

**PETERBOROUGH CATHEDRAL  
ENVIRONMENTAL MONITORING  
2nd NOV 1995 TO 31st JAN 1996.**

**PETERBOROUGH CATHEDRAL  
ENVIRONMENTAL MONITORING  
FIFTH PERIOD  
2nd NOVEMBER 1995 TO 31st JANUARY 1996**

During this monitoring period the reservoir at the base of the Gurney stoves was filled with water to act as a humidifier. This was carried out between 12th December and 12th January and involved those stoves adjacent to the monitoring area.

This completes the first year of monitoring, no extra equipment has been installed for this session and all sensors remain in their original positions, recording times continue at one reading per hour.

**EXTERNAL READINGS**

Relative humidities remained high for the entire period, temperatures reached a low in December and showed a steady rise towards the end of January. External readings can be seen in graphs 1 - 3.

**INTERNAL READINGS  
MAIN BODY OF CATHEDRAL**

Internal conditions can be seen in graphs 1 - 3, as in previous periods there is virtually no temperature gradient. Average temperatures for high, mid and low levels are 12.8, 12.7 and 12.6°C respectively. The relative humidity was reasonably constant but showed a drop at the beginning of December. It is possible that the fall in relative humidity would have been greater if the water had not been added to the Gurney stoves. The reason for the RH falling is that as the outside air cools it has a reduced capacity to hold moisture. Air within the building is constantly changing and will enter through doors, windows and other openings. As this "dry" air is introduced into the Cathedral, its temperature will rise and with no moisture added its relative humidity falls, resulting in lowered readings within the building.

It can be seen from graphs 1 and 2 that the low level temperature increased on a number of occasions. An expanded view of these peaks is shown on graph 8, as they are of relatively short duration they are unlikely to cause problems. Each incident occurred at 1100, as the sensor is located in the pulpit it would be interesting to check whether the person giving the sermon is "cheating" and has his/her own heater.

**PAINTED CEILING**

Temperatures either side of the ceiling are shown in graphs 4 to 7, in general the underside of the ceiling was warmer than the topside. The exception is shown in graph 7 when there were three occasions when the reverse occurred. This probably coincided with a sudden drop in outside temperatures and it took a couple of days for the building fabric to stabilise. The maximum temperature difference across the ceiling was 4°C, this is not considered to be a

sufficiently large differential to cause problems by warping.

Dewpoint temperatures for the ceiling are shown in graphs 9 - 11, there were no occasions when the surface temperature dropped below the dewpoint. Monitoring has now been in operation for a complete year and calculations have indicated that there will be no condensation problems on either of the ceiling surfaces.

## **ROOF SPACE TEMPERATURES**

Comparisons of “black ball”, external temperature and inside roof timber temperatures are shown in graphs 30 - 33. The inside is generally well buffered from the external conditions, the only time the roof boards approached the external is shown in graph 33 and coincided with a sharp drop in external temperature. Calculations show that condensation will have occurred on the outside between the tiles and the roofing felt on a number of occasions, predictions indicate that there is a small possibility of condensation occurring on the inside between the felt and the boarding. A visual inspection of the roof boarding shows some staining but there is no evidence of moisture falling onto the top of the ceiling.

## **MOISTURE CONTENTS AND VAPOUR PRESSURES**

These are shown in graphs 12 to 29, results indicate that during November and January effects were broadly neutral with moisture moving from inside to outside and vice versa. During December there was a tendency for moisture to move predominantly from inside to outside which was counteracted by the humidification effect of the water in the Gurney stoves.

Moisture movement across the ceiling was generally from the cathedral to the roof space. This may have been caused by the extra moisture induced into the cathedral as in the previous monitoring period moisture moved backward and forward fairly evenly.

## **RESULTS AND CONCLUSIONS**

The results for the first year show that the inside of the cathedral does not suffer from extremes of temperature and relative humidity. The mass of the building fabric acts as a very effective “buffer” against sudden internal changes of conditions. The heating system has proved to be effective and the absence of temperature “layering” in such a large building is surprising.

Temperatures were reported to have been reduced for this session, this has worked well. The high, mid and low level temperatures for this period were 12.7, 12.7 and 12.6°C against 17.1, 16.9 and 16.5°C for Jan 1995. Relative humidities were correspondingly higher for this session.

Calculations have shown that there is no likelihood of condensation occurring on either the topside or underside of the painted ceiling with the present heating system and its method of control.

As previously mentioned, using a computer programme, it is possible to predict that condensation will probably occur between the roof boarding and the felt. This is backed up by visual evidence of staining on the boards. This is unlikely to cause problems as the moisture is likely to soak into the timber and then be gradually released as conditions improve. Condensation will also occur between the roof tiles and the felt, this will not create difficulties as the moisture will be on the outside of the roof space.

K Waterman. April 1996

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 (to whom a copy has been sent) 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.

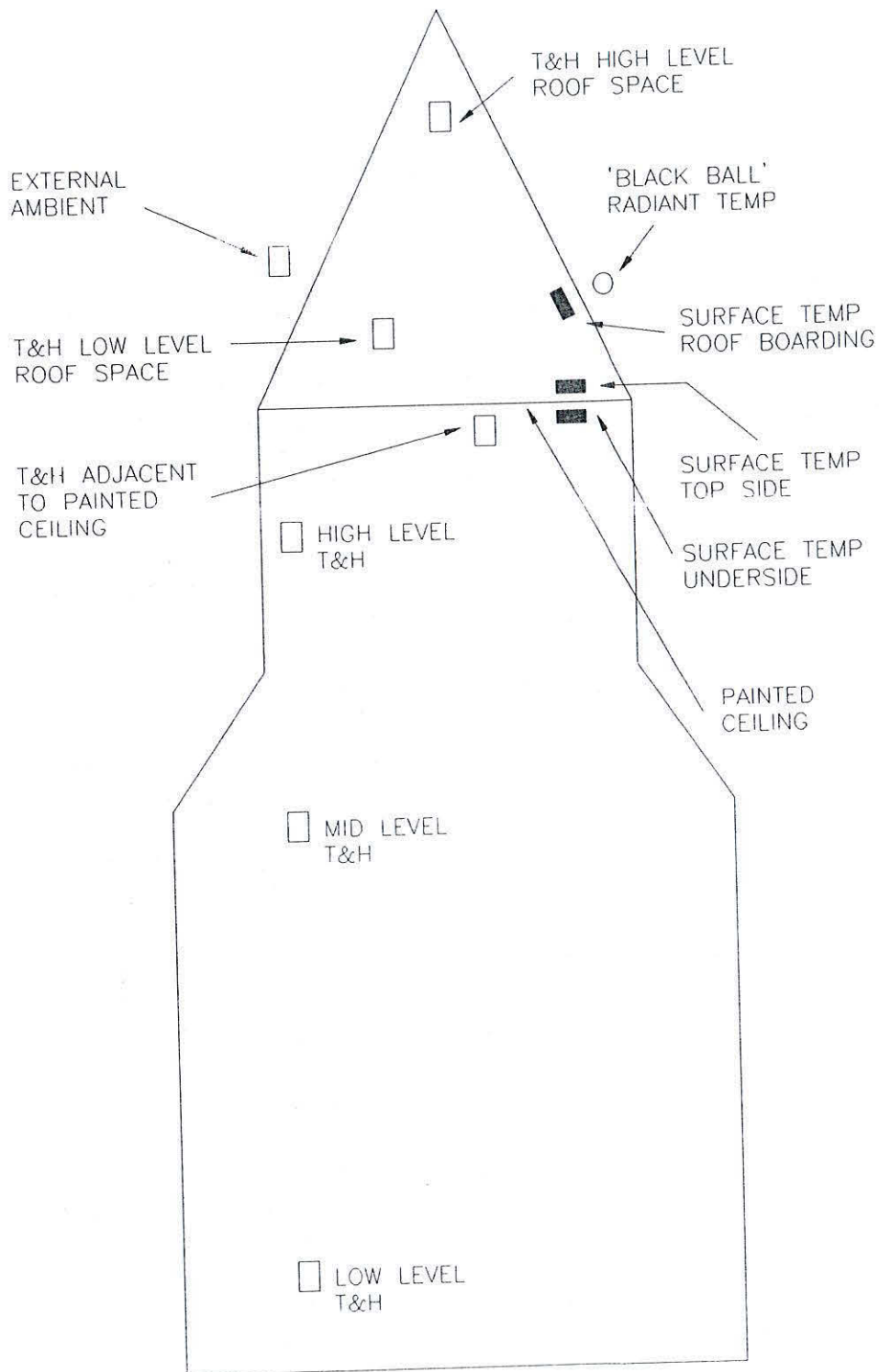
The advice which this report contains is of a preliminary nature given that so far as we are aware no firm commitment to carry out the work has yet been made. As and when you do decide to carry out the work then we are under an obligation to comply with the Construction (Design and Management) Regulations 1994 in respect of any element of the advice given which relates to the design of the work. We therefore need to be notified if you decide to proceed and will need details of the planning supervisor, principal contractor and any other designers appointed by you in connection with the project to enable us to comply with the duties imposed by the Regulations on designers.

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

This report/letter 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.

