

## Workshop Report

# Improving the Fundamentals Volume of the ASHRAE Handbook

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**Prepared on behalf of the  
workshop participants by:**

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## Handbook Improvement Workshop

### Introduction

The ASHRAE Handbook is the central technical resource and financial foundation of the Society. About 50,000 people renew their memberships each year, in large part because membership includes a copy of one of the four Handbook volumes.

The Fundamentals volume is perceived to be the flagship of the four-volume series. It's also the volume most frequently purchased by libraries, and the volume most likely to be owned by those outside the HVAC design community who need to learn about building energy use, thermal comfort and indoor air quality.

Audiences for Fundamentals include architects, building managers, mechanical service professionals and US and international government policy makers and regulators. The Fundamentals volume may well be the most widely used HVAC & Reference in the world—the first book pulled off the shelf when there is a need to consult an authoritative source on HVAC&R issues, technology, basic computations and reference data.

However, Fundamentals has been criticized by some as being overly academic and theoretical, and not as practical and understandable as it needs to be to be truly useful to those who seek information about issues for which ASHRAE is perceived to be the cognizant authority. Consequently, the ASHRAE Handbook and Technical Activities Committees developed a joint project to improve the 2005 Fundamentals volume in time for its 2009 revision.

Project goals included finding ways to increase the utility of the information for ASHRAE's primary professional constituencies and also to improve the review and revision processes, so that the Fundamentals volume becomes increasingly clear, more engaging, and more useful to the technical communities we serve, in order to benefit the public.

The project began in the fall of 2005. A diverse group of 14 professionals was recruited based on their principal perspectives of using the Fundamentals volume in connection with:

- Design (7)
- Installation or service (2)
- Building operation or occupant issues (2)
- Equipment design & manufacturing (1)
- Research, or development of handbook data (2)

After workshop participants reviewed the entire volume, they met as a group during a teleconference in January 2006. That meeting discussed the broad structural issues and identified items for the agenda of our two-day workshop in Atlanta. Between January and April, each member reviewed five chapters in detail, providing specific written comments and suggestions for improvement.

Finally the participants met as a group in Atlanta for two days in April 2006, guided by two facilitators and under the observation of the Chairs of Handbook and TAC and the Fundamentals volume Chair for the 2009 revision. Also, the group had strong support from the ASHRAE Staff—in particular the Manager of Technical Services and the Handbook Editor.

This report was prepared by the facilitators and reviewed by the group during a conference call in June 2006. The report represents the consensus of the group. It consists of three parts:

- I. Summary of observations and recommendations for improvement of the Fundamentals volume and for the revision process
- II. Implementation plan
- III. Appendices

## I. Summary of Recommendations

Members of this workshop greatly admired the depth and breadth of the information contained in the Fundamentals volume. Most members had not been involved with handbook preparation, and they expressed awe at the scale of the effort required to generate and to maintain this book.

It is useful for TAC, Handbook and all of the TC's to keep this universal admiration in mind as they review these recommendations for improvement. These are largely suggestions for improving the form and presentation of the information—not its substance.

Our principal recommendations to improve clarity and utility are divided into five main categories, which are:

- Connecting readers to the full body of relevant ASHRAE publications
- Balancing the need for reference completeness with the need for everyday usability
- “Out of the book” thinking - suggestions for delivering more information, in economically sustainable ways, to worldwide audiences
- Reorganizing chapter groups and moving chapters to other volumes for more logical navigation
- Articulating clear guidance on the extent to which Fundamentals should meet the needs of different interest groups, especially in the printed volume

### 1. Connecting readers to the full body of relevant ASHRAE publications

The printed Fundamentals is often the only ASHRAE publication near at hand for designers who are not current members of the society, or to architects, building managers, government regulators, or maintenance supervisors who do not invest in the entire 4-volume series. If you're only going to invest in “the most important” ASHRAE publication, chances are good that you'll start with Fundamentals.

This fact sometimes leads to disappointment and confusion. Fundamentals is not a textbook on “HVAC Basics” as many would assume. Also, while it discusses some technical aspects of topics of broad public concern such as thermal

comfort and indoor air quality, Fundamentals does not contain guidance for the process through which one actually *achieves* those results.

An introduction to HVAC basics, and how one could achieve good indoor air quality, are actually described in other ASHRAE publications. But if the only publication you have from ASHRAE is Fundamentals—as is often the case—you don't know what other publications ASHRAE provides.

To help the reader of Fundamentals see an overall view of ASHRAE publications which could be helpful to his or her specific needs, we recommend two improvements:

- a. In a single paragraph, located at the top of the inside front cover of each volume of the Handbook, to describe the role of the handbook and how to find additional information from ASHRAE. Suggested wording for such a paragraph is contained in the implementation plan.
- b. Add a new chapter to Fundamentals (as the first in the volume) with the title: “Building life cycle and ASHRAE Resources.” The chapter will be organized according to the stages in the life of a building. It will describe the principal roles of each professional group at each stage, and also outline the ASHRAE resources such as climatic design data, and guidance such as ASHRAE standards which are available to assist all professionals at each stage of the building's entire life cycle.

### 2. Balancing the need for reference completeness with the need for everyday usability

The word “fundamentals” means different things to different people. To some it means the physics and theoretical understanding which form the foundation of all HVAC & R phenomena. But to others, the word fundamental means “The Basics” such as the shorthand math, lookup tables, rules of thumb and abbreviated explanations which allow our everyday work to proceed in 80% of circumstances.

ASHRAE must meet both needs. We must, of course, provide the repository for complete and technically precise reference material in our field. At the same time, most of our audiences find that 100%-complete-for-all-circumstances technical detail is counterproductive and confusing.

Regrettably, we were not able to define the universal principles for achieving this balance throughout the Fundamentals volume. Each chapter seems to be an individual challenge in this respect.

But to begin the process, we discussed two chapters to understand how such apparently conflicting needs could be met. In the implementation section, we provide specific suggestions for these two chapters:

- a. Psychrometrics. Chapter 6 was chosen because that topic is indeed fundamental to so many topics in HVAC & R.
- b. Climatic Design Data. Chapter 28 was selected because its revisors face the huge challenge of providing ever-increasing amounts of data. If printed in its entirety, current data would now require over 4,000 pages in the Fundamentals volume.

### 3. “Out of the book” thinking - Delivering more information, in economically sustainable ways, to worldwide audiences

The problem of too much weather data to print is symptomatic of the underlying issue: How can the ASHRAE Handbook continue to be both useful and economically sustainable, as our volume of information expands? And how can the society meet the expanding expectations of a worldwide membership?

Clearly, we need to begin thinking “out of the book”, because the printed volume, provided yearly as the principal membership benefit, cannot expand indefinitely. We make these suggestions for the Board and the Handbook and Technical Activities Committees to consider:

- a. Expand handbook data via the web, rather than through more DVDs. **This is may be the most important and far-reaching recommendation to come out of this workshop.**
- b. Retain the printed version as a basic benefit of membership. But provide a menu of expanded handbook content and other information resources, available on the web, at additional cost. Specific suggestions are outlined in the implementation plan.

