The flexibility of sound masking: three case studies from Perth

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ABSTRACT

Sound masking increases the background sound level for the purposes of reducing either or both the impact of intrusive noise and the intelligibility of speech privacy. It is also a solution that offers a unique flexibility to reduce distracting noise within open plan and agile work spaces. This is increasingly important as activity-based office design becomes the norm. Using three Perth-based case studies, we demonstrate how sound masking can solve acoustic dissatisfaction while working within the agile requirements of the modern office. The 360 Medico Legal case study provides an example of scalability. The Alcoa case study demonstrates how zoning integrates flexibility into the design. The Department of Justice case study highlights how comfortable acoustics can be achieved with biophilic design principles. We then outline the importance of design in sound masking to ensure user comfort. Finally, we compare the measured masking range with the recommended design range in the AS/NZS 2107:2016 standard.

1 INTRODUCTION

The Australian/New Zealand Standard AS/NZS 2107:2016 (section 5.3) defines sound masking as follows:

> *In spaces where acoustic isolation and speech privacy are important and the sound levels are below the lower level of the recommended design range, there is an increased risk of inadequate acoustic masking. Where this occurs, the loss of acoustic and speech privacy can be a significant concern. In these situations acoustic masking can be introduced into the space to raise the sound level to within the recommended design sound range level in Table 1.* (Standards Australia, 2016)

In other words, introducing sound masking into a space increases the background sound level for the purposes of reducing either or both the impact of intrusive noise and the intelligibility of speech. Sound masking is particularly important where a space requires flexibility, like in the modern open plan office.

In this paper we highlight the key acoustic problems clients face within an open plan or agile office. We illustrate how sound masking can be used to solve these problems while ensuring the flexibility necessary within modern office design. We conclude by summarising key design principles to optimize the use of sound masking for the end user, and compare the measured masking range in the case studies with the recommended design range in AS/NZS 2107:2016 (Standards Australia, 2016).

2 OPEN PLAN OFFICE ACOUSTICS

Open plan offices have a mixed reputation. There are many benefits. For example, the open plan office provides floorplan flexibility and collaboration, which is important to workers and employers alike. Open plan offices are also cost effective. With an increasing number of employees working from home at least part of the time, the open plan space allows for hot desking which reduces overheads. However, the cost effectiveness diminishes when workers are interrupted by colleagues' conversations, intrusive noise, notifications, and other distractions. This can cost businesses thousands of dollars in productivity every week. For example, the average Australian worker loses 600 hours per annum to distractions (Economic Impact, 2023). In dollar amounts, employers paying an average wage earner would waste $18,600 per annum for each employee (Australian Bureau of Statistics, 2024). While workers who are constantly interrupted can work around the interruptions by changing their work patterns to complete the work faster, they experience more stress, higher frustration, more time pressure, and effort. In other words, this comes at a price that could be reflected in employee burnout or increased sick days (Marks, 2008).

Speech privacy is another problem that faces business. Without speech privacy, the majority of open plan office workers experience dissatisfaction with their working environment (Kim, 2013). There are also legal obligations underpinning auditory privacy within the open plan space – for example, where workers may collect or disclose sensitive information covered by health records or privacy legislation, or where lawyers have obligations of client confidentiality.

It can be daunting to balance these acoustic needs with cost and end user experience front of mind. This is especially true now office designs are seeking to be flexible, adaptable, and resilient (Candido, 2024). Innovative solutions to these acoustic problems have become necessary. Take for example, a recent agile office installation, where the workspace included:

> *internal moveable walls that team members can move themselves to expand or contract the amount of space their team needs, making the labs fully hackable. Some labs are fully enclosed with solid sliding partitions that separate what happens in them from adjacent open work areas, while others afford visibility to the inner workings and artefacts of a project team. Flexibility is made possible by overhead rigging that supports the movable walls, lighting and power and data receptacles that hang within reach of users, allowing them to make adjustments and mould spaces as they require.* (Candido, 2024)

The necessity to solve the acoustic issues with similar flexibility becomes obvious. While some can be solved with sound absorption, this alone will not eliminate distracting noise or optimise speech privacy in the open plan office whether it is a standard layout or an activity-based working environment. Further, absorptive materials often do not serve to reduce the business's carbon footprint. In contrast, sound masking ensures that distracting noise is masked, provides speech privacy, and reduces the carbon footprint of the space (Alamshah, 2024).