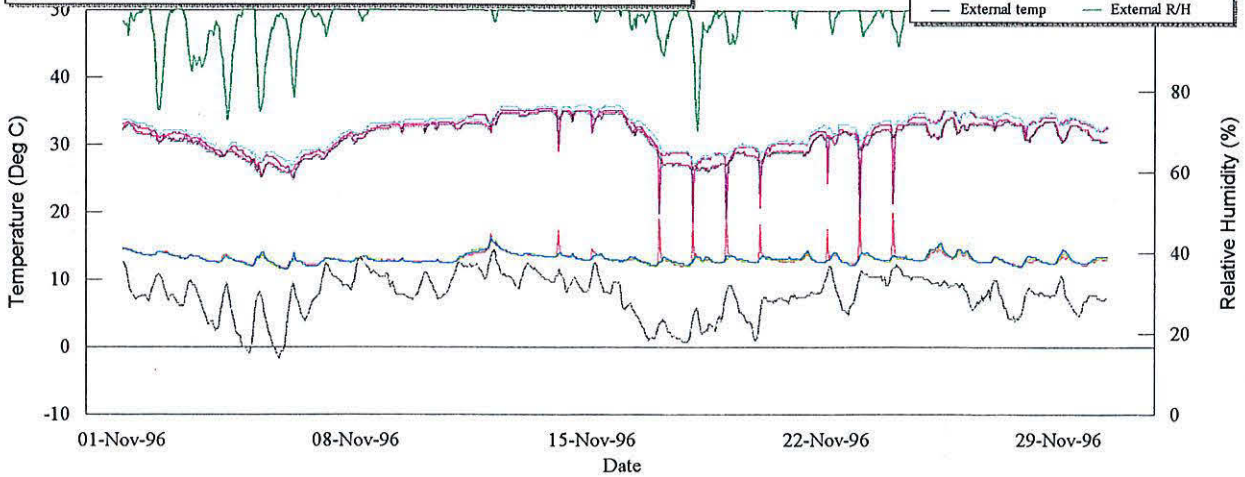
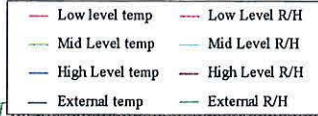
# PETERBOROUGH CATHEDRAL

## DESIGNATION OF SENSORS

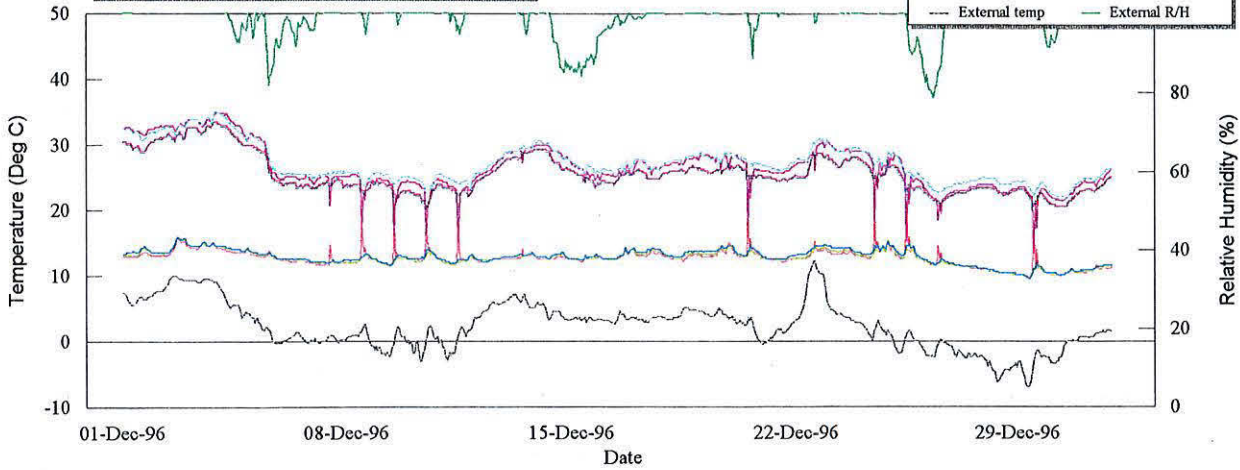
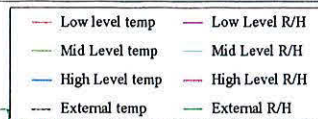


# PETERBOROUGH CATHEDRAL

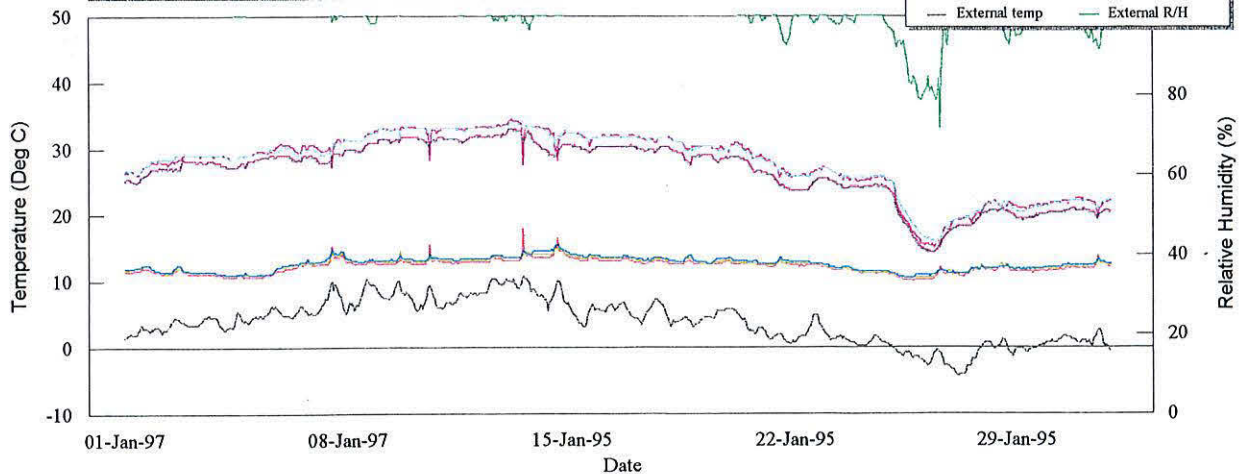
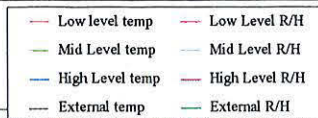
## Internal v External Conditions



## Internal v External Conditions



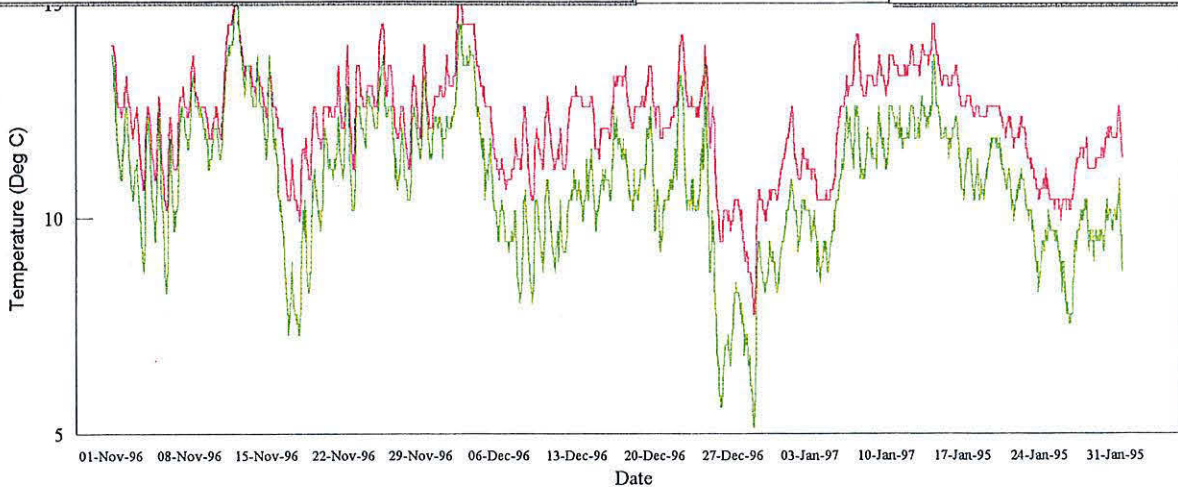
## Internal v External Conditions



# PETERBOROUGH CATHEDRAL

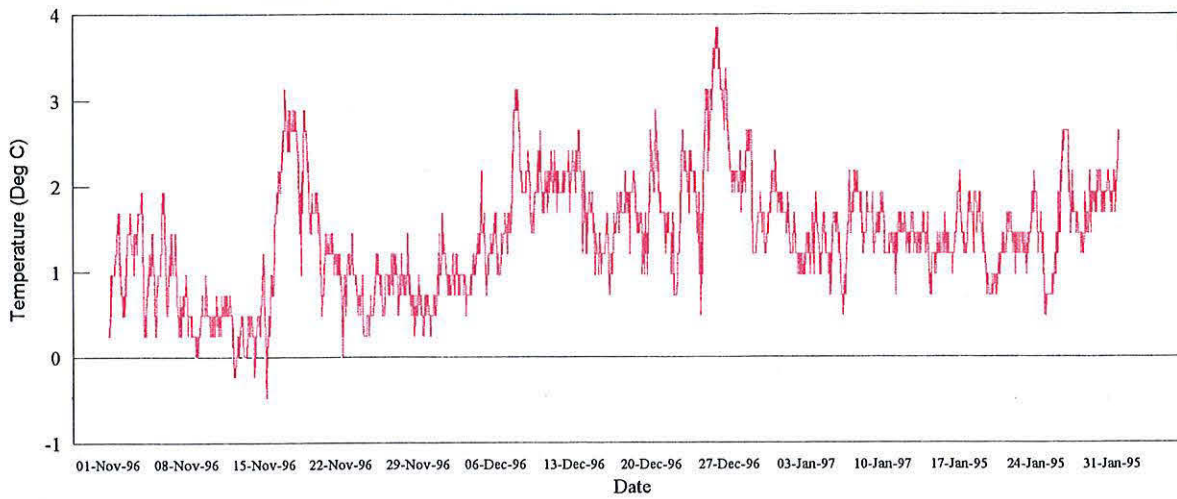
Temperatures either side of painted ceiling

