



# Protection against Noise for Cyprus



Technical Assistance for Reforming the Cyprus  
Planning & Building Legislation Framework

Heinz J. Ferk

2017-06-21

# Contents

- Status quo
- Recommendations
- Functional Requirements
- Technical Requirements – Draft Guideline 5
- Basic data and Requirement examples within Europe, ISO, WHO

# Status quo

- The StrBLaw\_15EN in 115/86 (health and comfort) includes an „overall “ statement which may be understood as an functional requirement concerning noise protection:
- *„No permit will be issued by the competent authority concerning a project ...unless the competent authority...is fully content, that the following prerequisites are met with regards to the intended building construction:....(ii) it will be used in such a manner **as not to have unfavourable effects on public health or the comfortable way of living of the residents of the area.**”*
- On the other hand, technical requirements specifying noise protection measures from the exterior, inside buildings and for the emission of noise are not part of the planning permit, and there are no such technical requirements given in the law.

# Status quo

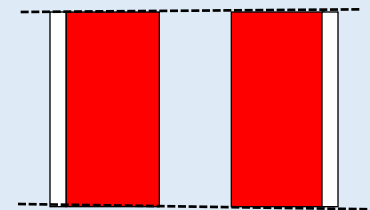
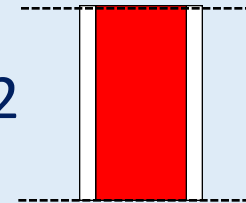
- Connection zoning plan to acceptable noise levels exists for „wind farms“ areas

*Mandate 2/2006: “the level of noise pollution must be within the specified limits..”*

Zone Type	Noise level during the day (DB (A))	Noise level during the night (DB (A))
Industrial Zone or Area	70	70
Craft Zone or Area	65	50
Residential or Tourist Zone (excluding areas with recreational and entertainment use prevailing)	50	35
Resting homes, sanatoria and hospitals	45	35

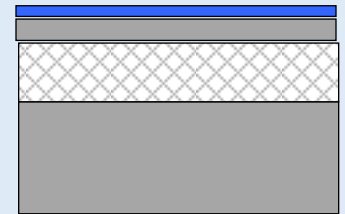
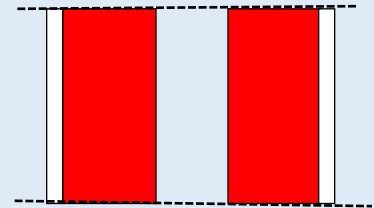
# Status quo typical construction systems

- „typical“ construction systems existing:
  - Internal walls:
    - 2 cm of plaster
    - 10 cm hollow brick wall ca. 200 – 220 kg/m<sup>2</sup>
    - 2 cm of plaster
  - Partition walls/dividing walls additional:
    - 2 cm of plaster
    - 10 cm hollow brick wall ca. 200 – 220 kg/m<sup>2</sup>
    - 5 cm cavity or insulation (optional)
    - 10 cm hollow brick wall 200 – 220 kg/m<sup>2</sup>
    - 2 cm plaster



# Status quo typical construction systems

- External walls:  
same as interior, in special cases cavity walls,  
sometimes combined with an inner structural  
leaf or concrete block, sometimes cavity  
filled with insulation material  
sometimes concrete framework
- Windows: different Aluminium frames with double  
glazing
- Separating floors  
3 cm Tiles on mortar  
10 cm lightweight concrete, pumice gravel,  
curuf or similar  
15 – 20 cm concrete



# Status quo

- If we use these construction systems to estimate existing sound insulation we can estimate the following values for the sound transmission index  $R_w$  /impact sound pressure level  $L_{nw}$ 
  - External walls:  
 $R_w$  ca. 40 – 50 dB (estimated, depending on weight and type of brick)
  - Partition wall  
 $R_w$  ca. 40 – 50 dB (estimated, depending on weight and type of brick)
  - Floor  $R_w \approx 55$  dB,  $L_{nw} \geq 70 - 80$  dB
  - Windows  $R_w \approx 15 - 35$  dB, depending on the quality of sealing

# Status quo

- If we use these constructions to estimate sound insulation of constructions we can estimate the following values for the sound transmission index  $R$  / impact sound pressure level  $L_{nw}$

- External walls:  
 $R_w$  ca. 40 – 50 dB (estimated for brick)
- Partitions:  
 $R_p$  ca. 30 – 40 dB

– A high percentage (69%) of the survey participants experience bothersome noises from the outside, probably as a result of poorly insulated wall surfaces and single glazing which not only allow heat enter and exit freely, but also allow noise to penetrate with little difficulty.

... weight and type

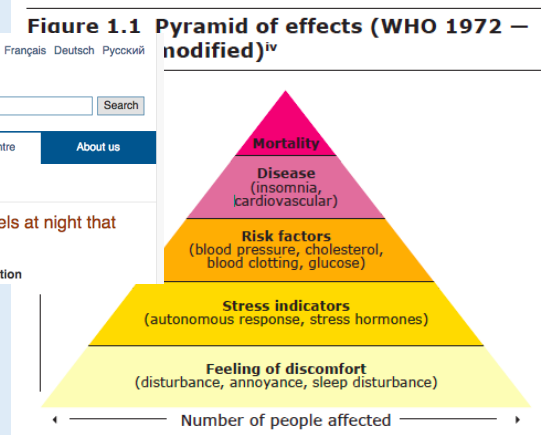
...  $R_w \approx 80$  dB

... shows  $R_w \approx 15 - 35$  dB, depending on the quality

P. Lapithis et. Al; Technical Improvements of Housing Envelops in Cyprus, 2011



# Status quo



- **Room Acoustics:**  
Noise reduction in rooms is also an essential item in health protection – but also for better productivity, comfort and wellbeing
- Room acoustic Requirements concerning noise reduction within rooms for e.g. workshops, restaurants etc. and for room acoustics in schools, lecture rooms, etc. for a better “speech intelligibility” are to be highly recommended



# Basic Requirements for Construction Works

- European Construction Products Regulation CPR\*
- 7 basic requirements
- 5<sup>th</sup> Basic Requirement

## Protection against noise

- The construction works **must** be designed and built in such a way that noise perceived by the occupants or people nearby is kept to a level that will not **threaten their health** and **will allow them to sleep, rest and work in satisfactory conditions.**

\* REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, The European Parliament, 2011

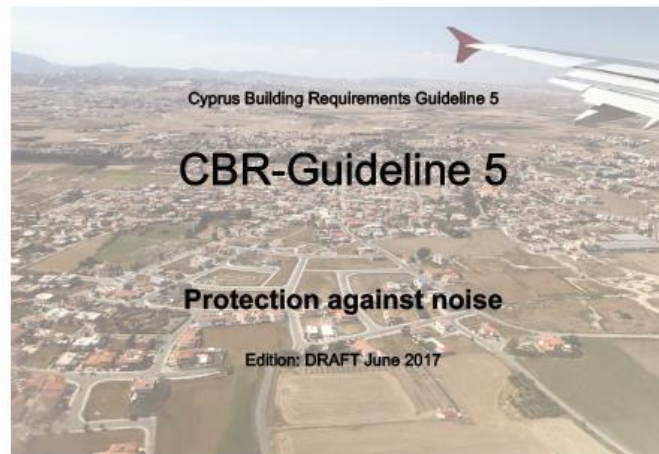
# Recommendations

- Include functional requirements concerning protection against noise in the building law
- Develop a cyprus „guideline“ for basic requirement 5 of the European construction product regulation CPR „protection against noise“
- Accompanying measures
  - Provide help for praxis, education, data, forms etc.
- Discussion concerning sensitivity and health/productivity matters
  - What is a suitable planning basis level for different room usages in Cyprus

