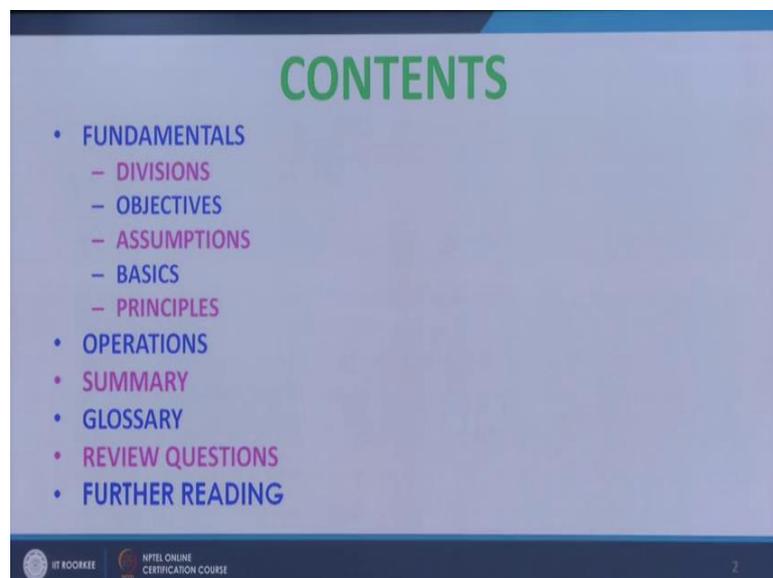


Digital Land Surveying and Mapping(DLS&M)
Dr. Jayanta Kumar Ghosh
Department of Civil Engineering
Indian Institute of Technology, Roorkee

Lecture – 02
Fundamentals and Operations

Welcome you students. Today I am going to talk on the lesson 2; topic is Fundamentals and Operations in Digital Land Surveying.

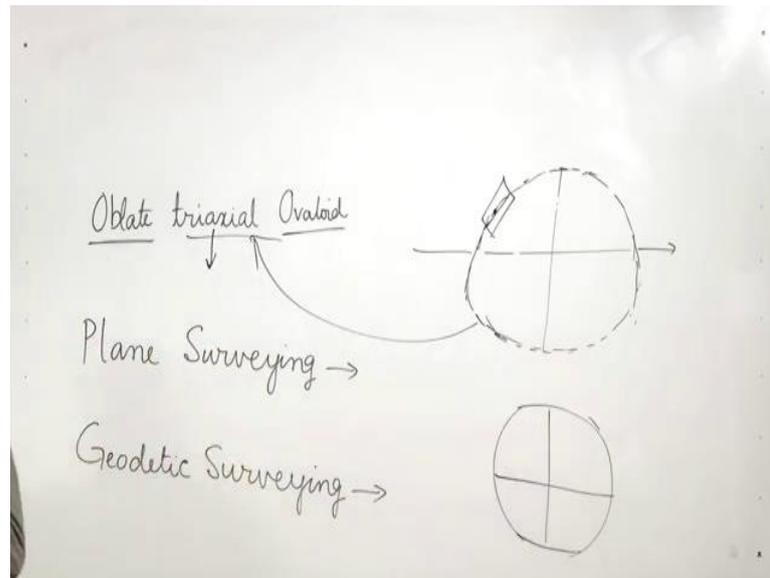
(Refer Slide Time: 00:53)



In this lesson first I will tell you the fundamentals of land surveying in which where we will discuss the different types of or divisions of land surveying, then, the objective of land surveying which will be adopting in this course, assumptions of the land surveying, basics of land surveying and principles of land surveying. Then I will discuss about the deferent operations involved in land surveying followed by summary, glossary, and review questions.

Now, as I told you the surveying is the science on measurement of the earth. Now we all know that earth is not a plane surface that is a curved you can say generally we say it is a spherical in shape.

(Refer Slide Time: 01:52)



But actually the shape of the earth is termed as oblate triaxial ovaloid. Now what is the significance of these three term oblate? Means it is two axis of the, if we see the axis of the earth; suppose this is the earth and this is one of the axis and another axis, these are not same, it is a bit like this. So, it is oblate in shape; that means it is equatorial axis is more from the polar axis; polar axis smaller than the equatorial axis. Triaxial: now if we take a sectional view along the equatorial plane also will not get a circle, but these axis and this axis will be defined, so a bit less in this direction so we call triaxial. That means, three axis.

