Industrial Engineering
Prof. D. K. Dwivedi
Department of Mechanical & Industrial Engineering
Indian Institute of Technology, Roorkee

Module - 03
Lecture - 11
**Performance Rating & Allowances**

Dear students, you know that the work measurement is one of the important techniques of the work-study. And this work measurement technique is mainly used to quantify the work content related with a job, in terms of the standard time, required to carry out that job; and also to investigate, the presence of ineffective time, if it is there and it is extent.

So, determination of the ineffective time, helps to find out the venues, where improvement can be done by method study. And the setting of standard of performance, helps in proper production planning, developing the ways and incentive plans and a number of estimations and fore castings. Setting of the time standard is done using the four techniques mainly these are the time study, work sampling predetermined motion time study and the standard data method.

In the time study is one of the most commonly used work measurement technique, in which the time study man, quantifies the time required to carry out the job, by an average qualified worker using the stop watch. And the time, observed time in carrying out the job determined by the time study man is normalized using the performance rating factor and adding the allowances. So, for arriving at the performance rating of the worker, and determining the percentage of the allowance, which should be added to arrive at the standard time, we should look into the detail.
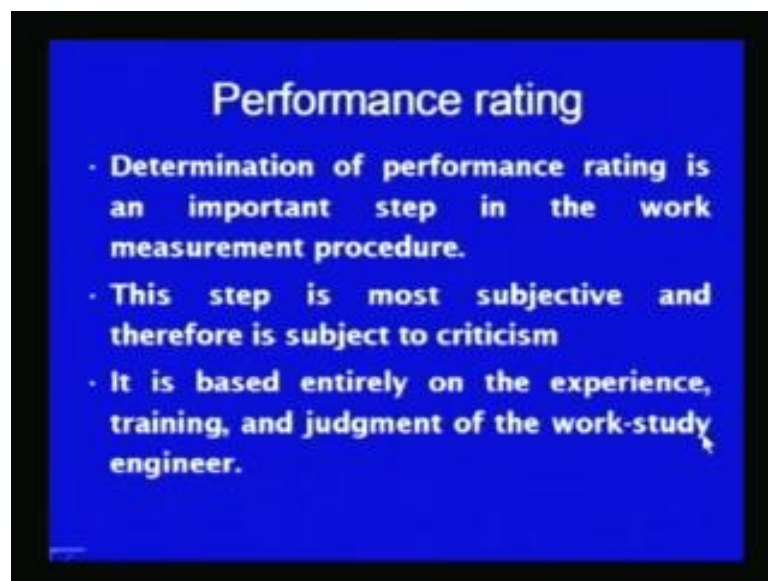
The performance rating of the worker, which is carrying out a particular job, for the time study is an important step, because it helps to quantify, the speed at which, the worker is working and following the standard method, which is expected during the operation.
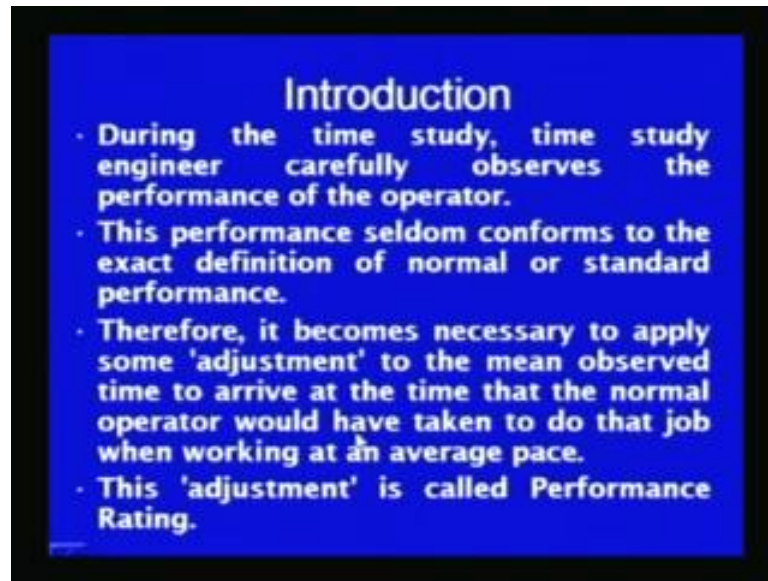
So, the time study engineer carefully observes the performance of the operator, during the work and this performance actually is normally found, always different from, what is a according to the normal or standard performance. And, the performance of the actual operator, seldom conforms to the normal or standard performance, and therefore, it becomes necessary, to apply some adjustment factor by the time study man. So, as to find out the, average time, which a normal operator, will take to do the same job, and this adjustment factor is termed as performance rating.

The determination of the performance rating therefore, is an important step in work study, because it helps to find out, the rate at which a worker will work during the study, and that is used to quantify and find out the standard time required for carrying out the job, and the same is expected to be done, by the other workers. This step is most subjective and that is why, it is frequently subjected to the criticism of the operator, because this the performance rating being given by the time study man. So only depends upon his experience, and his expertise related to the work which has, which is being investigated. So, because of it is subjective nature, it is subjected to the criticism also, that because the performance rating largely given by the time study man depends on the experience training, and the judgment of the work study man.

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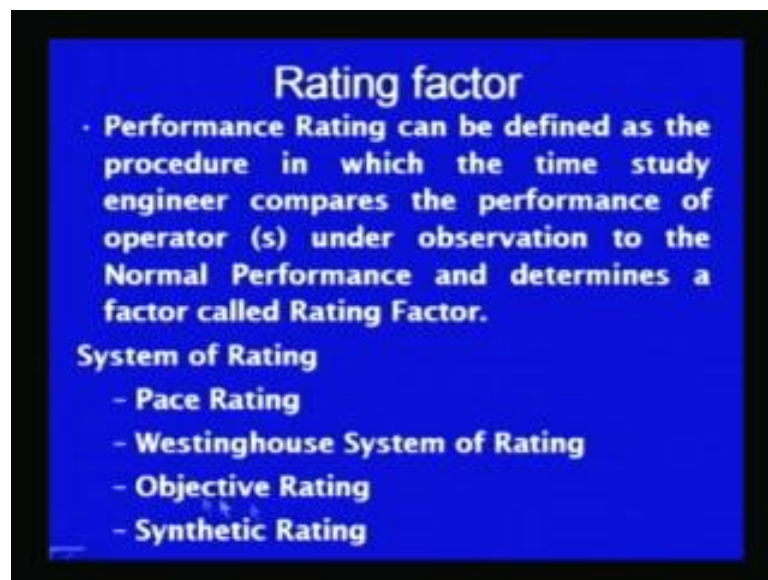
The rating factor or the performance rating is defined as the procedure, in which time study engineer, compares the performance of operator under the observation to the normal performance, and that is used to determine the rating factor. So, what is the working speed of the worker, and what is the performance, normal performance expected from the worker, these two are compared to arrive at rating factor.

So, the different methods have been developed over a period of time, to find out the rating factor, for an operator during the time study, and these are known as the pace rating, Westinghouse system of rating, objective rating and synthetic rating. Pace rating is about, the speed at which worker applies himself for carrying out the particular job,

while Westinghouse system of the rating, considers the skill of the operator, the pace at which he is working, the kind of conditions in which he is working, and the consistency which is being shown by the operator during the work.

While, the objective rating includes, the pace rating or the speed at which worker is applying himself for carrying out the job, and the degree of difficulty associated with the job, which is being done. Synthetic rating is a very simple method, because in this method, the time for carrying out a particular job is determined, like the time study and the time required, actually for carrying out a particular job is compared with the already available time values, in the data handbooks. So, the time available, from the handbooks is used to compare, the actually time being taken by the worker for carrying the job, and the this comparison gives the synthetic rating of the worker, one by one, now all these rating methods will be covered in detail.

