Ergonomics for beginners Industrial design Perspective

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Module No. # 03

Human physical dimension concern

Lecture No. # 10

Static and dynamic Anthropometry: Standing

Welcome to this tenth session of Ergonomics for beginners industrial design perspective.

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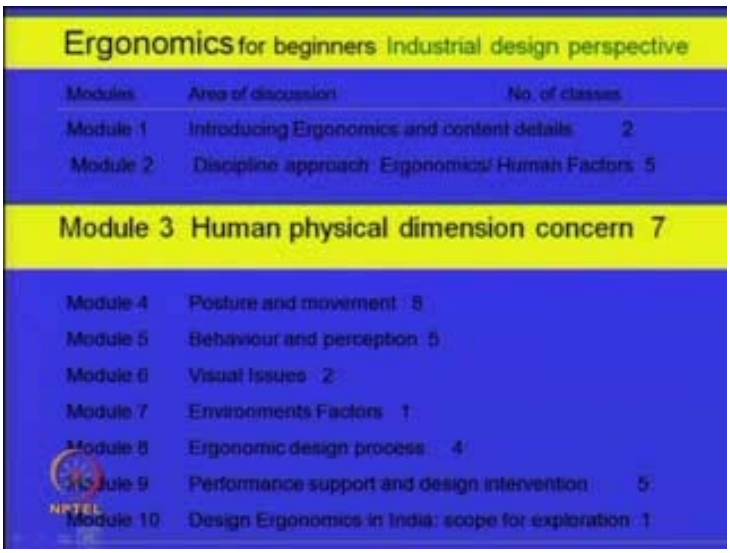

Today, we see, module 3 human physical dimension concern.

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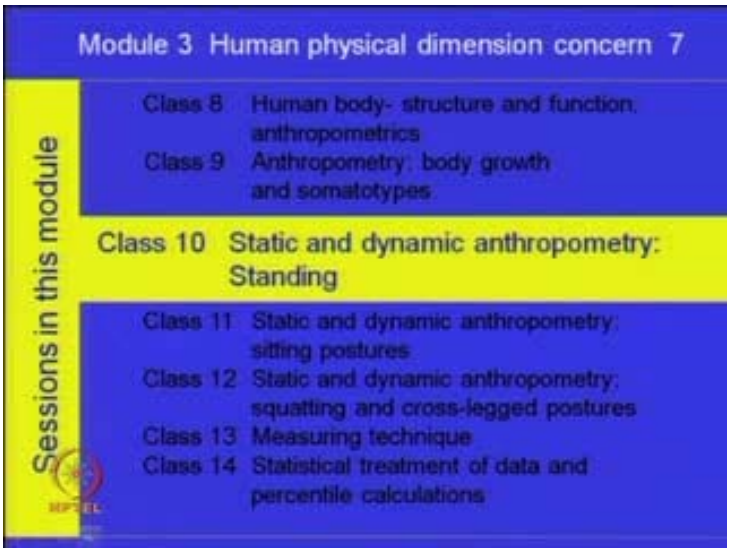

Under that, today's session is a tenth class; that is Static and dynamic Anthropometry: Standing.

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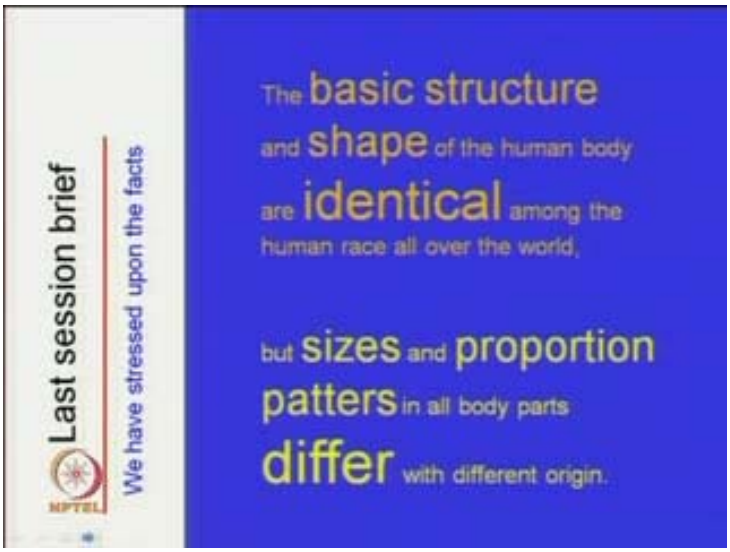

Now, last session brief: If I consider to just recall whatever we have discussed in last class, we have stressed upon the facts that the basic structure and shape of the human body are identical among the human race all over the world, but sizes and proportion patterns in all body parts differ with different origin. So, we need to have human body dimension measurements for a particular group of people when we are going to design

something for their use. So, information based on one population may not be suitable to use for another population group.

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In this slide, we can say that different proportions, the cultural differences, and the requirements - basically though it is same, but race, age and, other climate wise some different treatment is necessary.

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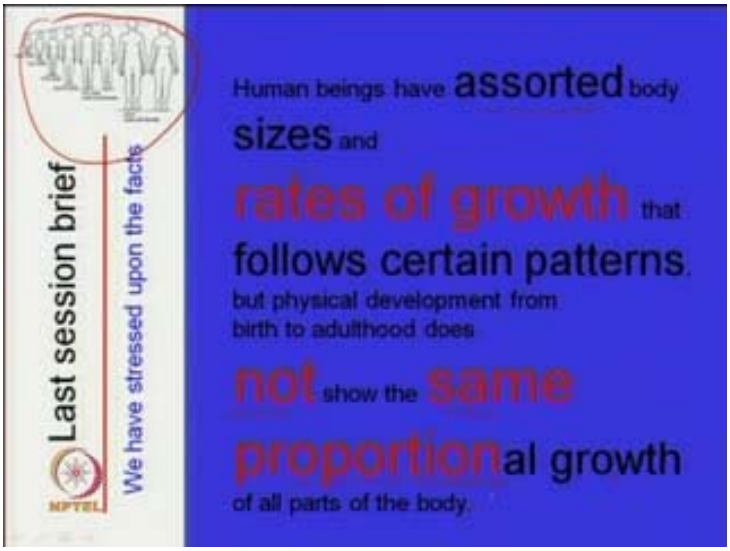

Now, when we see last class's growth pattern, human beings have assorted body sizes and rates of growth that follow certain patterns, but physical development from birth to

adulthood does not show the same proportional growth of all parts of the body. That we need to consider when we attempt to make a design to fit human body; that is for that particular user or that particular user's group.

