Principles of Industrial Engineering

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Lecture No. 21

Plant Layout: Process Layout Design

Hello, I welcome you all in this presentation related to the subject principles of industrial engineering, and we are talking about the plant layouts. I have introduced to all 5 types of the plant layouts like the process layout, product layout, combination layout, then cellular layout, and fixed layout. We will be talking about the procedure for designing the process layout and the product layouts.

So, in this presentation, I will be taking up the process layout design. As you know that in the process layout, the machines and facilities are arranged according to the type of operations they do, the machines performing the similar type of operations are grouped together. While they, well the flow of the material in the facility is not in considered, is not in consideration or in the arrangement of the facilities that is not a parameter. While in case of the product layout the facilities are arranged specifically according to the sequence in which operations are to be performed in the product to be manufactured.

So, this makes the job of the process layout design little bit clumsy and complex. Because here we have, we do not have any specific criteria for grouping of the machines. There is just one criteria for grouping of the machine that is that type of function, type of the job that they do. So, in this situation, in order to see that how the different facilities can be arranged in a plant, so that organization can realize its goal of manufacturing things at the minimum possible price of the required quality under the required quantity.

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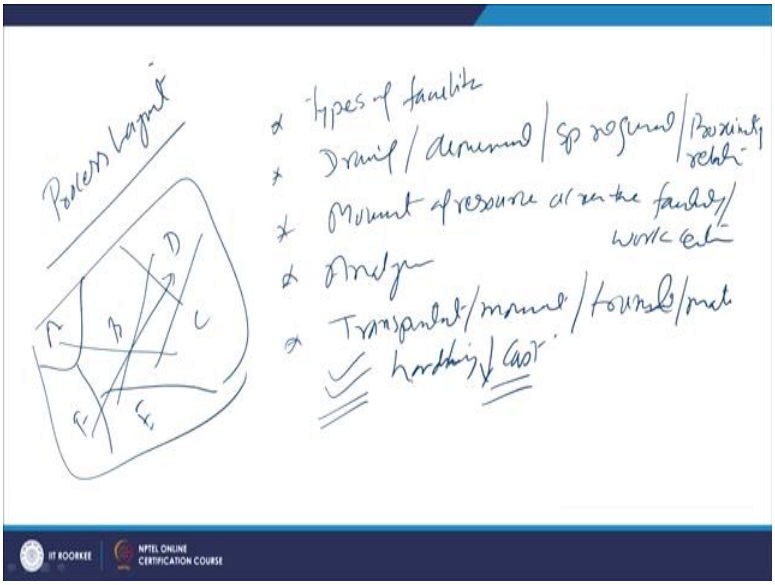

So, as far as the process layout is concerned for designing, basically we have to see what are the different types of the facilities to be, to be accommodated. What are the kind of the drawing, or the dimensional details, or the specific requirements, or the kind of the proximity relationship, how close they should be, proximity relationship. And what is the kind of the movement which is involved, movement of the resources like man, material, machines, across the facilities or the work centres.

Once if we have this information, we can analyse it suitably, to see what will be the combination for which if the facilities are arranged, the transportation, movement and, the associated travel, material handling. So, all these costs and times are reduced. So basically, idea here is that if there are various groups like this, A, B, C, D, E, F. So, whether we should have A close to C, or D close to E, or B close to, or F close to D. So, especially the nonadjacent work centres are analysed to see if really, they need to be close to each other or not.

Or what will be the kind of arrangement that will help in minimizing the distances to be travelled, the transportation, or material handling, so that material handling costs and the distance is related with can be reduced.

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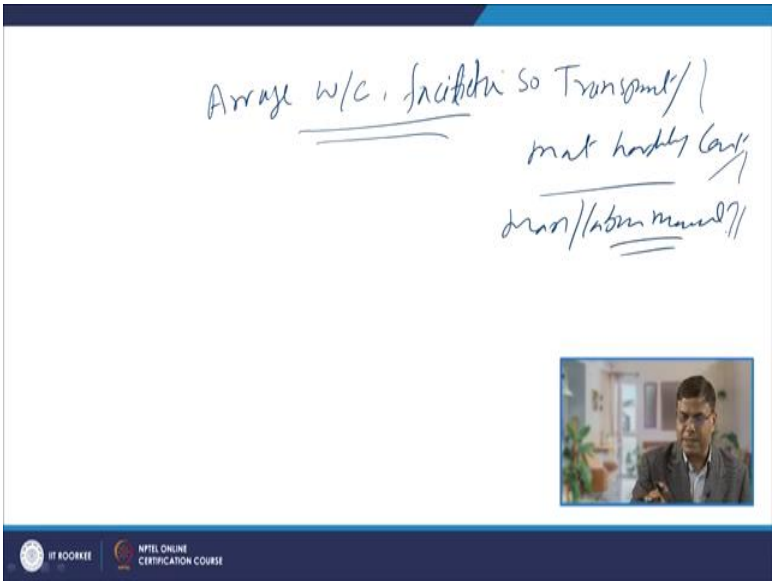

