GPS Surveying

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Lecture - 17
Procedure of GPS Surveying- II (Preparation & Field Observation)

Welcome friends. Today I am going to discuss on procedure for GPS surveying part two as a lecture number 17 for GPS surveying. Now, in the last class already we have seen that to arrive at the proper objective of the GPS surveying we need to carry out proper planning and efficient execution of GPS surveying and that is to be done through observing specific procedure we should be worked in proper steps. As a result of that procedure we have seen that after planning we should go for preparation and then we should go for field observation.

So, today I am going to discuss on the second part of the procedure that is the preparation and followed by the third step of our procedure that is field operation. Now the preparation of GPS surveying consist of few steps again like, first we have to select the proper observation window and then we have to identify the observation session followed by you should look into the receiver and personal requirements whether that is being properly that has to be arranged. Then survey design part, we have to make a survey design part nicely then, we have to have the identification of each of the site of observation properly, then we should take into consideration that training and logistic requirements and instrument calibration if required and finally, if anything else you need to do that has to be prepare for.

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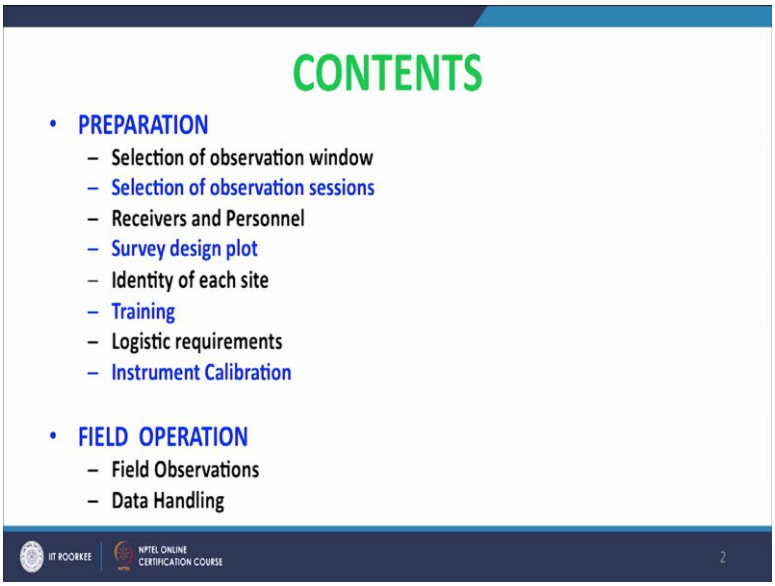

So, in that sequence we will be discussing about preparation and the field operation consist of two fundamental parts - one is the field observation another is data handling that we will be discussing next.

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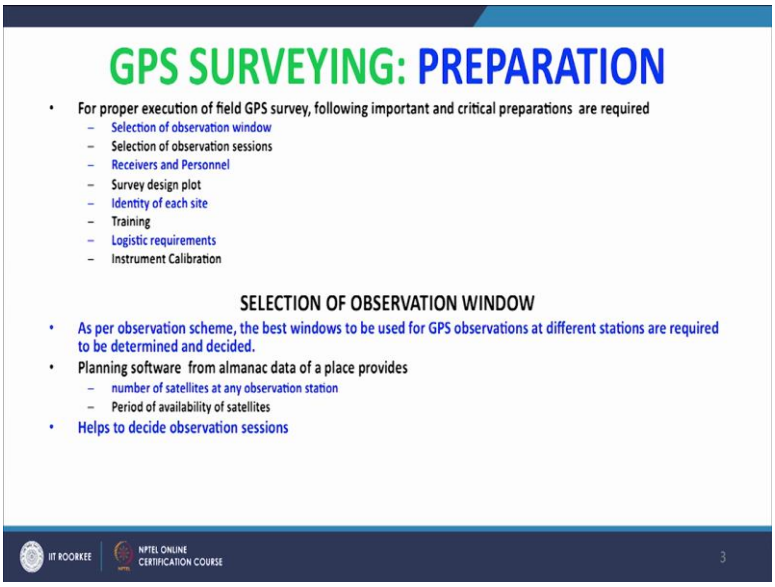

Now, the GPS satellites are revolving around the earth and the satellites are constantly changing the constellation of the satellites are constantly changing. So, we need to know at any instant of time during our observation how many satellites are available, which are those satellites, what those satellites are and how these signals will be coming all those

things we have to know before we are to select for our observation window. Now these can be achieved or we can select the observation window by making use of software called Planning Software.

