GPS Surveying
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Lecture – 01
Introduction (GPS Surveying &Applications)

Friends welcome you all to the NPTEL open course on GPS surveying. Today, the first class which will be dealt with introduction to GPS surveying and its application, this class will be dealing with basics of surveying than introduction to GPS and to introduction to surveying GPS surveying and its application.

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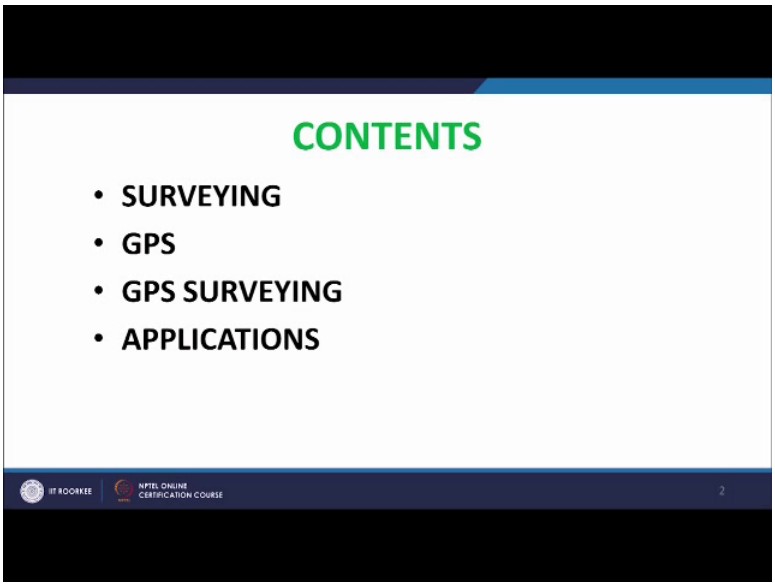

Now, what is surveying? Actually surveying is the science of measurements of the surface of the earth. In this what we do, we do find out the position of objects or points on the surface of the earth or near the surface of the earth, why you do this thing? We do this thing to prepare a plan or map of the area.

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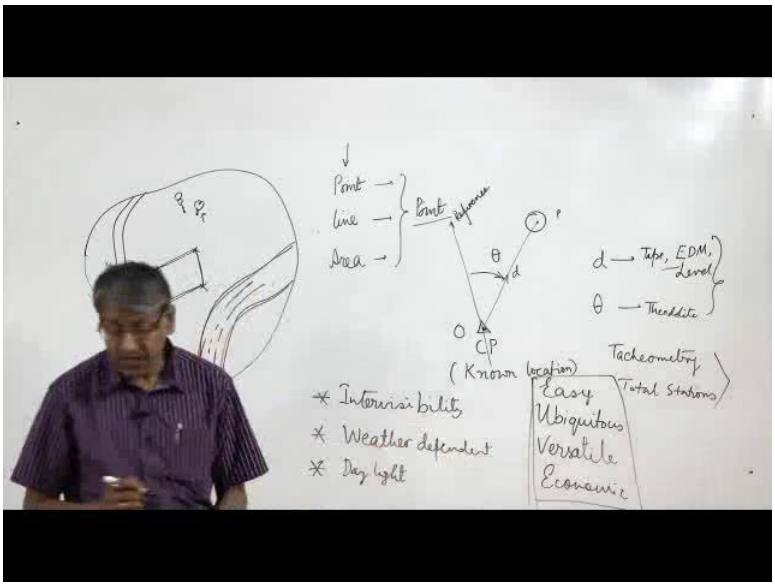

Let us suppose there is area of which we want to prepare the plan or map. Now in this area there may be some road, there may be some telephone lines, there may be some trees, and there may be a garden or some river etcetera. Now to prepare the plan and map of this area we need to find out the location of this telephone lines than the corner of this roads than, the boundary of this garden, location of these trees, again the bank of this river etcetera. Now how do you do this thing? This can be done simply by identifying some salient points for the object to be identified and from that points we can identify, we can make this object, how? Suppose I want to know all this trees. So, simply by knowing the location of this we can find out the tree.

