IN SITU THERMAL PERFORMANCE OF VIPS IN NORTHERN CANADA

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ABSTRACT

In the extreme cold climate of northern Canada, there is great potential to use Vacuum Insulation Panels (VIPs) for building envelope construction, particularly with interest created by the introduction of Canada's new national energy code for buildings. The introduction of the new energy code for buildings has increased interest in better building insulation in general, and in VIPs in particular. VIPs have thermal resistance values much greater than those of conventional thermal insulation materials. However, the long-term thermal performance VIPs has yet to be fully quantified. In Yukon, VIPs have been used as thermal insulation in two applications: in a retrofit of a commercial building, and in a new home. This extended paper abstract for presentation summarizes the long-term performance of VIPs in commercial buildings. The field thermal performance monitoring results, gathered over a period of six years, and the lessons learned, are presented to help the building enclosure construction community, researchers, designers, and end-users around the world to make the best use of the unique properties and performance of VIPs for energy efficient building envelope construction.

INTRODUCTION

Although little-known in the construction industry, vacuum insulation panels (VIPs) have thermal resistance values up to about 10 times greater than those of conventional thermal insulation materials, for the same thickness. However, VIPs are slowly but steadily gaining recognition for their potential use in building envelope construction. In Canada, the potential to apply VIPs in the building construction industry is estimated to be enormous, particularly with the introduction of the new National Energy Code of Canada for Buildings [1] that aims to achieve 25% less energy use in buildings than the energy code requirements set in 1997. Quite naturally, VIPs can play a major role in Canadian buildings to meet the requirements of the new energy code. However, lack of long-term performance credentials and various constructability issues are perceived to be the major barriers to mass application of VIPs in the Canadian construction industry.

Yukon, located in Northern Canada, is known for its sub-arctic weather, and because of its climate, thermal insulation plays a very important role in building envelope construction in this region. Use of high performance, lightweight, and thin VIPs in northern buildings is potentially an attractive option for the construction industry because of its high insulation value per unit of thickness, and low material volume.

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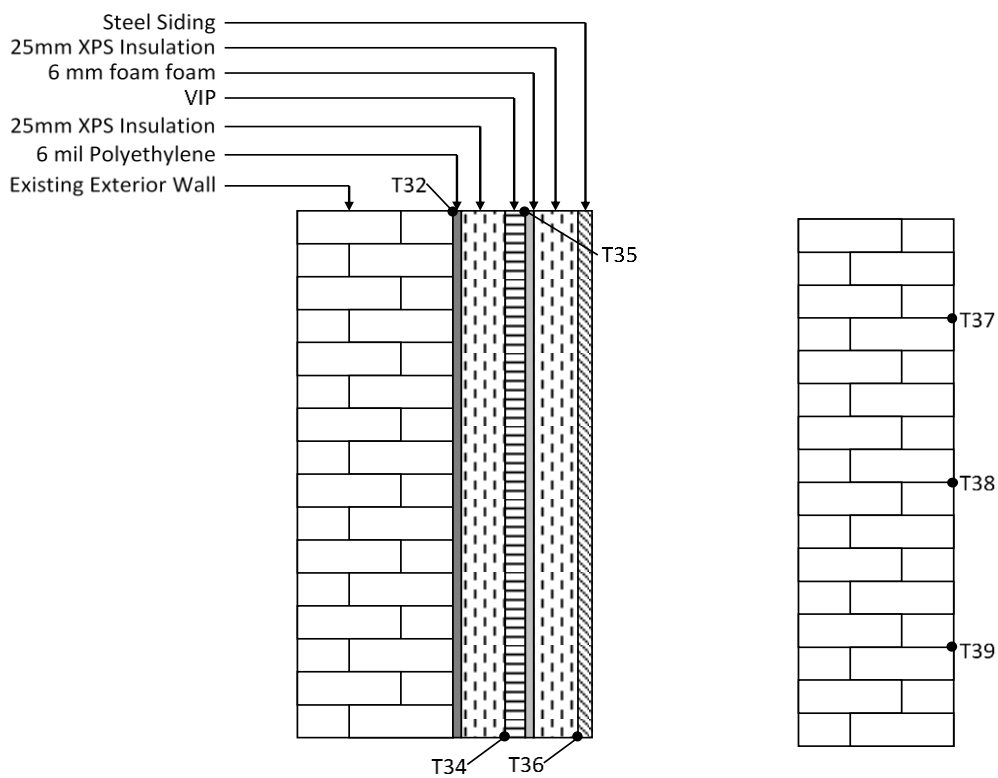
In this project, regional stakeholders and researchers collaborated to retrofit a portion of the exterior of an institutional building in Yukon with VIPs. This extended abstract paper outlines the construction details of the retrofitted wall assembly, instrumentation details, and long-term in situ thermal performance of VIPs.

CONSTRUCTION AND INSTRUMENTATION

The construction and instrumentation details are shown in Figure 1 below. The existing wall selected for retrofitting with VIP insulation was made of 50 mm x 150 mm (2”x6”) stud construction with fiberglass batt insulation and a concrete block exterior with a nominal total insulation value of RSI 3.5 (R20). The insulation goal for this wall after retrofit was based on previous studies that showed that the economic wall insulation level in northern locations was in the order of RSI 8.8 – 10.5 (R50 to R60) [2]. Thus, it was originally proposed to install two layers of VIPs with a total nominal RSI value of 10.5 (R60).



