QC VDK 4/12/23

$Footing_{width} := 6 \cdot ft$

$Footing_{length} := 8 \cdot ft$ Z direction

$Column\_Dia := 36 \cdot in$

$Soil\_Depth\_Above\_Foot := 5 \cdot ft$ Be conservative on soil depth as this is helping us

$\gamma_{soil} := 120 \cdot pcf$

There are two ways to do this.
Enter in the Vertical soil load as
1) a distributed load in the longitudinal (z) direction
2) one concentrated force on the column in the DL.as DL and EV are in every case and have approximatley the same

Unfortunately and stupidly there is no way to enter in a pressure load at the top of the footing. I think i have done both depnding on what i needed.

I think here we can input the soil at one magnitude outside the column, and one magintuide (within) the column

$EV\_End := Footing_{width} \cdot Soil\_Depth\_Above\_Foot \cdot \gamma_{soil} = 3.6 \cdot klf$

$EV\_Middle := \left(Footing_{width} - Column\_Dia\right) \cdot Soil\_Depth\_Above\_Foot \cdot \gamma_{soil} = 1.8 \cdot klf$

$EV\_End = 3.6 \cdot klf$ $Z1\_L_1 := 0$ $Z2\_L_1 := \dfrac{0.5 \cdot \left(Footing_{length} - Column\_Dia\right)}{Footing_{length}} = 0.313$

$EV\_Middle = 1.8 \cdot klf$ $Z1\_L_2 := Z2\_L_1 = 0.313$ $Z2\_L_2 := 1 - Z1\_L_2 = 0.688$

$EV\_End = 3.6 \cdot klf$ $Z1\_L_3 := Z2\_L_2 = 0.688$ $Z2\_L_3 := 1.0$

How much it will reduce uplift by

$EV\_End \cdot \left(2 \cdot Z2\_L_1\right) \cdot Footing_{length} = 18 \cdot kip$

$EV\_Middle \cdot \left(Z2\_L_2 - Z1\_L_2\right) \cdot Footing_{length} = 5.4 \cdot kip$

$Total\_Force := EV\_End \cdot \left(2 \cdot Z2\_L_1\right) \cdot Footing_{length} \ldots + EV\_Middle \cdot \left(Z2\_L_2 - Z1\_L_2\right) \cdot Footing_{length} = 23.4 \cdot kip$

$Pressure := Total\_Force \div \left(Footing_{width} \cdot Footing_{length}\right) = 0.488 \cdot ksf$

LEFT PIER CAP

$Neg\_Press\_L := -1.39 \cdot klf$ greatest service negative value @ corners 3 and 4

$Pos\_Press\_L := 7.65 \cdot klf$ least service positive value @ corners 1 and 2

$Inflection\_Point := \left| Footing_{length} \cdot \frac{Neg\_Press\_L}{(Pos\_Press\_L - Neg\_Press\_L)} \right| = 1.23 \cdot ft$

$Centorid\_Dist\_Past\_Inflection := \frac{2}{3} \cdot \left(Footing_{length} - Inflection\_Point\right) = 4.513 \cdot ft$

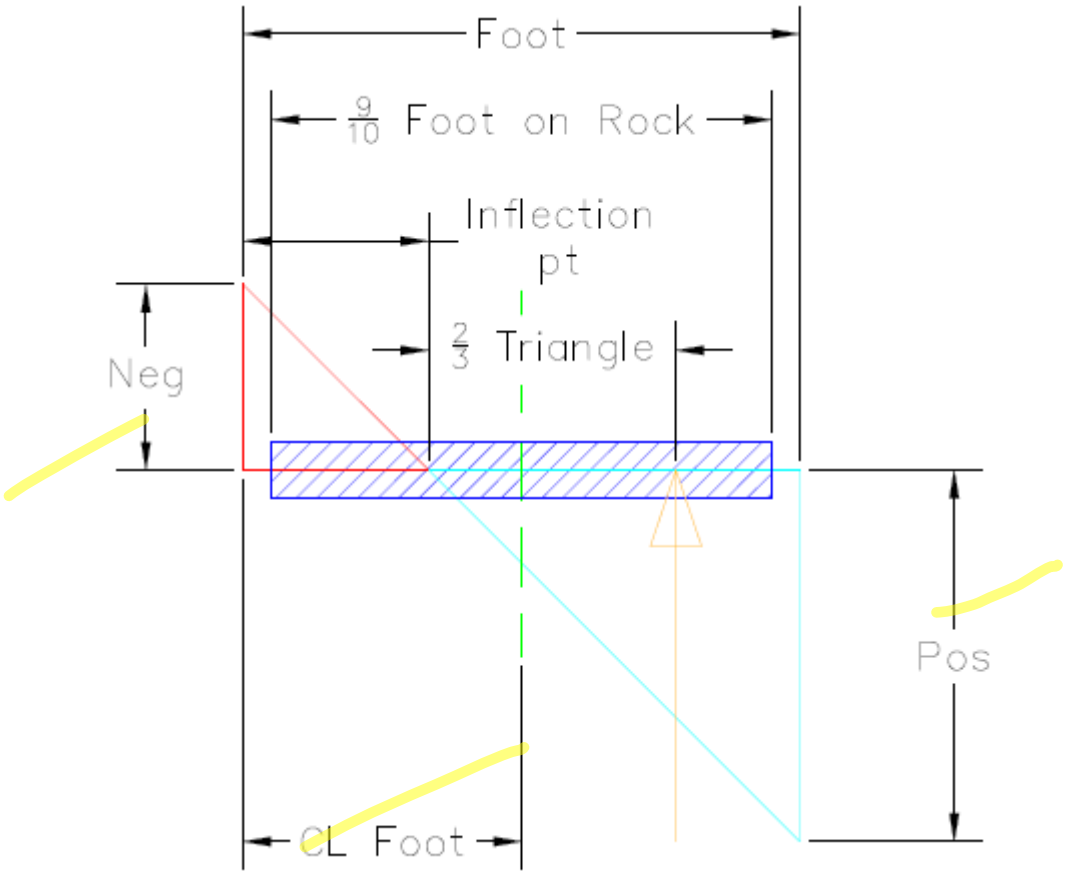
AASHTO 11.6.3.3
For Foundation on rock, the location of the resultant reaction forces shall be with the middle 9/10th of base

