

Assignment 8 | Ventilation Studies
Logan Weaver
Environmental Systems I

Design 01:Central Atrium

Start HereMain InputsTransient InputsBuilding DimensionsWindows and OpeningsVentilation StrategiesThermal Comfort Models

Simulation type

Transient (24 hour)

Steady state (snapshot)

Building type

Central atrium

Internal heat loads

Heat source level

Educational

12.7

BTU/(h-ft^2)

Occupancy schedule:

From

9

hours

to

24

hours

Off peak equipment load fraction

0.2

All zones but the atrium zones (if any) are assigned heat loads.

Terrain properties

Terrain type

Flat terrain with some isolated obstacles

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: central atrium

Building footprint:

23400.0

ft^2

Occupied area per floor:

16900.0

ft^2

Glazing-to-wall ratio per floor:

80.3

%

Opening-to-wall ratio per floor:

40.1

%

Ratio of roof opening to roof area:

0.2

%

Calculate inputs / Save scenario

Visualize results

Design 02: Chimney

Start HereMain InputsTransient InputsBuilding DimensionsWindows and OpeningsVentilation StrategiesThermal Comfort Models

Simulation type

Transient (24 hour)

Steady state (snapshot)

Building type

Chimney

Internal heat loads

Heat source level

Educational

12.7

BTU/(h-ft^2)

Occupancy schedule:

From

9

hours

to

24

hours

Off peak equipment load fraction

0.2

All zones but the atrium zones (if any) are assigned heat loads.

Terrain properties

Terrain type

Flat terrain with some isolated obstacles

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: chimney

Building footprint:

20150.0

ft^2

Occupied area per floor:

16900.0

ft^2

Glazing-to-wall ratio per floor:

73.6

%

Opening-to-wall ratio per floor:

46.8

%

Ratio of roof opening to roof area:

0.3

%

Calculate inputs / Save scenario

Visualize results

Design 01:Central Atrium

Weather data

Select a city:

Other

Browse

☐ Daily simulation

Select a month (first month of simulation):

July

☐ Ignore wind-driven ventilation

Last month of simulation (only for hourly simulation):

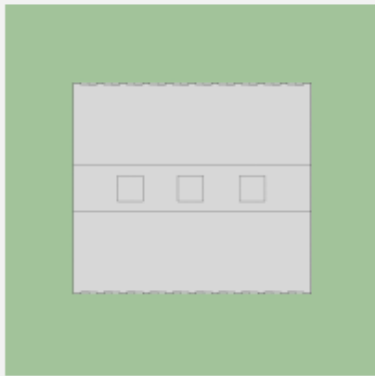
☐ Ignore solar heat gain

☒ Ignore heat gains through sidewalls

Orientation of front façade

S

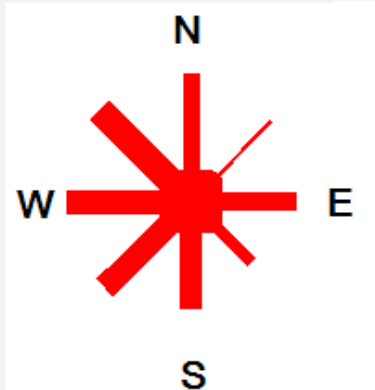
180 degrees



^ N

Plan view

Direction from which wind is coming:



Scenario

Scenario name

Scenario summary

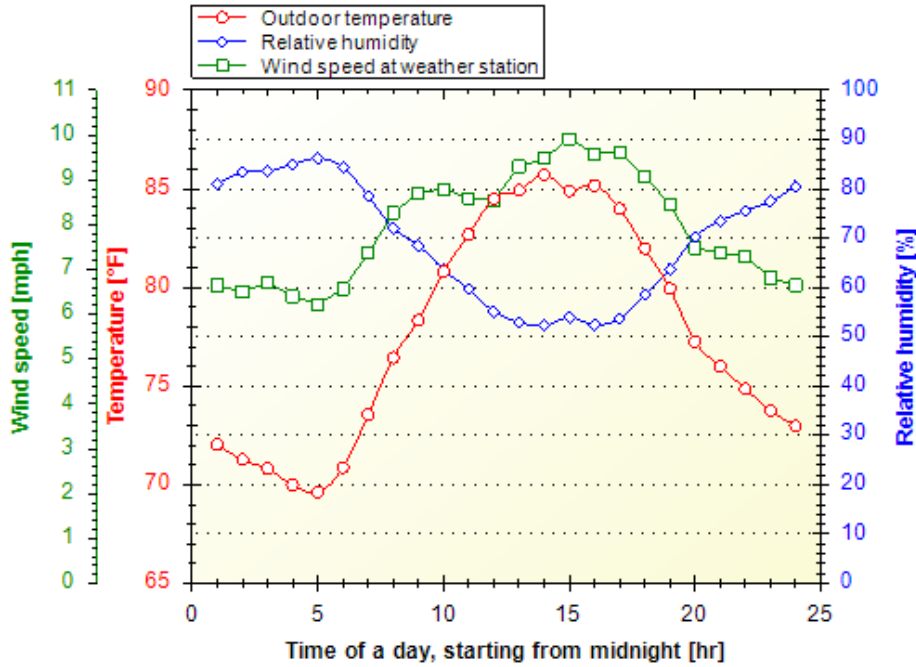
Simulation type: transient
Building type: central atrium

