Fire Protection, Services and Maintenance Management of Building
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Lecture – 12
Fire Safety: Escape and Refuge

So, continuing from where we stop.

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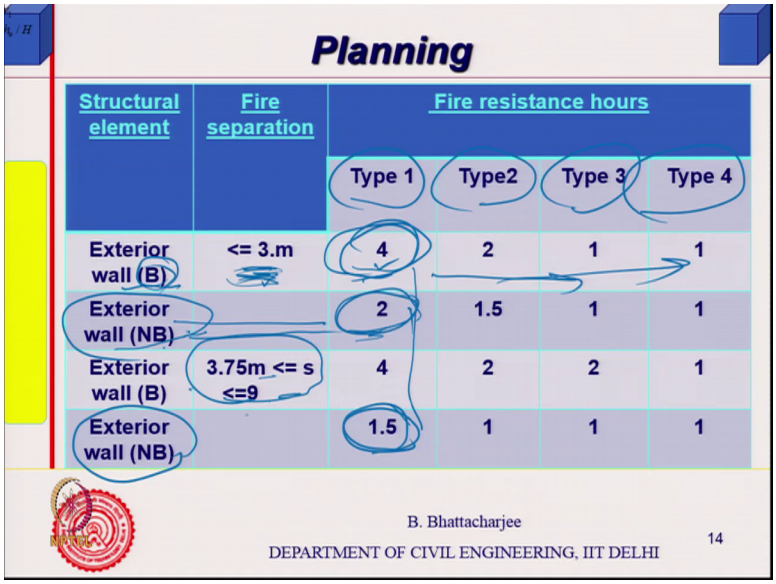

National building code gives you fire separation values. I have just picked up a portion of the national building code once. fFor example, if it is structural element, if it is structural element of wall and its load bearing, right, its load bearing B stands for load bearing, the minimum fire separation should be you know 3 meters; 3 meters, if the minimum fire separation, if the sorry not minimum. If the fire separation is less than 3 meters or equals to 3 meters, you need for type 1 construction 4 hours of fire rating.

So, what it does is it defines type 1, type 2, type 3, type 4 constructions; 4 types of constructions are defined: type 1, type 2, type 3, type 4, then its specifies where you should be using only type 1 specifies where you can use type 1, type 2 or type up to type 4. So, you can see that type 1 is that kind of construction where fire resistance is highest fire resistance reduces descending manner along this direction, right.

And this is load bearing wall it will have higher fire resistance, exterior wall will have higher values, and you know interior walls might be having less. If the fire separation is less you need higher fire resistance, for example, if the fire, you know is fire separation is greater than 3.75, you can reduce down from 2 to 1.5. So, if the fire separation is less, fire resistances required is high to qualify as type 1 construction.

So, type 1 construction, for example, would if your exterior wall non load bearing, it will require 1.5 hours of fire resistance to qualify as type 1, while exterior non bearing non load bearing wall would require 2 hours of fire resistance to quantify as qualify as type 1 also fire their separation goes onto it. So, it classifies national building code classifies construction into 4 classes 1, 2, 3, 4, one is the one which has higher fire resistance, right, it will have higher fire resistance for all cases, it will have compared to 2 3 4 that is one fire is.

And if your fire separation is less then also you need higher fire resistances. So, type 1, type 2, type 3 and 4 are classified based on fire resistance as well as fire separation and whether it is a structurally load bearing or non load bearing for a load bearing wall you will require more fire resistance hours in order to qualify as type 1, while same one you know everything else remaining same type 2 requires only 2 hours fire resistance when it is non load bearing because tough structural safety issue is concerned.

So, type 1, type 2, type 3. So, it says that where you can have type 1 construction only you cannot go to type 2, it also says where you can have as well type 4 constructions. For example, a boundary wall nobody, we will you know periphery boundary wall nobody it is it you will nobody will bother about it because its stability is also not much of an issue. So, you might have actually you know type 4 construction first, it does not matter; it does not matter while if it is a wall load bearing brick wall and next building is 3 meters and you want to ensure that it should have type 1 construction, then its fire rating must be 4 hours. So, that is what it said.

