Measured and Simulated Absorption Coefficients for Porous Elastic Materials and Their Use With SEA

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Introduction

Measurements

- Absorption Coefficients from the Impedance Tube, Reverb Room, and Alpha Cabin
- Foam material parameters

Comparison of measured and simulated absorption coefficents

- Normal Incidence
- Random Incidence

Consequences with applications of the model

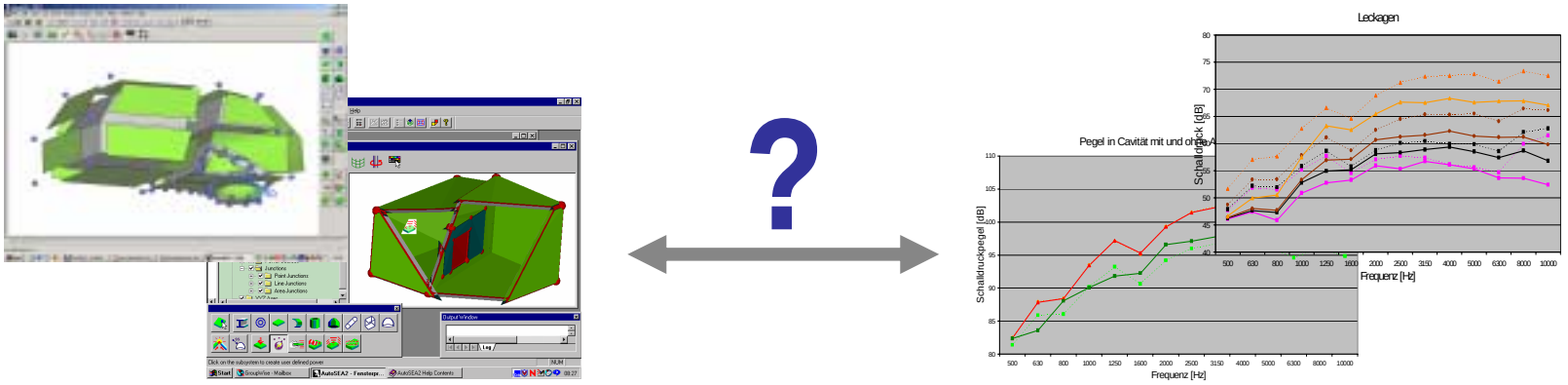
- Component Absorption from Material Parameters
- Component Absorption from Measured Parameters

