Desert Creek House - 802 Desert Creek Road - NUMBUGGA NSW 2550
www.desertcreekhouse.com.au desertcreek@skymesh.com.au

Solar architecture: principles

The 4 bases of comfort with solar architecture

1) Comfort: a very restricted field acceptable for human beings in comparison with the possible extreme conditions of a ruff natural environment

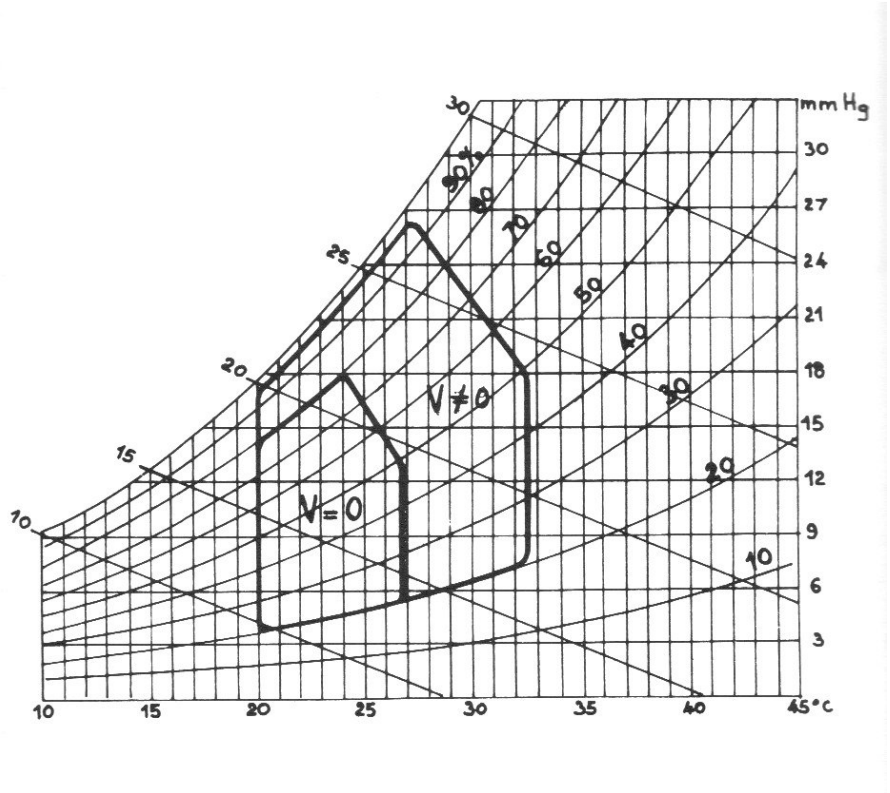
For human beings to feel good, the following comfort conditions must be fulfilled:

- temperature between 20 and 27 °C (or 33 °C with ventilation),
- relative humidity between 20 and 80% (or 95% with ventilation).

Diagram of comfort showing relations of comfort for:

- Horizontal at the bottom: temperature between 10 and 45 °C.
- Vertical on the right: atmospheric pressure between 0 and 33 mmHG.
- Oblique on the right: humidity between 0 and 100%.
- Oblique on the left: wind speed between 0 and 30 m/s (i.e. ventilation).

"V=0" is the zone of comfort without ventilation.
"V not equal to 0" is the zone of comfort with ventilation.
(Source: Lavigne, Architecture climatique, Edisud)



2) The envelop of the building is like a filter which has to retain heat inside if it is cold or to expel it if it is too hot

The envelop of the house refrains heat from escaping because of its insulating capacity, but heat gets always lost if the surrounding is cooler than the inner climate. Heat gets lost through the wall (conduction), through the cracks (drafts) and through ventilation (air renewal). Comfort cannot be maintained if heat gets lost - because the loss means it is cooler (too cool) outside - and new heat must be brought in, i.e. captured from the environment (glasshouse effect) or produced (inner heating or fire).