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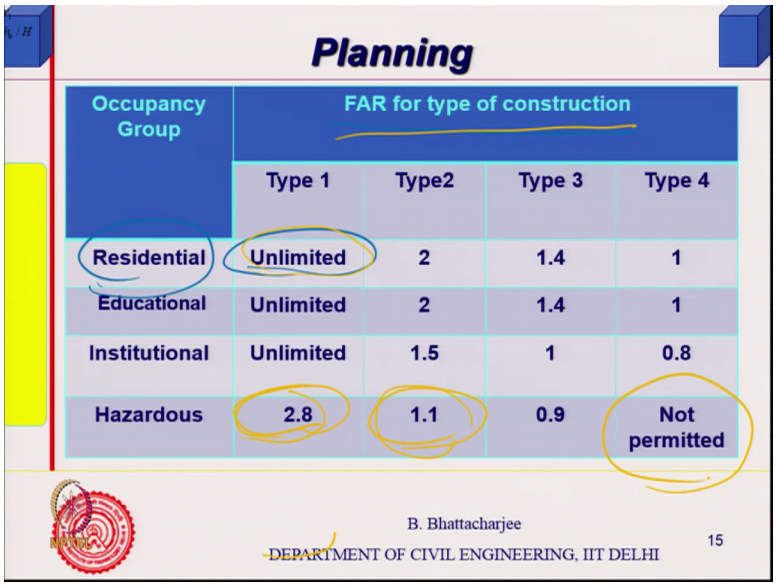

Now, based on this; what is done? It gives you a floor area ratio you know. So, for example, occupancy group residential it says if it is type 1 construction, it does not put a restriction on far, it does not put a restriction on far, it does not put a restriction on far, it does not put a restriction on far only from this consideration you know from this consideration while other consideration you will have a far restrictions.

So, far restriction would be restrictions are always the list of you know most stringent of all of them. So, from this point; from construction or supposing you make everything of type 4 hours construction you know, 4 hours fire resistance load bearing fire separation, etcetera you take care. So, residential unlimited; hazardous; it does not want fire to spread, therefore, it keeps it at.

Student: (Refer Time: 05:12).

It is floor area ratio is restrictive 2.8. So, therefore, to floor area ratio restrictions comes from many things, but this aspect is also one of them from the point of view of planning and fire spread. So, just a residential one does not generate fire and if you have 4 hours of fire rating in all of these walls, it will not spread fire as well.

So, its saying that ok; as far as this aspect is concerned fire far is not an issue, but if it is a hazardous building, then this is an issue, you cannot have even type 1 construction. You cannot have more than 2.8 floor area ratio, if it is type 2 construction, it gets reduced

further 1.1. That means, you know you because it can it if you if taller buildings people will also be there dangerous situations should be there. So, it does not allow for that and it does not permit type 4 construction.

So, in hazardous building it does not permit national building code does not permits type 4 construction type 3 if it is, then you cannot cover all the areas right only 90 percent of the area in a single storey building, you can cover right and possibly if it is 2 storey building, you can make only 55 percent of the area covered right 1.1 is resist. And if it is type 1 construction, then floor you know fire resistance is 4 hours fire separation for load bearing wall not more than 3 meters, etcetera etcetera. So, this is what it is.

So, it you know it is another way indirect way of controlling through floor area ratio for various types. So, spread of fire and you know hazard of the fire that is this is an instrument which is used for that purpose. So, these are the aspects which goes in planning these are the aspect goes in planning.

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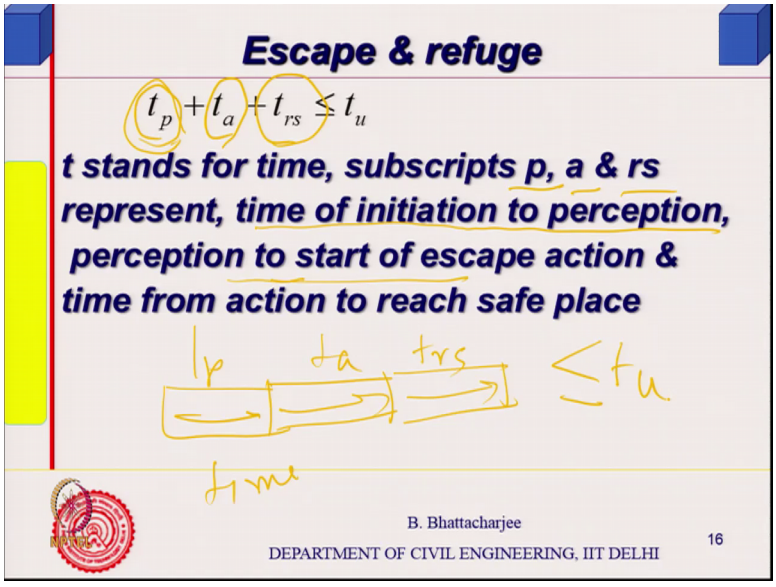

Then next aspect is this is to stop if you can see you know first. So far what we looked into spread of fire and we should select into fire fighting vehicle initiation, and spread of fire, and which is related to you know fire fighting also fire fighting also or fire extinction handling the fire itself. Now escape and refugees other most important aspect as far as fire is concerned escape and refuge.

