Indian Institute of Technology Kanpur
National Programme on Technology Enhanced Learning (NPTEL)
Course Title
Engineering Graphics

Lecture – 26
Space Geometry-Introduction

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So let us start space geometry what we have covered till now, till now we have covered projection of a point in a space on different projection planes.

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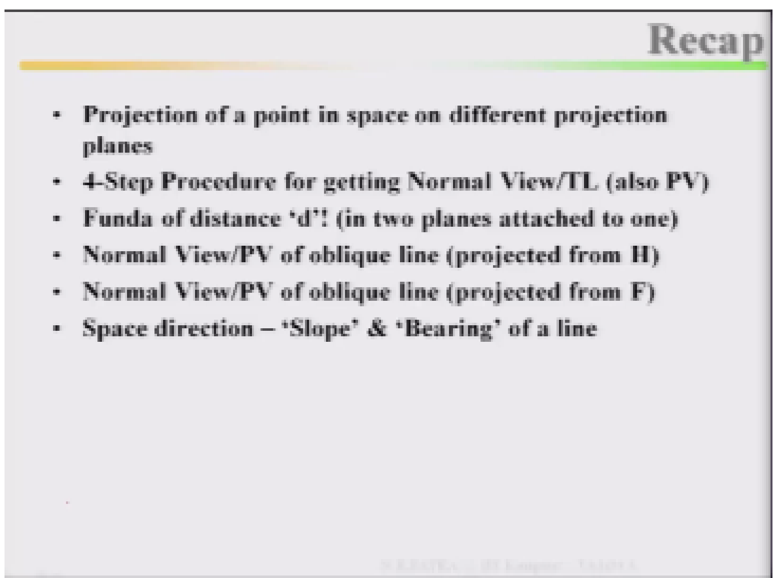

Then four step procedure for getting normal view or the true length. Funda of your distance d in two planes attached to one, normal view or point view of oblique line. Projection from horizontal plane as well as projection from frontal plane. Space directions, slope and bearing of lines, up to this we have completed.

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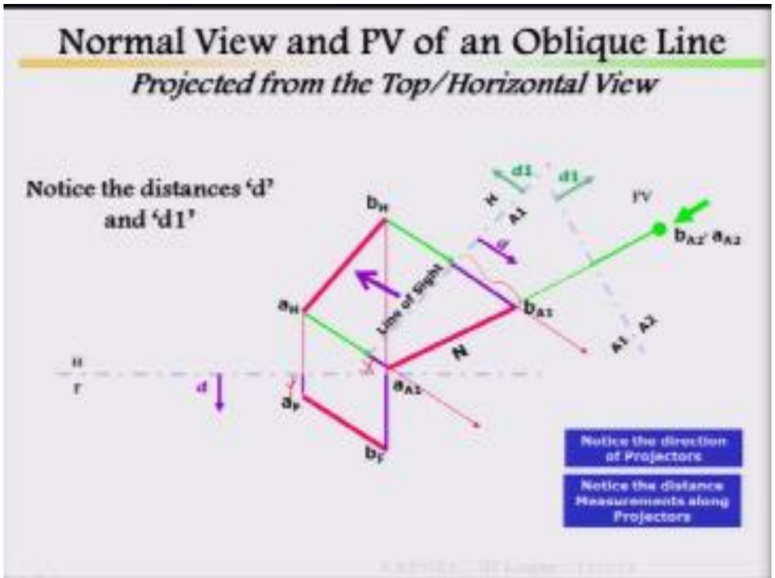

For revision what we have done, notice how the distance D come into picture here you notice it how the distance D, the distance D from here to here will be taken as distance D from here to here. This distance will be taken as this distance, and distance from here to here will be taken as the distance from here to here. It is with respect to frontal view, true length with respect to your frontal view.

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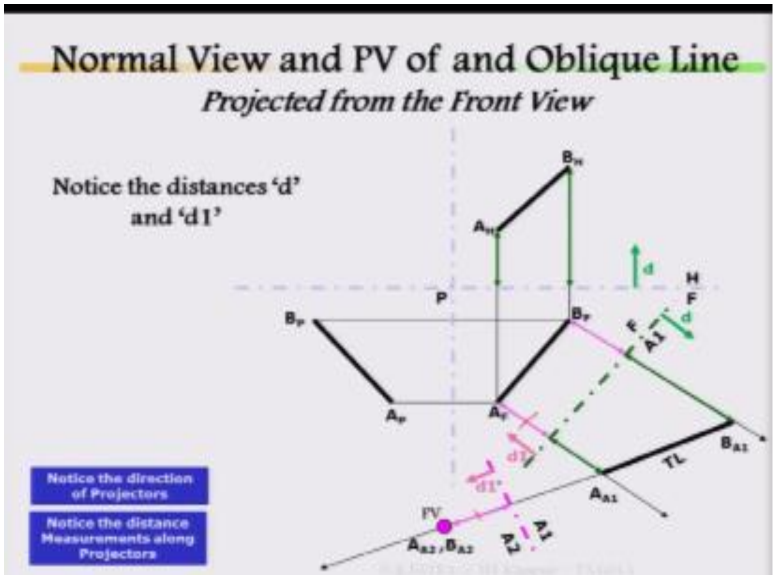

Now consider the second part of your normal view and point view and oblique line. In this case if you look at the point view this is your true length. Then the distance D you mark it, distance D from here to here, here to here taken as from here to here. The distance D and D1, just this is for a revision.

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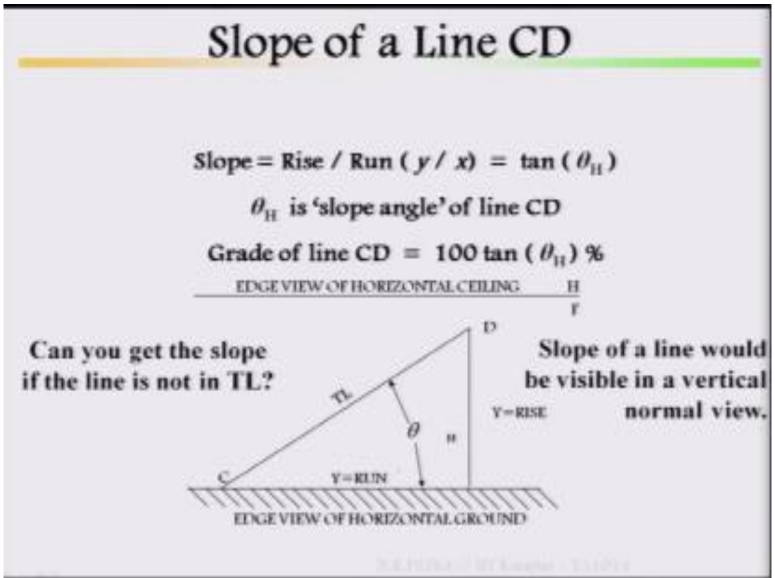

And what we have covered till now slope of a line, slope is nothing but is your Rise/Run y/x and it is mentioned as tan θ_H. So upward slope will be positive and downward slope will be negative. Grade of a line it is 100xtanθ in terms of percentage. Can you get the slope if the line is not in true length, yes or no? So it has to – you have to brought it back of the true length then only you can find it out your slope. Slope of a line would be visible in a vertical normal view.

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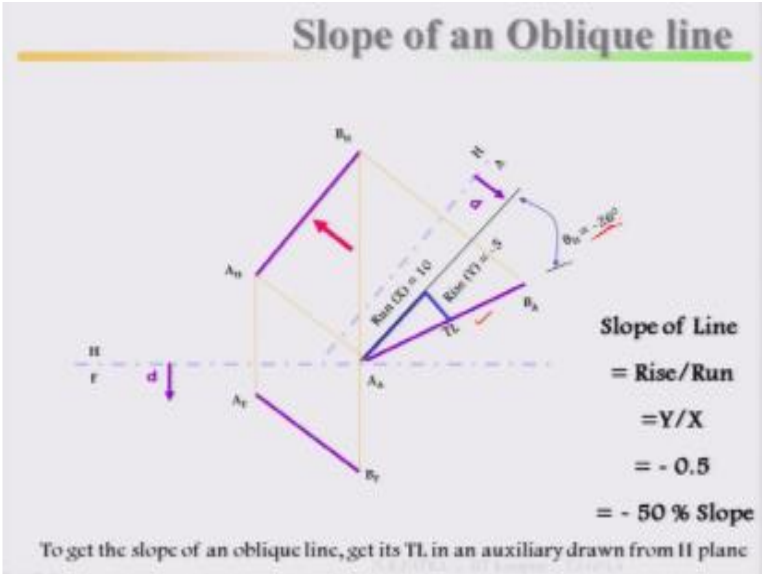

Now look at here slope of an oblique line, so there is oblique line, its front view as well as top view has been given. So then you find it out what is your true length, so this is your true length, once you get the true length then find it out the slope. So this slope is downward that is why this ɵ is negative and it is -26˚. And the percentage is 50% of your slope, to get the slope of an oblique line get its true length in an auxiliary drawn from horizontal plane.

