

## UNIT IV - CONCRETE

### Lesson 3: Site Preparation

**Competency/Objective:** Identify site preparation requirements.

#### **Study Questions**

1. What are factors in preparing a subgrade?
2. What are footings, and why are they needed?
3. How is the foundation of an agricultural structure laid out?
4. What are factors in preparing the final grade?
5. What tools are needed for site preparation?

#### **References**

1. *Agricultural Structures (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, Unit IV, 1999.
2. Transparency Masters
  - a) TM 3.1: Footing
  - b) TM 3.2: Equal and Unequal Diagonals
  - c) TM 3.3: Batter Boards
3. Activity Sheets
  - a) AS 3.1: Site Preparation
  - b) AS 3.2: Laying Out a Building



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### Lesson 3: Site Preparation

#### TEACHING PROCEDURES

##### B. *Review*

Lesson 2 described the components of concrete and some of the factors that affect the quality of fresh concrete. To use concrete at a specific site, various steps must be taken to prepare the site for pouring concrete. Lesson 3 will discuss the various factors that influence site preparation.

##### C. *Motivation*

Locate pictures of the Leaning Tower of Pisa, and show them to the students. Ask the students why the structure is leaning and what could have been done to prevent it.

##### D. *Assignment*

##### E. *Supervised Study*

##### F. *Discussion*

1. Subgrade preparation can be a detailed process due to the conditions of the site. The considerations discussed in the previous question can affect the factors in preparing a subgrade. Ask the students to think about factors that should be considered when choosing a location and how they might affect the preparation of the subgrade. Have students complete AS 3.1.

#### **What are factors in preparing a subgrade?**

- a) Drainage - If the construction site does not drain well, installing a drainage system below the site may be necessary.
- b) Removal of topsoil
  - 1) In some cases, the topsoil is scraped off the site with a tractor and blade prior to other excavation.
  - 2) The topsoil may be saved for later use, especially for landscaping the property, or sold.
- c) Removal of organic material
  - 1) Organic material is matter produced by plants and animals that is found in or on the soil.
  - 2) The organic material on the building site needs to be removed as much as possible.

- (a) Organic material does not readily mix with concrete and can even have a slightly oily surface, which further prevents mixing.
  - (b) The particles in the concrete cause inclusions, or holes created when the matter eventually decays, that weaken the overall strength of the concrete.
  - (c) 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.
- 3) Organic material is typically removed with a tractor and blade.
- d) Removal of rocks and stones
  - 1) Larger rocks and stones should be removed, since they may cause major differences in the slope of the land.
  - 2) They can be removed using a tractor and blade.
  - 3) These rocks can be placed in lower areas, as well as areas with poor drainage.
- e) Subgrade slope
  - 1) The site should be graded using a tractor and blade to create a desired slope for drainage.
  - 2) A 3 percent slope away from the building is considered minimal.
- f) Packing or compacting
  - 1) 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.
  - 2) Portable, hand-operated packers are also available.
  - 3) Packing is commonly done using a sheep foot roller.
  - 4) Packing prevents differential settling of the soil.
- g) Sand or aggregate fill
  - 1) Most construction sites use fill consisting of added sand or aggregates to create a level site and leave a more uniform surface under the concrete foundation.
  - 2) If the soil texture and structure 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.
  - 3) If fill is added, the site should be packed again after the fill is in place.
- h) Vapor retarder and insulation
  - 1) 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.
  - 2) The vapor barrier, typically polyethylene sheeting, prevents moisture from being absorbed into the concrete.
  - 3) In cold climates, insulation is also commonly placed under the concrete to maintain heat in the building and keep the floor warmer.
- i) Dampening the site
  - 1) If a vapor barrier is not used and the ground is dry, the site should be sprayed with water to dampen the fill.
  - 2) This practice will prevent excessively dry fill from pulling water out of the concrete during the curing process.

