Thermal Field Tests

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DOE PEER Review

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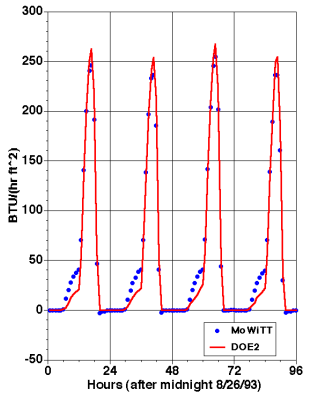
Current Work

- **Skylight Thermal Performance**
  - Electrochromic--Summer
  - Conventional Skylights
    - Flat--Summer & Winter
    - Domed--Winter

- **EnergyPlus Validation**
  - Utilization of existing data

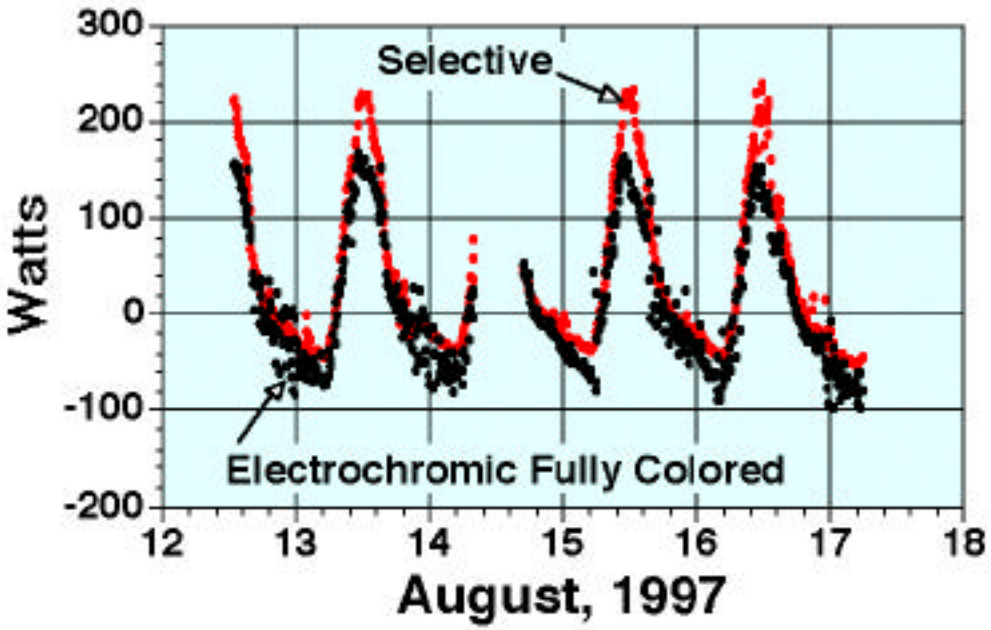


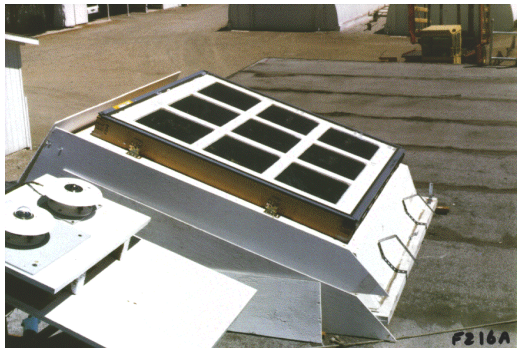
Why Skylight Performance?

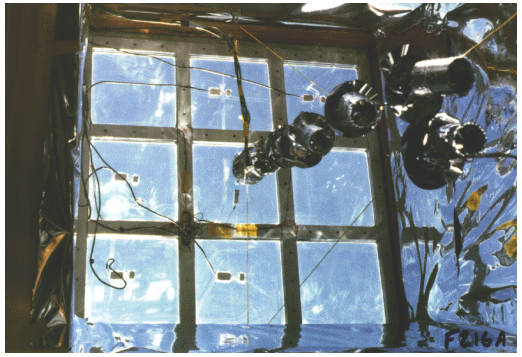
- ~10% of fenestration sales
- Popular architectural feature
- Daylighting potential in comm. bldgs.
- Equal treatment in NFRC ratings
- Early market niche for electrochromic glazings