Building footprint: **23400.0** ft²
Occupied area per floor: **16900.0** ft²
Glazing-to-wall ratio per floor: **80.3** %
Opening-to-wall ratio per floor: **40.1** %
Ratio of roof opening to roof area: **0.2** %

Calculate inputs / Save scenario

Visualize results

Weather data for a Typical Day



Design 02: Chimney

Start Here

Main Inputs

Transient Inputs

Building Dimensions

Windows and Openings

Ventilation Strategies

Thermal Comfort Models

File

English

Help

Weather data

Select a city:

Other

Browse

Select a month (first month of simulation):

July

Last month of simulation (only for hourly simulation):

☐ Daily simulation
 ☐ Ignore wind-driven ventilation
 ☐ Ignore solar heat gain
 ☒ Ignore heat gains through sidewalls

Orientation of front façade

S

180 degrees

^ N

Plan view

Direction from which wind is coming:

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: chimney

Building footprint:

20150.0

ft²

Occupied area per floor:

16900.0

ft²

Glazing-to-wall ratio per floor:

73.6

%

Opening-to-wall ratio per floor:

46.8

%

Ratio of roof opening to roof area:

0.3

%

Calculate inputs / Save scenario

Visualize results

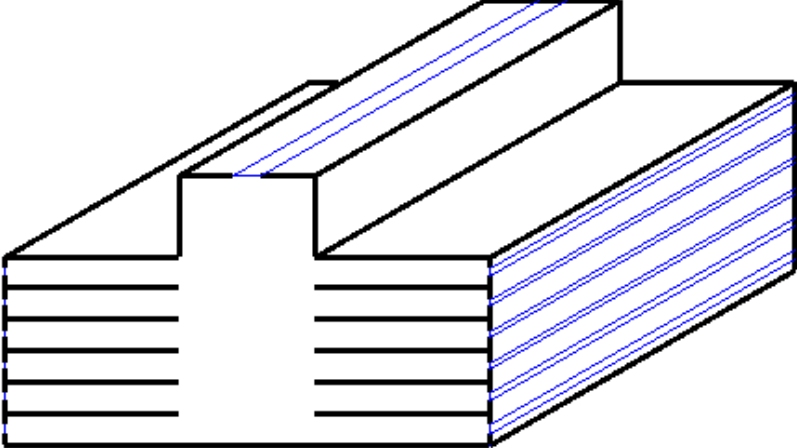
Weather Data for a Typical Day

Outdoor temperature

Relative humidity

Wind speed at weather station

Design 01:Central Atrium



Building dimensions

Help:
?

Number of floors:

6

Floor length:

130

ft

Floor (bay) width:

65

ft

Floor-to-floor height:

11.5

ft

Floor-to-ceiling height:

10

ft

Shaft width:

50

ft

Shaft height:

30

ft

Scenario

Scenario name

Scenario summary

Simulation type: transient
Building type: central atrium

Building footprint:

23400.0

ft^2

Occupied area per floor:

16900.0

ft^2

Glazing-to-wall ratio per floor:

80.3

%

Opening-to-wall ratio per floor:

40.1

%

Ratio of roof opening to roof area:

0.2

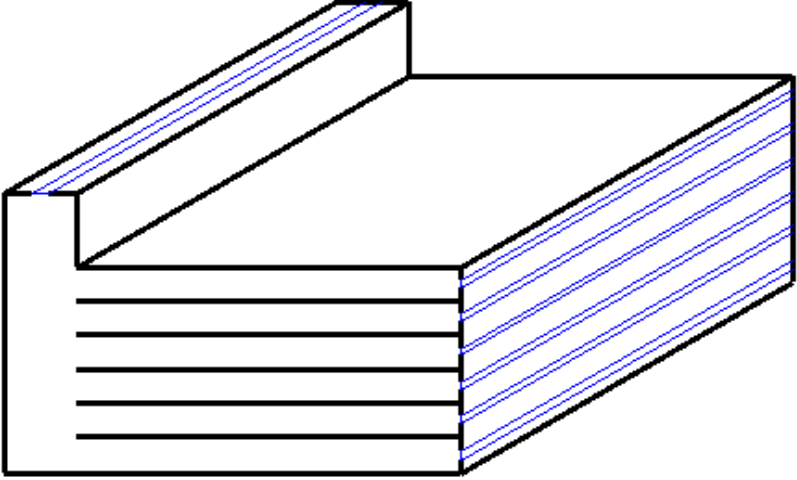
%

Calculate inputs / Save scenario

Visualize results

Design 02: Chimney

Start HereMain InputsTransient InputsBuilding DimensionsWindows and OpeningsVentilation StrategiesThermal Comfort Models



Building dimensions

Help:
?

