Principles of Industrial Engineering
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Lecture 18
Plant Layout: Purpose and Types of Layout

Hello, I welcome you all in this presentation related to the subject Principles of Industrial Engineering and you know we are talking about the plant location and the plant layouts. There are various situations when it is required to revise the existing layout or come up with the new layout as per the kind of the problems being encountered.

For example, if the new product is to be launched and we want to come up with a new manufacturing facility for that then entire layout is to be planned for that or in existing layout we have coming across very high in process inventory and a very long throughput time very frequent accidents, uncomfortable working environment for the workers.

So, it is required to modify and improve the existing layout. So, there can be various situations which can be forcing us to improve the existing layout. So, what we keep in mind while developing or coming up with the new layout for a plant that is what we have to see. So, first of all, what different things we keep in mind when coming up with the new plant layout or existing layout is being modified.

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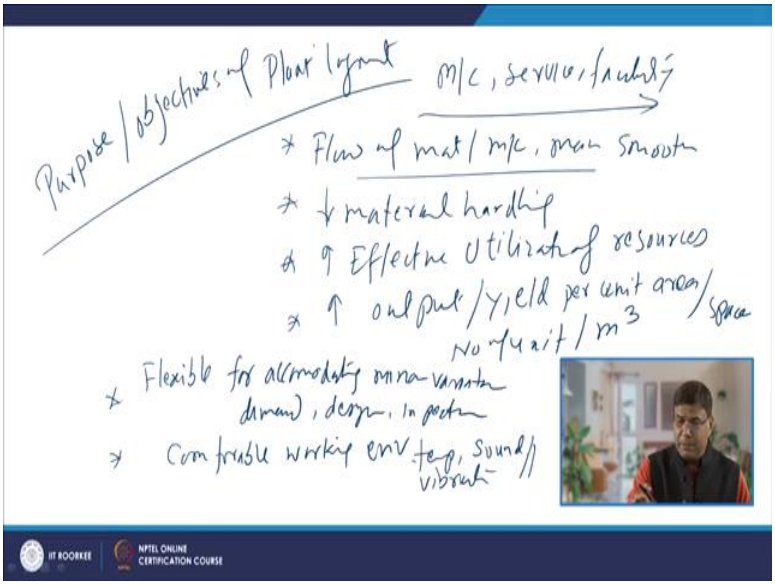

So, basically what the purpose or objectives of, purpose or objectives of development of layout, so that we can really address some of the things which are favorable, what we want that whatever layout what is the layout plant layout means? The machines, the services or the

facilities, whatever we have, those are arranged in such a way that the flow of the material machines and the man is very smooth and there is always forward movement. There is no backtracking in terms of the movements, so that the extent of the movement is increased.

Basically, the smooth flow of the resources is realized that is how it should be developed. Then whatever the flow is being designed for movement, the stages through which the things will be moving in course of the production of goods and services. In that process, the extent of the material handling needed is reduced.

So, minimize the material handling is the another objective in this process and whatever resources we have in terms of the man material and the machines that increase in effective utilization of the resources means increased or effective utilization of the resources is realized. Then whatever is the rate of production is there or the volume which is produced that is maximum for a given space which is being utilized for a development of the plant.

So, basically we have the higher output or we can say higher yield in terms of the per unit area, it can be or per unit space, if we want that even height is also effectively utilized, then let say the number of units produced per meter cube, then it will be the like output per unit space which is available for utilization.

And whatever layout is developed that is that can be easily that can easily accommodate the minor alterations in the product-product designs. So, the layout should be flexible, layout is developed in such a way that it is flexible for accommodating, accommodating the minor variations as per the requirement, these variations in terms of maybe minor change in the demand or minor change in the design or minor change in the inspection methodology.

So, those changes can be easily accommodated that is what is attempted when you when the plant layout is developed. Then we see that whatever layout is there, it provides very comfortable working environment, comfortable working environment. This may be in terms of like comfortable working temperature or the kind of the sound which is there is within the limits and the kind of vibrations which are experienced during the operation of the plant those are minimums, so that the workers can work for longer time with the minimum fatigue.

