$R := 18295\ mm$ $t := 17.8\ mm$ $a := 406.4\ mm$

Ratio $c_1 := \dfrac{R}{t} = 1.028 \cdot 10^3$ Ratio $c_2 := \dfrac{a}{R} = 0.022$

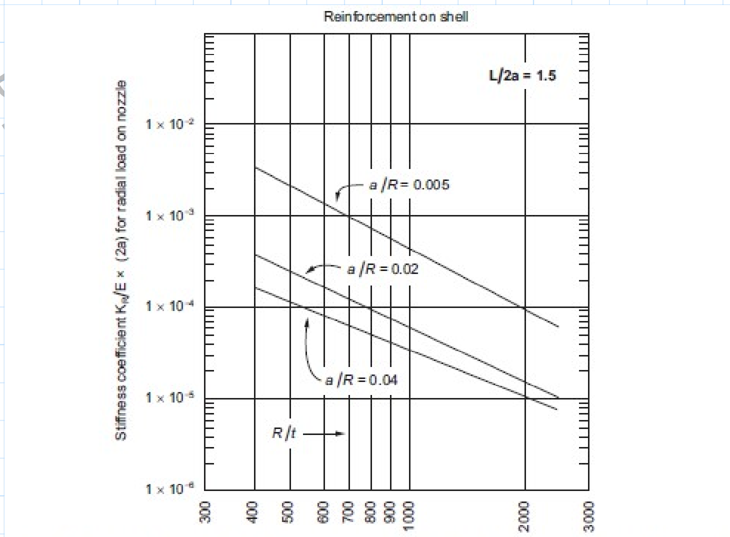


Figure P.2d—Stiffness Coefficient for Radial Load: Reinforcement on Shell (*L*/2*a* = 1.5)

Based on c1 ratio and c2 ratio, we will find the stiffness coefficient from the grap.

Modulus of elasticit (as per Table P1) $E := 198508\ MPa$

The first step is to bring the information into Mathcad. The plot above has straight lines on a log-log plot. Digitize the endpoints of the three straight lines:

R_t	S_{Rs}
407.819751	0.0001523318404
2502.106643	0.000006930082326
413.3167132	0.0003544124077
2518.480684	0.000009570496175
414.8804916	0.003155702911
2526.165758	0.00005585713629

The function Linterp does not work in Express; write a short substitute:

$$Ltrp(X, Y, x) := Y_0 + \left(Y_1 - Y_0\right) \cdot \left(\frac{x - X_0}{X_1 - X_0}\right)$$

$$Ltrp\left(\begin{bmatrix} 0 \\ 4 \end{bmatrix}, \begin{bmatrix} 0 \\ 8 \end{bmatrix}, 2\right) = 4$$

Linear interpolation on a log-log plot:

$$S_r(rt) := \begin{bmatrix} 10^{Ltrp\left(\begin{bmatrix} \log(R\_t_0) \\ \log(R\_t_1) \end{bmatrix}, \begin{bmatrix} \log(S_{Rs_0}) \\ \log(S_{Rs_1}) \end{bmatrix}, \log(rt)\right)} \\ 10^{Ltrp\left(\begin{bmatrix} \log(R\_t_2) \\ \log(R\_t_3) \end{bmatrix}, \begin{bmatrix} \log(S_{Rs_2}) \\ \log(S_{Rs_3}) \end{bmatrix}, \log(rt)\right)} \\ 10^{Ltrp\left(\begin{bmatrix} \log(R\_t_4) \\ \log(R\_t_5) \end{bmatrix}, \begin{bmatrix} \log(S_{Rs_4}) \\ \log(S_{Rs_5}) \end{bmatrix}, \log(rt)\right)} \end{bmatrix}$$

Now we need to plot and interpolate $\left[S_r\right]$ *against a/R:*

$$a\_R := \begin{bmatrix} 0.04 \\ 0.02 \\ 0.005 \end{bmatrix}$$

Again, Express does not have polyfit (a function that will develop a polynomial fit to data.) With three data points we can define a second order polynomial using least squares:

