Digital Human Modeling and Simulation for Virtual Ergonomics Evaluation

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Lecture – 05
Use of percentile anthropometric and bio mechanical data for product design Part III

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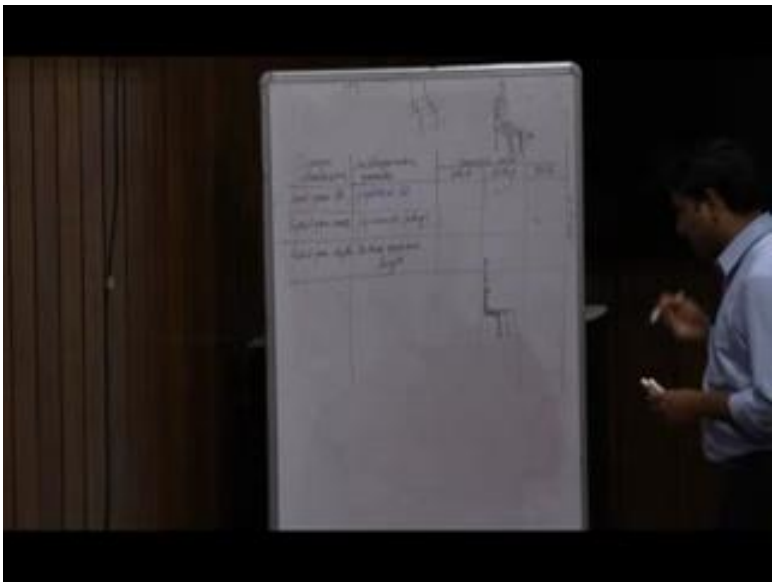

Next if we designing seat pan depth for seat pan depth corresponding anthropometric variable is buttock popliteal length, now which percentile data so do you use. For this purpose we may use 5th percentile 50th percentile and 98 percentile. So, let us see what happens, say first assuming that we are using 5th percentile. So, while you are using 5th percentile then 5th percentile person is sitting comfortable, but for 50th percentile what is happening their thighs going out or 98 percentile they are also not getting sufficient thigh support.

Next if we use 50th percentile data for this purpose then what will happen. This is the side view of the seat if we design as per the 50th percentile then 50 it is exactly matching with the 5th buttock popliteal length of the 50th percentile; this is the buttock popliteal length of 50th percentile it is exactly matching. But what will happen in case of 5th percentile? 5th percentile will sit like this they cannot use the backspace, because they cannot move. This is the 5th percentile if we use the design as per the 50th percentile

then what is happening 50th percentile which is exactly matching with their buttock popliteal length and this shifted. But if you have for 50th 5th percentile they cannot use a back space because their popliteal area is getting struck here, they cannot go backside. For 98 percentile what is happening, they are all bigger a larger body dimension. For them what is happening, they are not getting proper thigh support because they are part of popliteal length is more.

So, in this case 50th percentile if we decide this seat pan depth as per the buttock popliteal length of 50th percentile then 50th percentile is comfortable, but for 98 percentile they are not getting sufficient thigh support. On the other hand 5th percentile they cannot use the backspace

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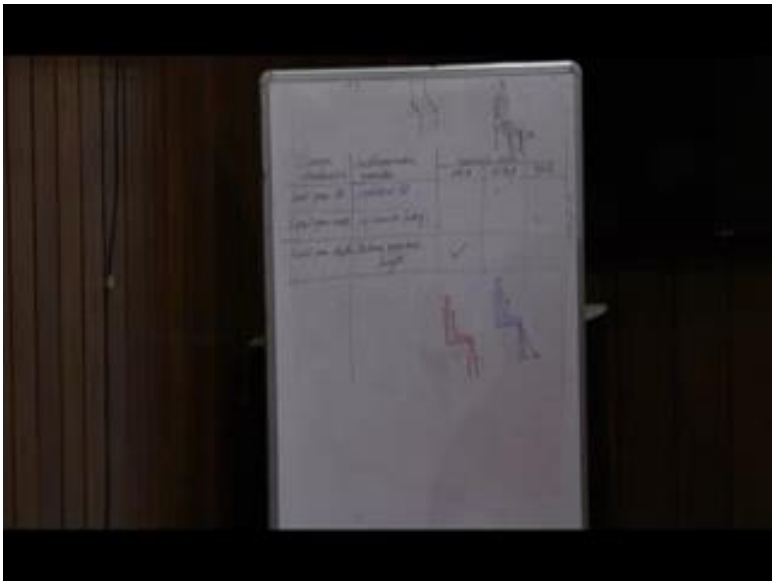