# Recommendations for accompanying measures

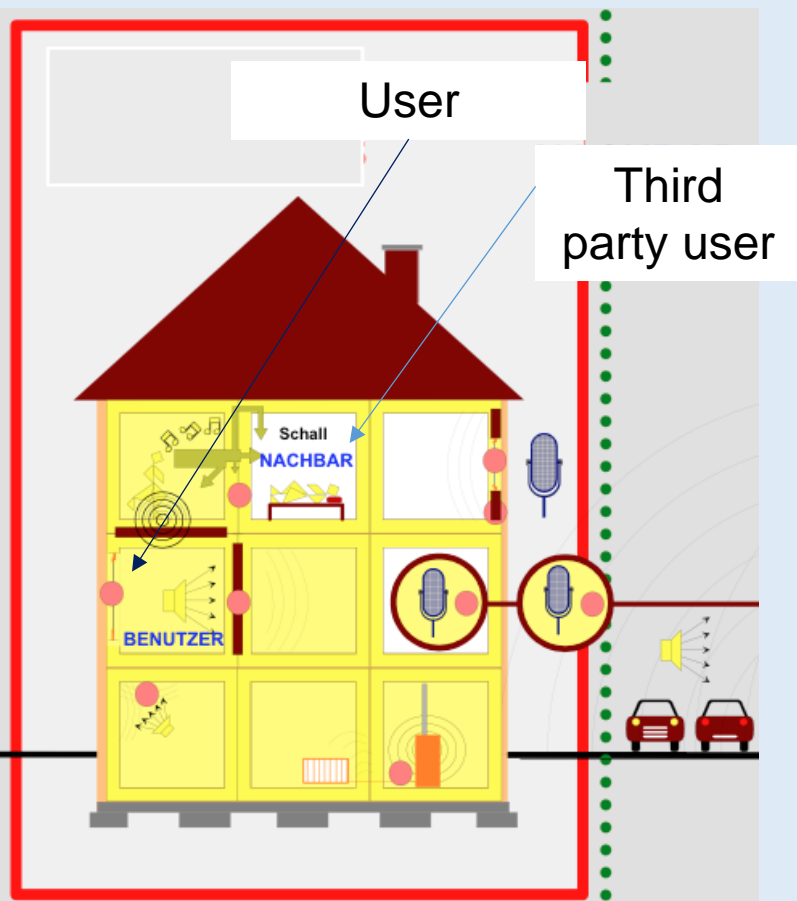
- Establish one (ore more) state- (or private) institutes with a lab, that help to spread acoustics knowledge, provide tools, testing and calculating materials, constructions etc. and on the other hand do certification acc. ISO 17020 / 17025
- Provide data:
  - rules how to estimate the environmental noise as a basis for the estimation of the acoustic performance of buildings from the acoustic performance of the elements.
  - basic sound levels
  - Collection of relevant acoustical data of specific building materials and constructions
  - Provide sample calculations and/or robust details
  - Work on noise maps and connect it to the dedication plan.
  - Proceed with strategic noise maps
- Adjust requirements for CE – marking of building materials and products
- Adapt the education and training for architects, designers and engineers, concerning building acoustic and room acoustics, but also provide practical knowledge for builders
- Introduce inspections for a random quality control measurement

# Draft GL 5 Protection against noise



<b>0</b>	<b>Preliminary remarks</b> .....	<b>2</b>
<b>1</b>	<b>Definitions</b> .....	<b>2</b>
<b>2</b>	<b>Protection against noise</b> .....	<b>2</b>
2.1	<i>Scope</i> .....	2
2.2	<i>Protection of a building/room against ambient noise</i> .....	2
2.3	<i>Protection against airborne noise within buildings</i> .....	4
2.4	<i>Protection against impact noise within buildings</i> .....	5
2.5	<i>Noise requirements for building equipment and appliances</i> .....	6
2.6	<i>Noise requirements between terraced houses and adjoining buildings</i> .....	6
2.7	<i>Additional noise requirements for buildings used other than for residential, office, or school purposes</i> .....	6
2.8	<i>Rooms with specific uses</i> .....	7
<b>3</b>	<b>Room acoustics</b> .....	<b>8</b>
3.1	<i>Scope</i> .....	8
3.2	<i>Requirements for acoustic quality</i> .....	8
3.3	<i>Requirements for noise reduction</i> .....	8
<b>4</b>	<b>Shock protection</b> .....	<b>8</b>
4.1	<i>Scope</i> .....	8
4.2	<i>Requirements</i> .....	8
	<b>REMARKS concerning Sound Protection Values:</b> .....	<b>1</b>

# Building & Sound protection



Zielorientierte Anforderungen	Leistungsmerkmale für akustische Eigenschaften	Maßnahmen zur Erfüllung der Anforderung
EXTERNAL AMBIENT NOISE	<p>Mindestschallschutz in dB (<math>R_{res,w}^*</math>, <math>R'_{w}</math>, <math>R_w</math> bzw. <math>R+C_s</math>) für maßgebliche Außenlärmpegel-Stufen</p>	Facade airborne sound reduction
AIRBORNE SOUND between rooms	<p>Mindest erforderliche bewertete Standard-Schallpegeldifferenz <math>D_{nT,w}</math> in Gebäuden</p>	Sound level difference
IMPACT NOISE Between ro	<p>Höchstzulässiger bewerteter Standard-Trittschallpegel <math>L'_{nT,w}</math> in Gebäuden</p>	Impact noise level
ABSORPTION	<p>Nachhallzeit in s bzw. Mittlerer Schallabsorptionsgrad</p>	Sound Absorption
NOISE BY SERVICE EQUIPMENT	<p>Höchstzulässiger Anlagengeräuschpegel <math>L_{Amax,nT}</math></p>	Airborne and structure borne sound reduction

# Draft GL 5 Standards, Definitions

Document Nr. <a href="#">↗</a>	Title <a href="#">↗</a>	Issue <a href="#">↗</a>	CBR Guideline: <a href="#">↗</a> <a href="#">↗</a>
EN ISO 717-1 <a href="#">↗</a>	Acoustics — Rating of sound insulation in Buildings and of building elements — Part 1: Airborne sound insulation <a href="#">↗</a>	2013-06 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
EN ISO 717-2 <a href="#">↗</a>	Acoustics — Rating of sound insulation in Buildings and of building elements — Part 2: Impact sound insulation <a href="#">↗</a>	2013-06 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 16283-1 <a href="#">↗</a>	Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation <a href="#">↗</a>	2016 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO/FDIS 16283-2 <a href="#">↗</a>	Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 2: Impact sound insulation. <a href="#">↗</a>	2015 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 3382-2+ Cor 1 <a href="#">↗</a>	Acoustics — Measurement of room-acoustic parameters — Part 2: Reverberation time in ordinary rooms <a href="#">↗</a>	2008/2009 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
EN 12354-1: <a href="#">↗</a>	Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 1: Airborne sound insulation between rooms <a href="#">↗</a>	2000 (NEW draft 2016) <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
EN 12354-2: <a href="#">↗</a>	Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 2: Impact sound insulation between rooms. <a href="#">↗</a>	2000 (new draft 2016) <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
EN 12354-3: <a href="#">↗</a>	Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 3: Airborne sound insulation against outdoor sound. <a href="#">↗</a>	2000 (new draft 2016) <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 10052 <a href="#">↗</a>	Acoustics — Field measurements of airborne and impact sound insulation and of equipment noise — Survey methods + Amd 1:2010 <a href="#">↗</a>	2004 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 16032 <a href="#">↗</a>	Acoustics — Measurement of noise from service equipment in buildings — Engineering method. <a href="#">↗</a>	2004 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 10140-2 <a href="#">↗</a>	Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation. <a href="#">↗</a>	2010 <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>
ISO 10848-2 <a href="#">↗</a>	Acoustics — Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms — Part 2: Application to light elements when the junction has a small influence. <a href="#">↗</a>	2006 (new draft 2017) <a href="#">↗</a>	CBR Guideline 5 <a href="#">↗</a>

To be completed... [↗](#)

[↗](#)

[↗](#)

[↗](#)

Ministry of Interior Cyprus	MOI-XXX	Annex XX Definitions
<b>single-number quantity for airborne sound insulation rating value</b> , in decibels, of the reference curve at 500 Hz after shifting it in accordance with the method specified in part 1 of ISO 717.		
<b>spectrum adaptation term</b> value, in decibels, of the reference curve at 500 Hz after shifting it in accordance with the method specified in part 1 of ISO 717.		
<b>airborne sound insulation between rooms</b> This is the characteristic of a building construction to protect against airborne sound transmission in a building. The rvalue is given as a single-number quantity expressed in decibels (dB).		
<b>impact sound pressure level</b> This characterises the extent to which a building construction transfers impact sound within the building to a specified room. The value is given as a single-number quantity s expressed in decibels (dB).		
<b>airborne sound insulation of facades and external elements</b> This characterises the facade's and/or external element's ability to insulate against airborne sound transmission into a building to a specified room. The value is given as a single-number quantity expressed in decibels (dB).		
<b>sound pressure level from service equipment</b> Received sound pressure level in a room due to the operation of a specific piece of service equipment or plant in a building. The measurement result is given as a single-number quantity A-weighted time-averaged sound pressure level and/or the A-weighted maximum sound pressure level using timeweighting Fast (F), expressed in decibels (dB).		
<b>service equipment</b> a building's permanent outdoor and indoor technical installations, such as ventilation systems, lifts, heating systems, cooling systems, emergency power supplies, sanitary installations, central vacuum cleaner, heat pumps, motorised equipment like roller shutters and garage doors, internal rainwater pipes, and other similar installations necessary for operation of the building		
<b>reverberation time</b> This time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The quantity is denoted by T, and is expressed in seconds (s).		
<b>Energy-equivalent system noise level (L<sub>Aeq,T</sub>)</b> A-weighted average equivalent sound pressure level based on standardized reverberation time.		
<b>Maximum system noise level (L<sub>A,max,T</sub>)</b> maximum A-weighted average equivalent sound pressure level, detected in position "fast" as maximum noise level during a measurement period or a noise event.		
<b>Rating Level (L<sub>r</sub>)</b>		

