Work System Design

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Lecture – 39
Steps and Equipment of Time Study

Namaskar friends, welcome to session 39 in our course on work system design and we are currently in the eighth week of our discussion and the focus of the discussion now has shifted to work measurement from method study. In the last 4 weeks, we have discussed on method study and we have tried to develop one must; one best method of doing the work and now, we need to understand that and how much time that work must be accomplished using the standard procedure or the standard sequence of operations which has been identified during the method study.

And in work measurement, this is the 4th session today and we are trying to introduce the concept or understand the concept of work measurement or time study and if you remember in the very first session, we had the basic concepts that what are the advantages of doing the work measurement or setting the standard times, what are the objectives, what we can gain, how it can help us in decision making.

Then, we have tried to see what are the various techniques such as stopwatch time study, synthetic data, PMTS, that is predetermined motion time system or one of the examples we have seen method time measurement MTM, then we have also studied the analytical approach as well as the historical viewpoint of finding out the standard time, so there are standard techniques which we have already introduced.

I am saying introduced because right now, we just know the names of these techniques, we have to further study in detail that how this technique operates, what are the specific application area for individual technique, what type of time standards we can set using these techniques, what are the types of focus areas, repetitive, non-repetitive, homogeneous, heterogeneous type of work, where which technique is applicable that also we will understand when we focus on each and every technique.

In the last session that is session number 38, our focus primarily was to understand that what are the steps involved but because the sessions are scheduled for 30 minutes only, we were not able to complete the steps involved. In session 38, we have seen the steps involved but we were able to cover the 4 important steps and as I have already highlighted that most important part is to identify, to select the work on which you want to set your time standard that there may be a lot of work happening in the organisation.

You may have time standards for some particular work elements, you need to identify what are the other work elements or we need to read time these work elements that are already being; that have already been time, so that is very, very important to identify, select, define that what you want to do, when you are doing your time study, what is the work you are going to focus when you are doing your time study.

So, that we have focused in the previous session and we have seen once, we have identified that this is a focus area we want to find out that I am standard for this particular work being done or this particular specific department or section need to be investigated always there is overtime coming from this particular sections, so let us say, how they are doing the work, can there be some improvement, can we set some time standard for each and every element of work being conducted in this section or department.

So, once after identification or identifying a specific department or a type of work that we need to do the time study for, we will record all possible information related to that, the information can be related to the way the work is being done, the work that is being done, the operator he or she who is doing the work, the working environments available or prevailing for during the work being completed.

So, we have get all possible information related to that work, then what we need to do? We have taken an example of stitching of a shirt that we can divide the total work of stitching a shirt into the individual elements. Why do we need to divide the work into the individual elements that we

have also seen in the previous session? we have seen that it is better to investigate the individual work elements rather than in totality.

Secondly, it will help us to differentiate between the effective and ineffective time also, we can micromanage the operation, we can see that which element is a high fatigue element, where the worker gets fatigued, so that when we divide the work into the individual elements, it is easier to comprehend as well as analyse. Then, we have seen for each element we need to record the time, how we will record?

We will record using the stopwatch and that stopwatch time study is one of the important direct measurement techniques under work measurement and we have seen that we can have a cumulative recording and then we can subtract the time for individual elements or we can have another method in which we will directly measure the time, so which is a direct measurement of the time for a particular element or for each element of the work.

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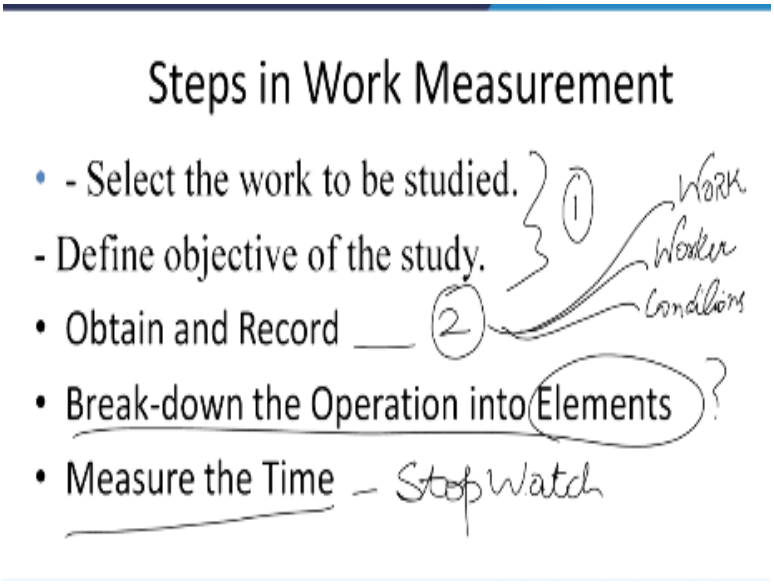

So, with there we end, we have concluded our discussion in the session number 38, so today we again start from the discussion that we have left in the session 38. The first is; the first part is let us see now, the first part is the selection; the first part is the selection of the work to be studied and defining the objective of the study, this is the first part which we have already covered. Second is obtained and record all information.

