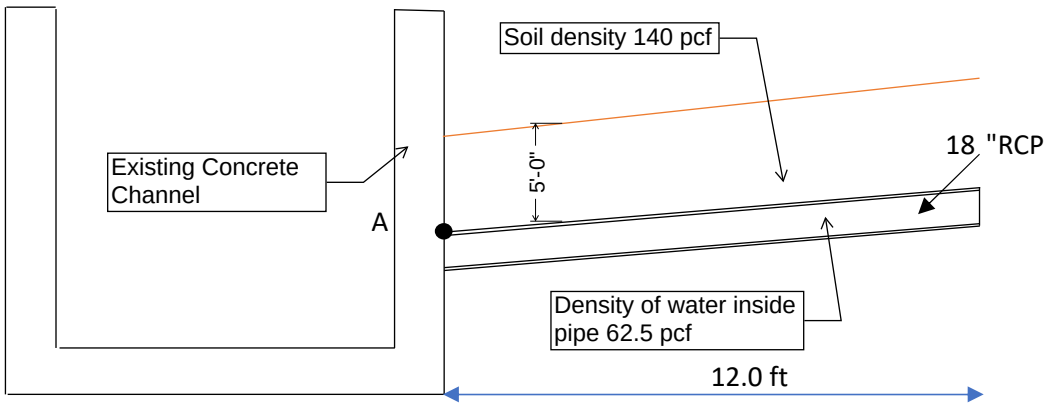
THE REINFORCED CONCRETE COLLAR ANALYSIS



A. Design Critia

1/ Code References

a - EM 1110-2-2014
b - EM 1110-2-2100
c - EM 1110-2-2007
e - EM 1110-2-2502
d - EM 1110-2-2902
f - Concrete Pipe Design Manual, American Concrete Pipe Association
g - Design Data , Highway Live load on Concrete Pipe, American Concrete Pipe Association

2/ Loading

For 18 inch RCP(D-Load 2500) located at 5ft from the finished grade

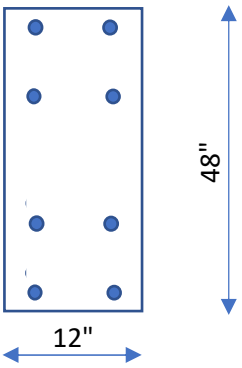
Pipe outter diameter	D_i =	1.5	ft	
Pipe outter diameter	D =	2	ft	
Pipe Length	L =	12	ft	
Soil height above pipe	h =	5	ft	
Soil density	g =	140	pcf	
Pipe self weight	w_p =	168	lb/ft	
soil above pipe	w_s =	1400	lb/ft	
Full water in pipe	w_w =	110	lb/ft	
Load combination				
Load factor	LF =	2.2		(3-2, EM-1100-2-2014)
U= LF*(Lp + Ltu + Ldu)	U =	3692	lb/ft	

U = 2.2*(168 + 1400 + 110)

B. Shear and Moment

Moment at collar	M =	266	k-ft
Shear at collar	V =	44	kips

C. Analysis of collar connection



β_1 =	0.85	
f'$_c$ =	4	ksi
f_y =	60	ksi
E_s =	29000	ksi
d =	12	in
b =	48	in
A_s =	1.24	in2

