Fire Protection, Services and Maintenance Management of Building
Prof. B. Bhattacharjee
Department of Civil Engineering
Indian Institute of Technology, Delhi

Lecture – 15
Introduction to Lift Design

So, we continue with smoke venting right.

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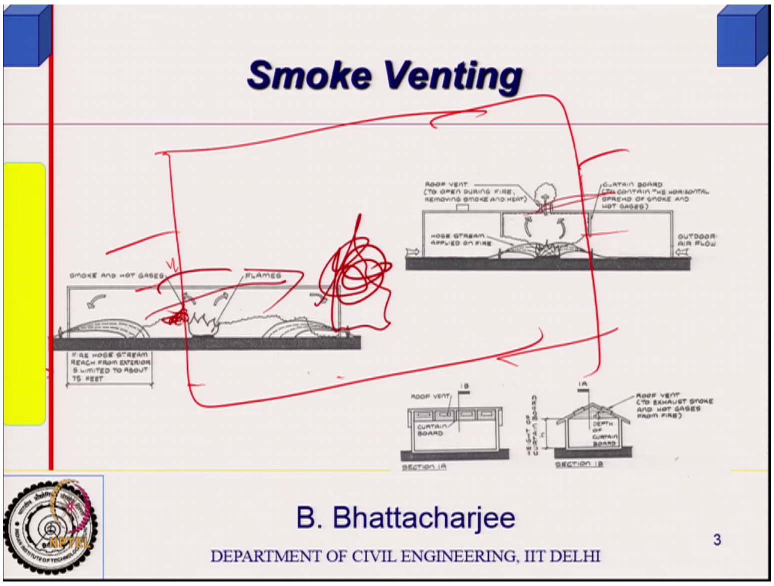

As we you know, we are doing in the last class, as I said, in a long factory like you know long factory like space or internal space, now it is difficult for firefighting people because, if the entry and exits are far away and large space something like very long space; let us say, something of this kind. The factory with a entry point here go downs and factories or even a water is may be. So, you have entry point here entry maybe another entry point or exit point here.

Now, fire starts somewhere in between fire starts let us say, somewhere in between fire starts, somewhere in between let us say, you know somewhere let us say, it starts somewhere here it starts somewhere here at this position.

Now, the fire you know firefighting cannot if it is trite you know, if it is attempted to be done from here; this end or that end. That would actually meet the fire. So, in such situation it is better to have something like smoke screens or kind of a what do you call compartmentation.

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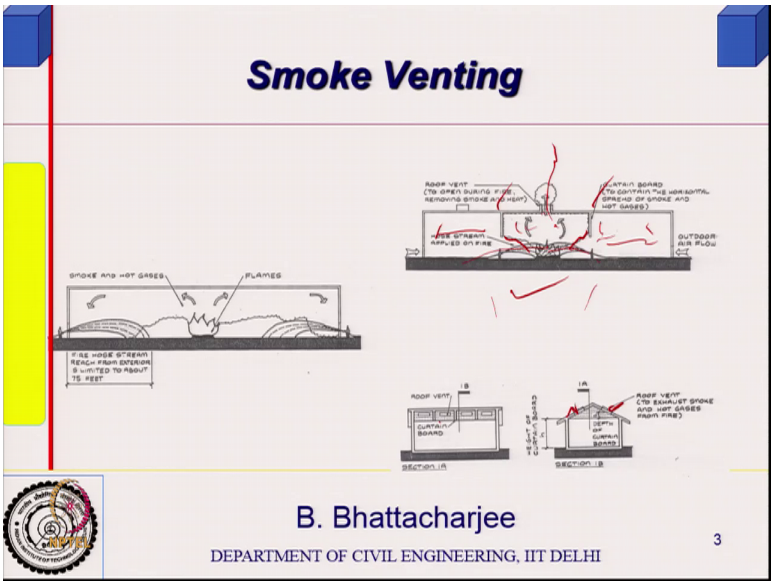

So, in such case, you put a smoke screen such that, smoke will simply accumulate here only smoke will accumulate only here before it can pass all right. And not only that, you provide a vent here. Now, this vent should open on it is own.

Student: Own.

So, as soon as the heat or temperature released, then it will open up and the smoke will simply go out and it will the smoke will not spread to this position. So, the people can come and extinguish the fire from nearby places.

Student: (Refer Time: 02:05).

So, this is compartmentation. Now, vent should be on this side as well as on this side, you know spacing should be on both the sides. Yes, and this is your smoke screen or compartment boundaries and in other direction, it would be something like this.

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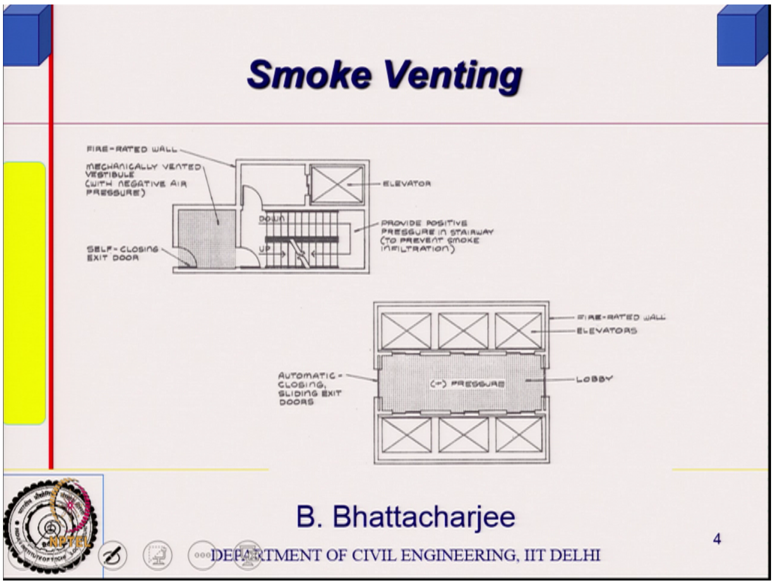

So, this is one thing. Now coming to tall buildings, what you can do is, you know you can you can the lift. For example, if the lift is lift lobby is there, you can do actually smoke venting. In fact, you can do compartmentation you can pressurize some of this portion. So, you have to a fire rated wall and mechanically vented space vestibule space right.

So, I will come to this. So, there can be for example, automatic this can should be automatic closing doors, there can be negative pressure created there.

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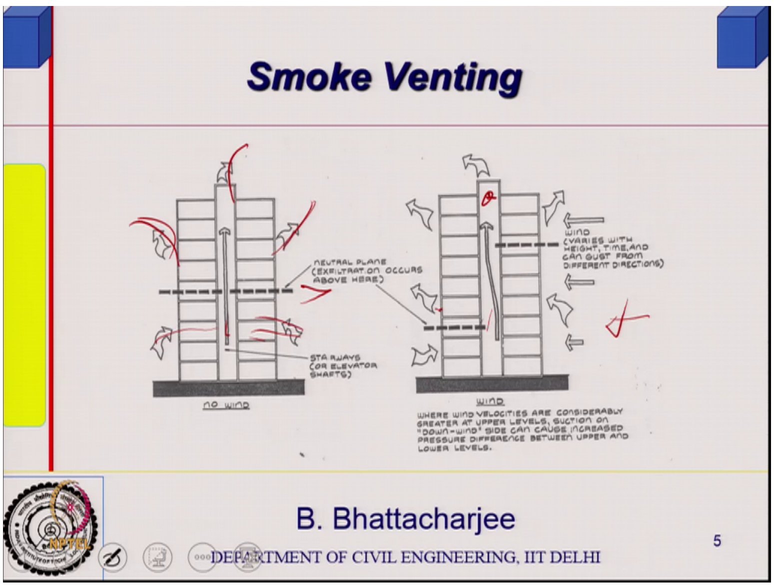

Now, basic idea is, when there is a when there is fire at some level, say something like this.

