

Acoustic performance of dwellings

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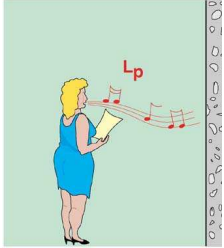
- *introduction*
- *performance quantities*
- *constructions principles*
- *what performance is required*
- *does heavy or lightweight matter?*
- *what need to be done?*

- **Acoustic performance is an important aspect of dwellings, affecting the health and comfort of the residents**
- **it concerns noise from**
 - **neighbours: TV, singing, screaming, walking, dancing ..**
 - **service equipment: toilet, shower, heating installation ...**
 - **outside: road traffic, playing children, barking dogs ...**
- **every country expresses the requirements in these areas differently, though another COST action tries to harmonize this for the future**
- **but fortunately the basic quantities behind these requirements are essentially the same.**

- **Building Acoustic quantities are already used since more than 50 years and are in principle not depending on material but just the performance.....**
- **current requirements are mainly based on experience in traditional buildings, that is mostly heavy materials like brick and concrete**
- **light weight building elements and construction methods become more and more popular**
 - transportation costs, prefab & mounting, sustainability, flexibility, extending existing buildings, ...
- **thus big question is:**

does heavy or lightweight matter?

- **aspects to consider are**
 - **airborne sound, from neighbours and from outside,**
 - **impact sound, and**
 - **sound due to service equipment.**
- **within Europe many different quantities and symbols are used to specify the performance and requirements, but largely with comparable meaning.**
- **in this presentation we will use the current proposals for the future by COST Action TU 0901**



- **Airborne sound:** level difference between rooms, standardized to reverberation time:

$$D_{nT,A}$$

assuming normal behaviour of neighbours, this gives an indication of the received sound levels, related to the subjective assessment

- for outdoor noise the same type of quantity is used:

$$D_{2m,nTAtr}$$

with knowledge of the noise impact, f.i. from road traffic, this gives an indication of the received indoor levels

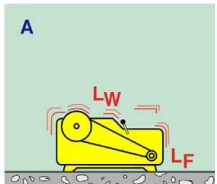
- *we will further disregard outdoor noise*



- **Impact sound:** level due to a standardized tapping machine:
(to be interpreted as f.i. walking level)

$$L_{nT,A}$$

which assessed appropriately can be interpreted as the sound levels due to human walking

