**Digital Land Surveying and Mapping (DLS&M)**
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Lecture - 23
Measurement of Horizontal Angle Using TS

Welcome students. Today is the 23rd lecture on Digital Land Surveying and Mapping. In today's lecture, I will discuss on how to Measure Horizontal Angle using Total Station.

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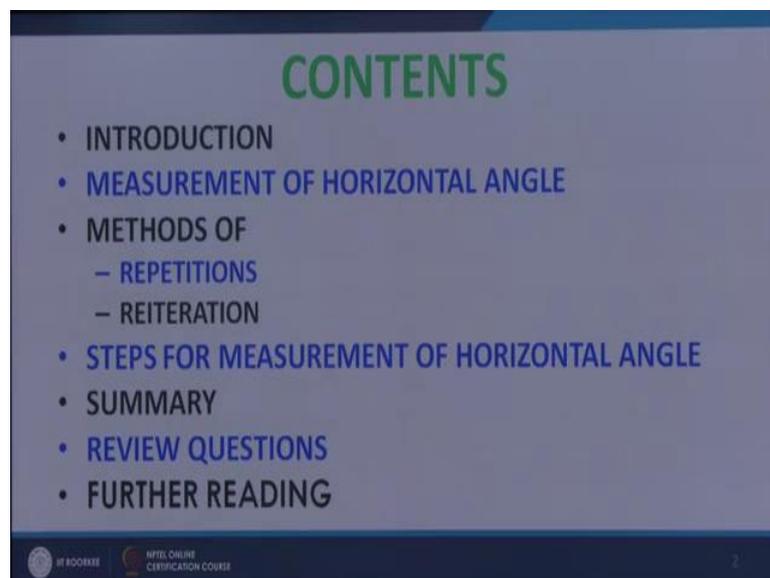
And this lecture will be discussed under the following heads first I will introduce. Then the measurement of horizontal angle, how a total station provides as the horizontal angle that I will tell you then different methods that we make use to measure the horizontal angle, one is measure the repetition another is reiteration. So, I will discuss that and followed by demonstration for each method.

Now, horizontal angles are measured in a horizontal plane. So, we have to make this totally station properly adjusted before taking any measurement of horizontal angle. So, proper adjustment means already we have discussed to make the instrument, first approximate leveling then find leveling along with centering and followed by the sighting of the object, so that is to be done before we go for any horizontal angle measurement. Well, before I really go about the measurement, how really this instrument provides as the horizontal angle that I would like to discuss. Actually as I have already

told that in this instrument, there is a pair of horizontal plates. All these plates become horizontal perfectly horizontal when we made the instrument level. So, we need to make this instrument level because horizontal angle is to measured in horizontal plane. Now, these two circles actually there are two circular plane circles, one plane and at the other and one of these circles the low one rotates, and upper one remains static.

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So, the lower plate lower circular plate is called rotor, and the upper circular plate is called stator. And one more point, this lower circular plate is having some equally divided alternate dark lines and slight spaces. And upper plate or upper circle contains slit-shaped patterns which is the same pitch as that of rotor circle. Now, actually these divisions actually provides us the precision of measurement of angles using this instrument, so the more precise these divisions are better précised angle will be able to measure. Now, what happens whenever we place these instruments properly leveled, then the horizontal plates where the plates which are one plate above the other having small place between them. They make they become horizontal. And then when we will bisects the objects and we will let to find out the horizontal angle.

Then this one plate will (Refer Time: 04:01) with respect to other and light will be passed through horizontal plates. And thus there will be creating alternating variations in light intensity, and from the below there light will be passed. And in the above there is a photo detector that photo detector detects the signal and the intensity. And that photo

detector then converts this light to electric pulse. And this process to the micro processor converting the amount of energy to corresponding digital values, and this digit then converted to angle. So, this is the basic arrangement that is made in this instrument which provides us the measurement of horizontal angle automatically whenever we rotates from one object to another object. And the finally, this value is displayed in this LCD.

So, this is the basic how automatically we do measure the horizontal angle using total station. And to measure the horizontal angle what we need to do as I have already told that before making any measurement using this instrument should be done properly that means, we should do the centering, leveling as well as bisecting the object nicely very accurately before the measurement the horizontal angle.

