

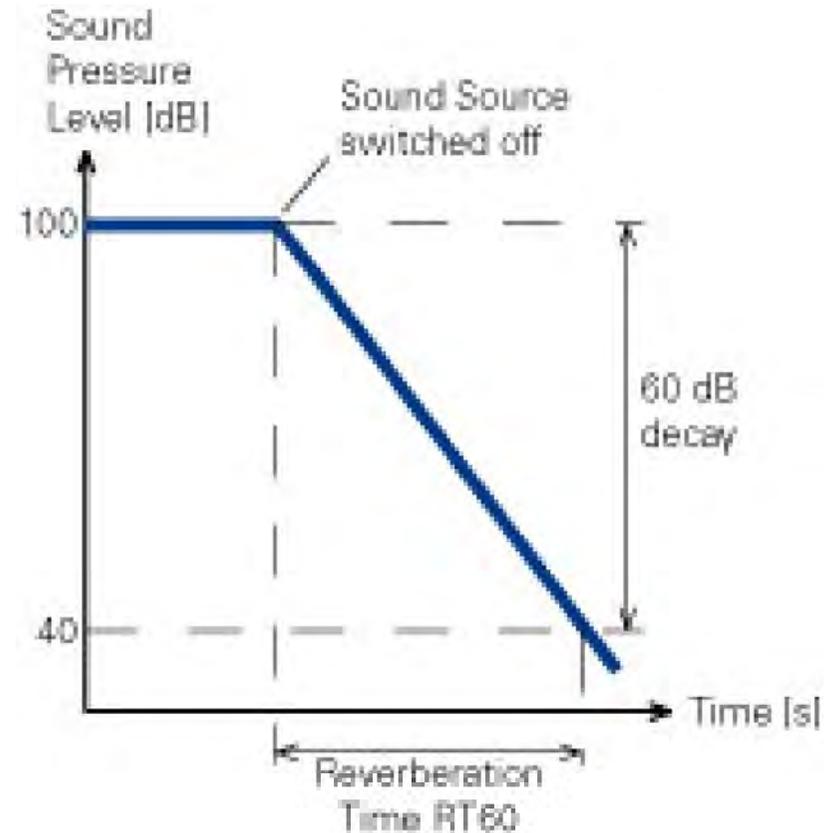
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Acoustic solutions



