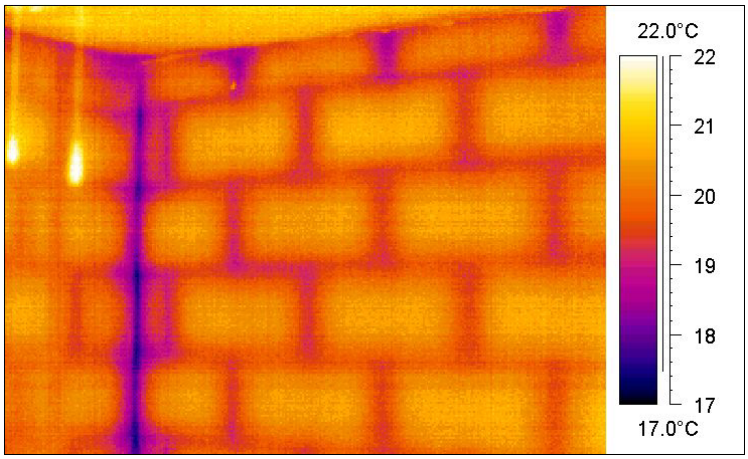
Thermography Code of Practice

Number 1



Building Thermography

Credits

This Technical Note was produced by a working group including expert thermographers, and research consultants. Additional consultation with other persons and organisations results in this document being widely accepted by all sides of industry.

Working Group

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This Technical Note is the first in a series that covers thermographic inspection and analysis methods in Civil (building) assessment. Others include:

2. Continuity of insulation
3. Cold bridging
4. Damp walls & roofs
5. Air leakage
6. Delamination/ disbonding
7. Structural detailing/ voids
8. Energy surveys
9. Cold stores
10. Practical guide to thermographic surveys inc. risk assessment, etc.
11. Quantification

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Introduction

Buildings contribute almost half - about 46% - of the UK's carbon dioxide emissions. The Royal Commission on Environmental Pollution reported that the UK needs to achieve a 60% reduction in $C0_2$ emissions by 2050 if we are to contribute to an avoidance of significant climate change.

It has been shown that the UK's housing stock could be made 60 per cent more efficient[1] while according to the Carbon Trust, UK business wastes £1 billion a year in lost energy. Building thermography can help to achieve these targets.

Building thermography (or 'Civil Thermography', a term used to differentiate it from electrical or mechanical engineering thermography) can also identify moisture in structures, risk of condensation, air leakage, structural delaminations, voids and buried services.

Over the fast few years the equipment, applications, software and understanding connected with thermography have all developed at an astonishing rate. As the technology has gradually become integrated into mainstream practices, a corresponding demand for application guides, standards and thermographer training has arisen.

UKTA is publishing a series of technical notes in order to establish the basic requirements of thermographic surveys. It is intended that specifiers should refer to this document as a guide to commissioning a thermographic survey. The Technical Notes give more detailed information on each thermographic survey method for practising thermographers.

Safety

Safety of workers and the public must always be paramount. All work should be done in accordance with relevant health and safety legislation. In the UK this is the Health and Safety at Work Act and guidance[2]. This includes conducting risk assessments and preparing method statements for safe systems of work.

Scope

This guide is intended to help users to specify the thermographic survey that they need. Specialist, Technical Notes published by UKTA provide detailed methods for conducting these surveys on buildings and structures. UKTA also publishes guides to Electrical and Mechanical thermography.

Background Information

Thermography can detect surface temperature variations as small as 0.08K and graphic images can be produced that visibly illustrate the distribution of temperature on building surfaces.

Variations in the thermal properties of building structures, such as poorly fitted or missing sections of insulation, cause variations in surface temperature on both sides of the structure. They are therefore visible to the thermographer. However, many other factors such as local heat sources, reflections and air leakage can also cause surface temperature variations.

The professional judgement of the thermographer is usually required to differentiate between real faults and other sources of temperature variation. Increasingly, thermographers are asked to justify their assessment of building structures and, in the absence of adequate guidance, it can be difficult to set definite levels for acceptable or unacceptable variation in temperature.

The Standard for thermal imaging of building fabric in the UK is BS EN 13187:1999[3]. This sets out requirements for environmental conditions and reporting but leaves interpretation of the thermal image to the professional expertise of the thermographer and provides little guidance on the demarcation between acceptable and unacceptable variations. Guidance on theory, practice and the appearance of a range of thermal anomalies can be found in the BINDT books on thermal imaging[4] that also cover a large part of the PCN thermography training syllabus.

Conditions and Equipment

To achieve best results from a thermographic survey it is important to consider the environmental conditions and to use the most appropriate thermographic technique for the task.