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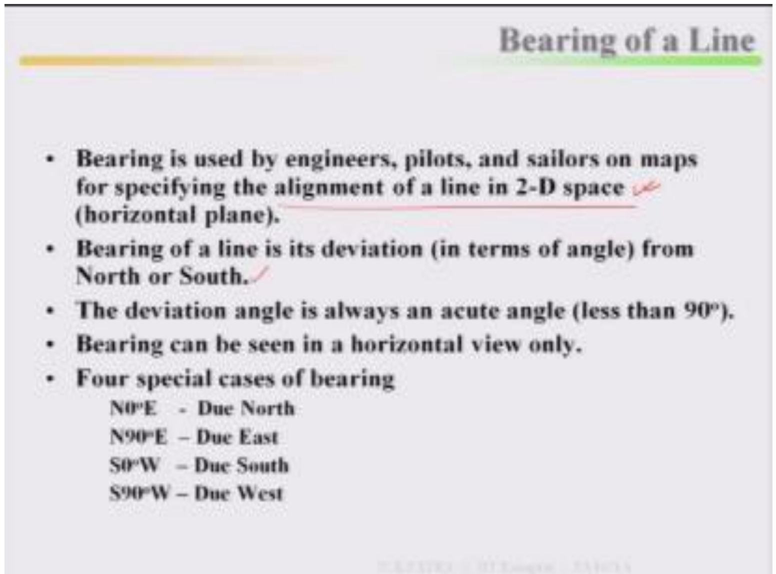

Now come to your bearing of a line, now we will start this from here, this is the beginning. Whatever we have covered that last two or three slide that was about the previous lecture. Bearing is used by engineers, pilots, and sailors on map for specifying the alignment of a line in 2-D space. Remember for specifying the alignment of a line in 2-D space bearing. Then bearing of a line is its deviation.

In terms of angle from north or south, bearing of a line is its deviation with respect to north or south, not east or west mark the difference. Then the deviation angle is always an acute angle that means it is less than 90˚. Then bearing can be seen in a horizontal view only, in a horizontal view only. Four special case of bearing, now look at N0˚E it is due north, N90˚E it is due east, S0˚W due south, S90˚W due west.

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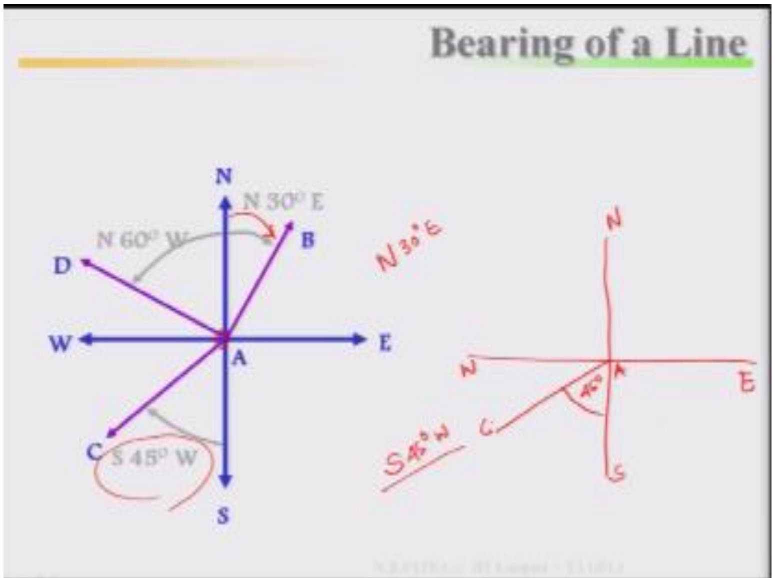

Now look at here north, south, east, west then there is a line here, let us say A and B, then it is traveling from north towards your east. So how it will be written, it will be written like N30˚E that means it will be towards like this from north to east. Now if I come to north to west similarly this is a line AD, it will be north to west it will be written N60˚W. As I said bearing with respect to either north or with respect to either south.

So here north with respect to west, so that means it will be your N60˚W this line is going. Similarly with respect to south S, so here if you look at S45˚W that means this line, if I write it bearing up a line is S45˚W that means the line starts from horizon. So suppose this is O it travels to us in such a way that moving from south. So first what happened you draw four quadrants you draw, mark it north, south, then east, then your west.

Now if it is S45˚W that means line starting from here it will go to your south and from south it will move towards west at an angle 45˚. So line will be covering this, so that means is the meaning from south towards your west that is your 45˚. So that will your A and this is your C, so this will be your south 45 degree west

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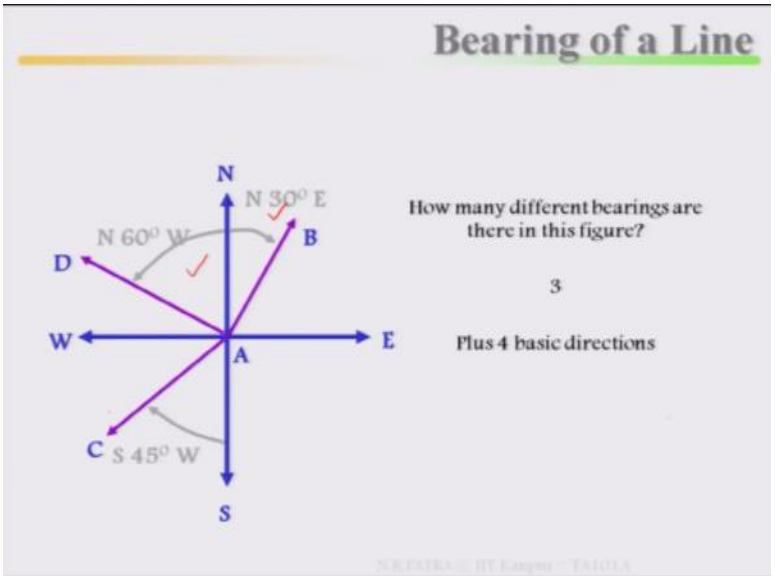

Now look at this questions you can answer in this case, how many different bearings are there in this figure, how many different bearings there in this figure, how many look at here how many bearings are there, as I said bearings with respect to either north or with respect to south. In this case with respect to north, north east, then north west bearing one, bearing two, and with respect to south it will be towards your west that means three bearings are there, three.

Answer is three then plus 4 basic directions, 4 basic directions north, south, east and west these are your basic directions.

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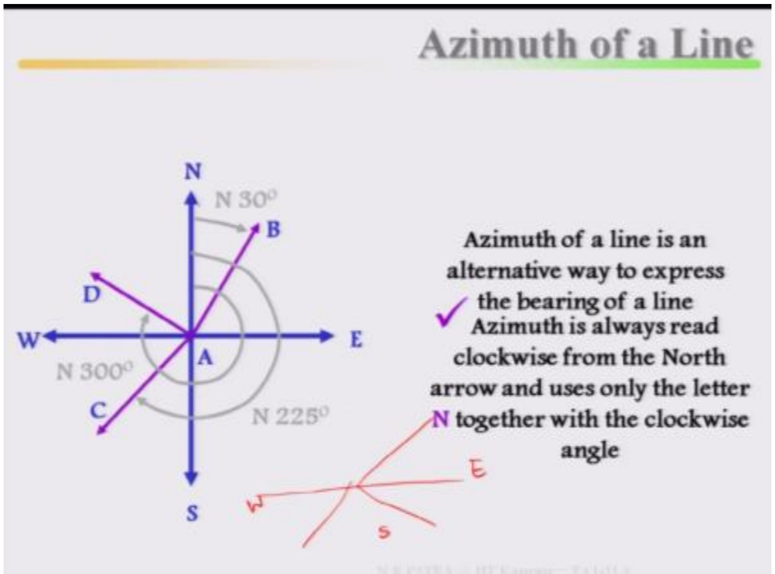

Look at here bearing definition is over now second part is called azimuth of a line, what is it mean, azimuth of a line is an alternative way to express the bearing of a line. It is an alternative way to express the bearing of a line. Now azimuth is always read clock wise remember the difference between your bearing and azimuth. Azimuth is always read clock wise from north arrow you just only the letter N together with the clock wise angle.