Number of floors:

6

Floor length:

130

ft

Floor (bay) width:

130

ft

Floor-to-floor height:

11.5

ft

Floor-to-ceiling height:

10

ft

Shaft width:

25

ft

Shaft height:

25

ft

Scenario

Scenario name

Scenario summary

Simulation type: transient
Building type: chimney

Building footprint:

20150.0

ft^2

Occupied area per floor:

16900.0

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Glazing-to-wall ratio per floor:

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Ratio of roof opening to roof area:

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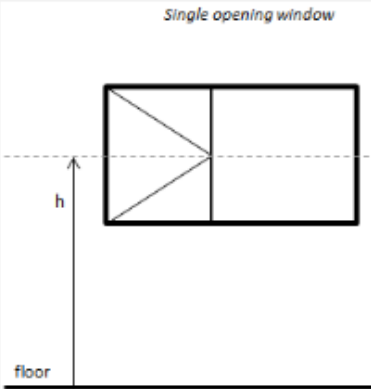
Calculate inputs / Save scenario

Visualize results

Design 01:Central Atrium

Side windows dimensions

Single opening window



☒ In each floor, there is only one opening per window (see schematic)

☐ In each floor, there are two openings separated vertically per window (see schematic). REQUIRED for single-sided ventilation

Window glazing area per floor per facade, fixed and operable (to calculate solar gains through windows):

1200

ft^2

Operable window area per floor (used to calculate air flowrate):

600

ft^2

Height from floor to mid-opening (h):

5.7

ft

Operable lower window area per floor per facade:

10.8

ft^2

Height difference between upper and lower opening (Delta H in figure):

3.3

ft

Roof opening dimensions

Roof operable area for chimney 1:

10.8

ft^2

Note: CoolVent does not account for solar heat gains through the roof opening(s)

Internal opening dimensions

Internal opening area per floor:

215.3

ft^2

Advanced internal opening options:

Advanced...

Additional opening options

More window options and opening specifications:

Advanced...

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: central atrium

Building footprint:

23400.0

ft^2

Occupied area per floor:

16900.0

ft^2

Glazing-to-wall ratio per floor:

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%

Opening-to-wall ratio per floor:

40.1

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Ratio of roof opening to roof area:

0.2

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Calculate inputs / Save scenario

Visualize results

Design 02: Chimney

Start Here

Main Inputs

Transient Inputs

Building Dimensions

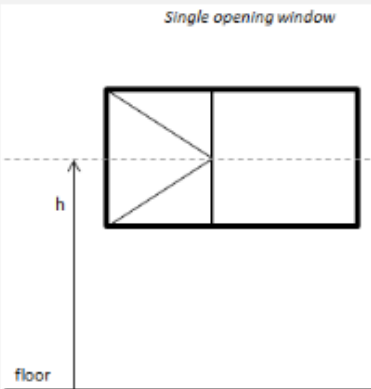
Windows and Openings

Ventilation Strategies

Thermal Comfort Models

Side windows dimensions

Single opening window



☒ In each floor, there is only one opening per window (see schematic)

☐ In each floor, there are two openings separated vertically per window (see schematic). REQUIRED for single-sided ventilation

Window glazing area per floor per facade, fixed and operable (to calculate solar gains through windows):

1100

ft^2

Operable window area per floor (used to calculate air flowrate):

700

ft^2

Height from floor to mid-opening (h):

3

ft

Operable lower window area per floor per facade:

10.8

ft^2

Height difference between upper and lower opening (Delta H in figure):

3.3

ft

Roof opening dimensions

Roof operable area for chimney 1:

10.8

ft^2

Note: CoolVent does not account for solar heat gains through the roof opening(s)

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Internal opening area per floor:

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Calculate inputs / Save scenario

Visualize results

Design 01:Central Atrium

Thermal mass

☒ Include slab thermal mass

Floor / roof slab thickness

12

in

Exposed area

90

% of floor area

Floor slab material

Concrete

Floor type

Exposed

Ceiling type

Suspended

Night cooling

☒ Use night cooling. Windows open at nighttime, when the air is cold enough to cool down the thermal mass. Windows close (down to 10%) during daytime to prevent hot outdoor air from entering the building. If the building has a fan, it will be used to assist night cooling.

☐ Time controlled: close all windows at

7

hours, open windows at

19

hours

☒ Temperature controlled: close windows in zones where temperature is lower than outdoor temperature; close windows otherwise

Window operation

☒ Close windows when the outdoor air temperature drops below

60.8

°F

☒ Close Window and turn on heating when any internal zone temperature drops below

64.4

°F

Hybrid ventilation mode

☒ Use hybrid mechanical-natural ventilation

☒ Turn on fan when any internal zone temperature is above

75.2

°F

or humidity ratio is above

0.012

(lb water) / (lb air)

Windows will open even if using night cooling.

