The E-Trap in use

A portable and tuneable electro-acoustic absorption system sounds almost too good to be true but that is what the E-Trap promises — a quick and easy way to eliminate room resonances. PHILIP NEWELL puts it through its paces.

The Bag End E-Trap is an electronically controlled, electro-acoustic absorption system that is tuneable over the frequency range from 20-65Hz; although the one supplied for these tests had been modified by the manufacturer to operate from 30-90Hz. This had been done at special request because most of the proposed tests were intended to be done in small rooms. The unit has two, selectable microphones built into it, a signal processor, a power amplifier and a loudspeaker. It has two independent filters that can each be tuned to any frequency in the overall range of operation as long as those frequencies are well separated. When working as a damping device the energy from the modes is absorbed, and ends up as heat in the voice coil of the loudspeaker. Although this is only a brief outline of the E-Trap, more can be found in *Resolution* V4.7 and on the Bag End website.

In fact, it was in that issue of *Resolution* that I first came across the E-Trap, in an article written by Jim Wischmeyer, who had spent many years developing the device. I was intrigued by the concept, and was subsequently sent an example to see what I could do with it.

In the July/August edition of *Resolution* (V6.5) I wrote an article on vocal rooms, in which there was a picture of a room and a plot of its very fast decay time (Figures 5 and 6 in that article). The plot shown was a 'real use' situation, with the microphone only about 70cm from the source, because the room is normally only used with an actor behind the lectern and a cardioid microphone in front of it. It was mentioned in the article that the resonances below about 70Hz were of little consequence because there was nothing in a human voice to excite them. Nevertheless, should someone want to record music in the room, with microphones and instruments more widely spaced, it could then be necessary to suppress those low frequency resonances. It therefore seemed to be an interesting proposition to take the E-Trap into the room to see if it could help to control the resonant response peaks.

Figure 1 shows the decay characteristic of the room at Sodinor, in Vigo, Spain, with the microphone this time spaced about 3m from the source. The trap was placed at one end of the room, and the measuring microphone was placed close by. The E-Trap needs to be placed in a high pressure region of the modes to be acted upon (such as a room boundary) or its damping effect cannot function. A small resonant peak around 70Hz was the one we chose to try to control first, though the room was quite well damped even at low frequencies. Figure 2 shows the before and after responses, but little audible effect was noticed by any of the three people in the room when the slamming of the door was used as an excitation source.

The trap had been tuned as per the manufacturer's instructions, using a loudspeaker and a pink noise source, and monitoring the effect via a very narrow band spectrum analyser, but the adjustments had not been as intuitive as expected. However, the modes in the room were not of a very high Q, due to the considerable amount of acoustic damping. Certainly the peak around 70Hz had been reduced a little, and the response up to around 90Hz had been flattened. In fact the dip around 63Hz had also been reduced, but the sound of the room had not changed by any noticeable degree.

I called Jim Wischmeyer at Bag End for advice and he explained that if the room already had an amount of damping that was greater than that which the E-Trap could supply, then there was not much left for the E-Trap to damp. Putting a little extra damping around a narrow frequency band in a broad mode would be unlikely to yield any very audible results, although he did add that there can be time response benefits.

In the 1980s, I was looking into the concept of active absorption at Southampton University, but came to the conclusion when I wrote the book Studio Monitoring Design (published in 1995) that the better a room was, acoustically, the less the active control systems had to offer, even to the extent that in some cases the artefacts of the processing could be more noticeable than the problems that they were supposed to be curing. So, once again, a highly acoustically controlled room had proved itself to be robust, and was resisting intervention.

To be fair, in Bag End's literature, it does say that the tuning of the E-Trap goes from narrow to very, very narrow, whereas we had been testing it in a room with rather broad modes. I had been hoping to get a little electro-acoustic help in controlling the bottom end in a room that had walls of a porous wood/cement composite material over 6cm of polyurethane foam. Conversely, the correction shown in the Bag End literature was in a room with concrete walls, and the review article that appeared on their website, written by David Kotch and edited by John Storyk, dealt with the treatment of a small 5.1 mixing room that was described as having relatively 'stiff' boundaries. The room needed high isolation but was too small for any significant acoustic low frequency control, so the E-Trap had been shown to be useful, here.

