

ENVIRONMENTAL MONITORING
20th SEPTEMBER TO 1st NOVEMBER 1995
PERIOD 4.

PETERBOROUGH CATHEDRAL
ENVIRONMENTAL MONITORING
FOURTH PERIOD
20th SEPTEMBER TO 1st NOVEMBER 1995

Monitoring is continuing to establish the environmental conditions within the cathedral so that an assessment can be made as to whether the medieval painted ceiling is being adversely affected by the heating system.

Temperature and humidity probes, and surface temperature sensors, have been installed in the main body of the cathedral and in various voids above the painted ceiling. Conditions are also being monitored externally to enable an estimate to be made whether extremes of temperature affect the internal readings. Extra sensors have been installed internally and externally to gain a greater understanding of the air flow and moisture movement patterns within the building.

EXTERNAL CONDITIONS.

During this monitoring period radiant temperatures varied between 2°C and 39°C whilst the shade temperatures ranged from 2°C to 33°C. The relative humidity fluctuated from 100% to 30%. Appendix A shows the daily variations of temperature and humidity and indicates a gradual decline in the external temperature towards the end of the period.

INTERNAL CONDITIONS.

The conditions in the Cathedral are shown in Appendix B, Graph 1. The relative humidity is very stable averaging at 70%, difference between the three levels is between 2 and 3%. Temperatures at each level are virtually identical, major discrepancies occur between the 6th and 18th of October, even at this time the maximum variations are less than 1°C, this is shown in Graph 2. As for previous monitoring periods, there is an almost total absence of temperature gradient.

Appendix C, Graph 1 shows the relationship between the topside and the underside ceiling surface temperatures. The underside surface temperature generally showed a greater variation than the high level air temperature, this was due to it as being affected by the topside ceiling surface temperature. There were only minor differences between the high level (scaffolding level) temperature and that adjacent to the ceiling.

Graphs in appendices D,E,F and G show dew point temperatures, vapour pressures and moisture contents. Dew point temperatures for the ceiling indicate that there was no condensation formed on either surface and that the roof boarding was also free from any problems during this monitoring period.

The vapour pressure graphs show that the moisture movement is predominantly from outside to inside but the conditions across the painted ceiling are relatively stable (see graph 3 of appendix F). The moisture content graphs also show that the conditions across the ceiling are

reasonably stable with the vapour pressure driving moisture in either direction.

Roof Void.

Conditions within the roof void varied by a greater amount than those in the cathedral, appendix C, graph 1 shows how the ceiling surface temperatures varied and graph 3 shows the temperature difference across the ceiling. It is inevitable that with an unheated roof space, there will be some temperature differential across the ceiling. Graph 2 shows an expanded portion of the data and indicates a maximum difference of 2 degrees. Given the heavyweight building structure, any flexing due to this deviation should be minimal.

Appendix H shows the graphs comparing internal and external conditions, it can be seen that the roof boards are directly influenced by the sun as their temperatures follow the black ball radiant figures. Internal surface temperatures are higher than the external ambient which are recorded in the shade.

Daily variations of external temperature are between 10 and 15°C. The roof space temperatures only vary by around 5°C which shows the considerable "buffering" effect of the building fabric.

CONCLUSIONS.

Results for this monitoring period show relatively stable conditions for the painted ceiling. There is no excess temperature variation across the ceiling, therefore any flexing or movement of the structure should be minimal.

From the calculations of vapour pressure and moisture content it can be seen that whilst moisture tends to move from outside to inside the building, moisture is moving fairly constantly in either direction across the ceiling. This should not lead to a situation where warping could occur through one side having a greater moisture content than the other.

Visual inspection of the ceiling should continue to check whether the condition of the wooden panels has stabilised or if the fastenings are continuing to become dislodged.

K Waterman
4/12/95

The advice which this report contains refers only to works of a building services nature and it should be borne in mind that there may be conservation or other issues on which the Architects and Inspectors of English Heritage may wish to comment.

This advice does not imply listed building or scheduled monument consent, neither does it imply that grant aid is either applicable or available for the work suggested.

