Computer Integrated Manufacturing
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Lecture - 44
Material Handling and Identification

Material handling, you might think why material handling is such an important thing when we talk about Sims environment. See, today material handling plays a very, very important role. When we talk about material handling, it is not just movement alone, it is movement plus tracking and then try to provide in a very safe manner under right quantity, right place.

Today we all enjoy courier service or online shopping. So, the best part of online shopping is, though you do everything online, but the best part comes when you can track where is your item and when it will be delivered. Buying an item online and delivering it after two months is no way fun.

Today, the success of online shopping is also because of proper material handling. So, you see where is the item currently and how is it getting moved? Who is going to give? What time he is going to ship it to you? When you accept the order or you? when you accept the product, immediately you digitally sign and then confirm, then immediately you get a message saying that your order is delivered and thank you for your delivery.

So, all these things comes under material handling. What if, if a courier boy comes and delivers a product in a very damaged condition? You return it back. So, now delivery in the right quantity at the right place, in the right fashion. Safe mode is material handling. So, today, computers play exhaustively important role in material handling, what I was discussing to you is only an example of a single product getting delivered to a customer, in a factory there will be lot size.

So, now we have to first decide what should be the lot size in terms of safety while moving and then the weight which a human can handle. So, all these things come under handling. If you have a proper handling device and everything is tracked online, your WIP goes down, your inventory is tracked properly. Your overall productivity of the company is increased. So, material handling plays a very important role like a CNC machine existing in your factory to give a quality output, automated material handling is also important.

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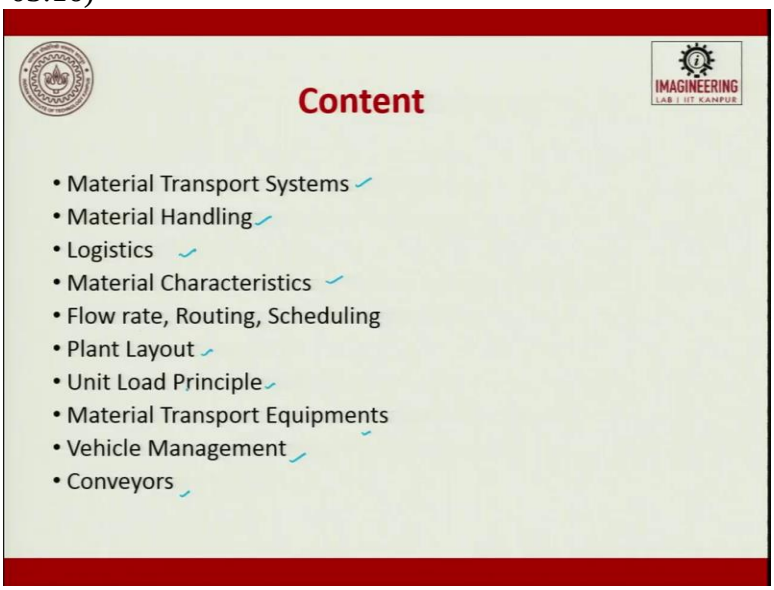

So, in this lecture, we will try to see material transport systems, then material handling, logistics material characteristics, lightweight, heavy, which occupies lot of volumes. For example, you can carry in a truck, few lead blocks, but you can carry a heap of cotton. So, characteristics of the material play a very important role. Then flow rate routing and scheduling were also part of material handling, plant layout, unit load principles, material transport equipments, vehicle management, and conveyors. All these things are part of material handling.

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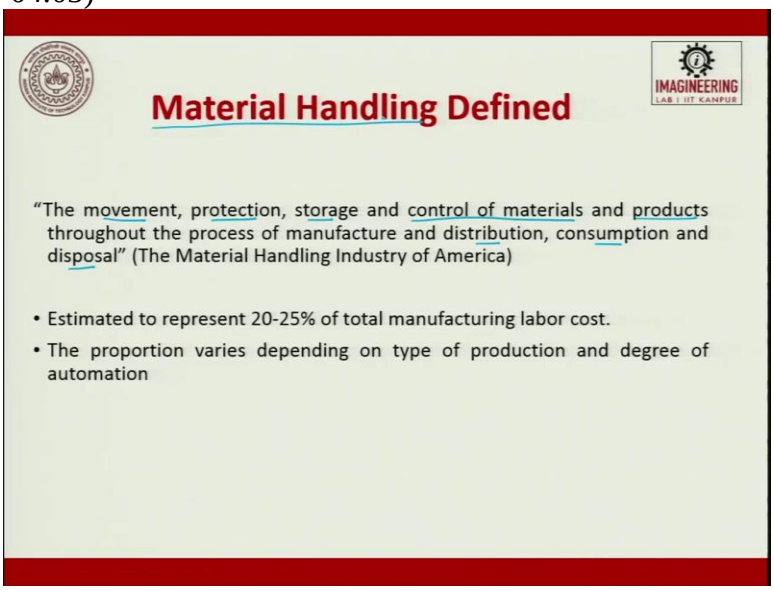

What is material handling? Let us see the definition, the movement, protection, storage, and control of materials and products throughout the process of manufacturing and distribution, consumption, and disposal is material handling. The movement, protection, storage, and control of material and products throughout the process of manufacturing and distribution, consumption, and disposal. Material handling also talks about disposal.

So, all these things put together comes in the definition of material handling. This is given by material handling industries of America, estimated to represent 20 to 25 percent of total manufacturing labor cost is material handling. You look at it, 20 to 25 percent. If we could automate it we can save much. The proportion varies depending on the type of production and degree of automation.

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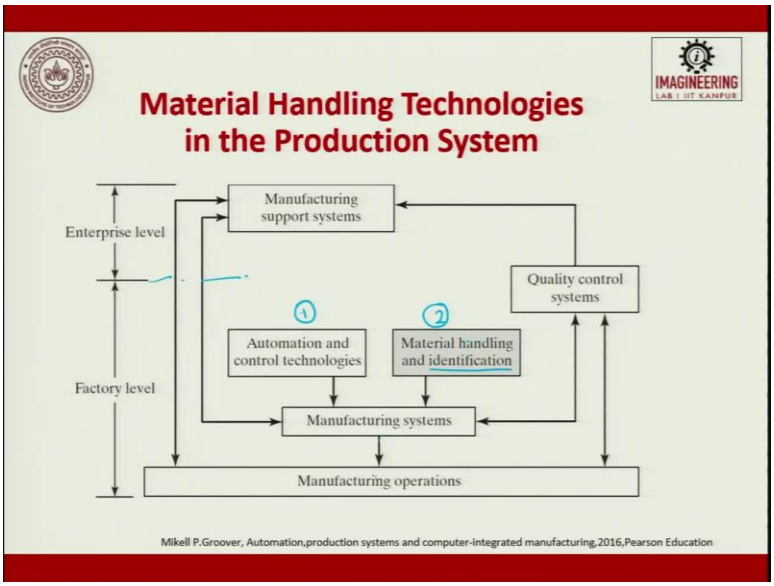

When we talk about material handling technologies in the production system, you will have a manufacturing support system which operates at the level of enterprise. So, that means to say business level. And below this, you have a factory level. In the factory level, we have automation and control technologies, 1 and the 2.

The second major one is material handling and identification. This is what I kept on repeating the right quantity, right item, right quantity at a safe mode. Right item. How do you do? Identification. So, material handling and identification. So, these 2 are part of manufacturing systems, which in turn is attached to manufacturing operations.

So, if you look at enterprise level, you will have support systems and factory level 2 major things out of which material handling and identification is one of the most important things, which is there in the factories.

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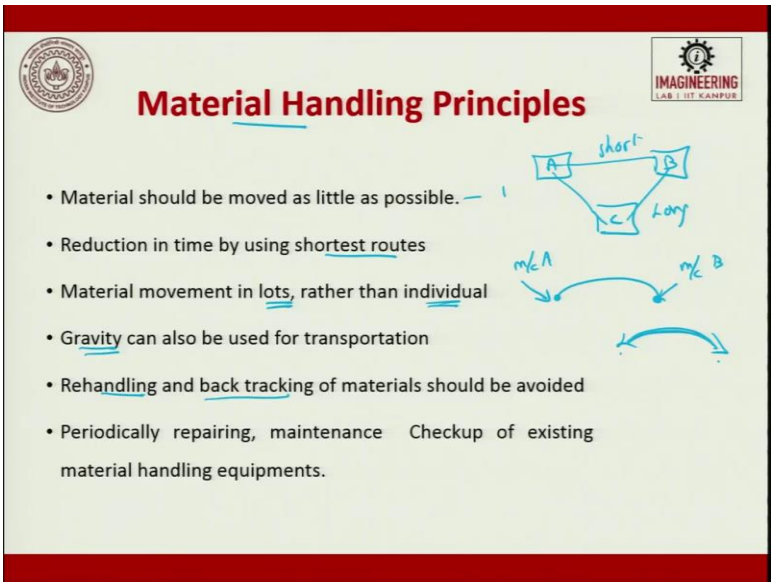

So, some of the material handling principles. Material should be moved as little as possible, you cannot bring it to 1, you have to bring it to some numbers, wherein which it is safe for moving.

Moment you add more number of quantity of material to be moved, between material to material when it touches it might damage. Second thing it is too heavy for a single man to handle. So, you can say robot can handle, robot also has weight limitations. So, we should carry as little as possible and as required as possible.

Next, reduction in time by using the shortest route. So, that means to say when the material is getting moved inside the factory, you should try to use the shortest path and you should try to avoid redundancy in the path. For example, machine A, machine B, machine C. So, if you are supposed to move from here to here, you can always move A to C, C to B, and come to B.

So, this is the longest path and this is the shortest path, you are always supposed to use the shortest path such that you will try to deliver it at the required time. Material movement in lots rather than individuals. See it is little contradicting as little as possible and it should not be as large and you have to define the lot size. Lot size definition is also a big challenge.

For example, when we try to take a carbonated drink, a cool drink, okay. Suppose, if it is moved from your factory to a factory, it is moved in your truck. The unit size or the lot size, you see a truck, when the same truck is getting to a bottling plant and where it is getting refilled in a bottle.

Now, what happens? It will be your cart, your carton of bottles is the unit size, or your crate of bottles is your unit size. When the same is delivered to a retail shop when a single man buys, it is your bottle, a lot size, a unit size. Look at it the same product is, lot size is getting completely changed in terms of volume and numbers.

So, lot sizing is a big challenge whether to put 12 bottles in the cartoon box or to put 8. How do you decide is it weight alone or is there safety of the material also comes into existence? When we try to move cigarette packets, is it going to be only 8 or is it going to be hundred? So, lot sizing becomes very important.

So, material movement in lot size rather than individual. So, I have already told, it has to be as little, it cannot be individual, it has to be a lot size. The biggest challenge is a lot size. Even the courier boy who comes and delivers the online purchase, his lot-sizing depends upon the baggage what he carries.

Is it volume based or is it weight-based? Trade-off. Gravity can be used for transportation, many a times if you see in the agriculture industry, we always use gravity for our advantage. For example, we try to, we know, so we try to take the paddy mixed with some dust, so we take it to a certain height. From there we drop.

So, the good paddy falls down straight and all the other unwanted things, which is light in weight flies off. So, we try to use gravity for our advantage, many times, including conveyors, which are used for unloading the baggage in your plane. We also use gravity for our advantage. So, you drop from the top, it comes down and when you go for a security check in the airport, we sometimes have the roller conveyors which are there.

So, in that roller conveyor, they always will have a small taper. So, you put your baggage of its own weight it will be sliding towards the X-ray machine. So, gravity is used to, for advantage. Rehandling and backtracking of the material should be avoided, that is what I said here, it should use a shortest path. Redundancy should be avoided, rehandling means one time you handle, you go here, next time again you put another machine.

So, here you use a machine A to do it. You drop it here then machine B takes it and then it does it. So, here if you see it is rehandling and backtracking is the object getting moved back and forth between two machines. You do 1 operation go here, then finish the second operation again come here.

So, this is backtracking of materials, it should be avoided. When we plan a factory, when we plan the machine layout, we are supposed to make sure that backtracking is not happening in our movement. Then periodically repairing, maintenance, checkup of existing material handling equipment has to happen.

So, these are some of the principles, which are followed in material handling, which tries to dictate the productivity of the company.