a. Steel ratio

ρ_{act} = As/(b*d) ρ_{act} = 0.00215

pb = 0.85*b1*f'c/fy ρ_b = 0.02851

ρ_{act} =0.0021 < 0.25 * ρ_b =0.0071

=> The detailed analysises of the serviceability limit states are not required

b. Compute the flexural capacity

rebar cover c = 2

ϕ = 0.85

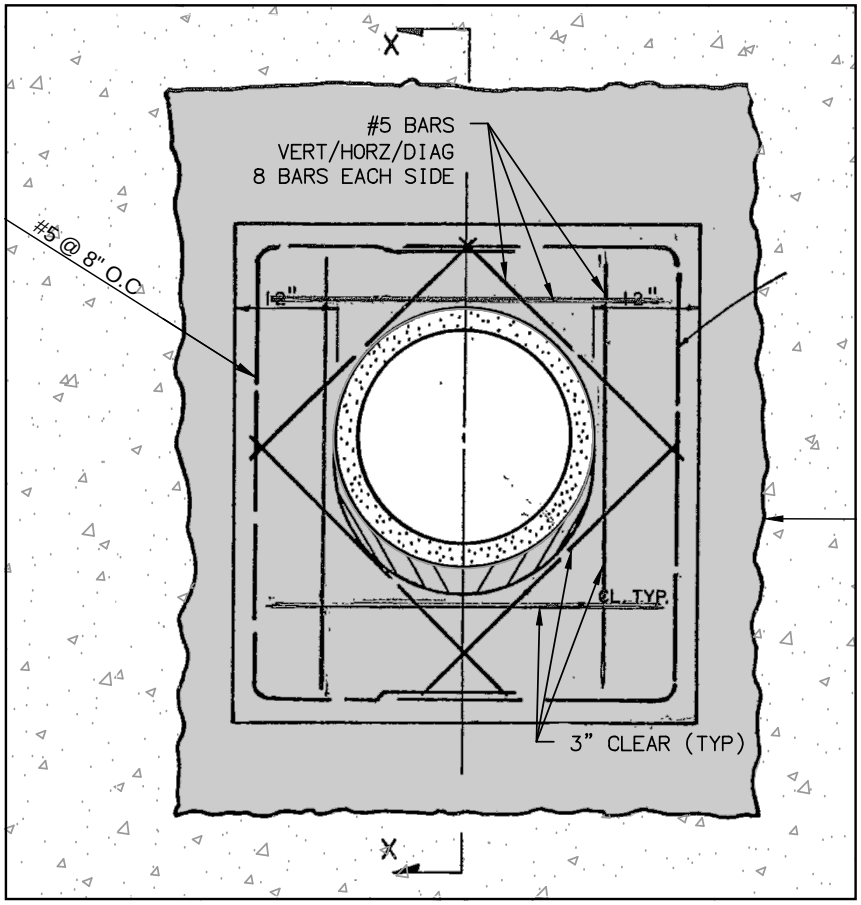
a = 0.455882353 in.

$\phi M_n = f * A_s * f_y(d - a/2)$ ϕM_n = 617.99 k-ft > 266 **:OK**

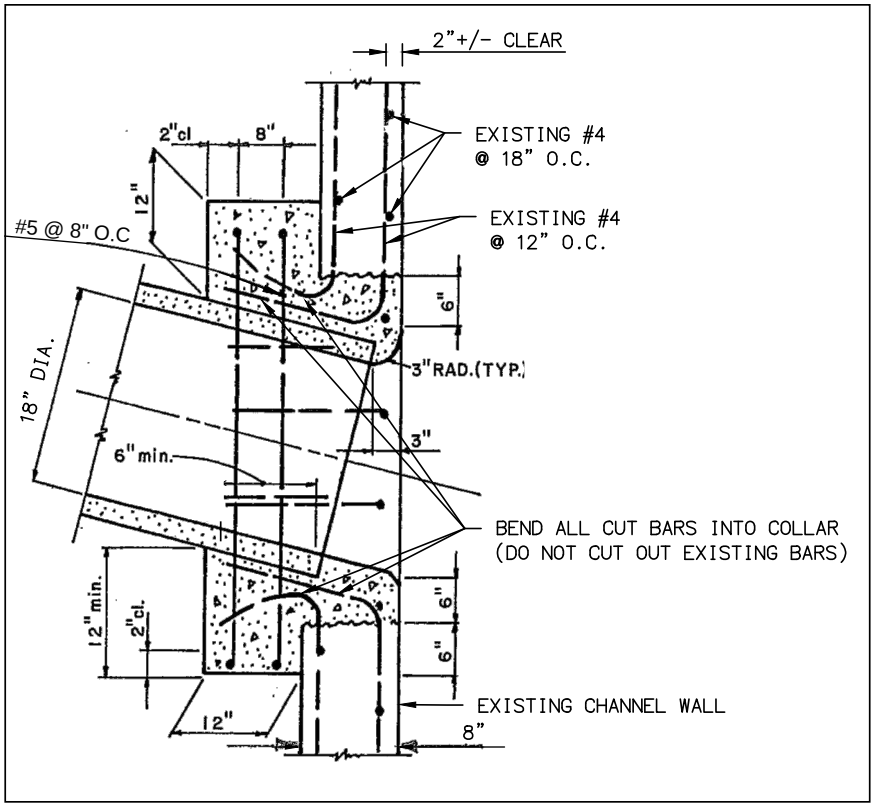
c. Check Shear

$V_c = 2\sqrt{(f'c)}*b*d$ ϕV_C = 1728 kips > 44 **:OK**

ϕ = 0.85



ELEVATION



SECTION X-X

D-Load Calculations For The Proposed 18-in RCP Side Drain.