Reverberation

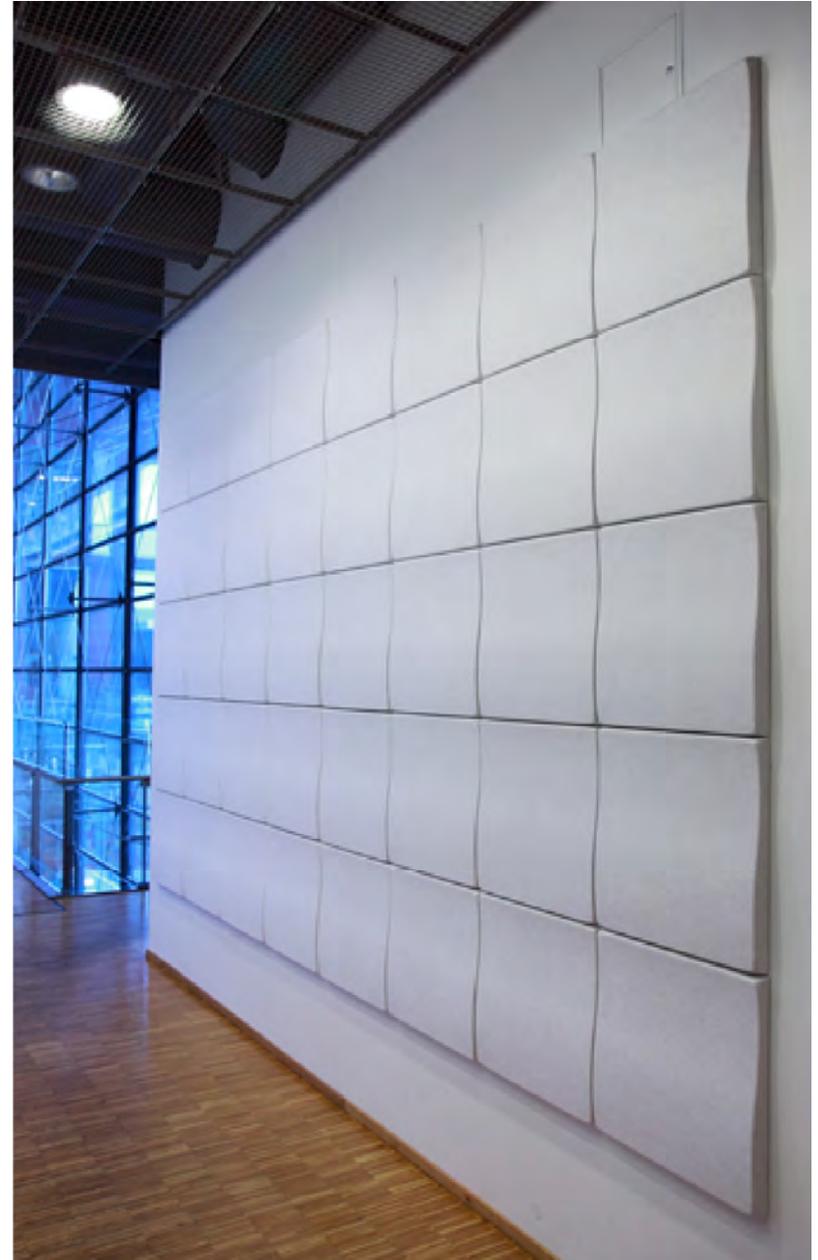
A reverberation, or reverb, is created when a sound is produced in an enclosed space causing a large number of echoes to build up and then slowly decay as the sound is absorbed by the walls and air. **RT60 is the time required for reflections of a direct sound to decay by 60 dB below the level of the direct sound.** When the reverberation time is short, the previous word of the speaker abates until the listener hears the next word. This makes the speech well-understandable. **When the reverberation time is longer, it is more difficult to understand speech clearly.** This makes people to raise their voices or for example watch the television louder. This leads to even noisier working or living environment.





Noise reduction

Materials used in the room have a great effect on the acoustics. Surfaces that are both hard and well sound reflecting do not reduce i.e. absorb the noise. Softer materials absorb the sound waves and reduce effectively the disturbing echoing sounds. The acoustic solutions should be carried out in a way that **on the opposite side of the hard surface there should be soft material.**



The Adverse Effects of Noise Pollution

Noise pollution can heavily influence a person's mental and physical well-being, and its adverse effects on public health has been the most widely examined after particulate matter suspended in air, or air pollution.

Noise pollution can deter even regular forms of communication by inducing **fatigue or stress**. Negative cognitive effects include **strain on a person's memory, thought processes or even control of their emotions**, **sleep disruption, difficulties in concentrating and learning**.

Additionally, chronic exposure to noise may cause physiological effects such as **dysfunction of the heart and circulatory system**. In the most extreme cases, **noise pollution may cause damage to, or complete loss of, hearing**.



Effects of Noise Pollution

- Hearing Loss
- High Blood Pressure
- Stress
- Sleep Disturbance
- Color Blindness

The Significance of Chronically Noisy Environments in Day Cares and Educational Institutions

A noisy environment causes stress to both the children and the staff. Clear verbal communication, speaking and listening are all key in a learning environment and, therefore, require the support of good acoustic elements. Precise enunciation and intelligible speech is particularly important in day cares, when considering the vital role of speech development in younger children. **An adult may be able to guess the meaning of the sentence using only a few audible bits and pieces, but this is not applicable when considering a young child's undeveloped speech abilities.** In this case, solid and controlled sound environments creates a better learning environment.

A chronic noise environment negatively affects the wellbeing of the teaching staff: poor noise reception causes voice impairment. The voice will not last, and continuous stress can even cause impaired movement of the muscles used for speech production, such as the lips. Exposure to chronic noise also induces fatigue and stress.

A comfortable, quiet learning environment is proven to facilitate calmer behavior and a more thoughtful use of sound. It also provides a more peaceful setting for learning basic tasks such as school work. Normal sounds and voices are more easily screened and recognized, resulting in a safer learning environment.