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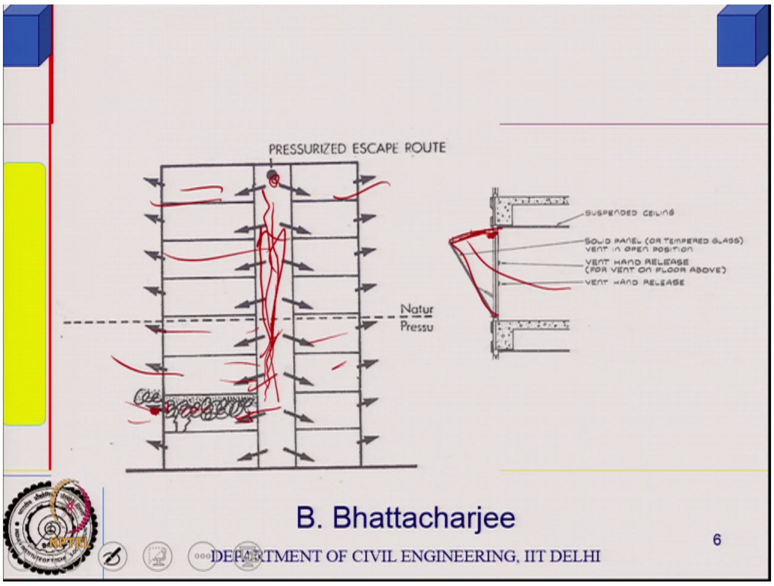

This will have a tendency to for smoke to go up along this direction. If there is a fire in this floor, it will have a tendency to go up along this direction right. So, what one can do is, you can do a vent here and you have a fan here in there skip route pressurized right, pressurize this. So, that air from outside will enter here and go out like this, go out from all this direction and air fresh air will enter from this side rather than entering from this side and you must have a smoke vent here.

Now, smoke vent; how does it look? It looks something like this. It will be normally closed in the window like that and as soon as you know, it would as soon as the fire breaks out, this fusible link here will cause it to open up it will cause it to open up. So, the smoke can get out through this; smoke can get out through this.

So, tall building, this is what one can do. Multi storey building one can do this kind of smoke venting. Normally, whenever there is a smoke, the tendency of the smoke would be to go up from this side enter from somewhere here in a fresh air will enter from here and hot gases will tend to go up vertically upward.

And somewhere in between, you will have neutral plane where the pressure actually from outside inside is 0 right and if there is a wind driven situation then direction is depending upon the direction of the wind this might get even shifted.

So, this would be the normal course if you do not pressurize this, if you do not pressurize this, but pressurizing alone is not enough. You have to do a venting here as well. So, vent should be there at every level and you will have fans. So, you have a pressurized bed, you know pressurized vestibule here. So, this is what one can do right and so, the normal you know this excess pressure would be there and which will allow.

So, this way, you can smoke spread into multi storey building you can actually stop by using kind of a vents which are normally closed at this position. And in case of fire, this will simply open up because, they are to be tied up with fusible link at the same time it should be supported. So, smoke can go out something like this. So, that is what is done in tall building.

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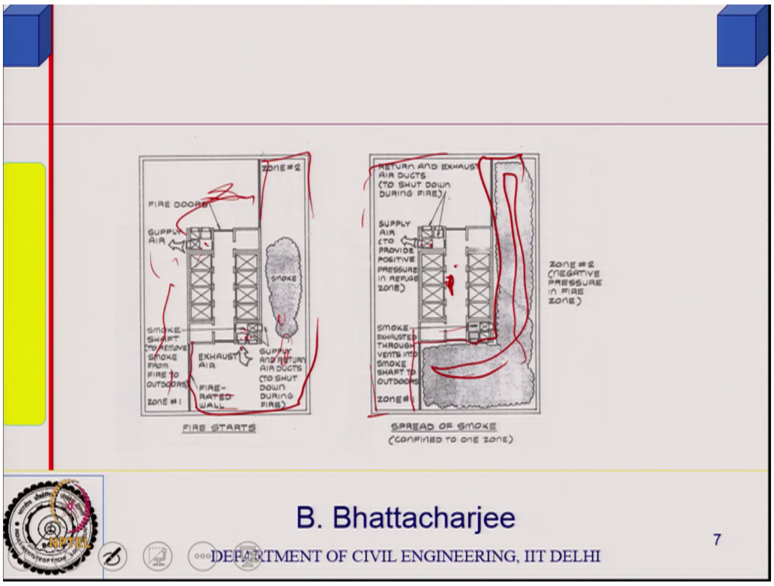

For example, you can do horizontal compartmentation in this manner. Say, this is one compartment right this is another compartment.

So, if there is a fire spread in a given floor only it would spread in this floor. Vertically It should not be spreading because, you will be pressurizing this; you will be pressurizing, there will be flat fan supply of fresh air right. So, fans should be there.

So, we will ensure that nothing spreads here and there will be firewall; that means, you will have something like 4 hours rated firewalls in the boundaries like even previous cases, you know you will have firewalls there should be firewalls, you know if this is this walls are firewalls actually.

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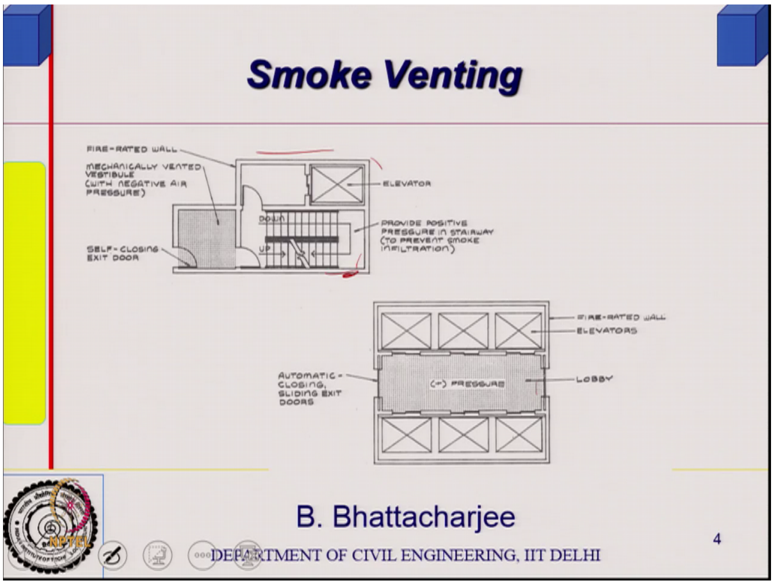

So, firewalls are basically 4 hours rated fire was which will sustain itself and there will be an is in that on top there can be an exhaust. This could be a duct for exhaust or a pressurizing pump you know a pump which will actually put air inside and there may be an exhaust.

So, if this compartment is on fire, the exhaust will ensure that the smoke state way go through those duct and here you will be actually supplying fresh air to pressurize this whole thing. And it would be pressurized here also, fresh air will enter here and ensure that no smoke goes and this compartment boundaries are all fire rated wall, fire rated walls. So, this is a one can do smoke venting in tall buildings, right.

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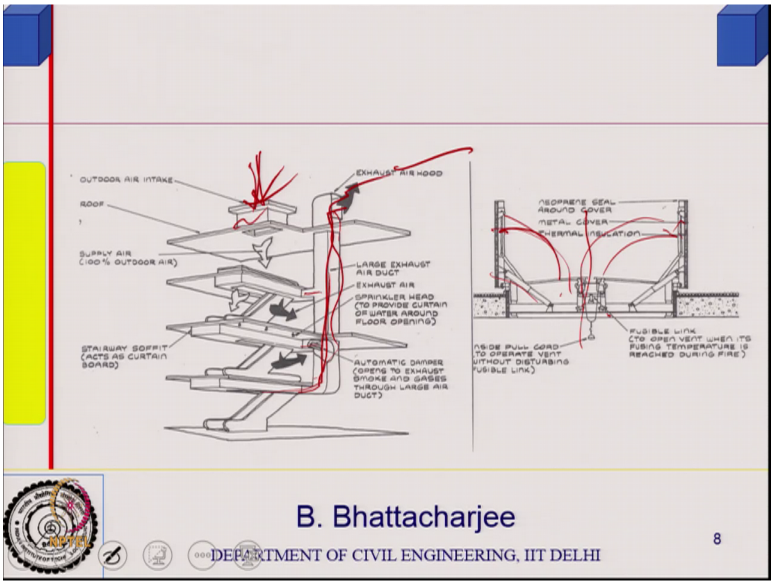

Typical smoke vents would look and vertical smoke vents can look like this is normally in closed position like this, right; held up by sort of a string, but supported in this manner. As soon as the fire breaks out, the few link that holds it in position breaks and it can go open up in this manner allowing smoke to go out.

