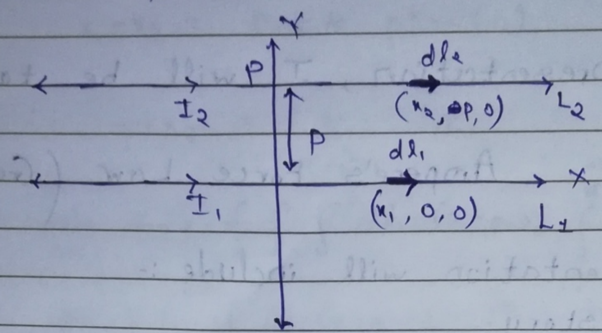
Case of parallel wires:-



Consider two parallel wires, one placed ~~at~~ along x-axis (L_1) and other (L_2) ~~at along~~ at $y = p$ parallel to L_1.

Differential (infinitesmal) element of L_1 at $(x_1, 0, 0)$ and that of L_2 at $(x_2, p, 0)$.

$$\therefore \quad dl_1 \equiv (dx_1, 0, 0) \quad \text{and} \quad dl_2 \equiv (dx_2, 0, 0)$$

$$\hat{r}_{12} = \frac{1}{\sqrt{(x_1 - x_2)^2 + p^2}} (x_1 - x_2, p, 0)$$

$$|r_{12}| = \sqrt{(x_1 - x_2)^2 + p^2}$$

The force on line wire 1 due to wire 2 is given by (According to Ampere's force law):-

$$F_{12} = \frac{\mu_0 I_1 I_2}{4\pi} \int_{L_1} \int_{L_2} \frac{dl_1 \times (dl_2 \times r_{12})}{|r_{12}|^3}$$

$$\therefore \quad F_{12} = \frac{\mu_0}{4\pi} I_1 I_2 \int_{L_1} \int_{L_2} \frac{(dx_1, 0, 0) \times [(dx_2, 0, 0) \times (x_1 - x_2, p, 0)]}{[(x_1 - x_2)^2 + p^2]^{3/2}}$$

The cross product ~~is~~, $(dx_2, 0, 0) \times (x_1 - x_2, p, 0)$ is,

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ dx_2 & 0 & 0 \\ x_1 - x_2 & p & 0 \end{vmatrix} = \hat{i}(0) - \hat{j}(0) + \hat{k}(p\,dx_2)$$
$$= (p\,dx_2)\,\hat{k}$$
$$\equiv (0, 0, p\,dx_2)$$

The cross product $(dx_1, 0, 0) \times (0, 0, p\,dx_2)$ is,

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ dx_1 & 0 & 0 \\ 0 & 0 & p\,dx_2 \end{vmatrix} = \hat{i}(0) - \hat{j}(p\,dx_1\,dx_2) + \hat{k}(0)$$
$$= (-p\,dx_1\,dx_2)\,\hat{j}$$
$$\equiv (0, -p\,dx_1\,dx_2, 0)$$

$$\therefore \quad F_{12} = \frac{\mu_0}{4\pi} I_1 I_2 \int_{L_1}\int_{L_2} \frac{dx_1\,dx_2\,(0, -p, 0)}{[(x_1 - x_2)^2 + p^2]^{3/2}}$$

$$\therefore \quad F_{12} = \frac{\mu_0}{4\pi} I_1 I_2 \int_{L_1} dx_1\,(0, -p, 0) \int_{-\infty}^{\infty} \frac{dx_2}{[(x_1 - x_2)^2 + p^2]^{3/2}}$$

Put,

$$x_1 - x_2 = z$$
$$\therefore \quad -dx_2 = dz$$
$$\therefore \quad dx_2 = -dz$$

$$\therefore \quad F_{12} = \frac{\mu_0}{4\pi} I_1 I_2 \int_{L_1} dx_1\,(0, -p, 0) \int_{-\infty}^{\infty} \frac{dz}{(z^2 + p^2)^{3/2}}$$

Consider,

$$A = \int_{-\infty}^{\infty} \frac{dz}{(z^2 + p^2)^{3/2}}$$

put; $z = p \tan u$

$$\therefore \quad dz = p \sec^2 u \, du$$

$$\therefore \quad A = \int_{-\pi/2}^{\pi/2} \frac{p \, du}{\cos^2 u \left[p^2 (1 + \tan^2 u)\right]^{3/2}}$$

$$\therefore \quad A = \int_{-\pi/2}^{\pi/2} \frac{\cancel{p} \, du}{(\cos^2(u)) \, p^{\cancel{3}2} \, (\sec^2 u)^{3/2}}$$

$$\therefore \quad A = \frac{1}{p^2} \int_{-\pi/2}^{\pi/2} \frac{\cos^{\cancel{3}} u \, du}{\cancel{\cos^2 u}}$$

$$\therefore \quad A = \frac{1}{p^2} \left[\sin u\right]_{-\pi/2}^{\pi/2}$$

$$\therefore \quad \boxed{A = \frac{2}{p^2}}$$

$$\therefore \quad F_{12} = \frac{\mu_0}{2\cancel{4}\pi} I_1 I_2 \left(\frac{2}{p^2}\right) \int_{L_1} dx_1 \, (0, -p, 0)$$

$$\therefore \quad F_{12} = \frac{\mu_0 I_1 I_2}{2\pi \, p^{\cancel{2}}} \cancel{p} \, (0, -1, 0) \int_{L_1} dx_1$$

$$\therefore \quad F_{12} = \frac{\mu_0 I_1 I_2}{2\pi p} \int_{L_1} dx_1 \quad (0, -1, 0)$$

Since, L_1 is infinite $\Rightarrow$ Force will be infinite

$\therefore$ Force per unit length is,

$$\boxed{\frac{F_{12}}{L} = \frac{\mu_0 I_1 I_2}{2\pi p} (0, -1, 0)}$$

i.e. Force is along $-\hat{j}$

i.e. Attractive.