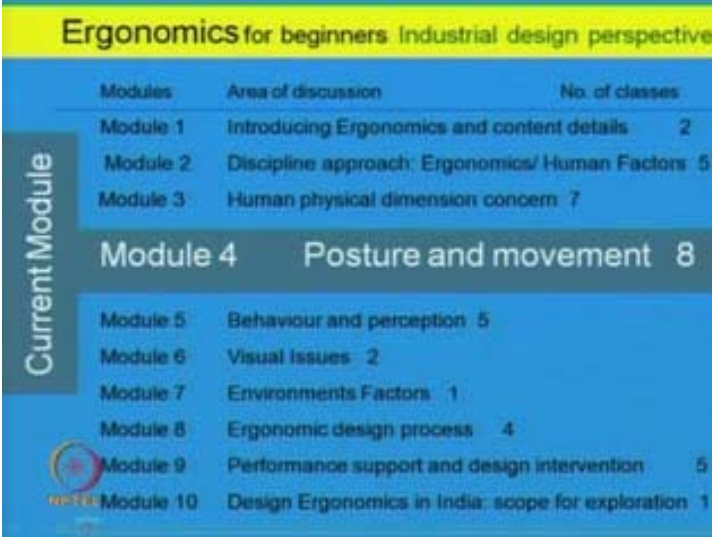


**Ergonomics for beginners Industrial Design Perspective**  
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**Indian Institute of Technology, Guwahati**

**Module No. # 04**  
**Posture and movement**  
**Lecture No. # 17**  
**Posture and body supportive devices**

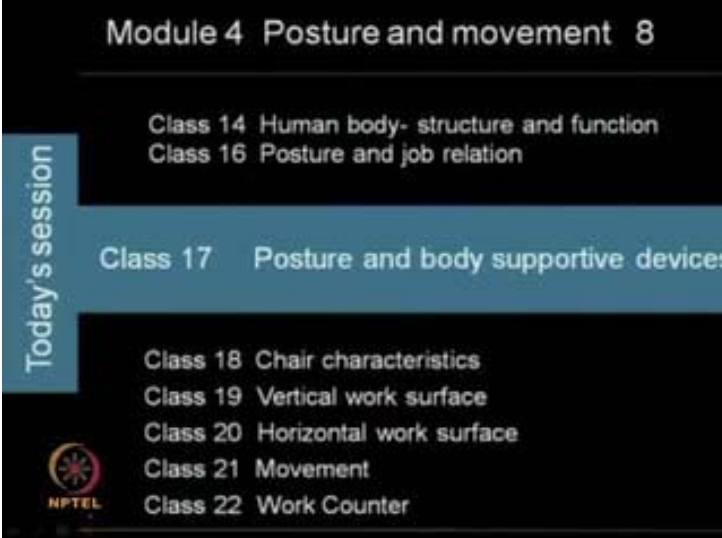
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**Ergonomics for beginners Industrial design perspective**

Modules	Area of discussion	No. of classes
Module 1	Introducing Ergonomics and content details	2
Module 2	Discipline approach: Ergonomics/ Human Factors	5
Module 3	Human physical dimension concern	7
<b>Current Module</b>	<b>Module 4 Posture and movement</b>	<b>8</b>
Module 5	Behaviour and perception	5
Module 6	Visual Issues	2
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**Module 4 Posture and movement 8**

<b>Today's session</b>	Class 14 Human body- structure and function
	Class 16 Posture and job relation
	<b>Class 17 Posture and body supportive devices</b>
	Class 18 Chair characteristics
	Class 19 Vertical work surface
	Class 20 Horizontal work surface
	Class 21 Movement
	Class 22 Work Counter

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Gist of last class

- Awkward adopted posture and inefficient work output has a parallel relationship.
- People have different capabilities and job/ task demand also varies.
- Towards making compatible interface between these aspects attempts are being made and ergonomics looks into "fitting the task to the human"

Welcome to today's session number seventeen of ergonomics for beginners industrial design perspective. Today the module is fourth module - posture and movement and today's session is class number seventeen, that is, posture and body supportive devices

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Gist of last class

Task requirements

Workspace design

Working posture

Personal factors

- Avoid bending, forward/ backward
- A twisted trunk strains the back
- Sudden movements and forces produce peak stresses
- Alternate postures as well as movements
- Limit the duration of any continuous muscular efforts.

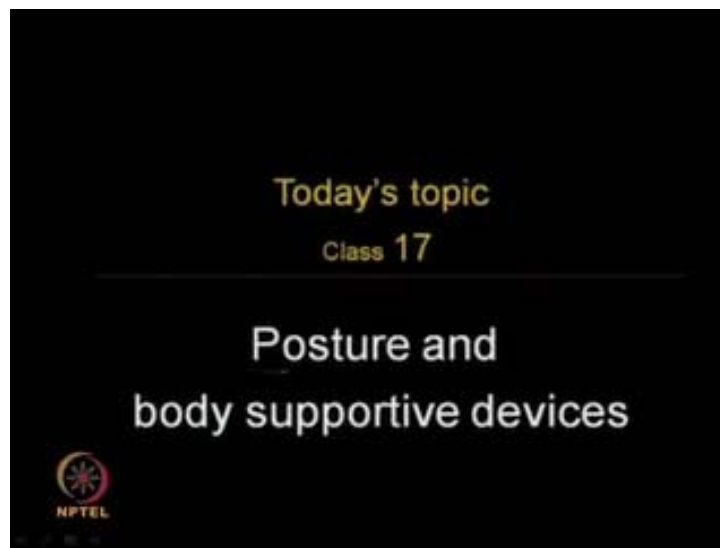
Now, just to have a gist of last class, where we mentioned that the awkward adopted posture and inefficient work output has a parallel relationship. People have different capabilities, and job and task demand also varies. Towards making compatible interface

between these aspects, attempts are being made and ergonomics looks into the aspect of fitting the task to the human.

In continuation to the last class, where we mentioned that working posture has three arms in the working posture triangle; that is, task requirements - as per various tasks, we need to adopt some postures and then workspace design - equipment or work item, the dimension and their layout in a specific space - that is the workspace design and some personal factors.

