Work System Design
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Lecture - 29
Therbligs

Namaskar friends. Welcome to session 29 in the course on work system design and currently we are in the sixth week of our discussion. In sixth week, today is the 4th session, which will be of half an hour and if you remember in the previous 3 sessions, we have covered the string diagrams. Then we have covered the principles of motion economy and then we have covered micromotion study.

Today the target is therbligs and if you remember in the last session when we have studied micromotions, we have seen that if you are able to analyse the work being carried out at the very basic or fundamental level and at the most elemental level, we can find out the sequence or pattern of this micromotions, which can help us to reduce the fatigue of the worker, can reduce the cycle time as well as improve the productivity of the labor.

So in order to do that, we require 2 things, first thing is how to break down the work into the most elemental level or at the micromotion level. So that can be achieved with the help of therbligs and other thing is that we need to do it in respect of time. So what can be the units of time and units of time if you remember we have seen that in winks, we use the time unit that is 1 wink=1/2000 minute, so that is basically the 2 things.

That is the time scale and the division or the breakdown of the work into the most elemental form that is the micromotion form. So we have seen that how we can do that and how we can do that, we have seen that we have first film the operation being conducted or performed by the worker. So for that we can use the most sophisticated video cameras that are available these days, then we have analyse, select the cycles that we want to investigate or a number of cycles that we want to examine.

Thereafter, frame by frame by moving the film at a very slow frame speed, we can try to analyse, we can try to note down that what are the basic elemental movements or motions of the limbs, maybe the work is being done by the hands. We have seen an example of assembly of nut, bolt and a washer. So there we can try to analyse the basic motions of the hands and try to jolt them down along with the time scale.

So we have this time scale and we have this micromotion and when we combine them together, we are able to draw a SIMO chart. Now what is a SIMO chart that we will be covering in the subsequent session, but today our target is, for the next maybe 25 minutes or so, we will be trying to understand that what are the various micromotions, but prior to going to that, we need to understand that what are the application areas of the micromotion study.

If you remember in the previous session, we have understood the basic concept of the micromotion study. Today, our target is to understand the technique of therbligs, which will help us to analyse the work at the basic or the elemental level. Now micromotion will help us as an aide in studying the activities of 2 or more persons or a group work.

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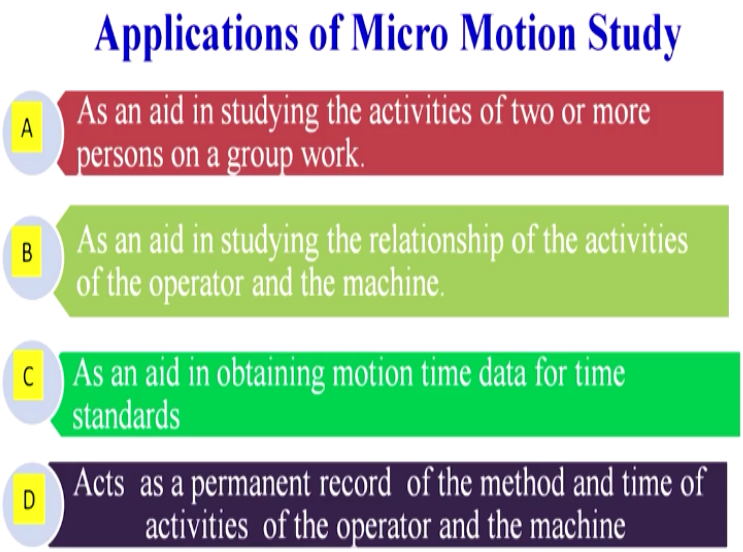

So we will be able to analyse the work being done by the worker at the most elemental or basic micromotion level. It can help us as an aide in studying the relationship of the activities of the operator and the machine. How the operator is operating the machine with the help of basic

movements of the hands and the feet, that level of analysis can be done using the micromotion study. It can help us as an aide in obtaining the motion time data for time standards.

So we can try to understand motion time data for time standard. This we can understand when we will study the concept of work measurement or time study. So there we will be using this in formation, which is generated by the micromotion study for setting the standard time for performing the various task. Micromotion study can also act as a permanent record of the method and time of activities of the operator and of the machine.

So basically, micromotion study is helping us in both our objectives, 1 objective is to develop, design a better, a best method of doing the work, second objective is to find out that standard time required for performing the work using the standard method that we have followed using method study. So micromotion study is helpful in both accounts. It will help us to find out the proper or optimal sequence of motions, which can economize the effort of the worker on one hand.

Also with time scale, it will help us to find out the elemental time for each micromotion, which can be added up to find out the standard time for doing the operation or the task at hand. So it is an important point, or it is an important ingredient or it is an important portion of the work study or we can say the topic, the work system design. So we can see that micromotion study is very, very important and then it can help us both in finding out a best method as well as the standard time for performing the task.

So today, our focus area is therbligs which is an important element of micromotion study. Now what are therbligs?

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Evolution of Therbligs

- The word therblig was the **creation** of Frank Bunker Gilbreth and Lillian Moller Gilbreth, American industrial psychologists who invented **the field of time and motion study.**
- It is a **reversal** of the name **Gilbreth**, with 'th' transposed.

These are some historical perspective of therbligs. So we have Frank and Lillian Gilbreth and if you write Gilbreth in the opposite form, for example g, i, l, b, r, e, t, h, so if you write it in the reverse order, it will be Gilbreth, so this therbligs are from these 2 scientists, Frank Gilbreth and Lillian Gilbreth. The word therblig was the creation of Frank Bunker Gilbreth and Lillian Moller Gilbreth. These are American industrial psychologists, who invented the field of time and motion study.

It is a reversal of the name Gilbreth with th transposed, you can see here. So this is maybe the basic essence of the word Gilbreth, maybe in some of the interviews, somewhere you may be asked that what are therbligs and why they are called therbligs only. So you can very easily answer the question with the help of the last sentence that it is the reversal of their name Gilbreth with th transposed.

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Therbligs: Introduction

- Therbligs are **18 kinds of elemental motions** used in the study of motion economy in the workplace.
- A workplace task is analyzed by **recording each of the therblig units** for a process, with the results used for optimization of manual labour by **eliminating unnecessary movements**.

