Ergonomics for Beginners Industrial Design Perspective

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Module No. # 03

Human Physical Dimension Concern

Lecture No. # 08

Human Body – Structure and Function, anthropometrics

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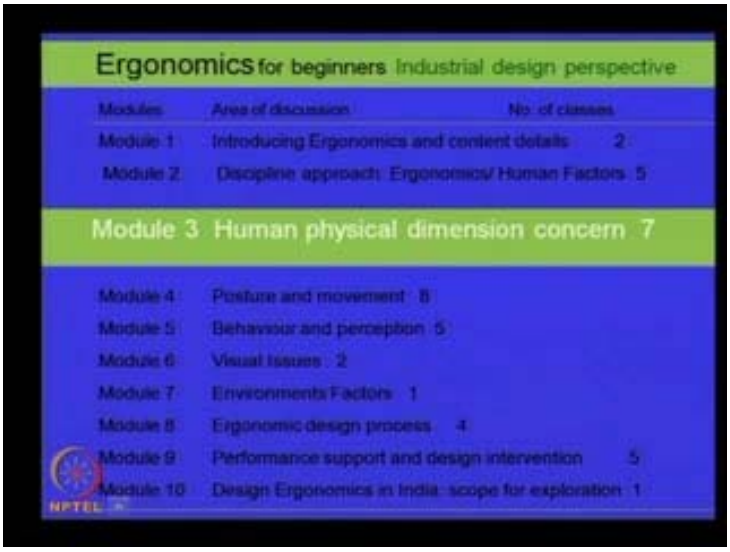

Welcome to this eighth session of ergonomics for beginners industrial design perspective.

Now, today we are starting module 3. Earlier, we have already completed module 1 and module 2. That is module 1: introducing ergonomics and content details, there are 2 classes and then second module with 5 classes discipline approach ergonomics and human factors that we have already completed.

Today, we are starting module number 3, that is, human physical dimension concern, and here we will have total 7 classes.

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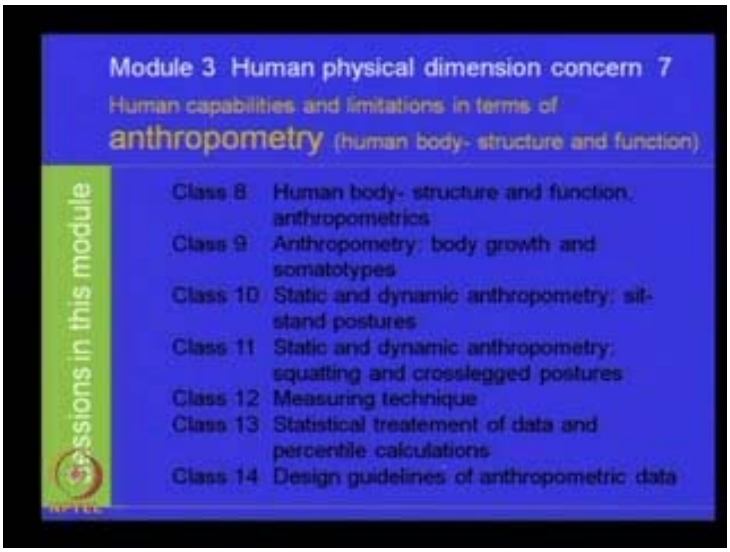

Now, with this, the human compatibilities and limitations in terms of anthropometry, that is, human body structure and function that we are going to discuss. Among these 7 classes, the eighth class today, human body - structure and function anthropometrics. Next, will be anthropometry: body growth and somatotypes, and then, static and dynamic anthropometry: sit-stand postures.

Next, static and dynamic anthropometry: squatting and cross-legged postures. Twelfth session will be measuring techniques of this human body dimensions. Thirteenth is statistical treatment of data and percentile calculations, and this session will be concluded with design guidelines of anthropometric data. So, whatever we are discussing, and how its application will be there in design, with that we will conclude this module.

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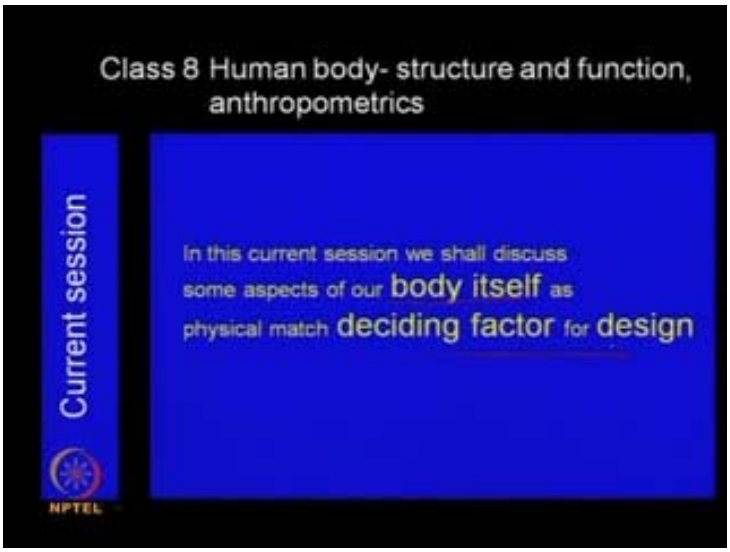

Now, current session, in this current session we shall discuss some aspects of our body itself as physical match deciding factor for design. So, on our own body the dimension and structure and all other limitations etcetera, how it decides that design dimensions and parameters.