Now what is, why it is important because people must be safely work waited before, they are in an dangerous condition, they are in a dangerous condition for example, you must have you know if you see there are 3 terms first p, a and rs. So, t p is initiation to perception, this is the time from initiation to perception, what does it mean? Supposing there are no people around, then fire will not be perceived it. There is a fire in a building large building especially, and there are no people near the fire, it will not be perceived it might be perceived certain period later.

But if you have an automatic fire alarm system fire detection and alarm system it will perceive the fire, but this also has a lag time. So, it will say take some time for fire to be perceived that I am calling as t p. Then after that perception to start of escape action once the lamina has bring or you know people have perceived that there is a fire people we start evacuating escaping. So, that action would take certain amount of time. So, start of as perception to start of you know start of escape action.

Then this is the time to reach a safe place. So, it will have something like this, if this is time t p. Then after that there will be t a, first perceived key of first one somebody has perceived you know you came to know that there is a fire, then you start taking action, and then travel to.

Student: (Refer Time: 09:40).

Which is safe right which could be within the building or outside the building depending upon the situation usually safe refuge area for low rise building is outside the building, for high rise building there is no way you have to have something in the building itself this should be less than t u; what is actually unacceptable condition you know unacceptable condition, because it could be fatal, it could be fatal or dangerous. So, that is what it is.

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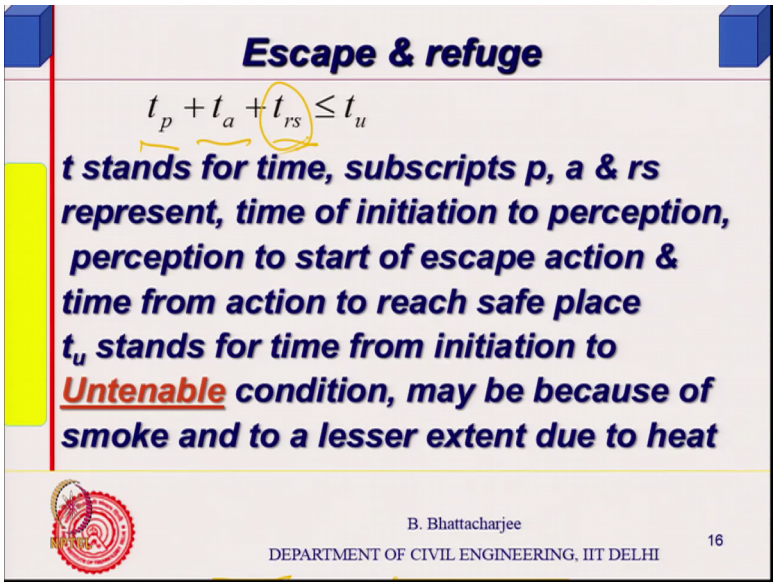

So, e t u stands for initiation to untenable condition and maybe because of smoke or lesser extent due to heat because of smoke itself; smoke is more dangerous, smoke is more dangerous.

So, this is. So, therefore, my escape perception and starting my escape and this is very very important you know escape is very very important, if I should be able to go. So, escape and refuge is required in taller buildings right. So, this is very very important, this is very very important.

