TECHNICAL INFORMATION ON BUILDING MATERIALS

TIBM - 10

FOR USE IN THE DESIGN OF LOW-COST HOUSING

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THE NATIONAL BUREAU OF STANDARDS
UNITED STATES DEPARTMENT OF COMMERCE
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CORROSION OF METALS USED IN HOUSE CONSTRUCTION

Atmospheric Corrosion of Ferrous Metals

The atmosphere may cause corrosion of metals either on the inside or on the outside of a building. However, the active corroding agents, oxygen and liquid water, must both be present on the metal. Inasmuch as air inside and outside of a building has the same content of oxygen, metals corrode at the same rate indoors and outdoors, providing the amount of water reaching the metal in a given time is equal in each case. Normally, however, the outside metal, being subjected to rain and snow, corrodes more rapidly.

The lowest rate of atmospheric corrosion occurs in rural or suburban locations, where the air is only slightly contaminated with smoke or oxides of sulphur from the combustion of fuel. The highest corrosion rates are found in industrial centers where the degree of contamination is relatively high. A high rate of corrosion is also common near the seacoast because of salt in the atmosphere. Rain dissolves such contaminating substances in the air and the resulting solution is much more corrosive to metals than is pure water. Rain water may also dissolve some corrosive material present in dust which is suspended in the air or has settled on a roof.

Atmospheric Corrosion Tests

Since 1916, The American Society for Testing Materials, has been investigating the outdoor weathering of metals and has obtained important data on the durability of ferrous metals exposed continuously to the weather in rural, industrial, and seacoastal atmospheres. This investigation is being conducted by committees on which are represented producers and consumers of metal. Before these tests were started, a mutually acceptable program was agreed upon. The tests were carried out at Pittsburgh, Pa. (industrial atmosphere), Annapolis, Md. (mild seacoastal atmosphere) and Fort Sheridan, Ill. (rural atmosphere somewhat contaminated).

Commercial size 16 and 22 - gage sheets of steels and irons were exposed as bare sheets, i.e., unpainted or without any applied protective metallic coatings. Subsequently, a similar investigation on galvanized iron and steel sheets was undertaken. Details of the latter study will be given in a subsequent memorandum of this series..

In the test of bare metals, two general types of steel and iron were used: (a) those containing the small amounts of copper unavoidably present as contamination in the iron ore or scrap used in producing the steel or iron, and (b) those to which copper was intentionally added during the melting operation, so as to finish with a copper content of from 0.15% to 0.30%. In a few cases a higher copper content was present. Inspections of the test sheets were usually made twice a year by committee members. A sheet was considered to have failed when perforated, by corrosion, at one or more places. Table I, page 3, summarizes the results of this test, which is still in progress at Annapolis but which could not be continued at Pittsburgh and Fort Sheridan until such time as all the sheets were perforated, as these sites had to be utilized for other purposes.

Results of Tests

From the data obtained, the following conclusions would seem justified:

(1) Steel or iron with 0.15% to 0.30% copper was more durable at all locations than companion material low in copper content.

(2) In heavy industrial atmospheres, such as found in the Pittsburgh area, bare metal sheets should not be used; painting or galvanizing, preferably both, is advisable, particularly for exterior parts of a house.

(3) In atmospheres of the less corrosive type, such as in Annapolis and Fort Sheridan, the life of steels without added copper is much longer than in Pittsburgh. The choice of metal in such cases should be governed by the frequency or regularity with which the structure can be painted.

TABLE I

RESULTS OF OUTDOOR WEATHERING TESTS OF BARE FERROUS SHEET METALS

CONDUCTED BY THE AMERICAN SOCIETY FOR TESTING MATERIALS

Location of Tests	Duration of Test (Months)	Material: Gage	Material: Kind of Steel or Iron	Material: Number of Sheets Tested	Number of Sheets Failed*	Percentage Failed
Pittsburgh, Pennsylvania (industrial atmosphere)	78	22 (.0306" thick)	With added copper	146	123	84.4
			Without added copper	84	84	100.0
		16 (.0613" thick)	With added copper	132	none	0.0
			Without added copper	126	102	81.0
Fort Sheridan, Illinois (rural atmosphere, somewhat contaminated)	132	22	With added copper	136	50	36.8
			Without added copper	83	77	92.8
		16	With added copper	136	none	0.0
			Without added copper	124	4	3.2
Annapolis, Maryland (mild seacoastal atmosphere)	216**	22	With added copper	148	7	4.7
			Without added copper	79	56	70.9
		16	With added copper	130	none	0.0
			Without added copper	129	none	0.0

*A sheet was considered to have failed when perforated, by corrosion, at one or more places.

**Last reported inspection, October 1935.