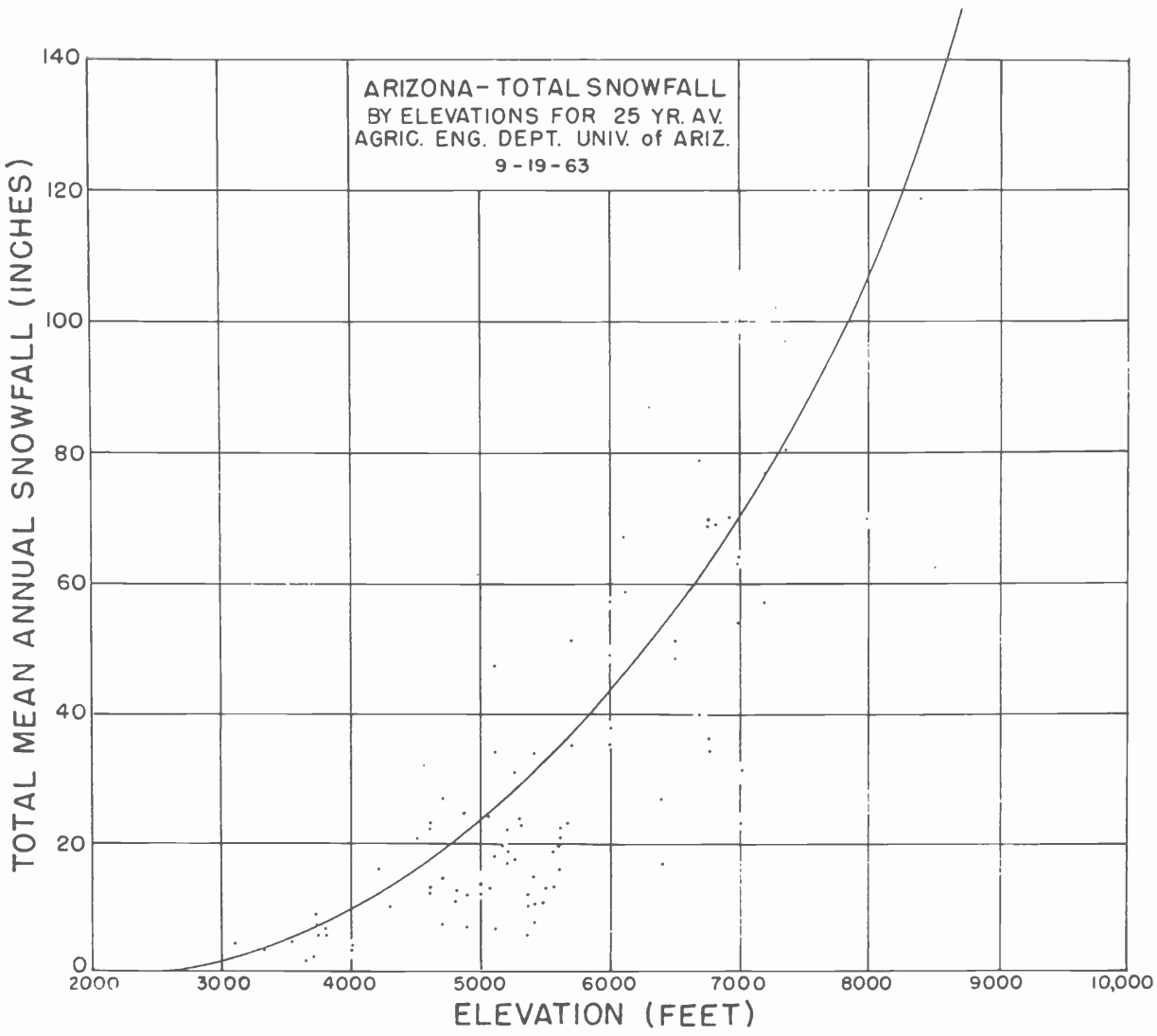


FIGURE 1 — Total measured annual snowfall by elevations at various Arizona weather stations.

as the snow pack increases, so does the water content, frequently approaching one inch of water per 2½ inches of snow equivalent. Therefore, information limited to snowfall and depth of snow pack is an inadequate guide for snow load design information. It is imperative that water equivalent loads be used. Figure 3 shows typical snow load data expected at various elevations.

Snow loads are assumed to be applied over a horizontally projected area. They are applied vertically and combined with other vertical and dead loads for roof and truss design. When snow loads are maximum, a critical wind load will seldom occur and may be neglected or applied as a fractional value.

Flat roofs retain all the snow that

(Continued on next page)

Snow Loads
Weight and Water

W. T. Welchert and Frank Wiersma

Construction activity in the higher elevations of Arizona has increased steadily during the past five years. Lack of proper snow load design information has resulted in the total collapse of some structures and many others show evidence of snow load damage.

