# Guide for Fan Assist Night Ventilation Measure

Measure Intent

- This measure is meant to provide a simple approximation of the benefits of fan assisted night ventilation.

- It does not use CFD or AirflowNetwork.

- It relies on many assumptions about airflow from user inputs.

  - Flow rate relative to windows size.
  - Feasibility of air to move through building geometry at the specified rates.

- Initial testing used un-conditioned model.
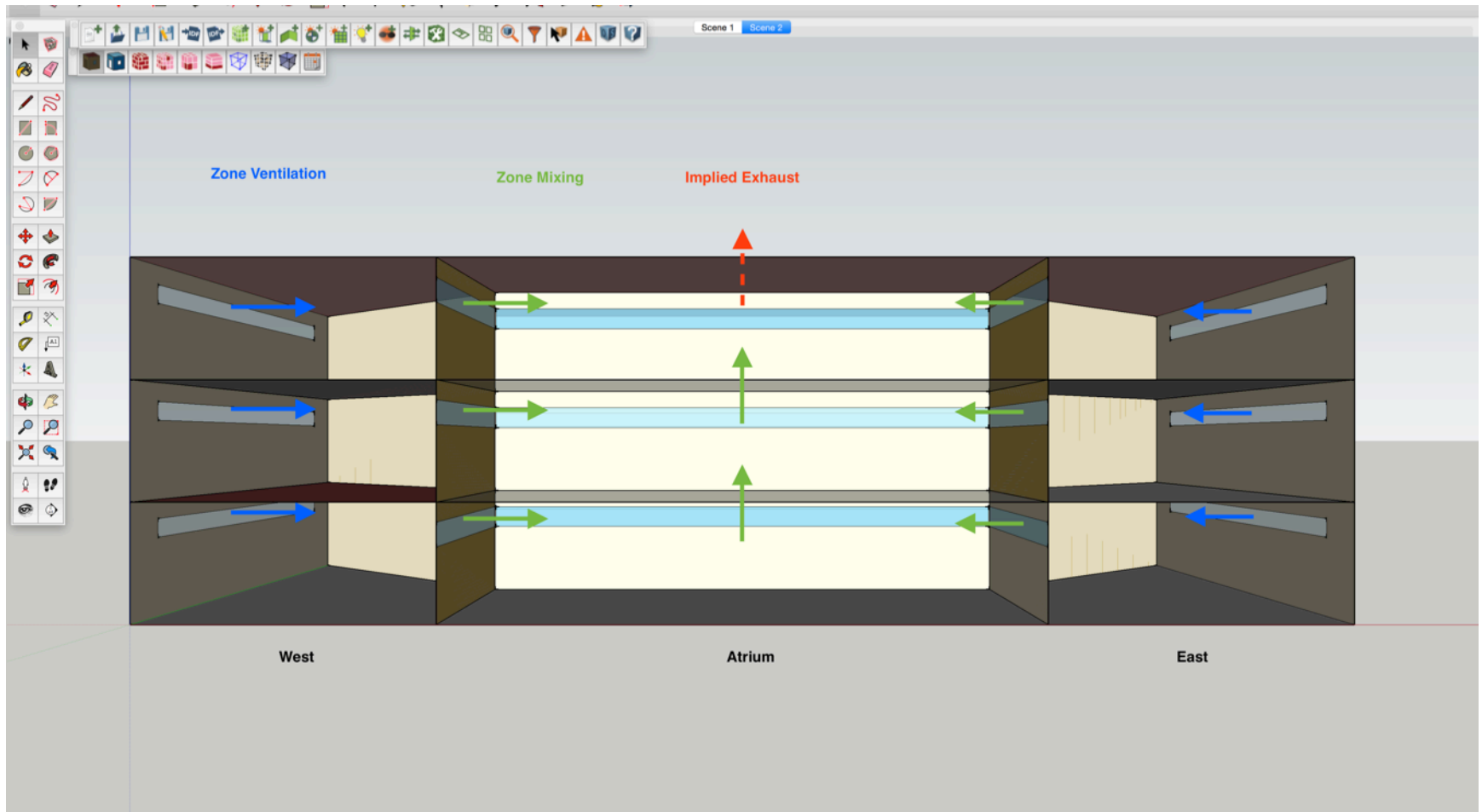
View of Model in SketchUp Plugin
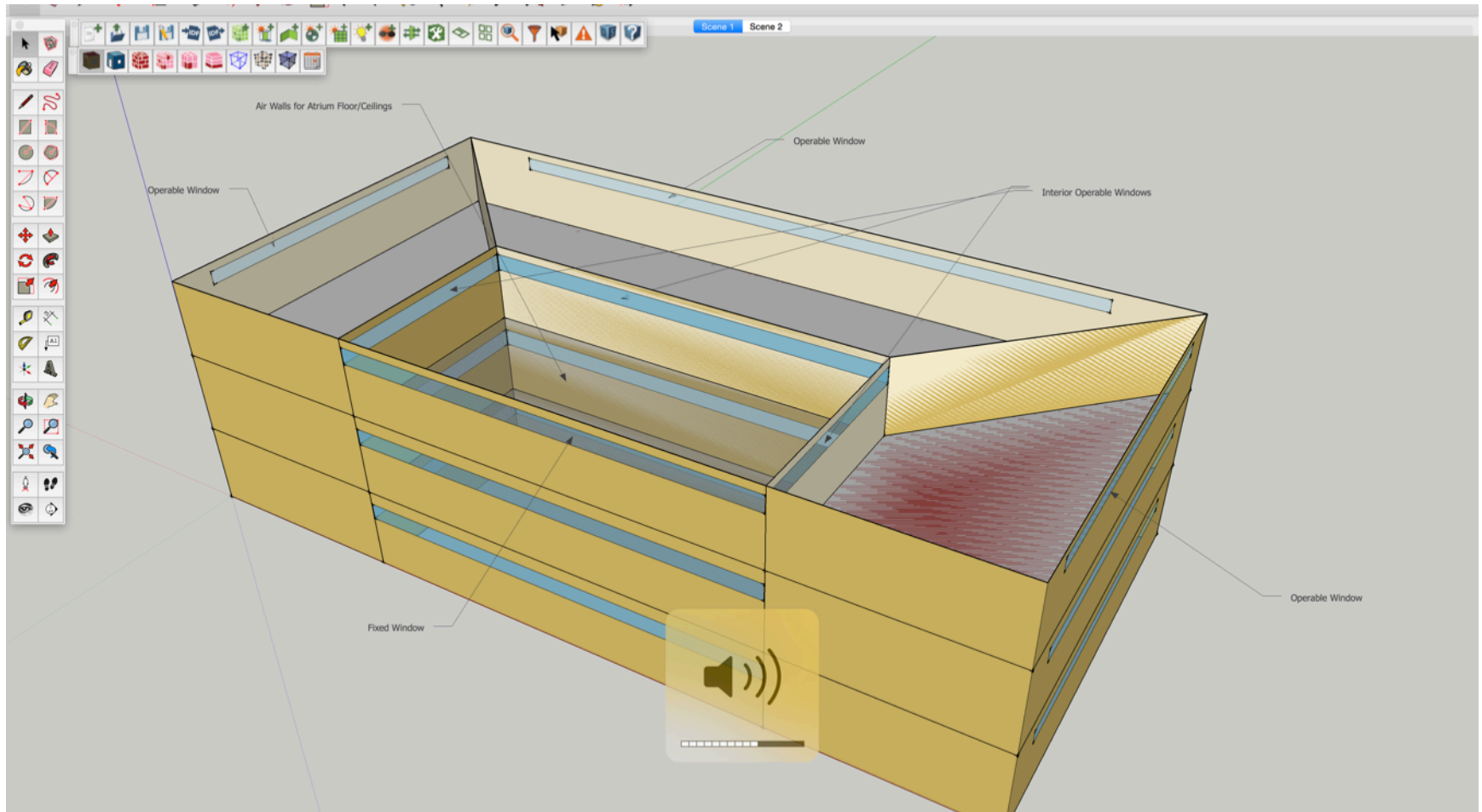
Seed Model Preparation