2. Ask students what the lowest part of a building is called. How are footings prepared? Show the class TM 3.1.

**What are footings, and why are they needed?**

- a) Footings are large supporting blocks of concrete between the foundation and the soil that are placed around the exterior edge of the building and under walls that will support the structure's weight.
  - b) They spread the weight of the building across a larger area and make the structure more stable.
  - c) Footings are necessary for several different reasons, including temperature, moisture, and soil structure.
    - 1) Temperature
      - (a) The frost line is the deepest point in the soil where frost is normally found during the winter.
      - (b) Footings located below the frost line will decrease or eliminate movement of the building due to expansion and contraction of the soil because of temperature changes.
      - (c) To place the footings below the frost line, the building site must be excavated to the proper depth.
    - 2) Moisture
      - (a) Variable levels of moisture during the year will cause the soil to expand and contract.
      - (b) The building can be stabilized by placing large footings on a sand or aggregate base.
    - 3) Soil structure
      - (a) Soils with a very loose soil structure tend to allow more settling of the building over time, which can be diminished by integrating larger than normal footings.
      - (b) 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.
3. Ask students how they would determine where to place the footings. Discuss how the foundation of a structure is laid out. TM 3.2 can be used to demonstrate diagonals, and TM 3.3 shows batter boards. Have students complete AS 3.2.

**How is the foundation of an agricultural structure laid out?**

- a) The first step in laying out a building is driving stakes into the ground where the corners of the structure are to be located.
  - 1) For an addition to an existing building, place the two corner stakes in relation to the building by measuring the desired distance from the building and the distance between the stakes.

- 2) For a new structure, drive a stake to mark the location of a corner and make measurements to the adjacent corners; after stakes are placed at these corners, make measurements from them to determine the placement of the final stake.
    - 3) After all the corner stakes are in place, strong twine or rope is tied between them to represent the sides of the building.
  - b) To determine if the stakes are square on all four corners of the building, diagonal measurements should be made from the corner stakes.
    - 1) When the measurements are identical, the building is square.
    - 2) If the building's diagonals are not equal, the stakes must be carefully moved until the diagonal measurements are identical.
    - 3) Because of the twine connecting the stakes, the building's dimensions remain correct.
  - c) The procedure for marking the corners so the stakes can be removed involves the use of batter boards.
    - 1) Batter boards are typically either 1" × 4" or 1" × 6" boards nailed to three 2" × 4" stakes at least four feet from the corner of the building.
    - 2) 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.
    - 3) 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.
    - 4) After the lines are in place, the position of the lines is marked, and a saw kerf about ¼ deep is sawn into the board to indicate the proper placement.
    - 5) When the position of the lines is marked, the stakes can be safely removed.
4. Ask students to explain how to prepare the final grade.

#### **What are factors in preparing the final grade?**

- a) Slope
  - 1) The final slope of the building site can greatly influence the amount of concrete needed and the degree to which the forms will need to be leveled.
  - 2) To determine the slope of the building site, several different methods can be used.
    - (a) Hand-held level
    - (b) Tripod-mounted transit or level, for increased accuracy
- b) Fill
  - 1) Fill needs to be added across the site to maintain the desired slope.
  - 2) Fill is especially important if major depressions or high spots are found on the building site.
  - 3) Low wet spots can be filled with aggregate or rocks.

5. Specific tools are used for all jobs, and site preparation for pouring concrete is no different. Although the tools are not specialized or complex, they are necessary for site preparation. Have students list tools needed.

**What tools are needed for site preparation?**

- a) Tractor with a blade
- b) Compactor or packer
- c) Shovel
- d) Transit or surveyor's level with tripod and surveying rod

**G. *Other Activities***

1. Have students prepare the subgrade for a concrete project like a sidewalk or a building, such as a new greenhouse.
2. Using resources from the local assessor or county zoning commission, discuss the zoning regulations of different areas around the community. Discuss any zoning regulations that might apply to the areas around where students live and what measures need to be considered for construction in that zone.

