Proceedings of The Institute of Acoustics

ACOUSTICS VS FIRE PRECAUTIONS IN OFFICES

H. BODYCOMBE

JOHN LAING DESIGN ASSOCIATES LIMITED

Introduction

The effect of good acoustics is not always apparent to the client. In contrast good fire precautions are apparent as they have direct financial implications, and often determine the form of construction of a building. Fire precautions can sometimes be designed to work in favour of good acoustics. Occasionally the two aspects are mutually incompatible.

Figure 1 shows how far a building must be moved in order to maintain the same degree of fire/sound penetration for an increased proportion of glazing. The facade is assumed to be 50dB at 0% glazing, and the sources of fire/sound are assumed to be linear, propagating over hard ground. The only significance of the 4M origin of the sound curves is that it is the minimum dimension for applying the distance correction for traffic noise (1). The source location for fire is taken as the boundary of the land on which the source building is located (as defined in ref. 2, i.e. including half the road). Essentially figure 1 shows that for a propagation of 4M, there is hardly room to locate a noise source while the practical limit for fire propagation has been reached for an office with a 3M storey height.

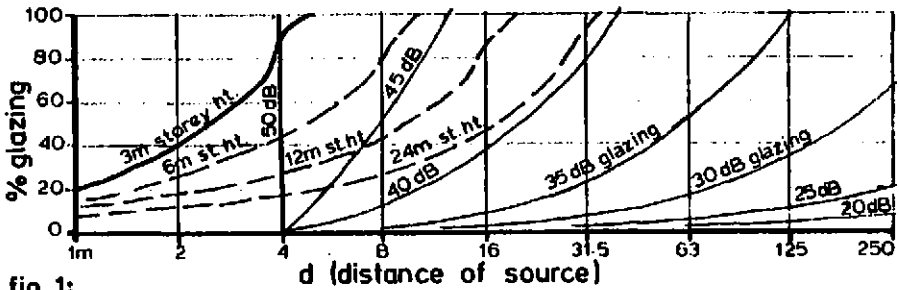

fig. 1:

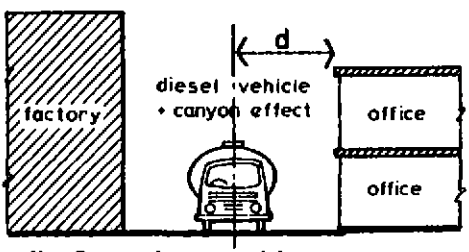

fig. 2: noise problem

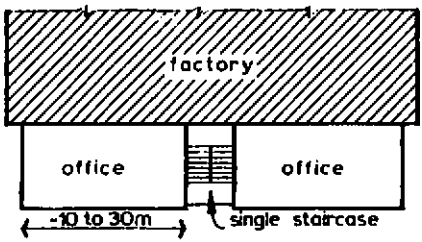

fig. 3: opening windows required

ACOUSTICS VS FIRE PRECAUTIONS IN OFFICES

The Industrial Office Block

(Typically built to a low budget and directly abutting main factory premises.) Machinery noise apart, the worst noise problem for industrial offices is due to commercial traffic (see figure 2). This is a particular problem when the background noise level of the site is low, as often occurs.

One solution to this problem is to use double windows, which can achieve a very high standard of insulation (3 &4). Taken to its logical conclusion, a double skin of glazing can clad an entire building, like the offices at the Peterborough factory of the British Sugar Corporation (5). Prior to 1965 such glazing was restricted by the liklehood of flames leaping from one storey to the next. (6) Vertical spaces between the skins have had to be fire stopped since 1976 (see figure 4).

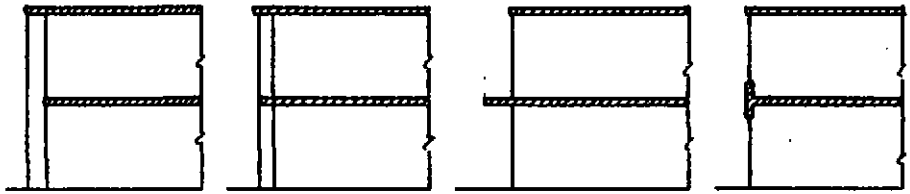

fig. 4: affect of fire regs. on glazed facade

Offices like the one shown in figure 3 require opening windows for fire escape (7). The standard of weatherstripping has risen so much in recent years that an openable window can be as sound tight as a fixed one. A double openable window, however, is an awkward means of escape.

Fire Alarms

Should be at least 65dBA and 5dBA above the background noise level in all places normally occupied by people. (8) The alarm system could be combined with a p.a./sound conditioning system. If, however, part of the alarm is to consist of spoken messages then the level should be nearer 10dBA above the background level. In any case, office p.a. systems are often less than 5dBA above background noise, and so fire alarms should have a separate volume control. Sound conditioning should also be cut for fire alarms.

