Black Belt Energy Modeling[1]

The concept of black belt energy modeling arose from a need to set forth expectations, training materials, and professional development paths for learning this specialized skill. While contributions can be made at many levels, becoming a master requires a depth and breadth of knowledge pertaining to engineering, building science and energy simulation tools. The Black Belt Energy Modeling Matrix presented below outlines a spectrum of modeling capabilities – from trainee to master – along with the associated skills and background knowledge to support success.

The framework and content of the matrix are based on providing integrated design assistance as typically delivered to the private sector. Thus the outline may not align well to other applications. It does not reflect the benefits of a streamlined BIM process or software that automatically generates a minimally code-compliant building model.

[1] Concept developed by Ellen Franconi, PhD, of the Rocky Mountain Institute.

Black Belt Energy Modeling Matrix

Belt		Capabilities	Examples	Background Knowledge[2]
Trainee	White	• Collect modeling input data	• Gather information needed for characterizing the building from construction documents, narratives, survey data, etc.	• Basic engineering methods, units, conversions • Reading construction drawings • Familiarity with construction materials, methods, and mechanical systems • Familiarity with space requirements as outlined in Standards (supply flow rates, outdoor air, lumen levels)
	Yellow	• Perform input data calculations	• Convert data collected from various sources to a form used by the simulation program (fan power calculations, EER to EIR calculations, window COG U-value to overall U-value, etc.)	• Spreadsheets • Building load calculation procedures • Mechanical system basics
	Orange	• Develop building geometry and zoning	• Import AutoCAD files and manipulate as needed to incorporate into modeling software • Develop zoning based on thermal block concepts • Finalize zoning after master modeler review	• Computer drawing programs as applicable • Basic heat transfer • Basic thermodynamics • Basic mechanical system design concepts

[2] Background knowledge for a belt includes that for lower-level belts

Belt		Capabilities	Examples	Background Knowledge[2]
Technician	Green	• Create building input file using software wizard	• Use modeling software graphical user interface and complete basic building model based on proposed design, project input data and software default values	• Building science (envelope, lighting, electrical, mechanical, renewable building systems)
	Blue	• Build minimally-code compliant building model	• Modify proposed design model to characterize minimally-compliant building in adherence to the referenced method	• Reference Standards (ASHRAE 90.1 - Performance Rating Method, ASHRAE 62.1, COMNET)
Core Analyst	Purple	• Perform parametric analysis for straight forward design alternates • Review predicted energy use by end use and costs for reasonableness • Complete utility and end-use level calibration of existing building models	• Outline energy conservation measures applicable to the project • Characterize the measures for modeling • Use modeling software parametric capabilities • For an existing building, reconcile actual with predicted utility resource use through repeated comparison and gross model adjustment	• Actual building energy consumption by end use for different types of buildings and systems • Energy efficiency measures and their performance characterization • Modeling software commands and keywords • Utility rate structures

Belt		Capabilities	Examples	Background Knowledge[2]
	Brown	• Perform modeling of complex features, systems or components not readily characterized in the software • Complete detailed quality assurance review • Complete system level calibration of existing building models	• Make the most of existing software capabilities to model UFAD, chilled beams, make-up air units, slab losses, etc. • Use detailed output reports and post-processing tools to perform a reality check on component and system-level results/metrics.	• Advanced heat transfer • Advanced thermodynamics • Advanced building science • IPMVP/EVO concepts including balancing risk with value
Master	Red	• Understand the engineering algorithms used by the software and modify modeling input/methods to improve input characterizations • Use supplemental detailed analysis to support simulation software work-arounds or short cuts.	• Use supplemental CFD modeling results to characterize impact of natural ventilation strategy. Build an hourly infiltration schedule to mimic CFD results and incorporate into whole-building model.	• Deep knowledge of modeling software • Experience applying heat transfer and thermodynamic algorithms related to building science
	Black	• Balance modeling level of detail against accuracy of results needed to support decision making	• Provide qualitative assessments of design options and conduct limited modeling as needed	• Vast project modeling experience • Understanding of application challenges and actual achieved performance

Black Belt Energy Modeling Matrix for PowerPoint Presentations

Belt		Capabilities
Trainee	White	• Collect modeling input data
	Yellow	• Perform input data calculations
	Orange	• Develop building geometry and zoning
Tech-nician	Green	• Create building input file using software wizard
	Blue	• Build minimally-code compliant building model
Core Analyst	Purple	• Review results for reasonableness • Complete calibrations
	Brown	• Perform complex modeling • Complete detailed QC • Complete system level calibration
Master	Red	• Understand the algorithms • Use supplemental analysis
	Black	• Balance modeling level of detail against accuracy of results needed to support decision making