

Science of Clothing Comfort
Prof. Apurba Das
Department of Textile Technology
Indian Institute of Technology, Delhi

Lecture – 02
Understanding Clothing & Clothing Comfort

Hello everyone, today's topic is: Understanding Clothing and Clothing Comfort. Before we go in depth in clothing comfort, we must understand what is clothing ok. So, we will first discuss about the clothing, how to select clothing, what are the factors which depend that clothing selection depends on this factors. So, first we will start with the different factors.

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Need and Selection of Clothing

- **Basic Needs: Food, Clothing, Shelter**
- Second most important basic need – **Clothing**
- **Human expectation – much more than basic need**
 - *Wealth*
 - *Status*
 - *Occupation*
 - *Age*
 - *Occasion*
 - *Gender*

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So, why do we need clothing? So, clothing is the one of the basic needs of human being, it is a second most important basic need after food. So, human expectation is much more than the basic need; depends on the wealth, status, occupation, age occasion, gender, there are many other factors which actually controls the selection of clothing. So, there are basic four factors on which clothing selection depends. So, we will first discuss the details of these factors. So, if we understand the selection of clothing then we can explain the comfort related to this and our area is we will actually limit our self the clothing related comfort.

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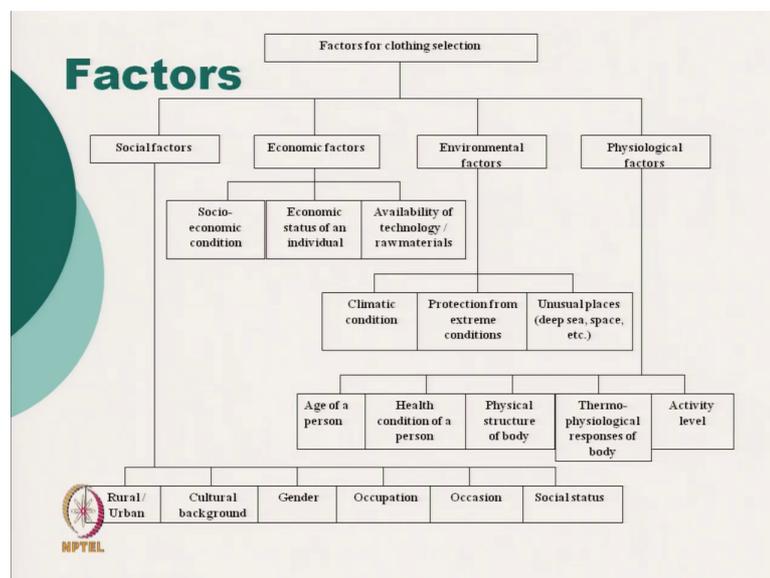
Factors affecting the Selection of Clothing

- Social factor;
- Economic factor;
- Environmental factor; and
- Physiological factor



So, first factor which effects the selection of clothing, is the social factors, then economic factor, then environmental factor and last one is physiological factor. So, we will discuss all these factors one by one.

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So, if we see the factors for clothing. So, these are the 4 factors I have already mentioned the social factor, economic factor, environmental factor and physiological factor. So, if we sub divided this factors, so there are factors actually the social factors can be subdivided into 6 subgroups.

So, the whether the person is from rural or urban background that clothing selection depends on that factor, his cultural background, the particular zone from which he is coming, all though this rural and cultural background. Now a days being normalized due to cosmopolitan nature of the urban cities, but still it exist. We can make out the persons actually social background from his clothing also nowadays then gender, occupation, occasion and social status.

So, these factors we will discuss one by one and after that economic factor. So, economic factor is divided into 3 sub factors, this sub groups are socio economic condition of the society, then economic status of individual person and then availability of raw material and technology for a particular zone or particular country. So, depending all of this factors the person selects his clothing, then comes another important factor which is environmental factor actually this environmental factor is that factor which controls the comfort related characteristics most which is effects them, these are the climatic condition of a particular place protection from extreme condition.

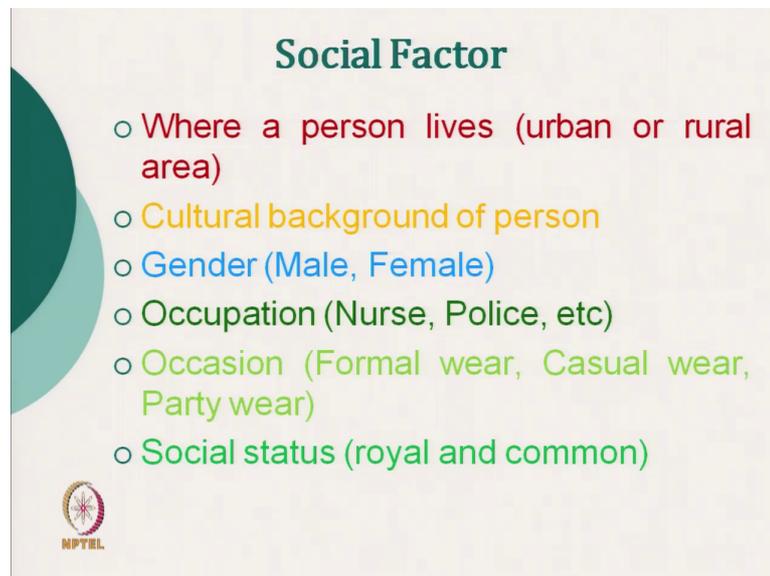
So, you may select clothing depending on the extreme condition requirement, like extreme cold condition you will require different clothing then extreme hot or normal condition. So, clothing selection depends on the whether it is you need protection from extreme condition or not and then under unusual condition there are various unusual situation like your army, so there his ballistic proof clothing is there fire fighter or even space suit or deep sea clothing.

So, these are the clothing, which actually needs special attention, then physiological factor of a particular person. So, physiological factors are subdivided into 5 subgroups. These are the age of person. So, at different age peoples physiological conditions are different. So, they need different clothing similarly health condition clothing. So, we will discuss one by one then physical structure of a person whether a tall, short or different. So, clothing selection depends and thermo physiological response of a person, it varies person to person.

