Fire Protection, Services and Maintenance Management of Building

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Lecture - 13
Fire safety: Internal planning, Detection and Suppression

So having looked at the type of construction and related to the site planning. So, what we looked at so far our site planning that is how much space should be left around a building, the floor area ratio conception this you know, control of some of those issues through wide area ratio of one of the measures. Besides that, height restrictions to the buildings, these are also there, because it would also depend upon height in a given city would depend upon what is the firefighting capability.

And then we have seen the escape and refugees route routes and you know issues related to strategy for escapes and refugees and we have just calculated possibly what is a exit which required for given types of occupancies, we did a simple problem. Basically the guidelines are available; how much floor area per meter square floor area per person that is available for different types of occupancies.

So, if you know your total floor area, how much population you can find out and for 50 centimeter exit width, how many people can be accommodated in a corridor or in a staircase or in a ram that is known. So, there are how much is the minimum width needed that one can calculate check. Also, we have looked into the distances maximum distances from a staircase or exit in case of buildings.

So, we will discuss some of them more a little bit not the distances, but some aspects of planning later on. So, site planning and escape and refugee we have covered.

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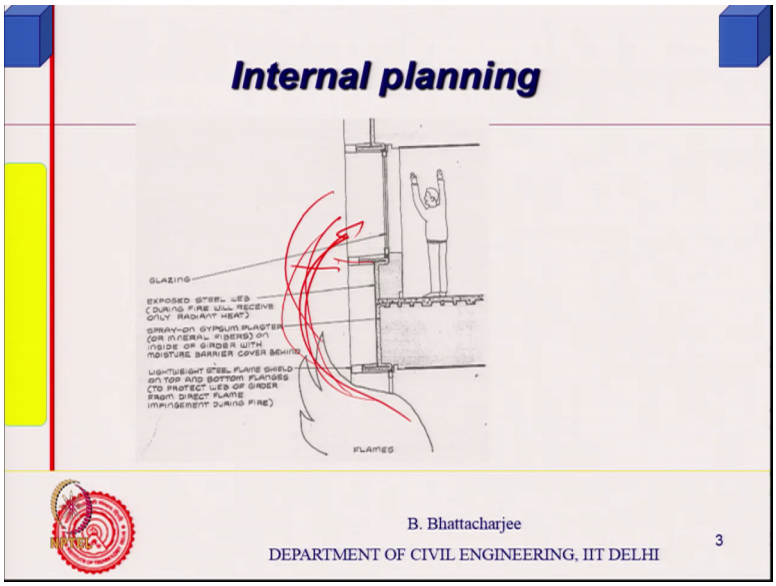

Let us look at now internal planning internal planning. So, internal planning means first of all one thing is important in multi storey building fire can spread from bottom floor to the top floor through the window. So, normally you know it can it can spread like this it can spread like this. So, you should have also you know, you should have sufficient kind of a even a protrusion does a good job, if you have protrusion, then it will not go that high and the material here. For example, this is those are eye garter here there is an you know protrusion here.

So, this sort of planning is required to see that the spread fire from a lower floor through the window this is does not take place neither it should take place through the surfaces and things like that. So, this is some of those some aspect, then there is something called fire dampers, fire dampers, fire dampers.

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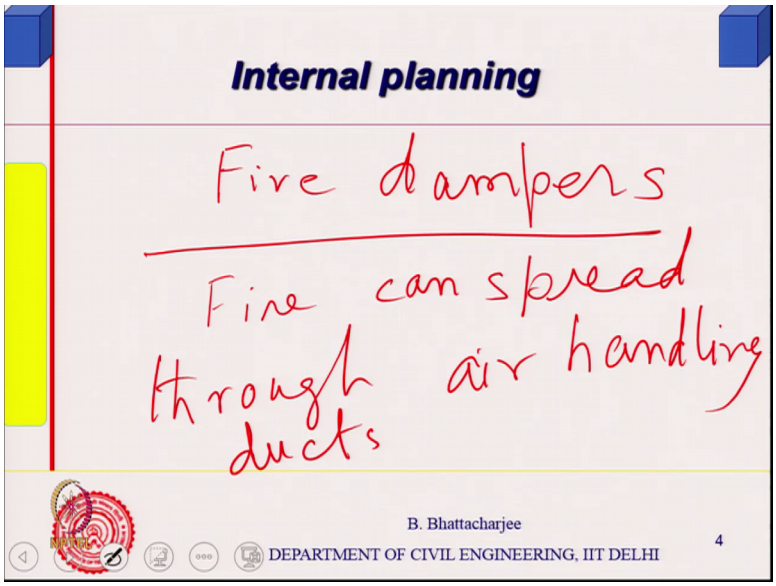

Now, as I mentioned earlier; as I mentioned earlier, fire can spread through can spread through air handling ducts, if there is a fire in the same room. And there is a fire in the room the outlet will now act as an inlet outlet for the a conditioned air, right, outlet for the you know a supply air that might act as an inlet for hot gases smoke and you know this can need to and it can get transmitted to other rooms where it will actually get discharged.

And it can actually spread fire over a long distance. So, therefore, what we use is fire dampers.