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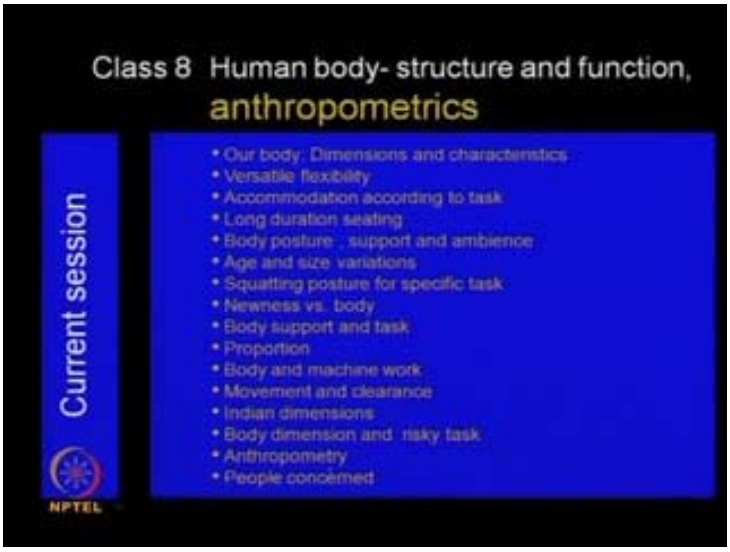

Today, we are going to look into these aspects with some examples. Now, in current session, we will have our body dimensions and characteristics, the versatile flexibility, accommodation according to task, long duration seating, body posture support and

ambiance, age and size variations, squatting posture for specific task, newness versus body, how it can cope body support and task proportions, body and machine working, movement and clearance, Indian dimensions requirement, body dimension and risky task, anthropometry, and the people concern for our discussion.

Now, if we see a small film, there we can find, that how people behave in a group, then sex variation, age variation; depending on different mood, how people behave with varieties of body supportive devices; when people interact with some design, how their body language changes; how inherently he feels the match of design item and its own body.

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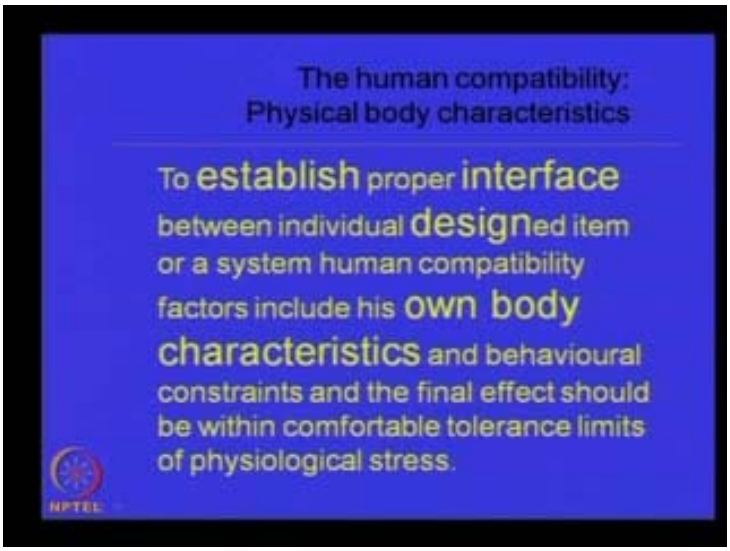

So, with this, we can say that the human compatibility the physical body - characteristics is based on and it says that, to establish proper interface between individual designed item, or a system human compatibility factors include his own body characteristics and behavioral constraints that makes body to take different changes and the final effect should be within comfortable tolerance limit of physiological stress.

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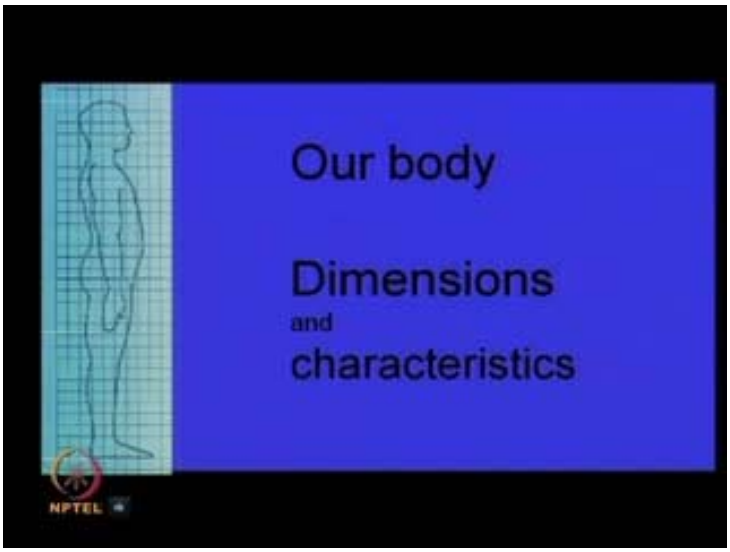

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So, now, how our body behaves in different context and what is its limits? Let us see that. Now, our body dimensions and characteristics - body characterized with versatile flexibility; the person can have different positions like this. Then we can extend his arms and body, even he can take a specific posture. So, for a certain task, the person needs to follow varieties of body movements.

If we would like to limit these movements, then what would be the design solution for that? What type of design aid we can give? But for that, we need to know his body dimension and how his body behaves, whether it is wrong, it is necessary, it is good. Accordingly, we have to do that.

So, the measurement of body dimensions and range of movement is necessary. Now, it can be said that the same age group, but size varies. It is not that the man growth is as per his age. So, in certain human body or human being, the limit of growth is there.

