

Linking Radiance & EnergyPlus in an Automated Design Workflow

Galen Burrell

August 26, 2011

Skylight Optimization

Grocery Store in Austin, Texas



LAKE | FLATO

ARUP

Goals

■ **Client:**

- Minimize energy (50% reduction)
- Maximize daylight amenity (metric: daylight autonomy)
- Achieve uniform daylight across vertical shelves

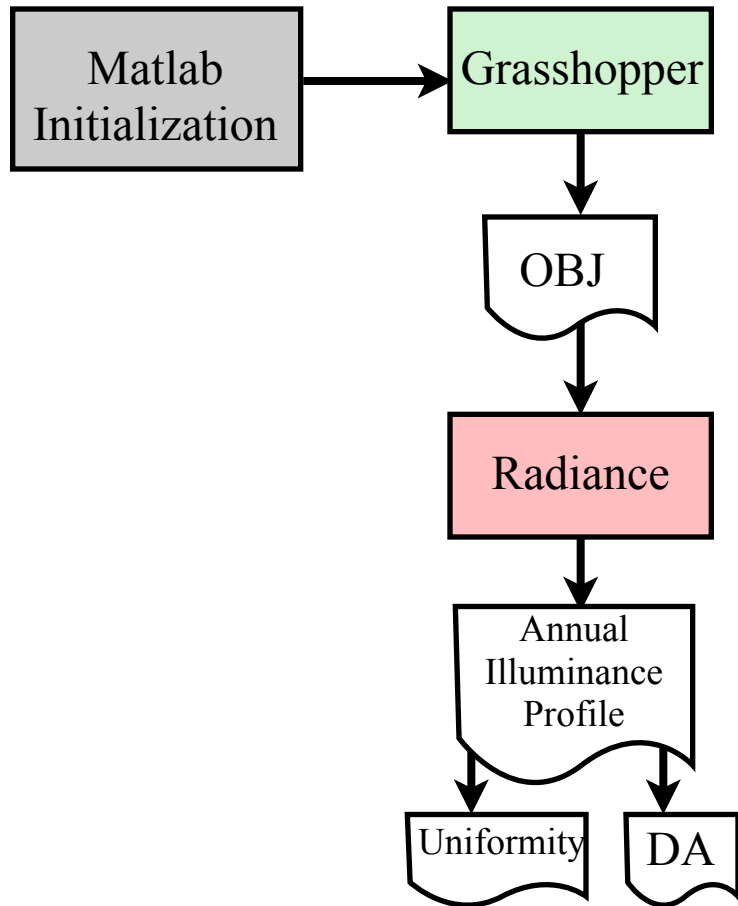
■ **Arup:**

- Try something new
- Implement 'automated design' workflow

Automated Design Components

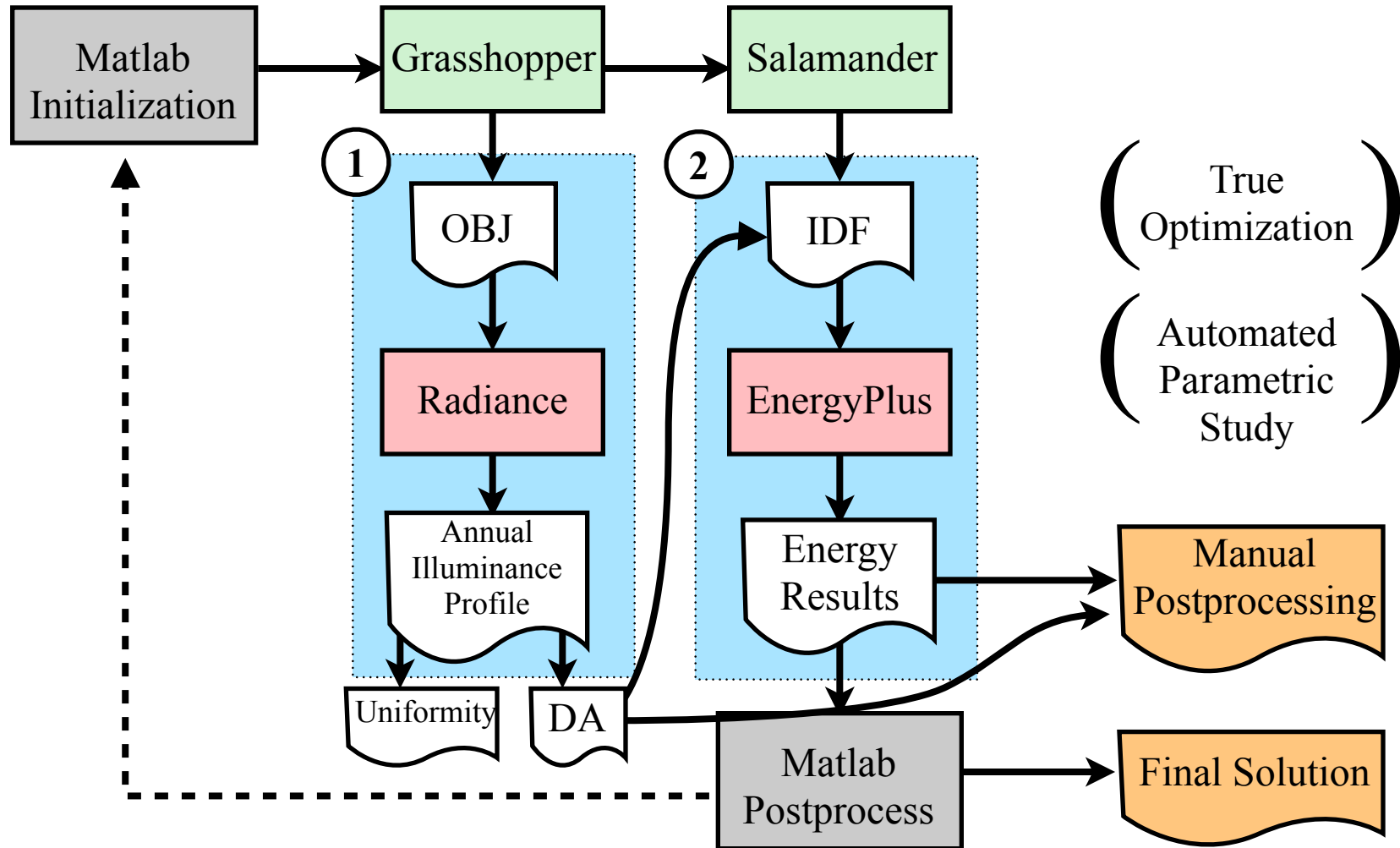
- **Rhinoceros** (3D modeling)
 - **Grasshopper** (Parametric geometry creation)
 - **Salamander** (EnergyPlus components)
- **EnergyPlus** (Energy analysis)
- **Radiance** (Daylight analysis)
- **MATLAB** (Execution control, geometry input parameters, data storage, optimization engine.)

