Variable

$\phi := 38°$

$\Delta := 1\,ft$

$\gamma_w := 62.4\,pcf$

$\gamma_m := 120\,pcf$

$\gamma_s := 130\,pcf$

$\gamma_{concrete} := 150\,pcf$

$H_w := 4\,ft$

$H_m := 12\,ft$

$H_s := 4\,ft$

$H_{slab} := 5\,ft$

$B_w := 15\,ft$

$a_m := 10.9412\,ft \quad b_m := 10.2353\,ft$

$a_s := 10.2353\,ft \quad b_s := 10\,ft$

$B_{slab} := 30\,ft$

$a_{wall} := 5\,ft \quad b_{wall} := 4\,ft$

$A_w := H_w \cdot B_w = 60\,ft^2$

$A_m := \frac{1}{2} \cdot H_m \cdot (a_m + b_m) = 127.059\,ft^2$

$A_s := \frac{1}{2} \cdot H_s \cdot (a_s + b_s) = 40.471\,ft^2$

$A_{slab} := H_{slab} \cdot B_{slab} = 150\,ft^2$

$A_{wall} := 76.5\,ft^2$

Loads

$k := 1 - \sin(\phi) = 0.384$

$$P_w := \Delta \cdot \gamma_w \cdot \frac{H_w^{\,2}}{2} = 499.2\ \text{lbf}$$

$$P_m := \Delta \cdot k \cdot \gamma_m \cdot \frac{H_m^{\,2}}{2} = 3.321 \times 10^3\ \text{lbf}$$

$$P_b := \Delta \cdot k \cdot \left(\gamma_s - \gamma_w\right) \cdot \frac{H_s^{\,2}}{2} = 207.85\ \text{lbf}$$

$$P_{ws} := \Delta \cdot \gamma_w \cdot \frac{H_s^{\,2}}{2} = 499.2\ \text{lbf}$$

$$P_s := \Delta \cdot \gamma_m \cdot H_m \cdot k \cdot H_s = 2.214 \times 10^3\ \text{lbf}$$

$$W_w := \Delta \cdot A_w \cdot \gamma_w = 3.744 \times 10^3\ \text{lbf}$$

$$W_m := \Delta \cdot A_m \cdot \gamma_m = 1.525 \times 10^4\ \text{lbf}$$

$$W_s := \Delta \cdot A_s \cdot \gamma_s = 5.261 \times 10^3\ \text{lbf}$$

$$W_{slab} := \Delta \cdot A_{slab} \cdot \gamma_{concrete} = 2.25 \times 10^4\ \text{lbf}$$

$$W_{wall} := \Delta \cdot A_{wall} \cdot \gamma_{concrete} = 1.148 \times 10^4\ \text{lbf}$$

Centroids - Distance to toe

$$D_{slab} := B_{slab} \cdot \frac{1}{2} = 15\ \text{ft}$$

$$D_{wall} := 15\text{ft} + \frac{\left(a_{wall}^{\,2} + a_{wall} \cdot b_{wall} + b_{wall}^{\,2}\right)}{3\left(a_{wall} + b_{wall}\right)} = 17.259\ \text{ft}$$

$$D_m := B_{slab} - \frac{\left(a_m^{\,2} + a_m \cdot b_m + b_m^{\,2}\right)}{3\left(a_m + b_m\right)} = 24.704\ \text{ft}$$

$$D_w := B_w \cdot \frac{1}{2} = 7.5\ \text{ft}$$

$$D_s := B_{slab} - \frac{\left(a_s^{\,2} + a_s \cdot b_s + b_s^{\,2}\right)}{3\left(a_s + b_s\right)} = 24.941\ \text{ft}$$

$$V_w := H_{slab} + H_w \cdot \frac{1}{3} = 6.333\ \text{ft}$$

$V_m := H_{slab} + H_s + H_m \cdot \frac{1}{3} = 13\,\text{ft}$

$V_b := H_{slab} + H_s \cdot \frac{1}{3} = 6.333\,\text{ft}$

$V_{ws} := H_{slab} + H_s \cdot \frac{1}{3} = 6.333\,\text{ft}$

$V_s := H_s \cdot \frac{1}{2} = 2\,\text{ft}$

Moments

$M_w := P_w \cdot V_w = 3.162 \times 10^3\,\text{lbf}\cdot\text{ft}$

$M_m := P_m \cdot V_m = 4.317 \times 10^4\,\text{lbf}\cdot\text{ft}$

$M_b := P_b \cdot V_b = 1.316 \times 10^3\,\text{lbf}\cdot\text{ft}$

$M_{ws} := P_{ws} \cdot V_{ws} = 3.162 \times 10^3\,\text{lbf}\cdot\text{ft}$

$M_s := P_s \cdot V_s = 4.428 \times 10^3\,\text{lbf}\cdot\text{ft}$

$M_{slab} := W_{slab} \cdot D_{slab} = 3.375 \times 10^5\,\text{lbf}\cdot\text{ft}$

