

ASHRAE
Hellenic Chapter

TEE

ENERGY IN BUILDINGS

EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT
- POLICIES & LEGISLATION
- ENERGY EFFICIENCY FIRST
- RESILIENCE TO CLIMATE CRISIS

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Acoustics in Plumbing piping systems

Agenda

What causes noise?

Importance of acoustics in design

Designing with acoustics in mind

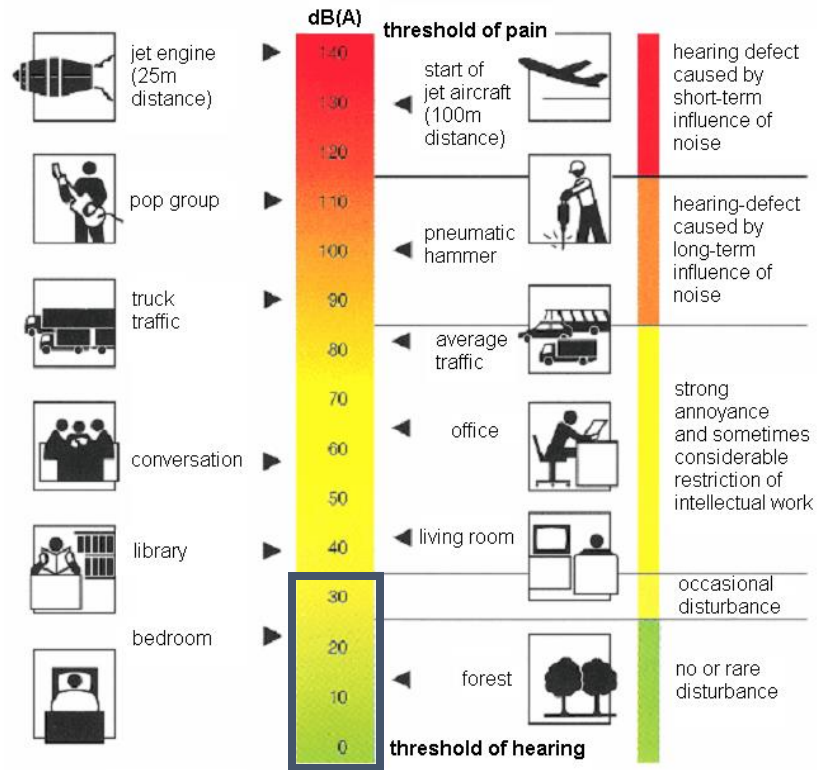
Acoustic regulations

Acoustic data

Summary

Noise barometer

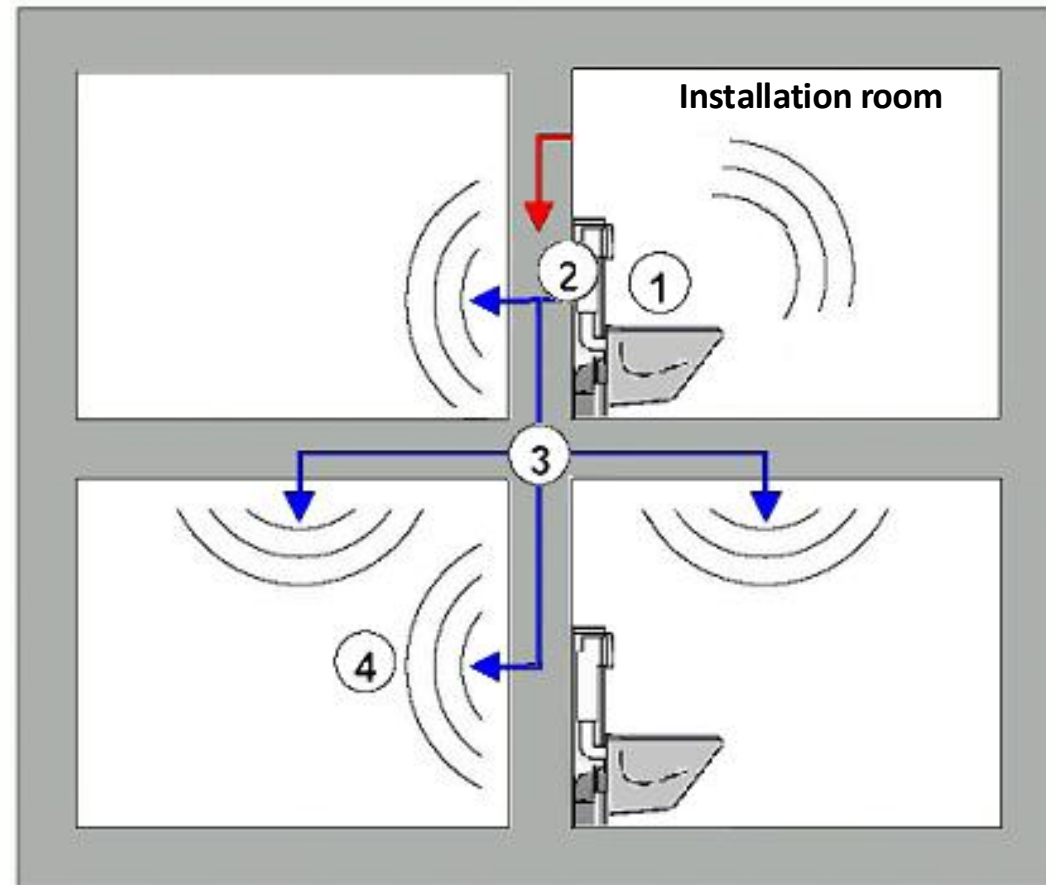
The basic noise level in quiet residential areas is about 30 dB(A).
All noises above this level will generally be noticed.



