Ergonomics for Beginners Industrial Design Perspective

Prof. D. Chakrabarti

Department of Design

Indian Institute of Technology, Guwahati

Module No. # 04

Posture and movement

Lecture No. # 18

Chair Characteristics

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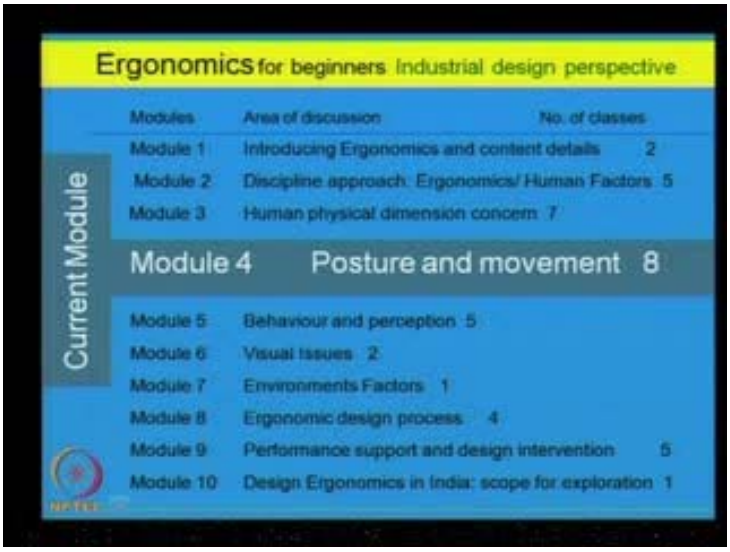

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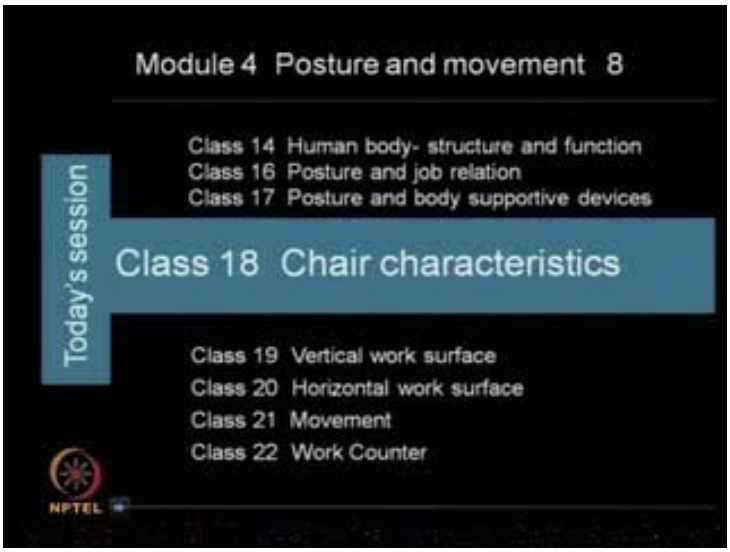

Welcome to this 18th session under the module 4 - posture and movement. We will be discussing under class number 18th that is the today's session is on chair characteristics.

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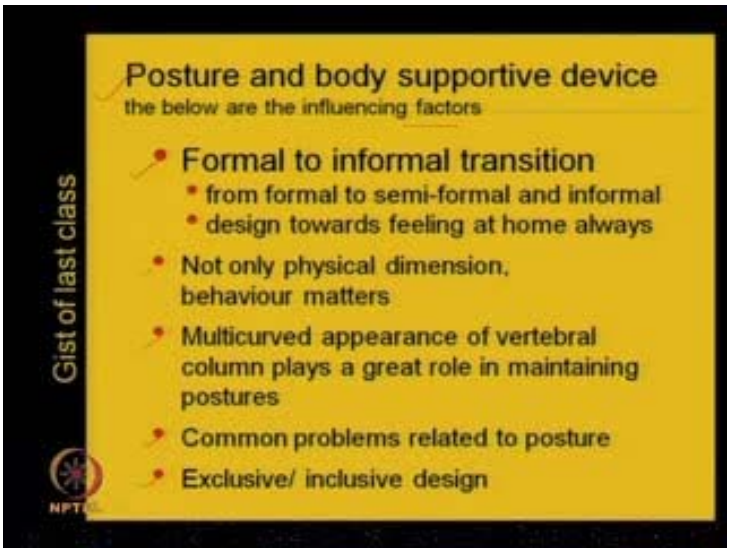

Now, to recollect whatever we discussed in last class; the gist of last class is that posture and body supportive device, the below are the influencing factors; these influencing factors what we mentioned - the formal to informal transition is going on, that is that, from formal to semi-formal and informal atmosphere, we are prettying to create, to invite creative environment, and design accordingly towards feeling at home always. So, if you

feel at home, in your workplace also, then one can work with creativity; means, the less physical load will be on him; so, he will be able to perform better.

Now, for that not only the physical dimension requirement is there, the behavior matters, how we behave to do certain work or spending leisure time, that also we should consider with physical dimension concerns.

Another topic we have discussed that the multicurved appearance of vertebral column that plays a great role in maintaining the postures. When we adopt awkward postures, this vertebral column takes the load additionally, and thus it affects the performance, and it raises quick fatigue.

The common problems related to posture, we also discussed; and finally, in last class we have discussed, the exclusive treatment of varieties of requirements with inclusive design ideation; so that, the exclusive requirement will be fulfilled within a framework of inclusive atmosphere.