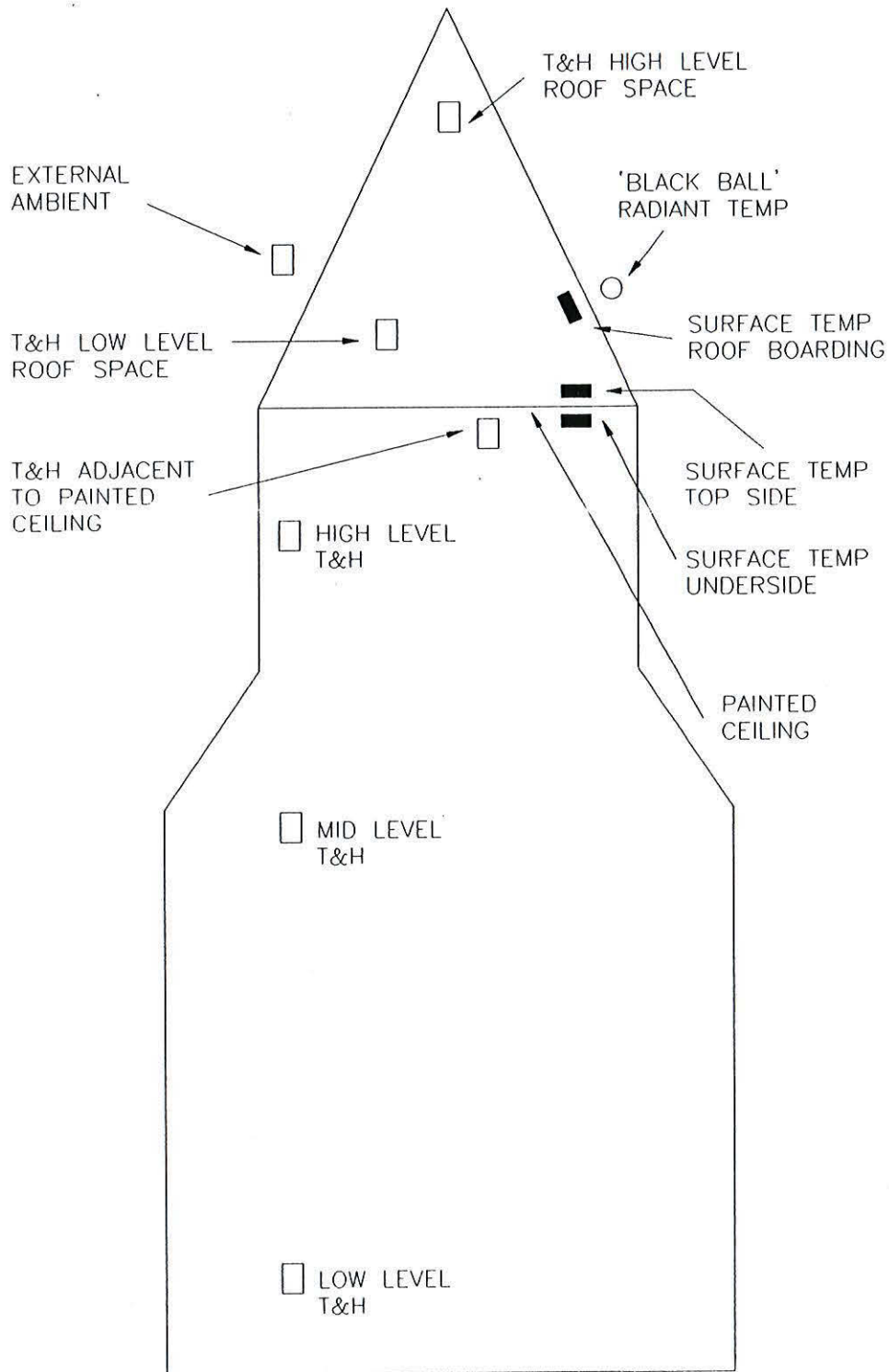
No legal liability will be accepted by English Heritage in connection with this advice, and the owner of the building/structure is reminded of the importance of taking his/her own professional advice if he/she wishes.

The execution of any works suggested in this report must be supervised by a competent person.

This report refers only to those parts of the building/structure inspected and unless specifically stated, it does not refer to inaccessible parts of the structure. The report is on the current condition of the installation and due care and attention to inspection and maintenance is vital to avoid further deterioration.

