and the architectural practicability of the required projection should be deciding factors.

INSTANTANEOUS HEAT GAINS VS. INSTANTANEOUS COOLING LOADS

The difference between instantaneous heat gain and instantaneous cooling load has been mentioned previously; its practical importance is sufficient to warrant further consideration. Fig. 4 offers a simplified schematic illustration showing how the *radiative* part of the instantaneous heat gain is first absorbed by solid objects, and is not encountered by the conditioning equipment as a cooling load until some later time, when it finally appears

TABLE 26. LENGTH OF HORIZONTAL PROJECTION REQUIRED FOR SHADING WINDOWS AND WALLS

For Shading 10 Ft Down From Projection For April 11 Through September 1

Latitude	Sun Time	Projection in Feet					
	A M → ↓	N	NE	E	SE	S	SW
30 Deg North	6 am 6 pm	17.4	[a]	[a]	[a]	—	—
	7 5	5.6	[a]	[a]	[a]	0.9	—
	8 4	2.0	11.2	17.4	13.8	2.5	—
	9 3	0.6	6.3	10.8	9.7	3.5	—
	10 2	—	3.3	6.3	7.1	3.9	—
	11 1	—	1.1	3.1	4.7	4.1	0.9
	12	—	—	—	2.9	4.1	2.9
40 Deg North	5 am 7 pm	[a]	[a]	[a]	[a]	—	—
	6 6	12.0	[a]	[a]	[a]	—	—
	7 5	3.5	[a]	[a]	[a]	1.8	—
	8 4	—	9.7	18.9	16.1	4.3	—
	9 3	—	4.7	11.2	11.6	5.4	—
	10 2	—	1.3	6.5	9.1	5.8	—
	11 1	—	—	3.1	6.5	6.1	2.2
	12	—	—	—	4.3	6.3	4.3
50 Deg North	5 am 7 pm	[a]	[a]	[a]	[a]	—	—
	6 6	8.4	[a]	[a]	[a]	—	—
	7 5	1.6	[a]	[a]	[a]	3.7	—
	8 4	—	9.4	19.7	18.9	6.5	—
	9 3	—	3.1	12.8	14.3	7.9	—
	10 2	—	0.6	7.6	11.6	8.4	0.6
	11 1	—	—	3.7	8.7	8.7	3.9
	12	—	—	—	6.5	9.1	6.5
	↑ P M→	N	NW	W	SW	S	SE

[a] Projection greater than 20 ft required.

in the air stream entering the equipment. While it is true that some lag also is inherent in convective heat transfer and the time required to change the air in the conditioned space, this is usually of the order of a few minutes to perhaps half an hour. Heat storage in the interior furnishings and structure increases according to the proportion of the instantaneous heat gain which is in the form of radiation, and also as the thermal capacitance of the objects and materials involved is increased.

Constituents of the total instantaneous heat gain which have appreciable radiation components include those due to glass areas, exposed walls and roofs, lighting, appliances, and people.

A large difference in the time-incidence of the peaks between various spaces or parts of the same space indicates the necessity for zoning. In a building having an east and west exposure, where solar heat gains forms a fair share of the cooling load, the times of individual zone peaks are

apt to be some hours apart, and the peak load of one plus the off-peak load of the other will be substantially less than their combined peak loads. Proper zoning will permit operation to take full advantage of this condition or of similar conditions of non-simultaneous peaks, and will result in a lower total load and in savings in equipment.

A factor similar in effect and closely related to the non-simultaneous occurrence of peak loads, is diversity. Typical of this is the case of a large department store where the air handling equipment serving a certain space must be sufficient to handle the load created by the throngs of people attending sales in that space. Under such a condition the number of people in other spaces is usually normal or below. While this means that the air handling equipment for certain departments must be large enough to cope with the situation, the refrigeration equipment need be only large enough to handle the average maximum. If a system employing zone recirculating fans and a single central fan and dehumidifier were used, the saving would be reflected in the capacity of the central fan and dehumidifier. Another example of this diversity is found in an office building having restaurants and stores of certain types in the first story

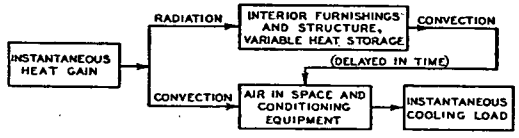

FIG. 4. ORIGIN OF THE DIFFERENCE BETWEEN THE MAGNITUDES OF THE INSTANTANEOUS HEAT GAIN AND INSTANTANEOUS COOLING LOAD

The radiation absorbed by the interior furnishings and structure reaches the conditioning equipment after a considerable delay in time.

and basement. At noon, when the restaurants and stores are crowded, the offices are below normal occupancy.

Heat lag should be carefully considered in the cooling load calculations. In certain types of buildings the effect of solar radiation is still apparent several hours after the sun has shifted from that exposure. In other types having a much lighter construction, the heat gain due to solar radiation decreases markedly with the passing of the sun. Some walls warmed by the sun, may radiate heat long after the passing of the sun, thus requiring lower inside temperatures to offset the radiant energy.

Buildings have considerable heat storage capacity which can often be utilized to great advantage, and which has more than once provided an unexpected safety factor. If a space is kept below the design inside temperature for some time, the interior walls, floors, furniture and fixtures begin to assume the temperature of the space. Where the time is sufficient the entire mass, rather than merely its surface, may reach the room temperature. Thus, when a space has been precooled below the design maximum temperature for a period of time prior to the advent of the peak load, and the heat gain begins to increase to peak conditions, some of the increase is used in raising the temperature of the furniture, fixtures, etc., to the design conditions and the cooling load can be reduced accordingly. However, unless very accurate data with regard to the mass, surface, specific heat, etc., of the items within the space are available, due caution must be used in discounting the cooling load for this storage