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We need to understand how our body behaves; accordingly if the design is made, it will be well accepted. Now, design behaves means, a human body behaves means the structure, movement, pattern, etcetera, like we can say, Ectomorph - lean and thin body structure; Mesomorph - mostly the muscular body structure; Endomorph is a fatty body structure. we also need to understand these figure types to attempt design for a specific group of people, where this type of figure types are represented, in which proportion, or which percentage wise.

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Now, from this slide, we can say that, though all look like same, but their requirement, face cut design and whatever they are wearing, is not the same; they have the special liking. Now, we cannot change our assorted body size; instead, we need to design something that fits to our body.

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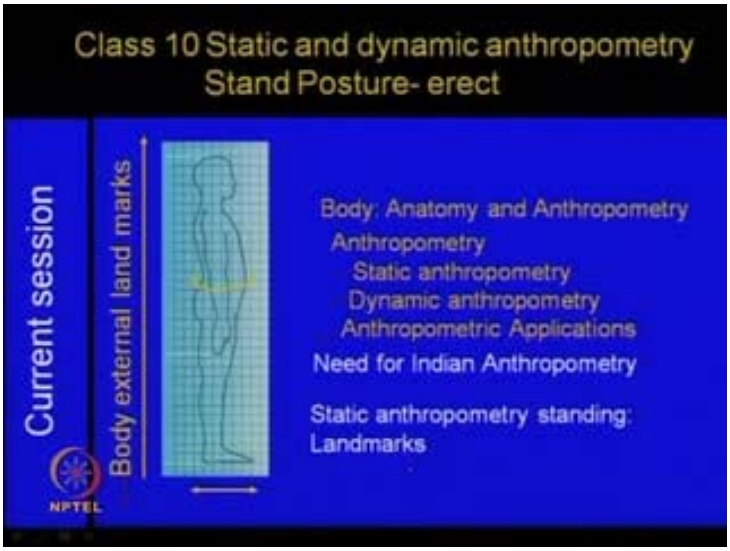

Now, with this, we can say that, in the current session, we are going to discuss certain body external landmarks for specific measurement. In this session, we are going to cover the body: Anatomy and Anthropometry. Specifications of Anthropometry that is static

Anthropometry, dynamic Anthropometry, Anthropometric data applications, Need for Indian Anthropometry data sources, and Static Anthropometry standing landmarks; specifically, we are going to discuss these in this present session.

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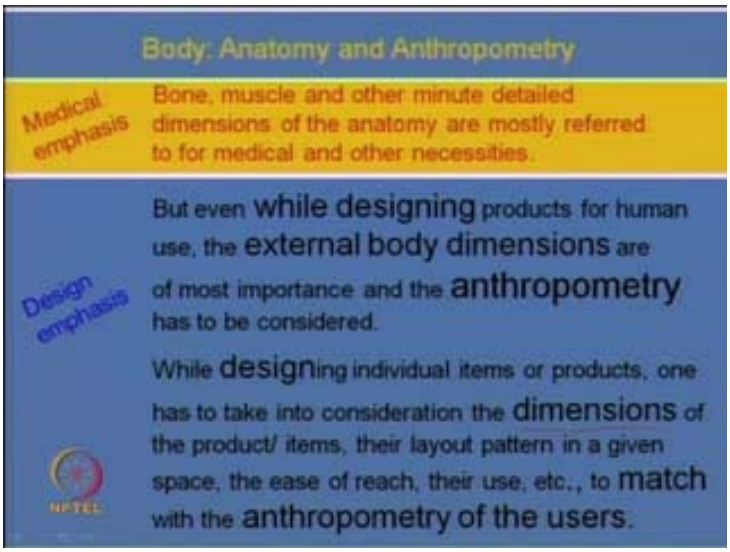

Now, Body Anatomy and Anthropometry: In this, the medical emphasis of our body dimension is that bone muscles and other minute detailed dimensions of the Anatomy are mostly referred for medical and other necessities. But for design emphasis, it would be even while designing products for human use, the external body dimensions are of most importance and the anthropometry has to be considered.

While designing individual items or products, one has to take into consideration, the dimensions of the product or items, their layout pattern in a given space, the ease of reach, their use etcetera, to match with the anthropometry of the users. It means human body dimension must match with the design dimensions; for that, we need to know the human body that is the body measurement; that is Anthropometry - height, breadths, lengths, circumferences, etcetera.

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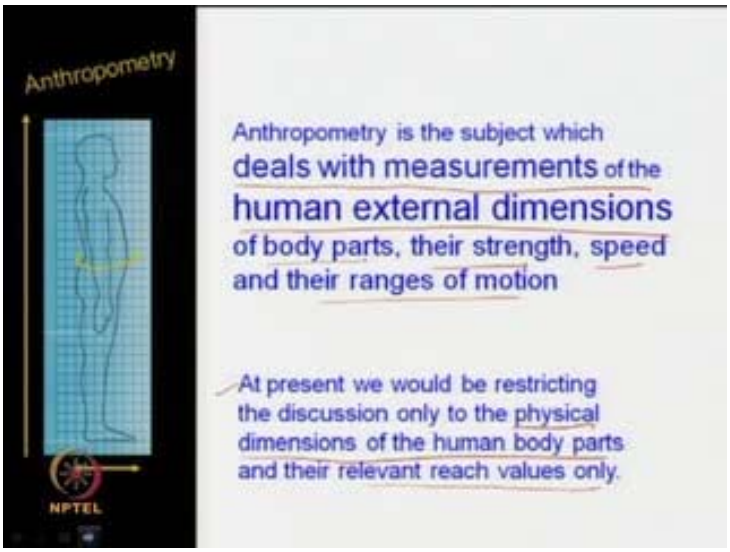

Anthropometry is the subject which deals with measurements of the human external body dimensions of the body parts, their strength, speed, and their ranges of motion. This is Anthropometry.

At present, we would be restricting our discussion only to the physical dimensions of human body parts and their relevant reach values only. In this module, we are not going to discuss the strength and body speed, and range of the motion of the body parts.