Summary

Introduction

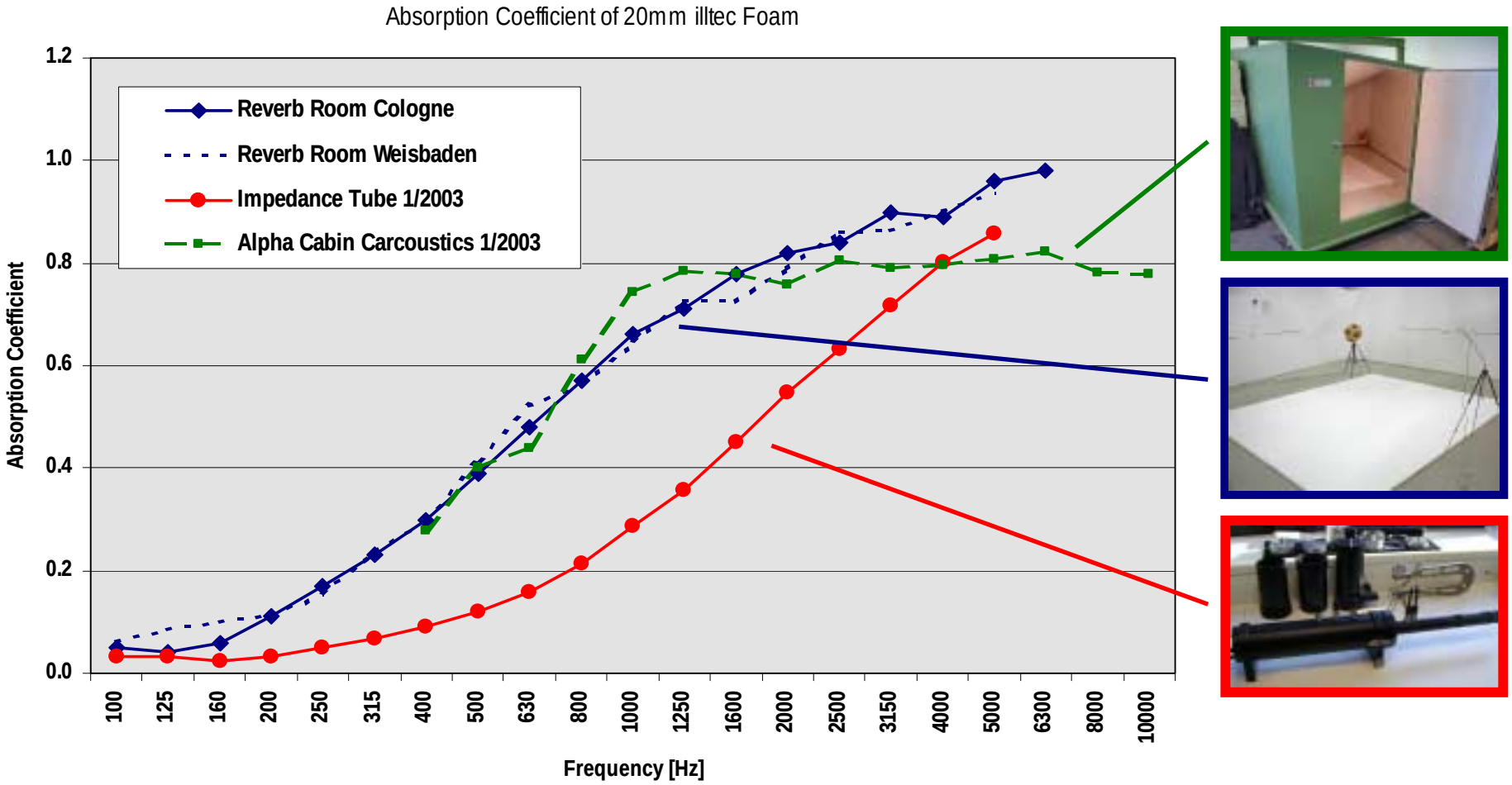
After using SEA for several years in simple and complex models, a question arose: Why do there appear to be systematic differences between measurement and simulations with the use of absorbers of varying size?

Though this is an important question for SEA, it is equally important for anyone quantifying the in-situ performance of an acoustically absorbent material based on a laboratory measurement.