— Underside temp  
— Topside temp



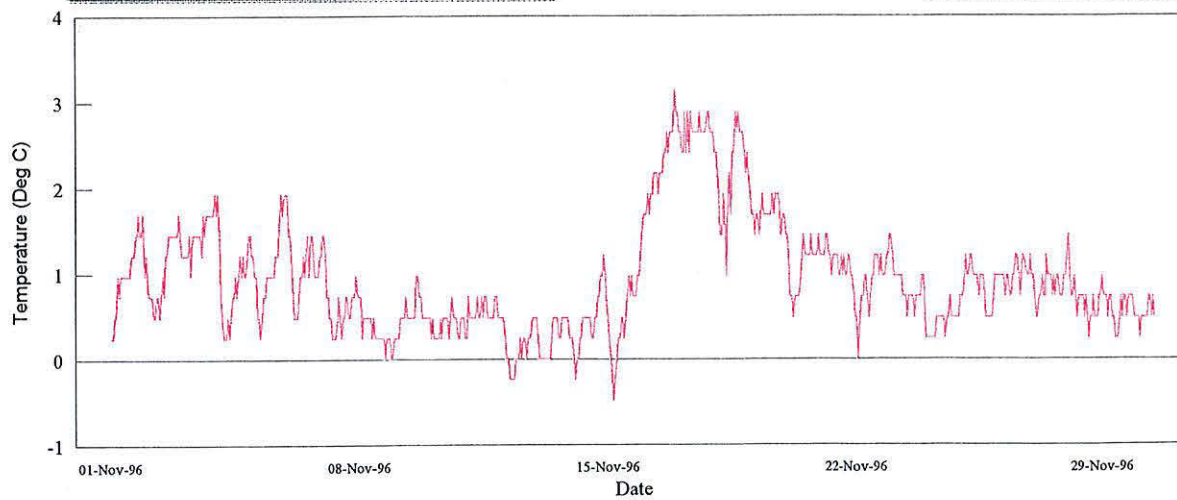
## Temperature difference across ceiling

— Underside minus topside



## Temperature difference across ceiling

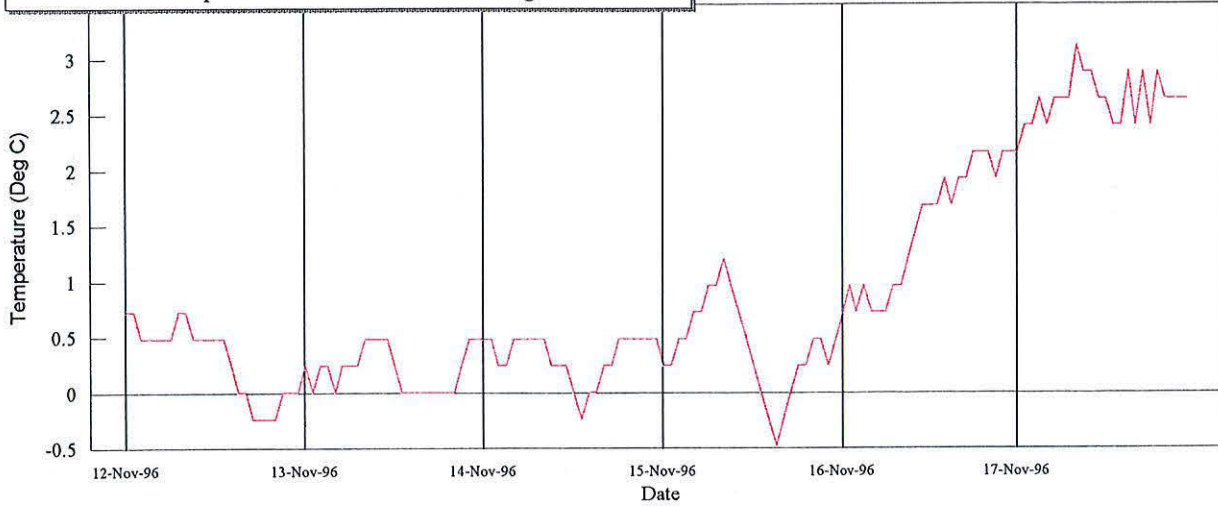
— Underside minus topside



# PETERBOROUGH CATHEDRAL

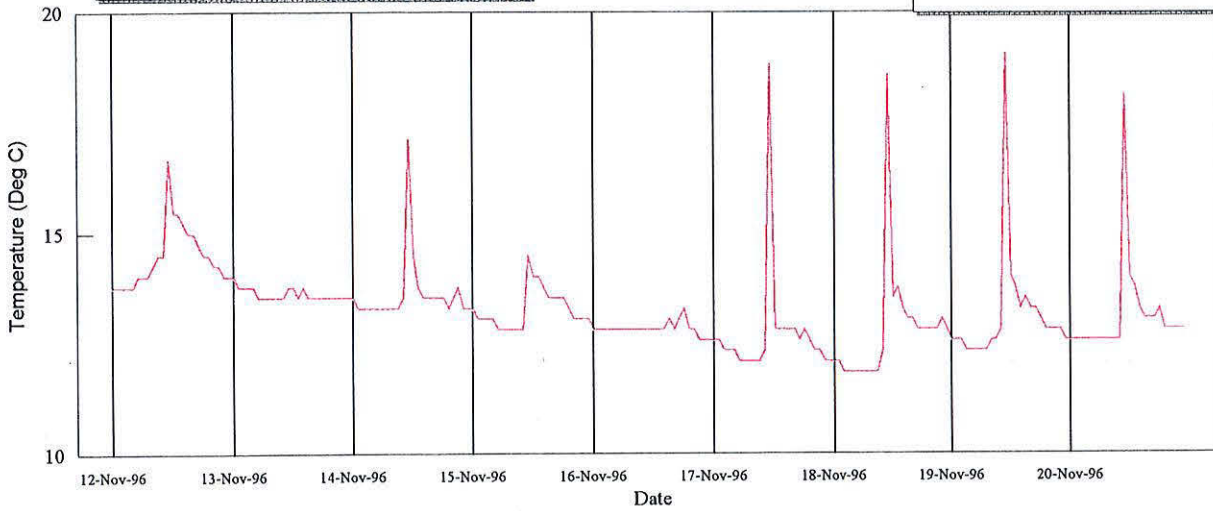
Temperature difference across ceiling

Underside minus topside



low level (pulpit) temperature

Low level temp

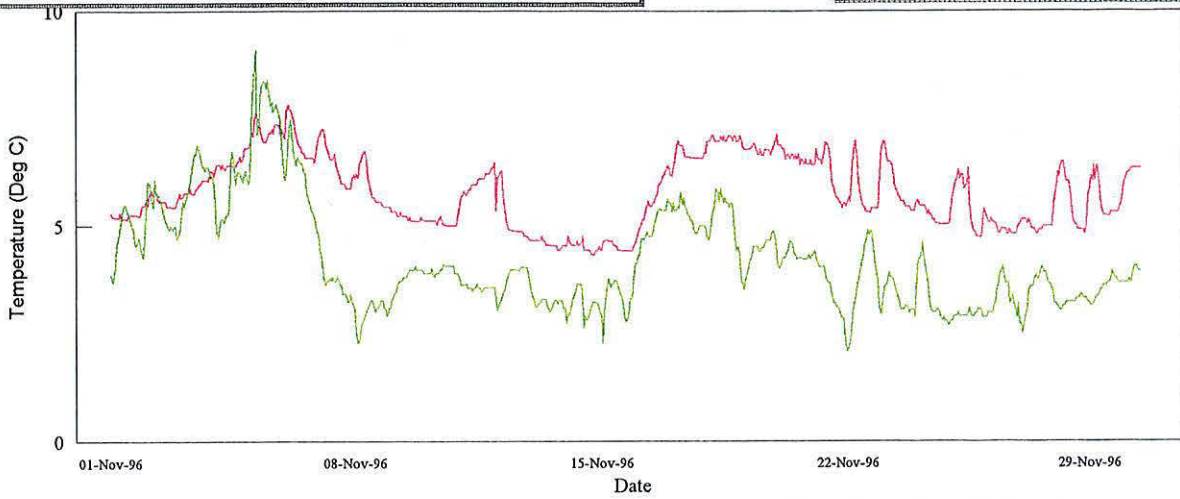




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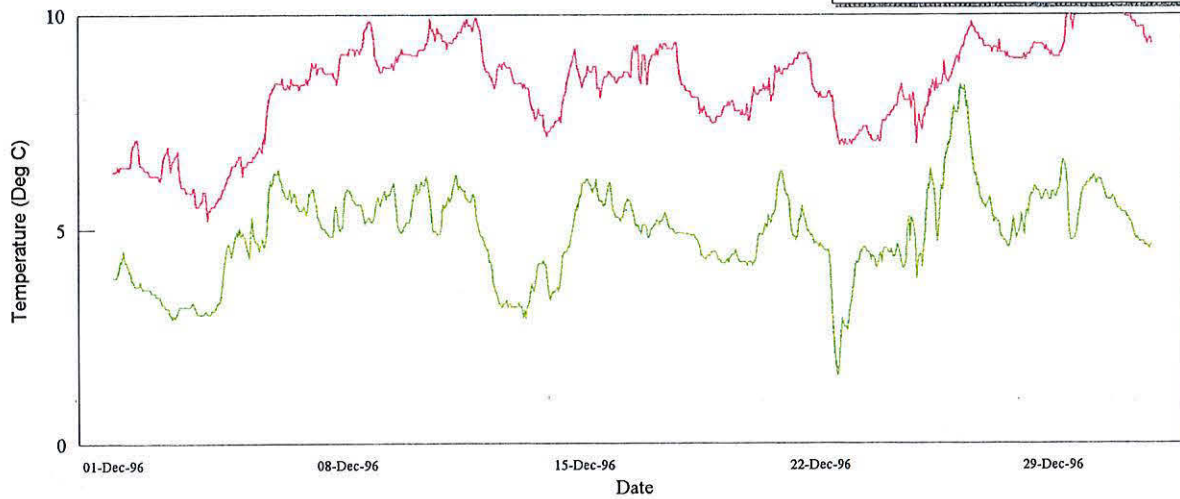
## Dewpoints