Now, Planning Software is a software which is freely available in the internet, also it is available in many of the commercial software or we can provide the almanac data of the area which is to be collected during our reconnaissance survey and from that data we will be able to know what will be the future status of the availability of GPS satellites, their member, their locations and many other parameters which will be adding as for selection all observation station.

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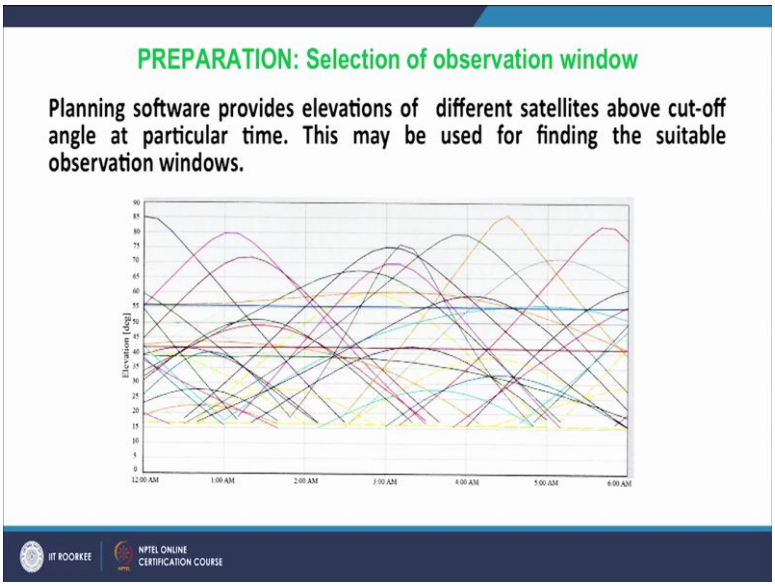

Like this (Refer Time: 04:30) here we can see that from planimeteric software we may have the information about the numbers of satellites available or after certain cut off angles suppose with a given 15 degree cut off angle. So, before above cut off angle 15 degree which is the satellites are available and how many satellites are available at any instant of time. If we take a line along this vertical line, so you will be able to say that along this line so many satellites are available. So, planning software provides as the number of satellites that will be available beyond cut off angle, also we can get which are the satellites are available at any particular instant of time and what will be their availability; that means, from which term to which term they will be available.

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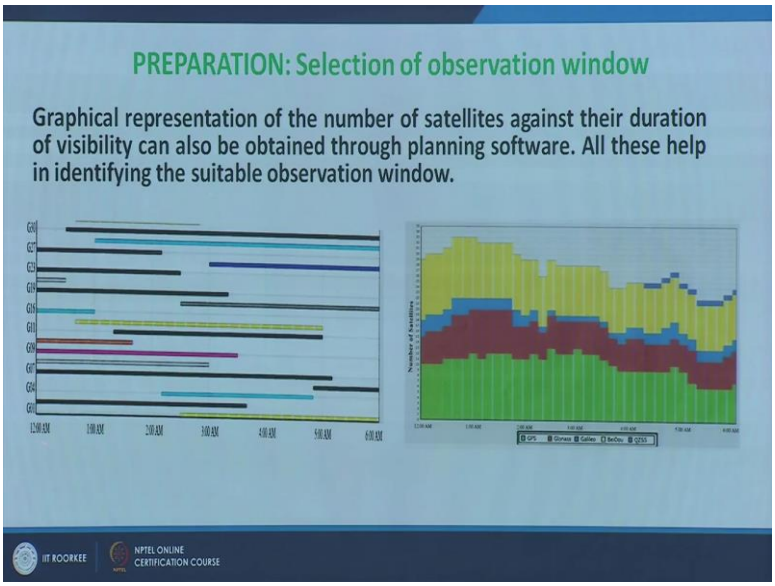

