3.2. How to choose passive solar building orientation and layout?

The position of the sun affects the temperature and energy efficiency of a building. By understanding the sun's trajectory and taking advantage of passive solar heating techniques, a building can maintain a stable temperature and reduce the need for artificial heating and cooling. Passive solar heating relies on several key elements, including south-facing windows, thermal mass, and insulation.

The *ideal* orientation for solar glazing is within 0° - 5° of true south. This orientation will provide maximum performance. Glazing oriented to within 15° of true south will perform almost as well and orientations up to 30° off – although less effective – will still provide a substantial level of solar contribution (Balcomb, J.D., and others).

The orientation of a building is important in maximizing the benefits of passive solar heating. The ideal orientation is east-west, with the longest wall facing south. This allows the sun to shine on the south-facing windows and heat the building during the day. The south side of the building should contain frequently used spaces, while infrequently used spaces can be placed on the north side (Fig. 3.2.1).

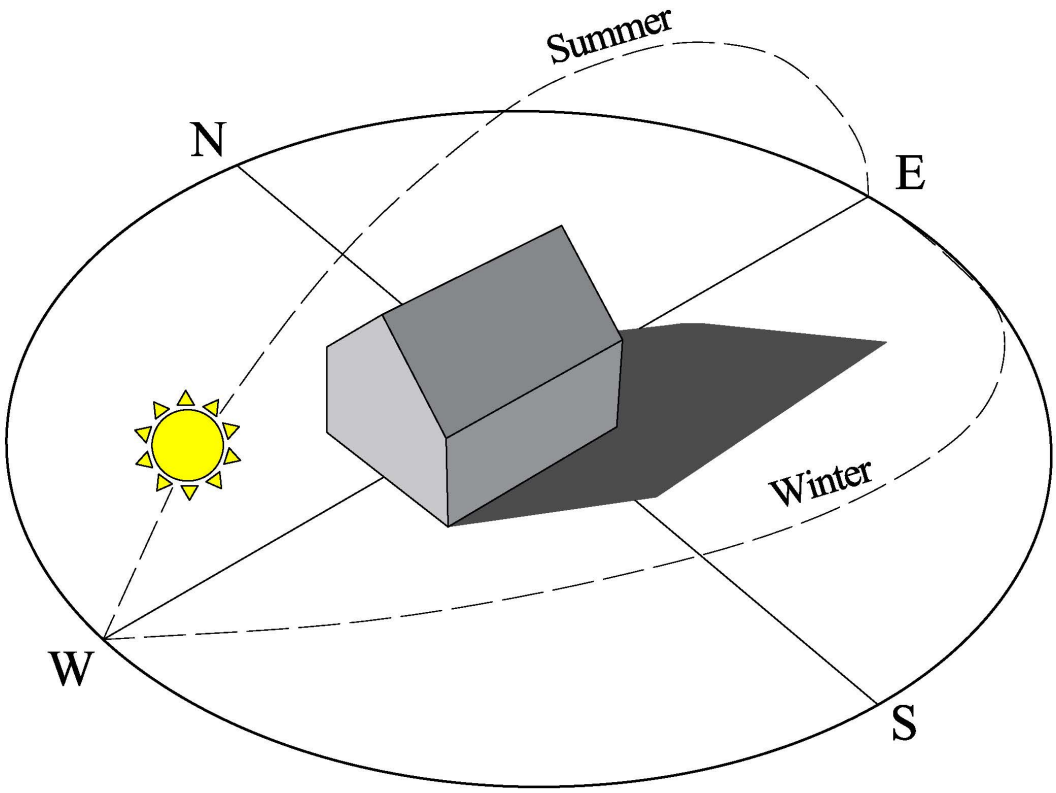

Fig.3.2.1. Passive solar building orientation. (Source: own elaboration).

The amount of solar energy received by a building decreases as it moves further away from a southern orientation. To protect the building from cold north winds and bad weather, it can be helpful to use a natural windbreak, such as a row of evergreen trees, on the north side of the site. Deciduous trees on the east, south, and west sides of the building can provide shade in the summer but allow the sun to shine through in the winter.

Figure 3.2.2 shows a diagram that shows the ratio of the angle of the axis of the building from the southern orientation and the amount of heat received.

