|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TALUDES (canales)**   |  |  | | --- | --- | | **ANCHO DE SOLERA** | | | Caudal (m3/s) | Solera b (m) | | Menor de 0.1 | 0.20 | | Entre 0.1 y 0.20 | 0.50 | | Entre 0.2 y 0.40 | 0.75 | | Mayor de 0.40 | 1.00 | | |
| Mateial | Talud |
| roca en buenas condiciones | 0 (vertical) |
| arcillas compactas o conglomerados | 0.75 |
| arcilla con grava, suelo franco | 1 |
| suelo franco con grava | 1.5 |
| arena y grava, y arena bien granulada | 2 |
| arena fina y limo (no plástico) | 3 |

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| **VELOCIDADES** | | | | |
| Material | | Velocidad (m/s) | | |
| Revestido de concreto | | 3 – 6 | | |
| Ladrillo con concreto | | 2.5 – 3.5 | | |
| Mampostería de piedra y concreto | | 2 | | |
| Terreno revestido de zacate | | 0.6 – 1 | | |
| Terreno arcilloso | | 0.8 - .0.9 | | |
| Terreno arenoso | | 0.5 – 0.7 | | |
| **COEFICIENTES DE RUGOSIDAD (n)** | | | | | | | | |
| Material | | | | | | Coeficiente | | |
| Tubos de barro para drenaje | | | | | | 0.014 | | |
| Superficie de cemento pulido | | | | | | 0.012 | | |
| Tuberías de concreto | | | | | | 0.015 | | |
| Canales revestidos con concreto sin pulir | | | | | | 0.014 | | |
| Superficie de mampostería con cemento | | | | | | 0.020 | | |
| Acueductos semicirculares, metálicos, lisos | | | | | | 0.012 | | |
| Acueductos semicirculares, metálicos corrugados | | | | | | 0.025 | | |
| Tuberías de plástico corrugadas ADS | | | | | | 0.012 | | |
| Tierra | | | | | | 0.025 | | |
| Canales en roca, lisos y uniformes | | | | | | 0.033 | | |
| Canales en roca, con salientes y sinuosos | | | | | | 0.040 | | |
| Canales dragados en tierra | | | | | | 0.0275 | | |
| Canales con lecho pedregoso y bordos de tierra enyerbados | | | | | | 0.035 | | |
| Canales con plantilla de tierra y taludes ásperos | | | | | | 0.033 | | |
| Corrientes naturales limpias, bordos rectos, sin hendeduras ni charcos profundos | | | | | | 0.030 | | |
| Corrientes naturales igual al anterior, pero con algo de hierba y piedra | | | | | | 0.035 | | |
| Corrientes naturales igual al anterior, pero menos profundas, con secciones pedregosas | | | | | | 0.055 | | |
| Ríos con tramos lentos, cauce enhierbado o con charcos profundos | | | | | | 0.070 | | |
| Playas muy enhierbadas | | | | | | 0.125 | | |
| Vidrio, plástico | | | | | | 0.010 | | |
| Madera cepillada | | | | | | 0.012 | | |
| Madera no cepillada | | | | | | 0.013 | | |
| Concreto terminado | | | | | | 0.012 | | |
| Gravas | | | | | | 0.029 | | |
| Planicie de inundación pocos matorrales | | | | | | 0.050 | | |
| Planicie de inundación árboles | | | | | | 0.150 | | |
| Hormigón (armado, simple o ciclópeo) | | | | | | 0.018 | | |
| Mampostería de piedra | | | | | | 0.022 | | |
| Acero galvanizado (ligeramente corrugado) | | | | | | 0.016 | | |
| Hierro fundido en uso | | | | | | 0.020 | | |
| Tierra, con pastos cortos, algunas malezas | | | | | | 0.027 | | |
| Cortes en rocas | | | | | | 0.035 | | |
| Tubos de barro vitrificado | | | | | | 0.011 | | |
| **RUGOSIDAD** | | | | | | |
| **MATERIAL** | ε (pie) | | | ε (mm) | | |
| Acero remachado (bridado) | 0.003 a 0.03 | | | 0.9 a 9 | | |
| Hormigón según el acabado | 0.001 a 0.01 | | | 0.3 a 3 | | |
| Duela de madera | 0.0006 a 0.003 | | | 0.18 a 0.9 | | |
| Hierro fundido | 0.00085 | | | 0.26 | | |
| Hierro galvanizado | 0.0005 | | | 0.15 | | |
| Hierro fundido revestido de asfalto | 0.0004 | | | 0.12 | | |
| Acero comercial o hierro forjado | 0.00015 | | | 0.046 | | |
| Tubería estirada | 0.000005 | | | 0.0015 | | |
| Vidrio, plástico P.V.C | Liso | | | 0.0015 | | |
| Asbesto cemento |  | | | 0.03 | | |
| Hierro fundido dúctil |  | | | 0.25 | | |
| **COEFICIENTE PARA LA FORMULA DE KUTTER m** | | | | | | | |
| Tubos nuevos de hierro fundido | | | 0.15 a 0.17 | | | | |
| Tubos nuevos de cemento | | | 0.15 a 0.11 | | | | |
| Tubos de hierro fundido (en servicio corriente con agua no incrustada) | | | 0.275 | | | | |
| Tubos de hierro fundido muy lisadas | | | 0.350 | | | | |
| Tubos de hierro fundido muy incrustados y con aguas sucias | | | 0.450 | | | | |
| Tubos de acero o comercial nuevo | | | 0.250 | | | | |
| Tubos de acero o comercial usado | | | 0.350 | | | | |
| tubos con interior con cemento pulido | | | 0.10 | | | | |
| Concreto acabado liso | | | 0.20 | | | | |
| Madera cepillada | | | 0.10 | | | | |
| Canales de mampostería de ladrillo | | | 0.50 | | | | |
| Canales de mampostería de piedra cortada | | | 0.70 | | | | |
| Canales de tierra | | | 1.50 | | | | |