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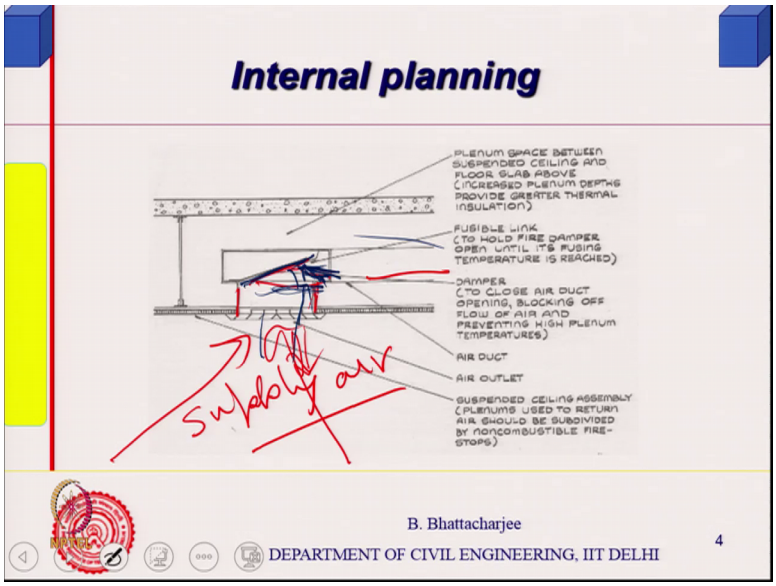

So, fire dampers are used basically fire dampers are used fire dampers are used something like this, there is a fire damper looks like something like this, you have the outlet; air duct outlet. You see this is the duct, this is a outlet normally for you know, for the treated over supply, air for supply air, for supply air, this should be the outlet for supply air right this is the outlet for supply air.

So, what happens is in case of fire hot gases and smoke may enter through this. So, a fire damper is used in order to block this now it has got a fusible link the principle is this is the entry point, you know from the duct the air would come and enter the here. So, it can go through this. So, what you have do is you just block this area how do you block it essentially, what you do? What you do is essentially, what you do is you know you have a fusible link here and this is a kind of a kind of a plate as a fusible link.

So, when heat or hot gases goes here, this fusible link will melt and as it melts this one will simply come in it will just rest over this. So, this fusible link keeps it supported upward the moment, it breaks, it comes and rest over the duct and you know circulation through this is actually now stopped. So, it have you know it is there are hot you know like essentially if this is does not allow air movement into the room anymore, it does not allow air movement into the room or out of the room anymore; that is a idea; that is a way.

So, fire damper works like this fire dampers works like this, there can be several construction of the same one.

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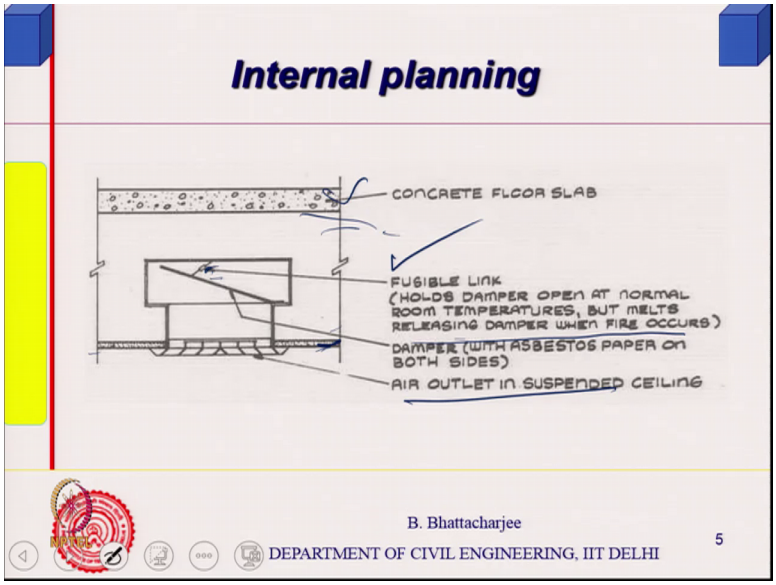

For example, we can have something like this as I said is a fusible link, you know and holds the damper open at normal room temperature, but melts releasing damper and you can have damper with a asbestos or insulation on both the sides. So, this is the fusible link which holds it and just it melts and then it can come or in some manner, it has to support essentially, it will be supported from the top, because that that is why it can hold it.

And outlet remains as suspended ceiling. So, this is your duct actually concrete floor, this is a fault ceiling and you might have insulations here.

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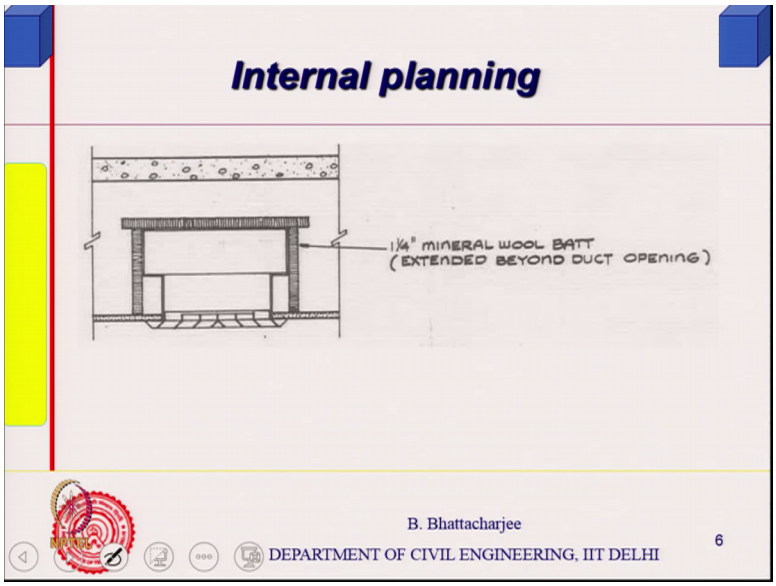

You might have insulations here. For example: you can have a insulations mineral wool insulations, mineral wool insulations, etcetera, etcetera, so that you know heat is not transmitted to the duct thermally thermal heat transfer is minimized. So, this is one issue.

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So, fire dampers were one issue fire dampers as I said, fire dampers fire dampers these are used in ducts used in ducts and in case of fire, they do not allow and an along a transmission of hot gases, etcetera, etcetera. So, essentially also you do a kind of insulation lining around the entry point. So, that the heat also hot you know the

temperature rise also does not occur. So, this is concepts of fire damper in internal planning.

