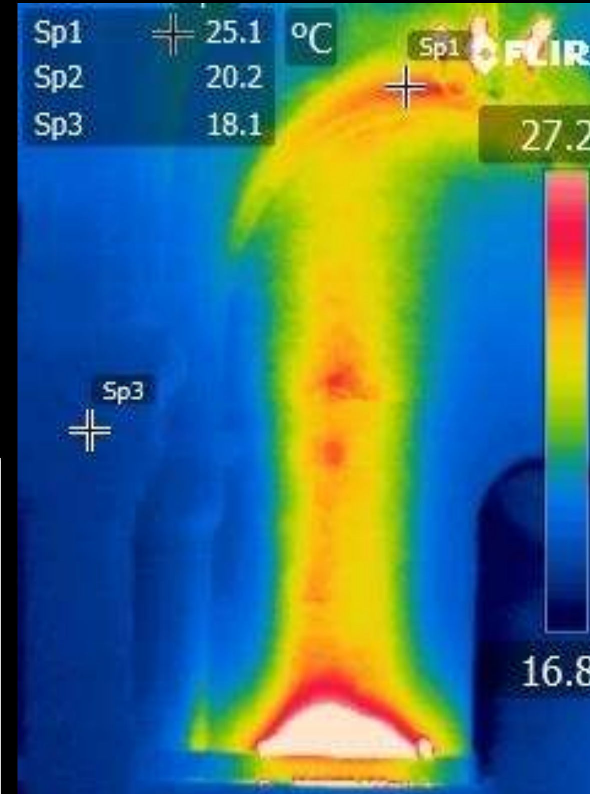
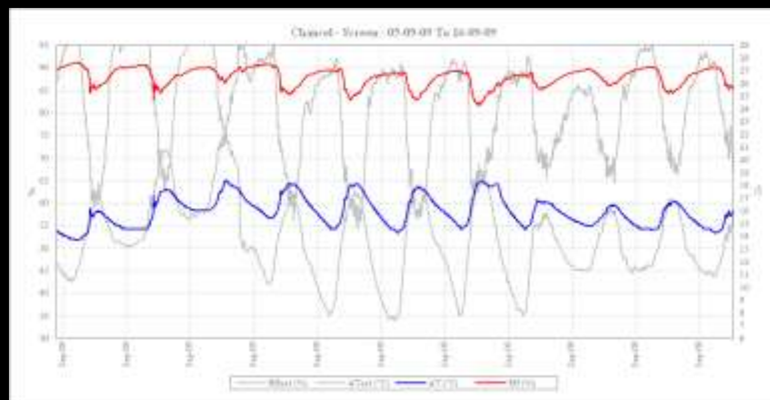
Building Conservation and Environment: Commissioning useful research and understanding practical results

Tobit Curteis Associates LLP


Sp1 25.1
Sp2 20.2
Sp3 18.1
°C
Sp1
FLIR
27.2
Sp3
16.8



❖ What is Building Environment. Why does it matter

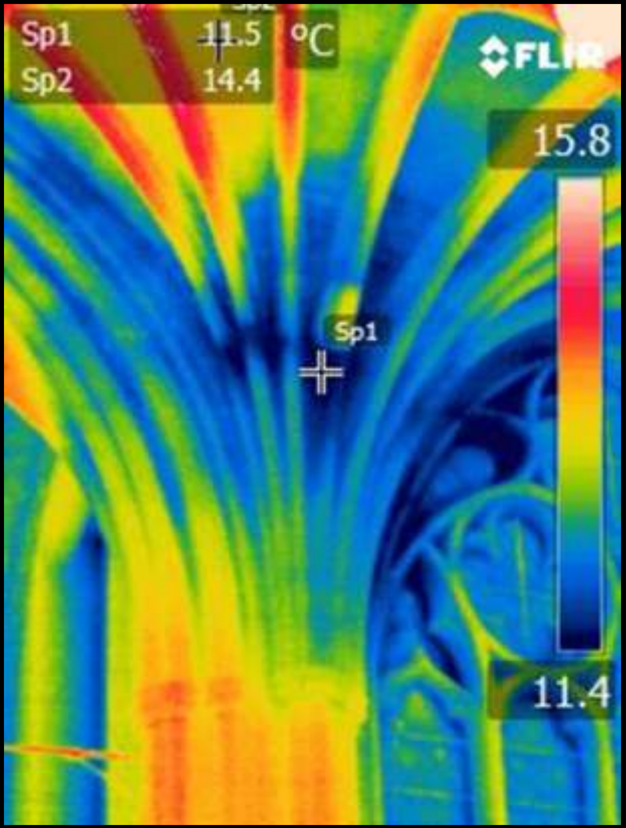
- Conditions to which historic fabric is exposed- moisture/ heat/ light
- Greatest agent of deterioration outside mechanical change
- Direct impact on energy efficiency/ cost
- We try and manipulate it for human comfort rather than building stability

Historic building environment is driven by the weather (very different to modern buildings)

❖ Defining the Questions – what do you want to know

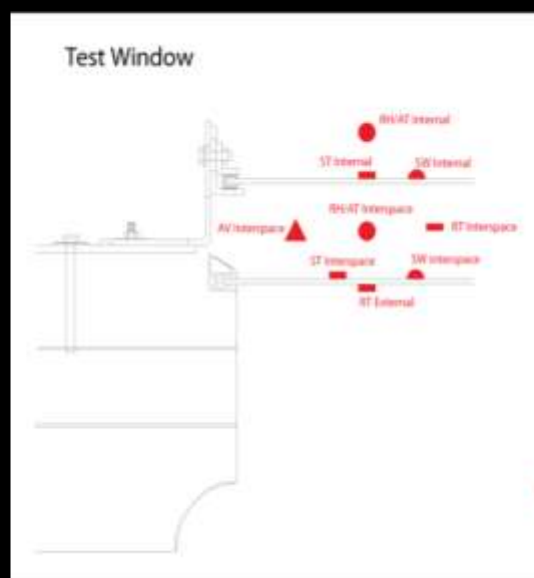
- ➢ Background Conditions (benchmark data)
- ➢ Specific Failures
- ➢ Specific Developments
- ➢ Exhibitions and Displays
- ➢ Building Performance

- Background Conditions (benchmark data)
  - Establish how a building performs before any problems or changes occur so when they do, you have the information available - allows long term planning. (building envelope/ rainwater disposal/ microclimate)



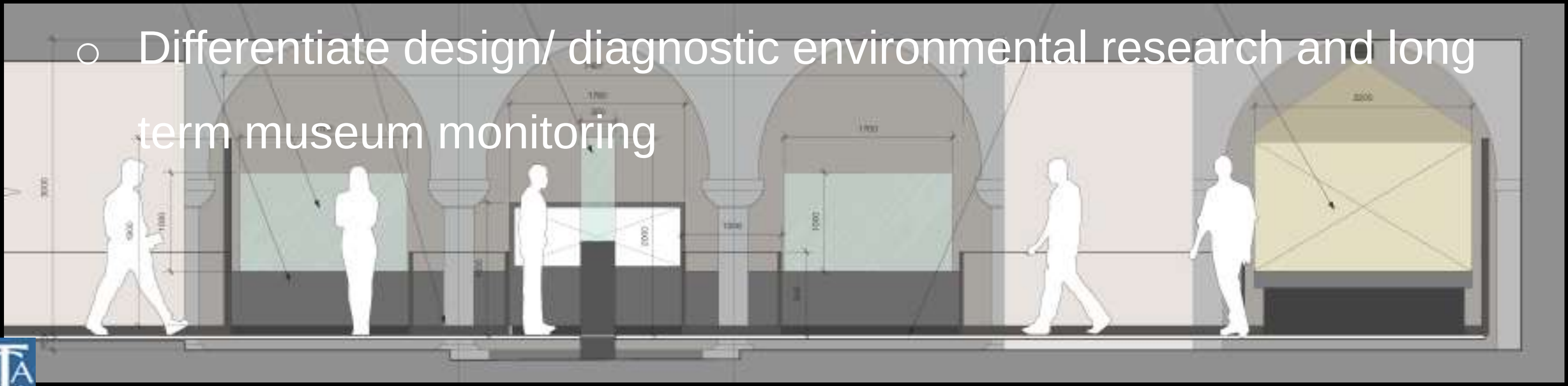
- Specific Failure
  - Damage to stonework/ fabric
  - Damage to artefacts
  - Discomfort of users

- Specific Developments
    - Glass doors to promote visual accessibility
    - Conservation measures – protective glazing
    - Heating changes anticipated
        - *Difference between heating engineer monitoring and performance/conservation monitoring.*
        - *Working with heating advisors/ M&E consultants/ heating engineers*

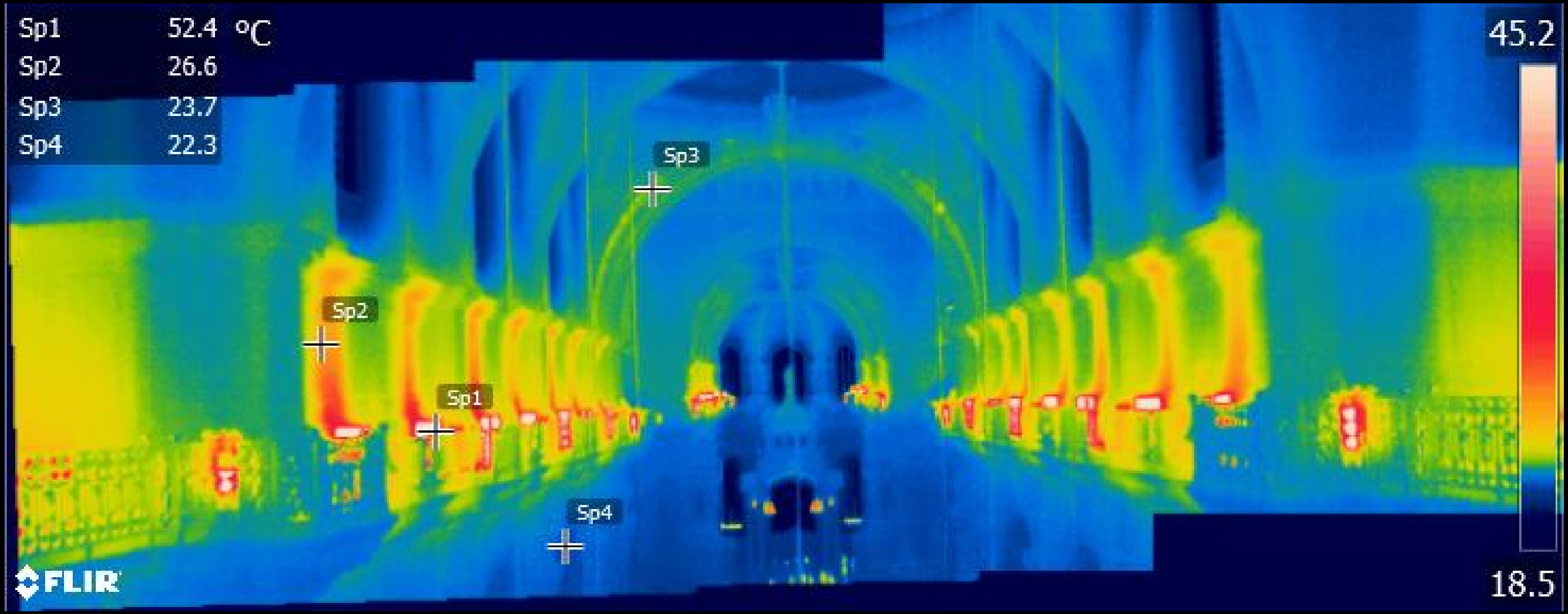


CAROE ARCHITECTURE LTD & MATTHEW LINTON FORD

- Exhibitions and Displays
  - Establish present conditions and risks
  - Design control measures
  - Evaluate impact of exhibition changes on historic fabric
  - Working with exhibition designers/ case manufacturers/ project managers/ architects
  - Most exhibition experience (designer/ conservator/ curator) is in museums – not uncontrolled cathedrals
  - Get building performance advice very early
  - Differentiate design/ diagnostic environmental research and long term museum monitoring

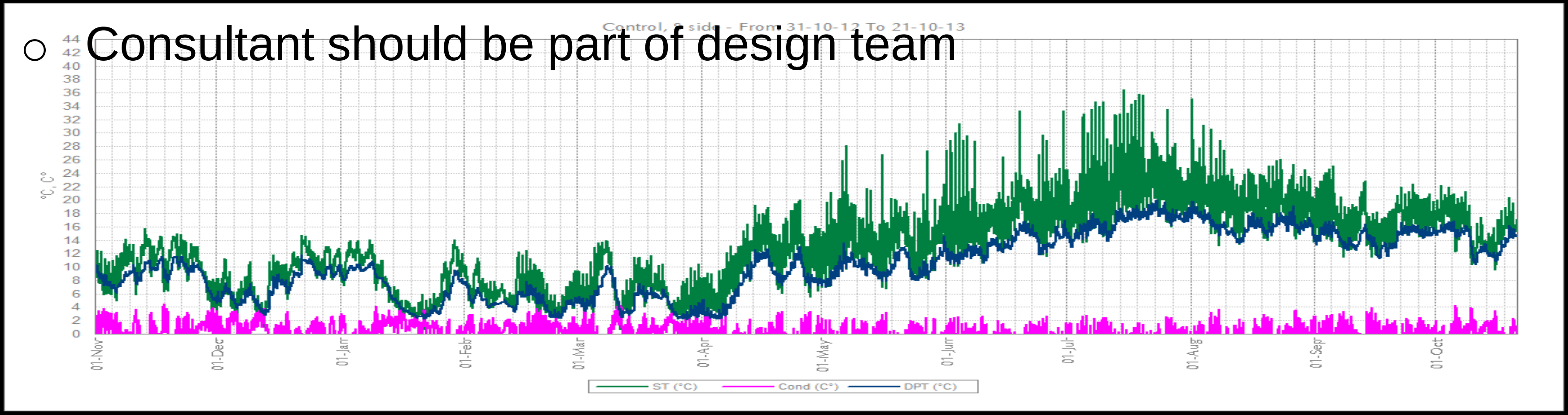


- Building Performance
  - Building heat is uncomfortable
  - Energy costs/ carbon footprint is unnecessarily high
  - Building fabric is deteriorating
  - Difference between building performance/ conservation specialist and consulting engineer.



❖ Commissioning Useful Research

- Identify the right discipline and consultant (moisture survey, engineering survey, MBG survey etc.)
- References/ methodology from similar projects
- Define the questions in <u>collaboration</u> with consultant and core project team (architect, client)
- Don’t produce a specification which is too prescriptive
- Don’t define tools – identify aims/ deliverables
- Consultant should be able to explain methodology and techniques
- Consultant should be part of design team



❖ Environmental Survey: Sequence and tools

- Preliminary environmental assessment
    - Physical history
    - Current building condition (deterioration types/ patterns)
    - Rainwater disposal system
    - Microclimate

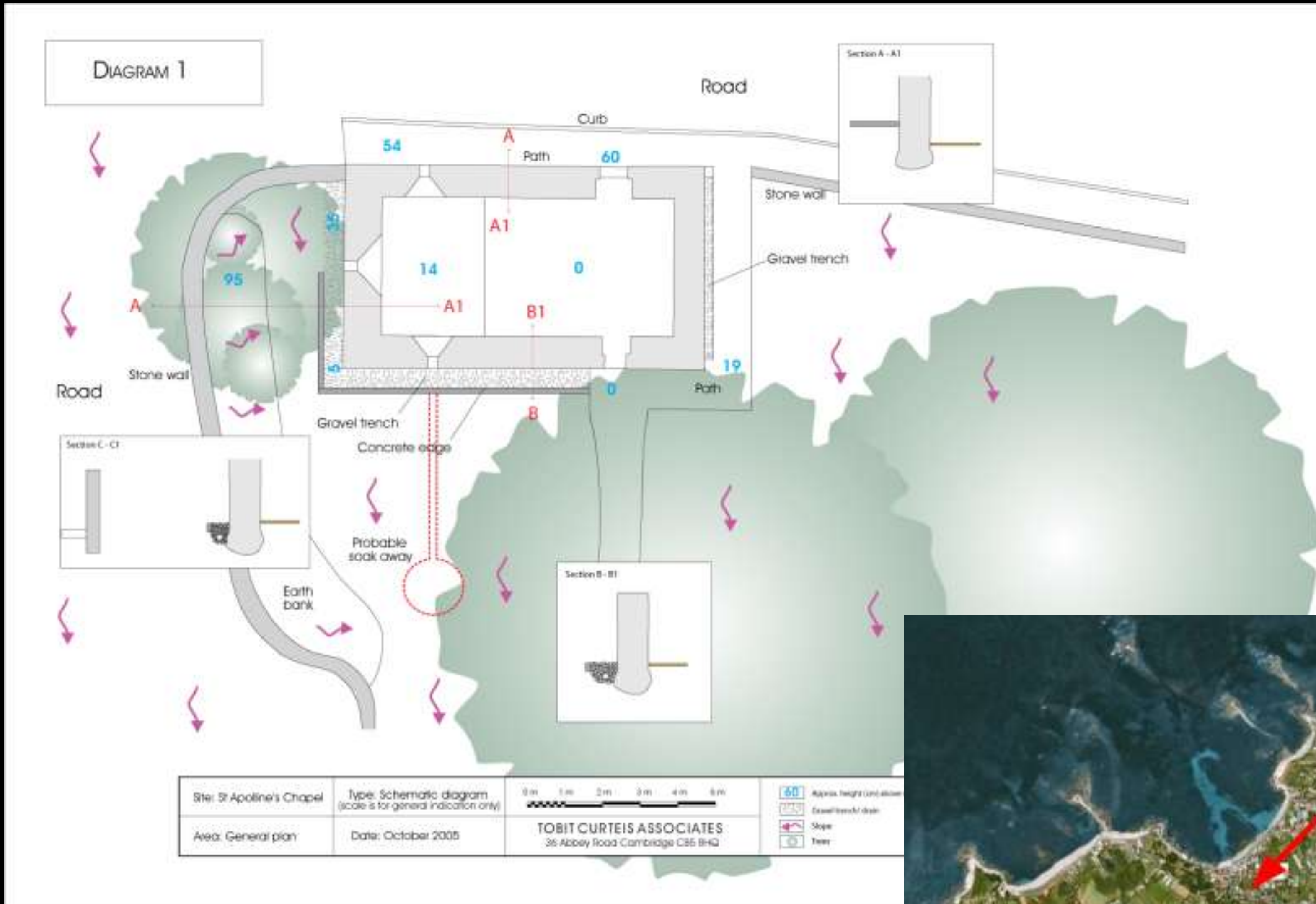
        Anticipated performance

        Actual performance

        Artificial influences (heating/ visitors)
    - Preliminary conclusions
    - Further research (if necessary)