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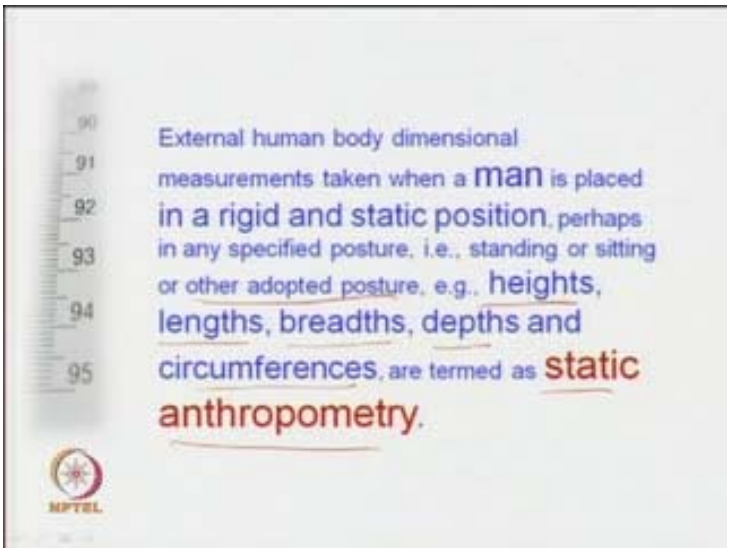

External human body dimensional measurements are taken when a man is placed in a rigid and static position, perhaps in any posture: that is if a person is a standing erect with arms put down hanging vertically from the shoulder, legs are straight, balance equally distributed through the legs, chest up, look front, at this position whatever the body dimensions measurement.

Sitting posture means: In a sitting posture where, all the knee, waist at the 90 degree angle, the trunk and head - straight upright, the arm is also hanging from the shoulder vertically down with elbow at 90 degree angle where, the forearm spread forward in that posture. Any other adopted postures for a specific task purpose and at that position when we are measuring heights, lengths, breadths, depths, and circumferences are termed as a static Anthropometry.

Static Anthropometry means one body in a rigid or static position; either in any specific posture or any adopted posture, the body measurements at that position are the static Anthropometry.

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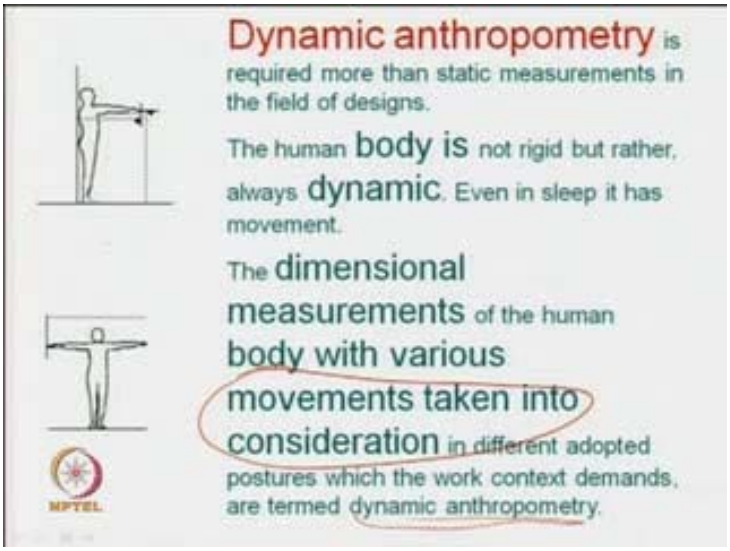

Now, dynamic Anthropometry is required more than the static measurements in the field of designs because when we do some task, we adopt some different body postures and do changes. If suddenly we take that arm length, so arm length is from this; this length is arm length, but without changing my body, I can extend my arm means this position is extended. Now, at this moment if I want to touch something, I can extend my arm. So,

this measurement is a dynamic measurement (Refer Slide Time; 11:41 to 11:59). though this was the static measurement so this movement allowance is we have

So, the human body is not rigid but rather, always dynamic. If you are in sleep, it has movement. The dimensional measurements of the human body with various movements taken into consideration in different adopted postures which the work context demands are termed as dynamic Anthropometry; it means movement taken into consideration. These two figures are saying what are the different body movements are one should take care of.

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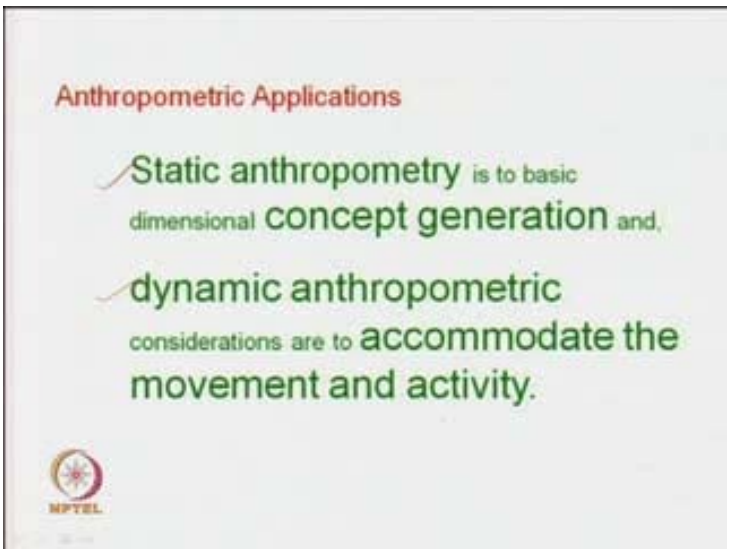

Now, the Anthropometric applications in design: The Static Anthropometry is to have the basic dimensional concept generation; that means Static anthropometry is to basic dimensional concept generation of a design and the dynamic anthropometric considerations are to accommodate the movement and activity.

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Now, with this, the anthropometric landmarks are the external points of the body structure with their muscles and skinny covers on it, and these should be taken into consideration. That means for these points, these height points and some prominent boney points are normally taken as landmarks. So, we are going to discuss these in standing postures.

