**Transportation Engineering II**
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**Lecture - 30**
**Airport Obstructions**

Dear students, we are back with the lecture series on course materials of transportation engineering 2. In the previous lecture we discussed about the various controls which are needed during navigation and then we have also discussed about the factors which we consider while selecting an airport site as well as while deciding about the size of an airport. In continuation of the same, another feature which is of importance is to look at the type of the development which is taking place on the sites of an airport. We have seen during the consideration of site selection that it has its significance. In the light of that in today's lecture we will be discussing about the airport obstructions. The airport obstructions will be discussed under the following headings: the airport obstructions, the imaginary surfaces, the height of objects in the approach zone and the turning zones.

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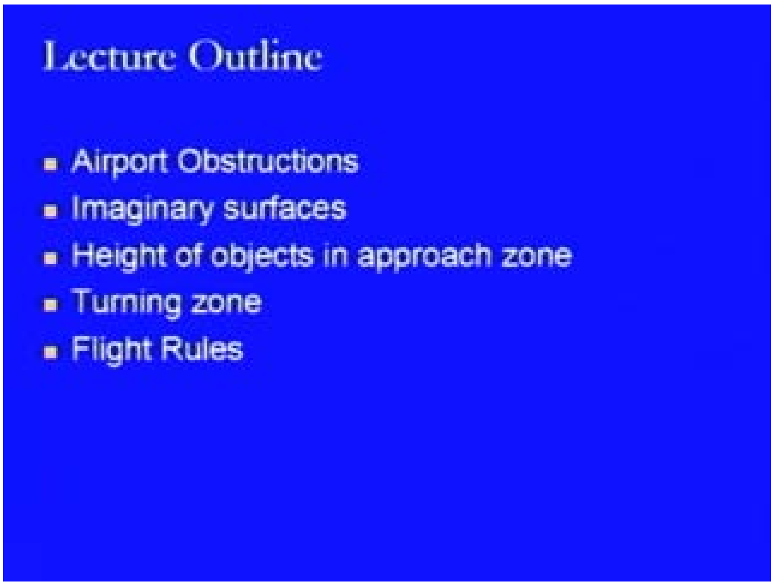


Apart from these we will be also looking, we will be also discussing about the various types of the flight rules because we have seen in the now previous lecture that it also has its effect in terms of the airport capacity. The flight rules which we have discussed there was the instrumentation instrument flight rules and the visual flight rules and we will like to see how they are different from each other and what they are. So we will be starting with the airport obstructions now. These airport obstructions basically are those obstructions which are provided on the sites of the airports which are related to the type of the development which has taken place on the sites of the airport and are related mostly with not only with the nature of the development but also with the height of that development.

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On the basis of that they can be divided into two categories which are imaginary surfaces and objects with actual heights. So we will be discussing the two cases that is imaginary surfaces where we assume that there can be any surface which may come up to this level and therefore we have just marked some surfaces on any airport by which the aircrafts should move above of that particular surface only and if it is coming below of that surface then it may be hazardous whereas the other cases with the actual conditions where the type of the development is going in the vertical direction then what is the height of that development and what can be the height in the light of the operation of the aircrafts on any airport.

So we will be starting now with the imaginary surfaces and then we will be going to the surfaces where the objects are provided with the actual heights. In the case of imaginary surfaces again there are different types of surfaces which we will be looking at and these imaginary surfaces are basically established surfaces in relation to airport and to each runway above which no obstruction should project.

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That is what it tries to speak out that for each and every runway on which the aircraft is going to land or from where it is going to take off with respect to that one then we start looking at some of the imaginary locations in space which are assumed to be surfaces and the aircraft follows those surfaces so that there is no obstruction projecting within that much area of navigation, and this size of imaginary surface depends upon the category of each runway and the type of approach planned for that runway. So these are the factors basically the creating an effect on what type of imaginary surface of what magnitude of that imaginary surface is to be provided or assumed or any of the runway strips on any airport. So that is going to be controlled by the runway strip itself, what category of runway strip is being provided and then with respect to that the aircrafts which are going to use that runway on the basis of that what type of approach is to be planned.

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Now in this case the very first one is that we have to look at the approach surfaces then another surface is the conical surface, then there is a horizontal surface, then there is a take off climb surface and transitional surface. So we will be looking at all these types of imaginary surfaces and how they are provided, what are the uses. This is one big diagram which is trying to show the imaginary surfaces. Here at the center of this one with this blue area that is being depicted by A. This A is basically the primary surface, this primary surface means this is we can assume that this is the runway strip being provided on any airport and alongside this runway strip or the primary area we have shown the marking this is a parallel line going on this side and a parallel line going on this side which probably shows the shoulder conditions and the total width of the runway strip being provided at this location. Out of this one then slowly and slowly the rest of the surfaces keep on coming out. So in the direction of this runway strip we will be having this location, that is, D and this D is nothing but this is the approach or departure surface. So this is approach or departure or clearance surface being provided here that is this one.

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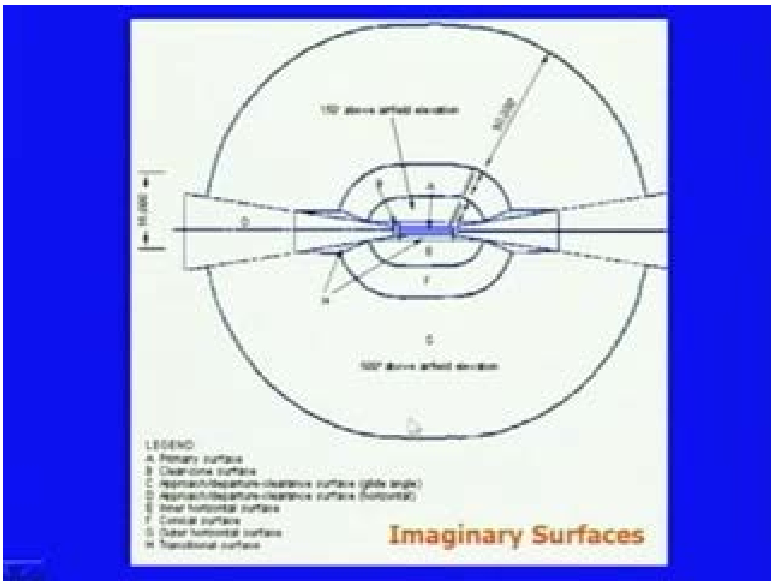


This is horizontal and we also have another one which is on this location which is basically at an angle which is coming from the low level of this runway to the level of this one. So it is at an angle reaching up to this level and then it becomes horizontal. Similarly, if we look at the other surfaces like there is an E surface being provided on the side of the runway strip and this E surface is known as the inner horizontal surface being provided. Then similarly, this F. F is the conical surface means it's a truncated cone. This is a horizontal surface and then again we will be having a horizontal surface afterwards and in between these surfaces the conical surface it is trying to expand in the outward direction.

Then we have the surfaces like a surface being provided here this one and the surface being provided here. These are H, this is shown by H and these surfaces are the transition surfaces means if they are trying to provide a transition from one surface to the another type of a surface and in between there is a B being shown. This B is nothing but it is known as a clear zone which is again at the horizontal level only with respect to this runway strip and it is an extension of this runway strip. So the runway strip basically remains of this much size along with the airways and the shoulders being provided on the two sides of this runway strip. This is runway strip, this is white shoulder, this is white shoulder, this is clear way on this side and the clear way on the other side.

When we look at this horizontal surface this horizontal surface is 150 feet above the airfield elevation where there is another G surface which is the outer horizontal surface. This is outer horizontal surface after the conical surface. This is at a height of 500 feet above the elevation of this airfield. Elevation of this airfield means the elevation of the runway strip and then as we go further away what we reach is that the distance which we have gone away up to in this direction is of 90000 feet. That is how we have gone away. This is the circular section will be at that much distance.

Similarly in this side where we are looking at this approach surface which is trapezoidal in shape here at this end it is 16000 feet wider at this particular location. So all these surfaces we will be discussing one by one just so as to give you an idea that how the various surfaces are and how they are coming out so the close surface with respect to this runway strip only and in between there is a transition surface and horizontal and gliding approach surface. Then there is an inner horizontal surface and there is an outer horizontal surface in between there is of these two there is a conical surface. So we will be discussing all these type of surfaces. We start with the approach surface .the approach surface is provided at the end of the landing side of runway, that is what we have seen.

