ASHRAE's Linked Criteria Proposal

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Concept Originator

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- Original paper – www.gard.com/lcs.zip

Current Approach in Energy Codes and Standards

- Many decisions about building made first
- Criteria imposed based on product selections
  - Type of HVAC chosen then efficiency found in 90.1
  - Type of envelope structure chosen then insulation level found in 90.1
- Criteria were derived based on this “Decision First” design process

Current Criteria Development

- Product categories serve as boundaries
- Life-cycle costs based on one or two independent variables for a product
  - Efficiency
  - Insulation R-Value
- Alternative values of efficiency variable considered and value chosen based on “scalar ratio” of 8

Building Owner Confusion

- Two buildings:
  - Both comply with 90.1
  - Same size and type
  - Both using same utility rates
  - Energy cost can vary by an order of magnitude
- "What does complying with 90.1 mean?"
- "Does following 90.1 get me to the lowest life-cycle cost for my building?"

Why This Current Approach?

- Keeps ASHRAE out of the battles
- Current efficiency criteria have (relatively) straight forward derivation
- Each subcommittee can focus on their section and not worry about interactions
- Criteria analysis across components more complex
- 1000 DOE-2 runs took 2 weeks in early 90's (now 3 hours)

An Alternative Approach – Linked Criteria

- Let product categories compete in life-cycle cost analysis
- Minimize life-cycle cost of entire building
- Have alternative “design packages” for using different product categories
- No building uses more energy cost (in model) than life cycle cost justified “design package”

Conceptual Example

- Base design package (lowest life-cycle cost) for Chicago Retail:
  - 13.4 EER ground source heat pump
  - R-6 concrete wall, R-15 roof
  - 1.9 W/sqft lighting
- Another design package for Chicago Retail:
  - 9.5 EER rooftop with 80% furnace
  - R-9 concrete wall, R-24 roof
  - 1.7 W/sqft
- 50 other packages to choose from

Four Non-Trivial Steps

1. Select appropriate building models, performance options, utility costs, and first costs
2. Develop optimal (lowest life cycle cost) building design for building type and climate
3. Optimal building design provides energy use target
4. Energy use target serves as basis for alternative “equal energy” design packages (“linked criteria”)

LOTS OF SIMULATIONS!

Advantages of Linked Criteria

- Promotes integrated design
  - Elimination of “worst envelope + worst lighting + worst mechanical + worst water heating + worst electrical” approach
- Greater energy efficiency
  - (direct result of integrated design)
- Easy to incorporate new features
  - daylighting, orientation, solar, and multiple levels of equipment efficiency
- More predictable energy usage from a “90.1 compliant” building

End Results of Linked Criteria Process

- Performance-based energy target by building type and climate zone for those who want to simulate
- Equal energy design *packages* for those who want a prescriptive approach

Hypothetical Performance Requirements

- Climate Zone 3
  - Office Building Design Energy Cost Target = $X per ft2
  - Retail Building Design Energy Cost Target = $Y per ft2
  - Hotel Building Design Energy Cost Target = $Z per ft2
  -
  -
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Partial Example Prescriptive Table

Table X Design Packages for Office Buildings in Climate Zone 3

Package	*Heating*	*Cooling*	*Wall*	*Roof*	*Fenestration*	*Lighting*
1	HP - 6.5	HP - 13.3	Mass – R6	Mass – R15	20% - 0.56/0.87	1.2
2	HP - 6.5	HP - 13.3	Mass – R6	Mass – R18	20% - 0.56/0.87	1.3
3	Furn-81	AC - 13.3	Mass – R11	Mass – R18	20% - 0.56/0.87	1.2
4	Furn-81	AC - 11.3	Mass – R11	Mass – R15	20% - 0.56/0.77	1.1

Additional Table Columns

- Minimum daylit fraction
- Exceptions taken
- Automatic daylighting controls
- Renewable energy
- Orientation
- Percent glazing
- Economizer requirement

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