Then ovaloid: not only this is flattened along the north-south direction also the Northern hemisphere is less and then Southern hemisphere is a with dilated, like an a. So, ultimately the shape of the earth is something like that. So, this is called oblate triaxial ovaloid. Now, the why I am discussing this thing, because as we know ultimately we need to have a map of the area for which we will be caring out deserving and the map is on a plane paper. So, we have to go for a curved surface on a plain paper.

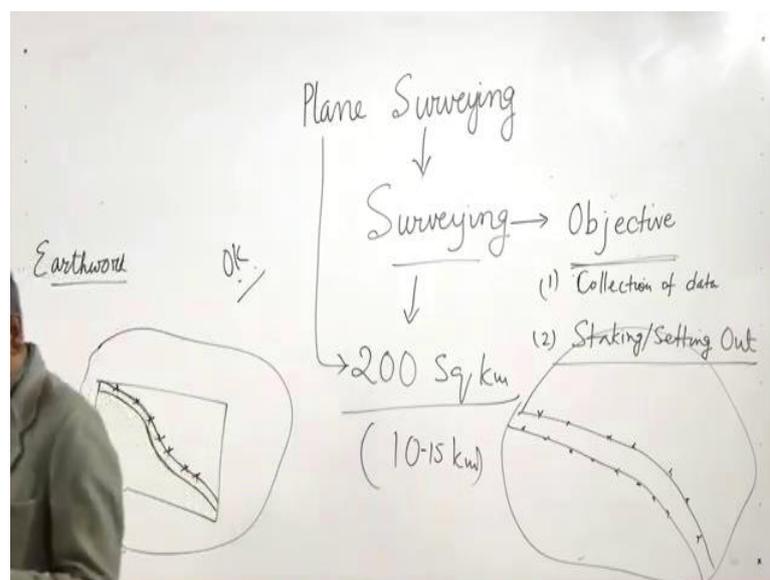
Now, if he see the dimension of the earth, if he take a very small dimension then there will not any defined between a plain surface and a curved surface. But if the dimension of the surveying work is much then there will be deference between the plane surface and the curved surface. So, depending upon the area to be surveyed the type of surveying is divided into two types: one is called plane surveying or the area to be surveyed does

not deform much whether it is a curved surface or a plane surface, and another is called geodetic surveying- when the area to be surveyed is such a big extent that we cannot assume that the surface is a plane surface.

So, in this course we will go for plane surveying; that means, in this course we will study or we will learn how to carry out the survey on the surface of the earth which is small in extent. That means, we will not have much defiance whether the surface is curved or plane, both will be. What about is the location? Suppose this is the location, if I take a small area like this, so they are not any difference between a curved surface and a plane surface.

Now in case of plane surveying the surface of the earth is (Refer Time: 06:48) horizontal in nature. So, hence forth whatever was surveying we will tell we will understand that it is the plane surveying.

(Refer Slide Time: 07:04)

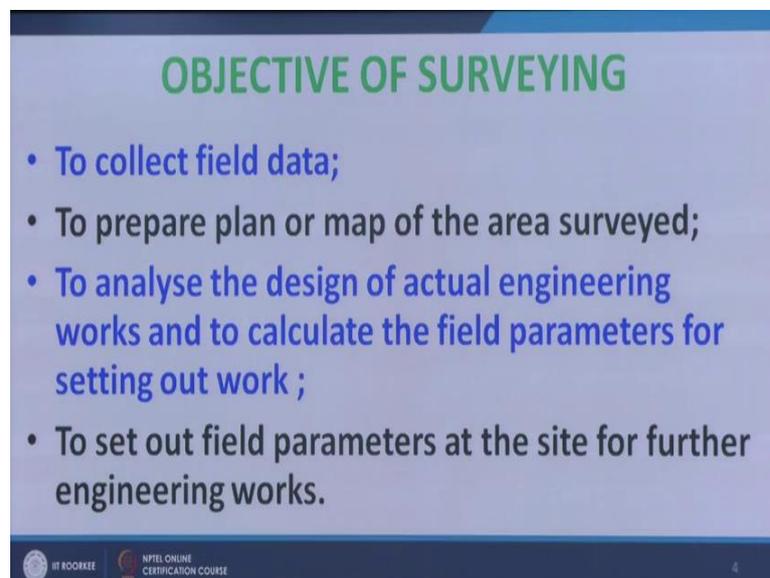


So, we will learn in this class plane surveying. And we will call surveying means; we will call it surveying. So, by surveying we will understand that we are going for plane surveying. That means, our area to be surveyed is such a small extent that there is no difference between the curved surface of the earth and the plane surface of the earth. So, to these; now this is for us, because most of the civil engineering projects we will see that the extent of the project is not much. Now maybe if the extend is within 200 square

kilometer and any one of the dimension is 10 to 15 kilometer then we can go for plane surveying.

