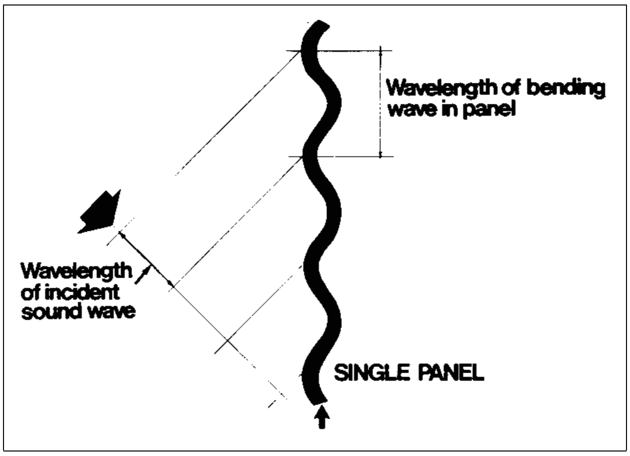

Fig 18 Coicidence
Effect

With the insulation of typical partitions affected by resonances (panel vibration) at the lower frequencies and the Coincidence effect at the higher frequencies, ideal materials for partitions should give rise to resonances outside the normal building acoustic range and internally damped. For instance 18mm of sheet lead, a highly internally damped material, has a superficial mass of 200 kg/m^2 and a critical frequency of 15 000 Hz whereas 20mm of plasterboard has a superficial mass of only 18 kg/m2 and a Critical Frequency of 2 000 Hz. Stiff materials show a reduced Coincidence Effect and improved insulation at the resonances if external damping is provided by the fixings. Lead clearly has many disadvantages, it can flow under its own weight, but it can be incorporated within the sheet material.

It is worth noting that for glass the Critical Frequency is given by:

f_{crit} = 12/h Hz where h is the thickness in mm.

Multiple Constructions

The practical increase in sound insulation of about 4 or 5dB per doubling of mass implies that massive constructions would be necessary to achieve high levels of insulation. For instance a typical 200mm concrete wall, superficial mass 400 kg/m^2, gives an insulation of about 50 dB. In order to achieve 60dB insulation an 800mm wall would be required! A similar problem arises with glazing. Single 4mm glazing may give 20dB insulation but to achieve 50dB it would need to be 200mm thick! If two layers of material are used separated from each other then the insulations can be added. Potentially two layers of 4 mm glass could give 40dB insulation. This assumes that there is no acoustical connection between the sheets of glazing but air is stiff and there will be some connection at the frame. Small air gaps are stiffer and therefore double glazing with small air gaps shows limited improvement in insulation. The major problem affecting any multiple construction is the mass-air-mass resonance as outlined in the section on absorption. This can reduce the insulation below that of a single panel. Above this frequency in the mass law region the insulation of a double partition theoretically increases by 12db per doubling of mass (or nearer 9 or 10dB in practice). The mass-air-mass resonance is inversely proportional to the square root of the air gap. A typical narrow gap sealed double glazed window has a mass-air-mass resonant frequency at about 280 Hz where a typical secondary glazed or double window unit has a resonance at about 70 Hz (about 200mm gap). Field studies (ref 12) have shown the following noise reductions. While the large air gap system is nearly always recommended for sound insulation it can be seen that the real insulation achieved depends very much on the frequency spectrum of the noise. For noises with a large high frequency content such as aircraft noise the choice is clear. The large air gap should be used. For noises with a high low frequency content the decision is less clear. Double windows are more difficult to maintain and keep sealed. Practical results (ref 12) showed that measured against road traffic noise the insulation of a double window was less than 1 dB better on average than a double glazed unit. Most descriptors of sound insulation use the standard building acoustics range of 100Hz to 3150 Hz. The average sound insulation over this range shows the double windows 3.5dB better and the weighted standardised sound level difference (see later notes) shows the double windows 5dB better. With road traffic noise using this frequency range can be questionable.

For good sound insulation with glazing systems (e.g. for radio/sound studios) the following precautions should be taken:
1) Use as wide an air gap as possible.
2) Use different thicknesses of glass (gives different critical frequencies).
3) Glazing sheets should be out of parallel(reduces resonance effects).
4) The reveals should be line with acoustic absorber (reduces standing waves)
5) Use good flexible seals.

Double walls need to be constructed with the same principles in mind. A typical brick cavity party wall with 50mm air gap has little better average insulation than a solid wall off the same mass. Increasing the air gap to 75 mm provides such an increase in insulation that the U.K. Building Regulations allow a reduction in total superficial mass of the party wall to 270 kg/m^2 from 400 kg/m^2 as likely to satisfy the requirements subject to workmanship.

The equivalent to the double partition is the floating floor. The separating material is resilient such as a mineral wool quilt which has very different impedance to that of the floor construction. The form may take that of a concrete floating floor with a screed on top of the quilt placed on the concrete floor or as a timber raft floor. Timber joist floors as found in many older European constructions can be improved by the addition of a floating layer or by using an independently supported additional ceiling below. This is now almost a universal requirement in the U.K. when larger older houses are converted into flats because of considerable noise complaints that have arisen.

Partitions with more than one element

Where a partition contains a more than one element e.g. glazing in a block wall the mean SRI can be calculated using the area weighted average of the transmission coefficients. As an example if we take a 10 m2 concrete wall of SRI = 50dB (T = 10-5) containing 2 m2 glazing of SRI = 20dB (T = 10-2) then the mean SRI is 27dB. Notice that a small area of poor insulation has a large effect. This is most noticeable with small air gaps e.g. cracks round windows. It is easy to show that the insulation