— Surface minus dewpoint underside ceiling  
— Surface minus dewpoint topside ceiling



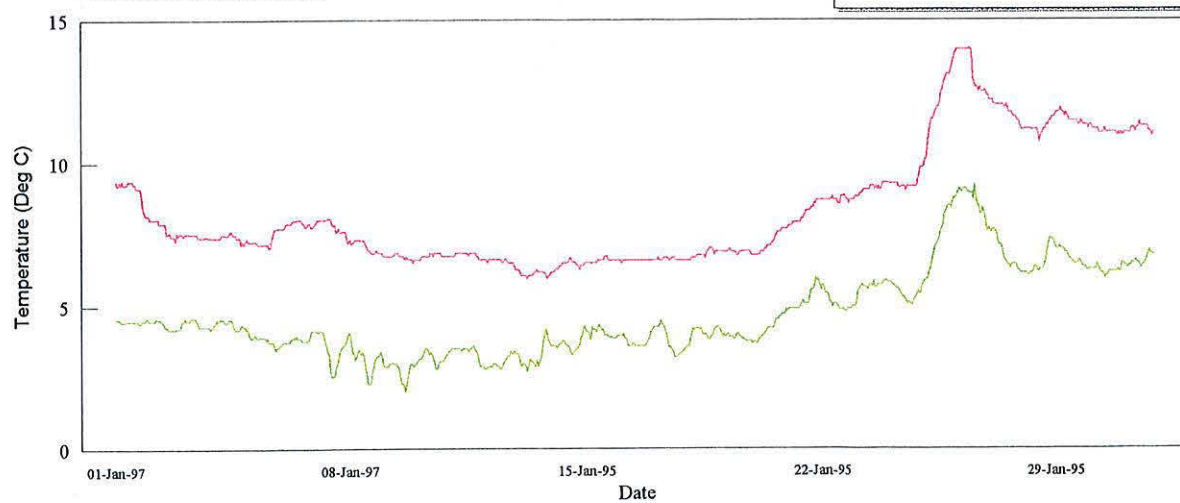
## Dewpoints

— Surface minus dewpoint underside ceiling  
— Surface minus dewpoint topside ceiling



## Dewpoints

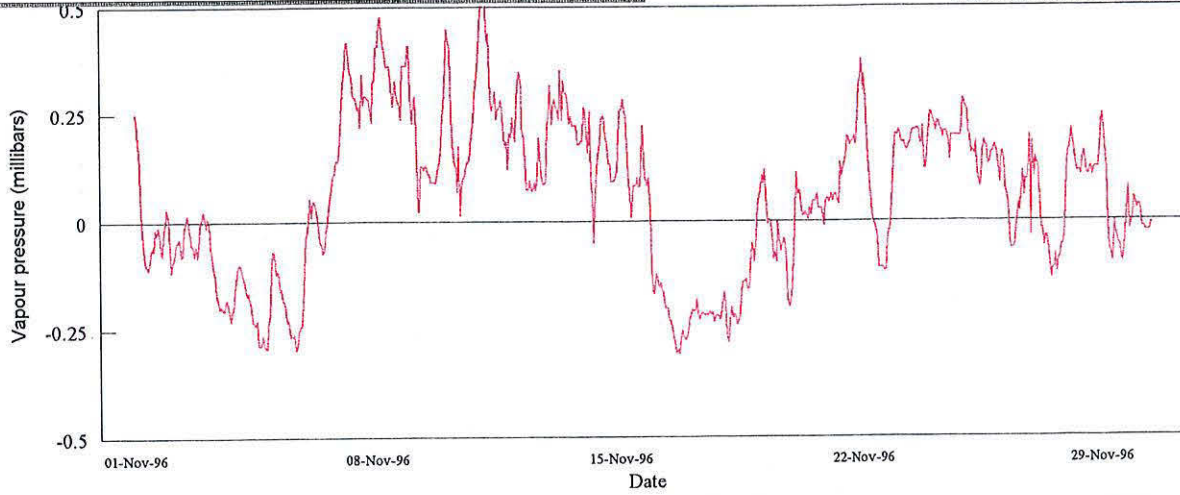
— Surface minus dewpoint underside ceiling  
— Surface minus dewpoint topside ceiling



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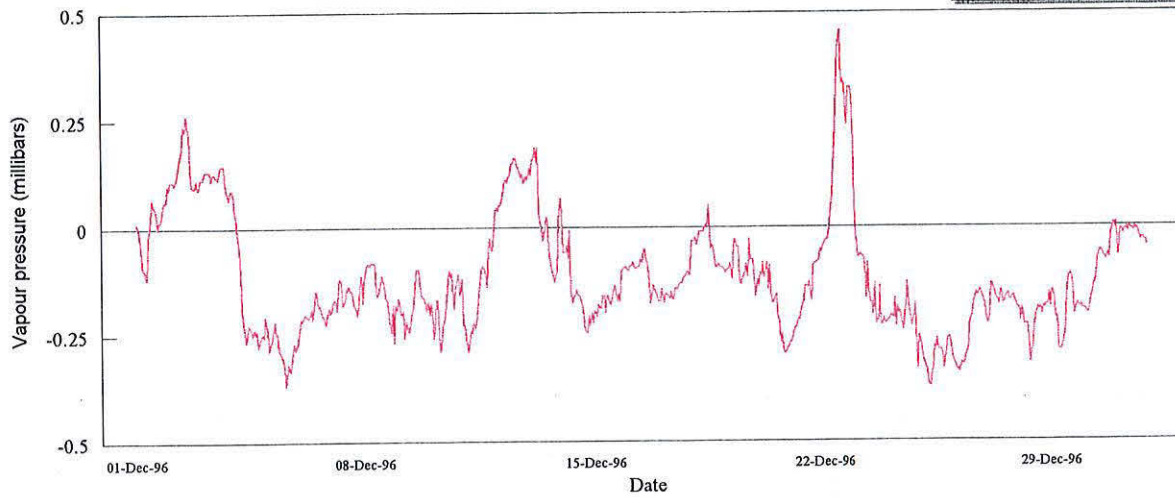
## Vapour pressure differences