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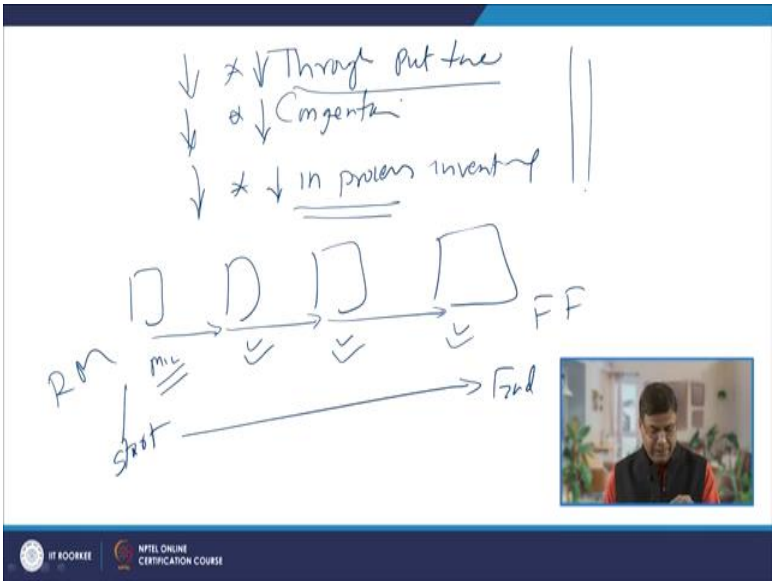

At the same time, it is also expected that the congestion during the operation or working operation or working of the plant is minimum. So, reduce the congestion and in process inventory is also reduced in process inventory. This according to this term like the kind the amount of the material, which has been partially processed is kept minimum in during the entire journey of its processing from the beginning to the end.

For example, if there are say four stages of the production from the raw material to the final finished product, then if the production is starts then it should move smoothly from one stage to another and in course of the production, minimum number of units are there at each of the stages.

So, the amount of the material being held up at each of the stages in course of the production that is less. So, this is what is termed as in process inventory or the number of items which are there in course of production at any moment of time. So, one more objective is there that is the throughput.

Throughput time is basically the time it takes to complete from the beginning it means from the start to the end stage how much time it takes. So, this is the time it takes to complete from the beginning to the end is the throughput time and this time is reduced. So, reduced in process inventory reduce the congestion and the reduced throughput time.

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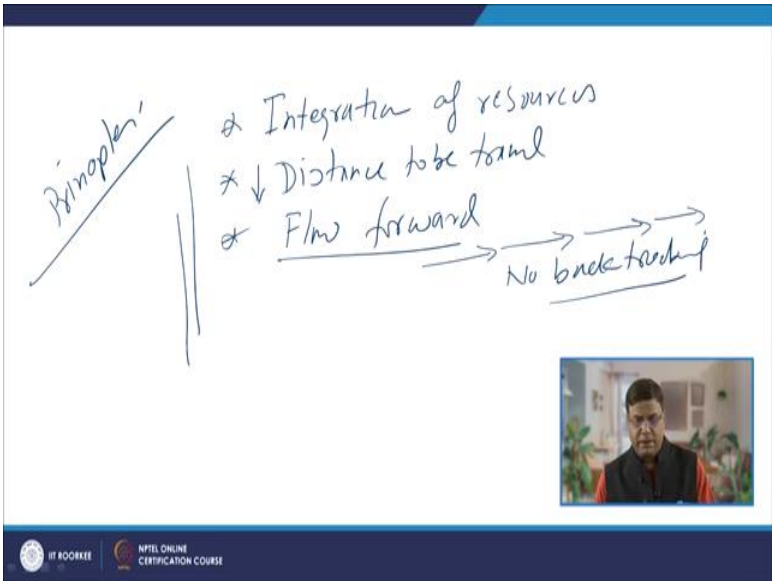

So, the layout has to be developed in such a way that these things are realized and when how these things can be realized for that few principles are used, like the principle of the integration of the resources, integration means the facilities, services and the other resources are arranged in such a way that they are well integrated with each other for a smooth flow of the things.