- Create operable exterior windows for all thermal zones that you want to participate in natural ventilation.
  - The size of the window affects the measure, but not the position.
- Create inter-zone windows or air walls for walls and ceilings to define the path of the natural ventilation from the zone it enters at to the zone it will be exhausted from.
  - The size and position of these windows or air walls is not important. They are serving as a bridge to communicate the desired zone connection for airflow.

Seed Model Preparation

- From each zone zone define exactly one possible horizontal path to a vertical shaft. Then define one path up to the intended exhaust zone.
  - The measure will always look up first, and then horizontally so it can handle may zones converging on a shared shaft.
- You don't need to any any geometry to define the exhaust zone. One or more exhaust zones are determined by the path traced from the ventilation zones.
- Add in a fractional schedule for the night ventilation
  - Tested with value of 1 or 0 but I think it should work with fractional values as well.

Diagram of Intended Outcome of Measure

Use Surfaces Sub-Tab to set Air Wall Constructions.

Use Subsurfaces Sub-Tab to set Subsurface type to "Operable Window"

View of Measure Log messages

Added natural ventilation to Thermal Zone: east 1 of 833.33 (cfm).
Thermal Zone: east 1 has 80.27 (ft^2) of operable windows, estimated airflow speed at operable window is 0.17 (ft/sec).
Added Zone Mixing Path: Thermal Zone: east 1 > Thermal Zone: atrium 1 > Thermal Zone: atrium 2 > Thermal Zone: atrium 3

How the Measure Works

- The measure takes the target CFM and distributes it based on exterior operable window area per zone.
  - Each zone with an exterior operable window will have a ZoneVentilation object.
  - Instead of using "Natural" for the ventilation type "Exhaust" is used. This along with the user fan inputs and CFM creates fan power consumption

- Ventilation Controls (user defined)
  - Schedule is pre-defined by the use in the model
  - Minimum outdoor temperature is a user argument for the measure

How the Measure Works

- The measure looks first for a ceiling with an interior operable window or air wall, and if it can't find that it looks for a wall with an interior operable window or air wall. It goes until it finds a dead end, adding a one way zone mixing object for each zone boundary it crosses.
  - Do not provide a path into another zone that also has exterior operable windows.
  - There is no ZoneVentilation object in the implied exhaust zone. It just receives AirMixing.
- Zone Mixing Controls (user defined)
  - Uses same schedule defined for ZoneVentilation
  - Uses the same minimum outdoor temperature as ZoneVentilation
- Output Variables are added for ZoneVentilation, Fan power from ZoneVentilation, AirMixing, and outdoor dry bulb temperature.

