Ergonomics for beginners Industrial design Perspective

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Module No. # 03
Human physical dimension concern
Lecture No. #12
Anthropometry: squatting and cross-legged postures

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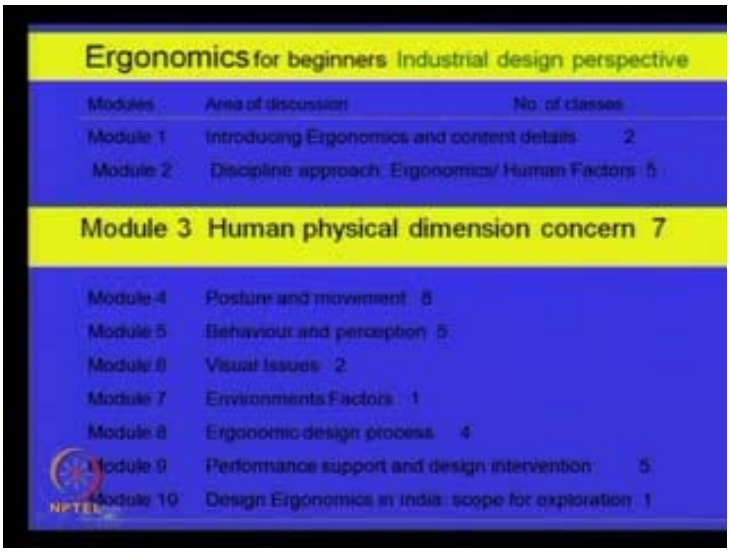

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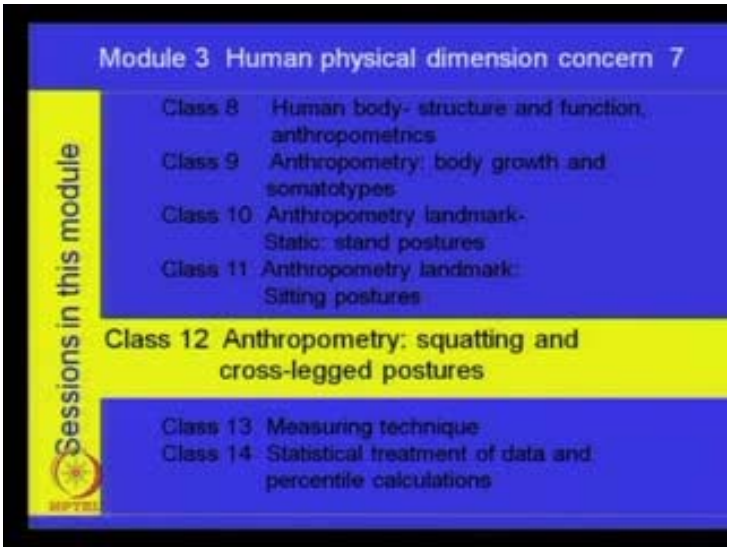

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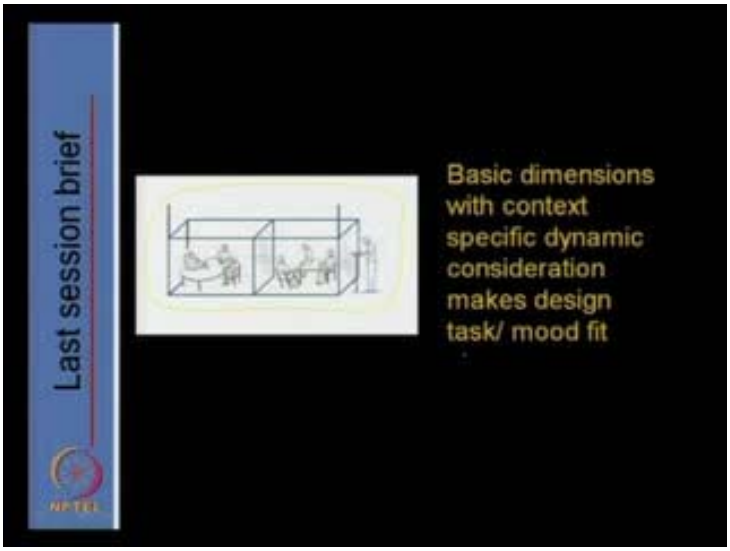

Welcome to today's session number 12 on ergonomics for beginners industrial design perspectives and module 3 - human physical dimension concern. Today's class is number 12 - Anthropometry: squatting and cross legged postures. Now, earlier in the last session, we have stressed upon anthropometric landmarks and relevant application aspects of sitting anthropometry, and that was based on seat-desk type of posture and there we

mentioned that basic dimensions with context specific dynamic considerations makes design task on mood fit.

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Now, today's topic is anthropometry that is squatting and cross legged postures. Now, in this, at the beginning of the first part we will discuss some of the postures, where these type of floor sitting are necessary or being practiced. Why it is relevant in or working conditions or working context and the specific body landmarks, we will discuss after that and some representative human body data.

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Now, here we can say that the task is being performed where a person has to sit on a squatting posture and there she is using a small stool to support this cross area, that is buttock. So, we require to know what would be the space necessary for support, and the height of the seat, and the stool height that would be preferable; for that certain dimension measurements are required.

These types of dimensions in available sources are not specifically reported or available. So, in a specific concern, if it is necessary one can measure it also. In the next class, we are going to discuss the measuring techniques where ready reference data are not available; there one can measure this type of data as we require.

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Now, in this, we can say that with low height stool support is here and in this right-hand corner picture, we can say that the floor sitting work posture, that the mixed posture is squatting and cross-legged, and also mixed type of sitting posture like that. So, while working in a group, different types of floor sitting are used and this type of floor sitting in a group creates an interactive environment where the group can perform certain tasks.

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In some industries, for specific requirement certain type of floor sitting is required and specific to Indian context, the woman those who are employed traditionally are comfortable while working on floor and that posture also being used in industries to match the require industrial requirement and traditional practices of postures.

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Here, the task demanding three postural adaptations and body dimensional variations; thereby, suppose in a library case when a person is getting reach the top shelf, to get lower shelf he has to bend, but whereas while bending, sometimes it is necessary to have a squatting posture and then while doing this squatting posture the total depth of body changes. In this case also for different type of squatting, different types of body dimensions takes place.

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Now, floor sitting provides free movement facilities and can create informal ambience where some serious topic can also be discussed in a classroom, where the design students are discussing some of the projects and that is generating some design ideas. At that time, it is seen that in place of or instead of using a seat desk posture and individually working, it is better to work in a group formation and floor sitting possibilities. It gives the idea generating facilities, because the person can choose their free body postures and can think alone.

