Thermal Bridging at Qloft as Compared with a Typical Apartment Building

Qloft is a super energy efficient multi-unit residential building (MURB). It was constructed using great care and sound engineering to meet the requirements of LEED for Homes® platinum. More importantly, it was constructed to reduce the energy resources and costs needed to provide a conditioned and comfortable indoor environment. On cold days in March 2017, DOC Engineering visited Qloft and another newly constructed MURB to document the envelope construction using thermography.

Thermographic cameras take "pictures" of the infared radiation that is emitted from objects. Infared radiation is basically light that is not visible to humans. The camera detects the radiation. The amount of radiation emitted by an object increases with temperature; therefore, thermography allows one to see variations in temperature.

In Canada, we build highly insulated structures to reduce our costs to provide heating and cooling. The more insulation we have in our walls and roofs the less energy that we will use to maintain a comfortable indoor living condition. All materials have a thermal conductivity. Some materials, like copper, conduct heat very well and are called "conductors". Other materials, like cork, conduct heat very poorly and are called "insulators".

Buildings are composites of a variety of materials. Some of the materials are used to provide structure, some provide moisture and air barriers, and others are used to provide insulation. In a steel frame building, the steel provides the structure. When insulation is applied between the steel frame, the portion of the wall with steel has a much lower insulating value than the portion of the wall with insulation. The steel conducts heat and forms a "thermal bridge" in the structure. In modern energy efficient buildings, the entire steel structure is also wrapped in insulation to reduce the thermal bridging affect. A typical modern steel wall construction is shown in Figure 1.

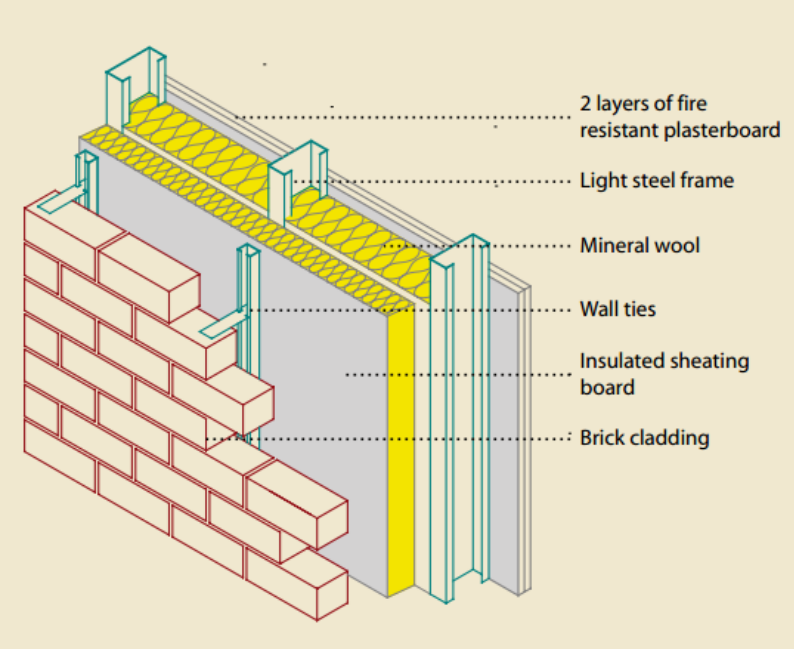

Figure 1 – Typical Steel Frame Construction [1]

[1] "A Comparative Life Cycle Assessment Modeling of External Wall Construction Systems: Case Study Residential Complex in Al-Ain, United Arab Emirates". Abdulaziz Banawi, Ghulam Qadir, International Journal of Construction Engineering and Management, p-ISSN: 2326-1080 e-ISSN: 2326-1102, 2015

Shown in Figure 2 is a thermographic image of a well-constructed apartment building that meets the requirements of the National Energy Code of Canada. The image was taken on a cold day in March, 2017. The thermal bridge created by the steel frame shows prominently in dark purple. The cavity between the frame is insulated and therefore the surface temperature of the wall is much higher. There is a difference of 4C° between the coldest part of the frame and the rest of the wall.

