

Sound insulation in multi-storey housing in Europe – Situation Anno 2017 and needs for upgrading

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ABSTRACT

The acoustic situation for the European housing stock depends on several factors, including national acoustic regulations during design and actual construction solutions applied. Regulations and constructions vary across Europe, both now and in the past, thus explaining a diversified situation in Europe. Acoustic regulations for housing exist in most European countries, valid for new housing. However, complying with regulations does not guarantee satisfactory conditions for occupants, and several countries have introduced acoustic classification schemes, enabling developers to specify and users to require an acoustic quality better than defined by regulations, but with no or few classes for old housing. Consequently, little attention is given to existing housing, even if extensive renovation takes place with several other upgrades "for the future" and that more than half of the European housing stock was built before implementation of acoustic regulations. Thus, it is necessary increasing awareness on the importance of acoustic conditions for quality of life.

While health implications of traffic noise have been quite thoroughly investigated, neighbour noise has mainly been considered a "social" problem to be solved by mediation, although e.g. sleep disturbances caused by neighbours may be unhealthier than those caused by traffic. Based on indications from the field, very low sound insulation implies total lack of privacy, and for "luxury" apartments the problems are more related to hearing neighbours, in all cases leading to restraints on own activities.

The paper will summarize main characteristics of the current national sound insulation requirements and quality classes for housing in Europe and suggest initiatives and policies for upgrading old housing.

Keywords: housing, sound insulation, acoustic regulations, acoustic classification, neighbour noise, Europe

1. INTRODUCTION

Quality labelling has in general become more widespread - compulsorily or voluntarily. Several products are labelled and noise data included, cf. e.g. [1] about the mandatory tyre label with specification of fuel efficiency, wet grip and rolling noise, and [2] for household products requiring several characteristics, including noise. For dwellings, energy marking is widely used, cf. [3], but in contrast, objective information about the acoustic conditions for a dwelling is not mandatory and rarely available – although a dwelling is often the biggest investment during most peoples' lifetime, much time is spent in the dwelling, and acoustic protection is important to the quality of life, both day and night. The situation is illustrated in Figure 1.

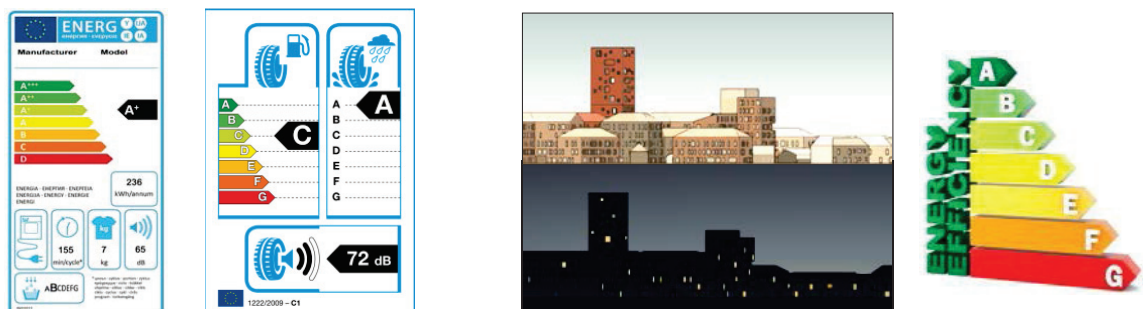


Figure 1 – In the left part of the figure examples of mandatory labelling in Europe for tyres and household products, both with noise characteristics. To the right, housing with energy labelling only. References [1, 2, 3].

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This is very unsatisfactory to prospective occupants of a dwelling, as acoustic quality is a 'hidden' quality, which is not easily evaluated by other means. The acoustic situation in Europe is described in the following sections, and some initiatives proposed.

2. Regulatory sound insulation requirements in housing in Europe

Acoustic regulations for housing specify minimum requirements aiming at protecting health for “normal” people with “normal” neighbours. Such regulations exist in most countries in Europe and define criteria for acoustical conditions in new housing. Comparative studies of regulatory requirements for sound insulation between dwellings in multi-storey housing - new-build - are described in detail in [4, 5] and [6].

In Figures 2 and 3, based on [6], but updated with revised requirements for Germany, Sweden, Slovenia, Turkey (proposal), are found diagrams illustrating the airborne and impact sound insulation requirements for housing, new-build. It is seen that especially the requirements for impact sound differ considerably across Europe (range airborne ~ 7 dB and impact ~ 18 dB). The reasons have not been investigated, but could be a mix of construction traditions and culture etc. For more details about regulations and constructions, see [4] and [6-7]. It could be interesting and relevant to know occupants’ satisfaction with the acoustic conditions in different countries. Indications for a few countries are found in Section 4.