**H. *Conclusion***

Taking the time to plan and prepare the construction site will make the rest of the building project run more smoothly and efficiently. Subgrade preparation is crucial to the construction process, since all the following steps and procedures rely upon the quality of the subgrade.

**I. *Answers to Activity Sheets***

AS 3.1

Answers will vary.

AS 3.2

1. The building will not be square unless the stakes are set at 90 degree angles.
2. Two tape measures are needed to measure the four diagonals and to place the four corner stakes.
3. The building will be crooked.

**J. *Answers to Evaluation***

1. b
2. a
3. c

4. To mark the corners of a building so stakes can be removed
5. For drainage
6. Temperature, moisture, and soil structure
7. The particles of organic matter in the concrete cause inclusions that weaken the overall strength of the concrete.
8. Answers may include any three of the following: tractor with a blade, compactor or packer, shovel, and transit or surveyor's level with tripod and surveying rod.



EVALUATION

**Circle the letter that corresponds to the best answer.**

1. The large support blocks under the foundation of a structure are the:
  - a. Bases
  - b. Footings
  - c. Sills
  - d. Underlayments
2. The layer of polyethylene sheeting over the subgrade is called a:
  - a. Vapor barrier
  - b. Sub-seal
  - c. Floor wrap
  - d. Soil seal
3. Which of the following factors should be focused on when preparing the final grade?
  - a. Removal of rocks and stones
  - b. Subsurface water
  - c. Slope
  - d. Removal of topsoil

**Complete the following short answer questions.**

4. Why are batter boards used?
5. Why is subgrade slope important?

6. What are three reasons that footings need to be used?

a.

b.

c.

7. Why is organic material removed from a site?

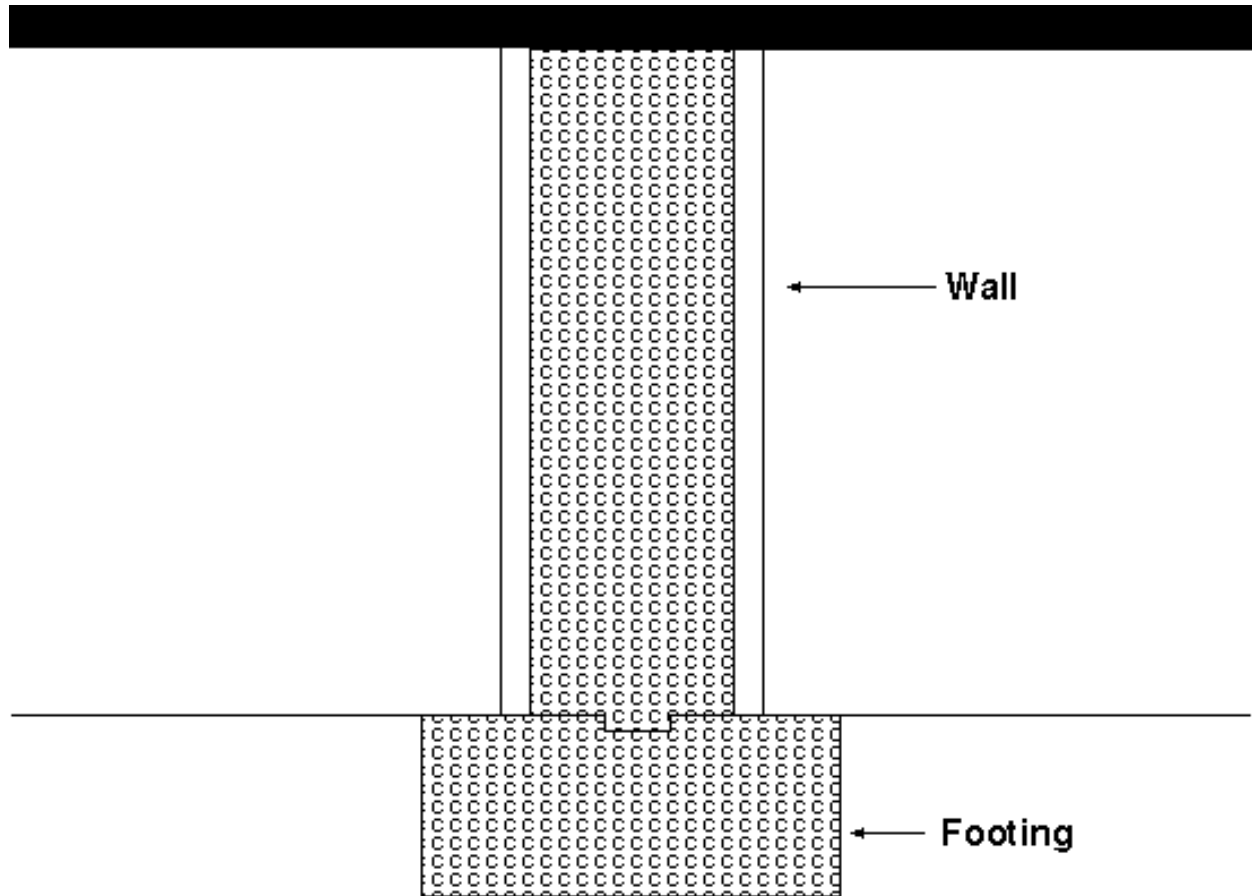
8. What are three tools used in site preparation?

