

# EMC Simulation Analysis of Enclosures



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**Introduction:** High switching frequencies in modern power supplies demand special attention with regard to the shielding of enclosures. From the early development stage on it is important to analyze radiated emissions in order to fulfil standards. It is necessary to consider openings like for fans, displays, cable connections, slots, grids and many more.

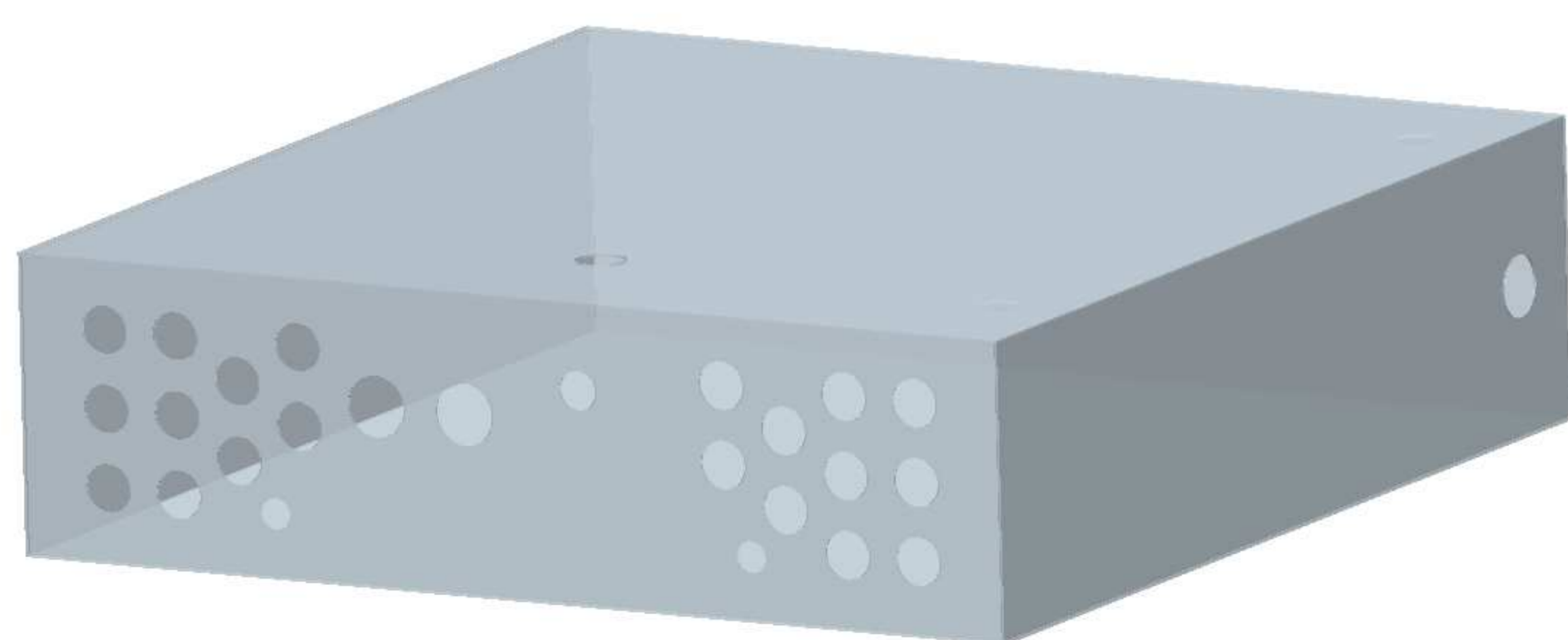


Figure 1. Typical Enclosure Concept

**Computational Methods:** Simulation analysis of the enclosure requires to solve the full wave Maxwell equations. Simulation was done in the frequency domain.

$$\nabla \times (\mu_r^{-1} \nabla \times \mathbf{E}) - k_0^2 (\epsilon_r - \frac{j\sigma}{\omega\epsilon_0}) \mathbf{E} = \mathbf{0} \quad SE = 20 \log \left| \frac{E_1}{E_2} \right|$$

The focus is on shielding effectiveness (SE,  $E_1$  without,  $E_2$  with shielding) of panels with different types of openings. One circular opening was selected, put in a simulation environment with a TEM wave excitation directed towards the panel. Special care has to be taken on boundary conditions.

