Science of Clothing Comfort
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Lecture – 01
Science of Clothing Comfort – Outline

Hello, everyone. Today, we will start the course, Science of Clothing Comfort.

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Today, in the first lecture I will give the overall outline of this course which we are going to discuss in next 12 weeks around 35, 36 lectures. The course is divided into 8 different modules. I will give brief outline about the each and every modules and what are we going to discuss in all these modules. Before we start the modules, first let us understand let us ask question what is clothing comfort? What is comfort? First, we should understand: what is comfort? Then we will try to co-relate the comfort with the textile material clothing.

We should remember that human comfort is not only related to the textile material textile comfort it relates with many other materials like building, in the building we also would like to feel comfortable. So, in that how we can control the comfort in a building material like thermal insulation of the wall, roof, even floor all these characteristics in have impact on human comfort, but in our present domain we will restrict our self in the clothing comfort clothing part.

How to impart a required clothing comfort by selecting proper fiber, proper yarn structure proper fabric structure all these things we will discuss in detail and without knowing this all this interrelationship between fiber characteristics, yarn structure, fabric structure even finishing technique we cannot achieve comfort, comfort in clothing and one should remember that a particular clothing may be comfortable to one person, may not be comfortable to other; that means, in that case that is human physiology comes into picture.

Even a particular person will not be comfortable with the same fabric at different environment. So, we should also know that which environment so, we should have knowledge about the environment we should have knowledge about the human physiological condition, even at various psychological condition it will be different sensation. So, all these characteristics, even neuro physiology depending on the skin structures sensation we feel different comfort you must have observed that if you wear woolens in summer we feel the pricking sensation. So, all this thing we will discuss stepwise.

First, let us understand, what is comfort. If I ask any one that what is comfort tell me in one word / one sentence it will be very difficult because comfort is not a particular physical only physical parameter it is a physiological parameter, it is environmental impact is there. So, everything is related. So, particular definition of comfort is very difficult like if you say that comfort is influenced by physiological reaction of the wearer.

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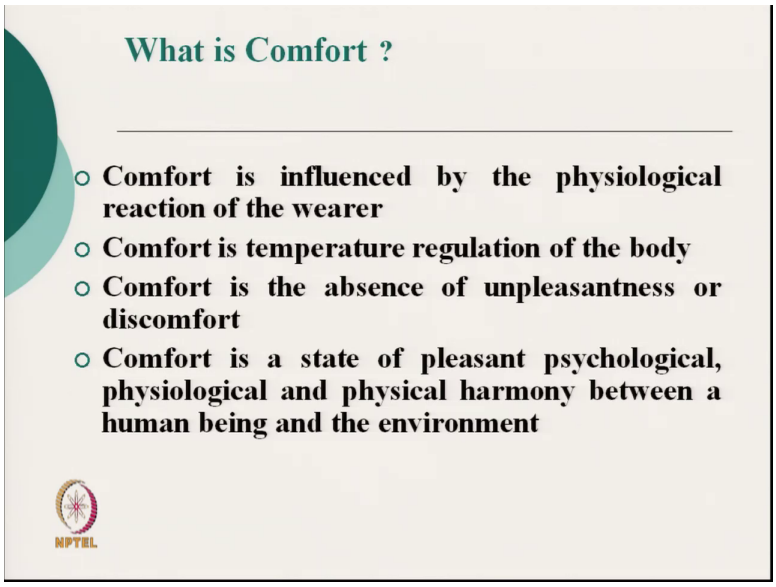

I cannot say it is 100 percent right or it is a 100 percent wrong. It is partially correct because my physiological behavior, physiological reaction is directly related with the comfort. Suppose, I am sweating I may feel warm with a particular fabric, but when I am sitting idle that same fabric I am a feel comfortable. So, that is a human you should understand clear clearly about the human physiological condition then you can design there. Like a sportswear, in the sportswear we know that the sports person like a high active sportswear like soccer a player releases huge amount of metabolic heat and also at the same time huge quantity of liquid moisture.

So, our fabric if it cannot handle this heat and liquid moisture, so, the particular fabric will be uncomfortable. Like if I ask you do you think that cotton is suitable for sportswear high active sportswear cotton is not suitable for high active sportswear although cotton is very comfortable for normal application. Why? Because the cotton has got a particular characteristics of high absorption, but cotton is very poor in moisture liquid moisture transmission and a release.

So, all these aspects we will discuss subsequently. So, after physiological behavior or reaction of wearer another definition one can give comfort is temperature regulation of body; that means, when we are generating higher metabolic heat that has to be released quickly. So, that we can keep our body core temperature constant our body core

temperature has to be almost constant. So, 37 plus minus 2 degree, it is a maximum we can typically 37 plus minus 0.5 degree Celsius is the ideal.

So, body core temperature we have to maintain by release or acceptance of the heat. Like if you are in the cold temperature so, our body temperature is 37 if you are at the cooler area what will happen that it will release the body will try to release the heat at very high rate. So, our clothing has to control the rate of release; that means, it has to regulate the body core temperature. So, this definition of temperature regulation of body is also correct, but it is not complete.

Third one is that comfort is absence of unpleasantness or discomfort here the definition is not very clear, it is a total mixture of all these characteristic. It talks about the final sensation of our brain which is from environment temperature related moisture related and touch related everything. So, that is also correct. Next one is that comfort is state of pleasant psychological, physiological and physical harmony between human being and environment that is comfort. It talks about the physiological, it is a psychological and physical harmony of that and we cannot control the environment we cannot control our body physiology. It will definitely change, but to have to be comfortable we have to be comfortable finally, we have to select our clothing accordingly.

Now, I will give you one example. Now, if I ask you this is an air conditioned room and if I ask you what is the comfortable temperature. So, comfortable temperature is basically we normally I have asked my students it is normally says that 25, 26 degree Celsius. Why is this 25 degree Celsius? Why when our body core temperature is 37 degree Celsius it should have been around 37 degree Celsius to make us comfortable then, but if you see the 30 at 37 degree Celsius then we normally feel a very comfortable highly uncomfortable. Why?