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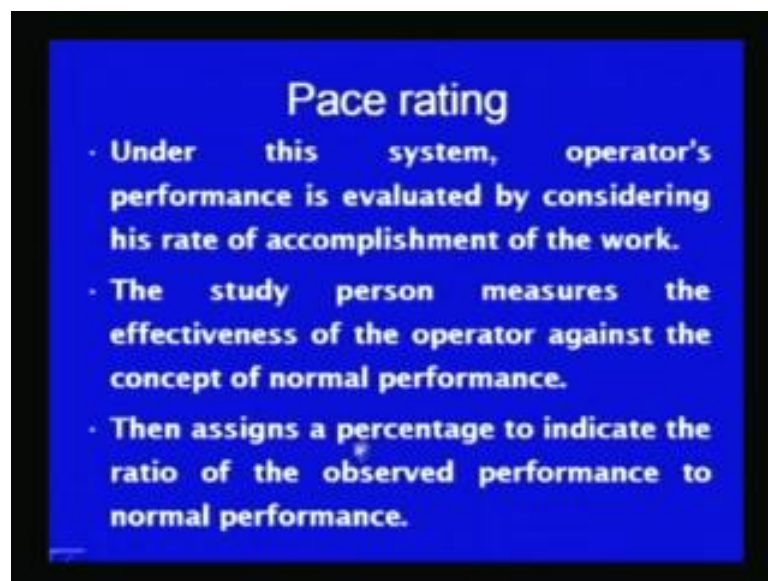
Pace rating under this system, operator's performance is evaluated, by considering his rate of carrying out the job. The study person measures the effectiveness of the operator, against his concept of the normal performance and then assigns a percentage to indicate the ratio of observed performance to the normal performance. So, from the time study persons concept of the standard of performance, he compares the performance of the operator and assigns 1 percentage, which will be indicating, the way by which worker is applying himself to carry out the job.
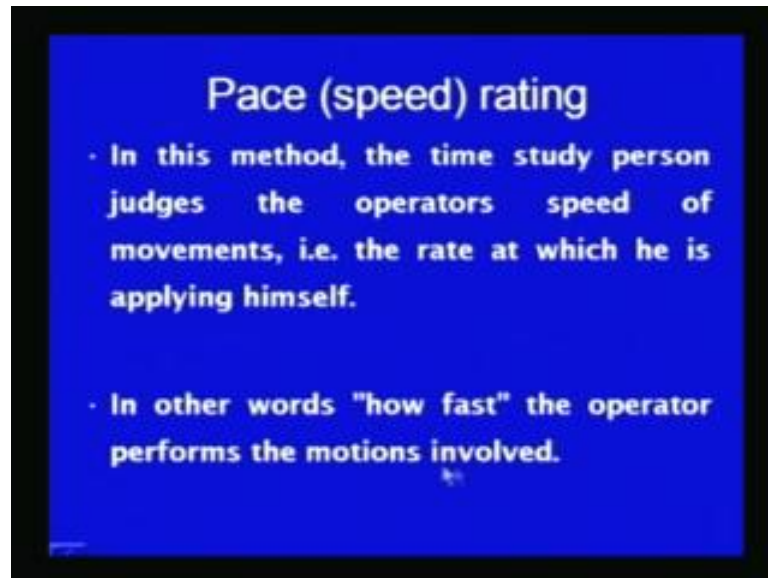
A speed rating, pace setting is also known as the speed rating, and which indicates, the time is that how operator applies himself, while doing the job. The mainly the time study person judges the operator's speed of movement, or the rate at which he is applying himself, while doing to job. In other words, how fast operator performance the motions, in while the job is being done, during the study.
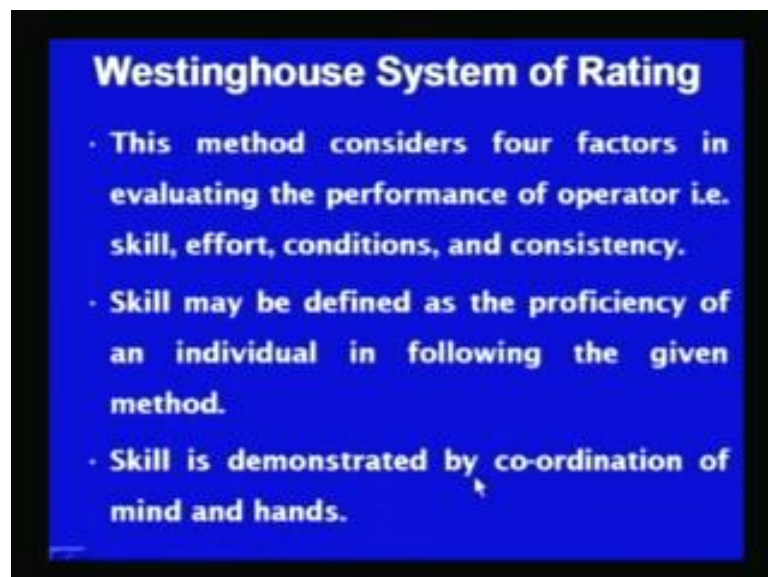
In Westinghouse system of rating, this method considers the four factors for evaluating the operators, performance and these are a skill, effort, conditions, and the consistency.

A skill is about the ability of the operator, to follow the instructions, clearly and accurately, and so as to complete the job. While effort is a about, how much effort and how to what extent, that the body parts are being used while performing the job. The conditions in which work is being done and how consistently he is performing the job, is also analyzed to arrive at the rating of the worker, under the Westinghouse system of the rating. The skill may be defined as a proficiency of an individual in following the given method, and skill is demonstrated by the coordination of the mind and the hands. How, he applies himself, using his thoughts and the body parts, for performing the job.

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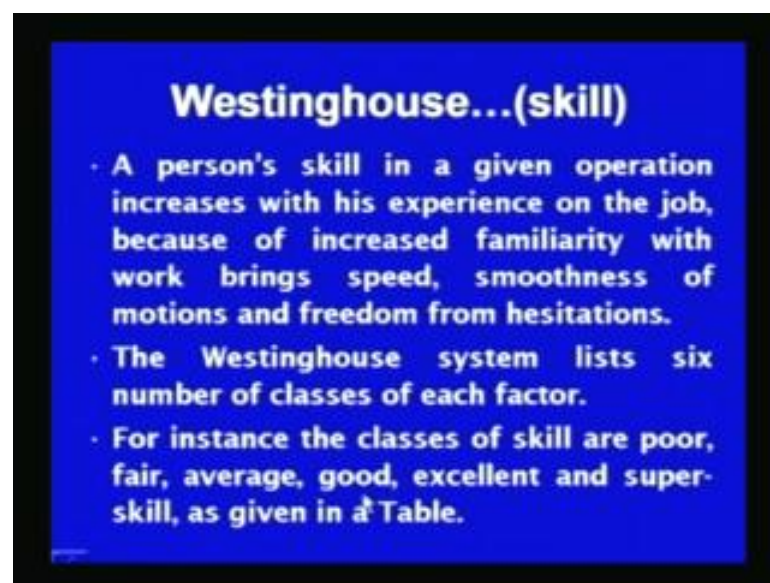
A person's skill in a given operation, increases with the experience on the job, because of increased familiarity with the work brings the speed, smoothness of the motions and freedom of freedom from the hesitations. And these factors in turn, helps to decrease the time required for carrying out, the job with the increase in experience on a particular job, so skill of the person, increases with the experience, due to the various factors, associated with the prolonged operation, by the worker on a particular kind of the job.

Westinghouse system lists the six number of six number of classes of the each factor, each of the above four factors, like skill effort conditions and the consistency are classified in six classes of like poor, fair average to the excellent. So, these six classes, the each factor is categorized into the six classes, which and these classes used for rating

the performance of the worker with respect to the each factor. For instance the classes of the skill are poor, fair, average, good excellent and the super skill, as given in table.

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Westinghouse...(skill)
- Each class has further two degrees. The time study person evaluates the skill displayed by the operator and puts him in one of the six classes and also decides the degree in that class i.e. higher or lower, i.e. 1 or 2.
- As equivalent % value of each class of skill is provided in the Table, the rating is translated into its equivalent percentage value, which ranges from +15 % (for super skill of higher degree) to -22 % (for poor skill of lower degree).

Here, the table will be shown in incoming slides, and the each of these 6 classes are further in allotted 2 degrees, means one is upper degree, and another is lower degree means, the skill say of the average, average will also have will have two degrees of the higher side, or the lower side. The time study person, evaluates the skill displayed by the operator, and puts him in one of the 6 classes and also takes the decision regarding, the degree in which, that class falls higher or lower, normally 1 is allotted for the higher, and 2 for the lower.

As equivalent percentage, value of each class of a skill is provided in table, and the rating is translated into the equivalent percentage value, which ranges from plus 15 percent for super skill of the high degree, higher degree to the minus 22 percent, for poor skill of the lower degree.

These values of the rating factors for skill, can be seen in this table, where super skill being given code of A, and having two degrees A 1 and A 2, upper and the lower, and then here, you can see 0.15 for super skill, and for poor also there are two degrees, the lower is 0.22 and upper one is 0.16. So here, these are in increasing order, of the value which is being allotted, from poor to the super skill.

And, the operator's performance is just on the basis of the A skill, and that is then, one class is allotted to him, and further in that class one degree is allotted in that class, he is on the upper or the lower, his performance is corresponding to the upper or the lower degree, and accordingly numbers are assigned.