Automated Design Process

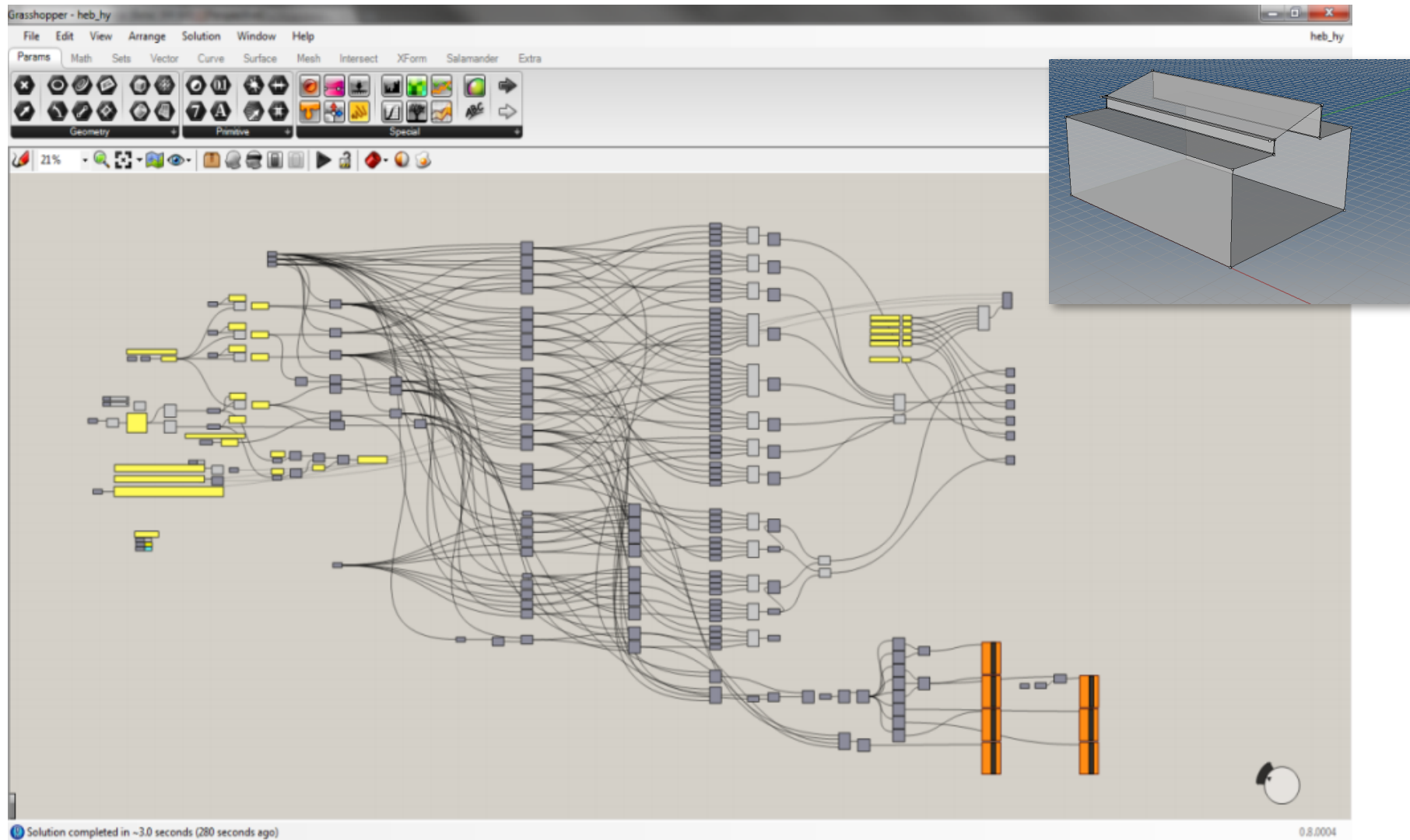


- Generate sky & sun matrix using Austin climate data
- Generate daylight coefficient matrix using rtcontrib