Now, while discussing that we mentioned that [people aspects] like avoid bending forward and backward, a twisted trunk strains the back, sudden movements and forces produce peak stresses must be avoided. Alternative postures as well as movements as much as possible should consider, limit the duration of any continuous muscular efforts so that we can work with comfort and less fatigue.

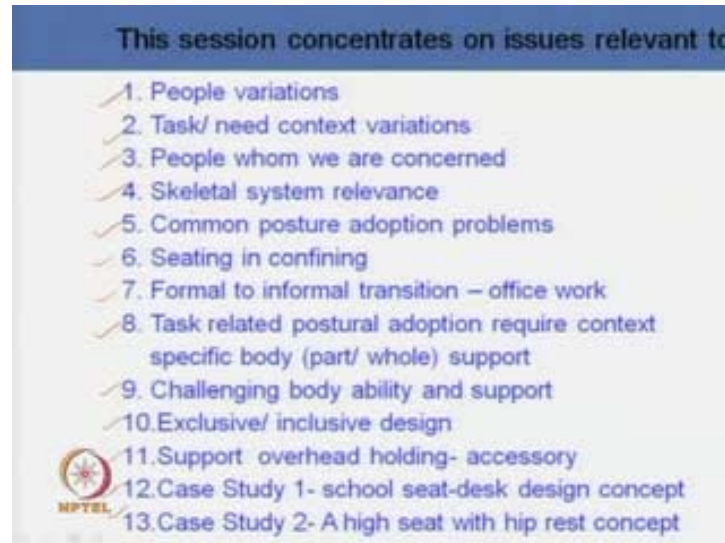
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So, with this, the today's topic in this class number seventeen is that posture and body supportive devices. Now, the difference between human body and other animals are that we can adapt to versatile body positions, postures and we can bend in any direction and to stand erect and sit, it appears or it seems to be easier for us than an animal. If the animals can or wishes to stand erect, that would be an additional effort for them, but for human body, it is natural due to evolution. Now, still standing for longer time or sitting like squatting etcetera, where muscular efforts are required, there we need some kind of

support to maintain that body posture. Now, today, we are going to raise some points on these types of body supportive requirements and what could be its design approach from ergonomics point of view.

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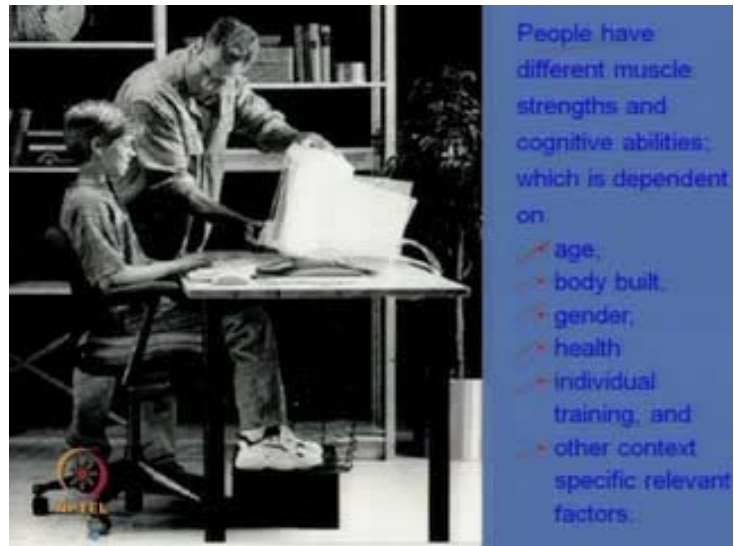


Now, this session concentrates on issues relevant to Now, here 13 topics, we are going to discuss today. The first topic being the people variations, task and need context variations, people whom we are concerned and their limitations and facilities, skeletal system relevance for our posture, common posture adoption problems, seating in confining into certain task, if we have to adapt a posture, that is not good, but we adapt to it. Formal to informal transition of our working, sitting, etcetera like office work. is what is the now Earlier office work; there is a formal atmosphere, but how the workstation design can be done in such a way that it should feel informal. In a formal context, the creativity does not open up. In the informal context, if you are free to decide yourself and that also has some postural constraints or something like that, if you are free from those then creativity can come.

So, in this context, we will discuss something about formal to informal transition - specific reference to office type of work, then task related postural adaption require context specific, either a part of body or whole body support. Next, the challenging body ability and support, exclusive and inclusive design approach, support overhead holding like accessories design.

Now, we will be discussing and after this, two case studies, where some design development trials have been taken like case study one - that school seat desk design concept and the last is the case study number two - a high seat with hip rest concept. So, these are today's topic matter.

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Now, if we see this left side figure, it is a well-known figure normally available in published form in a book that a person is adjusting all the work equipment including the seating, I mean height etcetera, all to suit the workstation to this boy.

Now, from here, if we analyze this figure, it can come that people have different muscles strengths and cognitive abilities, which is dependent on age, body built, gender, health, individual training and other context specific relevant factors.

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Now, always we talk about work, but spending leisure also imposes postural risk; like this left side figure explains that behaviour matters. So, what type of body support requires here? The body support is not only to give a physical support to your body to maintain a body position, but it also should match with the requirement for the task.

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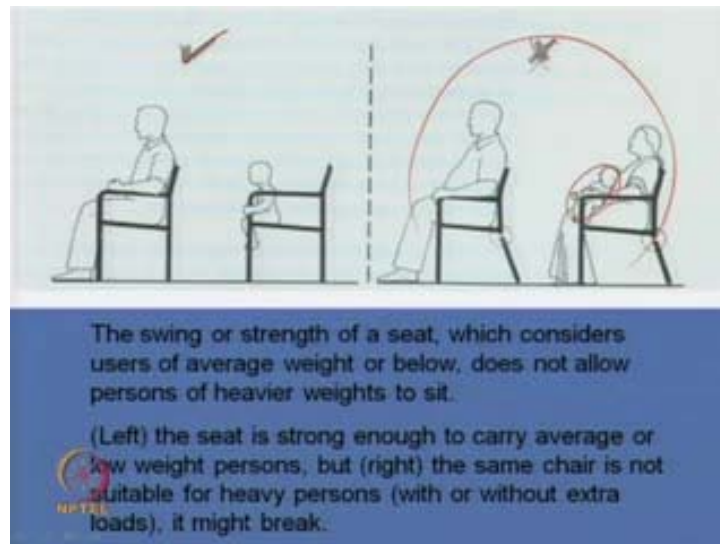


Body size itself links with postural risk. Now, in this case, in the figure, it says that the body figure shown here, as the body becomes fatty like endomorphic body type, the coordination among body parts reduces.



