

Why Slope in HEC-14 Riprap Calculator?

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Hi,

I was wondering how the riprap apron design values are calculated since they seem to include the slope value which does not appear in the HEC-14 equation from Fletcher and Grace (1972).

Regards,

Simon

Plainwater response:

The culvert slope is accounted for implicitly through the normal depth, when flow is supercritical. The culvert diameter is adjusted (as shown below), which results in the median rock diameter being adjusted for slope.

The following equation (Fletcher and Grace, 1972) is recommended for circular culverts:

$$D_{50} = 0.2 \cdot D (Q / (\sqrt{g} \cdot D^{2.5}))^{4/3} (D/TW) \quad (10.4)$$

where,

- D_{50} = riprap size, m (ft)
- Q = design discharge, m^3/s (ft^3/s)
- D = culvert diameter (circular), m (ft)
- TW = tailwater depth, m (ft)
- g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Tailwater depth for Equation 10.4 should be limited to between $0.4D$ and $1.0D$. If tailwater is unknown, use $0.4D$.

Whenever the flow is supercritical in the culvert, the culvert diameter is adjusted as follows:

$$D' = (D + y_n)/2 \quad (10.5)$$

where,

- D' = adjusted culvert rise, m (ft)
- y_n = normal (supercritical) depth in the culvert, m (ft)

Thanks,

Norm