# Draft GL 5 Requirement „frames“

Table 1:- Minimum sound protection by external building components elements

Minimum sound protection of external building elements									
Building Elements protecting rooms for residential purposes or similar as described	Minimum sound protection levels ( $R'_{max,w}$ , $R'_w$ , $R_w$ bzw. $R_w + C_{tr}$ in dB) in relation to environmental/ambient exterior noise levels								
row	1	2	3	4	5	6	7	column e	
Day	≤ 50	51 bis 55	56 bis 60	61 bis 65	66 bis 70	71 bis 75	76 bis 80	2	
Night	≤ 40	41 bis 45	46 bis 50	51 bis 55	56 bis 60	61 bis 65	66 bis 70	3	
May be adequate to zone	A, B	C	D	E	-	-		4	
For rooms in buildings for residential purposes, hotels, schools, nurseries, hospitals, spa buildings etc.								5	
- Exterior components, Facade (overall)	$R'_{max,w}$	33	38	38	43	43	48	53	6
Opaque exterior elements <sup>1)</sup>	$R_w$	43	43	43	48	48	53	58	7
Windows, external doors, etc. <sup>1) 2)</sup>	$R_w$ $R_w + C_{tr}$	28 23	33 28	33 28	38 33	38 33	43 38	48 43	8
- Building separating walls <sup>3)</sup> each leaf	$R'_w$	52	52	52	52	52	52	52	9
- ceilings and walls separating a room to an attic / a loft	$R'_w$	42	42	42	47	47	47	47	10
- Ceilings and Walls separating a room to a passage or garage	$R'_w$	60	60	60	60	60	60	60	11
For rooms in office buildings and similar used									12
- Exterior components, facade (overall)	$R'_{max,w}$	33	33	33	33	38	43	48	13
Opaque exterior elements <sup>1)</sup>	$R_w$	43	43	43	43	43	48	53	14
Windows and external doors, etc. <sup>1) 2)</sup>	$R_w$ $R_w + C_{tr}$	28 23	28 23	28 23	28 23	33 28	38 33	43 38	15
- Building separating walls <sup>3)</sup> (each leaf)	$R'_w$	52	52	52	52	52	52	52	16
- Ceilings and walls separating a room to an attic / a loft	$R'_w$	42	42	42	42	42	42	42	17
- Ceilings and walls separating a room to a passage or garage	$R'_w$	60	60	60	60	60	60	60	18

<sup>1)</sup> If the percentage of Area of windows and doors exceeds 30% of the external components of a room the required sound insulation index of the elements have to be determined according their percentage of area to fulfill the requirement of the resulting sound reduction index of the overall external component

<sup>1)</sup> Windows, French windows and external doors and comparable parts of the facade, "opaque elements".  
<sup>2)</sup> Walls, which will be built as a leaf of a separating wall (as a cavity wall) to an (current or future) adjoining building, regardless of the sound reduction index of an existing wall.

2.2.4 The sound protection of ventilation ducts to the exterior, such as window fans, individual room air handling units, and supply air and exhaust air openings must be chosen to ensure that the required resulting weighted sound reduction index  $R'_{max,w}$  of the external components is fulfilled in closed position and is not fallen short of by more than 5 dB when in minimum necessary operating position.

### 2.3 Protection against airborne noise within buildings

2.3.1 Walls, ceilings, and other partitioning elements between rooms have to be designed to provide reasonable protection against noise transmission by providing the following values of the weighted standard sound level difference  $D_{nT,w}$

Remark:  $D_{nT,120}$  or  $D_{nT,50}$  or  $R'_w$  are alternative possible descriptors

Minimum weighted standardized sound level difference $D_{nT,w}$ within buildings		
to	from	$D_{nT,w}$ [dB] without / with connecting Door, window or other opening
1 Residential rooms and equivalent	separated residential rooms of other utilisation units*	55 / 50
	separated common open rooms (z.B. Staircases, corridors, cellar rooms, rooms for common use)	55 / 50
	other separated rooms (bathrooms, restrooms etc.)	55 / 50
2 Hotelrooms, Classrooms, patient's rooms in hospitals, nursery group rooms, residential rooms in institutions	Rooms of the same category	55 / 50
	separated common open rooms (z.B. staircases, corridors, cellar rooms, rooms for common use)	55 / 38
3 siderooms	separated siderooms	60 / 35
	separated residential rooms	50 / 35
	common open rooms (z.B. Staircases, corridors, cellar rooms, rooms for common use)	50 / 35
* definition of other utilisation units: in schools the individual class rooms, in nurseries individual group rooms, in hospitals individual patient's room; in office buildings just separated office rooms used by third parties.		
Within buildings with a mixed utilisation used by third parties the requirements are according to these circumstances equivalent to the above mentioned.		

2.3.2 Protection against airborne noise Doors within buildings  
 Unless a higher weighted sound insulation index is required in order to fulfil the requirements for the required weighted standard sound level difference  $D_{nT,w}$  in accordance with Point



# Draft GL 5 Requirement „frames“

Table 1-- Minimum sound protection by external building components elements

Minimum sound protection of external building elements		
Building Elements protecting rooms for residential purposes or similar as described	Minimum sound protection levels (R <sub>w</sub> , R <sub>w</sub> + C <sub>w</sub> , R <sub>w</sub> + C <sub>w</sub> in dB in relation to	
	row	1
	Day	≤ 51
	Night	≤ 41
May be adequate to zone	A, B	
For rooms in buildings for residential purposes, hot		
- Exterior components, Facade (overall)	R <sub>max,w</sub>	33
- Opaque exterior elements <sup>1)</sup>	R <sub>w</sub>	43
- Windows, external doors, etc. <sup>2)</sup>	R <sub>w</sub>	21
- Building separating walls <sup>3)</sup> each leaf	R <sub>w</sub>	52
- Ceilings and walls separating a room to an attic / a loft	R <sub>w</sub>	42
- Ceilings and walls separating a room to a passage or garage	R <sub>w</sub>	60
For rooms in office buildings and similar used		
- Exterior components, facade (overall)	R <sub>max,w</sub>	33
- Opaque exterior elements <sup>1)</sup>	R <sub>w</sub>	43
- Windows and external doors, etc. <sup>2)</sup>	R <sub>w</sub>	21
- Building separating walls <sup>3)</sup> (each leaf)	R <sub>w</sub>	52
- Ceilings and walls separating a room to an attic / a loft	R <sub>w</sub>	42
- Ceilings and walls separating a room to a passage or garage	R <sub>w</sub>	60

<sup>1)</sup> If the percentage of Area of windows and doors insulation index of the elements have to be determined sound reduction index of the overall external comp

<sup>1)</sup> Windows, French windows and external doors and comparable parts of the facade, "opaque elements".

<sup>2)</sup> Walls, which will be built as of the sound reduction index

2.3.1, the weighted sound insulation index R<sub>w</sub> of doors (door leaf including frame) must not be less than the following

2.2.4 The sound protection room air handling that the required components is in minimum ne

2.3 Protection 2.3.1 Walls, ceiling designed to p following value

Remark: D<sub>ST,100</sub> or D<sub>ST,25</sub>

Minimum	
to	from
1 Residential room equivalent	third party (dwelling, institution, common attic/loft, common usable rooms)
2 Hotelrooms, Class patient's rooms hospitals, nursery rooms, residential in institutions	Rooms in common attic/loft, common
3 siderooms	Common

<sup>1)</sup> definition of other utili hospitals individual patie Within buildings with a m equivalent to the above n

Minimum weighted sound insulation index	
from	to
1 common used rooms (z.B. staircases, corridors)	Residential room
2 Residential room	Hotelrooms, Classrooms, patient's rooms in hospitals, nursery group rooms, residential rooms in institutions
3 Hotelrooms, Classrooms, patient's rooms in hospitals, nursery group rooms, residential rooms in institutions	Classrooms, group rooms, nurseries

<sup>1)</sup> definition of other utilisation units: individual patient's room; in office buildings within buildings with a mixed use/attic equivalent to the above mentioned.