So basically, idea here is in the layout design for the process layout is arrange the work centres or facilities so, that the transportation or material handling cost is reduced. And if it is just the, if the cost is not a major factor and it is just the movement of the manpower which is involved, then it will be reducing the time wasted in the movement of the manpower. So, that also is to, that is also considered in taking decision about when the facilities are arranged, man or the labour movement.

So, so this arrangement of the facilities to be identified, so that the transportation material handling or the man movement can be reduced. So, there are certain steps and stages.

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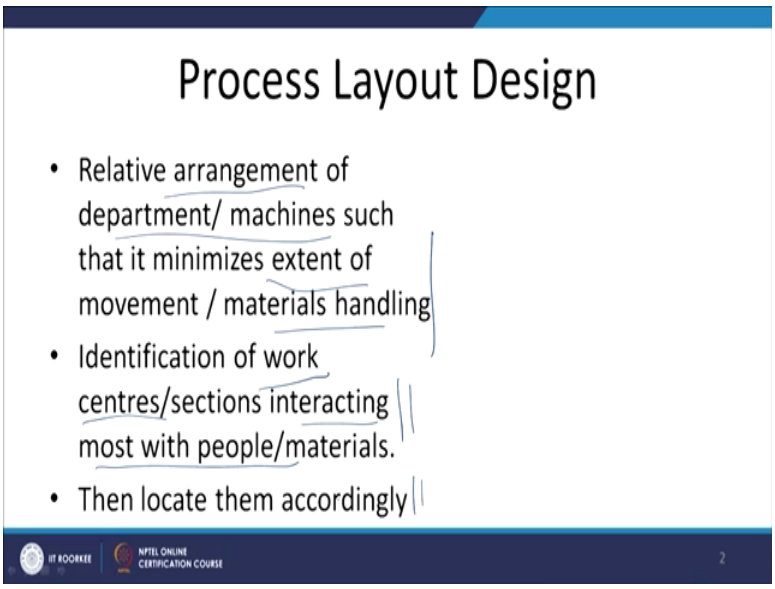

So, what are the procedural steps. In layout design, we have to identify what is the relative arrangement of the machines so, that it helps in minimizing the extent of movement, material or material handling across the centres, across the facilities. We have to identify what are the various facilities to be developed and what will be the kind of interactions or the movement between them. If the 2 facilities located very far apart and the movement between them is very high, then we have to give enough thought, so that they can be brought close to each other.

So, that the related movements can be reduced. So, considering the extent of movement or extent of interactions of the man material across the centres, the facilities are brought close to each other.

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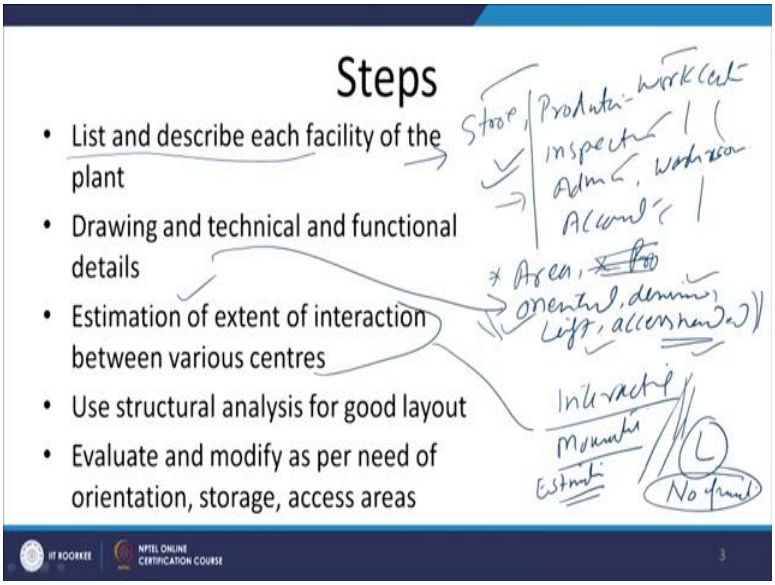