T32 - on existing block wall exterior surface
T34 - on 1" 1st Styrofoam layer (on interior side of VIP)
T35 - on exterior of VIP
T36 - on exterior of 2nd 1" Styrofoam
T37 - on existing block wall on exterior surface - 3'2" from top
T38 - on existing block wall on exterior surface - 5' from top
T39 - on existing block wall on exterior surface - 9'4" from top

Figure 1: Construction of retrofitted wall and locations of temperature sensors [3]

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As an initial step, a thermal image of the wall was taken at the site and is shown, along with a picture of the wall, in Figure 2. Note the virtual absence of thermal bridging in the post-retrofit wall.

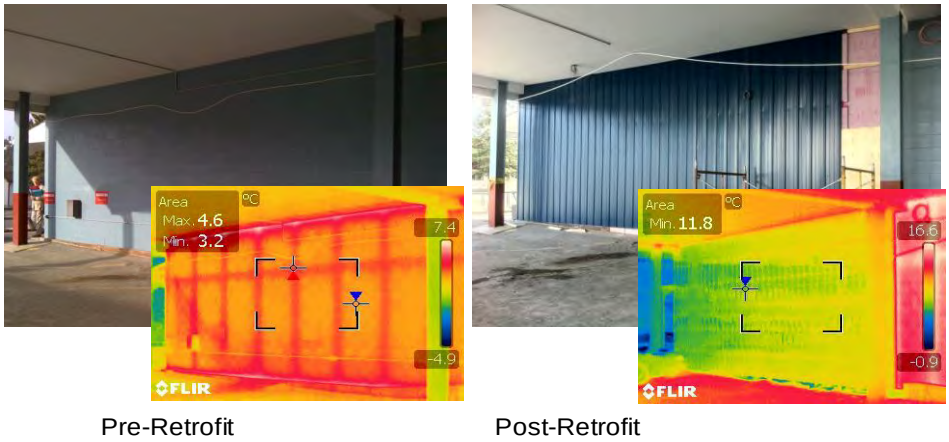

Figure 2: Infrared Image of the wall before and after retrofit [3]

The thermal performance of retrofitted composite exterior insulation (XPS-VIP-XPS) is shown in Figure 3 [3-4]. Figure 3 indicates that relative contribution (indicated by % temperature drop) of VIP towards the overall thermal insulating capacity of the exterior composite insulation (XPS-VIP-XPS) did not change significantly over a period of six years.

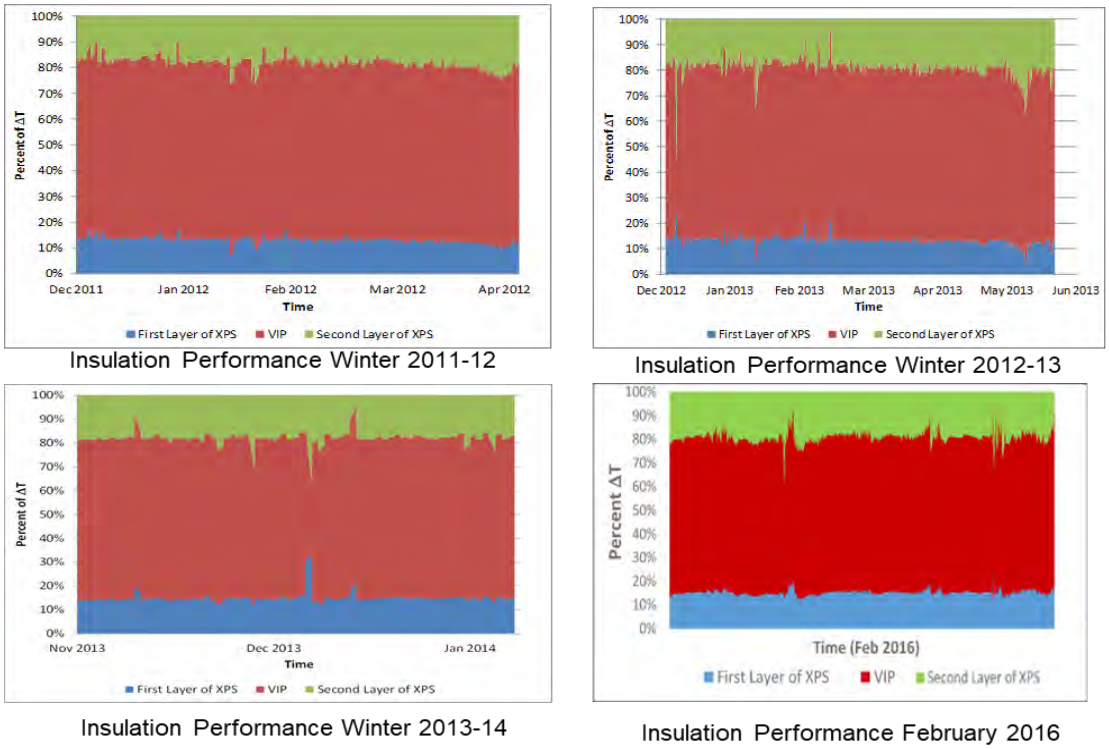

Figure 3: In situ thermal performance of VIP during 2011-2016

CONCLUSIONS

1. Policy, regulatory, environmental, economic, and developmental concerns in Northern Canada are driving forces for the development of energy efficient building envelope construction, and use of advanced thermal insulation materials such as vacuum insulation panels (VIPs) is a practical necessity.

2. There are and will continue to be concerns about the long-term thermal performance of VIPs.

3. Field performance data over a period of six years (2011-2016) show insignificant aging of VIP in an exterior retrofitted wall assembly construction located in Whitehorse, Yukon.

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