Stray-Field Loss in Power Transformer

Stray-Field Loss in Power Transformer (T.E.A.M. Problem 21b)

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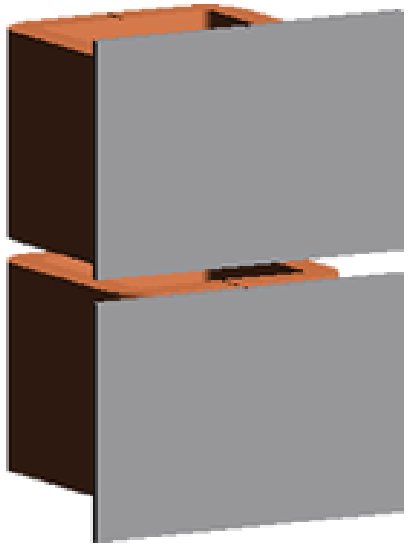
Shielding can be used to substantially reduce magnetic field strengths outside of a transformer. The electric properties and geometry determine what type of shielding is required. The focus of this example is calculating stray-field loss in a shielding plate.
The following is based on the Testing Electromagnetic Analysis Methods (T.E.A.M.) problem #21: 3-D Stray Field Loss Model. The benchmark can be found on the International Compumag Society's website.
Presented here is Simcenter MAGNET's analysis of the third set of configurations from the family of benchmarks involving two exciting coils directed in opposite directions and shielded by a pair of conducting steel plates.
The shield has three configurations; one magnetic and one non-magnetic conducting plate (indicated as MN in the figures below), two magnetic conducting plates (2M) and two non-magnetic conducting plates (2N). The nonlinear eddy current and hysteresis losses are compared to measured results.



MAGNETIC FLUX DENSITY OF THE POWER TRANSFORMER

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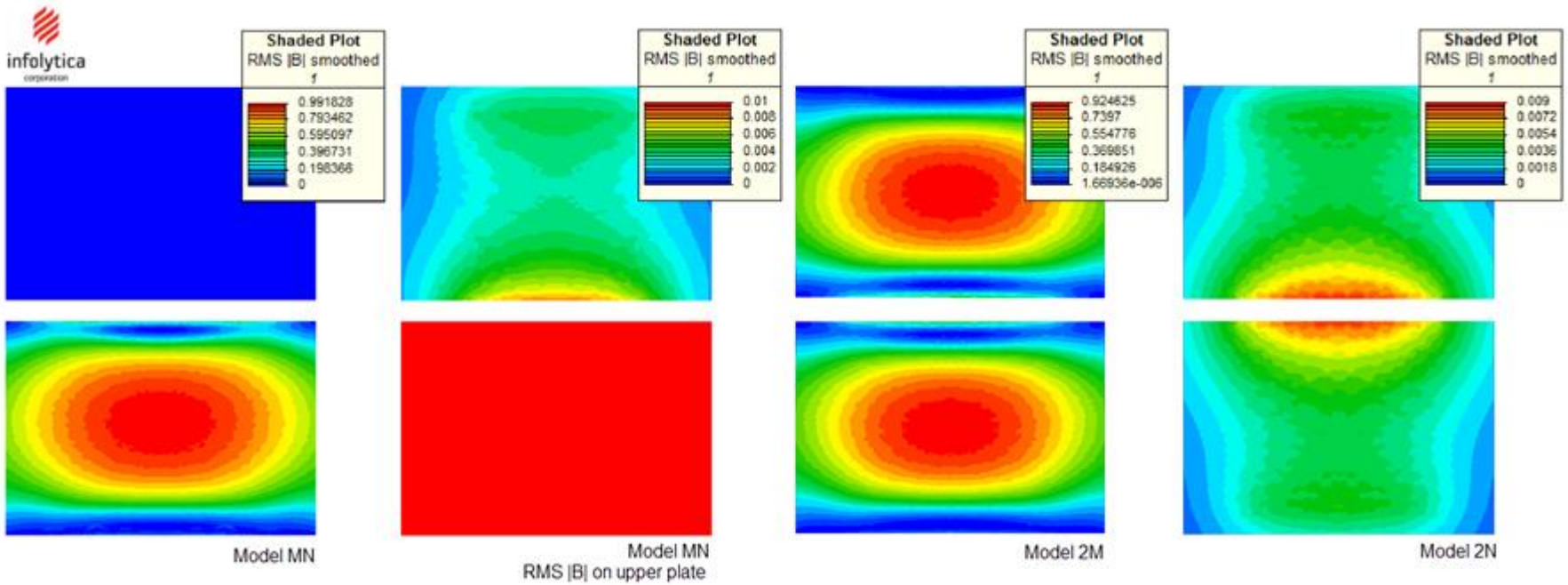
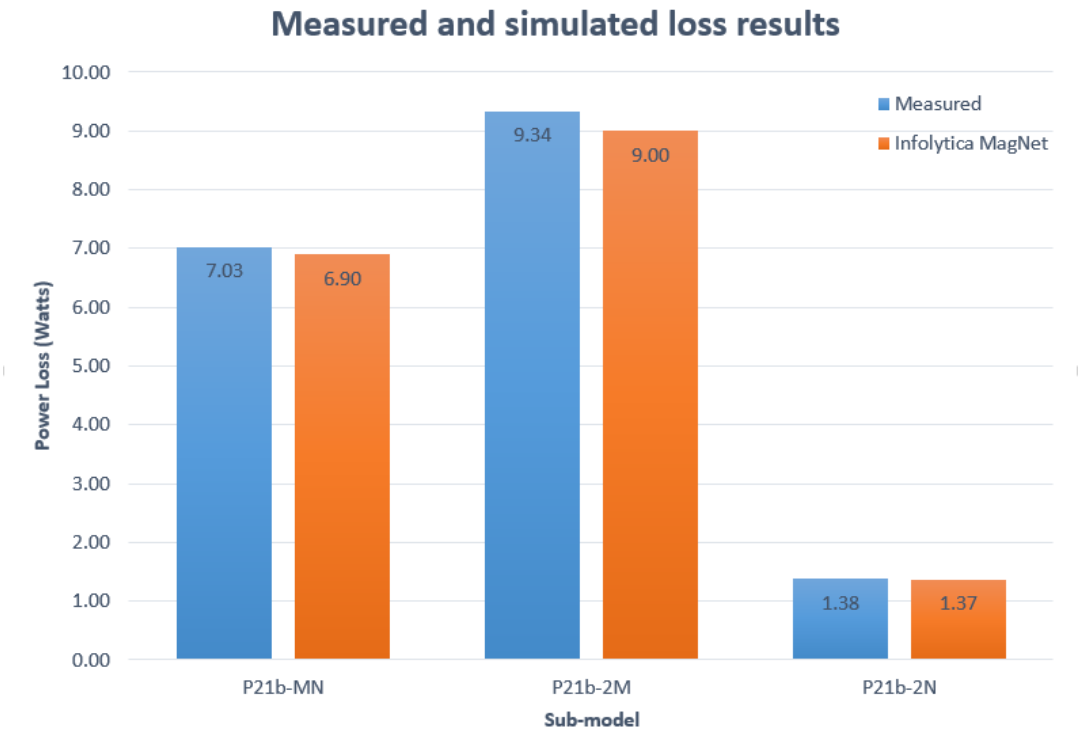


