Industrial Engineering
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Module - 03
Lecture - 08
Principle of Motion Economy

Dear students, in this presentation I shall be covering the Principles of Motion Economy and some important principles, which are used in design of the control and display devices.

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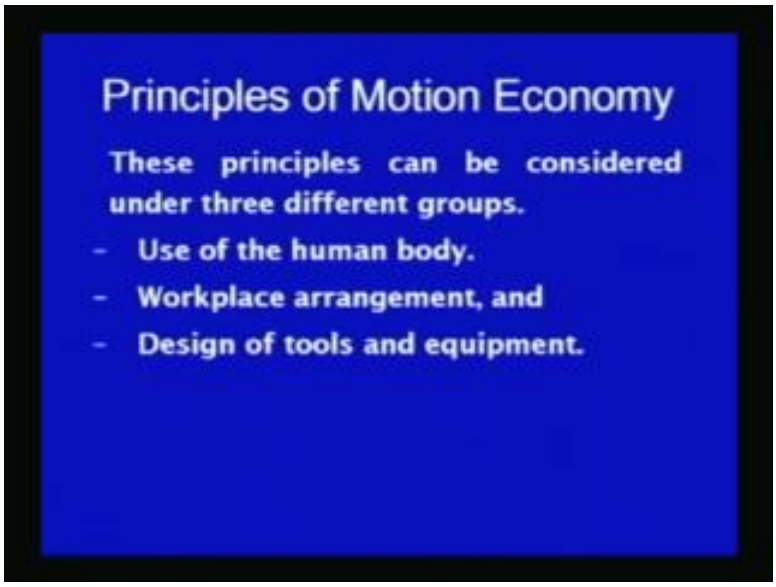

So first of all, I will be taking the principles of motion economy, there are three main principles related to the motion of economy, which have been developed over a long period of time by the persons who have been working in the area of the work system design, work study for improving the method. So as to reduce the operator fatigue, and the time required for carrying out the job.

In industry lot of work is carried out manually by the operators. So, if the method which involves the manual work is developed in such a way that it reduces the extent of movement and the movements are developed in such a way that it takes less time to the operator to complete a given job. Then, the productivity of the system can be improved

at the sametime; the less fatigue will also be experienced by the operator during the operation.

So, these principles related to the motion economy have been developed over a period of time based on the experience these principles fall in three broad categories. These are related with the use of human body the work place arrangement and the design of tools and equipments.

The principles related with the use human body are related with the way by which the human body parts like hands feet are to be used for effectively performing the job with the minimum effort and the minimum time. While the work place arrangement is related to the design of the work place in a such way that the given job can be done with minimum effort by the operator and it takes less time. So, that operator does not require unnecessary rest.

Design of the tool and equipments the principles related to the design of tool and equipments are also related with the designing the control devices. And, the display devices, tools, levers and handles in such a way that operator can operate them easily effectively without much effort and so as to reduce the time related with the operating for carrying out a given job; these principles will be covered one by one in detail.

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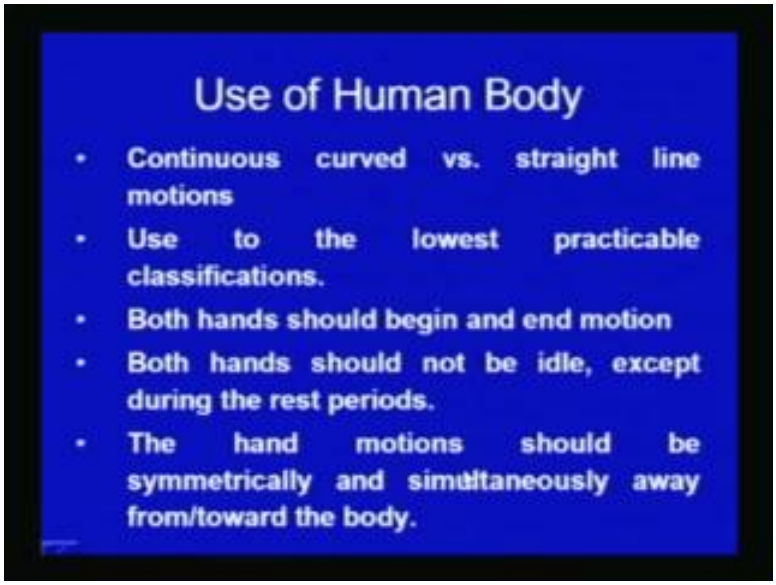

The principles related with the use of human body are say continuous curved motion should be preferred over the straight line motion, because more focused efforts are required for performing the straight line motion as compared to the continuous curved motions. So, as and when it is possible continuous curved motions should be designed in the work method.

And, they should be included suitably use to the lowest practicable classification of the body parts. The body parts like fingers and wrest. the finger, wrest and elbows, these have been classified according to the combination of their use and this classification will be covered in the next slide, but here as for as much as possible the lowest classification of the body parts should be used first. So, that the related fatigue can be reduced the lowest is the classification of the body part minimum will be the fatigue experienced by the worker during the use.

Both the hands should begin and end their motion; simultaneously, the work methodology should be designed in such a way that both the hands remain busy, and they should start and end their motions simultaneously. And both the hands should not be idle except during the rest periods.

The methodology should be such that the hands should remain engaged and the both the hands should not be idle in any case except when the rest is being done by the worker to recover his muscles and overcome the fatigue. The hand motions should be symmetrical and simultaneously away if from or towards the body. The moments of the human body parts should be designed or the hand motion should be design in such a way they are symmetrical and simultaneously carried out either towards or away from the body.

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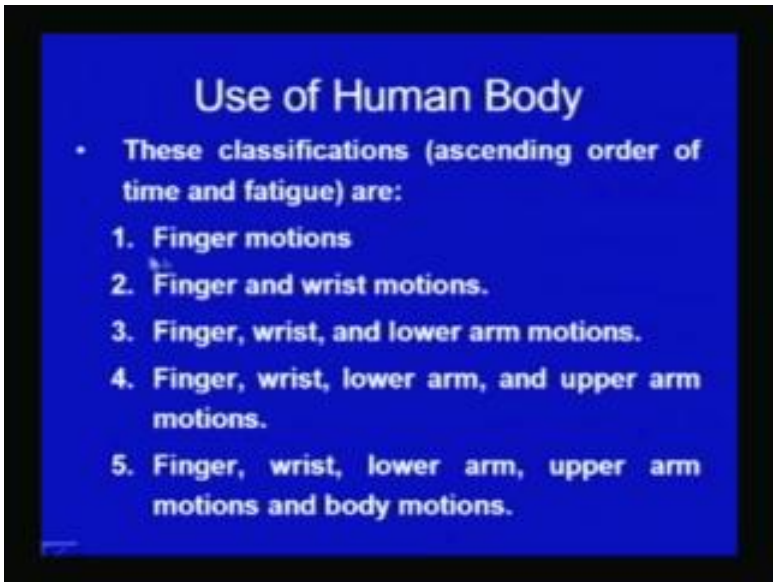

So, these classification as I have said earlier that the classification of the body parts a from one to five includes in is like this were classification one, covers the fingers motion only, the classification two includes the finger and wrest motions, and classification three covers those motions which include finger wrest and arms. All these three body parts are used in carrying out the certain motions. Those motions will be falling in classification three, when the fingers wrest lower arm and upper arm is used for carrying out motion. Then, it falls in classification four and when finger wrest lower arm upper arm and the trunk is also used to carry out the body motions.

Then, it falls in classification five categories, if the motion is carried out using the lowest possible classification that is finger. Then, it will be causing minimum fatigue and the maximum fatigue will be experienced, when the highest classification of the body parts are used for achieving a given motion.