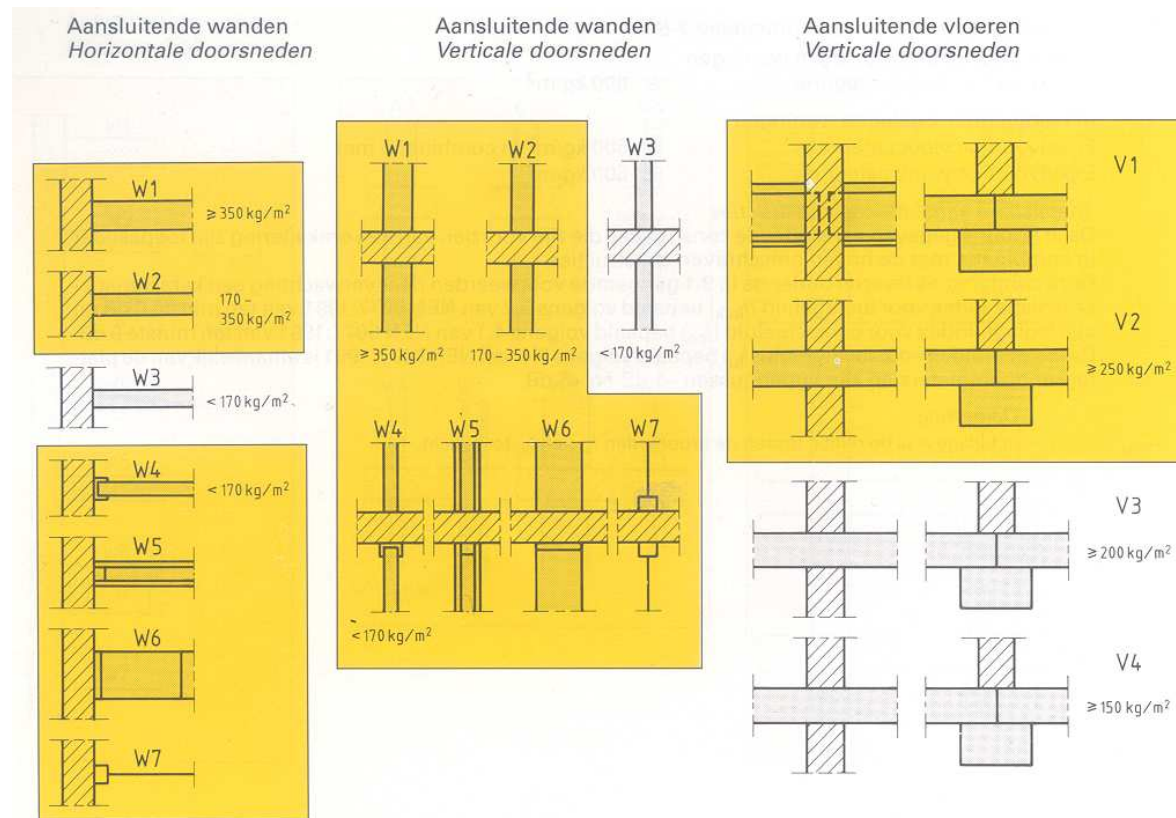


- **Equipment sound:** directly the A-weighted level

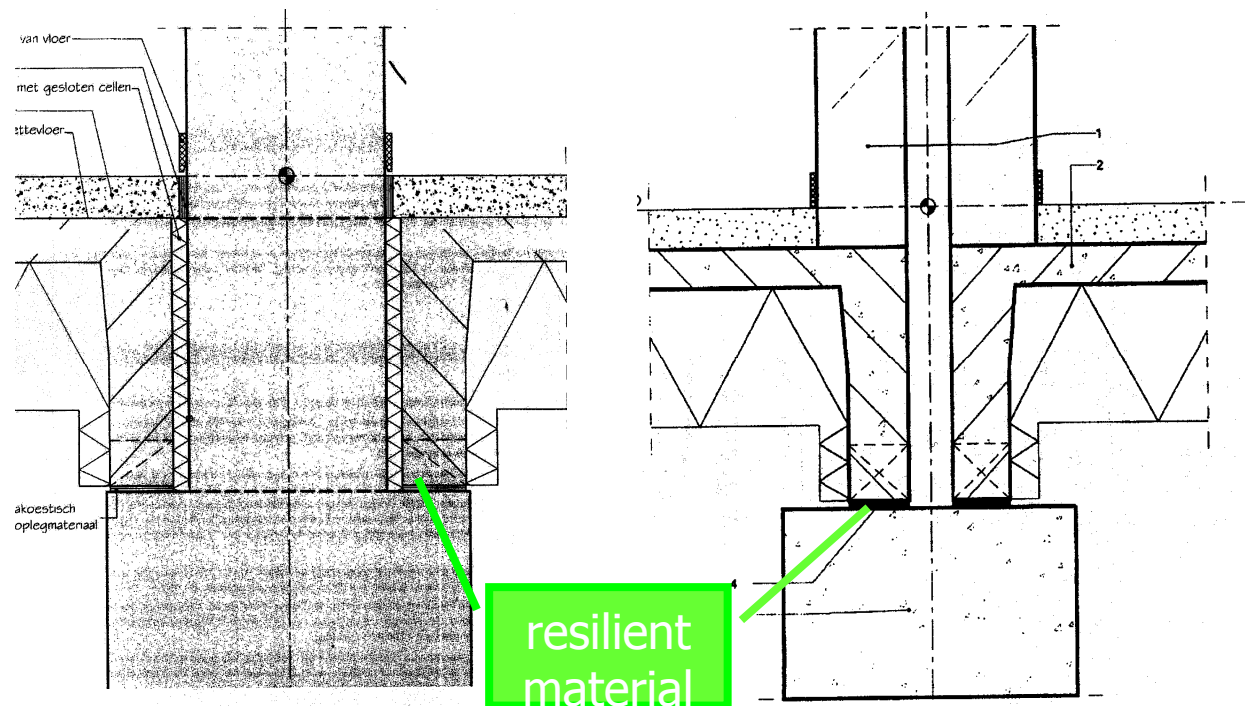
$$L_{I,A}$$

- **traditional buildings:**

- for better sound insulation heavier walls and floors
- reduce indirect transmission through lighter inner walls, floors and façade

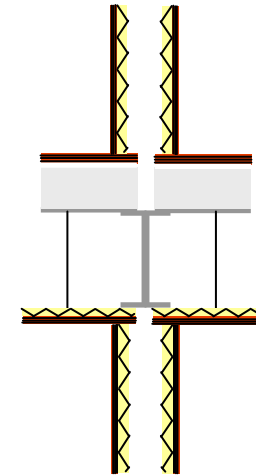
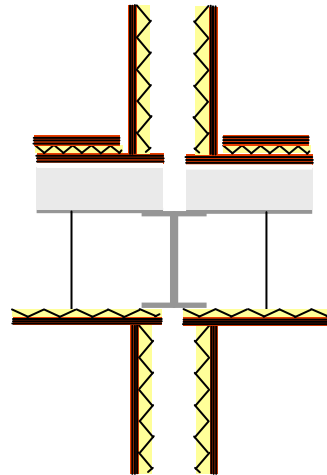
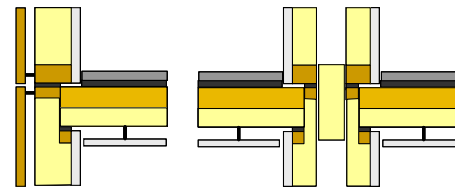
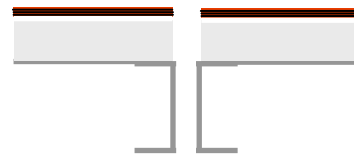


- **traditional buildings, for instance:**
 - separating wall or floor at least $> 500 \text{ kg/m}^2$, possibly heavier f.i. 250 mm concrete
 - heavy cavity wall with disconnected walls etc.
 - measures to reduce indirect transmission