☒ Close windows, turn off fan and turn on AC when any internal zone temperature is above

78.8

°F

or humidity ratio is above

0.012

(lb water) / (lb air)

☒ Allow independent window and AC control in each zone

Define fan / AC operating characteristics:

Specify fan / AC

Scenario

Scenario name

Scenario summary

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Building footprint:

23400.0

ft^2

Occupied area per floor:

16900.0

ft^2

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Ratio of roof opening to roof area:

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Calculate inputs / Save scenario

Visualize results

Design 02: Chimney

Start Here

Main Inputs

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Thermal Comfort Models

Thermal mass

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%

Ratio of roof opening to roof area:

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%

Calculate inputs / Save scenario

Visualize results

Design 01:Central Atrium

Comfort Model Selection

2010 ASHRAE Standard 55 Thermal Comfort Model

Occupants wear typical clothing for warm environment (0.5 clo of clothing)

Occupants wear typical clothing for cool environment (1.0 clo of clothing)

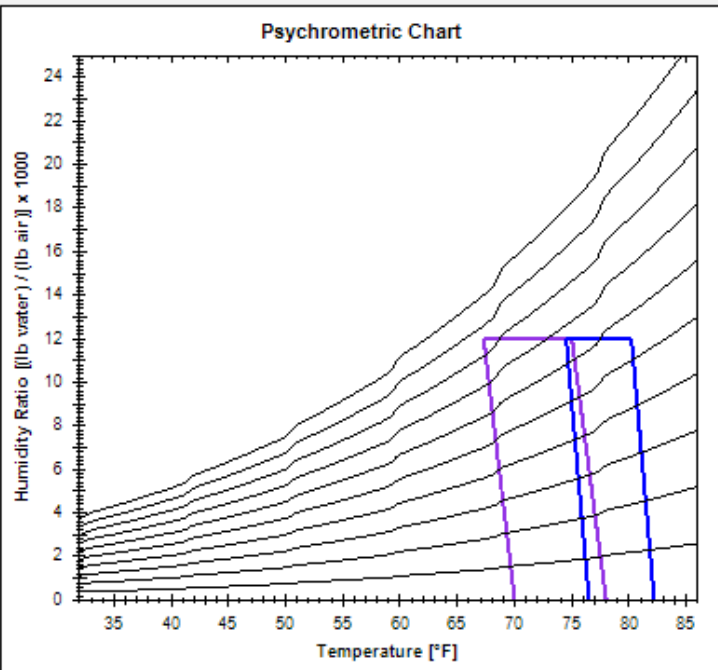
2010 ASHRAE Standard 55 Adaptive Comfort Model - for naturally ventilated spaces

90% Acceptability limits (always included)

80% Acceptability limits (includes 90% limits)

Custom Thermal Comfort Model

Psychrometric Chart



Note: thermal comfort analysis is performed by rounding the temperature to 1 significant figure after the decimal mark and the humidity to 3 significant figures after the decimal mark (in a [unit mass of water] per [unit mass of dry air] basis). For the adaptive comfort standard, the indoor operative temperature is calculated for an occupant in the center of each zone.

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: central atrium

Building footprint: 23400.0 ft^2

Occupied area per floor: 16900.0 ft^2

Glazing-to-wall ratio per floor: 80.3 %

Opening-to-wall ratio per floor: 40.1 %

Ratio of roof opening to roof area: 0.2 %

Calculate inputs / Save scenario

Visualize results

Design 02: Chimney

Start Here

Main Inputs

Transient Inputs

Building Dimensions

Windows and Openings

Ventilation Strategies

Thermal Comfort Models

Comfort Model Selection

2010 ASHRAE Standard 55 Thermal Comfort Model

Occupants wear typical clothing for warm environment (0.5 clo of clothing)

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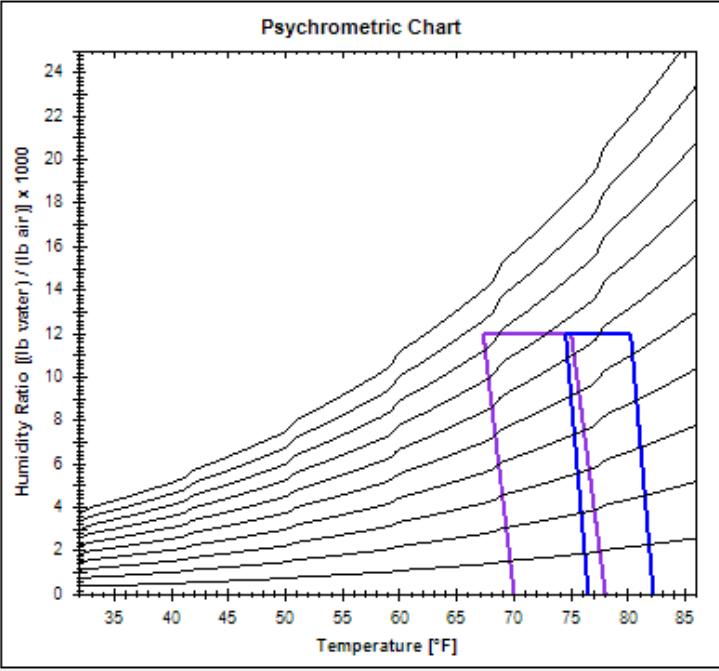
2010 ASHRAE Standard 55 Adaptive Comfort Model - for naturally ventilated spaces