The other issue is flame spread you know flame spread can be dangerous even if it is there in the external phase, because if this is your window is somewhere here if your window is somewhere here window is somewhere here and the flame goes outside the flames; you know flame goes flame goes like that; flame goes like that; you know flame and this is your window flame goes to the wall here. Now flame can spread upward and inside.

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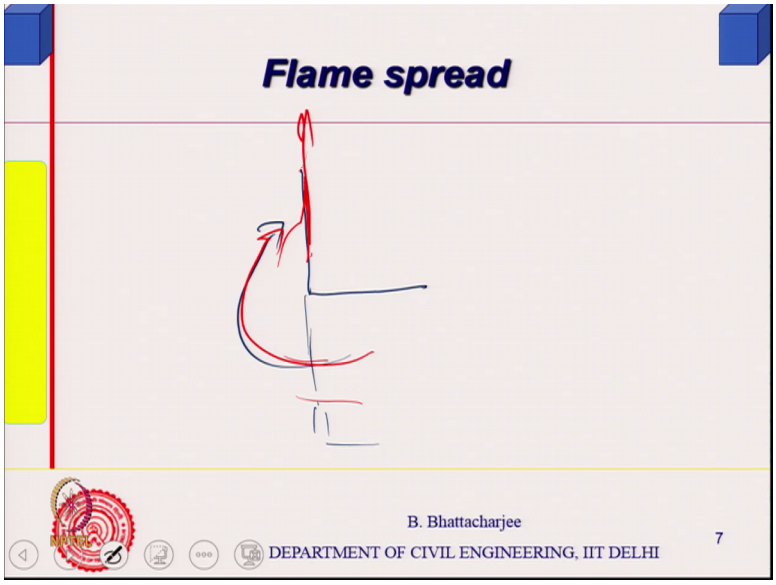

It is very important; flame should not because the painting, etcetera, etcetera. That is not the issue of where is the fire resistance flame can simply get carried paints, etcetera and carry the flame.

So, flame spread is related to that and it should not be on external surface painting in tall buildings or multi storey buildings one has to be careful, because if there are some plastic paints or something and it can carry it can spread the flame then it might go to the next level. So, this is important issue something like this.

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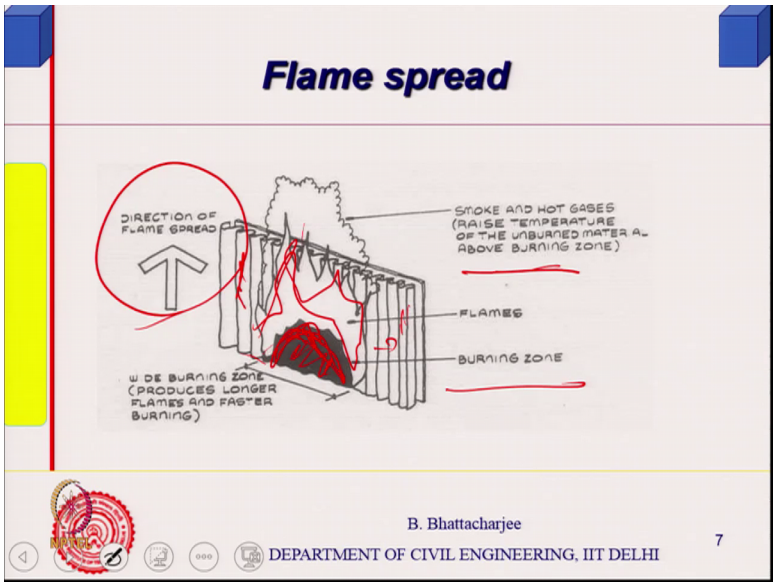

So, this is what happens and this you might have seen somewhere you know if you put a paint you will find that this is actually original the fire, the flame is here; fire on the flame is here.

And it goes on spreading vertical spread is usually more than horizontal vertical spread is usually and we measured this. So, you know hot gases and smoke that would be going upward. So, these are only the finishing item we are talking about the finishing item not the element as such not the whole element as such, right. So, this you know, this burning zone, then the spread of the flame this is a burning zone spread of the flame can occur this is the burning zone spread of the flame can occur and it will get widen the burning zone will get widen as well as it will get widen in both vertically and up you know horizontally.

In this particular case direction of flame spread it is a lengthwise it anyway you measure it in terms of length; length unit per unit length per unit time. So, how much spread of the flame would occur length per unit time? In this case vertical, there can be even horizontal flames spread would be there, but vertical will be more in this particular case.

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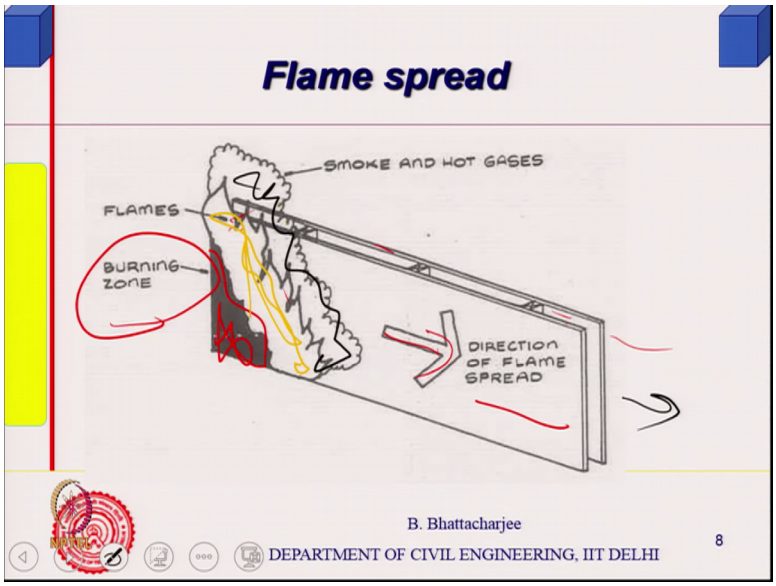

So, we express it in terms of like horizontal spread is spread is somewhere there, because vertically it says let us say there is a wall or shade or a cannot be or something which is blocking right or you know, it is in this corner of a let us say a beam.