So, that minimum material handling increased, reduced throughput time reduced congestion reduced in process, inventory all that is realized and minimize and the material handling is minimized.

So, integration of the resources is done effectively. So, that is the one, then the second the is like the facilities are arranged in such a way that the distance to be travelled are minimized. So, minimum distance principle distance to be travelled either by the manpower or the material in course of the production that is minimized.

So, minimum distance principle, then the flow forward, the flow forward. This is the case when the material always move is in the forward direction towards the completion from the beginning and there is no back tracking that is how the facilities are arranged.

So, that it will help in reducing the material handling and improved flow of the material. There can be, so a part from this, the other the basic things which about which I have talked about in the, during the objectives are also implemented in course of the development of the plant layout.

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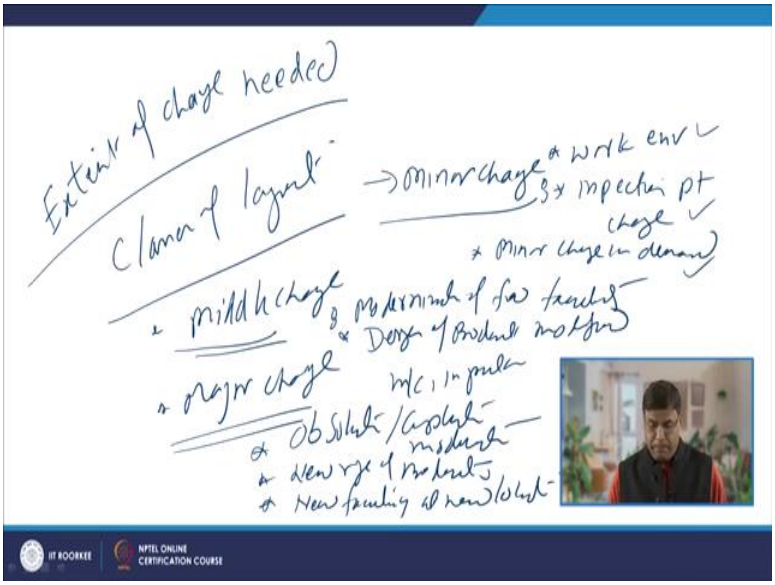

Now, there are different levels, there are different levels as per the kind of the extent of change which is needed during the modification of the plant layout. There are three different classes of the or the levels of the plant layout that is one, one is when minor change is needed or middle level change is needed or major change is needed. So, these are the three situations.

In case of the minor change, like say some due to the poor working environment, some kind of the ventilation is to be improved. So, minor alteration in the building is facilitated. So, for improving the work environment if either exhaust or as some kind of the system is to be fitted in, so that the work environment is improved or simply inspection point is changed inspection point is changed or the minor machineries are additional machineries are installed to meet the minor change in the demand for the product which is being manufactured.

So, these are the like said minor changes in when the plant layout is modified through the minor changes for improving the work environment or changing the inspection method or relocating the machine one or two machines for accommodating the minor change in design.

The middle level of change is realized when say like, we want the modernization of the sum of the facilities, modernization of few facilities is needed or middle level of change will be needed when we want like the design of the product has been modified and for that we need to add some of the machines. We need some inspection point. We need some additional packing and dispatching points.

So, some additional modifications will be needed in the existing case. The major change in the plant layout is needed when the complete facility is old, outdated and obsolete. So,

obsolete facility needs to the complete modernization of the entire plant or the entire new range of the products, new range of the products is to be incorporated or the entire new facility is to be developed, new facility at new location and this may be needed like the market has shifted to some other location. So, you want to come up with the newer production facility, newer processes are to be installed.