In the following three local case studies, we highlight some facets of flexibility in using sound masking that benefits the modern office.

3 CASE STUDY: 360 MEDICO LEGAL

While many clients have one specific space that needs masking, others require more flexibility. Indeed, scalability is increasingly important in a hybrid working environment where workers have the option of working from home all or part of the time. This flexibility may be required by large businesses scaling up, or small businesses using co-working spaces that themselves can be scaled depending upon need. In such situations, a sound masking system can be removed and taken with the business to a new office space or scaled up or down depending upon business needs. This ensures long term flexibility and cost effectiveness.

The benefits of scalability can be illustrated by the 360 Medico Legal installations. 360 Medico Legal is a law firm that requires auditory privacy because it receives instructions from solicitors, insurers and case managers. These instructions are highly sensitive, being covered by both legal privilege and health privacy legislation. Initially, the sound masking system was designed to address noise transfer between offices through air conditioning grilles (Figure 1). This is a common issue, and the addition of sound masking solved this key auditory privacy issue.

However, as time went by, the client needed to address auditory privacy across the whole firm. At this time, the sound masking system was expanded throughout the entire level including within the open plan office. Because the original design factored in any future expansion, it was easy to add to the design. The expansion took advantage of the scalability of the system. The sound generator used for the initial installation could service the expanded layout. Not requiring a second generator reduced the cost of the expanded installation. It also reduced the overall per square metre cost of the system.

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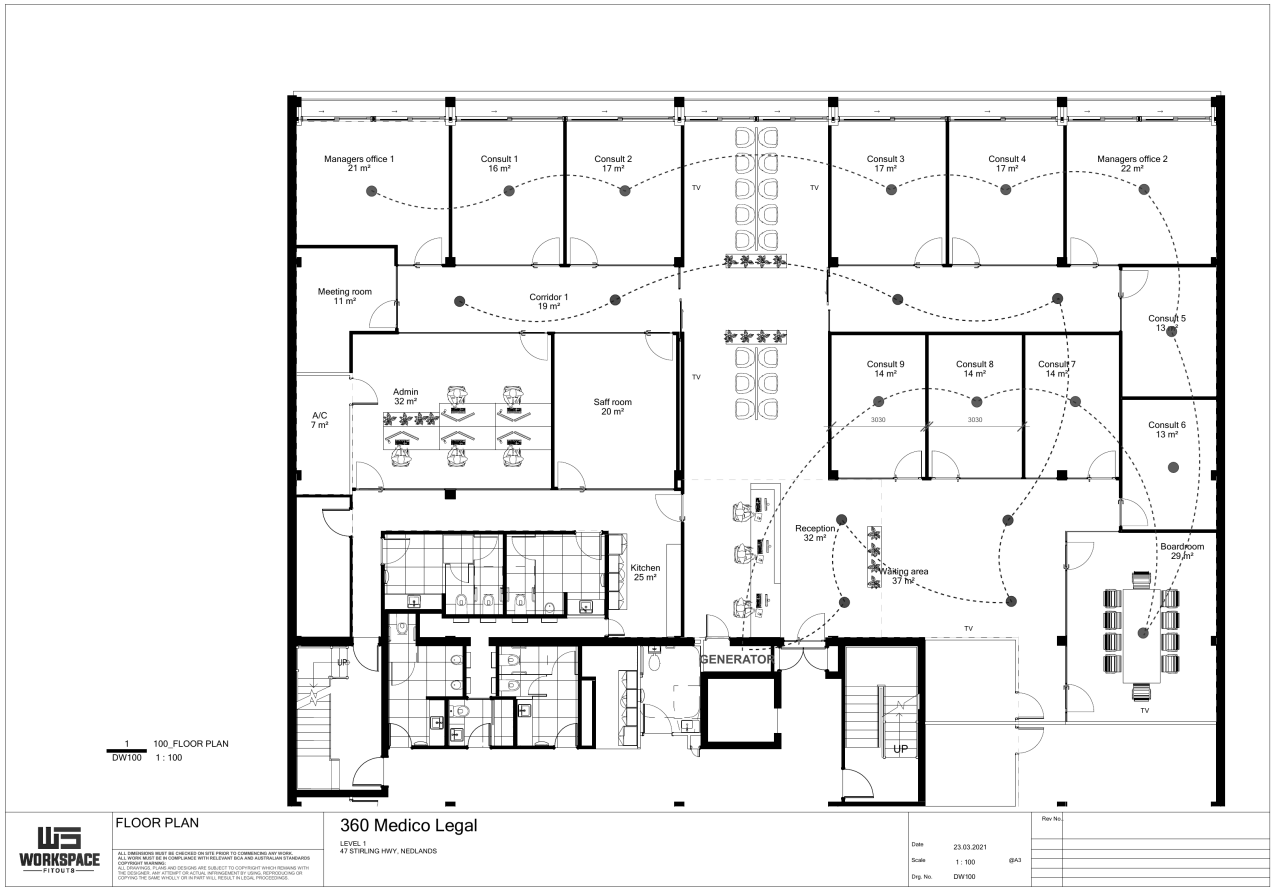