So, this is also information that we can get from planning software and which will help us to identify the proper observation window. Also it provides, you can see here the different types of satellites like GPS satellites, GLONASS satellites, Galileo satellite, midway satellites and number of satellites at any instant of time is also given. So, capability of our receiver will be able to capture data from so many satellites. So, all these information has such to identify the observation window at which we should look for or we should plan for our observation station.

Another important factor which is to be taken in to consideration during selection of observation window is the relative position of the different satellites and that is called the geometry of the satellites, and that geometry of the satellites is being identified or given by a parameter known as DOP, Direction of Precision.

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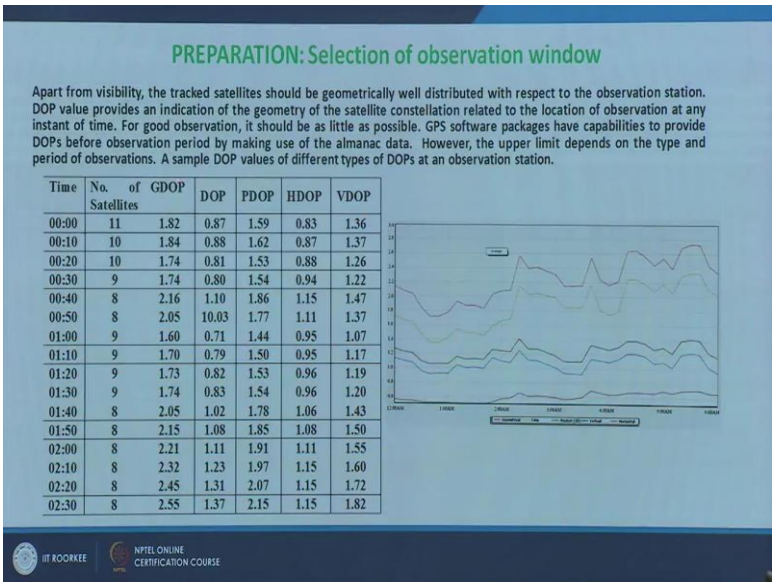

There are different types of direction of precision like GDOP that is the geometric direction of precision, PDOP positional direction of precision like that. And these different types of DOP also are provided by DOP planning software. So, if the planning software if we provide the location of the place of any place and at any instant of time what will be the DOP, which are the satellites will be available that will be given. Like this table we have given 5 locations and at any time t suppose zero hour. So, number of satellites available element GDOP 1.82, DOP is 0.87 like that I can have different types of DOP values. So, and you can see here the epoch interval is 10 second, so every 10 second what is the position of the number of satellites and given DOP value that is given in this table.

And that gets in a graphical way here. So, all these information helps us to identify the proper observation window. Another important factor is that which is important for identification of observation window is that the relation between the elevation and azimuth.

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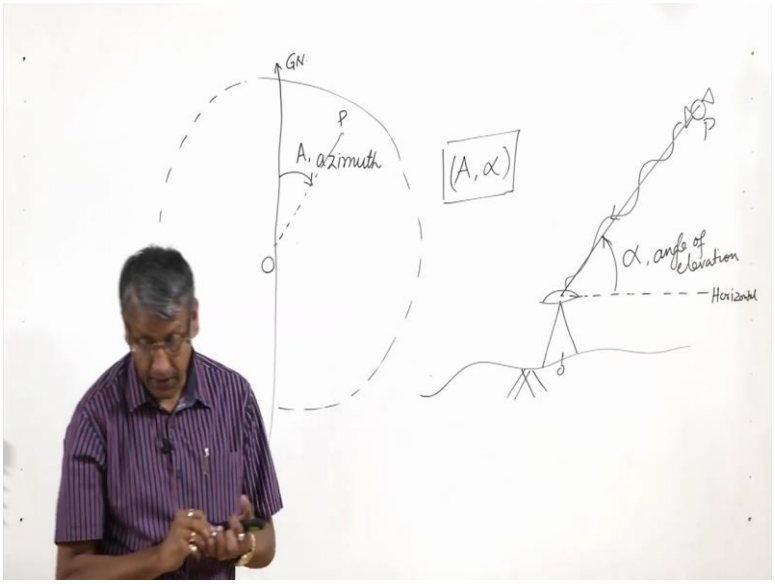