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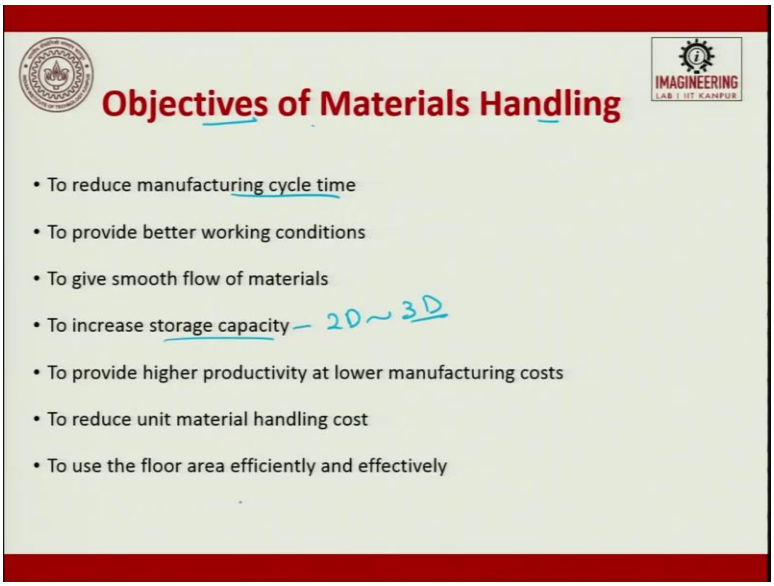

Next, what are the objectives of material handling? It will try to reduce the manufacturing cycle time, to a large extent it will try to reduce. It tries to give you a better working condition.

It tries to give us smooth flow of materials, these are the objectives of material handling. If material handling automation is not there, then smooth flow of the material will not happen, then increase in storage space because now we move from 2D space to 3D space. So, it will be stacking of 1 above each other.

So, if proper material handling is not there, then the stacking cannot happen. So, each container will have a locking device. So, if you see in ships, when the containers are moved, at the top of the container you will have locking devices which tries to lock with the next container which is stacked on top of it. To provide higher productivity at lower manufacturing cost is the other objective of material handling, and to reduce unit material handling cost. Finally, to use your floor area efficiently and effectively, these are some of the objectives which are laid for material handling.

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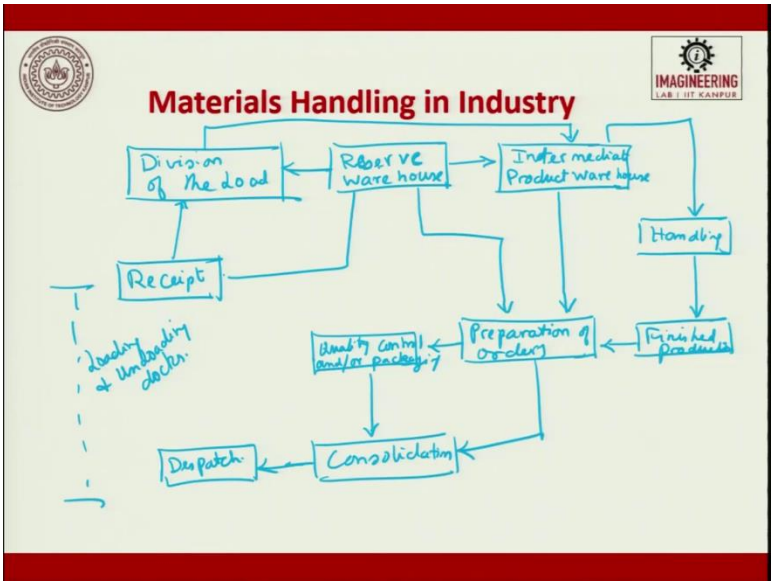

So, when we talk about material handling in any industry. First thing what we do is division of the load happens. Then we try to reserve warehouses. Then we do intermediate, intermediate product warehouse, we have handling. First, I will write down all the systems and then I will try to get the correction. Finished goods, finished products, preparation of order, then we have consolidation.

We have quality control and or packaging, here we will have receipt. So, if we start doing it from here, it will be division of the load. So, it gets from the warehouse and warehouse it also goes to the intermediate product. So, you can also get an input from, from here to here. So, then you will have from, intermediate you will have handling, from handling it goes to the finished goods, from finished goods it goes to the preparation of the ordering, then quantity to be packed, from the packed it gets consolidated.

So, from the preparation of ordering, it goes to consolidation, from consolidation it goes to dispatch. So, here, from here it goes to here and then from here, from reservoir house it goes to preparation, and from intermediate warehouse also it goes here. So, this is the dispatch. So, if you look at it, this is a point where we do loading and unloading dock. So, here loading, and unloading docks happen.

So, receipts, it also goes here. So, division of the load. So, that comes from the warehouse, from warehouse it also goes to intermediate, from intermediate it goes to handling as well as preparing of the order, from handling it goes to the finished good, it picks up ordering, and then from orders, it goes to quality control and their consolidation dispatch packing and it goes to the output.
So, receipt is also there. So, here it happens, loading and unloading dock are this portion takes care of the loading and unloading of the dock, dispatch, and receipts.

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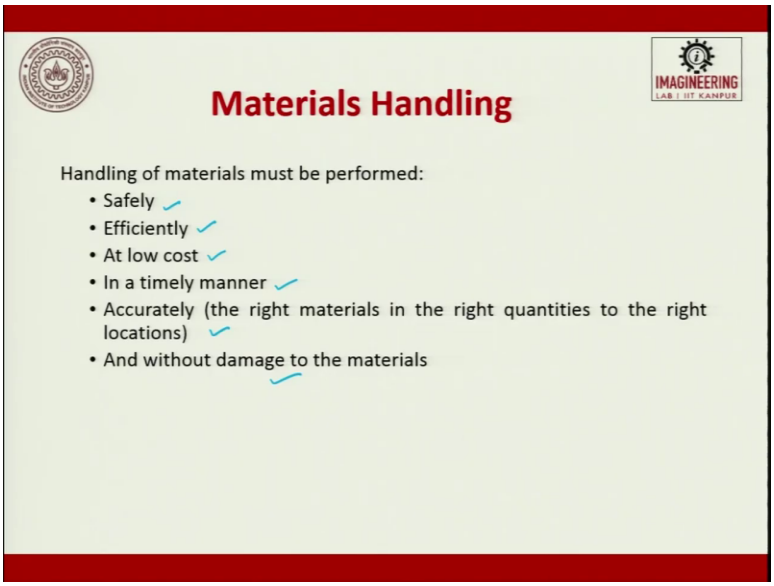

So, material handling must be performed safely, efficiently at low cost in a timely manner, accurately, and without any damage. You can put all these things for the courier which gets delivered or online shopping which gets delivered safely, efficiently, at low cost, timely, accurately, the right material in the right quantity to the right location, this is what I was trying to tell and without damage to the material. So, all these things must be performed during material handling.

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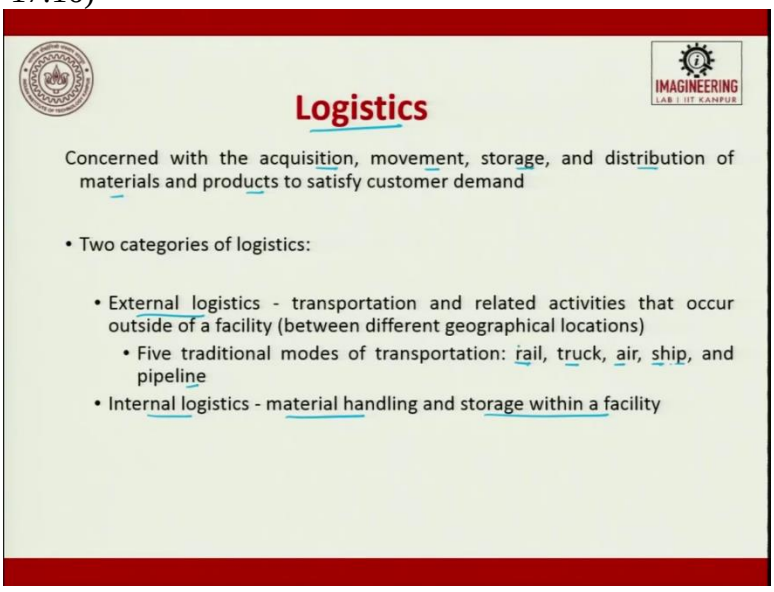

Logistics, logistics is concerned with the acquisition, movement, storage, and distribution of materials and products to satisfy customer demand. This is logistics, logistics is concerned with the acquisition, buying, movement, storage, distribution of material, and products to satisfy customer demand. 2 categories of logistics are there today. 1 is external logistics, the other one is internal logistics.

The external logistics are nothing but transportation and related activities that occur outside the factory. You are supposed to plan for your logistics internally as well as externally. Internally, it has material handling and storage within your facility. Your internal logistics, maintaining your kitchen in your home is internal logistics, where to keep rice, rice for daily consumption from where to take, and how do we keep a seasonal stock.

So, it is material handling and storage within your house. So, that is internal logistics, you will have to do both logistic control, the external logistic control as well as internal logistic control. 5 traditional modes of transportation for external logistics are rail, truck, air, ship, and pipelines. Interesting today, gas are pushed through pipelines. Between 2 CNC machines, movement of parts happen using pipelines.

So, rail you know, trucks you know, air you know, ship also you know, Indian government is more pushing towards truck movement, because this is why we started talking about the golden quadrilateral, which connects all the metro cities. So, trucks the road connection is very important there are so many places where rails and air cannot be accessible.

So, there we go for trucks. So, rail, trucks, air, ship, ship is in 1 vehicle, in 1 vessel you can transport huge loads in terms of tons. So, ship is the best thing to do. And then pipelines, when we talk about ship, we talk about weight is one, but volume is one when you talk about air, it is weight, truck it is weight, rail it is weight, pipeline it is only pneumatic, so we talk in terms of volume. So, these 2 are the logistics which apart from material handling logistics also play a very important role.

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These are the external logistics. This is a single ship which takes maybe 100 tones or 200 tons of weight. So, here these are all the containers. It looks like a very small, these are steel containers and in this container, you have a huge volume of space. You fill it up and these are stacked together, say, for example, you can have 1, 2, 3, 4, and 5 tires like that you will have all these containers arranged.

So, again this container, arrangement is also a big challenge, you have to do it with perishable items, nonperishable items like your bus to ship also tries to take where we travel by a way, it has to stop at several places. So, it has to plan for its loading and unloading of containers in each station. So, accordingly, it has to arrange.

And then, it also has to make sure that while moving through several ports, if it gets unloaded and if there is a disbalance in the loading, so then the possibility of ship getting toppled is very high. So, external logistics planning is also material part of material handling and it is a huge challenge today.

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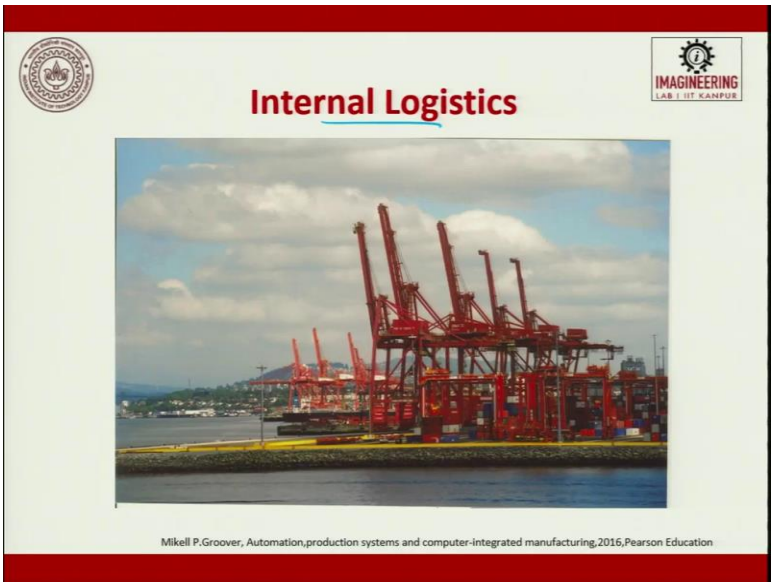

Next is internal logistics. I was talking to you about internal logistics about a house, but here we talk about internal logistics of within a country or within a port or within an industry we are trying to do.

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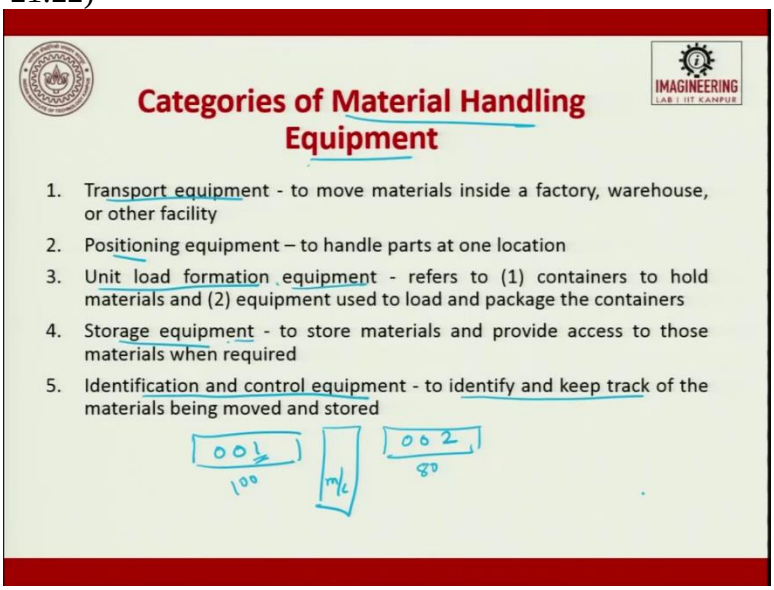

The categories of material handling equipment are, one transportation equipment, positioning equipment, unit load formation equipment's, storage equipment, identification, and control equipment, all these things are part of material handling. You thought initially it was only transportation, now you see transportation, positioning, up-down movement positioning, unit load

formation equipment, container packing, storage equipment, then finally, identification and control equipment all these things are part of material handling.