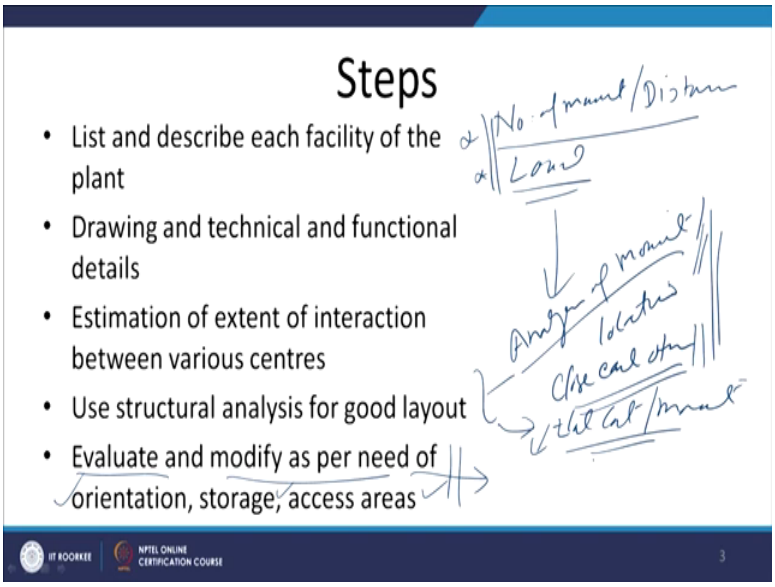

So, what are the steps, like in the steps at list, develop, prepare a list of the facilities which is to be developed, and along with its description. For example, what will be the kind of the facilities, like where the store space is needed for store of the different types of the inventory items. Then, the production facility, in production facility again there will be different work centres, where will be the inspection facility, where we will be the administration, where will be the washrooms for public utilities, where will be the account sections.

So, depending upon the type of the job being done by the different functional groups, different the centres, the facilities need to be arranged in such a way that the extent of movement is reduced. So, prepare a list and then also prepare the kind of the area which is needed. Or we have to see, if there is a special need of a, special aspect related with the closeness or proximity, or the 2 need to be kept apart. So, first develop a list and with the description kind of the job they will be doing, the kind of area they need.

Then get that drawings of the, drawings of course, will include the orientation, the dimension of the different facilities which are needed, and the kind of the location or any special feature which is to be incorporated. Like there will be, lifts, or any space of access which is needed for firefighting, or any other special requirements. So, the orientation, the dimension and the design requirements, the lifts, or any special access requirement that information about that is collected.

And then, what is the kind of the interaction across the centres, whatever centres are there, like store walk centres, inspection, administration, the washrooms, account so what, wherever these centres are interacting or needs the movement is needed between them, these centres are located. So, the estimate of that movement is determined. So, for this purpose, we may use work sampling or we can keep on having the record of the kind of the movement which is involved across the centres, of the material or of the man to have the smooth production. So, estimate of that movement or the extent of movement is developed.

And this may be considered as the, load or the number of the movements which is needed. This is very important thing, to have the data about the extent of the movement which is involved across the centres.

So, that load the number of the movements or the distance of the movement. And then, this is also termed as the load which is to be moved. Then this, the extent of movement which is there between the different departments that is analysed. So, a structural analysis is carried

out, so that through the proper analysis of the movement and their, possible locations is done in such a way that the centres having the maximum movement, in terms of the distances and the load to be travelled they are brought close to each other if possible, in respect of the proximity analysts says.

Sometimes it may not be possible to have like the store for the flammable items next to the pharmacist. So, they need to be kept apart, whatever is the kind of the movement which is needed between them.

So, once we have this, then we will access the kind of the movement in the, in light of this analysis of the movement. And the proposed location for the different centres, we identify the kind of the, the total cost or the movement which will be needed. We can work on if you are not happy, we can further revise the tentative locations, to see what will be the best possible kind of arrangements so that, so that the distances to travel are minimized.

