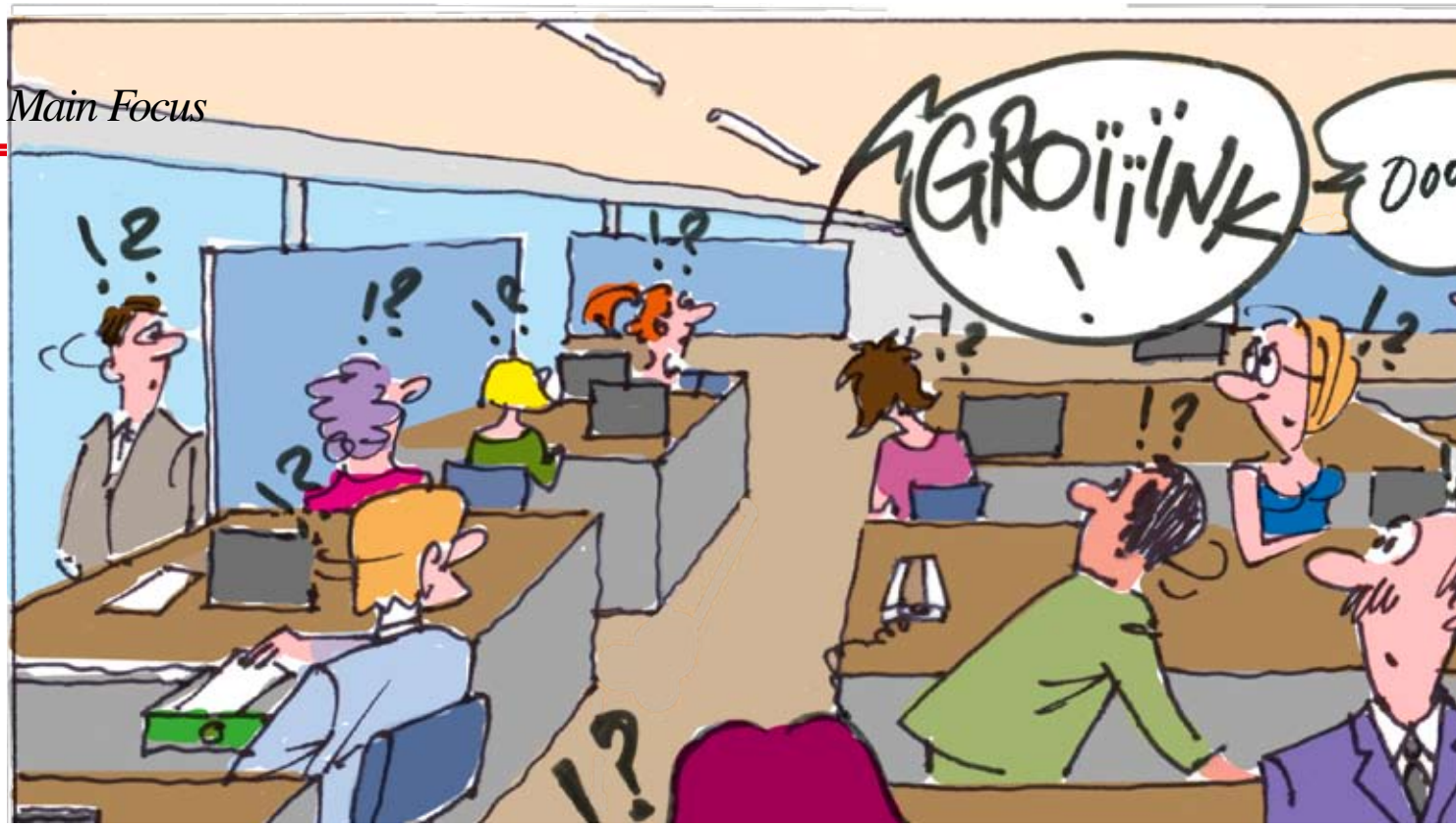

Quiet as a mouse

by Werner Scholl, Head of applied acoustics department, Physikalisch-Technische Bundesanstalt

Building acoustics are an essential factor for maintaining our comfort and health and that of people around us. In many countries, sound insulation is considered a matter of public interest and control. Lack of sound insulation can result in immense costs for health.

Whenever possible, acoustics should be considered during the early design stage of buildings, as subsequent modifications are much more costly. The acoustical design of buildings comprises several steps:

- characterization of acoustical performance of building elements through laboratory measurements;
- prediction of acoustical performance when combining such elements; and
- measurements in situ to control the achieved sound insulation.

The series of ISO 140 standards cover the laboratory measurement of airborne and impact sound reduction of building elements and *in situ* measurements in buildings. The ISO 140 series is entitled *Acoustics – Measurement of sound insulation in buildings and of building elements*, and is currently composed of 13 different parts (see **Box** on page 13). The series specifies detailed requirements on how to construct test facilities for sound insulation and verify their quality. It also provides procedures for checking the measurement equipment, as well as special test specimens to test the laboratories themselves.