In case of escalators right, you can pressurize it. So, for example, there can be exhaust which will ensure most you know air fresh air can come from here at the top right. If the top level in that area of escalators like in your shopping malls and similar sort of situation, there can be an fan at the top which can bring in fresh air right.

From the top supply of outdoor fresh air and there can be a duct which will ensure at every level it will be connected. So, in case of a fire, somewhere the smoke would be going out exhaust through the hood.

So, this sort of smoke venting planning can be done; smoke venting planning can be done, right. So, smoke vents are essentially nothing are such a openings either with the window level or at the roof level which normally remains closed and as soon as fire breaks out and temperature reaches a particular value or the smoke reaches there, generally there the heat sensors type and it breaks a fusible link which will open up and allow smoke to get out.

And wherever required you can supply excess you know supply pressure under pressure. So, that it will avoid smoke spreading all over the place. So, this sort of planning can go on particularly in tall buildings, they become important.

Now, let us look at some issues related to escape routes in buildings, tall buildings.

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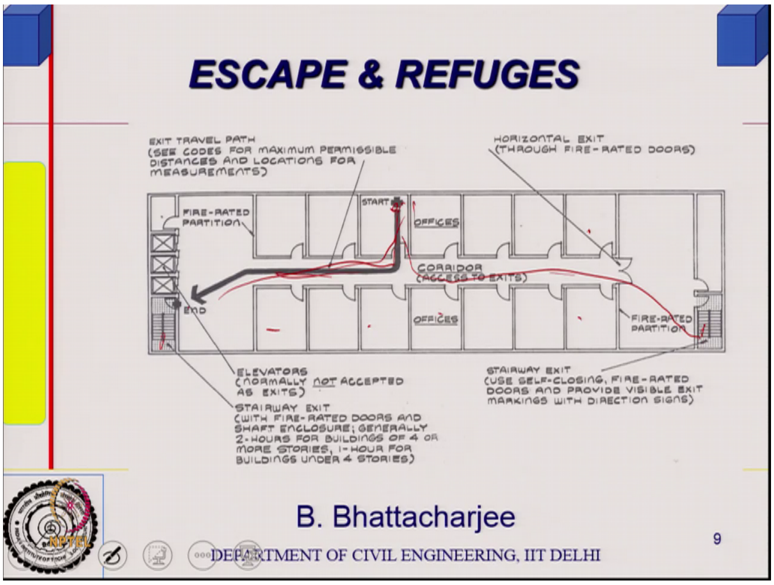

As I said, the staircase must lead to safe place outside in many cases. So, you have staircases at this end or this end and while can see considering 22.5 meter, as I said you know, this should be the extreme end extreme end is this is the extreme end right. So, because from here, otherwise people will go along this direction you know. So, there these are the let say of his space so something like that. So, this distance and this corridor must be free and safe this corridor must be safe right, this corridor must be safe. So, this is how one can plan access at the flow level.

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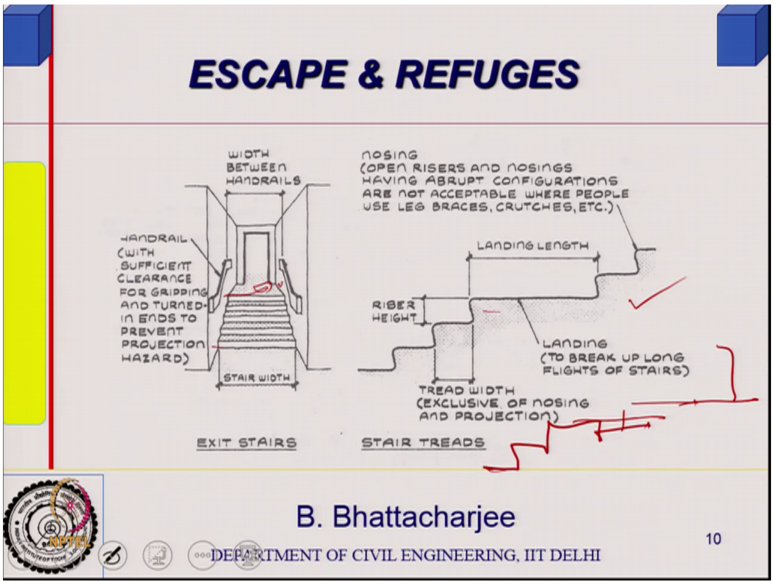

We mentioned that dime you know this dimension should be appropriate from ergonomics. Consider you know, you remove because, you have to you know the handrail between the handrail that space should be available for free movement. So, you are what we what we said that, you need to exit with or exit with will actually consider only between the rails; between the rails hand rails you know between the hand rails.

The slope and slope also the tread and rise, there should be appropriate because, at that point of time moving in an emergency situation, one has to you know move comfortably there can be situations or lot of people together would try to go. So, therefore, this is at the guidelines as per the guidelines of the course this should be provided, right.

So, you can actually provide landing in some places to break up long stairs. If there are long stairs you know, you can provide stairs like this and some place depending upon the half way through you might provide a landing then again. So, allowing people to move horizontally a little bit and then again provide. So, these guidelines are available in various codes, in all over the place.

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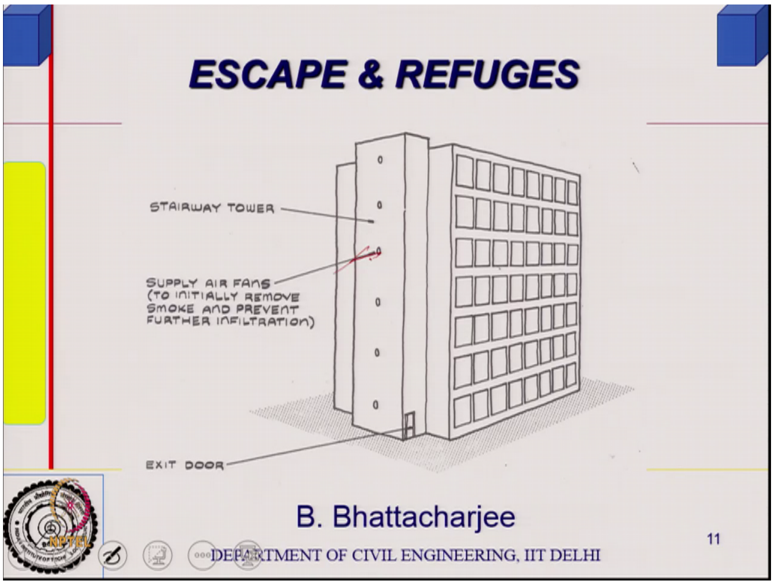

Now, this external stairs you would have seen in many places. In many places, you would have seen external staircase. If it is in such climate, particularly cold climate, then you might like to encase this external stair. So, this is the external staircase and you in that case, stair weight you know in this tower should have supply of fresh air, supply of fresh air, right.

So, that it knows anywhere smoke should not come besides that ventilation problem should not be there. So, you might have seen in some of those buildings, even a tend storey building you have staircases outside particularly hotels or similar sort of situation staircases outside. So, escape route is through outside staircase, right.

So, this is this is another thing and if it is in such climate where it is difficult to move, then it would be in case otherwise, you need not cover it up it can be open, in Indian scenario you can keep it open that is not a problem, but. So, that you get also the fresh air. So, that is that is idea.

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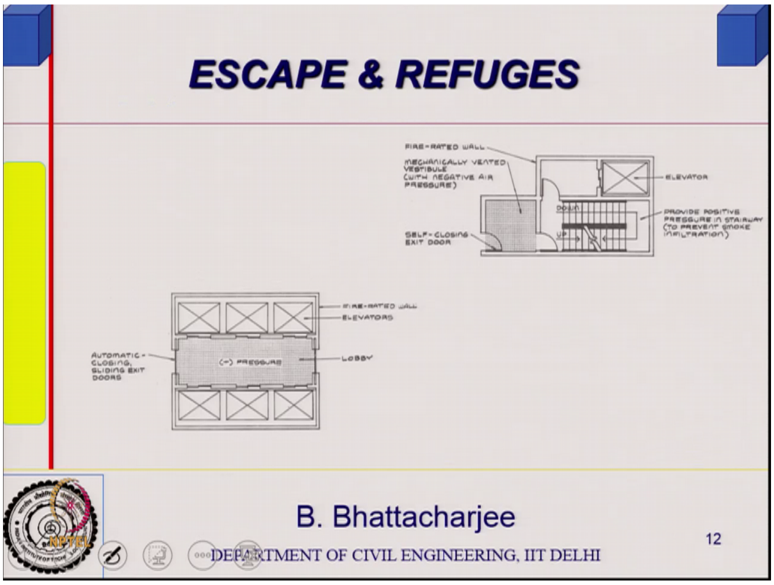

So, that is what I was saying since this is this you know, that you can pressurize this places put pressures pressurize this places depending upon the situation.