Now, this information may be related to the work being investigated, it may be related to the worker or it may be related to the conditions or the working conditions, so we have to obtain and record all possible information related to the work being done, the worker who is doing the work and the working condition, then we have to break down the operation into the individual elements, why? That we have already understood in our previous session.

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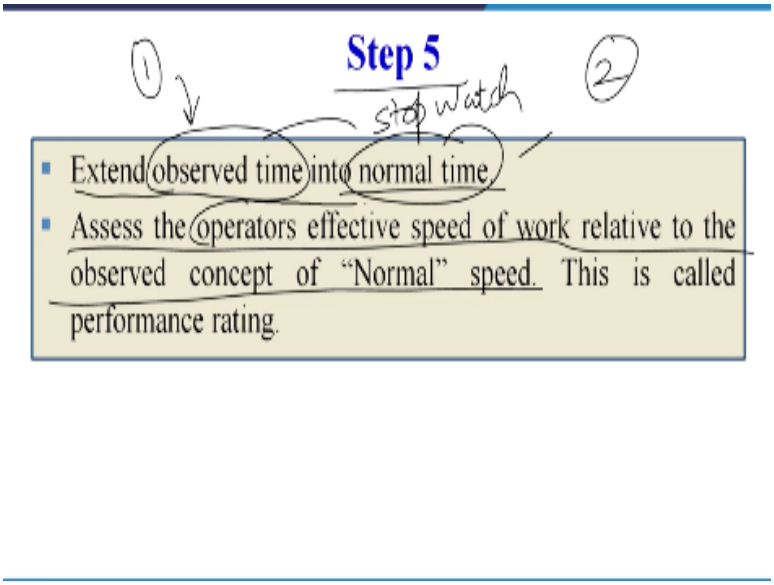

Then we have to measure the time, how may be one of the techniques can be stopwatch, there are different types of stopwatches, we will see in today's session. So, once we have measured the time, what we need to do; then we come to step number 5. Extend the observed time into the normal time, so whatever we have observed using the stopwatch, we need to extend it into the normal time.

So, maybe these definitions we will again try to understand, observe time, what is the observe time; normal time, what is the normal time but today, we are just trying to understand the steps involved. So, first we have to measure we have to find out the time for each and every element and then convert that observed time into the normal time, how it will be done? Assess the operators effective speed of work relative to the observed concept of normal speed.

So, here there is a ratio coming into picture, assess the operators effective speed, the operator will be working at a particular speed, he is performing a task may be he is making 10 components per hour or 20 components per 2 hours, so that is the speed at which the worker is working, then there is a concept of a normal speed, now what is normal? Suppose, I am the time study analyst, I may feel that 50 components per hour is a normal speed at which a worker must operate.

So that is normal from my point of view but the worker is producing 10 components per wish, I wish that a worker must produce 15 components per hour, so either time study analyst for me the concept of normal speed is 15 but the worker is performing, he is doing only 10, so he is slightly slow, so this is called the performance rating, we will discuss performance rating in detail because it is a very important concept.

And what do we mean by performance rating that we will see but for today you can just remember that we have to see, we have to rate the worker or the rate at which the worker is performing the tasks in contest or in relation to a normal rate at which are able bodied person who is suitably qualified and who is suitably skilled must work, so there is a concept of normal rate of working.

And in relation to that we have to rate the worker whether he is slow or he is fast, so based on the observed time, we will try to convert it into the normal time using the performance rating. How it is done?

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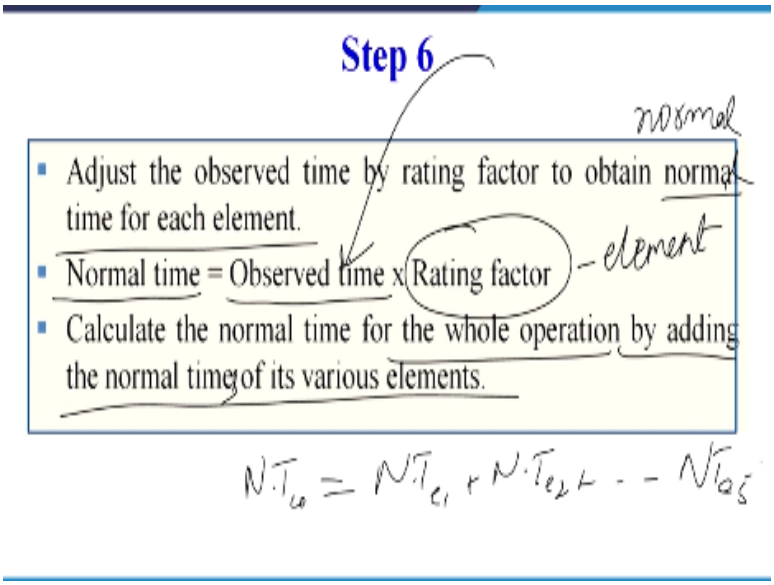

It is given here, we will calculate the normal time from the observed time by multiplying it by the rating factor now, what is the rating factor? We will try to understand it during the performance rating, our session on performance rating that is session number 14. So, adjust the observed time rating factor to obtain the normal time for each element, so it is slightly skipped here, this is the normal time for each element.