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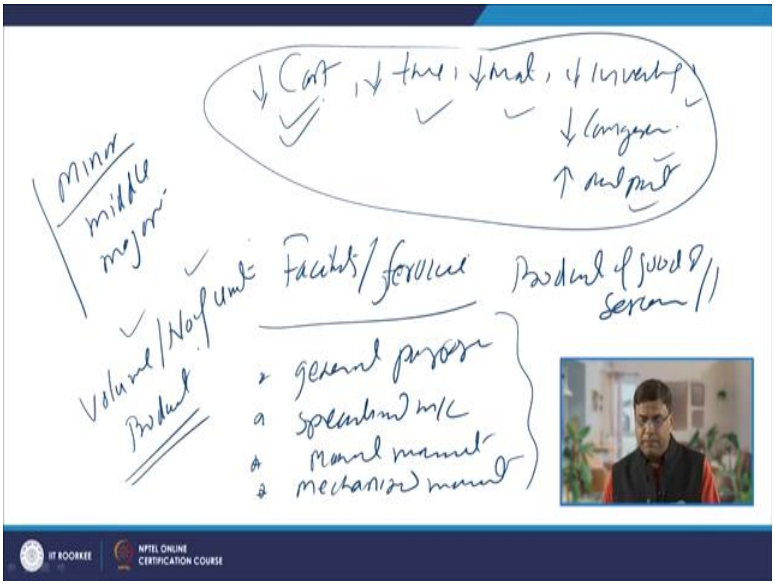

Now, so these are the kind of the levels at which the change in the plant layout can be incorporated, it can be very minor or it can be middle level change or can be major change as per the case.

Now, when we arrange the facilities in a plant, so that our production cost is reduced through the reduced time for production, reduced material handling, reduced in process inventory, reduced congestion, increased output in terms of the production rate. So, these things can be realized if the facilities, facilities thus other services which are being used for production of goods and services as per actual requirement.

So, what is that requirement, which will force us to arrange the facilities in such a way that, it is able to satisfy the cost require that the production of the things at the minimum possible cost, minimum possible time, reduced material handling, reduced inventory, reduced congestion, maximum output.

So, for that we have to see that simple, the kind of the volume or the number of units which are to be produced in say like say in per day or per month or annually, what is that volume which is to be produced. So, depending upon that volume, we will be identifying how the

facilities should be developed, whether these will be the general purpose machines or these will be the specialized machines.

There will be like the manual movement of the material using the individual machines or there will be mechanized movement of the material. So, these things will be decided as per the number of units or the volume of the goods or services which is to be produced because it will heavily effect the cost at which we are coming up for the unit or production.

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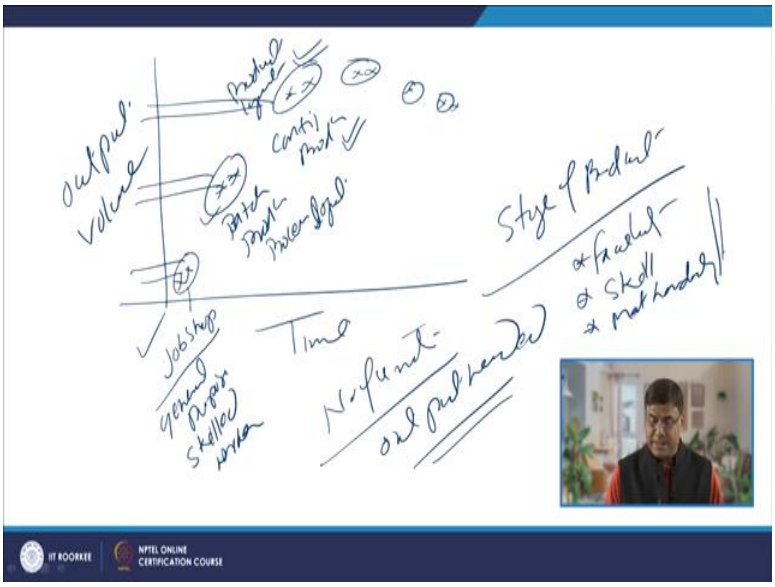

So, for this, we need to see that simple we have seen that as a function of time, how the product life cycle changes in terms of the output or the volume which is needed like the introduction stage when the volume is very limited.