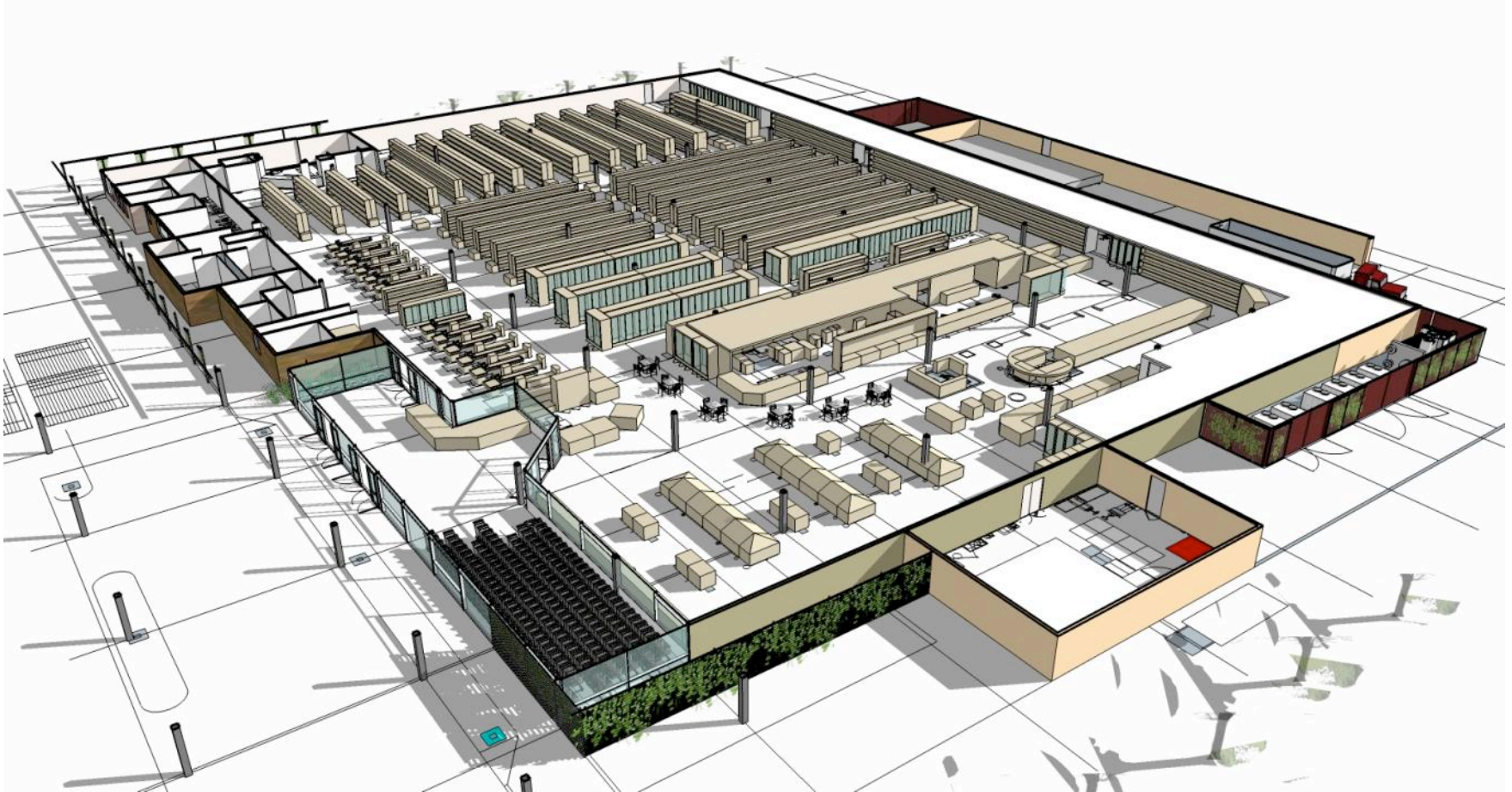
Automated Design Process



Automated Design



Scope of Study

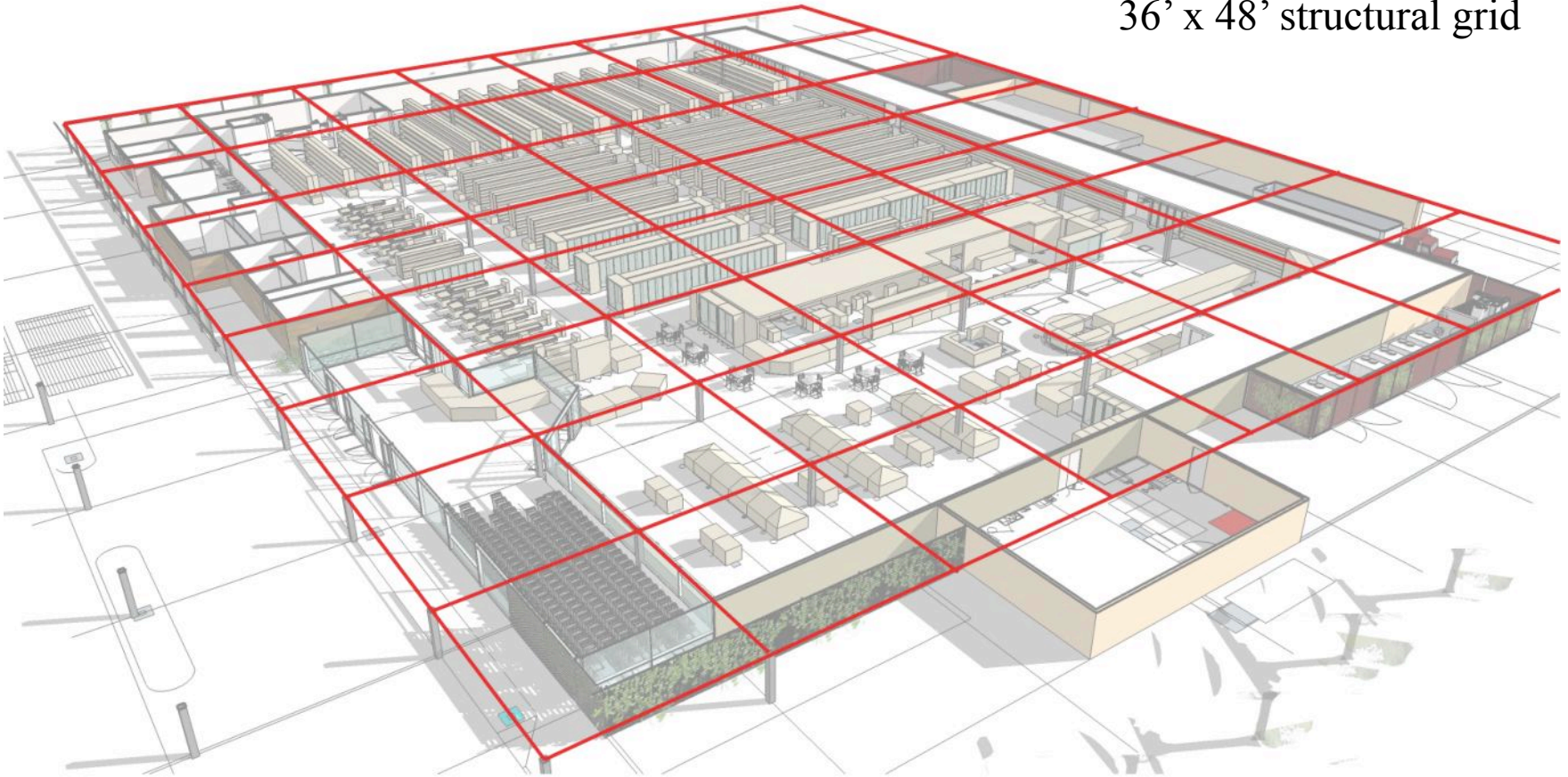


LAKE | FLATO

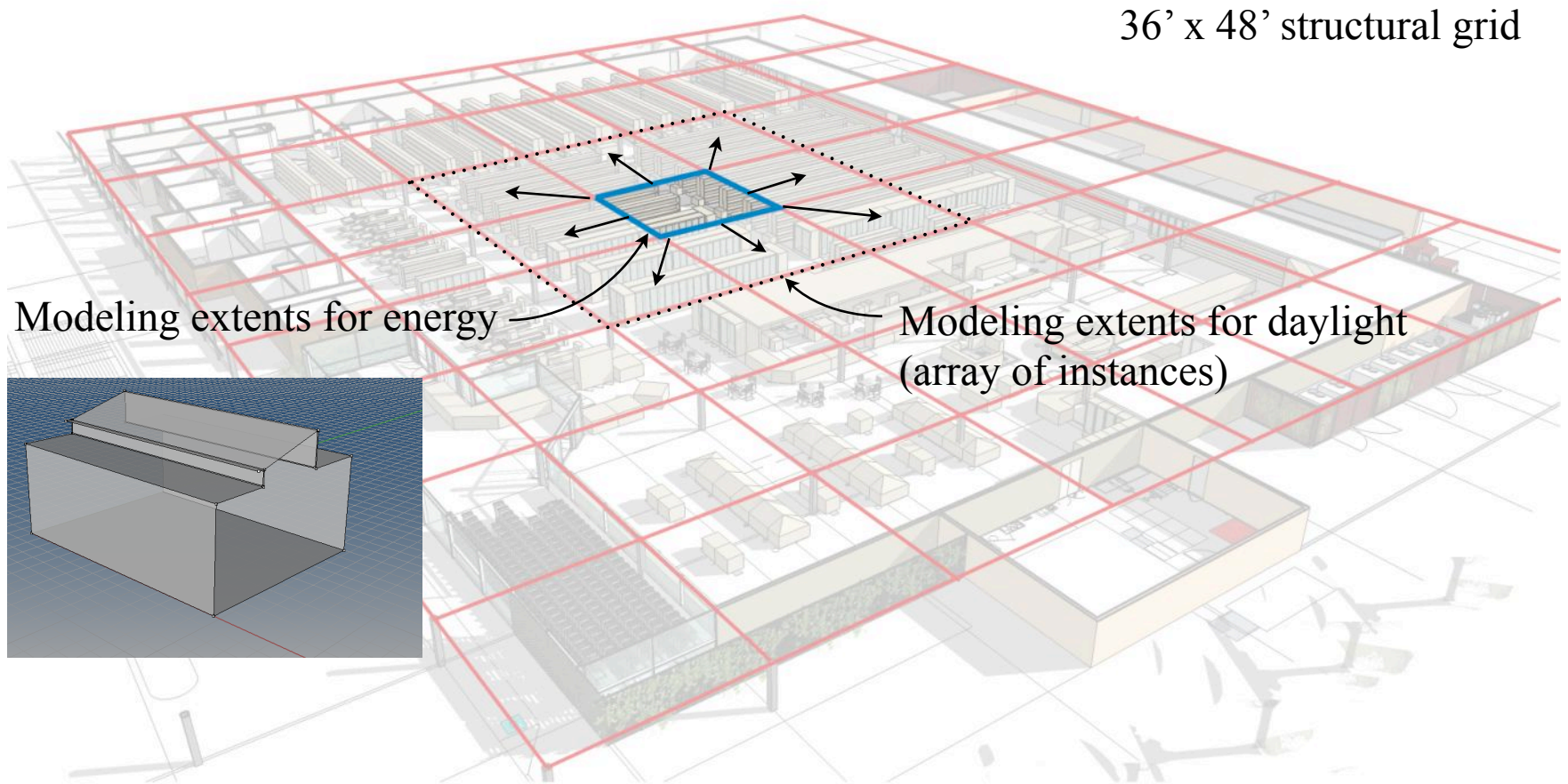
ARUP

Scope of Study

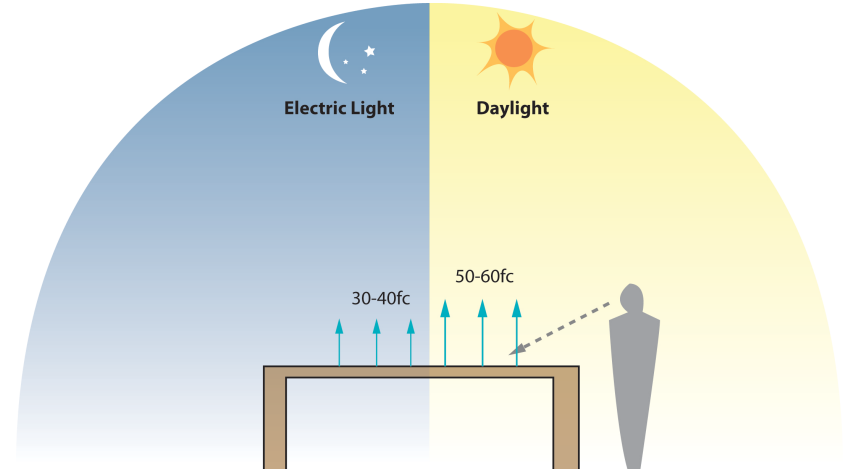
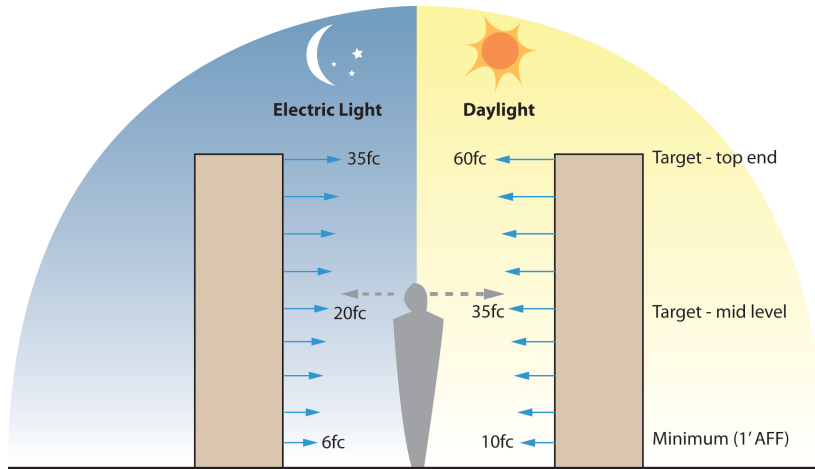
36' x 48' structural grid