So, we will calculate the normal observed time directly we have taken by direct measurement using the stopwatch, we are multiplying it by the rating factor, what is the rating factor? It is the rate at which the person is working in context of or in relation to the normal rate of working, we calculate the normal time for whole operation because we are doing this for one element, so we are calculating normal time for each element.

Now, for whole operation, how we will get; by adding the normal time for various elements, so for each element we will add the normal time and we will get the normal time for the complete operations, so the normal time if we can write for the complete operation will be the normal time for element 1 + normal time for element 2 + maybe it has 5 elements normal time for element 5, so there are 5 elements, so this way, we can very easily calculate the normal time for the complete operation.

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So again I am reading it for you, calculate the normal time for the whole operation by adding the normal times of its various elements. Now, next step is adding the suitable allowances, now what are these allowances this will also come up in our further discussion, add the suitable allowances to compensate for fatigue, personal needs, contingencies etc. may be miscellaneous to give standard time for each element.

So, we have calculated the normal time for each element from the observed time that we have recorded, now from the normal time we are adding the allowances, the allowances can be the fatigue allowance, the personal allowance, the contingencies, miscellaneous allowances to give the standard time for each element. Now, standard time for each element we have got but we want the standard time for the whole or the complete operation.

Now, compute the allowed time for the entire job by adding the elemental standard times considering the frequency of occurrence of each element. Now, for each element we have found out the standard time, so we can compute for the entire job by adding the standard time calculated for each element. So, if there are 5 elements, we will add the standard time for all the 5 elements and calculate the standard time for the entire job.

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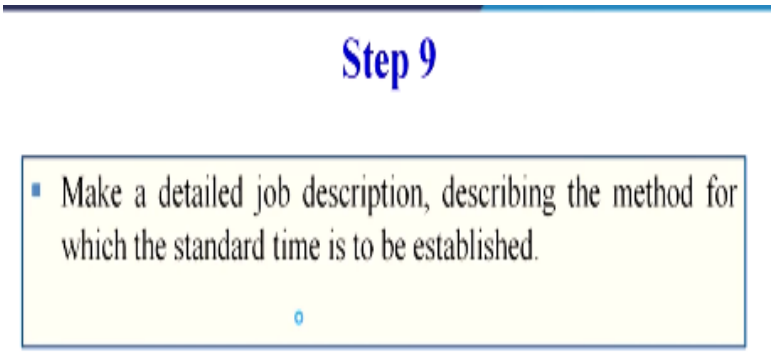

And if some elements the frequencies more, it will be multiplied accordingly in order to find out the standard time for the complete job. Now, there is the last part is you have already calculated the standard time, make a detailed job description describing the method for which the standard time is to be established, so that method is very, very important because you found out the time based on the sequence of work elements.

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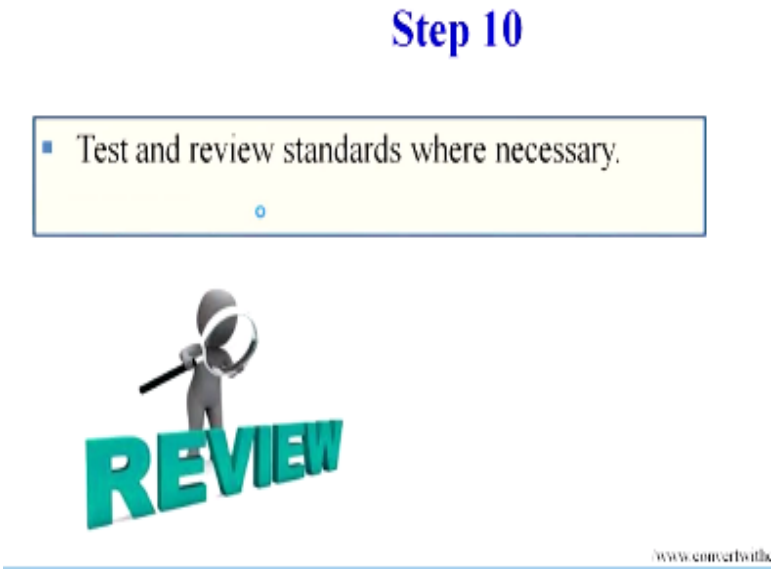

So, if the work element sequence is disturbed or there is change in the method the time standard will not hold good, so it is very, very important to make a detailed job description describing the method for which the standard time is to be established or has been established and then test and

review the standards wherever necessary, so this is the overall summary of the steps involved in typing or in work measurement or in time study.

So, we can very easily summarise that if we follow the systematic approach, we can very easily find out the standard time for performing the operation or for performing a job. Now, what are these steps; already we have revised today, so we can again maybe focus on the broad areas, so the broad areas are first is select and define the work that you want to perform or that you want to set the time standard for or for which you want to set the standard time.

So, after defining, you have to record, observed all the information or sorry, observe and record all the information possible, so after recording you can break down the work into the individual elements, after breaking down you can measure the time taken for each element using the stopwatch, after you have found out the observed time, it has to be multiplied by the rating factor, what is the rating factor?

It is the speed at which the worker is working in relation to the normal speed at which a worker must work after multiplying the observed time with the rating factor, we get the normal time and the normal time for each element is added to calculate the; in order to calculate the normal time for the complete operation. So, when you know the normal time for the complete operation, you can add allowances to that.

