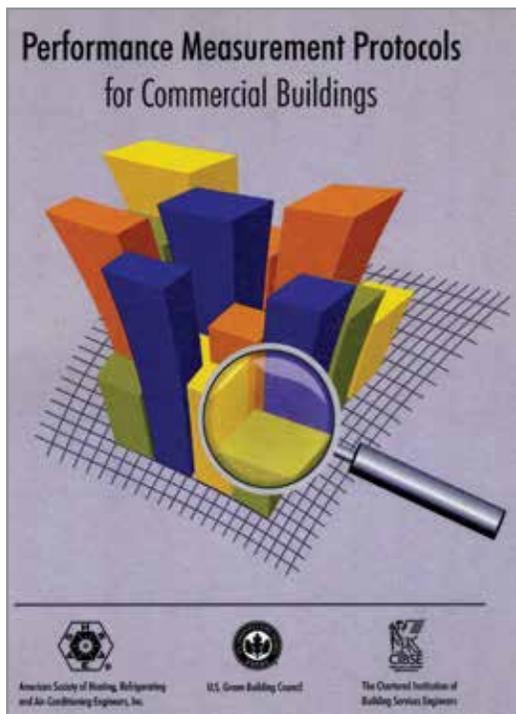


Conformance of SSA's **SpatialOperations** Product with ASHRAE's Performance Measurement Protocols for Commercial Buildings



Under ASHRAE's Special Project 15, a team that included staff from the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the U.S. Green Building Council (USGBC™) and the Chartered Institution of Building Services Engineers (CIBSE) collaborated to produce a document entitled **Performance Measurement Protocols for Commercial Buildings (PMPCB)**. Published in 2010, this document attempts to address a need to establish standardized performance goals and techniques for measuring six performance characteristics for commercial buildings:

- » Energy Utilization
- » Water Utilization
- » Thermal Comfort
- » Indoor Air Quality
- » Lighting Characteristics
- » Acoustical Characteristics

Each of these performance characteristics is discussed in the publication and protocols are established for monitoring buildings at three different levels of detail—**Basic**, **Intermediate**, and **Advanced**. These protocols were compared to the measurement approach and analysis/reporting functionality found in the SpatialOperations product.

Energy

According to the PMPCB, buildings in the U.S. are responsible for over 40% of the total energy use in the country. Half of this, or about 20%, is consumed by commercial and institutional buildings. Estimates for potential savings of 30% of that total, or nearly 7% of the total energy use in the country, can be achieved through judicious monitoring and adjustment of operational characteristics of these facilities. According to the joint document: *"Additional metering in and of itself saves no energy. However analysis of the data often available only from advanced metering is needed to provide the information that allows building owners and operations staff to make informed decisions about how to improve or best operate mechanical/electrical systems equipment so as to potentially achieve energy savings. Measurement and analysis are also needed to verify energy savings achieved."*

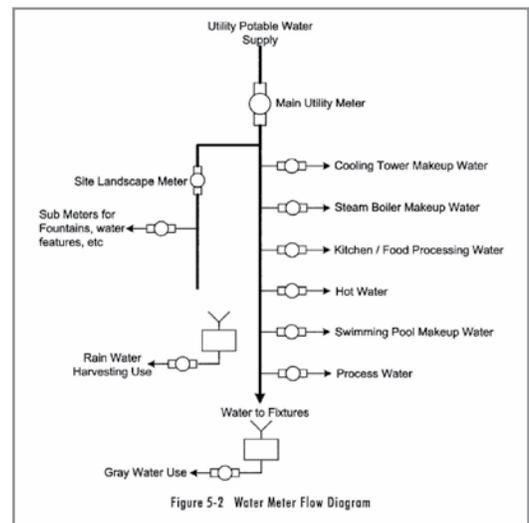
SSA's SpatialOperations product provides for such advanced metering, analysis, and reporting at whatever level the building owner desires, and provides information in a clearly understandable and timely manner to provide for the desired level of management oversight. The PMPCB suggests that the energy use of buildings be measured, and that the Energy Use Index (EUI) be calculated on an annual basis and compared to similar buildings. Table 3.3a of the PMP-

CB (pages 56-57) provides guidance as to what acceptable EUI values are for a variety of building occupancy uses. The SpatialOperations product provides this EUI metric as part of its standard reporting function. SpatialOperations also provides the ability to automatically calculate the Electrical Load Factor (ELF) as defined in the PMPCB. When configured for advanced monitoring, SpatialOperations allows for the calculation of Electrical End Use Intensities for comparison with tables 4-1a and 4-1b in the PMPCB, and can provide inputs to the whole building calibration simulation models described in the publication.

