Site Analysis and Planning

Lecture 2

Welcome to UGC lecture series for B.Architecture. The topic is Site analysis and planning. Subject code - AR 6512. Unit 1 - Introduction, lecture 02.

Presentation outline - presentation is divided into first, introduction, Plane surveying, Geodetic surveying and then we will look at definitions and surveys.

Site Surveying

Surveying defined - What is surveying? Surveying is the art of measuring distances, angles and positions on or near the surface of the Earth. The process in which you measure distance or land or how elevated an object is from the given plane or how low it is, it is called surveying. Why is it called an art? Because only a surveyor who possesses thorough understanding of surveying techniques will be able to determine the most efficient methods required to obtain optimal results over a wide variety of surveying problems. Since we have tremendous methods of surveying, the only people who have studied surveying completely can give a good idea of what type of surveying can be adopted for the requirement or the distance that has to be measured to reduce the errors and to also minimize the effort that goes into the whole process.

Why is it scientific? Because the use of mathematical techniques to analyze field data accuracy and reliability depends on understanding scientific principles underlying and affecting survey measurements. It is scientific because it uses a lot of mathematical analysis and techniques that goes into each surveying technique used by the surveyors which reduces your errors and mistakes. To increase its efficiency, they need to use a lot of mathematical techniques and equations which makes it completely scientific. Types of surveying - there are two types of surveying; plane surveying - Earth's surface is considered to be a plain of x-y dimensions. When you take something in x-y dimension which is like a table or a plain, is called plain surveying. It has only two dimensions which are mentioned as x axis and y axis. Z-dimension (height) referenced to the mass spherical surface of the Earth (MSL) which is above the main sea level. Z is the height from the elevated point. Main sea level is mentioned as z axis. This usually comes under Geodesic surveying. Most engineering and property survey are plane survey correction to curvature is made for long strips (higher). For most of the construction works that we usually carry out, usually the site is marked a x b. If you take a site that's 100m by 300m, we usually take into 3 or 4 dimensions which usually goes into making a plot, which happens to be just a plain. Plain surveying is usually widely used in construction industry.

This is an example of plane surveying. These are instruments. For example when you see this parcel of land, it has just these two dimensions and there is no vertical dimension that has to be measured. All these are examples for Plan surveying.

The next type of surveying is Geodetic Surveying - Earth's surface is considered spherical in resolution, actually ellipsoid, x-y. Z is referenced to MSL (surface to Earth). As mentioned earlier, plane surveying takes care of x axis and y axis. When the height comes into account which is usually taken for a parcel of land or the whole sphere, it comes under Geodesic surveying. Very precise surveys, boundaries and coastal networks. It is very precise surveying method, it is usually used to survey coastal areas and boundaries where very accurate surveying has to be made. We don't need to share our boundaries with the third person. That's why Geodesic surveying is used for much bigger or much more important places. As you see here, this is the sea level and this height or elevation from the sea level is marked here and this is the core from where the Earth starts and this is the Geodesic distance. This is the surface distance you see. When you need to find such type of information, you need to go into Geodesic surveying.

Classes of Survey - Preliminary Survey - data gathering is the gathering of data (distances, position and angles) to locate physical features (rivers, roads, structures) so that data can be plotted to scale (map or plan) also include difference in elevation so that contour could be plotted. Preliminary data is that data or information that must be understood before you get into actual technical part of surveying. The first hand information you get is preliminary surveying which includes where your rivers, where your trees and basic data with physical features such as rivers and roads or surfaces located is called preliminary surveying. If you take this parcel of land, the preliminary surveying for this parcel of land will be that is being abutted by road on two sides and there is an area of inventor here and there is a club or a municipal corporation area that is located here. This type of information is actually the preliminary survey information.

Next is layout survey, using sticks, iron bar or concrete monuments. The features show on a design plan are - property lines, engineering work, z dimensions are given for x-y directions. You create a layered survey when you are going to create a boundary line. Say, property lines or engineering works, we need to move on from preliminary survey to layered survey. Usually it's done by these type of pecks and metal poles which are being usually tied and immersed into the ground along the boundaries. So, it actually creates a line or defines the boundary line. This concrete poll and metal poll is almost above 2m in height and these concrete poles are usually 40 to 60 cm and it has to be immersed right. If it is slantingly done like this, it gives misleading

information and the surveyor won't know where exactly is the line going to happen. It has to always be straight.