Acoustics and Wellbeing in the Workplace

Acoustics are a vital element of ergonomics. Noise commonly plagues an office and leads to difficulties in distinguishing voices from other disruptive sounds. **Room acoustics should be considered in any work and office space, as it directly and significantly impacts an employee's mental and physiological health.** A controlled sound environment supported by acoustic elements will facilitate an environment with **improved performance and productivity, while at the same time reducing stress and increasing overall employee satisfaction.**

The open office concept has become popular and provides further flexibility in arranging workstations. However, this imposes challenges with acoustics and sound control. Employees are often disrupted by much of the background noise produced, noises coming in from outside the building. **The most prominently audible and destructive sound, however, is other people's conversations.** An open floor plan can be acoustically successful when conversations between workstations are kept to a minimum.

Noise levels can be influenced by the careful positioning of sound absorbing materials. Once the noise level is lowered, people no longer feel the need to raise their voices and may even begin using quieter tones when speaking. As a result, the background noise is reduced and the overall noise environment improves. Acoustics must be considered as a whole. Speech and conversations should also be acoustically dampened, which supports the overall noise reduction solution.

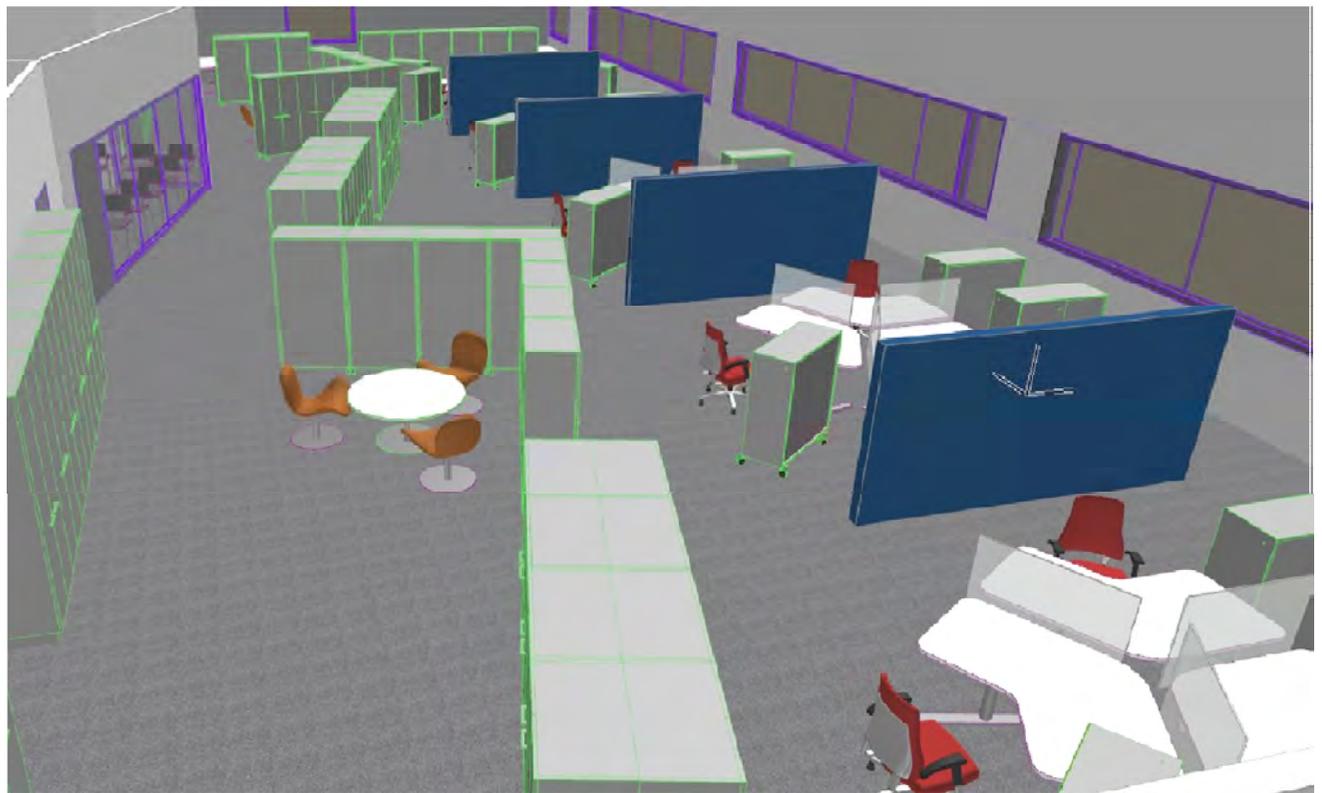
Roughly 10% of the working age population suffers from hearing impairment in one form or another. For example, **special attention should be paid to employees wearing a hearing aid.** Hearing aids heighten all ambient sounds, including background noises, which may therefore, impede the ability to follow someone speaking. Acoustics should be strongly emphasized and carefully considered in the workspace design in this case.



