Industrial Engineering
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Module - 4
Lecture - 15
Materials Handling

A very warm welcome to all of you in this lecture on materials handling over the past couple of days we have been having lectures related to the different topics of industrial engineering. Materials handling is also one of the most important aspects to be considered whenever we design a manufacturing plant. We have to see that the materials handling should be easy it should be cost effective and it should be very efficient. So, in today's lecture we will see that what are the salient features of materials handling? What are the various definitions of materials handling?

What are the objectives of materials handling? when, we have to design a material handling plant like, when we have to take a decision regarding the material handling systems then we will see, what are the principles of material handling, and finally, we will see that if we go for a automated handling system what are the limitations of such a process. So, basically the important point to realize here is that material handling is an important aspect. And it has to be looked into if we want to make profit. Basically, profit maximization is the main or the soul, aim of the any manufacturing activity.

Now, if we spend too much of money of in material handling or our material handling systems are not efficient, not effective too much of time is wasted in taking the material from one to place to another place or the breakdowns are very frequent in those cases the overall manufacturing activity stops and we run into losses. So, it is important to understand that material handling is an important aspect of any manufacturing activity.

Here, I am talking about manufacturing because in most of our lectures our focus has been towards manufacturing, but material handling is not at all lying between the domain of manufacturing activity only. It has its scope in a large number of other fields as well So, by the end of this lecture we will see that what is the scope of material handling.So; now, let us start our discussion with a slight introduction to material handling. Material handling means providing the right amount of the right materials,

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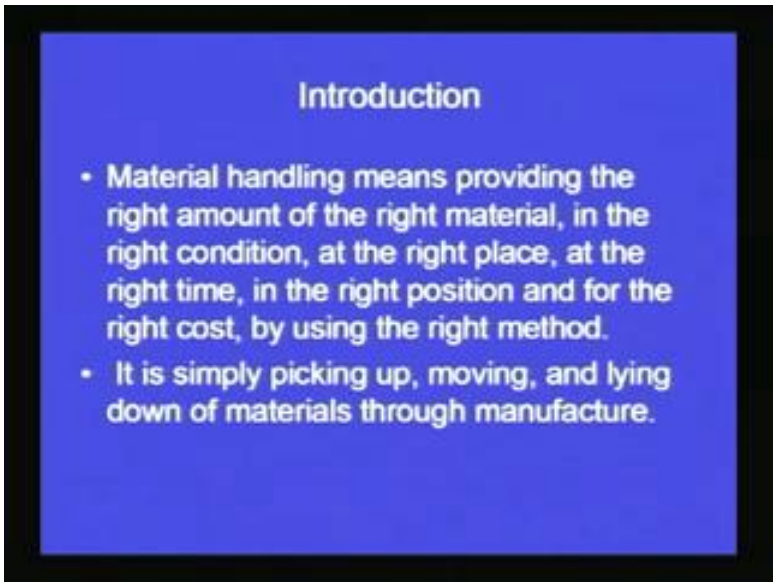

So, kindly go through each and every point very carefully. So, each and every sentence, each and every word in this particular introduction gives us the major important definition of material handling. So, material handling means providing the right amount of means the quantity, right quantity of right material right material means the material which is actually required in the right condition, in the condition means that it is in the usable condition it has not been altered or it has not been damaged when, it is being transported or handled from one location within the plant to the another location within the plant. So, 3 things has been addressed till now what are the 3 things, that right amount of means the volume should be right.

The type of material should be right and its condition should be good at the right place means wherever it is required it should be provided and at the right time in the right position. So, the time is also important and the position where, we are providing it is also equally important. The place is also important and the position is also important may be if it's on the other side of the conveyor or this side of the conveyor that is also important, and then for the at the right cost also by using the right method.

So, you see. So, many different aspects have to be seen whenever we design a material handling system. So, material handling basically means that we are providing the right amount of the right material in the right condition, at the right place, at the right time, in the right position and for the right cost by using the right method. So, many different

things; are incorporated in the science and engineering of material handling. So, material handling is an important aspect which I have already addressed.

So, many things have to be optimized and there after we can say out material handling is very effective and efficient. So, if we are able to provide such a system which can, address to all these points which are mentioned in the very first introductory definition of material handling then we can say, yes our material handling system is very efficient and it is very effective. It is simply picking up, moving and lying down of materials through manufacture. So, this simplifies the top definition or the first point has been simplified in the second point that it is simply picking up, moving and lying down of materials through manufacture.

So, we can say just from the first slide it becomes very clear that what are the major objectives of material handling? Like, what do we want to do? When, we think of material handling we want to transport the right material, at the right place, in the right position in the most cost effective manner. And by using the right method, right method means there may be. So, many methods of material handling we may not be able to cover. So, many methods of material handling, but it is better to understand that it is not a single method there are. So, many other methods of material handling they means what I means to say is, that there is no single method of material handling there exists a large number of methods of material handling, which can be used in industry or which are being used in the industry. So, let us continue our discussion on material handling. We are just trying to address that what do we mean by material handling?

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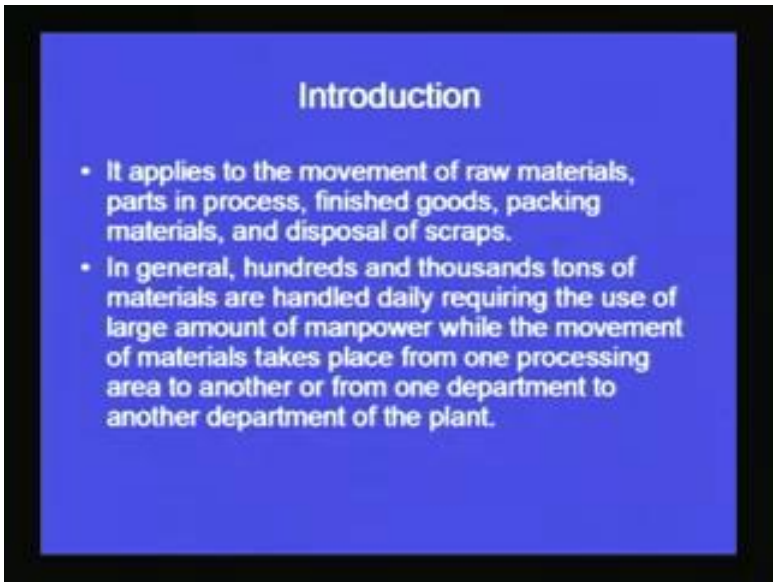

It applies to the movement of raw materials, parts in process, finished goods, packing materials and disposal of scrap. So, what type of materials we are addressing we have already seen. If we summarize what we have covered till now in the first slide we have seen that right amount of material of right quality at right time. In the cost and in right position and place in the most cost effective manner, that is the basic crux of material handling. So, what types of materials are going to be handled?