### 4. Reorganizing and retitling chapter groups for more logical navigation

The current organization of the volume is not as logical as one might wish. Also, it begins with the most technically complex and computationally dense chapters, which creates an intimidating impression of the volume no matter how technically-accomplished a reader might be.

The group suggests that the material be reordered into new sections, and that at least two chapters would be better located in other volumes. In the implementation section, these suggestions are described in specific detail.

### 5. Clear guidance on meeting the needs of different interest groups

Future workshops and the Handbook as a whole will benefit immensely from a clearer articulation of the needs of groups served by the ASHRAE Handbook. In addition, authors and revisors need clear guidance of the extent to which the needs of each group should be considered when deciding what information should be included in the printed volumes and electronic editions, and just how it will be presented.

Illustrating this need, our workshop participants had great difficulty achieving consensus on many aspects of “improving” the Fundamentals volume.

The majority supported the view that much of the information in the Handbook is excessively abstract and complex to be useful for the day-to-day practice of design engineering, and is even less useful to those in important allied professions such as architecture, building management, indoor environmental assessment and maintenance engineering. There were strong opinions that most chapters need top-to-bottom rewrites to make the information more accessible.

On the other hand, a forceful minority argued that the detailed information currently contained in Fundamentals (and its presentation) is useful to some parts of the ASHRAE constituency. Further, that if the current information is too complex to be useful for many or even most readers, such readers should seek simpler presentations in other publications. In the view of this minority, readers should not expect everyday simplicity and utility to be found in the Fundamentals volume.

Recommendation	Priority	Resources			Implementation Requires Action From...			Board
		Funds	Staff	Pages	TAC	Handbook	Other	
<b>1. Connecting readers to the full body of ASHRAE information</b>								
a. Paragraph on the inside front cover	1	-	Minor	-	Agreement	Approval	-	-
b. New chapter - Building Life Cycle	1	-	Minor	±10	Agreement	Approval	Assign chapter to TC	-
<b>2. Balancing the needs for completeness vs. utility</b>								
a. Modifications to chapter 6 - Psychrometrics	1	-	Minor	-	Agreement	Approval	Handbook instruction to TC	-
b. Modifications to chapter 28 - Climatic Design Data	2	-	Minor	±70	Agreement	Approval	Handbook instruction to TC	-
<b>3. Delivering more information to a worldwide readership</b>								
a. Expand Handbook via the web, not DVDs	3	Major	Major	-	Agreement	Approval	Coordination with Pubs Council	Approve
b. Generate & allow expanded choices for the pub benefit	3	Major	Major	-	Agreement	Approval	Coordination with Pubs Council	Approve
<b>4. Improved chapter groups and locations</b>								
a. Proposed structure & new sections	1	-	Minor	-	Agreement	Approval	-	-
<b>5. Clear guidance on readership needs</b>								
a. Define reader groups, needs and priorities	1	-	Minor	-	Agreement	Approval	Update authors guide	-
		<b>Priority Codes</b>						
		1 Improvement which can be implemented with volunteers						
		2 Significant improvement, at little or no additional cash outlay						
		3 Improvement which needs significant cash outlay and/or significant staff time						

Table 1. Implementation summary

The minority view of the readership and their needs was so difficult to resolve that our workshop had to leave the issue and proceed to areas of closer agreement. But based on our observations as we led the workshop, the facilitators have provided some brief suggestions for TAC and handbook committees to consider, in the implementation section.

## II. Implementation Plan

Table 1 provides a summary of suggestions which emerged from the workshop, along with their relative priorities.

### 1. Connecting readers to the full body of relevant ASHRAE publications

a. The first suggestion is easily implemented. This simple statement can be added to the inside front cover of each volume:

“The four-volume ASHRAE Handbook provides reference information for engineers working in the fields of heating, ventilation, air conditioning and refrigeration, and for professionals working in allied fields. The printed version of the four-volume series is revised on a four year cycle, with one volume issued every year. Tables of contents giving chapter titles for the four most recent volumes appear below, and a composite index for these volumes may be found at the end of this volume. ASHRAE publishes an electronic

edition of this handbook, which contains the text from all four volumes, as well as supplemental data which cannot fit into the printed edition. The Society also produces educational materials, standards, design guides and databases which can assist those who need either more or less detail than what is contained in these volumes. Information on these publications may be found at the on-line ASHRAE bookstore at [www.ashrae.org](http://www.ashrae.org).”

b. The second suggestion is to produce a new chapter for Fundamentals which describes the stages in the life of a building, roughly who does what at each stage, and what resources ASHRAE provides at that stage. A working title for the chapter could be: “The Building Life Cycle & ASHRAE Resources”

This chapter would help meet the need, identified by many workshop participants, to explain to younger engineers, clients and to professionals working in other professions:

- What basic information, skills and knowledge each profession might be logically bring to a building at each stage of its life, beginning with development decisions and proceeding through design, construction, startup, operation and renovation.

- When and how the different professionals might consider interacting more formally during the life of a building, and in pursuit of what goals.

This chapter can also serve as the ideal location for explaining the many ASHRAE standards (and any other publications which are under constant revision), and just when and to whom these become useful during the life cycle of a building.

The new chapter is not a simple undertaking. It must provide an overview but not establish a standard of care. There is an great variety of contractual arrangements governing HVAC & R design, construction and operation services. But if the focus remains on the overview, and if the chapter explains that this is a menu of choices and possibilities rather than “every professionals responsibility and every owners basic entitlement”, it will help connect all readers to the full body of ASHRAE resources.

The Technical Activities Committee should appoint one TC as the lead for this chapter. Several TC's could be considered for this role. For example, Technical Committee 7.1 (Integrated Design) might be one logical choice. And certainly the lead TC would need formal ongoing assistance from:

- TC 7.9 - Commissioning
- TC 7.3 - Operations and maintenance
- TC 1.7 - General legal education
- ASHRAE Staff - Standards
- ASHRAE Staff - Special publications

## 2. Balancing the need for reference completeness with the need for everyday usability

a. For Psychrometrics (chapter 6), the group recommends:

1. Moving the lengthy psychrometric property tables (2 and 3) to the end of the printed chapter. At present they create a lengthy obstacle to the “clear line of narrative” of the text.
2. Adding a new section at the very beginning of the chapter with the title: “Working Definitions” This section will provide respectfully-simplified definitions, suitable for most commercial and residential HVAC design purposes, and suitable

for communication with other professions and interested members of the public. The discussion of each variable will also contain an explanation of the circumstances when the working definition is no longer suitably accurate and complete, referring the reader to the comprehensive definitions described under “Humidity Parameters.”