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Working environment

Landscape offices





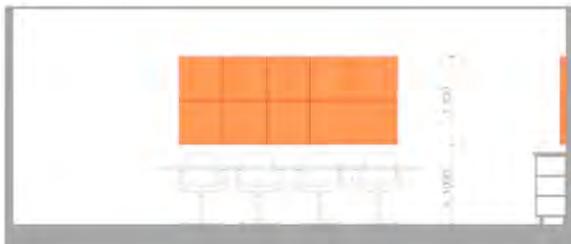
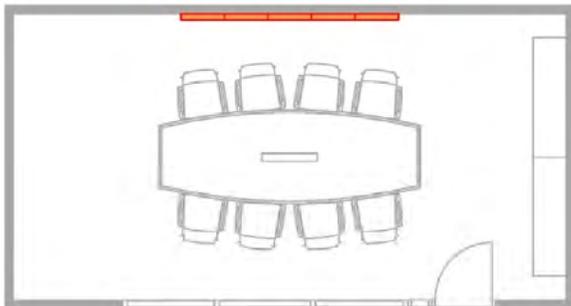
Absorption of speech sounds with different amount of panels.
Absorption Class A, EN ISO 11654.
Meeting room size 3 x 8m.
Room height 2,8m.

Acoustic planning guide – Meeting room

Fare



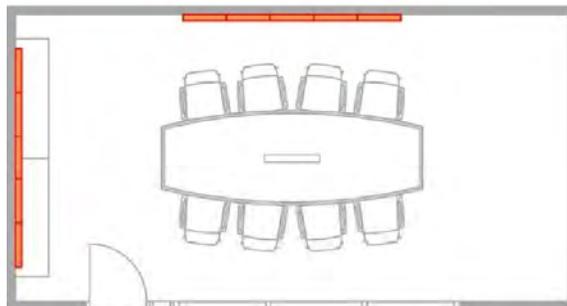
Soften S1e, 10 pcs



Good



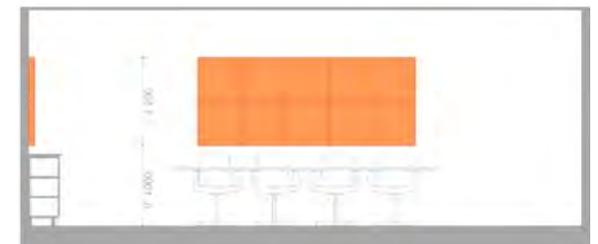
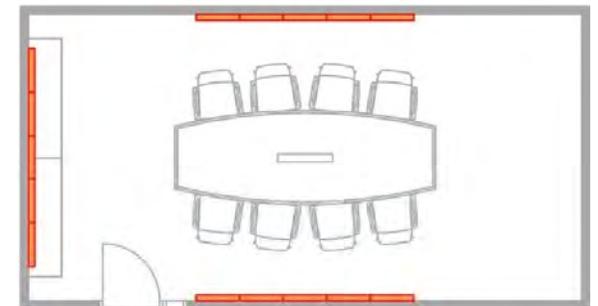
Soften S1e, 20 pcs