Now these are the therbligs. You can see box here. There are 2 things. There are micromotions, #1, their names are given. #2 the symbols are given. These are the symbols and here we have the symbols here. What is the third thing, maybe a very common sense based question. The third thing is the colors of the therbligs. So 3 things are there, the description of the therblig, which is for example I read for you, search, find, select, grasp, hold, transport loaded, transport empty.

So the description for each micromotion, second is the symbol of each micromotion, third is the color of each micromotion or the color of the symbol for each micromotion. So this is a summary of the micromotions and then when we analyse a particular work, we divide it into the basic micromotions and then for each micromotion, we can use a symbol and the color for that symbol will be different.

Now the description you can see, therbligs are 18 kinds of elemental motions used in the study of motion economy in the work place. So if you remember we have already, in this particular week, that week #6 already we had a session on string diagram and principles of motion economy and then we had a discussion on micromotion study today we are discussing therbligs, so we already are focusing on economizing the motions.

In principles of motion economy, we have seen that how we can try to make our task easier, make our task efficient, make our task effective, then we have seen that we need to focus on the

micromotion level also. In the previous session, we have focused on micromotion study and today we are trying to understand that how we can implement the method study at the micro level and at micro level, we will make use of these therbligs, which are represented with the help of different colored symbols.

So a workplace task is analyzed by recording each of the therblig units for a process with the results used for optimizing of the manual labour. So optimization of the manual labour is the important objective of conducting the micromotion study and this is achieved by eliminating the unnecessary movements. So when we need to eliminate the unnecessary movements, first and foremost is we must be able to identify the unnecessary movement.

For identification of unnecessary movement, we first need to record the movements that are being done and for recording the basic movement, we make use of the therbligs. So if you remember in the previous session, we have seen that how to conduct a micromotion study. We have seen that first we need to film the worker who is performing the task at the micromotion level. So after filming, we will analyze the film frame by frame.

Then, at different slow motion pictures, at different speeds we will try to analyze identify that what are the various basic motions being done by the worker. Once we are able to identify those basic motion, we will prepare a SIMO chart, in which we will have a time scale also and where we will use this symbols to depict or describe the work being done by the worker at the micromotion level.

So first we need to make a film, then we need to analyze a film, then we need to break down the work into the micromotion, then we need to make a SIMO chart, in which we will use this micromotion symbols and then analyze that what are unnecessary movements, what are the unnecessary motions of the human limbs, which can be avoided, are there some motions which can be economized, are there few motions, which can be combined, are there few motions, which can be totally eliminated.

So when we are able to reduce or economize or eliminate the unnecessary motions, in that case, what we are achieving. We are achieving a better sequence or better pattern of movement, which is not only economical from the point of view of time, but is also helpful for the worker in reducing his fatigue. So he will get less tired if you use this economized sequence of body motion, so that is important from the worker's point of view and it is also important from the organization's point of view.

Because the overall labour productivity will improve, when the worker will perform the task in a much more effective and efficient manner. So this therbligs are really important tools which will help us to economize our efforts. Now types of therbligs. Now broadly they are divided in to 2, 1 is the effective therbligs. Now what are these effective therbligs.

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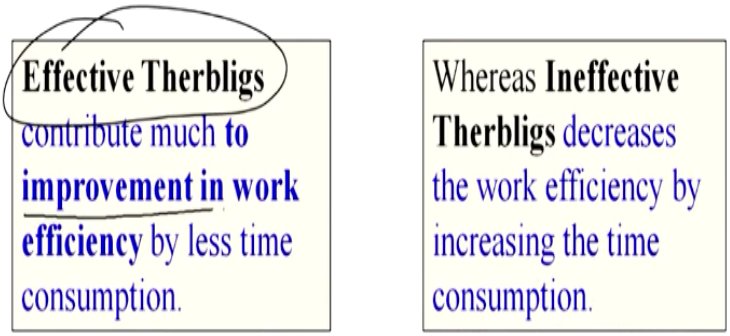

They contribute to the improvement in the work efficiency by less time consumption. So they will lead to less time consumption and will lead to the improvement in the work efficiency. Ineffective, opposite of effective, so effective are leading to improvement in the work efficiency, ineffective will lead to increasing the time that is consumed, maybe sometime there is a rest period, so it is an ineffective time, so it will lead to increase in the time consumption.

So it decreases the worker's efficiency by increasing the time consumption. Broadly, they are divided into 2, but in general we can keep in mind all these 18 therbligs, the symbols used for

these therbligs and then we can plot the way the worker is doing the job, first we need to understand what are the various motions and then plot it. How to plot it using a SIMO chart, we will see in the subsequent class. What are these therbligs, we will try to understand.

You may not classify them into effective or ineffective, but we must know that what are the various therbligs and depending upon the requirement, we must use them in the specified form in which they are listed. Now let us see the therbligs one by one. So what the effective therbligs, first one is reach or transport empty. So why the word or is coming because the book that we are following as per ILO book on work study, it is transport empty.

In some of the other references, you may find it as reach also.

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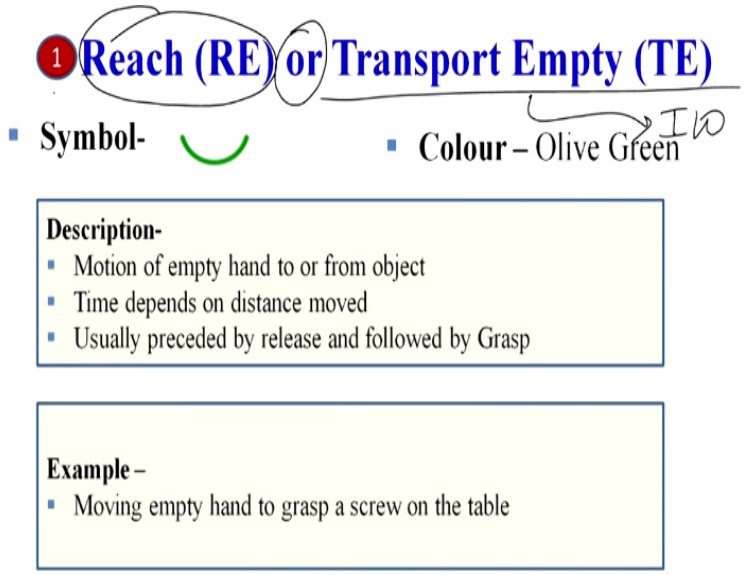

But the symbol is more or less same, this is transport empty symbol, colour is olive green. Now instead of going into the difference in the nomenclature or the name being followed by different books or by different e-notes, or different internet sources, but the meaning remains same. Transport empty basically means motion of an empty hand to or from the object. Now suppose this pointer is lying here. I am standing here.