Now third scenario if we use 95th percentile. So, this is the side view of the seat, this is the seat, if we design this seat as per the buttock popliteal length this is the buttock popliteal length of 95th percentile. So, 95th percentile can sit they can use back space also because it is exactly matching with their buttock popliteal length. So, 95th percentile they can sit comfortably, but 50th percentile they cannot use the back space and 5th percentile they are again sitting forward. So, they are also not able to use the back space, because they cannot go back side they are the popliteal area is getting struck here.

Now the question then which percentile buttock popliteal length should we use for deciding the seat pan depth if we have only these three option 5th, 50th and 95th then we

should go for 5th percentile. Why? 5th percentile not 50th or 95th percentile in this case you mention if we use 50th more number of people will be accommodate, but in this case we are not going for 50th percentile we are going for 5th percentile. Because if we use 5th percentile buttock popliteal length then what will happen everybody will get buttock support, but probably will not get thigh support because thigh support is not important in this case as they are feet is on the ground they are keeping. Their leg either in extended or vertically on the ground.

As the leg is supported on the ground and they are getting buttock support. So, thigh support is not that much important. If we use 5th percentile then what is happening? This will the scenario 5th percentile it is exactly matching for the buttock popliteal length, 50th percentile they are there is no sufficient thigh support but they can sit like this, and 98 percentile they can sit like this. Because thigh support is not important as they can use the rest their leg on the ground. But if you use 50th percentile data in this case what will happen if you use 50th percentile data then only 50th percentile is comfortable if we use this 50th percentile data for this seat pan depth then, 50th percentile person he can sit comfortably, but whatever 5th percentile they have to sit like this only they are this popliteal area is getting stuck with the forward portion of the bench, forward portion of the chair.

So, for that purpose they will not went use the back space. For this reason we are using 5th percentile, but generally 5th percentile in this case 5th percentile is too less. So, their size is too small. We can increase it instead of 5th percentile we can go up to 20th percentile or 30th percentile. But as we have at the very beginning we have mentioned only we have to select on this seat percentile value then we have to select 5th percentile instead of 50th percentile. But we can increase it little bit more because 5th percentile value is two less so you can go for 10th percentile or 20th percentile up to 30th percentile as per our requirement.

So, what we understand from this one. From this chair dimension although this is the single product single facility for various design dimensions we need to consider various anthropometric variables. And that anthropometric variable also is of different percentile value. Sometimes for this purpose we are using 50th percentile popliteal height, for this one we are using 95th percentile, for this dimension we are using 5th percentile it may be

20th percentile or 30th percentile also whatever. But in this case we are assuming 5th percentile, so in this case we are using 5th percentile buttock popliteal length.

So, for a single product its various design dimension we are using various corresponding various anthropometric variable and their different percentile value. For a single facility design it never like a (Refer Time: 08:02) this chair design we will only use 5th percentile anthropometric data or 50th percentile anthropometric data for all design dimension, it is not like that. For different design dimension we have to consider corresponding anthropometric variable and for that corresponding anthropometric variable also we have to identify which should be the appropriate percentile value.