So, the way a normal mesomorphic person will use this chair or while sitting the pressure on the chair falls, this endomorphic type body figure find it uses this seat, it differs; the pressure point differs due to sway of body and etcetera. So, it requires proper support system. Somatotype plays role in maintaining posture and accordingly, the support system should be developed.

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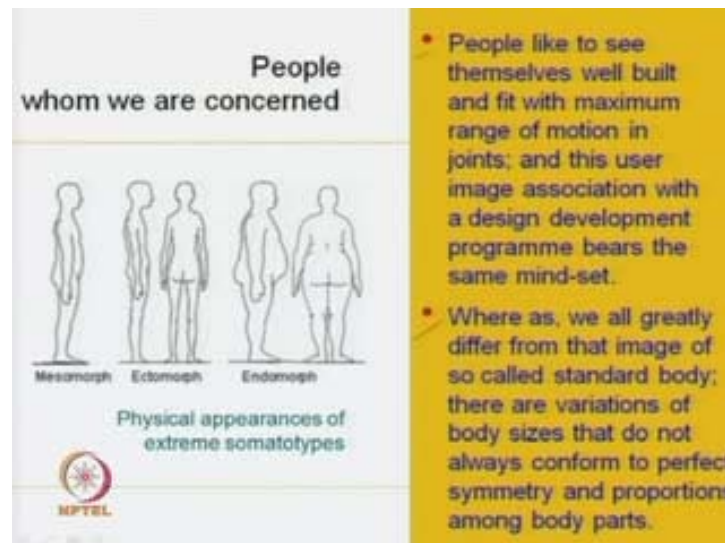
Now, some allowances are also necessary to add or to consider while developing a body support system like seats. Here, it can be said that the right hand and left hand, two figures are shown here. This says that it is ok while it says that it is not good because the swing or strength of a seat, which considers users of average weight or below does not allow persons of heavier weights to sit. In the left figure, the seat is strong enough to carry average or low weight persons, but the right hand side figure, the same chair is not suitable for heavy persons with or without extra loads; it might break. So, while developing a body supportive device, we must consider its other allowance requirement.

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Now, body supportive device, when it comes to our mind, we consider bed comes to our mind, but the common bed also acts as a multiuse requirement not only for sleeping at a [waist], but while sleeping some activities are done. So, that support has to be given and not only is it used for sleeping, but some other activities also that need to be considered.

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Now, people whom we are concerned, the mesomorph and ectomorph and endomorph that we have discussed in earlier sessions, but now the relevances, the physical appearance of extreme body types are different. Now, people like to see themselves well-



built and fit with maximum range of motion in joints and this user image association with a design development program bear the same mindset whereas, we all greatly differ from that image of so called standard body. There are variations of body sizes that do not always conform to preferred symmetry and proportions among body parts.

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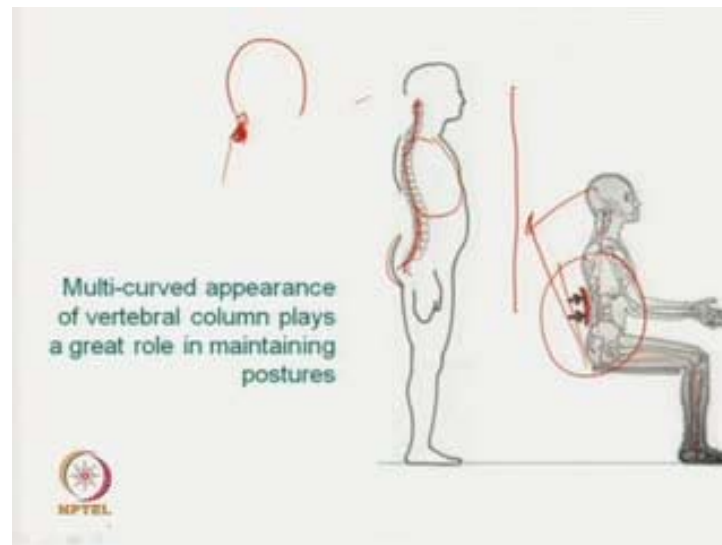


With that, we can say that if we see this figure that the persons are typical office workstations are shown here. Your perception of a good job may not necessarily tally with that of someone else means everybody's task requirement is different and accordingly, their furniture support is also different; the requirement is different.

Now, sometimes to overcome those unwanted features, we overdo clothing and use varieties of decorations, which in turn affect in a negative way. In some cases, it is said that if a chair or a seat like a car does not fit you, then some people suggest that put some cloth, a packet of packed cloth in the back of your seat. means seat backrest and your back, just keep there so that you can adjust your body.

Now, that may be a concern, but why we require that, why that design cannot support each and every user? What would be the considerations for that we need to think? Our design activity must consider various body types and limitations thereby; our design activities are to aid all the users rather than making a design and then asking them to fit in.

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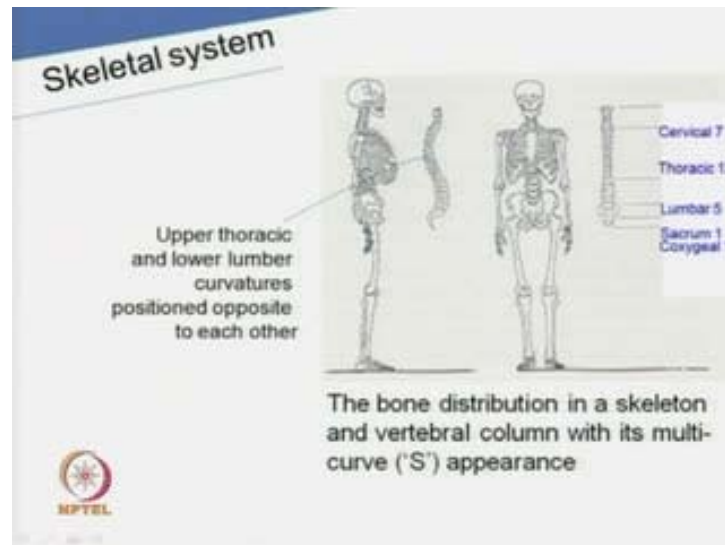


Now, comes our body and for the posture relevance, the **[hard]** backbone. In this backbone, a multi-curved appearance of vertebral column plays a great role in maintaining posture. Now, see this bone structure has an S type, double S type of curvature. Why it is like that? Why it is not straight vertebral column? There are many thoughts behind it.

