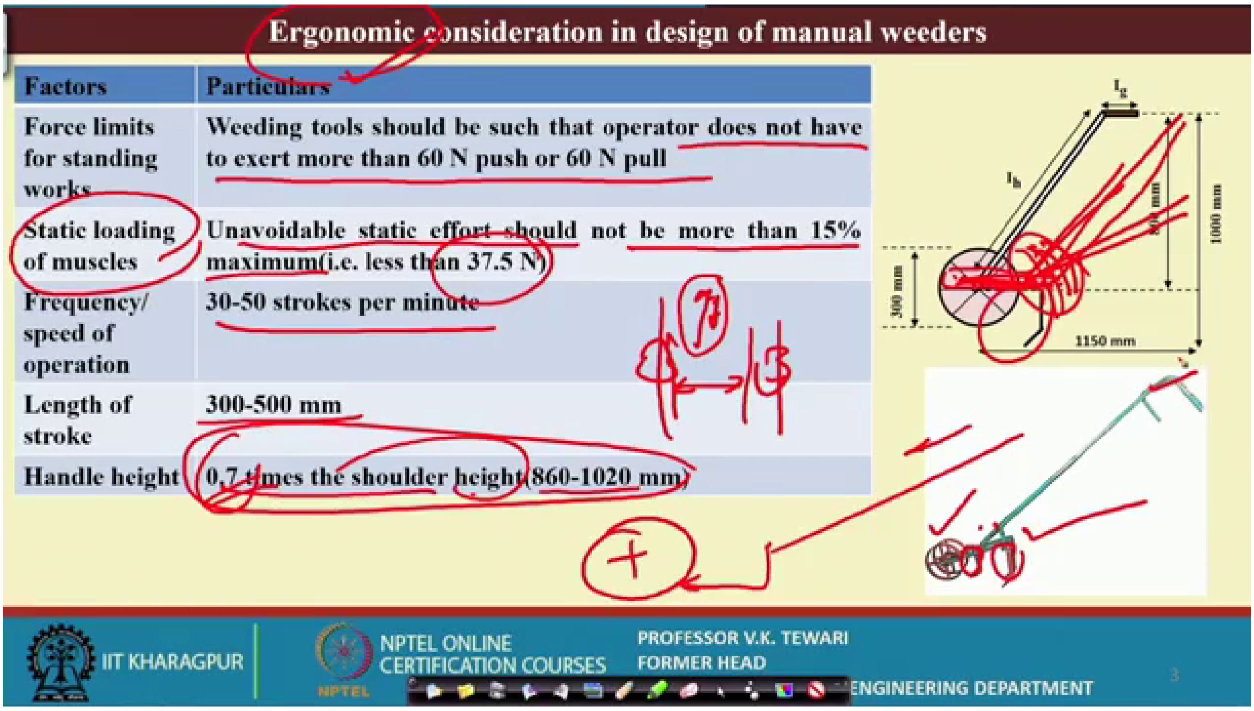

Now, there are certain other considerations see this one thing is [noise] [vocalized-noise], see we are talking of the [vocalized-noise] talking of the tine we had toggle of this tine. In fact, this should be [vocalized-noise] here and then we should be talking of the handles [noise] ok, so something like this the weight is shown over here you see [vocalized-noise]. So, this is the tine we have talked of [vocalized-noise] what else [noise].

Now, [vocalized-noise] there are 2 other things one is this wheel [vocalized-noise], now you can have single wheel you can have double wheel depending upon what you will say [vocalized-noise]. But the purpose of this wheel is to [noise] to give forward motion [vocalized-noise] and also to maintain the depth of operation because [vocalized-noise] if this is not there you can imagine that we will you will have simply a device like this [vocalized-noise] and there will be a tine [vocalized-noise].

So, if you push this here if you push in this direction then you will find that [vocalized-noise] this [vocalized-noise] ah particular device will keep on going ah further and further [vocalized-noise] and then it will not be within the capacity of the human being to do this thing [vocalized-noise], therefore we [vocalized-noise] this [vocalized-noise] the wheel which is here in the front [vocalized-noise]. Now this wheel actually with the [vocalized-noise] momentum that we are getting with the wheel [vocalized-noise], it will maintain the depth as well as it will help us in going because these devices are push pull type remember [noise] [vocalized-noise]. I had told you in my [vocalized-noise] previous lecture [vocalized-noise] that these are push pull type weeders we are pushing certain distance and then pulling back certain distance. I had also shown you the mechanics of [vocalized-noise] how push pull force comes and then how do you measure those forces [vocalized-noise] and actually find out the power required for that [vocalized-noise].

Now, when [vocalized-noise] we have this device like this and we have talked of the tines [vocalized-noise]. So, we [vocalized-noise] depending upon the [vocalized-noise] design [vocalized-noise] we you can think of [vocalized-noise] what should be the material construction, what should be the width of cut that width of cut will depend on ah what is their spacing [vocalized-noise]. Because you cannot take ah a spacing [vocalized-noise] exactly [vocalized-noise] the [vocalized-noise] equal to the spacing of the crop [vocalized-noise], you have to [vocalized-noise] leave certain amount [vocalized-noise] on both sides [vocalized-noise] near the root of the [vocalized-noise] 2 plants and the 2 rows when you are considering [vocalized-noise]. If you are considering say 2 rows like this [vocalized-noise] there is a plant over here [noise] in the top view [vocalized-noise].

So, we need to [noise] consider [vocalized-noise] see the distance is here this is the effective distance which it showed [vocalized-noise], otherwise it will also [vocalized-noise] go near this and try to cut [vocalized-noise]. So, [vocalized-noise] this push and pull pushed here [vocalized-noise] and then pulled certain distance [vocalized-noise] we had talked of this so push and pull types such devices [vocalized-noise]. Now question is [noise] the human being is [vocalized-noise] using this device [vocalized-noise].

So, you can see that the human beings [vocalized-noise] are of different sizes [vocalized-noise] and ah [vocalized-noise] strength parameters [vocalized-noise] hands etc [vocalized-noise] are of capacity [vocalized-noise] of application of force. Several [vocalized-noise] things are varying from men to men [vocalized-noise] from women and all that [vocalized-noise] and in fact [vocalized-noise] from a small [vocalized-noise] women's to a large [vocalized-noise] male [vocalized-noise]. If you find that there is a large variation [vocalized-noise] and this variation [vocalized-noise] ah known as the anthropometry because, about the body dimensions and the strength parameters [vocalized-noise].