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It is trapezoidal in shape, it diverges away with upgrade as we are going upwards away from the runway strip then it is diverging outwards. So that is how it is increasing in size. It is longitudinally centered on the extended center line of the runway. So it is with respect to the center line of the runway, it is symmetrical in location. This is another diagram which tries to show you the same of the thing.

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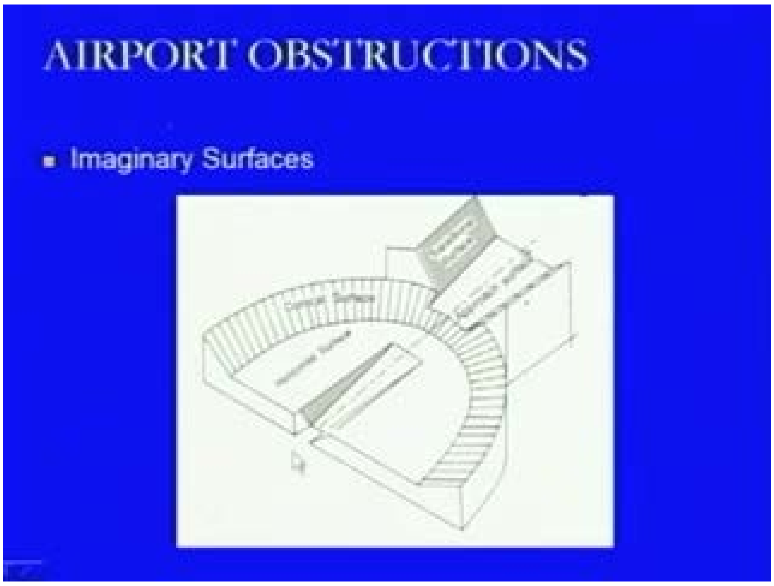


Here the runway strip is being provided and at this location if we go in this direction the runway strip is provided. So that is the level of the runway strip. Out of this after this one there is a clear way and then from clear way there is a gliding surface which is going up and while it is going up it is expanding. So this is a divergence it is this much wider here but this is this much wide at this location. So it is expanding outwards and then once it goes up to the certain level it becomes horizontal. So that is the type of the surface which is provided and this is what is the approach surface. The side of this approach surface this gliding angle as we can see comes to this level after which the horizontal surface will come and then after some distance again there will be a conical surface and then again it will become horizontal. So these things also you can be visualizing very easily in this diagram where it is shown in the 3D form.

Then further in the case of this approach surfaces the some of the specifications have be laid down here where this is length of horizontal projection of surface in meters and longitudinal upgrade in percent and these are provided for the two conditions that is I L S condition and non I L S condition, that is, the instrument lending system condition and non instrument lending system condition means the lending is being controlled either by the instruments or it is not being controlled by the instruments, it is a simple visual condition. In these cases what are the values.

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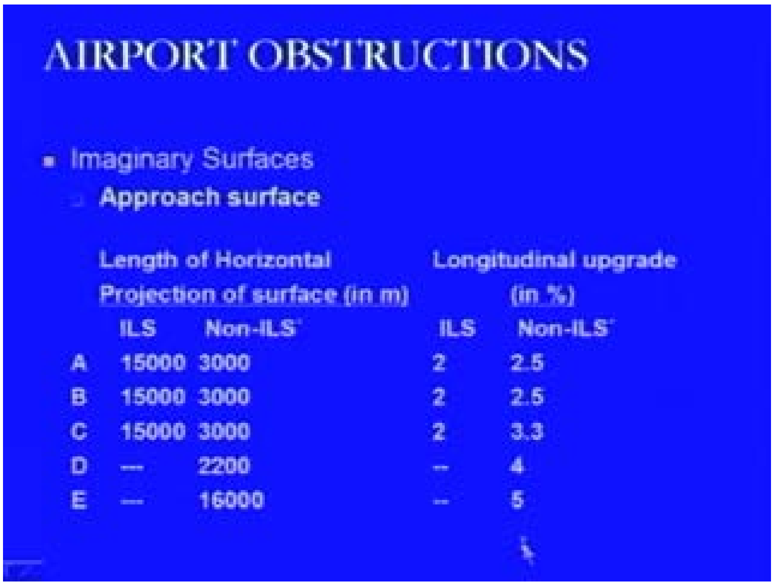


So it depends on the type of the airport for with respect to the category of the airport these values are. For A is it is 15000 for I L S and 3000 for non I L S whereas the upgrade is 2 percent or 2.5 percent respectively for the two cases. Then for B it is again remains the same value throughout, then for C again there is a the same value in the case of length of horizontal projection but in the case of longitudinal upgrade it is 2 percent and 3.3 percent respectively for I L S, non I L S condition. Then for category D for non I L S condition it is being defined as 2200 meters whereas for the longitudinal upgrade it is 4 percent and for E it is 16000 and 5 percent respectively. Further we have the another thing, that is, the width near the end of the runway and the divergence of sides in percent, that is, what we have seen at the end of the runway the width of this approach surface remains the same as equal to the width of the runway but then after that as it diverges then how it is diverging in how much percent it is diverging that is we will be looking.

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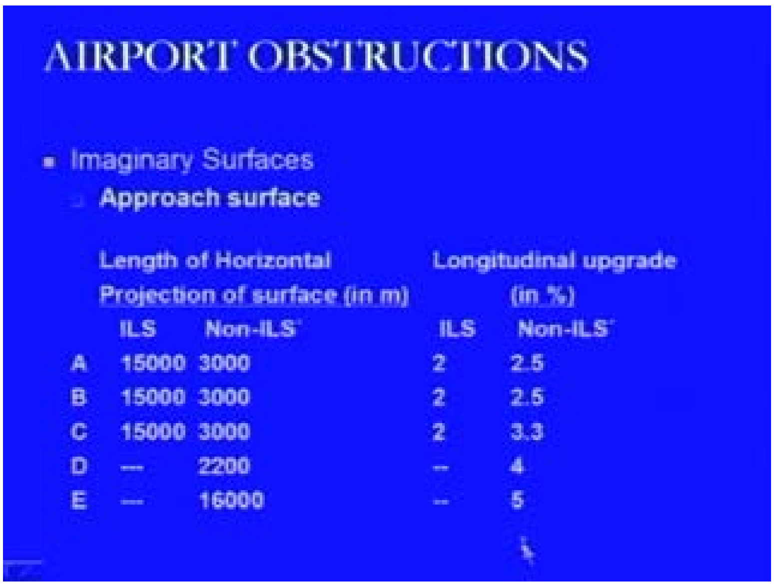

The width is in the I L S condition for A category of airport it is 300 and 150 meters for non I L S and it is diverging at a 15 percent rate in I L S and 10 percent rate in non I L S condition. In case of B again it remains the same as we have seen previously also it was same for C also this remains the same. For D it is 80 for non I L S and 10 percent for divergence value and for E type of airport it is 60 for non I L S and 10 for the divergence of sites. So this is how the values are changing for the approach surfaces. The another type surface which is again another imaginary surface used during the flight of an aircraft is the takeoff climb surface.

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This is similar to the approach surface and it is provided at the take off end of the runway, that is, sometimes in the case of the runway we use the two ends for specific uses like one end is used for landing and another end is used for taking off. So it means in this case if the at that where the taking off is going on then we provide the takeoff climb surface and this surface also is trapezoidal in shape and there are certain specifications with respect to the type of the airports A, B, C, D and E.