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So, though, almost the same age group but still female, male variations body sizes are different. Now, the body gets acquainted according to task. Now, in this case, -many people are sitting on a horse cart. So, the position of sitting, and how to climb up and get down? These dimensions, how we can fix it?

We know that staircases case, but here -whether we need something of that kind or maybe in a design matter we can say that. Let this platform come down with a specific mechanical arrangement that man can simply sit on it and then the whole platform can go up.

So, whatever we are deciding here, it depends on the human body dimensions and its limitations. Now, the same furniture, how these people can feel comfortable? Whether the seats are comfortable?

Now, another thing we can say that, in this auto rickshaw the person, the comfort or the reach to the different controls for the driver will be different. Then the passengers are sitting rear. So, depending on the task or requirement, the human body has to be considered; human body limitations and etcetra.

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So, we can say that, body gets accommodated according to task requirement, and accordingly, design can be developed. Now, another point is that, this is a common feature in any academic institute. So, from here, we can say that, confined long duration seating with mind to concentrate, not only sitting and doing some activity where the dynamic movement is there. So, some kind of relaxes in body means- the postural loads shifting from one group of muscle to another group of muscle to hold that body position is there for dynamic conditions.

But in this case, what is happened? They have to sit for a long time, say, three to four hours continuously and that also with concentrating the mind. So, he may forget his body comfort at that movement, but ultimate result will be there. So, the proper body dimension fit furniture we have to make; for that we require to understand the different body parts that will be matched with this furniture. So, human body measurement, etcetera are necessary.

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Now, if we say that how to make this ambiance? That ambiance should not be monotonous; it should be lively. Now, everything is in order then it may not be that inviting ambiance. Now, in this case, when visitors form or maybe in a family, body posture - it speaks, and selection of body support is varieties of seating arrangements, creates an ambiance. So, while selecting these body supportive devices, the comfort should be there, and to get that comfort, human body dimension is necessary, to be considered,

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Now, many times we say that a design should confirm a universal requirement or to meet accessibility, but case thing is that the same design cannot fulfill all requirements, all body sizes like, all body sizes including age variations, do not fit in a single type of seating, as we are seeing in this figure.

Then the question comes, should we make - different types of seating arrangement here to fit different body sizes or maybe some specific attachment will be provided, so that it can compensate the body size differences. For that, we require to understand human body itself.

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Now, mostly we discussed from ergonomics point of view in available literature or books. Mostly, it says that sitting in a chair table condition -or -a working in a machine condition, where standing, leaning or sitting on a seat, but there are many working conditions, that require such body postures,- sitting on floor, like that. Here, the person is drilling a hole, almost keeping parallel to the floor, the drilling machine and he holds it. So, -now, how can he hold it? Whether holding is –possible -or not? So, here what happened is, not only the full body, even the body parts like fingers and etcetera, palm etcetera; that dimensions are also necessary.

So, body dimension measurement does not mean the whole body and the major body parts, but the small movements and etcetera, these are also considered. So, it can be said that body without movement, the measurement is static measurement, and body as a

whole or component part of this. In a dynamic movement condition, whatever the variations in those measurements, that will be the dynamic anthropometric measurements and its design considerations accordingly will be done.

So, body in action, in a squatting posture for specific task this type of data reference is not very much available. So, we require considering to generate specific human body information for these type of work requirement and body dimensions, accordingly, we need to measure.

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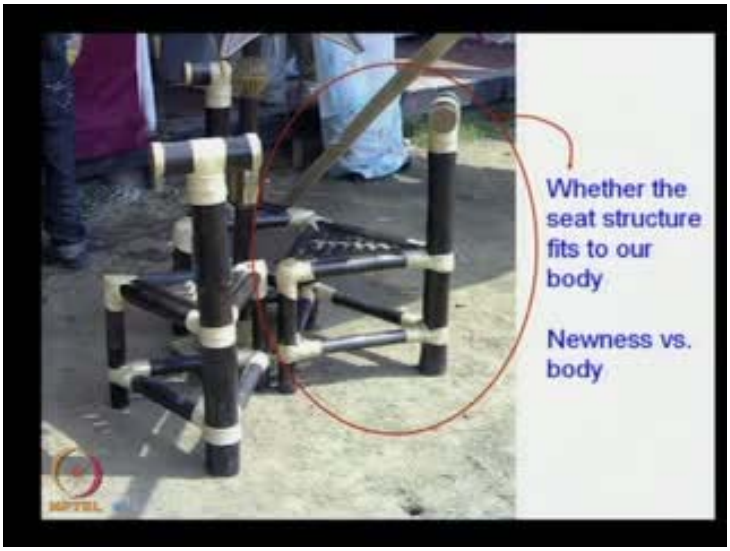

Another example: why human body observation is necessary. Now, newness versus our assorted body size. Now, in this case, specific triangular furniture is developed.

Now, here, what happened is, the front part is broad and back portion near the backrest is a narrow point, but actually what happened is when man sits, his buttock comes like this and then the leg comes like this. So, what happened is, it requires a largest supporting area, but it is not permitted in this.

So, whether the seat structure fits to our body. Now, the designer or manufacture or artist or the craftsman, who have developed this new product, we must understand what is our body? How body behaves in different position? If he has to use this chair, whether it will be comfortable? For that, we need to understand the total human body dimension and its specific behavior wise, its variations; that is necessary.

Another question comes, when we say that disability, normally it comes to our mind that it should be permanent disable. If we say that he is impaired with eye vision, then immediately image comes to us, that he must be totally blind. So, design first, something that visual is not necessary. So, with other senses, he can get the feeling of the work.