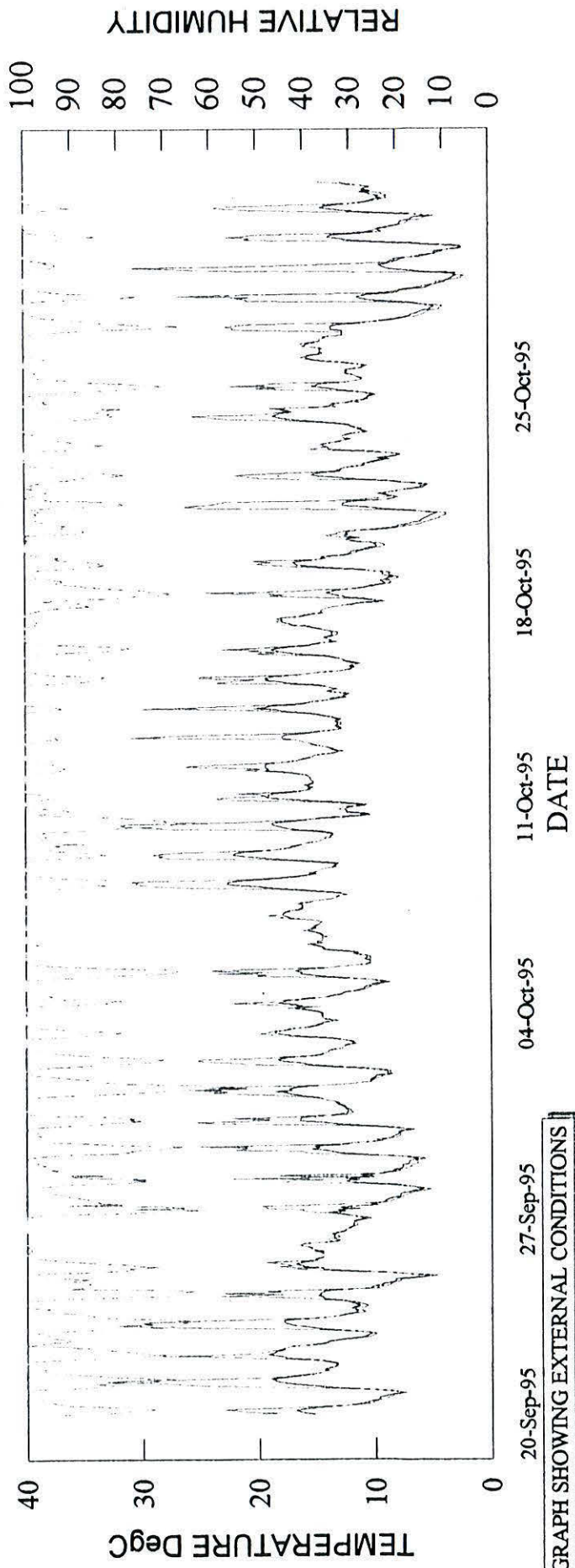
PETERBOROUGH CATHEDRAL

DESIGNATION OF SENSORS



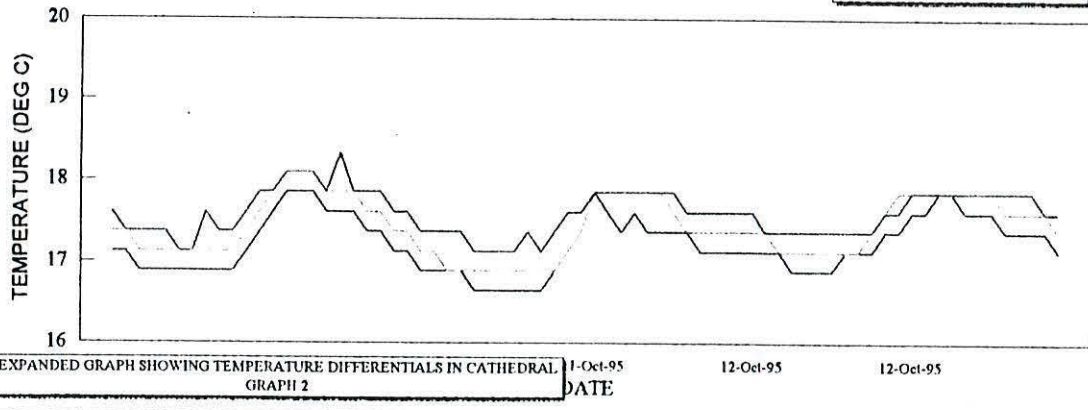
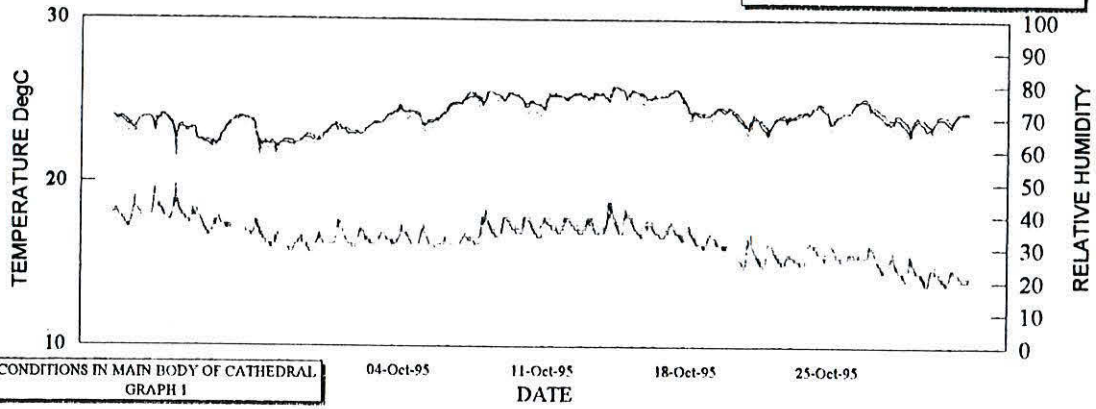
PETERBOROUGH CATHEDRAL

