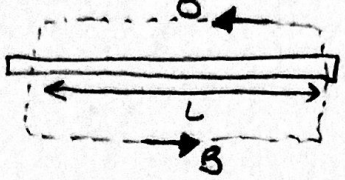
9.1.

1. Treating the top of the duct as a sheet:

top sheet $\vec{K}_1 \odot$

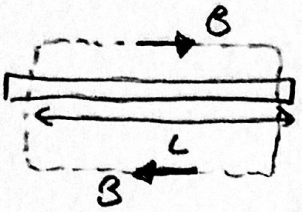


$\oint B \cdot dl = \mu_0 I_{encl}$

$B(2 \cdot L) = \mu_0 (K_1 L) \rightarrow B = \frac{\mu_0 K_1}{2}$ under sheet

$B = -\frac{\mu_0 K_1}{2}$ above sheet

Bottom sheet $\vec{K}_1 \otimes$



$\oint B \cdot dl = \mu_0 I_{encl}$

$B(2 \cdot L) = \mu_0 (K_1 L)$

$B = -\frac{\mu_0 K_1}{2}$ above sheet

$B = \frac{\mu_0 K_1}{2}$ below sheet

$B_{total} = -\frac{\mu_0 K_1}{2} + \frac{\mu_0 K_1}{2} = 0$ outside

$B_{total} = \frac{\mu_0 K_1}{2} + \frac{\mu_0 K_1}{2} = \mu_0 K_1$ inside

2. $\Phi_m = \int B \cdot dA = \int \mu_0 K_1 \, dA = \mu_0 K_1 (h_1 w)$

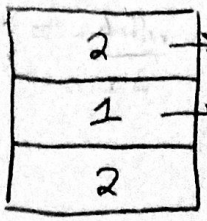
$\Phi_m = \mu_0 K_1 h_1 w$

$-L_1 \frac{dI_1}{dt} = -\frac{d\Phi_m}{dt}$

$L_1 = \frac{d\Phi_m}{dt} \cdot \frac{dt}{dI_1} = \frac{\Phi_m}{I_1}$

$L_1 = \frac{\mu_0 K_1 h_1 w}{(K_1 L)} = \frac{\mu_0 h_1 w}{L} = \frac{\mu_0 A_1}{L}$

3.



$B_{tot_2} = B_2 = B$

$B_{tot_1} = B_1 + B_2 = 2B$

$$\mathcal{E}_1 = -\frac{d\Phi_m}{dt} = -\frac{d(B_{tot_1} \cdot A_1)}{dt} = -\frac{d\,2BA_1}{dt}$$

$$\mathcal{E}_2 = -\frac{d\Phi_m}{dt} = -\frac{d}{dt}(B_{tot_2} \cdot A_2 + B_{tot_1} \cdot A_1) = -\frac{d}{dt}(B(A_2 - A_1) + 2B \cdot A_1)$$

$$\mathcal{E} = \mathcal{E}_1 + \mathcal{E}_2 = -\frac{d\,2BA_1}{dt} - \frac{d\,BA_2}{dt} + \frac{d}{dt}BA_1 - \frac{d\,2BA_1}{dt}$$

$$\mathcal{E} = -\frac{d\,3BA_1}{dt} - \frac{d\,BA_2}{dt} = -\frac{d}{dt}(3BA_1 + BA_2)$$

$$\mathcal{E} = -3\mu_0 K_1 (h_1 w) - \mu_0 K_2 (h_2 w)$$

$$\mathcal{E} = -\frac{3\mu_0 K_1 \cdot L \cdot A_1}{L} - \frac{\mu_0 K_2 \cdot L \cdot A_2}{L}$$

$$\mathcal{E} = -L_n \frac{dI_n}{dt}$$

$$L = \frac{\mathcal{E}}{I} = \frac{\mathcal{E}}{K_n L} = \frac{3\mu_0 A_1}{L} + \frac{\mu_0 A_2}{L}$$

4. $$L_{ext} = -\mathcal{E}_1 \cdot \left(dt/dI\right) = -\frac{d(2BA_1)}{dt} \cdot \frac{dt}{dI}$$

$$= \frac{2BA_1}{2I} = \frac{BA_1}{I}$$

$$L_{int} = -\mathcal{E}_2 \cdot \left(dt/dI\right) = -\frac{d(B_{21}(A_2 - A_1))}{dt} \cdot \frac{dt}{dI} = \frac{B(A_2 - A_1)}{I}$$

$$L_{total} = L_{ext} + L_{int} = \frac{BA_1}{I} + \frac{BA_2}{I} - \frac{BA_1}{I} = \frac{BA_2}{I}$$

5. Based on these results, the inductance computed in #4 is smaller because it was missing the effect of the flux from the first duct on the second duct.