For an example of the need for respectfully-simplified definitions, consider the comprehensively correct definition of “relative humidity.” This term is defined on page 6.12 of Chapter 6 of Fundamentals as being: “...the ratio of the mole fraction of water vapor  $x_w$  in a given moist air sample to the mole fraction  $x_{ws}$  in an air sample saturated at the same temperature and pressure.”

That definition, along with its accompanying Greek-letter equation, is correct in all cases. But reading that description is probably not the best way for most designers to quickly understand the concept for their own use, nor to use when explaining “relative humidity” to those in allied technical professions.

For most uses, a respectfully-simplified explanation would be more useful, such as:

“The warmer the air, the more water vapor it can hold. Relative humidity is the ratio, usually expressed as a percentage, which describes the amount of water vapor currently in the air compared to the maximum amount of water vapor that the air could hold at its current temperature.”

These two definitions are not mutually exclusive. The second is more quickly understood, and is accurate for most everyday purposes, and the first definition is more comprehensively correct. We suggest that the way to meet the needs of all readers is to include both definitions, but always with a caution which explains the circumstances when the simplified definition does not apply.

b. For Climatic Design Data (Chapter 28), we struggled for several hours with our unanimously-strong belief that most users of Fundamentals want the “most important” climatic data elements to return to the printed book. This belief runs up against the

obvious problem of choosing which are the “most important” data and the “most important” locations to print. After considering several alternatives, the group recommends:

1. Providing all climatic design data for all locations on the CD version of the chapter, as in the 2005 volume, in the same format. Continue to provide the CD with all copies the printed volume, in a plastic pocket at the back of the book.
2. In the printed volume, provide a reduced number of stations and a reduced data set, in a familiar format. Using appropriate climatic analysis techniques, select a number of worldwide locations to provide a reasonable representation of global climates. Then expand that set of climatically-relevant locations based on the need to serve all countries in the world for which reasonably accurate data exists. Then expand the set based on the need to serve the principal ASHRAE membership, which practices primarily in the more populated cities of the US, Canada and Europe. Based on those three criteria, select a total of 1450 locations—roughly the same number as contained in the 2001 chapter. Provide data for these locations in the printed volume, using the same data elements used in the 2001 edition of the chapter, and in the same format.
3. In the printed volume, save pages by eliminating the complete list of all stations for which data is contained on the CD. Instead, provide a one-line note in each political division’s printed data, stating the number of additional stations within that state, province or country which are provided only on the CD. (For example: “Climatic data for 73 additional stations in China are provided in electronic form on the Handbook CD.”)

### **3. “Out of the book” thinking - Delivering more information, in economically sustainable ways, to worldwide audiences**

a. For ongoing expansion of material in the Handbook, workshop participants believe that the web will be the most sustainable and most accessible long-term solution.

This will require a substantial amount of additional resources at ASHRAE HQ. At present the handbook staff is not equipped with enough personnel, nor all the right skills, the right software and right hardware for a smooth, continuous production flow for web-based Handbook maintenance.

On the other hand, the web-based handbook holds the potential for reaching a far wider worldwide audience. So it provides the income potential of that wider audience. One can envision a future in which ASHRAE members are provided with the printed volume and some limited access to the web-based expanded edition as part of the membership benefit. But for unlimited access, members might pay more, and certainly non-members would pay for web-based access at higher rates, although perhaps in attractively small amounts for each access event.

Some steps should begin in the near term to allow web-based handbook expansion, including:

1. Through the near-term addition of staff and budget at ASHRAE HQ, assist the activities of the electronic publication subcommittee of the handbook committee, greatly accelerating current efforts and aiming them clearly at web-based expansion rather than on DVD expansion.
2. Based on the accelerated of this subcommittee, supported by this expanded staff, select a volume and year as a specific target date for the first full-scale implementation of web-based supplemental Handbook information.
2. Assume that the Handbook will need a separate site within the ASHRAE website. One which will be graphically harmonized with the printed edition.
3. Assume that developing the appropriate, economically-sustainable website design, graphic standards and work-flow are non-trivial tasks,



and ones which will be ongoing. These should be budgeted accordingly, in both personnel and dollars and by long-term commitment from the society.

3. The current printed edition of the Handbook, for all its shortcomings, is a model of structural clarity and graphic consistency compared to most other technical publications. The web-based expansion of our flagship publication should equal or exceed the standard of the printed volumes in structural clarity and graphic consistency, while also accommodating the web-specific variables of color, interactivity, video and audio in an equally consistent and clear way.

b. Workshop participants also provided suggestions for additional information products beyond the handbook, and suggestions for payment methods to sustain them. These include:

1. Access to local building code databases on an ad-hoc basis. Practicing designers would be willing to pay for access to a database which could provide current copies of local building codes, which change constantly. If such a database exists, it would be useful for ASHRAE to negotiate favorable rates for ASHRAE members as a membership benefit. The Publication Council may be in the best position to investigate this possibility.
2. Access to HVAC-related litigation database. Like local codes, many ASHRAE members would like to have access to information about litigation related to HVAC & R issues, and would be willing to pay for that access.
2. Produce and sell PDF summaries of ASHRAE award-winning projects as examples of what can be done to advance the state of the art. Provide links to the bookstore from the relevant chapters of the web-based edition of the Handbook.
3. Provide an expanded menu of ASHRAE publications and services as part of the membership benefit, to increase revenue while providing

expanded services. For example, allow the basic membership benefit to be a credit of \$225.00 towards any ASHRAE publication or online service. Given that the printed volume of the handbook costs \$195, most members will elect to use the credit for that publication, but then will likely spend time considering how best to invest the balance of the membership credit. This thought process will almost certainly expand sales beyond the remaining \$30.00, by gently encouraging members to survey the catalog of pubs and services, with an intention to buy, each and every year when they renew their membership. The board would have to agree that this is a useful plan, and the Publications Council would have to decide how to implement it.

#### **4. Reorganizing and retitling chapter groups for more logical navigation**

Table 2 shows the consolidated suggestions in table form. These suggestions include:

- a. Begin with an introductory section which provides an overview of the building life cycle and ASHRAE resources to assist in different phases of that cycle. This will serve as a de facto index to ASHRAE resources, as well as a reminder of all parts of the building's life, and which professions and functions fall into each stage. The introductory section would also be a logical location for the chapter which currently describes global energy resources.
- b. Provide a section heading to highlight chapters dealing with the quality of the indoor environment - the reasons that HVAC systems exist.
- c. Provide a section heading to highlight those chapters which assist HVAC designers most directly and most frequently.
- d. Provide a section heading to highlight chapters which deal with the building enclosure, its design and behavior, a matter of general information to the HVAC designer, and of more major, direct importance to Architects.