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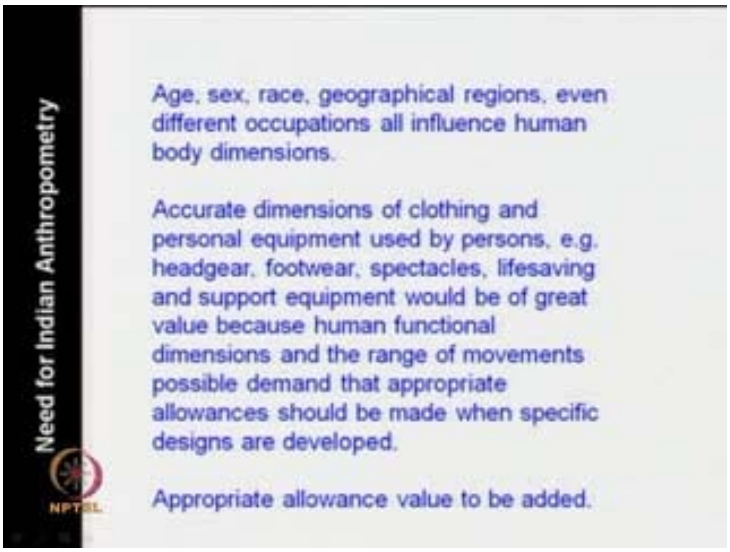

Now, why we need Indian Anthropometric data consideration? The age, sex, race, geographical locations or geographical regions, even different occupations - all influence human body dimension. In earlier class also we have discussed this matter.

Now, accurate dimensions of clothing and personal equipment used by persons: As per example, headgear, footwear, the spectacles that are used lifesaving and support equipment, would be of great value because human functional dimensions and the range of movements possible demand that, appropriate allowances should be made while specific designs are developed.

Appropriate allowance value to be added, like if we take a door height, then to cross, a person through that door his body height is enough if we consider but we are not sure whether that person will wear a headgear or will carry something on his head so that clearance is necessary. If we do not know whether that person will be a short height person, average height person, or a tall height person; in that case, the appropriate allowance value addition is necessary.

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It is advocated by experts that the anthropometric data to be used for specific design considerations of specific user's groups, should be based on same population groups; that means data from another group may not fit in to other group.

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The use of non-Indian anthropometric data in Indian designs and other imported readymade designs often results in mismatches with the requirements of Indian users. Now, some readymade garments are available. When we buy it, suppose the trousers, when our waist matches and the label length does not match - these are quite often experienced accidents. Serious mistakes may occur if any design dimensions do not exactly match the body dimension of specific groups.

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Now, Indian behavior, the way we use our body is also not similar to that of foreigners. We squat on the floor; we sit on floor or any other platform on a squatting or a cross legged position; we adopt many combinations of postures that is sit, stand, squat, leaning and etcetera; sitting on chair and desk positions; also, leaning and bending. So, Indian behaviors in all respect may not be similar to others. Some Indians prefer sitting on the floor and performing a range of activities there. Non-Indian data sources do not provide the references for these Indian specific requirements.

So, in this module, we are going to discuss the specific measuring techniques so that if any designer Ergonomist or someone wishes to conceive a design idea for Indians use, those specific dimensions - Indian dimensions, are not available. How those data can be generated? Those techniques and used principles, we will discuss in this module. Now, we are going to discuss the some landmarks points.

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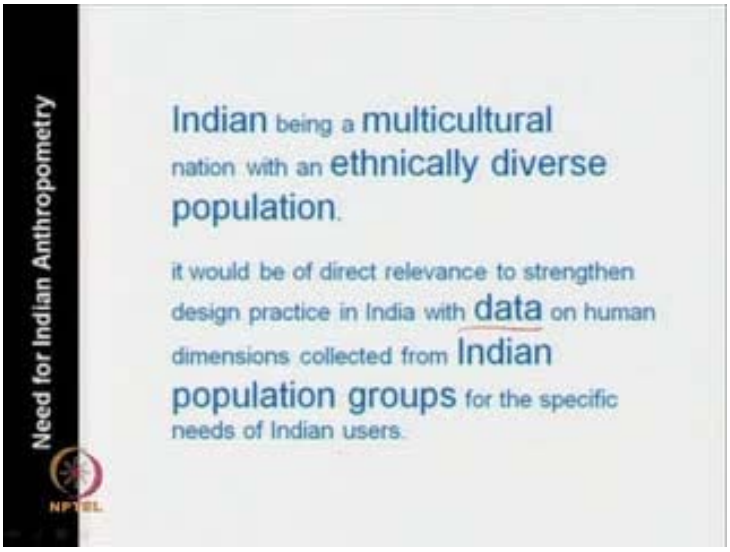

Now, India being a multicultural nation with an ethnic diverse population, we need to consider when we are going to design something like a walking stick. Suppose that walking stick should match with different population groups within India or whether we should make a design for a specific group - that we need to consider. It would be of direct relevance to strengthen design practice in India with data on human dimensions collected from Indian population groups for the specific needs of Indian users.

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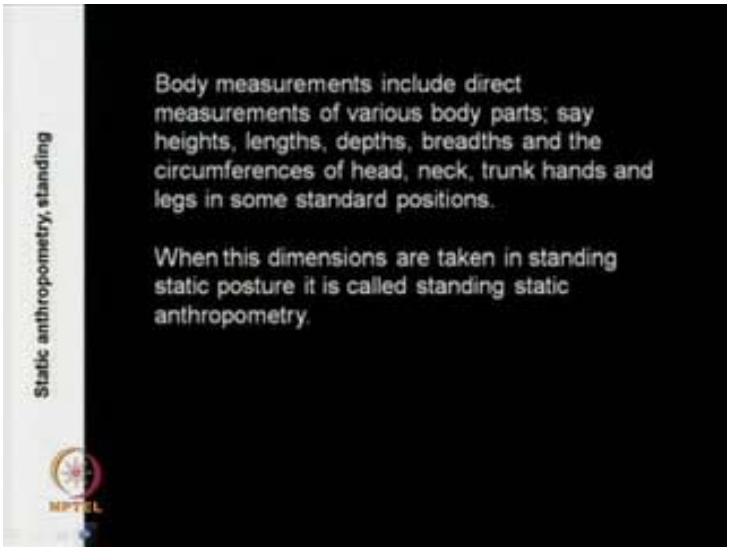

Now, the static Anthropometry standing position landmarks; now, the static Anthropometry standing that body measurements include direct measurements of various body parts; say heights, lengths, depths, breadths and the circumferences of head, neck, trunk, hands and legs in some standard positions. When these dimensions are taken in standing static posture, it is called Standing Static Anthropometry.