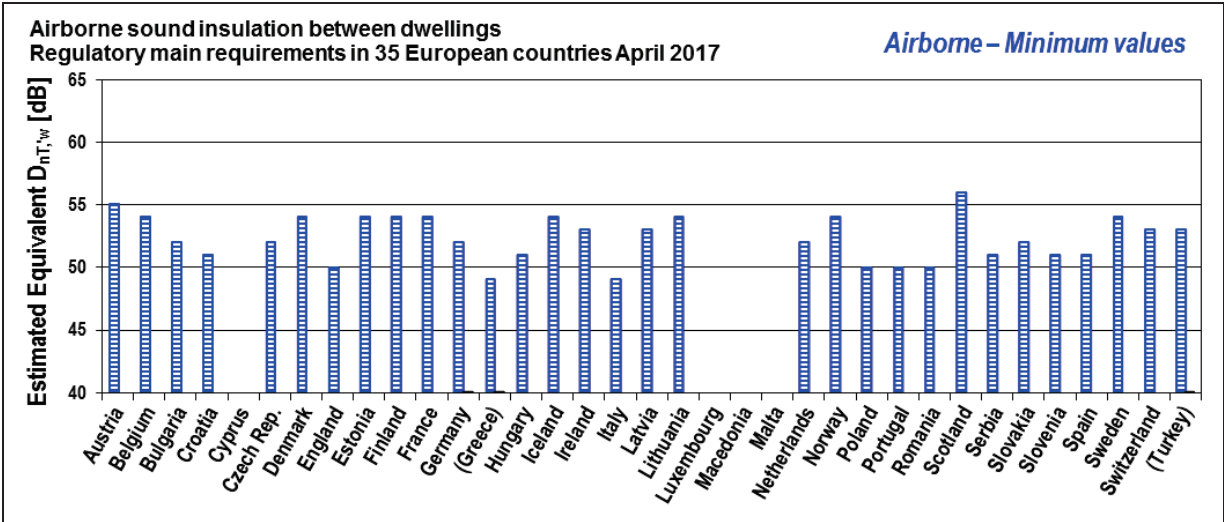


Figure 2 – Overview of airborne sound insulation requirements between dwellings. Status April 2017.
Graphical presentation of estimated equivalent values of $D_{nT,w}$.
Note: The equivalent values are estimates only, as exact conversion is not possible.

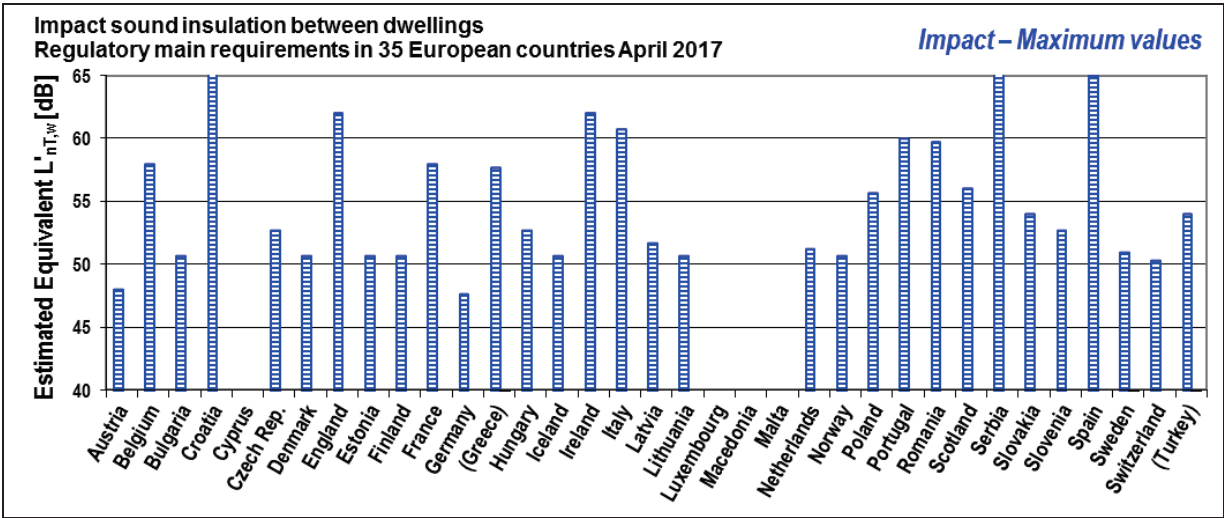


Figure 3 – Overview of impact sound insulation requirements between dwellings. Status April 2017.
Graphical presentation of estimated equivalent values of $L'_{nT,w}$.
Note: The equivalent values are estimates only, as exact conversion is not possible.