So, ergonomics [vocalized-noise] I have just to introduce here [vocalized-noise] because this itself is a science which should [vocalized-noise] talks of [vocalized-noise] the application of the [vocalized-noise] application of the capability of the [vocalized-noise] application of the capability of the man [vocalized-noise] with the engineering knowledge that he has. So, that he designs machines equipment and ah processes [vocalized-noise] which are comfortable to operate [vocalized-noise] and ah [vocalized-noise] which are giving maximum output and safe to operate comfortable or safe to operate and gives maximum output [vocalized-noise].

So, the science is talking about the ergonomics that the ergo means work nomo is means law [vocalized-noise]. So, there should be a certain law followed for [vocalized-noise] doing this particular work or any work for that matter and that work because the human being is involved [vocalized-noise], it must be ah such that it is comfortable safe and he should be able to work for a longer duration of tine without ah harming his body [vocalized-noise] or harming [vocalized-noise] his own [vocalized-noise] physic [vocalized-noise].

So, that is why [vocalized-noise] ergonomics considerations are very important [vocalized-noise] so far as the design of the handle is concerned [noise], because the handle height this handle height will vary from human to [vocalized-noise] person to person [vocalized-noise]. Now because he does not have to hold it here he has to hold at a certain location, so the moment is you need to have the different dimensions. So, [vocalized-noise] there has to be [vocalized-noise] in this one, there has to be some device by which [vocalized-noise] and there is in fact [vocalized-noise] there are [vocalized-noise] locations here [vocalized-noise] by which you can adjust the [vocalized-noise] ah the [vocalized-noise] the position of this so this is important. So, that [vocalized-noise] when the person is walking he should not his leg should be in such a position that he should not come and hit this ah blade, so this is very important [vocalized-noise]. So, [vocalized-noise] weeding tool should be such that the operator does not have [vocalized-noise] to exert more than 60 nutrients ah push or ah pull.

In fact, ah pulling [vocalized-noise] he will not require man of force because, then he has to only pull the weight this ah [vocalized-noise] weight of the [vocalized-noise] equipment. But pushing he has to exert force ah because it has to cut the soil and cut the widths [vocalized-noise]. But then from literature we have found out that it should not be more than 6 kg or so [vocalized-noise] because, this this has to be operated for a longer durational tine [vocalized-noise] and we need to also work out [vocalized-noise] because when you have these designs you need to work out what should be work recycles how long the person should be able to operate that [vocalized-noise] and when should we take rest [vocalized-noise]. So, that ah the output is also more and ah the [vocalized-noise] the person is also comfortable he is safe [noise] [vocalized-noise].

Well a static loading unavoid a static efforts should not be more than 50 percent [vocalized-noise] of maximum, see static loading on the muscles [vocalized-noise] definitely because when the person is holding them [vocalized-noise] and tries to operate the [vocalized-noise] these muscles [noise] actually come into picture and ah [vocalized-noise] this loading should not be [vocalized-noise] from literature, we have found out this should not be 37.5 [vocalized-noise] Newtons [vocalized-noise] see less than that. So, it should not be more than that [vocalized-noise] these are the values which has been [vocalized-noise] which has been which have been found [vocalized-noise], now the frequency of operation.

Now, this of course depends from person to person and ah his ability depending upon the ability of the person who is operating the device [vocalized-noise]. So, about 30 to 50 strokes per minute have been found to be most optimum [vocalized-noise], ah when he is [vocalized-noise] doing this job [vocalized-noise] which will also give you enough ah rest and work output [vocalized-noise] ah. The length of the stroke is about 300 to 500 mm which we have [vocalized-noise] seen [vocalized-noise] because [vocalized-noise], in my equation which I showed you the mechanics while [vocalized-noise] [noise] showing the mechanics of push and pull [vocalized-noise], I had indicated that [vocalized-noise] ah the length of the stroke should be 300 to 500 mm [vocalized-noise].

Now, handle height well this is the one which is ah dependent on this ergonomics, then the handle height [vocalized-noise] should be this this is very important [vocalized-noise]. So, it is tells 0.7 tines the shoulder height now this will vary from here to here depending upon the height of the person, height is we call in ergonomics because the structure of the person total height of the person [vocalized-noise] from the [vocalized-noise] foot to the [noise] top here [noise] what is the total height and [vocalized-noise] ah then this h [vocalized-noise] 0.7 tines [vocalized-noise] of the shoulder height, now this is the total height now [noise] shoulder height [noise]. So, 0.7 tines from shoulder height [noise] depending upon [vocalized-noise] the height of the person is the one where the handle height should be there and accordingly therefore then you have to design here [vocalized-noise] what should be the [vocalized-noise] distances, what should be [vocalized-noise] the places where it should be ah bolted. So, that you get ah this particular one comfortable for a shorter person also for a longer person, this we have done lot of studies [vocalized-noise]. You will find particularly this a new in science [vocalized-noise] and ah it has been [vocalized-noise] used for ah many things in your daily life you might have seen [vocalized-noise].

If I give you an example that right from the [vocalized-noise] toothbrush which you [vocalized-noise] use in the morning [vocalized-noise] to the bed etc and recycle, now you can see everything has been thought of keeping in view the requirement the capabilities and the liking and the [vocalized-noise] feeling of the [vocalized-noise] human being that is why those [vocalized-noise] things have been designed [vocalized-noise]. This is another science [vocalized-noise] now we have utilized that science into design of the handle of this. So, that is one which has to be taken into consideration when you are designing [vocalized-noise]. So, what the element [vocalized-noise] is the cutting element next is this [vocalized-noise] and the wheel which I said that wheel has to be [vocalized-noise] enough ah diameter of the wheel. If you have a very big diameter of the wheel then also it will not help [vocalized-noise] because, then this will [vocalized-noise] the height of this will be higher [noise] [vocalized-noise].