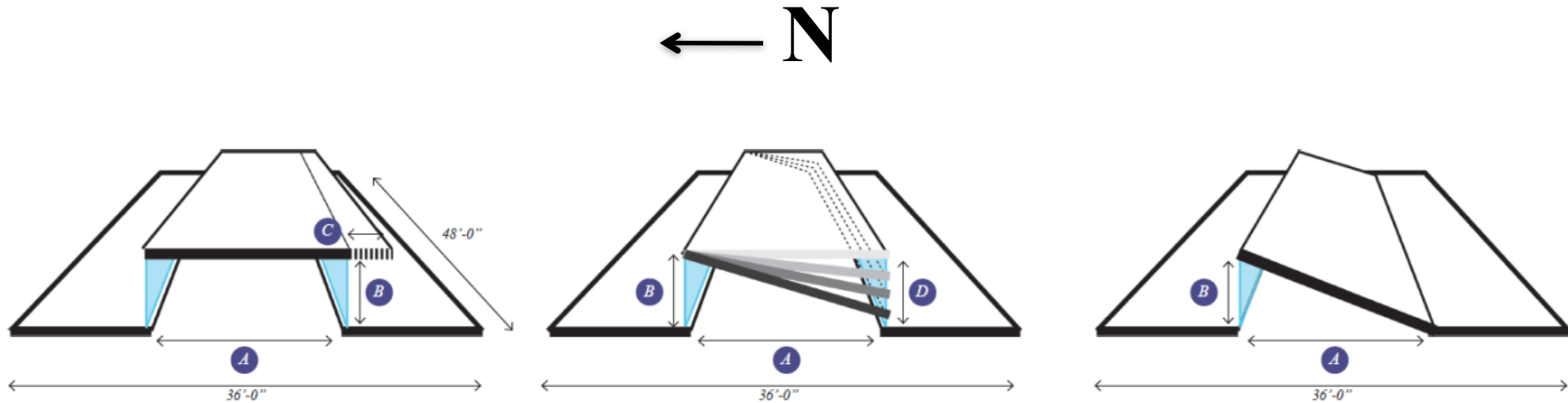
Scope of Study



Lighting Design Criteria



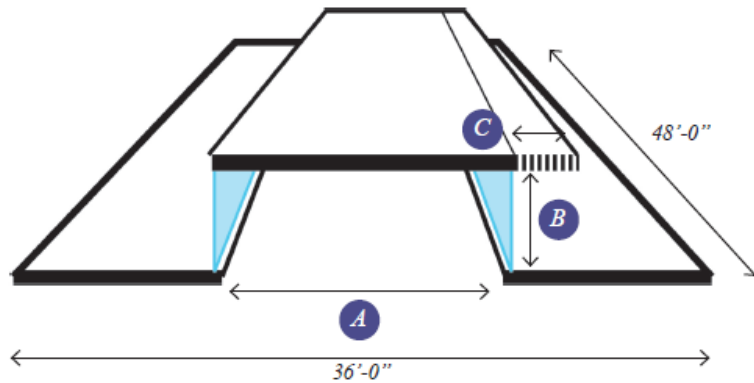
Skylight Options Studied



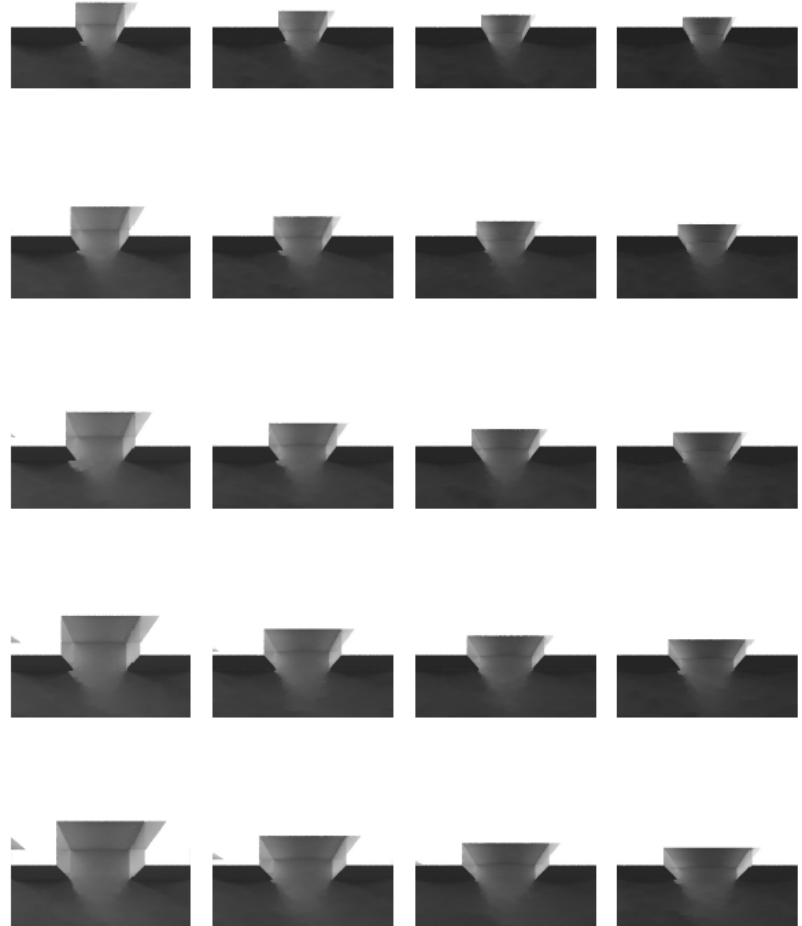
Skylights run continuously across length of structural bay

Skylight Options Studied

Pop-Up Skylight

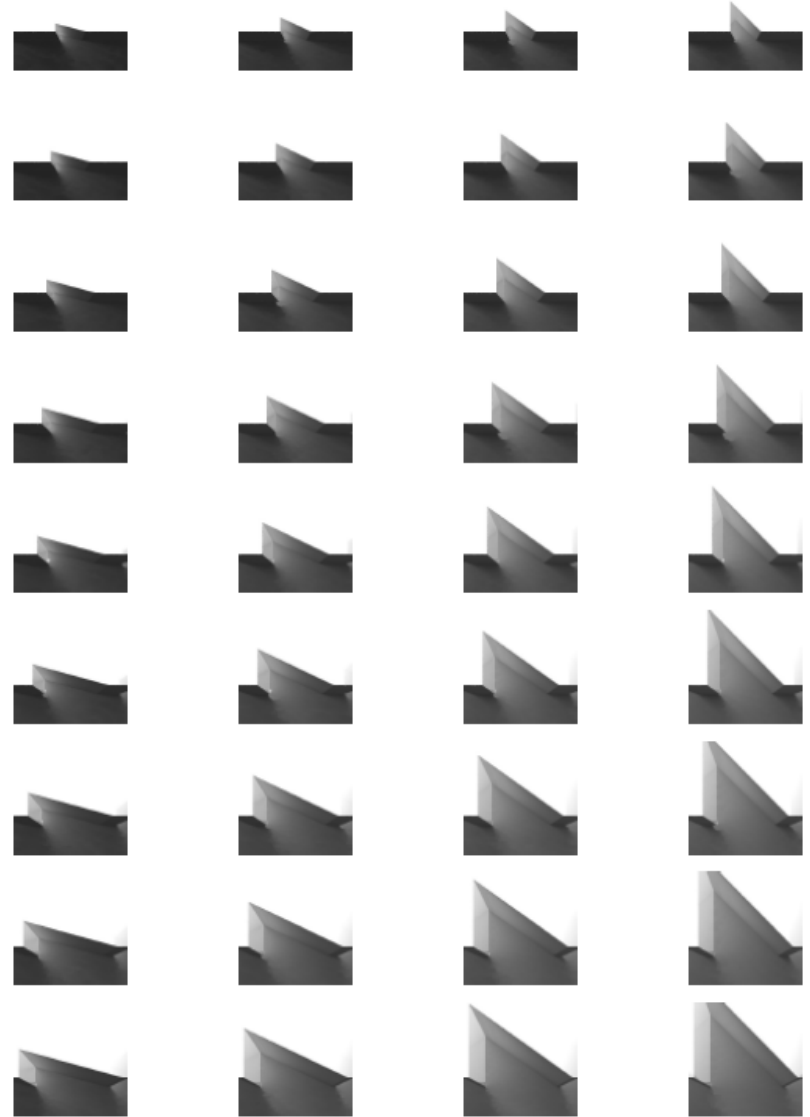
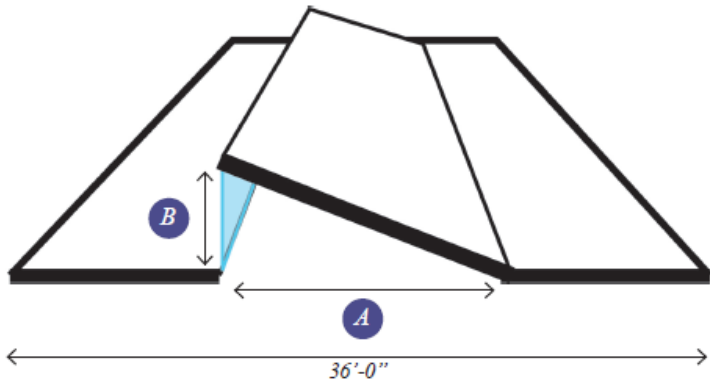