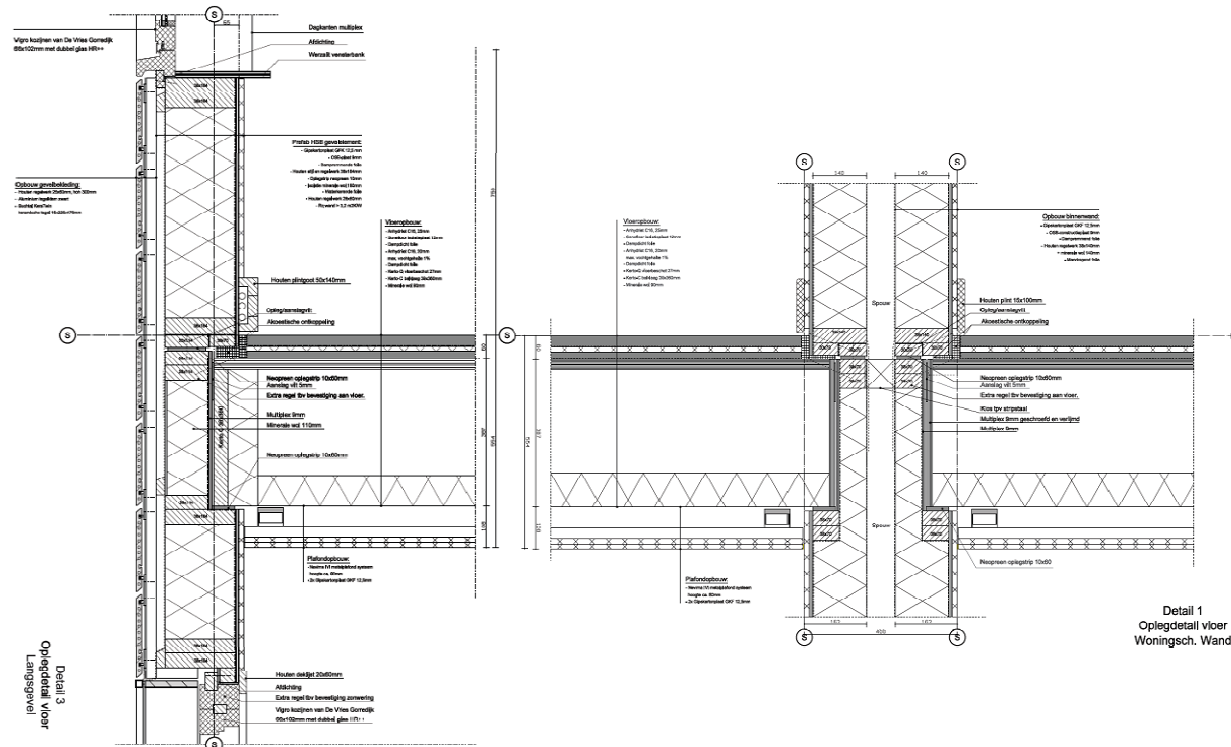


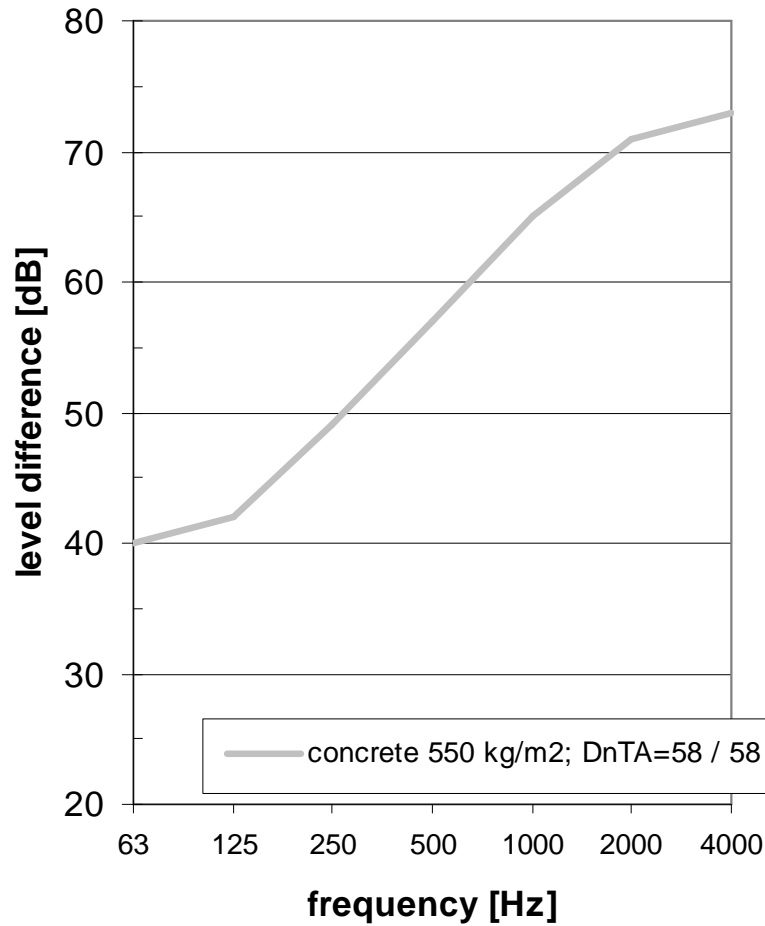
details ground floor junction

- **lightweight buildings:**
 - separate elements, use wide cavities, minimize contacts
 - apply two or three layers, resiliently mounted
 - use dilatation for inner walls and façade