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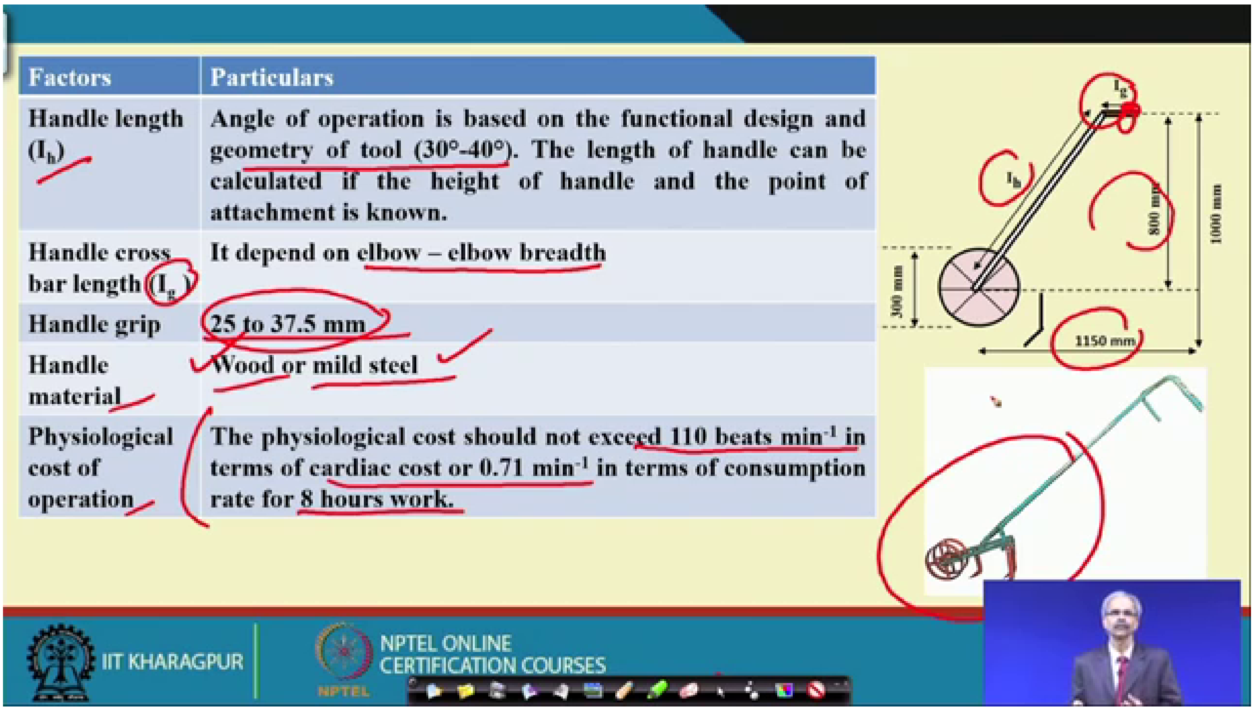

Well the [vocalized-noise] handle lengths ah with these are certain things which have been [vocalized-noise]. In fact, handle [vocalized-noise] length [vocalized-noise] sorry [noise] [vocalized-noise], see the handle length [vocalized-noise] I h is this handle length what should be the handle length. Now this will again depend on [vocalized-noise] what is the height that you want to maintain [vocalized-noise]. If you are maintaining a height 800 here [vocalized-noise] ah to 1000 depending on this and ah this distance [vocalized-noise]. So, the when you are this you need to know what is this I g what it is this I h [vocalized-noise] these are, see I g is the handle cross bar length this is this one [vocalized-noise] ah it depends on the elbow to elbow breadth [noise] yes this is there.

Because [vocalized-noise] how much the distance between these 2 [vocalized-noise] tool dependent then handle [vocalized-noise] length, well length of the handle will depend [vocalized-noise] ah what is the geometry of the tool [vocalized-noise] and how much height we want to [vocalized-noise] measure [vocalized-noise].

Now, what should the grip here in fact the handle grip [vocalized-noise] see the handle grip here this is [vocalized-noise] these the grip. So, this grip is also important [vocalized-noise] because a grip of ah person is smaller person [noise] and the taller person will vary. So, the grip has to be such that [vocalized-noise] he is in a position to grip it properly [vocalized-noise] and it should not be rough also because otherwise [noise] he will have problems here. So, it should be smooth [vocalized-noise] and he should be able to [vocalized-noise] hold it properly [vocalized-noise], larger person will have a bigger [vocalized-noise] grip [vocalized-noise] and for a smaller person smaller grip [vocalized-noise]. So, this also is very important [vocalized-noise] and that is way we are saying that [vocalized-noise] you can see the handle grip vary from 25 to 37.5 millimeter [vocalized-noise].

Now, these are data from the anthropometric [vocalized-noise] ah analysis [vocalized-noise] which we have done for [vocalized-noise] the [vocalized-noise] whole country [vocalized-noise] and in fact these are worldwide data available [vocalized-noise] and for India we have developed at IIT Kharagpur and from there [vocalized-noise] I am in a position to give you that [vocalized-noise] this handle grip [vocalized-noise] is this to this [noise] vary a variation [vocalized-noise]. Which in fact depending upon [vocalized-noise] the height of the person [vocalized-noise] can be utilized [vocalized-noise]. Handle material [vocalized-noise] well the material of the handle simple [vocalized-noise] is very simple [vocalized-noise], handle of material will depend on what you want, it should be a lighter one [vocalized-noise]. So, [vocalized-noise] lighter mild steel pipes or enough [vocalized-noise] or you can have wood if you are thinking to have a device which will be easier fine you can have we use our strong [vocalized-noise] bamboo sheet [vocalized-noise].

You can see that [vocalized-noise] bamboo rods ah you can see [vocalized-noise] or wood [vocalized-noise] whatever, but I would say that ah if you put wood and all that maybe the [vocalized-noise] the cost will be higher than having a simple pipe, which is [vocalized-noise] a worth enough a mild steel pipe will do the job [vocalized-noise] the cost of operation [vocalized-noise]. Now, we need to also [vocalized-noise] think about this part [vocalized-noise] see [vocalized-noise] I had just talked earlier [noise] that ah [vocalized-noise] these are a design within the capacity and capability of the man [vocalized-noise] or the human being [vocalized-noise]. So, when we are talking of the amount of work done [noise] definitely a person when he starts muscles [noise] starts working [vocalized-noise], then he will [vocalized-noise] start getting [vocalized-noise] fatigued after [noise] some tine [vocalized-noise].