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Floor sitting preferred tasks, individual posture choice: some like to work in a standing posture in a kitchen and some like to work in a sitting posture in a traditional way. It is seen, that while standing and working for a longer time, some cases have been reported of varicose veins at the calf muscles at lower leg. But sometimes, if there is an alternate postural changes at their standing and squatting sitting on floor, in a cross legged, etcetera, then that chances of getting varicose vein problem reduces.

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Now, floor sitting also increases the interaction and here what happens that if a single person or multiple person needs to come together, then the space requirement for that specific human body dimensions posture at home, feels like these type of postures gives home feeling; that is, free to change at own will to flexible posture and for that what would be the human body dimension would like to give a design for these type of

activities.

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Traditional task and posture: In this case, the reach value would be the normal reach, that we need those type of data even if we change this traditional model. If we use this wheel on a desk and sitting instead of squatting, it is a chair type of seating arrangement and still this type of human body measurement data are necessary to consider for design development.

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Now, cultural relevance of sitting: in our society work posture and craft sector and the bamboo work activities are found suitable to work on floor sitting posture. So, in that case, the human body dimensions, the total volume space, the work equipment and the workspace relations are necessary to understand the human body dimension in this posture and movement patterns and varieties of reach values.

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Work posture and craft sector metal work: earlier, we have seen that bamboo craft and even the metal craft see the specific posture is being adopted by people. Now, tasks traditionally practiced sitting on floor posture is some in a metal craft industry. All type of different activities in that metal craft is being shown here and most of all the activities are being done on a floor sitting manner.

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Now, design induced postural adaptation: sometimes, it seems that this person is squatting here, but he also can stand and work. So, in this matter design induced means that this machine made this person to adopt this posture and then if we need to have a series of machines in rows and columns, then what would be the gap in between. So that this person can stand and squat and what would be the distance, then this specific gaps space requirement is there and the additional allowances freeness should be considered, and we need to understand the body dimensions of this postures.

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Now, in certain cases, we see that leisure for a free sitting still has a specific body dimensions. Now, if we allow a free sitting space and for that movement to have proper sitting freeness. At the same time, to interact among themselves would be the total space requirement, and the individual space, and the allowances for free movement should be considered.

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Task and posture: this type of specific task is the posture or adopted, then what would be the minimum space required here? That measurement is necessary. In certain cases, that task is being studied to understand how body measurement movements are freely chosen. Now, for this type of activity, while making a small craft this person moves pattern when he requires a seat, small stool and what type of leg movements he makes. And

accordingly, if we want to make a seating device we need to understand its movement pattern and a specific simulated experiment was developed, where this person is made to work at his own will and the videography was taken and the online videography presentations are on the screen. On a greeted screen breed, from a distance, it can be recorded and accordingly it may be analyzed.

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Now, we cannot remain in a same posture for longer time; in the same posture like here, while reading this book the straight erect posture was there and slowly the bend increases again to have an erect type of posture. Finally, the book is lifted, so that in this case what is happened to maintain eye to this vision distance, the posture changes and accordingly if we want to make covered on it, a specific space than total human volume and its movement pattern and the space requirement need to consider and accordingly, the design development would be possible or if we need to practice this type of posture then we can have a sitting platform and a backrest type of thing. So that this person can have a back rest and can do some meditations type of practice.

If this type of design need to be made then this length, breadth, depth and height of this person in this posture is necessary to measure. So with all this, we can say that the squatting and in cross legged postures and some mixed floor sitting posture, specific

body dimension measurements are necessary to develop some designs that, we may require or we may use.

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Just one example, this is a specific seat design where the person can sit in any normal sitting posture as well as this seat provides a space, where this person can sit in a cross legged fitting posture. So this design can provide a floor sitting facility as well as a high platform so that, it can also be used to normal sit. For that, this type of body dimensions are necessary to understand.

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Now the space interactive, in this left hand corner, figure says that they are using the seats, but interaction is little less though, the teacher concern can go round to meet everybody but, still these children are not in a good interactive arrangement. But whereas, the floor sitting sometimes increases the interaction where, the teacher can meet student easily.

So sometimes, the furniture provides better opportunity and also without furniture the floor seating arrangement also increases the interactivity. For that this type of body dimensions are necessary to make.

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Privacy space demarcation and relation with body posture and dimension: Now, this person is sitting here, but the space he made spreads, this persons height and then the sitting area. So, the proportionately space gives him a privacy feeling so, what would be the relation between the body dimension and the privacy space feelings that, we need to study properly.

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Sometimes, like this sitting and privacy enclave, but this is a worst area in a temple front space, where there is no demarcation; but the person sitting has kept all the work equipment in such a position that it gives privacy feeling. So, what would be the relation between this space and this privacy space and what would be the relation area wise. Like this, another example for that

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Now task movement posture and space constraints. In this case, in open space working he can take any posture from any side and can approach. But in some other place this person is constraint. So, while moving in this and what activities he is supposed to do accordingly, the space has to be maintained. So, the body dimension is also necessary for that, means the basic principle here is that, if a person stand and if he sits like this, the square area and then the height of the ratio. When a person stand, the square area and the height ratio is inverse proportional that means, if the height is more and then this space is inversely proportional.

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Now space and posture, where the space is given there for sitting in a temple area where, the pilgrims are supposed to cross this way and then they can meet this people. So, this much space is provided. Now question comes whether, there will be special seating arrangement or it will be kept free. So that, when we are not sure how many people occupy here, the open space open floor sitting will be better for this judgment we require.

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Now posture can adopt anywhere, if it is a floor sitting posture. Like that, this is in a city area in front of a very big hotel, the snake charmer is playing snake, where a foreigner is looking at and now, see the posture and etcetera. But this is not possible with body supportive devices or specific furniture. So, it can be said that floor sitting posture had some facility to get adopted anywhere. So it is also necessary.

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So accordingly, we need to think habitual floor sitter. Now in this case, these ladies could have used this place as sitting because, this is normally sitting under tree but still they are sitting on a squatting posture. So we can say that, there is a habitual floor sit; they are the habitual floor sitter. Now, if somewhere we want to employ somebody or use somebody's skill, those who are not habitual in a new workspace and working with a specific equipment can alternatively think that the workstation or workplace can be designed according to the occupants habitual practice and in that case, we need to understand this requirement.