External minus cathedral



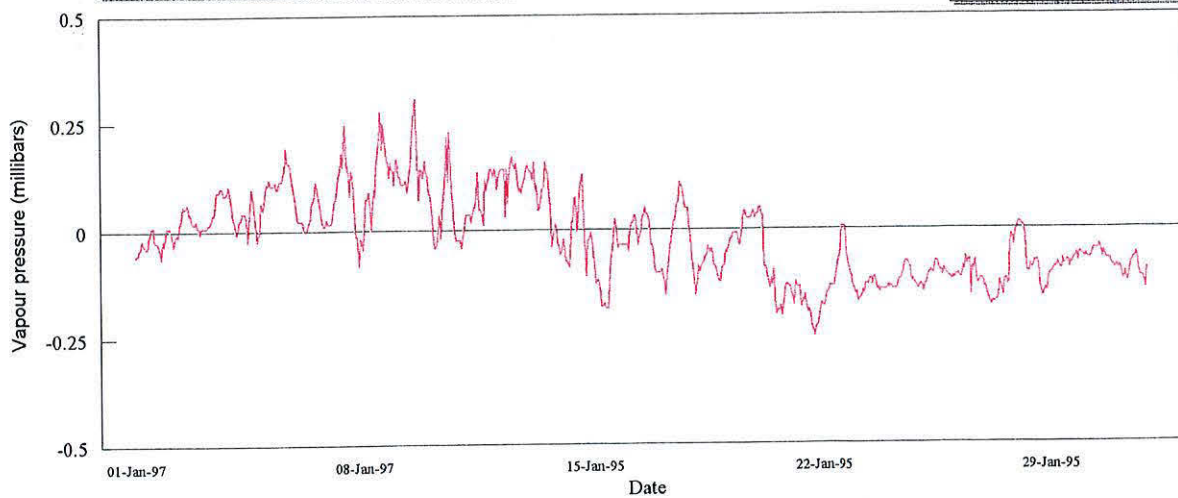
## Vapour pressure differences

External minus cathedral



## Vapour pressure differences

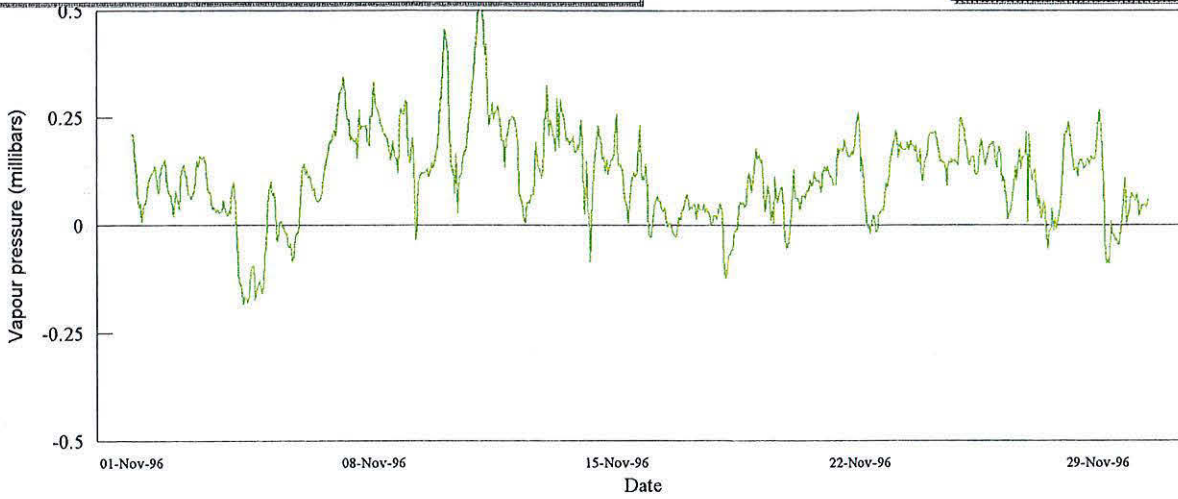
External minus cathedral



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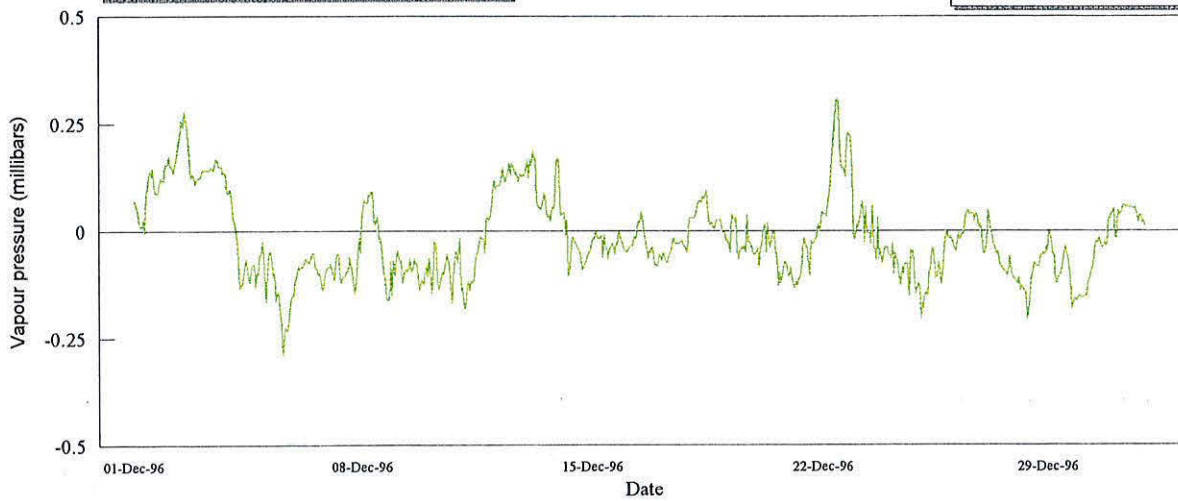
## Vapour pressure differences

External minus roof space



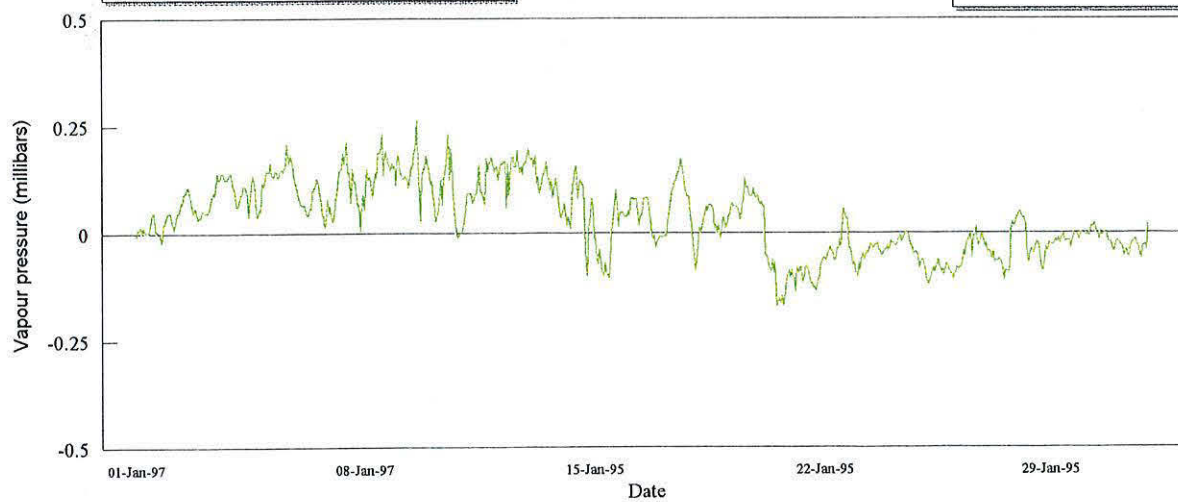
## Vapour pressure differences

External minus roof space



## Vapour pressure differences

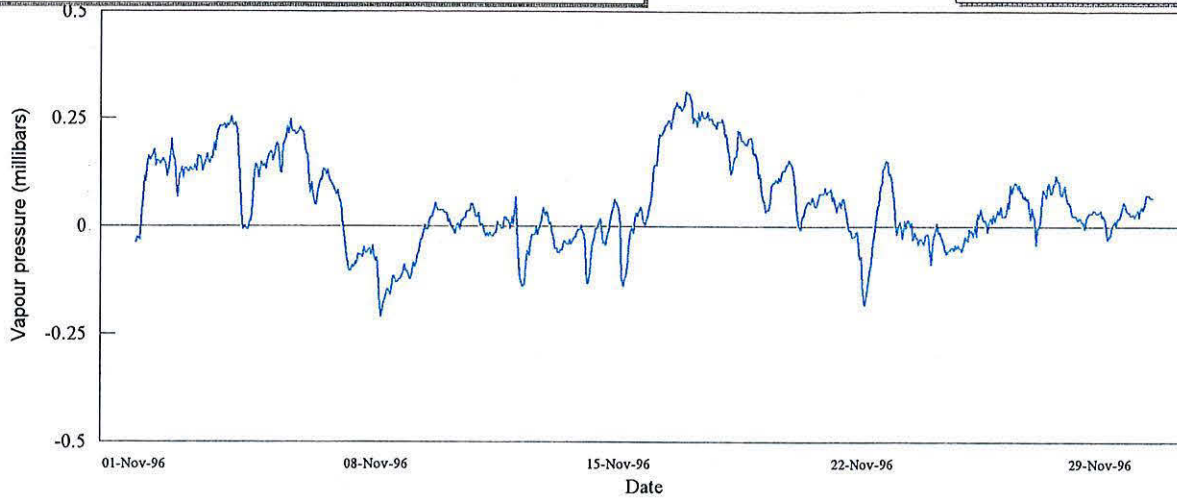
External minus roof space



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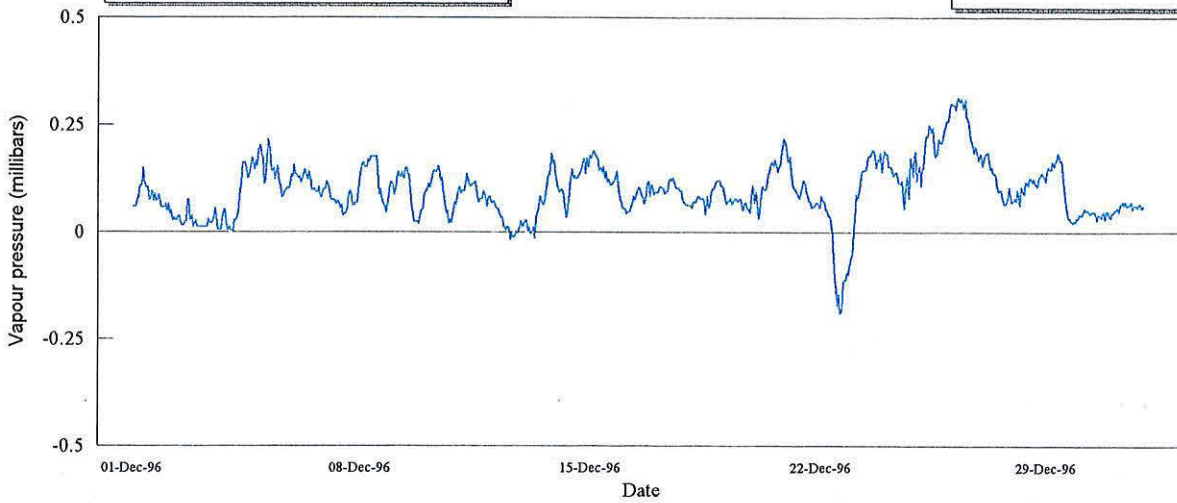
Vapour pressure differences

