HVAC Systems: Understanding The Basics

SMACNA & SMWIA
2006 Partners In Progress Conference
Las Vegas/March 30, 2006

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“... the most reliable way to anticipate the future is by understanding the present.”

John Naisbitt

Megatrends
21st Century Buildings

- Purpose of a building is to provide a controlled environment for occupants.
- Building is a collection of systems that provide a controlled environment.
- Systems’ integration is the key to effective and efficient building operations.
- Buildings will be optimized as a system.
- Traditional approach: optimize building subsystems leaving building suboptimal.
- Building quality will be measured by its ability to efficiency support the activity it houses - not its utility bills.

*HVAC Systems Establish Environment*
Sustainable Construction
LEED: Energy & Atmosphere

EA P1  Fundamental Building Commissioning
EA P2  Minimum Energy Performance
EQ P3  CFC Reduction In HVAC&R Equipment
EA C1  Optimize Energy Performance
EA C2  Renewable Energy
EA C3  Independent Commissioning
EA C4  Ozone Protection (No HCFCs)
EA C5  Ongoing Measurement & Verification

*Example HVAC System Related Prerequisites & Credits*
# Sustainable Construction

**LEED: Indoor Environ Quality**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>EQ P1</td>
<td>Minimum IAQ Performance</td>
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<tr>
<td>EQ P2</td>
<td>ETS Control</td>
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<tr>
<td>EQ C1</td>
<td>Carbon Dioxide Monitoring</td>
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<tr>
<td>EA C2</td>
<td>Ventilation Effectiveness</td>
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<td>EA C3</td>
<td>Construction IAQ Management Plan</td>
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<td>EA C5</td>
<td>Indoor Chemical &amp; Pollutant Source Control</td>
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<td>EA C6</td>
<td>System Controllability</td>
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<tr>
<td>EA C7</td>
<td>Thermal Comfort</td>
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*Example HVAC System Related Prerequisites & Credits*
Building Integrated Photovoltaics

Doxford Office Park, England (www.solarcentury.co.uk)
Smart Vision Glass

Photos by Research Frontiers, Inc. (www.smartglass.com)
ZigBee (IEEE Std 802.15.4) Wireless Bldg Controls

Self-Organizing, Self-Healing Mesh Network
“Motes” = Smart Sensors

- Tiny, self-contained, battery-powered sensors and computers that use rf technology to communicate and exchange data with one another.
- Able to self-organize into ad hoc networks to form wireless sensor networks.
- Use TinyOS.
- Applications in agriculture, structure monitoring, industrial controls, military, security, etc.

UC Berkeley “Smart Dust” Prototype

Smart (RFID) Tags

- Passive
- Active
Mitsubishi “iGlassware”

Mitsubishi Electric Research Laboratories (MERL)
http://www.merl.com/projects/iGlassware/

How it Works...
System monitors fluid level of glasses through wireless connection and alerts wait staff when to ask for new drink order.
Integrated Automation
Open Architecture Control Systems: LonMark & BACnet

Security & Life Safety

● Available Today:
  – Surveillance Cameras
  – Bomb Sniffers
  – Basic Biometrics
  – Chemical & Bio Detectors

● Coming Soon:
  – Millimeter Wave Cameras
  – Vein Maps

● Under Development:
  – Remote Iris Tracking
  – Ears & Gaits
  – Odor Sensors
  – Saliva Scans
  – Universal Sensors

Intelligent Building

Building that provides a productive and cost-effective environment through the optimization of its structure, systems, services, and management as well as the interrelationships between them.

Words For Today ...

Convergence & Interoperability

SMACNA/SMWIA New Role: System Integrator
HVAC Systems: Understanding The Basics

Manual Objective

Provide a practical guide to HVAC systems including equipment and controls that will assist project personnel in the marketing, estimating, design management, procurement, installation, commissioning, and maintenance of HVAC systems.

Systems Approach To HVAC
HVAC Systems: Understanding The Basics

Target Audiences

- HVAC Contracting Firms:
  - Project Managers
  - Project Engineers
  - Estimators
  - Superintendents & Forepersons
  - Others

- Construction Programs – Colleges & Universities:
  - Engineering (Construction Emphasis)
  - Construction Science, Management, & Technology
  - Other Related Academic Programs

- General Contractors & Construction Managers

This Is Not A Design Manual
HVAC Systems: Understanding The Basics

How Will This Manual Be Used?

- Chapter Education Program
- Self Study
- Reference
- College Text
- Combination
HVAC Systems: Understanding The Basics

HVAC Systems Applications

I Introduction
II Basic HVAC Systems
III HVAC Control Systems
IV Multizone Systems
V Dual-Duct Systems
VI Terminal Reheat Systems
VII Variable Air Volume Systems
VIII Induction & Induction Reheat Systems
IX Special Applications
X Hydronic Systems
XI Unitary & Heat Pump Systems
XII Cooling/Refrigerant Systems
XIII Hydronic Heat Recovery Systems
XIV Engineering Data, Tables & Charts

HVAC Systems: Understanding The Basics’ objective is to complement existing HVAC Systems Applications.
HVAC Systems: Understanding The Basics

Issues Addressed In Manual

- HVAC System Operation:
  - System
  - Equipment
  - Controls
  - Relative System Cost & Life-Cycle Economics

- Fabrication & Installation Issues:
  - Cost Estimating
  - Procurement
  - Scheduling
  - Sequencing (Fragnets)
  - Productivity
  - Other

- Commissioning & Closeout (TAB, LEED, Etc.)
HVAC Systems – Understanding The Basics

Table Of Contents

1 Introduction To HVAC Systems
2 HVAC Operating Characteristics
3 HVAC System Types
4 HVAC Piping Systems
5 HVAC Air Distribution Equipment
6 Central Heating & Cooling Equipment
7 HVAC Instrumentation & Control
8 HVAC Equipment Installation
9 Special HVAC Systems & Equipment
10 HVAC System Commissioning & Closeout
HVAC Systems – Understanding The Basics

Manual Format

- Conventional Paper-Based
- SMACNA Publication References
- Problems
- Case Studies
- PowerPoint Slides

Possible Electronic Format With Hyper-Linked Topics
Questions?