If I am right if you understand if you take it this four 2 quadrant this is your north, this is your east, this is your south, this is your west it is always read clock wise from the north, that means if line is here, line is here, line is here it will read from the north and clock wise this is one bearing, this is second bearing, this is your third bearing, and this is your fourth bearing.

Now take this example A, B it is north starting from north and clock wise it is azimuth it is not bearing, difference between bearing and azimuth. Azimuth reference point is your north with respect to north move towards clockwise and in case of bearing with reference point is north, south with respect to either north or with respect to south you move whether it is clockwise or anticlockwise it does not matter. Now in this case it has to go with your clockwise.

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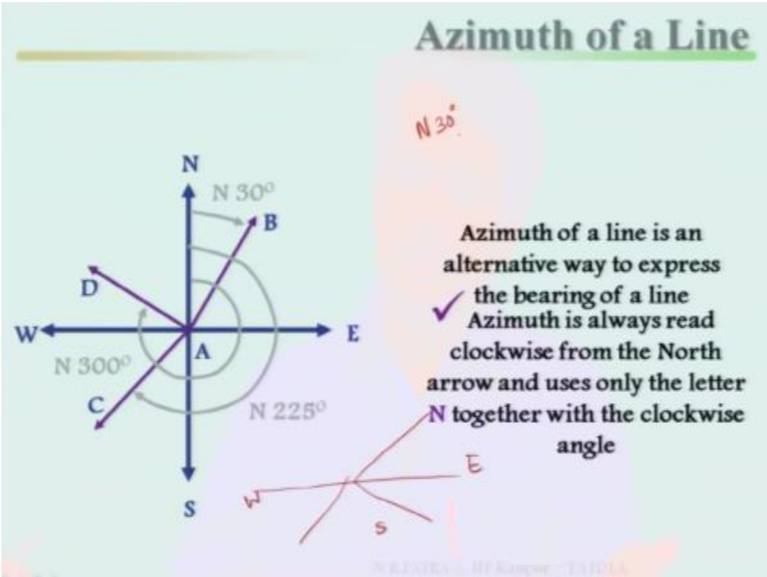

So here A,B north 30 degree, here only with respect to north N degree will be there 30 degree, 45 degree and another difference is in bearing these are all acute angles less than 90 degree but azimuth not necessarily that acute angles. So second case

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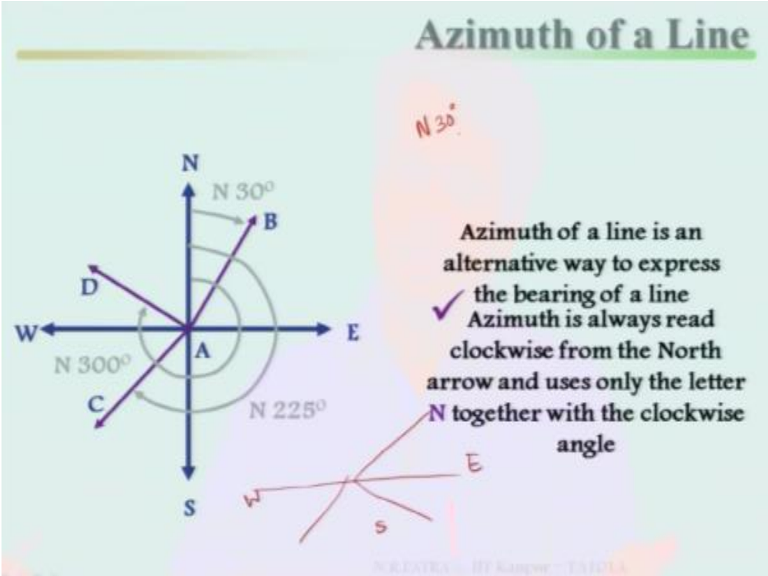

If you look at here A,C it is north 225 degree A,C north 225 degree A,D it is north 300 degree, now this clear about your bearing as well as azimuth, once again I am repeating bearing with respect to north and south, north and south if you come back to bearing definition.

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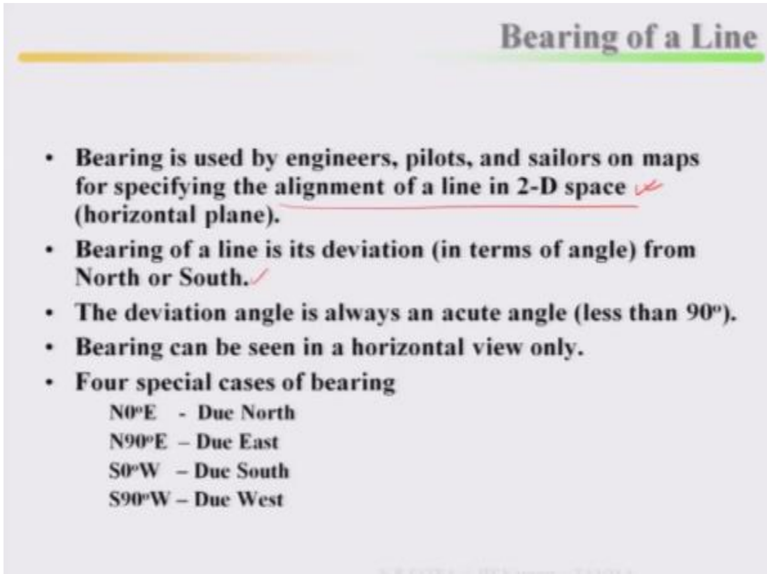

Bearing definitions the deviation angle is always acute angle, it is with respect to either north or south it is always an acute angle or less than 90 degree then

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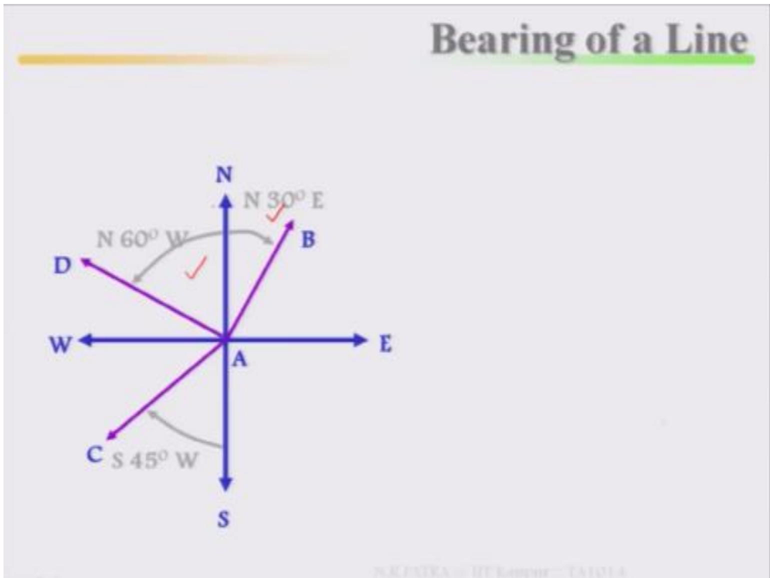

If you see it A one line, second line, third line, it is with respect to north and south and it is an acute angle, then go to, go to your azimuth.