So, these materials can be these (( )) basically can be movement of raw materials, parts in process, finished goods packing materials and disposal of scrap. So, all these type of handling or handling of all these type of materials is falling under the category of material handling. So, in general 100 and 1000 tons of materials are handled daily, requiring the use of large amount of manpower while the movement of materials takes place from one processing area to another or from one department to another department of the plant.

So, large number of people or a huge amount of manpower is required to transport the material from one unit to another unit or from one department to the another department and a volume of material that is transported from one area to the another area is also very large. So, if we see the costs that are involved in this type of transport from one place to another place, it would be very high if we see that breakup of the total manufacturing cost of a particular product.

Some amount of cost is also contributed by the material handling which is the cost that we want to address and we want to minimize. So, if that cost is large and it is adding to the cost of the product what we would like to do is that we would like to reduce that material handling cost to a minimal. So that the overall cost of the product can be minimize. So, basically material handling in the very first slide we have seen that what do we mean by basic material handling?

Now, we have seen what type of materials are transported within the plant this can be raw material, it can be work in process materials, It can be finished goods, it can be scrap or it can be other inventory items of equipment that is being transported from one place to another within the manufacturing plant. So, all these activities are important they are usually done manually or can be done by automated systems also. And what is our major objective is to minimize the costs that are associated with this material handling activity. Now, what are the basic definitions we have seen the introduction what do we mean by material handling? What type of materials is handled within the manufacturing plant. So, let us now see, some of the very basic definitions of material handling.

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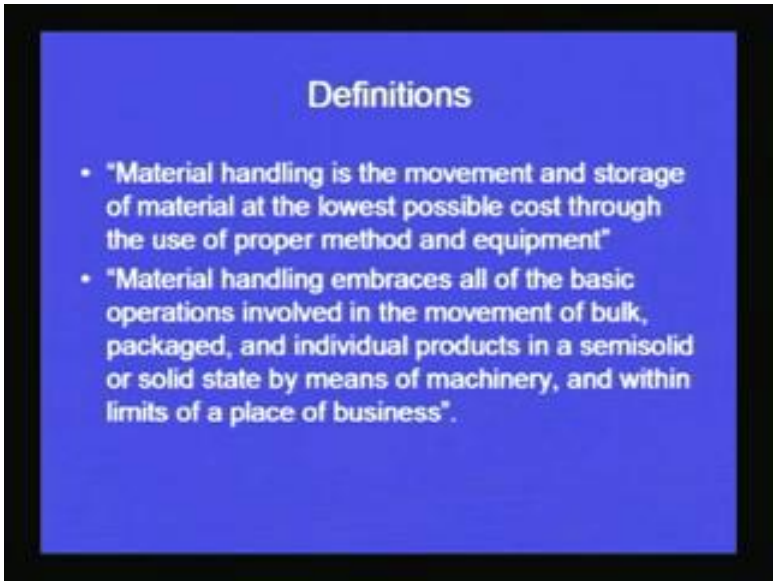

Material handling is the movement and storage of material at the lowest possible cost through the use of proper method and equipment. So, we can divide this definition into 3 important parts.

So, first part is the movement and storage of material. So, basically in material handling we are transporting the material from one place to another place for storage or for use. Second point is the lowest possible cost. So, this activity which is the material handling activity has to be performed in the minimal possible cost. And the third point of the definition is by the use of proper method and equipment. So, basically what do we mean by this definition is that we have to move and store the material, this activity has to be done in the minimal possible cost and the third point is by using the most efficient and effective method of handling.

So, this activity if we are able to perform effectively and efficiently the total cost of making the product would reduced, which would further lead us into profit maximization. Now, let us see what has what the second definition has to say. "Material handling embraces all the basic operations involved in the movement of bulk, packaged and individual products in a semisolid or solid state by means of machinery and within the limits of a place of business".

So, this definition also says that there is a movement of material then it specifies the type of material which are moved. If you see what are the type of material movement of bulk, packaged and individual products. Now, these products can be in semisolid or solid state by means of machinery and within the limits of the place of business. So, with the help of machinery means that manpower may be required may not be required. So, machines are being used for material handling. Similarly, this type for movement is taking place within the place of business. So, we can say within the limits of place of business. So, the materials material handling of the material, outside the business place is not considered in this definition.

So, in this definition we see the type of material the movement of material takes place and it is done with the help of machines and the movement of materials is restricted within the (( )) of the business activity within the plant. So, two definitions we have already seen, which very clearly defines what do we mean by material handling? Now, let us see some other definitions which give us the basic meaning of material handling.