So, I may feel warm or due to my metabolic condition, so that my selection of clothing will be controlled by this condition and level of activity. So, suppose at different level of activity you need different type of clothing; so, that we will discuss one by one. So, first

is the social factor, social factor means the where a person lives is it he is from is he from urban area or from rural area; you can make out the difference.

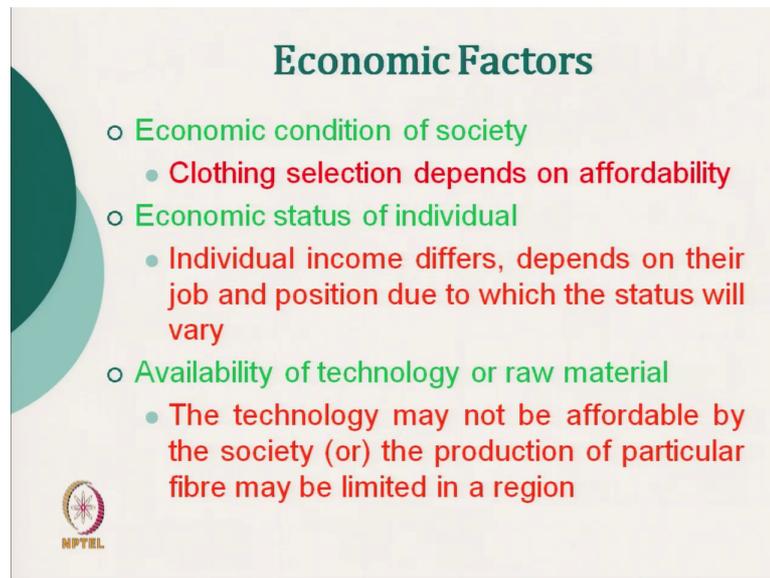
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So, it actually from his background from the rural background; so, it as I told that it gradually it is minimizes, but still exist. Cultural background, so in our country or even in worldwide people can be identified based on the clothing. So, that depends on the many factors depends on the social requirement or cultural requirement and all these things. Third one is the; obviously, it is very obvious that is gender wise we select clothing that is occupation. So, some for a particular occupation needs particular type of clothing one is to identify themselves like or some special requirement like doctor they wear a gown protective gown to protect themselves from different microbial attack or different.

Similarly, fire fighter they will require different clothing, for police, for nurse, so depending on the occupation they select the clothing and occasion. So, I will wear a formal cloth, or casual wear, or party wear depending on the occasion. So, I will definitely not wear a party wear always, so depending on the occasion. So, these are the social factors and also social status of the person. It now a days it may not exist, but earlier days, so royal they would like to wear a different type of clothing then common person. So, these are the factors which actually control the social factors, which control the selection of clothing.

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Economic Factors

- Economic condition of society
 - Clothing selection depends on affordability
- Economic status of individual
 - Individual income differs, depends on their job and position due to which the status will vary
- Availability of technology or raw material
 - The technology may not be affordable by the society (or) the production of particular fibre may be limited in a region


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Next come economic factor so, economic condition of the society of society, which is say supposed to be poor or rich you can make out from their selection of clothing their affordability and also it is a economic status of the particular person his income and depending on their income, job, position ok. So, they select the clothing depending on these factors. Third one is the it is very important it is availability of technology and raw material like the if the raw material is locally available for a particular area people and also technology is available people would like to select their clothing based on this fiber and all this, like in India cotton is available plenty.

So, India, basic clothing is made of cotton based, it is cotton based clothing or in cold zone in India even in cold zone, you will find that it is a basically the where your in if you go to the Himachal Pradesh. And, all these where it is a cold zone and the wool is available and locally available technology to convert wool fiber to yarn and then fabric you will find their clothing is depending on this technology.

So, depending on the availability of technology and raw material people try to select this thing; suppose we will not try to we are we are will not try to select those type clothing which the fibers are not available here locally or technology is not available, so this is the main one of the most important driving force for selection of clothing. Third is which is very important and as I have told that it is a, it directly controls the clothing comfort.

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Environmental Factors

- Climatic conditions
 - Winter, Summer, Rainy seasons
- Protection from extreme environment
 - Protection from radiation, extreme cold, fire, etc.
- Unusual places
 - Space suit, deep sea suit, swimwear, hazardous place, battle field etc.

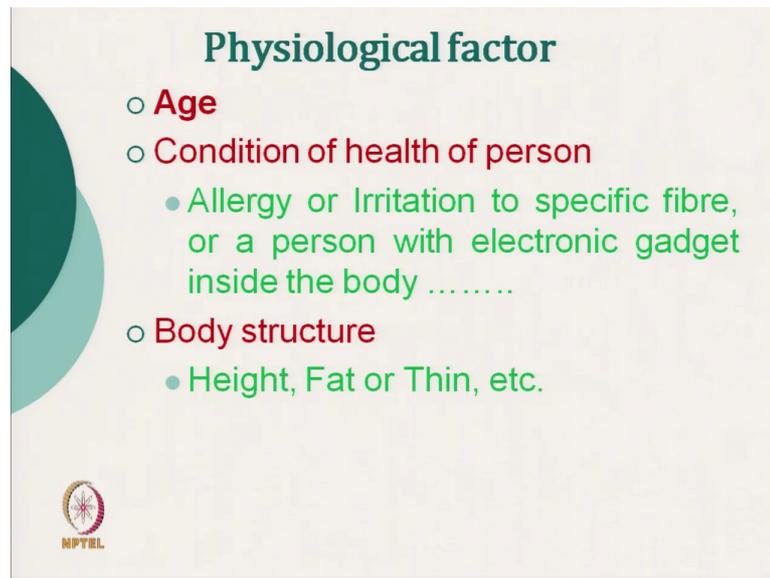


So, first one is the climatic condition. So, whether it is a winter or summer or rainy season, we select our clothing accordingly, so that is a, that is a very common and to keep our self comfortable, so that type of clothing selection is there then comes the protection from extreme environment. Here comfort comes in the second phase, first is the protection, suppose army personnel he is in battle field, so his first priority is that it is not the comfort, first priority is the protection from the bullet.

