

Commercial Building Construction Characteristics: An Assessment of National Current Practice and Energy Code Compliance

Understanding energy use in the current building construction practice is vital before effective energy standards and state energy codes that meet the Energy Policy Act can be adopted. A study that assessed the energy-related characteristics of over 160 buildings planned for construction in and after 2001 showed that the majority of newly constructed commercial buildings in the United States already meet or exceed the ASHRAE/IESNA 90.1-1989 standard for envelope requirements. At least 2/3 of these meet the 90.1-1999 standard as well. Similarly, the buildings meet or exceed the 90.1-1989 standard for lighting requirements, and approximately 10 to 25 percent of these also meet the 90.1-1999 standard.

Dataset Origin and Format

The Building Energy Codes Program (BECP) at the Pacific Northwest National Laboratory (PNNL) developed the detailed National Commercial Construction Characteristics (NC³) dataset as a data source to answer energy- and code-related questions. Originally, the dataset was intended to address current commercial lighting technology, but the benefits of collecting building characteristics beyond lighting and square footage were quickly realized. BECP then launched an effort to create a current practice dataset of new construction. It attempted to include all characteristics available from building plans and specifications that would support analyses and building modeling needs.

At the same time, BECP prepared a list of building types of interest that corresponded to those used in ASHRAE code development work and the widely used CBECS data sources. The match with CBECS data sources would allow leveraging specific CBECS data as enhancements to the NC³ dataset.

BECP also acquired 200 sets of plans and specifications and used the DodgeView software tool developed by F. W. DODGE to develop detailed characterizations of the energy and construction features of each building. Various tables of data were linked and entered in a flexible table array format using the Microsoft Access Database tool.

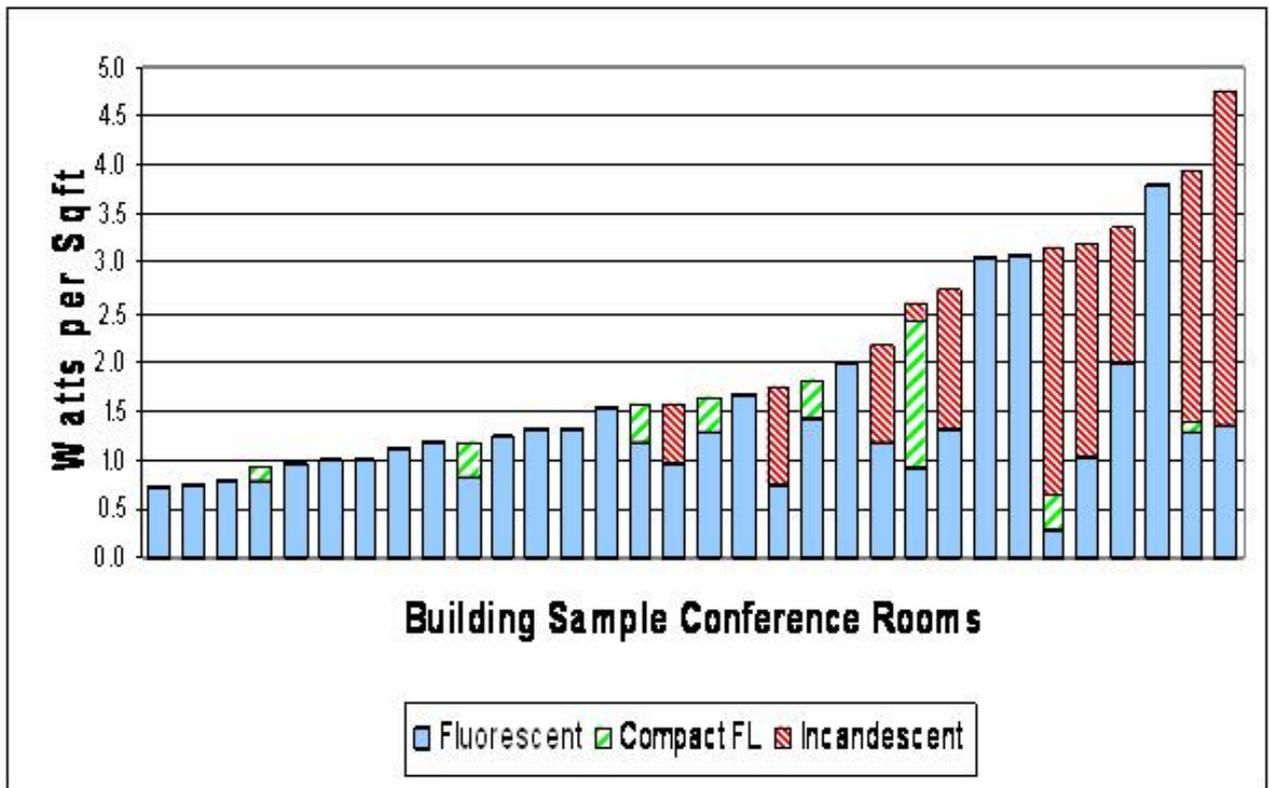
Building Characteristics Data Collection

The buildings were selected with the following general guidelines in mind:

- Choose new buildings, not just remodels
- Avoid building types of mixed categories
- Not extremely small -- buildings smaller than 1,000 to 2,000 square feet may not reasonably represent complete buildings of a building type
- Not extremely large -- buildings over a half million square feet may not exhibit fundamental differences from those in the 100,000 square foot range and would require the same effort as 2 or 3 smaller buildings
- Distributed randomly across the nation

Engineering students working for BECP created a set of extraction procedures to ensure reasonable consistency within the data. During the summer of 2002, they also conducted an extensive set of quality assurance checks on the approximately 60,000 data points currently in the database. The quality assurance effort resulted in a dataset sample of 162 commercial buildings representing 12 general building categories. For some building types such as office and retail, the sample sizes were large enough (approaching 30) to have statistical validity on a national basis, but others needed additional numbers to represent more than an idea of the current practice.