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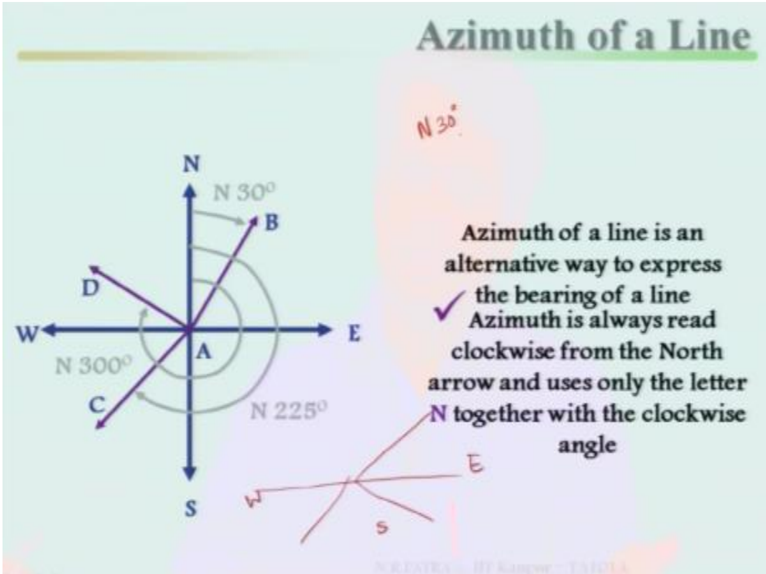

Azimuth is with respect to north and here it is it will be written as north with degree but in case of bearing.

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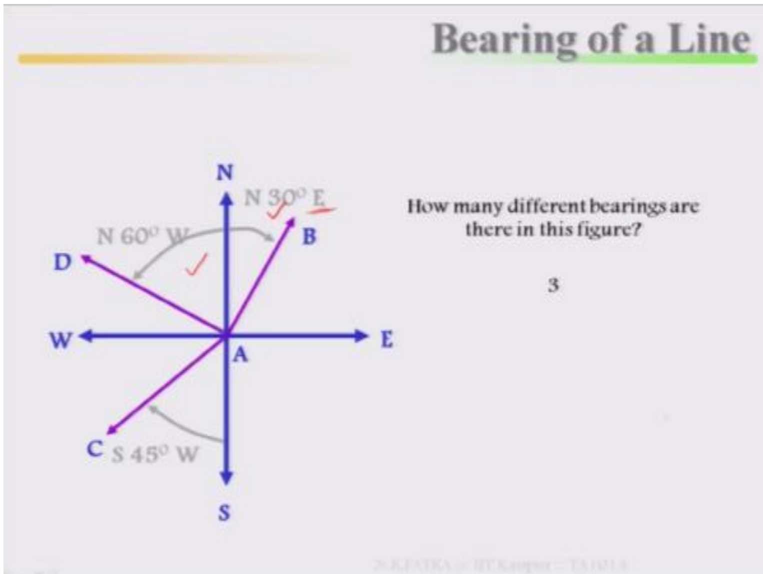

It will be written as north with degree with another directions whether it is east or west it will be written very clearly but azimuth only north 30 degree that is it. It means starting from north clockwise 30 degree starting

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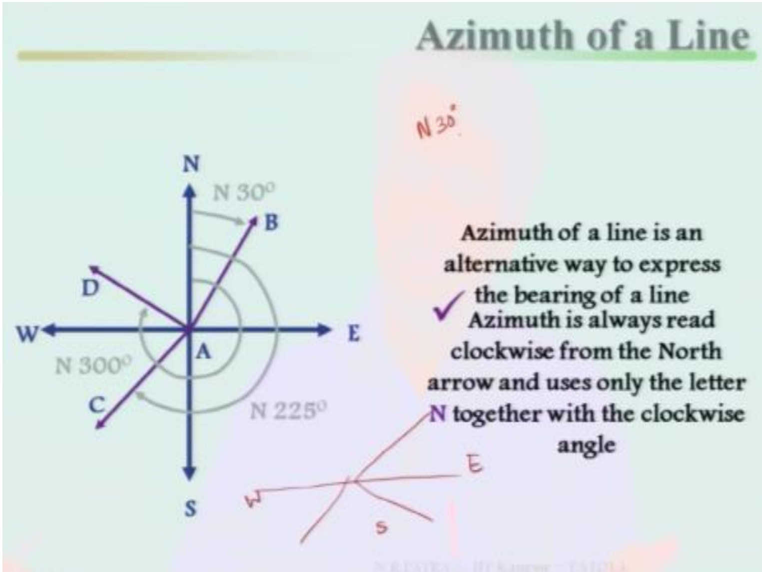

From the north clockwise 30 degree this is the difference between bearing at azimuth.

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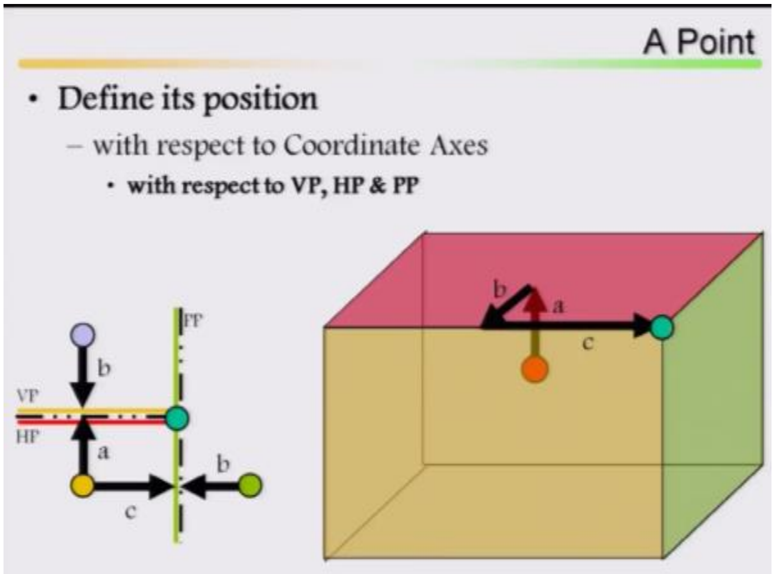

Define its position a point, now let us look at the point, define its position with respect to its coordinate axes, with respect to vertical plane, horizontal plane, and profile plane. Look at a point here, here, here, here, now this point look at this point with respect to vertical plane, with respect to horizontal plane, with respect to profile plane, look at this point I have mark it 1, 2, 3 then take it point A,B,C these are the points marked in your front, top, and profile, front, top, and profile.

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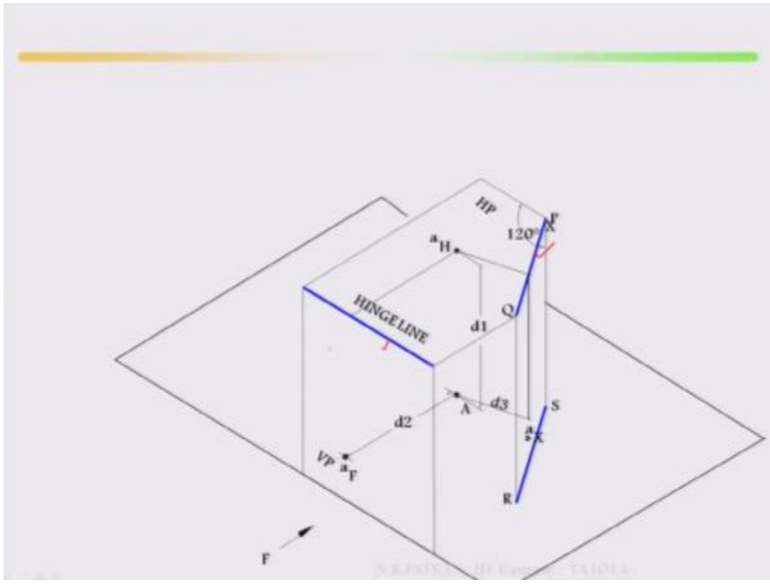

Now come to next part is look at this hinge line and concept of distance D, this is your front view, this is your horizontal view plane and this is your, this is your auxiliary plane. As I said here if you look at here, here you look at this point A it located at a distance D2 with respect to your front, point A it located at a distance D1 with respect to horizontal plane. Now look at here this is your hinge lines with respect to, this is your hinge line, this is your hinge line with respect to hinge line if this is your point it located at a distance D that means this point and located distance D2 and located distance D3, how is your auxiliary plane is coming into picture, this distance, this distance from hinge line to here as I said this distance is nothing but the distance from here to opposite end, what is the distance.