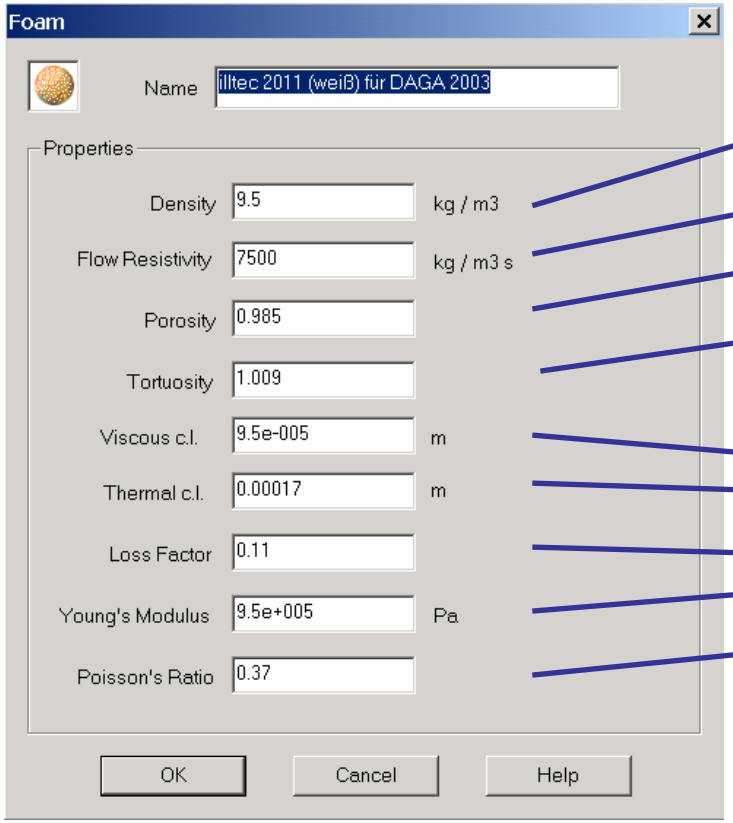
Measurements

Measurements



Measurements

Values for Material Parameters



Density

Airflow Resistance

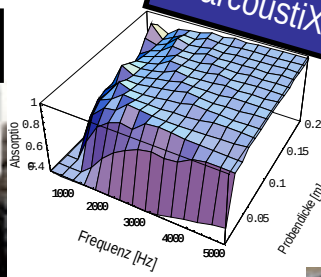
Calculation

Tortuosity

CarcoustiX

DMA

