Review of Parts 1 and 2 of the ASTM Manual on Moisture Control in Buildings

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INTRODUCTION

Need for Manual

Much information on moisture in buildings is currently available but is widely scattered throughout the literature. While earlier literature treats moisture as a serious, distinct, and separate potential problem, since about 1974 the issue of moisture in buildings has been largely relegated to the position of a side effect of energy conservation concerns. It is the hope of the editor and the authors that an ASTM manual focusing on moisture in buildings will help to make the process of moisture control a straightforward engineering design procedure, comparable to procedures for thermal and structural performances, and that it will provide the building community with a valuable tool for solving one of the most significant problems in constructing buildings. The need for the book is underlined by a growing number of court cases dealing with issues of moisture-related building failures and an increasing awareness of the potential health hazards of excessive exposure to moisture-related mold and fungus.

Objectives

It is the purpose of the manual to bring together in one volume, as a desktop reference, the information on applicable state-of-the-art technology relating to moisture problems in buildings, their diagnosis, prevention, and rehabilitation and to synthesize the existing information and technology as a basis for indicating good design practice.

Scope

The manual will address all major building and construction types: one- and two-family residential; low-, medium-, and high-rise residential; low- and high-rise commercial and institutional buildings; and light industrial construction. The manual will not cover requirements for process-dominated structures and heavy industrial construction. The manual will cover the major climatic zones of the contiguous United States, Canada, Alaska, and the Pacific and Caribbean islands: cold and dry, moderate and humid, warm and humid, and "swing climates" where warm and humid summers alternate with moderately cold weather. Both air-conditioned and non-air-conditioned buildings are discussed.

Parts 3 and 4 of the ASTM moisture manual are discussed in a companion paper by P. Reece Achenbach.

Method of Manual Preparation

The manual will consist of some 25 chapters, each written by an individual selected for knowledge and competency in the chapter's subject.

CHAPTER 1.1, ON FUNDAMENTALS OF MOISTURE CONDENSATION AND TRANSPORT, M.K. Kumaran, G.P. Mitalas, and M.T. Bomberg

This chapter will provide a solid foundation of the basic physical phenomena relating to moisture in buildings. It will discuss the various mechanisms of moisture movement, resistances to such movements, condensation, and evaporation. The chapter will also provide simple calculations of the plane of condensation, water vapor transfer, etc. Other chapters will provide inputs relating to climate, temperatures, properties of materials.

CHAPTER 1.2, MODELING AND CALCULATING MOISTURE TRANSPORT AND STORAGE IN BUILDING MATERIALS AND COMPONENTS, Tuomo Ojanen, Reijo Kohonen, and M.K. Kumaran

This chapter discusses three computer models that allow the analysis of moisture transport, wetting, drying, and moisture accumulation within building elements. The three models are described, their major application discussed, and sample of their output provided.

CHAPTER 1.3, MOISTURE-RELATED PROPERTIES OF BUILDING MATERIALS, Ronald Tye

Here, moisture-related properties of materials will be discussed in general, for example, definitions of terms such as *permeance* and *permeancy*, *adsorption*, *absorption*, and *desorption* and their application to specific material types and individual building materials. Included will be, in tabular form, information on moisture-related properties of typical building materials. The chapter will also discuss

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moisture-related effects of the interaction of individual building materials in components, such as the incompatibility of sealants with substrates and galvanic action between dissimilar materials. Particular material-related areas that need special attention to prevent moisture problems will be discussed and typical solutions presented.

CHAPTER 1.4, MOISTURE-RELATED PROPERTIES OF WOOD AND THE EFFECT OF MOISTURE ON WOOD AND WOOD PRODUCTS, Gerald Sherwood

Not only is wood a material predominantly used for single-family housing construction in North America and many other areas of the world, but wood and wood products have many properties that cause them to behave differently in the presence of moisture than most other building materials. Wood can store copious amounts of water; moisture and its absence can lead to swelling and shrinking; and, under certain conditions, moisture in wood can cause mold and mildew growth, leading to rot and the premature deterioration of wood. However, different species of wood behave differently in the presence of moisture. This chapter will discuss the various factors relating to wood and moisture, the properties of the different species, the conditions that are most harmful and should be avoided, and the measures the designer or remodeling professional may be able to take to eliminate, or at least significantly delay, the deterioration of wood building components.

CHAPTER 1.5, EFFECT OF MOISTURE ON THERMAL PERFORMANCE OF MATERIALS, Catherine Langlais, A. Silverstein, and P.I. Sandberg

While moisture primarily affects the strength and durability of structural and space-enclosing materials and systems, the moisture content of thermal insulation can also affect its thermal performance. This effect will be discussed in general theory and as it applies specifically to the major types of thermal insulating materials.

CHAPTER 1.6, MOLD AND MILDEW AND HEALTH EFFECTS, Harriet A. Burge, H. Jenny Su, and John D. Spengler

A major concern in building construction is the growth of mold and mildew on building materials and building contents. The concern is twofold: mold and mildew affect the strength and service life of building materials and finishes and are suspected of contributing to health hazards in the built environment. In this chapter, the conditions conductive to fungus growth will be examined, preventive measures discussed, and the susceptibility of various building materials outlined. The chapter also discusses the current state of the art relating to adverse health effects relating to mold and mildew in buildings.