Now, what is that? Actually if we take a receiver like this, now this is the satellite from which signals are coming. Now if we say that this is the horizontal line then this is the line of site so this is called angle of elevation and if we see in a planimetric position and this is the position of our receiver O and this is the location of the satellite P.

Now, if we say that this is the geographical north or true north direction then this angle is our azimuth A, this angle azimuth A. So, the parameter azimuth and elevation angle of the satellite this is an important factor and that is also we can get from our planimetric software and that is given by graphical diagram like this which is called Sky Plot.

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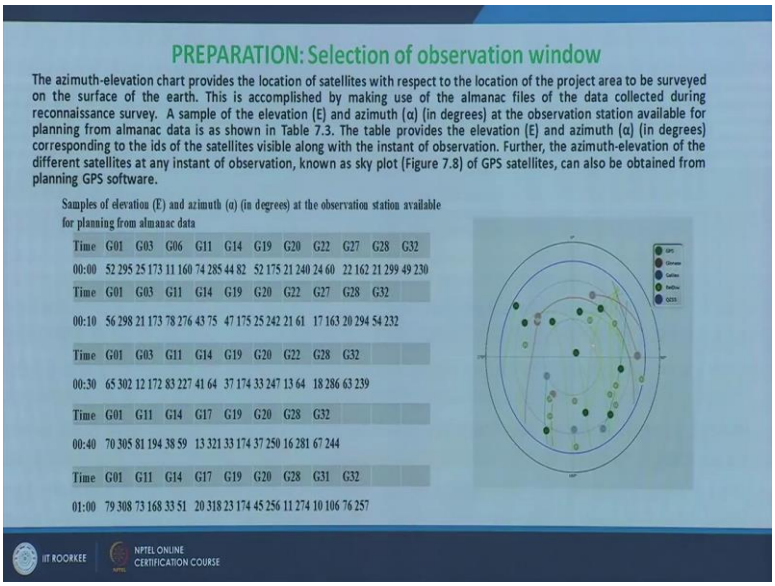

So, this is also helps us, this information also helps us to identify the observation window. So, with this information we can identify during which we should go for our observation.

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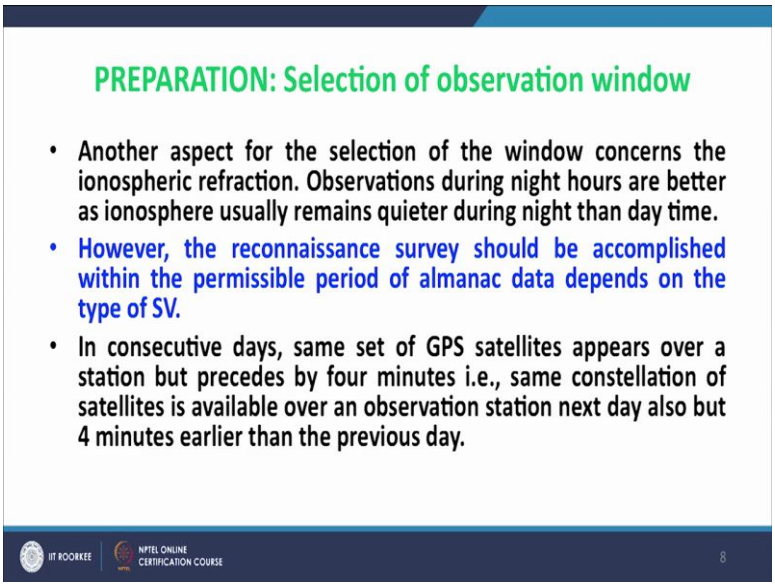

Another, important information is that that whatever satellites are available today the same set of satellites will be available tomorrow also, but 44 minutes before what is available today. So, whenever we will in need to go for repetition of observation this

information will help us to get the data or observation from the same set of satellites in consecutive days.