The effort rating includes the extent, up to which the different body parts are being used, and the kind of efforts being used by the operator, during the operation. These, there are again six classes, which range from poor, fair, average, good, excellent to the excessive, and each of the class, will be having for the two degrees like, higher degree and the lower degree. So, according to that, the class of the effort rating, here you can say excessive and the higher degree, will be assigned a value of 0.13, while the poor of the lower degree will be assigned of value of minus 0.17.
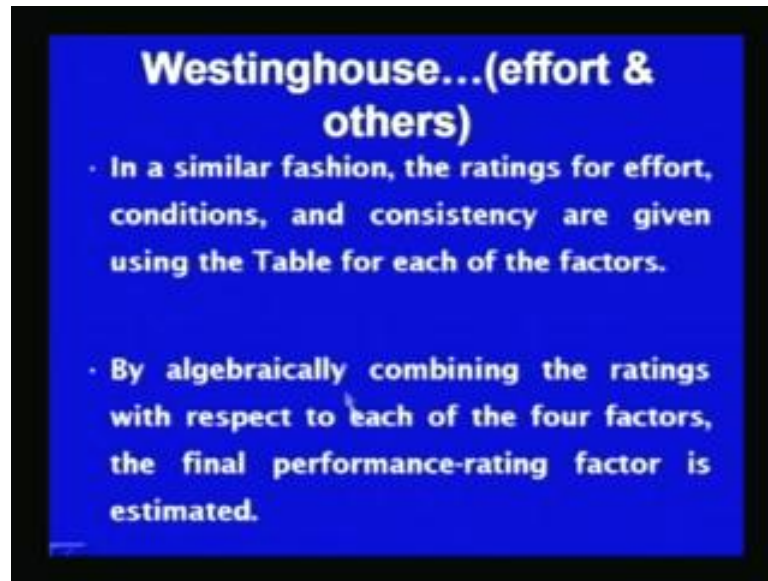
Similarly, the values are also assigned for, the conditions of working, the poor conditions of working or ideal working conditions, and accordingly the values are assigned for, say 0.06, value for the ideal working conditions and for poor working conditions minus 0.07, value is assigned.

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In the same way, consistency is also rated, workers performance is also rated, worker performance is also rated in terms of the consistency, and there are six classes from poor to the perfect and the perfect class is allotted 0.04, and while the poor class is allotted the point minus 0.04.
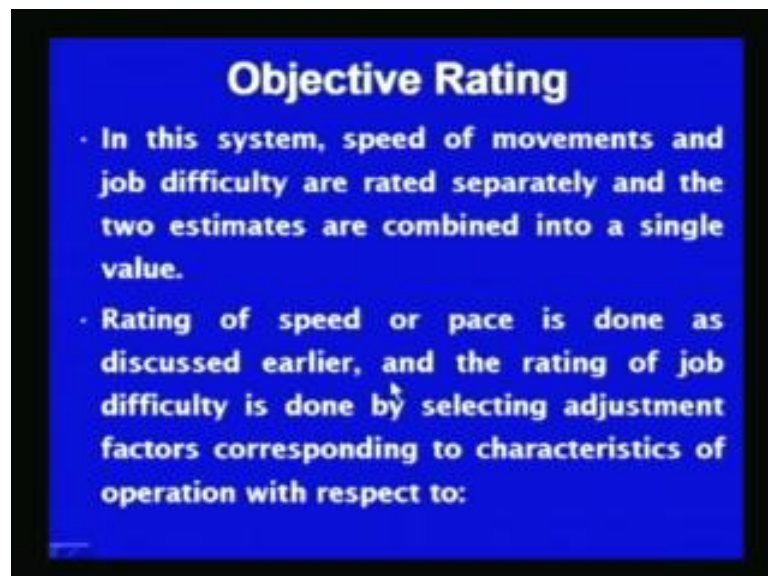
And, so here, you can see, the rating for the effort is skill conditions and the consistency are obtained, from the table for given performance and of operator, while doing the job, and by algebraically combining the rating with respect to the each of four factors, final performance rating is estimated. So, algebraic sum of the values of all these factors, which have been rated by the time study man, is of is used to find out, the performance rating of the worker.

In objective rating, as I have said, that the pace rating and the degree of difficulty, related with the job is used to arrive at the performance rating of the worker. In this system, speed of the movement of the body parts, while doing the job, and the job difficultly are rated separately, and the two estimates are combined into a single value. The rating of the speed or the pace rating is done in the same way as described earlier for the pace rating, while the rating of the job difficulty is done by selecting the adjustment factors, corresponding to the characteristics of the operation with respect to the number of factors, the way by which different body parts are being used while doing the job. So, the adjustment factors for degree of difficulty, involves the consideration of the manufactures the way by which, the body parts are being used.

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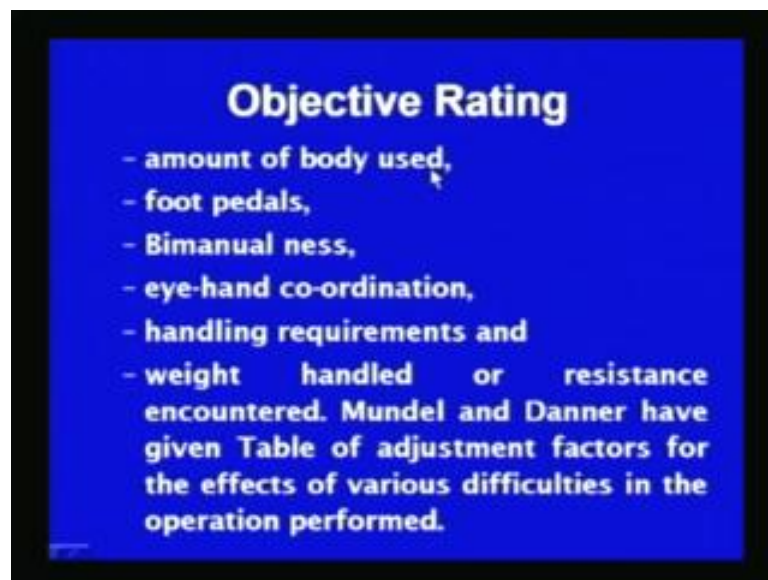
And, the amount of the body used, the foot pedal use, bimanual ness, eye or hand coordination, handling requirement, and the weight we handled during, the work or the resistance, which will be encountered by the operator during the work. These the if degree of difficulty is obtained by categorizing the work of the operator, under these headings, amount of the body used and eye hand coordination, and all these factors while doing the job.

The Mundel and the Danner have given a table for giving table indicating the adjustment factors, for the effect of various difficulties, when job is carried out. So, these values are

obtained, and the algebraic sum of those values is used to arrive at the degree of difficulty.

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So, here the, for all those six factors, the job is analyzed under the different valves are assigned, along with the resistance in carrying out the job or weight which is to be and handled. So, after obtaining the numerical values, related with the degree of difficulty in carrying out the job.

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The rating factor of the worker is obtained by clubbing it with the pace rating, for an operation under study, a numerical value for each of six factors, related with the job difficultly, assigned is obtained and algebraic sum of the numerical values of the job difficultly, adjustment, adjustment factor is estimated. And then, rating factor, for the operator can be expressed as, rating factor equal to R equal to the P into D.

Where P indicates, the pace rating factor which has been assigned by the worker, has been assigned by the time study man to the worker, and D is the degree of difficulty, related with the job, which has been obtained, in terms of the job difficultly adjustment factors, product of these two, gives the rating factor to the operator, in the objective rating method.

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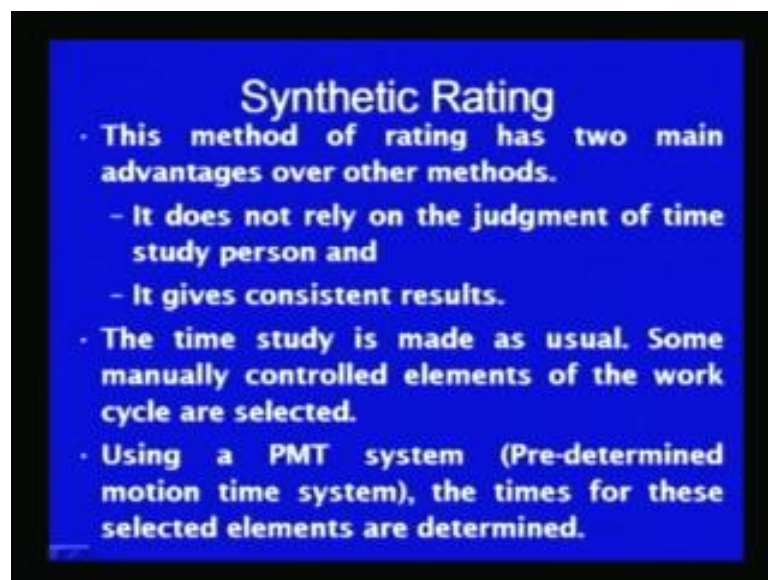
Synthetic rating method is the last method, which is being covered for rating the performance of the worker, in this method, this method has the two main advantages that it does not rely on the judgment of the time study person. And, it is very consistent, because time values are obtained from the data handbook PMTS data bank, and the time study is actually conducted, for time study is actually conducted, in the conventional manner to find out the observed time, in doing a particular job.

In synthetic method, the time study is generally conducted for manually controlled elements, which may be selected from the entire work cycle, and then time values are obtained from the PMTS tables. And, the actual actually observed time values, when

compared with the time values obtained from the PMTS table, are used to arrive at the performance rating of the workers.