So, the next step was to go to a room with clearly isolated, high Q, ringing modes. This would be consistent with what Jim Wischmeyer had written in his *Resolution* article: 'The electronic bass trap, while not likely to replace all passive bass trap implementations, offers a precise tool to attack the very worst problems (in a fraction of the space of a passive absorber).'

We took the E-Trap to the acoustics laboratories of Vigo University, and set it up in a concrete-walled corridor that had an absorbent suspended ceiling. Pink noise was played through a loudspeaker at one end of the short corridor, with the E-Trap and the measuring microphone at the other end. An 'almost real-time' FFT analyser was used to measure the response, and a peak was noticed at 39Hz. Several attempts were made to tune the E-Trap but the results were disappointing, and certainly by ear little was changing. It was a repeat of the Sodinor situation.

In one, last-ditch attempt to get something useful, we tried using a sine wave, and swept the frequency until we got a peak on the measuring system,

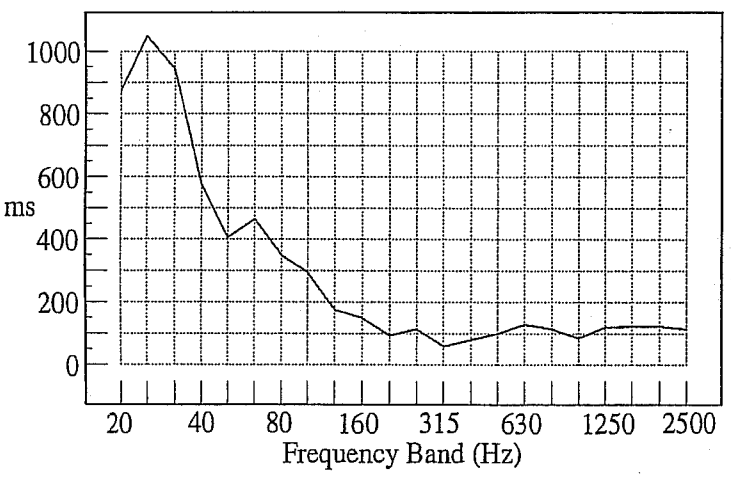

Fig 1. Decay characteristic of the room at Sodinor.

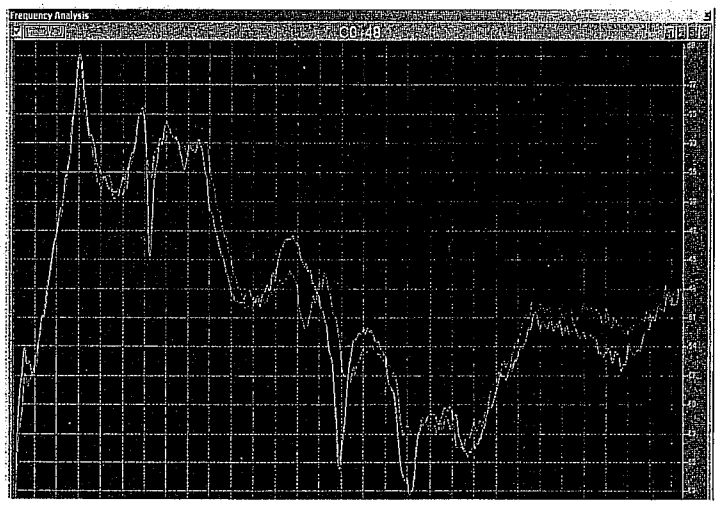

Fig 2. Blue line E-Trap off; pink line E-trap on.

