

" THERMOGRAPHIC APPLICATION FOR THE CONDITION ASSESMENT OF BUILDINGS - AN EXPERIENCE"

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ABSTRACT:

During the condition assessment of a Hotel building for assessing its existing air conditioning system and energy loss/ distribution, several minor to medium discrepancies were observed which, if controlled, can save energy with a high cost benefit. in fact, in some areas, the cause of energy dissipation is due to unawareness of the staffs and lack of knowledge. Several steps have been taken based on results and recommendation of Thermographic Survey to reduce energy losses and thereby decreasing the cost to a minimum.

Keywords: Condition Assessment; Energy loss; building Survey.

1. Introduction:

Thermography of buildings is a very effective method for the detection of damage in the building structures and for gathering information regarding building technology and elements, their shape, their material characteristics and the state of decay. Although typical monsoon is almost absent in the Middle East and gulf region, humidity due to sea closeness and seepage of drainage system or irrigation water sometimes causes water to diffuse through the porous layers of concrete and brick walls thereby damaging the structures and reducing their strength. During routine survey of the present condition of structure of a hotel building in UAE, although no such considerable damage was noticed, moisture and evaporation of water at several areas throughout the boundary walls and roof could be observed which was reported for future attention and possible corrective actions to prevent such damage.

2. Moisture Diffusion Mechanism:

The presence of water in a structure and its change of state (solid, liquid & vapour) are mainly responsible for the damage to the building and its contents. The same material can be damaged differently at different times depending on the environmental conditions like humidity and especially on the amount of water on the walls of concern. An additional issue related to moisture damages of the surfaces is the water diffusion between the walls and the surrounding environment because of evaporation and dew. The main paths of water coming to the building materials are: -

- a) From the ground by capillary action.
- b) By condensation from air.
- c) From infiltration because of broken piping or guttering or leakage from the roof.

Except the cause indicated in (b) above, which is generally uncommon in this region, the other two causes of moisture intrusions were clearly evident from the thermographic study.

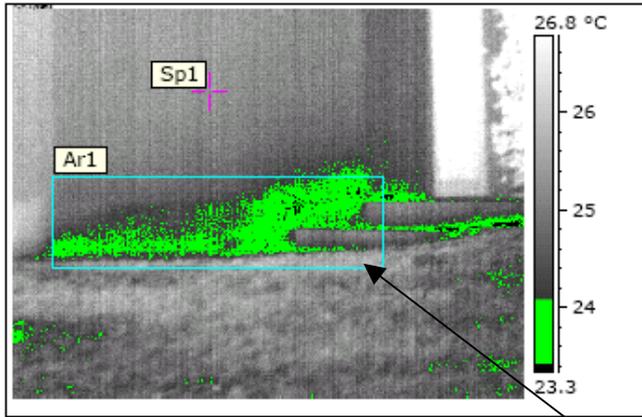
3. Thermographic images revealing moisture ingress:

As described above, there are main three reasons for water ingress into the building walls. We now briefly discuss the mechanisms of those diffusions:

Capillary Rising: The bases of the walls are the typical areas affected by rising damp. It does not depend so much on the fluctuations of temperatures during seasonal changes. Rather the water ingress in to the walls and its distribution generally vary on the condition of water content and supply in the underground soil. The presence of water in the ground generally depends on various factors including but not limited to the following: -

- a) Shallow ground water.
- b) Impermeable ground layers such as clay, which prevents water drainage.
- c) Proximity of rivers, sea, lakes and channels,
- d) Leakage through sewage systems and/ or drainage systems nearby.
- e) Inadequate slope of the ground.
- f) Broken waterproof layers/ slabs as pavements near the walls etc.

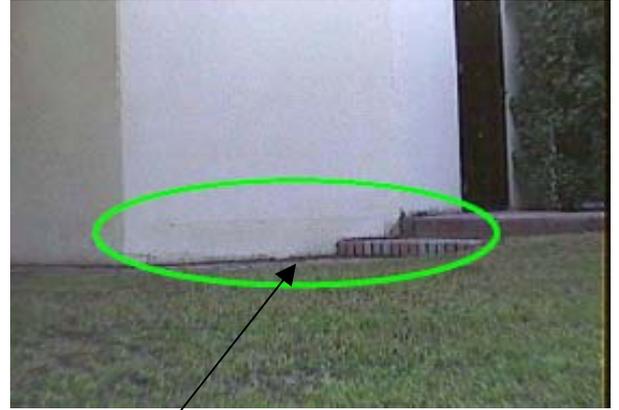
During the thermographic survey of the outside walls, water ingress was evident at the ground-connected portions where capillary rising played a major for moisture build-up. Refer to photographs and associated Thermographs in the following figures (1, 2, 3 & 4):



