

# Thermography in Construction Industry.

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**Abstract - Infrared Thermography is a modern non destructive measuring method which helps in defining faulty works in electrical connection, Thermal power plants as well as in medical field as it uses to identify temperature. Introducing this new technology in construction industry for water leakage source detection as well as the inspection work before hand over or possession and maintenance work of the flats.**

Infrared cameras provide a means for temperature measurement in building constructions. Thus heat bridges can be detected. As it uses temperature hot spots and cold spots are spotted which helps to find the air and water leakage and heat losses sources, degradations of building structures. The paper gives a brief description of the theoretical background of infrared thermography. A case study has been added in the paper for the better understanding.

**Keywords** —infrared thermography; examination of buildings; emissivity; dwelling ; mapping moisture; Nondestructive method.

## I. INTRODUCTION

Thermography is non-destructive test method used in a variety of building applications identifying locations of air as well as water leakage, monitoring internal air temperatures, inspection of electrical and mechanical building services, detecting moisture within building structures and identifying cracks on external wall finishes.

This paper discusses an application thermography which helps in assessing the build quality and thermal performance of new structures, specifically apartment buildings, *during construction*. In future, include requirements for testing post-construction to demonstrate compliance with energy and carbon performance targets.

## II. APPLICATION OF IR THERMOGAPHY

The thermographic scanning system can measure and view temperature distribution based on IR radiations that is emitted from a heated surface of an object without physical contact between the measuring equipment and surface which is to be investigated. As a result, a thermal image of the object is obtained, in different shades of colors or a gray scale. This shades of colors helps us to identify the temperature of the surface. The principle of measuring test is based on the fact that any material continuously emits energy proportional to their surface temperature. This energy depends on the thermal properties and other physical properties of the material (porosity, density, water content)

From Construction perspective, consequential remedial work post construction is held to be expensive. Hence, testing during construction is considered. It is proposed that thermography has a potential role in this emerging need for site inspection tools to test and validate the thermal performance of the building.

## III. LITERATURE REVIEW

1) Thermography is a complementary technique helps for assessing the thermal performance of building during and post-construction as well as helps for the maintenance work after the handover of the structure.

2) The high variations of temperature in the thermal image indicates structural changes, abnormalities, the lack of insulation, cracks, air leakage sources, heat losses, moisture, etc. With the help of these variations spotting of the above mentioned problems becomes easy to handle and take care of.

3) The infrared measurement gives a qualitative image of the thermal protection level of buildings envelope and identifies the weak zones hidden from eye visual contact.[6]

## IV. METHODOLOGY

A. *Where does it help?*

1. Water leakage sources from bathroom –

1.1 Concealed pipe line

1.2 Floor tile grouts failures

1.3 Bathroom door frame damages

- 1.4 Wall tiles grout failures.
- 1.5 Floor traps failures.
- 1.6 Leakages in Sanitary wear & Pipe fittings
2. Water Leakage sources from terrace
3. Water Leakage Source from External Wall cracks
4. Water Leakage source from pipe lines as well as choked pipe lines.
5. Swimming pool water leakage
6. Overhead & Underground water tank leakages.

#### B. How it is Carried out ?

The thermal testing indicates the water accumulation in floor & walls as a cold spot compared to surrounding wall temperature. This helps to find out the water seeping in the floor or wall, which will be the source for water leakage.

This testing is mainly carried out to find out the source of the leakage rather than just showing the spot. As thermography is based on IR Technology it uses temperature to spot the exact location and source of the leakage without breaking any structure (non-destructive), it shows the location with the cold spot denoted on the thermal camera. It helps to show us the exact source from where the water is coming out and causing severe leakage to the structure.

For example if there is any ceiling dampness in flat number 101 there can be many different possibilities of leakage in flat number 201. There are two types of types of leakages 1) Continuous and 2) Non continuous.

In continuous leakage it includes concealed line leakage due to which major leakage can take place. Concealed line leakages may take place take place take place take place due to

- 1) Improper fitting of pipelines during construction or not checking the installed pipeline before handing over of the flat.
- 2) Improper joint filing.
- 3) Cracked threading of brass elbow and not fitted properly.
- 4) Improper fitting using Teflon tape.