Zone Ventilation heat map for First Floor Atrium
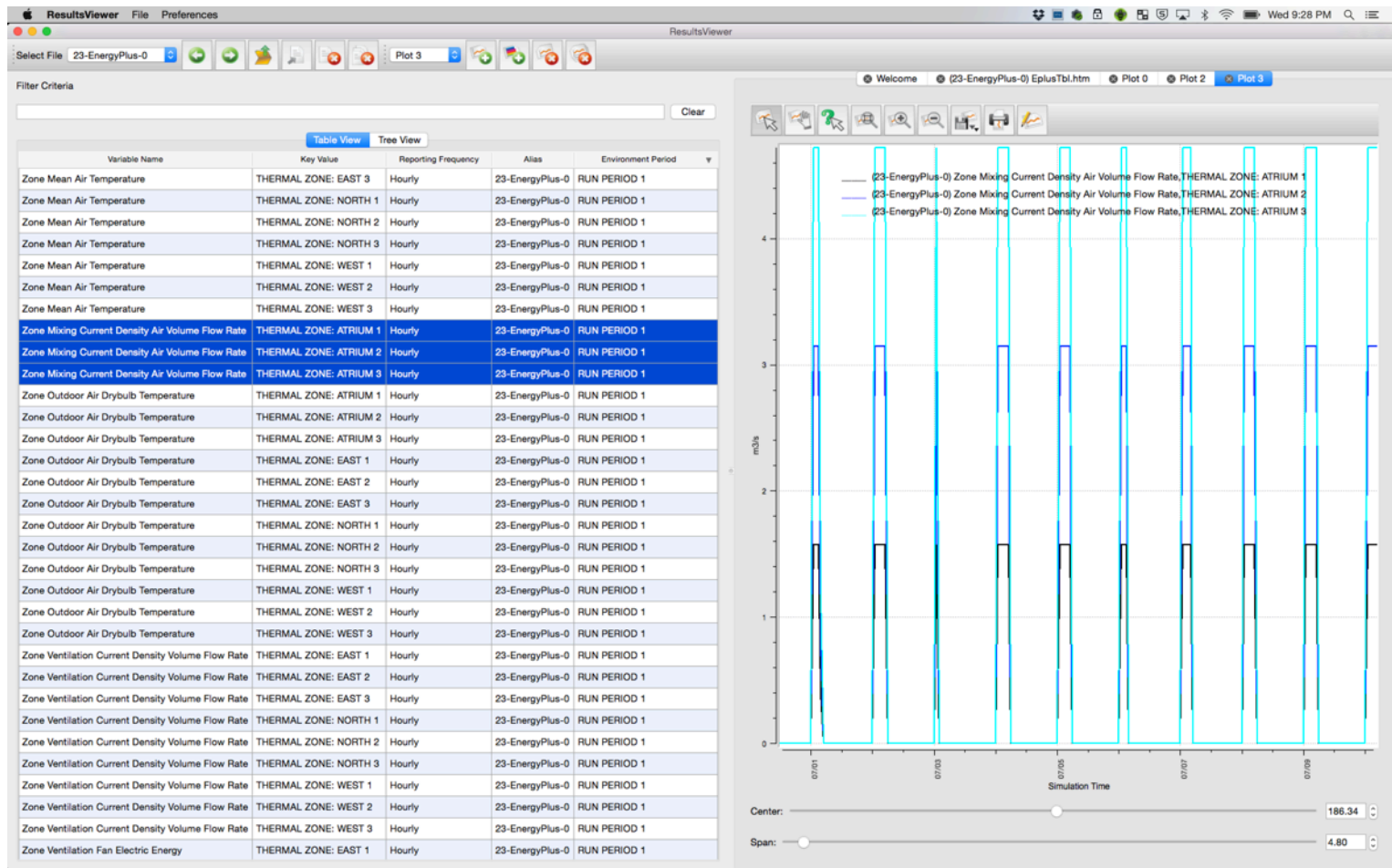
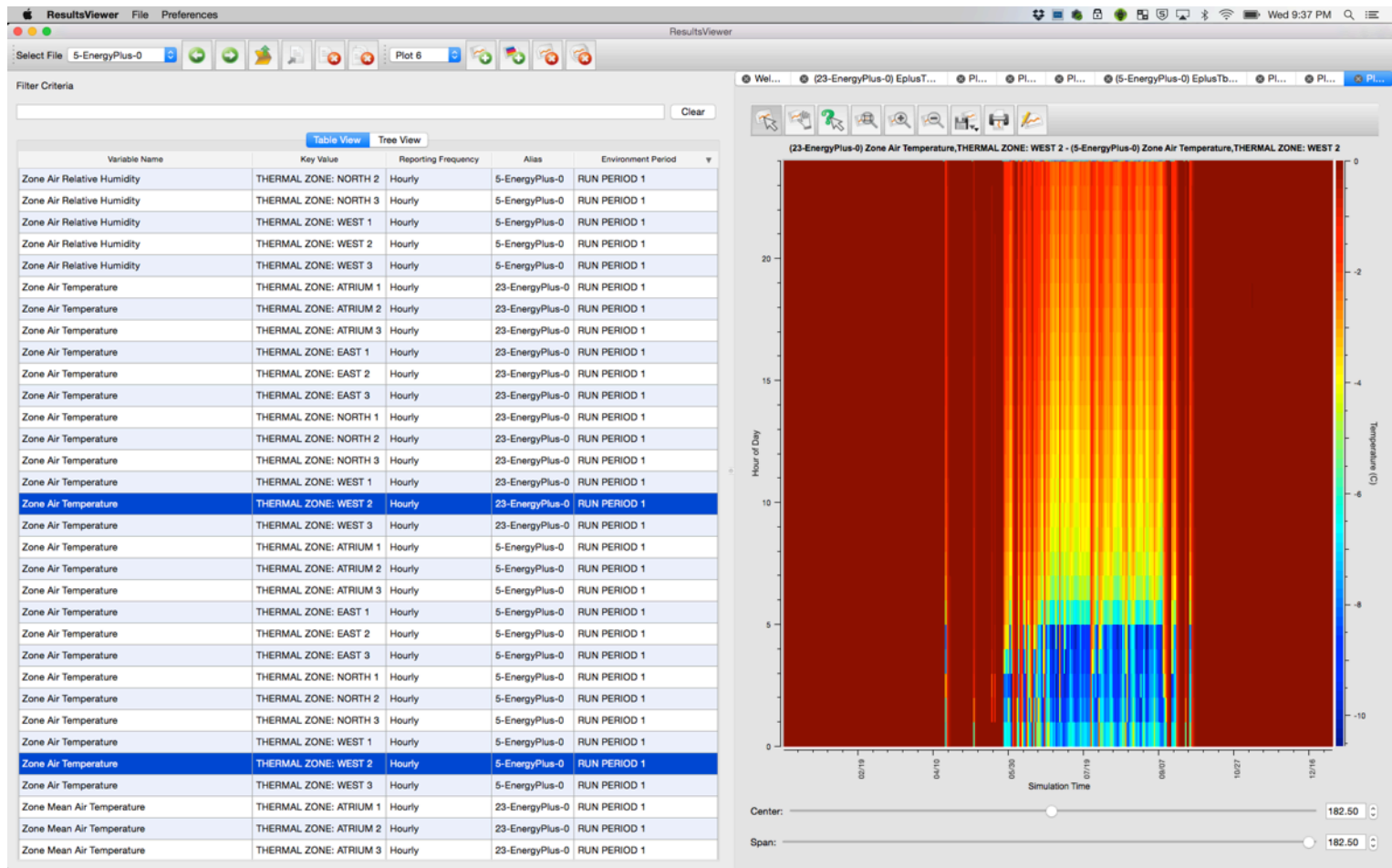