Figure 1: 360 Medico Legal sound mask system initial layout

4 CASE STUDY: ALCOA

Responsive, landscaped floor plans integrate worker requirements for flexibility. This is generally achieved through zoning. Best practice interior design principles include the following recommendations:

> *Spaces need to be zoned in such way that do not clash in terms of tasks performed. The layout should be reconfigurable in at least some parts to allow zones to change to respond to different uses and appropriation of space. The spaces also ride the wave of sensing technology to harness the power of data to inform changes based on the evidence coming from actual use and performance of the layout over time.* (Candido, 2024)

This means the acoustics of a space must be just as flexible; a requirement naturally suited to sound masking. Sound masking system design principles provide two key benefits to multiple zones. The first is the ability to tune the spectrum shapes and levels to account for different ceiling surfaces or purposes. The second is inbuilt adaptability and future proofing.

In this case study, zoning played a key role. The client's requirements necessitated tailored acoustic requirements where each zone was set to meet the needs of the space. To achieve this, the design layout divided the space into seven acoustic zones: the hallway and reception area, then six open plan office spaces (Figure 2). The sound levels were set between 39dBA to 41dBA (+/-1dBA) for the hallway transitional sections, 40dBA to 42dBA (+/-1dBA) reception area, and 41dBA to 43dBA (+/-1dBA) for the open plan areas to create a comfortable working environment for the end users. This met the requirements to enhance worker productivity and comfort by reducing the impact of distracting noise and ensuring speech privacy.

