Notice of the Final Oral Examination
for the Degree of Master of Applied Science
of
VIVIAN CHAN
BEng (University of Victoria, 2017)

“Long Term Thermal Performance and Application of Glass Fiber Core Vacuum Insulation Panels”

Department of Civil Engineering

Friday, November 6, 2020
10:00 A.M.
Remote Defence

Supervisory Committee:
Dr. Phalguni Mukhopadhyaya, Department of Civil Engineering, University of Victoria (Supervisor)
Dr. Min Sun, Department of Civil Engineering, UVic (Member)

External Examiner:
Dr. Ajith Rao, Corporate Innovation Centre, USG Corporation

Chair of Oral Examination:
Dr. Lin Cai, Department of Electrical and Computer Engineering, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies
Abstract

Glass fiber core Vacuum Insulation Panels (VIPs) have thermal performance per unit thickness of about 5-10 times higher than the traditionally used building insulation materials such as mineral wool, XPS, EPS, foam, etc. This advantage of VIP has made it very attractive new option for innovative building designs. Especially in Canada, where some of the areas have long and very cold winters.

Confidence in the service life of a building material is necessary before putting a product to market. Extensive research has been conducted on the product development, quality improvement, and field application of VIPs around the world. However, there is lack of consistent and simple prediction method for the long-term thermal performance of VIPs.

This paper discussed the process and performance of a field project using glass fiber VIPs to retrofit a commercial building in Yukon, Canada. The thermal performance of the VIPs used in this project was continuously monitored and critically analyzed since the start in 2011. The results have shown satisfactory thermal performance of VIPs for the past 8 years. The findings were also used to validate glass fiber core VIP accelerated aging tests conducted by the National Research Council Canada (Ottawa), and the aging rate of VIPs in a cold and dry climate was determined.

The second part of this study investigated the monitored performance results from two sets of simplified accelerated laboratory aging tests, the results were analyzed with the aim to separate the impact of air diffusion from water vapour on the long-term thermal performance of glass fiber VIPs.

In addition, this study also investigated the potential application of VIPs in balcony constructions to reduce heat transfer through thermal bridges. Computer modeling exercises, using a benchmarked (EN ISO 10211) three-dimensional transient and steady-state heat transfer simulation tool HEAT3, were carried out on the most optimal (thermal performance) balcony assemblies of wood framed buildings using VIP as insulation. This niche application of VIPs can significantly increase the energy efficiency of building envelopes/skins in extreme climates of Canada and elsewhere in the world.