Tensile Test

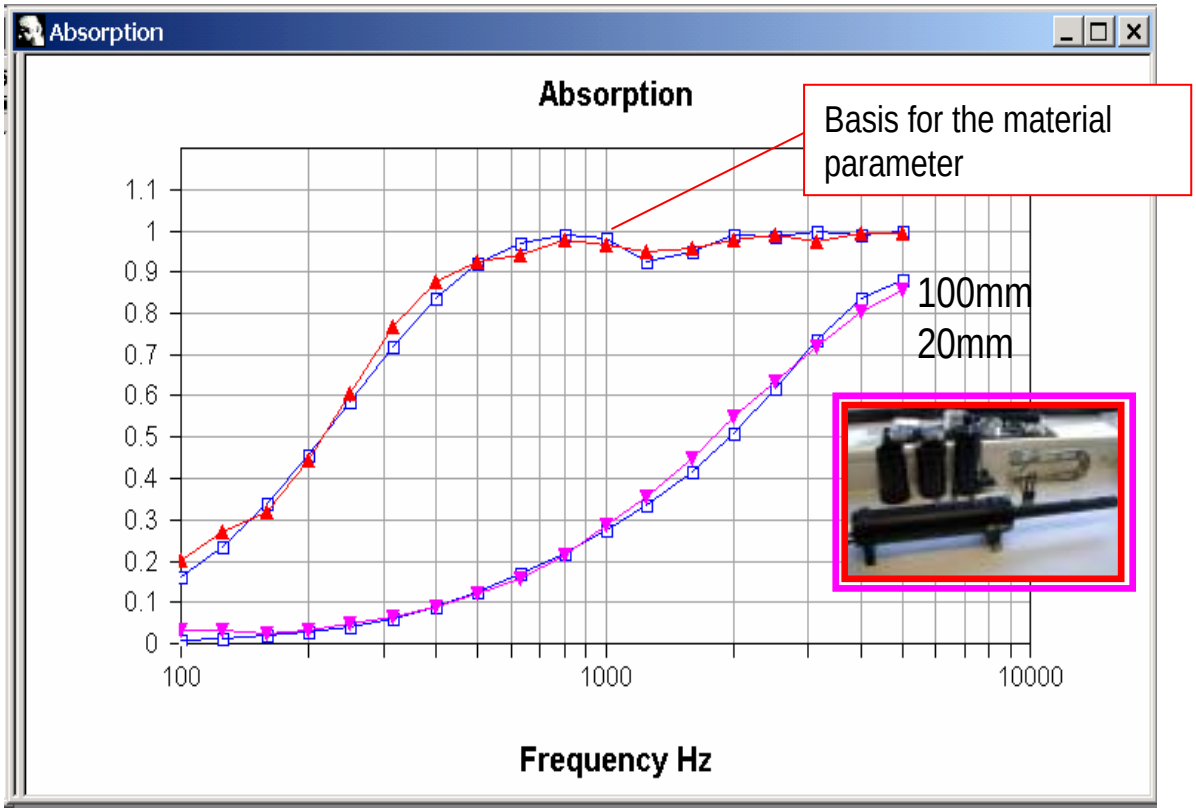


Impedance Tube

Comparison of Measured and Simulated Absorption Coefficients

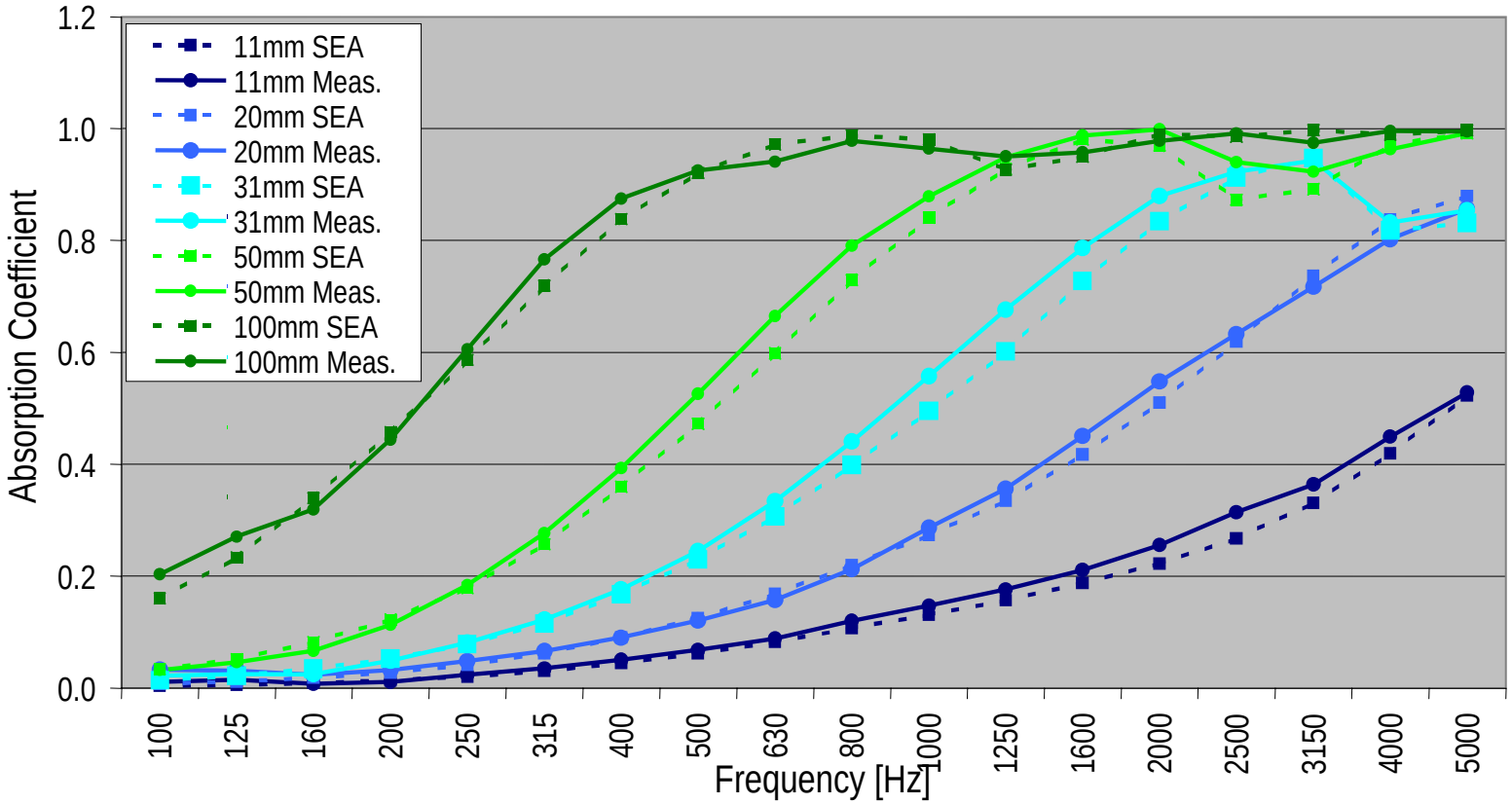
Comparison of Measured and Simulated Absorption Coefficent

