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EduMind, Inc.

Passive Strategies

INTRODUCTION

The integration of a building into the site is critical in designing the building to be energy efficient and in employing passive strategies. Buildings have a substantial impact on the environment, so it is imperative for the architect to design considering this influence. By integrating passive strategies (design moves that utilize form), material, and natural features for thermal performance, the architect is able to reduce the need for active systems (such as air conditioning) and therefore reduce overall the energy consumption of the building.

Properly siting a building in response to the environment requires an understanding of the sun and its movement, building location, and orientation. The climate in which the building is located, along with its location geographically, greatly influences building performance.

3.1 THE SUN'S PATH

The sun's path has a critical influence on the orientation of a building. Determining orientation to the sun often involves a sun path chart. A sun path chart demonstrates the movement of the sun throughout the day and year at a specific geographic location per its latitudinal coordinates. In the Northern Hemisphere the sun is higher in the summer months, lower in the winter months, and is always located slightly south in the sky. The opposite is true in the Southern Hemisphere, where the sun sits to the north in the sky. This information can help the architect in designing shading devices and glazing that allow sunlight into a space to keep it warm, or block the sun out to keep the space cool. Sun path charts are based on a location's latitude. From the sun path chart, one can determine the sun's **altitude angle** and **azimuth angle** at different times of the year and at different times of the day, all in one chart. Using a sun path chart, an architect can know exactly where the sun will be at any given day and time of the year for a given latitude. The vertical height of the sun is measured by the altitude angle; its horizontal location throughout the day is the azimuth angle.

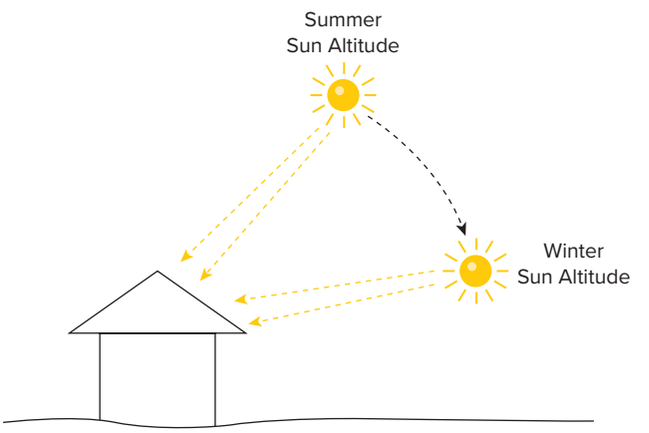


FIGURE 3.1 Sun Altitude

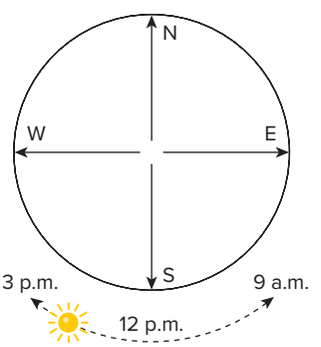


FIGURE 3.2 Sun Azimuth

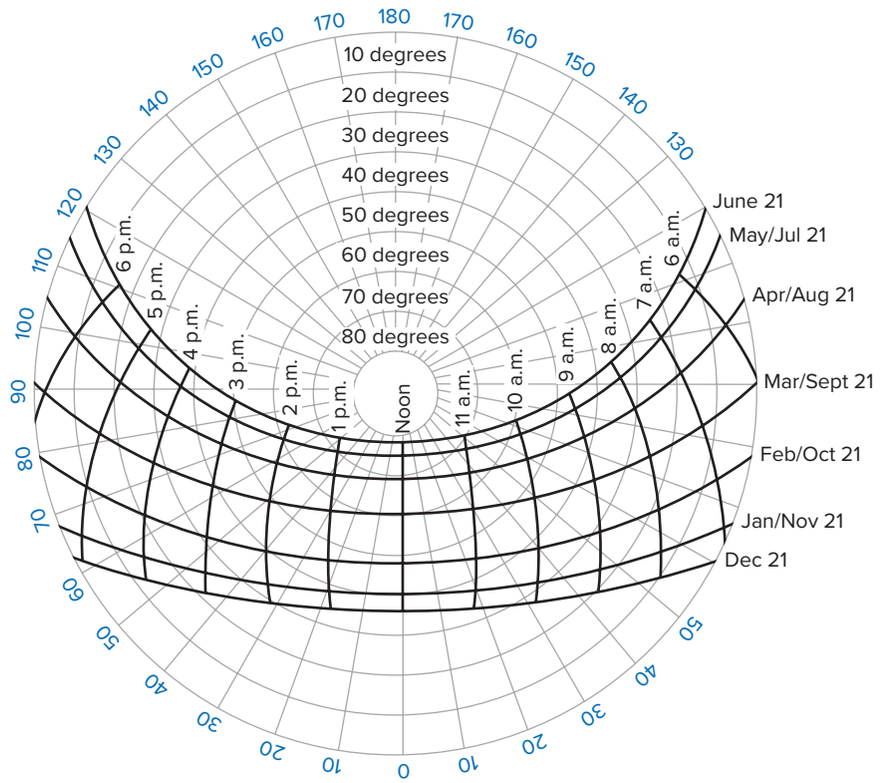


FIGURE 3.3 Sun Path Chart

For the Northern Hemisphere, the path of the sun will be located on the bottom half of the chart, while for the Southern Hemisphere, the path of the sun will be on the upper half of the chart. For locations on or about the equator, the path of the sun will be in the middle of the chart. This reflects the actual location of the sun in the sky and helps the reader understand solar orientation in relation to the building site.