So, after that protection then comes the comfort. So, comfort is required for his better performance, similarly for extreme heat fire fighter, fire fighters first priority is to protect himself from fire it does not he does not get do not get damage injured by the fire, but at the same time the comfort is also required. So, we will discuss in later classes that how to improve the clothing comfort of all these things protective clothing.

Protection from radiation, so we have to select clothing based on all these environment extreme environment, then comes unusual space as we have discussed like sorry as we have discussed like space suit. So, for space suit, we first have to analyze the requirement of this machine now accordingly we will design the clothing, like for swim wear we need special type of clothing hazardous place and all these. So, unusual place we have to select clothing we have to design our clothing and also we have to impart the comfort and.

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Physiological factor

- **Age**
- **Condition of health of person**
 - Allergy or Irritation to specific fibre, or a person with electronic gadget inside the body
- **Body structure**
 - Height, Fat or Thin, etc.



Then it comes the physiological factor, physiological factor first comes age as we know that age according to age our metabolic heat generation changes and also our skin structure changes. So, we have to select clothing accordingly. At different particular clothing particular type of fiber may not be suitable for different age.

So, age of a person as we have discussed next is that condition of health of person. So, if someone has allergy or irritation in skin, so he will select a particular clothing according to his health requirement or a particular person who has electronic gadget in his within his body, so he will select clothing accordingly. So, these depend on the health of a person and body structure.

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Physiological factor

- Physiological response of body
 - Comfort level of an individual varies for same type of clothing depends on the thermo-physiological response of the body
- Activity level
 - Athlete, etc.



So, a different type of people they will require different clothing depending on their body structure. Then physiological factor is the physical logical response of the body. So, comfort of an individual varies for same type of clothing, so different person will react, will respond differently. So, that also depending on the particular persons requirement a comfort we have to select the clothing and then comes the activity level of activity.

So, at if I am sitting idle, so, I will require a different clothing then when I am doing some activity, so that depending on the body physiological activity and the sweat generation and heat generation. So, I will select my clothing then as we already we have discussed, so how to define clothing.

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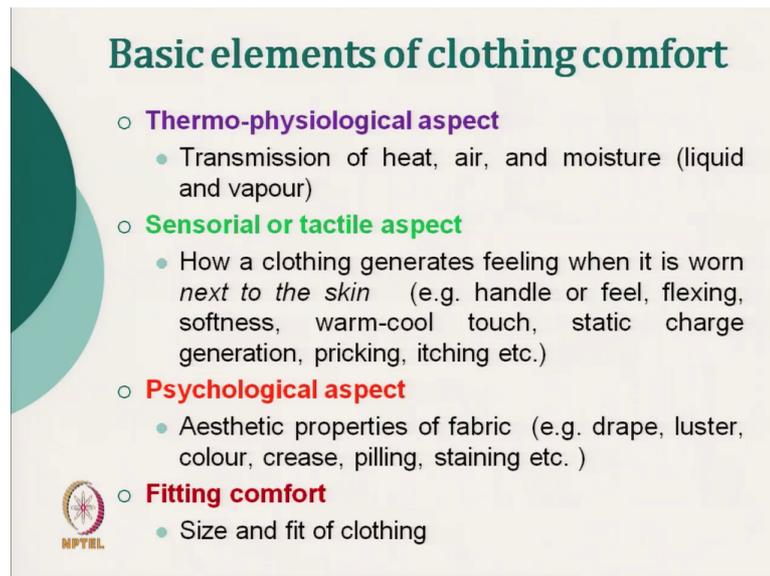
Comfort - Definitions

- Comfort is influenced by the physiological reaction of the wearer.
- Comfort is temperature regulation of the body.
- Comfort is the absence of unpleasantness or discomfort.
- Comfort is a state of pleasant psychological, physiological and physical harmony between a human being and the environment.



Now comfort so, comfort we have discussed that comfort is influenced by physiological reaction of the wearer, also comfort is the temperature regulation of the body, comfort is absence of unpleasant or discomfort and comfort is the state of pleasant psychological and physical harmony of human being and environment. So, this all 4 definitions actually it is valid for them which basically ultimately it is a psychological response of a body.

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Basic elements of clothing comfort

- **Thermo-physiological aspect**
 - Transmission of heat, air, and moisture (liquid and vapour)
- **Sensorial or tactile aspect**
 - How a clothing generates feeling when it is worn *next to the skin* (e.g. handle or feel, flexing, softness, warm-cool touch, static charge generation, pricking, itching etc.)
- **Psychological aspect**
 - Aesthetic properties of fabric (e.g. drape, luster, colour, crease, pilling, staining etc.)
- **Fitting comfort**
 - Size and fit of clothing

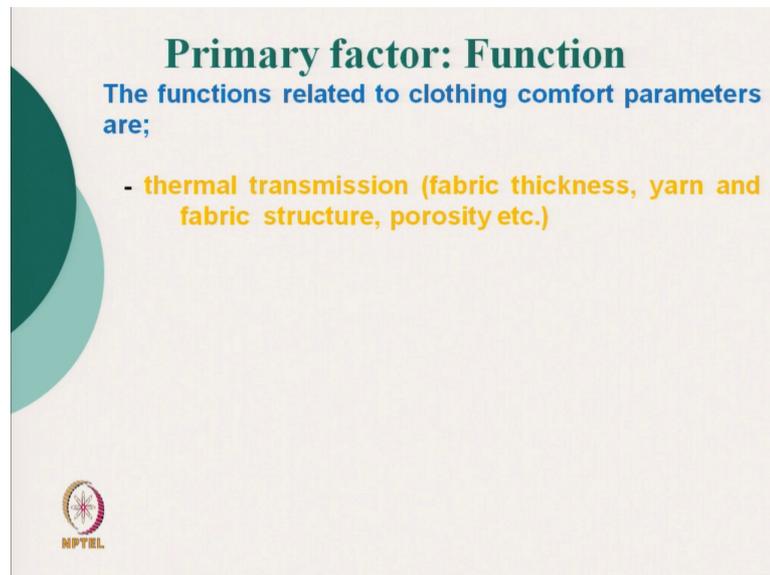
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So, and the basic elements are we have also mentioned, first is the thermo physiological aspects of the clothing, what is thermo physiological aspect it is a basically transmission of heat, air, moisture, moisture in a liquid form in a sweat or in vapor form from the body to the environment in between sensorial or tactile aspect. So, a person may feel comfortable during the transmission for a particular fabric it is transmits very nicely or it protects heat very nicely, but he may not feel comfortable due to tactile sensory, if it is rough if it is harsh, it is not flexible, it is not soft, so he may feel uncomfortable. So, tactile sensation is also important.

