Digital Land Surveying and Mapping(DLS&M)

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Lecture - 22
Measurement of Distance Using TS

Welcome students, this is the 22nd lecture on Digital Land Surveying and Mapping. In this class, I am going to explain about how to measure distance using total station. Now this class we will be discussed on this points like this; first measurement of distance introduction and there are two ways actually we can measure the distance using total station; one with reflector, another without reflector.

So, I will be telling you about some points on these two methods or in these two types and then I will actually demonstrate how to measure distance using total station with reflector and without reflector. Already I had explain in the last class that total station makes the measurement with the help of an electronic distance measuring instrumentation associated with it and it makes use of electronic distance measurement principle in which path travelled by the electromagnetic signal in going to the target and coming back.

So, we have found that to measure distance using total station the electromagnetic signal need to reflect from the target now the target may be of two types one is our call reflector which is the reflecting surplus another is the object itself for about which we want to know the distance. So, depending upon that there are two types as we call one having the reflector using reflector is calling measurement distance measurement with reflector and if we do not use the reflector that is called distance measurement without reflector. Now as you know we make use of a single prism or a three prism unit as the reflecting surface or for the reflectors that is already I had shown you in some other class and the measurement using reflector actually it is precise rapid also or we can do normal mode as well as tracking mode.

So, most of the time we do carry out measurement using reflector; however, now-a-days reflector less measurements are getting more popularity because of many other reasons. Now these reflector that we use for distance measurement they may be placed on a pole like you see.

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Let us take an example of a single prism, this is a single prism this prism may be placed on this pole that is called reflector on pole or with some tripod arrangement placing over tripod stand also we can fix the prism and when we need to measure distance very accurately and centering and leveling is to be done very accurately then only we go for setting up of the prism on tripod stand, otherwise generally we make use of prism fixing on a pole as I had already shown. Now whenever we will be using the reflector; that means, the prism based reflector like this; so one thing we have to be very much careful about is the that prism constant.

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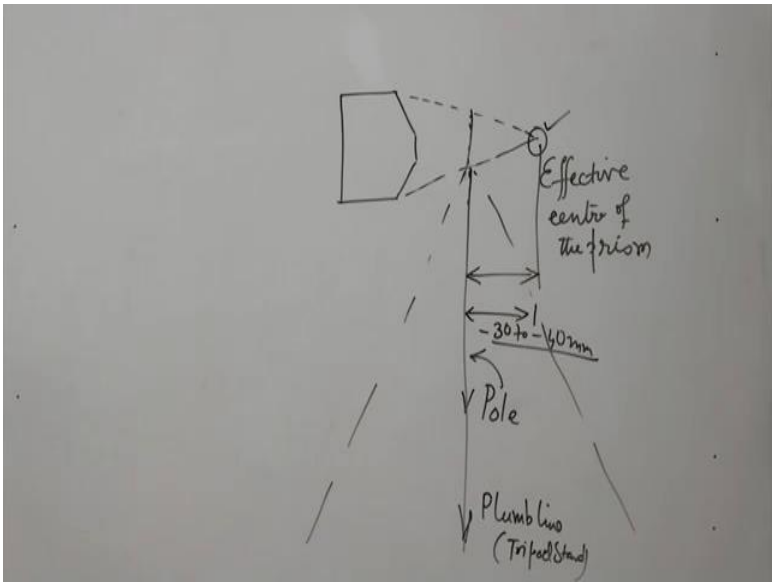

Now, what is prism constant actually if we see the prism is something like this then the actual center of the prism measurement will be somewhere like this; this is the effective center of the prism. But now we generally hold the prism some other point like this; this is the line, this is the pole or this is the either it is pole or it is the line plumb of line; plumb line; in case of if it is placed on a tripod stand, so this defines in distances is called our prism constant. So the measurement we do with respect to this, but we want to get this so there is a distance of some minus of 30 to 40 millimeter which is called prism constant which we need to take into account whenever we measure using the reflector.