CHAPTER 1.7, CLIMATE, Frank Powell

The prevailing climate in a particular location determines to a large degree the type of moisture problem a building may face and the type of preventive or remedial action that may be called for. In this chapter, the various climatic types will be defined, their characteristics and broad effects on the buildings indicated, and the relevant climatological data described. The chapter will discuss when and under which conditions average, design, and extreme weather data must be used. It will also provide guidance in interpolating weather data for locations at some distance from weather stations. Necessary climatic data for use in calculations presented in other chapters will be provided in tabular and map form.

CHAPTER 1.8, SOURCES OF MOISTURE, Jeffry Christian

In analyzing moisture problems in buildings, probably no issue is more fundamental and critical than the correct determination of the source of the moisture. Accordingly, this chapter will discuss the major sources of moisture in buildings and their rate and frequency of dissipation (constant, daily, seasonal, etc.). The effect of occupant density on the total moisture balance in buildings, will also be discussed.

CHAPTER 2.1, EFFECTS OF AIR INFILTRATION, VENTILATION, David Harrje

Air infiltration and ventilation affect moisture in buildings significantly. Probably best known is the drying effect when infiltrating cold and dry outdoor air or ventilation air is heated to room temperature in the winter. An opposite effect can take place in summer when warm infiltrating and humid outdoor air or ventilation air is cooled by air-conditioning equipment with insufficient dehumidification capacity. In this chapter, the significance of air infiltration and ventilation to the moisture balance will be identified and discussed. The chapter will identify the relation of air changes and moisture load and outdoor climate and adequate indoor circulation, particularly in corners, closets, and behind furniture. It will also discuss the concept of moisture load and positive and negative aspects of infiltration, natural ventilation, and mechanical ventilation for moisture control.

CHAPTER 2.2, MECHANICAL EQUIPMENT—HEATING AND COOLING, Russell Keeler

This chapter will discuss the moisture-related performance of HVAC equipment, its effect on the moisture

balance in the building, and its selection for optimal mitigation of moisture problems. Special emphasis will be given to the calculation and provision of adequate dehumidification for preventing mold and mildew in warm and humid climates for new and existing buildings.

CHAPTER 2.3, DESIGN TOOLS, Anton TenWolde

The building designer, operator, and renovator have currently available a number of design tools to prevent moisture problems. But it is believed that many designers are insufficiently aware that these tools are available or are ill equipped to apply them. This chapter will provide and discuss relevant literature and calculation methods and will identify and explain useful computer programs. The programs discussed will include those both for the researcher, professional, and large commercial users, and the small practitioner. Where appropriate, sources will be provided.

CHAPTER 2.4, TESTING AND MEASURING, Peter Lagus

Before determining the causes of moisture problems, it is important to develop a measured data base. (Although experience may be a valuable attribute of the investigator, conclusions should be based primarily on measured data.) The relevant measured data may relate to characteristics of materials, components, or the entire building. The chapter will outline the test methods, instrumentation needed, and practices that are available to establish the required data base, particularly as input for computer programs. It will discuss statistical procedures to determine the minimum number of tests required for a reliable data base. The conditions in buildings can vary considerably over even a short period of time and from one location to another. Accordingly, the number of tests to be conducted and the number of specimens to be tested may be critical. Thus, it is important to design a specific testing program at or near the beginning of the investigation. Piecemeal and ad hoc tests seldom provide a solid base for determining the causes of and the design for remedial actions.

CHAPTER 2.5, TROUBLE SHOOTING, Heinz Trechsel

Under chapter 2.4, "Testing and Measuring," the importance of designing and establishing a testing plan will be stressed. In this chapter, a methodology will be outlined for developing detailed testing plans. In real life, however, the investigator of moisture problems frequently does not have the luxury of developing a massive testing plan in advance. More typically, he/she will examine the construction drawings and, if they are available, the specifications and conduct a preliminary site visit. Based on the results of these preliminary investigations, he/she will then conduct initial tests, reach some preliminary conclusions, recommend remedial actions on a trial basis, and monitor the results. If the problem persists, the investigator will conduct more tests, reach additional or different conclusions, recommend additional or different remedial actions, and monitor the results again. The chapter suggests a protocol for these investigations. The availability and use of a uniform protocol will allow the development of a general data base on moisture problems, facilitate the communication between investigators, and lead to more effective and efficient moisture investigations.

CHAPTER 2.6, CASE HISTORIES, George Tsongas

For twenty years or more, many moisture problems have been investigated, but reports about them either have not been published or are spread among many books and symposia proceedings. Since these reports are invaluable for the investigator of moisture problems, they will be identified and their salient conclusions summarized. Emphasis will be on measured data, its collection (instruments used), and on conclusions reached. The case studies will be divided into those on residential and high-rise, commercial, institutional buildings, and into climatic types.