So, wall is wall height is this is the wall height this is the beam or something this showing of course, a sandwich wall, but any finishing. So, there is a beam or something which is which will not allow further it to go you know for flame to go further. So, flame spread direction could be along this direction. So, burning zone is here, this is your burning zone flame is somewhere there flame is somewhere there flame is flame is somewhere there somewhere; there is your flame, flame is somewhere there this is the flame and smoke gases are somewhere there smoke gases are somewhere there.

So, these are the smoke and flame can go on spreading along this direction flames gets spread along this direction, right. So, we do not want this, we want it to be restricted at least in certain areas was the within the building itself within the building itself for example, corridors. So, which we expect escape and you know what people will expect people to escape the flame spread should be sufficiently low. So, in this context actually one can measure this flame spread then natural building code or various codes actually classify this flame spread in terms of class 1, class 2, class 3 and class 4.

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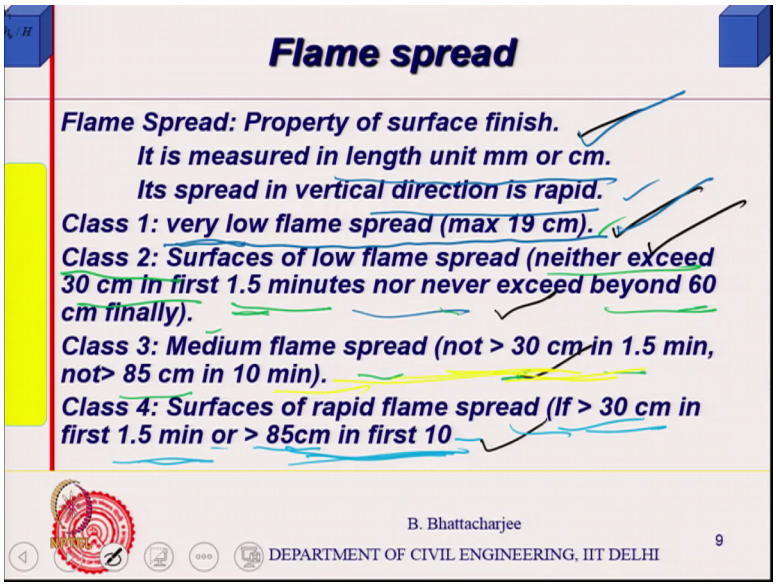

So, 4 classes of flame spread finishings is essentially related to finishing surface finish right. So, it is the property of surface finish actually property of surface finish property of surface finish right. So, this is the; and its unit is millimeter or centimeter in length unit right now we can talk in terms of rate of spread. So, rapid flame spread usually vertical flame spread is faster so, but there can be situations where it is horizontal space more.

So, you call class one where your flame spread is very very low which is less than 19 centimeter within 19 centimeter it will extinguish itself it will not spread you can have such kind of you can see sometime you might be one interesting. I mean small example you which maybe if you have, I do not know, people do not use match boxes these days too much.

So, if you have a match box you take that match box the shell of it out put it in fire you will find that little bit corner you know, this flame goes on spreading right. So, that that is that is something synonymous to flame spread. So, paints through paints flames can spread now it might extinguish itself after certain distance. So, class 1 type of low very type very low flame spread maximum 19 centimeter class 2 very low class 2 is just low, flame spread class 2 is low, flame spread class 2 is low flame spread.

So, it is it neither actually thirty centimeter in first 1.5 minutes nor or never exceed beyond 60 centimeter. So, this is 19 centimeter, this is maximum 60, but within first 1.5 minutes should not spread more than thirty centimeter class 3 is medium flame spread

not more than thirty centimeter in first 1.5 minutes and not 85 centimeters in 10 minutes, you know, it might have a overall still more overall, it might have still more right overall, it might have still more, but not more than 85 centimeter in 10 minutes.

And class 4; class 4 is a obviously, the worst part of it I mean you know you know it is just a lot of you just allow a lot. So, that is actually flame spread is thirty centimeter in 1.5; 85 you know if its exceeds this 85 centimeter in first 10 minutes also it is just 30 centimeter in first 1.5 minutes in its class 4. So, certain spaces you can only use class one you are not allowed to use right where the risk is there.

So, you are not allowed to use I mean the guideline is that you do not use flame spread material.

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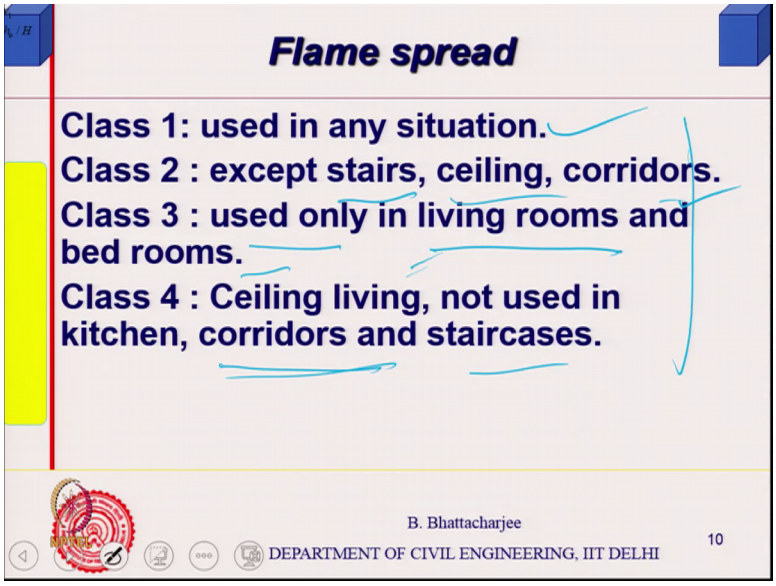

For example, class 1; you can use in any situation because is a least flame spread very low flame spread low flame spread, you can use in almost all places except staircases sealing and corridors, because you expect people to escape through that and class 3 is used only in living rooms and bedrooms, right, you do not expect you know, flame to generate there and class 4 ceiling of you know ceiling of the living room not used in kitchen corridors staircases where you can use in.