$M_{wall} := W_{wall} \cdot D_{wall} = 1.98 \times 10^5\,\text{lbf}\cdot\text{ft}$

$M_{wv} := W_w \cdot D_w = 2.808 \times 10^4\,\text{lbf}\cdot\text{ft}$

$M_{mv} := W_m \cdot D_m = 3.767 \times 10^5\,\text{lbf}\cdot\text{ft}$

$M_{sv} := W_s \cdot D_s = 1.312 \times 10^5\,\text{lbf}\cdot\text{ft}$

Summations

$H_\beta := P_m + P_b + P_{ws} + P_s - P_w = 5.742 \times 10^3\,\text{lbf}$

$V_\alpha := \frac{\left(M_m + M_b + M_{ws} + M_s - M_w - M_{slab} - M_{wall} - M_{wv} - M_{mv} - M_{sv}\right)}{\theta \qquad B_{slab}} = -3.409 \times 10^4\,\text{lbf}$

$V_\beta := V_\alpha - W_w - W_m - W_s - W_{slab} - W_{wall} = -9.231 \times 10^4\,\text{lbf}$

friction angle? of both soils

depth into page

specific gravity of water

specific gravity of moist soil

specific gravity of saturated soil

specific gravity of reinforced concrete

thickness of the water level on inner face of retaining wall

thickness of the moist soil layer

thickness of the saturated soil layer

thickness of the concrete slab/foundation

width of water layer on inner face of retaining wall

top and bottom width of the moist soil layer

top and bottom width of the saturated soil layer

width of the concrete slab/foundation

top and bottom width of the concrete wall

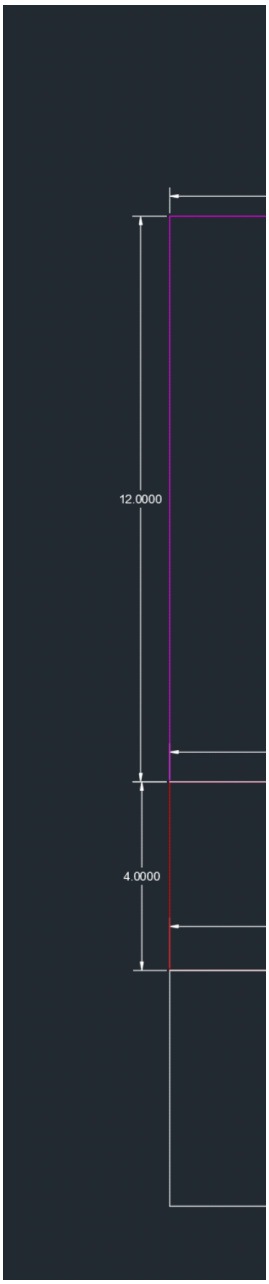
area of the water layer on inner face of retaining wall

area of the moist soil layer

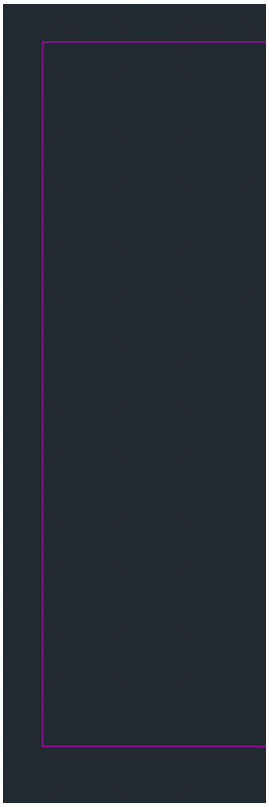
area of the saturated soil layer

area of the concrete slab/foundation

area of the concrete wall



friction coefficient



horizontal load from water on inner face of retaining wall

horizontal load from moist soil

horizontal load from buoyant soil in saturated soil

horizontal load from ground water in saturated soil

horizontal load from surcharge, moist on top of sat.