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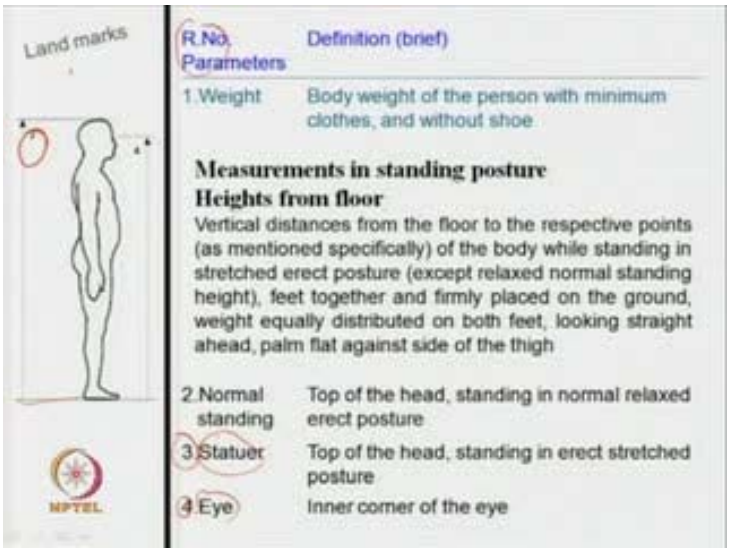

Now, the specific landmark in a standing posture is that. Now, in the rest of the slides, we are going to discuss some landmarks where, some figures have been shown. In this figure, some numbers, the reference numbers where these definitions are given; definitions are very brief. Now, here, one - the body weight of the person with minimum clothing and without shoe, but while using these data, we need to consider allowances that he may wear a heavy jacket.

So, this weight we considered as per standard measurement system minimum clothes and without shoe. But while the person is in working condition, he may have a heavy shoe also; these allowances, we need to consider.

Now, the heights: the measurements in standing posture; heights from floor: If this is the floor and then what are the heights - vertical distances, from the floor to the respective points, as mentioned specifically we are going to discuss now, of the height of the body while standing in stretched erect posture, except relaxed normal standing height, feet together and firmly placed on the ground, weight equally distributed on both feet, looking straight ahead, palm flat against side of the thigh. In this condition, the normal standing would be from this floor when a person is standing normally, without stretched erecting.

Normally, when the person is standing in normal relaxed erect posture, this is the normal standing height; normally heights are measured in millimeters. The statuer is that

suppose this number 3; these are the some reference numbers and these are the parameters. This parameter is suppose the statuer is the parameter, eye height is a parameter; 4 is the reference.

Now, in this figure, this 3 is a statuer; that means top of the head standing erect stretched posture from the floor, as it is mentioned that heights from floor, eye height - inner corner of the eye. So, now, when we see that, eye height is perfectly standing erect. When we measure, this inner corner of the eye height is high. This is taken as a normal eye height measure because when we look at a person with the normal eye position, that is the center of the eye vision, it becomes a center of the eye vision. So, these are the eye height conditions.

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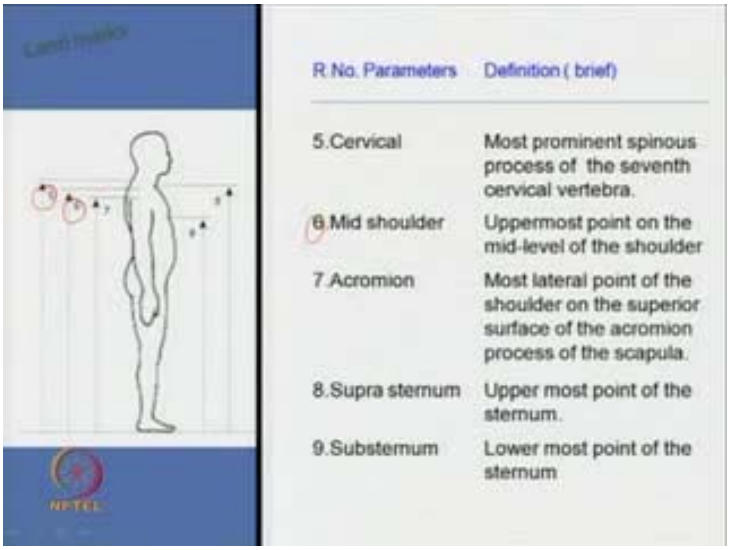

Now, number 5 is the cervical height: Cervical height is that, if we see from this head end, here a grove is here (Refer Slide Time: 26:06 to 26:27). From this grove, it will come down; especially, this one most prominent bone structure is here. So, this is the seventh cervical bone. Most prominent spinous process of the seventh cervical vertebra - this point, and this height is a cervical height.

Mid shoulder: Mid shoulder is that upper most point on the mid level of the shoulder, like here, in this case, the mid of the shoulder and that height is the number 6; It is the mid-shoulder height.

Acromion: where arm ends, where this collar ends, this position is acromion point. So, that height - acromion point, is looking for that movement posture.

Most lateral point of the shoulder on the superior surface of the acromion process of the scapula this scapula this bone triangular bone this point is matching here (Refer Slide Time: 27:17). So, it is the seventh. The acromion point here is an acromion height.

Supra sternum: If we see here (Refer Slide Time: 27:31) this notch area is the supra sternum group. Upper most point of the sternum is the upper sternum height.

Substernum: If we see like this, the where this sternum ends this group, this height is the (Refer Slide Time: 27:49) substernum height; lower most point of the sternum is that substernum height.

These are some standard landmarks mostly used in anthropometrics and these are necessary for various design dimensions fixation.

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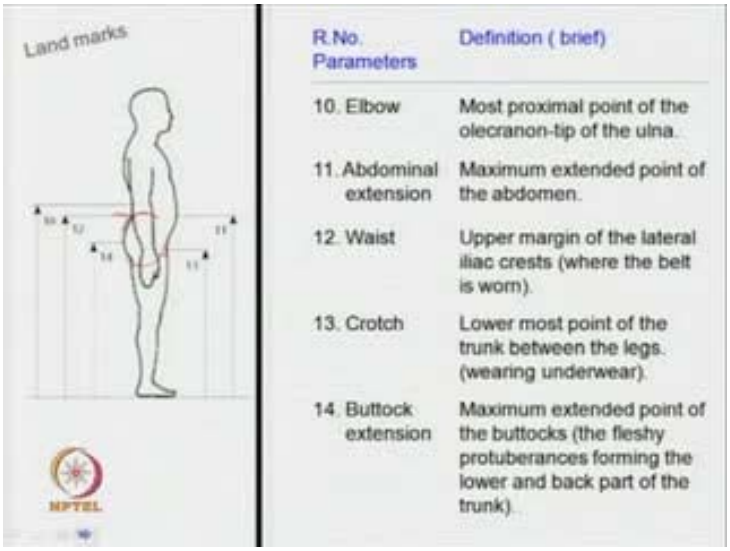

Now, number 10 is the elbow height. Elbow height: When you put your arm down this elbow this point (Refer Slide Time: 28:30) the most proximal point of olecranon tip is a olecranon tip of the ulna bone this is elbow height.