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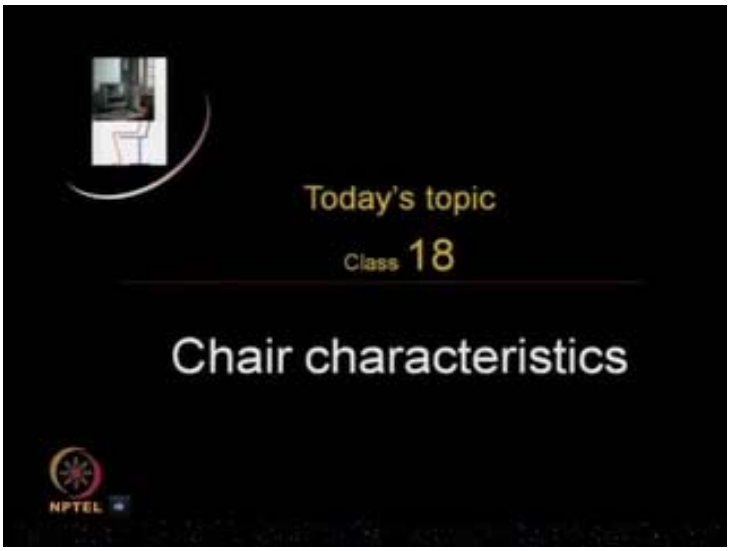

So, with this background, the today's topic the class number 18th is chair characteristics. Now, what are the elements or concerns we should consider for a chair design?

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Now, the if we see the seat, now the free sitting arrangement, sitting arrangement with a beautiful atmosphere in a busy work, busy place, varieties of seats and the sitting posture also varies and seen here; with that varieties of furniture's are being developed, and this concern demand more from your furniture. Now, with this, it can be said that - the seat should have context and requirement, concerns, need and value addition; though a chair or a seat requires a seat platform, at a specific height; and a back rest, to support the back and armrest, to support the hanging arms; with this basic structure, the addition that a value addition with aesthetics, and comfort, is our concern today for ergonomic design practice, while considering some seat design aspect.

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The chair characteristics: now a days, the chairs are coming in market, that quite often, it claims that exclusive ergonomics, etcetera, turnings. Now, these names, these words attached to this furniture, it is a business claim or it is a beneficial effect that needs to be analyzed and considered critically; so, the chair characteristics, the approach to design in the ergonomic way that we are going to discuss now.

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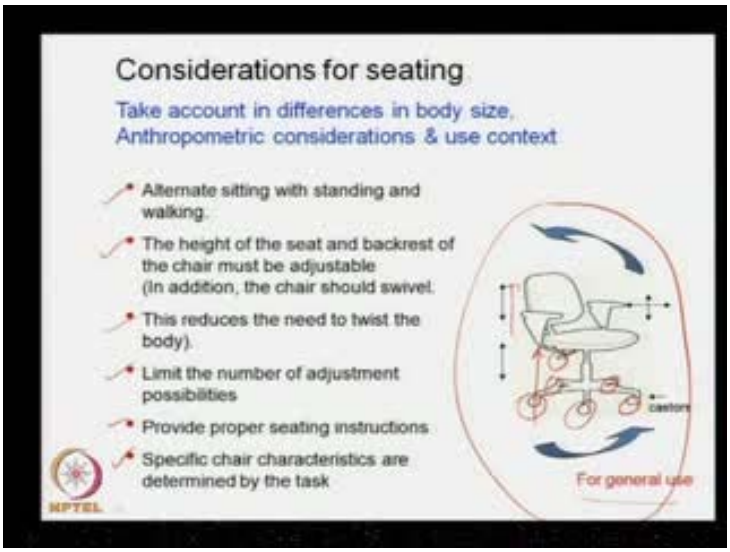

General considerations for seating, is that, take account in difference in body sizes, anthropometric considerations and use context. Now, if we see a typical chair here, it

should have some bases, if these bases have casters, the swiveling wheels, then it can move. If less than four legs components are there, then the free movability, may be a problem, with the pipe legs and all the swiveling wheels fitted in it; it provides a free movement, specialty height adjustability. The armrest, it also should have adjustability front, back, and up, down and the back rest also.

So, these figures are the necessary for general use. Now, for a working condition, what should be the ideal usage of seats? It is said that - alternate seating, with standing and walking is necessary, to avoid a static load on body. The height of the seat and back rest of chair must be adjustable - in addition, the chair should be swiveled - this reduces the need to twist the body.

Limit the number of adjustment possibilities; now, furniture we may provide many adjustability features, so that, it can adjust the body as we prefer, but for mass use, and for the easy maintenance and use, it would be better; if we can limit the number of adjustment possibilities to fit a certain requirement.

Now, provide proper sitting instructions; now, furniture is a chair seat is given, but how to use that chair? How to sit, whether you should bend or how you should use the armrests and etcetera? It should be properly instructed or what are the adjustment facilities are there, and how to adjust? This should be instructed properly, either with inbuilt features, inbuilt made or a supplement of with the instructions seats. The specific chair characteristics are determined by the task. Now, for dining chair, for dining purpose, it is better to have almost 90 degree angle, hip the thigh and trunk angle.

So, the chair, back rest and etcetera, it should be in such a way that it does not allow your back to go more than 100 degree backwards, it assists you to attain that upright position; like that, if a sofa is used for that it is assumed that back rest will go back, means, the trunk and the thigh that angle should be more than 120 degree or around 120 degree, like that; and obviously the dining chair height should be more than the sofa height, and why it is necessary? That we are going to discuss in next slides.

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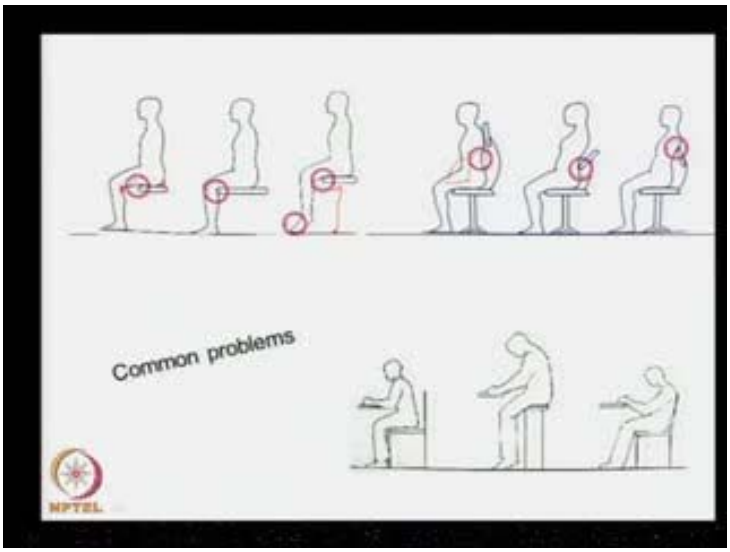

Now, certain common problems if the seat base is shorter than the your buttock to the popliteal length, then there is a place cart at the lower thigh area; if it is more, than there will be a problem in lower the back of the knee, that is the popliteal point area.