There are different types of allowances like fatigue allowance, there can be a miscellaneous allowances, so when you add all these allowances to the normal time, you will get the standard time for each element and then for each; standard time for each element is added up to calculate the standard time for the entire job and then you have to put a complete description of the sequence of elements or the standard method which has been used for doing the work for which the time standard has been set.

And finally, you have test and review the standards wherever necessary, so this is the complete sequence of finding out the standard time for a given job. After this, now we will quickly have an overview of the time study equipment because it is fairly standard and every maybe year or 2

there are so many changes relate to the technology and when the technology changes, the equipment that we use also changes or also change.

And therefore, we are just going to have a 10 to 12 minutes' overview of the different types of equipment that we use because if we go and perform a time study ourselves how to use the equipment, we must know, so this is going to give you a brief overview only of the equipment that is used for conducting the time study. Now, time study equipment now first of all just revise what is time study.

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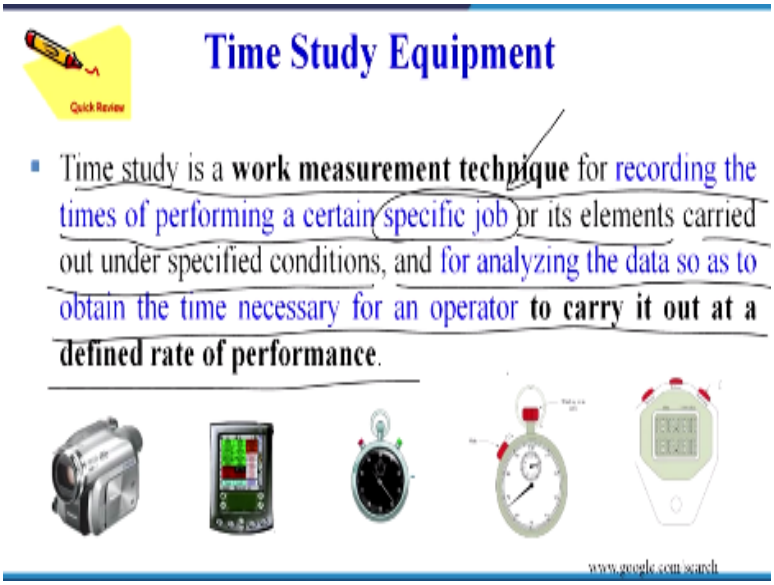

Time study is a work measurement technique for recording the times of performing a certain specific job, very, very important or its elements carried out under specified conditions and for analysing the data, so as to obtain the time necessary for an operator to carry it out at a defined rate of performance, so there is no need to get confused with this long definition. If you break down the definition into individual words, you will be able to understand rate of performance.

Now, I think you have little bit of idea about this thing, then specified job, there has to be a standard method of doing the job or the various; we can find out the time or recording the times of performing a certain specific job or its elements which we have seen in the steps that sometimes we divide the total work into its elements, carried out under specific conditions which

we have already recorded during the second step of our time study that we need to record all the information related to the working conditions.

And then, we analyse the data, we are doing some mathematical multiplications and additions in order to setting up of the standard time, if you have seen the various steps involved, we multiply the observed time with the rating factor, then to the normal time we add, we perform additive operation of the allowances in order to find out the standard time so therefore, we analyse the data, so as to obtain the time necessary for an operator to carry it out at the defined rate of performance, rate of performance also you know.

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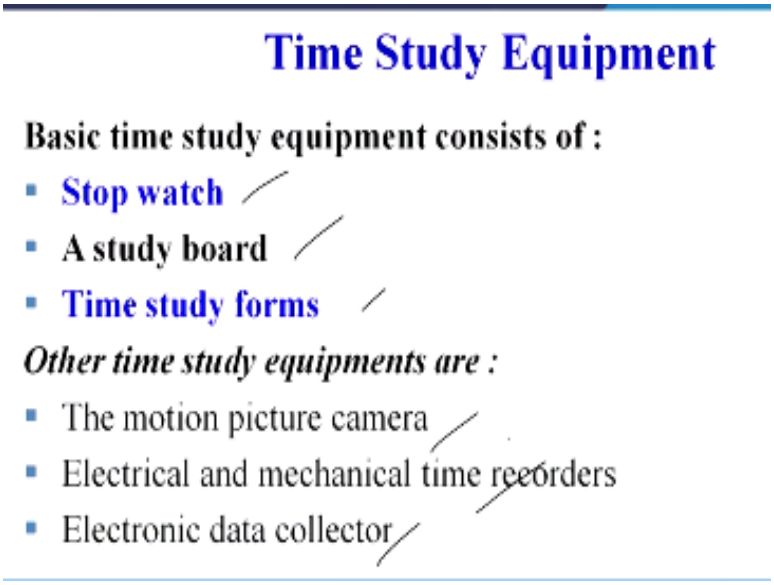

So, this is the basic summary, some of the diagrams like a camera is shown here, stopwatch are shown. Now, what are the time study equipment; the basic time study equipment consists of a stopwatch or study board and time study form, so this is very basic necessary equipment that is required for performing the time study. Other time study equipments are motion, picture camera, electrical and mechanical time recorders, electronic data record collectors.