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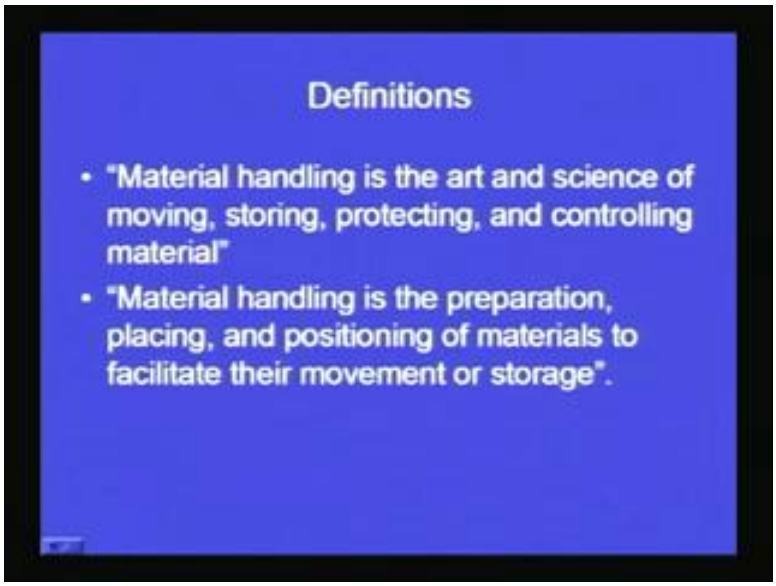

Material handling is the art and science of moving, storing, protecting and controlling material. So, this gives another aspect of material handling. So, it is the art and science of moving. So, moving we have seen in the previous two definitions also the movement of materials is an integral part of material handling. Then, storing of material is also falling under the broad definition of material handling. Then, we have protecting and controlling material. So, we have to protect the material, may be material in the broad under the broad umbrella of material handling, protecting is also coming sometime we have to protect the material from a from different types of insects may be, from different type of hazards or from the different types of unnatural calamities or natural calamities.

So, we have to see we have to protect the material. So, protecting is also falling under the definition of material handling. So, moving storing protecting and controlling mean sometimes we have to control the flow of material in a particular direction. So, this is also falling under the category of material handling. So, once again to summarize this or to memorize this material handling is the art and science of moving, storing, protecting and controlling the material. So, we can see that these 4 broad activities fall under the category of material handling. So, what are the 4 activities moving, storing, protecting and controlling of material.

Then material handling is the preparation, placing and positioning of materials to facilitate their movement or storage. So, movement or storage already we know, but it is

the preparation, placing and positioning of materials. So, that they can be easily moved and easily stored. So, that is also a material handling or material handling activity. So, we have seen that there are different definitions of material handling, but basic crux is that the material handling activity involves movement of material within a business unit or within a factory or within a plant. So, movement of material this has to be accomplished at the minimum minimal possible cost and by making use of the most efficient method of movement.

In order to minimize the total cost or we can say to maximize the profit of the organization. Now, what are objectives of material handling? Now let us see, what are the objectives? The primary objective of a material handling system is to reduce the unit cost of production.

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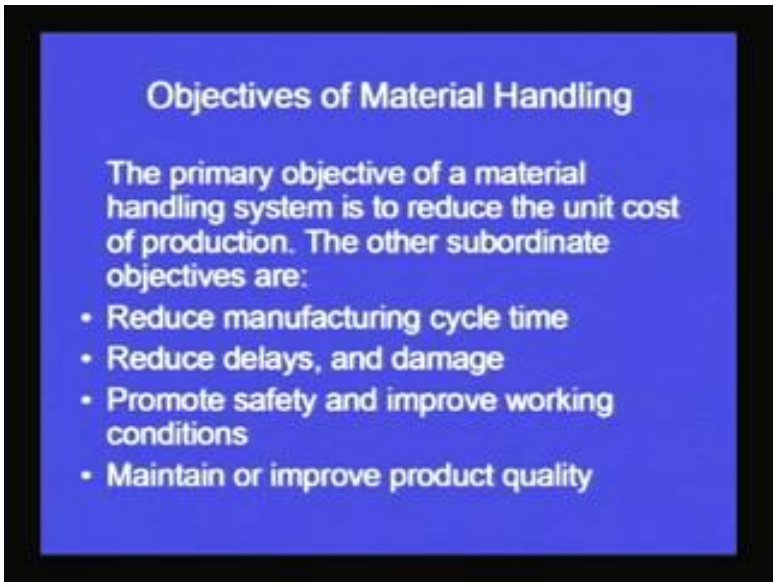

The other subordinate objectives are. So, I have been discussing, we have seen in the previous 2, 3 slides we have said that the cost has to be minimized the profit has to be maximized. So, the primary aim is or the primary objective is to minimize the unit cost, but there are some other objectives also. So, that we are going to see one by one. Now, let us see the first objective reduce the manufacturing cycle time. I have already told that we are focusing on the manufacturing aspect of material handling.

So, if we are handling the material in a more efficient or most efficient and effective manner. The manufacturing cycle time would be reduced. How it would be reduced

means that material handling we are doing by transporting the material from one particular processing unit to another particular processing unit. So, if the material handling is efficient and it is effective means that within the minimum possible cost we are able to transport the material from one particular unit to another particular unit. The cycle time would reduce. Otherwise, if we are not doing the things effectively, then the material may take a lot of time to be moved from one particular location to another particular location. And this time would add up to the total manufacturing cycle time.

So, we can conclude here that if we are very efficient and effective in material handling. Then we would be very easily able to reduce the manufacturing cycle time. So, we will see certain other examples, also in the course of the lecture if possible that how this manufacturing cycle time can be reduced. Then, it reduces the delays and damage. Sometime, it has been observed, it has been seen that the material being transported from one particular place within the organization to anther particular place within the organization gets damaged. So, that damage is going to add up to the total scrap or total wastage. Always there is a trust to minimize this wastage.

So, if we are handling the material properly and effectively, then this damage can be reduced moreover if we have a very efficient material handling system in place the delays in the manufacturing activity would also be minimal. So, 2 major objectives have to be achieved by any material handling system that is that it should be able to reduce the manufacturing cycle time. And it should be able to reduce the delays and damage during the material handling. Now, third of major objective of material handling system is that it should promote safety and improve working conditions.

So, 2 important aspects already we have seen, now third important aspect is that it should promote safety and improve working conditions. Which means that the system should be such that it is very safe in operation? Sometimes, we can take an example of a over head crane. So, over head carne is in place. So, it is picking up the material from one place and then it is taking that material to another place. And if we have people working under the working area of the crane sometimes there may be a accident also. So, our design of a material handling system should be such that no such accident takes place.