So, evaluate the above developed the layout and modify as per the need to reduce the movements further or to accommodate the further requirements of the specific orientation, storage, or the access area requirements. So, we will propose something and will modify, if required to reduce the transportation and movements further or to accommodate the special requirements related with the orientation, storage and the special access requirements.

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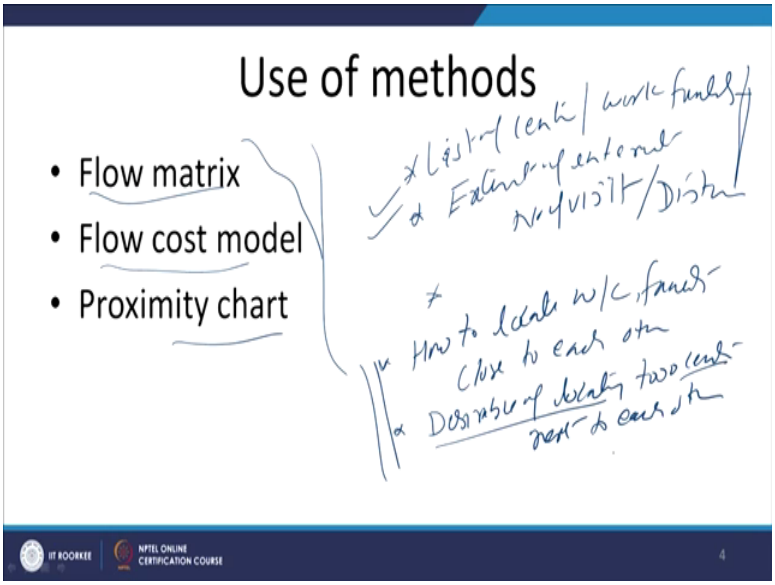

So, for the analysis purpose, like we have got the information about the list of centres or the work facilities, for which layout is to be developed. We have got the information about the extent of interaction, in terms of the number of visits or the distance to be travelled. Next job

is to do the analysis, analysis of this information, so that we can come up with the best possible arrangement of the facilities according to the process layout, so that the distances to be travelled are reduced, while other objectives are also realized.

There are 3 methods which, about which we will be talking related with the analysis of this data that will help in, in identifying that the things. Like, how to locate the work centres, or facilities close to each other, so that the distances to be travelled are minimized, that is one. And the second, is about the what is the kind of the desirability of locating 2 centres next to each other, next to each other.

So, these 2 things are analysed with the help of these 2 approaches. One is the flow matrix, and another is the flow cost model, and the third is the proximity chart. So initially, I will talk about the proximity chart in which will try to see what is that kind of, how to identify that desirability of locating the 2 work centres close to each other.

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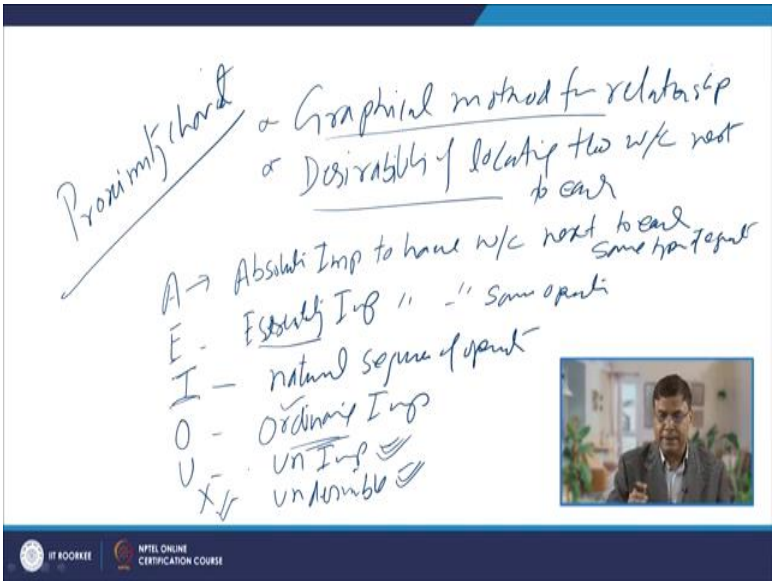

So here, the proximity chart we develop a proximity chart, basically proximate relationship chart. This chart is a basically, graphical method for understanding the relationship between the 2 work centres, what if they are located next to each other. And this helps in, in identification of the desirability of locating the 2 work centres next to each other. So, this is basically graphical method of understanding the relationship and what we try to understand is the desirability of locating the 2 work centres, next to each other.