If I tell it is a temperature is balanced, but it is not actually that and then why 25, 26 degree Celsius? Basically, at the back of our mind we think that we are wearing one shirt or T shirt, ok, one trouser that is our actually mindset and then with that at assumption if you have say 25 degree Celsius. So, 37 and 25, 12 degree 12 degree your it is a difference temperature difference, temperature gradient and thirty 27 degree or 25 degree Celsius comfortable temperature means when you are sitting idle.

That means at that temperature at that time sitting at activity whatever metabolic heat you are generating that heat needs to be released. We have to released that heat and to release that heat from your body you need a temperature gradient. So, that from higher temperature the heat should get transmitted to the lower temperature and the rate of release of heat is proportional to the temperature gradient and metabolic heat when you are sitting idle we generate heat at a certain rate I will discuss in later a stages detailed.

So, you must know your metabolic heat generation. So, at that rate when you are sitting idle that heat you have to release and release through your clothing and your normal one single shirt or one inner the whatever thermal insulation it provides it is sufficient to provide or to allow the heat to release at that rate whatever rate you are producing. But, let us see in this room it is a say 25 degree Celsius and we are very comfortable sitting.

Suppose, I am now reducing the temperature of the room gradually what will happen gradually I am reducing say 10 degree Celsius or say I am bringing it down to 0 degree Celsius, what will happen? Basically, at that time you will find that the temperature gradient has increased, earlier it was 10 to 12 degree Celsius. Now, it has become 35, 36 degree Celsius or 37 degree Celsius.

So, what will happen, the rate of heat release by the body will increase a lot. So, rate has increased which means your body rate at the rate body is generating heat it is much less than the release of heat. So, you will feel start feeling uncomfortable due to your you will feel uncomfortably cool because of you are releasing more heat than what you are generating; that means, here you just see it is not it is not a balanced, it is not balanced.

So, now at that stage if we want to make yourself comfortable what will you do we have to reduce the rate of heat release. Now, here comes your clothing part, your environment you are not able to control, your body we cannot control here and what we are doing we have to reduce the rate of heat we have to actually make the insulation more, so that your rate of release of heat is slower.

So, we have to bring it down to the rate equal to whatever rate heat we are generating, but if you keep on. So, what how will you do it? we will put on another layer of cloth if it is not sufficient then we will put another jacket and finally, we will find, now it is that we are doing from our day to day experience and this thing actually what we are doing we unknowingly what we are trying to bring we are trying to bring our heat balance.

Suppose, now you are you keep on at 0 degree Celsius also you keep on adding your cloth one jacket two jackets and three jackets, very thick how will you feel? You will feel start feeling the uncomfortable feeling due to heat you will feel warm because you have slowed down the heat release of heat. So, that means, the rate you are generating is actually more than the release. So, that means, your psychological and environmental all these human activity also is important.

So, all these things you have to keep in balance like at say 0 degree Celsius you are wearing a single cloth again, let us come back at 0 degree Celsius we have actually you are feeling uncomfortably cool with our single layer of clothing. Now, so what it is a physical harmony? Now, what are you doing we have started jogging say at 0 degree Celsius with single layer we have started jogging now what we will feel after certain time we will not feel cooler because we have by jogging by activity, physical activity we have started generating more and more heat and as soon as the heat generation by the body through metabolic heat is equal to the heat release rate of heat release you will start feeling comfortable.

You must have observed that with the normal clothing when you we just start take food immediately you will you feel warm because you have enough food for energy you are actually metabolic energy you are generating. So, all these things all these interrelationship we will discuss in this course.

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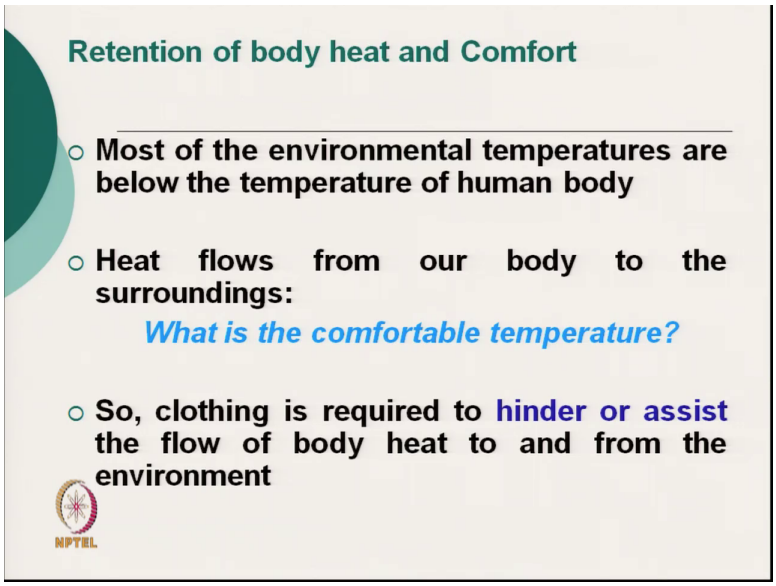

So, we have discussed that retention or release of body heat. It is a prime requirement of clothing; when to retain the body heat, when to release the body heat it depends on the clothing and proper selection of fiber, proper selection of yarn structure, proper selection of fabric structure it is very important you must know all these things. So, heat in normal case if you will see most of the environmental temperatures are below the human body temperature most of the day except in extreme heat condition. If you see just leave aside that extreme heat or in front of fire most of the, this environmental temperature is below body temperature and if it is above human body temperature the total mechanism will be different; so, that we will discuss in detail, at different conditions.

So, you have to be comfortable in extreme weather extreme cold weather you have to be comfortable with in front of fire also like in front of fire. So, fire fighter you have developed clothing which does not catch fire, and it is with very highly thermally insulated. So, it will protect the fire fighter, but if there is no heat transmission from the body; that means, your body core temperature, body metabolic heat will keep on generating. So, that there will be special mechanism through which the fire fighter will release heat that this things we will discuss in detail.

