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PRACTICAL CONSIDERATIONS AND EXPERIENCES WITH SOUND MASKING'S LATEST TECHNOLOGY

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Abstract

This report considers the practical effects of sound masking and highlights various subjective experiences.
As modern office environments tend to exhibit lower NR (Noise ratings) the acoustic challenges for organisations become more apparent.
Using actual installations, two types of applications were studied – Speech intelligibility and distractions in the open plan office and speech privacy in closed offices, meeting rooms and pods.
Closed offices, meeting rooms and pods are often placed next to or in the open plan increasing the need for effective privacy levels.
Subjective tests in rooms with different acoustic properties were carried out in order to establish the effectiveness and the comfort level for each space.
It was concluded that for both applications it is important to establish and manage the background noise level of the spaces.
Speech privacy requires a good partition construction but is often challenged by the HVAC delivery methods used in some buildings which means it can sometimes be over specified.
The open plan needs an acceptable reverberation level in order for the sound masking to be unobtrusive and unnoticeable.
In both applications an upper limit on adjustment and zone size is critical to ensure effectiveness as acoustic conditions and user needs vary between private offices, meeting rooms, corridors, reception areas and the open plan.

1. Introduction

Background sound is critical to a facility's acoustic performance. All acoustical design inherently considers this factor when determining noise insulation requirements or speech privacy requirements.
Background noise level is vital to signal-to-noise ratio, dynamic range and overall comfort.
BS8233:2014 Guidance on sound insulation and noise reduction for buildings [1] advises internal ambient noise levels (LAeq,T) for conditions for work requiring concentration.
Staff/ meeting Room, training room – 35-45 dB

Executive Office – 35-40 dB
The standard also advises that noise levels should be within the range of 45-50dBA within open plan offices where acoustic privacy is important.
Guidance from BS8233:2014, the BCO (British Council for Offices) 2014 [2] and Chartered Institute of Building Services Engineers (CIBSE) Guide A [3] suggest that meeting rooms should have NR of around 30-35 and open plan 40-45.
All the studies except one found that the NR is at the lower end of the design criteria.
Distractions and speech privacy in the open plan and speech privacy from closed offices depends on the background level such that the only way to improve the situation is to reduce the dynamic range through masking.

2. Methods and Results

2.1 Open Plan – Low NR

Leading outsourcing company with 500 staff handling hundreds of telephone calls per day. Each operative spends 90% of their time working alone making concentration and low stress a priority. The background noise level with no one talking was measured at 38dB(A).
HVAC system is traditional mechanical but with low level noise.
Sound pressure levels were measured up to 10 m from the source. Measurements were taken with no speech and then with a 'telephone speaking' voice.
The sound level at the receiver was 55dB(A) at 1 m and at 8 m the level was just above the background of 38dB(A).
Introduction of sound masking installed in the ceiling void increases the background level to 45dB(A) reducing the distance at which conversations can be heard down to approximately 4.5m.

2.2 Open Plan - Low NR with ceiling absorption only

Global marketing and communications business with three floors of large open plan office of 5000m2 each all with exposed concrete ceiling and chilled beam ventilation system.
The background noise level with no one talking was measured at 25dB(A).
Sound pressure levels were measured up to 20 m from the source. Measurements were taken with no speech and then with a 'telephone speaking' voice.
The sound level at the receiver was 55dB(A) at 1 m and at 16 m the level was just above the background at a level of 30dB(A)
Introduction of sound masking increasing the background level to just under 45dB(A) reduces the distance at which conversations can be heard down to approximately 4.5m.
The lack of reverberation control and desk screens meant that the system tuning was critical to ensure the correct masking zoning.

2.3 Open Plan – Higher NR with ceiling absorption only

A government organisation with safety critical systems operating 24 hours a day. Ceiling solid metal deck and plastered brick walls with no option for wall treatment.
The average background noise levels from the mechanical ventilation (polythene ducting system consisting of inflatable polythene ducts suspended overhead from steel wires) were measured at 45dB(A) by the acoustic consultant. This level is just under the maximum based on the guidelines BSENISO11064 [4].
Acoustic modelling by Atkins [5] showed that the reverberation time would be too high for the space to operate properly. Treatment provided in the form of ceiling islands to underside of the

metal deck. However the background noise level and its frequency spectrum (plotted against a speech masking curve) are sufficient to enable suitable masking to reduce distractions.