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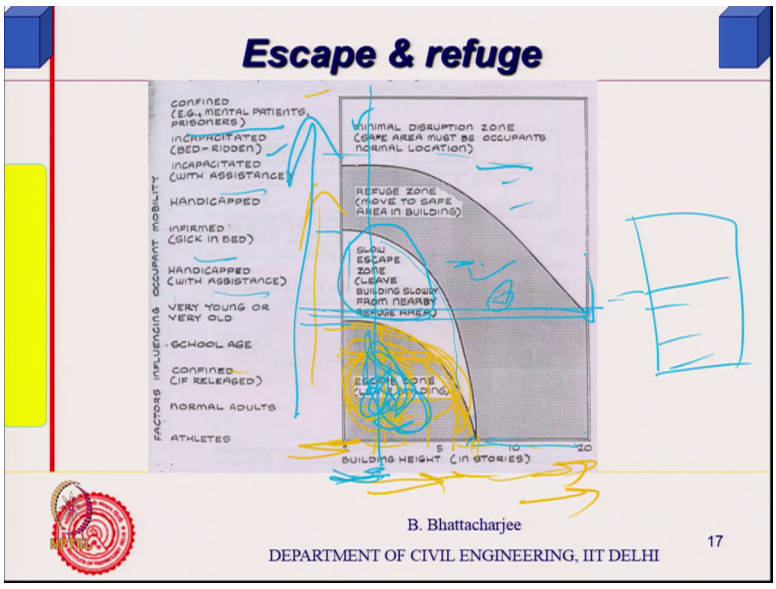

Now, this is this is a diagram available in DVD Gun's book which tells you that as the storey height increases on this axis. You have agility of people occupants you know agility how agile they are this is athletes and this is confined bedridden people. Now, this is height of the building this height of the building this height of the building. So, as the storey height increases, you see this is escape zone means agile people athlete to school aged children they can escape.

Student: (Refer Time: 11:33).

Up to 7 storey building up to 7 storey building or 8 7 you know 7 and 8 storey building somewhere around that leave the building on their own without any assistance, they can just leave you easily single storey building you see a fire you straight over run away and athlete will run away even up to 4-5 storey building.

Now, this is the normal adults they can run away up to five storey building may be confined if released you know confined people means jail they are confined, but if released they can run away right. So, then generally confined, but they can run away school age people up to 2 storey, they can go away this people can go possibly up to 3 storey. So, this is escape zone you know, I rather put it in some other color, this is escape zone this is escape zone this is escape zone right escape zone.

Now, people very young something like 3 years 4 years who cannot take decision on their own or very old people who are not able to move so fast to possibly somewhat differently abled people right, and stuck to bed single storey building up to 2 storey building they must still be able to get out on their own. But as the storey height increases well they just cannot leave on their own, but they can leave with longer period of time.

So, this is slow escape zone leave the building slowly from nearby building, but beyond 7 storey building its difficult for those people to even get out and leave the building on their own or leave to go to a safe place this is must have if the storey height increases beyond 7 or 8 storey you must provide and refuge zone within the building, because it would be almost impossible to buy anybody to get to a safer place outside the building from such building. So, it could be another building next door nearest building or it could be escape zone within the building. So, what you do the code actually national building code provides you this kind of guidelines up to 8 storey building up to 8 storey building you must have a safe refuge zone somewhere.

So, you actually do vertical zoning of the building and if this goes well with other kind for them lifts also for vertical transportation you do zoning 8 storey for water supply also you have to do vertical zoning. Otherwise if there is a tank at the top and it comes you know is sixty or twenty storey building same tank supplying water to the ground well the pressure will be so high, right.

So, therefore, you do zoning actually right. So, vertical zoning; so, refuge zone for up to 8 storey or above, you need refuse zone move to the safe place within the building itself and there should be some place where you do not expect much disruption at all. So, there you do what is called compartmentation make compartments such compartments are one where fire will not spread from one compartment to the.

Student: Another.

Another; so it is a horizontal zoning each is a compartment only thing you can do is maybe if there is a fire you provide all protection from fire, you know, if we like kind of automatic sprinkler system alarm system, everything, it should detect automatic detection system and alarm that may not play there play somewhere else and it should extinguish it itself there and it should not spread because it will have all fire rated walls.

So, you cannot touch this, for example, hospital intensive care unit, you cannot expect people to move out of that. So, it should be not 100; 150 percent protected should have an automatic system of all kinds alarm system which will ring somewhere else right at the same time, it should not catch get fire from next compartment. So, compartmentation is done limited compartmentation is done in such some in places.

So, it normal occupant zone safe area must be occupants normal location hundred percent safe or mentally retarded patients who cannot move take decisions on with or need not people there all the time at that places such places should be you know. So, this is basically confined mental patients prisoners who are tied up let us say are not able to go out right such places and people who are bedridden people who cannot move incapacitated old people or otherwise not able to move.