<b>INTRODUCTION</b>		<b>BUILDING ENCLOSURES</b>	
1. Building Life Cycle & ASHRAE Resources (NEW)		27. Thermal and Moisture Control in Insulated Assemblies--Fundamentals	
2. Energy Resources		28. Thermal and Moisture Control in Insulated Assemblies--Applications	
		29. Thermal and Water Vapor Transmission Data	
		30. Fenestration	
<b>THERMODYNAMICS &amp; FLUID FLOW</b>		<b>MATERIALS</b>	
3. Psychrometrics		31. Combustion and Fuels	
4. Thermodynamics and Refrigeration Cycles		32. Refrigerants	
5. Fluid Flow		33. Thermophysical Properties of Refrigerants	
6. Heat Transfer		34. Physical Properties of Secondary Coolants (Brines)	
7. Two-Phase Flow		35. Physical Properties of Materials	
8. Mass Transfer		36. Sorbents and Desiccants	
<b>INDOOR ENVIRONMENTAL QUALITY</b>		<b>APPENDICES</b>	
9. Thermal Comfort		37. Abbreviations and Symbols	
10. Indoor Environmental Health		38. Units and Conversions	
11. Air Contaminants		39. Codes and Standards	
12. Odors			
13. Sound and Vibration			
<b>LOAD CALCULATION &amp; HVAC DESIGN</b>			
14. Residential Cooling and Heating Load Calculations			
15. Nonresidential Cooling and Heating Load Calculations			
16. Ventilation and Infiltration			
17. Climatic Design Information			
18. Fundamentals of Control			
19. Measurement and Instruments			
20. Airflow Around Buildings			
21. Space Air Diffusion			
22. Duct Design			
23. Pipe Sizing			
24. Insulation for Mechanical Systems		<b>(Move to APPLICATIONS Volume)</b>	
25. Energy Estimating and Modeling Methods		• Environmental Control for Animals and Plants (former chapter 10)	
26. Indoor Environmental Modeling		• Physiological Factors in Drying and Storing Farm Crops (former chapter 11)	

**Table 2. Revised Sections**

- e. Re-title and move the section dealing with thermodynamics, heat, mass transfer and fluid flow away from the beginning of the book.
- f. Move chapters 10 and 11 (Environmental control for animals & plants, and Physiological factors in drying and storing farm crops) to the application volume. The information contained in these chapters, while certainly important to some, is not as frequently referenced as the printed climatic data will be when it returns to the volume.

**5. Clear guidance on meeting the needs of different interest groups**

Workshop participants did not get very far with this problem. So the facilitators suggest that the Handbook and TAC joint committee consider this issue as an agenda item for their next

meeting. We recommend that the TAC-Handbook joint committee consider this subject and then:

- a. Clearly identify and describe the general needs of all groups intended to be served by Fundamentals, and indeed by each volume of the Handbook.
- b. Briefly (but compellingly and comprehensively) articulate the order and the extent to which each groups needs must be considered by authors and revisors.
- c. Accelerate the implementation of the Handbook communication database (recommended last year and currently underway) through which the revisors, the Handbook Committee and TAC will know whether the needs of each group are being met now, and through the future.

## Appendix a. Workshop participants

### Meeting Facilitators



*Lew Harriman, Mason-Grant Consulting, Portsmouth, NH*

Consultant and author. Frequent revisor for ASHRAE handbook chapters. Lead author of ASHRAE Humidity Control Design Guide.



*Bill Bahnfleth, Co-Facilitator, Penn State University, State College, PA*

Professor of Architectural-Engineering, teach mainly graduate classes on chilled water and co-generation systems, IAQ, and Director of Indoor Environment Center. Small consulting engineering practice also maintained.



### Designer Perspective

• *Becky Thompson - Leach-Wallace, Baltimore, MD*

Current Activity: Practicing mechanical engineer for past 2-1/2 years. Current specialty is in the design, construction, and commissioning of healthcare facilities.

10-years ago: Excited about turning 16 and getting driver's license.

• *Li Yuan, GRG Engineering, Orlando, FL*

Current Activity: Engineer for consulting design firm with experience in healthcare facilities, high-rise condos, and hotels.

10-years ago: Mechanical engineer working in Beijing, China. He did not have opportunity to use ASHRAE handbooks then.

• *Pam Immekus, Sunbelt Engineering, Atlanta, GA*

Current Activity: President and owner of Sunbelt Engineering Group, which is a small woman-owned business that has been in existence for 20 years. She is a mechanical designer and not an engineer by training. Her degree is actually in interior design and how she ended up in HVAC she has no idea. Firm designs HVAC systems for condos, churches, restaurants, retail, MRI suites, and even funeral homes. The primary technical focus is on energy efficiency and geothermal energy but they will do just about anything. Most of her clients are architects. She is the first female president of the ASHRAE Atlanta chapter.

10-years ago: Same thing as above.

• *Alan Traugott, CJI Engineering, Pittsburgh, PA*

Current Activity: Design engineer, also liason for ASHRAE to the US Green Building Council

• *Richard Keleher, Keleher & Associates, Concord, MA*

Currently: Architect in sole practice. Provides consulting services to architects on technical quality control with a specialty in the exterior enclosure. Recently founded a building enclosure council in Boston, which is the first of a national network of enclosure councils being launched by AIA and BETEC- Building Enclosure Technology & Environment Council.

10-years ago: Responsible for technical quality control for the "Big Dig" in Boston for architecture only and not tunnels and leaks.



• *Richard Rooley, Rooley Consultants, Bucks, England*  
 Current Activities: Consulting engineer in sole practice. He provides general consulting, expert witness and arbiter services to a variety of clients. Most often his work involves sorting out the differences between the designer's dream and the operating person's reality. He recently completed a term as President of ASHRAE. No company in the world today is teaching their design professional to design a system with an eye towards maintenance.

10-years ago: Partner in a practice with 10 partners and 300 staff. Design experience in the development of healthcare, education and defense facilities.

• *Frank Eisenhower, Karpinski Engineering, Cleveland, OH*  
 Current Activity: Mechanical engineer for a 65-person design firm where he specializes in healthcare facilities, museums and laboratory work.

10-years ago: Recent graduate of Penn State as architectural engineer.

**Building Owner/Occupant Perspective**

• *Terry Brennan, Camroden Associates, Westmoreland, NY*

• *Carl Grimes, Healthy Habitats, Denver, CO*  
 Currently: Operates small IAQ consulting firm that specializes in the occupant use of the building and the equipment that goes into it. Most of his work is generated from building occupant complaints involving the HVAC system of IAQ. He is Vice-President of the Indoor Air Quality Association. He is also a leader in the organization IICRC - Institute of Inspec-



tion, Cleaning and Restoration Certification to develop better standards for moisture & mold control in buildings (S-500 and S-520). He is also working with NADCA – National Air Duct Cleaning Association on integrating the S-520 into their duct cleaning standard.

10-years ago: Same thing

• *Jim Bergmann, Cuyahoga Valley Career Ctr, Brecksville, OH*  
 Current activity: Instructor of HVAC technology, with an emphasis on field service and installation technicians, and on proper use of instruments and commissioning.

