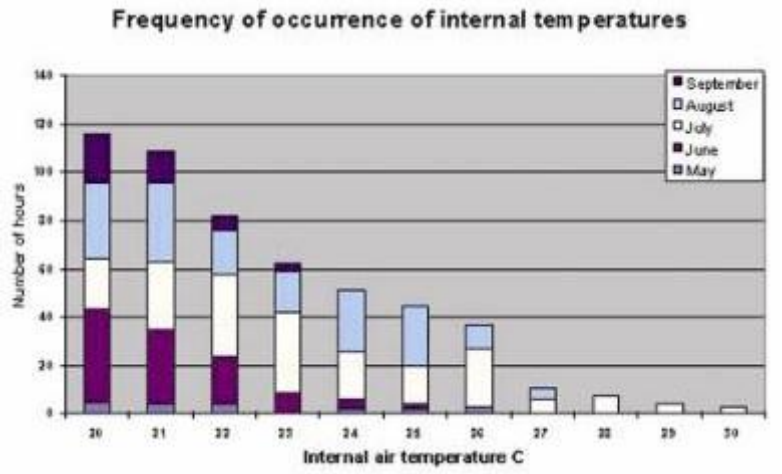
# Natural Ventilation and Passive Design

When you design the building envelope and structure to control, or partly control the internal environment, the quality of analysis needs to be more accurate and cover a wider range of issues than simplified cooling load calcs.

## A major step forward

A building with a reasonable amount of thermal mass can absorb and store energy for a number of hot days while slowly rising in temperature. When the weather cools the stored heat will be lost. These longer-term dynamics are the key to successful passive design. A building with good solar protection and some thermal mass, with maybe night time ventilation with cool air, can ride through a three to four-day heat wave keeping fairly stable internal conditions. This is the major advantage simulation has over single design point calculation methods, it knows about the transient performance over time! So, simulation moves on from single peak load analysis to give an operational view of building performance over days, weeks and seasons. TAS uses the response factor method for the transient analysis of the building structure, which is more accurate than finite difference methods and can be up to ten times quicker in computational speed.




## What else is important?

The impact of solar energy on and in a building is critical. The 3D model is used for detailed external shading calculations used in the simulation. TAS is unique in being able to shade diffuse sunshine. This is very important for solar shading over windows and, if not considered, can add ~2oC to predicted internal temperatures. Another unique function from TAS is internal solar shading and tracking sunshine across spaces. It's important to know how much solar energy entering an atrium ends up in adjacent offices. Realistic analysis of glazed double façade systems, with the possibility of natural or mechanical ventilation, requires good modelling of the transition of solar energy across the various glazing elements.

## Building simulation with integrated bulk air flow

By generating a natural ventilation air flow network between the apertures in the building model, TAS is uniquely able to perform fast and stable simultaneous building simulation with integrated bulk air flow for commercial-size buildings. The weather data used for simulation has hourly values of wind speed and direction. This allows the calculation of variation in wind pressure for all external apertures, which means that wind-driven ventilation rates and direction are calculated for each hour. By simultaneously calculating internal air temperature, the effects of buoyancy forces are also integrated into the analysis. It's even possible to have interaction between mechanical ventilation and natural ventilation forces. With all these ingredients carefully modelled, TAS can produce hourly dynamic simulations that accurately reflect reality, for any period of days up to a complete year. The resulting data can be automatically processed to give frequency distributions of internal temperatures.