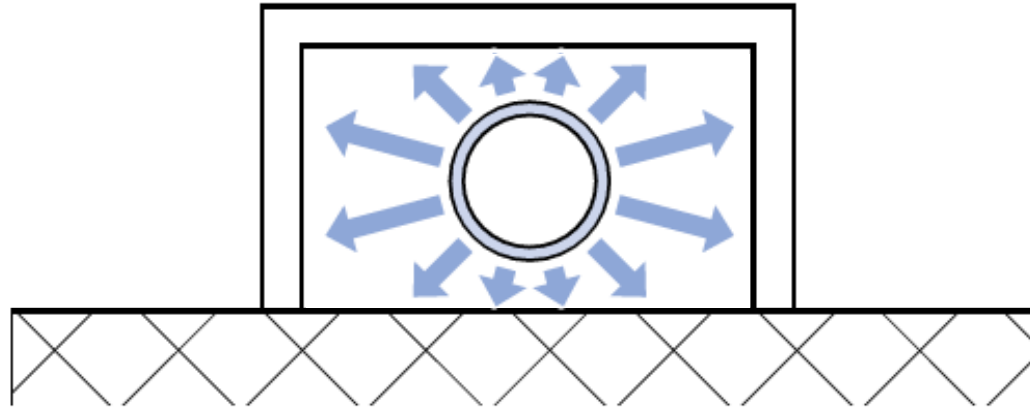
Airborne and structure-borne sound

1. Sound source and airborne sound
2. Structure-borne sound
3. Distribution of structure-borne sound
4. Airborne sound radiation in receiver room

In general, airborne sound is most dominant in the installation room only!

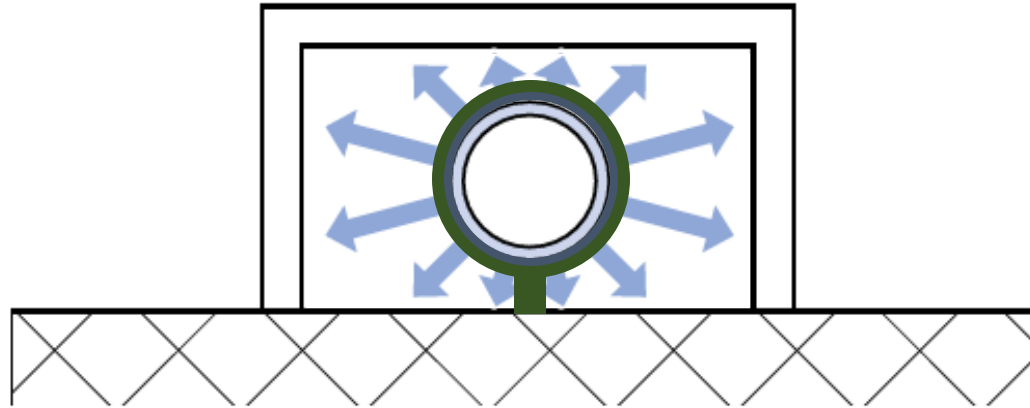


How to reduce an air borne sound?



Encapsulation for sound reduction

How to reduce a solid borne sound?



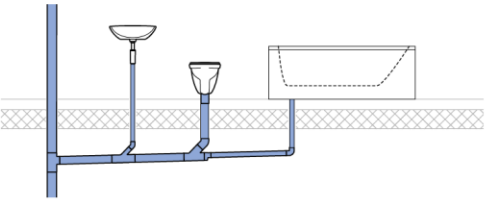
Absorbing with bracket with rubber inlet or insulation mat (cast in concrete)

- Waste water noise is neglected in planning.
- Installation elements have direct contact with walls and floors.
- Some drainage pipes do not absorb the noise.