If the height is more than your popliteal height, then what is happen? The leg hangs, and so, a place cart at the underneath of the thigh, and also to get the foot hold, there is a problem in the foot area. If in the 90 degree angle here, if back rest is given at the shoulder level, then it creates a problem at the lower back, the lumbar area; if the back rest is in a slanting position, the nib points here, inches here, and so, the problem is here; and if it is a reverse also, it does not provide a good back support. Now, the heights and etcetera are also, it says, the same problem, similar problems.

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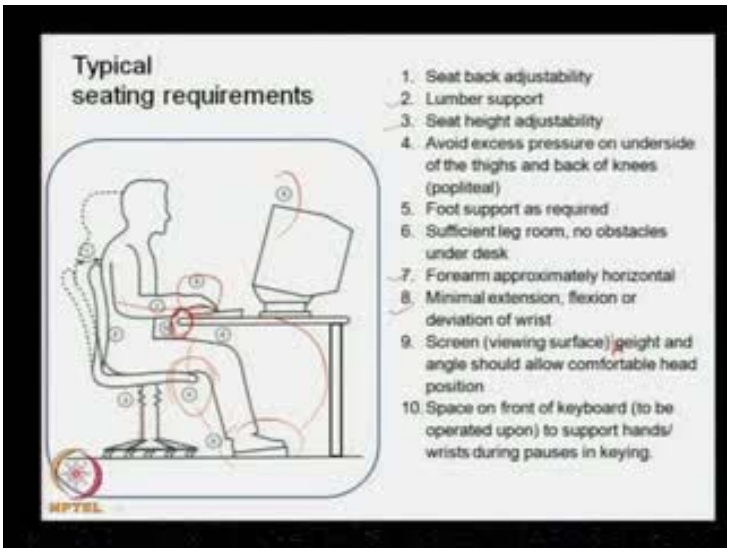

Now, if we see a typical seating requirement, here a seating requirement in a video, the visual displayed unit maybe computer or whatever, now here 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 points are given here that needs to be considered. Like, 1 that seat back adjustability should be maintained; the lumber support has to be provided; seat height adjustability should be there; number 4, this one avoid excess pressure on under side of the thighs, and back of knees popliteal, these are the concerns; foot support as required - foot support; sufficient leg room, so that, this space a sufficient leg room should be provided, no obstacle under the desk; number 7 is that the forearm approximately horizontal to the work horizontal forearm; minimal extension, flexion or deviation of the wrist; number 9, the screen or viewing surface, the height and angle should also comfortable head position; number 10 is that space on front of the keyboard, this much space has to be kept free for palm support here, to support hands or wrist during pauses in keying function. So, these are the general typical seating requirements for a reading.

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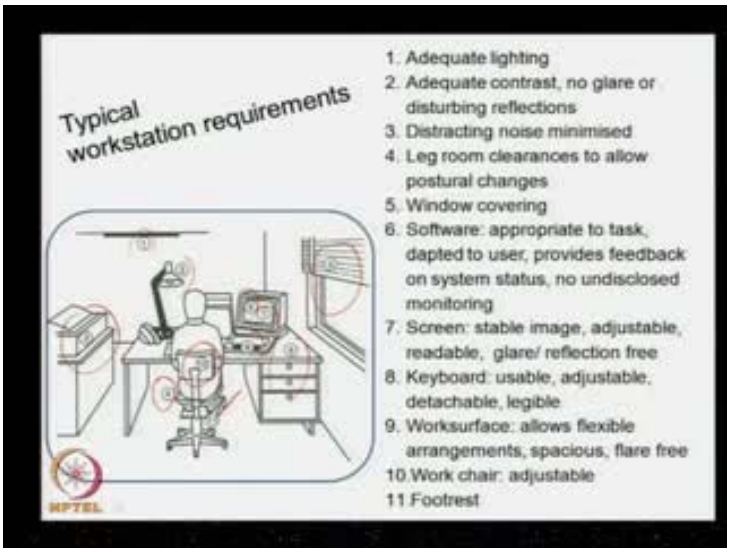

Now, the typical workstation requirement: so, this workstation, the person is working here with computer, and some other accessories in this, then what should be there? Now, we all are discussing in reference to the seat design.

Now, the adequate, here also 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 points are here. The point number 1 is that adequate lighting should be there; point number 2, the adequate contrast, no glare or disturbing reflections; number 3, the distracting noise minimized; number 4, here the leg room clearance to allow postural changes; number 5, window covering, needs to be there; number 6, software, etcetera, related matter that appropriate to task, adapt to user, provides feedback on system status, no undisclosed monitoring, etcetera; number 7, the screen: stable image, adjustable, readable, glare and reflection free, and if these problems are there then this person accordingly will adopt a equilier posture, to focus on that, and then that the seat may not support those positions; number 8 is that the key position keyboard: usable, adjustable, detachable, legible; number 9, work surface: this one allows flexible arrangements, spacious, flare free; number 10, is that, work chair: adjustable; and the foot rest should be provided if it is necessary.

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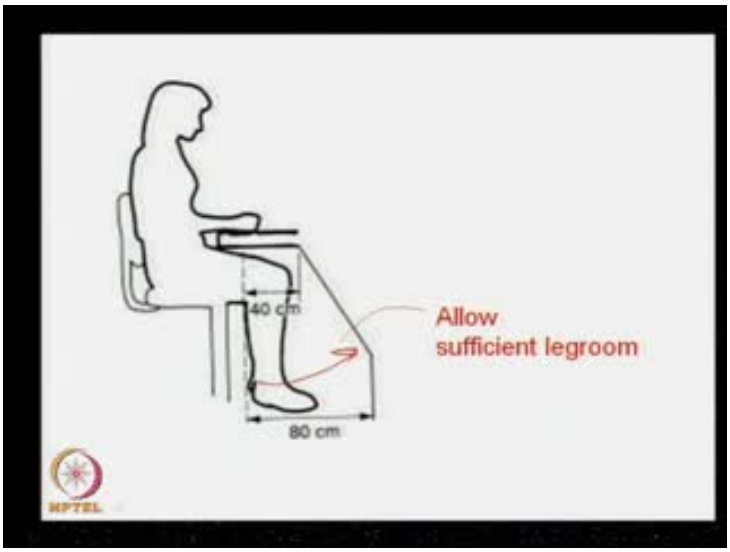

So, with this we say that - there should be sufficient leg room, so that the leg free movement is possible.