So, in that way we can identify the duration of observation window at which we will likely to take our observation during actual field work. So, after we will be selecting the observation window next thing we need to prepare for is to selection of observation session. Observation session means it is the actual period of time during which the observation has to be taken at any station or at any pair station. So, this observation session is very important parameter and this depends on the type of survey which we have to carry on. It also depends upon the accuracy of the work to be achieved, nature of project, then project site, then number of satellites available, what is the PDOP, what is the strength of the signal that is coming. So, there are so many parameters on which this observation session depends.

So, depending upon all those factors actually from our experience we have to decide what will be the duration for observation session and for any particular set of station what will be the duration, but in general we can say that if the method is static method then the observation duration will be less than kinematic condition or if the method is an autonomous position then the observation duration should be more than the relative condition.

Now, if the number of satellites is more then we will need to take less duration then if we have number of satellite less. If the geometric direction of precision is more then we will be in need to take more duration than the duration DOP is less. So, like that some thumb rules are available. So, which guides us about the observation station duration of observation station that we have to take at the time of actual observation time, but during preparation we should have a fair idea about the different observation session that we have to observe during the data collection.

Next the receiver (Refer Time: 14:06) we should ensure during preparation that we are carrying or we are ready with sufficient members of specified receivers and we should have enough number of resource person which is capable of carrying out the method of GPS surveying which we have decided during our planning stage. So, these thing we have to take due (Refer Time: 14:38) during our preparation.

Next, another thing we have to prepare is to during our preparation or is to have a good survey design plot because and in that plot we need to have the detail of the position of the mutual position of the stations. Then we have to note down the different observation schemes; that means, between which stations we are taking what will be sequence of observations, baseline observations that we are decided through survey design. Then we have to already decide during which observation window we have to observe what will be the duration of observation session, what will be the travel scheme during along which part we will be travelling like that.

So, all those thing has to be properly note down in a paper that is called survey design plot. For each and every station and on the baseline observations we must have a unique identification which should be predecided during pre-preparation stage. So, that during actual observation or actual walking in the field we are clear about the name and their position and their existence. And also we should predecide about the name of the different files that in which we will be storing the data that will be collected during observation.

Another important point is the transportation because generally surveying is carried out in a difficult terrain or in a (Refer Time: 16:45) terrain where there may be route or there may not be actual road. So, we have to be very much familiar with the thing that along which route we have to board what will be the mode of convenience whether it will be by car or by walking or may be some other way like board may be helicopter may be some animal riding. So, all those things we have to decide before and have to prepare for it during preparation.

Sometimes good project also need training of the personnel's because there may not be adequate personnel who will be combustion with the methods or the different activities that we have planned to do. So, the training part has to be completed during preparation then for big work also a lot of logistics are required which need to be prepared before we actually start our surveying work, like what to stay, how to communicate from your stay, place to your project place and many other thing.

So, logistic requirement has to be also decided and get prepared during preparation, many important project needs the calibration of the instrument because if there is any small error in any instrument that will be a systematic error and accumulated over the

whole observation and that may really (Refer Time: 18:27) as a project work. So, for sensitive project or for important project we need to calibrate all most of the part of the instrument.

And finally, for any project there may be some specific requirements which may not be well identified before, but during reconnaissance survey or during the development of the project work we may come across and during the preparation stage we should take care of those specific need for a specific project and carry forward our further one. With this one, the preparation will be over then we should go for actual field operation once the preparation for GPS surveying is over then we can proceed for GPS field operation.

