MEASURING THE HEAT LOSSES AND SOLAR GAINS OF BUILDINGS VIA A NOVEL ANALYSIS OF THE DATA

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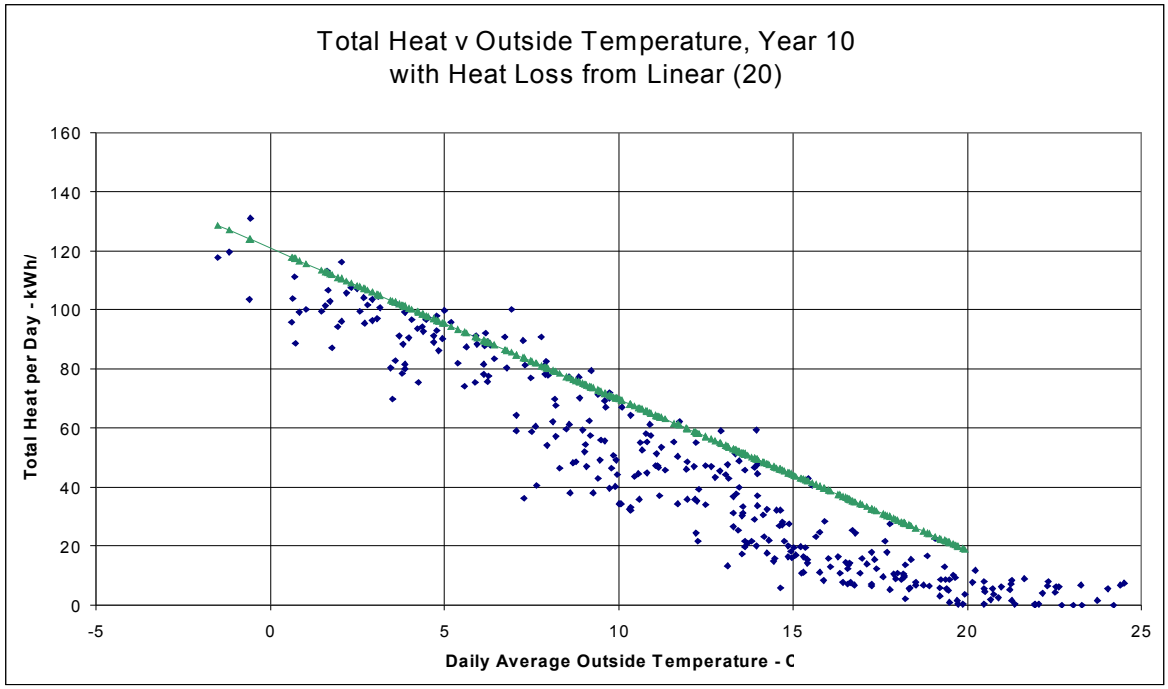
1. Abstract

The work was prompted by published results for Passive Houses, showing that the Total Heat from the heating system is much less than the Gross Heat Loss, as calculated with a steady-state thermal design procedure. (Feist, 2006). Solar gains account for most of the difference but would be extremely difficult to measure directly. Other gains come from electrical appliances and lighting and from the occupants, which are easy to determine from electricity meter readings and known metabolic rates. Direct measurement of the Gross Heat Loss is also impractical, since days with zero solar gain – i.e. heavily overcast - are very rare. The paper describes a method of determining the Heat Losses and hence the solar gains from the Total Heats supplied by a gas-fired central heating system with auxiliary electricity input. The novel analysis is based on the observation that days with high solar gains are associated with large Outside Temperature Swings – the differences between the maximum and minimum - and assumes that they are proportional. Total Heat values inherently vary, so the method uses data sets for extended periods, such as a year. The Total Heat, Outside Temperature and Temperature Swing values are fitted by a plane surface, so that extrapolation to zero Temperature Swing and solar gain gives the Heat Loss line over the range of Outside Temperatures. Adding the electrical and metabolic gains gives the Gross Heat Losses. For the test house, which faces near-south but has no special solar features, the solar gains over a typical year were about 20% of the Gross Heat Losses.

The method should be applicable to most existing buildings, including those supplied with group or district heating. These may use heat-only boilers or co-generated heat, from fossil fuels or renewable energy from e.g. solar, wind or biomass. Indeed it should be even easier to apply in these cases, since the heat supplied is often already metered and logged, as are the outside temperatures. Also, by using the method before and after, it enables the experimental determination of the effectiveness of insulation and air-tightness measures in place. Since most existing buildings will remain in use for many decades, such a method for determining their gross and net heat demands will help to meet the challenges of fossil fuel depletion and climate change.

2. Figure



3. Reference

Feist, 2006. 15 jähriges Jubiläum für das Passivhaus Darmstadt-Kranichstein - der Faktor 10 ist Realität. http://www.passivhaustagung.de/Kran/Passivhaus_Kranichstein_15Jahre.pdf. Last accessed 2011-03-21.