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dB
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hertz
frequency
diffraction
sound
attenuation
ambient
noise
wave
diffraction
EAV
zwicker
screens
cover
white noise
ground effect
acceleration
vibration
absorbing
dB
reverberation
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CONTENTS

WHAT IS ACOUSTICS?

The science of sound and understanding how sound travels.

Why should this concern you?

We all know how hard it is to hear and be heard in a crowded restaurant or walking along a busy street. Have you ever tried competing against the sound of a building site? All of this is what's referred to as **Noise pollution**.

The frustration of battling against such noise is an everyday occurrence and can leave you feeling drained and unable to focus. The office environment is no different and all of us will experience a range of auditory distractions in the workplace.

These can include telephones, air conditioning units and office equipment together with multiple conversations. All these sounds are conflicting with each other.

To compound matters the need for adaptable work spaces has led to more open plan offices and collaborative communal areas. Traditional walls have given way to modular furniture systems which service greater numbers of people who are quite often working in close proximity.

All of these factors have meant an increase in **noise pollution** at work.

Why do we experie pollution at work?

Reverberation time – “keeping it brief”.....

This is the time it takes for a sound to decay (die down). It's important that this time is as short as possible.

Imagine standing in a room and shouting. The sound will leave your mouth, travel and hit the hard wall. The sound will bounce off that wall and travel back into the room. As that sound is travelling back through the air you shout again. Before the first sound has had time to die down you have created another sound and these two sounds conflict against each other one on top of the other.

Now imagine you stand in the same room but this time the walls are covered in acoustic wall tiles. As you shout the sound hits the wall tiles and the soft acoustic panel absorbs some of that sound leaving less sound to bounce back into the room. More importantly it reduces the time it takes for the sound to die down. By the time you shout for a second time the first sound has died and the second sound has nothing to compete against.

ence noise

So, back to the question, why should this concern us?

Well, this constant noise is distracting, it can reduce concentration and affect health and well-being which in turn will affect productivity and it's not just us saying that, extensive research has been carried out to support this.

Over the last decade the Centre for the Built Environment (CBE) has shown that poor acoustics is the number one cause of workplace dissatisfaction and the most significant factor affecting employee performance.

Specifically, research shows that distractions result in:

- Shifts in attention that reduce focus;
- Increased efforts to concentrate, which can increase stress levels and fatigue;
- Abandoning a current task to deal with demands caused by an interruption;
- Losing flow of thought and the need to re-orient to the task, which can take up to 15 minutes.

Research also shows that distractions and interruptions are most detrimental for complex cognitive tasks with high information processing demands.(1.)

A survey of 400 Business Managers conducted by the Building Owners and Managers Association (BOMA) and the University of Maryland identifies noise control as the greatest opportunity for productivity improvements with an estimated average increase of 26% per person.

By investing in acoustic solutions you can not only improve your efficiency and the well-being of your staff but in time see a return in your initial investment over a matter of months.

Another way of looking at it.....

Perhaps because sound is not visible, we tend to underestimate its importance. For instance, if water were leaking into a space rather than distracting sound, the Facilities Manager would be "on it" immediately. Sound leaks can be just as damaging to workplace functions but we are expected to dismiss them much more readily than a soggy carpet. We dismiss acoustic distraction at the expense of worker effectiveness.

RETURN ON INVESTMENT

CASE STUDY
Research on Investment Capital

Research commissioned by Brother proves that it takes an average of 15 minutes to regain concentration after being distracted from a difficult task by unwanted noise. This is illustrated in the following example.

A company employs 200 staff with an average annual salary of £20,000 per person. Annual outlay on wages is therefore £4million.

If each person is interrupted 5 times a day and it takes up to 15 minutes to regain full concentration, this equates a 14% reduction in productivity over an average 8 hour working day.

By reducing noise interruptions the potential increase in productivity is in excess of £600,000 per annum, which is equivalent to 30 people's annual salary.

The return on investment is likely to occur over a period of months, not years.