20mm foam at normal incidence



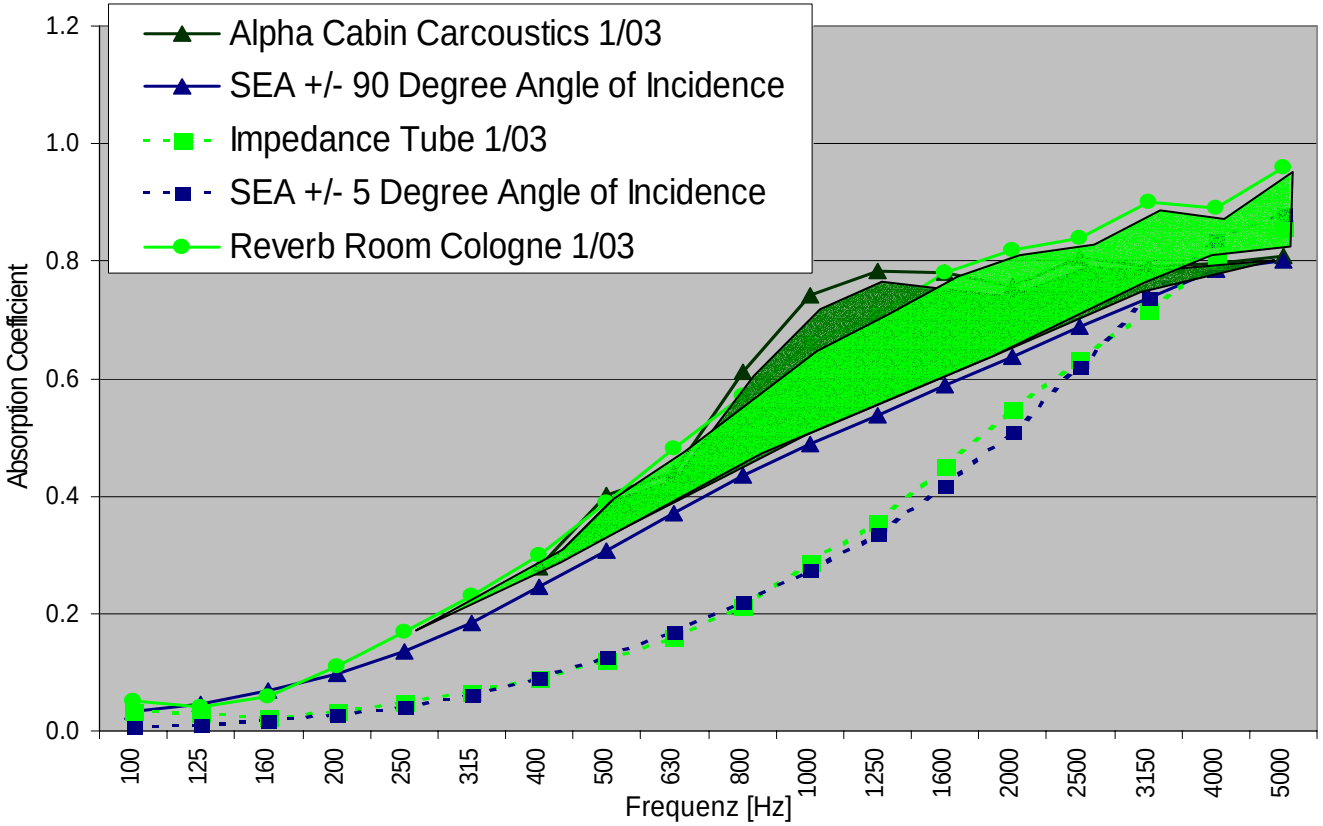
Comparison of the Measured and Simulated Absorption Coefficients

Normal Incidence Absorption Coefficient at a Variety of Thickness'



