Condition assessment of facades with infrared camera

Autor(en): **Kaasinen, Harri**

Objekttyp: **Article**

Zeitschrift: **IABSE congress report = Rapport du congrès AIPC = IVBH Kongressbericht**

Band (Jahr): **13 (1988)**

PDF erstellt am: **10.07.2024**

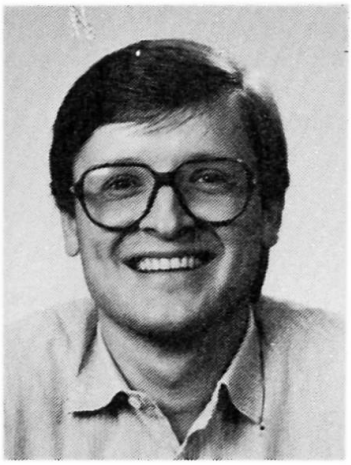
Persistenter Link: https://doi.org/10.5169/seals-13007

Condition Assessment of Facades with Infrared Camera

Auscultation des façades à l'aide de la thermographie infrarouge

Zustandsaufnahmen von Fassaden mit Infrarot-Thermographie

Harri KAASINEN
M.Sc. (Eng.)
Techn. Res. Centre of Finland
Espoo, Finland



Harri Kaasinen, born 1957, received his master degree at the Helsinki University of Technology. For two and half years he was structural designer in a consulting firm. Now he is a researcher and involved in building physics.

SUMMARY
Infrared thermography is widely used for localization of air leakages, cold bridges and other thermal failures in the building envelope. In this article several new applications are proposed. The results of some investigations carried out in the laboratory and field are presented. The problems of outdoor investigation are also discussed.

RÉSUMÉ
La thermographie infrarouge est largement appliquée pour localliser des bulles d'air, des ponts thermiques et d'autres défauts thermiques de l'enveloppe du bâtiment. De nouvelles applications sont proposées. Les résultats de quelques recherches de laboratoire et dans le terrain sont présentés. Les problèmes de recherches à l'extérieur sont également discutés.

ZUSAMMENFASSUNG
Infrarot-Thermografie wird allgemein eingesetzt für die Feststellung von Leckagen und anderen wärmetechnischen Mängeln der Aussenschale eines Gebäudes. In diesem Beitrag werden zahlreiche neue Einsatzmöglichkeiten vorgestellt, neben Untersuchungsergebnissen von einigen Labor- und Felduntersuchungen. Verschiedene Probleme der im Freien durchgeführten Untersuchungen werden ebenfalls erläutert.

1. BACKGROUND

Infrared radiation is part of the electromagnetic wave spectrum. It is also known that every object with a temperature higher than absolute zero kelvin (-273 ^{0}C), emits, reflects and absorbs electromagnetic radiation at its surface. The amount and wavelength of the emitted radiation are dependent on the object's surface temperature and its ability to emit energy, called emissivity.

Infrared camera is a device which responds to radiation emitted and reflected from object's surface and converts this radiation into black and white or colour image. Variations in image brightness or colours indicate varying levels of radiation. Most infrared cameras are sensitive to wavelengths of 2 - 5,6 μm or 8 - 12 μm. Wavelegths of 0,38 - 0,78 μm are detectable by the naked eye, which means that the human eye cannot see the light to which the infrared camera is sensitive and vice versa.

2. APPLICATIONS OF IR-THERMOGRAPHY FOR CONDITION ASSESSMENT IN BUILDINGS

2.1 Current applications

Infrared thermography has in recent years become an important method for detecting air leakages, cold bridges and other thermal failures in the building envelope. Another popular application of IR-thermography has been to use it as a nondestructive method to detect wet insulation in flat roofs.

There are several possible new applications proposed in many articles. Principally the IR-camera could be used for investigation of any kind of effects in which temperature differences exist or occur.

2.2 Delamination of layers

Delaminated areas in the surface of the structure emit infrared radiation different from that of sound areas, because heat transfer from or to the inner structure is interrupted. As an example some asphalt autobahn decks and concrete bridge desks have been investigated to localize possible delaminations [1], [2].

