Bulk Material Transport and Handling Systems
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Lecture – 21
System Layout

So, welcome back. We will be discussing today in our ongoing discussion on stacking, blending and reclaiming about the system layout. So far, you have learnt about the different machines used for stacking and blending. And, we have seen that there are wide range of machinery are there. And then, they are used at different purposes at different locations. Now, whenever you are deploying this machinery for this job to be done how exactly you are placing the equipment.

And then, what area you are using for developing the stock yard that has got a very direct and very big impact on the profit on the investment cost on the productivity as well as the way you manage it. That is why overall this stacking, blending and reclaiming they will be working as a system. And, in that system, you will have to deploy the machines over an area. And then, the system layout is very important.

Now, as a material handling engineer, you will have to identify that in which way you will be deploying them. The detailed design of the layout is a architectural plan. And, but, the input you will have to give so that the architects can design it. So, that is why it is essential to know what are the basic input required for such designing.

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So, today we will be discussing about the factors that to be considered in designing a layout for stacking and blending. And also, we look into that some of the examples which may give you some ideas. And, you can start your query why it is like that and then what it could have been different. And, the objective of your, this learning will be to give a look into what are the scopes available in our country.

How exactly we are doing the things and whether there are better way of doing it. If there are better ways then what type of new knowledge and new technology will have to be brought into this sector? So, from that point of view, let us discuss today, what is this layout of stacking, blending and reclaiming facility.

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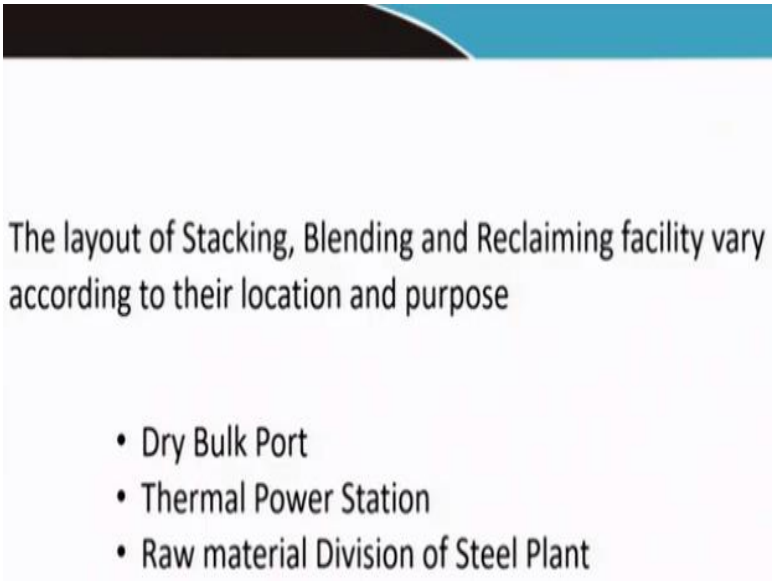

So, what it is there this is again it can be sometimes studied as a facility planning. That is for the stacking, blending, reclaiming. What type of facility planning will have to be done there at a dry bulk port? We say always in the port you import a lot of things they come in container. And, if you see a normal look of any port is there that is the containers are just taken out from the ship.

And then, they are unloaded and keep stacked over there which are then from there it is taken to be either truck or by rail. But, thing is that when it is a matter of importing coal as India imports more than 200 million tonne of coking coal every year because India is not having the metallurgical coal. Now, there is a need for us to properly receive that from the ship because the shipping company their liability only up to the unloading.

That is you will have to have a ship unloader to unload the material from their this from the ship. And then, after that your job is to transport it to the user steel plant. Steel plant maybe at Rourkela or Bhilai or at Durgapur at or some of these other private steel plants, but, thing is that if we while doing this stacking and then transporting the quality should not get deteriorate. And, you should not lose any material as a spillage during handling.

Or, it should not get burnt out. So, those are the points to be looked into in a dry port. Dry bulk port means a port where your solid or this powdered material or the bulk material without any containers are collected and stacked. And also, as you see that in India's thermal power stations where we need to maintain a stock of coal so that there is a uninterrupted supply of coal to the boiler takes place.

And there also, we have got many metallurgical plants in which different raw materials will be coming as a bulk material whether it is a cement plant that is a, with the limestone's coming over whether there is a copper smelter where the copper ore will be coming whether it is a thermal. That is your iron ore steel plant where that is all the materials your iron ore your that for the stack material for this your this coke all these are brought over there. And, you need to stack. Now, how you will be placing them.

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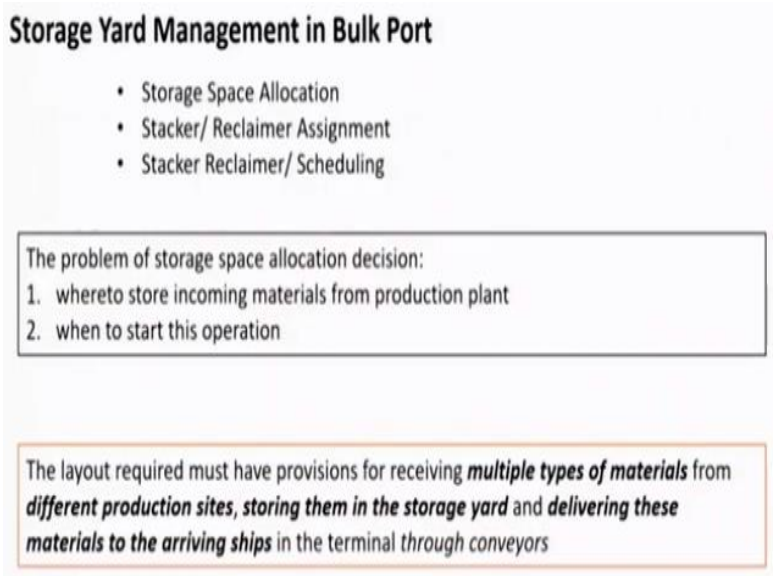

It is a matter of fact very important issue. Now, in a bulk port which is exactly the, there is a huge investment is there because it is a big quantity need to be managed. Unlike your in a steel plant or in a thermal power stations, it is a limited. And there, you know that only one particular type of material will be coming. But, in the port, there exactly depending on the needs of the country, there could be wide range of material may be coming in.