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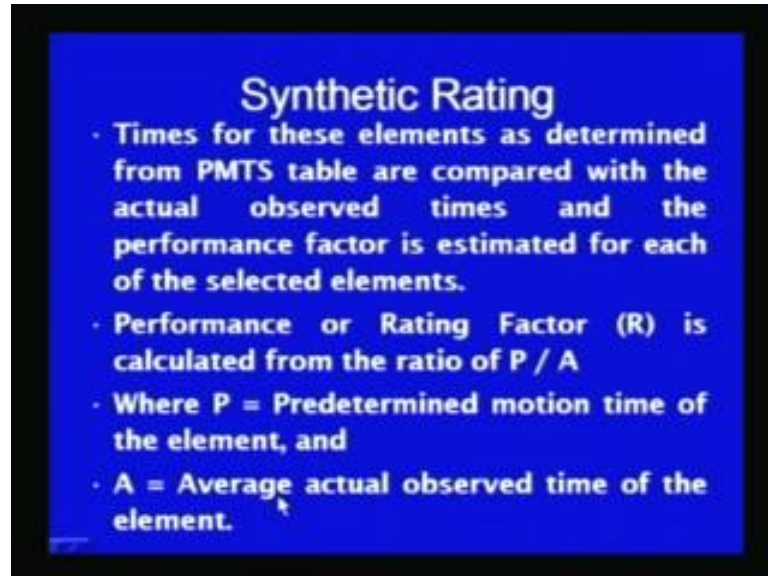
The time for, these elements determined from the PMTS table and compared with the actual observed time, in order to estimate the performance rating factor. The performance rating factor, is given as ratio of the time obtained from the PMTS system and the time actually observed, so the ratio of P by A, where P indicates the predetermined motion time for an element, and the A indicates the average actual observed time of the time taken by the worker in carrying out an element during the time study. So, the ratio of the time obtained from the predetermined motion time study tables, and the actual time is used to calculate, the synthetic rating performance of the worker.
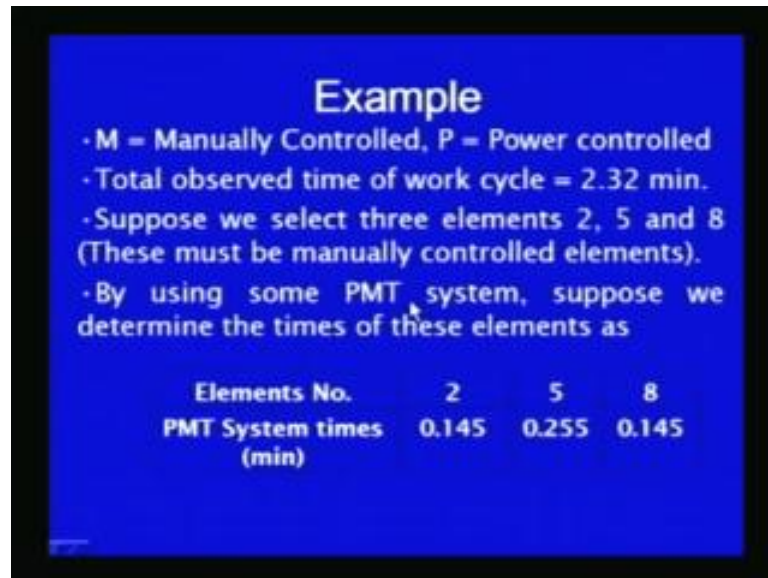
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It can been seen from this example, that if the work cycle has been divided into the 8 elements. And, the time study has been conducted, the average observed time for elements, are as a under where say, the elements from 1 to 8, are there and out of these 8 elements, the 7 elements are in are carried out manually these are indicated, by the and the number M, while the element third is carried out by the machine indicate in, indicated by the letter P and for carrying out this element, the powered system was used and a time take for this is 0.3 minutes.

While all other elements carried out manually, and that time study indicated, the time for the different elements. It can be seen the average actual time for the different elements, 1 to 8 except the time for the element 3, time for actual time for element 3 also has been given, but it is done, with the help of powered system.
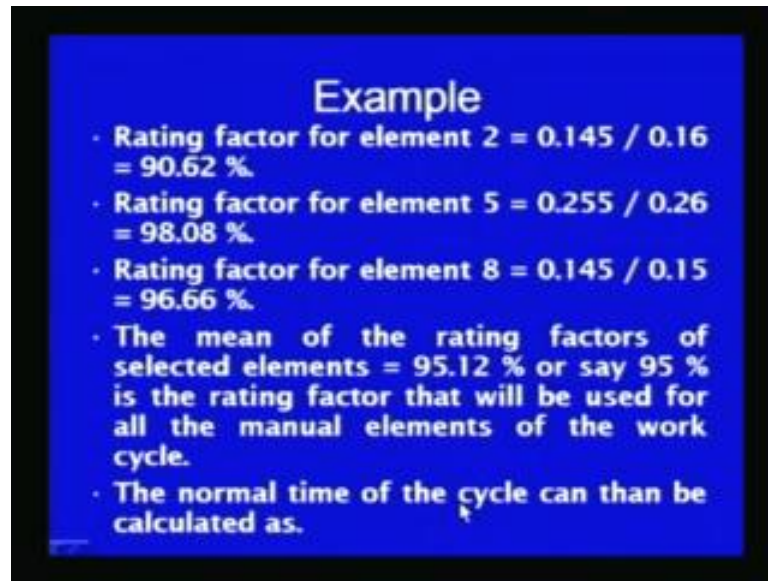
So, if we see further, M indicates the manually controlled elements P are carried out using the power controlled systems. The total observed time of the work cycle, which is obtained from the sum of the time required for completing all the 8 elements, is coming 2.32 minutes. Suppose, if we select 3 elements, 2, 5 and 8 and which are done manually, and the time values also obtained for these elements from the PMTS table.

And, suppose if we get these time values, for the same 2, 5 and 8 elements, from the PMTS table, then the these time values are say corresponding to, say for element number 2, it is 0.145, for element 5 it is 0.255, and for element number 8 it is 0.145. So, these time values are compared, with the actually observed time values for these 3 elements.

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And, if we see the rating factor element 2 is determined from the ratio of the time required time obtained from the PMTS table and the time, which is actually required for carrying out the job, obtained from the time study. So, the ratio of the 2 gives the rating factor for element number 2, in the same way, rating factor for element number 5, and the rating factor for element number 8 can be obtained. And, we can see, the rating factor for element number 2 is 90.62, rating factor for element number 5 is 98.08, and the rating factor for element number 8 is 96.66.

So, average of, a average rating factor for of all these elements is obtained, the mean of the editing factors of selected elements, say comes out to be 0.9 in 95.12 percent. Say approximately, it is say performance rating, for a performance rating of the operator by the synthetic method, synthetic rating method for element 2, 5 and 8 is coming 95 percent, is the rating factor that will be used for all elements of the work cycle. So, what is assume that, the 95 percent is the rating factor, the by which operator will be working, when he will be doing other manually controlled elements also, so the normal time of the cycle, can then be calculated as given below.

Here, this table shows the element number it is type, the actually observed time and the performance rating factor, which has been allotted, 95 is the average rating factor, for the manually controlled elements. So, all the manually, controlled element, will be indicated, by the performance rating factor of the 95, while element number 3, which is carried out using the power controlled system, has been allotted performance rating factor a 100 percent. So, it is important to notice, that the powered systems, the elements which are being carried out by the powered systems are not rated, and they are always given 100 percent rating.

So, to arrive at the normal cycle time, the 0.95 per percent, point nine 5, that is 95 percent performance rating, is multiplied with the actual observed, time values for the 7 elements. And, the 100 percent performance rating is multiplied with the actual observed value, for the powered controlled element and the sum of these, gives the total normal cycle time of the 2.22 minutes. It should be noted, that power controlled elements or machine paced elements, are always given 100 percent the rating factor.

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So, we have seen so far in this presentation, that there are different methods, which are used for rating the performance or of the operator, and these rating factors are subsequently used, to calculate the normal time and arrive at the standard time. But, to determine and to estimate the standard time, in addition to the normal time, allowances are also added. Allowance are frequently added, to cope with those situations, which will force the worker to stop the work, and do other things, and which are may be the part of work or which may be very important, because of which the work is being stopped. So, the factors, which are beyond the control of the operators, to take into the account those factors some of the allowance are given.
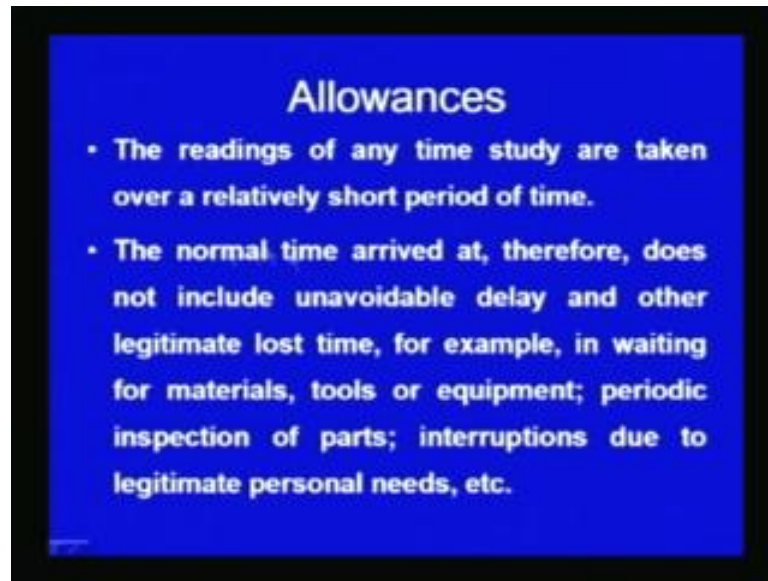
So when, rating of ratings of any time study values are taken, over because, why allowance are given, that we can see, here from, from the fact that, when the rate time study is conducted, it is normally conducted for a very short period of time. And normal time, arrived therefore, does not include the unavoidable delays, and the other legitimate time lost, for example, in waiting for material, tools equipments, periodic inspection of the parts, and interruptions due to the legitimate personal needs.