Thermograph - 1

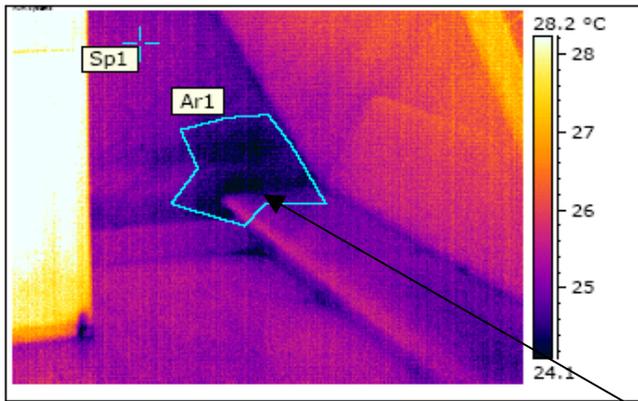
Label
Sp1
Ar1: Min
Iso1

Value
25.5 °C
23.1 °C
24.0 °C



Photograph - 1

Evidence of water ingress due to capillary rising.



Thermograph - 2

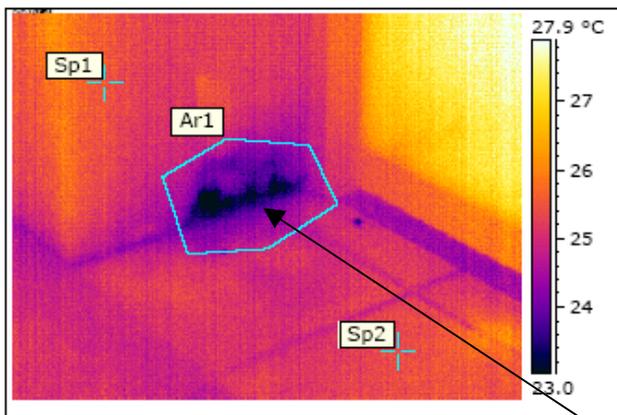
Label
Sp1
Ar1: Min

Value
25.4 °C
23.6 °C



Photograph - 2

Evidence of water ingress due to capillary rising or possible water leakage.



Thermograph - 3

Label
Sp1
Sp2
Ar1: Min

Value
25.8 °C
25.3 °C
22.5 °C



Photograph - 3

Evidence of water ingress due to capillary rising or possible water leakage.



Thermograph – 4

Label
Sp1
Ar1: Min

Value
26.1 °C
24.8 °C



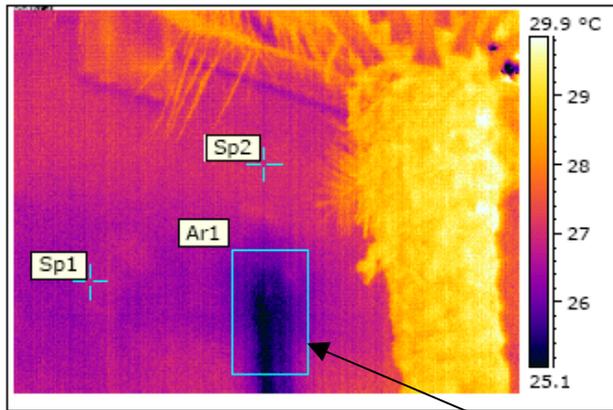
Photograph - 4

Evidence of water ingress due to capillary rising or possible water leakage.

Water condensation: In places where relative humidity is very high and ambient temperature goes lower, condensation of water vapour takes places in colder regions. The amount of condensation depends on several factors including Relative humidity of surrounding, condition and extent of cold and evaporative surfaces etc. water may condense at any part of the walls, where dew is formed. However the corners of the walls are the most preferred regions for this condensation to occur since the air circulation or flow is very limited in those areas.

Water infiltration and leakage: broken water pipes or sewage lines concealed through the walls, or going down the walls alongside may be a great cause for water infiltration. Broken pipes cause localised high concentration of water molecules, which eventually causes the adjacent wall, be moistened rapidly by diffusion of water molecules. Even though in many instances the extent of leakage or infiltration is not very apparent and also not so close to failure, infrared images can map the extent of spread for future consideration. In some cases, the indications of water infiltration can be estimated by staining on the walls, but those staining eventually disappear when the wall dries out during bright sunlight.

