

LINED WATERWAY OR OUTLET

Chute Design

Standard 468 – Criteria

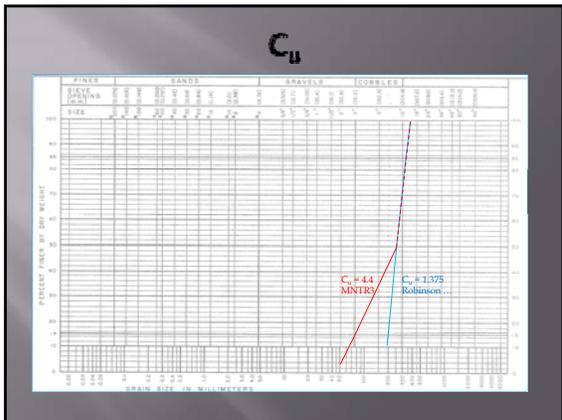
Stable rock sizes and flow depths for rock-lined channels having gradients between 2 percent and 40 percent may be determined using the following detailed design process. This design process is from **Design of Rock Chutes by Robinson, Rice, and Kadavy**.

For channel slopes between 2% and 10%:
 $D_{50} = [q (S)^{1.5} / 4.75(10)^{-3}]^{1/1.89}$

For channel slopes between 10% and 40%:
 $D_{50} = [q (S)^{0.58} / 3.93(10)^{-2}]^{1/1.89}$
 $z = [n(q) / 1.486(S)^{0.50}]^{3/5}$

Design of Rock Chutes Robinson, Rice, & Kadavy, 1998

- Full scale testing of rock chutes.
 - 38 chutes, slopes 2% - 40%
 - 9' bottom, 2:1 side slopes
- Recommendations of paper based upon:
 - Angular Riprap
 - Riprap Coefficient of Uniformity (C_u)
 - 1.25 - 1.75
 - $C_u = D_{60} / D_{10}$



Robinson – Factor of Safety

- Not Addressed in Standard 468
- Not Addressed in “Design of Rock Chutes” by Robinson, Rice, and Kadavy
- Minimum of 1.2 recommended by Robinson

Standard 468 deficiencies

- The Robinson paper is the “State of the Art” for rock chute design, but the reference in the standard is incomplete
- C_u of rock should be between 1.25 and 1.75
- A factor of safety of 1.2 should be applied to the resulting D_{50}

Recommended Tool

Spreadsheet:

[Rock Chute 401.xls](#)

Originally written by Eric Lorenz

- ❑ Variable factor of safety and $C_u < 2.0$
- ❑ Spreadsheet originally written for the design of rock chutes, contains hydraulic design considerations that may not be required for a waterway outlet
- ❑ Computes a rock thickness of $2 * D_{50}$ which is on the low size. Recommend following MN TR3 and use $1.25 * D_{100} \text{ (upper limit)} = 2.5 * D_{50}$