

Building Design For Mixed Mode Systems

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Mixed mode buildings are attracting a considerable amount of interest due to their apparent potential to deliver comfortable, healthy conditions with significant energy and environmental benefits. BRE and WBA are currently engaged in a three year research programme to generate the guidance necessary to achieve the effective integration of various mixed mode strategies into the most appropriate building forms, considering the occupying organisation's mode of operation. The project will culminate in the production of a CIBSE Applications Manual.

This paper reports on an a state of the art review of mixed mode designs, discussing findings related to best practice system design, and other practical issues that might affect the successful operation of the installed system. The paper also considers the acceptability of mixed mode buildings to the marketplace in terms of their attractiveness to developers and potential tenants.

Why mixed mode?

Mixed mode is an approach to ventilating and cooling in which natural ventilation (normally using opening windows) and mechanical ventilation and / or cooling (possibly incorporating humidification control) are deliberately combined. Potentially this can offer:

- More sustainable and cost effective buildings which can be adapted to changing requirements, standards and priorities, and which can be serviced to meet occupiers' real needs whilst avoiding wasteful over-provision or energy dependency.
- Better occupant satisfaction by combining the perceived advantages of openable windows with mechanical servicing for suitable levels of health, comfort, and safety.
- Reductions in energy use and the associated greenhouse gas and pollutant emissions through avoiding the unnecessary operation of mechanical systems at times, and in places, where natural ventilation could meet the requirements more efficiently.

However there are potential drawbacks including:

- Systems which may require as much, or more, management input due to a relatively complex control strategy.
- A potential lack of understanding of the system by the building occupants (and of the occupant by the designer).
- Inefficiencies which might result from the use of inappropriate plant and conflicting plant operation.
- A perception that systems might restrict flexibility and might become prematurely obsolescent, at least in part.
- Buildings which currently have a confused market image and are of uncertain rental value.

The Building Research Establishment, in association with William Bordass Associates, are currently reviewing the subject and developing ideas for a CIBSE Applications Manual on the responsible and appropriate use of mixed mode systems. It will highlight areas where current understanding seems to be lacking and in which BRE will be carrying out work over the next 12-18 months to facilitate the production of the Manual.

System Classifications, Benefits and Potential Problems

An earlier National Conference paper ⁽¹⁾ described four distinct strategies for mixed mode operation, summarised in Figure 1.

Strategy	Description
Contingency	The building is not mechanically ventilated or cooled but has service routes, voids and plant space available (either physically or potentially) as contingency for possible future needs.
Concurrent	Openable windows and mechanical systems are simultaneously available either all of the year, or in selected places at selected times. Often low capacity mechanical ventilation (ie 1-3 ach) provides fresh air in winter, some cooling and air movement in the summer, and some degree of night cooling. Occupants can open the window at any time though this should be inhibited if refrigeration is operating.
Changeover	At different periods in the year the building (or parts of it) are treated differently using different systems. For example in the mid-seasons opening windows may be sufficient but during the winter or summer the windows are sealed and mechanical systems operate.
Zoned	Different areas have different systems which operate independently as required. This includes naturally ventilated buildings with localised areas of high heat gain such as conference rooms.

Figure 1 - Originally Proposed Mixed Mode Classification

Classifying existing mixed mode buildings

The study team is already aware of over sixty mixed-mode buildings in the UK, 28 of which have been visited to date and reviewed against the original classification:

- Most buildings fall into more than one category. Their classification can also change as they evolve in operation and use.
- Pure contingency designs were rare - the Body Shop headquarters ⁽²⁾ remains the clearest example. While its strategy (space to install conventional VAV air conditioning) suited the property market at the time, there may now be simpler, more incremental and more cost-effective upgrade routes.
- Some buildings were also planned such that air conditioning could be removed; the opposite application of a contingency design strategy. In one 1970s example, removal is now being seriously considered. Other sealed buildings have already been altered to include natural ventilation or mixed mode systems.
- The most common form of operation was concurrent, comprising two thirds of the buildings visited and also popular in newer designs.
- Changeover operation was rarer in practice than in designers' minds, and most often used for night cooling. Some local changeover systems used detectors to switch off mechanical cooling when a window was opened.