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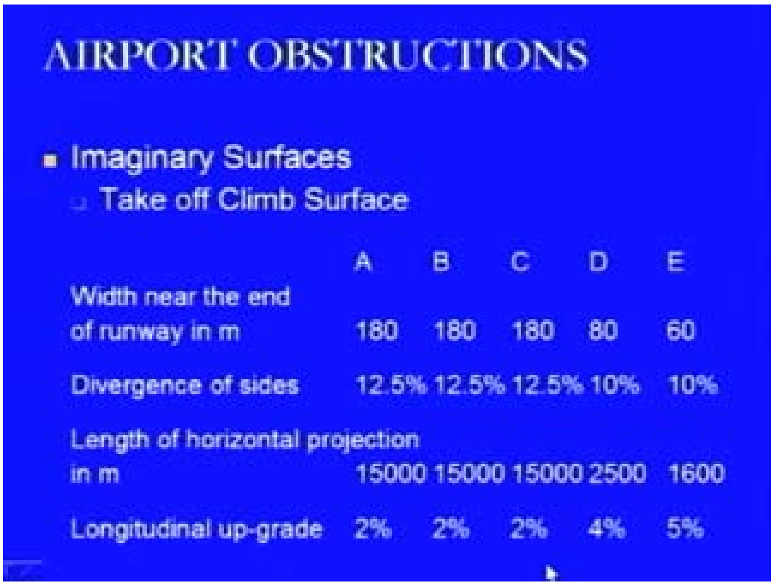


It is the width near the end of the runway in meters. It is 180 meters up to C and 80 meters for D and 60 for E categories. Then divergence of sides as we have seen previously it is 12.5 percent here in the case of A, B and C and 10 percent for D and E category. Length of horizontal projection in meters, it is 15000 meters up to C and 2500 meters for D and 1600 meters for E and longitudinal upgrade is 2 percent up to C and it is 4 percent for D and 5 percent for E. So that is how the dimensions of this take off climb surface which is again trapezoidal in shape are fixed and with respect to these particular upgrade rates and the length in which it is moving. So if it is if we assume it like this that this is the size of 180 meters at this level and we are going away like this, in this direction. Then if we move 15000 meters then out of 15000 meters if we keep on going at a rate of 2 percent means or all these 15000 for every 1000 meters we are increasing 20 meters in height. So if this is 15000 meters. It means 2 percent of this will be 300 meters. So by the end of 15000 meters it will raise to 300 meters and then at that location because it is going in the outward direction diverging so the size will be defined again on the basis of this value, that is, 12.5 percent for every hundred it becomes wider by 12.5 meters.

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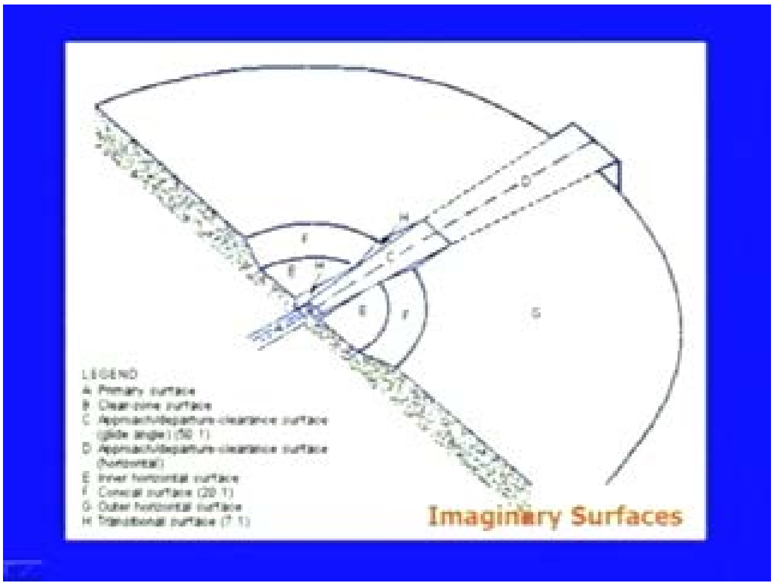


So this is another diagram where we are trying to show the same sort of the conditions in the composite form that is how it is happening that this is the airport runway strip, this is the clear way, then it is increasing in dimensions like this. So that is a variation trapezoid form going upward also as well as it becoming more wider at this side as we go away. So this is 15000 meters on horizontal, then at this point if we take the height like being shown here then it will be 300 meters and then at 12.5 percent rate it is coming outwards in this direction and in this direction. Then similarly we can see the elevations being shown here. This is going up or going up like this, then it becomes horizontal. So this is a transition phase which we can see at this location small one or we can see a bigger transition phase area facing us this one H and then after this again it becomes conical, so it is raising we can see the height at this side and then it becomes horizontal. So this is a conical surface this is a horizontal surface.

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Now we look at the horizontal surface this horizontal surface extends from the upper edge of the transition surface that is what we have seen and it ends at the lower or inner circular edge of the conical surface because just after the horizontal surface if we look at the initial horizontal surface then at the end of this one the conical surface is starting. The height of outer horizontal surface extends from 150 meter above the ARP elevation; this is the airport reference point ARP. For every airport there is a reference point with respect to which the elevations are taken and that is known as ARP elevation. So with respect to this it is 150 meters above and it extends to 9900 meter for the airports with the length of runway between 900 meters and 1500 meters whereas it extends to 15000 meters. It is one zero coming extra. This is not this way and this is for airports having runway length more than 1500 meters above the elevation of airport reference point.

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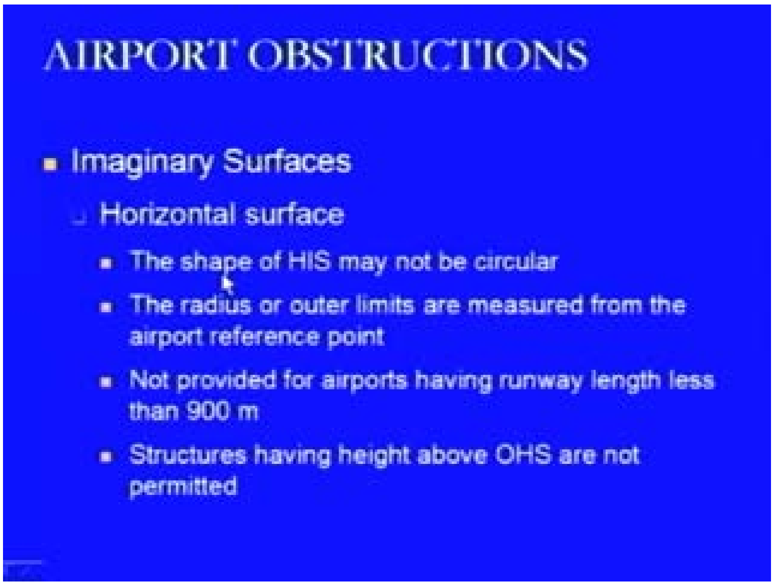


Then in the case of the same horizontal surfaces this shape of this horizontal imaginary surface that is HIS it is may or may not be circular, that is, the shape because it is a transition between the trapezoid shape being provided by the climb up surface or by the surface and the conical surface. The radius of outer limits are measured from the airport reference point that is again ARP and these are not provided for airports having runway lengths which were it is less than 900 meters and the structures having height above OHS are not permitted that is outer horizontal surface. If there is any structure which is going at the height above than OHS that is outer horizontal surface then those are not allowed.

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Then we come to another imaginary surface that is transition surface. This transition surface again is trapezoidal in shape and it extends along the landing strip and it slopes out upwards and outwards to the in inner side of the that is inner horizontal surface IHS, that is, what again we have seen that we go from the inner horizontal surface to the outer horizontal surface and it is extending in the outward direction and it is going up.

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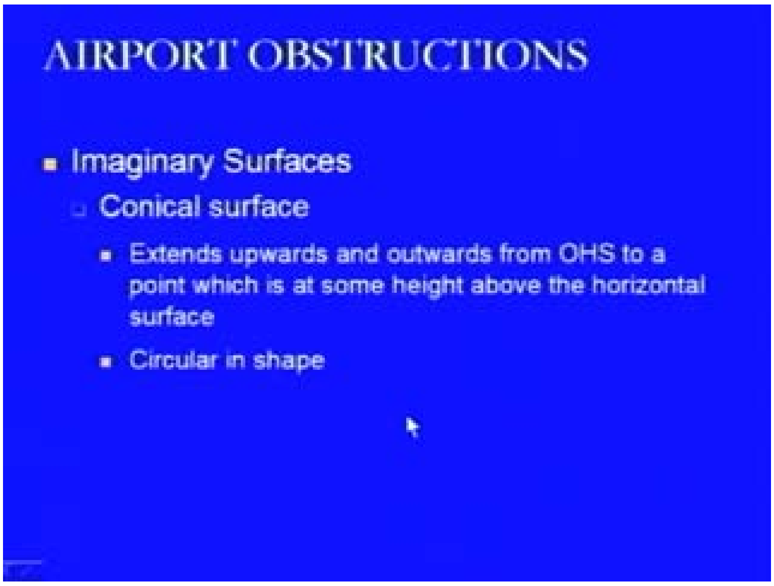


Then there is a conical surface between the inner horizontal surface and outer horizontal surface which is extended in the direction of outer horizontal surface in the outward direction from the inner horizontal surface. So therefore, the height is increasing in this respect and obviously because this is conical surface this is circular in shape. Here some of the values have been shown in terms of by side slope in percent for the transitional surface for the conical surface the height of outer or the

upper circular edge of the conical surface above horizontal surface in meters and the radius of inner circular edge conical surface with respect to the airport reference point in meters. So for the category A the values are 14.3, 5.0 that is in percent
100 meters and 4000 meters that is for the first case. Similarly, for the second case that is B the values remain the same and for C there is a change in the value of the height of outer or upper circular edge becomes 100 meters instead of 75 meters instead of 100 meters. Then for D this value is changing and the value becomes 20 as the side slope for the transitional surface though for the conical surface it remains the same.