So, the system should such design that it should promote safety and it should improve the working conditions also. So, these are the 3 important points we have already

discussed now the fourth point is the maintain or improve the product quality. Now, suppose we take an example during the handling on a conveyor the material is being transported from one processing unit to another processing unit. So, suppose the material has been finished at the last processing point or the in the processing sequence we have achieved the final finishing of the product.

Now, it is being transported by a conveyor to the packing unit. Now, if the conveyor is not proper the material are heating one another the products that has been finalized those who have gone through the processing sequence are being transported to the final packaging unit. During this transportation or during this movement over a conveyor they rub against each other. Then the surface finish may be spoiled. So, what should be an ideal material handling system?

What is the objective of material handling that the product quality should be maintained or it should even rather be improved? So, whatever quality we have achieved in one for the final sections of processing should be there when we are packing the product. So, within this transportation or this movement or this conveying the material should not get damaged or it should not loss its quality. So, our material handling system design should be such that this problem does not arise.

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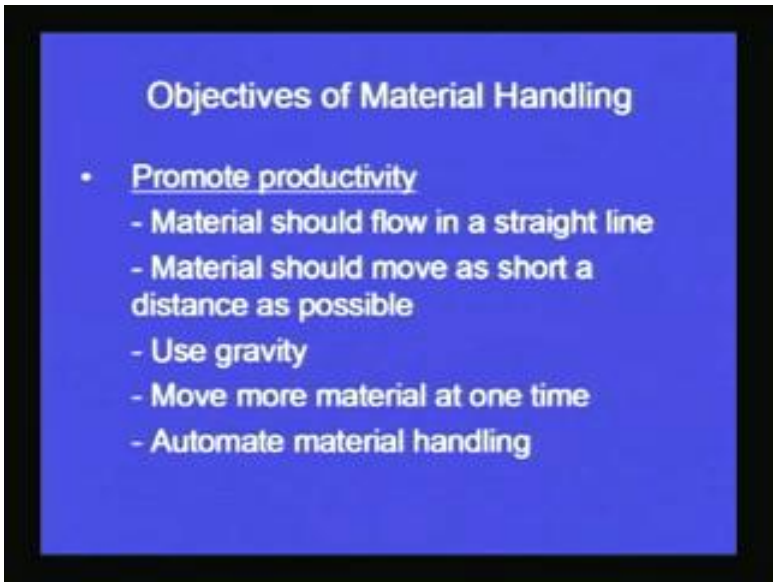

Then another objective of material handling is that it should promote productivity. Now, how it will promote productivity material should flow in a straight line no jig jag path

should be there then material should move as short as distance as possible. So, the movement should be restricted movement should be minimal otherwise, it would cause delays also. So, we have to take into account important points which are required to improve the productivity of the manufacturing plant. So, flow should be smooth it should in a straight line then it should be as less as possible or the distance travelled should be as short as possible then most of the times the focus should be on use of gravity.

Now, basically this is a important aspect which is used by most of the industries. So, gravity can be used to transport the material one area to another area. So, this can be used in order to minimize the cost of material handling which in turn would lead to minimizing the total cost of the product, which would lead into the maximization of the profit. So, gravity we see that earth has its gravitational pull. So, if we are making use of that particular aspect, then what we are doing is no additional source of power or energy would be required. So, if we are making use of the gravity we are saving certain amount of power and energy which would be helpful to us in maximizing our profit.

So, another important point is how we can improve the productivity. 3 points already we have covered what are the 3 points that material should flow in straight line. Material should move as short distance as possible; we should be making use of the principle of gravity. Wherever, it is applicable and feasible or we can say wherever it is possible we should make use of gravity then move material at one time. So, economies of scale should be taken into account. So, more material if transported at once would be saving in terms of cost also it may be saving in terms of energy and power also.

Then automated material handling is another system which would help us to promote the productivity. So, the major advantage of a automated material handling system is that is promotes productivity or it enhances or improves the productivity. During the course of this lecture we would also like to see, what are the limitations of automated material handling system? The advantage already has been addressed in the objectives of material handling where we say that if we have a automated material handling system, it would lead to promotion in the productivity or we can say increase in the productivity.

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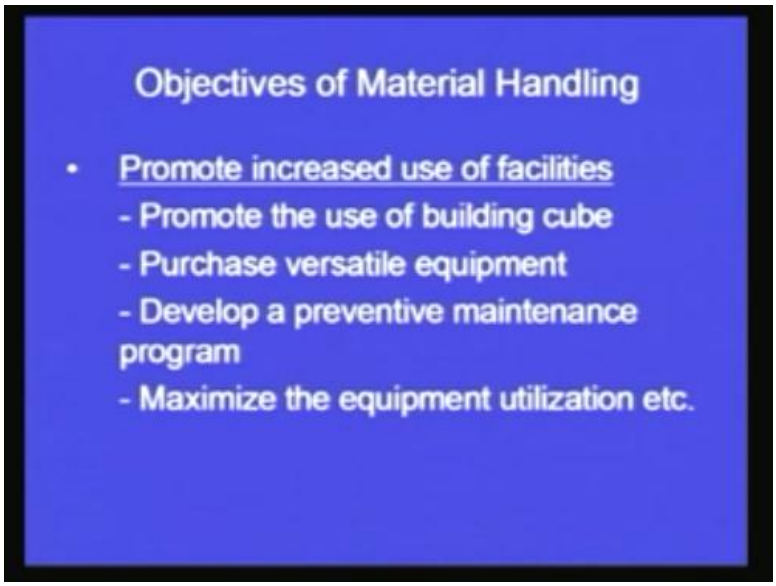

Then what are other objectives? On your screen you can see if promotes the increased use of facilities. So, it can increase or promote the use of building cube, then purchase the versatile equipment, develop a preventive maintenance program, maximize the equipment utilization. So, material handling should lead to all these things also. So, it should promote the use of a building cube, then it should purchase versatile equipment. So, this is also one of the objectives of material handling. So, versatile equipment should be there it should not be dedicated to one type of products only.