# First floor atrium ZoneMixing and three feeder zones ZoneVentilation values.
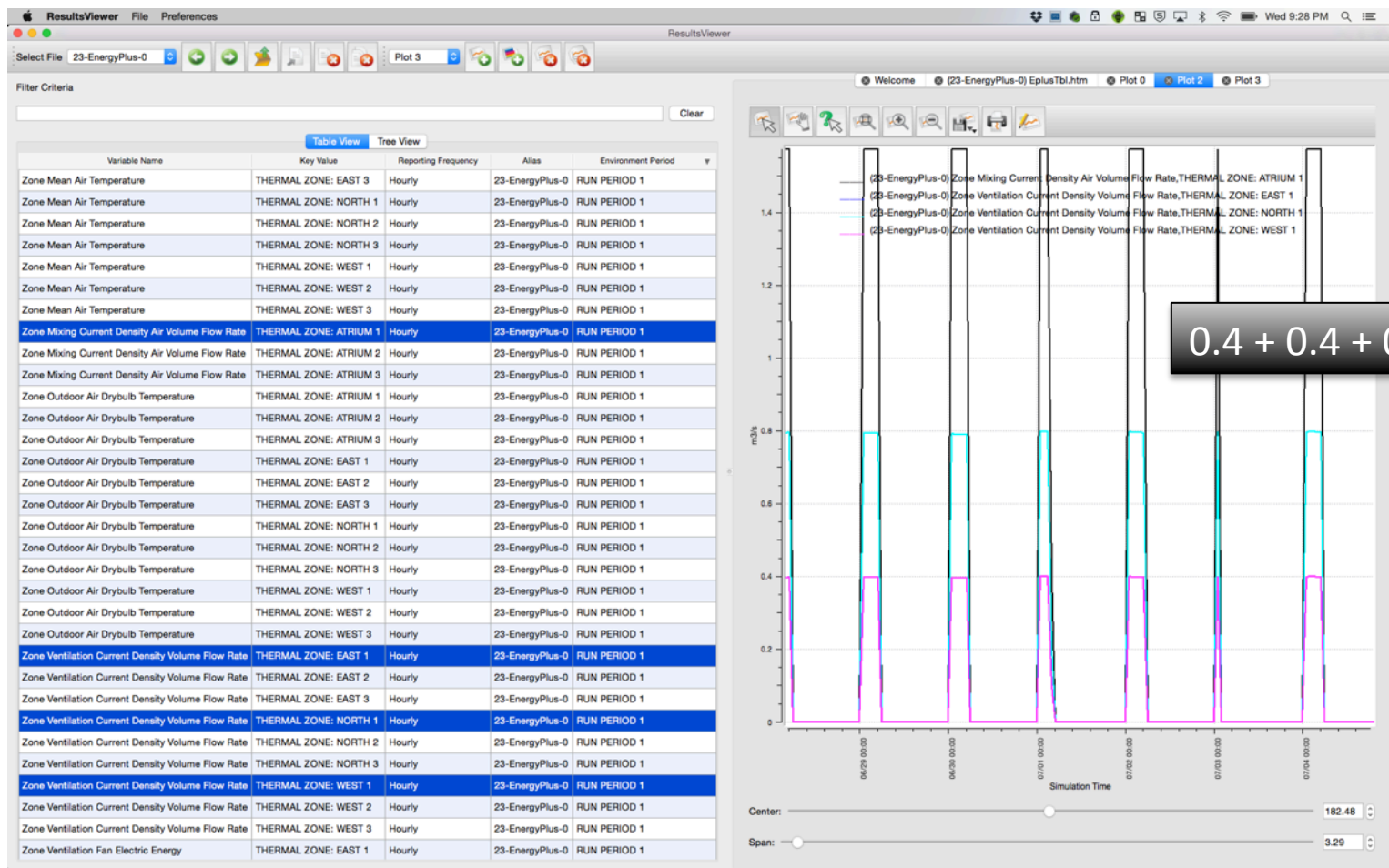
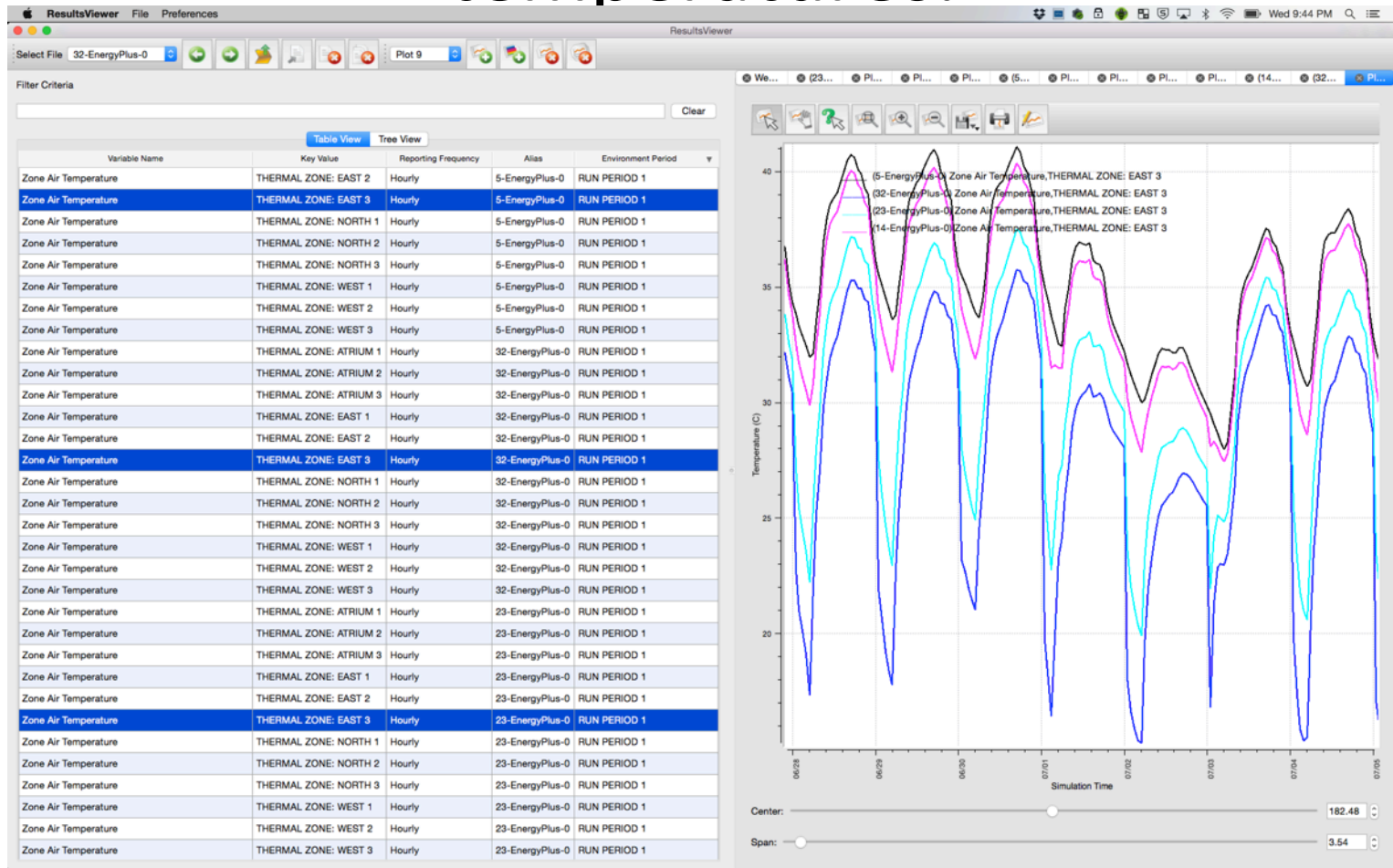# ZoneMixing ratesfor three atrium zones.