So, there are various factors, because of which, work may be stopped by the worker, and if those are not included, and then the whatever, normal time is there, these extra time requirements will not be part of the normal time. And, therefore to deal with the, with this situation, where normal time has been obtained, which does not include the factors, due to which work is to be stopped, so to deal with these factors, some additional allowance are given.
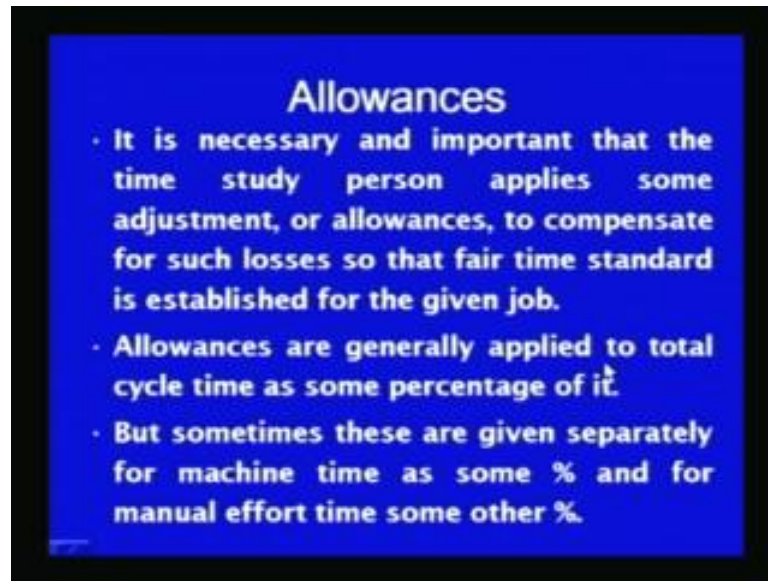
It is necessary and important that, time study person applies some judgment or allowance to compensate for such losses, so that the fair time standard, is established for a given job. Because the when the normal time is obtained, it does not include the factors, because of which the work is stopped, so to include to take into account those factors, some allowance are always given to compensate such losses, so that the fair time standard can be established allowances are generally applied to the total cycle time as a percentage of it. So, the allowance are normally expressed, as a percentage of the normal time for carrying out the one cycle of the job, but sometimes, these are given separately for, machines as a some percentage, well for manual activities as a other percentage.
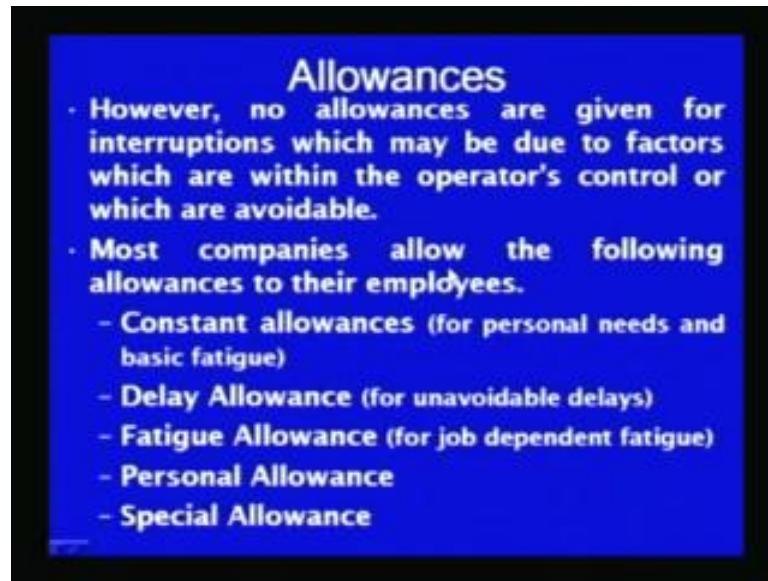
However, no allowance are given for the factors, which may be due within the control of the operator or the factors which are avoidable, the factors, which are not avoidable, only those are taken into account, while identifying the percentage of the allowance to be given. Most of the companies, allow the following types of the allowances to their employees, some of them are constant allowances, which are given for personal needs, and to overcome the basic fatigue.

Well the delay allowances are given, for dealing with the situations, because of which work is, is stooped, due to the lack of material, lack of availability of the instructions or the job, or the lack of availability of the machine itself, due to break down. Personal allowance is given to fulfill, the personal legitimate needs of the body, and to overcome the basic fatigue, which will be occurring during the job, normally 5 percent allowance is given, for the for fulfilling the personal needs. And the special allowances are also given by the organizations and these are decided, in such a way that the operators and the workers or the trainees, can have the reasonable level of the earning for fulfilling, their daily life requirements.
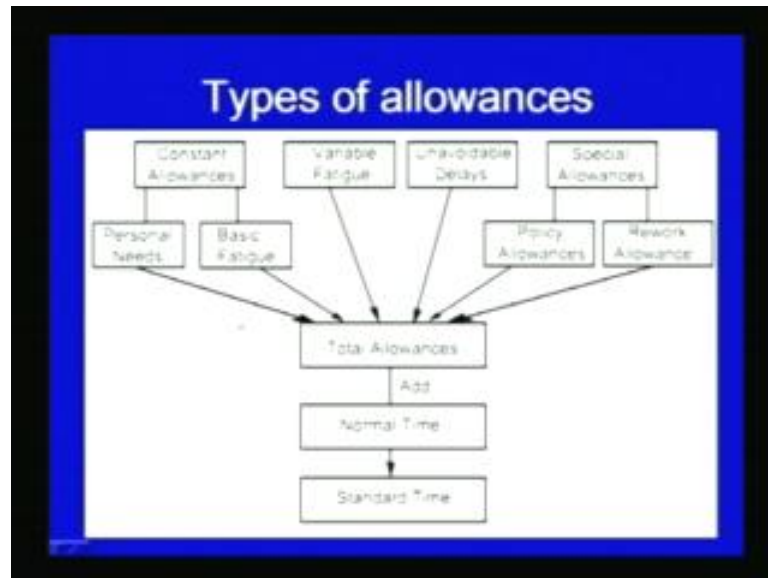
So, if you see this block diagram, how we arrive at, the standard time after adding the different types of the allowances. If we see here, the allowances are added to the normal time, to come up with the standard time, and these allowances, include the personal need allowance and the basic fatigue allowance, which are the part of the constant allowances, variable fatigue allowance is that which will mainly occurring in the cases, where very heavy work is expected to be done by the worker during the operation. While unavoidable delays, delay allowance is allotted, to deal with the situations, which are beyond, the control of the worker and the special allowances, are given in form of policy allowance or the rework allowance.
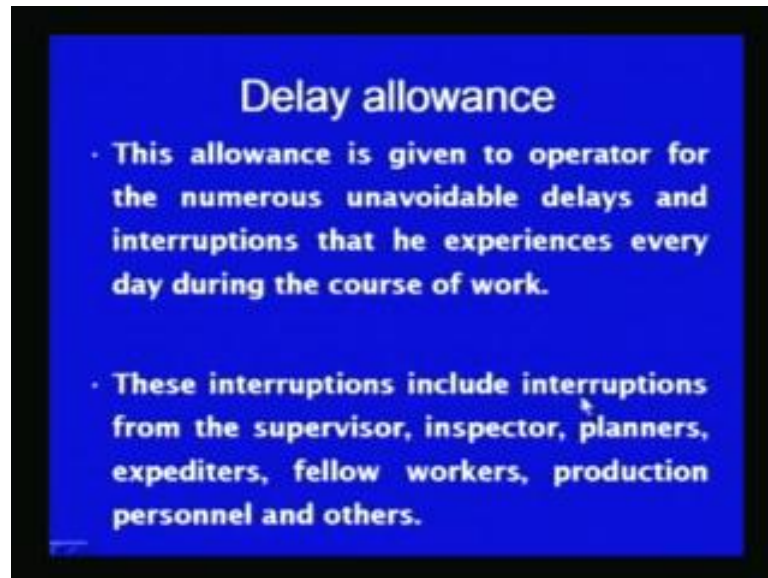
The allowance which is allotted, the first one is the delay allowance this type of allowance is given to the operator for numerous delays and interruptions that he experiences during the day or during the course of work. These interruptions include interruptions from the supervisors, inspectors, planners, expediters, fellow workers production personnel and others.
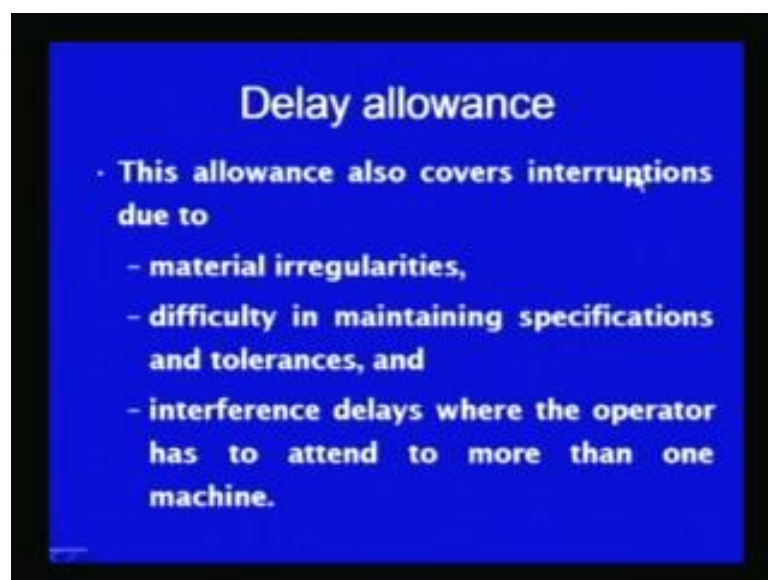
These allowance, covers the interactions interruptions due to the following factors also like the regularities in the material or the defective material, due to the defective