**Installer/Contractor Perspective**

• *Mike Meteyer, Marshall Erdman & Associates, Madison, WI*

Current Activity: Manages a 10-person HVAC department that specializes in healthcare facilities (6,000-200,000 sqft.) and provides design, build and maintenance services. He is a member of TCs 9.6 and 9.8. He has also served as an ASHRAE chapter president.

10-years ago: HVAC engineer at the same firm. Just prior to that was a professional triathlon athlete.

**Equipment Manufacturer Perspective**

• *Roy Crawford, Trane, Tyler, TX*

Current Activity: Works in product development for a major HVAC manufacturer.

10-years ago: Past contributor to the handbook. He has experience also as a former professor and designer.



### Researcher/Data Provider Perspective

- *Tobias Sienel, United Technologies Research Center, Hartford, CT*
- *Dru Crawley, U.S. Department of Energy, Washington, DC*  
Current Activity: Program Manager with the Department of Energy where he manages about \$6-7 Million dollars worth of research into low-energy commercial buildings and software development of energy analysis tools. Active in ASHRAE TCs 2.8 (Chair), 4.2, and 4.7  
10-years ago: Worked with EPA/Energy Star Buildings and with a national lab doing research analysis.

### Oversight

- *Eckhard Groll, TAC Chair, Purdue University, West Lafayette, IN*  
Current Activity: Originally from Germany but he has lived in the U.S. for the past 14 years. Professor of Mechanical Engineering at Purdue University where mostly teaches thermodynamics, refrigeration and HVAC equipment. Research focus is on alternative refrigeration technology and refrigerants, compressors, and conventional refrigerants and equipment.  
10-years ago: Assistant Professor at Purdue University.
- *Bill Fleming, Handbook Committee Chair, Jacwill Services, St. Petersburg, FL*  
Current Activity: Jacwill Services is a 1-2 person design firm that specializes in cost-effective HVAC systems for buildings around the world (South Africa, China, California, etc.)  
10-years ago: He was leading the Fleming Group design firm, which had a peak staff of 80 persons with offices in Syracuse, California, Washington, and other places around the country between mid-70s to mid-90s.
- *Dennis O'Neal, 2009 Volume Editor, Texas A&M, College Station, TX*  
Current Activity: Head of Mechanical Engineering Department for Texas A&M University. He has been involved in HVAC research since 1977.  
10-years ago: Professor in Mechanical Engineering Dept. at Texas A&M

### ASHRAE Staff Support

- *Mike Vaughn - Manager of Technical Services*
- *Mark Owen - Handbook Editor*

## Appendix b. Statement of work for the project

### OBJECTIVES

The objective of this workshop is to provide a blueprint for improving the clarity and utility of the 2009 Fundamentals volume of the ASHRAE Handbook. This blueprint will identify and describe actions which can:

- 1 Increase the utility of the information for ASHRAE's primary professional constituencies; designers, installers, owners and operators of comfortable, healthy and energy-efficient buildings, as well as students and instructors of those professions.
- 2 Provide new content for topics of broad importance that should be added to the Fundamentals volume in particular, or the other handbook volumes in general
3. Allow less widely used, but still-important topics to be moved to other volumes or other publications
4. Improve the connection between the information in Fundamentals and the daily, real-world needs of professionals engaged in the engineering, installation and operation of heating, air conditioning and refrigerating systems for the benefit of the public.

The content, format and structure of the 2005 Fundamentals shall be examined as necessary to provide this blueprint.

### BACKGROUND

The four-volume ASHRAE Handbook is the most widely used and recognized ASHRAE publication both by members and non-members. Within this set, the Fundamentals volume is the flagship. It is the volume most likely to be owned and used by professionals within the HVAC&R professions and trades, as well as by those working in allied professions. Consequently, maintenance of current, relevant, high-quality content in the Fundamentals volume must be a high priority. Contemporary examples might include such topics as energy efficiency,

sustainability, moisture in buildings and security of HVAC&R systems. The workshop described by this statement of work is a follow-on to a similar, successful review of the 2004 Systems and Equipment Handbook. These workshops are organized and managed jointly by the ASHRAE Handbook Committee (HBC) and Technical Activities Committee (TAC) with the approval of Publishing and Education Council and Technology Council

### SCOPE OF WORK

The workshop will be a two-day working session conducted at ASHRAE Headquarters in Atlanta and preceded by a series of planning activities, telephone conferences, and detailed review of volume content. The workshop participants will establish criteria and methods for review, conduct the review, document specific issues, identify needed improvements, propose modifications to handbook content, propose modifications to the Authors and Revisers Guide and suggest specific committee actions by the HBC, TAC or both. Criteria for review of chapter content may include accuracy, balance, usefulness, references, consistency, continuity, practicality, degree to which contemporary issues are addressed, and others. A key element in the definition of criteria will be identification of the primary and secondary users of the Handbook and what their needs are.

The workshop will focus especially on the usability and practicality of the information contained in the volume, and offering detailed suggestions for improvements in each chapter as well as suggestions for the overall structure and organization of the volume. Any proposals to remove material from the "paper" Handbook must also include a recommendation on whether it should be relocated to a special publication or to the CD+ version of the handbook.

Participants will be asked to do the following in addition to attending the two-day working session in Atlanta:

- Participate in two pre-session conference calls
- Read the current Handbook Author's and Reviser's Guide
- Skim the entire Fundamentals volume
- Review recommendations for the 2004 Systems

and Equipment Volume workshop and actions taken in response that are applicable to all Handbook volumes

- Review and compile comments on assigned chapters of the Fundamentals volume in detail (including the latest additions and corrections and corrections posted on the ASHRAE web site)
- Review other background materials provided by the Co-Facilitators, including summaries of comments on the Handbook from various sources.
- Participate in at least one post-session conference call to review the workshop report prepared by the co-facilitators

## PARTICIPANTS

Workshop participants will include :

- a) TAC and HBC Chairs.
- b) Handbook 2009 Fundamentals Volume Chair
- c) ExCom members from HBC and TAC as assigned by the HBC and TAC Chairs,
- d) ASHRAE staff members who support the activities of the handbook and TAC committees
- e) Twelve (12) practicing professionals from several fields representing a cross-section handbook users, and
- f) Two (2) Co-facilitators.

The practicing professionals will be selected for their broad perspective and their many desirable professional attributes, including age and stage of career. Priority will be given to those currently engaged in the daily practice of their particular profession, at the working level. First priority for selecting participants shall be ASHRAE members or past members, but non-ASHRAE members shall also be included to ensure objective assessment of the needs of the public and other relevant professions.

For this workshop, between the core working group and the practicing professionals, the principal ASHRAE constituencies will be represented by at least these numbers of individuals: six [6] Design Engineers, two [2] Contractors/Service Techni-

cians, Two [2] Educators, two [2] Building Owner/Operators, one [1] Manufacturer and two [2] Researcher/Developers of data contained in the Fundamentals volume. At least one participant should be from outside the U.S. and Canada. (A given individual may count toward the total in more than one of these categories.)