Excellent



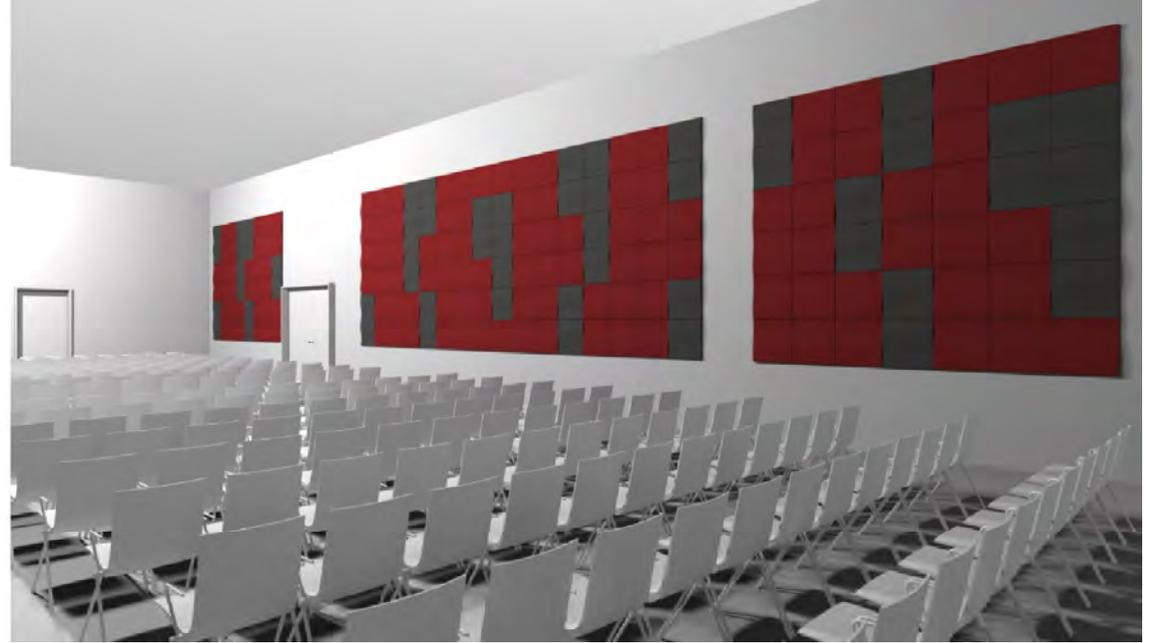
Soften S1e, 30 pcs



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Working environment

Auditoriums

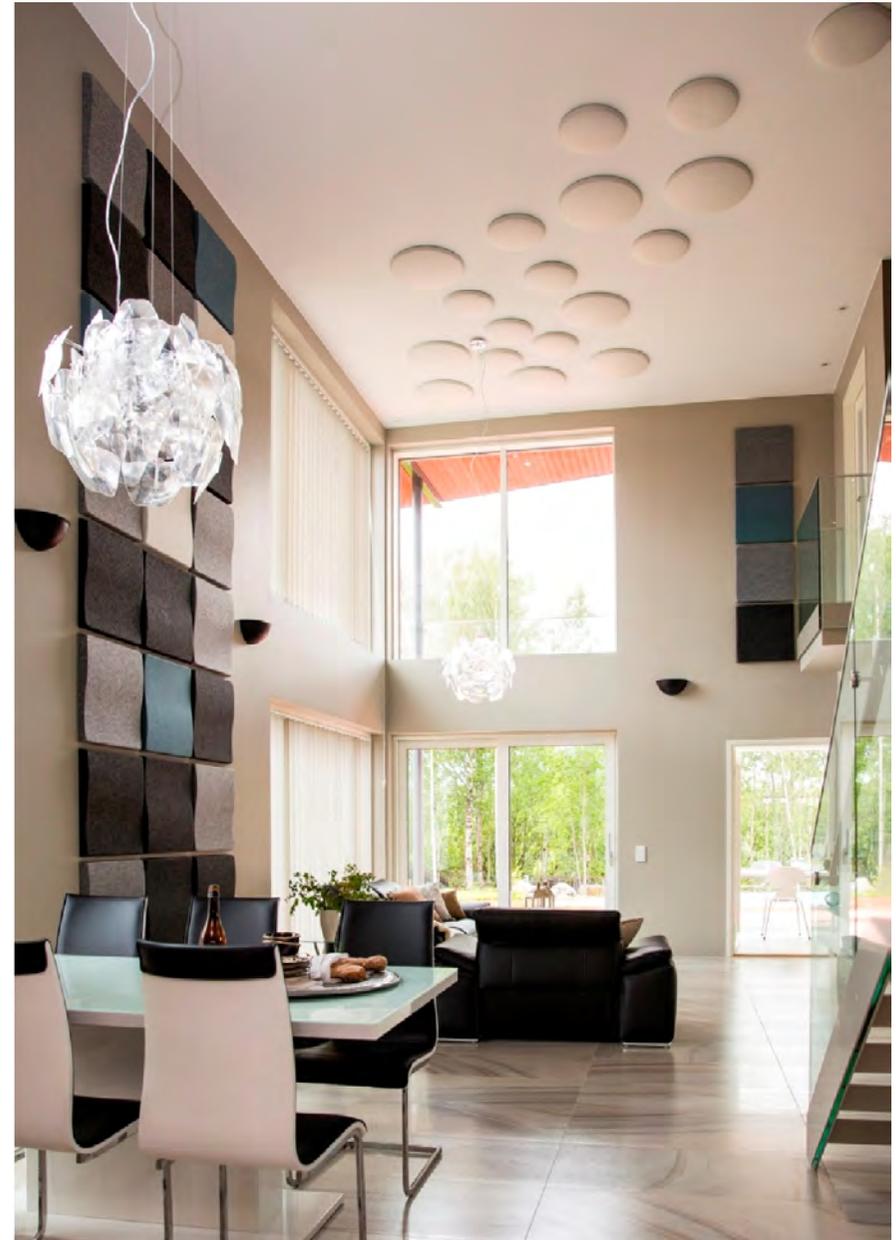


Living environment - Homes

Open living space solutions can be difficult from an acoustic perspective. In more recent times, more attention has been directed toward the improvement of sound conditions in the living environment. Currently, planning in a residential space favours **a large area with high ceilings, large windows, hard-surfaced floors and walls - leading to echo problems.** Soft furnishings are less common in today's interior design trends, resulting in homes that cannot absorb the sound, highlighting the space's overall echoing properties.

In residential spaces, acoustic properties can be easily incorporated and considered when planning recreational areas, such as **the home theater, areas for listening to music.** Musicians and hobbyists also require a strong acoustic environment in order to achieve the perfect pitch and sound. Additionally, **the staircase** can be acoustically designed to minimize movement of noise between the different levels.