DESCRIPTION

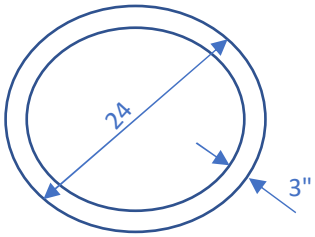
D-Load calculation were per formed for a 18" RCP being punched through the existing retaining wall

FIGURES

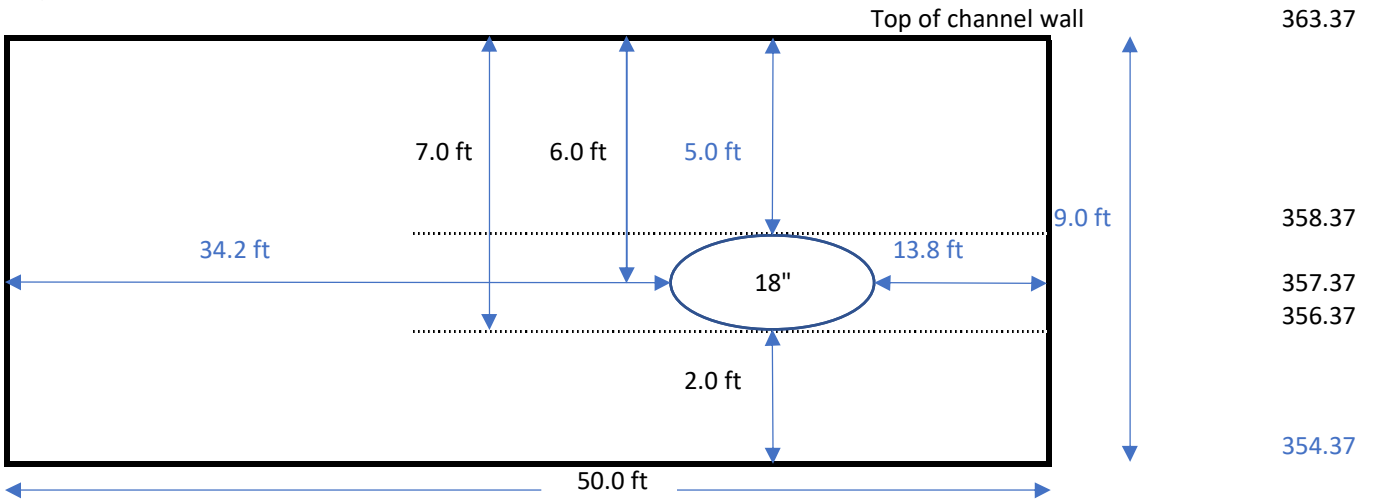
All measurements in feet unless specified otherwise

Actual pipe dimensions

(considering 11.7% vertical slope noted on HDR plans CD00006)



Top channel wall section



D-LOAD

Pipe properties

Internal pipe diameter	D_i =	1.5 ft	
pipe thickness	t =	0.25 ft	
soil unit weightt	Y_s =	140 pcf	
Height of fill above conduit	H =	5 ft	
Factor of safety	FS =	1.25	(Storm drains)

Loads

Soil friction coefficient	K_u '=	0.15	(for trench condition)
Trench width	B_d =	4 ft	
Trench coefficient	C_d =	1.04	

$$C_d = \frac{1 - e^{-2K_u' \frac{H}{B_d}}}{2K_u'}$$

(base width of pipe +12" on each side per Flood Control District plans)

Earth load	W_e =	2334.91

$$W_e = C_d \gamma B_d^2$$

Live load	W_l =	0
Total vertical load	W =	2334.91
Load factor		
Load factor for trench condition (case 3 bedding installation)	L.F. =	2.7

D-Load

$$D - load = \frac{W\ x\ S.F.}{D_i\ x\ L.F.}$$ D-Load = 720.65

Rounding factor

For pipes 36" and less in diameter, round the calculated D-Load value to the next highest 250

$D\text{-}Load_{0.01}$ = **750** lb