Third one is the psychological aspect. So, a person if the clothing, does it look good whether it is a lustrous or not, a drape is good or not, color is beautiful or unusual color, creasing, peeling, staining all this things are actually psychologically, actually effect the clothing output. So, the aesthetic property which is actually it you cannot measure, you cannot measure objectively, a particular fabric, a particular drape may be aesthetically beautiful for me, may not be aesthetically beautiful for other.

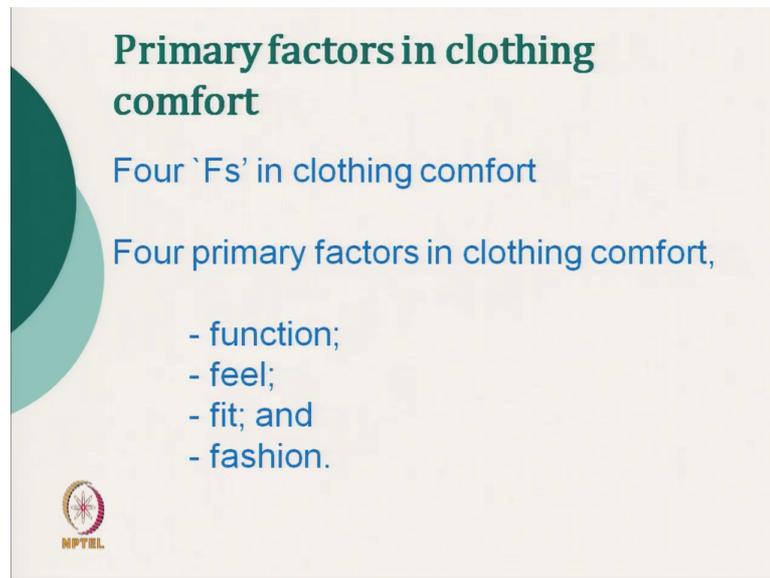
So, it is actually personally person to person it vary and then it is a fitting comfort a at, a particular clothing of fitting wise it is a very nice, but it may not be comfortable for my body movement. So, in that case it is tactile comfort is not good. So, all this 4 basic elements send signal to our brain and brain evaluates and finally, gives a comfort sensation. So, in the next segment we will discuss the psychological aspects of clothing. So, and then the how this total all the sensation we receive from a different parts of the body.

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There are 4 different factors which controls the clothing comfort, which is which are called four Fs of clothing factor.

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Primary factors in clothing comfort

Four `Fs' in clothing comfort

Four primary factors in clothing comfort,

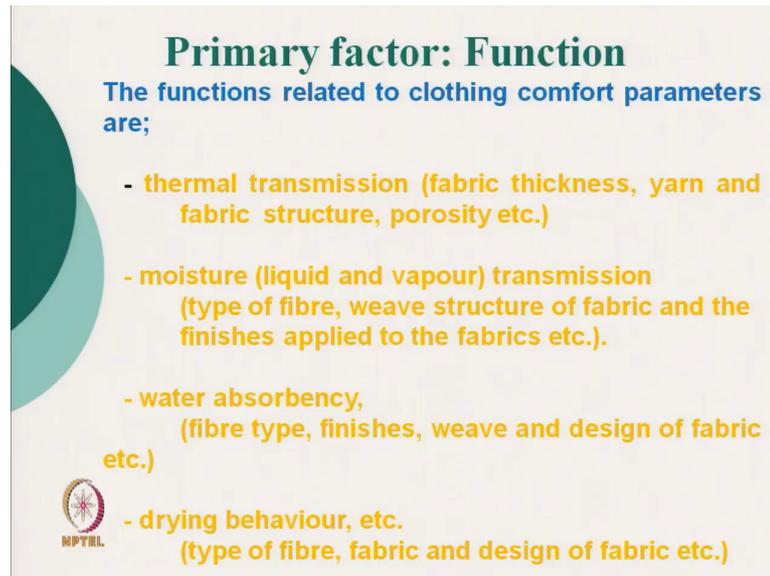
- function;
- feel;
- fit; and
- fashion.

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First is the function, then feel function, means the functionality of clothing, functionality of fabric. How the fabric transmits the moisture, transmits the heat this comes under functionality of. Then feel the touch of the body, the handle of the body. This fabric, it is a it feels soft that is that comes under feel, then fit as we have discussed fit is directly or indirectly related to the pressure exerted on the body ease of our body movement ok, this fabric may be nicely fit, but it actually hinders my free body movement.

So, that this type of comfort comes under fit and then fashion; obviously, fashion is actually it is a psychological one, sometime it is diametrically opposite to the a function, so that we will discuss. Now, coming to the function, the functions related to clothing comfort parameters are the thermal transmission.

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Primary factor: Function
The functions related to clothing comfort parameters are;

- thermal transmission (fabric thickness, yarn and fabric structure, porosity etc.)
- moisture (liquid and vapour) transmission (type of fibre, weave structure of fabric and the finishes applied to the fabrics etc.).
- water absorbency, (fibre type, finishes, weave and design of fabric etc.)
- drying behaviour, etc. (type of fibre, fabric and design of fabric etc.)