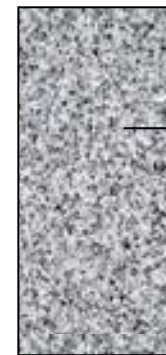


- **lightweight buildings, for instance:**
 - two sides 2x12,5 mm gypsum, 250 mm cavity with mineral wool
 - wood joist floor, with independent ceiling at 400 mm and floating floor on top

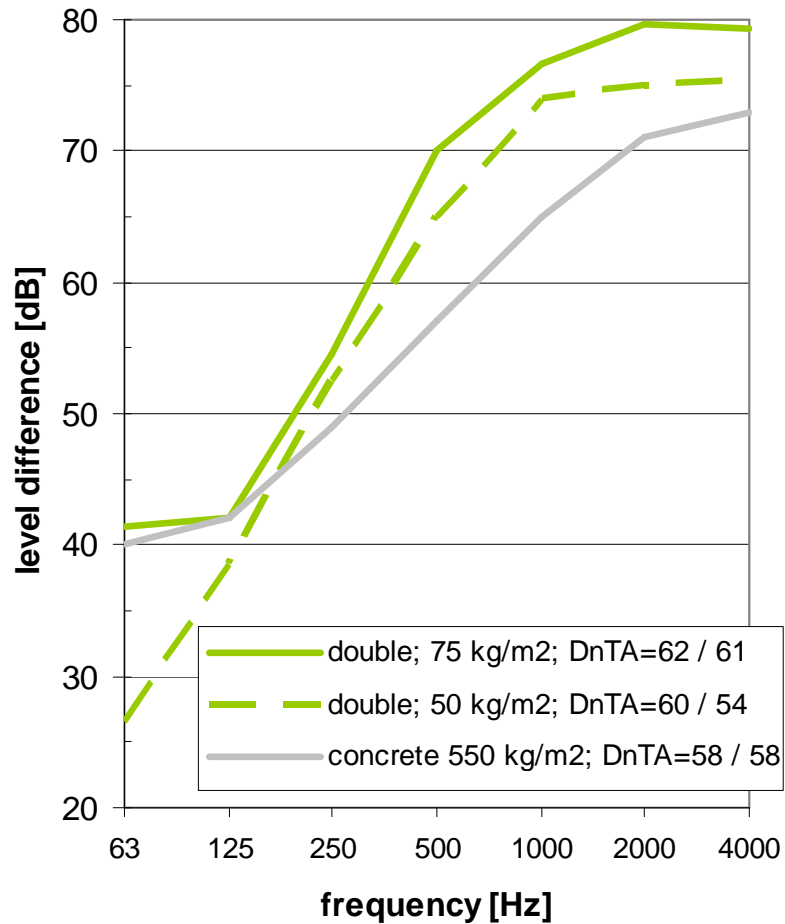




