

**Full air-conditioning in modern structures**

by

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and

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**Mr C. L. C. Allan** (Deputy Chairman, South of Scotland Electricity Board) said that he had read the Paper with considerable interest and commended the Authors on their treatment of this subject.

88. In §§ 22–25 of the Paper, dealing with panel heating, the Authors referred to embedded electric heating. Mr Allan wished to suggest the possibility of combining this form of heating with either full or partial air conditioning.

89. It would be possible to combine off-peak electric floor-warming or off-peak thermal-storage plenum-heating with air conditioning. In addition to providing an excellent heating/air conditioning service, a suitable combination of unrestricted and off-peak tariffs would ensure economy in operation.

90. An example of how this arrangement could be applied to a hospital ward with zoned heating, ventilation, and air conditioning was given on pp. 8–9 of a publication entitled 'An enquiry into the use of electricity for the major services in a hospital' issued in 1963 by the Electrical Development Association.

**Mr R. E. McNamara** (Managing Director, Cementation (Muffelite) Ltd; Director, Absorbit Ltd) observed that the Authors gave an excellent general picture of some of the problems and their solutions in the technique of air-conditioning. Inevitably in a Paper of average length some of the points had been dealt with only cursorily, and he felt that some additional comments were necessary on the subject of vibration and noise control, if some readers were not to be misled.

92. The Authors commented (§ 51) on the dangers of vibration and noise from pumps and oil burners. Yet, while these items certainly deserved care, they did not constitute the major causes of complaints. In general, vibration troubles arose most frequently from reciprocating refrigeration compressors and noise troubles from fan-noise transmitted through the air ducts. Careful design could avoid these troubles, but for greatest economy and convenience the design must be for prevention and not for cure.

93. The techniques of vibration-control were now fairly generally understood and several competent specialist suppliers of anti-vibration mountings were available for advice. One incidental problem which could frequently be avoided arose from the selection of reciprocating compressors having large unbalanced inertia forces and/or couples of such magnitude that isolated concrete foundations were required. The weight of these foundations which were essential to control the motion of the compressor on its isolators, might be a severe embarrassment insofar as floor loadings were concerned. The need for such isolated concrete foundations could be avoided

or reduced by selecting multi-cylinder machines, preferably of V or W cylinder pattern. Vibration isolators were still required for such machines in order to prevent the transmission of residual forces and couples and the transmission of structural noise.

94. Though fans were nowadays normally dynamically balanced, it was not by any means unknown for them to be a cause of excessive vibration troubles. When such equipment was mounted on a suspended floor it was possible, particularly with the higher-speed fans now used, for the rotational frequency of the fan to match the natural frequency of the floor itself. This was a condition of resonance and led to a sharp build-up in the magnitude and effect of such unbalanced forces as might exist in the fan. The answer to this problem was to insert anti-vibration mountings having a stiffness much less than that of the floor itself. This would generally require the use of steel spring mountings having a deflexion of the order of 1 in. In series with the spring mountings it was necessary to use a pad of resilient material such as cork, felt or rubber, as steel springs would transmit the high frequency (i.e. audible frequency vibration), though dealing effectively with the low frequency vibration occurring at the rotational speed of the fan.

95. The prediction of fan-noise transfer through a duct system was now a fairly exact matter and in the majority of systems some form of noise control was essential if reasonably quiet conditions were to be obtained in the conditioned areas. The lining of an air duct with a sound absorbent material was not a particularly efficient way of controlling fan noise even when very high efficiency sound absorbant materials were used. This was because the attenuation of noise through a duct was related to the ratio of the periphery of the sound-absorbing duct to the cross sectional area of the duct. Consideration of this relationship showed the advantages of using sound-absorbent splitters in the air duct, so that a more favourable ratio was obtained. A wide range of proprietary silencers and mufflers was now available and selections could be made from manufacturers' data. It was perhaps better, however, to place on the manufacturer the responsibility of ensuring that the noise level in the air-conditioned areas did not exceed a certain criterion, as the data published by various silencer manufacturers were not comparable. There was as yet no standard procedure for testing silencers and the different test methods used gave widely varying results.

96. The specification of the maximum noise level to be permitted in any area must include a statement of the frequency spectrum. This was most conveniently done by using the noise criterion or noise rating curves which would be found in most recent books on air-conditioning and acoustics.

**The Authors**, in reply, considered that when an air-conditioning system was proposed for a new building, there was little technical advantage in employing an independent heating system since the former could equally well perform both duties. A greater capital outlay would also be involved.

98. Modern air-conditioning systems were usually only operated during the occupied period, plus two to three hours for pre-treatment and stabilizing of space conditions. A case could not really be developed for a saving of operating costs with electric embedded heating which, by its basic principles of operation, would heat the building 24 h/day.

99. Mr McNamara's contribution expanding the references to noise and vibration-control was welcome and the Authors were in general agreement with his comments.

100. They thought that the references made to the delegation of responsibility were not out of place but considered it would be better if the consultants, contractors, and manufacturers concerned with vibration and noise attenuation could agree upon a common basis of comparison and method of testing—possibly on the lines of a Code of Practice.