brick, concrete, or steel may be found in *Kent's Mechanical Engineers' Handbook*[4] or the *Handbook of Building Construction*.[5]

RESIDENTIAL CHIMNEYS

Since residential heating appliances depend to a large extent on the natural draft of residential chimneys for satisfactory performance, the chimneys must be of adequate height and of optimum cross-sectional area, reasonably gas tight, and as smooth as practicable internally. They must be of such construction as to create no fire hazard to the building. The height and location of a residential chimney are usually limited by architectural and structural considerations, and therefore the draft produced

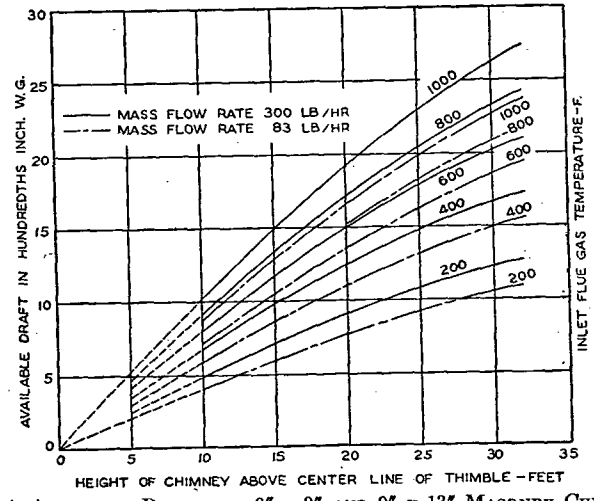

FIG. 4. AVAILABLE DRAFT FOR 9" x 9" AND 9" x 13" MASONRY CHIMNEYS
(*Ambient Temperature 0 F*)

will sometimes be inadequate for satisfactory and efficient operation of the fuel burning equipment. The basementless house, the one-story ranch or rambler type, and the flat-roofed structure are usually restrictive, particularly with regard to adequate chimney height. The limitations of chimney height should be carefully considered to determine whether or not the type of heating equipment specified will operate properly. If the available draft of the chimney is less than the draft required for the particular heating equipment specified, auxiliary means such as forced or induced draft should be included.

Until recently most chimneys for residences were constructed of masonry. The National Building Code of the *National Board of Fire Underwriters* specifies a minimum of 4 in. of masonry enclosing a fire clay flue liner. Within the past several years, however, the *Underwriters' Laboratories* have tested and listed as approved *Type A* flues, several chimneys of prefabricated construction. Their advantages, compared with masonry chimneys, are ease of installation, and usually lower cost and a greater degree of safety under abnormal firing conditions. Through the use of insulation or other means to reduce heat transfer through the chimney walls, these *Type A*

flues usually operate at a higher mean temperature for a given entering temperature and therefore produce slightly higher drafts.

AVAILABLE DRAFT FOR THE RESIDENTIAL CHIMNEY

Equations 3 and 4 cannot readily be used for computing the available draft for residential chimneys because of the relatively greater importance of friction losses, cooling of the gases, and soot deposits in small chimneys. Eddy currents and simultaneous flow both upward and downward can occur in a residential chimney for very low flue-gas velocities.

At present, it is best to rely on actual test data for determining the available draft of residential chimneys. Fig. 4 shows the available draft

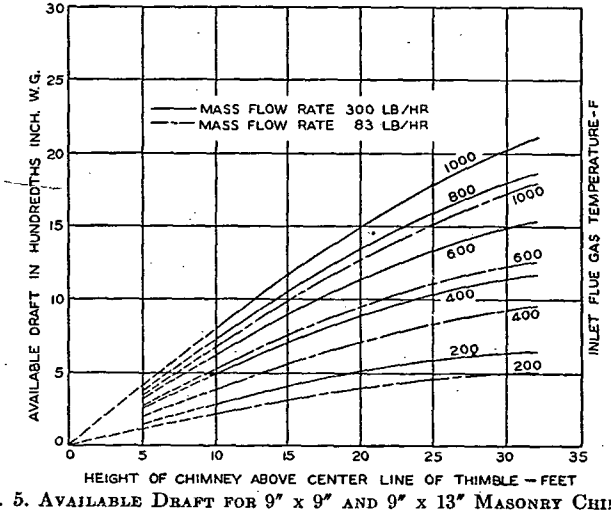

FIG. 5. AVAILABLE DRAFT FOR 9" x 9" AND 9" x 13" MASONRY CHIMNEYS
(*Ambient Temperature 60 F*)

of nominal 9 × 9-in. and 9 × 13-in. masonry chimneys with an ambient temperature of 0 F for a range of effective heights from 5 to 32 ft, a range of entering flue-gas temperatures from 200 to 1000 F, and for mass flow rates of 83 and 300 lb per hr. Fig. 5 shows the same information for an ambient temperature of 60 F. The available drafts produced by 9 × 9-in. and 9 × 13-in. masonry chimneys are equal for practical purposes over the range of mass flow from 83 to 300 lb per hr.[6] In tests of these chimneys the smaller chimney produced slightly greater drafts in the lower end of the range of mass flow rates whereas the larger chimney produced slightly higher drafts in the upper end of the range.

The chimney height for heating plants that operate on an *on-off* or *high-fire low-fire* cycle should be selected to produce the desired draft from Fig. 5 since this class of heating system is required to operate at rated input for short periods when the outdoor temperature is 60 F. Heating plants whose fuel-burning rate is gradually increased as the outdoor temperature decreases are not required to operate at rated input except when outdoor temperatures approach design conditions. For such systems, the chimney height should be selected from Fig. 4 which shows the available draft for