During the thermographic survey of the outside walls as stated earlier, water leakage and infiltration were also evident at the some where concealed piping were located. Refer to photographs and associated Thermographs in the following figures (5, 6,7, 8 & 9):



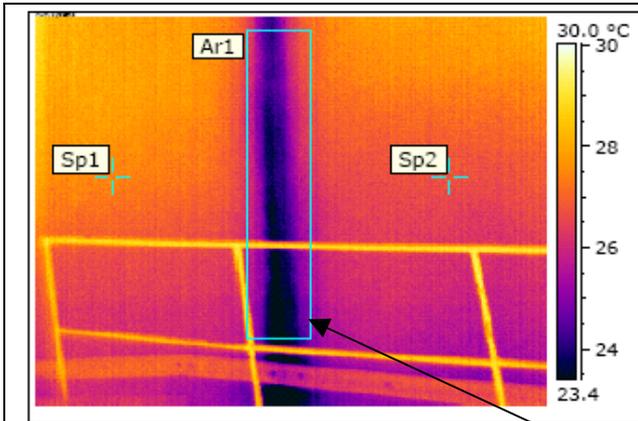
Thermograph - 5

Label	Value
Sp1	26.8 °C
Sp2	26.8 °C
Ar1: Min	24.7 °C



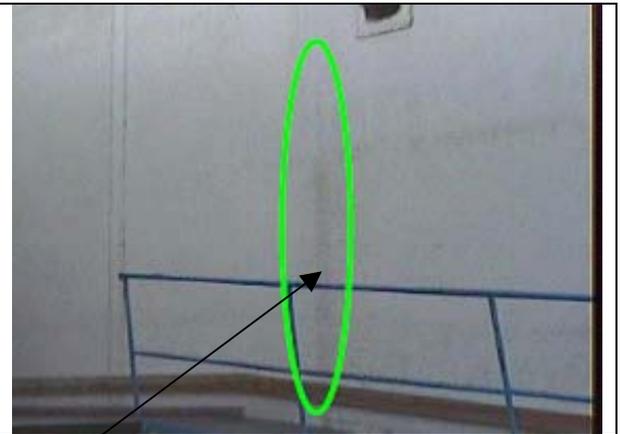
Photograph - 5

Evidence of water infiltration due to possible leakage of adjacent concealed piping. No visual staining could be noticed.



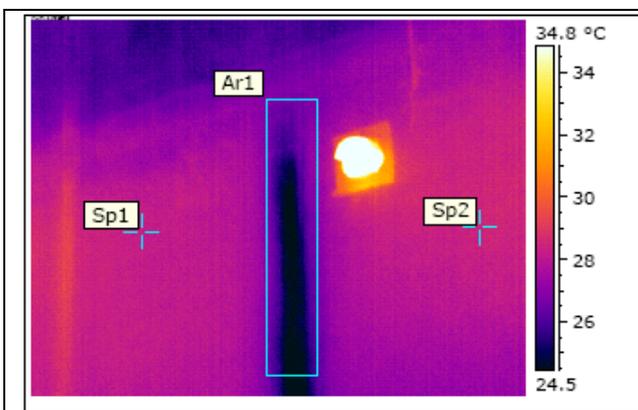
Thermograph - 6

Label	Value
Sp1	27.4 °C
Sp2	26.7 °C
Ar1: Min	22.5 °C



Photograph - 6

Evidence of water infiltration due to possible leakage of adjacent concealed piping. A faint visual staining could be noticed.



