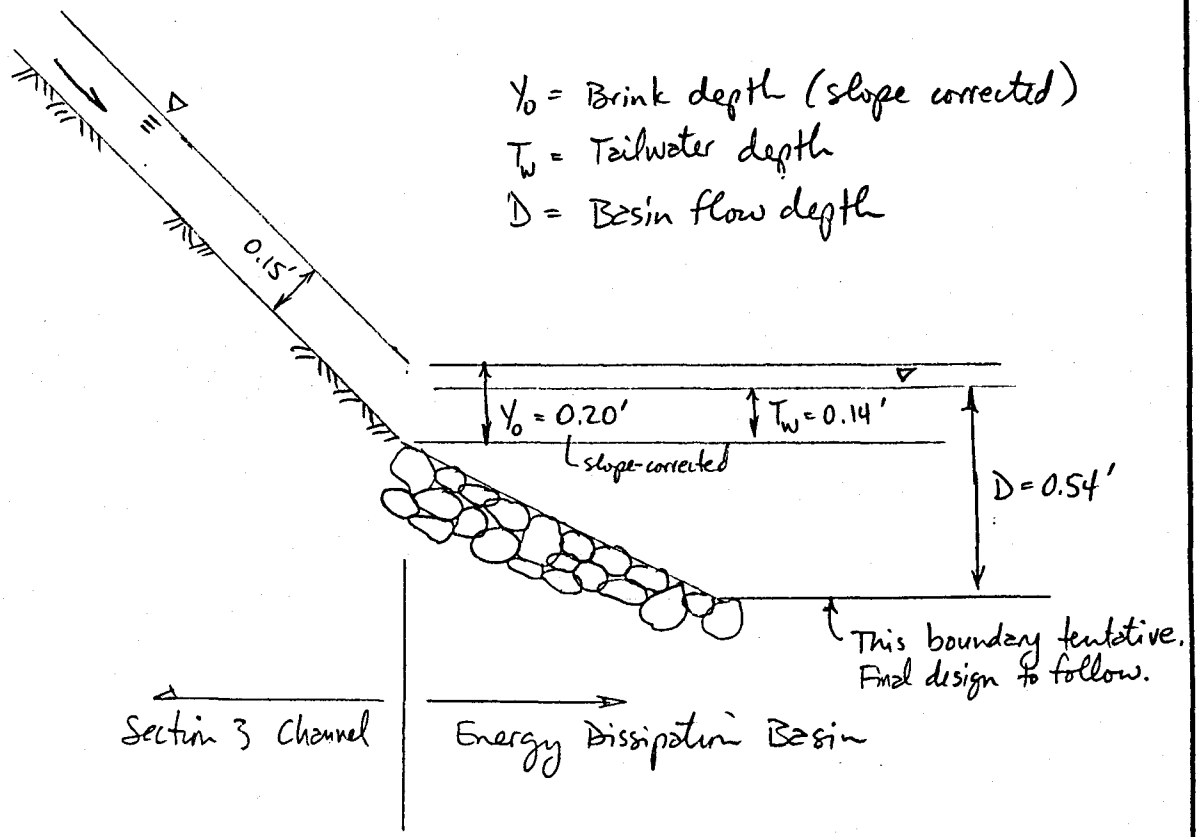
Design of Energy Dissipation Basin at Downstream Edge of Section 3 Channel (where rock face meets pad) – use the design procedure of Corry et al. (1975):
↳ HEC-14

Depth of flow in basin – Assume 1% slope on basin floor
4 ft bottom width
2:1 sideslopes

TRAP1 results:

Bed Slope =	.01	
Manning's N =	.035	
Bottom Width =	4	feet
Channel Side Slope =	.5	
Flow Depth =	.5392388	feet
Cross Sectional Area =	2.738512	square feet
Wetted Perimeter =	6.41155	feet
Hydraulic Radius =	.4271218	feet
Discharge =	6.62	cubic feet/sec
Velocity =	2.417371	feet/sec
Froude Number =	.5801293	

General schematic:



$$\frac{T_W}{Y_0} = \frac{0.14}{0.20} = 0.70 < 0.75 \quad \underline{\underline{OK}}$$