Transportation equipment are used to move materials inside a factory, warehouse, or other facilities. Positioning equipment are only to handle parts at one location. For example, when you visit the processing industry like iron and steel industry, where they make rolls, where they make flat plates.

So, here handling is the hot plate will be made and it will be wound into your bin, a bale will be made and then that bale will be moved. So, the positioning equipment will move up and down left and right like gantry, cranes, right. Next is unit load formation equipment refer to 1 container to hold material to equipment used to load and package of the container.

So, unit loading, so, you pack 50 of them together and then it just forms a, a package, it just compresses it and then binds it. So, unit load formation equipments is the next one. Storage equipments to store materials and provide access to those materials when required. So, storage equipments are like you go to a library, where there are stacks of books available, they are all stored.

So, when you go to a library, it is very difficult for you to track the book what you want, you spend hours together to locate it and then you try to go. So, you first look at the rack number and then look at the book number, and then you go to that spot and pick it up. What if something happens you go to your place, you tell it that I need this book, then immediately within two minutes, it picks and then throws in front of you.

So, here the storage equipment should be in such a way such that when the customer gives back, it has to go to the particular location loaded, and when a customer wants it has to be pulled from there and given. So, that is what is a storage equipment we are talking about. Next identification and control equipments to identify and keep track of materials being moved within the store.

In an industry, a part which comes as 001, part number will be 001. Here is a machine, which does some work on it, now, the part number is converted to 002, why? Because there is a value addition which is happening in this machine. So, once there is a value addition, there is money which is involved and it changes its form and maybe at this form, it finds out a customer for sale.

So, here what happens at every location, you have to have your track of the materials which are getting moved and stored inside the factory. So, after the value addition, you will not see 001 anymore. For example, you have 100 of them, you know 001 and if you have 80 of them, you quickly can find out this machine is a culprit which produced 20 scrap.

So, in order to have a track of the material being moved and stored, we need to have a material handling equipment. So, these are all the categories transportation, position, unit load formation, storage equipment, and identification and control equipments are part of it.

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Use of computers in handling today, you can see a computer talks to anybody and everybody inside a factory. It talks to a controller, it talks to your power, it talks to your hopper, it talks to your, so many places, everywhere a computer keeps talking there is a data coming, data going, if there is a starvation of, of raw materials happen, immediately traces a bill and then it raises your order for new materials to flow in, everywhere today computer plays a very important role.

If computer would not have been there, this material handling would have not gone to this maturity level.

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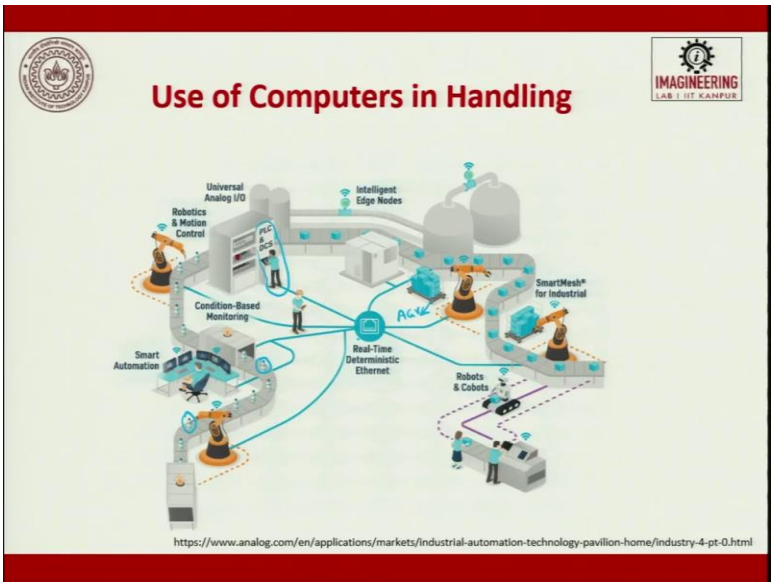

So, you can see here how real-time deterministic Ethernet is used, and it helps in communicating within the factory. So, you can see here, your robot does your job. So, a moment your robot does a job, it gets communicated to this gentleman who is sitting here and then this gentleman also checks the quality whatever is coming out.

Suppose, here if it makes a defect, then here what he does is as soon as it goes here, he identifies the defective one and here in this, while it is moving along the track, if there is a defective product going, this robot has option of knocking it out and allowing the fresh pieces alone to go. So, here you will try to have a control over the product by using PLC.

So, there is a universal I/O analog. And then it gets packaged it goes inside several boxes, and then from here, it is then packed and put inside here, unit load. This is the AGV, you put on the AGV, and this AGV is moved to the central stores and it is stored here. So, you can see everywhere the computer data is used and throughout what we are trying to do is, we are trying to only handle data, handle material such that it tries to give better productivity.

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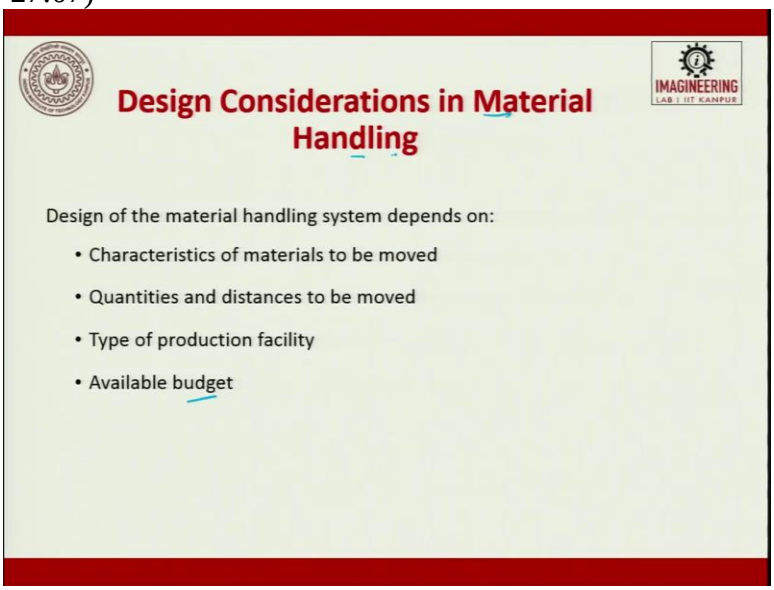

Design consideration in material handling, we generally has to have one is looking into the characteristics of the material to be moved, whether it is volume-based or weight-based, characteristics of the material to be moved than quantity and distance to be moved. Then type of production facilities available budget. So, these are the 4 design considerations we should think of while deciding a material handling device.

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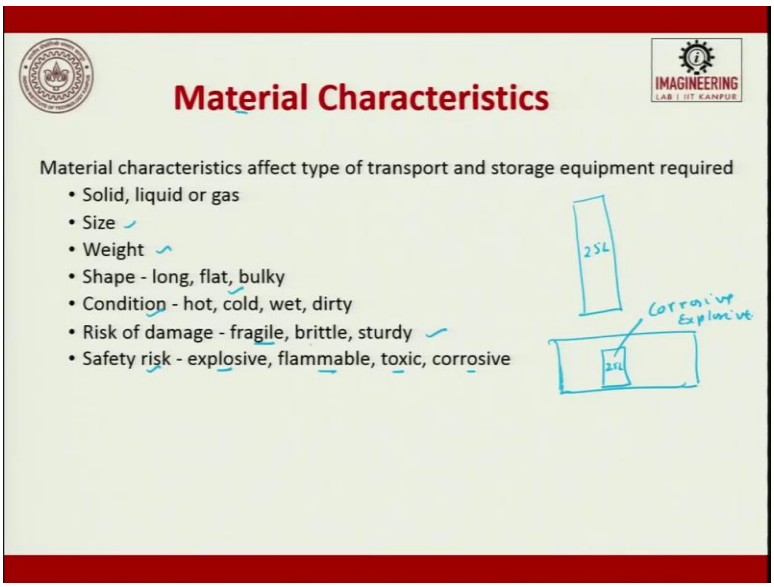

So, the material characteristics which generally comes into existence are whether it is a solid, liquid, or a gas. When it is a gas, we try to apply high pressure, liquefy and push it inside. There

are liquid nitrogen, nitrogen gas which has been moved from Siberia to other countries. So, it will all be in a liquefied state, high pressure it will be liquefied. So, then size, whether the state then, the size, weight, shape, condition, risk of damage, fragile, brittle, sturdy comes into existence and finally, safety risk, explosive, flammable, toxic, and corrosion.

For example, I do a lot of experiments in laser and in laser, there are corrosive gases which are used. So, the container with which it is getting moved from some X country to India. It will come through a ship via ship. So, when it comes via ship, the bottle will where the corrosive gases are stored. It is 25 liters, but it will be placed inside a container, which is so big, and then this, this fellow alone sits here and comes 25 liters.

Why? Because this is corrosive and this is the explosive. I have to pay a bill for the entire container getting shift from one country to India. So, here the safety risk explosive, flammable, toxic, and corrosive also plays an important characteristic when we decide the material. So, these are important depending upon this, we decide the material handling equipment.

So, solid, liquid, gas, size, weight shape, condition, risk of damage, and safety. For example, if they are fragile, they cannot be moved in a ship very easily, because the ship rocks as and when it moves in the sea and they all go at very high speeds. So, when it rocks the parts might get broken.

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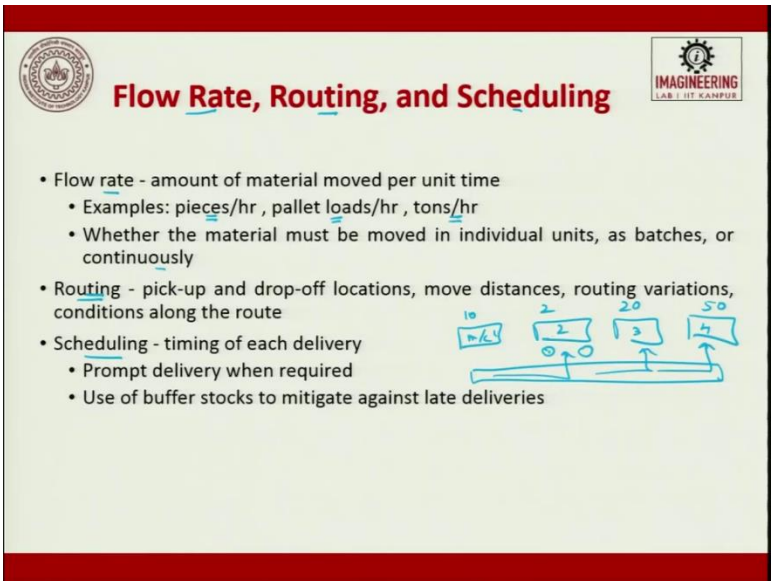

Next, flow rate, routing, and scheduling. Flow rate is amount of material moved per unit time is also very important. For example, it is number of pieces to be moved in an hour. When we talk about cigarette packaging, bottling, we talk pieces per hour. When we talk about movement of slightly lower weight or low cost, we could talk in terms of pallet, loads per hour.

When we talk about coal and other things we talk in terms of tones per hour. So, the amount of material moved per unit time is a flow rate, whether the material must be moved in individual units as batches or continuous is very important, which helps in deciding the material handling device.

Routing, pick up and drop off location, move distance, routing variations, conditions along the route are routing. For example, picking up kids while a school bus go is called as routing. The pickup location and the drop location can be the same, can be a little far off, and the distance, then the routing variation condition along the route.

So, these things are part of routing which has to be considered for material handling. Scheduling, timing of each delivery is also very important. For example, if there are machines, 4 machines machine 1, 2, 3, and 4 and if the cycle time for each machine are 10 minutes, 2 minutes, 20 minutes and 50 minutes. So, what happens? Within 5 times 1 part is produced here you can produce 5 parts here.