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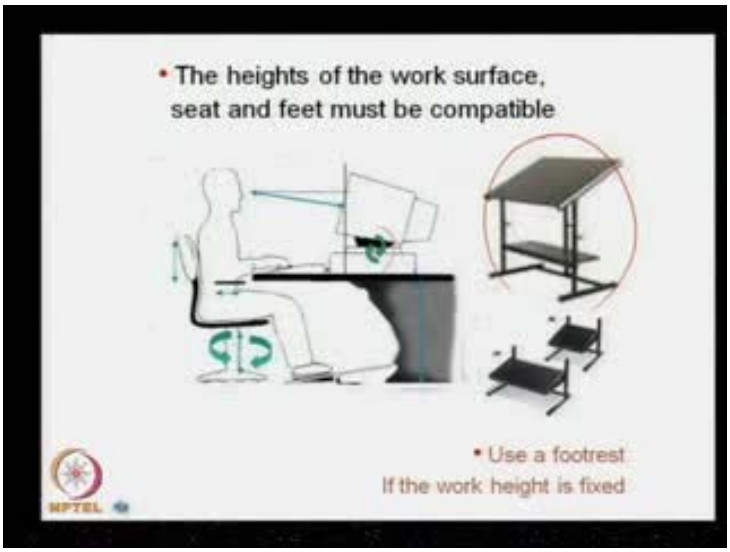

The heights of the work surface, seat and feet must be compatible. So, these are the movement possibilities should be there, here also movement possibilities should be there. And specifically, this type of furniture if it is used, then foot rest and you the table surface maybe adjustable; and some foot rest can also be used like this. Use a foot rest if the work height is fixed, so that you can get proper foothold.

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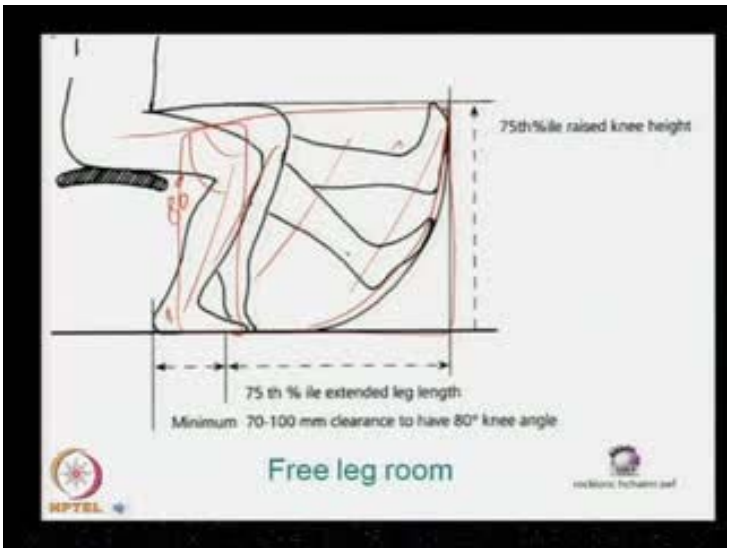

Now, if a person sits, now normally what is happen? This is the 90 degree angle, to assist raising, one cannot raise with this 90 degree foot position; so, foot has to go back around 80 degree; and then, this from this top or a knee this area is that around 7 to 10 centimeters, space should be kept free, so that it should assist raising. And now, if the leg extends it takes us furniture like this; so, this must space to be kept free, for free leg room.

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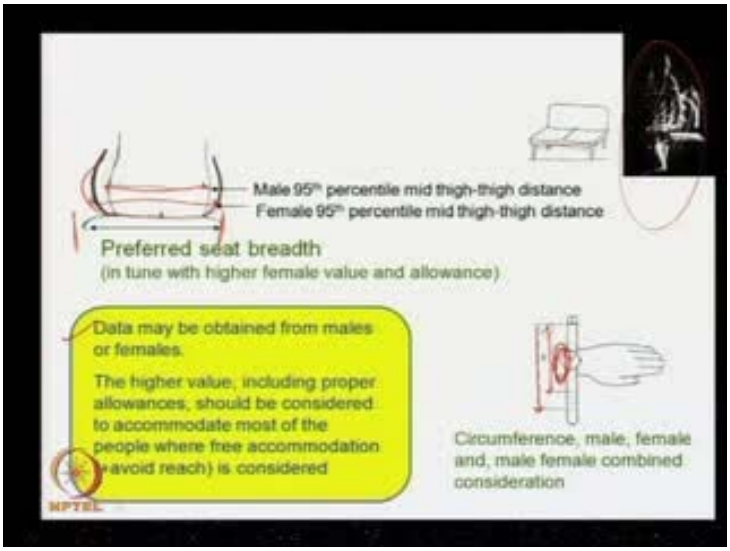

Now, the percentiles figures and etcetera, now for any seat design, we require body dimension; now, for what type of dimension we should consider specifically for seat with its breadth. Now, if this is a seat here, now suppose this is a back of a male form and this is back of suppose female form. Now, if we see the 95th percentile of this thigh to thigh distance, and this is the female 95th percentile of thigh to thigh distance, then which one we should considered; instead all those things, take a combined data male and female combined form, and then its 95th percentile you take. And then accordingly, if you have the seat, then male, female most of the people, below that combined 95th percentile of hip breadth, may sit or may accommodate in this seat.

As for example, it can be said that - why we should use this percentile figures and etcetera? Like, you watch and wrist watch, a wrist watch, the circumference male and female, and male, female combined considerations, is that, suppose this a, this dimension circumference is the fifth percentile, and this b, this is, this circumference is the 95th percentile of the wrist dimension. Now, the distance in between the 5th percentile and 95th percentile, this area we should have the various, this holes here; so that, this wrist watch, any person having wrist circumference from 5th percentile to 95th percentile can use it.