These problems takes place mostly internally and can cause severe damage to severe damage to the structure and it also weakens the structure.

Whereas, in non continuous leakage continuous leakage it is used related and causes dampness only when the water is used continuous. Leakage can be caused mostly in bathrooms and kitchens where there is continuous flow of water on the floor. It can also be due to

- 1) Over washing of the floor the floor or Joint opening of tiles.

- 2) Improper slope in bathrooms and balconies.
- 3) Door frame gaps open window frame gaps open and not filled not filled properly.
- 4) External cracks on wall due to which rainy water may enter inside.

#### V. CASE STUDY

To explore this hypothesis, thermography techniques have been applied by author A in a case study of big project which was in possession stage and was facing some major leakage issues. Many such leakages and various problems were solved using thermography some of them are mentioned below :

1) Let's assume this as flat number 102 the sealing dampness which we can see took place in the master bedroom of this flat which is clearly visible in digital image and the water which is stagnant in the slab is visible in thermal image. To find the source of this ceiling dampness thermography test has been carried out in flat number 202 after the thermography test was carried out the source which was detected was due to the water getting stagnant near door frame in master bathroom which was percolating through the open joints of door frame and tile the grouting which was done got washed away and all the water was seeping through these gaps and it got stagnant at that one point which was visible in flat number 102. So the conclusion which was provided is to fill those gaps with epoxy grout and avoid stagnation of water at that door frame.



Fig no (1) Digital Image.

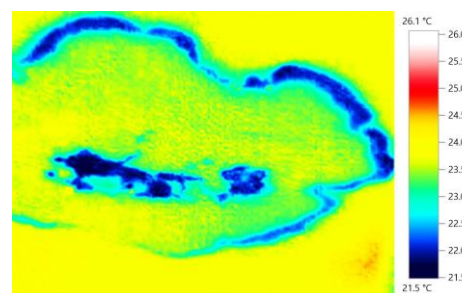


Fig no (2) Thermal Image

2) Assume this as flat number 203, as we can see in digital image that this is a health faucet tap in a bathroom. The water is coming out from the joint which is inside the tile

and is not visible in digital image and to the naked eye but with the help of thermal image we are easily able to see the exact source of leakage as there is this continuous source of water and water is continuously coming out from this tap internally and is traveling from inside the ledge wall which is seeping through the slab and affecting it. This major flow of water is causing a severe damage which is reflected in the flat below (i.e. in flat no 103) in the form of dripping. Such kind of major leakages which may affect the physical strength as well as the aesthetics of the flat are sometimes difficult to find out and this is where thermography helps.



Fig no (3) Digital Image.

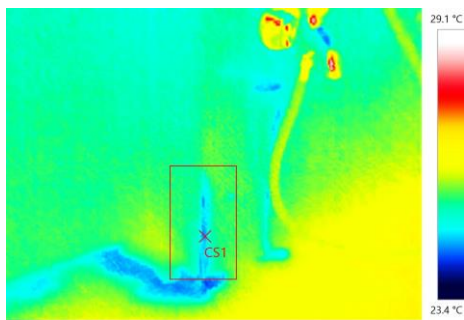


Fig no (4) Thermal Image

## VI. FACTORS AFFECTING THERMOGRAPHY

The main factors affecting the IR thermography study are shown below:

- a) *Climatic conditions*: insulation, wind, ambient temperature, humidity, greenhouse gases concentration.
- b) *Pattern characteristics*: emissivity/reflectivity, roughness or unevenness, stains and color of wall surface; construction of wall finish.
- c) *Environmental deficiencies*: angle of vision and survey distance, orientation of building to the path of sunshine during the survey, existence of any heat generating plants or machines inside the building.

Generally, it is possible to find leaking heating systems, faulty applied insulation or hidden timbered framework, which has been plastered over. Nondestructive infrared thermography method reveals accurately hydrothermal transfer through building envelope systems.

## VII. CONCLUSION

Thermographic testing non-destructive technique has the main purpose to provide information by analyzing the real characteristics of the existing buildings in order to determine surface cracks, voids, etc. Mainly focused on this paper and the cases studies discussed above, thermography is used for the detection of water leakage source, moisture content in the construction, seepage, etc. This helps to identify the problems which may occur after the handover of the flat.

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