And then, there also that is even sometimes the grains and all also may be handled in a bulk material. So, there you need to properly allocating the storage space. And then, your assigning job that which reclaimer at what time will be serving to which stockpile. Sometimes, there may not be adequate machine. Say, for example, a port may be having handling of 20 different types of bulk material.

And, there you may not be having a 20 stacker because all the material all the time will not be coming. So, that means there will be different bay on which this stacker or the reclaimer will have to be there. And, they will have to travel and move and place over there. So, that means where you will be stacking and where how which machine you will be deploying that allocations and things is a logistic management at the port.

Then, you will have to do a scheduling job over there which will have to keep lot of external factor as well. That is your arrival of the ship which is also related to the weather conditions. That is, what is the warning on the sea route? Those things are also there. And also, that is your how the shipping company they have allocated they are allocated by the port to give their place.

Sometimes it may happen that the port management have not given the, that clearance for a particular ship which is bringing your material for your stock yard. So, there are lot of issues in the real life which need to be just you should have been you should just take a note of it. Make a list of the things that for designing is a bulk terminal where this material will be coming. What are the factors to be considered?

Now, as a, after getting those input information, what is your objective of your decision? You again you might be studying in your management classes that as a decision making that is your tools. So, here, your decision making tools will have to be used to decide where to store incoming materials from the that is your product from the production plant because exactly for the production plant or it is coming from different locations.

So, this to be matched properly and when to start this operation that is a time allocation. That is a scheduling. So, once you give this as a prescription and all, then another job comes over there to monitor it that whatever you have scheduled and whatever space you have given, is it properly utilized or not that how will you determine or decide the calculate. What is the space utilization factor? That is, is that particular allocated space is utilized accordingly?

Or, there is a space is not utilized whereas the other area because of the less. That is your because of the no availability of your space somewhere you are giving a (()) (10:27) for the waiting machines and things like that. So, those are the points need to be taken considered. Then, the layout required must have provision for receiving multiple types of materials. As I said, there will be different type of materials.

The coal you have to stock there. It may be coming with different grade depending on the calorific value. And also, sometimes, that coal coming from Indonesia or coal coming from say, Australia, they may be having different from their proximate analysis or ultimate analysis. You may find that they are having a different ash content. They may be having different sulphur content. So, that means that depending on that you will have to stack them.

And similarly, when you are sending your iron ore or any ore you are exporting or this, your bauxite if you are exporting, there depending on the quality that buyers may be different other countries. So, for each of them, they will have to be kept properly for this. So, that is how the

space will have to be allocated. Now, that is the delivering the materials to the arriving ships. So, your 2-way management of space and that is your allocations of the machine flow materials flow.

So, that means whether this, your receiving side it may be by conveyor belt but it may be receiving side may be coming by truck or it can be coming by railway. Depending on that if it is coming by railway then what will be the necessity. That means your whole train will have to be evacuated. That is from the wagon the material will have to be taken out. And then, one by one that empty wagons will have to be sent back to the railway.

Because if you are holding the empty wagons for a longer time then also you will have to give the (()) (12:31) then that there is a time given by Indian railway that within this time your this if you are coming getting a train of 70 wagons that your time is this much within that you must give this rack back otherwise there will be a (()) (12:47). So, now, for that, wagon evacuations depending on the type of wagon you may be having a different things.

That wagon tippler will be discussing some of our classes that exactly how will you evacuate from the, that from the wagon whether you are using a single tippler or you are using a tandem tippler those points you will be discussing in one class of wagon tippling. Now, after that wagons from there the material can be again it will be from a, there will have to be on a hopper. And, from there to take it to your yard, it will have to come by a conveyor belt.

Now, that what will be the length of it? The, for there comes the things of your what is the space available. So, within your that space which is available you will have to accommodate them. There you will have to see if your after the conveyor belt also there will have to be some arrangements for the traffic or at least there should be a road so that the people can go for inspecting and all that thing.

So, nowhere there should be congestions or interference of 2 machines. So, those considering all that you will be giving the space allocation.

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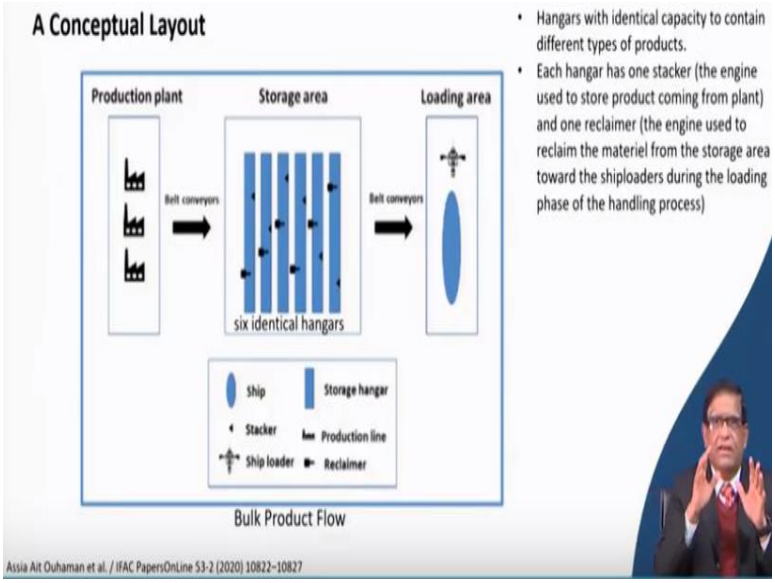

So, that what is the general layout as this figure is showing it in a bulk product flow how it goes. So, that means when a ship comes that is ship to be loaded the materials which may come from the plants from different places by rail or whatever you are bringing from the belt conveyor. So, there could be (()) (14:30) where from your materials are coming and then putting over here. So, then, next thing is you will be having a storage area.

