Room and building acoustic regulations and directives in Hungary – Revisions and new requirements

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Summary
This paper gives an overview about the current state of Hungarian regulation and standardization in the field of building and room acoustics.
Sound insulation requirements in buildings are defined in two standards that were created in 2007. The first part covers the internal sound insulation requirements – both airborne and impact –, whilst the second standard deals with facade sound insulation. After 10 years of application, although their basic concept has proved to be practical, a revision was necessary. The revision of the standard was initialized by the Hungarian chamber of Engineers. The aim was to correct, extend and clarify ambiguous parts and uncertainties and to comply both new architectural and European standardization trends. In this paper we give a summary on the status of the ongoing revision.
In case of room acoustics, there hasn't been any regulation or standardized design criteria in Hungary up until recently. As the demand for acoustical comfort in the building industry is becoming more and more important, regulations and standards are needed as the basic tools that define quality metrics and help realize different levels of comfort. For this purpose a new national directive has been created that defines basic requirements of acoustical comfort in premises of different functions. The requirements are twofold: for each different room type where people work and socialize, limits for background noise level and mean reverberation time values are given depending on room volume. For each function an enhanced comfort criteria is also given. This approach conforms to typical international standards and also with the Hungarian standards defining the sound insulation requirements. In this paper we also present this new directive in detail.

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1. Introduction

Most of acoustics related Hungarian standards are harmonised with the international, or primarily with the European system of standards.

Like in other European countries, system of Hungarian standards is not limited exclusively to national standards. International and regional (European) standards can be introduced to each country's own system, but due to differences between countries' capabilities, nature and interest, member states of international standardisation organisations participate in the standardisation work to different extents. Consequently, member states are not obliged to introduce all international standard automatically, and if introduced, adaptation is allowed.

The ratio of international to national standards in the EU member states is continuously increasing, however, national standards will always remain valid in fields that inernational or European standardization does not cover, and new national standards can also be developed.

2. Hungarian standards in building acoustics

Hungarian standards are marked with MSZ (stand for Magyar Szabvány – Hungarian Standard). Adopted European standards, as everywhere, are marked with EN, whilst international with the ISO tag.

Standards in building acoustics can be divided into 3 larger groups:

- standards about requirements,
- standards on test methods,
- standards on calculation methods.

There are two national level standards about building acoustical requirements, especially about sound insulation in Hungary, both were published in 2007:

- MSZ 15601-1: Sound insulation requirements inside buildings
- MSZ 15601-2: Sound insulation requirements of facades.

When developing these standards, Hungarian experts relied on other, well known standards in Europe, like the then valid version of DIN 4109, but also kept in mind local possibilities and needs. This resulted in a modern, up-to-date system of requirements.

There is no national standard on test and calculation methods, as Hungary has introduced EN ISO standards on these topics several years ago. The new versions of these (10140 series, 16283, 3382 and so on) are also turned into national standards generally within a fairly short time frame.

3. Revision of standards on building acoustical requirements in Hungary

The Hungarian standards on building acoustical requirements – MSZ 15601-1 and MSZ 15601-2 – as stated above, were published in 2007. Ten years have passed since then, during which a lot of experience has been gathered about their application. Building industry and society's needs, as well as customers' demands and the available solutions have changed. Although the basic concept of the standards has proved to be practical, their revision is necessary: errors should be corrected, they need to be extended, ambiguous parts and uncertainties should be clarified.

The Acoustic Section of the Hungarian Chamber of Engineers launched a workgroup in 2017 in order to prepare the revision of the standards. As a result of its work, a revision report has been created, that lists the identified problems. In the next section we summarize this comprehensive document – focusing mainly on the sound insulation requirements in buildings. Based on the findings of the revision report, a more wide survey will start to collect opinions of other experts, potentially all end-users of the standard. This will be followed by a targeted research to find aswers for all emerged questions and problems, and finally, the draft version of the standard will be assembled. The draft version is expected to be ready by end of 2018, beginning of 2019.