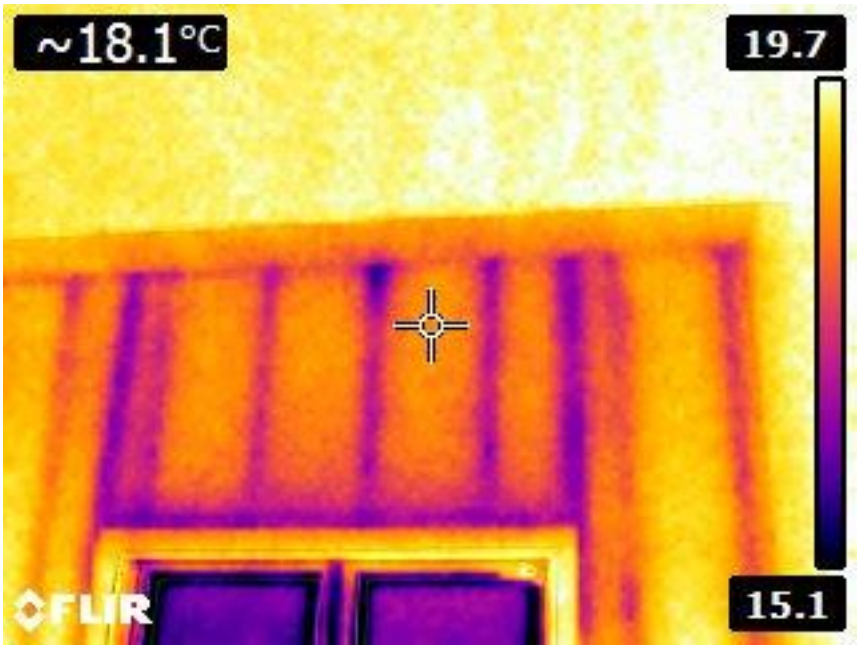

Figure 2 – Thermographic Image of a Steel Frame Construction
Halifax, March 23, 2017

Qloft was designed and constructed to meet the requirements of LEED for Homes® platinum which is a much higher standard than the National Energy Code of Canada. Engineering and care was used to construct the building envelope so that thermal bridges are minimized. Rather than use steel frame construction, Qloft is built using an insulated concrete form (ICF) system. ICF is a system of formwork for reinforced concrete usually made with a rigid thermal insulation that stays in place and provides insulation to the exterior walls. The forms are modular units that interlock and are filled with concrete as shown in Figure 3.

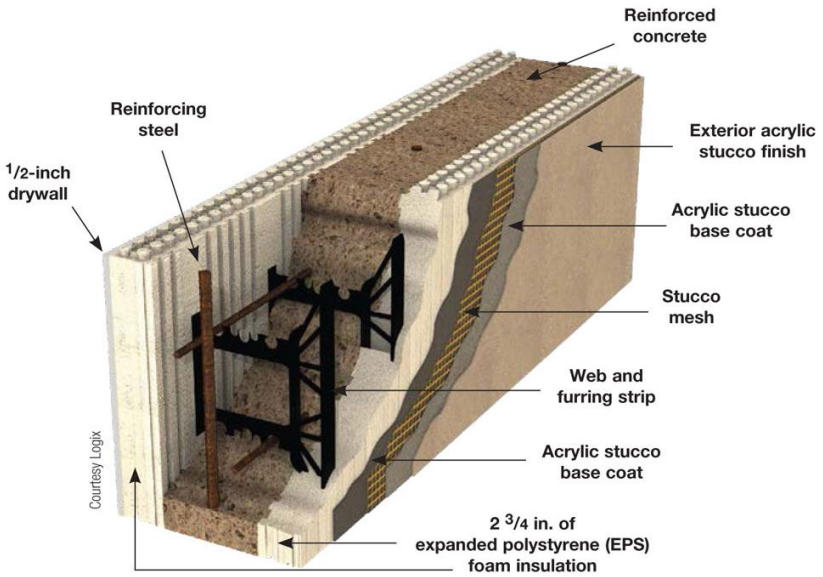

Figure 3 – Typical ICF Construction[2]

[2] "Why ICF is a Better Choice", United Architecture & Construction

In an ICF wall, the structure is provided by concrete with a very small amount of steel added for reinforcement. While concrete is not the best insulator, unlike steel, it is not a conductor. The entire ICF wall has a continuous insulating value without thermal bridges. Figure 4 is a thermographic image of an exterior wall corner at Qloft. The image was taken on a cold day early in March, 2017. The colour variation is small when compared with the steel frame construction. Neither temperature extreme appears in the image. The temperature of the entire wall is 17.8°C with a small temperature variation of +/- 0.5C°.