Current Work

- **Electrochromic Skylights**

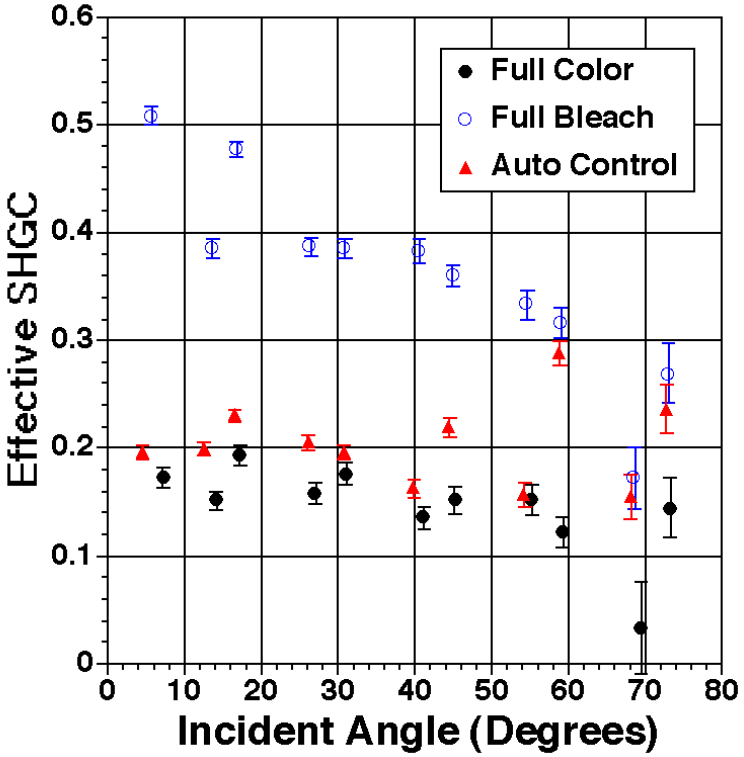


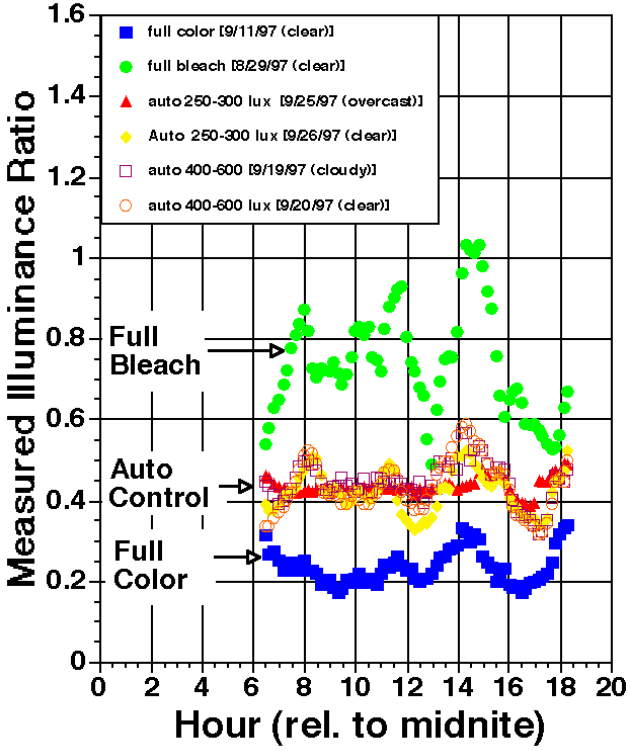




Current Work

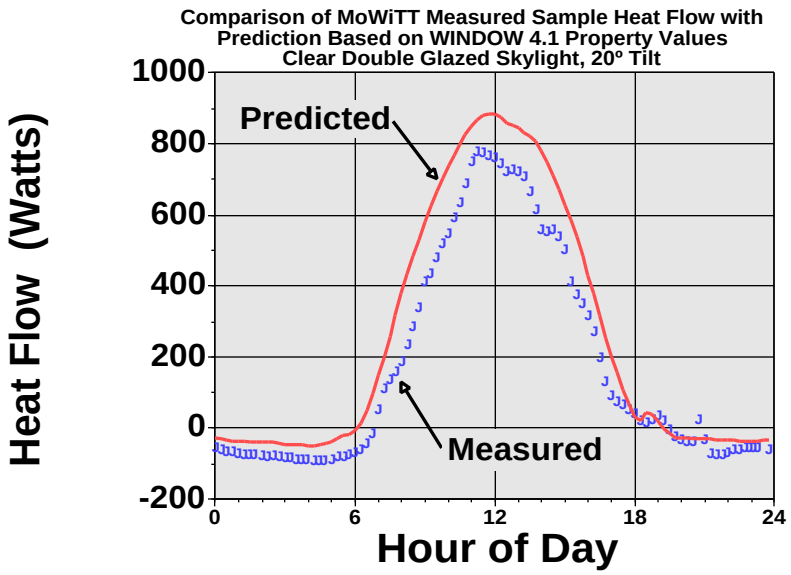