It should be for different types of product the material handling can be done for different types of product; then it should develop a preventive maintenance program also that is also very important. If maintenance is not there then there may be frequent breakdowns, then we should maximize the equipment utilization. So, material handling should also look into this aspect or the material handling system should also take care of all these points. So, we have seen that what are the major objectives of material handling we have covered?

So, many different points related to the objectives of material handling. Now we have seen that we have a certain objective that we keep in mind whenever we have a material handling system we feel that these are the aims, these are the objectives that should be satisfied. If we have a very effective and efficient material handling system. Now, we come on to another point that what are the costs of handling or different types of cost

associated with handling? And our major aim is to minimize these costs in order to maximize the profit.

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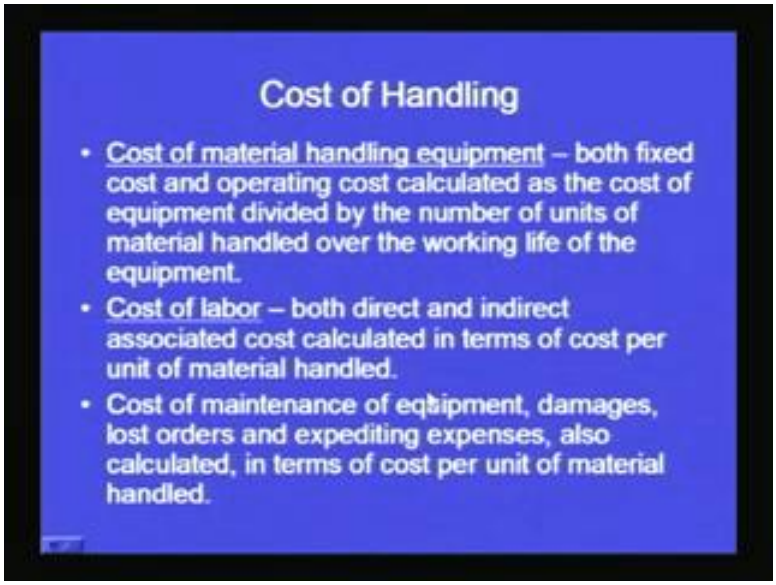

So, the cost of handling is the cost of material handling equipment: Both fixed cost and operating cost calculated as the cost of equipment divided by the number of units of material handle over the working life of the equipment. So, first thing is the cost of the material handling equipment. So, that is the first cost that is associated with the material handling. So, we have may be a conveyor belt system or we may have a crane system. So, different types of material handling system are there and there are different costs for each and every type of system that the company tries to procure or focuses to procure.

So, we can say we have a certain amount of cost involved in procuring a material handling system. Then, the cost of labor is the second type of cost. So, both direct and indirect associated cost calculated in terms of cost per unit of material handled. So, cost of labor is another cost which is there in material handling. Then cost of maintenance of equipment, damages, lost orders and expediting expenses also calculated in terms of cost per unit of material handled.

So, we have seen that there are 3 different types of important cost elements that are there in material handling. Now, what are these 3 different types of cost element that a cost of material handling equipment, cost of labor and the cost of other maintenance and other activities damages or lost order etcetera. Now, when we are talking about an efficient

material handling system then we say that we should have such a system which is very efficient. Efficient means, that it should be handling a large number of parts or products. And the cost of that particular equipment should be spread into a cost of large number of products.

So, that we get the economies of scale. Similarly, if we are talking about material handling by equipment very less labor force should be required that is; should be semi automated or automated type of material handling system. If we are talking about a manual material handling means only people have to transport or move the material from one area to another area, then we should have that kind of system. So, that minimum number of people should be required to transport or move the material from one particular area within the industry or within the plant to the other area. So, our major aim is to minimize the total cost of material handling.

Similarly, the breakdowns or the maintenance should be as less as possible. Also we have to take into account that the material during transportation or the damage to the material during transportation should be minimal. So, if we are able to minimize these costs associated with material handling we would be able to make profit or add into the profit of the organization. Now, we know that we have to minimize the cost. Now, let us see that when we need to design a material handling system?

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So, one your screen you can see the need to design a material handling system arises when: Now, when does the need arise there are. So, many different circumstances when the need for designing a material handling system could arise. The let us see what are the various circumstances one by one. Now, first one is a new product is being planned for manufacture. So, the company has taken a decision that a new product would be manufactured. Now, for that particular product we need to design a material handling system. That how that product would be handle in different stages of the manufacturing activity. Now, suppose it enters as a raw material and then it is processed at different stations finally, it goes out as a final product.

So, we have to take a decision that now the product has changed a new product has to launch. How it would be handled at different stages within the plant? So, whenever a new product is there we have to take decision that yes a material handling system has to be designed. Change in the existing product design requiring a corresponding change in the layout. Now, already we have seen that there are different types of layouts product layout process layout fixed position layout or cellular type of layout. Now, whenever a product change takes place sometimes we may have to change the layout also.

If you see the advantages and disadvantages of different types of layout in certain circumstances we may have to go for changing type of the layout. So, whenever the new product has been launched we may have to completely design the material handling system, but whenever there is a change in the design of the product also. The layout changes and as soon as the layout changes we have to change our material handling system. So, two things we have already seen new product launched into the manufacturing cycle. We need to change the material handling system a old product has been redesigned leading to the change in the layout which will subsequently lead into the change in the material handling system.

Then a third point is obsolescence of facilities; some of the facilities may become obsolete may be a new facility has been added an old machine has been removed from the factory. So, when old machine has been removed there might have been a material handling system that was bringing the semi process parts to that particular machine. Now, when that machine has been removed another machine can be added at that place or it can be a slightly modified version of the older machine.