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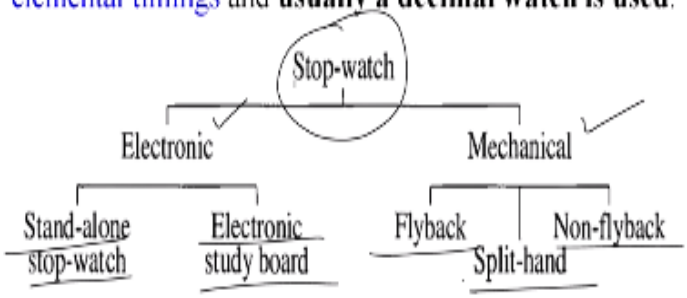
Stop Watch

- Stop watch is the measuring instrument to observe the elemental timings and **usually a decimal watch is used**.



Source: Introduction to work study, ILO, Geneva

So, there can be advanced equipment even advanced than what is listed on your screen, now let us see, what is a stopwatch? Stopwatch is the measuring instrument to observe the elemental timings and usually a decimal watches use, so the classification is given, this is from the standard book, introduction to work study by ILO. So, stop watch is it can of electronic type, it can be mechanical type, within mechanical, it will be fly back and non-fly back or it can be split hand.

This fly back home we have already seen in our previous session, then electronic and we standalone stopwatch or electronic study board, so we can have different types of stopwatches.

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Stop Watch: Mechanical Type

Mechanical-type watches may be obtained with any one of three graduated scales:

- Recording one minute per revolution by intervals of one-fifth of a second, with a small hand recording 30 minutes.
- Recording one minute per revolution calibrated in 1/100ths of a minute, with a small hand recording 30 minutes (**the decimal-minute watch**).
- Recording 1/100th of an hour per revolution calibrated in 1/10,000ths of an hour; **a small hand** records up to one hour in 100 divisions (**the decimal-hour watch**).

Now, what is the mechanical type of stopwatch; mechanical type watches may be obtained with any one of the 3 graduated scale, so we will see one of the examples of the scale but there can be different types of graduations now. Why different types of stopwatches? If you remember in methods study, we have seen that we may do a broad observation and prepare an outline or operation process chart.

Or we can go to the micro motion; divide the work into grasp, move, transport empty transport, so we can do a micro motion analysis or the motion of the study of the motions of the body or the basic motions of the body or we can do the complete analysis of the movement of material in the shop floor, so the level of analyses may be different and therefore, depending upon the requirement we have different types of stop watches.

And which can record time up to different levels, so regarding 1 minute per revolution by intervals of 1/5th of a second with a small hand recording 30 minutes we will see one example of the work, so here intervals of 1/5th of a second hour also recorded, recording 1 minute per revolution calibrated in 100th of a minute, so 100th of a minute is calibrated on the scale which is small hand recording 30 minutes at the decimal minute watch.

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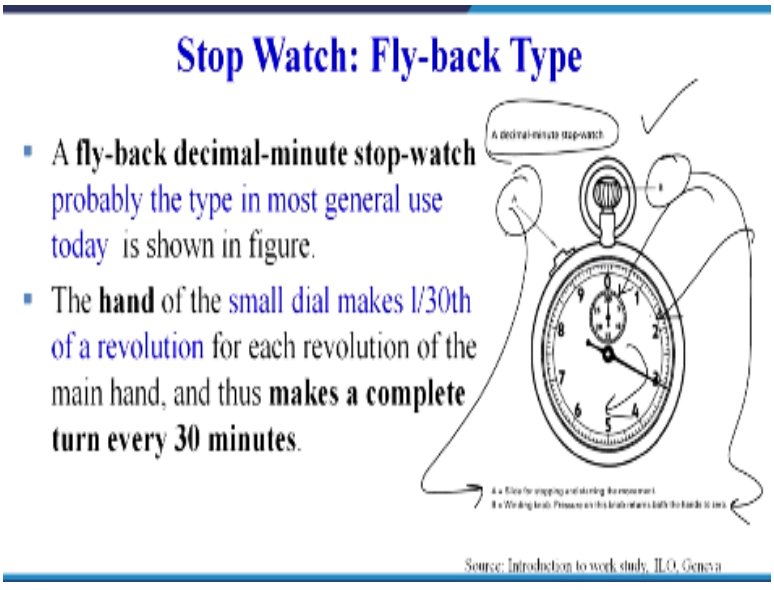

So, we can have 2 hands maybe a bigger hands and smaller hands, smaller hand with a small hand recording 30 minutes, let us first see the watch, this is the watch you can see, so there is a

smaller watch, smaller indicator inside and a bigger graduation here, this is the difference between the discussion that we are doing here, small hand recording 30 minute which means the inner hand may record 30 minutes.

The outer hand will have different graduations 100th of a minute recording 100th of an hour per revolution calibrated in 1/10000 of an hour, the small hand records up to 1 hour in 100 divisions, so that also is possible, so here you can see a fly back decimal minute stopwatch, it is written here a decimal minute stopwatch, which we have already used this word, the decimal minute watch, the decimal hour watch.