3.1. MSZ 15601-1 Sound insulation requirements inside buildings

The MSZ 15601-1 standard defines airborne and impact sound insulation requirements inside buildings. It gives minimum performance values for most building types of homogeneous function, and also defines an optional enhanced, higher value for higher acoustic comfort. To cover buildings with mixed functions, the standard introduced correction factors (ΔR_s, ΔL_s) that increase the sound insulation requirement depending on the function of the noisier premise.

The revision report's general conclusion was that the system consisting of a minimum and a higher, optional value, together with the correction factor is in general a practical and flexible system. Minimum performance values define basic acoustical comforts for general (normal) usage of the premises. By defining the minimum requirements, the intent of the standard's developers was to ensure a complaint-free, undisturbed living and working environment for the majority of population.

An everyday application problem is the design of mixed function buildings. The number of these buildings is increasing, whilst requirements for some of the new, more frequent function-combinations are missing, or their determination is indefinite. Although the standard's concept is appropriate to cover these cases too, reconstruction and revision of correction factors and main categories based on exhaustive data collection is needed.

Another task is the harmonization of this standard with the latest ISO standards on test procedures. MSZ 15601-1 for some cases includes requirements expressed not in apparent, but in laboratory measured sound reduction index (e.g. for connection between corridor and dwelling), the in-situ verification procedure of which in general and its accuracy is undetermined. Similarly, there are cases where the measurement standard is not applicable for verification of sound reduction index between rooms (e.g. the sound field is not diffuse). These should be investigated, and an accurate and straightforward verification method should be developed.

3.2. MSZ 15601-2: Sound insulation requirements of facades

MSZ 15601-2 standard defines a procedure for determining sound insulation requirement for facades. The requirement is calculated from the traffic noise load on the facade, the permissible noise level inside the room behind the facade, the geometrical properties of the facade and the equivalent sound absorption in the room. The system of requirements is logical and easily applicable for the majority of the cases. But

there are sloping facades (roof), where the requirement is uncertain, and shell-and-core office buildings, where the final layout of rooms is not determined in advance, and at the time of building handover there isn't any room of suitable size to perform standardized measurements for verification. Furthermore, the question of permissible noise levels needs and its compatibility should be reconsidered: the standard gives values to be used for determining the sound insulation requirement, but there is a ministerial decree about permissible noise levels too.

3.3. Connection between standards on requirements and ministerial decrees in Hungary

The revision report also concluded that beside the two standards in question, the ministerial decree on permissible noise and vibration levels should also be revised [1]. Sound insulation is only a tool for fulfilling noise level requirements that are given in this decree. Therefore their connection should be cleared and their content harmonized.

This decree has been revised several time since its first issue. Still it contains unclear parts, terms and concepts, therefore its revision is necessary not only due to its connection to building acoustical requirements.

4. Suggested modification, clarification and reconstruction points

In the next points we give some examples on what problems and questions were found in the standards during their analysis. The list is incomplete and concise.

4.1. Clarification of minimum sound insulation values being mandatory

Application of standards in general, as in other countries, is voluntary in Hungary (Act XXVIII of 1995). However, another decree or act may make the requirements given in the standard mandatory in certain cases: the governmental decree on national town planning and building requirements[2] gives such a reference.

The first task in the revision of the standard as identified by the workgroup is to clarify the description of the cases, when the application of the requirements are mandatory: what level of refurbishment, modernization and extension, change in the building's function justifies the application, and not less important, for what cases is 'requirement cannot be fulfilled' an acceptable choice. Formulation of the exceptions should guarantee exclusion of cheap financial and others reasons that would result in a weak rule.

4.2. Definition of typical usage of rooms and buildings

The standards explain in which circumstances do the requirements ensure acceptable acoustical comfort. In case of sound insulation values (both airborne and impact) these circumstances are the typical noise level in the room for a given function (source room) and the permissible maximum noise level in the room to be protected against noise (receiver room).

