SOLID ANGLE AND RADIATION EMISSION: EXAMPLE

A small surface of area \( A_i = 10^{-3} \text{ m}^2 \) is known to emit diffusely, and from measurements, the total intensity associated with emission in the normal direction is \( I_n = 7000 \text{ W/m}^2 \cdot \text{sr} \).

Radiation emitted from the surface is intercepted by three other surfaces of area \( A_2 = A_3 = A_4 = 10^{-3} \text{ m}^2 \), which are 0.5 m from \( A_i \) and are oriented as shown.

1. What is the intensity associated with emission in each of the three directions?
2. What are the solid angles subtended by the three surfaces when viewed from \( A_i \)?
3. What is the rate at which radiation emitted by \( A_i \) is intercepted by the three surfaces?

EMISSION INTENSITY

Diffuse emitter assumption ⇒

SOLID ANGLES

Definition:

\[
d\omega = \frac{dA_n}{r^2},
\]

where \( dA_n \) is the projection of the surface normal to the direction of the radiation.
• $\omega_{2-1}$ calculation

$\omega_{2-1}$

• $\omega_{3-1}$ and $\omega_{4-1}$ calculation

$\omega_{3-1}$ and $\omega_{4-1}$

**RADIATION RATE**

From the notes, the radiation intensity is expressed as:

\[ I_e = \frac{dQ_e}{dA \cos \theta d\omega} \]

Therefore, for surface $j$:

Integration yields the total radiation for surface $j$: 