I want to pick this pointer and point it out towards the screen. So my hand is moving to the pointer, so this is transport empty, TE and now if I pick it and bring it back, it will be transport

loaded, because now the hand is moving and in the loaded condition. I have picked this up. Now suppose in 2-handed process chart, we will depict these motions by transportation symbol only if we want to depict.

So here this movement is further subdivided, so it will be transport empty or reach, then it will be grasp, then it maybe lift, and again transport loaded, so you have now one motion, which is normally the transportation in 2-handed process chart. We have further subdivided into transport empty, grasp, or sometime if 3, 4 things are lying here, I have to first locate. So location can be one thing or searching can be one therblig, then after searching, I have to find, then I have to grasp and then move.

So one motion of transport normally in case of higher level of graphical tool used in case of method study. Micromotion divides the total element or the activity into its most elemental motions. So here grasp is also added, which we have seen in the previous session also when we started our discussion on micromotion study. So this is the first symbol reach or transport empty. So what is given here, motion of an empty hand to the object, time depends on the distance moved, usually preceded by release and followed by grasp.

So maybe it is followed by grasp and preceded by release. So preceded by release means that suppose my hand is having this thing, now I have released it, so it is preceded by release and then I am coming back, it is transport empty. So normally, it is usually it is not in all the cases just to explain that in some of the cases, like now I have used this pen, I have released it and now my hand is empty to transport empty to my pocket.

So that is basically the symbol or micromotion symbol for transport empty. For example, moving empty hand to grasp a screw on the table, which I have already explained moving empty hand to grasp the pen, which is lying on the table. This is one micromotion.

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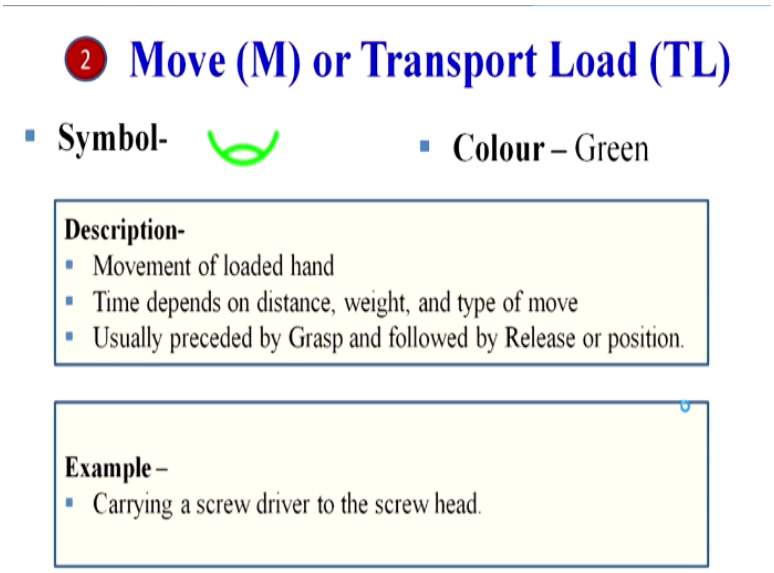

The second micromotion is move or transport loaded. So it is opposite to the transport empty means, the hand is not carrying anything, transport loaded means that the hand is carrying a pen or a pointer or a screw or a nut or a screw driver, anything. So movement of a loaded hand, time depends on the distance, weight and type of the move. So in case of empty, it was only dependent on the distance, but when it is loaded, it will depend upon the weight that you have lifted and the type of the move also. Usually preceded by grasp.

So before transport loaded, what you need to do, what can be the preceding activity, grasp, because first you have to grasp, then you have to move, that is transport loaded and followed by release. So first you grasp it, transport loaded and then you have to release it somewhere, release, so it is followed by release and preceded by grasp. So first, you have to grasp, then transport loaded and then release. For example, carrying a screw driver to the screw head.

So carrying this point to the dashboard or to the screen, this is the transport loaded operation. It is followed by, suppose both my hands are empty, grasp or maybe transport empty, grasp, transport loaded, do the operation, transported loaded only and release and this is maybe a simple sequence of micromotions. So carrying a screw driver to the screw head is transport loaded example. Then grasp.

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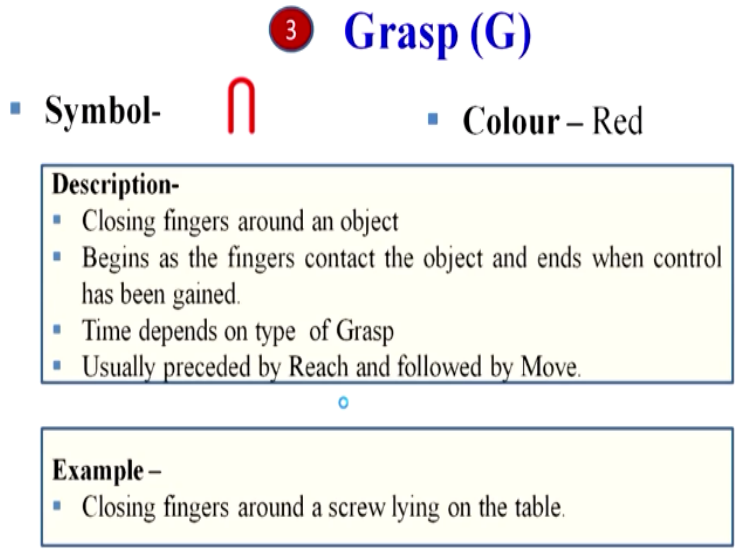

Closing fingers around the object, begins as the fingers contact the object and ends when the control has been gained. Time depends on the type of grasp, usually preceded by reach and followed by move. So grasp is preceded by reach, so I have reached this, I have grasped this, then I will move, so move we have seen that in the previous case, if we go back and see the reach is transport empty. Again we are following the same word is there, it is reach.