- normal range 100-3150 Hz



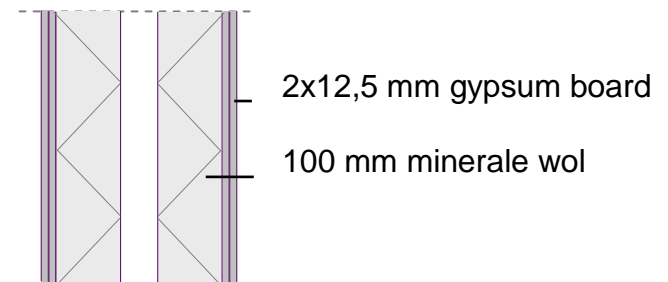
250 mm concrete

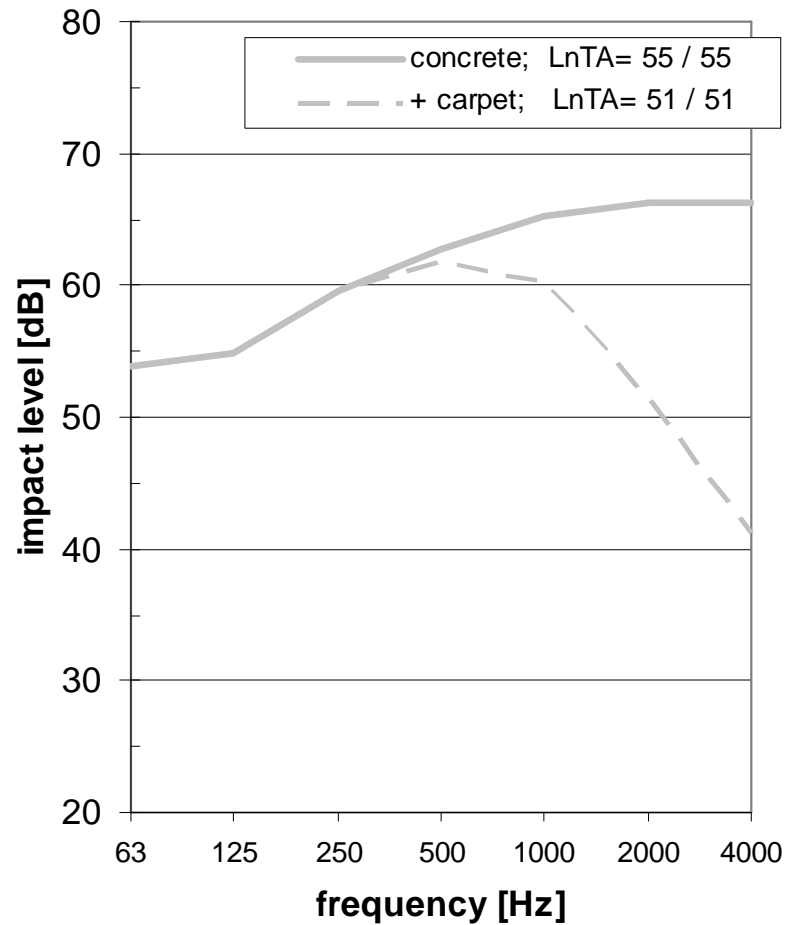


- normal range 100-3150 Hz

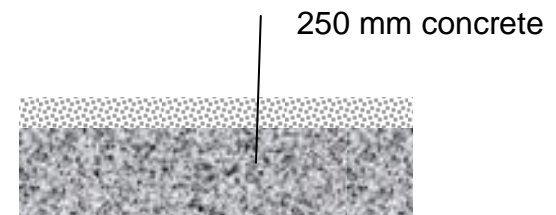
- even better in this range
- dip at lower frequencies
- $D_{nTA-63\text{ Hz}}$: 1-6 dB more severe