— External temp
— Black ball temp
— External R/H



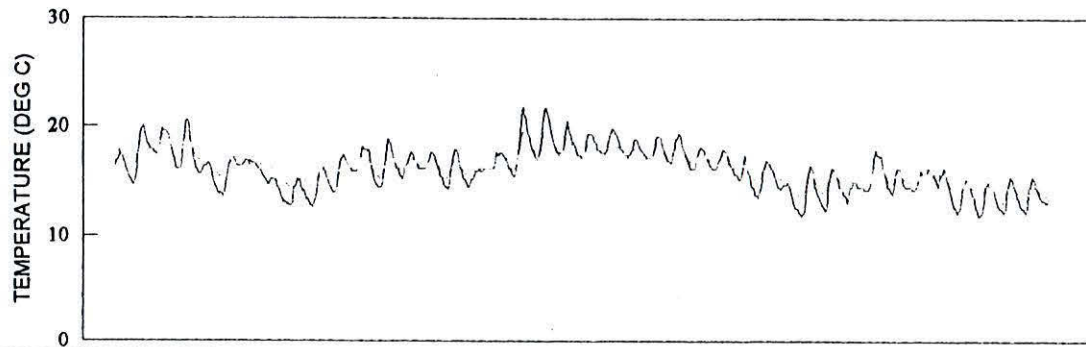
GRAPH SHOWING EXTERNAL CONDITIONS

PETERBOROUGH CATHEDRAL



PETERBOROUGH CATHEDRAL

— Topside Ceiling
— Underside Ceiling

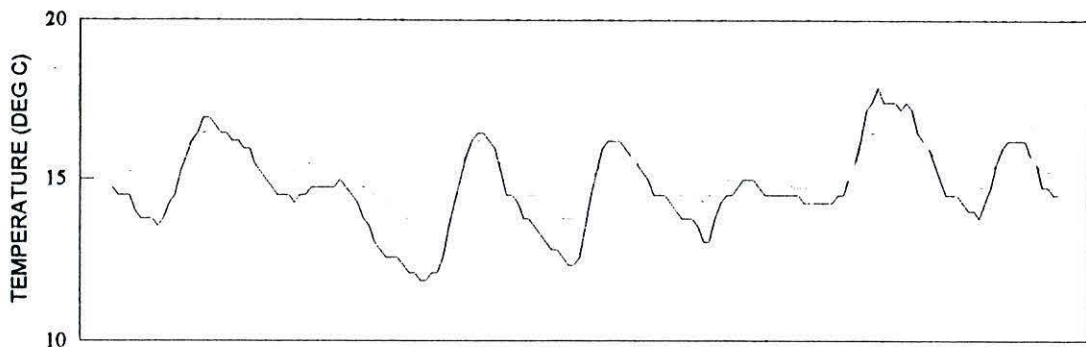


SURFACE TEMPERATURES EITHER SIDE OF PAINTED CEILING
GRAPH 1

11-Oct-95
DATE

18-Oct-95

25-Oct-95



SURFACE TEMPERATURES EITHER SIDE OF PAINTED CEILING
GRAPH 2

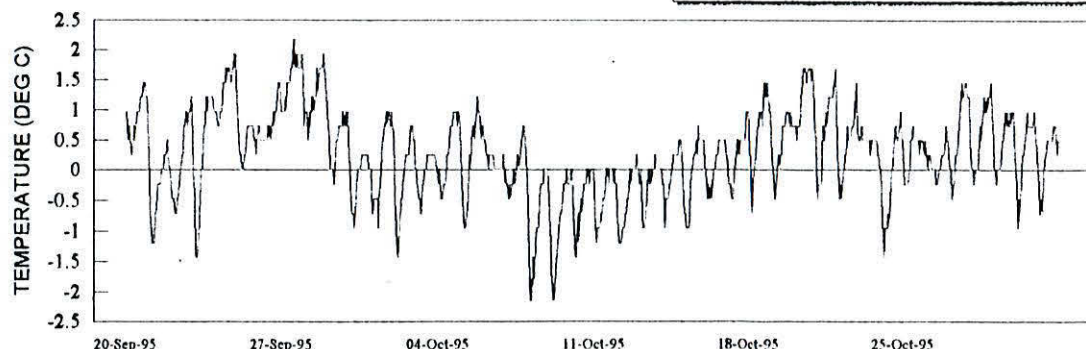
22-Oct-95

23-Oct-95

24-Oct-95

25-Oct-95

DATE



— Temperature difference across ceiling

GRAPH 3

DATE

20-Sep-95

27-Sep-95

04-Oct-95

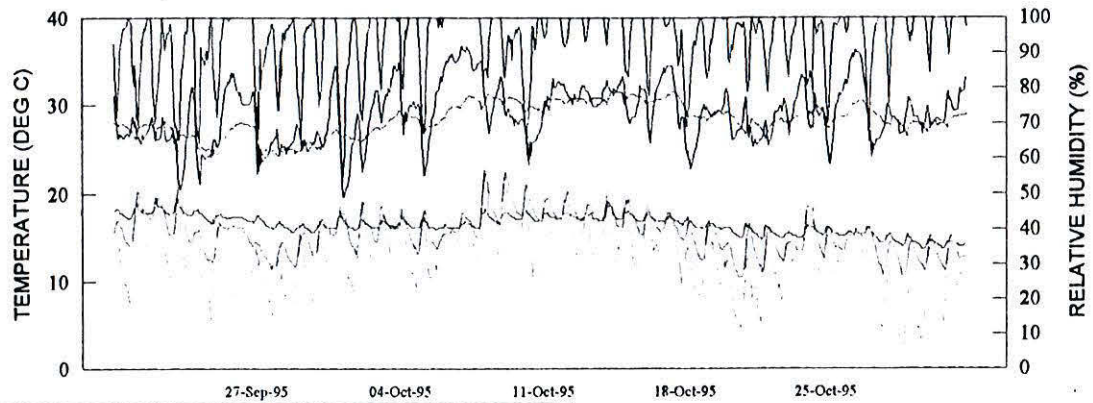
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18-Oct-95