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Similarly, the body dimension wise also, a same type of understanding or image building we have, but most critical point is that, temporary disability, and due to progressive age, the difficulties we are going to face is not a permanent illness; it gradually comes. To How design can support? How our body behaves? In this figure, we are seeing that this boy has some leg problem. So, this is here and for that a support is given to him. It is temporary.

Now, while sitting here, he has to extend his leg; he cannot sit like this person. Should we develop different chair for these types of two requirements? Or a specific attachment or something to be done, so that the same person can use the same furniture, he used to use earlier, even with this difficulties. So, what could be the solution for that? That is necessary to be considered. So, not only the able body measurements, we must consider the likely to be or anticipated problems of progressive age and varieties of unknown accidental possibilities of modifying body.

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So, need to support body disability of temporary nature. Use of other utility items requirements remain same that we need to consider. Another case, in this figure, in left hand figure, we have taken from a very good jewelry company, but still the person sitting, you can see like this way.

So, the postures change, because he has to get a vision here; his arm angle is this way; so, different supports we require. He does not have any back support, but to work here, his elbow support is necessary; the cloth piece and etcetera is placed here.

Now, what type of support system we can provide here to fit with this body dimension? His sitting angle is like this, but the support here is straight one. So, here there is some problem. Now, another thing is that, in this case, when this person is laying some stone marble slabs, he has to take a wide range of back movement backhand.

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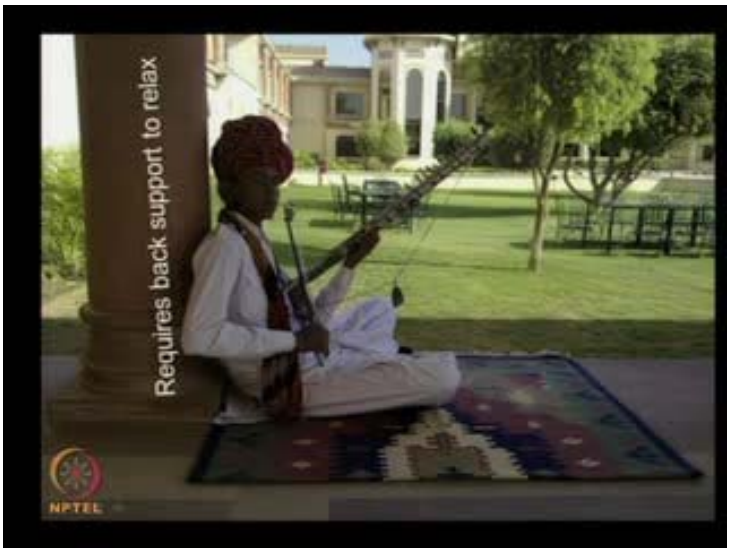

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So, now, whether design can give some solution here? So, that solution should match with his physical body requirement. Here, work adopted postures, how design can attend this? Now, human body requires back support here to do certain task in a relaxed mode, it requires a body support; even in this figure, we can see that this person is using a pillar as a backrest. So, he requires back support to relax. Then back relax means, which portion of back should get relaxed, to be supported. So, that measurement is necessary. In this case, concern working elbow height, there is no support possible here, require arm support.

So, how we can understand that from a seat surface, how much is the elbow height, and to do certain task, what is the vision and length is required, and accordingly some support system can be developed. Here, the reach task and work posture. So, if she has to work with various objects, various items, within her control, then we must understand the normal arm length, and this movement, she can do with the furniture. So, these matters we need to consider. So, this is that body dimension with movement of the body requires to understand for these type of purposes.

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Now, a group of people are arranged here. Though apparently look alike, all people look the same type but whether all the furniture support they are using whether it suites to everybody or not?

The body dimensions and proportions vary with at ethnic variations. So, all are not same; even all the body proportions are different, bit among different body parts are also not same, even in that same ethnic group or in different ethnic groups. Now, one ethnic group to another ethnic group, that there is a total variation.

So, while making any design, the human body dimension data taken from a specific ethnic group may not fully match with other ethnic group. If they want to use without any modification, for this purpose also we need to know our own body dimensions, for that measurements are necessary and understanding is also necessary.

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In this big airport, now as the height is too big, the space is too big; the people here do not get the major feeler type of appearance. It means, what happened is, whatever the dimensions are, height or whatever in relation to this height, it becomes very negligible. But, if it is within a small room or door, then the proportion of space and person value will appear as a deciding factor or to make this door frame and etcetera.

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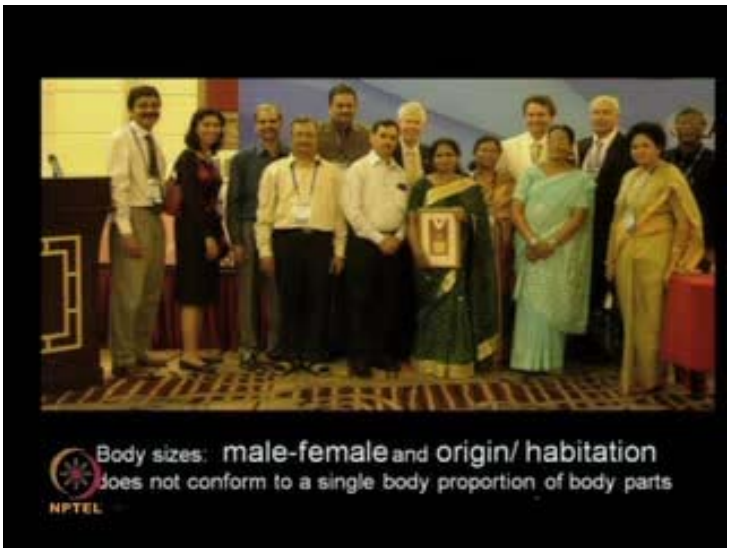

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So, space and proportion feeling is there. Now, body sizes- male, female and origin or habitation does not confirm to a single body proportion of a body. Now, while interacting with the machine, the different body parts movement, the body should match with the machine dimensions. Like, if he stands here then, how much he can extend his arm? What is the normal height of this thing? So, that he can work in the main working area. It should not cross the heart level; normally it should be below that. So, all these considerations basically based on physiology, and its dimension will come from the person's whole body data.

