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CONFIGURATION FACTOR FOR A SPHERE

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Summary

An expression is obtained for the configuration factor for a sphere. The method involves considering the sphere to be replaced by an equivalent surface, in this case a circular disc.

1) Introduction

In a previous report [1] an expression has been derived for the configuration factor for a sphere by an approximate method. A more elegant method is now described which does not involve any approximations and which gives the same expression in a more convenient form.

2) Equivalent surfaces

In evaluating the configuration factor an equivalent surface, in this case a circular disc, is considered in the place of the sphere. The legitimacy of this method follows from the fact that the equivalent surface subtends the same solid angle at the receiving element and that the integration of the expression for the configuration factor is unaltered. [2]

3) Configuration factor for a sphere

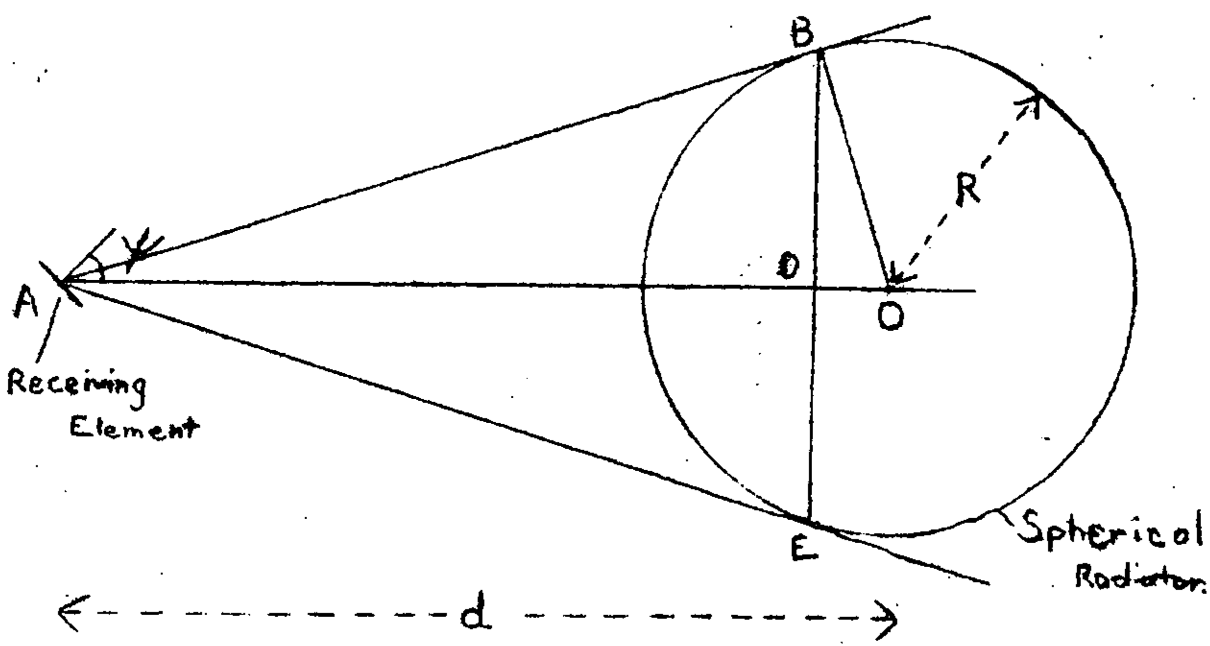

Figure 1

In figure 1 BE represents the equivalent circular disc which is considered in the place of the spherical radiator.

If the receiving element at A were parallel to the disc then the configuration factor would be given by the expression [3]

$$\phi = \frac{BD^2}{BD^2 + AD^2} \qquad \ldots\ldots (1)$$

Application of the cosine law applying to configuration factors by virtue of their vectorial property [4] gives the result, for the case of figure 1,

$$\phi = \frac{BD^2}{BD^2 + AD^2} \cos \psi \qquad \ldots\ldots (2)$$

Expression (2) may be expressed in terms of the dimensions R and d from the geometry of figure 1, for $BD^2 + AD^2 = AB^2$

$$\therefore \quad \frac{BD^2}{BD^2 + AD^2} = \frac{BD^2}{AB^2}$$

But since Δ AOB and Δ ABD are similar

$$\frac{BD}{AB} = \frac{BO}{AO} = \frac{R}{d}$$

$$\therefore \quad \phi = \frac{R^2 \cos \psi}{d^2} \qquad \ldots\ldots (3)$$

References

1) F.P.E. 38. "Heat Transfer by Radiation". J. H. McGuire, para. 2.7.
2) Loc. cit. para. 2.3.
3) Loc. cit. para. 2.8.
4) ~~Internal Memorandum~~ F.R. Note No. 2/1962. "The Vectorial Property of Configuration Factors". J. H. McGuire.