So, for this we use few symbols, symbols like A. A is used when it is absolutely important, absolutely important to have the 2 work centres or the facilities next to each other, it is very

important, means it is absolutely important. The second is E, E is used when it is essentially important or especially important, essentially important or especially important to have the facilities next to each other. So, in the first case say, what we have the same type of the facilities, same type of the equipments like the 2 lathe machines are kept close to each other.

Essentially important in that case, like say the same operator is working on the 2 or more machines. So, they will be kept close to each other. So, that is essentially important and next is important. When it is, when arranging the 2 facilities close to each other is important because this is the natural, the equipments will following, following in the natural sequence of operations. Like first of all cutting, after cutting if the drilling is normally performed so, then cutting and drilling can be brought close to each other or after finishing operation if it is the heat treatment to be done. So, they can be brought close to each other.

So, if the 2 work centres or facilities are coming, are having the natural sequence of the operations, means after completion of one other will be done then the facilities are arranged and next to each other. So, that is the situation of like important to have them close to each other because they are falling in the natural sequence of operation. O is used when the putting the 2 facilities together is of the ordinary in importance. So, if it is good, if the 2 are brought close to each other, otherwise it is not that important. And then we have, it is good if they are 2 are brought close to each other. but it is, if they are not kept together, then also it is a fine.

Then U is when unimportant, unimportant it does not matter, wherever the facilities are located with the 2 facilities, the proximity of the 2 facilities is immaterial, if located good, if not located, so it does not matter. So, that is the case then U a letter is used for unimportant proximity. And X is used undesirable, when it is important that 2 are kept apart far away from each other because of the variety of reasons, then the proximity relationship is expressed through the X.

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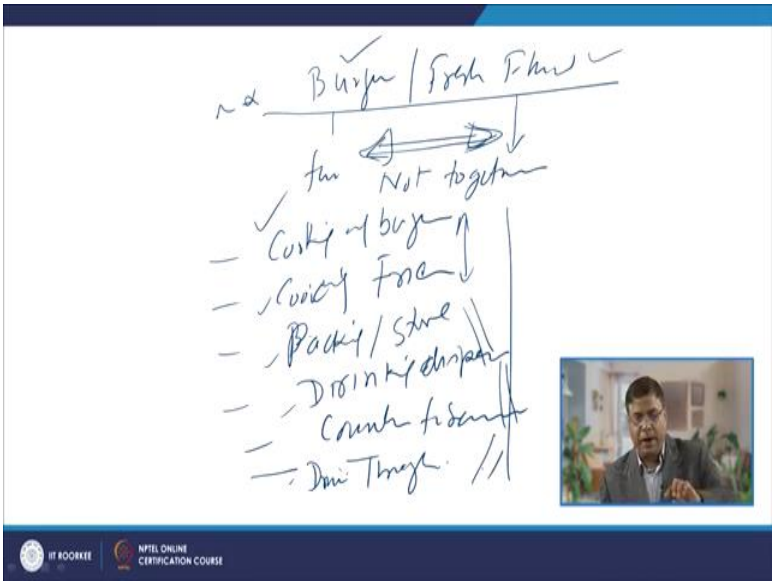

So, like say in, in just for an example, I will give you like in a restaurant, restaurant, preparing the burgers and french fries. So, there is a, there is a cell, there is a facility for burgers and the facilities for the deep frying of the french fries. And it is desired that the 2 facilities are not together due to the safety reasons; it is about the restaurant. So, in the restaurant the burgers are prepared, and the french fries are prepared, and it is required that the, the facility is being used for preparing the burgers and french fries are not kept close to each other.

So, what we will say, as far as the list of the centres is concerned cooking of the, like say burgers, cooking of the french fries, And then, like say it is required to have a corner or centre or counter for packing and store. Then there is a drinking dispenser, and then there is a counter for service, and then like say the drive through, drive through kind of thing.

So, these are the different kind of the, the centres or the facilities which are needed. If it is desired that the 2 are not kept close to each other, then what is the kind of the close proximity relationship between the packing and storing area, approximate relationship between the drinking and the dispensing machine, proximity relationship with the counter surface and the drinking facility, like that.