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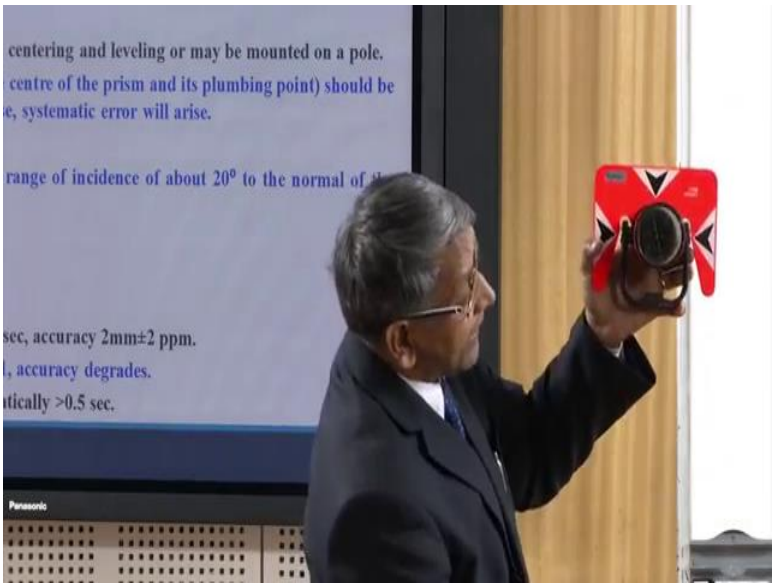

And with each reflector this value you will be able to get this thing here minus 30 millimeter offset. So, this is the actually prism constant that if we fix the prism in the other direction then the prism effective center of the prism and the plumb line or the pole on which it will be fixed will be identical, so the object will be 0 millimeter.

So, we should be careful also we have to see whether we are fixing our prism; this end or that end. So, accordingly the prism constants we have to take into consideration otherwise there will be always some systematic error in making use of the prism.

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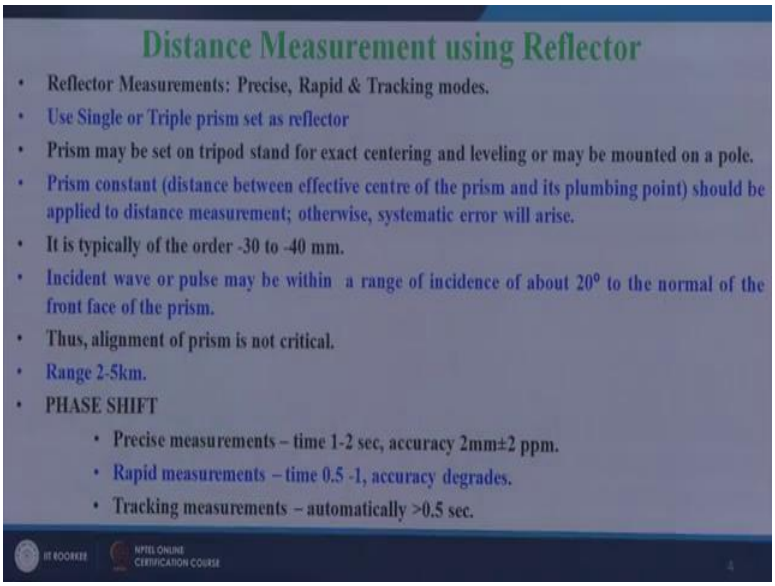

Now the one more thing which is important whenever we will use this reflect a prism as reflector, actually if the line of incident or reflected light has within comes within 20 to the normal of the front face of the prism, our work will be done nicely. So, should not be very much critical about the positioning or the place of the prism, so it is a advantageous in making use of prism that we should not be very much critical about it is alignment.

Now, by using the prism as the reflector or reflector based measurement using total station; the range of measurement may be from 2 to 5 kilometer distance. So, this is a very important thing that if the line of sight is clear up to 5 kilometer 3 to the 5 kilometer distance, we will be able to take measurement using the reflector. So, in that way can be very productive in our work (Refer Time: 08:34) now already I told you that the distance measurement can be done in two ways one is that phase shift method and another is our pulse measurement method.

