

Sound Insulation

Carl Hopkins

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As another book on sound insulation is published, it brings up the question as to what the author could include as new to this fundamental, and somewhat classical, topic of practical acoustics. The answer is that much has been added.

The author has done an excellent job in collecting, describing, and arranging all aspects of sound insulation to fix a contemporary state-of-the-art in the field. In fact, the title “Sound Insulation” is somewhat misleading as the book covers all theoretical and practical aspects of building acoustics and noise control in buildings.

Chapter 1 describes all types of sound fields relevant in sound insulation and building acoustics. This includes sound fields in rooms, in cavities, and also exterior sound fields in the vicinity of surfaces, like facades.

Chapter 2 on “Vibration Fields” treats all wave types, also including modes on beams and plates. The methods used to describe damping include the structural reverberation time and also the new term “absorption length,” which is the equivalent in structure-borne sound to the well-known “absorption area” when dealing with sound fields in rooms. Furthermore, the different methods for assessing the radiation efficiency of finite plates are discussed, becoming vital when measuring flanking transmission or junction data with combinations of building elements. Side aspects of the Chapter cover the radiation into porous material such as into soil.

In 180 pages, Chapter 3, “Measurement,” deals with all classical and modern measurement methods applied in building acoustics. This includes the physical background of all measurement procedures coded in the ISO-standards series ISO 140 with regard to airborne and impact noise, and also the new method on radiation by rain excitation in ISO 140-18. The different methods for measuring reverberation time (including the effects of the detector and of filtering) and the application of Maximum Length Sequence (MLS) are discussed. Further sections treat the measurement methods to evaluate material properties (such as airflow resistance, sound absorption, and dynamic stiffness). The final section discusses measurement methods for assessing flanking transmission, in the laboratory as well as in a building. Major aspects are to study the energy flow and to rank the sound power radiated by complex structures, and to identify defects and their location.

Chapter 4 titled “Direct Sound Transmission” covers, besides an introduction to Statistical Energy Analysis (SEA), the airborne and impact sound insulating properties of various types of building elements. Included in airborne sound insulation are: solid homogeneous isotropic and orthotropic plates, membranes, plate-cavity-plate-systems (“double walls”) including structural coupling by point or line joints, sandwich panels, surface finishes and linings, and the sound transmission through porous material and through gaps, holes, and slits. Also windows and glass units are covered to some extent. The section “Impact Sound Insulation” discusses heavy and lightweight base floors, and various types of floating floors to improve overall performance.

Chapter 5 on combining direct and flanking sound transmission might be seen as the principal chapter of the book, revealing the authors knowledge and long experience with the various methods and models used for the prediction of sound insulation in buildings. This includes a review of the calculation methods in the standard series EN 12354, being transferred to ISO as series ISO 15712. The vibration transmission across junctions are discussed for rigid X-, T-, and L-junctions, junctions with elastic interlayers and junctions of angled plates. The bending wave approach is discussed versus the combined approach, considering bending and quasi-longitudinal and transverse shear waves. Finally, the author discusses the statistics in prediction of junction data using FEM and SEA, when plate dimensions are slightly changed (causing different mode frequencies). The book ends with an annex listing acoustically relevant properties of materials used in building construction.

This book is certainly not a construction guide helping design engineers to solve practical design problems, such as answering the question: “Which type of sound-proofing should I use in a medical office to respect the requirement?” Carl Hopkins’ book has a different intention: to provide a principal understanding of the fundamental physics of phenomena relevant in building acoustics and apply the measurement of material properties and element data to the application of models to predict building performance. Already in the book’s preface the author pens out his “philosophy” with sentences like this: “A model provides no more than the word implies” or “Every model is correct within the confines of its assumptions”. And as complexity is not a characteristic of its own: “Choosing the most accurate and complex model for every aspect of sound transmission is unnecessary”. So far, so good.

Highly recommended.

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