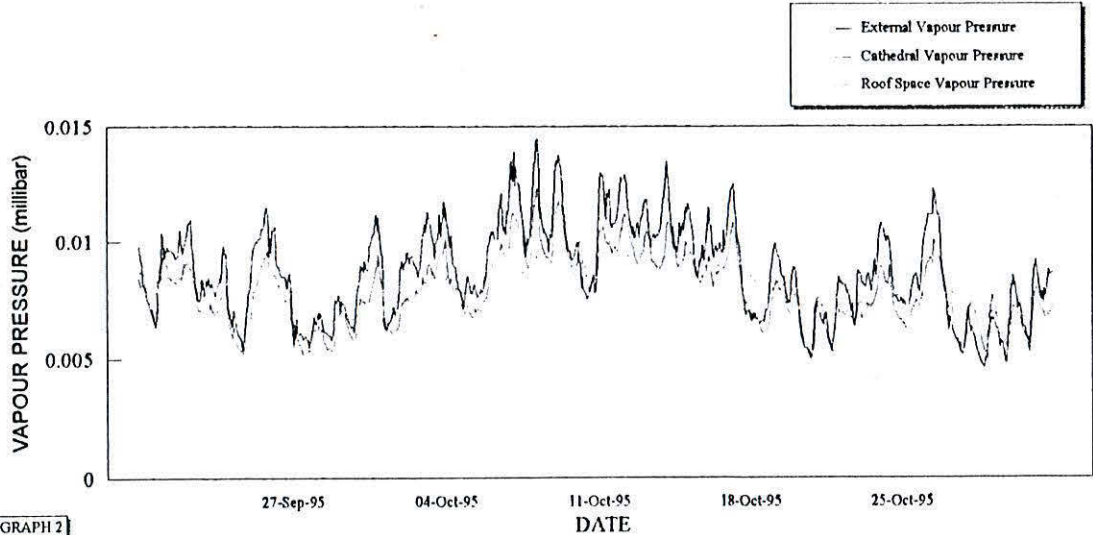
25-Oct-95

PETERBOROUGH CATHEDRAL

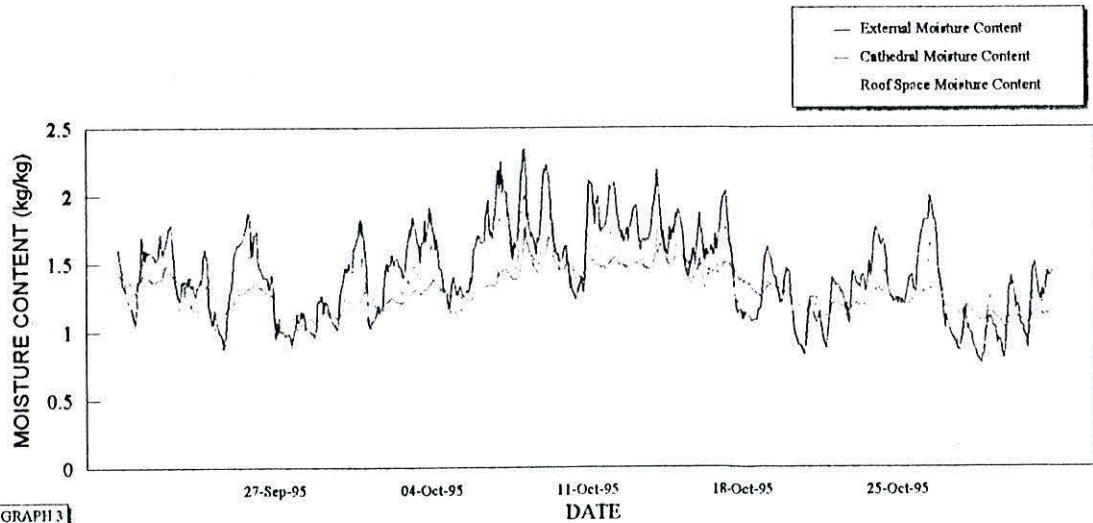
— Mid level Cathedral Temp — R/H
 — Roof space Temp — R/H
 External Temp — R/H