Water

According to the PMPCB, *“The best way for a building operator to lower water usage is to continuously monitor the building’s water usage and compare past readings with present readings to see if the reduction strategies are working. To do this, usage should be measured for as many separate end uses as practical.”* The protocol establishes building, landscape, and wastewater monitoring approaches and provides guidelines as to the targeted level of water usage based on the operational characteristics of the facility.

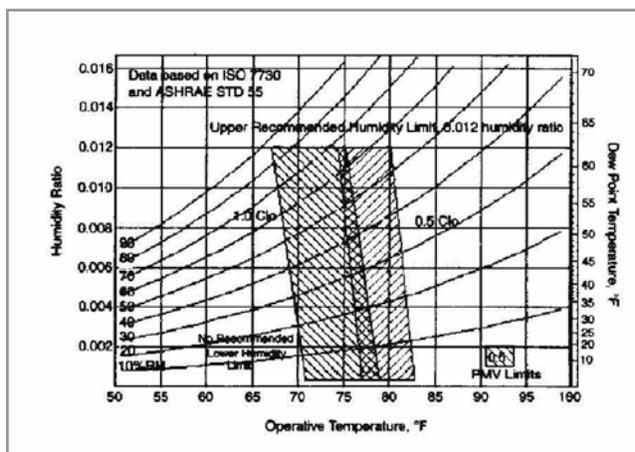
The PMPCB suggests tracking water use in as much detail as possible, and comparing the use against the Water Use Indices (DOE FEMP) listed in Table 3-4, page 61. For a variety of building use types, this table specifies target water use in terms of gallons per day per person or its equivalent based on the building use. The SpatialOperations product provides for monitoring of water consumption at whatever level of detail the building owner/operator desires (as depicted on the adjacent figure 5-2 taken from the PMPCB), and has the ability to analyze/report on usage characteristics for use in comparison to the DOE FEMP criteria, and to compare to the Daily Water Consumption standards from Table 5-3 of the PMPCB.



Thermal Comfort

As stated in the PMPCB: *“The heating and cooling of buildings significantly contributes to global energy consumption and carbon emissions. It is the largest component of energy consumption in buildings, accounting for 20% of total national energy use in the U.S. However, this large expenditure of energy does not always produce a comfortable environment for occupants. Office workers report thermal comfort to be a primary source of dissatisfaction with their buildings.”*

The protocol goes on to say that *“future buildings must have comfort-performance feedback—the sensing of physical indoor environmental data, collection of occupant responses, and evaluation of the thermal comfort performance against standardized benchmarks. . . . Physical measurements should be continuous, ideally obtained with sensor systems permanently installed in the building.”*



In the U.S., ASHRAE’s Standard 55—Thermal Environmental Conditions for Human Occupancy—is the established guide for what the measured characteristics should be. The adjacent chart, taken from that standard, indicates acceptable temperature ranges for a variety of humidity conditions.

The SpatialOperations product gathers thermal information within the building either from the building's HVAC control system or from independently installed monitors at whatever level of detail is requested by the client. The analysis and reporting functionality of SpatialOperations then reports to the owner/operator on whether the thermal conditions within the facility are being met in conformance with this standard. Since, like all other readings, the reported temperatures are stored in a permanent database, SpatialOperations provides the ability to analyze temperature readings over a short or long period of time, and compare these readings with outdoor weather conditions and energy consumption data during the same time period.