## 2.4 Protection against

2.4.1 The weighted standard required values: Remark: L<sub>ST,100</sub> or L<sub>ST,25</sub> or L<sub>ST,a</sub>

Maximum	
within	from
1 residential rooms and comparable	third party (dwelling, institution, common attic/loft, common usable rooms)
2 bathrooms, siderooms	Rooms in common attic/loft, common

L<sub>A,sp</sub> characterizing peak level within the service room in dB  
L<sub>Tn</sub> planning basis level according to 0 in dB

Table 1-- planning basis level L<sub>Tn</sub> in the residential or similar used third party room depending on the relevant ambient noise level

In the residential or similar use		
Relevant ambient noise level		
day (6:00 - 22:00)	Relevant ambient noise level	dB
	Planning basis level L <sub>Tn</sub>	dB
night (22:00 - 6:00)	Relevant ambient noise level	dB
	Planning basis level L <sub>Tn</sub>	dB

<sup>1)</sup> An estimation by planning zone allocation

## 3 Room acoustics

### 3.1 Scope

Requirements for room acoustics shall apply if a number of minimum measures are required with respect to acoustic quality or noise reduction in rooms. This does not include rooms with special requirements for their acoustic performance (e.g. opera houses, concert halls, sound recording studios).

### 3.2 Requirements for acoustic quality

3.2.1 For rooms which are used for speaking in (auditoriums, lecture rooms) for volumes V between 30 m<sup>3</sup> and 10 000 m<sup>3</sup>, the requirement for the reverberation time T = (0.37 × lg V) - totals 0.14 in seconds for the octave bands from 250 Hz to 2 000 Hz.

3.2.2 For rooms which are used for communication purposes (classrooms, media rooms, meeting rooms, rooms for audio-visual presentations) for volumes V between 30 m<sup>3</sup> and 1 000 m<sup>3</sup>, the requirement for the reverberation time T = (0.32 × lg V) - totals 0.17 in seconds for the octave bands from 250 Hz to 2 000 Hz.

3.2.3 Deviations of ± 20 % from the various requirements in accordance with Points 3.2.1 and 3.2.2 are permitted within the individual octave bands.

3.2.4 The reverberation time has to be calculated according to the generally recognized rule of technology.

### 3.3 Requirements for noise reduction

3.3.1 The following minimum requirement for noise reduction must be observed for rooms in which requirements for noise reduction have been created in order to protect users (e.g. working stations, work rooms, and corridors in schools, nursery rooms, recreation rooms, dining rooms):

(d) The average sound absorption level of the external peripheries (empty room, planning value) must, in octave bands 250 Hz to 4000 Hz, be at least α<sub>n,B</sub> = 0.20, for the octave band centre frequencies of 500, 1000, and 2000 Hz α<sub>n,B</sub> = 0.25 if possible. The average sound absorption level α<sub>n,B</sub> must be determined according to the state of the art.

3.3.2 It is recommended that the reverberation time in staircases and corridors or joint access

# WHO noise levels day/night

Selected values from the WHO Community Noise Guidelines and WHO Night Noise Guidelines

Specific environment	Critical health effect	Day: $L_{Aeq}$ (dB(A)) Night: $L_{night}$ (dB(A))	Time base (hours)
<b>Day-time and evening noise</b>			
Outdoor living area	Serious annoyance, daytime and evening	55	16
	Moderate annoyance, daytime and evening	50	16
Dwellings, indoor	Speech intelligibility and moderate annoyance, daytime and evening	35	16
School class rooms, and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	During class
School playground, outdoor	Annoyance	55	During play
Hospital ward rooms, indoors	Sleep disturbance, daytime and evenings	30	16
Hospital, treatment rooms, indoors	Interference with rest and recovery	a	
<b>Night-time noise</b>			
At the façade, outside	Body movements, awakening, self-reported sleep disturbance	30	During the night

<sup>a</sup> As low as possible.

# Examples for Planning Basis Levels

## EN 15251

Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

### Annex E (informative)

### Indoor system noise criteria of some spaces and buildings

Table E.1 Examples of design A-weighted sound pressure level

Building	Type of space	Sound pressure level [dB(A)]	
		Typical range	Default design value
Residential	Living room	25 to 40	32
	Bed room	20 to 35	26
Child care institutions	Nursery schools	30 to 45	40
	Day nurseries	30 to 45	40
Places of assembly	Auditoriums	30 to 35	33
	Libraries	28 to 35	30
	Cinemas	30 to 35	33
	Court rooms	30 to 40	35

Annex E  
(informative)

Indoor system noise criteria of some spaces and buildings

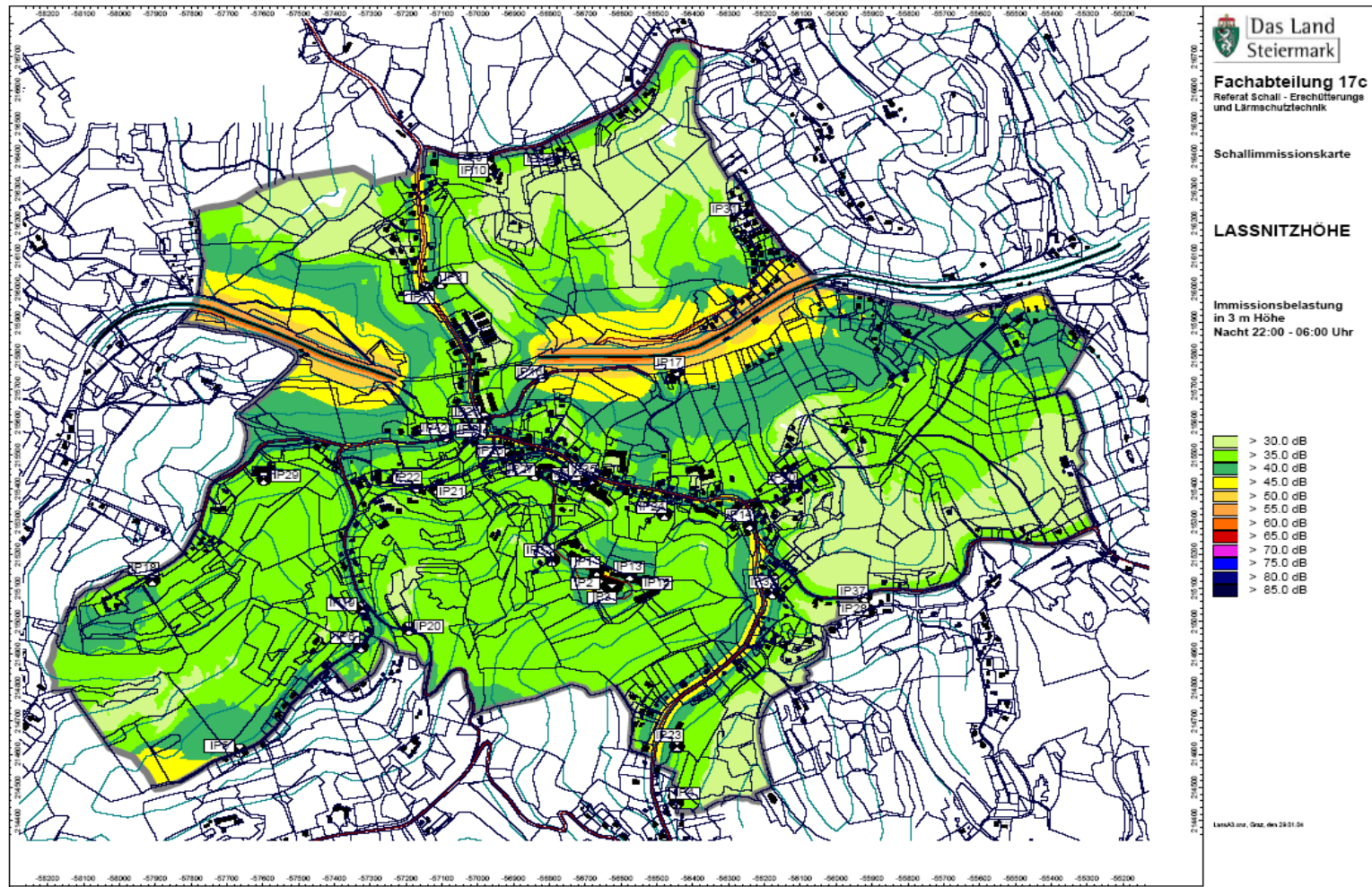
Table E.1 Examples of design A-weighted sound pressure level

Building	Type of space	Typical range	Default design value
Residential	Living room	25 to 40	32
	Bed room	20 to 35	26
Child care institutions	Nursery schools	30 to 45	40
	Day nurseries	30 to 45	40
Places of assembly	Auditoriums	30 to 35	33
	Libraries	28 to 35	30
	Cinemas	30 to 35	33
	Court rooms	30 to 40	35
Commercial	Hotel office	30 to 35	33
	Department stores	40 to 50	45
	Supermarkets	40 to 50	45
	Computer rooms, large	40 to 50	50
Hospitals	Computer rooms, small	40 to 50	45
	Corridors	35 to 45	40
	Operating theatres	25 to 40	40
	Wards	25 to 35	30
Hotels	Bedrooms night time	20 to 30	30
	Bedrooms daytime	25 to 35	30
	Lobbies	35 to 45	40
	Reception rooms	35 to 45	40
Offices	Hotel rooms (during night time)	25 to 35	30
	Hotel rooms (during daytime)	30 to 40	35
	Small offices	30 to 40	35
	Conference rooms	30 to 40	35
Restaurants	Lobby/reception offices	35 to 45	40
	Other offices	35 to 45	40
	Cafeterias	35 to 50	40
	Restaurants	35 to 50	40
Schools	Kitchens	40 to 50	50
	Reception areas	30 to 40	35
	Corridors	35 to 45	40
	Open-plan areas	35 to 45	40
Sport	Teacher rooms	30 to 40	35
	Control room (stadium)	35 to 50	45
General	Swimming baths	40 to 50	45
	Trains	40 to 50	45
Discontinues	Trains	40 to 50	45
	Discontinues	40 to 50	45