So, plane surveying is for whenever we will go for a survey (Refer Time: 08:28) an area to be surveyed is 200 square kilometer or the any one of the dimension is within 10 to 15 maximum up to 10 to 15 kilometers then we can go for plane surveying. So, here what is written? So, generating surveying the project extended to large; and whenever we like to go for very precise or accurate project then only we need to go for genetic surveying which will not be taking into consideration in this course.

(Refer Slide Time: 09:15)



Now, I will like to tell you about the objective of surveying. What is the objective of surveying? That means, whenever we go for plane surveying really what we want to do; the first thing we need to want to do is to collect the relative location of (Refer Time: 09:33) points or objects present on the surface of the earth. So, this is the first and most important thing which we want to do in surveying.

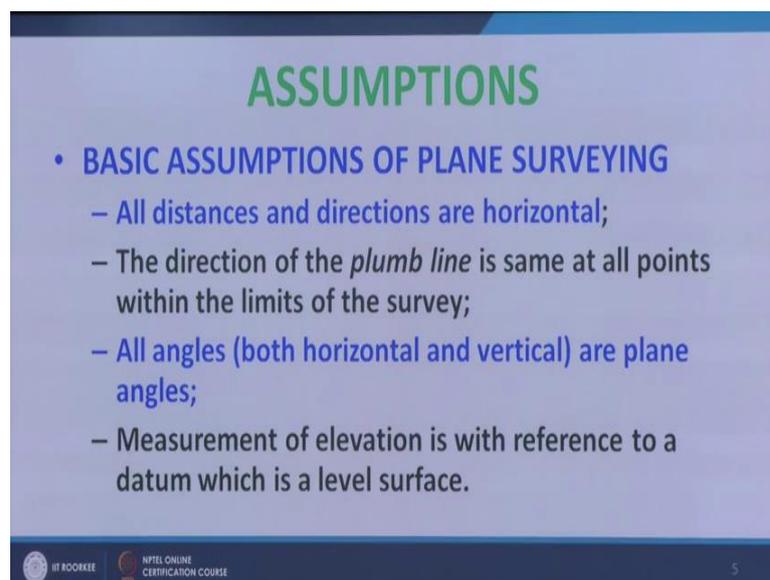
Once we collect the field data that means relative location of surveying points, and the direction also then we will go through prepare a plan or map of the area. So, once we get the plan or map of the area that plan or map of the area is the representation of the actual land surface which is available as a surface of the earth. On that plane surface on that plan or map next we will go for our analysis for the design of our civil engineering projects. Like suppose, this is the area in which or the plan or map of this area, I want to

construct a road on this so suppose this is the line along which I want to construct the road. Now in carrying out this thing let us take one example earth work; earth work that means, how many how much of earth has to be imported to this area or how much earth has to be taken out from this.

So, from our topographic map we can do all this work. As well as we can lay out our road in the map first then we will go to the actual field and we will locate some salient points along this. Suppose you have the point whose points location we have noted down in the map same points we will transfer it here, so now we will join in the field to get that road in the actual field. So, that is what is called setting out operation. So, these are the works we do during; these are the objective of surveying.

Now, in doing these works means to collect the field data at number one; as I told you collection of field data, then suppose staking out or setting out.

