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BASICS OF BUILDING ENERGY MODELING - BEM

ONLINE PROFESSIONAL COURSES LED BY THE WORLD'S TOP SPECIALISTS

ONLINE TRAINING BY KRISHNAJI PAWAR

LEED AP(BD+C),GSAS CGP,GCP,ISO 14001

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MODULE 2

What is Building Energy Modeling (BEM)?

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BASICS OF BUILDING ENERGY MODELING - BEM

BEM is physics-based software simulation of building energy use. A BEM program takes as input a description of a building including geometry, construction materials, and lighting, HVAC, refrigeration, water heating, and renewable generation system configurations, component efficiencies, and control strategies.

Learning Objectives

- Introduction
- What is Building Energy Modeling (BEM)?
- Building Energy Codes and Standards
- Building Energy Modeling Tools
- LEED and Building Energy Modeling
- Building Energy Modeling and Commissioning
- Benefits of Building Energy Modeling
- Professional energy modeling specialist certification
- Summary and Resources
- Basics of BEM Quiz_Test Your Knowledge!

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INTRODUCTION

- Today, using BEM in building design is crucial to a successful architectural practice.
- Energy modeling is crucial for early energy decisions.
- This introductory course answers these questions and reviews in a non-specific software format how to use the tools, when to use them, and what to do with the outputs to help design.
- BEM specialists recognized by a coalition of professional organizations are increasing in energy modeling.
- This course is for architects /engineers who want to implement the most energy-efficient strategies in building design without becoming BEM experts.



WHAT IS URBAN BUILDING ENERGY MODELING (UBEM)?