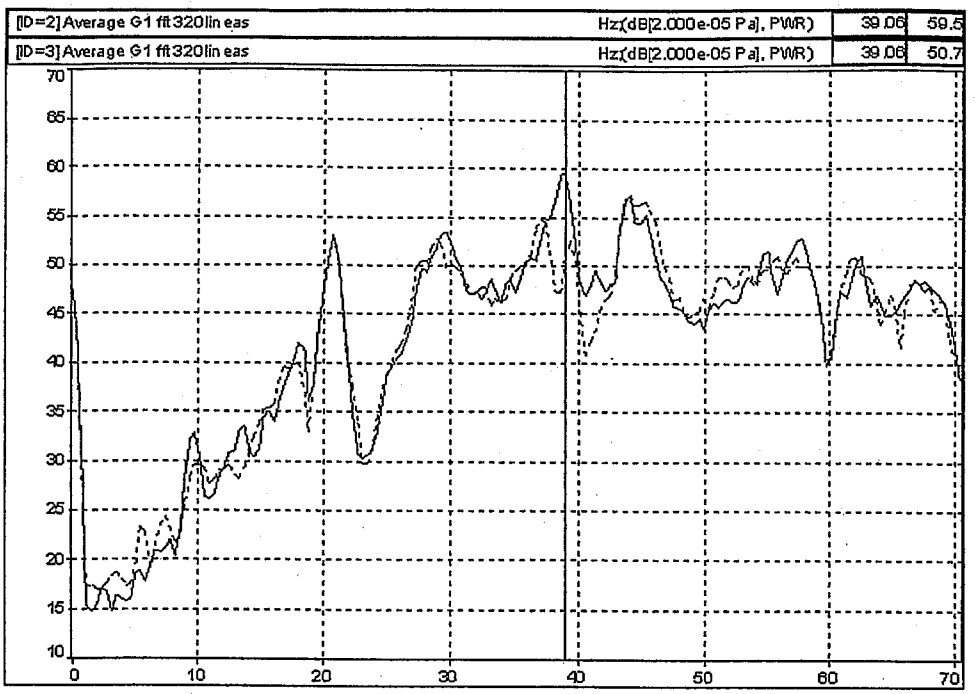

Fig 3. Before and after responses.

showing that we had energised a high-Q mode. On the anti-nodes, the places of highest pressure, the sensation was a most unpleasant 'bloom' in the ears. Tuning the 'coarse' frequency control on the E-Trap this time had a clearly audible effect, and it was hardly necessary to refer to the analyser. Further reiterative tuning of the 'contour', 'feedback' and 'fine frequency' controls brought the level of the resonance down by an enormous 15dB. We then listened at the central anti-node position, and when we switched the E-Trap on and off the effect was dramatic. Subjectively, the mode was annihilated with the E-Trap switched on.

Leaving everything set as it was, we reverted to the pink noise, and Figure 3 shows the on/off comparison, with a clear 12dB reduction close to 39Hz, just to the left of the vertical cursor position. Obviously the E-Trap was working.

Armed with this new technique we then went back to the vocal room where we had done the earlier tests. This time, using only a sine-wave generator and a simple sound level meter, we did a frequency sweep from 25Hz to 70Hz, using a low frequency loudspeaker at one end of the room, and noticed that there were peaks around 31Hz and 62Hz. With the E-Trap at the opposite end of the room, and by means of ear and sound level meter, we tuned one channel to the 31Hz peak and the other to the 62Hz peak. Initially, the best achievable responses were those as shown in Figures 4 and 5, which showed something more akin to modal splitting and shifting (which can be beneficial in some circumstances) rather than any useful absorption. However, when the E-Trap was moved close to the centre of the wall, and away from the corner (only a position change of about 1m), the response change was huge, as indicated by Figure 6.

Once again, the graph suggests modal splitting rather than absorption, because with the E-Trap 'on' there is more energy above 34Hz and below 29Hz, but if it had been the 31Hz peak that had been causing problems then the E-Trap could probably have made a useful contribution. On the other hand, when we tried banging on the window and closing the door, the perceived level of 'boom' with the E-Trap on and off was not noticeably different when acting on these medium-Q modes.