Determine riprap sizing for basin — see pg 27s4 of this calc:

Select d_{50} such that $0.25 < \frac{d_{50}}{Y_e} < 0.45$

AND

$$2 < \frac{h_s}{d_{50}} < 4$$

Y_e = equivalent depth = $(A/2)^{1/2}$ where A is for Section 3 channel

$$= \frac{(2.74/2)^{1/2}}{\sin 47.5^\circ}$$

$= 1.59$ ft

To meet the design criteria ($0.25 < d_{50}/Y_e < 0.45$), select $d_{50}/Y_e = 0.35 \Rightarrow d_{50} = (0.35)(1.59') = 0.56$ ft (min)

However, the Division has requested the use of $d_{50} = 1.25$ ft (see pg 27s7). Thus, this size will be used. Filter blanket calculations included on page 27s8 of this calc.

From pg 2 1s4 $\rightarrow \frac{h_s}{Y_e} = 0.90 \Rightarrow h_s = (0.90)(1.59)$
$= 1.43$ ft (scour hole depth)

$$\frac{h_s}{d_{50}} = \frac{1.43}{0.70} = 2.04 \Rightarrow \underline{\underline{OK}}$$

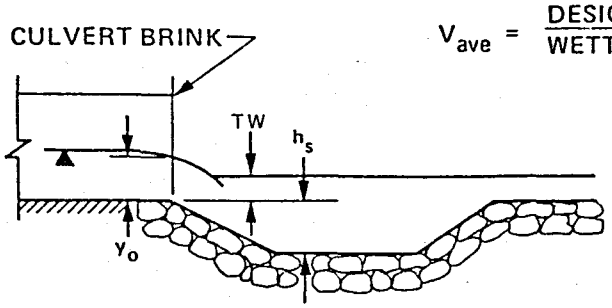
Basin length = $10 h_s = 14.3$ ft $\Rightarrow$ use 15 ft

Apron length = $5 h_s = 7.15$ ft $\Rightarrow$ use 7.5 ft

Freeboard = 1.0 ft

Total basin depth = $h_s + Y_o + 1.0$
$= 1.43 + 0.20 + 1.00$
$= 2.63$ ft $\Rightarrow$ Construct with depth = $\underline{\underline{2.75 \text{ ft}}}$

Design sections $\rightarrow$ see pg 27s5 and 27s6 of this calc.



