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Rasmussen, Birgit

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## **HARMONIZATION OF SOUND INSULATION DESCRIPTORS AND CLASSIFICATION SCHEMES IN EUROPE: COST ACTION TU0901**

Birgit Rasmussen

SBi, Danish Building Research Institute, Aalborg University,  
Dr. Neergaards Vej 15, DK-2970 Hørsholm, DENMARK

e-mail: bir@sbi.dk

### **1. Introduction**

Regulatory sound insulation requirements for dwellings exist in more than 30 countries in Europe. Classification schemes exist at present (2010) in 10 countries. In some countries, sound insulation requirements have existed since the 1950s. The first classification schemes for dwellings were implemented in the early 1990s.

Findings from comparative studies of regulatory sound insulation requirements in 24 countries in Europe and sound classification schemes in 10 countries show that sound insulation descriptors, regulatory requirements and classification schemes in Europe represent a high degree of diversity. Unfortunately, there is no sign on increasing harmonization, rather the contrary, i.e. evidence for an even more diverse situation in Europe. The studies conclude that harmonization of descriptors and sound insulation classes are needed to facilitate exchange of data and experience between countries and to reduce trade barriers. Most important is, however, that review of sound insulation requirements should be encouraged in several countries to adapt regulations to current construction trends and peoples' needs for health, wellbeing and comfort.

Looking into the future, harmonization of sound insulation requirements seems unrealistic. However, by preparing a harmonized European classification scheme with a number of quality classes, member states could select a "harmonized" class fitting the national needs and conditions.

A joint European Action, COST Action TU0901 "Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions" has been approved and runs for four years from November 2009. Until now (end 2010), 28 countries in Europe and 3 overseas countries have signed up for TU0901, and about 85 peo-

ple have been nominated for the management committee and working groups. The main objectives of TU0901 are to prepare proposals for harmonized sound insulation descriptors and for a European sound classification scheme with a number of quality classes for dwellings. Other goals are e.g. to establish a catalogue of sound insulation data and an on-line compendium on good workmanship.

The paper will summarize the background, discuss the present situation in Europe and describe the joint efforts to reduce the diversity in Europe, thus supporting and initiating – where needed – improvement of sound insulation of new and existing dwellings in Europe to the benefit of the inhabitants and the society.

## 2. The need for sound insulation in housing

Social surveys in several European countries have shown that occupants of multi-storey housing are considerably annoyed by noise from neighbours' activities. The World Health Organisation (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”, cf. [1]. Based on this definition, noise effects on health should not simply be understood as the adverse physical effects due to noise exposure, but also as disturbance of well-being, i.e. psychological effects of noise, which in the long term may lead to adverse physical effects. WHO has identified a considerable number of specific adverse health effects caused by environmental noise, cf. [2]. These effects can be medical conditions, but can also include sleep disturbance, stress etc.

The relevance of the sound insulation issue is illustrated in Figure 1 (ref. [3]) showing the amount of serious noise annoyance in national surveys in three EU countries, representing about 1/3 of the total EU population. In spite of uncertainties due to different methodologies (including questionnaires) applied for the surveys, the author of [3] concluded that the neighbour noise problem in Europe is significant. In [4], results from different social surveys are included, and the shortcomings due to inconsistent questionnaires in different countries are described. Neighbour noise has been addressed in a large pan-European LARES study (Large Analysis and Review of European housing and health Status) coordinated by WHO/Europe. The WHO LARES study included eight European cities, and the purpose was to evaluate the health impact of housing conditions. Results are found at the WHO website [2].

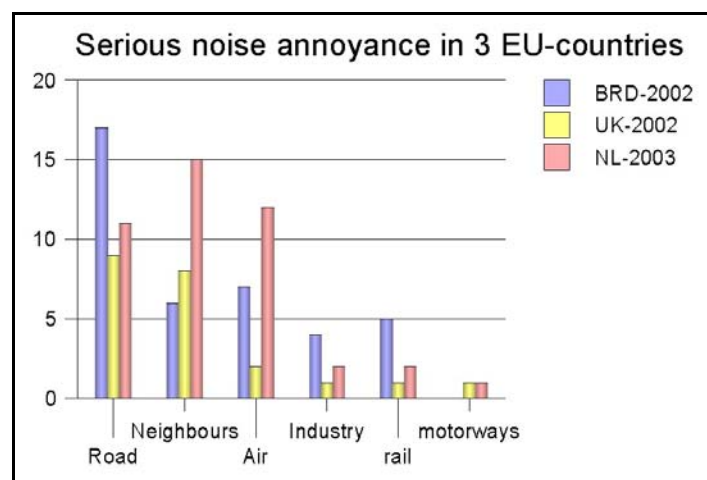


Figure 1 – Sources of serious noise annoyance (% of inhabitants) in three EU countries.  
Ref: Martin van den Berg, 2004, [3].

When ranking annoyance from different noise sources, road traffic noise is the most dominant source, followed by neighbour noise. Based on statistics about populations [5] and findings from noise annoyance surveys (see eg Figure 1 or [4]), it seems that more than 50 million Europeans are exposed to neighbour noise causing adverse effects on quality of life. Quotes from the WHO LARES study and more detailed references are found in [6].

To keep towns and cities attractive, homes in multi-storey housing must be attractive for a variety of people and offer “quietness”. Thus, new housing must meet the needs of the people and offer comfort. Also for existing housing, sound insulation aspects should be taken into account, especially when renovating housing. The challenge is huge, and knowledge exchange between countries is highly needed.

Comparative studies of sound insulation descriptors and regulatory requirements (2008) in Europe are described in [6-7] and sound classification schemes described in [8-9]. However, a high degree of diversity is found for descriptors, level of requirements and classification schemes in Europe, thus impeding exchange of experience of housing design and construction details for different levels of sound insulation. The need for harmonization is emphasized in [6-7] and several research initiatives suggested.

The situation in Europe is summarized in Section 3 for sound insulation descriptors and regulatory requirements. An overview of classification schemes is found in Section 4. The need for harmonization in Europe, tools for upgrading, implementation and enforcement of requirements are described in Sections 5 and 6. The harmonization efforts through COST Action TU0901, [10], are described in Section 7. This paper – like COST TU0901 – focuses on neighbour noise and sound insulation between dwellings.

