Understanding Your House energy Rating

You have received the results of a house energy rating - as a heating and cooling load or as a star rating - but you are wondering, how was it calculated and what does it mean? This document attempts to answer these questions.

Building Thermal Simulation

Building thermal simulation provides a way of comparing the simulated thermal performance of building designs. The thermal performance is presented as the total heating and cooling energy required *per square meter* of floor space per year. The units are Megajoules/square meter/year.

All ratings use standard settings of thermal comfort (temperature and humidity) and the time periods when that thermal comfort must be maintained. The hourly simulated heating load and cooling load are separately totalled over the year and divided by the conditioned floor area. These simulated loads do not include any other energy use in the house. However, they are influenced by the standardised heat inputs from sources such as cooking and lighting.
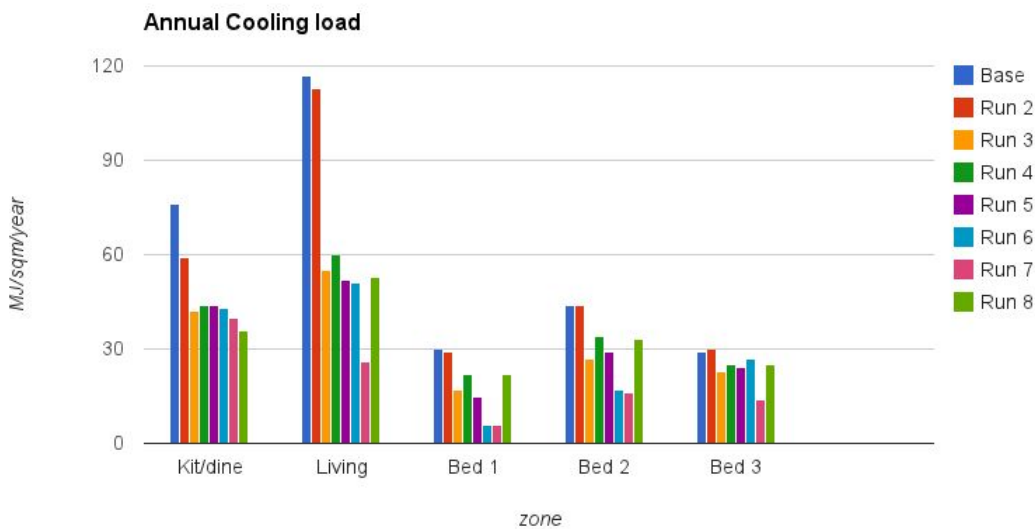

figure 1 - simulated heating loads for an alterations and additions

Changes in the design can be trialed to see what impact they have on the heating and cooling loads in each house zone. For example, the simulated heating loads above are for a renovation in Sydney. Run 3 is the same as Run 2 except in Run 3 draught proofing and R4 ceiling insulation are added to all areas in the existing house (including the Living room). This information can help us decide which modifications are worth the investment.

House Energy Rating

A 10 star rating system for houses was developed by CSIRO to simplify comparison between house designs. Firstly, the annual heating and cooling loads are added together to give the total load per sq m.

For each of the 69 different climate zone in Australia a star rating has been assigned corresponding to a total heating and cooling load. For example, in East Sydney, a total load of less than 5 MJ/sqm/yr corresponds to 10 stars. A house with this rating would in theory would require almost no heating and cooling over the simulated year. The star bands are different for each climate zone to reflect the fact that some climates are quite thermally comfortable for most of the year whereas others have either a very cold winter or a very hot humid summer.

The National Construction Code sets a 6 star rating as the minimum standard house which is permitted to be built in Australia. Some states allow a slightly lower House Energy Rating if other sustainability measures are implemented. In NSW, instead of 6 stars, the simulated heating and cooling loads for new dwellings are separately limited to a level corresponding to about 4 stars.

If you are interested, the heating and cooling load corresponding to the star bands for all 69 climates can be downloaded at: http://nathers.gov.au/about/pubs/starbands.20121129.pdf

How A House Energy Rating is conducted

This is how it works….