So, we need to have a control on this and that is why this [vocalized-noise] physiological cost of operation what is the physiological cost operation, that means how much [vocalized-noise] this heart beat and then we do measure all these things over a period of tine [vocalized-noise] and that is why a recalls a rest and work cycle [noise] has to be created [vocalized-noise]. So, rest and work [vocalized-noise] cycle has to be created for [vocalized-noise] operation of such devices [vocalized-noise] [noise], then only you can get ah [vocalized-noise] an output and enough [noise] [vocalized-noise] load or [vocalized-noise] you can say that enough [vocalized-noise] good design and work output [noise].

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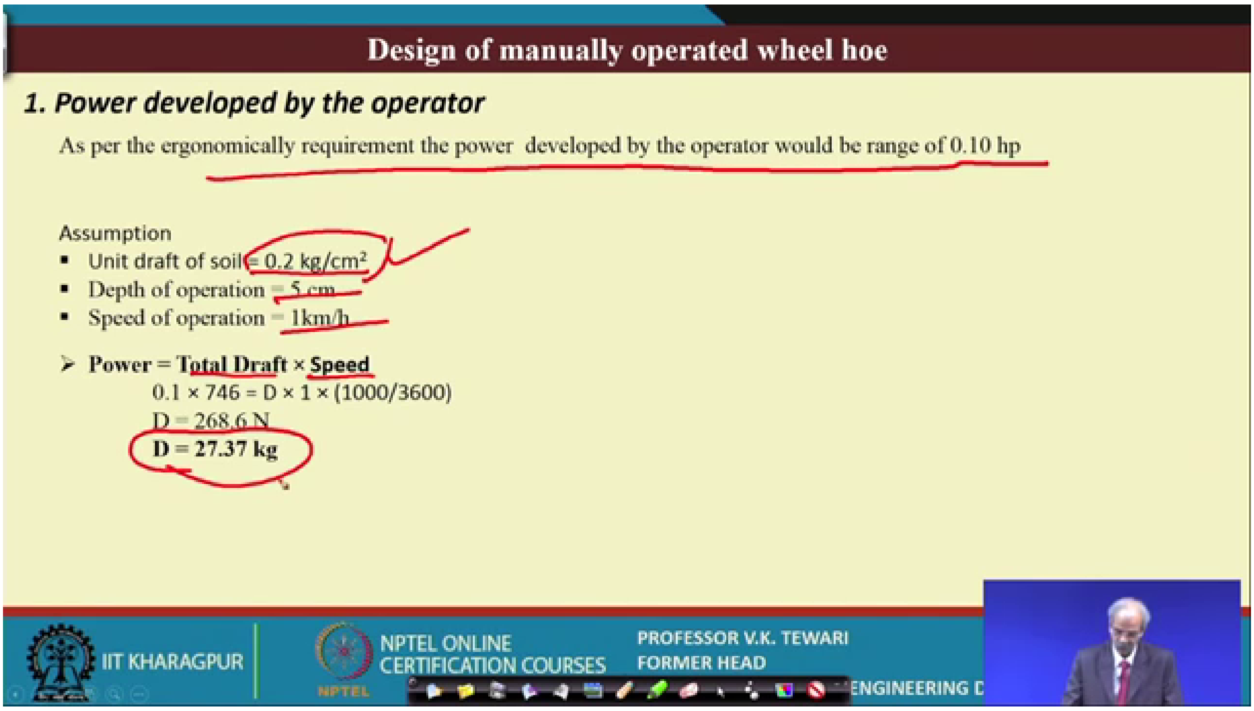

Well power developed by the operator well this is one thing which [vocalized-noise] we which [vocalized-noise] we have done at IIT Kharagpur and in fact [vocalized-noise] for this [vocalized-noise] I will not tell you what are the instrumentation we required [vocalized-noise]. But then [vocalized-noise] ah very nutshell [vocalized-noise] in nutshell I would like to explain [vocalized-noise], that ah how did we measure the power of the person [vocalized-noise] [noise] as such [vocalized-noise] the maximum power that a person can develop [vocalized-noise] is very high ah it has been found to be about 5 horsepower so [vocalized-noise] and what is that 5 horsepower?

In fact, you might have seen that the [vocalized-noise] weightlifters [noise]. So, when they lift the weight of say 200 250 kg suddenly [vocalized-noise] [noise] up to a distance of that, so [noise] in that short duration of tine [vocalized-noise] that [vocalized-noise] ah weight is lifted. So, m g h and from there you can convert and say [vocalized-noise] maximum of 5 horsepower so they can develop [vocalized-noise].

But that [vocalized-noise] those power [vocalized-noise] are very instants [vocalized-noise] instantaneous powers or instant powers [vocalized-noise] we cannot use them [vocalized-noise]. But what we want is the power which ah can be utilized over a period of tine without hurting the [vocalized-noise] physic [noise] of the person health of the person [vocalized-noise] and ah maintaining [noise] every safety of that person in the device or in the task which has been given to him [noise] [vocalized-noise].

So, here [vocalized-noise] I just want to [noise] ergonomically requirement of power developed by the man is 0.1 [vocalized-noise] hp that is what we take [vocalized-noise] is just 1 tenth of a horsepower that we take [noise] [vocalized-noise] and ah [noise] so unit draft of soil if the unit depth of soil is [noise] 0.2 kg. Depending upon the [vocalized-noise] ah type of soil that we are using, see this is the this will vary [vocalized-noise] generally [vocalized-noise] soil where [vocalized-noise] you are talking of ah first opening the soil.

But this is a condition where the soil is [vocalized-noise] rather very [vocalized-noise] softer not [vocalized-noise] ah very moist as such, but softer [noise] [vocalized-noise] and ah it is easier to move through this [noise], that is why the unit draft considered here a [noise] [vocalized-noise]. A consideration has to be given on this value whether you want to be 0.2 or or 0.4, say maybe for a particular [vocalized-noise] soil here we take 0.4. But here [vocalized-noise] we have taken 0.2 [vocalized-noise] because that much of force is not required [vocalized-noise] at that condition of [vocalized-noise] cutting of the wid[ths]- [vocalized-noise].

