

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 BACKGROUND**

Infrared thermography (IRT) is a powerful device to examine structural condition and similarly useful for damage valuation. It is a non-contact and non-destructive method that permits fast investigations. Extremely efficient infrared cameras and versatile software have simplified thermography significantly over the years. While IRT has broad applications in process industries, it is not yet extensively implemented in the investigation of buildings.

IRT has emerged as a widely used method for non-destructive testing. Thermography offers noncontact, wide area detection of subsurface defects, and can be used as an alternative or complement to conventional inspection technologies.

IRT was a chance discovery made around 1800 by Sir William Herschel, an astronomer (1738 – 1822), while searching for new optical filter materials to reduce the brightness of sun's image in telescopes during solar observations. The temperatures were found to increase from violet to red colours of the spectrum, and increased to a maximum value in the dark region well beyond the red end of the light spectrum. He named the phenomenon 'dark heat' and 'invisible rays', and called that segment of the electromagnetic spectrum as 'Thermometrical Spectrum'.(Rao, 2008)

The first 'heat picture', as it was then called, was obtained in 1840 by Sir John Herschel, the illustrious son of the discoverer of infrared radiation. The light reflected from the differential evaporation of a thin oil film exposed to a heat pattern forms an image visible to naked eye. The thermal image obtained on paper was called 'thermograph' by John Herschel. It is only since the 1950s that the secrecy shrouding the wartime developments was lifted, and thermal imaging devices were made available for civilian applications..(Rao, 2008)

The infrared camera senses the exitant (radiated, reflected and transmitted) thermal energy from the body, converts into temperature and displays thermal images. While thermal images provide useful data, the exitant energy should be considered in analysing and interpreting the thermal images. While the exact values of thermal properties (surface and body) are not always required to assess thermographs, the sources of radiation from the body (emitted, reflected and transmitted) help in correct assessment. A source of radiant thermal energy close to a body may lead to incorrect interpretation of the image.(Bagavathiappan, Lahiri, Saravanan, Philip, & Jayakumar, 2013).

IRT is equipment of method, which detects infrared energy emitted from object, convert it to temperature, and displays image of temperature distribution. To be accurate, the equipment and the method should be called differently, the equipment to be called as infrared thermograph and the method to be called as IRT. The equipment call as infrared thermography considering such generalization of terminology. The basic detectors led to development of modern thermal imaging. IRT provides a real-time pseudo colour coded image of the object and visual manifestation of defects. Applications of IRT as a condition monitoring technique in civil structures like material deformation under various loading conditions.(Wild, 2007)

The energy emitted by a surface is affected by the properties of the body. The changes in the quality of concrete due to local deficiencies such as poor compaction, seepage of water and deterioration, for instance, result in small changes in the surface temperature. Such images enable damage assessment of structures. The images are processed by software to yield thermal images. Various thermal patterns can be obtained by varying the palette (colour pattern), brightness and contrast of the image for locating details and correct interpretation of images. Various colour palettes can be selected, including grey palette. Thermal images appear as zones of different colours or shades depending upon the temperature range and mean temperature selected. (Bagavathiappan et al., 2013)

IRT is a modern tools for examination of non-destructive structural building. Thermography is determination surface temperature of object with help of infrared camera. Infrared camera provide a visual of temperature measurement in building from inside and outside. IRT used to check concrete condition during the concrete under stress using the image and visual that provided by the IRT. The measurement presented performed by using compression machine given certain load to the concrete. Image from IRT show several of colour's pattern causes of the stress happen on the concrete. Difference colour on the image shows difference load react to the concrete's structure, IRT image been taken before the compression test, during the compression test, and after the compression test to achieve good result and data. (Balaras & Argiriou, 2002).

Today IRT is widely employed for buildings diagnostics. IRT is based on the measurement of the radiant thermal energy distribution which is emitted from a target. Non-homogeneities in the near surface region of a structural element will result in many cases in measurable temperature differences. The thermal energy which is measured by the thermal sensor of an IR camera consists of the energy emitted by the target itself as well as the energy reflected by the surroundings via the object's surface. In civil engineering, the method is used for the localisation of voids and other irregularities in the near surface region; the detection of plaster delamination; investigation of the masonry structure behind plaster; the detection of moisture in the near surface region; and many more. The approaches of IRT for qualitative and quantitative evaluations for building diagnostics vary from passive and active. (Kylili, Fokaides, Christou, & Kalogirou, 2014)