So, these are the people for them you need several. So, you can see as your agility of the people reduces you know you have to height at lower height also you may have to provide all this and as agility of people show up to 20 storey building; you know, if you

can see that 20 beyond you know for very young or old people even in twenty storey building, you cannot expect people to move out. So, that kind of escape and refuge strategy should be adopted in buildings and that is why the fatality comes, because of those kind of scenario both now internationally also we are hearing such kind of fatalities there somewhere the lack of planning, but something is lacking otherwise this could not have happened so minimum.

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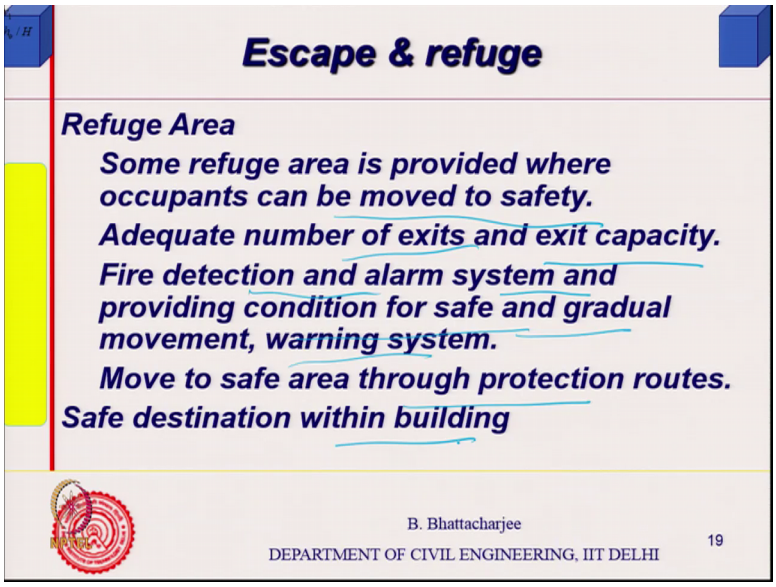

So, each zone again, I am defining minimum disruption zone where it will they will remain they are safe area must be occupied normal location prevent heat intrusion with fire rated construction prevents smoke penetration with smoke barriers, and pressurization will do some of these examples manual or automatic suppression systems smoke venting all this kind of things should be minimal in zone, that is top zone. That is least you know minimum disruption zone refuge area is next zone which have some refuge areas provided where occupants can be moved safely within the building.

Then you must have adequate number of exits which will lead to that place and right kind of capacity number as well as capacity of exit fire detection alarm system. So, that people can move and providing condition for safe and gradual movement and there should be warning system. Move to safe area through protected routes safe destination within the building itself that is the next case.

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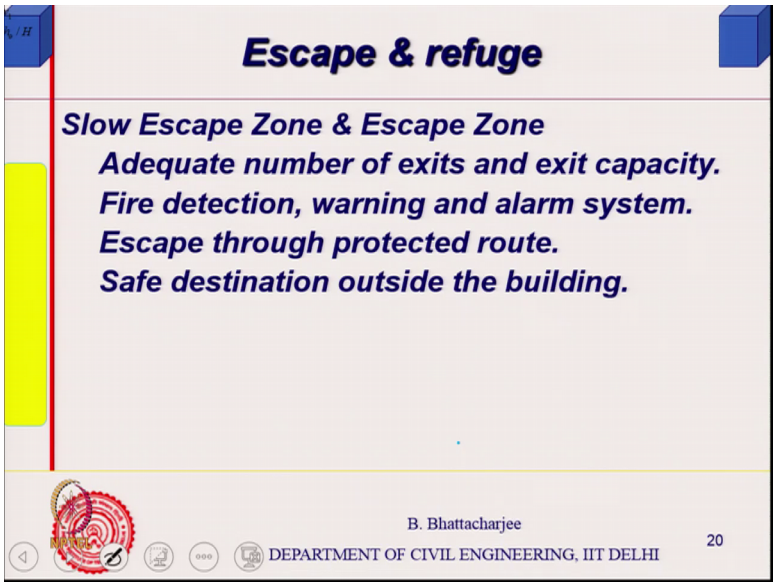

And next one slow escape zone adequate number of exits that is the requirement; I must have adequate number of exists and exit capacity. So, that people can slowly move out fire detection warning and alarm system escape through the protected route and safe destination may be outside the building itself.