Our grasp will be preceded by reach, so first we have to reach it or transport empty, then grasp it and then followed by the move. Example is closing fingers around a screw lying on the table. Now on the table suppose a screw or a nut or a bolt are lying, so we are transport empty, reaching there, grasping it, that is closing down our fingers, taking control of that thing, that is basically an example of grasp. Release load.

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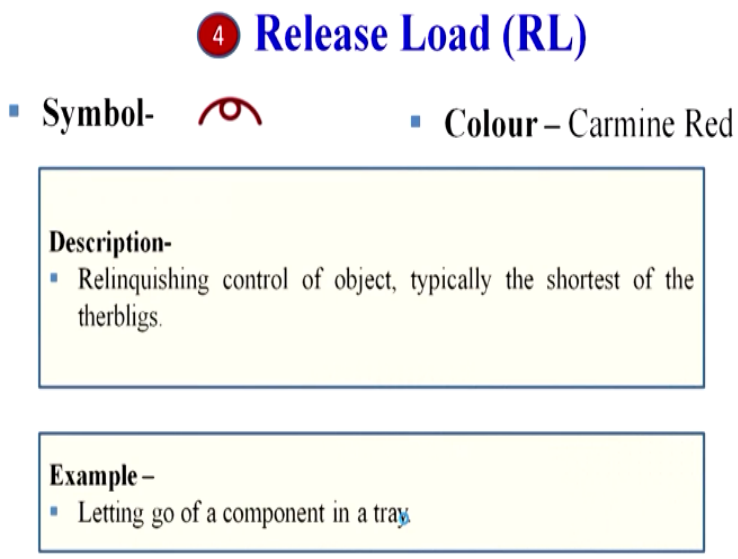

You can see the symbols also clearly depicting that this load will be released in this direction. Relinquishing control of object typically the shortest of the therblig. So releasing a particular thing or a particular particle or equipment or a part that you are carrying, releasing it is the release load, letting go of a component in a tray. So if you are having some component in hand.

For example, you have completed the assembly, now you release the assembly in the drop box or in the box storing the final assemblies, so that operation will be or micromotion will be release the load.

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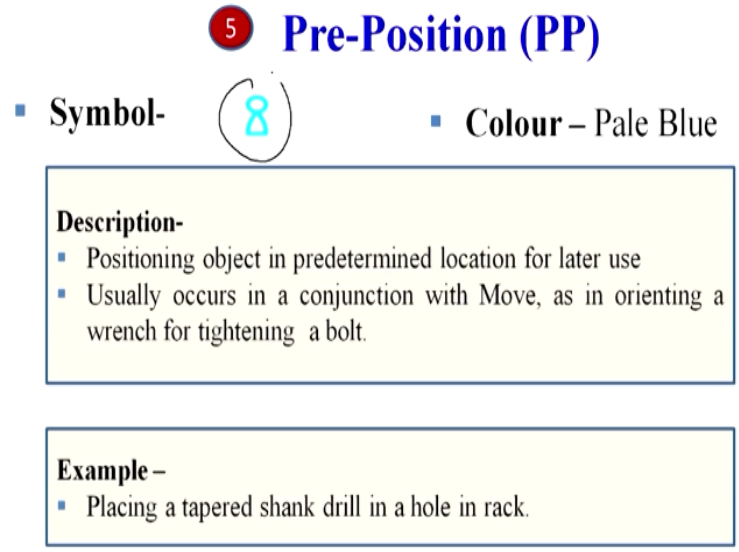

Pre-position, symbol is given here. Pre-position, positioning object in predetermined location for later use, usually occurs in consumption with move as in orienting or wrench for tightening a bolt. So first you have to pre-position wherever you have to use the wrench, so first you pre-position there and then you will operate. So first you can say positioning it at a place where a later operation has to be carried out, which is given as positioning object in predetermined location for later use.

So later use may be the fastening, but you are just positioning your wrench at a particular place around the head of the bolt that is basically the pre-position micromotion. Placing a tapered shank drill in a hole in a rack, that can be one pre-position of later we have to use it, but right now you are pre-positioning it at a point.

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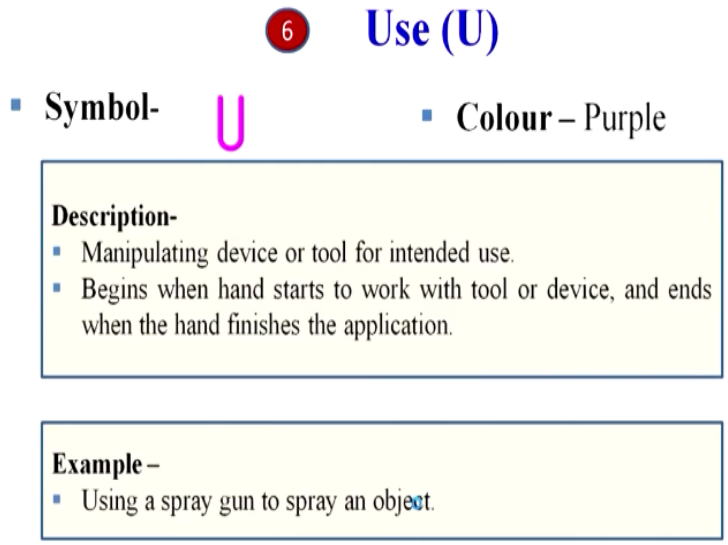

Then use, manipulating a device or a tool for intended use, begins when hand starts to work with a tool or service and ends when the hand finishes the application. Now that is use can be, if I am using this pen to write on the screen, so this is use. I have manipulated the device or tool for the intended use, begins when the hand starts to work with the tool and device and ends when the hand finishes the application using a spray gun to spray on an object that is depicting a use.

For example, if you go to the previous therblig that is pre-position, now pre-position means I have used the wrench and positioned it around the head of the bolt, so that is pre-positioning, use

means that I start tightening the head of the bolt. So that is basically we can say a use or therblig use. So use will be normally preceded by any case of fastening operations, maybe preceded by pre-position. So first you have pre-position, then you have to use.