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So, body and work machine match to be established. For that, we must understand the person's working behavior with this machine, and the man and machine, that direct interface we need to know. Here, task and man machine match.

Now, when we are going to see this one, then, a specific case will appear to us. Now see, the person is working with a machine with can making machine for pineapple. Now, his total movement, the reach, the load he is supposed to carry, and then the fixing leg movement, arm movement, everything has to be considered.

So, in this case, mostly the human body and its different movement positions, it is highly necessary for a body supportive, device design or a product, where or with whom he is interacting with.

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Now, not only the human body itself, but when he moves, it requires some specific clearance. There is an additional space to him. If we see this one- that everybody is sitting there and eating, but while coming out and etcetera, they require a specific space to be there. So, in that case, human movement and space clearance is necessary. Suppose, while sitting in a chair table condition, if you stand and want to stand up like this, then, the chair has to go back; so that it provides you a space to stand and to move out or come in.

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These are the specific clearance and it has relation with the whole,- the original- body dimension. Now, as per body built, the body dimension depends. Built differences are there between city dwellers and village group. There are many factors are influencing here - like food, genetic matter also and other environment and the exercise training etcetera.

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Now, if we want to design something for city dwellers or for rural people or villagers, this may need to be considered.also. Now, in an office cabin, the workstation, the person

work equipment and etcetera, and the space around, this is the workstation. Workstation that - including human body dimensions and many other human factors are considered. While operating like this, his arm is coming to this position. This arm, we can say, he is coming like this, whereas, his center is like this.

So, this angle; we have to maintain. So, not only the human body length and breadth, it also requires understanding the different body angle comfortable. So, this is some biomechanics of body dimensions or whole body is also necessary to be considered.

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Now, while we make manikin, manikin to follow our body dimension, to fit with us. Indian anthropometric data would fulfill the Indian body dimensional requirements. The manikin with other body dimensions may not generate a garment that will fit to our requirements.

So, proper data generation effort is necessary, and now, in India, this data is available. So, manikins also can be developed with our own datasets. National institute of design has developed a dataset - Indian anthropometric data for ergonomic design practice; their Indian dataset is provided.

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Now, interaction among people of similar group facilitates the arrangement. Now, not only the body dimension, but here, we can say that these gradations is given here, so that everybody can get clear views. So, the eye height of this person is what the clearance we require, accordingly, this slope is made, and the arrangement, instead of a like normal class, all students sits in front and then teachers delivers his lecture.

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If we need to demonstrate something, then this type of arrangement may be beneficial; where the person can demonstrate also the things while discussing. Task and risk: we

cannot say what would be the anticipated behavior. Now see, she is sitting on a kitchen platform because of many factors like, window lights coming and also she feels comfortable, whatever, but this is the risk.

So, now, whether this much space is appropriate for a person to sit that we need to consider. Then what happened is, some training is necessary; likely to be risky appears. How we can give this training? Through, design communication by providing information or making. If this is supposed to be encouraged, then give a larger space or mix certain texture or something there that discourages person to sit on it.

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Now, body in motion static as well as dynamic dimension. The person, she is sitting here in a straight position, then the buttock height is something. When she tries to reach little distance, the head height decreases and the body also comes forward and arm it reaches.

So, what are the modifications that take place during this dynamic task requirement that is necessary? For this, if we want to make a special low height sitting stool, then what would be its behavior? Whether it will be a strong sit with horizontal surface or there must be some kind of bending and etcetera; this will depend on the body posture and the body behavior on that requirement.

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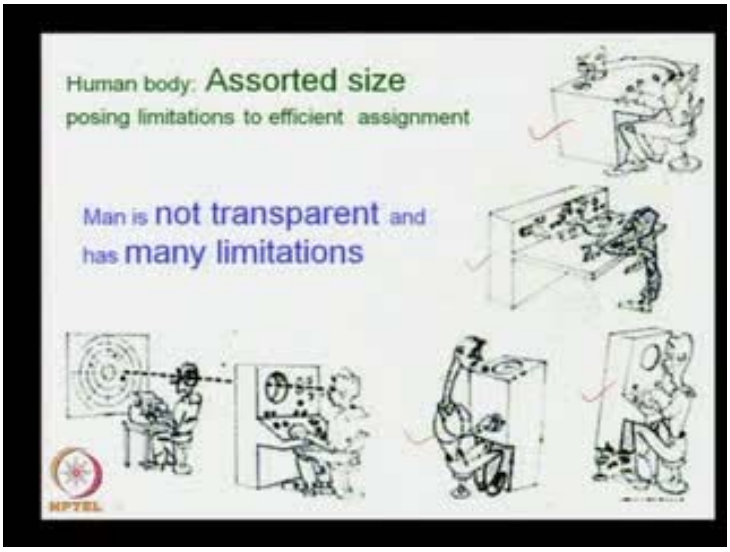

We need to know our body dimensions. So far, we have discussed whatever, and relevant characteristics, that is relevant to design practice for our own benefit. Now, if we see this, human body assorted size; it cannot grow with much food; limitless growth is not possible. So, posing limitations to efficient assignment, If we can see this figure.Now, see the context, the mismatches, so, the design should be according to human body. One most important thing we need to consider is, a man is not transparent in this. So, if we see one person behind another person, then they feel difficult to reach like in cars,-when the front seat person sits there, the rear person sits just back, difficult to see. So, in

auditorium or some other, where group of people accommodation is there, they make a little zigzag way- the seat arrangement.