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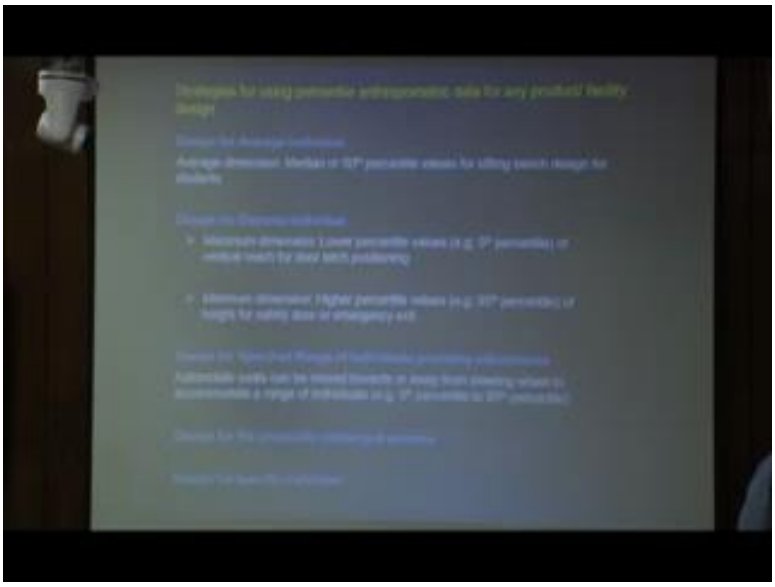

Now, while designers or engineers are designing some product facility then they have to follow various strategies of using percentile anthropometric data. What are the strategies designed for average individual, second design for extreme individual and third design for specific range of individual, others are design for physical challenged person, design for specific individual. So, we will discuss one by one. First one is design for average individual. While you are designing any product of facility for average individual as we have already discussed about the height of the chair or height of the seat pan height of the bench or seat pan height of the chair in that case we are using 50th percentile data. If I use 50th percentile data from normal institution of anthropometric data I have already understood that if we use 50th percentile data which is the average or mean value then

good number of people whose body dimensional value is near about that 50th percentile they will be accommodated. In many situations we use 50th percentile anthropometric value or designing various type of facility, so one example is seating with design for students as we discussed.

Next one design for extreme individual; extreme individual mean people with shorter body dimension or smaller body dimension or larger body dimension. Here two things are there; one is maximum dimension another in minimum dimension. This is very important to note maximum dimension for extreme population if we want to accommodate wide range of people then we want it we are using maximum dimension. Now it example it will be easy to understood. Say we had want to design we want to decide door height.

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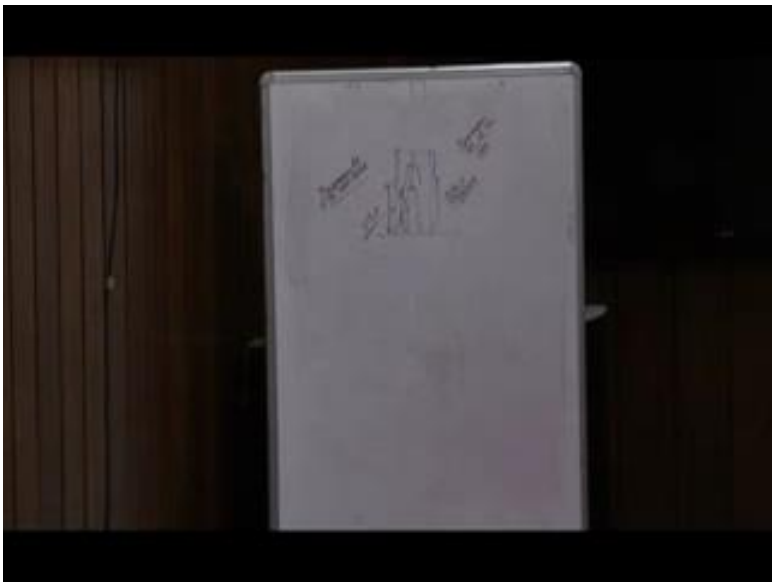

So, this is the door for that purpose what should be the height, the corresponding anthropometric variable of obviously human head height or structure first structure we will use which percentile value. So first want to discuss about this one, minimum height of the door. First should be the minimum height of the door. Minimum height of the door should be the maximum height of their population, mean we will use 95th percentile data for this purpose. So, minimum height of the door is the maximum height of the people. In this case we will use 95th percentile data of head height of structure value.