You are you may keep a hangar may be a closed hangar or maybe an open space. Somewhere you are having a storage area. There will be number of lines from where there will have to be another conveyor belt which will be taking the material near to the loading area. There again from the conveyor belt, you will have to transfer to a ship loader in a where you are coming to a exporting terminal in Goa.

Suppose you are where there were the, you are transferring that say you are exporting iron ore or you may think of (()) (15:22) where from you will be exporting say bauxite. That is a alumina. So, those type of things there from coming from the production plant you will have to maintain this space. Now, here, what you will have to know that you know that you will be having the stacker and also you will be having the reclaimer.

So, this is as a small triangle you can see these are the stacker. So, that means the stacker is putting the material over here. That means from that belt conveyor this material is coming over here. And then, these are the reclaimer. So, now, there are number of stacker and reclaimer are working and in between there will be the routes of that conveyor belt which again will be (()) (16:01).

Now, whether it is going to be fed by one single conveyor or it could be by a multiple conveyors. It may be there in a single conveyor at different locations different equipment may feed material. In sometimes, depending on the locations, it may be that you do not have a separately blending while you are loading onto that conveyor which is taking the material over here on route under conveyor belt itself it is getting.

That is a certain blending is taking place and then when it is putting over there in that ship they will be getting the blended material for the user. So, there is a n number of alternatives possible. And, that is why this whole issue becomes an optimization problem which number of solution is possible. You will have to select the best one for it. So, now, one thing is there that operations.

As a machines wise your everywhere it is a stacker and reclaimer and that conveyor belt. You may have 1 or 2 different types. And, from there, you will have to optimize the system.

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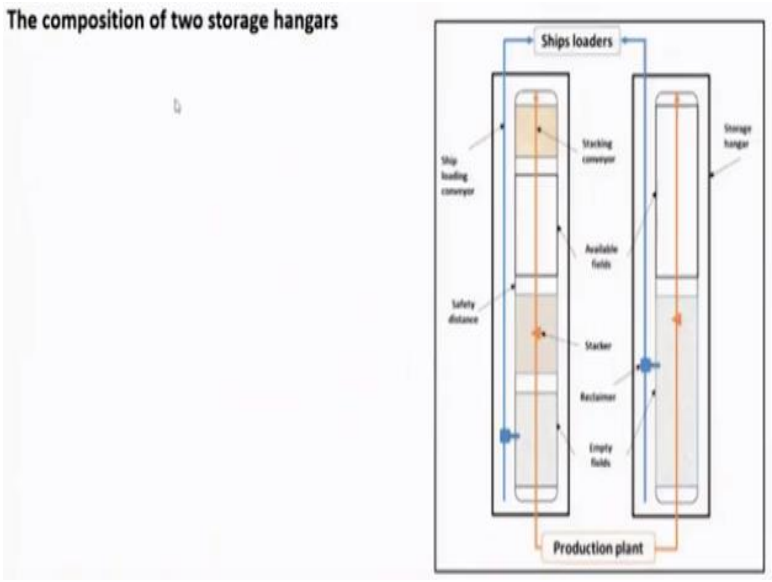

So, if you see here in a how in that place in this figure what is here exactly in one you can see a little bit as a ship loader is to here your this conveyor belt wherever your reclaimer is there this is a reclaimer that reclaimer is feeding to this blue color conveyor belt and it is going to the ship loader. So, there is another machines at the end is there. We have not discussed so far in our stacking, blending. That ship loader is the, another type of machines for doing.

Maybe in our some classes we will be discussing about different type of ship loaders also. Now, what happens? From the production plant site, the material will be coming. Again, I am not showing in this figure that how it is getting collected to this conveyor. This conveyor receiving stations is separately will have to manage depending on the product. Now, here, mainly, the stacker is there. It is forming the stack.

Now, when this portion is getting reclaimed at that time you are stacking it over here. Now, to maintain the continuation operations that one ship has gone and before the next ship comes, your, this stacking operations will be completed. And then, this get will get emptied. This will be moving over here. And, by that time, this one will be moving over here. And then, in that way, you can use which bay, which stock.

And, what type of pile that your instructions will be coming. What ship is coming? How much material will have to be loaded over there? How much time is there? Those things, accordingly, those information the operations here will have to be scheduled. That is in a port that scheduling is very important things. Then, sometimes, you have got some available field. That is these are the area which are available now.

If anything extra load is coming then you can from here you can shift it over here also. You can keep, say, after stacking over here, you have said no. Now, we have got the (()) (19:23) we are giving this coke. Now, another thing has come. Now, we need to copper or concentrated copper concentrate has come. Now, you need to keep that. You can keep it over here.

So, like that, you keep some space in the stock yard. I hope now it is clear that what is the layout of a system? This is a system layout.

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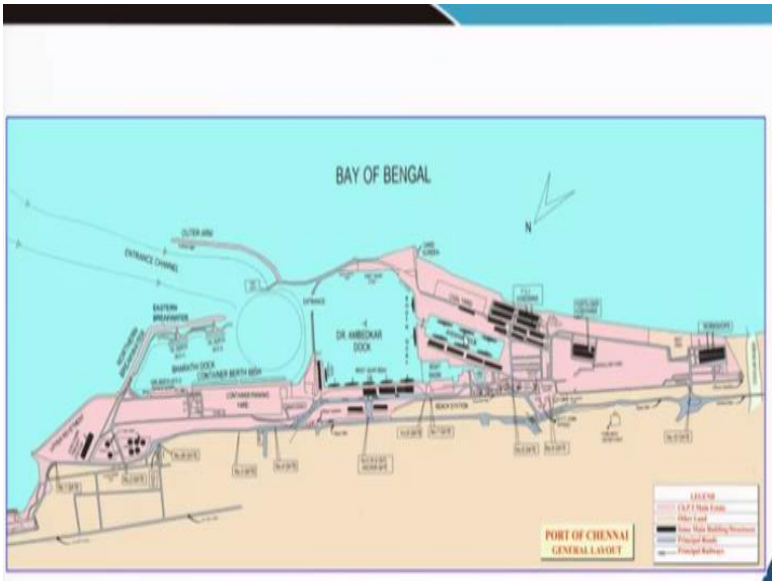

Now, the job is that can be if you see in a real life say here this is a diagram of our Chennai port. Here, we have got one coal yard is there at Chennai port because for some of these in south India we do not have much coal. That is many of the thermal power stations they are depending on that your imported coal only. So, here they have got also a fertilizer plant. That is we import lot of fertilizer also.