So, restrictions are there, but I think I have not compiled all the restrictions if you look at the codes. So, that will then it give me the details of the full restrictions. So, therefore,

flame spread finishes are important and their test available for measuring that flame spread and accordingly one should be using them at a appropriate places, because even in a external surface which was not there earlier. But, you might find them in some paint and it might spread from lower level of the building to the higher level through even flame spread can carry and a whole of the you know like it can it can actually spread the fire very high, listen fire in England was one of those kind you know the London one of those tall building forty storey building fire or something of that kind while large number of fertilities were there.

Actually these are spread it through the outside paint. So, one has to be one has to be careful right. So, having looked into this kind of internal and external and internal planning in terms of first do not a in see that it should not you know. In case of fire I should have you know you looked into the beginning when you are looking at we said that there should be a sufficient space around the building. So, that firefighting becomes you know the ease of firefighting its must be maintained.

Then you look at escapes and refugees within the building how people should go to the safe places right and then also the type of construction or which will not allow a type 1, type 2, type 3, you know construction we talked about which you know, it depending upon fire separation and all that which will not allow a fire to spread and also conception for you know the spread should not be high. So, planning you can do then we have looked into issues of internal planning like fire dampers and flame spread, etcetera.

Now, having done all that you would still like to have some you know this is in the planning stage, but you still like to have some passive features in building or passive or active features in building which would active of course, the energy uses very little of the you know in the next thing I am going to talk about. So, some kind of a active fire protection system should be there. These are all passive they are part of the building itself put them in the planning right, in the planning stage and they are not mobile things you know you may be like how much how much what should be the width of the corridor, and all these are passive aspects of planning.

But some active aspects of planning you can look into what is active as aspects like detectors fire detectors, right. So, we will see that automatic fire detectors.

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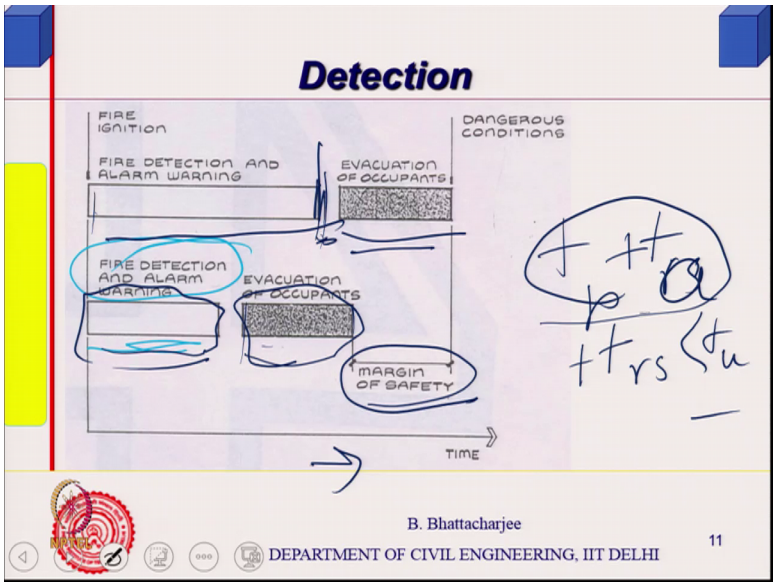

Now, if you as I as you remember I gave you an expression I said that there is time of evacuation would involve first realizing that there is a fire first you know the first of all realizing then acting that after the fire has started acting with. So, people should be able to move about freely. So, a detection system help in the set.

For example if you detect it a early if you detect fire detection, you know, alarm system let us say; you have a automated fire detection in alarm system, right and you detect fire early you detect fire early you have an automatic detection system and you detect fire early then evacuation of the this is time axis evacuation of the people take this much of time. So, you will have some additional margin of safety compared to one where your fire detection in alarm system takes longer time you know. So, detection system warning, etcetera, etcetera, people starts more the evacuation time is somewhere here. So, you know we talked in terms of t p perception time remember perception time, then t what was the other one? t u, I think t p there are 3.

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A resistor you have you know plus should be t t p plus.

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T a is.

Student: It is start of this (Refer Time: 18:49).

And then there was another one the evacuation time.

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And this should be less than some safe time (Refer Time: 18:58).

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And untenable condition or not; so you see the t p and t a is here, there is a gap t p is here, t a is somewhere there people will try to move. So, if you do it early it would say we did not have larger margin any margin of safety larger margin of safety right now how do I do detect fire if I have to detect fire I have to see what are the features of fire.

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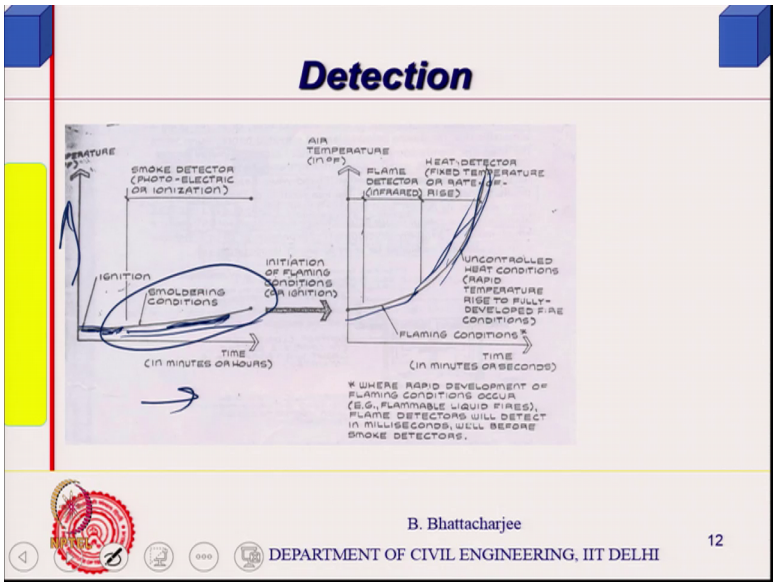

So, features of fire is function of time, if I look at it temperature time temperature curve we have look at it the initial phase. You remember fully grown fire initial phase after ignition there will be kind of first thing will be generating was a smoke and what are smoke basically the product of pyrolysis, you know that we have product of pyrolysis also there together with the gas of combustion, right.