- The Co-Facilitators, should be experienced in conducting meetings involving brainstorming to develop creative solutions to problems, and have organizational skills, knowledge of editing techniques, and technical writing experience. The co-facilitators will be paid for their services. They shall be responsible for planning, leading, and reporting on the workshop, with oversight from a TAC/Handbook monitoring committee. The facilitators shall also participate in the identification and selection of workshop participants in collaboration with the TAC and Handbook Committee chairs.
- Engineer/Designer participants should have experience in Building, HVAC&R systems and/or equipment design and application.
- Contractors/Technician participants should have experience in HVAC&R system and equipment installation, operation and maintenance.
- Educator participants should have experience in teaching of HVAC&R system and/or equipment design and application.
- Owner/Operator participants should have experience in HVAC&R system and/or equipment application and facility management or facilities engineering.
- Manufacturer participants should have experience in system and/or equipment application, as well as design of the equipment itself.
- Researcher/Data Provider participants should have experience in HVAC&R related research or development of data required for design and analysis, ideally with the data currently displayed in the Fundamentals volume. Since educators are included as a separate category, at least one

of these data developer participants should not be an academic.

Emphasis in selection of workshop participants will be placed on experience as users of the Handbook. In addition, experience in writing in general, or of revising Handbook chapters in particular, is also desirable.

**IMPLEMENTATION**

The workshop final report will be distributed to all TC's with responsibility for chapters in 2005 Fundamentals Volume and to all members of TAC and Handbook Committees. Comments on specific chapters will be provided to the cognizant TC's, which will be asked to indicate to their respective section heads and handbook liaisons how they will respond, by the next national meeting after they receive the comments. Other recommendations of the workshop may result in modifications to HBC and/or TAC Committee objectives or action, or the Authors and Revisers Guide. General conclusions and recommendations of the workshop will be discussed in TAC Section and HBC committee meetings at the first meeting following their release to these committees.

**DELIVERABLES**

A final report will be prepared by the Co-Facilitators with assistance of the workshop participants and supervision by HBC and TAC:

- Criteria and methods for review
- Summary assessment of volume
- Description of specific issues
- Description of proposed improvements
- Implementation plan
- Individual reviewer comments on each chapter

Workshop findings and recommendations will be presented at a winter or annual meeting of the Society by the facilitator and other workshop participants

**SCHEDULE**

- Planning [November-December 2005]
- Get-acquainted conference call [December 2005]
- Preparation [January-April 2006]
- Volume overview & workshop agenda planning conference call [January 2006]
- Workshop [Saturday & Sunday, April 22-23, 2006]
- Post-workshop report review conference call [late May 2006]
- Report [June 2006]

**ADMINISTRATION**

TAC/Handbook staff support (minutes and arrangements)

The facilitators shall report to a monitoring committee chaired by the TAC Chair and including at a minimum the Handbook Chair and Current Fundamentals Chair.





## Appendix c. Individual chapter assignments

<b>2005 ASHRAE Handbook—Fundamentals</b>				
	<b>Chapter Number &amp; Title</b>	<b>TC</b>	<b>1st reviewer</b>	<b>2nd reviewer</b>
<b>THEORY</b>				
	1. Thermodynamics and Refrigeration Cycles		Alan	
	2. Fluid Flow		Li	
	3. Heat Transfer		Frank	
	4. Two-Phase Flow		Tobias	
	5. Mass Transfer		Dru	
	6. Psychrometrics		Mike	Jim
	7. Sound and Vibration		Carl	
<b>GENERAL ENGINEERING INFORMATION</b>				
	8. Thermal Comfort		Carl	Jim
	9. Indoor Environmental Health		Carl	Frank
	10. Environmental Control for Animals and Plants		Mike	
	11. Physiological Factors in Drying and Storing Farm Crops		Terry	
	12. Air Contaminants		Alan	Becky
	13. Odors		Carl	
	14. Measurement and Instruments		Roy	
	15. Fundamentals of Control		Terry	Li
	16. Airflow Around Buildings		Alan	
<b>BASIC MATERIALS</b>				
	17. Energy Resources		Richard K.	Richard R.
	18. Combustion and Fuels		Dru	
	19. Refrigerants		Tobias	Roy
	20. Thermophysical Properties of Refrigerants		Tobias	Roy
	21. Physical Properties of Secondary Coolants (Brines)		Tobias	
	22. Sorbents and Desiccants		Mike	
	23. Thermal and Moisture Control in Insulated Assemblies--Fundamentals		Richard K.	
	24. Thermal and Moisture Control in Insulated Assemblies--Applications		Richard K.	Richard R.
	25. Thermal and Water Vapor Transmission Data		Terry	
	26. Insulation for Mechanical Systems		Mike	
<b>LOAD AND ENERGY CALCULATIONS</b>				
	27. Ventilation and Infiltration		Roy	Becky
	28. Climatic Design Information		Frank	Richard R.
	29. Residential Cooling and Heating Load Calculations		Terry	Jim
	30. Nonresidential Cooling and Heating Load Calculations		Li	Becky
	31. Fenestration		Richard K.	Richard R.
	32. Energy Estimating and Modeling Methods		Alan	
<b>DUCT AND PIPE DESIGN</b>				
	33. Space Air Diffusion		Pam	Dru
	34. Indoor Environmental Modeling		Pam	
	35. Duct Design		Pam	Jim
	36. Pipe Sizing		Pam	Becky
<b>GENERAL</b>				
	37. Abbreviations and Symbols		Li	
	38. Units and Conversions		Frank	
	39. Physical Properties of Materials		Jim	
	40. Codes and Standards		Dru	

## Appendix d. Chapter review guidance

### ASHRAE Handbook Improvement Review Form Fundamentals Volume Chapters, 2005 edition

Chapter number: <NUMBER>  
 Title: <TITLE>  
 Reviewer name: <YOUR NAME>  
 Completion date: <DATE>

Information based on your review will be given to the technical committee responsible for this chapter (lightly edited, if necessary, and anonymously, if you prefer).

Please be concise, candid and clear, because our highest responsibility is to future readers of the book.

1. In your opinion, is this chapter structured, written and illustrated so that a person who is technically *competent, but not familiar* with this particular equipment or system can understand it and put the information to use? *Please use the following table and ratings from one to three to summarize how well* you believe this chapter is likely to provide for the needs of the target readership:

**1** = Information in this chapter probably meets the needs of *this part of the audience* rather well, (which is not to say that it couldn't be improved).

**2** = Probably confuses a good portion of *this part* of the audience, or leaves out key information likely to be needed, or includes much information that will not be relevant or of interest to most readers in this group... consider significant changes in structure and/or content to avoid confusion and to make the Fundamentals volume a more frequently-useful reference, on this topic, for this particular group.

**3** = Seems likely that *this part* of the target readership will seldom if ever need to refer to information in this chapter. Consider moving the information to some volume or some publication other than Fundamentals, so that more frequently-useful information for this group can be included in Fundamentals.