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Now in certain cases, if we want to develop a specific kiosk for these type of things. In this case, if we want to make some special arrangement, here a design so that, for the buyer he does not need to bent in such a way as well as to get reach the seller he does not require to bent much or to extend himself much. So in that case, that normal arm reach and etcetera has to be considered.

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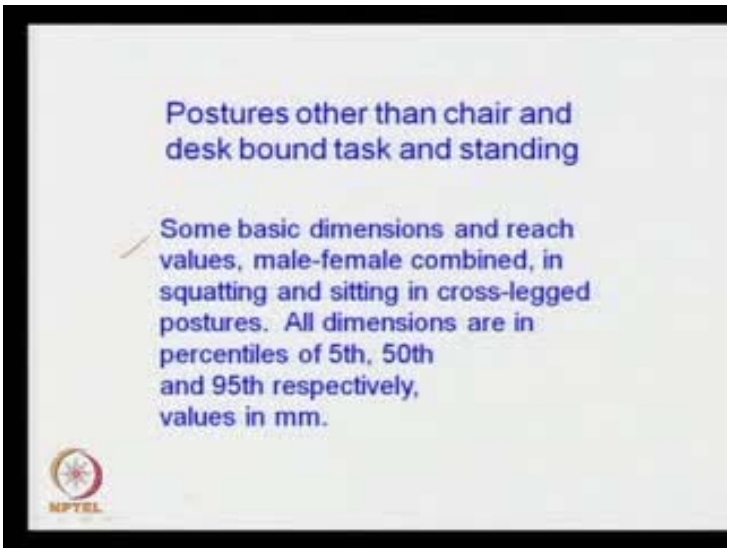

So in this posture, normal arm reach value at the front and sometimes it is necessary in the sideways and the back side and back reach values are necessary to understand. So, postures other than chair and desk bound task and standing task is necessary. Some basic dimensions and reach values, male-female combined in squatting and sitting in cross legged postures are necessary in our context.

Now, we will be showing some of the slides where there are different landmarks and some specific measurement data. Now, we will be discussing this and all these dimensions are in percentiles of 5th, 50th and 90th percentiles respectively and values are millimeter that we are going to show now.

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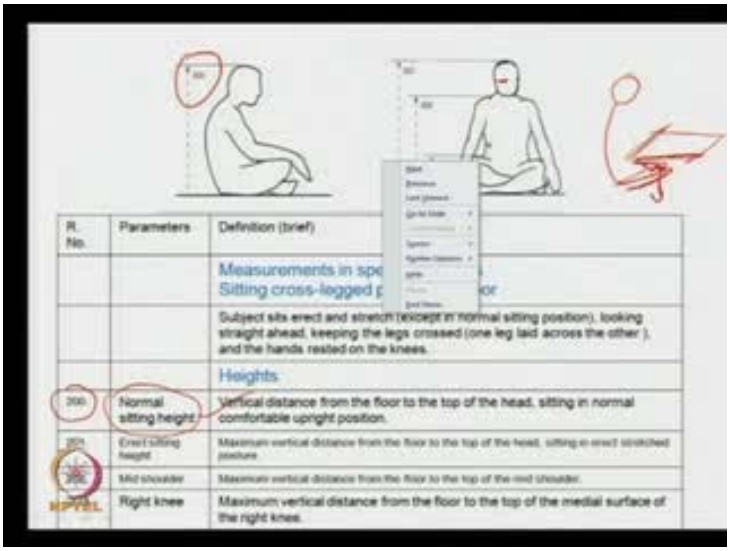

Now in this case, the length, breadth, depths etcetera and the different reach values now. If we see there is some data concern, that if a person as we have shown in earlier classes that, these figures have some specific numbers; this is a reference number and these reference numbers are here and the name of the parameter and the definition of the parameter. So here, this 200 is the normal sitting in a normal as we little bent. And the

height is normal sitting height. These are the normal sitting height and when you are sitting erect like 201 it is erect sitting.

Now, the erect sitting height is that maximum vertical distance from floor to the top of the head sitting in erect stressed posture; this is the height and accordingly, the eye height will be there and then mid shoulder height and then this is that mid-thigh height right knee height. Why we require this knee height? Suppose, if we design some play activity, where this is a play item. So, both persons can sit, and here when he sits in a cross legged posture some clearance should be maintained and for that, this height is necessary; this thigh height, this is a knee height is necessary.

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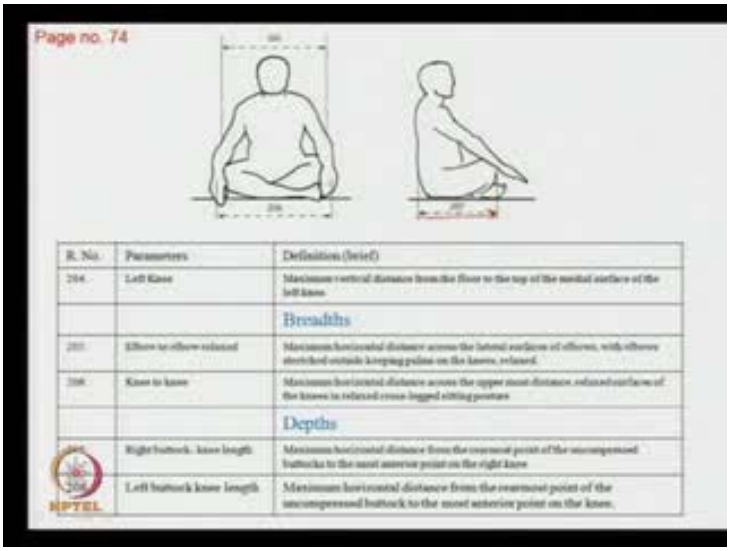

So, knee height is the maximum vertical distance from the floor to the top of the medial surface of the right knee. If in certain cases, the left knee is higher, then we must consider the higher value or design purpose. Now the left knee also, left knee height, then elbow to elbow relaxed dimension. Elbow to elbow relaxed dimension means- when we are sitting by keeping these two arms at the side of the knee, at that position, the elbow to elbow distance, the knee to knee distance is that, from this knee position to knee position this knee to knee distance; these are the breadths.