COMPARISON OF CONDITIONS IN CATHEDRAL, ROOF SPACE AND EXTERNAL. GRAPH 1



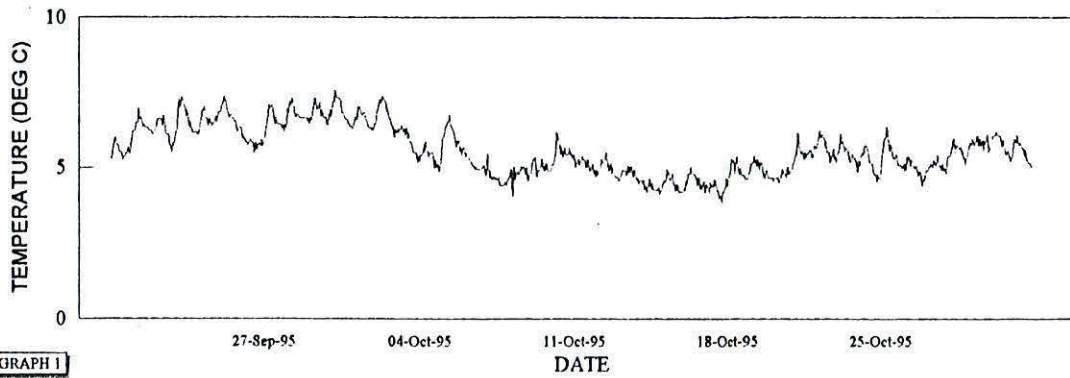
GRAPH 2



GRAPH 3

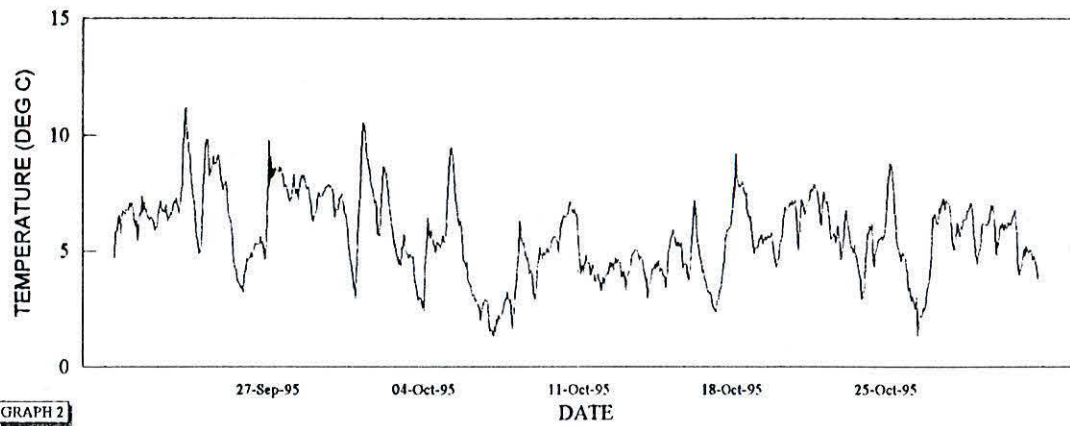
PETERBOROUGH CATHEDRAL

— Dewpoint minus Underside Ceiling Temp



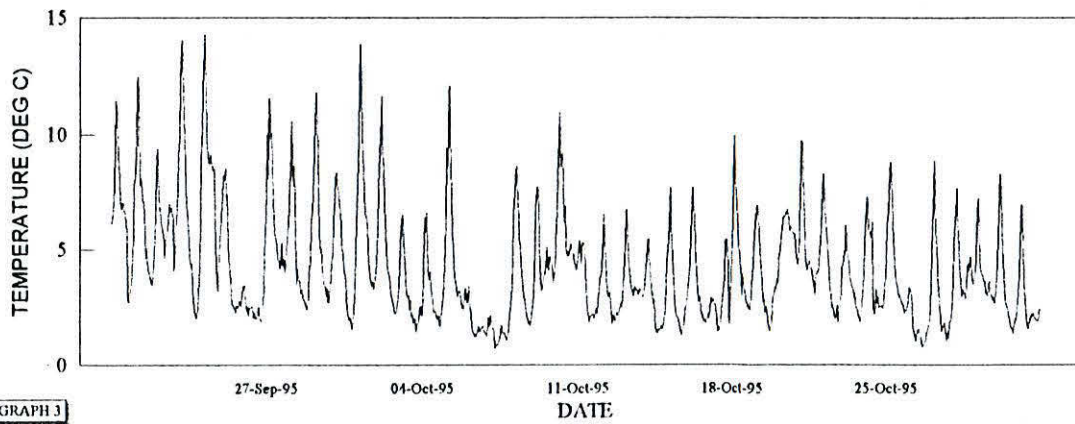
GRAPH 1

— Dewpoint minus Topside Ceiling Temp



GRAPH 2

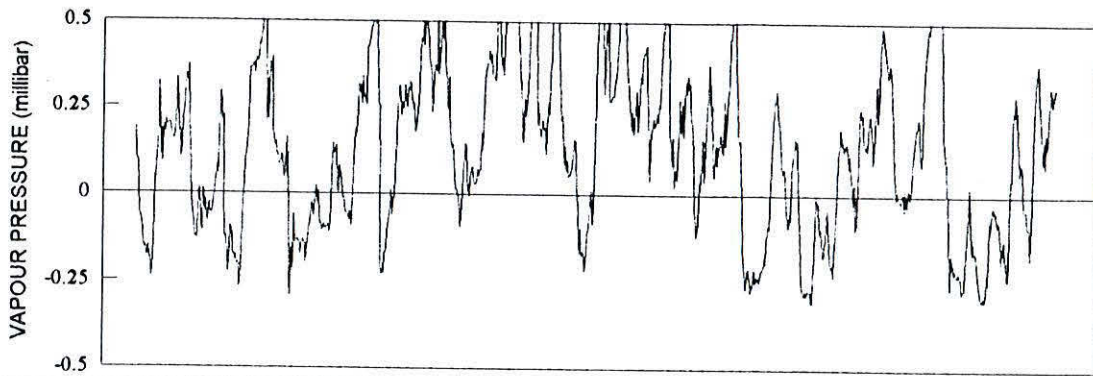
— Dewpoint minus Roof Board Temp



GRAPH 3

PETERBOROUGH CATHEDRAL

External minus Cathedral



POSITIVE INDICATES MOVEMENT OUTSIDE TO INSIDE
GRAPH 1