HVAC Designers And Architects	Installers	Building owners And occupants	Manufacturers and researchers
[Your rating here]	[Your rating here]	[Your rating here]	[Your rating here]
Designers of mechanical systems and/or buildings, who need an overview of basic operating principles, critical variables and their interrelationships, important reference values, and diagrams or illustrations of concepts which are truly "fundamental" to the design of those buildings and systems.	Installers, who need overview of any key points, which are more frequently addressed by the contractor rather than by others when designing, installing and commissioning buildings and their mechanical systems.	Building owners and occupants, who need an overview of the key decisions they will need to make to guide the designer and system operators in their work.	Equipment manufacturers or researchers, who need to understand basic properties of materials and processes

2. What significant *changes in buildings or systems* have in your understanding become important for at least several hundreds or several thousands of buildings (not just dozens), but which are not yet fully discussed in this chapter? (Please remember our readership is worldwide, not just North American.)

## Appendix d. Chapter review guidance (Continued)

3. Which concepts or explanations discussed in this chapter are *no longer common* in the industry, so that their descriptions might in your opinion be reduced and/or moved entirely to some other reference publication?
4. In your opinion, are the equations and mathematic derivations in this chapter needed by technical professionals who design, install and operate systems every day? Or *could some of them be moved* to a separate publication for higher education classes or less-frequent reference use? If so, *which* equations or derivations would you suggest could be moved to another publication without greatly affecting day-to-day needs of most designers, installers, owners, manufacturers and researchers?
5. In your opinion, what simple equations, reference tables, sample calculations, rules of thumb and diagrams or ~~tradebook~~ technical paper references *should be added* to this chapter to meet the more frequent "I-better-look-it-up" needs of designers, installers, owners and operators?
6. Any other comments, observations or suggestions on general topics, or on specific paragraphs, sections, equations or diagrams in this chapter?

## **Appendix e. January teleconference meeting minutes**

**TAC/Handbook Committee  
Handbook Improvement Workshop  
2005 Fundamentals Volume**

**January 18, 2006 Conference Call Notes:**

Attendees:

Lew Harriman	Li Yuan	Jim Bergman
Bill F.	Roy Crawford	BeckyThompson
Tobias S.	Carl Grimes	Mike M.
Frank Eisenhower	Richard Keleher	Mark Owen
Richard Rooley	Allan Traugott	Mike Vaughn
Bill Bahnfleth	Dennis O'Neal	
Eckhard Groll	Pam I.	

Agenda:

1. Explain Purpose of Call
2. Introductions (name, affiliation, geographic location)
3. Review Objectives of Project
4. Individ. Overall Review Comments on of 2005 Fundamentals Volume
5. Nominations – 3 most important things to discuss in workshop
6. Plans going forward
7. Additional comments

Objectives: (See statement of work for project)

Checklist for Overall Review: (See page 2 &3 of Guidance document)

Individual Comments:

1. Becky Thompson: I don't reference the handbook that often now. It is often easier to ask a more experienced fellow engineer for the information. The handbook includes too much formularies and theory now. It should also include more information on ASHRAE standards. I reference Std. 62 a lot and it would be nice to have key information from this standard also included in the handbook. The structure of the handbook is hard to follow. The General Engineering section is not general. The handbook needs an easier structure to understand and it should be written with a young engineer in mind. An example of a reference that I use with a good structure is the DHS – Design Guidelines for Healthcare Facilities.
2. Li Yuan: The fundamentals volume is a great book and it includes a lot of information. Weather data is my primary use of this volume. Unfortunately, I now need to use a CD to access it. I would like to see the weather data put back into the printed volume so that we can use it on-site. I agree with Becky the General Engineering section

is not general. Why include information on environmental controls for plants and animals in the fundamentals. This seems more appropriate subject matter for the applications volume. I also noticed a lot of overlap in the volume. Why do we need separate chapters on insulation in chapters 24 & 26? We need to combine this information into one chapter. Lew asked Li if he thought the agriculture data was still needed in the handbook for use by developing countries such as China. Li responded that he had no experience in agriculture and could not offer an informed answer to the question.

3. Pam I: I agree that the published weather data is needed back in the handbook volume. Weather data is the major reason that I use the book. Lew asked what key weather data do you get from the handbook. Pam responded that she uses the weather data for load calcs. Li added that he uses it for load calcs., wind data, normal air conditions, peak dry/wet bulb conditions.

4. Allan Traugott: I also miss the printed weather data from the handbook. Degree days and percents needed back in the book as a minimum so that they can be easily referenced in the schematic stage of a project. A good compromise solution may be to publish the more common data in the book and the entire set of weather data on the CD. The handbook appears to be lacking in sustainable design information and IAQ. What information that is included appears to focus on sustainability from an energy conservation standpoint only. No information on the integrated building design approach in book for sustainability. Some pieces are included such as day lighting and thermal bridging, but no overall direction is given on how to get there. Suggest separate chapter be added on overall approach and then new section in each applicable chapter on how it relates to the overall approach. Chapters on IAQ – filtration – dilution have no tie-in to related ASHRAE standard 62, 52.1 & 2, and 90.1. No best method information is provided throughout the volume. The handbook needs more overview in each chapter / sequence of thought also.

5. Carl Grimes: First impression on handbook: overwhelmed/amazed/math beyond me. Amount of detail/references in the handbook is incredible. Questions he uses to assess IAQ: What is function of space? What is structure? What is cost? What affect on occupants. AIHA document – 80% of occupants satisfied – safe building, non-toxic. Less than that percentage, you have a sick building situation. How does the information relate to the comfort of the occupant? Ho do you bring in OA to offset pollutants? Or prioritize HVAC to conditioned air and maximize comfort. No chapter or section on how comfort relates to mechanical system. What one does to achieve overall comfort seems to be missing from book. Bell curve for general satisfaction and allowances for hyper sensitive individuals is needed. A discussion of acceptable IAQ based on building type 7 uses might be useful, e.g., hospitals need better air than office. Affect of equipment and settings on end user. Lew mentioned the frequent GSA customer satisfaction surveys and the fact that 80% complaints are related to comfort and IAQ.

6. Roy Crawford: Has a unique background that includes contributor to handbook, professor, designer, and manufacturing experience. Manufacturing is not defined as a

target audience for the handbook volume, but they use the fundamentals volume a lot. There is a common perception that the handbook is used every day, but I use it only occasionally and I try to computerize the information that I do use on a regular basis, e.g., Chapter 6 – Thermodynamics and Psychrometrics – I don't use it every day and instead use computer programs. The printed weather data, however, should be put back in volume. Some chapters in volume now are not fundamental but rather application in nature, e.g., Chapter 7 – Energy Resources – I didn't know this even existed in the handbook. Looks like a new chapter. It does not look, however, like a fundamentals chapter. It also seems to contain very dynamic and political information that should not be a handbook that is updated every 4 years. A key issue is that the handbook appears to be written by experts, who write for themselves and not the end-user.

