TRITON-PDH.COM
6757 W. Charleston Boulevard, Suite B
Las Vegas, NV 89146
(702) 254-1480
Admin@triton-pdh.com

Examination for **Engineering and Design CONDUITS, CULVERTS, AND PIPES**

Life Cycle Design

1. Economic analysis used as a part of project authorization studies usually calculates costs and benefits projected for a 50- or 75-year project life. However, many USACE projects represent a major infrastructure for the Nation, and will likely remain in service indefinitely. For major infrastructure projects, designers should use a minimum project service life of ___ years when considering life cycle design.
   a. 75 years
   b. 100 years
   c. 150 years
   d. 200 years

2. Corrugated steel pipe usually fails due to
   a. corrosion of the invert or exterior
   b. exterior paint failure
   c. erosion at the invert
   d. improper installation

3. Plastic pipe. Many different materials fall under the general category of plastic. Each of these materials may have some unique applications where it is suitable or unsuitable. Performance history of plastic pipe is limited. A designer should not expect a product service life of greater than ___ years.
   a. 25 years
   b. 50 years
   c. 75 years
   d. 100 years

4. Conduit Materials includes cast-in-place concrete, pre-cast concrete, steel, ductile iron, aluminum, and plastic. In general, concrete conduits are designed as rigid conduits, and the other materials are designed as _____.
   a. flexible conduits
   b. short term conduits
   c. drop in conduits
   d. none of the above

5. Controlled backfill placement for any type of conduit; cast-in-place concrete, pre-cast concrete, steel, ductile iron, aluminum, and plastic has the following affect.
   a. minimizes pipe deflection
   b. maintains joint integrity
   c. reduces water piping
   d. all of the above

6. Because leaking joints will lead to piping and to the premature failure of the conduit and the embankment, designers need to control the following
   a. conduit deflections
   b. conduit settlements
   c. joint movement
   d. all the above

Cast-in-place Conduits for Dams

7. A rectangular conduit entrenched in rock to the top of the conduit may be economical for higher fills since the applied vertical load need be only the weight of the earth directly above with no increase for differential fill settlement. The ratio of height to width should be about ____ to accommodate the range of loading conditions economically.
   a. 1.00
   b. 1.50
   c. 2.00
   d. 2.50

8. The conduit supports the weight of the soil and water above the crown. Internal and external fluid pressures and lateral soil pressures may be assumed as uniform loads along the horizontal axis of the conduit when the fluid head or fill height above the crown is _____ twice the conduit diameter or span.
   a. less than
   b. greater than
   c. equal to

9. Where the conduit walls are placed directly against rock and the rock surface is at or above the top of the crown, the soil weight should be taken as ____ times the weight of material above, rather than 1.5, and the lateral pressure should be hydrostatic only, where applicable.
   a. 0.5 times
   b. 1.0 times
   c. 2.0 times
   d. 4.0 times

10. Cast-in-place conduits can be designed using simplified elastic analysis or with finite element codes.
   a. true
   b. false
   c. not enough information for a specific answer
   d. too many variables for a specific answer

11. Transverse monolith joints; maximum contraction joint spacing should not exceed ____ on earth foundations.
   a. 10 feet
   b. 15 feet
   c. 20 feet
   d. 25 feet

12. Flexible-type waterstops should be used in all transverse contraction joints. Where large differential movement is expected, a center-bulb-type waterstop and a joint separation of approximately _____ should be used.
   a. 1/4”
   b. 1/2"
   c. 1”
   d. no center-bulb-type waterstop is needed, only two coats of mastic are required

13. When conduits are cast-in-place, large settlements are usually not a major concern. However, where considerable foundation settlements are likely to occur, camber should be employed to ensure positive drainage.
   a. true
   b. false
   c. not enough information for a specific answer
   d. too many variables for a specific answer

Circular Reinforced Concrete Pipe for Small Dams and Levees

14. Reinforced concrete pipe discussed in this chapter is designed by either the direct or indirect (D-load) method. This approach indirectly compares the moments and shears for the pipe section to a standard three-edge bearing test. The minimum diameter pipe used should be _____ to facilitate installation, maintenance, and inspection.
    a. 24 inches
    b. 36” inches
    c. 48” inches
    d. 60” inches

15. When the steel cylinder is used, the cylinder should have a minimum thickness of 1.5 mm (0.0598 in.) and 25 mm (1 in.) minimum concrete cover.
    a. 1/2 inch
    b. 3/4 inch
    c. 1 inch
    d. 1 1/2 inches

16. Mortar covering. The minimum concrete cover over prestressing wire should be _____.
    a. 1/2 inch
    b. 3/4 inch
    c. 1 inch
    d. 1 1/2 inches

17. Concrete cover. The minimum concrete cover over plain reinforcing bars or welded wire fabric should be _____.
    a. 1/2 inch
    b. 3/4 inch
    c. 1 inch
    d. 1 1/2 inch

18. Pipe laying lengths. Lengths of pipe used should not exceed _____ for conduits when minimal foundation settlements are expected.
    a. 8 feet
    b. 12 feet
    c. 16 feet
    d. 20 feet

19. Reinforced concrete pipe protruding through the select impervious material of a dam embankment, lying between the intake structure and the stilling basin should conform to
    a. AWWA C 300
    b. AWWA C 301
    c. AWWA C 302, when used in less critical area of the dam
    d. All the above

20. Joints for pipe through dams should be field-tested using a hydrostatic test after pipe is installed and prior to placement of the concrete cradle, the grouting or mortaring of joints, and the backfilling of the trench above the bedding. Hydrostatic testing should be ____ percent of the maximum design pressure for the pipe and in accordance with AWWA standard.
    a. 100 percent
    b. 120 percent
    c. 150 percent
    d. 200 percent

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Answer Sheet for Conduits, Culverts & Pipes
TPDH-00007

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