So, with this it can be said that - data may be obtained from males or females, but the higher value including proper allowances, should be considered to accommodate most of the people, where free accommodation plus avoid reach value is considered. Now, another thing is that why in certain furniture, for a two seaters, a specific reese is provided here? So that, this reese does not allow a third person to seat here. So, this type of special features also can guide people how to use the furniture; and this type of studies are normally done to see that what would be the seat pattern while standing to sitting, the what body behaves, and accordingly the seat angles, and etcetera are decided.

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Now, if we see this figure, though seats are provided, but now see the posture they are attaining; so, same furniture, similar furniture, but varieties of postures are being adopted, depending on the tasks they are performing – phoning, reading, and etcetera the replaying that.

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So, furniture usage depends on the context; now, here a common feast had been shown here; now see the clearance value is a concern here, so that to come out and to go in. And now, when this figure says that - when for eating he leans forward, the leg also comes back; so means, what is, now with this it can be said that - when you bend forward, the lower leg also takes a parallel position. In this figure, when a person sits like this way, when the angle goes back, this back rest, then it is difficult to keep leg in a direct hanging position; so, it leg also goes straight.

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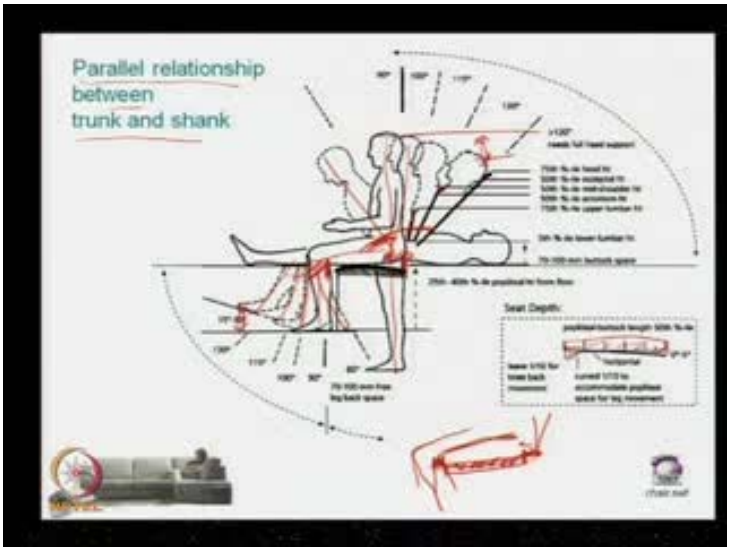

Now, it says that, now with this figure, it can be clearly mentioned that there is a parallel relationship between trunk and the shank; the shank is that lower leg and this is the trunk. Now, here if we see from this figure, when a person is standing, so the trunk and leg in a vertical plain; now, when he is sitting with a 90 degree angle, then this trunk and this lower leg is in a parallel position.

Now, when this back goes around 100 degree here, then leg also comes forward; so, when this is 100 degree, this is also similar leg goes here. Now, till here, it is said that - till 100 to 115 angle, we, it is require only lumbar support. Now, when it goes to around 115 to 120 degree angle here, then it requires around shoulder support, and then accordingly the leg also comes forward; and then when it comes forward, now you can see that this buttock also extends to forward, when it goes back. Now, when this angle is around 130 degree or more, then in this position to maintain head in upright position is difficult; so, we require a total head support.

Now, when it is 130 degree head support is there, the leg also comes with this 130 degree like that; so, now from here to here whatever the distance, it comes down, here the same thing, it also goes up, and then this also the same; so, this one top, there is buttock area, and the foot height these are almost same. So, with this it can be said that - the trunk and the shank, it maintains parallel relationship, when it goes front like this way, then leg also comes back; means, what is happen? When we try to Reese one leg normally goes back, and with the pushing force, it goes it takes upward standing position; so, this feature, we must consider while developing any kind of sitting device.

Now, thing comes, the what would be the length of this seat depth, seat? Normally, it is said that - from this popliteal point to the buttock, if we take this length, suppose this is the total length; now, we can say suppose this is the total length from buttock to lower leg, this distance; now, if we use back rest, then this comes little forward, so around some space, we do not use; to assist raising when leg comes like this, in this position, then this portion, we do not use. So, these are the space, is the only effected length for the sitting; so, this part is kept maintained here like that, if this total distance if we divide into 5 portion, and then the last one tenth of this if we do not use, and then second one tenth, if we have a curvature like this way, then it matches with our normal body here.

And now, our thigh bone is not a straight one, it is a little bent like this; so, to match this, it is said that - from this two third position, if the front one takes a 0 to 3 degree angle, and the backside 0 to 5 degree angle, it gives a good comfort for the thigh. Now, with this figure, if we have a foam over it, so from distance, it will looks straight, same, but with your body pressure, it will take automatically this shape; so, it will be a comfortable seating; so, all this seating, these are the principles. Now, we have to use this in specific design concern.

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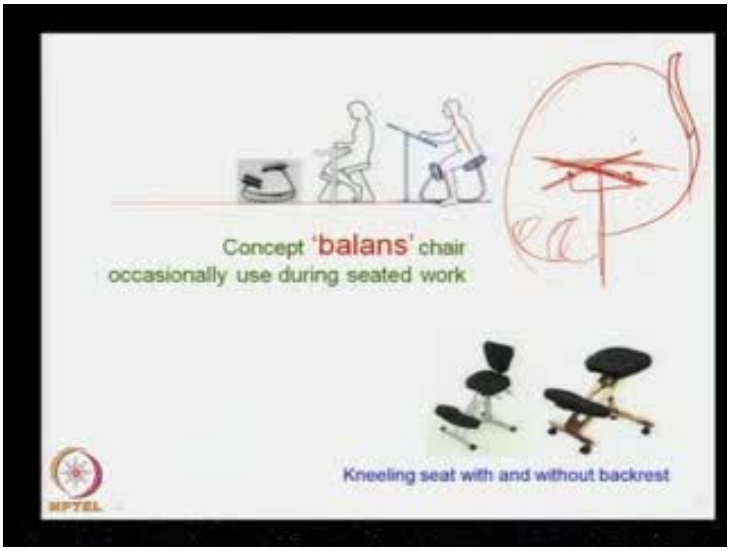

Now, with this just we will see here a little demonstration, if, that how it is used. Now, with this, now lastly we said that - if a body tends to bend forward, then leg also tends to go back; now, with this position if we want to do certain work in front bending, then there may be, a, you to falling tendency. So, at that time, no back rest is required, but a specific knee rest may be provided. And then, how the seat and knee rest joining to be developed? Is a special design concerns; now there is varieties of joiner is maybe possible.