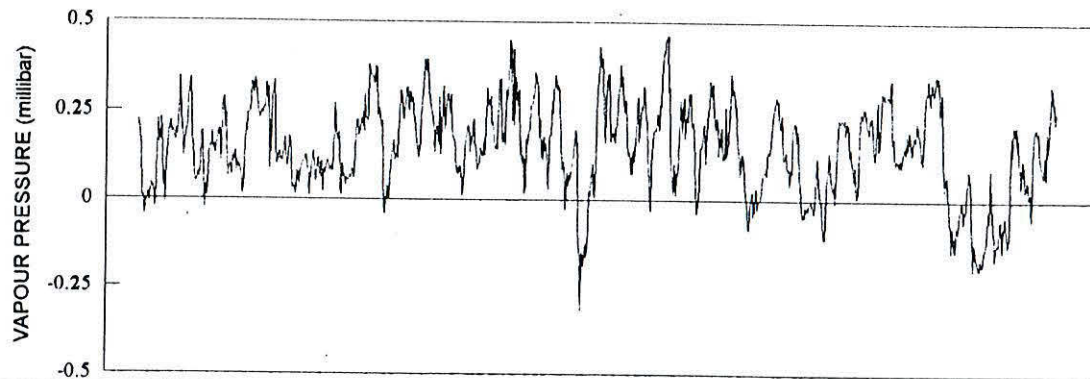
04-Oct-95

11-Oct-95

18-Oct-95

25-Oct-95

DATE



External minus Roof space

POSITIVE INDICATES MOVEMENT OUTSIDE TO ROOF SPACE
GRAPH 2

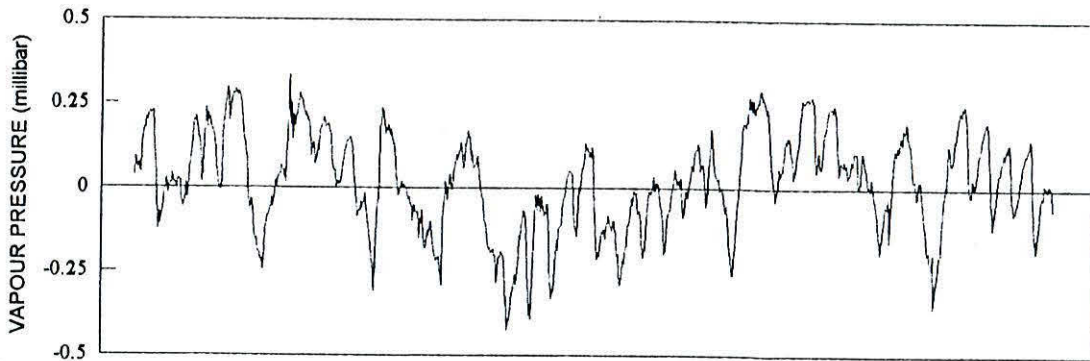
04-Oct-95

11-Oct-95

18-Oct-95

25-Oct-95

DATE



Cathedral minus Roof space

POSITIVE INDICATES MOVEMENT CATHEDRAL TO ROOF SPACE
GRAPH 3

04-Oct-95

11-Oct-95

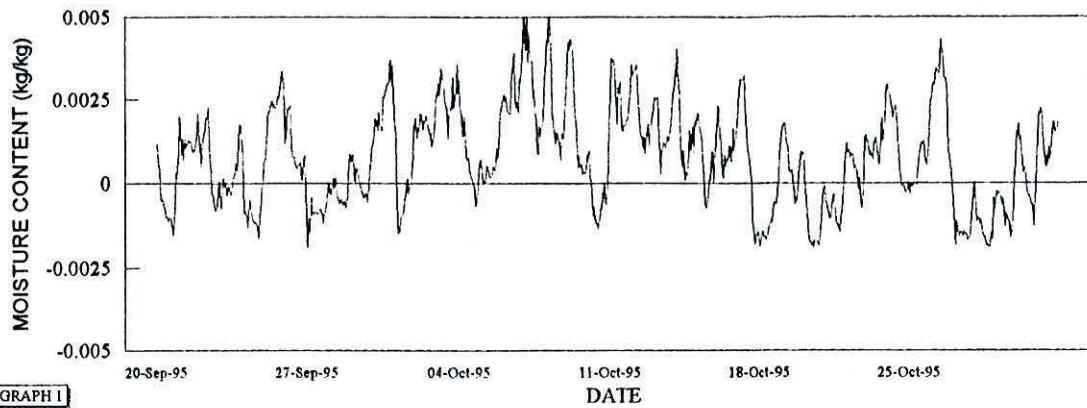
18-Oct-95

25-Oct-95

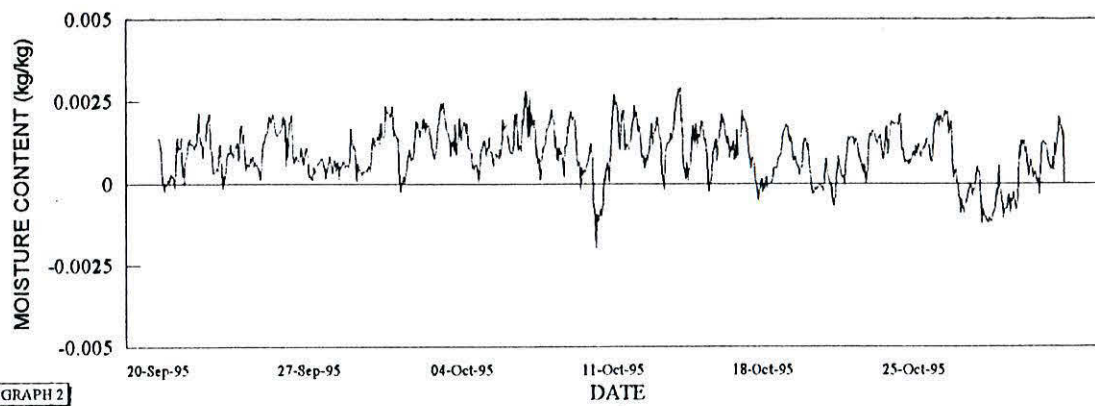
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PETERBOROUGH CATHEDRAL