Suitable installations for acoustics – Branch pipe

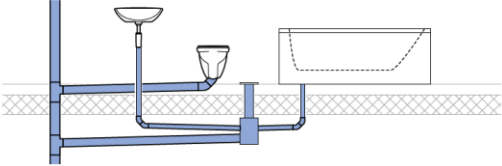
Cross floor



Not suitable



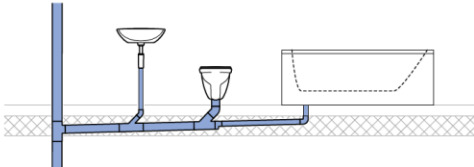
Cross & same floor



Partly suitable



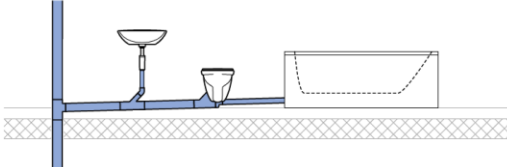
Cast in concrete



Suitable



Same floor



Suitable



Reducing sanitary noise - RECEIVER

Acoustically optimised room layout

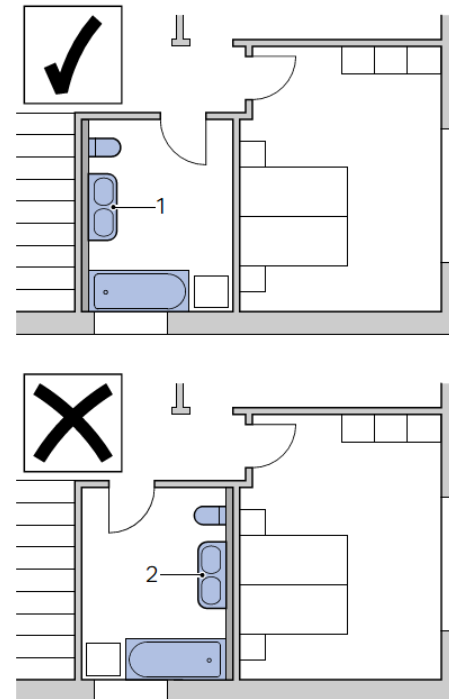
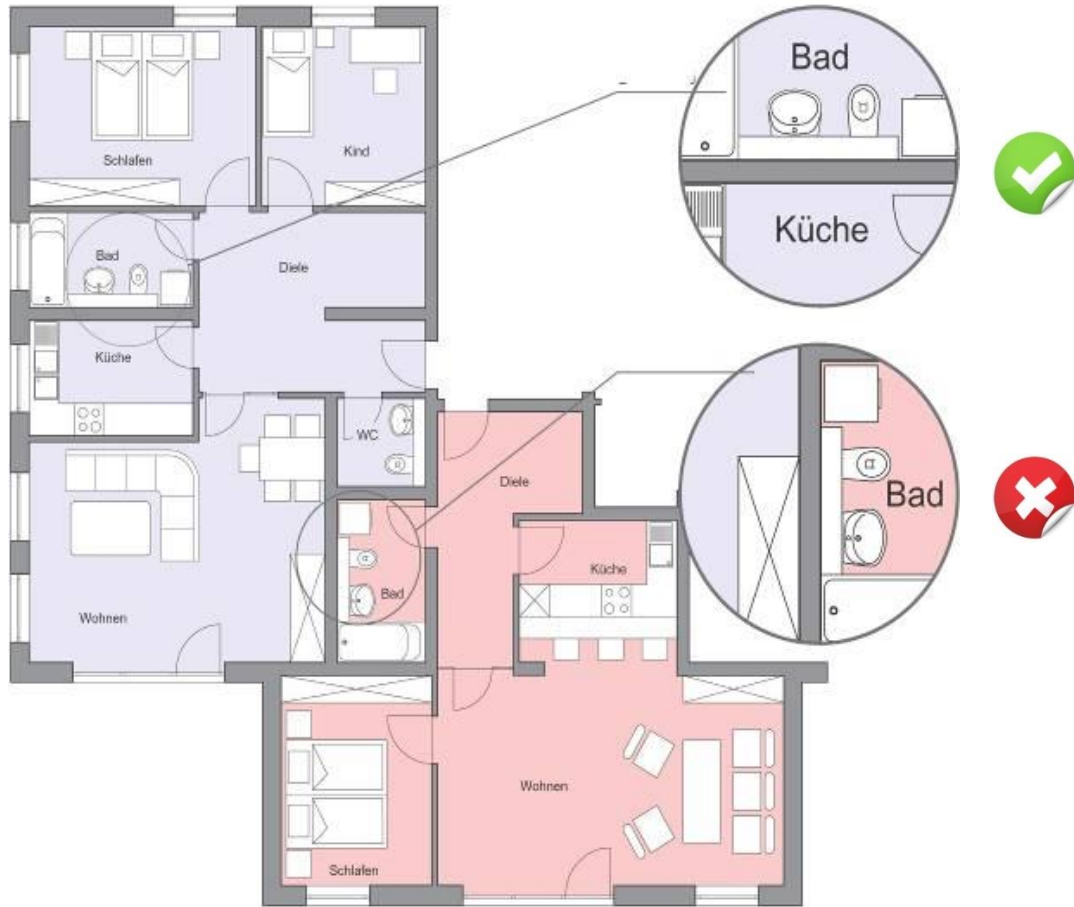
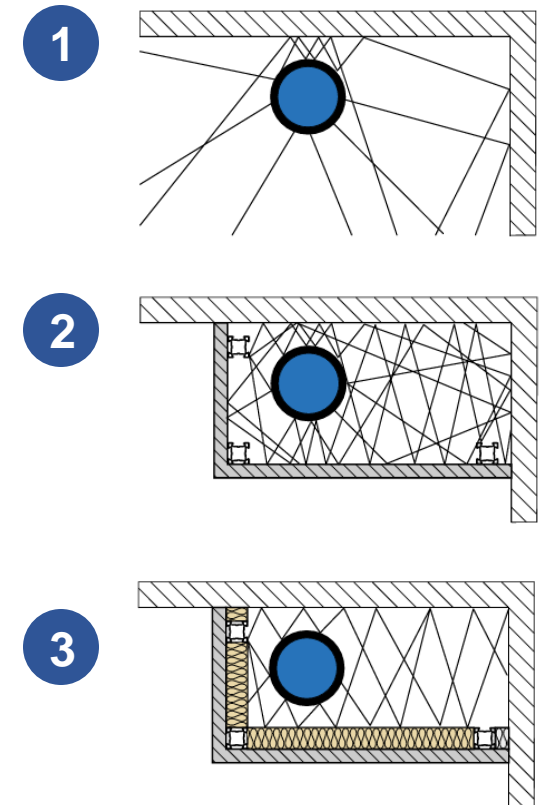