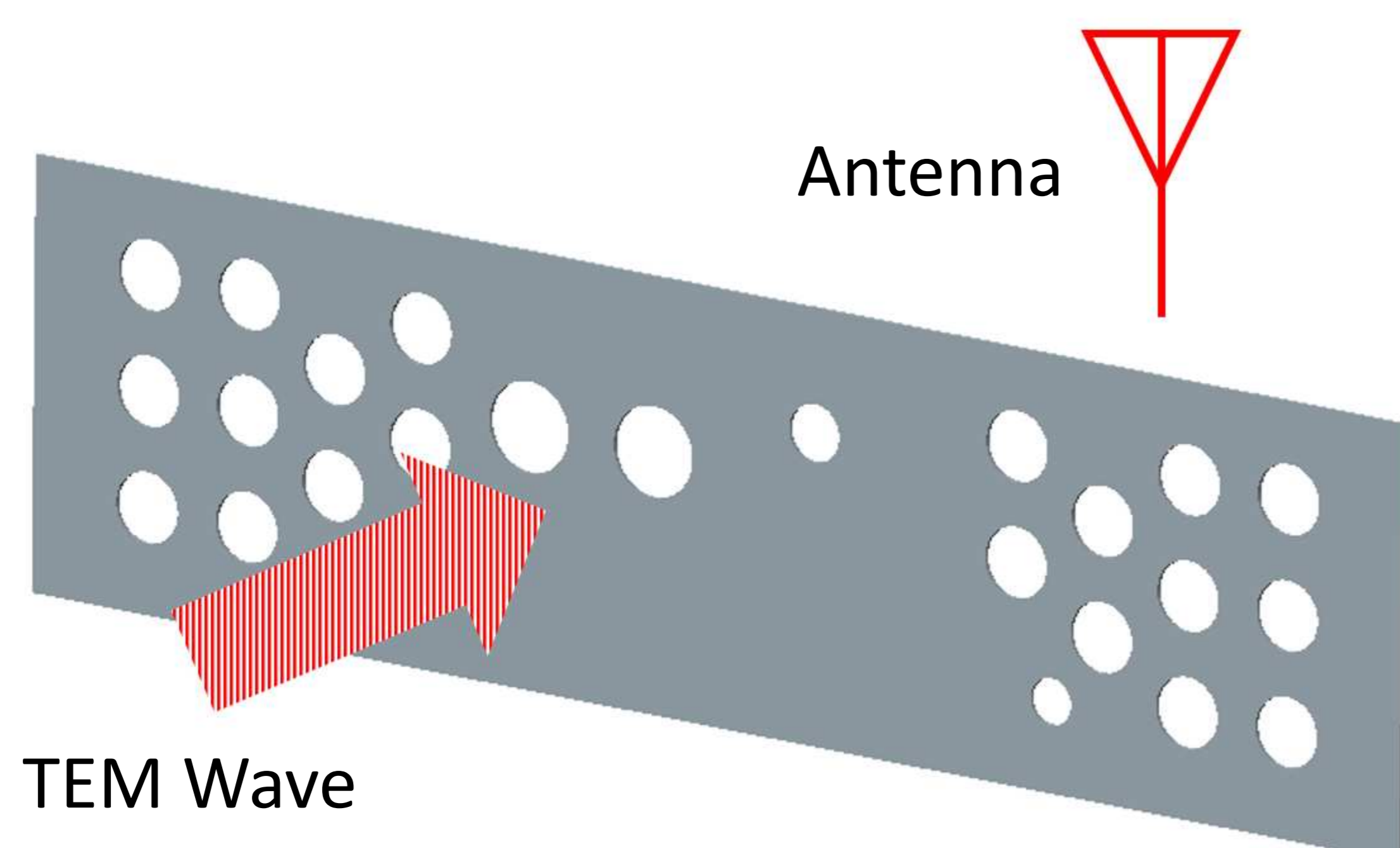


Figure 2. Enclosure Panel with Openings

**Results:** Simulated fields have been virtually measured in a test chamber with PML layers behind the circular hole of the plate. The field damping was compared to analytical calculations and results from the literature.