### **3. Sound insulation descriptors and requirements in Europe**

Building acoustic requirements for dwellings now exist in more than 30 countries in Europe. In some countries, national sound insulation requirements have existed since the 1950s. Sound insulation requirements are expressed by descriptors defined in standards. Within building acoustics, ISO standards are implemented as European (EN) standards and national standards

#### ***3.1 Sound insulation field descriptors***

The current international descriptors for evaluation of airborne and impact sound insulation are defined in ISO 717:1996 [11]. Table 1 provides an overview of the basic 1/3 octave ISO 717 field descriptors (single-number quantities) and the spectrum adaptation terms intended for specification and test of:

- Airborne sound insulation between dwellings
- Airborne sound insulation for facades
- Impact sound insulation between dwellings

The single-number quantities and the spectrum adaptation terms are derived from values measured according to ISO 140 [12]. The spectrum adaptation terms in ISO 717 [11] have been introduced to take into account different spectra of noise sources. A detailed overview of standardized sound insulation field descriptors is found in Table 1, and the total number of descriptors is indicated. Table 2 describes the intended use of spectrum adaptation terms according to ISO 77 [11]. The issue of descriptors is further elaborated in [13].

Table 1 – Overview ISO 717 descriptors for evaluation of sound insulation in buildings

ISO 717:1996 descriptors for evaluation of field sound insulation	Airborne sound insulation between rooms (ISO 717-1) <sup>(b)</sup>	Airborne sound insulation of facades <sup>(a)</sup> (ISO 717-1) <sup>(b)</sup>	Impact sound insulation between rooms (ISO 717-2) <sup>(b)</sup>
Basic descriptors (single-number quantities)	$R'_w$ $D_{n,w}$ $D_{nT,w}$	$R'_w$ $D_{n,w}$ $D_{nT,w}$	$L'_{n,w}$ $L'_{nT,w}$
Spectrum adaptation terms (listed according to intended main applications)	None $C$ $C_{50-3150}$ $C_{100-5000}$ $C_{50-5000}$	None $C$ $C_{tr}$ $C_{50-3150}$ $C_{tr,50-3150}$ $C_{100-5000}$ $C_{tr,100-5000}$ $C_{50-5000}$ $C_{tr,50-5000}$	None $C_i$ $C_{i,50-2500}$
Total number of descriptors	3 x 5 = 15	3 x 9 = 27	2 x 3 = 6
Notes			
(a) For facades, the complete indices for $R'_w$ , $D_{n,w}$ , $D_{nT,w}$ are found in ISO 717.			
(b) For simplicity, only 1/3 octave quantities and C-terms are included in the table, although some countries allow 1/1 octave measurements for field check.			

Table 2 – Relevant spectrum adaptation term for different types of noise sources

Type of noise source	Relevant spectrum adaptation term
Living activities (talking, music, radio, tv) Children playing Railway traffic at medium and high speed Highway road traffic > 80 km/h <sup>(1)</sup> Jet aircraft short distance Factories emitting mainly medium and high frequency noise	$C$ (Spectrum 1: A-weighted pink noise)
Urban road traffic Railway traffic at low speeds <sup>(1)</sup> Aircraft propeller driven Jet aircraft large distance Disco music Factories emitting mainly low and medium-frequency noise	$C_{tr}$ (Spectrum 2: A-weighted urban traffic noise)
ISO tapping machine	$C_i$
Ref.: ISO 717-1:1996 and ISO 717-2:1996. The spectra 1 and 2 are defined in ISO 717-1.	

A requirement may be expressed as the sum of a single-number quantity and a spectrum adaptation term or solely as the single-number quantity. Examples of airborne and impact sound insulation requirements could be:

$$\begin{array}{ll}
 D_{nT,w} \geq 55 \text{ dB}; & L'_{nT,w} \leq 50 \text{ dB}; \\
 D_{nT,w} + C \geq 55 \text{ dB}; & L'_{nT,w} + C_i \leq 50 \text{ dB}; \\
 D_{nT,w} + C_{50-3150} \geq 55 \text{ dB} & L'_{nT,w} + C_{i,50-2500} \leq 50 \text{ dB}
 \end{array}$$

For some types of buildings, e.g. for light-weight buildings, it is important to include low-frequency spectrum adaptation terms or other criteria taking into account low frequencies, cf. e.g. references in [6-7].

### 3.2 Requirements for sound insulation between dwellings

Comparative studies of descriptors and regulatory sound insulation requirements in 24 countries in Europe are described in [6-7]. The comparison reveals significant discrepancies in descriptors and requirements for dwellings. For both airborne and impact sound insulation requirements, several descriptors are applied in Europe. In Table 3 is indicated how many countries apply the different descriptors and besides, there are variants; recommendations and special rules.

The most recent version of the standard EN ISO 717 [11] has contributed to the diversity in Europe by allowing many different descriptors and by introducing spectrum adaptation terms with different extended frequency ranges.

Table 3 – Sound insulation descriptors applied for legal requirements in 24 countries in Europe in 2008. Table from [6].

Airborne		Impact	
No. of countries	Descriptor	No. of countries	Descriptor
12	$R'_w$	15	$L'_{n,w}$
2	$R'_w + C$	1	$L'_{n,w} + C_{l,50-250n}$
1	$R'_w + C_{50-3150}$	6	$L'_{nT,w}$
4	$D_{nT,w}$	1	$L'_{nT,w} + C_l$
2	$D_{nT,w} + C$	1	$I_{CO} (= 59 - L'_{nT,w} + C_l \text{ dB})$
1	$D_{nT,w} + C_{100-5000}$	?	Variants
1	$D_{nT,w} + C_{fr}$	?	Recommendations
1	$D_{n,w}$	?	Special rules
1	$I_{l,u,k} (= R'_w + C - 52 \text{ dB})$		
?	Variants		
?	Recommendations		
?	Special rules		

The main requirements on airborne and impact sound insulation are presented in Figures 2 and 3. In order to facilitate a comparison between countries, all requirements (cf. [6], Tables 2 and 3), have been converted into estimated equivalent values of  $R'_w$  and  $L'_{n,w}$  based on assumptions about rooms and construction types. In case of the equivalent  $R'_w$  being an interval, the average value has been used. The equivalent values are estimates only, as exact conversion is not possible. The results in Figures 2 and 3 show big differences between countries, especially for impact sound insulation requirements with max differences of equivalent  $L'_{n,w}$  limits more than 15 dB for multi-storey housing. For more detailed findings, see [6-7].