- South glazing is diffuse, north is clear
- Overhang dimension is fixed



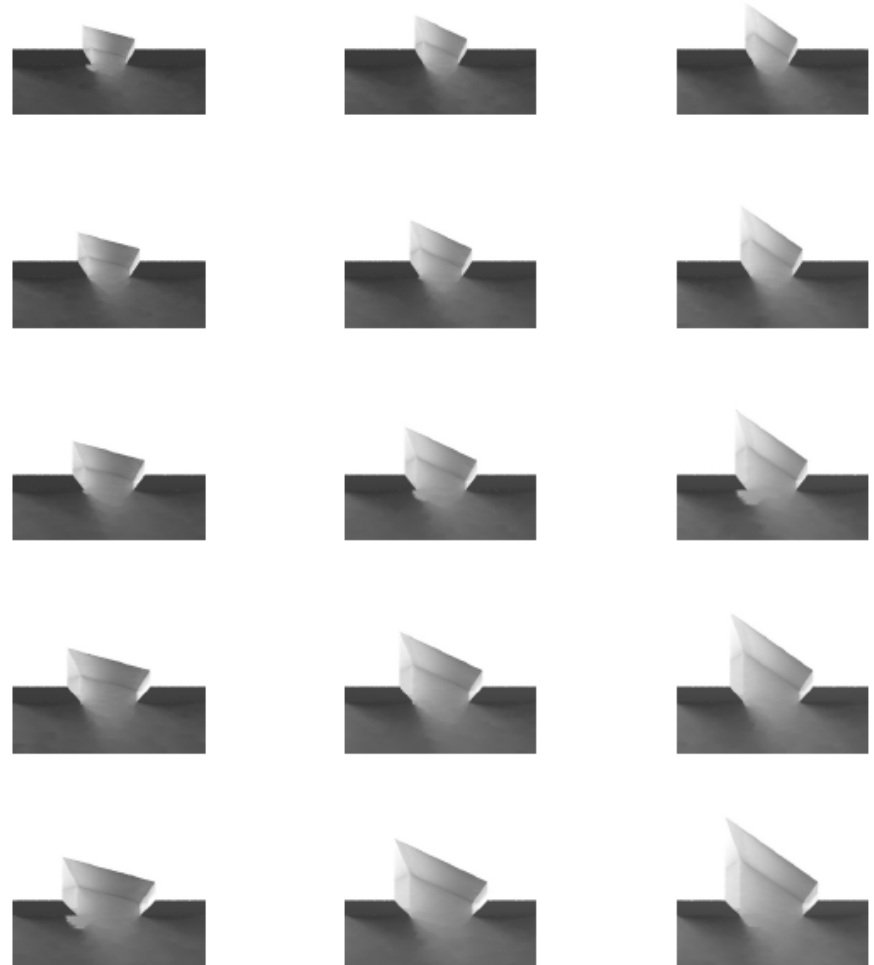
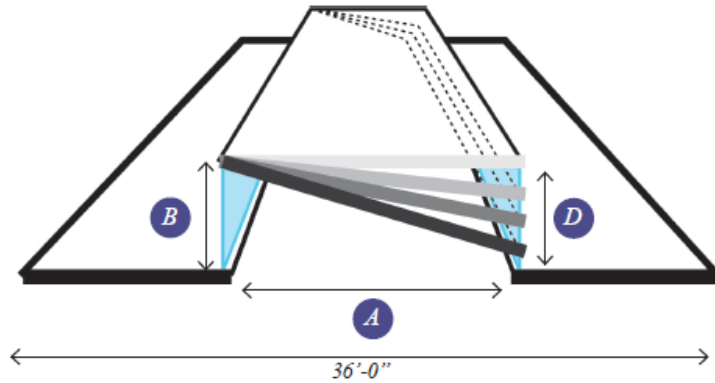
Skylight Options Studied