So, this is area where you are having this you can see the way from here it is evacuated. And then, ultimately that whole load will have to come to this road. And then, it will go to the main railway stations to or to the main road network. So, you can see here that when a port layout is prepared there different dock they do it. And then, for different operations, your machines and all maintenance, you will have to have a workshop.

The total logistics support for maintaining it will have to be given. So, there could be different type of the dock depending this is a container yard where your big box container things are coming. They are getting evacuated over here. They are getting that business in this side. So, there are 2 separate sections where you are taking the bulk and where you are taking the container. And, this is the way how it looks like.

So, that means your picture of designing a layout is where only for this part. But, while doing that you will have to take the input from the other sections. How it is coming?

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And, how will do it? Now, when we talk about that exactly a layout for the bulk material handling not only stacking, blending and you can see here there is a stacking and reclaiming is going on. If you go to our (()) (21:58) area you will find near railway stations there are lot of this iron ore are coming over here. And, this is only a front end loader loading on to this. You may think of that how much time is going over here.

And then, how the area is looking like. Now, this is a very familiar scene. Also, you can see if you go to any Jharia Coalfield or Raniganj Coalfield also you will see such type of situations. That means we are, there blending is not necessary. But, only for stacking and reclaiming, we are doing this way over the last 100 years. We have mines. We have got this railway transportation system working in the country for 100 years.

But, still this scenario is existing. The big question here is, are they environmentally friendly? Are they cost effective? Are they energy efficient? Are they safe? As a bulk material handling engineering is not taught in many of the thing it is not a usual. I am happy that you are learning bulk material handling as a course. It is for serving this type of situations in the country. Now, you will think now how to that is a exercise for you.

How to make such type of system environmentally friendly? How you can make it energy efficient? That is your loading all these things by this burning diesel on the front end loader you can do a cost calculations. How many number of that your wagons are there? There are being say 30 tonne capacity. If you are using a wagon loader of having 4.2 meter cube capacity, how many times it is going to give?

And then, what is the cycle time of this? How much exactly travelling it will make? And then, after that, how many number of them will have to be placed for putting it within a given time? And, if you do not do that, how much exactly the (()) (24:08) you will be paying to Indian railway? You can make a theoretical mathematical model and then you can verify with the practical data. And then, you can find out and give a solution that this need to be changed.

So, that is the way. Then, your, what are the safety aspects of it? That is the neighbouring people who are living over here, how much exactly the, that your suspended particulate matter of less than 2.5 micron are getting as a daily dust dose of this people? You can calculate. You can just correct it. That is depending on this material property you can make an estimation.

And then, you can make a survey of in the nearby pharmacy, what are the medicines are being sold per year? How much? And, that will be giving you the total idea of this.

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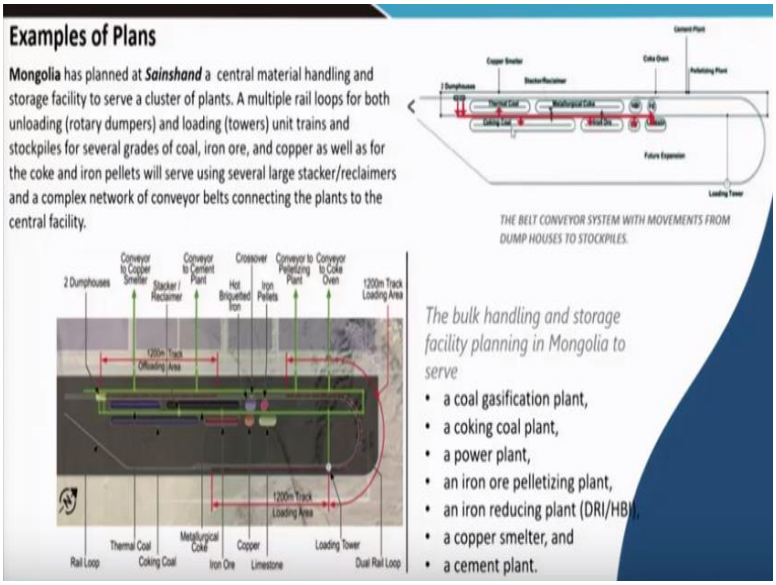

Now, let us come to see how a planned activities can be carried out. Now, here, you can see an example of a plan that was in a Mongolia, there is a Sainshand central area because Mongolia you know it is a, that is a landlocked country. There they need to get materials from different places. They will be coming by railway only. From there, how they will be distributing one planning which has very recently done in last 2 years they are developing it.

You can see here. In a one location itself they are having thermal coal. They have got the coking coal that metallurgical coal. They have got coke. They have got copper. They have got iron ore. They have got limestone. And, all these things are stacked over here. And then, they are giving it to a copper smelter. The copper ore is going for the cement plant. That your coal and then also the limestone's going.

Then, your hot briquetted iron that your (()) (26:14) iron ore is going over there. Then, they are going also to a pelletizing plant. All these are there to be a facility need to be created over here. So, there one centralized locations they have created in which they will be having this coal gasification plant, coking coal plant, power plant, all these different plants are coming. And, in that area, how they have (()) (26:42) you can see it over here.

So, these are the different your stocks. And then, from there, they have developed this whole system in a very systematic manner.