3. Acoustic classification of housing

Complying with regulatory requirements does not guarantee satisfactory conditions for the occupants, and since the mid 1990's, several countries have developed and introduced acoustic classification schemes with classes reflecting different levels of acoustical comfort/protection. The purpose has been and still is to make it easier for developers to specify and for users to require a standardized acoustic quality better than the quality defined by regulations.

An overview of existing national acoustic classification schemes in Europe for dwellings, [8-18], is found in Table 1. For each scheme listed, the class denotations, number of classes and the relation to the national building code are indicated. Information about an international proposal is found in [19] and [20]. Tables with specific main class criteria for airborne and impact sound insulation are found in [21] although some data need to be updated. Table 1 also includes number of classes below the national regulations, in most cases none or one, but LT and NL have two classes below regulations.

Table 1 – European schemes for acoustic classification of dwellings [8-18], relation to building codes and information about number of classes. ISO/2ndCD 19488 (2016) has been included for comparison.

Acoustic classification of dwellings - Schemes in Europe and relation to building codes – Status April 2017							
Country	Year of publication	CS Reference (latest version)	Class denotations ⁽¹⁾	BC link to CS	BC ref. to CS & Comments	No. of classes	No. of classes < BC
DK	2001/2007	DS 490 (2007)	A / B / C / D	+	Class C	4	1
FI	2004	SFS 5907 (2004)	A / B / C / D	–	N/A (BC = Class C)	4	1
IS	2003/2011/2016	IST 45 (2016)	A / B / C / D	+	Class C	4	1
NO	1997/2005/2008/2012	NS 8175 (2012)	A / B / C / D	+	Class C	4	1
SE	1996/1998/2004/2015	SS 25267 (2015)	A / B / C / D	–	N/A (See note ⁽⁴⁾)	4	1
LT	2003	STR 2.01.07 (2003)	A / B / C / D / E	+	Class C	5	2
IT	2010	UNI 11367 (2010)	I / II / III / IV	–	N/A (BC ~ Class III)	4	1
DE	1994/2007/2012	VDI 4100 (2012) ⁽²⁾	III / II / I	–	N/A (BC ~ Class I ⁽²⁾)	3	~ 0
DEGA	2009/Entwurf2017	DEGA Empfehlung 103 (E2017) ⁽³⁾	A* / A / B / C / D / E / (F)	–	N/A (BC ~ Class D ⁽³⁾)	6+npd	1+npd
AT	2012	ÖNORM B 8115-5 (2012)	A / B / C / D / (E)	–	N/A (BC = Class C)	4+npd	1+npd
NL	1999	NEN 1070 (1999)	I / II / III / IV / V	–	N/A (BC ~ Class III)	5	2
ISO/WI	ISO/WI 19488 since 2014	ISO/TC 43/SC 2 N 1371 ISO/2ndCD 19488 (Dec. 2016)	A/B/C/D/E/F and npd	N/A	N/A (See note ⁽⁵⁾)	6+npd	N/A

Abbreviations: BC = Building Code (regulatory requirements); CS = Classification scheme

(1) Classes are indicated in descending order, i.e. the best class first. Denotations in brackets correspond to npd.

(2) The revised version of VDI 4100 published in 2012 changed descriptors from R'_{w} and $L'_{n,w}$ to $D_{nT,w}$ and L'_{nT} (as had been discussed for years for the regulations), and class criteria were made stricter, i.e. above and regulations. After tightening of DIN 4109-1 in 2016, the basic criteria for the lowest class I for MS-housing are again similar to regulations, but VDI 4100 has additional criteria, e.g. on internal sound insulation.

(3) In addition to VDI 4100, the German Society of Acoustics (DEGA) has published a recommendation, DEGA-Empfehlung 103, "Schallschutz im Wohnungsbau – Schallschutzausweis". For MS-housing, Class D criteria in general correspond to regulations, but there are additional criteria.

(4) SS 25267 (2015) does not include class C criteria, but refers to values in the BC as class C.

(5) Original proposal prepared by COST TU0901 in 2013. ISO/WI 19488 from 2014, ISO/CD in 2016.

In Figures 4 and 5 are found graphical comparisons of lowest and highest classes for the existing classification schemes [8-18]. The regulatory requirements in the same countries have been added. More information is found in the same references and in [19, 20].

Comparing the data from the classification schemes in Europe, see Table 1 and Figures 4-5, detailed class criteria in [8-18] and explanations in [21, 22], several differences are found, e.g. the following:

- Number of quality classes (3 to 6) and denotations (see Table 1). Note: "npd" not counted as a class.
- Descriptors used for sound insulation criteria.
- Use of low-frequency spectrum adaptation terms according to ISO 717:2013.
- Intervals between classes.
- Range of quality classes (~ 8 to 22 dB for airborne, ~ 14 to 30 dB for impact) and position.
- Relation to regulatory requirements.

