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BUILDING ENERGY SIMULATION ANALYST - BESA OVERVIEW
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MODULE 4

Building Energy Modeling Tools

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BUILDING ENERGY SIMULATION ANALYST - BESA OVERVIEW

This topic discusses the importance of choosing suitable design simulation software for architects, emphasizing the need for testing compatibility with workflows. It emphasizes the need for non-specialists to validate results against the simulator's understanding of building science, with initial projects serving as test cases.

Learning Objectives

- Introduction
- Getting Started with BEM
- Establishing the Model Scope
- Building Energy Modeling Tools
- LEED, Commissioning, & Energy Conservation
- Benefits of Building Energy Modeling
- Certification for energy modeling specialists
- Summary and Resources
- Building Energy Simulation Analyst - BESA Practice Test V.4.1

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INTRODUCTION

- Software systems are based on research and validation from the last 40 years of computer-based energy modeling experience.
- The software has improved methods and accuracy, making it more user-friendly for nonspecialists, including architects.
- Dr. Andrew Marsh's approach to creating Ecotect informs the software, which features an intuitive graphical user interface, a variety of simulation types, 3D modeling programs, graphical outputs, and default values for quick model setup.
- Each firm has a unique choice of design simulation software, and testing is crucial to ensure compatibility.
- Architects should exercise caution when learning to use software for design decisions.
- The first few projects should serve as test cases while learning to use the design simulation process.

GRAPHICAL SIMULATION SOFTWARE DEVELOPMENT

Emergence of Energy Modeling in Engineering

- Energy modeling emerged as a method for sizing mechanical systems and estimating energy loads.
- It became a separate profession due to the complexity of energy use in modern buildings.

Decline in Architects' Understanding of Energy Use

- The specialized nature of energy modeling has led to a decline in architects' understanding of comfort and energy use.

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GRAPHICAL SIMULATION SOFTWARE DEVELOPMENT +

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Evolution of Design Simulation

- Design simulation has appealed to non-specialists like architects.
- Architect Dr. Andrew Marsh created Ecotect software, which Autodesk purchased in 2008.

Post-Ecotect Landscape

- Ecotect transitioned to Autodesk, allowing architects to run simple models with compelling graphical outputs.
- It includes a wide variety of analysis types, including daylighting, acoustics, solar path analysis, climate analysis, insolation, and simple energy modeling.

DESIGN SIMULATION SOFTWARE ELEMENTS

- Design simulation software requires a user interface, a method of creating or receiving 3D geometry, and an engine.
- A graphical user interface (GUI) is the look and feel of the software, allowing the simulator to input and change parameters.
- GUIs detect thermal zones and material properties from 3D software and can locate grids of sensors within base 3D geometry.
- GUIs suggest design alternatives based on climates, typologies, and simulation results, but are not a substitute for architectural skill, knowledge, and research.

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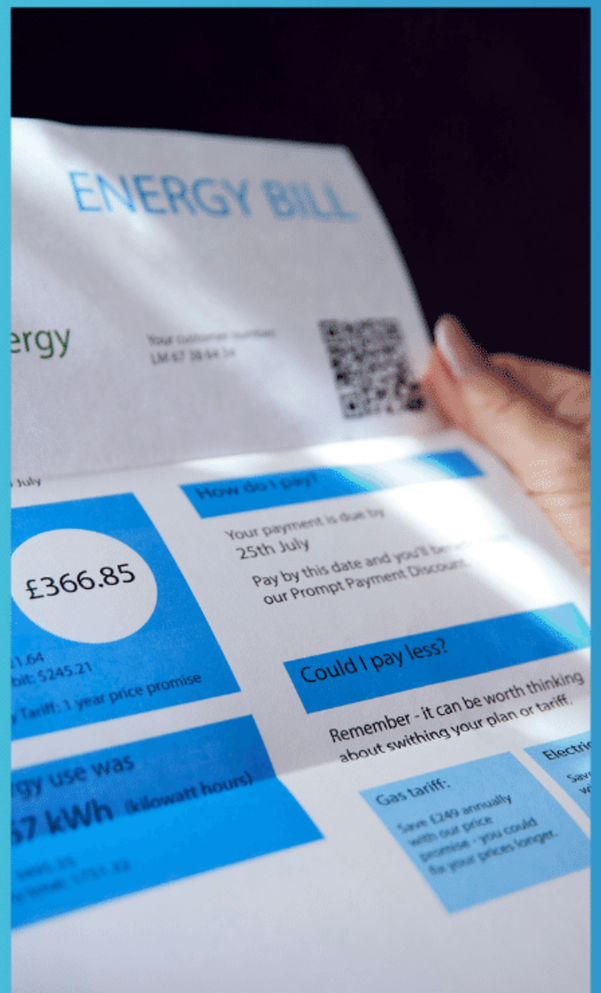
DESIGN SIMULATION SOFTWARE ELEMENTS +

- Three-dimensional modelers allow the creation of geometric forms with material assignments.
- Models are often modified or specifically built for each type of analysis to frame the question more specifically, test options, and exclude extraneous geometry.
- Green Building XML (gbXML) allows the translation of 3D geometry between software and any meta-data associated with energy modeling.
- Engines contain complex formulas and tables that simulate the interaction of elements in the physical world.
- Plug-ins and modules are additive software elements that increase functionality.