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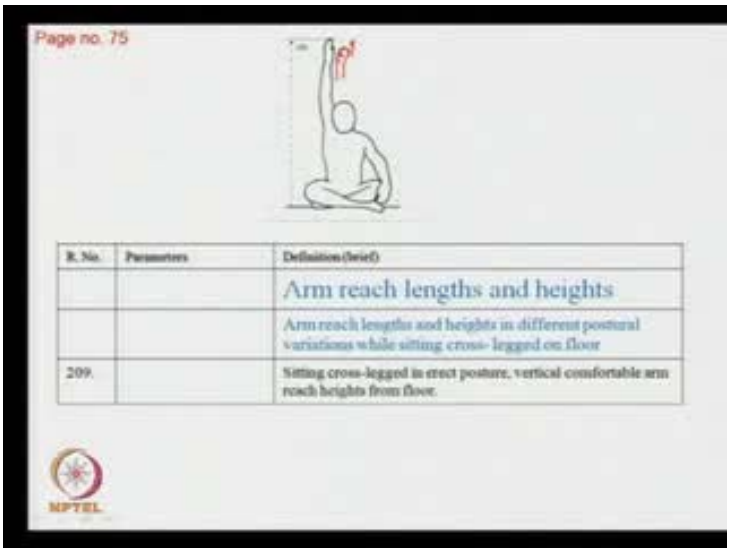

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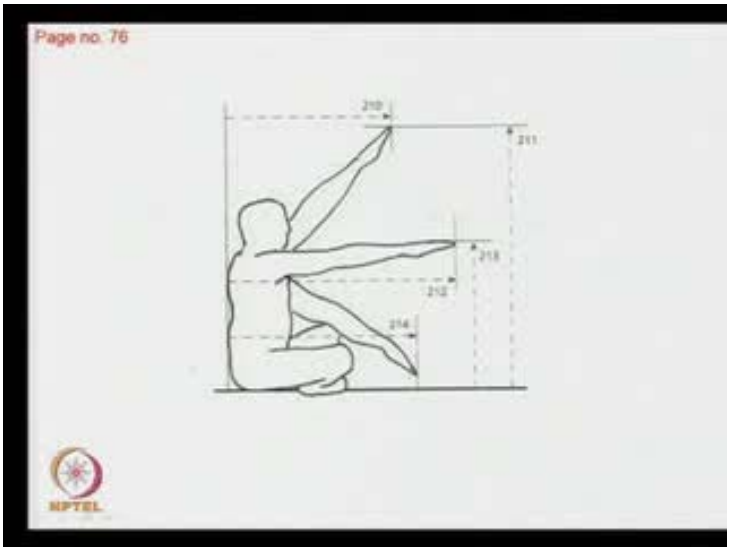

Now, depths: what is the depth if we sit like this way than from buttock position to the right knee? This is the position and then left buttock to left knee is also this measurement. Now, arm r each lengths and heights: if the total arm is raised, is the arm length and height. So, the arms reach lengths and heights in different postural variations while sitting cross legged on floor; this arm reach value the sitting cross legged in erect

posture vertical comfortable arm reach height from floor. Now, if we have the grasp reach like this way, from this grasp reach to the steep it is around 7 to 10 centimeter.

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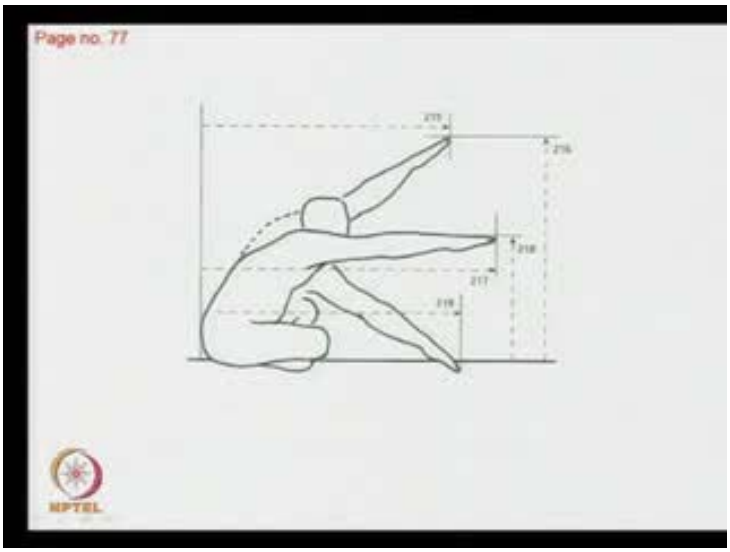

So, the vertical arm reach and now if we want to grasp something on the top, then it should be below 7 to 10 centimeter. Now at different heights reach, if a person sits in a erect posture from the axis that touches the back and buttock, from there the total distance- the comfortable distance- is the depth or length and height from floor. This point and the similarly at the center midpoint is also like that. Length, height and a comfortable lower distance when it touches the floor, this is the length and the height maybe touching the floor.

In bending posture, suppose, in a soft or at home while doing something, we sit in a cross legged and we try to get something from the front. At the time, we may need to bend it. Sometimes, if we want to make a curved surface from there, we need to take some item, then what would be the length and heights from here from the point of its buttock point? Therefore, the buttock reference point- we can say that- with bending the normal upper arm reach length in a comfortable position and the height also. At the same middle comfortable height and length and the lower level the reach, when it touches the floor.

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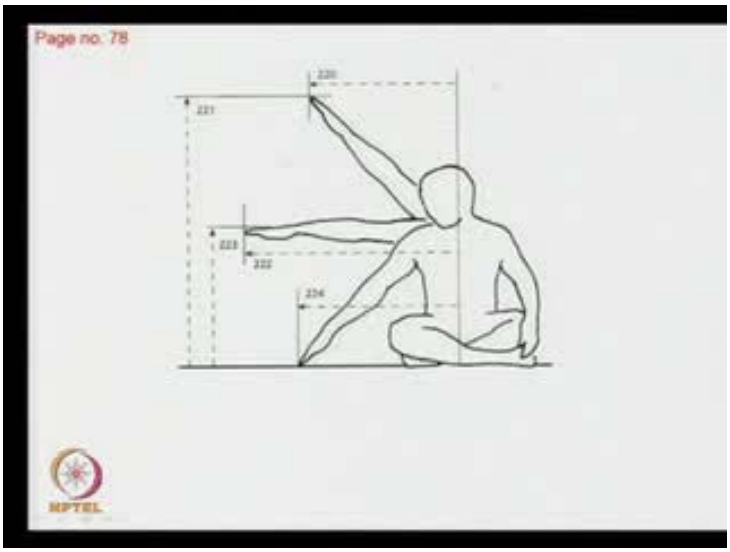

