Site Analysis and Planning

Lecture 4

Welcome to UGC lecture series, today's topic is Site analysis and Planning, Subject code - AR 6512. Unit 2 - Site Drawings, Lecture 04.

Presentation outline - The presentation is divided into introduction, then we move on to setting out a building and then, Site layout methods. Under setting out a building, we are going to see how a building is going to be converted from just a drawing to an actual building on site and then setting layout methods encloses what are the different methods in which these drawings are being converted into actual buildings, this is called site set out methods.

Setting out a building Plan on Ground

First is, Site setting out a building plan on ground. A building is set out in order to clearly define the outline of the excavation and the centre line of the walls, so that, construction can be carried out exactly according to the plan. The centre line method of setting out is generally preferred and adopted. Setting out a plan means transferring a building or a design from paper or your laptop to an actual ground is setting up of a building. This is done to exactly replicate what we have designed or what your whole ideology is to the actual construction site. Usually, Central line method is one method which is usually adopted which is very convenient for the workers as well as the people preparing as designers to adopt this kind of a method in which errors can also be rectified or minimized to a great extent.

If you take a look at the image on the left, this is the centre line of one room and then the whole plan is being marked. The double lines that have been marked as seen on the right is going to be the excavation which is going to come below the ground level. Now, they are going cut down these points and excavate all these points to create a foundation of walls through the ground. This is how initially the drawing is being drawn on the floor and the excavation starts happening.

Procedure - Example plan to be set out on the ground. From the plan, the centre line of the walls are calculated. Then the centre lines of the rooms are set out by setting perpendiculars in the ratio 3:4:5. Suppose the corners are a,b,c,d,e,f and g which are marked by pegs with nails on top. As you see, this is a two room building in which we are going to make a set out plan on the ground using centre line method. In these two lines, as you see these two dotted lines that go through these buildings are the central lines for the two rooms which is being marked by alphabets A,B,C,D,E,F and G. These are the points at which the central lines ar being marked and nailed on top so that we don't miss out or the accuracy is not reduced. To keep these two points in precise, nails are being nailed at each of these points.

Step 2 - the setting of the corner points is checked according to diagonals ac, bd, cf and eg. If we need to know if the marked drawing is actually perpendicular to each other, then, the distance between the points say bd, ac, cf and eg, these are all diagonal lines drawn. These measurements are being measured to cross check with the drawing the architect initially prepared and then we will know if the plan is exactly replicated from the drawing to the ground.

During excavation, the centre points a,b,c,d,e,f,g may be removed. Therefore, the centre lines are extended and the centre points are marked about 2m away from the outer edge of excavation. Thus, the points A1, A2, B1, B2 and likewise are marked outside the trench. As you can see, these points are being marked outside the trench because when you are going to excavate, you are obviously going to remove the nails and going to start excavating. Once the excavation is done, you might miss out where the points are. Before you taking out the nails, you can extend the centre lines almost 2m away. As you see, these centre lines are extended by 2m and a new marking is being made, B1 and B2. When you see B1 and B2, you'd know the triangle which connects these two is going to be point B. This is one of the methods that are commonly used before excavation happens. Centre lines are shown clearly by stretching a thread or a rope. The centre points are fixed 2m away from the excavation and marked with sit out pegs. These are being extended and these points are marked with sit out pegs or the pegs are nailed on these two points.

From the plan details, the width of the excavation to be done is also marked by thread with pegs at appropriate positions. From the plan details to the width of the excavation, everything is being marked and the centre points are also marked with pegs and nails. The excavation width is then marked by lime or with a furrow and spade. After you make the centre line, you need to know how much is the width of excavation going to be made. Say for example you are going to make a 9 inch thick brick wall throughout, from the centre line, you need to offset 4 and half inches on either side and you need to make a which is 9 inches thick or say 230mm, that is your excavation line. This has to be drawn throughout your central line to make a marking in which your excavation has to be followed.