— Cathedral minus roof space



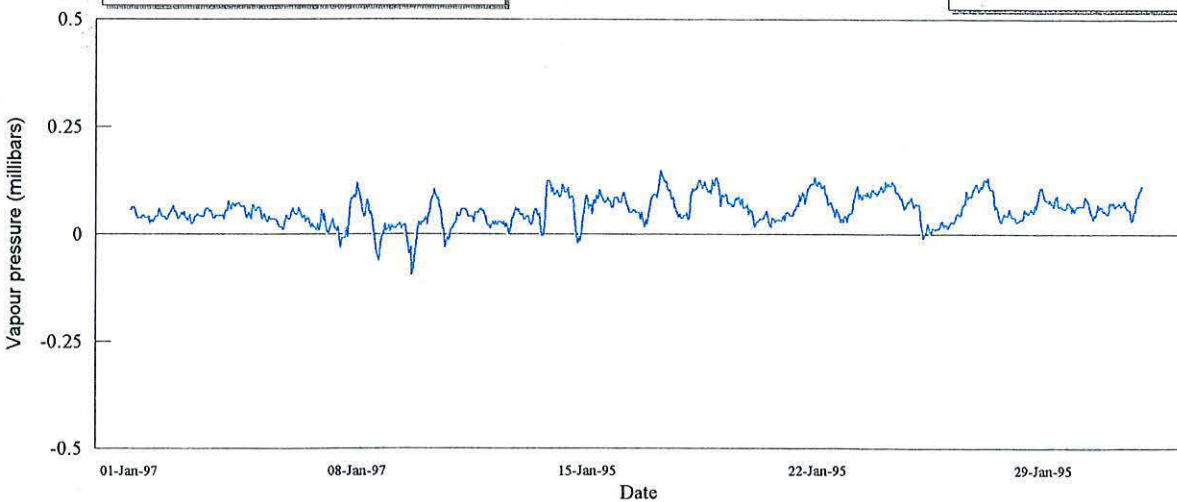
Vapour pressure differences

— Cathedral minus roof space



Vapour pressure differences

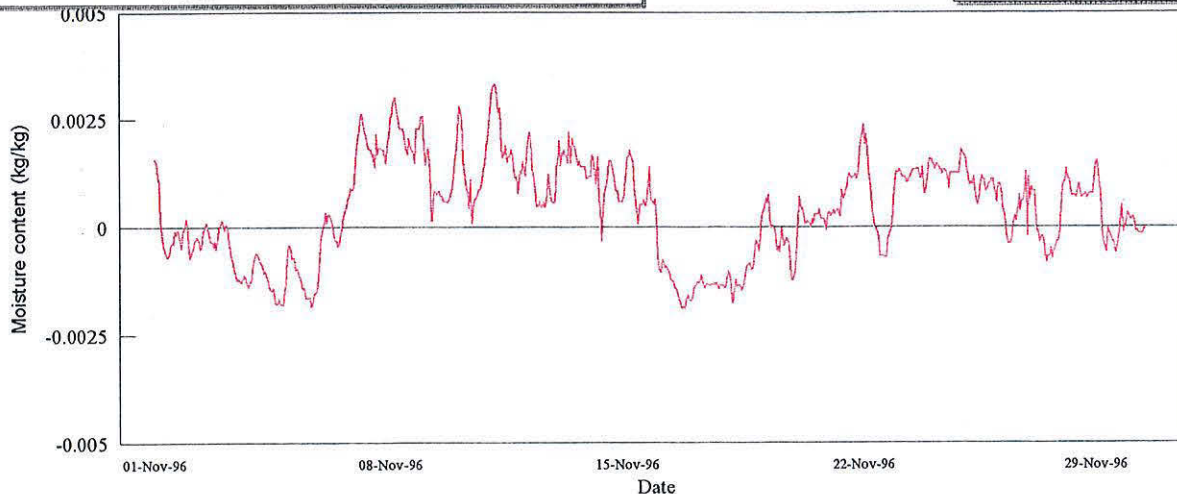
— Cathedral minus roof space



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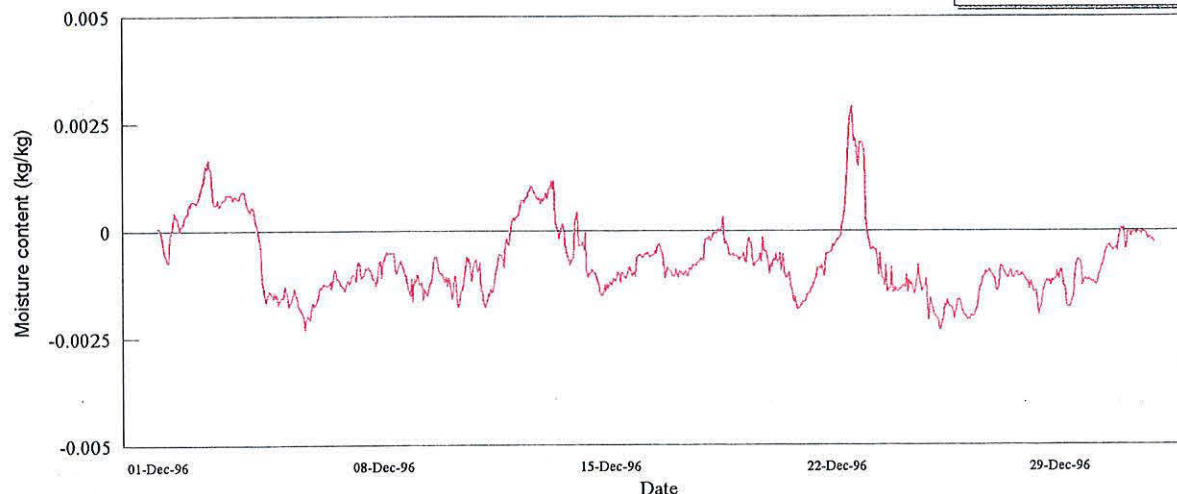
## Moisture content differences