But mostly, we can say that in this skull, there is a small groove; it is called occipital groove at the back of the head, where the vertebral column's first bone - atlas bone meets here with it before joint and then all other bones joins together to form a vertebral column. Now, as it is placed at this end part, one part and the head comes forward. So, to maintain that balance probably, this is the cause of this bent and this thoracic bent is to have the rib cage and to counter balance it. The next portion has gone back and then the buttock etcetera is there.

But why it has taken this shape, instead of **going for** analyzing that, it would be good to see how best we can maintain this natural position; like when we sit, mostly, it is said that we require a backrest at this lumbar region maximum. When this body bends further, then we require another backrest extended till shoulder or head like that.

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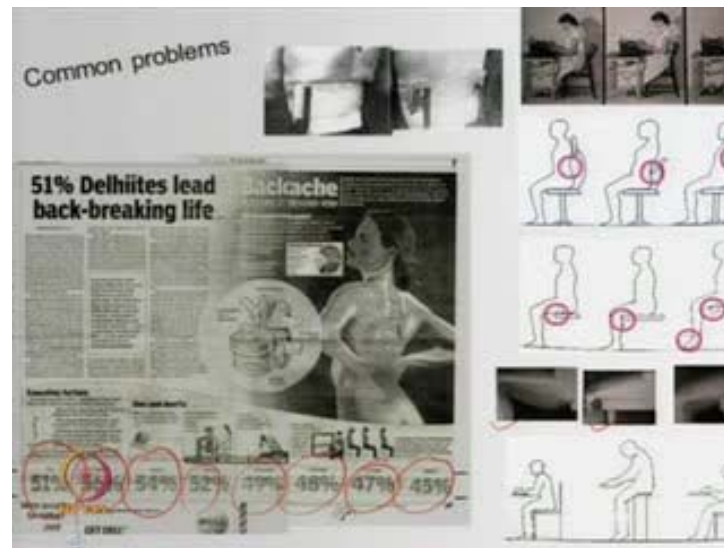


That we will discuss in next sessions, but here it can be said that if we see the skeletal system, these are the specific points. The bone distribution in a skeleton and vertebral column with its multi curved S appearance, it requires maintaining even while sleeping also. **This should be.**

Now, another thing is that if we use too much soft bed, then with the natural body pressure, where the more pressure is there, that portion will go down and where the less pressure is there, it will be up. So, the natural position of vertebral column disturbs and ultimately, it does not give a good comfort.

While sitting also, if the seat surface is too soft, then the buttock bony portions, it does not get proper support and so with that very softness, the equal distribution of body load does not form; so, it gives a tiring effect.

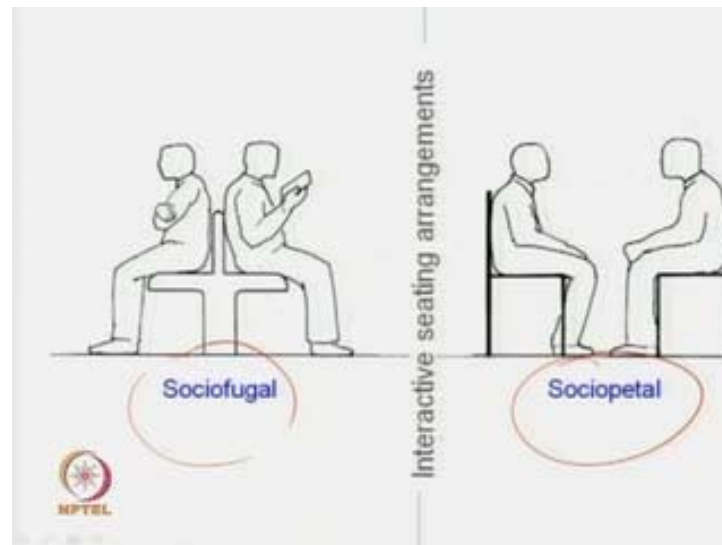
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Now, the common problems faced by furniture. Now, in a newspaper article, it says that in different cities, like this way it is said that in some cities area, 51 percent of population, those who they asked, inquired, they felt back pain; some had 56 percent; some had 54 percent like that. In different cities, different type of responses they got. So, it means, it says that back pain is a problem nowadays coming up and people say that this backache is probably due to bad posture adaptation, judge and lack of proper body supportive devices.

Now, here in the right hand corner, some figures have been shown that if the furniture chair does not match properly, then what are the problems may come. These are the problems that may come, if the furniture dimension does not match.

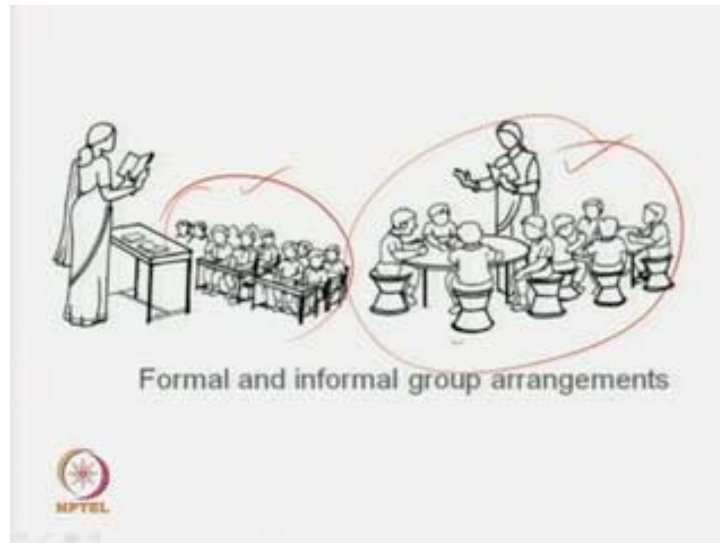
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Now, the social aspects of seating: it also acts positively or negatively or it affects on posture like interactive seating arrangements. If we sit back to back, we do not want to see at each other, like that, it is called sociofugal seating arrangement. In certain cases, where this type of atmosphere needs to be maintained, but the facilities are not like that, then people take some different type of postures to keep away from that another person may be due to privacy or whatever the reason is there.