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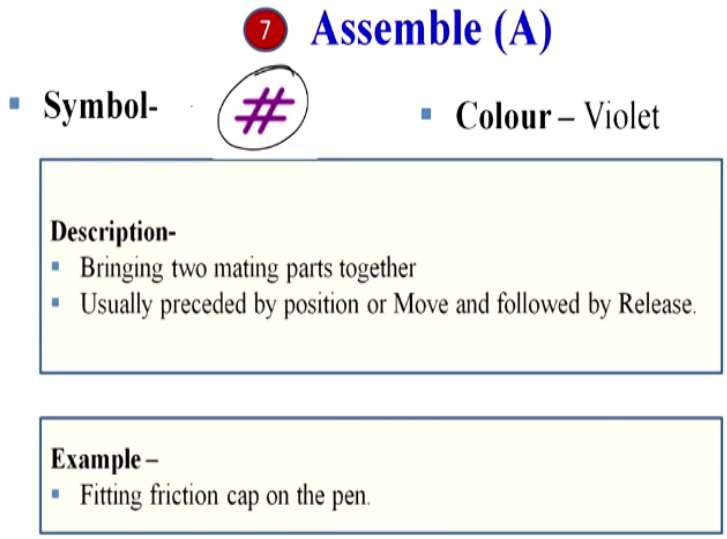

Then another thing assemble, you can see the operation symbol here or micromotion symbol here assemble, opposite will be disassemble, so assemble bringing 2 meeting parts together, usually preceded by position, so first you have to position for example, we want to assemble and attend a bolt, so we have to first bring the nut and the bolt together, so we will bring the 2 parts together and it is preceded by position or move and followed by release.

So once we have fastened it or assembled it, then it is followed by release. So this is the assemble operation fitting friction cap on the pen. So you bring a pen and the cap together and then you press it and then it is assembled, the pen and the cap are assembled followed by release, you can put it at a place where you want to put the pen.

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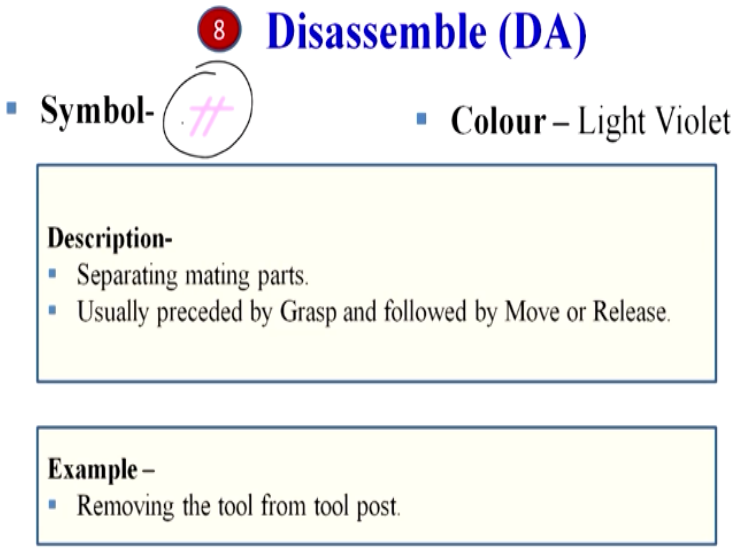

Disassemble, the symbol is shown here. If I need to convert it to assemble, I need to put a line here. If you can go to the previous slide, you can compare the 2 symbols, assemble, the next symbol is disassemble without this line. This is the symbol for disassemble. So this is disassemble symbol, what do we mean by disassemble, separating the meeting parts, usually preceded by grasp.

So when we have to disassemble, first I have to grasp the object, then followed by move or release, then disassemble it, then move or release to the particular point. For example, the nut and bolt assembly disassemble, and release the meeting parts at the respective positions or in the respective bins or in the respective boxes, release the disassembled parts into the respective boxes, so that is the symbol of disassemble or micromotion of disassemble, removing the tool from the post or the tool post.

On a lathe machine, you have a single point tool mounted on the tool post, so you unscrew the bolt from there and take out the tool, this is disassemble of the tool from the tool post.

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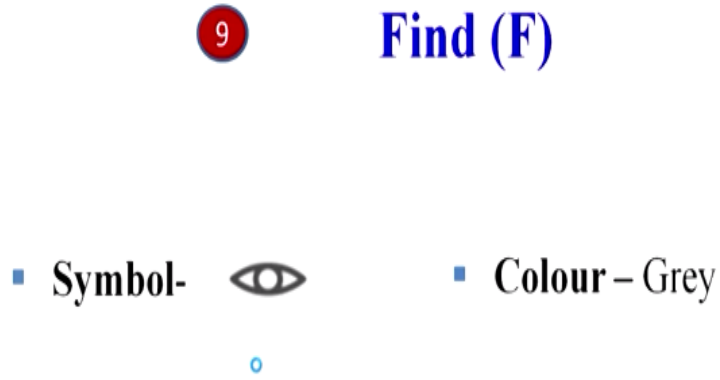

Find, you can see here. This is the symbol for find colour is grey and maybe you can find out a situation where you can see an application of find. This can be taken as an assignment. Then we can go to the ineffective therbligs. Find, you must remember that you have to do this as an assignment, can be a question in the exam related to example of a therblig that is find.

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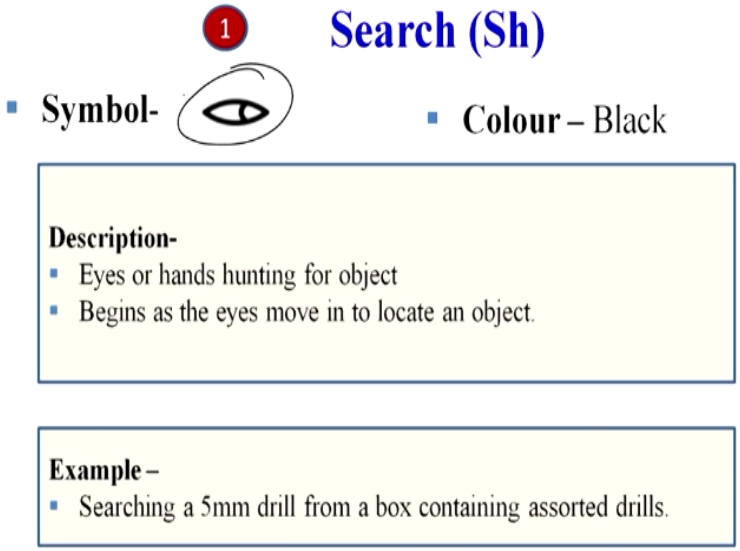

Now ineffective therbligs, this is search. Find means you have found something, so that is maybe find will be preceded by search. First you will search something, then you will be able to find. After finding, you may be grasping. So the finding will be preceded by search. So what is search, that we can see here. Eyes or hands hunting for an object, begins as the eyes move in to locate an object. That is searching a 5 mm drill from a box containing assorted drills.