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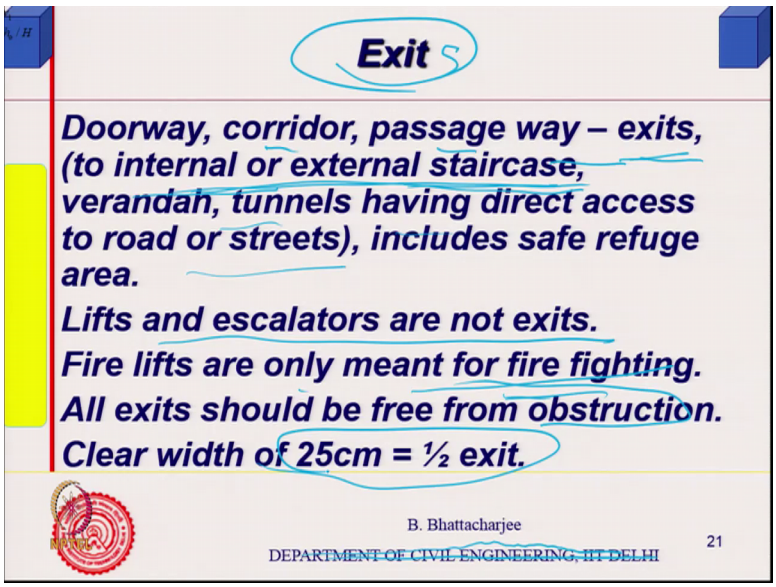

And this last one obviously requires least you know where athletes etcetera they can move out on their own, but you must provide adequate exists and exit to its. So, this is important exits are very important and doorway corridor passage way these are exits

right. For example, this lecture have we have only we have 2 exits: one here one there many other laboratories you will find there is one exit.

It is not a very good thing to have right, you should have at least alternative exits, but this place chances of fire is relatively less some of the lab laboratories, where you are you know one is doing in the chemistry type of thing there can be burners some reactions are going on which can exothermic reaction which can generate heat. So, those are the ones.

So, essentially you should have escape routes more than one alternative routes which usually available to people all the time. So, these are the extra internal or external, you know exits, they lead to internal or external they are staircases verandah tunnels having direct access to the roads or streets. So, these are the exit exits actually doorways corridor passage way these are actually exits which will lead to internal or external staircases through which you can get out go to the next one.

Lifts are and escalators are not exits they are not they are not and you will find that notice in almost all the lifts that do not use the lift during fire, because you know lift shaft acts almost like smoke chimneys you know. So, hot gases because of buoyancy convection effect it will tend to move upward it will tend to move upward and it gets filled with smoke. There are something called fire lifts specific on within fire rated walls not used ordinarily, but only firemen can use there are called fire lifts.

So, these are not to be used by occupants only the meant for firefighting people. And all exits should be free from obstruction that is very very important clear width you define half exit width there are some change in the code, but basic concepts remain same because new code has made some kind of changes related to this.

So, 25 centimeter earlier used to be called as half exit to it fifty centimeter is one exist, right, but another way would be just tell if the dimension state where the minimum dimension of the exit should be this much this is based actually on ergonomics. This is based actually on ergonomics whether I think I do not have diagram, but it is actually based on ergonomics.

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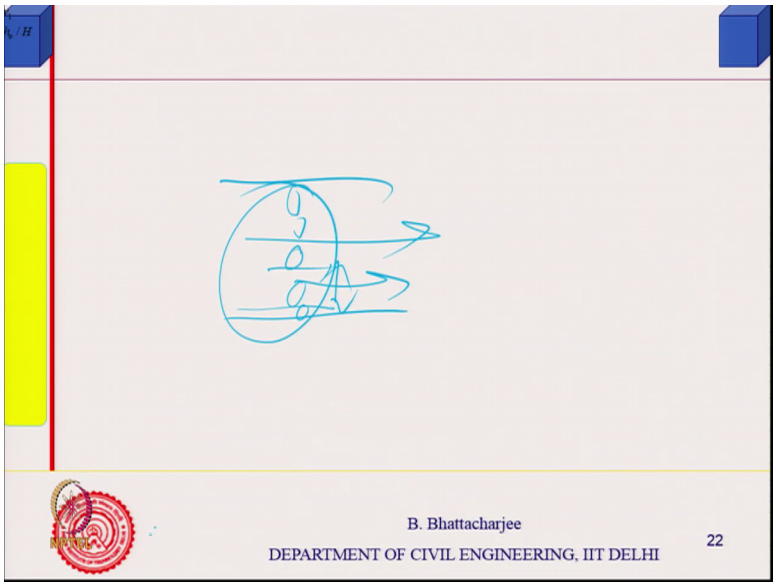

For example, if this is my width you know this is the width. So, space required for a single person to the space required for a single person or if you expect wheelchair bound person, then in a ramp; how much is the spacing of a wheelchair.