Other relevant comparisons between the acoustic classification schemes are e.g. about:

- Sound insulation internally in dwellings
- Sound absorption in stairwells
- Outdoor noise levels
- Classification certificate

When comparing the information in Table 1, some schemes may appear similar, e.g. NL and IT, but they are very different. Even the Nordic schemes originating in the same Nordic proposal are more different than they appear from Table 1, see [23]. Due to lack of coordination between countries, the schemes in Europe are very different, thus impeding exchange of experience and causing trade barriers.

The sound insulation descriptors applied in acoustic classification schemes in Europe are the following:

Airborne: R'_{w} ; $R'_{w} + C_{50-3150}$; $D_{nT,w}$; $D_{nT,w} + C$; $D_{nT,w} + C_{50-3150}$
 Impact: $L'_{n,w}$; $L'_{n,w} + C_{1,50-2500}$; $L'_{nT,w}$; $L'_{nT,w} + C_1$; $L'_{nT,w} + C_{1,50-2500}$

The most striking differences between countries and between classes are found in impact criteria and a few countries don't have any overlap, cf. Figure 5, thus illustrating the challenge on finding a common international ground for class criteria in a situation, where every country has struggled to make decisions themselves, when defining the class criteria. Also, it should also be noticed that the ranges in ISO/2ndCD 19488 [19] do not include all national classification ranges completely, neither for airborne or for impact sound insulation, cf. Figures 2-3 compared to Figures 4-5.

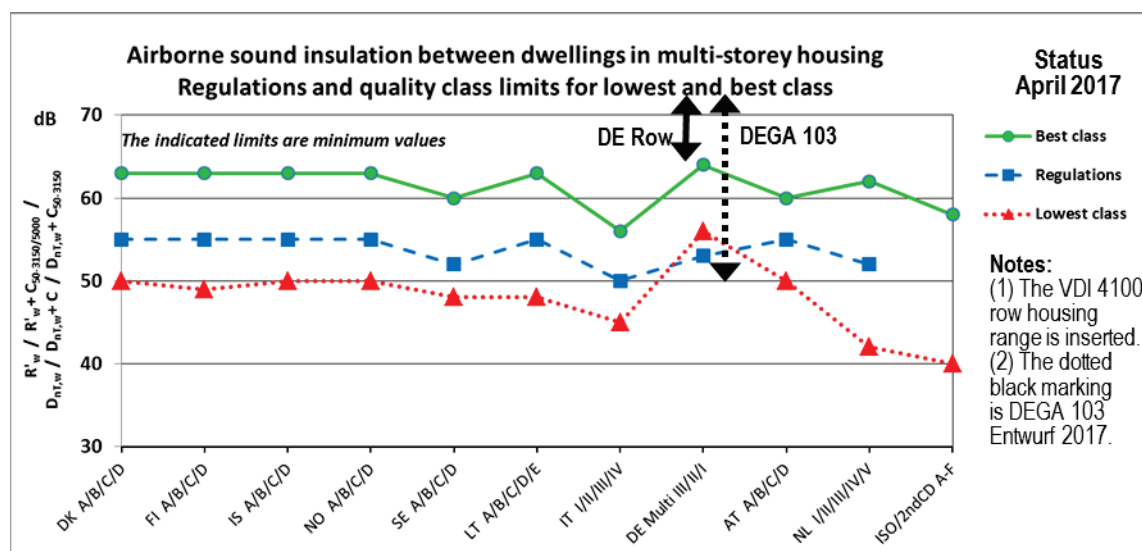


Figure 4 – Airborne sound insulation limits for highest and lowest classes in classification schemes in Europe and regulatory requirements for the same countries. ISO/2ndCD 19488 class limits [19] added for comparison.

Note: The diversity of descriptors appears from the Y-axis label. The graphs present the numbers only. No conversions between descriptors applied.