a.

b.

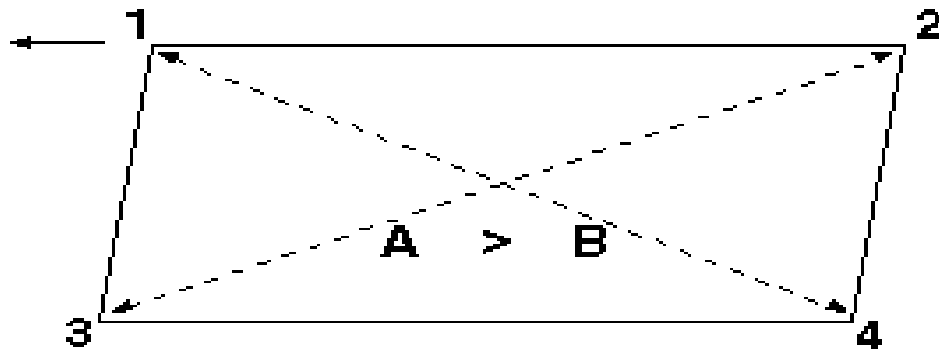
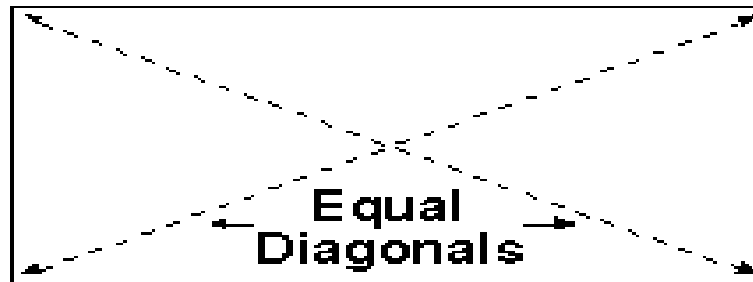
c.