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| **COEF PARA LA FORMULA DE BAZIN Δ** | |
| Tubos nuevos de fibrocemento | 0.16 |
| Tubos nuevos de acero laminado | 0.10 |
| Tubos nuevos de hierro fundido | 0.16 |
| Tubos de cemento bien terminado (concreto) | 0.18 |
| Tubos usados de hierro fundido | 0.23 |
| Tubos de hierro fundido con incrustaciones | 0.36 |
| Asbesto cemento nuevo | 0.16 |
| Concreto acabado común | 0.18 |
| Canales de mampostería de ladrillo | 0.30 |
| Canales de mampostería de piedra cortada | 0.69 |
| Canales de tierra | 0.69 |

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| **COEFICIENTE PARA LAFORMULA DE HAZEN WILLIANS Y KOZENY** | | |
|  | **CH** | **N** |
| Acero corrugado | 60 | ---- |
| Acero galvanizado (nuevo y usado) | 125 | ---- |
| Acero remachado (bridado) nuevo | 110 | 31 |
| Acero remachado (bridado) usado | 85 | 28 a 26 |
| Acero soldado y con remache nuevo | 120 | 34 |
| Acero soldado y con remache usado | 90 | 31 a 27 |
| Tubería de hacero forjado (comercial) nuevo | ---- | 38 |
| Tubería de hacero forjado (comercial) usado | ---- | 36 |
| Acero soldado con revestimiento especial nuevo y usado | 130 | ---- |
| Hierro fundido nuevo | 130 | 35 |
| Hierro sin incrustaciones usado | 110 | ---- |
| Hierro con incrustaciones viejo | 90 | 30 |
| P.V.C | 150 | ---- |
| Asbesto cemento nuevo | 135 | ---- |
| Cobre y latón | 130 | ---- |
| Conductos con acabado interior de cemento pulido | 100 | ---- |
| Concreto acabado liso | 130 | 38 |
| Concreto acabado común | 120 | ---- |
| Concreto con acabado tosco | ---- | 27 a 36 |
| Concreto con juntas toscas | ---- | 30 |
| Conductos para alcantarillado | ---- | 28 |
| Tubos de barro vitrificado (drenes) | 110 | 34 |
| Madera cepillada | 120 | ---- |