So, how many person can actually move through this that is based on ergonomics and this guideline comes from there, this guideline comes from there. And if it is wheelchair bound people then it requires more you know and in a ramp or something of that kind or even in a corridor if it is normal adult then this record is relatively less compared to wheelchair, but there is a number is you know; it is given.

So, ideas from the national building code which was there in the previous one; previous one right, it is something like this, but this is the basis suppose you know; total occupant per unit exit width.

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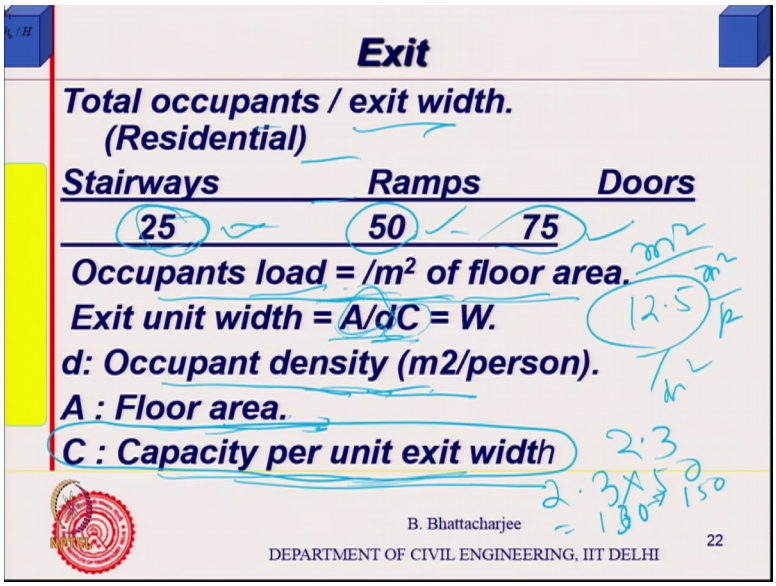

So, if you have 25; 50 centimeter is a one exit with half is 25, you cannot have less than like you cannot have 60 centimeter if we can consider only 50. So, it is 50; maximum 70; you know 75 half you can take 75 centimeter or it should be in terms of you know units of 50 centimeter basically right multiples of 50 centimeters. Now occupant load is given in the code in terms of meter square.

Student: Meter square.

Per meter square floor area; for example, for residential building 12.5 persons per meter square while in assembly it will be much less. So, occupant load is how many persons per meter square you want to calculate out the number of persons. So, if it is a classroom or academic you know like institutional building, then the number would be much less per unit area. So, number of people you want to move one people to move around move go to the exit would be much higher.

So, occupant load is defined in this manner for example, 12.5 persons per meter square, it is for residential floor area. So, if you know the floor area, you can calculate our total number of people there for whom we should provide the exit. So, unit exit width is given by a these occupant density right floor area capacity per unit exit width.

So, occupant density is what you get occupant load that is what you get meter square per person would be one over that one over that right one over that one over that d meter

square per person. So, it is 12.5 person per meter square meter square per person is one over that you can find out and C is the capacity per unit exit with does give the guideline given in the code how many people should can suppose, you have 50 people how much exit with 3 unit right or 100 people for a particular area because supposing, this is the room the just outside this is the exit the corridor.

Now, this corridor; if it there is another room ending on to that corridor the total population that would be using that corridor will be sum total of the people here and you know how many persons would be here, because you know the floor area. So, if you know the occupant load can be calculated or occupant density you can find out meter square per person therefore, you know the floor area is known. So, floor area. So, if you know a is the floor area divided by meter square per person right and c is the capacity of unit exit to it.

So, there should be in number of people actually that has to be number of people number of people this should be A is the area d is the meter square per person. So, A by d will give me what person, A is the meter square divided by this is meter square per person. So, divided by meter square per person so that will give me the number of persons for whom I should provide the exit and for A C is the capacity per unit exit to it.