Control survey - used to reference preliminary and layout surveys. Control survey is the next stage which is used as a control and as a reference to preliminary and layout survey. Horizontal control - arbitrary line tied to prop line or HWY center or coordinated control stations. Vertical control - Benchmarks points to whose elevation above sea level is carefully determined. These are horizontal controls that come for plain surveying and vertical controls come when you need to measure something that is elevated from your main sea level. In control survey more care to accuracy. Control lines should be easy to re-establish. You need to control your points so that the accuracy or the boundaries can be made precisely and control lines can also be subject to variation.

These are some of the examples in which, if its a Geodesic survey, you need to consider the distance from the center of the Earth to the Horizontal line P which is called the vertical line. This is level line and this is how it is actually leveled right now. This is an example for geodetic surveying. When you are doing a plane surveying, these are some of the instruments that have to be immersed when you try to create control points. Definitions - Topographic survey: preliminary surveys used to tie Earth surface features. Usually, topographic surveys take into account the land that have elevations, contours or terrains. Hydrographic survey: preliminary surveys tie underwater feature to surface control line. When you are making checked dams or water bodies like a reservoir, we need to control points in which water can be stacked in it and can be used in a later stage. All this falls under Hydrological survey in which we are doing surveying for water and things related to water. Route surveys: preliminary, layout and control surveys that range over a narrow but long strip of land (highways, railroads, electricity transmission lines and channels). Route surveys is when you take care of longer routes or pathways such as national highways, roadways or rail networks is called road surveying.

Property surveys: Preliminary, layout and control surveys determine boundary locations for a new map. So property as we know, is survey that is used to create a border. Aerial survey: Preliminary and final surveys convert aerial photograph into scale map using photogrammetric tech. This is what's used in Google maps or Google Earth in which they take aerial photographs and match it with the actual photographs present. Construction survey: Layout of engineering work. Construction survey is what we do usually, we take care of surveying a small piece of land in which the construction is going to take place. Final (as built) survey: Preliminary surveys tie in features that have just been constructed. Final as built survey, you need need to make a survey after the complete construction process is over. There will be small and slight variation from what you have planned or to what is being executed on site. You need to measure all this. In

case your client comes up with a new design proposal or he needs to change something in the future, you already have your as built drawings which you can open and refer and make suggestions to the clients which can be completely effective for what clients envision or what the project requires.

Classification of Surveying

Based on instruments. Chain survey: Only linear measurements are made with chain or tape no angular measurements taken. As we know chain survey is connected with continuous metal links, when you are going to make a chain survey, it can be done only for places which are completely linear in measurement. You cannot make an angular measurement in chain surveying. Compass survey: Horizontal angles are measured with the help of magnetic compass. When you need to make angular surveying, you can move on from chain surveying to compass surveying in which the compass will show how much is it being tilted or how much from the south how much is it being tilted. You can make your survey accuracy from compass surveying. Plane table survey: The map is prepared in the field itself by determining the directions of various lines making linear measurements, and plotting the details on paper using a plane table. Plane table surveying is usually a 2 dimensional plan made on a table where the site is considered to be a table and the whole plan is plotted, this is called plane table surveying.

Classification of surveying based on instruments. Levelling survey: this type of survey is used to determine the elevations and relative heights of the points with the help of instrument known as level. As you see, these are levels, this is the surveying in which it is kept and it is being supported by a 40mm peg. The height is being measured and for varying terrain you can actually immerse these pegs at regular intervals and you can measure the difference in terrains, difference in lengths through this instrument. Thereby letting you know how much your ground is going to be elevated as you grow up. Even for a flat land, you can find out where you water drainage point is and how your rain water is going to run off. All this type of information can be gathered from this type of surveying method.

Theodolite survey - Theodolite survey is primarily used in traversing and triangulation for providing controls. The horizontal and vertical angles are measured with the help of theodolite. This is an instrument which is also used for horizontal surveying in which it is mainly used for transverse and triangulation of providing controls. This is the main use of theodolite.

Next is, Tacheometric survey. This is a special type of theodolite known as Tacheometer, is used to determine horizontal and vertical distances directly. This is a theodolite which has been installed. Here, we can actually see what is the distance between horizontal as well as vertical.

These two distances are measured simultaneously. This is usually used in contour spaces as well.