So there are a lot of drills of different sizes, different colour, so we want to find out a 5 mm drill from there. So that is basically a searching operation. So once we have searched it, we have located, we have found out. The search will be followed by find and find will be preceded by search. Select, so once you have found out the drill, you will select.

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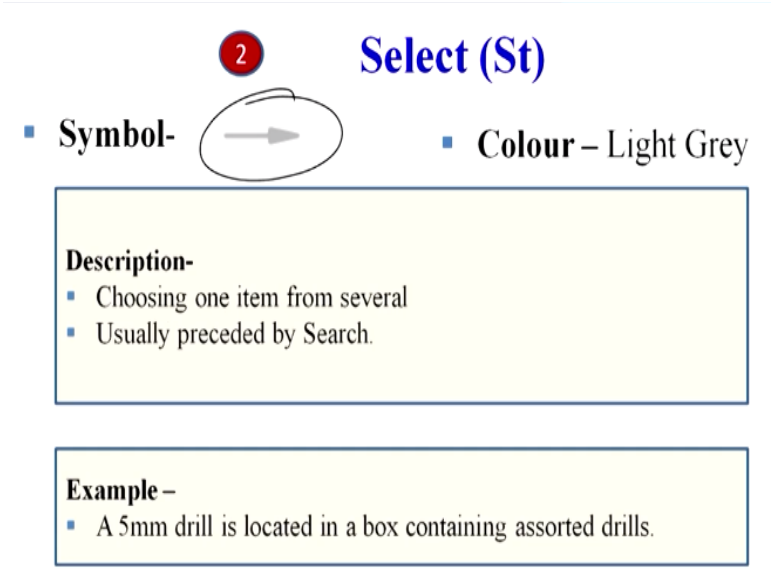

So symbol is also given here, light grey colour, choosing one item from the several usually preceded by search, so first you will do search, then you will find and then you will select. A 5-mm drill is located in a box containing the assorted drill. So you have now out of a number of assorted drills in the box, now you have selected the 5-mm diameter drill. Then the position, the next therblig, symbol is given.

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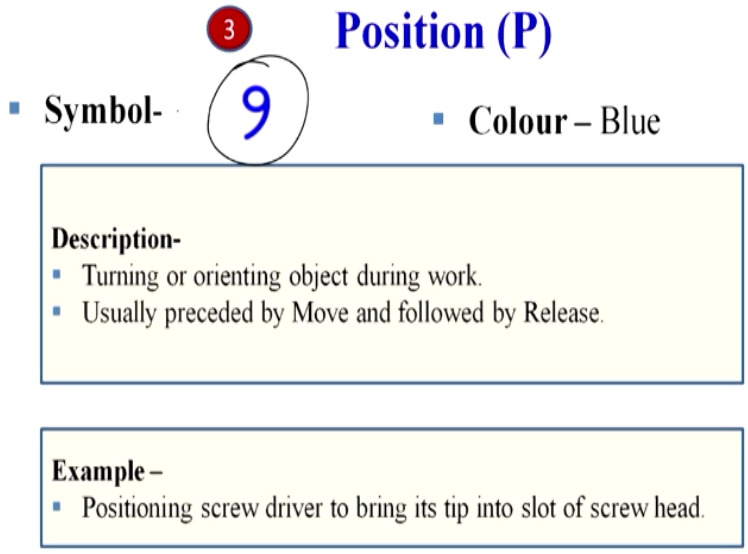

Turning or orienting object during work usually preceded by a move and followed by release, so position means, I have suppose this pen here, let us see what do we mean by position, first one is move, so my hand moves to this particular pen, then it is followed by position. I have grasped it, maybe and then I have moved, transport loaded and then I have if I want to write something here or draw a particular symbol here.

This is, you can say, use and when I have used it, I have drawn in, but position means, I have just taken the position here. My pen is now on top of the board or top of this screen. So this is position and then once I have positioned, I will release, maybe in different scenario, the definitions may be slightly different, because in this case so many other therbligs or micromotions are coming into picture.

So position can be, suppose I want to fix a nail in the wall. So position means I have placed the nail on top of the wall and now I want to use my hammer and fix the nail in the wall, so that can be one example of positioning the nail at the place where you want to insert it or positioning the screw driver to bring it steep into the slot of the screw head, very good example given here that there is a screw head, I will bring my screw driver and position it at top.

I have not started to rotate or screw. I have just positioned or aligned my screwdriver with the screw head, so that is basically the meaning of position. The next one is the symbol for inspect.

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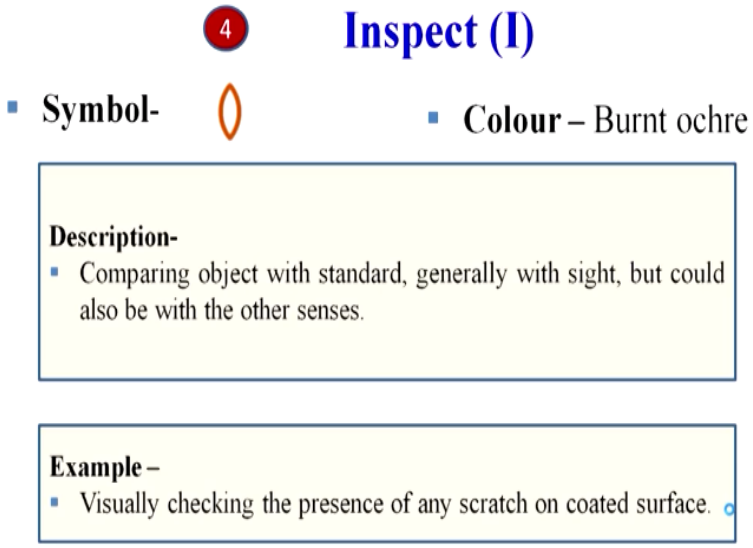

Comparing object with standard generally with sight, but could also be with other senses also. So once you are inspecting something, example can be visually checking the presence of any scratch on a coated surface or if you have painted a surface, you can check whether the painted surface is okay whether the painting is uniform or are there some aberrations, or some problems or some non-uniform distribution of the paint, so all that can be observed using your visual perception.