We use one manufacturing strategy and accordingly the manpower and the facilities are developed. When the volumes increase, the our production strategy is modified accordingly, so that we can really produce more and gracefully with the further growth of the product in its life cycle, it reaches to the maturity level when very high volumes are needed.

So, for producing very high volumes, the production strategy will be different and thereafter we will see after maturity decline will start. So, initially when very few units are to be produced, we will be using the job shops. Job shops basically use the very general purpose machines. So, for operating these general purpose machines very skilled workers will be needed. On the other hand, when the volumes increase little bit, we go for the batch production.

So, like the batches of 50 or 100 units are to be produced, then this requires like the process kind of layout and intermittent production of particular type of product will be there. When the volumes increase significantly when we are in position to work continuously, produce continuously same thing.

Then we go for product layout kind of thing, this is particularly justified when continuous production, continuous production is possible to justify or to facilitate the high volume production requirements. So, this is the situation when the product layout will be suitable and thereafter it will decline.

So, what we can see here, initially there, we have we rely on general purpose machines for in our job shops and little bit semi-automatic machines for batch production and then automatic machines and semi-skilled workers for the continuous production. So, as per the stage of the product in its life cycle, what is that basically?

The number of units that we need to produce to satisfy the demand of the product, so depending upon the number of units to be produced or the volume which is to be produced output basically needed that will dictate which kind of facility that will be established. What kind of the skill of the workers needed and how the material handling or the movement of the material will be facilitated.

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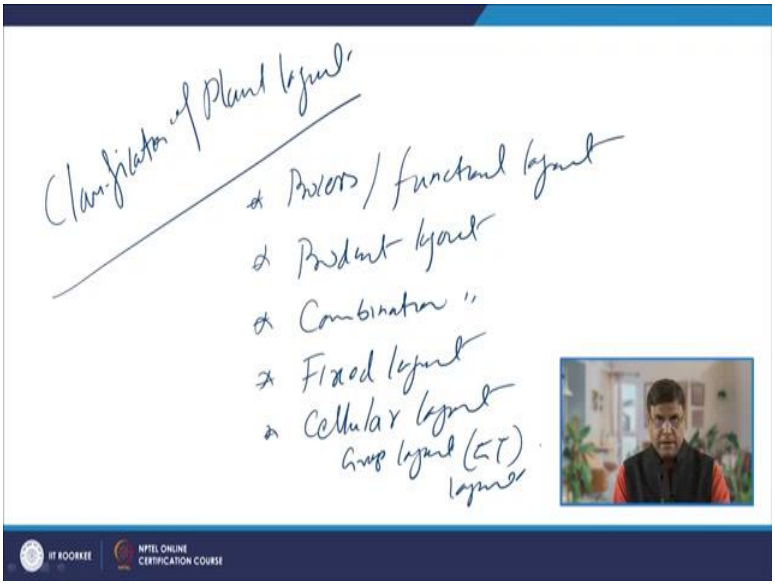

So, considering this in mind there are three, five types of the layouts. So, we can say classification of plant layout. One is simple process or functional layout, second is the product layout, third is combination layout, fourth is the fixed layout and fifth is like the

cellular layout or this is also termed as group layout GT, basically group technology layout. So, these are the 5 types of the layouts and these will be suitable under different conditions of the output which is needed, so starting with the process layout.

