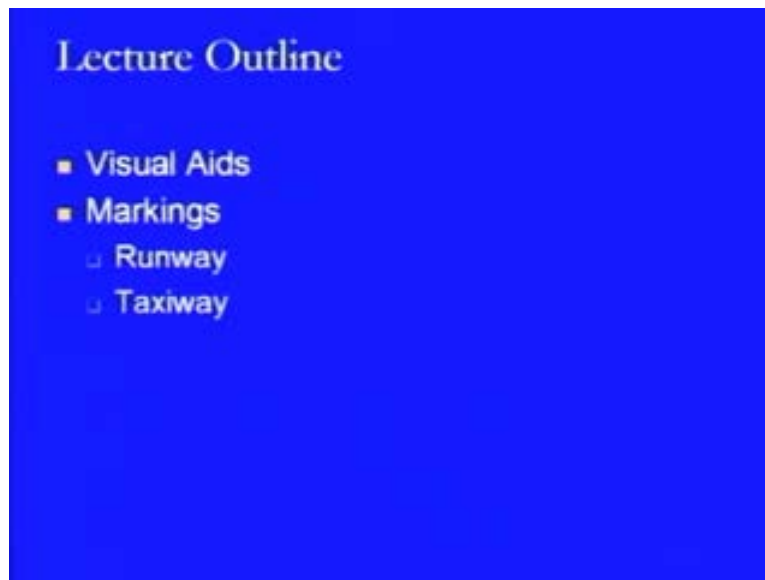


Transportation Engineering – II
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Lecture – 39
Visual Aids – Markings

Dear students, we are now reaching towards the end of our lecture series and at this junction, we will be discussing about some of the remaining things which are important as far as operation of aircraft on any airports are concerned. In that sense we will be looking at the various visual aids and these two lectures, that is this and the coming lecture, are devoted to this aspect only. In today's lecture, we will be looking at the visual aids related to markings which are provided on any of the components of the airport. So, in that sense, this lecture is being outlined in the following way.

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We will be looking at what are the visual aids and then, what are the markings which are provided for different components, specifically for runways and taxiways. In this connection we will be starting with visual aids.

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Visual Aids

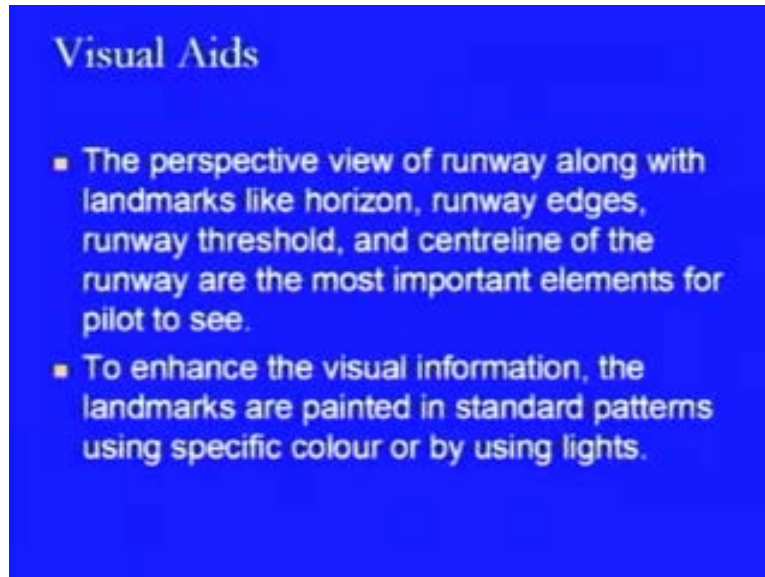
- Certain landmarks are required as aids for the pilots to perform landing and taking off operations safely
- These visual aids are required both in good weather as well as bad and during day as well as night.
- The runway or conventional aircraft appears as a long and narrow strip with straight sides and free of obstacles.

The visual aids are basically the things like they are the landmarks which are required, so as to provide an aid to the pilots. So, for performing the landing or take-off operations and the major objective here is to maintain the safety of that operation. So, the various markings, various aids which are going to be provided in any of the form, they try to ensure that whatever operation is going on, the pilots and related crews or the related controlling persons are in a position to visualize that this operation goes on smoothly and efficiently, at the same time maintaining the safety aspects of that operation.

These visual aids, whatever the way they are provided, are required both in good weather condition as well as during the bad weather condition or not only during the days, but also during the nights. So, it means the visual aids which are provided on any of the airport should have a universal applicability and it should not be dependent on any of the aspects which may create its effect on the operation of aircrafts on that airport. The runways or the conventional aircraft appears as long and narrow strip with straight sides and free of obstacles. This is how it looks like. If you look at any of the runway strips or if you are looking at any of such operations, then what we find is that those runway strips or the aircrafts which are using those runway strips, they look like long and narrow strips with certain straight sides which are defined and we will be, we will be finding that they

have been marked in a certain way, so that we can clearly distinguish between the strips being provided or the surrounding areas and then in all the cases, these are going to be free of obstacles.

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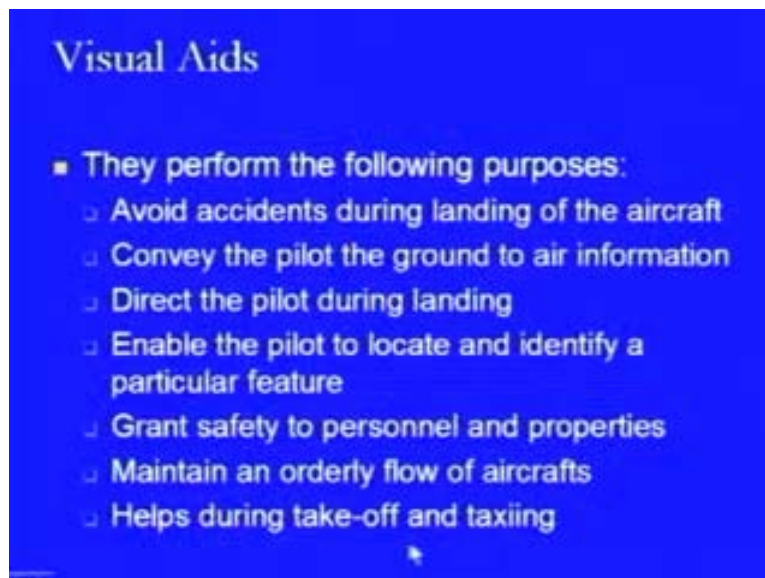
The perspective view of the runways along with the landmarks like horizon, runway edges, runway threshold and centreline of the runway are the most important elements for pilot to see, because if any pilot is making a sort of an operation like there is a landing operation which is going on, then in that case it becomes very important for the pilot to understand that **or tend** to locate that where is the horizon, where the runway edges are, what is, where is the runway threshold which needs to be crossed at a certain height with the specified speed and then, where is the centreline of the runway along which the aircraft needs to be aligned, so that the safety is ensured while it is taking a landing.

Similarly is the case for take-off and we have seen when we have designed the length of the runways strip, that during the take-off also at end of the runway strip or certain distance away from the runway strip, there are specific heights which needs to be maintained. So, in that sense, if we are looking at these considerations, then it becomes very important for the pilot to understand and to find out all such components, all such

type of say markings or lightings or any other type of aid which has been provided, so that the pilot can make a perspective view of overall runways strip which they are going to utilize for landing or take-off operation and within that perspective view, the whole of the operation will be taken care of.

So, in this sense, if we have to enhance the visual information **and the** so as to enhance that, certain specific type of paints needs to be used and these landmarks are painted in standard patterns, which are going to be uniform throughout. They are generally defined by the bigger guiding agencies which provide the guidelines regarding these visual aids and when we are using these in the standard pattern across all the airports or across the countries, then the pilots do not have any problem in understanding those patterns and the significance of those patterns and on the basis of those significance of the patterns, they can do the landing or the take-off and therefore, there are certain specific colours which needs to be used or if it is lighting system, then again in that case also the different coloured lights needs to be used, so that the visual information reaches the pilot in as clear way as possible, so as to make a safe landing or take-off.

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Visual Aids

- They perform the following purposes:
 - Avoid accidents during landing of the aircraft
 - Convey the pilot the ground to air information
 - Direct the pilot during landing
 - Enable the pilot to locate and identify a particular feature
 - Grant safety to personnel and properties
 - Maintain an orderly flow of aircrafts
 - Helps during take-off and taxiing

In that sense the visual aids are going to perform certain purposes and they are that there is a need to avoid accidents during landing of the aircraft. That is the one objective of providing the visual aids. Then, the visual aids help in conveying the pilot the ground to air information. This is the way by which the overall information which is available on the ground is conveyed to the pilots, so that they can arrange themselves, they can orient themselves with respect to that information during the operations. They direct the pilot during landing.

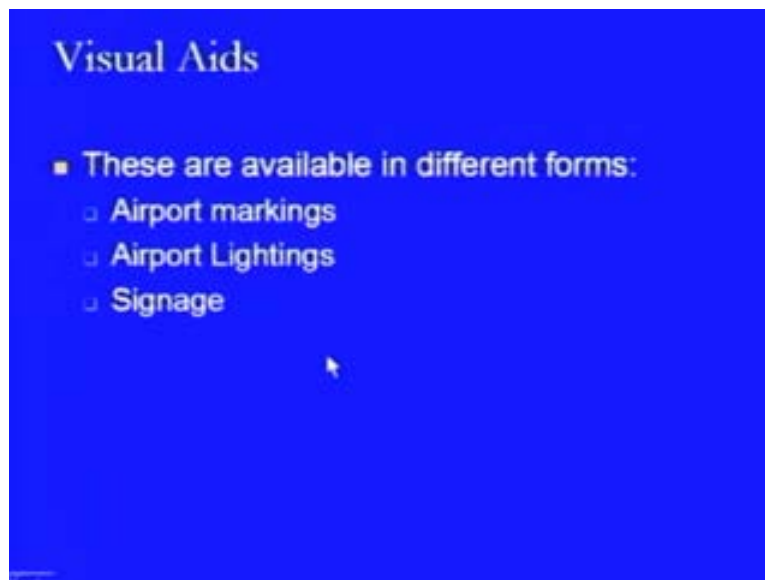
This is another important aspect, because as we have seen that there are certain distances and there are certain points like there is a touch down point on the runways strips, similarly there is a lift off point on the runways strip. These points are all located on the strips in certain form and the pilot understands that and accordingly they orient themselves, so that they can use that particular area which is being specified for that type of operation and it also enables to pilot to locate and identify a particular feature.