Now in the phase shift method, actually if we make use of reflector we better go to phase shift method of measurement and that provides as a very precise measurement and the time taken will be very small 1 to 2 second. So, if we keep our telescope pointed to the reflector 1 to 2 second will be sufficient to get the reading and make the measurement and we may will be able to arrive at the accuracy of 2 millimeter plus minus two parts per million. So, it is a very good measurement accuracy also we can go for very rapid measurement, so when the accuracy is not that important means not that very much

required so then we can go for rapid measurement and half a second to 1 second will be sufficient to take our reading and of course, we will sacrifice some bigger accuracy.

Now also there is another mode of measurement which is called tracking measurement, so we can place many reflectors and our robotic total station will be going on tracking the defined reflectors automatically and the measurement of we can take less than 0.57. So, because that will be automatically the instrument will decide what is the duration to take the measurement and it has been observed that the duration may be as little as 0.57 or less than that. So, reflector based measurement; distance measurement is preferable for when for long range measurement.

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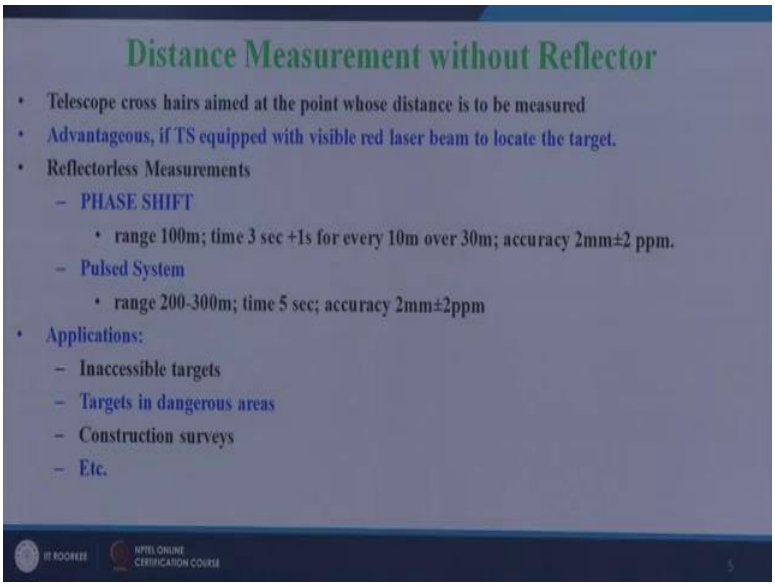

Now, there is another way how we can go for measurement of distance using the total station that is called reflector less; that means, we can directly take the reading using the total station to the object without having any reflector. So, actually this is a method of taking measurement which is now getting very popular because of many reasons; first point is that as we will not using the reflector, so number of person involved in surveying will be less. There will be many times when the points or the measurement location is in accessible; in that case reflector less is a very good one.

There may be so many other case where going to that place may be dangerous like some; so very stiff, slope or very high building. So, in those cases reflector method measurement is very much convenient and more and more reflector less measurements

are getting encouraged specifically in construction industry where we are getting very high rise buildings, bridges where it is very difficult to really hold the reflector or go personally to monitor it and in that case reflector less measurements will be very much beneficial and that is getting popular.

Now, but one thing is that reflector less measurements can be done only within certain range that is the limitation. So, and you can see here if we can make use of phase shift method of measurement then range is up to 100 meter; may be it is improving day by day 200 meter, 300 meter, but not more than like that and the time of observation will also be more and the and accuracy is as only good as the, but this is a very small distance so accuracy we should not say good because distance is less, but within this limitation this equation is good.