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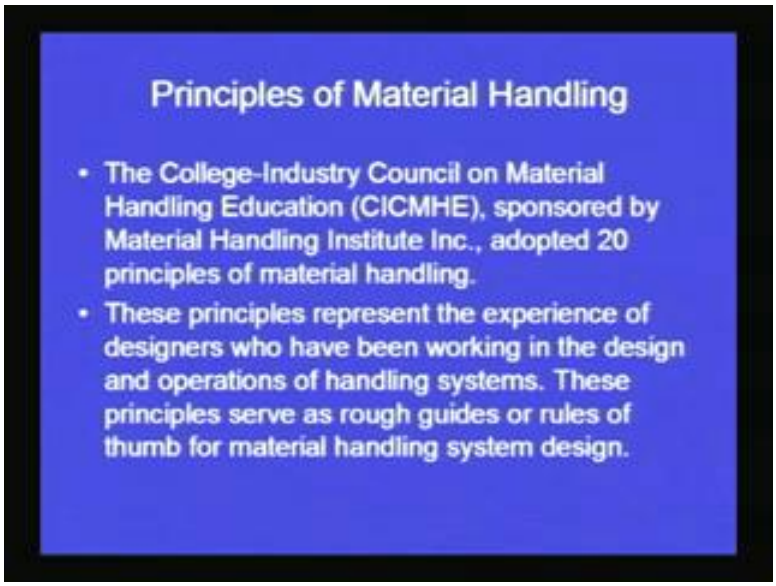

Now, talking about these principles of material handling now, these principles represent the experience of designers. Who have been working in the design and operations of handling systems? So, whenever we have to design a particular system we need to work on different factors. Now, these factors may be in large number and it becomes difficult to incorporate each and every factor into the design. So, basically these designers have summarize their experiences related to the design of handling system. Which are coated in terms of different principles. So, we are going to see what are these principles?

So, whatever these principles are this is the experiences or this is summary of the experience of the designers. Who have a long history of working in the area of design of material handling systems. These principles serve as rough guides or rules of thumb for material handling system design. So, these principles sometimes may be used, sometimes may not be used, but they serve as a rule of thumb where for any designer whenever he is planning to design a material handling system for a particular application.

So, we have seen from where these principles have come and how these principles have been summarized or formulated. And how these can be used? So, it is these are just rules of thumb. May be used, may not be used. So, now we will see one by one what are these 20 principles and we would try to address one or two of them in detail.

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Now, on your screen you see twenty principles of material handling. Now, the first principle is very simple Planning principle, Systems principle, Material flow principle. If you remember in one of the previous slides we have seen that the material flow should be in a straight line. It should be a smooth flow. So, this principle should be taken into account whenever the material handling system is being designed. Then the simplification principle this should be kept in mind that the material handling (( )) system should be very simple in nature.

If it is very complex, it is very cumbersome; it may result into damage of the material during the handling process. So, simplified system would make the overall manufacturing system very simple. So, simple principle of simplification should also be taken into account, then the gravity principle should always be made use of wherever it is possible and feasible and it can be justified. Already we have seen that principle of gravity would help us in reducing the energy requirement or the power requirement which would add to the reduction of the total cost of the product and would result into maximization of the profit.

So, gravity principle wherever it is possible we should make use of the principle of gravity. Then space utilization principle minimum amount of space should be required or we should design the material handling system. In such a way that it would take the minimum amount of space. Because, we have seen that whenever we layout the plant

area our objective is of space utilization we should make the maximum possible utilization of the space. So, whenever we are designing a material handling system within a plant the space utilization principle should also be kept in mind. Then the safety principle already we have seen that safety guidelines have to be taken into account. And wherever there are a large number of accidents happening in a particular type of a system or material handling system .We need to redesign that system keeping into account the safety principle in mind.

Then Standardization principle should also be kept mind. Maintenance principle the Standardization and Maintenance very routine term, very simple terms that are used. So, Standardization means that always wherever possible we should implement or we should install a standardized material handling system. Then Obsolescence principle should also be taken into account, Flexibility principle is very important the material handling system should be very flexible in nature. Sometimes, it may. So, happen that we may have to design a system dedicated to a particular material type of material handling, but if possible if the need is not that stringent for a particular type of material. Then a generalized type of or a very flexible type of material handling system should be designed.

So, that it may handle a large variety of and a large type of products. Then the Mechanization principle, whether to go for manual material handling or to go for a mechanized type of material handling, that also has to be taken into account cost principle has to be taken into account. The minimization of the overall cost or the economies of scale that is the number of material or the volume of material handled for a particular investment of cost in a particular material handling system.

So, whenever we (( )) design a material handling system we should lay emphasis on the point that we are spending, so much of money on this type of material handling system. How (( )) how much material it should handle or how many units of material it should handle over a period of time. So, cost principle also should be taken into account agronomic principle energy efficient it should be efficient energetically means, energy required should be less than the ecology principle should also be taken into account Computerization principle should also be taken into account, Orientation principle layout principle unit load principle.

So, we have seen that we cannot we one lecture we cannot go into discussing all these principles, but an overview of these principles has been presented here, that whenever we have to design a material handling system. We have to take into account all these principles. These principles are basically rules of thumb which may be applicable in a particular system or may not be applicable in a particular system, but if we take into account all these principles while designing our material handling system. This is going to lead into a design of a very effective and efficient material handling system.

Effective and efficient means that it would be requiring less space, it would be requiring minimum amount of energy to operate it would be very easy to operate it would be having a smooth flow and all other principles incorporated into a very optimal material handling system. So, if we design a system which is optimal or which is efficient or which is effective. This would further lead into minimization of the manufacturing cycle time. This would reduce the total cost of the product and in turn it will result into the maximization of the profit.

So, manufacturing cycle time is reduced, cost is reduced or the cost of the product is reduced and the profit is maximized. So, every business man entrepreneur or the organization head would certainly like to have such type of a material handling system. So, we would be able to achieve that kind of a system if we take into account all these principles which have been highlighted on this particular screen. Now, whenever we have to design a material handling system we have to take into account 2 or 3 very important aspect.

So, these aspects can be related to the material, these can be related to the movement of the material or these can be related to the type of equipment or system that is being used for material handling. Now, we will see one by one; that what are the various aspects that we have to bear in mind whenever we are designing a material handling system. So, let us see the factors to be considered while designing a material handling system.