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So, thermal transmission by measuring the thermal transmission we can tell whether this fabric is suitable or whether the fabric is going to be comfortable or not, but we cannot say it will be hundred percent comfortable. Suppose I am I have developed one fabric which very good thermal transmission, but it is, it does not have the softens it is harsh so that then it will fail.

So, thermal transmission if we want to control we can control by fabric thickness yarn or fabric structure porosity etcetera. So, if we want to have higher insulation, so what we have to do? We have to increase the thickness, if we increase thickness. So, ultimately one thing what we are doing? We are incorporating more and more material in that also more and more air steel air we are trying to entrap. So, that makes the fabric insulating.

So, accordingly we can engineer the fabric by enhancing the thickness, also what we can do we can also increase the thickness by not by incorporating extra material, but by incorporating the extra air pocket. So, one best example is that the woolen acrylic made of bulk yarn. So, by changing the yarn structure, so by incorporating the air inside the steel air inside the yarn or fabric structure we can change the thermal insulation or incorporating the porosity, if we make the yarn porous we will make the, we can make the yarn the yarn highly insulating.

So, simply by changing the yarn or fabric structure we can control the thermal insulation moisture. So, moisture also we can, if we can control the moisture vapor or liquid

moisture transmission we can control the functionality of clothing as far as comfort is concerned and these are controlled by selection of proper type of fiber like as I have already mentioned, if we want to transmit the liquid moisture the water or a sweat we have to select a particular fiber which does not absorb moisture, but transmits wicks moisture.

So, for say extreme sweating condition is we can take the example of the active sportswear, high active sportswear where the sports person are in a very high active level and the sweat generation is at very high rate we can have say around 2 liter per hour sweat. So, if use a fiber which absorb moisture like cotton what will happen it will absorb moisture and the structure will be saturated and cotton absorb moisture, but it cannot transmit moisture quickly. So, in that case what will happen the fabric will or clothing will get wet and the mass of the clothing will increase and the wet clothing the heat transmission will be very fast and the athlete will or player will feel uncomfortably cold and heavy fabric and ultimately he will feel uncomfortable.

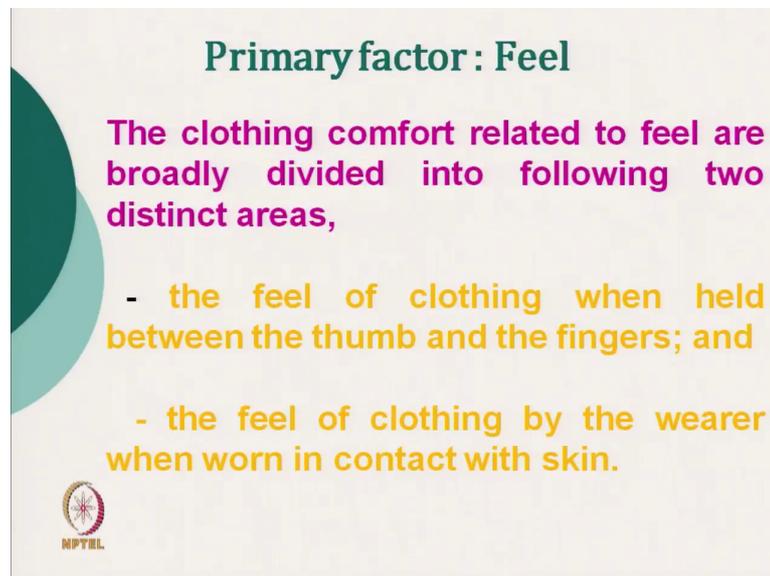
So, what is the way we have to select fiber which absorbs, which transmits moisture quickly. So, the best is that to select a fiber like polyester which does not absorb and special cross section with high safe factor if you select polyester that will give very high wicking written, this all this aspects we will discuss gradually weave structure. So, depending on the weave structure we can control the moisture transmission and say cotton fiber is suitable for a very good moisture in vapor form transmission of moisture in vapor form.

So, in case of cotton it absorbs moisture vapor at slow rate and it transmits there are mechanisms that we will discuss. So, by controlling, but selecting a typically fiber typical weave structure and the finish application different type of finish application we can absorb and finish. So, we can control the moisture transmission. Water absorbency if we need a particular clothing to absorb water or it transmits for first we have to absorb moisture and then you have to transmits it has to. So, fiber type finishes weave type by controlling or design of the clothing by controlling all this things.

We can actually control the water absorption or absorbency and last one is the drying behavior, drying behavior is extremely important if the fabric absorbs moisture and does not actually dry quickly then the it cannot provide comfort. So, these are the function

related characteristics. So, drying behavior depends on again fiber type fabric type fabric design and all these thing.

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Primary factor : Feel

The clothing comfort related to feel are broadly divided into following two distinct areas,

- the feel of clothing when held between the thumb and the fingers; and
- the feel of clothing by the wearer when worn in contact with skin.

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The next primary factor is that it is a feel there is a touch of the body. Now, feel we can have in two different ways. So, two distinct area of feel, one is by feeling by finger between thumb and fingers. So, we normally try to feel the cloth by thumb and finger and another one is that feel of cloth by the wearer, a particular fabric may be very soft may be very soft when we feel by thumb and finger and if we select the fabric based on that criteria, we may land up with the wrong decision.