Now one more thing in reflector less measurement, generally we prefer for pulsed system of measurement because that provides us bigger range, better range and though the time of duration of observation will be more; however, the accuracy will be better then what we will get in phase shift measurement. So, this is the two basic methods of measurement which we generally take in film and more and more reflector less instruments are coming up and they are day by day increasing. So, the future of measurement of total station will lie with you know with the help of a reflector less, but one more thing in reflector less measurement, we make use of visible weight laser beam that will be more helpful, so in all today I will also demonstrate that these thing that we will make use of some red laser beam to locate the target. So, that will be very much advantageous to locate the target; however, sometimes we may miss exact location of the target.

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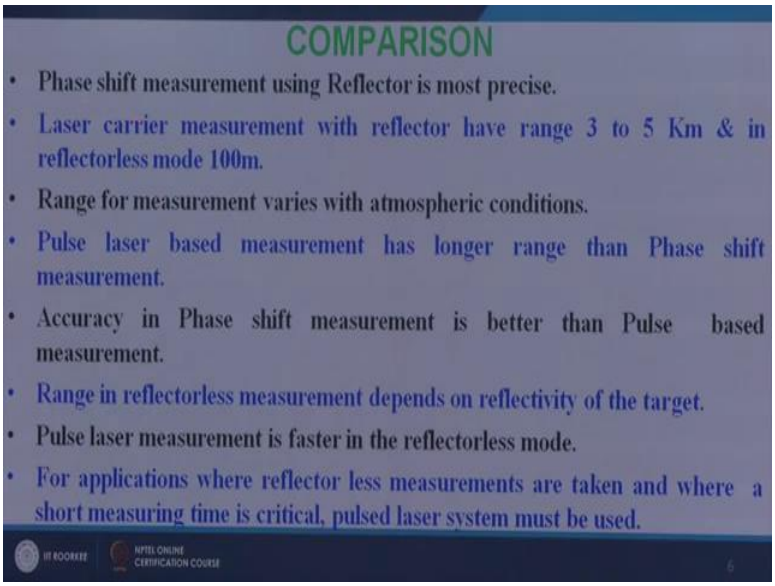

So, with this lie I like to now compare between the two the methods of measurement now the phase shift measurement using reflector is the most precise also and the laser carrier measurement with reflector have range 3 to 5 kilometer and in reflector less we have only 100 meter; however, and also these range that range of measurement actually it depends upon the type of atmosphere that will prevail between the instrument and the reflector or the object target, so when the atmosphere is favorable then we will have no range and if the it unfavorable condition the range will be poor

Pulse laser based measurement has longer range than phase shift measurement either in case of a reflector less pulse laser based measurement has longer range than phase shift measurement (Refer Time: 15:16) an accuracy in phase shift measurement is better than pulse based measurement. So, and the range in reflector less measurement depends on the reflectivity of the target, also apart from the atmospheric condition also the reflectability of the target is also important in case of reflector less measurement if the target in reflector less measurement having a very high reflection; reflectability than we will be able to get better range, pulse range laser measurement is faster in reflector less mode when we will though we have seen that pulse measurement will take more time but in case of reflector less mode there it will be better. For application where reflector less measurements are taken and where a short measuring time is critical pulsed laser system must be used. So, this is in short about the mutual advantages and disadvantages of the two way of taking measurement.

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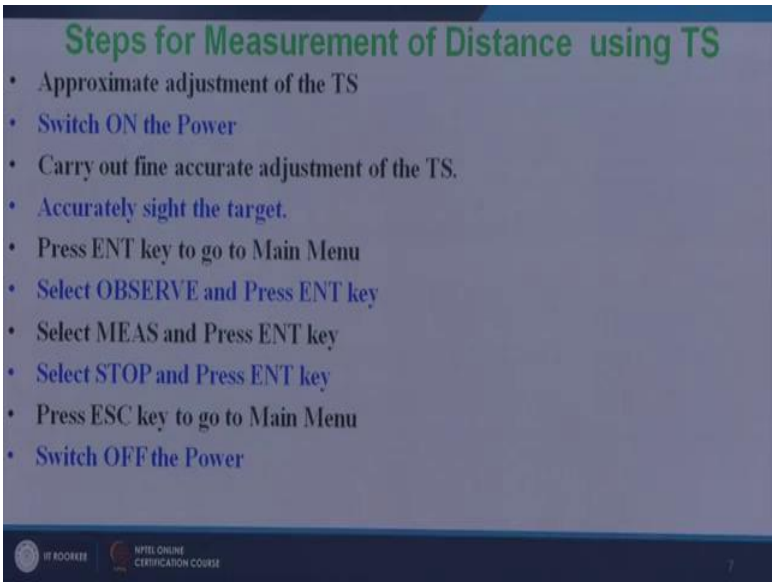