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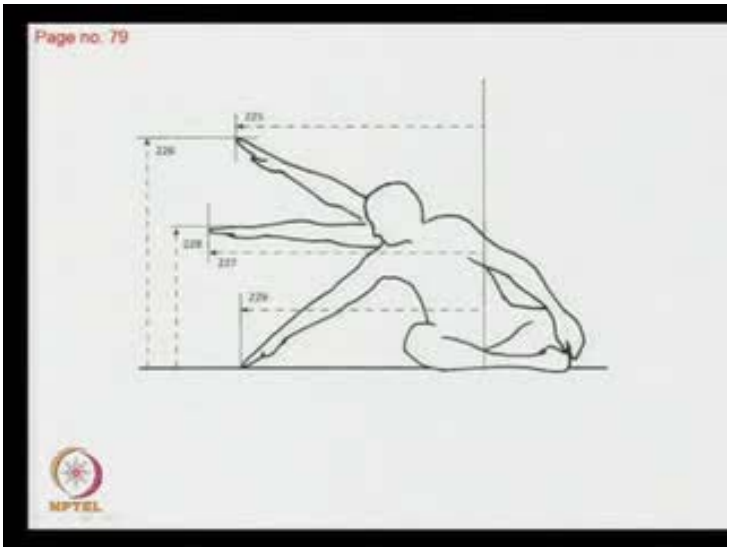

So, at that level, we can have a surface. Now, at the sideways when a erect posture the sideways is that upper comfortable reach and the middle comfortable reach and lower comfortable reach. At the bend posture in the sideways, bending from this mid body point where and when we are sitting in an erect posture. At the center body axis and from that point when we are bending, those comfortable upper arms reach length and height,

upper middle range and height and then lower length and when it is touching the floor.

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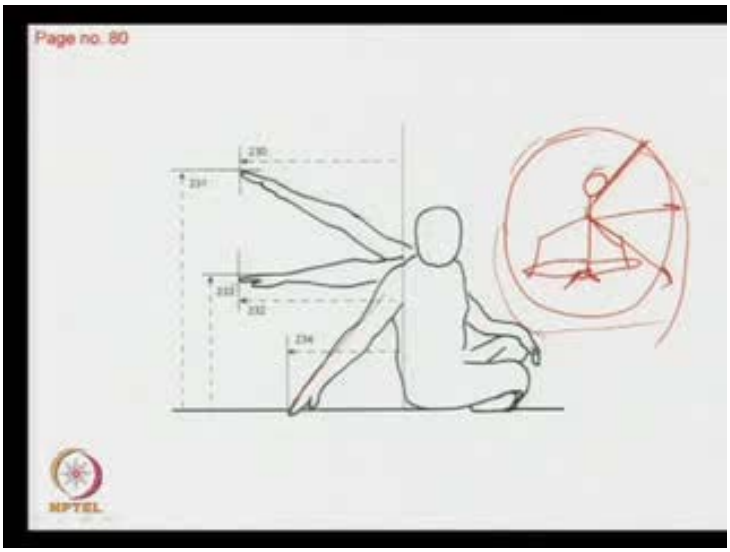

If someone cannot touch the floor, then here we may have specific height. Also in backward movement, if we need to take something from back then upper comfortable reach middle, comfortable reach and lower comfortable reach. Now, what we can do with this if a person sits like this? What happens from the top, where he can touch bottom? He can touch center he can touch at the sidewise front wise and back wise by that way we can make the total work volume.

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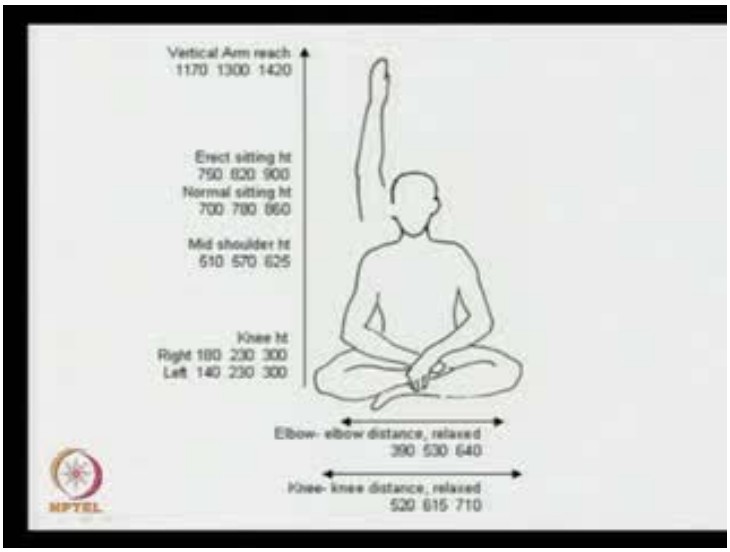

So, this is the arm workspace envelop. In a cross legged sitting posture, in an erect and when we are concentrating these dimensions in bending posture, so this is the backward movement. Now, some of the data here is given in a standing. In an erect sitting posture, vertical arm reach all these dimensions in millimeters.

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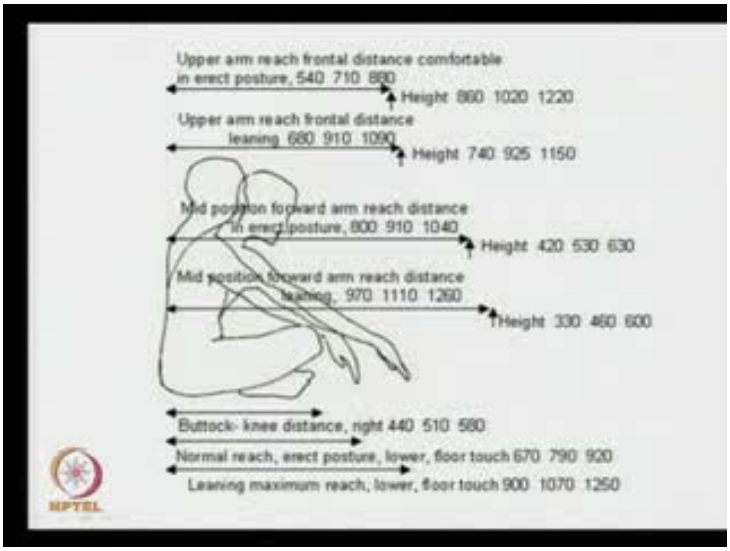