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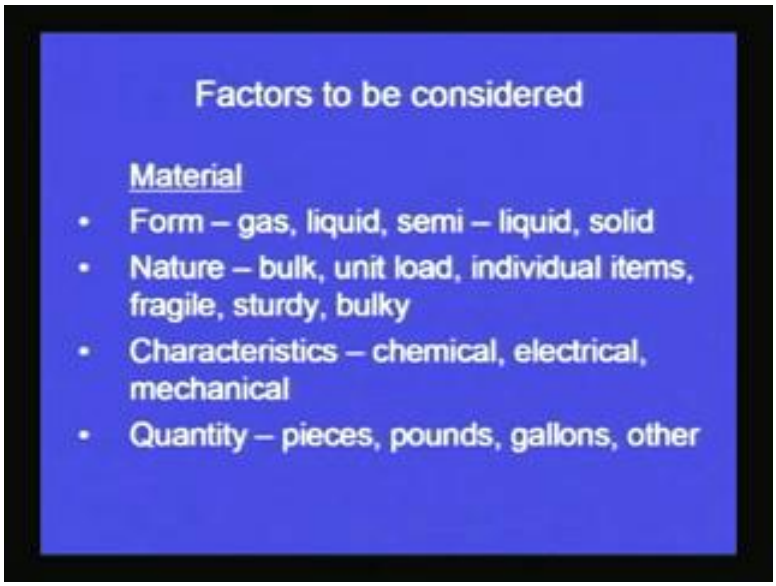

So, first important aspect or factor to be taken into account is the material. So, we have to take into account the form of material that has to be transported or moved from one area to another area. So, the form can be either in the gaseous form, liquid form semisolid or semi liquid or solid form. So, it can be gaseous liquid, semi liquid or solid. So, depending upon the form of the material we have to design the system then the nature of material also plays very important role.

So, how it is going to play a very important role that we will see that if the bulk material has to be moved. The material handling system has been designed accordingly if unit load or individual items or some items; which are very fragile or very sturdy on the other hand or they are very bulky. Then, we have to design the system accordingly if the items to be handled or fragile then the system should be such that they do not get damaged during the movement or during the transportation. If it is very sturdy or bulky the system has to be such. So, that it should be able handle the sturdy or the bulky items;

If individual items have to be transported then the system has be such that one by one it should move the item from one place to another place. So, we have seen that whenever we are designing a material handling system the first important aspect is the material aspect. That what material has to be moved then within the material we have to see that what is the form of the material? What is the nature of the material and then thirdly we will see, what are characteristics of the material?

Now, from the characteristics point of view we either the it can have certain chemical characteristics, it can have certain electrical or mechanical characteristics. So, those characteristics also have to be born in mind. So, from electrical point of view it can be conducting it can be Non-conducting or there can be other some mechanical characteristics also. So, all these characteristics have be to born in mind whenever we are designing the system. Then quantity also plays a very important role whether it is pieces or it is pounds or gallons or otherwise;, so what is the quantity that has to be transported that is also very important. So, from the materials perspective or from the point of view of the material, we have to take into account the form, the nature, the characteristics and the quantity of the material that has to be transported from one area to the other area.

Now, let us see from the movement point of view what are the factors that we have to keep in mind? From the movement point of view we have to see source and destination. Receiving stock room, warehouse, same floor or may be some other floor, other floor other department.

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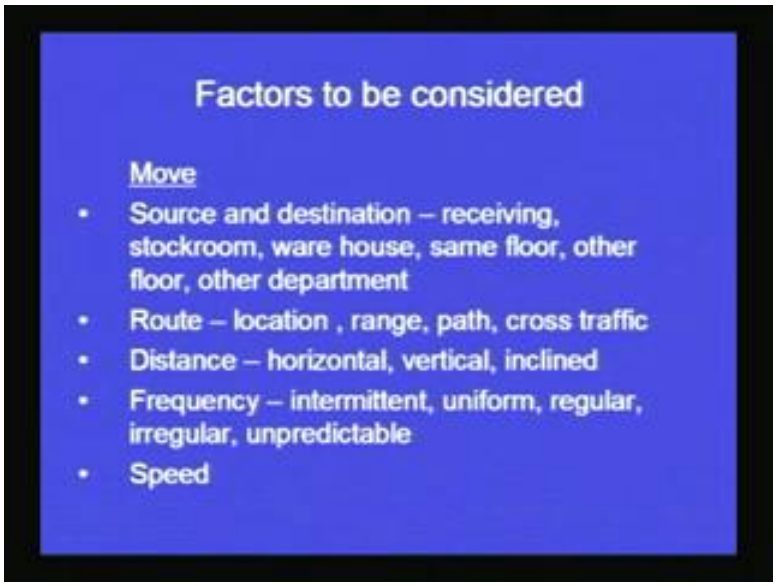

So, we have to see that what is the source and destination of the materials from where the material has to be taken, where it has to be delivered or transported. Then the route which route it is going to follow; the location, range, what is the path it is going to follow and the cross traffics. The sometimes there may be cross traffic also, this material is being moved from this place to this place there is a cross movement of another type of

material which is being handled from this source to some particular destination. So, when movement is being considered. We have to see, what is the source? and what is the destination.

We also have to see, what is the route the material is going to follow? Then we have to see, the distance what is the horizontal distance? What is the vertical distance or the inclined distance? So, far in route we have to see, in distance we have to see, source and destination we have to see and the frequency also has to be seen. That is whether it is a intermitted transport or it is a uniform transport the… Whenever it is uniform, we may think of putting up a continuous conveyor belt. Because, the continuously we are transforming transferring material from one place to another place. It can be regular, irregular or unpredictable.

So, we have to see that how the material is being transported. What is the frequency of transfer? Then we have to see the speed also that at what speed we have to transfer the material. So, from the movement point of view we have to take into account all these points. So, what are these points let us summarize them once again source and destination from where to what place? What is the route which has to be followed what is the distance total distance, then the frequency of transport or transfer or movement and then finally, the speed. So, we have seen that whenever we have to design a material handling system we have to take into account the material itself. What has to be transported? Then we have to see what is the movement or from the movement point of view we have to address all these points.