That is what I was just telling that if they have to locate the touch off point, then they will be able to understand that where the touch off point will be coming and so, they can bring their aircraft with that altitude and a speed, so that at a time of touching there is no safety hazard and it grants safety to personnel and properties and that is how it is going to happen. So, who so ever is traveling in the aircraft, the crew, the passengers, similarly the properties which are associated with it, like the aircraft itself, the cargo which is being transported or the things which have been provided on the sides of the runway strips, everything needs to be maintained as safe as possible and this is the way by which we can do it.

Another important thing is that it also maintains an orderly flow of aircrafts. This is another important aspect, because if these type of markings are not being provided, say there is a runway strip which is utilized for unidirectional type of operations that is from one end there is a take-off and from other end there is a landing, then in that case, the aircrafts cannot do the opposite operation on these particular ends.

So, that is the thing which is there that is there is an orderly flow of aircrafts. From the landing side there will be only landings and from the take-off side, there will be only take-off on the runway strip as an example and it also helps during take-off as well as during taxiing, because the aircraft which has already landed on the runway strip can understand the other markings, other visual aids being provided by which it can move towards the exit taxiways or the taxilanes or to the taxiways by which it will be going towards the storage area or the aircraft stands, where they will be taxiing or where they will be holding or they will be going towards the terminal aprons. Everything is being defined in terms of the visual aids and following those visual aids, the aircraft can reach their ultimate destinations and these visual aids, as we have been discussing, are available in different forms.

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They are available in the form of airport markings or airport lightings or signage. So, these are the three ways in which we can get the different visual aids. Airport markings, or airport lightings or signage, they are all related to various type of operations. They are related to the different components which are provided on any of the airport and that is why at each and every point, we will be getting the information and we will be looking at all these three types of information during these two lectures. So, in this lecture we are

going to concentrate on the markings. In the next lecture, we will be discussing about lightings and the signages. So, in that sense, once we have taken an idea and the objectives of providing the various visual aids, we start looking and discussing about the airport markings.

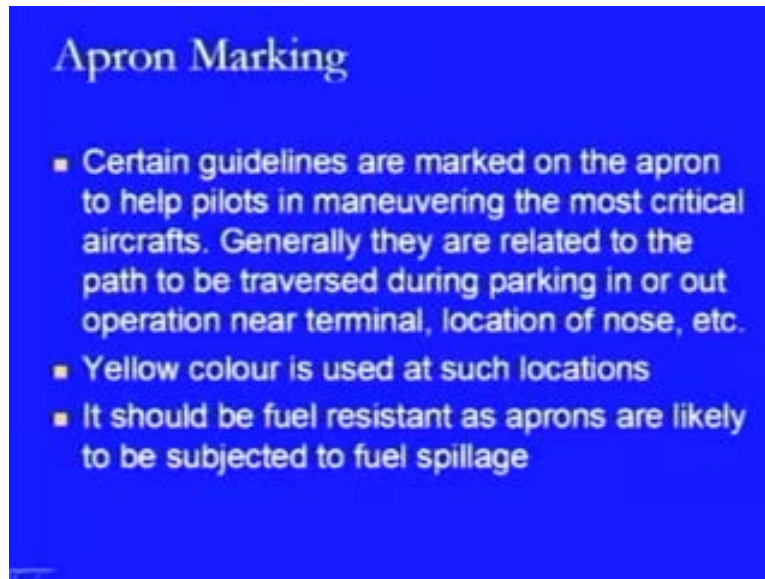
The airport markings are the things which are basically provided on any of the component and they are being provided in the form of the strips or in the form of the patches or in the form of the solid lines or in the form of the hollow lines or the cart lines and there are different ways in which these are done. They are perpendicular, they are angled and they are used in all the components, so as to define those things. In that sense, if we look at the various types of the markings which can be there, they can be grouped on the basis of the component where they are going to be provided.

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In that way these are provided in the following groups like apron markings, the landing direction indicators, the runway markings, shoulder markings, taxiway markings, wind direction indicator. So, once we have all these type of markings, then we will be starting now with the first one that is apron marking.

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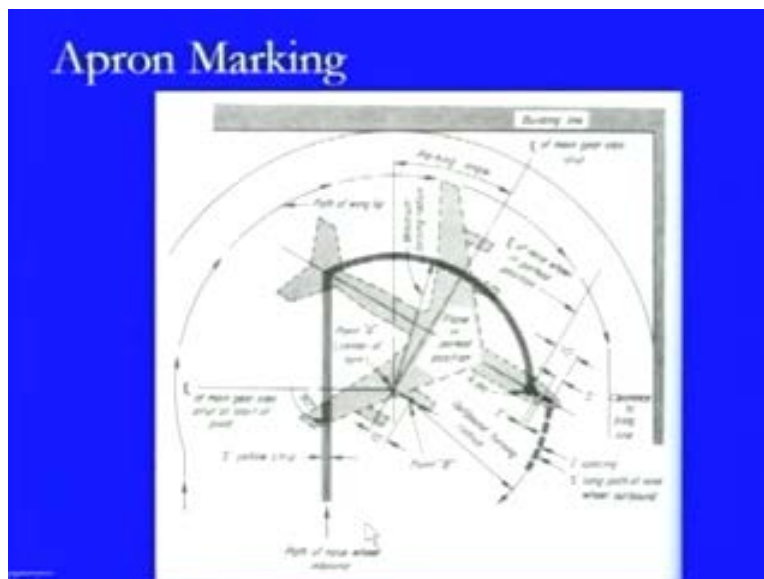
Apron marking provides guidelines which are marked on the apron to help the pilots in maneuvering the most critical aircrafts. So, most critical aircrafts means here is that whatever is the biggest type of the aircraft which is going to use the airport, then the operation of that one, the maneuvering of that one in terms of its turning, in terms of its movement, everything is guided by using the apron markings and generally, these are related to the path to be traversed during parking in or out operation near terminal location of nose, etc., means as we are, as we have seen previously when we have discussed about the terminal aprons and the terminal aprons are being utilized by the aircrafts, so as to stand on that one very near to the terminal building, where they need to be loaded and unloaded. So, they have also looked at the various orientations or the type of parkings in which that can be done.

Now, how an aircraft is going to be parked or how an aircraft is going to be taken out or taken in or how it is going to take a turn, at what particular location it has to stop and then, there can be a loading and unloading, everything is defined by using some markings, which are provided on the pavement which is located on which the aircraft is standing and that pavement is nothing but, it is the apron way. This is, this type of thing we have observed in one of our lectures and we will be looking at the same in this lecture

too. In this case, most of such things are provided by using yellow colour. So, yellow colour painted things are provided on the pavement surface and on the basis of that it is being defined.

Another thing is that, when we are using this colour or in that colour should be fuel resistant because there are all chances that during the filling of the aircrafts or during certain other maneuvers, the fuel may spill and that may create a problem to such markings. So, that is one important specification of the paint which is used as a marking on the airports. That is they should be fuel resistant.

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This is one diagram which I was talking about and which we have looked at previously too and this is one of the type of the marking which will be found just on an apron. This is basically the pavement and the aircraft is going to come and stand on this pavement and what is the orientation which this aircraft is going to take with respect to the building line that is already being defined that it is an angled condition, wherein this is coming with nose in condition. This is angled nose in condition by which it is coming, because this is some angle θ with respect to this building line or this building line, because this

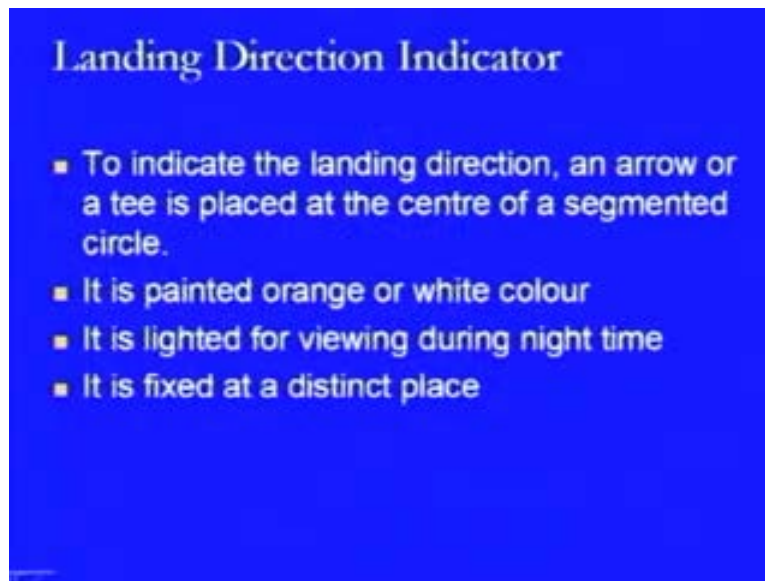
is L shape building line being provided and in that sense, if the aircraft is coming from this side, then it will be taking a turn and will stand in this form.

So, if the turn is going on, then obviously it is to be defined in the form of the path this wing will be taking and that is how it is being defined by this line. That is this is the path which will be taken by the wing. Similarly, when it will be going out after the loading, then this will be taking a turn in this way. So, this is how it is going to take turn with respect to this point of turning which is found out on the basis of the main gear line and the steering gear line and the point of intersection of these two is defining this turning point.

So, when we are looking at this type of maneuvers, then this aircraft location is being shown as here will be depicted on the pavement surface in yellow colour and then, this type of path of the nose wheel or the inbound condition or outbound condition. So, this is the path of the nose wheel. First of all, the aircraft will come in this form and then, it will start taking a turn. So, this is how it will be taking at turn and will be come in this condition. So, once it has done this, so this is how the nose wheel will be moving, it will be in, the initial condition will be here and then, as it will start taking a turn, it will be taking a path like this. So, this is how it will happen and then, once it is being loaded, it is to be taken out.

Now, this will be moving along this particular path. So, we have the out bound turning radius and we have the inbound turning radius and the minimum radius with which it will be working that is this value. So, likewise, everything is defined for this sort of an operation and some clearance with respect to the building line is also being provided, so that there is no damage to the wings of the aircraft while it is taking a turn and moving away from the building.