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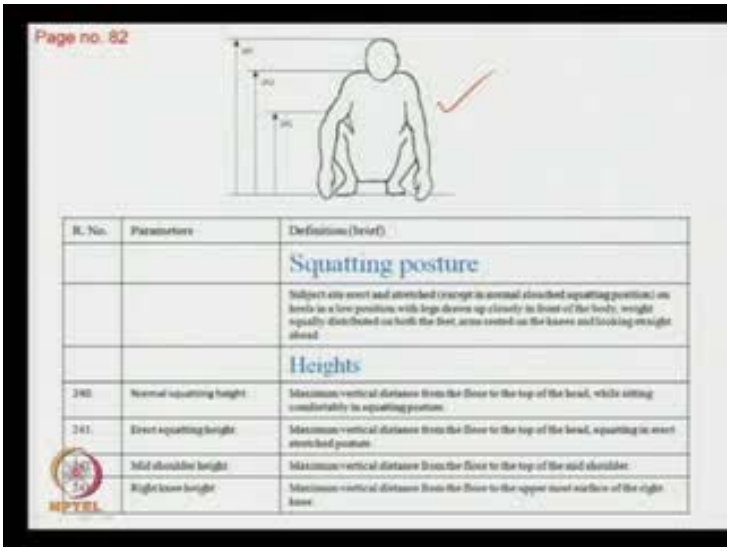

This is the depth for some of the depth upper arm reach, frontal distance etcetera in erect posture, height, length etcetera. Some dimensions are provided in this slide. So, this slide can be noted to keep reference. Now in a squatting posture- squatting posture is typical squatting posture; subject sits erect in stressed accept in normal slouch squatting posture. On heels in a low position with legs drawn up closely in front of the body, with equally distributed on both the feet arms rested on knees and looking straight ahead is the standard posture.

Now, on heights, normal squatting height means when we are in a normal squatting position, a little slow position and in the erect squatting height is that, when we are stressed erect. At that time, the total height to the top from the floor to the top is the normal at the erect squatting height. The mid shoulder height and is the knee height from the mid top point these are the different heights.

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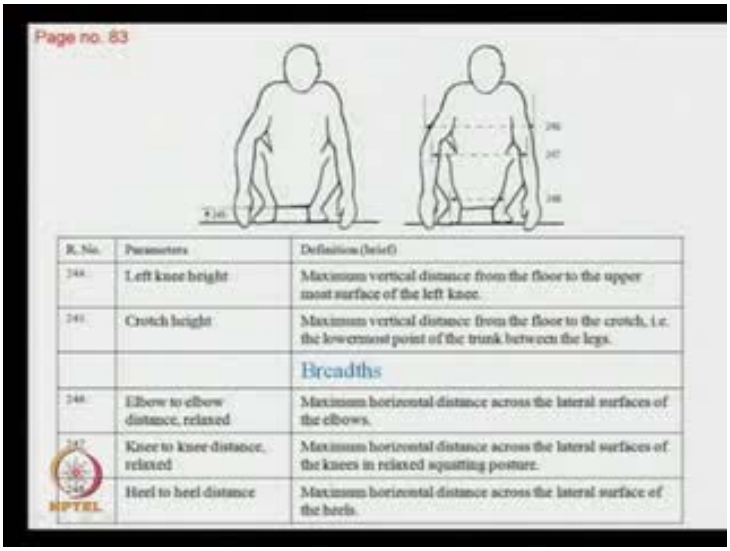

Now, a specific requirement, say that a crotch height means where the lower most body is there, this height is crotch height. It is specifically necessary to have a low sitting stool device design and when the body in a different movement would be the variations in that. It is necessary then breadths elbow to elbow distance in a relaxed position, knee to knee, outer knee to outer knee distance and then heel to heel distance. It is necessary and this specific posture dimensions are required when we make an Indian style toilets. There these dimensions are necessary to make that total pandist pan dimensions.

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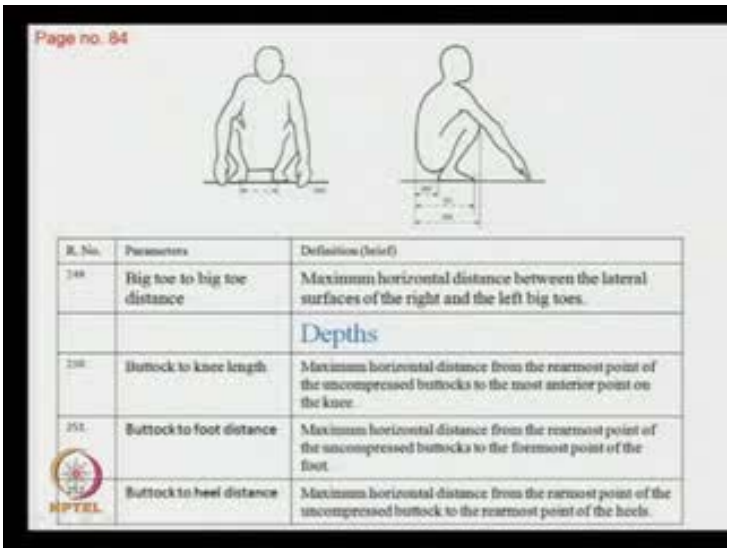

Now big toe to big toe distance and different things as from back to knee back to toe back to heel. These distances and the total arm reach distances are also required to measure and these are necessary in addition to this dimensions as per an example we can say that toilet area.

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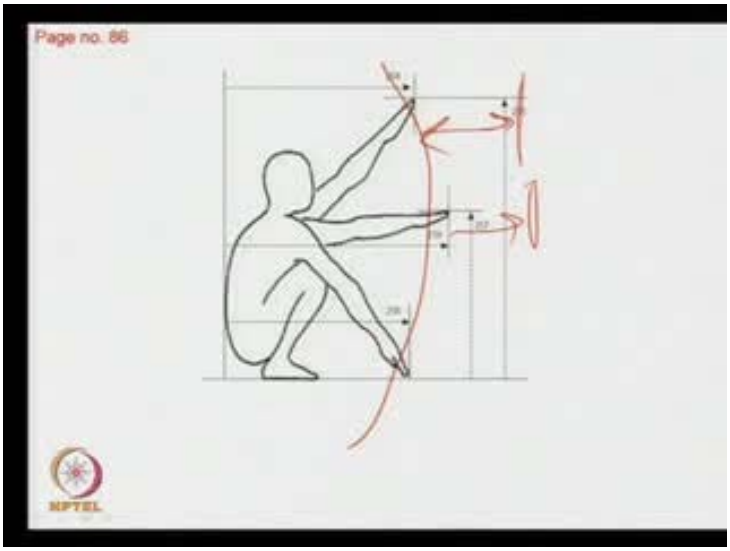

Now the different heights, reach values frontal erect posture touches. Suppose while in a toilet sitting position, if we have some water knob or something or maybe towel holder or some handle to grab specifically for the aged people, or maybe when the total in train journey, where the total space is in a settee position so that you need to hold a rod or a handle to stabilize your sitting position. At that time what would be the heights and etcetera. Like in that example, we can take that length and then height. At the sitting the middle height and length and the lower reaching distances in bending posture is maximum.

