simply average of winter and summer outside moisture levels would suggest. With the use of motorized vents [Fig. 24] and a software driven Building Management System (BMS), repository and outdoor air temperature and moisture contents are monitored, and automatic ventilation permitted when beneficial.

Archive material influence

Including a representation of the stored archive material in the computer simulation demonstrated the significant influence of the surface area of a paper type material. The effect on room conditions is considerable [Fig. 25]. On the daily time scale it appears that the archive material would provide the bulk of the moisture stability effect. This is probably largely because of the large surface area exposed to room air as well as its higher absorption rate. Compared with this, the moisture storage effect of thick building fabric components was likely to be of more influence across the seasons of the year.

Building design details

Within the Archive's perimeter walls, for this particular application, it is the 200mm nearest the room that acts as the main flywheel zone. To gain most from the thermal inertia it was found necessary to protect against south- and west-facing sun exposure by adding a layer of thermal insulation and an outer sun-shade wall leaf. The latter also doubled as screen to reduce rain penetration [Figs. 26a and c]. Window summer heat gain and winter heat loss could be significant but is avoided by severely limiting windows in the repositories themselves. This also reduces the infiltration so often associated with jointing window frames into walls.

The dense concrete blockwork (c1900 kg/m^3) produced locally in Jersey provides significant benefits over more conventional blockwork because its high density enhances both moisture and heat holding ability. It also allows floor slabs to bear directly onto the blockwork so reducing construction drying out shrinkage cracks identified on other archive repositories as causing excess outside air infiltration.

Compared with the walls, the roof thermal performance has to be enhanced because of its greater exposure to summer sun and cold night sky radiation; 200mm of insulation is provided in lieu of 100mm, together with a fully ventilated roof cavity. To further reduce the long-wave radiant heat transfer, an aluminium foil type low emissivity finish can be provided to both faces of the cavity [Figs. 26b and c].

Compared with the annual amount of flywheel moisture movement, the initial construction moisture exceeded it many times over. This had to be evaporated and ventilated out from the building materials before the building was sealed. This required careful construction programming to allow the inner wall leaf and floor slabs to dry out over a complete summer before installing the vapour barrier, outer wall leaf and doors. A similar process was followed for the construction of the Ipswich Record Office (Jones, 1991) – the only other non-air-conditioned repository constructed in recent years in the U.K.

A low temperature (approx. 40°C) water pipe heat emitter is provided against the repository perimeter walls to give low-grade winter background heating effect. Of all the heating options available this minimized the local high temperature, and hence low humidity, effect that most smaller emitters and electric heaters give. Although the predictions indicated it should not be needed, this background heating can also provide a back-up facility for lowering relative humidities during peak summer conditions.

Performance in use

To date the feedback on how the Jersey Archive passive environmental control operates in practice has been good. Like most archives there is continuous monitoring of repository conditions. Although this is not comprehensive it has provided an indication of the building performance and some useful feedback. It is hoped that in-depth monitoring of the building may be able to start soon once the initial construction drying out period is over.

The repositories experience an annual swing in conditions with the highest moisture levels recorded during the summer. During these periods the relative humidity limits were maintained. At times, the temperature rose slightly above the target range. The automatic controls system has needed attention. Sensors have failed, on occasions together with the back-up checking sensors, making diagnostics difficult. This meant that for some extended periods the ventilation was not opened as much as was intended, particularly during the part of the year when most drying effect could have been provided.

It has been interesting coming to the realization that because the tight range of repository environmental conditions do not directly relate to human comfort parameters, it is difficult for personnel to easily identify if the control system is acting as it should. The human body may respond to relative humidity, but it does not respond to air absolute moisture content.

We now know a lot more about the range of conditions the automatic controls need to respond to and which are critical for repository conditions. This will allow the automatic controls algorithms to be simplified and so allow the functioning of the controls by archive personnel to be more easily checked.

BS5454 revision

It is worth noting that BS5454:1989 has now been revised and issued as BS5454:2000. Its relative humidity recommendations have been lowered by 5% and the temperature limits tightened to +/− 1°C. Although these new proposals did not form part of the scope of the study described in this paper, it appeared likely that for most of the year they could be easily achieved, particularly after further construction moisture is evaporated out over the first few years. Consequently the BMS control strategy was configured so the revised room set points can be used.