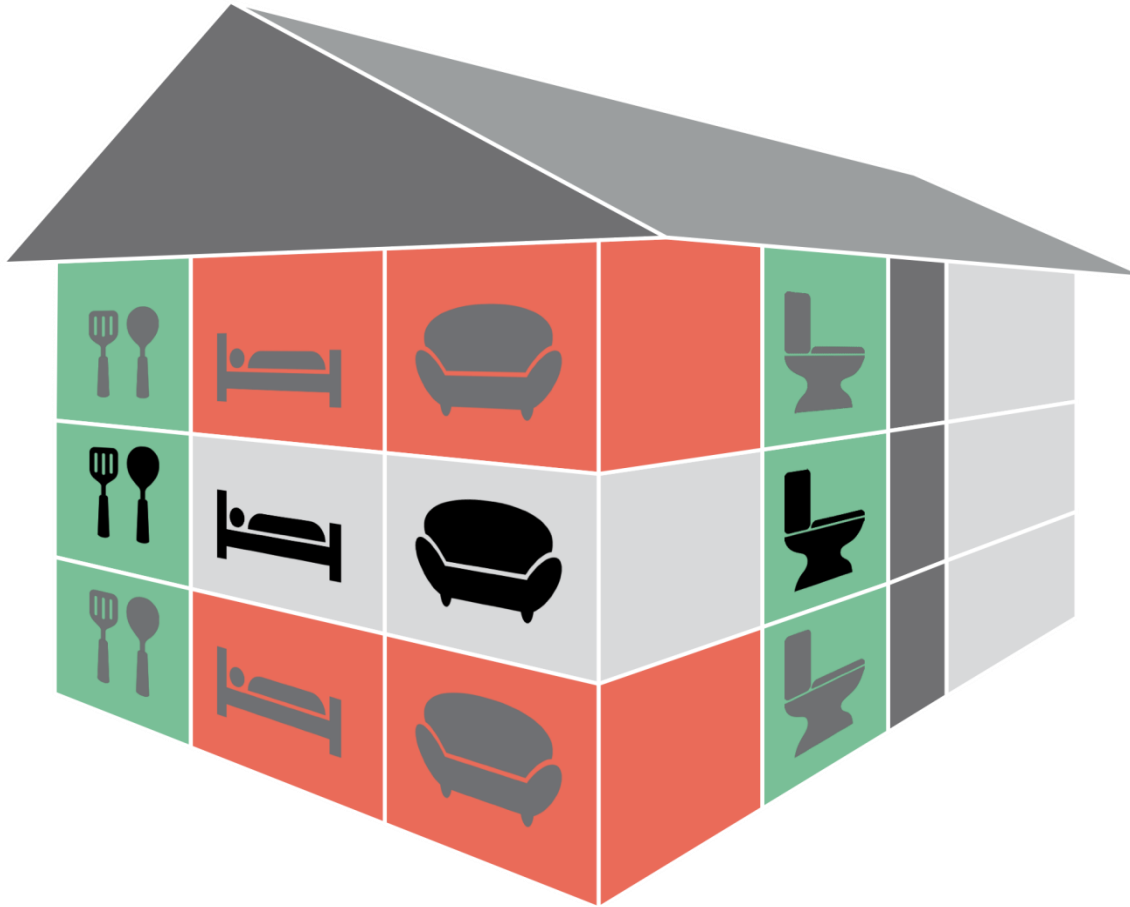
Figure 17: Optimum floor plan layout




- 1 Installation wall adjacent to stairs
- 2 Installation wall adjacent to quiet area