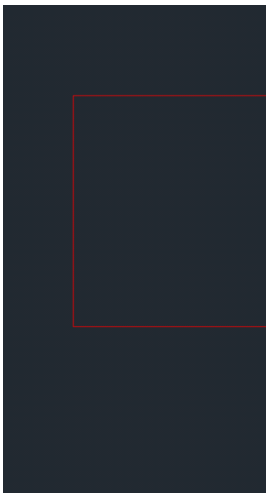
vertical load from water on inner face of retaining wall

vertical load from moist soil

vertical load from saturated soil

vertical load from concrete slab/foundaiton

vertical load from concrete wall



horizontal distance to toe from centroid of concrete slab/foundation

horizontal distance to toe from centroid of concrete wall

horizontal distance to toe from centroid of moist soil

horizontal distance to toe from centroid of water on inner face of retaining wall

horizontal distance to toe from centroid of saturated soil

vertical distance to toe from centroid of water on inner face of retaining wall

vertical distance to toe from centroid of moist soil

vertical distance to toe from centroid of buoyant soil

vertical distance to toe from centroid of ground water in saturated soil

vertical distance to toe from centroid of surcharge

moment of the horizontal load of water on the inner face of the retaining wall and of its vertical distance to the t

moment of the horizontal load of moist soil and of its vertical distance to the toe from its centroid

moment of the horizontal load of buoyant soil and of its vertical distance to the toe from its centroid

moment of the horizontal load of ground water in the saturated soil and of its vertical distance to the toe from it

moment of the horizontal load of surcharge and of its vertical distance to the toe from its centroid

moment of the vertical load of the concrete slab/foundaiton and of its horizontal distance to the toe from its cen

moment of the vertical load of the concrete wall and of its horizontal distance to the toe from its centroid

moment of the vertical load of the watter on the inner face of the retaining wall and of its horizontal distance to

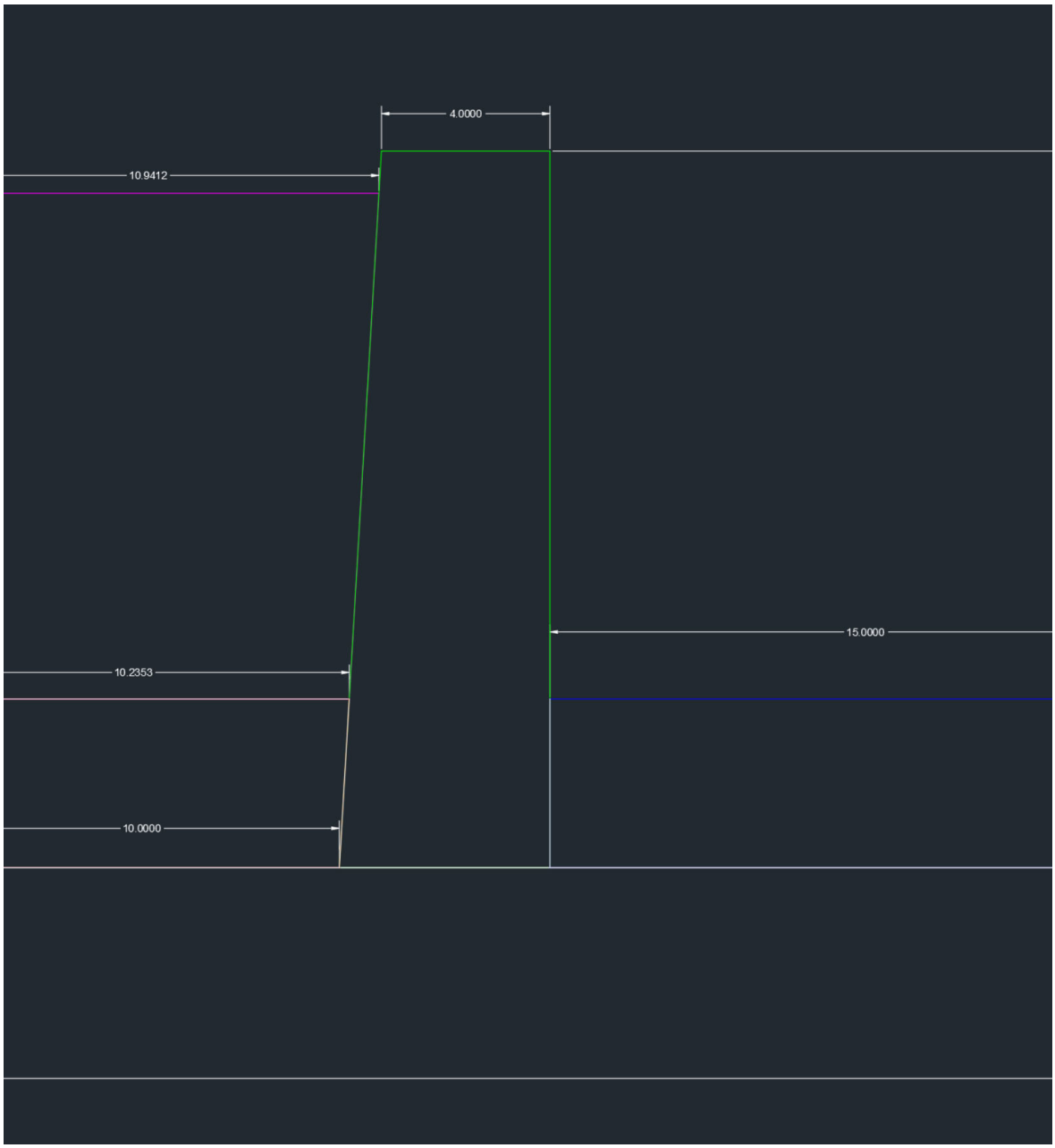
moment of the vertical load of the moist soil and of its horizontal distance to the toe from its centroid