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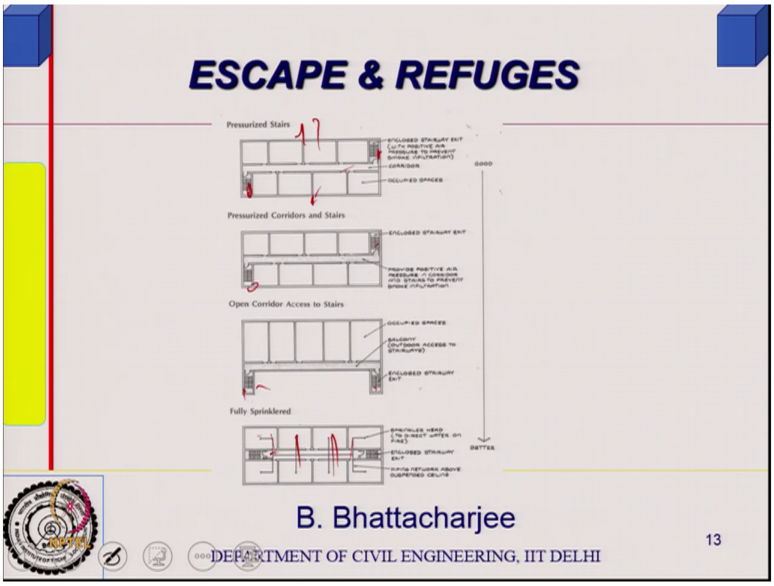

And you can plan staircases in manners like this for example, you can have stair here, stair on this side in a long building. But distances should be maximum distance from the furthest point should not be more than 22.5 meters or whatever specified in the code or you can have stairs like this or you can have stairs like this which are externally anyway or you can have stairs like this right; with sprinkler here with sprinkler head here.

So, essentially ensuring that, it is protected root is protected root and corridors must have appropriate class of flame spread finishes etcetera. So, this is some guidelines related to escape and refugees the flame additional thing is, you must have you must have visual as well as audio alarms in tall buildings visual and audio alarms.

For example, if I am in a 30 storey building and if there is a fire in, let us say, 3rd floor, floor number 3, not say 0 1 2 3. Let us say, the around is 0 or something of that order and I have a you know I am in somewhere around 28 floor, I would know even just like that unless there is an alarm system, and even sometimes the people in the 4th floor may not know that there is a fire in the 3rd floor.

So, an audio system should guide them; how to where to go.

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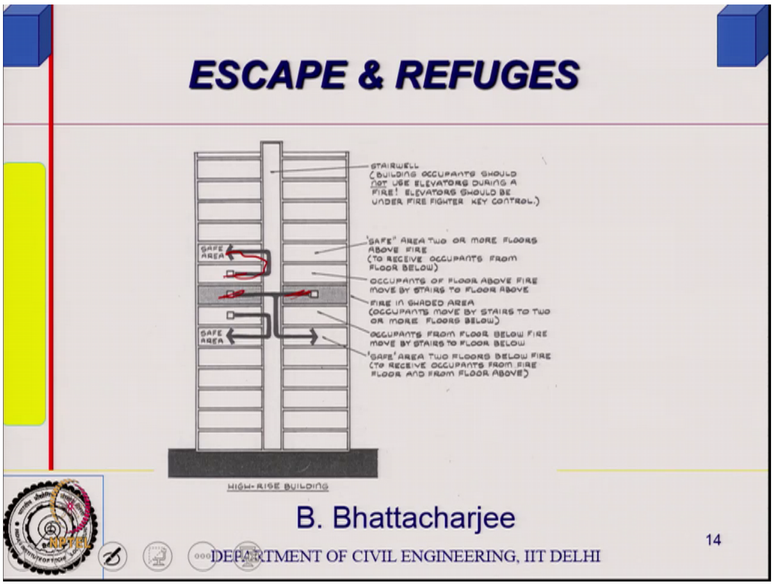

Now, it is expected that in case of a fire if there is a fire in this floor, you ask people all the people around there should not get panicky. The public address system might tell, they took a look the people here must move one floor up. People here through the through the through the planned escape routes which could be internal stair. If it is pressurized right, internal stairs or whatever it is internal you know compartmentation and sprinkler system and pressurization if everything is done planned, accordingly in a planned manner.

So, in case of fire, in this floor, you ask the people here to move to floor down. In case the people here, you ask them to one floor down and people here you ask them to go one floor up and this must be announced through the public address system together with the alarm and detection system.

So, you know one must take care of everything and we says or visualize the possibilities in case of an emergency, and accordingly provide the planning according to provide the planning, you know like escape for all people depending upon type of occupancy. Because, the hospital the matter might be much more dangerous hospital might may like for example, it may not be intensive care unit, but some other multi storey hospital some other level let us say, is not it intensive care unit you will have to have complete compartmentation, ensure that sprinkler system maybe fresh air supply pressurization you know, you plan it that way.

So, that you do not have to know people will be moving, but if it is such persons which can be moved with help you have to provide that kind of information and a routes safe routes to safe places.

So, that is how you know fire protection is done in tall buildings as well ok. I think that would finish of our discussion on tall buildings I think that is you know so this will finish this at the moment. So, having looked at the fire protection in general the services and then let us look into lift vertical transportation. So, vertical transportation first of all it is I will come to this later on is a first thing else that vertical transport and building.

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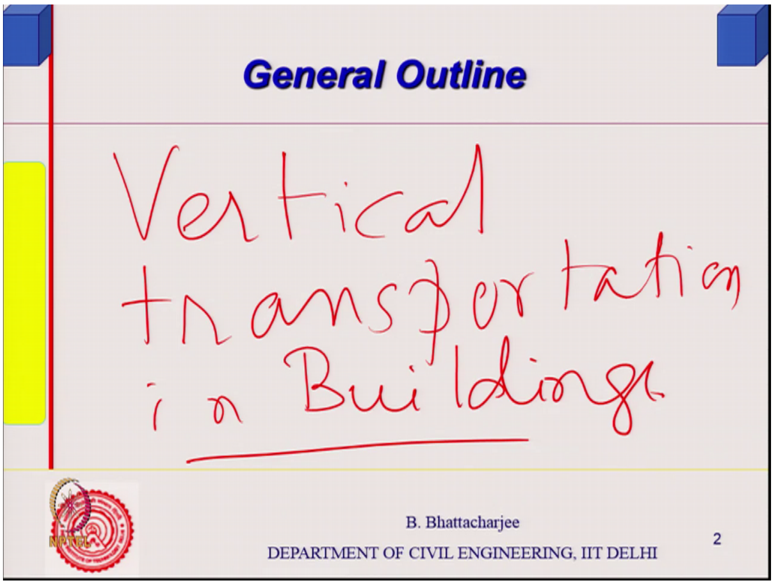

First thing is, unlike good, normally we will have transportation for goods right. For people one thing one has to be you know main issue is nobody likes to wait.