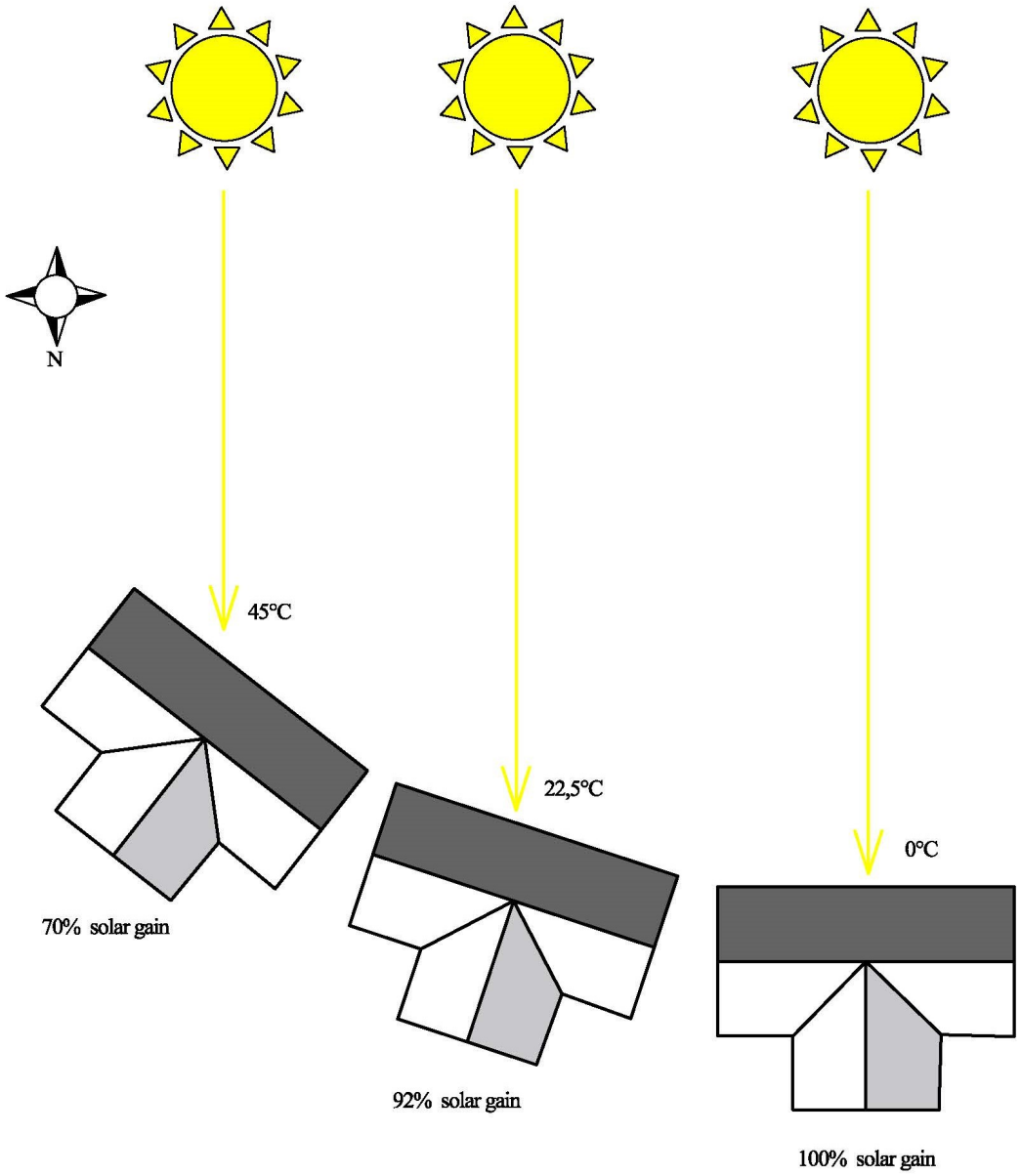

Fig.3.2.2. Solar gain is based on the angle. (Source: own elaboration).

To design a passive solar non-residential building, follow these steps:

1. **Determine the ideal orientation:** The best orientation for a passive solar building is east-west, with the longest wall facing south. This allows the sun to shine on the south-facing windows and heat the building during the day.

2. **Place frequently used spaces on the south side:** The south side of the building should contain the spaces that are used most often, as this is where the sun will shine the most and provide the most heat.

3. **Place infrequently used spaces on the north side:** The north side of the building will receive less sunlight, so it is a good location for spaces that are used less often and do not need to be as warm.

4. **Use thermal mass to store heat:** Thermal mass refers to materials that can absorb and store heat, such as concrete, brick, or tile. Incorporating thermal mass into the design of the building can help to regulate the temperature by storing heat during the day and releasing it at night.

5. **Include sufficient insulation:** Proper insulation is important to prevent heat loss in the winter and keep the building cool in the summer. Insulation should be included in the walls, ceiling, and floor of the building to ensure an even temperature throughout.

6. **Utilize south-facing windows:** South-facing windows are an essential element of a passive solar building. They allow the sun to shine in and heat the building during the day, while also providing natural light.

7. **Use a natural windbreak:** To protect the building from cold north winds and bad weather, it can be helpful to use a natural windbreak, such as a row of evergreen trees, on the north side of the site.

8. **Plant deciduous trees on the east, south, and west sides:** Deciduous trees on the east, south, and west sides of the building can provide shade in the summer but allow the sun to shine through in the winter, helping to heat the building.

The shape of a passive solar building and its individual spaces can affect the efficiency of passive solar heating. Here are some **general guidelines** to consider:

1. Rectangular shapes are generally the most effective for passive solar buildings. A rectangular shape allows for a longer south-facing wall, which can maximize the amount of sunlight received.

2. Avoid overly complex shapes or irregular floor plans. These can create corners and angles that block the sun's rays, reducing the effectiveness of passive solar heating.

3. Consider the size and orientation of windows. Larger windows on the south side of the building will allow more sunlight to enter and heat the building.

4. Use thermal mass to store heat. Incorporating materials such as concrete, brick, or tile into the design of the building can help to regulate the temperature by storing heat during the day and releasing it at night.

5. Design the building to take advantage of natural ventilation. Cross-ventilation, where cool air enters through windows on one side of the building and warm air is exhausted through windows on the other side, can help to keep the building comfortable without using artificial cooling.

Overall, **the best shape** for a passive solar building is one that maximizes the amount of sunlight received and uses thermal mass and natural ventilation to regulate the temperature.

References

1. Balcomb, J. D., and others. *Passive Solar Design Strategies: Guidelines for Home Builders*. Passive Solar Industries Council. Solar Energy Research Institute, Charles Eley Associates.