Of course, noise conditions and acoustic design in the home should also incorporate any personal requirements of the residents, while also offering comfort and being **aesthetically pleasing.** Acoustic design should be considered in the earliest stages of the architect's planning to ensure that the most functional and affordable solutions are implemented, rather than being the cause of a problem at later stages.

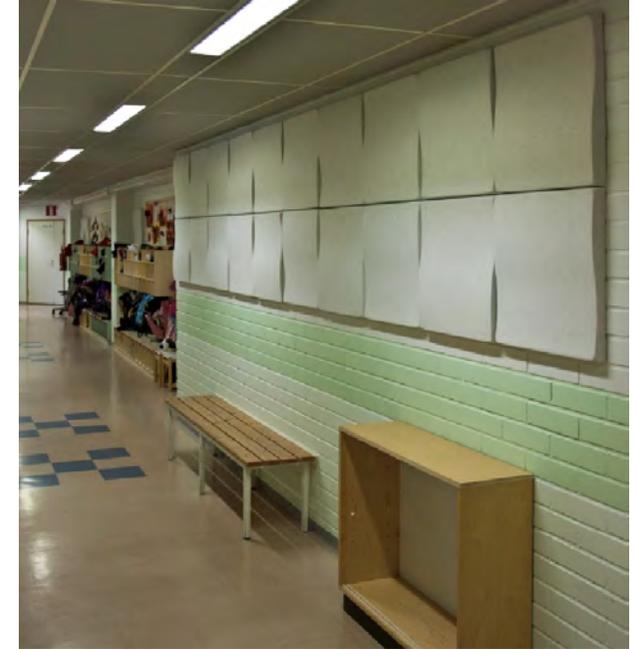


Sound environment – Schools and day care centers

- Sound environment must be good enough to understand speech
- The class room must support teachers work – speaking – without causing any stress to voice. Long term strain can cause problems for vocal cord and other sound organs.
- Cozy and calm environment encourage students to work peaceful behaviour and use of voice.

Acoustic planning of class rooms

The most important acoustic goal is to create a sound environment that supports teacher in use of his voice, and that the speech is easily distinguishable. This way the environment in the class room stays calm and stressless.



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