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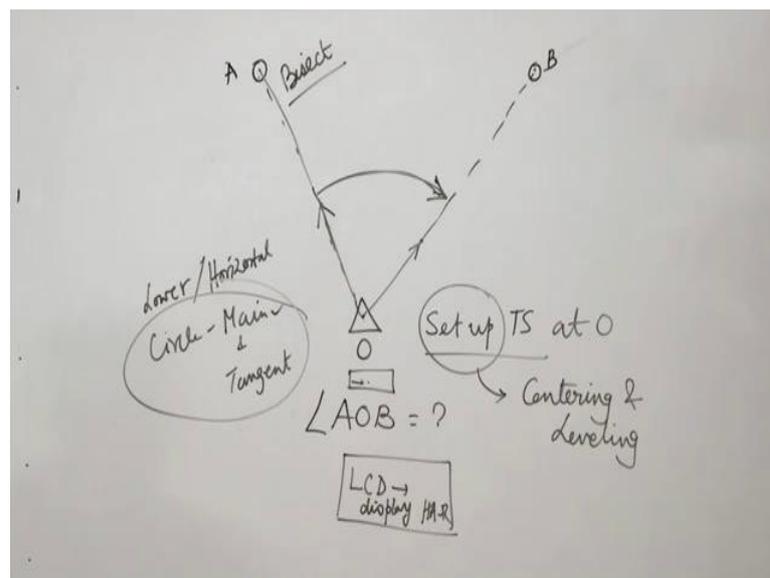
Now, suppose there are two objects, two targets we had two targets between A and B whose angle with reference to our instruments station O. Now, our instrument is setup on the station O, we want to find out the horizontal angle between A and B with O as the instrument location that means, O want to find out the angle AOB. So, what we need to do first we have to setup our instrument setup total station at O. And then now we set up in goods the centering and leveling of the instrument has to be done on perfectly on O location O.

Then what we will do, we will first bisect, we will make this object bisected, bisect O, A from O, then now when this has been done by using the telescope we should first we make use of the lower or horizontal circle mainly screw and mainly tangent screw to perfectly bisect this object O. Or we making perfectly bisect to then we will whatever reading will be displayed we will make it 0. Now, after doing that we will open the main horizontal screw and then we will look to object B and by making use of the horizontal circle main and tangent screw, again we will bisect this object B. So, as soon as we will bisect the object B, the display LCD display, we will display the horizontal angle. Now, here you have to keep it in mind that the lower is measured along as rotating the telescope in the clockwise direction that is towards the right of the observer. So, this is another point which has to be we are kept in mind.

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So, in this figure you see this is the station O and we have placed our instrument this is the location of the telescope and first we have to bisect the object P. We have to make the horizontal circle reading 0, then we have to bisect the object Q and then we will get the horizontal angle and horizontal angle will be in horizontal plane. So, the horizontal angle between POQ, P O Q will be the P dash O dash Q dash or P double dash O Q dash that will be the horizontal angle between the object P and O with station O. So, in taking the horizontal angle between two objects, we should take bisects to the left object and we should take the foresight to the right object. So, that is another point we should note down it.

So, now I will like to demonstrate these phenomena using this total station. So, as I told you that this instrument has to be first properly leveled and centered. So, we will do the centering and leveling first. So, now to as I told you in our previous class to make these centering and leveling first we have to make it approximately centered and level. The approximate centering and level of this instrument has to be done by making use of the tripod stand. And whether it is approximately leveled and centered or not that we have to verify we can verify by looking into the circular bowl here. If the circular bowl is at the center that means, it is approximately level, then we have to loop through this optical planet to see whether our instrument is exactly on the top of the centered or not.

Now, if there is any mistake or any then we need we can open this one and we can shift the instrument, we can shift the instrument and by shifting the instrument, we can center it, so that is what approximately centered and leveled. After doing this we have to make the power on. If we make the power on then our instrument will be on. So, now we are using this, now you have to take this, our data collector parallel to this, and more less this in the center. So, third one, you can see this one if there is a blue that means, this leveling is ok, which we can carry forward I want to show one more thing.

Now, suppose is you like that now you can see that this is our centering and leveling is described here with red sign that means, it is not properly done. So, we have to do till it becomes blue. So, every instrument there will be some information indication like that,

so because it is blue, so we can go for it. So, once it is centered and leveled; now this is in blue, so it is centered the leveled. Now, I can go for measurement of horizontal angle. Now, to measure the horizontal angle, so now, first I will like to take the horizontal angle between reflector keeping here and somewhere here. So, to make our work easy to see, and first I have bisect to this by looking using this horizontal plate main screw or the lower plate main screw and the vertical plate main screw, I had oriented my telescope towards this and then approximately I had focus the object then using find tangent screw.

I had bought the center of the reticle, so I have a reticle central like this and the prism having these from center like this. So, this center I have bisected this center.