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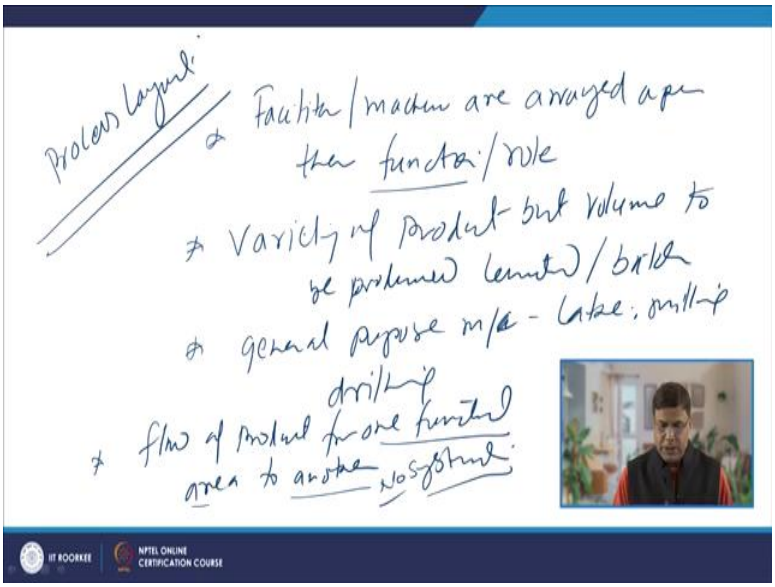

So, the process layout, according to the process layout the facilities or machines are arranged, arranged as per their function or as per their function as per their rule, the kind of the jobs that they do. So, here this kind of the layout is found to be justified when variety of the products are to be produced.

But, the volume or the number of units, volume to be produced is limited or we can say batches. So, this is justified when just a little bit volumes are sufficient to, now produce this generally uses the general purpose for this layout general purpose machines are used like the center lake, the milling machines, drilling machines.

So, these are the general which can be used to perform the variety of the jobs to perform. In this case, when the facilities are the machines are grouped as per their function or as per their nature. Then we find that the flow of the product from one functional area to another one.

Obviously, for completion of the product, there has to, there will be movement of the material. So, that movement or the flow of the material will be there from one functional area to the, another. Now, there is no systematic movement because our no systematic movement because the design of the product and the type of the product which are being manufactured in this case are changing.

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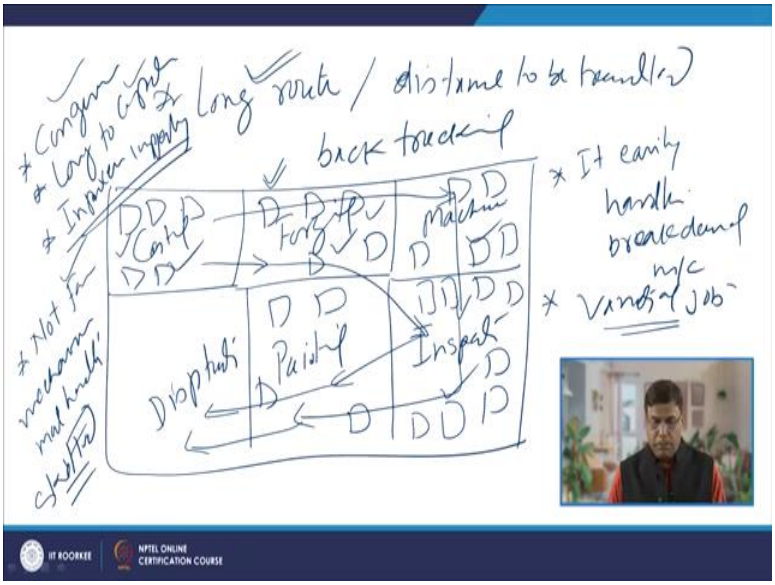

So, what we find the kind of the routes that will be followed, the product may follow long routes or the distance to be traveled, distance to be traveled during the production may be long. So, there is a possibility of little bit backtracking not necessarily always there will be forward movement.

So, for example, in this case, say this is the plant and here what we have like initially we have one costing, all costing processes and after that like say there is a facility for forging variety of forging machines after forging they are all machining processes are here, then after machining the inspection section. Then after inspection, there is like say painting section and then dispatching section.

