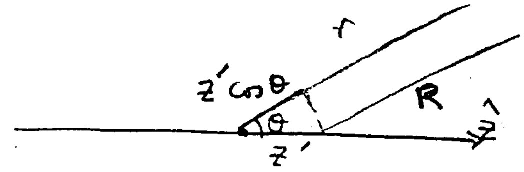
pp. 225 – 227 Text

Derivation of Eqns for Traveling Wave Antennas

$$I_t(z) = I_m e^{-j\beta z} \quad (a)$$ (6–4) p. 226 Text

From the General Theory of Radiation for Conduction Current Antennas p. 2 of the Class Notes

$$\vec{A} = \int_{-L/2}^{L/2} \frac{I(z') e^{-j\beta R}}{4\pi R} dz' \quad (b)$$



$$R = r - z'\cos\theta \quad (c)$$

$$\vec{A} = \frac{I_m L}{4\pi r}\left[\frac{\sin\left\{\frac{\beta L}{2}(1-\cos\theta)\right\}}{\frac{\beta L}{2}(1-\cos\theta)}\right]\hat{z} \quad (1)$$

$$\hat{r}\times\hat{z} = -\hat{\phi}\sin\theta \longrightarrow (2)$$

$$\vec{H} = \nabla\times\vec{A} = -j\beta\,\hat{r}\times\vec{A} = +j\beta\sin\theta\,A\,\hat{\phi} \quad (3)$$

$$\vec{E} = \frac{\nabla\times\vec{H}}{j\omega\epsilon} = -\frac{\cancel{j}\beta\,\hat{r}\times\vec{H}}{\cancel{j}\omega\epsilon} = -\eta\,\hat{r}\times\vec{H}$$

$$= +j\beta\eta\frac{I_m L}{4\pi r}\underbrace{\sin\theta\left[\frac{\sin\left\{\frac{\beta L}{2}(1-\cos\theta)\right\}}{\frac{\beta L}{2}(1-\cos\theta)}\right]}_{P(\theta)}\hat{\theta} \quad (4)$$

(6–5) Text; 6–5 p. 227 Text

In the presence of a ground plane from eq. (51) on p. (27)

$$\vec{E}_T = 2E_{(1)}\sin(\beta d_g \sin\theta\sin\phi)$$ with $d_g \leftarrow h$, $\phi \leftarrow \alpha$ See p. 62 Eq. (1)

for $\phi = 90^\circ$ i.e. in the yz plane, maxima of radiation for

$$\beta d_g \sin\theta_m = \pi/2 \quad (d_g \leftarrow h)$$

for $L = 6\lambda$, $\theta_m = 20^\circ$

$$\frac{2\pi d_g}{\lambda} \rightarrow \beta d_g = \frac{\pi}{2\sin 20^\circ} \Longrightarrow \boxed{d_g = \frac{\lambda}{4\sin 20^\circ} = 0.731\lambda}$$ ($d_g \leftarrow h$)