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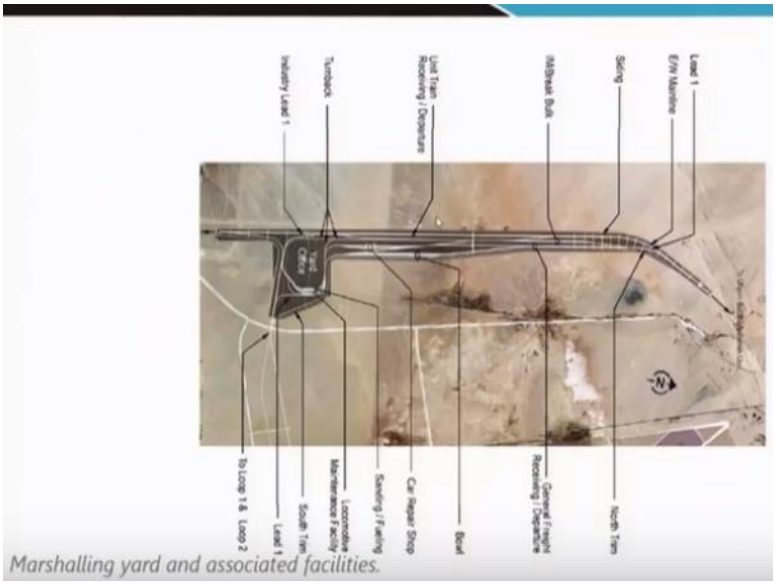

And then, we can see how they are doing the, their marshalling yard. The railway will have to be properly fit. So, I am just giving you it as an example. We will not discuss the details over here. But, you can see that. That means for a detailed planning, you will have to have a marshalling yard. You will have to have a unloading yard. You will have to be a loading yard.

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All that things will have to be planned. Another example you can see that what is there in that the Newcastle in Australia. That is the largest. That is a coal exporting. This export coal to India also. From this particular port, it is coming. That you can see here. From the mines, the materials are coming. Coal is coming and stocked over here. And, from there, they are transferring this material.

And then, ultimately, it is going to the ship loader. Loading on the ship and then that will be going. So, they are maintaining this dock in a nice way over here as because there they have got the space over here. And, they have been maintaining in this fashion.

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Queensland coal export terminal

The same thing is also there at the Queensland. They have got also a terminal. You can see how the whole thing is being taken over here. From this point, the ship will be loaded like this. But, in a, depending on the site and depending on the conditions, say, for example, when Goa was exporting the iron ore that near the Goa in that port the mother ship cannot come the big ships do not come.

So, for that is why that small ships are coming in the Mandovi river. From that river, they are going and then loading to another smaller ships. Together, this material go. And then, the material transfer takes place from one ship to the, another ship on the sea. There are different arrangements are there like that. So, now, you can see here the planning site planning it requires. And then, the way the environment is managed. That is also very important.

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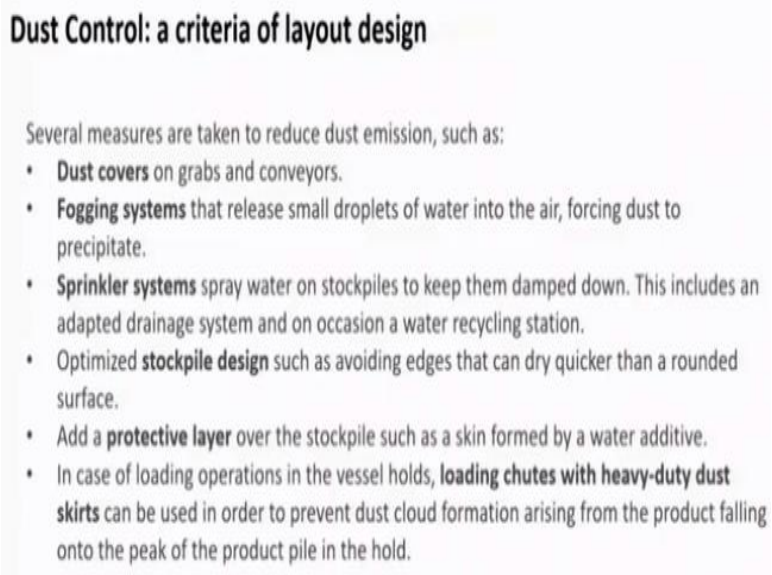

Now, in the environment management, what comes as a main thing in our mind is the dust control. Now, that your layout design will have to be that is you must consider this dust. Particularly, now, I have just shown you the figure of the, that open storage. But, if it is in a coal storage, there is a, that is whenever you are having a in a closed area storage, the dust particles when the coal dust get accumulated and they can be an explosive mixture.

And, there could be a dust explosions may take place. So, that is why collecting the dust and then taking more control and then monitoring the air is a very important thing. So, that is why the design comes about that dust (()) (29:47) either by giving a cover or by fogging or by sprinkler or by stockpile design itself is so that air will not be dust coming. Then, protective layer you can give it over here over the stockpile.

And also, the loading arrangements, how you are doing? There also, dust should not come. While you are transferring, there also you will have to manage. And also, there is called your the windscreen. That is why depending on the wind directions you will be making lot of dust screen which could be saving over there.

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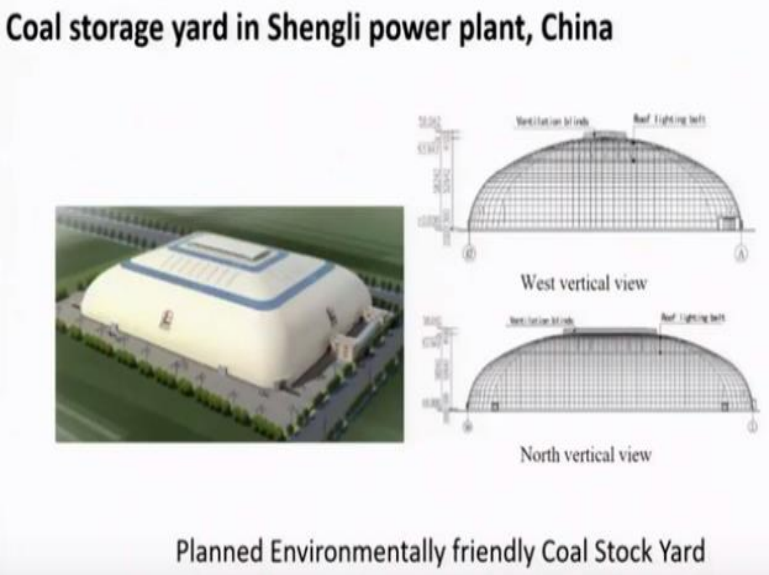

So, now, then, last class also, I told you about the some of these closed that is your environmentally friendly stockyard. In China, they had at a, that is your Shengli power plant they made this one arrangements.