Now, if I want to go for these side of this road we can identify some salient points on this road and joining these points we can get the side of this road or if we want to plot this garden simply we will identify the salient corners and joining these corners will get this side this corner this side, joining this two point we can get this side and like this side. So, I am joining all this sides we can get the garden; that means, what we can say that whether the object is appoint object or line object, object may be divided into this type point object, line object and area object and all these type of objects can ultimately can be delineated or mapped by identifying salient points of the map, of the object. So, the whole of surveying involves in finding out the geospatial location of some salient points and surveying is a very old engineering method and about the period of time there are so

many instruments as well as methods has already been developed to geospatial locate the point.

Now how do we locate a point, how can we locate point? A point can be located or a point gets located suppose a point p suppose this is the tree, point p how can we locate? We locate it with respect to another point whose location is already known, in surveying this point whose location is already known this is known as control point; that means, known location. Now with respect to known location of the control point, we will get the location of the point p if we know the distance between the point and the known point suppose d, and also the direction of this line. Now to know the direction we need to have a reference and then we will get some direction.

So, distance and direction of any point with respect to a point whose location is already known we call it control point or also we can call it as origin then only we will be able to get the position of the point p. So, this is the fundamentals how we go for measurement of; that means, we have to measure distance and radiant direction in normal conventional methods and to measure the distance there are so many methods just like tape then, EDM - electronic distance measuring instrument then, for angle we use theodolite and there are some instruments which can measure both. Now the distance is again there are two types horizontal and vertical distance, vertical distance we can measure using level then there are some methods like tachometry method by which we can get both the distance and directions or then we can go for total stations. But these methods provides us the location ours with respect to some relative point.

More over these instruments and methods can only work mostly work in day time and to work this instruments we need to have the inter visibility between the reference point and the object point. Again these methods can work only when the weather is favorable. So, the conventional methods has the limitations of inter visibility and then where it is weather dependent then, it can only work when the light is sufficient, day light suppose.

Now, also these methods are very much lower intensive and time consuming. So, these are not that economy. So, scientist and engineers are looking for some method which should be which will be ubiquitous means anytime it can be done, it should be versatile, it should be economic, and it should be easy like that, all and so with this objective there are so many instruments and methods are going on developing about the years. So, it is

the latest develop system which is scientists and engineers and surveyors want to apply or use in surveying is the global positioning system GPS.

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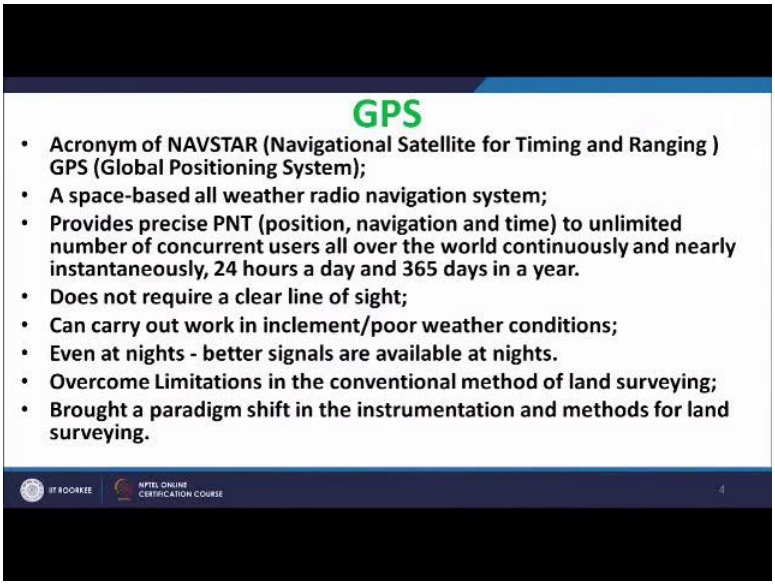

Actually, its full name is NAVSTAR.

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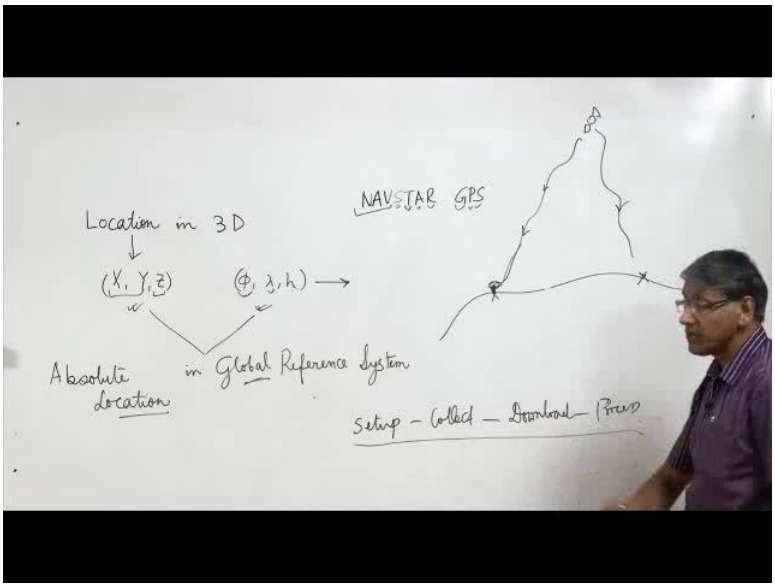

GPS NAVSTAR stands for navigational satellite for timing and ranging and GPS means global positioning system it is a radio navigation system means it works in the radio range of the electromagnetic wave and it is all weather system - means it can work in all weather condition, whether it is sunny or rainy or fog is there. This system has been

developed by US department of defense for military purpose, later they made it available for the civilian use. Now these GPS is; that means, signals from GPS is available to innumerable infinite numbers of concurrent users all over the world, all throughout the day and 365 days in a year; that means, it is a ubiquitous system whose signal may be used by infinite numbers of users together in all about the world.

More over in this system the line of side between; suppose we want to find out the distance between this point and this point. So, we do not need the intervisibility between this point and this point because we will be getting signals from satellites. So, it will reach both like this. So, intervisibility between the stations or from the refines to the absorb point is not required as I told you this works day and night as well as it also works in implement weather. So, the GPS system has overcome many limitations of the existing conventional surveying methods and this has brought a (Refer Time: 12:20) shift in methods as well as instrumentation for taking measurements for land surveying.

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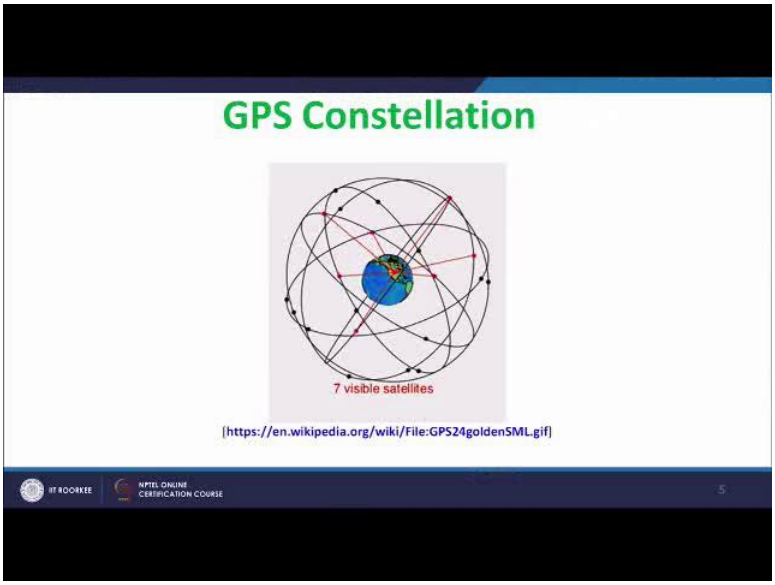

Now this picture will give you an idea how GPS signal arrives on the surface of the earth let us say this is a point where the signals are coming from some satellites. Now you can see at any instant of time at any location the numbers of satellites are different with time or with position. So, and the idea is to get at least four supply signals from at least four satellites will be coming to the station.

Now GPS system provides the location in 3D; that means the location is given by GPS system either in Cartesian coordinate or in geodetic coordinate. So, the position is Cartesian x y z or geodetic lambda, lambda phi h latitude, longitude and height. So, this is a big advantage about the conventional methods where we get the position either the horizontal (Refer Time: 14:06) position or vertical position.

Another advantage of this GPS system is that it provides this location of this location in a global reference system, so we get the position always with respect to some fixed define system. So it is an absolute location in comparison to relative location we get in case of conventional methods, and it works very simple because in case of GPS what we need to do only we have to set up the instrument at that point of observation and signal will come from the satellite. We need not to do anything else and later we have to download the data and process the software. So, set up the instrument, collect the data and then download the data and process the data. So, this work does not involve much of physical involvement as well as it does very simply. So, the method is very quick as well as simple to do and not (Refer Time: 15:59).

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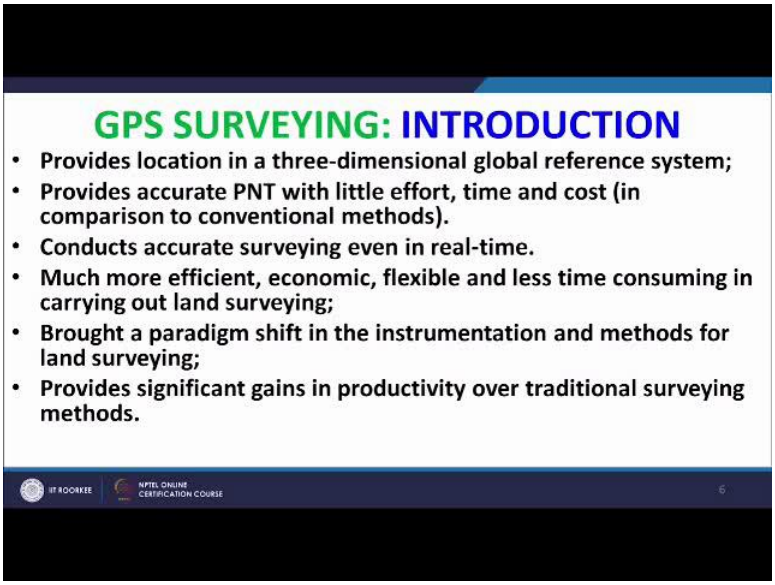

So, the surveying or GPS involvement will be economic, efficient, flexible, less time consuming, in carrying out, land surveying, and all these has brought a paradigm shift in the methods of land surveying and that is the productivity of surveying using GPS will be much more than what we do we get in conventional method of surveying.

More over GPS receiver nowadays are widely available as well as it is economic and there are many softwares available even in the open source it is available. So, GPS is becoming very popular among the users and surveyors.

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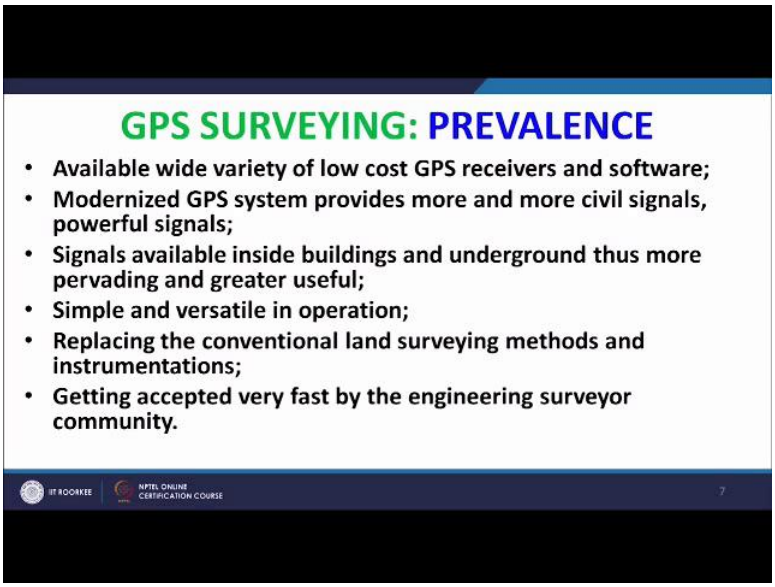

Now as further this GPS system is getting modernized day by day; that means, it is improving, so I will write.

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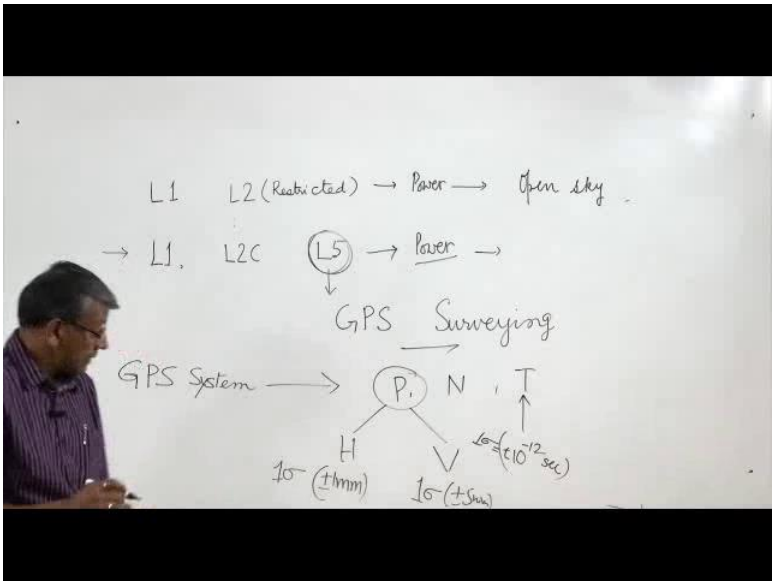

For example, initially we used to get only one civil signals and L1 and L2 having the restriction. Now at present we do get three civil signals like L1 L2C L5. Not only the

numbers of civil signals are increased, the power of this signal was much less than the power of the signal now we are getting. That means now these signals are more reliable and the amount of measurement, quantity of information we can easily get. So, this availability of good quality, receivers economically as well as availability of softwares as well as availability of better signals and not only it is a powerful and number also now a days this L5 signal is available inside building as well as underground. That means, initially the signals were available when the sky is open, in open sky, but this restriction is also overcome in the present day GPS signals.

So, the GPS signal is now finding out to be more versatile. So, as a result of this our GPS surveying work becomes easy, more versatile, widely available and economic as well as it is economic, and so it is going to replace many of the existing land surveying methods. More over the GPS is getting accepted very fast by the engineering survey or community, as a result GPS is being used for different types of surveying including land surveying.

It is becoming the primary instrument to make precise measurement specifically whenever we are in need to go for measurement of position or we want to go for navigation or if we want to go for measurement of time than GPS is a very good, GPS system provides position that I could see up in positioning is for horizontal positioning we can get very easily millimeter accuracy. So, 1 sigma plus minus 1 millimeter and the vertical accuracy 1 sigma plus minus 5 millimeter, this is the kind of accuracy we can achieve easily using GPS system. And time, we can achieve accuracy in time of the order 10 to the power 12 minus 12, 7. So, GPS system is coming up very; one sigma.

So, nowadays any work that involves the measurement or position navigational time GPS is the best solution. Now regarding surveying you can see, there are different types of surveying that is conducted over the defined community like for land surveyor community, GPS is being used for land surveying one of the premier application of GPS is for land surveying.

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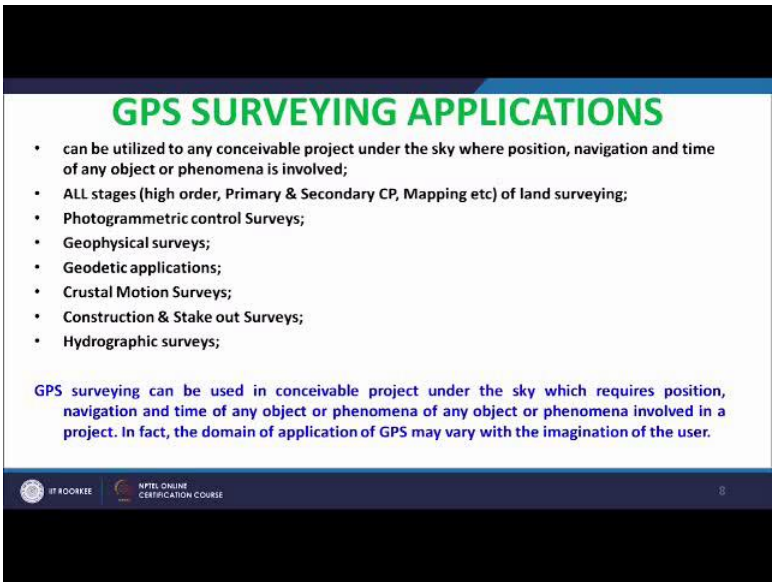

Now, how do you carry out the land surveying? The basic principle of land surveying is to working from whole to part, what is that?

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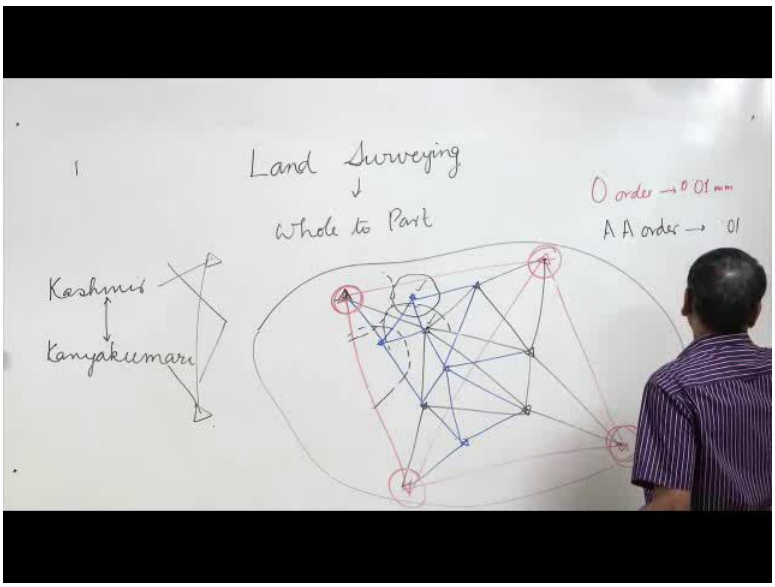

Now, suppose there is a big area which we want to go for surveying. So, to start with first we should go for some very precise measure control point this is called zero order or this is called zero order highest order and its accuracy is of the other 0.1 millimeter, 1 sigma. So, the network first has to be, now once this primary network is there then we go for some (Refer Time: 22:52) order network like this. So, within this network again we

may go for still lower order, like that. So, once this lowest order network has been done then we go for surveying, about some areas suppose like this from here I can go for this, from here we can go for this, like that. So, in that area in that way we go carry out surveying.

Now, in the beginning GPS use, was being used to establish the highest order control points, but as GPS is coming up very easily economically and also it is widely available receivers. So, now, GPS is not only used for establishment of the secondary or tertiary control point, but also GPS nowadays is also easy used for surveying work and mapping work. Next land surveying not only that nowadays GPS is being used to measure the baseline, now what is baseline? It is the distance between two primary control points.

Now suppose we want to measure the distance from Kashmir to Kanyakumari, now this is involved 1000s of kilometers, earlier it was a proposition it used to be a proposition near to impossible, but nowadays we can do it quite easily; simply we have to set up two instrument one at Kashmir station another at Kanyakumari station and between that we will take the observation of these Kanyakumari station, we will take the observation at Kashmir station and we will take together this two observations when we can process it and we can get the distance between two stations, very quickly, and also economically.

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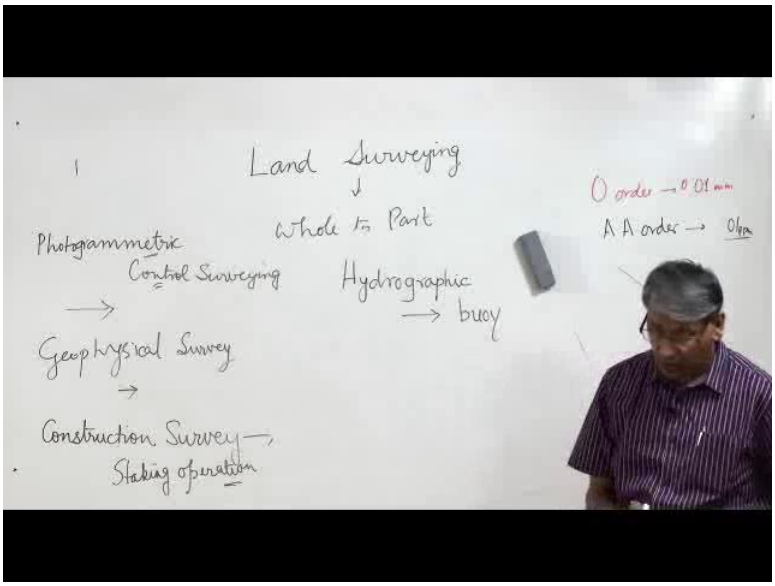

So, this is called highest order baseline that is A A order of the accuracy 0.1 parts per million. So, apart from that there are other surveying like photogrammetric control

surveying, what is that? Actually in photogrammetry we make use of some Arial photographs to get the pictures and objects on the surface of the earth, but in order to get the pictures and objects with their exact position we need to first establish the congruence of the photograph with the land and that is done by using control surveying, photogrammetric control surveying. And this was a very difficult proposition earlier, nowadays using GPS we can do it quite easily and more accurately than it used to be done earlier.

Then geophysical survey GPS is also used in geophysical survey what is that now in geophysics we did do a study about that deformation of the earth due to earthquake, volcano like that and then preseismic, postseismic, deformation then inter-seismic deformation, volcanic time series, what is the growth of volcanic deformation. So, all these are nowadays possible. Then there is a moment of cuts. So, how these cuts (Refer Time: 28:47) what is the rate of movement then there are plates on which all continents are belonging, now this plates are moving from each other. Now what is rate of mobbing between the plates? Before GPS it was impossible to know what to do, how to do, how to know, now we can measure all these deformations, crustal deformations and all these things.

Then another area which is very much GPS is coming up that is called construction surveying. Now in construction survey we have already prepared map of the construction site using autocrat and by using the autocrat map and using GPS the staking operation, staking operation which was very difficult to do earlier now can be done very easily quickly and accurately using GPS.

Now another area of survey which is being benefited by GPS and widely used by using GPS that is hydrographic survey, in hydrographic survey generally buoy used to find out the coastal variations of the water level and that is being nicely or quite easily measured by using GPS. Now this is in short about what GPS can do how GPS can be used in surveying, but the amount of use in GPS surveying is depends on the imagination of the users, any users, any project or any work which involves the measurement of or determination of or need the position or velocity or navigation or time measurement there GPS can be used. So, in short we can say that the use of GPS, application of GPS, domain application of GPS may vary with the imagination of the user.

With this I want to conclude this class. See you again for the next class which will be held on GPS system.

Thank you.