So, smoldering condition more of those product of pyrolysis, you might see the burning would have been relatively less. So, if you detect that. In fact, you can our common sense says if you can smell the fire early for example, you may not be seeing the fire, but

you will still get the smell that is nothing smell is essentially related to particulate matters. So, those particulate matter moves also relatively spread is also fast.

So, that is the earliest one you can detect the particles now particles of pyrolysis basically particles produced through pyrolysis process. So, that is one thing then second thing is after that the heat would start coming out. So, you can even sense the heat to detect the fire. For example, if there is a fire or you are just entering illustrating this; this entering through one of the corners of the room and in one of the doors and you feel that the heat. So, we realize that there is a fire there.

So, therefore, we can how do we do any detection system for any detection system we have some indirect measures even in biological system for example, you want to see somebody has got fever or not you put a thermometer and see the temperature. So, there is some kind of a you know implications or some kind of you know manifestation comes are available from any kind of thing. For example, if you put a load you find a structure bends deflects or whatever it is. So, there is a deformation. So, supposing you check the deformation and you do not know whether load has been applied or not or if there is an overloaded or whatever it is you see it is deflected too much then you really.

So, there is some sort of manifestation whenever there is something. So, fire manifestation of fires is in terms of the smoke then flame in some cases and then heat. So, we have detectors. So, you can detect smoke detectors you can have smoke detectors right smoke detectors. So, initial phases will be smoke detectors. Now there are 2 more than one principle, I will talk about that. Then you have got flame detectors in some cases will be useful where flame comes out in large quantities you know huge flame is available after that is heat detector.

Now, heat detectors operate in this zone just before fly over flash over you know. So, earliest one detection system would be smoke detection is a one quick smoke detection in some manner. And then next one would be flame, if there is a flame likely to come now flame do not come everywhere flame. For example, if it is a inflammable gases liquid petrol then it will come flame will come very fast the last one is the heat detector which is not sensitive as sensitive because heat will be realized much later, right.

So, this is how it is. So, you have got smoke detectors or we also called ionization chambers ionization chambers you know. So, ionization chambers and we will come to this later on suppression part will come later on.

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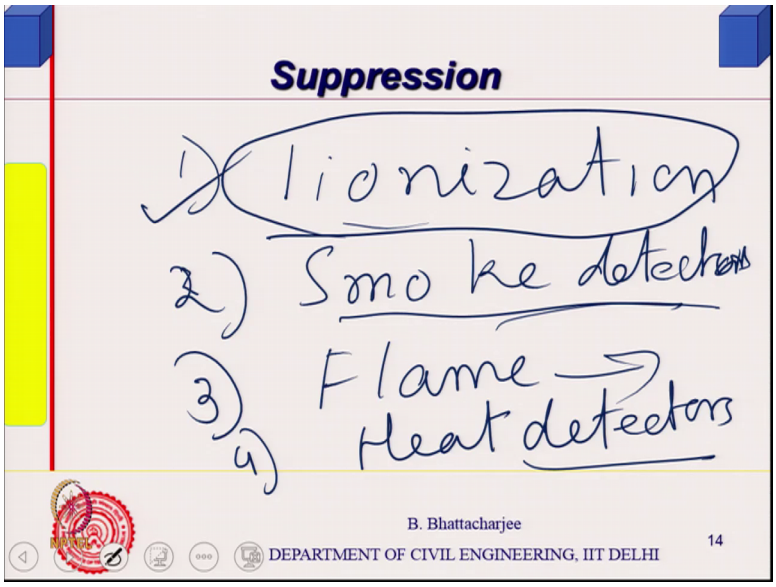

So, just let us look at the ionization chamber ionizes first one is ionization chamber ionization detector actually ionization detector 2 is smoke detector third is flame in some cases and 4 fourth is heat detectors. So, these are manifestation of the fire and their freedom now the particles of pyrolysis you know, they can be detected through ionization chamber. So obviously, this will be more sensitive we will look into this. Again in the next lecture or next sometime later smoke detectors ionization detects the smoke all right, but smoke detector are distinguish from that in the sense that I mean they detect the visibility.

In case of smoke, visibility will reduces visibility. So, photodetectors actually; so, what would happen the light passing through would be would get reduce. So, there are these are smoke detectors are other ones are the photodetectors actually right, then flame detectors are essentially they detect the infrared radiation that comes out from the flame and there as I said there will be use full in places where you are likely to have lot of inflammable liquid and so on.

The flame can generate quickly and heat detectors are nothing, but temperature sensing devices. So, as the temperature rises as the temperature rises right. So, they will activate

or there will you know these are usually connected to the connected to the alarm system. So, as soon as it is its detects, it triggers off electrically an alarm system may be like warning system it has to be alarm system which could be visual as well as a you know or audible system or both visual as well as audible.

So, this is what they do I will talk about the principle a little bit later on right, but there can also we can have even manual detectors right and some of them can be linked to our suppression system also. So, it is just quickly look into some of the suppression system let us look into some of the suppression system right. So, detection system that is what I said then that is a little quickly some simple suppression system then we will come back to the detection system again we will come back to the detection system again.

