DESIGNER'S GUIDE TO CEILING-BASED AIR DIFFUSION

This publication was prepared under ASHRAE Research Project RP-1065 in cooperation with TC 5.3, Room Air Distribution.

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American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ISBN 1-931862-11-7

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and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, N.E.
Atlanta, GA 30329
www.ashrae.org

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Printed in the United States of America

Cover design by Tracy Becker.

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ACKNOWLEDGMENTS

This guide is a result of a cooperative research agreement between the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., and the University of Kansas Center for Research, Inc., for ASHRAE Research Project 1065, Development of Room Air Distribution Design Guide. The support of ASHRAE and guidance by the RP-1065 Project Monitoring Subcommittee (PMS) of TC 5.3, Room Air Distribution, are appreciated by the investigators. The PMS members were David John (Chair), Julian Rochester, Yan Chen, Leon Kloostra, and Harold Straub.

CHAPTER 1

INTRODUCTION

This *Designer's Guide to Ceiling-Based Air Diffusion* is intended to assist engineers and designers in the creation of effective HVAC systems. Experience has shown that the performance of air diffusion equipment for buildings has a substantial effect on the thermal comfort and productivity of occupants, so proper design of these subsystems is essential. It is anticipated that this guide will serve as a practical introduction for those who are just entering the field or as a refresher for experienced HVAC engineers and designers. Reviewing the guide should be beneficial to architects and building owner/operators as well.

This guide's coverage is largely limited to conventional ceiling-based air diffusion equipment. Such ceiling placement is prevalent in most new U.S. commercial and institutional buildings, but other approaches are common as well. Many of the fundamentals presented in this guide, as well as portions of the recommended design methods, are applicable to non-ceiling-based equipment, too. After reviewing this guide, additional design information on air diffusion products may be obtained from the *ASHRAE Handbook*, papers in the *ASHRAE Journal* and ASHRAE *Transactions*, and manufacturers, for example.

1.1 ASHRAE

The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), is an international technical society based in Atlanta, Georgia, with about 55,000 members worldwide. ASHRAE is dedicated to advancing the practice of HVAC engineering through research, standards, publications, and education. Because providing ther-

mal comfort and acceptable indoor air quality are important goals of HVAC designers, ASHRAE has sponsored many studies concerning these issues. This guide, which covers the topic of conventional ceiling-based air diffusion, is the result of such an ASHRAE-sponsored project. More information on ASHRAE may be obtained via its web site at http://www.ashrae.org/ or by calling (404) 636-8400.

1.2 HVAC DESIGN

The design of heating, ventilating, and air-conditioning (HVAC) systems is both an art and a science. To be successful, an HVAC engineer or designer should become well versed in the phenomena affecting system performance. This guide for HVAC engineers, designers, and others is intended as an introduction to some of the physical, thermal comfort, acoustical, and indoor air quality issues that have an impact on your selection and placement of ceiling-based air outlets and inlets. If more in-depth information is required, readers are encouraged to seek the original sources listed in the bibliography at the end of this guide and in the ASHRAE RP-1065 Literature Report (ASHRAE 2000). A more general and largely non-numerical introduction to HVAC design is the *Air-Conditioning Systems Design Manual* (ASHRAE 1993).

The primary units used in this guide are of the inch-pound (I-P) system, with the SI equivalents given in parentheses. As of this writing, use of I-P units is still dominant for HVAC projects constructed within the U.S. and for the equipment manufactured here. Familiarity with SI is increasing, and a transition to it is occurring very slowly in the U.S., however.

1.3 AIR DIFFUSION DESIGN

There are many factors that influence the short- and long-term success of HVAC systems in meeting the objectives of designers, owners, and occupants. One such factor is the performance of the air diffusion equipment. Many types of air diffusion products are currently used in residential, commercial, institutional, and industrial buildings, and many new types of equipment will likely be introduced in the future. HVAC designers need to become familiar with the available options and should select the most appropriate air diffusion products for their projects. For most conventional commercial and institutional buildings in the U.S., various types of ceiling-based air outlets and inlets are commonly specified when built-up or rooftop all-air or air/water HVAC systems are employed.

Through many years of research and field experience, successful methods for selecting such conventional ceiling-based products have been developed. However, due to time pressures in design firms and sometimes