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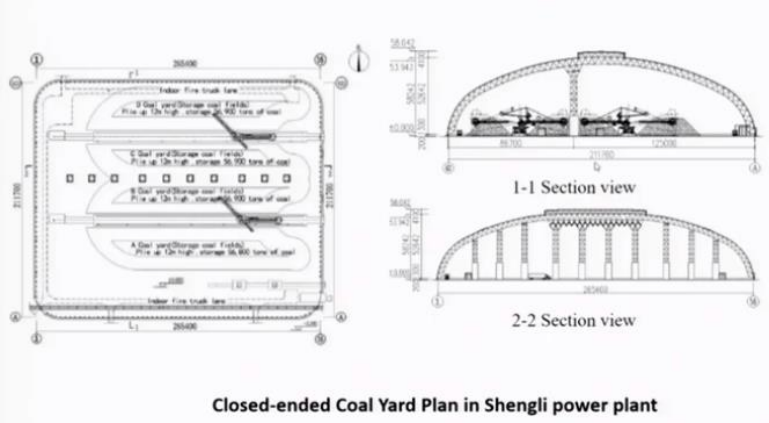

You can see over here. That is the whole that inside that dome you can have this how they are structured. These huge structures are constructed with one central column. And then, you can see the stacker and reclaimers are working inside.

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So, that is another arrangements can be made. Now, you may have to do a retrofitting of some of the, this type of stockpile. How can you change to a structured that is a plan design? For planning, what are the main functions? You will have to provide is this stacking, blending and homogenizations. And, for that, you will have to do a new location design or redesign or retrofitting. While operation whole operation is going on there itself you want to make a cover.

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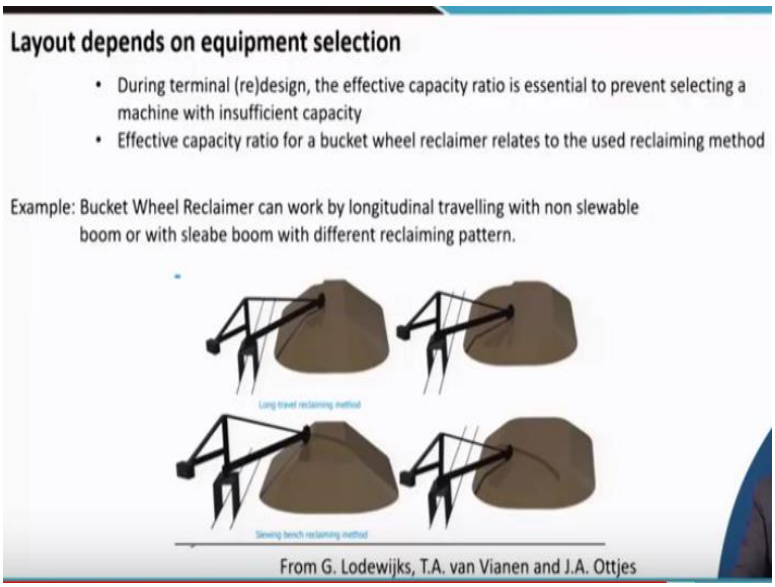

So, for that, you need to know about the layout design that during that redesign, what you will have to know? What is the main capacity? And then, what type of equipments are used? Say, if we have said the different type of reclaimer are there, now, if it is a non slewable reclaimer, your, this is the railway on which the reclaimer is moving, then there will be a parallel type of this type of collections will be there. The stockpile will be forming a stock.

But, the reclaimer cannot collect all the material. It is having only a limited reach. So, there will have to be arrangements for how all the time it will be coming to the reach. But, then, another thing is there you can take the whole thing by having a slewable reclaimer. This slewable reclaimer when it will be moving, it can cut like this. But, thing is that there also at the end, some portions will be there.

You will have to put a dozer to keep the material over here. So, that operational part functional part will have to be looked first before going to the space design.

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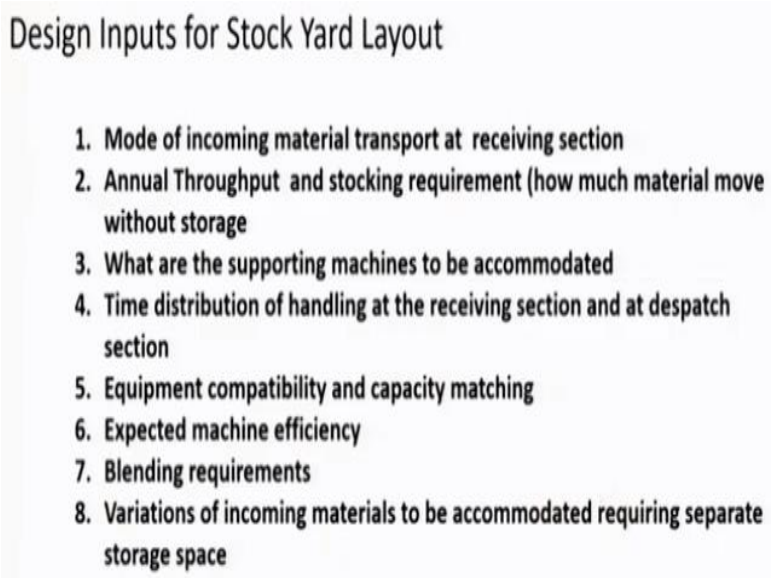

Now, while you will be that input stock you (()) (32:38) what is the mode of incoming material for that you will have to give a space. Annual throughput, how much is the capacity of that area of that stockpile? On that basis, you will have to collect the information. What are the supporting machines to be accommodated? Your, whether you are giving a dozer or whether you are giving a front end loader or just a scrapper all that thing will have to be considered for special location.

Time distribution of handling receiving section, that how much time it will be required for sending from here to your main loading point. Then, equipment compatibility that difference whether stacker and the reclaimer their sizes are matching or not whether because then that stacker will be doing the stack stockpiling at one place. Now, when the reclaimer will be going to that they may become very approximate.

