

**Daylighting**

Natural daylighting reduces the need for electric lighting and contributes to bright and productive indoor environments. The selection, size and placement of windows will determine the level of natural daylighting in a room. Things to consider are the path of the sun and seasonal variations, optimal amount of daylight, glare control and the resultant heat gains and losses associated with the choice of windows and frames.

**Passive Heating**

Buildings can attract and retain solar heat energy through window design and the choice of building materials. It is important to have a well-insulated envelope to deter unwanted heat losses. Window to wall ratios must be carefully determined in order to reap the benefits of views and daylight, while avoiding the heat losses associated with too much window area. Materials such as concrete with high thermal mass – the capacity to store and slowly release heat energy – help to regulate indoor temperature.

**Passive Cooling**

Passive cooling strategies prevent buildings from overheating by blocking excessive solar gains. Cooling can be achieved by installing shading devices on the exterior of the building. There are a number of options for shading, ranging from roof or balcony overhangs to louvers, panels and operable shades. Building materials can also contribute to a building’s cooling capacity; for example, light-coloured materials reduce heat gain by reflecting rather than absorbing the sun’s energy.

**Passive Ventilation**

Passive ventilation involves circulating fresh air from the outdoors by passive means. Design for passive ventilation requires taking into account natural wind and air flow patterns and designing buildings to take advantage of them. Operable windows are key to achieving effective ventilation, as they allow a fresh supply of outdoor air and provide the opportunity for cross-ventilation.

**Thermal Comfort**

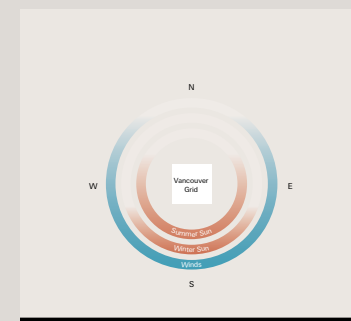
One of the primary goals of passive design is to optimize human thermal comfort – a person’s thermal perception of their surroundings. To maximize the level of comfort, designers must keep in mind air temperature, surface temperature, humidity and wind velocity. In order to address this range of conditions, designers had to work together creatively, and consider the experience and comfort of the building occupants as the key design goal.

The simplest way to create a bright, comfortable indoor environment is by taking advantage of the free and plentiful energy of the sun.

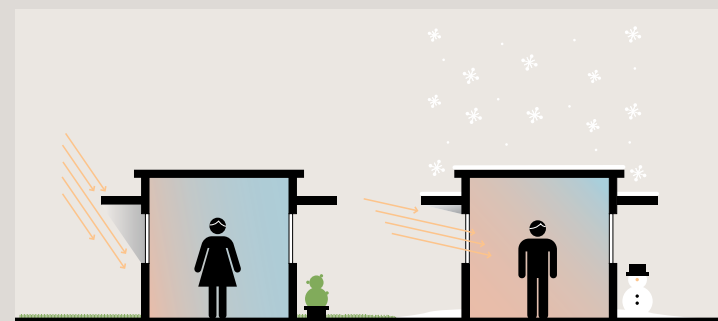
**Working Together to Maximize Efficiency**

Energy efficiency was high on the list of priorities for the Olympic Village design team and a cornerstone of its integrated approach to sustainable design. As such, architects, mechanical engineers and envelope and sustainability consultants became involved in establishing these principles at the outset of design. Instead of tailoring the mechanical design to meet the energy-efficiency goals, the team used passive design to greatly reduce building energy requirements before even considering mechanical systems. Once the baseline energy loads were established, mechanical comfort control systems could be sized appropriately.

The integrated design team worked to maximize the application of passive design principles. The process was not without challenges. For example, optimal building orientation that takes advantage of the path of the sun could not be achieved due to the previously established orientation of the street grid. The team recognized the constraints, and optimized as best they could under the circumstances. In the case of orientation, architects ensured that each façade of the building responded to the particular directional conditions: rain and wind, sun and shade.



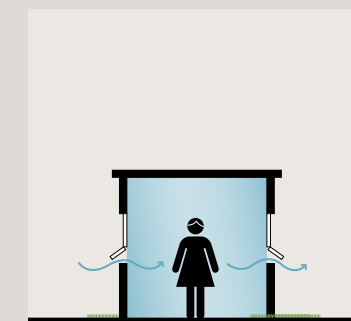
**ORIENTATION** The first step to passive building design is understanding the parameters of the building site. Taking into account the relationship between the path of the sun and a building’s form is a priority. This diagram illustrates the climatic variation on each side of a building’s façade (in the northern hemisphere).



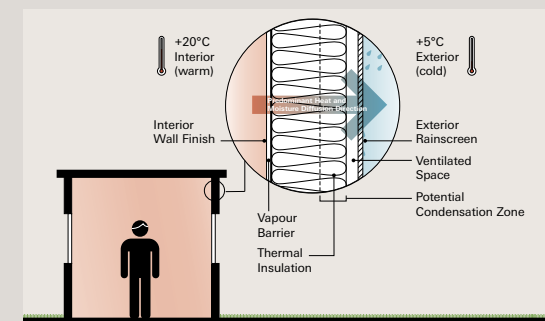
**SHADING DEVICES** Shading devices can be designed to block the sun’s rays to avoid overheating in the summer (when the sun is at a high angle) and to allow the sun to heat the building in the winter (when the sun is at a low angle).



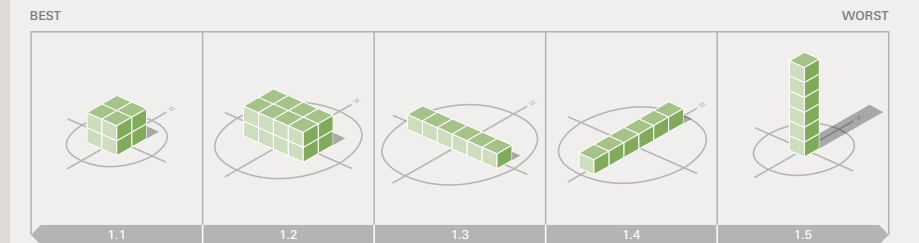
**EXTERIOR VS INTERIOR SHADING** The choice of shading devices can greatly affect a building’s cooling capacity. Shades on the exterior of a building block the sun before it meets the building envelope. Interior shades allow the sun’s energy to penetrate the window, heating up the building’s interior.



**CROSS-VENTILATION** Cross-ventilation is a cheap and simple way to ventilate a building with fresh air. It can also be implemented as part of a passive cooling strategy.



**ENVELOPE AND INSULATION** A building must have a well-insulated envelope to perform well in terms of energy efficiency. Effective wall assemblies and insulation prevent heat and moisture diffusion. Windows and window frames must be selected and installed efficiently in order not to compromise the envelope’s overall performance.



**BUILDING MASSING AND ORIENTATION** The total surface area of the envelope will determine the efficiency of a building. The more surface area, the more opportunity for heat loss or excessive heat gains through the envelope.