$Ecc\_Limit_1 := 0.05 \cdot Footing_{length} = 0.400 \cdot ft$ $Ecc\_Limit_2 := 0.95 \cdot Footing_{length} = 7.600 \cdot ft$

Eccent limit is based on distance from edge of footing

$Centorid\_Location := Inflection\_Point + Centorid\_Dist\_Past\_Inflection = 5.743 \cdot ft$

$Eccen\_Check := if\left(Ecc\_Limit_1 \le Centorid\_Location \le Ecc\_Limit_2, "Okay", "No\ Good"\right) = "Okay"$


Foot
9/10 Foot on Rock
Inflection pt
2/3 Triangle
Neg
Pos
CL Foot

11.6.3.3—Eccentricity Limits

For foundations on soil, the location of the resultant of the reaction forces shall be within the middle two-thirds of the base width.

For foundations on rock, the location of the resultant of the reaction forces shall be within the middle nine-tenths of the base width.

11.6.3—Bearing Resistance and Stability at the Strength Limit State

RIGHT PIER CAP

-1.61

$Neg\_Press\_R := -.75 \cdot klf$ greatest service negative value @ corners 1 and 2

$Pos\_Press\_R := 6.98 \cdot klf$ 6.11 least service positive value @ corners 3 and 4

$$Inflection\_Point := \left| Footing_{length} \cdot \frac{Neg\_Press\_R}{(Pos\_Press\_R - Neg\_Press\_R)} \right| = 0.776 \cdot ft$$

$$Centorid\_Dist\_Past\_Inflection := \frac{2}{3} \cdot \left(Footing_{length} - Inflection\_Point \right) = 4.816 \cdot ft$$

AASHTO 11.6.3.3
For Foundation on rock, the location of the resultant reaction forces shall be with the middle 9/10th of base

$Ecc\_Limit_1 := 0.05 \cdot Footing_{length} = 0.400 \cdot ft$ $Ecc\_Limit_2 := 0.95 \cdot Footing_{length} = 7.600 \cdot ft$

Eccent limit is based on distance from edge of footing

$$Centorid\_Location := Inflection\_Point + Centorid\_Dist\_Past\_Inflection = 5.592 \cdot ft$$

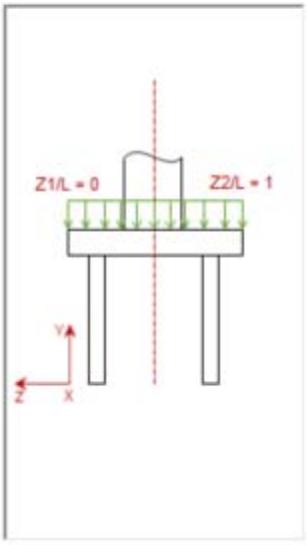
$$Eccen\_Check := if\left(Ecc\_Limit_1 \le Centorid\_Location \le Ecc\_Limit_2, "Okay", "No Good" \right) = "Okay"$$

remove pages after this

LL19

Loads: Load data

Footing



Vertical soil pressure

	Foot Nr	Load Type	Dir	Mag1	Z1/L	Mag2
▸	1	UDL	Y	-3.6000	0.0000	-3.6000
	1	UDL	Y	-1.8000	0.3130	-1.8000
	1	UDL	Y	-3.6000	0.6880	-3.6000

Passive Resistance

$Resist\_Ht := Soil\_Depth - 2 \cdot ft = \blacksquare \cdot in$

$k_p := 6.5$ *From AASHTO Figure 3.11.5.4.1 -*
δ =0° as wall is not sloped, so no reduction needs to be made. Θ = 90°

$R\_k_p := 0.467$

$soil\_cohesion := 0$ *conservatively assume 0*

$p_p := k_p \cdot \gamma_{soil} + 2 \cdot soil\_cohesion \cdot \sqrt{k_p} = 0.78 \cdot \frac{kip}{ft^3}$

$Col\_Dia := 3 \cdot ft$

$Pass\_Force := \frac{1}{2} \cdot p_p \cdot Resist\_Ht^2 \cdot \left(\frac{1}{2} \cdot \pi \, Col\_Dia \right) = \blacksquare \cdot kip$

$Pass\_Mom := \frac{1}{2} \cdot Resist\_Ht \cdot Pass\_Force = \blacksquare \cdot kip \cdot ft$

Z2/L	Units
0.3130	klf
0.6880	klf
1.0000	klf