Meeting the needs of manufacturers

Typical building elements characterized by ISO 140 are walls, floors, floor coverings, suspended ceilings, acoustical linings, doors, windows, glazings, facades, roofs and small elements relevant for sound insulation like ventilation openings, among others. The series is thus of great importance for the large majority of manufacturers of buildings and building elements.

Furthermore, no control of sound insulation requirements would be possible without the standardized measurement methods included in ISO 140. Manufacturers demand accepted measurement procedures, which yield results that can be easily compared to others. This eases the market, and allows them to concentrate on the improvement of their products. Their interest is reflected in the large participation of industry in most working groups dealing with sound insulation. In fact, many determinations included in ISO 140 are the result of focussed discussions among the involved parties.

Love thy neighbour

The ISO 140 series not only improves the market but is also powerful protection for the occupants of buildings. Clear choices regarding sufficient sound reduction will help to avoid future lawsuits.

ISO 140 is quite complicated from the technical point of view. Determining sound reduction of buildings and building elements means finding a number which characterizes the power ratio of the soundfields in two (adjacent) rooms. This involves not only a lot of spatiotemporal averaging, but also the correction for unwanted bypass sound transmission and background noise. To make it more complicated, in most cases, a noticeable structure-borne sound interference between test specimen and lab cannot be avoided and has to be taken into consideration. Knowledge and experience based on the ISO 140 series and the need to supplement the existing parts have lead to worldwide efforts in acoustical research. Thus, new questions could be solved and standardized, such as reducing noise produced by rainfall on lightweight roofs or impact noise (by walking people) improvement by placing floor coverings

on lightweight floors, which are becoming more and more widespread, although with a certain tendency to produce different noise problems. The "old" ISO 140 tapping machine – five motorized 500 g hammers hitting the floor under test – has become the starting point for research in new structure-borne sound sources which will be seriously needed in the future to simulate structure-borne impacts in buildings.

The question of uncertainty

ISO 140 has grown like a plant over the years (or should one say like a jungle) and is now undergoing a renovation process in order to remove duplication in its different parts, to rearrange topics which belong together and to remove conflicting requirements in different parts of the series. The chance is now being taken to approach one of the big remaining questions in acoustics: the uncertainty of measurements specifically in building acoustics. This turns out to be even more complicated than the measurement itself, partly because many perturbations cannot be quantified and thus cannot be used for "simple" error analysis. To make it worse (or more interesting), many effects in building acoustics are nonlinear, and simple "Gaussian" statistics cannot be applied because samples are usually very small, due to high costs for building and building element testing. So, scale model testing in building acoustics (as successfully applied at PTB in Germany) has become another "child" of the ISO 140 series.

Finally, it should be mentioned that the measurement standard series ISO 140 is narrowly linked to the ISO 717 series, *Acoustics – Rating of sound insulation in buildings and of building elements*, which allows the reduction of the frequency spectra of sound insulation quantities to a single number, which is easier to handle in practice, when comparing products or performance of buildings with requirements. On the other hand, ISO 140 is linked to prediction standards, e.g. the EN 12354 series, *Building acoustics – Estimation of acoustic performance of buildings from the performance of products*, used in Europe to predict sound insulation in buildings.

ISO 140 is like a living organism, and will develop and grow as long as development in buildings and building elements will continue. ■

The ISO 140 series *Acoustics – Measurement of sound insulation in buildings and of building elements* is composed of 15 parts:

- Part 1: *Requirements for laboratory test facilities with suppressed flanking transmission*
- Part 2: *Determination, verification and application of precision data*
- Part 3: *Laboratory measurements of airborne sound insulation of building elements*
- Part 4: *Field measurements of airborne sound insulation between rooms*
- Part 5: *Field measurements of airborne sound insulation of façade elements and façades*
- Part 6: *Laboratory measurements of impact sound insulation of floors*
- Part 7: *Field measurements of impact sound insulation of floors*
- Part 8: *Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor*
- Part 10: *Laboratory measurements of airborne sound insulation of small building elements*
- Part 11: *Laboratory measurements of the reduction of transmitted impact sound by floor coverings on lightweight reference floors*
- Part 14: *Guidelines for special situations in the field*
- Part 16: *Laboratory measurement of the sound reduction index improvement by additional lining*
- Part 18: *Laboratory measurement of sound generated by rainfall on building elements*

About the author

Prof. Dr.-Ing. Werner Scholl has been Head of the applied acoustics department at Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany, since 2003. Previously, he worked at PTB's section on applied acoustics. From 1995 to 2001 he was Head of the department building acoustics, at Fraunhofer-Institut Bauphysik, and from 1990 to 1995 he was Head of the working group building elements at the same institution. Prof. Scholl worked as a consulting engineer in ITA Wiesbaden from 1985 to 1989. Before that, he was a scientific employee at the Technical University of Berlin. His academic training is as an engineer in electrotechnics.