So, the clothing is required to hinder or to assist the flow of heat to and from the environment. So, from environment some time we need heat to be arrested or from body some time we need to heat to be arrested. So, that this things we have to be very careful about selection of the material. So, hindrance and assistance is extremely important.

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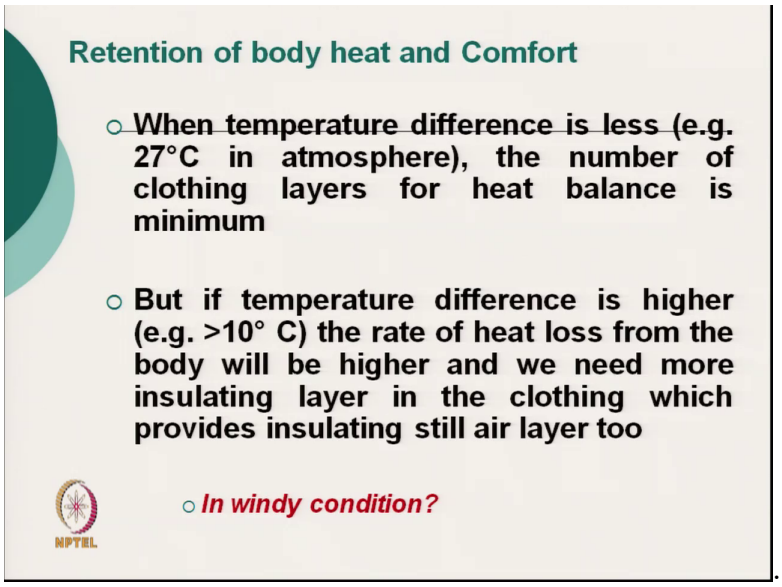

So, this part we have already discussed, ok. So, normally if we reduce the temperature reduce the temperature we need to have more and more layer or higher insulating clothing. Now, we have insulated the clothing what about the windy is condition. So, this is this will bring our clothing is a more complex. So, if we talk about the windy condition; that means, it will have forced convection we will start suddenly start feeling very cold. So, for windy condition we have to block the pores so that the heat that wind does not carry take away the body heat along with that, but we have to be very careful that while coating, the coating should not block 100 percent.

If it blocks if the coating blocks the pores 100 percent what will happen it will not allow our moisture that is perspiration in moisture form the body to the environment it which is must, otherwise we will start feeling highly uncomfortable because our moisture will get accumulated inside the body and we will feel uncomfortable due to that. Now, we will discuss a 8 as we have discusses that this course have been classified in eight different section. In first section we will discuss about the, what is clothing comfort how to decide how to select the clothing all these aspects we will discuss in this.

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Now, need and selection of clothing we will start with that what is the need like clothing as we know after food clothing is the second requirement. So, there was a need basic need was there, but the selection of clothing depends on the need it is not only need, but there are various factors of that this all this part we will discuss. And, then we will discuss the basic elements of clothing comfort, like selection; if I ask you how to select clothing particular? It may be depending on the social status it may be depending on the occasion, it may be depending on the profession, like traffic police you will have different set of clothing requirement then nurse a doctor. So, there are different types of requirements all these things we will discuss in this segment.

Then we will discuss the basic elements of clothing comfort. If you see the there are four basic elements of clothing comfort, I will discussed just now ok, four basic elements that I will just discuss. So, this detailed we will discuss there what are the basic elements. So, by knowing all these things we can decide our clothing. Then we will discuss the clothing comfort and wearers attitude. So, sometime wearers attitude dominates over clothing comfort, ok. He may or may not be that much comfortable with that, but he needs that type of clothing, like casual clothing and formal clothing.

So, this type of all this details we will discuss, and how much we can sacrifice our clothing comfort, and then we will discuss the human clothing interaction. Clothing human and environmental interaction this part we will discuss and how to understand.

How to study the clothing comfort if you want to understand the if you want to study if you want to know the clothing comfort what are the components you have to study, specific components we will discuss in this part total introduction part. So, this will give you a broad overview about the need of the clothing wear how to actually manipulate the structure this things we will discuss. So, four elements as we have discussed earlier; so, these are the four a basic elements of clothing comfort, it is a thermo physiological comfort.

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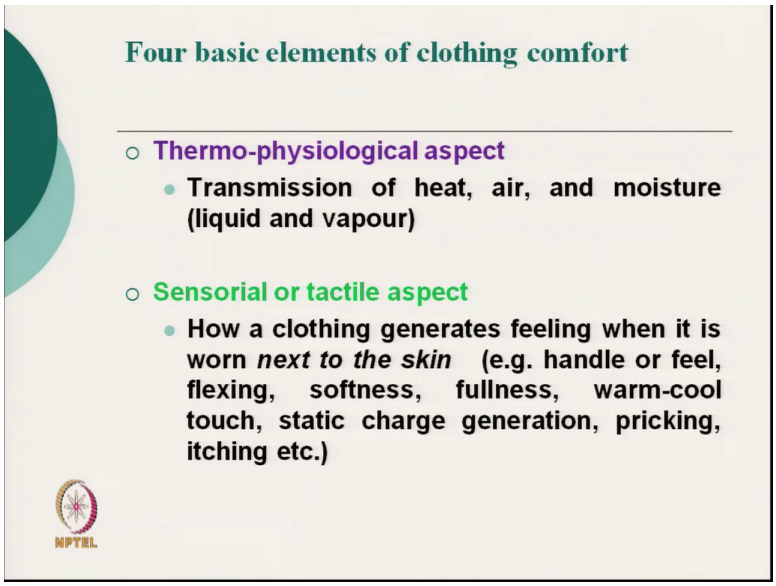

The first element is thermo-physiological comfort, where we will deal with the heat and mass transmission. Air transmission, obviously, it is there. So, how clothing transmits heat from the body or transmits heat form environment to the body, which is actually this is the foremost basic elements. If I ask anyone are you feeling comfortable, if you are not feeling comfortable may be the reason you are feeling warm or you are feeling cold. So, that is a it is a very important.