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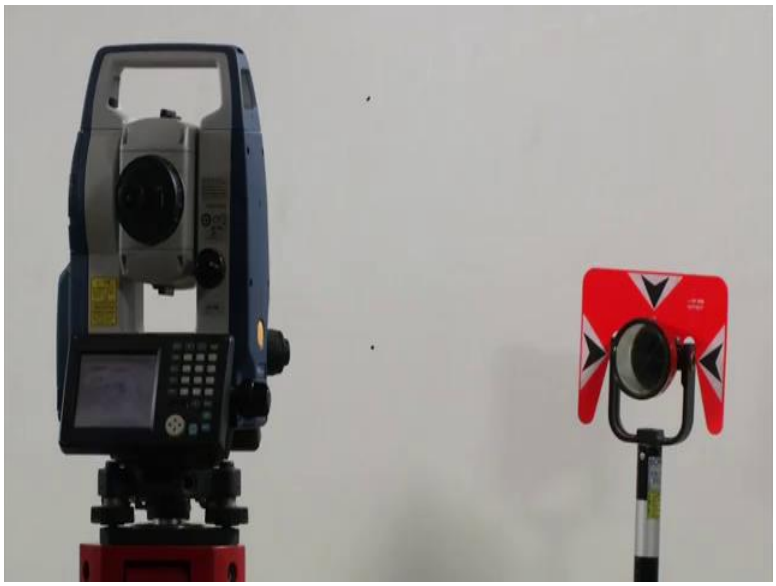

Now, I will demonstrate how to actually measure the distance using the total station. First as I told you to make the survey measurement using total station, the first thing we need to do is the temporary adjustment of the instrument and you know that the temporary adjustment of the instrument starts from fixing of the tripod stand and already I have told you that you have see all throughout that the tripod stand should be well spread and if we make use of a platform like this which is very plain with where is every chance to get our instrument slip.

So, you should make use of a frame like this on which we will we should set up the tripod stand that will help not only well spread the tripod legs, but also it will resist in getting it slipping, so this is one more thing you should keep it in mind. Many times we have seen that we are bound to use our instrument on a hard surface in the field. So, in those cases also we should prefer to have a frame like this; this frame like this will not cost much, but only thing is that that attitude we have to develop and if we set up our instrument a instrument like this then the chance of getting it spoiled or some damage will be much less.

So, and we have to first level the approximate level that here head of this tripod stand then so you see here we have to first see the approximate level of this is level approximately this is level and also this if you look here this and the centering of this head should be above this centre. So, this is a centering way then we have to bring our put these screws in the middle between the tribrach and tribrach or base plate and then only we should hold on this with the handle and we keep it on this and then we should fix the base plate with the tripod head by way we are doing.

Now we have to see whether our now here you can see this is the circular bubble; this circular bubble we should check whether it is in the center on not, but since I can found that this circular bubble is not in the middle. So, using this tripod stand we should bring the circular bubble in the middle. So, we are making it, so one thing you see that if we make use of this tripod stand then you must have some holes in it so that you can also take out these say along this direction outward or inward and also. So, now we have brought the circular bubble; the bubble in the circular level in the middle.