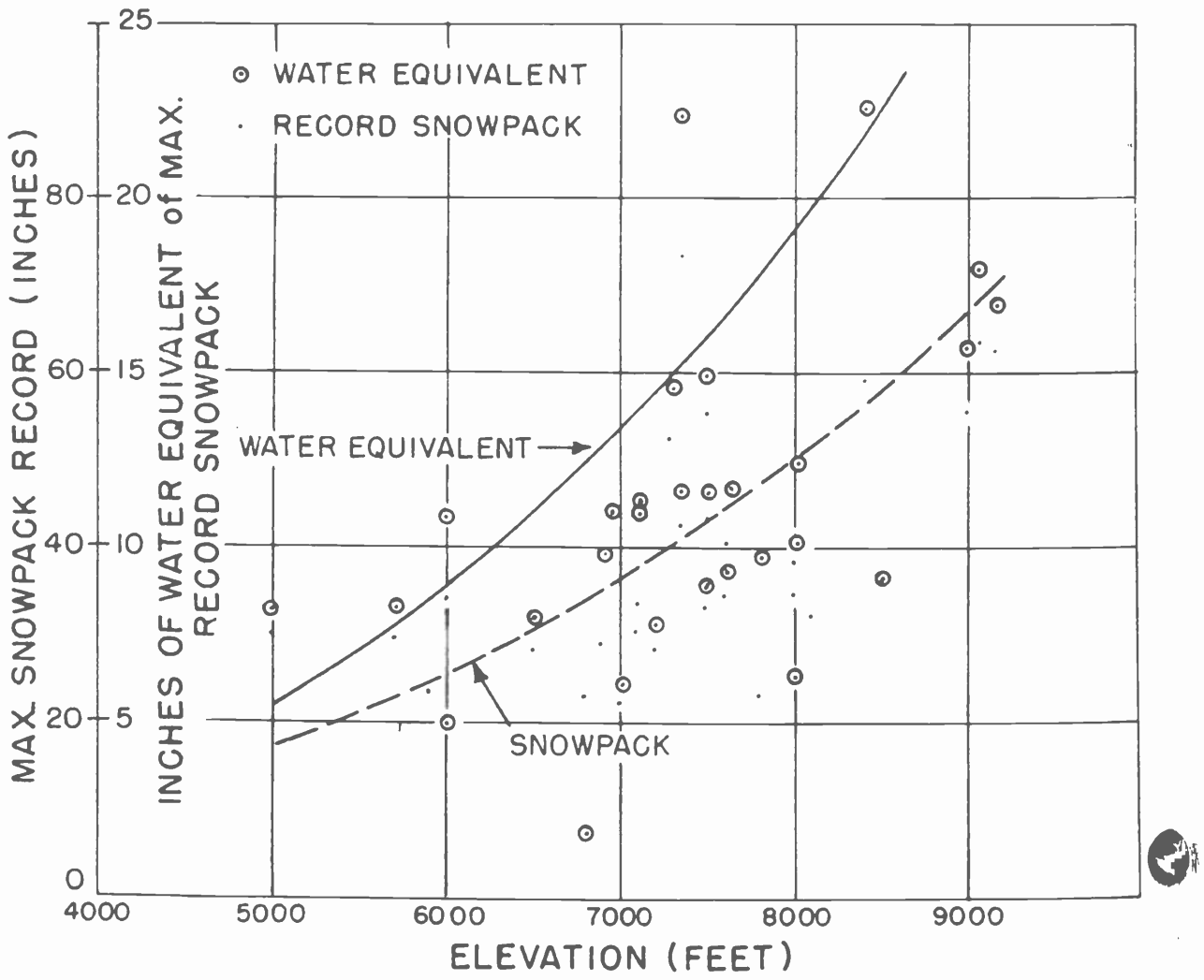
Roof framing must be capable of withstanding the loads of snow that accumulate on the roof. The annual snowfall depends upon the elevation and latitude. See Figure 1. In the cactus belt of Southern Arizona (1000 to 4500 feet elevation) the expected snowfall is light, and any snow that does fall soon melts. However, the mountain and plateau areas have maximum record snowpack which varies from 3 feet at the 5000 foot elevation to over 10 feet at the 9000 foot elevation. (Figure 2)