Or some time you may feel sweaty, you are sweaty you are actually you are not able you are clothing is not able to absorb that moisture; so, that you may feel uncomfortable. Like as I have given example; of cotton is very comfortable at this point at this environment. Why? Because cotton what it absorbs moisture in the liquid form and in the vapor form.

So, in the vapor form it also absorbs moisture at slow rate and also due to it is hydrophilic in nature it transmits moisture to the other side which is extremely important. So, it transmits moisture vapor in the other layer and gets released, but you may not be comfortable if you wear polyester. 100 percent polyester may not be comfortable even in the air conditioning room. Air-conditioned environment you may not be come out because polyester does not absorb moisture.

So, if it does not absorb moisture in vapor form I am talking I am not talking about the liquid moisture. It absorbs moisture, but at the same time as it does not absorb moisture so, it cannot release it cannot transmits moister in the outer layer. So, polyester you may not be comfortable at that time, but it is reverse when you have started sweating profusely. In that case like sports person, In sport person they use specific type of fiber polyester fiber with specific shape we will discuss later.

There it does not absorb moisture, polyester does not absorb moisture, but it transmits moisture from inner from skin to the outside out surface and from there it gets released. So, that is the mechanism. So, cotton is comfortable for normal temperature, but it is not comfortable for that.

So, the all this transmission behavior we will discuss. Even air; air when you are to control the air, to increase the air permeability it is a very simple you just make the pores larger open structure. So, the air will get transmitted and heat to control the heat, you have to make the yarn structure or fabric structure bulkier. Like, you must have observed that in woolens; woolen clothing it entrap large quantity of air, still air large quantity of still air. So, it is it gives insulation.

So, your yarn or fabric structure has to be such that if it entraps more and more air still air then it will be warm. So, if you want to increase the thermal insulation by only by twisting suppose only by twisting. So, if you reduce the twist. So, it is yarn is an loose structure. So, it will entrap loose still air and it will become thermally insulating, but same fabric if you increase the only do not change anything only change the yarn twist, make it a hard twisted. So, what will happen, it will give you low thermal insulation because of the less entrapment of still air.

Then next basic element is the sensorial or tactile comfort. Whenever we wear our skin is the first our body part only body part you can say which is in touch with the clothing and

there are different types of sensation which sense. So, in this aspect in this component we will discuss that the sensorial comfort of that.

Now, this sensation may be feel or handle whether the feeling is soft, harsh feeling, or it is a whether it is a flexible whether it is a fullness warm or cool touch static charge generation we will we may feel some time with the static charge generation pricking sensation, itching sensation, all this sensation which is actually which when fabric interact with the skin or in skin interact with therefore, this skin receives all this sensation through our different receptors. There are two types of main receptors; one is mechanical receptors another is thermal receptors and we must know that our receptors to actually have comfortable with the tactile aspect and sensorial comfort. We should have clear knowledge about this, so that you can select the fabric properly.

So, a particular fabric may be highly uncomfortable in sensorially uncomfortable, but that fabric after certain changes or certain changes in yarn characteristics fiber characteristics or fabric characteristics we may make it comfortable. Like one example I will give you; suppose, a fabric a made of coarse wool, very rough type of a like carpet type of wool or say blanket type of wool, if it touches you feel uncomfortable. It is a some sensation and it is a itching sensation is there, but a very high grade wool like suiting shirting you may not feel that main that much uncomfortable session you may feel softer.

So, what is the difference here main difference is the diameter of wool. Diameter of wool that is a carpet and blanket we normally use coarser wool which is a bending stiffness is very high. These wool fabrics are short in length. So, they have their end point projected from the surface and it penetrates in the, with the skin and we get uncomfortable sensation. So, it is very important to understand all these a characteristics, sensorial characteristics.

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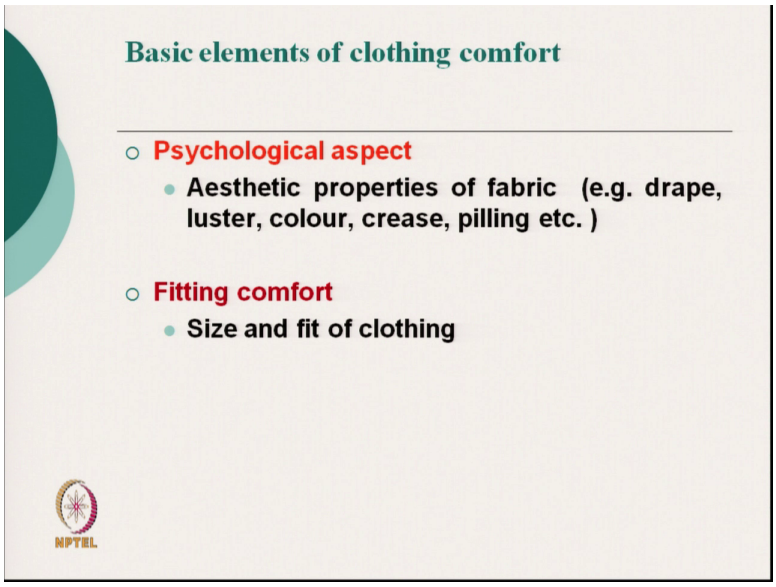

Third is that psychological aspects. So, color, luster, crease, pilling so, all this things give you a psychological. If you are cloth does not have a color which is actually it is a normal in sense or your fabric gives a high pilling creased structure. So, that psychology you will feel uncomfortable you are wearing suppose suddenly you have you are wearing a offbeat color you may feel psychologically uncomfortable, your fabric does not drape properly. So, all these aspects we will also discuss psychological aspects and fitting comfort which is very very important.

Like I am wearing I want to wear tight fit clothing. So, if I want to wear tight fit clothing do we need woven clothing or knitted. So, you must have clear understanding about the type of structure, ok. Like a knitted fabric has got stretch ability and woven fabric normally it does not stretch. Suppose I am wearing a cloth of tight fit clothing, how will I feel with a made of woven fabric?