- **Control in Electrochromic Skylights**

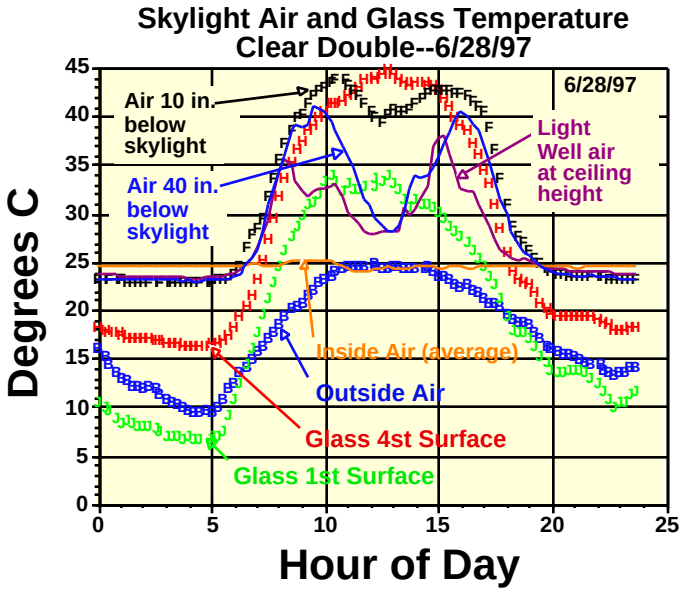




Current Work

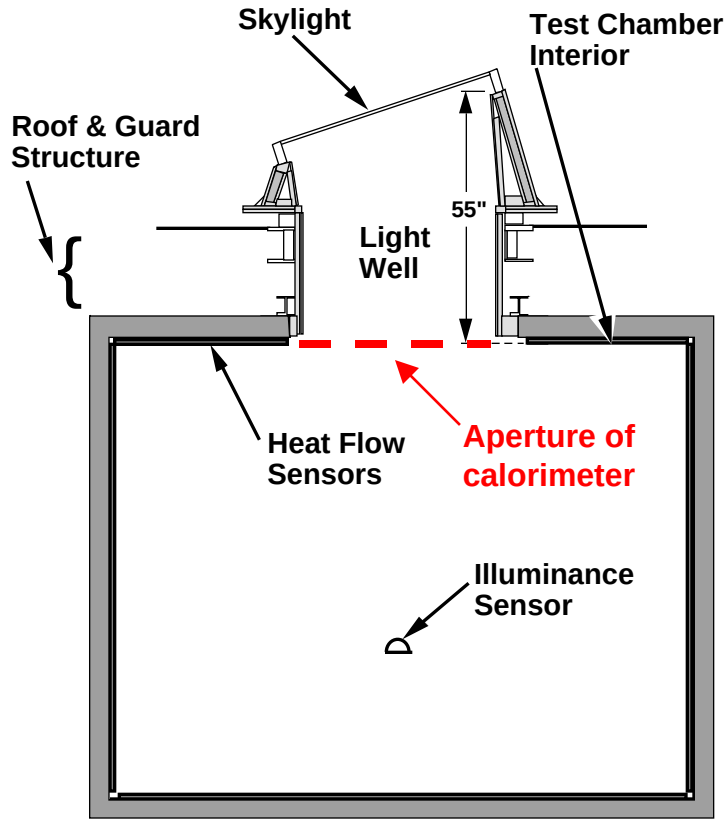
- **Conventional skylights--significant differences from standard NFRC model**