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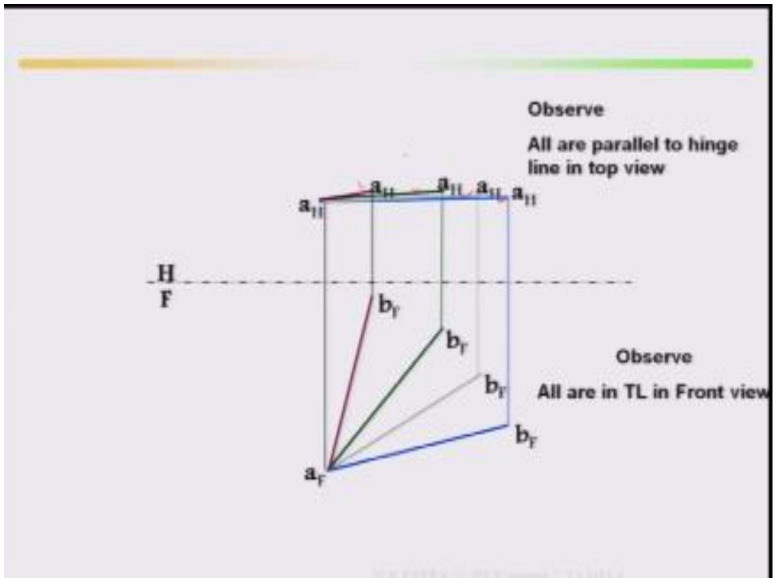

Now look at this view, a line having frontal, having top, look at this. All are parallel to hinge line in the top view, if you look at here all are this, this, this, this are parallel to hinge line in top view, then observe all are in true length in your front view, that means if line opposite view is parallel to hinge line, then opposite to this front view.

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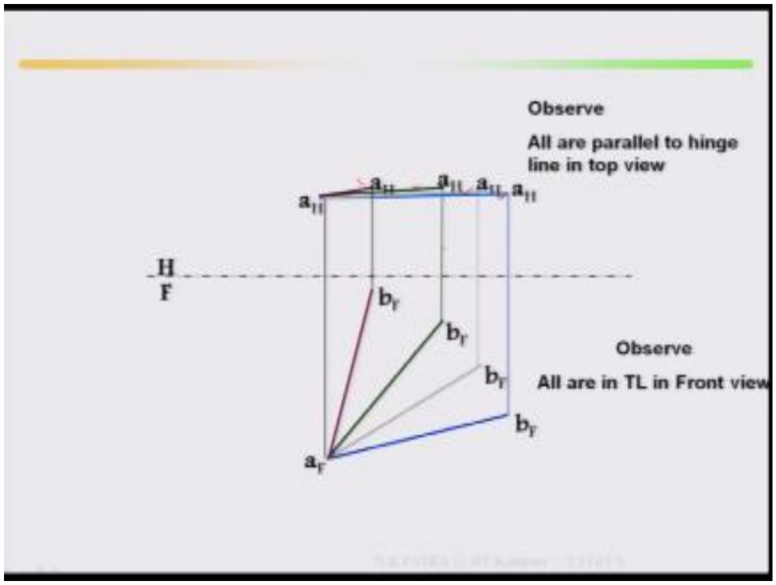

These are all true length because this is parallel to your hinge line.

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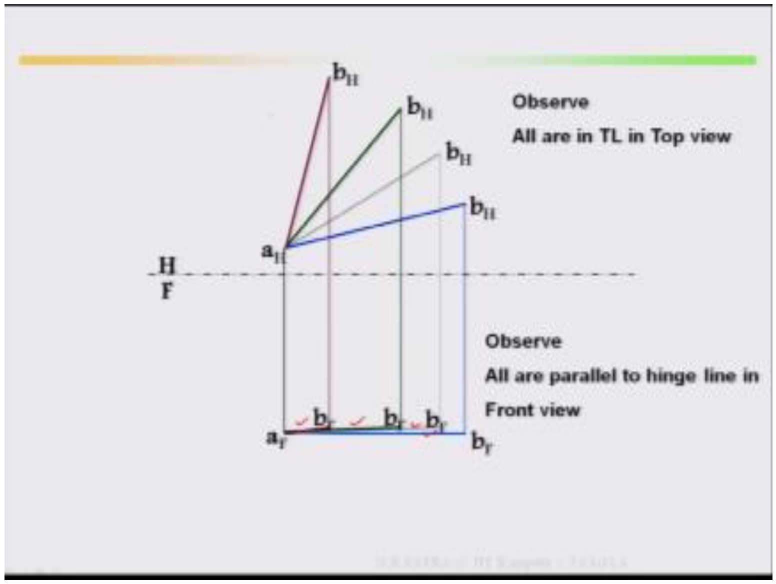

Now look at the line, similarly all lines here, all lines all are parallel to hinge line in front view, I talked about your parallel to hinge line in top view, in this case all are parallel to this line, this line, this line, this line all are parallel to hinge line in front view. That means here in the top view these are all your true length, these are all your true length because this has been projected back, parallel means if this stick is this is parallel to this plane, if I project it back, what happen? This you are supposed to get a true length.

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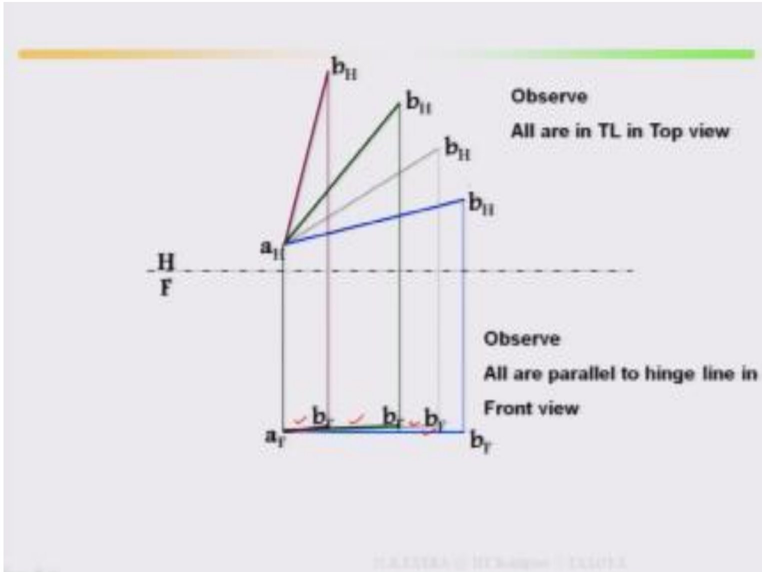

Similarly this is your parallel if I project back I am supposed to get a true length.

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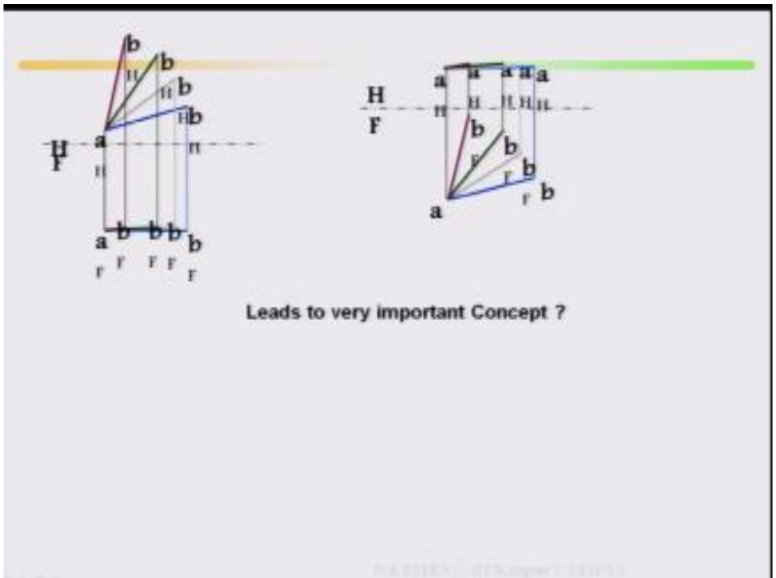

Lead to a very important concept, what is that concept? In one view, in one view it is parallel that means other view if you project it back you will get a true length.