So, that capacity matching so that there when they are operating they do not interfere each other and their booms do not get collision. That also need to be seen. Then, what is the efficiency of the machine? What efficiency will have to be you will be achieving? Because that the way we will deploy, the machine will be performing accordingly. Then, what are the blending requirements?

You will have to see that the type of raw materials coming if they require blending you will have to do differently, then variations of incoming material.

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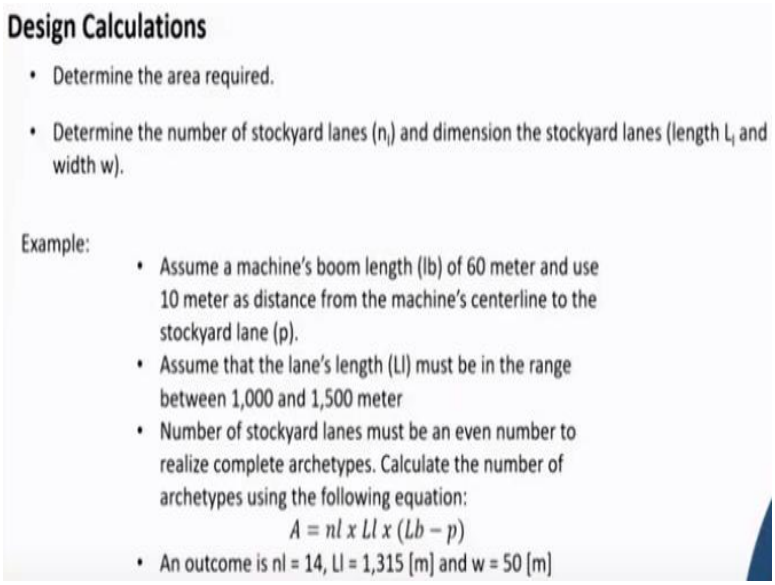

What are the different types of material? So, then, you will have to do some of the design calculations. That is determine the area required. What will be that space in which you will be doing? And, determine, what is the number of lanes? How many lanes will have to be there? And each lane, what should be the width between these 2 lanes? That is the main design (()) (34:23) criteria. You can do that calculation by assuming the machine boom length.

That is 2 machines from the 2 stacker. How they will be working? How much clearance you will be giving? Then, assume the length total, what is the length available from that? You can calculate from your requirement of the target and throughput. And then, you will verify whether this is at the side that space is available or not. Then, what is the number of lanes? And then, number of lanes that could be very simple.

With the carrier area that yard area calculations with the dimensioning that depending on the situations, you can create your own formula for doing that.

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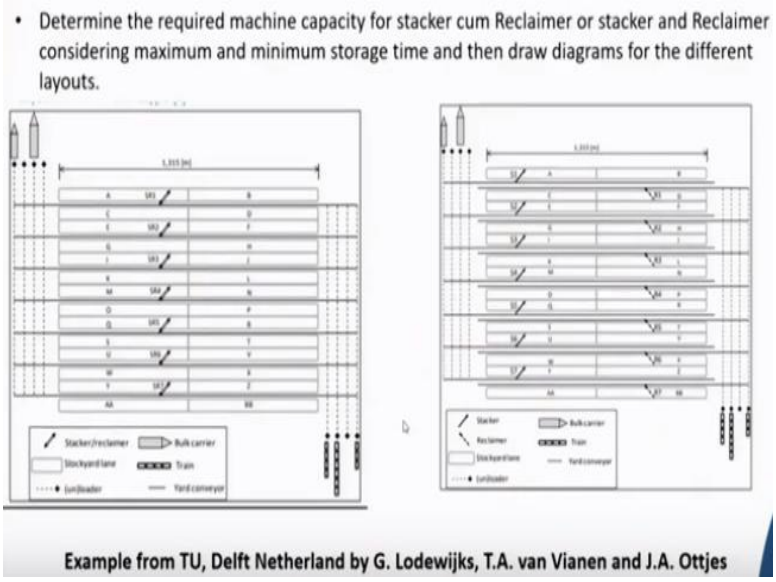

And then, this is in the Netherlands Delft University they do a lot of this bulk material handling work because in Belgium and in that Antwerp port, there are lot of studies the students do a lot of field studies over there. You can search. You can get lot of articles also there. But, what you can do a similar type of that is where the stacker. Is there stacker cum reclaimer? Here is a stacker and a reclaimer.

So, you for a given situations, you can consider, assume 2 types of this system. And then, you put the values and all. Then, you can calculate recalculate back that how much exactly the handling capacity of each of these 2 years. And putting them, you can give a generic equations. Then, compare them and then see that (()) (35:52) this side this space is available for this type of capacity of the machines.

So, determine the required machine capacity of the stacker cum reclaimer or stacker and reclaimer considering maximum and minimum storage time and draw diagrams for the different layout. This is the work they do and after that the analysis come. First, you assume few things. Get that a particular way of handling things. Then, analyze. Then, find out that what are the factors actually affect? Then, of those factors, you can do a sensitivity analysis.

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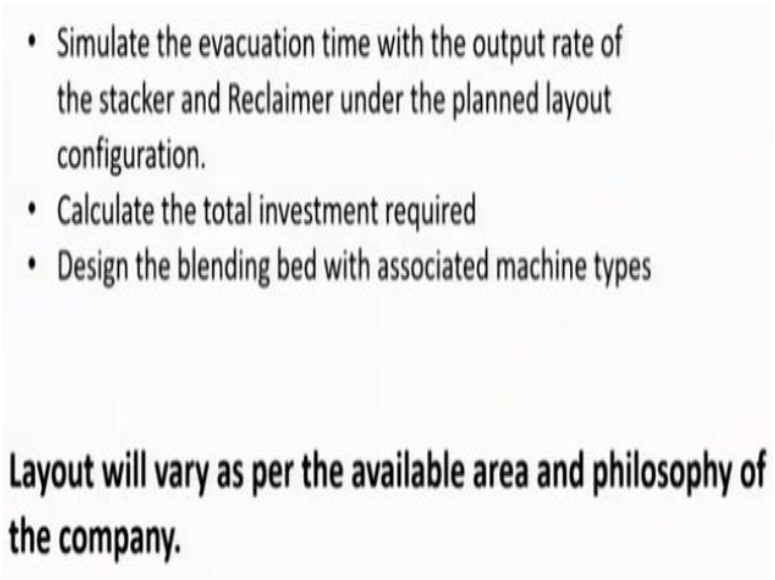

That is the way how exactly a little bit of research and little bit of calculation is done well in that doing the design problem. Now, after that you can simulate the evacuation time with the output rate. This whole problem can be brought under the simulations. You can do even if you are expert you can get the animations and all that I do not know of course how to do that simulated things to make an animated so that on the computer it will be moving.