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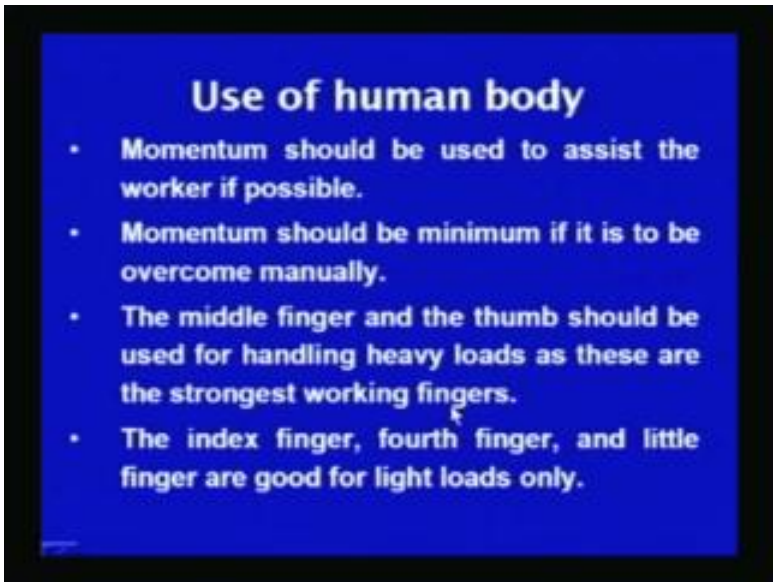

Some other principles related to the use of human body are like momentum should be used to assist the worker in carrying out the given job. If the momentum is used effectively the efforts required by the operator to carry out the same job will be reduced. But, in many cases momentum comes against the job which is being done and in those cases momentum is to be overcome. First manually and under those cases may momentum should be reduced to the minimum level, if it is to be overcome manually by the operator during the job.

And, the middle finger and the thumb should be used for handling the heavy loads as these are the strongest fingers. The work should be designed in such a way that the strongest fingers carry the maximum load, while the light loads for the light loads the index fingers for fourth finger and the little finger should be used. So, according to the capability of the fingers the work should be designed, so that either middle finger or thumb used for the heavy work, while other fingers are use for the light loads only.

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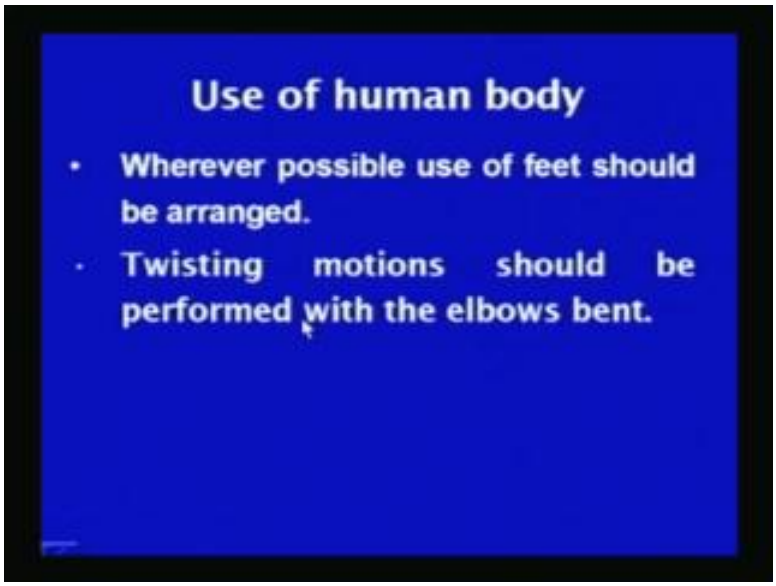

Wherever possible the use of feet should be encouraged, so that work can be carried out either simultaneously by both the hands and legs or alternatively by hands and the feet. So, that operator does not feel fatigue and work is also does not remain monotonous. The twisting motions should be performed with the elbows in bent condition.

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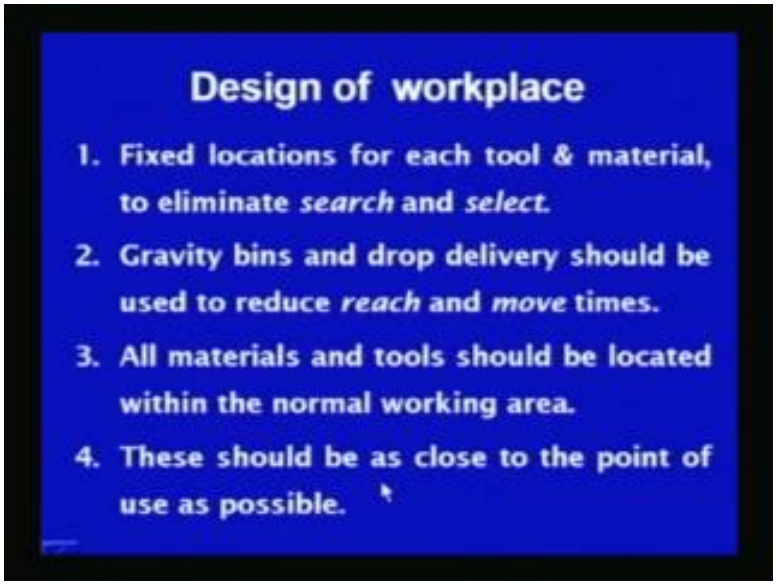

The next principle in the principles of motion economy is related with the design of workplace. The workplace is to be design in such a way that, whatever the tools equipments, raw material is to be used the same can be easily effectively used by the

operator with the minimum effort and the fatigue. And, the workplace should be designed keeping in mind certain aspects like fixed location for each tool and material should be provided, so that it will not require unnecessary searching and the selection related steps.

Because, lot of time is consumed in finding the desired item and then to get it for carrying out the further operation either assembling or further processing of the raw material or using the tools for further processing. So, fixed location should be provided for the each tool and the material, so that the unnecessary search and the select related steps can be eliminated.

And, the gravity bins and drop deliveries should be used to reduce the reach and the move related items. These are other steps, which can be reduced by encouraging the use of gravity bins and the drop deliveries. All materials and tools should be located within the normal working area. If the distance of the tools and the materials to be used from the body is increased, then it wills simply increase the efforts which are to be carried out by the worker that is why, material and the tools are to be located and placed in such way that operator can use them easily with the coverage of the minimum distance and that is why, they should be located within the normal working area. So, that worker will not require will not be required to put unnecessary extra effort for carrying out the job.

These should be as close to the point of use as possible, the places for tool and work material should be as close to the point of use as possible. So, that distances to be covered by the material can be reduced and so that the fatigue of the operator related with the handling of the tools and other raw materials can be reduced and the total time of the operation also can be reduced. So, if these are placed as close to the point of use as possible it will reduce the operators fatigue and the time required for carrying out the job also is reduced.

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Some other points related with the design of workplace like work table height should allow the alternate sitting and standing posture. So, that the fatigue being caused by the work to the operator can be relieved with the alternate sitting and the standing posture during the work, so what table height should be such that, it permits the use of alternate working in a standing and a sitting positions.

The Glare-free adequate illumination, proper ventilation and the proper temperature should be provided. So, that operator can work comfortably without unnecessary feeling anxiety or experiencing and the fatigue and the pressure due to either excessive glare or the poor ventilation or excessive high or low temperature. So, these good working conditions should be provided. So, that operator can deliver his best with the minimum fatigue and can produce the desired goods.

The control and the display devices should be designed in such a way that operator can use them easily and effectively without any error. So, end the principles related with the design of control and display devices will be covered in detail later on, but the these devices should be design in such a way that they can be used easily quickly without any error.

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The third principle related with the use of motion economy is related with the design of tools and equipments. The design tools and equipments should be designed in such a way that they need minimum attention of the worker and they need minimum effort form the operator during the operation. And for this purpose the use of proper coding of the control devices in the tools and equipments should be there, so as to maximize the speed and minimize the minimize the error during the operation.

Inefficient coding, improper coding leads to the accidental wrong use of the control devices which simply leads to the sometimes accidents or poor quality of the jobs, that is why, the proper coding of the control devices is important to maximize the speed of the work and minimize the errors related with their operation.

All levers handles wheels and other control devices should be located in the most preferred places. So, as to use the mechanical in advantage, the devices which are to be operated by the worker should be located in such a way that operator can use them with them at mechanical advantage were less effort, so are required to carry out the same job.

So, the location will decide the extent of the mechanical advantage is being use in their operation. Efforts should be made to locate the devices and levers and handles in such a way that they need less effort and less force to operate them and that is possible by using the mechanical advantage related factor in the proper location.