Indoor Air Quality (IAQ)

The PMPCB states “Good IAQ requires control of contaminants in the air supply. ... The purpose of performance measurement is to verify that efforts to limit indoor air pollutant concentrations are working”. ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality, defines “acceptable indoor air quality” as “air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which the substantial majority (80% or more) of the people exposed do not express dissatisfaction.” ASHRAE 62.1 provides two mechanisms for attempting to ensure adequate IAQ—minimum ventilation rates and ongoing measurements of pollutants. Ventilation rates can be monitored by measuring air flows in the building exhaust system and comparing those rates against the established standard, however this procedure assumes uniform exhaust throughout the building and may not provide adequate assurances of individual space IAQ without supplemental monitoring and control systems. Typical pollutants that are measured include carbon dioxide (CO₂) and Volatile Organic Compounds (VOCs). While not addressed in the PMPCB, another common factor associated with IAQ is the humidity level within the building.

The SpatialOperations product allows for monitoring of all of the IAQ parameters mentioned in the PMPCB along with humidity levels, similar to the monitoring of temperature. The number and placement of monitors is up to the building owner/operator. Monitoring is continuous and the data is stored in a permanent database, available for analysis and reporting on demand.

Lighting Characteristics

Lighting is divided into two components—day lighting and artificial lighting. Day lighting refers to the availability of light from natural sources outside the building. Artificial lighting refers to the availability of lighting from engineered sources. In general, acceptability of lighting is measured based on the light intensity (lumens) available at specific work locations and on the presence of glare that would inhibit comfortable use of lighting for reading or other work.

Normally, lighting (and acoustics) are not given the same level of attention that energy, water, thermal, and IAQ characteristics are afforded. Nevertheless, the USGBC awards credits for adequate consideration of the use of day lighting. Further, many of the most popular energy conservation techniques involve replacement of existing lighting fixtures with more energy efficient fixtures or replacement of standard switches with motion detection enabled devices to automate turning off lights when a space is not being used.

SpatialOperations can incorporate lighting level sensors in as many spaces as are requested by the owner/operator, and like the other sensors, can monitor lighting characteristics on a continuous basis, providing a means to analyze and report characteristics of lighting throughout the facility.

Acoustical Characteristics

According to the PMPCB, of all the indoor characteristics surveyed in a recent study, the factor with the greatest occupant dissatisfaction is acoustic performance, which includes both noise and speech related issues. The PMPCB states “the building's acoustical environment is made up of internal sound contributions from occupant conversations, HVAC equipment, electrical equipment, and plumbing systems as well as from external sounds penetrating the

building envelope. In most commercial buildings, the key issues relate to worker productivity and confidentiality of sensitive information; these can be expressed in terms of background noise, annoyance and distraction, reverberation time, speech intelligibility, and speech privacy.”

The decibel notation system is used to compress the range of audible sound to a workable scale. Devices are available that will measure instantaneous sound levels at a given location. Spatial Systems has not identified permanently installed monitoring technology to track background, instantaneous noise levels, or reverberation time on a continuous basis, but when the technology becomes available it can be integrated into our SpatialOperations product. In the meantime, the software includes the ability to take readings on demand at any location in the facility, to store that data, analyze, and report on demand based on the needs of the owner/operator for comparison with the recommendations stated in table 9-1 of the PMPCB.

Summary

The PMPCB establishes a standard protocol for measuring six characteristics of the sustainability level of commercial buildings. The SpatialOperations product provides a flexible and comprehensive tool that allows building owners/operators to monitor and evaluate individual buildings or campus environments for conformance with these protocols at whatever level of detail the client desires. Further, because it is modular, additional detail can be added to the monitoring system at any time based on the client’s need for additional information.

SpatialOperations also offers incorporation of space allocation information, equipment and furniture inventory, the inclusion of as-built building record data, and subsystems that are not part of the PMPCB protocol such as computer network cabling, HVAC infrastructure, electrical system infrastructure, water system infrastructure, site development data, fire protection subsystem, etc. A spatially-enabled Facility Management Information System (FMIS), SpatialOperations, is a single system for capturing information, managing information, and analyzing and reporting operational characteristics of your facility.



FOR MORE INFORMATION

For additional information on the SpatialOperations product or to arrange for a live demonstration, please contact Spatial Systems Associates.