The sun path chart is especially important in determining shading for a building project and siting a building. For sustainable projects (and simply good practice), the goal of saving energy through lighting is to harness as much natural light as possible. However, with solar energy comes heat. **Heat gains**, heat that is gained through the building envelope, are driven primarily by solar exposure. High-performance assemblies restrict the amount of heat introduced into an area from sunlight, but ultimately, the best way to keep heat out is to block direct contact through shading. Shading allows an exterior surface to accumulate the heat of the sun and prevent it from transferring into the building. Shading can be accomplished naturally using trees or artificially using shading devices built into the exterior of the building. Shading devices typically are one of two types. The first is louvers, which are horizontally oriented and best used on the south facade of a building. The second is fins, which are vertically oriented and most effective when used on the east and west facades of a building. Exterior shades are more effective than interior shades, such as blinds, because they impede solar heat gain before it enters the interior of the building.

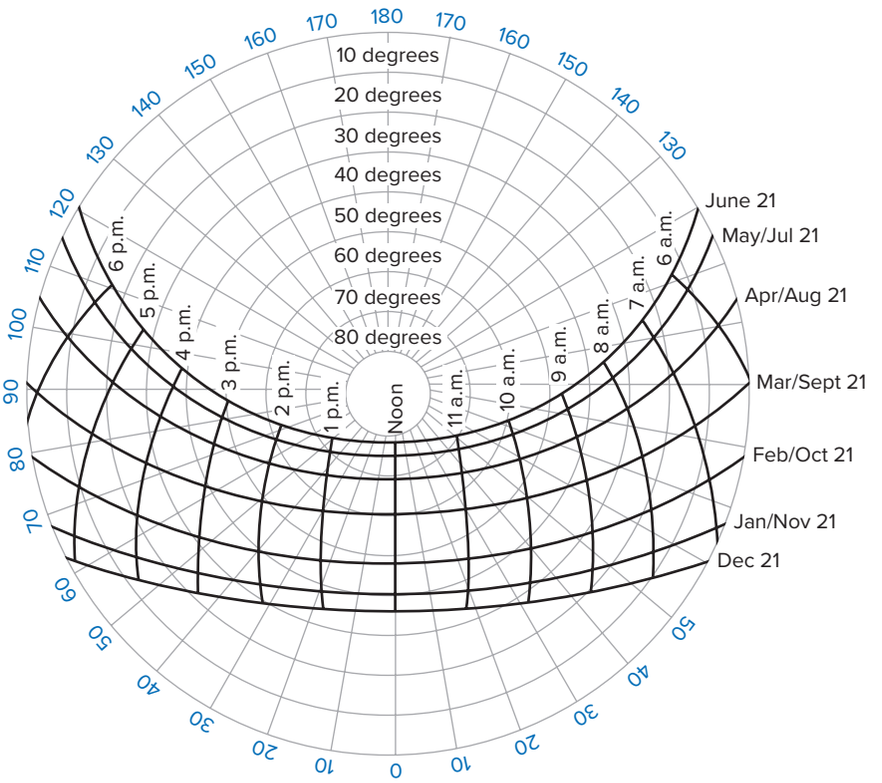
The altitude of the sun at different times throughout the year will help the architect design shading devices to block out summer sun (when the sun is at its highest and strongest) while allowing the sun (and thus the heat) to enter in the winter, when the sun is at its lowest and extra heat would help warm the interior space. Shading devices are often not needed on north-facing facades (in the Northern Hemisphere) because the light that enters through the windows is indirect and does not have the same level of heat gain. Light through northern windows provides the most uniform light throughout a day. The east- and west-facing facades present the biggest challenge to shading because when the sun is shining on these facades, it is at very low angles in the early morning and late afternoon, which are harder to control from a design perspective.