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Similarly, there is a change at height of outer or circular edge that is 55 meters and the radius of inner circular edge becomes 2500 meters. Then for E the values for the side slopes remains the same as D but here in the case of height of outer or the upper circular edge it becomes 35 meters and for radius of inner circular edge it becomes 2000 meters.

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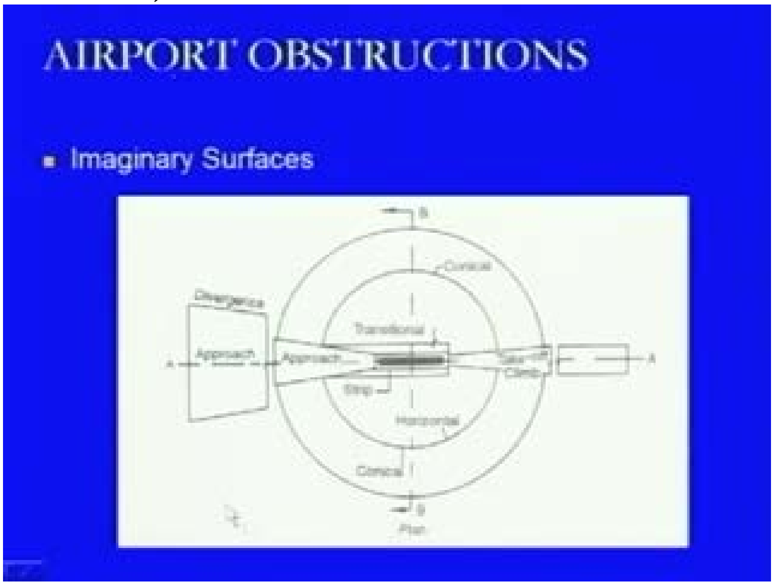


This is another diagram which is trying to show how the values are going away and it has two sections, that is, one section being taken in the longitudinal direction in AA and another section is taken as transverse direction of that that is BB and if you look at the diagram with respect to this one because here we are talking as this is the lending area and this is the takeoff conditions so in this side there is an approach zone and on this side this is take off climb zone. So that is the difference in this case and this landing strip is being shown or take off strip is being shown at the horizontal surface.

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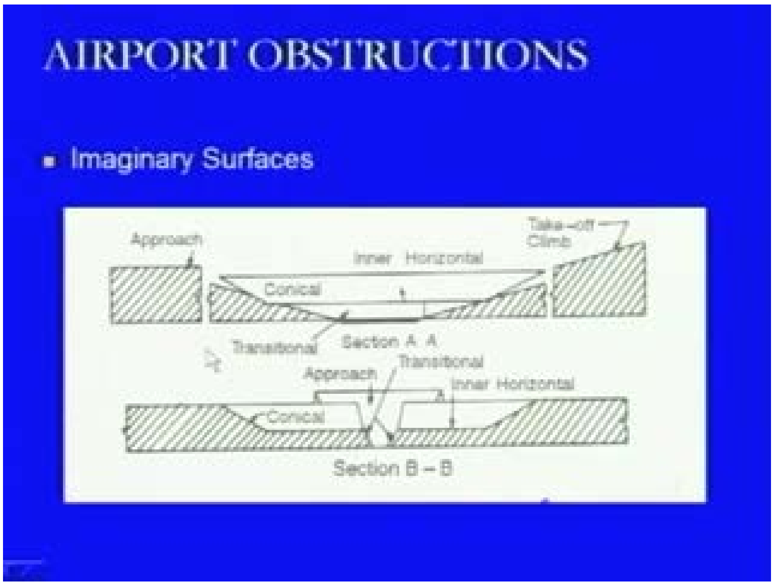


If you look at the sectional view of these, in the case of AA which is along the longitudinal direction of the runway strip. So the runway is at this level, then there is a transition condition like this then it becomes horizontal at this position but it remains little climbing condition here, so this is horizontal surface then there is a conical surface. So the conical surface is also coming at this location too and then there is a takeoff climb surface which is going upwards like this in a trapezoidal form whereas here there is a horizontal approach surface being provided. so that is the sectional view how the elevations are changing as we go away from the runway strip in the outward direction and away from the runway strip. this is another section which is being cut at the 90 degrees of this one we look at that at this point if we are looking at then we will be looking the width of the runway strip so at the bottom we are looking at the width of the runway strip then there is a transition side so this transition side is inclined and therefore we look at this small transition side after that transition side then we have the surfaces like inner horizontal surface and we have the conical surface and then we have the outer horizontal surface.

Then in the case of the approach zone or in the case of the climb of climb up zone we will looking at the certain locations where it is increasing upwards and it is increasing in dimension in the width like this and finally further it increases and becomes much wider and that is what is the overall approach section which we can see like this as shown here. So that is how the elevations in these two directions are changing and this is how the heights keep on varying.

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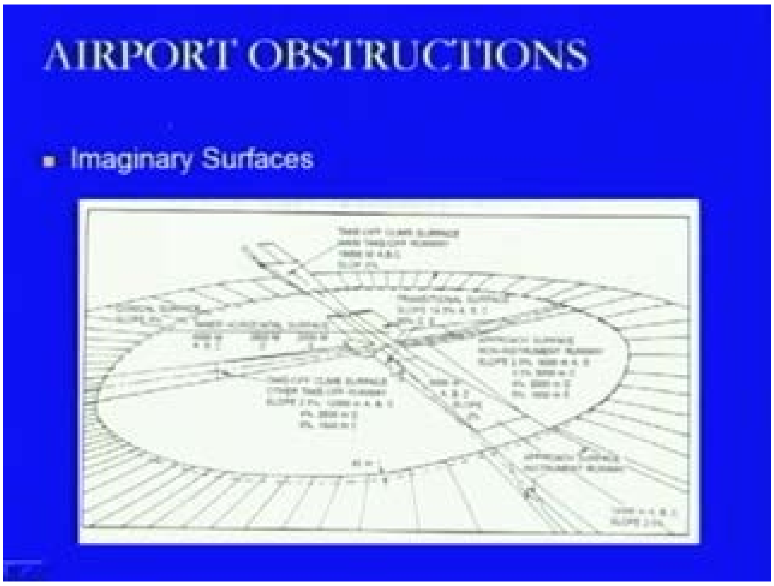


This is the overall view of the same airport that is this is the runway strip being provided and this is how the things are changing if you go this direction, if you go in this direction we can see this is the approach surface instrument condition whereas this is the take off climb condition. So, this is provided like this then there is the transition area being provided at this location being provided here, being provided here or provided here and this is 3000 meters for A B C slope is 2 percent. then this is 45 meter variation in this level, Then slowly and slowly we are moving further, we are this is 12000 meters for A, B and C with the slope of 2.5 percent. That is how it is moving further. This approach surface non instrument runway slope for 2.5 percent or 3000 meters for A B 3.3 percent for 3000 meters at C or 4 percent for 2500 meters for D and 5 percent or 1600 meters for E category of runway strip.

Here the transitional surface slopes have been shown as 14.3 percent for A, B and C and 20 percent for D and E. This is for this area and if we look at this inner horizontal surface then it is varying and it is 2000 meter for E, 2500 meters for D and 4000 meters for A, B and C. So this is the size which is going in this form and the conical surfaces having a slope of 5 percent like this and then again it will be extending in the horizontal direction.