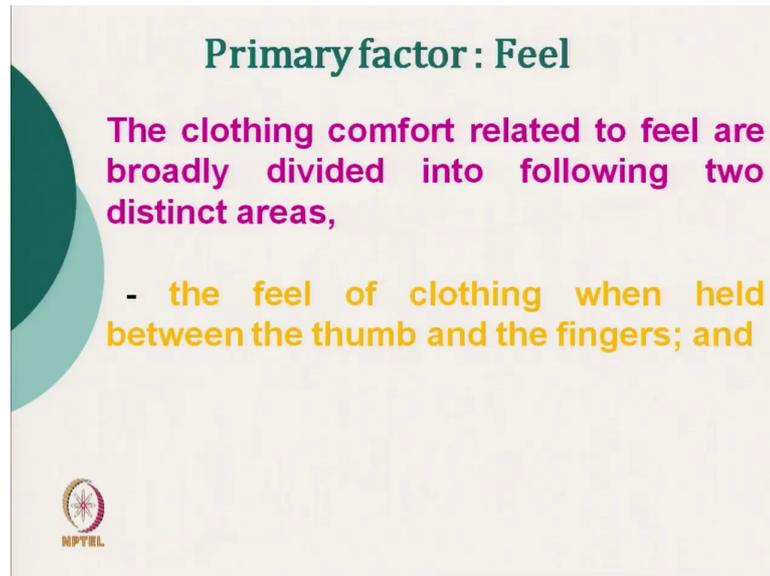
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So, just I will this picture we will give the idea about the fabric handle characteristics when we select normally we select fabric based on all these characteristics by bending we try to bend the fabric by finger to see that whether it is a flexible or not, stretching we try to stretch the fabric, we try to press the fabric whether it is a compressible or not whether it is a soft or not.

Rubbing whether it is a friction is high or not whether it will give you scratchiness or not and shearing. So, all this characteristics we try to do and based on all this parameter we have to take decision. So, we will land up with taking wrong decision only by feeling the cloth by thumb and finger.

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Primary factor : Feel

The clothing comfort related to feel are broadly divided into following two distinct areas,

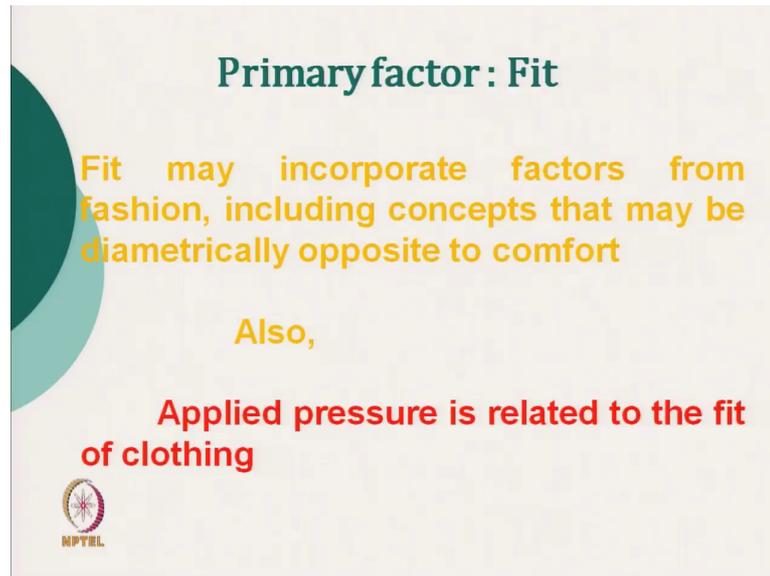
- the feel of clothing when held between the thumb and the fingers; and



Suppose one example is that a fabric is very soft and it is a thick one a thick layer of say non woven it is very soft. Now, if we take decision based on this softness then if we see that fabric is it is not it is a very stiff one, if we make a clothing out of thick non woven what will happen it is a feel will, will not get good feel, because of the of the stiff in nature. So, we have to take care of all this aspects. So, for a fabric the, it should not be harsh enough it. So, by rubbing we can take fully.

So, all this aspects we will discuss in tactile sensation we can measure by Kawabata evaluation tester and all these things that we will discuss. Next is the fit, fit may incorporated by the designer ok.

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Primary factor : Fit

Fit may incorporate factors from fashion, including concepts that may be diametrically opposite to comfort

Also,

Applied pressure is related to the fit of clothing



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So, you can have very good fit and, sometime the fit as I have mentioned it may be diametrically opposite to that of comfort of every you may have very good fit, but some time it is uncomfortable ok. So, applied pressure is related to the fit if we I am wearing a loose fit clothing, the applied pressure is less, but loose fit clothing the issue is that if I am wearing a loose fit clothing and I am sitting idle then the clothing will give you the required insulation due to entrapment of the still air.

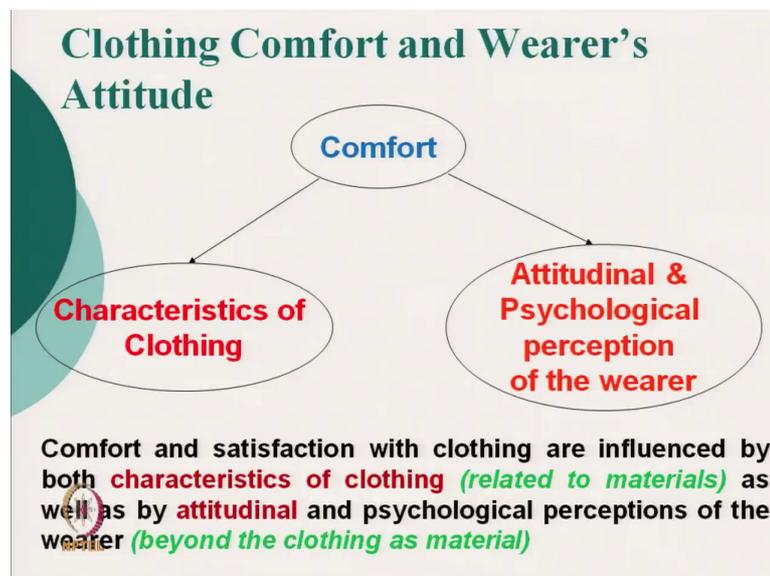
But on the other hand if I am wearing tight fit clothing, so it will restrict my body movement and it will give undre pressure on the body and I will I may feel uncomfortable. But the tight fit clothing it will give you very good thermal a thermal transmission, because of less entrapment of heat.

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So, ultimately our brain takes signal receives signal from all this aspects and finally, you judge this and fashion is the basically totally related to the psychological comfort, which is actually we will not discuss in this a area it is not or area, but it is a directly related to the physiological comfort fashion ok.

