EECT PROJECT PROPOSAL

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AIM

1) To use FINITE ELEMENT ANALYSIS (FEA) Method to Calculate the Inductance of a Gapped EI-Core Inductor.
2) To calculate the Result upto a more accurate level than regular Magnetic Circuit Theory Approximations by not neglecting Fringing and Flux leakage.

SOFTWARES USED

1) ANSYS - multiphysics engineering simulation software
2) FEMM - Finite Element Method Magnetics

THEORY

From Ampere's Circuital Law, we know that Magneto Motive Force (MMF) is equivalent to:

$$R\phi = ni$$

$$\phi = \frac{ni}{R}$$

$$n\phi = \frac{n^2 i}{R} = Li$$

$$L = \frac{n^2}{R}$$

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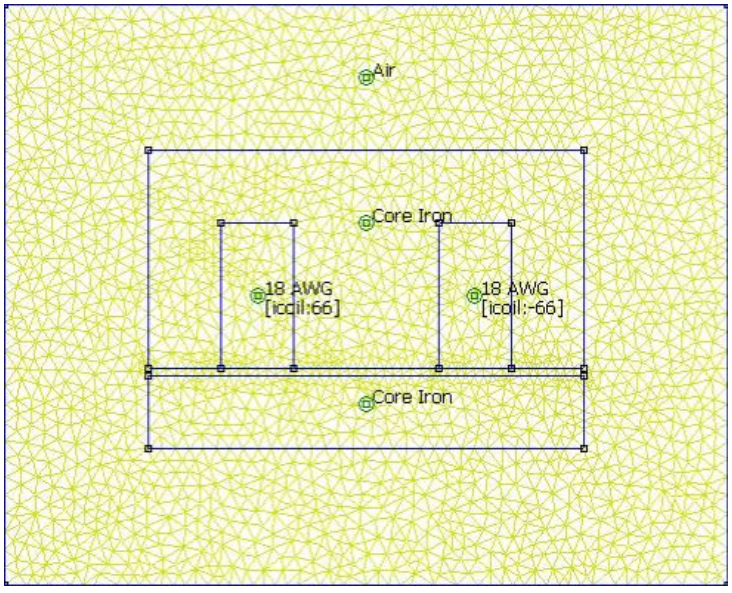
This shows us that Inductance is equal to the Product of Square of number of Cores and Permeance. However, in the above example, factors such as Flux Leakage due to Fringing have been neglected. If we have to consider these conditions as well we can use the Finite Element Method to solve the problem.

APPROACH I

We may place the inductor at the center of a 2" by 2.5" box. On the boundaries of the domain,we define a boundary condition of A=0 and apply an arbitrary current of 1A across the coil.
A fairly coarse mesh density with the mesh size constrained to be no larger than 0.05" must be defined everywhere.

Once the analysis is performed and the postprocessor is run, the inductance can be derived by pressing the Circuit Properties button in the post-processor.A Circuit Properties dialog will then appear with a number of properties of the winding as seen from the winding terminals. Since, there are no other auxiliary Permanent Magnets or Coils, the “Flux/Current” Is equal to Self Inductance.



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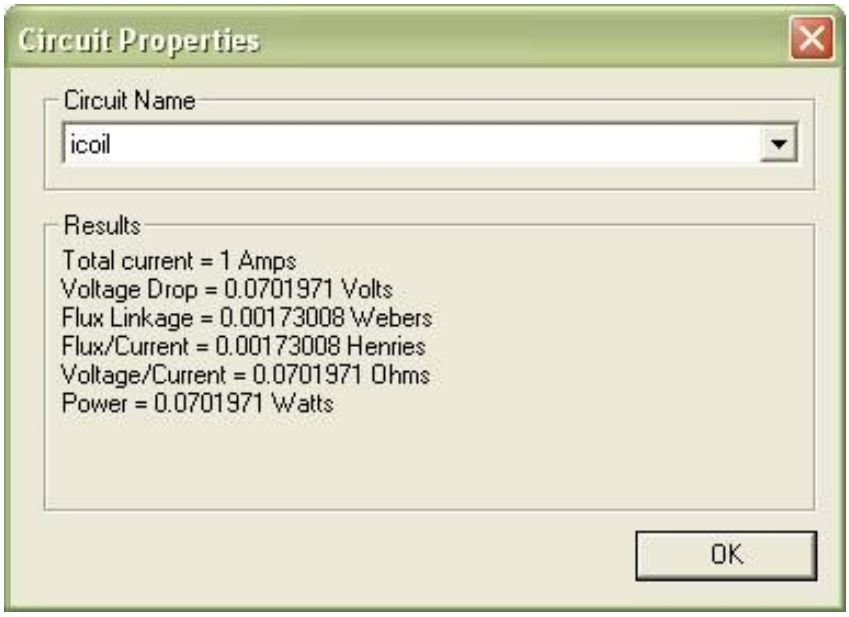

APPROACH II

We may Calculate Magnetic Field Energy using the Integral given below and use it to find the Inductance.

$$W = \frac{1}{2}\int B \cdot H \; dV$$

To perform this integration in the postprocessor, we

1) switch to block integral mode by pushing the button on the task-bar.
2) Select each region in the problem via left mouse button clicks.
3) When the entire problem region is selected, push the Integral button and select the “Magnetic Field Energy” integral from the drop list of volume integrals.

$$L = \frac{2W}{i^2}$$

OBJECTIVE

After calculating the accurate value using the 2 methods given above we may calculate the Percentage Error in the Approximate Value Calculated by the Theoretical Method using MATLAB.