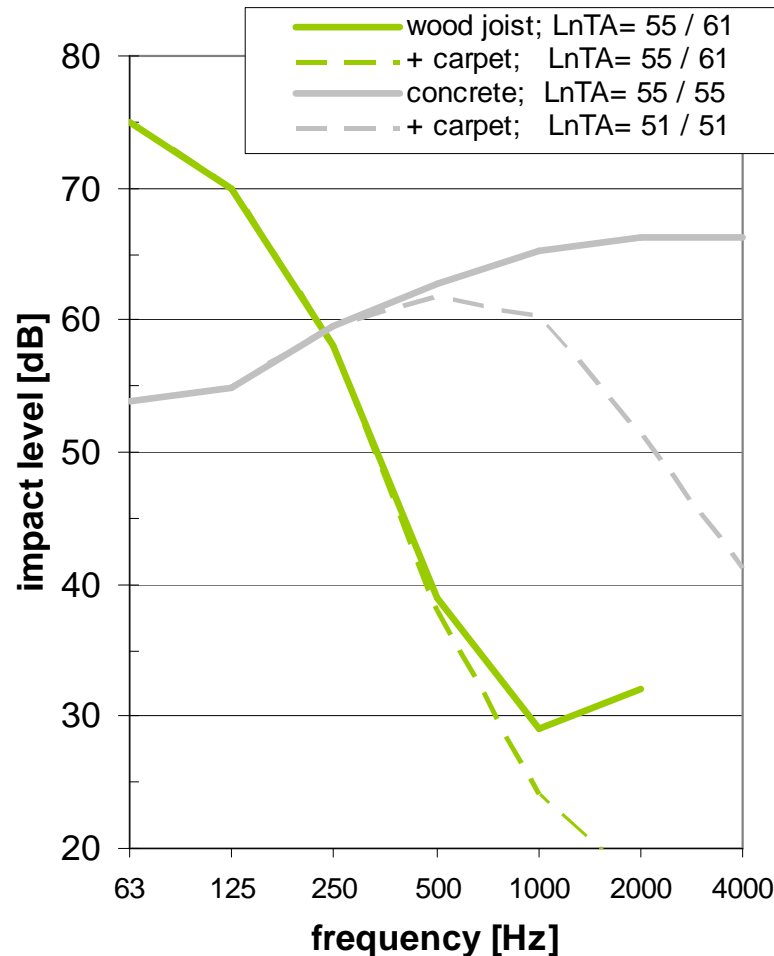
- consider at least 63 Hz for equal performance as heavy wall