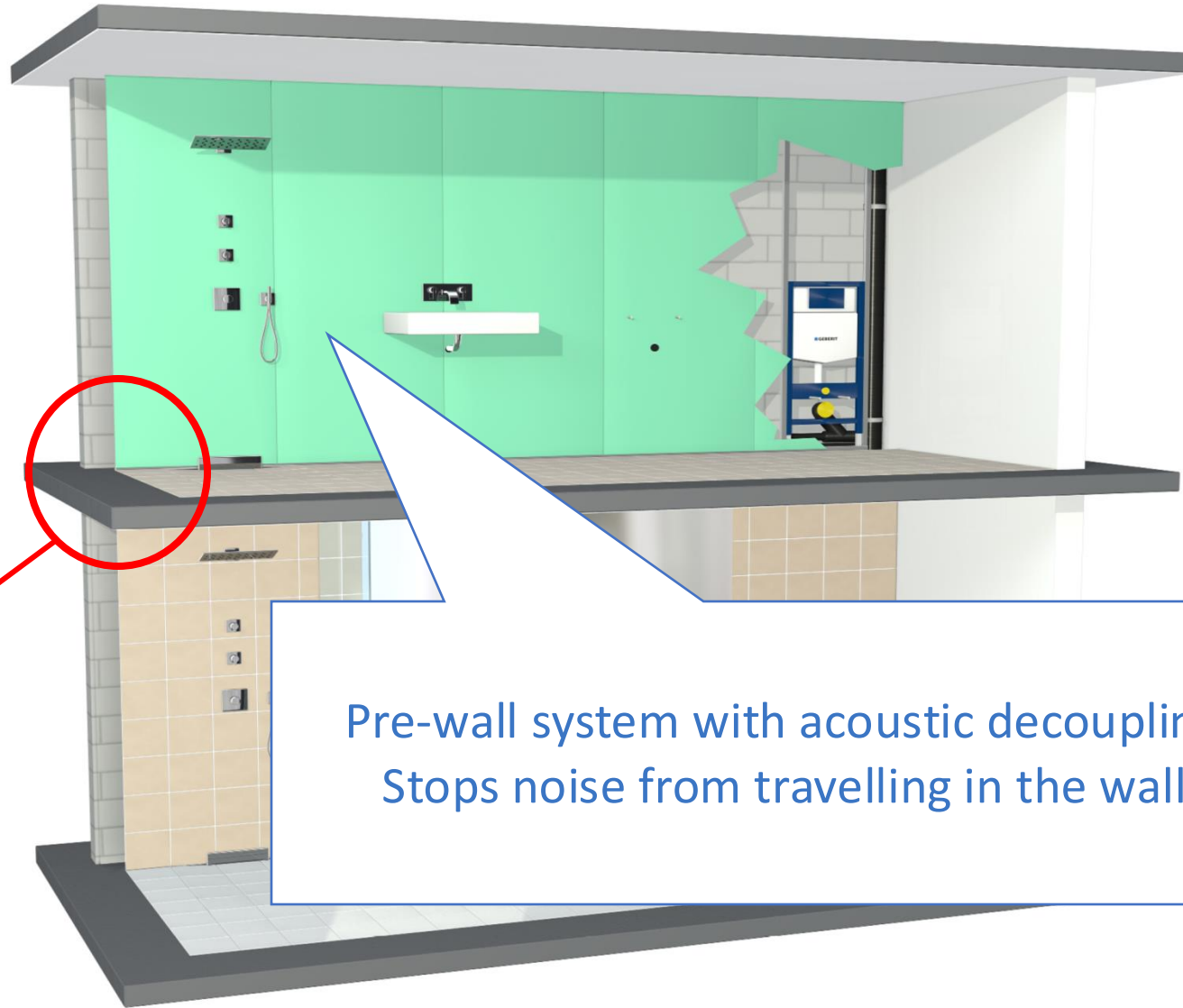
Enclose pipework in duct




Respect the different room types



-  **Own rooms**
Noise is own disturbance
-  **Uncritical rooms**
Noise is a minor disturbance
-  **Critical rooms**
Noise is a major disturbance



Pre-wall system with acoustic decoupling:
Stops noise from travelling in the wall.

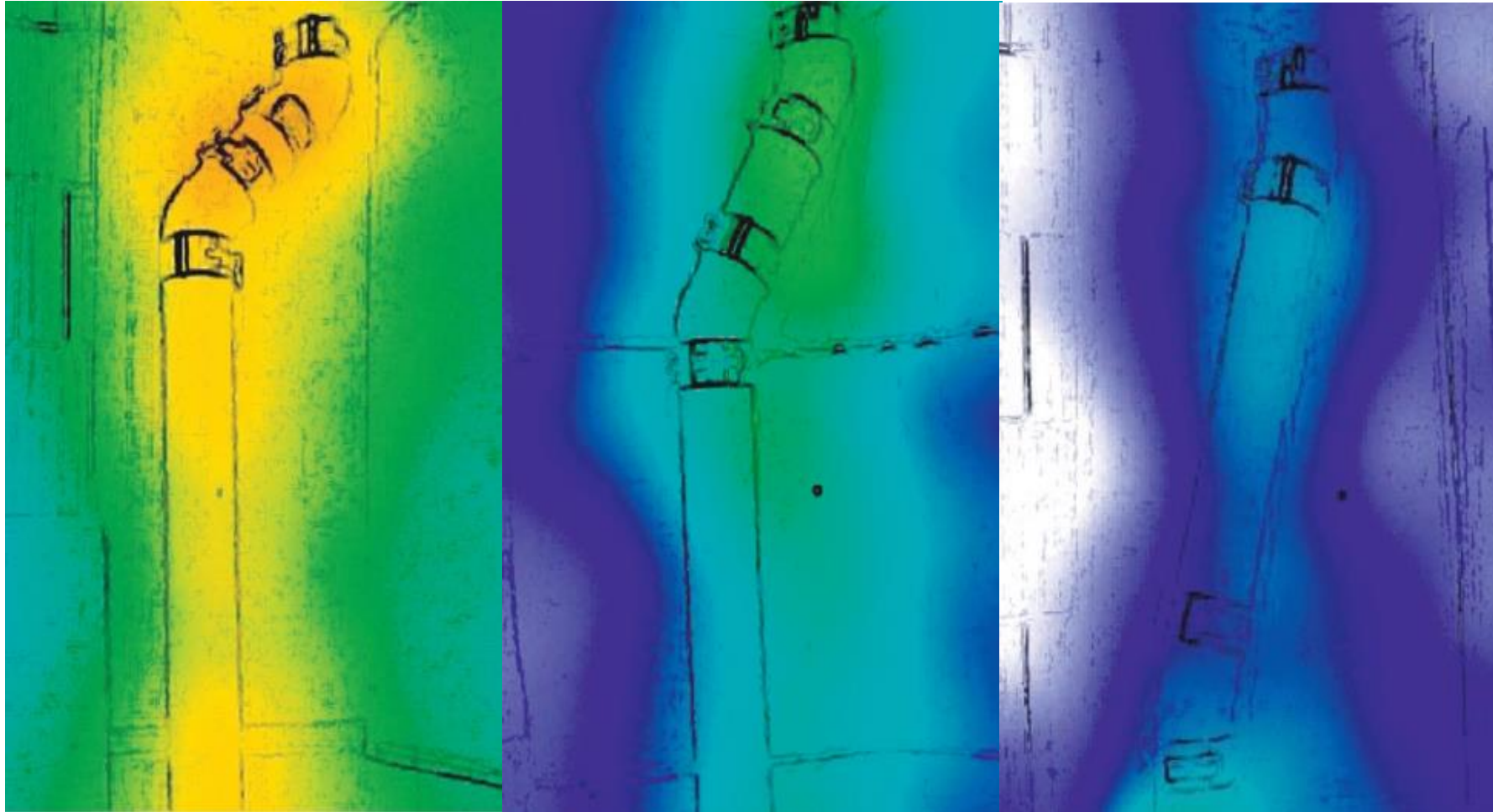


Wall-hung toilet:
Stops noise from travelling in the floors.