Building the Model

First, a computer model of the building is constructed using an accredited house energy rating software. The model represents the dimensions and thermal characteristics of each wall, floor, window, roof etc of the building and how they are related to each other.

The house model is built up of zones. There are different zone types for different room usage types - eg Kitchen/Living, Living, sleeping.
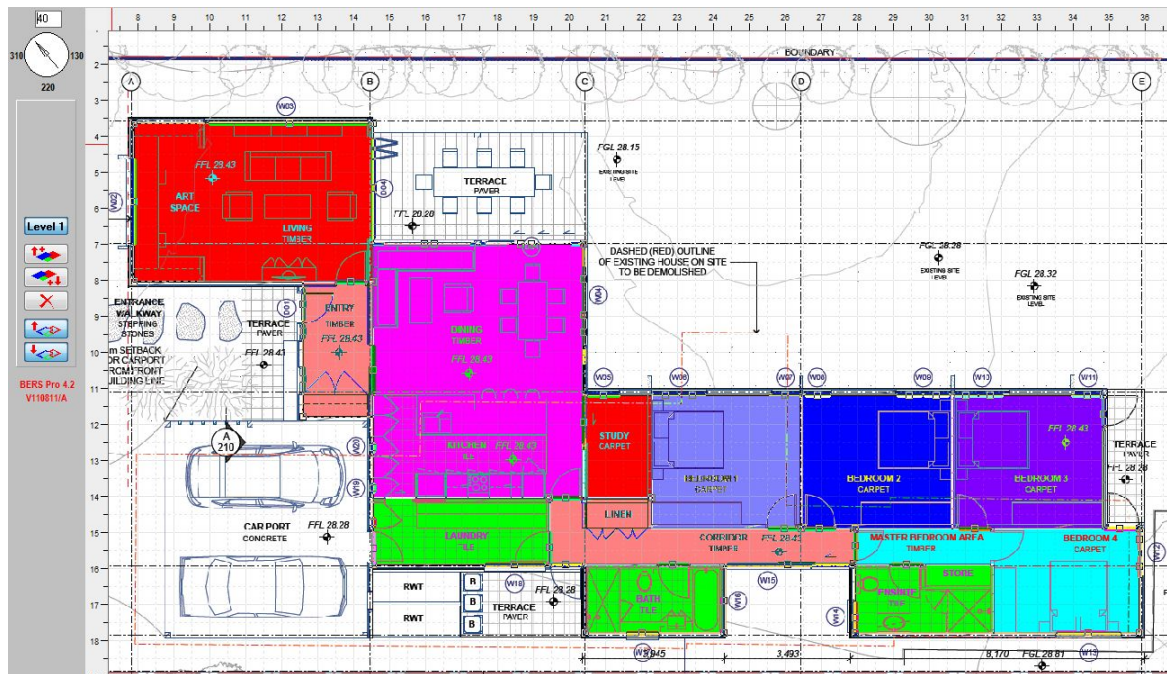
figure 2 - zoning of a new single level house design

Each zone type has built in standard assumptions for:

- Internal heat sources eg, a kitchen/living zone has internal heat sources for cooking in the morning and the evening.
- the room temperature and humidity range that most people would consider comfortable at each time of the year.
- The times of day that a zone must be kept within thermal comfort limits.

Representing the Weather

Next, the climate data representing the climate where the house will be built is selected based on the postcode. The climate data includes hourly temperature, humidity, solar irradiation, wind speed and direction, and cloud cover data. The wind exposure and orientation of the house is chosen and any significant shading objects such as neighbouring buildings are also represented by simple rectangular walls.

Running a Simulation

Once the computer model is built, a simulation of a standard year can be run, choosing either "free running" or "Conditioned" mode.

Free Running Mode

In free running mode, the software starts at midnight on the 1st January calculating the heat transfer between building elements and to outside, the solar gain in through glass ,and works its way through the year hour by hour. At the end of the simulation, you can review the simulated hourly air temperature in each zone. In experiments, the simulated temperatures have been found to correlate very closely to real measured temperatures in houses for the same climate data.