2.4 Open Plan - Reverberation Time – Uncorrected

Open plan sales office for an international office furniture manufacturer. The office works in four time zones – USA, Europe, Middle East and Far East. Activity levels vary according to the time of day. Customer requested sound masking but hesitant to introduce reverberation control.
The calculated reverberation time is over 1.8 seconds and should be about 0.7 seconds.
The current suspended ceiling is not acoustic. If at least half were replaced with acoustic tiles the reverberation would be reduced to just over 0.7 seconds.
Network sound masking installed but set low so as not to be amplified by the reverberation.

2.5 Open Plan – Reverberation time corrected but limited ceiling access

Leading international legal business with offices across the UK, Europe, Asia Pacific and Latin America employing over 2,300 people.
Newly acquired offices in Birmingham with raised floor but with restricted access to the ceiling. Distractions and privacy a concern owing to the under floor ventilation system and lack of cavity barriers. Cross talk attenuators and cavity barriers installed but owing to practicalities and work-manship not as effective as laboratory tests show.
Holes drilled in tiles. Noise paths studied and established to ensure the area is flooded adequately – can be a challenge so takes longer. Speakers point upwards rather than downwards.
However there is always a lack of control in such applications owing to potential rearranging of furniture, covering grilles etc. There is also a higher user acceptance of ceiling mounted systems.

2.6 Open Plan – Glazed Private Offices next to the open plan

Finance Director and HR offices next to the open plan. Both offices are fully glazed except for the outside wall which has windows. The doors are also glazed.
Cavity blockers have been installed above the partition together with acoustic ceiling tiles with a good level of noise attenuation.
The joining of the glazed panels and the narrow openings around the glazed door set mean that con-versations outside the rooms are intelligible.
However loitering or eavesdropping by the door set would demonstrate poor office etiquette. It would be seen easily by the occupants of the office suggesting that it would not happen in practice.
Background noise level measured at 39dB(A).

2.7 Open Plan – Part Glazed Private Offices with door in curved wall

The original design was for a glazed door near to the edge of the office adjacent to an outside wall.
Penetrations through walls and ceilings for services allowed crosstalk between spaces and these were filled.
Initially the room was designed for casual use for non-confidential one to one meetings.
The use was changed to a CEO AV room and private office.
The design of the office also changed so that the door was further into the office than before and also fitted into a curved wall. The door position is in a worse place as far as speech privacy from the

open plan is concerned. The rectangular door fitted into a curved wall is an issue especially with regards to the frame and sealing.
It was possible to demonstrate speech privacy however it meant that the system volume was encroaching on the upper limit of acceptability. Recommendation was to either move the door back to its original position or improve the door frame.
Care must be taken when changing the use and also the design of the space so as not to adversely affect the acoustics.

2.8 Open Plan – Reverberation time corrected, Glazed screen

A government organisation which is undergoing a transition from field based and separate controlling centres to fewer and larger operating centres.
It involves the space being occupied by both quiet and noisier activities. Both teams require different acoustic conditions yet still need to collaborate visually.
The acoustic consultant Arup [6] established that reverberation control on its own would not solve the issue of distractions in the open plan and noise travelling from one side of the office to the other.
A combination of reverberation control reducing the overall noise level and a screen dividing the areas but part glazed so still maintaining visual contact and not disrupting the ventilation system.
Network sound masking was also specified to enable more productivity from fewer distractions.
Owing to the exposed concrete soffit the network (speakers and programmable hubs) was installed above acoustic ceiling islands with discrete cable connectors.
A keypad in the room offers masking volume increases for when there is a critical event involving significantly louder activities on the noisier side.

3. Conclusion

Sound masking is an effective method of reducing distractions in the open plan and also providing speech privacy from closed to open offices. This is because in many situations the background noise level is too low or bordering on the lower limit.

However its implementation must be considered with the practicalities and issues that are apparent on site and which are not necessarily realised at the design stage.

REFERENCES

1 BS8233:2014 Guidance on sound insulation and noise reduction for buildings

2 BCO (British Council for Offices) 2014

3 Chartered Institute of Building Services Engineers (CIBSE) Guide A

4 BSENISO11064 Ergonomic design of control centres

5 Atkins Ltd Report for client

6 Arup Acoustics Report for client