Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

QI ZHOU

BSc (Northeastern University, 2013)

“Design versus Actual Energy Performance in Green Buildings”

Department of Mechanical Engineering

Tuesday, November 20, 2018
9:30 A.M.
Engineering and Computer Science Building
Room 467

Supervisory Committee:
Dr. Caterina Valeo, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Phalguni Mukhopadhyaya, Department of Civil Engineering, UVic (Co-Supervisor)

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

Chair of Oral Examination:
Prof. Ajtony Csaba Szakacs, School of Music, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

The secondary energy use and GHG emissions have noticeably increased during recent decades in Canada; the residential sector accounted for the third largest portion of total energy use. The government and market turned to build highly efficient residential buildings for energy savings. However, premature technologies and designs brought countless issues from conception to operation stages resulting in performance discrepancies between the modelled results and field performance. This thesis looked into ten LEED Gold certified social housings in Victoria and Vancouver, BC to reveal their performance gaps, to investigate possible causes, to seek practical solutions and to summarize proper recommendations for the green building industry. It was accomplished by collecting LEED energy model and utility data for two years of each building, comparing their predicted and actual energy consumption, examining each site, discussing with facility managers and analyzing performance gaps. In addition, occupancy and building staff surveys served as the robust support of the research. The assessment shows only two buildings realized their preliminary high-performance goals. Other buildings sustained an offset of energy consumption from the minimum of 22.1% to the maximum of 281.7% compared to their proposed models. The reasons for the discrepancy covered all the phases of a building's life from design to construction, to commissioning and to post-occupancy. The most common concerns were the unexpected inefficiency of air source heat pumps and unpredictable occupancy behaviours such as leaving windows open in winter. In consideration of these, the calibration of energy models according to refined performance curves of heat pumps and particular inputs for social housings would provide a more accurate prediction. Together with improved designs, adequate commissioning and appropriate operation, performance gaps can be narrowed to a great extent.