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So, another type of indicator is landing direction indicator. This landing direction indicator is a helpful aid to the pilot, at the time when they are coming to the airport and looking for a runway strip and the direction from which they can land on that runway strip. So, that defines the pilot and the pilot will be able to visualize, pilot will be able to see that particular indicator and on the basis of that indicator, he or she will be orienting the aircraft, so that they can land in that direction. So, this is what it indicates, the landing direction and it is provided in the form of may be an arrow or a tee is placed at the center of a segmented circle. These are the two ways in which it can be provided.

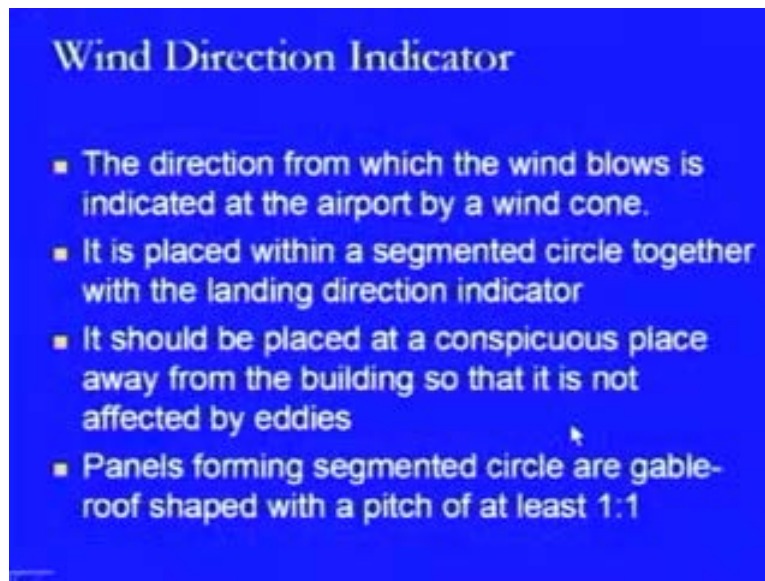
So, if it is not in the form of an arrow, then there can be a segmented circle that is a circle being provided with cut off lines and then, in the center of that segmented circle, there can be a tee shape being located. It is painted orange or is painted white in colour. So, these are the two colours which can be used for this landing direction indicator. It is lighted for viewing during night time. So, all these indicators which are provided, they are provided with the lighting systems, so that the pilot can view, can locate these landing direction indicators during the night. They are fixed and they are at a distinct place.

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This is the T shape landing direction indicator, which needs to be provided in some of the cases. In that case, there will be an encircling circle like this and this one and that circle will be cut off at uniform distances. The size of this T is being defined here for a specific type of runway strip and depending on the size of the runway strip there can be some modifications, but in general it is like 4 meter wide in this way. 0.4 meter wide is this strip. Similarly, this strip is also 0.4 meter wide and this is again is 4 meters. So, this is the type of landing direction indicator.

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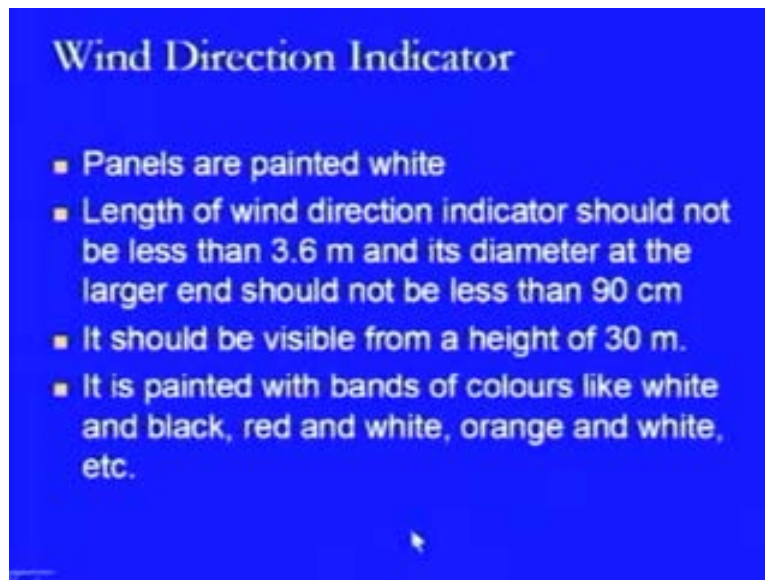
Another indicator which is provided on any of the airport is the wind direction indicator, which helps the pilot to understand, to find out in which particular direction the wind is blowing and this is important as far as to be understood by the pilot that what type of food needs to be provided at the time of taking off or at the time of landing. If the wind is coming in the cross wind component form, then what will happen or of it is coming in a head wind or a tail wind component form, then what is going to happen. So, that will become very clear as shown as the pilot looks at this wind direction indicator and it is generally provided in the form of wind cone on all the airports.

Generally, this is placed within a segmented circle together with the landing direction indicator. So, means the pilot need not to look to two different directions, so as to locate both the information. Both the information will be available to the pilot at the same location and it is in the form of segmented circle on which a T is being placed and then, along with that T, there is a has been provided on which a wind cone will be there, which moves in certain direction indicating the direction in which the wind is blowing.

Then, it should be placed at a conspicuous place away from the building, so that it is not affected by the eddies, because if there is heavy wind blowing, then if it is very near to

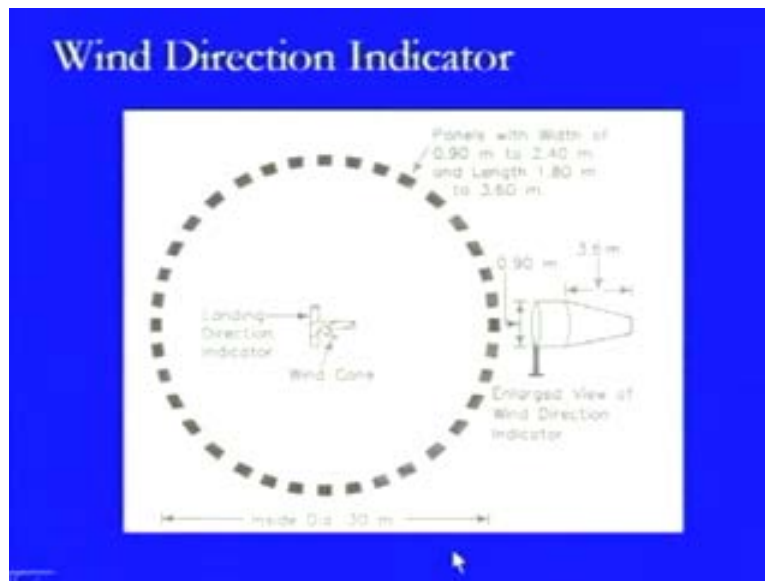
the terminal building, then the eddies will be formed and in that case, it will not be useful to the pilot to understand the behavior of the wind. The panels forming segmented circles are gable-roof shaped with a pitch of at least 1:1. That is the specification for the segmented circle which is provided. So, it is a gable shaped segmented circle.

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Panels are painted white in colour and the length of wind direction indicator should not be less than 3.6 meters and its diameter at the larger end should not be less than 90 centimeters. So, this is the specification related to wind direction indicator. The length is being defined and the diameter is being defined at the larger end. It should be visible from a height of 30 meters. So, this is height which is generally required at some kilometers away from the runway strip that is the end of the runway strip or the reference point being taken with respect to the airport or the airport runway reference point. It is painted with bands of colours like white and black, red and white, orange and white, etc. This is the way it is provided.

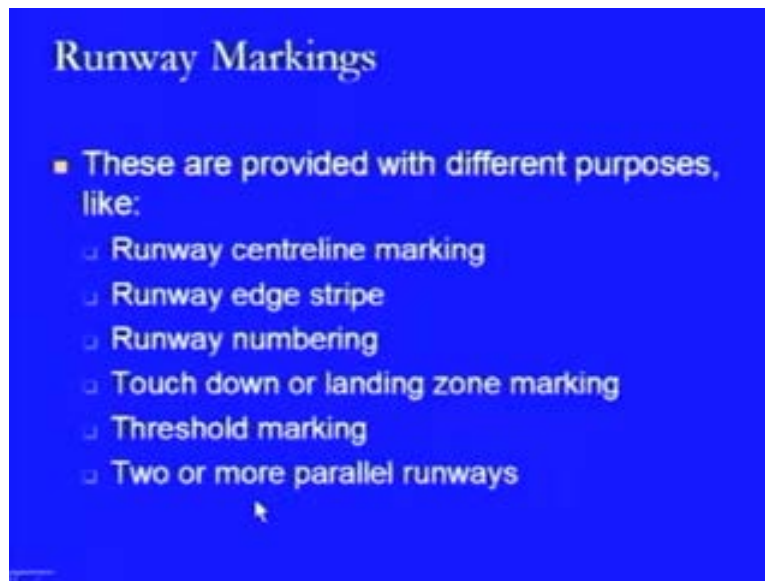
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This diagram tries to show the same thing. This is one segmented circle, has been shown here. The inside diameter of this segmented circle is 30 meters. Within this segmented circle we are providing the landing direction indicator as being shown here. This is a T which is being located, so this is trying to tell the landing direction and then, at the side of this one, this wind cone is being provided which is showing that the wind is flowing in this direction here and this will be in the form of, like this. There is a hole and top of this hole there will be a this conical form of surfaces being provided with 0.9 meter of the diameter at this side and 3.6 meter length of the cone. So, that is the minimum specification related to this one.

At the same time, these segments which are provided or the panels which are provided, the sizes of these panels are also being specified. Here, these panels are having a width of 0.5 meters to 2.4 meters and the length is from 1.8 meters to 3.6 six meters and they are provided with spacing between the panels and the value is again almost the same way as being provided with respect to the length of these panels. So, that is how they are uniformly placed in this way.