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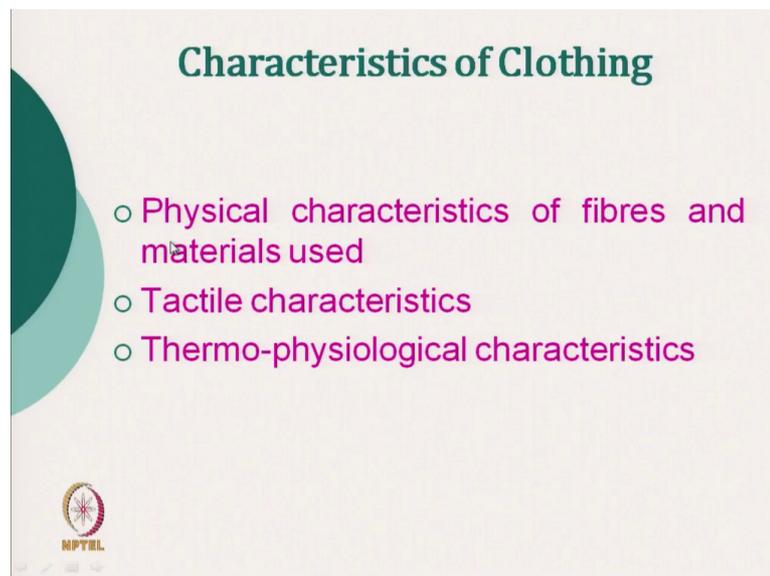


Now, coming to the comfort and wearers attitude; so, comfort you can we can now divide into two aspects one is the fabric aspect, clothing aspects, material aspects, and next one is the wearers attitude I can have very good thermal transmission, moisture

transmission all sorts of tactile related characteristics very good, but if it is not liked by the wearer then it is fail it is not comfortable. So, psychologically he is not comfortable. So, that is why wearer attitude towards that particular clothing is very important. So, we will discuss one by one. So, comfort we can actually broadly divide into two aspects, one is the fabric or clothing aspect characteristics of clothing and then attitude of the clothing towards the clothing of the wearer.

So, comfort and satisfaction with the clothing influenced by both characteristics of clothing a related to the material as well as attitudinal and psychological perception of the wearer which is beyond the clothing material. These are you have to take care while selecting a clothing for a particular comfort aspect. So, you have to take care of all these aspects, very good clothing, very good material may fail if the wearer does not like ok. If we does not, if it is not he does not feel comfortable ok. So, that both these things we have to take care.

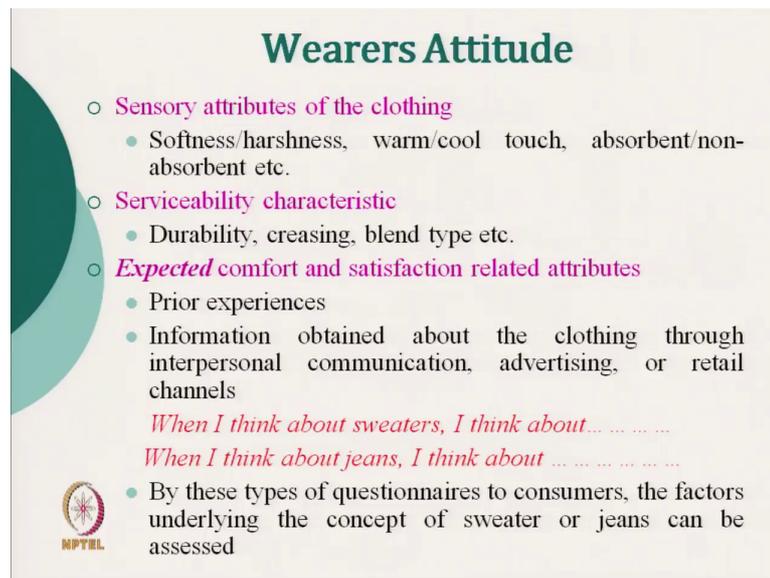
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So, characteristics of clothing it depends on, it is a basically physical characteristics of fiber. So, this characteristics of clothing it depends on the physical characteristics of fiber and material used. So, as we have discussed if we want high moisture absorption we have to select particular fiber or particular material particular yarn fabric tactile characteristics of clothing whether touch wise it is a it gives very good feel and thermo psychological characteristics of clothing.

So, this all these things are related with the clothing as material; so, this is controllable this we can control ok, but the thing which we cannot control this all these three things we can control which we cannot control is the wearers attitude, it is dynamic, it changes with the time changes with the fashion. So, that thing we have to take care of and also our idea is to first analyze the wearers attitude then incorporate the comfort then select the other parameter select the fiber, select the material.

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Wearers Attitude

- **Sensory attributes of the clothing**
 - Softness/harshness, warm/cool touch, absorbent/non-absorbent etc.
- **Serviceability characteristic**
 - Durability, creasing, blend type etc.
- **Expected comfort and satisfaction related attributes**
 - Prior experiences
 - Information obtained about the clothing through interpersonal communication, advertising, or retail channels

When I think about sweaters, I think about
When I think about jeans, I think about

- By these types of questionnaires to consumers, the factors underlying the concept of sweater or jeans can be assessed



So, all these things we can select. So, wearer's attitude it is a basically first thing is the sensory attributes of the clothing that depends on it is a whether it is a warm touch or cool touch. So, I like warm touch clothing so; that means, my attitude towards that is a I like little bit stiffer fabric it is my attitude. So, that particular aspect we have to take first then only suppose from the market survey we have come into conclusion that 90 percent people work want the harsh fabric so; that means, there is no point of going developing a soft fabric.

So, we have to select your material like that and try to incorporate other comfort related characteristics. So, person requires harsh fabric warm touch absorbent [vocalized-noise, so these are the characteristic these are the information you have to gather from the wearers attitude serviceability I do not bother about the durability I want softness. So, develop fabric like that depend on otherwise it is useless, it is creasing I may require a very good crease, but some other I do not require it is a casual look I need. So, you have

to first understand the wearers attitude towards your clothing, see if I do not like say softness whatever you provide I will not like it.

