

Why can't I hear the preacher?

Some folk complain that they cannot hear the preacher¹ clearly, and they wonder whether the problem cannot be solved by more skilful adjustment of the sound reinforcement system. Unfortunately it is not as easy as that, so here is an attempt to explain in simple terms the limitations of a sound reinforcement system, and the need for preachers and others to speak clearly when addressing a congregation.

A. Why not just turn up the volume?

With a typical sound reinforcement system, the microphone receives recycled sound from the loudspeakers as well as direct sound from the preacher. If the gain of the system is set too high, the sound system will amplify the recycled sound again and again and again. This uncontrolled amplification will result in a loud howling sound from the system. This is usually known as feedback. To avoid feedback, we need to ensure that the microphone receives less recycled sound energy from the loudspeakers than direct sound energy from the preacher. There is therefore a clear limit to the amount of amplification that we can apply to the preacher's voice without producing feedback. Even at levels of amplification that do not cause sustained feedback, you can get an unpleasant 'ringing' character to the sound.

It might appear then that moving the loudspeakers further away from the preacher and closer to the congregation would help to cure the problem, but, because of sound reverberation in a closed space, this is not as effective as you might expect

B. So why is reverberation a problem?

Most chapels are big boxes with hard walls; and hard surfaces reflect sound and cause echoes; and many echoes arriving at different intervals produce reverberation. This reverberation can result in a nearly uniform level of sound energy throughout the whole room. The consequence is that, unless you are very close to either the preacher or a loudspeaker, this reverberant sound is louder than the direct sound from either source.

At what is termed the *Critical Distance* from a sound source, the loudness of direct sound is equal to the loudness of reverberant sound; move beyond the *Critical Distance* and the reverberant sound predominates; move closer to the sound source and the direct sound predominates. In Ebenezer Chapel in Bangor the *Critical Distance* is around 2.5m for the loudspeakers and 1m for the preacher; and therefore most of the congregation and, most importantly, the preacher's microphone are in this uniform, reverberant sound field; and both therefore receive nearly the same sound energy from the loudspeakers.

Since, to prevent feedback, the microphone must receive less sound energy from the loudspeaker than from the preacher, and since the loudspeaker produces the same sound energy level at the microphone and in the congregation, because both are in the reverberant sound field, then it follows that, to avoid feedback, the loudspeakers must deliver to the congregation less sound energy than the preacher delivers to the microphone. Therefore the only way to deliver a greater sound level to the congregation is for the preacher to deliver a greater sound level to the microphone, either by placing the microphone closer to the preacher, or by having the preacher speak more loudly, or both. But low sound level is not the only hindrance to intelligibility

¹ I have used the word 'preacher' rather than 'speaker' to avoid confusion with the system loudspeakers. 'Preacher' here also includes leaders of meetings, and anyone, he or she, who makes announcements, reads, prays or teaches in public.

in large chapels.

C. Why is the sound still unclear?

The clarity, or distinctness, of speech is also important if listeners are to understand the spoken word. Background noise tends to mask speech; and most of us experience difficulty in carrying on a conversation in a noisy room. To be intelligible, speech needs to be louder in the presence of noise; but whereas loud background noise is not normally a serious issue in chapels, a large congregation will necessarily generate some additional noise; and speech, to be intelligible, will need to be louder than usual.

Early reflections of sound from hard walls and ceiling arriving less than 30 milliseconds² after the direct sound from preacher or loudspeaker can improve the intelligibility of speech; but reflections arriving later than 100 milliseconds can reduce intelligibility. In a reverberant room, the echo of an earlier, louder syllable can mask a later, quieter syllable, especially if the preacher speaks quickly. Ebenezer Chapel with a *Reverberation Time*³ of just over 1 second is probably typical of medium sized chapels. This is high enough to have some impact on the clarity of speech, and I have noticed a problem when people speak too fast. Larger chapels and churches will have longer reverberation times, and greater problems. To improve intelligibility, in the presence of reverberation, the preacher must not only speak up, but he must also speak more distinctly and more slowly than face-to-face conversation demands.

D. Can technology solve our problems?

Loudspeakers with a high directivity index, by increasing the *Critical Distance*, can project the direct (and clearer) sound further into the congregation; and the choice of loudspeakers and their positioning are vitally important for an effective system. Given that appropriately designed loudspeakers tend to be expensive, that pitfalls for the inexperienced are many, and that it is rarely wise to alter a system in a piecemeal fashion, it may be wise to consult a competent sound reinforcement system contractor or audio systems design consultant before making changes.

A directional microphone in the pulpit, by increasing gain in the direction of the preacher, helps to discriminate between preacher and loudspeakers, but, because of reverberation, the benefits are modest. A lapel microphone places the microphone slightly closer to the preacher, but lapel radio microphones are usually omni-directional and do not discriminate in favour of the preacher; and, unless more expensive, high quality units are chosen, are prone to radio interference and tend to give a poorer quality sound. They are perhaps best reserved for situations when the preacher must be mobile. A more radical solution is to use a mini-boom microphone of the type used by many concert singers and convention speakers. This is hooked over the ear and places the microphone very close to the lips of the preacher, and would allow a louder sound without feedback to be delivered by the loudspeakers.

A high quality notch filter, which allows the gain of selected bands of the audio spectrum to be reduced with near-surgical precision, can produce a reduction in gain at those frequencies which are most likely to cause feedback and will provide a little more overall system gain before feedback occurs. A 1/3rd octave equalizer can be used to optimise the system frequency response to favour those frequencies that are the most important for producing intelligible speech. It can also be used to reduce gain at

² Millisecond – one thousandth of a second.

³ In simple terms, the time it takes for all the echoes to die away. More formally, it is defined as the time that it takes the sound energy to fall by 60dB, i.e. to one millionth of the starting level.

the main feedback frequency. But to use such devices competently requires understanding and experience. There is also the cost of the equipment to be considered, and the problems associated with maintaining a more complicated sound system, especially if the operators have little understanding of the underlying acoustics.

E. So what are the main learning points?

- Too much gain in the sound reinforcement system will cause noisy feedback.
- The system cannot deliver a louder and clearer sound to the congregation than the preacher delivers to the microphone.
- Reverberation makes the preacher's speech less clear. The preacher's voice must at all times be loud enough, and his words clearly enunciated, if the congregation is to hear the message.
- Putting the preacher closer to the microphone and/or getting him to speak up are the simplest and cheapest ways of getting more sound volume without feedback.

F. Can we improve the situation in our churches?

- It is reasonable to identify obvious deficiencies in a sound reinforcement system and to attempt to remedy them; but the resulting improvements are likely to be modest, unless the existing system is of very poor design.
- Accept that you cannot make a purse out of a sow's ear. A better sound reinforcement system will never make a poor preaching voice intelligible; but it can help a competent preacher to be heard more clearly at the back of a large church.
- If people complain that they cannot hear the preacher, then those who speak publicly during services, and indeed in other gatherings such as prayer meetings and business meetings, have a duty to make themselves heard. This will involve speaking loudly enough and not too fast, and enunciating clearly. This is really a matter of commitment, technique and discipline.
- Aspirant preachers should be trained to speak clearly; and theological colleges should give serious thought to having an elocution coach to improve the speaking skills of their trainees.
- We can help the younger generation to develop useful speaking skills by asking them to read during services and other meetings, and by giving them sensitive encouragement, and practical advice in speaking competently.
- Surely our duty to our Master demands that we demonstrate competence, or, better still, excellence in all our work for Him; and, since the spoken word is such an important part of the church's ministry, this must include competence in public speaking. Sadly, to quote a famous landscape gardener, "There is capability for improvement".

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