So, due to this different posture adaptation, some problem might be there and when this front to front meeting is necessary, it is that this seating arrangement is called sociopetal arrangement seating. Now, what is necessary for the specific purpose and accordingly, the furniture placement and body supportive devices may be designed.

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Now, another thing is that formal and informal group arrangements. **These are** Now, here these boys are also using some kind of furniture sitting support and they also use some kind of support, but **the cases** in the formal case, what is happening in this case, these students, they cannot move of their own; this is a confined space here **sitting**. So, it will be a more tiring than this one. Why it is not that much tiring in relation to this one sitting? Because it is individual seats; they can modify, they can change and **they can** even they can shift their positions also.

So, more freedom is there. Now, in a seat body supportive device, when we are using, whether it confines the posture or it gives freedom to change, it is necessary to consider and accordingly, the furniture support system should be developed. With armrest, backrest etcetera it confines.



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Here it is a mixed type of atmosphere. Another thing is that if you are not allowed to change your posture as you wish, it gives problem; like when we are sitting or standing in a specific posture, a group of muscle is responsible to maintain that posture, but after certain period it will get fatigue and then the total body load should be taken over by next group of muscles. While taking that change, while exchange or taking over this body load, sway is there and sometimes, we require to change the posture to relieve those things; that facility, whether it is provided needs to be considered.

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In this case, in this figure, they said that some presentation is going on, where a group of faculty members are judging those presentations. Now, here, though they are sitting in a specific posture, but they are free to move. So it is less tiring, but **where this** if there is some other form of sitting, where the members are not allowed to move, it is tiring and accordingly, the body supportive devices has to be designed.

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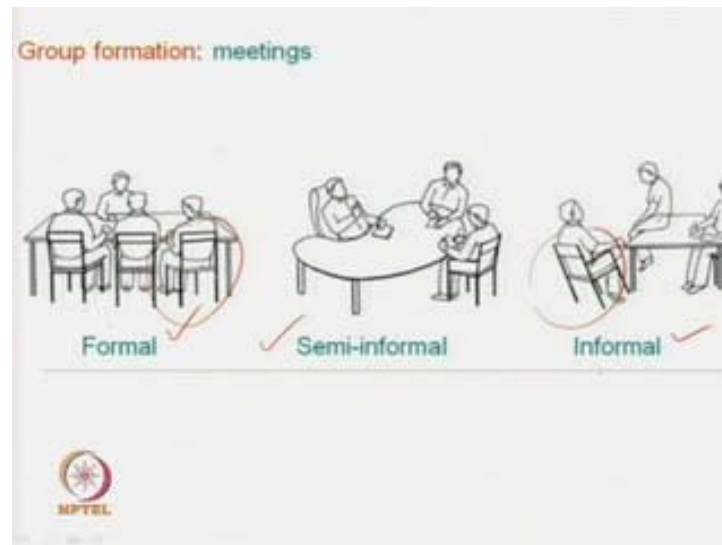


This is an office now. See how the furniture arrangement and the workstation give you postural strain. Now, the body supportive device is this one chair, is a good chair it seems for me in this figure, but the computer monitor is placed in this corner so that this space is available here to keep the monitor.

But here is this is a tray, where the keyboard is kept. Now, to operate this keyboard and mouse here and he has to look here and the seating here and so, there are variety of various body angles and postural changes are there. So, obviously here, his productivity as well as the body strain both are getting affected.

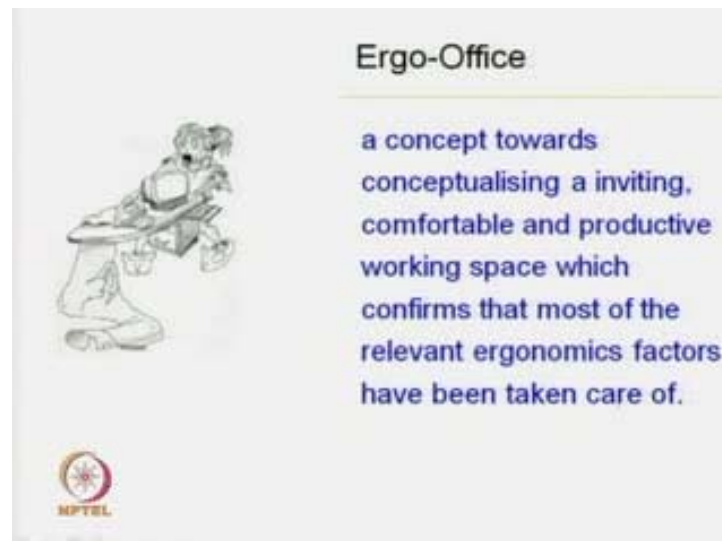
So, then either modify the good workstation design or if it has to be there, then if allow him to use a short length type of chair here, so that at least he can move without much resistance. So, that can be considered.

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Now, finally, we can say that the formal atmosphere, semi informal atmosphere and then the informal atmosphere. The same furniture, if we use for the three different purposes, it does not suit. Like this, to make it informal, so this furniture and this furniture same furniture cannot give that scope. So, depending on the specific requirement of formal, semi-informal, informal, body supportive devices and furniture should be designed accordingly

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Now, a concept of ergo office is coming nowadays, people say. That many tasks one should do at a time. In addition to that, that thinking, that creative ability has to be cultivated. So, for that a concept towards conceptualizing and inviting, comfortable and productive working space, which confirms that most of the relevant ergonomics factors have been taken care of. Now, I am showing some of the examples.