200 x £20,000	= £4,000,000
5 x 15 min	= 1hr 15min
£20,000 ÷ 250 days	= £80 pp pd (per person/per day)
£80 ÷ 8 hours	= £10.00 ph (per hour)
1hr 15min	= £12.50 pp pd (per person/per day)
£12.50 x 250	= £3,125 pp py (per person/per year)
£3,125 x 200	= £625,000

£625,000 loss per year

So how can we achieve acoustic comfort?

The introduction and the strategic placement of sound absorbing surfaces such as acoustic ceilings, chairs, screens and floor finishes, together with appropriate acoustic barriers, partitions and where necessary noise masking systems, can all contribute towards an environment that provides acoustic comfort.

The A, B, C, Approach.....

Absorbing, Blocking and Covering is the principal method in order to achieve effective acoustics.

Absorbing: Acoustic ceiling tiles and wall panels, carpeting, and soft furniture all help to absorb noise from people and equipment. The more absorptive the material added to the open space and the higher the acoustical performance rating of the material, the more acoustically comfortable the environment will be.

Desk mounted screens should ideally be absorptive in order to reduce the volume of the occupant's voice before it is reflected into the space.

Blocking: Sound barriers are used to interrupt paths that carry sound from the noise source to the receiver.

By placing sound absorbing screens that are wide enough, high enough and low enough close to the source of the sound and close to the receiver of the sound you can effectively block and prevent the noise from travelling.

Traditionally, blocking was achieved by using partitioning, however the need for more flexible systems that can be reconfigured has meant the increased use of demountable and modular solutions.

Covering: There is a comfort zone for the volume of sound, and it is not zero. If there is no noise, then conversations and noises can easily be heard even from a distance. Covering noise refers to the use of a sound masking system. A masking system can dramatically reduce the distance that voices can be heard and increase speech privacy.

Your voice can carry on average 40 feet without masking and only 20 feet with masking (every environment will differ a little depending upon the entire building envelope).

If the "ABC Rule"is applied correctly, then the acoustics will enhance the overall experience of people working in open-plan environments; thus improving their concentration and increasing their ability to focus on tasks so they are more productive.

Our behaviour matters.....

We should consider peoples work patterns and identify the balance of concentration and interaction between people. Once we have done this we should provide the appropriate work environments.

Different people with differing tasks require different levels of speech privacy. If someone is predominantly desk based spending a considerable amount of time focusing on a particular task, they need to concentrate and interruptions should be kept to a minimum. However, a sales team that rely on interaction and collaboration to help them achieve their goals look for the additional sensory stimulus provided by others.

Watching your P's & Q's.....

How we behave in the office and the consideration we show others is important.

Things to consider.....

Limit conversations in open plan workspace.

Hold meetings behind closed doors.

Do not use speaker phones at your desk in an open plan office.

Keep phone conversations short or move them to an enclosed space that is conveniently located.