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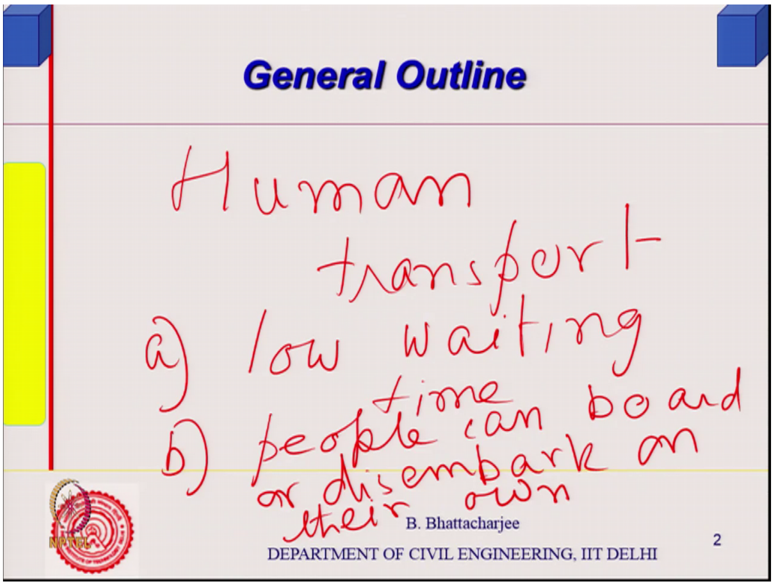

First is for, so, human transport basically we are looking at human transport and one low waiting time low waiting time right. That is number one. Otherwise, people will get annoyed you know, it is disturbing, annoying. If something is waiting for the lift for too long, other main important issue is human being can take decision on their own to board at any level and get out at you know disembark at any level.

So, people can board or disembark on their yes on their own choice you know. So, this is this is one thing and it should be safe; of course, it should be safe. You know, it should be safe. So, obviously, safety is most important. So, it has to be safe. It has to be safe. Actually it has to be safe. So, C is it has to be safe should be safe.

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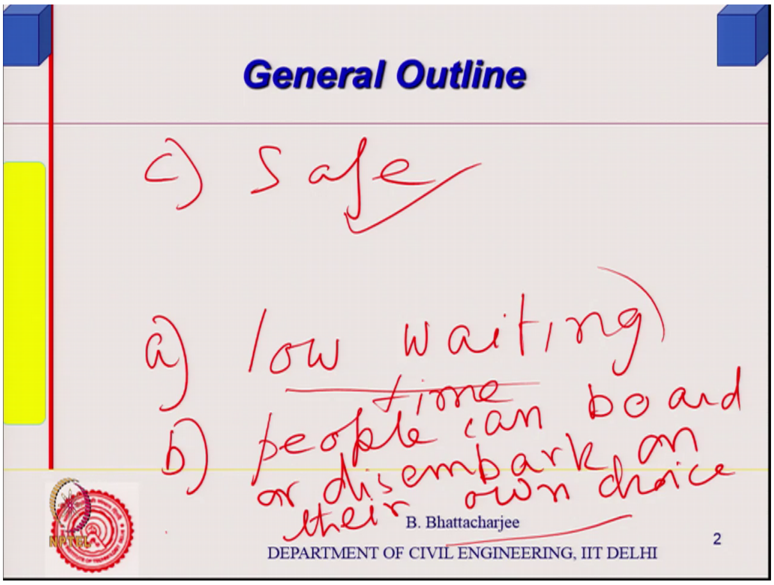

Now, one interesting digression here, I think it was some around 1832 or similar sort of time not 1832 somewhere around that time, before that building somewhere around the 19th century, you know first part of the 19th century, it was easy to build construction technology and materials started developing like steel was available. So, they could go to tall buildings, they can go high rise building 7 8 buildings. So, it was structurally not impossible construction problem.

But nobody could build anything taller than 4 stories because, they are lift system or system was not there. Lift system was not there; you know how to go you cannot expect people to actually climb staircases up to 8 10 storey’s. Unlikely, it was not very popular. I mean, you us and then it was Otis mister Otis. In fact, they he was the first possibly inventor of lift and you know in motorized system which will take people up and one would not he had to show. In fact, by going up and down through a lift that is the same.

So, people are not very cool very much comfortable safety was an issue. Then there is going up and down; may not be very safe. So, till this kind of confidence was developed lift income through. So, lift is very important from that point of view and these are the requirement of lift. First is, I mean although I have put it as number 3; obviously, it is to be safe. Low waiting time and we must take care that people can board and disembark at any level.

Now, if I look at our design part of it, lift design essentially you know we will be looking at we will be looking at what we will be looking at number of lifts required.

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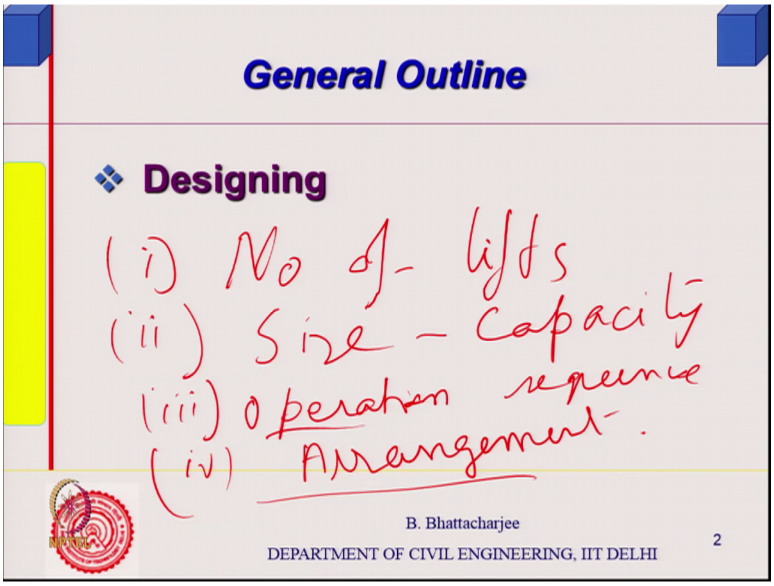

Not the mechanism of lift you know mechanical aspects of movement. Number of lifts required their sizes, size or capacity as we call it capacity right and possibly operation sequence. Operation you know, operation sequence I will say sequence or guidelines or whatever you can call it because, all lifts no not stop everywhere.

So, number of lifts is important size and capacity is important and also their arrangement to certain extent. How do you arrange them? Arrangement operation you know it is operation, I mean it can be stopping at all or floors stopping at all even floors or maybe passenger up to certain point, then express and all that. So, these are operation sequence or operation you know this is what I am call it number of lift.

Now, if you look at it, which is most which could be the which type of occupancy is most crucial where people come in all in one go, where people will come all the passenger come in one go. Now, of course, the lift time talked about that is within building, but certain types of building people do come in one go, but they come in large volume, but the traveling distance is not very large.

For example, a metro station railway station or airports, there you do not provide lift, really. What you provide is an escalator because, it can carry large number of people, but over a shorten distance, we will come to that later on, but lifts are for relatively higher heights lifts. Therefore, relatively higher heights, right.

So, the occupancy type on which people come in one go could be of course, if you depend upon varieties or occupancy. For example, the classroom in a lecture theatre complex classroom, in a lecture theatre complex, that that essentially you know classroom in and lecture theater complex essentially everybody will comment if the class starts at 8 am, everybody will come around possibly 7:40; you know 7:55 7 around that time. So, their large number of people might come.

While coming down, again they might come. After the class ends, large number of people might come. So, you can see that type of occupancy where people come in large number in at a is given time that is very important, but this just is as an example I have given because, we have a lecture theater complex here and this sort of crowding you might be seeing so that is why, I have given you an example,

But typically office is the one office building is the one where single purpose office. Let us say, you know or single timing office all there are a number of offices in the let us say, in a 16 storey building, but all starts at 9 am or 8 am. In that case, the maximum load would be around.

Student: 9.

8 am or 8 am so, office is the one which is normally, you know office is the one which is normally considered for load purpose.