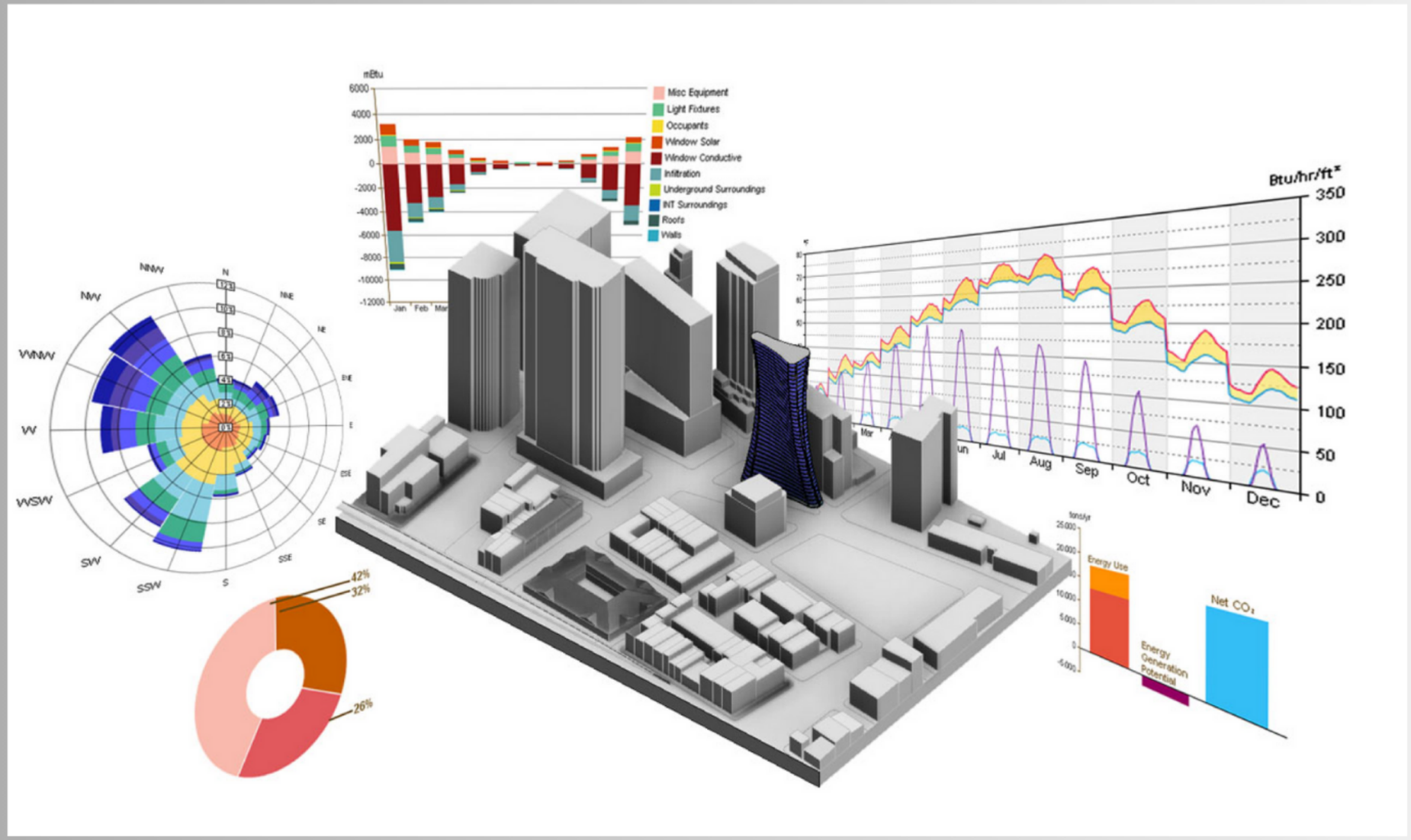


Whole-Building Energy Modeling (BEM) is a versatile, multipurpose tool that is used in new building and retrofit design, code compliance, green certification, qualification for tax credits and utility incentives, and real-time building control. BEM is also used in large-scale analyses to develop building energy-efficiency codes and inform policy decisions.

So what exactly is BEM? And what roles does the U.S. Department of Energy (DOE) play in the BEM industry and community?

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FIG.1 OVERVIEW OF BUILDING ENERGY MODELING



WHOLE BUILDING ENERGY SIMULATION

Whole building energy simulation measures expected energy use (fuel and electricity) based on the building's geometry, climate, building type, envelope properties, and active systems (HVAC & Lighting). It takes into account the interdependencies of the building as a whole system, so it is a particularly useful way to "keep score" as you work to reduce building energy use.

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The building's occupancy, lighting, plug-loads, and thermostat settings are also recorded.

With these inputs and local meteorological data, a BEM computer calculates thermal loads, system response, energy use, occupant comfort, and energy costs using physics equations.

BEM programmes calculate a year hourly or shorter.

They consider system interactions like lighting-heating/cooling.

HOW BUILDING ENERGY SIMULATION IS USED

BEM applications employ their ability to tackle difficult problems. Major applications include:

- BEM helps architects quantify trade-offs between up-front construction expenses and operational energy costs when designing energy-efficient buildings. BEM often lowers energy and construction costs.
- Large and complicated commercial HVAC systems require design and operation. BEM helps mechanical engineers design effective building thermal load HVAC systems. It also develops and tests system control strategies.





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BUILDING PERFORMANCE RATING

BEM may evaluate a building's performance while controlling for use and operation. Code compliance, green certification, and financial incentives are based on inherent performance rating.

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Building Stock Analysis

BEM analysis on prototype models supports the development of energy codes and standards and helps organizations like utilities and local governments plan large scale energy-efficiency programs.



National building codes and regulations aim to increase building energy efficiency, but compliance and enforcement issues limit their efficacy.

However, combining these restrictions with local policies and improving them based on municipal planning and development strategies can be one of the best methods to meet climate mitigation and sustainable development goals.

NEED FOR DECISION-MAKING TOOL

- Benchmarking and certification systems have been used to identify and implement energy efficiency and use reduction measures in buildings.
- Green certification methods like LEED and BREEAM are used by decision-makers and stakeholders worldwide.
- Benchmarking compares a building's energy performance over time to similar buildings or simulations of a reference building.
- Dynamic energy modeling and simulation of individual buildings have been used in benchmarking for years to plan, demonstrate, and evaluate energy conservation and thermal comfort improvements.



NEED FOR DECISION-MAKING TOOL +

- Considering interactions between buildings and the urban environment, their role in renewable resource envelope solutions, and the dynamic effects of building energy use on district energy systems, bench-marking and individual building energy studies have given way to district and city-level solutions.
- In the latest carbon-free Boston action plans, urban building energy modeling is the only metric of building energy efficiency improvement.