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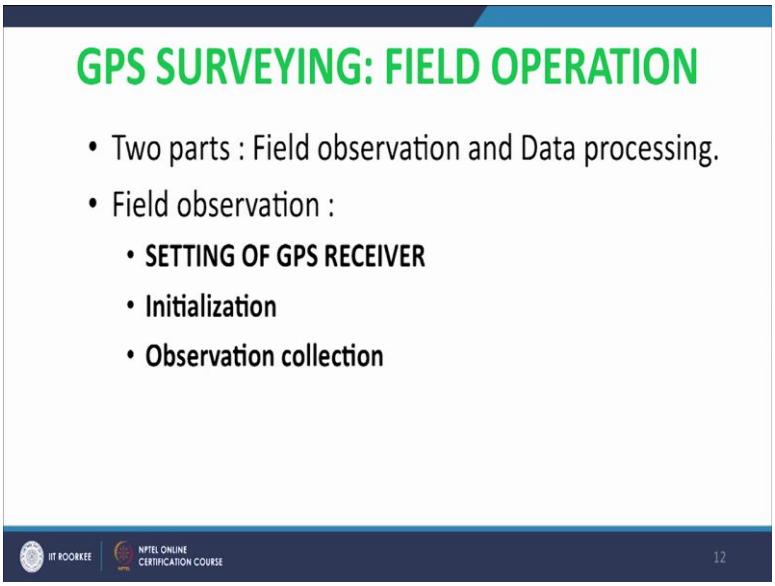

Now, GPS surveying field operations consists of two parts one is that actual observation for the data, field observation that is called field observation and data handling. Now under field observation we had three steps one is that setting of the instrument, next we have to go for initialization or providing the minimum data information default data and finally, the observation collection. Under setting up of the instrument we have two parts again - one is that your our antenna should be properly placed on the station that is called centring and levelling of the antenna and all the centring and levelling of the antenna is done then we have to connect the other part of the receiver with the antenna.

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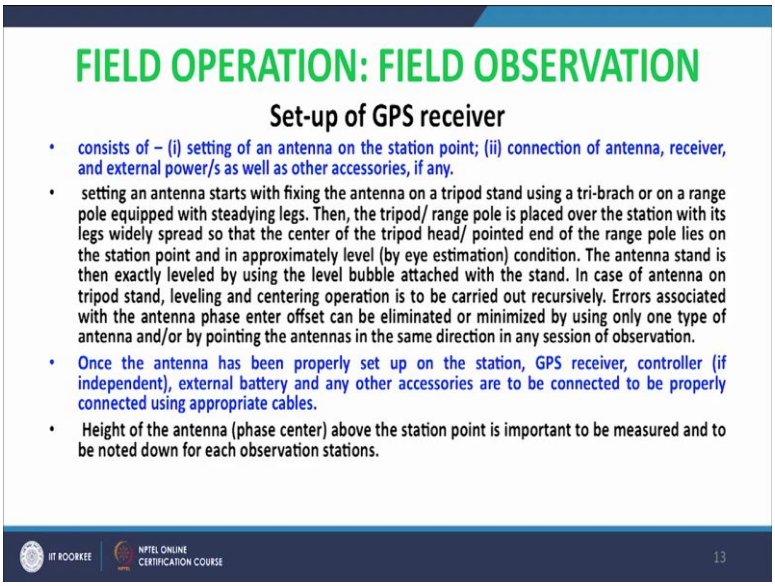

Now that is called setting up of the GPS receiver. In during our setting up of the instrument also we should note down the height of the antenna from the station point.