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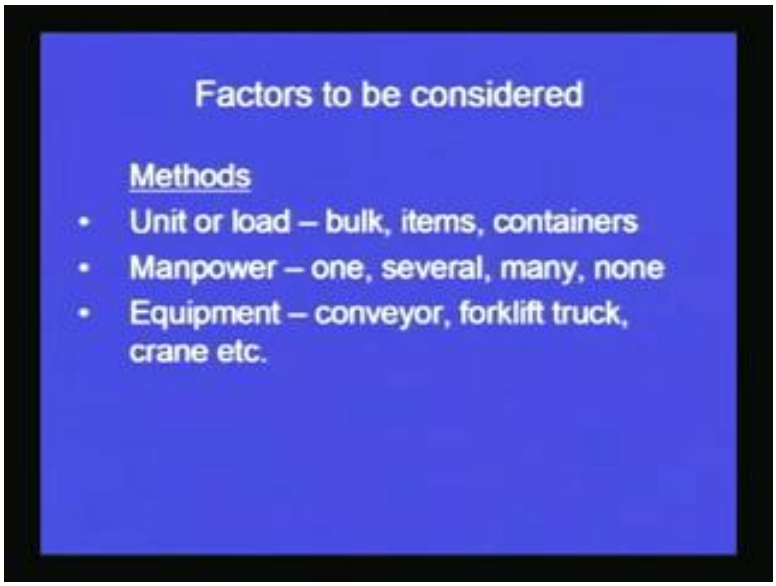

And then finally, the methods unit or load may be bulk items are transported or containers are transported. So, whether the material is being transported in bulk or in form of items or a big container is transported. Or transferred from one place to another place or moved from one place to another place within the business activity. Then we can have manpower that has to be considered. Like, how many number of people would be require? One, several, many, none. So, this is also a one of the important aspects in designing the material handling system. Then the equipment either we are going for conveyor forklift truck or crane this also has to be taken into account.

So we have seen that what are the various factors that have to be taken into account whenever we are designing a material handling system? So, these factors can broadly be categorized into the material aspects like type of material, form of material, that has to be transported there were many other factors as well, and then we have to into account the movement in which we have seen, speed frequency of travel and all those aspects. So, depending upon the movement, depending upon the type of material and depending upon the type of method or the kind of methods that we can use we have a large number of material handling systems. And if we take into account all these factors while designing the system our system would result into the optimal transfer of materials from one place to another place within the organization.

Then we have seen that, so many different types of material handling systems are there. So, we take into account all these factors which we have covered in the previous slides. Previous 3 slides specifically and these factors would lead us into designing a particular type of a material handling system. So, we have seen that automated material handling systems had certain advantages; if we remember in the same lecture we have seen that during the objectives of material handling. We have seen that improving the productivity can be easily achieved or we can improve the productivity with the help of automated material handling systems, but these types of systems had certain limitations as well.

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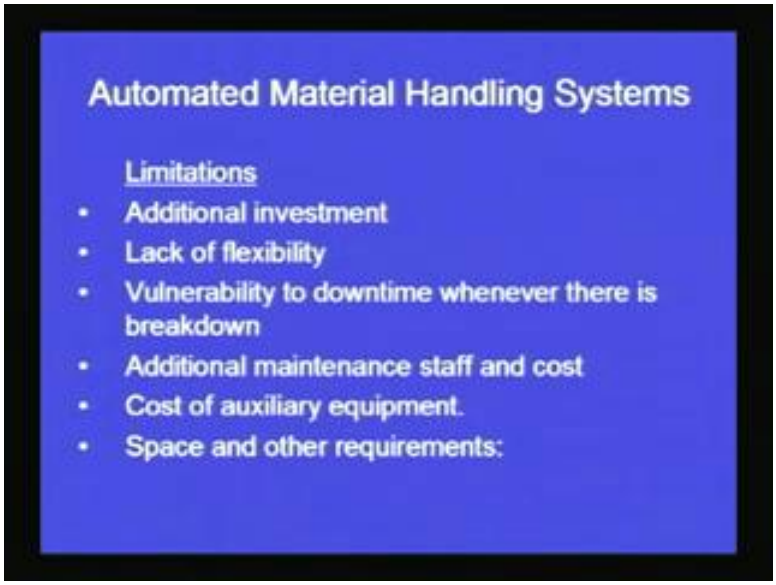

So, what are these limitations; additional investment is required, because these systems are costly and expensive lack of flexibility. So, if we have a automated material handling system for a particular application. It cannot be used for any other type of material handling. So, lack of flexibility, vulnerability to downtime whenever there is breakdown. So, breakdowns are for a large period of time. Because the maintenance requires proper, personal proper, skilled personal who can take care of these types of systems. Then additional maintenance, staff and cost already I have told about that cost of auxiliary equipment may be high space and other requirements.

So it is, so happening that although these types of systems are very efficient, very effective. They improve the productivity, but they have certain limitations as well which have to be taken into account, and we have to do a feasibility analysis a cost benefit

analysis that if we are spending so much of money in a installing a automated material handling system is it worth spending or is it worth having or is it reducing the per unit cost of the product. So, if we see that yes the benefits are there, then only we should go for a automated material handling system.

Now, let us take into account the scope of material handling. Now, we have focus this lecture on material handling system we have seen that the material handling is important from the manufacturing point of view. Wherever a manufacturing activity is taking place raw material is getting transformed into the final product. In between a large amount of material handling is required. We have seen various aspects of material handling, but it is not that within the manufacturing activity only material handling is required.

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Scope of material handling is very wide. It can industrial material handling, which we have covered a little bit in today's lecture it can be transportation industries. Warehousing wherever we are maintaining a large amount of inventory of may be finished products then extractive industries, process industries. So, different types of industries require material handling. So, whatever topics we have covered our discussion was focused on our examples, were focused on manufacturing industry, but the aspects of material handling are very open very general in nature.

The factors that we have considered for designing a efficient and effective material handling system are very general in nature. These can be used in any of these types of

industry. So, we have covered in today's lecture the basic definitions of material handling. We have seen the principles of material handling we have also covered the various factors that have to be considered for designing a efficient and effective material handling system.

Thank you.