So, suppression system if you look at it manual type.

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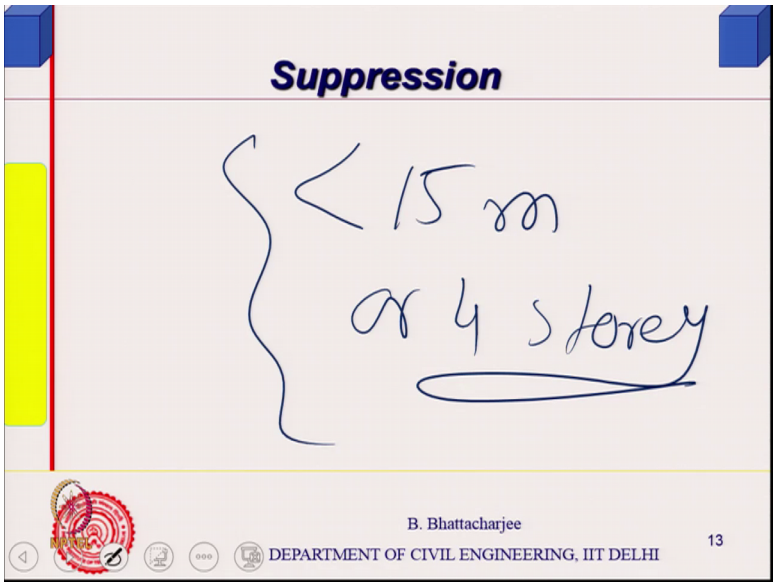

Now, as long as your building is less than fifteen meter height or 4 storey, it is not mandatory to put in a in house firefighting system manually I am talking. So far, it is manual not automatic, you will come to the automatic later on, but if it is more than that you cannot expect the pipe to be leaked from the ground to let us say 5th or 6th floor and if it is taller than there is no question. So, you must have something built in the building itself passive features straightaway.

Now, it can also be there depending upon the occupancy type to somewhere it is mandatory to put in put these ones some other places it may not be mandatory, but let us look at the principle. So, these are all manual fire a manual suppression system right; now I am talking about automatic will come to later on.

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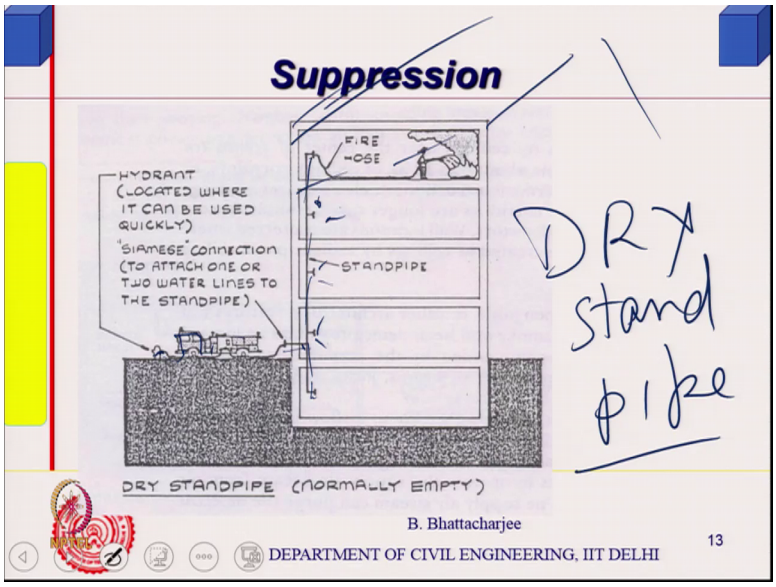

So, manual system; if I look at it this is what we call dry standpipe system.

So, you have nothing but a pipe lead down; you have nothing, but pipe lead down, right and there will be host boxes. So, there will be host boxes now the fire tender normally we will have a pump. So, what they do this is the vehicle this will connect through the fire hydrant remember I talked the fire hydrant earlier. So, they will fire hydrant to the stores fire reserve you know with the water storage would be there tank would be there. So, it will connect use that water and pump it into this dry stand pipes.

So, this dry stand pipes are dry and they have connectors from yours siamese connector; siamese connector to 2 in of them; 2 of them and host boxes are kept in the building itself in the same place you know host boxes would be there in the floor itself you know like in this one you will have host box is kept somewhere in the floor itself. So, host box is a somewhere there you know somewhere there.

So, dry stand pipe system is something like this dry stand pipe system is something like this. So, there is no water nothing only pipe lead down which is a passive feature and it is

connected to the outside you know somewhere close to the one of the outside wall. And then the water somebody can use the may even the occupant they can be trained to use this sort of force open term, but simultaneously manual alarm system also could be there together with this kind of thing manual you know this is manual as I am saying.

And manually I am seeing alarm system is nothing, but is a switch it is a simply a switch box switch box kind of thing you might have seen with some you know red switch in between red switch in between somewhere there will be a red switch and it is covered with glass. So, in case of fire you break it and press it the safety; you know for safety, but was no false alarm should be there. So, it is covered with glass. So, manual alarm systems are there.

Now, in a IIT building, you will find lot of manual fire alarm system in the a blocks main building there is a wet wiser system, but in this you know this you know this block 2, 3, 4, etcetera, you will find lot of places near the in the corridor near the stair you will find that. There is a manual alarm system and also you have got dry stand pipe system you might have seen rolls of pipe and you might have seen also the fire hydrant nearby right fire hydrant nearby.

So, this rolls of pipe can be lifted up put it together this should be connected some cases, if they are connected to the what you call wet pipe system is there which will be filled in with water. So, I will come to that. So, you look into the wet pipe system just now quickly, then we will look into the next class again going to.