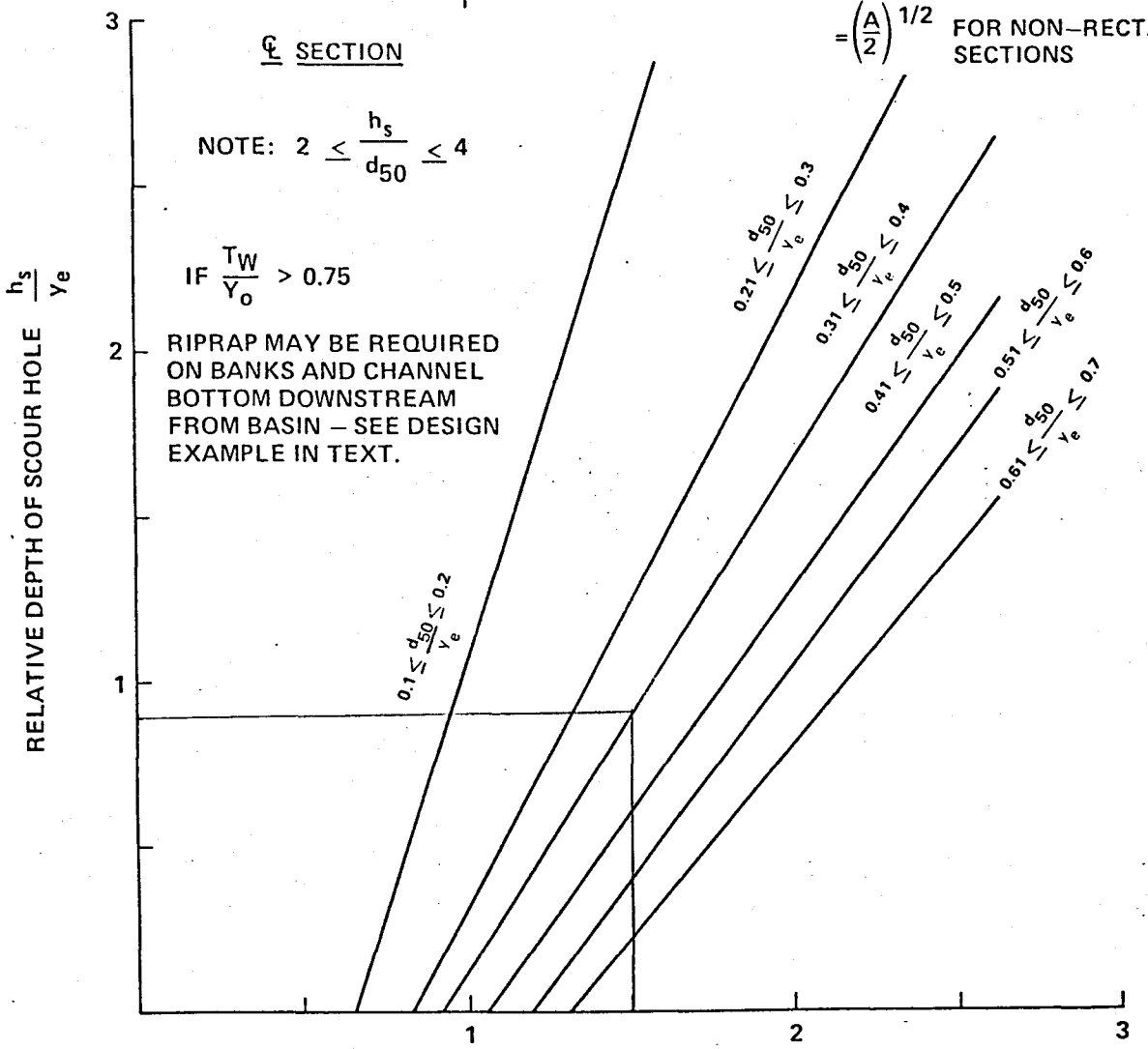
$$V_{ave} = \frac{\text{DESIGN DISCHARGE} - Q}{\text{WETTED AREA AT BRINK OF CULVERT}}$$

d_{50} = THE MEDIAN SIZE OF ROCK BY WEIGHT. ROUNDED ROCK OR ANGULAR ROCK.

