CACTUS and SUCCULENT SOCIETY of NEW MEXICO
P.O. Box 21357
Albuquerque, New Mexico 87154-1357
https://www.CactusSocietyNM.org
CSSofNM@gmail.com

FREE-STANDING PASSIVE SOLAR GREENHOUSES

Appropriate design changes to standard design will allow a passive solar greenhouse in Albuquerque to maintain temperatures above 30°F with little or no auxiliary heat.

• *General Design:* Long axis of the greenhouse is east-west with the north wall covered by insulation. (An east-west axis greenhouse collects about 20 percent more sunlight in the winter than a north-south axis greenhouse.) The south wall is tilted at an angle of about 45 degrees from vertical to maximize solar heat gain. If the average outdoor temperature is 35°F (average of high and low temperatures on the coolest average days of the year in Albuquerque), the average indoor temperature in a properly designed greenhouse could be 70°F. Thermal storage (water, masonry, rock) is used to decrease the temperature swing between day and night and to store heat for cloudy days. An 8-inch thick masonry wall will reduce temperature fluctuations to about 45°F. The following table shows the effect of water storage.

Amount of Water Per Square Foot of Glazing		Greenhouse Temperature Swing (F)
.33 cu ft	2.5 gal.	30°-41°
.50 cu ft	3.7 gal.	28°-34°
.67 cu ft	5.0 gal.	26°-31°
1.0 cu ft	7.5 gal.	24°-29°

The previous comments are directed at maintaining a warm greenhouse in the winter. Ventilation requirements for the summer should be about the same as a standard greenhouse, because solar heat gain in the summer is primarily through the roof. On June 21, the sun in Albuquerque is within 40 degrees of vertical for 6 of 14 hours. Calculations show that an east-west axis greenhouse will collect 20 percent less solar heat on June 21 than a north-south axis greenhouse. The accompanying figure shows the general design. Reference — *The Passive Solar Energy Book,* by Edward Mazria, Rodale Press, 1979.

• *CSSNM Member's Greenhouse:* The north wall is cinderblock. Floor dimensions are 4'x8', and it is 4' tall. South glazing is 32 square feet. Thermal storage consists of potted plants' soil and about 20 gallons of water in gallon milk jugs and 2-liter plastic bottles yielding about .7 gal./sq ft. An automatic ventilator opens two small doors when the temperature reaches 80°F. There is no auxiliary heating. Cost is about $100, including $40 for the automatic ventilator. The minimum temperature seen was after Christmas 1982 when there was a prolonged cold spell. At that time, the greenhouse temperature fell to 26°F. The average high and low from December 26 to January 4 was 36° and 14°F, with a minimum of 8°F. During this period, 3.1" of snow fell, and this was not cleaned off the greenhouse. Plants within the greenhouse included *Mammillarias, Rebutias, Lobivias,* etc. None were lost to the cold weather. Other records follow.

Date	**Outside Air Temps**			**Comments**	**Greenhouse Temps**		
	High	**Low**	**5:00 p.m.**		**High**	**Low**	**5:00 p.m.**
1/4	45	12	33	Sunny	72	32	62
1/5	48	20	43	Sunny	76	34	62
1/18	47	32	42	.15" rain, partly cloudy	65	40	60
1/19	48	26	39	Sunny	80	35	63
1/20	42	30	40	Trace snow, cloudy	55	42	50
1/21	32	26	29	3" snow, cloudy	49	36	42
1/22	40	18	33	Partly cloudy	75	32	55

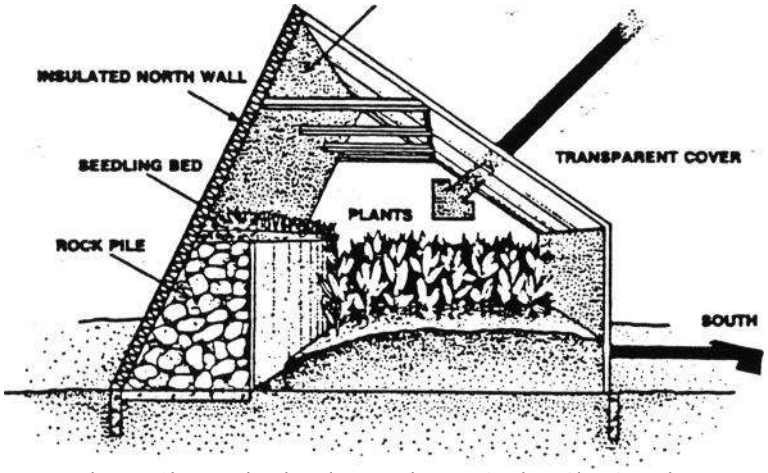

Fig. IV-19b: Laval University greenhouse, Quebec City, Canada.