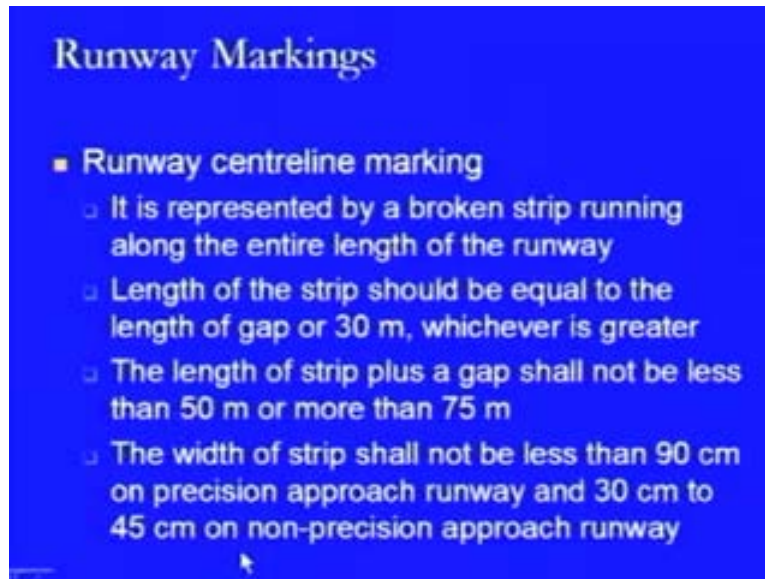
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Now, once we have looked at these two types of specific indicators which help during the landing operation then, now we are going to look at some of the markings which are provided on any runway strip which helps the pilot, may be during landing as well as during the take-off. These are provided with different purposes and these purposes are like they have to be provided for the centreline, they need to be provided for the edge of the runway strips or there is a numbering for each and every runway strip, which we have seen in the previous some of the figures, which we have discussed during some lectures, where numbers were shown like 27, 9 or so on. So, that is the numbering of the runway strip that needs to be provided.

Then, as we have been discussing about the landing condition, so touch down zone or it is also known as the landing zone, so for that reason where this landing zone or touch down zone is that marking needs to be provided. Then, there is a threshold marking, which defines the specified height by which the aircraft should cross it, so that they can reach the touch down point in very safer condition. Then, in case there a more of runway strips, then the markings relate to those two or more parallel runway strips.

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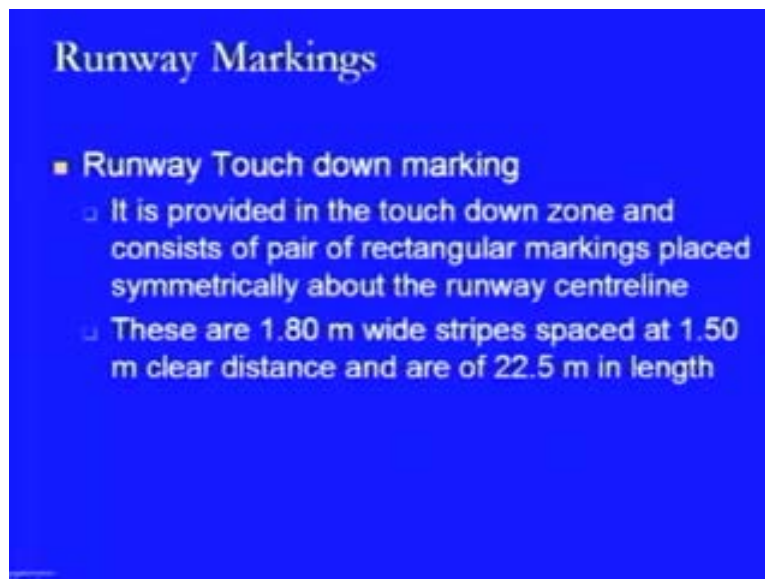
Now, we look at the very first type of the runway marking which is provided and this is runway centreline marking. This runway centreline marking is provided along the entire length of the runway strip. Now, this is one thing, because from very starting to the end this has to be there. Second thing is that it is not solid continuous line, whereas it is a broken strip. So, as we have seen in the case of segmented circle, here it will be straight line profile, but then again there will be certain length for which the marking will be provided and then, there will be a gap between the two centreline markings in this form.

The length of the strip should be equal to the length of the gap or 30 meter, whichever is greater. So, that is the way this centreline strip is provided. Length of the strip plus a gap shall not be less than 50 meter or more than 75 meter. So, in this sense if we look with respect to the previous one, where we are talking about that it should be equal to the length of the gap or 30 meter whichever is greater and if we assume this 30 meter is the greater value, then in that sense the gap is going to be 20 meters if we take the value of 50 meters or otherwise, if it is going to be more in the case of the length of the strip is taken more than 30 meters, then we can have again in this case something like 30 meters to 40 meters gap. So, depending on what length of this strip is being taken and with respect to that we can find out the gap using this specification.

The width of the strip shall not be less than 90 centimeter on precision approach runway strips and 30 centimeter to 45 centimeter on non-precision approach runway strip. So, these has been defined on the basis of the type of the runway strips being provided and what type of approach is being provided for that runway strip, whether it is a precision approach means it is instrumental condition, where everything is being defined by the instruments, the altitudes, the speeds, the grades, everything, whereas in the other case, if it is a non-precision condition where such type of devices are not being used and on using the markings and the standards known to the pilot the operations are carried.

Another type of runway marking is runway touched down marking. We will be looking at all these markings like the first one which we have just discussed that is centreline marking and one of the diagrams where combination of these markings has been shown.

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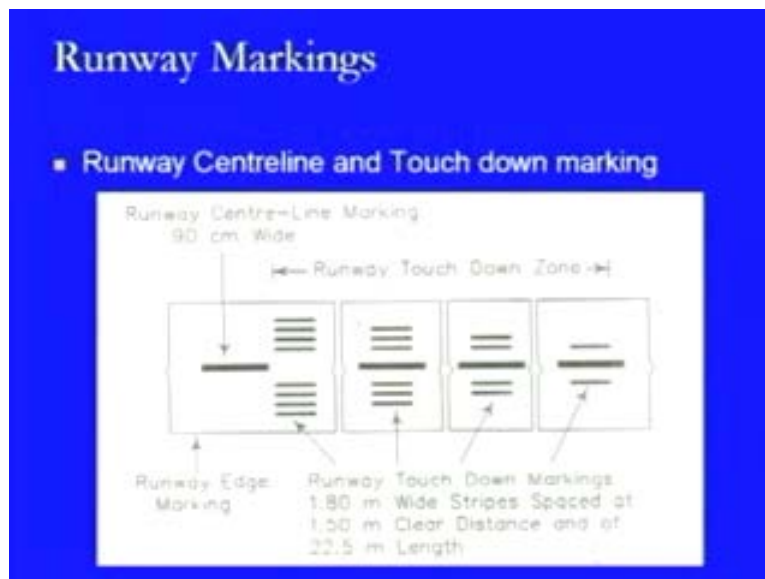


Now, in the case of this touch down marking is provided in the touch down zone and it consists of pair of rectangular markings which are placed symmetrically about the runway centreline. What happens is that the aircraft is coming along the centreline on a runway strip and it is coming slowly and slowly down that is there is a downward **grid** with which it is coming. So, these centreline marking, these touch down markings,

basically define the way the aircraft has to move and by what particular point afterwards only the touch down can be done. So, therefore there will be a zone in which this touch down will be made.

These markings which are provided on the both of either of the side of any centreline marking of the runway strip, they are 1.8 meters wide and they are spaced at 1.5 meter clear distance that is from the end of one marking to the start of the other marking, the distance is 1.5 meters. The length of these markings are 22.5 meters. So, they are 22.5 by 1.8 with the gap of 1.5 meters.

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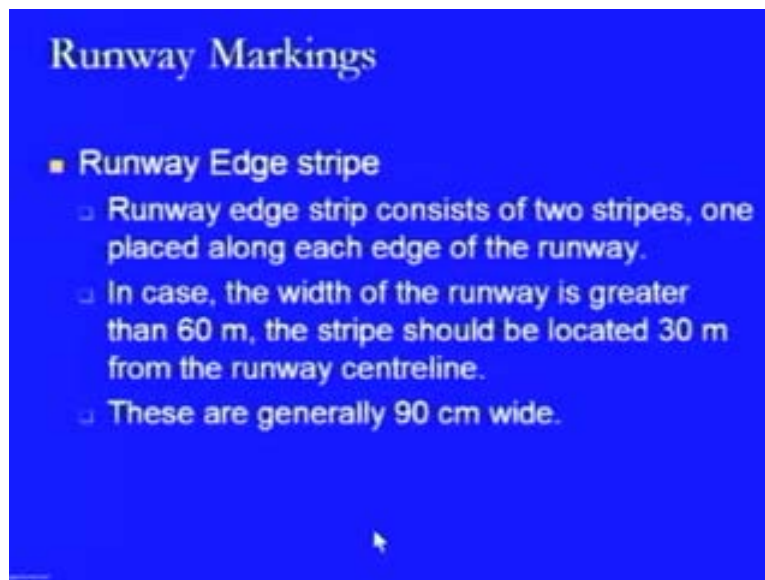


Here, in this diagram we are going to look at the combination of the runways, centreline marking and touch down marking. Here, in this diagram, we can clearly see the centreline marking. This one is the centreline marking, has been shown here. This is 90 centimeter wide strip and then, there is a touch down marking which is being shown in the form of 4 strips on either of the side at the start. Then, it reduces to 3 on either side, then it reduces to 2 on either side and then, it becomes 1 on either side. The length of this remain 22.5 meters, the width remain 1.8 meter wide and the gap between the markings is 1.5 meter, clear.

degrees is the angle in this case and then, this is the centreline being shown in this basic diagram and along with that one, we have the touchdown zone markings, which has been as a single strip on both the sides and T is going up to this distance. So, this becomes the touch down zone.

Here, in this case as we have seen in the previous diagram there are some more lines, like there is a three line and three lines likewise and then there are two lines and so on and then, there is a single line and finally, we have this much distance which is defined as the touch down zone marking. So, this is with the direction coding and this is with the basic type of patterns. So, direction coding means this will be going in this direction for the landing.