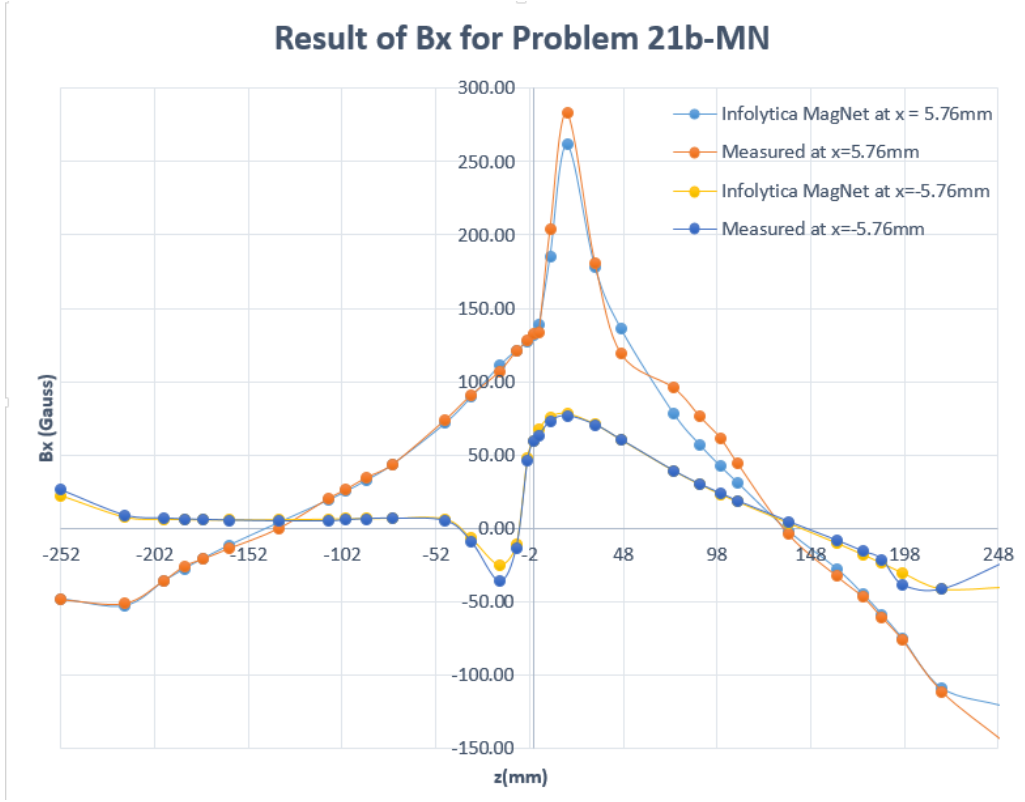
Simcenter MAGNET's Time Harmonic 3D solver is used to simulate this model as the power sources are sinusoid. The magnetic flux density plots on all three steel plate configurations are presented here (MN, 2M, 2N as described above). The first two images are for the case of one magnetic and one non-magnetic conducting plate (MN) with different extents on their shaded plot legends; this is done on order to see the field in the magnetic and non-magnetic plates.

POWER TRANSFORMER TANK FLUX DENSITY



The integral of the ohmic loss and iron loss fields in Simcenter MAGNET are used to compare to the measured eddy current-hysteresis model of T.E.A.M. Problem 21b.

POWER TRANSFORMER FRAME FLUX DENSITY



T.E.A.M. Problem 21b also includes measured magnetic flux densities along contours off of the surface of the steel plate for the configuration involving a magnetic and a non-magnetic plate. Shown here is a comparison between Simcenter MAGNET and the measured results along a contour just above and just below the plates.