So, here you can see this a and b are also equally important, what is a; it is clarified here, a means slide for stopping and starting the movement, so we can start the stopwatch from this a and we can stop it and what it is b? it is given here, b is; it is a winding knob pressure on this knob returns both hands to 0, so this is hand 1, this is hand 2, so if you press this knob b, both will come to the 0 position.

So, this is the way we can operate the stopwatch, so fly back decimal minute stopwatch probably the type is most generally used is shown in the figure, the hand of the small dial makes 1/30th of a revolution for each revolution of the main hand, so for each revolution of the main hand, the inner hand this one, which is in the inner dial makes 130th of the revolution which means that it makes a complete turn after every 30 minutes.

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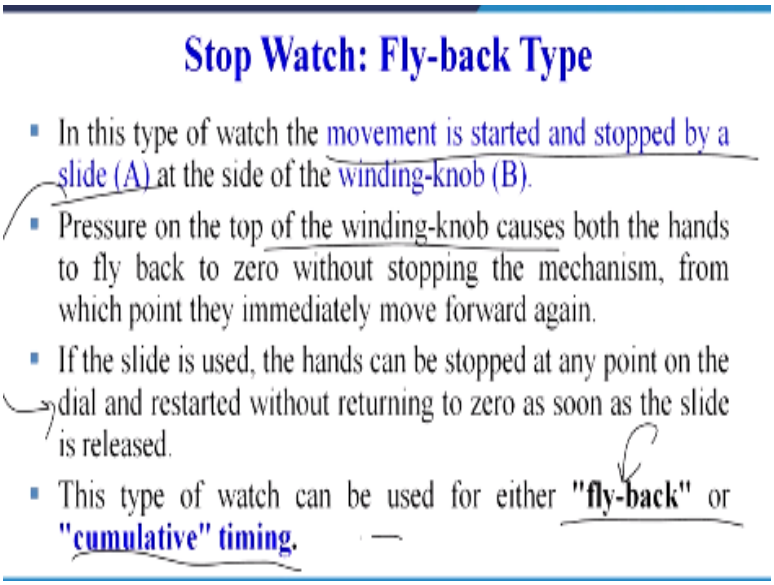

So, this is going, if this is it is shown, this is 30, so one rotation of this inner hand will give you 30 minutes. Stopwatch fly back type; in this type of watch, the movement is started and stopped by a slide A at the side of the winding knob B, pressure on the top of the winding knob causes both the hands to fly back to 0 without stopping the mechanism from which point they immediately move forward again.

If the slide is used, the hands can be stopped at any point on the dial and restarted without returning to 0 as soon as the slide is released, so what is a slide it is shown here, the movement is started and stopped by a slide, so this slide is being referred back again here, that the slide is used the hands can be stopped at any point on the dial and restarted without returning to 0, if you want to return to 0 then you have to use the winding knob which is given here.

Pressure on the top of the winding knob causes both the hands to fly back to 0 without stopping the mechanism from which point they immediately move forward again, this type of watch can be used for either fly back or cumulative timing and if you refer back to the previous session, we have already differentiated between the 2, what is the difference between the fly back and the cumulative timing.

In cumulative, we do, we start at the start of the first element and at the end of the work cycle and then with cumulative subtractions, we try to calculate the time for each and every element

whereas, in fly back we can directly record the time for every element without the need of a subtraction after the completion of the cycle.

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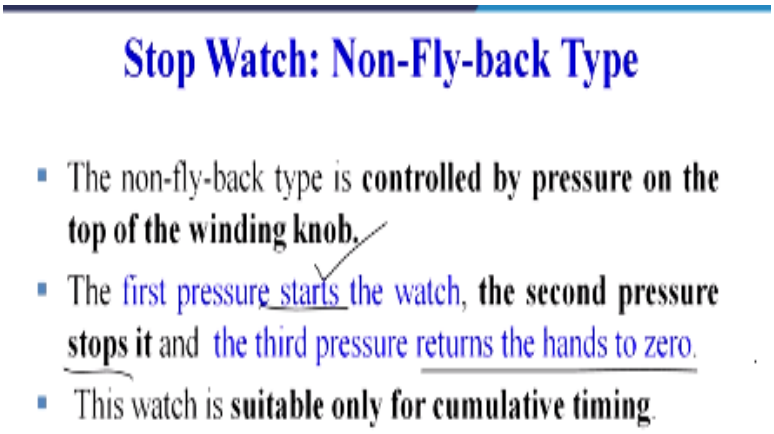

Now, non-fly back type of watches is also there, the non-fly back type is controlled by the pressure on the top of the winding knob, the first pressure starts the watch, the second pressure stops it and the third pressure returns the hand to 0, so in fly back type of watches; stop watches we have seen there are 2; A and B control mechanisms but here there is one, the non-fly back type is control a pressure on the top of the winding.

Now, the first pressure starts, the second pressure stops and third pressure returns the hands to 0, this was a suitable only for a cumulative timing, so we have seen cumulative and in previous case, fly back timings but here this non-fly back watch is used for cumulative timing only.

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Stop Watch : Conclusion

- Whatever **type of watch is used**, it should always be remembered that it is a delicate instrument which must be treated with care.
- Watches **should be wound fully before each study**, and should be allowed to run down overnight.
- At **regular intervals** they should be sent to a watchmaker for cleaning and routine overhaul.