So, correspondingly you can produce 25 parts here. So, now what happens, you have to see if I have to feed material to this station to machine 2, I have to feed in at regular intervals of time. For every 5 minutes, I have to keep feeding, but when the machine is running at 50 minutes I do it only once in an hour.

So, here I might do 5 times in an hour. So, now, you see I am scheduling the machines or the material moving device to these machines. So, that is nothing but the timing for each delivery is talked about. So, prompt delivery when required, use of buffer stock to mitigate against late deliveries will be also taken care.

So, what we do is, we also try to have buffer. So, that they do not starve. So, from the buffer, it starts using and it, and you keep feeding the buffer. So, scheduling is very important as far as material handling is concerned. So, deciding a material handling design consideration, flow rate, routing, scheduling, apart from the material characteristics is very important.

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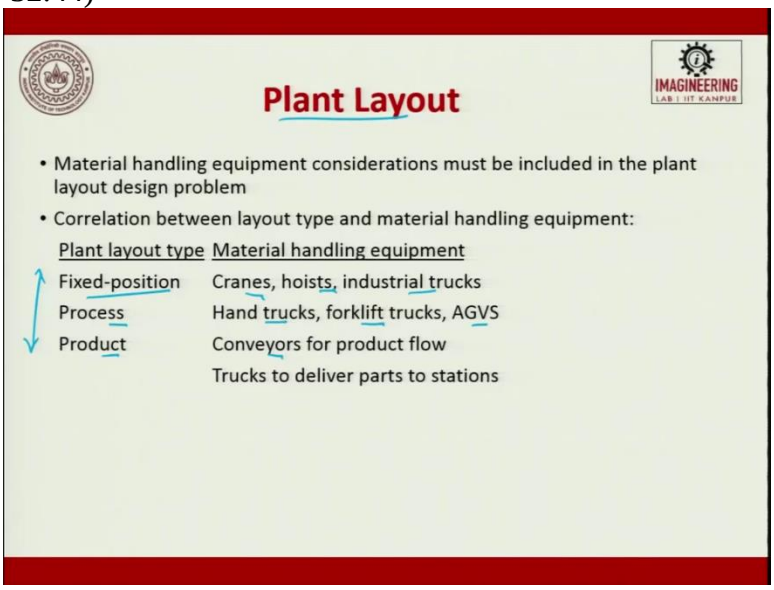

Then comes a very important aspect is plant layout. Material handling equipment consideration must be included in the plant layout design problem itself. Suppose, if you are trying to develop your colony, inside a colony you are trying to plan for a shuttle bus to run. So, right from the beginning, you should plan for your road where at least 2 shuttle buses can move. So, that is what

we are saying material handling equipment consideration must be included in the plant layout design problem itself.

So, correlation between the layout type and the material handling equipment is very important. When we talk about fixed positioning, we put cranes, hoists, and industrial trucks. When we have process industry, we talk about hand tracks, forklifts, and AGVs. We will see what is AGVs later. When we talk about products, we talk about conveyors for product flow, trucks to deliver parts to stations.

So, these are the material handling equipments based upon the decision of your layout, these material handling equipments will be picked up. When we talk about fixed positions, we talk about cranes, hoists, and industrial trucks. So, when we talk about products, product means from station to station the product will move. So, we always look for a conveyor to be used.

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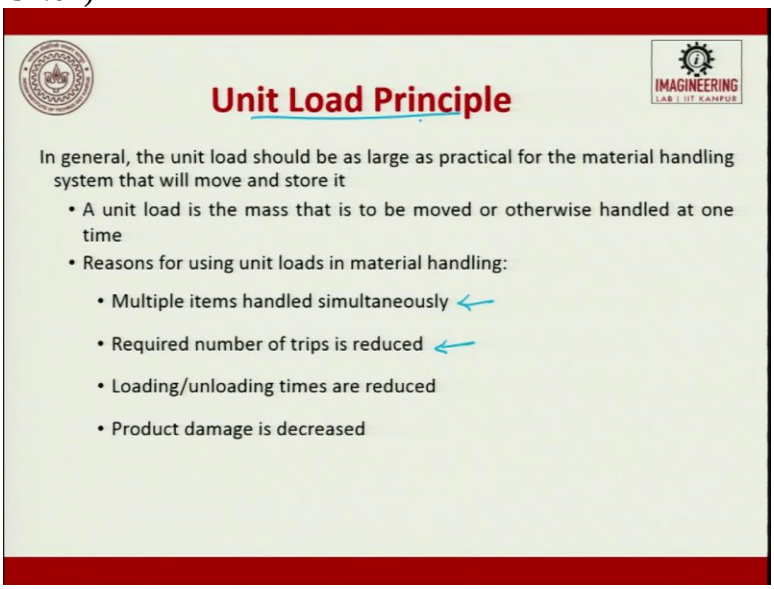

So, what is unit load principle? This is very important, what should be the unit load size while doing material handling? In general, the unit load size should be as large as practical for the material handling system that will move and store it. So, here I was giving you an example of a truckload then coming into a crate load, coming into your bottle.

So, each one at each level is a unit load. So, a unit load should be as large as practical for the material handling system that will move and store items for it, a unit load is the mass that is to be moved or otherwise handled at 1 time, can be a truckload, cotton load or a bottle. The reasons for using unit loads in material handling are, multiple items handling simultaneously can be done required, see for example, when a truck is moved or if somebody comes at delivery at your home.

So, he tries to bring multiple items handling simultaneously, required number of trips is reduced. When we have properly planned the unit load, loading and unloading time is reduced and the product damage is decreased. So, unit load decision is very, very important in material handling.

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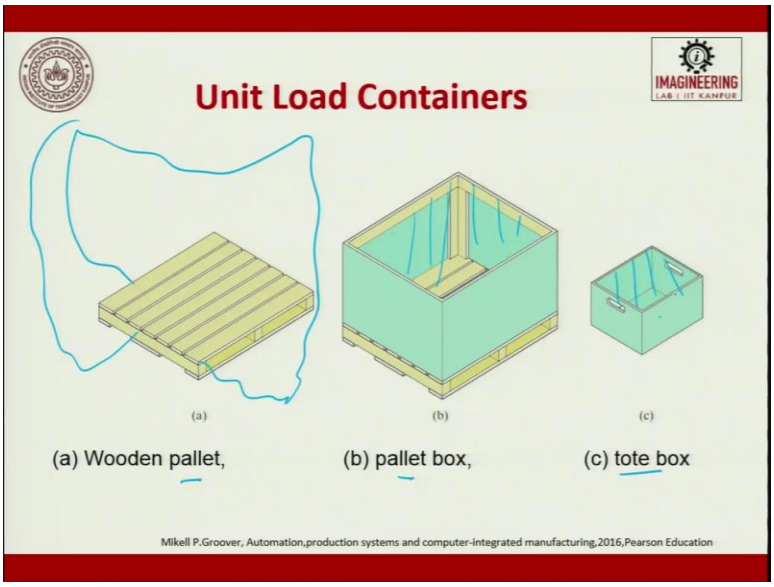

So, a unit load can be a wooden pallet, it can be a pallet box, it can be a tote box, small box, slightly larger, very large.

So, here I can store it like this, outside the pallet I can go, right. But here in this pallet box, I have to fill only up to this level. Now, I fill only up to this level. So, the unit size varies from condition to condition and place to place. Depending upon the material requirement and the costing involved.

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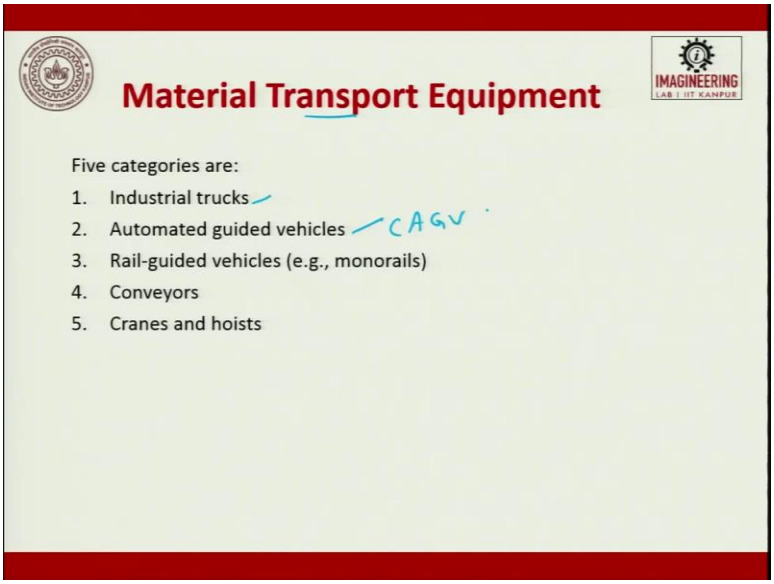

When we talk about transportation equipment, we have 5 types of transportation equipments, 1 is industrial truck, AGVs. These are AGVs, then rail-guided vehicles, conveyors, cranes, and hoists. These are all 5 different types of material transport equipments, which are generally used for material handling.

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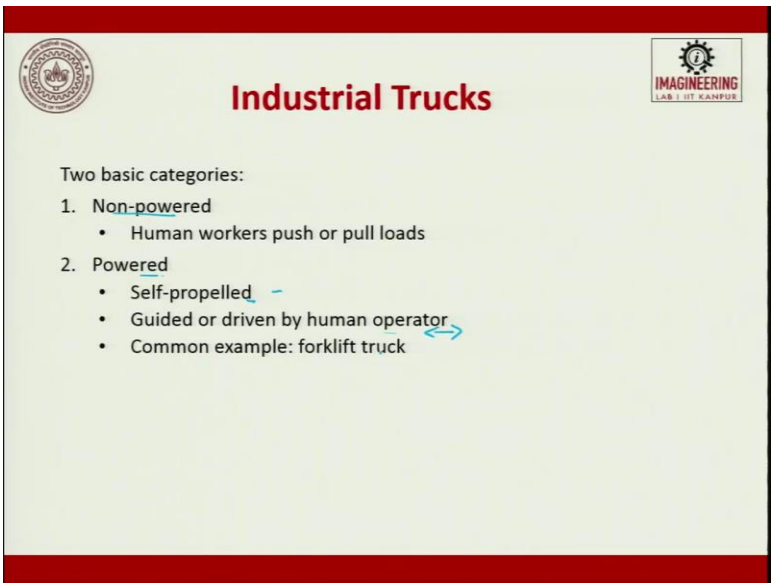

There are 2 categories of trucks. So, one is non powered, the other one is powered. Non powered is human worker pushes or pulls, you can see in many of the malls or Walmart, Big bazaar, when

a small quantum has to be moved from a truck it will be brought down to a warehouse, from a warehouse it will be brought down to the line for moving.

So, where we use non-powered human worker pushes or pulls, or you can even think in an airport when you are trying to take your baggage out, you try to put in a trolley and that trolley is non powered. There are powered trolleys. So, you can see some disabled person or some people with ailment who cannot pull or push a truck, they always use a powered vehicle.

So, self-propelled vehicle is there, guided or driven by human operator. So, this is what we use, guided or driven by human operator, self-propelled as it moves of its own. So, then using gravity, the common example is forklift or powered one. Self-propelled is, it has its energy to move its a battery operated.

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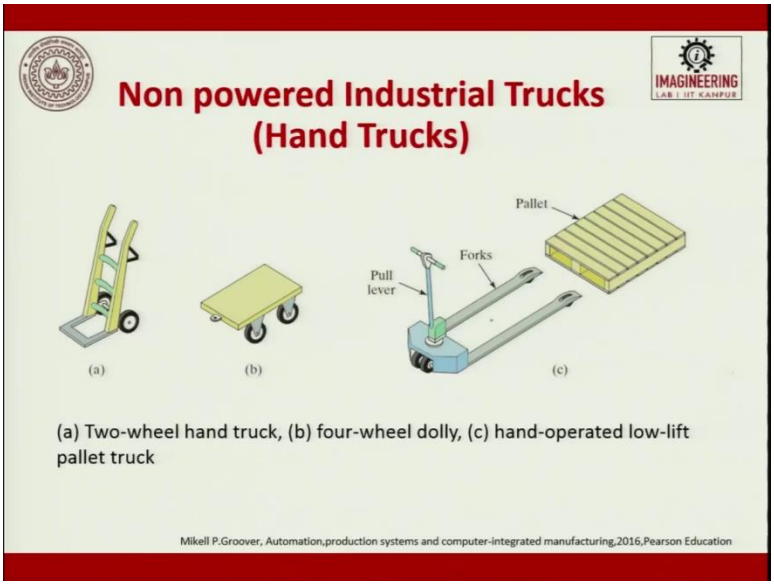

So, non-powered industrial trucks can be 2 wheel hand truck. So, you can see, when the, when the carton box of cold drinks are moved, so they put it in a 2 wheel hand trucks. Then 4 wheel dolly is also used, then you have hand-operated forklifts, which can lift the pallet from 1 place to the other. So, that it can be used for our transportation.