Expected comfort and satisfaction related to attributes. So, it is a experience based. So, I know this linen fabric it gives very good coolness. So, I will definitely go for the linen or cotton, cotton is it is a soft I like softness. So, I will go for cotton, so depending on the prior experience of the clothing. Next is that information obtained by interpersonal discussion or advertisement analyzing. So, my friend he told me that this is the cloth which is which gives you very good I will go for that, but irrespective of the factor that material factor. So, these are the attitude like example when I if you ask, when you think of sweater a company would like to launch a sweater.

So, he would they would try to gather information about the what are the basic requirement, basic characteristics people want from the sweater, like denim jeans they will luck they will first ask you what which color you like, what type of denim within do you like thicker denim or lighter denim or stretchable or not. So, whether blue denim or, so this type of attitude you have to first study then we can either I without these things the clothing comfort does not mean anything.

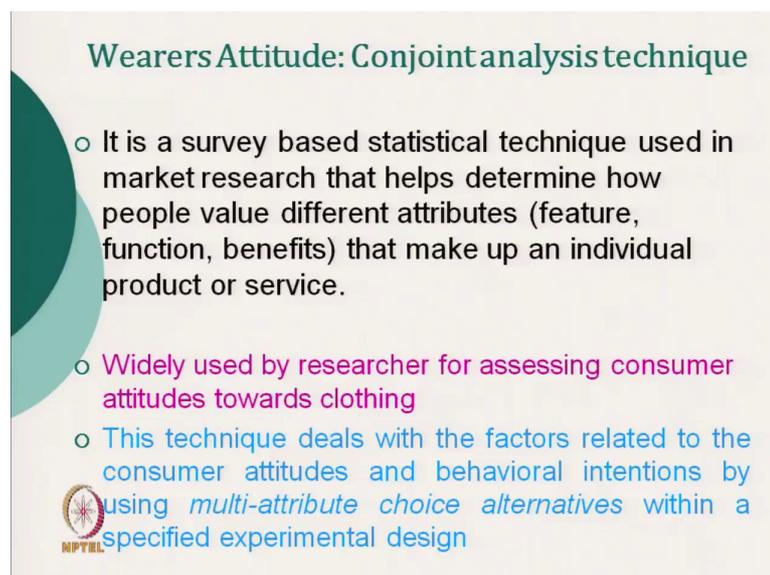
So, this type of questionnaire we can get we can then we can analyze and select. So, as we have discussed the material related characteristics will give you some physical parameter. But, psychological the wearer attitude we have to take in into consideration like in 50 years back if you see that polyester was the actually it is a in high demand people wearing a polyester they feel it is a comfortable it is a very good, but now we do not like polyester the trends is towards the natural fiber. So, it depends on the attitude.

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So, design feature of the clothing. What is that latest design? So, that actually it is you have to that actually indirectly gives you the psychological comfort, brand level information on garment care price also; obviously, it is a if it is a very highly expensive someone like it is a if it is expensive you will simple buy and ultimately you will feel it is a psychologically comfortable. So, that these are the attitude; so, designed feature of the clothing brand level information on garment care and price. So, to study the wearers attitude there is a analysis technique which is known as conjoint analysis technique.

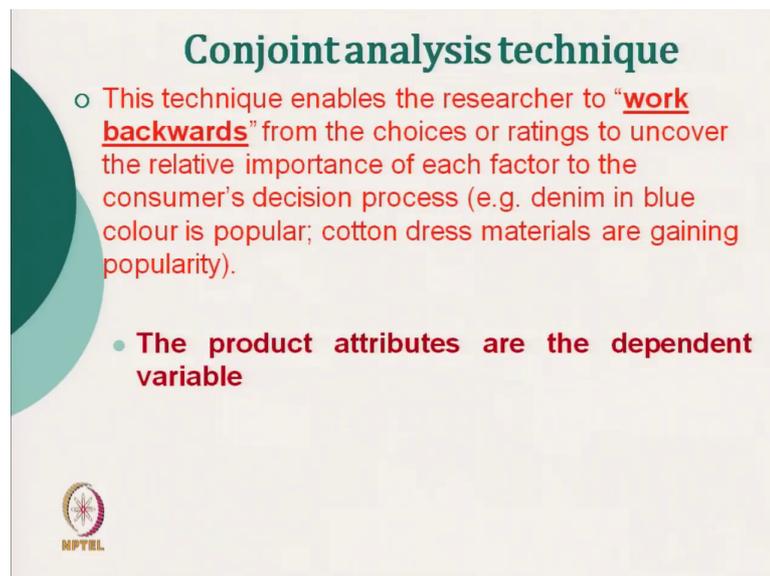
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What is this? It is a survey based statistical technique used in market research that helps determine how people value different attitude attributes like a feature, function, it is benefit and that make up an individual product and service. So, first you have to analyse the wearers attitude then you decide the type of clothing. So, this is widely used by researcher for assessing a consumer attitude towards the clothing in, actually in clothing industry this technique conjoint analysis technique is used before you decide the comfort clothing, this technique deals with the factors related to the consumer attitude and behavioral intentions by the multi attribute choice alternative within a specified experimental design.

So, you have to design some specified experimental design you have to evolve then gradually you get information. So, this goes in it works backward fine, what does it mean you get information first then as I have told then you develop your clothing you select your fiber, you select your clothing, you select your color.

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Conjoint analysis technique

- This technique enables the researcher to “**work backwards**” from the choices or ratings to uncover the relative importance of each factor to the consumer’s decision process (e.g. denim in blue colour is popular; cotton dress materials are gaining popularity).
- **The product attributes are the dependent variable**

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And the product attributes are dependent variable the product attributes the dependent on this attitude. And, now we will stop here and next class we will discuss the human clothing interaction ok.

Thank you.