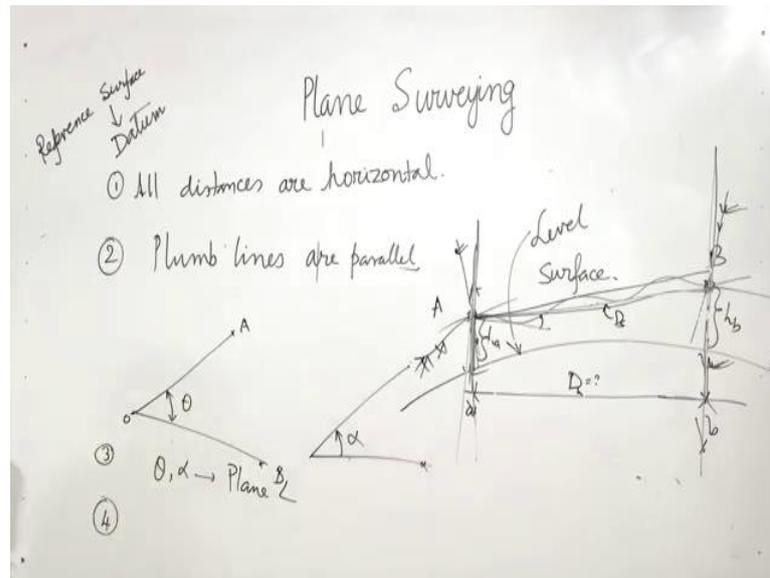
(Refer Slide Time: 12:44)



The slide is titled "ASSUMPTIONS" in green text. Below the title, there is a bullet point "• BASIC ASSUMPTIONS OF PLANE SURVEYING" in blue text. Underneath this, there are four sub-bullets in blue text: "– All distances and directions are horizontal;", "– The direction of the *plumb line* is same at all points within the limits of the survey;", "– All angles (both horizontal and vertical) are plane angles;", and "– Measurement of elevation is with reference to a datum which is a level surface." At the bottom left of the slide, there are logos for "IIT ROORKEE" and "NPTEL ONLINE CERTIFICATION COURSE". At the bottom right, there is a small number "5".

All these works of surveying are done; in case of plane surveying is done assuming something like basic assumptions. Like in surveying as you know they are the surface of the earth is curved, but in case of plane surveying.

(Refer Slide Time: 13:06)



In case of plane surveying we assume that all distances are horizontal. Now if you imagine the surface of the earth you will see; if you imagine we can see that the surface of the earth is not a plane (Refer Time: 13:29) it is not plane, but whenever we talk about distances it is the horizontal distance. So that conversion you have to do; you have to think, we have to visualize during our surveying work.

Number 2: from between any two points as you know these surface of the earth something like that. So, if I say this point and this point actually we are thinking of the horizontal distance between these two points. Like this suppose A and B are the two points on the surface of the earth which are considered, but the distance between A and B we will consider as this like this. Now you know if I measure the distances along this line it will be more than this. So, in plane surveying we consider the distances like this.

Now, you know that if we hang a plumb line actually it will be perpendicular to this tangent to this, and if I take a tangent to this, it will be taken to this. But in case of plane surveying we do you assume that this one is taller to this. So, plumb lines are parallel; this is the assumption. So, because we assume that these surfaces are plane, so this should be parallel. Like if I take a plumb line at this and at this they will be parallel; they will be parallel. So, this is the assumption second assumptions. All angles are plane angle. So, our horizontal angle if I measure the angle between two stations A and B from any location O ; so now as you know you in the surface of the earth it cannot be plane, but

we assume that in plane surveying this is the plane; this angle is plane angle. Whether it is horizontal angle or if it is a vertical angle, so it should be all alpha and theta all are plane angles.

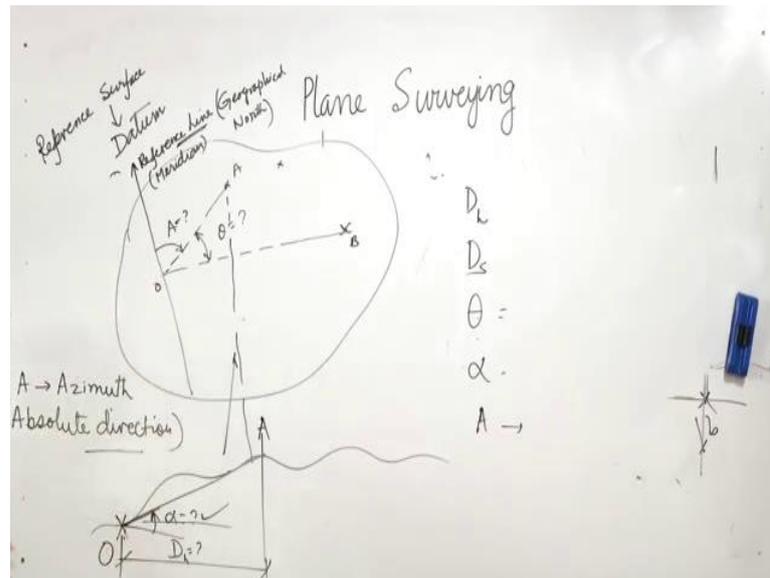
This is the plane angle. And the more another important thing is that if we want to find out the height of these points; now height means allows we should with respect to some reference datum, with respect to some reference surface and in surveying time this is called data. Data means it is a reference surface with respect to which we reserve the height. Now in plane surveying to find out the height of these points would you take not a horizontal surface not, but a level surface, this is called level surface.