In case of the 'noisy' (source) room we assume that it is used as intended, in a general, typical way, therefore the noise load on its boundary structures can be characterised by its function (typical usage noise). On the other hand, we also assume that the receiver room is used as intended, in a general, typical way, and thus the permissible noise level from the adjoining dwelling is also depending on the function of the (receiver) room. If both source and receiver rooms are used in their intended, typical way, the given sound insulation requirements ensure acceptable acoustic separation and comfort.

Although intended or typical usage was a key factor in forming the system of requirements, the standard does not declare explicitly what noise levels are assumed as intended or typical for each room type. This was done on purpose, as 'typical' noise levels of normal living are not verifiable or controllable. Still, if the usage and thus the noise level produced is a-typical, unusually high, the sound insulation requirements are dissatisfactory.

In case of a professional usage (any economic activity, production or service), noise limits exists which can serve as basis for sound insulation design. If function of a room changes, the sound insulation requirement should change accordingly. In general, this is managed suitably by using the correction factors (ΔR_s, ΔL_s).

Conclusion: Compared to other international regulations ([1]), the basic sound insulation values given in the standard yield satisfactory acoustic separation for most typical cases. A-typical cases should be managed somehow, but probable this goes beyond the scope of the standard. International experience on this topic should be gathered.

4.3. Correction factors

In general, if function of the two adjoining premises is different, correction factors should be added to the basic sound insulation requirement values to determine the actual requirement for the connection. This is

[1] 27/2008. (XII.3.) KvVM – EüM együttes rendelete a környezetvédelmi és vízügyi miniszter, valamint az egészségügyi miniszter környezeti zaj- és rezgésterhelési határértékek megállapításáról.

[2] 253/1997. (XII. 20.) Korm. rendelet az országos településrendezési és építési követelményekről.

straightforward, when the basic function of the building is clear (ie. dwelling, office building). In multifunctional buildings, the application of the correction factor is undefined, uncertain: which is the basic function that determines the basic requirement value? Which basic requirement should be modified by the correction factor?

The question might be answered by considering the assumed typical, intended noise level, but without explicit typical noise levels, this is not always possible. The identification of the noisier and the less noisy room is sometimes too cumbersome, if not impossible.

Proposed task: the standard should be made more straightforward, and should include guidelines for its application to unspecified cases. International experience on this topic too should be gathered and studied.

4.4. Selection of main sound insulation descriptors

The current standard for sound insulation requirements inside buildings uses sound reduction index (both laboratory and apparent), corrected with spectral adaptation terms. However, European research results [1] show that standardized level difference (D_{nT}) correlates more to the subjective estimation of insulation than sound reduction index, and also this is the proposed harmonized descriptor.

At first look using standardized level difference would make design too cumbersome, furthermore it would make the standard rather uninterpretable and thus useless for the lame user (for a typical, non-acoustician architect). Still in some cases, where the geometry of rooms are complex, or for extreme room dimensions, standardized level difference could be a solution for describing sound insulation requirement. On the other hand, many experts do already use standardized level difference in their practice as investors ask for assessment of building according to other European standards or classification procedures (like BREEAM).

Products and systems for building constructions are characterised by sound reduction index, this makes it inherently compatible with the current requirement system. Whereas standards on test method use standardized level difference for some cases.

Conclusion: Sound reduction index with spectral adaptation term is slowly becoming accepted by stakeholders and architects. Changing sound reduction index, or extending the existing requirements with a new descriptor might be unfortunate. Nevertheless the transition must be considered. This must be thoroughly discussed by experts, the possible transition and translation of descriptors should be examined. International research results and experience should also be gathered and studied.

4.5. Extension of room connection types

The MSZ 15601-1 standard defines requirements for horizontal and vertical room connections, ie. only for rooms on the same level or below each other.

The workgroup proposes that the revised standard should include requirements for diagonal connections where there isn't any common separating structure (surface). Furthermore, the standard should emphasize that in vertical connections sound propagation from the lower room to an upper room is also possible, and thus the requirement for vertical connections also applies.

As in these cases only standardized level difference can be measured, the extension of the standard on requirements with these new connection type should be considered (see previous section).