Now, depth operation is [noise] slightly higher we are [vocalized-noise] considering, but then [vocalized-noise] even depth operation is [vocalized-noise] ah up to 5 centimeters maybe 2 inches [vocalized-noise] which is not so in the case. But then [vocalized-noise] up even if it is [vocalized-noise] 5 centimeters [vocalized-noise] the operation is about 1 kilometer per hour [vocalized-noise] or 1 to 1.5 kilometer per hour [vocalized-noise]. So, the total power developed [vocalized-noise] total draft into is speed [vocalized-noise], this comes to be this is the [noise] ah D which comes as 37 [vocalized-noise] 27.37 kg [vocalized-noise] this is the total draft [noise] that we [vocalized-noise] get here [vocalized-noise] [noise] power developed by the switch [vocalized-noise]. So, much of ah is the draft which we can [vocalized-noise] ah think of out of the [noise] human being over here [noise] [vocalized-noise].

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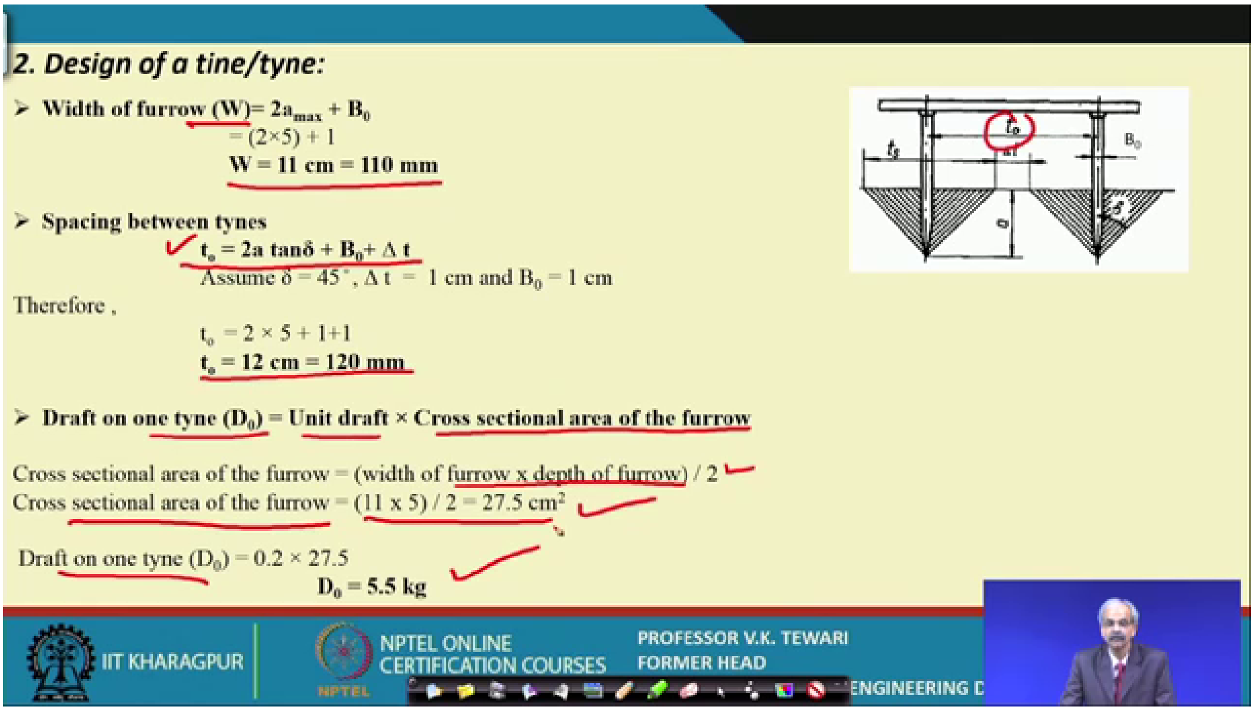

Well when we are [vocalized-noise] talking of the designs [vocalized-noise] of the tines [vocalized-noise], how do you tines to work in and if [vocalized-noise] in the soil [vocalized-noise] and what is this a zone of working. So, this has already been shown to you if you recall [noise] ah I had [vocalized-noise] dealt with this [vocalized-noise] treatment of the [vocalized-noise] tines [vocalized-noise] working [vocalized-noise] and the [vocalized-noise] width of operation as well as the [vocalized-noise] ah spacing between these, these [vocalized-noise] if you recall I had talked up. But then [vocalized-noise] it is quite ah relative and relevance here that is why I have brought it back here [vocalized-noise] to [vocalized-noise] to and to [vocalized-noise] tell you that what considerations we do give [vocalized-noise], because the zone [noise] of working is very important [vocalized-noise].

Why you get ah [vocalized-noise] 2 tines why we have 3 tines in that [vocalized-noise] any particular width row to row is spacing of the crop [noise], that is the one where [vocalized-noise] this will [vocalized-noise] be utilized for [vocalized-noise] how many [vocalized-noise] types you want to have [noise] this is one where it is [vocalized-noise] [noise] right and therefore [vocalized-noise] ah the width of this [noise], therefore the width of this is see [vocalized-noise] width of ah w here [noise] then this is the width 110 [vocalized-noise] [noise]. Now spacing between the tines well we have talked of the spacing's and then this is the value which is shown over here this is the value [vocalized-noise] so the spacing is this [noise]. Now, therefore t0 is about 120 millimeter draft on 1 tyne we had talked of the value of draft which we got there [noise] [vocalized-noise].

So, unit draft into cross sectional area of the furrow [noise] [vocalized-noise], so cross sectional area of the furrow width of the furrow into depth of furrow [vocalized-noise] by 2 here takes [vocalized-noise] cross sectional area of the flow [vocalized-noise] actually this value [vocalized-noise] and actually draft on one tine [noise] is something like this this is the value [noise] [vocalized-noise].

Now, ah where we can say that the force [vocalized-noise] that was talked of [vocalized-noise] should not be more than 60 [vocalized-noise] ah Newton or 6 kg [vocalized-noise], so here you can see that more or less we are in a [noise] position to show [vocalized-noise] that the [vocalized-noise] ah requirement of this tine also [noise] is within this range [noise]. Of course, then therefore [vocalized-noise] of course we have thought that the [noise] width ah depth operation is about ah 5 centimeters or so [vocalized-noise].