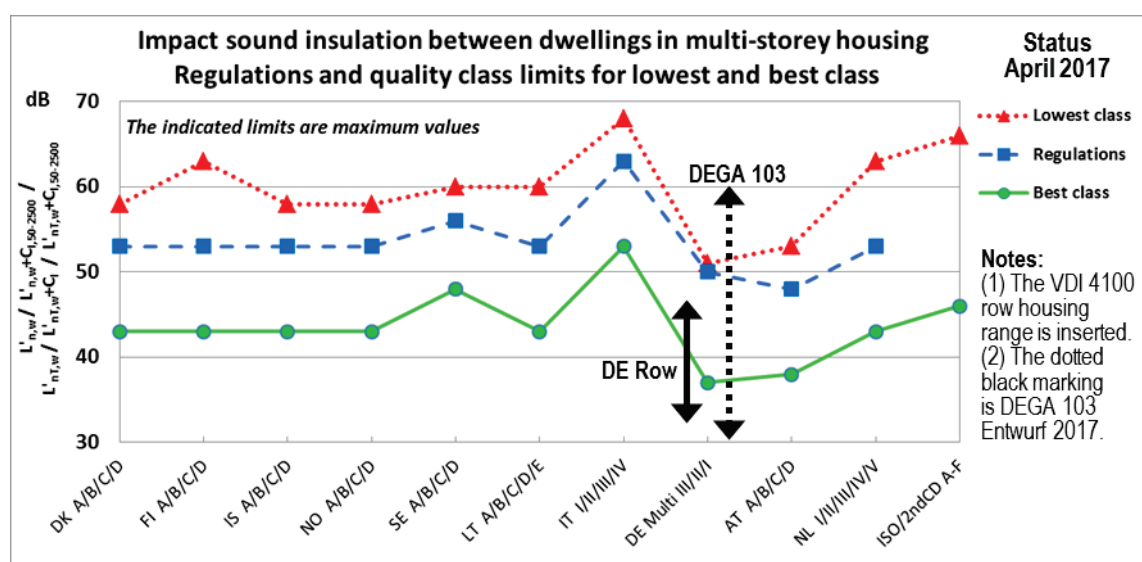


Figure 5 – Impact sound insulation limits for highest and lowest classes in classification schemes in Europe and regulatory requirements for the same countries. ISO/2ndCD 19488 class limits [19] are added for comparison.

Note: The diversity of descriptors appears from the Y-axis label. The graphs present the numbers only. No conversions between descriptors applied.

The German VDI 4100 [15] and DEGA 103 [18] have stricter high-end classes than all others, incl. the ISO/2ndCD [19], see Figures 4-5. It could be interesting to know how much they are used in practice? In general, it could be useful to know the use of classification in all the relevant countries.

Although it is obvious that acoustic classification for existing housing could be relevant before renovation by using lower classes suitable for old housing – like for energy labelling [3] – only few countries address this issue. From Table 1, giving an overview of [8-18], it is seen that the five Nordic countries, Italy and the German recommendation DEGA 103 have one quality class below regulations, Lithuania and the Netherlands have two classes. Germany (VDI 4100) has none, thus following the original idea of acoustic classes to be only/mainly for specifying better acoustic conditions than regulations. To sum up briefly, the existing acoustic classification schemes do not in general include acoustic classes fitting major parts of the existing housing stock. In [24], which includes mapping of the Danish housing stock, i.e. number of dwellings according to construction year, constructions and estimated sound insulation, it is suggested to extend the present DS 490 [8] with two lower classes E and F suitable for older housing.

Another important topic is how building regulations deal with sound insulation, when renovating housing. Here, more aspects are relevant, as both the actual contents of the regulations and how it is dealt with by the builders and building industry and enforced by the authorities are important issues. A small, simple survey was made by looking into the regulations in selected countries, in some cases by asking acoustic colleagues. Concerning policies for renovating or retrofitting, the most clear rules exist for change of use of a building (or parts of it), where requirements are the same as for new-build, e.g. when offices are converted to flats. Other general findings are that it is not (for the same use) allowed to degrade the sound insulation, and new partitions should fulfil current regulations, although these rules are not necessarily clear from the regulation text and the enforcement is unknown. In some countries the rules are linked to whether a building permit is needed, and if so the current rules for new-build must be complied with. In general, technical possibilities are taken into account, and cultural heritage must be preserved. An initiative from Spain about preparing an “Existing Building Evaluation Report” [25] before retrofitting old housing for public funds is interesting and might be considered, when updating procedures and policies in other countries. In fact, the same principles could be applied for other building categories. Several existing acoustic classification schemes (about half) also include classification of other types of premises, e.g. schools, kindergarten, offices, hotels and healthcare facilities, see [22].

When considering upgrade of sound insulation for older housing, the current regulations for new-build could be the goal – or as close as possible, but awareness of acoustic issues seems to be very little.

4. THE EUROPEAN HOUSING STOCK AND NEIGHBOUR NOISE SURVEYS

The European housing stock is in many ways very diverse both in the individual countries and between countries. Extensive information, except about constructions, can be found at the Eurostat website and publications, see [26-28], about e.g. dwelling sizes, qualities, shortcomings and insufficiencies due to lack of maintenance or upgrading. More than half of the world’s population is living in urban areas, but almost three quarters of the European population live in an urban area (2015). With an increasing urbanization, the demand for proper urban housing at reasonable rates is rising at the same time as a considerable part of the existing housing stock needs renovation. The qualities of dwellings and possibilities for maintenance or upgrading are positively and negatively influenced by home ownership. As with the different types of dwellings in the housing stock, there are considerable differences between EU Member States in relation to levels of home ownership. In 2014, see [28], 70 % of the EU-28 population owned their home. This share peaked at 96 % in Romania, while e.g. Hungary, Croatia, Lithuania and Slovakia also reported very high shares of home ownership (within the range of 88–91 %). By contrast, a sizeable rental market for accommodation may promote residential mobility and improve labour market flexibility. Countries with a relatively high share of tenants (30-50 %) are e.g. Denmark, United Kingdom, France, Netherlands, Ireland, Sweden, Austria and Germany.