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Like in this, the workstation concept is totally changed; that chair table concept. For this this is in a This person for him, this is the personal work area whereas, for meeting, this is a separate table.

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So, work and meeting, it is being separated out. For a meeting, if this table is rectangular, it gives a formal feeling, when organic form which means that non-square or straight line form is there, it gives more interactive and more pleasing kind of thing.

So, here it is like this so that for certain, more closeness and comfort is also there with the chair development. What type of chair, chair height, length, breadth etcetera, can be adjustable that is there.

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Now, for a personal seating arrangement, it can be said that personal workspace, office general workspace and this is that interaction with visitors are totally three different setup and is combined together with specific identity and then the person with swiveling wheelchair, he can attend the three as and whenever, it is necessary.

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Now, formal to informal transition - that car inside also has become office. Now, the office space is also like that, mount on to interact between persons working, the surface is developed like this way so that more closeness is there. While in office, resting either on a floor or the sofa, it should provide that facility which means we are thinking for office system means less constraint should be there so that the person with his own feeling, he can adopt postures.



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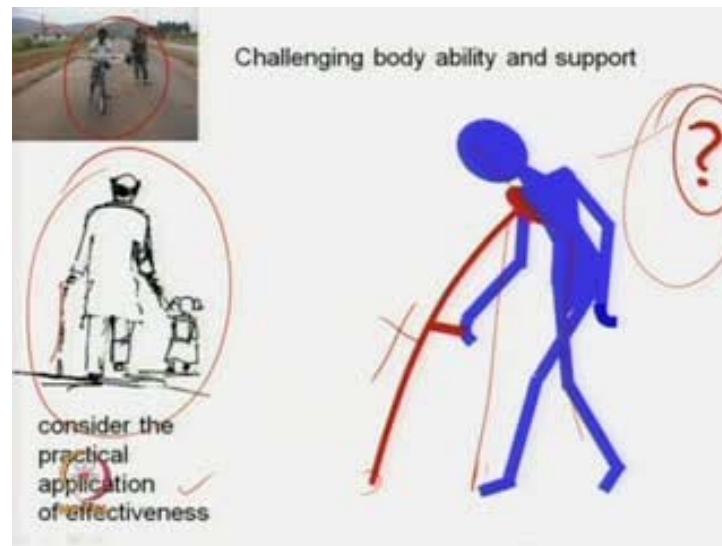
These are the some of the cases - the concepts taken from various publication sources. These are the some of the new office workspace or new work style is shown here. It gives like this, in this figure, we can say that now the furniture, the body supportive device and then work area is in such a way that work as well as rest, all is possible and if it is possible, the furniture can become formal furniture also. So, this type of thinking nowadays has started and people are developing variations in it, depending on task requirement and body supportive devices requirement also.

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Now, the challenge to make new workplace, the functional with freeness, this is the main matter coming nowadays. So, from formal to semi-formal and formal feeling at home always - these are the some of the specific cases that can be summarically mentioned here.

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Now, we will be shifting towards another type of body support. There is challenging body ability and support. Now, left hand corner, the crutch is necessary as it is shown here. The aged person etcetera, they require stick to walk. Consider the practical application of effectiveness. Now, here, I will show that see I will tell always over design is not good. Here, one design was developed. Now, we may see that whether it gives a good response or not. That a person, old person or a person with movement disability, he requires stick. Now, the designer has a developed a special thing that instead of a straight stick, he made a bow type of walking stick, where armpit support and hand support is given here.

The idea he developed that while walking, the stick end, it would not come in contact with the front foot. So, there will be always gap. So, he does not need to keep the stick sideways so that it should not touch the foot - number 1. Number 2 is that as it has a bow type of structure, at every step, it would give him a spring type of action feedback so that it will be very pleasing to walk.

Now, the question comes, why we require a walking stick. As we cannot stand properly, we require a structural support. Now, if that structural support itself moves, then this bow type structure is not suitable, if it is not giving that support. So, this structure may not work.

But in an amusement park or somewhere, this type of things may work well. Why? Because the person is not dependent on that walking stick as structural support, but here, when the person needs structural support, it would be better to give a support not that spring.

So, the question comes, with enthusiastically many developments we think, but at the same time we also think whether those development possibilities are really good or it creates some other problems.

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Now, body supportive device accessories: now, the wheelchair bound people or may be some persons who cannot walk properly, stand properly like that type of problems like that, suppose, a temporary problem or suppose, if I have a problem in my leg, I do not like to go to a toilet or a bathroom, where only wheelchair bound people go because mentally, I am not prepared to accept that and my this illness that is a leg problem I break my leg or I developed some sprain with a plaster and etcetera I know that after few days, it will be over.

So, it is very difficult for me to accept that I am disabled. So, what will happen if I will feel to go or to use the same toilet facilities, where I am using when I am able for it? So, in those cases, some special structure support, if we develop here, then it would be easier to assist for that.

So, take the wheelchair for temporary purpose or even the permanent also, then this will be used as accessories. So, this is the exclusive requirement is fitted within or on an inclusive requirement. So, this is the exclusive and inclusive design requirement, we can do it.

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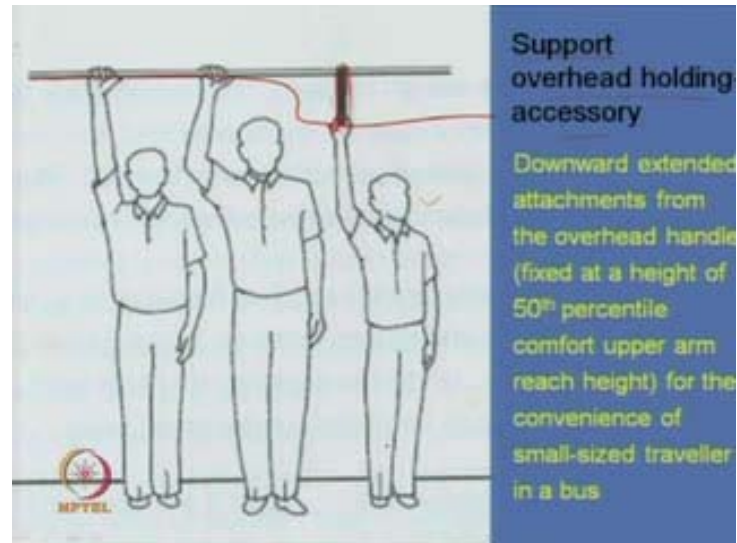


Now, another example of inclusive design: the toilets some people are habituated with this, some people are habituated with WC seats, **matter** but in a certain area, if we do not know, suppose, a guest house or somewhere, we do not know what type of people are going to come there. So, there both the systems, if we keep. Another feeling is that if we use a WC, but with the Indian style. Indian style means what happens, one can squat on it.

