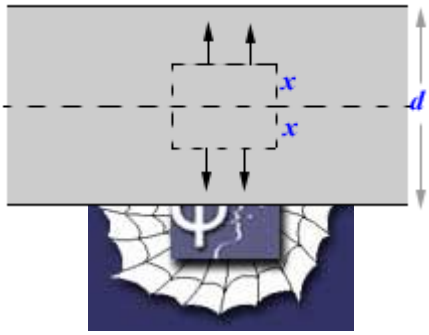
**331.**

**Problem 29.46 (RHK)**

*A plane slab of thickness d has a uniform volume charge density* $\rho$. *We have to find the magnitude of the electric field at all points in space both* (a) *inside and* (b) *outside the slab, in terms of x, the distance measured from the meridian plane of the slab.*




**Solution:**

(a)

Plane slab of thickness d has a uniform volume charge density $\rho$. By symmetry the field inside the slab and outside the slab will be perpendicular to the slab. The magnitude of the electric field at distance *x* on both sides of the meridian plane will also be equal. Let us consider a Gaussian surface of cross-sectional area *A* as shown in the figure.

Then, by applying the Gauss' law we get

$$\varepsilon_0 2AE(x) = 2xA\rho.$$

$$\therefore\ E(x) = \frac{x\rho}{\varepsilon_0}.$$

(b)

Now by considering a Gaussian surface that is symmetric with respect to the meridian but lies outside the slab and by applying the Gauss' law, we find

$$\varepsilon_0 2AE(x) = dA\rho,\ \ |x| \geq d/2$$

Therefore,

$$E(x) = \frac{d\rho}{\varepsilon_0}.$$