Tools for investigations

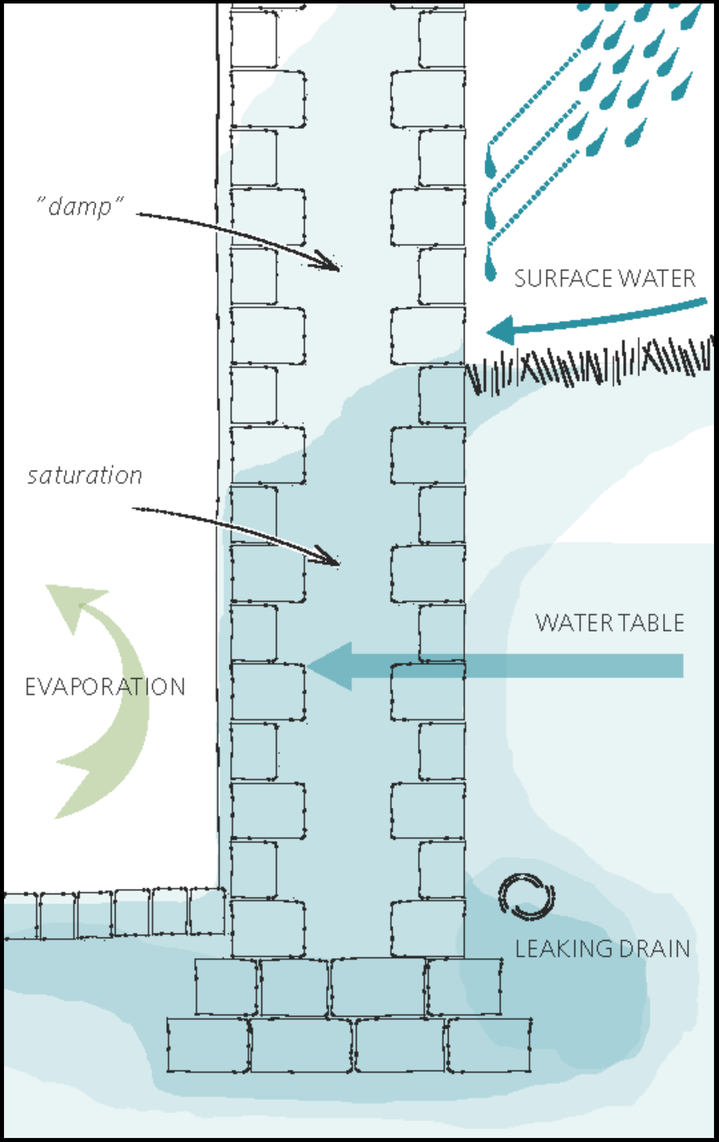
Basic building examination



GEOGRAPHY & MACRO CLIMATE

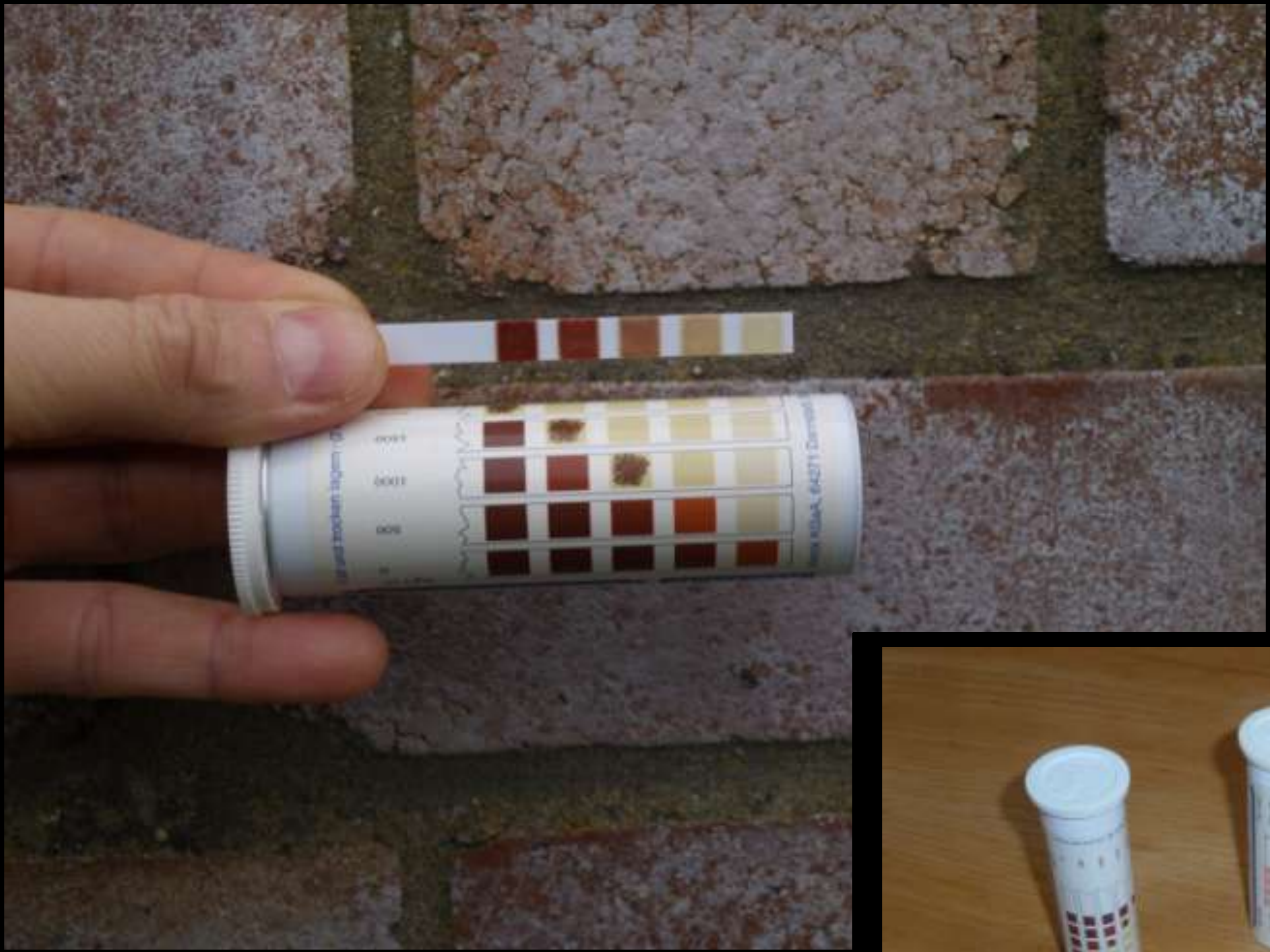
(MAPPING TOOLS ONLINE DATA)

Understand Rainwater disposal (local opening up)

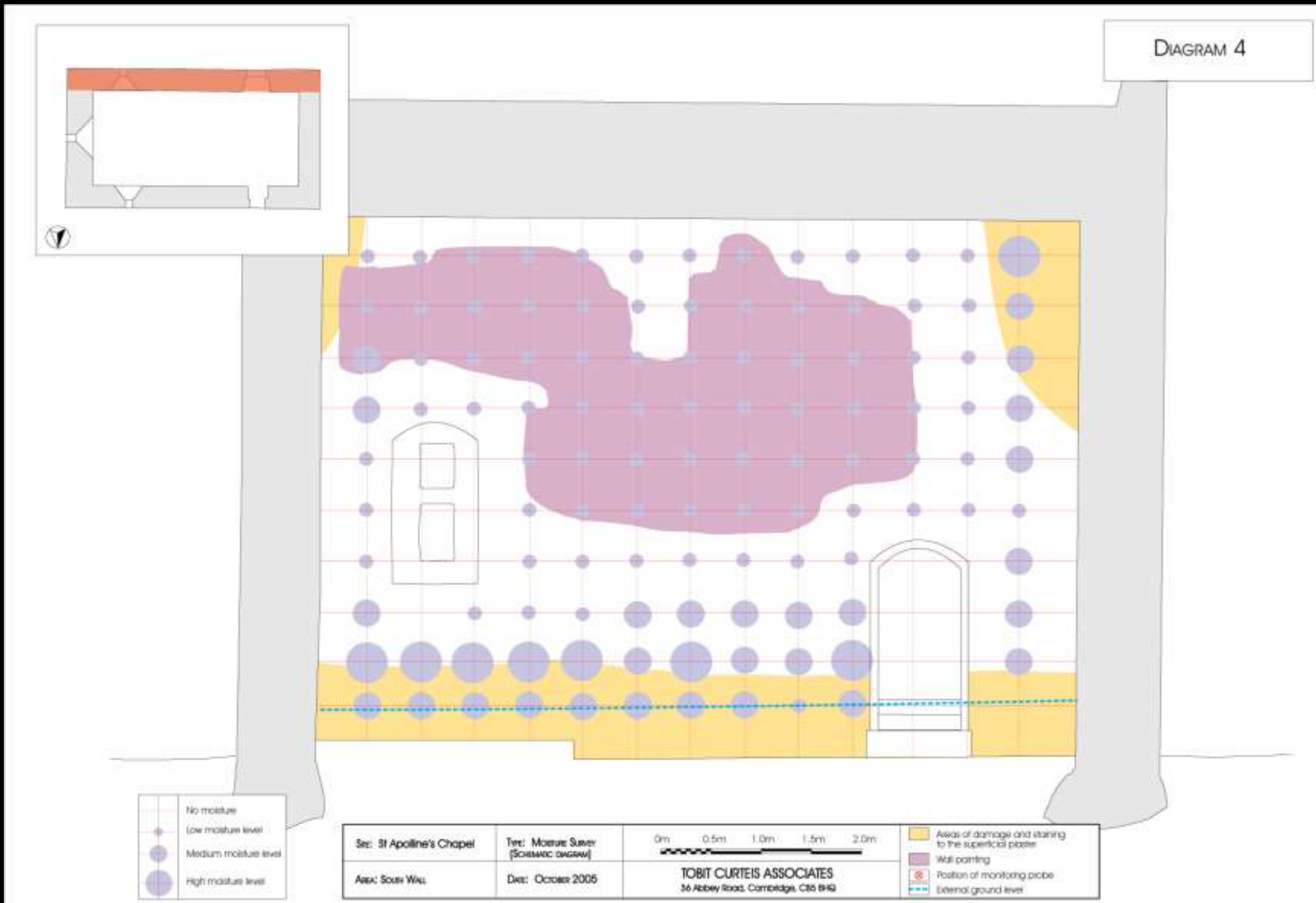


SUPERFICIAL MOISTURE MAPPING

HUMIDITY, TEMPERATURE, LIGHT, UV RADIATION

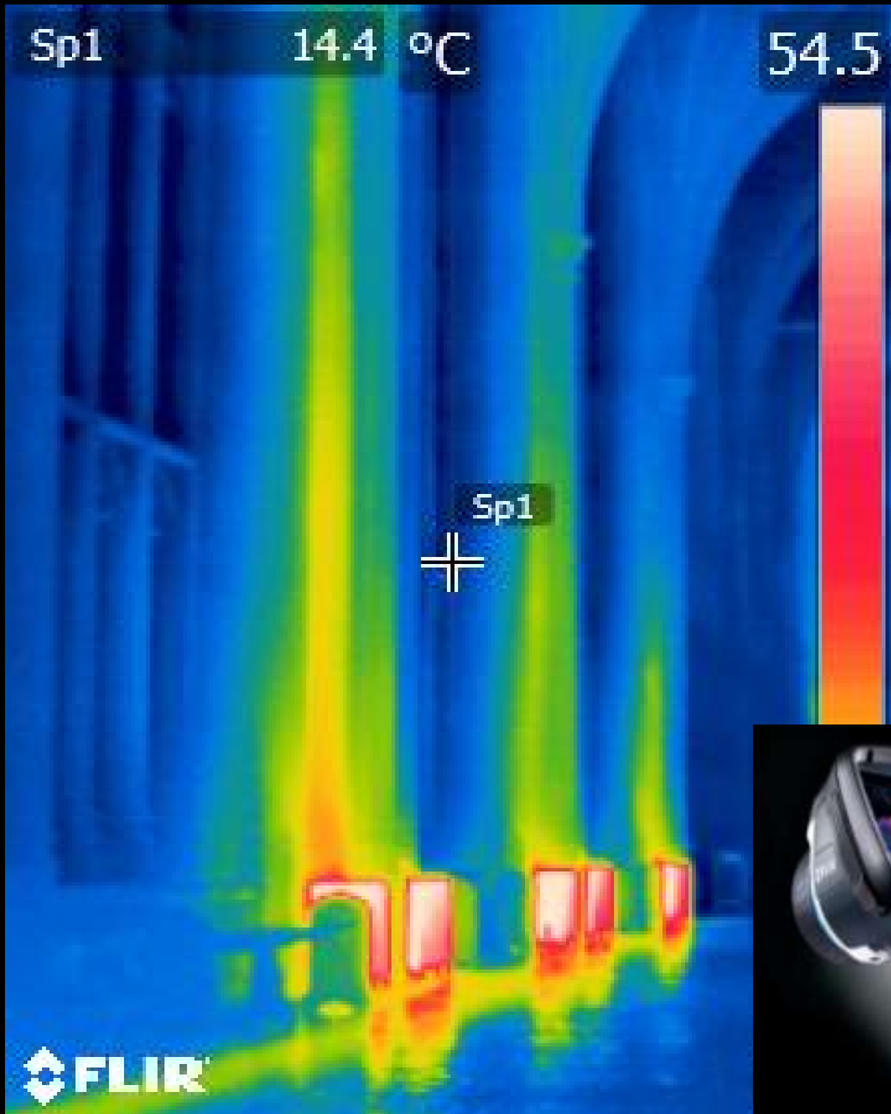


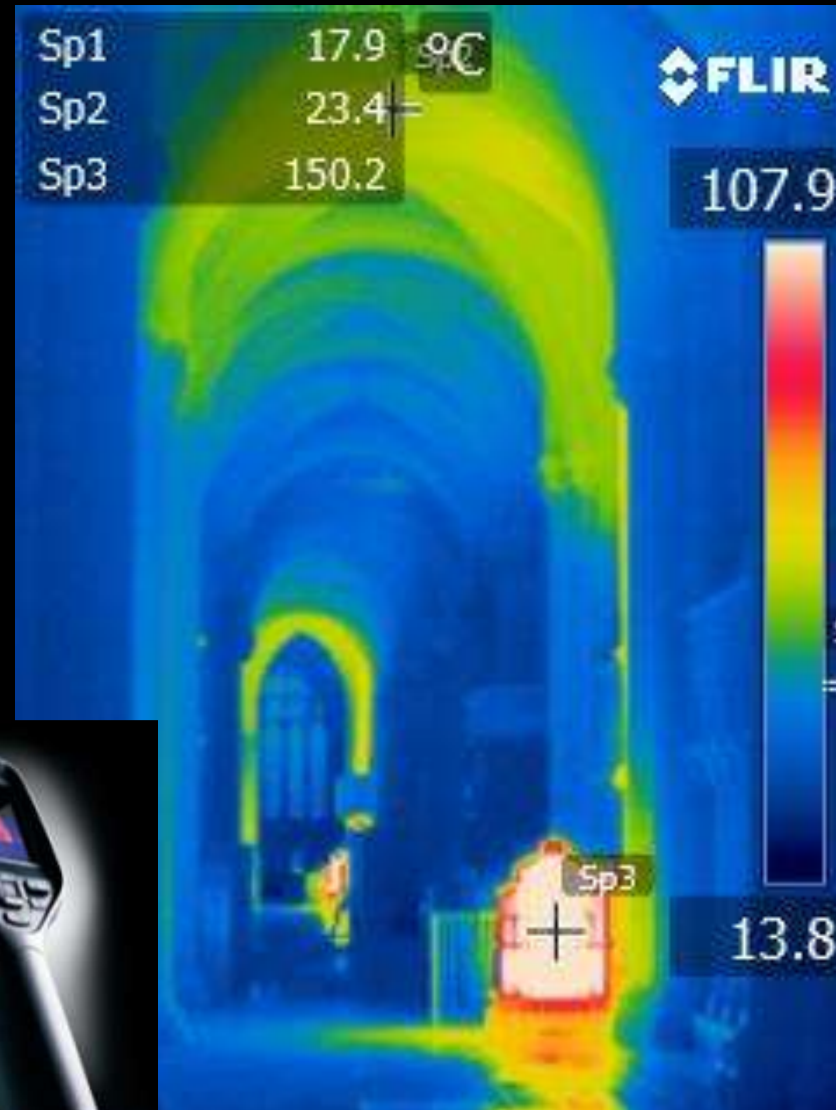
Understand the limitations of the analytical technique