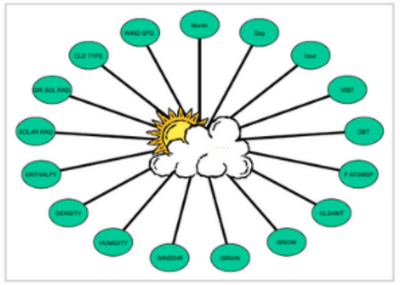
SIMULATION ARCHITECTURE

Building simulation tests design elements under real-world conditions using mathematical models, allowing architects and engineers to evaluate their designs' performance in a virtual environment.

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SIMULATION ARCHITECTURE

Weather Data



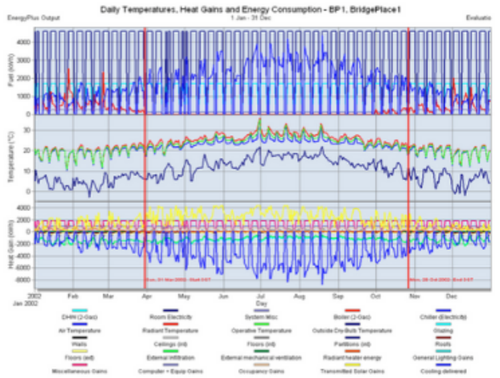
Calculation Engine

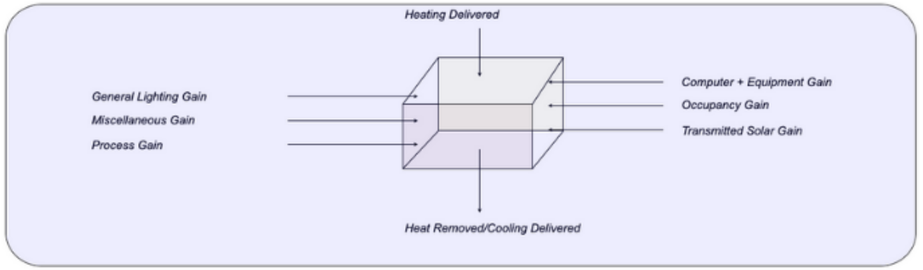
1. *Conductive, convective and radiative heat transfer calculation*
2. *Heat and Mass transfer Calculation*
3. *Thermal Inertia Calculation*
4. *Equipment Sizing Algorithms*
5. *Building Geometry, surface and Shading Algorithms*



