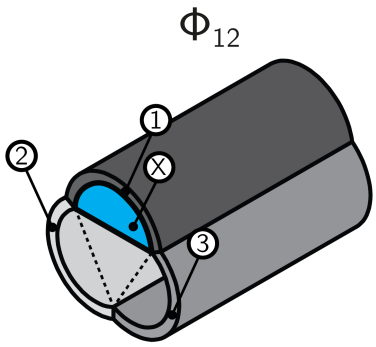
View Factor 19

The image shows a combination of three long equal semicircles (cross-sectional area of three equal half cylinders). Determine the view factor Φ_{12}:



One could think of a diagonal auxiliary plane X.

A flat plate can never see itself and therefore:

$$\Phi_{XX} = 0$$

From the summation rule of the top of the auxiliary plane X ($\Phi_{XX} + \Phi_{X1} = 1$), it yields:

$$\Phi_{X1} = 1 - \Phi_{XX} = 1$$

Using the reciprocity rule it yields that ($A_1\Phi_{1X} = A_X\Phi_{X1}$):

$$\Phi_{1X} = \Phi_{X1}\frac{A_X}{A_1} = \frac{DL}{\frac{1}{2}\pi DL} = \frac{2}{\pi}$$

Where D and L are the respective width/diameter and length of surfaces 1 and X.

From the summation rule ($\Phi_{11} + \Phi_{1X} = 1$) it can be found that:

$$\Phi_{11} = 1 - \Phi_{1X} = 1 - \frac{2}{\pi}$$

Furthermore, from symmetry it yields that $\Phi_{12} = \Phi_{13}$, combining this with the summation rule ($\Phi_{11} + \Phi_{12} + \Phi_{13} = 1$) one finds:

$$\Phi_{12} = \frac{1 - \Phi_{11}}{2} = \frac{1}{\pi}$$