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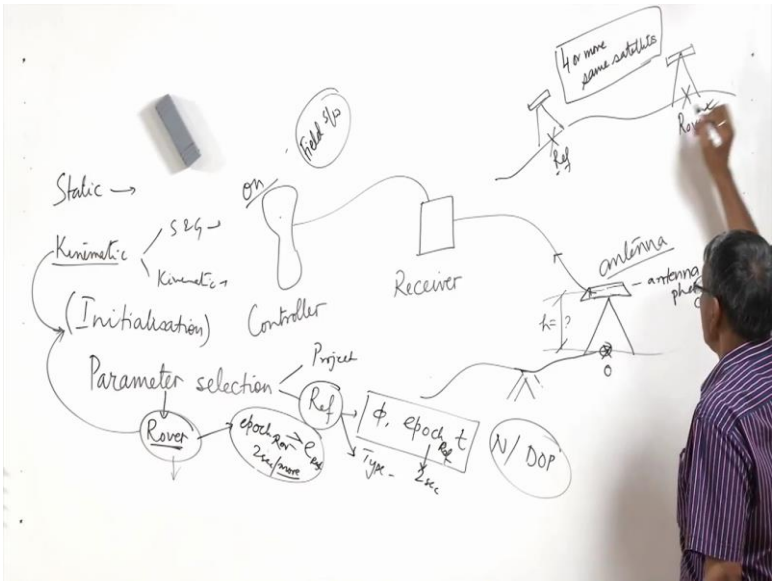

So, let us consider, suppose we want to set up our instrument somewhere here. So, we have to place the tripod stand of the antenna in such a way that it is centred then the antenna is to be placed over it so that antenna face centre is antenna face centre should be just above the station and we need to know the height of this antenna face centre above

the station centre, this height we need to know that is called antenna height and that is to be noted down during our centring and levelling operation of the antenna.

Once it is done, then antenna has to be connected to the receiver and receiver has to be connected with the controller. So, this is controller and this is the harder receiver of GPS and this is the antenna. Now in some instrument these two may be put together or in some instrument all these three may be together. So, after this connection is done then we have to make it on. So, if we make it on, automatically it will be connected to it will make it on and as antenna is placed there, it is connected it will start sending signals to the receiver. But before starting the work after make it on through the field software, as I told you field software will be inside the controller through filed software we have to set up some parameters called parameter selection.

Now, to set the parameters first we have to open one project where we will be collecting the data. So, after opening the project we need to say whether we are going for reference or rover. Now suppose we start with the reference and then we should set up some parameters like cut off angle, we should go for epoch of observation, we should go for we should also give some time of observation, of course, before going to this again we should see whether the number of satellites and the DOP is suitable of our work or not. Then we should choose the type of survey whether it is static or kinematic or stop and go something like that.

So, those parameter selection has to be done, once the within the project. And in case of reference receiver once the parameter has been selected then we can start to take our observation, but if now for the rover receiver we have to do same thing project and then we have to also select the parameters, but one thing we have to keep it mind during rover receiver is that the epoch of observation of the rover receiver should be equal to or less than epoch of reference receiver. So, this one condition we have to keep it in mind. So, suppose the epoch of reference receiver is 2 second. So, we have to keep it 2 second or more; that means epoch deviation is more, but epoch is less anyway. So, this is we have to keep it in mind.

Now, if the method of surveying is static then we can start taking observation even after setting up the instrument for rover, but if the method of surveying is kinematic; that means, either it may be stop and go or kinematic. In either of this case we need to go for

initialization of the rover station. So, initialization of rover is required if the method is kinematic. Now in initialization process, what we will do? We do plus suppose this is our reference station and we have to take any other point as the rover station where we have to place our rover antenna, rover receiver and we have to do the initialization process; that means, simultaneously we have to observe at least four or more same satellites.

So, we have to collect data from four or more same set of satellites, both in the reference receiver and the rover receiver that is called initialization and that is to be done for a particular period. Once that period is over then we can start, we can make use of the rover receiver for collection of more data. So, this is what we have to do during initialization and then once initialization is over then we should go for observation collection. So, already I have told you that for reference receiver once the parameter has been initialized, we may start the observation, but for rover receiver we can start taking observation. If once the parameter has been initialized in a static condition immediately you can start, but in case of kinematic method the observation has to be started after carrying out the initialization process.