So, I will not have proper easy body movement it will try to restrict my body movement. So, what will happen, I will feel uncomfortable. So, if I want to have tight fit clothing so, I want to have fabric with stretchability. You must have seen in that stretch jean. So, when denim we want to wear a tight fit denim so, it has to be stretchable. So, we can make it stretchable; so, this all this suspects will discuss wear. And, also another thing tight fit and loose fit like in a loose fit clothing what we want, we want to entrap the

entrap the still air like jacket it is a loose fit. So, we want to entrap extra layer of clothing to make our self warm. So, all these are fitting comfort we will discuss in this issue.

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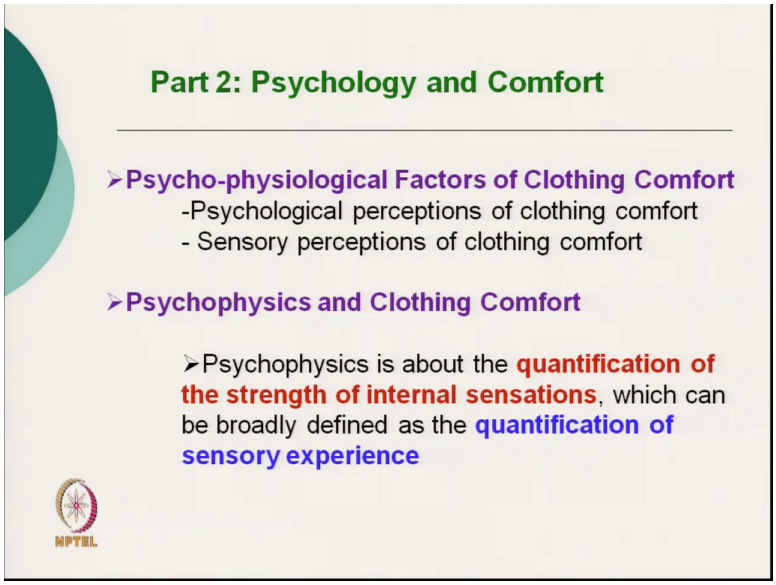

Next is that, next segment is the psychology and comfort. So, total human psychology we will discuss here like psychological psycho-physiological factors of clothing comfort. So, that how the or physiological may interaction psychological interaction with the body effects the psychological sensation. So, these things were.

And, then we will have we will discuss the different psycho-physics laws of psycho-physics and it is relation with the clothing comfort. So, what is psycho-physics? Psycho-physics is about the quantification of the strength of internal sensation which can be broadly defined as the quantification of sensory experience. Like I am feeling cold, but how much cold we have to quantify.

So, we have to quantify this sensation then only you can tell you can decide the clothing. So, you must have clear knowledge of psycho-physics. So, there are different laws of psycho-physics we must understand and we will also discuss about the for a clothing comfort specific psycho-physics law and then if we know the our body psychology psychological sensations and all then only we can design our clothing. So, psycho-physics means we have to quantify that; how to quantify this same thing.

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Then laws of psychophysics that we have discussed then types of psychological psycho-physical scaling; there are scaling like it is a suppose it is a cold I told you it is how much it is a too cold or too warm. So, what is the scaling. So, that you have to scale then only we can actually get that we can get the idea about the comfort. So, types of scaling. Different there are different types of scaling that we will discuss, and psycho-physiological scaling of clothing comfort that one. Then wear trail technique this is a particular a actually practical application of psychophysical wear psychophysics basically.

Wear trail technique where we deal about that it is not the measurement of the comfort by basically by objective measurement it is not the thermal comfort, thermal transmission measurement, moisture transmission measurement or liquid transmission measurement it is about the person will wear the cloth and there will be certain guidelines and whatever sensation he it is a he is a receiving whatever sensation he is getting you will actually express in terms of some terms it is a too cold or too hot, it is a moderately comfort like that. So, we will discuss this is a technique or practical technique which is very important of them.

Even objective measurement of clothing sometime fails. A fabric with very high insulation or low insulation sometime fails in the pyscho wear trail technique this part we will discuss in detail. We have actually research data which says the fabric which is

highly insulating sometime fails at the subzero temperature that we will discuss and psychological aspect of aesthetic comfort, that we will discuss evolution of clothing aesthetic, concept of clothing that we will discuss, what are the how to evaluate the clothing aesthetics.

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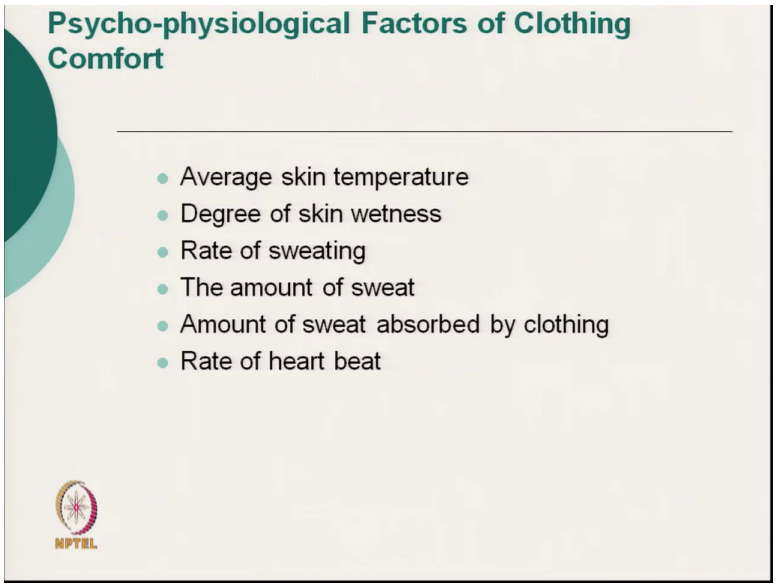

That psycho-physiological factors; what are the factors of psycho-physiological, how you are you will you will get the psycho-physiological factor. These are the average skin temperature, degree of skin wetness, rate of sweating these are the factors of clothing comfort. The amount of sweat, amount of sweat absorbed by the body, rate of heart beat. So, these are all this psycho physiological factor we will discuss.