4.6. New categories and requirements

The workgroup has given a list of typical, everyday cases where the current standard does not specifies any requirement. The most urgent deficiency is healthcare buildings. The requirement given in the current standard is too rough, too general: treatment room, ward, bedroom and operating theatre and their connection types should be distinguished.

4.7. Problems from new construction technologies

For office buildings the current standard distinguishes room connections between the same and between different tenants, the requirements are stricter for the latter case. Unfortunately, the in shell-and-core buildings the drywall constructions are determined rather by technology, best practice and financial aspects, and not by the acoustical requirements. Typically there is false floor and suspended ceiling to hide the HVAC system and electrical cabling – these are already installed by the handover of the building –, whilst the floor layout and location of separating walls are determined only later on, by the tenant. This results in separating walls starting from the floor and running only up to the level of the suspended ceiling. Sound insulation requirement values and the entire system of requirements should be re-considered by taking into account the available and typical constructions and practices.

This is a serious problem: requirements must not confront with construction trends. On the other hand, requirements must not follow inappropriate construction solutions and typical building operator habits – requirements must not be lowered only because of bad practice. Requirements should be revised based on careful research. It should be investigated, whether the acoustical separation achievable with current construction practice is satisfactory for the end-users of

the office buildings. Secondly, sound insulation requirements of other countries should be studied. Alteration of any requirement must not be made before evaluating these information

We must note that tenants may change by time. Due to protection of sensitive information, higher level sound insulation might be needed between some premises. When specifying the requirements, it must be noted, that necessary sound insulation might not be achieved after the layout and construction technology are settled.

4.8. Harmonization between requirements in standards and decrees

In Hungary there is concurring (dual) regulation in the noise and vibration control section. For some cases both sound insulation requirement and permissible noise level are given.

The concurring regulation should be resolved and made straightforward. The sound insulation requirement is a tool to ensure sufficient levels of protection against typical usage noise levels. Typical usage noise is a normative load, just like Summer and Winter temperature, payload, wind load, etc. It depends on the rooms function, if function changes, noise load changes too. As written above, the basic problem is that typical usage noise is undetermined.

5. Room acoustical requirements in Hungary

5.1. Requirements in room acoustics

Up until 2018 there has never been a global, comprehensive regulation on room acoustical requirements in Hungary, no standard, decree or directive. Acoustic experts have worked by their experience, based on national and international best practice, and by trying to enforce requirements from standards or recommendations of other countries. In most cases, the Swedish classification standard ([2]) or DIN requirements were used. For room acoustical measurements, international standards have been adopted (ISO 3382 series, ISO 18233).

Hungarian experts have made serious efforts in order to create an appropriate and applicable regulation in this field too. A development of a new standard on room acoustical requirements was started in the end of 2016. The long process of the development is still ongoing.

In Hungary, it is common to issue technical directives in fields, which are not covered by any existing standard or regulation, or where the existing standards and decrees are inadequate. Application of this directives is voluntary, but can be made mandatory by each contract separately.

Technical Directives on Building Construction are developed by workgroups initiated by the Technical Committee on Building Construction.

As there had been no regulation on room acoustical requirements, development of a directive was necessary. Its preparation started in middle of 2016, and the development concluded by the end of 2017. This directive fills the gap and can be used until the standard on room acoustical requirements is issued.

The directive gives requirements of acoustical comfort for rooms of different functions. The acoustical comfort of a room is determined by the appropriate room acoustical environment (equivalent sound absorption and other factors influencing sound propagation), the noise level from service machinery and other sources inside the building, and also the sound insulation of the facade (noise from outside of the building). Of course all three are slightly depending on eachother, therefore it is useful to handle them together.

In many cases, appropriate acoustical environment is necessary for the proper usage of the room (lecture halls, concert halls, studios), whilst in other rooms, acoustical environment can serve as an added value and helps relaxation, more efficient work or studies, or faster recreation. Acoustically pleasant environment helps to maintain a more balanced lifestyle, which is beneficial not only for the individual but also for the entire society. In special cases – like for emergency communication or public address systems – even lifes may depend on the acoustical environment and on the speech intelligibilty.