But then this is not that much [vocalized-noise], but [vocalized-noise] even then [noise] if you take that to be on the higher side [noise] well with this is well within our requirement or well within the capacity of the person [vocalized-noise] and of course this will vary from person to person if the [vocalized-noise] stronger person is here, you may do it more and their output will be more [vocalized-noise] as compared to another person [noise].

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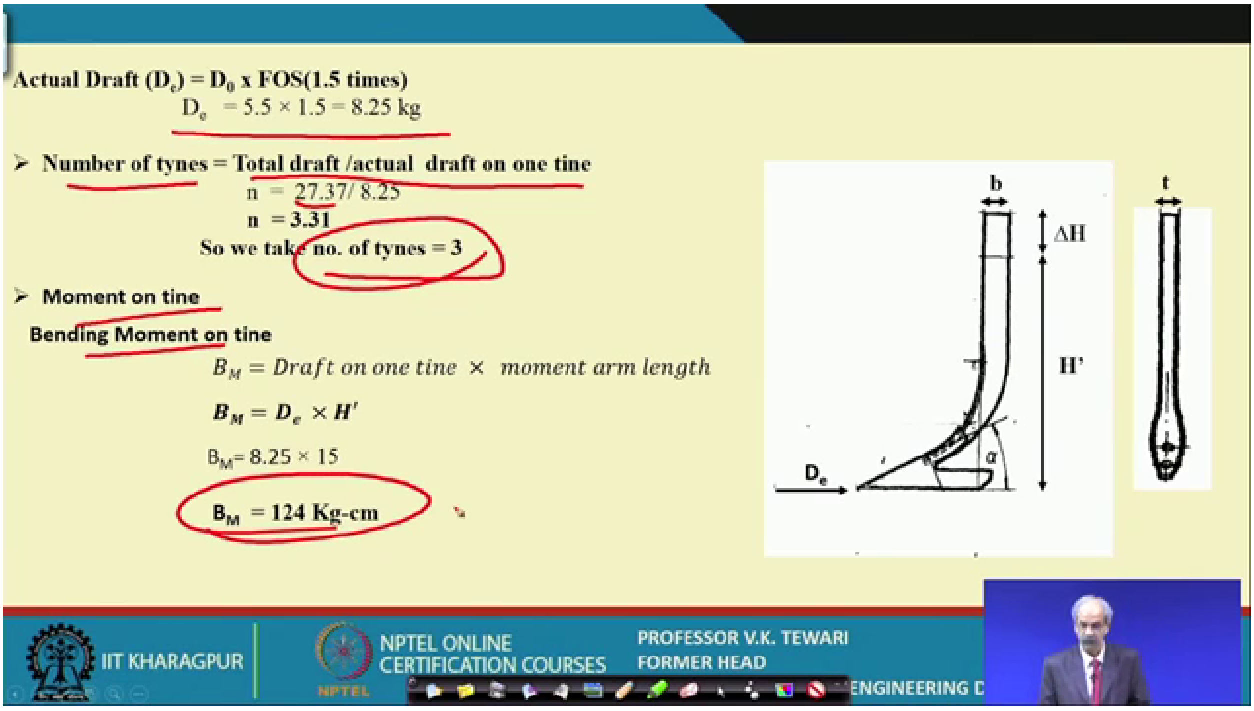

Actual draft then [vocalized-noise] what is the actual draft then [vocalized-noise], the factor of safety you need to attend a factor factor of safety [vocalized-noise] ah always when you have the design here [vocalized-noise]. So, the factor using factor of safety [vocalized-noise] then you are getting here [vocalized-noise] that this value is about 8.25 kg [vocalized-noise], so [vocalized-noise] well [vocalized-noise] the [vocalized-noise] value is swelling a bit [vocalized-noise].

But then ah [vocalized-noise] you have to control with the number of tines a number of tines and the [vocalized-noise] design of ah the tines and ah spacing etc [vocalized-noise] [noise] and ah you have to see [noise] whether [vocalized-noise] which crop you have taken [vocalized-noise]. These are some of the things which we need to be thought of [vocalized-noise] and we [vocalized-noise] found that the number of tines there are 3 tines which can be utilized [vocalized-noise] because, this is the [vocalized-noise] draft that you got [vocalized-noise] and this is the draft per a unit [vocalized-noise]. So, therefore it is well within [noise] [vocalized-noise] and you can go up to a maximum of 3 [vocalized-noise] ah tines [vocalized-noise].

Now, you can go up to 3 tine this is what ah theoretically we have a got [vocalized-noise], but depending on the spacing you can ah think of ah whether you have 2 or 3 or you have [vocalized-noise] 2 in the front and 3 back depending upon what ah you are ah [vocalized-noise] how much is the width etc of the tine [vocalized-noise] and so what

what details are there how do we go it [vocalized-noise] about the ah strength of those [vocalized-noise]. We have to follow the similar machine designed ah values machine design theory [vocalized-noise] and from there you can know that the [vocalized-noise] moment on the tine is required what is the bending moment [vocalized-noise] on the tine. So, we can find out that this bonding moment is finding a [vocalized-noise] appear to be [vocalized-noise] about 124 [vocalized-noise] kg of centimeter for a given value [vocalized-noise] for a given value or given size of the tine that we have considered [vocalized-noise] in this case [noise] [vocalized-noise].