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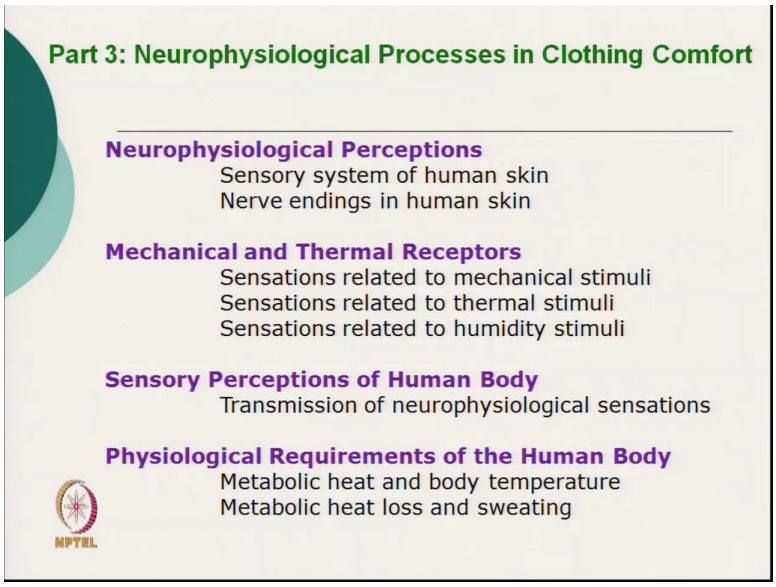

Next we will come the neurophysiological processes of clothing factor. What is neurophysiological? It is a basically sensation. The neuro physiological process is that sensory system of the skin, we will try to understand the detail about the sensory system of the cloth skin there are nerve endings of in human body. As I have told that there, are mechanical sensor and thermal sensor there are different types of sensors this things we will discuss mechanical and thermal receptors that we will discuss and their stimuli at different level they work.

Some sensor work on pressure, we will find some sensor we will work on pricking, pain type sensor that we will discuss, ok. Sensory perception of human body so, transmission of neurophysiological sensation. So, you have your body has sensed, that it has to the sensation has to be transmitted to the brain. So, that it is very important there. Then physiological requirement of human body, metabolic heat and all this things we will discuss in this part. So, the all these things are interrelated, part 3.

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And, part 4 deals with the tactile component. It is a touch with the body. So, it is a basically it is totally fabric related characteristics whether it is a softness, it is a stiff, all this things we will discuss and then it is related with the fabric handle aptitude attributes. So, tactile sensation of fabric arm wearing it is a harsh feeling, it is a soft it is a like this type of sensations are directly it is called fabric handle or tactile sensation and this we have to we can measure objectively. There are various techniques available.

So, a it is there are basically two types of sensation; one is subjective type. We can tell a fabric a soft or harsh or a by touch. Whether it is in if we go to the market it is a subjective technique we normally use it is smooth, it is a rough, it is a flexible, it is a soft. So, all these characteristics we normally discuss. And, the next come how to measure these subjective characteristics in objectively. So, there are techniques available and most important actually widely used technique is the Kawabata Evaluation System for Fabric KES-F techniques, another technique is FAST technique. So, that these things we will discuss in detail though how to measure this tactile characteristics, objectively.

Another method is the nozzle extraction method we will discuss. The nozzle through nozzle extraction you can get simple idea about the fabric tactile characteristics, and there are then we will discuss that various fabric parameters which will affect the tactile characteristics. Keep everything suppose keep everything constant you increase the end and pick density warp and weft density, what will happen? The fabric will be little bit

stiffer, fabric will be little bit a heavier. So, these things we will discuss in detail. So, what are the fabric or how to control the fabric handle, tactile characteristics simply by changing the parameters. So, this interrelationship we should we must know.

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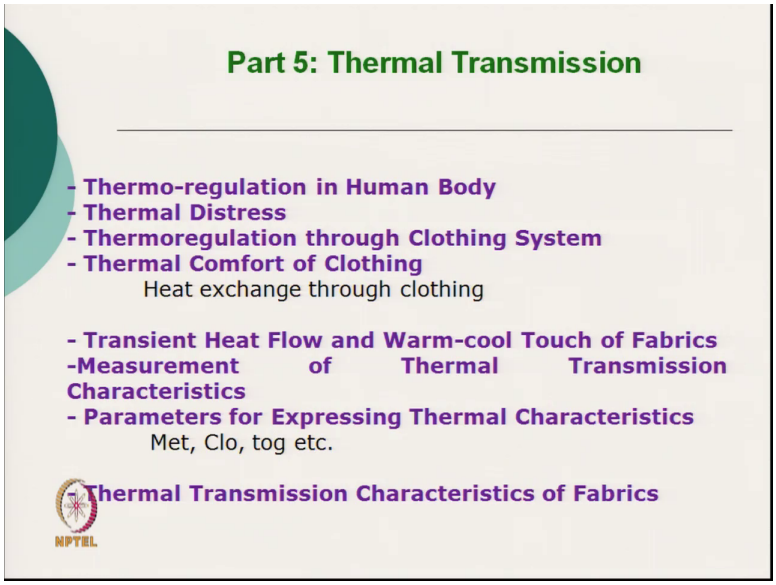

Then thermal transmission characteristics; so, we must first know the thermo regulation of human body. Then thermal distress: at extreme cold and extreme heat condition what is there in our within or body we must first know, ok, how our body reacts with this extreme temperatures, ok. Thermal regulation through the clothing system; so, how to control this thermal regulations and this things detail we will discuss.

Thermal comfort of clothing, heat exchange through clothing that we have we will have to discuss here in this and transient heat. So, one cool touch, so, if you touch some time if you touch a particular fabric you will feel warm or some other fabric you will feel cool touch, why is it so? All this things we will discuss, how to measure this warm cool touch.

And, then thermal transmission characteristics, measurement of thermal transmission; so, we will discuss the various methods of measurement of thermal transmission characteristics. So, that how to measure the thermal like sweating guarded hot plate and all the there are various techniques we will discuss.