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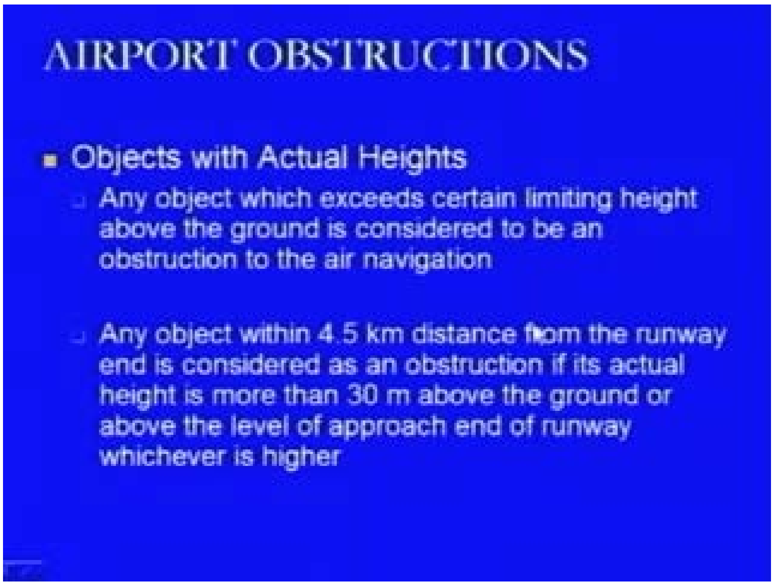


Now we come to the next type of airport obstruction, that is, objects with the actual heights. In this case any object which exceeds the certain limiting height above the ground is considered to be an obstruction for air navigation. So we have to control all these heights. So any object within 4.5 kilometer distance from the runway end is considered as an obstruction if it is actual height is more than 30 meters above the ground or above the level of approach ends of runway whichever is higher. So with respect to the ground or with respect to the level of the approach end of the runway we have to look at out of these two whatever is higher from there taking as a reference if we consider thirty meter height at a distance of 4.5 kilometer then that is the height of the object which can be there in the vicinity of an airport within this distances.

Further any object which is located beyond a distance of 4.5 kilometer from the runway end is considered as an obstruction if its height above 30 meter increases by more than 7.5 meter for each additional 1.5 kilometer distance from the runway. So after 4.5 kilometers for every 1.5 kilometer distance above this 30 meters the value is plus 7.5 meter. So this is how it will keep on increasing. So at a value at a distance of 6 kilometers it is 37.5 meters height.

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So within 37.5 meters height the development can take place but nothing can have a height of 37.5 meters or more than that. Similarly, when we reach value of 15000 meters or 15 kilometers from the runway and then it should not exceed the 75 meters value then if it is exceeding 75 meters than that an obstruction. Further, any object which projects above the minimum approach flight altitude or whose height exceeds 150 meter above the ground is also to be considered as an obstruction.

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So, if we look at the flight altitude of the approaching aircraft to any of the airport and there is any object which is having a height more than 150 meter then that is also considered as obstruction.

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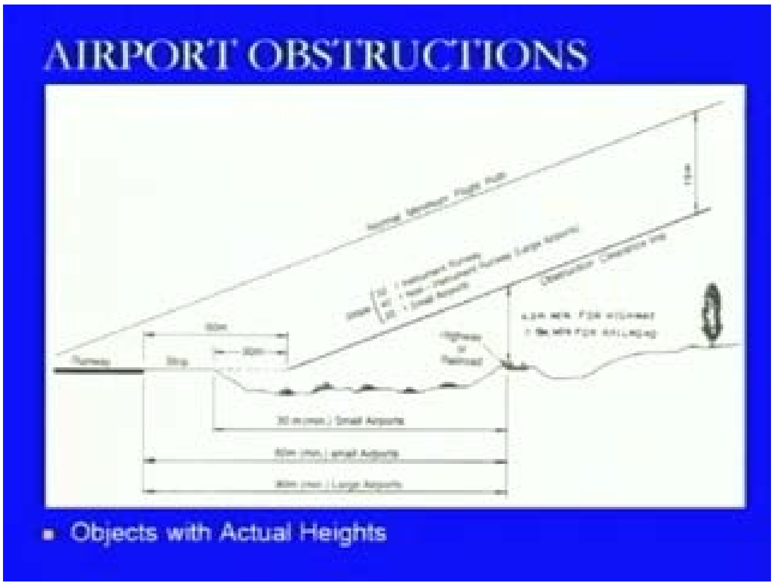


This is one of the diagram which tries to show how the airport obstructions can be talked about and this is the runway strip being shown at this location, a dark black line, and this is the normal flight path of any aircraft. So the aircraft will be going like this, this way. Now we are looking at this strip and then this is the clear way for the strip in this direction and this is the distance up to 60 meters we go and then from these 60 meters here we are talking about a slope and this slope is different from different conditions, it is fifties to one for instrument runway it is forties to one for non instrument runway in the case of large airports and it is twenties to one for small airports. So this is the slope at which this obstruction clearance line will keep on moving and there should be always a distance of 15 meters between the obstruction clearance line and the normal minimum light path. So that specification for the safe movement of aircraft.

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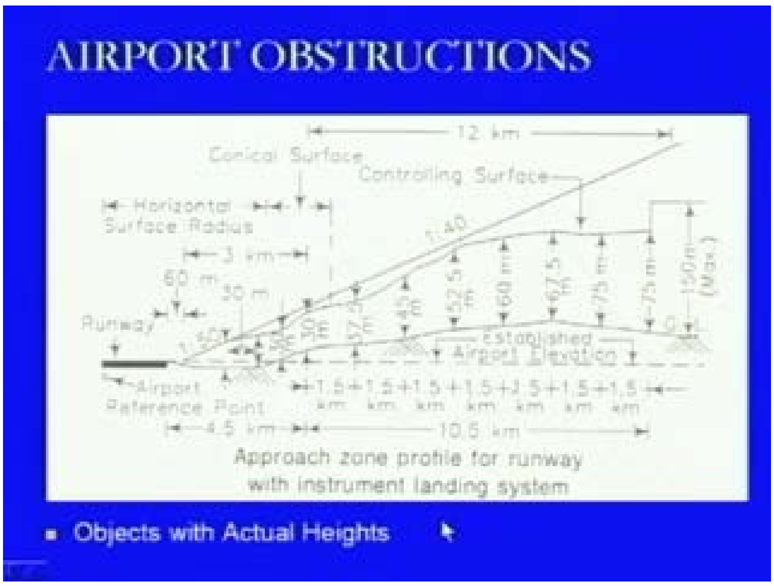

Now in this diagram we will be looking at the actual heights of the objects with respect to the end of the runway. This is the runway, this is the end of the runway and here there is somewhere the airport reference point with respect to which the elevations are measured. If we go 4.5 kilometers away from the end of the runway strip then this is what is being shown here and this is the natural ground level. So we take a height of 30 meters and then this is what is defined that this 30 meter should be there, so this slope comes out to be 1 is to 50. Then for every 1.5 kilometers, 7.5 meters will keep on adding so the 7.5 meters are getting adding for every 1.5 kilometers and when we reach distance of 10.5 kilometers from this point for 15 kilometers from the end of the runway strip then this height will become a minimum value of 75 meters and the maximum value at this level can be 150 meters. This is how it defines and it will transform into a gradient of 1 in 40. So that's becomes this is the controlling surface and this is the flight path which should be clear of this particular clearance line. So this is the clearance line and above this clearance line there can be a flight path by which the aircraft can come and may land from a takeoff. So, that is the same thing which we have discussed in the previous some of the slides.

We look at the another thing in the case of obstructions that is related to the runway clear zone, as we have seen in the imaginary surfaces also there is a clearance zone which is provide at the end of the runway strips and it starts at 60 meters from the end within approach area. So this is how it is located it is up to 60 meters end and it starts and goes within the approach area and the length is determined by the approach surface attaining a height of 30 meter. So it is dependent on the rate at which the approach surface is going up and if as soon as it attains a height of 30 meters by whatever is the distance in the horizontal direction is that will be the length of that clear zone.

We will look at some of the dimensions of the run clear zone that is dependent on this type of the runway, an instrument runway or the non instrument runway where W1, W2 or L means W1 is the width of that trapezoidal area being provided at the end of the runway strip after 60 meters and W2 is the width of the clear zone after it has moved a distance of L, that is, 750 meters in the case of instrument runway strip. So, this is for instrument runways whereas for the non instrument runways where it is dependent on visibility. If the visibility is as low as 1.25 kilometers then it is W1 is 300 meters, W2 is 435 meters and L is 510 meters where the visibility is greater than 1.25 kilometers then it will be reducing to 150 meters, 303 meters and 510 meters respectively. Then the approach for utility is 150 meters, then 240 meters and 300 meter respectively. Then visual approach for a larger than utility this is defined as by the values of 150 meters, then 210 meters and 300 meters respectively and the visual approach for utility it is defined by the values as 75 meters, 135 meters and 300 meters.