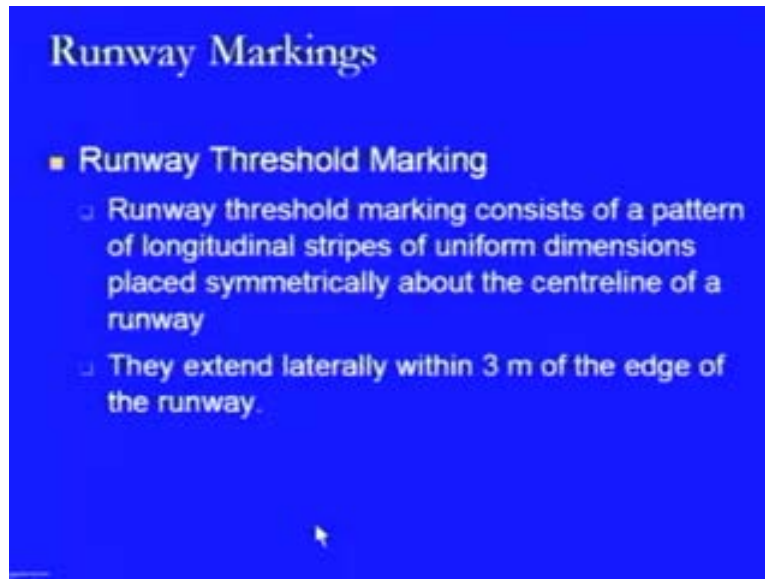
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Now, we look at another runway marking that is the edge stripe marking, which defines the ends of the runway strips on the two sides of the centreline markings. So, this runway edge stripe consists basically of two strips. One is placed along each edge of the runway and it is continuous in nature and in this case, the width of the runway if it is greater than 60 meters, then the strip is located 30 meters from the runway centreline. So, that is the

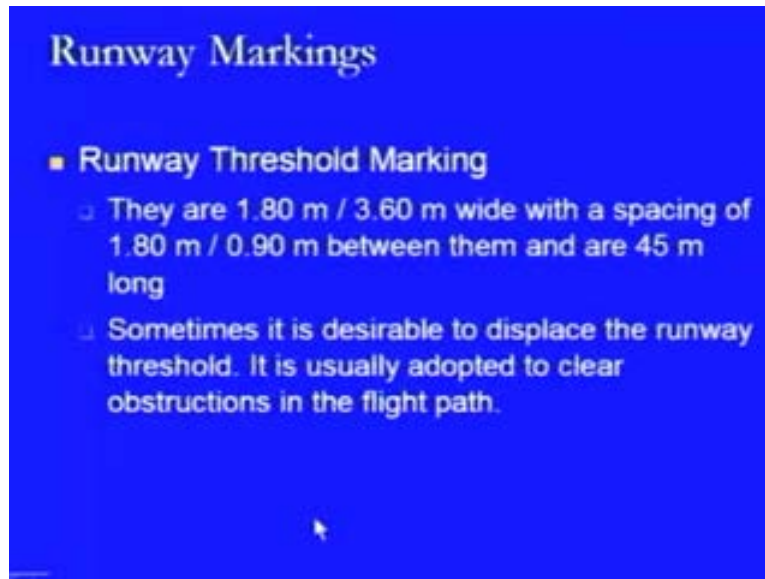
way it is provided. Generally, these are 90 centimeter wide. This is the most general width which is used for the strips.

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There is another type of marking which we have seen in the previous diagram, which is the runway threshold marking. This runway threshold marking consists of a pattern of longitudinal strips of uniform dimensions. That is they are of same length and same width and they are placed symmetrically about the centreline of a runway strip and they extend laterally within 3 meter of the edge of the runway strip, means from the edge of the runways strip it goes up to 3 meters from the sides. So, that is how they are located. So, on the basis of this particular specification, whatever are the number of strips needs to be provided for threshold marking will be computed based on the width of each marking as well as the clear gap between those markings.

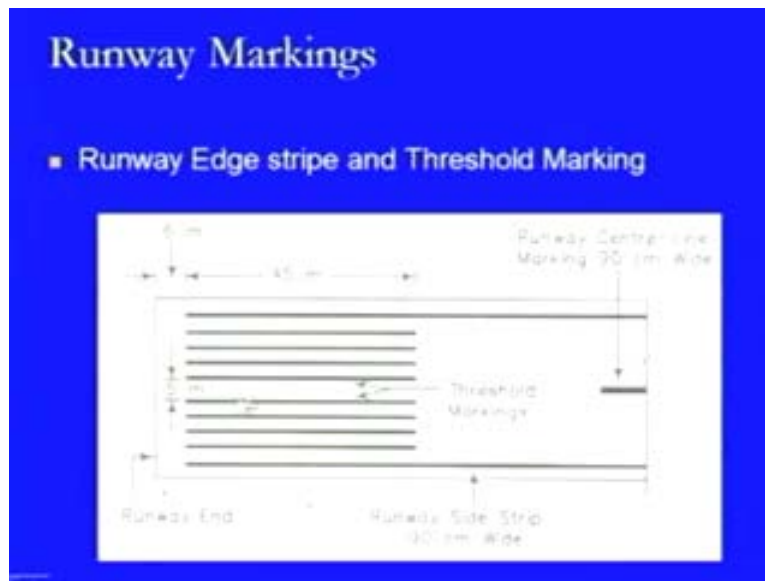
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These are generally 1.8 meters or 3.6 meters wide with spacing of 1.8 meters or 0.90 meters between them and are 45 meter in length. So, these are the specifications for providing these markings. Sometimes, it is desirable to displace the runway threshold and it is usually adopted to clear obstructions in the flight path, because if there are certain obstructions which comes on the flight path, then if by just displacing the threshold, means taking the aircraft to a certain further distance towards the airport, may clear those obstructions and therefore, it becomes safer movement.

We look at the runway edge stripe and the threshold markings in this diagram.

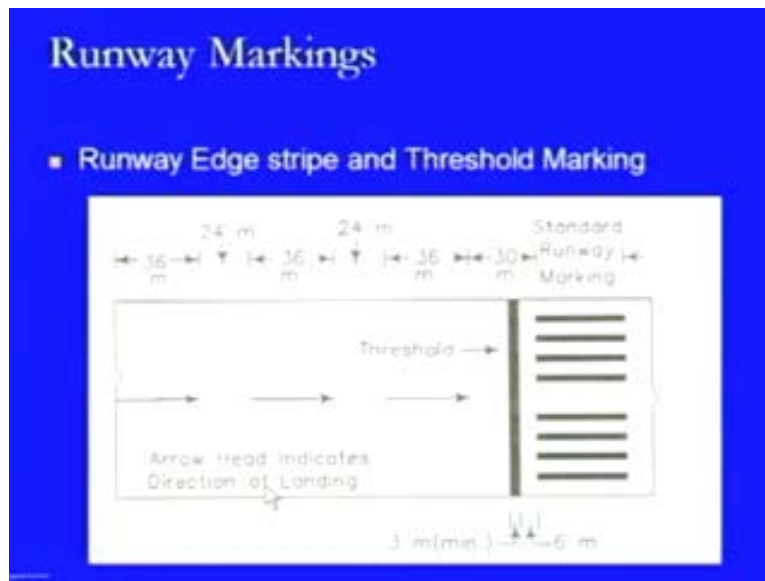
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What we can see is that, here this was the centreline marking which was, which we have discussed previously. Then, here with respect to this centreline marking, at this position the centreline marking is there, this is the alignment. With respect to this one, symmetrically we are providing threshold markings, on this side as well as on this side. So, they are starting at distance of 6 meters from the end of the runway strip. So, this is what is the normal basic way of providing the threshold markings. These are 45 meters in length and then, as we have seen the width is variable along with the gap being provided.

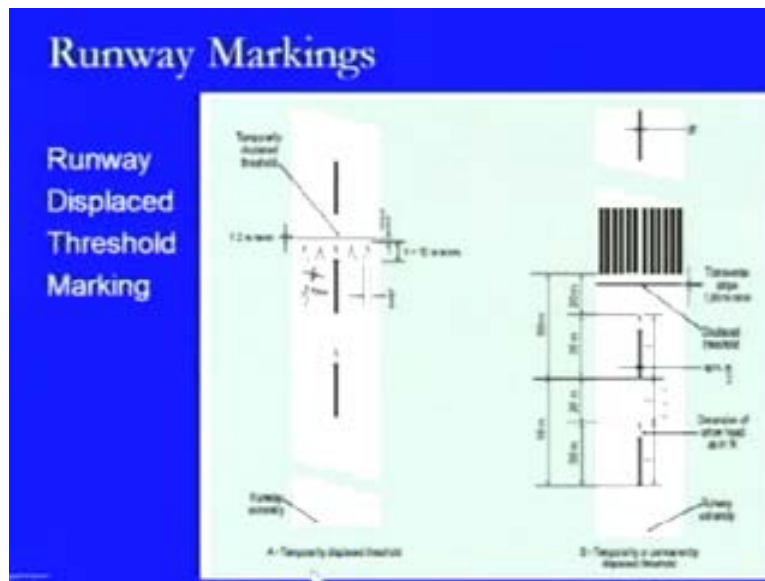
Here, another type of marking which is shown is the edge stripe marking which as I have told, is a continuous strip, 90 centimeter wide and is located at the edge from this side as well as from this side. Therefore, there is a pair of this marking and these threshold markings can come within 3 meters of this edge stripe marking.

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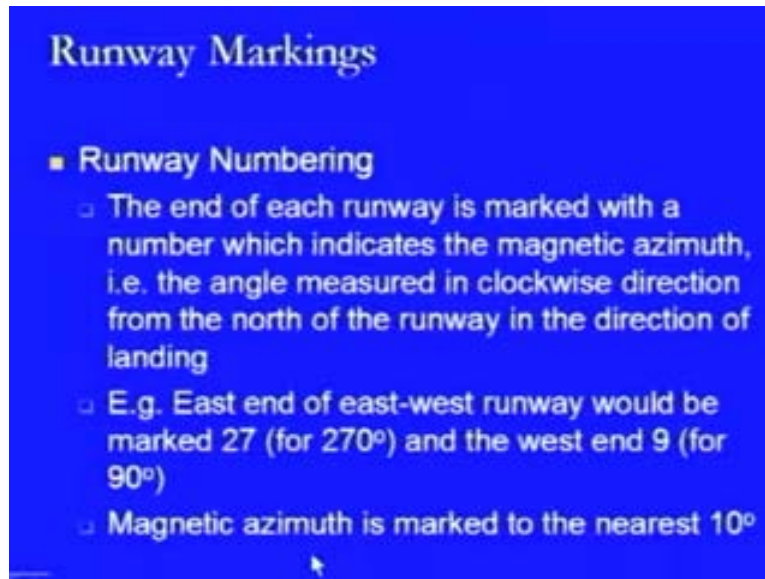
This is another diagram which tries to show the displaced threshold. Here, the arrows are showing the direction in which the landing will be taking place. So, this is another type of landing direction indicator which is used on any runway strip and then, in case of the displaced threshold a line is to be provided like this which is 3 meters minimum of width and moves across the runway strip. So, it defines that this is the end of the runway strip in this sense, because we cannot use this end of the runway strip due to the obstructions and then use, as the same way as we have done with respect to the end of the runway strip, from a distance of 6 meters the threshold markings will be provided and here the arrows which are being located they are 36 meters in length with the clear gaping of 24 meters between the two arrows stripes.

