Proceedings of the Institute of Acoustics

SOME EXPERIENCES WITH RESILIENT TIES IN DRY WALL CONSTRUCTIONS

Ian Thompson Arup Acoustics, Cambridge

1. INTRODUCTION

In 1997 Arup Acoustics became involved in two large scale multi-screen cinema developments: a 30 screen site in Birmingham with cinemas on first floor above leisure and entertainment spaces, and a 12 screen site in Bradford, also having cinemas at first floor over leisure tenancies. In both cases the appointment covered cinema shell design, including responsibility for sound insulation between cinemas.

This paper describes aspects of the acoustic design of these schemes, including the use of resilient ties within wall constructions having high sound insulation performance.

2. DESIGN CONSIDERATIONS

2.1 General

As with many projects, the acoustic design of these cinema developments required an appropriate balance to be made between factors including acoustic performance, construction cost (time, materials and quality) and risk to the scheme developer.

Acoustic performance requirements were specified by the incoming cinema operators and reviewed and agreed by the developers' design teams. The key points of the specifications covered control of intrusive noise and the standard of acoustic separation between cinemas. In both projects, the requirement for sound level difference between cinemas was set at $D_{nT,w}$ 65 dB, standardised to 1 Second.

Early design work on the schemes was directed towards building planning and the most appropriate distribution of the proposed uses. Location of cinemas at first floor was an early fix in each design, with subsequent discussion concentrated on the layout of activities such as 10 pin bowling, pubs, restaurants and night-clubs. With cinema location confirmed at first floor, it was agreed that the cinemas should be constructed as fully independent isolated boxes. Each auditorium floor slab would be supported on elastomeric bearings and walls would be constructed off the floating slab.

Some experiences with resilient ties in dry wall constructions – I Thompson, Arup Acoustics

Auditorium wall construction options were reviewed by the design teams, including use of block, drywall and combinations of the two materials. Drywall construction of cinema walls was adopted on both projects, the principal reasons being:

I. Reduced structural framing costs – a major design point. High walls would require substantial secondary steel for framing and bracing; very high line loading substantially increased the size of ground floor framing and foundation provision

II. Speed of construction – drywall would be erected quickly and provided flexibility in programming and scheduling of work on site

III. Availability of experienced contractors – shortage of skilled labour for bricklaying adversely affected cost and programming of masonry construction

IV. Good availability of materials

2.2 Drywalls

Review of the published sound reduction data for drywall materials indicated that a wide range of systems and wall build up could be employed to achieve the performance requirements set for the auditoria. However, from an engineering design viewpoint, it would be preferable to use an arrangement that would meet the specification targets with a minimum material and construction cost. The architectural requirements for auditorium plan size also dictated that the wall widths should be at a minimum, to provide the agreed area of accommodation within the building.

As a means to achieve a strong visual presence for the development in Birmingham, the architect has included barrel vaults, producing an identifiable and striking roofline. Internally this provides great height in areas of the first floor, and the cinemas include walls that are 10 m high to the solid sound insulating ceiling, with stud heights up to a maximum of approximately 15 m. Structural stability of the cinema walls requires either large studs (> 300 mm cross section) or bracing to tie the leaves together. Although detailed consideration was given to building free-standing walls with wide studs, the width of the walls was considered unacceptable, and the adopted solution was based on inclusion of ties.

Laboratory figures for walls of similar thickness and leaf construction with and without ties were reviewed. It was found that rigid ties could reduce overall performance by 5 to 6 dB, although it was acknowledged that site constructions would have a lower number of ties per unit area than the laboratory test arrangement. This reduction in performance is roughly equivalent to removing one layer of board from either side of typical cinema drywall construction. Simple resilient ties maintained performance close to the standard of completely independent leaves. Test information on site performance of a number of walls was reviewed in a similar manner, indicating the reduction in performance to be allowed in translating laboratory performance to site conditions.

The acoustic design risks, including the risk of not meeting sound insulation targets, were assessed for a selection of wall constructions. Arup Acoustics concluded that the sound reduction expected from a wall of minimum board thickness with rigid ties did not provide sufficient margin of safety. There was also concern that rigid ties between walls may not accommodate the potential differential movements between auditoria on separate structural isolation construction. A recommendation was made for use of resilient ties in the cinema walls.

Initial discussions with drywall system suppliers and drywall contractors produced few options for providing a resilient connection. Inclusion of resilient grommets in the fixing between the ties and the studs was offered as a way forward, but this was considered by Arup Acoustics and the developer to have potential difficulties in quality control, and high installation cost through increased construction time. It was our view that a component similar to a 'sway brace' would be most appropriate. Such components were then put forward by a number of drywall system suppliers and evaluated.

3. CONSTRUCTION

The resilient tie used in both projects is formed from pressed metal, with two similar sections joined by means of a bolt through a rubber grommet. The tie is screw fixed to the studs at either end, and can accommodate some variation in distance between studs. The rubber bush is of moderate stiffness and prevents mechanical contact of the two metal sections. The tie can accommodate a small amount of bending around the centre, although the specification for installation requires the constructor to install the component without bending.