So that is basically, if you are doing that, that will be called as inspection, then plan.

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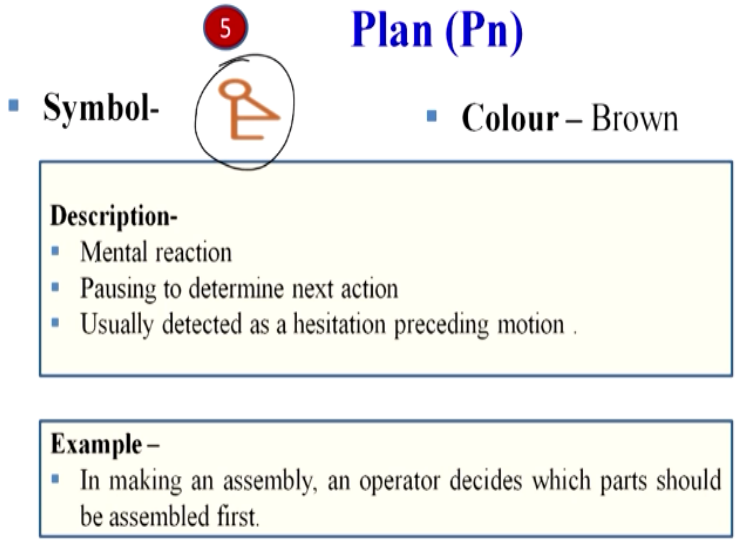

All of us do a little bit of planning, so the plan symbol is given here. It is a mental reaction. It is passing to determine the next action usually detected as a hesitation preceding the motion. So when we are not doing actually any physical work, but we are trying to figure out that how to do the next operation, in that case we will put the micromotion symbol, micromotion activity as planning activity. In making an assembly, an operator decides which part should be assembled first.

So suppose, 3, 4 parts have to be assembled and which is a new work being assigned to a worker, he is not aware that which part must be assembled first, so he has all the parts with him, but he is trying to figure out without doing any physical activity, that which part, he must take first, that can be termed as a micromotion of planning. Unavoidable delay.

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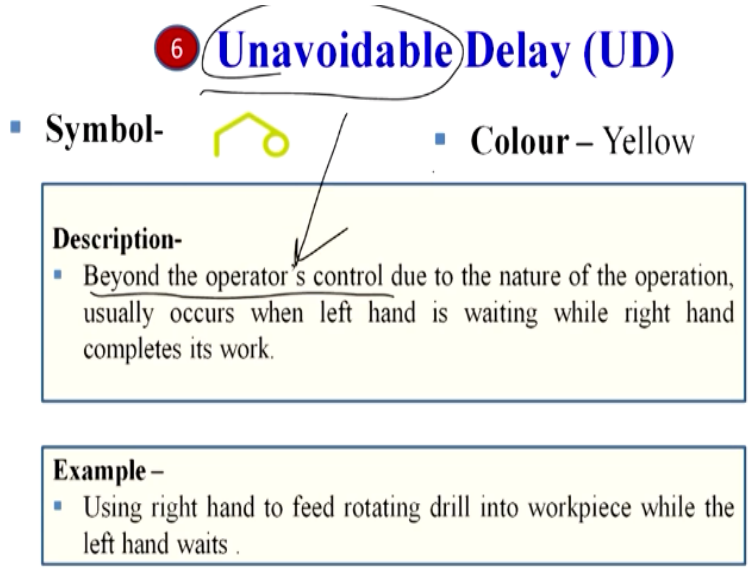

Unavoidable, as the word say beyond the operator's control. So unavoidable is beyond the operator's control due to the nature of the operation. Now suppose, usually when the left hand is waiting while the right hand completes its work. So it is unavoidable delay. Using right hand to feed the rotating drill into the work piece while the left hand waits. So for the left hand it is unavoidable delay, it has to be there, symbol is also given here.

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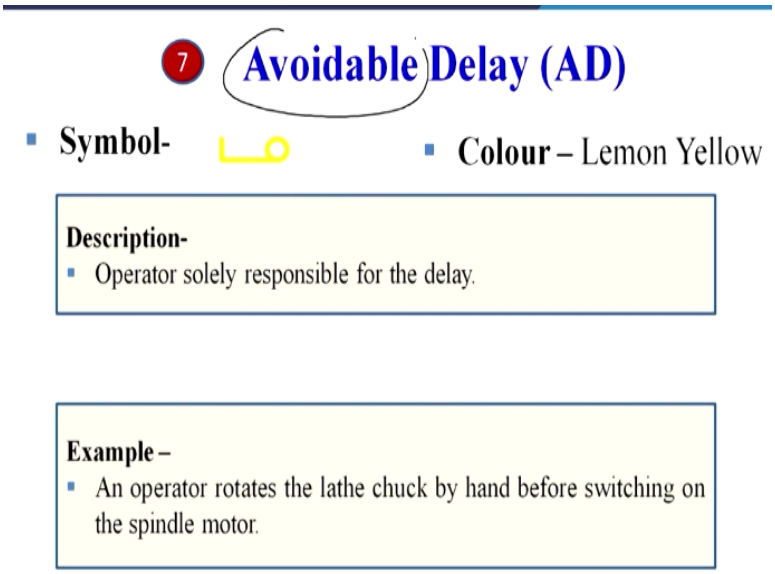

Then the avoidable delay, operator solely responsible for this type of delay, can be easily avoided and operator rotates the lathe check by hand before switching on the spindle motor. So maybe he can directly switch on the spindle motor the check will automatically start to rotate. So he is unnecessarily delaying it by just trying to rotate the check with his hand.