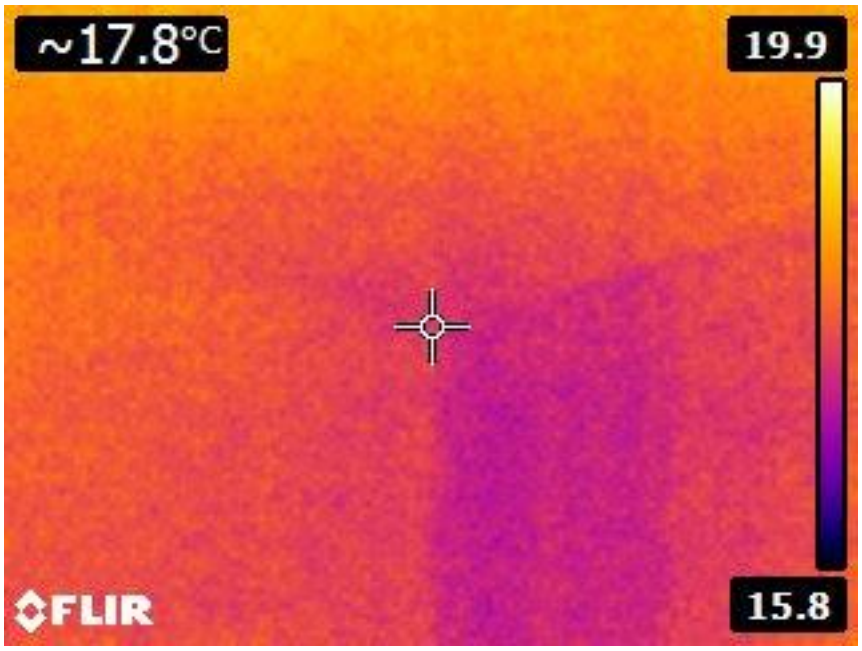

Figure 4 – Thermographic Image Qloft - ICF Construction
Halifax, March 3, 2017

For one final comparison, a thermographic photograph was taken at a corner of a well-insulated energy efficient wood frame construction as shown in Figure 5. The image was taken on a cold day in March, 2017 for a house in Halifax. In this case, the wood frame forms the thermal bridge and has a much lower insulating value than the insulation. It is very clear in the image where the wood frame is located. The difference in temperature between the coldest and warmest surface in this image is 4.5C°.

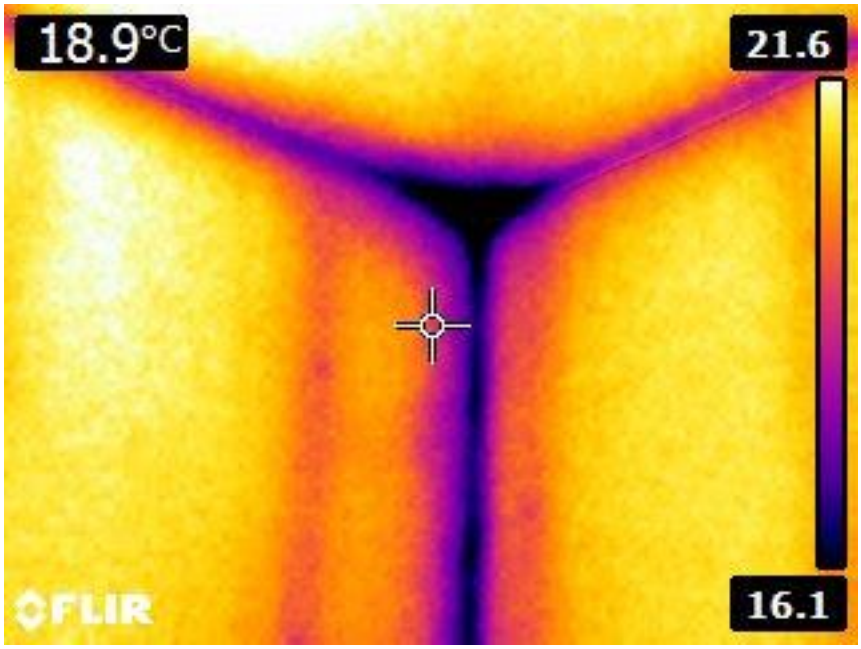

Figure 5 – Thermographic Image Wood Frame Residence
Halifax, March 24, 2017