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1-1-2005

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Recommended Citation
Hawks, Leona K.; Peterson, Celia; and Sowards, Rachel S., "SOLAR SOUTH, ROOF OVERHANGS, AND LIGHT SHELVES" (2005). *All Archived Publications.* Paper 1269.
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ENERGY SMARTS: SOLAR SOUTH, ROOF OVERHANGS, AND LIGHT SHELVES

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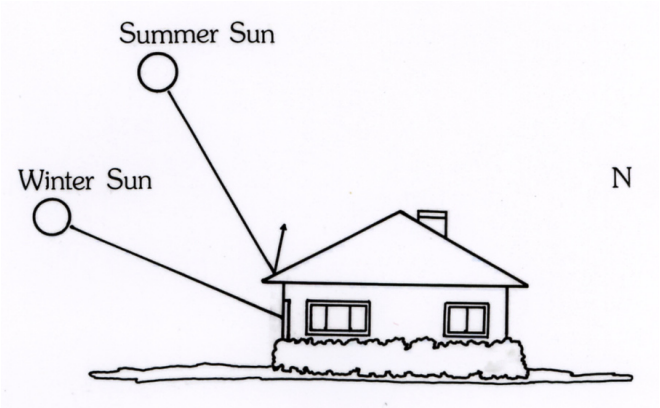
During cold weather, solar heat gain can add beneficial heat to rooms in a house, but that heat gain can be a problem during the warm summer months. A properly designed home can take advantage of the sun's warmth by using passive design concepts, including proper building orientation and well designed roof overhangs or light shelves. In northern climates, a house should be oriented so the long axis of the house runs in an east-to-west direction and the largest amount of wall surface and windows face south in order to take advantage of the winter sunlight.

Depending on the season and the sun's path, properly designed overhangs can protect south-facing windows and other surfaces from high angle summer sun, while allowing heat from lower angle winter sun to penetrate into the house (see Figure 1). Overhang design depends on the location of solar south, the building site's latitude, and the length of the heating and cooling season. The purpose of this worksheet is to provide information on how to determine solar south, and how to calculate the length at which overhangs should extend from the southern wall to block summer sunlight and allow winter sunlight to penetrate into the house.

Figure 1. Sun's Angle During Different Seasons



DETERMINING SOLAR SOUTH

To site your home for passive design, it is important to know the "true" or "solar" south. Solar south is different from magnetic south, which can be determined with a compass. The solar south takes into consideration the sun's path. The following instructions will help you calculate solar south for your home.

Tools

In order to determine solar south from your home's location, you will need: four stakes (any size), a tape measure or ruler, a calculator, and two pieces of string.

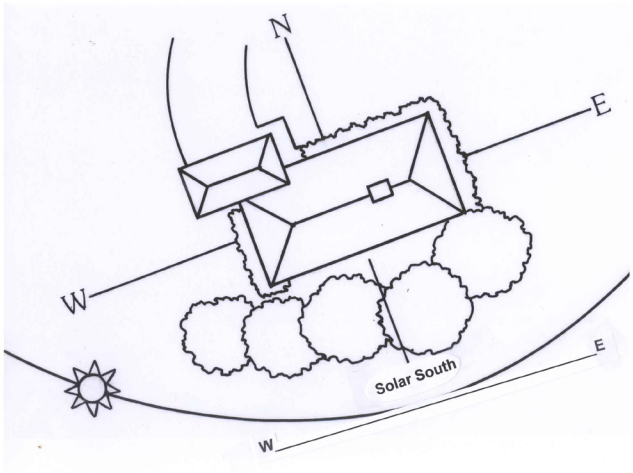
Steps

1. Determine solar noon using the instructions found in Appendix A. You can also consult the following Web site to find sunrise, solar noon, and sunset, allowing you to skip steps in Appendix A. U.S. Naval Observatory (2005) Web site: aa.usno.navy.mil/data/docs/RS_OneDay.html Note: Solar noon is called Sun Transit on this Web site.

2. At solar noon for the particular date you've chosen, find the flattest outdoor surface on the south side of the lot or building. Take two stakes. Place one in the ground at exactly solar noon. Place the second stake in the ground at the end of the shadow cast by the first stake. Tie a string between the two stakes to provide a north/south axis.

3. Place the next two stakes in the ground so the second string will be directly perpendicular to the first string. Tie the second piece of string around the remaining two stakes. This perpendicular line to the original north/south axis will give you the desired southern exposure (east/west axis). For maximum passive solar benefits, buildings/windows should be parallel with the east/west line, facing solar south (see Figure 2).

Figure 2. House Parallel with East/West Line



CALCULATING SOUTH FACING ROOF OVERHANGS

In order to prevent the sun from heating your home in the summer, you can employ roof overhangs or light shelves above south facing windows. Being able to calculate the proper depth of the overhang ensures proper indoor shading during the summer and solar heat gain during the winter. The depth of the overhang will depend on the latitude of the building. Latitudes for cities in Utah vary from 37° 2′, St. George, to 41° 45′, Logan (see Table 1). If you have situated your home 15 degrees east or west of due south you may wish to lengthen the length of the overhang by 10% to ensure proper shading.

Table 1. Utah City Latitudes and Factors to Block Sunlight

Utah City	Approximate Latitude (in degrees)	Factor to block sunlight on June 21st	Factor to block sunlight on August 1st
St. George	37	4.2	2.9
Cedar City	38	4	2.8
Price	39	3.7	2.6
Provo / Vernal	40	3.4	2.5
Salt Lake City	41	3.2	2.3
Logan	42	3	2.2

(Adapted: Quest Enterprises, 2003)

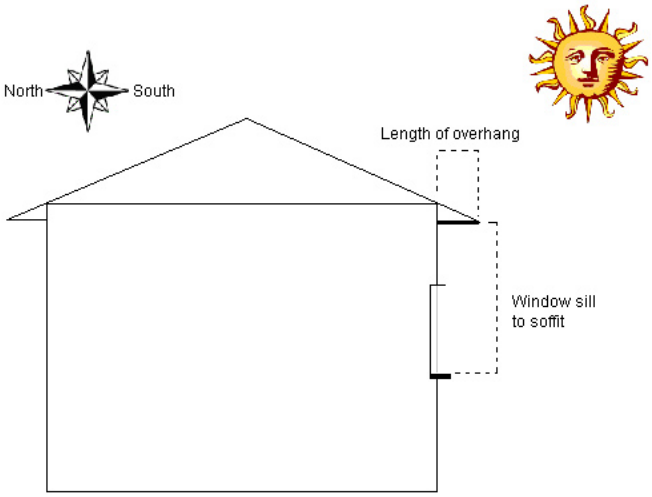
Tools

In order to determine the proper length which your roof overhang should extend from your home's south-facing exterior wall, you will need a measuring tape.

Steps

1. Measure the distance from your window's lower sill to the roof soffit (see Figure 3). A soffit is the underside of the roof overhang or porch ceiling that covers the rafter bottoms.

Figure 3. Measurements to Calculate Roof Overhang/ Light Shelf



2. Use the following formula to determine the length your roof overhang. You can figure overhang length for both June and August. Some people want to shade windows during the summer (June) and other people want to also shade the windows during August. August is generally hotter than June, so shading in August can be very important. If you do both calculations, you will find that the August overhang length is deeper than June.

   If you would like to do this on the internet and download free software go to http://www.susdesign.com. This web site "Sustainable by Design" has other design tools that you might find interesting

Formula

L=D÷F

Where L= length of overhang

D= distance from window sill to soffit

F= multiplication factor (See Table 1).

An example for north latitude of 40 degrees, the F Factor would be 2.5 to 3.4. The window height is a little less than 6 feet from the window sill to the underside of the soffit. Always round up on the size of the window.

Jun 21: 6 feet (divided by) 3.4 = 1.8 feet

Aug 1: 6 feet (divided by) 2.9 = 2.1 feet

CONCLUSION

A properly designed home can take advantage of the sun's warmth by using passive design concepts, including proper building orientation and well designed roof overhangs or light shelves. If you will follow these steps outlined in this fact sheet, you will be able to determine solar south, and the proper size of roof overhangs or light shelves which will help you take advantage of sunlight in the winter and avoid sunlight into the house during the summer.

REFERENCES

Quest Enterprises (2003). Earth Shelter Design Considerations [Online] Available: http://www.lcs.net/users/pinecrest/text/design.htm

U.S. Naval Observatory (2005). Complete Sun and Moon Data for One Day. [Online] Available: aa.usno.navy.mil/data/docs/RS_OneDay.html

APPENDIX A. CALCULATE SOLAR NOON AT YOUR HOME'S SITE

1. Determine sunrise and sunset for your site from the local news or an almanac.
2. Count the number of daylight hours and minutes separately.
3. Using a calculator, multiply the number of daylight hours by 60 to convert to minutes.
4. Add the remaining minutes to get total daylight minutes.
5. Divide the total daylight minutes in half to find the mid-point of the total daylight minutes (i.e., solar noon).
6. Divide by 60. The number left of the decimal point is the number of daylight "morning" hours (i.e. before solar noon).
7. Now the leftover fraction of minutes must be converted back to actual minutes. Subtract the number of hours

to isolate the leftover fraction of minutes, a decimal between 0.0 and 0.9999...

8. Multiply this number by 60 to figure the remaining minutes. Add these minutes to the number of "morning" hours.
9. Now add the total "morning" daylight hours and minutes to the time of sunrise. The result is the exact time of solar noon.

For example:

1. In Salt Lake City on June 21st, sunrise is at 5:56 a.m. and sunset is at 9:02 p.m.
2. There are fifteen total daylight hours, plus six additional minutes.
3. (Number of daylight hours) multiplied by (60)
   15 x 60 = 900;
4. (Number of daylight minutes from hours) + (additional daylight minutes)
   900 + 6 = 906.
5. (Number of total daylight minutes) divided by (2)
   906 / 2 = 453
6. (Midpoint of total daylight minutes) divided by (60)
   453 / 60 = 7.55
7. Subtract (number of hours)
   7.55 – 7 = 0.55
8. Multiply remaining minute's fraction by 60
   0.55 x 60 = 33
9. Solar noon is 7 hours and 33 minutes later than sunrise:
   5:56 am + 7 hours and 33 minutes is 1:29 pm

Calculate Your Home's Solar Noon:

1. Date:_____ Sunrise:_____ Sunset:_____
2. Hours_____ & Minutes_____ between Sunrise & Sunset
3. (_____Hours) x (60) =_____
4. (_____minutes from Hours) + (_____additional Minutes) = _____
5. (_____total daylight minutes) / (2) = _____
6. (_____[answer from step 4]) / (60 = _____ [interger from step 5] = _____Hours
7. (_____[answer from step 5]) - (_____[interger from step 5]) = _____
8. (_____[remaining decimal number from step 6]) x (60)= _____Minutes
9. Sunrise plus _____ Hours and _____ Minutes = _____Solar Noon

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