North Facing Sawtooth



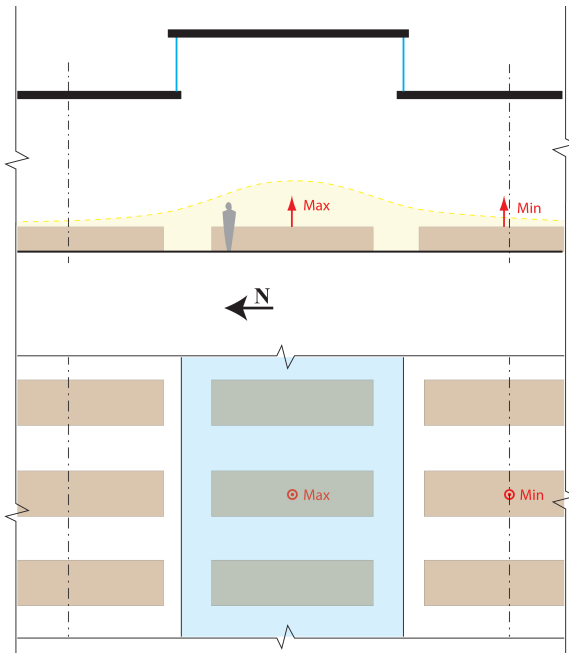
Skylight Options Studied

Hybrid

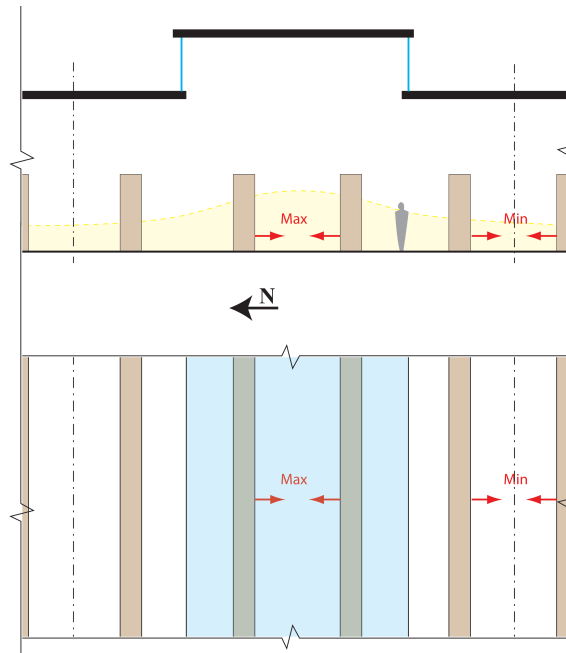


Calculation Points

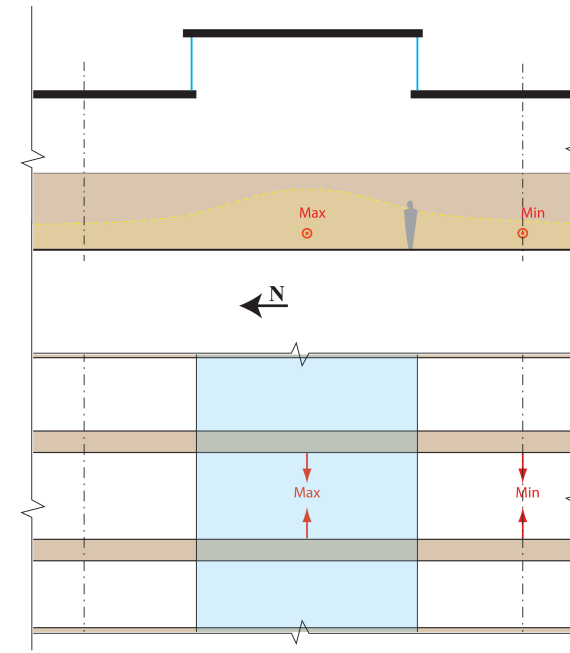
Horizontal



Vertical - Parallel

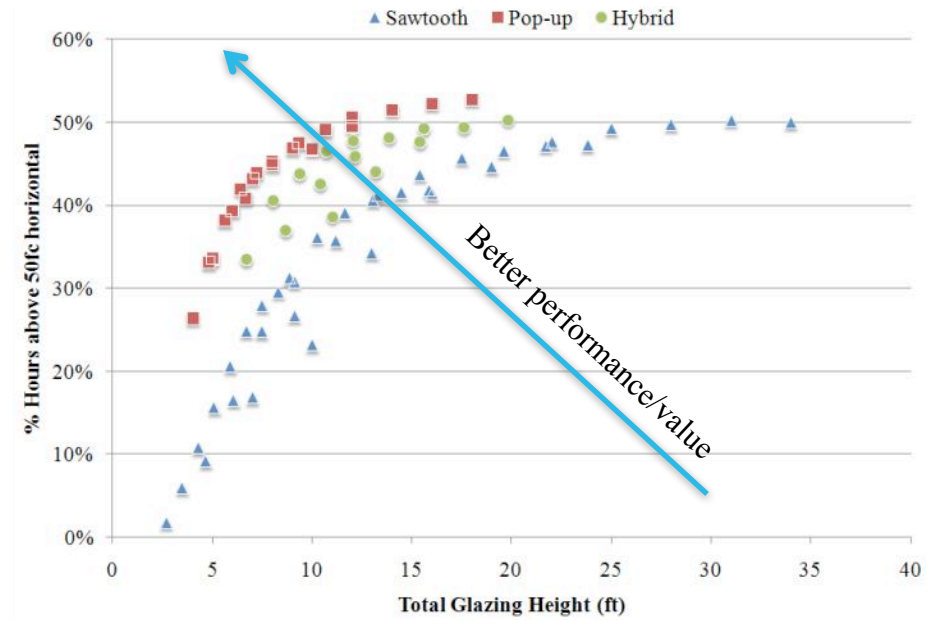
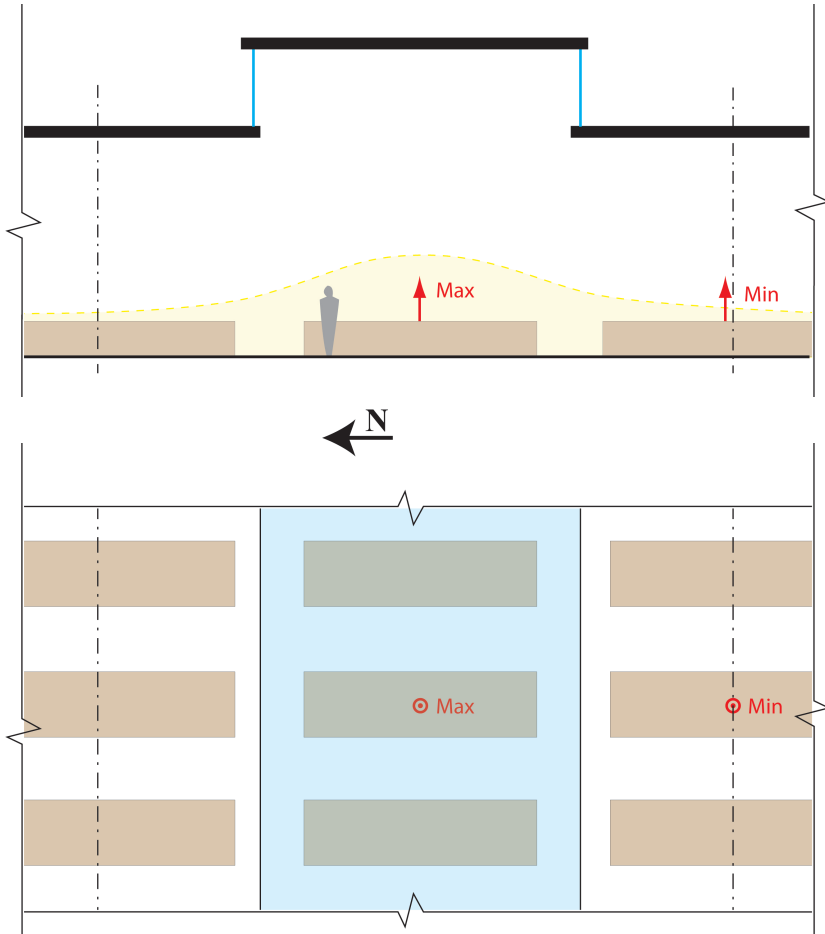


Vertical - Perpendicular



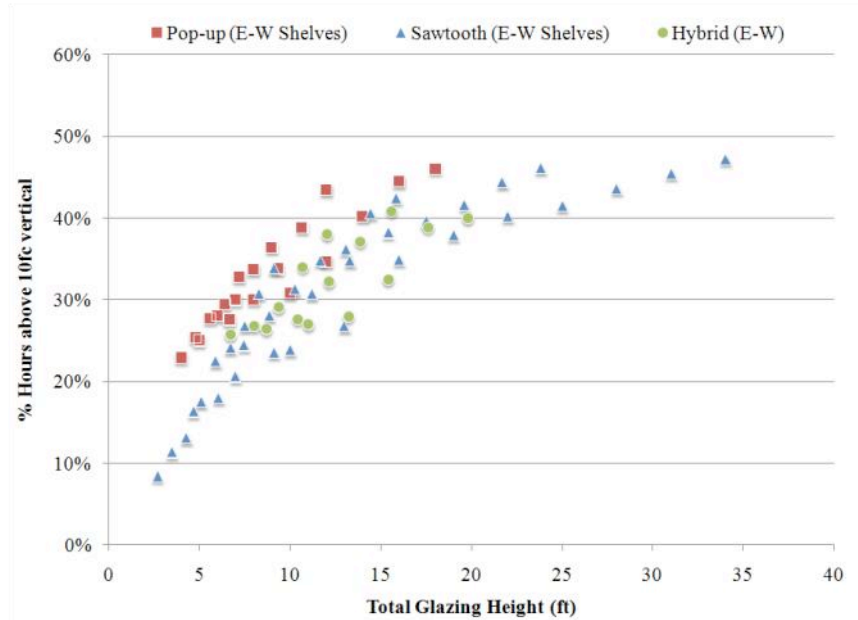
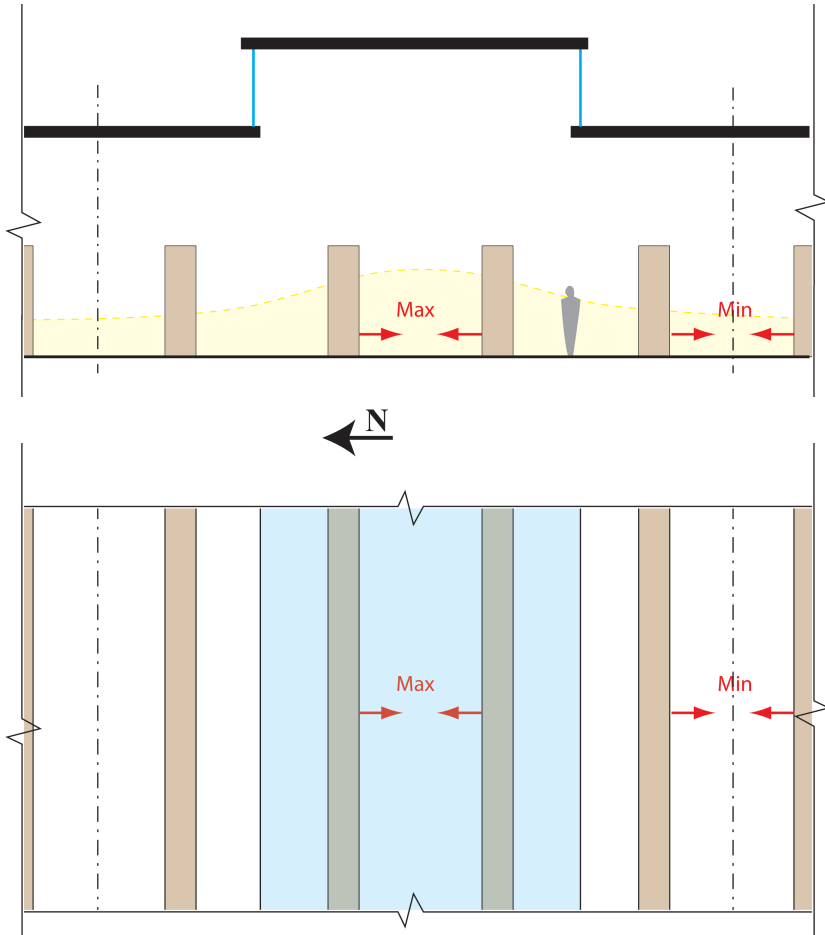
Daylight Performance