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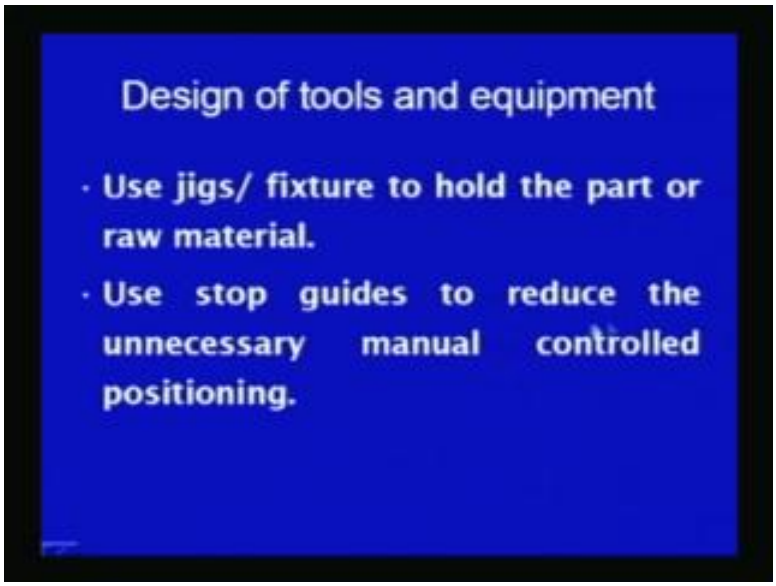

Some other points related with the design of the tools and equipments are like use of jigs and fixtures to hold the tool raw material and for guiding of the tools should be used. Fixtures reduce the time required to hold the work piece in proper position and they also reduce the efforts required for holding of the work piece, while the use of jigs reduces the time and efforts required for holding the work piece and also guiding the tool in proper position where it is required.

The role of fixtures is mainly to hold the work piece while fixtures in addition to holding the work piece also guide the tool in the position where they are required. So, use of jugs and fixtures will not only reduce the efforts of efforts required for carrying out a given job by the operator, but will also save a lot of time.

Use of a stop guides to reduce the unnecessary manual controlled positioning. A stop should be used as and when it is possible, so that manually it will not be required to start or stop or control the motions as per requirement. The systems will automatically respond if the stop guides or stops and guides are used and that will help to avoid the unnecessary manual controlled positioning of the tool or of the work piece during the operation.

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In the some other principles related with the design of tools and equipments are like the design of workplace layout, it should be done keeping in mind some of the following points like height of the workplace should be determine in such a way that it allows the working of the operator in standing and the sitting positions alternatively.

And, the operator is able to sit on the chair comfortably for long time as required. The design of the operator chair, if work is to be done in the sitting posture should be such that it can be used by the operators by of the different height. So, for that purpose it may have the prevision for adjustment of the height of chair, such kinds of chairs are frequently used in the computer centers, where people of the different heights can use those chairs for the operations required. So, the adjustable range design of adjustable range features is a principle is use for designing such kind of chairs.

And, allow the use of anti fatigue mats for standing of the operators. So, that related fatigue can be reduced and the determination of the location of tool materials controlled display devices. In such a way that the operator can use the tools and the materials with the minimum effort and fatigue and at the same time error of and easy control is possible with the proper designing and the location of the control and display devices.

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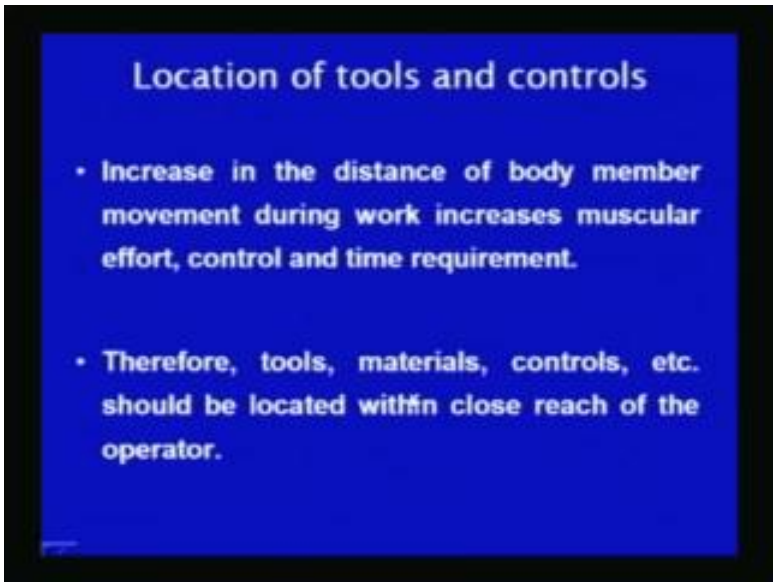

For location of the tools and the controls as we know that with the increase in distance of these tools, materials and the controls from the body, the distance to be moved by the body member increases.

So, increase in distance of the body member movement during the work increases the muscular effort, the control and the time required for carrying out the job and that is why, the tools materials and the controls should be located in such a way that the distance of the body member movement during the work is minimum. So, that the related muscular effort control and the time required can be reduced. And therefore, tools materials and control etcetera should be located within close reach of the operator.

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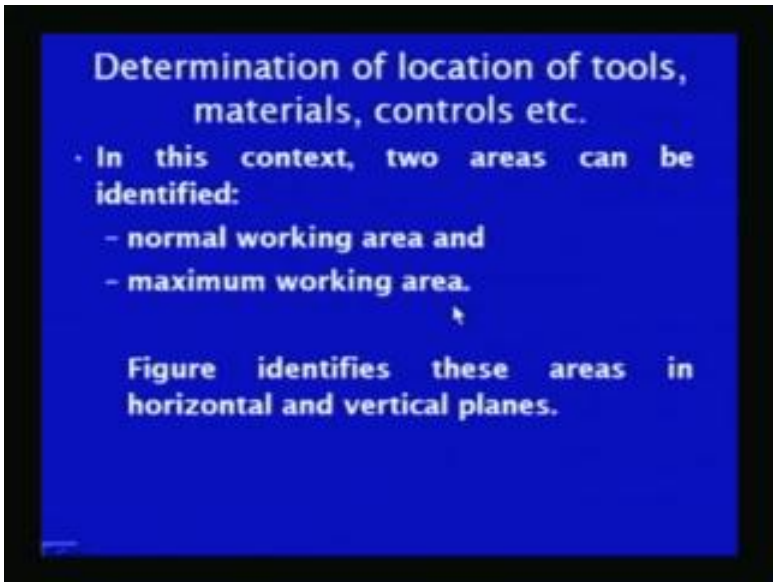

The location of the tools, materials and the controls is decided in light of the anthropometric data of the operator or the group of the operators and that is based on the normal working area concept and the maximum work area concept.

The figure in the next slide will show, what is the normal working area? Normal working area is one where the area which can be covered by the hand without a stretching the whole arm, while the maximum area includes the area which can be covered by stretching the full arm during the work. So, these areas can be seen in the horizontal plane also and the in the vertical planes, so for group of people average normal working area and the maximum working areas have been identified.

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Can you see in this slide, this slide shows the arm when it is in if fully stretched and arm is not stretched upper arm is in the normal condition and the only the lower arm portion is a stretched. So, the area which is covered by stretching of the lower arm only up to the fingers on both the sides it comes under the category of the normal working area.

Here, if you can see here from this elbow to this finger tip this entire area which can be covered by this right hand and the area which can be covered by the left hand indicates the normal working area, while this is the distance of the maximum possible reach of the hand, when arm is fully stretched.

It is of say about 60 centimeters and when it is fully stretched, this entire area this radius indicating the entire area which can be covered when arm is fully stretched. This area is termed as the maximum working area and this area is for the left hand maximum working area for left hand and this indicates the maximum area for right hand. The normal working area is in the radius of the 40 centimeter and the maximum working area in radius of 60 centimeter, 30 centimeter is considered as a average width between the two hands.

