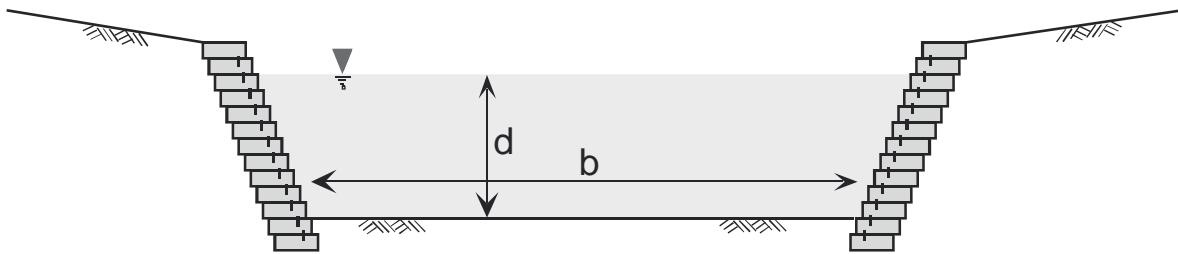




Water Flow - Manning's Number

Keystone walls are increasingly being utilized for water channelization projects due to low cost and ease of installation as well as providing obvious technical and aesthetic benefits. Water resource engineers have always asked what the roughness coefficient or Manning's "n" value is for the tri-planer fractured face of a typical Keystone structural unit to insure that their flow calculations are correct.

A typical channel cross section and Manning's "n" values are provided below. Since only the tri-planer split-faced units were tested, we believe that straight split-faced units would provide slightly lower values due to less facial relief if required.



$$\text{Manning Equation, } V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

Where: V = velocity (feet per second)
 n = Manning roughness coefficient
 R = hydraulic radius (area / wetted perimeter)
 S = slope of channel

Manning's Roughness Coefficient, n

| Lining Category | Lining Type | n- value (d> 2'depth) |
|-----------------|----------------------------|-----------------------|
| Rigid | Concrete | 0.013 |
| | Grouted Rip Rap | 0.028 |
| | Stone Masonry | 0.030 |
| | Asphalt | 0.016 |
| | Keystone, Tri-Split | 0.023 |
| Unlined | Bare Soil | 0.020 |
| | Rock Cut | 0.025 |
| Rock Rip rap | 6 inch, D50 | 0.035 |
| | 12 inch, D50 | 0.040 |

Ref: Design Procedures for Channel Protection and Streambank Stabilization-IECA 1996
 Water Effects on Keystone - Utah State University 1991