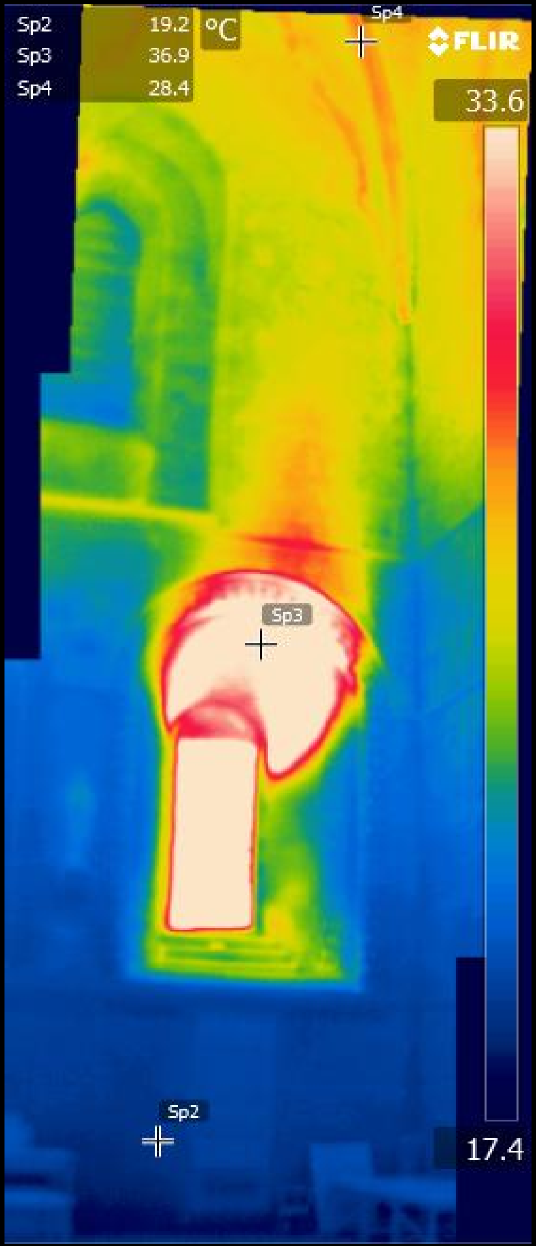


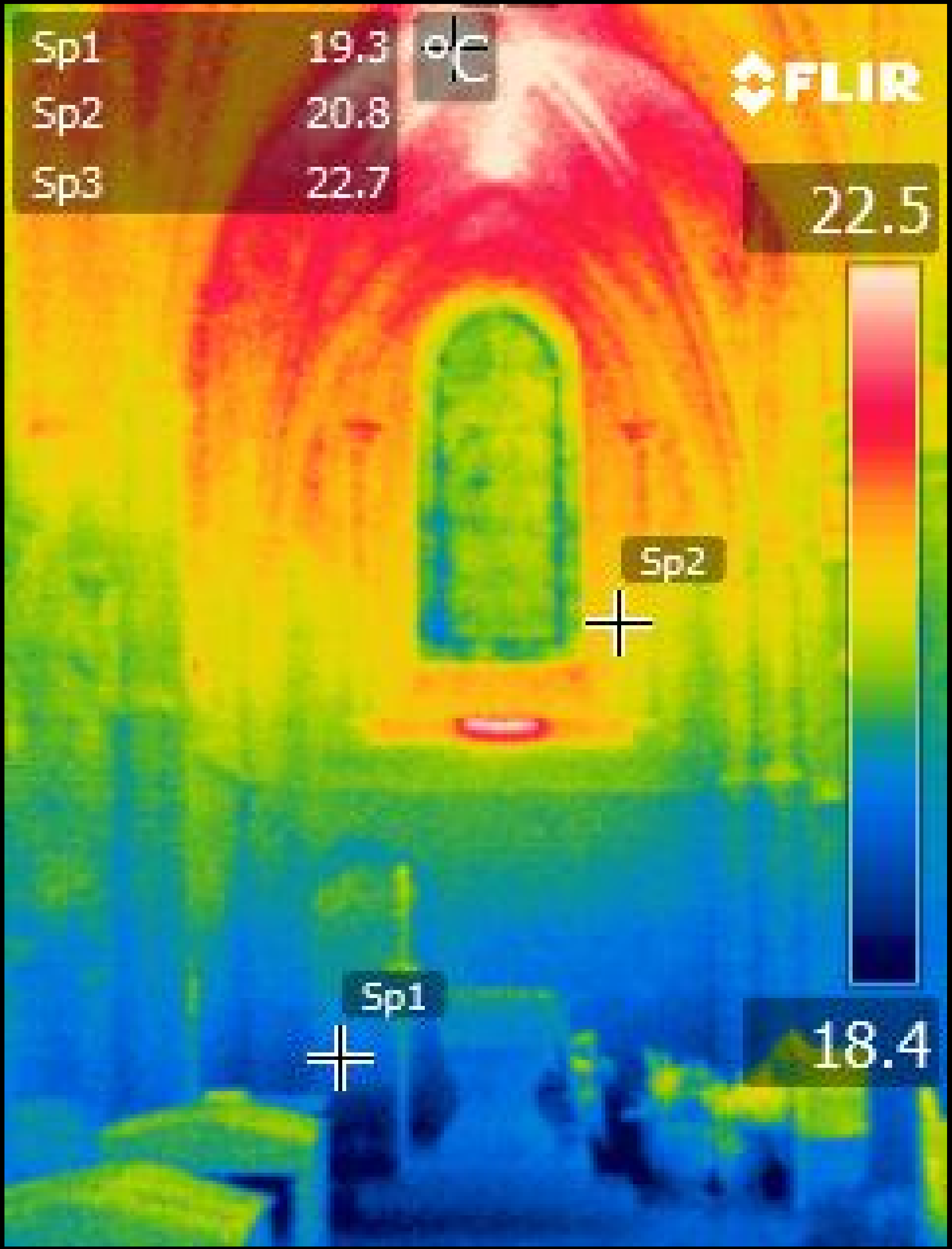
CORRELATE DATA WITH DETERIORATION: DEVELOP MODEL

IR Thermography (thermal imaging)