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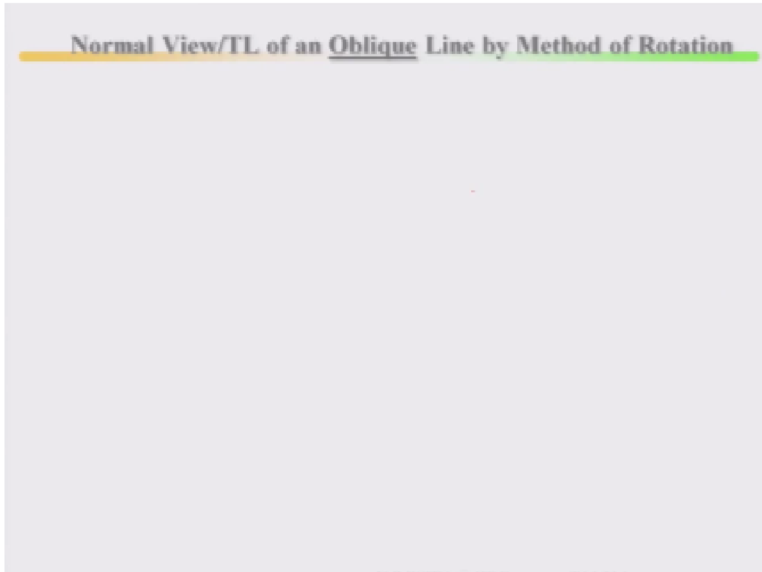

Normal view true length of an oblique line by method of rotations, then there are different procedures how to get true length of a line?

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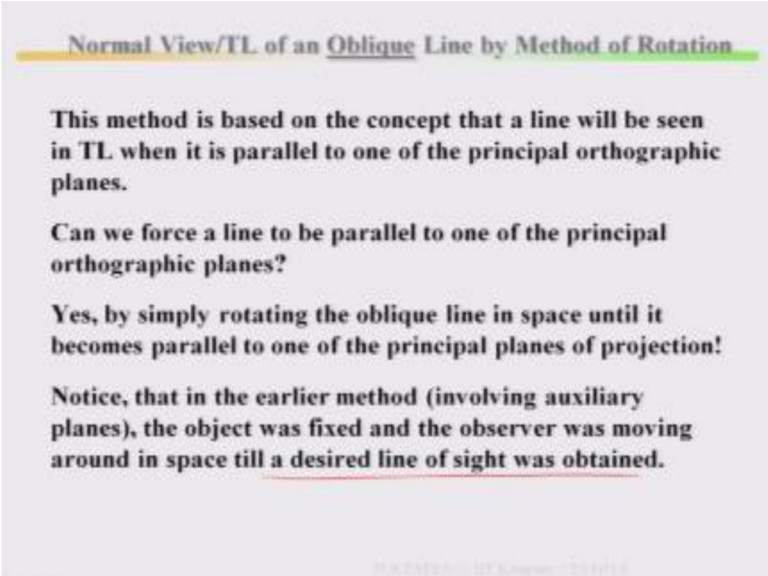

This method is based on the concept that a line will be seen in true length when it is parallel to one of your principle orthographic planes, a line will be seen in true length when it is parallel to one of the principle orthographic planes, right? One of the principle orthographic planes. Now can you force a line to be parallel to one of the principle orthographic planes, yes. If it is inclined we can force it to parallel to one of your principle orthographic planes, yes by simply rotating the oblique line in the space.

It becomes parallel to one of the principle planes of projections; it becomes parallel to one of the principle planes of projections. Notice that in the earlier method involving auxiliary planes the object was fixed, object was fixed and observer was moving around in the space till a desired line of sight was obtained by means of auxiliary method, by means of auxiliary plane method what is the difference? A object is fixed, an observer is moving around the space so that desired line of sight he should get perpendicular to this. so that you should get a true length.

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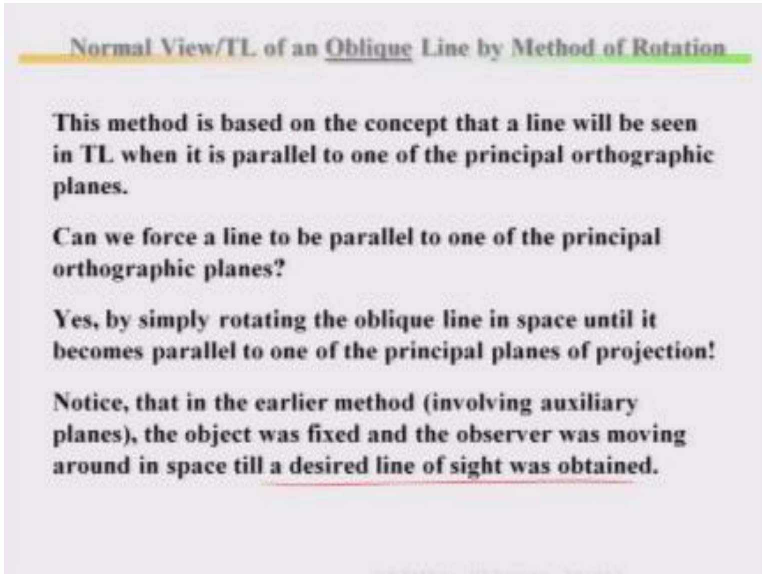

But in this case this oblique line has been rotated in such a way that it should be parallel to one of your principle planes.

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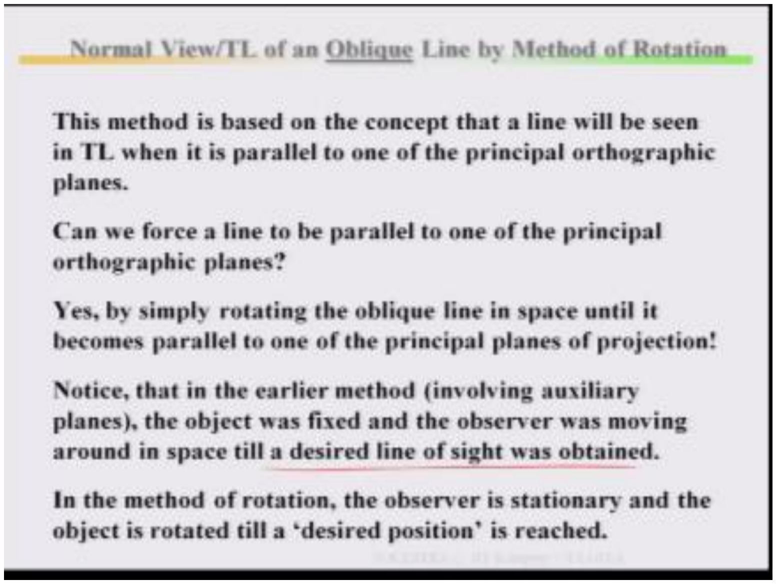

So that you can get a true length of the line, in the method of rotation the observer is stationary and the object is rotated, do you notice the difference between your auxiliary plane method and by means of method of rotation.

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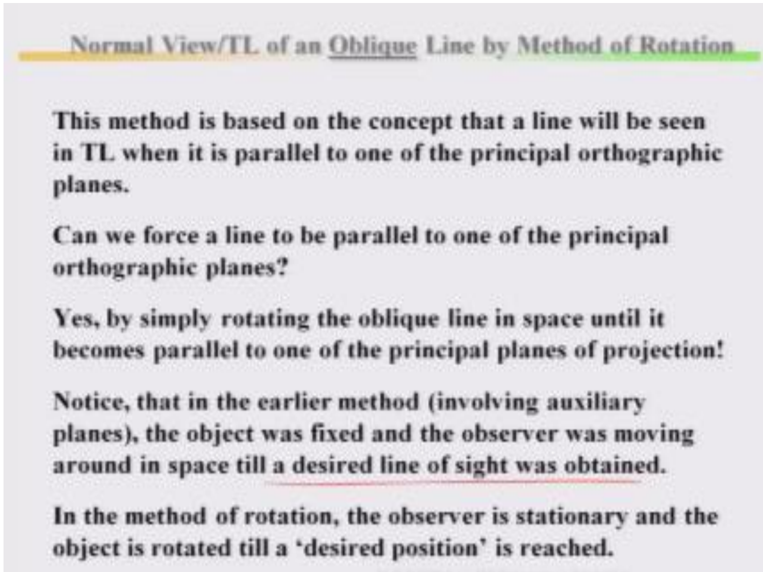

In auxiliary plane methods object is fixed observer is moving, but in case of method of rotations observer is stationary object is rotated, here other case object was fixed. So this is the difference. So this each call method of rotations.