Y_e = EQUIVALENT BRINK DEPTH

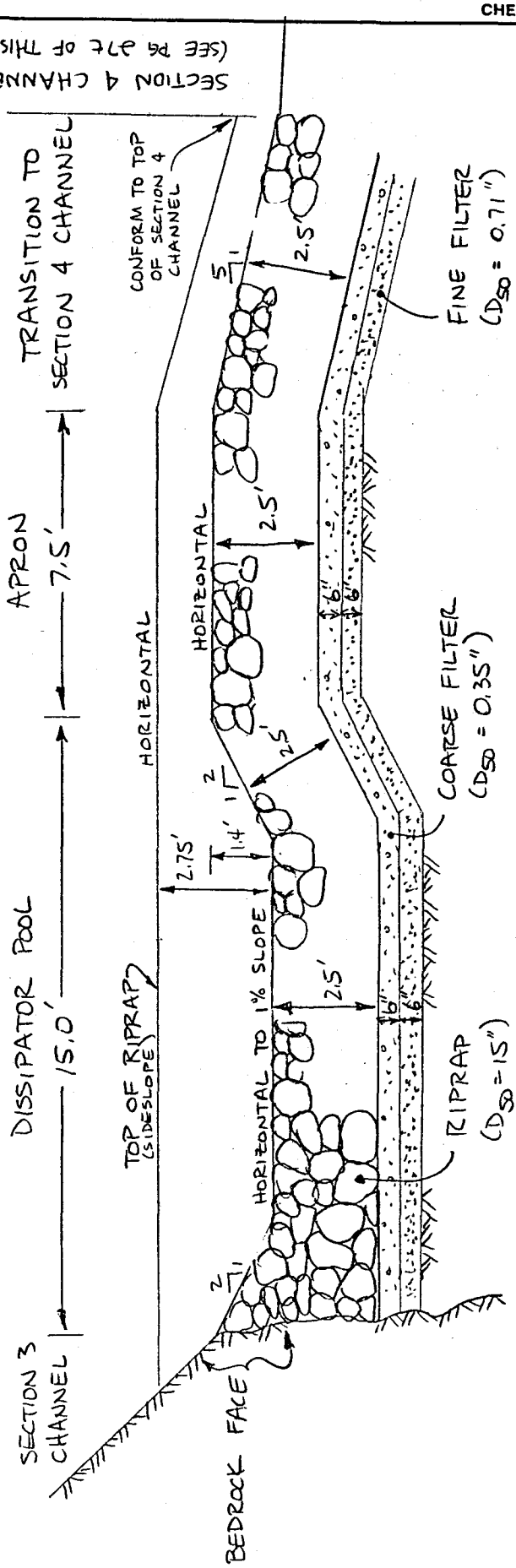
= BRINK DEPTH FOR BOX CULVERT

$= \left(\frac{A}{2}\right)^{1/2}$ FOR NON-RECTANGULAR SECTIONS



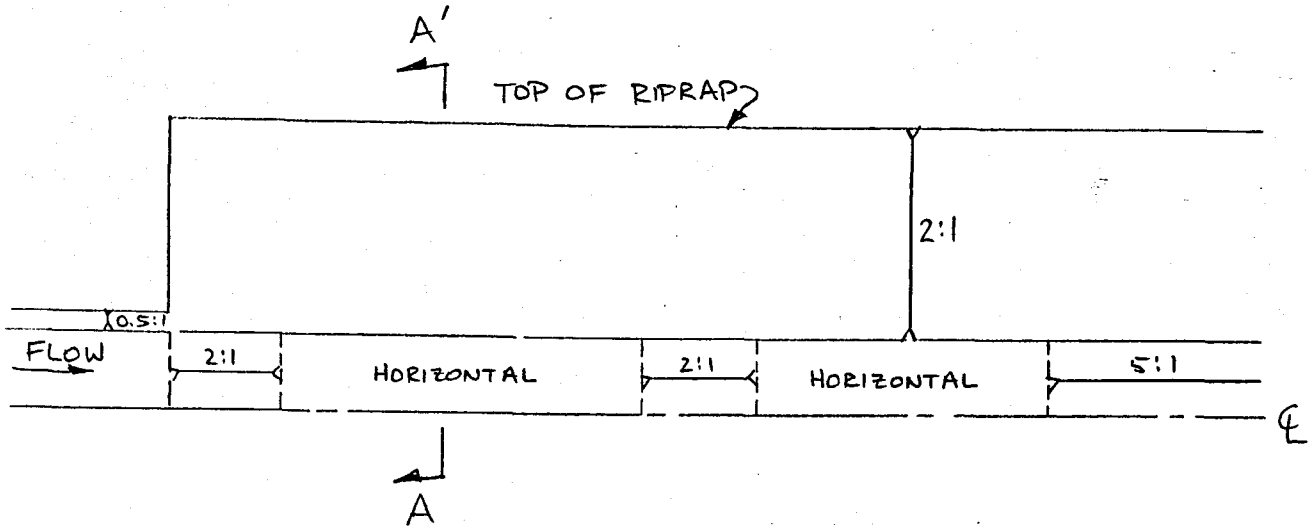
$$\text{FROUDE NUMBER} = \frac{V_{ave}}{\sqrt{(32.2)(Y_e)}} = \frac{10.7}{\sqrt{(32.2)(1.59)}} = 1.50$$ for Section 3 channel

Source: Corry et al. (1975) (HEC-14)