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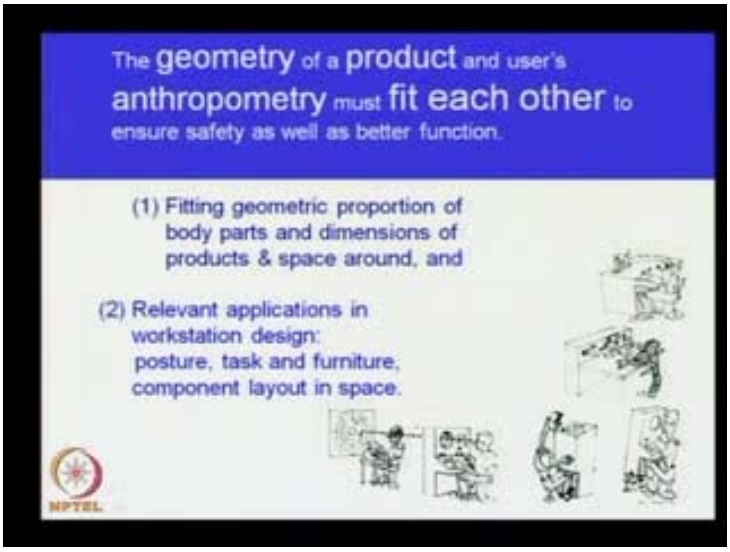

So that, from two persons, if it is like this, then the next row person will be at -middle and like that. So, the view will be easier. Man is not transparent and has many limitations. Now, the geometry of a product and users anthropometry must fit each other, and to ensure safety, as well as better function anthropometry. Anthropo is a man; me try—measurements -

Now, fitting geometric proportion of body parts and dimensions of products and space around and relevant applications in workstation design posture task and furniture, comfort layout in space; these are necessary to be considered.

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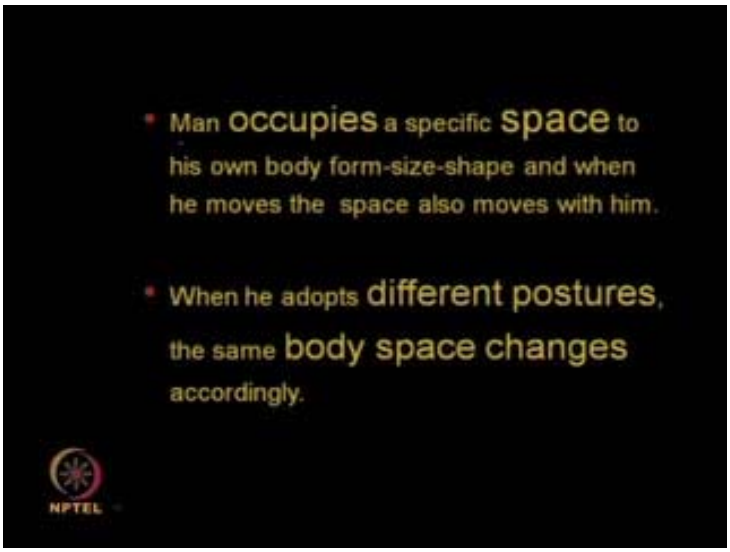

Very important aspect of human body is that, man occupies a specific space at his own volume, to his own body size and shape. And when he moves. the space also moves with him; when we are making some space arrangement, it should be considered.

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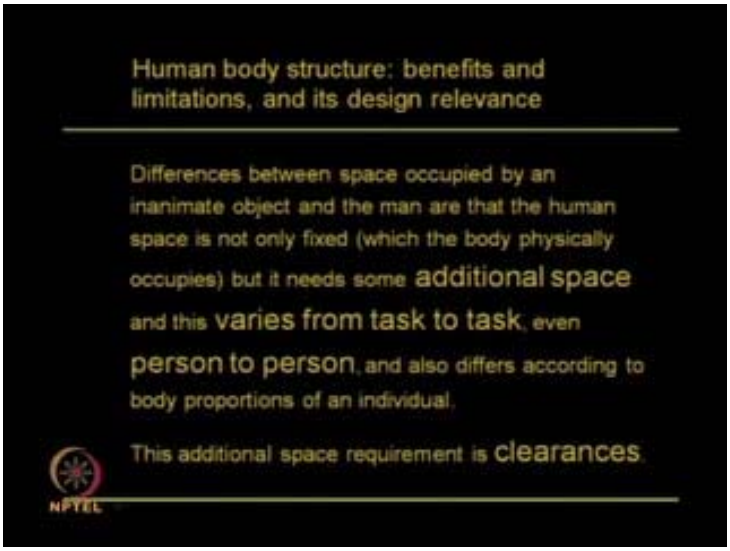

When he adopts different postures, the same body space changes accordingly. Human body structure: benefits and limitation and its design relevance of that, differences between space occupied by an inanimate object and the man are that the human space is not only fixed which the body physically occupies - but it needs some additional space

and this varies from task to task, even person to person and also differs according to body proportion of an individual.