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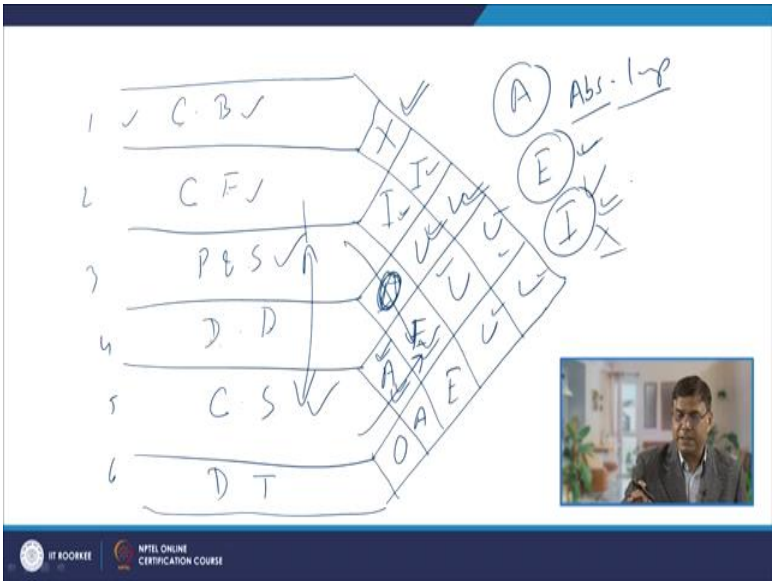

So, to have, to understand the proximity relationship between these centres. What we prepare, we prepare one graphical chart like this. Like say, here first of all cooking of the burgers, cooking of the french fries, then we have the packing and store, then drinking dispenser and then we have counter for service and then drive through. So, these are the different centres that are needed 1, 2, 3, 4, 5, 6. So, to understand the proximity relationship, what we do, we prepare one graphical chart like this and then all these are connected through these lines this way and similarly, this way.

So, what we want, if we want that if the kind of the relationship which is being given is like the X, I, A, I, then O, then A, and then O. Then next is I, U, E, A, then U, U, E, U, U, U. So, if this is the kind of the relationship which has been identified between the different work centres. So, if you want that the cooking burger and cooking french fries facilities are not next to each other, then it will be rated through the X, which means that 2 facilities should not be kept close to each other. It is important, kind of the rating when it is given like the packing and stores, and the french fries are next to each other.

Similarly, the packing, and stores, and the cooking burger facilities are also important. It is not, it is a, it is important kind of the relationship. When like the drinking and dispenser is a relationship with the like packing and store its O, ordinary importance. While, in case of the drinking dispenser and the counter service, they are next to each other. So, it is absolutely important that they are close to each other. So, likewise, what we see here the french fries cooking and the drinking dispenser are of the undesirable or unimportant. And here, are the

likewise the cooking burger and the drinking dispenser are having the unimportant relationship.

So, when it is the 2, the proximity of the 2 is not important, it will be rated like U. If the 2 should not be close to each other, then will be rated X, if it is absolutely important and will be rated A. And if it is desired that, like the relationship between the and the packing and store area and counter surface is having the kind of, it is essential to have the 2 facilities close to each other then it will be rated say E, this is the kind of relationship. This is how we try to understand the relationship between the, various work centres.

So, those facilities which is, which are being rated through A, means it is absolutely important that the 2 facilities are kept to close, kept close to each other than efforts are made to bring them together. And likewise, essentially important than those which are rated. Thereafter, efforts are made to bring the facilities close to each other which are rated by I, and like E. And then likewise the, we will give the importance to the facilities which are being rated through, I likewise. So, this will help us to see that the, how important it is to have the 2 facilities close to each other.