As an other example, thermography has been used to assess the conditon of walls bearing ancient paintings. Paintings were heated prior to the test and delaminations were detected with an IR-camera.

2.3 Moisture penetration

Moist surfaces demand heat for drying and therefore show a lower surface temperature than dry areas. This phenomenon is emphasized if a radiator is used. In this case radiator and camera are positioned in such a manner that radiaton from the radiator is reflected on the surface of the body to be investigated and then arrives at the camera. If there are moist areas at the surface, they absorb more infrared radiaton than dry ones. Therefore the camera senses a lower level of reflected radiaton. This method is called infrared reflectography and it has been used to detect moisture on masonry [1], [3].

3. TESTS

3.1 Laboratory tests

3.1.1 Threshold moisture content

The lowest moisture contents of some building materials that IR-camera can detect were determined. Thermal images of specimens with different moisture contents were taken. Moist specimen emits less radiation than a dry one, and this difference can be detected with the IR-camera. The lowest difference which can be measured is called threshold moisture content.

Specimens made of concrete, cellular concrete, timber (with and without painting) and brick were tested. The threshold moisture values of all these materials were within the hygroscopic moisture range of that material. At the same time the effect of IR-radiators were tested. The radiator emphasized differences between moist and dry surfaces, but it may be too complicated to use in field tests.

3.1.2 Test walls of brickwork

Thermal images of some plastered test walls were taken in order to find delaminations between plaster and bricks. Specimens were kept in cold conditions at -20 ^{0}C temperature before taking the infrared images. First warm water was sprayed on the surface of the specimen to emphasize temperature differences. Later the same effect was created with the aid of fan. Both methods worked well and delaminated areas are visible in figures 1 and 2.

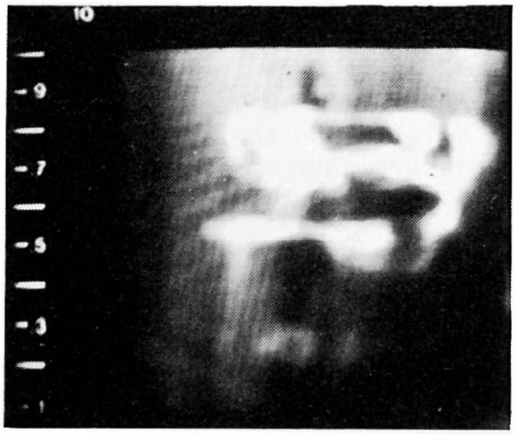


Fig. 1. Delamination of plaster, sprayed warm water.

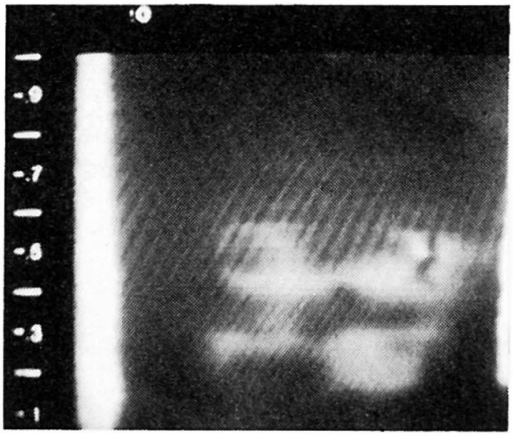


Fig. 2. Delamination of plaster, warm air fan.

Another interesting case was to study the rising moisture in masonry wall. A test wall was constructed of old bricks and laid in a water tank. Thermal images were taken before (fig. 3) and after (fig. 4) injection. Moisture penetration limits and the effect of injection are clearly seen in figures 3 and 4.