ARCHITECTURAL SOFTWARE PACKAGES



- Autodesk's Vasari: Used as a testing ground for new ideas for Revit, offering design simulation analysis capabilities. It also includes an export to the Green Building Studio.
- IES-VE: Four levels of detail, with a proprietary energy modeling engine and modules for various analysis types. It can use SketchUp as a base 3D modeler.
- Diva for Rhino: Complete design simulation tool within the Rhinoceros 3D environment, inexpensive, and easy to interact with. It can perform single-zone analysis using the EnergyPlus engine.

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ARCHITECTURAL SOFTWARE PACKAGES +

- OpenStudio: Freeware from the National Renewable Energy labs, capable of producing whole building energy simulations and daylighting analyses. It includes advanced tools for estimating energy performance and for daylight and glare simulations.
- Sefaira: A newcomer to the design simulation field, gaining market share with its graphic user interface and proprietary thermal engine.

SOME IMPORTANT THINGS TO CONSIDER WHEN LOOKING INTO A SOFTWARE

- Testability within project workflow: Essential for software vendors and trainers to demonstrate simplicity.
- Training level: Limited intuitive software like COMFEN and ClimateConsultant require minimal training. Complex software may require more training, which can be costly.
- User-friendly and graphic design: Software should be enjoyable and learnable for architects, unless only a specialist is involved.
- Interoperability with 3D modeling workflow: First-hand testing is necessary.
- Exporting results to spreadsheet format: Allows customization of data and output format.

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SOME IMPORTANT THINGS TO CONSIDER WHEN LOOKING INTO A SOFTWARE +

- Web-based or computer-based software: Results can be shared among team members with various permission settings.
- Energy analysis capabilities: Software should contain libraries of default wall assemblies, glazing types, and HVAC system options.
- Parametric modeling: Used for quick testing of geometric options and adjusting building geometry.

BUILDING ENERGY MODELING TOOLS

- Why do we need energy modeling software?
- Building Energy Modeling Tools
- Common Energy and Renewable Energy Tools
- Summery of Available Analysis & Modeling Tools

WHY DO WE NEED ENERGY MODELING SOFTWARE?

- Residential and commercial sectors consumed 40% (40 quadrillion British thermal units) of U.S. energy in 2018 [EIA, May 2019].
- Energy modeling software can help project teams examine design options for life-cycle cost impacts to enhance building performance.
- Material choices, mechanical and electrical systems, sun orientation, temperature, and human usage all affect building energy performance.
- Complex interactions might result from design component modifications, making them hard to analyse.
- Building energy modeling software evaluates energy consequences across dynamic linked systems.

BUILDING ENERGY MODELING TOOLS

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- The choice of which BEM tool to use will also influence the amount of data required and the level of detail needed.
- Choosing the right BEM for what you want is important, and two key factors to consider are at which point in the design process and for what purpose the BEM tool is used.
- Each BEM tool's features are its distinctive attributes, and they include different analysis processes or default templates—essentially, specific elements that aid in our input and output from the software.

BUILDING ENERGY MODELING TOOLS +

- How they operate with other software and their interoperability with your BIM or CAD program is a pathway to understanding BEM's applicability and ease of adoption into your work.
- What we can conclude from this is that there is no one-size-fits-all program for BEM.

AVAILABLE ANALYSIS & MODELING TOOLS

SUMMERY OF AVAILABLE ANALYSIS & MODELING TOOLS

Stage	Requirements	Tools	Reality Checks
Scoping	- Quick analysis - Comparative results - Reduce alternatives to consider - Control strategy modeling	- System Analyzer™ - Modified bin analysis (where load is not entirely dependent on ambient conditions)	- Operation cost per ft^2 - Payback or other financial measure
System Design	- Accurate output - Industry-accepted methods	- HAP - TRACE 700 - Elite Design	- cfm/ft^2 - cfm/ton
Energy/Cost Analysis	- Accurate - Industry-accepted methods - Flexible - Allows modeling of complex control strategies - Complies with ECB method requirements of ASHRAE 90.1-2001 - Works for existing building and systems	- EnergyPlus - DOE - HAP - TRACE 700 - SUNREL	- Btu/h-ft^2 per year - Operation cost per ft^2 - Payback or other financial measure
Monitoring	- Simplicity - Intuitive interface - Systemwide - Interoperable	- BacNET—compatible auto-mation systems	- Trended operating character-istics - Benchmark comparisons (such as system kW/ton)

DESIGN SIMULATION OVERVIEW

- Follows the scientific process of question generation, testing, and implementation.
- No single software suitable for all questions.
- Most firms invest in software and training for common analysis types.
- Most complete package software can perform a wide range of analyses.
- Software sophistication continues to mature, enhancing the range and ease of use of in-house simulation.

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