material, the processing is not being carried out. Or the difficulty in maintaining the specifications and the tolerance, like machine condition is poor that is why, it is taking long time or interference delays where operator has to attend, one or more machines at the same time.

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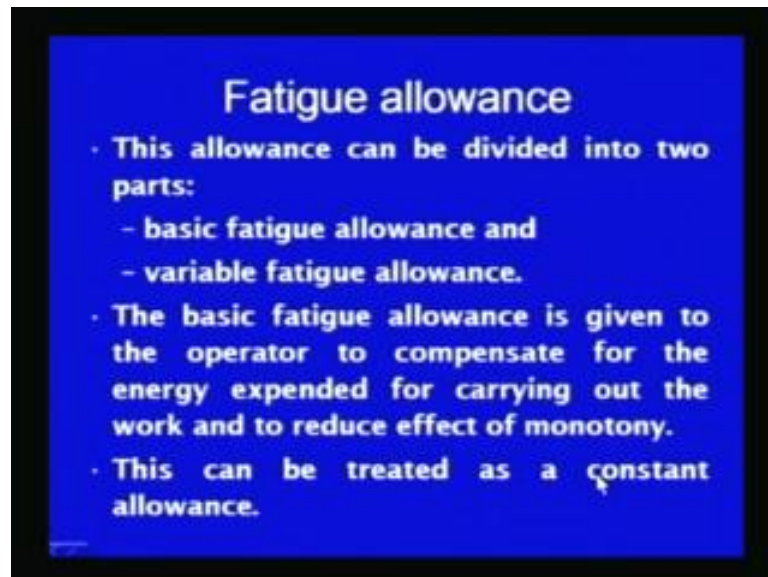
The fatigue, allowance is the, another one, which is given to the workers to overcome the fatigue, which is caused by the work, during the work cycle, this allowance can be divided into the two parts, one is the basic fatigue allowance and the variable fatigue allowance. Basic fatigue allowance is given to the operator to compensate for the energy expended for carrying out the job and to reduce the effect of the monotony, and this can be treated as constant allowance.

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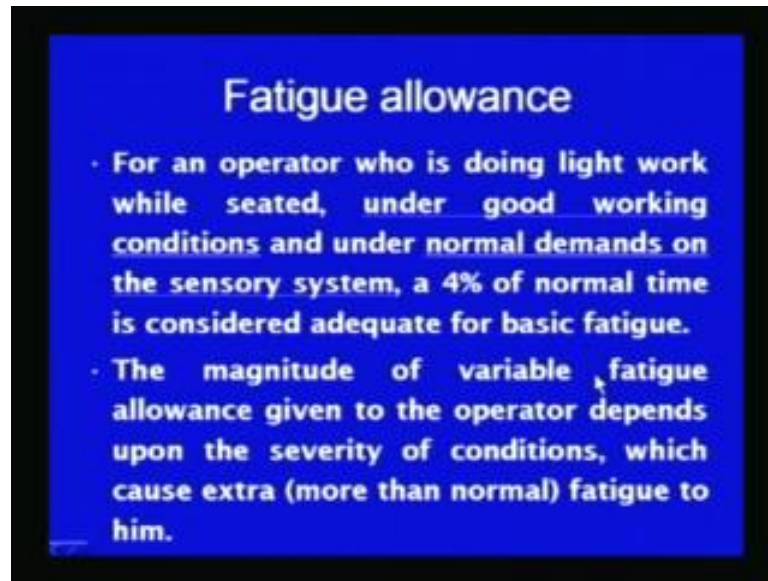
While, the operator who is doing light work, and under the setting conditions, and good working conditions, it is normally given as 4 percent of the normal time, sufficient for the basic, to overcome to the basic fatigue, and the magnitude of the variable fatigue allowance, given to the operator, depends upon the severity of the conditions, in which he has to work during the operation. Severe conditions, force the operator to take early breaks and that is why, under the very bad working conditions, the fatigue allowance can be as high as, the 50 percent of the cycle time.

So, depending upon the severity of the conditions variable fatigue, allowance is fixed, however, lot of bargaining between the labor unions and the management also takes place in identifying, the extent of the fatigue allowance, which is to be allotted. The fatigue allowance, fatigue is caused either due to the physical efforts being, made by the worker or the kind of the mental strain, in which he is working, in both the cases fatigue is experienced by the worker, and whatever, is the cause of the fatigue, it will be decreasing the output of the worker. So, for to accommodate, this reduced output of the worker, due to the fatigue, these fatigue allowance are given.
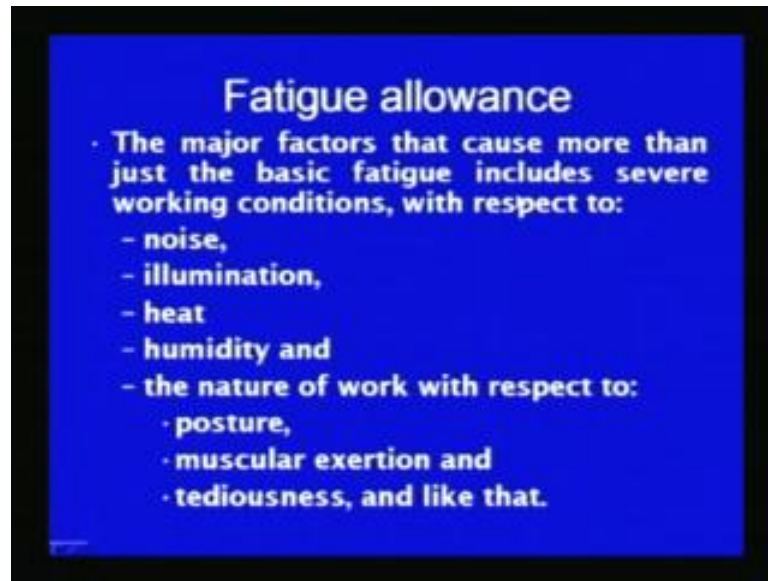
The major factors that cause more than just basic fatigue, includes the severity of the working conditions, in terms of the noise, illumination, the heat, humidity, and the kind of the nature of the work, which is to be done. The work can be seen in terms of the posture required, for carrying out the job, and the kind of the muscular efforts to be made for doing the job, and the degree of difficulty associated with that, so for identifying the extent of variable fatigue, these factors should be taken into account, and at the same time nature of the work, should also be investigated to see, what kind of posture, muscular, exertion or the degree of difficulty is associated with the job.
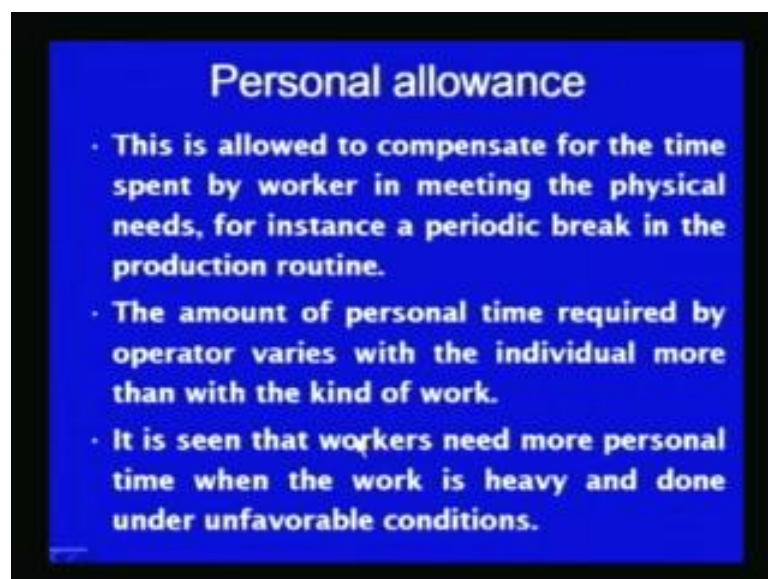
Personal allowance is mainly given to compensate, the time spend by the worker in meeting the personal needs for instance, a periodic break in production routine. The amount of personal time required by the operator varies with the individual and it has nothing to do with the kind of work, which he has to do. It is seen that workers need more personal, some of the workers need more personal time, compared to the others. In general, heavy work if heavy work is being done, under the severe conditions, then the workers and need more personal time, compare to those, who are working under the normal or ideal working conditions.