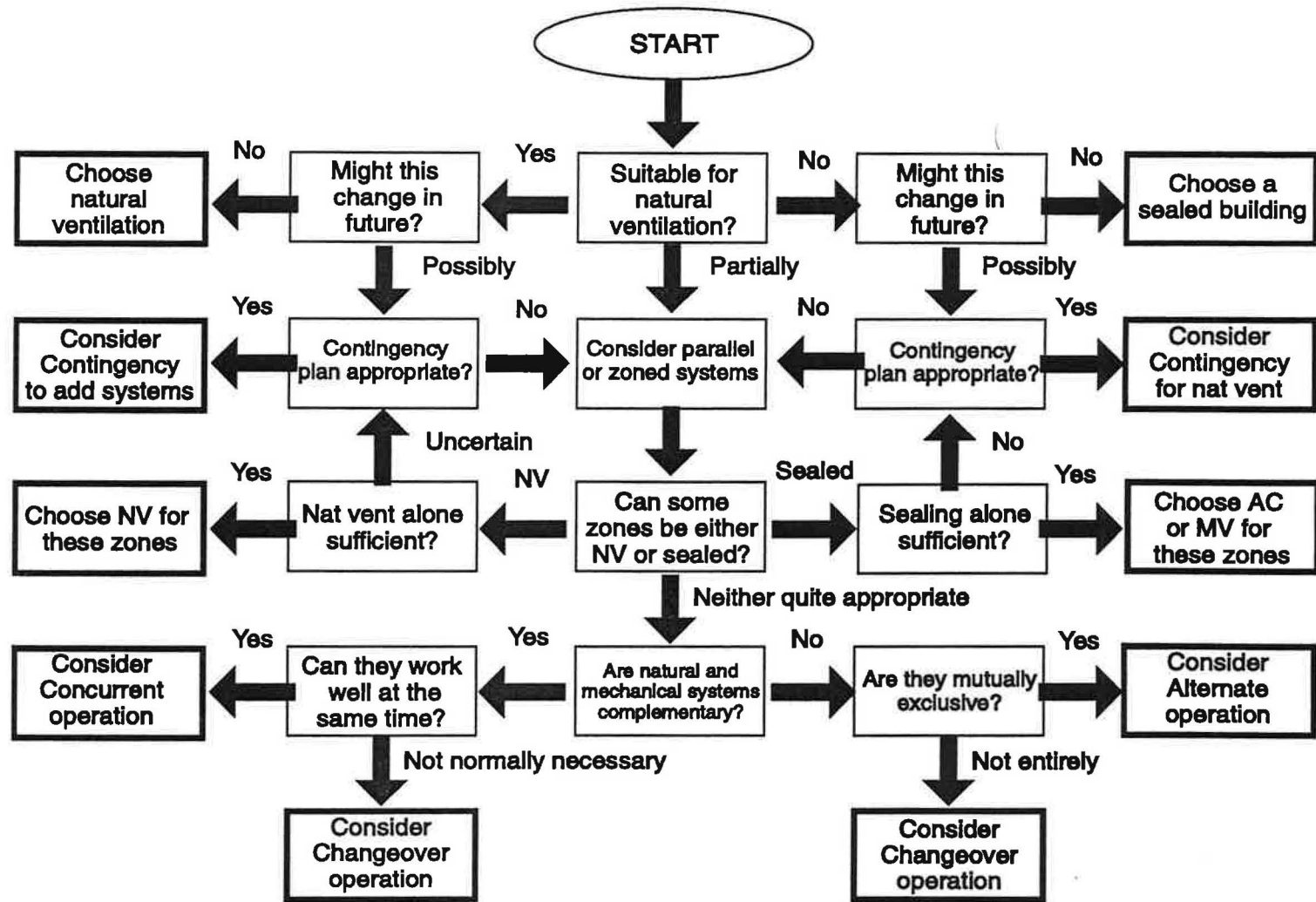


Figure 2 - Mixed Mode Strategy Selection Chart

- *Ensure effective handover.* Mixed mode systems can be designed and fine tuned to satisfy a large number of situations if sufficient time is allowed for commissioning. If possible a fund should be available to finance 'sea trials' and to pay for any small alterations which are likely to prove necessary after the building comes into use.

The Applications Manual

Over the next 12 - 18 months BRE will be carrying out market research, case studies and modelling exercises to gather the information necessary to produce a CIBSE Applications Manual. The emphasis will be on practical guidance for design including the selection of appropriate windows and shading methods. To facilitate life cycle costing a checklist of items to include in such a calculation will be provided. There is a dearth of suitable monitored energy consumption data from modern low energy buildings. Rationalising what little data is available is difficult because of the broad range of operating strategies available and a widespread absence of metering of special end uses. BRE is now attempting to coordinate related projects in order to assist cross comparison of energy and occupant survey data. A parallel examination of the claimed abilities of current thermal modelling packages to forecast the likely outcome of a mixed mode design is being undertaken. Results from this will be used to generate a framework for life cycle costing analyses.

It is envisaged that user education and facilities management training issues will be covered in the Manual through the inclusion of check lists. Facilities managers will be interviewed as part of the case study process to give feedback on the success or otherwise of any training they have received, and of their attitudes to mixed mode design.

With support from BRECSU the marketing possibilities of mixed mode will be investigated. In spite of their potential very few mixed mode buildings have been built speculatively, hence the greater popularity of mixed mode systems in countries where more buildings are owner occupied. BRE is currently gathering supplementary feedback from mainland Europe.

Conclusion

Mixed mode systems offer a number of benefits, not least their cost-effective adaptability to changes in building use. However some issues are not well understood and codified, hence there are pitfalls for the unwary. The production of the CIBSE Applications Manual will help to promote the design of appropriate, efficient, and economic buildings and systems.

A draft manual will be completed by December 1997, with a proposed contents list presented at the 1996 National Conference. Feedback from CIBSE members is welcomed at all stages of production of the Manual.

References

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