Now, the conclusion for the stopwatch we can see that whatever type of watches used it should always be remembered that it is a delicate instrument, which must be treated with care. Watches should be wound fully before each study and should be allowed to run down overnight at regular intervals, they must be sent to watch maker for cleaning and routine overhaul, so this sums up that the regarding the maintenance and the proper use of the watches that what are the safety precautions for the stopwatches.

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The Study Board

- The study board is simply a flat board, usually of plywood or of suitable plastic sheet, needed for placing the time study forms.
- It should be **rigid and larger** than the largest form likely to be used.
- It may have a **fitting to hold the watch**, so that the hands of the work study person are left relatively free and the watch is in a position to be read easily.
- For right-handed people the watch is normally placed at the top of the board on the right-hand side, and the **forefinger or middle finger of the left hand used to press the winding knob** when resetting the watch.

Then, we use the time study board; the study board is a simply a flat board usually of plywood or any suitable plastic sheet needed for placing the time study forms, now what are this time study forms, we will take one example. It is a board like this on which we place our time study form. It

should be rigid and larger than the largest form likely to be used, it may have a fitting to hold the watch, so you can hold the watch also on the time study board.

So that the hands of the work study person are relatively free and the watch is in a position to be read easily, so on the board, you can have a facility for putting up a time study form and you can also may have a facility for putting the watch also on the time study board only. For a right handed people, the watches normally placed at the top of the board on the right hand side and the fore finger or the middle finger of the left hand used to press the winding knob when resetting the watch.

So, you can put it, suppose, I am right handed, it can be put here and left hand can be used to as it is given here, the fore finger or the middle finger of the left hand used to press the winding knob, this is one example you can see this is the stopwatch.

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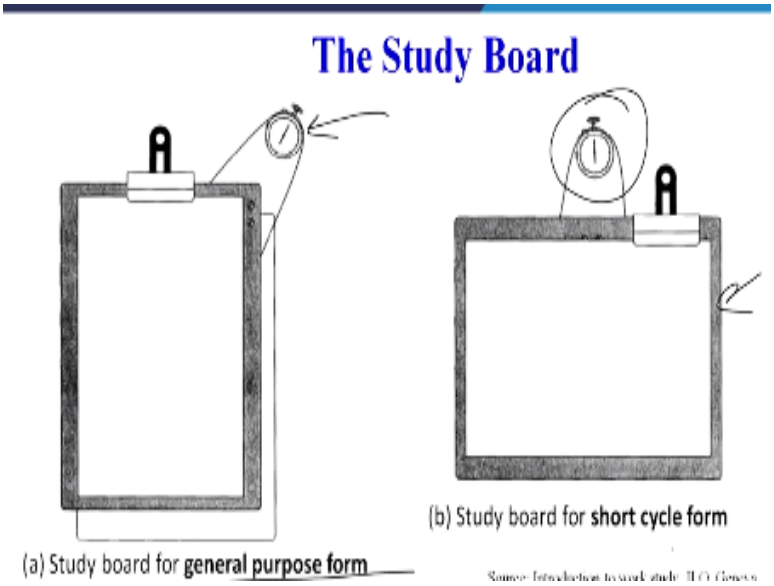

This is the board, this is a stopwatch, this is the board, so you can see you can have for this is a general purpose and maybe here this is for a short cycle form because quickly, you need to change it again and again.

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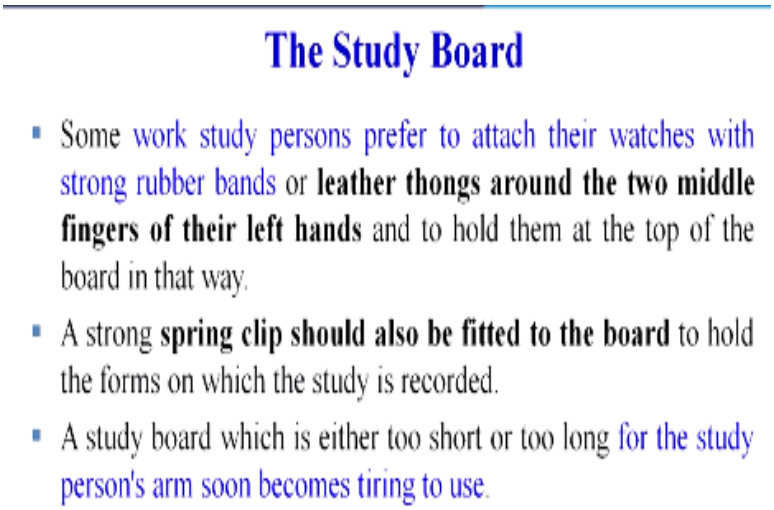

Some work study persons perfect to attach their watches with a strong rubber bands or leather thongs around the 2 middle fingers of their left hand, so sometimes you would like to hold the watch in your hand also, some work study persons prefer to attach their watches with a strong rubber bands or leather thongs around the 2 middle fingers of their left hands and to hold them at the top of the board in that way.

So, they may keep the watch like this, hold the watch like this and they can operate also, a strong spring clip should also be fitted to the board to hold the forms on which the study is recorded as we do in our engineering graphics classes when we make drawing sheets. A study board which is either too short or too long for the study person's arm soon become tiring to use, so the size of the board must also be taken into account.