90% Acceptability limits (always included)

80% Acceptability limits (includes 90% limits)

Custom Thermal Comfort Model

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Note: thermal comfort analysis is performed by rounding the temperature to 1 significant figure after the decimal mark and the humidity to 3 significant figures after the decimal mark (in a [unit mass of water] per [unit mass of dry air] basis). For the adaptive comfort standard, the indoor operative temperature is calculated for an occupant in the center of each zone.

Scenario

Scenario name

Scenario summary

Simulation type: transient

Building type: chimney

Building footprint: 20150.0 ft^2

Occupied area per floor: 16900.0 ft^2

Glazing-to-wall ratio per floor: 73.6 %

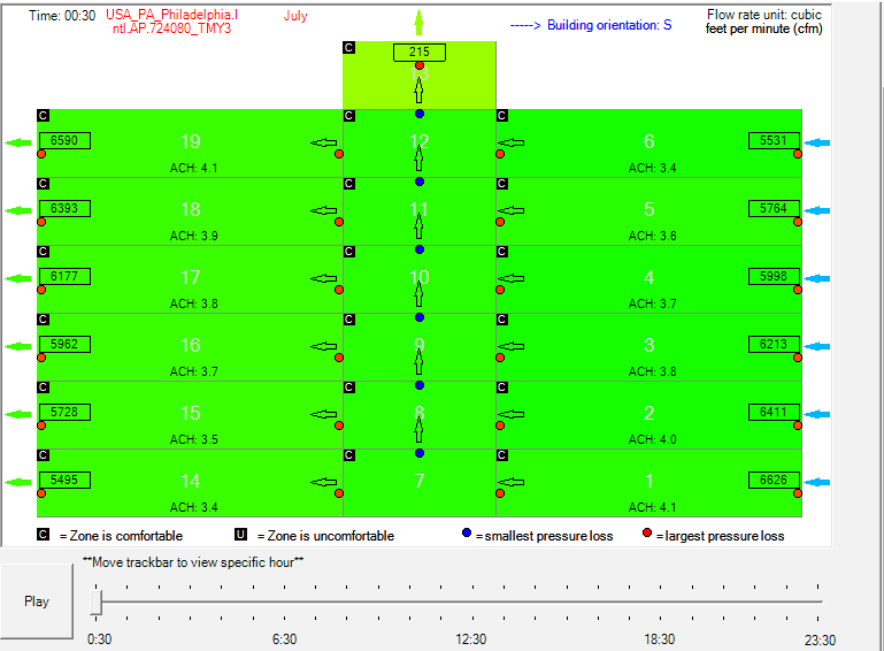
Opening-to-wall ratio per floor: 46.8 %

Ratio of roof opening to roof area: 0.3 %

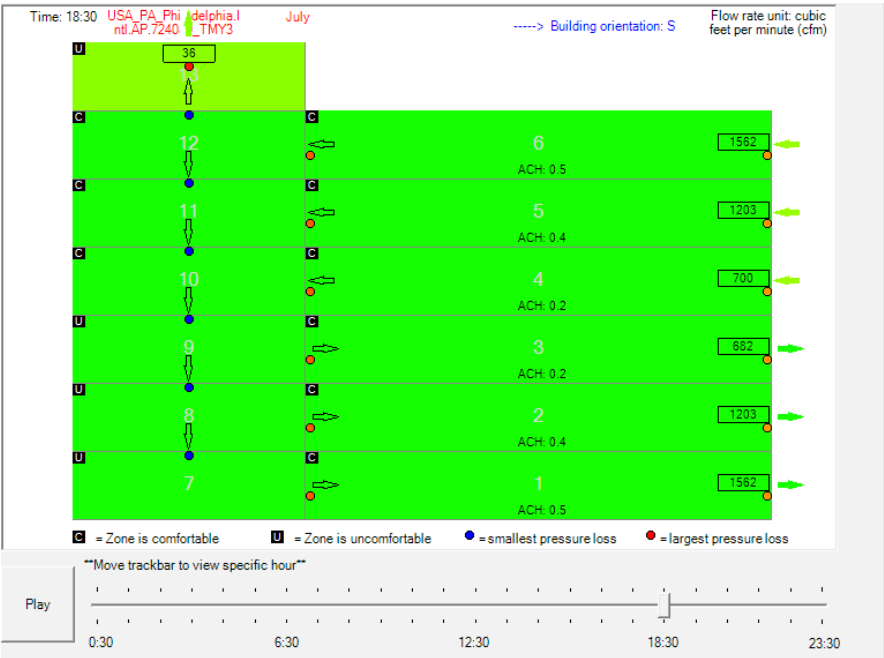
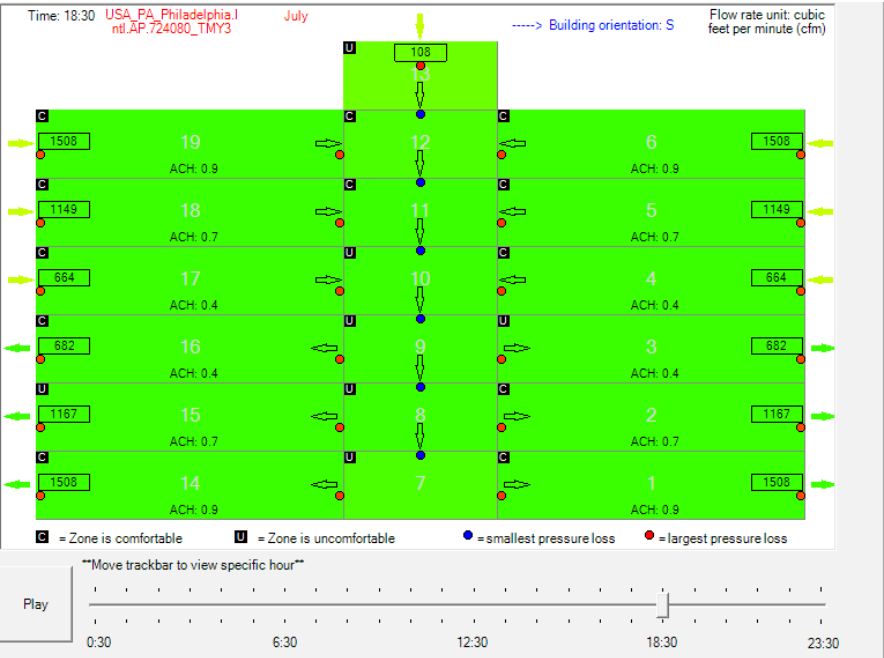
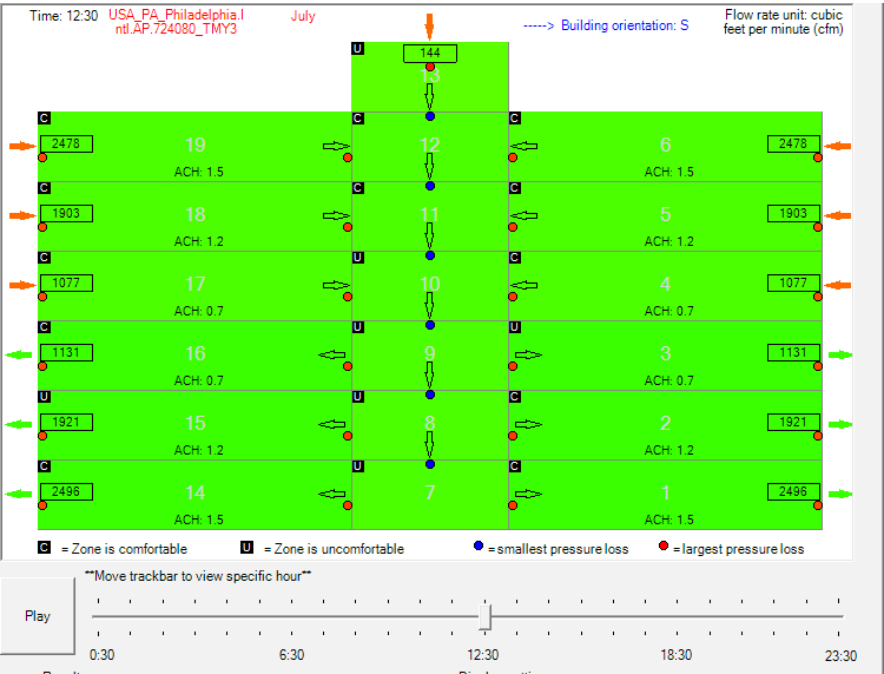
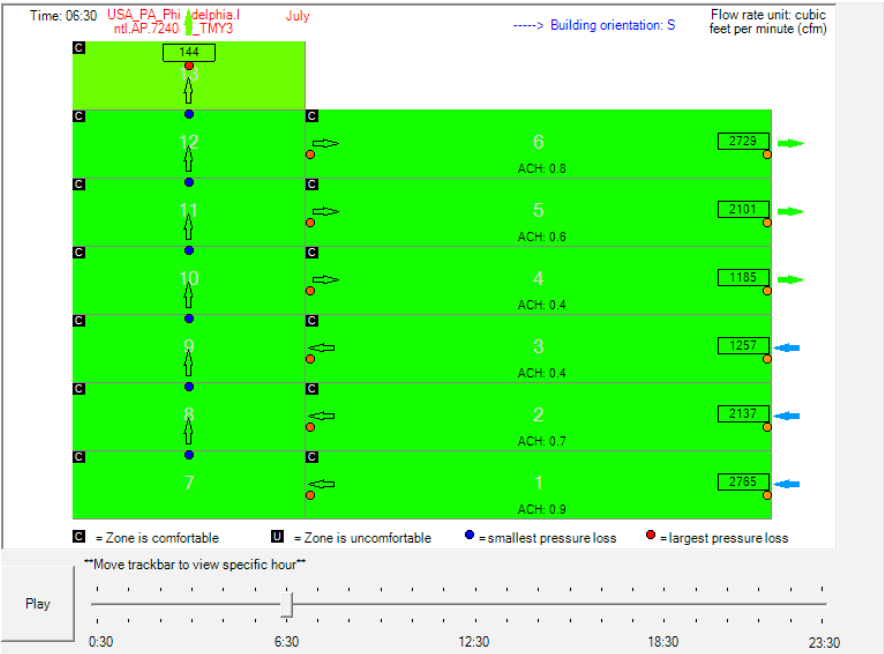
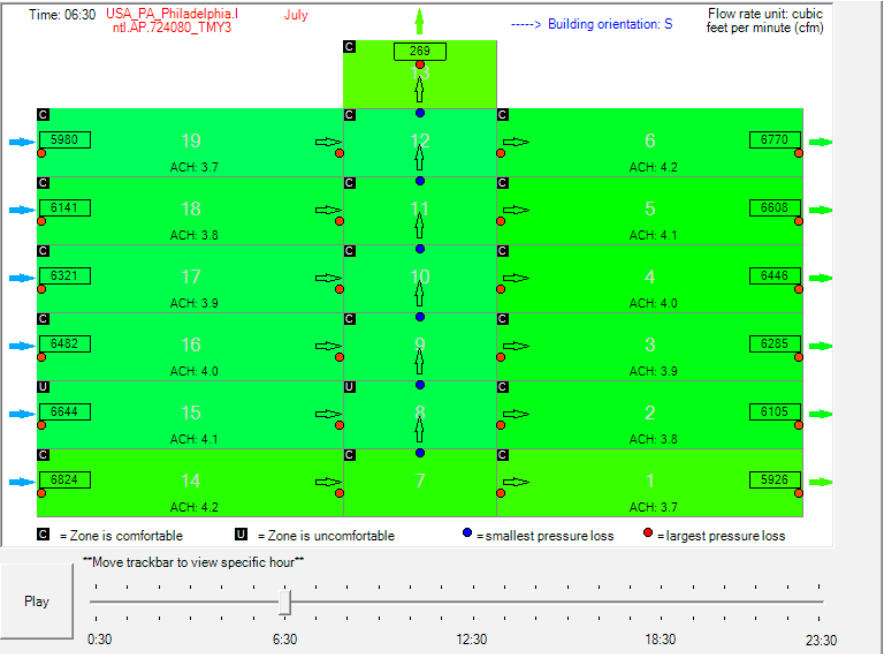
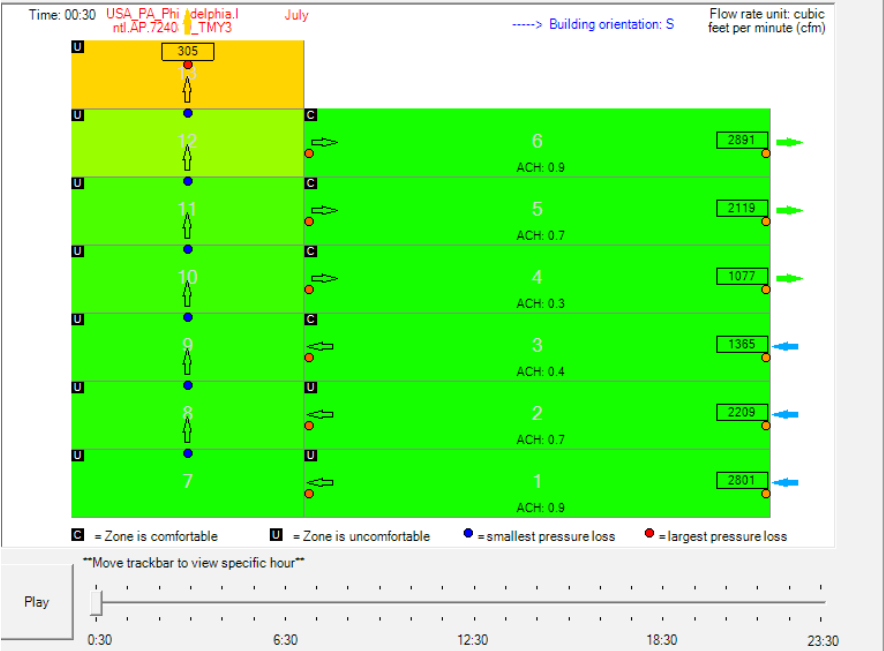
Calculate inputs / Save scenario