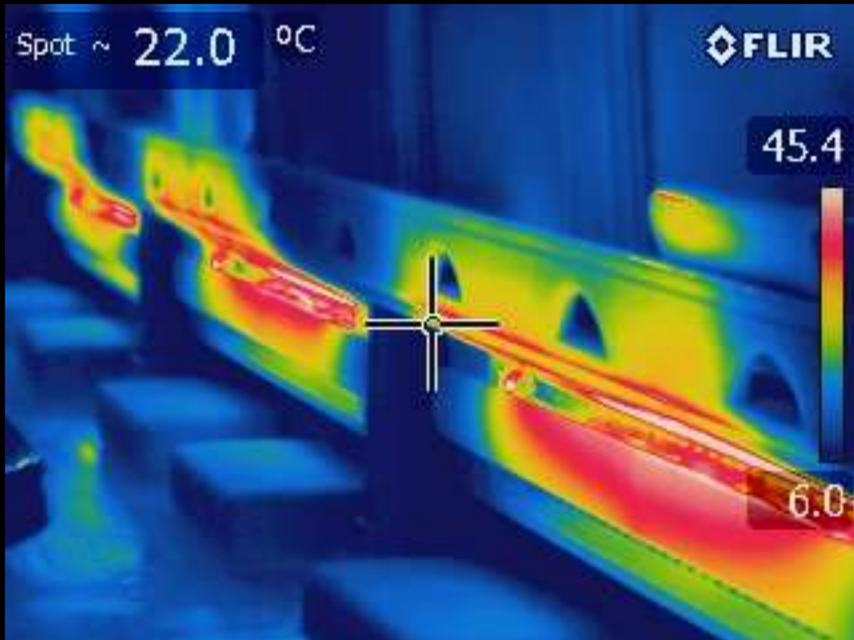


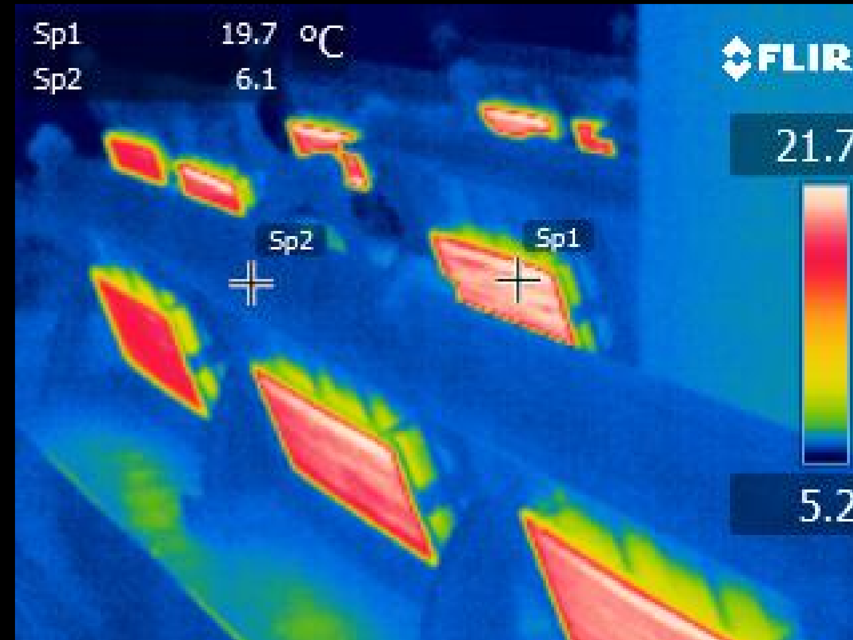


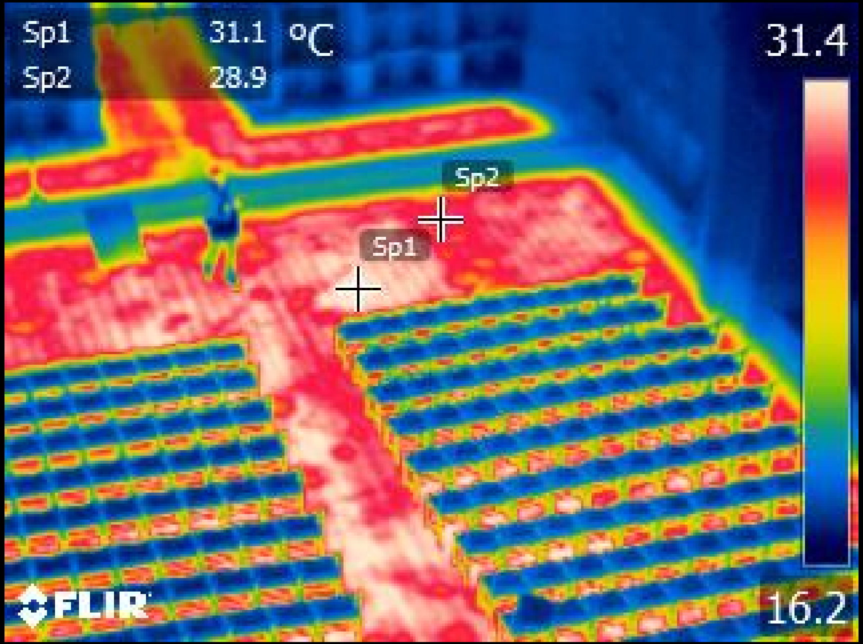




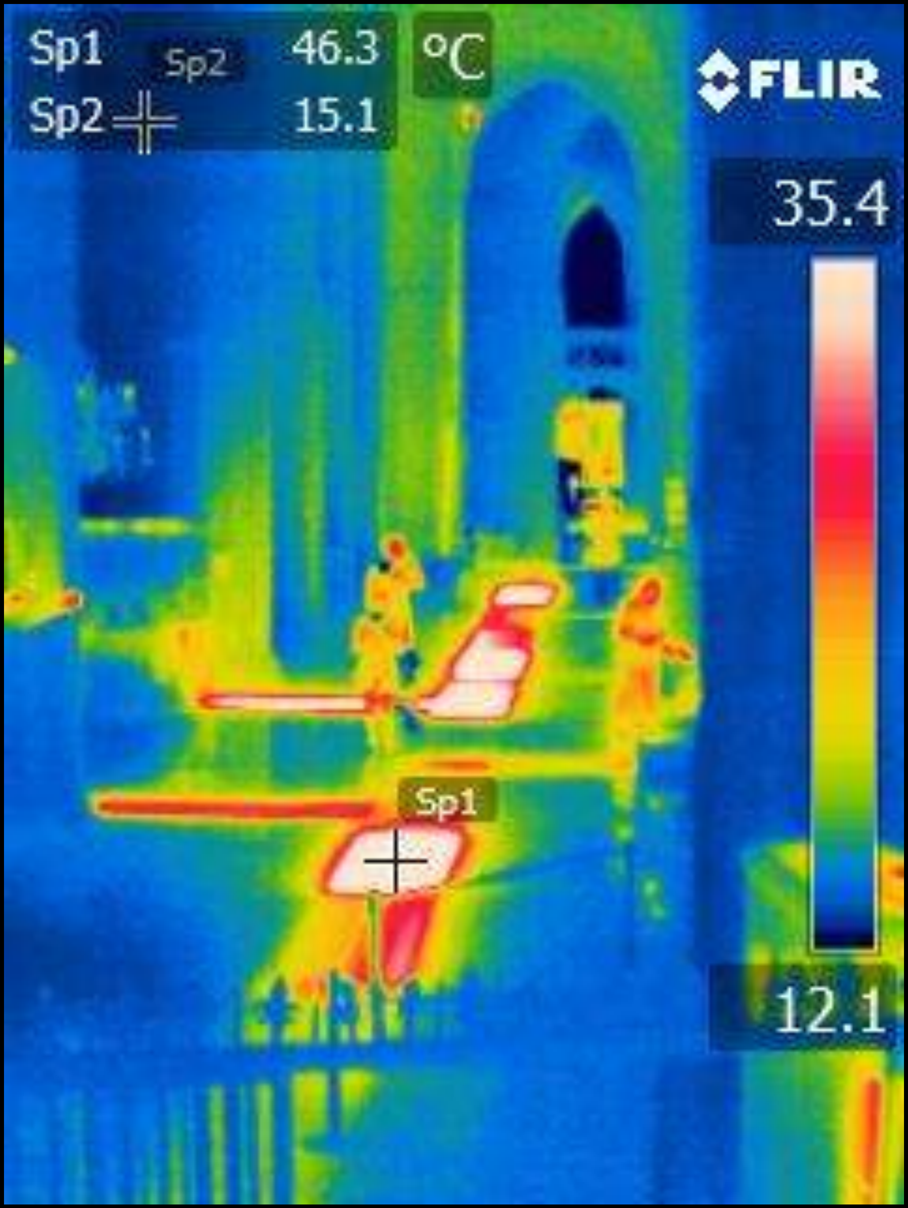
CONVECTIVE SYSTEMS





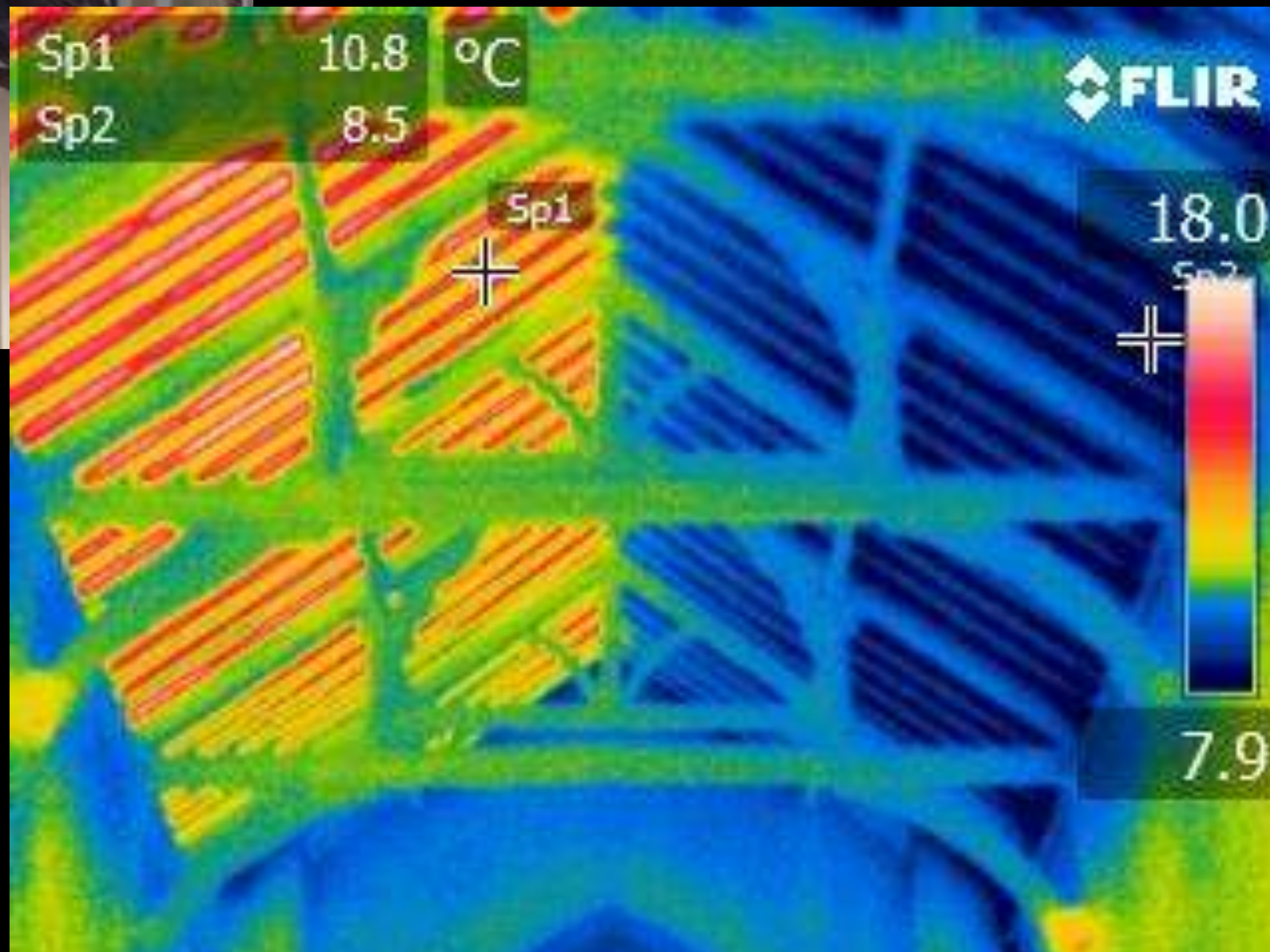


Radiant systems



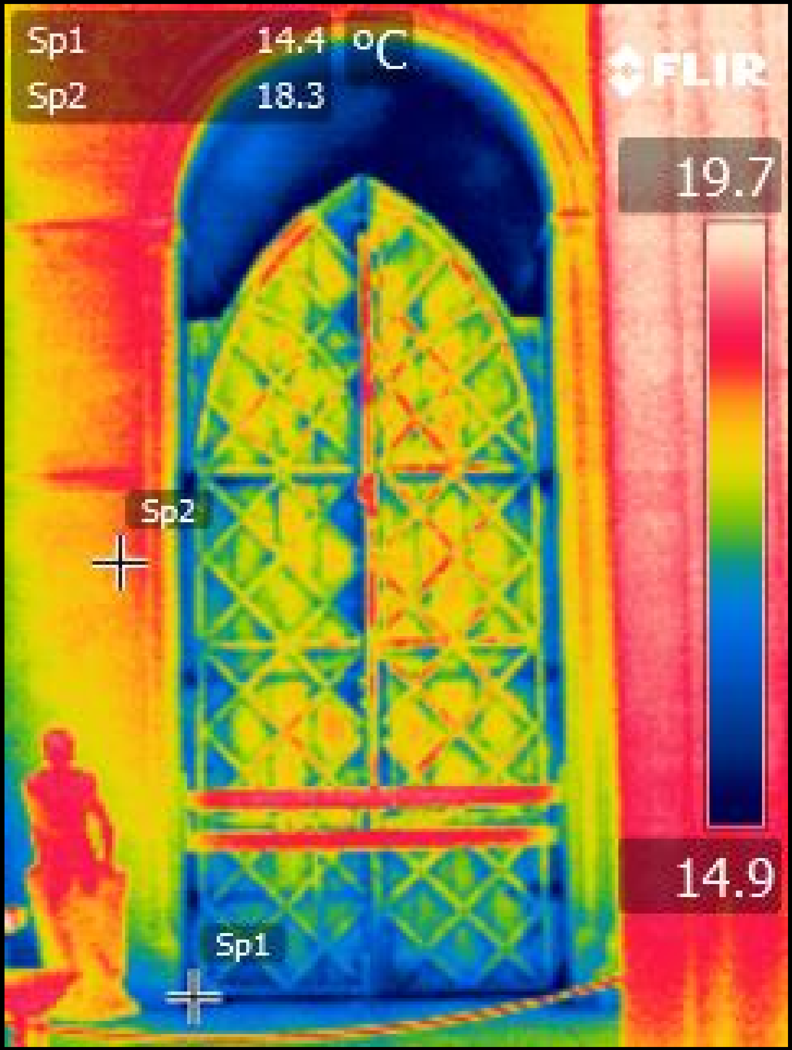
RADIANT SYSTEMS

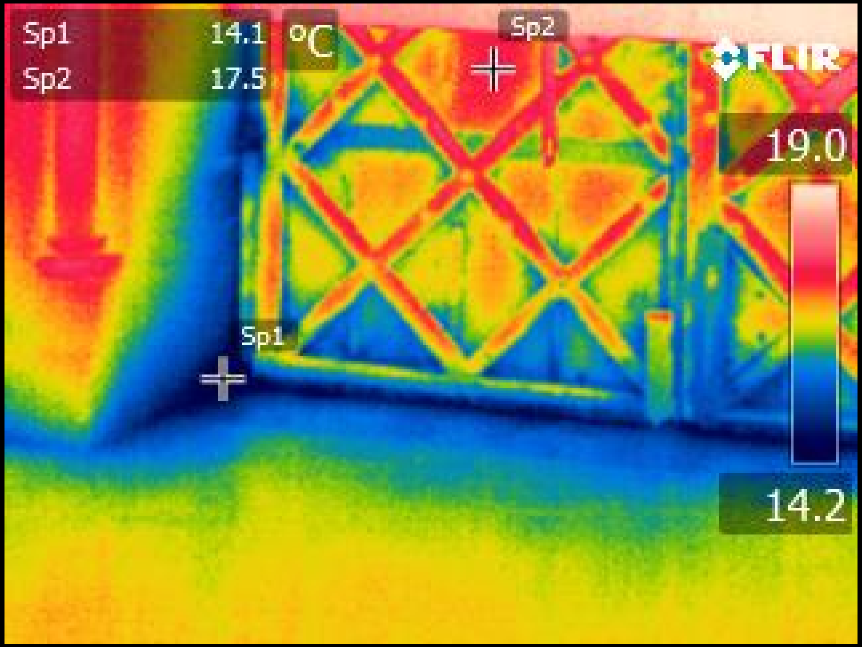
Heat Loss as well as Heat Input



Building Heat Loss

Microclimate: Building Heat Loss (air leakage)