If the plan is much too complicated and follows a zigzag pattern, then the centre pegs are kept at suitable positions according to site conditions. This is much simpler when you are having a much simpler plan. Say if you are having a two room plan or a three room plan, this type of marking with pegs and measuring with dimensional links can be used very easily. But if you are having much more zigzag pattern of your plan and has to be transferred to your drawings to your ground, then you need to have your marking or centre line pegs at certain intervals in

order for the surveyors or for people who are going to carry out the construction not to miss out from what is actually being perceived or what is actually being inculcated. To maintain the accuracy, you need to have the pegs and continue with the excavation.

Layout of a building - the real meaning and purpose of setting out is to transfer the plan, length and width of its foundation on the ground so that the foundation can be excavated for construction of proposed building per drawing. Layout of the building is transferring all the dimensions that is being on your drawings to the actual site so that the building and the excavation eventually begins happening and your building or design which is perceived in a 3-d model can actually be transferred into an original building. The following preliminary works should be executed before actual planning of layout for the house. This is how the initial marking is made and then clear the site from all grass, bushes, trees, etc. After knowing where your site is located, you need to clear out everything where the construction is going to happen. It has to be completely clean without any disturbance for the construction to happen. Record spot levels on the ground. You need to record levels on the ground so that you can find out how your rain water or your natural land slope is. You can use that as an advantage for draining or drainage patterns on your site or to take care of inspection chambers and things like that. Construct a permanent bench mark in construction area. These permanent bench marks are like reference points from which each of your dimensions can be taken or started with. Say, for example this can be the huge site but this is the area within which construction is going to happen. They have started clearing this site and started creating markings and then the spot is recorded to find out the natural terrain of the site.

Baseline method - for setting out/layout the most important requirement is to establish a baseline. This is marked on the ground as per site plan requirement with the help of offsets which are taken from the existing road or existing building. Baseline is creating an initial line from which your construction or perpendicular lines are going to be drawn from or lines parallel to the initial line is going to be drawn. The first line you make on your site is called the baseline. Usually this is made from knowing the distance from the already existing tree point or road, the distance between each point from the existing road to the site is being marked and then all these points are connected together and being named as Baseline.

For example, this is the existing road from which they share the points and from where they measure all the other points you need to create plan. You need to measure the points from each of these stones and then a line is created, which is called as Base line.

Next is Centre line. Centre line divides the plan into 2 equal parts. As I said earlier, centre line is the line in which everything is going to be equal on either side. Say for example if you are going

to make a 9 inch wall, you are going to have a centre line and on either side you are going to have 4 and half inches or 115mm length on either side of the centre line. This centre line is a line which divides the plan into 2 equal halves. This can be marked in the field with the help of the base line. To start you need to have a baseline. If you take a look at this picture, this is a road and from this existing road, the baseline is being marked. From this point it is 150 ft, 4 and a half inches. This is the line which is being marked first. This is called baseline. It is also done on this side as well for the already existing school building. So, the baseline is created on either side of this building. This line should be transferred to Burjis and be kept up to the completion of foundation work. These two lines become the initial point or the base from which all the measurements will be taken. This has to be marked, bench marked from which all your other measurements and your markings are going to take place. This has to be kept intact until your foundation is done.

Setting out of Foundations

How do you set out foundation? Before commencement, of the excavation of trenches for foundation, a setting out plan is prepared on paper. The setting out plan is a dimensioned ground floor plan usually drawn to the scale of 1:50. The plan is fully dimensioned at all breaks and openings. To make a foundation on your site, the first thing you need to understand is, how your ground floor is going to happen. After making a ground floor plan, you need to mark each and every dimension. Say for example, how wide the wall is and where your windows are going to be placed, where your ventilators are going to be placed as well. You need to know all these locations, a detailed dimension complete plan is made. This is the first step to make a foundation plan. After you make it, you then transfer it to the site. This is the complete dimension plan with the centre line on either side and this is a two room plan. Next is, one of the methods of setting out of foundations is to first mark the centre line of the longest outer wall of building by stretching a string between wooden pegs driven at its ends. This serves as the reference line for marking the centre line of all the walls of the building. Initially to start of with the foundation, the first thing you need to do is, you need to mark the biggest or the longest centre line that is going to happen in your entire project. Then, this is being transferred to your site and acts as a baseline to carry out other dimensioning. The centre line of the wall, which is perpendicular to the long wall is marked by setting up a right angle. Right angle is set up by forming triangles with sides 3,4 and 5 units long. After you make these base lines, then you measure the right angles using 3,4,5 method which will be discussed later on in the presentation. Say for example, this is the base line, they have pointed out that this is going to be the longest centre line that is going to happen in the building and they have marked it already with pegs, they are going to use 3,4,5 triangulation method in which they are going to find out the right angle to this baseline from which your foundation can be made and you can be sure that your foundation is 90 degrees in angle.