COMMENTARY

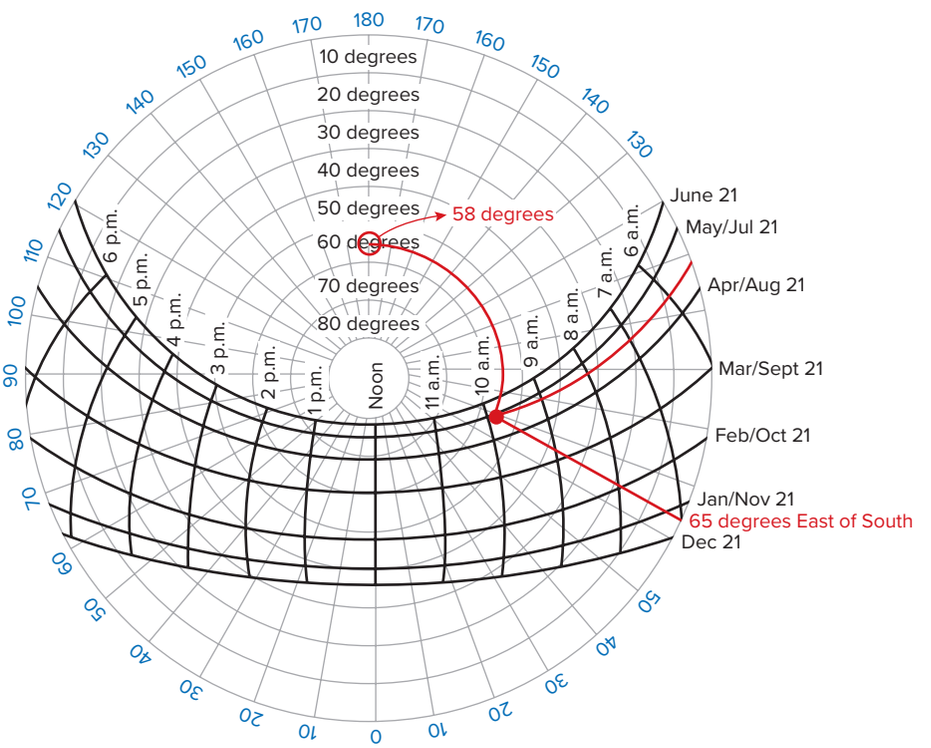
The path of the sun in the chart does not map shadows. However, the altitude allows us to place the vertical angle of the sun, which will help to map shadows on the site. In the Northern Hemisphere, the sun shines from the south and casts shadows north. The opposite is true for the Southern Hemisphere.

Example 3.1: Determining Altitude and Azimuth

Solve for the altitude and azimuth of the sun on May 13 at 10:00 a.m. per the sun path chart.



Solution

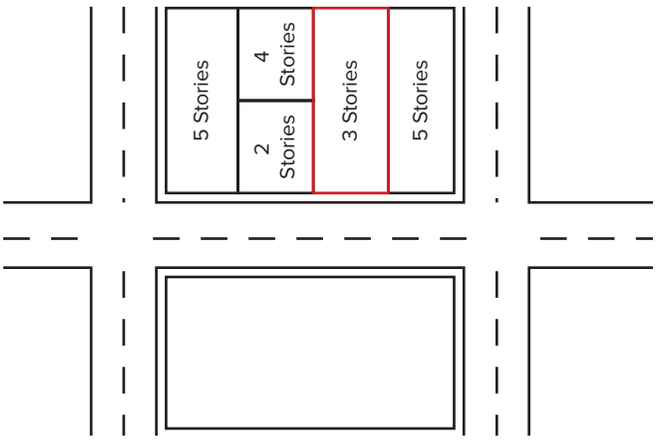


Example 3.1 *(continued)*

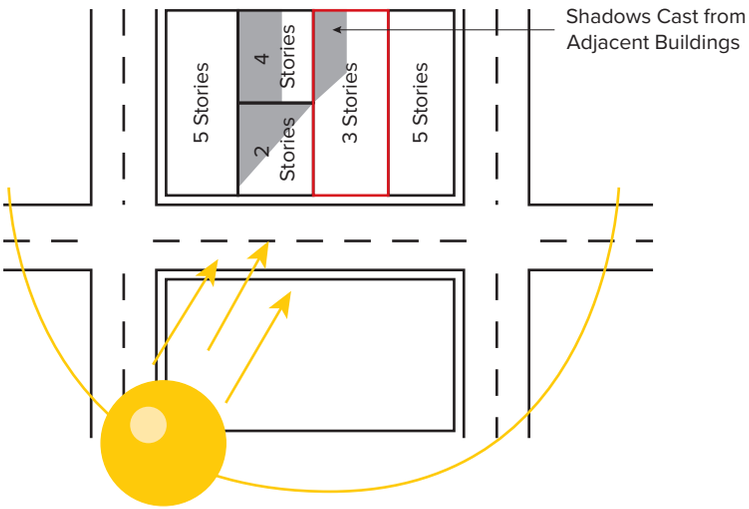
Answer:
Altitude = **58°**
Azimuth = **65° east of south**

Example 3.2: Locating Rooftop Functions

Solve for the best location for a rooftop dining area on this building so that it receives direct sunlight and no shade in the early afternoon. This project site is in the Northern Hemisphere.



Solution



Answer:
Considering the shading of the adjacent buildings, the southernmost area of the restaurant roof space will receive the most direct sunlight and will not be shaded in the early afternoons.