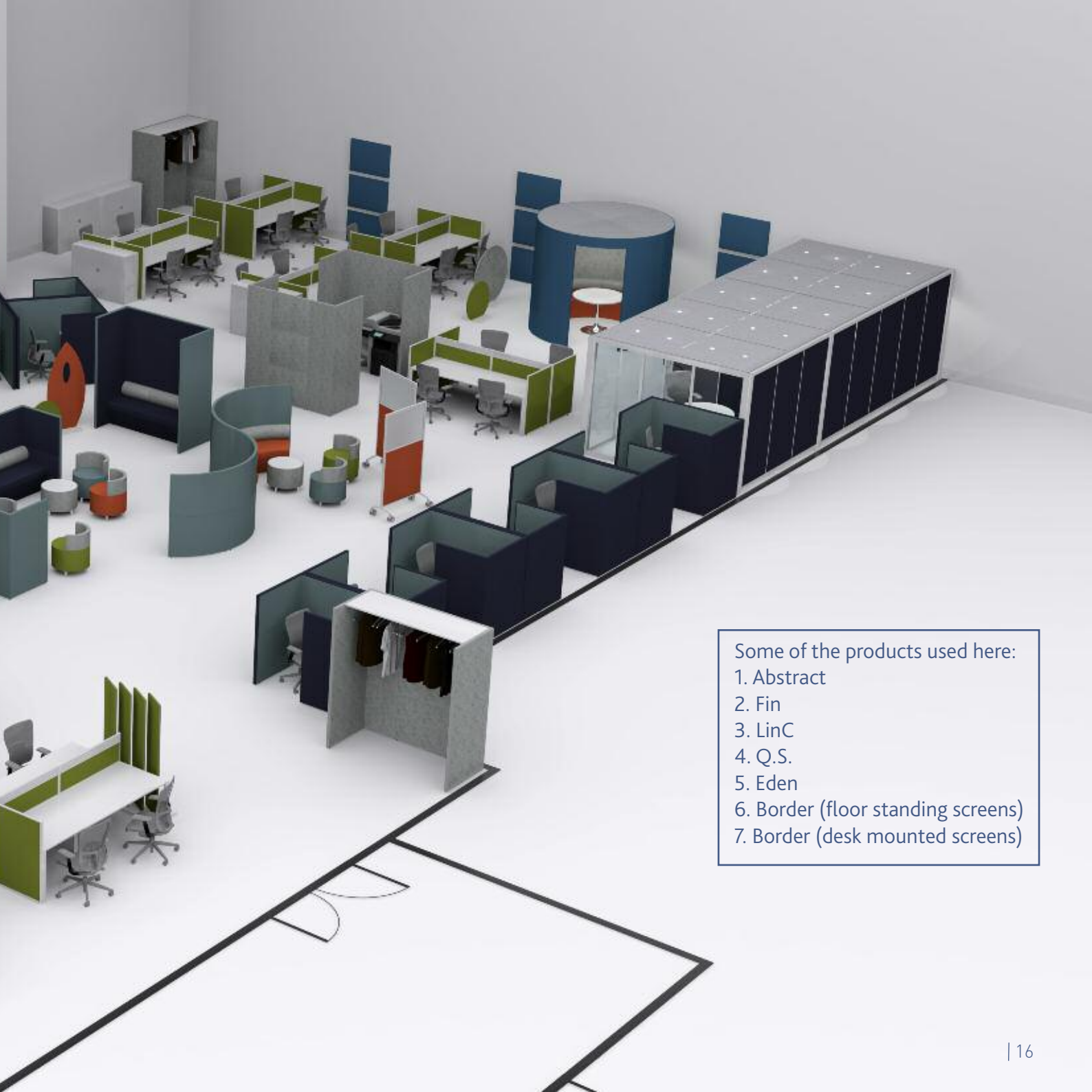
If you are going to hold a lengthy phone call, could you take it in an enclosed office space?

Not everyone wants to hear about the weekend's football or what you ate the night before. Sharing your news is good but be aware of others when you do.

Look before you interrupt; if someone appears to be concentrating, come back later or use an alternative means to communicate such as email.

An acoustic office on a typical day.....

The introduction and the strategic placement of sound absorbing surfaces such as acoustic wall tiles, floor standing screens and soft seating together with acoustically enhanced meeting pods and work booths help create spaces you can enjoy.



Some of the products used here:
1. Abstract
2. Fin
3. LinC
4. Q.S.
5. Eden
6. Border (floor standing screens)
7. Border (desk mounted screens)

Product summary

Here we have listed our acoustic products together with the relevant materials and their acoustic values. Please contact our Customer Services Department for further technical information.