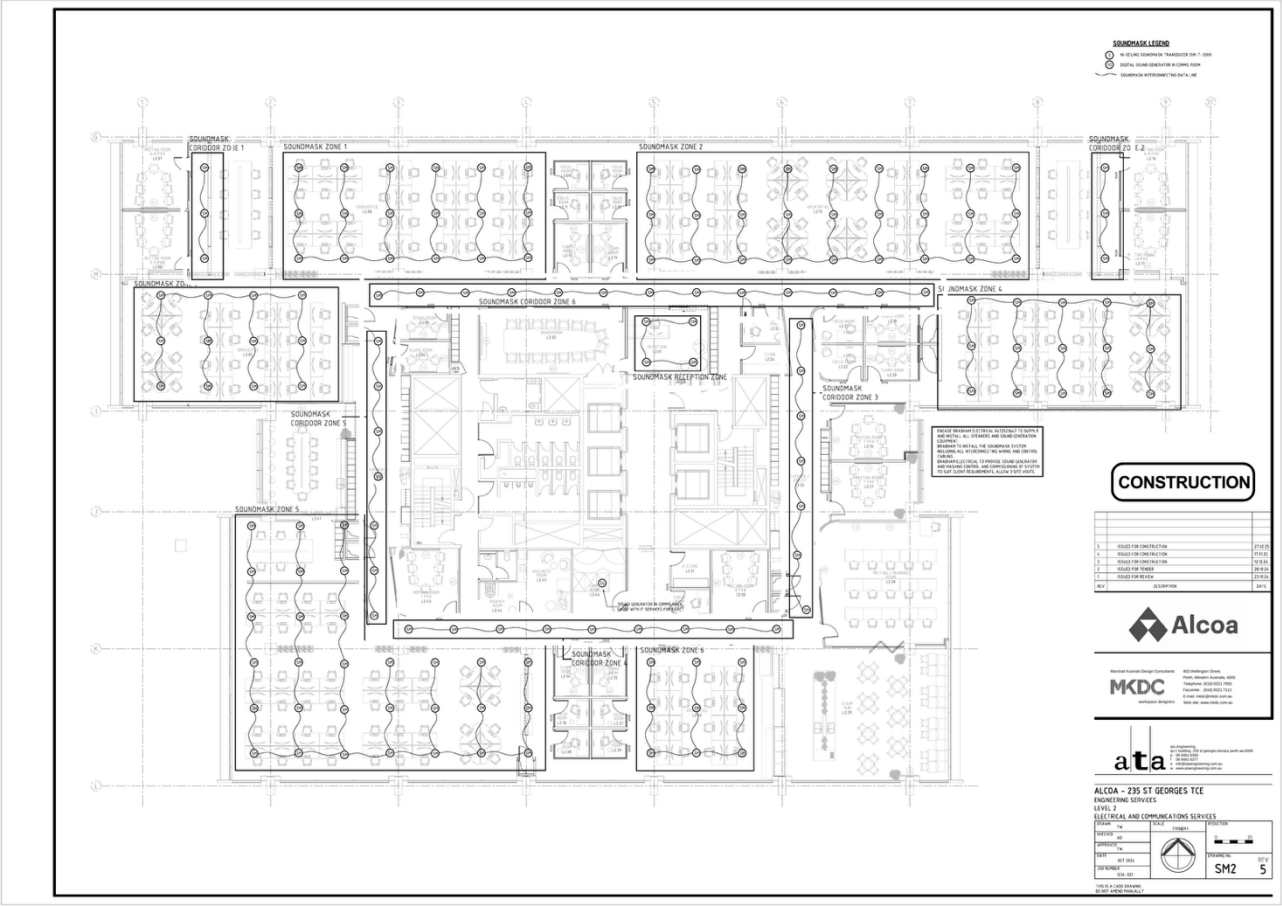

Figure 2: Alcoa sound mask system zoned layout

There was also an in-built flexibility in the zoning. This means that if the client changes their floor design in the future, or wants to adapt spaces for different uses, the sound masking system can be adjusted to fit the new requirements with negligible cost. This is because there will be no need to re-install a sound masking system. Instead, the system can be easily reconfigured. This can include changing the zones themselves or simply adjusting the sound levels to accommodate the new zone requirements. The responsive design gives the client piece of mind and full control of the acoustic environment.

5 CASE STUDY: DEPARTMENT OF JUSTICE

Biophilic design, where nature is integrated into the office environment, is another imperative for the modern office space. Biophilic design is a design strategy that enhances employee well-being in the office environment (Valor, 2024). It may include physical plants within the office but can also include windows that look out onto trees or other greenery surrounding the office. Biophilic design does not just work visually, but there is some evidence that it positively impacts sound perception (Van Renterghem, 2024).