So, if I know for a given type of occupancy if I know how much is a you know type of staircase let us say is 25; 25 person per unit exit width, right for you know residential given occupants per unit exit width is given 54 ramps 75 for doors. So, these guidelines are given based on ergonomics as I said how many people can move around.

So, if it is 25. So, I have got persons for whom I should provide divided by 25 with that number of exit width and each exit width is 50 centimeter supposing you get 2.3 exit width, I am just saying hypothetically. So, it will be 2.3 into 50 centimeter which would make 160, you know, 130 you know 130 which means that you will actually provide 150; you cannot provide anything you know 25 multiple of 25 at least. So, 150 that is what you will be providing is this idea clear A. These are given in A is the floor area that you know occupant load per meter square of floor area that is given in the code in tabular form well for example, it is 12.5 for residential for assembly etcetera it will be much lower occupant per unit area.

So, if you one over that would give you occupant density if you know the occupant density area divided by occupant density will give you number of occupant in unit exit width how many occupant can pass through that is given in the code again in tabular. So, this is for residential I picked up one row of the table which says staircase 25 people ramps 50 people and doors 75 people.

So, if you divide by that you get the how many unit of exit width you need multiplied by fifty that many exit width centimeter that many centimeter you will get it that many centimeters increase it to the nearest multiple of 25 that many sometimes the guidelines have given straightway in meters or that kind of thing depending upon the situation. So, this is A, but idea is like this basic idea behind this is this. So, this is how it should determine exit width minimal, right and maximum distance traveled is also given.

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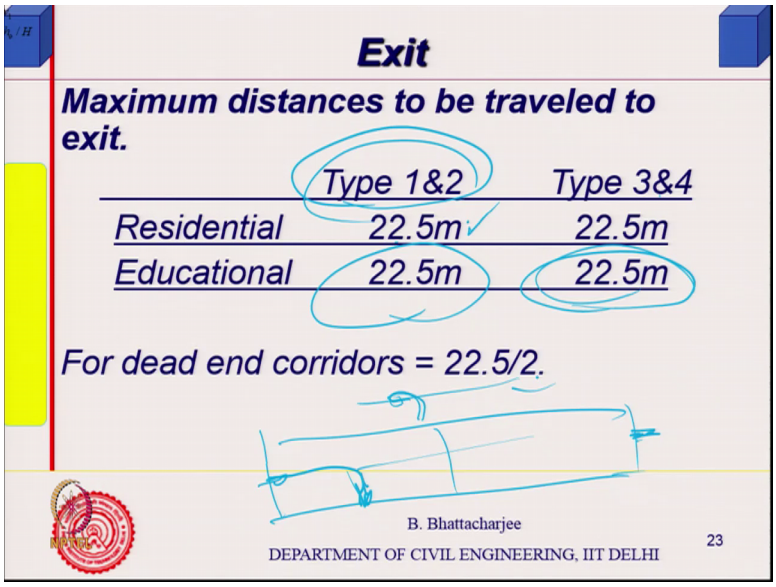

So, final exit to get out of this space is also given; so nothing more than 22.5 meter. Now if I have a long building let us say long building long building blocks 3 you know 3-4 storey blocks, then I must have a; if I have a staircase here and if I have some rooms here the extreme point, I should consider my traveled distance to this place should not be more than 22.5 meters.

Now, if I have only 2 staircase here, 1 here, 1 there, it might be more. So, I provide external staircases like helical staircases helical staircases. So, this is that do you know educational also 22.5 meters, it also is given by type 1 and type 2 construction type 2.

You know, in this case, it is all same some other occupancies, it could be different since this is more fire resistant more stringent sort of situation this will have less distance required I mean more distance required this will have somewhat less because type 3 or 4.

So, this is the other part of planning you know. So, for dead end corridors minimum this should be 22.5. So, you should have a staircase from a dead end at about 11.25 meters, right, 11.25 meters. So, if you are extending your building for example, in IIT, you would have seen blocks you will finds helical staircases, this is the purpose and the blocks if you have seen block 2, 3, 4, etcetera, there is an extension beyond the staircase this came later on.

So, they could maximum keep the length you know from the extreme end corner of the room from there, it should be 11.25, because that is dead end, one cannot go. One can also where our transportation people you know transportation labs are there in second floor that is a dead end. So, from there you know the staircase should not be more than 11.25. So, that is the idea right.