When digging deeper into the building codes and related documents, hidden special rules and/or conditions are often revealed. For example, cf. [14], the Swiss standard SIA 181:2006 with sound insulation requirements has become very complex to apply due to several nuisance levels and receiver sensitivity levels. Furthermore, national methods, procedures and correction terms have been defined. The symbol table is 11 pages! As another example could be mentioned special rules in the Nordic countries, see [15-16]. Even in case of seemingly identical limits, sometimes they are different due to special rules, eg volume limitations.

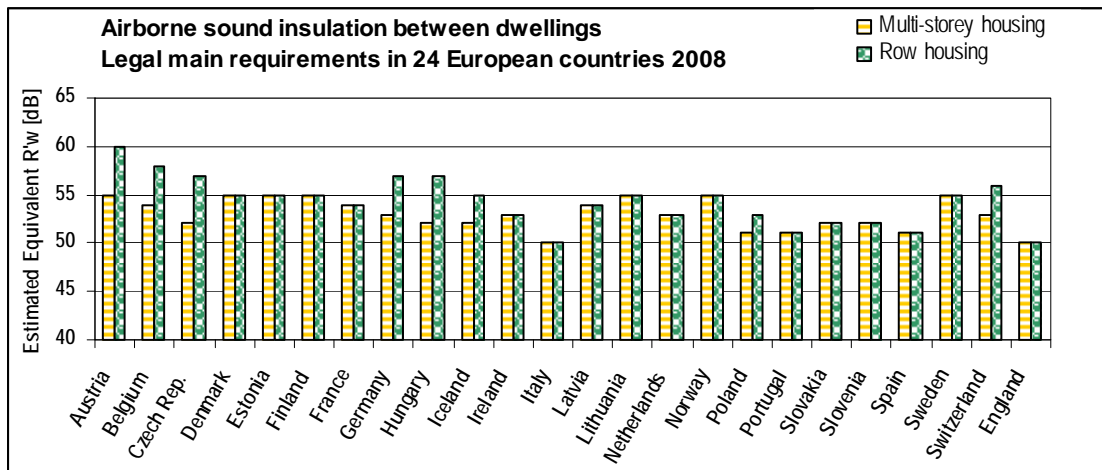


Figure 2 – Overview of airborne sound insulation requirements between dwellings. Graphical presentation of estimated equivalent values of  $R'_{w}$ . Figure from [6].

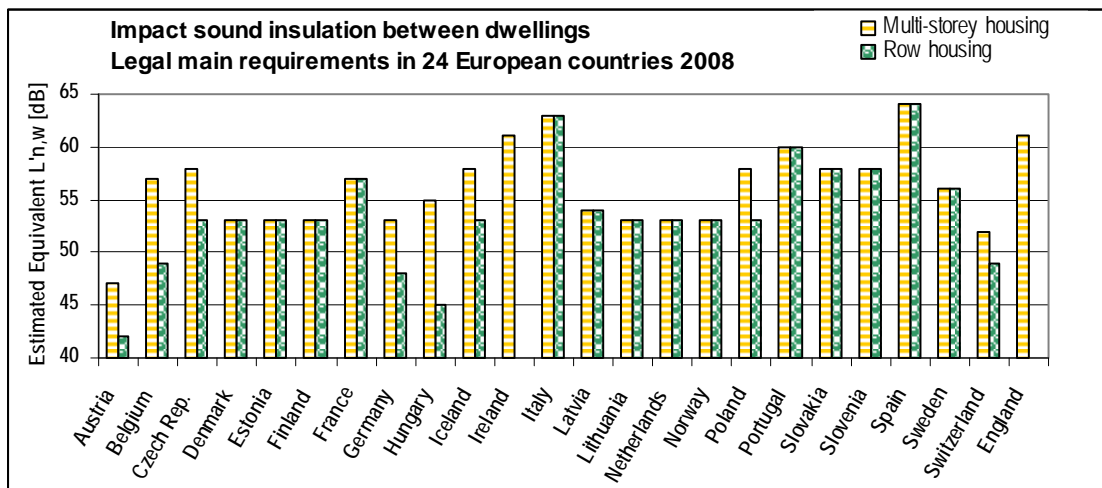


Figure 3 – Overview of impact sound insulation requirements between dwellings. Graphical presentation of estimated equivalent values of  $L'_{n,w}$ . Figure from [6].

Concerning regulations, a big challenge seems to be that for some types of light-weight constructions, the subjective sound insulation is ranked lower than for a heavy construction with the same objective sound insulation. Regulatory requirements are objective, and the same requirements should be applicable for all types of housing constructions and materials. Thus, an important research task is to develop new objective descriptors (evaluation methods) correlating with the subjective evaluation for all types of constructions. – In Norway, a survey [17] about satisfaction with newly built homes (2005) has been carried out in 2007. In general, people are satisfied (about 80%, 10% dissatisfied). Least satisfaction (17% dissatisfied) is found with sound insulation, especially for 2-storey housing (27% dissatisfied). According to [18], the reason is likely to be light-weight constructions applied for this type of housing.

### 3.3 Requirements for facade sound insulation

This paper focuses on sound insulation between dwellings, and only general principles for facade sound insulation requirements will be dealt with. As shown in Table 1, there are 27 facade sound insulation descriptors based on ISO 717 [11]. However, regulatory requirements for facade sound insulation can be expressed in more ways, directly or indirectly:

- Minimum facade sound insulation as a function of outdoor noise level (e.g. FR, DE, LT, NL, AT)
- Max indoor noise levels (e.g. DK, FIN, IS, NO, SE)
- Max “night event” levels - combined with other criteria (e.g. NO, SE)

Consequently, descriptors applied limits related to traffic noise are not always defined in ISO 717. Nevertheless, all ways will lead to sound insulation requirements for the facade components. The needed facade sound insulation depends on the outdoor noise level and maximum indoor level. The outdoor noise levels are calculated based on the traffic data and conditions. Often, the traffic noise levels are available from authorities. The levels vary with positions, see eg Figure 4. Figure 5 shows housing facing a busy road. The housing blocks behind those facing the road are less exposed to traffic noise, and thus requirements could be less strict.