External minus cathedral



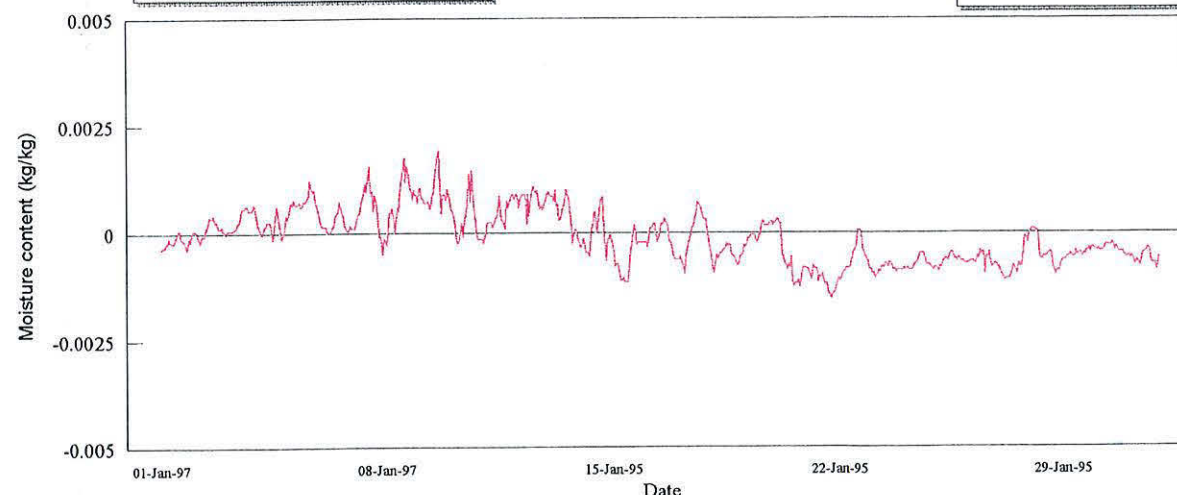
## Moisture content differences

External minus cathedral



## Moisture content differences

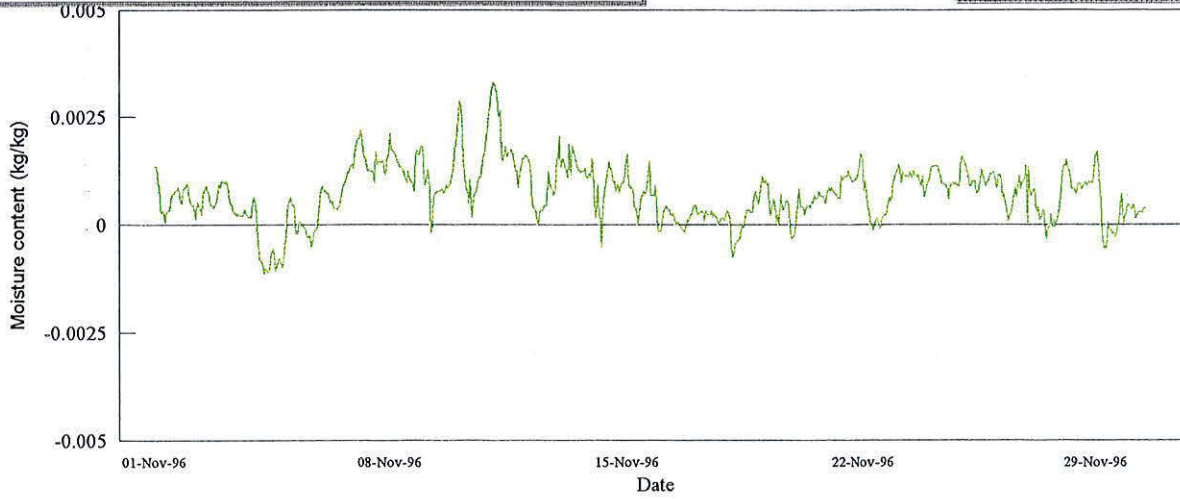
External minus cathedral



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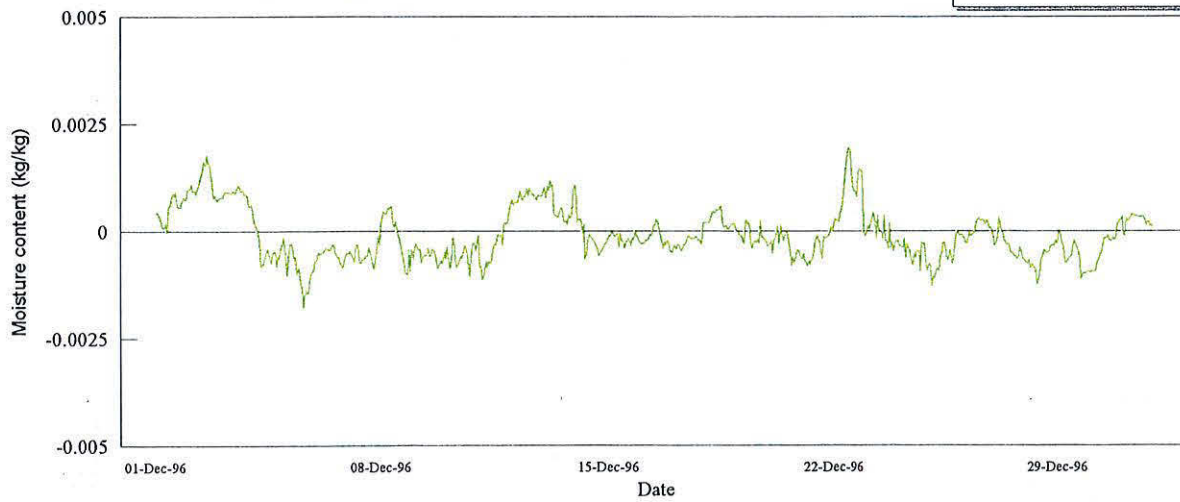
## Moisture content differences

External minus roof space



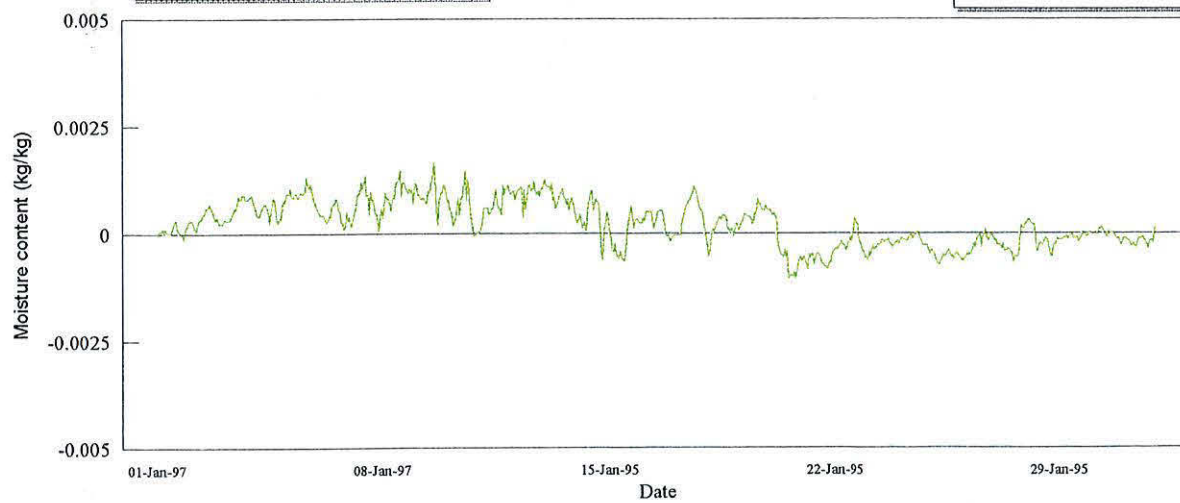
## Moisture content differences

External minus roof space



## Moisture content differences

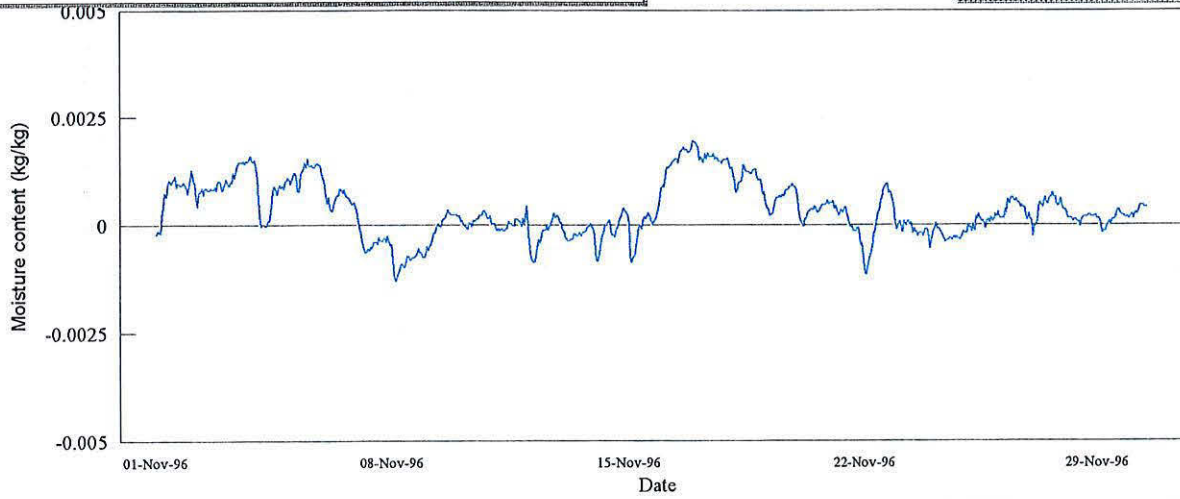
External minus roof space



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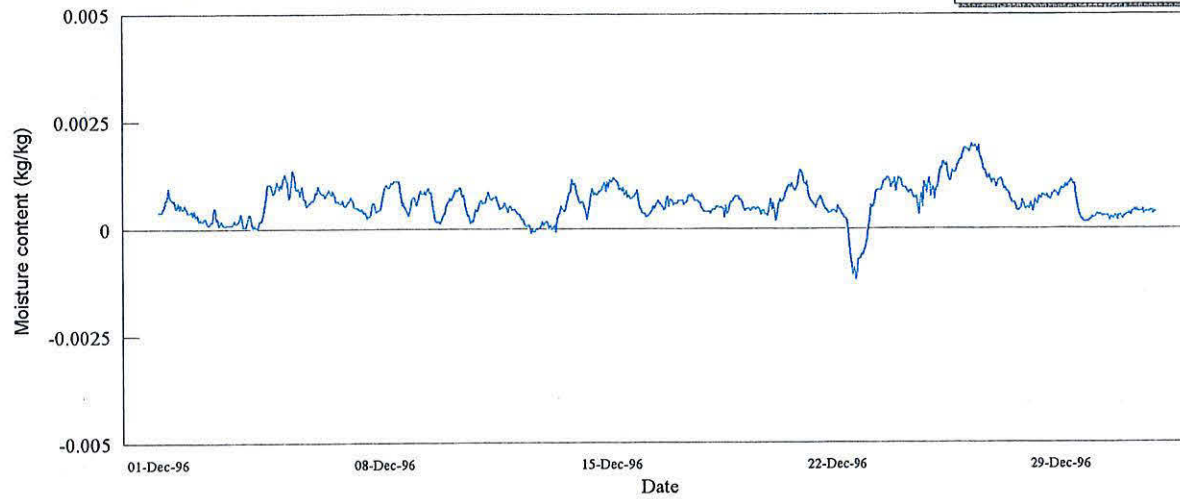
## Moisture content differences