**COEFICIENTE (K) PARA DIFERENTES ACCESORIOS**

|  |  |
| --- | --- |
| **ACCESORIOS** | **K** |
| Válvula de globo, completamente abierta | 10 |
| Válvula en ángulo, completamente abierta | 5 |
| Válvula de retención, completamente abierta | 2.5 |
| Válvula de compuerta, completamente abierta | 0.2 |
| Codo, radio corto (r/D=1) | 0.9 |
| Codo, radio mediano | 0.75 a 0.80 |
| Codo, radio grande (r/D=1.5) | 0.6 |
| Codo de 450 | 0.40 a 0.42 |
| Retorno (curva en U) | 2.2 |
| Te en sentido recto | 0.3 |
| Te a través de la salida lateral | 1.8 |
| Unión | 0.3 |
| Ye de 450 en sentido recto | 0.3 |
| Ye de 450 salida lateral | 0.8 |

**COEFICIENTES PARA VALVULAS PARCIALMENTE CERRADAS**

|  |  |  |
| --- | --- | --- |
| CERRADA  AL | Relación | |
| Válvula compuerta | Válvula globo |
| 25% | 3.0 a 5.0 | 1.5 a 2.0 |
| 50% | 12 a 22 | 2.0 a 3.0 |
| 75% | 70 a 120 | 6.8 a 8.0 |

**COEFICIENTE (K) PARA CODOS EN FUNCION DE SU ANGULO DE DEFLEXION**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 10 | 15 | 22.5 | 30 | 45 | 60 | 90 |
| K | 0.044 | 0.062 | 0.154 | 0.165 | 0.42 | 0.684 | 1.265 |

ENSANCHAMIENTO BRUSCO VALORES DE (K)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0.10 | 020 | .30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 |
| 0.60 | 1.00 | 1.00 | 0.96 | 0.74 | 0.71 | 0.44 | 0.29 | 0.15 | 0.04 |
| 1.50 | 0.95 | 0.95 | 0.89 | 0.69 | 0.69 | 0.41 | 0.27 | 0.14 | 0.04 |
| 3.00 | 0.93 | 0.91 | 0.86 | 0.77 | 0.67 | 0.40 | 0.28 | 0.13 | 0.04 |
| 6.00 | 0.88 | 0.84 | 0.80 | 0.72 | 0.62 | 0.37 | 0.24 | 0.12 | 0.03 |

**ENSACHAMIENTO GRADUAL VALORES DE (K) PARA UN ANGULO α DE ABERTURA DEL CONO**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 00 | 100 | 150 | 200 | 300 | 500 | 600 |
| 1.2 | 0.02 | 0.04 | 0.09 | 0.15 | 0.25 | 0.35 | 0.37 |
| 1.4 | 0.03 | 0.06 | 0.12 | 0.23 | 0.35 | 0.50 | 0.53 |
| 1.6 | 0.03 | 0.07 | 0.14 | 0.25 | 0.42 | 0.57 | 0.61 |
| 1.8 | 0.04 | 0.07 | 0.15 | 0.28 | 0.44 | 0.61 | 0.65 |
| 2.0 | 0.04 | 0.07 | 0.16 | 0.29 | 0.46 | 0.63 | 0.68 |
| 2.5 | 0.04 | 0.08 | 0.16 | 0.30 | 0.48 | 0.65 | 0.70 |
| 3.0 | 0.04 | 0.08 | 0.16 | 0.31 | 0.48 | 0.66 | 0.71 |
| 4.0 | 0.04 | 0.08 | 0.16 | 0.31 | 0.49 | 0.67 | 0.72 |
| 5.0 | 0.04 | 0.08 | 0.16 | 0.31 | 0.50 | 0.67 | 0.72 |