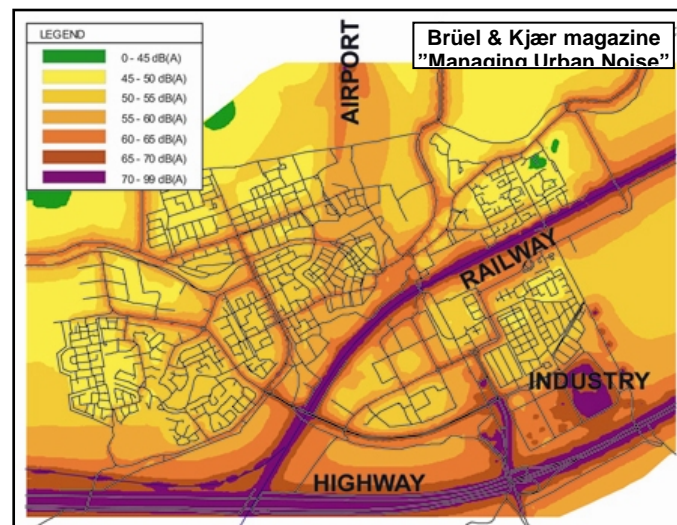


Figure 4 – Example of mapping of outdoor noise from road traffic, railways, airports and industry. The regulatory sound insulation requirement for facades depends on the outdoor level and thus of the position.

In general, requirements concern the facade and not single components. Thus the required window sound insulation has to be calculated based on the requirement for the facade and the areas and sound insulation performance for the facade components. .





Figure 5 – The required window sound insulation is calculated based on the facade requirement and the performance and areas of components.

Noise mapping and action plans are mandatory according to the European Environmental Noise Directive (END), cf. [19]. A strategy for a quieter Europe is presented in [20]. In several countries, facade sound insulation requirements are specified as a function of the outdoor traffic noise levels calculated according to other methods than defined in the END [19], and in some countries there are additional limits for night events. When reviewing such limits, the WHO night noise guidelines in [21] might be useful.

Like requirements for sound insulation between dwellings, the situation seems quite chaotic, when trying to exchange experience between countries.

#### 4. Sound classification schemes in Europe

Sound classification schemes describe different quality classes to meet different needs of activities and quietness in the home. Classification schemes exist at present in 10 countries in Europe dwellings [22-31]. In Germany, an additional recommendation [32] has been prepared. The first classification schemes for dwellings were implemented in the early 1990s (France and Germany). Sound classification schemes in Europe are national schemes, the majority being published by national standardization organizations, see Figure 6. An overview of existing sound classification schemes for dwellings [22-31] is found in Table 4. For each scheme listed in Table 4 is indicated the relation to the national building code and the classes intended for new and for existing (old/renovated and other not new) housing, respectively. The schemes specify class criteria concerning several acoustic aspects. The schemes and main class criteria are described in more detail in [8-9], for facades in [33]. Aspects related to sound classes for renovated housing are described in [34]. More schemes are under development in other countries, unfortunately different from and not coordinated with update of other schemes in Europe.

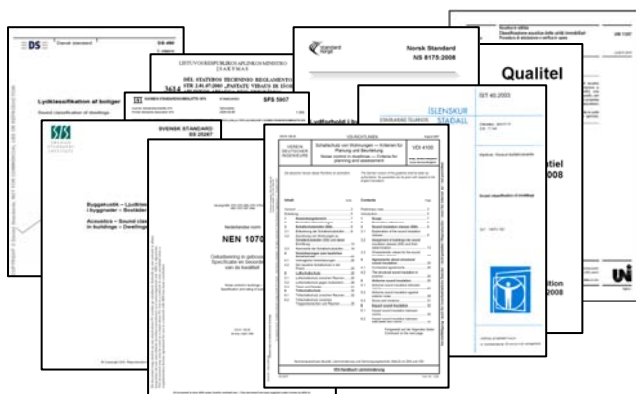


Figure 6 – Most classification schemes in Europe are published by national standardization organizations. Only in Germany and France, the schemes are published by "private" organizations. An overview of schemes is found in Table 4.

The different classes in the classification schemes are intended to reflect different levels of acoustical comfort. Thus, to be able to make a qualified choice of sound class, it is of course relevant to know the degree of acoustical comfort or occupants' satisfaction for the respective classes.

Example: Concerning regulatory sound insulation requirements for dwellings, the Danish Building Regulations 2008 refer to Class C in DS 490:2007. This standard also defines limits for dwellings with better acoustic conditions (Classes B and A) than specified in the regulatory minimum requirements (Class C). Furthermore, the standard also includes a weaker Class D intended for renovated dwellings, where improvement up to Class C is inappropriate (e.g. for architectural reasons), impossible (for technical reasons) or too expensive. In DS 490 are found brief definitions of classes, and an Annex describes in more detail the principles for occupants' subjective evaluation and provides information about expected percentage of satisfied and dissatisfied people for the respective classes. Summarized information based on DS 490 [22] is found in Table 5.

Table 4 – European schemes for sound classification of dwellings [22-31], relation to building codes and indication of classes intended for new and “old” dwellings

Country	Class denotations <sup>(1)</sup>	CS Reference (latest version)	Link BC to CS	BC Reference to CS	Comment	Classes for new dwellings	Classes for “old” dwellings
DK	A / B / C / D	DS 490 (2007)	+	Class C		A, B, C	D
FI	A / B / C / D	SFS 5907 (2004)	(-)	None	BC = Class C	A, B, C	D
IS	A / B / C / D	IST 45 (2003)	(-)	None <sup>(3)</sup>	(3), (6)	A, B, C	D
NO	A / B / C / D	NS 8175 (2008)	+	Class C		A, B, C	D
SE	A / B / C / D	SS 25267 (2004)	+	Class C		A, B, C	D
LT	A / B / C / D / E	STR 2.01.07 (2003)	+	Class C		A, B, C	D, E
NL	I / II / III / IV / V	NEN 1070 (1999)	-	None	BC ~ Class III	I / II / III	IV, V
IT	I / II / III / IV	UNI 11367 (2010)	-	None	BC ~ Class III	I / II / III	IV
DE	III / II / I	VDI 4100 (2007) (5)	-	None	BC ~ Class I	III, II, I	None
FR	QLAC / QL <sup>(2)</sup>	Qualitel (2008)	-	None	(4)	QLAC / QL	None

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

- (1) Classes are indicated in descending order, i.e. the best class first.
- (2) The indicated class denotations are applied for sound insulation between dwellings, but there is only one performance level for e.g. facade sound insulation.
- (3) For sound insulation between dwellings, BC recommends limit values as for Class C, which defines stricter criteria than the regulatory requirements.
- (4) Class/label QL for airborne sound insulation between dwellings equals BC requirement. For impact sound level, QL is 3 dB stricter than the BC.
- (5) In addition, the German Society of Acoustics (DEGA) has published a recommendation for labelling of acoustic quality of new and existing buildings, cf. DEGA-Empfehlung 103 [32]. “Schallschutz im Wohnungsbau – Schallschutzausweis”, March 2009. <http://dega-schallschutzausweis.de/>. The labelling system has seven classes described by the letters A-F and a colour code, the lower classes intended for old buildings.
- (6) IST 45 is being revised, publication expected January 2011. Reference to Class C is foreseen in the next BC, publication expected February 2011.