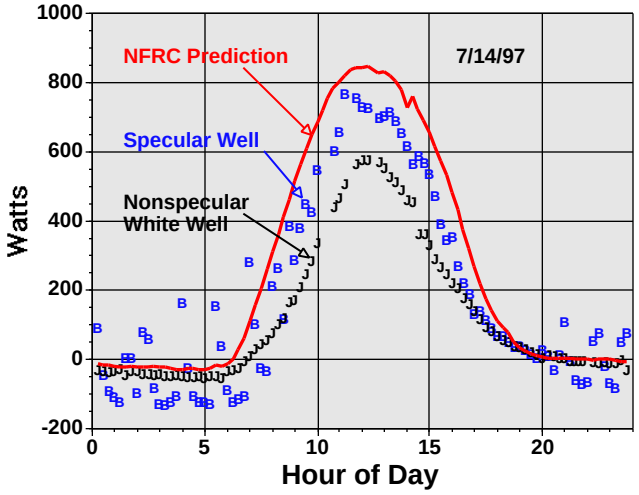
Current Work-Skylights

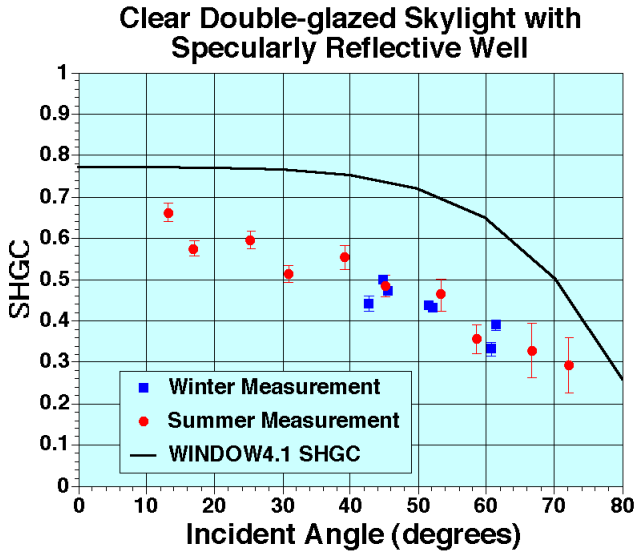
- **The skylight test configuration has a light well depth comparable to a slant-roof residential application**



Current Work-Skylights

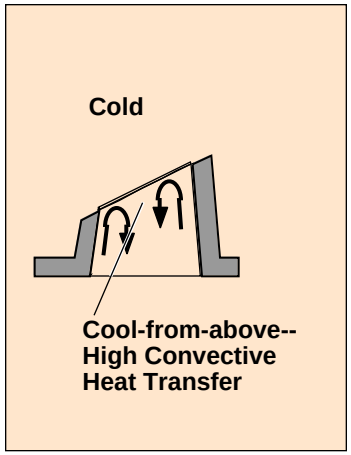
- **Conventional skylights--Daytime heat rejection depends on well, occurs in all seasons**