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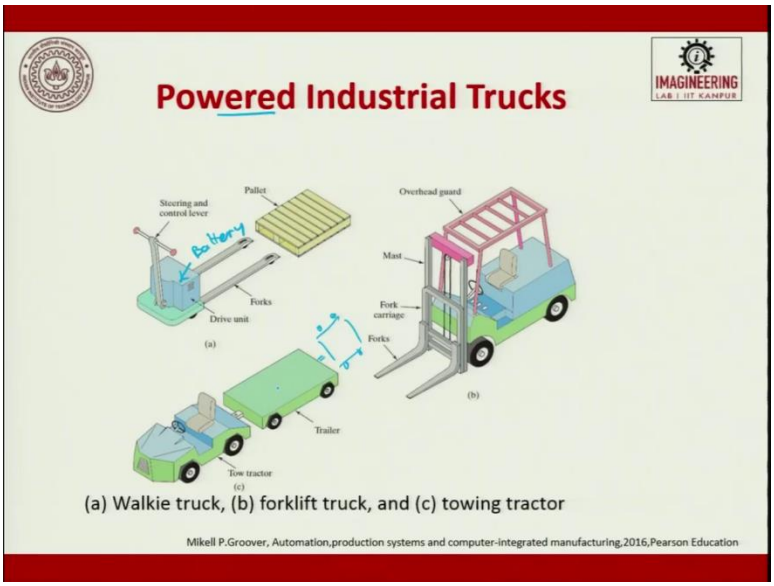

Powered vehicles as I told you there is a battery-operated, battery is there. So, here you have a steering and a control lever is there. So, it is like acceleration, deceleration, left, right movement all these things can be done. So, it is done for a pallet. The other 1 is you have here a forklift, which is again automated, which is powered by, this movement is powered by a diesel, and this movement can be powered by battery.

The last one is like a tow tractor, tow tractor is you can have many stations, where at individual stations you keep towing to the pallet, which is attached or your compartment which is attached to the towing vehicle.

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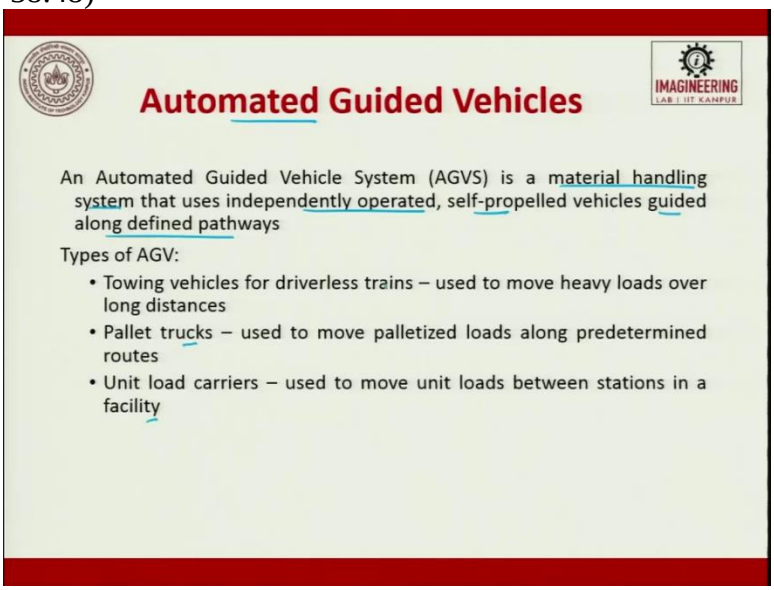

AGVs, AGVs is a material handling system that uses independently operated self-propelled vehicles guided along defined pathways. AGV are nothing but material handling system that uses independently operated, you can have a labor, you need not have a labor.

So, independently operated, self-propelled vehicle guided along a predefined path. So, this is AGVs. Today in a Sims environment, we use AGVs for material handling, forklifts, and other things are there, but exhaustively in a Sims environment we tried to go for AGVs which industry uses, mass production industries uses it. So, that we use AGVs.

For example, the printing press, newspaper printing industry uses AGVs. Types of AGVs, towing vehicles for driverless train uses to move heavy loads over a long distance, pallet trucks use to move palletized load, along a predefined path as pallet trucks, unit load carries, used to move unit load between station to station or station to facility.

These are the different types of AGVs. One is towing vehicle for driverless trains, next is pallet trucks and the last one is unit load carrier.

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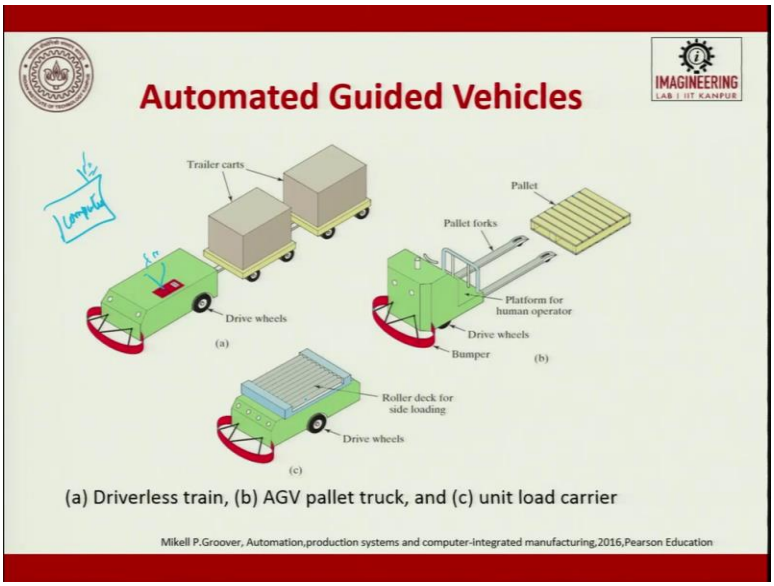

So, this is driver less train. So, here all the communications are received from your center computer. It has a Wi-Fi, this Wi-Fi communicates here and it tries to control. So, it is already taught, which all parts to take. So, it goes along those parts guides, and then it tries to move towards the destination. So, automated guided vehicles, so it is a driverless train. So, here we can drop each cart box or cartons at the required machine stations or in the warehouses. So, next is AGV pallet trucks, these are all AGV pallet trucks.

So, here it can be self communicating or there can be operator, who is used to do the loading and unloading of the work. Then the last one is unit loading. So, here it is pallet, here it is unit load, so that is the difference pallet, unit. And here it is several of these pallets can be taken or loads can be taken.

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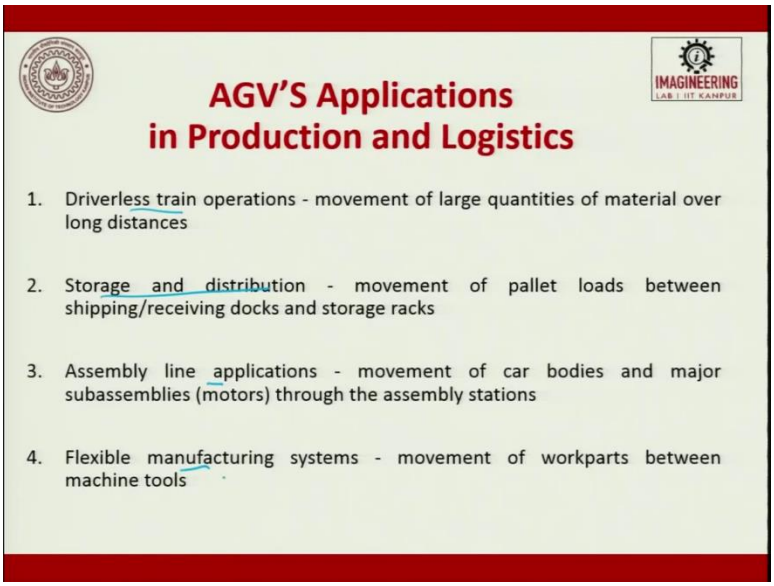

AGV application in production and logistics, driverless train operation, movement of large quantities of material over a long distance happens in driver-less trains. Long-distance, here long-distance, please do not think it is few thousand kilometers. It will be 3, 4 kilometers within the factory. Storage and distribution. Movement of pallet loads between shipping and receiving docks and the storage rack is storage and distribution movement.

Assembly line application, movement of car bodies, and the major sub-assemblies through the assembly station is assembly line application, where AGVs are used. Flexible manufacturing system, movement of parts between the machine tools. So, these are the 4 operations which are done as part of AGV application production and logistics.

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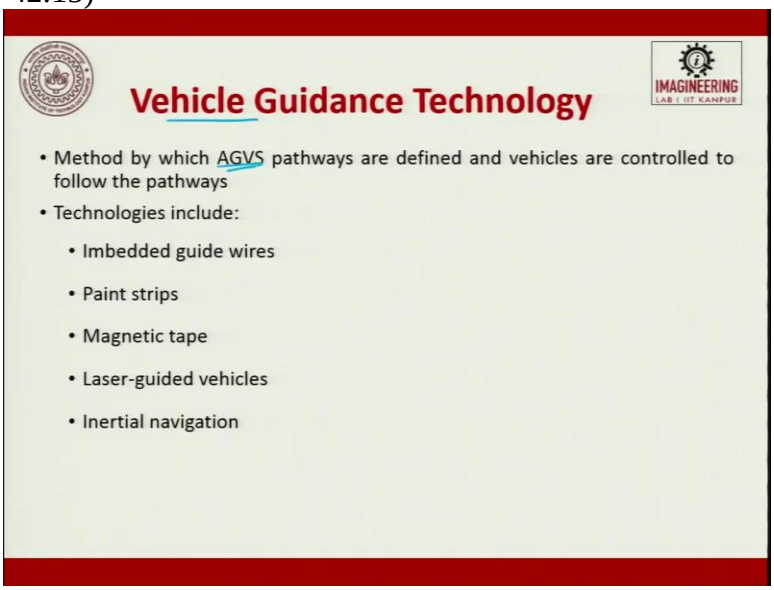

When we talk about vehicle guidance technology, these are some of the vehicle guidance technology used. So, when I said driverless vehicle, AGV has to be guided to move along a predefined path. Though if there is no driver, then how are you going to guide it. So, these are the guiding technologies which are used in AGVs. Embedded guided wire, paint strips, magnetic tapes, laser-guided vehicles, and inertial navigation. So, these are the 5 technologies which are used for guiding an AGV.

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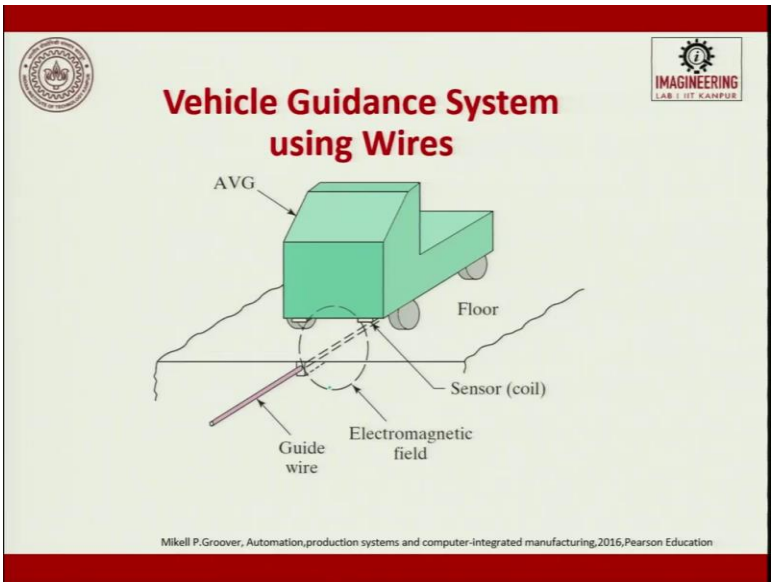

So, this is what is the vehicle guided system. So, here there is an embedded wire, which is slightly deeper from the surface and then you have a current which is passing through the guided wire. So, it tries to create an electromagnetic field. So, based upon the electromagnetic field it is created, the vehicle can move left, right or it can go straight to go towards the destination.