Photogrammetric survey - measurements are made with the help of photographs. This is also a type of aerial photographic survey method. EDM Survey - linear measurements are made with the help of EDM instruments. This is one of the instruments that can be used in contrast to plain table surveying, when your distance is very large, you can use this type of instrument to achieve more accuracy.

Astronomic survey are conducted for the determination of latitudes, longitudes, azimuths, local time, etc, for various places by observing heavenly bodies such as suns and stars. This is much more broader in the sense that it covers more latitude and longitude from the Earth and the Equator, the distance from which we are located. Basically, when you study a country or a continent, this type of surveying is used. Geological survey, this is used to determine the strata of the Earth's crust for geological studies. When you need to know about the depth of the lava, the crust, how the rocks are formed, what is the depth of each layer of rock; for these type of analysis, we use Geological surveying.

Archaeological surveys - Unearthing relics logical surveying is usually collecting antique or historical elements which have significant effects or tracing the whole history of mankind.

Mine surveying - exploring of mineral deposits and to guide tunnelling and other operations associated with mining. Mine survey is usually done in places like NLC or other gold mines in which we need to understand how deep the deposit is being made and how much we need to dig in more to get those resources. Such type of information is usually made for mines and such spaces.

Satellite surveys - to establish intercontinental, inter datum and interisland geodetic ties over the world by making satellite observations. These are some of the satellite surveys and observations and that's what making the internet and television possible currently. This has become very essential in today's world.

Military surveys - conducted for military purpose. This is usually used to mark military borders and military terrains. Let's have a look at the different types of instruments used for such type of surveying.

At first we have the Steel tape. This measures horizontal and slope distances. Next is, Theodolite, establishes straight or curved lines, horizontal and vertical angles. Levels - also called stadia principle, measures difference in elevations, it is usually used when you are having terrain or contour plot on site. GPS - global positioning system receiver. This is a total station which can be used to measure everything together.

Survey Geographic reference

Define reference as the surface of the Earth. Latitude - east, west/ equator. Maximum angle is 90 degrees north or south. Longitude - north/south converge at poles and maximum angle = 180 degree east or west from the plane of 0 degree longitude Greenwich. From Greenwich line that passes through UK, 180 degrees to the East and to the West makes India fall under the Eastern side and the US to fall on the Western region. The 0 line passes through UK. The Equator line passes below Sri Lanka and then we come within the whole tropical region. This type of surveying is made through geographical method. Used in geodesic, not plane survey. As we understand, this is much more spherical, it is not actually a plane surface, it is geodesic surveying method in which we take care of all the three dimensions of a sphere; x,y and z. Plane survey uses coordinates grid system.

Survey Grid Reference. States and provinces have adopted the grid system best suited to their needs. If you see the green colour marked area is the map of UK. It has been divided into several grids. This is the grid and this is measured in km. Each grid has been marked, one grid here makes 100 x 100 km. Surveying has to be made for NC grid, what they can do is, they can locate hte coordinates, find where the grid falls and what type of information they can take from them. When you are surveying for a huge space like a country or a continent, it is ideal to divide the space into a grid system and then mark each grid a unique name and make your measurements and studies within the grid. When there is any reference required, you can actually go back to the grid and know more about the information.

Limited in size, no serious errors due to the curvatures. Easy to use, plane geometry and trigonometry. Since, it is being divided into grids, it is much more simpler, a much more simplified version and can be used in the long term without any confusion. Common tatum for x and y dimensions. Usually uses x and y dimensions of studying the land. Easy to translate into geodesic survey. Since x and y dimensions are being done very clearly, it is very easy to convert, to add the height or z dimension and make it geodetic surveying.

Let's move on to Survey vertical reference - vertical dimension can be referred to any datum. Mostly used datum is mean sea level, MSL = 0.000 ft, which means datum is actually the level from which the surveying is made. When you are making a vertical survey, usually the datum

point taken is MSL. For example when you read about hill stations or elevations, it is usually mentioned as, this hill is located 80,000 feet above MSL which means the datum for surveying is made from main sea level.

Benchmarks - permanent points whose elevation has been precisely determined. There are benchmarks that are precisely determined, which can be linked or studied with reference to the vertical distances for which the surveying is made.

Distance measurements - Distance between two points can be horizontal, slope or vertical and are recorded in feet (foot units) and meters (SI units). Horizontal and slope distances can be measured by using fiberglass, steel tape or EDM (electronic distance measuring) + difference in elevation and slope distance. These two, Steep tape and EDM can be used to study about elevation or slope distances which is used when you have a terrain land or a contour map. Vertical distances can be measured by using tape as in construction work or level and levelling rod. These are levelling rods which are being immersed into the site and the difference between these two points are being studied and how much two points is being elevated is recorded in which we understand how much the land being elevated at each point can be studied in this method.