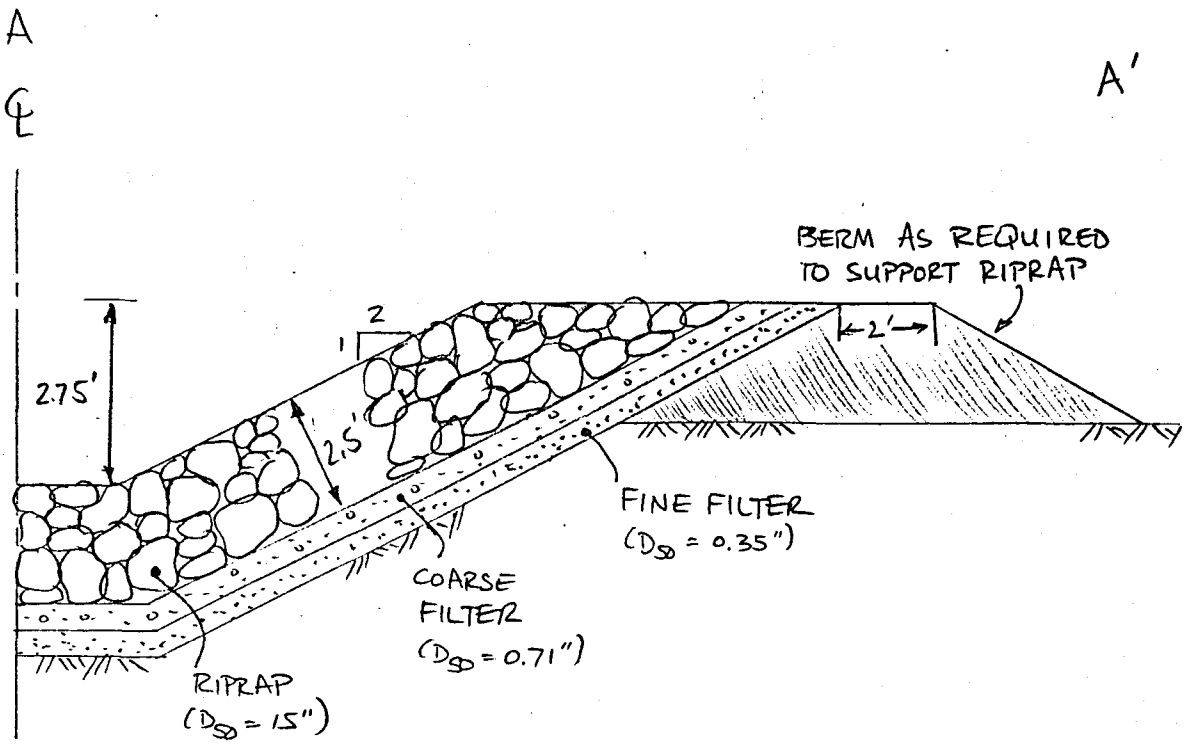


ENERGY DISSIPATION BASIN
CENTER LINE SECTION

SCALE: 1" = 4'