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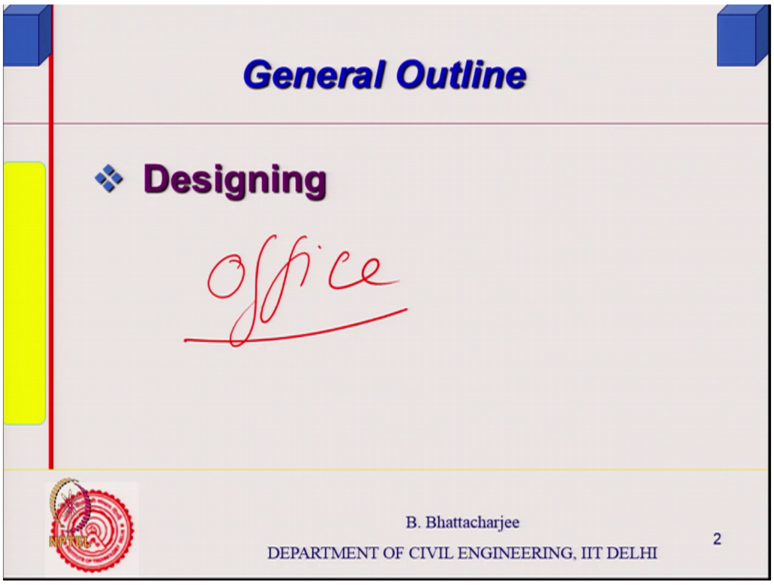

And normally, in case of office, you see as I said in case of our classroom, you find 8 am there are large number of people coming. Maybe next class, starts at 9 again, you will find a chunk of people coming, but then classes generally continue even in a staggered class scenario such as in an institute of the our kind, but offices what will happen offices you know, this is not a very classy an electron.

It will not a very typical clay case like our lecture theater complex this is one, but the original concept of design started with offices. Why everybody comes around? Let us say, office starting time and then they remain there for the whole day and then they come back again everybody comes down at a given time again right with some deficiencies. So, original concepts of planning of live is essentially with respect to office traffic. Now, how this office traffic will behave, it is something like this.

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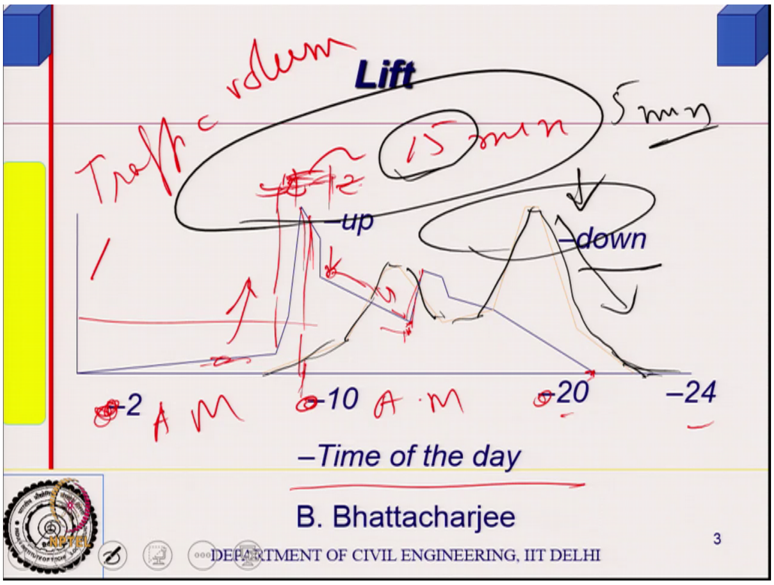

You know, for example, if I said time of the day this is not minus, this 2 am 10 am and you know this is 20 or 24 something like this. So, supposing typically office starts somewhere around here 9 am or something of that kind, right. So, they will be very little traffic early in the morning, you know night after 8 pm very little people will be actually coming up well little, but some people might come for cleaning up etcetera before the office time.

But the 15 minutes around, it office time you will have maximum number of people coming 15 minutes around the office time. So, the peak time will be somewhere starting from here. So, 15 minutes sorry this is the 15 minutes you know this 15 minutes, you will have maximum number of people will be coming. So, this somewhere here is office timing some people do come a little bit early, some people come about 1 or 2 minutes late some things like that.

So, this is with a typical 15 minutes around which the maximum number of traffic would be there and then, this up going this is only up going traffic. This is up going traffic. Now, up going traffic will diminish after that after this, office time will be very little some people still might come around this point of time. Some people still might come because, other persons who have worked in the office, they might come a little bit late right and then this goes down the number of people coming up.

So, this is up going traffic, up going traffic number of you know up going this is population or traffic you can say, traffic volume on y axis time on x axis and it goes down traffic volume goes down.

Now, lunch time, maybe people will go up again after post lunch post lunch, again people will go up because, they would have come down and then again, this will come you know not many people and it if this up going up going traffics practically comes to very small value at 8 pm or so. Well down coming traffic, if you look at it down coming traffic.

If you look at it, down coming traffic, down coming traffic would be something like this almost a kind of mirror image of the same thing mirror image of the same thing you know mirror image of the same thing. You will have very little damage down coming traffic. So, these are the people who are coming down this is the up going traffic, but you will have a peak somewhere in the time when everybody is going out at home.

So, for my design the load that I should consider actually will be this 15 minutes or this 15 minute because, this is the crucial time. When everybody would like to go more crucial is this because, everybody tries to come and gather at the ground floor lobby everybody tries to come and gather at the ground floor lobby right. So, lift handling capacity has been defined with respect to 5 minutes peak time 5 minutes peak time, right.

So, it is actually the number of people the system of lifts; that means, which might have a number of lifts system of lift can carry in peak 5 minutes. That is what we call as handling capacity.

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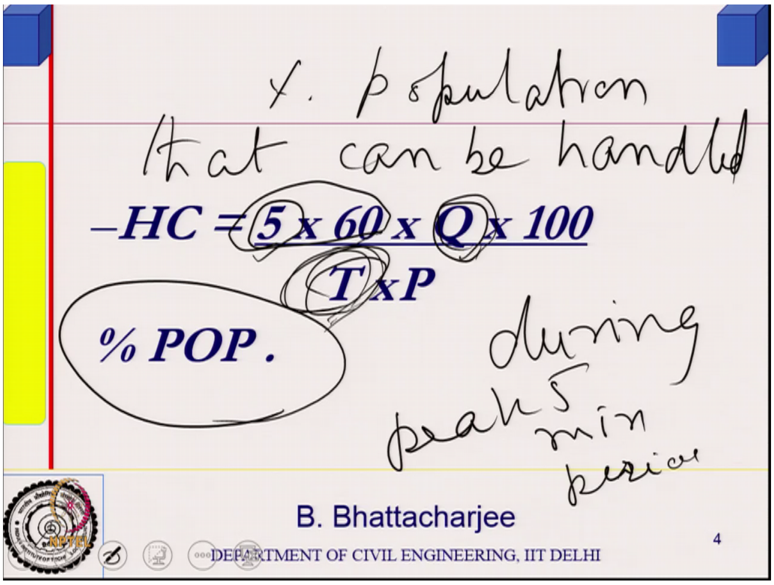

So, handling capacity we define as handling capacity. We define as percentage express sometimes as percentage of population. So, percentage population that can be handled during peak 5 minutes period peak 5 minutes period.

Now, supposing a single lift a lift has got a capacity of Q right, I mean it can carry Q capacity of a single lift because, that would depend upon the machine capacity size everything mechanical design of it can carry Q. You will find that any lift it will have tell you the number or weights also right total 1350 kg you know x number of people and things like that.

So, Q is the capacity number of people it can carry and on an average waiting time is T on an average not waiting time. Sorry this is the round trip time; this is you know Q is the number of people in go 5 minutes is the time into 60 that many number of seconds and after every T interval of time Let us say, if after every T interval of time T, interval of time T is a waiting interval actually T interval of time average waiting interval, 5 the you know a trip takes place. Let me just draw it like this it is this everything out it is everything out.

So, 5 into 60 seconds supposing a trip occurs after every T seconds. So, I will have that many number of trip in 5 minutes T seconds is the time after which on an average I get the car, lift car on an average I wait for T or not a wait after every T seconds a car comes because, I have maybe 6 lifts or 8 lifts, right. And or 2 lifts let us say, and it comes on an average during this period of time it comes on an average T seconds.

