TSM 352 HOMEWORK ASSIGNMENT 05

**Due Thursday, March 2, at 11:59 pm**

# Drain Size Capacity

1. Determine the size of plastic drain tubing required to drain a 20-acre area, using a 3/8 inch drainage coefficient with the following slopes:

|  |  |  |
| --- | --- | --- |
| **Slope** | **Tile Size** | **Velocity** |
| 0.10% |  |  |
| 1.20% |  |  |

1. Determine the size of smooth (dual wall) drain tubing required to drain a 20-acre area, using a 3/8 inch drainage coefficient with the following slopes:

|  |  |  |
| --- | --- | --- |
| **Slope** | **Tile Size** | **Velocity** |
| 0.10% |  |  |
| 1.20% |  |  |

1. a) What size of plastic main with a 0.2 % grade is required for a 40 acre field using a 3/8 inch drainage coefficient?

b) Would this size main be adequate if it had to travel 1200 feet with a 0.1 % grade through a neighboring field to reach an outlet? The required lateral spacing is 100 ft.

c) What should the size of the main be if the neighbor wishes to connect a 20-acre drainage system into the main as it passes through his field?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field** | **Slope** | **Discharge** | **Tile Size (Plastic)** | **Tile Size (Smooth Wall)** |
| 40-acre field | 0.2% | 0.63 |  |  |
|  | | | | |
| 1200 x 100 sq. ft. (2.75 acre) |  | 0.04 |  |  |
| 40-acre field and main | 0.1% | 0.67 |  |  |
|  | | | | |
| 20-acre |  | 0.32 |  |  |
| 40-acre field, main and 20-acre field | 0.1% | 0.99 |  |  |

1. A plastic tile with a diameter of 12 inches is silted to a depth of 6 inches, assuming that the grade in the tile is 0.2 feet per 100 feet:

a. What was the original capacity in CFS?

b. What is the present capacity in CFS?

c. What size of smooth wall pipe would be required to replace the plastic pipe at its original capacity?

d. If the smooth wall pipes cannot be larger than 8 inches in diameter due to machine limitations, how many 8-inch pipes in parallel would be required to replace the plastic pipe at its original capacity?

1. A corrugated metal outlet pipe is to be added to an existing (clay) main tile with a diameter of 10 inches where it enters the ditch. The main with a diameter of 10 inches is laid on a 0.3 grade. Determine:

a. The maximum number of acres drained by the main

b. The minimum grade required for a corrugated metal outlet with a diameter of 10 inches. The roughness coefficient for riveted corrugated pipe is 0.023 – 0.027.

c. The minimum grade required for a corrugated metal outlet with a diameter of 12 inches

1. Determine the size of the concrete tile at the outlet of a 50-acre drainage system:

(a) if the drainage coefficient is 3/8 inch and the tile grade is 0.3 percent, and

(b) if the grade is reduced to 0.1 percent.

# Lateral Specifications

1. What would be the required spacing for drains placed 4 feet deep in this Drummer Silty Clay Loam, if the system is to be designed to lower a water table initially at the surface by 2 feet in 36 hours?
2. What is the minimum size of plastic tubing that can be used for the situation above, if the laterals are to be 1500 ft long with a slope of 0.1 %?

What would the minimum size be if the drain depth were changed to 3 feet?

What would the minimum size be if the laterals were designed to have adequate capacity when they were filled with an inch of sediment?

1. What length of plastic tubing is required for draining a 40-acre field if the drains are to be placed 60 feet apart? What is the maximum length of 3-inch laterals that can be used in this field if the slope is 0.1 % and the drainage coefficient is ½ inch per day?
2. A drainage system is to be placed under a drain field for a septic system, to maintain a 3 foot separation between the bottom of the drain field and the water table. The bottom of the drain field and the drains are to be placed 1 foot and 5 feet, respectively, below the soil surface. What should the spacing of the laterals be if the soil type is Flanagan and the system should be designed to from the water table from the soil surface to required separation depth in 6 hours?

# Ditch Capacity

1. A drainage system is designed to outlet to a trapezoidal ditch with a base with of 15 feet and a 2:1 (H:V) side slope. The drainage area in the watershed above the drain outlet is 640 acres. Determine the minimum height of the outlet above the ditch bottom if the drainage channel is designed to provide
   * 1. Excellent Drainage
     2. Good Drainage
     3. Satisfactory Drainage

# Economic Analysis

1. The following materials were used in the design of a drainage system for a 44 acre field. Determine the per acre cost for the materials used in the design.

|  |  |  |
| --- | --- | --- |
| **Material** | **Quantity** | **Cost** |
| 4-inch tubing | 18500 ft | $1.00/ft |
| 5-inch tubing | 200 ft | $1.10/ft |
| 6-inch tubing | 100 ft | $1.85/ft |
| 8-inch tubing | 500 ft | $2.15/ft |
| 10-inch tubing | 355 ft | $3.55/ft |
| Fittings | - | $567 |

1. A drainage system with an estimated life of 40 years was installed at a cost of $432/acre. Determine the break even income for each of the following scenarios.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F |
| Depreciation Period | 2 years | 5 years | 10 years | 2 years | 5 years | 10 years |
| Interest Rate | 4% | 4% | 4% | 6% | 6% | 6% |
| Tax Rate | 18% | 28% | 18% | 28% | 18% | 28% |
| Break Even  Income ($) |  |  |  |  |  |  |

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