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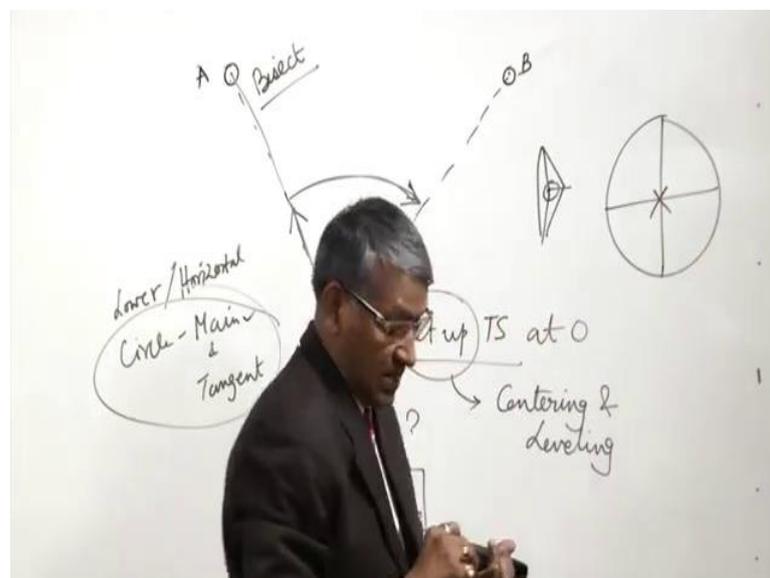
Now, I will make what the main menu object and for these because is the first object. So, I will like to set this line as 0, 0, so 0 set. So, if I make it, now you can see that the horizontal angle is 0, actually there is an error 6 second here. So, sometimes there some errors, so that can be taken care of by noting it down. So, it is 0 degree, now 0 degree. Now, I will take the horizontal reading between this angle and some kept someone this. So, now, it is 0, 0 line. So, now, I will open the lower plate main screw, and I will rotate this instrument in the to my right pointing to this prism. So, now, I will fix the lower plate main screw, and loop through this. Now, I can see the object, so I can make use of fine adjustment screw. Now, I have perfectly bisected it.

And now you can see there is a reading 92 degree 49 min 40. So, this angle is 92 degree 49 minutes 42 second, and there is a error of 6 second. So, I can say that the angle is 92 degree 49 minutes 48 second. Now, here you can see the measurements of angles are done automatically. We need not go for any measurement or as we did in case of slope distance measurement, we have to place the key menu measurement, but in case of horizontal angle measurement, the instrument provides us automatically this angle. So, angle is measured. Already you have seen that there is some error of 6 seconds. So, initially to make it 0, and then we can simply add it. However, there may be some other errors associated with this instrument in setting up the instrument as well as inside the instrument.

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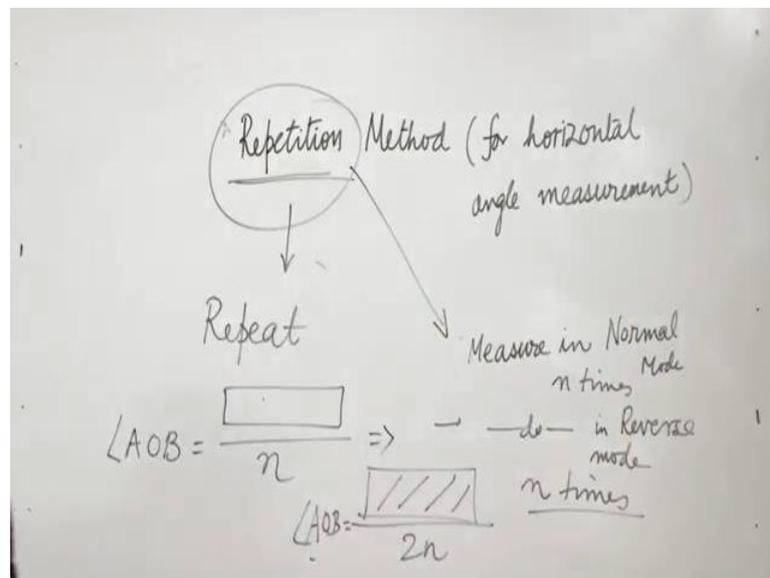
So, in order to aware that errors or minimize the error as well as if we want to increase the precision of measurement, so we do carry out the measurement of horizontal angle by a method called method of repetition. By repetition method or repetition method of method for horizontal angle measurement, that by the name you can understand repetition means here method mean repetition. Why we will repeat, repeat the measurement of horizontal angle of the same angle number of times. So, if we measured by same angle, suppose AOB and A did n numbers of times, we will get a value which will be divided by n we will get, we will say that there is the another value of the angle. So, well in repetition method actually there are two ways we can do in each repetition method there are two steps, one is to measure in measure in normal mode and other n

times. And also measures in reverse mode reverse mode another n times. So, whatever value we will get finally that has to be divided by 2 n angle AOB to be 2 n.