There are two main measuring systems; English system and Metric system which is called SI system. All countries will change to Metric system. We are all adapting to metric system, this is a more universal system. Angles are measured by degrees, minutes and seconds. Say 22 degrees, 5 minutes and 3 seconds is usually how a measurement is made for an angle. Since we are changing to Metric system which is m, mm and cm, the usage of ft and inches is becoming more colloquial and the international system is m and mm. So, it is best to use our international system and adapt to it.

1 revolution = 360 degrees, 1 degree = 60 minutes and 1 minute = 60 seconds. This is how an angle is expressed in degrees, minutes and seconds.

Location method - (a) right angle offset tie. (b) the angle distance tie (polar tie). (c) the angle at A and B of distance BP of AP, this is the intersection technique. There are three methods that you could study, the first one takes care of how you can find the right angle. If these three are the points, you can actually draw a point from point C and you can find the right angle line here. This is right angle offset tie. The next is angle distance, when there are three points being defined, you can connect these three points and find the angles using compass surveying. The next method is used when you need to find both angles as well as distance, you can use total

station or theodolite surveying methods through which you can determine both angle as well as distance.

Accuracy and Precision - accuracy is the relationship between measure and true value of measurement. There is usually a minor error in human measurements, what the actual measurement is and what is usually recorded is usually a small error, this is called accuracy. Precision - degree of refinement with which the measurement is made. Say for example, when you are measuring something, if the distance between the two points is 6.543281, what we write finally is precision. How much we round it off to, is called the precision amount.

For example - True distance, Measured distance and Error. Say cloth tape, the true distance is 157.22, the measured distance is 157.3 and the Error is 0.08. When it is measured via a steel tape, it achieves the same true distance, the measured distance is 157.23 and the error is significantly reduced to 0.01. More precise method results in more accurate. When you are making huge measurements, say for kilometers of roads or anything. When these small errors can make significant amount of change. When you are using comparatively finer instruments, it gives much more accurate measurements. Less precise methods may result in less accurate measurement. Less precise methods should be avoided to avoid errors and get into less accuracy.

Accuracy ratio, error of closure - the difference between the measured location and the theoretical correct location. For example, experiencing measured distance is 250.56, errors is 0.06. Known distance is 250.50. Accuracy ratio is 0.06/250.50 = 1/4175 = 1/4200 is the accuracy ratio for this measurement. Fraction whose numerator is unity and denominator closest 100 unit. Usually it is rounded off to 100 units.

Errors - no measurement except count can be free of error. True value is determined statistically mean to calculate error. Systematic error - error whose magnitude and algebraic sign can be determined and eliminated which is temporary error. Random error - error due to surveyor skill, tend to cancel each other, little significance except for high precision survey. These two types of error have to be eliminated. Systematic error is because of the usage of instruments, random error is due to the surveyor's error. Unskilled or careless surveyor can cause problems. Large random error doesn't result in accurate work even if they cancel.

Mistakes - there are many mistakes that could happen to surveyors. Blunders made by survey personnel. For example, instead of writing 68, the surveyors might write 86. Miscounting tape length, measuring from wrong point. Mistakes will occur and must be discovered and eliminated by verifying the measurement, repeat geometry analysis etc. Every measurement

should be repeated to eliminate mistakes and improve precision. Each measurement is repeated twice or thrice to cross check if all the measurements are made with exact accuracy and errors have been eliminated to the maximum.

Stationing along baseline - stations or champagne. At night angle - offset distance. Say 0, +- 0 ft which is much more closer to accuracy.

As we increase from 0, it is 00, the distance goes up, your errors are in station also go up. We need to cut down or cancel these type of errors by locating the stationing at precise numbers.

Let's summarize what we have learnt in the whole presentation into learning outcomes - surveying and its importance. Classification of surveying - plane and geodetic surveying. Classification of surveying based on instruments and functioning. Various methods of surveying for vertical, horizontal distances. Methods to find error and rectify accuracy.

Questions - what is surveying? How is it essential? What are the instruments used in surveying? Explain in detail about surveying by function. Define route survey and topography survey. What is the accuracy ratio in surveying? Explain with examples. Thank you!