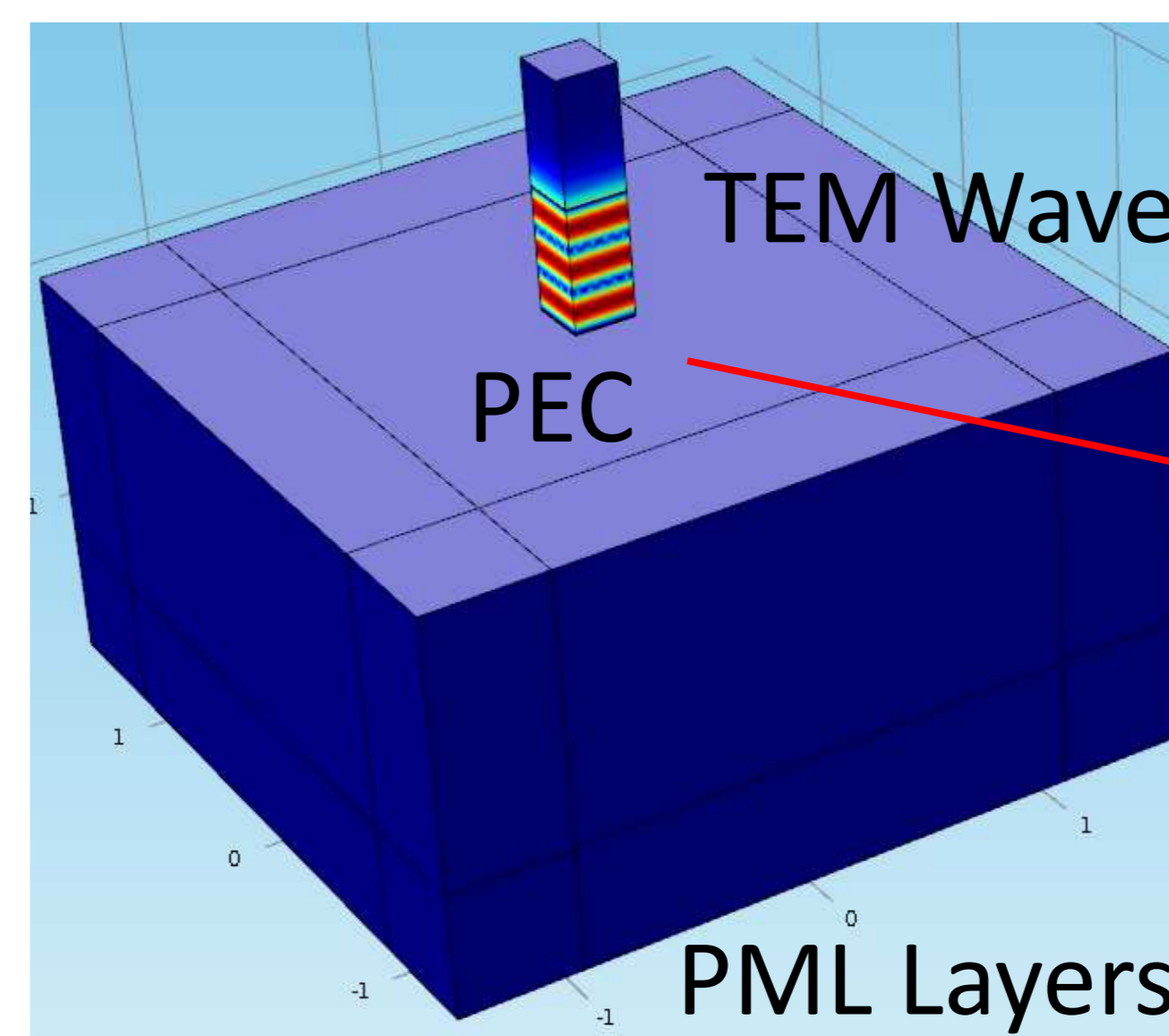


Figure 3. Test Chamber

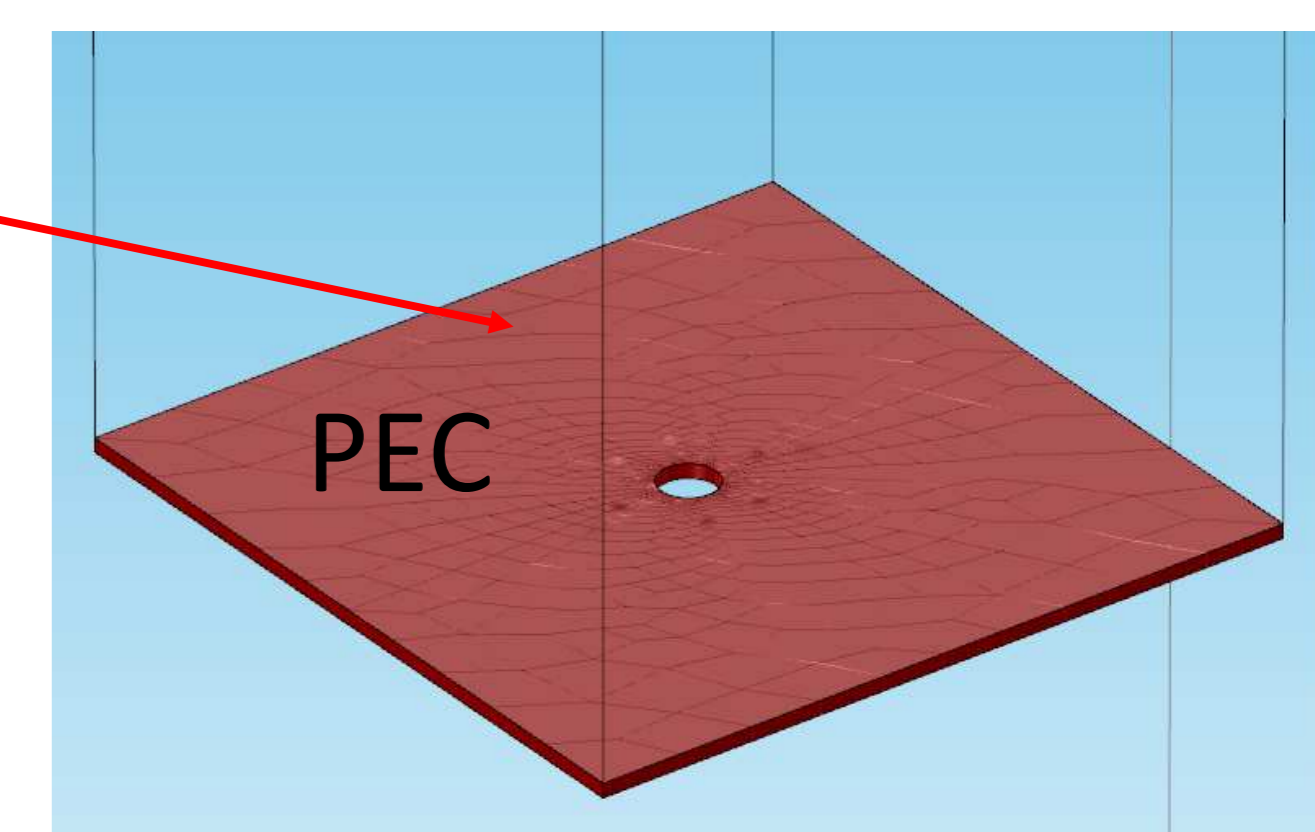


Figure 4. Panel Opening

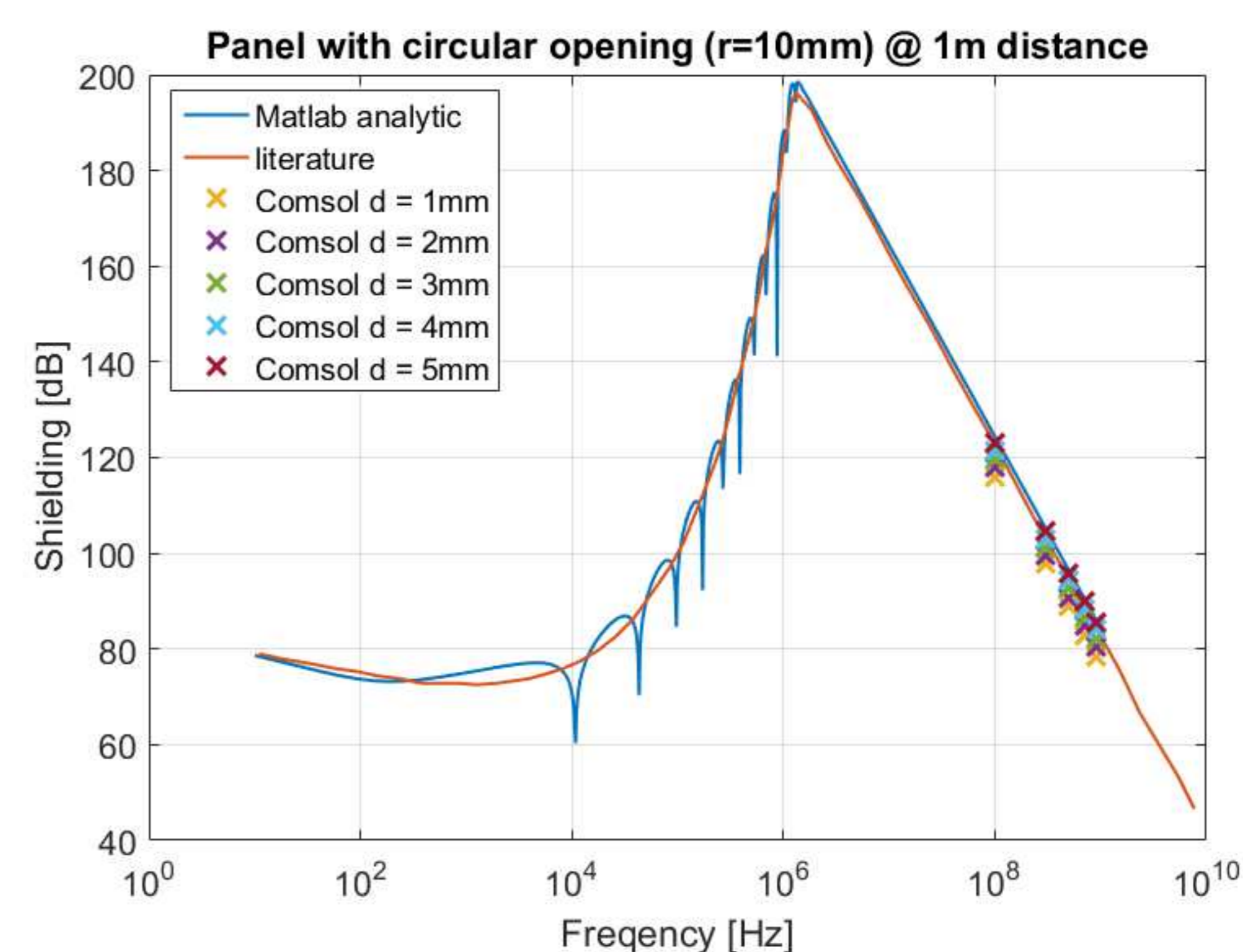


Figure 5. Results for variable panel thickness  $d$

**Conclusions:** Good agreement of simulations and analytic results could be achieved. For direct comparison of measurement and simulation the whole measurement setup has to be taken into account.

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## References:

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