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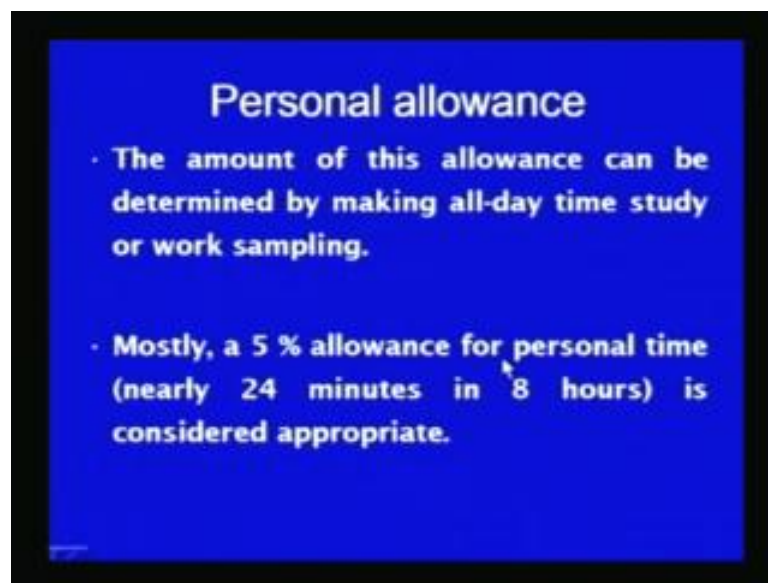
The amount of this allowance can be determined by all day time study or by the work sampling. And, the most of the time, the 5 percent allowance for 5 for personal needs is given, which comes out to be 24 minutes in 8 hours, shift is considered appropriate.
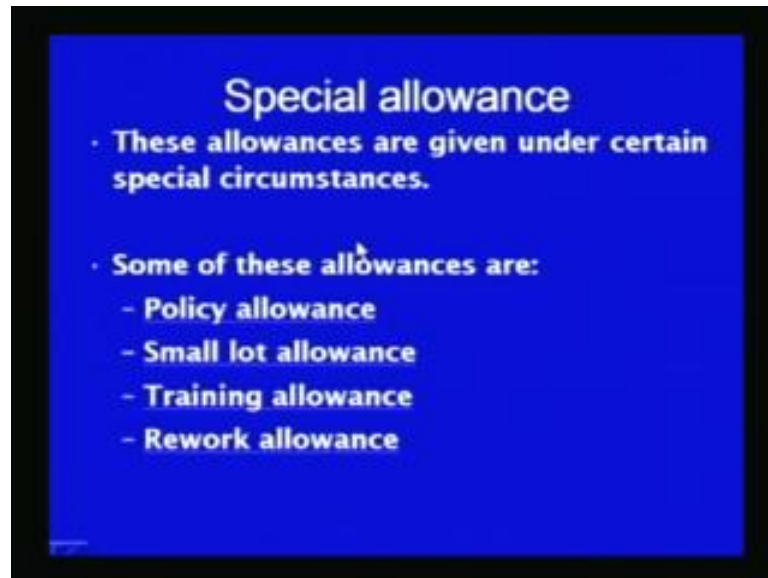
Some of the special allowance are also, given by the organizations to their employees and these are mainly given, in such a way, that the operators can earn the reasonable amount of funding, so that they can support their lives. Some of these, allowance are policy allowance, a small lot allowance, training allowance and the rework allowance.
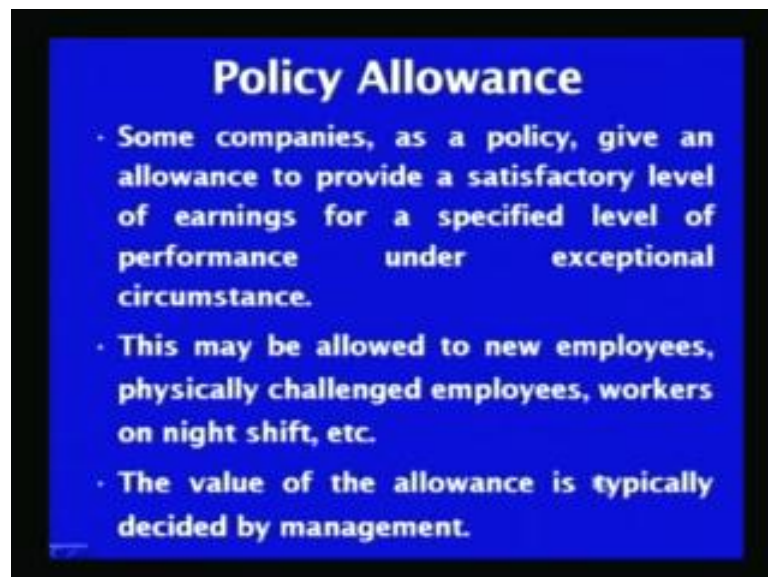
The companies as a policy, many times decide to give an allowance to provide satisfactory level of earnings, for the specified level of performance under the exceptional circumstances. So, as a policy organization decide, that some allowance is to

be given to the workers, so that they can earn enough, to support their lives, provided they are up to, a specified level of performance. This may be allowed to, the new employees, physically challenged employees or the workers, who are working in the night shift, the valve of the allowance, this allowance is typically decided by the management.