A potential, adverse influence on health is the main reason for having minimum airborne and impact sound insulation requirements in many countries, but the requirements are typically valid for new housing only. However, a big part of the housing stock in Europe has been built before implementation of building regulations, and with a sound insulation typically much lower than for new housing. In addition, improvements of sound insulation are seemingly seldom included in housing renovation, e.g. due to lack of knowledge, focus, policies and regulations.

When considering promoting sound insulation improvements in renovation projects, the basis for discussion and development of tools is information about the existing housing stock, the current national requirements for new housing as well as the decision processes and practices applied for renovation of existing housing. As neighbour noise is a bigger problem in flats than in other types of housing, highest priority should be given to multi-storey housing.

The population in EU-28 is over 500 million inhabitants, and there are above 200 million dwellings according to Eurostat or other sources. A profile of the housing stock in Europe is found in [29] and country descriptions in [7]. Eurostat has published census data about population and housing; see e.g. [26]. The below Figure 6 shows distribution of dwelling types for the individual countries in EU28+, sorted according to decreasing % of flats in the countries. In 2014, 4 out of every 10 persons in the EU-28 lived in flats; one quarter (~26%) in semi-detached houses and one third in (~34%) in detached houses, see [27] or Figure 6. The year of construction is important to identify construction types and evaluate sound insulation, especially from before regulations existed. As construction practice varies across Europe, such mapping should be done on a national basis.

For further discussions, it is relevant to know occupants' satisfaction with the acoustic conditions in different countries. Indications for a few countries are found in Table 2. However, since the methodologies and details of questions are very different, more detailed comparisons and discussions are necessary to make qualified comparisons between countries.

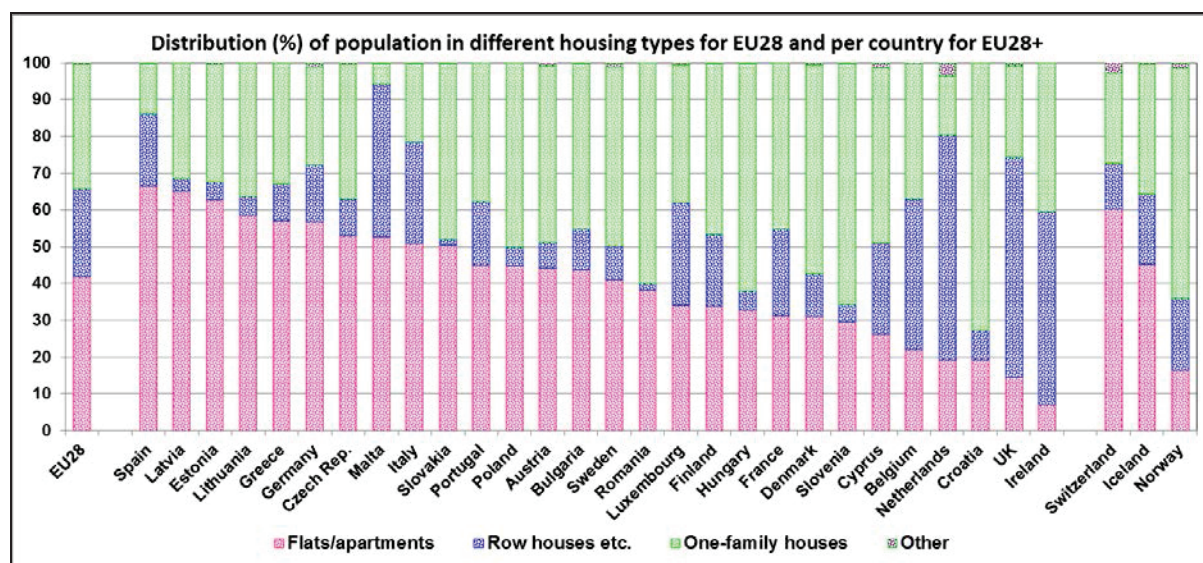


Figure 6 – Distribution (%) of population in different housing types for EU28 and per country for EU28+. Data source: Eurostat, data for 2014 [26].

Table 2 – Examples of survey results from four countries of occupants' satisfaction with the acoustic conditions in housing.