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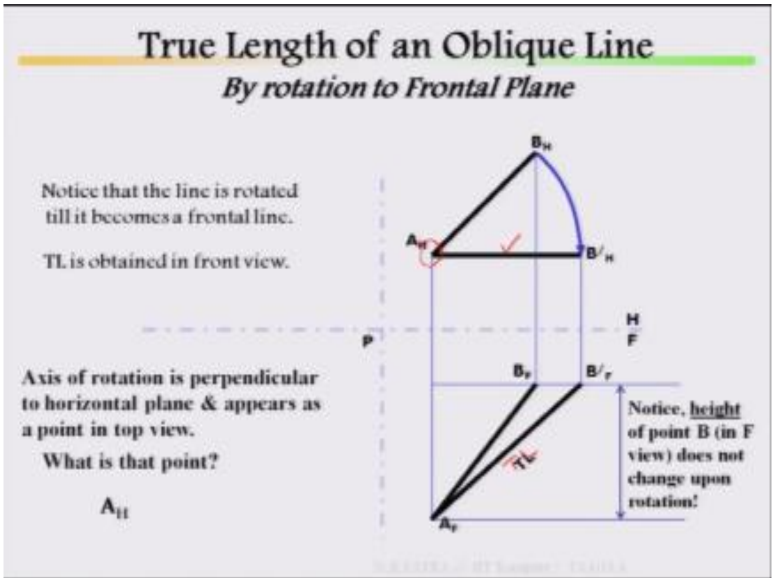

So true length of an oblique line by rotation to frontal pane look at this, I make it horizontal plane, frontal plane, draw a line AH, BH line in your top view, then similarly line in the front view AF and BF. So by means of rotation in the frontal plane. So you take the rotation in the top view then make the line, why I rotate it?

Once you rotate it this line supposed to be parallel to your one of your principle plane. So this line is parallel to one of your principle plane, then you project it back to your opposite view. Line is rotated till it becomes a frontal line that is true, then you project it back to your other view it has been projected back, then this line has been joined, line has been joined. So this is your true length, true length you are getting in front view. Axis of rotation is perpendicular to horizontal plane and appears as a point in top view. Remember axis of rotation is perpendicular to horizontal plane and appears as a point in top view. What is that point?

$A_{H,}$ axis of rotation this is your axis of rotation is perpendicular to the horizontal plane and appears as a point in the top view, this point is your axis of rotation with respect to this point. Notice height of point B, height of point B in front view does not change upon rotation, this height does not change upon the rotations, by method of rotation it changes its positions. But this height is not going to be changed, this is important point.

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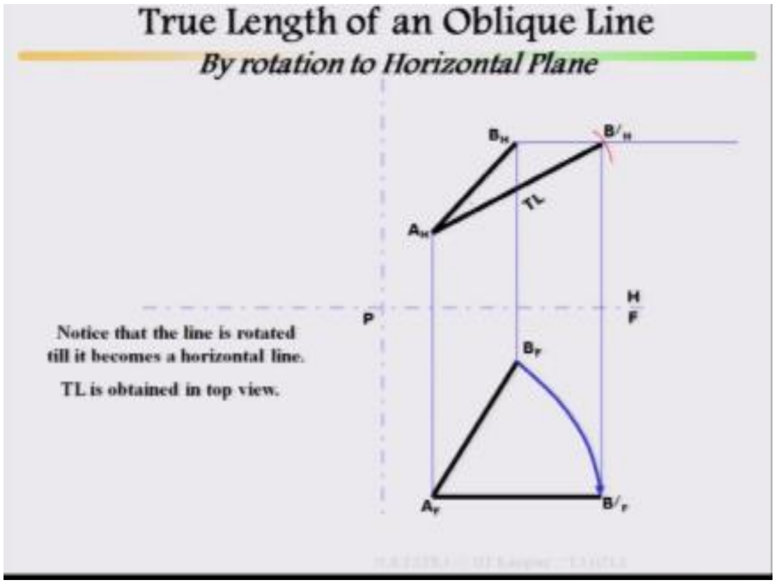

Now true length of an oblique line by rotation to horizontal plane. Similarly, A_H, B_H in the top view, similarly A_F, B_F in the front view, so it has been rotated in the frontal plane, so A,B is parallel to your one of your principal planes, then you project it back. The line is rotated till it becomes horizontal line. True length is obtained in the top view, then you project it back, then from here draw your horizontal line because this distance is not going to be changed, then from here you project it back where it cuts from here to here this line has to be join, so this is your true length, this is your true length.

The line by rotating at top view you are getting a true length in the front view. A line rotated in the front view we you are getting a true length in the top view.

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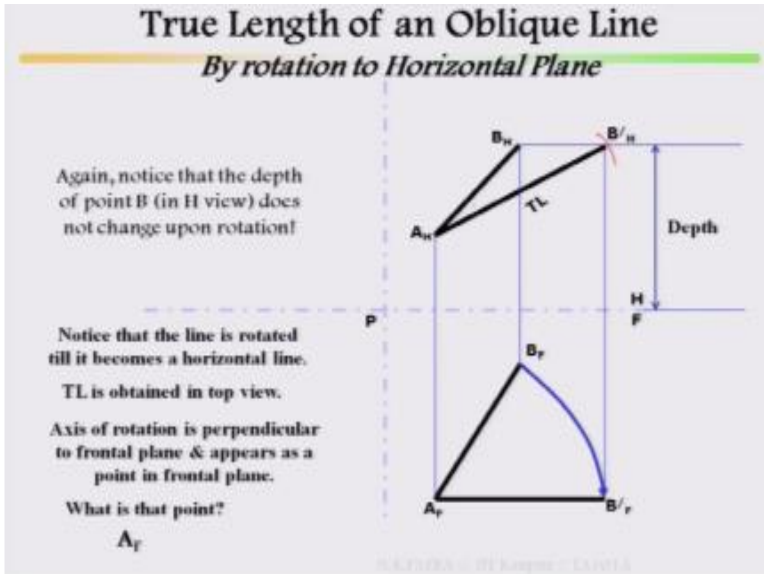

A axis of rotation is perpendicular to frontal plane and appears as a point in the front plane. What is that point? A_F. Again notice that the depth of point B in H view does not change upon your rotation.

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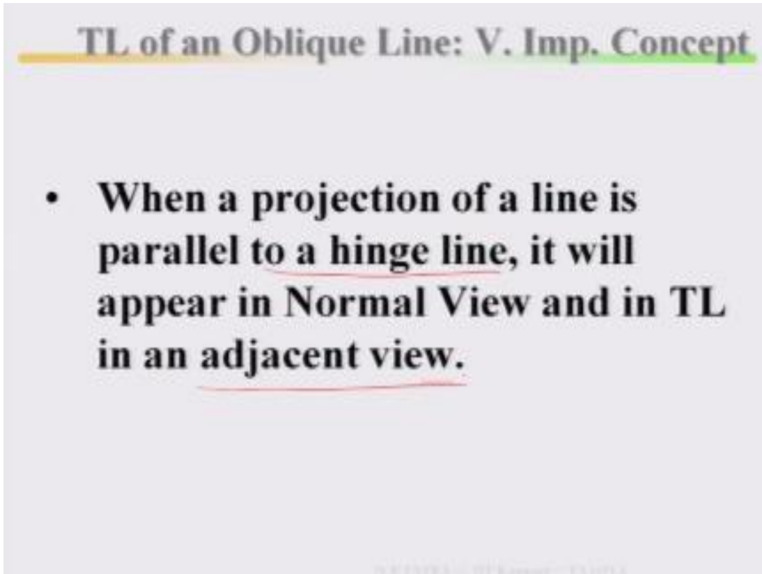

True length of an oblique line, very important concept. When a projection of a line is parallel to a hinge line, it will appear in normal view and in true length in adjacent view, remember in adjacent view. When a projection of a line is parallel to hinge line it will appear in normal view and in true length in an adjacent view, that means if I am rotating parallel a line in your top view that means I should get true length in your adjacent view, that means in case of this it is in front view.