Horizontal



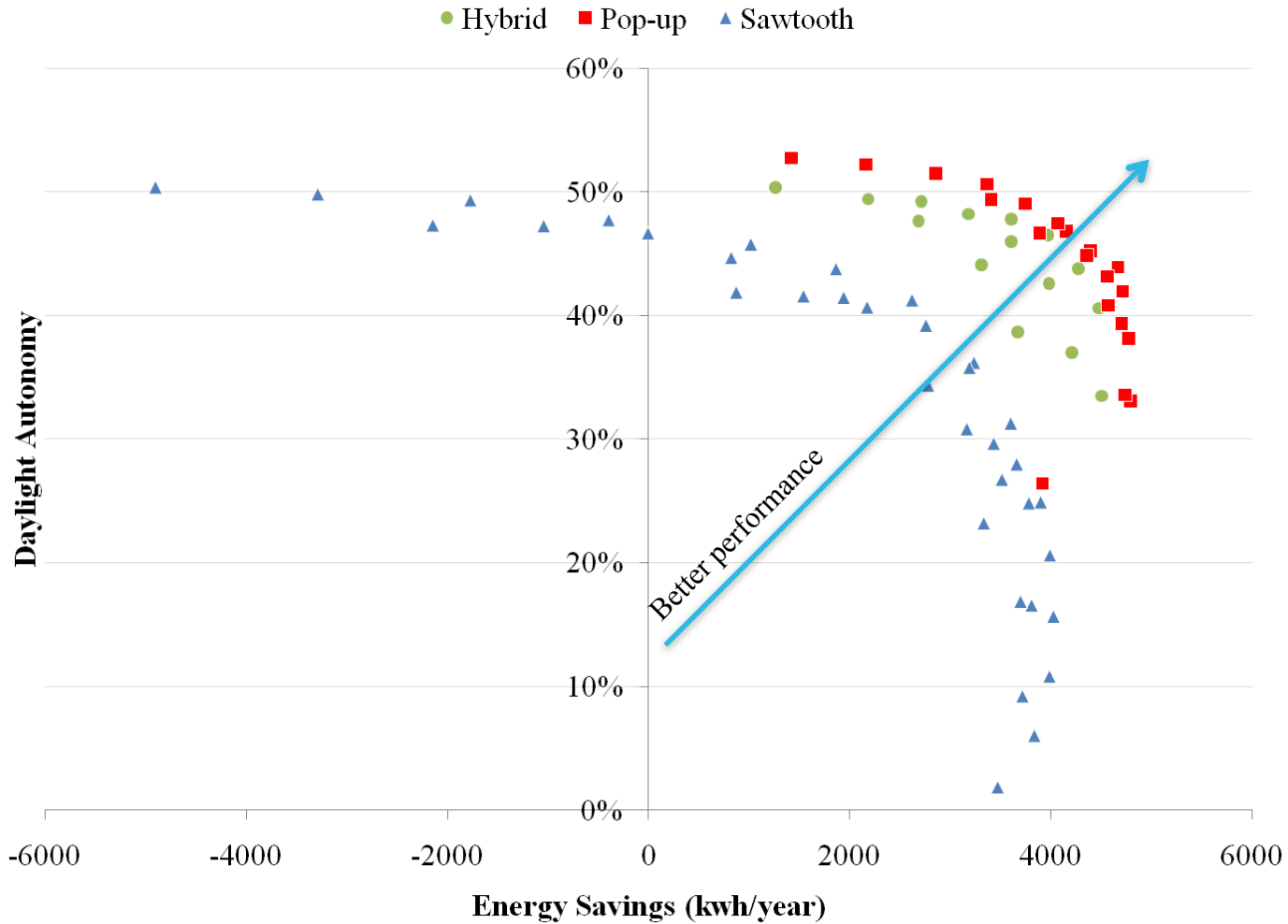
Daylight Performance

Vertical



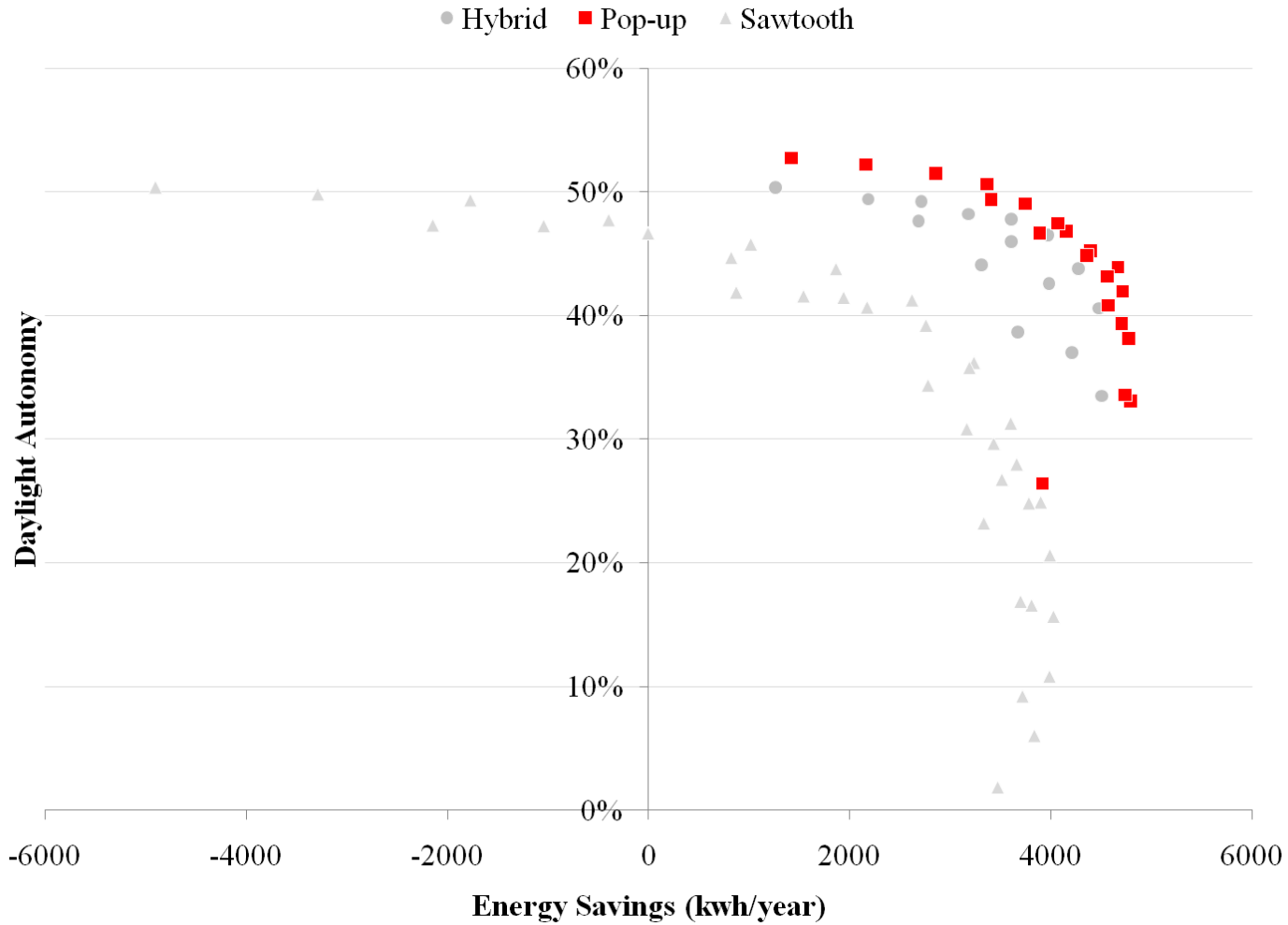
Overall Performance

Daylight vs. Energy



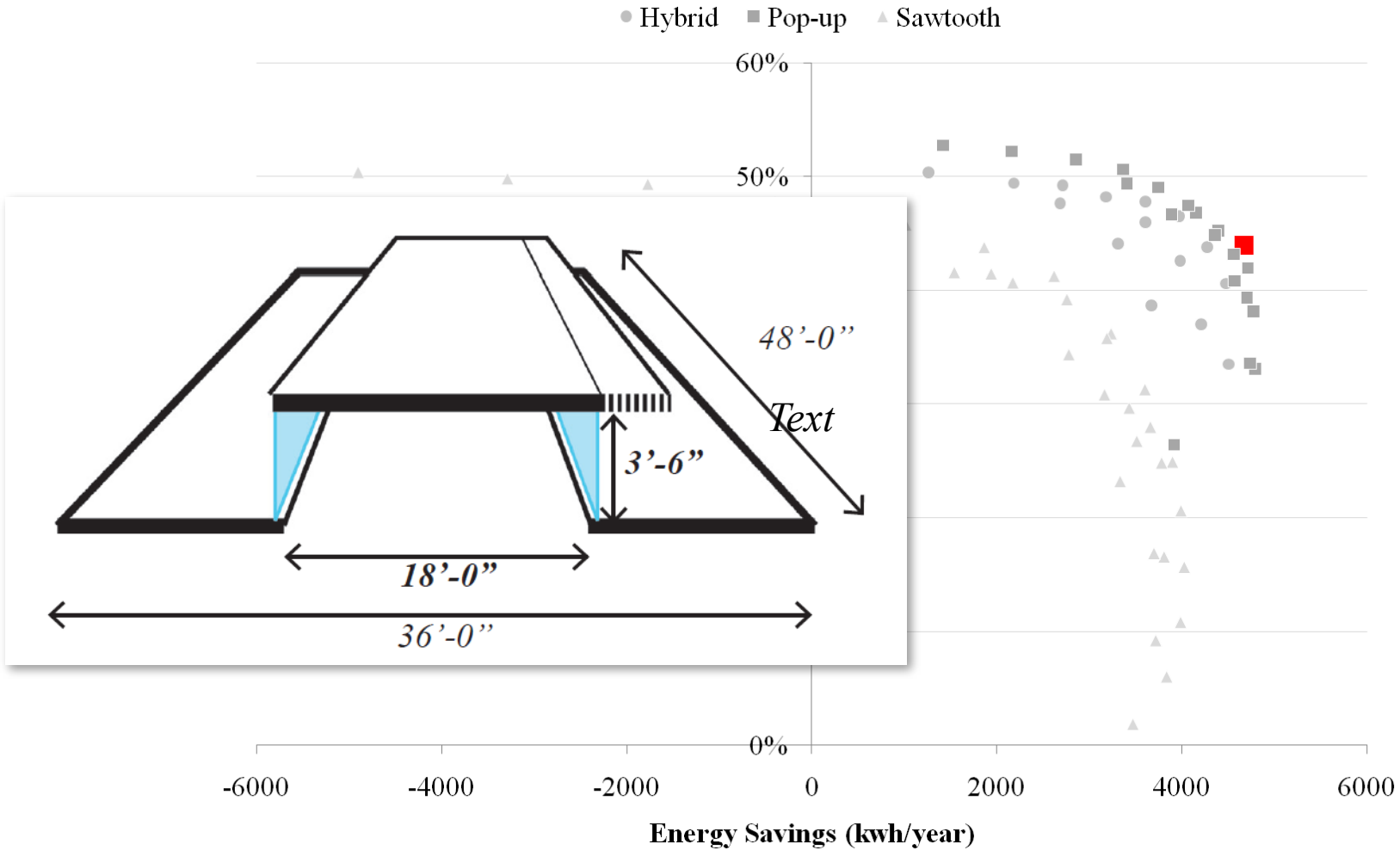
Overall Performance

Daylight vs. Energy

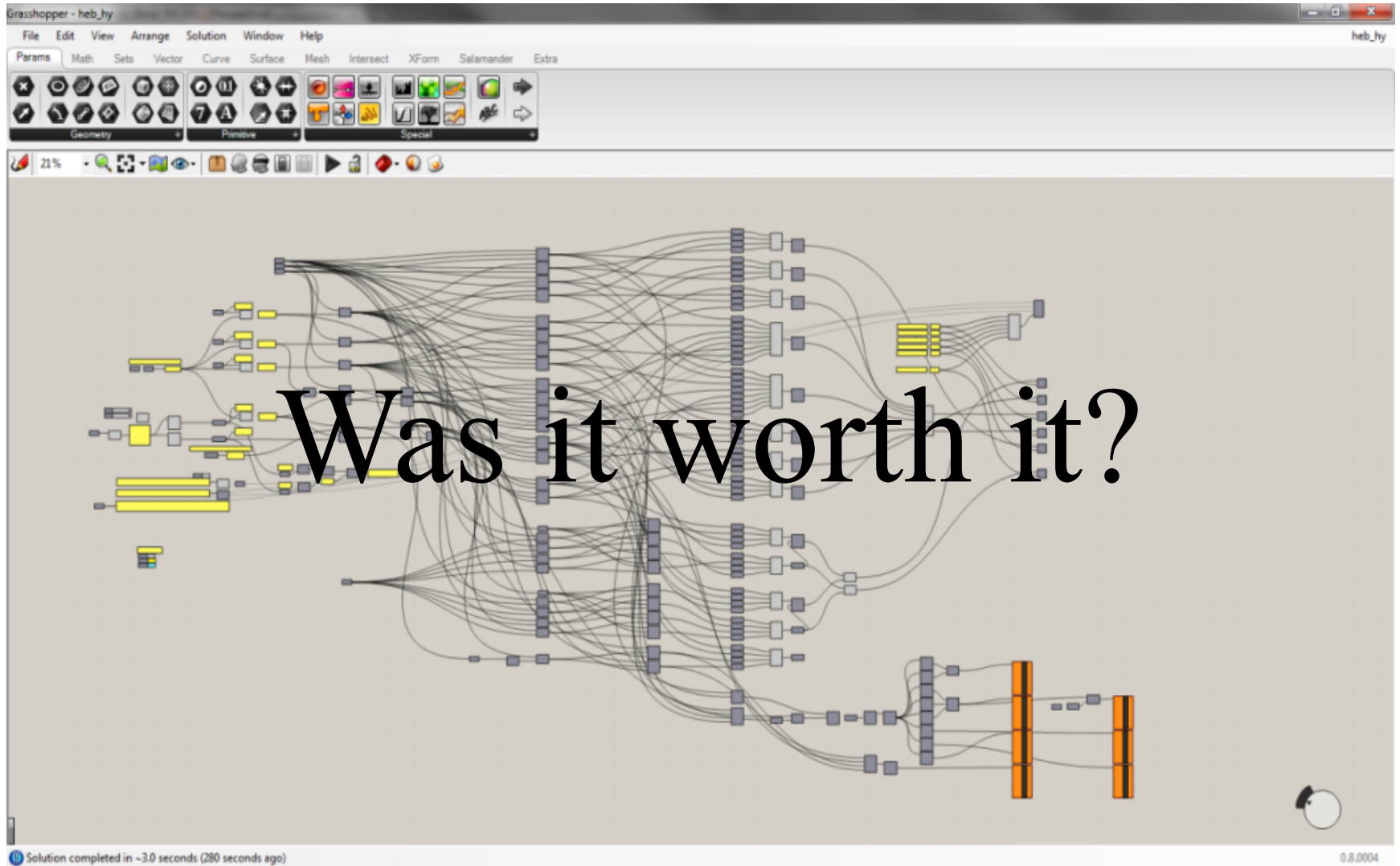


Overall Performance

Daylight vs. Energy



Automated Design Summary



Automated Design Summary

- Permitted a much larger set of parametrics
- Optimization could have reduced number of parametrics required (important for longer simulations)
- Facilitated the linkup of Radiance & EnergyPlus using same model