Thermal anomalies will only present themselves to the thermographer where temperature differences exist and environmental phenomena are accounted for. Each type of thermographic survey has its own specific environmental requirements For example insulation continuity and thermal bridging surveys require temperature difference across the building fabric to be greater than 10°C to be maintained.

As well as temperature, there are other environmental conditions that should also be taken into account when planning a thermographic building survey. External inspections for example, may be influenced by radiation emissions and reflections from adjacent buildings or a cold clear sky, and even more significantly the heating effect that the sun may have on surface.

Infrared cameras for professional surveys must have a sufficiently high resolution to detect small anomalies at a reasonable distance. Typically, cameras use detectors with 320 x 240 (=76,800) pixels. The total pixel count should be at least 40,000 for good results, and the camera should have a temperature sensitivity of at least 0.2°C (usually specified as NETD or noise equivalent temperature difference) so that surface anomalies with small temperature differences can be detected.

Dynamic conditions

Whilst thermal insulation surveys require stable environmental conditions, moisture surveys and delaminations surveys require a changing thermal environment to create a thermal contrast between areas with different thermal capacity. When the environmental conditions change rapidly, such as at sunset, high thermal capacity areas change temperature slowly but low thermal capacity areas such as delaminated rendering change temperature rapidly.

Training and Certification

With the extensive availability, low cost and greater sophistication of thermal imaging cameras on the market today, the need for proper training and certification of thermographers has never been greater. A building thermographer should have appropriate training in thermography theory and specific training and experience in Civil Thermography. A good thermographer should be able to demonstrate appropriate qualification, recent relevant experience and a satisfied customer base.

The aim of UKTA is that thermographers or signatories to the report hold a minimum Level 2 PCN with Civil Applications endorsement. However, it is recognised that as the PCN (Personnel Certification in Non-Destructive Testing), the only approved academic certification process in the UK conforming to ISO 18436, was only introduced in early 2005 it may take some time for the expected number of required thermographers to become fully trained.

As an interim requirement, membership of a recognised thermographic Professional Association and a minimum of two years relevant demonstrable experience may be accepted.

Details of PCN Certification, training organisations and the ISO Standard syllabus requirements are available from PCN, British Institute of Nondestructive Testing, 1 Spencer Parade, Northampton. NN1 5AA, Tel: 01604 630 124.

Reporting

Surveys are often repeated after remedial work so reports must include basic information that would allow the survey to be repeated under similar conditions. The details required vary with the type of survey, but usually include a minimum of: objectives, location, date, construction details, equipment used, weather conditions, any special influencing factors, anomalies found, likely causes thermographers name, qualifications and contact details.

Supplementary assessment methods

Thermographic surveys identify thermal anomalies, surface temperature patterns that cannot be easily explained. They cannot always fully identify the causes of these anomalies. It is often necessary to use supplementary methods to identify the anomalies or complete the analysis. These methods include: Endoscope inspections, heat flux meters thermal resistance probes, anomaly area measurement etc.

Commissioning a thermographic survey

The benefits of thermographic surveys are not widely known to potential users. Good thermographers are aware of a wide range of applications and when consulted can demonstrate their expertise to prospective clients. Clients need to go through a logical process in commissioning a thermographic survey, often working with a thermographer or building professional.

- Identification of a problem – cold environment, mould growth etc.
- Classification of problem – cold structure, damp, etc.
- Decision to use thermography to diagnose the problem
- Developing suitable method
- Agreeing the deliverables – report, video or presentation
- Equipment and preparation
- Health and safety
- Selecting suitable time for onsite inspection (weather conditions)
- Survey
- Analysis of results
- Production of report
- Presentation to clients

Reference to technical notes must be made on sections of significant technical depth. The UKTA series of Civil Thermography Guides covers the following topics:

2. Continuity of insulation
3. Cold bridging
4. Damp walls & roofs
5. Air leakage
6. Delamination/ disbanding
7. Structural detailing/ voids
8. Energy surveys
9. Cold stores
10. Practical guide to thermographic surveys inc. risk assessment, etc.
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References

[1] Lower Carbon Futures, The 40% House Project, Environmental Change Institute at Oxford University, March 2005
[2] Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance L21 (Second edition) HSE Books 2000 ISBN 0 7176 2488 9
[3] BS EN 13187:1999, Thermal Performance of Buildings – Qualitative detection of thermal properties in building envelopes – Infrared method (ISO 6781:1983 modified)
[4] Infrared Thermography Handbook; Volume 1, Principles and Practice, Norman Walker, ISBN 0903132338, Volume 2, Applications, A N Nowicki, ISBN 090313232X, BINDT, 2005.