So, it acts has Indian style and when it is used as a chair kind of thing, then it can work as a western WC. So, here the things are developed. So, this piece, if it is placed here, then it becomes normal WC and if it opens up, then this becomes Indian style. So, this is the combination of both the requirements; if we use this then it may be inclusive design and this is also a body supportive device. Body supportive device does not confine to

only the chair, seat, bed, that type of things. To maintain a specific posture to do or to meet a specific task, what type of support system one can develop, that is the body supportive device.

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Now, another example, we can give here that accessories development also for body supportive purpose. In this case, it is shown that in this figure that in a bus handle, the bus handle is a tall; so, short height people, how they can use it?

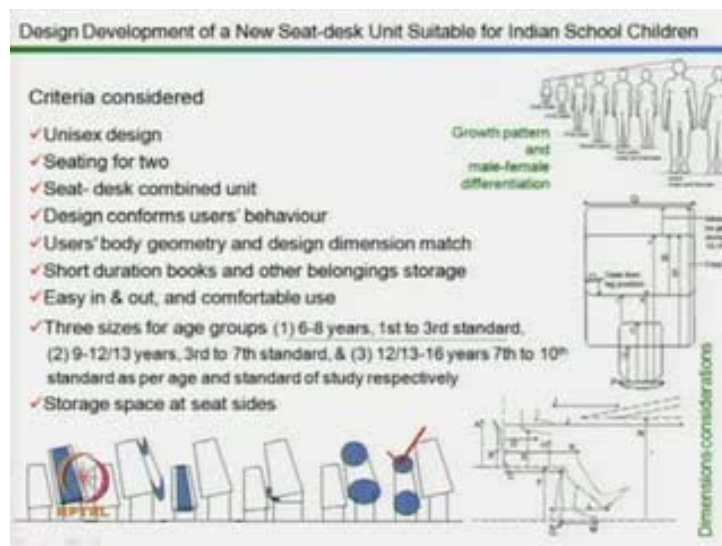
So, what happens is the support overhead holding accessory like downward, extended attachments from the overhead handle, fixed at a height of 50th percentile comfort upper arm reach height, for the convenience of smaller size travellers in a bus or may be a short height person, ladies, children or anybody.

So, without this, somewhere, these rods are also like this, **so that** but here, this is also possible and without that that having a handle down, it is also possible. So, either modify the whole design or use accessories for body support to maintain a specific posture.

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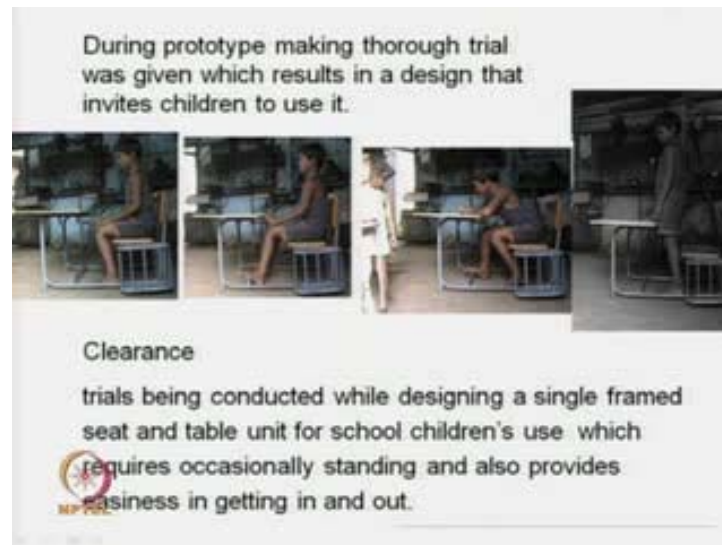
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Now, the case studies: case study number 1: In this case study, it is shown that there are many figures have been shown that school children, how they behave and what are the postural problems are there? After this, a study was done that how to develop a specific school furniture for them.



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Now, specific school furniture for two persons sitting was developed and while developing, each and every step, the real users were taken as subject reference. Now, here during prototype making, through trial was given which results in a design that invites children to use it. Now, here **the what a clearance and etcetera use now** while making this design, dimension etcetera mainly their behaviour was considered with that.

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The final design developed was like this. In this final design, the seat plate, backrest, 5 degree inward inclined tabletop, the gap and this is that fixed books holder and this is a

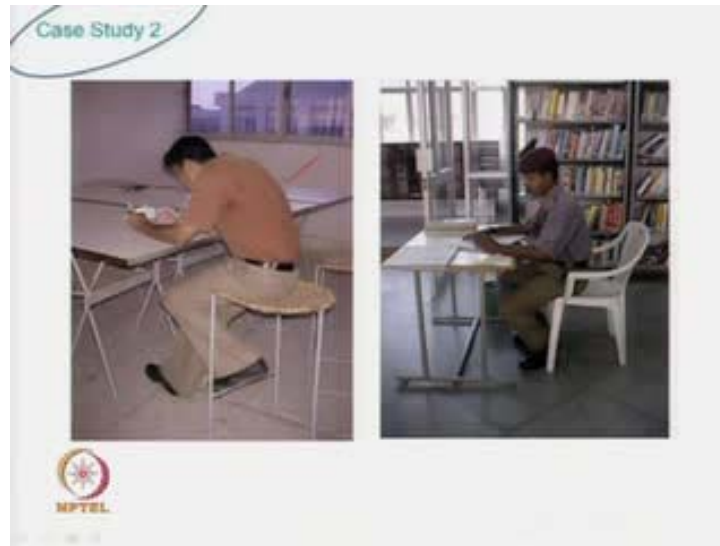
specific thing that two floating additional storage bin in the front may be used. If it is necessary easy to enter, come out etcetera and a special hook is given in the two sides for that hanging of the bottles, like that way, water bottles, etcetera, it is given and this is for 6 to 8 years child - to be used by first to third standard classrooms and also other dimension furniture was developed for other higher group of students.

