

Lesson 3: Site Preparation

In any situation where a building is being constructed, the building site needs to be prepared to make future steps of construction more efficient. A number of factors affect the final quality of a building site. The process of site preparation addresses these factors.

Preparing a Subgrade

Once a site has been selected, it needs to be prepared for construction. This process begins with preparing the subgrade, which is a surface leveled off in preparation for laying a foundation.

The subgrade will be slightly bigger than the foundation. The steps in forming a subgrade are important for the rest of the construction process and so should be followed closely.

Drainage - If the construction site does not drain well, installing a drainage system below the site to remove excess water may be necessary. If the system is needed, installation is much easier before any construction occurs. A drainage system typically consists of a series of underground pipes that collect excess water and direct it away from the site. Systems are usually installed by a licensed business on a contract basis.

Removal of topsoil - In some cases, the topsoil is scraped off the site with a tractor and blade prior to other excavation. The topsoil may be saved for later use, especially for landscaping the property. If the topsoil is not used for landscaping, it can be sold, since many people buy good quality topsoil for use around their homes.

Removal of organic material - Organic material consists of matter produced by plants and animals that is found in or on the soil. The organic material on the building site needs to be removed as much as possible. This material does not readily mix with concrete and can even have a slightly oily surface, which further prevents mixing. The particles in the concrete cause inclusions, or holes created when the matter eventually decays, that will weaken the overall strength of the concrete. Also, organic material will keep the ground from being packed tightly to support the weight of the structure, and

as the material decays, settling will occur. Organic material is typically removed with a tractor and blade.

Removal of rocks and stones - In addition to topsoil and organic material, larger rocks and stones should be removed, since they may cause major differences in the slope of the land. They can be removed using a tractor and blade. These rocks can be placed in lower areas, as well as areas with poor drainage.

Subgrade slope - After the removal of topsoil, organic material, rocks, stones, and trash, the site should be graded using a tractor and blade to create a desired slope for drainage purposes. Typically, a 3 percent slope away from the building is considered minimal.

Packing or compacting - Once the site has the proper slope, the soil needs to be packed. Driving a tractor back and forth across the site so that the tires form a pattern across the previous tire tracks will pack the soil down. Portable, hand-operated packers are also available. Packing is commonly done using a sheep foot roller to compact the soil. Packing prevents differential settling of the soil, in which some areas settle more than others because of soil compaction due to the weight of the concrete.

Sand or aggregate fill - Most construction sites use fill, which consists of added sand or aggregates, to create a level site and leave a more uniform surface under the concrete foundation. If the soil texture and structure (the shape of the particles the soil normally forms) do not permit proper soil drainage, placing 4 to 6 inches of sand or aggregate on the site will enhance drainage by allowing water to flow downward more readily. If fill is added, the site should be packed again after the fill is in place.

Vapor barrier and insulation - If a drainage system cannot be used or if excessive soil moisture is a continual problem, a vapor barrier or retarder should be used under the concrete. The vapor barrier, which is typically polyethylene sheeting, prevents moisture from being absorbed into the concrete. In cold climates, insulation is also commonly placed under the concrete to maintain heat in the building and keep the floor warmer.

Concrete

Dampening the site - If a vapor barrier is not used and the ground is dry, the site should be sprayed with water to dampen the fill. This practice will prevent excessively dry fill from pulling water out of the concrete during the curing process. If the ground is relatively moist already, dampening the site is not necessary.

Footings

Once the subgrade is prepared, construction of the building can begin. The first step in constructing a building is to construct the lowest part of the building, the footings. Footings, as shown in Figure 3.1, are large supporting blocks of concrete between the foundation and the soil.