Number 11 is that abdominal extension height; maximum extended point of the abdomen wherever it comes maximum protruded point. The waist is that, here upper margin of the

lateral iliac crest; like see here like this, upper margin of the iliac crest where the belt is worn; so, this is that waist point. The crotch is that for male and female where, the lower most point of the trunk between the legs - that wearing underwear position; our body is like this. So, this position is crotch height. Then, buttock extension height is where the maximum extension of the buttock point; this is the buttock extension height that is maximum extended point of the buttock, the fleshy protuberances from forming the lower and back part of the trunk this is the buttock extension point (Refer Slide Time: 29:12 to 30:11).

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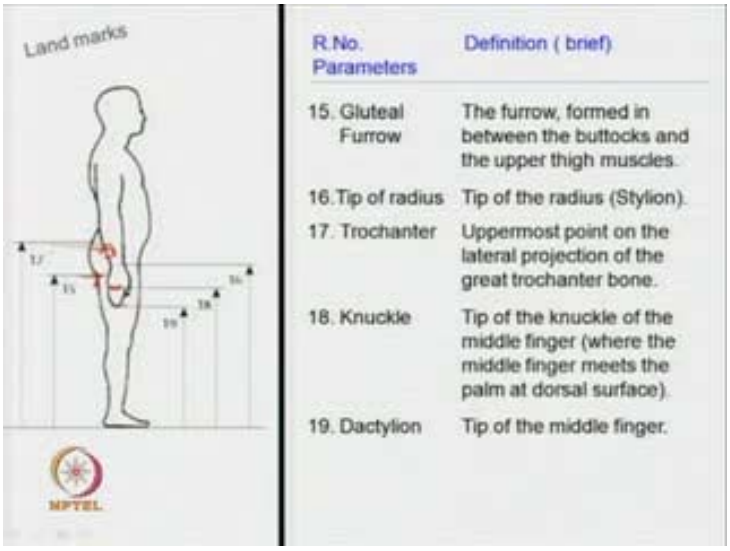

Now, the Gluteal furrow point is where, there is a furrow point here. So, this point is that gluteal furrow point. The furrow formed in between the buttocks and the upper thigh muscles. This is the buttock; the gluteal furrow point. Number 16 is the the tip of radius - the tip of the radius stylion bone; this tip radius is 16.

The Trochanter: Upper most point on the lateral projection of the greater trochanter bone. Earlier, we said that some of the body and anthropometric landmarks depend on the different tips of skeleton structure. Here, the trochanter bone if we see, this bone is like this. So, this is the trochanter bone over here, upper most point of the lateral trochanter bone. Here, the bony structure is like this in this point (Refer Slide Time: 31:17 to 31:33) - upper most point on the lateral projection of the great trochanter bone.

Now, knuckle: These are the knuckles so that when we hand down our palm the most prominent point of the knuckle, tip of the knuckle of the middle finger where the middle finger meets the palm at dorsal surface where, the middle finger meets with dorsal surface here. This point like here, it meets here; this is the point like this that height so this is the point (Refer Slide Time: 32:12 to 32:28).

Now, Dactylion: The tip of the middle finger this is the dactylion - point 19.

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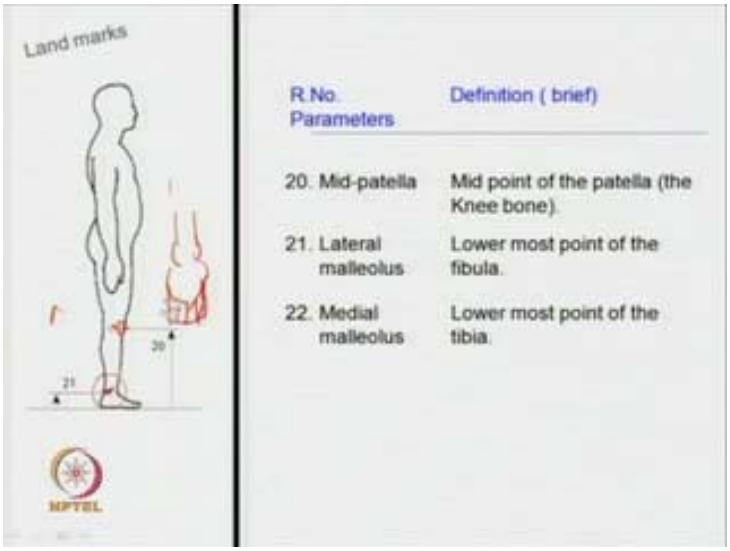

Now, Mid-patella: In this patella small knee bone is here. This mid portion is the patella. Midpoint of the patella - the knee bone, this is the height. So, it describes where you can bend your legs like this from this point (Refer Slide time: 33:03).

Now, Medial malleolus: Medial malleolus and lateral malleolus: If we see this leg, this position, from the front side if we see, it is like that way. So, these two bony projections are there. So, inner part is medial malleolus and outer side is lateral malleolus. So, outer side this portion this height; lower most point of the fibula is the lateral malleolus and inner side is that lower most point of the tibia is medial malleolus.