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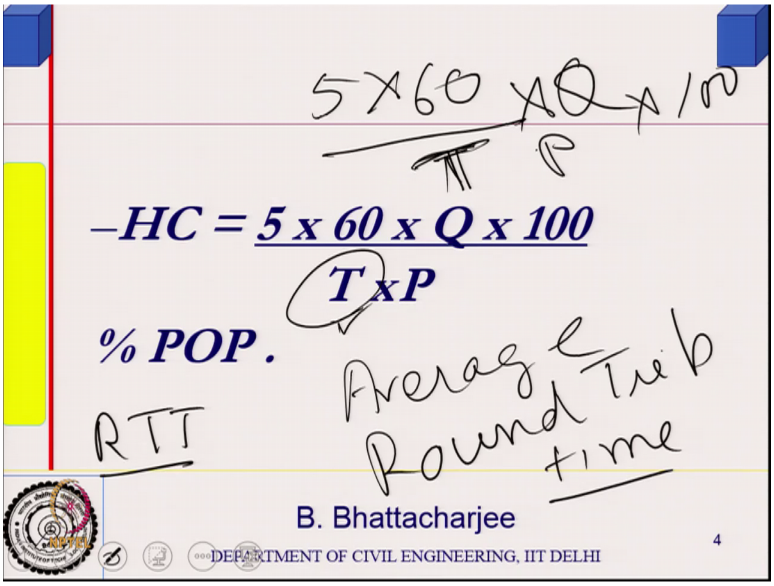

So, 5 into 60 seconds divided by T will be that will number of trips each trip carries Q. This divided by the population into 100 is the handling capacity as percentage expressed in terms of percentage of population, right. Now, question is you know after every seconds, I have after every T seconds, I will have a trip, I will have a trip after every T seconds. So, this is an important issue this is an important issue.

Now, one important point that, I will like to mention is that what we are assuming here is that the lift goes up because, it is up going traffic only we may not considering up random traffic. We are considering up going traffic because, that is the crucial. So, up going traffic it goes up and unloads at every level, it goes up and unloads at every level.

For example, it starts at the ground floor lobby some people will simply get down at maybe 3rd floor, some people will get down at 6th floor etcetera and reaches the top floor where almost everybody will I mean everybody will get down.

Now, our assumption is that once that is happened since it is the peak office time and there will be hardly anybody to come down at that point. So, it will actually come down straight it will simply come down straight right.

Now, in this manner the time required for it to come down going up and come down, we call it round trip time average round trip time round trip time, average round trip time you call it average round trip time. Generally, we will be calling it RTT round trip time average round trip time. So, it for a single lift average round trip time for a single lift.

Now, supposing I have got n number of lifts and there, you know all basically people will come together. So, it will go up if the other lifts were all available right. In the beginning, let us the initial stage then once this lift gets filled in the next one, will get filled in and so on so forth. So, what will happen is if n number of lift is there R T divided by n will be actually T there are round trip time one lift goes up and comes right.

Now, if I have n number of lifts then, by the time it comes back, another lift will start and in the long run average waiting interval T would be simply R T divided by number of lift. Because, if I have 2 lifts; one lifts only T will be equals to R T round trip time, if I have 2 lifts lift you can say that it will get it will become half and 3 one-third and so on so forth. So, it is RTT divided by n is a waiting interval.

So, T is what is we call it average waiting interval; so, 5 into 60 divided by average waiting interval right. Average waiting interval or for each lift order average waiting interval for each lift, actually would be like this multiplied by Q is a capacity. That is a handling capacity we express in percentage. So, handling capacity we express in percentage.

Now, one important issue is if I have all the lifts are passenger lifts in a very tall building. Let us say, something like 40 storey building all lifts are passenger lifts stops at every floor then it will take very long time to actually go up to 40 floor and come down. So, it is not done that way and then you need large number of lift actually number of lifts required because, round trip time will increase it will depend of number of flows and if there are n number of lifts then only T will reduce.

So, T is a decent T would be 25 seconds 30 second whatever I will just tell you about those values and you know comfortable I know like the acceptable waiting interval that is known to us. So, that that you know for that I have neutralize large number of lifts and also considering that you might you have to have parallel staircases around the unit very tall building the space that you will cover for lift.

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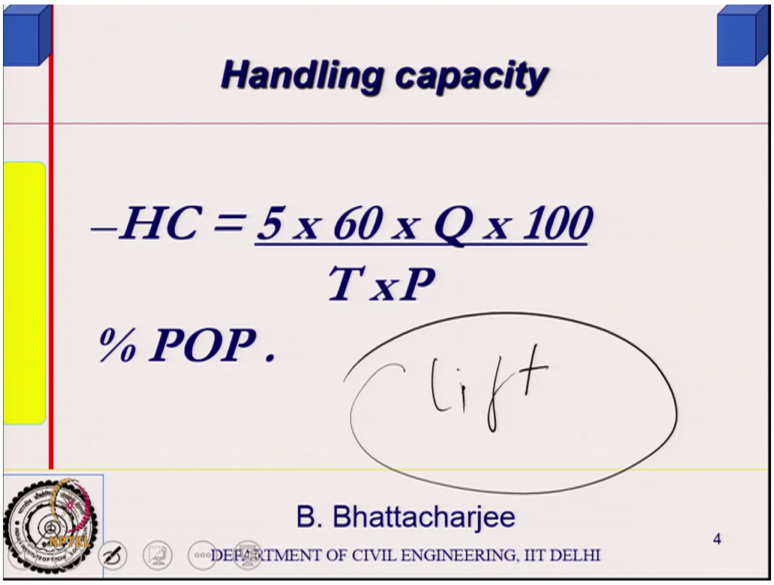

And also, stair it would occupy almost all your space of the floor space. So, it will not be economical, right. Besides that, it would be somewhat uncomfortable also same lift stopping in between anywhere and going to 40 storey's.

So, what we do we do what is called vertical zoning we do vertical zoning, right so we do vertical zoning.

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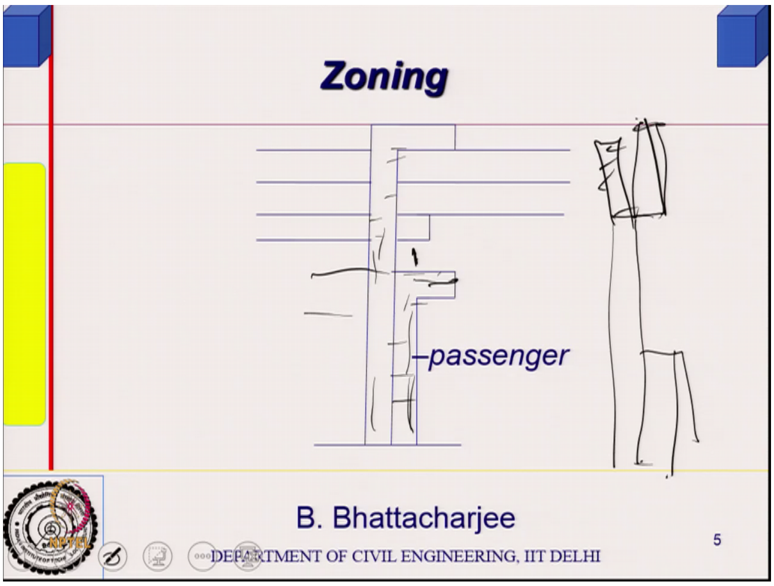

So, vertical zoning; that means, some lift will operate as passenger here this is a machine room, you have to have a machine room above for lifting up. You know lifting device and things like that. So, this is the duct. So, this lift access passenger here while this goes as an express and then my tech test passenger somewhere there.

So, then you get this floor space free you are getting floor space free and supposing I am I can plan this I can plan this for example, very tall buildings very tall buildings. Maybe this goes as expressed this is passenger, this floor space is free and then I can have another passenger scenario. Somewhere up there or it takes like a passenger here.

So, all kind of vertical zoning so you do around eight storey, but vertical zoning 7, 8 storey's vertical zoning and you can have spaces free dip by proper planning you know this floor space is free because, all lifts are not going up duct sizes can be shipped you know. Lift duct sizes core sizes can be reduced and some of these size can come when may be used for some other purpose can be a very good kind of I mean one can do innovative planning on this sort of situations.

So, vertical zoning is done in order to minimize the space and improves the comfort level comfort level you know. So, improve the comfort level. So, both verticals you know, vertical zoning is done and for both purposes that is you do it for improving the comfort level as well as for saving on the space right. So, this is vertical zoning.

Now, remember we talked about when in case of fire also, we talked about vertical zoning that about 8 storey building 7, 8 up to it is 8 floors, you would provide an you know kind of an egress sort of seen some platform or something. So, you see a vertical in in tall buildings vertical zoning is done for various purpose. Lift fire I said another one and even for water supply and such things.