So, what is the height of the point A? If this is the height above this is the plumb line. So, this is the height of A and this is the plumb line so height B. So, in case of plane surveying whenever we go for the measurement of height it should be with respect to a level surface. So, this is one of the important things you should remember. So, with these assumptions, actually all measurements will take place. So, this is very important to know; what are the basic assumptions.

Now really what we measure in surveying or in plane surveying? We measure the; as I told you the horizontal distance D , if we know two points A and B what is the horizontal distance between them, that is what we will like to measure. What is the slope distance? Means if I join these with a horizontal line; with an inclined line now what is the slope distance. So, this is the horizontal distance.

Then we will like to measure the horizontal angle between two stations with respect to one reference station, and what is the vertical angle of any station I will respect to any station.

(Refer Slide Time: 19:38)



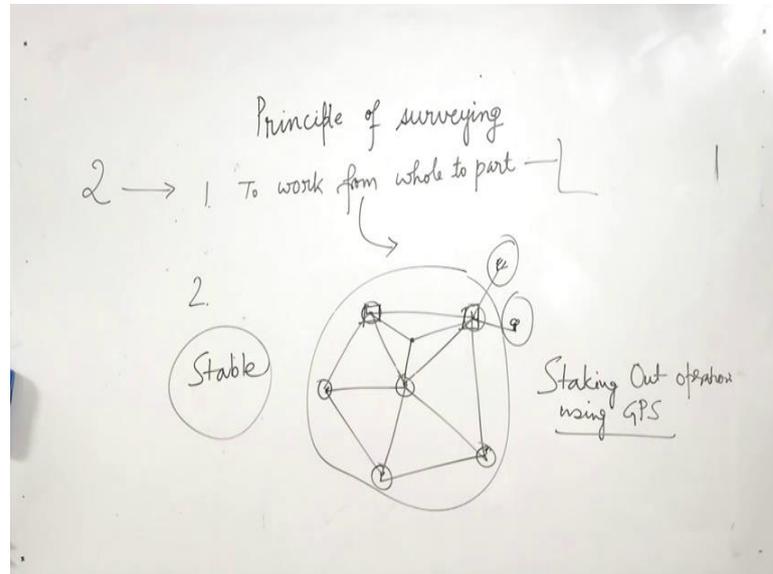
So, like suppose this is a point O and this is a point suppose this is A, O. So, I may like to know what is the vertical angle. Now suppose if we project it this is the ground, this is our O, this is our A suppose this is our B. So, this is the horizontal angle between A and B with reference to station O. So, we will be interested to know what is the vertical angle of A with respect to the station O, then what is the horizontal angle between A and B with respect to O, then what is the slope distance between O and A, then what is the horizontal distance between O and A. So, these are the things which really we will like to know, we like to measure in surveying.

Further we will like to know what is the direction of the point A with respect to O. Now to find out the direction of the line A actually we need to take a reference line which will also called meridian. So, we like to know what is the angle. This is also we measure A plane surveying that is the horizontal angle. Now if the reference line is Geographical North then this angle A is called Azimuth. And this provides the absolute direction.

So, in short we will like to measure the horizontal distance, the slope distance between two stations, that horizontal angle between two stations with respect to one station, then vertical angle, then your direction of a line, and azimuth. So, these are the parameters really we do measure in case of plane surveying and from these parameters we do get the relative location of station or points or objects of important features. And from there we convert it to mapping of the area.

Now with this background now I like to discuss; what is the principle of surveying; that means what principle really we do adopt for carrying out surveying.