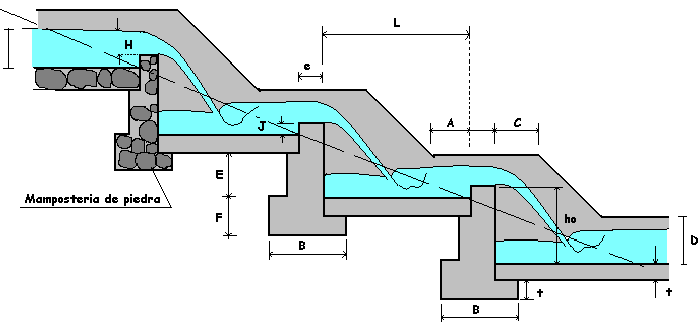
**CONTRACCION BRUSCA VALORES DE (K)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| K | 0.08 | 0.17 | 0.25 | 0.34 | 0.37 | 0.41 | 0.43 | 0.45 | 0.45 |

**CONTRACCION GARDUADA VALORES DE (K)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 30 | 45 | 60 |
| K | 0.02 | 0.04 | 0.07 |

**CAIDAS CASCADA (FLUJO SALTANTE) TIPO SAF**



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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TIPO A | | | | | | | | | | | MURO FRONTAL | | |
| TIPO | PENDIENTE TERRENO % |  | J | I | D | Lmin | A | C | e | t | B | E | F |
| A- 1 | 5 < ≤ 10 | 0.30 | 0.10 | 0.20 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.20 | 0.40 | ----- | 0.40 |
| A- 2 | 10 < ≤ 20 | 0.50 | 0.10 | 0.40 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.20 | 0.50 | 0.20 | 0.40 |
| A- 3 | 20 < ≤ 30 | 0.70 | 0.10 | 0.60 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.20 | 0.55 | 0.40 | 0.40 |
| A- 4 | 30 < ≤ 40 | 0.90 | 0.10 | 0.80 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.20 | 0.60 | 0.60 | 0.40 |
| A- 5 | 40 < ≤ 50 | 1.10 | 0.10 | 1.00 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.25 | 0.70 | 0.75 | 0.50 |
| A- 6 | 50 <≤ 60 | 1.30 | 0.10 | 1.20 | 0.35 | 1.80 | 0.60 | 0.40 | 0.20 | 0.26 | 0.80 | 0.95 | 0.50 |

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| TIPO B | | | | | | | | | | | MURO FRONTAL | | |
| TIPO | PENDIENTE TERRENO % |  | J | I | D | Lmin | A | C | e | t | B | E | F |
| B- 1 | 5 < ≤ 10 | 0.35 | 0.10 | 0.15 | 0.40 | 2.30 | 0.60 | 0.40 | 0.20 | 0.20 | 0.40 | --- | 0.40 |
| B- 2 | 10 < ≤ 20 | 0.60 | 0.10 | 0.60 | 0.40 | 2.30 | 0.60 | 0.40 | 0.20 | 0.20 | 0.50 | 0.30 | 0.40 |
| B- 3 | 20 < ≤ 30 | 0.66 | 0.10 | 0.75 | 0.40 | 2.30 | 0.60 | 0.40 | 0.20 | 0.20 | 0.55 | 0.55 | 0.40 |
| B- 4 | 30 < ≤ 40 | 1.10 | 0.10 | 1.00 | 0.04 | 2.30 | 0.60 | 0.40 | 0.20 | 0.20 | 0.60 | 0.80 | 0.40 |
| B- 5 | 40 < ≤ 50 | 1.40 | 0.15 | 1.25 | 0.45 | 2.30 | 0.60 | 0.40 | 0.20 | 0.25 | 0.75 | 1.00 | 0.50 |
| B- 6 | 50 < ≤ 60 | 1.65 | 0.15 | 1.50 | 0.45 | 2.30 | 0.60 | 0.40 | 0.20 | 0.25 | 0.95 | 1.25 | 0.50 |