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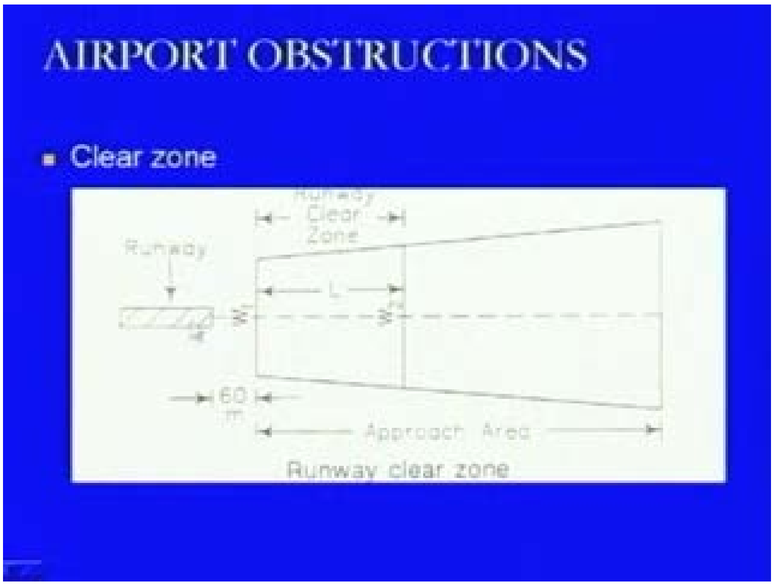


This is the diagram which shows the clear zone, this is the runway strip after 60 meters from the end of the runway strip the clear zone starts. So this is the width of the clear zone W1 then we are moving in this direction this is the approach area within the approach area the clear zone is provided, so this is having a shape of a trapezoid and once we move a length of L it will be having a width W2. So these are the values which we have seen W1, W2 and L in the previous discussion only.

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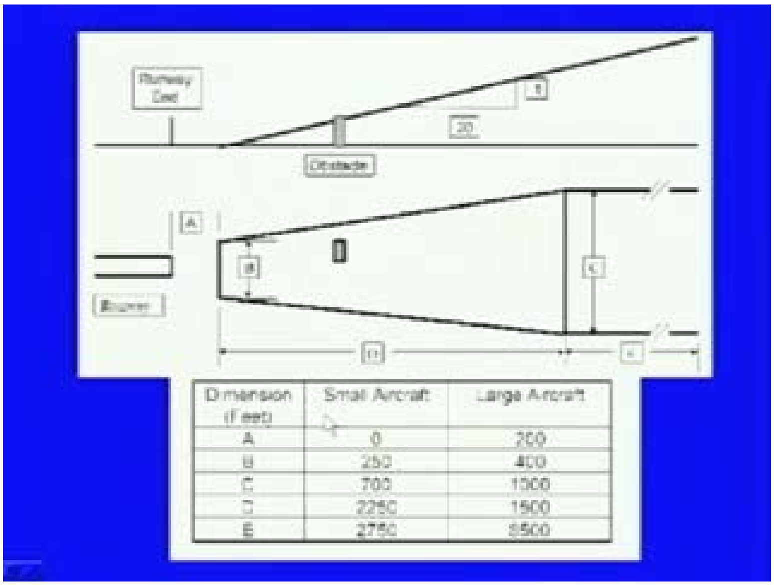


This is another figure which is trying to show the approach area along with the clear zone condition area and then the dimensions which needs to be provided. Here we have this value of A, this A is the distance from the end of the runway strip to the start of the clear zone then what is the width of the clear zone at this position is defined by B. what is the width of this approach zone when it becomes horizontal that is defined as C. then the distance between this B and C is defined as D and then after that when it becomes horizontal then what is the distance up to which the horizontal is extended is defined as E and this is in the elevation condition so this is 1 in 20 elevation grade being provided starting from this 60 meters away or distance A from the end of the runway strip and this should clear the obstacle being provided in between. So that is how the obstacle is being defined here. So, the dimensions there are being given in feet or in the case of small aircraft or in the case of the large aircraft they have been defined here and they vary and what we found is that this distance D is 2250 for small aircraft but it is 1500 for larger aircraft. So this as to take a higher flight path as compared to the smaller aircraft which have less of the propulsive power therefore the go at a lower flight path.

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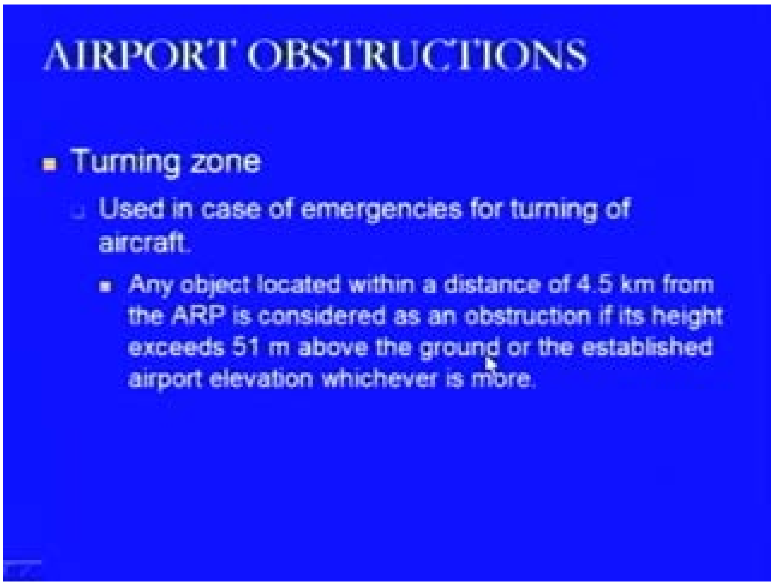


Then we come to the turning zone, in this case it is used in the case of emergencies for turning of aircraft and any object which is located within a distance of 4.5 kilometers from the ARP is considered as an obstruction if its height exceeds 51 meter above the ground or the established airport elevation whichever is more. So with respect to these two values, that is, ground level or the airport elevation if we take a height of 51 meters at a distance 4.5 kilometers then anything which is projecting out of this is an obstruction for those aircrafts which are required to take a turn because of the emergencies during taking off.

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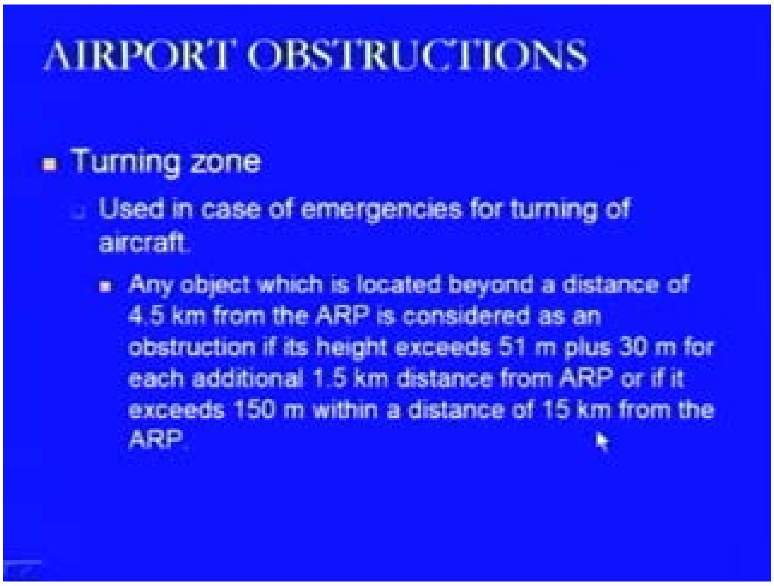


Then these are used in the case of emergencies for turning of aircraft and any object which is located beyond a distance of 4.5 kilometers from the ARP is considered as an obstruction if its height exceeds 51 meters plus 30 meters for each additional 1.5 kilometers from ARP. so if we are at a distance of 6 kilometers then it becomes 81 and so on and if it exceeds 150 meter with a distance of 15 kilometers from ARP. So this value remains the same as we have discussed in the previous case.