PRODUCT TYPE		INTERNAL ACOUSTIC MATERIAL
Q.S.		CoustiLam
LINC		SA25 CoustiLam (NS)
BORDER		SA12
VIEW 30 **VIEW 50**		SA12 SA25 CoustiLam (NS)
FIN **ABSTRACT**		- -
EDEN 25mm **EDEN 38mm**		SA12 SA25 CoustiLam (NS)

CoustiLam = acoustic foam with Polymeric barrier

SA12 = 12mm thick acoustic foam

SA25 = 25mm thick acoustic foam

dB = decibel

NRC = Noise Reduction Coefficient

all ratings tested at 1000Hz - 4000Hz

(NS) = non standard

MATERIAL ACOUSTIC RATING
46.5dB
0.95NRC 46.5dB
0.80NRC
0.80NRC 0.95NRC 46.5dB
- -
0.80NRC 0.95NRC 46.5dB

UPHOLSTERY TYPE	UPHOLSTERY ACOUSTIC RATING
Camira Blazer Lite	0.15NRC
Camira Blazer Lite (foam backed)	0.23NRC
Camira Blazer	0.30NRC
Camira Blazer (foam backed)	0.30NRC
Gabriel Europost 2	0.60NRC (class C)

Q.S. pods have a sound reduction rating of 29dB

(test report no. C/22348/C01)

how is this achieved.....

Sliding glazed doors fully sealed on all edges when closed.

We recommend carpeted flooring and acoustic underlay.

Upholstered acoustic panels are supplied with CoustiLam internals which has an acoustic rating of 46.5dB.

The air circulation unit has noise insulating perforated internal skin. The radiated sound levels do not exceed 44dB.

Ceiling tile upholstery has an acoustic rating of 0.15 NRC.

Glass panels have an acoustic rating of 30dB.

Glass is sealed within an aluminium frame on all edges.

Automatic, adjustable floor closure on all sides of pod.

GLOSSARY

Ambient:

The background sound, including sounds from sources near and far, associated with a given work environment.

Behavioural protocols :

A protocol is a code related to adherence to specific etiquettes. In the workplace behavioural protocols are agreed on assumptions about how people will behave in the workspace. Acoustically they will relate to how and where people interact/talk.

Decay rate:

Is the time taken for the Sound Pressure Level in a room to decay - measured in decibels per second (dB/s).

Decibels (dB):

A basic metric measurment for describing the magnitude of sound.

Frequency:

The number of cycles of pressure fluctuations within a given period of time. The human audible frequency scale extends from about 20Hz (ie cycles per second) to 20,000Hz.

Loudness:

The subjective response of the human hearing mechanism to changing sound pressure.

Masking:

The process by which sensitivity to a sound is decreased by the presence of another (masking) sound. Masking noise can be used to reduce the intelligibility or distraction of an intruding sound, such as speech.

Noise Reduction Coefficient (NRC):

The reduction in level of unwanted sound by any of several means (e.g: by distance in outdoor space, by boundary surface absorption, by isolating barriers of enclosures etc).

Pitch:

Is a subjective auditory sensation and depends on the frequency, the harmonic content, and to a lesser extent on the loudness of a sound.

Privacy:

Private conversations cannot be understood as a whole by others, even though an occasional word may be intelligible.

Reverberation:

Sound that persists in an enclosed space, as a result of repeated reflection or scattering, after the sound source has stopped.

Reverberation time:

The time (in seconds) required for the sound pressure level to decrease 60 dB in a room after a noise source is abruptly stopped. Reverberation time relates to a room's volume and sound absorption.

Sound absorption:

The property of sound energy possessed by objects and surfaces, including air.

Sound insulation:

Sound Insulation is the ability of building elements or structures to reduce sound transmission.

Sound masking:

Use of an electronic sound system to deliver a minimum low-level, unobtrusive background sound through speakers that is matched to the spectrum of human speech so that normal conversation is rendered unintelligible by casual listeners.

Sound (noise) leakage:

Airborne sound transmission via gaps or cracks around or through building elements and services that allows sound to escape from one area to an adjacent area and thus lower the element's potential sound reduction.

Sound wave:

Acoustic waves transfer sound energy from one point to another.

Vibration:

Mechanical oscillations occur about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random. Vibration is commonly expressed in terms of Acceleration, Velocity, Displacement and Frequency which are related.

White Noise:

Broadband (often electronically generated) noise, but can also be attributed to running water, air movement and other random sounds.