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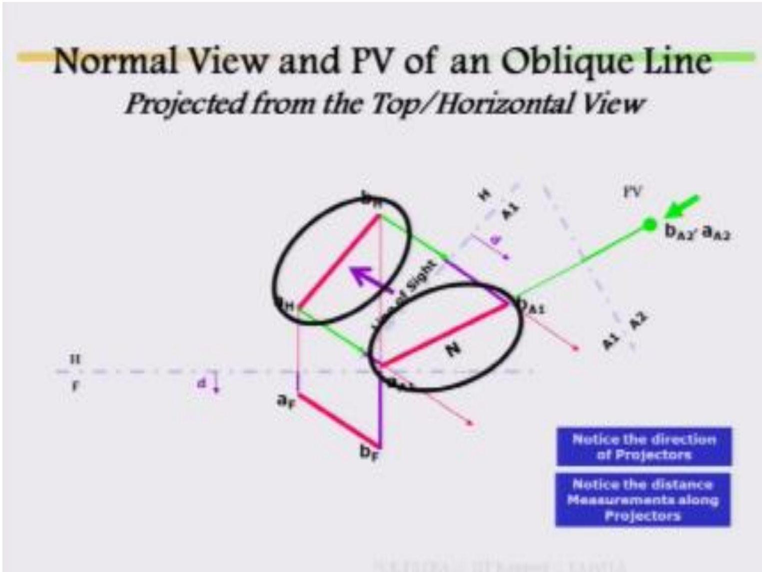

Look at here, look at here, line of sight, line of sight, this is case of your auxiliary view.

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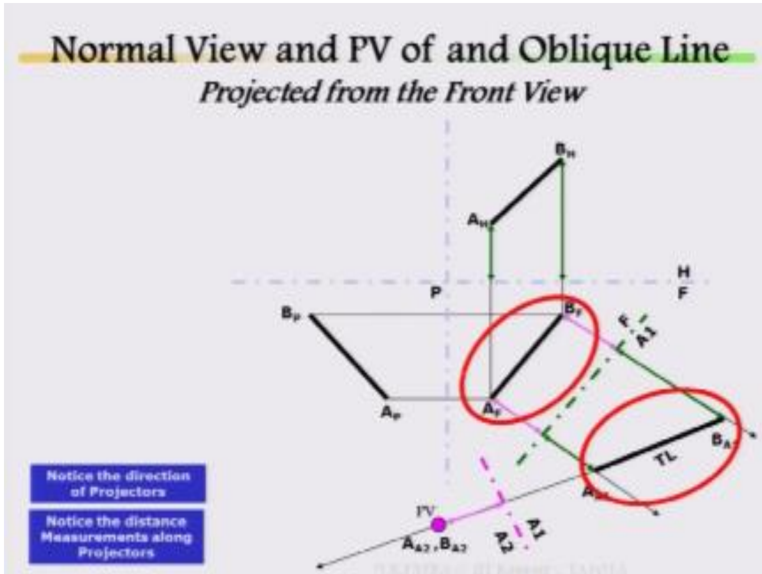

Look at here, true length you are getting.

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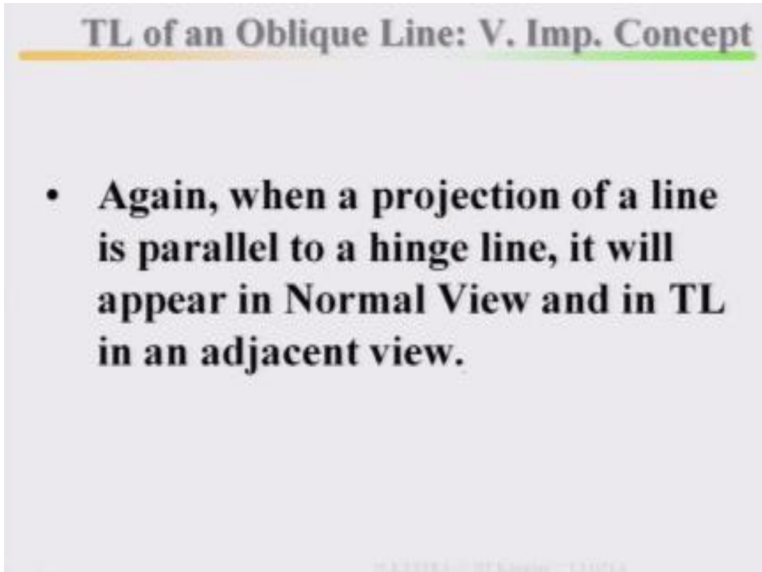

Again when a projection of a line is parallel to a hinge line, it appears in normal view and true length in an adjacent view.

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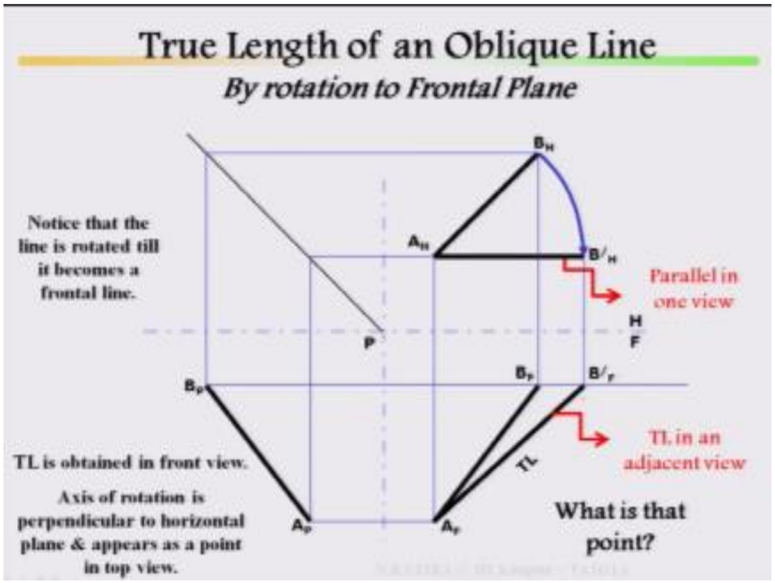

Here you look at here, notice that the line is rotated till it becomes a frontal line. True length is obtained in front view because this has been done in case of top view, so opposite view you are getting a true length. Axis of rotation is perpendicular to horizontal plane and appears as a point in top view. Parallel in one view, parallel in one view, true length in an adjacent view whatever I have said.

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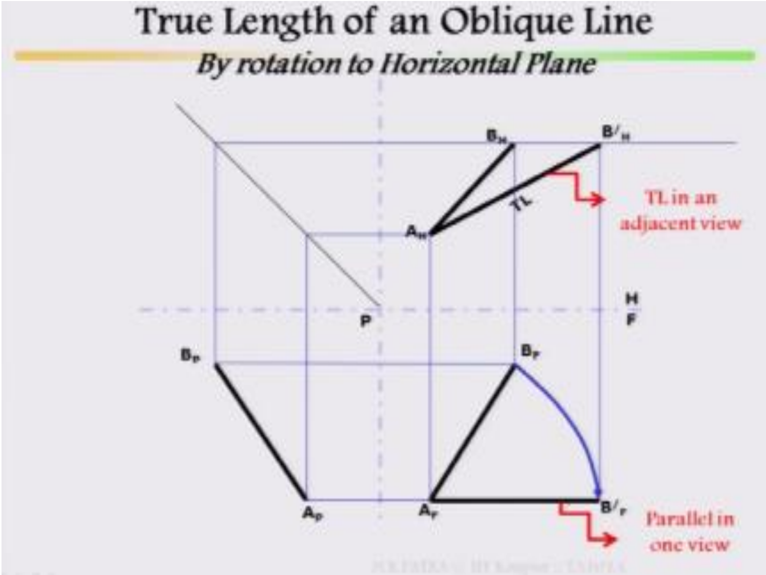

Similarly opposite end, parallel in one view then true length in adjacent view.

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We will exploit this very important concept in finding true shape of an oblique plane, so I will stop it here. I will start now onwards second class I will start next class planes, line is over how to get the true length by means of auxiliary planes, auxiliary view by means of method of rotation it is over. Now we will go by means of method of rotations true shape of an oblique plane, I will start from next class. Thank you.

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