Silent drainage piping:
Reduce the noise at the source.

Acoustically optimised pipe layout



45° offset = +9db

30° offset = +7db

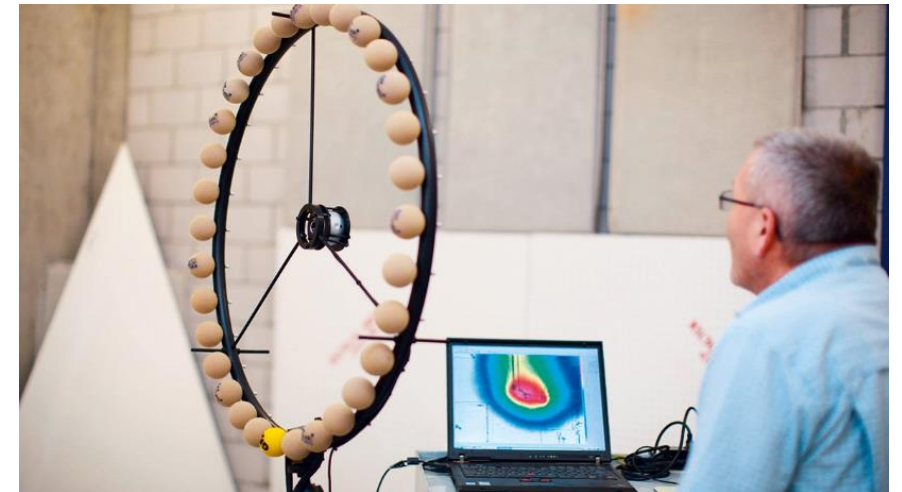
15° offset = +5db

The responsibilities

The demands on sound insulation in living, sleeping and work areas increase with the need for peace and quiet and the desire to be separated from the neighbor. The realization of sound insulation in **water supply and drainage systems** and other building systems is an essential task of:

- **the architect** (in the layout design)
- **the planner** (definition of the installation walls)
- **the sound specialist** (when selecting the suitable installation systems) => If available
- **the installer** (for the practical implementation on the construction site)

Planners and installers should know **the exact sound insulation requirements of the Client** (Owner / Developer) when signing the building contract and **agree the details in writing**.



Acoustic standards

| Name of standard | Country | Purpose of standard |
|-----------------------|-------------|---|
| DIN 4109 | Germany | Definition of acoustic values within buildings |
| VDI 4100 | | |
| SIA 181 | Switzerland | |
| ÖNORM B 8115 | Austria | |
| British Standard 8233 | UK | |
| SI 1004 | Israel | |
| DIN EN 14366 | | This standard specifies a process by which waste water and rainwater installations can be measured under unrealistic laboratory conditions |

British Standard 8233

7.7.2 Internal ambient noise levels for dwellings

In general, for steady **external noise sources**, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4.

Table 4

| Activity | Location | 07:00 to 23:00 | 23:00 to 07:00 |
|----------------------------|------------------|-------------------------------|------------------------------|
| Restin | Living room | 35 $L_{Aeq, 16 \text{ hour}}$ | - |
| Dining | Dining room/area | 40 $L_{Aeq, 16 \text{ hour}}$ | - |
| Sleeping (daytime resting) | Bedroom | 35 $L_{Aeq, 16 \text{ hour}}$ | 30 $L_{Aeq, 8 \text{ hour}}$ |

Annex H

The recommendations for ambient noise in hotel bedrooms are similar to those for living accommodation

H.4

Noise emission from hydraulic systems, including domestic hot and cold water services, refrigerant pipework, and soil and waste pipes serving other bedrooms, is not to cause disturbance in normal use