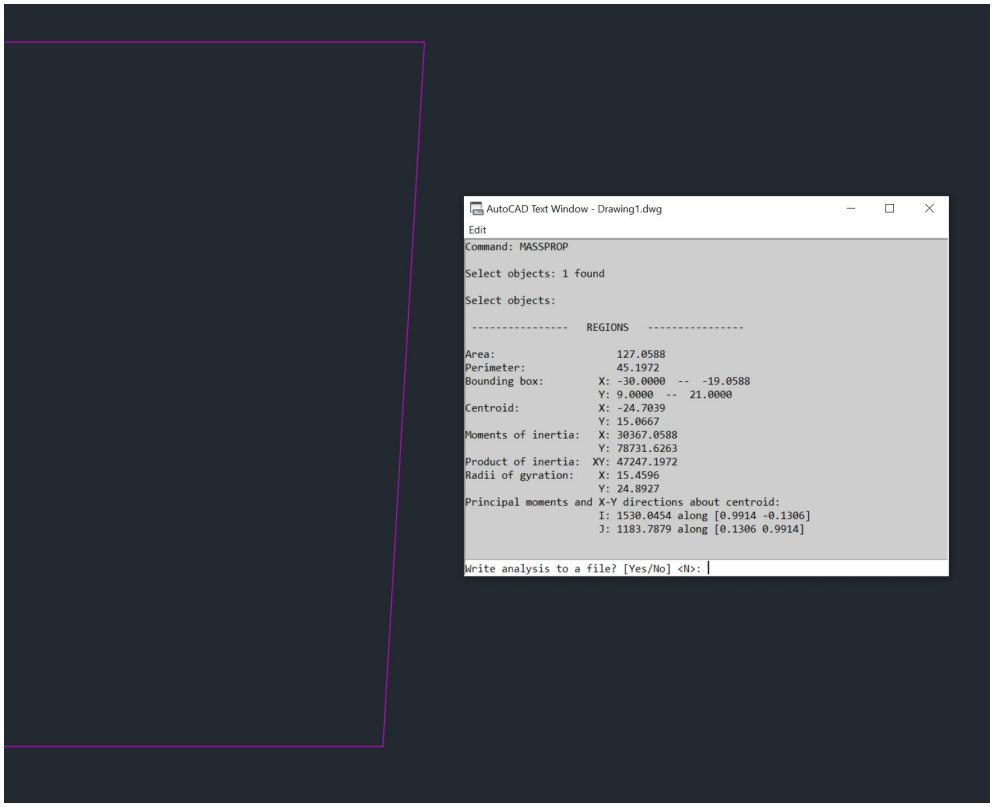
moment of the vertical load of the saturated soil and of its horizontal distance to the toe from its centroid