Table 5 – Occupants' expected satisfaction for different sound classes according to DS 490:2007. Summary based on information in DS 490.

Sound insulation between dwellings Main class criteria in DS 490:2007			Characteristics of DS 490 sound classes for dwellings and occupants' expected evaluation Information compiled based on DS 490		
Class	Airborne	Impact	Sound class descriptions	Good or very good	Poor
A	$R'_{w} + C_{50-3150} \geq 63$ dB	$L'_{n,w} \leq 43$ dB and $L'_{n,w} + C_{1,50-2500} \leq 43$ dB	Excellent acoustic conditions. Occupants will be disturbed only occasionally by sound or noise.	> 90 %	
B	$R'_{w} + C_{50-3150} \geq 58$ dB	$L'_{n,w} \leq 48$ dB and $L'_{n,w} + C_{1,50-2500} \leq 48$ dB	Significant improvement compared to minimum in class C. Occupants may be disturbed sometimes.	70 to 85 %	< 10%
C	$R'_{w} \geq 55$ dB	$L'_{n,w} \leq 53$ dB	Sound class intended as the minimum for new buildings.	50 to 65 %	< 20%
D	$R'_{w} \geq 50$ dB	$L'_{n,w} \leq 58$ dB	Sound class intended for older buildings with less satisfactory acoustic conditions, e.g. for renovated dwellings.	30 to 45 %	25 to 40%
Reference: DS 490:2007, "Lydklassifikation af boliger" (Sound classification of dwellings).			Note: Within each sound class the percentage of satisfied or dissatisfied occupants may depend on the type of criterion. The grouping is mainly based on the subjective assessments of airborne and impact sound from adjacent dwellings.		

Considering the 10 classification schemes in Europe there are several differences:

- Descriptors used to describe sound insulation and noise criteria
- Number of quality classes and intervals between classes
- Use of low-frequency spectrum adaptation terms according to ISO 717:1996 [11]
- Sound insulation internally in dwellings
- Common or separate quality levels for multi-storey and row housing
- Balance between criteria for airborne and impact sound insulation
- Relation to regulatory requirements

When comparing the information in Table 4, some schemes may appear similar, eg NL and IT, but they are very different. Even the Nordic schemes are more different than appearing from Table 4.

### 5. Is harmonization of sound insulation descriptors and classes possible?

Looking into the future, harmonization of sound insulation requirements seems unrealistic. However, by reducing the number of sound insulation descriptors and by preparing a harmonized European classification scheme with a number of quality classes, each member state could select for regulations a "harmonized" class fitting the national needs and conditions. Having said that, it must be emphasized that there are big jungles to fell, before "transparent" limits can be implemented.

#### Jungles to fell – Replanting forbidden!

Jungle 1: The variety of standardized sound insulation descriptors, cf. EN ISO 717, [11]

Jungle 2: Complex national rules making it difficult to find the limit values, see eg. [14]

Jungle 3: National special rules in addition to standardized methods, cf. eg. [15-16]

## 6. Implementation and enforcement of sound insulation requirements

Important tasks and tools for upgrading sound insulation requirements and to make an efficient and effective implementation in practice are:

- Review of national requirements and upgrade, if needed
- Suitable predictions and test methods (EN 12354 and ISO 140)
- Knowledge of uncertainties (see eg [35])
- Construction databases and guidelines for improvement of existing housing
- Construction databases and guidelines for new housing
- Enforcement of regulations
- Feedback from field testing

### Examples of guidelines and enforcement

Examples of instructions for improvement of existing/old housing are found in Figure 7. For new buildings, “Robust Details” [36] implemented in UK is an example of a coordinated approach, including construction design, acoustic site inspection, checklists, field testing and systematic feedback to the design and performance review. In practice, Robust Details supports enforcement. Examples of construction details and checklists are shown in Figure 8.

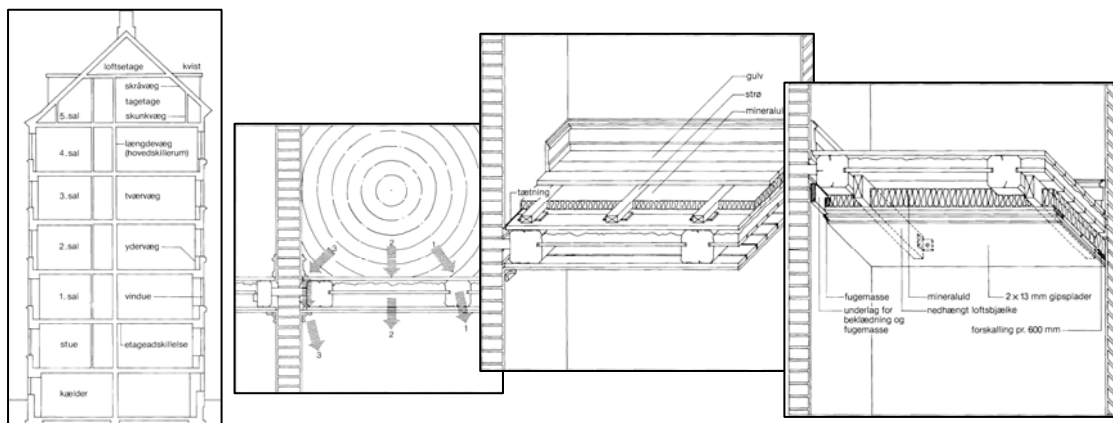


Figure 7 – Examples on instructions for improvement of sound insulation of old housing. Source: SBI Guidelines 173, Sound insulation of buildings – Old buildings, 1992 (in Danish).