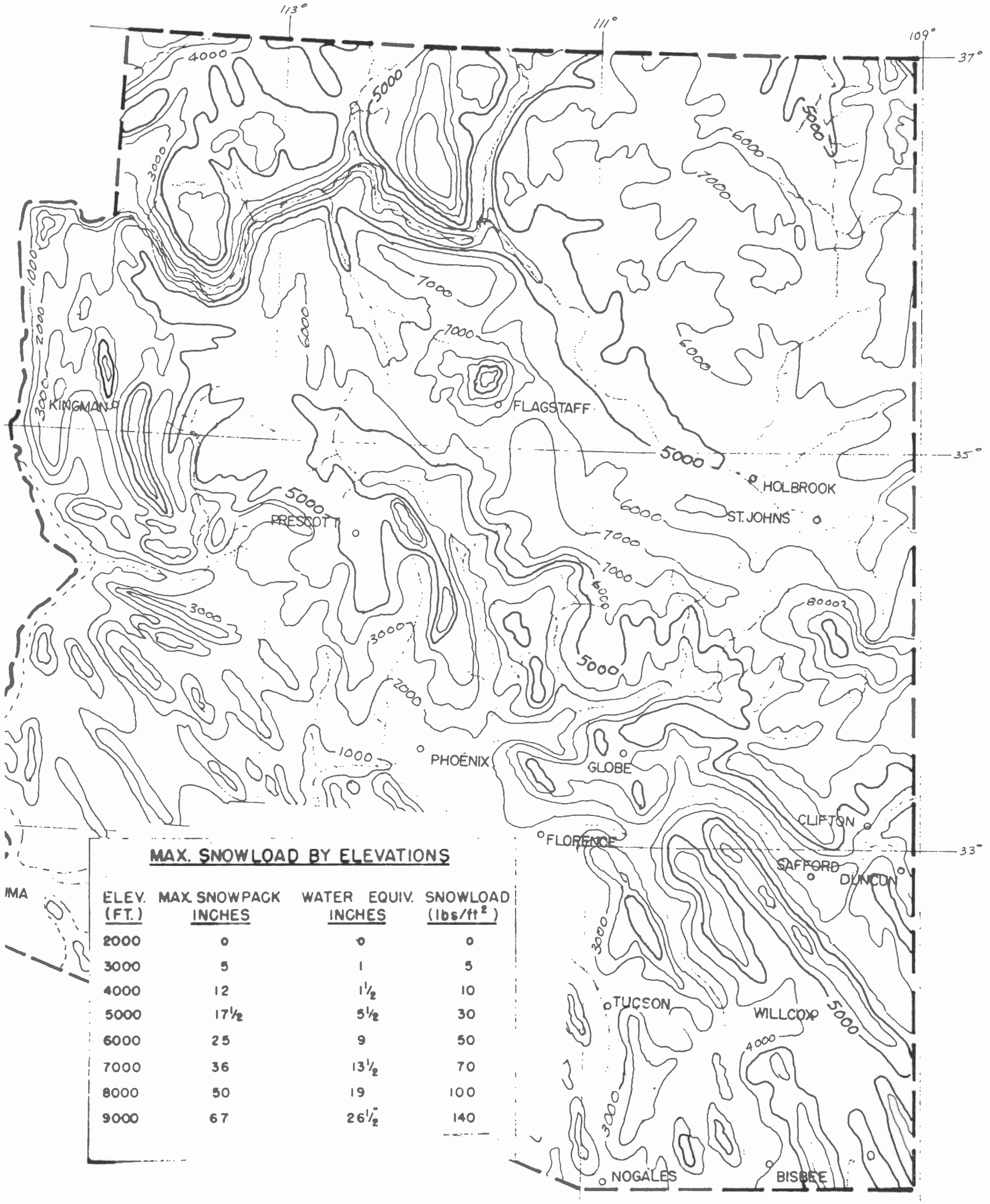
The authors are members of the Department of Agricultural Engineering.

Water Content Varies

Water content of snow varies widely (Figure 2). Fresh snow usually contains one inch of water per 10 inches of snow. For most average conditions 6 inches of snow is equivalent to one inch of water. However,

FIGURE 2 — Record snow pack and water equivalents by elevations are shown (below) for various Arizona snow courses from 1938-58 summary of snow measurements for Arizona.





MAX. SNOWLOAD BY ELEVATIONS

ELEV. (FT.)	MAX. SNOWPACK INCHES	WATER EQUIV. INCHES	SNOWLOAD (lbs/ft²)
2000	0	0	0
3000	5	1	5
4000	12	1½	10
5000	17½	5½	30
6000	25	9	50
7000	36	13½	70
8000	50	19	100
9000	67	26½	140

falls except that which is blown off by the wind. As the slope of the roof increases, more and more of the snow slides off.

Snow load on a sloping roof is less than on a flat surface because the combination of wind and slope affect snow retention. Snow slides off of slopes that are as steep as 45 to 60 degrees, depending upon the roughness of the surfaces.

Thus, structures in high elevation areas should either be designed to resist horizontal loads in the ranges indicated or should have a roof slope steep enough to limit snow retention.

FIGURE 3 — A look at an Arizona contour map quickly shows that U. S. maps showing isopleth lines of equal snow weight, found in most design manuals, are of little value in the mountain areas. Welchert and Wiersma suggest that designers and builders make local investigations as to site elevations and accurate snow load information.