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Now, there is another diagram for this runway displaced threshold. We can see different type of ways of doing the same thing. This is the one which we have already seen, where this is the, this defines now the end of the runway strip and with respect to this we have the threshold markings and this is the centreline marking and these are the arrows being provided this way. Different dimensions have been shown here. Another way of doing the same is in this form and then, there is a temporary displacement is there. That is why this is thinner line and the arrows are showing that you are moving in this direction. So, this is temporarily displaced threshold condition. This may be a temporary or a permanent displaced threshold condition.

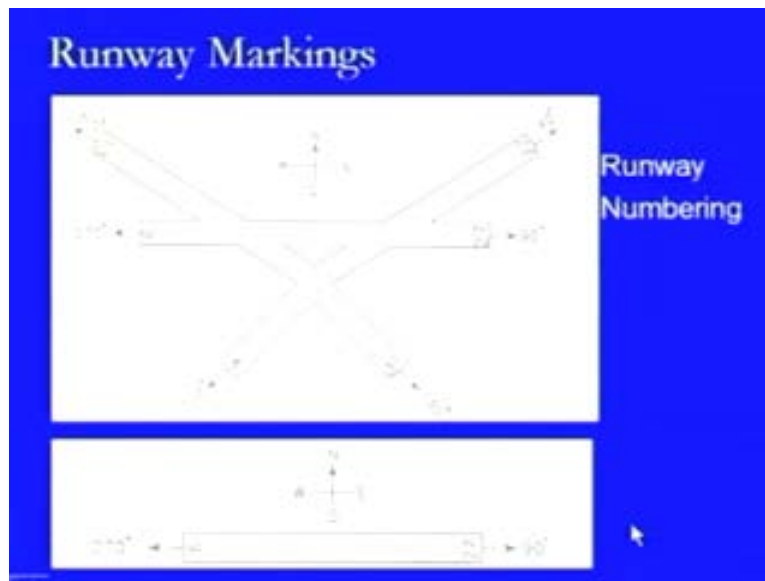
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Then, another type of marking is the runway numbering. In this case, the end of each runway is marked with a number which indicates the magnetic azimuth that is what we have seen in the previous one diagram that 20L was written. So, 20 is trying to define the magnetic azimuth. That is the angle measured in clockwise direction from the North of the runway in the direction of landing. So, if we move with respect to the North direction in this form of a clockwise direction, then at an angle of 200 degrees, we are trying to show this runway strip and for that it will be written as 20L.

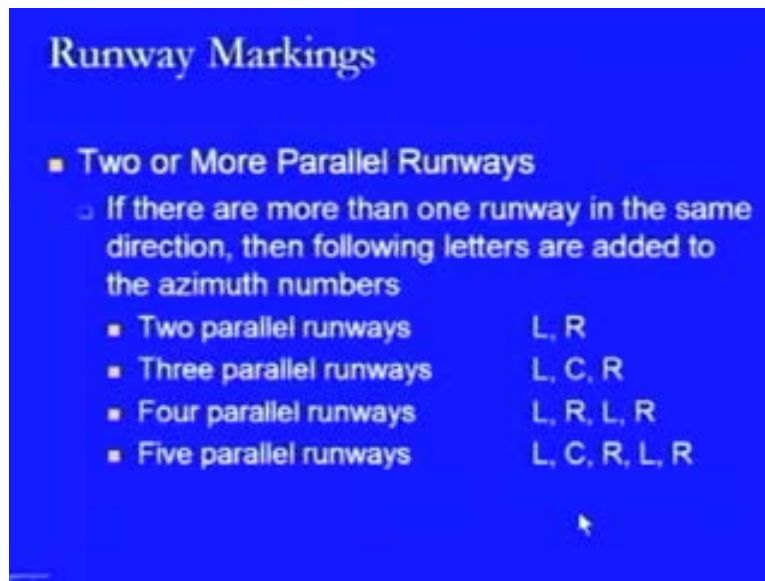
Like there is an example, there is an East end of East-West runway would be marked as 27 for 270 degrees and the West end will be marked as 9 for 90 degrees. The magnetic azimuth is marked to the nearest 10 degrees value.

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Here, in this diagram, we are trying to show again, there are number of runways strips which are intersecting with each other and in that sense, here this is 13, this is 13. 13 is for this direction. So, this is 130 degree, whereas when we are looking at 31, so this is for this direction, it means we are going at an angle of 310 degrees with respect to the North direction. Similarly, like this is 27, because we are going into 270 degree angle condition or this is 9, because we are going towards the 90 degree angle condition. So, it is all respect to North condition and this is another example which we have just discussed with respect to East and West and that is having a value of 9 and 27. So, these are the runway numbering stripes.

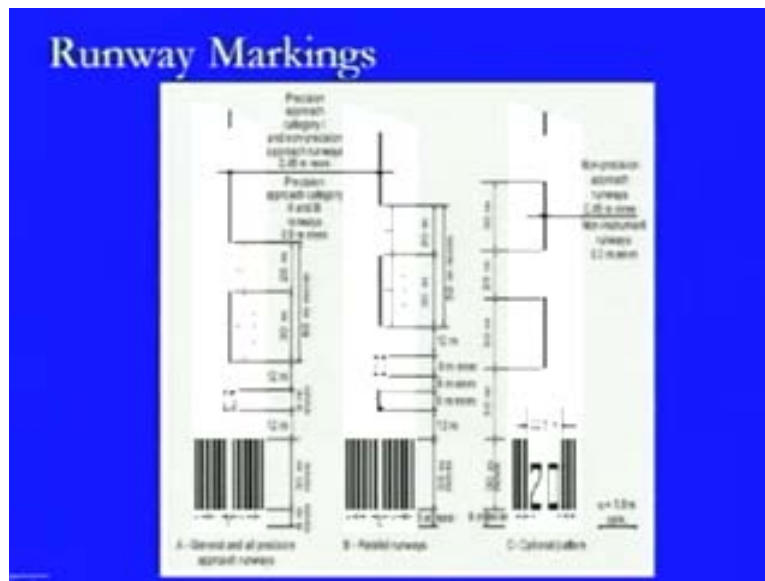
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Then, two or more parallel runways if are provided on any of the airport, then in that case, there is a specific way in which this is to be defined to the pilot. As we have seen in the previous one of the cases that it was written 20L, it means that there are two runway strips and in that case, one will be a left runway strip, another will be a right runway strip. So, if there are more than one runway, in that case, we will be using some of the letters, so as to define what number of runway stripes are being provided and here like for two parallel runways we will be using L and R, for three parallel runways we use left and right with central. If there are four parallel runways, then there is left and right on this side and left and right on the other side. When it is five parallel runway conditions, then we have L C R and L R, like it depends in which particular way the parallel runways have been provided.

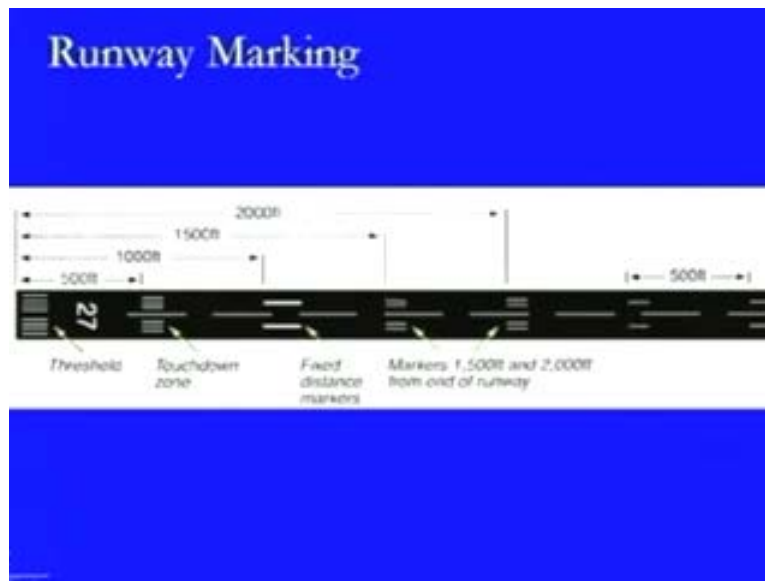
So, we have one set which has L C R condition and then there is another parallel set being provided which is defined by L and R condition. So, this gives the information to the pilot that there is another runway strip on the other side and the pilot has to be careful with respect to the operations which are going on, on the other runway strip.

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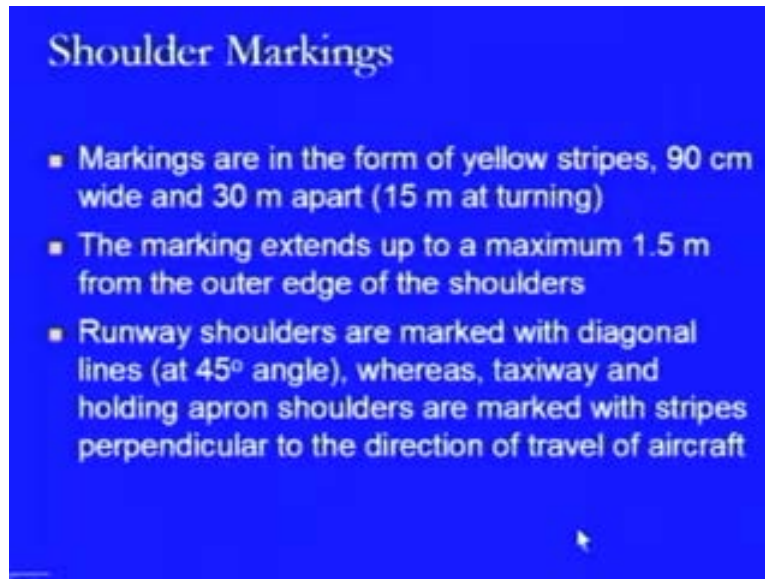
These are the things which have been shown here. There is a number of different ways by which this marking can be shown, like it is 20 being defined here, it is 9 meters long in this form. So, this is 9 meters long. Another way is that there is a 20L condition. So, 20L can be written as 20 with L as the bottom or it may be 20 and L in continuation. That is the two ways by which it can be done and the other one, third way is that we can use this 20 within the threshold markings. So, this is the way this within threshold marking it is being done. So, there are different ways by which the runway markings can be provided.