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Now, the students are using like this. This simple design can be mass produced. This design goes in tune with the playful nature of children and such look good and work good furniture would promote an atmosphere more conducive to the learning process. What specifically we have done here is that children behaviour, their body dimension, how they put pressure on the furniture and what task they do, accordingly, that design was developed.

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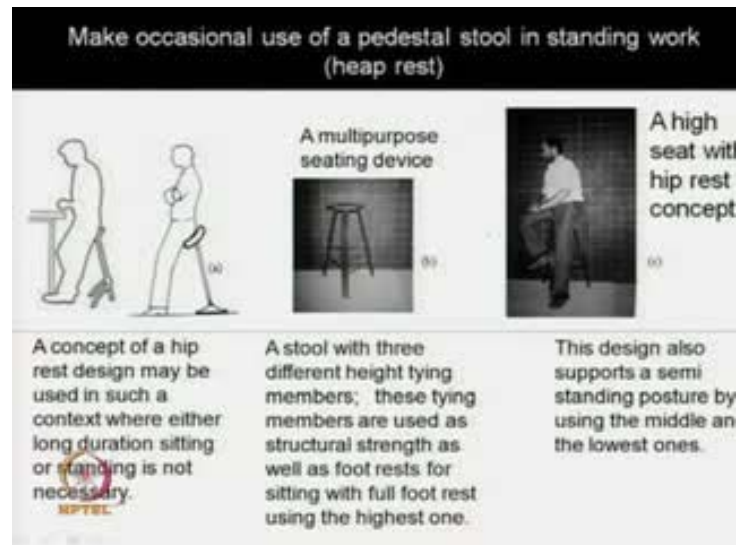


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Now, the second case is that now people work like this way, also like this way. Now, this is a drawing classroom in an engineering institute so where they supposed to work here and also a small stool is provided to sit, but mostly it is seen that the boys and girls, they stand and work.

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So, with that, it was decided whether a hip rest type of seating arrangement can be developed, but hip rest cannot be used for continuously longer time, it may be short period. Now, make occasional use of a pedestal stool in standing work that is a hip rest kind of thing. Like here, a concept of a hip rest design may be used in such a context, where either long duration sitting or standing is not necessary.

A product was developed like this way, where it is 30 centimeter diameter plate and **with this** the rods are like this and this **joinery** rods are in three different heights to accommodate three different body postures. A stool with three different heights tying members; these tying members are used as structural strength as well as footrests for sitting with full footrest using the highest one.

Now, it is shown here, a high seat with hip rest concept. This design also supports a semi standing posture by using the middle and the lowest one, means sitting as well as hip rest, both can be done.

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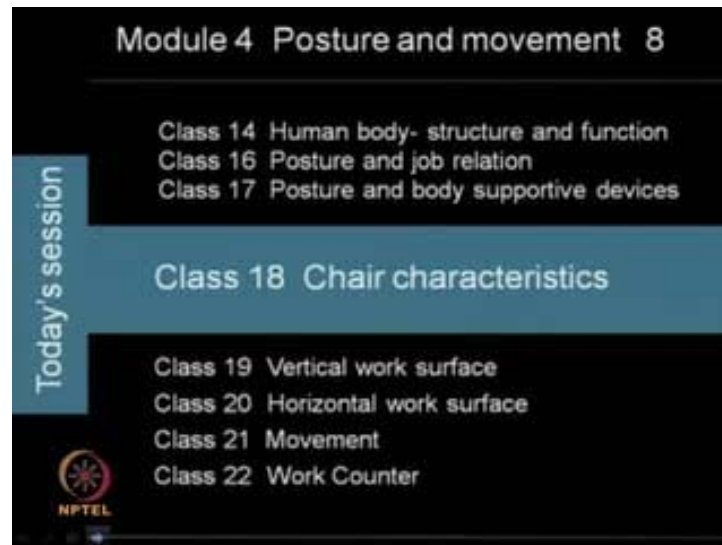


So, a device was developed like this way. So, this is a context specific requirement, a body supportive device. Now, there are varieties of furniture seating arrangements available. This is the natural things, the natural surroundings - people like this type of comfort like this. So, variations and value added seating design a concern nowadays.

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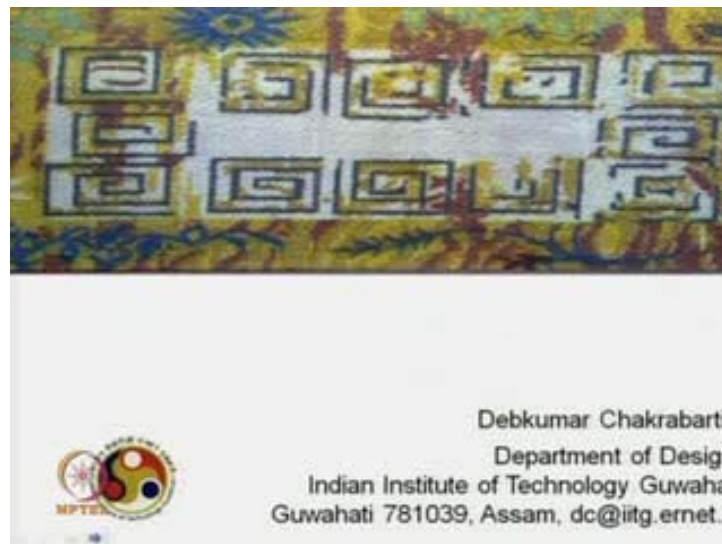


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Now, the next class, we are going to discuss the next session topic is seat - approach to design ergonomics way. So, next class will be class number eighteen, the chair characteristics.

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So, till then, goodbye. We will see you next day with the chair concepts and the concerns. Thank you.