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# Commissioning of Exterior Building Envelopes of Large Buildings for Resultant Moisture Accumulation Using Infrared Thermography and Other Diagnostic Tools

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## ABSTRACT

*Infrared thermography is used extensively in the building construction industry as a quality control and forensic tool to assess air leakage and the presence of moisture in exterior wall assemblies. Infrared thermography applied to large buildings however requires a good building science background and understanding of the dynamic forces which act on the building envelope. This paper shall focus on diagnosing building envelope anomalies in large buildings using infrared thermography and other diagnostic tools.*

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## INTRODUCTION

Infrared thermography applied to large buildings is an excellent tool to help identify and locate air leakage and the presence of moisture in exterior wall assemblies. Infrared thermography alone however will not identify the cause or source of any given anomaly. In fact, what appears to be an anomaly based on thermographic imaging alone may not necessarily be a problem at all. Proper interpretation based on a thorough assessment of the building being evaluated as well as a solid understanding of building science principles and the dynamic forces which act on the building envelope are of utmost importance.

## PRINCIPLES

Infrared thermography is a technology that allows infrared or heat radiation to be transformed into a visible image. Combined with other diagnostic tools, infrared thermography can be used to assess the overall air leakage and thermal performance of a building envelope. Heat loss by conduction, convection and air leakage as well as the presence of moisture in an exterior wall assembly can be detected by use of infrared thermography. Each of these different heat and moisture transfers produces different thermal expressions and need to be interpreted accordingly. Strict adherence to the necessary

environmental conditions for each type of building inspection is required to ensure suitable results from the thermographic inspection. An inspection carried out under unsuitable environmental conditions will provide no results at best and erroneous results at worst.

## EQUIPMENT AND QUALIFICATIONS

Infrared cameras for building applications are available in a wide variety of models and price ranges. Apart from using the proper camera and lens for a given application, the qualifications of the person operating the camera and performing the inspection is the most determining factor in obtaining an accurate assessment of the performance of the building envelope. An excellent camera used with the wrong settings and under inappropriate environmental conditions will ultimately yield misleading and inaccurate results. Reporting results based on an inaccurate assessment will have an important impact on the subsequent decision making process. In certain instances, what appears to be an anomaly may in fact not be a problem at all and an inaccurate assessment may result in needlessly recommending extensive remedial measures. In other instances, an inaccurate assessment may result in important anomalies being overlooked. When dealing with large buildings, the inaccurate assessment of a given deficiency can

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be repeated several times throughout the building and may as a result imply serious implications.

A prerequisite for any thermographer dealing with buildings, particularly large buildings, is a thorough understanding of building science and construction. A thermographer's level of expertise will vary considerably depending on his fields of application. An experienced roofing thermographer, for example, does not necessarily have the necessary experience to undertake a building envelope thermographic assessment, just like a building thermographer is not necessarily qualified to undertake electrical inspections. Another distinction is the difference between home inspections and large building assessments which require different qualifications and often different equipment and diagnostic tools.

## **SUMMARY AND CONCLUSIONS**

Infrared thermography is a technology that allows infrared or heat radiation to be transformed into a visible image. Combined with other diagnostic tools and when undertaken in strict adherence to the necessary environmental conditions, infrared thermography applied to large buildings is an excellent tool to help identify and locate air leakage and the presence of moisture in exterior wall assemblies. Given the complexity and scale of assessing large buildings, in addition to recording infrared still images, the entire infrared inspection should be videotaped and reviewed in detail after the inspection as part of

the reporting process. Infrared thermography alone will not identify the cause or source of any given anomaly.

The thermographer must have an in-depth knowledge of the use, operation and limitations of the specific camera he is using. Apart from using the proper infrared camera and lens for a given application, the qualifications of the person operating the camera and performing the inspection is the most determining factor in obtaining an accurate assessment of the performance of the building envelope. A thorough inspection process in accordance with industry recognized standards must be well established and rigorously followed to ensure consistent and reliable results. Identifying and validating the causes of the observations noted with the infrared camera is an important and often neglected step in the assessment process. Observations and recommendations should be backed by referencing detail drawings and conducting further investigations consisting of exterior or interior dismantling combined with smoke testing on an as required basis. In order to adequately assess the performance of the building envelope of large buildings and provide conclusions and recommendations forming part of the thermographic analysis process, technical or professional training in building envelope design and hygrothermal performance coupled with pertinent field experience dealing with large buildings is essential.