So, this is important because while you are talk talking minimum height of the door; minimum height of the door, but we are considering maximum height of the people that is the 98 percentile even we can use 99th percentile or we can even allow more than that also so that everybody can go through the door. While we are using 95th percentile structure value then 95 percent of the population whose head height value is less than 95 percent whose head height is less than that they can easily pass through the door.

On the other hand if we use want to position a door latch, door latch for locking the door. In case of door latch what should be the maximum height from the ground of the door latch; the maximum height of the door latch from the ground is the minimum height of hand reach value. If we want to design this one for that purpose what we need to consider. So, this is the person so hand reach value, vertical hand reach value and also we need to consider in that case 5th percentile hand reach value. If we want to position a door length what should be the maximum height? It should not go more than that. If it goes that more that then people with lower percentile and this value they will not be able to use.

For this purpose we need to use 5th percentile hand reach value so that students or the particular population for whom we are designing they can use the facility. If we decide the position of this door latch as per the 5th percentile hand reach value then what will happen, all others people whose hand reach value vertical hand value is more than 5th percentile value for that population everybody will be able to use. So 95 percentile, if we use 5th percentile vertical hand reach value for positioning the door latch then all other people whose value vertical hand reach value is more than 5th percentile that 95 percent of the people will be able to use that. Only people whose hand reach value is less than 5th percentile they will not be use that one.

While, it is important minimum dimension minimum height, so minimum height of the door while you are talking about minimum dimension then we need to consider the maximum percentile of the population for that particular uncertain variable. While you are talking about the maximum height of the door latch or maximum height or maximum dimension while you are talking about maxi then we need to consider the minimum percentile, 5th percentile or first percentile

Next point is design for specific range of individual. In many situations as we described about the adjustable chairs. So, chair height or height of this table top if it is adjustable it if we can adjust that elbow style this this is my elbow style if we adjust this height of the table surface from 5th percentile average height to 95th percentile average style then from starting from 5th percentile to 95th percentile average height all this people will be able to use this table.

Similarly in this example automobile car seat; automobile seat is we use from 5th percentile to 95th for quite why that the people will use the facility. For that purpose we start from 5th percentile to 95th percentile. A seat 5th percentile as well as 98 percent all the people should use the steering wheel their feet will be on the accelerator if (Refer Time: 17:46) update in different types of (Refer Time: 17:49) so their leg position is still hand position is on the steering wheel now they have to move the seat forward and backward as per the requirement. In that act shift at double limit we have to say said that shift at double limit in such a way so that 5th percent starting from 5th percentile to 95th percentile people with body dimension. Particular in this case say let dimension starting from 5th percentile to 95th percentile everybody should be able to use that one. So, if you want to accommodate a wide range of a people then we need to consider these take of adjustable feature.

Design of a physically challenged; if we want to design for physically challenged their body dimension is also different from normal population. So, for that purpose different data base we need to develop and those data after percentile calculation we need to use. Similarly, design for specific individual. If we want to design any product or facility for specific individual, so example directors chair. So, director's chair will be used by directors only. So, for that purpose we need not to go for percentile calculation or percentile anthropometric data.

In that case we can directly measure the body dimension of that particular individual and accordingly we can make his required for whichever any other product or facility, because in that phase of facility it will be used by that particular individual. So, individual specific product we can also develop, for that purpose percentile data is not required.