# Footing



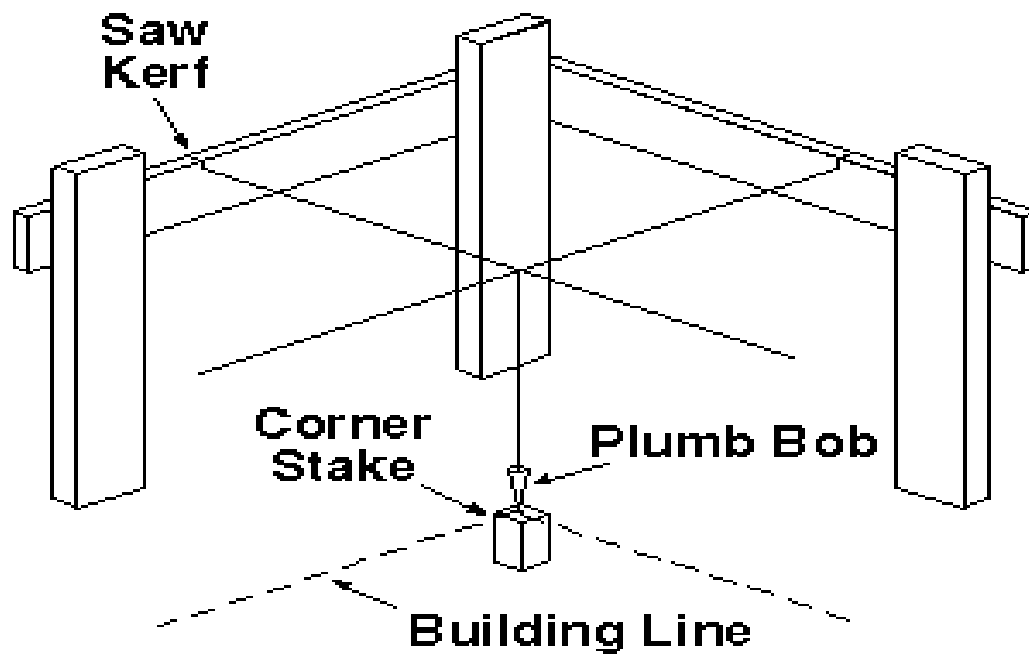


# Equal and Unequal Diagonals











**Subgrade Preparation**

**Objective:** Explain factors that are important in the preparation of a subgrade.

**Using a sample plot of land identified by your instructor, determine what work needs to be done to prepare the subgrade for construction. Based on the factors listed below, describe the steps needed to prepare the land for the type of building suggested by your instructor.**

<u>Factor/Category</u>	<u>Preparation</u>
1. Drainage	
2. Removal of topsoil	
3. Removal of organic material	
4. Removal of rocks and stones	
5. Subgrade slope	
6. Packing/Compacting	

7. Sand or aggregate fill
8. Vapor retarder/insulation
9. Dampening the site
10. Removal of rocks
11. Fill
12. Frost level
13. Soil texture/structure

## Lesson 3: Site Preparation

Name \_\_\_\_\_

**Laying Out a Building****Objective:** Lay out the corner stakes of an 8' × 10' building.**Materials and Equipment:**

4 stakes  
2 tape measures  
Twine

**Procedure:**

1. On a spot away from other groups of students, place the first stake for a corner of your building.
2. Using the tape measure to determine the correct distance, place the second stake 8 feet away from the first stake.
3. Measuring from the first stake along a line forming a 90 degree angle to the other two stakes, place a stake 10 feet away from the first stake.
4. Using the two tape measures, measure from the second and third stakes and place the fourth corner stake the correct distance from them.
5. Join the stakes with twine.
6. Using one of the tape measures, measure both the diagonals from opposite corners. Record your measurements below.

Diagonal 1: \_\_\_\_\_  
Diagonal 2: \_\_\_\_\_

7. If the two diagonals are equal, the building is perfectly square. If the two diagonals are not square, move the stakes.
8. Once the four stakes are in place, measure the diagonals again and record your answers above in Trial 2.

Diagonal 1: \_\_\_\_\_  
Diagonal 2: \_\_\_\_\_

9. If the diagonals are not square, repeat steps 6 and 7 until the diagonals are equal.

**Key Questions:**

1. If the stakes are placed at the correct distance apart, why is the building not necessarily square?
2. Why are two tape measures needed to perform this activity?
3. If one diagonal measurement is longer than the other, how will the difference affect the later construction of the building?