Indeed, the addition of natural sounds like water or birdsong is not necessary (or even desirable) for the full effect. Only if the noises are expected and within the auditory context of the environment do they have a positive impact (Eşmebaşı, 2024). This explains why in an office environment, neutral masking sounds that mimic the air-conditioning are well accepted by end users. Pairing sound masking with well-chosen indoor plants or views of trees or other urban greenery will maximise indoor environment quality.

The Department of Justice (**DoJ**) epitomised this balance between an acoustic solution for distracting noise and speech privacy within modern biophilic design principles. Delivered as a design and construct project, the installation needed to cover all ten floors of the DoJ with the aim of supporting better focus, confidentiality, and daily workflow. The acoustic requirements were to a) significantly reduce distractions, and b) maintain operational integrity and auditory privacy in a high-sensitivity environment.

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The sound masking system was deployed across a variety of spaces, including executive offices, open plan work areas, meeting rooms, quiet zones, and corridors, all with tailored acoustic settings to meet departmental needs and maintain discretion across various work modes. An example of how zoning was designed is pictured below in Figure 3.

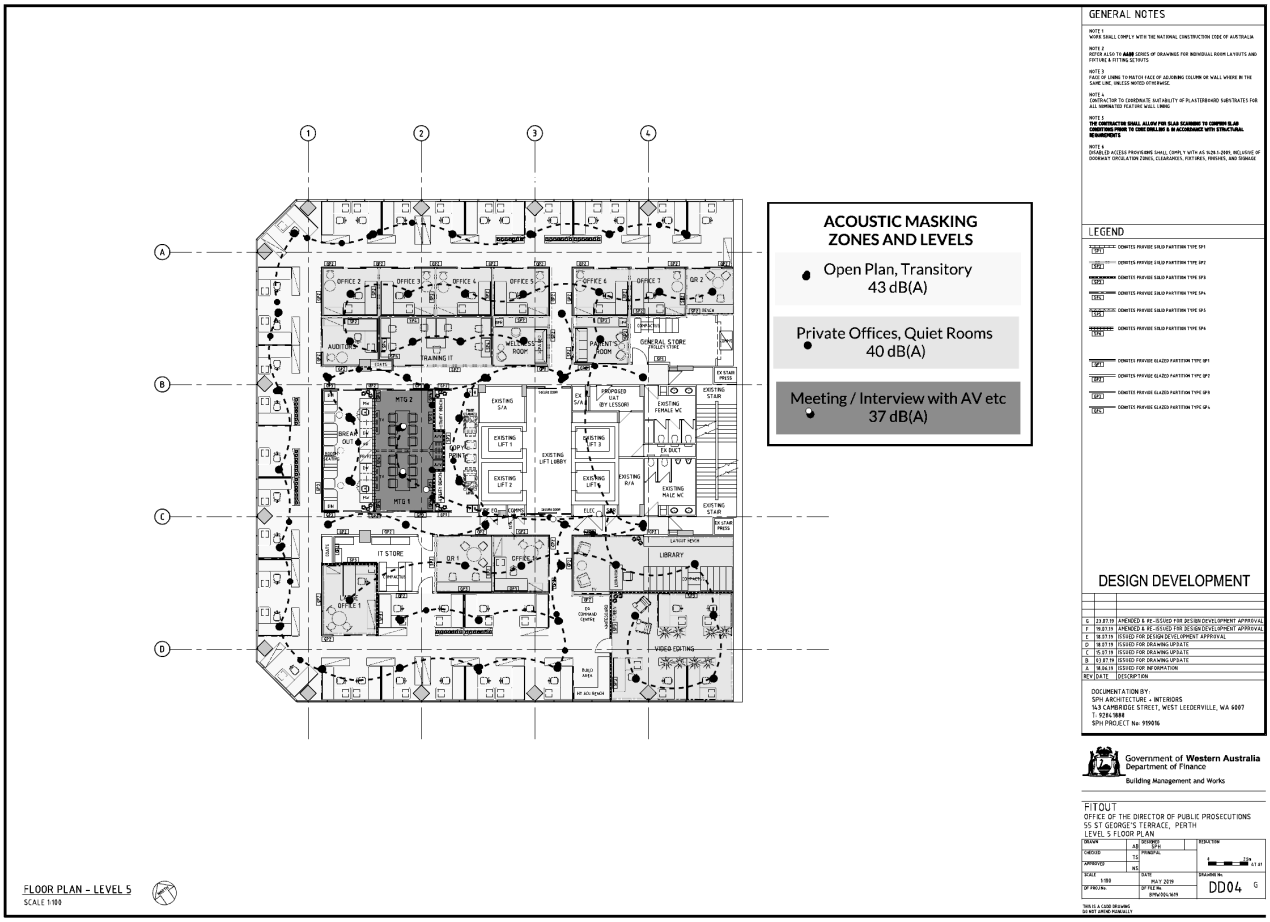

Figure 3: Department of Justice example layout

Here, zones were allocated between open plan and transitory areas (around 43dBA), private offices and quiet rooms (around 40dBA), and the meeting rooms and interview rooms with audiovisual equipment (around 37dBA). These comfortable sound levels ensured that the system would not intrude within the space. Instead, the expected sound environment enhanced the indoor environment quality.

6 OPTIMISING END USER EXPERIENCE

The case studies above demonstrate some of the principles of modern office design – scalability, adaptability, and adjustability within a zone-specific floor plate. These are used to enhance client value and usability. However, there an overarching design principle that deserves highlighting: the importance of end user experience.

Optimising user experience is one of the most important factors in a sound masking installation. This is because achieving a comfortable acoustic environment is entirely dependent upon how the people working within that environment experience it. If workers feel they do not have control over acoustic stimuli that cause distraction, this can cause significant dissatisfaction with the working environment (Forooraghi, 2021).