High grade cellular offices are more difficult to deal with than other offices. Partitions may be up to 45dB. Nevertheless the low background noise level in such offices helps alarm audibility. Corridor alarms are generally satisfactory provided offices open onto the corridor with a standard cellular-core door. If an office is only accessible through a communicating office, one could consider leaving down the plenum barrier above the corridor partition in order to provide a sound path.

ACOUSTICS VS FIRE PRECAUTIONS IN OFFICES

Alarm sounders should generally not be located in protected escape routes, as the heavy and well rebated doors will tend to insulate the sound. This effect will be mitigated by the reverberent conditions characteristic of escape routes, if locating a sounder in a protected corridor is unavoidable.

Most office premises of any size have at least one alarm sounder outside. While local residents would no doubt welcome the warning of a fire, it should be borne in mind that frequent testing of such sounders may cause a mild nuisance.

Steel Framed Office Building

It is possible to economise by omitting the fire casing to steel beams, and to rely on the fire resistance of the ceiling. There are strict rules governing the penetration of such ceilings by services. Such a ceiling may be sufficient on its own to achieve adequate insulation between offices (9). Nevertheless, despite the fire resistance of a ceiling, fire stops are required in the ceiling void for all ceilings above a certain size (10). The locations for these barriers could be chosen so as to increase the sound insulation to sensitive offices.

Partitions often coincide with beams on plan as both are likely to be on a design grid. It could be argued that the fire stop grid should be offset from the main grid in order to avoid steel beams. However, although there may be a need for more than one grid (11) there should be as few grids as possible in order to avoid unnecessary complexity. Rolled steel beams may form part of the fire stop. Care should be taken to stop all voids above steel beams supporting profiled metal decking.

Another way of reducing the effect of the ceiling flanking path is to lay a mineral quilt over the ceiling. This, it might be thought, would also increase the fire resistance of the ceiling. It may, in fact, reduce the resistance by causing the ceiling to heat up faster in a fire. If a quilt is required it should be suspended a short way above the ceiling.

The partition/fire-stop/ceiling detail is an awkward junction. Perhaps the best way of dealing with it is by means of a performance specification, thus enabling the contractor to choose fire-stopping materials to suit site operations. It must be said, however, that contractors generally do not like performance specifications (12). On the other hand fire resistance requirements are already laid down by means of a performance specification; and how better to encourage a contractor to achieve the necessary standard of workmanship than to lay down the performance required?

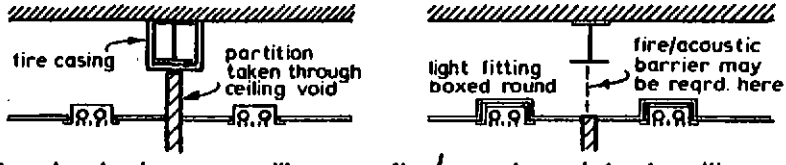

fig.5: standard susp. ceiling fire/sound resistant ceiling

ACOUSTICS VS FIRE PRECUATIONS IN OFFICES

Conclusions

Most facades subject to an external noise source (e.g. traffic) are far enough away from other buildings not to be affected by fire regulations, and consequently may be entirely glazed. Double windows can be used for noise insulation, but may need to be fire stopped.

There are now specific requirements for the loudness of fire alarm sounders. Fire alarm systems could be combined with p.a. or sound conditioning systems.

A fire resistant ceiling may be sufficient for inter-office acoustic insulation. Extra insulation can be achieved by utilising fire-stops as acoustic barriers. The effect of flanking transmission can be reduced by issuing a performance specification in order to encourage good workmanship.

References

1. B.R.E. 1976 "Predicting Road Traffic Noise" (HMSO).
2. S.I. No. 1676, 1976 "The Building Regulations 1976" (HMSO).
3. H. BODYCOMBE 1978 "Suggested Revisions to the Draft Standard Code (Revision of CP 3:Chap. 3 1972)" (John Laing R & D).
4. S.R.L. 1976 "Practical Building Acoustics" 196 & 202 (Spon).
5. M. CROWLEY 1975 Architects Journal 8.10.75. 731-744 "Office Building B.S.C"
6. G.J. LANGDON-THOMAS and M. LAW 1966 "Fire note No. 8, Fire and the external Wall" (HMSO).
7. B.S.I. 1968 B.S. CP 3:Chap IV; Part 3, "Precautions against Fire: Office buildings".
8. B.S.I. 1980, B.S. 5839:Part 1 "Fire detection and alarm systems in buildings code of practice for installation and servicing".
9. G.A. BENNETT and G. BERRY 1976, IoA Conference at Liverpool Polytechnic "The Sound Insulation of Suspended Ceiling Systems".
10. F. SPIEGELHALTER 1977, BRE CP7/77 "Guide to the design of cavity barriers" (BRE).
11. F. DUFFY 1973, Architects Journal 5.9.73 553 "Grids".
12. A.W. RICKARD 1978 "Further comments on the Draft Standard Code (Revision of CP 3:Chap. 3; 1972)" (John Laing R & D).