So, he are all costing jobs, all forging jobs, all machining jobs, all inspection jobs are done in these sections. So, as per the type of product to be manufactured, it may move, it may follow different routes like if the after costing it is required to force then it will be moving from costing to the forging and after forging, if it does not require machining then it will be moving directly to the inspection section and after inspection it will be sent to the painting section and then dispatch section.

In some cases, it may be required, our cast components will directly be manufactured to the after cast components they will directly be sent to the machine, after machining they may be sent to the inspection and then after inspection painting and then dispatching.

So, here we have variety of the costing processes where 80 of the forging machines when forging processes variety of the machining processes, variety of the inspection processes like NDT ultrasonic magnetic particular hardness, etc and the paint section having all facilities.

So, in this case, all these costing process will be doing the similar kind of jobs. Similarly, the forging kind of the process will be doing the similar kind of jobs. So, even if a one or two machines goes off or the breakdown in one or two machines take place, the entire production facility is not affected. So, here it easily handles the machine breakdown, breakdown of few machines.

Few machines are breakdown, if there is a breakdown of few machines then the production facility is not much affected. The production is not much affected. The second thing, since there, the machines are arranged according to their functions. So, it can handle the variety of the jobs, variety of jobs, there is no fixed movement of the material as per the requirement of the operations to be performed on the job, it can be moved suitably. So, it can easily handle the variety of jobs.

But if we see there can be the, there is a possibility of the long route or distance to be traveled backtracking possibility, there is little bit congestion in this kind of the setup. It takes very long to complete the job, long to complete the job means the throughput time is really long.

And we will notice that lot of items are they are in pending for further processing or completion of the processing. So, in process inventory, in process inventory in case of the process layout is really high. So, congestion long means long throughput time in process inventory these are some of the issues.

And since, there is no systematic movement of the material, so it is not possible not for mechanized, this mechanized material handling that is not possible in this case. We need specialized or a skilled workers because they need to handle the variety of jobs. So, these are the some of the features related with.

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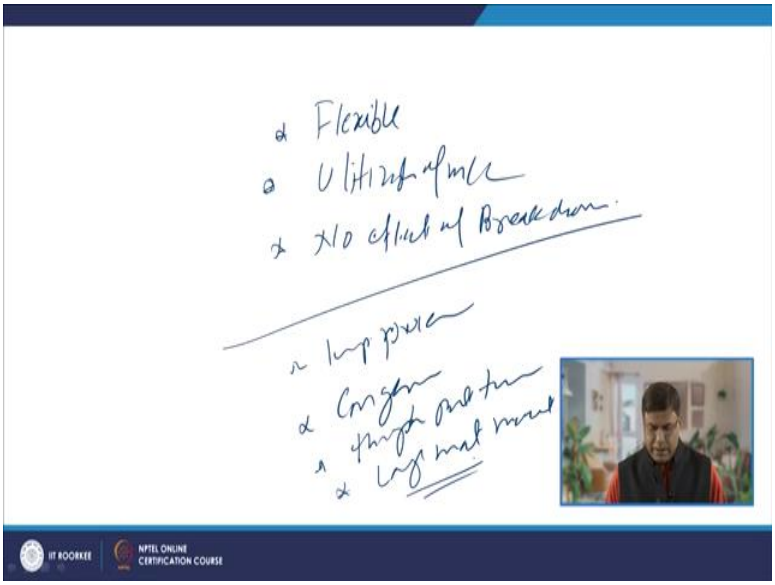

So, the good part is that this kind of the arrangement is flexible. It can accommodate any design. So, it can accommodate any kind of the design, the utilization of the machine is in general, utilization of the machines and equipment is high and it does not effect, no effect of breakdown of few machines.

And as far as the limitations are concerned, in process inventory, in process, inventory is high, congestion is high, throughput time is long and the work there is a long material movement. There is no mechanized way for movement of the material from one section to another because there is possibility of the very random movements.

So, now here I will summarize this presentation, in this presentation basically I have talked about the, the purposes of developing a good plant layout, what are the different classes of the plant layout and the different types of the plant layouts. In detail, I have talked about the process layout, thank you for your attention.