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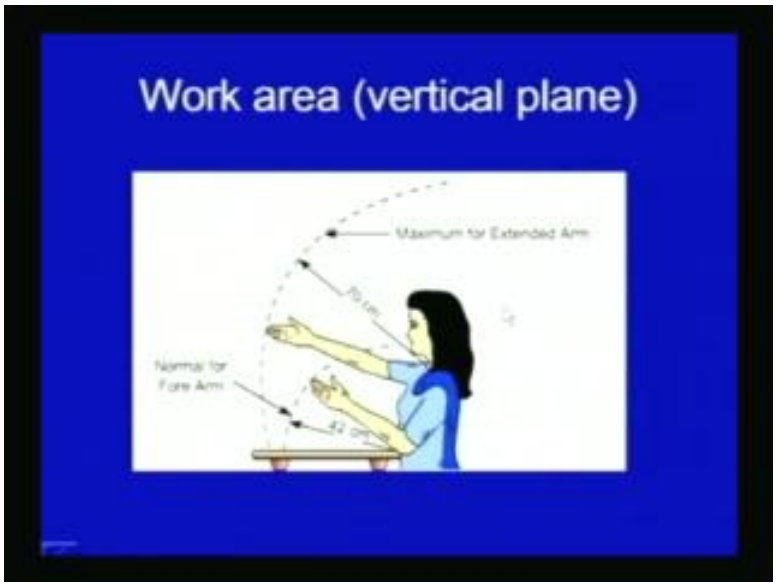

What we have seen, was the horizontal in the in the working areas in the horizontal plane. Now, we can see the working area in vertical plane, here from the shoulder to the maximum stretch of the hand is of 70 centimeter maximum for extended arm indicated by this will be the maximum working area.

And here, it is a 42 centimeter in the vertical plane indicating the normal working area, normal for forearm and the maximum for extended arm is of 70 centimeter. So, effort should be made first to locate the tools and the devices in the normal working area first, so that the tool and the raw materials will be as close to the body as possible. And, there after the things which are less used and needs less effort can be located away from the body and they can be located in the maximum working area region.

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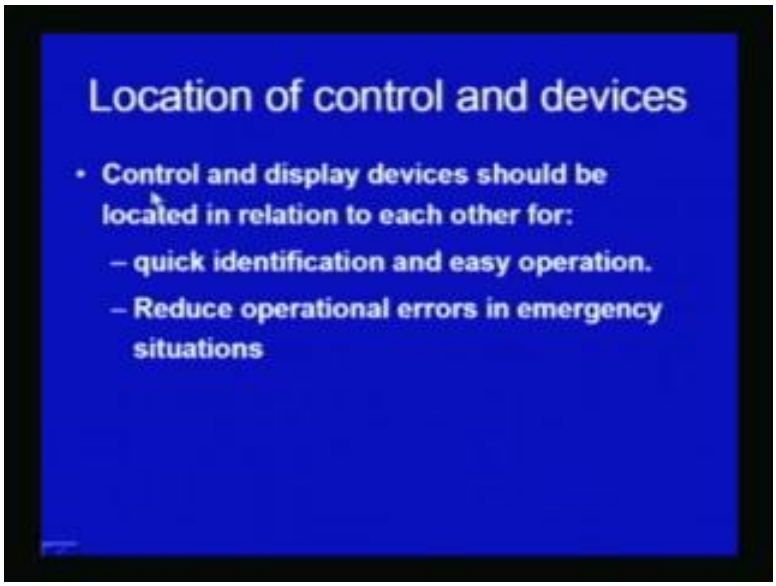

The location of the control and display devices for effective utilization is very important, because if these have been located in such a way that either operator cannot operate them effectively or cannot operate them in such a way that, what result he is going to get or he is not able to see the kind of results which are being achieved through the display devices.

Then, that indicates the control and display devices have been located properly. The control and display devices should be located in relation to each other, so that when control device is operated operator is able to see that what kind of response he is getting by giving the inputs through the control device. And, it is important that control devices and display devices are located in such a way that he can see response. So, that the operation the control devices can be operated easily and the quickly they are identified and they are operated easily.

Easy identification of the control devices is an important for easy operation at the same time to reduce the operational error in emergency situations it is necessary that, what kind of response he is getting by, by when control devices adjusted through the display devices.

Display device is giving the status or the kind of change which is taking place with the change of control through the control devices. So, to locate the control devices the best possible area is selected, the control devices and display devices are located in such a

way that when control device is operated display can be seen in the display device, that is the first thing and when the control devices are to be located some of the points are kept in mind like what kind of performance.

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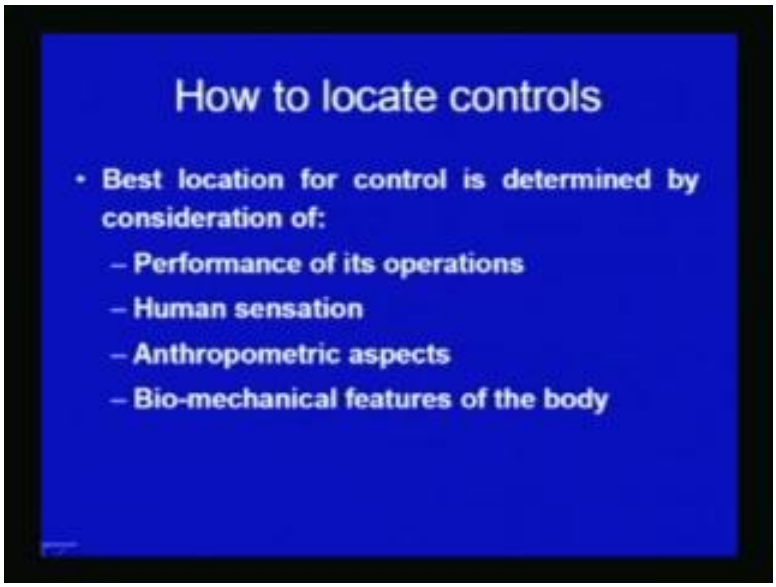

Performance of the operation which is being controlled the kind of human sensation required for controlling the things and the anthropometric aspects required in locating the things properly and the biomechanical features of the body means the kind of movements and the forces required for operating the control devices. So, these considerations of these four factors will help in locating the control devices in optimum manner.

Performance will indicate the criticality of a particular control in success of it is operation. Human sensation will indicate that which kind of how the body will be getting the sense when the device is operated control devices operated like touches to be used or just means by is seeing it will be used or by hearing it will be used. So, anthropometric data indicates that, what is the maximum range or the minimum range which can be covered, if it is located at a particular place and what is the average anthropometric data of the human being, which can use the given controlled set of the devices or the display devices.

Biomechanical feature indicates the kind of force is speed of movement, accuracy of movement which is possible by the body part which is to be expected to perform for controlling the device.

So, these four factors are considered for identifying the optimum area and in that optimum area the control devices will be located. So, based on the consideration of above four factors a best possible area is identified for a group of persons or for group of the tools.

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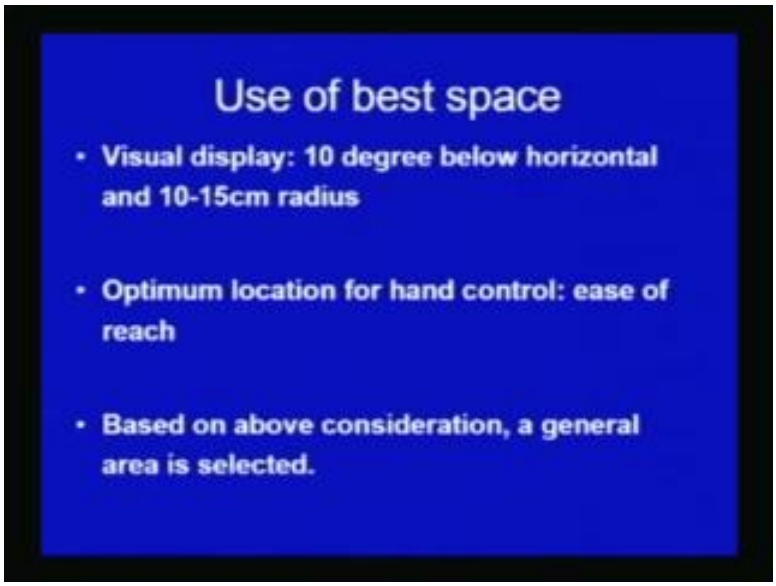

In general these are the general points which help to find out the best possible space for locating the control devices. Like visual display should be located at 10 degree below the horizontal of the human being site level and it should be at 10 to 15 centimeter radius. The optimum location for hand control should be within easy reach of the hand and based on the above consideration a general area is selected. So, how to use the best possible area, which has been selected for locating the different control devices which are available different devices, which are available for locating in optimum manner. Certain principles are used based on which the control devices are located in the best possible area.