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Electronic Stop Watches and Study Boards

- An electronic stop-watch **performs exactly the same role as a mechanical one** -the recording of element durations.
- One of the **main advantages** is that it allows flyback timing to be performed without any loss of accuracy.

Source: Introduction to work study, ILO, Geneva

Now, these are the electronic stop watches and a study board, an electronic stopwatch performs exactly the same role as a mechanical one, the recording of the element durations, so what is our purpose of using the stopwatch? To record the duration of time or to record the time taken for individual elements of the work being done, one of the main advantages is that it allows fly back timings to be performed without any loss of accuracy.

So, it allows fly back timing may be direct timing can be done without any loss of accuracy which so it means that the digital watches are slightly more accurate as compared to the other types of stopwatches.

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Time Study Forms

- Time study forms are **usually printed forms of standard size**.
- The use of standard forms is desirable as the constant information, such as part number and part name, operation description, observer's name and **other description are pre-printed on the top of the form** which eliminates the possibility of any details being missed.
- As the size of the forms are standardized they can be **easily filed for future referencing**.

Now, time study forms quickly we can see what are the different types of time study form only one example we will take, so the time study forms are usually printed forms of standard size, the use of standard forms is desirable as a constant information such as part number, part name, operation printed on the operation description, observers name, so what all can be there, we can see with the help of the form.

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Time Study Forms: Example

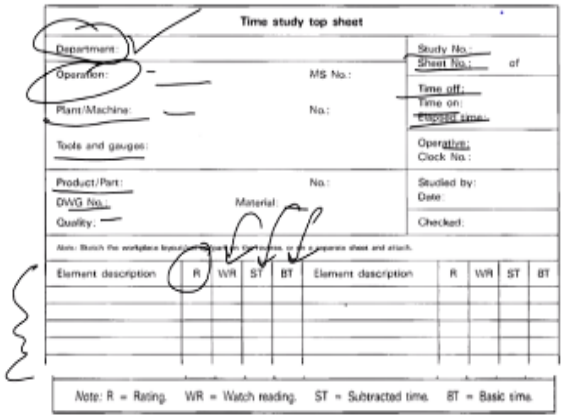

Figure- General purpose time study top sheet

We will go to the forms, you can see this is one of the time study form, what is written here, the name of the department can be there, operation; what is the operation being done maybe it can be related to deliver for whole or maybe machining on a lathe machine of a shaft or whatever can with operation, then plant and a machine operation, machine department tools and gauges used, then the product, drawing number can also be there.

The quality required can be there, material can be there, study number, sheet number, time on, time off, elapsed time, so operative all details are available, then the element description, what are the elements for which we are finding out that time, then the rating as we have seen performance rating, this is watch reading, subtracted time, basic time or the observed time, again the element description here.

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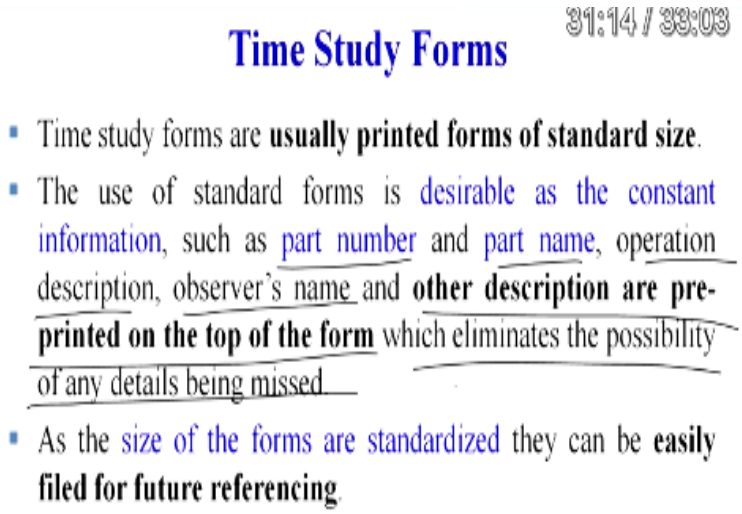

So, this is one of the standard types of time study forms, which is used for recording the times or the durations taken for the various elements for performing the task. So, coming back to the time study forms, so time study forms are usually printed forms of standard sizes, so use of standard forms is desirable as the constant information which we have already seen such as a part number, part name, operation, description, observers name.

Other descriptions are printed on the top of the form, which eliminates the possibility of any detail is being missed, so we want to put all possible details information on the form. As the size of the forms are standardised, they can be easily filed for future referencing, so there can be other types of time study forms also but one of the forms I have tried to introduce that what all information we need to put in the time study form.

And we have try to see the 3 important types of equipment that are required for conducting the time study, now these equipments are the stopwatches, there are different types of stopwatches available, then we have also seen the time study board and the time study forms, also we have try to complete our discussion which we started in the previous session regarding the steps involved in the work measurement or time study.

So, with this I conclude the today's session, there was another description which I have tried to highlight today that in future we will be talking about the allowances, we will be talking about

each of the techniques that are used for finding out the standard time for the various types of work being done in the organisation. Thank you.