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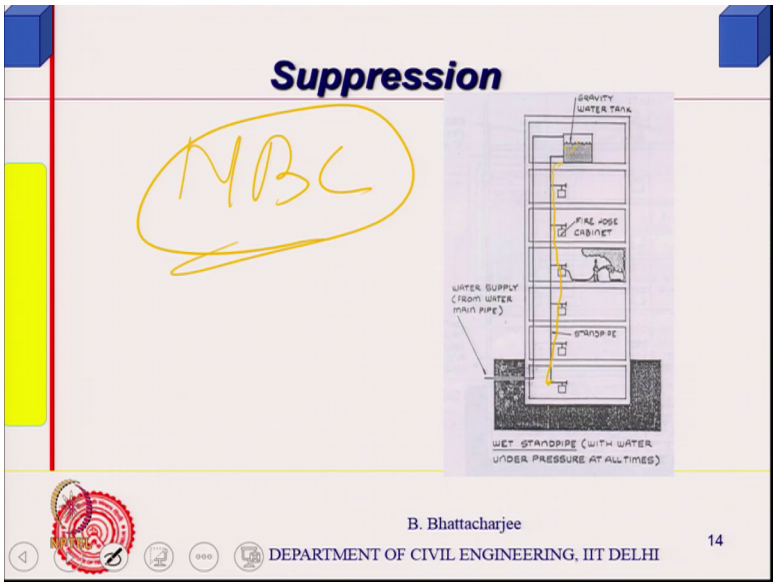

So, this was a wet pipe system you have a tank and this is always water is under pressure if this is the pipe, this is the wet wipe you know on which water is under a pressure.

So, this is specifically for firefighting purposes the capacity of such tanks underground overhead whatever it is in the specifications these are given in codes natural building code gives you how much minimum for what type of occupancy how much minimum capacity 50,000 liters or so and so forth capacity tends should be there for firefighting. So, if you look at natural building code fire, you know fire protection part you will find in appendices, it is given for each of the occupancy type the special requirements. They give you the capacity because it depend upon you know occupancy type residential you might need less while other places you might need more or assembly and similar kind also. So, capacities are given.

And then this is what we call as a wet riser system or a wet pipe system you know. So, wets you know this is wet stand pipe. So, this is the water this also a passive feature main building were this IIT main building, it store a building with this sort of a thing. So, here the water would be stored here this as vertically, but the you can have a underground tank also in that case you must have a motor to operate you know this one.

So, this is a wet riser system. So, wet riser systems are and dry stand pipe system both are there. So, in it guidelines are also available in the code depending upon the floor

height occupancy types where you should be using water and some cases you will be using automatic system.

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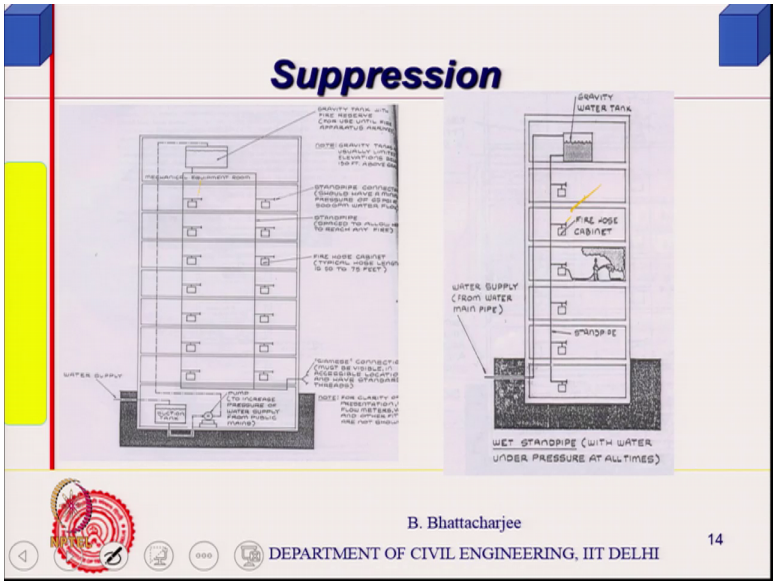

So, now, you can have combination you can have combinations for example, we can have a wet riser as well as you know you can have wet riser as well as dry pipe systems of this is your dry.

So, wet riser; this is wet and there can be combinations also there can be combinations or we can have a all kind of combinations generalize them dry wet and connect to the pump to the water supply system right you know; so various kinds of configuration can be thought over so that is the basic principle.

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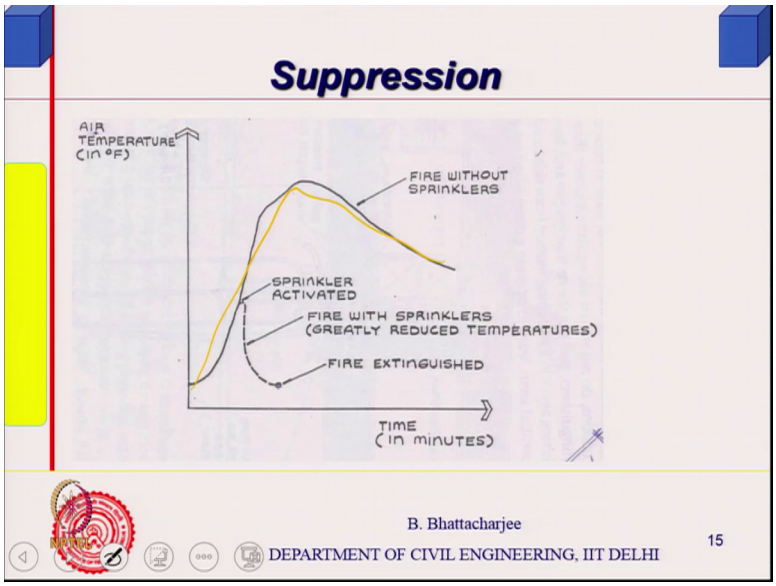

So, I think this is what we will stop at this point just only one point, I would like to mention, that if you suppress it early temperature rise could not occur damages will be less. So, we stop at this point.