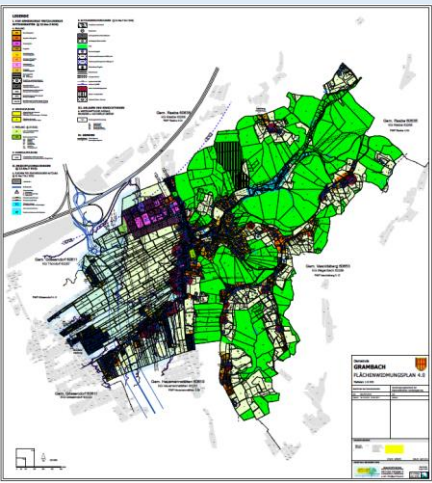
# Example: Environmental Noise Levels

Planning values for zone related noise immission			
Zone	Description of zone	A-weighted equivalent continuous sound pressure level $L_{A,eq}$ in dB	
		Day	Night
A	Quiet zone, special noise protected area	45	35
B	Suburb residential area, rural residential area	50	40
C	Urban residential area, agricultural and forestry enterprises with residential housings	55	45
D	Urban core areas (offices, shops, trade and commerce without noise emission) mixed with residential buildings, zone for business without noise emission	60	50
E	Zone for low noise emission (logistics, production, services, management...)	65	55

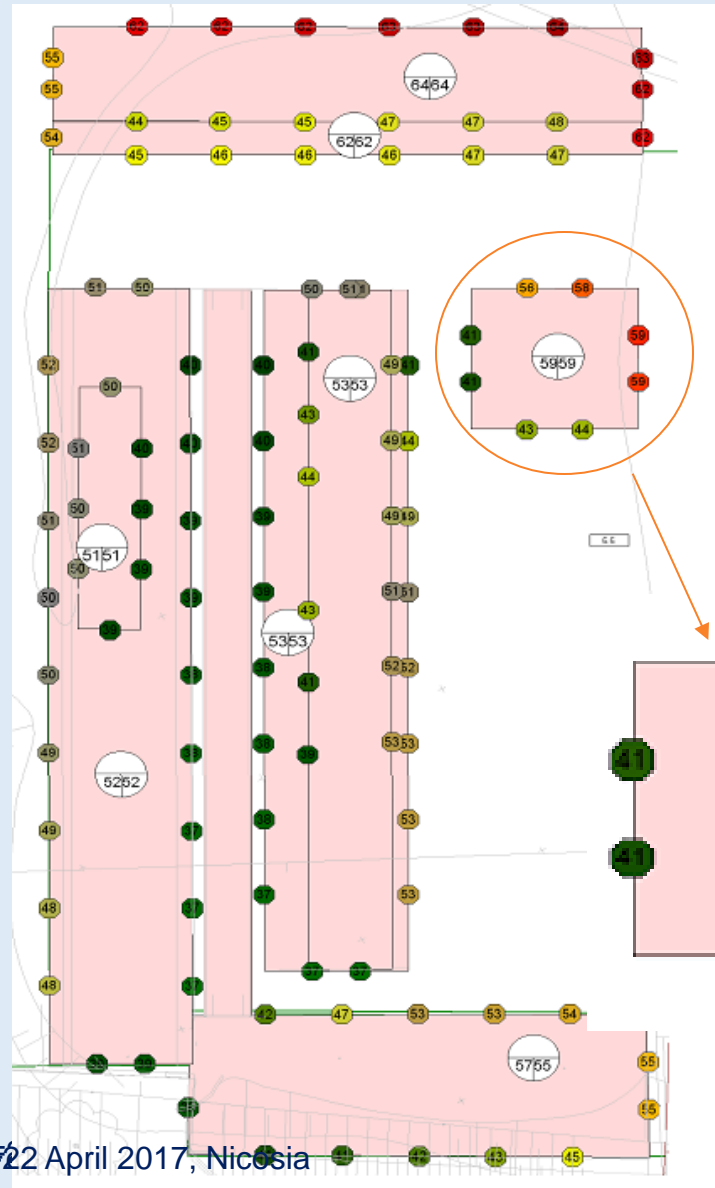
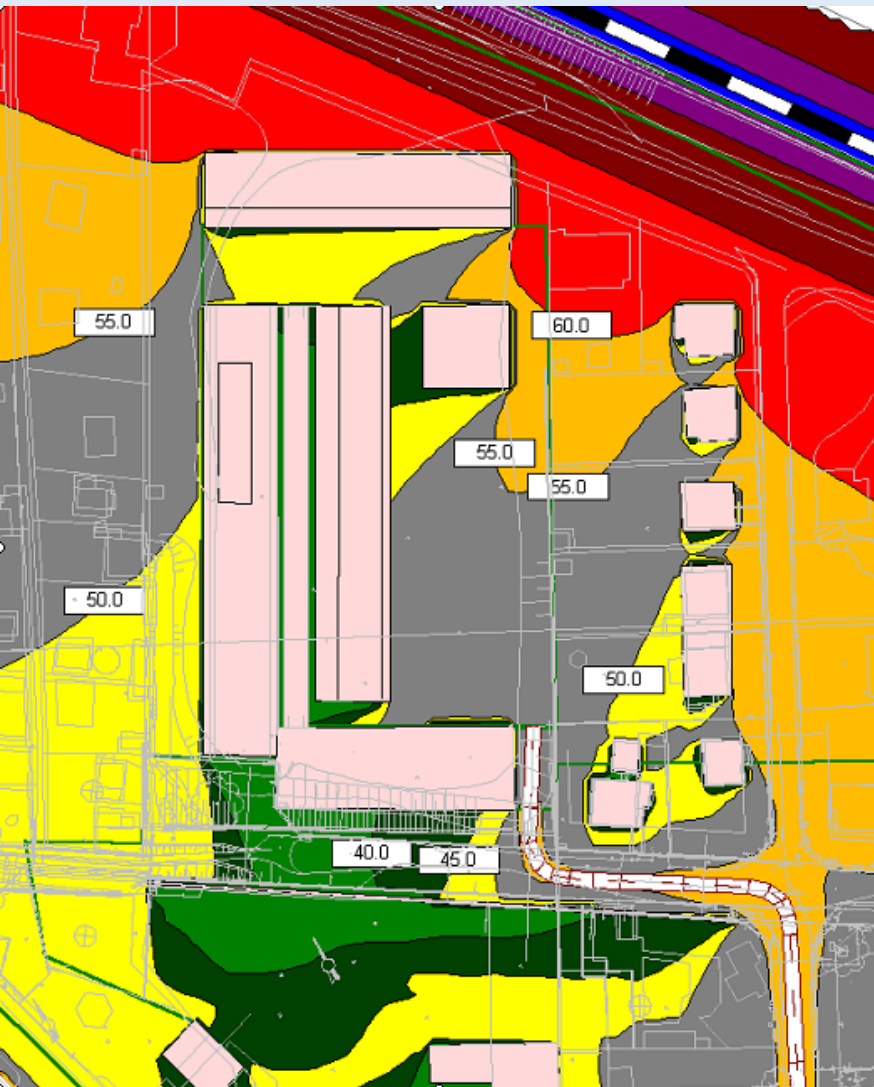
# Environmental Noise noise maps