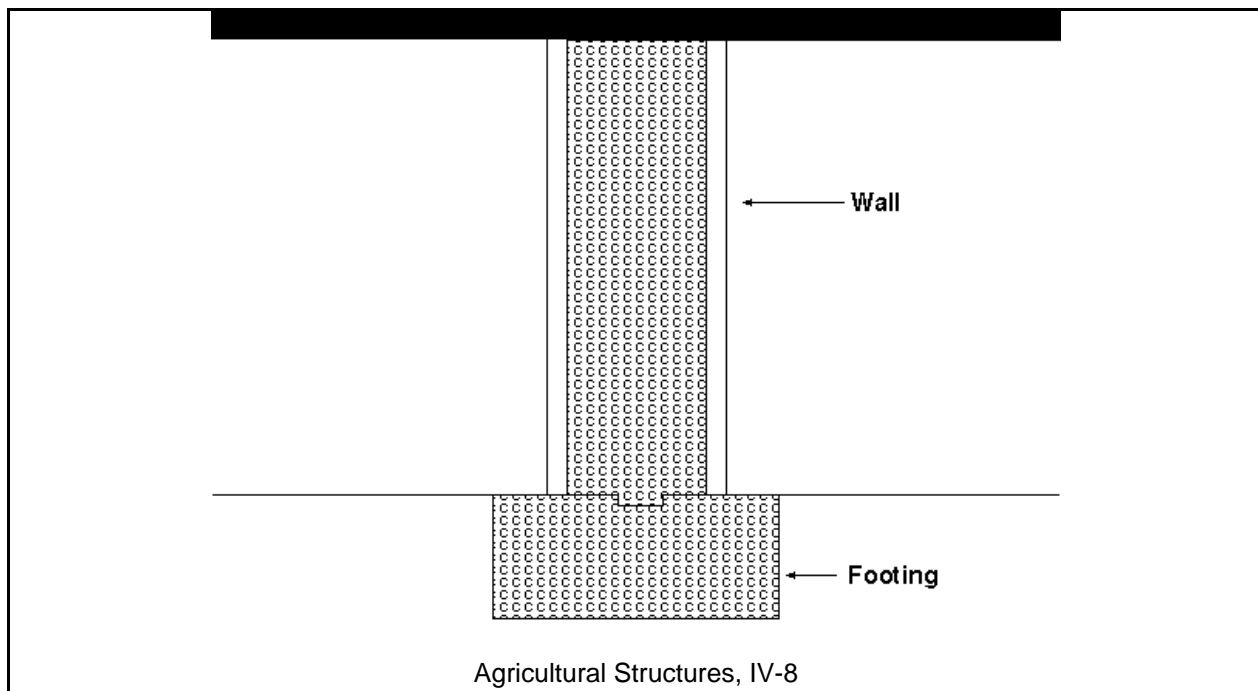
They are normally placed around the exterior edge of the building and under walls that will support the structure's weight. The footings spread the weight of the building across a larger area and make the structure more stable. Footings are usually poured on site but can be poured at another location and later placed at the site. They are necessary for several different reasons, including temperature, moisture, and soil structure, all of which can affect the foundation of the building.

The frost line is the deepest point in the soil where frost is normally found during the winter. Footings located below the frost line will decrease, if not eliminate, movement of the building due to expansion and contraction of the soil because of temperature changes. To place the footings below the frost line, the building site must be excavated to the proper depth.

Variable levels of moisture during the year will cause the soil to expand and contract as well. The building can be stabilized by placing large footings on a sand or aggregate base.

Soil structure can affect the use of footings. Soils with a very loose soil structure tend to allow more settling of the building over time. This settling can be diminished by integrating larger than normal footings. Also, certain clay soils expand and contract dramatically when wet. Placing footings on a layer of sand and aggregate can reduce the movement of the building due to these changes.

Laying Out the Building

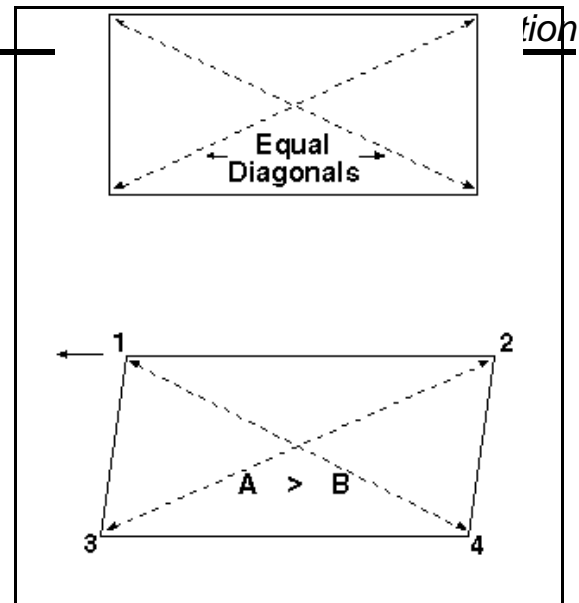


Footings need to be placed carefully, since they will determine whether the building is placed squarely in the correct location. The first step in laying out a building is driving stakes into the ground where the corners of the structure are to be located. If an addition to an existing building is planned, the two corner stakes should be placed in relation to the building by measuring the desired distance from the building and the distance between the stakes. For a new structure, a stake is driven to mark the location of a corner, and measurements are made to the adjacent corners. After stakes are placed at these corners, measurements can be made from them to determine the placement of the final stake. The measurements between the stakes should be made carefully so the building is exactly the size desired. After all the corner stakes are in place, strong twine or rope is tied between them to represent the sides of the building.