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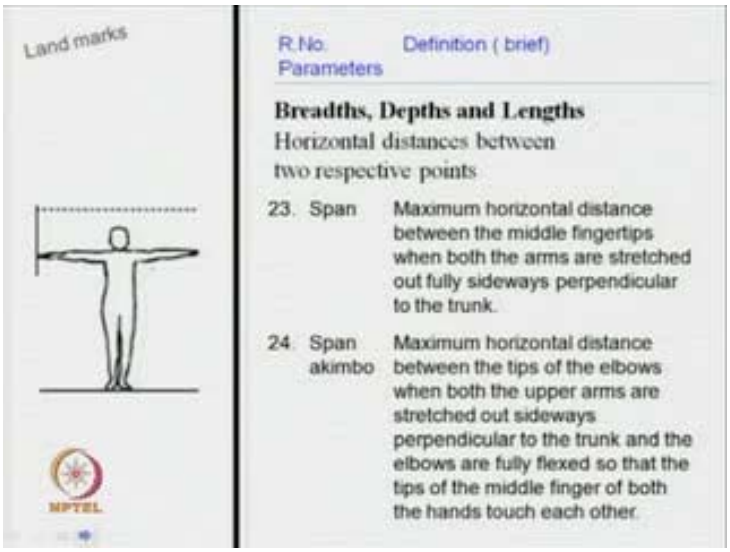

Now, after this basic body heights in standing erect posture, some breadths, depths, and lengths. A breadth is this breadth; depth is that from front and back breadth. Some other lengths like span and span akimbo span is that, when you are extending your full arm, this is the span. When both arms are folded at this elbow point like this and this is span akimbo point. So, breadth, depths, and lengths are that horizontal distances between 2 respective points. Now, first span is that maximum horizontal distance between the middle finger tips when both the arms are stretched out fully sideways, perpendicular to the trunk. Span akimbo is that maximum horizontal distance between the tips of the elbows when both the upper arms are stretchedout outside sideways perpendicular to the trunk and the elbows are fully flexed, so that the tips of the middle finger of both the hands touch each other.

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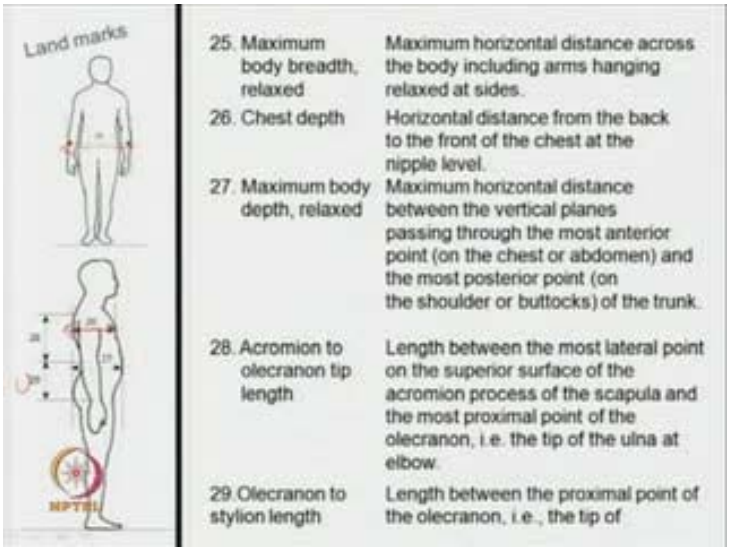

Maximum body depth, breadth relaxed: when you are standing in a relaxed position, this is the maximum body breadth. The chest depth from sideways this is the chest depth. Then maximum body depth: Whatever the posture, stand erect or relaxed, from front and the back if we make a plate, then the maximum distance between these two plates is that maximum body depth. Then from acromion point to olecranon tip, this olecranon tip to this length, and olecranon to stylion length like that and etcetera (Refer slide Time: 36:36 to 36:50).

So, if we read this point, then maximum body breadth relaxed, chest depth, maximum body depth relaxed, acromion to olecranon tip length is that length between the most lateral point on the superior surface of the acromion process of the scapula. This is the scapula - The most proximal point of the olecranon that is the tip of the ulna at elbow. Olecranon to stylion length, that is 29th - this one, length between the proximal point of the olecranon that is the tip of the stylion length.

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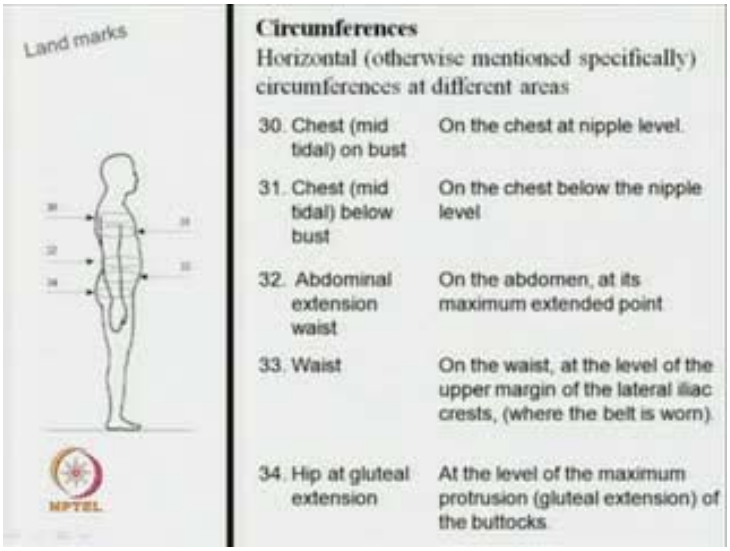

Now, circumferences: There are different body circumferences; anywhere we can take it, but here, we are giving some representative landmarks. Circumferences are horizontal; otherwise, mentioned specifically, circumferences at different areas like 30th chest mid tidal on bust; bust is a 2 nipple point. A mid-tidal means when we are taking breath in full, at that time, the total circumferences is the chest mid tidal on bust on the chest at the nipple level. Then 31st is the below nipple level. On the chest below the nipple level means we can say that roughly at a sub sternum level. The 32 point - this 32 is that abdominal extension waist point at the waist, where the maximum abdomen point is there on the abdomen, at it is maximum extended point at waist. 33 is the waist level on the waist at the level of the upper margin of the lateral iliac crests where the belt is worn. 34 hip at gluteal extension: gluteal extension is by the maximum mass of the buttock - at the level at the maximum protrusion gluteal extension of the buttocks.

Now, we said that different time and others also change this dimension. Just for one example of that waist measurement, if we go to a tailor to give our body measurements for making a trouser and if we give the waist measurement circumference after full stomach food, then whatever measurement they take, accordingly if the trouser is made, when we wear the trouser when the stomach is empty, then that pant - that trouser will be loose fitting; at the same time, if it is a reverse, in a hungry stomach if we go and give measure of this trouser circumference at that waist, then after a full stomach food, it will appear as little tight.