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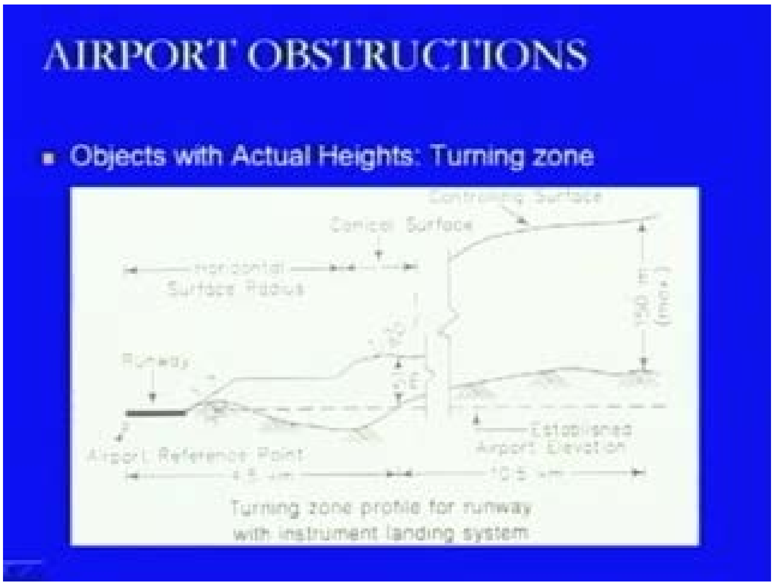


This is for the turning zone profile from the runway where this starts from the end of the runway strip and this is what we see is at a conical condition of 1 is to 7 grade becomes horizontal. Then again it increases and tries to take a value of 1 is to 20 and this is at a distance of 4.5 kilometer the surface should have a height of 51 meters above the ground or above the established airport elevation, whatever is higher. Then when we reach a distance of 15 kilometers then this value becomes 150 meters at maximum and that is how we just connect the controlling surface. So this controlling surface is the surface below which all the development should remain and flight path will be clear of this surface.

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Now we look at the zoning laws with respect to the different type of the obstructions which we have discussed so far and what we find is that it is related to the height zoning where the heights have to be prescribed on the basis of what we have discussed. These are given with respect to the 4.5 kilometers distance and then further with respect to every 1.5 kilometer distance and up to a distance of fifteen kilometers from the airport. So that is an area which is going to be affected by the presence of an airport in any city. So this much area needs to remain with the low profile of development. then what type of land uses are there so there is another zoning law which is related to the land use and it governs the type of the development which will be taking place at the adjoining areas of the airport and these are classified as closely related like terminal buildings, parking etcetera because these cannot be removed.

They are related totally with the activities which are associated with navigation where there are some activities which are non aviation use like commercial activities, industrial activities, recreational activities etcetera and we have to look at whether these type of activities have been provided in that area then whether that is permissible or not or that needs to be restricted. Some of the factors which should be considered with respect to the zoning laws are that the legal interests and the rights or whatever laws we are trying to frame they should not be such that they hamper somebody's rights which have been mentioned by our constitution.

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So we should not try to create a condition where it becomes a legal matter and the legalities create a cause of where we have to stop the operations, that should be the thing. So the zone rules should be such that we are not creating any problem to anybody and then the nature of ordinance should be such that it is a restrictive condition but it is not condition that you are not enforcing something somebody by your own choice where the other person cannot at any cost accept what you are trying to enforce, it should not unreasonable, it should not arbitrary decide and that is what needs to be seen. That is another aspect of zoning law.

Then the third thing is the zoning map has to be provided. The zoning map defines that what type of activity can take place up to what distance from the airport. so if we can show that then that helps the persons to decide that what type of activity they can try within that area if they acquire the land in that area. So it should show the property line, it should show the land use pattern, it should show the permissible heights, it should show the limits of the zoning laws etcetera. Apart from these, another aspect which we will be discussing today is the rules which are related to the flying of the aircraft.

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These rule they bring in a certain degree of orderliness in the aircraft movement in the airspace. From the time of takeoff to landing and they maintain the safety by applying separation standards between the aircrafts which are moving simultaneously in the airspace. So that is, what is the advantage of having the rules related to flying of the aircrafts. If we have these type of rules then we can maintain the separation between the aircrafts and we can also maintain the safety of those aircrafts using different type of operations. In this flight there are two types of flight rules available. The visual flight rules which are in short generally termed as VFR and instrumental flight rules which are in short again termed as IFR.

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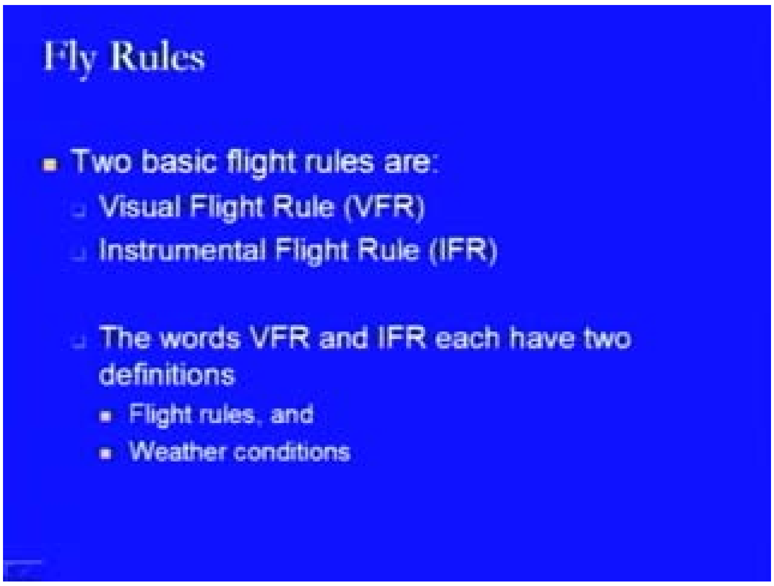


So we have VFR and IFR rules. The words VFR and IFR each have two definitions and these are related to flight rules related to weather conditions. These are the two ways by which we can define both of the things.

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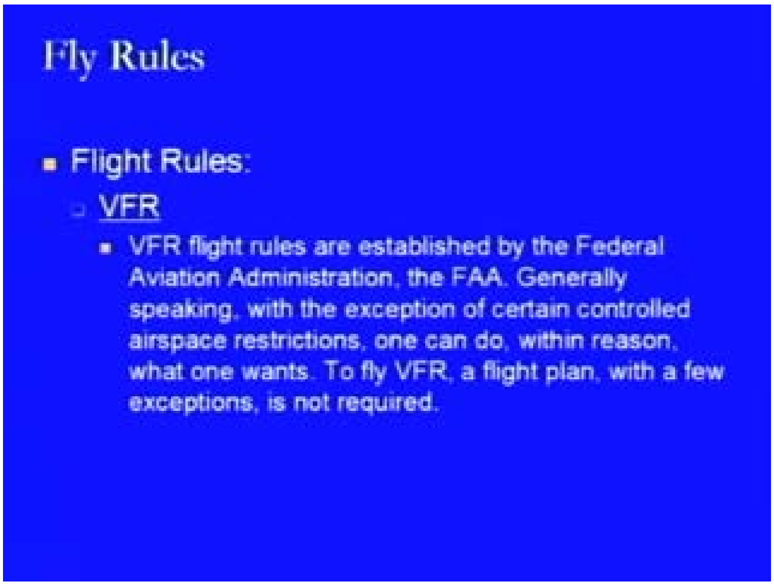


We look at the flight rules, with respect to the flight rule the VFR can be defined as the VFR flight rules are established by the Federal Aviation Administration that is FAA and generally speaking with the exception of certain controlled airspace restrictions one can do within reason what one wants that is what it says because you are looking at so you can do within the reasonable conditions what you are interested to do but within certain controlled airspace restrictions. To fly VFR a flight plan with a few exceptions is not required because it is a condition where you are looking at the other end trying to operate your vehicle. So that is the flight rule condition for VFR.

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Whereas in the case of IFR, the I says that the IFR flight rules are again they are being established by the Federal Aviation Administration of US and they can be quite complex and may cover most every aspect of the operation. To fly IFR a flight plan is required because everything is going to be controlled by the instruments and in this case those flight plans will be required so as to mark the various specifications which will be required during the flight and that needs to be fed to the instruments. so that's way it's a complex condition but then it is a more detailed aspect of operation and take care of each and every thing.

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Similarly, on the basis of the weather condition it can be defined here we are defining the VFR and VFR is defined as this is being established by the Federal Aviation Regulations which says that the prevailing flight visibility must be and how far the airplane must remain away from clouds that is what is the being to be defined as far as the fight rule is concerned with respect to the weather condition. The visibility and clouds minimum varies depending on the airspace that one is in. Generally speaking if the ceiling or the broken or the overcast cloud base are more than 1000 feet above the ground then the visibility is 3 miles or more the weather is VFR. So that is how it defines in the case of the weather condition.

In the case of weather condition again if we have in vigilant and we have read and we have the news items also and there is a speaking that the flight rules related to the weather conditions on the Indian International airports are quite stringent and all the airlines global airlines are requesting the director general that this should be reduced from a present value of somewhere around 200, 250 or 300 meters to 50 meters. So that is a distance by which the aircrafts can come very close to each other.