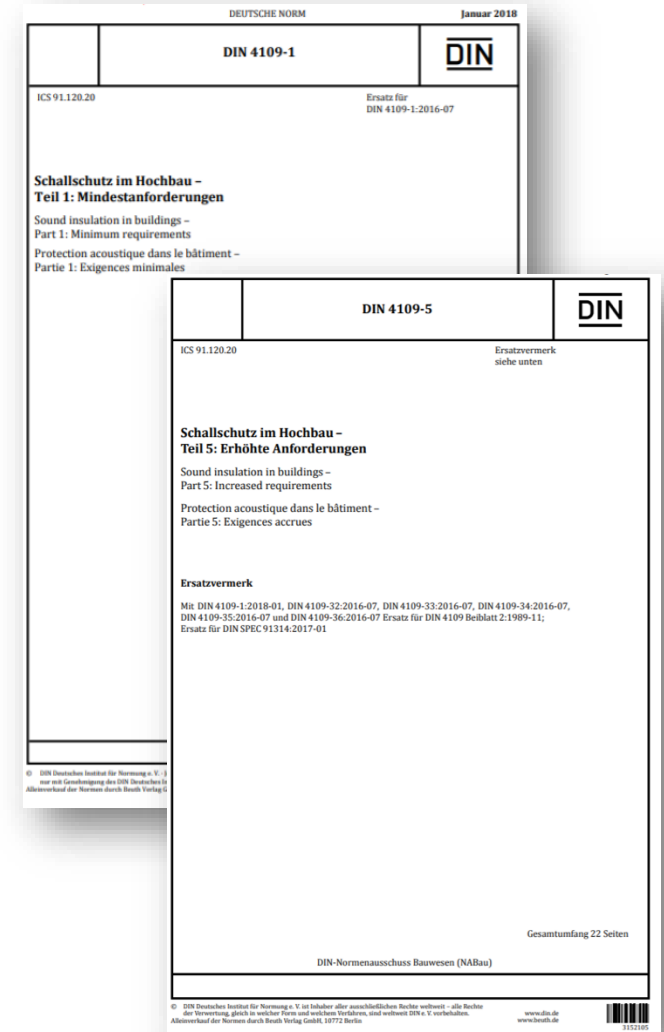
THERE IS NO BASELINE FIGURE FOR THE SOUND PRESSURE OF WATER AND DRAINAGE PASSING THROUGH PIPE SYSTEMS IN UK PROPERTIES; THUS NO MINIMUM STANDARD FOR ARCHITECTS AND CONSULTANTS TO MEET

DIN 4109



In most of the countries outside of Europe there is no clear defined standard for the professionals available. The widest developed and practical used standard is DIN 4109.



Norms and limit values:

- DIN 4109-1 Sound insulation in building construction (Minimum requirements)
- DIN 4109-5: Sound insulation in building constructions (Increased requirements)



DIN 4109-1 and DIN 4109-5

| Acoustic regulations | Protected area | | Maximum allowed Installation noise level | |
|----------------------|---|---|--|---------------------------|
| | | | Living spaces + bedrooms | Classrooms + Office space |
| DIN 4109-1 | Vulnerable room located diagonally below in foreign area |  | $\leq 30 \text{ dB(A)}^*$ | $\leq 35 \text{ dB(A)}^*$ |
| DIN 4109-1 | Adjacent vulnerable room in own area |  | No requirements | No requirements |

| Acoustic regulations | Protected area | | Maximum allowed Installation noise level | |
|----------------------|---|---|--|---|
| | | | Living spaces + bedrooms Apartment buildings | Living spaces + bedrooms double family and row houses |
| DIN 4109-5 | Vulnerable room located diagonally below in foreign area |  | $\leq 27 \text{ dB(A)}^*$ | $\leq 25 \text{ dB(A)}^*$ |
| DIN 4109-5 | Adjacent vulnerable room in own area |  | No requirements | No requirements |

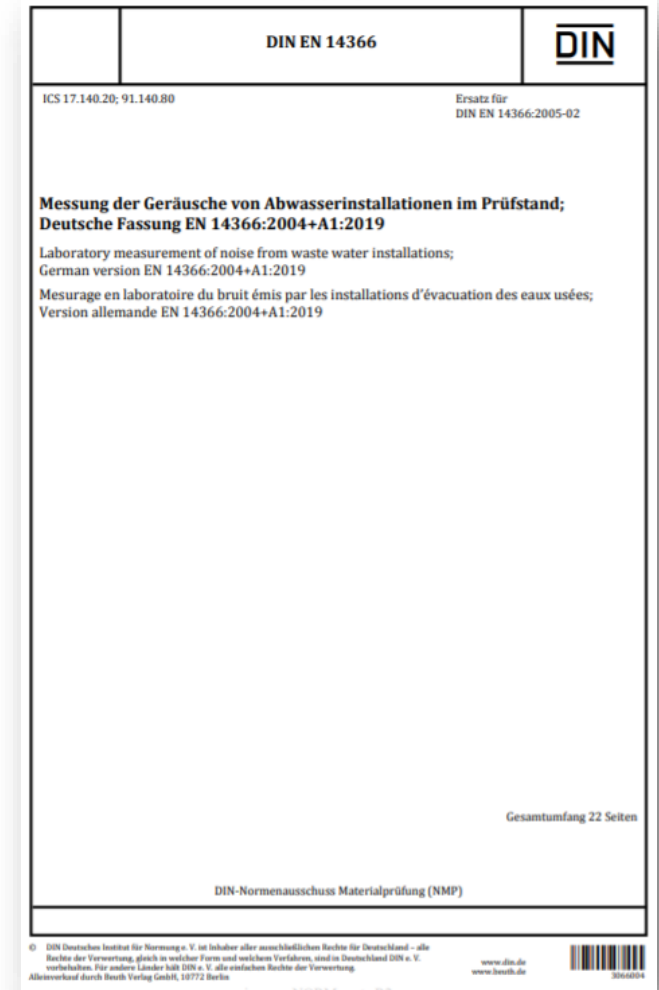
DIN EN 14366

This standard specifies a process by which waste water and rainwater installations of air and structure-borne noise can be **measured under laboratory conditions**.

Quotation DIN EN 14366, chap. 1 Scope:

“However, this standard does not provide a standardized procedure to calculate the acoustic properties of such installations in a building.”

Previous measurements by various manufacturers cannot be used for comparisons, since the type of assembly and in particular the used pipe clamps are not standardized and each manufacturer has build up its own superstructures.