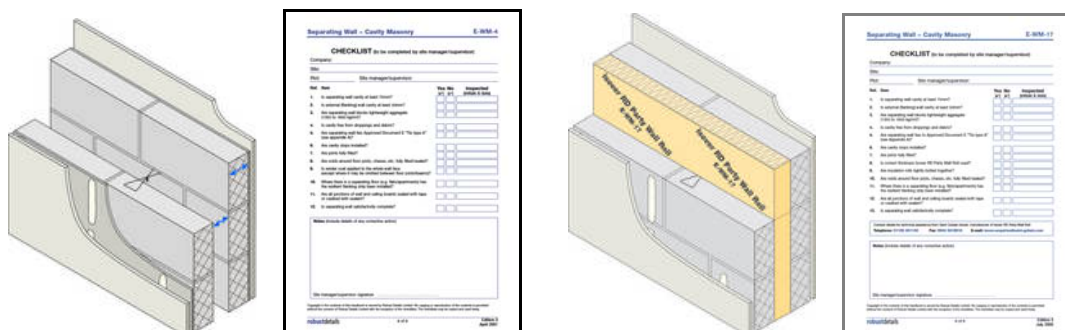


Figure 8 – Examples construction details and related checklists from Robust Details [36].

According to [37], the coordinated approach in Robust Details [36] “can lead to an accelerated uptake in improved construction practice and allow government policy performance objectives to be met sooner”.

## **7. COST TU0901 as a tool for harmonization in Europe**

Sound insulation descriptors, regulatory requirements and classification schemes in Europe represent a high degree of diversity. Unfortunately, there is no sign on increasing harmonization, rather the contrary, i.e. evidence for an even more diverse situation in Europe. The studies, cf [6-7] conclude that harmonization of descriptors and sound insulation classes are needed to facilitate exchange of data and experience between countries and to reduce trade barriers. Most important is, however, that review and update/upgrade of sound insulation requirements should be initiated in several countries to adapt regulations to current construction trends and peoples' needs for health, wellbeing and comfort.

To coordinate research and initiate harmonization, it was decided – following a discussion with the board of EAA [38] – to apply for a COST Action, which would be a big step compared to the rather limited perspectives through activities in EAA.

### **7.1 About COST - Main characteristics**

Quote from [http://www.cost.eu/about\\_cost](http://www.cost.eu/about_cost): "COST – European COoperation in the field of Scientific and Technical Research – was the first and is the widest European network for the coordination of nationally funded research activities. It is based on an inter-governmental framework for cooperation agreed following a Ministerial Conference in 1971. The mission of COST is to strengthen Europe in scientific and technical research through the support of European cooperation and interaction between European researchers. A "Bottom-up" approach (idea and subject of a COST Action comes from the European scientists themselves), equality of access (open to all COST countries) and a flexible structure are main characteristics."

COST supports meeting costs (travelling, facilities), dissemination and other activities, but never research itself, which – including time for cooperation – must be funded in other ways. Thus, COST provides the framework and pays the marginal costs enabling extensive cooperation, which might probably not become reality otherwise.

Possibilities are described at [http://www.cost.eu/about\\_cost](http://www.cost.eu/about_cost), and guidelines are found at <http://www.cost.eu/participate/guidelines>.

### **7.2 Establishing COST TU0901**

A preliminary proposal "Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions" was prepared by researchers from 10 countries and submitted to COST in September 2008 under so-called open calls. The preliminary proposal was approved two months later, implying an invitation to prepare a full proposal before mid January 2009. The full proposal was prepared, mainly by the same people, but now with contact to 15 more countries, and a list of interested experts from 25 countries was included. In May 2009, the European Action, COST TU0901 "Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions" [10], was approved. TU0901 runs for four years counted from the kick-off meeting in November 2009. Before the kick-off meeting, 22 parties had signed up (four under intention), and four more countries followed during the next months. The first – and until now (Nov. 2010) only WG meetings took place in Berlin in March 2010.

Until now (end 2010), 28 countries (two of these after one year from Action start) have signed up for TU0901, and about 85 people have been nominated for the management committee and working groups. Participating COST countries are: AT, BE, HR, CZ, DK, EE, FI, MK, FR, DE, GR, HU, IS, IT, LT, MT, NL, NO, PL, PT, RO, RS, SK, SI, ES, SE, CH, UK. In November 2010 institutions from three non-COST countries, namely New Zealand, Australia and Canada, joined TU0901. For detailed information about the Action, the MoU, the parties, the MC members and the activities, see [10].

### ***7.3 TU0901 objectives according to the TU0901 MoU [10]***

#### Main objectives

- Propose harmonized descriptors for airborne and impact sound insulation.
- Propose a European acoustic classification scheme for dwellings.

#### Secondary objectives

- Include low frequency range adequately
- Prepare a uniform questionnaire on annoyance by neighbour noise
- Provide a correlation between sound insulation and annoyance
- Establish a catalogue of sound insulation data for construction solutions found in the different participating countries
- Produce an on-line compendium on good workmanship practice

### ***7.4 TU0901 Working Groups***

#### **WG1: Harmonized sound insulation descriptors and classification schemes in Europe**

**Topics:** Common descriptors, classification schemes, legislation, enforcement, harmonization, rating and prediction methods (ISO and EN standards) for all member states in the fields of airborne and impact sound insulation of dwellings.

**Examples current tasks:** Evaluate scientifically the suitability of different performance descriptors. Make recommendations for descriptors to be applied in future building regulations. Discuss how to involve national building authorities in a change process.

#### **WG2: Subjective evaluation of sound insulation - Laboratory tests and harmonized field surveys**

**Topics:** Collection and interpretation of research data in the participating countries about the social surveys and psychoacoustic evaluation of neighbour noise: annoyance, impact on health, quality of life, correlation with acoustic comfort.

**Examples current tasks:** Collect, analyze, compare questionnaires and results from social surveys and experience from laboratory listening tests. Make summaries of studies. Make research proposals.

#### **WG3: Design and acoustic performance of building constructions for multi-storey housing**

**Topics:** Collection and discussion of construction details and sound insulation data. Prepare a European database with traditional and innovative "robust" solutions for sound insulation of new dwellings and for improvement of existing dwellings.

**Examples current tasks:** Collect information from countries to mosaic project “Existing and New Build Dwelling Stock Profiles” about housing types and sound insulation. Make proposals for presentation of sound insulation data, construction details and typical construction errors in a database.