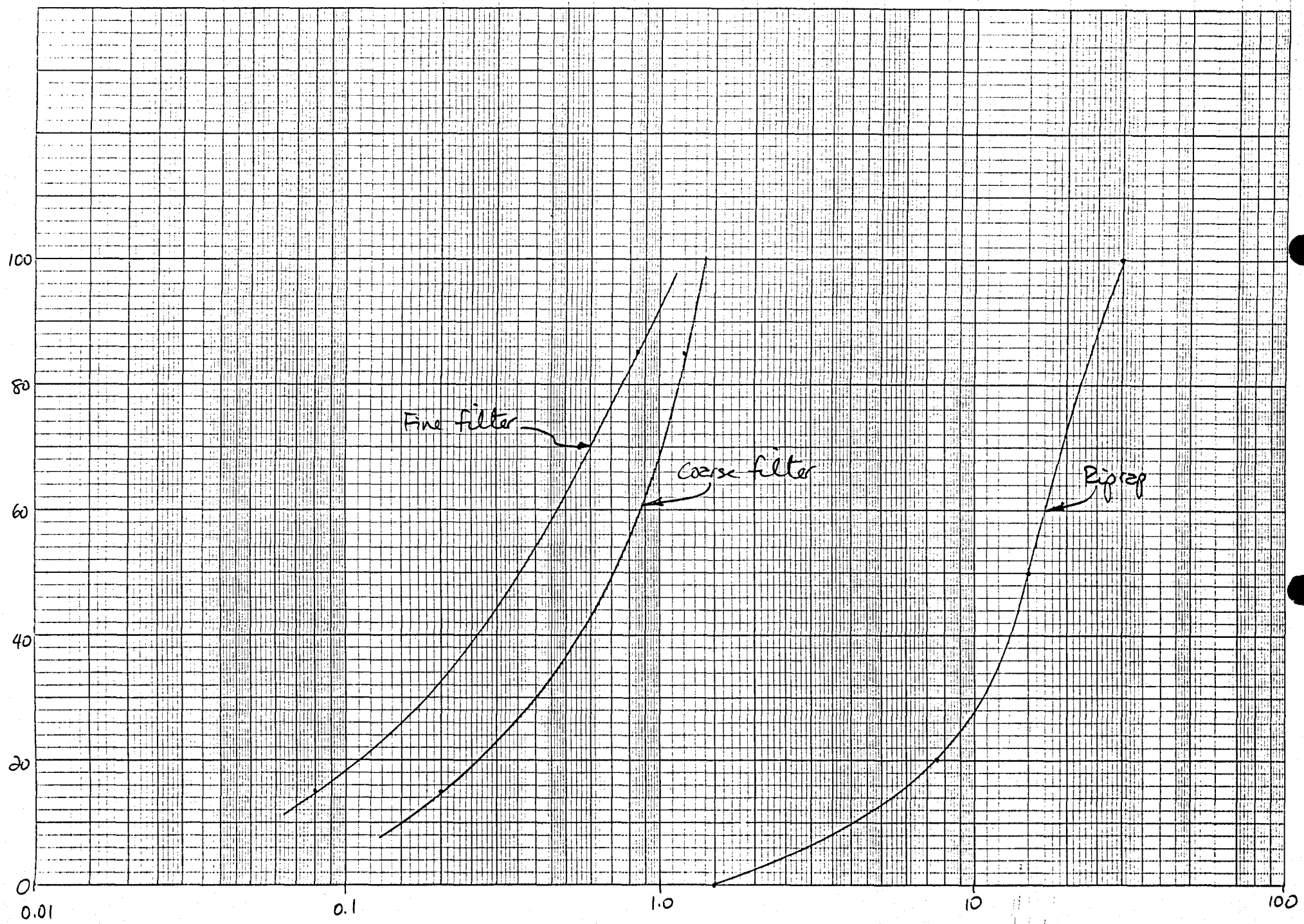


ENERGY DISSIPATION BASIN
HALF PLAN
SCALE: 1" = 50'



ENERGY DISSIPATION BASIN
SECTION A-A'
SCALE: 1" = 4'

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6010



Check filter blanket design using the RD-2 blanket (see pg. 27l of this calc.):

$$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (filter)}} = \frac{5.7\text{ in}}{0.85\text{ in}} = 6.7 > 5.0$$

$$\frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (filter)}} = \frac{5.7\text{ in}}{0.08\text{ in}} = 71.2 > 40$$

Unacceptable

New filter blanket design (see pg. 27s7 of this calc.):

$$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (filter)}} = \frac{5.7\text{ in}}{1.2\text{ in}} = 4.8 < 5.0 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (filter)}} = \frac{5.7\text{ in}}{0.2\text{ in}} = 28.5 < 40 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\text{ (filter)}}{D_{85}\text{ (bed)}} = \frac{0.2\text{ in}}{0.94\text{ in}} = 0.2 < 5.0 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\text{ (filter)}}{D_{15}\text{ (bed)}} = \frac{0.2\text{ in}}{0.0021\text{ in}} = 95.2 > 40 \quad \underline{\underline{\text{Unacceptable}}}$$

Include two filter blankets (the coarse blanket above and the RD-2 blanket). Check design between the two:

$$\frac{D_{15}\text{ (coarse)}}{D_{85}\text{ (fine)}} = \frac{0.2\text{ in}}{0.85\text{ in}} = 0.24 < 5.0 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\text{ (coarse)}}{D_{15}\text{ (fine)}} = \frac{0.2\text{ in}}{0.08\text{ in}} = 2.5 < 40 \quad \underline{\underline{OK}}$$