Then we will discuss few extremely important characteristics to know the thermal transmission characteristics of clothing. Like Met, Clo, Tog these are the few important

parameters important actually quantity we must understand and their interrelationship to express the clothing comfort clothing thermal transmission characteristics thermal and then we will discuss few research study on thermal transmission characteristics of clothing different clothing of fabrics.

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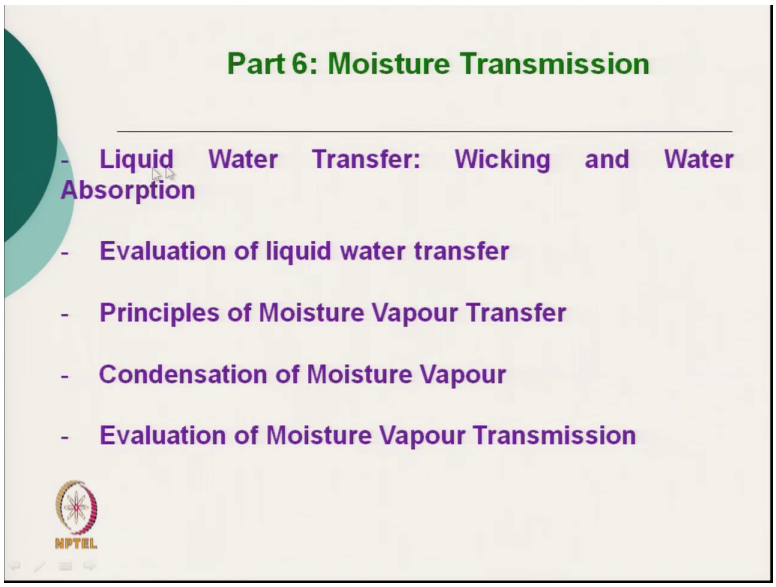

Then sixth is that we will here we will deal with separately the moisture. Moisture transmission moisture in the form of liquid and moisture in the form of vapor; so, the two different phenomena you will see, two different physical phenomena and that we will discuss in detail. So, if you talk about the moisture transmission in liquid form it is wicking and wetting so, and absorption. So, wicking means it is transmission of a moisture and absorption means it is actually storing of liquid, then we will discuss the evolution of liquid water transmission, then next is that moisture in vapor form we will discuss. The total physics is totally different moisture in vapor form.

Then condensation of moisture vapor part within the structure, with in the fabric structure at extreme cold condition then this sometime creates problem, it is reduces the thermal insulation. So, this part we have to discuss and evolution of moisture vapor transmission how to evaluate the moisture vapor transmission this part.

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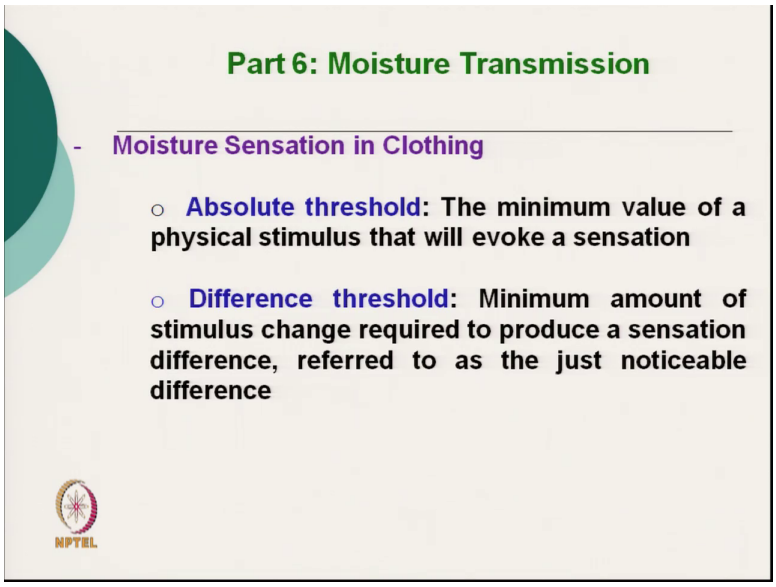

Then moisture sensation of clothing that we will discuss one is absolute threshold and differential threshold, this part we will discuss. Absolute threshold means the minimum value of physical stimulus that will evoke the sensation. Sometime suppose touch, sometime you may feel it is not suppose even although you are some things touching you may not feel sensation, but that is a minimum sensation minimum pressure required to have sensation and that depends on different position of the cloth, depends on the number or position of the receptors and similarly for moisture also there are receptors; so, that we will discuss.

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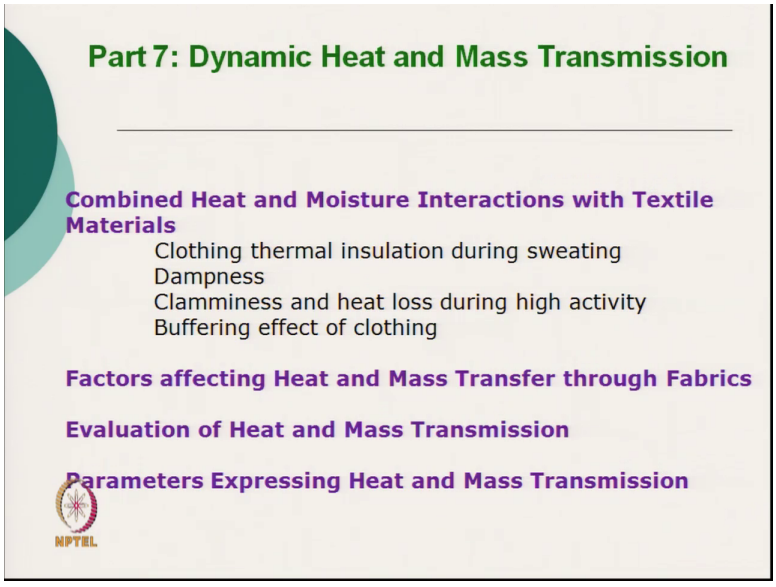

Dynamic heat and moisture transmission characteristics; here in this segment, segment 7 we will discuss the combined heat and transmission, heat and moisture transmission. Basically, in human comfort it is not the heat and moisture does not go separately, it is a isolation they are basically it goes together. When you are feeling heat so, you are actually body physiology we will start sweating. So, you have actually release the heat dry heat as well as the sweat. So, it we must understand the combined effect of heat and moisture.