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| TIPO C | | | | | | | | | | | MURO FRONTAL | | |
| TIPO | PENDIENTE TERRENO % |  | J | I | D | Lmin | A | C | e | t | B | E | F |
| C- 1 | 5 < ≤ 10 | 0.45 | 0.13 | 0.30 | 0.50 | 2.80 | 0.50 | 0.40 | 0.20 | 0.20 | 0.40 | ---- | 0.40 |
| C- 2 | 10 < ≤ 20 | 0.75 | 0.13 | 0.60 | 0.50 | 2.80 | 0.50 | 0.40 | 0.20 | 0.20 | 0.55 | 0.40 | 0.40 |
| C- 3 | 20 < ≤ 30 | 1.05 | 0.15 | 0.90 | 0.50 | 2.80 | 0.50 | 0.40 | 0.20 | 0.20 | 0.65 | 0.70 | 0.40 |
| C- 4 | 30 < ≤ 40 | 1.35 | 0.15 | 1.02 | 0.50 | 2.80 | 0.50 | 0.40 | 0.20 | 0.25 | 0.80 | 0.95 | 0.50 |
| C- 5 | 40 < ≤ 50 | 1.65 | 0.15 | 1.50 | 0.50 | 2.80 | 0.50 | 0.40 | 0.20 | 0.25 | 0.95 | 1.25 | 0.50 |
| C- 6 | 50 < ≤ 60 | 2.05 | 0.15 | 1.90 | 0.50 | 2.97 | 0.50 | 0.40 | 0.20 | 0.30 | 1.10 | 1.60 | 0.50 |

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| TIPO D | | | | | | | | | | | MURO FRONTAL | | |
| TIPO | PENDIENTE TERRENO % |  | J | I | D | Lmin | A | C | e | t | B | E | F |
| D- 1 | 5 < ≤ 10 | 0.82 | 0.20 | 0.32 | 0.60 | 3.00 | 0.70 | 0.60 | 0.20 | 0.20 | 0.40 | ---- | 0.40 |
| D- 2 | 10 < ≤ 20 | 0.84 | 0.20 | 0.64 | 0.60 | 3.00 | 0.70 | 0.60 | 0.20 | 0.20 | 0.55 | 0.44 | 0.40 |
| D- 3 | 20 < ≤ 30 | 1.22 | 0.20 | 1.02 | 0.60 | 3.20 | 0.70 | 0.60 | 0.20 | 0.25 | 0.70 | 0.88 | 0.50 |
| D- 4 | 30 < ≤ 40 | 1.80 | 0.20 | 1.40 | 0.60 | 3.30 | 0.70 | 0.60 | 0.20 | 0.30 | 0.95 | 1.10 | 0.60 |
| D- 5 | 40 < ≤ 50 | 2.00 | 0.20 | 1.60 | 0.60 | 3.40 | 0.70 | 0.60 | 0.20 | 0.30 | 1.50 | 1.80 | 0.60 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TIPO E | | | | | | | | | | | MURO FRONTAL | | |
| TIPO | PENDIENTE TERRENO % |  | J | I | D | Lmin | A | C | e | t | B | E | F |
| E- 1 | 5 < ≤ 10 | 0.59 | 0.25 | 0.34 | 0.70 | 3.20 | 0.70 | 0.70 | 0.20 | 0.25 | 0.50 | ---- | 0.50 |
| E- 2 | 10 < ≤ 20 | 0.99 | 0.25 | 0.74 | 0.70 | 3.50 | 0.70 | 0.70 | 0.20 | 0.25 | 0.60 | 0.49 | 0.50 |
| E- 3 | 20 < ≤ 30 | 1.40 | 0.25 | 1.15 | 0.70 | 3.63 | 0.70 | 0.70 | 0.20 | 0.30 | 0.80 | 0.95 | 0.60 |
| E- 4 | 30 < ≤ 40 | 1.05 | 0.25 | 1.60 | 0.70 | 3.80 | 0.70 | 0.70 | 0.20 | 0.30 | 1.00 | 1.80 | 0.70 |