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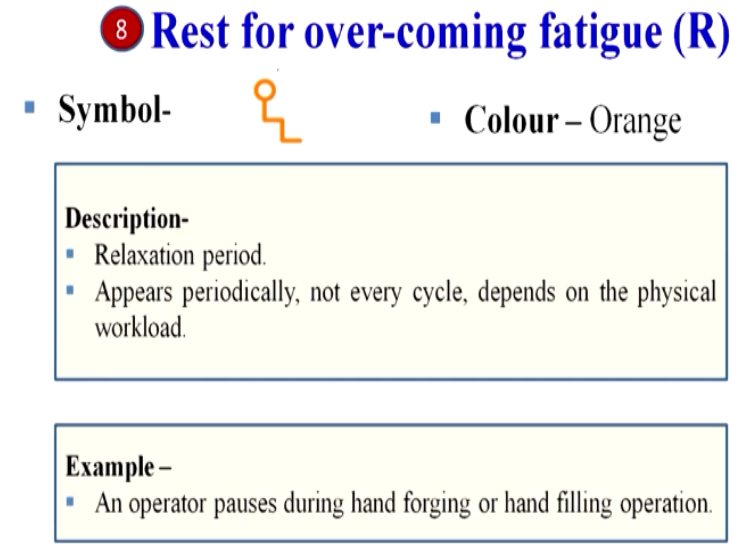

Rest for overcoming fatigue, so this is a symbol, relaxation period appears periodically, not every cycle depends on the physical work load. An operator pauses during hand forcing or hand filing operation. So when the worker feels tired, he is taking some rest, a micromotion symbol that is therblig for rest or overcoming fatigue can be used in such as situation. Then, hold is another therblig.

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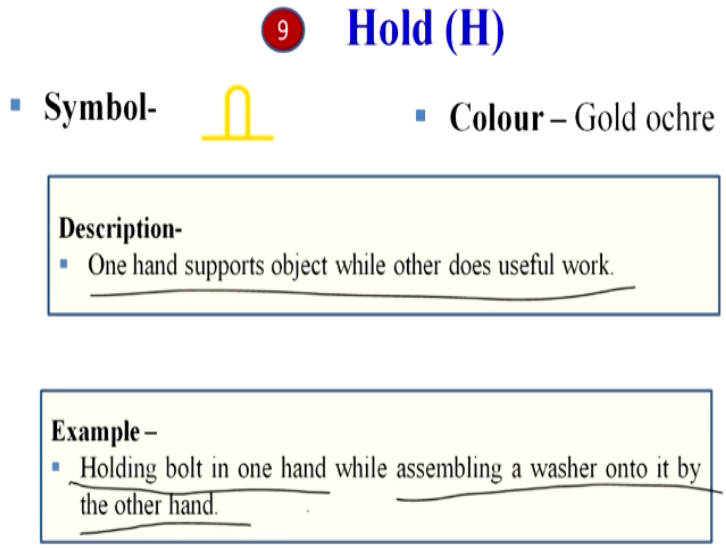

One hand supports the object while the other does the useful work, especially in case of fastening of nut and bolt, one end is holding the bolt in one hand while assembling a washer or the nut with holding and the other hand is fastening the nut on to the bolt, so that is holding and the other one is use, that is using or doing some operation. Now this is one example.

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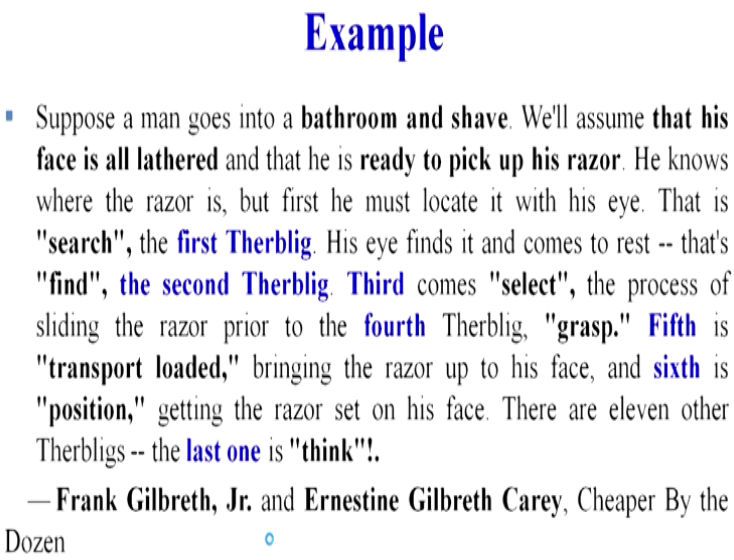

Suppose a man goes into the bathroom and shave, we will assume that his face is all lathered and that he is ready to pick up his razor. He knows where the razor is, but first he must locate it with his eye, that is search, the first therblig. So he is going to shave and already he has applied all the

shaving cream. So first he has to locate the razor, so the first therblig can be search. His eye finds it and comes to rest that is find. So he is first looking for the razor.

He has located it, he has selected it, he has found, then the next can be that is find. First one is search, his eye finds it and comes to rest that is find. So I have left the example for find during the discussion, now you can see what do we mean by find and now you can frame your own examples of find, so search and find that is the second. Third comes is select, the process of sliding the razor prior to the 4th therblig that is grasp.

Now just he is going there, he knows where the razor is, for that motion of getting the razor for doing the shaving there are 4 micromotions. What are these 4 micromotions, search, find, select and grasp. So this is a summary that we have covered today. In the very beginning, I told that at higher levels of analysis, we may use only one symbol for this whole activity, taking the razor, one activity. Now taking razor is further divided into 4.

That is the first one is search, then find, then select, then grasp. Fifth is transport loaded. He has selected it. After grasping, he is bringing it to the place where he wants to use it. transport loaded, bringing the razor up to his face and the sixth is positioning. He positions it at the point from he wants to start the shaving, getting the razor set on his face, position it. There are 11 other therbligs and the last one is you can think.

Now for this activity, you can make a chart, the list of sequence of activities for a person performing the shaving operation. So you can see that we have gone to the most elemental level of the body motions, or the micromotion and these can help us to economize the effort of the worker. So with this, we conclude today's session. We will start our discussion for the last session of this week and we will focus our attention on SIMO chart and we will see that how SIMO chart can help us to improve or to find out the best way of doing the work. Thank you.