### ***7.5 Cooperation with standardization groups and with other COST Actions***

There is a close contact to and cooperation with Standardization Boards at National, European (CEN) and International (ISO) levels as well as with other COST Actions as mentioned in the TU0901 MoU: FP0702 [39], TU0701 [40], TD0804 [41]. Status for cooperation:

- ISO and CEN WGs: About 15 TU0901 participants are members of such WGs, and in addition several TU0901 participants are active at a national level.
- FP0702 (Acoustics for Timber based Lightweight Buildings) [39]  
About ten TU0901 people are also MC or WG members in FP0702. Two FP0702 WG leaders are TU0901 WG co-leaders. Status and main interfaces between TU0901 and FP0702 will be presented at the TU0901 symposium in December 2010 [42].
- TU0701 (Improving the Quality of Suburban Building Stock) [40]  
TU0901 had a presentation at the TU0701 Midterm Conference in May 2010, cf [34] and [40]. A TU0701 presentation will be given at the TU0901 symposium in December 2010 [42].
- TD0804 (Soundscapes) [41]  
About five people are members of both Actions. The TD0804 Chair and Vice-Chair are also TU0901 members.  
TU0901 and TD0804 were cooperating about the training school, cf. Section 7.6.

### ***7.6 Training school and STSMs***

A Training School took place in September 2010 in Ljubljana. It was organized in cooperation with EAA [38] and two other COST Actions, one of them TD0804 [41]. The course consisted of different acoustic courses, participation in a conference and an exam (worth 2 ECTS credit points, if passed). TU0901 supported the one-day building acoustics course, which had 98 participants. 72 of these took part in the exam, and 66 passed. A TU0901 report is found at the Action website [10].

TU0901 STSM offers are announced at the website [10]. In 2010, two STSMs have been made. Further STSMs have been suspended due to budget restraints caused by 26 parties (countries) the first year of TU0901 and a budget designed for only 18 parties.

### ***7.7 Current TU0901 tasks and challenges***

In addition to WG tasks, key MC tasks are to finish review of completed and ongoing research projects, identify gaps in the research needed to meet the TU0901 objectives. The main challenges are to obtain research funding as needed and to establish efficient and effective cooperation in and between working groups, who until now have met only once due to cancelled WG meetings (caused by budget cuts).

## 8. Conclusions and acknowledgements

Most European countries have regulatory sound insulation requirements for dwellings, and classification schemes exist in several countries. However, descriptors and performance levels represent a high degree of diversity. A harmonization is necessary to stimulate innovation and reduce trade barriers and – most important – facilitate the exchange of experience between countries, thus improving chances of better quality of dwellings to the benefit of peoples' comfort.

The author - and Chair of TU0901 – is grateful to all those enthusiastic people from many countries having signed up for TU0901: The Vice Chair, the WG leaders and co-leaders, the MC and WG members, in total about 85 people from 28 countries in Europe and three overseas countries. In addition: Thanks to COST people for support.

COST TU0901 has – through members with different academic backgrounds (architects, physicists, civil engineers etc.) and from different types of institutions (universities, building research institutes, authorities, private companies etc.) in 28 countries in Europe and 3 overseas countries – the potential to establish a change process in a direction ensuring strengthened scientific basis for changes in sound insulation descriptors, requirements and classes.

## 9. References

- [1] Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19 - 22 June 1946; signed on 22 July 1946 by the representatives of 61 states (official Records of the World Health Organization, No. 2, p. 100) and entered into force on 7 April 1948.
- [2] <http://www.euro.who.int/>
- [3] Van den Berg, M. "*Neighbour Noise: A rational Approach*", pp. 151-154 in Proceedings of the 2nd WHO International Housing and Health Symposium. WHO, Bonn (2004).
- [4] J Lang, R Pierrard, W Schönback, "*Sound Insulation in Housing Construction*", TU Wien, Vienna, July 2006. A summary is found in J Lang (2007), "Schallschutz im Wohnungsbau". WKS 59/2007.
- [5] <http://www.europa.eu>
- [6] B Rasmussen, "*Sound insulation between dwellings – Requirements in building regulations in Europe*". Applied Acoustics, 2010, 71(4), 373-385.  
<http://dx.doi.org/10.1016/j.apacoust.2009.08.011>
- [7] B Rasmussen & JH Rindel "*Sound insulation between dwellings – Descriptors in building regulations in Europe*". Applied Acoustics, 2010, 71(3), 171-180.  
<http://dx.doi.org/10.1016/j.apacoust.2009.05.002>
- [8] B Rasmussen, "*Sound insulation of residential housing - Building codes and classification schemes in Europe*". Chapter 114 in Handbook of Noise and Vibration Control. Wiley & Son, USA, 2007.
- [9] B Rasmussen, "*Sound classification of dwellings – Comparison of schemes in Europe*", NAG/DAGA 2009, Rotterdam, Netherlands. Paper ID 453.
- [10] COST Action TU0901 "Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions", 2009-2013,  
[http://w3.cost.eu/index.php?id=240&action\\_number=TU0901](http://w3.cost.eu/index.php?id=240&action_number=TU0901) (public information at COST website) or [www.costtu0901.eu/](http://www.costtu0901.eu/) (Action website).  
STSM offers: <http://www.costtu0901.eu/stsm>