If we fix two sides of the right angle triangles to be 3m and 4m, then the third side i.e the hypotenuse should be taken as 5m. This is from the trigonometric equation. The dimensions should be set out with a steel tape, the alternative method of setting out right angle is by the use of theodolite. This instrument is also helpful in setting out acute or obtuse angles. Small right-angled projections are usually set out with mason's square. This is the theodolite with which you can measure both obtuse and acute angles and with which you can also create right angled triangles using the mason square. This is how initially the baseline is being marked and then the excavation is carried out after marking, the width of the whole excavation. This whole centre line drawing is being transferred to the ground. The location at which the foundation is going to be done is marked and then finally excavation is made and the foundation is being carried out.

The method of setting out of foundations described above is not so reliable for important works as there is likelihood of the wooden pegs being pulled up or displaced. If you are doing a huge project, you cannot complete this whole foundation thing in one day. When you are going to carry this out for a longer duration, there are chances of wooden pegs to fall out or for someone to move it around, so it is not very reliable when you are carrying this out for bigger projects or when you are making projects which have to follow very precise dimensions. This cannot be completely reliable.

In an accurate method, the centre lines of the building walls are carefully laid by means of small nails fixe into the head of the wooden pegs driven at the quoins. After the whole plan is being set out you can actually make much more. Just not the wooden peg, it can be made of small nails fixed into the head of the wooden pegs. It can be marked, which is much more reliable and it can give accurate dimensioning for huge projects.

In case of rectangular buildings, the diagonal from the opposite corners are checked for their quality. Small brick walls, pillars or platforms are constructed 90cm clear of the proposed foundation trench. If you are making a rectangular building, to ensure your dimensions are correct and making right angles, diagonal measurements between these two points can be measured. It can be cross checked with your drawings and if it matches, what you are making on the site is a proper rectangle. This can be cross checked in such a way.

The platforms are about 15cm wider than the trench with and are plastered at the top. The tops of all platforms or pillars should be at the same level preferably at plinth or floor level of building. A trench is made 15cm wide with a plaster on top, this is much more fixed benchmark from which your dimensions can be made. The strings are then stretched over the nails in the

pegs and the corresponding lines are marked on the wet plastered platforms top by pressing the stretched string on the plastered surface by a trowel. The outside lines of the foundation trench and the plinth lines are marked on the wet plastered platform top in the similar manner. When you are making these type of foundation markings for a huge site, you can build a temporary platform on which you can keep your wooden pegs and then that can be tied together and can become much more stronger and reliable when compared to these temporary wooden pegs that are immersed into the soil.

Before starting excavation, the strings are stretched between the outside lines of the foundation trench marked over the platform top and the cutting lines are marked on the ground by lime powder. If necessary, the lines may be marked by a daghbel or pick-axe. These are another set of guidelines that can be followed when making foundation plans for bigger projects. Say for example, these are the platforms which are being made temporarily and it is being tied together and this is the width of the foundation. This is being marked by using lime powder. This lasts comparatively much longer, it can also be marked with pick-axe with which you can mark the boundaries, later on the excavation begins to happen.

Site layout plan for Construction

Site layout plans are prepared by contractors as a part of their mobilization activities before work on site commences. Site layout plan is actually the design of the plan that is going to get constructed, this is prepared by contractors or architects who are in charge of this type of work. They are a crucial part of construction management, as sites can be very complex places involving the co-ordination and movement of large quantities of materials as well as high-value products, plant and people. This becomes very important because what you are going to design or what you are going to pursue on paper or on your computer is what is going to actually get transferred onto the actual site. You need to be very sensitive. A proper construction management team has to work together to make this whole process much more reliable and much more precise.