In the E-Trap literature, it does state that it is a narrow-band device which can solve serious problems. Clearly, in our first test we were using wide-band excitation in a room with rather broad

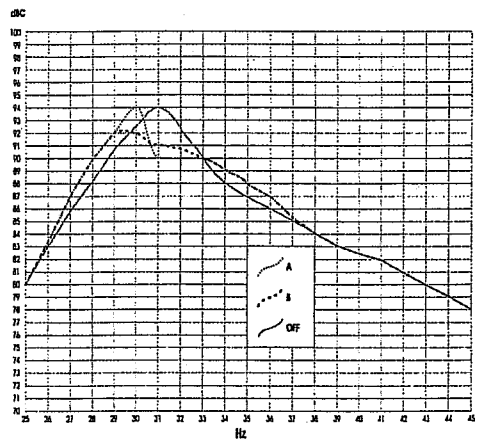

Fig 4. E-Trap on floor at right of wall using Mic A +Mic B.

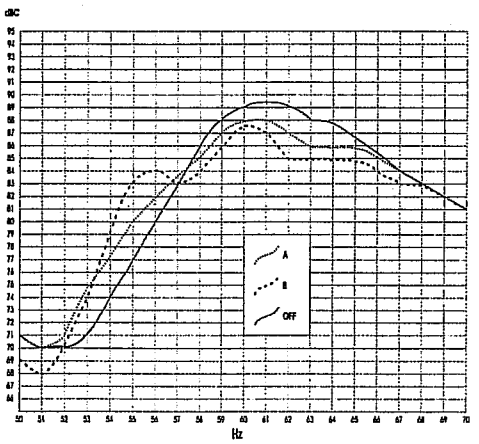

Fig 5. 62Hz mode, two different microphones.

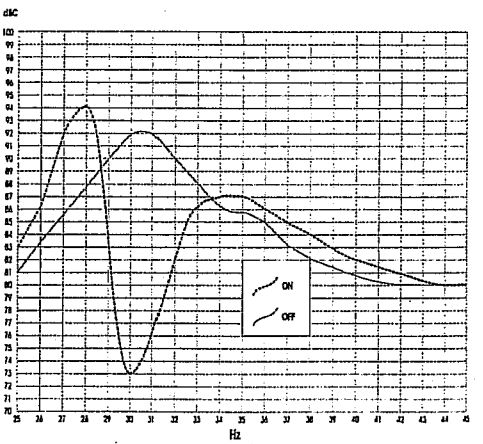

Fig 6. Last test: E-Trap at centre of wall, on floor.

modes. However, in a poorly treated rehearsal room, for example, or a temporary situation in a theatre dressing room, which had an awful honk each time the bass guitarist hit a certain note, the E-Trap could be a useful tool. It is easily portable, and weighs only about 15kg. I would not like to think that too many people were mixing in rooms with isolated modes that needed the E-Trap treatment, but many performance spaces, rehearsal rooms, and even domestic listening rooms may exhibit isolated modes which, for practical or aesthetic reasons, do not lend themselves to acoustic solutions. In reality, also, people do mix in poor rooms.

Initially, we had found the E-Trap tricky to set up by the recommended pink noise method, and high speed FFT analysers can also sometimes be hard to find at short notice. In fact, calling in a specialist with the appropriate gear to set an E-Trap up could be almost as expensive as the purchase price (US$900/€600). However, the system we used, employing sine waves, seems to be cheap and effective and is also quite intuitive, Even a musical keyboard instrument could be used as a tuning source and the tuning can even be done by ear.

I am going to hang on to the device for a while longer because it intrigues me. Basically, my job is to design rooms where the E-Trap will not be needed, but it could be a useful device to have around for specific situations.

The unit is designed for continuous use, and may be left on 24 hours a day. It consumes only 24 watts when idling and around 62 watts maximum when damping a mode at 110dB SPL, which is the limit of its correction range. It is designed to be set and left, and comes in two versions; black, textured paint or wood veneer. The latter could be useful domestically, or in listening rooms where, heaven forbid, aesthetics override acoustics.

My intuitive feeling is that, one day, it is going to be just what I need to solve some otherwise intractable problem somewhere. ■

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