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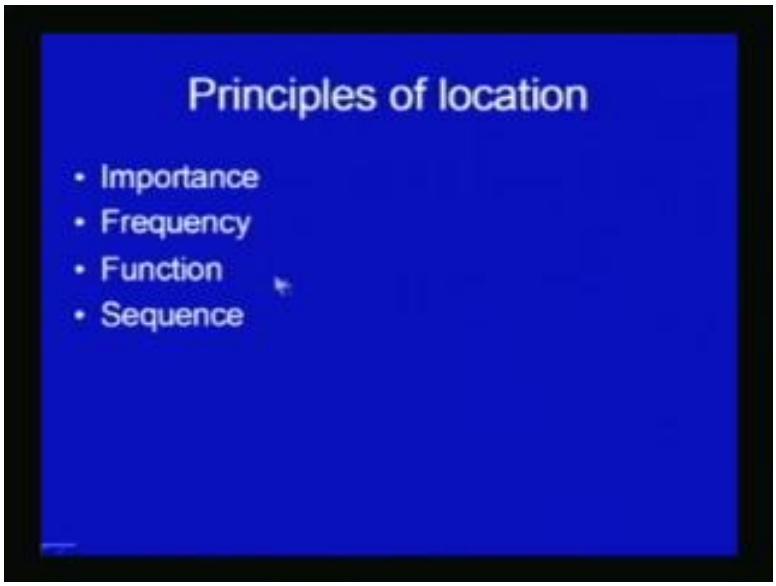

And, these principles for related with the location of the control devices are importance are based on importance, the frequency of use, the sequence their functions and the sequence of operation. So, the control devices should be located in light of these four principles, these are the importance frequency of use functions which are performed by the different controls and the sequence of their use.

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So, based on the importance the control devices may be in use of the different types. Some of the control devices may be use just to switch on and switch off the things and

some of the control devices may be there to regulate the speed feed depth of cut or to achieve any specific function. So, the functions depending upon the criticality of the functions control devices are located as per needs.

So, the most based on this principle of importance to locate the control devices, the most important items or group of items is located first within the normal working area in the best possible position. The most importance is given to those which are very important for the smooth functioning of the process.

So, the most important controls will be placed in the normal working area in the best possible positions first and there after other items or group of items is selected and located within the other areas which are left. So, the next important component and item or group of items is then selected and located in the best location within the remaining area.

So according to this principle, the optimum use of the best possible space is decided on the basis of importance of the particular control device. The second factor which is also used for deciding, where the controls are to be located in the best possible area that is the frequency of use. According to this principle, the controls which will be used to the maximum level and the max with the maximum frequency they are located first in the possible area.

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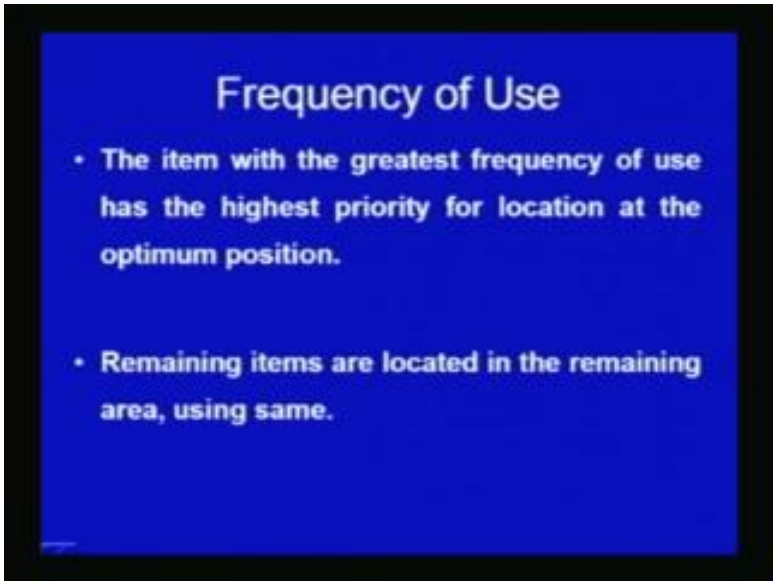

So, the items with the greatest frequency of use, has the highest priority for location at the optimum position, while the remaining items are located in the remaining area using the same principle. So according to this principle, control devices are located on the basis of the frequency of their use. The another principle which is used for locating the control devices is that function, the control devices which are used for performing the similar type of the functions are grouped at one place.

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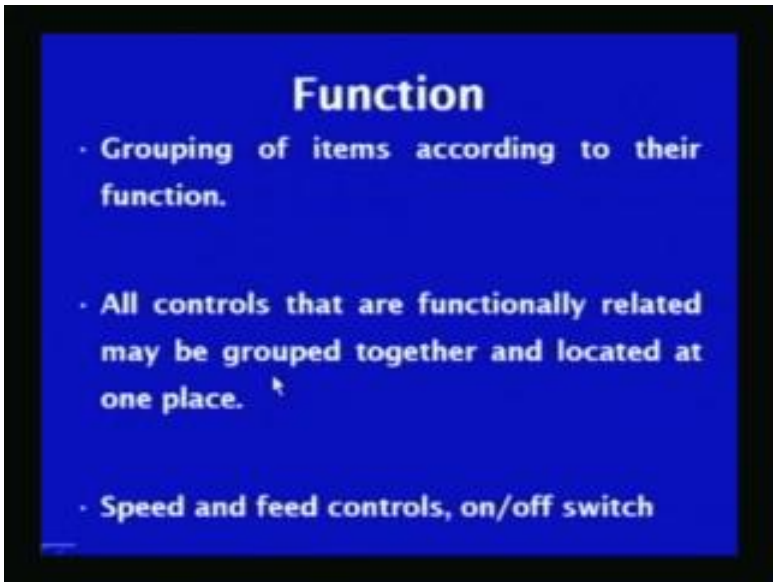

So, grouping of the items according to their functions easy is done according to this principle like all control devices functionally related may be grouped together and located at one place. For example if some of the control devices are used for increasing or decreasing the speed or feed, then they will be grouped at one place like on off controls are grouped at one place.

So, the devices which are of similar type in nature of their are function they are grouped at one place. So, that operator can use them effectively without making extra efforts to identify and locate them where they are so as to use them. Some of the examples are like feed and speed controls are located at one place or grouped in one category switching on and switching off the systems also placed at one place.

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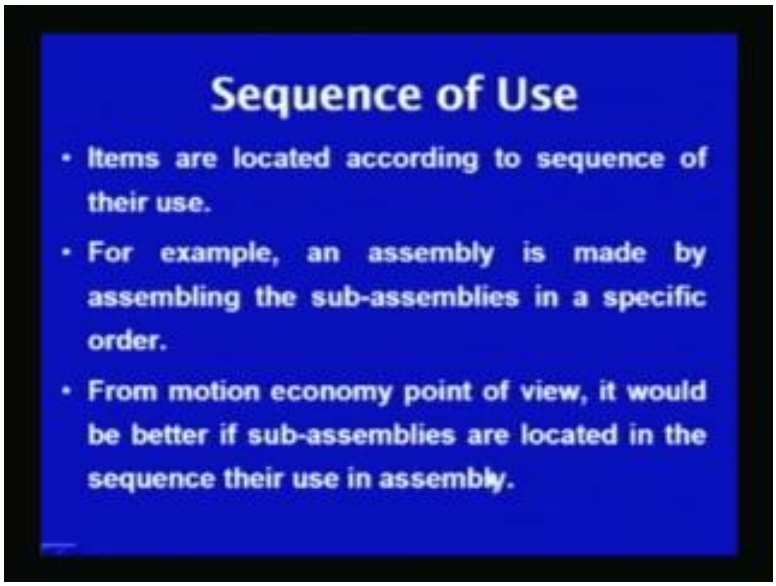

The another principle which is used for locating the control devices is the sequence of use some of the control devices are used in one particular order of the items that are located. Items, according to this principle are located, according to use their sequence.

For example, an assembly is made by assembling the sub assemblies in a specific order in the same way if the control devices are to be used in sequence, then accordingly they will be located either from the top to bottom or bottom to the to the top or left to right or right to left. So, based on the sequence of use the control devices can be located.

