Calculations for JMTSCADLIB

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1 Functions

1.1 Height of Sloped Cylinder

Given a bottom radius (r_1), top radius (r_2), and slope (θ, where 90° is a vertical/unsloped and 0° is a completely flat circle), determine the height (h) of the cylinder.

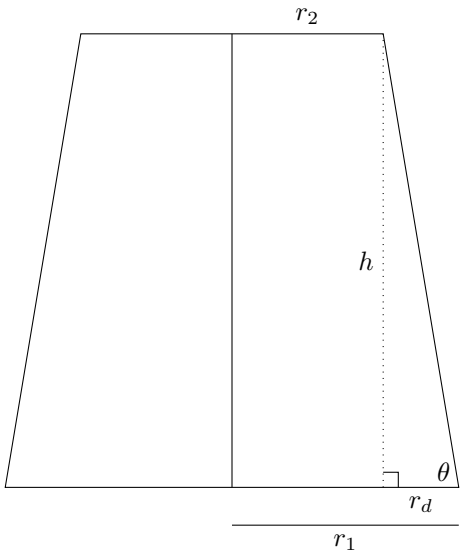

Figure 1: Side view of sloped cylinder

Adding the value r_d, equaling $r_1 - r_2$, we solve for h:

$$\tan(\theta) = \frac{h}{r_d} \qquad \text{SOHCAH}\mathbf{TOA}$$
$$h = r_d \tan(\theta) \qquad \text{Multiply by } r_d\text{, switch sides}$$
$$h = (r_1 - r_2)\tan(\theta) \qquad \text{Substitute } r_d$$

1.2 Packed Field of Circles

Given a radius (r), maximum width in x direction (w_{max}), maximum depth in y direction (d_{max}), pack circles to fill (but not overflow) the area. Then calculate the actual width (w_{actual}), actual depth (d_{actual}), number of columns (c), number of rows in odd-numbered columns (n_{odd}), and number of rows in even-numbered columns (n_{even}). This relationship is shown in Figure 2.

To determine c, n_{even} and n_{odd}, we need to express w_{actual} and d_{actual} in terms of r and these target variables. Figure 3 shows this relationship for width and TODO shows this relationship for depth.

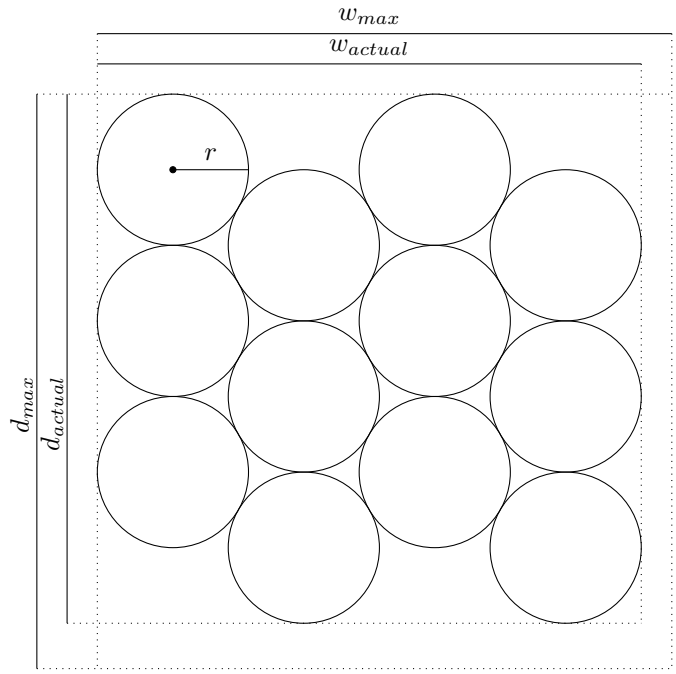

Figure 2: Layout of packed circle field

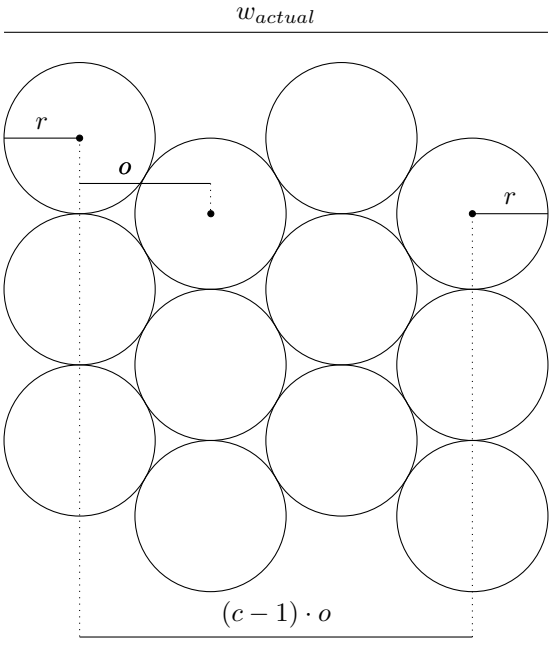

Figure 3: Width relationship between w_{actual}, r, c, and an unknown overlap value o

In the width relationship (Figure 3), an unknown variable, o, represents the width of the overlap between the columns of circles.

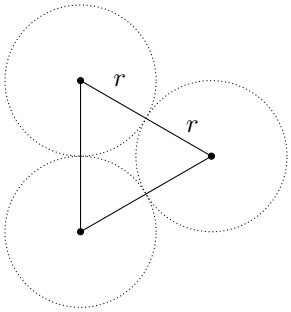

Figure 4: Relationship between o and r