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This additional space requirement is clearances. Human body- structure, growth pattern, somatotype and function - these are the main area of human body. We discussed the posture, movement and biomechanics.

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People for whom we are concerned, context India – Indians - the potential users. So for that or any design, we want to make our own requirement. We need to know our own body dimensions and our body variations through, cultural requirement, traditional and the original body.

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Context and user specific - our context is not only the cosmopolitan context; these contexts should also we need to be considered. Going global and mass need, multicultural and heterogeneous identity of ours; that should be kept in our mind..

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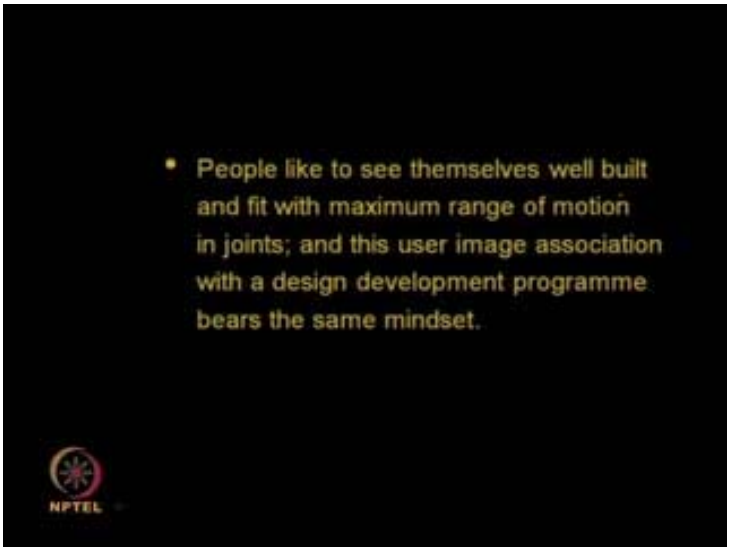

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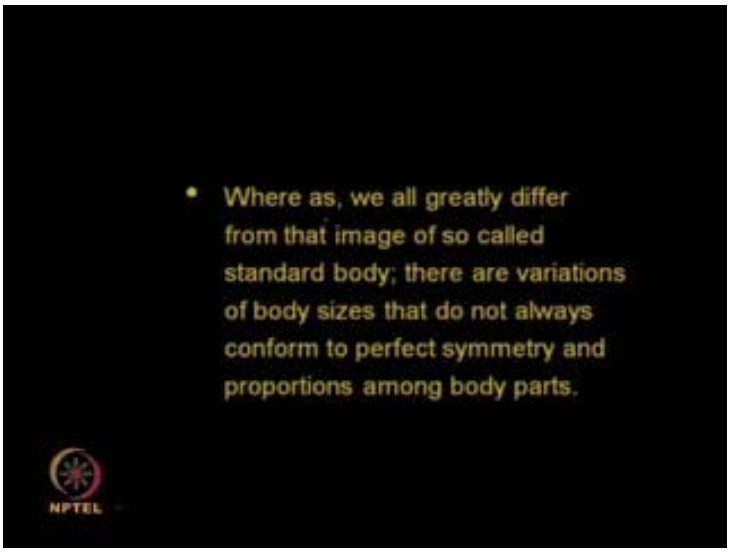

People like to see themselves well-built and fit with maximum range of motion in joints; and this user image association with a design development program bear the same mindset. Whereas, we all greatly differ from that image of so called standard body; there are variations of body sizes that do not always conform to perfect symmetry and proportions among body parts. All these things are necessary when we are considering some design for mass use. We need to know the ranges of different types of body structure.

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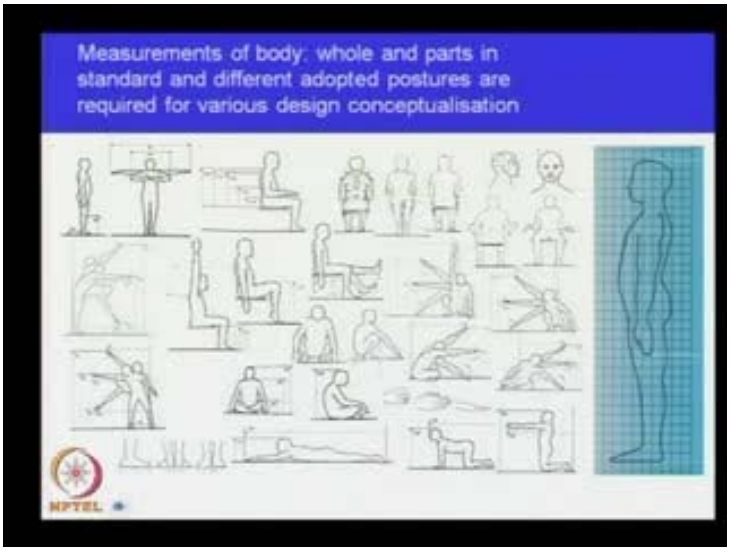

Sometimes, to overcome those unwanted features, we overdo clothing and use varieties of decorations, which in turn affect in negative way. Our design activity must consider various body types and limitations thereby; our design activities are to aid all the users, not any specific user or a specific person rather than making a design and then, asking them to fit in. Measurements of body: whole and parts in standards and different adopted postures are required for various design conceptualizations. We are going to discuss this in next session.