— Cathedral minus roof space



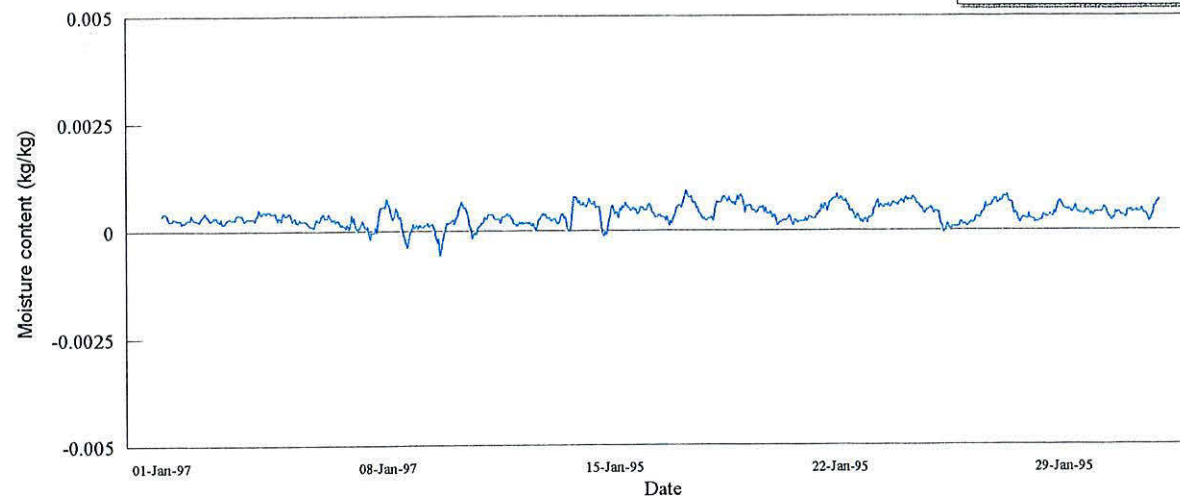
## Moisture content differences

— Cathedral minus roof space



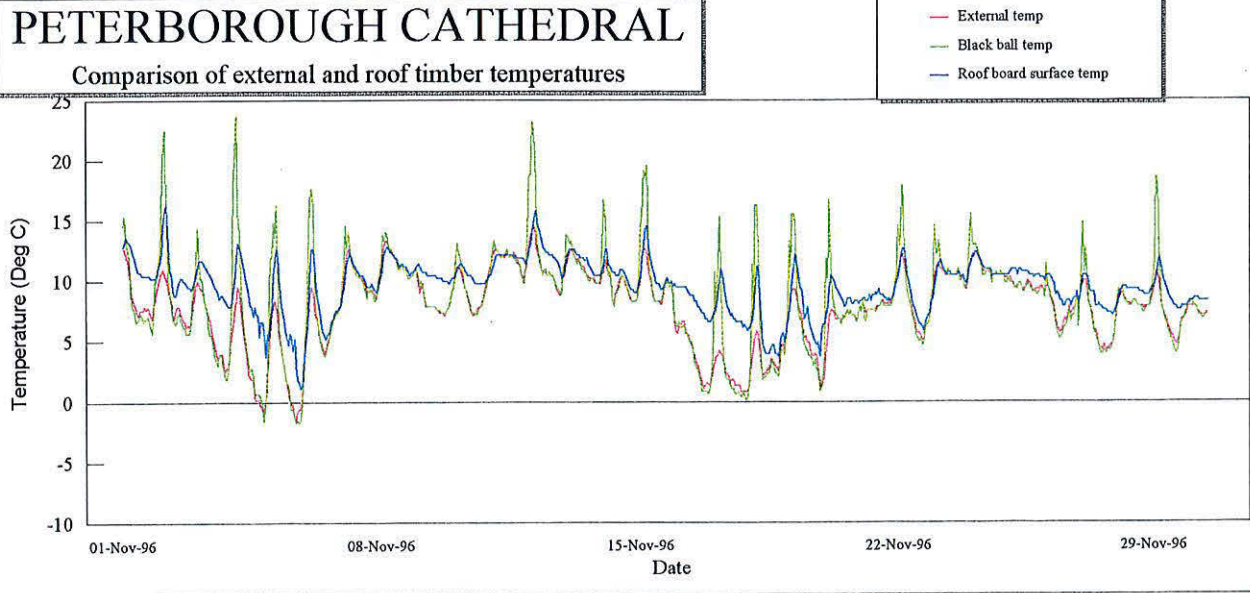
## Moisture content differences

— Cathedral minus roof space

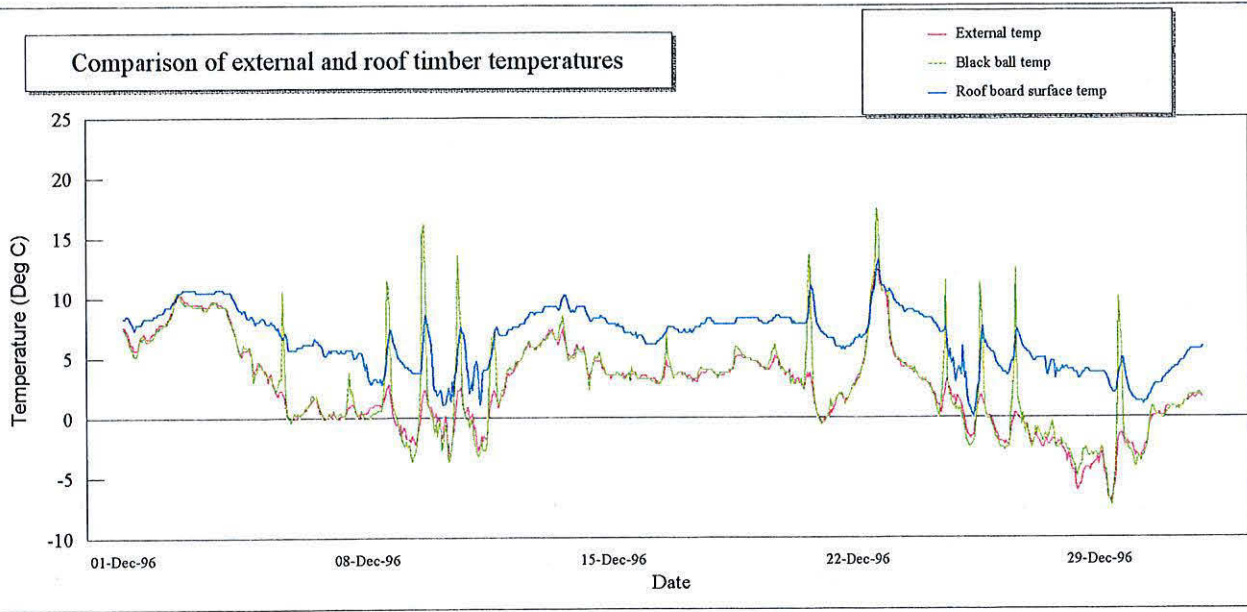


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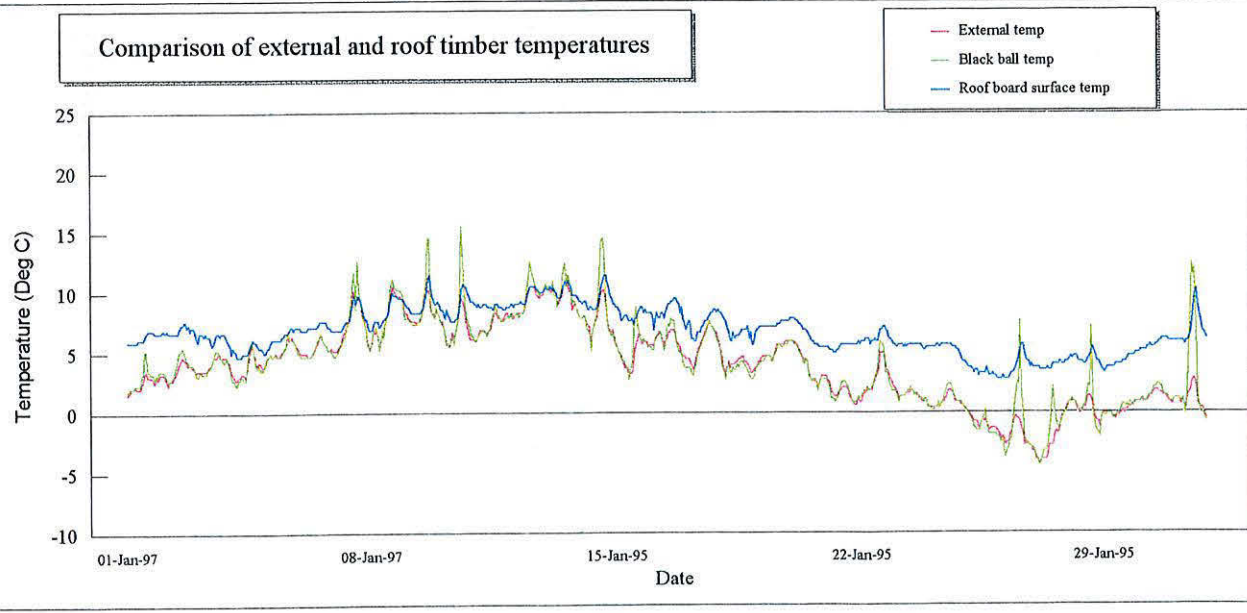
## Comparison of external and roof timber temperatures



## Comparison of external and roof timber temperatures



## Comparison of external and roof timber temperatures

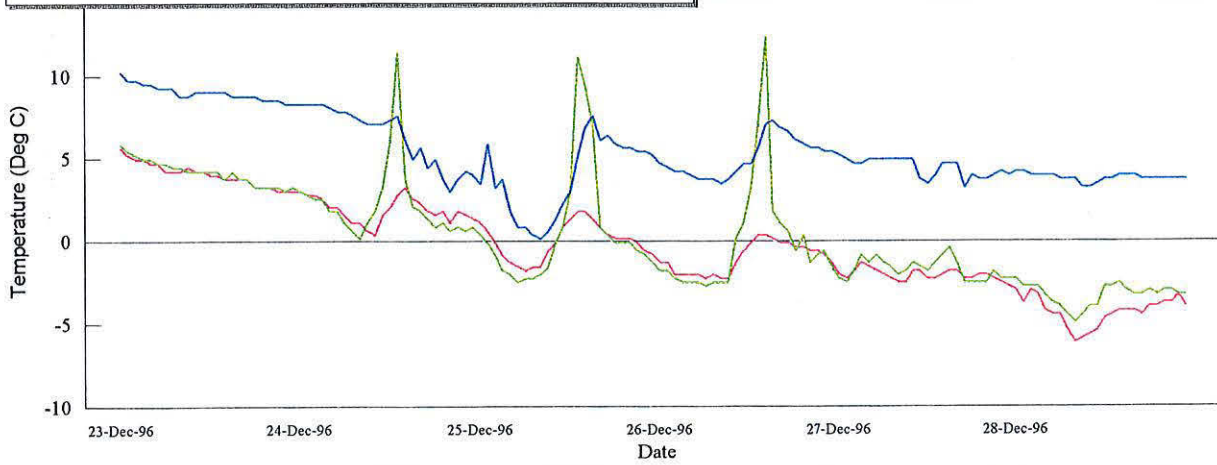




# PETERBOROUGH CATHEDRAL

Comparison of external and roof timber temperatures

- External temp
- Black ball temp
- Roof board surface temp



GRAPH 33