Country	Ref.	Year	Survey mode and sampling	No. of responses	Type of survey and brief information results
UK	[30, 31]	2012	Face-to-face, representative	2747	National Noise Attitude Survey 2012 (NNAS2012). Extensive noise survey in 2012. All types of housing. People asked about "Hear" and if they were Bothered/Annoyed/Disturbed a little or moderately, very or extremely (=M-V-E). 54% hear road traffic noise, 25% M-V-E. 83% hear neighbours inside their homes, 13% M-V-E. 83% hear neighbours or other people nearby, 26% M-V-E, i.e. the same as for traffic noise. Also questions about noise impact on home life and sleep. disturbances, people visiting outdoor quiet areas.
NL	[32]	2008	Face-to-face, representative	1200	Annoyance, concern and residential satisfaction. All types of housing. Results for housing, all types. Annoyed or severely annoyed: Road traffic noise: 18%; Sleep disturbance 8% Neighbour noise: 14%; Sleep disturbance 7% Annoyance from radio and TV rated separately. Results from a new survey in 2016 to be reported end of 2017.
DK	[33]	2013	Self-administered, representative	14265	Health & Morbidity study. Results for multi-storey housing Traffic noise: 16% slightly or very annoyed (all housing 10%). Neighbour noise: 33% slightly or very annoyed (all housing 15%). Survey 2015 Multi-storey Housing (97%), built 2002-2015.
NO	[34]	2015	Self-administered, not representative	986	Extremely, very or moderately annoyed: Speech: 10% (incl. slightly 23%); ~ 33% worried disturbing others. Music: 11% (incl. slightly 29%); ~ 37% worried disturbing others. Footfall noise: 20% (incl. slightly 44%), ~ 17% worried disturbing others. Traffic: 20%, (incl. slightly 43%)

In the Norwegian survey [34], an especially interesting question is included by asking the occupants, if they are worried disturbing the neighbours. It is seen that 33% and 37%, respectively, are worried disturbing neighbours due to speech and music, whereas only 17% are worried about disturbing neighbours with footfall noise, which is actually the noise disturbing most occupants, but probably an activity, most people don't think about not doing, since it could be considered a natural "right" to walk on one's own floor.

The WHO assessment report for Europe, [35], includes compiled main data for 30 countries, based on Eurostat's EU-SILC data. There is only one noise question combining all types of noise in one question with answer options Yes and No: *"Do you have any of the following problems related to the place where you live?", including answer category "Too much noise in your dwelling from neighbours or from outside (traffic, business, factory, etc.)"*. Different survey modes are applied for the interviews. The EU-SILC survey is carried out once per year, and data for noise from neighbours or from the street are found at http://ec.europa.eu/eurostat/web/products-datasets/-/ilc_mddw01. The prevalence for EU (28 countries) was 18% for 2015, with country results in the range 8-26%, with lowest annoyance (8-10 %) in Ireland, Estonia, Croatia and Bulgaria and highest (25-26%) in Germany, Netherlands and Malta. Although providing an indication of the overall noise problem subjectively evaluated, such simplification lead to results that are insufficient as a basis for qualified decisions on relevant actions for improvements.

In general, it seems difficult to quantify and monitor noise annoyance in single countries as well as comparing countries due to lack of consistency in methods over time and differences in methodologies. However, for future upgrading of acoustic conditions in housing, it is important to exchange experience with as well occupants' satisfaction as well as constructions. It should of course be noticed that for different cultures, living habits and climates, occupants might have different expectations.

Considering the inconsistency in surveys in various countries, it seems necessary to extend research in this field and prepare coordinated surveys to find comparable results.

5. ACOUSTICAL PROTECTION, COMFORT AND FREEDOM IN HOUSING

While health implications of traffic noise have been quite thoroughly investigated, see e.g. [36], a European directive published, cf. [37], extensive research initiated, cf. e.g. [38], and various reports and guidelines prepared, see e.g. [39], a similar national or European interest for health implications of neighbour noise seems to be non-existing, although there is no reason to think that neighbours' noise impacts on home life, incl. sleep disturbances, are less unhealthy than those caused by traffic. In the below table are indicated principles and characteristics of acoustic quality classes for housing and the qualitative implications for protection, privacy and comfort as well as for freedom to do own activities without disturbing neighbours. See also Table 2 about noise surveys and Section 4 about quieter homes.

Table 3 – Principles and characteristics of acoustic quality classes for housing.