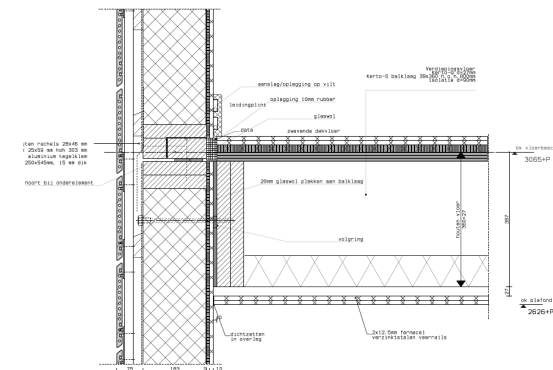


• normal range 100-3150 Hz

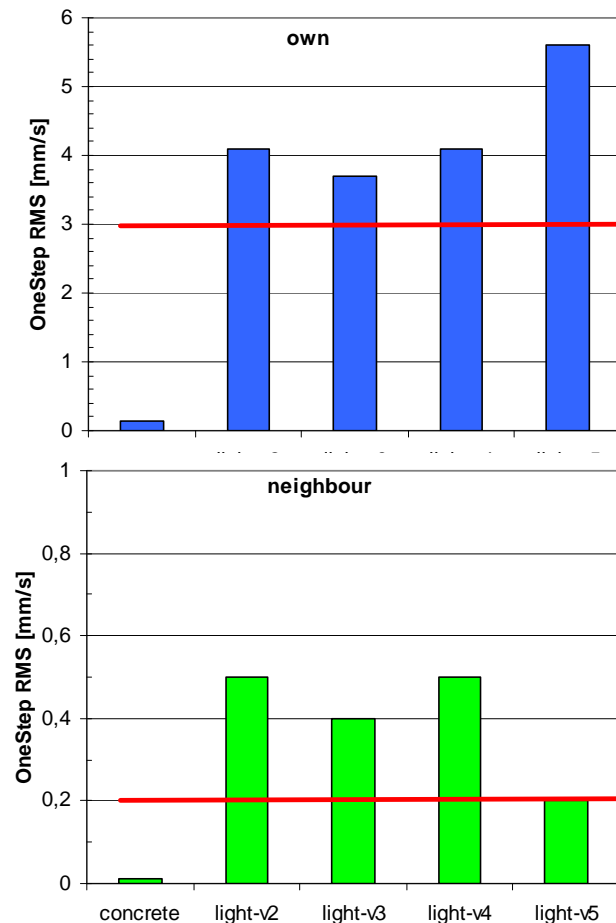




- normal range 100-3150 Hz
- ‘booming’ sound of walking
- $L_{nTA-63 \text{ Hz}}$: 3-6 dB more severe
- carpet does not help
- consider at least 63 Hz for equal performance as concrete floor
- 31 Hz probably not relevant, but 10 Hz vibrations?



- **lightweight buildings: walking induced vibrations relevant**
 - own floor: require sufficient stiffness (f_{res})
 - neighbours floor: also junction attenuation needed

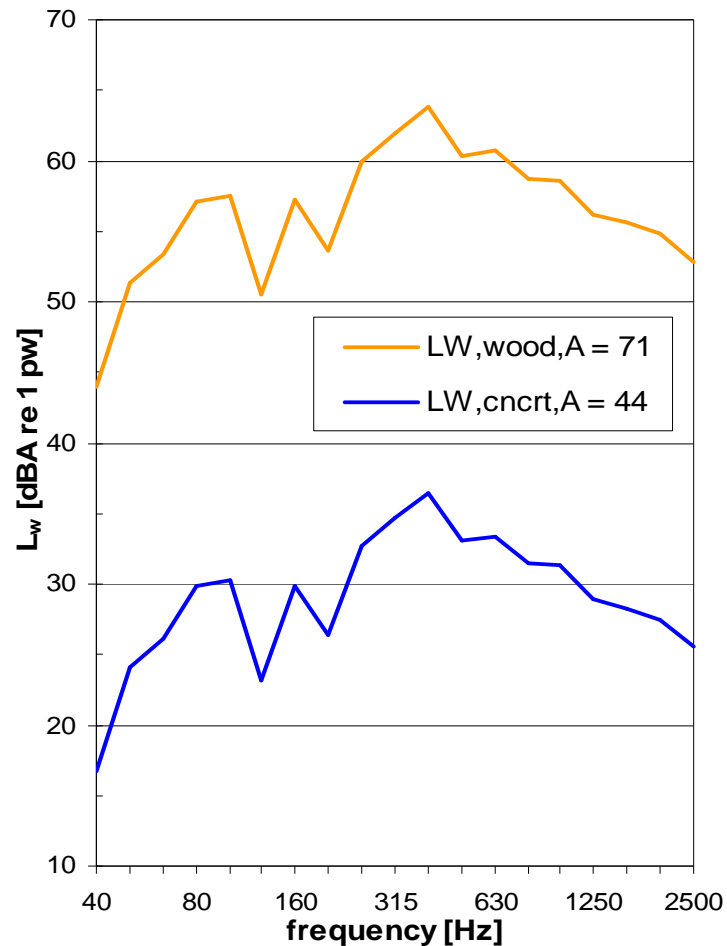


**general quantity (could be):
rms velocity by one foot step**

experiments various floors and junctions:

- often still too high, both on own as on neighbours floor
- also ‘rattling’ sounds of cups and plates reported
- indications on how to improve designs

- sound levels due to service equipment depends on source type, mounting method and mounting surface



example of washing machine on concrete and wood joist floor:

about 25 dB more power injected, so additional measures needed!

does heavy or lightweight matter?

- ❖ with lightweight, multiple constructions, equal or even better acoustic performance is possible
- ❖ but, if for lightweight buildings only the current requirements are used, it means big trouble
- ❖ it is essential to take into account lower frequencies for airborne and impact sound insulation
- ❖ additionally, walking and equipment induced vibrations need to be considered and treated

- ❖ **action FP0702 addresses these points of attention,**

**indicating appropriate
prediction and measurement methods, and**

**describing practical solutions for (timber based)
lightweight building systems**