INFLUENCE OF DESIGN PARAMETER VARIABILITY OF THERMOPLASTIC HONEYCOMB SANDWICH PANELS ON THEIR DYNAMIC BEHAVIOUR

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Summary. This paper deals with design parameter variability of thermoplastic honeycomb sandwich panels and how this reflects on the dynamic behaviour of rectangular panels with free boundary conditions.

ABSTRACT

Honeycomb panels are sandwich structures. Their high specific strength and stiffness together with a low areal mass makes them ideally suited for ground transportation vehicle purposes. They are complex but regular structures.

A first part of this paper gives an overview of the various design parameters that govern the dynamic behavior of freely suspended panels. The specific kind of thermoplastic honeycomb panels that are used for this study is illustrated. Each relevant design parameter is discussed, along with its influence on the dynamic panel behaviour. The dynamic panel behaviour is mainly natural frequencies and mode shapes of panels with totally free boundary conditions. The way how sensitivity analysis are carried out is discussed, along with the results. A number of the design parameters can be determined experimentally. Special attention goes to the measured variability on these parameters. Some parameters cannot be measured easily so
they have to be determined indirectly via finite element simulations that are validated experimentally. The paper fully illustrates how this is done.

The second part of the paper deals with the way the FE model for the numerical prediction of natural frequencies and mode shapes is set up. The way how the different sandwich layers are homogenized is fully treated. For all considered design parameters the relation between parameter variability and variability on the dynamic behaviour of the panels is discussed.

A third part in this article discusses the experimental determination of the considered dynamic panel behaviour. The different experimental setups for the various measurements is outlined. Special attention goes to the estimation of the variability on modal parameters during modal analysis. This part of the paper describes the error assessment for the actual measurements, as well as the errors in the process of estimating modal parameters. The way errors on modal parameters are estimated from the coherence function and the frequency response function synthesis algorithm is fully discussed and illustrated with experimental results. Experimentally determined natural frequencies and mode shapes are used to update the finite element modal. The updating process, along with its results, are briefly discussed.

The final part of the article describes how the dynamic behaviour of a honeycomb panel can be regarded as a stochastic process that is governed by a set of stochastic variables, each having some variability or uncertainty. The two types, epistemic and aleatory uncertainty, are considered. In this study epistemic uncertainty arises from the fact that only limited experimental data is available for the description of the dynamic behaviour or its governing parameters. Aleatory uncertainty of the dynamic behaviour arises from the inherent variability on its governing parameters, namely the design parameters of the honeycomb panel. The principle of describing the stochastic process by means of Random Fields is discussed. Conclusions so far, together with the planned evolution of the research are outlined.
REFERENCES