From the motion economy, it is important that the sub assemblies are located in the sequence of their use. But, sometimes it is not found very effective because sequence of use may not lead to the most effective motion or it may lead to the excessive time required for search, and select the items which are to be used during the operations. However from the principles of economy point of view it would be better if the controls and sub assemblies are located in the sequence of their use.

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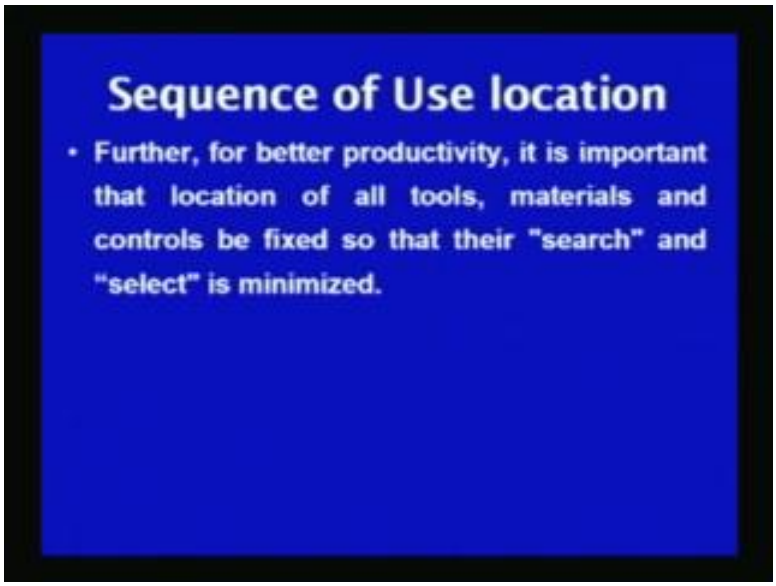

So, this is the point that for better economy and better productive better economy of the work and for increased the productivity. It is important that all locations of all tools materials and the controls be fixed in such a way that the search and select is minimized. It is not necessary that the control devices should be located only in light of the principles of motion economy should also be seen that the control devices tools and materials are located in such a way that the search and the select related activities can be minimized. So, that the time required for carrying out the job can be reduced and the operator efforts also can be reduced. And therefore, the engineering system which will be used by the worker while carrying out the job should be designed in such a way that it needs the less effort from the operator for performing the desired job.

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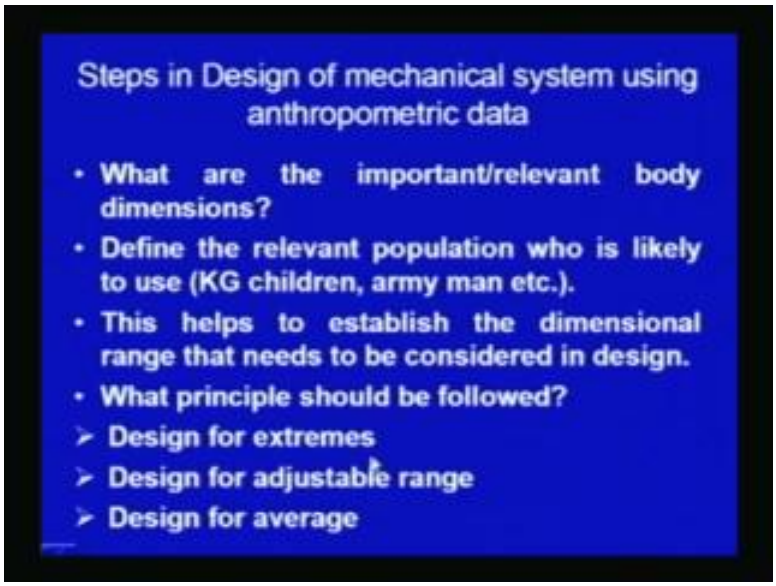

For designing the mechanical systems which will be used by the worker during the operation should be for designing the systems which will be used by worker during the operation should be based on the anthropometric aspect of the worker which who will be operating mechanical systems.

For designing the mechanical systems some of the points are kept in mind like what are the important and the relevant body dimensions? Like the mechanical system will be operated by which part of the body, whether feet will be used or hands will be used knee or toe will be used. So, according to the type of the body part which is required to operate the mechanical system the dimensions of the body parts are kept in mind, while designing a mechanical system.

And, defining the relevant population who will be using a given mechanical system like mechanical systems can be used by the variety of the people like a chair we can be used by the adult by the army man by woman or by the kg children, so for the different group of the people since the anthropometric data is different.

So, if the population targeted population for a given mechanical system is defined properly, then it will help to get the idea about the range of the dimensions which can be there as far as height length or the weight is concerned. So after, defining the group of population and the important body dimensions which are required to be used in operation of the mechanical system, these are used in designing of the mechanical system. Like

defining the population helps to establish the dimensional range that can be considered in design of the mechanical system.

And, once the data about anthropometric data about the targeted population has been received and the average and the dispersion of the data has been obtained, what principle is to be used is decided, the mechanical systems which can be used by the general public should be designed using the three can be designed using three different types of the principles. These principles are designed for extremes where it is kept in mind that, what is the maximum or the minimum dimensions of the individuals, who can use a given mechanical system.

So, design for extreme is based on that, what is the maximum possible dimension of the human body part, who can use the given system. On the other hand the design for adjustable range is if the design for the adjustable range principle is used for designing the mechanical systems.

Then, it allows the use of the mechanical system by the population having wide range of the anthropometric data like if the people of the smaller height can use the one chair, then the people higher height can also be used the same chair by adjusting its position. So, the adjustable range feature is included in the systems mechanical systems like the computer chairs and the by skills, where the people of the different heights can use the chairs in the mechanical systems which are being designed by the organization.

The design for average this principle of the design for mechanical systems is used, when there is no specific group of the population who can use a mechanical system like a tap or the location of the switch board in public place. The switch board or tap in public place can be used by a small kid also by children, by adult person or means the variety of the people can use a given device under those conditions.

The design for average is used which indicates that that this design will not be optimum for anybody, but it will cause the less inconvenience to all those who will be using the given mechanical system. So, in designing of the mechanical systems the three principles are basically used, so which of these three principles is to be used for designing a given mechanical system.

Decision on that is taken where the whether the component or the mechanical system is to be designed for the extreme people. People with the extreme anthropometric features or for people with the variety of the anthropometric data or people where entire range of the people who can use a given mechanical system.

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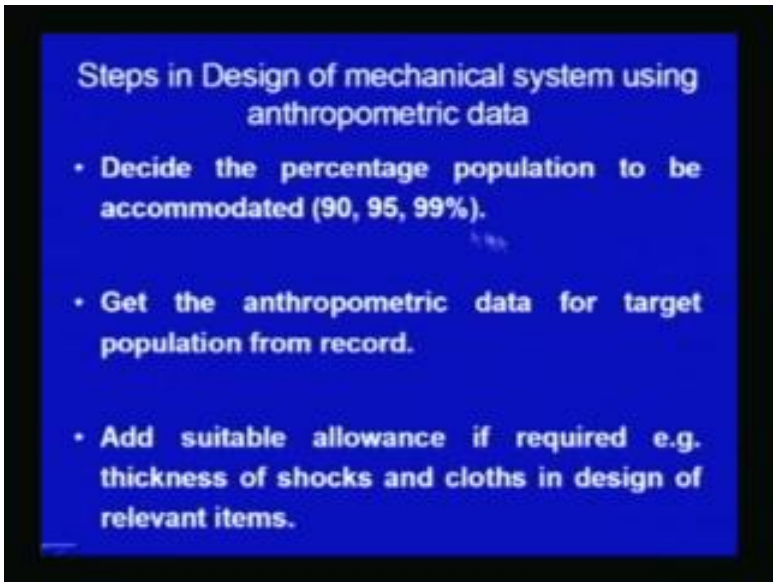

So, other steps which are there in design of the mechanical system using anthropometric data are like deciding the percentage of population which is to be accommodated. Like this principle is considered means this percentage of the population is decided in case of principle for extremes and the principle for the adjustable range.