Visualize results

Design 01 | 6 hour comfort samples

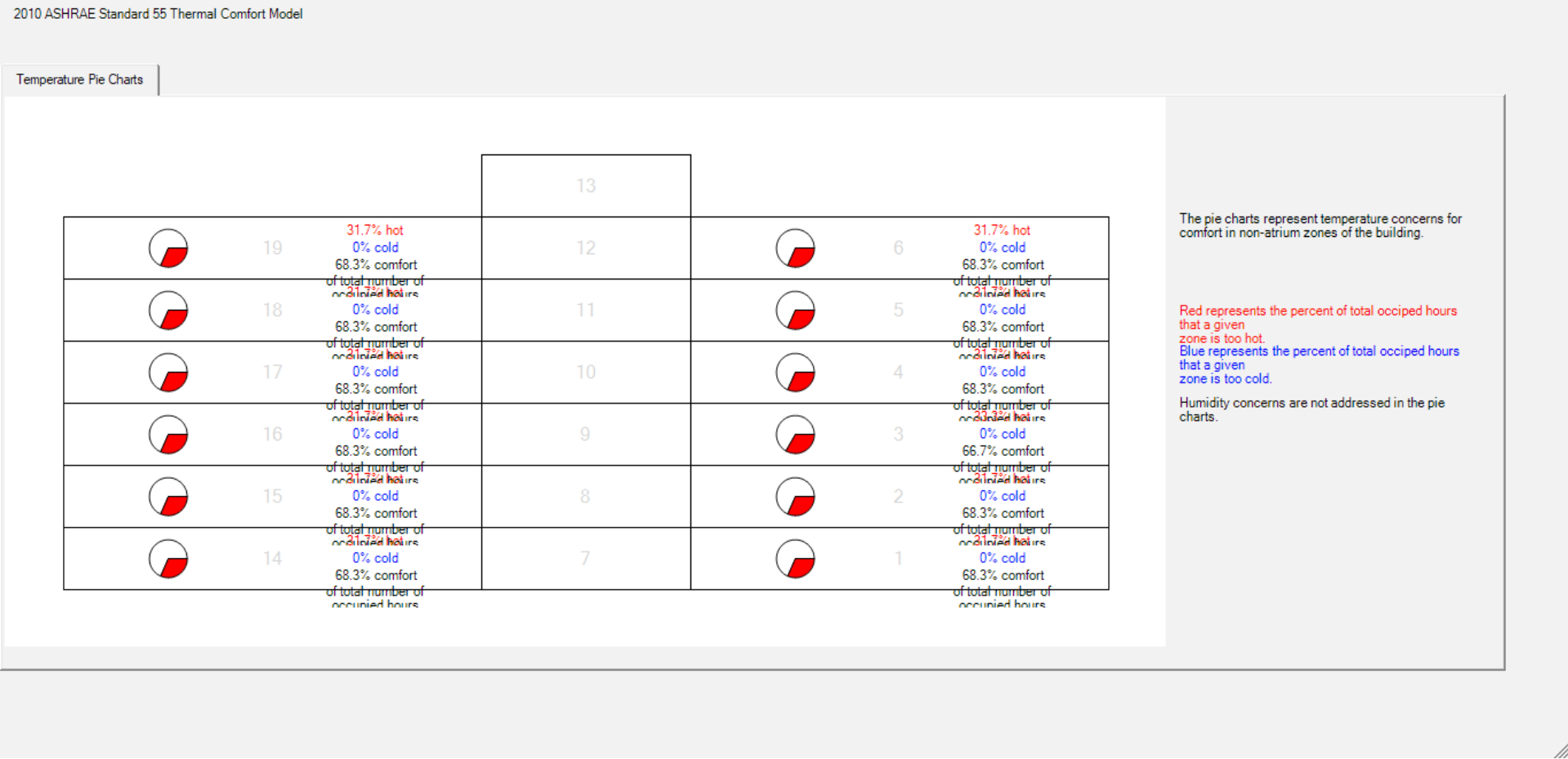


Design 02 | 6 hour comfort samples



Design 01 | Thermal Comfort Pie Charts

Design 01 | 1/6 hour comfort samples USA_PA_Philadelphia.Intl.AP.724080_TMY3 Design 02 | 1/6 hour comfort samples



Design 02 | Thermal Comfort Pie Charts

CoolVent Thermal Comfort Results USA_PA_Philadelphia.Intl.AP.724080_TMY3