Dataset Capabilities

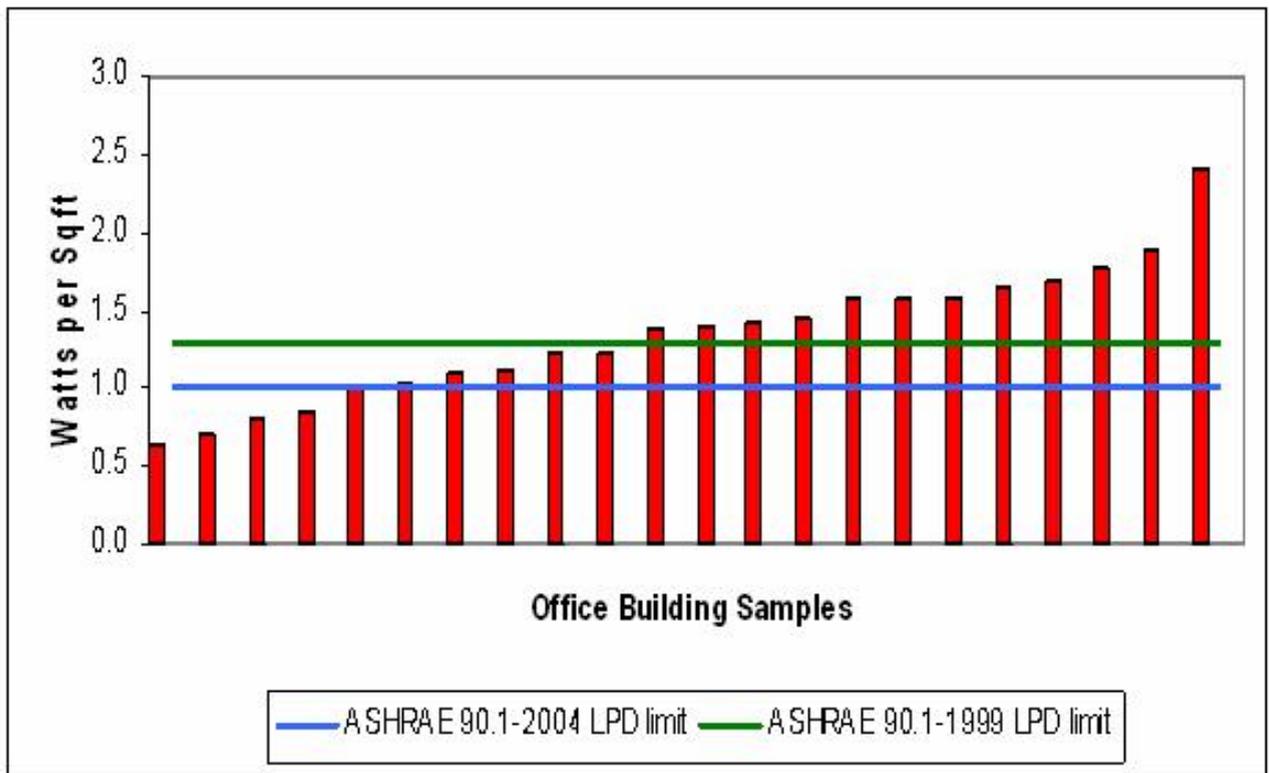


The power of the dataset is its ability to present collected characteristics that can be sorted to identify common practices, trends by weather location, and lighting power density by building, space, and technology as well as potential code compliance. Another noteworthy capability is representing specific space type lighting densities by their individual technologies (see Figure).

National Energy Code Compliance Comparison

The data for each building sample were processed through [COMcheck](#) (an energy compliance software tool developed by BECP) to obtain percentage compliance readings with various levels of national code compliance. Because the ASHRAE/IESNA standards and other national codes are "minimum standards" and not advanced design guides, it was expected that some new buildings would naturally be designed above these standards. This reinforces the idea that buildings can be designed above code requirements without any apparent hardship.

Conclusions



For most of the buildings in the dataset, the older 90.1-1989 code was in effect at the time of design and this seems to have had a slight influence on their compliance compared to the newer 90.1-1999 requirements, as these buildings generally complied by the biggest margins. Office buildings showed a mixed level of compliance (see Figure). More than half failed the current 1999 standard, indicating that office lighting will need to be considered more closely by designers and builders to meet modern energy codes. Dining facilities were in the worst position for meeting future code lighting levels, suggesting redesigns.

A future step for analysis would be to investigate problem building types and evaluate individual space types for changes to assist in meeting code levels. The dataset is structured to provide space type level lighting data that could support this.

Additional Resources

If you are interested in using the data from the NC³ database please contact techsupport@becp.pnl.gov.