# Environmental Noise + Land using Map



# Calculation of Environmental noise



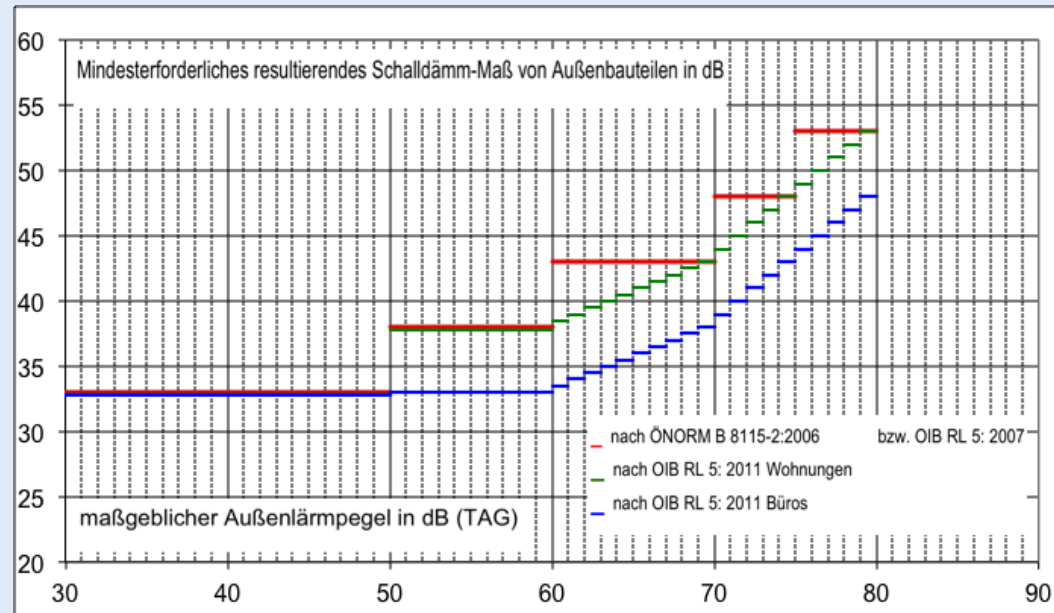
# Environmental Noise/resulting insulation levels

Sound reduction index of Building Envelop elements

Table 1:- Minimum sound protection by external building components elements

Minimum sound protection of external building elements									
Building Elements protecting rooms for residential purposes or similar as described	Minimum sound protection levels ( $R'_{res,w}$ , $R'_{w}$ , $R_w$ bzw. $R_w + C_w$ in dB) in relation to environmental/ambient exterior noise levels								
	row	1	2	3	4	5	6	7	column
	Day	≤ 50	51 bis 55	56 bis 60	61 bis 65	66 bis 70	71 bis 75	76 bis 80	1
	Night	≤ 40	41 bis 45	46 bis 50	51 bis 55	56 bis 60	61 bis 65	66 bis 70	2
May be adequate to zone		A, B	C	D	E	-	-		3
For rooms in buildings for residential purposes, hotels, schools, nurseries, hospitals, spa buildings etc.									4
- Exterior components, Facade (overall)	$R'_{res,w}$	33	38	38	43	43	48	53	5
Opaque exterior elements <sup>1)</sup>	$R_w$	43	43	43	48	48	53	58	6
Windows, external doors, etc. <sup>1) 2)</sup>	$R_w$	28	33	33	38	38	43	48	7
	$R_w + C_w$	23	28	28	33	33	38	43	
- Building separating walls <sup>3)</sup> each leaf	$R'_{w}$	52	52	52	52	52	52	52	8
- ceilings and walls separating a room to an attic / a loft	$R'_{w}$	42	42	42	47	47	47	47	9
- Ceilings and Walls separating a room to a passage or garage	$R'_{w}$	60	60	60	60	60	60	60	10
For rooms in office buildings and similar used									11
- Exterior components, facade (overall)	$R'_{res,w}$	33	33	33	33	38	43	48	12
Opaque exterior elements <sup>1)</sup>	$R_w$	43	43	43	43	43	48	53	13
Windows and external doors, etc. <sup>1) 2)</sup>	$R_w$	28	28	28	28	33	38	43	14
	$R_w + C_w$	23	23	23	23	28	33	38	
- Building separating walls <sup>3)</sup> (each leaf)	$R'_{w}$	52	52	52	52	52	52	52	15
- Ceilings and walls separating a room to an attic / a loft	$R'_{w}$	42	42	42	42	42	42	42	16
- Ceilings and walls separating a room to a passage or garage	$R'_{w}$	60	60	60	60	60	60	60	17

<sup>1)</sup> If the percentage of Area of windows and doors exceeds 30% of the external components of a room the required sound insulation index of the elements have to be determined according their percentage of area to fulfill the requirement of the resulting sound reduction index of the overall external component

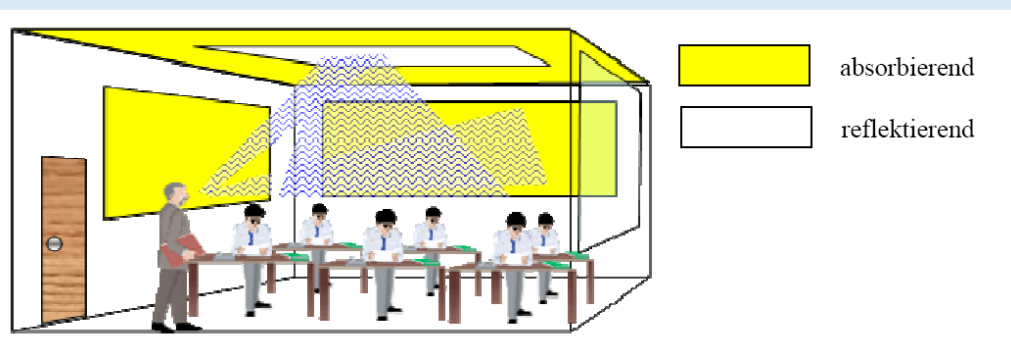


Ambient / environmental noise levels

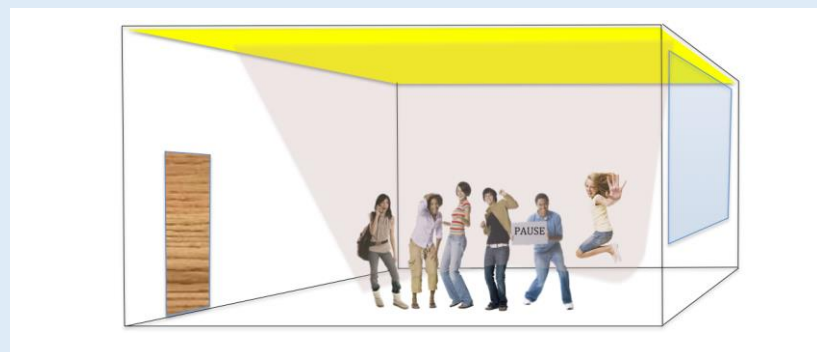


# Room Acoustics

## a) Speech Intelligibility

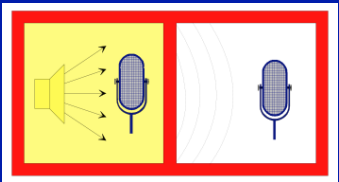


## b) Noise protection



## c) Recommendation for sound level reduction (staircases, access levels)

# Examples for requirement levels: Requirements Airborne Sound



Land	Kenngröße	Anforderung in dB	
		MF-Haus	Reihen-Haus
Österreich	$D_{n,T,w}$	55	60
Deutschland	$R'_w$	53	57
Italien	$R'_w$	50	50
Dänemark	$R'_w$	55	55
Norwegen	$R'_w$	55	55
Schweden	$R'_w + C_{50-3150}$	53	53
Finnland	$R'_w$	55	55
Großbritannien	$D_{n,T,w} + C_{tr}$	45	45
Frankreich	$D_{n,T,w} + C$	53	53
Schweiz	$D_{n,T,w} + C$	52	55
Niederlande	$I_{l,u;k}$	0	0
Belgien	$D_{n,T,w}$	54	58
Spanien	$D_{n,T,w} + C_{100-500}$	50	50
Portugal	$D_{n,w}$	50	50
Polen	$R'_w + C$	50	52
Tschechien	$R'_w$	52	57
Slovakai	$R'_w$	52	52
Ungarn	$R'_w + C$	51	56
Slovenien	$R'_w$	52	52
Estland	$R'_w$	55	55
Lettland	$D_{n,T,w}$ oder $R'_w$	54	54
Lithauen	$R'_w$	55	55
Island	$R'_w$	52	55
Irland	$D_{n,T,w}$	53	53

# Examples for requirement levels: Requirements - Impact sound



Land	Kenngröße	Anforderung in dB	
		MF-Haus	Reihen-Haus
Österreich	$L'_{nT,w}$	48	43
Deutschland	$L'_{n,w}$	53	48
Italien	$L'_{n,w}$	63	63
Dänemark	$L'_{n,w}$	53	58
Norwegen	$L'_{n,w}$	53	53
Schweden	$L'_{n,w} + C_{1,50-2500}$	56	56
Finnland	$L'_{n,w}$	53	53
Großbritannien	$L'_{nT,w}$	52	0
Frankreich	$L'_{nT,w}$	58	58
Schweiz	$L'_{nT,w} + C_I$	53	50
Niederlande	$I_{co}$	5	5
Belgien	$L'_{nT,w}$	58	50
Spanien	$L'_{nT,w}$	65	65
Portugal	$L'_{n,w}$	60	60
Polen	$L'_{n,w}$	58	53
Tschechien	$L'_{n,w}$	58	53
Slovakai	$L'_{n,w}$	58	58
Ungarn	$L'_{n,w}$	55	45
Slovenien	$L'_{n,w}$	58	58
Estland	$L'_{n,w}$	53	53
Lettland	$L'_{n,w}$	54	54
Lithauen	$L'_{n,w}$	53	53
Island	$L'_{n,w}$	58	53
Irland	$L'_{nT,w}$	62	0