3) By day time, if the sky is clear, the glasshouse effect by windows and glass walls exposed to the sun produces part of the heat which is needed and compensates part of the losses

The glasshouse effect with its 3 elements (sun, glass, inner material) allows to capture heat which will replace the heat which escaped through the envelop of the building or through ventilation. The rest of the heat needed must be produced by fire or similar.

4) The following 6 functions of solar architecture are necessary to assure a good balance in comfort

They are: 1) capturing, 2) storing, 3) returning, 4) transporting, 5) regulating, 6) protecting.

The 6 functions of solar architecture (definitions only)

1) Capturing

Capturing includes all the means which allow to catch the heat or the energy of the sun into the building. They are 3 ways:
1) Passive system: it consists mainly in the use of the glasshouse effect which captures heat through the windows or any glass surface exposed to the sun. It is said passive because it works without any use of any other energy. The envelop of the house captures the heat by itself, because of the property of the glass, without the use of any appliance.
2) Active system: it uses solar absorption panels which heat up water or air in a separate circuit. It is called active because it is often necessary to have a pump to activate the system if the simple convection effect cannot do the job, and because it is a system as such which is added to the house as a kind of appliance the role of which it is only to capture solar heat.
3) Photovoltaic system: it is also made with solar panels but panels which are very different from the precedent absorption ones: there are composed with silicium cells the property of which it is to transform the light of the sun into electricity. It does not use the glasshouse effect property but a chemical property: silicium cells produce an electric tension when they are exposed to sun light. It is fundamentally different, but it is nevertheless often used on solar houses to produce electrical power for light and general use of appliances.

2) Storing

Heat from the sun is usually available during the hottest part of the day when there is little need for heating, but heat is usually needed later in the evening, when the sun has already set, or during grey days, when no sun heat is available. It is why it is necessary to store the heat which is available in order to use it later. One can store heat in the walls or in the floor of the house, or in water

containers for instance. Storing allows to put heat aside and to avoid a high increase of temperature during the time when the house is capturing heat; if the whole quantity of heat would be used immediately, the temperature in the house would rise so much that one would have to open the windows and lose the precious heat which has been collected before it can be used purposefully.

3) Returning

If one stores heat in order to use it later, this heat must be accessible and usable at the right moment. The storage must give it back when needed. One must control the way it is returned.

4) Transporting

Heat can only be captured through the glass surfaces, i.e. on the north side where the sun is radiating (southern hemisphere). It is always needed also elsewhere then where it is captured, for instance on the south side of the house. The quantity of heat is never equally spread in the house: there is too much heat in a part of the house and not enough in another part. It is why heat must be transported from one place to another, especially from the storage to the liveable space.

5) Regulating

The captured heat flow is never regular and its intensity is never equal to the losses out of the building. There is certainly a possibility to reduce or to increase the loss of heat by opening or closing the windows, but it has its own limits, because it can only increase the losses when there is too much heat but it cannot reduce the losses of heat through the envelop of the house, when it is too cold inside. There is also a possibility to reduce the inflow of heat by preventing the sun to radiate on the thermal mass of the house through glass, using screens and shadowing mobile elements. On the other hand it is rare that sun heat is sufficient to replace the lost heat of the cold days and a heating system must often be used as a temporary complement when it is cold. It is therefore a need to co-ordinate these different heat sources and flows (in and out) to maintain the right inner temperature. Ventilation, heat transport and storage are also part of the ways of regulating the inner temperature.

6) Protecting

Seasons and days present different needs for heat and different possibilities to capture heat. In summer one wishes to protect oneself from the sun, but in winter one wishes to capture as much heat as possible. It is important to protect the house from incoming sun during the hot season and to expose it during the cold season. The orientation and shape of the roof are important ways to find the right balance for each season. Nevertheless it must be also possible to protect oneself or the house from the incoming heat with mobile elements because each day is different and the flexibility of adaptation is always a good thing.

---

www.desertcreekhouse.com.au
desertcreek@skymesh.com.au