So, this concept is called balance chair, and occasionally used during seated work may be useful, but this also will have some other constrains like that Indian ladies wearing sarees and etcetera or those who have knee problem for them, it maybe some problem or longer duration work, it may not be possible; so, there varieties of kneeling seat with and without back rest is being developed nowadays.

Now, a concern, is that, in a counter kind of thing, where the back rest as well as front bending is necessary, then what type of design solution we may have? Like, if we have seat surface like this, and then the stand, and then a back rest like that, and then if a concern something like this way; so, while bending forward, then the seat may take this type of shape, and while bending back, if we press it then it may give a common back rest or intended sitting facility.

Now, when you come forward, then there may have a special holding knee rest and etcetera; so, this type of concepts, one may develop and a series of furniture ranges can be conceptualized.

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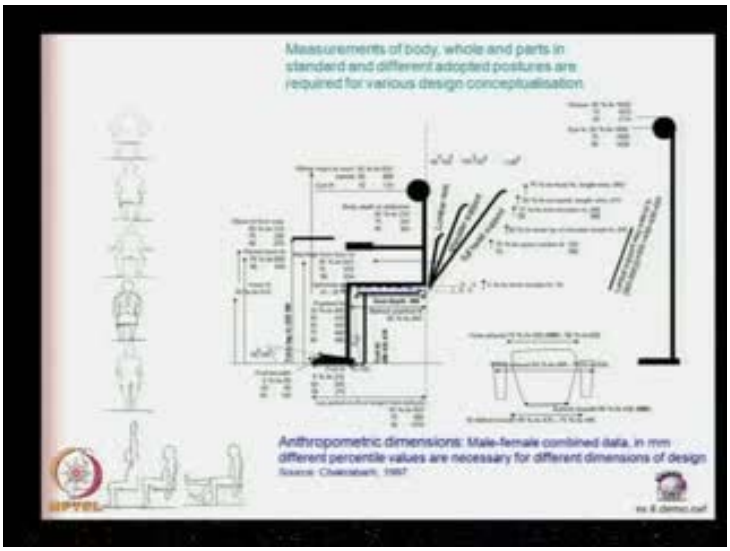

Now, these are the some of the dimensions are provided here; so, all these dimensions concern, here the percentile values and the Indian data concern. This Indian data the reference has been taken from a the source, is that, Chakrabarti 1997 that is that a book called Indian Anthropometric Dimensions for Ergonomic Design practice published by national institute of design, for that this dimensions have been taken; and male and female combined data in millimeter is provided here in different percentiles. So, this is for the different armrest, table top height, footrest, and then different supports are also provided, here in this diagram; so, this diagram maybe considered while making a design concept.

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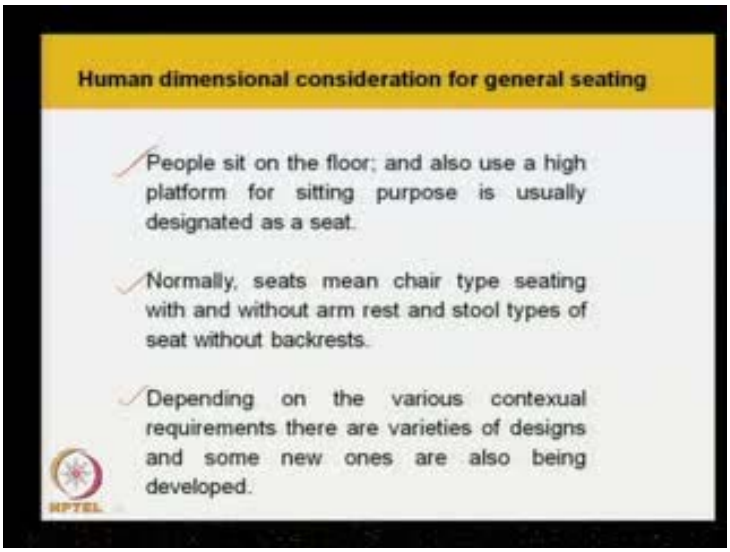

Now, with this, now what are the specific features we should consider? That is that, human dimensional consideration for general seating. The first thing we should feel that people sit on the floor; and also use a high platform for sitting purpose is usually designated as a seat. Normally, seats mean chair type seating with and without arm rest and stool types of seat without back rests. Depending on the various contextual requirements there are varieties of designs and some new ones are also being developed.

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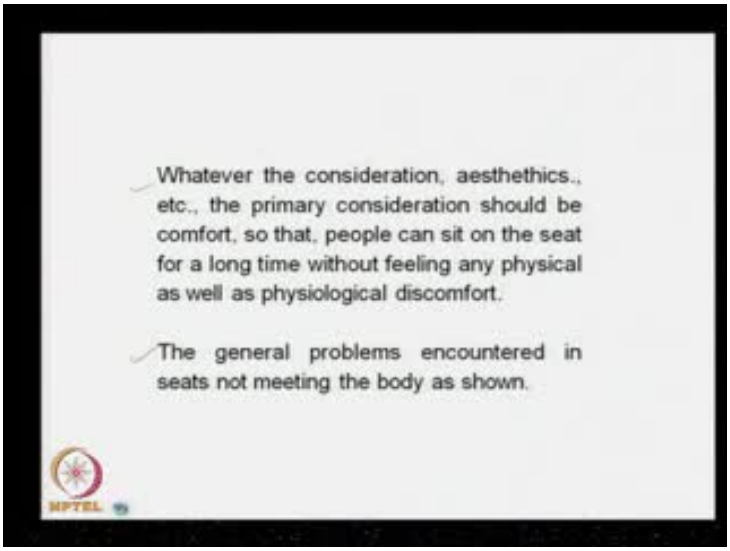

Whatever, the considerations aesthetics, etcetera the primary consideration should be the comfort, so that, people can sit on a seat for a long time without feeling any physical as well as physiological discomfort. So, after developing a furniture, it should be properly evaluated with proper trials, from the subjects opinions, as a rate using different rating scales should be conducted; and objective measurements like physiological parameters should be considered for evaluation, whether that furniture is really good one.