After this we have to make it exactly on the center that we have to we will do by using the automatic compensative that is lying inside it and to make use of that we have to make it on first. So, we have made on this instrument now here you can see that now you can see here as I had told you in some other class to make the instrument perfectly centered and leveled. So, there are two cross bubbles this one longitudinal bubble in the y direction, this one is the longitudinal bubble in the x direction and this is a cross bubble, so these three bubble should be in the middle in the respective axis. So, first we will take this instrument parallel to any two foot screws and then; that means, this is parallel to y axis.

Now, we have got it and now we will bring these bubbles in the middle; first we have done it in the; first we will bring this bubble in the along the y axis. Now we will bring this y bubble in the center, more or less now you can see this bubble in the x as well as is y or in the center also this will see in the middle. Now we will see whether our instrument is properly centered or not through optical plummet, so through optical plummet we have to check it.

So, now we can say that you can see there is one that our bubbles are the center bubble in the center and the outer bubbles you can see cross bubbles are also in the respective center, so we can very well say that our instrument is perfectly centered and leveled. Now one thing you see that our reading is constantly changing, so the reason behind is that this platform is very sensitive; we are moving or we are walking or there is some; so there is a little vibration. So, our instrument is so sensitive that it can sense it that there is some movement or vibration.

So, otherwise a bubble shows that the instrument is perfectly centered and leveled. Once this instrument is properly centered and leveled, now we have to orient this telescope to the object; so that is called sighting. So, we have to open the horizontal circle and vertical circle both and looking through collimator, we should approximately make. So, find the object then horizontal mini screw is fixed, now we have to use the focusing screw. So, now I have centered the ethical center with the center of the laser beam, so now setting is over. So, now we have to start measurement, so to measure first I have to enter it.

So now by pressing the p r g key, we are coming to the main menu and here we can see this measurement so if we and that is selected we measure, now it will start measuring; now it has measured. So, I can stop it that now you can see the distance is 1.76 meter, so this is one way how we can measure; actually there are different ways we can measure this. Now another way I can show you now; so through this menu also as it is written in this p p t after accurately sighting the target, press enter to go to the main menu this is the main menu so now I can select the observed.

So, through measurement it is measuring and you see this is the distance it is showing; now I can stop it and I can take out and I can shift this to another point, we can take the measurement. So, this is a sample measurement; so I am not doing anything else now, so

in this way we can use reflector to measure the distance. Now I will demonstrate how to take measurement with reflector less, so in order to do that I will like to find out the distance from here to this white board.

So, now first I have to bisect the white board, so I will look through this; now, I have focused my telescope to this white board. Now I will goes to observe mode; in the observe I should go to the e d m, now e d m I have selected no prism; now I can I will do the measurement m e s; now it is measuring. Now you can see there is a red laser beam here you should take care not to go in front of it because it may harm your eyes. So, this is the laser beam, you can see it has been used to find out the distance and stop. So, I can get that it is the distance 1.97 meter. So, from here to here it was 1.76 meter and here to here it is 1.97 meter, so this the way how we do measure distances using reflector or without reflector.

So, this is the demonstration I wanted to have you to see, so with this I like to conclude the deliberation on this topic. However, I would like to summarize distance can be measured using total station, using a reflector or along with total station we may use a reflector or we may also use without reflector and in case of one; we will use without reflector, we will use we will prefer to use a red laser beam which will fall on the object and that will give very precise measurement, distance measured with reflector actually provides better accuracy and more range.

The range of measurement will be more; however, it has some disadvantage like you have you have to personally go on hold the stop reflector, but so now-a-days reflector less measurements are getting popular especially inaccessible areas or area where which is dangerous for us to go in those cases reflector measurement provides very good service.

However, the range of reflect less measurement is less, so there are some mutual advantages and disadvantages which we should know and accordingly we make use of, but one thing we have to keep it in mind that laser base measurements are associated with some hazard, so its implications we should know and accordingly we should take care. The important point is that we should not expose our eye to any laser beam.

So with this I like to conclude today's class and next class I will demonstrate, I will tell you about how to measure horizontal angle as well as I will measure the horizontal angle between two points, two stations and I will demonstrate it through the total station.

Thank you very much.