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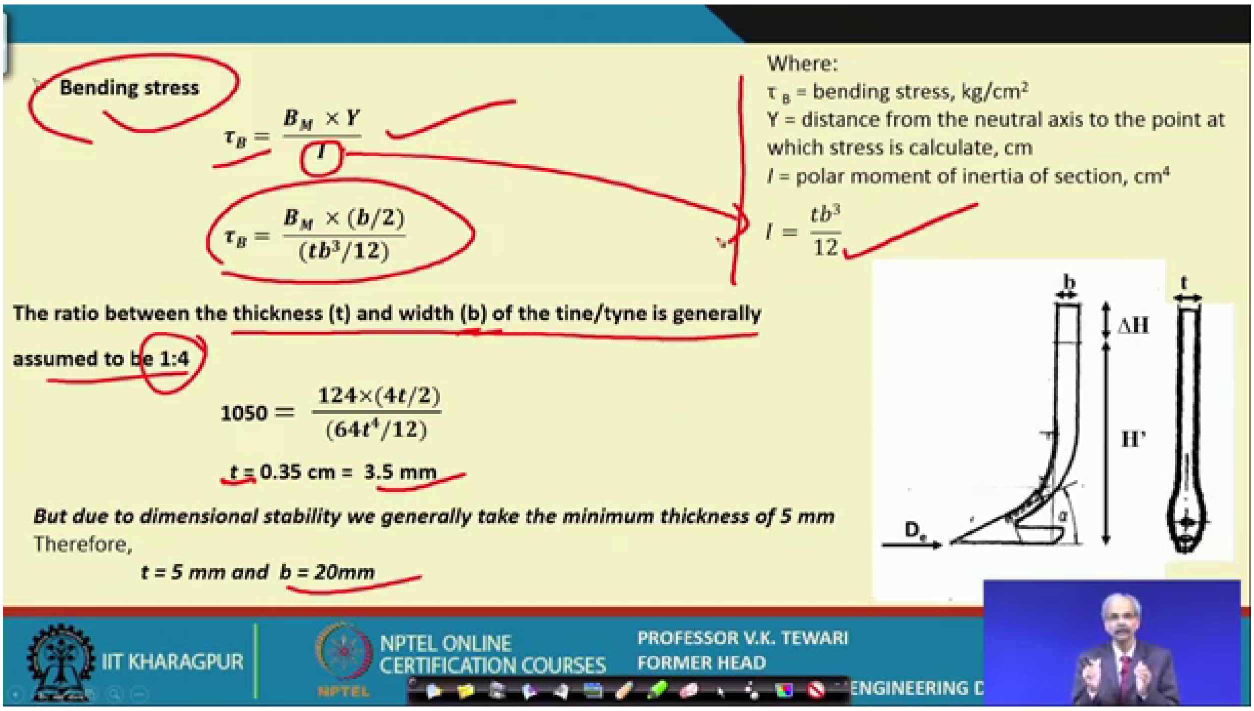

So, similarly bending stress you will be in a position to get ah the bending stress [noise] here [vocalized-noise], bending stress is known [vocalized-noise] and then this ah bending is torsionally [noise] stress [vocalized-noise] you can [vocalized-noise] sorry [vocalized-noise]. Bending stress is here [vocalized-noise] now the ratio between how do we get once we get this [noise] because, we are not getting torsional here [vocalized-noise] we are talking of only the bending part [vocalized-noise]. So, [vocalized-noise] what we do here is [vocalized-noise] t is to be [vocalized-noise] a width which you had discussed earlier [vocalized-noise], your similar thing can be taken about 1 is to 4 [vocalized-noise] and then you are getting t the thickness of this [noise] [vocalized-noise] tine [vocalized-noise] and the width of this tine here [vocalized-noise].

So, thickness is this and the width is about approximately this [noise] [vocalized-noise] now although we have got 3.5 millimeter. But then you have to choose this what is available in the market [vocalized-noise], what is the size of the material which is available for [vocalized-noise] making it to [noise] [vocalized-noise] this ah type of a tine which you have [vocalized-noise] ok [vocalized-noise] and then of course these are ones which come from the [vocalized-noise] machine design, formally which [vocalized-noise] which have been utilized here [vocalized-noise] you can see this is the one which is here [vocalized-noise].

So, these are the [vocalized-noise] designs which [vocalized-noise] I have already discussed, but then they are relevant here [vocalized-noise] because although it is a very small equipment [vocalized-noise]. But [vocalized-noise] kindly appreciate that [vocalized-noise] what sort of [vocalized-noise] a you can say assumptions and considerations are required for giving a proper shape of a design for a [vocalized-noise] weeding tool particularly a manual drawn push pull type of weeding tool [noise] design of the handle.

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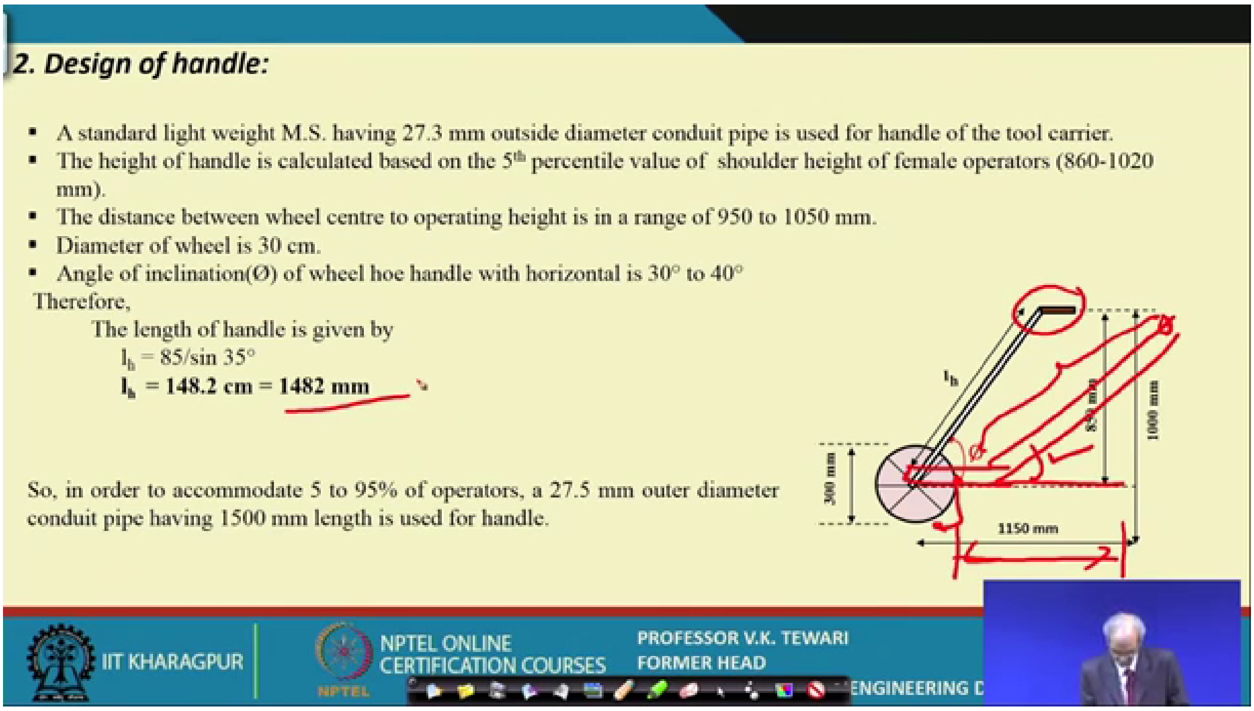

Well we have talked of the design of the handle [vocalized-noise] earlier already and I have talked of the what should be the material [vocalized-noise], material I have said that well material in the length etc [vocalized-noise]. Depending upon the angle that you are trying to maintain actually [noise] [vocalized-noise] this should be not here [vocalized-noise] this should be like this and then it goes like this here [vocalized-noise].