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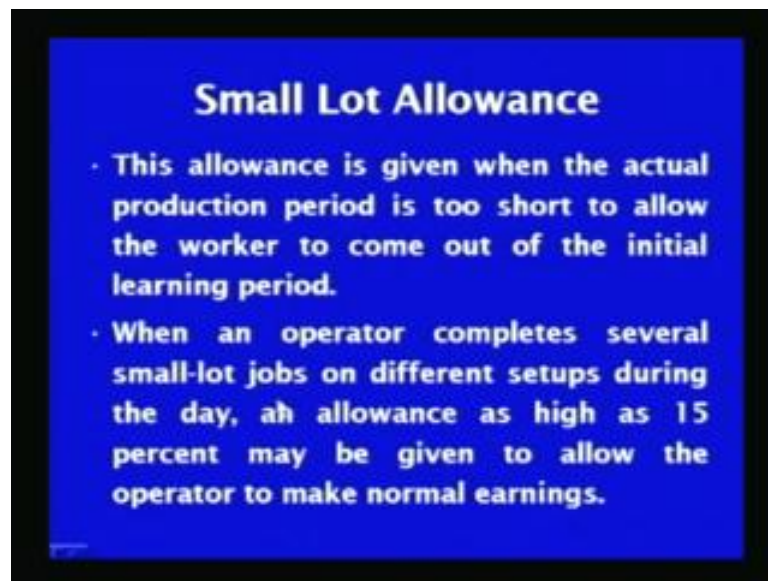
A small lot allowance is the one, which is allotted to the workers, when workers are supposed to carry out the variety of the jobs in a day, and that is why, if they are not able to get expertise, under sufficient experience in carrying out the job, then obviously, they will be taking longer time to complete the job. So, and a long taking the longer time, will reduce their output, and which can also reduce their earnings, so this allowance is given, when the actual production period is too short to allow, the workers to come out of the initial learning period. And, when an operator completes the several small jobs on different setups during the day, an allowance as high as 15 percent may be given, to allow the operator to make, normal earnings to support their lives.
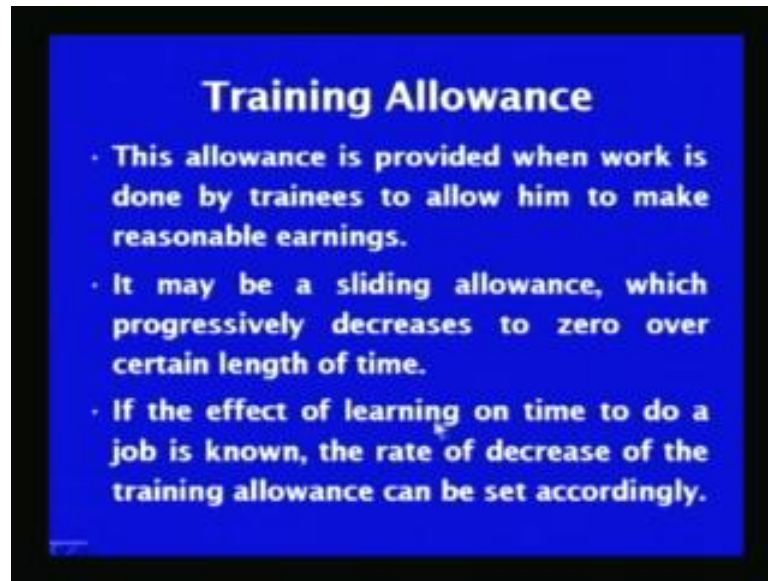
The training allowance is provided when work is done, by the trainees to allow him to make the reasonable earnings. It may be a sliding allowance, which progressively decreases to zero, over a certain period of time, if the effect of learning on time is known, then, the rate of decrease of the training allowance, can be set accordingly.
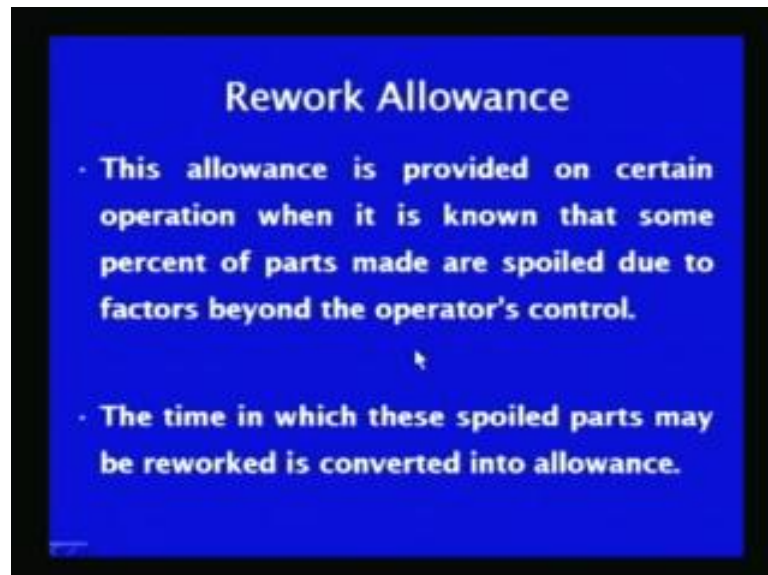
The rework allowance is provided on the certain operations, when it is known that the job, which will be produced of a particular standard or on a particular kind of system are going to be spoiled, due to the factors, which are beyond his control. So, under these
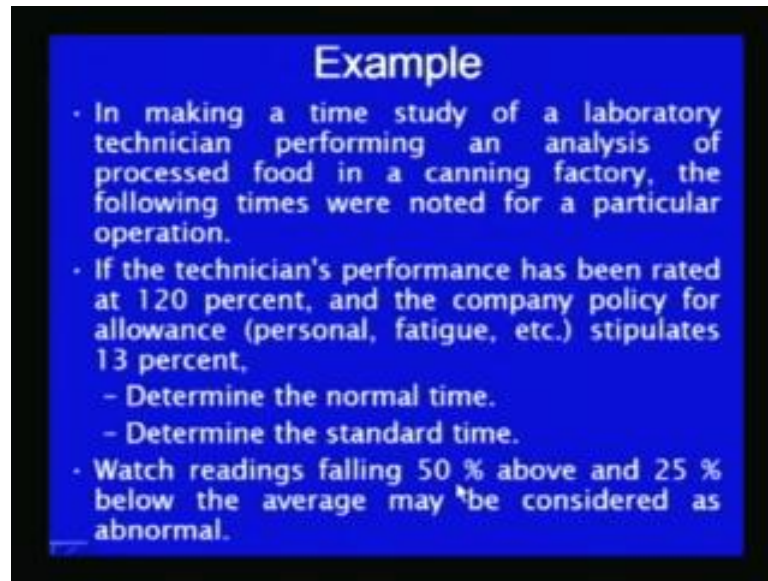
circumstances, where some of the qualities, which are very difficult to achieve or the systems are such that, some of works products are going to be rejected, under those conditions, the rejected works products will be reworked by the operator. So whatever, time is being, is taken to rework those rejected products is allotted as a rework allowance, so the time in which the spoiled parts, in which the spoiled parts are reworked is converted into the rework allowance.

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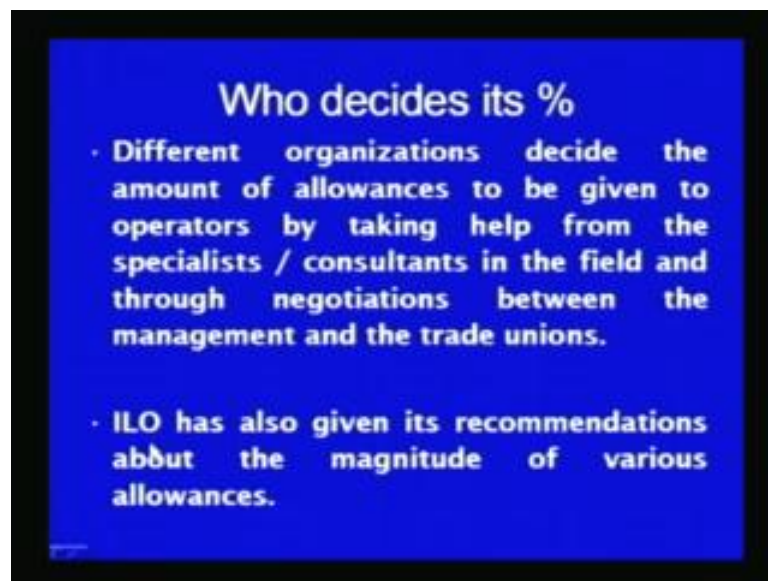
And the decision regarding, the percentage of the allowance to be given to the workers, is taken by the management, with the assistance of the specialists and consultants in the field, and also through the negotiations between the management, and the trade unions. And the ILO, international level of organization has also given it is recommendations about the magnitude of the various allowances which is to be given.

Now, we will see, one case study, where if the time being taken by the workers, are too much and the allowances are also of the different types, then how it can effect, the standard time required for carrying out the job. In making, in a in a time study, of a laboratory technician performing, an analysis of processed food, in canning factory the following items were noted down, for a particular operation.

If the technician's performance has been rated, at to 120 percent and the company policy for the allowance stipulates to the 13 percent, then how we can arrive at the normal time, and determine the standard time. If the watch readings show, that if it is considered that the readings, above the 50 percent of the average, and below the 20 percent of the average are considered abnormal, then those readings are to be discarded, for arriving at the normal time.

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So, if the different runs are carried out, and the time required for carrying out, those runs is evaluated and measured, and it here, the first row indicates the number of runs, and third row also indicates the number of runs, in total there are 24 runs. And, the operation indicates the time being taken for carrying out those runs, so here, if we see most of the runs take 20, 25 or 15 to 25 minutes range of the time. While the run number 11 is taking the 40 minutes, while other runs are in general in range of 15 to 25 minutes.

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The average time of the all elements can be obtained from the total cycle time and the number of cycles, which are being used and we can see, that it comes out to be approximately 20 seconds. If we have to discard the values greater than the 50 percent of the average time, and below and the 25 percent below the average, then accordingly we have to calculate, the values 1.5 times of the average and 0.7 times of the average.

It comes out to be 30 seconds and 15th seconds, so accordingly, we have to see data once again, to see that how many time values are falling, beyond the 15 to 30 range. So here, if again we scrutiny and check the table values, we will notice that the 40, second value is falling beyond this range of 15 to 30 seconds, so here by discarding that valve, of the forty seconds for one operation, again if we calculate the average, then it comes out to be 19.2 seconds.

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Here, we can see, the same thing, that the table indicating the time values for the different runs and the four run number 11 the time values are value is 40, which is, which need to be discarded, as per the condition imposed.

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And, that is why, it is required to recalculate, the average observed the time value and this average observed time value, can be used to calculate the normal time, with the normal time, and that can be obtained from the product of average observed time. And, the rating factor allotted by the time study man, and which has been 120 for the technician, so normal time, can be obtained from 19.2 into the 120 divided by 100, that is a performance rating and the normal time comes out to be 23.04 seconds.

And the standard time then can be calculated using this equation, and where in addition to the normal time allowance is also incorporated, and then we get a time value of 26.5 seconds. So, here we can see, if the performance rating value has been given and the observed time values for the different runs has been given, and allowance which is to be allotted has been given, how can be arrived at the standard time.

Now, I shall conclude this presentation, in this presentation I have mainly covered the different techniques of the performance rating, and we have seen that, the performance rating is an important factor, and the important step, in the time study for arriving at the standard time value. And for arriving at the standard time value, we have to add the allowances, with the normal time, and the why, the different types of the allowance are to be given, what is the ((Refer Time: 49:42)) behind the different types of the allowances which are generally allotted, those things we have discussed in detail.

Thank you for your kind attention.