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Then in the case of IFR for the weather condition it stays in the form of generally speaking if the ceiling or the broken or the overcast cloud base are less than 1000 feet above the ground or the visibility is less than 3 miles the weather is IFR. then that is termed as that if the visibility is less than 3 miles then it is to be controlled by a by the IFR condition. If it is more than 3 miles then it can be controlled in terms of VFR condition.

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So the complete definition becomes that the visual flight rules are a set of aviation regulations under which a pilot may operate an aircraft. In weather conditions sufficient to allow the pilot by the visual reference to the environment outside the cockpit to control the aircrafts altitude, navigate and maintain safe separations from obstacles such as terrain, buildings and other aircraft. So that is what is the complete definition which takes into consideration the flight rule as well as the weather condition, both of the things. Similarly, in the case of VFR the essential collision safety principle guide the VFR pilot and this is termed as see and avoid.

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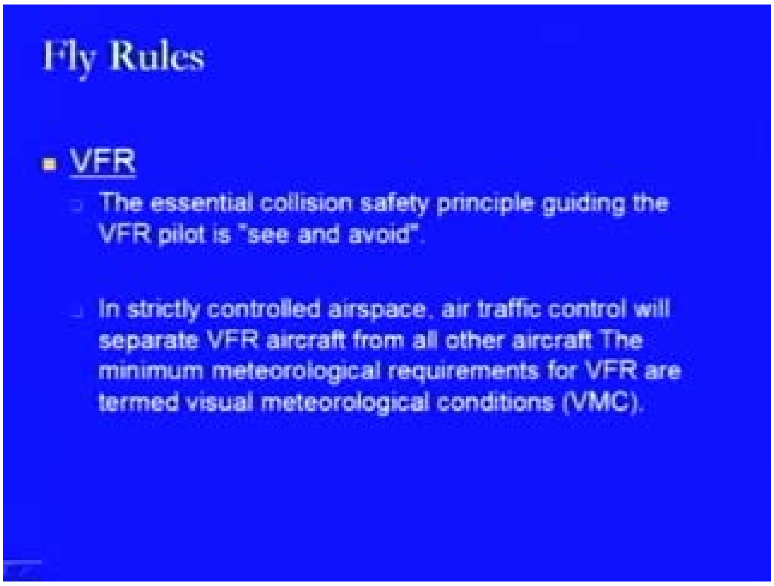


This is what is the safety principle in VFR condition; we look at and try to avoid the collision. In a strictly controlled airspace the air traffic control will separate VFR air traffic from all other aircrafts. The minimum meteorological requirements for VFR are termed visual meteorological conditions. So if we are operating under VFR conditions then the meteorological conditions related to that are termed as visual meteorological conditions.

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So this VFR of the controlled VFR flight is used in locations where aviation authorities have determined that VFR flight should be allowed but that ATC separation minima and guidance are necessary in this case and the CVFR concept is used in Canada and Europe but not in US where the private pilot certificate itself authorizes the pilot to accept clearances under VFR condition.

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In the case of IFR the complete definition is something like the instrument flight rules is a set of regulations and procedures for flying aircraft without the assumption that pilots will be able to see and avoid obstacles, terrains and other air traffic.
So that is the case in this one. We are not assuming that pilots will be able to do all these things and therefore the instruments are required to define that since navigation and control of the aircraft under IFR is done by instruments the flying through clouds is allowed.

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Then commercial traffic that is a flight carrying paying passengers and cargo operates under IFR almost exclusively because if there are passengers or cargo then in that case IFR is generally used.

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In the case of IFR there is a certain separation needs to be maintained and that is the distance which is achieved when avoiding obstacles or other aircraft and this is what is separation. In controlled airspace the air traffic control that is ATC separates IFR aircraft from obstacles and other IFR aircraft by applying separation based on time, distance and altitude differences between aircraft. This is how the two aircrafts are made separated from each other. It is maybe on the basis of time, maybe on the basis of distance or the difference in the altitude. By relying either on radar or reports of aircraft positions traditionally sent as voice radio transmissions by the pilots basically but increasingly as electronic data exchanges.

Now slowly and slowly the use of more of the electronic devices is increasing and we rely on the information which is being gathered by such devices and accordingly decide what needs to be done. In the case of weather condition for IFR the one advantage is that it's ability to fly an aircraft in instrument meteorological conditions. In the previous case where the meteorological conditions where defined for VFR it was visual meteorological conditions here it is instrument meteorological conditions. The weather conditions that do not meet the minimum visibility requirements for VFR that is what they are being defined as. In such conditions the pilot will control the altitude of the aircraft by watching the flight instruments and will rely entirely on the ATC for separation.

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So ATC, the air traffic control system will be providing the information for maintaining the separation between the aircrafts so the obstacles and the altitude will be maintained by the pilot using the electronic gadgets provided on board.

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Further, during the flight during FIR there are no visibility requirements and as such flying through clouds is permitted. There are still minimum conditions that must be present in order for the aircraft to takeoff or land.

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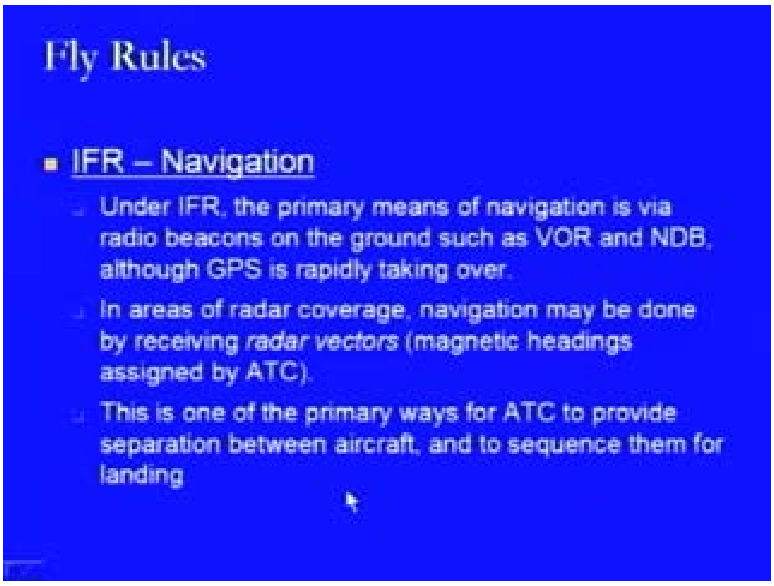


Then there is related to navigation under IFR the primary means of navigation is via radio beacons on the ground such as VOR and NDB although GPS is rapidly taking over. So we are relying for navigation mostly on the beacons or we are now –a-days slowly and slowly moving to the geographical positioning systems being provided for the navigation. In areas of radar coverage the navigation may be done by increasing radar vectors that is the magnetic headings assigned by ATC. This is one of the primary ways for ATC to provide separation between aircrafts and to sequence them for landing that is how one after the other landing will take place. Then there are certain IFR procedures, there are three stages to an IFR flight first is departure then en route means during the flight and approach.

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The departures are described by simple departure procedures normally providing an initial heading and altitude or for busier airports by standard instrument departures providing more detailed instructions often accompanied by diagrams or charts,
That is the way how the departures are scheduled. In the case of en route flight it is defined by IFR charts which show navigation aids fixes and standard routes called airways with minimum safe altitudes for each segment.

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Then further for third stage that is approaches which are described by terminal procedures often called approach plates describing a series of steps and segments to make the transition from en route flight to a position where the aircraft can complete a landing visually often from a low altitude and close to the airport. So that is how the three types of the procedures are defined in the IFR condition. This is just the case of IFR where

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an easy to read chart for IFR being provided where it defines the various classes of airspace on the basis of entry requirements, the pilot qualifications, the radio communication the type of air  allowed with respect to weather, with respect to flight and likewise values. This is the case being used in the US.
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Then there is another chart, this is the sectional chart which tries to define this is one airport, this is another airport. Here it tries to define the type of the development which can take place and the circles are being provided in terms of the distances in terms of the altitudes which can be taken by the pilots, so this is these are provided to the pilots how they move away what needs to be done. So these are the different things which are done in the case of fly rules as far as the VFR and IFR conditions are concerned.

this is what we are discussed today is that we have looked at the various type of obstructions which can be there for any safe movement of aircraft while landing or takeoff and these can be segregated as we have seen in the imaginary conditions and the objects with the height and then we have looked at various type of the fly rules. We will be stopping at this position and we will be discussing the certain other aspects in the coming lecture. Till then good bye and thank you.