Using the definitions of curl and divergence, and \( \frac{\partial}{\partial y} = \frac{2}{3} \cdot \mathbf{0} \).

From \( \nabla \times \mathbf{E} = 0 \Rightarrow -\frac{\partial E_z}{\partial x} \mathbf{a}_y + \frac{\partial E_y}{\partial x} \mathbf{a}_z = 0. \times 1 \)

\( \nabla \cdot \mathbf{E} = 0 \Rightarrow \frac{\partial E_z}{\partial x} = 0. \times 2 \)

\( E_y = E_z = 0 \) and \( E_y \) must be constants independent of \( x, y, z \). However, boundary conditions requires they should both vanish on the conducting plates; otherwise the continuity of tangential \( \mathbf{E} \) would require the existence of \( \mathbf{E} \) field within the conducting plates. This \( \mathbf{E} \) field in turn would exert a force on the charge, causing them to move, contrary to the assumed stationary character of the charge distribution.

The condition may be satisfied only if

\( E_y = E_z = 0. \)

and \( \times 2 \Rightarrow E_x = \text{constant} \cdot C \)

\( D_x = \varepsilon_0 E_x = \varepsilon_0 C. \)

\text{Boundary condition} : \[ \nabla \cdot (\varepsilon_0 \mathbf{D} - \mathbf{P}) = \rho_s. \]

\( \Rightarrow D_x = -\rho_s. \)

Similiar for lower plate, \( C = -\varepsilon_0 \rho_s. \)

and at any point between the plates, \( E = \varepsilon_0 \mathbf{D} = -\varepsilon_0 \frac{\partial \mathbf{P}}{\partial x}. \)