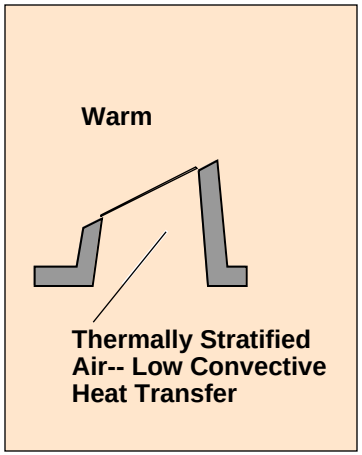




Current Work

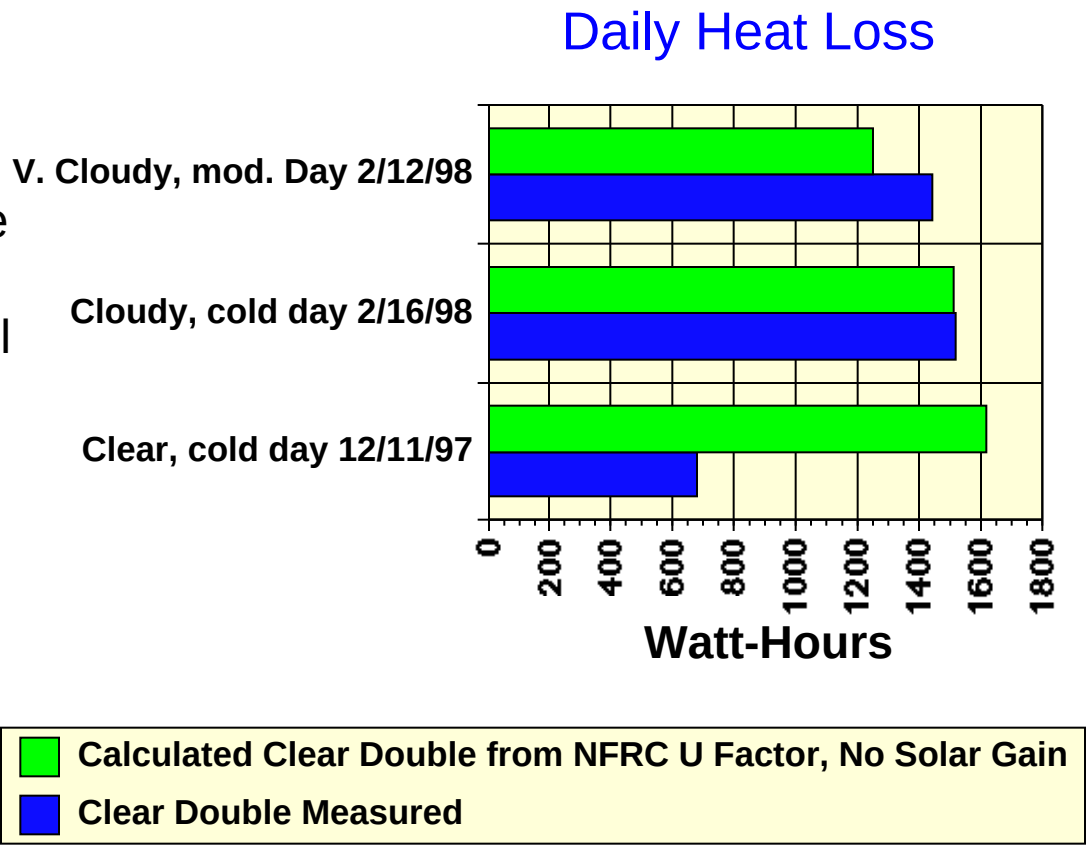
- **Skylight & Light Well Show a "Thermal Diode" Effect**
  - Reduced heat transfer in heat gain mode
  - Enhanced heat transfer in heat loss mode





Current Work--Skylights

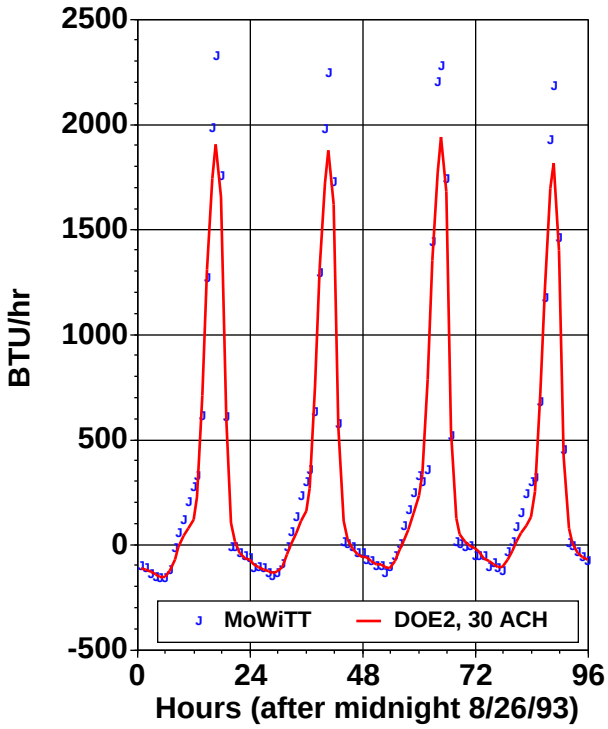
- **Overall winter performance**
  - Actual U-Factor worse than calculated with standard NFRC model
  - Offset by diffuse solar gain
  - Direct solar makes significant difference