Load / Temperature Profiles from the start of 8 FEB to the end of 14 FEB
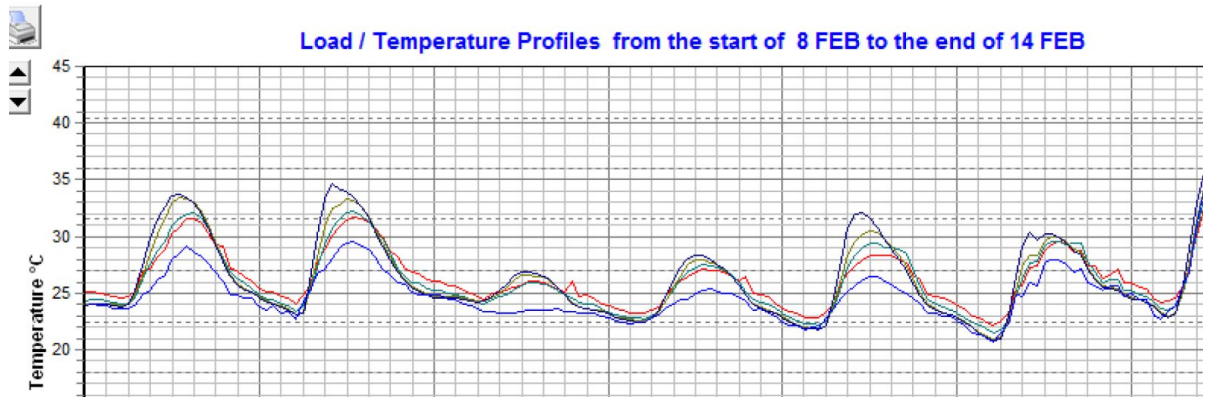
Rating Mode

In rating mode, the software performs a similar task, however, if the temperature and humidity at the end of an hour are outside the thermal comfort settings for that room at that time of day and time of year, the software then makes changes to bring the room to thermal comfort as follows:

Heating

> Heating is applied if the zone temperature at the end of the hour without heating is below the heating thermostat setting. Enough heat is supplied so that the zone temperature at the end of the hour is equal to the thermostat setting.

Cooling

> Cooling is invoked in a more complicated way because of the impact of humidity and also because the cooling effect of cross ventilation is modelled.

- If at the end of the hour the zone temperature is above the outdoor air temperature, ventilation is switched on (i.e. windows and other openings in this zone are opened).
- The new zone temperature is calculated and an indoor air speed is estimated.
- If the indoor air speed is above 0.2 m/s, an allowance is made for the cooling effect on the skin due to cross ventilation.
- If the zone condition is still outside the extended comfort region, the zone openings are closed and sufficient cooling is applied so that the zone temperature at the end of the hour is the cooling thermostat setting.

The hourly heating and cooling loads applied to each zone are summed over the year to give the annual load for that zone. These loads can also be viewed by month.

Rating New Build Vs Alterations and Additions

The Thermal rating software is designed to assess an entire dwelling. Assessors are directed not to model just the addition to a building. This is because
- the performance of the retained building section can have a major impact on the performance of the new or altered part of the building

- The assessment needs all the different zone types to be represented

Existing houses with little or no insulation and low performance glazing typically have poor performance - a star rating of between 1 and 3 stars. The rating for a dwelling with alterations and additions will be the combined performance of the existing and the additions.

When looking at the heating and cooling loads of the new zones of an alteration and addition, also bear in mind the impact the retained house zones on the heating and cooling loads for new and altered sections. For example if the existing zones are poorly insulated, an additional room might lose heat to the existing through the shared wall

More Information

In NSW all thermal modelling must be done in accordance with the BASIX thermal comfort Protocol:
https://www.basix.nsw.gov.au/iframe/images/BASIX_Thermal_Comfort_Protocol_Dec14_amdt4_Feb2016.pdf
and the NatHERs Technical Notes:
http://www.nathers.gov.au/sites/prod.nathers/files/publications/Technical%20Note%201.2.pdf

If you have any questions, feel free to contact John Caley at Ecological Design