

CIEG 440

Culvert Flow

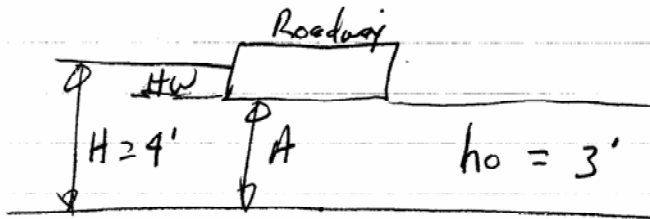
Inlet / Outlet Control Charts

$$Q = C_d A \sqrt{2gH}$$

$$C_d = 0.62 \text{ (square edge)}$$
$$= 1.00 \text{ (Round Edge)}$$

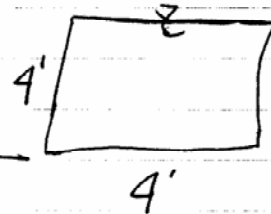
A = Area of culvert (sf)

H = Headwater



$$H_w = H - h_o$$

C_d	A	H _w	$\sqrt{2gH}$	Q
1.0	4x4=16	$\frac{4-3}{=1}$	$\sqrt{2(32.2)(1)} = 8$	128
1.0	16	2	$\sqrt{2(32.2)(2)} = 11.3$	181
1.0	16	3	$\sqrt{2(32.2)(3)} = 13.9$	222
1.0	16	4	$\sqrt{2(32.2)(4)} = 16$	256



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Weir Flow

$$Q = C L H^{3/2}$$

C = weir coefficient

C = ~~0.60~~ 0.60 (V-notch)

= 3.5 (rectangular)

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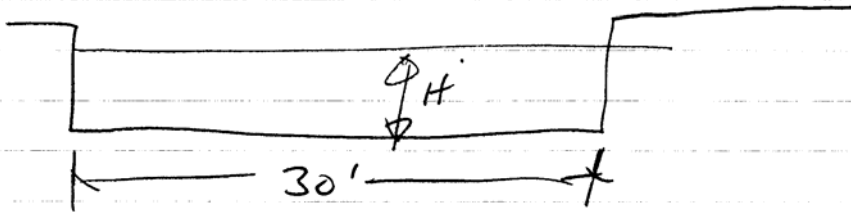
C = 3.2 - 4.1

L = weir Length (ft)

H = Height of water over crest of weir (ft)

Rating Curve

Q = 300 cfs, Find H



C	L	H	H ^{3/2}	Q = CLH ^{3/2}
3.5	30	0	0	0
3.5	30	0.5	0.35	36.75
3.5	30	1.0	1.0	105.00
3.5	30	1.5	1.84	193.2
3.5	30	2.0	2.80	294.0
3.6	30	2.5	3.95	414.75
3.6	30	3.0	5.2	546.0

$$Q = c_d A \sqrt{2gH_w}$$

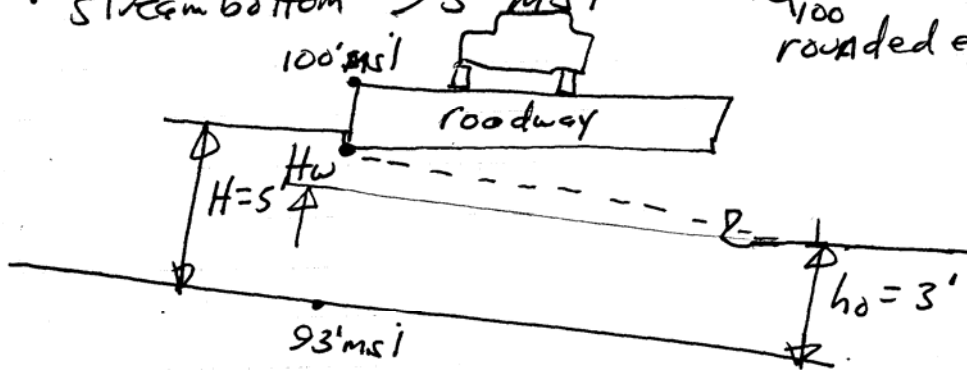
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Ex. 1

Size a roadway culvert for:

- Headwater (H) = 5'
- Backwater, tailwater $h_o = 3'$
- 1 foot of freeboard between above roof of culvert
- roadway elev. 100' msl
- stream bottom 93' msl

$Q = 500 \text{ cfs}$
 Q_{100}
 rounded edge.



c_d	A_{eff} (ft ²)	H_w	$\sqrt{2gH_w}$	Q (cfs)
1.0	4x4=16 R x W	5-3=2	$\sqrt{2g(2)} = 11.3$	180.8
1.0	4x6=24	5-3=2	11.3	271
1.0	4x8=32	2	11.3	363
1.0	5x10=50	2	11.3	<u>565 cfs</u> OK

Use 5' R x 10' W
 box culvert.