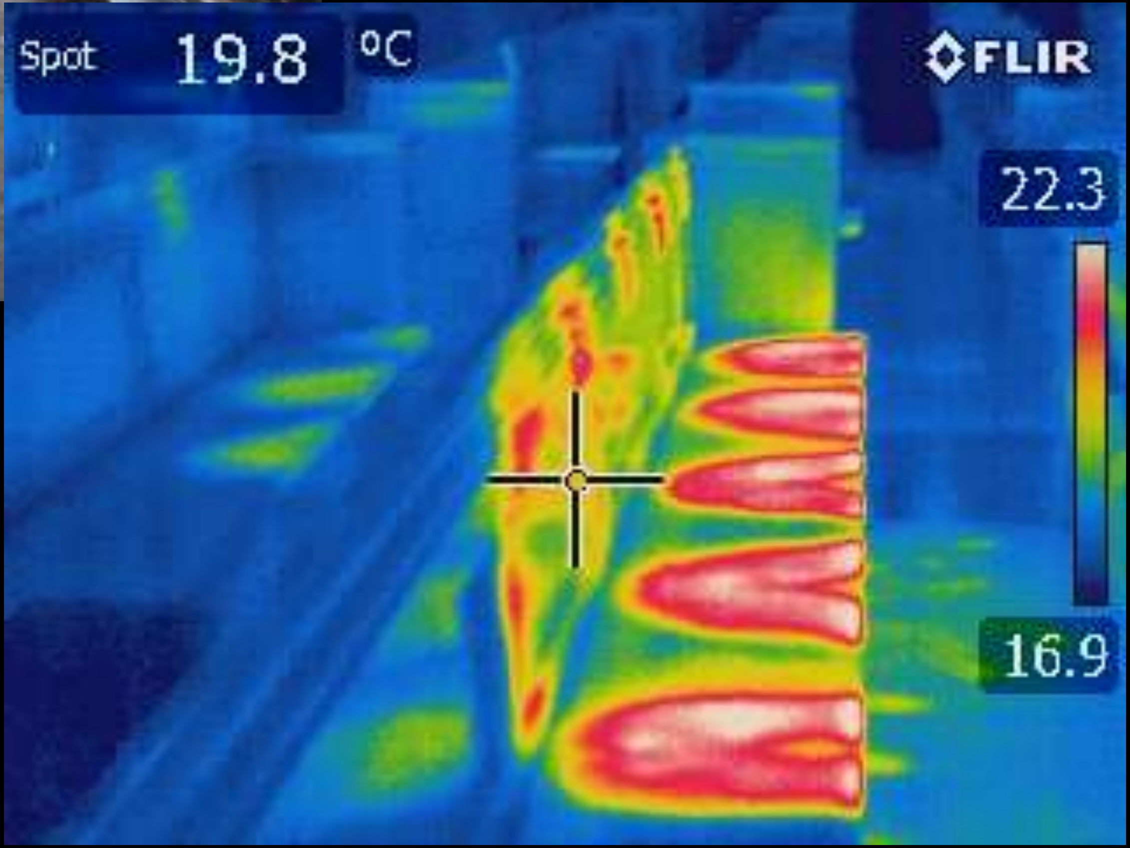


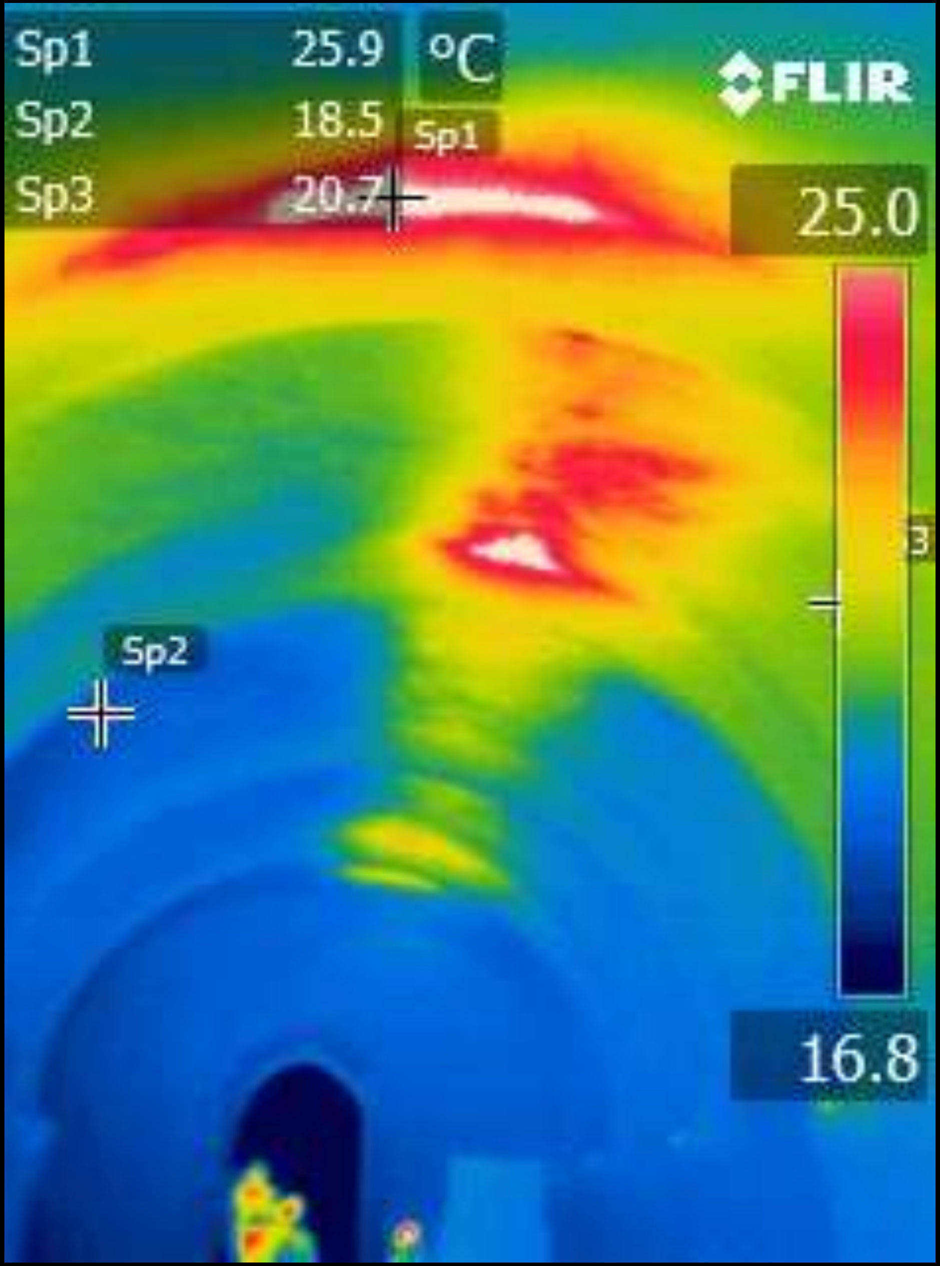
PERSONAL / LOCAL HEAT LOSS

RADIANT/ CONVECTIVE HEAT LOSS

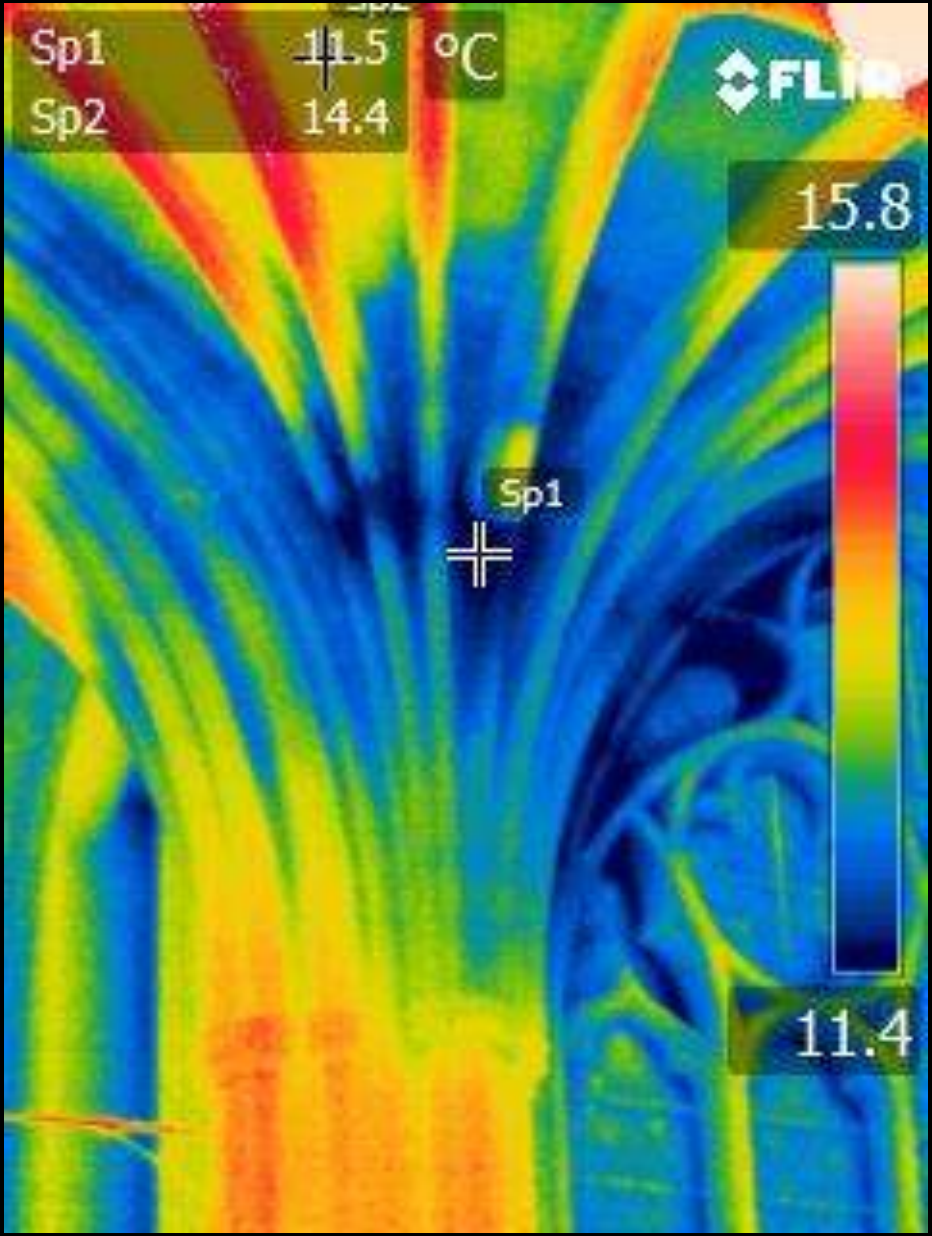

Sp1 7.8 °C
FLIR
23.8
Sp1
-3.9

CONDUCTIVE HEAT LOSS



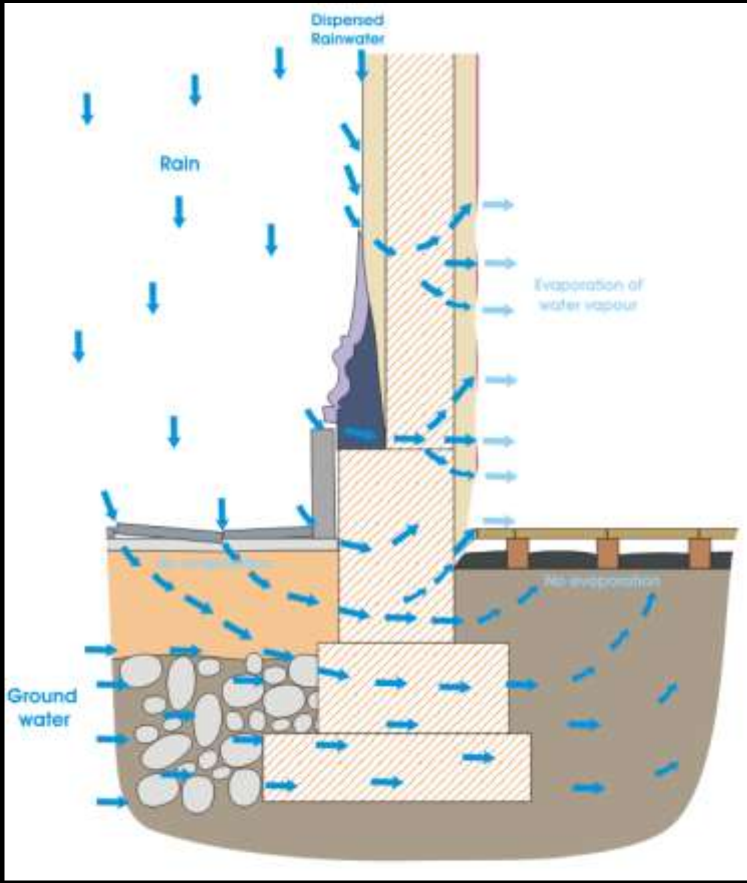


HIDDEN HEAT SOURCES/ DAMAGE



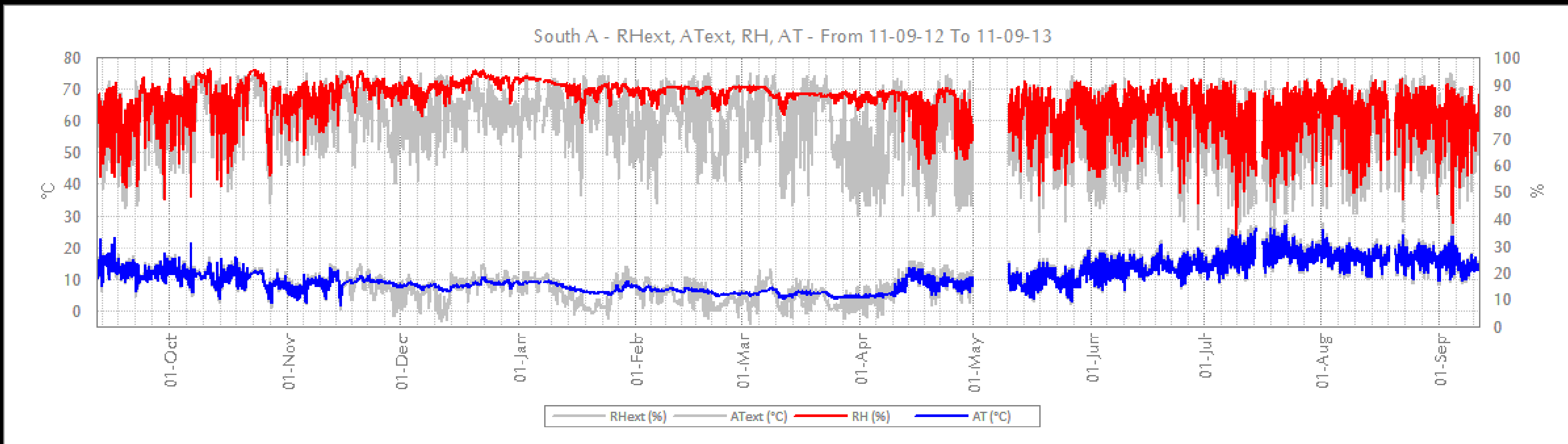
Moisture evaporation

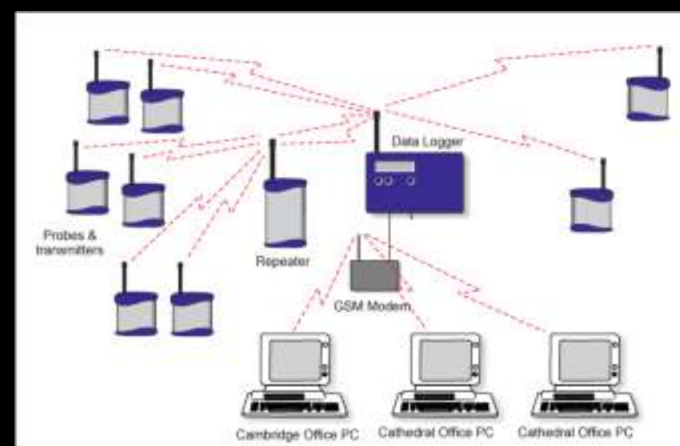
- USE RESULTS TO ESTABLISH BUILDING PERFORMANCE MODEL
    - Identify areas of failure that are understood
    - Identify areas of failure which require further investigations



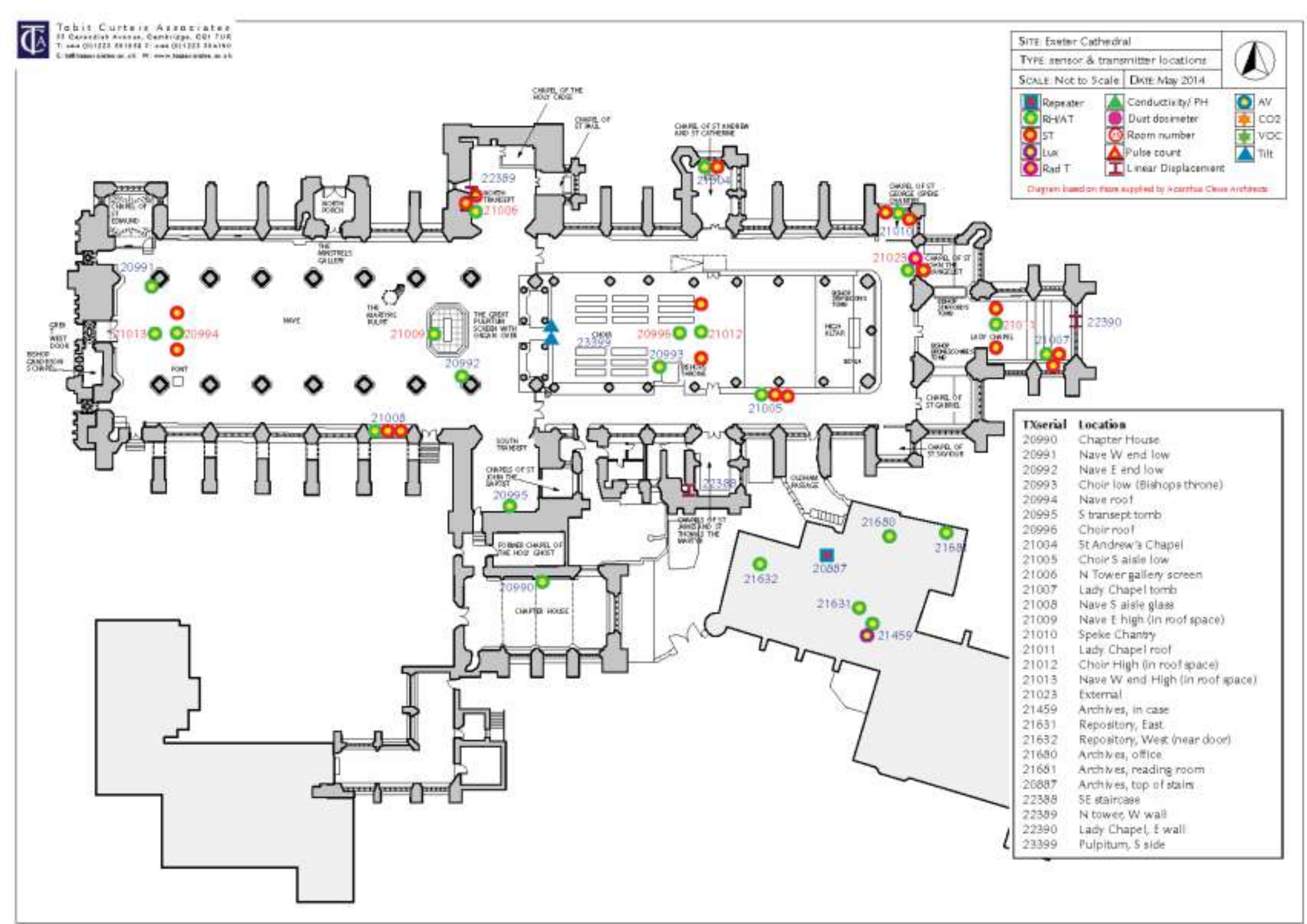
❖ Further Investigations: Environmental Monitoring

Long term temporal data correlating physical change with environmental parameters