# Second floor West zone temperatures – Baseline vs. Night Ventilation

Parametric Study of 0, 1, 10, and 50 thousand cfm effect on zone temperatures.

Limitations and Known Issues

- The measure doesn't do anything to confirm that the CFM defined for the operable windows on the building (size and position) is reasonable.

- It also doesn't take the size or position of interior windows, other than to create connections across zones.

- The measure reports out a log of activity that includes the inferred path. Review that to see that it matches what was expected.

- Review time-series data to confirm that controls are working as expected. Note that simple ventilation on the outdoor air table of the EnergyPlus tabular output will generally show zero values if the schedule for ventilation doesn't overlap with building occupation.

Render By Data Zone Ventilation
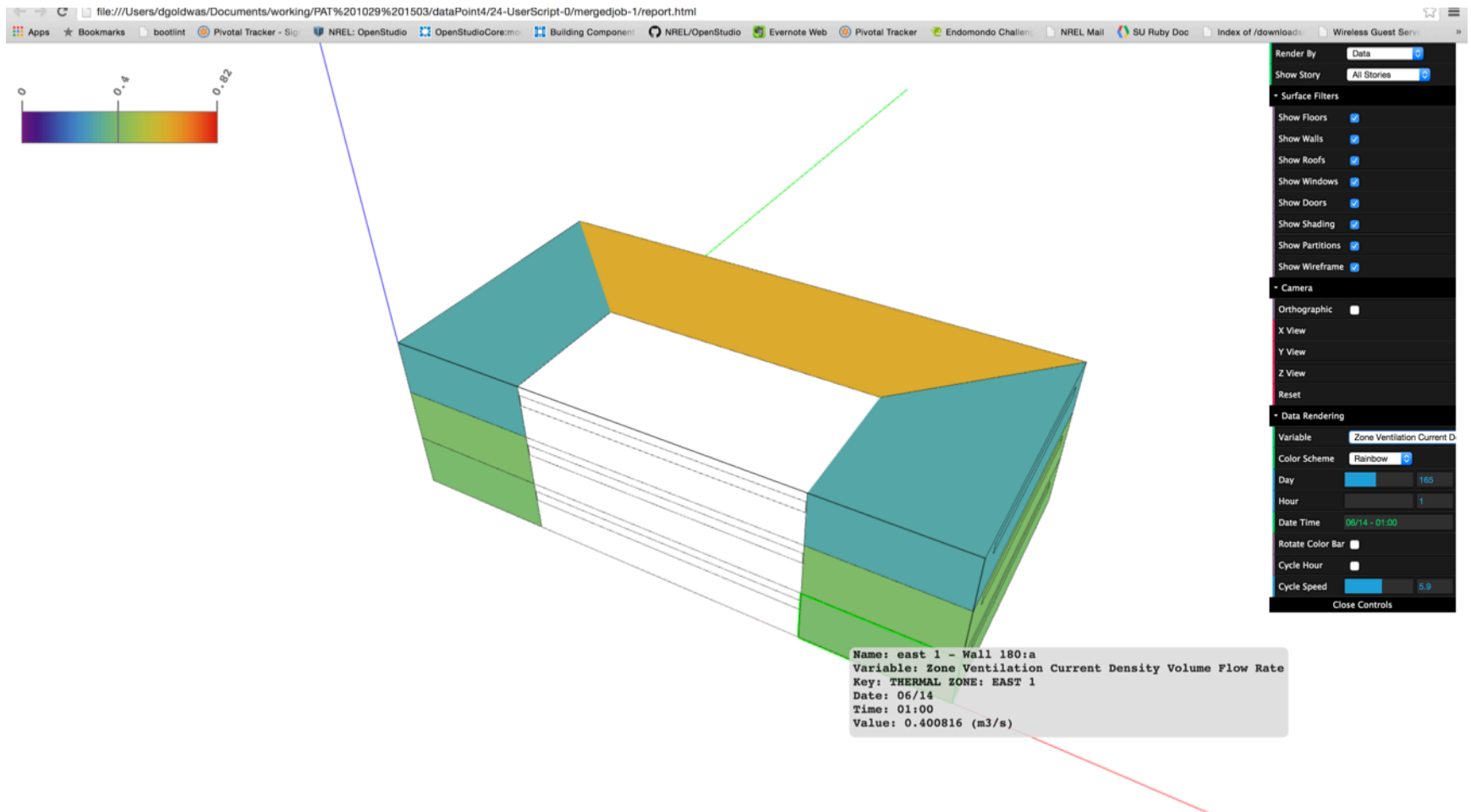
Render By Data Zone Mixing
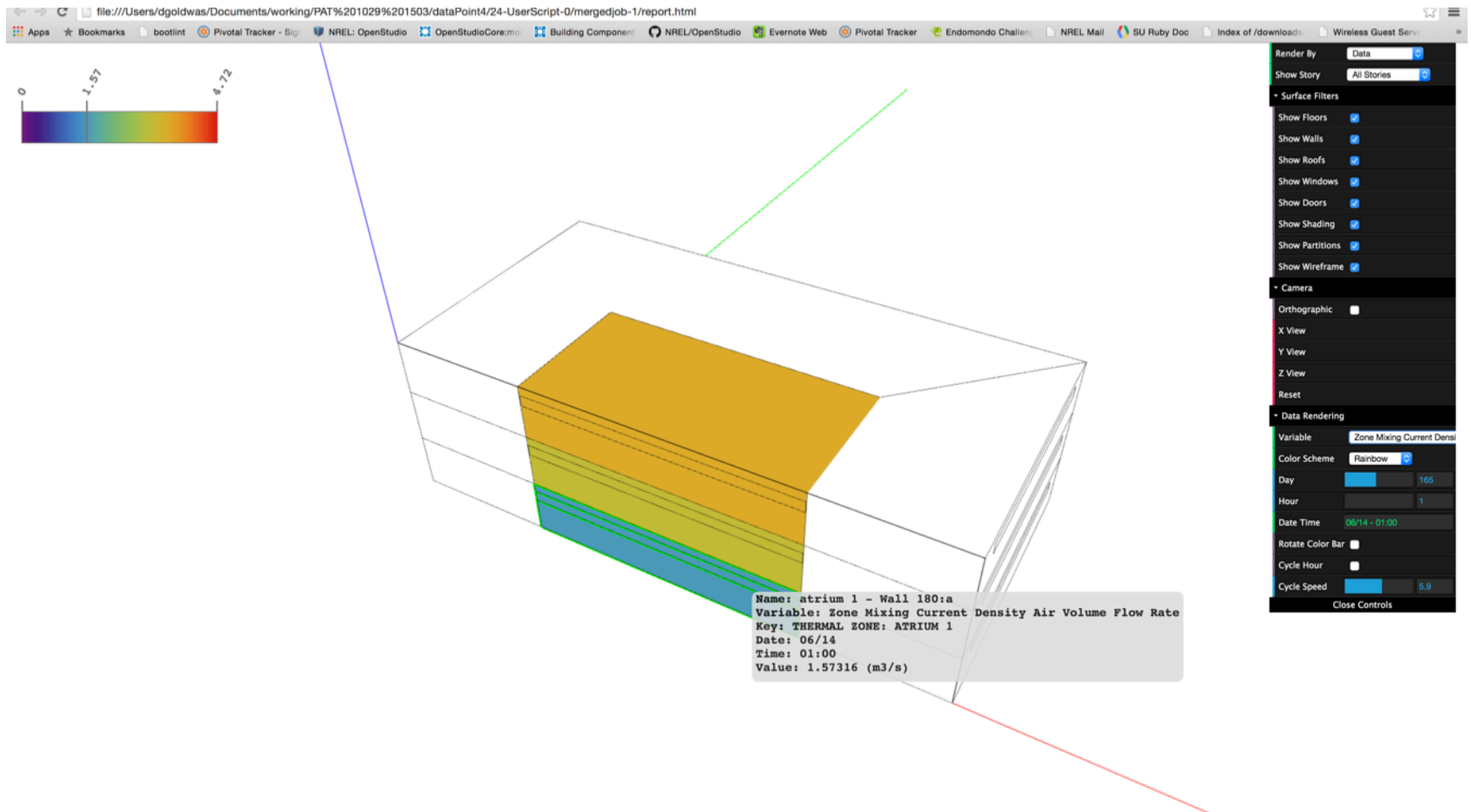
Render by Data Zone Temperature