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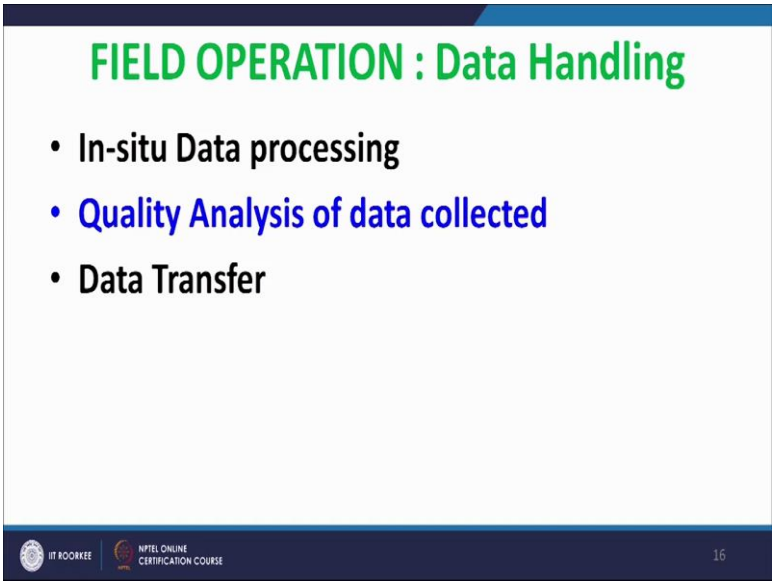

And the duration of this observation will depend upon the type of surveying we will be doing. After the collection of data we will have the observed data that has to be carried out that is to be data handling. Now it contains three steps; that mean, data processing, quality analysis and data transfer. Now once the data has been collected from the GPS

receiver, we have to see whether the data collected is satisfying or adequate and will satisfy our project work or not, for that we have to process a sample data in the field itself and to see whether our data is adequate or not; that means, it is quality is OK or not.

Now, to test the quality we should go for quality analysis, what we should do? First we should see whether the data is available; that means, whatever code and carrier data observables we are in need for our project work, whether those are available in the data observed or not, whether what is the signal to noise ratio - if the signal to noise ratio is poor then it is the good data. We should see whether the cycle slips are not lesser the cycle slip better the data it is, then we have to find out correlation coefficient if it is more than the data quality is more good, like we have to see what is the nature of distribution of the data - if it is normalized distribution and the normal distribution is sharp in nature then the quality of the data is considered to be good.

We should see that whether there are blunders in the raw data or not, if there is less numbers of blunders; that means, our data is good. Like that we had some parameters which we should test in the field itself to see about the quality of the data. Now if we see many of this quality has been achieved by our observe data, then we can say our data is good then we should go for transfer of data. Otherwise if we find that the data is not meeting our many of the quality estimates then in what condition we should take into consideration that we need to go for re-observation of the data.

So, this is very important thing if we want to maintain the quality of the GPS surveying or if you want to achieve our objective. So, once the data quality has been met as we want or as the project demands then we should go for the transfer of the data from our field computer or field receiver to the office computer or some other storage device so that in subsequently we can transfer the data to office computer for further processing. So, with this the field operation will be completing; that means, after transferring the field data to the office computer. But one thing before transferring also we should ensure that whatever information we have noted down like name of the station, name of the baselines, height of the instruments, antenna and many other parameters we may be noting down physically.

Now, we should before transferring the data we should ensure that those noted data has been properly recorded inside the file of the data. If there is any discrepancy then the field party has to take care so that all those discrepancies should be taken care of.

So, with this I like to conclude today's class. So, in summery we can say that we need to prepare properly for carrying out our surveying work properly. GPS surveying work needs a through preparation and during the preparation we should ensure that we should we have selected the proper window for our GPS observation we should also decide about the observation session. We should ensure the proper instrument and personnel's are available for carrying out the work, we should ensure the proper logistic requirements, transportation facility and any other special requirement, and during actual surveying we should ensure that the instrument is properly centred and levelled having adequate power supply and all the parameter noted has to be properly recorded in the observed file.

So, with this I like to conclude today's class. See you in the next class, having the third part on GPS surveying where I will like to tell about the basics or the salient steps which has been done for processing GPS data, and finally how to record the GPS surveying work.

Thank you.