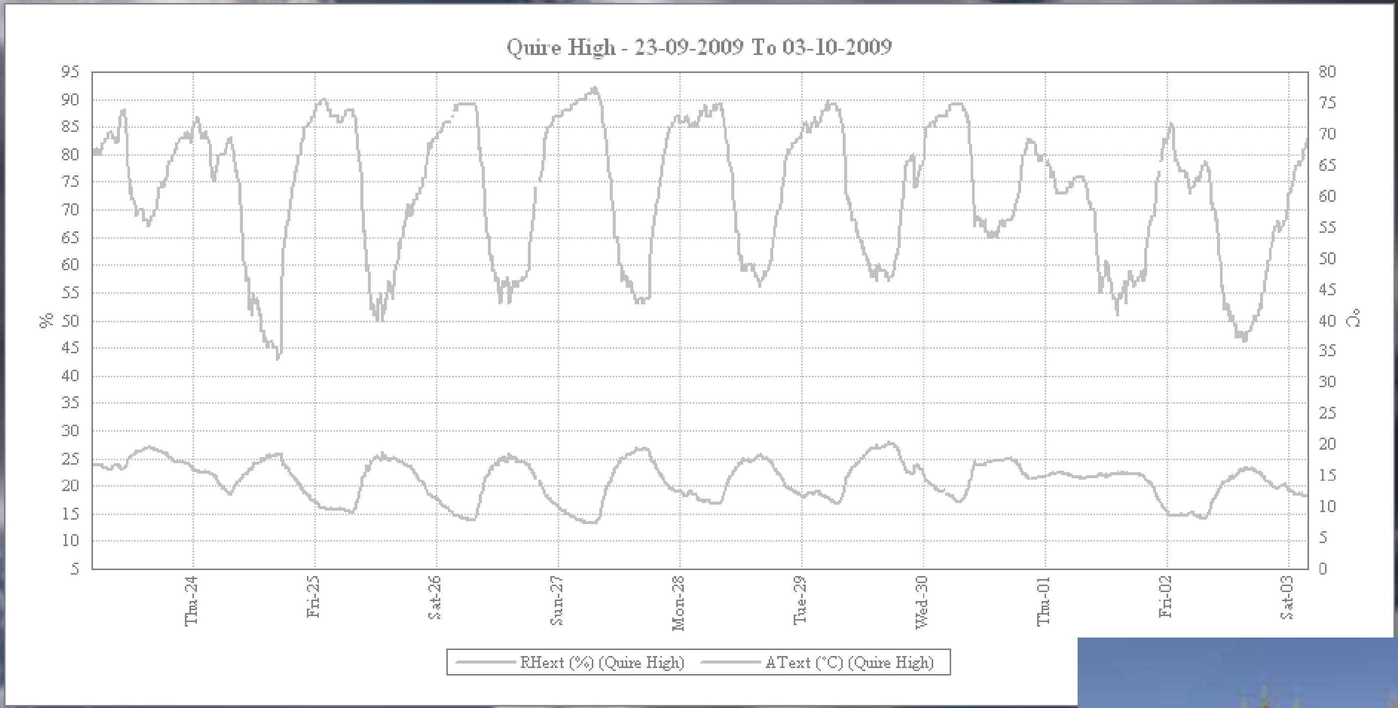


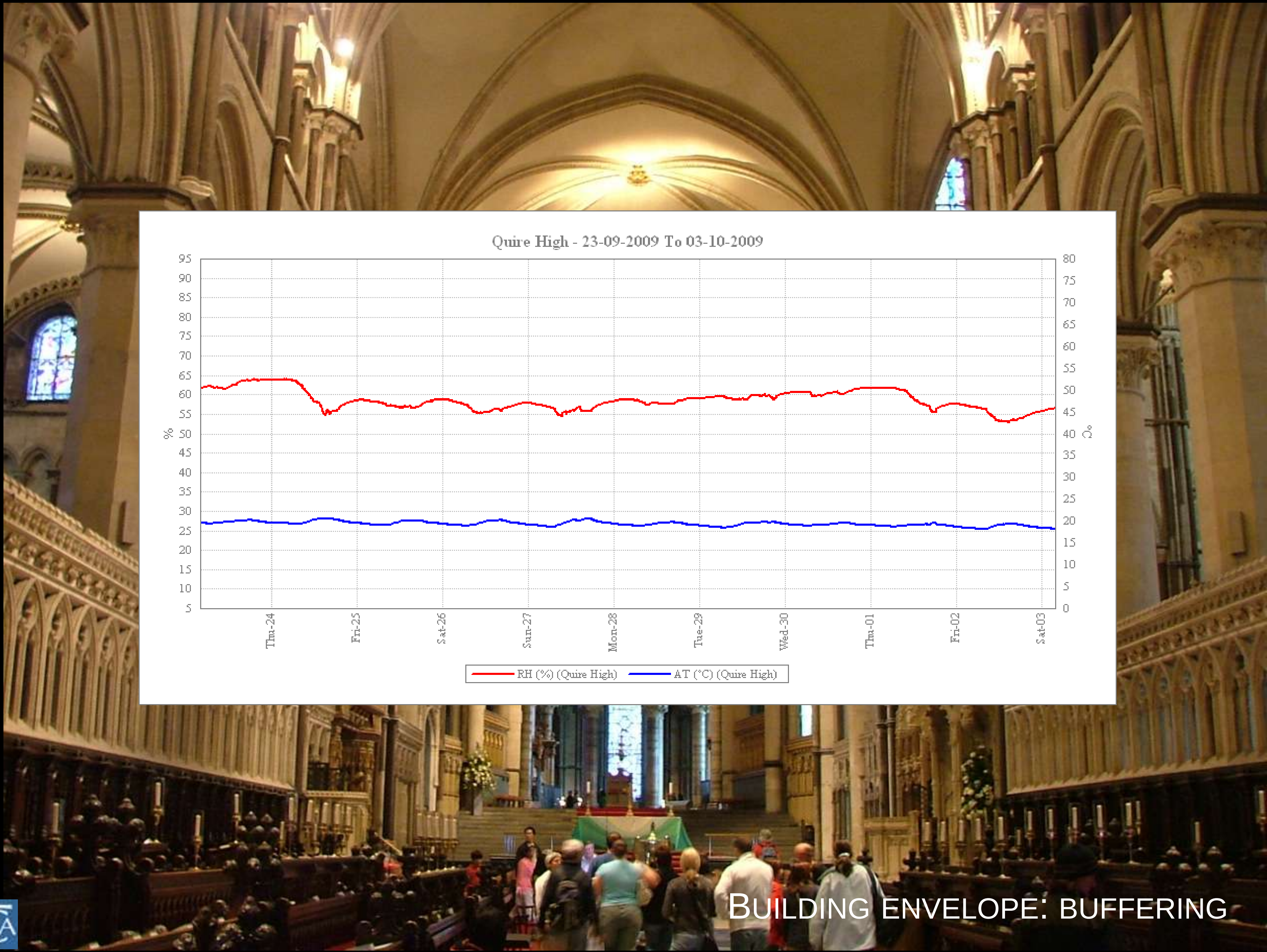


DESIGN MONITORING TO ADDRESS SPECIFIC QUESTIONS

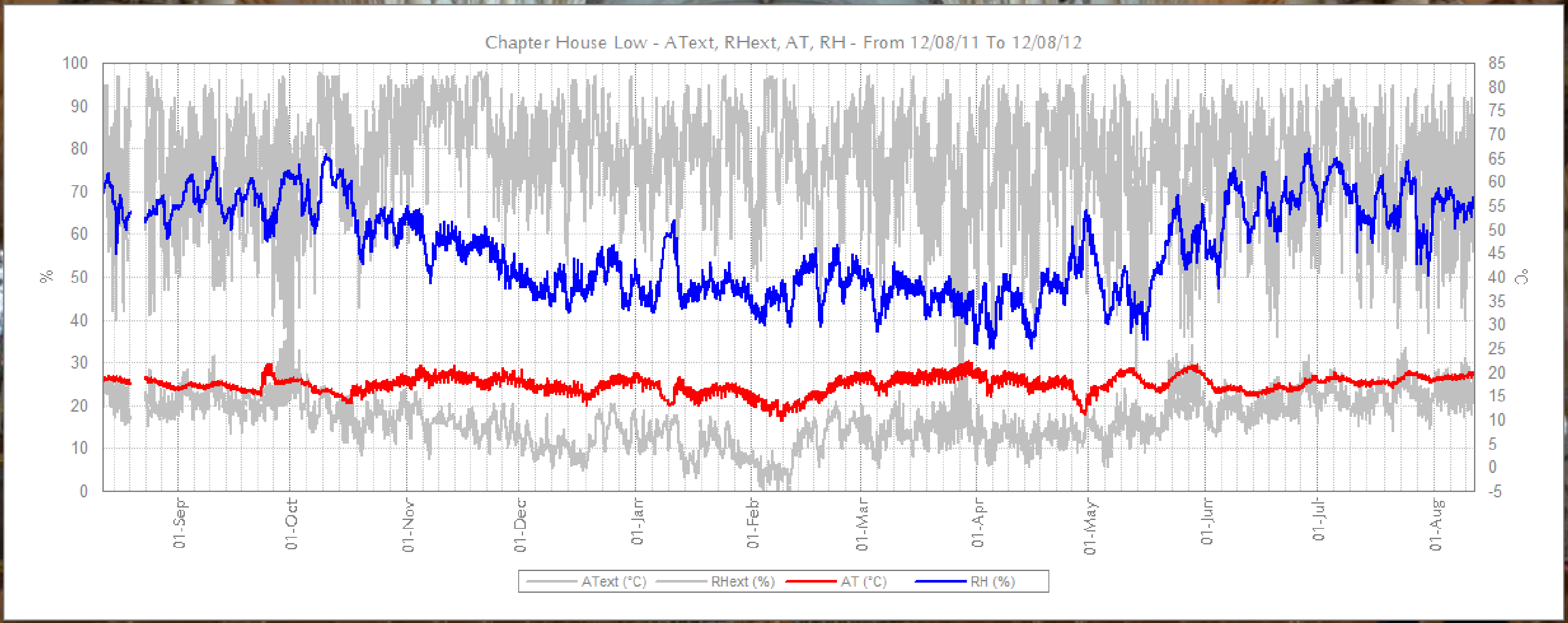


EXTERNAL WEATHER



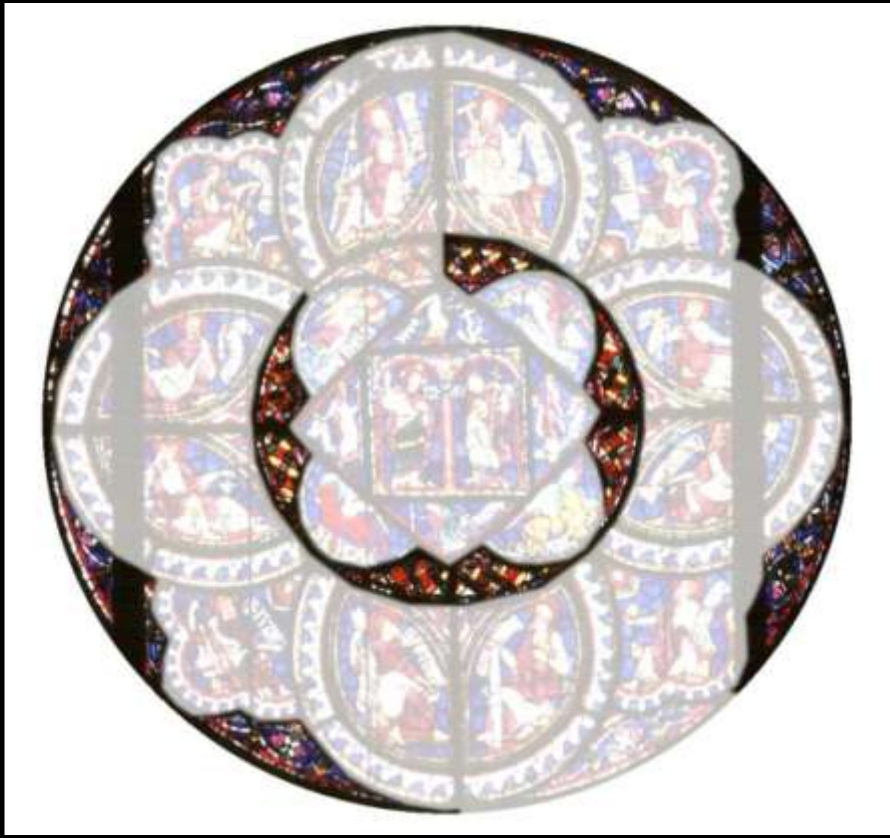


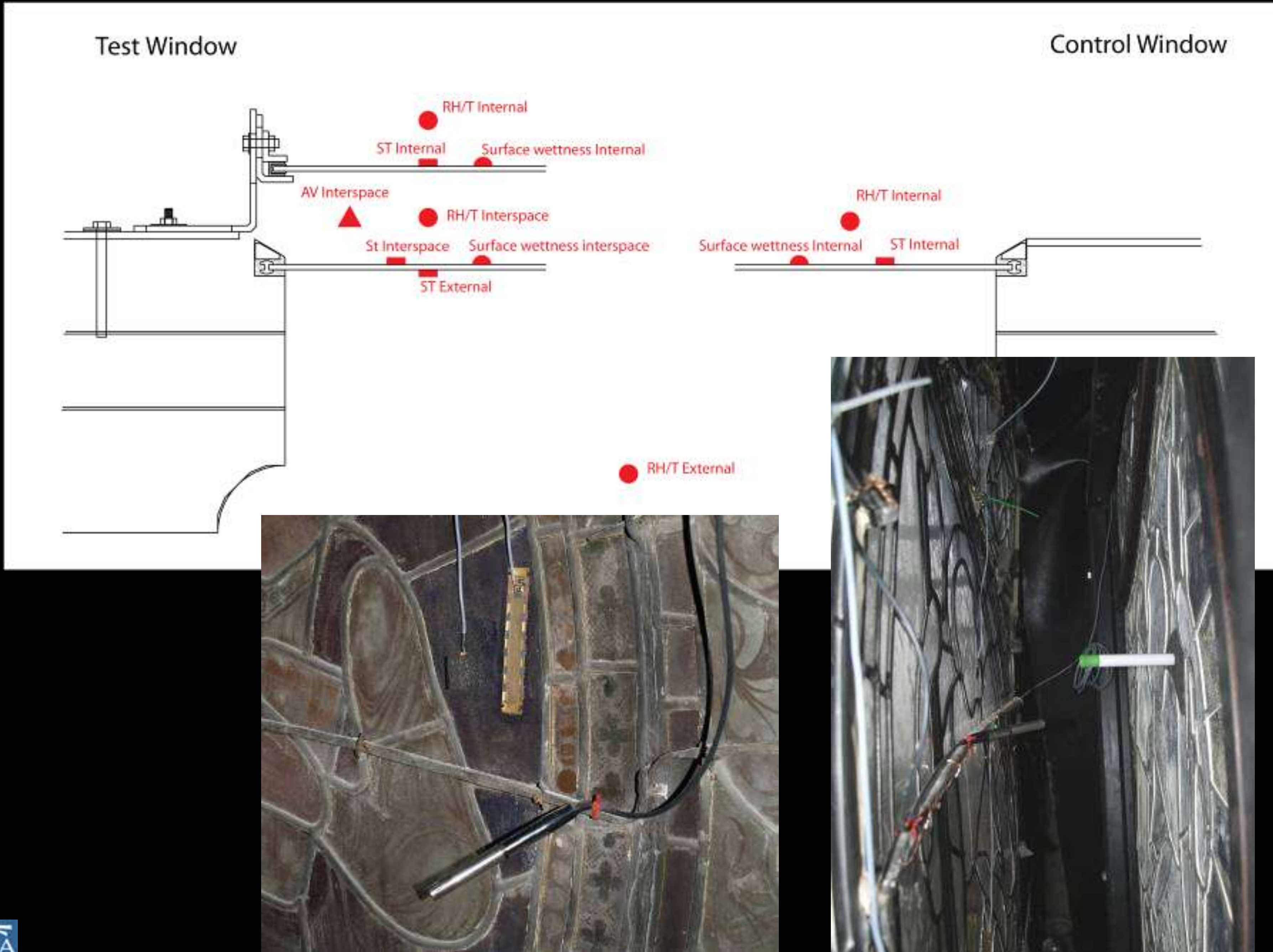
BUILDING ENVELOPE: BUFFERING



Seasonal patterns/ heating effects

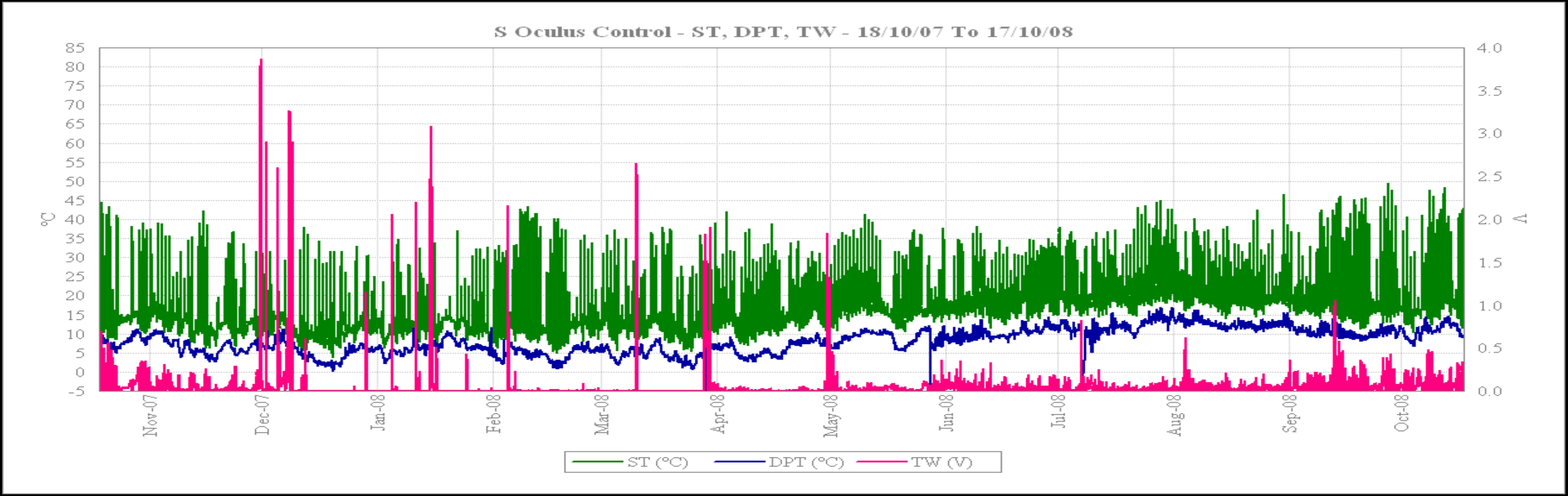
CANTERBURY CATHEDRAL: SOUTH OCULUS

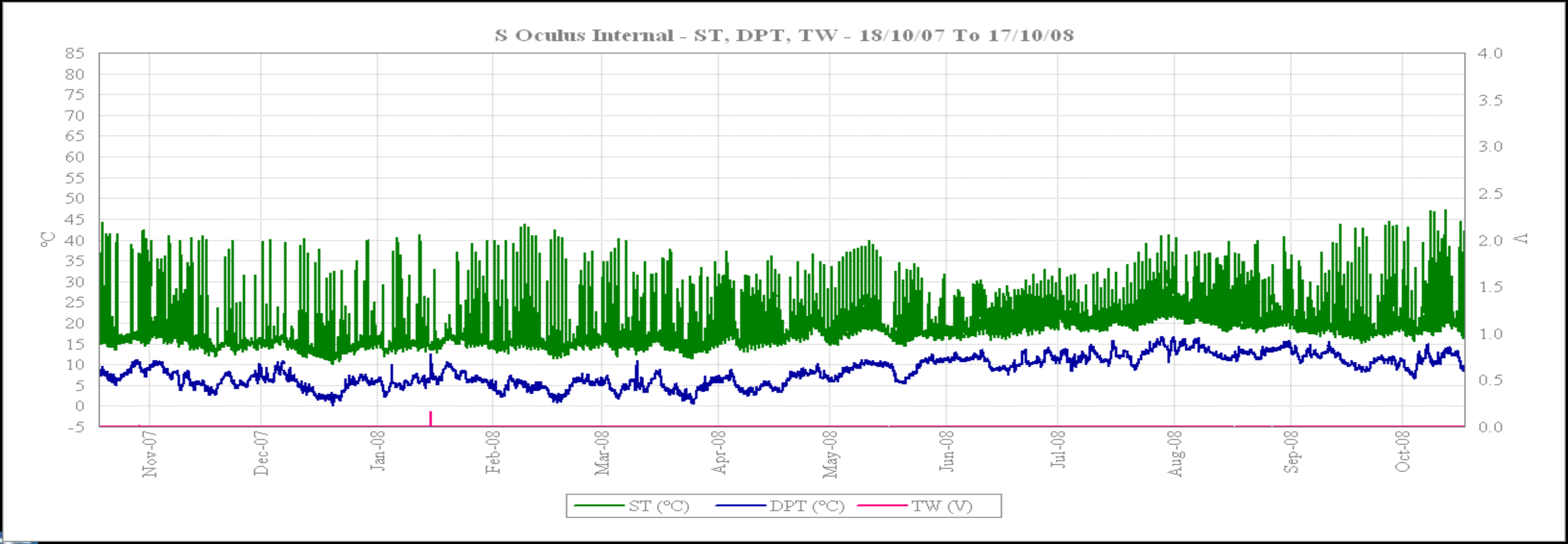




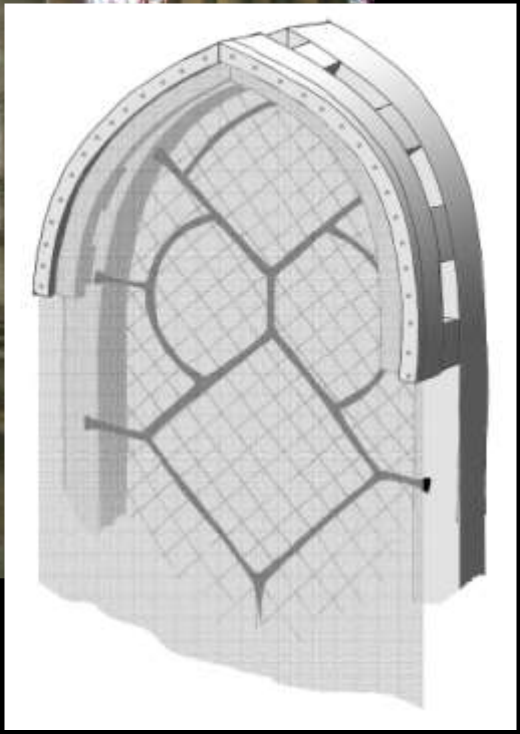
Test Window
Control Window
RH/T Internal
ST Internal
Surface wettness Internal
AV Interspace
RH/T Interspace
St Interspace
Surface wettness interspace
ST External
RH/T Internal
Surface wettness Internal
ST Internal
RH/T External

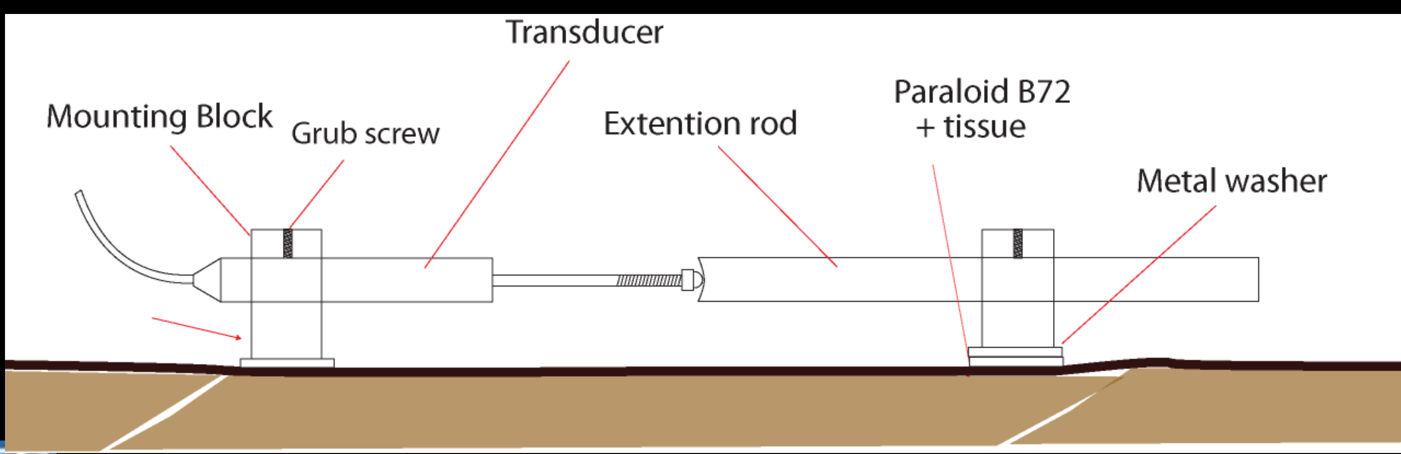
Condensation on protected/ unprotected glass