The general problems encountered in seats not meeting the body as shown, in earlier figures that should be considered.

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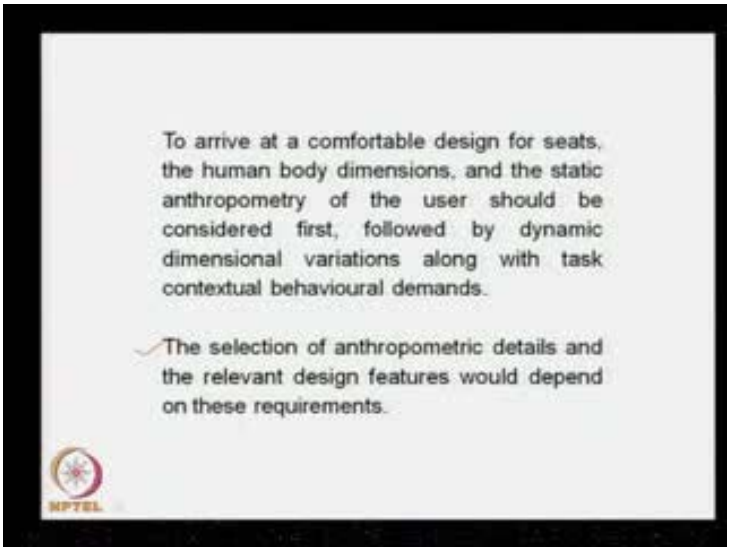

To arrive at a comfortable design for seats, the human body dimensions, and static anthropometry of the user should be considered first, followed by dynamic dimensional variations along with task contextual behavioral demands.

The selection of anthropometric details and the relevant design features would depend on these requirements.

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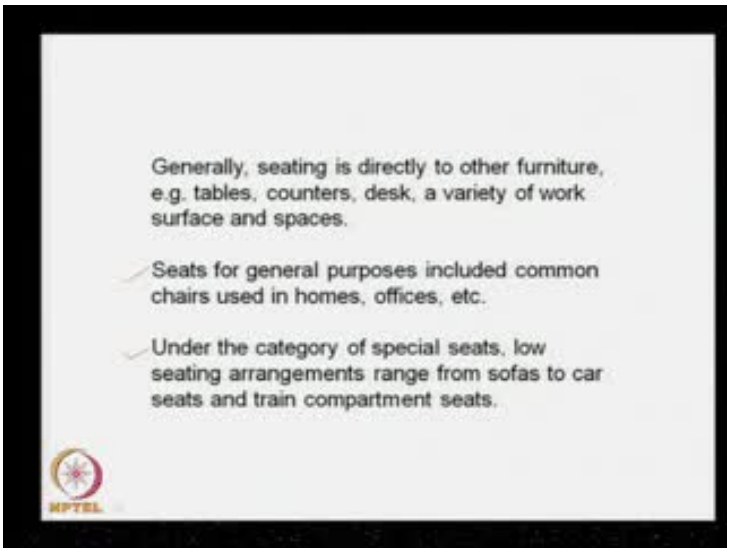

Generally, seating is directly to other furniture, as for example, tables, counters, desks, a variety of work surface and spaces, should be considered. Seats for general purpose included common chairs used in homes, offices, etcetera.

Under the category of special seats, low seating arrangements ranging from sofas to car seats and train compartment seats, should be taken care of.

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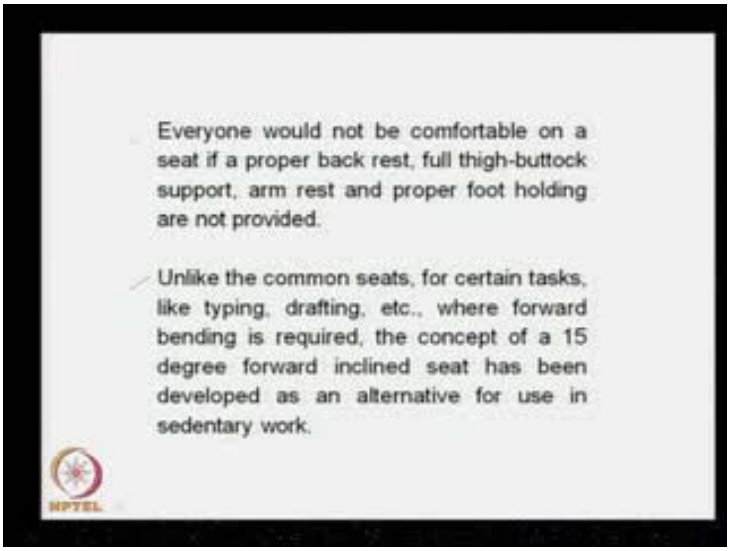

Everyone would not be comfortable on a seat if a proper back rest, full thigh-buttock support, arm rest and proper foot holding are not provided. Unlike the common seats, for

certain tasks, like typing, drafting, etcetera where forward bending is required, the concept of a 15 degree forward inclined seat that is balance chair type of concept has been developed as an alternative for use in sedentary work.