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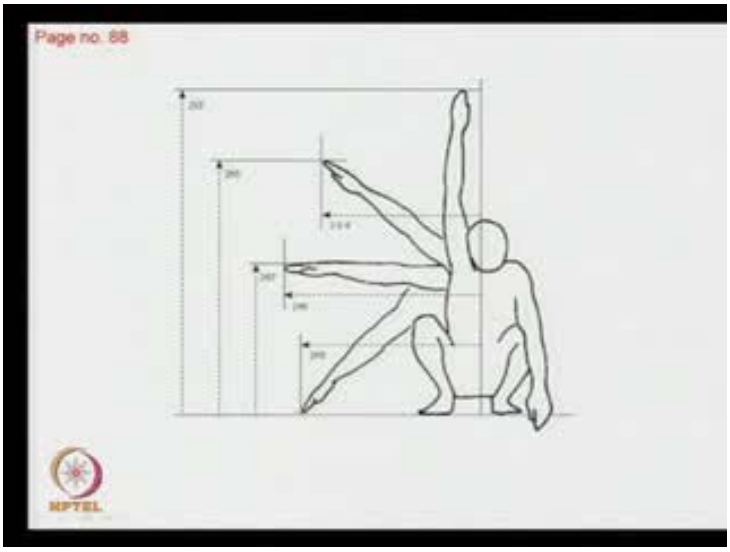

So, if we have to design something that handrail; these dimension and then the bending dimension in between, we have to keep it so, if this is the erect position and if this is the bending position then, within this space we have to maintain that handrails. Now, this is sidewise movement bending top reach maximum reach upper comfortable reach middle comfortable reach and height and the lower comfortable reach when it touches the floor.

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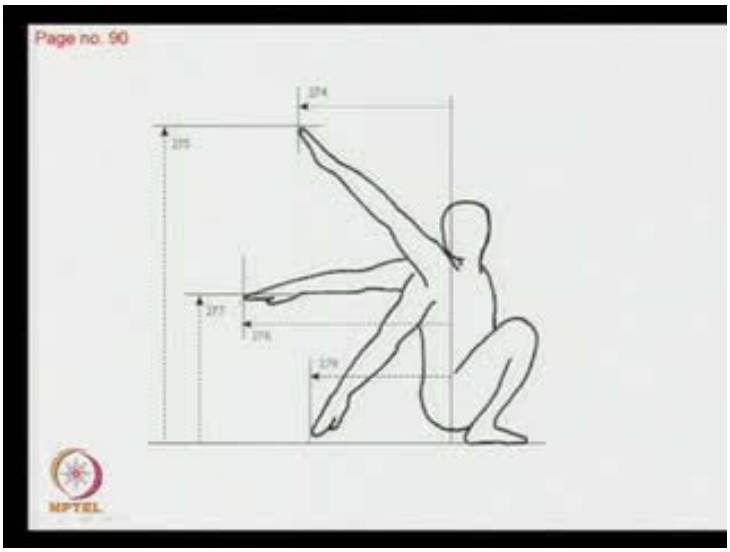

Similarly, the stressed and little bending; the comfortable upper height and length middle length and height lower length backward movement. Sometimes in this posture also we may need to take something from the back. Now, at that position what will be the comfortable top distance and height comfortable length and height at the middle position and lower length comfortable. This is the maximum bending at the back in different reach values.

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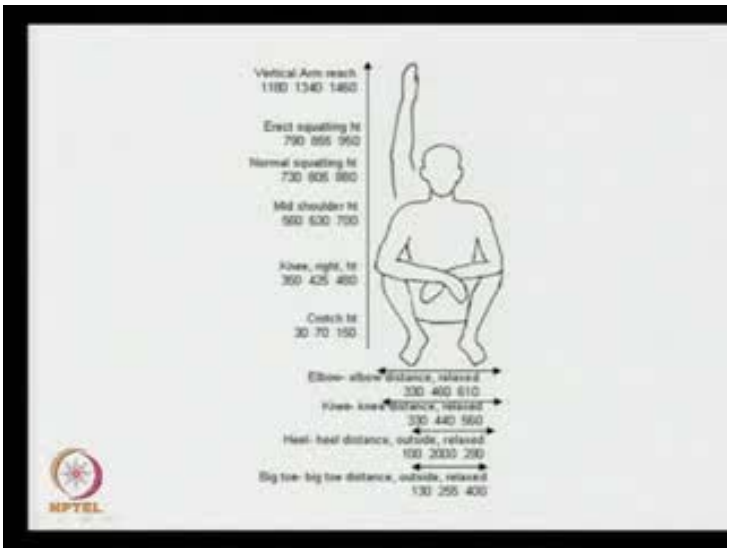

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Now, some data concern like height. In this slide, it can be noted specifically that some dimensions are provided. Here, all these dimensions are in millimeter like in vertical arm reach, erect squatting height and normal squatting height, mid shoulder height, knee height, crotch height. This one crotch height and elbow to elbow distance, normal and knee to knee distance, relaxed heel to heel distance, relaxed and big toe to big toe

relaxed. This dimensions are provided here and in this figure we can say that body in motion static as well as dynamic dimensions. Now, when this lady was in a erect posture relatively, then the height she bents to reach something here then the height reduction as well as the buttock movement. It takes place like this way; the foot movement is like this way, then if we want to make a stool here then what will be the design for that not only in a static squatting posture. The dimensions as well as task demanding dynamic posture and the measurements in that would be considered.