Comparison of the Measured and Simulated Absorption Coefficients

20mm foam with normal and random incidence



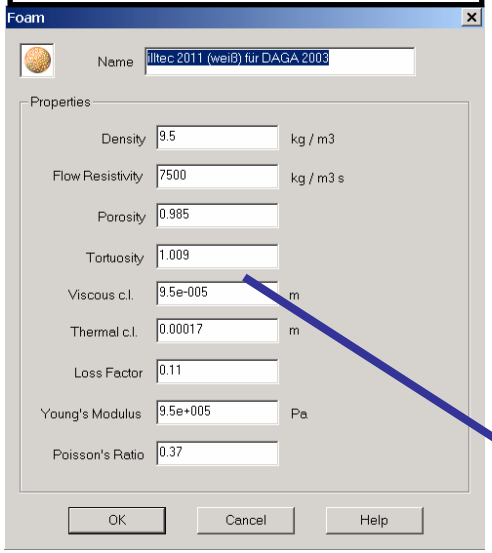
Independent of the random incidence measurement technique (Alpha Cabin or large reverb room) there is a significant difference between the simulated and measured absorption.

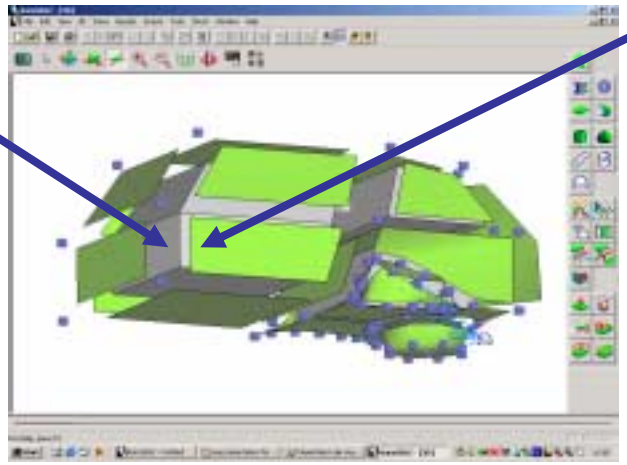
This effect shows up not only with illtec foam (a very homogeneous material), but also with other foams.

Consequences with Application to an SEA Model

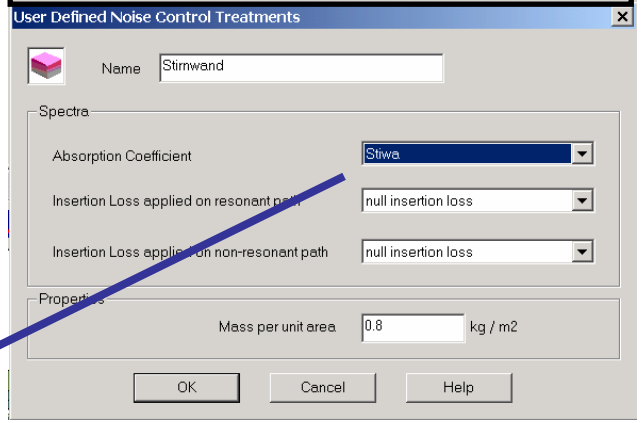
Consequences with Applications to the Model