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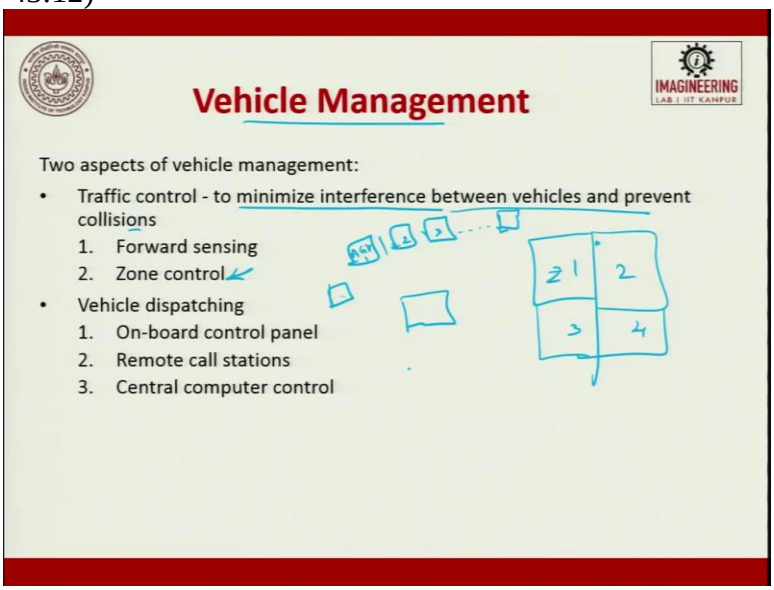

The vehicle management, there are 2 types of vehicle management which is important as far as AGVs are concerned. So, we will have one as traffic control, the another 1 is vehicle dispatching. Traffic control is to minimize interference between the vehicle and the prevent collision. So, traffic control to minimize the interference between vehicles and prevent collisions. So, there is a forward sensing available, there is a zone control available. So, forward sensing is it puts an ultrasonic sensor or put any other proximity sensor, it tries to see whether there is anybody coming in between so that it will stop and then starts moving, so forward sensing.

The other one is zone control. I divide the factory itself into several zones, 4, 5 zones, and zone 1, 2, 3, and 4. So, if there is already 1 AGV here, so, the entry will be switched off. So, no AGV can enter inside and go. It is almost like a railway track when there is a signal, the train goes, and when there is no signal the train stops, why there is no signal because already in the same track, there will be another train which is coming in the opposite direction.

Vehicle dispatching, onboard control panel, remote call stations, and central computer control. So, these are all some of the vehicle dispatching techniques which are used, such that you know, from a centralized computer, you are trying to, you are trying to converse with various AGVs. In a factory, you will have AGV 1, 2, 3 up to n.

So, now you have, between these AGVs there can be an accident, the AGV and a man can be an accident. So, in order to control all these things, there will be a onboard control panel in the vehicle and remote call stations will be there, somewhere here, and then there will be a central computer. So, this can talk with each other and try to control the vehicle movement.

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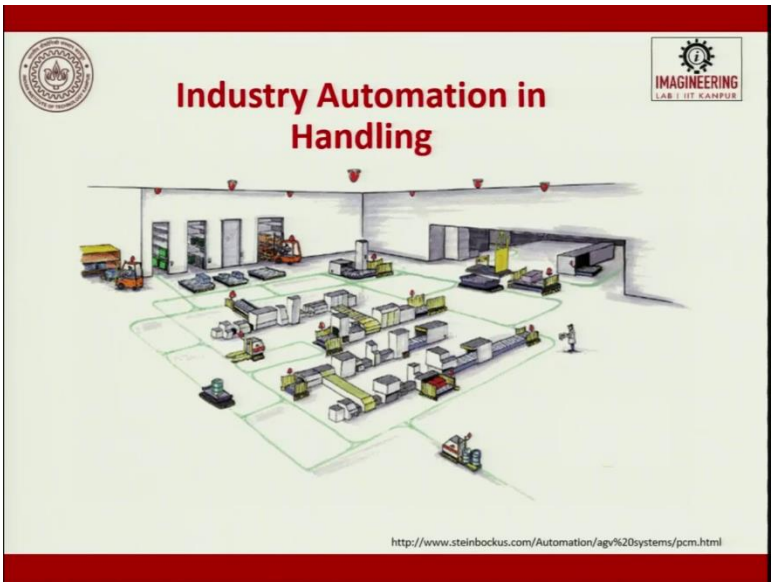

So, you have a look of this Gif figure. So, here these are all folks which are moving, these are all unit palletized AGVs, which are moving. So, the entire factory is now divided into several zones. So, once the operation is over, it goes, gets inside the zone, pulls the load, and then tried to take it to the stores, very interesting.

So, what we do is we, we cut them into several zones. So, in each zone, we try to control. Once there is 1 AGV there, the other AGV does not come into existence. And if 1 AGV is conked off then from outside there will be an AGV which comes and helps them.

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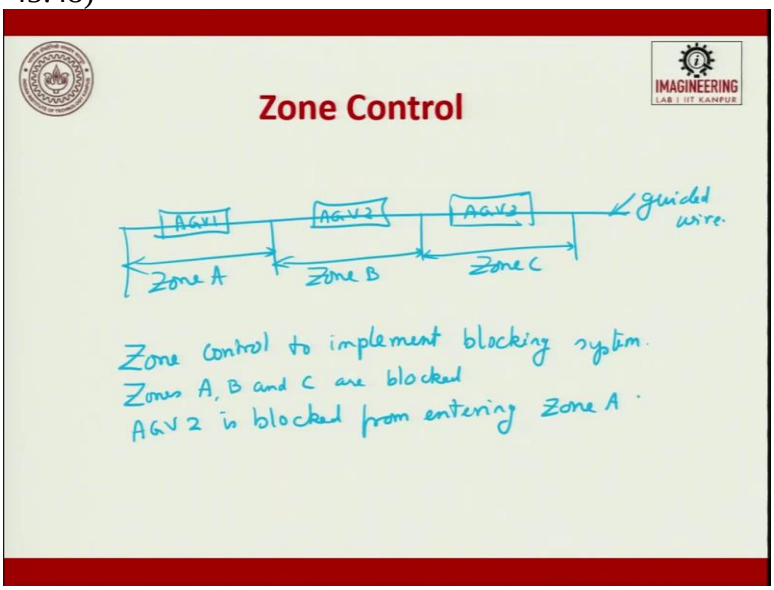

The next one is zone control. So, in zone control, As I earlier told you, there will be a guided path, there will be 1 AGV, AGV 1, AGV 2, AGV 3, this is the guided wire. So, this is zone A, zone A, zone B, Zone C, okay. So, this is a guided wire, so zone control, control to implement blocking system. Zones A, B, and C are blocked.

So, no other vehicle can enter inside. So, AGV 2 is blocked from entering zone A. Because there is zone A. So, you can see that so, this is how a zone is controlled. So, it can be 1 vehicle, it can be 3, 4 vehicles. Close just like a railway track and this is a guided wire which goes, so, the guided wire takes you, guided wire is your railway track but if you put like a railway track, it will be project, projecting outside. So, people might fall or it might create a lot of disturbance for the other vehicles to move. So, we sink the rail inside and through which we pass current and get electromagnet and that is how this material handling is done.

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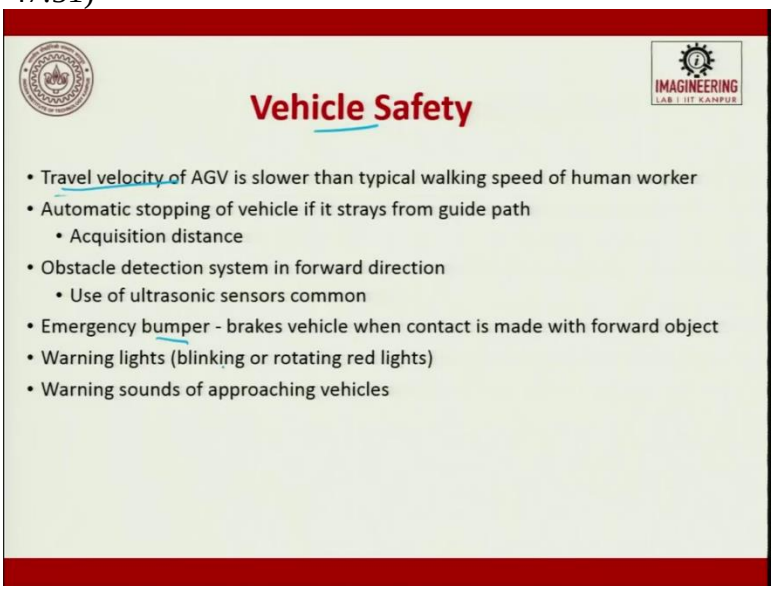

Vehicle safety. Vehicle Safety is very important, travel velocity of these AGVs are slower and typically walking speeds of human worker will overlap with the travel velocity of AGVs. The automatic stopping or the vehicle, if it is traced from guided path. So, it tries to find out the distance, how far is it the object and other things. Obstacle direction systems are set and forward, so, use of ultrasonic sensors are there, emergency dampers, brakes, vehicle when contact is made with forward objects, then warning lights are given, then warning sounds of the approaching vehicles are given. So, these are some of the vehicle safety which are inbuilt in the AGV. The speeds of the AGV will be almost equal to the human worker walking speed.

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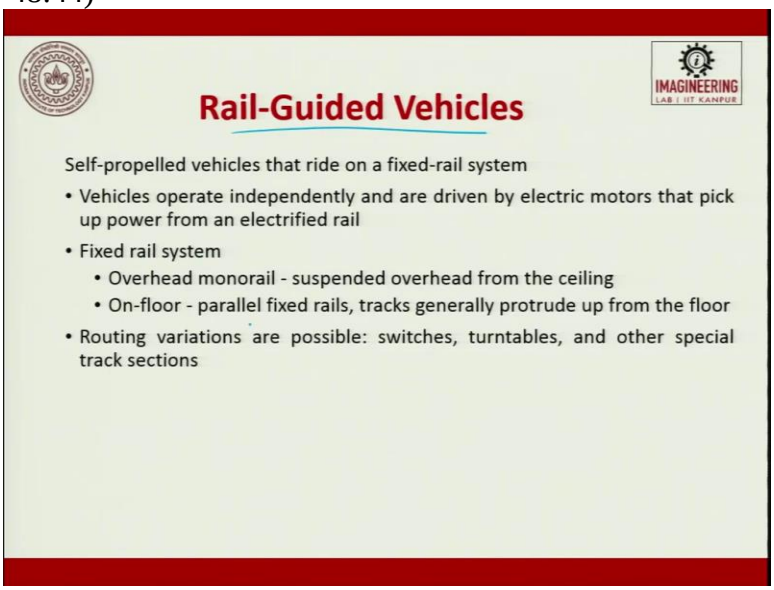

The guided rail vehicles, self-propelled vehicles that rides on your fixed rail system. The vehicle operate independently and is driven by electric motor that picks up power from an electrified rail like your train. Then fixed rail system, the overhead monorail, suspended overhead from the ceiling, then you can also have a fixed rail is on floor, parallel fixed rail tracks generally protruding up from the floor that is also possible.

The last one is routing variation are possible, switches, turntables, and other special tracking sections are available. So, your rail-guided vehicle, a rail-guided vehicle is also possible in AGVs. First was AGVs without rail-guided and then we are talking about rail guided.

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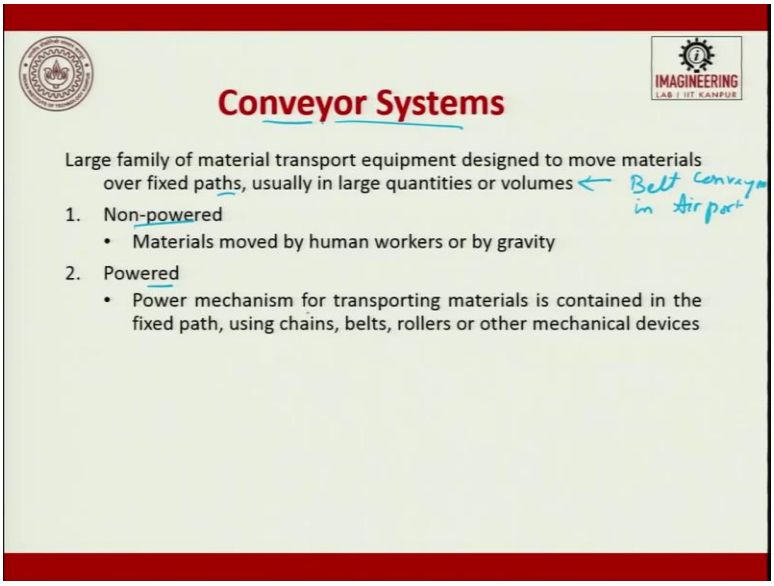

The last one is going to be conveyor systems, a large family of material transport equipments designed to move materials over a fixed path usually in large quantities or volumes. This is what we used our belt conveyor in airport. It is designed to move materials over a fixed path. So, there is no change in path entry from 1 side exit on the other side, it keeps on going after some point of time somebody comes in. After all, the passenger picks their baggage and leaves there will be few baggages which keep on be rotating, and then revolving around and then finally they remove those baggages and close.