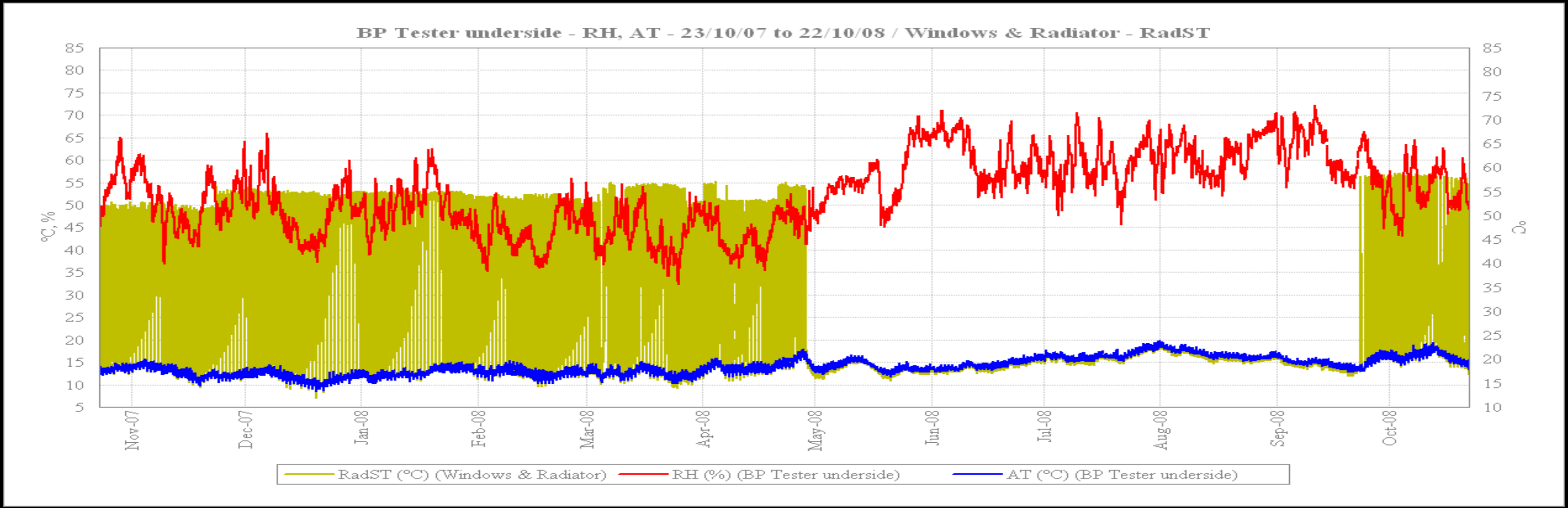


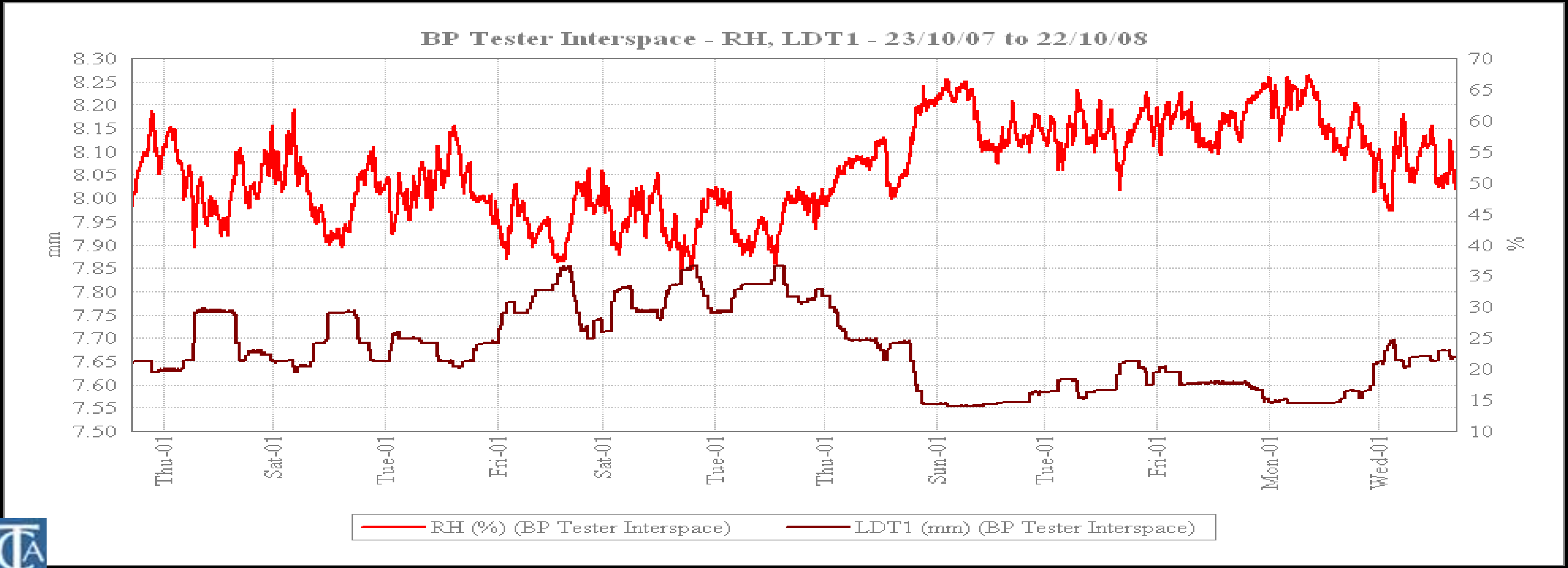
Canterbury Cathedral: Black Prince's Tester



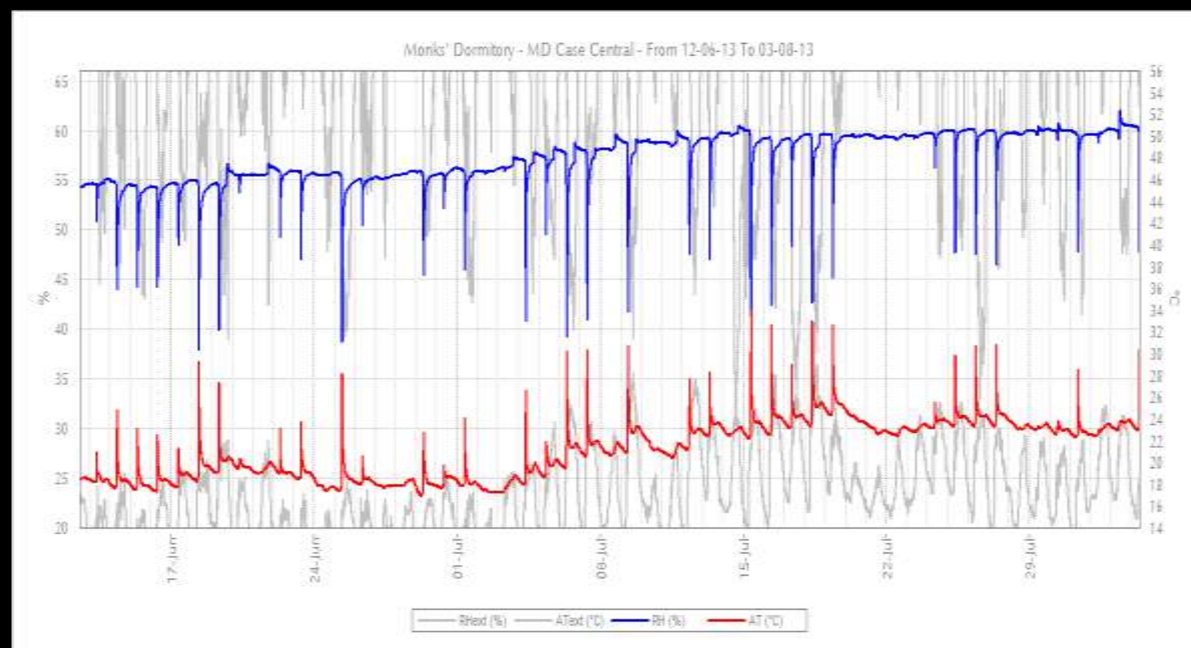

Transducer
Mounting Block
Grub screw
Extention rod
Paraloid B72
+ tissue
Metal washer

HEAT INPUT FROM HEATING, HEAT LOSS FROM WINDOWS

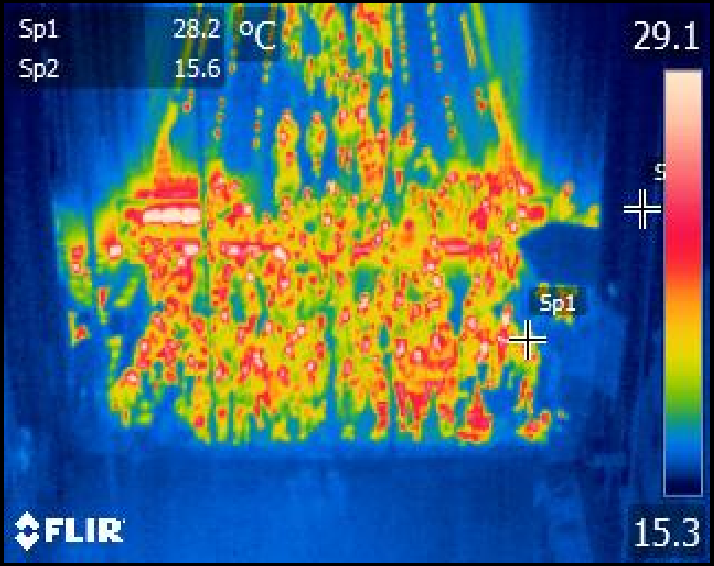


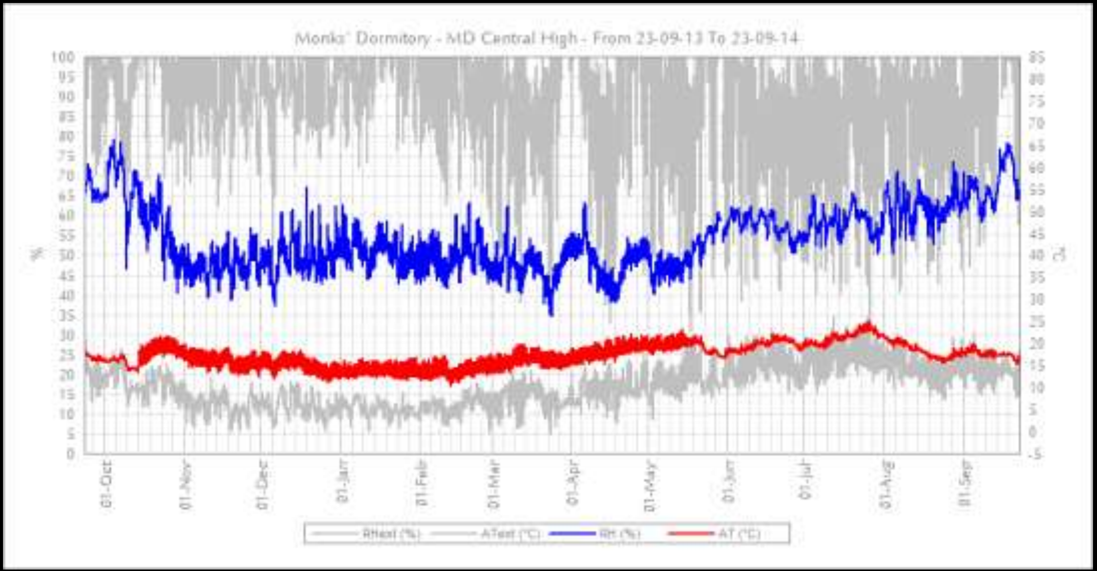


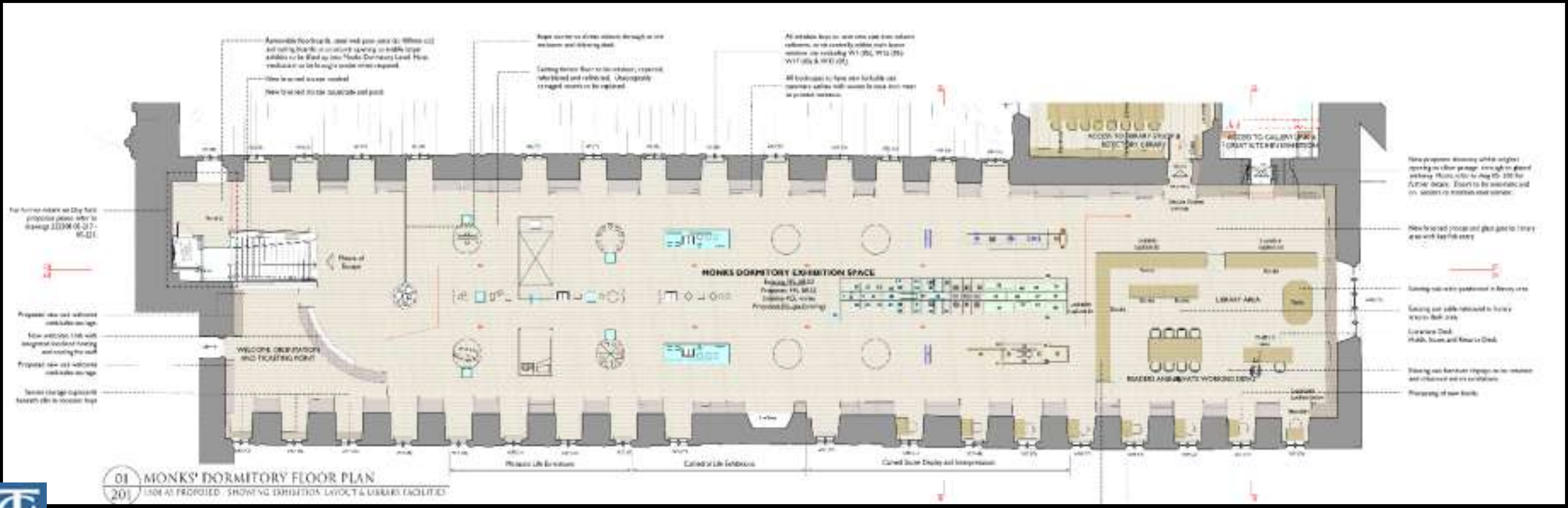
CASE/ DISPLAY ASSESSMENT



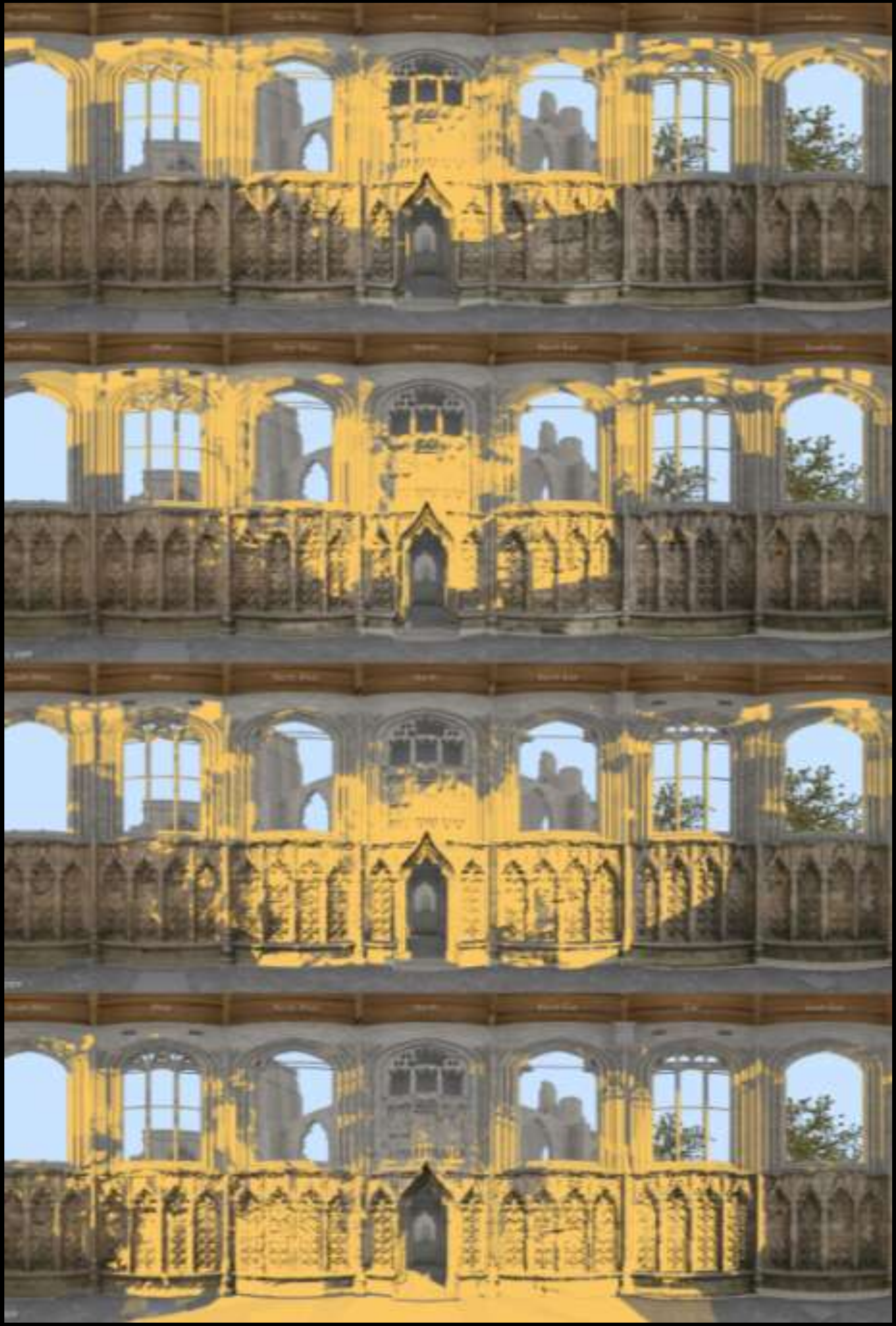
EXHIBITION DESIGN AND ENVIRONMENTAL CONTROL MEASURES