Absorption from Material Parameters

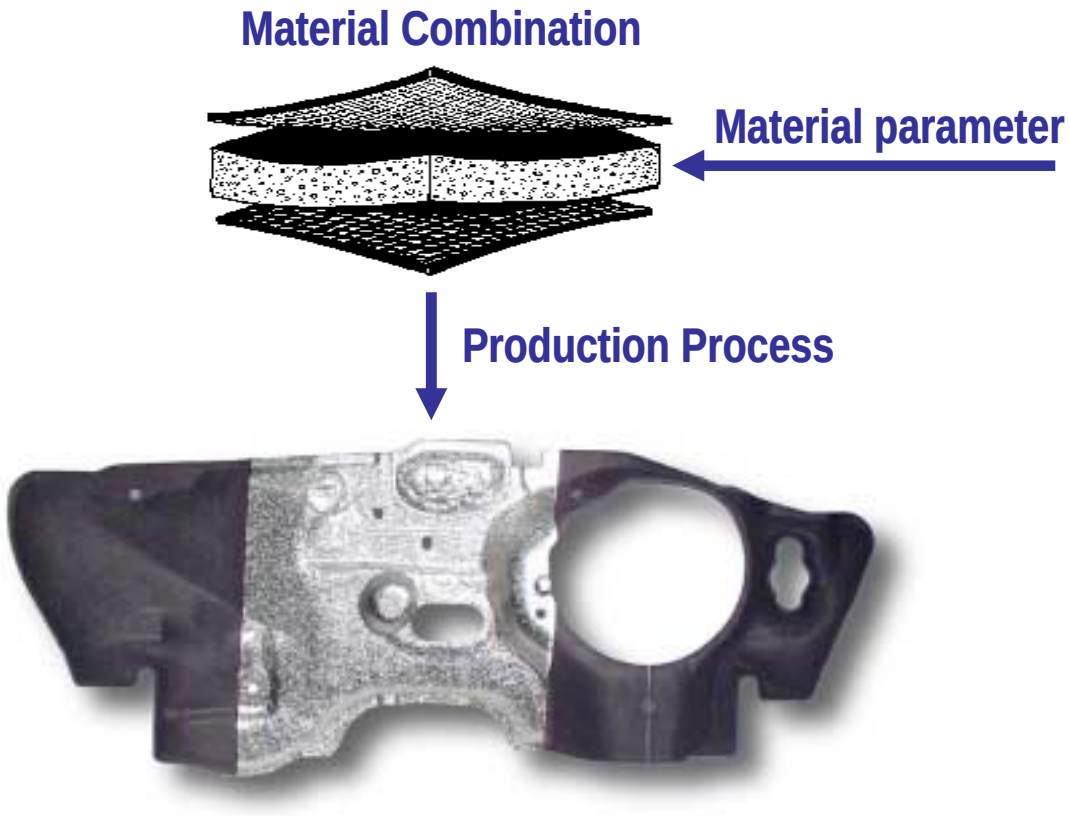




Absorption from Measurements (Alpha Cabin / Reverb Room)



Consequences in the SEA Model



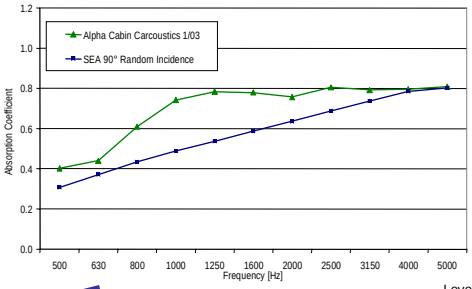
Use a Component Absorption Determined from Material Parameters

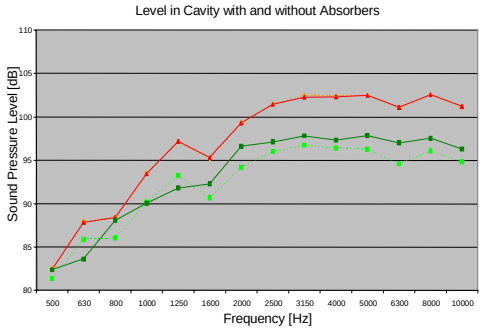
Generate component absorption from material parameters in the model. This component consists of foam with a cover scrim and the material variables can easily be determined.

Layered material models can account for the various materials, but can not easily account for the effects of the manufacturing process. These include the effects of adhesives, effects of the molding process, non-uniform part thickness, etc..

What is the correct absorption coefficient for the component? What is the correct angle of incidence to apply?

Consequences in the SEA Model





Use Actual Measured Absorption

Even when component measurements are available there are still differences between the measured and predicted values for random incidence.

If measurements are available, the effective surface area of the sample can be adjusted to better predict the effect of the absorber.

Summary and Conclusion

The simulation of absorption, based on material parameters, provides reasonable results for models with normal incidence.

With random incidence a clear difference between simulation and measurement of the absorption exists in the middle and high frequency range.

If in place of the simulated absorption, the measured component absorption is used, we must still consider which angle of incidence is present at the location of the component. If the component's absorption is measured in an alpha cabin or reverberation room, then the too high an absorption coefficient leads to an overestimation of the absorption and a corresponding drop in the predicted energy level.

This brief note is to remind SEA users that the angle of incidence plays a very significant role in the measured absorption of a material. In addition, the user is cautioned to consider the complexities of determining the actual component's absorption and the actual angle of incidence the component will experience in-situ.