So, now, what is normal mode and reverse mode. Normal mode is that measurement whenever we will make use of the instrument, if we maintain this is the vertical circle to the left of the observer that is called a normal mode. And reverse mode is that by making these horizontal angle, so if we by rotating the telescope by 180 degree and then allowed it horizontal axis, and again 180 degree in a vertical axis, we will have this element and that is called reverse mode. So, we can take the measurement also in reverse mode and once we in if the instrument is to be used in reverse mode then we need to have the data collector in both sides this instrument only one side we have the data collected. So, it is not preferable to go for plunging or the reversing of this here anyway. So, this is the normal mode which I am keeping.

So, now, I can demonstrate you also the measurement of horizontal angle by measure the repetition keeping the instrument in normal mode. Again for the same normal mode, first we have to set up the instrument and we have to make our temporary adjustment of the instrument as we did in case of measurement instrument. So, let us assume already it is already it is centered. So, let us assume that the centering and leveling has been done properly with this. Now, to carry out reputational again the first we have to for the method of measurement first. We have to bisect this object and we will make it 0, we have make it 0. So, after make it 0, we will open the lower plate circular screw and then we will loop to this and we will bisect the object. Now, we got some an angle. Now, what we have to do, now in this we will go to this is phase one will go to the phase two. And note down this angle 96 degree 27 minute 11 second. Now, I will take this we will set here and 97.267 correct.

Now, I have bisected it and then again I will open this. Then again I will bisect it. So, now, I am getting the double the approximately double the angle which has been red. So, in that way I can go on repeating it actually in the field we need to have more numbers of targets, so that we can make use of the same target, we need not shift the target. So, in that way, we can measure the method of repetition, so that is what it is written these steps. So, the main thing here it is that horizontal set for the first seven point whatever angle we will observe that has to be set through a set menu. And the first object, we will have to do target it and then with horizontal set next angle we can say. In that way, we

can repeat a numbers of times, and we will get the submission of the angle in this and the divided by the number of the repetition, we will get the average value of the angle that is the angle value.

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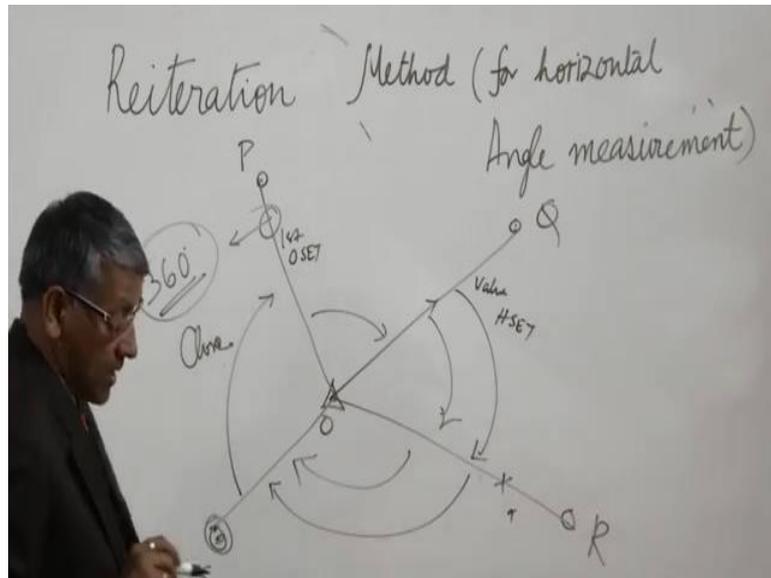
Now, another method which we do generally apply for measurement of horizontal angle that is the method of reiteration for horizontal angle measurement; so what is generally if from a same station we want to find out the position angle between numbers of objects. Suppose, P, Q, R, S and we want to know. What is the angle P, O, R, R, O, and S? So, these angle if you want to know; what is the angle this is the angle then we make use of method of reiteration. What we do first we bisect the object P and make the 0 set, and then we will rotate the telescope in the right hand and bisect the object Q.

And we will get some value and that value higher can be we can set HSET and then from that value we can measure this value. So, we will get this value and then again whatever value we are getting here. We can set it and from there we can done. In that way, we can go on adding and finally, we can close it. And by closing it we must get 360 degree. So, that is a check. So, that is method of reiteration this is another method of horizontal angle.

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So, you can see using total station the measurement of horizontal angle can be done automatically. With this I like to conclude today's discussion on horizontal angle here we have found that the horizontal angle is measured in a horizontal plane. So, the prerequisite condition to measure horizontal angle using a total station is to make it properly leveled and centered. And then our target should be proper that means, if the target is not visible or we are not able to see properly then the angle measurement will be not proper. And to input the precision as well as to minimize the error, we should go for the measure the repetition. And when there is a condition where we will like to measure a number of horizontal angle from the same station, then we will go for the method of reiteration.

With this, I like to conclude to this class. And the next class, we will discuss on measurement of vertical angle and how to measure the height as well as difference in height using total station.

Thank you.