And, you can see and get the, your result. How you represent? How you visualize the data? That is todays your expertise. But, thing is that we can calculate it out that what are the area required from which stacker will be working. When this stacker is working that which conveyor belt is running? These things can be seen and that in the field, in the control room, you will see a mimic panel.

In that, you can see that which machine is working and which conveyor is going. And then, if anyone is not working over there the signal can come. And, that is how that exactly system control or the, that your operational control is done. So, while you are doing studying this exercise, you can visualize that and then start working a very small work you can think of a small problem of a say small only 200 megawatt thermal power station.

For that, how that coal will be coming? If the coal supplier are there, say, 3 or 4 mines. From them, the coal is coming. And then, you want to maintain a stockyard. Take this problem and do a space area. And then, design that what should be the maximum. You can think of if there is a open one how you can make it a closed one. You can make a just imagine a type of

solution of course which could be an input to a architecture for architect for the architectural design.

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So, there as another thing we have said about the circular stacker. That is your radial stacker. That stacker cum reclaimer it is there. That is a, it can make a circular stockpile. And then, it can collect by a, that is you can see a portal scraper reclaimer is there. As radial stacker is stacking and then this, your, this one is a scraper reclaimer. They are reclaiming the material within a dome. So, this is there are advantage and disadvantage.

This is done by Sandvik I think. The Sandvik Asia that big company they manufacture such type of systems. So, you can imagine that such type of clean operations can be done. We can do a retrofitting of some of our systems which is generating lot of dust and unsafe and all. But, there is of course it will cost a lot of money that whether that money can be given or not. Considering the, that our aesthetic considering the environmental, we can do it.

So, much money is spent on the name of environment. But, none of such type of that is your none I should not have said none because already as I told you in the limestone mining sector, number of this type of dome has come. Birla has already introduced at Chittorgarh. You can see that these are there as a reality. But, in our coal mining sector, I do not know if anywhere it is coming.

And then, you can easily study that having such type of system for to make many of our that townships which look like only if you cannot go say in Dhanbad area or in Jharia area your

clothes become black because of the coal dust in the air. There if many of the sites can be converted to such type of system it will improve.

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So, this is exactly as a learning activity, undertake desktop research to determine what is the status of bulk solid stacking, blending and reclaiming practices in the world. You can make a desktop study. And another, you can make a comparison table for advantage and disadvantage of radial stackers and reclaimers with other type of stacker and reclaimer. There are a lot of problem with radial stackers.

And, if you search, you will find it. I am not going to tell you here. So, but you do this to learning activity you will be knowing about that how the systems are working.

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And, there are some very good articles you can read. But, these are just only a sample article I have given. Lot of other things are there. But, the Trans Tech publication which did publish a book on stacking, blending and reclaiming in 1977 I think. That book is still a very good book. Of that, Germany was pioneer in designing many of these stacking, blending, reclaiming systems.

So, please go through that and try if you can see online the bulk solid handling is a journal. In that journal, very good research articles are there.

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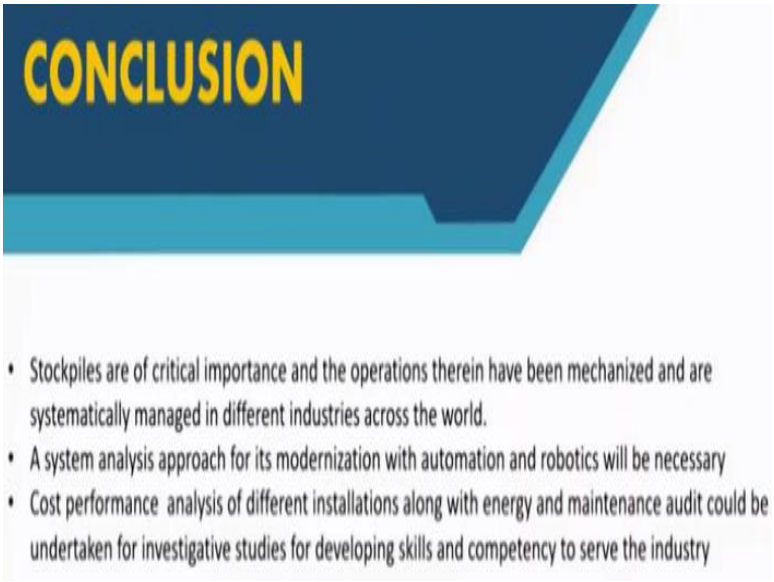

You should make a habit of reading it. So, stockpiles are of critical importance and operations therein have been mechanized and are systematically managed in different industries across the world. You need to know that what is the status by making a desktop research and just make yourself that is a acquainted with all those recent work which is being done in this field. A system analysis approach will be very useful.

So, you will have to those who will be doing a little bit of higher study if you happen to study the system engineering, how system engineering approach can be applied over here? How a system can be analyzed? As a, your project work, you can take up. Work with this. The cost performance analysis of different installations along with energy and maintenance audit could be undertaken for investigative study for developing skills and competency to serve the industry.

I am giving you some clue because under your B Tech project or program, you will have to take some B Tech projects. In some institutions, they exactly could not handle this B Tech project and remove the B Tech project and made a course work. Do not go by that. You make a B Tech projects out of some of this may be a cost performance analysis project. You go, take a study. And then, try to put the engineers way of looking into a project.

That is a very important. And, the learning activities done in this will be helping you to take up projects like this. Thank you very much.