King Fahd University of Petroleum & Minerals

جامعة الملك فهد للبترول و المعادن

CE 442

Construction and Maintenance of Highways and Airports

HW No. 7

1. A highway culvert is to be designed for a 105-acre drainage area near Nashville, Tennessee. The height of the most remote point above the outlet is 20 ft, and the maximum length of water travel is 2400 ft. The drainage area consists of rolling farmland with extremely impervious soil. Using a 10-year recurrence interval, determine the runoff in ft^3/sec.

2. A railroad culvert is being designed for a 64-hectare drainage area near St. Louis, Missouri. The time of concentration is 10 minutes. It is estimated that 70 percent of the rainfall will infiltrate the ground, evaporate, or otherwise not show up as runoff. Estimate the runoff in m^3/sec, assuming a 25-year recurrence interval.

3. A 24-inch circular corrugated metal culvert (n = 0.024) is to be placed under a roadbed for a rail transit line. The estimated flow is 22 ft^3/sec. The culvert is 68 ft long and has a square-edged headwall. Determine the difference in elevation between the upstream and downstream water surfaces.

4. A smooth concrete two-ft flat bottom channel with a 2:1 side slopes has a slope of 0.4 percent, and the depth is 1.5. Determine the quantity of flow in m^3/sec.

5. Given an allowable headwater depth of 7 ft and a runoff of 52 ft^3/sec, determine the required size of circular concrete pipe and the actual headwater depth. The slope for the location is 0.3 percent and the length of culvert is 106 ft. The pipe has a square-edged entrance.

6. A collector drain pipe is to be designed to carry an estimated 50 cfd/ft. If distance between outlets = 1000 ft with an average gradient of 0.02, calculate:

   (a) size of smooth pipe.

   (b) size of corrugated pipe.

7. Determine the depth and velocity of flow in a trapezoidal channel (n = 0.03) with 2:1 side slopes and a two-foot bottom width, given a flow of 175 ft^3/sec and a slope of 2.0 percent. Determine the depth and velocity of flow if n = 0.012.

8. Given an allowable headwater depth of 12 ft and a runoff of 150 ft^3/sec, determine the required size of circular corrugated metal pipe and the actual headwater depth. Assume that the pipe has a projecting entrance and will operate with inlet control.