HEAT TRANSMISSION THROUGH CORRUGATED IRON.

An investigation to determine the coefficient of heat transmission through corrugated iron sheathing has recently been conducted by the Green Fuel Economizer Company, of Matteawan, N.Y., with the view of securing reliable data to be used in the calculation of the heating requirements of such buildings. Experiments were made in a shop of the company, used for the manufacture of fans and blowers.

The building is 225 ft. long by 48 ft. wide, with an average height of 32 ft. There are continuous windows on one side 15 ft. high and on the opposite side 19 ft. high. Otherwise the building is covered with corrugated iron of single thickness without lining. The crevices at the eaves are filled with asbestos and the corrugated iron is cemented in at the bottom, and other measures have been taken to make the building as air tight as possible. The exposure of the windows is east and west, the smaller windows being on the east side.

A study of the available data on the subject showed the coefficient for the rate of heat transmission through single windows with a southern exposure to be 1 b.t.u. per square foot per hour per degree difference in temperature between inside and outside, according to Prof. Homer Woodbridge. For northern exposure the same authority suggests adding 35 per cent., for eastern exposure 15 per cent. and for western exposure 25 per cent. According to Mr. Ludwig Dietz, quoting Dr. Rietschel, of Berlin, and also the specifications of the Prussian Government, the coefficient for single windows is 1.026, with an increase of 10 per cent. for northern, northeasterly or northwesterly exposures and 10 per cent. for especially strong winds. The only figure for corrugated iron without sheathing that has been found is one of 2.132 by Dr. Rietschel, but without any statement as to whether this refers to superficial wall area or to the actual surface of the iron.

The formula commonly employed for the determination of the coefficient of heat transmission from one fluid to a solid substance and from the solid to a second fluid is of the form,

$$k = \frac{1}{\frac{1}{Ai} + \frac{1}{Ao} + \frac{x}{e}}$$

wherein Ai is the transmission from the inside fluid to the wall surface and Ao is the coefficient of heat transmission from the outside wall surface to the second fluid, e is the conductivity of the material in heat units per square foot per hour per degree difference per inch of thickness, and x is the thickness in inches.

For the value of Ai and Ao Mr. Grashof gives the following equation:

$$a = c + d + \frac{(40\,c + 30\,d)}{10{,}000}\,T$$

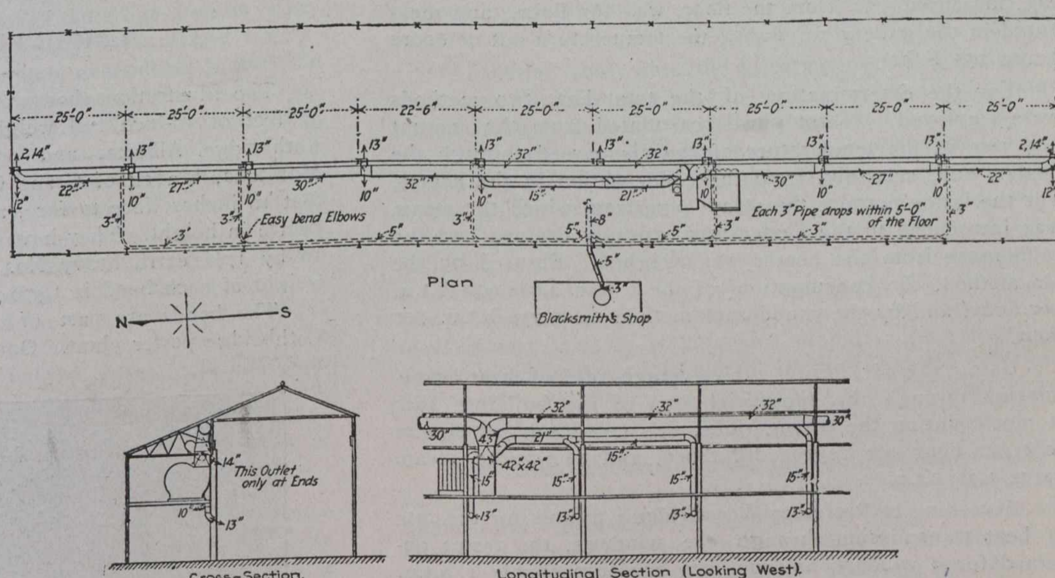
in which c depends upon the velocity of the fluid. Dr. Rietschel gives for air at rest c = 0.82; in slow motion, as in contact with cold windows, c = 1.03; in rapid motion, as outside of buildings, c = 1.23. d for glass is given as 0.60 and for sheet iron as 0.57. T for single windows is given as 36, no value being given for iron.

Calculating from the above values, we find that for a single glass window Ai is 1.84 and Ao is 2.07. For sheet iron the value for Ai equals 1.81 and for Ao equals 2.04.

For e Dr. Rietschel gives 190 for iron and 6.6 for glass. It will therefore be seen that the third term in the denominator of the expression for k can be neglected for iron and is practically negligible for glass.

Using the values of Ai and Ao just found, k for a single window works out as 0.958 and for a single thickness of sheet metal as 0.955, practically the same.

This, however, is not taking account of the additional surface of the sheet metal wall due to the corrugations. The corrugated metal used in the building under discussion has one corrugation to every 2½ in., the depth of the corrugation being 1 in. The actual surface of the metal is approximately 1.35 times the superficial area. This would make the rate of heat transmission for corrugated sheet iron, figured on the basis of superficial area, approximately 1.35 times 0.955, or 1.29.



Plan and sections of New Fan Building, Green Fuel Economizer Company.

According to the engineers conducting the test the values obtained by Grashof's method for both glass and sheet iron are lower than the values used in ordinary practice. This may possibly be explained on the hypothesis that the constants used in ordinary practice have been increased to account for losses due to leakage, the opening and shutting of doors, etc. Weight is lent to this view by the results of the tests which follow, bearing in mind that the construction of the present building makes it practically air tight. At the same time the values obtained were slightly greater than Grashof's formula would call for. The sheet-metal-working machinery and shafting housed in the building were in constant operation during the test, producing heat which was not measured, while, on the other hand, doors were being opened for the passage of men and materials on an average of once every ten minutes.

The total surface of the building is made up of approximately 7,538 sq. ft. of window, including the sash, 8,247 sq. ft. of wall surface and 11,925 sq. ft. of roof, the walls and the roof being given in superficial area. The total of wall and roof areas is 20,172, which, increased by the factor 1.35 to account for the corrugations, gives 27,130 sq. ft. total