# Examples for requirement levels: Future ISO Acoustic Classification

ISO/CD 19488.2:2016-12

Date: 2016-12-17

ISO/CD 19488.2:2016-12

ISO TC 43/SC 2/WG 29

Secretariat: DIN

## ISO/CD 19488.2

### Acoustics – Acoustic classification of dwellings

#### Warning

This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

# Examples for requirement levels: ISO Draft: Airborne sound insulation

**Table 1 — Airborne sound insulation between dwellings and other rooms - Class limits <sup>(1)</sup>**

Type of space	Class A	Class B	Class C	Class D	Class E	Class F
Between habitable rooms in a dwelling and rooms outside the dwelling, both in the horizontal and the vertical directions (MAIN REQUIREMENT)	$D_{nT,50} \geq 58$	$D_{nT,50} \geq 54$	$D_{nT,A} \geq 52$	$D_{nT,A} \geq 48$	$D_{nT,A} \geq 44$	$D_{nT,A} \geq 40$
Between habitable rooms in dwellings and common stairwells or access areas with an entrance door in the separating wall	$D_{nT,A} \geq 44$	$D_{nT,A} \geq 40$	$D_{nT,A} \geq 36$	$D_{nT,A} \geq 32$	$D_{nT,A} \geq 28$	$D_{nT,A} \geq 24$
Between habitable rooms in a dwelling and premises with noisy activities <sup>(2)</sup>	$D_{nT,50} \geq 64$	$D_{nT,50} \geq 60$	$D_{nT,A} \geq 58$	$D_{nT,A} \geq 54$	$D_{nT,A} \geq 50$	$D_{nT,A} \geq 46$

## NOTES

- 1 Different descriptors are applied to reflect use of different frequency ranges and weightings. Instead of  $D_{nT,A}$ ,  $D_{nT,w}$  may be applied, if 2 dB is added to the limit value. If  $D_{nT,A}$  is applied instead of  $D_{nT,50}$ , at least 4 dB must be added to the limit value of  $D_{nT,50}$ .
- 2 Premises with noisy activities are rooms for shared services like laundries, central boiler house, joint/commercial kitchens or commercial premises like shops, workshops or cafés. However, in each case, noise levels should be estimated and the sound insulation designed accordingly, e.g. for party rooms, discotheques etc. Then, the limits given in Table 4 for service equipment noise could be used as design goals.

# Examples for requirement levels: ISO Draft: Impact sound pressure level

Type of space	Class A	Class B	Class C	Class D	Class E	Class F
In habitable rooms in dwellings from other dwellings, both in the horizontal and the vertical directions (MAIN REQUIREMENT)	$L'_{nT,50} \leq 50^{(1)}$ and $L'_{nT,w} \leq 46$	$L'_{nT,50} \leq 54^{(1)}$ and $L'_{nT,w} \leq 50$	$L'_{nT,w} \leq 54$	$L'_{nT,w} \leq 58$	$L'_{nT,w} \leq 62$	$L'_{nT,w} \leq 66$
In habitable rooms in dwellings from: - common stairwells or access areas - balconies or terraces or bath rooms not belonging to own dwelling <sup>(3)</sup>	$L'_{nT,w} \leq 50$	$L'_{nT,w} \leq 54$	$L'_{nT,w} \leq 58$	$L'_{nT,w} \leq 62$	$L'_{nT,w} \leq 66$	$L'_{nT,w} \leq 70$
In habitable rooms in dwellings from premises with noisy activities <sup>(2)</sup>	$L'_{nT,50} \leq 44^{(1)}$ and $L'_{nT,w} \leq 40$	$L'_{nT,50} \leq 48^{(1)}$ and $L'_{nT,w} \leq 44$	$L'_{nT,w} \leq 48$	$L'_{nT,w} \leq 52$	$L'_{nT,w} \leq 56$	$L'_{nT,w} \leq 60$

## NOTES

1 Experience has shown that when applying the low-frequency rating, potentially disturbing high frequency sounds are not rated appropriately, and for this reason, an additional criterion for  $L'_{nT,w}$  is applied. In order to account for both hard floor impact sounds as well as low frequency footstep sounds, it is required to fulfil the limit values for both criteria  $L'_{nT,50}$  and  $L'_{nT,w}$ . The limit values for  $L'_{nT,w}$  are 4 dB lower than those specified for  $L'_{nT,50}$ .

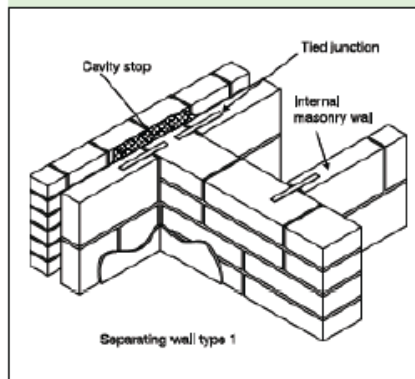
2 Premises with noisy activities are rooms for shared services like laundries, central boiler house, joint/commercial kitchens or commercial premises like shops, workshops or cafés. However, in each case, noise levels shall be estimated and the sound insulation designed accordingly, e.g. for party rooms, discotheques etc.

3 Impact sound from small balconies and rooms (area less than 4 m<sup>2</sup>) are not included, e.g. toilets and utility rooms.

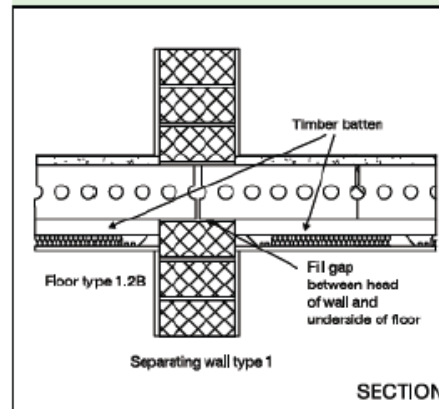
Sources:	A	B	C	D	E	F
very loud speech	just audible, but not intelligible	audible, but hardly intelligible	just intelligible	intelligible	clearly intelligible	
loud speech	hardly audible	just audible, but not intelligible	audible, but hardly intelligible	just intelligible	intelligible	clearly intelligible
normal speech	not audible	hardly audible	just audible but not intelligible	hardly intelligible	just intelligible	intelligible
very loud music, party	just audible	audible	clearly audible	very clearly audible		
loud music	not audible	just audible	audible	clearly audible	very clearly audible	
normal music	not audible		just audible	audible	clearly audible	very clearly audible
walking	not audible	hardly audible	just audible	audible	clearly audible	very clearly audible
kids playing	hardly audible	Just audible	audible	clearly audible	very clearly audible	
dropping & moving objects	not audible	hardly audible	just audible	audible	clearly audible	very clearly audible

# possible “translation” to “building construction systems” (example: England)

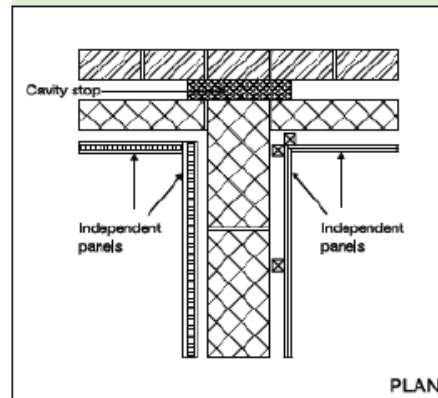
**Diagram 2.7 Wall type 1 – tied junction – external cavity wall with internal masonry wall**



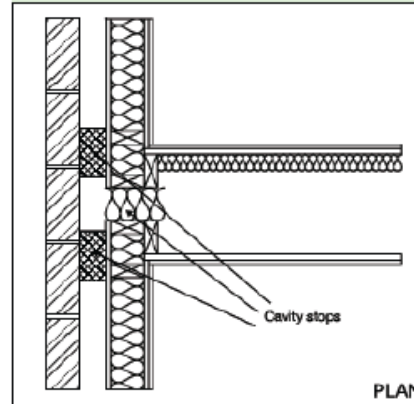
**Diagram 3.6 Floor type 1.2B – wall type 1**



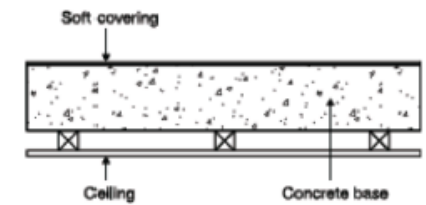
**Diagram 2.31 Wall type 3 – external cavity wall with masonry inner leaf**