- [11] ISO 717, Acoustics - Rating of sound insulation in buildings and of buildings elements.  
– Part 1: Airborne sound insulation, 1996.  
– Part 2: Impact sound insulation, 1996.  
Note: In 2008, ISO/TC 43/SC 2 decided to revise ISO 717. The task is given to WG 18.
- [12] ISO 140, Acoustics – Measurement of sound insulation in buildings and of building elements  
– Part 2: Determination, verification and application of precision data, 1991.  
– Part 4: Field measurements of airborne sound insulation between rooms, 1998.  
– Part 5: Field measurements of airborne sound insulation of facade elements and facades, 1998.  
– Part 7: Field measurements of impact sound insulation of building elements, 1998.  
– Part 14: Guidelines for special situations in the field, 2004.  
Note: ISO 140 consists of more parts. The above parts are relevant to field measurements.
- [13] B. Rasmussen and J. H. Rindel: “Concepts for evaluation of sound insulation of dwellings - from chaos to consensus?” Forum Acusticum 2005, Budapest, Hungary, Paper ID 7820.
- [14] V Desarnaulds and B Rasmussen, “*Harmonisation des réglementations européennes dans le domaine de l’isolation acoustique dans le bâtiment (COST TU0901)*”. 10ème Congrès Français d’Acoustique, Lyon, 12-16 Avril 2010.
- [15] Heikki Helimäki and Birgit Rasmussen, “*Airborne sound insulation descriptors in the Nordic building regulations – Overview special rules and benefits of changing descriptors*”. Baltic-Nordic Acoustics Meeting 2010, Bergen, Norway. SINTEF Byggforsk, 2010.
- [16] Klas Hagberg and Birgit Rasmussen, “*Impact sound insulation descriptors in the Nordic building regulations – Overview special rules and benefits of changing descriptors*”. Baltic-Nordic Acoustics Meeting 2010, Bergen, Norway. SINTEF Byggforsk, 2010.
- [17] Barlindhaug, Rolf, & Ruud, Marit Ekne. “*Beboernes tilfredshet med nybygde boliger*” (Resident satisfaction with newly built homes). Norsk institutt for by- og regionforskning. NIBR-rapport 2008:14, Oslo 2008.
- [18] Sigurd Hveem, “*Unngå byggsaker – Lydisolasjonskvalitet i boliger*” (Avoid building faults – Sound insulation quality in dwellings). SINTEF Byggforsk, 2010.  
<http://www.sintef.no/upload/Artikkel-05-10-ByggAktuelt.pdf>. Note: This article summarizes main findings about sound insulation from [14].
- [19] “European Directive 2002/49/EC of 25 June 2002 relating to the assessment and management of environmental noise”. Note: Often referred to as the Environmental Noise Directive or END. Europe - Environment - Noise Policy,  
<http://www.europa.eu.int/comm/environment/noise/home.htm>
- [20] “Research for a Quieter Europe in 2020”. An updated strategy paper of the CALM network. European Commission. Research Directorate - General, 2007. [http://www.calm-network.com/index\\_preports.htm](http://www.calm-network.com/index_preports.htm)
- [21] "Night noise guidelines for Europe". Copenhagen, WHO Regional Office for Europe, 2009. [http://www.euro.who.int/eprise/main/WHO/Progs/NOH/Activities/20040721\\_1](http://www.euro.who.int/eprise/main/WHO/Progs/NOH/Activities/20040721_1)
- [22] DS 490:2007, “Lydklassifikation af boliger”. (Sound classification of dwellings), DK.
- [23] SFS 5907:2004, “Rakennusten Akustinen Luokitus“, Finland. English version “Acoustic classification of spaces in buildings” published in July 2005.
- [24] IST 45:2003, “Acoustics - Classification of dwellings”, Iceland. Note: Under revision, cf. Draft IST 45:2010, “Acoustic conditions in buildings - Sound Classification of Various Types of Buildings” (publication expected in 2010).

- [25] NS 8175:2008, “Lydforhold i bygninger, Lydklassifisering av ulike bygningstyper” (Sound conditions in buildings - Sound classes for various types of buildings), Norway.
- [26] SS 25267:2004, “Byggakustik – Ljudklassning av utrymmen i byggnader – Bostäder”. (Acoustics – Sound classification of spaces in buildings – Dwellings). Sweden.
- [27] STR 2.01.07:2003, Dėl Statybos Techninio Reglamento Str 2.01.07:2003, “Pastatu Vidaus Ir Isores Aplinkos Apsauga Nuo Triuksmo” (Lithuanian building regulations. Protection against noise in buildings). Patvirtinimo, Lithuania.
- [28] NEN 1070:1999, “Geluidwering in gebouwen – Specificatie en beoordeling van de kwaliteit” (Noise control in buildings – Specification and rating of quality), Netherlands.
- [29] UNI 11367:2010 Acustica in edilizia – Classificazione acustica delle unità immobiliari – Procedura di valutazione e verifica in opera (Building Acoustics - Acoustic classification of building units - Evaluation procedure and in-situ measurements)
- [30] VDI 4100:2007, “Schallschutz von Wohnungen - Kriterium für Planung und Beurteilung” and “Noise control in dwellings – Criteria for planning and assessment”. Germany.
- [31] La méthode qualitel”, 2008, Association Qualitel, France. [www.cerqual.fr](http://www.cerqual.fr)
- [32] DEGA-Empfehlung 103, “Schallschutz im Wohnungsbau – Schallschutzausweis”, DEGA, March 2009. <http://dega-schallschutzausweis.de/>
- [33] B Rasmussen, “Facade sound insulation comfort criteria in European classification schemes for dwellings”, EuroNoise 2006, Tampere, Finland, Paper ID 434..
- [34] B Rasmussen, “*Sound classification schemes in Europe - Quality classes intended for renovated housing*”. SUBURBAN 2010 “Improving the Quality of Suburban Building Stock”. University of Malta, 2010. COST TU0701 Midterm Conference.
- [35] Christian Simmons, “*Managing uncertainty in building acoustics: comparisons of predictions with the 12354 standards to measurements*”. Dissertation, Luleå University of Technology, 2009.
- [36] Robust Details, <http://www.robustdetails.com/>. Definition of RD: see <http://www.robustdetails.com/Robust-Details-for-Part-E-separating-walls-or-floors-sound-insulation-and-testing-Robust-Details-Limited-65d22b1>
- [37] S Smith, D Baker, R Mackenzie, J B Wood, P Dunbavin, D Panter, “*The development of robust details for sound insulation in new build attached dwellings*”. J Build Appraisal 2006;2 (1):69–85.
- [38] EAA European Acoustics Association: <http://www.european-acoustics.org/>  
EAA TC-RBA: <http://www.european-acoustics.org/technical-committees/rba>  
EAA TC-RBA WG4: <http://www.eaa-fenestra.org/technical-committees/rba>
- [39] FP0702 "Net-Acoustics for Timber based Lightweight Buildings and Elements (TBLB)" [http://w3.cost.eu/index.php?id=143&action\\_number=FP0702](http://w3.cost.eu/index.php?id=143&action_number=FP0702)
- [40] TU0701 "Improving the Quality of Suburban Building Stock" [http://w3.cost.eu/index.php?id=240&action\\_number=TU0701](http://w3.cost.eu/index.php?id=240&action_number=TU0701)
- [41] TD0804 Soundscape of European Cities and Landscapes [http://w3.cost.eu/index.php?id=240&action\\_number=TD0804](http://w3.cost.eu/index.php?id=240&action_number=TD0804)
- [42] Symposium of EAA TC-RBA and Cost Action TU0901 "Harmonization of European sound insulation descriptors and classification standards". Florence, Italy, 14<sup>th</sup> December 2010, see [10].