Comparison of Air Tightness of Prefabricated and Site-Built Canadian Homes

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Background Information

Air leakage can cause up to 30 to 40% heat loss of the total heating requirements of properly constructed Canadian houses. In order to reduce the residential energy consumption for space conditioning (heating, cooling and humidification/dehumidification), it is important to evaluate and improve the air-tightness of houses. This research investigates the air-tightness of Canadian houses based on measured data.

Methodology

The investigation considers the effect of different factors such as year built, location, house size, and construction method on air leakage. Natural Resources Canada (NRCan) was contacted for data on new and existing homes in Canada. From this data, house properties such as year built, region, house volume, and air leakage are retrieved. Blower Door Test was used by house auditors to measure the air leakage (in L/s) of houses under a specified pressure difference (50 Pascals) between indoor and outdoor. Less air leakage means a more airtight home. The provinces of Alberta, British Columbia, Saskatchewan, and Northwest Territories are chosen for the investigation. The influencing factors- year built, house size, and location- are analyzed for both existing (measurement was made some time after occupation) and new homes (measured right after construction). However, construction method - stick built or prefabricated - is examined only for the new houses. Later, a company which performs a panelized method for constructing homes was contacted for additional data. This data will be known as a hybrid building method between on-site and prefab methods.

Data and Results

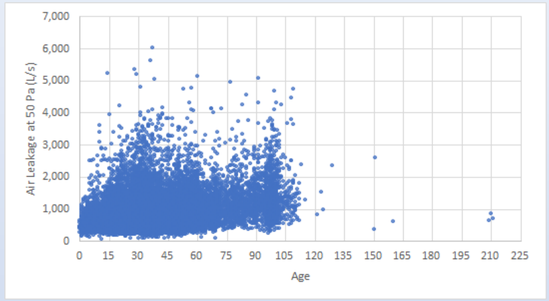
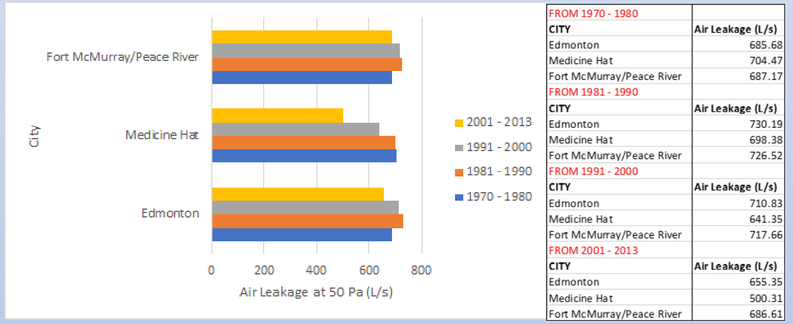


Figure 1: A Plot of air leakage (measured at a 50 Pascals pressure difference between indoors and outdoors in L/s) against the age of the existing houses. Data from houses located in Alberta.

As seen in figure 1, age has an impact on air leakage; the older the home, the higher the air leakage.



FROM 1970 - 1980	
CITY	Air Leakage (L/s)
Edmonton	685.68
Medicine Hat	704.47
Fort McMurray/Peace River	687.17
FROM 1981 - 1990	
CITY	Air Leakage (L/s)
Edmonton	730.19
Medicine Hat	698.38
Fort McMurray/Peace River	726.52
FROM 1991 - 2000	
CITY	Air Leakage (L/s)
Edmonton	710.83
Medicine Hat	641.35
Fort McMurray/Peace River	717.66
FROM 2001 - 2013	
CITY	Air Leakage (L/s)
Edmonton	655.35
Medicine Hat	500.31
Fort McMurray/Peace River	686.61

Figure 2: Closer look into 1970 to 2013 existing homes data. Air leakage versus City in Alberta.

Figure 2 shows that climate (the effects of wind and temperature combined) do not impact air leakage as much. Wind and temperature work in creating a pressure difference between indoor and outdoors which drives air movement across the building envelope.

It can be seen that house size is an influencing factor on air leakage. The results correspond with the theory that air leakage would increase for larger houses, since surface area is increasing and the possibilities of intentional and unintentional openings for air to move through increase as well.

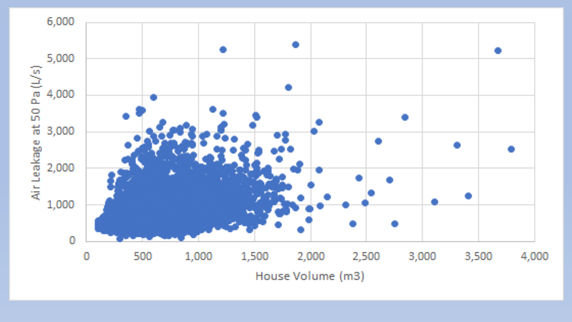


Figure 3: Graph of air leakage versus house volume for the years of 1980 to 2016. Data is from existing homes in Alberta.

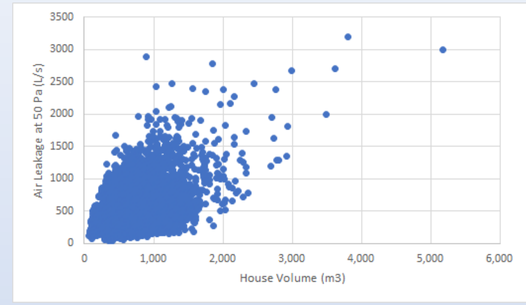


Figure 4: A plot of the air leakage against house size for stick built new homes.

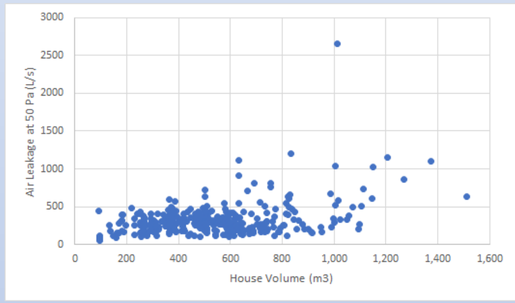


Figure 5: A plot of air leakage against house volume for prefabricated new homes.

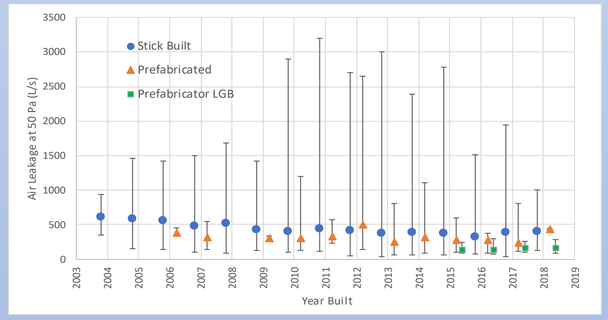


Figure 6: A comparison of air leakage for stick built, prefabricated homes. The ends of the error bars represent the maximum and minimum air leakage values in each of the years and the points are the average air leakage per year.

After examining figures 4 to 6, it shows that air leakage is lower for prefabricated homes over the years. In prefabricated homes, the majority of the house is manufactured in a controlled environment rather than the entire construction process occurring outdoors in any sort of weather. Thus, this method provides more security and protection from other external factors that a site-built home would not have. Due to these fewer disturbances, prefabricated homes tend to be more air-tight.

Conclusion

Air leakage is dependent on factors such as year built, the surrounding climate, and house size. After analysis, it is discovered that the method of construction- whether the house was built all on-site or manufactured in a factory- also influences air leakage. This report outlines these influencing parameters and how they affect air leakage. Further study and analysis will continue on the impact of these parameters on air leakage.

Acknowledgements

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