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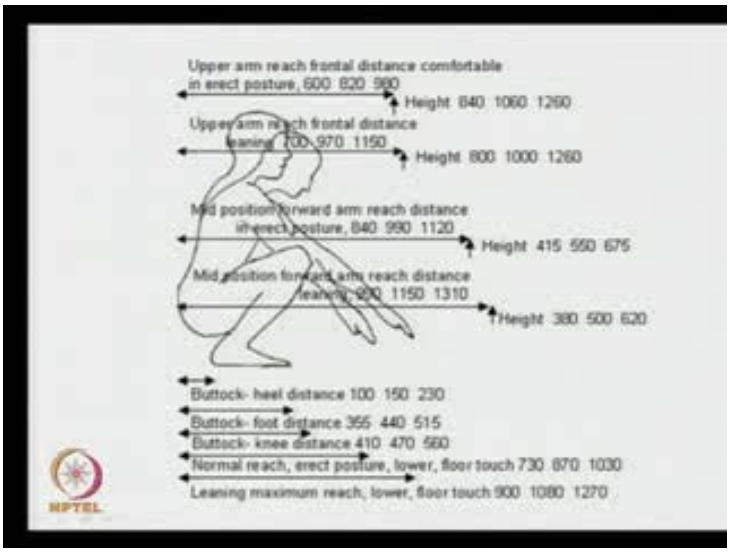

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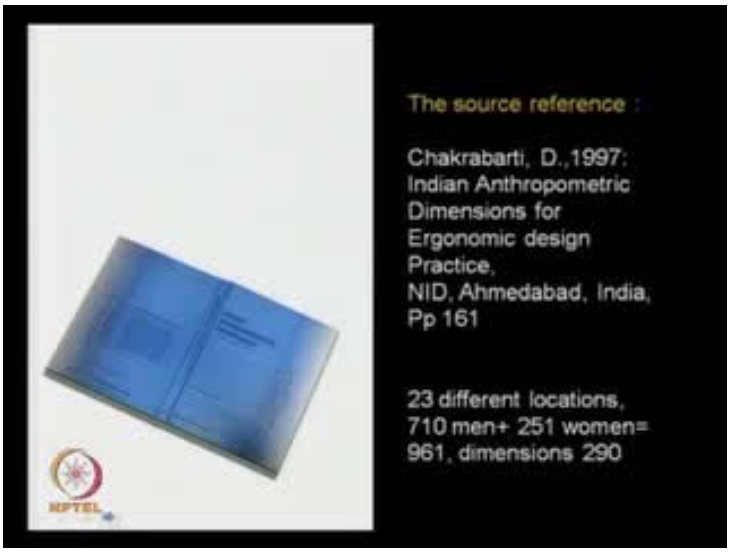

And some dimensions in this squatting posture, as provided in this maybe noted specifically in all these dimensions and etcetera. The source reference is Chakrabarti D, 1997, Indian anthropometric dimensions for ergonomic design practice published from National Institute of Design Ahmedabad India. Total 161 pages here 23 different locations in India were covered 710 men and 251 woman were counts measured. Total 961 male and females and total dimensions were measured 290. This book is available still at the National Institute of Design, Ahmedabad and most of the dimensions in data we discussed in this book is data taken from these book concern.

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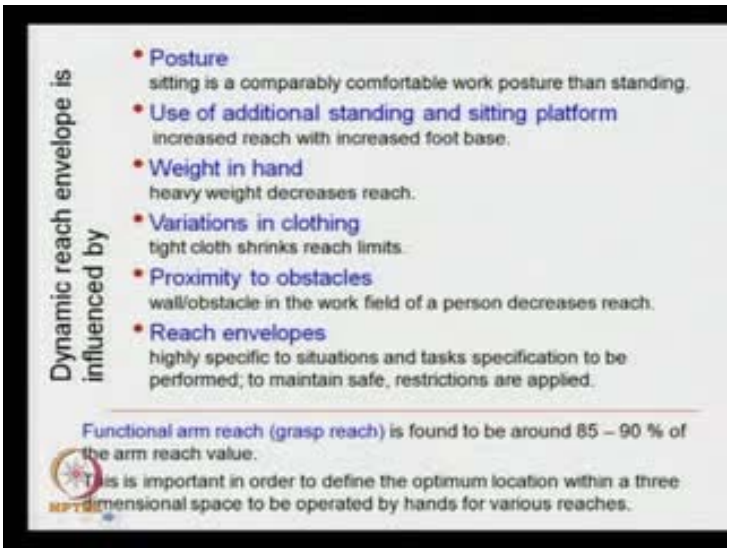

Now, the dynamic reach develop by influenced posture is that sitting is comparably comfortable work posture than standing. Use of additional standing and sitting platform is increased reach in foot base. Weight in hand- heavy weight decreases the reach values of arm reach values. Variations in clothing - tight cloth shrinks reach limits because if we wear a bit of tight cloth then our reach limit will be reduced. We cannot extent reach proximity to obstacles; wall of obstacle in the work field of a person decreases the reach. Reach envelopes - highly specific to situations and task specification to be performed; to maintain safe, restrictions are applied. Functional arm reach is a grasp reach; this total reach and this grasp reach distance is found to be around 85 to 90 percent of the total arm reach value means, roughly it can be said that around 10 to 7 centimeter of this space required from this position to this position.

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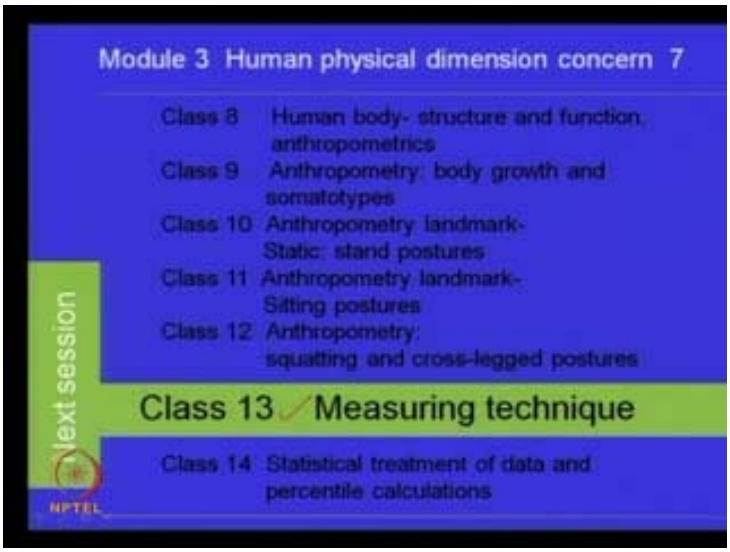

This is important in order to define the optimum location within a 3 dimensional space to be operated by hands for various reaches. Now with this, we are concluding this session and now in next session it will be the class number 13 and there, we will discuss measuring techniques. whatever in this last few classes, we have discussed the landmarks and dimensions and requirements. Now how it is measured will discussed in next class and after getting all these measurements how to make this data statistically, statistical treatment of the data will be done and the percentile calculation will be discussed; means how this data are used in a design guidelines will be provided in that classes. So next class will be measuring techniques, with this we are concluding today's session. Thank you very much.