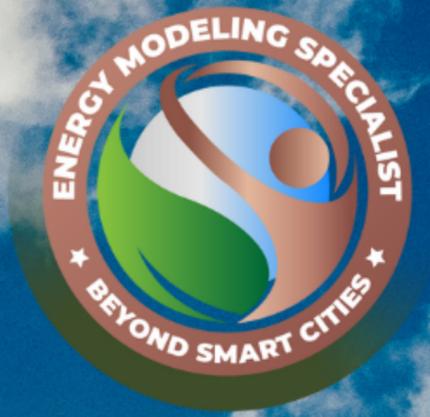




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APPLICATIONS OF ENERGY MODELS FOR BUILDINGS

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MODULE
L3

Compare a Simulation to Measured Data

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APPLICATIONS OF ENERGY MODELS FOR BUILDINGS

In building energy modeling (BEM), accurate predictions of a building's energy performance are crucial for effective design, operation, and management of energy consumption. Guideline 14 provides a framework for comparing simulation results to measured data to validate models, identify discrepancies, calibrate models, and ensure that energy simulations reflect real-world performance.

Learning Objectives

- Introduction and Course Outline
- **Compare a Simulation to Measured Data**
- Modeling Energy Performance
- Evolution of Simulation Techniques
- Baseline Building Models
- Communicate Analysis Results
- Collaborate Within Project Teams
- Applications of Energy Models for Building
- Case Study: Application of BEM
- Summary and Resources
- BEMP Practice Test V.5.1



INTRODUCTION

- Importance of accurate predictions for effective energy consumption management.
- Guideline 14 provides a framework for comparing simulation results to measured data.
- Data collection, normalization, and statistical methods are used to validate models.
- Visual assessment helps identify patterns, trends, or biases.
- Calibration adjusts model parameters to align simulated outputs with measured data.
- Calibration is an iterative process requiring multiple simulation cycles.
- Model validation against a separate dataset ensures improvements in prediction accuracy are not coincidental.
- Integration of calibrated building-specific data enhances model reliability.

BUILDING ENERGY MODELING OVERVIEW

- Building energy modeling (BEM) requires accurate predictions of a building's energy performance.
- Guideline 14 provides a framework for comparing simulation results to measured data to validate models.
- The primary objective is to ensure the reliability and accuracy of energy models.
- Comparison procedures include data collection, normalization, statistical analysis, and visual assessment.
- Calibration process includes identifying parameters, using calibration software, iterative process, and validation.
- Integration of calibrated building-specific data enhances model reliability.
- A commercial office building model showed significant discrepancies, leading to improved simulation output.
- Validation and refinement of energy models are crucial for achieving energy goals.