So, in this segment we will discuss all these issues, like clothing thermo clothing thermal insulation during sweating, dampness, clamminess all this things we will discuss and buffering effect of clothing which is extremely important buffering effect of clothing by exothermic heat generation and all these thing. So, buffering effect we will discuss in detail. Factors affecting heat and moisture transmission; so, that all these things we will discuss evaluation of heat and mass transmission. So, this together how can we evaluate so, and parameters expressing the heat mass transmission; so, there are different parameters how to express.

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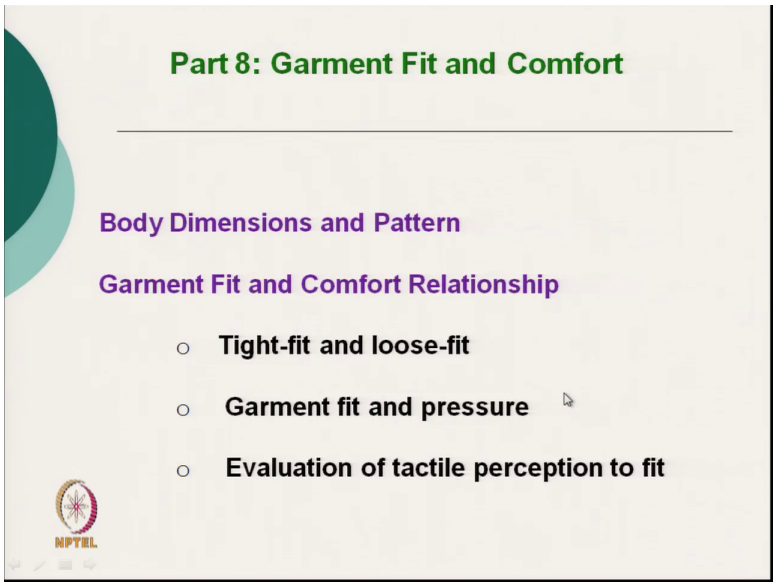

And, last one is that the garment fit and comfort. So, this part we have discussed body dimension and pattern where garment fit and comfort relationship, tight fit and loose fit comfort, ok, garment fit and pressure that we have we will discuss and evaluation of tactile comfort. So, how to evaluate the tactile comfort due to the garment fit.

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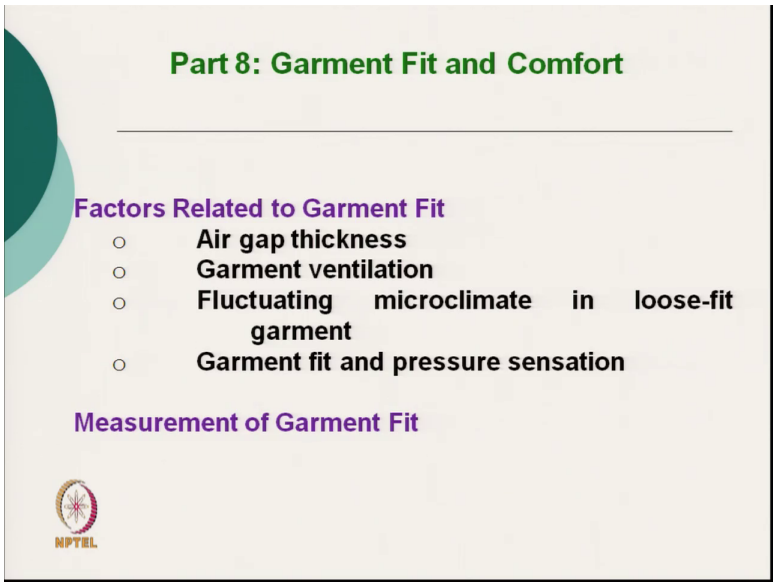

And factors' affecting the garment fit means air gap, thickness, garment ventilation, and fluctuating microclimate. So, if you are wearing a loose fit garment and you are started walking or body movement your that a your micro climate will thickness will fluctuate, that is a becomes a complex phenomenon. So, that also affects the comfort, ok. And, garment fit and pressure sensation that we will discuss and measurement of garment fit, how to measure the garment fit, what are the various ways to measure the garment fit.

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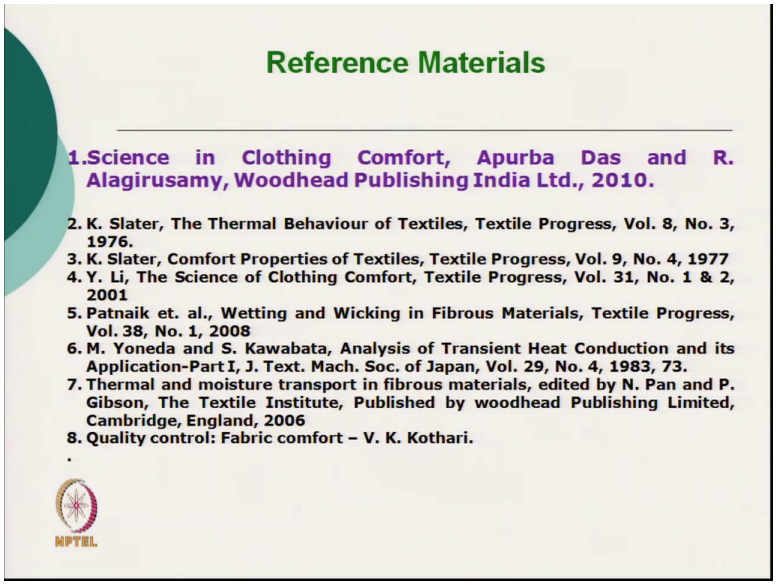

And, these are the reference books one can refer another is a standard book available Science in Clothing Comfort which is actually which deals with all this aspects as and there are other books one can refer.

Thank you for your attention.