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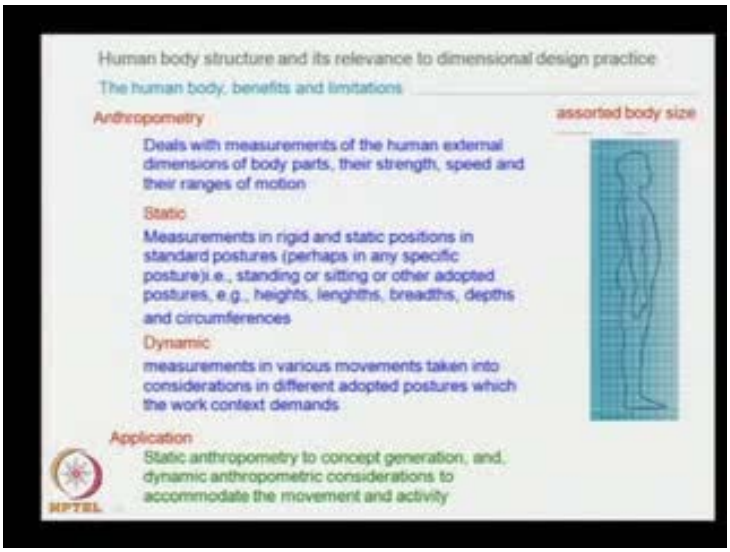

Human body structure and its relevance to dimensional design practice-- the human body benefits and we have assorted body size. Anthropometry is that, deals with measurements of the human external dimensions of body parts,, their strength, speed and their range of motion.

The static anthropometry is that, measurements in rigid and static positions in standard postures - perhaps in any specific posture - that is, standing or sitting or other adopted postures, for example: heights, lengths, breadths, depths and circumferences.

The dynamic measurements are measurements in various movements taken into considerations in different adopted postures which the work context demands. Then application of measurements- static anthropometry is to concept generation, and dynamic anthropometric considerations are to accommodate, the movement and activity. These details we will discuss in coming classes.

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Now, if we see this figure, how man behaves and what are the body parts and its interaction, -what items is operating with in a car? While going in and coming out, the differences, and all design descriptions are depending on the user's body dimensions. Who will be the users? A short height user, tall height user, fat or lean and thin users; we have to consider that range. This aspect we will discuss next classes.

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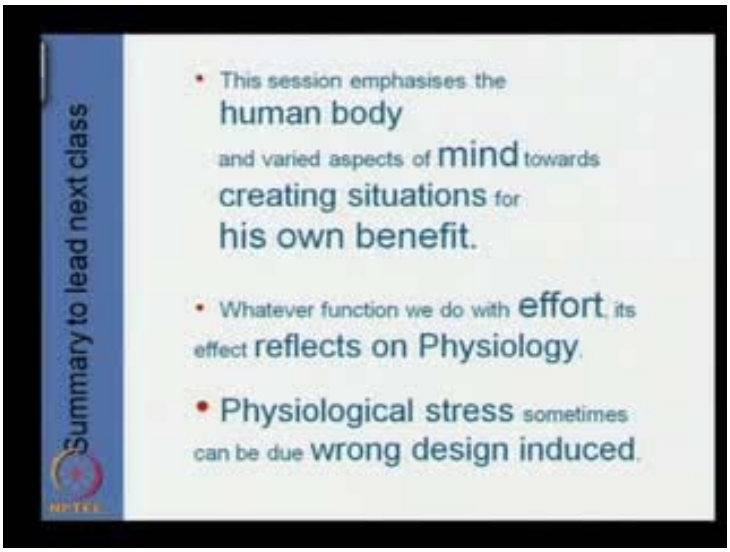

Now, summary to lead the next class is that: this session, today's session, emphasizes the human body and varied aspect of mind; how we behave with our body towards creating situation for his own benefit. Whatever function we do with effort is effect reflects on physiology.

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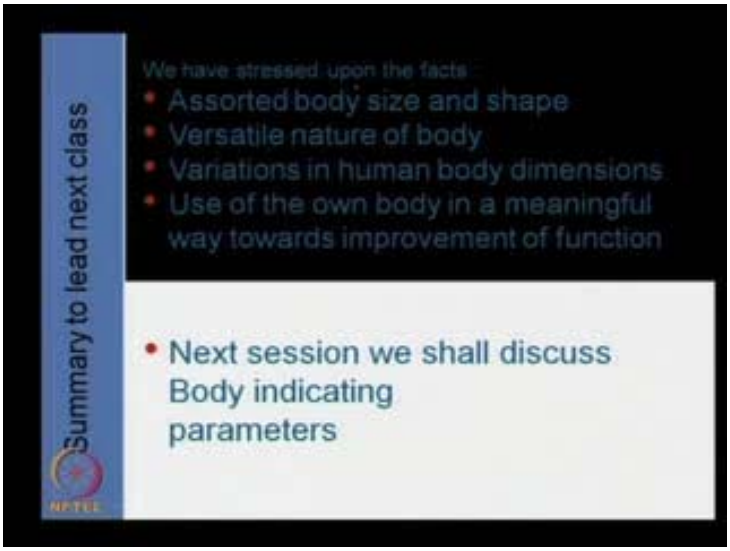

Physiological stress sometimes can be due to wrong design induced. So, we need to understand the body dimension. If it fits with body dimension, then we can say that it will be a good design. We have stressed upon the facts that, assorted body sizes and

shape, -a versatile nature of body, variations in human body dimensions, use of the own body in a meaningful way towards improvement of our own functional abilities.

Now, in next session,, we shall discuss body indicating parameters, that is body growth, somatotypes, and physiology and physical body land marks for anthropometric measurements. Start measuring techniques and its application in design.

So, the next class will be next session, the class number 9 will be anthropometry with body growth and somatotypes. With this, we are ending today's session.

Thank you.