DESIGN AND CONSTRUCTION OF SMOKESTACKS.

In a recent issue of Building Progress, a periodical published by the National Fire Proofing Company, of Pittsburg, there is published an article by Henry V. Feder, on "The Design and Construction of Smokestacks." A great part of the discussion deals with the use of hollow tile instead of brick for chimneys. We present herewith an abstract of the article.

To approach the problem properly, the first points to be considered are the maximum area of grate under the boilers on which coal will be burned at any time; the kind and quality of coal, and the greatest quantity of coal that will be consumed per hour per square foot of grate surface. Ordinarily twenty pounds of coal per square foot of grate surface will be the right allowance to make, although the rate of combustion will average from ten to twenty pounds per square foot of grate surface, with an average of about fifteen. The maximum, however, is what must be provided for, consequently the smokestack must be made large enough to take care of the gases of combustion during forced firing.

There are two—yes, three—important points outside of the stability of the smokestack to be carefully worked out by the designer. They are the height of the stack, its area and wall insulation. Taking up first the area of the stack brings us back to the combustion of coal on the grate. For the economical combustion of coal each pound must have from 143 to 169 cubic feet of free air to burn it, and this will necessitate an area capable of taking care of from 155 to 170 cubic feet of chimney gas per hour per square foot of grate surface on an average, and a much larger quantity than that when coal is first put on the fire.

If the chimney lacks either in area or in height to take care of this volume of gas, the effect will be much the same as though the air were not supplied to the coal, for a feeble fire will result, and there will be the additional annoyance of more smoke than when the stack is of sufficient size to furnish a supply of air for the combustion of the gases which cause the smoke.

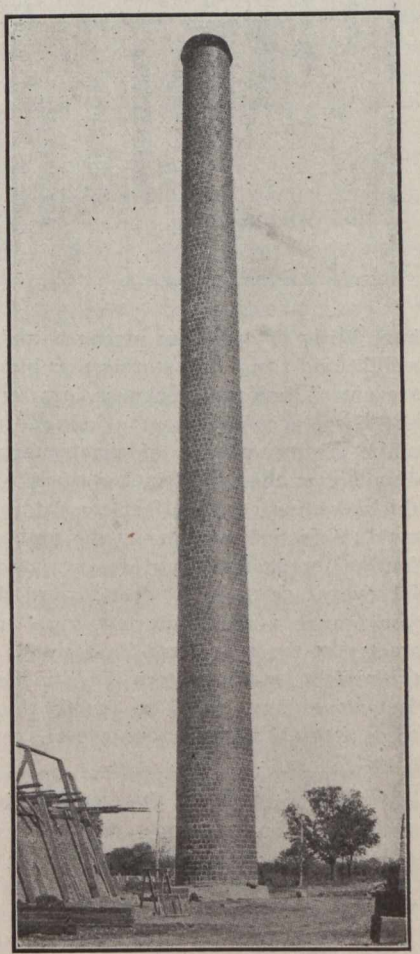
Height of chimney comes next, for without height there will be insufficient draft, and the gases will not escape fast enough, even with a smokestack of enlarged area. The draft of a chimney, or the velocity of gases through it, depends entirely on the difference in weight between the column of gases in the smokestack and an equal column of air outside of the stack. The hotter the gases in the stack the greater the difference in weight between this column and a column of the air outside, and so long as the temperature of these two columns are different it stands to reason that the higher the stack the greater the total difference in weight will be. In engineering practice it is assumed that the hot gases from the boiler at the uptake where they enter the smokestack will have a temperature of 450 deg. Fahrenheit. Without this temperature the desired draft will not be attained, for, owing to the large area of exposed surface to the smokestack, loss of heat by radiation and conduction will lower the inside temperature of the stack to such an extent that the upward movement of gases will be sluggish.

This brings us naturally to the third consideration in smokestack design, the wall insulation. To keep down to the lowest possible limit the loss of heat through the walls of the stack, they should be made as heat retarding as possible, and, as nothing is quite so good as a practical insulator against loss of heat as air cells, hollow walls or compartments of some kind are commonly used for this purpose. The walls of the stack, however, have to do more with the structural design, which will be explained later.

In smokestack design the proportions of the stack must first be obtained. It might be well to explain here that chimney draft is affected by so many varying conditions that no absolutely reliable and infallible rule or formula has ever been devised for proportioning smokestacks for a certain desired draft pressure. The type of boiler, kind and size of grate, size and kind of coal to be used, frictional resistance of the smoke connections, number and size of boiler flues—these all have more or less effect on chimney draft. While absolutely accurate results cannot be obtained by rules and formula, approximate results, which, when interpreted in connection with all the modifying circumstances, will yield accurate results, can be obtained by rule, while for ready reference practice has established certain well-defined proportions for smokestacks to be used in connection with boilers of different-rated horsepowers. In the table appearing on the following page the heights of chimneys, their diameters and areas can be found for any size of boiler, or battery of boilers, from 23 horsepower to 5,031 horsepower. These proportions will be found safe for all ordinary conditions.

When the height of smokestack and area of flue are known there still remain the structural features of design and construction to be worked out. For example, what should be the diameter of a smokestack at its base when it is 175 feet high?

There is a simple empirical rule that a smokestack in order to be stable must have a diameter at its base of from one-tenth to one-twelfth of its height. If in place, subject to an open, exposed strong winds, or on a floating foundation on poor soil, a diameter of one-tenth would be about right, while if the footings rested on bedrock, and the stack is partially sheltered from strong winds, the stack could be narrower at the base, perhaps one-twelfth the height of the stack being sufficient. Any proportion between these two extremes may be used, the designer being guided by judgment in assuming the proportions.



Hollow Tile Smokestack at the Plant of the National Fire Proofing Company of Canada, Limited, Near Hamilton Ontario.

Applying this rule and assuming a height of 175 feet on a floating foundation of hard-packed sand or dry clay, the proportion of one-tenth the height may safely be taken as the diameter of the stack at the base. One-tenth the height is 17½ feet, which would be the proportion in such a case.

But smokestacks are not of uniform diameter throughout their entire heights, but grow smaller toward their tops. This batter gives them greater stability, while at the same