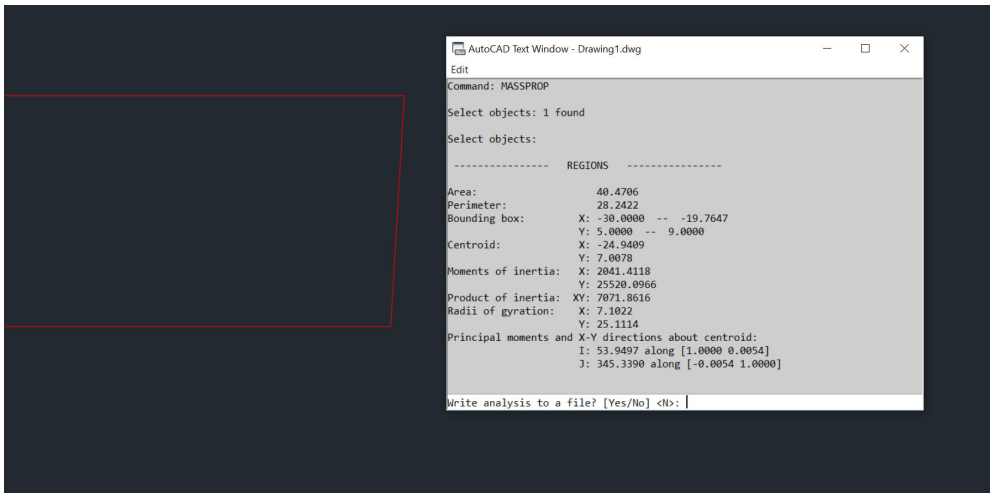
algebraically solved equation for the magnitude required of a force to set the system's sum of horizontal loads

algebraically solved equation for the magnitude required of a force to set the system's sum of moments equal

algebraically solved equation for the magnitude required of a force to set the system's sum of vertical loads eq


4.0000
10.9412
15.0000
10.2353
10.0000


AutoCAD Text Window - Drawing1.dwg
Edit
Command: MASSPROP
Select objects: 1 found
Select objects:
---------- REGIONS ----------
Area: 127.0588
Perimeter: 45.1972
Bounding box: X: -30.0000 -- -19.0588
Y: 9.0000 -- 21.0000
Centroid: X: -24.7039
Y: 15.0667
Moments of inertia: X: 30367.0588
Y: 78731.6263
Product of inertia: XY: 47247.1972
Radii of gyration: X: 15.4596
Y: 24.8927
Principal moments and X-Y directions about centroid:
I: 1530.0454 along [0.9914 -0.1306]
J: 1183.7879 along [0.1306 0.9914]
Write analysis to a file? [Yes/No] <N>:


AutoCAD Text Window - Drawing1.dwg
Edit
Command: MASSPROP
Select objects: 1 found
Select objects:
---------- REGIONS ----------
Area: 40.4706
Perimeter: 28.2422
Bounding box: X: -30.0000 -- -19.7647
Y: 5.0000 -- 9.0000
Centroid: X: -24.9409
Y: 7.0078
Moments of inertia: X: 2041.4118
Y: 25520.0966
Product of inertia: XY: 7071.8616
Radii of gyration: X: 7.1022
Y: 25.1114
Principal moments and X-Y directions about centroid:
I: 53.9497 along [1.0000 0.0054]
J: 345.3390 along [-0.0054 1.0000]
Write analysis to a file? [Yes/No] <N>:

oe from its centroid

s centroid

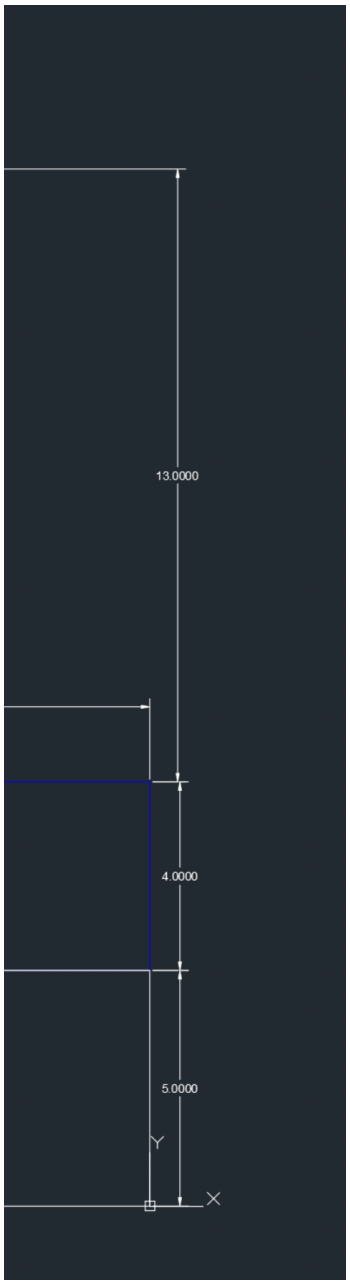
ıtroid

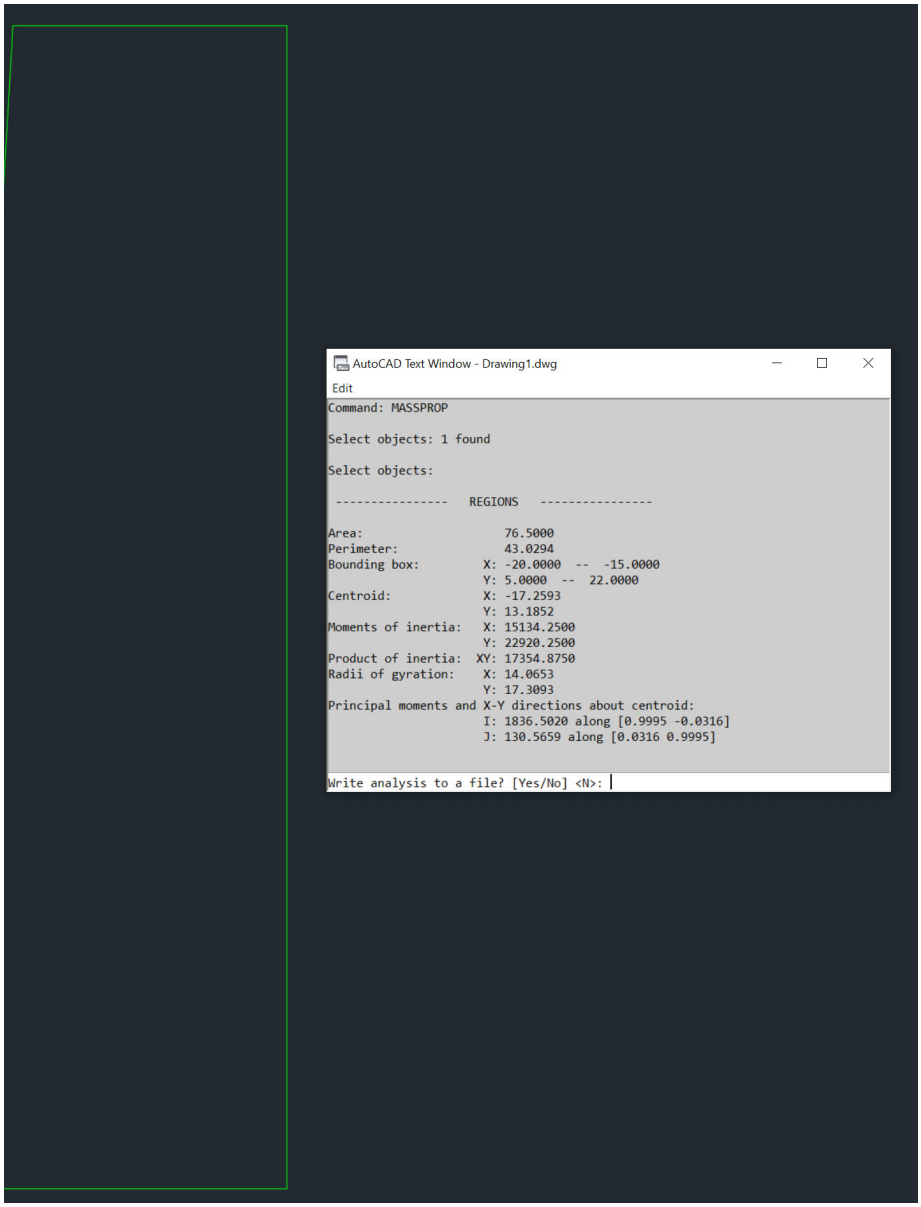
the toe from its centroid

equal to 0

to 0

ual to 0


13.0000
4.0000
5.0000
Y
X


AutoCAD Text Window - Drawing1.dwg
Edit
Command: MASSPROP
Select objects: 1 found
Select objects:
---------- REGIONS ----------
Area: 76.5000
Perimeter: 43.0294
Bounding box: X: -20.0000 -- -15.0000
Y: 5.0000 -- 22.0000
Centroid: X: -17.2593
Y: 13.1852
Moments of inertia: X: 15134.2500
Y: 22920.2500
Product of inertia: XY: 17354.8750
Radii of gyration: X: 14.0653
Y: 17.3093
Principal moments and X-Y directions about centroid:
I: 1836.5020 along [0.9995 -0.0316]
J: 130.5659 along [0.0316 0.9995]
Write analysis to a file? [Yes/No] <N>: