FLORIDA SOLAR ENERGY CENTER®

Concepts in Passive Design #1

Roof Overhangs

Author

Fairey, P.W.

Publication Number

FSEC-DN-1

A Research Institute of the University of Central Florida
1679 Clearlake Road, Cocoa, FL 32922-5703 • Phone: 321-638-1000 • Fax: 321-638-1010
www.fsec.ucf.edu

DESIGN NOTES
FLORIDA SOLAR ENERGY CENTER
CONCEPTS IN PASSIVE DESIGN #1

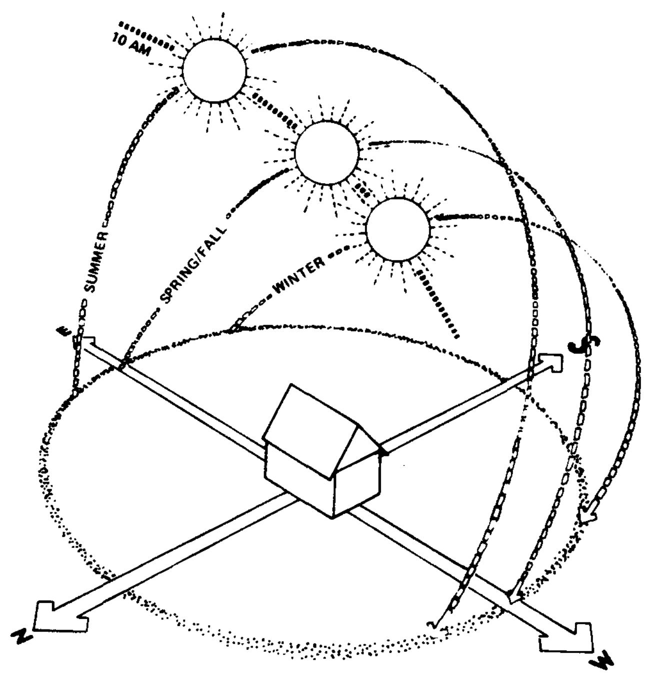
Roof Overhangs

By P.W. Fairey

A major source of heat in buildings is direct solar radiation through windows--welcome in cold weather, but a problem in hot weather. Since Florida has such a lengthy cooling season, it is most important to protect windows from the sun; however, there are times between November and March when some heat is needed. Fortunately, the change in the sun's path from summer to winter is such that a properly designed roof overhang can protect south-facing windows from the high summer sun, yet allow the lower winter sun to come in.

Effective design of roof overhangs depends on two factors: (1) the building site latitude (the further north, the lower the sun path across the sky), and (2) the times of the year when protection from the sun is needed (i.e., the length of the cooling season). When these items are known it is possible to size roof overhangs to shade south-facing windows during the cooling season yet admit solar gain through the windows during the heating season.

SUN PATHS



Seasonal Temperatures and Degree Days:

Heating and cooling seasons are better defined by local climate conditions than seasons of the year. Important factors to consider are average monthly temperatures and the local demand for heating (expressed in degree days). The degree day concept is relatively new to many designers and most homeowners and deserves clarification.

Heating degree days are calculated by subtracting the average daily temperature on a given day from an established base temperature (for heating, this base temperature is usually set at 65°F). For instance, if the average daily temperature is 64°F it represents one degree day, and if the average daily temperature is 63°F it represents two degree days. The sum of an entire month's degree days represents the monthly heating load. Similarly, the sum of all monthly degree days represents the yearly heating demand. A similar procedure is used for cooling degree days, but a different base temperature is usually used (70°-75°F).

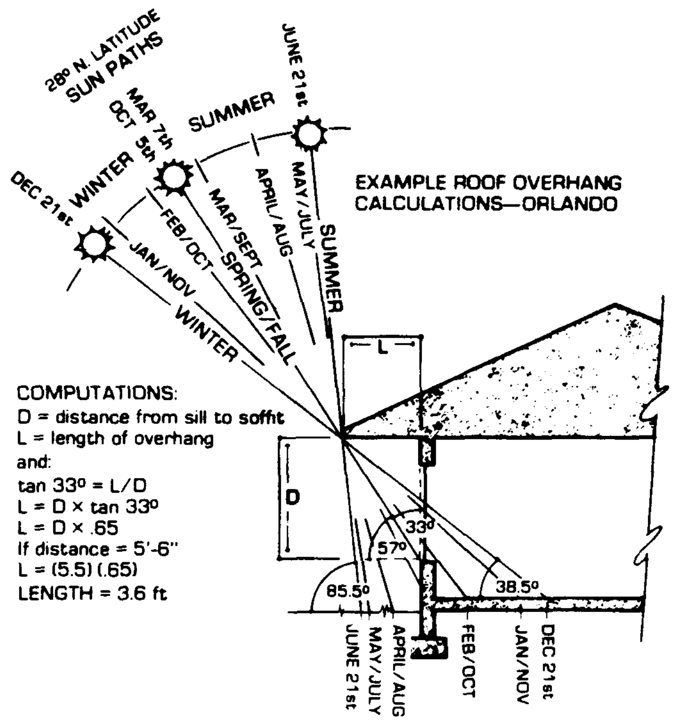
Overhang Calculation:

Below is an example roof overhang calculation for Orlando, Florida. The required shading period is determined by observation of the average monthly temperature and degree day heating demand.

ORLANDO CLIMATE DATA			SHADE NEEDED										
Month	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Average Monthly Temp. - °F	60.3°	61.5°	65.9°	71.3°	76.4°	80.2°	81.4°	81.8°	80.1°	74.3°	66.6°	61.5°	71.8°
Heating Degree Days (Base = 65°F)	197	184	94	13	0	0	0	0	0	0	75	170	733
Solar Altitude (21st of month at solar noon)	42.0°	52.0°	62.0°	73.6°	82.0°	85.5°	82.6°	74.3°	62.0°	51.5°	42.2°	38.6°	

After the shading period is determined, the solar altitude angles for Orlando's latitude are used to calculate the required overhang by means of simple trigonometric functions. The compatibility between overhang length and natural solar paths over a yearly cycle ensures shade during the cooling season and solar heat gain during the heating season.

DESIGN NOTES



The Florida Solar Energy Center has compiled climatic data for various Florida locations and determined multiplication factors which appear optimum for the state's various latitudes. These functions, when multiplied by the distance from the window sill to the soffit, will provide adequate overhangs to protect against solar heat gain during the cooling season.

An example calculation for a building located in Panama City, Florida, (approximate latitude = 30°) with south-facing windows and having a distance from window sill to soffit of 4 feet 6 inches is:

$L = D \times F$

where: L = length of overhang
D = distance from window sill to soffit
F = multiplication factor (from above table)

and: $L = (4.5')(.58) = 2.61' = 2'\text{-}7''$

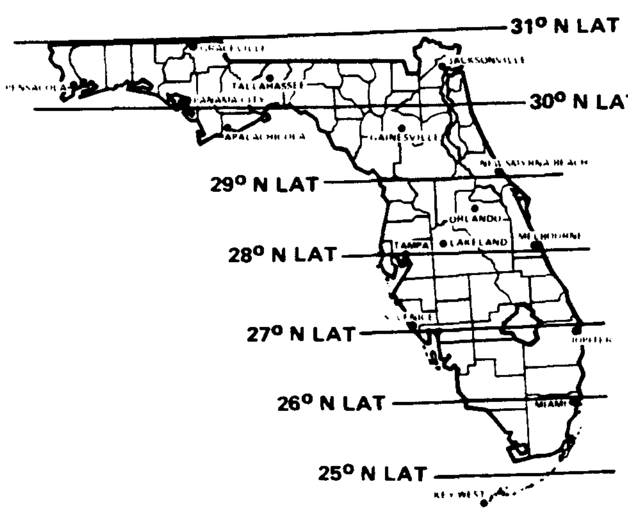
Therefore, the correct overhang in this example is 2 feet 7 inches.

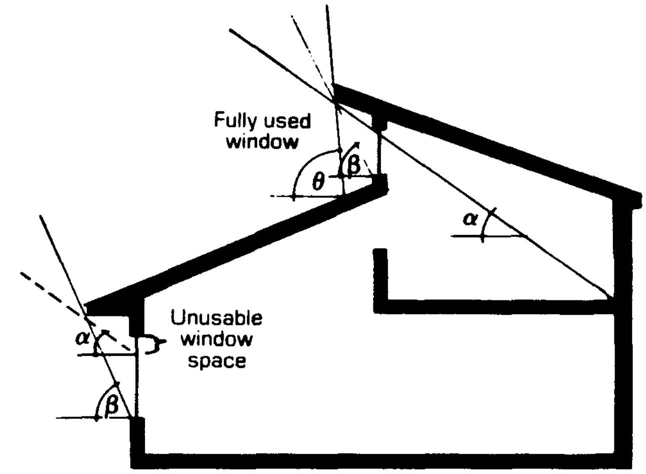
These overhang calculations are valid for south-facing windows only; solar gains on east- and west-facing windows must be controlled by either shade trees or other types of shading devices which block early morning and late afternoon sun.

It is sometimes more appropriate to use actual sun angles than multiplication factors for overhang design. On a south-facing clerestory, the roof which will shade the clerestory is often rising and multiplication factors become less appropriate since they are calculated for horizontal soffits.

Therefore, the sun angles, α, β and θ, are shown below in addition to the multiplication factors for each Florida latitude. As shown in the diagram below, the optimum location for all south-facing overhang extensions is the point at which angle α crosses angle β, but angle β is the dominant angle where practicality does not allow optimization.

Latitude		**Factor**	Dec. 21 12:00 noon **Angle α**	date of year varies with latitude **Angle β**	June 21 12:00 noon **Angle θ**
25°	Keys	.77	41.5°	52.5°	88.5°
26°	Miami	.73	40.5°	54.0°	87.5°
27°	Jupiter	.69	39.5°	55.5°	86.5°
28°	Tampa	.65	38.5°	57.0°	85.5°
29°	New Symrna Beach	.61	37.5°	58.5°	84.5°
30°	Panama City	.58	36.5°	60.0°	83.5°
31°	Graceville	.54	35.5°	61.5°	82.5°





Clerestory vs. Soffit Overhang Design

FSEC-DN-1 April 1980 Revised March 1981
Florida Solar Energy Center