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Protection against noise is one of the six essential requirements of the European Construction Product directive. In buildings, airborne sound insulation is used to define the acoustical quality between rooms. In order to develop wall structures with optimal sound insulation, an understanding of the physical origins of sound transmission is necessary. The purpose of this thesis was, firstly, to study and compare the validity of existing physical models to predict the sound insulation of wall structures, and, secondly, to study the benefits of the sound intensity measurement method for determining the sound insulation. To develop the kind of knowledge that is applicable to the improvement of real wall and door structures was the motive behind this study.

Five main results are summarized in the following. 1. It was possible to measure wall structures with a considerably, up to 22 dB, higher sound reduction index with the intensity method than with the pressure method. Thus, the intensity method enables the determination of sound insulation in the presence of strong flanking where the pressure method gives only an underestimate. 2. The sound transmission through doors was modelled by two separate paths: a structural path through the door leaf and a leaking path through the door slits. The structural path was predicted using Sharp's model. The agreement with measurements was reasonably good except at high frequencies where overestimations were obtained. The leaking path was predicted using the model of Gomperts and Kihlman. The agreement with measurements was good for free apertures. 3. Thirteen existing prediction models of double panels were compared. The variations in predicted sound reduction indices were high, 20-40 dB. Further work is needed to rank different models according to their reliability for practical structures. In addition, there is an obvious need to develop a hybrid model where all the important parameters are considered. 4. A new flanking mechanism could be observed *in situ* for a floating floor covering over a concrete slab. Identical floor structures in adjacent dwellings led to strong flanking transmission at the double panel resonance frequency of the floors. Strong flanking could be avoided by modifying the double structure in one dwelling. 5. In general, the most typical design fault of sound insulating double structures was strong mechanical connections, either in the form of rigid interpanel connections (studs) or in the form of bonded cavity absorbent (sandwich structures). In the case of door structures, efforts are usually wasted on the development of the structure, while the leak transmission may be the main transmission path.

The results of this study are useful when the intensity method is used in the presence of strong flanking sound, the sound insulation of wall and door structures are predicted or improved and when prediction models are developed.

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