Continuing Education Course #608
Introduction to Culvert Hydraulics

1. What flow regime is described by a situation where the water surface undergoes abrupt changes over short distances?
- a. Gradually varying flow.
- b. Rapidly varying flow.
- c. Flow with inlet control.
- d. Flow with outlet control.

2. If a culvert barrel is capable of conveying more flow than the inlet will accept, outlet control conditions occur.
- a. False.
- b. True.

3. Which of the following parameters have a very small effect on the flow under inlet control conditions?
- a. Headwater depth.
- b. Inlet area.
- c. Inlet Configuration.
- d. Barrel slope.

4. What is a typical Manning's roughness coefficient (n value) for a concrete culvert.
- a. 0.013.
- b. 0.13.
- c. 0.0013.
- d. None of the above.

5. If the Froude Number is greater than 1 what is the flow regime?
- a. Critical.
- b. Subcritical.
- c. Supercritical.
- d. The Froude Number does not determine the flow regime.

6. What is the "Unsubmerged M" constant for a circular concrete culvert with an inlet configuration of "Groove End with Headwall"?
- a. 1.33.
- b. 1.5.
- c. 2.5.
- d. None of the above.

7. What is the 10 year headwater depth of the structure shown in the photograph below? It is an circular, 15" diameter concrete culvert with a headwall (the square edge of the pipe is at the inlet). The peak 10 year design flow into the culvert has been determined to be 10 CFS. Assume that the inlet is not submerged.

- a. 7.8".
- b. 78".
- c. 24".
- d. There is not enough information given.

8. Under outlet flow conditions which of the following loses make up the total energy loss within the culvert barrel?

- a. The entrance loss.
- b. The friction loss through the culvert.
- c. The exit loss.
- d. All of the above

9. What is the exit loss for a culvert flowing with velocity of 12 FPS?

- a. 1.0 feet.
- b. 2.2 feet.
- c. 5.2 feet.
- d. 9.2 feet.

10. What is the entrance loss coefficient for the socket end of a concrete pipe with a headwall and wingwalls ?

- a. 0.2.
- b. 0.5.
- c. 0.7.
- d. 0.002.

11. The Darcy equation and the Manning's equation are two formulas used for calculating hydraulic resistance of a culvert barrel.

○ a. True.
○ b. False.

12. The X axis of the Moody Diagram is the friction factor.
○ a. True.
○ b. False.

13. What does turbulent flow refer to?
○ a. When the water travels smoothly or in regular paths without abrupt changes in velocity.
○ b. An in-between state of flow somewhat between laminar and turbulent.
○ c. When chaotic changes in pressure and flow velocity occur.

14. Which of the two equations for calculating hydraulic resistance is based on empirical data?
○ a. The Darcy equation.
○ b. The Manning's equation.
○ c. The Reynold's Number.

15. For a culvert with a hydraulic radius of 2 and a Darcy f value of 0.0004 what is the Manning's n value"
○ a. 0.002.
○ b. 0.20.
○ c. 0.040.
○ d. 0.075.

16. If the inlet side of a culvert settles more than the outlet side what may result?
○ a. The culvert may have an adverse slope.
○ b. The slope will increase.
○ c. The resulting velocity of the flow may increase.

17. If a the culvert with an adverse slope is flowing under outlet control what modifications need to be made to the analysis?
○ a. 0.014 should be subtracted from the HW/D value read from the nomograph.
○ b. 0.014 should be added to the HW/D value read from the nomograph.
○ c. Both of the above.
○ d. Neither of the above.

18. What is a broken -back culvert?
○ a. A culvert that is leaking due to excessive loading.
○ b. A culvert that has one or more breaks in its profile.
○ c. A culvert with an adverse slope.
○ d. All of the above.

19. If there is a significant amount of storage upstream of a highway culvert this will increase the flow through the culvert.
○ a. True.
○ b. False.

20. If a roadway is overtopped during a storm, the flow across the road surface will approximate which structure?
○ a. A rectangular orifice.
○ b. A broad-crested weir.
○ c. A V-notch weir.
○ d. A sharp-crested weir.

21. What coefficient is generally used for weir flow in modelling flow over a roadway?

- a. 2.6.
- b. 3.0.
- c. 3.2.
- d. 1.5.

22. The submergence factor for flow over a roadway is independent of whether the roadway is gravel or paved.

- a. True.
- b. False.

23. If there is a sloping roadway, the weir equation method cannot be used to approximate the flow over the road even if the methodology is modified somewhat to approximate the road surface.

- a. True.
- b. False.

24. What is one reason to put a protective barrier on a culvert.

- a. To keep fish out of the culvert.
- b. To keep fish in the culvert.
- c. To prevent children from entering the culvert.
- d. All of the above.

25. A three-sided culvert with no bottom is generally a good option to allow for fis h passage.

- a. True.
- b. False.