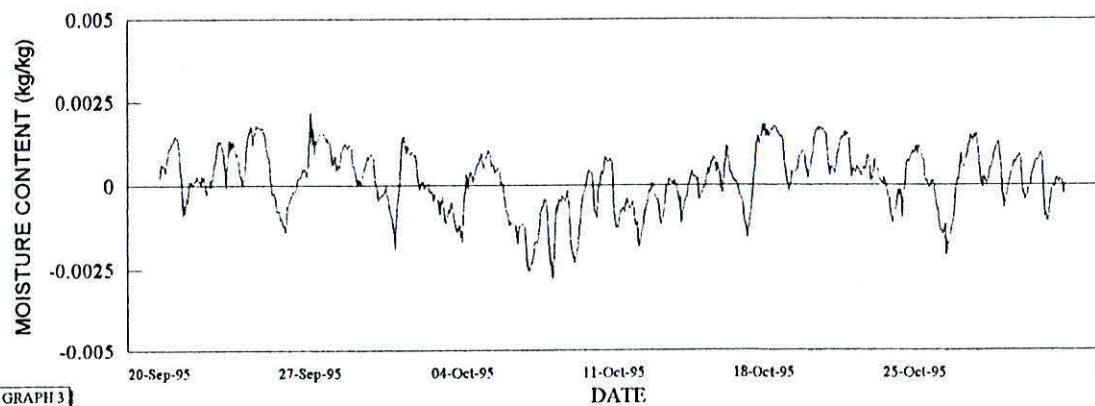
— External minus Cathedral



— External minus roof space temp

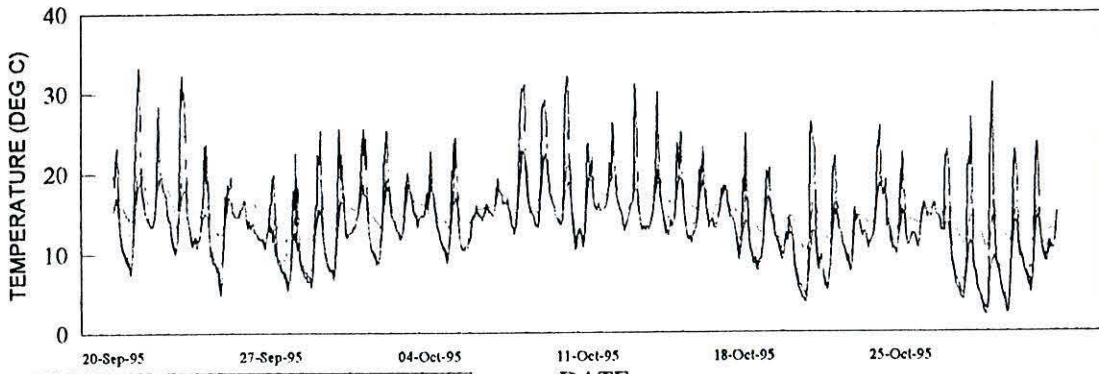


— Cathedral minus Roof space



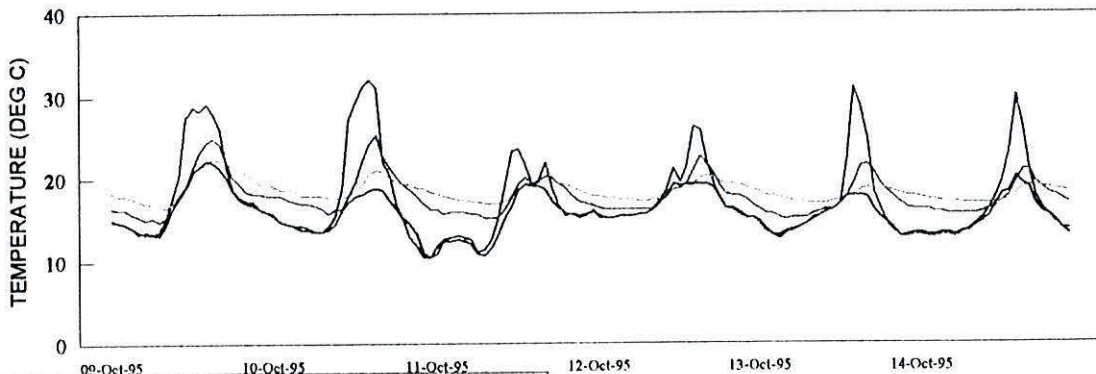
PETERBOROUGH CATHEDRAL

— black ball temp — inside roof surface
 - - - inside roof space temp — external temp



COMPARISON OF TEMPERATURES - EXTERNAL AND ROOF SPACE
 GRAPH 1

— black ball temp — inside roof surface
 - - - inside roof space temp — external temp



EXPANDED GRAPH SHOWING BUFFERING EFFECT OF THE BUILDING FABRIC
 GRAPH 2