So, these are some cases we need to consider and designer has to use contact, when and how to use these measurements. So, when these measurements are taken, the subject's condition has to be recorded properly. So, while using, one can use it with all these considerations.

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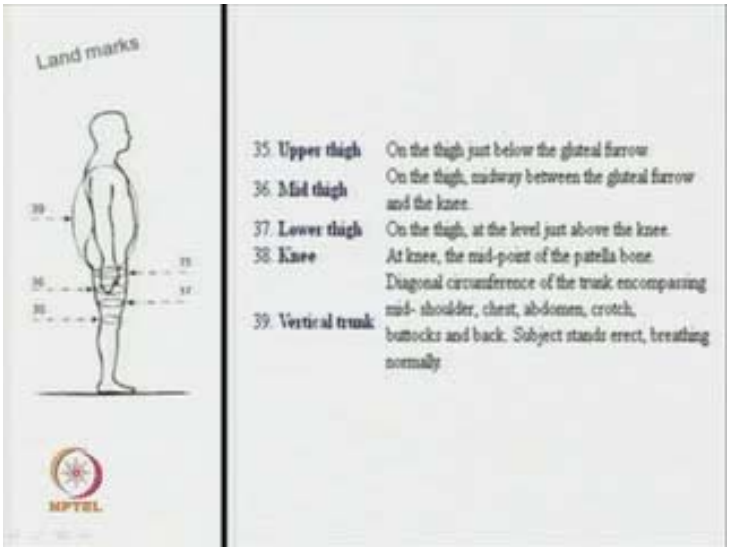

Like some other landmarks that upper thigh and etcetera, upper thigh, middle thigh, lower thigh and knee circumferences, like that calf and etcetera - all circumferences are measured.

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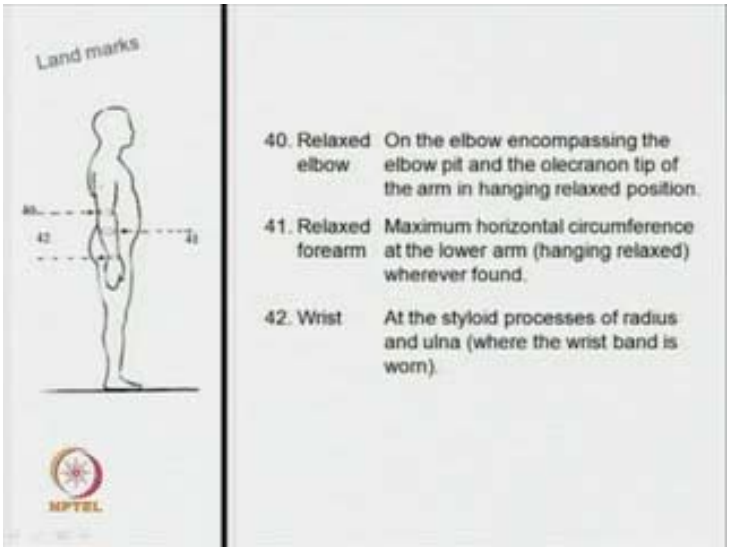

Then, relaxed elbow: When elbow is relaxed, this circumferences like on the elbow encompassing the elbow pit and the olecranon tip of the arm is hanging relaxed position. Adictum circumference and at relaxed forearm maximum horizontal circumferences at the lower arm hanging relaxed whenever found. So, like that, and 42 is that wrist circumferences and like that with different circumferences are taken, and that we will talk later.

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Now, lead to next classes. With this, what do we understand? Practicing designers and others use ready references and thereby arrive at varied human dimensions in design context. Sometimes some data might need to be generated for some specific design application and for that, the methodology of the general survey and statistical compilation may be of relevance to ergonomic practitioners, researchers and students. The following session would help in understanding the procedure and becoming acquainted with the statistical implications of anthropometric data as used in design, in general that we are going to discuss.

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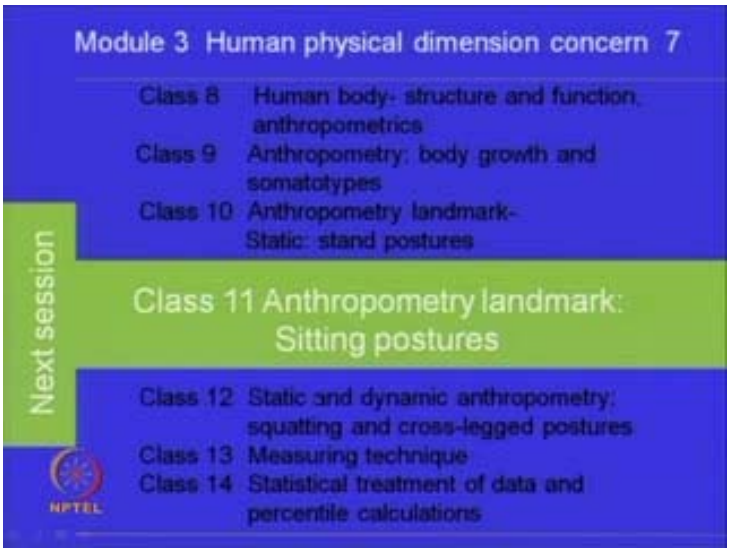

Now, in the next session, we are going to discuss on the sitting posture body landmarks that are used for different ergonomics activities and rest, there will be other 3 classes, where we are going to discuss in the class.

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Now, coming session will be class number 11 - Anthropometry landmarks sitting postures, followed by class number 12 - static and dynamic Anthropometry squatting and cross legged postures; class number 13 - the measuring techniques of all these body dimensions like in standing, sitting and different squatting and cross legged postures and

others relevant. Class number 14 of under this module will use statistical treatment of data and percentile calculations for design application. So, the next lead to next class is that we are going to discuss this sitting Anthropometry.

So, till then, I think we have to think how we can use human body dimensions in day to day life experiences. We must observe furniture and other design items we use in everyday life and compare with our body, whether it matches; what are the problems we are facing out of this mismatch? If it does not match, then how can it be modified? Or, if we want to develop some specific design for that, what type of body dimensions we must consider for that? Let us have a look into our own life because whatever design has been designed, that is for our use, for our benefit.

So, we must feel comfortable. Our body dimensions should get acquainted of the compatible with the designed items that we are going to use. So, we will meet next day. So, thank you very much on this day.

Thank you.