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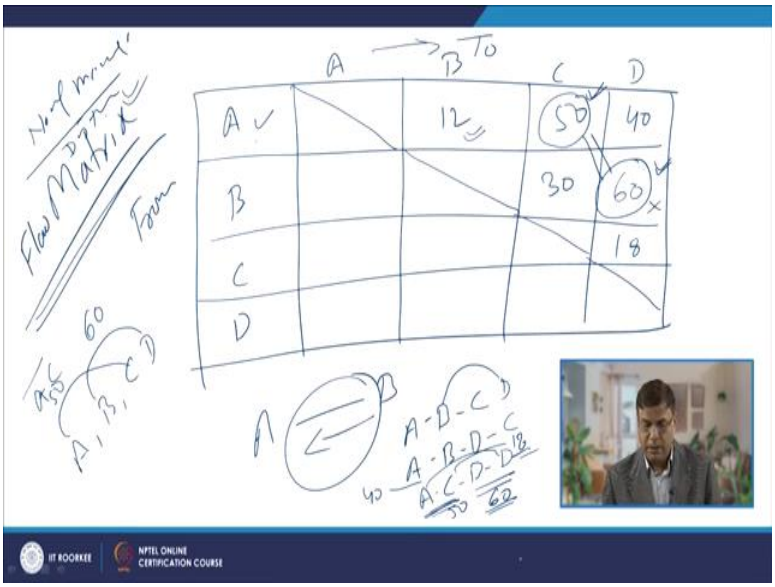

Now, we will see the matrix, the flow matrix approach. In the flow matrix approach, what we do like we identify the different work centres. Like say, they are different work centres being named as A, B, C, D kind of thing, work centre A, B, C, D. So, these are the, like the two work centres, where the movement is occurring from these centres. So, what we will have

here we have say, A, B, C, D. So, there 4 work centres and we want to understand what is the kind of the, what is the extent of movement between the work centres.

So, obviously, the A to A movement is not there, B to B movement is not there, C to C movement is not there, and D to D movement is not there. And it is immaterial, whether we are moving from A to B or B to A. So, it is important that, so as far as the extent of movement between the two centres is concerned, we are mainly concerned that whether the movement is from A to B or B to A, that total movement is to be identified.

So, in this chart what we will be doing, whatever is the movement from the station A to station B that is quantified, say that movement is coming out to be say 12. And say from A to C, the movement is coming out to be 50, and A to D movement is coming out to be 40.

Similarly, B to, B to A we have already considered here that the 12 is the net movement, either A to B or B to A. Likewise, A to C or C to A is 50, and like A to D and D to A is 40. Similarly, what will be doing B to C movement will be identified say it is 30, and B to D movement is 60. Now, we will also see what is left C to D movement is how much, say 18. So, now, we have got the all movements between the different centres.

So, what it is suggesting, from here what we can see that the movement between A and B or B and A is just 12. So, it is not important to bring them close to each other. We will try to look for those movements which are maximum in numbers between the 2 centres. So, considering that if we see A to C movements is the second highest movement, A to C or C to A movement is the second highest movement. While, B to C movement is 30 and B to D movement is 60.

So, the highest movement between among these 4 work centres A, B, C, D, B to D movement is the highest 60, and the A to C movement is the second highest, A to C movement is second highest.

So, what will we make an effort, so here it is 50. So, what we will be doing will try to, try to see the arrangement if the 2 can be brought close to each other. So, what can be done, so B, and D, say if the arrangement is like A, B, C, D. So, what we will be doing, we will try to first see like A and in D, B and D are brought close to each other, A and C are far away. There is another, so in this case, the 60 movement will be B and D having the maximum movement have been brought close to each other, but A and C have been taken apart.

There is another possibility, A and C are brought close to next to each other and then B and D are brought to each other. So, A and C having the 50 movement, and B and D having the 60 movement, both are next to each other. While, A to D movement, A to D movement is 40 and like say the C to D movement is C to D movement is just 18. So, the in this way through the flow matrix chart, we are able to identify the work centres where the movement is maximum, or the second highest or third highest.

So, then efforts are made to see really, if we can bring them close to each other. Here, basically we consider the number of movements, here the distance is not a criteria, distance has not been kept in mind. So, if the distance is to be kept in mind then distance will be brought in instead of the number of movements. So, if the distance is surface then we have to multiply the number of movements with the distances between the 2 work centres, for minimizing the distance of movement.

But here this is the first stage, where flow matrix will help us in identifying the work centres where the movement is maximum, so that they can be brought close to each other, well distance is not the criteria. And the cost is also not the criteria, only the extent of movement is being considered to bring the 2 work centres close to each other.

Now, I will summarize this presentation. In this presentation basically, I have talked about the procedure for designing the process layout. And there are different steps which are used for designing the process layout. And I have also talked about, one method which is used to quantify the kind of the movement between the different work centres, that is the flow matrix method. Thank you for your attention.