So, depending upon [vocalized-noise] the the [vocalized-noise] this angle which we are trying to maintain, this angle [vocalized-noise] the length etc [noise] this length [vocalized-noise] as well as the height here [vocalized-noise] and the [vocalized-noise] distance from [vocalized-noise] this point. So, these are to be considered [vocalized-noise] as I have said earlier [vocalized-noise] and it has to be at the [vocalized-noise] [noise] the holding etc everything has to be considered. We have discussed this [vocalized-noise] and a [vocalized-noise] a representative value comes 1482 [vocalized-noise] millimeter [vocalized-noise]. So, this can be [vocalized-noise] developed I have discussed it in detail about this part [noise] [vocalized-noise].

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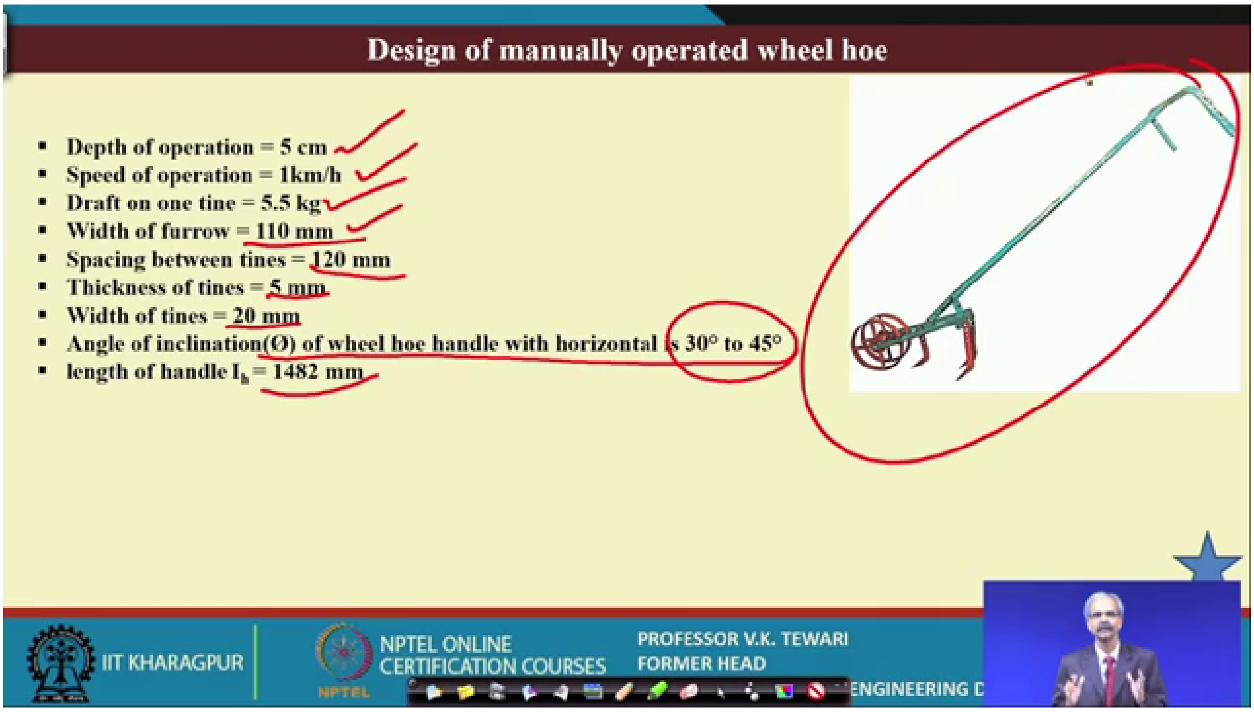

So, actually then if I say that how [vocalized-noise] how you have (Refer Time: 31:15) designed [vocalized-noise], we can see that [noise] what we have got a [vocalized-noise] weeding device [noise] [vocalized-noise]. Weeding device [vocalized-noise] which can operate maximum 5 centimeter depth speed operation could be 1 kilometer per hour [vocalized-noise] and the draft on one tine will be this width of furrow is taken to be this much [vocalized-noise] and then spacing between ah the tines is 120 [vocalized-noise] thickness of the tine is this. Then the [vocalized-noise] width of the tine is this much the angle of inclination of the handle [vocalized-noise] ah between to 30 to 45 degree [vocalized-noise] and the length of this [vocalized-noise]. A representative [vocalized-noise] design ah has been shown [vocalized-noise] from [vocalized-noise] mechanical as well as ah ergonomic points of view for a manually operated wheel hoe [vocalized-noise] which is a push pull type of a weeder [vocalized-noise].

Now, you can so here this is the design which we are given as a representative one [vocalized-noise], you can use this concept and the consideration and the procedure what is important here I want to emphasize is [noise] that. The procedure that we have followed for each and every component [vocalized-noise] ah for [vocalized-noise] giving a good design which can be done for if you want a [vocalized-noise] mechanical device if you want to have a power source.

Then accordingly, but these considerations will be definitely there [vocalized-noise] and ah power may be utilized for only moving or power may be applied for a [noise] rotation of the device etc. Many [vocalized-noise] derivations or many [vocalized-noise] ah you can say that [vocalized-noise] many models could be created [vocalized-noise] using this, I think ah I have discussed at length [vocalized-noise] and your questions will be most welcome as and when required [vocalized-noise].

Thank you [noise].