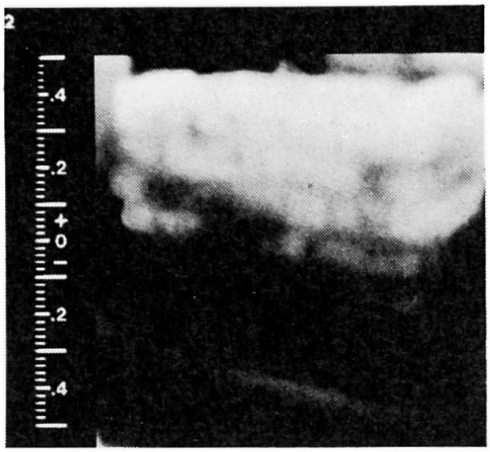


Fig. 3. Moisture penetration before injection.

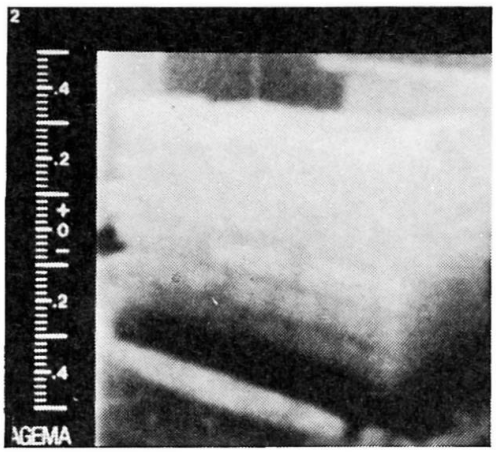


Fig. 4. Moisture penetration after injection.

3.2 Field tests

There are several restrictions to and distrubances in outdoor infrared testing. The temperature of air and structure are changing continuously as sun radiation changes in direction and intensity, shadows must be taken into consideration etc.. On the other hand if we, e.g., need to localize delaminations in facades by means of IR-camera there must be some kind of energy source which creates temperature differentials on the surface. Great care must be taken when interpreting thermal images, because thermal differentials could be caused by variations in sun radiation or reflections and not by any delamination.

As an example the facades of a supermarket were investigated. Some of the ceramic tiles had come loose and dropped on the street. Thermal images of facades were taken in order to localize possible loose tiles. The investigation was conducted in spring when the nights were cold but during the day the facades were warmed by the sun. Some posible loose tiles were found (fig. 5). These areas were high up in the facade and therefore they coud hot be checked in an other way.

In an other example IR-camera were used to localize moisture on the surface of the masonry exterior wall. Samples were taken and moisture contents measured after that and excess moisture were found.

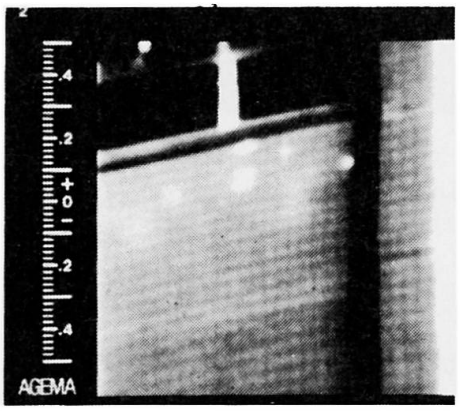


Fig 5. Loose ceramic tiles in facade.

4. CONCLUSIONS

It can be stated that there are many potential applications for IR-technics in nondestructive condition assesement of facades. Primarily the IR-camera can be used for investigation of any kinds of effects where temperature differences exist or occur. However, due to climatic conditions there are several restrictions to outdoor investigation. Still more research is therefore needed.

REFERENCES

1. Schickert G., Infrared Thermography as a Possible Tool to Detect Damaged Areas in Buildings. Durability of Building Materials, 3/1985, pp. 87 - 99.

2. Holt F., B., Manning D., G., Infrared Thermography for the Detection of Delaminations in Concrete Bridge Decks. IRIE 1978 AGA Corporation. pp. 61 - 65.

3. Böttcher B., Richter H., Ein Beitrag zum Nachweis von Feuchtigkeit in Mauerwerk mit Hilfe einer Infrarotkamera. Materialprüfung 24, Januar 1982. pp. 5 - 9.

Leere Seite
Blank page
Page vide