The adjustable range is decided in such a way whether 95 percentile of the people will be covered or 90 percentile of the people will be covered or 99 percentile of the people will be covered by a given the adjustable range. It becomes uneconomical to design a mechanical system covering the 100 percent range of the people with wide variety of the anthropometric data.

It becomes uneconomical because the narrow range with the variety narrow adjustable range of the features the most of the people are covered. For example, like 10 percent adjustable range or 10 centimeter adjustable range can accommodate the 95 percentile people, while 15 centimeter adjustable range may be required, in bicycle for 99 percentile of the people, while 100 percent of the people coverage needs adjustable range 26 centimeter.

So, unnecessary increasing the adjustable range will increase the cost also, but which may not increase the significant percentage percentile of the people who can be accommodated using the adjustable range. So, what is the percentage of the people population to be accommodated by the given design regarding that decision is taken.

First and then anthropometric data is obtained from the record and the central tendency of the anthropometric data which is of use for a given design and the its spread in form of a range or standard deviation are calculated. And, if required suitable allowances are also considered in designing of the mechanical systems say like thickness of the shocks in design of the shoes is considered or cloths thickness is considered in design of the relevant items.

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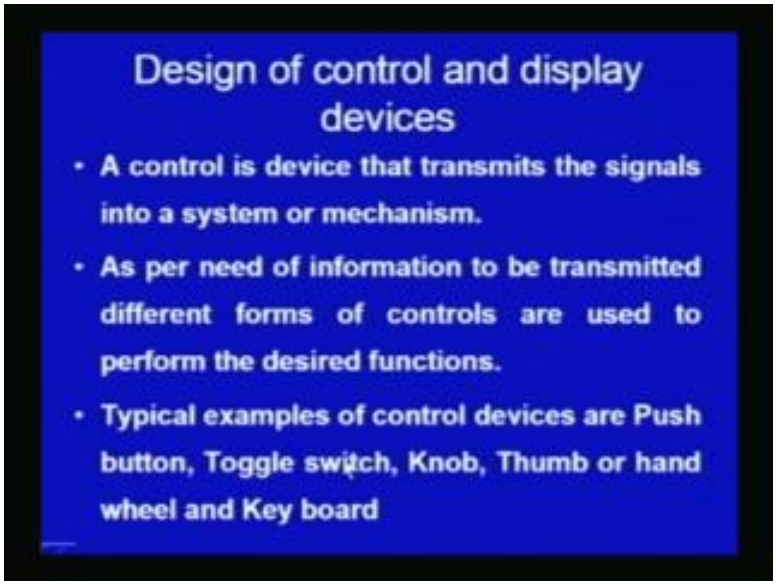

So here, designing for control and display devices the many important things which are kept in mind for, so that operate can use them effectively without much error a control device is control is a device that transmits the signal in to a system or the mechanism. For controlling given mechanical system the devices are used and which transmits the signals to the system or mechanism.

So, that the systems respond in different way, so control device is basically a control is a device transmits the signal in to the system or the mechanism. So, that it changes its response as per needs need of the information to be transmitted different forms of the control devices are used to perform the desired functions.

For example, like the push buttons toggle switch knob thumb and hand wheels and the key boards are typical control devices, when these are operated system responds to when these devices are operated. Most of these are these this control devices are activating the system while the key board is mainly used for entering the data in the system. For efficient use of the control devices, it is necessary that these are identified by the worker easily and so that the required function can be performed.

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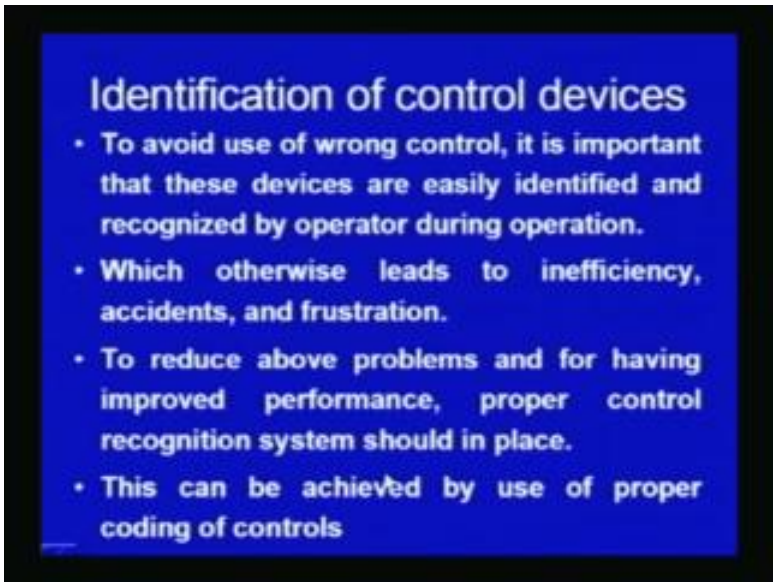

To avoid the use of wrong controls it is necessary that these devices are easily identified and recognized by the operator during the operation, while otherwise if the operator is not able to recognize these control devices easily. Then, it can lead to the inefficiency accidents and continued wrong use mainly to the frustration in use of the control devices that is why, the control devices should be design in such a way that they can be recognized easily. To reduce the said problems and for having the improved performance proper control recognition system should be should be used in design of the control devices. This can be achieved by use of the proper coding of the controls.

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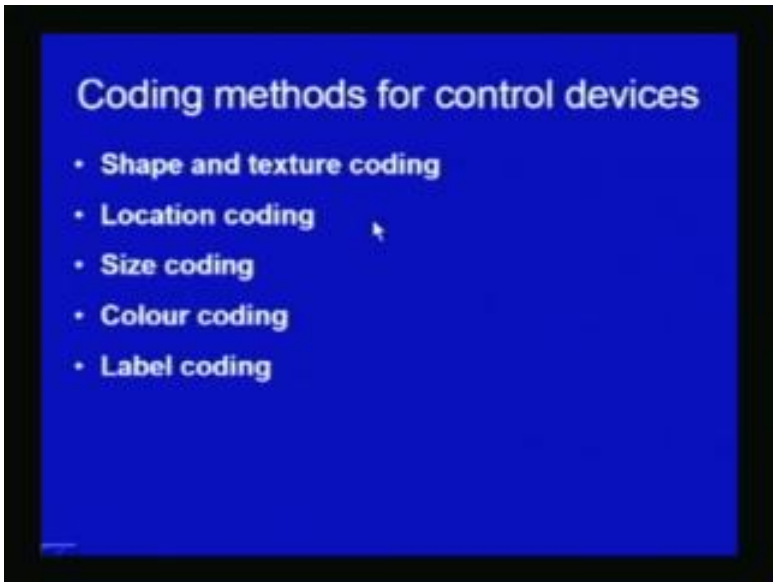

Various methods have been developed over period of time for coding the control devices. These methods are based on like shape and texture coding is different types of the coding methods are there for control devices, one is shape and texture coding, location coding, size coding color coding and label coding of each coding method has got its own advantages and the limitation. So, depending upon the anthropometric data and the working conditions strain conditions or the working conditions in which a worker is working in during the operation all those are kept in mind, while selecting any of these coding method for controlled devices.

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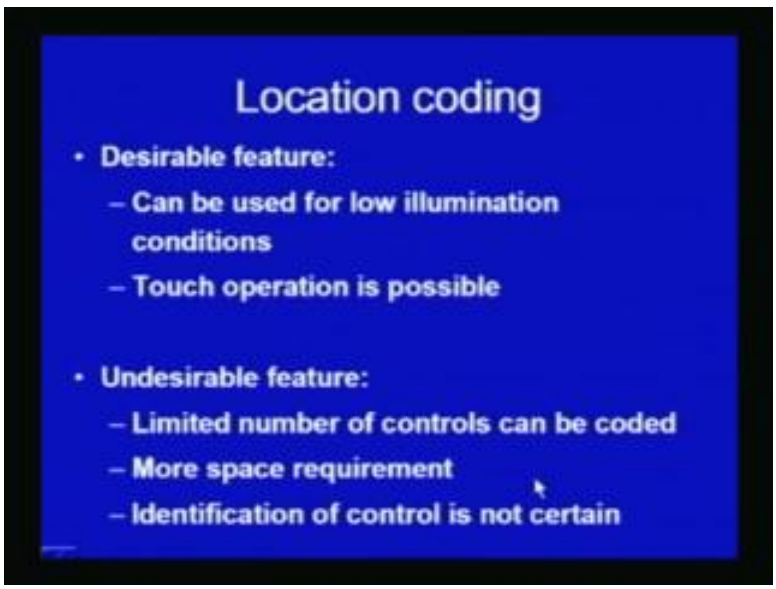

So, we will cover first the shape and texture coding method, the desirable feature of this coding method for control device is that it can be used for row low illumination conditions and the touch operation is possible. Undesirable features of location coding methods are limited number controls can be coded more space requirements and identification of the control is not certain by this method. So, this unlimited feature these are the undesirable features relate to the location coding method.

