climates, however, where air conditioning is the primary consideration, the summer air-flow rate may be used the year around.

The registers may be placed either in the high sidewall or in the perimeter location. For the high sidewall applications, it is necessary that the deflection of the air be different for summer than it is for winter to prevent the jet from dropping into the living zone (60 in. above the floor and below) where the velocity should be not greater than 35 fpm. For registers located at the perimeter of the residence,[6] it is not necessary to change the deflection from summer to winter.

The air distribution system should be designed for the largest air-flow rate which is to be used, as outlined in Manual No. 11[4] of the *National Warm Air Heating and Air Conditioning Association*. For small-pipe perimeter systems, it is necessary to have more outlets than for the larger duct systems. In some applications, it may be necessary to close off some registers during the winter so that adequate register-air velocities will be obtained. These registers would then be opened during the summer to give a sufficient number of outlets.

Recent investigations have shown[7] that the use of perimeter duct systems for air conditioning gives excellent results, and that objectionable air motion does not occur within the living zone except in the immediate vicinity of the registers. Care must be taken, however, to use only registers or diffusers that are specifically designed for perimeter application. This is necessary to permit the introduction of the air into the room in a pattern which does not cause drafts. Floor diffusers which distribute the air in a fan-shaped pattern along the wall or low sidewall diffusers which blanket the wall are recommended. For supply-air temperatures not more than 15 deg below room-air temperatures, diffuser face velocities of 500 fpm are recommended.[8] For supply-air temperatures 20 deg below room-air temperature, the diffuser face velocity should not be less than 700 fpm.

OPERATING COSTS

The operating cost of residential cooling equipment during a particular summer depends on variables such as the amount of sunshine and rain, the number of abnormally hot or cool days, the efficiency of the equipment, and the local power rate. It is also influenced by human factors such as operation of equipment only during the hottest weather, opening windows at night[9], and difference in preferred indoor temperatures. Nevertheless, it is important that lending agencies and prospective buyers of equipment be given a reasonably accurate estimate of the operating cost during normal summer weather and under usual operating conditions. Adjustments can then be made for any special conditions anticipated.

The basis of a method reported[10] is that the power cost S of residential cooling equipment, expressed in dollars, is predicted from the equation

$$S = \frac{RPT}{100} \qquad (1)$$

where

R = power rate, cents per kilowatt hour.
P = average power input to the equipment over the season, kilowatts.
T = predicted total operating time of equipment, hours.

Note: Symbols for Equations 1 and 2 are those used in paper.[10]

For a given application, the power rate is obtained from the local public utility. The average power input depends on the particular make of equipment and condensing method, and consequently must be obtained from the manufacturer.

The operating time T to be used in Equation 1 is found from the equation

$$T = \frac{24HD}{C\,(t_m - 70)} \qquad (2)$$

where

D = number of cooling degree-days above 70, Fahrenheit.
H = average hourly cooling load over the 24 hours comprising the design day, Btu per hour.
C = average total cooling capacity (sensible plus latent) of equipment over the season, Btu per hour.
t_m = design mean temperature = design outdoor dry bulb minus one half the daily range, Fahrenheit.

Tabulated values of cooling degree-days above 70 F for various localities are not yet available. Until they are, approximate values can be obtained from degree-day maps.[11, 12] Values of C must be obtained from the equipment manufacturer, whereas values of the daily range for computing t_m are given in the literature.[13]

It is emphasized that the value of H in Equation 2 is not the maximum instantaneous heat gain but the *average hourly cooling load over the 24 hours comprising the design day*. Consequently, it should be evaluated by a method similar to the one reported.[2] To facilitate application of the method, the original paper[10] contains charts from which values of T and S can be obtained directly.

If the evaporator fan cycles with the compressor, the power cost S also represents the total operating cost for air-cooled condenser applications. For continuous fan operation the value of T is subtracted from the number of hours in the cooling season to obtain the extra hours of fan operation. Equation 1 is then used with the appropriate value of P for the fan motor only, and the result is added to the power cost during compressor operation.

For water-cooled condenser applications the water cost, as determined from the operating hours, water rate and manufacturer's data on equipment water usage, is added to the power cost to obtain the predicted total operating cost.

EFFECTS ON FUTURE HOUSE DESIGN

Air conditioning, like automatic heating, has brought about improved practice in residential construction, particularly in those regions where cooling is of primary importance. Although it is true that construction practices which reduce the heating load also reduce the cooling load, there are certain considerations which are unique in their effect upon the cooling load. Special attention must be paid to window orientation and means of shading the windows. South windows may be shaded by awnings or roof overhangs, but it is not practicable to shade large window areas having an east or west orientation except by exterior solar screening of some type. The use of insulation in the walls and ceiling of the residence will reduce the cooling load appreciably. In addition, attention should be paid to adequate ventilation of the attic. Double-glazed and weatherstripped windows, heat-absorbing glass, planned shade tree locations, and light colored exterior wall and roof surfaces, also help to reduce the cooling load.