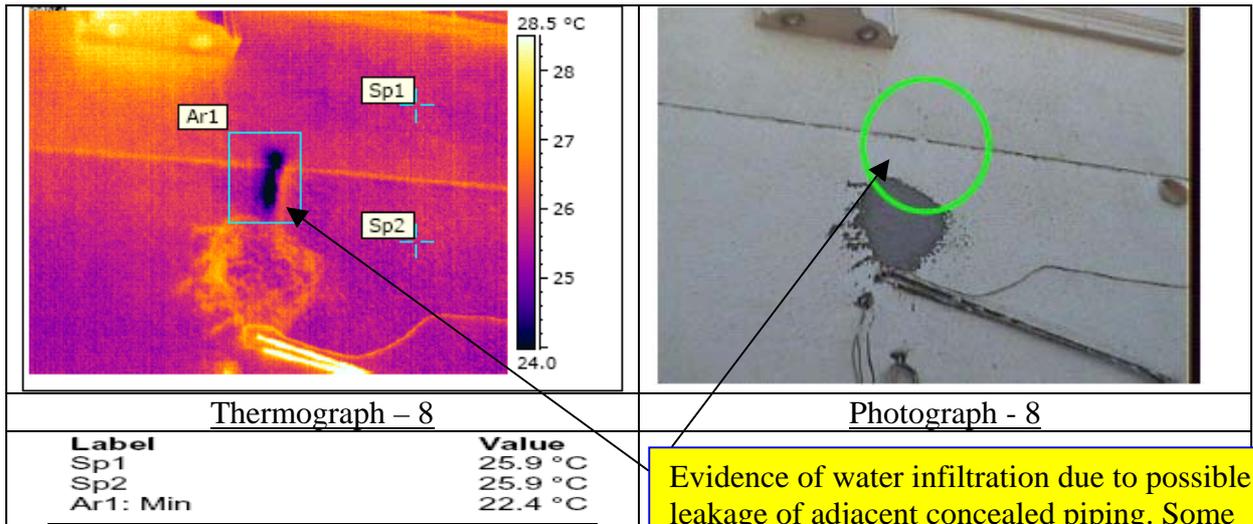
Thermograph - 7

Label	Value
Sp1	28.1 °C
Sp2	28.6 °C
Ar1: Min	23.7 °C

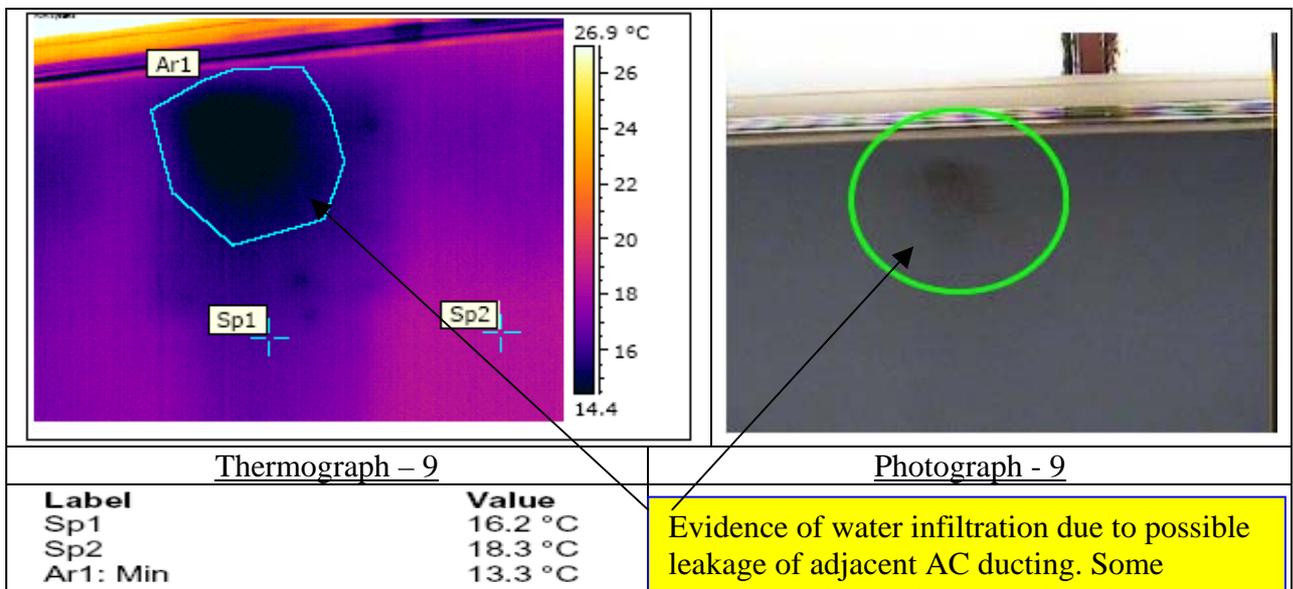


Photograph - 7

Evidence of water infiltration due to possible leakage of adjacent concealed piping. No visual staining could be noticed.



Evidence of water infiltration due to possible leakage of adjacent concealed piping. Some repair work could be noticed, possibly due to water spillage.



Evidence of water infiltration due to possible leakage of adjacent AC ducting. Some staining could also be noticed on the paints.

4. Conclusions:

Thermographic survey conducted in the hotel building helped the management to decide the future course of actions required to prevent further progress of damaging mechanisms prevalent in the structures. Although most of the findings are not of immediate concern, planning for future renovation/ repair can be effectively done and cost reduced.

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