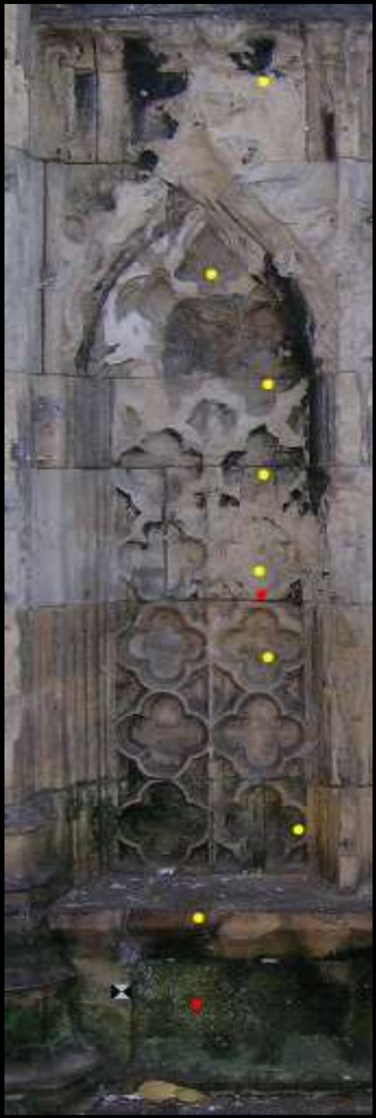


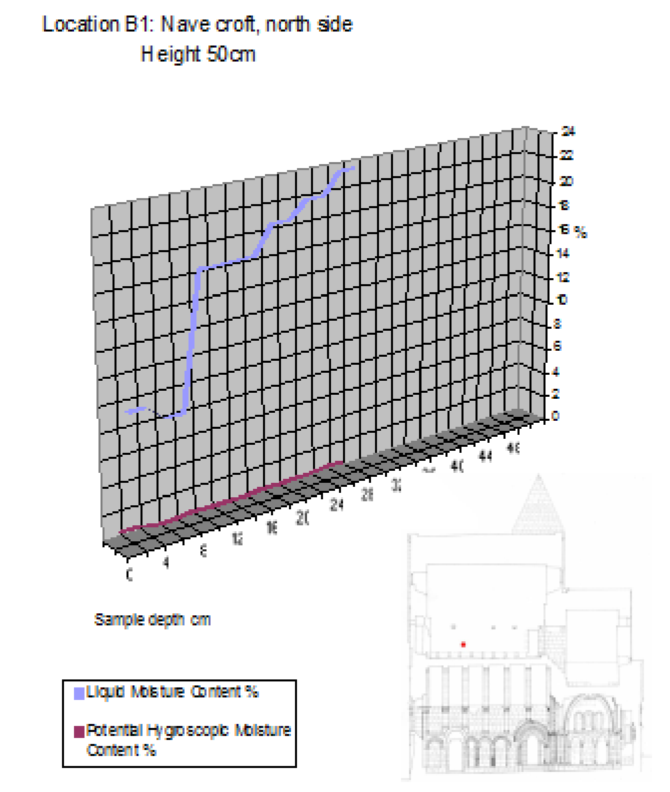


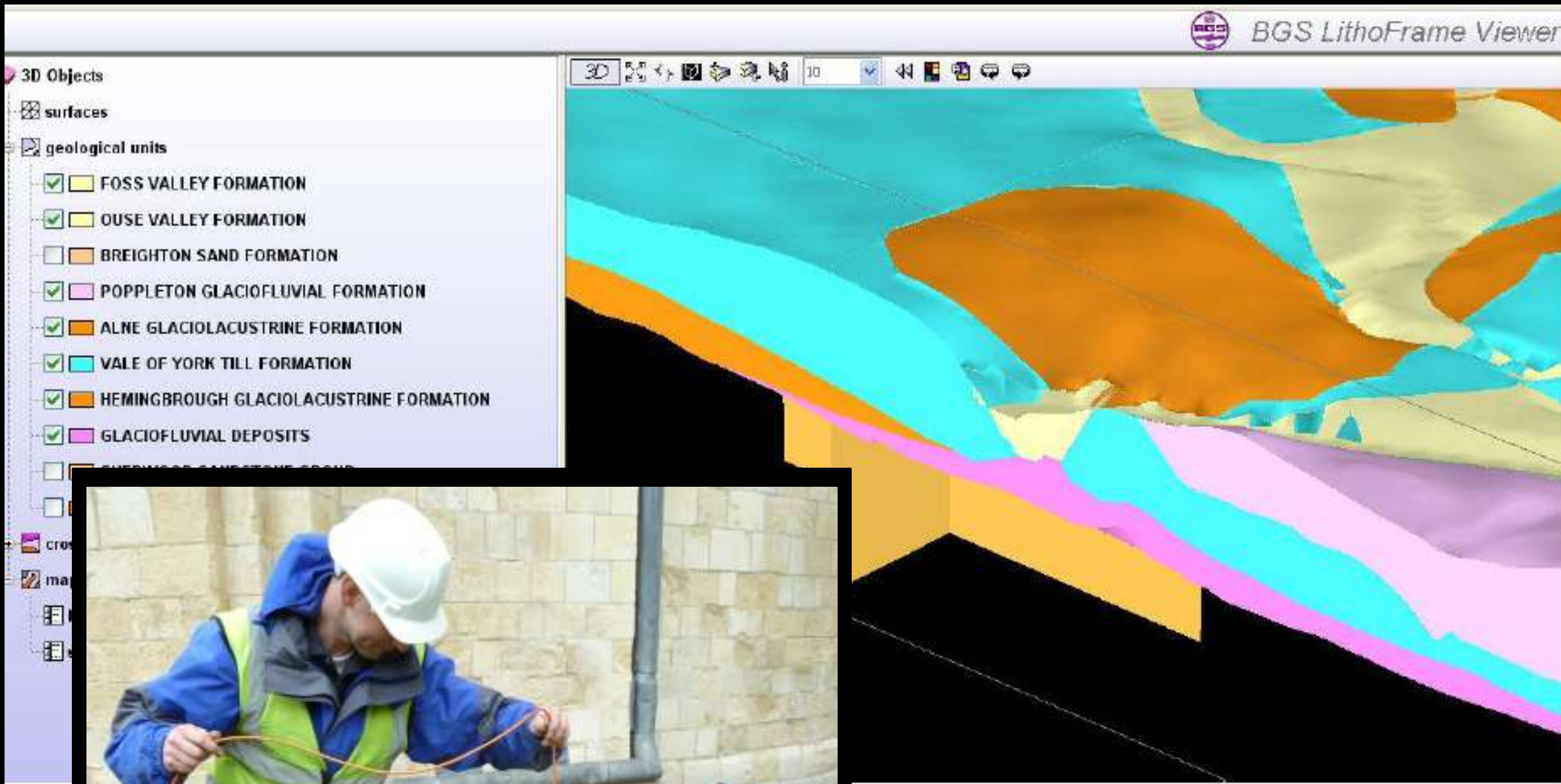
SOLAR MAPPING

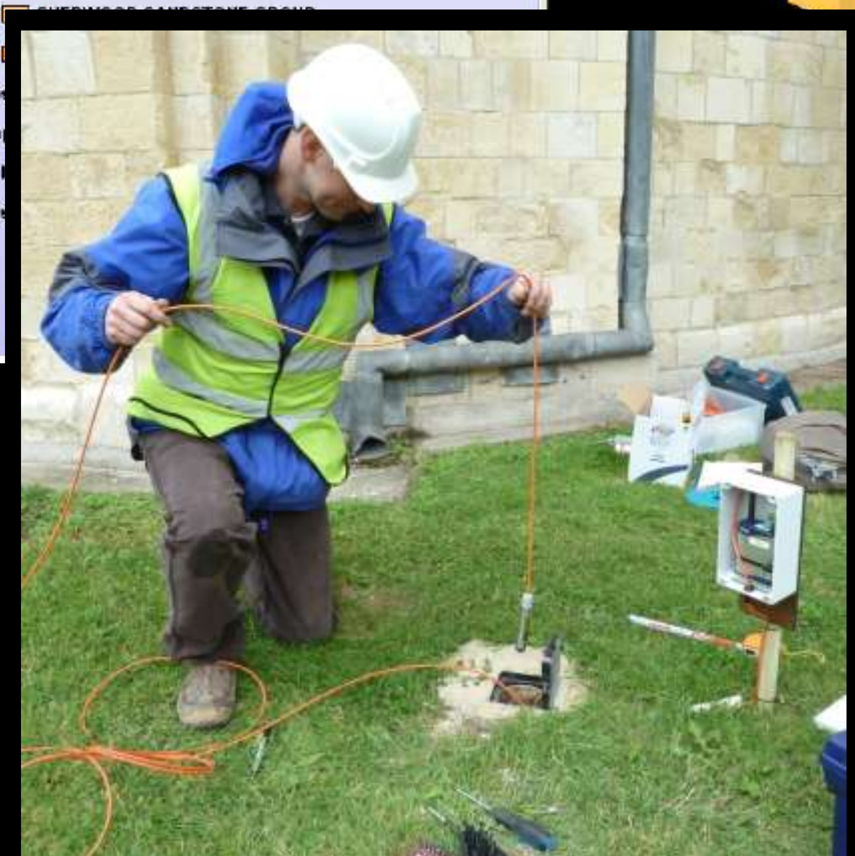


IN DEPTH MOISTURE INVESTIGATION




Location B1: Nave croft, north side
Height 50cm
%
Sample depth cm
Liquid Moisture Content %
Potential Hygroscopic Moisture Content %

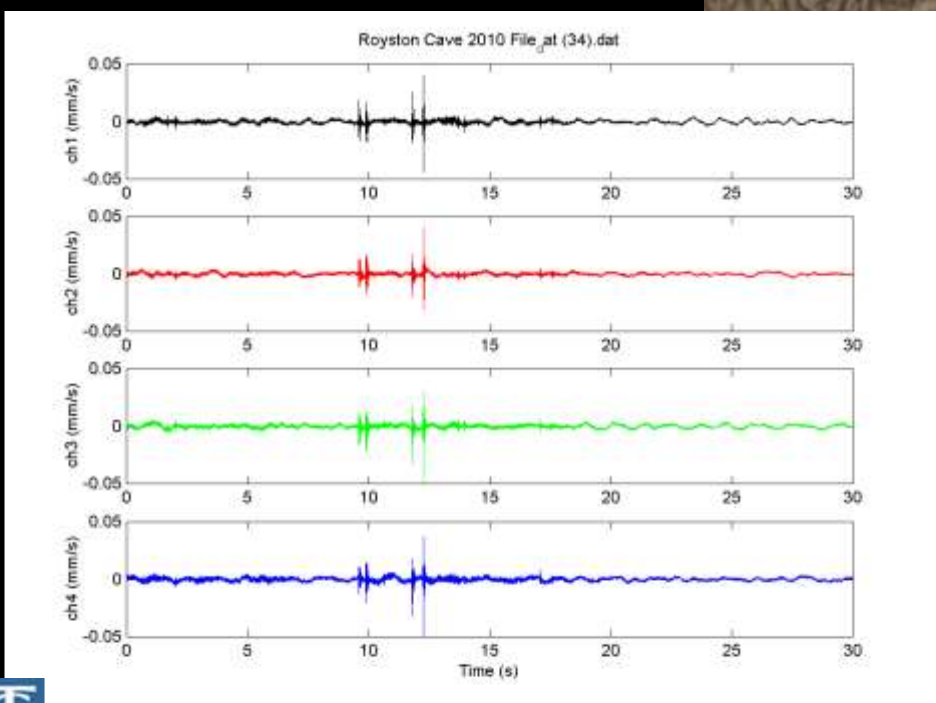


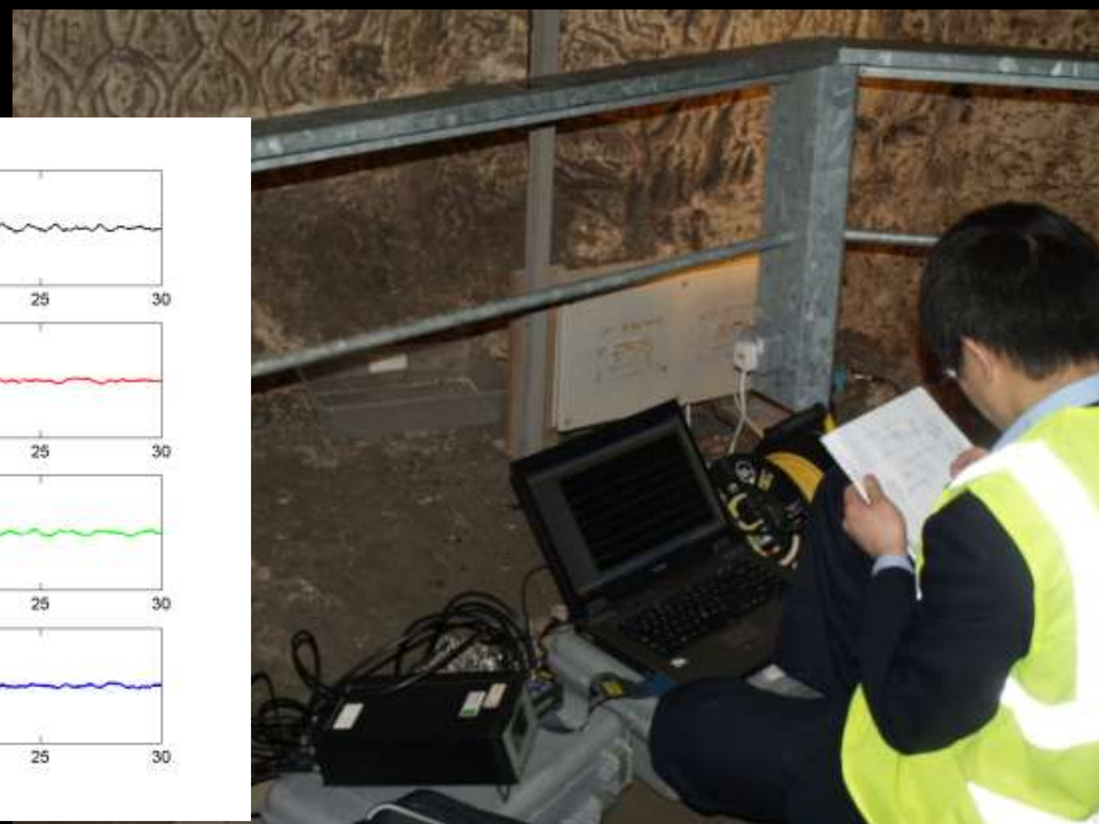


Below-ground water & Hydrogeology

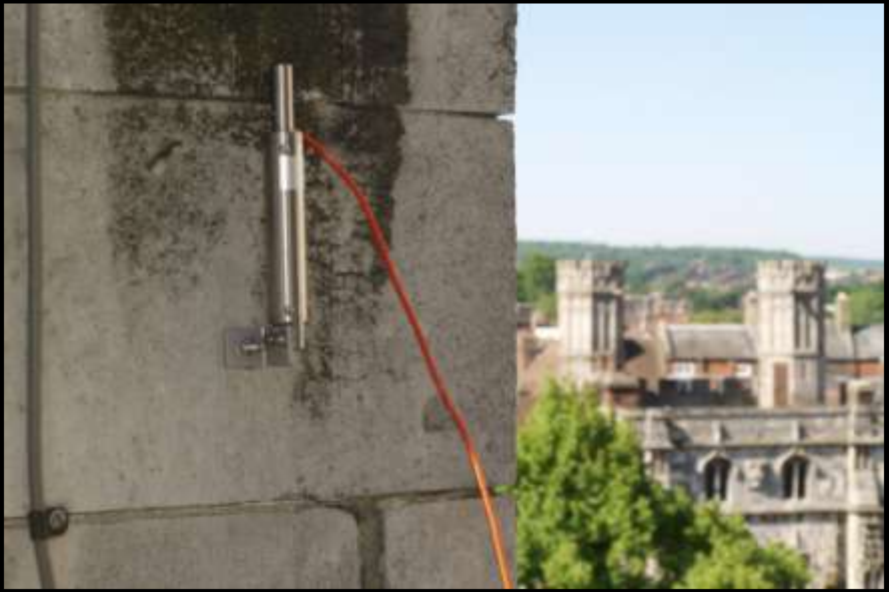
VIBRATION MONITORING

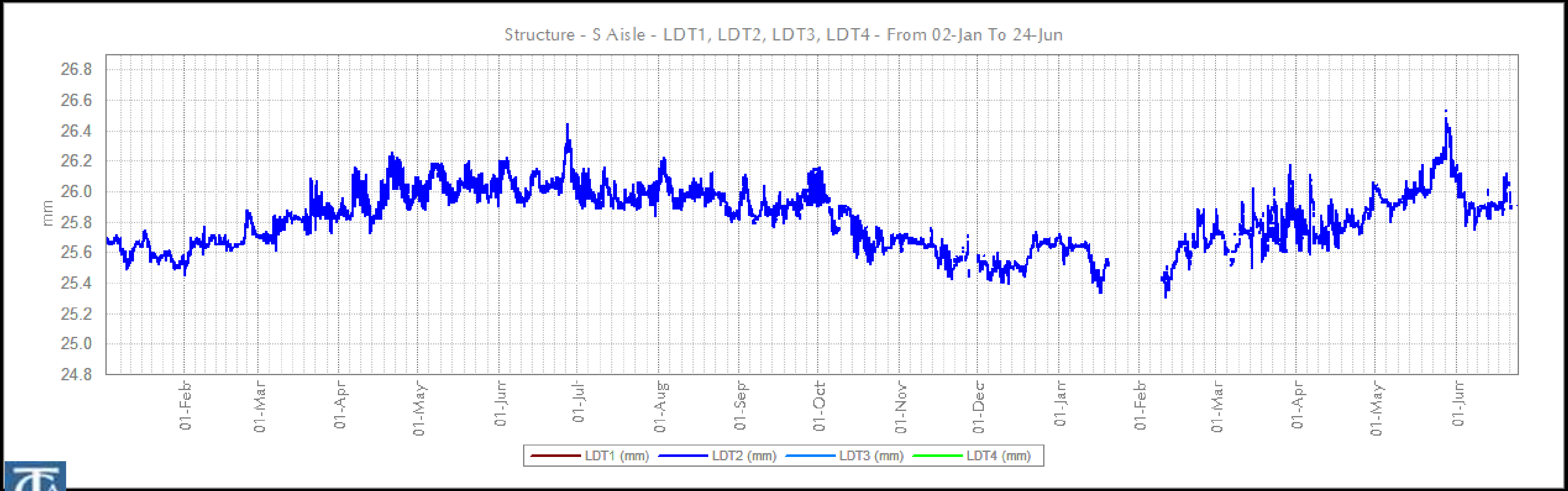
Work with structural engineers





Structural Monitoring





❖ Commissioning and understanding Environmental Research

Key Points

- Identify consultant with precise skills/ experience
- Define question accurately with consultant
- Research must have practical building applications
- Specify aims and deliverables, not tools
- Always carry out preliminary environmental assessment first
- Obtain baseline environmental data before any project, if possible
- Address environmental issues at outset of any project
- Establish long term relationship with consultant