7. Tobias Siemel: Echo Roy's comments. I use the handbook as a reference but not for daily use. I reference it for information on a new subject. Book is great. It has amazing detail. Until recently, I never went through the entire book. I noted inconsistencies between chapters in structure. Some contain are just words. It needs more practical examples. Make is easier to read with more charts and tables. There appears to be an overlap between chapters 24 & 26. And chapters 10 & 11 should not be in the Fundamentals volume at all but in the Applications volume. What can be added? What can be eliminated? Elimination of the HFC/HCFC under alternative refrigerants discussion is needed in chapter or new chapter in 2009 volume should be used to discuss alternative cooling systems and refrigerants. Fundamental understanding of different systems is needed in book.

8. Frank Eisenhower: Like CD for weather data. Sell separately or put on web with member ID. Too much theory provided in chapters 1 through 7. I was scared and intimidated by the material after reading it. If goal is to make handbook everyday reference, then design information upfront and move theory to the back. Handbook is boring without color compared to other books. I don't go to it for information now. Use instead the Carrier Design Manual, AE books from Penn State, and Sparkius(sp?). It is hard to find information quickly in the handbook. After 4 years, I have to retab the new volume for my needs. Weaknesses of book: ME out of school does not have the experience that an AE does with HVAC systems and buildings coming out of school. How to coordinate SE & EE professional on project is not covered. More business information on fee derivations is needed. Controls – I call HVAC reps now for help and don't rely on book or ASHRAE. Chp. 20 – Ref. move to Refrigeration Volume. It needs more rules of thumb for checking calcs. Fees not high for designers.

9. Richard Rooley: Australia/Malaysia another resource. Badly ordered and grouped. I suggest 8 groups instead. I will e-mail to Lew list of 8. Ordering section (chapter) better is needed. Introduction to each section is needed. Inconsistency noted across volume. The EHC chapter is unintelligible to me. Levels of use: Designer, jury, etc. Animal information should be moved to the Applications volume. The third page of handbook is inconsistent with ASHRAE bylaws and the ROB for handbook - Advancing Arts & Sciences – The statement in the book located above disclaimer is too commercial – “Dedicated to the Advancement of profession and its allied industries...” The

handbook does not tie-back to other publications for standards, guidelines, special pubs, etc. Each chapter should state all related ASHRAE standards, guidelines and publications and how they tie together. Add some key information from standards to handbook.

10. Jim Bergman: The handbook is more of a novel than a reference. You need to read it to get information out. A lot of information could be foot noted. Put most pertinent information first. Write book for liaison to field – Service Technician/Design engineer. Every chapter should be shortened. Reference the engineering data & details, formula explanation and derivation in back of the book for reference if needed. Add to book chapter on standard measurements in field. How it works in reality. Any person should get the same measurements using same methodology. Indicate derivations from design conditions and how to quantify design performance. Young engineer responsible for verifying system performance. Not easy book to reference; footnote more; not written for layman/professional engineer. It is hard to find standard formula in the book, e.g., sensible heat formula, and psychrometrics. Needs easy reference in back of book to find formula with short explanation on how to use it and where you can find derivation.

11. Mike Meteyer: Echo Rooley's comments. Need new and old engineer viewpoints reflected in fundamentals volume. In general, reorganize headings & information. There needs to be Fundamental Theory & Fundamental Applications information in the handbook. What are the fundamental applications of this information? Go back to college books or new kid you hired to get the theory. The first five chapters of the handbook belong in an engineering textbook. Thermal comfort chapter – the heat output information needs to be summarized, and footnoted. This is not practical information for designers. Look at the Fundamentals and Applications volumes side by side. Get rid of theory and seismic & wind restraint and move to Fundamentals volume basic information that any engineer needs to know. Add construction information. Sound and vibration information requires that you go to three volumes to get all the information. All of this information should be placed in the fundamentals volume. More practical examples, rules of thumb, more tabulated data, and bounds of problem or typical answers are needed. Dichotomy – Is the handbook an occasional reference or a daily reference tool?

12. Richard Keleher: Noticed that all chapters are assigned to a TC. What is the role of this review panel? Lew explained how ASHRAE handbook is currently developed. Overview of handbook from architect: Delete 19 of the chapters. Leave climate data in the printed handbook. It needs a chapter on integrated design at the beginning of the book. Richard will send an e-mail to Lew indicating the 19 chapters to delete out of total of 40 chapters. Delete equations and add more tables and graphs. Chapter is needed on computer programs used for energy calcs. Each chapter needs an overview section. Ventilation chapter – Don't know what point is. CO2 monitoring & RH control. Over-sizing equipment and associated problems.

### Three Most Important Things to Discuss in Workshop

1. Reorganize chapters within volume.



2. Restructure each chapter, provide overview section, add rules of thumb, eliminate equations, and add more tables and graphs. Each chapter should be consistent in structure and depth.
3. Incorporate key information from ASHRAE standards into handbook.
4. Quick reference charts are needed.
5. Add information on integrated design to handbook.
6. CO2 monitoring. Clarify fresh air.
7. Indicate other ASHRAE related publications and standards in appropriate chapters.
8. Improve handbook format so that it is more visually friendly.
9. What is a handbook versus a textbook or manufacturer's manual?
10. What is Fundamentals?
11. Who is the handbook written for?
12. What is intent of handbook?
13. What should be in it?
14. What is the style and content of each chapter?
15. What is meaning of equation? What is ultimate purpose and how do we know we have reached our purpose? Are we optimizing equipment or are we optimizing end user comfort & safety?

Additional Comments from Lew:

- Workshop April 22 & 23 – May get together socially in evening of 4/21 also.
- Indicate to Mike Vaughn ASAP if you have a chapter review assignment preference.
- Reviews can be done at any depth or level of understanding that you are comfortable with. Goal is to get general and detailed comments on each chapter.
- We will send WORD template for comments to all reviewers.
- Completed reviews due back to Mike V. by April 2.
- Encourage volunteers with your comments on what they did well also.
- Plan to leave Atlanta on April 23 at 2 p.m. or later.

## Appendix f. Chapter reviews

Beyond the general suggestions, the workshop participants were each assigned to review four chapters in detail. The resulting comments and suggestions are provided as an appendix to this report, arranged for easy distribution to the TC's concerned with each chapter.

The depth and detail of these comments varies widely. They represent the individual opinions of each reviewer. It was simply neither practical for all participants to read all chapters nor practical for the group to discuss all comments and arrive at a consensus on each chapter. Nevertheless, we expect the TC's will find many of these comments useful and in some cases, thought-provoking.

All workshop participants came away impressed with the volume, depth and quality of the information. Consequently, we ask the hard-working volunteers who produce the chapters to keep our great admiration in mind as they read through our suggestions, which may not always be worded in a way that reflects our underlying awe of their great effort and superb accomplishments!