The partition contractors on both projects found the ties simple to incorporate in the cinema walls and there were no adverse effects on construction progress. Inspection to ensure the correct provision of ties and the quality of installation was straightforward.

4. PERFORMANCE

Testing of cinema shells prior to handover has shown that the wall designs consistently meet the specification requirements for separation between cinemas. At Birmingham the average weighted standardised sound level difference from 12 tests was $D_{nT,w}$ 66 dB. The octave band sound level difference data from a number of tests are summarised in figure 1.

Testing of the Bradford project is only just starting, but the initial results show a similar overall pattern of performance. Sound insulation in the 63 and 125 Hz octave bands is slightly higher than at Birmingham.

5. CONCLUSIONS

Experience from two projects has shown that incorporating resilient connections in cinema drywall construction enabled sound insulation targets for critical applications to be met with appropriate control of risk. The availability of purpose-made resilient components allows for quick construction with good quality control. There is additional benefit when used in structurally isolated construction because of the ability to accommodate movement. In walls where the design allows a greater margin of performance over the target standards, the use of such ties is less likely to be appropriate on acoustic performance grounds.

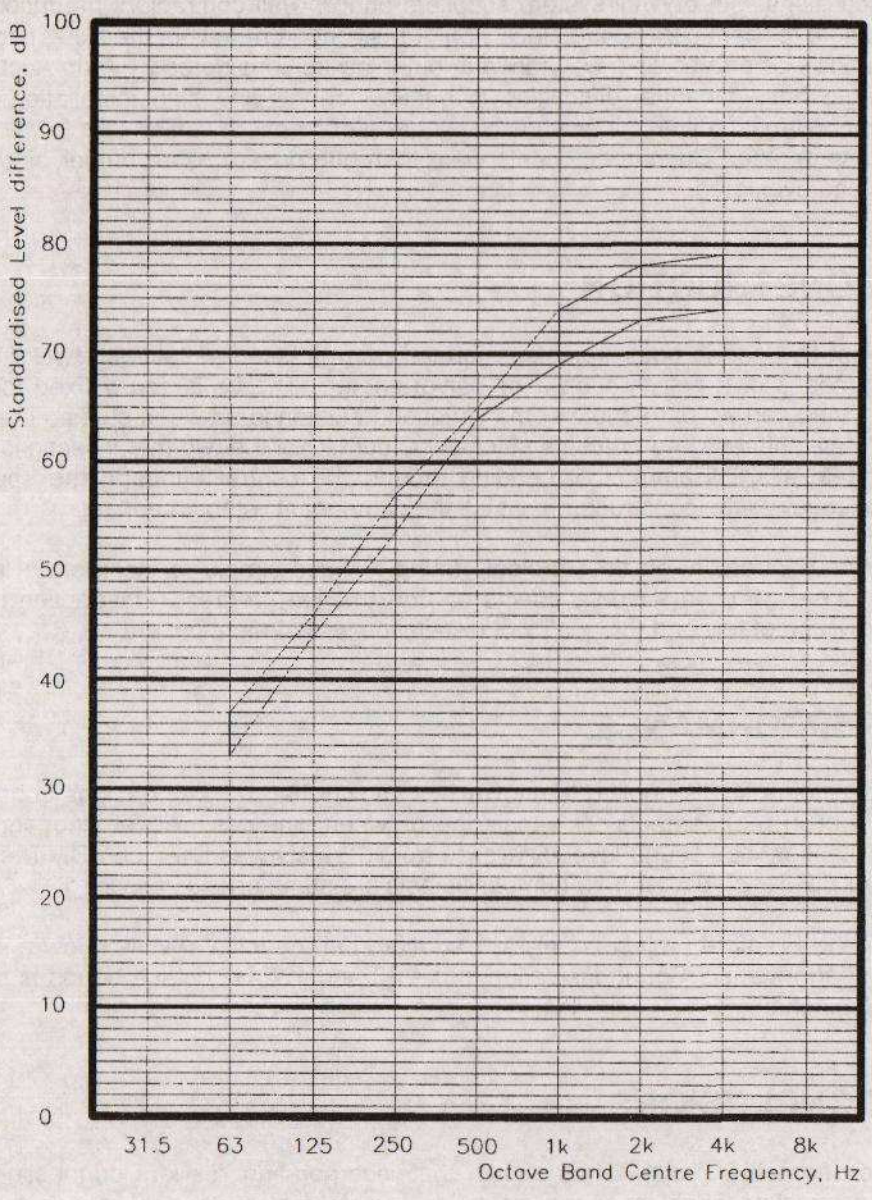

FIGURE 1: Range of standardised level difference from 3 examples of cinema wall with resilient ties at Birmingham site

ARUP

AUTHORS INDEX

Notes

Notes

ISBN 1 901656 25 X
ISSN 0309 - 8117