As a result, a poorly designed or specified sound masking system risks creating an uncomfortable acoustic environment which will not improve productivity or cost effectiveness for the business.

> *To be comfortable, the sound masking system needs to become part of the environment. It should be static, not changing, so that it can fade into the background and quietly do its job.* (Short, 2024)

In an activity-based working environment, this becomes even more critical because workers are regularly moving between spaces. While sound levels should be set to suit the activity—for example, the open plan areas will be set higher than a quiet room—it is important that the transition in levels is not audibly different to the end user.

Comfortable sound levels are dependent upon each individual installation, and the appropriate level is often lower than the AS/NZS 2107:2016 (Standards Australia, 2016) recommendations. This requires trained technicians familiar with diverse sound masking installations.

7 CONCLUSIONS

Sound masking has a demonstrated track record in reducing the impact of distracting noise and enhancing speech privacy in the office. Modern office design trends toward activity-based, agile working environments, which brings with it the old problems of the open plan office along with new problems of required acoustic flexibility. Three case studies outlined the flexibility of sound masking as an acoustic solution for diverse buildings, summarised in Table 1.

Table 1: Summary of case study findings

Case Study Name	Type of occupancy / activity	No of Zones	Measured masking range (dBA)	AS/NZS 2107:2016 recommend range ($L_{Aeq,t}$)
360 Medico Legal	Office building / various	2	38-43	40-50
Alcoa	Office building / various	8	39-43	40-50
Department of Justice	Office building / various	30	37-43	30-50

The overall comfortable masking range is similar in each case study and peaks at the lower end or below the AS/NZS 2107:2016 recommendations in Table 1, Part 5: Office Buildings (Standards Australia, 2016). Based upon evidence from the three case studies and the latest research, we conclude that a well-designed sound masking system that prioritises end user comfort solves the problems of flexibility needed in acoustic design.

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