So, we look into this, and then in case of lift, you do horizontal zoning also you might do horizontal zoning also. For example, you might you know like some cases. Supposing, I have got typically in some cases you might have some offices or shopping places at the lower level very and the higher level you might have residences. So, you provide separate lifts for those areas. So, might do horizontal zoning as well horizontal zoning as well, right horizontal zoning as well.

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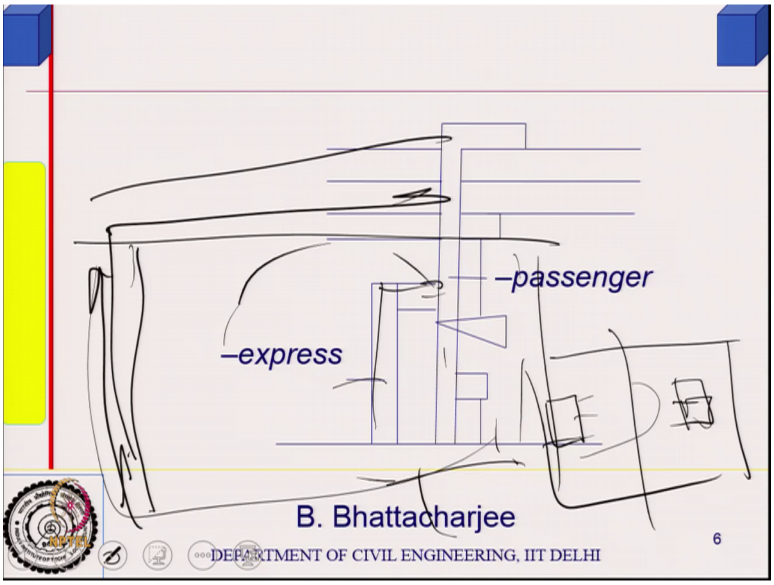

So, this should be express, then there might be a transform lobby going from express portion to the passenger portion and you might even have an escalator somewhere in between I mean that kind of planning can be done going from one level to another which is a only 1 or 2 level only; 1 or 2 level.

And if you have horizontal zoning, it can be if it is very large sort of a building very large sort of a building. So, residences go up there for them, express lift for offices or shopping etcetera, you might have some sort of other kind of those.

So, this goes caters to the top floor only. This caters to the lower level. So, horizontal zoning also can be done and if it is a very long and white building, then you will have different zones catering different set of lifts like a like what you see in our main building, you will see 2 lifts actually. 2 sets of lifts although they lift somebody are less 2 1, you know main building you would see that 2 1 you know, it is a plan.

If you see it is a rectangular plan anyway. So, you will see 2 lift somewhere here set of lifts and 2 lift somewhere there.

So, it is a kind of horizontal zoning they have done in between they are provided a ram right in between, they have provided a ramp. It was essentially meant for taking the equipment because the plan the physics and chemistry labs upstairs have been taking some equipment’s as well. The ramp is there besides this you know it is good having good purpose for differently abled people now. But originally it was actually meant for carrying equipment's and things like that. So, in any case, horizontal zoning one can do. So, this is our lift zoning is done.

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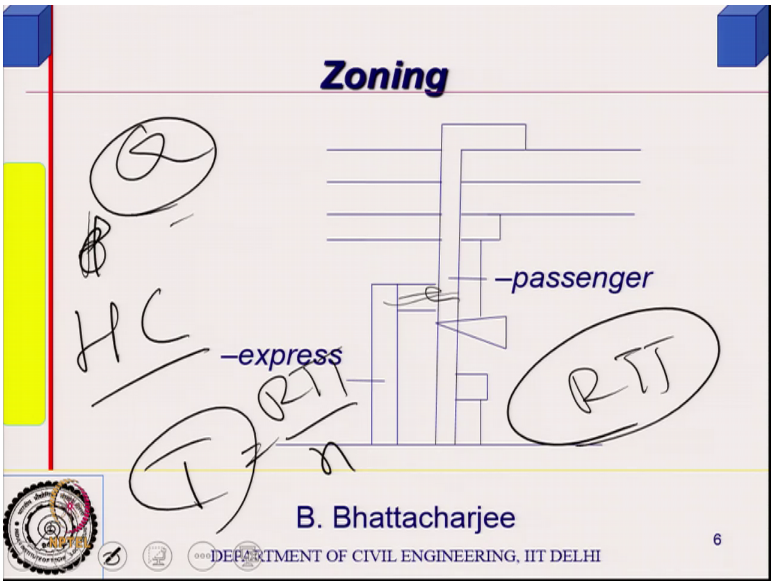

Now, vertical zoning provide express lift up to certain point then passenger might even use and transfer lobby not very far off depending upon the situation and horizontal zoning is done. When it is a large space or basically, mixed occupancy type scenario where your lower level you might have office or shopping areas and higher level residences and things like that. So, this varieties of planning can be done. So, zoning can be done.

Now, what is if I want to calculate out handling capacity what I need? If I want to calculate out handling capacity, what I need?

Student: (Refer Time: 41:18).

T Q is a lift capacity that is known to us right, Q is handling capacity that would be provided by manufacturer or I might you know it is a one of the one part of the design decision which I make in the beginning because, T will depend upon Q, T will depend you know T might depend you know will depend upon Q as usual see.

If a lift care is more number of people right and you have more number of lift then, obviously, T would get. So, will calculate see that. So, RTT first I must find out T is nothing, but RTT divided by n. So, I must find out RTT I must have a way to find out RTT.

Now it is relatively simpler to find out RTT in case of up going traffic one directional traffic I am considering one dimensional traffic not random x random you know random inter floor traffic is relatively more complex because anybody will enter anywhere now.

Student: (Refer Time: 42:20).

Yeah.

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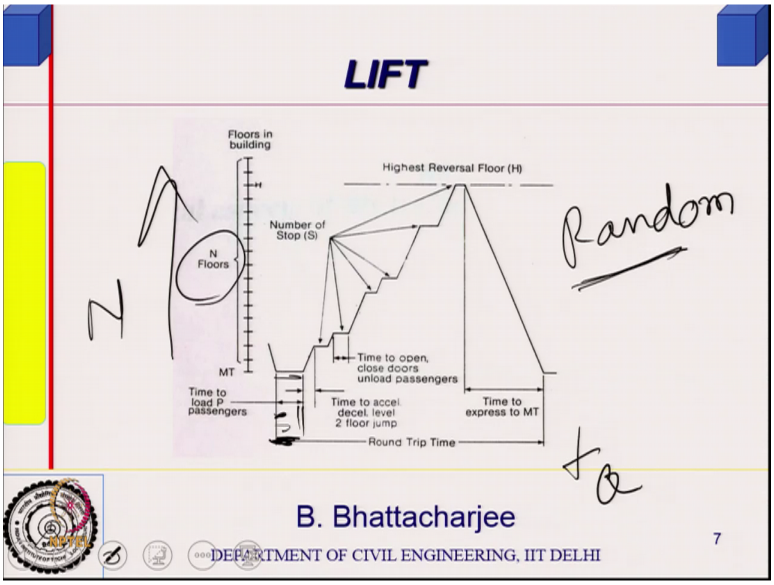

So, people do come people do come in some sort of a you know random manner, they do come in some sort of random manner. They appear I mean then you know there is no nothing like every person comes after 1 second.

So, not of that kind, but there is some sort of randomness, but; however, it is like a you know coming for getting the service like queuing system queuing theorist something similar to that. So, coming to get a service the lift is provided service in it provides a service.

So, for simply designed with up going traffic or down coming traffic which is saying we might there are heuristic way of doing it you know the simple heuristic way of doing which you look into or some statistics are derived heuristically, let us see what these are.

So, essentially supposing I have got N number of capital N number of floors. Now lift will start at the ground floor, lift will start right. So, before just it opens up, then it starts loading people this is the loading time. So, there is now some time for loading right sometime for loading. So, let us say I call it t Q is the time required to load Q passenger into the lift.

So, this is t Q time and we assume that this will be the same time as outgoing time also same time. So, people entering time and outgoing time is same and we are assuming one important thing is that, that everything is you know everything is getting fooled all the time. It is getting running fooled. Why we are assuming this because, we are considering all people coming in one go the extreme situation, design condition when all people are coming and want to go to their office.

So, therefore, we are saying that all the time, lift will run full to it is capacity or we actually put it as 0.8 80 percent of the capacity on an everything.