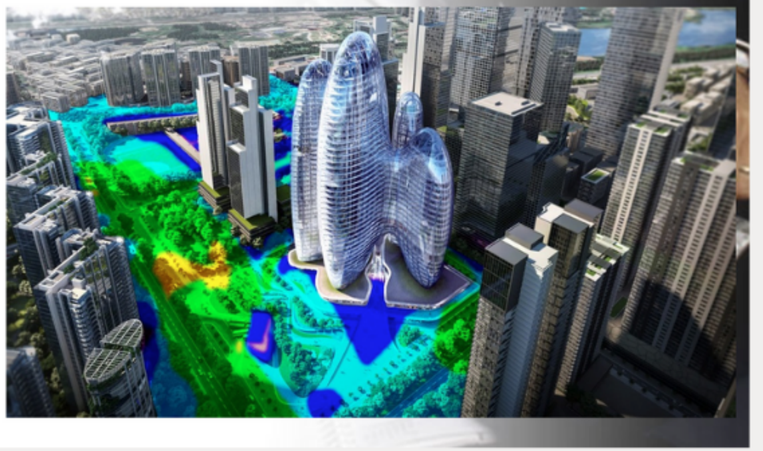
Building Envelop

Results/Patterns

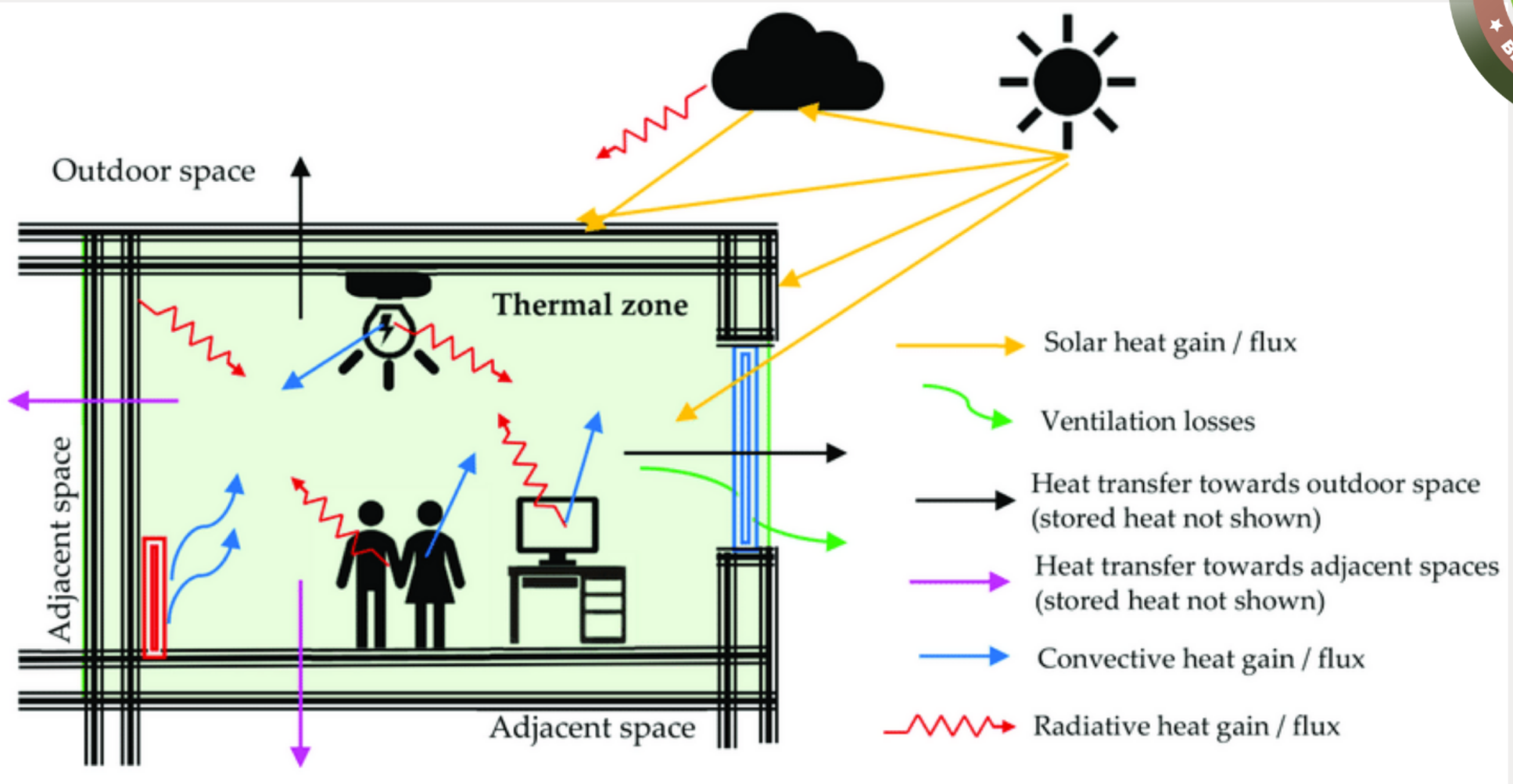








HEAT BALANCE IN A BUILDING



SIMULATION PARAMETERS

- Drawing of HVAC System
- Drawing of Central Plant
- Drawing of water heating System Material of Roof ,Ceiling, and partitions
- No. of floors
- Floor to floor height
- Plenum
- Sizes of windows and sky lights
- LPD
- EPD
- Occupancy Type
- Zone type for each block and Daylight control
- Site Elevation
- Front azimuth angle Architectural detail drawings Wall constants
- Glazing
- Window Choice
- Bay Width
- Sill height
- Discount rate for project life cycle
- Project Life cycle
- Electricity rates





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