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National Institute of Building Science Hearing on Data Needs to Achieve High Performance Buildings
July 18, 2011

Thank you for this opportunity to speak on behalf of the Architects/Engineers community regarding Data Needs to Achieve High Performance Buildings. My name is Teresa Rainey and I am the leader of the Sustainable Engineering Studio of Skidmore, Owings & Merrill's Washington, DC office.

Background – Reference Codes and Design Criteria

As a design engineer, I am held responsible for meeting minimum design requirements dictated by building codes, Federal Mandates, or LEED requirements.

The International Code Council (ICC) publishes the International Codes which prescribe the minimum standards for the safety and performance of the built environment. The International Energy Conservation Code (IECC) adopts ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings as a compliance option. Currently, The IECC is adopted in 42 states and Washington, DC making ASHRAE 90.1 the predominant energy standard in the United States.

The ICC also publishes a green code standard, the International Green Construction Code (IgCC). The 2010 IgCC adopts ASHRAE 189.1 – Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings as a compliance option.

Federal Mandates including the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding, the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, Executive Order 13423 and Executive Order 13514 require building performance that exceeds minimum ASHRAE 90.1 code requirements.

USGBC's LEED® 2009 for New Construction and Major Renovation also requires a building's performance to exceed the minimum ASHRAE 90.1-2007 requirement. Energy and Atmosphere Prerequisite 2 requires new construction projects to exceed ASHRAE 90.1 by 10% energy cost and major renovation projects by 5%. Credits are earned when the project exceeds 12% for new construction and 8% for major renovation projects.

In addition to energy performance requirements, the Federal Mandates address Water Efficiency and Renewable Energy generation requirements. Water efficiency requirements include the reduction of potable water use for building standard plumbing fixtures and landscape irrigation. Renewable energy requirements focus on increasing renewable energy

generation sources. Each Mandate increases performance requirements, however the comparison metric is not necessarily consistent.

Energy Targets as defined by the Federal Leadership Guiding Principles, EPAct 2005, and LEED 2009 are established as a comparison to a minimally code compliant building prescribed by ASHRAE 90.1. EPAct 2005 requires a comparison of energy consumption reduction from a baseline ASHRAE 90.1-2004 minimally compliant building, but plug/receptacle energy consumption is *excluded*. LEED 2009 requires a comparison of energy cost reduction from a baseline ASHRAE 90.1-2007 minimally compliant building and plug/receptacle energy costs are *included*.

The Energy Independence and Security Act (EISA) of 2007 described a new type of comparison. EISA states that New Federal Buildings shall be designed so that the fossil fuel generated energy consumption is reduced as compared with the energy consumption by a similar building in FY 2003 as measured by the Commercial Building Energy Consumption Survey (or CBECS), by the percentage specified in the following table.

"Fiscal Year	Percentage Reduction
2010	55
2015	65
2020	80
2025	90
2030	100.

And Executive Order 13514 Section 2(g)(i) states beginning in 2020, and thereafter, ensuring that all new Federal buildings that enter the planning process are designed to achieve zero-net-energy by 2030.

Data Needs for Achieving High Performance Buildings

The next generation of Energy Targets is no longer a comparison to a minimally code-compliant building. The new target is the building's actual Energy Use Intensity or EUI measured in kBtu/sf. So, the question we in the design industry are asked is what is the "benchmark" building EUI and what is the appropriate high-performance building target? Additionally, what are the benchmark targets for water use or on-site renewable energy generation?

SOM has reviewed the CBECS data as it relates to projects we are currently working on since they are all Federal projects that require compliance with EISA 2007. The projects include a major Healthcare campus, a 24-hour office building, a Museum, and a 24-hour call center. What we found is summarized in this chart:

- Approximately 95% of the buildings are less than 50,000 SF
- 0.1% of the buildings are hospitals
- No buildings classified as Museum are listed
- 0.09% of the buildings are open continuously

The data is insufficient to properly understand if our design complies with the EISA 2007 requirements.

We also learned there are gaps in design information that greatly affect the energy model results for predicting actual energy use intensity. These gaps are not as problematic when a comparative analysis is being conducted. But when the goal is to predict a building's EUI, the results can vary significantly. For example, we recently performed an energy model analysis for a 120,000 SF building. The owner requirements stated to provide a 4 W/sf plug load allowance. The lighting power density was assumed to follow ASHRAE 90.1 for typical office and the schedules followed the DoE Benchmark Building schedules for typical office, which is based on ASHRAE 90.1-1989.

We first ran the model following the ASHRAE 90.1 plug load schedule and the results show the building's EUI slightly over 100 kBtu/sf per year. We then ran a second model following the client's anticipated plug load schedule – which included more diversity associated with these loads. The result was an EUI at approximately 65 kBtu/sf per year. The difference between these models clearly shows a need to better understand the actual end use consumption of plug loads in buildings.

I am aware of several potential sources of data that could be incorporated into a larger database.

- LEED 2009 Minimum Program Requirements #6: requires that all certified projects must commit to sharing whole-building energy and water usage data for a period of at least 5 years.
- EPA's Energy Star Portfolio Manager: this is a tool building managers use to track energy and water consumption.
- New York Greener, Greater Buildings Plan – Local Law 87 passed. Requires energy audits for existing buildings greater than 50,000 SF. An audit is required every 10 years.

- San Francisco Existing Commercial Buildings Energy Performance Ordinance: Requires existing buildings greater than 50,000 SF to meet an ASHRAE Level II Audit. Buildings less than 50,000 and greater than 10,000 SF must meet ASHRAE Level I Audit. EPA's Energy Star Portfolio Manager is to be used to track energy use.

Data that is needed to inform the Energy and Water consumption targets include

- Increase Building Performance Database
    - Building Size – buildings greater than 50,000 sf
    - Building Primary Activity Type
        - Museums
        - Hospitals
        - Laboratories
        - Data Centers
        - Call Centers
- Energy Consumption Data broken down by End Use
    - Plug/Process loads
    - Lighting power
    - Mechanical equipment
- Data on Water use
    - Building plumbing fixtures use
    - Process water – cooling tower makeup water, laundry, food service
    - Landscape irrigation

Data Needed to Aid Design

- Database of common Energy Conservation Measures (ECMs) by climate zone and building type
    - Energy savings impact
    - Lifecycle cost
- Database of Water-saving technologies and strategies
    - Water savings impact
    - Lifecycle cost
- Weather file data to include rainfall amounts by month
    - Currently just a flag if there is rainfall
- Weather file data to include measured solar data
    - Data is generated by a computer algorithm

Recommendations

I recommend that a central repository for existing building information databases be created. One organization should be responsible for co-locating data that is currently being collected by EIA, LEED, EPA Energy Star, NY Local Law 87 and SF Existing Commercial Buildings Energy Performance Ordinance into this central database. The National Institute for Building Science (NIBS) is the recommended organization to hold this responsibility. It is also recommended that NIBS create a means for the individual organizations to gather and enter the data in a manner such that refined end use consumption can be easily extracted.

It is recommended that rainfall amounts and solar data be measured and collected and included in weather file data.

And finally, I recommend engaging the Energy Service Contract companies to participate in sharing/collecting data on the energy saving impacts and associated lifecycle costs of Energy Conservation measures by climate zone and building type. Similarly, data on water saving impacts and associated lifecycle costs of water conservation measures by climate zone and building type should also be shared/collected. This data base will provide designers a valuable reference source for appropriate, cost-effective energy and water saving strategies for their building type in specific climate zones.