So, the conveyors are something like an endless chain, endless belt. So, non-powered and powered. So, non-powered materials moved by human worker or by gravity is done on the conveyor, which I told you for X-ray and other things. Powered ones are powered mechanism of transportation. Transporting materials is contained in a fixed path using chains, belts, rollers, and other mechanical devices.

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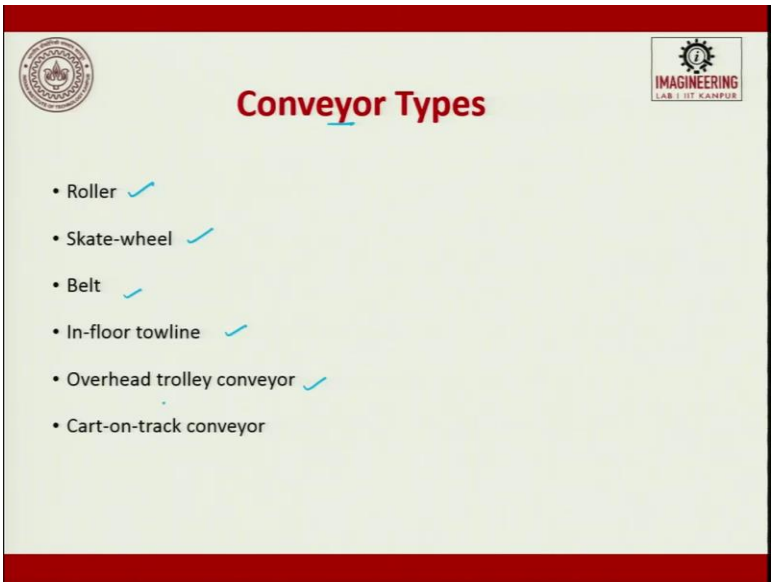

Conveyor types, roller types, skate wheel, belt type in-floor towing line, overhead trolley conveyor, if you look at automobile industry, it will be overhead trolley conveyor because the vehicle, if it occupies only 2D space utilization for assembly it takes lot have space. So, it goes up and down can have a train station up, it can have a drying station up and at the ground level, they can have other heavy assembly stations.

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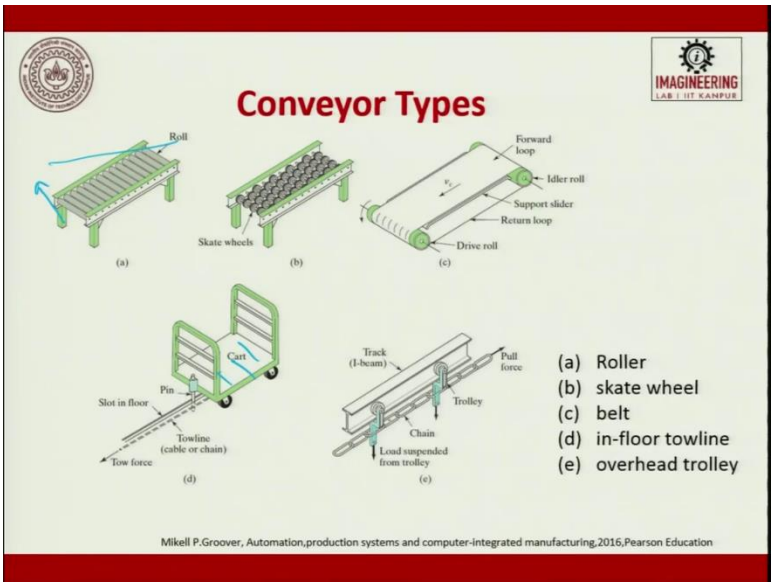

Then cart on track conveyors. So, these are all roller conveyors, these are all skate wheel conveyors, this is what is used in airports, I was trying to talk about. If this portion is lifted, so by

gravity it blows, rolls. Same with skating. So, endless belt rollers are also talked about. So, this is like a carton, in-floor towing line, which is used.

So, you can have this carton so you can fill up things in this cart, and then it can move. The last one is going to be overhead trolley conveyors which we were talking about automobile car assembly.

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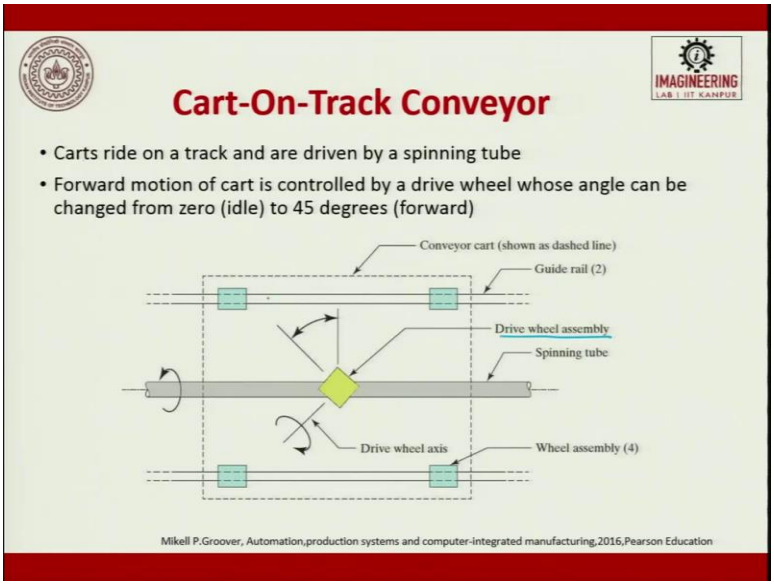

Cart on track conveyor, so carts ride on track, and are driven by a spinning tube. So, this is a spinning tube, it rotates, right and then you will have your driver wheel assembly which is there. So, it can swell about this axis and it is at axis. So, this will try to guide the vehicle, these are the rollers, guide the vehicle on to tracks, this is a spinning tube and this is a driver wheel assembly.

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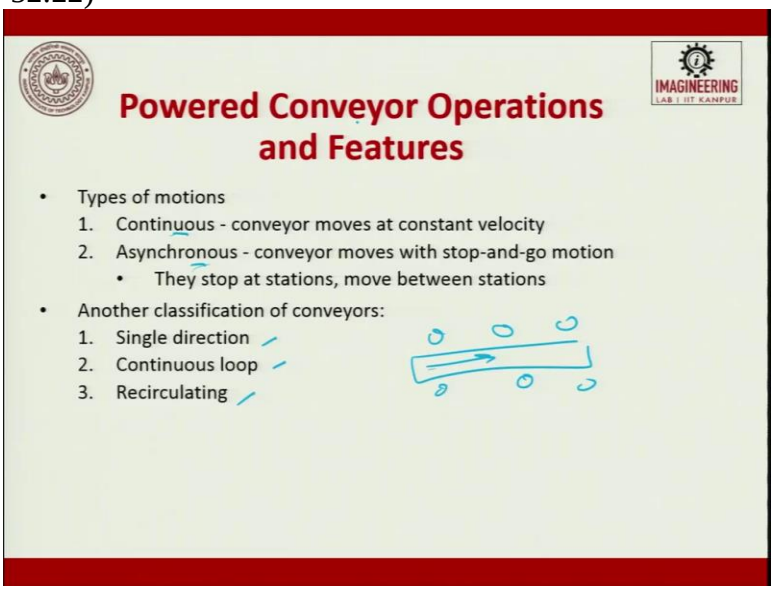

The powered conveyor operation and features, there are 2 types of this.1 is Asynchronous conveyor another 1 is Synchronous conveyor. Synchronous conveyor means, it continuously moves, it stops at 1 station and all the stations it will stop and then move. Asynchronous conveyors, conveyor moves with stop and go motion, they stop at stations, move between the stations. So, continuous the belt going around for an airport conveyor.

So, that is no stop at all, it continuously moves. Asynchronous it goes stops, you do some operation, so when you do some operation all the other stations, the conveyor belt has come to standstill. So, it is Asynchronous. So, in a assembly line what happens is, you will have several stations.

So, each station the conveyor will go and stop and then the machines will come and operate. Once the operation is over then the conveyor moves to the next station, this is how a car assembly line happens. So, Asynchronous is this, another classification of conveyor, it can be single direction, it can be continuously low, it can be recirculating. So, all these things are classifications of powered conveyor and their features.

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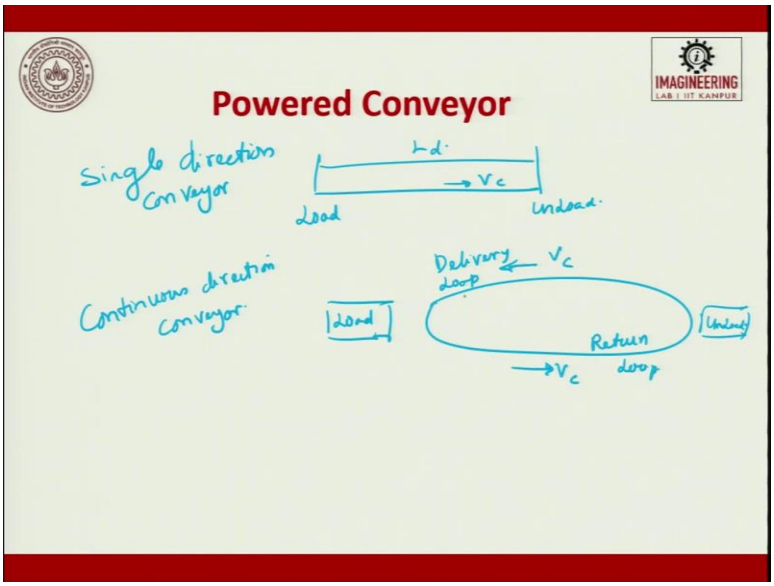

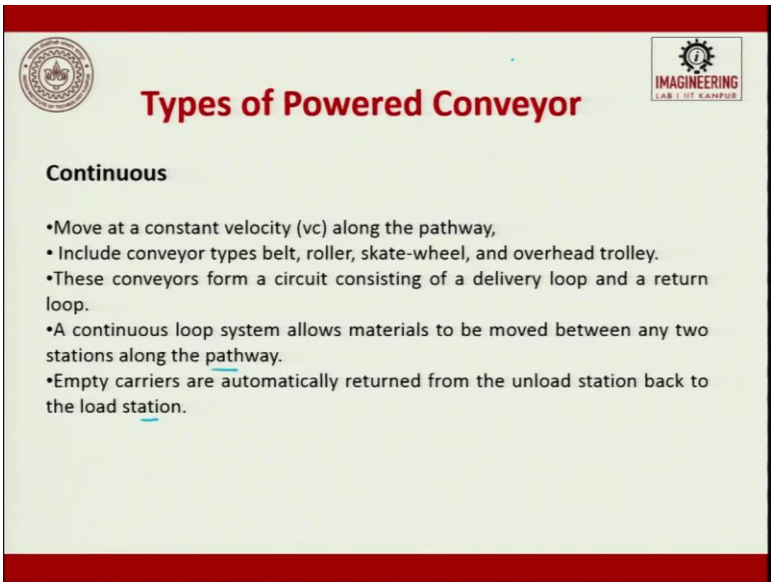

When we talk about power conveyor, so single direction conveyor. So, you will have load, unload, this is what is the velocity with which it moves, this is the distance. So, when we say continuous direction conveyor, you will have load, you will have unload.

So, this is what it moves V_c, velocity and this is the return loop. This is the delivery loop. This is a delivery loop, this is a return loop. So, this is loading, unloading. This is single direction conveyor. This is continuous direction conveyor. So, continuous moves at a constant velocity along a path includes conveyor type like belt, roller, skate wheel, and overhead trolleys.

These conveyors form your circuit consisting of your delivery loop and the return loop. We saw it is a second one, a continuous loop system allows material to be moved between any 2 stations along a fixed path. Empty carriers are automatically returned from the unloading station back to the loading station.

You can see a bucket which is a bucket conveyor which is there, it tries to lift some weight from 1 position goes and drops it at the highest most position, and then comes down as an empty bucket and then does next movement. So, it is all continuous forward movement.