As there are valid standard in Hungary for sound insulation requirements, the directive on requirements of acoustical comfort determines only room acoustical requirements and permissible noise levels.

5.2. Room acoustical descriptors

The directive uses mean reverberation time (T_m) as the main descriptor. Its value is calculated as the average of reverberation times measured in 250, 500, 1000 and 2000 Hz frequency octave-bands. We must note however, that when designing rooms of higher acoustical demand — like studios, concert halls, theatres — target values of other room acoustical parameters are also needed. It is beyond the scope of the directive (and also of a standard) to formulate regulations and define these requirements for such spaces, and it is also beyond the scope of room acoustical

For most general purpose rooms that are intended for human use, control of reverberation time is typically sufficient to ensure satisfactory room acoustical quality. If demanded, other room acoustical parameters can be introduced and finetuned, but target values of them can not be generalised and hence are not regulated in other countries either. Ensuring high speech intelligibilty of sound reinforcement system is an electroacoustical design task. Achieving the reverberation time requirements given in the directive pro-

vides a good basis to reach the intelligibility goal with the electroacoustical system. Furthermore, reverberation time also helps to control noise levels in rooms.

Reverberation time requirements are given as maximum permissible values in the directive. An optimal region for reverberation time might be necessary for high speech intelligibility, but there is no lower limit in the directive. Overdamping of rooms (too many absorption) is rare with the usual interior design solutions. For most cases the directive can be used by anyone to determine the requirement for each room. For special cases a room acoustical consultant should be involved, and frequency dependent tolerance for reverberation time should be used.

5.3. Field of application

The directive lists most room types, where demand for acoustic comfort might emerge. For cases that are not covered by the directive, requirements should be determined by acoustic consultant.

The directive mainly deals with general purpose rooms and spaces intended for human use. There is no requirement given for other places, like farms, plantations, etc. The directive includes no guideline on how to achieve the requirements, on design, calculation and modelling methods, and does not cover verification methods either.

The directive covers the following building types:

- Educational buildings, day centres, preschools, kindergarten
- Offices
- Hotels
- Healthcare buildings
- Leisure-time centres and sport halls
- Dwellings

5.4. The system of requirements

There are three comfort levels specified in the directive. For general cases, the *basic design target level* yields satisfactory acoustical quality, which can be regarded as an economical-technical optimum. In case for higher acoustical quality, requirements listed as *enhanced acoustical quality level* should be used.

The third category, called '*E*', result in a significantly lower acoustical comfort. For new buildings and for changes in function, category „E" must not be applied. This category is for cases, where other aspects of priority higher than acoustical comfort do not allow compliance with the other two categories (eg. security, life hazard). Even if not realizable completely, one must intend to fulfill requirements specified for the basic design target level. In case category ‚E' is applied, its reason must be indicated clearly in the design documents.

6. Conclusions

Acoustics related standards in Hungary are gradually adjusted to the system of international, and primarily European standards. In building acoustics, standards for test methods and standards on calculation methods are mainly adopted ISO standards, whilst standards on requirements are national ones.

Standards about requirements on sound insulation inside buildings and of facades were issued in 2007. Ten years have passed since then, during which a lot of experience has been gathered about their application. A workgroup of acoustic experts was established in 2017 by the Acoustic Section of the Hungarian Chamber of Engineers in order to prepare the revision of the standards: to collect errors, uncertainties, unclear parts, emerged questions and problems. As a result of their work, a revision report has been created. We have summarized the main findings of this document above. Based on the findings, a targeted research will start to help realization of the revision.

There is no existing Hungarian standard on room acoustical requirements. The development of a new standard has started in 2016, the work is still ongoing. The progress and the main concept of the standard is detailed in a separate paper. A technical directive on requirements of acoustical comfort was developed in 2017 by a group of experts, led by ÉMI Non-profit Ltd., which can be used until the development of the standard is finished. The basic concept and structure of the directive was explained in this paper.

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