The size coding also has the desirable features like the low illumination conditions under conditions, this method can be used and touch operation is possible. And, the limited number controls can be done can be coded by this method, more space is required in size coding for coding the number of for coding the controls and identification of the control is also not certain in size coding especially when gloves are used.

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Color coding is useful for visual identification and the moderate number of controls can be coded by this method. But, it is necessary that codes are view directly and the illumination conditions are there and adequate color vision of the operator is also needed for successful use of the color coding.

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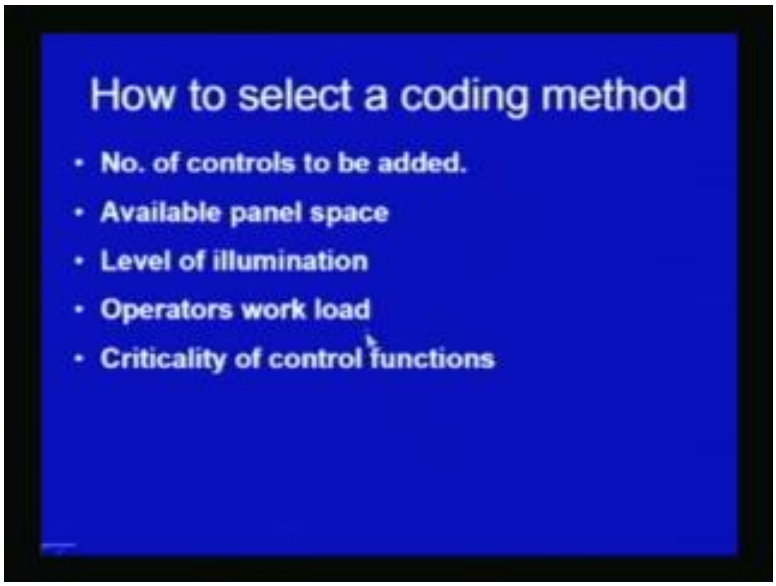

For selection of the optimum, color code optimum coding method for controls depends upon the number of controls which are to be covered and included in the given area. And, the available panel space is to be seen, the level of illumination available in the working conditions and the operators work load this indicates the mental and the strain conditions of the worker. So, these points are kept in mind while selecting the coding method. The criticality of the control function is also kept in mind like any error in the operation of the control function can lead to the accidents or severe economical losses also. So, these points are kept in mind while selecting the proper coding method.

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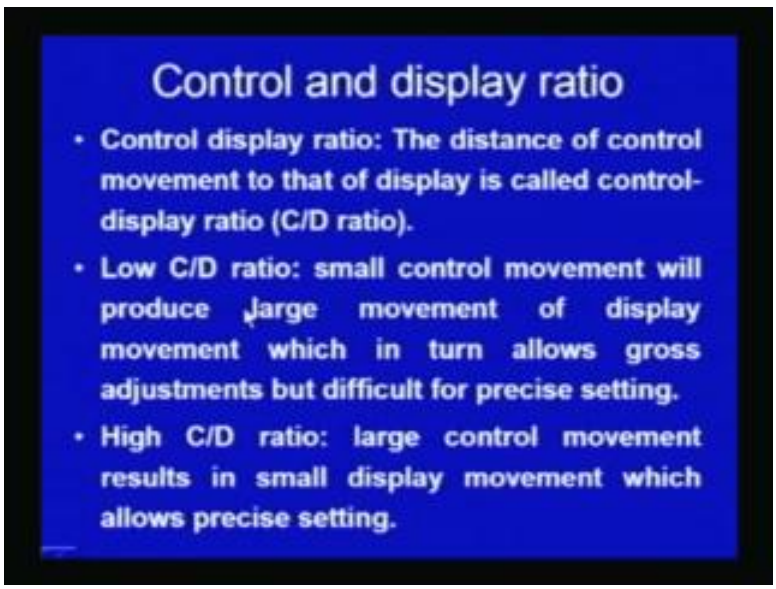

The control and the display ratio is the one important parameter which is used in design of the control and display devices. The control and display ratio indicates the sensitivity of the control device. When a small movement of the control is required to give the large movement of the display, then we have the then we have the low control to the display ratio. The control to the display ration indicates the distance of the control movement to that of the display movement is called control display ratio or C by D ratio.

The low control and display ratio results in a small control movement will produce the large movement of the display movement and which in turn allows the gross adjustment. But, it becomes difficult to achieve the precise setting using the control device control and display device which offers the low C by D ratio.

On the other hand high C by D ratio permits the means results in the large control movement for a small display movement which allows the precise setting for achieving the desired function. So, the C by D ratio is very important in designing the control and display devices low C by D ratio is used when grass adjustments in the readings or the control settings are required, while the high C by D ratio is used when the precise settings are to be used or very accurate setting is required.

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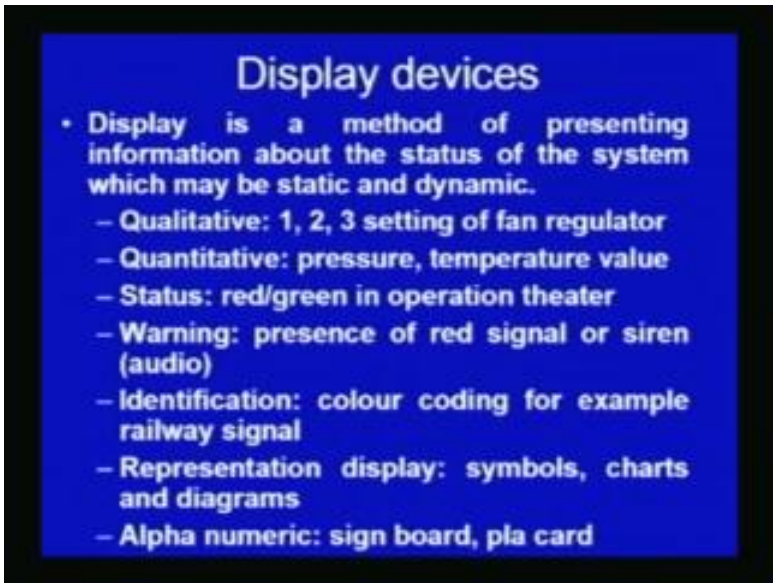

The display devices are those devices which are used to show the information about the status of the system. The system may be in static or the dynamic condition.

The different types of the display devices are used which may give the data inform of quality or the qualitative data like the display devices which are used typically in the fan regulators that in where we find either 1, 2, 3, 4, 5 in the fan regulators. Actually does not indicate the speed of rotation of the fan it is just a symbolic that has been the control position is changed it affects the speed of the fan. One is for minimum two is for somewhat higher three is for further higher.

So, the qualitative the display devices where the numbers or the alphabets are being used does not represent the actual value of anything. The quantitative data will be showing the numerical value of the different characteristics like pressure wing in pressure is indicated in terms of the kg per centimeter square or the temperature is shown in degree centigrade or degree Fahrenheit.

The status of the system means the status of the system can be shown by the display devices in form of the red or green signals in the operation theater, where red indicates that the operation is going on. And the warning is indicated by the presence of the red signal or some sort of the siren.

Identification is shown by the color coding, for example railway signals in the railways. The representation display where symbols charts and the diagrams are used to show the things desired. Alpha numeric all also used to display the things in form of the sign boards and the pla cards.

Now, I would like to summarize this presentation, in this presentation we have seen that the three principles which are commonly used for designing the work place for use of the human body and for designing the tools and equipment which are to be used by the operator during the work. And, at the same time we have also seen that the different principles which are used for designing the control and the display devices.

Thank you for your kind attention.