multiplied by 136 Btu per square inch, indicates the heat delivery *at the register*. The latter figure should equal or exceed the heat loss figure.

The register delivery of a gravity coal-fired furnace may be established by the following equations:

$$H = \frac{G \times p \times f \times E_1 \times E_2 \times 0.866\,[1 + 0.02\,(R\text{-}20)]}{144} \qquad (1)$$

in which:

G = grate area, square inch.
p = combustion rate, pounds coal per square foot of grate per hour.
f = heating value of the coal, Btu per pound.
E_1 = efficiency at bonnet, ratio of heat delivered at bonnet to heat developed in furnace.
E_2 = efficiency of duct transmission, ratio of heat delivered at register to heat delivered at bonnet.
0.866 = factor of safety to allow for contingencies under service conditions such as accumulations of soot and ashes, ineffective firing methods, etc.
H = total heat loss from structure.
R = ratio of heating surface to grate area.

The preceding empirical formula provides a 2 per cent increase in furnace capacity for each unit of value whereby the ratio of actual heating surface to grate area exceeds 20. This addition is based on tests conducted at the University of Illinois on seven types of furnaces having varying ratios of heating surface to grate area. Neither this correction, nor the Standard Code[4] Ratings, apply to values of the ratio less than 15 and greater than 30.

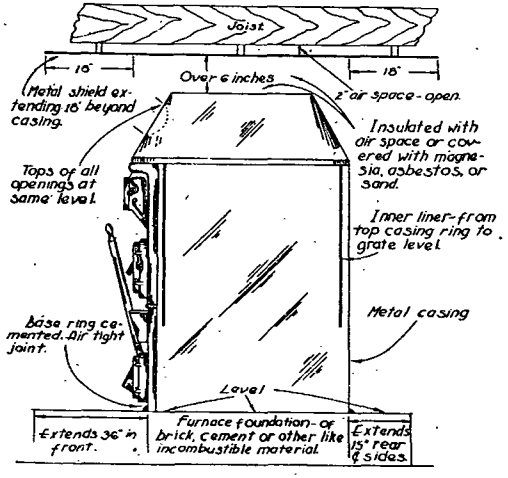


FIG. 6. DETAILS OF FURNACE BONNET, CASING, AND FOUNDATION (FROM STANDARD CODE APPLICATION MANUAL)

[4]Standard Gravity Code for the Design and Installation of Gravity Warm Air Heating Systems in Residences. This code has been sponsored by the *National Warm Air Heating and Air Conditioning Association*, the *National Association of Sheet Metal Contractors*, and the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. It is recommended that the installation of all gravity warm-air heating systems in residences be governed by the provisions of this code, the eleventh edition of which may be obtained from the *National Warm Air Heating and Air Conditioning Association*.

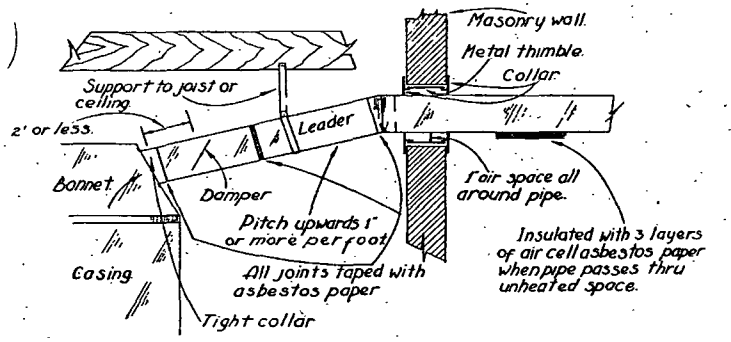


FIG. 7. DETAILS OF BONNET AND LEADER OF GRAVITY WARM-AIR FURNACE (FROM STANDARD CODE APPLICATION MANUAL)

Fig. 5 represents Laboratory data on a typical furnace, illustrating the fact that for a given register temperature, each furnace will have a definite capacity and efficiency, and will require a certain chimney draft to draw the air for combustion through the fuel bed. Test data gathered on the basis of the register design temperature of 175 F, permit rearranging the formula for Equation 1 into the following form:

$$G = \frac{144 \times H}{7.5 \times 12{,}790 \times 0.55 \times 0.75 \times 0.866\,[1 + 0.02\,(R\text{-}20)]} \qquad (2)$$

$$G = 0.004205\,\frac{H}{[1 + 0.02\,(R\text{-}20)]} \qquad (3)$$

As used in Equations 2 and 3, H equals the hourly heat loss of the entire building, in Btu per hour, including the heat required to warm any outdoor air introduced through a fresh air duct.

Figs. 6 and 7 show recommended practice as given in the *N.W.A.H. & A.C. Assn.* Standard Code Application Manual.