EN 14366 measuring of drainage pipes in a test stand

EN 14366

Sanitary installation
Sound measurement with discharge pipe – without WCs or additional sanitary installations

Supply feed for sound measurement
Flow-rate controlled supply feed two storeys above the measuring location

Supply feed flow
Consistent, laminar water flow without Turbulence

Pipe brackets
Use of high-quality pipe brackets such as Bismat 1000. Pipe brackets are partly unsecured during the measurement

Measuring location
Measurements two storeys below the supply feed in a room diagonally underneath

Wall construction
Solid wall with a basis weight of 220 kg/m²

Cellar acoustics
Fully sound-decoupled cellar

DIN 4109

Sanitary installation
Sound measurement with complete sanitary installation

Supply feed for sound measurement
Supply feed one storey above the measuring location via operation of toilet flush

Supply feed flow
Turbulent flow, caused by operation of the toilet flush

Pipe brackets
Use of system pipe brackets. Pipe brackets are mounted according to the installation manual.

Measuring location
Measurements in the neighbouring room and in the room diagonally underneath

Wall construction
Measurement with different realistic wall constructions

Cellar acoustics
Non-sound-decoupled cellar

EN 14366 measuring of drainage pipes in a test stand

EN 14366

- The DIN EN 14366 standard establishes methods for measuring sound arising in waste water installations under laboratory conditions.
- The precise structure of the drainage system to be tested remains largely undefined.
- The standard does not provide any methods for calculating the acoustic characteristics of a building's facilities

Measurement results as per DIN EN 14366 are in practice not suited for demonstrating compliance with sound insulation requirements in real buildings

Cost-effective way for keeping customers happy but not giving them practical values which can't be applied in daily work

DIN 4109

- DIN 4109 regulates sound insulation and room acoustics in building construction.
- It defines strict limit values for the maximum sound level of technical building systems, guaranteeing a high level of living comfort.
- The standard does not make any specifications in terms of structure. For this reason, only sound measurements taken under realistic conditions are suitable for demonstrating the required sound insulation.

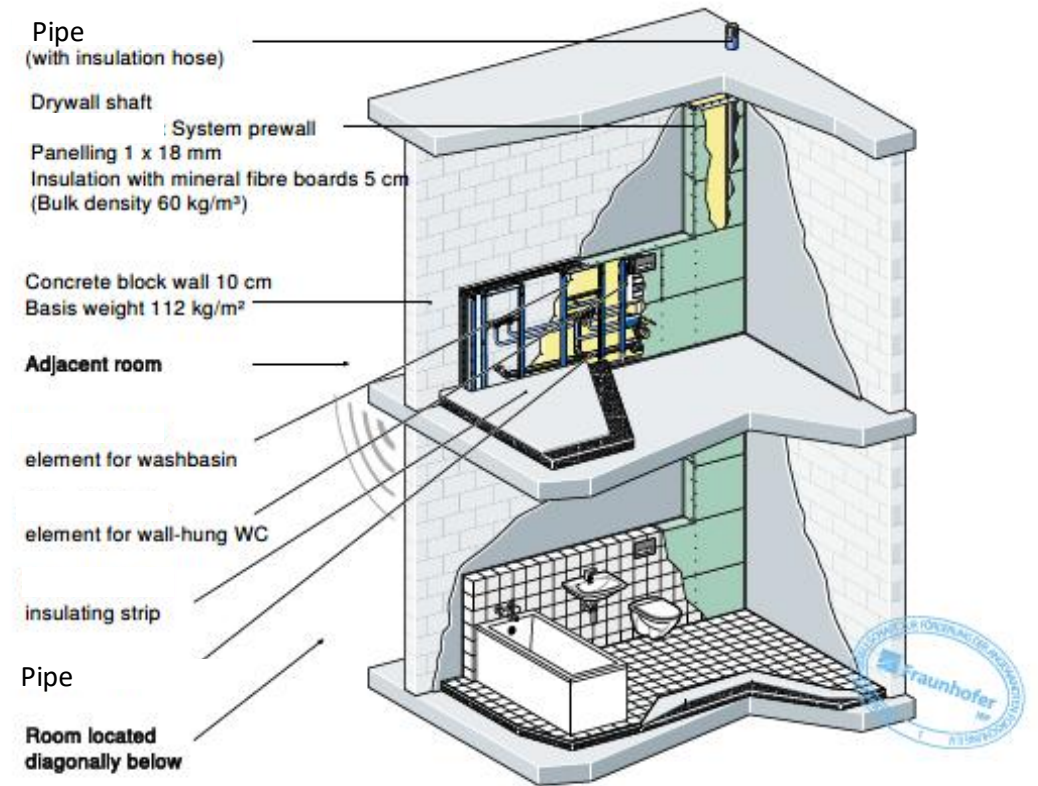
Realistic construction situations. This is confirmed by the Fraunhofer Institute and is also pertinent for comparable construction situations.

Expensive way for giving customers practical values which can be applied in daily work

Measurement data for common situations

- Measurements for various real-world situations
- Measurements under realistic conditions
- Certified by renowned Fraunhofer Institute

4.4.2 System Wall Used as Prewall Construction in Front of Solid Partition Wall



| Sound measurement | Measured values up to | |
|-------------------|-----------------------|---|
| Diagonal Room 2 | 25 dB(A) | A |

Installation issues affecting acoustics



Summary

- No body cares about drainage... until it becomes a problem
- Design with acoustics in mind from the outset
- Ensure good installation practice
- If you get a EN 14366 certificate make sure that you get a signed confirmation of the values if they are measured once the installation is finished

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