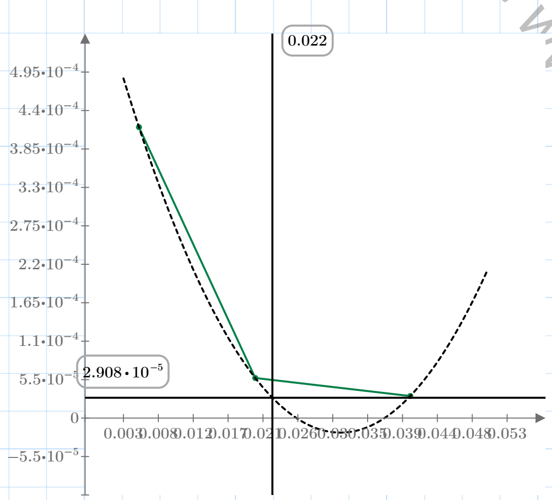
$$im := 0..\text{rows}(a\_R) - 1 \qquad aa_{im} := 1 \qquad X := a\_R \qquad Y := S_r(c_1)$$

$$A := \text{augment}\left(aa, X, \overrightarrow{X^2}\right) = \begin{bmatrix} 1 & 0.04 & 0.002 \\ 1 & 0.02 & 4 \cdot 10^{-4} \\ 1 & 0.005 & 2.5 \cdot 10^{-5} \end{bmatrix}$$

$$Ap := A^T \cdot A = \begin{bmatrix} 3 & 0.065 & 0.002 \\ 0.065 & 0.002 & 7.213 \cdot 10^{-5} \\ 0.002 & 7.213 \cdot 10^{-5} & 2.721 \cdot 10^{-6} \end{bmatrix} \qquad Ab := A^T \cdot Y = \begin{bmatrix} 5.051 \cdot 10^{-4} \\ 4.49 \cdot 10^{-6} \\ 8.383 \cdot 10^{-8} \end{bmatrix}$$

$$cc := Ap^{-1} \cdot Ab = \begin{bmatrix} 6.004 \cdot 10^{-4} \\ -0.04 \\ 0.646 \end{bmatrix} \qquad A \cdot A^T = \begin{bmatrix} 1.002 & 1.001 & 1 \\ 1.001 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

$$fn(x) := cc_0 + cc_1 \cdot x + cc_2 \cdot x^2 \qquad arr := 0.003, 0.0035..0.05$$



a_R

arr

$S_r(c_1)$

$fn(arr)$

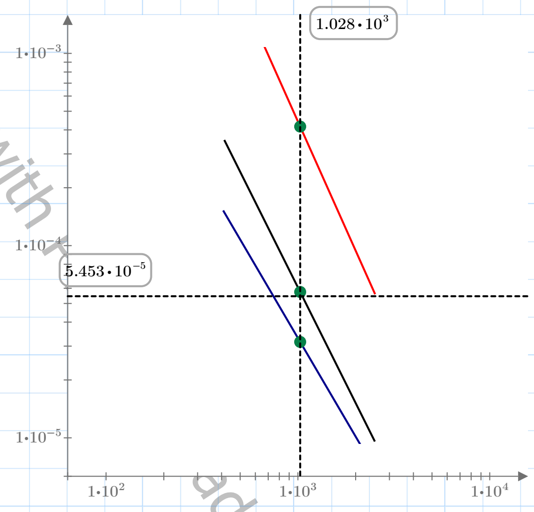
Clearly the stiffness can never go negative, so this cannot be correct. Use linear interpolation between two points:

stiffness coefficient for Radial Load - reinforcing on shell as per fig P-2a.

From graph

$$S_{Rss} := Ltrp\left(\begin{bmatrix} a\_R_0 \\ a\_R_1 \end{bmatrix}, \begin{bmatrix} S_r(c_1)_0 \\ S_r(c_1)_1 \end{bmatrix}, c_2\right) = 5.453 \cdot 10^{-5}$$

$$K_R := S_{Rss} \cdot E \cdot 2\ a = 8797.929\ \frac{N}{mm}$$



1.028·10^3
5.453·10^-5
1·10^-3
1·10^-4
1·10^-5
1·10^2
1·10^3
1·10^4