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Effective Material Parameters for Perforated Shells

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In this talk we discuss both static loading and free vibration of thin perforated shells of revolution, their asymptotics as the thickness tends to zero, and opportunities for homogenisation of the material parameters. By homogenisation we mean the process of transferring the original problem from a perforated one to one on some reference structure by means of suitably scaled material parameters – the so-called *effective material parameters*.

For source problems homogenisation of material parameters, in other words, derivation of the effective material parameters, is constrained by the dependence of the local features on the dimensionless thickness [1]. Solutions of shell problems under pressure loading are characterised by boundary and internal layers, that actually can be the dominant features thus making homogenisation impractical for certain ranges of the parameter without modifications to the underlying model.

For modal analysis the situation is exactly the same in that localisation does occur, but here the interaction of the perforation pattern and the dimensionless thickness is the key. For shells of revolution the modes have integer valued wave numbers in the angular direction, and the lowest ones are not localised enough to excite boundary layers with large amplitudes. However, when the characteristic length scales of the modes are smaller or equal than those of the perforation patterns, the modes will remain periodic, of course, but with non-trivial linear combinations of different wave numbers [2]. Given a perforation pattern, there exists a *critical thickness* t_c at which the structure of the modes changes and thus, a single homogenisation process cannot be valid over all thicknesses.

REFERENCES

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