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Now, in this diagram, we can look at the various types of the markings which we have discussed so far, like these are the threshold markings being provided. Then, there are the centreline markings being provided like this. Then, there are the touch down zone parking being shown in this form, in this form or this form. This is the fixed distance marker or the airline pointer. These are provided in wave form. The distance is also being shown. Then, there will be an edge strip marking to be located on this side which is not being shown in this diagram.

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Apart from these runway markings, then another set of markings are shoulder markings. Here, the markings are in the form of yellow stripes, which are again 90 centimeter wide and they are provided at a distance of 30 meters from each other. But at the point where there is a turning, these are provided at a distance of 15 meters. The marking extends up to a maximum of 1.5 meter from the outer edge of the shoulder. So, whatever is the edge of the shoulder, from that point it goes up to a value of 1.5 meters.

Runway shoulders are marked with diagonal lines that is at an angle of 45 degrees, whereas the taxiway and holding apron shoulders are marked with stripes which are perpendicular to the direction of travel of aircraft. So, that is how a pilot can understand that they are moving away from the runway and they are coming on the taxiway or holding apron. So, as soon as the markings become straight or perpendicular to the edge, it means the runway is over and they are moving on taxiway or holding apron.

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Shoulder Markings

- Blast pad at the runway end is marked with chevron or V-shaped lines

The blast pad at the runway end is marked with chevron or V-shaped lines. So, we can have the V-shaped lines, which defines that this is the blast pad or from that particular direction the take-off will be taking up on that runway stripe.

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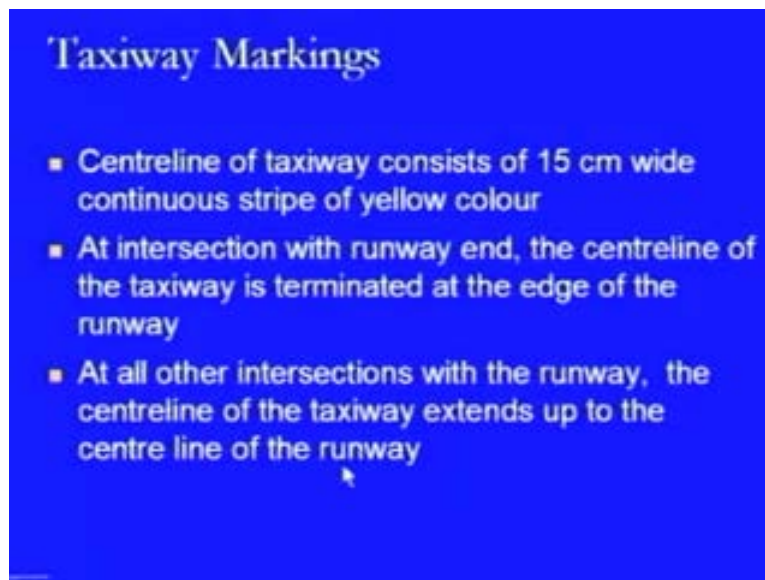
Shoulder Markings



This is one diagram which tries to show the things like this is a runway strip. So, with respect to this runway strip, on the two edges the markings have been provided at an

angle of 45 degrees and they are located at a distance of 30 meters, but when it comes towards this turning area, then it will be located at a distance of 15 meters. Then, here in this location, a blast pad is being provided and this is provided with V shaped chevron that is the way it is being located, it is being provided and the aircraft will be taking a take-off in this form. Then, here what we see is that, in this one still they are the angle conditions. That is the part of the runway and as soon as it comes to the holding apron, then they become perpendicular to the edge. So, we can look at these perpendicular strips being provided and at the maximum, they can go up to a distance of this 1.5 meters, like this one, like this and here this is the point of turn and in between these point of turns it is located at a distance of 15 meters. So, this is how they are being located here. From the edge it is 1.5 meters on this side.

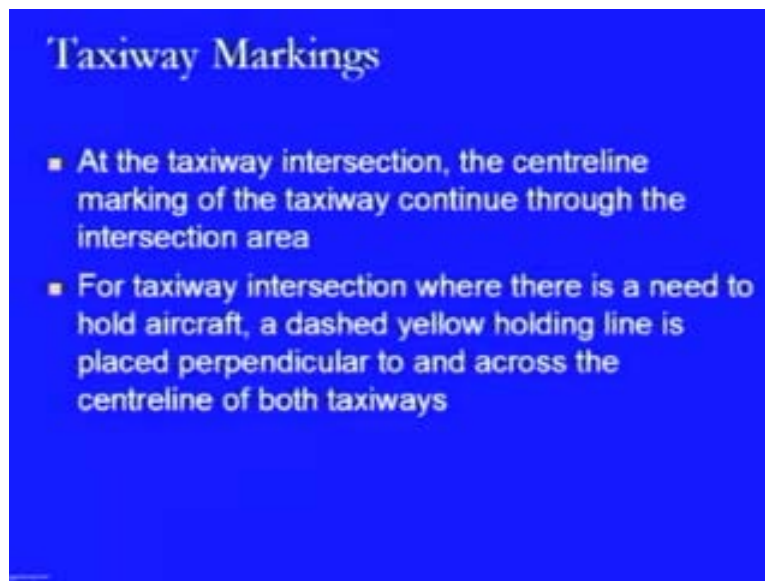
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Now, centreline of taxiway consists of 15 centimeter. This is another type of marking, which is 15 centimeter wide and it is provided in the form of continuous stripe of yellow colour. So, along with this one, there will be again the different other markings which will be there on a taxiway. One of the types of the marking we have already seen in the previous diagram, where we have looked at the edge markings provided on the taxiway also. Now, the intersection with runway end, the centreline of the taxiway is terminated at

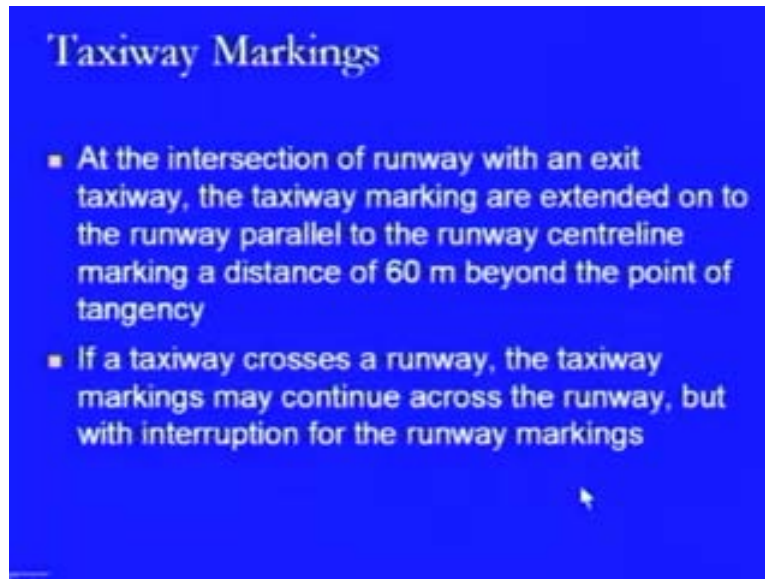
the edge of the runway. So, that is the way whatever is the centreline is coming from the taxiway if it reaches the runway strip, then at the edge of that runway strip it will be terminated, will be stopped. At all other intersections with the runway, the centreline of the taxiway extends up to the centreline of the runway. So, we will be looking at these types of ways in which these markings are provided.

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At the taxiway intersection, the centreline marking of the taxiway continue through the intersection area. So, if it is only a taxiway intersection, then that can cross each other. For taxiway intersection where there is a need to hold the aircraft, a dashed yellow holding line is placed perpendicular to and across the centreline of both taxiways. So, that is that particular line we defined, that aircraft needs to be stopped by this position, if it is required.

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Similarly, at the intersection of runway with an exit taxiway, the taxiway markings are extended on to the runway parallel to the runway centreline, marking a distance of 60 meters beyond the point of tangency that is with respect to the exit taxiway and runway connectivity. If a taxiway crosses a runway, the taxiway markings may continue across the runway, but with interruption for the runway markings. So, the runway markings should remain clearly visible and there should not be any vagueness in understanding those markings with respect to the crossing markings being provided for taxiways.

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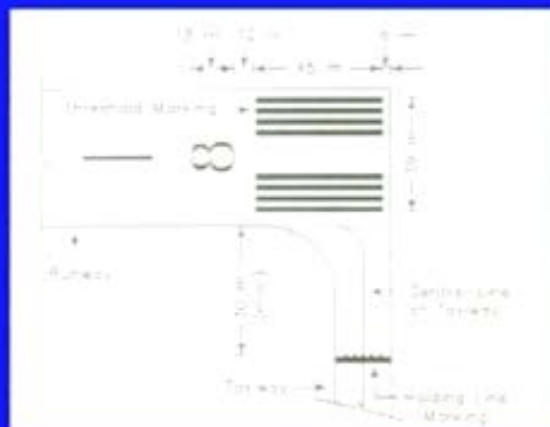
Taxiway Markings

- When the edge of the full strength pavement of the taxiway is not readily apparent, the edge of the taxiway is marked with two continuous 15 cm wide yellow stripes 15 cm apart.

When the edge of full strength pavement of the taxiway is not readily apparent, the edge of the taxiway is marked with two continuous 15 centimeter wide yellow stripes which are 15 centimeter apart.