Current Work

- **EnergyPlus validation**
  - Utilize existing MoWiTT measurements
  - Re-do unpublished DOE2 study for EnergyPlus
  - Produce standardized data set for BSM validation

Space Load



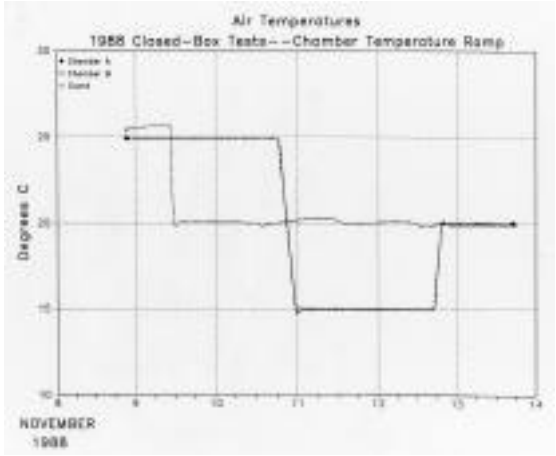
Example from DOE2 Study

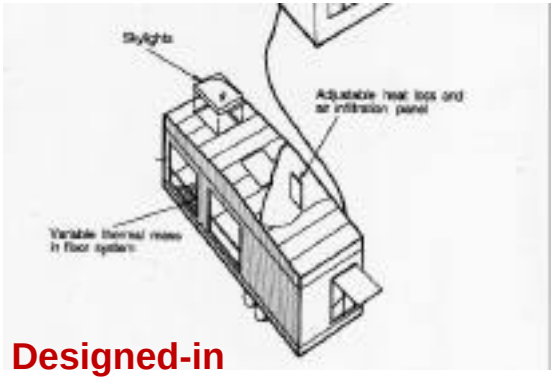
Conclusions (Current Work)

- **Electrochromic skylights reduce heat gain under extreme summer conditions**
  - Full exploration of control & its effect on performance requires other conditions
- **Skylight/light well shows a "thermal diode" effect**
- **Significant potential for EnergyPlus validation**

Future Work

- **EnergyPlus Validation**
  - Mine MoWiTT data set for test situations
  - New experiments: MoWiTT is near-ideal apparatus for testing perimeter space & equipment modeling





Designed-in "simulation mode"

Future Work

- **A model of skylight well efficiency**
  - Dependence on well depth & geometry?
  - Coupled radiation/convection model needed
  - MoWiTT experiments to develop & validate model

Future Work

- **Optimal window strategies for US northern tier**
  - ***Focused validation of current annual calculation method based on DOE2/RESFEN***
  - Critical review of modeling input assumptions (esp. incident solar)
  - Economic/energy/carbon analysis

Future Work

- **Does the air leakage test on windows allow correct prediction of air infiltration/exfiltration rates?**
  - Direct comparison of windows with different leakage rates
  - Measurement of pressure differential, infiltration rate (by tracer gas), wind
  - Separation of infiltrating & exfiltrating modes

Conclusions (General)

- **MoWiTT has a unique role in assuring tests/simulations represent actual fenestration performance**
  - More fenestration issues to be addressed
    - ***Skylight well, electrochromic control, air infiltration***
  - Public sector vs industry goals
    - ***Different focus: Insuring public benefit may take more research than increasing sales or market share***

Conclusions (General)

- **MoWiTT "simulation mode" capabilities can benefit other areas besides fenestration**
  - EnergyPlus validation
  - Methods for next-generation perimeter space modeling (e.g., CFD)
- **Programmatic utilization of facility should be broadened to maximize DOE's ROI**