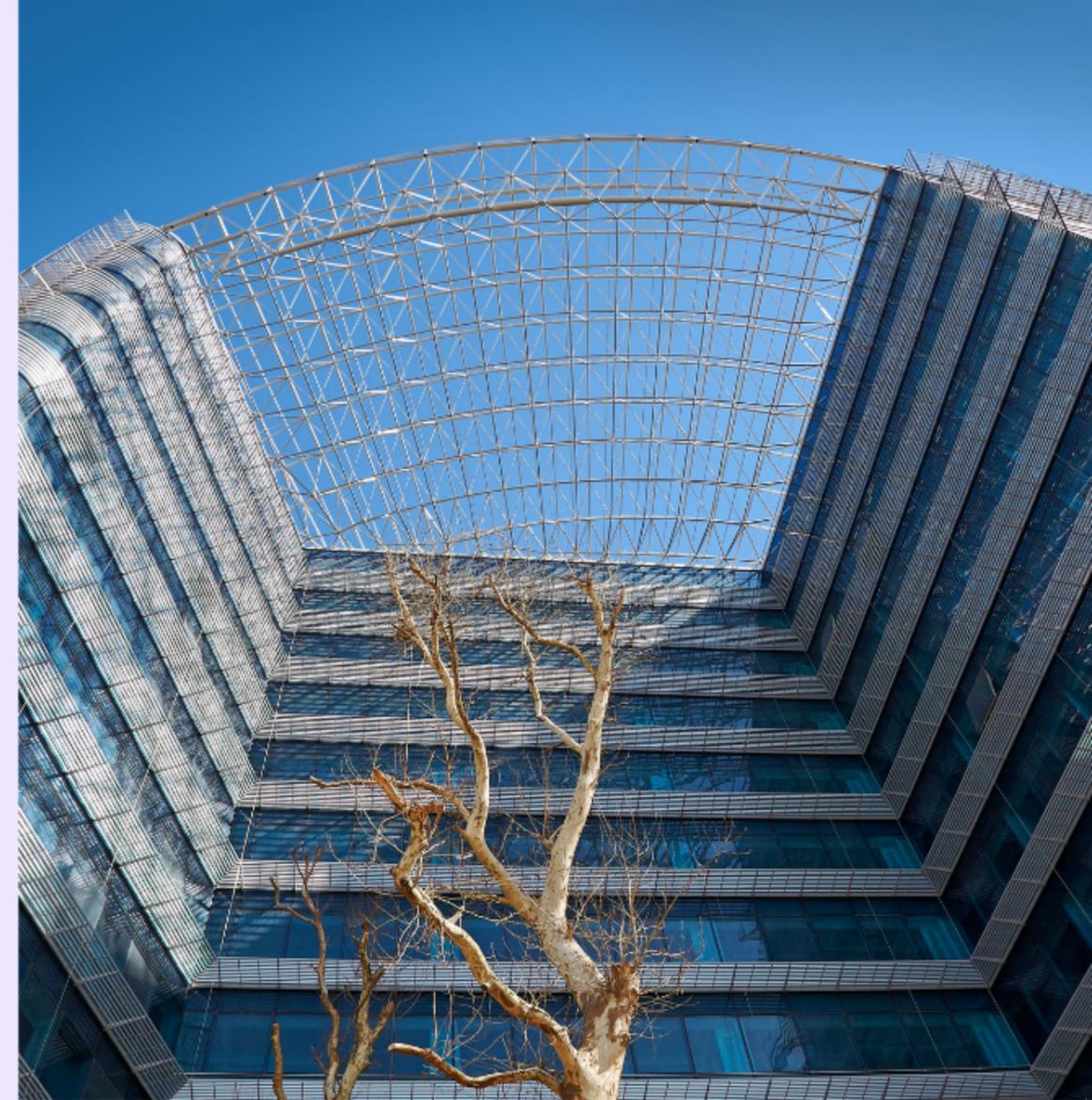
GUIDELINE 14 OVERVIEW

- Developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), it provides a framework for assessing and validating the accuracy of BEM simulations.
- Sections 4 and 5, along with Annexes B and D, address methodologies and statistical models necessary for comparing simulated results with measured data.



STATISTICAL MODELS FOR COMPARISON

- Mean Bias Error (MBE): Measures the average bias in the simulated data compared to measured data.
- Root Mean Square Error (RMSE): Quantifies the dispersion of prediction errors and is useful for understanding the accuracy of predictions.
- Coefficient of Variation of the Root Mean Square Error (CV(RMSE)): Provides a normalized measure of the RMSE and allows for a direct comparison across different datasets or scales.



PRACTICAL APPLICATION OF STATISTICAL MODELS



- Data Collection: Gathers comprehensive measured data from the building operation.
- Simulation Execution: Runs the BEM software to produce simulated energy consumption results.
- Statistical Analysis: Evaluates the differences between simulated and measured data.
- Model Calibration: Adjustments may be made to the BEM assumptions or parameters based on the statistical analysis.

Data Presentation and Reporting Requirements

- Annex B: Provides guidelines for effectively presenting the results of the comparison.
- Annex D: Outlines the requirements for reporting the comparison results.



COMPARISON OF SIMULATION TO MEASURED DATA: CALIBRATED BUILDING-SPECIFIC DATA

- The process of comparing simulation data to measured data is crucial in building performance evaluation.
- Accurate assessment and calibration of simulations against real-world data enhances operational efficiency and compliance with energy codes and standards.



Role of Calibration in Building Simulations

- Calibration involves adjusting a simulation model to align with measured data from a specific building.
- The calibration process includes data collection, initial simulation, comparison and adjustment, and validation.

IMPORTANCE OF MEASURED DATA

- Measured data serves as the benchmark against which simulations are evaluated.
- Types of calibrated, building-specific data include forensics, utility bills, and Measurement and Verification (M&V).
- Forensics investigates energy use patterns, utility bills provide a means of assessing energy use, and M&V is a systematic approach to quantifying energy savings.



CASE STUDY EXAMPLE



- A commercial office building used energy simulation software to evaluate energy conservation measures.
- The model initially predicted an annual electricity consumption of 1,000,000 kWh based on default parameters, but actual consumption was approximately 850,000 kWh.
- Adjustments made to calibrate the model included adjusting occupancy profiles, updating HVAC efficiency, and incorporating weather data.

CONCLUSION

- The comparison of simulation results to measured building-specific data is a fundamental aspect of energy modeling and performance verification.
- The iterative nature of this process enhances the accuracy of predictions and informs better decision-making for energy efficiency upgrades and operational strategies.



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