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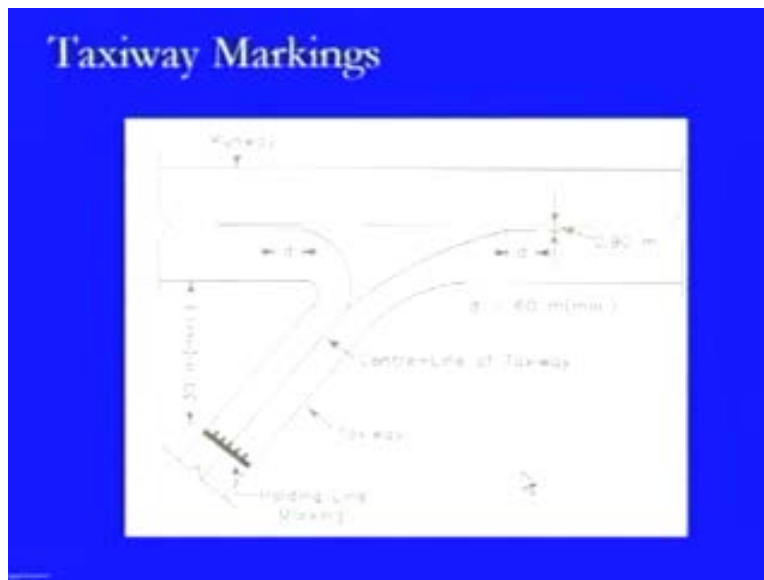
Taxiway Markings



So, here we can look at these markings in a diagrammatic form. This is the diagram which tries to show the markings with respect to this runway stripe. This is the runway

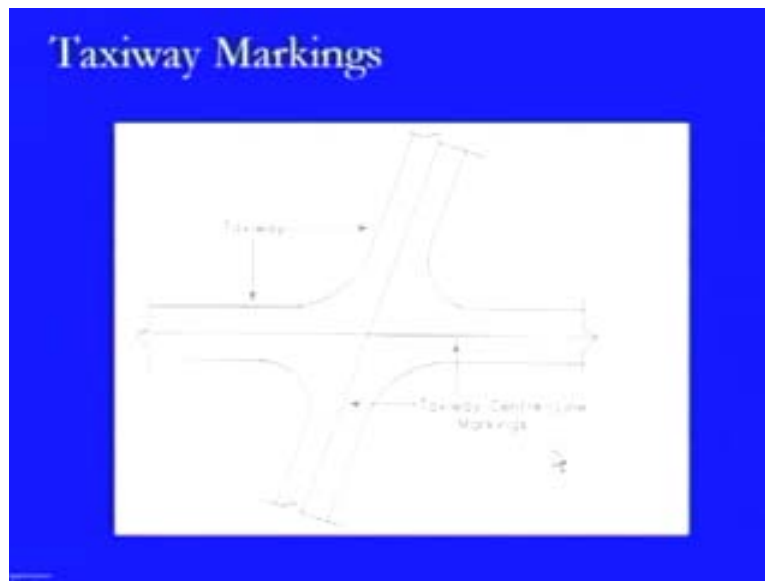
stripe, the markings we have already discussed. Here, there is a taxiway, there is an exit taxiway being provided. So, this is the centreline of the exit taxiway which is going and ends at the edge of the runway stripe. This is what we have already discussed. Here, there is a holding line which is provided and if an aircraft is to be stopped then, it is to be stopped by this point, so that there is no problem as far as the operation on this runway stripe is concerned.

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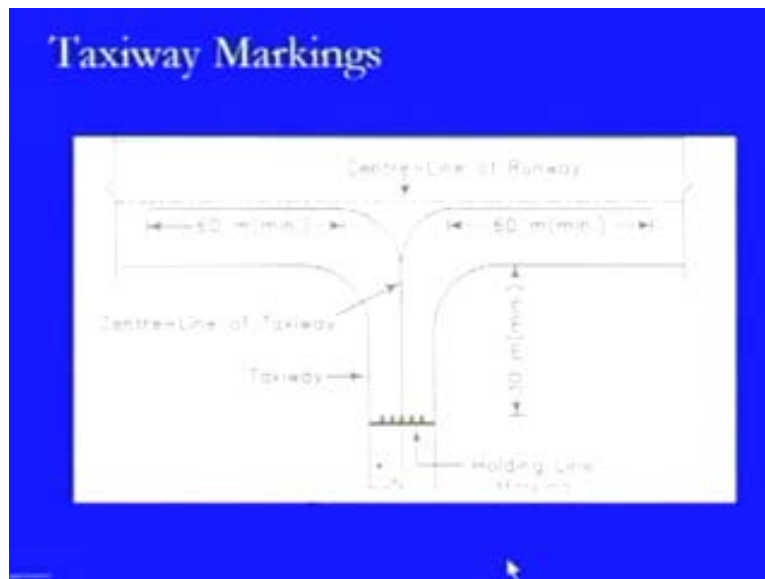
This is another diagram which tries to define the connectivity of the runway strip with this taxiway and here, the centreline markings have been extended up to the centreline of the runway strip, but are displaced by a distance of 0.9 meters from that one and there is some distance by which it continues parallel to the centreline marking of the runway strip that is D , which is minimum 60 meters and the rest of the things are as such and this holding line is at a distance of minimum 30 meters from the end of the. from the edge of this runway stripe.

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This is a crossing of two taxiways and therefore, it is permitted that the lines of or markings of the taxiways may cross each other as been shown here. So, these are the two centrelines which are crossing each other.

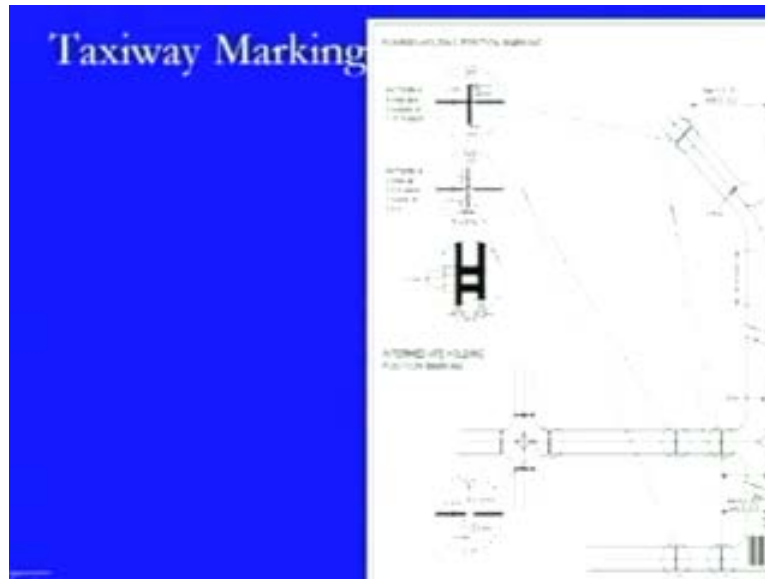
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This is another diagram which tries to provide the connectivity between the runway strip and this is the exit taxiway which is perpendicular to runway strip. Here, the centreline of

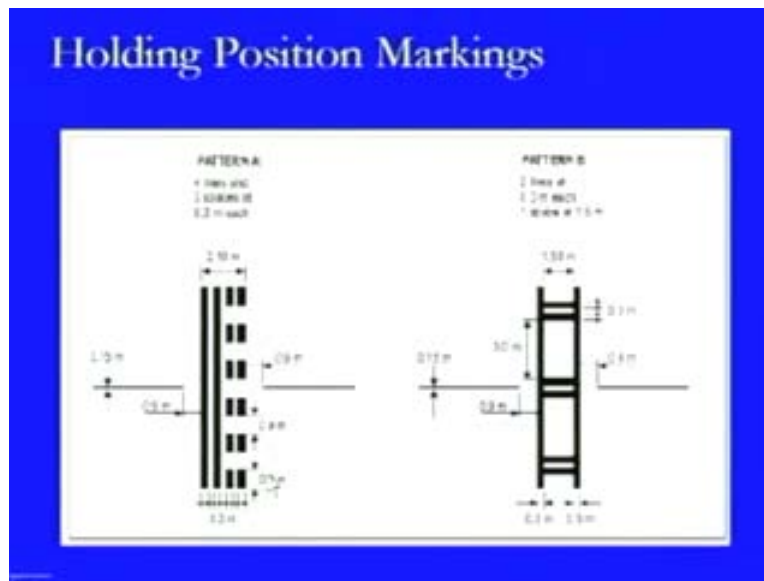
this taxiway is going and it extends again for a 60 meter minimum distance on this side as well as 60 meter minimum distance on this side and becomes, remains parallel to the centreline of the runway strip.

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This is another big diagram which tries to show the various types of connectivities. We have the runway stripe on this side. We have the exit taxiway being provided at the end of this runway strip, then there is perpendicular taxiway being provided to this runway strip and then there is an exit taxiway, rapid exit taxiway being provided here, by which the aircraft which is coming in this direction can move away. So, all the three conditions with respect to the runway stripes have been depicted and the linings have been shown. At the same time, there is a crossing which is being shown here, which is with respect to this exit taxiway and another parallel taxiway being provided with respect to this runway strip. So, the connectivities as well as the various markings have been shown at this location also.

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This is a diagrammatic view of the holding position markings and its condition by which we can provide. There are two ways in which it can be done - the two parallel lines with the two segmented lines, whereas here it is two parallel lines which are jointed together by the perpendicular lines being located by a pair of perpendicular lines located towards the ends as well as the center.

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Airport Markings

- **Closed Runways or Taxiways**
 - For temporarily closed runway, yellow crosses are placed at the two ends
 - For permanently closed runways, yellow cross one at each runway end and at 300 m intervals are placed, and threshold, runway designation and touch down markings are obliterated
 - For temporarily closed taxiways, barricades with orange and white marking are used
 - For permanently closed taxiways, a cross is placed at each entrance to the taxiway.

Now, we look at another type of airport marking which is closed runway or taxiway marking. In the case this is for temporarily closed runways, then it is, yellow crosses are placed at the two ends which defines that it is temporarily closed. In case it is permanently closed, then the yellow cross one at each runway end and at 300 meters intervals are placed and the threshold runway designation and touch down markings are obliterated. For temporarily closed taxiways, barricades with orange and white markings are general used. In case there is a permanently closed taxiway, then a cross is placed at each entrance to the taxiway.

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This is the way generally we do this closed runway or taxiway marking. Here we can see that this is a cross being provided, the dimensions are been shown here that is 1.8 meter wide with this distance is 14.5 meters and this distance is 35 meters and this is another type of marking which is provided. This is for basically the closed taxiway marking which is provided. This is for basically the closed taxiway marking. So, this is for closed runway marking and this is for closed taxiway marking. So, this is what is related to the various types of markings which are provided on any of the airport in the form of the visual aids which helps the pilots to do certain operation like take-off and landings.

In the case of landings they are more important, because the safety is to be ensured at the time of landing as well as at the time when the speed of that aircraft needs to be reduced by reaching the exit taxiway or rapid exit taxiways. So, this is the point at which we will be closing our discussion regarding the visual aids and we continue the same in the coming lecture. Till then, good bye and thank you to you.