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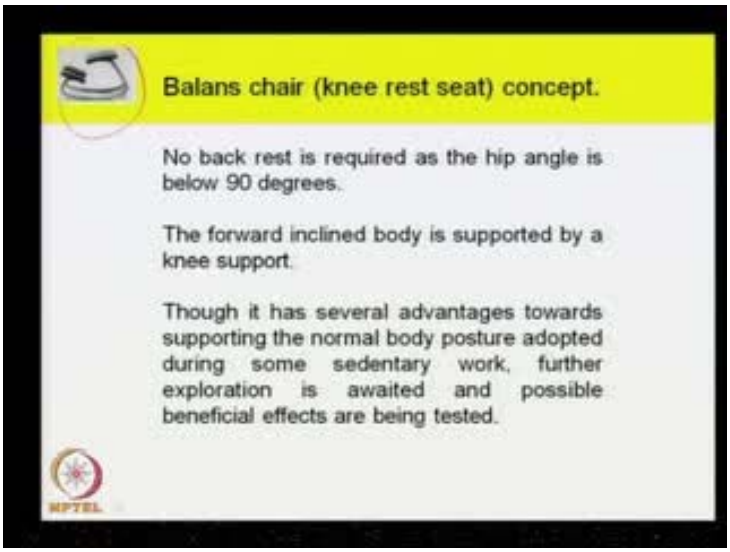

Now, the balance chair - the knee rest seat – concept: like this, no back rest is required as the hip angle is below 90 degrees. The forward inclined body is supported by a knee support. Though it has several advantages towards supporting the normal body posture adopted during some sedentary work, further exploration is awaited and possible beneficial effects are being tested.

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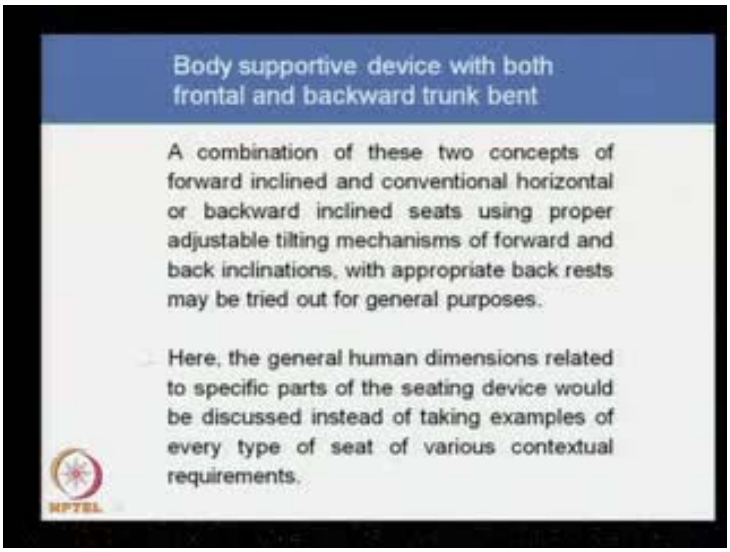

Now, body supportive device with both frontal and backward trunk bent: a combination of these two concepts means with back rest backward and without back rest frontal are forward inclined and conventional horizontal or backward inclined seats using proper adjustable tilting mechanisms for forward and back inclinations, with appropriate back rests may be tried out for general purposes.

Here, the general human dimensions related to specific parts of the seating device would be discussed instead of taking examples of every type of seat of various contextual requirements.

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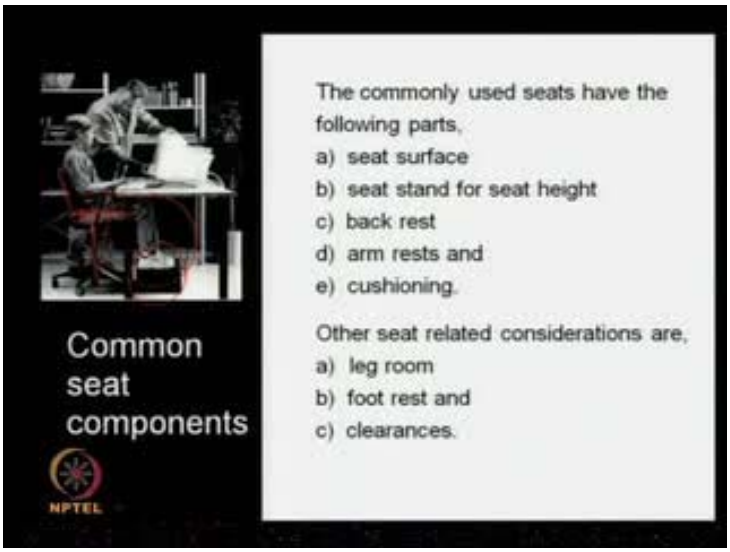

Now, the common seat components are the commonly used seats have the following parts: the seat surface, seat stand for seat height, back rest, arm rest and cushioning. Other seat related considerations are, leg room, foot rest and clearances like that. So, with this, we can say that - the seating device design is not only the physical body dimension concern, it also concerns with the different task oriented behavior that the person or the occupant of that seat performs and feels comfortable.

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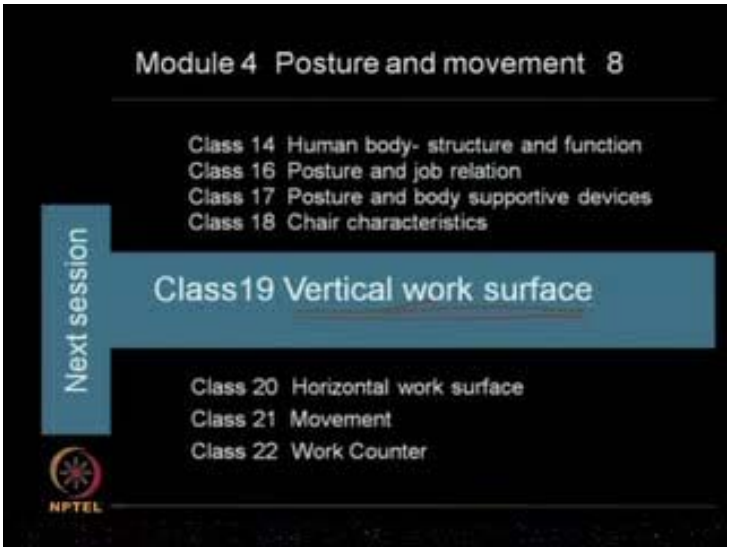

So, now with this we are ending today's session, and next session the class number 19, there we will be discussing the vertical work surface and its dimensional concerns and behavioral requirements for a design development concern. Now, with this we are concluding today's session thank you.