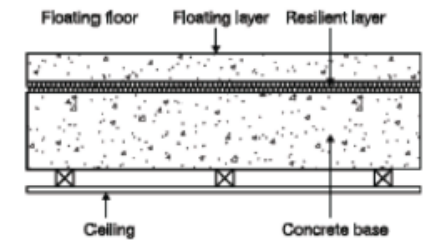
**Diagram 2.38 Wall type 4 – external cavity wall with timber frame inner leaf**



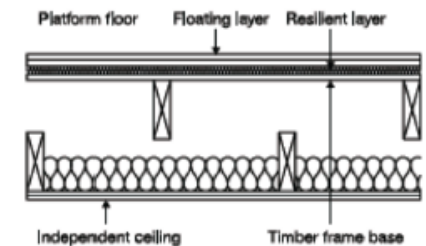
**Diagram 3.1 Types of separating floor**



**(a) Floor type 1**



**(b) Floor type 2**



**(c) Floor type 3**

SECTION



# EN ISO - Calculation Models



ÖNORM  
EN 12354-1

Normengr.  
Ident (IDT)  
Ersatz für (



**DRAFT**

ÖNORM  
**EN ISO 12354-1**

Edition: 2016-03-01

ICS 91.120.20  
Bauakustik  
Berechnung der akus-  
von Gebäuden aus de  
Teil 1: Luftschalldämmung z

## **Building acoustics — Estimation of acoustic performance of buildings from the performance of elements**

### **Part 1: Airborne sound insulation between rooms**

(ISO/DIS 12354-1:2016)

Bauakustik — Berechnung der akustischen Eigenschaften von Gebäuden aus den Bauteileigenschaften — Teil 1: Luftschalldämmung zwischen Räumen  
(ISO/DIS 12354-1:2016)

Acoustique du bâtiment — Calcul de la performance acoustique des bâtiments à partir de la performance des éléments — Partie 1: Isolement acoustique aux bruits aériens entre des locaux

(ISO/DIS 12354-1:2016)

3rd Mission, 19-22 April 2017, Nicosia

# Thank you for your attention!

*There are a lot of different noises.  
But there is just one silence ... in Cyprus!  
Let's*

*following Tuchoslky (1890-1935)*



Contact:

DI Heinz Ferk

Laboratory for Building Science/Building Physics, LKI

European Notified Body & accredited Laboratory


Graz University of Technology

Inffeldgasse 24

8010 Graz, Austria

ferk@tugraz.at

# Standards for Calculation



**DRAFT**

**ÖNORM**  
**EN ISO 12354-1**  
Edition: 2016-03-01

**Building acoustics — Estimation of acoustic performance of buildings from the performance of elements**

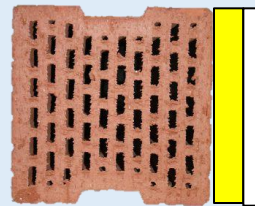
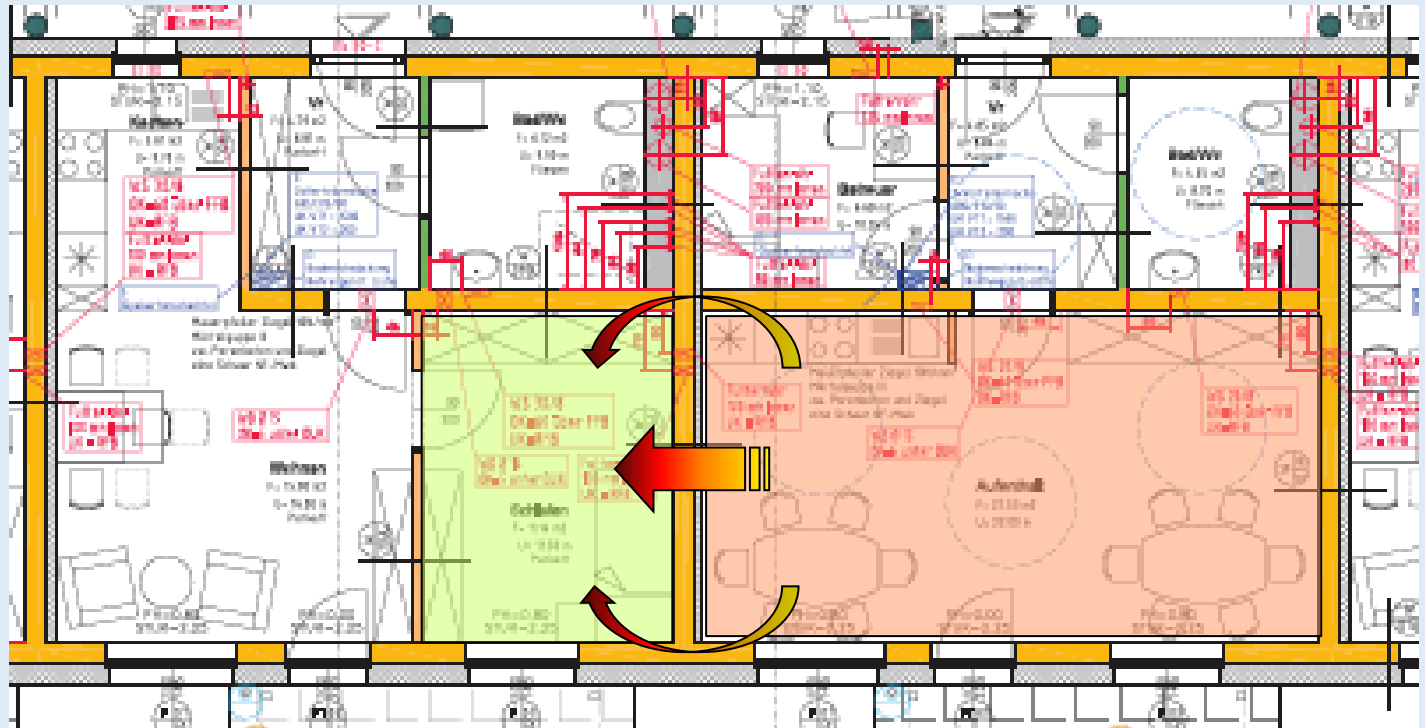
**Part 1: Airborne sound insulation between rooms**  
(ISO/DIS 12354-1:2016)

Bauakustik — Berechnung der akustischen Eigenschaften von Gebäuden aus den Bauteileigenschaften — Teil 1: Luftschalldämmung zwischen Räumen  
(ISO/DIS 12354-1:2016)

Acoustique du bâtiment — Calcul de la performance acoustique des bâtiments à partir de la performance des éléments — Partie 1: Isolement acoustique aux bruits aériens entre des locaux  
(ISO/DIS 12354-1:2016)

- EN 12354-1, *Building Acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 1: Airborne sound insulation between rooms;*
- EN 12354-2, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 2: Impact sound insulation between rooms;*
- EN 12354-3, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 3: Airborne sound insulation against outdoor sound;*
- EN 12354-4, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 4: Transmission of indoor sound to the outside;*
- EN 12354-5, *Building acoustics — Estimation of acoustic performance of building from the performance of elements — Part 5: Sounds levels due to the service equipment;*
- EN 12354-6, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 6: Sound absorption in enclosed spaces.*

# Example



# Calculation with Software

ERGEBNISSE (Gleichungen (27), (28), EN 12354-1:2000)

		MW $R_w$	Vorsatzschale	$K_{ij}$	$10 \cdot \log_{10}(S/l_i)$	SUMME
Wand	$R_{0d} =$	58,8	5,6			64,4 dB
	$R_{1d} =$	52,4	0	11,6	4,6	68,6 dB
	$R_{2d} =$	52,4	0	11,6	6,1	70,1 dB
	$R_{3d} =$	50,5	0	13,2	4,6	68,3 dB
	$R_{4d} =$	53,4	0	9,0	6,1	68,5 dB
Fußboden	$R_{01} =$	52,4	5,6	11,1	4,6	73,7 dB
	$R_{11} =$	46,0	0	19,0	4,6	69,6 dB
Decke	$R_{02} =$	52,4	5,6	11,1	6,1	75,2 dB
	$R_{22} =$	46,0	0	19,0	6,1	71,1 dB
Fassade	$R_{03} =$	50,5	5,6	13,2	4,6	73,9 dB
	$R_{33} =$	42,2	0	26,4	4,6	73,2 dB
Innenwand	$R_{04} =$	53,4	5,6	9,0	6,1	74,1 dB
	$R_{44} =$	48,0	0	13,2	6,1	67,3 dB
<b><math>R'_w =</math></b>		<b>58,4</b>	<b>dB</b>	<b><math>D_{nT,w} =</math></b>	<b>57,4</b>	<b>dB</b>