



$$r_f = 1.2$$



$$r_l = 1.4$$



$$w = 1.9$$



$$r_i = 1$$



$$r_u = 1$$



$$n = 2$$

7

$$\theta_1 = \arctan\left(\frac{r_i}{r_u}\right)$$

= 45

8

$$X = \frac{w\sqrt{1 + \tan^2 \theta_1} - r_f}{\tan(\theta_1)}$$

= 1.48700576851

9

$$Y = r_f + nr_i - \tan(\theta_1) \left(\frac{nr_i}{\tan(\theta_1)} + r_l - X \right)$$

= 1.28700576851

10

$$w_{min} = \frac{|\tan(\theta_1)r_u - r_f - \tan(\theta_1)X|}{\sqrt{\tan^2(\theta_1) + 1}}$$

= 1.19289321881

11



$$(r_u, r_f)$$

= (1, 1.2)

12



$$(kr_u, r_f + kr_i) \text{ for } k = [1, 2 \dots n]$$

= (1, 2.2) (2, 3.2)

13



$$y = \tan(\theta_1)(x - X) \left\{ X \leq x \leq \frac{r_u - r_f}{\tan(\theta_1)} + r_l \right\}$$

14



$$y - r_f = \tan(\theta_1)(x - 0) \left\{ 0 \leq x \leq \frac{R_u - r_f}{\tan(\theta_1)} \right\}$$

15




$$R_u = r_f + nr_i$$

= 3.2

16



x_2	 y_2
0	0
0	r_f
X	0
$\frac{R_u - r_f}{\tan(\theta_1)}$	R_u
$\frac{R_u - r_f}{\tan(\theta_1)} + r_l$	R_u
$\frac{R_u - r_f}{\tan(\theta_1)} + r_l$	$\tan(\theta_1) \left(\frac{R_u - r_f}{\tan(\theta_1)} + r_l - X \right)$



17



$$\left((1-t)0 + 0t, (1-t)0 + tr_f \right)$$

$$0 \leq t \leq 1$$

18



$$\left((1-t)0 + tX, (1-t)0 + 0t \right)$$

$$0 \leq t \leq 1$$

19



$$\left((1-t) \left(\frac{R_u - r_f}{\tan(\theta_1)} \right) + t \left(\frac{R_u - r_f}{\tan(\theta_1)} + r_l \right), (1-t)R_u + tR_u \right)$$

$$0 \leq t \leq 1$$

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$$\left((1-t) \left(\frac{R_u - r_f}{\tan(\theta_1)} + r_l \right) + t \left(\frac{R_u - r_f}{\tan(\theta_1)} + r_l \right), (1-t)R_u + t \left(\tan(\theta_1) \left(\frac{R_u - r_f}{\tan(\theta_1)} + r_l - X \right) \right) \right)$$

$$0 \leq t \leq 1$$