(Refer Slide Time: 23:29)



Basically, surveying is carried out adopting two basic principles: principle of surveying. There are two basic principles: one is to work from whole to part- actually now we work for whole two part, the reason main is that by adopting this principle we can minimize the amount of error also we can restrict the accommodation of error. So, fundamentally to improve or to reduce the error associated with our serving work we do adopt the principle of working for whole two parts.

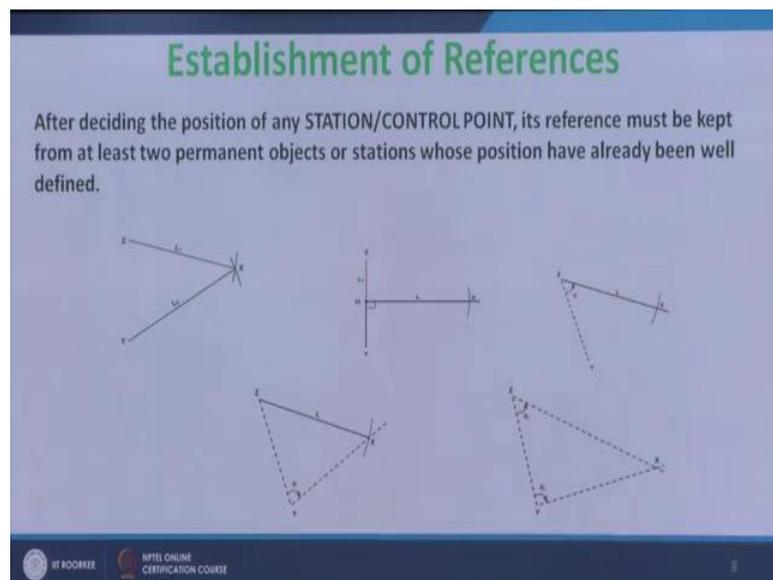
Now what is that, actually whenever we go for surveying first we derived the whole area in to some primary geometric figures usually it is a triangles. And suppose this is the area first we will like to decide this area to be divided in such; we will like to take the station in such a way so that the area is divided into some triangles. And location of these triangles, vertices of this triangle which will be termed as control point or control station; depending upon the accuracy it will be primary control point or secondary control point tertiary control point we will first establish.

And depending upon the whether it is primary secondary or tertiary we will maintain the accuracy. So, within this triangles are formed within this triangle again we will go for some other station and we will go for another set of triangle. So, whatever error is accumulated in these error in this triangle that will be divided into three triangle small

triangle. In that way we are reducing the amount of (Refer Time: 25:57) reducing the accumulation of error. So, this is called working for whole to part.

And setting principal is that once we identify the location of the station this station should be maintained or its location has to be maintained with reference to at least two permanent objects. Suppose building corner a big tree. Now, of course, it is an old method of keeping this, of course we will like to have it, but if the area is stable; stable means if there is no chance of having any deformation or variation or change of this area we also keep this by through is staking out operation. Staking out operation using GPS- of course, you will learn in after words we can also go to this is station any way. So, this basic principles having is to work for whole to part and to maintain the location from at least two permanent objects.

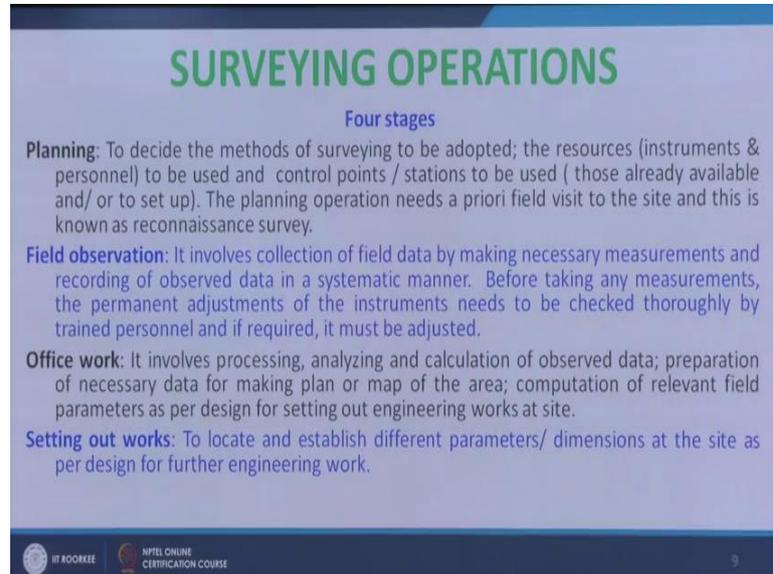
(Refer Slide Time: 27:23)



Now here there are some figures which show how to maintain the location of any station. Suppose in this figure x is the point which is the location of any control point like this, is the suppose this is x. Now these x location can be maintained with respect to two (Refer Time: 27:48) object like y and z. How to do it? By taking the distances from z to x and y to x. If we know the distances from this suppose l_1 and this is l_2 the intersection of these two we will be the location of the point x. So, in future if we want to go to the point x simply by making these two measurements and intersection of that will gives as the location of x.

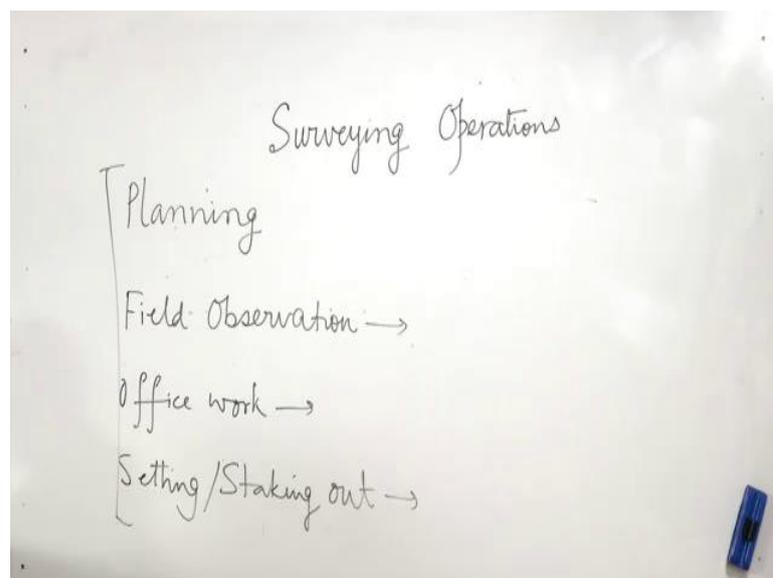
So, in that way you can see there are so many other ways how we can keep the different measurements and we can maintain the location of our control points.

(Refer Slide Time: 28:38)



Now the final topic of this today's second class; our today's class is that what are the different operations we need to do doing surveying.

(Refer Slide Time: 28:51)



So, there are four fundamental operations: surveying operation. So, what are the fundamental operations we need to do for carrying out any surveying work? First we should plan; we should plan our work that is called planning. Now for planning work

we need to go for recognizing survey of the area already I have told you. Once after carrying out the recognizing survey or sometimes we can do the planning also; nowadays lots of Google map and other sources of maps are available from there we can go for planning. And then we can go to the field and do further planning.

And after the planning operation is over we should go for field observation. So, field observation involves, like as I told you to identify the salient objects of points and then we should go for measurement of horizontal distance, slope distance, horizontal angle, vertical angle, reference direction, absolute direction, all those thing. Once we go for the measurement field observation has been done we come back to our office and then we should go for office work.

Now, in the office we do download the data, we do process the data, we do reduce the data to arrive at some parameters which are required for our project. So, once our office work is over then we makings of that people are the map, we do plane our project on the map, and then we do find out some salient points of our projects, and then finally we do you go back again to the field for setting or staking out operation. So, these are the four fundamental steps which we do (Refer Time: 31:17) for carrying out any surveying.

With this highlight to conclude today's class, before final conclusion I like to summarize this class. There are this fundamentally two types of surveying depending upon the area to be surveyed. In this course we will be considering the area to be small, so we will consider that this surface of the earth is plane and thus we will learn the plane surveying.

Plane surveying means where we will assume that distances and angles, direction all are; distances angles are plane in nature, and height is above the level surface. And while carrying out the surveying we need to adapt two principles: one is to work for whole two part- this will help us to reduce the error, and whenever we will carry out this surveying we need to go for first planning then we should go for field observation after that office work we will do. And finally, we can go for staking out operation.

With this I will like to conclude that glossary and review question is for your study. And if you want to study more you can consult these two books.

Thank you.