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CHAPTER 10

WATER VAPOR AND CONDENSATION IN BUILDING CONSTRUCTION

Basic Principles, Visible Condensation, Vapor Transmission Through Materials, Permeance Data and Testing, Concealed Condensation in Heated Buildings, Control of Concealed Condensation, Condensation in Cooled Structures

WATER as a vapor is present in all air and as adsorbed moisture in building materials such as wood. Even dense materials like glass hold considerable adsorbed moisture on their surfaces. In each of these places water may be harmless or even desirable, if its quantity is not excessive. Excessive moisture in building materials may cause mold, rot, and rust. Water blistering may damage seriously the exterior paint on wood siding when the siding moisture content rises above a safe level. While excessive moisture in building materials may be caused by rain leakage, it frequently is due to water vapor migration, a phenomenon likely to be associated with a temperature difference. Thus it may occur in the walls and roofs of heated buildings in winter, and in the enclosure of refrigerated spaces at all seasons. Water vapor released within a building, either incidentally or intentionally, may result in excessive moisture in the structure.

The behavior of water vapor is too often overlooked or given scant consideration in the design and construction of buildings and in the layout of air conditioning processes. It is an important factor to consider in the construction of residences and public buildings in cold climates and to a lesser extent in warm climates. It is extremely important to consider the moisture problem in the construction of cold storage and low temperature rooms. Manufacturing processes which demand a high humidity, require buildings designed to reduce the effect of moisture on the structure.

Moisture problems in residences occur in winter and become increasingly important as homes are built smaller and tighter. Water vapor originates from such necessary living requirements as cooking, laundering, bathing and the breathing and perspiration of people. In a typical family of four, the average daily production of water vapor from these sources may be as much as 25 lb, and may be much greater where such appliances as humidifiers, automatic washers and dryers are used.[1] Another large source of water vapor is sometimes the bare earth in a crawl space or basement. All this water vapor must escape from the dwelling.

BASIC PRINCIPLES

Water vapor in air is a gas which occupies all the space and has the same properties that it would have if the (dry) air were not present. It is steam at a low temperature and pressure. Generally it is superheated, *i.e.*, not saturated. When water vapor is saturated, the space (or air) holds all the water vapor that it can at the existing temperature, and its vapor pressure is a maximum. A smaller content of water vapor produces less vapor pressure. The ratio of this pressure to the saturation pressure at the given temperature is called the relative humidity of the space.

If an air-vapor mixture at a given relative humidity is cooled, its vapor pressure is unchanged but its relative humidity increases until at some