Problem 1

a) Relation between

$$E_{1t} = E_{2t} \quad \text{and} \quad B_{1n} = B_{2n}$$

b) and between

$$\hat{a}_{n2} \cdot (\bar{D}_1 - \bar{D}_2) = \rho_s \quad \text{and} \quad \hat{a}_{n2} \times (\bar{H}_1 - \bar{H}_2) = \bar{J}_s$$

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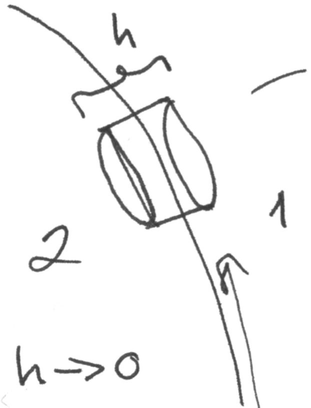
a) We can rewrite these two conditions as

$$\hat{a}_{n2} \cdot (\bar{B}_1 - \bar{B}_2) = 0 \quad \text{and} \quad \hat{a}_{n2} \times (\bar{E}_1 - \bar{E}_2) = 0$$



consider a small volume. If

$$\hat{a}_{n2} \cdot (\bar{B}_1 - \bar{B}_2) = 0$$

at the surface then also

$$\hat{a}_{n2} \cdot (\partial_t \bar{B}_1 - \partial_t \bar{B}_2) = 0$$

Now we use $\bar{\nabla} \cdot (\hat{a}_{n2} \times \bar{E}) = \bar{E} \cdot (\bar{\nabla} \times \hat{a}_{n2}) - \hat{a}_{n2} \cdot (\bar{\nabla} \times \bar{E})$

to get

Maxwell - Faraday

$$\hat{a}_{n2} \cdot (\partial_t \bar{B}_1 - \partial_t \bar{B}_2) = - \hat{a}_{n2} \cdot (\bar{\nabla} \times \bar{E}_1 - \bar{\nabla} \times \bar{E}_2)$$

$$= \bar{\nabla} \cdot \left\{ \hat{a}_{n2} \times (\bar{E}_1 - \bar{E}_2) \right\} = 0$$

integrate over the volume

use Gauss theorem to see that on the end surface

$$\underline{\hat{a}_{n2} \times (\bar{E}_1 - \bar{E}_1) = 0}$$

$$\hat{a}_{n2} \cdot (\bar{D}_1 - \bar{D}_2) = \rho_s$$

$$\hat{a}_{n2} \cdot (\partial_t \bar{D}_1 - \partial_t \bar{D}_2) = \partial_t \rho_s$$

$$\hat{a}_{n2} \cdot \left(\bar{\nabla} \times \bar{H}_1 - \bar{J}_1 - (\bar{\nabla} \times \bar{H}_2 - \bar{J}_2) \right) = - \bar{\nabla} \cdot \bar{J}_s$$

$$\hat{a}_{n2} \cdot \left(\bar{\nabla} \times \bar{H}_1 - \bar{\nabla} \times \bar{H}_2 \right) = - \bar{\nabla} \cdot \bar{J}_s + \hat{a}_{n2} \cdot (\bar{J}_1 - \bar{J}_2)$$

$$- \bar{\nabla} \cdot \left\{ \hat{a}_{n2} \times (\bar{H}_1 - \bar{H}_2) \right\} = - \bar{\nabla} \cdot \bar{J}_s + \underbrace{\hat{a}_{n2} \cdot (\bar{J}_1 - \bar{J}_2)}_{=0 \text{ orthogonal}}$$

integral as before

$$\rightarrow \quad \hat{a}_{n2} \times (\bar{H}_1 - \bar{H}_2) = \bar{J}_s$$