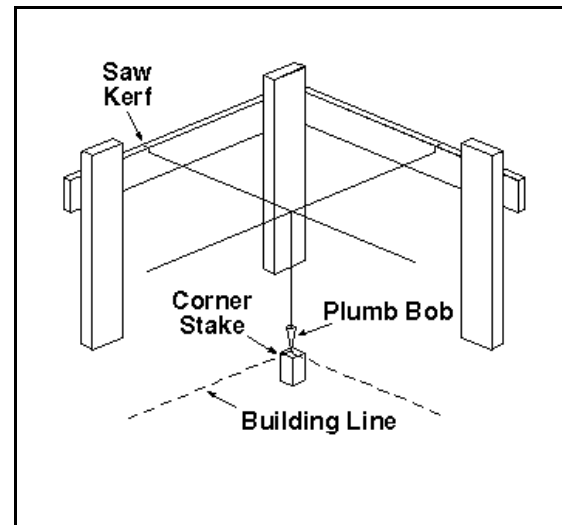
To determine if the stakes are square on all four corners of the building, diagonal measurements should be made from the corner stakes. When the measurements are identical, the building is square, as illustrated in Figure 3.2. If the building's diagonals are not equal, the stakes must be carefully moved. For example, if diagonal A was longer than diagonal B, as in the second diagram in Figure 3.2, stakes 1 and 2 would be moved to the left until the diagonal measurements are identical. Because of the twine connecting the stakes, the building's dimensions remain correct.

The corner stakes are where the forms will be placed for pouring the footings, so a method is needed to indicate the corners when the stakes are removed. The procedure for marking the corners involves the use of batter boards, which are shown in Figure 3.3. Batter boards are typically either 1" x 4" or 1" x 6" boards nailed to three 2" x 4" stakes at least four feet from the corner of the building. If the twine connecting the stakes is extended to the batter boards, the corner stakes can be removed because the intersection of the strings still marks the location of the corner of the building. Suspending a weight like a plumb bob from where the strings intersect at the corners will ensure that the strings cross exactly at the corner of the building.

After the lines are in place, the position of the lines is marked, and a saw kerf about 1/4" deep is



placement. The lines can then be removed and



replaced if necessary. When the position of the lines is marked, the stakes can be safely removed. Forms, which will be discussed in greater detail in the next lesson, can then be placed under the string in preparation for pouring the footings.

Preparing the Final Grade

After the footings have been placed and soil is added around them to create a level surface, the final preparation of the site can be done. Preparing the final grade is the last step prior to pouring the concrete. For the final grade, more care should be given to the slope and fill on the site.

Concrete

The final slope of the building site can greatly influence the amount of concrete needed and the degree to which the forms that will hold the concrete will need to be leveled. To determine the slope of the building site, several different methods can be used. A hand-held level can offer reasonably accurate readings for the site. Once the exact location of the building has been determined, fill needs to be added across the site to maintain the desired slope. Fill is especially important if major depressions or high spots are found on the building site. Hopefully the initial work with a tractor and blade has made the location nearly level, but often fill is needed to make the entire site level. Low wet spots can be filled with aggregate or rocks.

Equipment Needed

The tools used in site preparation are not specialized. However, they make site preparation easier and more accurate. The tools needed to prepare a building site include a tractor with a blade, a compactor or packer for the soil, shovels, and a transit or level with a surveying rod and the tripod for the transit or level.

Summary

Site preparation is a very important step in building construction. The subgrade and final grade should be prepared properly to provide a good base for the foundation. Footings should be planned to support the structure, which needs to be laid out carefully to make sure that it is square. Proper site preparation will make the

To increase accuracy, a tripod-mounted transit or level should be used. This tool will provide much more accurate readings indicating the amount of soil to be removed, or cut, or the amount of fill added to various locations on the site.

rest of the steps in building construction easier to accomplish and result in a higher quality finished product.

Credits

Ahrens, Donald L. *Concrete and Concrete Masonry*. St. Paul, Minn.: Hobar Publications, 1976.

Boyd, James S., and Carl L. Reynolds. *Practical Farm Buildings*. 3rd. ed. Danville, Ill.: Interstate Publishers, 1993.

Cooper, Elmer L. *Agricultural Mechanics: Fundamentals and Applications*. Albany, N.Y.: Delmar Publishers, 1997.

Lindley, James A., and James H. Whitaker. *Agricultural Buildings and Structures*. Rev. ed. St. Joseph, Mich.: American Society of Agricultural Engineers, 1996.

Materials Science and Technology (MAST) Teacher's Workshop. "Concrete." Produced by the Department of Materials Science and Engineering at the University of Illinois, Urbana/Champaign. <http://mach-pc66.mse.uiuc.edu/~tw/concrete/concrete.html> (29 Aug. 1998).