Effectively and accurately laying out a site can help ensure that the works are undertaken efficiently and safely. Careful sizing and positioning of temporary facilities can help reduce travel times, congestion, waiting times and so on and help to make the site a more effective workplace with better worker morale. When you are making effective and accurate planning, you can actually reduce the time required for construction and also the cost of construction by planning everything ahead of time. You must know how long will each work will take, if the workers will be engaged throughout the process and they are not actually being ideal in the project which is going to be just a waste of money. You need to plan everything beforehand and

you need to make a proper schedule of time required for work to happen which can help the architects and contractors assign the next job immediately.

Site layout planning involves four basic processes - Identifying the site facilities that will be required. Determining the sizes, and other constraints of those facilities. Establishing the inter-relationships between the facilities. Optimising the layout of the facilities on the site. These are some of the site layout planning processes that have to be taken care of. You need to understand what are the facilities that will be required for the site and what are the facilities that can be brought from outside and how effectively can it be brought onto your site. What are the constraints that are present in bringing those facilities to your site. You need to create an interrelationship between these facilities so that we don't overdo the services or utilities that are required. For example, how much are people going to use the site, for these people how much water should be used; all this information should be collected beforehand so that you can design accordingly. You can procure your water resource from outside to inside. All this is information that has to be collected beforehand, that has to go in during your research and data collection stage.

Site layout plans might include locations for and sizes of - Zones for particular activities. Cranes including radii and capacities. Site offices, Welfare facilities, off-loading, temporary storage and storage areas. Subcontractor facilities, car parking, emergency routes and muster points. Access, entrances, security and access controls, temporary roads and separate pedestrian routes. These are some of the aspects to site layout planning. When you plan a site layout, you need to make space even for all this, even though you are going to have a temporary site office, you need to provide space for your caravans or temporary office spaces that your engineers and contractors can use while the whole process is going to be taken care of. Other processes such as welfare and safety for the workers or for the people who are going to get involved in the whole construction process, facilities and services that they might need; all these aspects should also be addressed while you are constructing. Vehicle wheels and washing facilities. Also, waste management and recycling areas. Site hoardings and existing boundaries. Protection of trees, existing buildings, neighbouring buildings and so on. These are some of the details that you must know to make sense of site planning and site layout process. Signage. Temporary services, including electric power, lighting, water distribution, drainage, information and communications technology, site security systems and so on. Even though the construction is going to be a temporary activity, the construction may prolong say from 1 year to 10 years. When you are making such a huge or such a prolonged activity, you need to make sure your site has all the facilities that might be needed for the workers and for the construction process to be carried out without any delay. Say for example, you need electricity throughout your site for your motor to run or to prepare your ready-mix concrete. You also need water for curing

process and to mix your materials. You need to make sure all your other facilities that have to be available to take care of construction is present for workers.

Temporary works such as propping solutions to retained structures, sheet piling details and so on. Areas for the construction of mock-ups for testing. Fabrication facilities. If you are making a huge steel structure, you need space for fabrication for fabricators to work with their instruments. For those type of spaces is also needed on the site. You can cover the space entirely and then there won't be any space for them to work around or to create any structure. There won't be any space for them to work and move the structure within your building.

Problems caused by poor site layout planning can include - Inappropriate storage which can result in damage to products and materials. Poor siting of plant. Poor siting of welfare facilities. Inadequate space provision. These are some of the facilities, some of the problems which can happen if you are not making a proper site plan. Unsatisfactory access, security and safety issues, poor wayfinding due to complex layouts or inadequate signage. Demoralized workers, delays and increased costs.

Let's see what we have learnt from the entire presentation as learning outcomes - first we looked into introduction about converting drawings on site. Discussion about centre line and baseline method. We also studied about setting out of foundation on ground. Problems caused by poor site planning and means to avoid them and what is layout planning. Questions - How to convert drawings to site? What is the difference between centre line and baseline method? How is setting out of foundation done on site? What are the problems faced by poor site planning? What is layout planning? Explain in detail. Thank you!