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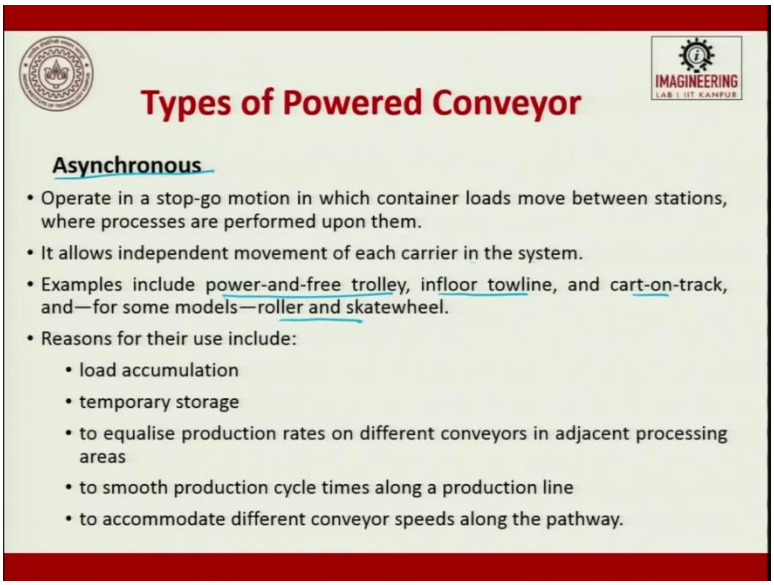

Asynchronous operation in a stop-go motion, in which containers load move between stations, where processes are performed upon them. So, this is what I told about assembly line. It allows independent movement of each carrier in the system. So, power and free trolley, in-floor towing, cart or track, and some models, roller and skate wheels are also used. Reason for this includes load accumulation, temporary storage, to equalize production rate on different conveyors in adjacent processing, to smooth production cycle time along a production line, and to accommodate different conveyor speeds along the same path.

These are the reasons why we go for Asynchronous type, you should know when to go for Asynchronous and when to go for Synchronous.

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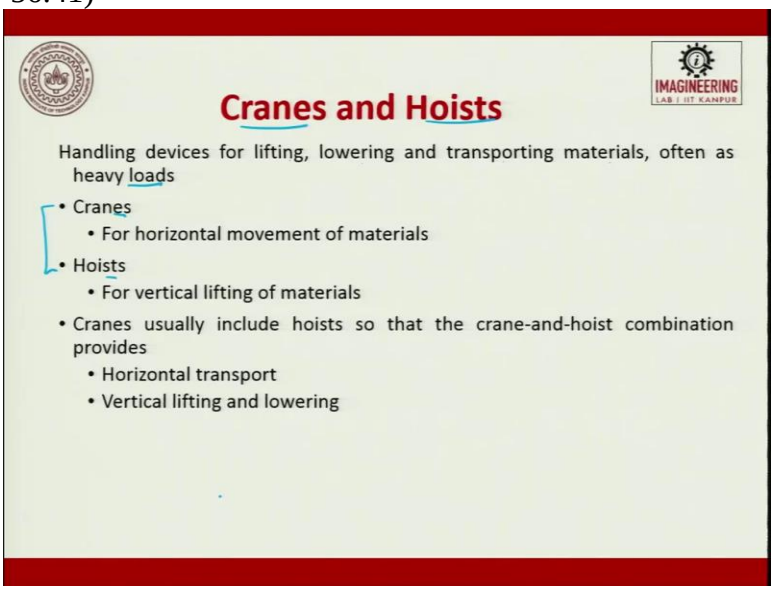

When we move to cranes, cranes, and hoists. This is the last material handling, handling devices for lifting, lowering, and transporting materials are often as heavy loads. We use this cranes and hoists. You can see a multi-storey building, in a multi-storey building, when the heavyweights are moved from the ground level to the topmost 56th floor, we use cranes and hoists. Cranes for horizontal movement of material, we use cranes. When it is only vertical up-down, we call it as hoists.

Cranes usually include hoist, so that the crane and hoist combination provides horizontal transportation as well as vertical lifting and lowering. So, you should know the difference between a crane and the hoist. Crane horizontal, hoist is only vertical.

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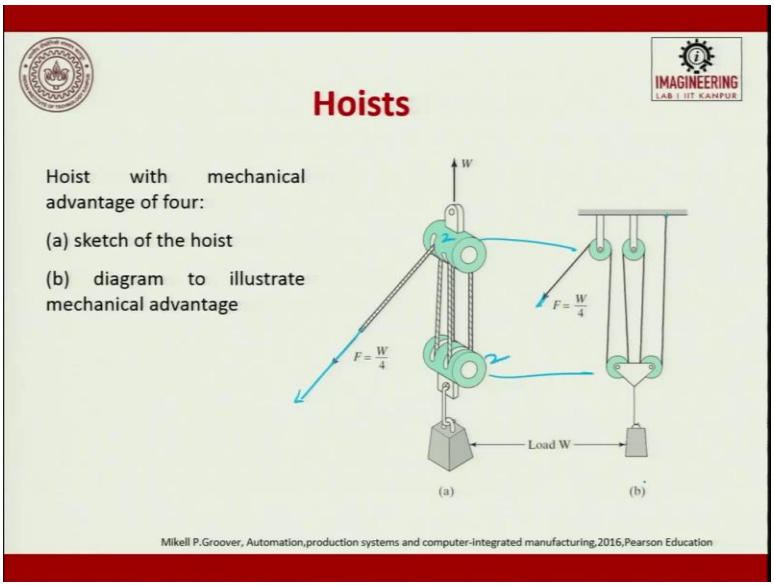

Hoist with mechanical advantages of 4, you can see the sketch here. So, this is a weight which is applied and here are 2 rollers and this is a steel rope which will be pulled. So, you can see the weight going up and down. In the same way, if we can make a mechanism like this, so it holds here and then a roller goes passes through the roller the wire, steel wire and passes through another roller and you have a force which is applied W by 4, you can lift this weight.

So, the highest with mechanical advantage of 4, 2 options are shown here. Sketches of the hoist, then diagram of illustration of the mechanical advantage is shown here. So, what was given here, so, 1, 2, 3, 4 what is there, that 2 is here, top 2 is here, and the bottom 2 is here. And the weights are moved up and down to get this mechanical advantage of 4.

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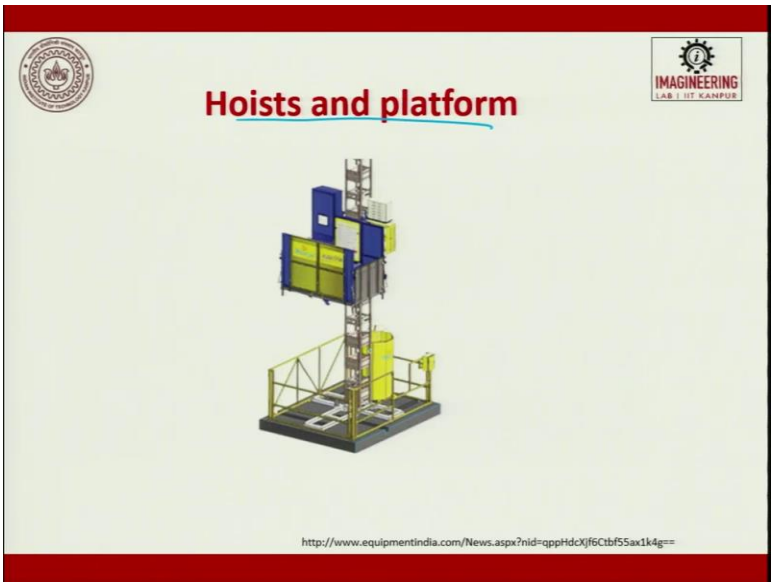

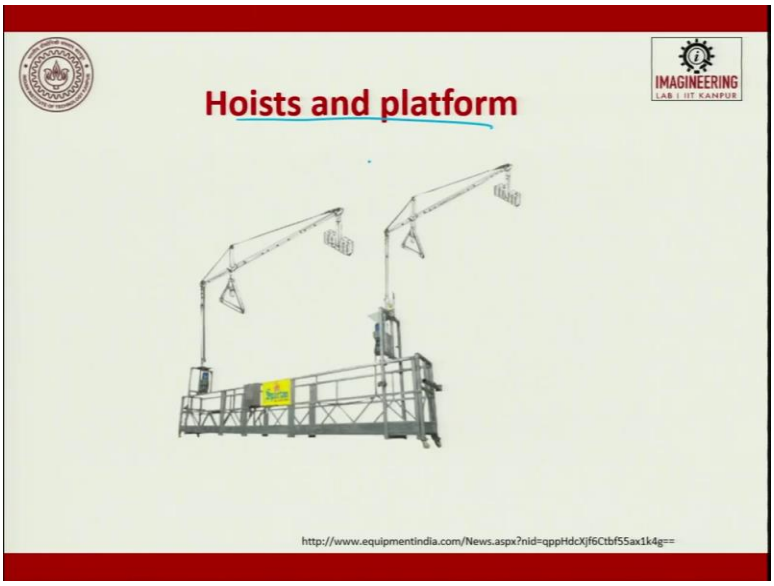

So, this is a hoist under platform. So, many a times an operator stands here and then he moves up and down. And this is another thing, if you see in amusement parks, there are several hoists which are there, they take you at a slow speed, then they ramp up speed and then they drop you from there those are hoists and platforms. For several requirements, only for the vertical thing, we might use hoists and platforms.

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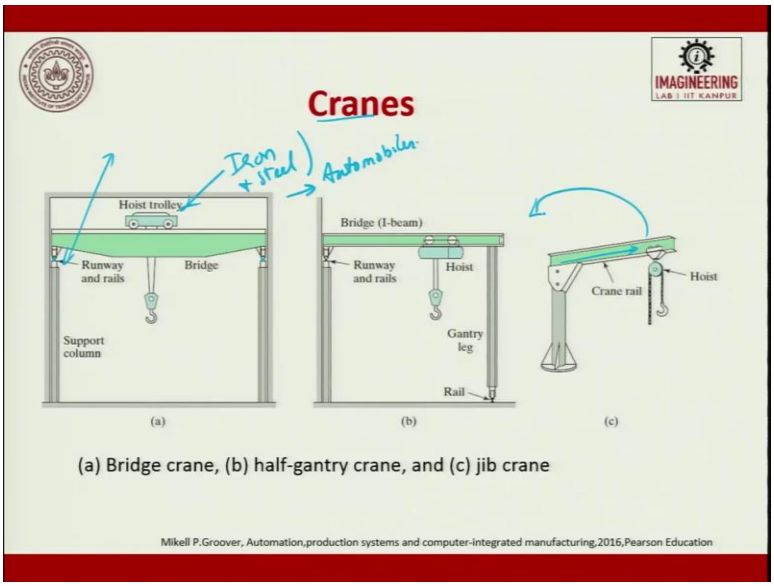

So, when we talk about cranes, cranes, these are all bridge cranes which are used in iron and steel industry, iron and steel industry we use, and then we also use it in automobile industry, where heavy loads are to be moved. So, we have here run and runaway rail. So, this is a runaway rail and

then we try to move on a supporting column, then we try to move in a horizontal, this is hoist, and it is moved in this way. So, this is bridge with an I beam, this is an I beam, this is a hoist bottom and this is a hoist trolley at the top.

So, this is a bridge-type crane, bridge type, this is a half gantry, and this is your jib crane. So, this is a jib crane, and this is like something like a cantilever, which is used to for moving and it can also move around it. So, what is used in the construction industry where multi-storey building will be a jib crane. So, this is a hoist and these are some of the applications which are used.

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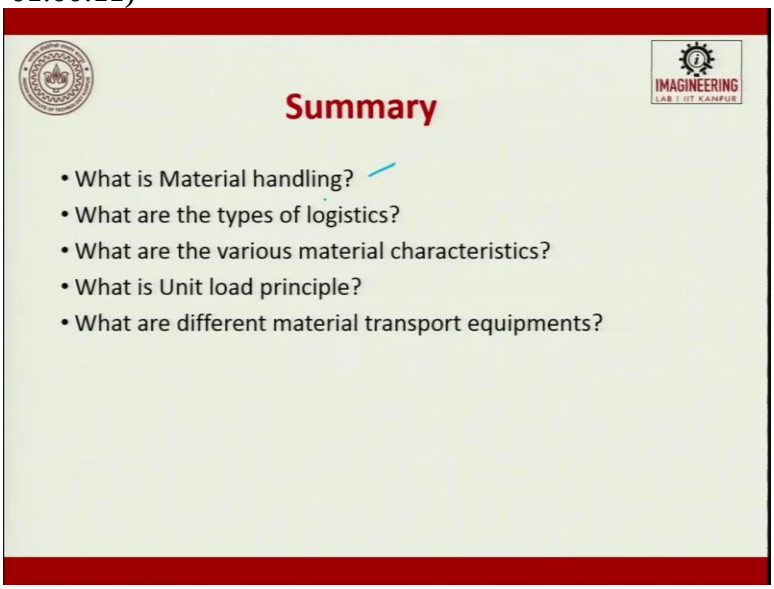

To summarize what we saw in this particular lecture was material handling. Finally, in a nutshell, material handling means, right quantity, right condition at the right place, right time material to be given. In order to maintain productivity or increased productivity. This is what is the importance of material handling, what are the different types of logistics we saw air, water, rail, truck, and other things.

Then what are the different material characteristics which are to be considered while designing a material handling device, then what is a unit load principle and at last we saw different material transportation equipments as part of material handling. Thank you.