High acoustic protection and comfort ☺	Acoustic quality class						☹ Very low acoustic protection and comfort
	A	B	C	D	E	F	
Improved quietness, privacy Improved freedom for own activities without disturbing/annoying neighbours	←						Increasing disturbance/annoyance from neighbours, e.g.: Footfall noise, playing children Music, radio, speech Barking dogs
	←						

In UK, the government (DEFRA) has prepared the *Noise Policy Statement for England (NPSE)*, [40]. The following lines are quoted from NPSE. *"Noise Policy Vision: Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development. – (1.5) This NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise. The NPSE does not apply to noise in the workplace (occupational noise)."*

It could be relevant to introduce a similar policy on a European level, aiming at creating awareness about acoustical protection, privacy, comfort and freedom in housing.

6. QUIETER EUROPEAN HOMES?

Considering again the END [37], it's worthwhile mentioning the efforts related to establishing and protecting quiet areas (outdoor), cf. e.g. [41-42], aiming at improving health. A big question is why the same efforts have not been made investigating the benefit of quieter European homes?

Most European countries have regulatory requirements for sound insulation between dwellings in multi-storey housing, mainly intended and applied for new housing and thus in many countries not describing rules for housing renovation. However, more than half of the European housing stock was built before acoustic regulations were implemented, and due to extensive renovation of the housing stock in most countries and the seemingly very limited attention to upgrading of sound insulation, potential tools for promoting sound insulation improvement have been identified, hoping that joint efforts in the future could lead to more focus on the issue and the recommended tools could prove useful.

In addition, the present national acoustic classification schemes for housing do not have acoustic classes suitable for old housing. Considering the ongoing and expected extensive renovation of housing all over Europe, much more attention to improvement of sound insulation between dwellings should be promoted, since the importance to occupants of dwellings is high, evaluated from the prevalence of neighbour noise annoyance in several surveys, see e.g. Section 4. Better sound insulation would provide more freedom for occupants, i.e. less restraints on activities, see Table 3.

The following tools and initiatives could be recommended aiming at promoting and facilitating upgrading of sound insulation in multi-storey housing. National initiatives related to new housing and existing housing could include:

- Review acoustic regulations for new-build and – if needed – propose stricter requirements for new housing to avoid acoustic slum in the future and establish a goal for all housing.
- Review the national acoustic classification scheme, if existing, or consider implementing a scheme.
- Revise acoustic classification schemes to include lower classes appropriate for existing dwellings, like for energy labelling.
- Inform builders, contractors about construction solutions and importance of sound insulation.
- Assessment of acoustic performance should be a part of the building evaluation before renovation.
- Prepare a national catalogue of typical housing constructions and related sound insulation.
- Revise building regulations to include more clear requirements or recommendations for improving sound insulation, when renovating housing.
- Develop construction solutions and guidelines for improvement of sound insulation.
- Describe retrofitting cases in “Good Practice” publications.
- Construction solutions for new-build and renovation to be developed further – innovation needed.
- Sound insulation requirements to be enforced for new-build. Building authorities might need to pay more attention to the acoustic regulations and enforcement. Similarly, attention to any rules or recommendations for renovation should be increased.

One of the first steps should be to make the acoustic conditions more visible by introducing a “label” or an alternative system that together with other incentives could lead to improvement of sound insulation. It is important to emphasize that the initiatives listed above can be launched in parallel. The goal is that upgrading of sound insulation is considered on equal terms with improvement of other qualities, when renovating housing.

In Turkey – based on inspiration from participation in COST Action TU0901 – proposals have been prepared for acoustic regulations, acoustic quality classes, and guidelines for various types of buildings, including enforcement, cf. [43]. Turkey did not have acoustic regulations before, and in the actual situation, it was seemingly easier, although still challenging, to prepare a new set of regulations than a smaller revision is for many other countries.

7. CONCLUSIONS AND RECOMMENDATIONS

The before-mentioned initiatives could benefit from a coordinated, European or even more international approach. Besides harmonization of sound insulation descriptors, questionnaires for social surveys could be – voluntarily – “harmonized” to allow comparison between countries. In addition to social surveys, which do not include information about the actual sound insulation, there is a need for more research examining the correlation between the construction types, the measured sound

insulation and the acoustical comfort of the occupants of the dwellings. The main obstacle for joint projects is lack of funding, but it might be worthwhile considering “pooling” the national efforts aiming at meeting the objectives sooner.

Inspired by the END [37], it could be proposed to prepare an acoustic performance directive with the same key elements: (a) Harmonization; (b) Information; (c) Action. – An acoustic performance directive could speed up awareness and actions, including activities and research initiatives related to sound insulation mapping of housing in Europe and a strategy for improving sound insulation of housing in Europe. In analogy with the title of the END strategy paper “*Research for a quieter Europe in 2020*” [38], the title of the housing strategy paper could be “*Research for quieter European homes in 20XX*”. Concerning the speed of mapping, information, action plans and actions related to END, there have been delays and disappointment, cf. [44-45], and similar challenges could be foreseen for acoustic improvement of housing, aiming at quieter European homes.

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